

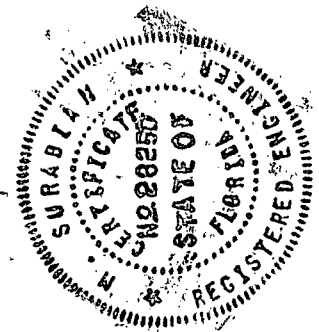
SITE CERTIFICATION AND TESTIFICATION
FOR
INDIAN TOWN COGENERATION PLANT

Martin Surabian

Martin Surabian, P.E.
Florida No. 28250

Bechtel Corporation
9801 Washington Boulevard
Gaithersburg, MD 20878-5350

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Volume 1

INDIANTOWN COGENERATION PROJECT

Site Certification Application

Submitted by Indiantown Cogeneration, L. P.

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APPLICANT INFORMATION

Applicants Official Name: Indiantown Cogeneration, L.P.Address: 7475 Wisconsin Avenue, Bethesda MD 20814-3422Business Entity (corporation, partnership, co-ownership) PartnershipName of Project: Indiantown Cogeneration ProjectName and Title of Chief Executive Officer Joseph P. ... President
and Chief Executive Officer ...Name, address, and Phone Number of Official Representative for
obtaining certification: Stephen A. Sorrenti, 1000 Main Avenue
Bethesda, MD 20814-4322; (301) 913-5845/After Hours: (301) 913-4686Site Location (county): Martin CountySite Address: State Road 710; 3 miles northwest of Stuart, FloridaNearest Incorporated City: StuartLatitude and Longitude: 27° 2' 20"N 80° 30' 45"WUTM's Northerly 2990.69
Easterly 548.02Section, Township, Range: Sections 26, 27, 34, 35 Township 39 South,
Range 38 EastName Plate Generating Capacity: 330 MWICL Environmental Legal Counsel: Hopping, P. C. Box 100, Tallahassee, Florida 32314 Gary P. Sams,RECEIVED
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**LIST OF ORGANIZATIONS THAT PARTICIPATED
IN THE PREPARATION OF THE SCA**

PG&E/Bechtel Generating Company
Bethesda, MD

- o Overall SCA Management and Direction

Bechtel Corporation

Gaithersburg, Maryland

- o Environmental and Engineering Contractor

Arch R. Campbell, Consultant

Pearsall, Texas

- o Subcontractor for Geohydrology

Ardaman & Associates, Inc.

Port St. Lucie, FL

- o Subcontractor for Geohydrologic Field Investigation

CH2M Hill

Gainesville, FL

- o Contractor for Hydrogeology field work and analyses

ENSR Consulting and Engineering

Acton, MA

- o Contractor for BACT analysis

Environmental Consulting & Technology, Inc.

Gainesville, FL

- o Contractor for Ecological, Socioeconomic and Land Use

Gunster, Yoakley & Stewart

Stuart, Florida

- o Attorneys Coordinating with Local Governments

Hessler Associates, Inc.

Cabin John, MD

- o Subcontractor for Noise Analyses

Hopping, Boyd, Green & Sams

Tallahassee, Florida

- o Environmental Attorneys

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Kimley-Horn and Associates, Inc.

West Palm Beach, Florida

- o Contractor for Traffic Analyses

Lindahl, Browning, Ferrari & Hellstrom, Inc

Stuart, FL

- o Subcontractor for boundary and bore hole surveys

Moore/Bowers

Tampa, Florida

- o Consultant for land use/socioeconomics

Piper Archaeology

St. Petersburg, Florida

- o Subcontractor for Cultural Resource Surveys

Southern Resources Mapping Corporation

Holly Hill, FL

- o Subcontractor for aerial surveying

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PREFACE

Indiantown Cogeneration, Limited Partnership (ICL) is an energy company that intends to construct, own, and operate a new state-of-the-art, clean coal-burning cogeneration facility in the industrial area of Indiantown, Florida. The general partners of ICL are indirect subsidiaries of Pacific Gas & Electric Company (PG&E), one of the largest utilities in the United States, and Bechtel, Inc., one of the largest architect/engineering firms in the world. ICL has access, therefore, to the expertise in both of these firms to ensure that the proposed Indiantown plant is developed in a timely manner and operated reliably.

The ICL cogeneration plant will produce steam to support the operations of the Caulkins Citrus Processing Plant. The plant will also produce approximately 330 MW of electricity for sale to Florida Power & Light (FPL). This additional capacity will help FPL support Florida's increasing need for reliable and economical sources of electricity. The plant also should enhance economic development in the Indiantown area.

ICL is seeking approval for the Indiantown Cogeneration Project under the Florida Electrical Power Plant Siting Act, Chapter 403, Part II, Florida Statutes (PPSA). The PPSA provides a centralized review process for new electrical generating facilities in Florida, involving a balancing of "the increasing demand for electrical power plants with the broad interests of the public," including human health, the environment, and state waters and wildlife. Under the PPSA, the Florida Public Service Commission (PSC) is the sole forum for the determination of "need" for a proposed facility. The Florida Department of Environmental Regulation (FDER) acts as the coordinator for the remainder of the certification process, with input from various state, regional, and local agencies and ultimate disposition by the Governor and Cabinet sitting as the Siting Board.

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ICL submitted jointly with FPL a "Petition to Determine Need for Electrical Power Plant" to the PSC on August 20, 1990. The Petition, along with supporting documentation, addresses the manner in which the Indiantown Cogeneration Project will meet the need for electric system reliability and integrity; meet the need for adequate electricity at reasonable cost; and be the most cost-effective alternative available. A summary of the Need Petition is presented in Section 1.0 of this Site Certification Application (SCA).

This SCA is being filed with the FDER pursuant to Chapter 17-17, Florida Administrative Code. It addresses the environmental and socioeconomic aspects of the ICL Project by presenting information on the existing natural and human environments, on the generating and associated facilities proposed to be constructed and operated, and on the impacts of those facilities on those environments.

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Indiantown Cogeneration, L.P.**

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 - CPT No. B-112
 - CPT No. B-113
 - CPT No. B-114

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LIST OF ACRONYMS AND ABBREVIATIONS

ac	acre
ac-ft	acre-feet
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
AQCR	Air Quality Control Region
ASR	Aquifer Storage and Retrieval
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BACT	Best Available Control Technology
bls	Below land surface
BMP	Best Management Practice
BOCC	Board of County Commissioners
Btu/lb	British thermal units per pound
CEMS	Continuous Emissions Monitoring System
CFR	Code of Federal Regulations
CFRPC	Central Florida Regional Planning Council
cfs	cubic feet per second
CGMP	Comprehensive Growth Management Plan
cm/sec	Centimeters per second
CO	Carbon monoxide
COA	Council on Aging
COC	Cycles of Concentration
CR	County Road
dB	decibels
dBA	decibels, A-weighted
dbh	diameter-at-breast-height
DCA	Department of Community Affairs
DER	Department of Environmental Regulations (FDER)
EI	Elevation, relative to ground level
EMS	Emergency Medical Services
FAAQs	Florida Ambient Air Quality Standards
EPA	Environmental Protection Agency
FAC	Florida Administrative Code
FCREPA	Florida Committee on Rare and Endangered Plants and Animals
FDACS	Florida Department of Agriculture and Consumer Services
FDOT	Florida Department of Transportation
FEC	Florida East Coast Railway
FEMA	Federal Emergency Management Agency
FGC	Flue Gas Cleaning
FGFWFC	Florida Game and Fresh Water Fish Commission
FHSRC	Florida High-Speed Rail Corporation
fps	feet per second
FPL	Florida Power and Light
FRP	Fiberglass reinforced plastic
FSC	Florida Steel Corporation

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ft	feet
FY	Fiscal Year
GEP	Good Engineering Practice (stack height)
gpd/ft	gallons per day per foot
gph	gallons per hour
gpm	gallons per minute
HDPE	High density polyethylene
ISC	Industrial Source Complex Model
ISO	International Standards Organization
ICL	Indiantown Cogeneration, Limited Partnership
K'/b'	Leakance
kV	kilovolts
lb/acre-mo	pounds per acre-month
lb/hr	pounds per hour
lb/MMBtu	pounds per million Btu
LCD	Local Climatological Data
Ldn	Day/night weighted average noise level
LOS	Level of Service
mEq	milliequivalents
MDF	Maximum Daily Flow
MGD	Million Gallons per Day
mg/l	milligrams/liter
mi	mile
mi ²	square mile
mph	miles per hour
MSL	Mean Sea Level
MW	Megawatt
MPO	Metropolitan Planning Organization
ug/m ³	micrograms per cubic meter
umhos	micromhos
NAAQS	National Ambient Air Quality Standards
NAS	National Audubon Society
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NO _x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NWS	National Weather Service
O ₃	Ozone
PC	Pulverized Coal
PM-10	Particulate with diameter of 10 μ or less
ppm	parts per million
PSD	Prevention of Significant Deterioration
PUD(i)	Planned Unit Development-Industrial
PSC	Public Service Commission
PVC	Polyvinyl chloride
ROW	Right-of-way

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SACTI	Seasonal/Annual Cooling Tower Plume Impact Model
SDA	Spray dryer absorber
SFWM	South Florida Water Management District
SR	State Road
S	Storativity
SCA	Site Certification Application
SCR	Selective Catalytic Reduction
SCS	Soil Conservation Service
SHPO	State Historic Preservation Office
SNCR	Selective Non-catalytic Reduction
SO ₂	Sulfur Dioxide
SWIM	Surface Water Improvement Management (Act)
T	Transmissivity
TC/NS	Taylor Creek/Nubbin Slough
TCRPC	Treasure Coast Regional Planning Council
TDS	Total Dissolved Solids
tph	tons per hour
TSP	Total Suspended Particulate
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USDW	Underground Source of Drinking Water
VOC	Volatile Organic Compound

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1.0 THE NEED FOR POWER AND THE PROPOSED FACILITIES

A Joint Petition to Determine Need for Electrical Power Plant was submitted to the Florida Public Service Commission (PSC) by Indiantown Cogeneration, L. P. (ICL) and Florida Power and Light (FPL) on August 21, 1990. This submittal to the PSC discussed the DER's requirement for information on (1) internal benefits to the cogeneration owners, (2) benefits to the county, region, and state; and (3) an assessment of the impact of the proposed facility on the reliability, generation planning, unit dispatching, and generation costs of the power purchasing utility, as coordinated with the affected utilities. What follows is a brief summary of the need determination document submitted to the PSC.

ICL proposes to construct a cogeneration project near Indiantown, Florida (the "Indiantown Cogeneration Project"). This project is a pulverized coal fired steam unit that will produce approximately 330 MW of electricity for sale to FPL and approximately 225,000 lb/hour of process steam for sale to the Caulkins Indiantown Citrus Company ("Caulkins"). The project is projected to start commercial operation between September 1, 1995 and December 1, 1995.

The document submitted to the PSC demonstrates the need for the new electrical generating capacity to be provided by the Indiantown Cogeneration Project, consistent with the requirements of the Florida Electrical Power Plant Siting Act, Section 403.519, Florida Statutes, and Section 25-22.081 of the Florida Administrative Code.

Under the policy expressed by the PSC in Order No. 22341 in Docket No. 890004-EU (the 1989 annual planning hearing order), the document submitted to the PSC also addresses the need for the Indiantown Cogeneration Project's electrical generating capacity from the viewpoint of FPL, the purchasing utility.

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Where possible, the document submitted to the PSC relies on information concerning FPL's need that has previously been furnished to the Commission in the need determination dockets for FPL's Lauderdale Repowering Project and its Martin Units 3 and 4. In doing this, "FPL's Petition to Determine Need for Electrical Power Plant 1993-1996 (Revised November 1989)" [hereafter referred to as "FPL's 1989 Need Study"] was included as an attachment and was cross-referenced throughout.

FPL's 1989 Need Study shows that FPL has a need by 1996 for the 330 MW represented by the ICL Indiantown Cogeneration Project, in addition to capacity and/or demand reductions available to FPL from other sources. The information in the document submitted to the PSC reconfirms FPL's need for capacity and shows that the Indiantown Cogeneration Project is a cost-effective and reliable method of satisfying the need.

The PSC hearing on the Joint Need for Power submittal by ICL and FPL was held on December 5, 1990.

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2.0 SITE AND VICINITY CHARACTERISTICS

2.1 SITE AND ASSOCIATED FACILITIES DELINEATION

The Indiantown Cogeneration, L. P. (ICL) project will be constructed in southwestern Martin County, Florida.

The site and its access facilities occupy Sections 26, 27, 34, and 35, Township 39 South, Range 38 East, Martin County, Florida. Figure 2.1.0-1, entitled Site Vicinity Plan, illustrates the general location of the ICL project site. The site, which occupies approximately 232 acres, is located 9 miles east of Lake Okeechobee and about 3 miles northwest of the unincorporated town of Indiantown. To the north of the site are the Caulkins Citrus Processing Facility (Caulkins) and the vacant Florida Steel Corporation (FSC) site. Both of these facilities border State Road 710 and the CSX Railroad. The ICL project site is bounded on the west by Tampa Farm Products and on the south and east by unimproved industrially zoned land.

The site is currently unimproved and is zoned industrial. There are no existing buildings and the only structures on the site are the transmission towers in the FPL transmission line right-of-way.

Approximately 21 acres of the site will be used to construct the power block portion of the cogeneration plant. The power block includes the boiler, turbine generator, air pollution control equipment, cooling tower, water treatment facilities, lime and ash storage, and administration and maintenance buildings. Another 15 acres will be used for coal handling and storage facilities. A cooling water storage pond will be constructed on approximately 25 acres. A 12-acre area will be used as temporary construction storage and laydown.

Within the site boundary are 23.9 acres of wetlands which will be preserved. Around each of the wetlands a 50-foot buffer zone will be maintained, accounting

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SITE VICINITY PLAN

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— — SITE BOUNDARY

Scale: 1 Inch = 2000 Ft.

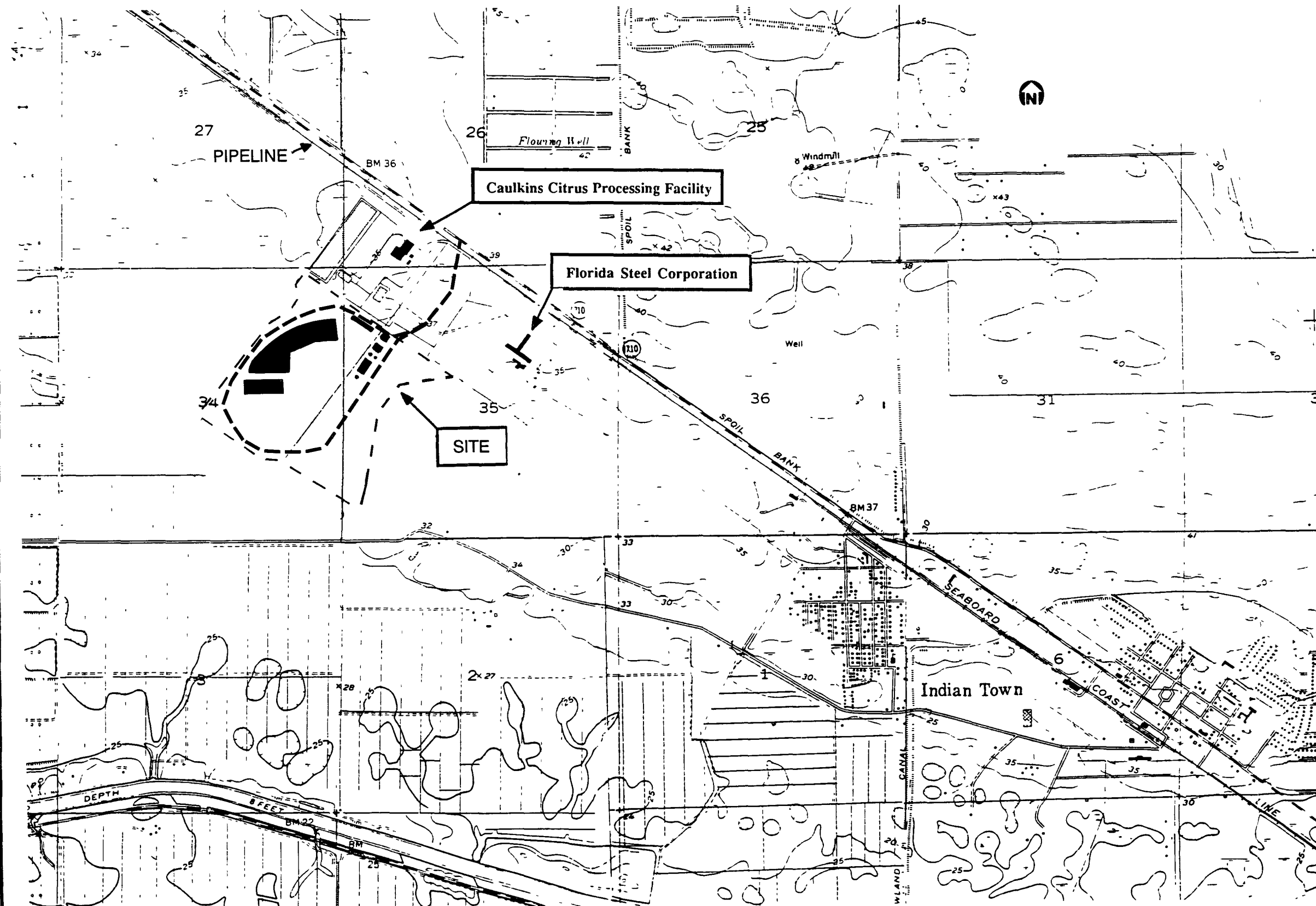
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for an additional 8 acres. As required by Martin County, 25 percent of the pine flatwoods onsite must be preserved as uplands. Therefore, 50.5 acres have been allocated as uplands.

The remaining 76.6 acres include the rail loop, roads, and other miscellaneous non-preserved areas.

The ICL project will be within Zone B as defined by Flood Insurance Rate Maps (FEMA, 1984). Therefore, no portion of the site is within the 100-year flood zone.

In addition to the above mentioned site, an intake structure will be constructed on the canal at Taylor Creek/Nubbin Slough approximately 19 miles from the power plant site. A pipeline will be constructed along the CSX right-of-way (ROW) from the canal to the site. Chapter 6.0 further describes the pipeline and intake structure.

An easement also will be obtained from Florida Steel Corporation to connect the site to the CSX railroad. A new rail spur will be constructed to bring coal and other materials to the site through this easement, which may encompass a maximum of 75 acres.

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2.2 SOCIOPOLITICAL ENVIRONMENT

2.2.1 GOVERNMENTAL JURISDICTIONS

The proposed Indiantown Cogeneration, L. P. (ICL) project is located in portions of Sections 26, 27, 34, and 35 of Range 38 East, Township 39 South, in southwestern unincorporated Martin County. The ICL site is located along State Road (SR) 710 and the CSX rail line, and lies west of and adjacent to the existing Caulkins Indiantown Citrus Processing Plant and an abandoned Florida Steel Corporation (FSC) plant. The location of the associated cooling water pipeline is discussed in Section 6.2.

The project is located within the local jurisdiction of Martin County, and is also under the regional jurisdiction of the Treasure Coast Regional Planning Council (TCRPC) and the South Florida Water Management District (SFWMD). The study area is shown on Figure 2.2.1-1, with 1-, 2-, 3-, 4-, and 5-mile radii delineated from the approximate center point of the plant's stack.

The majority of Martin County's urban development is located to the east of the ICL site between the Florida Turnpike and the Atlantic Ocean, and includes the Palm City, Stuart, Port Salerno, and Hutchinson Island communities. The nearest community to the proposed project is the unincorporated town of Indiantown, located approximately 3 miles southeast of the site along SR 710.

A review of surrounding areas for land under the jurisdiction of federal, state, or regional agencies shows that none of these are located within 5 miles of the ICL site. Barley Barber Swamp, a wetland preserve, is located about 5 miles to the northwest of the project as shown on Figure 2.2.1-1.

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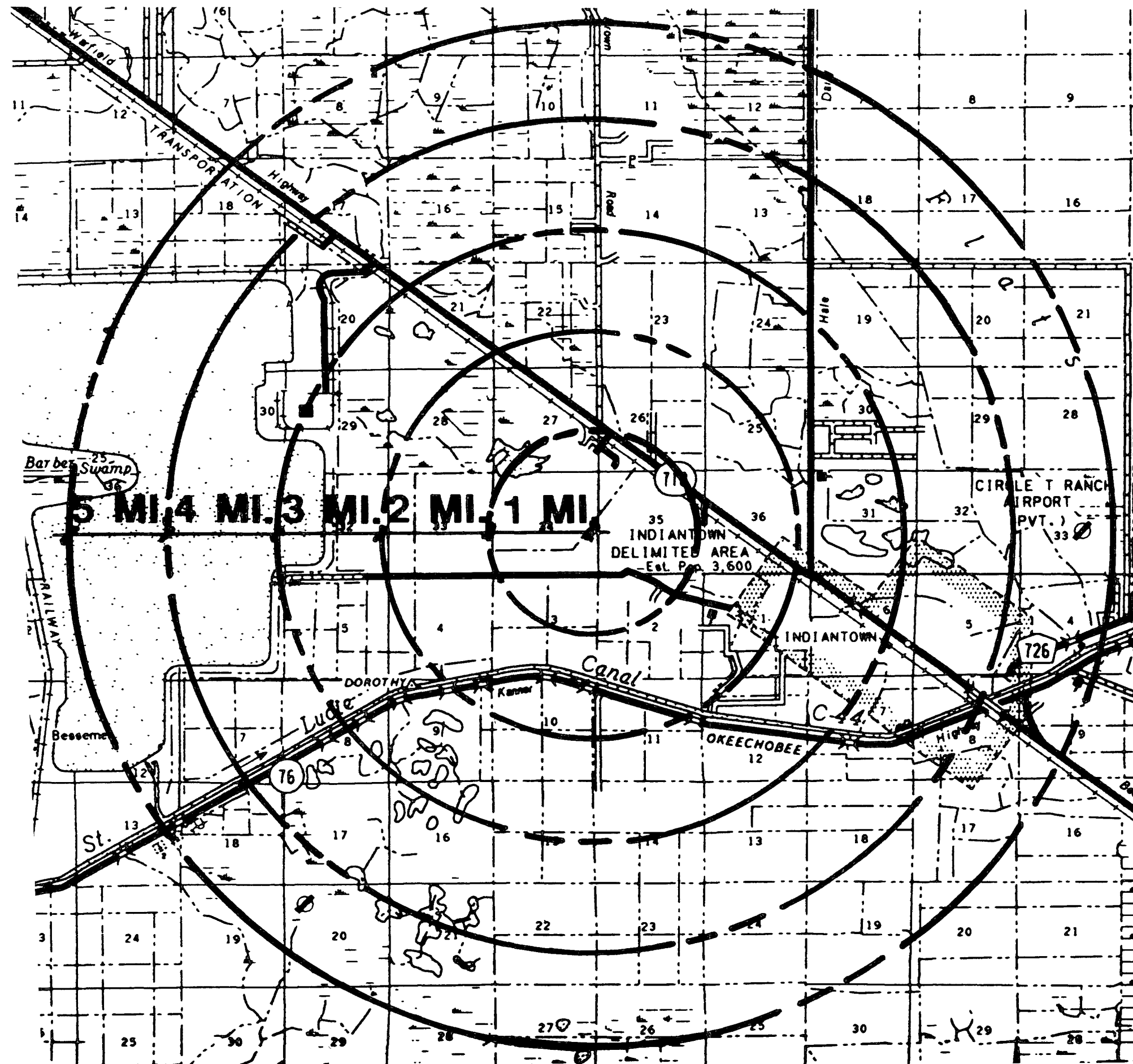


Figure 2.2.1-1.

GOVERNMENTAL
JURISDICTIONS WITHIN FIVE
MILES OF THE ICL SITE

SCALE 1" = 1 MILE

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Sources FDOT, 1976, 1985 ETC, 1990

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Barley Barber Swamp is a 400-acre preservation area maintained as a private landholding by Florida Power & Light Company (FPL). Barley Barber Swamp is maintained as a natural preserve, and consists of ecologically valuable wetland and upland communities. FPL provides public access to the swamp and its boardwalk, restrooms, and parking area, by appointment.

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2.2.2 ZONING AND LAND USE PLANS

Martin County has developed its Comprehensive Growth Management Plan (CGMP) in accordance with the requirements of the Local Comprehensive Planning and Land Development Regulation Act, Chapter 163, Part II, *Florida Statutes* (FS); and Chapter 9J-5, Florida Administrative Code (FAC). Martin County's CGMP was adopted by the Martin County Board of County Commissioners on February 20, 1990 (Martin County CGMP, 1990).

The location of the proposed ICL plant in relation to the county's future land use plan categories is shown on Figure 2.2.2-1. This figure shows that the majority of the project site falls within the industrial land use category. A very small portion, approximately 1.5 acres or 0.65 percent of the total site area, falls within the Agricultural land use category. This area is located in the extreme southeast portion of the site and will not be developed. The site is partially located within Martin County's Primary Urban Service District. Figure 2.2.2-2 shows the current zoning of the site and the surrounding property. Most of the ICL project site is currently zoned M-3, Heavy Industrial. A small portion of the site is zoned M-1, Industrial.

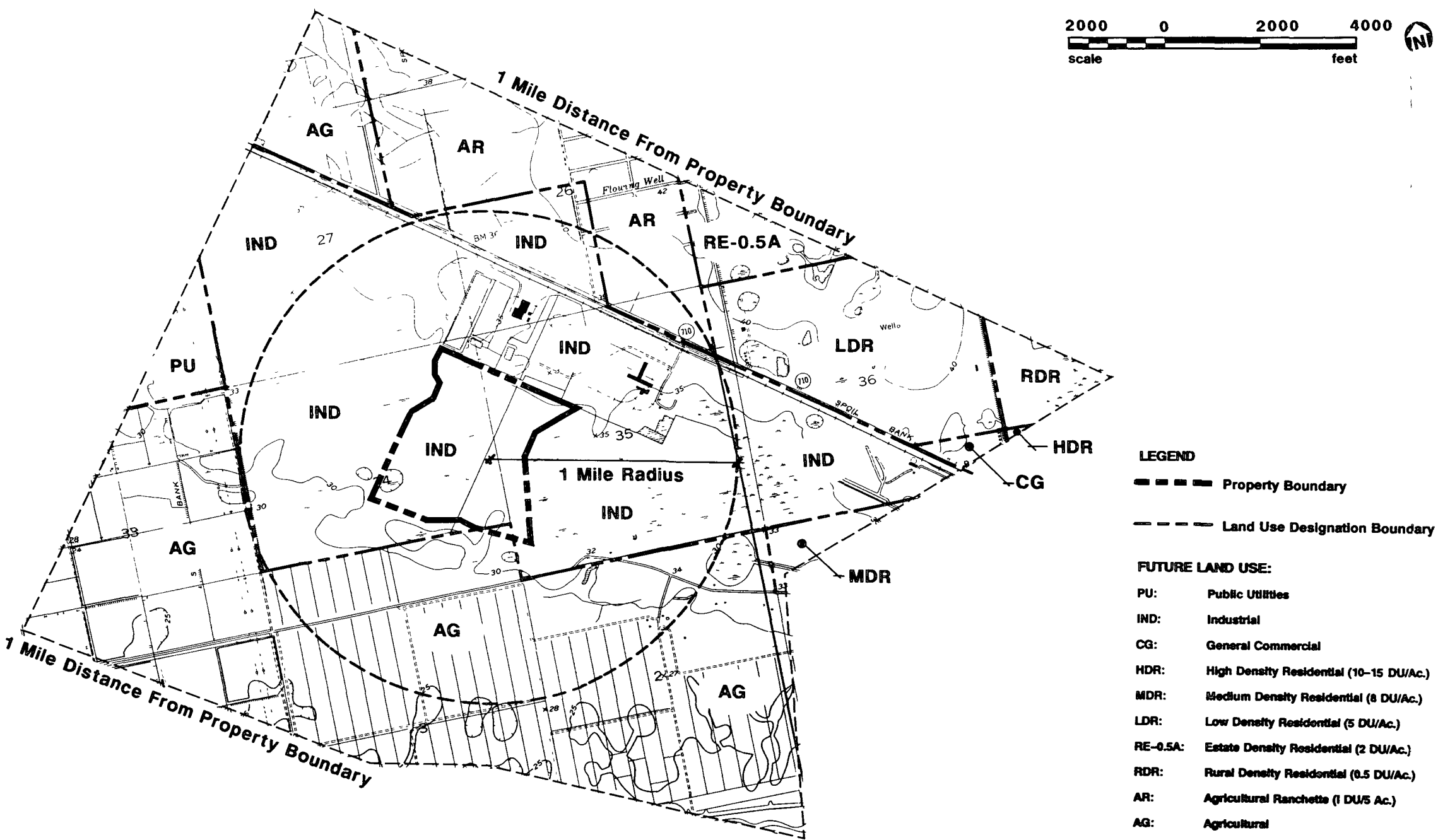
The Future Land Use Element of Martin County's CGMP includes a number of policies related to industrial development. They can generally be characterized as follows:

1. Policies for the concentration of higher intensities of development within Primary Urban Service Districts--Goal G beginning on page 4-39, especially Objective 1, Policies b and c
2. Policies providing for adequate and appropriate lands for industrial land uses--Goal K beginning on page 4-48, including Objectives 1-4
3. Policies for land use allocation--Goal M, Objective 1f (Industrial Development) and 1h (Public Utilities - Major Power Generation Facilities)

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Figure 2.2.2-1.

LAND USE PLAN
DESIGNATIONS WITHIN ONE
MILE OF THE ICL SITE



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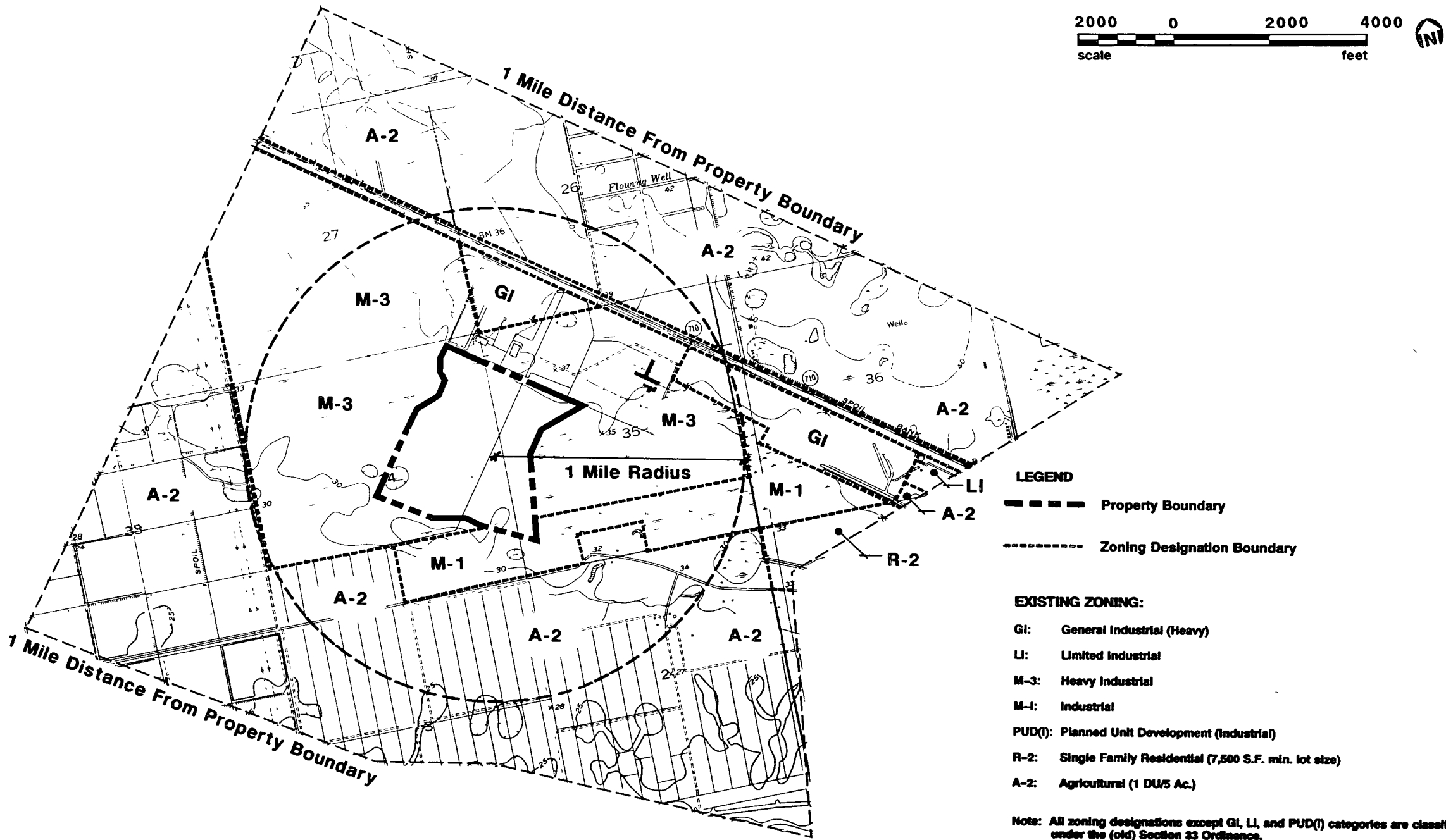
Sources USGS, 1983 Martin County Growth
Management Department, 1990 ECT, 1990

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Figure 2.2.2-2.
ZONING DISTRICTS WITHIN
ONE MILE OF THE ICL SITE



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Sources USGS, 1983 Martin County Growth
Management Department, 1990 ECT, 1990

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4. Performance standards--Section 4.5B, C, D, F, G, H, I, J, K, and L
5. Implementation strategies--Section 4.6C and D

Applicable excerpts from the Martin County CGMP Future Land Use Element are included in Section 10.3.

The ICL cogeneration facility is designed to provide process steam to the Caulkins citrus processing plant. The cogeneration concept involves efficient use of fuel to produce electricity and a second form of useful energy, in this case process steam. The electricity will be sold to FPL. Proximity to its steam host is a necessary prerequisite to the efficient operation of the cogeneration system. As an integrated part of the Caulkins processing plant, the ICL project is appropriately located in the industrial land use category and will not require a change in Martin County's future land use map.

The project is undergoing Martin County preliminary development plan review in conjunction with a rezoning to Industrial Planned Unit Development [PUD(i)]. The rezoning is being sought because of the County's preference that the project be developed under a PUD zoning rather than the existing M-3 (Heavy Industrial) and M-1 (Industrial) zoning. PUD zoning provides for in-depth development plan review, as well as maximum project design flexibility. Simultaneously with the PUD(i) rezoning, ICL is seeking an exemption from Martin County's height regulations to accommodate the project's stacks and other facilities which may exceed Martin County's 60-foot height restriction. The Martin County Board of County Commissioners' (BOCC) approval of the PUD(i) rezoning, preliminary development plan, and the height exemption are expected in early 1991. Applicable provisions of the Martin County Zoning and Land Development Codes are included in Section 10.2.

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2.2.3 DEMOGRAPHY AND ONGOING LAND USE

2.2.3.1 Population of the Surrounding Area

There are no incorporated towns and cities within a 5-mile radius of the Indiantown site. The unincorporated community of Indiantown lies within the 5-mile radius approximately 3 miles southeast of the site. The majority of land surrounding the ICL site is either agricultural or undeveloped in nature.

The Martin County Community Development Department has divided the county into several planning areas for planning and analysis purposes. The Indiantown project 5-mile radius study area includes two of these planning areas: (1) Indiantown, and (2) West County, as shown on Figure 2.2.3-1. On this figure, the West County planning area includes all the area within the 5-mile radius, except for the shaded area for the Indiantown planning area. The population projections for these two planning areas and the entire county are shown in Table 2.2.3-1. The Indiantown area has a significantly higher population and population density in comparison to the West County area. The estimated 1990 population for the Indiantown planning area is 5,852 persons (Martin County CGMP, 1990) and the population density for the 16.5-mi₂ area is approximately 355 persons per square mile. The estimated 1990 population for the West County area is 3,247 persons. This planning area covers approximately 241.3 mi²; due to its agricultural and undeveloped character, it has a population density of approximately 13 persons per mi².

2.2.3.2 Historic and Future Population Growth

Between 1970 and 1980, the population of Martin County grew by 128 percent (Bureau of Economic and Business Research, 1990). During the period 1980 to 1989, the total population of Martin County increased 51 percent (Bureau of Economic and Business Research, 1990). Comparable historic growth rates for

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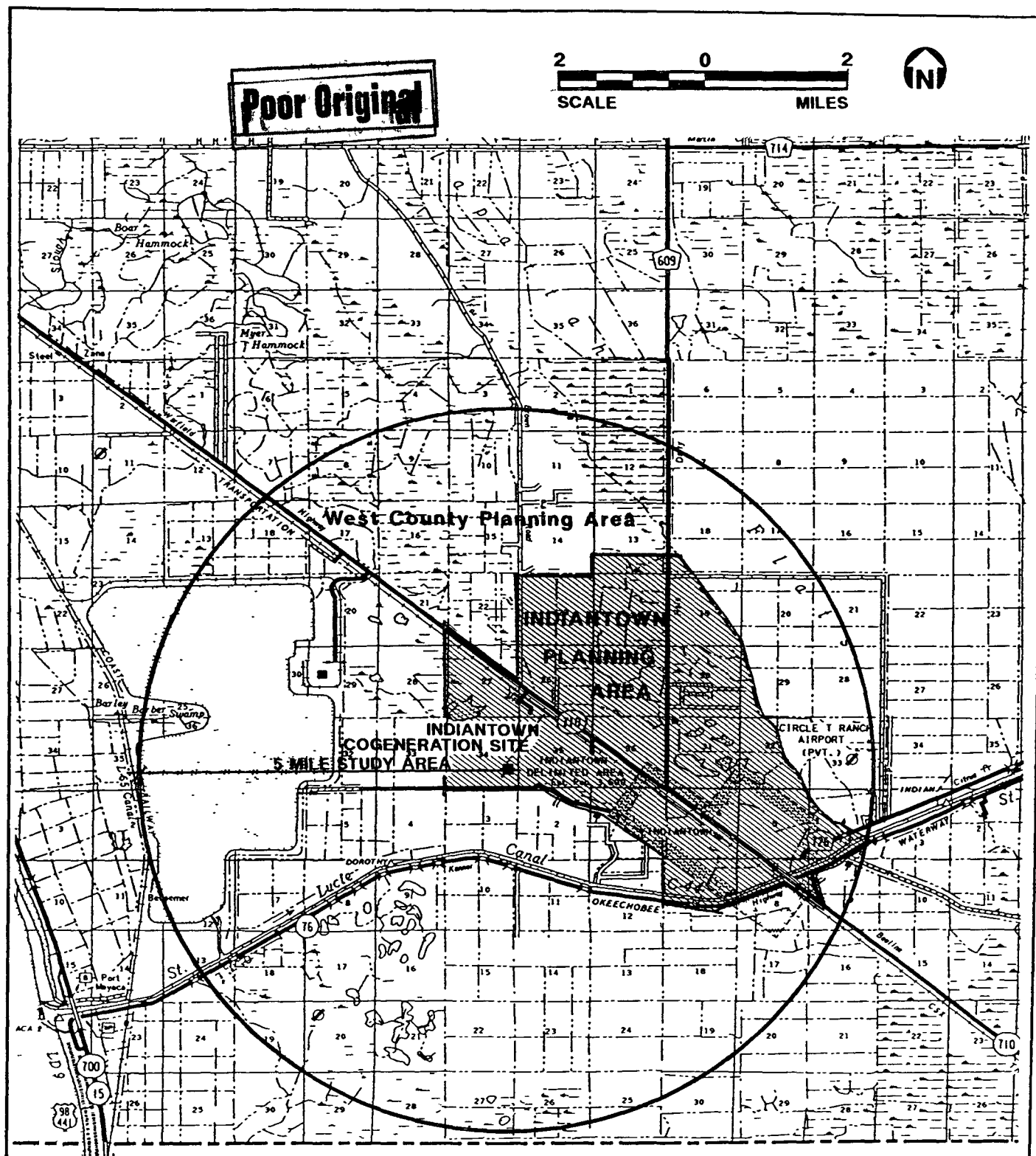


Figure 2.2.3-1
MARTIN COUNTY PLANNING AREA

Sources FDOT, 1976, 1983 Martin County Growth Management Department, 1990 ECT, 1990

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Table 2.2.3-1
POPULATION PROJECTIONS, MARTIN COUNTY, FLORIDA

Year	Martin County	Indiantown Planning Area	West County Planning Area
<u>Population (number of persons)</u>			
1990	107,437	5,852	3,247
1995	127,527	6,910	4,079
2000	149,845	8,085	5,004
2005	172,165	9,260	5,929
<u>Average Annual Growth Rate %</u>			
1990 - 1995	3.5	3.4	4.7
1995 - 2000	3.3	3.2	4.2
2000 - 2005	2.8	2.8	3.5

Source: Martin County CGMP, 1990.

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 MARTIN COUNTY
 PLANNING AREA

the planning areas are not available because the planning boundaries have changed over time.

Projected future annual population growth rates for the Indiantown planning area, as previously shown in Table 2.2.3-1, will be slightly slower than for the entire county, at 3.4 percent per year from 1990 to 1995, 3.2 percent per year from 1995 to 2000, and approximately 2.8 percent per year from 2000 to 2005. The 2005 population for the Indiantown planning area is projected to be 9,260 permanent residents (Martin County CGMP, 1990).

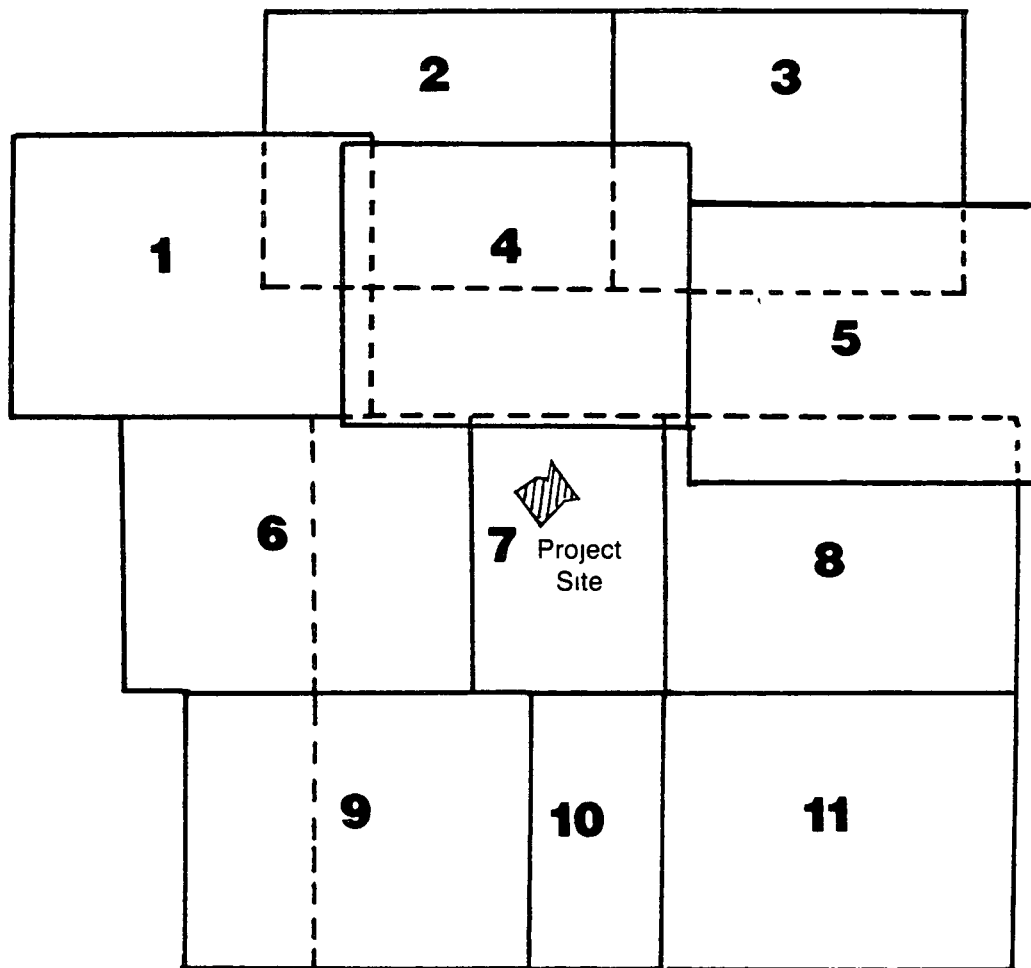
The projected future annual population growth rates for the West County planning area, as previously shown in Table 2.2.3-1, are slightly higher than those for the entire county due to the amount of land available for development, and the low density of the existing population. The average annual growth rates for the period 1990 to 1995 are projected at 4.7 percent per year, 4.2 percent per year during the period 1995 to 2000, and 3.5 percent per year for the years 1995 to 2000. The West County planning area population for the year 2005 is projected to be 5,929 permanent residents (Martin County CGMP, 1990).

2.2.3.3 Land Uses of the Surrounding Area

The land use analysis of the 5-mile study area was based on 1986 SFWMD land use maps prepared as overlays on U.S. Geological Survey (USGS) 7.5 minute quadrangle maps. The information contained in these maps is shown in a reduced form on Figures 2.2.3-2 and 2.2.3-3 (pages 1 through 11). This information was also field verified. A complete listing of land uses found within the 5-mile radius is shown in Table 2.2.3-2.

The majority of the lands within a 5-mile radius of the project site are undeveloped or agricultural in nature. These undeveloped lands contain grasslands, brushland, old fields, pastures, water bodies, and forested, non-forested, and mixed forested wetlands. Lands utilized for agriculture within the 5-mile radius are primarily

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Figure 2.2.3-2
LAND USE AND LAND COVER MAP KEY SHEET
FOR THE FIVE-MILE STUDY AREA

Source ECT, 1990

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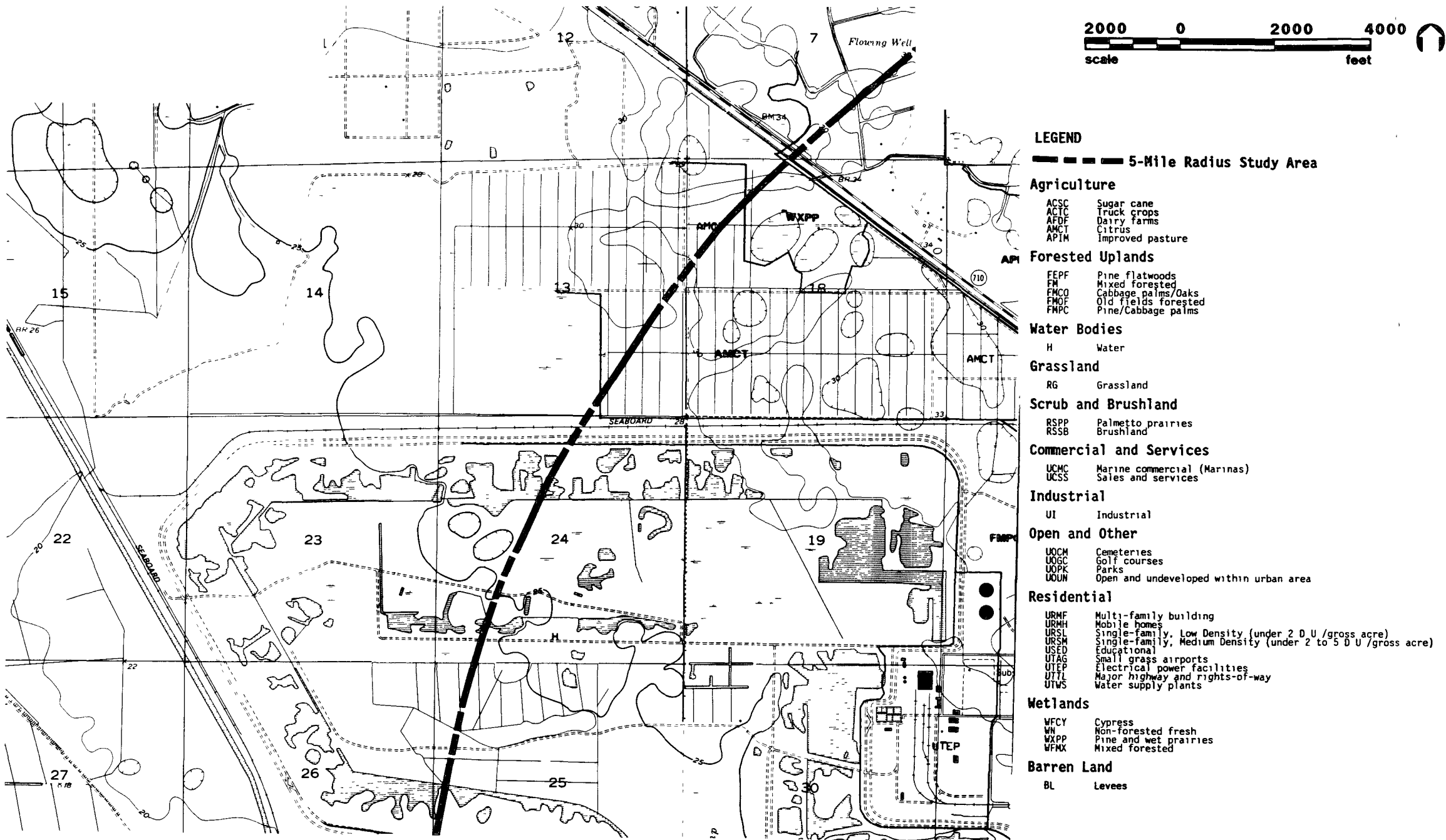
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Figure 2.2.3-3. (Page 1 of 11)

LAND USE AND LAND COVER DESIGNATIONS
WITHIN A FIVE-MILE RADIUS
OF THE ICL SITE



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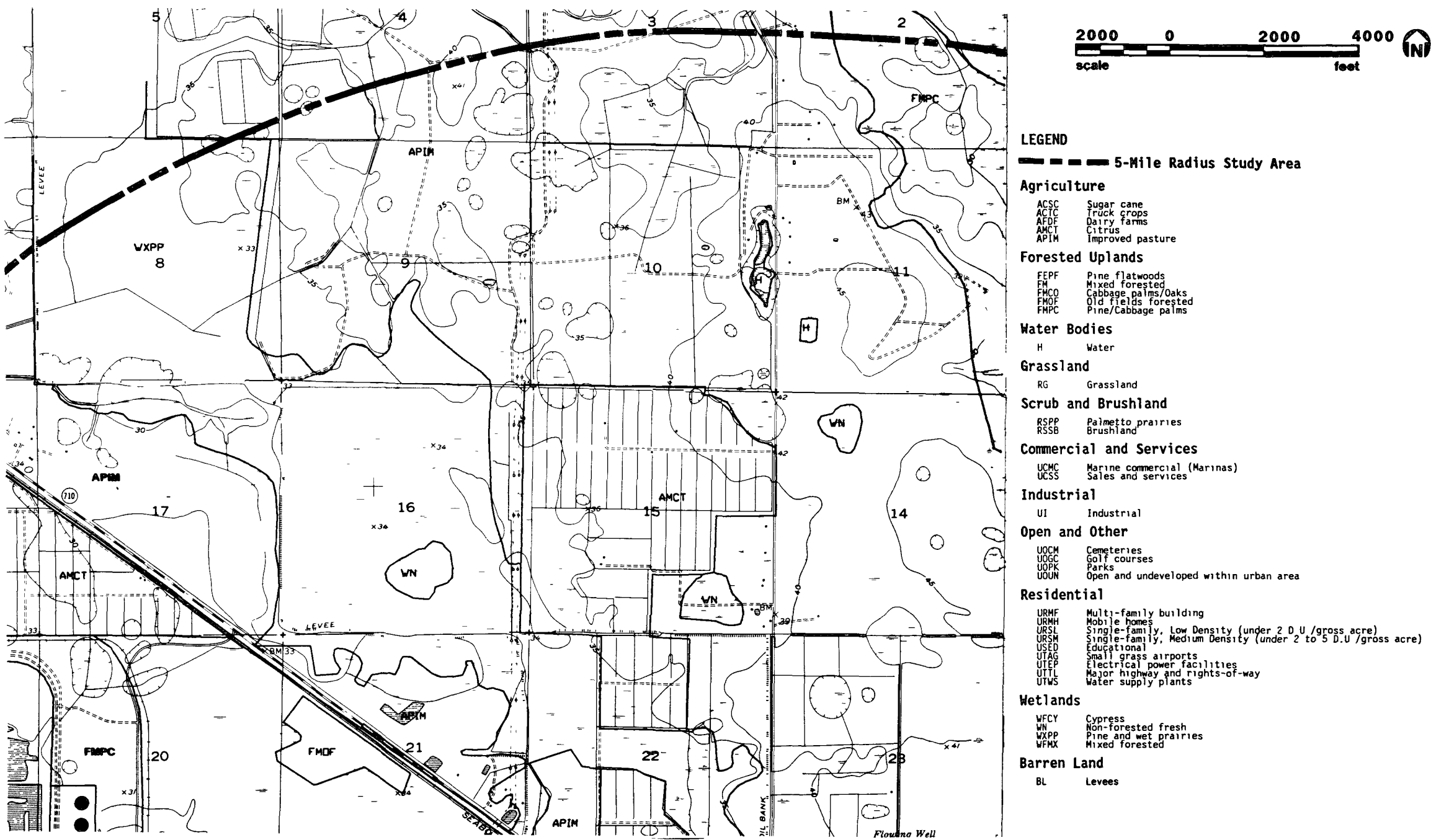
Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Figure 2.2.3-3. (Page 2 of 11)

LAND USE AND LAND COVER DESIGNATIONS
WITHIN A FIVE-MILE RADIUS
OF THE ICL SITE



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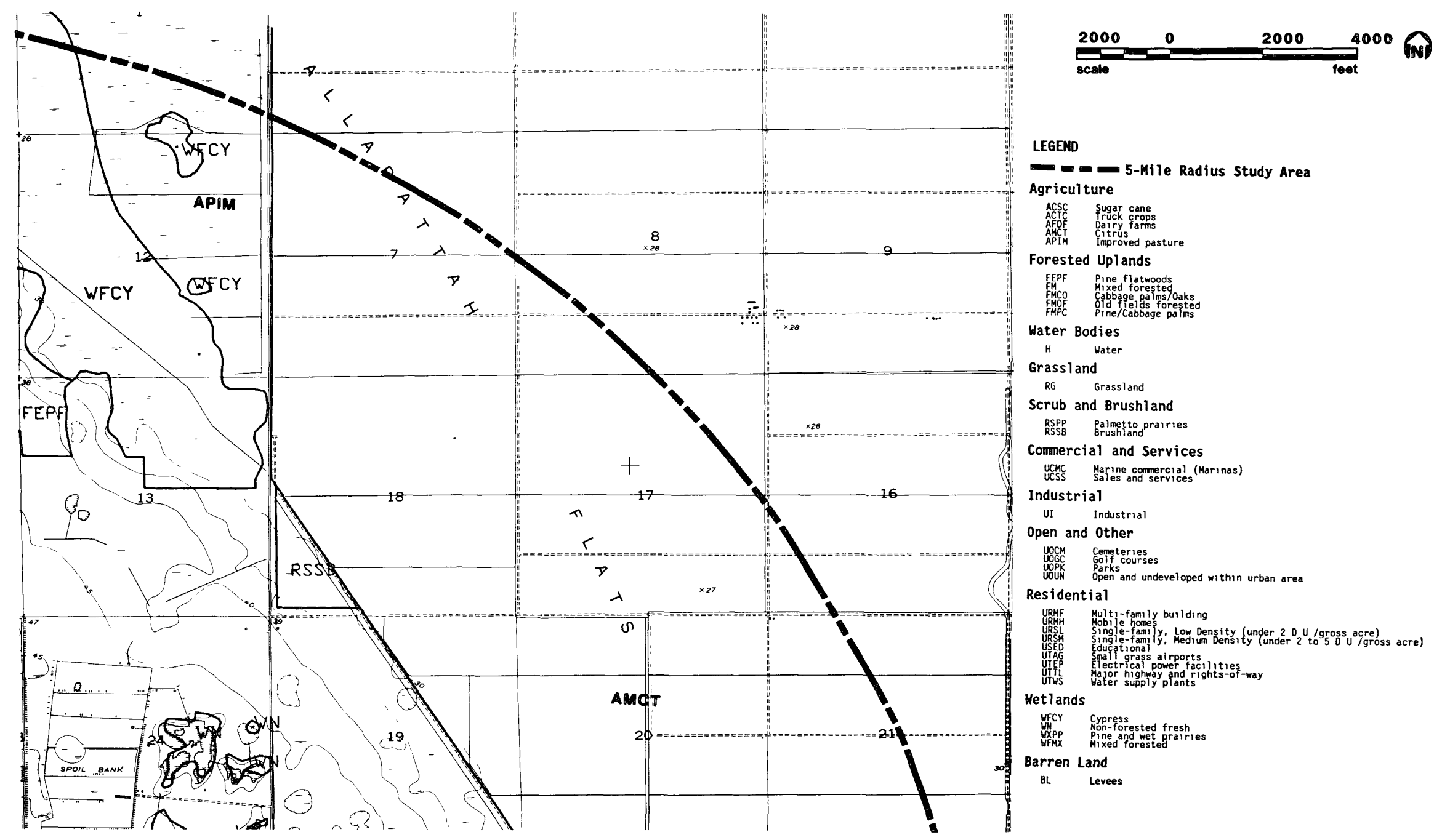
Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Figure 2.2.3-3. (Page 3 of 11)

LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE



Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE

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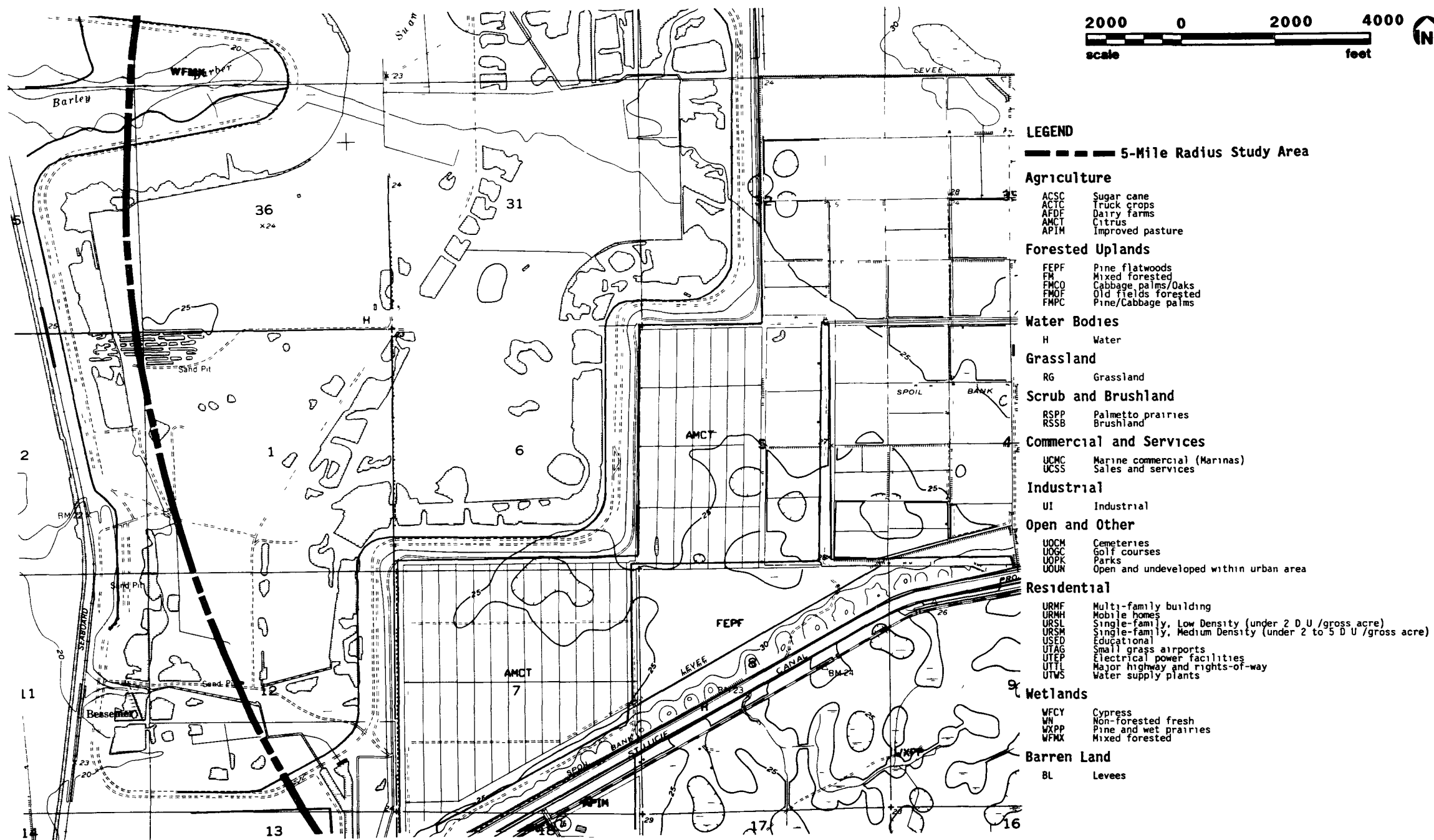
LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE



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Figure 2 2 3-3 (Page 6 of 11)

LAND USE AND LAND
COVER DESIGNATIONS
WITHIN A FIVE-MILE RADIUS
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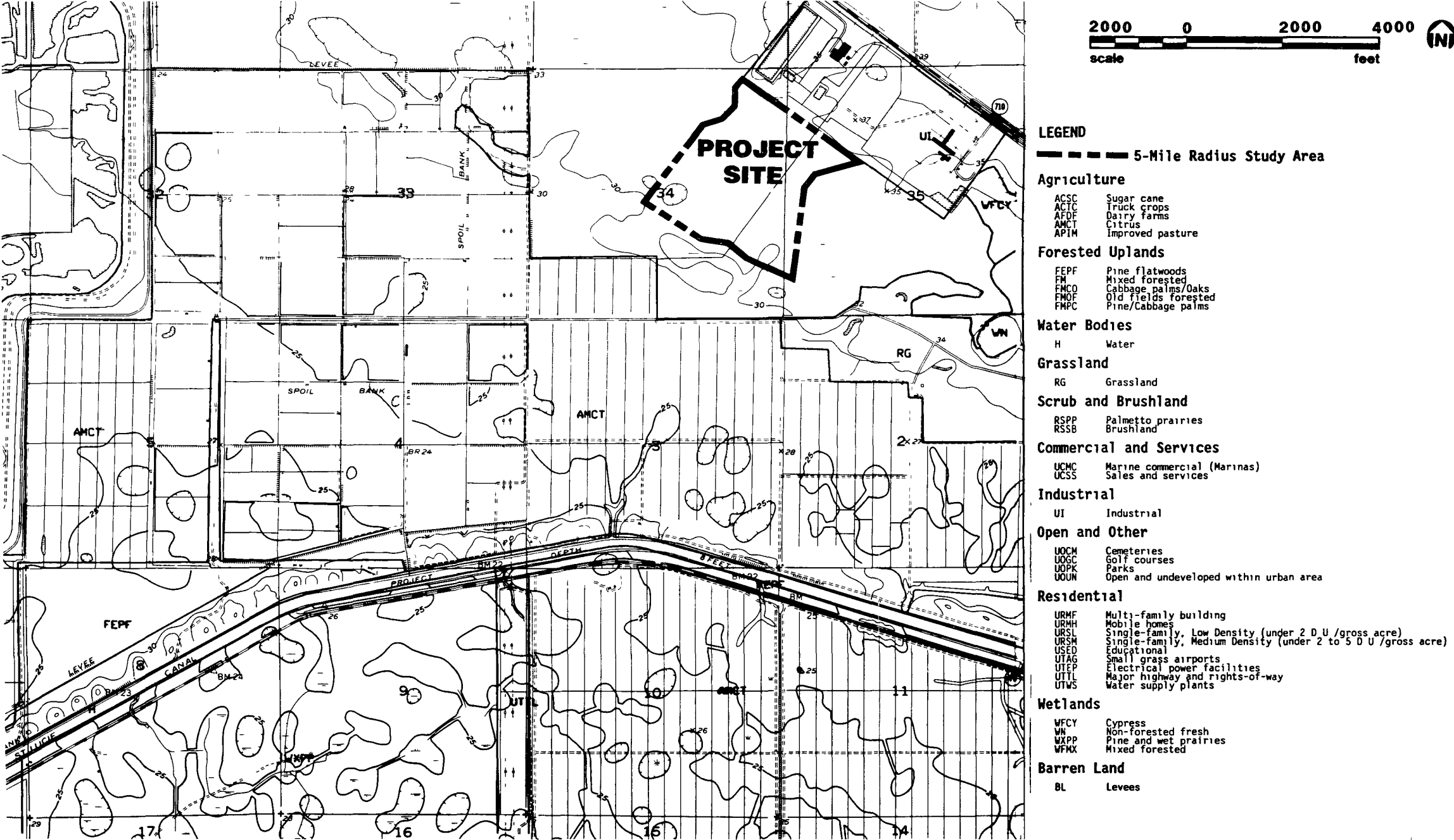
Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Figure 2.2 3-3 (Page 7 of 11)

LAND USE AND LAND COVER DESIGNATIONS
WITHIN A FIVE-MILE RADIUS
OF THE ICL SITE



Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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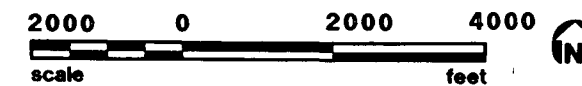
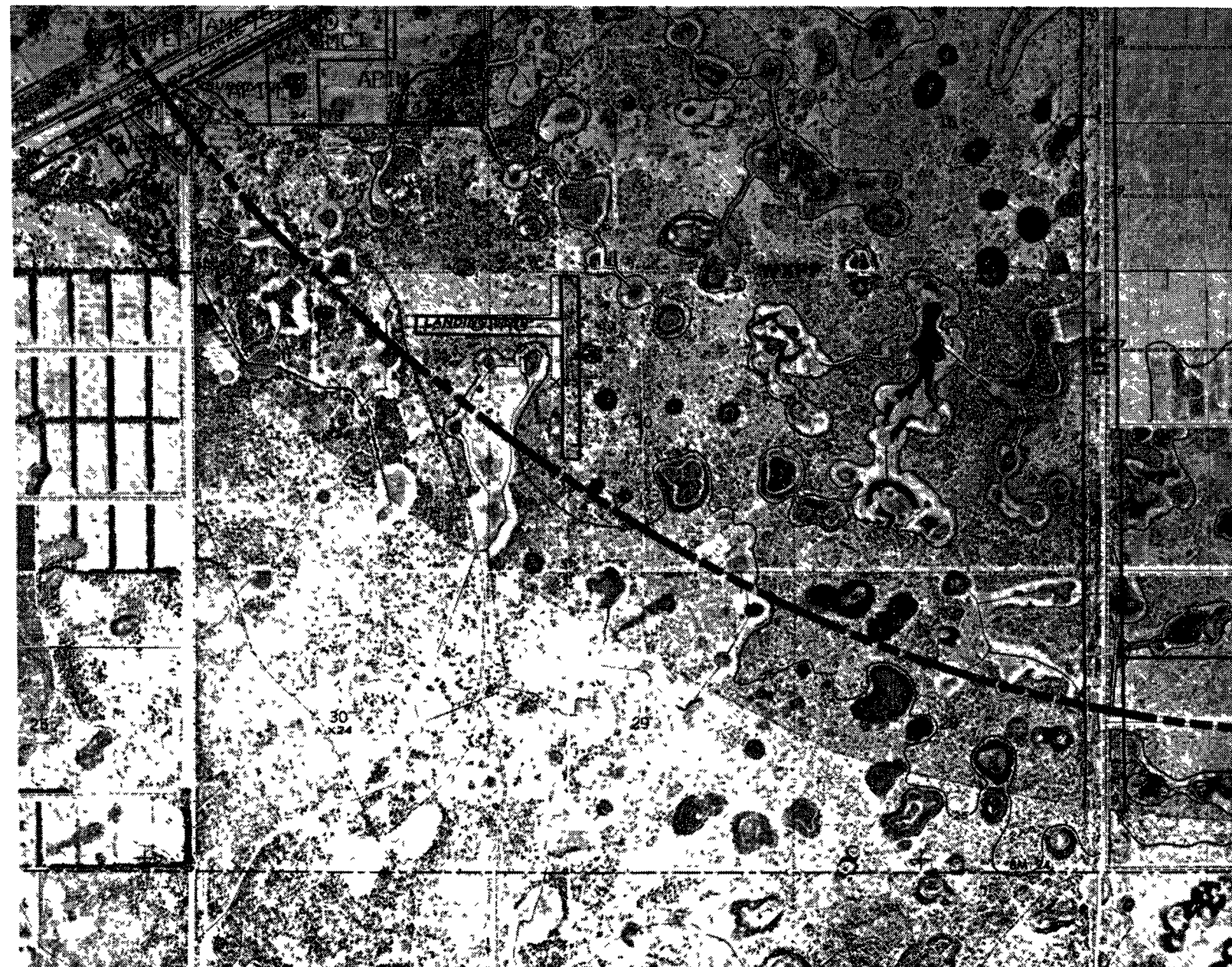
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LAND USE AND LAND COVER DESIGNATIONS WITHIN A FIVE-MILE RADIUS OF THE ICL SITE

**Indiantown Cogeneration, L P**

Figure 2.2 3-3 (Page 9 of 11)

LAND USE AND LAND
COVER DESIGNATIONS
WITHIN A FIVE-MILE RADIUS
OF THE ICL SITE



LEGEND

----- 5-Mile Radius Study Area

Agriculture

ACSC Sugar cane
ACTC Truck crops
AFDF Dairy farms
AMCT Citrus
APIH Improved pasture

Forested Uplands

FEPP Pine flatwoods
FM Mixed forested
FMCO Cabbage palms/Oaks
FMOF Old fields forested
FMPC Pine/Cabbage palms

Water Bodies

H Water

Grassland

RG Grassland

Scrub and Brushland

RSPP Palmetto prairies
RSSB Brushland

Commercial and Services

UCMC Marine commercial (Marinas)
UCSS Sales and services

Industrial

UI Industrial

Open and Other

UOCH Cemeteries
UOGC Golf courses
UOPK Parks
UOUN Open and undeveloped within urban area

Residential

URMF Multi-family building
URMH Mobile homes
URSL Single-family Low Density (under 2 D U /gross acre)
URSM Single-family Medium Density (under 2 to 5 D U /gross acre)
USED Educational
UTAG Small grass airports
UTEP Electrical power facilities
UTL Major highway and rights-of-way
UTWS Water supply plants

Wetlands

WFCY Cypress
WN Non-forested fresh
WXP Pine and wet prairies
WFMX Mixed forested

Barren Land

BL Levees

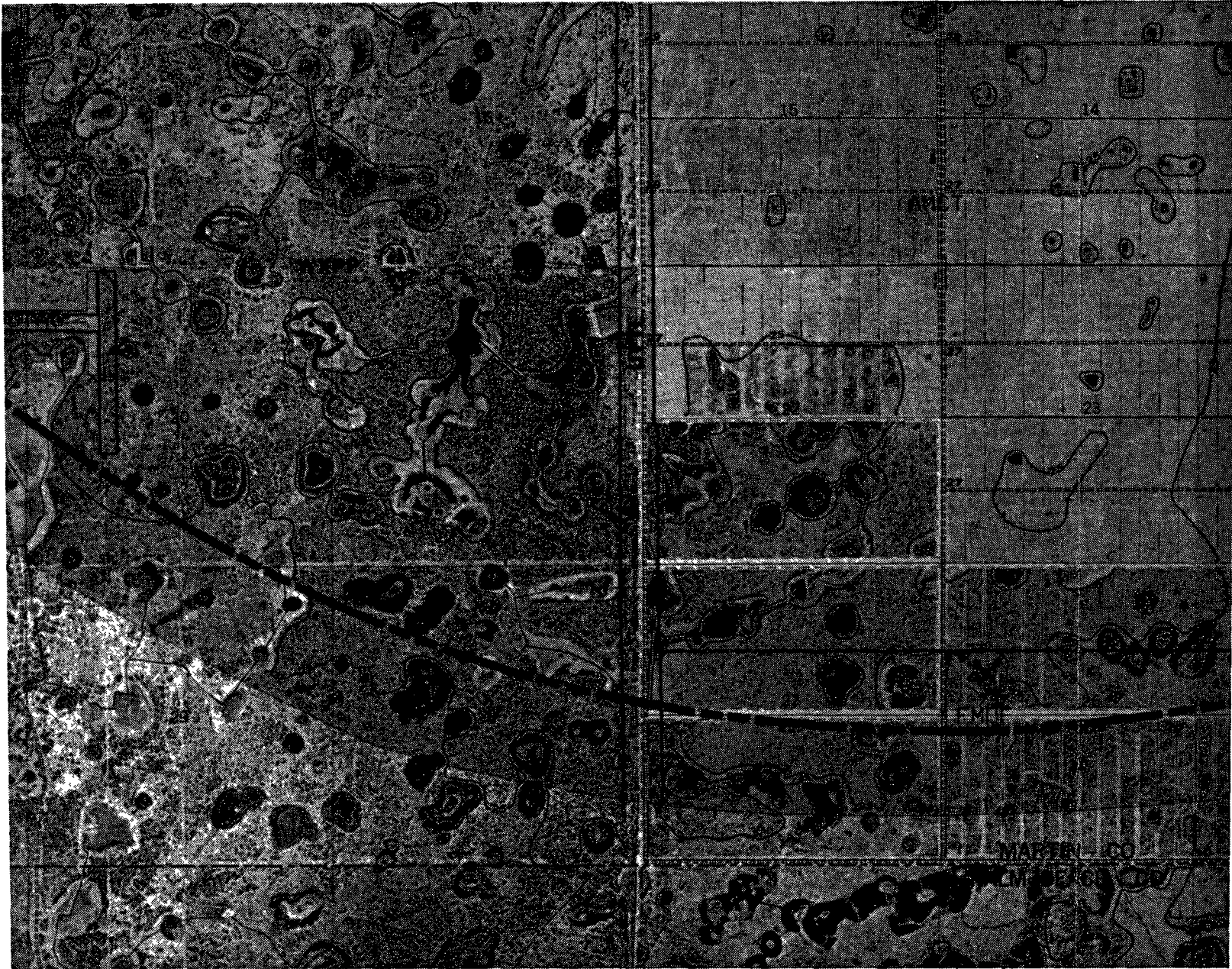
Sources USGS, 1983 SFWMD, 1986 ECT, 1990

INDIANTOWN
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Figure 2.2.3-3. (Page 10 of 11)

LAND USE AND LAND
COVER DESIGNATIONS
WITHIN A FIVE-MILE RADIUS
OF THE ICL SITE



- LEGEND**
- 5-Mile Radius Study Area
- Agriculture**
- ACSC Sugar cane
 - ACTC Truck crops
 - ADFC Dairy farms
 - AMCT Citrus
 - APIM Improved pasture
- Forested Uplands**
- FEPP Pine flatwoods
 - FW Mixed forested
 - FMCO Cabbage palms/Oaks
 - FMOF Old fields forested
 - FMPC Pine/Cabbage palms
- Water Bodies**
- H Water
- Grassland**
- RG Grassland
- Scrub and Brushland**
- RSPP Palmetto prairies
 - RSSB Brushland
- Commercial and Services**
- UCMC Marine commercial (Marinas)
 - UCSS Sales and services
- Industrial**
- UI Industrial
- Open and Other**
- UOCH Cemeteries
 - UOGC Golf courses
 - UOPK Parks
 - UOUN Open and undeveloped within urban area
- Residential**
- URMF Multi-family building
 - URMH Mobile homes
 - URSL Single-family Low Density (under 2 D.U./gross acre)
 - URSM Single-family Medium Density (under 2 to 5 D.U./gross acre)
 - USED Educational
 - UTAG Small grass airports
 - UTEP Electrical power facilities
 - UTTL Major highway and rights-of-way
 - UTWS Water supply plants
- Wetlands**
- WFCY Cypress
 - WN Non-forested fresh
 - WXPP Pine and wet prairies
 - WFMX Mixed forested
- Barren Land**
- BL Levees

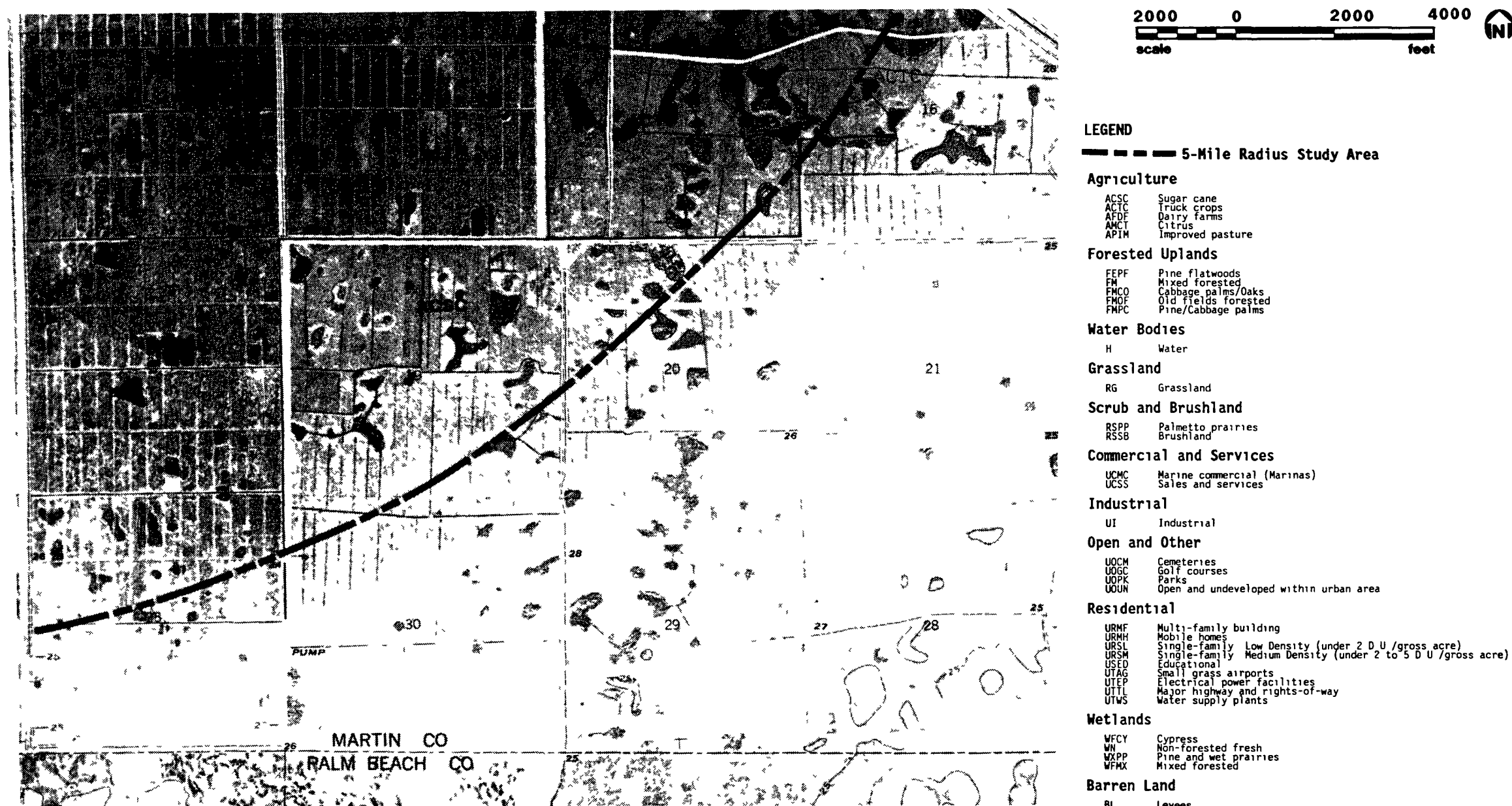
Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Figure 2 2 3-3. (Page 11 of 11)

LAND USE AND LAND
COVER DESIGNATIONS
WITHIN A FIVE-MILE RADIUS
OF THE ICL SITE



Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Table 2.2.3-2
LAND USES FOUND WITHIN THE 5-MILE STUDY AREA OF THE ICL SITE

Agricultural

- Unimproved pasture
- Citrus groves
- Sugar cane
- Truck crops cropland

Residential

- Single-family, low density (less than 2 DU/GA)
- Single-family, medium density (2 to 5 DU/GA)
- Multi-family
- Mobile home

Commercial and services

- Sales and services
- Cultural and entertainment
- Marine commercial

Industrial

Institutional

- Educational

Transportation

- Small grass airports
- Electrical power facilities
- Major transmission lines

Open and others

- Golf courses
- Parks
- Cemeteries
- Open and undeveloped within urban areas

Sources SFWMD Land Use and Land Cover Classification Code, no date
 ECT, 1990

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categorized within citrus groves and unimproved land uses. A few comparatively small agricultural areas within the 5-mile study area are utilized for cropland land uses including sugar cane and truck crops.

Developed lands classified as urban and built-up land are found in three primary areas within the 5-mile radius study area. In the existing FPL Martin electric generating facility located to the northwest, the Caulkins Indiantown Citrus plant, the Bay State Milling Company, and an abandoned FSC site adjacent to the ICL site, and in the unincorporated community of Indiantown. The FPL plant is categorized broadly under the transportation classification and is specifically designated as an electrical power facility. The FPL site also has associated major transmission lines located within the 5-mile radius. The Caulkins Indiantown Citrus Company operates a processing plant directly adjacent to the ICL site, which is categorized as an industrial land use by the SFWMD Land Use and Land Cover Classification Code. FSC also has industrial property located directly adjacent to the ICL site. However, though structures currently exist on the adjacent FSC site, the buildings are abandoned and no steel processing or manufacturing takes place.

The majority of urban or built-up lands within the 5-mile radius are located within the unincorporated community of Indiantown. The general pattern of development in Indiantown consists of residential uses formed around a linear strip of commercial services fronting SR 710. The majority of land uses adjacent to and behind the SR 710 commercial strip primarily consist of low and medium density single family and mobile home residential development. A more recent mobile home development, not shown on the SFWMD maps, is located adjacent to the Indianwood Golf and Country Club.

A few other land uses are located in scattered patterns in Indiantown, which include parks, institutional, and industrial. Several parks are contained in Indiantown and most notably include Big Mound Park and Kiwanis Park. Several institutional land uses are scattered among the commercial area and include the

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local fire station and several churches. A few industrial parcels are also located among the commercial area, as well as in relatively undeveloped portions and along the St. Lucie Canal.

2.2.3.4 Land Use Projections

Current land use designations within 1 mile of the project site boundary, as dictated by the Martin County CGMP, were previously shown in Figure 2.2.1-1. With the exception of the unincorporated community of Indiantown, the majority of the land within the 5-mile study area is planned to remain in agricultural uses. Though less prevalent, other land use designations are located within the 5-mile study area and include low density residential (less than two dwelling units per acre), an industrial area from the project site east toward Indiantown, and public utilities land use designation for the FPL Martin site located west of the ICL project (Martin County Future Land Use Maps, 1990).

Within Indiantown, a variety of future land use categories are designated, which directly correlate to land use patterns previously discussed in Section 2.3.3.3. Though a variety of future land use designations exist within Indiantown, these projected patterns of land development closely follow the existing character and will not bring about any substantial change. Because of the relatively developed nature of Indiantown, future development will primarily consist of the infilling of currently vacant parcels of land.

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2.2.4 EASEMENTS, TITLE, AND AGENCY WORKS

No easement, title, or crossing approval other than those required for the water pipeline are required from any governmental agency For a discussion of the water pipeline, see Section 6 2

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2.2.5 REGIONAL SCENIC, CULTURAL, AND NATURAL LANDMARKS

As previously discussed in Section 2.2.1, only one area valued for its natural, scenic, or cultural significance lies within the 5-mile radius study area for the ICL project. This natural feature, Barley Barber Swamp, is a 400-acre freshwater cypress swamp located adjacent to the Martin FPL power plant cooling pond. This natural feature is managed by FPL as a nature preserve, and is open to the public by appointment.

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2.2.6 ARCHAEOLOGICAL AND HISTORIC SITES

A comprehensive evaluation of archaeological and historic resources within the ICL site was conducted by Piper Archaeological Research, Inc , and is presented in Section 10.8

The methodology utilized for the assessment of cultural and archaeological resources is in accordance with guidelines established in the Historic Preservation Compliance Review Procedures of the Florida Department of State, Division of Historical Resources, Final Draft, 1990. In addition, the assessment was based on a comprehensive, detailed site evaluation of the ICL project site, as opposed to a random sample site area review. The general methodology, including the comprehensive field review techniques, were discussed and verbally approved by a representative of the Florida Department of State, Department of Historical Resources (DHR) prior to research and site assessment (Piper, 1990).

This research found no previously recorded archaeological sites, and a low probability of finding additional significant historical resources on the project site. No archaeological or historic sites eligible for inclusion on the National Register of Historic Places were found during research and assessment (Piper, 1990).

Prehistoric earthen embankments were found in the vicinity of the Barley Barber Swamp, approximately 5 miles west of the project site. However, during field evaluation, no similar mounds were found on the project site (Piper, 1990).

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2.2.7 SOCIOECONOMICS AND PUBLIC SERVICES

2.2.7.1 Study Area Definition

The study area for the analysis of existing baseline socioeconomic and public services conditions in this section is Martin County. As shown on Figure 2.2.7-1, Martin County is bordered by the Atlantic Ocean to the east, Lake Okeechobee to the west, Palm Beach County to the south, St. Lucie County to the north, and Okeechobee County to the northwest.

Martin County is expected to be the primary area to experience potential socioeconomic and public services effects resulting from the construction and operation of the project. As discussed in Section 7.0, overall, these potential effects are expected to be beneficial to the county's economy, primarily due to increases in employment opportunities and the county's tax base and revenues. Potential socioeconomic and public services effects of a proposed power plant in an area are related to the expected permanent in-migration and settlement patterns of workers who fill the new employment opportunities created by the project and their families.

Based on the temporary nature of construction employment and the size of the available workforce within a reasonable commuting distance from the site, only a minimal number of persons are expected to relocate to Martin County or adjacent counties during construction of the ICL project. In addition, ICL will initiate programs to encourage car pooling and, possibly, private busing services to further reduce the potential for changes and related effects in workforce in-migration patterns in Martin County and the region. Therefore, Martin County is expected to be the primary area to experience temporary, potential socioeconomic effects during the construction of the ICL project.

The ICL project will employ a total operational workforce of 80 persons. This number of permanent employees, while beneficial in creating new job opportunities,

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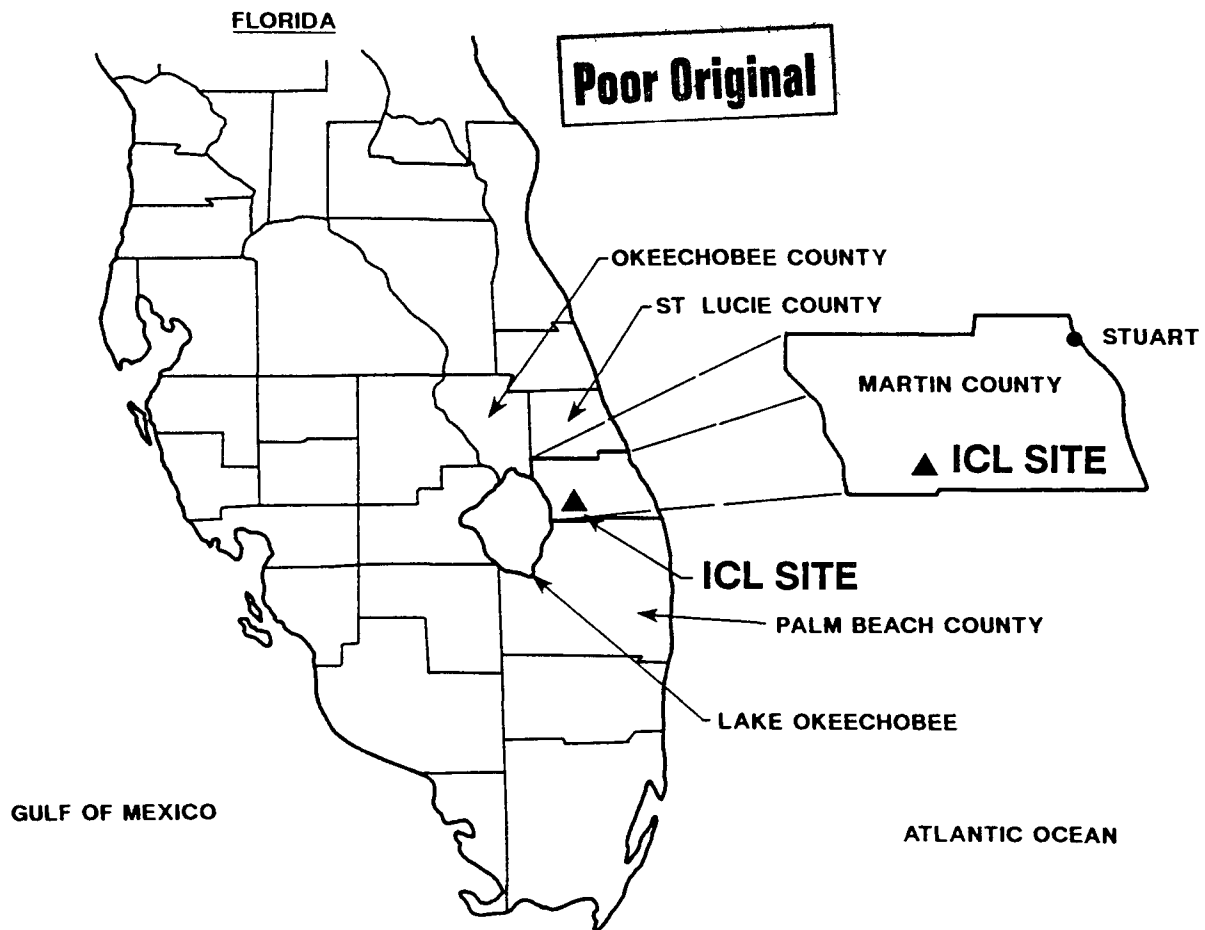


Figure 2.2.7-1
SOCIOECONOMIC STUDY AREA FOR THE
INDIANTOWN COGENERATION PROJECT

Source ECT, 1990

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is small compared to the total population and workforce in Martin County ICL will actively encourage the hiring of operational workers from the local Indiantown and Martin County areas Also, ICL will encourage any workers hired from other areas to relocate and live in Martin County Thus, any identifiable socioeconomic and public service effects resulting from the operation of the ICL project are expected to occur in Martin County

Based on these considerations, the study area for the socioeconomic and public service baseline characteristic descriptions and affect analyses was focused on Martin County Any potential effects resulting from the operational employment opportunities of the ICL project in other adjacent counties are expected to be negligible, although positive on the local economies

2.2.7.2 Labor Force and Employment

The most current data regarding the labor force and employment in Martin County was obtained from the Florida Department of Labor and Employment Security, Bureau of Labor Market Information Table 2 2 7-1 contains 1989 labor force and unemployment information for Martin County and, for comparison purposes, the state of Florida The percentage of the population in the labor force in Martin County is lower than the statewide average, which is partially explained by the relatively larger number of retirees living in the county The 1989 unemployment rate in Martin County is higher than the statewide rate

Table 2 2 7-2 provides the 1987 baseline estimates for employment by occupation in Martin County and projected levels for the year 2000 As shown in this table, the production, operation, and maintenance occupational category was the largest occupational employment group for both 1987 and projected year 2000 levels

Table 2 2 7-3 provides the estimated and projected employment in Martin County by industrial sector In the county, the largest employment group for both 1987

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Table 2.2.7-1
LABOR FORCE AND EMPLOYMENT (1989)

	Florida	Martin County
Population*	12,797,318	96,636
Labor force ⁺	6,193,000	41,126
Labor force as percent of population	48 4	42 5
Percent unemployment	5 6	6 4

* Population figures as of April 1989

+ Labor force represents the annual average

Sources Florida Department of Labor and Employment Security, 1990
ECT, 1990

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**Table 2 2 7-2
EXISTING AND PROJECTED EMPLOYMENT BY OCCUPATION, MARTIN COUNTY**

Occupation Code	Occupation Title	1987		2000		Change in Employ- ment	Percent Change
		Total Employ- ment	Percent of Total	Total Employ- ment	Percent of Total		
00000000	Total, all occupations	36,788	100 00	56,558	100 00	19,770	53 74
10000001	Managerial and management related	2,806 (6)	7 63	4,334 (6)	7 66	1,528	54 45
20000000	Professional, para- professional, technical	5,800 (3)	15 77	8,700 (4)	15 38	2,900	50 00
40000269	Sales and related	4,526 (5)	12 30	7,523 (5)	13 30	2,997	66 21
50000293	Clerical and admin- istrative support	5,749 (4)	15 63	8,723 (3)	15 42	2,974	51 73
60000396	Service	6,324 (2)	17 19	10,414 (2)	18 42	4,090	64 67
70010494	Agriculture, forestry, fishing	2,575 (7)	6 99	3,125 (7)	5 52	550	21 35
80000000	Production, opera- tion, maintenance	9,008 (1)	24 49	13,739 (1)	24 30	4,731	52 52

Note () = ranking

Sources Florida Department of Labor and Employment Security, Bureau of Labor Market Information, 1990
ECT, 1990

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Table 2.2 7-3
ESTIMATED AND PROJECTED EMPLOYMENT BY INDUSTRIAL SECTOR
(PAGE 1 OF 2)

SIC Industry Code	Industry	Martin County			
		1987 Annual Average Employment	Projected Employment	Change in Employment	Percent Change
01 - 99	Total all industries	36,781	56,558	19,777	53 77
01 - 09	Agriculture, forestry, and fishing	2,292 (6 3%) [7]	2,778 (4 9%) [7]	486	21 20
10 - 14	Mining	0 (0%) [10]	0 (0%) [10]	0	0
15 - 17	Construction	3,916 (10 6%) [3]	5,924 (10 4%) [3]	2,008	51 28
20 - 39	Manufacturing	3,410 (9 3%) [5]	5,229 (9 4%) [5]	1,819	53 54
40 - 49	Transportation, communication, and utilities	1,428 (3 9%) [2]	2,014 (3 5%) [9]	586	41 04
50 - 59	Wholesale and retail trade	8,464 (23 0%) [2]	14,003 (24 7%) [2]	5,539	65 44
60 - 67	Finance, insurance, and real estate	2,499 (6 7%) [6]	3,847 (6 8%) [6]	1,348	53 94

Table 2.2.7-3
ESTIMATED AND PROJECTED EMPLOYMENT BY INDUSTRIAL SECTOR
(PAGE 2 OF 2)

SIC Industry Code	Industry	Martin County			
		1987 Annual Average Employment	Projected Employment	Change in Employment	Percent Change
70 - 89	Services	9,237 (25 1%) [1]	14,996 (26 5%) [1]	5,759	62 35
91- 97	Government	1,754 (4 8%) [8]	2,491 (4 9%) [8]	737	42 02
99	Self-employed, unpaid family, workers, private households	3,781 (10 3%) [4]	5,276 (9 4%) [4]	1,495	39 54

Note () = percentage of total
 [] = ranking

Sources Florida Department of Labor and Employment Security, Bureau of Labor Market Information, 1990
 ECT, 1990

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and projected in 2000 timeframes is within the services sector, the second largest sector is wholesale and retail trade

2.2.7.3 General Income Characteristics

A description of general income characteristics, including per capita income, is shown in Table 2 2 7-4. As shown in this table, the Martin County per capita income is 26 percent higher than the statewide average. This is mainly due to the relatively high percentage of income generated by retirement benefits and also from dividends, interest, and rent.

Average wage and salary information as derived by the Florida Department of Labor and Employment Security is shown in Table 2 2 7-5. The average annual wages for covered workers for all industries is approximately 6 percent lower in Martin County than the statewide average. The two categories of industries with the highest average annual wages for Martin County are transportation, communication, and public utilities, and federal government.

Projected numbers of households by income group in Martin County for the years 1995, 2000, and 2005 are shown in Table 2 2 7-6. This information is based on data contained in the Martin County CGMP.

2.2.7.4 Existing Housing Stock

Changes in the existing inventory of housing within Martin County have directly reflected the growth patterns in population. During the period from 1980 to 1987, total single-family and multi-family dwelling units increased 45 percent, from 34,000 units to 49,337 units in January 1987. This growth represented an approximate annual average growth rate of 2,200 units for the entire county and 1,900 units for unincorporated areas of the county (Martin County CGMP, 1990).

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Table 2.2.7-4
GENERAL INCOME CHARACTERISTICS, 1988

	State of Florida (\$)	Martin County (\$)
Total personal income	204,855,400	2,150,980
Per capita income	16,607	22,450
Total earnings	130,087,000	958,222
Transfer payments	32,161,620	283,135
Dividends, interest, and rent	50,483,260	856,109

Sources University of Florida Bureau of Economic and Business Research, 1990
 U S Department of Commerce, Bureau of Economic Analysis, unpublished data

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Table 2.2.7-5
AVERAGE ANNUAL WAGES OF WORKERS COVERED BY
UNEMPLOYMENT COMPENSATION BY
INDUSTRY AND COUNTY, 1987

	Martin County (\$)	State of Florida (\$)
All industries	18,860	20,065
Agriculture	13,369	24,455
Mining	--	28,314
Construction	22,636	20,979
Manufacturing	24,745	24,248
Transportation, communication, and public utilities	28,693	26,477
Wholesale	24,176	27,077
Retail	12,257	12,373
Finance, insurance, and real estate	25,653	24,936
Services	20,528	19,907
Government		
Federal	26,684	28,138
State	22,031	20,174
Local	18,241	22,549

Sources Florida Department of Labor and Employment Security, Bureau of
Labor Market Information, 1990
ECT, 1990

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Table 2 2 7-6
PROJECTED NUMBER OF HOUSEHOLDS BY INCOME

Year	Under \$5,000	\$5,000 to \$9,999	\$10,000 to \$14,999	\$15,000 to \$19,999	\$20,000 to \$24,999	\$25,000 to \$34,999	\$35,000 to \$49,999	\$50,000 to and above
<u>Martin County</u>								
1995	4,570	6,076	5,072	5,172	5,172	5,373	5,976	6,578
2000	5,116	6,802	5,678	5,790	5,790	6,015	6,690	7,364
2005	5,583	7,432	6,196	6,318	6,318	6,564	7,300	8,036

Source Martin County CGMP, 1990
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The Martin County Growth Management Department conducted a windshield survey in July 1987, to determine the amount of substandard housing units within the county. At that time, it was found that 0.65 percent of the unincorporated county's housing stock, or 321 units, were found to be substandard (Martin County CGMP, 1990). Within the Martin County Comprehensive Plan, the priority of resolving the substandard housing issue was emphasized. Within the Indiantown Action Plan, resolving the presence of substandard housing units was also emphasized. Within this document, it was estimated that 71 percent of the total substandard housing units within Martin County were located in southern and western portions of the county (Indiantown Action Plan, 1990). In addition, the Indiantown Action Plan also estimated that approximately 16 percent of the total 1,627 housing units in Indiantown were overcrowded, having more than 1.01 persons per room (Indiantown Action Plan, 1990). The Indiantown Action Plan also stated that 56 percent of the total dwelling units within Indiantown were constructed prior to 1970, as compared to 38 percent for all of Martin County (Indiantown Action Plan, 1990).

A substantial residential element in Indiantown is the migrant camps, which may house as many as 3,500 Guatemalan Indian migrant farm workers. The majority of these workers live in these camps which include Blue Camp, White Camp, Goat Camp, and Waynesboro (Indiantown Action Plan, 1990).

The largest residential development in Indiantown is the planned unit development of the Indianwood mobile home park. This development primarily caters to retirees, and contains an adjacent 125-acre golf course. All of the units in Indianwood are considered to be in good condition, and the development is planned to expand an additional 1,465 units on 565 acres (Indiantown Action Plan, 1990).

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Housing Costs

The average selling prices of homes within Martin County are shown in Table 2 2 7-7. This table shows that the largest percentage (i.e., 24.3 percent) of single-family homes by selling price increment were those homes valued over \$100,000. The second largest grouping of homes by selling price was the \$50,000 to \$74,000 group, which represented 22.9 percent of the total homes. For multi-family units, the largest grouping by selling price increment was the \$50,000 to \$74,000 group, which represented 29.4 percent of the total units. These values do not reflect the overall low to moderate income economic character of the Indiantown community, whose average price for single-family units was \$56,000, the lowest of all areas in the county (Indiantown Action Plan, 1990). This relatively low housing value reflects the high percentage of low income households within unincorporated Martin County. As shown in Table 2 2 7-8, the total percentage of households earning less than \$15,200 in unincorporated Martin County was 31.3 percent (Indiantown Action Plan, 1990).

Building Activity

Building activity in Martin County for the years 1980 to 1986 is shown in Table 2 2 7-9. For the year 1989, Martin County experienced an increase of 1,501 single-family homes and 659 multifamily homes (Bureau of Economic and Business Research, 1990).

2.2.7.5 Education

Information regarding public education characteristics for Martin County is provided in Table 2 2 7-10. Martin County has its own board of education with jurisdiction over each public school. Although the Florida Department of Education has not established a minimum ratio for teachers to students, the fall 1989 statewide average teacher/student ratio is 1 to 17.18 (Florida Department of Education,

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Table 2.2.7-7
SELLING PRICE OF HOUSING UNITS BY TYPE, MARTIN COUNTY, 1981 TO 1986

Price (in \$1,000)	Single-Family		Multifamily		Total	
	No	Percent	No	Percent	No	Percent
< 25	1,240	19.4	436	8.9	1,676	14.8
25 - 49	1,268	19.8	952	19.5	2,220	19.7
50 - 74	1,466	22.9	1,853	37.9	3,319	29.4
75 - 99	867	13.6	493	10.1	1,360	12.1
100 >	<u>1,561</u>	<u>24.3</u>	<u>1,155</u>	<u>23.6</u>	<u>2,716</u>	<u>24.0</u>
TOTAL	6,402	100.0	4,889	100.0	11,291	100.0

Source Martin County CGMP, Martin County Property Appraiser's 1986 Tax Roll, 1990

Table 2.2.7-8
AFFORDABLE RENTS AND HOME PURCHASE PRICES,
BASED ON INCOME DISTRIBUTION OF PROJECTED
NEW HOUSEHOLDS FOR UNINCORPORATED MARTIN COUNTY, 1987

Category	Percent Households	Mid- Point	Monthly Rent	Purchase Price
<u>Very low income households</u>				
Under \$7,400	12 1	5,000	\$104	\$13,500
7,400 to 11,000	9 1	9,250	193	24,975
11,101 to 15,200	<u>10 1</u>	13,151	274	35,508
SUBTOTAL	31 3			
<u>Low income households</u>				
15,201 to 24,390	20 6	19,796	412	53,449
<u>Moderate income households</u>				
24,391 to 29,670	10 7	27,031	563	72,984
29,671 to 37,090	<u>11 9</u>	33,381	695	90,129
SUBTOTAL	22 6			
<u>Middle and high income households</u>				
37,091 to 51,920	13 4	44,505	927	120,163
51,921 to 74,180	7 0	63,050	1,314	170,235
74181 +	<u>5 1</u>	74,101	1,544	200,073
SUBTOTAL	25 5			
SUBTOTAL	100.0			

Note The mid-point or average income in each range was used (with the exception of the lowest and highest ranges) to calculate affordable rent or the purchase price of a home for each income range. Median home for the Martin County area as of January 1988 is \$27,700 (U S Department of Housing and Urban Development). It was assumed that 90 percent of all households desired to purchase and that it may be practical to accommodate this demand, except for very low income households, where 100 percent of demand was calculated for rental use.

Source Martin County CGMP, 1990

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**Table 2.2.7-9
BUILDING ACTIVITY, 1980 TO 1986**

	1980	1981	1982	1983	1984	1985	1986	Total
<u>Martin County</u>								
Single-family	937	777	597	934	871	918	1,066	6,100
Multi-family	1,345	1,681	783	1,203	942	854	1,045	7,933
Mobile home	148	208	159	228	177	198	186	1,304

Note NA = not available

Source Bureau of Economic and Business Research, 1990
ECT, 1990

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Table 2.2.7-10
PUBLIC EDUCATION SYSTEM CHARACTERISTICS, 1990

	Martin County
Elementary schools	8
Elementary school students	5,618
Middle schools	3
Middle school students	2,571
High schools	3
High school students	3,233
Teacher/student overall ratio	1 15 75

Sources Martin County Board of Education, 1990
 Florida Department of Education, Management Information Systems,
 1990
 ECT, 1990

1990) Martin County's overall teacher/student ratio is slightly lower (i.e., better) at 15.75

Martin County has recently completed the construction of one new elementary school which opened in the fall of 1990. No additional new schools are planned at this time (Martin County Board of Education, 1990).

2.2.7.6 Transportation

Existing Transportation Networks

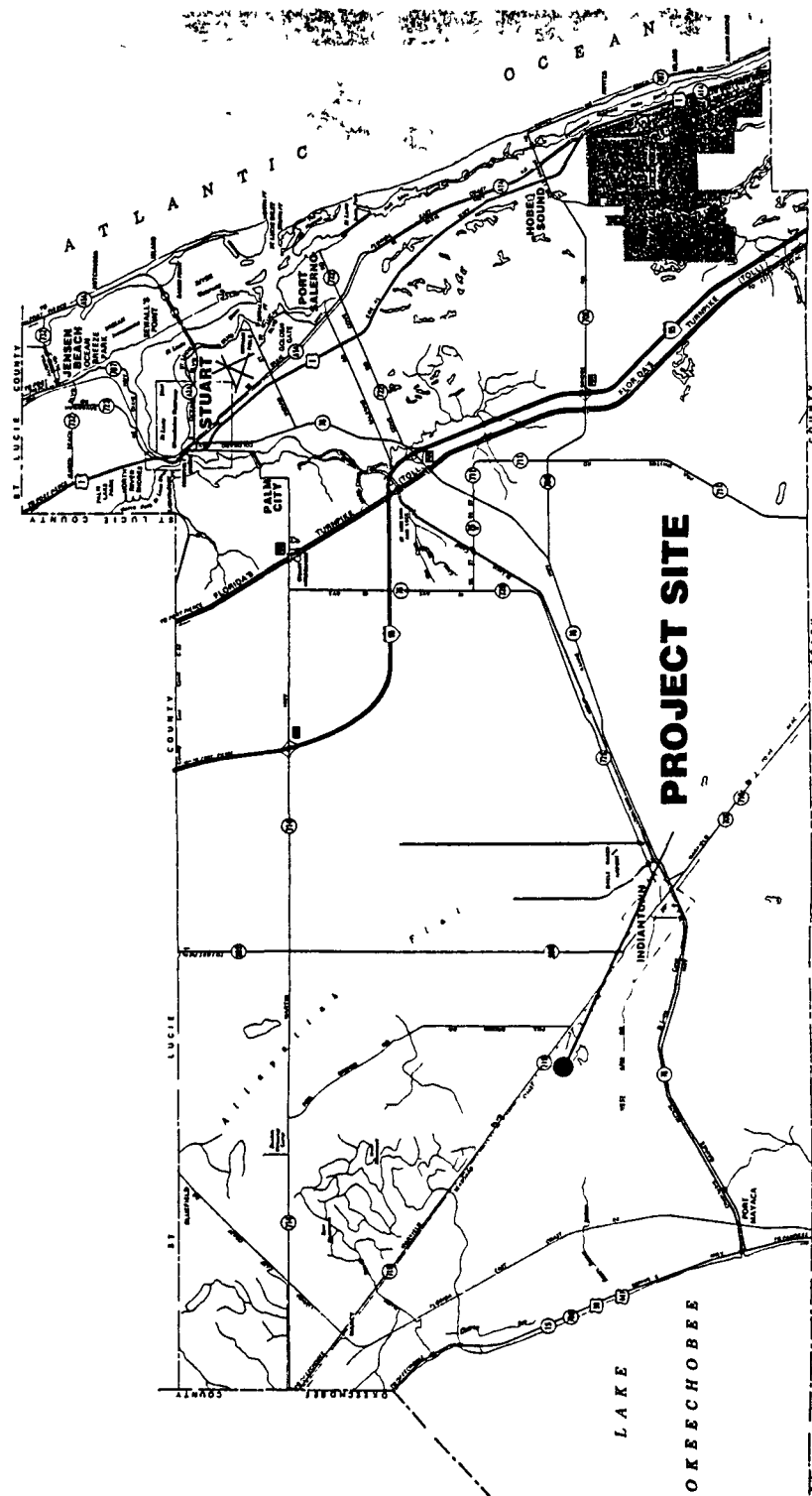
Major transportation facilities within Martin County are shown on Figure 2.2.7-2, and described in Table 2.2.7-11.

In Martin County, the two major highway transportation corridors are the Florida Turnpike and Interstate (I) 95, which provide north-south movement. Both facilities operate at Level of Service (LOS) A, indicating a generally free flow of traffic, and the least level of congestion on the A to F scale. Both of these roadways are multi-laned, limited access facilities. Western Martin County's major arterial is SR 710, a two-lane undivided facility, which operates at LOS A.

Additional roadway networks servicing Martin County as shown in Figure 2.2.7-2 include the principal arterials of U.S. Highway (U.S.) 1 and SR 714, and the collector SR A1A. Segments of U.S. 1, SR A1A, and SR 714 operate below acceptable LOS, at either E or F, and these deficiencies have been identified within the Martin County CGMP. Roadway improvements are planned to upgrade the segments' capacities to acceptable LOS (Martin CGMP, 1990).

Within Martin County, two rail lines are operated by the Florida East Coast (FEC) Railway, consisting of a main freight line which roughly parallels the Atlantic coastline, and a secondary track running northeasterly from the Palm Beach County line across SR 710 into St. Lucie County. These two rail lines provide

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Figure 2.2.7-2.
 MAJOR HIGHWAYS IN MARTIN COUNTY

Source AAA 1990

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Table 2.2.7-11
MAJOR TRANSPORTATION FACILITIES IN MARTIN COUNTY

Facility	Martin County
Major north/south routes	I-95 Florida Turnpike
Major east/west routes	SR 710 SR 76 SR 714
Proposed or adopted county- wide LOS	Urban service area, LOS D, all others, LOS C
Mass transit	COA shuttle
Airports	Witham Field, Indiantown Airport
Average no of aircraft operations per day	246
Rail--passenger service	None
Proposed Florida High-Speed Rail	Yes
Freight service	FEC CSX

Sources ECT, 1990

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freight service between Jacksonville, Tampa, and Miami. The CSX Railroad and Amtrak share service along a third rail line which parallels SR 710.

The Florida High Speed Rail Corporation (FHSRC) has proposed a corridor which traverses Martin County along SR 710 from the Palm Beach County line through Indiantown to a point approximately 1 mile past the project site, where it turns north into St. Lucie County. No stations are planned for Martin County at this time (Martin County CGMP, 1990).

The Council on Aging (COA) provides a shuttle transit service within Martin County. Round-trip service from Indiantown to Stuart is provided each Monday, Wednesday, and Friday, excluding holidays; service within Indiantown is provided on Thursdays. The primary public transportation service area within Martin County covers an area from the Atlantic coast to approximately 2 miles west of the Florida Turnpike.

The long-range public transportation plans for Martin County include the expansion of service in several different capacities. These plans include the following: the expansion of local public transit service within the Stuart urban area, the expansion of shuttle service within Indiantown, the establishment of a fast-link express service connection to Palm Beach and St. Lucie Counties, the establishment of a subsidized public transportation system or comparable private enterprise system, the provision of transit links to proposed FHSRC stations planned for Palm Beach and St. Lucie Counties, and a connection to a potential Martin County station which may become part of the FHSRC's ultimate long-range plans (Martin County CGMP, 1990).

In terms of aviation transportation, Martin County is serviced by two public use airports, Witham Field and the Indiantown Airport (formerly the Circle "T" Ranch). Witham Field is located in the Stuart urban area, south of Monterey Road and east of Dixie Highway [County Road (CR) A1A], and is a county-owned facility leased to Grumman Aircraft Systems. Witham Field has 90,000 estimated annual aircraft

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operations Indiantown Airport is closer in proximity to the project site, located north of CR 726 and east of CR 609, and is a privately-owned public use airport Indiantown Airport has 10,000 estimated annual aircraft operations One privately-owned, private use airport, Cox's Hammock, is located north of SR 710 and west of Fox Brown Road, and is in relatively close proximity to the project site (Martin County CGMP, 1990)

Programmed Transportation Improvements

Programmed improvements to roadways within Martin County to be implemented by the end of 1995 are shown in Figure 2 2 7-3 A complete listing of all transportation improvements planned for Martin County, as described in the Capital Improvements Element of the Martin County CGMP as well as in the FDOT and Florida Turnpike Five-Year Work Programs, are found in Section 10 6 The majority of programmed improvements in terms of road widening or new roadways to expand the existing capacity and levels of service are located east of I-95 in the urbanized areas of Stuart and Port Salerno

According to the current FDOT Five-Year Work Program for Martin County, a widening improvement is planned for a segment of SR 710 within Indiantown, and repaving is planned for essentially the entire remaining span of SR 710 within Martin County As scheduled for implementation by the end of Fiscal Year (FY) 1993/1994, a widening improvement from two lanes to five lanes (center turn) for approximately 2 2 miles of SR 710, from west of 5th Street west of Adams Avenue within Indiantown is programmed

The repaving of SR 710 from the St Lucie Canal Bridge to SR 76 juncture, and from the SR 76 juncture to the Palm Beach County line is scheduled for FY 1992/1993 and FY 1990/1991, respectively Construction is planned for FY 1992/1993 for the resurfacing and repaving of SR 710 from Hale Dairy Road/CR 609 east to the Okeechobee County line (FDOT, 1990)

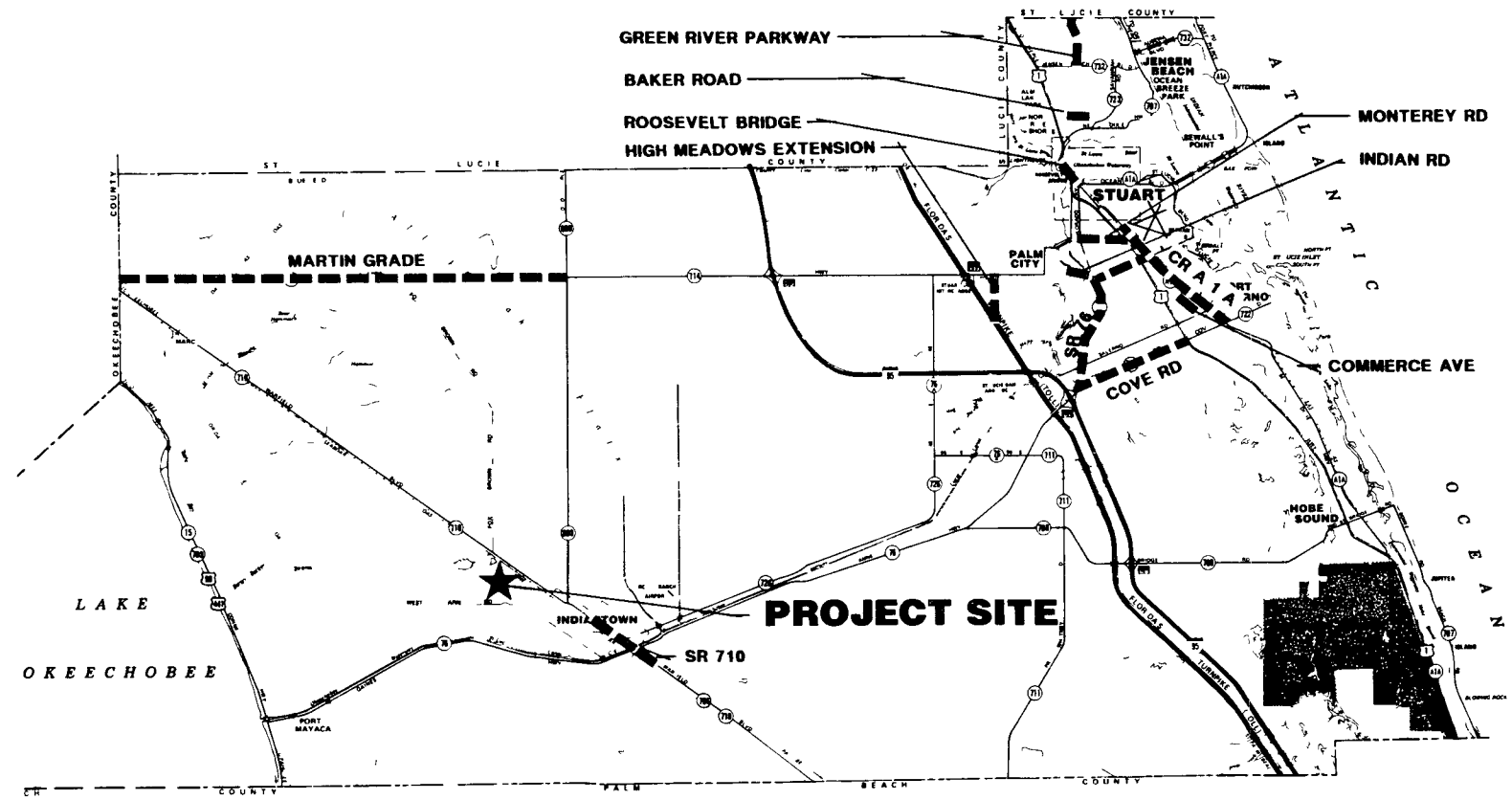
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Figure 2.2 7-3
PROGRAMMED ROADWAY
IMPROVEMENTS WITHIN
MARTIN COUNTY TO BE
CONSTRUCTED BY 1995

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Source Traffic Circulation Element, Martin County
Comprehensive Plan Update, 1990 ECT, 1990

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The remainder of programmed improvements within Martin County are associated with roadways located east of I-95, and will improve service within the urbanized areas of Stuart and Port Salerno

The FDOT Five-Year Improvement Plan for Martin County has also identified \$4,616,000 worth of improvements to be made to Witham Field Airport over the period FY 1990/1991 to 1994/1995

2.2.7.7 Utilities and Public Services

Medical Services

The primary health care provider in Martin County is the Martin Memorial Hospital. As shown in Table 2.2.7-12, this hospital is licensed for 336 beds, staffed by approximately 180 physicians, and includes pediatric care and a 24-hour emergency room (Martin County Medical Society, 1990). The hospital is transferring 100 beds to a separate satellite facility located on Port Salerno Road in Port Salerno. This facility will also contain office space and laboratory facilities, and is expected to be completed and occupied by the end of October 1990 (Martin County Medical Society, 1990). This transfer will allow an increase in utilization of the facility by enabling the privatization of rooms. The Martin Memorial Hospital also operates the Coastal Medical Center, a private medical facility with full-time physician and nursing staff. Emergency medical services (EMS) are provided by emergency medical technicians located at each county fire station. The closest EMS-equipped fire station is located in Indiantown. Indiantown also has a public health clinic staffed one day per month by county health department staff.

The ratio of 214 physicians to 100,000 population for Martin County, as shown in Table 2.2.7-12, is below the national and state averages of 241 and 225, respectively (Martin County Medical Society, 1990). With the exception of the transfer of the beds within Martin Memorial Hospital, no expansion of medical

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facilities is planned for Martin County (Florida Department of Health and Rehabilitative Services Monitoring Department, 1990).

Firefighting Facilities

Data regarding firefighting facilities is shown in Table 2.2.7-12. Martin County utilizes a combination of full-time firefighters in addition to trained volunteers. Within Martin County, the combined number of full-time and volunteer firefighters yields a ratio of 3.6 firefighters per 1,000 residents, which is above the national average of 2.2 (Martin County Fire Department, 1990).

The nearest full-time fire station to the project site is Station 50, located in Indiantown. This station is manned by 3 full-time firefighters in addition to volunteers. Another all-volunteer station manned by approximately 10 volunteers is located within the Booker Park area of Indiantown (Martin County Fire Department, 1990).

Law Enforcement

Data pertaining to existing law enforcement services for Martin County is shown in Table 2.2.7-12. Martin County has an officer-to-population ratio above the national standard of 2.2 officers per 1,000 population. The nearest station to the project is the Indiantown station, which is manned by 15 sworn officers (Martin County Sheriff's Department, 1990).

Recreational Facilities

Because of the presence of numerous rivers, Lake Okeechobee, and the Atlantic Ocean, many recreational opportunities are available to residents of Martin County. Martin County contains two regional and urban district parks, Jonathan Dickinson State Park and the St. Lucie Inlet Park (Martin County CGMP, 1990).

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Table 2.2.7-12
PUBLIC SAFETY FACILITIES IN MARTIN COUNTY

	Martin County
<u>Medical</u>	
Hospitals	1
Hospital beds	336
Physicians	180
24-Hour physician-staffed emergency room	Yes
Physicians/100,000 population	214
<u>Firefighting Facilities</u>	
Fire stations	14
Firefighters	
Full-time	90
Volunteers	200
Firefighters/1,000 population	3.6
Average response time (minutes)	
Developed areas	5
Rural areas	10
<u>Law Enforcement</u>	
Sheriff's stations	2
Sworn officers	241
Patrol units	21
Officers/1,000 population	2.70
Auxiliary/volunteer officers	10-12
Average response time (minutes)	7-10

Sources: Martin County Medical Society, 1990.
Martin County Sheriff's Department, 1990.
Martin County Fire Department, 1990.

Martin County has identified, within their comprehensive plans, a LOS standard for providing recreational facilities. Martin County has recommended a recreational LOS standard of 2 acres per 1,000 residents (Martin CGMP, 1990). Based on this standard, Martin County has projected the need for 145 acres of parks by the year 2000 (Martin CGMP, 1990).

The nearest recreational facilities to the ICL project site are located within Indiantown. The total acreage of the five recreational facilities located within Indiantown equals 34 acres, with Big Mound Park accounting for 21 acres, or 61.7 percent of the total acreage (Martin County CGMP, 1990). Two of these five facilities are shared at school sites. The Indiantown Action Plan has proposed an additional 20-acre site for recreation to be located on county school board property along Southwest Farm Road across from the Indianwood Mobile Home Park (Indiantown Action Plan, 1990).

Electricity and Gas

FPL provides electricity to Martin County. The two major FPL power generation facilities within the regional area are the Martin site, and the nuclear powered facility located on Hutchinson Island.

Natural gas service to residential and commercial users is supplied by private suppliers. The principal suppliers are Tri-County Gas and Tropigas. Within Indiantown, the Indiantown Gas Company supplies services to residential and commercial users. ICL will purchase gas from this local supplier for the proposed project.

Water and Sanitary Sewer Facilities

Central water and sanitary sewage facilities in Martin County are provided by both private and public entities. Information regarding average daily flows and design capacities are shown for potable water and wastewater in Tables 2.2.7-13 and

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Sources Martin County CGMP, 1990
Martin County Public Utilities Department, 1990

2 2 7-14, respectively The nearest potable water and wastewater facilities to the project site is the Indiantown Company in Indiantown This private supplier serves an area slightly larger than the community of Indiantown (Martin County CGMP, 1990) As shown in Tables 2 2 7-13 and 2 2 7-14, the design capacities of both water and wastewater are above average daily flows

Portions of Martin County are not within the service areas of public or private suppliers of potable water and wastewater services In these areas, individual private wells and septic tanks are used

Solid Waste Facilities

Solid waste collection in Martin County is provided primarily by private franchised hauling companies However, within the incorporated area of Stuart, refuse collection is provided by the city

Solid waste is deposited at a county-owned and operated landfill The total capacity of Martin County's Palm City Landfill Number 2 is 320 acres, and has 258 acres of remaining capacity This equates to approximately 80 6 percent available capacity, and has an anticipated closing in 2003 (Martin County Public Works Department, 1990)

2.2.7.8 County Revenues and Expenditures

A summary of revenues for Martin County for the fiscal year ending September 30, 1989 is provided in Table 2 2 7-15 This table illustrates that the major source of revenues are generated from taxes, which include ad valorem or personal property taxes, sales and franchise taxes, and utility services taxes

A summary of Martin County's expenditures is shown in Table 2 2 7-16, for the fiscal year ending September 30, 1989 The greatest demand for expenditures was required for providing public safety, which includes law enforcement, fire control,

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Table 2.2.7-14
EXISTING SANITARY SEWER FACILITIES IN MARTIN COUNTY, 1989

	Existing Daily Flow (MGD)	Design Capacity (MGD)
North Martin County (county)	1 20	0 60
Port Salerno (county)	0 80	1 00
City of Stuart (city)	1 56	3 00
Martin Downs Utilities (private)	0 34	0 50
Hydratech Utilities (private)	0 37	0 60
Indiantown Utilities (private)	0 41	1 0

Sources Martin County CGMP, 1990

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Table 2.2.7-15
SUMMARY OF MARTIN COUNTY REVENUES,
FISCAL YEAR ENDING SEPTEMBER 30, 1989

	Martin County
Population*	110,012
Taxes ⁺	55,956,158
Licenses and permits	5,324,802
Intragovernmental revenue**	26,501,060
Charges for service	39,938,476
Fines and forfeitures	6,187,336
Miscellaneous revenue ⁺⁺	47,447,760
Other financing sources***	25,199,842
Total Revenues	205,555,434
Revenue per capita	1,868

- * Based on Department of Banking and Finance population figures
- + Includes property, sales, franchise, and utility services taxes
- ** Includes federal, state, and local grants and shared/pilot programs
- + + Includes interest earnings, rents and royalties, special assessments, sales and compensation for assets, and contributions and donations
- *** Includes interfund transfers, contributions, dept proceeds, and trust fund receipt

Sources Florida Department of Banking and Finance, 1990
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Table 2.2.7-16
SUMMARY OF MARTIN COUNTY REVENUES,
FISCAL YEAR ENDING SEPTEMBER 30, 1989

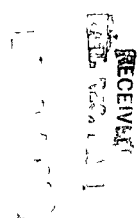
	Martin County
Population	110,012
General governmental services	18,978,053
Public safety	37,404,127
Physical environment	16,582,821
Transportation	13,734,415
Economic environment	94,726
Human services	4,003,667
Culture and recreation	4,840,878
Debt service	11,838,863
Other*	10,789,767
Total	118,264,320
Expenditures per capita	1,075 01

*Includes interfund transfers and capital asset acquisitions

Sources Florida Department of Banking and Finance, 1990
ECT, 1990

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detention or correction facilities, protective inspections, and ambulance and rescue services



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2.3 BIOPHYSICAL ENVIRONMENT

2.3.1 GEOHYDROLOGY

2.3.1.1 Geologic Description of the Site Area

The Indiantown Cogeneration, L P (ICL) site is in an area underlain by approximately 13,000 feet of sedimentary rock strata (Lichtler, 1960) The basement complex in this area consists of Paleozoic age igneous and metamorphic rocks about which little is known due to their great depth

Overlying the basement complex to the ground surface are sedimentary rock strata and unconsolidated deposits that are primarily marine in origin Below a depth of about 400 feet these rocks are predominantly limestone and dolomite, while above 400 feet the deposits are largely composed of sand, silt, or clay The deepest formation in Martin County on which significant published data are available is the Eocene age Avon Park, although limited information is available from wells penetrating the underlying Lake City Formation (Lichtler, 1960) The published information on the sediments comprising the formations below the Avon Park Limestone in western Martin County is based on projections from deep wells in Okeechobee, St Lucie, and Palm Beach Counties (Miller, 1986, Puri and Winston, 1974) Figure 2 3 1-1 is a stratigraphic section showing the Cenozoic age units present beneath Martin County The combined thickness of these units is about 4,800 feet (Miller, 1986) Brief descriptions of the formations shown in this section are presented below

Cedar Keys Formation

The lowermost Cenozoic unit is the Paleocene age Cedar Keys Formation which conformably overlies sediments deposited during the Late Cretaceous period. The Cedar Keys Formation in south Florida consists predominantly of dolomite, gypsum, and anhydrite, and is about 1,500 feet thick (Puri and Winston, 1974)

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GEOLOGIC AGE	FORMATION/GROUP	AQUIFER
Post-Miocene	Pamlico Sand Fort Thompson/Anastasia Fms Caloosahatchee Marl	Surficial Aquifer (90-200' thick)
Miocene	Tamiami Formation	
	Hawthorn Group < Peace River Fm. Arcardia Fm.	Confining Layers (350-600' thick) Top of Floridan Aquifer System (2800-3400' thick)
Oligocene	Suwannee Limestone	Producing Zone 1
Eocene	Ocala Limestone	----- Semi-permeable zone -----
	Avon Park Limestone	Producing Zone 2 ----- Semi-permeable zone ----- Producing Zones 3 and 4 -----
	Lake City Limestone	Semi-permeable zone
	Oldsmar Formation	----- Boulder Zone -----
	Cedar Keys Formation	Semi-permeable zone

Figure 2.3.1-1

GENERALIZED HYDROSTRATIGRAPHY OF MARTIN
COUNTY (AFTER LICHTLER, 1960; BROWN AND REECE,
1979. JOHNSTON AND BUSH, 1988 SCOTT, 1988)

Source FPL, 1989

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The upper third of the Cedar Keys Formation is generally characterized as a gray to cream, coarsely crystalline dolomite which is moderately to highly porous (Miller, 1986) The pores are commonly filled with gypsum (Stringfield, 1966) Interbedded tan to gray, finely crystalline to microcrystalline dolomite and white to clear anhydrite comprise the lower two thirds of the Cedar Keys Formation (Miller, 1986)

As shown on Figure 2 3 1-2, the top of the Paleocene age strata in the site area is at approximately El -3,250 feet (Miller, 1986)

Oldsmar Formation

The Early Eocene age Oldsmar Formation conformably overlies the Cedar Keys Formation The Oldsmar Formation is composed of off-white to light gray, very fine grained, pelletal limestone that is interbedded with gray, tan, and light brown, fine to medium crystalline dolomite which is commonly vuggy The thickness of the limestone and dolomite interbeds is quite variable within the section The lower part of the Oldsmar Formation is more extensively dolomitized than is the upper part (Miller, 1986) Within this lower part of the Oldsmar Formation in south Florida is a zone of extremely high transmissivity called the "Boulder Zone" due to its difficult drilling characteristics This zone has developed an extensive cavernous permeability, as a result of the paleosolutioning of horizontal and vertical fractures, that allows it to be used for the underground injection of treated sewage and other industrial wastes

The Oldsmar Formation extends throughout the peninsular area of Florida to the southeastern corner of Georgia The top of the Early Eocene age strata, which corresponds to the top of the Oldsmar Formation, is at about El -2,000 feet in the area of the ICL site (Figure 2 3 1-3) As determined from Figure 2 3 1-4, the thickness of this strata in Martin County varies from approximately 1,100 feet in the eastern part of the county to 1,200 feet in the area of the ICL site in western Martin County (Miller, 1986)

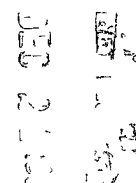


Image Quality

**As you review the next group of images,
Please note that the original documents
were of poor quality.**

EXPLANATION



Indian town Site

— 500 —

Structure contour Shows altitude of top of rocks of Paleocene age Interval 100 feet Datum is sea level

U
D

Fault — Vertical or nearly so

U

Upthrown side

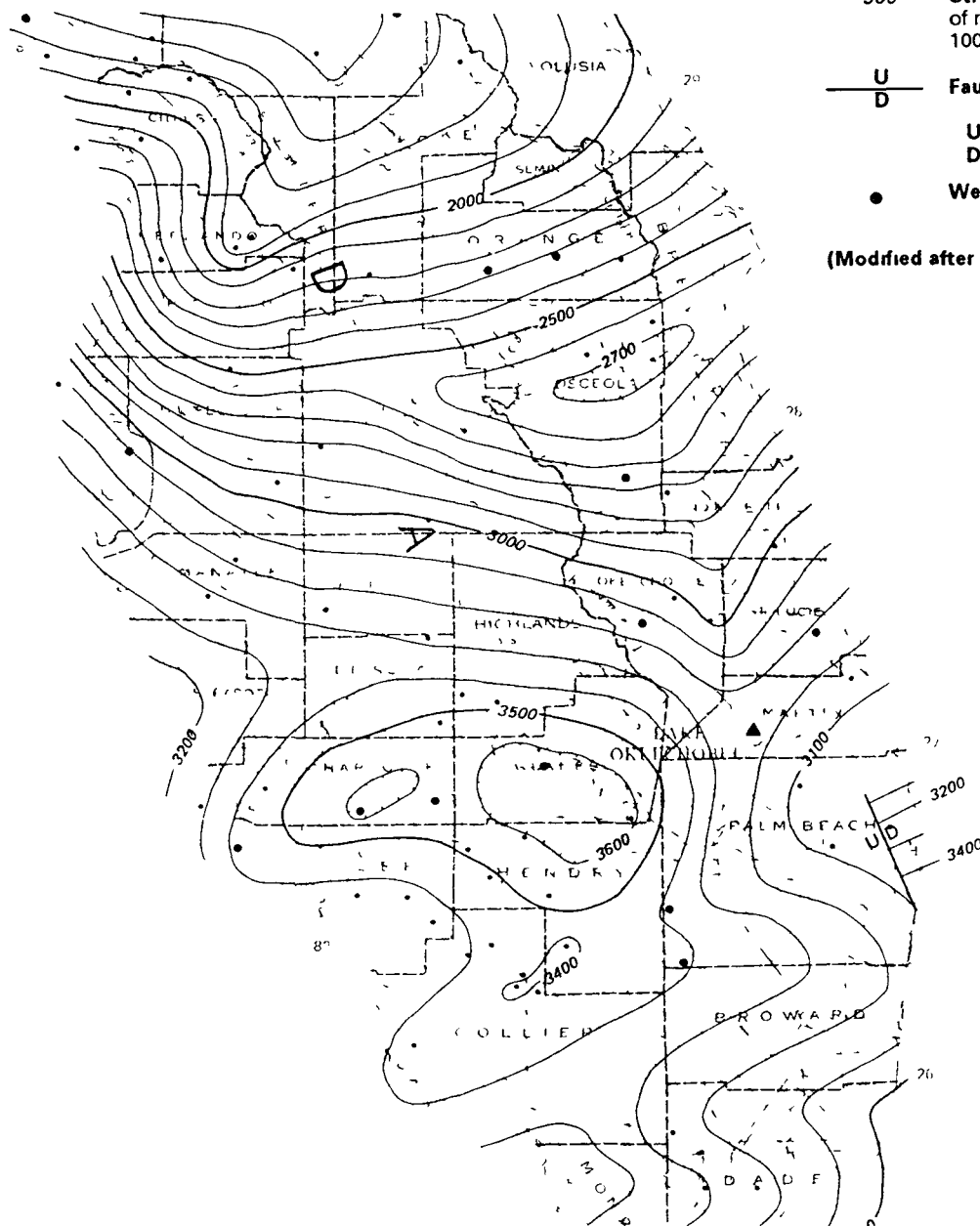
D

Downthrown side



Well control point

(Modified after Miller, 1986)



SCALE 1 2 000 000

0 10 20 30 40 50 100 MILES
0 10 20 30 40 50 100 KILOMETERS

Figure 231-2

STRUCTURE CONTOURS ON TOP OF PALEOCENE AGE STRATA (CORRESPONDS TO CEDAR KEYS FORMATION IN MARTIN COUNTY)

Source FPL 1989

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Indiantown Cogeneration, L P

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EXPLANATION



Indiantown Site

— 400 —

Structure contour Shows altitude of top of rocks of early Eocene age Interval 100 feet Datum is sea level



Fault — Vertical or nearly so

U

Upthrown side

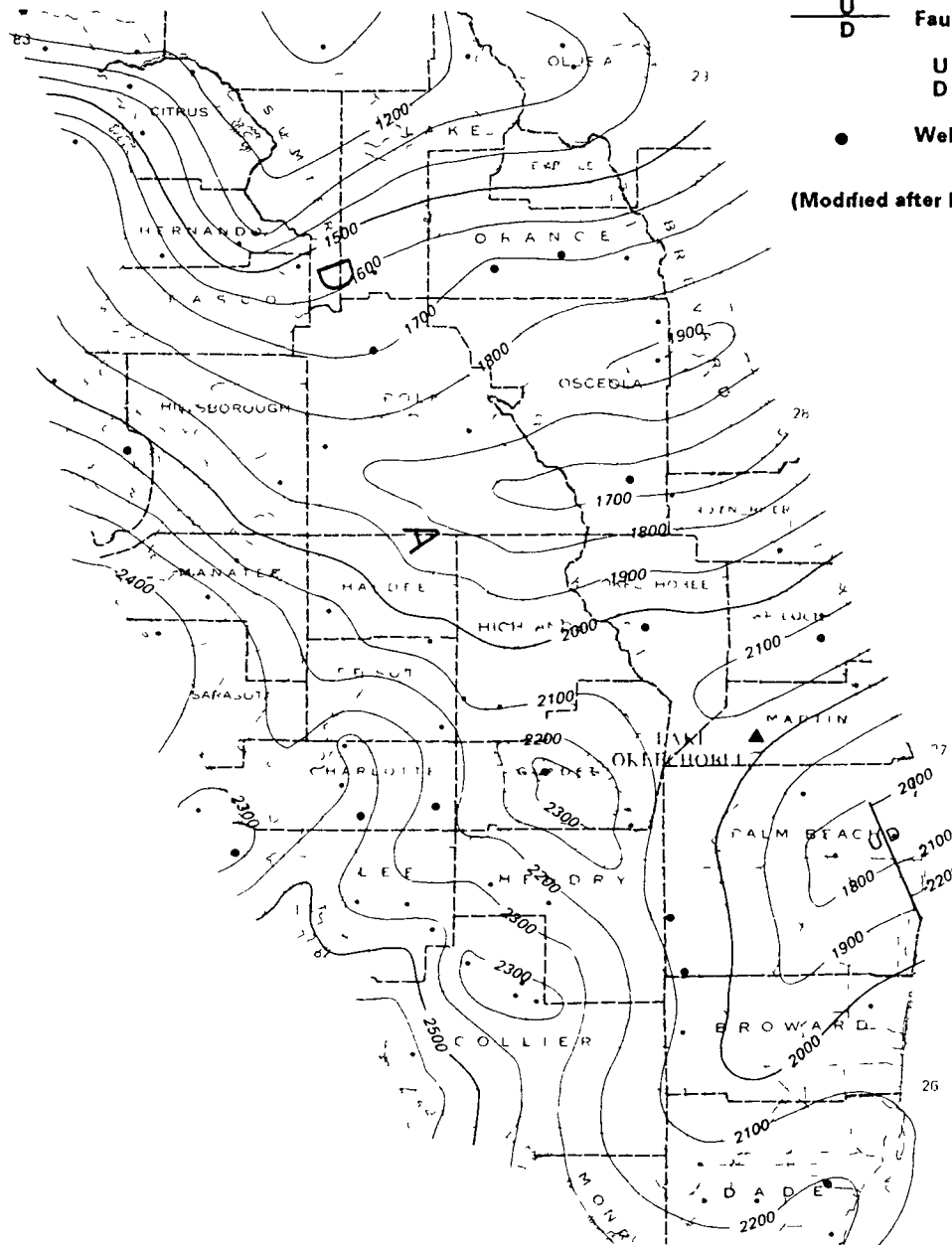
D

Downthrown side



Well control point

(Modified after Miller, 1986)



SCALE 1 2 000 000

0 10 20 30 40 50 100 MILES
0 10 20 30 40 50 100 KILOMETERS

Figure 231-3

STRUCTURE CONTOURS ON TOP OF EARLY EOCENE AGE STRATA (CORRESPONDS TO OLDSMAR FORMATION IN MARTIN COUNTY)

Source FPL 1989

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L P

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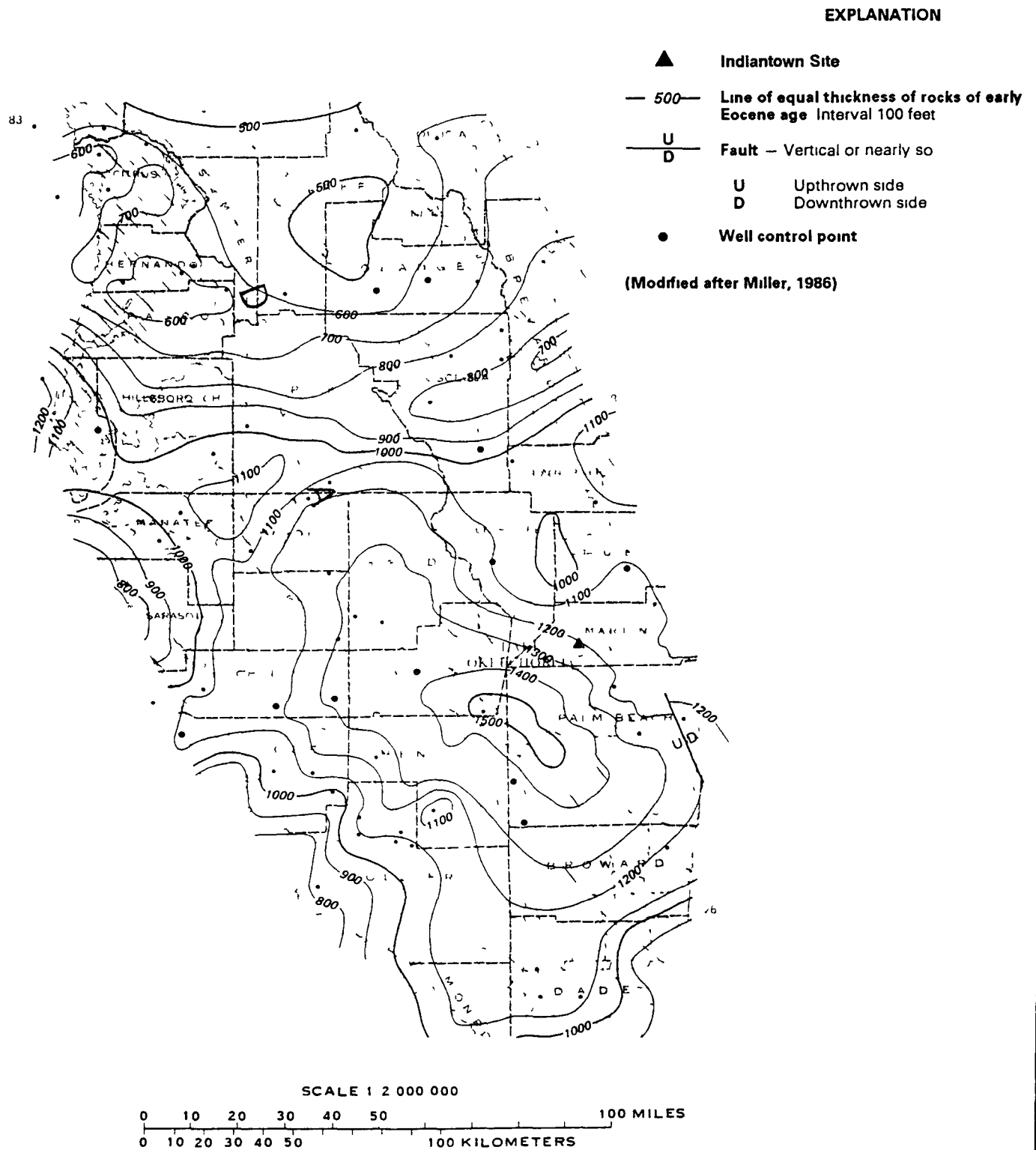


Figure 2.3 1-4
ISOPACH MAP OF EARLY EOCENE AGE STRATA
(CORRESPONDS TO OLDSMAR FORMATION IN
MARTIN COUNTY)

Source FPL 1989

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Indiantown Cogeneration, L P

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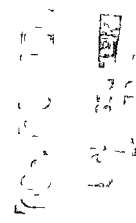
Lake City and Avon Park Limestones

The Lake City and Avon Park Limestones were initially named by Applin and Applin (1944) to differentiate dolomitic and fossiliferous limestones of Early to Middle Eocene age. The distinction between the two units was based on the presence of a dominant microfauna, Dictyoconus americanus (Shaw and Trost, 1984) and other foraminifera. Based on a larger sampling of deep wells than were available to Applin and Applin, Miller (1986) has proposed to combine the Lake City and Avon Park Limestones into one unit to be called the Avon Park Formation. The premise for this is the similarity of lithologies and the presence of the diagnostic fossil assemblages throughout the total thickness of both units. For the purposes of this discussion, however, the Lake City and Avon Park Limestones will be described separately.

Lake City Limestone

Applin and Applin (1944) named the lower Middle Eocene age Lake City Limestone from the descriptions of alternating beds of dark brown crystalline dolomite and dolomitic limestones, and tan to cream, soft to hard, chalky, fossiliferous limestone encountered in wells drilled at Lake City, Florida. The sequence also contains peat and lignite beds with chert nodules and thin chert layers. Dolomitization of the limestone is highly varied throughout the sequence. In areas where the process has occurred partially or completely, diagnostic fossil assemblages are difficult or impossible to identify. Pore spaces in the limestone are commonly impregnated with anhydrite and gypsum (Stringfield, 1966).

The Lake City Limestone is reported to be in disconformable contact with the Oldsmar Formation because of the presence of marine peats and gypsum and anhydrite nodules near the contact (Stewart, 1966). Other investigators (Vernon, 1951) suggest that the contact may be unconformable.



Avon Park Limestone

The Avon Park Limestone of Middle Eocene age is described as a cream to dark brown, hard to medium-soft, nearly pure, chalky, crystalline limestone. It is differentiated from the overlying Ocala Group primarily by its fossil content. It exhibits lithologic changes both horizontally and vertically (Lichtler, 1960) with numerous thin, porous, granular, sand-like zones (Stewart, 1966). Lichtler (1960) indicates that the thickness of the Avon Park Limestone outside Martin County is estimated to be at least 400 feet. However, a regional cross section through the vicinity of the ICL site indicates that its thickness in this area may be only about 200 feet (Figure 2 3 1-5). Miller (1986) indicates that the thickness of Middle Eocene age rock strata, including the Lake City and Avon Park Limestones, is about 1,250 feet in the vicinity of the Indiantown site (Figure 2 3 1-6). The top of the Avon Park Limestone, as shown on Figure 2 3 1-7, is at about El -800 feet in the site area.

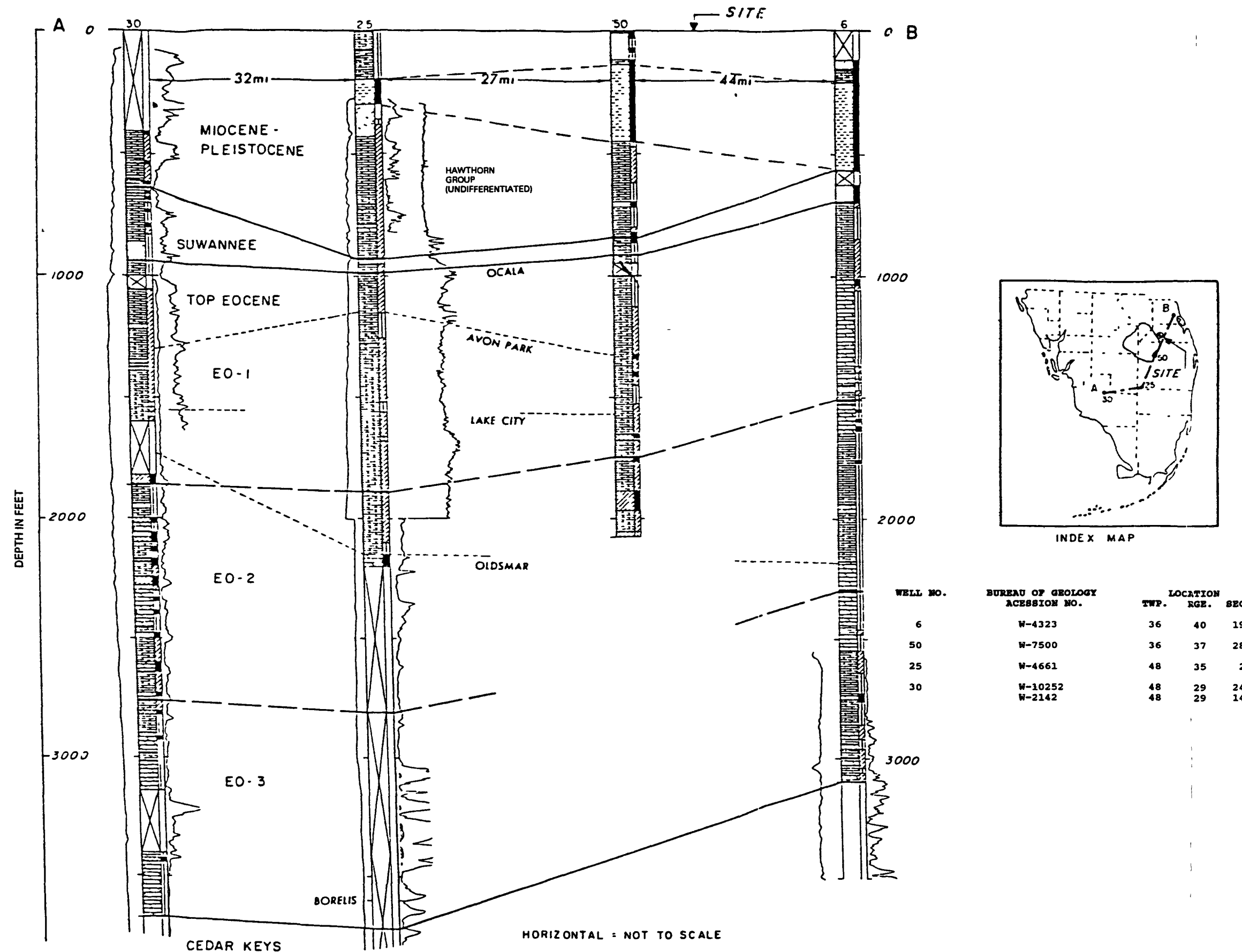
Ocala Limestone

Unconformably overlying the Avon Park Limestone is the Late Eocene age Ocala Limestone. The Ocala in Florida is commonly referred to as a group which includes the Crystal River, Williston, and Inglis Formations. Miller (1986) states that the three formations cannot be distinguished lithologically at their type section or in the subsurface, and refers to all three units as the Ocala Limestone. In Martin County, the group, because of insufficient materials for study and classification, has not been subdivided (Lichtler, 1960). Therefore, the term Ocala Limestone will be used in this discussion.

The Ocala consists chiefly of limestones that are generally granular, white to cream or slightly pink, soft to medium hard, and that contain an abundance of crystalline calcite in some areas. The Ocala also contains occasional beds of foraminiferal coquina.

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Figure 2.3.1-5
REGIONAL GEOLOGIC
CROSS SECTION



LEGEND

- ANHYDRITE
- DOLOMITE
- LIMESTONE
- SANDSTONE
- SHALE
- MISSING SAMPLE
- IMPERMEABLE
- HIGH PERMEABILITY
- LOW PERMEABILITY

Source FPL, 1989
MODIFIED AFTER PURI AND WINSTON, 1974

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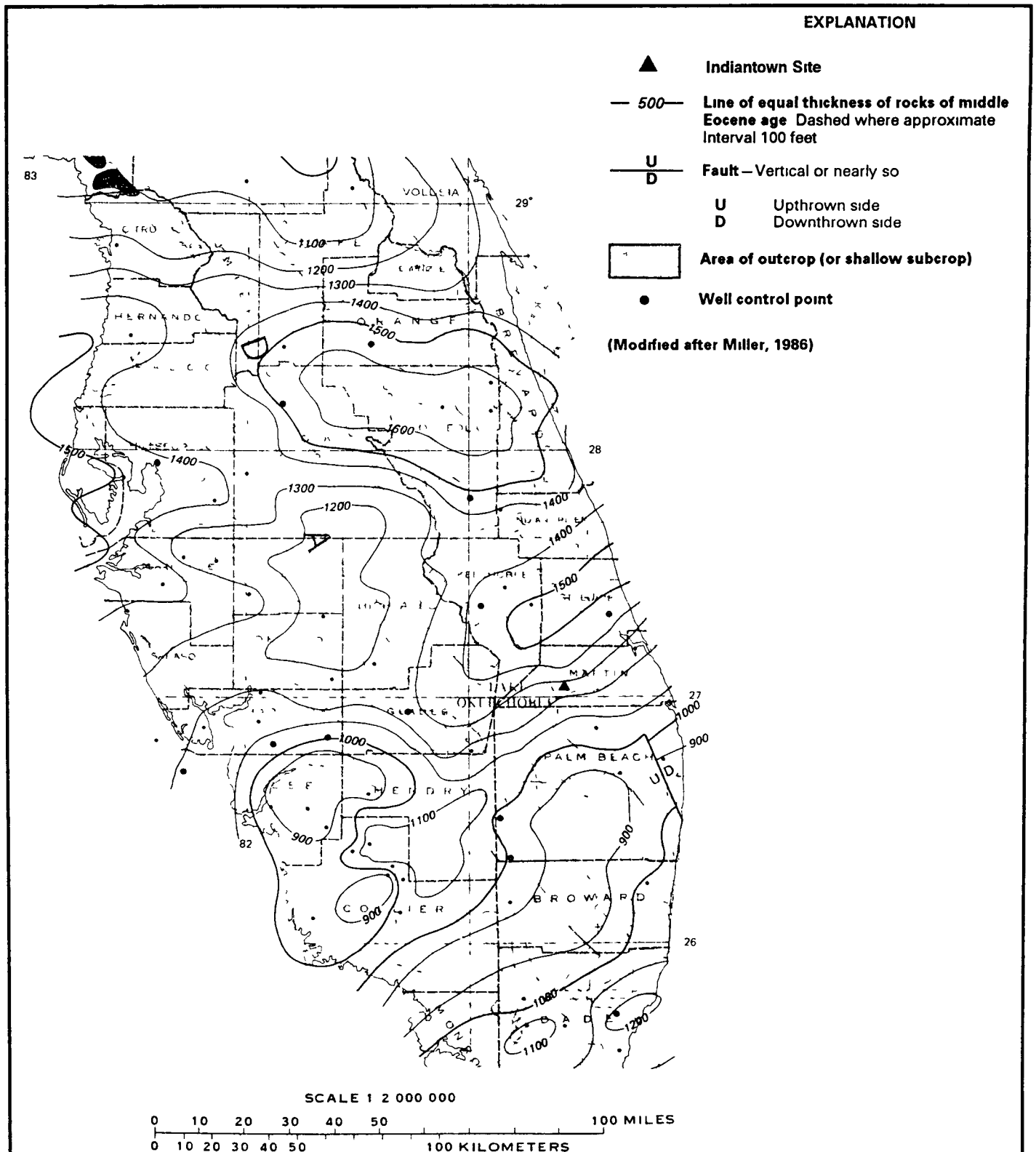


Figure 2.3 1-6
ISOPACH MAP OF MIDDLE EOCENE AGE STRATA
(CORRESPONDS TO AVON PARK LIMESTONE IN
MARTIN COUNTY)

Source FPL, 1989

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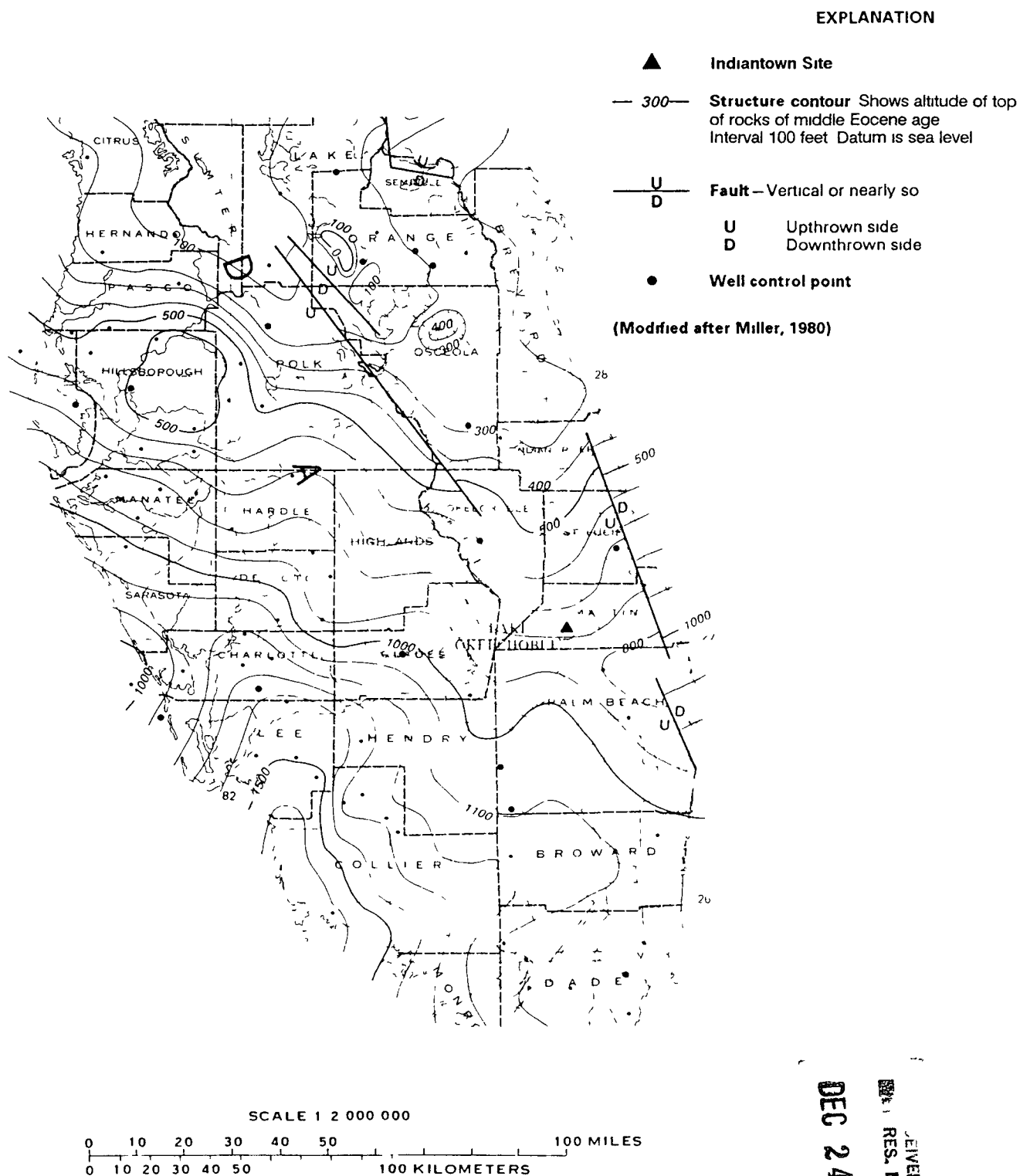


Figure 231-7.

STRUCTURE CONTOUR ON TOP OF MIDDLE
EOCENE AGE STRATA (CORRESPONDS TO AVON
PARK LIMESTONE IN MARTIN COUNTY)

Source FPL, 1989

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Lichtler (1960) states that the Ocala Limestone is generally less than 100 feet thick in Martin County. However, the regional cross section shown on Figure 2 3 1-5 indicates that the Ocala may be on the order of 400 feet thick in the ICL site area. Miller (1986) indicates a thickness for the Ocala Limestone of about 200 feet in the site area (Figure 2 3 1-8). The log of a deep well that penetrates the entire Ocala Limestone at the nearby FPL Martin site shows a thickness of 100 feet (FPL, 1982). The top of the Ocala, at about El -700 feet based on the logs of wells in the vicinity of the ICL site, is an erosional surface that creates an unconformity with the overlying Oligocene age deposits.

Suwannee Limestone

The only formation known to be of Oligocene age in Martin County is the Suwannee Limestone (Lichtler, 1960). This formation is bounded by unconformities and is described as a cream colored, slightly porous, soft, granular mass of limy particles, many of which seem to be of organic origin.

Lichtler (1960) states that the thickness of the Suwannee in western Martin County ranges from about 20 to 60 feet. The regional cross section shown on Figure 2 3 1-5 indicates a thickness on the order of 80 feet in the vicinity of the site. Miller (1986) suggests that Oligocene age rocks are absent in Martin County except for a thin band east of a northwest trending fault which parallels the east coast through Martin, St. Lucie, and Indian River Counties (Figure 2 3 1-9). Although Miller does not indicate the presence of Oligocene age rocks west of the coastal fault, it is possible that, due to the contour interval used for the mapping (100 feet), identification of these rocks was omitted from the area immediately west of the fault. Based on a larger sampling of wells throughout Martin County, Knapp (1988) indicates a combined thickness for the Tampa Formation and Suwannee Limestone of between 75 and 100 feet. Erosion of the surface of the Suwannee Limestone in western Martin County has produced an unconformity with the overlying Miocene sediments.

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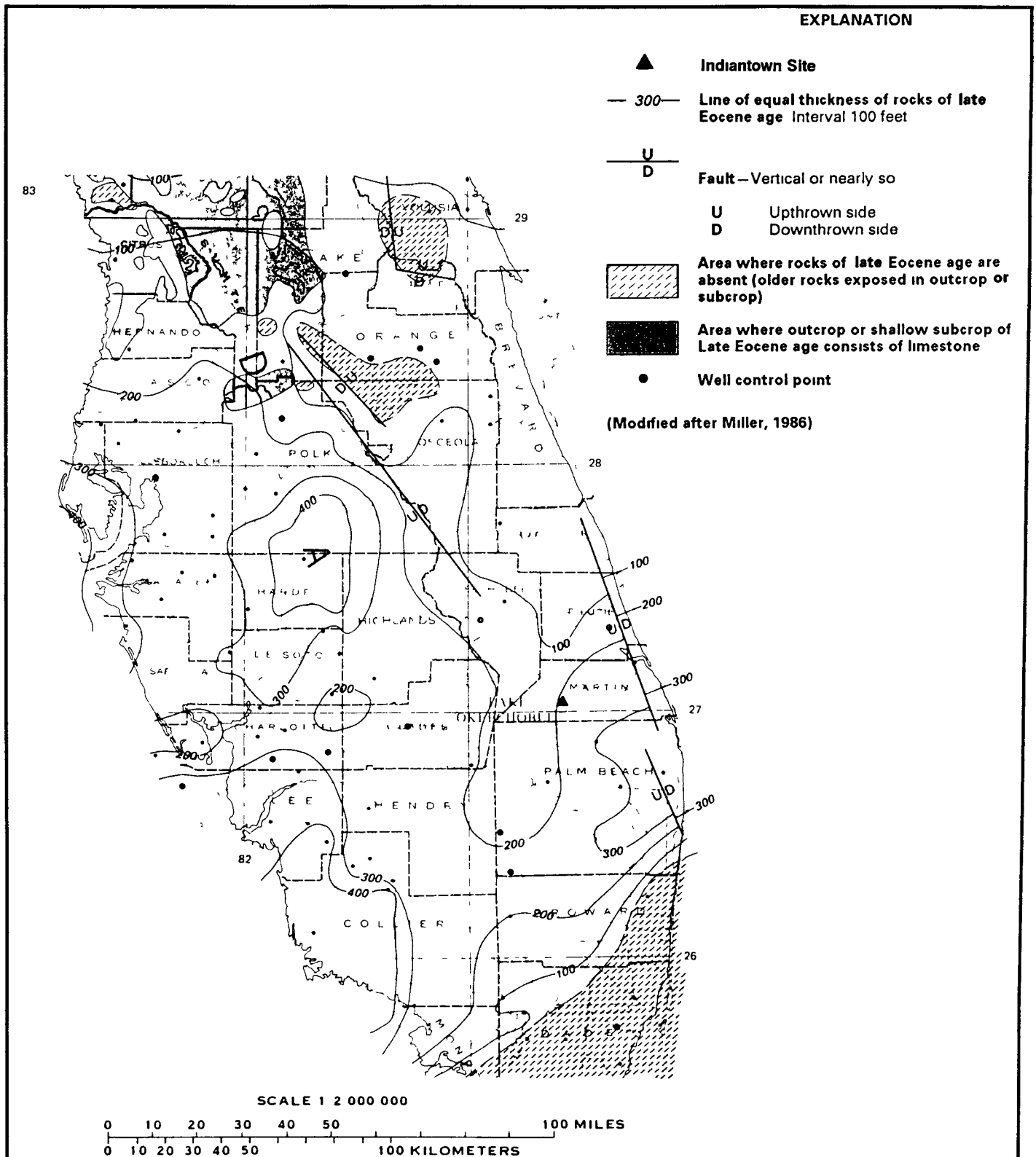


Figure 2.3 1-8
ISOPACH MAP OF LATE EOCENE AGE STRATA
(CORRESPONDS TO OCALA LIMESTONE IN MARTIN
COUNTY)

Source FPL, 1989

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EXPLANATION

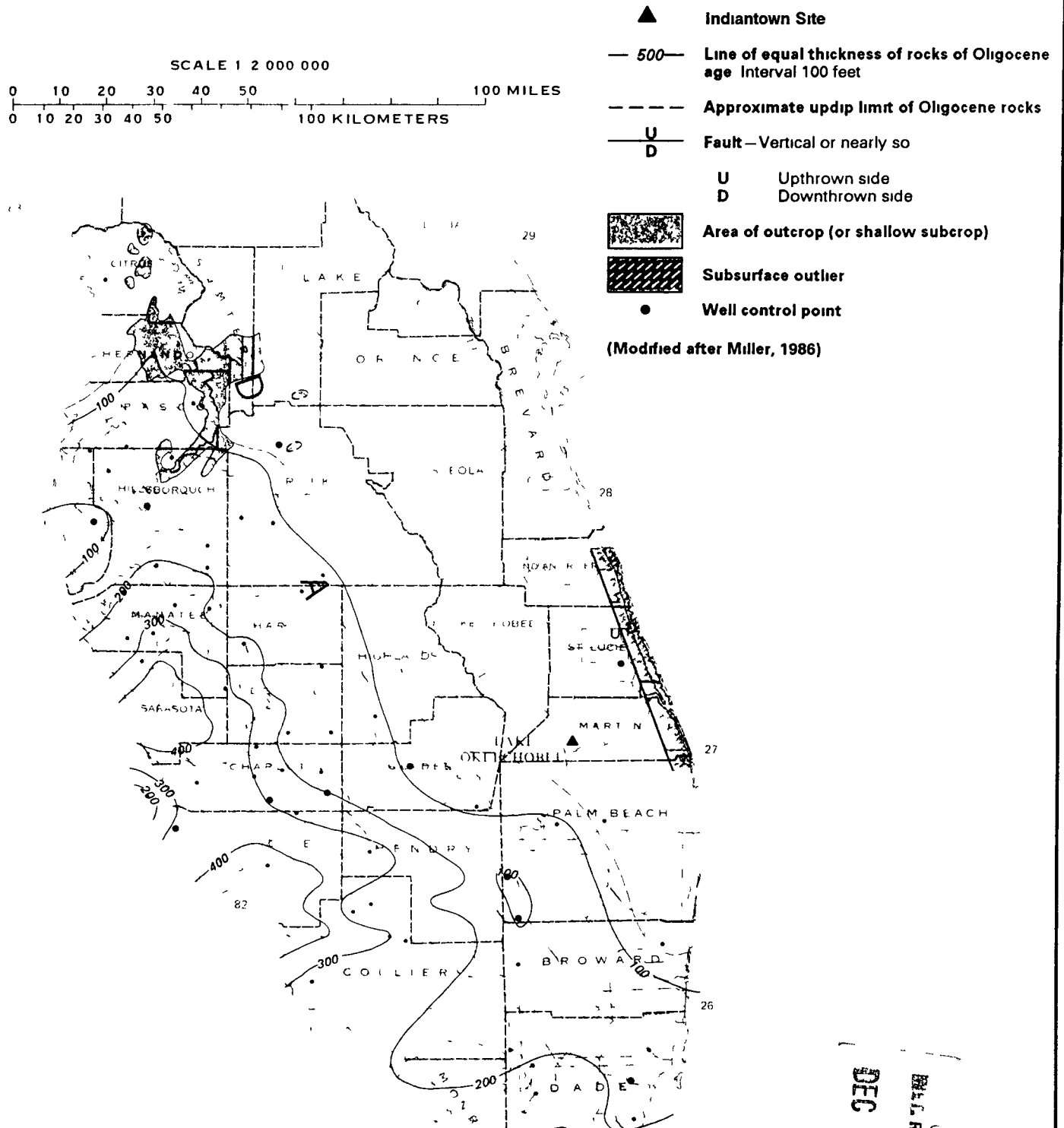


Figure 2.3.1-9
ISOPACH MAP OF OLIGOCENE AGE STRATA
(CORRESPONDS TO SUWANNEE LIMESTONE
IN MARTIN COUNTY)

Source FPL, 1989

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Tampa Formation

Lichtler (1960) indicates that the presence of the Tampa Formation has not been definitely established in Martin County, where it is only tentatively identified in 10 to 15 feet of sandy limestone in one well located about 2 miles south of the city of Stuart. This identification is based on a similarity with the type-locality near Tampa. Scott (1988) proposes to reduce the status of the Tampa Formation to a member within the Hawthorn Group due to its limited areal extent, facies changes, and apparent gradational contacts with the units above and below it. The cross section shown on Figure 2 3 1-10 indicates that the Tampa Member of the Hawthorn Group has not been identified east of DeSoto County. In its type-locality near Tampa, the member is described as a fairly hard, dense, white-to-yellowish, variably sandy and clayey limestone (Scott, 1988).

Hawthorn Formation/Group

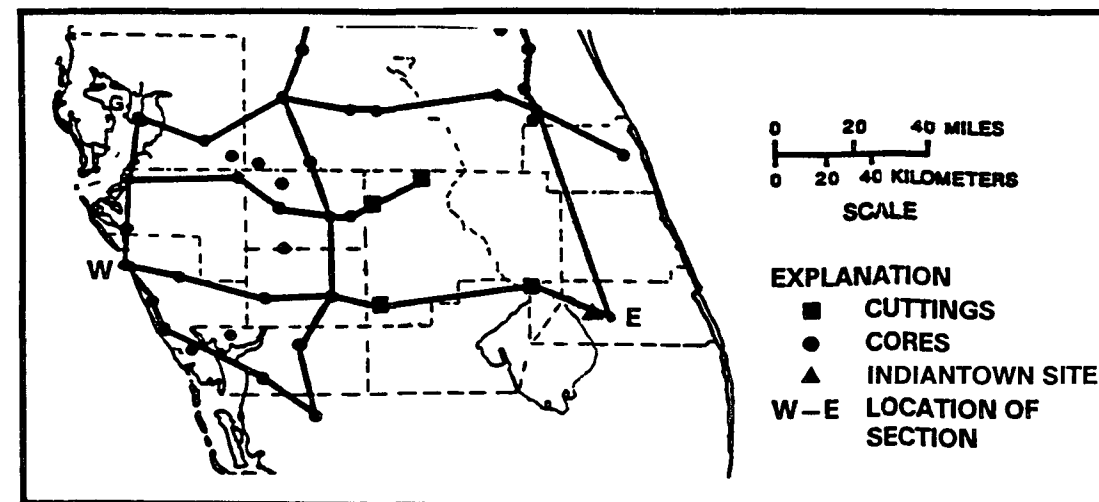
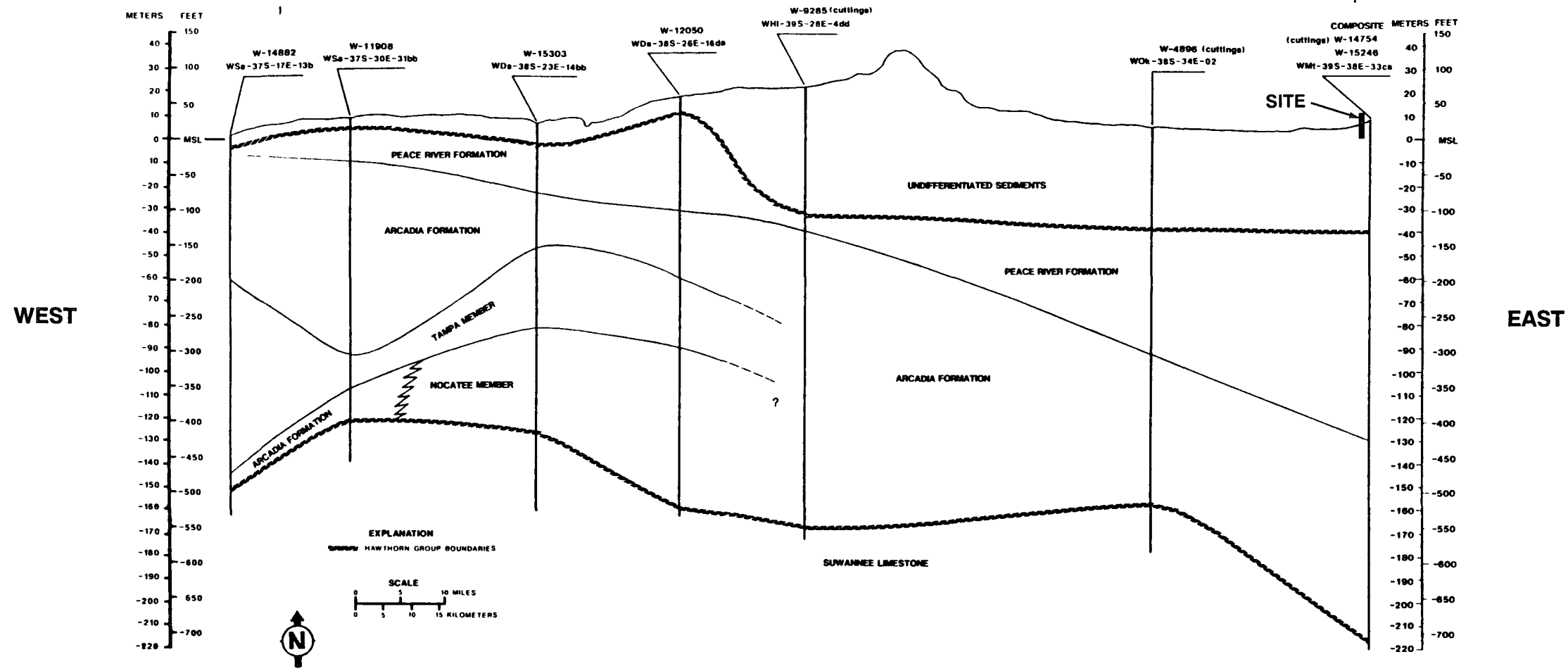
The Hawthorn Formation, as described by Lichtler (1960), conformably overlies the Tampa Formation, where present, or unconformably overlies the Suwannee or older limestones in Martin County. In the site vicinity, the Hawthorn Formation consists of beds of dark green to white phosphatic clay containing silt and quartz sand. The lower part of the formation varies from thin layers of sandy phosphatic limestone and chert to lenses and thin layers of phosphatic sand and abundant shells. Due to this apparent heterogeneity, it has been proposed by Scott (1988) to characterize the Hawthorn as a group by dividing it, based on clastic and carbonate lithologies, into two formations: the Peace River Formation (clastic) in the upper part, and the Arcadia Formation (carbonate) in the lower part.

The relationship between the Peace River Formation and the Arcadia Formation in south Florida is shown in the cross section on Figure 2 3 1-10.

The proposed Arcadia Formation in south Florida unconformably overlies either the Ocala Limestone or the Suwannee Limestone. It consists mainly of a yellowish-

Figure 2 3.1-10

SUBSURFACE CROSS SECTION: WEST-EAST



INDEX MAP

Source FPL, 1989
(MODIFIED AFTER SCOTT, 1988)

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gray to olive-gray dolostone and white to yellowish-gray limestone. Both the dolostone and limestone are sandy, clayey, finely crystalline, and phosphatic. Recrystallization of the limestones is common. Clay and quartz sand beds less than 5 feet in thickness occur throughout the formation.

The proposed Peace River Formation is characterized by seams of interbedded light-gray to olive-gray quartz sands, clays, and carbonates consisting of limestone and dolostone. The sands are poorly consolidated, very-fine to medium grained, clayey, and calcareous to dolomitic with a variable phosphate content. The yellowish-gray to olive-gray clays are poorly to moderately indurated, calcareous to dolomitic, and contain quartz sand and silt. The carbonates comprise less than one-third of the formation and vary in color from yellowish-gray to white. They are variably sandy, clayey, and phosphatic and poorly-to-well cemented.

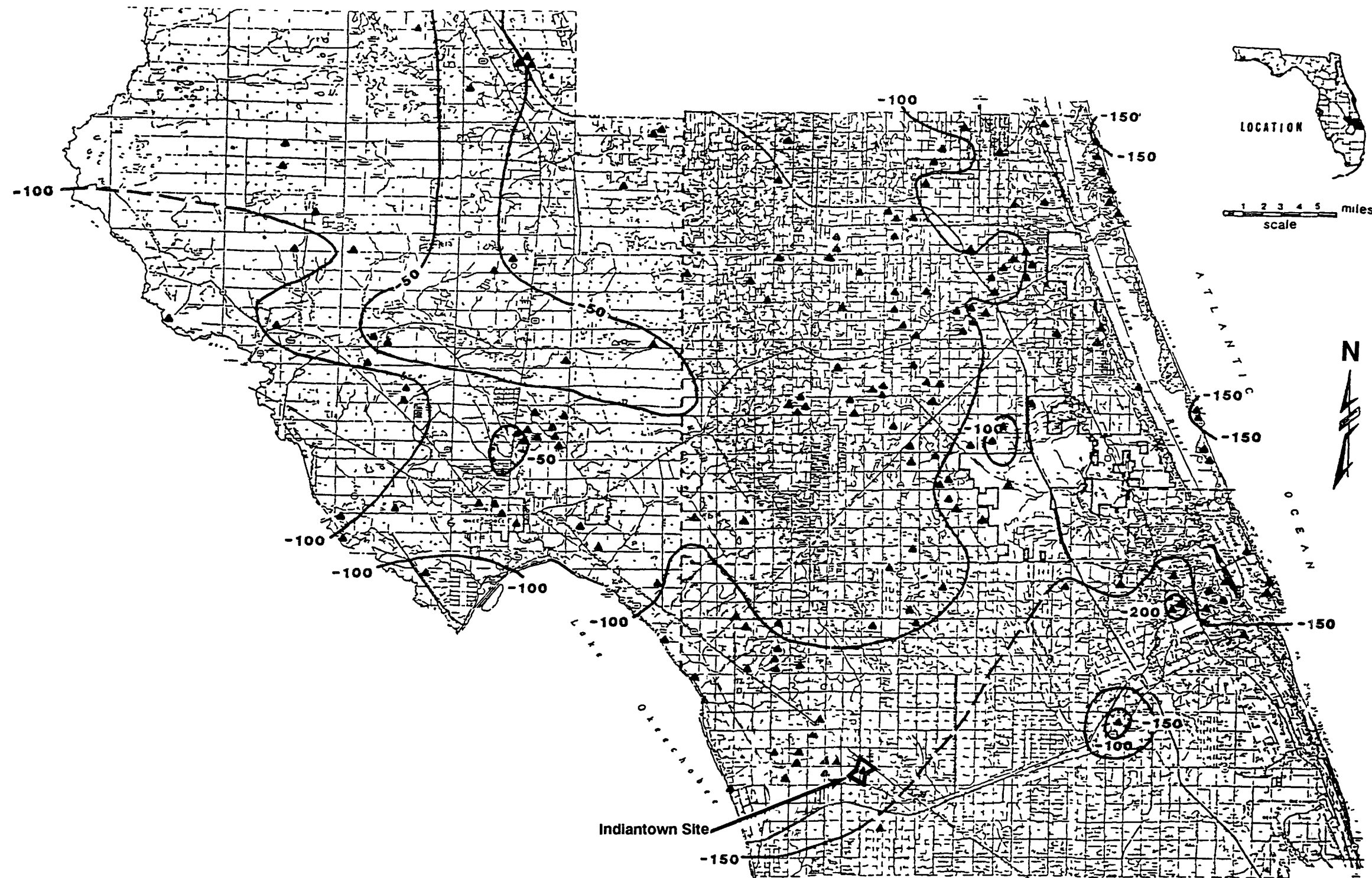
The top of the Hawthorn Group occurs at approximately El -105 to -150 feet in the vicinity of the ICL site. These elevations are based on the logs of test wells and exploratory borings drilled in the area, and are in general agreement with Miller (1986) and Knapp (1988). Figure 2.3.1-11 shows structure contours on the top of the Hawthorn Group in Martin, St. Lucie, and Okeechobee Counties. The upper portion (5 to 20 feet) of the Hawthorn Group in this area consists predominantly of greenish-gray clay with subordinate amounts of shell, limestone, silt, and sand. The Hawthorn Group is about 550 to 600 feet thick in the site area (Knapp, 1988, Miller, 1986) as shown on Figure 2.3.1-12.

Tamiami Formation

The Tamiami Formation in south Florida has generally been defined as including all deposits of Late Miocene age overlying the Hawthorn Group (Lichtler, 1960). Where no distinct lithologic break occurs between Middle and Late Miocene sediments, the Tamiami can be differentiated from the Hawthorn only by fossil content. Based on lithologic descriptions of materials from exploratory borings



Figure 2.3.1-11
 TOP OF THE HAWTHORN
 GROUP (CONTOUR INTERVAL
 50 FEET)



▲ Well Location
 — Contour Line

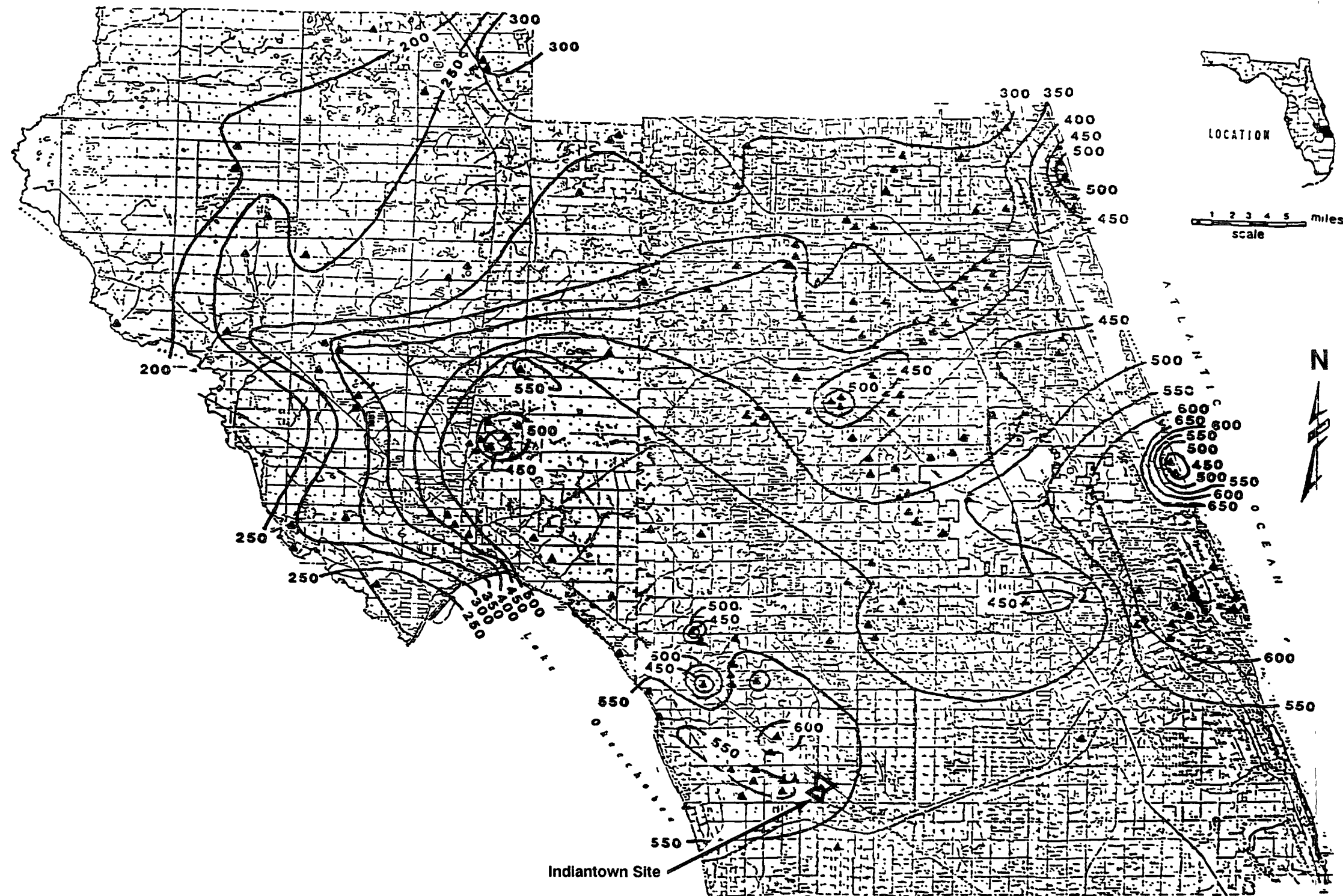
Source FPL, 1989
 (MODIFIED AFTER KNAPP, 1988)

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Figure 2.3.1-12
ISOPACH MAP OF THE
HAWTHORN GROUP
(CONTOUR INTERVAL:
50 FEET)



▲ Well Location
— Contour Line

Source FPL, 1989
(MODIFIED AFTER KNAPP, 1988)

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drilled at the ICL site, the top of the Tamiami Formation is estimated to occur at about El. -85 feet and is approximately 25 to 30 feet thick.

Caloosahatchee Marl

The only Pliocene age formation present in the site area is the Caloosahatchee Marl, which is composed largely of sand and shells (Lichtler, 1960). The top of this unit at the ICL site occurs at about El. -50 feet and is approximately 35 feet thick.

Anastasia Formation

The Anastasia Formation is the oldest Pleistocene age formation in Martin County. It is estimated to be over 100 feet thick in the eastern part of the county, but presumably thins to the west, where it pinches out or merges with the contemporaneously deposited Fort Thompson Formation west of Martin County (Lichtler, 1960). The Anastasia lies unconformably on the Caloosahatchee Marl or older formations and is, in turn, unconformably overlain by the Pamlico Sand. Although from place to place its composition varies, ranging from coquina to sand, in Martin County it consists primarily of sand, shell beds, and thin, discontinuous layers of sandy limestone or sandstone.

The Anastasia Formation and the overlying Pamlico Sand are the only geologic units exposed in Martin County. In those areas where it is not exposed, the Anastasia Formation is expected to underlie the surficial Pamlico Sand. At the ICL site, the Anastasia Formation extends from near the ground surface to about El. -50 feet.

Pamlico Sand

The Pamlico Sand of Pleistocene age forms a thin veneer, where present, over the Anastasia Formation. Although this unit could not be identified at the ICL site, if present, it is expected to have a maximum thickness of only a few feet.

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2.3.1.2 Detailed Site Lithologic Description

A drilling program to evaluate the ICL site lithology was implemented in July and August 1990. The drilling effort consisted of six test borings, designated TB-1 through TB-6; construction of five monitor wells, MW-1 through MW-5; two piezometers, POW-1 and POW-2; and an aquifer test well, PW-1. The six test boring locations (TB-1 through TB-6) are situated at the approximate corners and in the middle of the site (Figure 2.3.1-13). The borings were plugged with neat cement, and monitor wells and piezometers were drilled and installed within 10 feet of each boring.

A separate but concurrent geotechnical investigation was also performed at the site to determine subsurface conditions for preliminary foundation evaluation purposes. The logs of two borings drilled for that investigation (B-102 and B-105) were used to assist in construction of the site geologic cross sections discussed below.

Summary of Drilling and Sampling Methodology

The borings, monitor wells, and piezometers were drilled and constructed by Ardaman and Associates, Inc., West Palm Beach, Florida. The aquifer test well was installed by Drilling Services, Inc., Ft. Pierce, Florida. Technical supervision of the drilling and well construction activities was provided by a hydrogeologist from CH2M HILL of Gainesville, Florida.

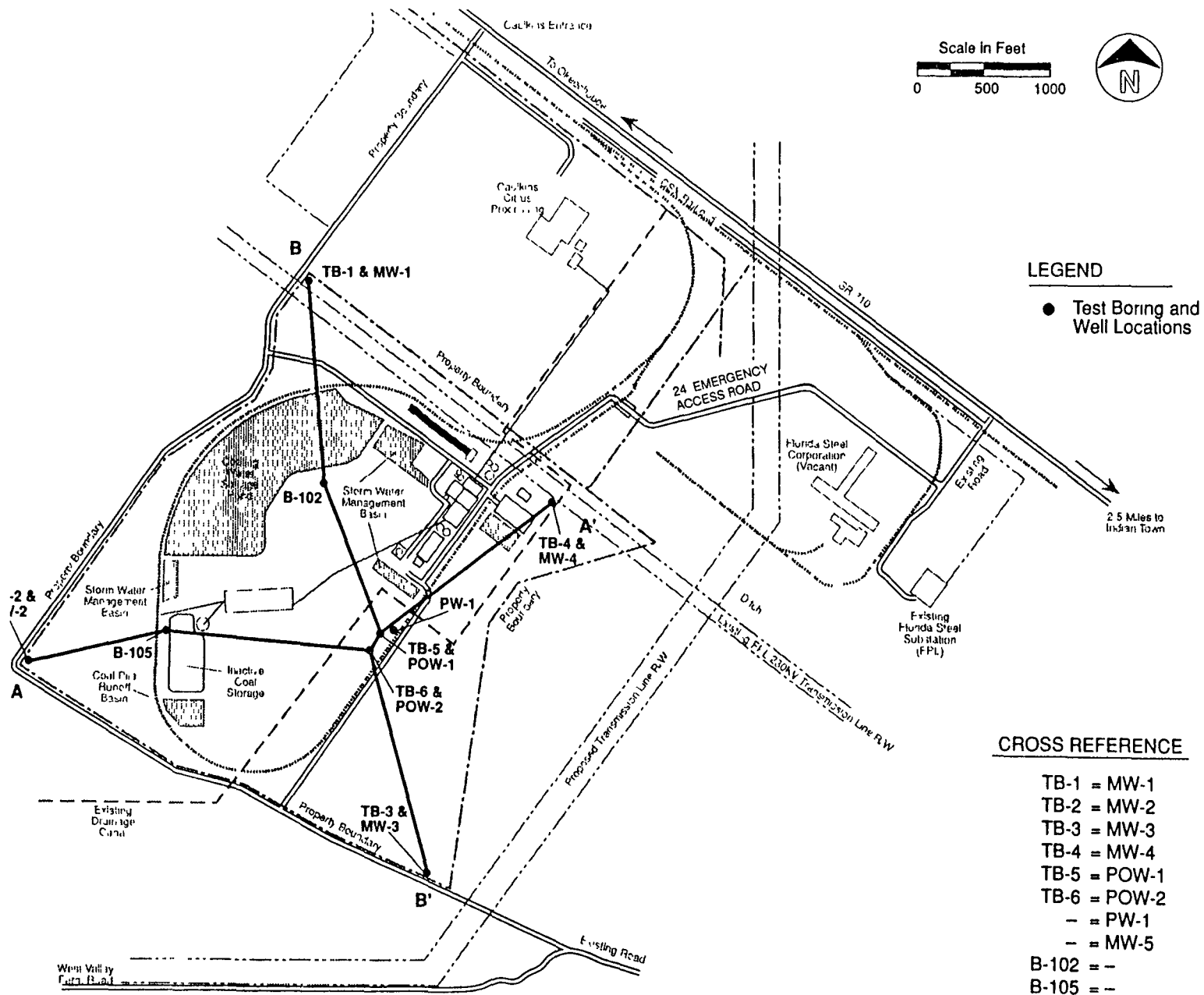
All test borings were drilled using mud rotary drilling techniques. A bentonite mud, Quik Gel[®], was used to facilitate drilling of the soil borings. The drilling rig, tools, drill rods, and bits were steam cleaned before drilling a new borehole.

The 4-inch-diameter test borings were drilled to approximately 110 to 150 feet in depth. The deeper borings penetrated the top of the Hawthorn Group sediments at the site. During drilling, the soils were sampled at 5-foot intervals using the standard penetration test (SPT) and a split-barrel sampler (ASTM D 1586). Thin-

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Figure 2.3.1-13.
TEST BORING, WELL, AND GEOLOGIC
SECTIONS LOCATIONS

Source CH2M Hill, 1990



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walled tube samples (ASTM D 1587) were obtained at selected depths where low "N" values (blow counts) indicated soft material that would allow the tube to be pushed into the formation. This technique allowed relatively undisturbed samples to be obtained. Both the onsite hydrogeologist and the driller prepared a lithologic description as the boring progressed. The boring logs prepared by CH2M HILL are presented in Section 10.5.1. Representative soil samples (up to ten per borehole) and thin-walled tube samples were obtained from the borings and sent to Ardaman and Associates geotechnical laboratory for analysis. Soil samples were not obtained during the drilling of PW-1 because split-barrel samples were collected at POW-1, 50 feet away.

After the test borings were drilled to their final depth, geophysical logs were run on five of the borings (TB-1 through TB-5). Logs at these locations were determined to be sufficient to characterize the geology at the site. The logs run included mechanical caliper, natural gamma ray, long and short normal (LSN) electric, spontaneous potential (SP), and single-point electric. Copies of the geophysical logs are presented in Section 10.5.1. Following the geophysical logging, each boring was cemented from the bottom of the borehole to the land surface with neat cement. New borings were then drilled using mud-rotary techniques within 10 feet to facilitate installation of the monitor well or piezometer.

Results of Investigations

Boring Logs

Boring logs were prepared by the site hydrogeologist based on lithologic descriptions of split-barrel samples from each boring. Copies of the boring logs are presented in Section 10.5.1. Figures 2.3.1-14 and 2.3.1-15 are geologic cross sections through the site using the borings shown on Figure 2.3.1-13.

In general, a fine-grained, silica sand unit was encountered from the land surface to a depth of approximately 30 feet below the land surface (bls). A thin "hardpan" layer of organically cemented sand was found in some of the borings within this

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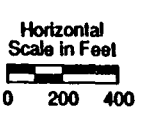
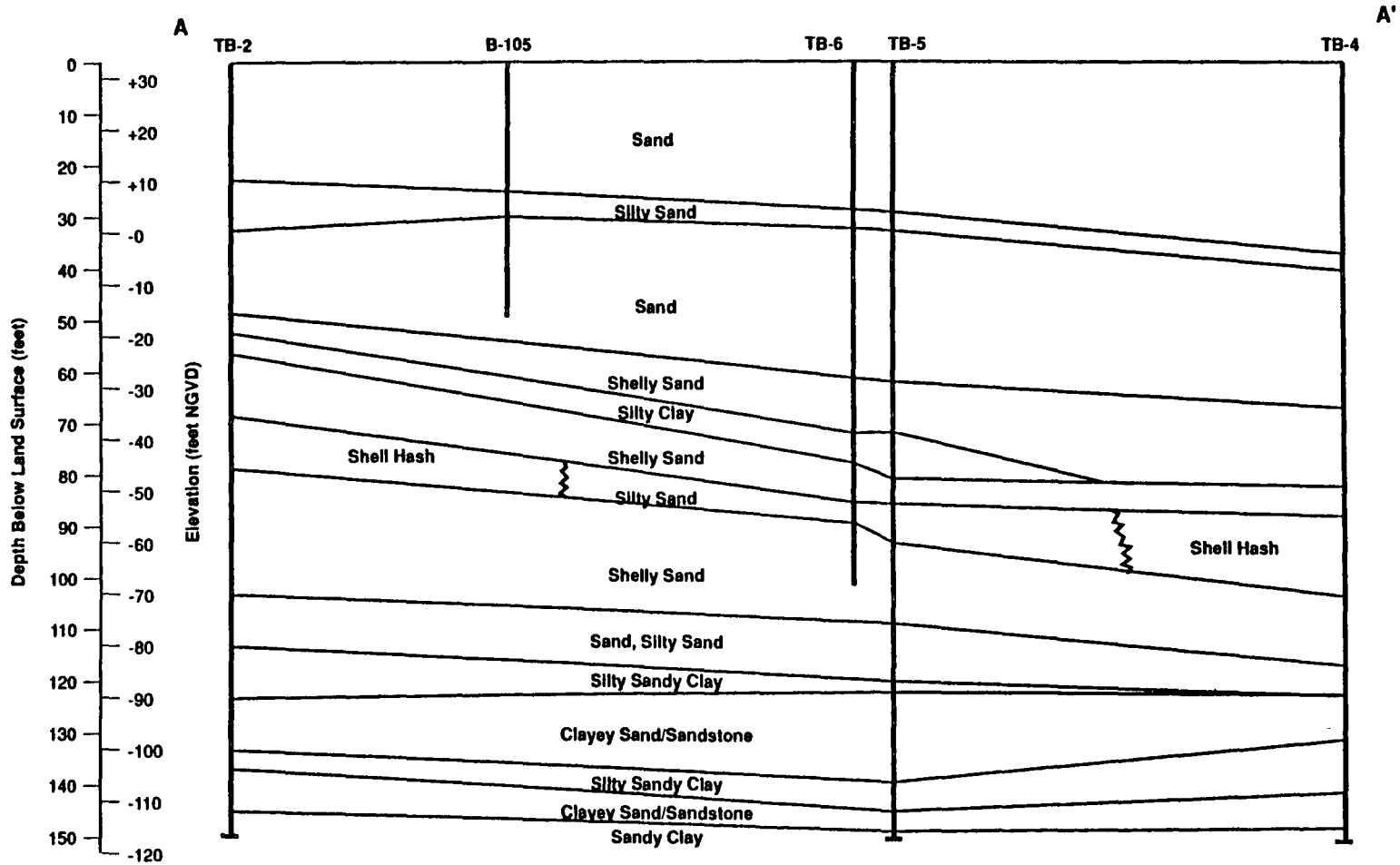


Figure 2.3.1-14.

GEOLOGIC CROSS SECTION A-A'

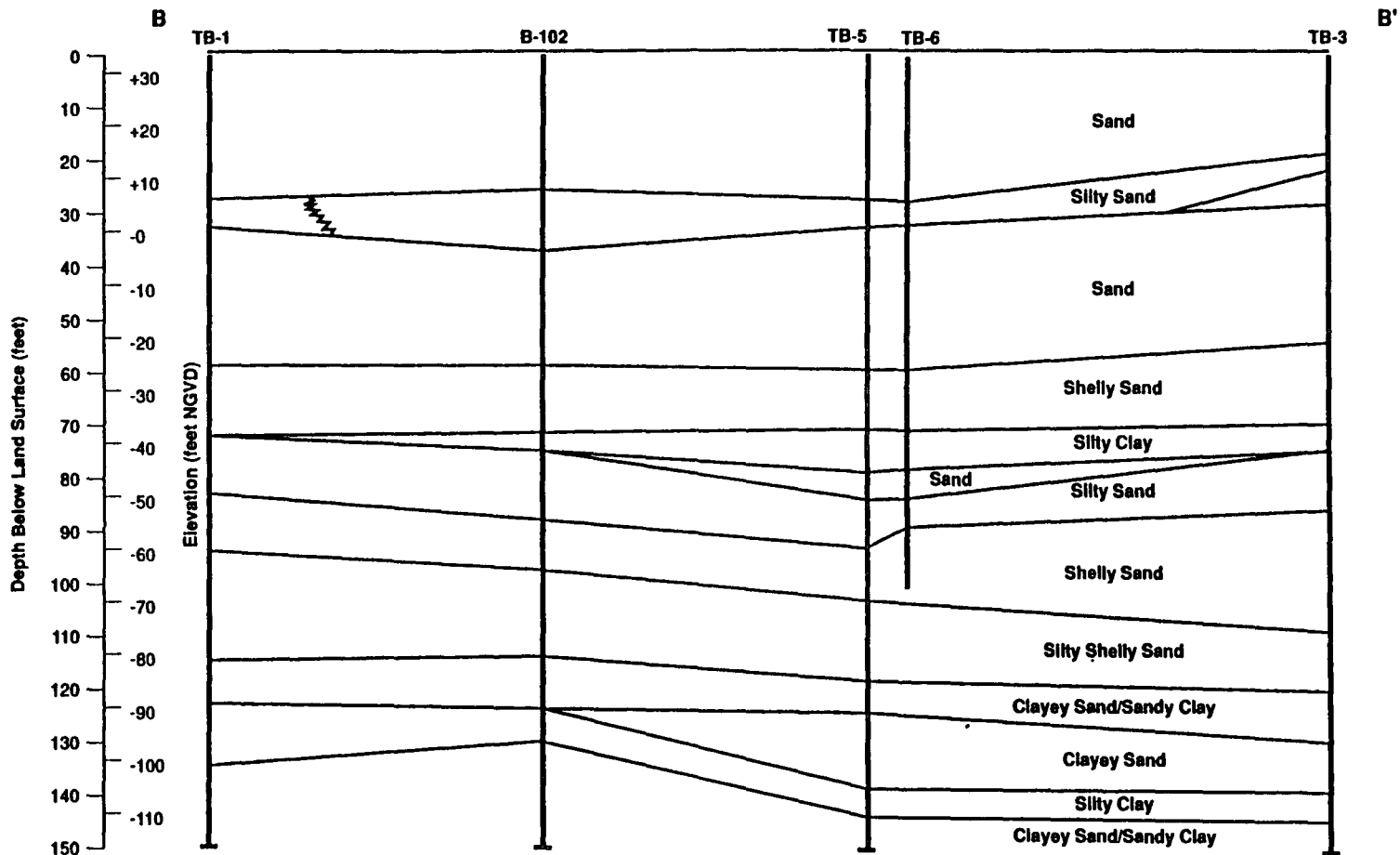
Source CH2M Hill, 1990

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Figure 2.3.1-15.
GEOLOGIC CROSS SECTION B-B'

Source CH2M Hill, 1990



Horizontal
Scale in Feet
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sand unit. Below the sand unit is a silty sand layer with an average thickness of 5 feet that grades laterally to cemented sand and limestone at TB-1 and TB-3.

At a depth of approximately 35 feet bls, a very fine-grained, very dense, light olive-gray sand unit was encountered with a thickness of about 20 feet. Below this unit is a fine quartz sand with a significant amount of black phosphorite grains and some shell that extends to a depth of about 70 feet bls. This shelly sand layer grades laterally and downward to a silty clay zone in the center of the site (Figure 2.3.1-15).

A shelly sand unit occurs at a depth of approximately 85 feet bls. This shelly sand unit increases in shell content radially from the center of the site and has alternating silt content throughout. The shelly sand unit grades to a silty sand, which extends to a depth of approximately 120 feet bls. Alternating beds of sandy clay, clayey sand, and poorly cemented clayey sand were encountered from a depth of 120 feet bls to the total depth of the borings (± 150 feet bls).

Sieve Analyses

Sieve analyses were conducted on 47 split-barrel samples from test borings TB-1 through TB-5. The purpose of these analyses was to evaluate the grain size distribution of the geologic units at each boring location. Laboratory test results of the sieve analyses are presented in Section 10.5.1. A review of these grain size curves confirms the fine, silty sandy nature of the soils that predominate throughout the site as indicated on the boring logs.

Porosity and Vertical Hydraulic Conductivity

Thin-walled tube samples were obtained from TB-2, TB-3, TB-4, and TB-5 at depths ranging from 26 to 136 feet bls. The samples were sent to Ardaman and Associates geotechnical laboratory for determination of the vertical hydraulic conductivity and porosity values of these undisturbed samples.

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Hydraulic conductivity was determined using a triaxial-type testing cell, while final volumetric and dry weight measurements were used to determine the porosity, with an assumed specific gravity of 2.70 based on the higher percentage of silica sands found at the site. The results of the tests are shown in Table 2.3.1-1. The hydraulic conductivity values range from 1.0×10^{-3} cm/sec for fine sands at a depth of 36 feet bls to 1.73×10^{-8} cm/sec for silty clay at a depth of 71 feet bls. As expected, coarser-grained materials exhibit higher hydraulic conductivities than the finer, clayey samples. Porosity values vary from 36.1 percent to 57.4 percent and average approximately 40 percent for samples with significant sand content. The 57.4 percent porosity value was obtained from a silty clay sample, which generally has higher porosities than coarser-grained sediments.

Cation Exchange Capacity

The cation exchange capacity (CEC) of a soil is defined by Hem (1989) as the "total number of negative charge sites at which reversible cation adsorption and desorption can occur." This analysis is usually performed on clay-rich sediments and is expressed as the number of milliequivalents (mEq) of cations that can be exchanged per 100 grams dry weight of sample.

CEC analyses were performed on two samples: TB-5 at 71 feet bls and TB-4 at 134 feet bls. Values of 6.6 and 5.95 mEq/100 grams, respectively, were obtained for these two samples. The laboratory test results for these analyses are presented in Section 10.5.1. In general, these CEC values are considered low, but other factors such as pH also control the sorptive capacity of sediments.

Geophysical Logs

Natural gamma ray, single-point electric logs, spontaneous potential (SP), LSN electric logs, and caliper logs were run in selected boreholes. The natural gamma ray and single-point electric geophysical logs were found to be the most useful to delineate individual strata in the geologic column at the site.

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Table 2.3.1-1
SUMMARY OF GEOTECHNICAL ANALYTICAL DATA
FOR THE ICL SITE

<u>Boring No</u>	<u>Interval (ft, bls)</u>	<u>Lithologic Description</u>	<u>Hydraulic Conductivity (cm/sec)</u>	<u>Void Ratio</u>	<u>Porosity (%)</u>	<u>Plasticity (%)</u>	<u>Cation Exchange Capacity (mEq/100g)</u>
TB-5	26-29	Very Fine Sand Trace Silt	6.8×10^{-4}	0.688	40.8	NA	NA
	71-74	Gray Silty Clay	1.73×10^{-8}	1.349	57.4	51	6.6
	36-38.5	Gray Fine Sand	1.0×10^{-3}	0.64	39.0	NA	NA
TB-4	96-98.6	Silty Shell Hash	8.0×10^{-6}	0.61	37.9	NA	NA
	134-136	Gray Silty Sand	9.6×10^{-5}	0.77	43.5	1	5.95
TB-3	71-73.5	Silty Shelly Clay	4.5×10^{-6}	0.565	36.1	0	NA
TB-2	26-29	Gray Silty Sand	9×10^{-6}	0.589	37.0	NA	NA

bls = below land surface

mEq = milliequivalents

NA = not applicable

Note: All analyses performed by Ardaman and Associates, Inc.

Source CH2M Hill, 1990

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Four major lithologic units can be distinguished based on the gamma ray and electric logs. These units correspond well to lithologic units identified from the samples collected during drilling. A shallow unit of relatively clean sands occurs to a depth of 30 feet bls, which is distinguished on the gamma ray logs by a relatively low gamma count rate, with little vertical variability. At a depth of 30 feet bls, a high gamma peak is noted, which corresponds to the silty sand layer identified from the samples collected at this depth. At TB-3, a high gamma peak occurs at a depth of 21 feet bls, correlating to a sandy limestone unit noted on the boring log.

A distinctive unit of much higher gamma ray counts occurs over the interval from about 30 feet to a depth of about 80 feet bls. The count rate changes sharply over short vertical intervals, giving the log a characteristic "jagged" appearance. The higher gamma ray activity in this interval is attributed to the uranium content of the phosphorite grains noted on the boring logs. In TB-1, TB-3, and TB-4, the highest gamma ray counts correspond to fine-grained or silty sands, with 20 to 25 percent black, very fine grained phosphorite. In TB-5, the gamma peak at 69 feet bls correlates with a silty clay unit noted on the boring log. In TB-2, the gamma peak correlates with thin clay lenses encountered by the boring at a depth of 60 feet bls.

The top of the third unit at a depth of about 80 feet bls is marked by a substantial decrease in gamma ray activity to a level intermediate between the first two units, and by a corresponding lower resistivity on the electric logs. This level of gamma ray activity continues until a peak is encountered at the base of each borehole. The intermediate gamma ray activity in this interval corresponds to interbedded, shelly sand; silty shelly sand; clayey sand; and silty clay layers to depths of about 140 to 145 feet bls. The amount of phosphorite grains in this interval varies from trace quantities to 10 to 20 percent of the sample. Within this third unit, the lowest gamma ray count corresponds to a shelly sand bed occurring at a depth of approximately 90 to 110 feet bls.

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The fourth major unit distinguishable on the gamma ray logs is the top of the Hawthorn Group. The sharp increase in gamma ray activity seen at the base of each borehole is consistent with the geophysical signature of the top of the Hawthorn Group sediments. These sediments are typically rich in clays and phosphates, which produce high gamma counts.

On some of the single-point electric logs, a 5- to 10-foot-thick clay bed is indicated by a sharp deflection to the left. The feature is noted in TB-1, TB-3, and TB-5, and has a corresponding gamma ray peak at the same depth. The deflection occurs in TB-1 at a depth of 74 to 80 feet, and corresponds to a sandy, shelly clay on the boring log. In TB-5, the feature is a more subdued peak in the interval between 65 and 75 feet, and corresponds to a silty clay. The silty, shelly clay in TB-3 appears as a sharp peak in the interval between 65 and 70 feet bls on the electric log. Gamma peaks, in general, correspond to clay layers encountered in the borings.

The spontaneous potential log also provided some useful information when delineating formation contacts. In TB-2, a gradual increase in resistivity beginning at a depth of 113 feet bls correlates with the occurrence of a clayey, shelly sand unit. This increase in SP response occurs from 113 to 145 feet bls and correlates with the interbedded clayey sands and sandy clays on the boring log of TB-2. In TB-3, a gradual decrease in SP response from 75 to 115 feet bls corresponds to the shelly sand unit noted on the TB-3 boring log. In TB-4, a sharp decrease in SP response at 30 feet bls delineates the bottom of the fine silica sand unit noted on the boring log. Also, an increase in SP response at 120 feet bls denotes the beginning of interbedded clayey sands and clays. Lastly, a low resistivity spike at 85 feet bls in TB-5 denotes the beginning of shelly sands.

Geologic Formations at ICL Site

The stratigraphic nomenclature discussed below corresponds to that used by Lichtler (1960) and Scott (1988). Because lithology varies both laterally and

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vertically in shallow marine depositional environments, the formation names assigned to the various site lithologic units is considered arbitrary.

Pamlico Sand

The Pamlico Sand is identified as a thin veneer of fine silica sand that unconformably overlies the Anastasia Formation. Lichtler (1960) notes that these marine terrace sediments may not be present on the Orlando Ridge, a subdivision of the Eastern Flatlands physiographic region in which the Indiantown site is located, because this land may not have been covered by the sea during Pamlico time. If present at the site, this unit is only a few feet thick.

Anastasia Formation

At the site, the Anastasia Formation, which extends from near the land surface to a depth of about 85 feet, consists mostly of fine silica sand with variable quantities of shell and phosphate. Thin, discontinuous layers of silty sand, clay, and sandy limestone also are present within this formation.

Caloosahatchee Marl

The Caloosahatchee Marl is composed largely of sand and sandy shell beds (Nealon et al., 1987). At the site, this formation extends from approximately 85 to 120 feet bls, and is characterized by increasing silt content with depth.

Tamiami Formation

The Tamiami Formation consists of alternating layers of silty sand, sandy clay, and indurated clayey sand at the site. This formation is encountered at a depth of approximately 120 feet bls and extends to a depth of approximately 145 feet bls. The top of the Hawthorn Group sediments occurs at this depth, based on the gamma logs.

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2.3.1.3 Geologic Maps

The near-surface sediments at the ICL site consist of Pleistocene age deposits of the Pamlico Sand and Anastasia Formation. A regional geologic map showing the surficial geology of south Florida is presented on Figure 2.3.1-16. The Pamlico Sand, where present at the ICL site, is estimated to have a maximum thickness of only a few feet. The description of sediments encountered by exploratory borings drilled at the site indicates that the Anastasia Formation extends to a depth of approximately 85 feet.

A review of the site surficial soil classification (USDA, 1981) indicates that the majority of the northern half of the site consists of Basinger fine sand, while the southern half of the site consists mainly of Waveland sand (Figure 2.3.1-17). The third largest area, near the center of the site, is covered by the Lawnwood fine sand. The remaining minor soil types include Lawnwood fine sand, depressional; Waveland sand, depressional; Basinger fine sand, depressional; Placid sand; Sanibel muck; and Tequesta Variant muck.

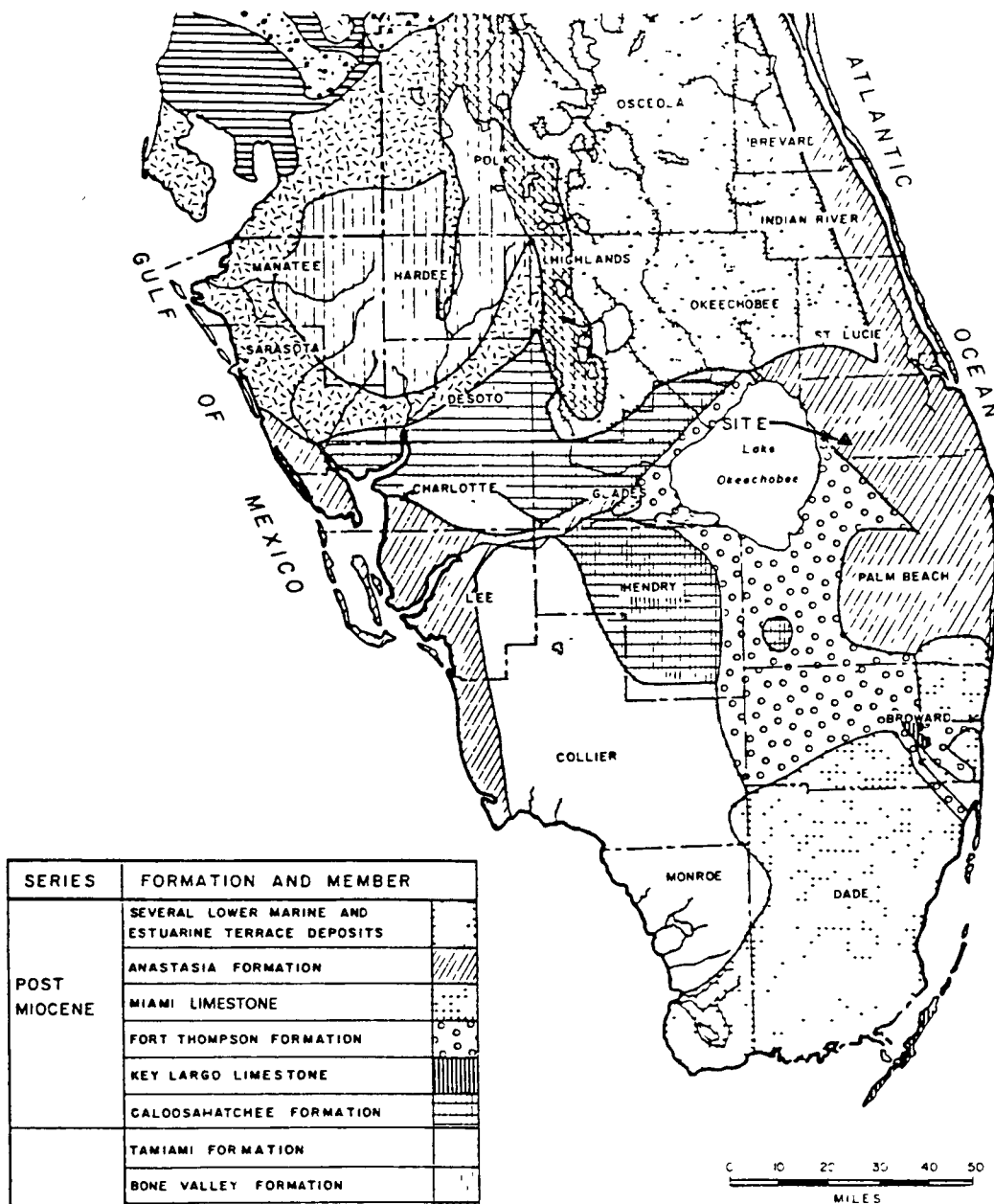
The three main soil types covering most of the site are all characterized as poorly drained, nearly flat-lying soils. The Basinger fine sand is characterized by very high permeability values throughout the soil profile, while the Waveland sand and the Lawnwood fine sand have high permeability values in the surface and subsurface layers, and low to very low permeability values in the subsoil.

Figure 2.3.1-13 shows the locations of two cross sections through the site. The sections are presented on Figures 2.3.1-14 and 2.3.1-15, and are based on exploratory drill hole data from a recent site investigation. They show the materials encountered in the borings from the ground surface to a depth of about 150 feet. These sections show that the site is generally underlain by layers of sand, silty sand, and shelly sand to the base of the Anastasia Formation. However, occasional zones of sandy or silty clay were encountered within this interval by

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MODIFIED AFTER: VERNON AND PURI, 1964

Figure 2.3.1-16.

REGIONAL GEOLOGIC MAP

Source FPL, 1989

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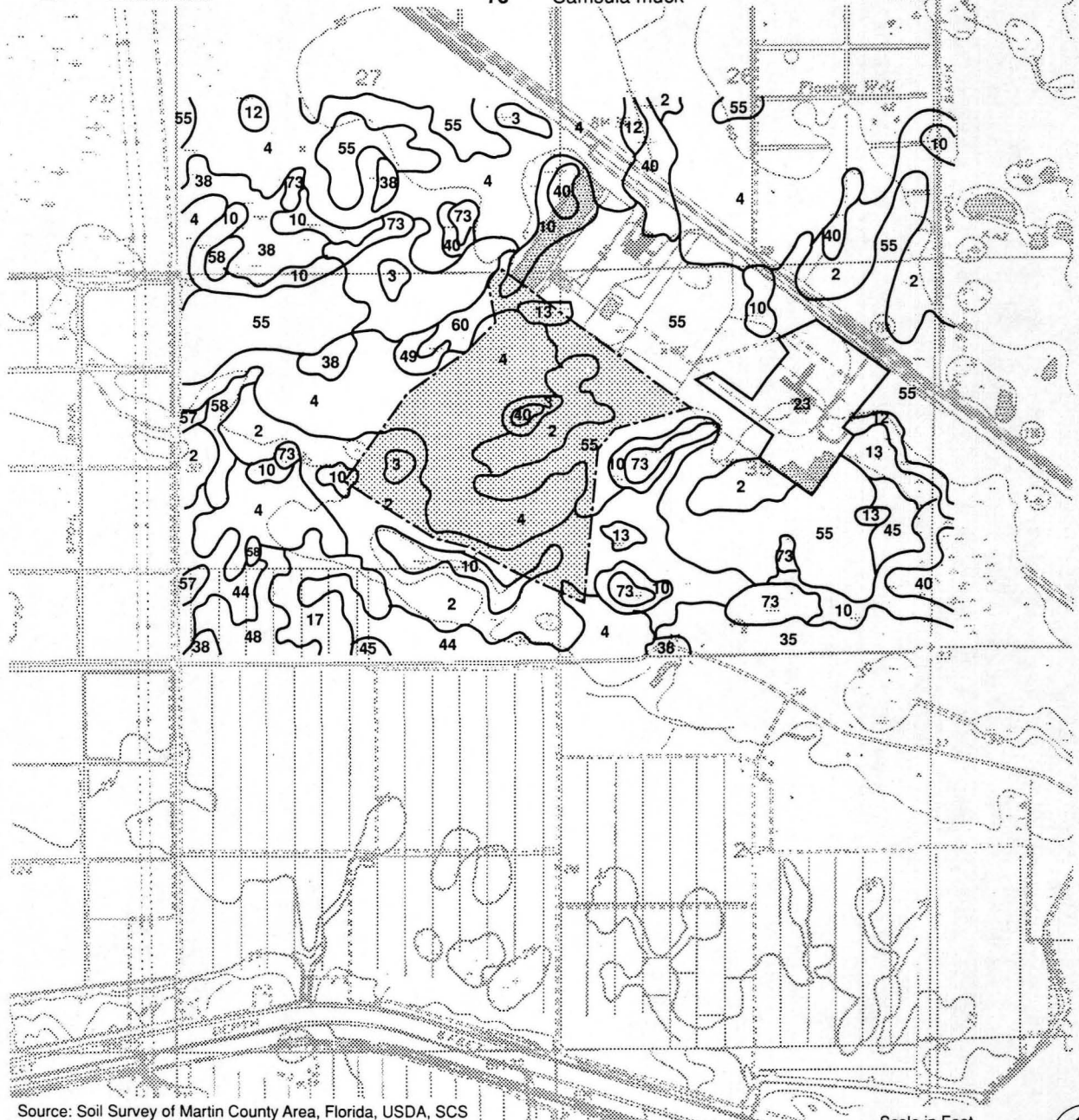
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LEGEND

---	Property Boundary	35	Salerno sand
2	Lawnwood fine sand	38	Floridana fine sand, depressional
3	Lawnwood fine sand, depressional	40	Sanibel muck
4	Waveland sand	44	Boca fine sand
5	Waveland sand, depressional	45	Hilolo fine sand
10	Basinger fine sand, depressional	49	Riviera fine sand, depressional
12	St. Johns Variant sand	55	Basinger fine sand
13	Placid sand	57	Chobee loamy sand
17	Wabasso sand	58	Gator muck
23	Urban sand	60	Tequesta Variant muck
		73	Samsula muck



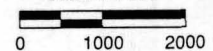
Source: Soil Survey of Martin County Area, Florida, USDA, SCS

Figure 2.3.1-17

SOIL SURVEY OF THE SITE

Source: CH2M Hill, 1990

Scale in Feet



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some of the borings, indicating the presence of discontinuous layers of finer-grained material.

2.3.1.4 Bearing Strength

For satisfactory performance, the foundation of any structure must meet two independent design criteria. First, it must have an acceptable factor of safety against bearing failure in the foundation soils. Second, settlements during the life of the structure must not be of a magnitude that will cause structural damage, endanger piping connections, or otherwise impair the operational efficiency of the facility. In order to assess these two criteria, a preliminary subsurface exploration was conducted.

The subsurface exploration was made during July 1990, by Ardaman & Associates, under the technical direction of a Bechtel geotechnical engineer. This exploration consisted of eight Standard Penetration Test borings drilled to depths ranging from 30 to 150 feet, and eight Cone Penetration Test soundings to depths ranging from 30 to 48 feet. The borings were widely spaced over the site, to generally cover areas where structures and facilities are proposed. Ardaman drilled the test borings with a CME 45 truck-mounted drilling rig, and made cone soundings with a truck-mounted Dutch cone probe. Generally, test borings were drilled to the depth of interest appropriate for the structures proposed in the boring's vicinity (i.e., 150-foot depth borings in the vicinity of heavily loaded proposed structures, usually power block structures, and 50-foot depth borings near lightly loaded structures). Cone soundings were made to refusal depth, the depth at which the equipment could no longer advance the test probe. Boring logs and cone test data are presented in Section 10.5.1.

The results of the subsurface exploration indicate a soil profile consisting predominantly of sands. The sands are generally loose near the surface (approximately the top 5 feet), with density increasing with depth, as shown in Figure 2.3.1-18. Analysis and experience indicate that bearing capacity or strength

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STANDARD PENETRATION TEST RESULTS

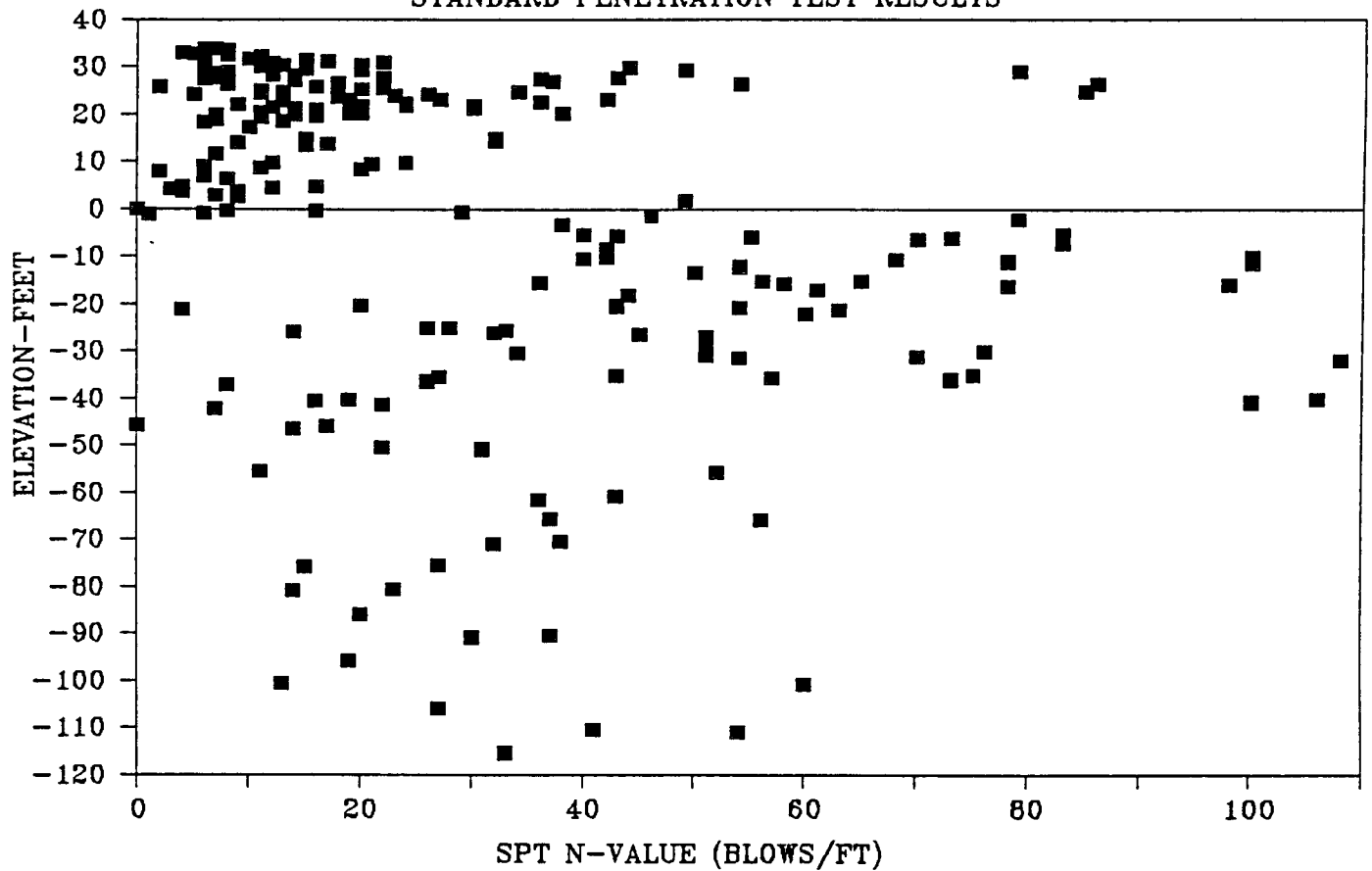


Figure 2.3.1-18.

SPT VALUES VS. DEPTH

Source Bechtel, 1990

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is almost never a controlling design criterion when foundations are placed on sands. Rather, foundation settlement usually governs foundation design. For the cogeneration plant and related facilities planned, light to medium foundation loads will be accommodated using shallow, spread foundations. Heavily loaded structures will be placed on either a thick mat foundation (after removing the loose upper soils, and replacing them with compacted backfill), or on deep foundations, bypassing the upper, loose soils.

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2.3.2 SUBSURFACE HYDROLOGY

2.3.2.1 Subsurface Hydrologic Data for the Site

The hydrogeologic framework beneath the Indiantown, Florida, site can be divided into three main parts. From shallow to deep, they are: the Surficial aquifer system; the relatively impermeable sediments of the Hawthorn Group; and the Floridan aquifer system.

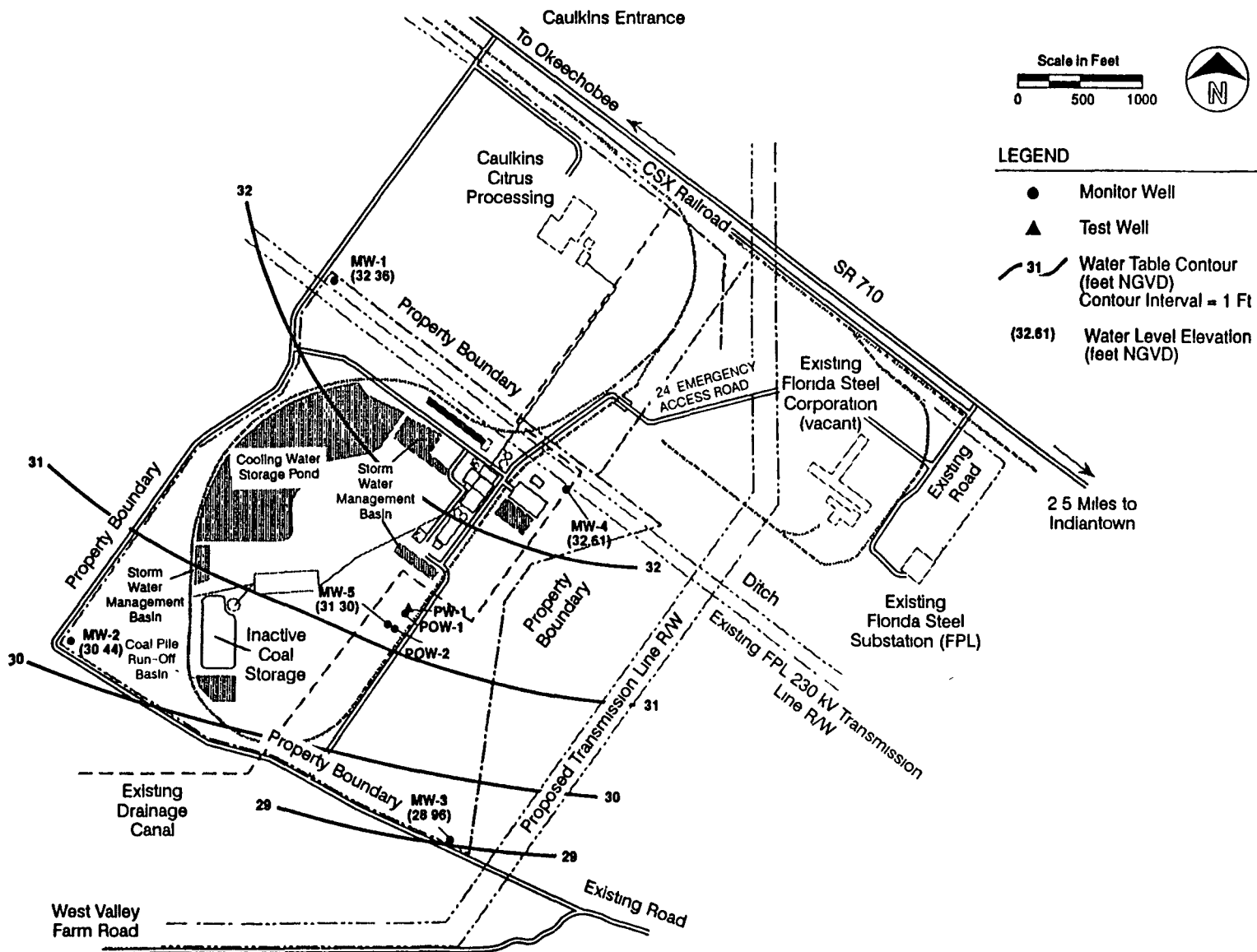
A field testing effort was performed to characterize the hydrogeologic conditions within the Surficial aquifer system at the site. This field effort included drilling and split-barrel sampling of five 150-foot soil borings. Thin-walled tube samples were obtained at various depths in four of the borings and were analyzed for vertical hydraulic conductivity and porosity by Ardaman and Associates, Inc. Four 30-foot monitor wells and one aquifer test well were constructed near the soil boring locations. Two deep piezometers and one shallow monitor well were constructed to obtain water levels during a 72-hour pumping test that was conducted to determine aquifer characteristics at the site.

Summary of Drilling and Sampling Methodology

Eight wells were constructed to characterize the hydrogeology of the ICL site. An 8-inch-diameter test well (PW-1) was completed to a depth of 120 feet by Drilling Services, Inc., Ft. Pierce, Florida. Two 110-foot-deep piezometers (POW-1 and POW-2) were installed within 50 and 200 feet of PW-1. A shallow (16-foot deep) monitor well, MW-5, was constructed approximately 200 feet from PW-1 to monitor the water level in the upper portion of the Surficial aquifer. The remaining four monitor wells (MW-1 through MW-4) are located at the approximate corners of the site (Figure 2.3.2-1). The purpose of the monitor wells is to determine the direction of groundwater flow and to characterize groundwater quality in the Surficial aquifer system at the site.

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Figure 2.3.2-1.
MONITOR WELL, TEST WELL, AND GEOLOGIC
SECTION LOCATIONS



Source CH2M Hill, 1990

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All wells were constructed using mud rotary drilling techniques. A bentonite mud, Quik Gel[®], was used on PW-1, and either Vari-Flo[®] or Poly-Sal[®], both bio-degradable muds, were used to drill the other well borings. The drilling rig and all tools, drill rods, and bits were steam-cleaned before drilling each borehole.

All wells were constructed with Schedule 40 polyvinylchloride (PVC) casing. Except for a 40-foot length of 0.030-inch slot, PVC wire-wrapped screen at PW-1, all wells were completed with a Schedule 40 PVC, 0.020-inch slot screen. Well construction diagrams are provided in Section 10.5.3.

Screens were sand packed with 8/20 silica sand in all wells except PW-1. PW-1 was packed with 6/20 silica sand. The monitor wells (MW-1 through MW-5) had a 2-foot cap of bentonite pellets emplaced above the sand pack.

The tremie method was used to fill the annulus above either the sand pack or the bentonite cap with Portland Type II neat cement, with variable amounts of bentonite added. The cement top was tagged, and the cement brought to the land surface. A steel protective casing and cement pad were emplaced around the well casings to complete the well installation.

PW-1 was developed using the air lift method, but all other wells were developed by pumping. The development time varied from about 1/2 hour at MW-5 to approximately 8 hours over a 2-day period at PW-1. Wells were developed until the water produced was reasonably sediment-free.

Characterization of the Surficial Aquifer System

Relationship of Aquifer to Local Geology

The results of the field investigation indicate that the Surficial aquifer system is comprised of two zones of relatively high permeability separated by a unit of lower permeability. The upper zone is unconfined and bounded above by the water table

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and below by a thin, somewhat discontinuous, silty layer at a depth of approximately 30 feet below the land surface (bls). Monitor wells MW-1 through MW-4 are screened from approximately 20 to 30 feet bls. Lithologically, the upper zone consists of fine-to-medium sands, with a discontinuous hardpan layer near the land surface (Figure 2.3.2-2).

Below the silty layer is approximately 55 feet of very dense, very fine grained sand, with interbedded clay lenses that provide additional confinement of the lower zone.

At a depth of approximately 85 feet bls, a sandy shell layer with a thickness of approximately 30 to 40 feet is encountered (Figure 2.3.2-2). This is the lower zone of the Surficial aquifer system, within which the aquifer test well (PW-1) and deep piezometers (POW-1 and POW-2) are completed. The lower zone is generally regarded as the most productive of the two zones of the Surficial aquifer system. Lichtler (1960) notes that a shell bed at a depth of 95 feet bls is the principal production zone in the Indiantown area.

At a depth of approximately 120 feet bls, a light olive-gray, silty clay formation thought to be the Tamiami Formation is encountered, which forms the base of the Surficial aquifer system.

Water Table

The water table configuration at the site was determined from water level measurements obtained from recently installed monitor wells and piezometers. Table 2.3.2-1 summarizes the well construction details and groundwater elevations in the Surficial aquifer system at the site. In general, the depth to water from the land surface is only a few feet. The groundwater contours based on water level measurements obtained on August 17, 1990, are shown on Figure 2.3.2-3.

In addition to water level measurements obtained at the site, Figures 2.3.2-4 and 2.3.2-5 show wet and dry season water table contours throughout Martin County during 1974 (Miller, 1978). These figures indicate that the water table can be

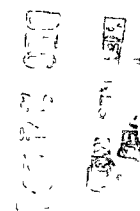
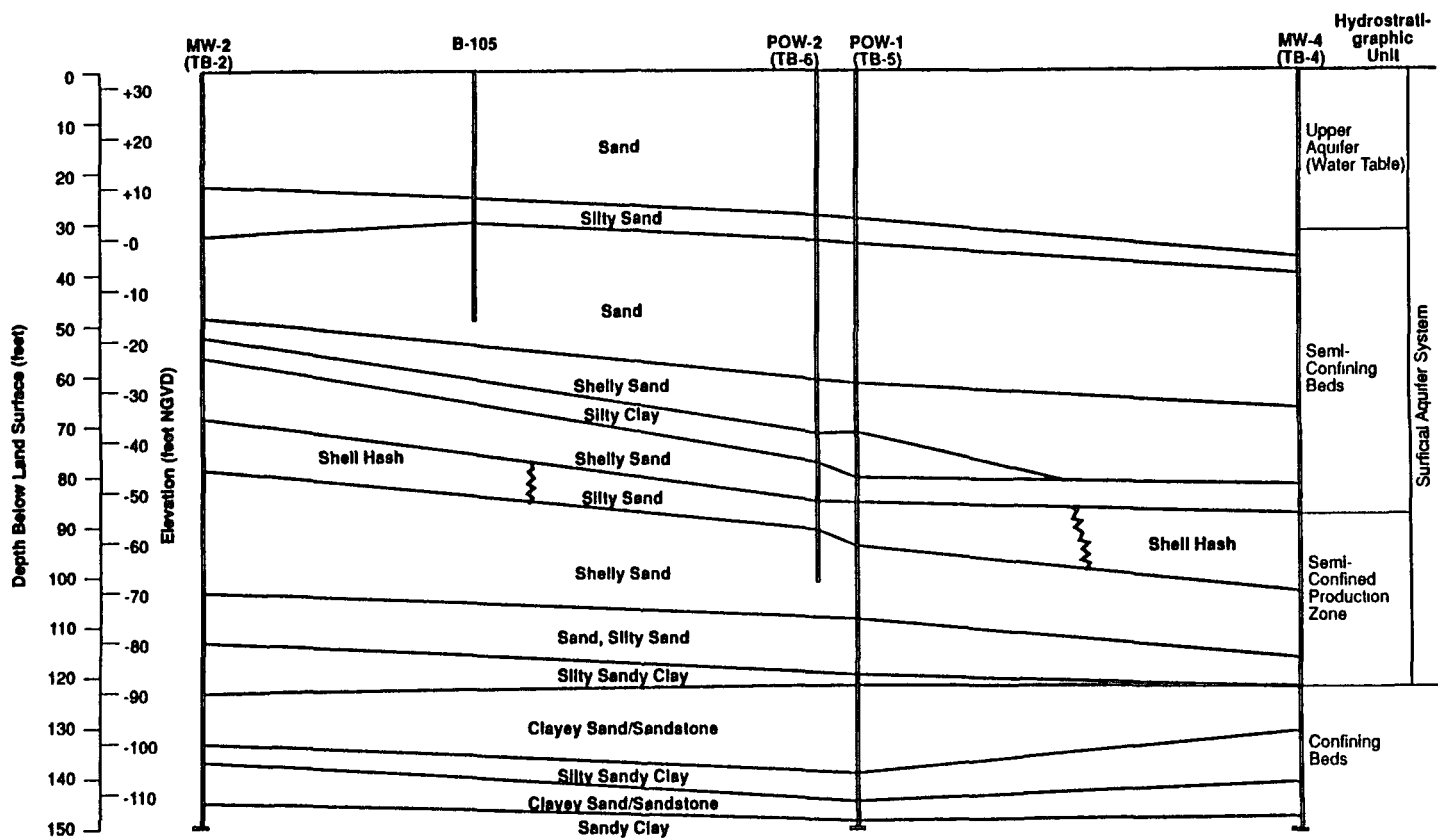


Figure 2.3.2-2.
HYDROGEOLOGIC CROSS SECTION

Source CH2M Hill, 1990



Horizontal
Scale in Feet
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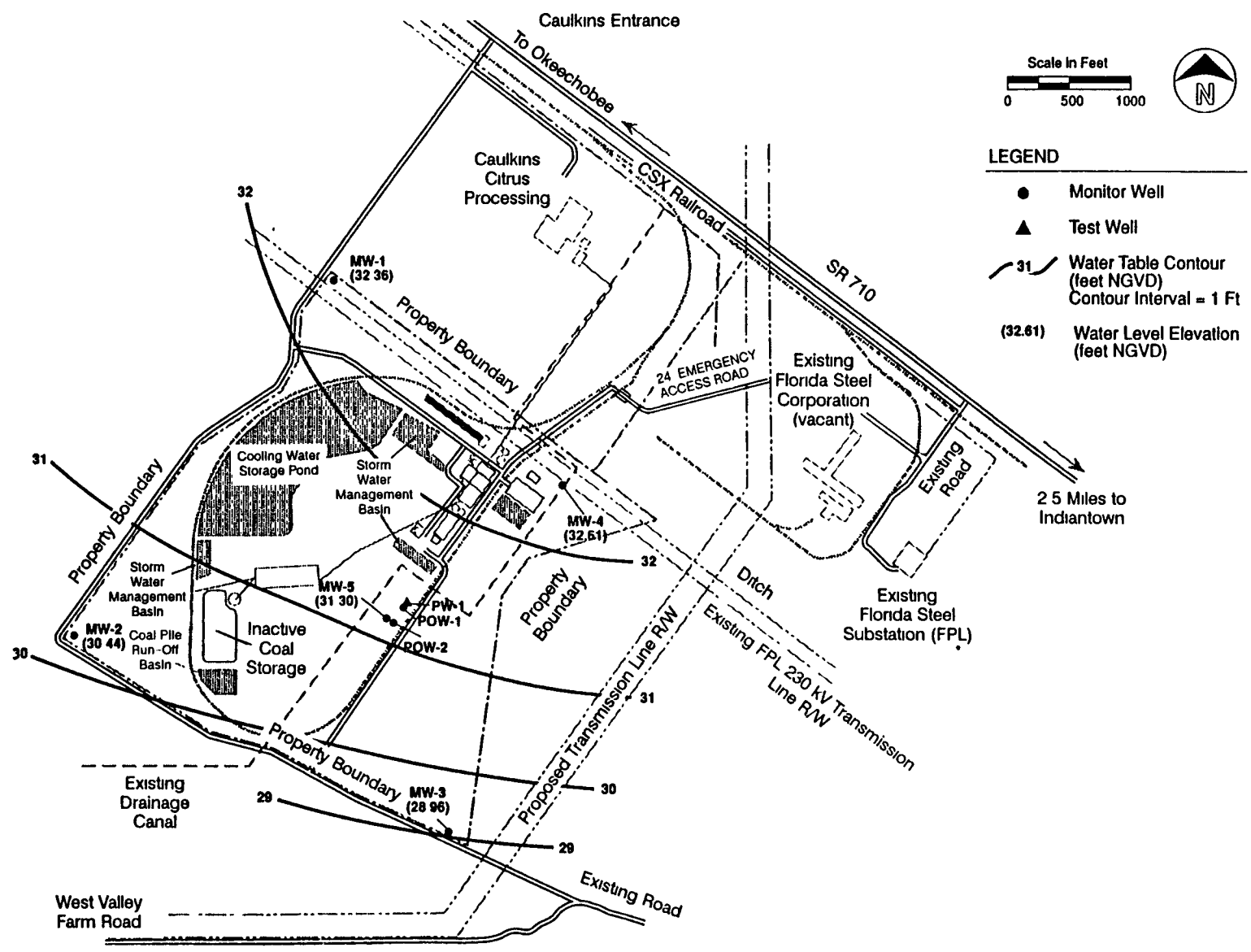
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Figure 2.3.2-3.
GENERAL CONFIGURATION OF THE SURFICIAL
AQUIFER WATER TABLE, AUGUST 17, 1990

Source CH2M Hill, 1990

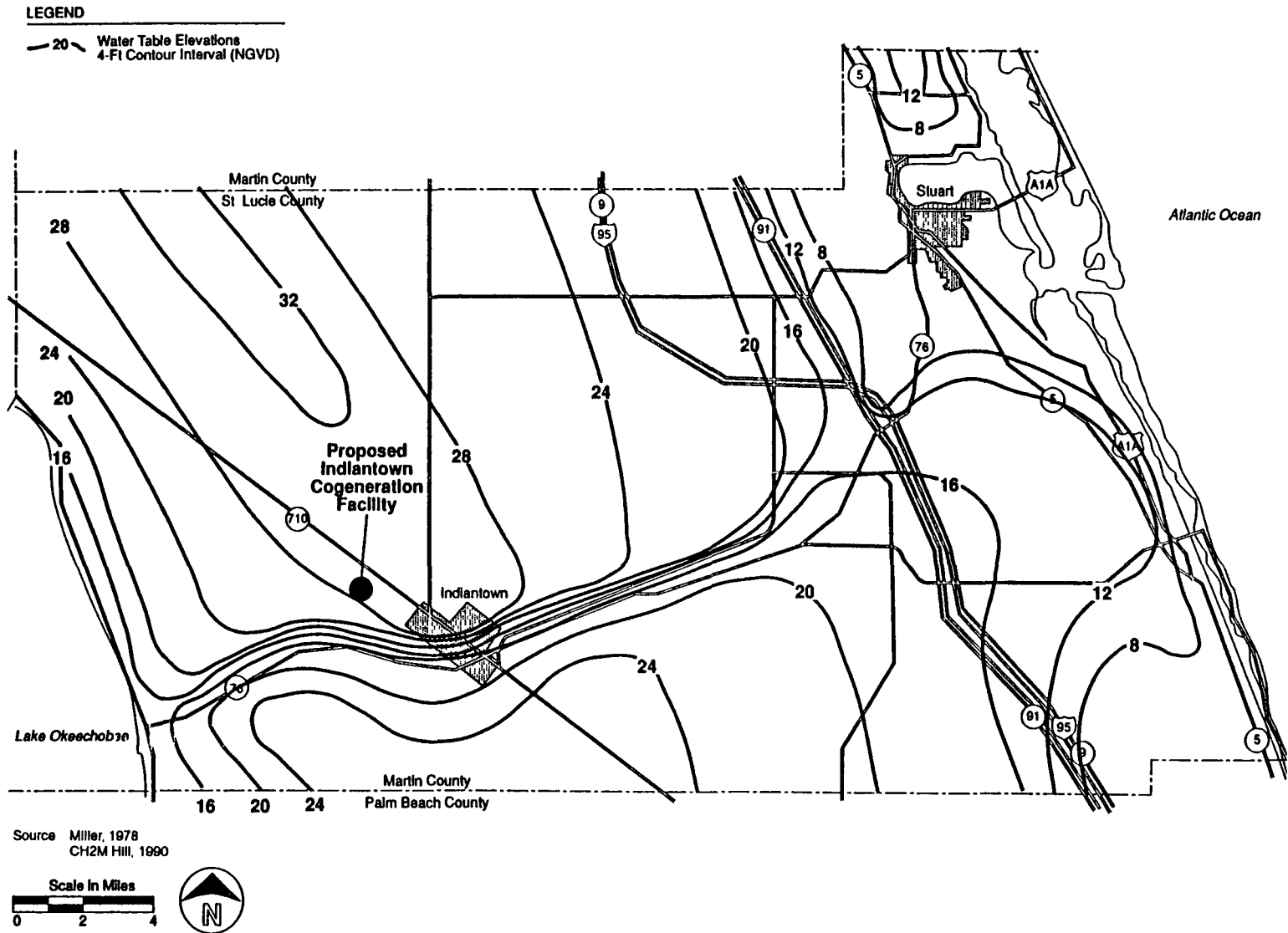


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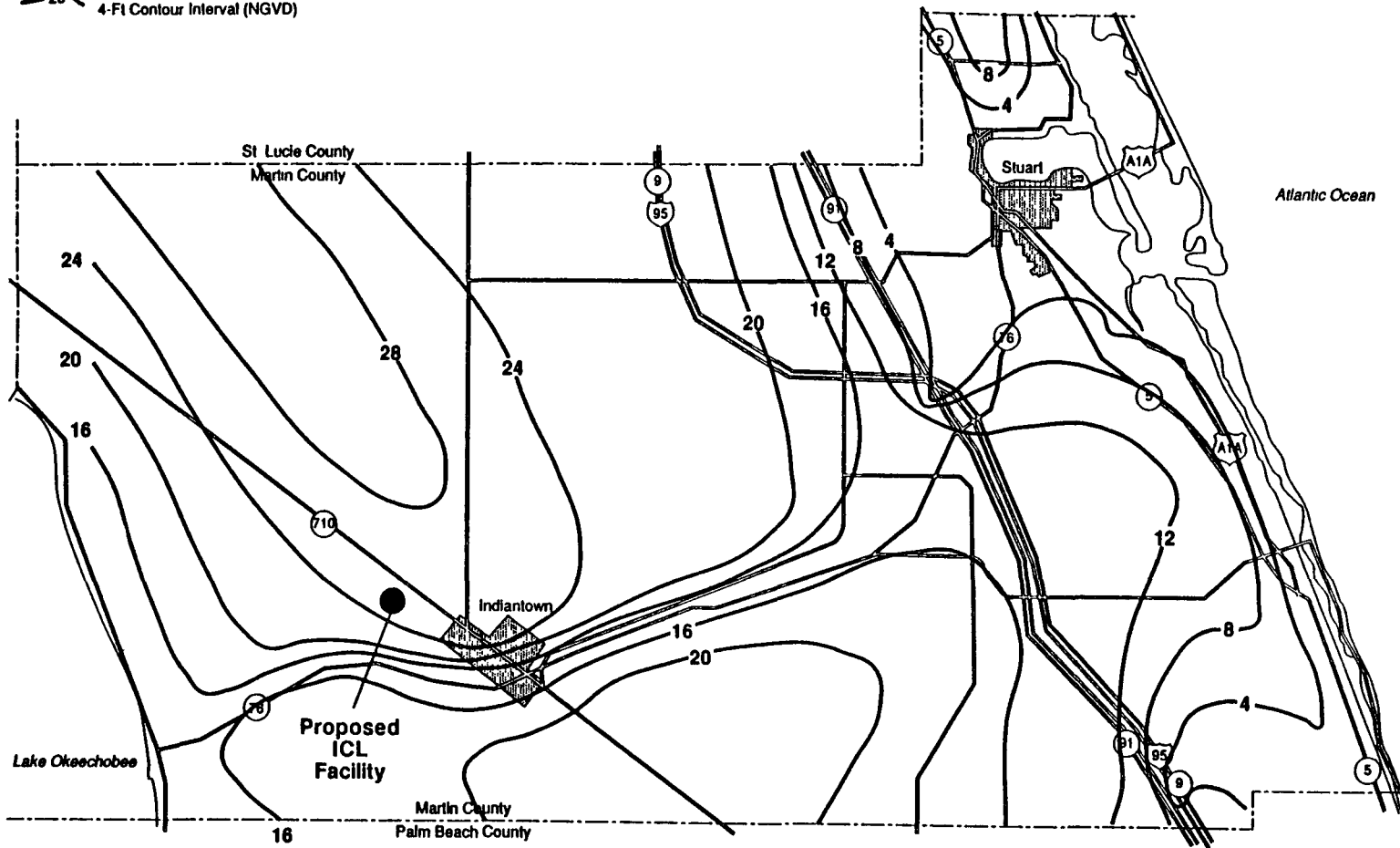
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Figure 2.3.2-4.

WET SEASON WATER TABLE CONTOURS IN
MARTIN COUNTY, OCTOBER 1974



LEGEND
 — 20 — Water Table Elevations
 4-Ft Contour Interval (NGVD)



Source Miller, 1978
 CH2M Hill, 1990



Figure 2.3.2-5.

**DRY SEASON WATER TABLE CONTOURS IN
 MARTIN COUNTY, MAY 1974**

Source CH2M Hill, 1990

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Table 2.3.2-1
SUMMARY OF GROUNDWATER ELEVATIONS AND WELL
CONSTRUCTION DETAILS AT THE ICL SITE
AUGUST 1990

<u>Well Number</u>	<u>Screened Interval (feet)</u>	<u>Well Diameter (inches)</u>	<u>Top of Casing Elevation (feet)</u>	<u>Depth to Water (feet)</u>	<u>Water Level Elevation (feet)</u>
MW-1	20 - 30	4	37.72	5.36	32.36
MW-2	15 - 25	4	34.02	3.58	30.44
MW-3	20 - 30	4	33.69	4.73	28.96
MW-4	20 - 30	4	38.21	5.60	32.61
MW-5	10 - 15	2	35.86	4.56	31.30
PW-1	80 - 120	8	35.38	5.45	29.93
POW-1	92 - 112	2	35.41	5.53	29.88
POW-2	90 - 110	2	35.87	6.31	29.56

- Notes:
- Top-of-casing and water level elevations referenced to National Geodetic Vertical Datum (NGVD).
 - Water level measurements obtained on August 17, 1990.
 - Screened interval referenced in feet below land surface.
 - Depth to water referenced from top-of-casing.
 - All wells installed by Ardaman and Associates, except PW-1, installed by Drilling Services, Inc.

Source: CH2M Hill, 1990

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expected to fluctuate a few feet between the wet and dry seasons. Also, the shape of the water table appears to mimic the topography, in that topographic highs correspond to higher water levels

Groundwater Flow

In general, the water table slopes gently to the south-southwest with a horizontal hydraulic gradient of approximately 1.0×10^{-3} feet per foot (ft/ft). This gradient is similar to that obtained from wells completed in the lower producing zone (PW-1, POW-1, and POW-2) of the Surficial aquifer system. The groundwater flows southwesterly and discharges to the St. Lucie Canal, located approximately 2 miles south of the site (Figure 2.3.2-4).

Vertical hydraulic gradients between the upper and lower zones of the Surficial aquifer system were determined by comparing water level elevations from wells completed in these two zones. The vertical hydraulic gradient between these zones is probably affected by the thickness and areal continuity of the semi-confining unit between them. The water levels summarized in Table 2.3.2-1 indicate that, where wells are completed in both zones around the test well, the upper aquifer has a head about 1.7 feet higher than the lower aquifer. This is a 0.03-ft/ft downward gradient across the 55 feet of low permeability material from approximately 30 feet to 85 feet in depth.

Aquifer Characteristics

A 72-hour pumping test was conducted to determine aquifer characteristics at the site. The pumping test began on August 13, 1990, at 10:15 a.m. A submersible pump was installed in PW-1 and connected to a 4-inch-diameter discharge line emptying into a nearby drainage ditch. The well was pumped at a constant rate of 150 gallons per minute (gpm). Flow measurements were obtained with a manometer tube and a 4-inch by 3-inch orifice plate at the end of the discharge piping.

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PW-1 was pumped and POW-1, POW-2, and MW-5 were used as observation wells from which water levels were obtained throughout the test. Water level readings were also obtained at perimeter monitor wells MW-2, MW-3, and MW-4, and at observation wells OW-101, OW-102, and OW-115. The observation wells, installed as part of the preliminary foundation evaluation at the site, are screened from approximately 20 feet to 30 feet bls. A data logger was used to obtain water level data at regular, timed intervals in POW-1 and POW-2. Two pressure transducers (30 and 10 pounds per square inch [psi]) were used in POW-1 and POW-2, respectively. The data logger was programmed to record water levels at logarithmic intervals so that readings were obtained frequently at the beginning of the test and less frequently as the test progressed. Manual water level measurements also were taken with an electrical water level indicator (M-scope) or steel tape as backup data. Field data sheets and data logger output for the pumping test are contained in Section 10.5.1.

Following 72 hours of operation, the pump was shut off, and the water levels were allowed to recover. Water levels were measured during recovery at PW-1, POW-1, POW-2, and MW-5.

Two days of background water level data were obtained prior to the test by using the data logger on POW-2. Water level data also were obtained at POW-2 following the 72-hour pumping test. These data show that the naturally occurring water level in POW-2 was essentially the same before and after the pumping test. Therefore, adjustments to the drawdown data were not required.

The data were evaluated using the following three techniques:

- Walton (1962)
- Cooper-Jacob (1946)
- Theis recovery method

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The drawdown data from POW-1 and POW-2 were evaluated using the Walton method, which applies to unsteady state flow in semi-confined (leaky) aquifers and assumes no storage within the semi-confining bed. Transmissivity (T), storativity (S), and leakance (K'/b') were estimated for the aquifer at POW-1 and POW-2 by plotting drawdown versus time on log-log paper and by superimposing type curves. The calculations to determine these parameters are presented in Section 10.5.1.

Second, the data were evaluated using the Cooper and Jacob (1946) "straight-line" method. For this analysis, a semi-log graph of drawdown versus time was developed for POW-1 and POW-2. These graphs are also contained in Section 10.5.1. Finally, recovery data from PW-1, POW-1, and POW-2 were evaluated using the Theis recovery method to determine transmissivity. Graphs of residual drawdown versus a time ratio (t/t') were plotted on semi-log paper to determine T values. Storativity was not determined because of inherent limitations of the Theis recovery method.

The Surficial aquifer system in Martin County is regionally regarded as being unconfined (Lichtler, 1960). However, analysis of the pumping test data at the project site indicates semi-confined (leaky) conditions. A summary of aquifer coefficients determined from the pumping test analyses is provided in Table 2.3.2-2. The Walton method assumes unsteady state flow in leaky aquifers. However, the straight-line method (Cooper and Jacob, 1946) and the Theis recovery method both assume perfectly confined aquifers; this limiting assumption tends to yield slightly higher T values for these methods because leakance is not taken into account. Data at POW-2 illustrate this concept (e.g., the Walton method yielded a T value of 4,775 gpd/ft, while Cooper-Jacob and Theis recovery methods yielded T values of 6,286 and 6,397 gpd/ft, respectively). Thus, the Walton method, which assumes leaky aquifer conditions, appears to yield results most representative of the field conditions.

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Table 2.3.2-2
AQUIFER COEFFICIENTS DERIVED FROM
72-HOUR PUMPING TEST
AUGUST 1990

<u>Well No.</u>	<u>Method</u>	<u>Transmissivity (gpd/ft)</u>	<u>Storativity (Dimensionless)</u>	<u>Leakance (gpd/ft³)</u>
POW-1	Walton	5,372	1.40×10^{-4}	1.3×10^{-3}
	Cooper-Jacob	5,657	1.32×10^{-4}	NA
	Theis-Recovery	5,306	NA	NA
POW-2	Walton	4,775	1.33×10^{-4}	2.7×10^{-3}
	Cooper-Jacob	6,286	1.11×10^{-4}	NA
	Theis-Recovery	6,397	NA	NA
PW-1	Theis-Recovery	5,236	NA	NA
	Average	5,600	1.3×10^{-4}	2.0×10^{-3}

Note: NA = Not applicable

Source: CM2M Hill, 1990

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As stated previously, water level data also were obtained in perimeter monitor wells and observation wells completed in the upper 30 feet of the Surficial aquifer system at the site (Section 10.5.1). Water levels in these wells varied randomly, with no apparent response to pumping the aquifer at PW-1.

Groundwater velocity beneath the site was calculated according to the following equation:

$$v = Ki/n \quad (\text{Heath, 1983})$$

where:

- v = average groundwater velocity in feet per day (ft/day)
- K = hydraulic conductivity (ft/day)
- i = hydraulic gradient (ft/ft)
- n = effective porosity (dimensionless)

Using an average T value of 5,600 gpd/ft, an aquifer thickness of 40 feet for the lower producing zone, and the relation $T = Kb$, a K value of 140 gpd/ft² (18.7 ft/day) was calculated. Assuming an effective porosity of 0.35 (based on the laboratory test result on a sample collected from the pumping zone), and the calculated hydraulic gradient of 1×10^{-3} ft/ft, a groundwater velocity of 5.3×10^{-2} ft/day was determined.

Water Quality

Water quality samples were obtained from PW-1 at the end of the pumping test and from MW-1 through MW-4 to determine background water quality. Water quality samples were obtained directly from the pump discharge piping at the end of the pumping test at PW-1. Before sampling the monitor wells, a minimum of three well volumes were purged from each well to ensure that native formation water was obtained. Once the temperature, conductivity, and pH of the water had stabilized, a clean Teflon® bailer was lowered into each well to collect the

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groundwater sample. The pump and intake hose used to purge the well and bailer were cleaned between wells with an isopropanol rinse, followed by rinsing with deionized water to avoid cross-contamination. Quality assurance samples (travel blanks) also were submitted to the laboratory for analysis.

Water quality samples were analyzed for general inorganic parameters, metals, ethylene dibromide (EDB), pesticides, herbicides, and Environmental Protection Agency (EPA) Methods 601/602 parameters. Laboratory analytical data for the water quality samples are contained in Section 10.5.1 and represent the first of four quarterly sampling events to be performed at the site. Additional sampling will be performed to determine if any seasonal fluctuations in water quality occur. The results of selected inorganic parameter analyses are summarized in Table 2.3.2-3.

For EPA Methods 601/602, EDB, pesticides, and herbicides analyses, no parameters had values reported above the detection limit. Samples from MW-1 through MW-4 exceeded drinking water standards for three parameters -- color, turbidity, and iron (Section 10.5.1). Samples from MW-1, MW-2, and MW-4 exceeded the pH standard as well. Also, MW-3 slightly exceeded drinking water standards for total dissolved solids (TDS) with a value of 562 mg/l.

The metals analyses were essentially below the detection limit except for two metals in MW-3 and MW-4. Copper was noted in MW-3 at 0.02 mg/l and at 0.03 mg/l in MW-4, while lead was detected in MW-4 at 0.003 mg/l. However, it should be noted that lead was present in the travel blank at 0.011 mg/l. Boron was detected in all samples and ranged from 0.025 mg/l to 0.039 mg/l. The highest value was reported in MW-3.

The selected inorganic parameters presented in Table 2.3.2-3 are grouped to show the differences and similarities in water quality. The range of values for MW-1, MW-2, and MW-4 is presented in one column because the results were so similar. This water is slightly acidic, moderately colored with some turbidity, and contains moderate concentrations of chloride and sulfate.

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Table 2.3.2-3
SUMMARY OF BACKGROUND WATER QUALITY
AUGUST 17, 1990

<u>Parameter^a</u>	<u>MCL^b</u>	<u>MW-1, -2, & -4</u>	<u>MW-3</u>	<u>PW-1</u>
pH (standard units)	6.5 - 8.5	4.85 - 6.40	6.95	7 15
Alkalinity, Total (as CaCO ₃)	--	<1.0 - 88.0	280	280
Color (APHA)	15	50 - 90	50	10
Conductivity (μmhos/cm)	--	125 - 370	783	567
Hardness, Total (as CaCO ₃)	--	30 - 122	336	340
Turbidity (NTU)	1	5.7 - 16.3	12.6	<0.2
TDS	500	168 - 334	562	392
Calcium	--	1.9 - 35.0	124	85
Copper	1	<0.02 - 0.03	0.02	<0.02
Iron	0.3	0.96 - 2.0	2.7	<0.02
Lead	0.05	<0.002 - 0.003	<0.002	<0.002
Potassium	--	0.31 - 1.30	0.79	1.66
Silica	--	8.2 - 9.1	10.6	17.2
Sodium	160	15.8 - 23.4	28.7	11.9
Boron	--	0.025 - 0.029	0.039	0.025
Chloride	250	29.1 - 32.1	72 0	18.3
Fluoride	4.0	0 03 - 0.05	0.34	0 12
Sulfate	250	3.9 - 5.3	1.2	<1.0
Ammonia	--	0.19 - 0 86	1.89	0.52
Total Phosphorus	--	0.09 - 0.18	1.18	0.35

^aValues are mg/l as substance unless otherwise stated.

^bMCL = Maximum Contaminant Level per Ch 17-550 F.A.C.

Source. CH2M Hill, 1990

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By contrast, the data from MW-3 and PW-1 are more similar to each other than to the other monitor wells. These samples have higher values for pH, alkalinity, conductivity, hardness, TDS, calcium, and fluoride. Differences in water quality between MW-3 and the other Surficial monitor wells may be due to the lithology screened by the well. Inspection of the boring logs (Section 10.5.1) indicates that MW-1, MW-2, and MW-4 are screened within fine sands, but MW-3 is screened within a sandy limestone unit.

Other Potentially Impacted Aquifers

The lower Floridan aquifer (Boulder Zone of the Floridan aquifer system) will be utilized for wastewater disposal, and the upper Floridan aquifer will be used as the alternative water supply purposes by the ICL facility. The Floridan aquifer system is a regional carbonate aquifer underlying Florida, south Georgia, and portions of Alabama and South Carolina. The rock units comprising the aquifer system range in age from Paleocene to early Miocene (Miller, 1986). A description of the geologic units in the study area is provided in Section 2.3.1.1.

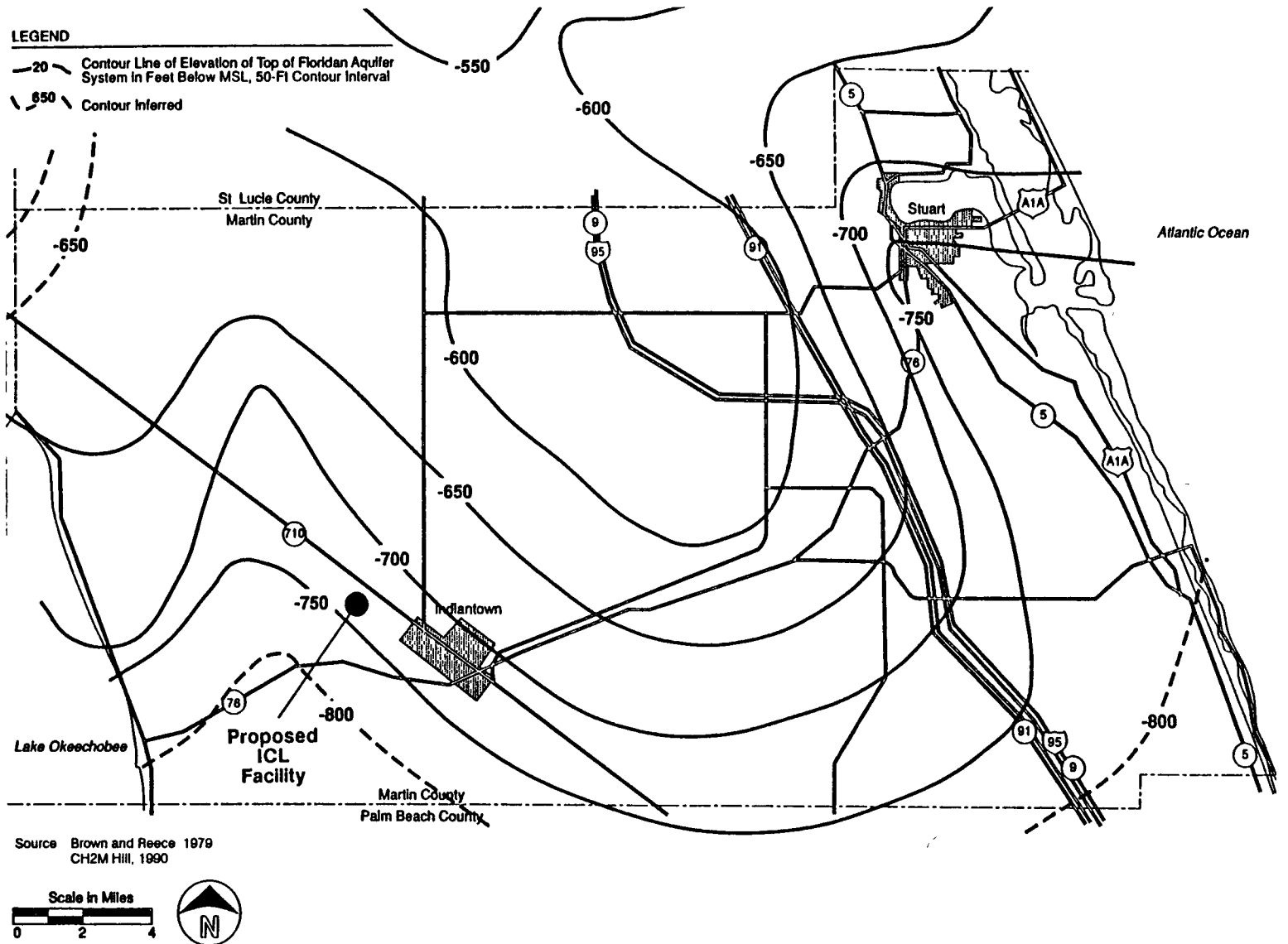
The limestones and dolomites comprising the aquifer system vary from highly permeable zones to moderately permeable zones. Meyer (1989) divides the Floridan aquifer system into three hydrogeologic units based on geology, hydrochemistry, and hydraulics. The upper Floridan aquifer and middle confining unit contain brackish water, and the lower Floridan aquifer contains water similar to seawater (Meyer, 1989). Based on field data in the vicinity of the site, the upper Floridan aquifer may be further divided into an upper and lower unit (CH2M HILL, 1985 and 1989; Florida Power and Light, 1990).

The upper Floridan aquifer will be impacted by the operation of the ICL facility because it is proposed to be used as an alternative source of cooling tower makeup water and plant process water. Production wells constructed in the lower portion of the upper Floridan aquifer are expected to withdraw a maximum of 6.2 million gallons per day (mgd) for up to 90 days during years of severe drought.

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Figure 2.3.2-6.
ELEVATION OF THE TOP OF FLORIDAN AQUIFER
SYSTEM, MARTIN COUNTY

Source CH2M Hill, 1990



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final casing set to 1,268 feet in depth. The well is completed in a fractured, dolomitic unit with calculated transmissivity values ranging from about 4.4 to 5.7×10^6 gpd/ft.

A similar zone of high transmissivity was identified at the Pratt and Whitney plant (CH2M HILL, 1985), located about 9 miles from the ICL facility. Beginning at about 1,390 feet bls, Middle Eocene age strata consisting of highly sucrosic and honey-combed dolomite persist to a depth of approximately 1,750 feet. This zone was found to be highly permeable and was difficult to drill through because of extensive fractures and solution cavities.

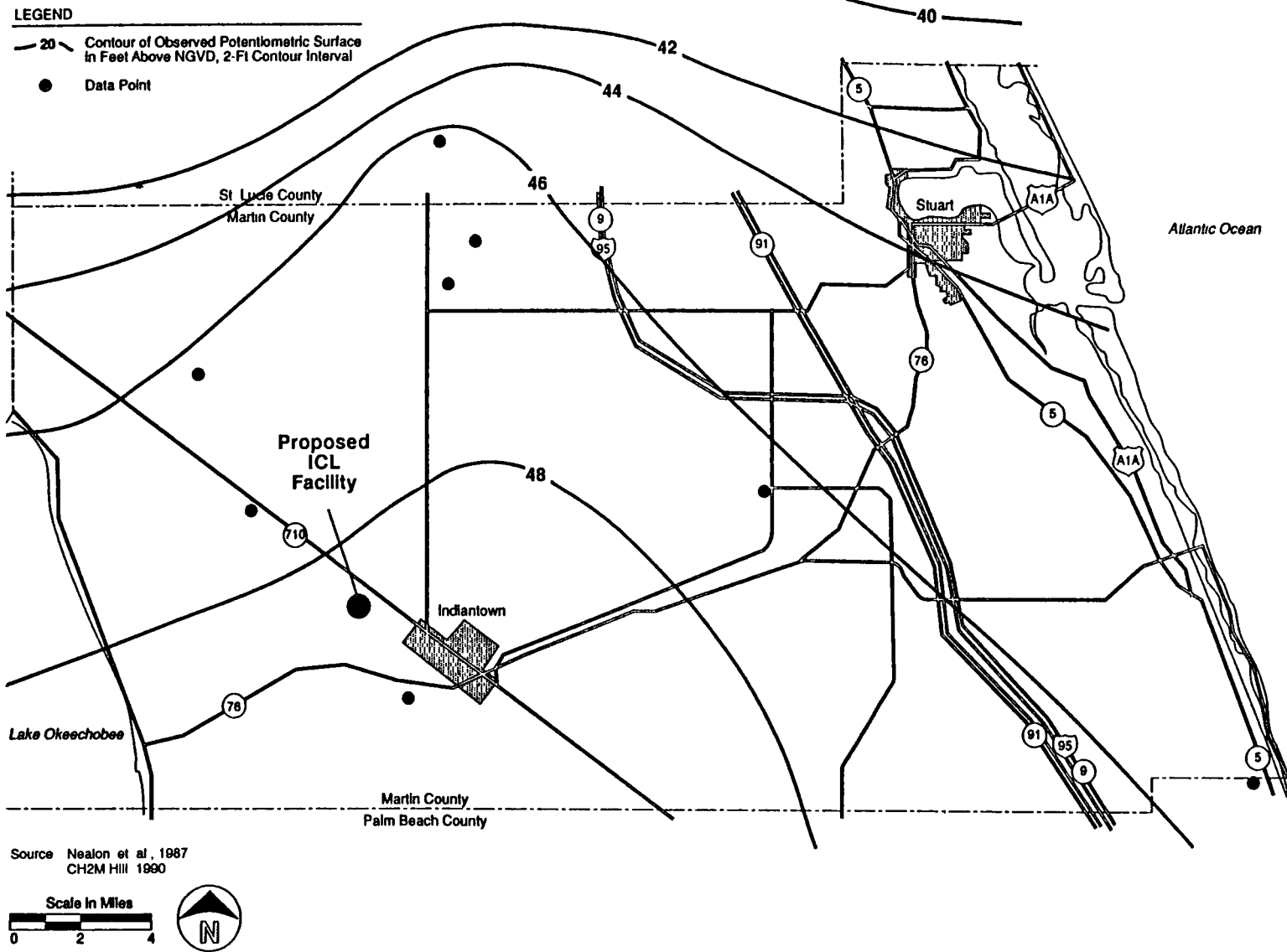
A high transmissivity value was determined for the lower zone of a Floridan aquifer well (LFM-1) located approximately 3.5 miles northwest of the ICL facility at the FPL Martin site. A transmissivity of 2.5×10^6 gpd/ft was determined for the interval from about 1,350 to 1,450 feet (FPL, 1990). A log of this well indicates that this zone contains a "somewhat vesicular dolostone with high to moderate visible porosity".

Potentiometric Surface - In general, the potentiometric surface of the Floridan aquifer system in Martin County is above the water table surface, but has undergone a gradual lowering in the last three decades (Nealon et. al., 1987). Except for some topographically high sandhills in the eastern part of the county, the potentiometric surface is above the land surface in Martin County (Lichtler, 1960).

The most recent published map available showing the potentiometric surface of the Floridan aquifer system is found in Nealon et. al. (1987), and provides a dry season potentiometric surface from May 1984. The most recent published wet season potentiometric map available is found in Brown and Reece (1979), and shows the potentiometric surface from September 1977. Both these maps are reproduced here as Figures 2.3.2-7 and 2.3.2-8.

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER SYSTEM IN MARTIN COUNTY, MAY 1984

Figure 2.3.2-7.



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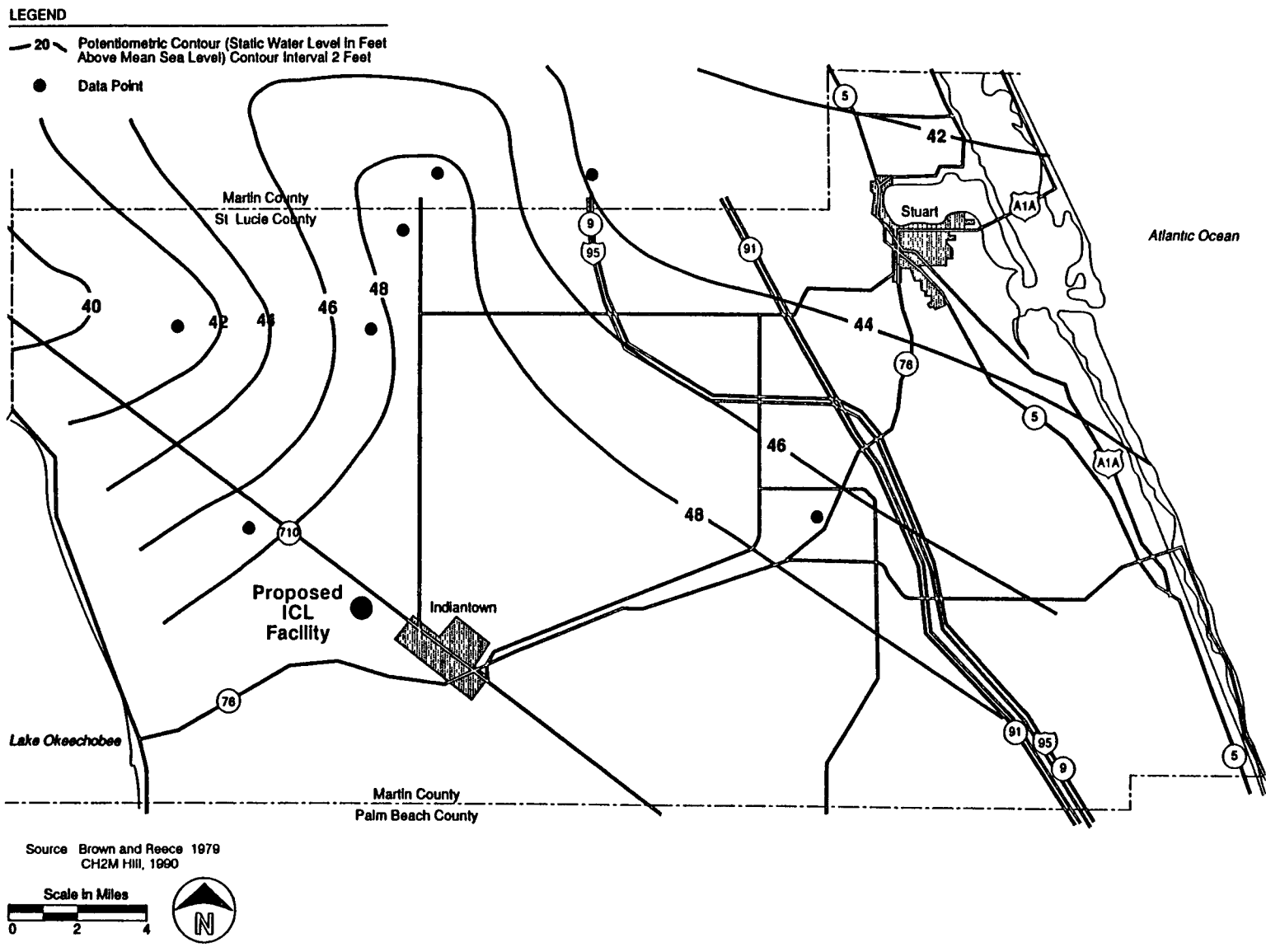


Figure 2.3.2-8.

POTENTIOMETRIC SURFACE OF THE FLORIDAN
AQUIFER SYSTEM IN MARTIN COUNTY,
SEPTEMBER 1977

Source CH2M Hill, 1990

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Lichtler (1960) reports that in December 1957 the potentiometric surface ranged from 48 to 53 feet above mean sea level, and that it sloped in an east-southeast direction in Martin County. By May 1984, the gradient had changed to a north-northeast direction, and the surface elevations ranged from 41 feet above mean sea level in the northeast part of the county to 48 feet in the southwest part (Nealon et. al., 1987). The general configuration of the potentiometric contours is the same at the end of the wet season for September 1977, but the elevations are up to 2 feet higher. Nealon et. al. (1987) attributes the lowering of the potentiometric surface and the change in groundwater flow direction to irrigation withdrawals from the aquifer system.

Groundwater Flow - The regional direction of groundwater flow is illustrated on Figure 2.3.2-9, as adopted from Meyer (1989). Meyer indicates that groundwater movement is generally southward from the Polk County potentiometric surface high shown on Figure 2.3.2-9. Groundwater then flows from the groundwater divide to the Atlantic Ocean and the Gulf of Mexico. Flow in Martin County, as indicated by lines perpendicular to the potentiometric contours, is generally to the northeast.

Meyer (1989) attempted to assess the rate of flow in the upper Floridan aquifer from the Polk County high southward by calculating velocities and transit times along segments of the flow lines shown on Figure 2.3.2-9 from estimated pre-development (late 1800s to early 1900s) hydraulic gradients. The velocities ranged from a minimum of 0.5 feet per year to a maximum of 93.0 feet per year along the selected flow segments.

Hydraulic gradients were measured in Martin County from the May 1984 potentiometric map, and averaged 0.42 feet per mile. Meyer (1989) reports that the predevelopment potentiometric surface in south Florida was probably 5 to 10 feet higher than it is now. Water use practices north of Lake Okeechobee may have lowered the potentiometric surface high, resulting in reduced hydraulic gradients in south Florida.

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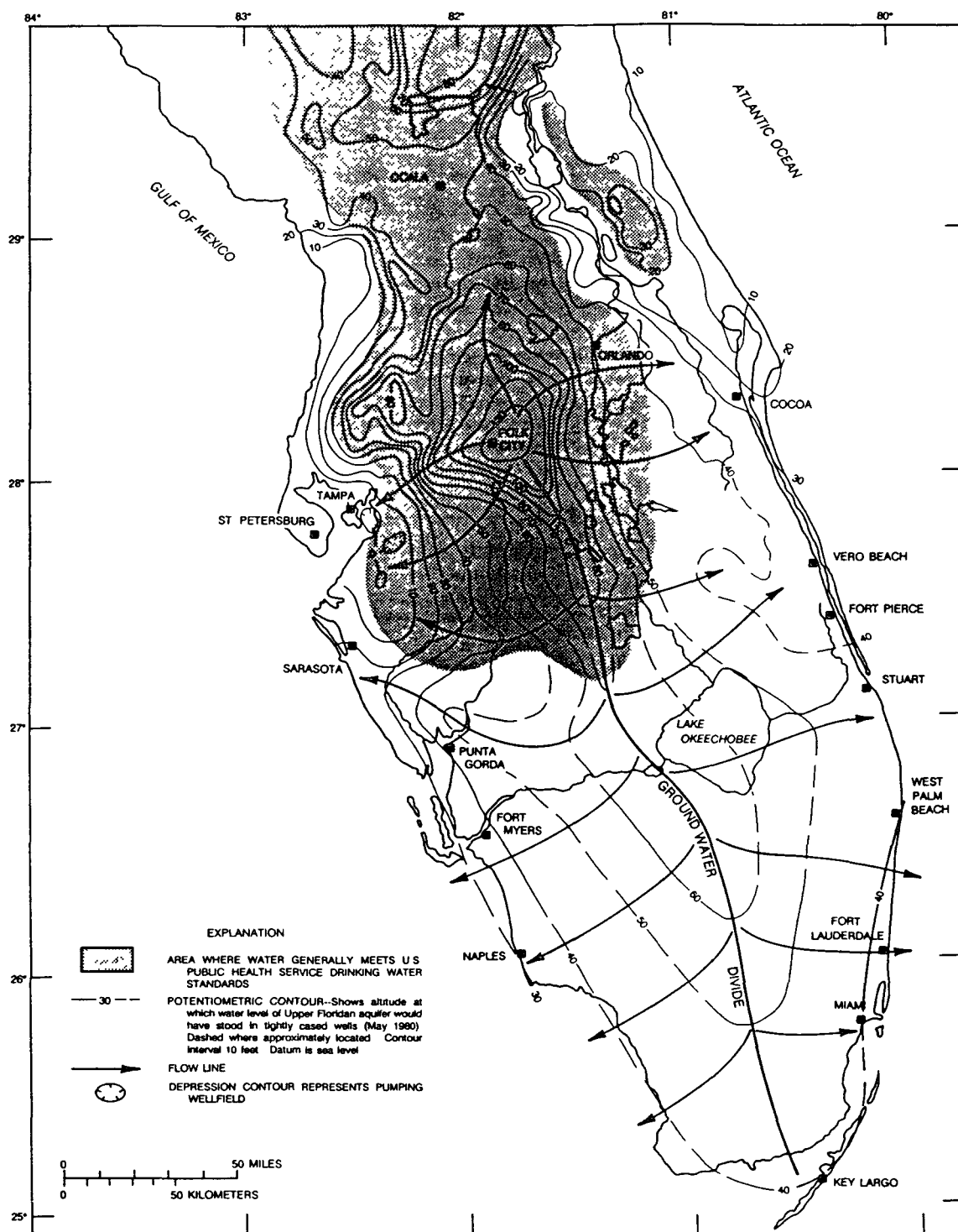


Figure 2.3.2-9.

POTENTIOMETRIC SURFACE OF UPPER FLORIDAN AQUIFER. PENINSULAR FLORIDA IN MAY 1980

Source CH2M Hill, 1990, Meyer, 1989

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All of south Florida is a discharge area for the upper Floridan aquifer. Lichtler (1960) indicates that there are no known springs in Martin County. Johnston and Bush (1988) estimate that discharge from the upper Floridan aquifer in south Florida was entirely from diffuse upward leakage under predevelopment conditions. Aucott (1988) indicates that this diffuse upward leakage is less than 1 inch per year. All other water flowing through the aquifer system in Martin County is eventually discharged into the ocean (Nealon et. al., 1987).

Aquifer Characteristics - Plate 28 of Miller (1986) shows the thickness of the upper Floridan aquifer throughout the state. In Martin County, the thickness varies from approximately 400 feet in the western part of the county to 700 feet in the eastern part, and is estimated to be about 500 feet at the site.

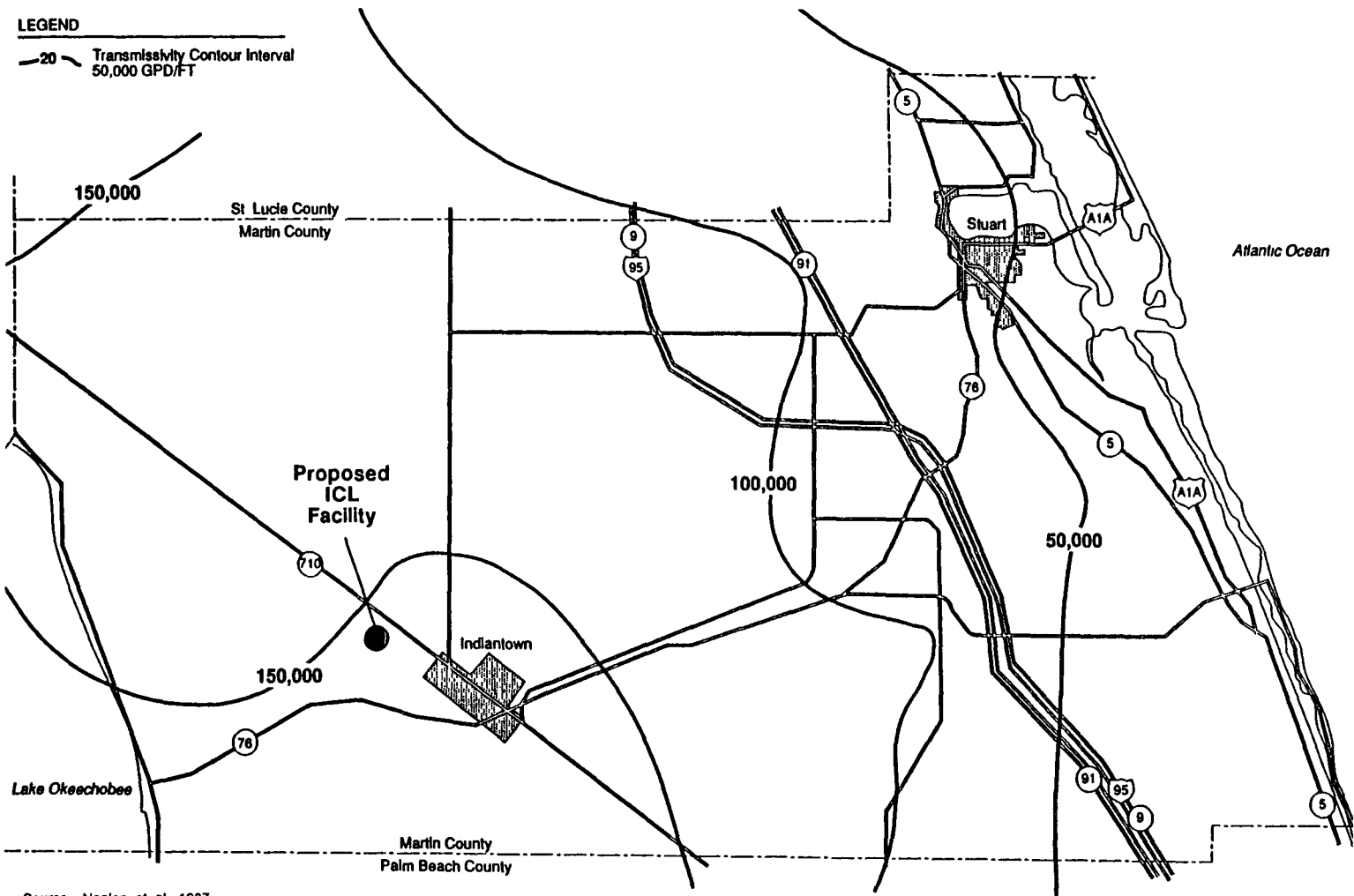
Values of transmissivity contained in the literature on the upper Floridan aquifer indicate that the western half of the county has a higher transmissivity than the eastern half. Nealon et. al. (1987) report a transmissivity ranging from less than 50,000 to over 150,000 gpd/ft, with a distribution as shown on Figure 2.3.2-10. Johnston and Bush (1988) provide a range in the storage coefficient of the upper Floridan aquifer from 1.0×10^{-5} to 2.0×10^{-2} , with the most common values in the 10^{-3} to 10^{-4} range.

A deep well at the FPL Martin site (MF-23) is completed within the upper unit of the upper Floridan aquifer. Aquifer testing in this well yielded a transmissivity of 100,000 gpd/ft, which is consistent with published data for irrigation wells in the area (FPL, 1990).

Water Quality and Utilization - Water from the upper Floridan aquifer is generally suitable only for irrigation and other non-potable purposes. Irrigation use occurs principally in the west and north parts of the county. Johnston and Bush (1988) estimate that 5 to 20 mgd of water is withdrawn from the Floridan aquifer system in Martin County. Brown and Reece (1979) report chloride values in the Floridan aquifer system ranging from 200 to 1,400 milligrams per liter (mg/l) in

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 50,000 GPD/FT



Source Nealon et al., 1987
 CH2M Hill, 1990



Figure 2.3.2-10

TRANSMISSIVITY OF THE UPPER FLORIDAN
 AQUIFER, MARTIN COUNTY

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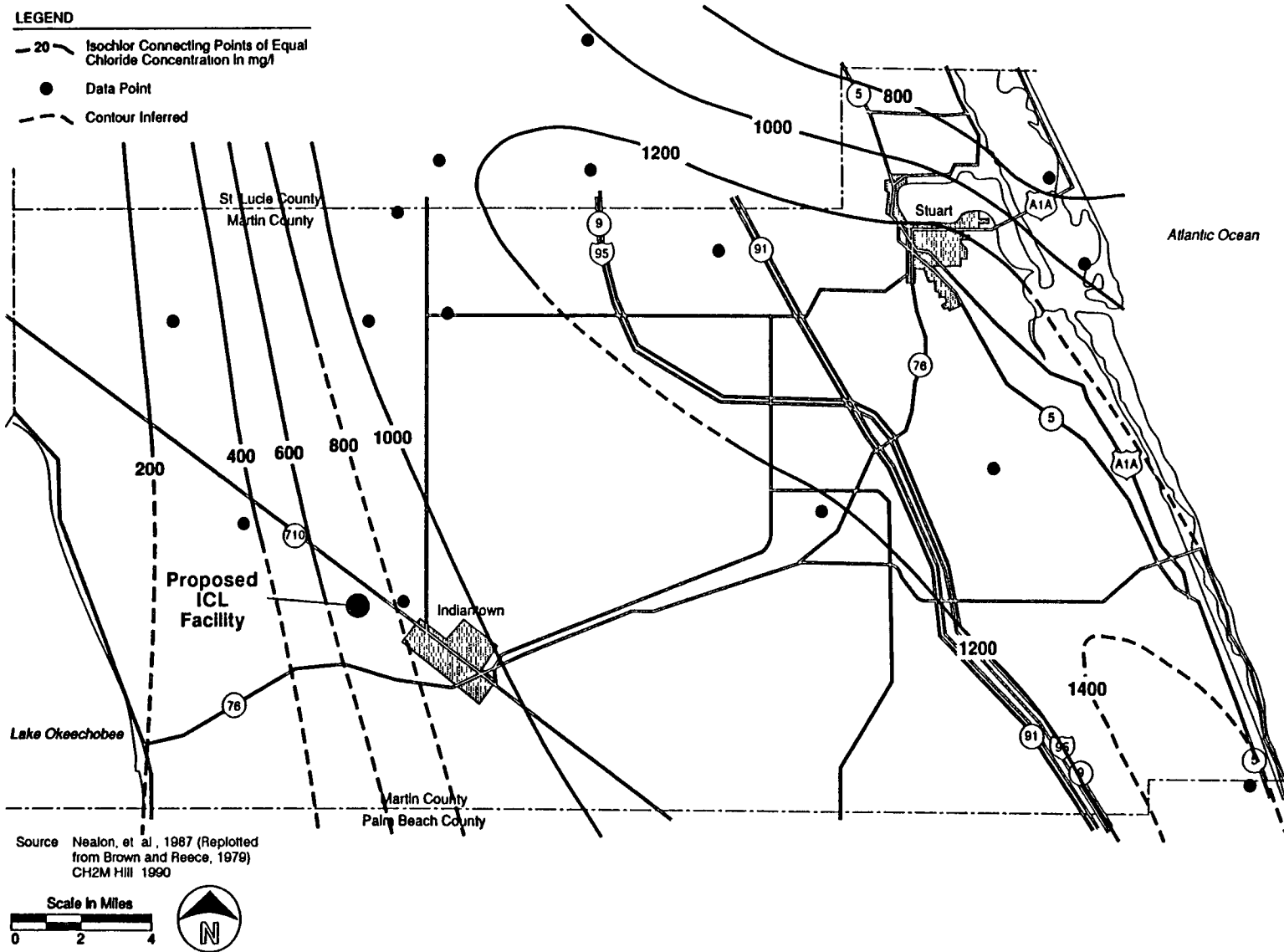
September 1977, with the contoured distribution as shown on Figure 2.3.2-11. Sprinkle (1989) reports chloride values from 250 to 1,000 mg/l in the western one-fourth of the county, and less than 1,000 mg/l in the eastern three-fourths of the county. Groundwater samples from LFM-1, representing the highly transmissive zone of the upper Floridan aquifer, yielded a chloride concentration of 2,488 mg/l and a TDS value of 4,735 mg/l (FPL, 1990). Comparison of this data with that from MF-23 indicates that the highly transmissive zone has higher chloride concentrations than that of the upper part of the lower transmissivity zone.

Brown and Reece (1979) report TDS concentrations ranging from 500 to over 3,000 mg/l for September 1977 (Figure 2.3.2-12). By comparing the TDS values from three wells that were sampled by Lichtler in 1957, Brown and Reece concluded that the TDS of the Floridan aquifer in Martin County has not significantly changed in the last 20 years. Meyer (1989) provides a contour map of the dissolved solids in the upper Floridan aquifer that shows a similar range in concentrations from 1,000 to over 3,000 mg/l of TDS.

Water samples obtained from reverse-air drilling and packer pumping tests at the ASR well (CH2M HILL, 1989) were analyzed in the field and laboratory. A water quality change was noted at approximately 1,300 feet bls. Above 1,300 feet, water quality analyses identified concentrations of 564 mg/l of TDS, 115 mg/l of chlorides, and 920 μ mhos/cm of conductivity. Below 1,300 feet, these concentrations increased progressively to 6,040 mg/l of TDS; 2,920 mg/l of chlorides; and 10,360 μ mhos/cm of conductivity at 1,619 feet in depth.

Four reverse osmosis plants currently exist in Martin County (Nealon et. al., 1987) that use the Floridan aquifer as a raw water source. These plants provide potable public water supplies on the barrier islands. The upper Floridan aquifer was identified in that report as a potential alternative supply that could augment the Surficial aquifer supply.

Figure 2.3.2-11
CHLORIDE CONCENTRATION OF FLORIDAN
AQUIFER SYSTEM IN MARTIN COUNTY,
SEPTEMBER 1977

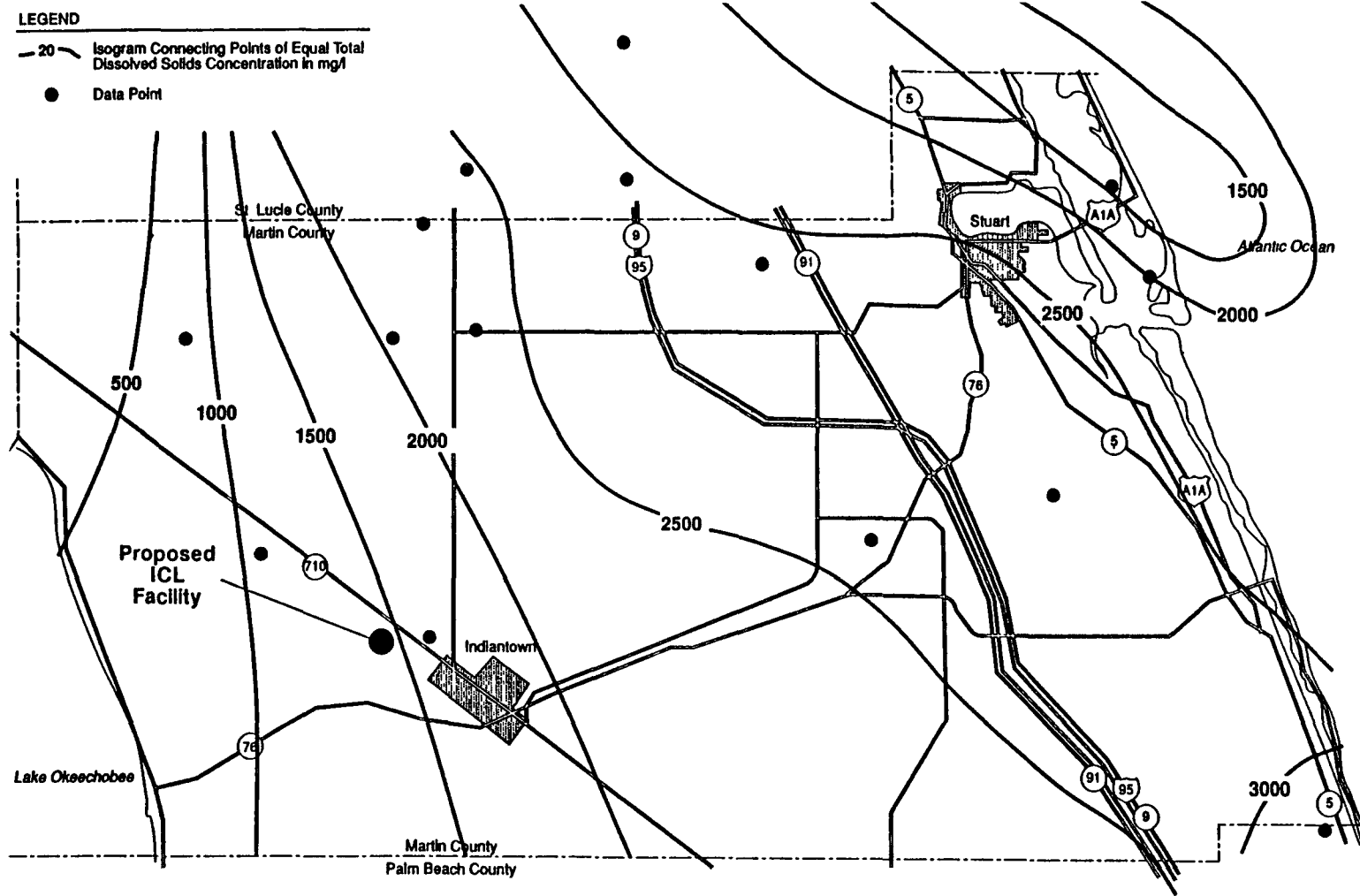


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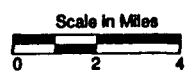
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**TOTAL DISSOLVED SOLIDS OF FLORIDAN AQUIFER
SYSTEM IN MARTIN COUNTY, SEPTEMBER 1977**

Figure 2.3.2-12.



Source Brown and Reece, 1979
CH2M Hill, 1990



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Aquifer Characteristics - The thickness of the lower Floridan aquifer is mapped for the state on Plate 32 of Miller (1986). For Martin County, the thickness ranges from less than 1,900 feet in the northwest corner of the county to greater than 2,500 feet in the south-southeast portion of the county.

Transmissivity values for the Boulder Zone of the lower Floridan aquifer range from 3.2×10^{-6} ft²/day to 2.4×10^{-7} ft²/day (Meyer, 1989). Meyer (1989) used a transmissivity value of 2.5×10^{-7} ft²/day for the calculations found in Table 2.3.2-4. No storage coefficient values for the lower Floridan aquifer were found in the literature.

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Table 2.3.2-4
ESTIMATED HYDRAULIC GRADIENTS AND RELATED HYDRAULIC DATA
BASED ON MEASURED WATER LEVELS AND RADIOCARBON DATING
BOULDER ZONE OF THE LOWER FLORIDAN AQUIFER

<u>Measurement No</u>	<u>Referenced Segment</u>	<u>Distance (miles)</u>	<u>Head Difference (feet)</u>	<u>Hydraulic Gradient (feet per foot)</u>	<u>Average Velocity (feet per year)</u>	<u>Transit Time (years)</u>
1	Site 9 to Site 10 ^a	44.5	0.20	8.5×10^{-7}	39.0	6,025
2	Site 9 to Site 10 ^b	44.5	0.28	1.2×10^{-6}	54.6	4,300
3	Subsea outcrop to Site 9 ^b	10.5	0.21	3.8×10^{-7}	17.3	3,200
4	Subsea outcrop to Site 10 ^b	55.0	0.24	8.4×10^{-7}	38.7	7,500

Note Based on transmissivity of 2.46×10^{-7} ft²/day, thickness of 650 feet, and porosity of 0.30.

^aCalculation based on fluid density, water-level measurements, and assumed aquifer characteristics.

^bCalculation based on radiocarbon age and assumed aquifer characteristics.

Source: Adapted from Meyer, 1989
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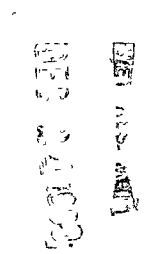
Water Quality - The water quality of the Boulder Zone is similar in chemical composition to that of sea water. Background water quality analyses are presented in Table 2.3.2-5 for an injection well completed into the Boulder Zone and located about 24 miles southeast of the ICL facility. Background water quality is also available from several other injection wells within a 25-mile radius, but the water quality is so similar that results from one site are considered to be representative of the water quality in this zone.

Sprinkle (1989) indicates that the chloride and dissolved solids concentrations of the waters from the lower Floridan aquifer in south Florida exceed 10,000 mg/l. Thus, the most beneficial use of this zone is for waste disposal because it has no potential for water supply.

Confining Unit Between the Surficial and Upper Floridan Aquifers

Lichtler (1960) describes the Hawthorn Formation in Martin County as consisting of low-permeability strata of Miocene age, primarily consisting of phosphatic clay with silt and quartz sand, and thin layers of sandy, phosphatic limestone and chert. The Hawthorn Group (Scott, 1988) provides confinement between the Surficial aquifer system and the upper Floridan aquifer.

Lichtler (1960) reports that the Hawthorn Formation is 350 to 550 feet thick in Martin County. Nealon et. al. (1987) report that a thickness of 450 to 650 feet of phosphatic clay, dolosilts, and quartz sand are attributable to the Hawthorn Group. Miller (1986) identifies the confining unit between the Surficial aquifer system and the upper Floridan aquifer as the "upper confining unit." Miller (1986) in Plate 25 shows that the upper confining unit ranges from less than 500 feet to greater than 650 feet in thickness in Martin County. Scott (1988) shows an isopach map of the Hawthorn Group, with the thickness ranging from less than 550 feet in the northwest corner of the county to greater than 600 feet in the southeast corner of the county.



**Table 2.3.2-5
TYPICAL WATER QUALITY LOWER FLORIDAN AQUIFER
(BOULDER ZONE)**

<u>Parameter</u>	<u>Value</u>
pH (Laboratory)	7.35
Conductivity (μ mhos/cm @ 25°C)	45,200
Total Dissolved Solids (@ 180°C)	38,200 mg/l
Chloride	19,400 mg/l
Fluoride	0.62 mg/l
Iron	0.76 mg/l ^a
Calcium	2,800 mg/l
Magnesium	3,670 mg/l
Sulfate	2,680 mg/l
Carbon Dioxide	8.7 mg/l
Alkalinity, Total	100 mg/l
Bicarbonates	122 mg/l
Carbonates	<0.1 mg/l
Total Hardness	6,470 mg/l
Carbonate Hardness	100 mg/l
Hydroxides	<0.1 mg/l

^aBy Method of Standard Addition

Note: Analysis from 3,320-foot-deep injection well at Pratt and Whitney, approximately 24 miles from ICL facility.

Source: CH2M Hill, 1990

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Miller (1986) attributes a lack of knowledge about the hydraulic characteristics of the upper confining unit to the variability in its lithology, interbedding of the unit, and its generally low permeability. He identifies a range of vertical hydraulic conductivity values for the clays within the Hawthorn Group ranging from 1.5×10^{-2} feet per day (ft/d) to 7.8×10^{-7} ft/d. The upper confining unit at the site is expected to be at the lower end of this range.

The hydraulic head at the top of the confining unit is the same as the water level in the Surficial aquifer system. Some variation in this level exists between the wet and dry seasons, with the levels ranging from approximately 25 to 30 feet National Geodetic Vertical Datum (NGVD). The hydraulic head at the base of the confining unit is the potentiometric surface of the upper Floridan aquifer, or about 48 feet NGVD. The upward hydraulic gradient across the thickness of the confining unit (approximately 550 feet) is calculated to be 0.042 ft/ft during the dry season.

The upward leakage rate across the confining unit may be approximated by using the hydraulic gradient of 0.042 ft/ft and the vertical hydraulic conductivity values that Miller (1986) provided. The leakage rates range from 6.2×10^{-4} ft/day to 3.2×10^{-8} ft/day.

The continuity of the confining unit throughout the site and the general area is well documented in numerous literature sources. The statewide isopach map of the Hawthorn Group that Scott (1988) presents clearly shows that, for at least the southern half of the state, the Hawthorn Group is continuous and thickens to the south.

Confining Unit Between Upper and Lower Floridan Aquifers

Miller (1986) identifies the confining unit between the upper and lower Floridan aquifers as the middle confining Unit I. The thickness of the middle confining Unit I is generally 400 feet throughout Martin County, but approaches 500 feet in thickness in the southeast and northwest portions of the county. Miller (1986)

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reports that the lithologies of the middle confining unit and the permeable units above and below are relatively similar.

Some data are available from the injection well drilling and testing in adjacent Palm Beach County. Geraghty & Miller (1986) report that the vertical hydraulic conductivity of the confining zone, as defined by the lithologic cores taken in the interval between 2,300 and 2,900 feet bls, ranged from 7.52×10^{-7} to 4.87×10^{-5} centimeters per second (cm/sec). For the Pratt and Whitney injection well, CH2M HILL (1985) reports permeability results from cores in the 2,000- to 2,400-foot interval of approximately 1.7×10^{-6} cm/sec.

Information on the hydraulic head at the top and bottom of the middle confining Unit I is not available. Miller (1986) states that limited hydraulic data show a range of head differences between the upper and lower Floridan aquifers, with larger differences associated with greater confinement.

The middle confining Unit I occurs throughout the eastern half of Florida to South Carolina (Miller, 1986; Figure 11). In Florida, it thickens from the central axis of the state eastward to a maximum of 600 feet along the coast.

2.3.2.2 Karst Hydrogeology

The ICL site lies outside that portion of Florida where extensive historical subsidence has occurred due to the solution of carbonate and other rocks which results in the formation of karst terrain (Davies, et al., 1984). The site area is underlain by unconsolidated sediments of sufficient thickness above soluble rock strata so as to virtually preclude the development of karst conditions that would impact operation of the proposed plant. The exploratory borings drilled at the site did not encounter any significant shallow rock strata that could be subjected to solutioning as a result of the movement of groundwater or lowering of the water table. Therefore, evidence for the movement of shallow groundwater through

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sinkholes, caves, springs, and fractures or joints, characteristic of karst terrain, is not present in the Indiantown area.

As further evidence for the lack of potential karst development at the site, data were reviewed related to a regional screening study conducted by FPL (1979) of a 25-county area in central and south Florida that addressed the presence of karstic (solution cavity/sinkhole) features. The FPL study, which included Martin County, was based on a review of topographic maps of the area, published reports on the local geology and groundwater resources, analysis of satellite imagery, and regional reports of sinkhole occurrence. It concluded that favorable conditions for karst development were not present in Martin County. Studies conducted by others (NSS, 1973, 1974) of local depressions at the nearby FPL Martin site, however, presented evidence for the existence of buried karst in the limestone layers of the Pliocene age Caloosahatchee Marl.

For the regional screening study (FPL, 1979), criteria were developed to delineate areas of karstic conditions or conditions that could be favorable for karst development. On a regional basis, the development of karstic features in Florida is most common in areas where:

- Pre-Miocene age carbonate rocks are at or near the ground surface
- Recharge occurs to the Floridan aquifer
- There is a high density of lakes per unit area
- Reports of sinkhole occurrences are persistent

With respect to the near-surface occurrence of carbonate rocks, local experience generally shows that post-Miocene (Pleistocene) age carbonates do not pose the same potential for karstic development as do older carbonates in Florida, nor do they show the same correlation of occurrence with a high density of lakes, as do

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the pre-Miocene carbonates. Figure 2.3.2-13 shows the extent of near-surface pre-Miocene age limestones in central and south Florida, and indicates that none exist from Lake Okeechobee southward. The closest pre-Miocene limestones in the near-surface are approximately 140 miles northwest of the site. Major pre-Miocene age limestone formations that experience solutioning and cavity development occur at a depth of over 740 feet at the ICL site and are overlain by thick, impervious strata. The solutioning of these limestones has resulted in the development of the highly transmissive zones of the Floridan aquifer.

Recharge to the Floridan aquifer system in central Florida occurs through sinkholes, sinkhole-related lakes, or precipitation that is transmitted directly to the aquifer from Polk County northward where the pre-Miocene limestones are near the surface. Figure 2.3.2-14 shows the southern portion of the recharge area for the Floridan aquifer system.

The qualitative interpretation of a false-color infrared satellite image of Florida by Dames and Moore, as part of the 1979 FPL regional screening study, is the basis for Figure 2.3.2-15. This figure shows areas containing a high density of lakes relative to surrounding areas. The interpretation is based upon the sensitivity of the imagery to areas containing greater or lesser amounts of moisture.

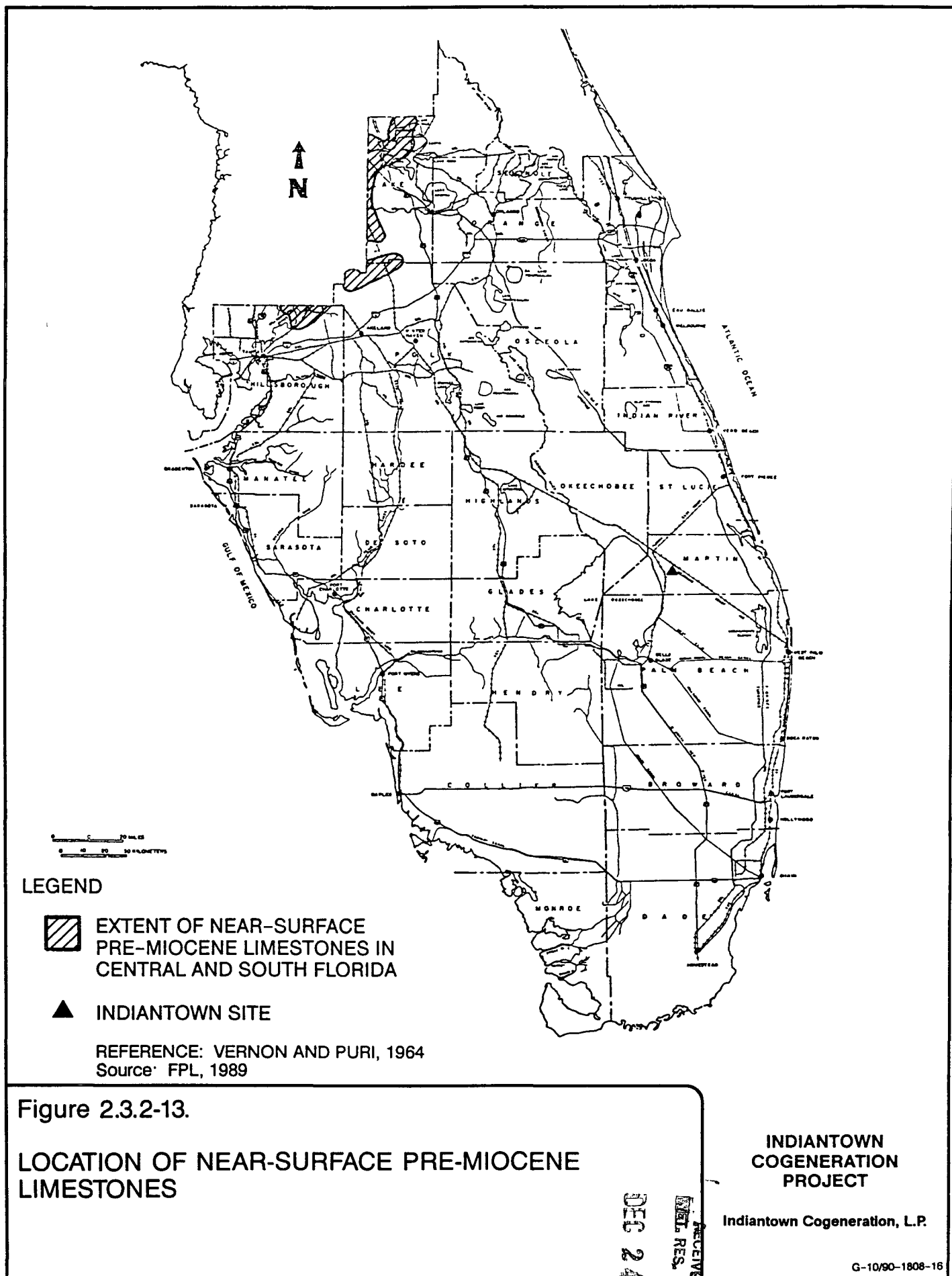
Areas that have exhibited persistent collapse because of sinkholes are shown on Figure 2.3.2-16, based upon a map of Florida published by the U.S. Geological Survey.

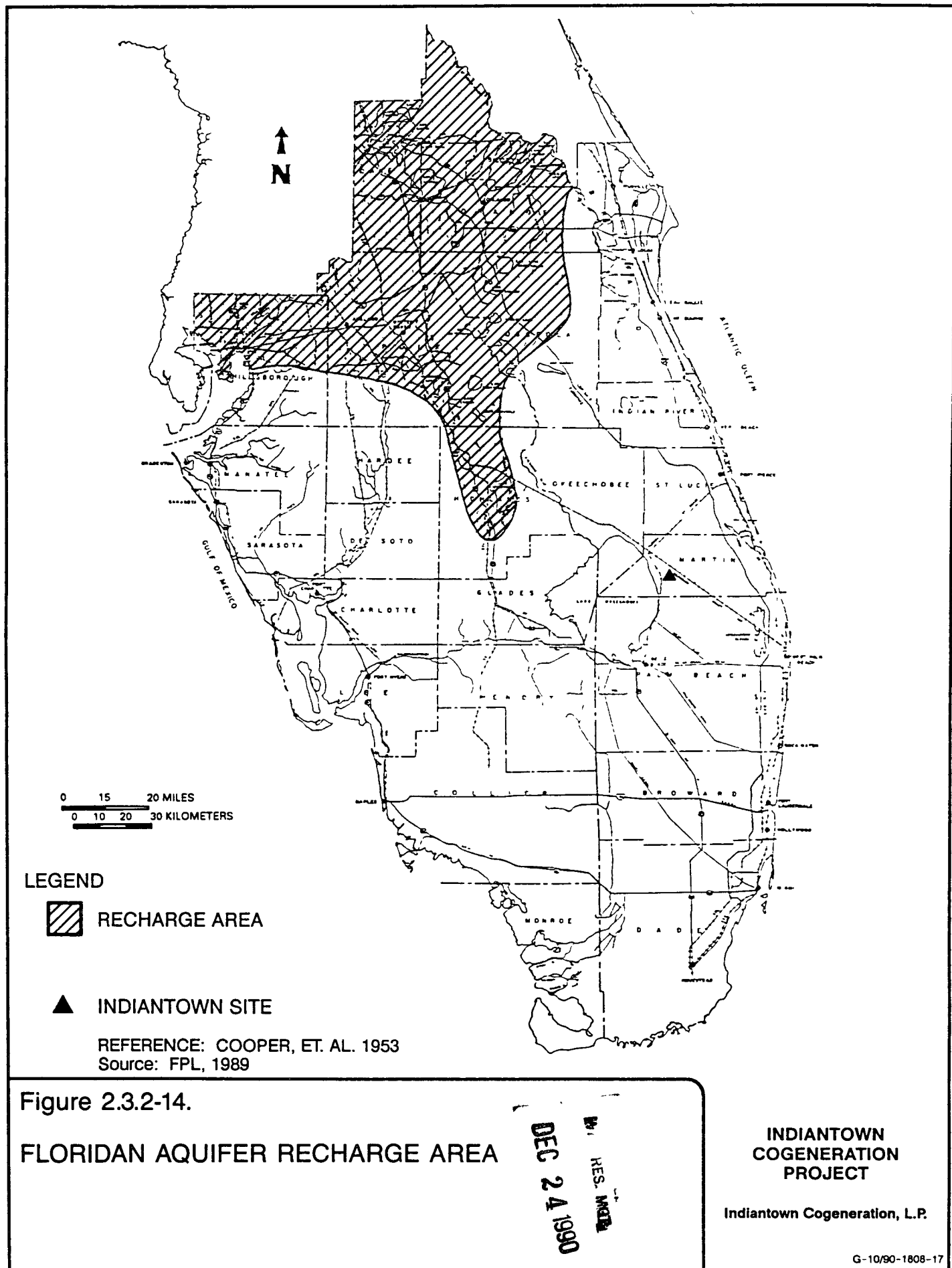
A correlation of the features shown on Figures 2.3.2-13 through 2.3.2-16 resulted in the development of Figure 2.3.2-17 (FPL, 1979) showing the potential for the development of karst in portions of central and south Florida.

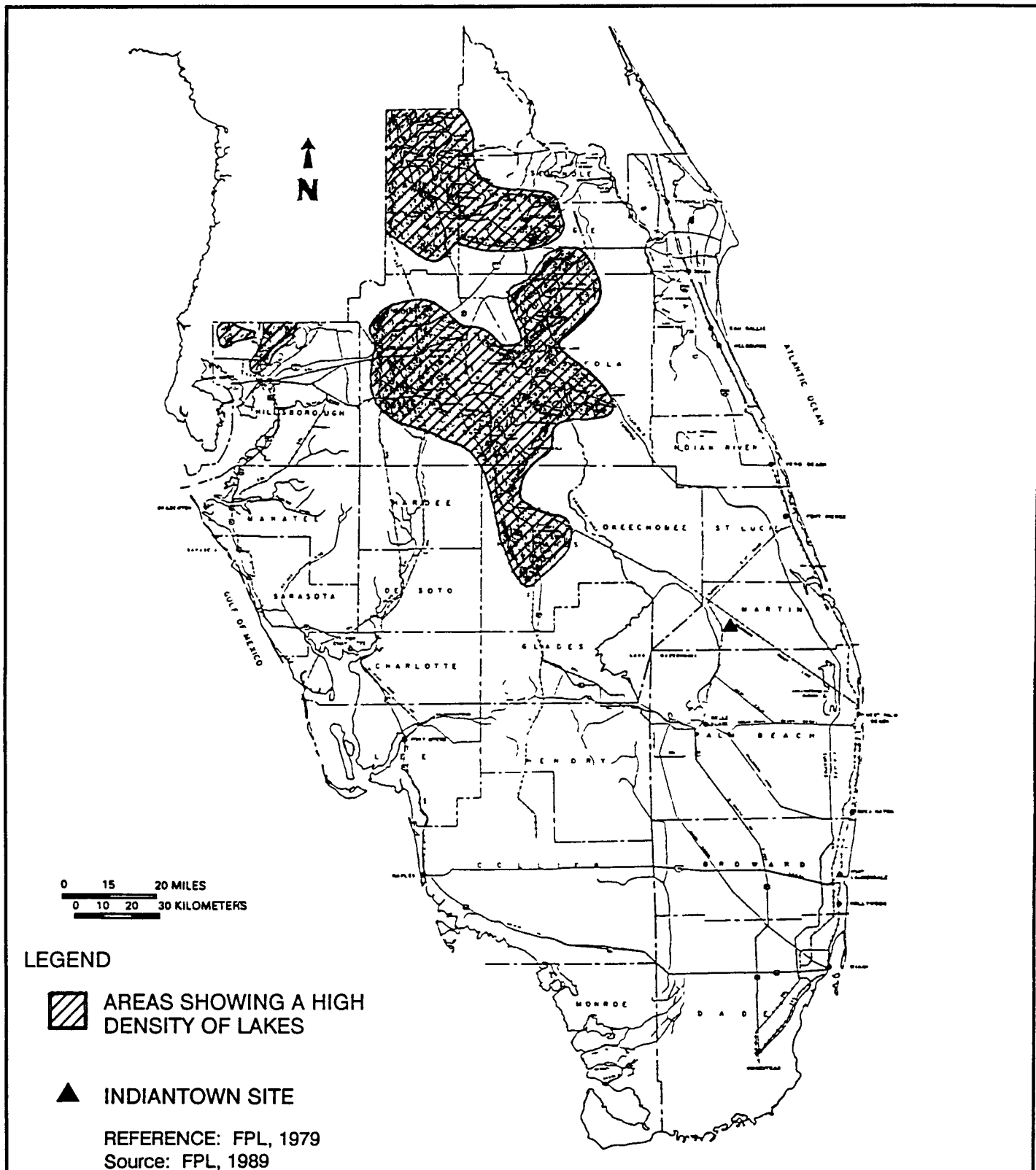
The FPL Siting Study (1979) relied on published information and the lack of surficial expressions of karst development to identify areas not susceptible to the formation of karst. No subsurface investigations to identify buried karst conditions

Image Quality

**As you review the next group of images,
Please note that the original documents
were of poor quality.**







LEGEND

 AREAS SHOWING A HIGH DENSITY OF LAKES

 INDIANTOWN SITE

REFERENCE: FPL, 1979

Source: FPL, 1989

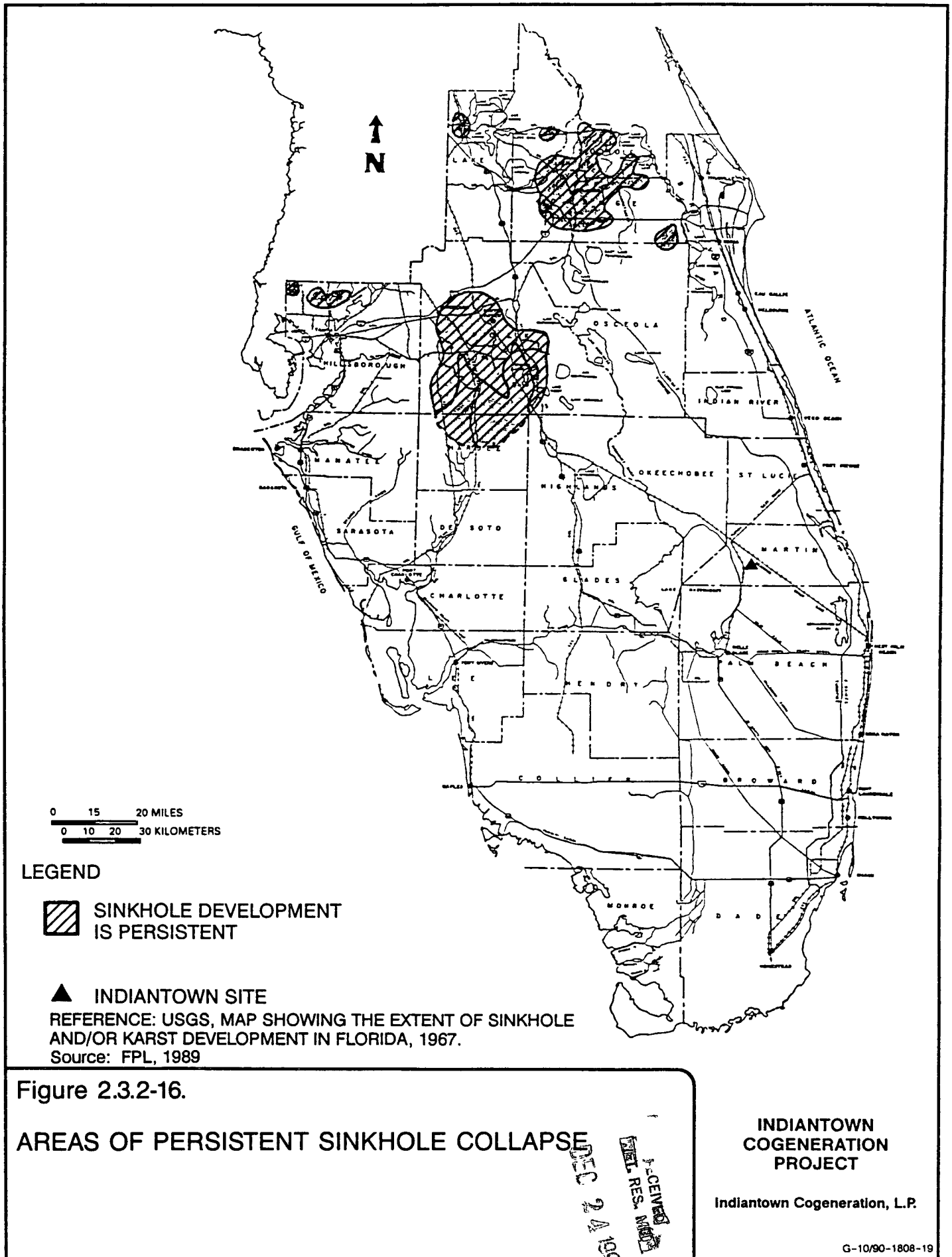
Figure 2.3.2-15.

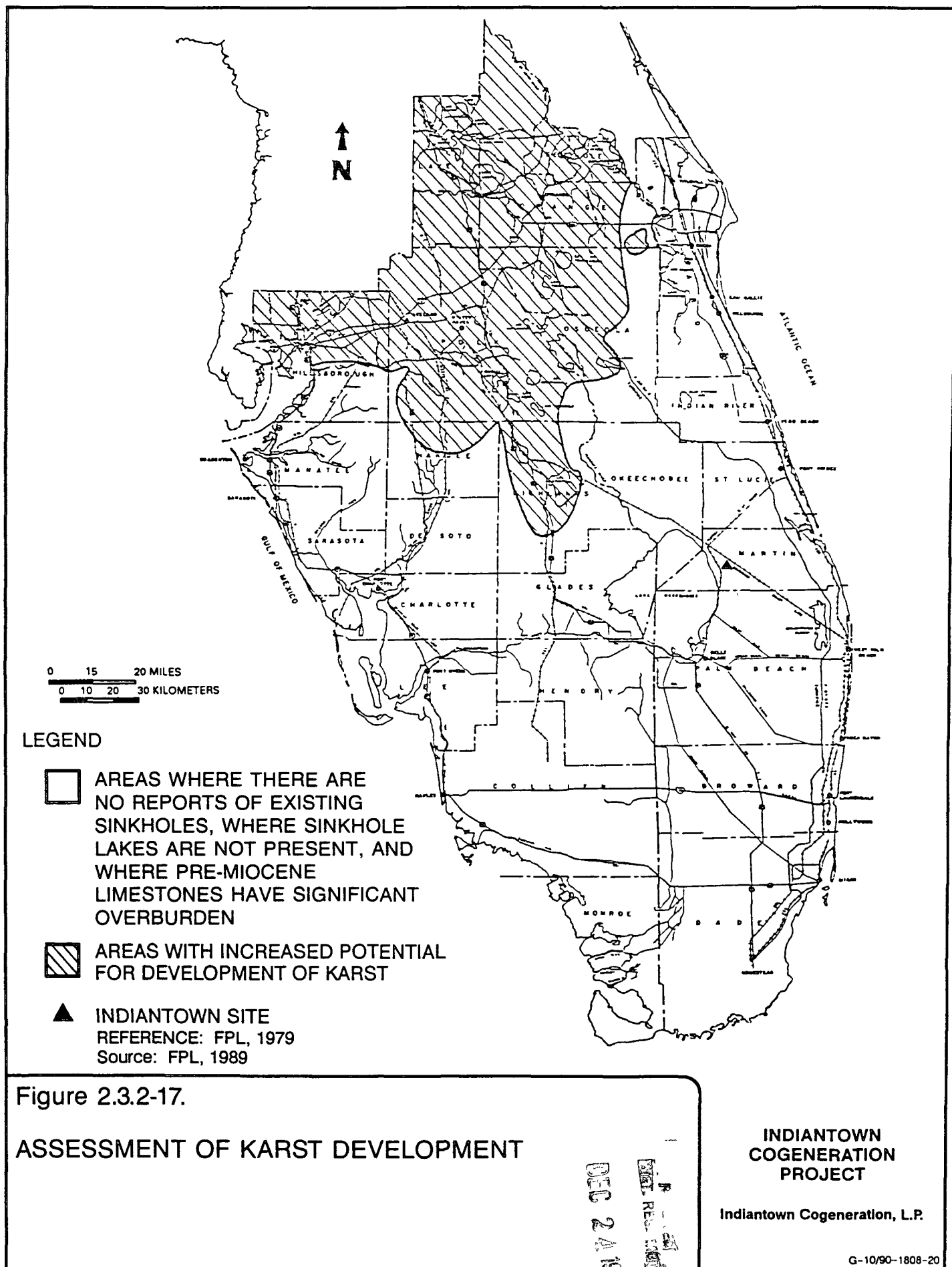
AREAS WITH A HIGH DENSITY OF LAKES

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(paleokarst) were performed as part of the study. However, previous investigations conducted at the nearby FPL Martin site by NSS (1973, 1974) did include studies to determine the origin of numerous shallow, closed depressions occurring throughout the area.

Based on the studies of these shallow depressions, including drill hole information, it was concluded by NSS that they were caused by the solutioning of calcite and aragonite in the shallow Pleistocene age Pamlico and Anastasia sands and possibly in the upper zones of a lenticular limestone of the Pliocene age Caloosahatchee Marl.

These studies indicated that development of the paleokarst features occurred during the Pleistocene epoch when the sea level was lower than it is now. Lower groundwater levels and increased rates of vertical and lateral percolation during the Pleistocene resulted in increased solution activity. NSS (1974) therefore concluded that current solution activity is negligible because of shallow groundwater levels and low rates of infiltration.

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2.3.3 SITE WATER BUDGET AND AREA USES

This section presents a summary of the sources and characteristics of surface water in the vicinity of the ICL site. The information is based on historical data collected at several gauging stations near the site by federal, state, and local agencies. These data encompass surface water flow, precipitation, evaporation, and other meteorological information.

This section also presents a summary of the groundwater resources and users of both surface and groundwater in the vicinity of the Indiantown site. The SFWMD water use permit allocations presented herein reflect the maximum total amounts of both surface and groundwater available for use by each permitted user. No information is available to account for the exact amounts of water actually withdrawn from the individual wells and/or surface water sources covered by each permit.

2.3.3.1 Site Water Budget

Climatic Condition

The ICL site is located in the east central segment of Florida, which has a mild subtropical climate. The nearest Class I weather station is West Palm Beach, Florida. Historical data shows an average monthly temperature of 65.6 °F in January and 82.7 °F in August. The daily maximum and minimum, and monthly mean averages for the period of 1939 to 1987 are shown in Table 2.3.3-1. During this period, the extreme high temperature of 101 °F was recorded in July and extreme minimum of 27 °F was recorded in January.

The mean monthly precipitation was measured at Port Mayaca, Florida, which is about 10 miles southwest of the ICL site. Based on these historic data, the average annual rainfall is 47.2 inches. Maximum and minimum recorded annual rainfall were 60.65 inches and 26.03 inches, respectively. Table 2.3.3-2 presents

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Table 2.3.3-1
NORMAL MEAN AND EXTREME TEMPERATURES (°F)
AT
WEST PALM BEACH*, FLORIDA 1939 - 1987

<u>Month</u>	<u>Extreme Maximum</u>	<u>Extreme Minimum</u>	<u>Mean Monthly</u>
January	89	27	65.6
February	90	32	66.7
March	94	30	70.1
April	99	43	73.8
May	96	53	77.7
June	98	61	80.8
July	101	66	82.4
August	98	65	82.7
September	97	66	81.5
October	95	46	77.7
November	91	36	72.1
December	90	30	<u>67.8</u>
Annual			74.9

*Location: West Palm Beach is approximately 30 miles SE of the ICL site.

Source: NOAA, Local Climatological Data, Annual Summaries, 1987, Part II
 Southern Region

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Table 2.3.3-2
MONTHLY PRECIPITATION (INCHES)
AT
PORT MAYACA, FLORIDA 1951 - 1982

<u>Month</u>	<u>Maximum Monthly</u>	<u>Minimum</u>	<u>Average</u>
January	7.06	0.00	1.70
February	5.79	0.14	2.04
March	14.65	0.09	2.59
April	6.88	0.03	2.19
May	10.27	0.45	4.99
June	14.75	1.95	7.14
July	13.48	0.98	6.52
August	10.22	1.65	5.93
September	10.36	1.15	6.52
October	11.15	0.84	4.83
November	5.33	0.06	1.24
December	5.69	0.02	<u>1.52</u>
Annual			47.21

Note: Port Mayaca is approximately 10 miles west of the ICL site.

Source: NOAA, Environmental Services, Monthly Precipitation Data of Florida, 1951-1982

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monthly precipitation data at Port Mayaca (U.S. Department of Commerce, 1951-1982).

The main source for the plant cooling water makeup is from Taylor Creek/Nubbin Slough at a location 1.1 miles upstream of the S-191 control structure. This location is about 19 miles northwest of the ICL site.

Precipitation data were measured at Raulerson-3 Station in Okeechobee County. This station is located in the Taylor Creek watershed about 32 miles northwest of the ICL site. For the period from 1957 to 1984, the mean annual precipitation is 48.8 inches, and maximum and minimum annual precipitation are 66.63 and 28.49 inches, respectively. Table 2.3.3-3 shows maximum, minimum, and monthly average precipitation at this station. Comparison of the precipitation data in Tables 2.3.3-2 and 2.3.3-3 shows nearly identical distribution at both stations.

Pan evaporation was measured at Raulerson-3 Station in Okeechobee County. These data showed mean annual pan evaporation of 59.4 inches. Pan evaporation is converted to lake evaporation through the use of the pan coefficient for the area. Using a pan coefficient of 0.73, (NOAA, 1982) and the pan evaporation of 59.4 inches, the estimated mean annual lake evaporation is approximately 43.4 inches. Pan evaporation in Belle Glade, Florida from 1940 to 1979 (NOAA, 1982) showed an annual mean of 62.2 inches. The corresponding lake evaporation is 45.4 inches.

The South Florida Water Management District estimated monthly evapotranspiration rates for various land uses (SFWMD, 1987). The annual values are shown in the following table.

<u>Land Use</u>	<u>Annual Evapotranspiration (Inches)</u>
Urban	23.91
Agricultural	48.44
Swamp	56.24
Vacant Land	42.55

Table 2.3.3-3
MONTHLY PRECIPITATION (INCHES)
AT
RAULERSON-3 STATION 1957 - 1984

<u>Month</u>	<u>Maximum Monthly</u>	<u>Minimum Monthly</u>	<u>Average</u>
January	6.83	0.11	1.84
February	7.08	0.53	2.58
March	9.27	0.05	3.30
April	5.78	0.00	1.98
May	11.25	0 00	4.41
June	17.73	1.23	7.80
July	13.21	1.61	6.78
August	11.13	2.06	6.56
September	20.00	0.58	6.60
October	10.94	0.40	3.71
November	4.40	0.07	1.61
December	4.14	0.10	<u>1.63</u>
Annual			48.80

Note. Raulerson - 3 is in Okeechobee County, about 32 miles northwest of the plant and 12 miles northwest of S-191 structure.

Source: South Florida Water Management District, Data Management Division,
Department of Research and Evaluation

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The maximum evapotranspiration occurs during April through September.

For the ICL Project, a mean annual evaporation of 45.4 inches is estimated from the above data for use in the water budget of the storage pond on the site.

Surface Water Resources

The cooling water and process water for the plant will be obtained from the proposed intake structure to be located on the Taylor Creek/Nubbin Slough at the intersection of C-59, L-63N, and L-63S Canals. Additional makeup water to meet the plant water requirements during drought periods (when water from the Taylor Creek/Nubbin Slough is not adequate) will be withdrawn from wells withdrawing water from the Floridian aquifer located on the plant site.

Groundwater Resources

The two major sources of groundwater (aquifers) in Martin County are recharged from different areas and are separated by a thick layer of sand and clay of low permeability known as the Hawthorn Formation (Lichtler, 1960). The Surficial (non-artesian) aquifer, extending from the water table to a depth of approximately 120 feet below the ground surface, is recharged by rainfall within Martin County. A small amount of recharge to the Surficial aquifer also results from the downward percolation of water used for agricultural irrigation. Recharge rates to the Surficial aquifer of 6 to 9 inches/year have been estimated as being "typical" (Ruskauff et al., 1989).

The upper Floridan (artesian) aquifer, extending from a depth of about 740 feet to an estimated depth of 1,450 feet below the ICL site, is recharged by rainfall occurring to the north and northwest in areas where the aquifer is in an unconfined or semiconfined condition (Bush and Johnston, 1988). These areas are generally found as topographically high outcrops and central inland regions occurring from Polk County northward. In those areas where the aquifer is unconfined or

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semiconfined, recharge is estimated to average 10 to 20 inches/year. However, recharge to the regional Floridan Aquifer system has been estimated to average about 5 inches/year over the long term. No recharge to the upper Floridan Aquifer occurs within Martin County due to the thickness of the overlying strata. Natural discharge from the aquifer in Martin County occurs almost exclusively as diffuse upward leakage through the overlying strata at less than 1 inch per year (Aucott, 1988).

2.3.3.2 Area Water Users

Surface and groundwater use in the vicinity of the ICL site is regulated by the SFWMD. Water use permits have been issued by SFWMD for many years. However, a program of well construction permitting was only established by SFWMD in 1985. Information obtained from SFWMD (1989), USGS, and local users (CH2M Hill, 1990) was used to prepare this summary of water uses near the site. It should be noted that there is a possibility of some additional (unpermitted, but legal) potable water wells in the vicinity of the site, but their presence has not been confirmed because they have not been permitted or otherwise reported to SFWMD.

The list of all surface and groundwater users in the 5-mile radius of the plant site is summarized on Table 2.3.3-4 and their location is shown on Figure 2.3.3-1. As shown on Table 2.3.3-4, most of the surface water and groundwater used within 5 miles of the plant site is for industrial purposes, agricultural irrigation, and potable water use. Sources of water used for these purposes include St. Lucie Canal (C-44), the shallow water aquifer, and the Floridan aquifer.

Taylor Creek/Nubbin Slough Water Users

The Taylor Creek/Nubbin Slough water is basically used for agriculture use. The existing surface water users are from Taylor Creek and are summarized on

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Figure 2.3.3-1.

WATER USERS WITHIN FIVE
MILE RADIUS OF INDIAN-
TOWN SITE



Poor Original

Scale: 1 Inch = 1-Mile

LEGEND:

- Site Boundary
- 1 Water User Location.
Number Corresponds
to the Water User Identifi-
cation Number Shown
in Tables 2.3.3-4 and
2.3.3-6

Sources: SFWMD
USGS
FPL

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L.P.

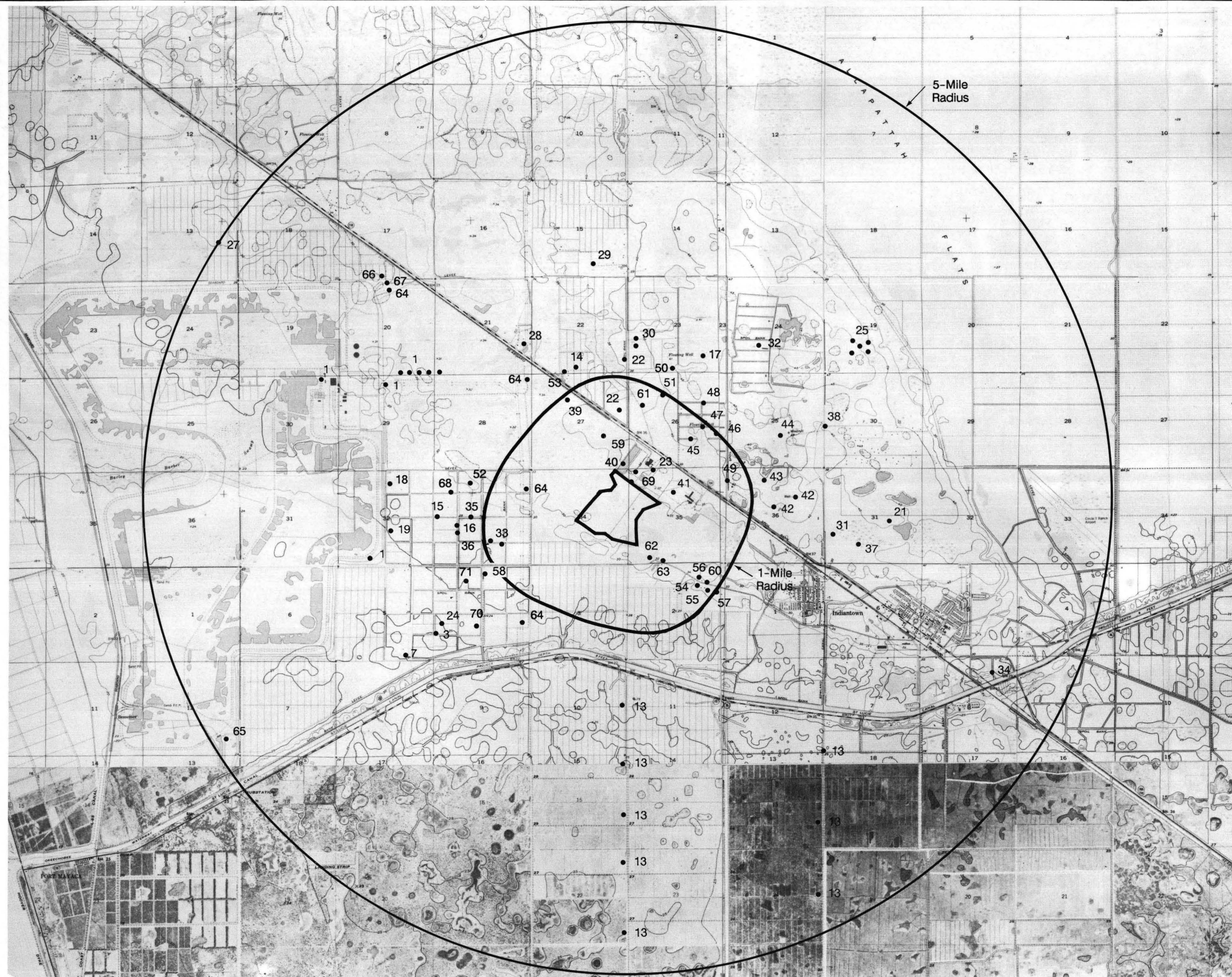


Table 2.3.3-4
EXISTING WATER USERS WITHIN A 5-MILE RADIUS OF THE ICL SITE
Page 1 of 8

IDENTIFICATION NO *	PERMIT/ REF NO	ANNUAL WATER ALLOCATION (mil gals)	DESCRIPTION OF USER AND WATER SOURCE
1	43-00022	300	Florida Power & Light Corporation, GW¹ use 6-wells of 175 gpm capacity
2	43-00025	1105 2	Metropolitan Life Insurance Co., SW² use 18,000 gpm capacity and 14,000 gpm from C-44 canal
3	43-00028	28 52	Byron Grant/Grant Citrus Grove, GW use One well of 1,000 gpm capacity
4	43,00034	118 54	Thomas M. Chastain, SW use Via culvert from C-44 canal
5	43-00038	2,992 17	Mayaca Land Corp., SW use 25,000 gpm and 17,000 gpm capacity withdrawal from C-44 canal
6	43-00047	16,290	Florida Power & Light Corporation, SW use 4-pumps of 90,000 gpm capacity withdrawal from C-44 canal
7	43-00071	57 49	Joseph D. Farish, GW use One well
8	43-00072	4,641 35	St Lucie River Company, SW use. 2 withdrawals, one of 10,000 gpm capacity and other of 14,000 gpm capacity from C-44 canal
9	43-00084	432 29	Indiantown Water Control District, SW use. 11,000 gpm from C-44 canal
10	43-00094	4,230 71	Coca Cola Company, SW use. 12 withdraws of 18,000 gpm capacity, 8 withdraws of 2,400 gpm and 2 withdraws of 1,200 gpm capacity from Troup - Indiantown Canal

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Table 2.3.3-4 (Cont'd)
Page 2 of 8

IDENTIFICATION NO *	PERMIT/ REF NO	ANNUAL WATER ALLOCATION (mil gals)	DESCRIPTION OF USER AND WATER SOURCE
11	43-00095	7,033	Troup Indiantown WCD, SW use 4 withdraws, 2 - of 25,000 gpm, one of 35,000 gpm and one of 20,000 gpm from C-44 canal
12	43-00112	625 54	Talquin Corp , SW use. 2 withdraws, one of 10,000 gpm and one of 6,000 gpm from C-44 canal
13	43-00122	3,099 97	Caulkins Land, SW & GW use 4 surface water withdraws, 2 of 20,000 gpm capacity and 2 of 25,000 gpm from C-44 8 wells with 1-800 gpm, 2-850 gpm, 1-975 gpm, 1-1,050 gpm, 1-1,275 gpm, 1-1,450 gpm and 1-1,500 gpm
14	43-00159	49 21	Sullivan & Huffman, GW use. One well of 720 gpm
15	43-00172	73 59	T & T Enterprises, GW use One wells of 800 gpm capacity
16	43-00206	18 4	Blood's Hammock Groves, Inc., GW use One well of 300 gpm capacity
17	43-00217	12 0	Caulkins Indiantown Citrus (Wastewater), GW use One well 200 gpm using reclaimed water from citrus processing
18	43-00229	15 64	Greene, Mccarthy, Abbot & Whittler (Shanalli Groves), GW use One well of 60 gpm capacity
19	43-00231	15 64	Greene, Mccarthy, Abbot & Whittler (Shanalli Groves), GW use. One well of 60 gpm capacity
20	43-00247	34 5	Agri + Lan, SW use. One withdrawal of 800 gpm capacity

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Table 2.3.3-4 (Cont'd)
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IDENTIFICATION NO *	PERMIT/ REF NO	ANNUAL WATER ALLOCATION (mil gals)	DESCRIPTION OF USER AND WATER SOURCE
21	43-00260	89 89	Indianwood Assoc , Inc , SW & GW use 3 SW withdraws from on site lakes, two of 400 gpm capacity and one of 200 gpm capacity One GW withdrawal of 800 gpm capacity
22	43-00351	63 57	Walter J Hatcher, GW use. Two wells of 525 gpm capacity
23	43-00362	50 0	Caulkins Indiantown Citrus Company, GW use 3 wells, two of 60 gpm and one of 300 gpm capacity
24	43-00418	35 42	S.N & Stephen Knight & S. Carpenter, GW use. One well of 500 gpm capacity
25	43-00424	745 21	Norman F. Hales, GW use. 5 wells of 600 gpm capacity
26	43-00436	2,446 4	Armstrong Properties, SW use. One 10,000 gpm surface water withdrawal capacity from C-44 canal
27	43-00445	8 74	F. Ray Daniels (Daniels Grove), GW use. One well of 300 gpm capacity
28	43-00501	15 27	Fennel 43 Acre Grove, GW use. One well of 310 gpm capacity
29	43-00503	11 29	Fennel 35 Acre Grove, GW use. One well of 230 gpm capacity
30	43-00516	35 03	J. Bargas (Go For Broke, Inc.), GW use. 2 Wells of 55 gpm capacity
31	43-00522	3,162	Indianwood (Golf Course Facility), GW use. 2 wells of 14 gpm capacity
32	43-00540	55,140	V B.Q. Tree Farm, GW use. One well of 120 gpm capacity

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Table 2.3.3-4 (Cont'd)
Page 4 of 8

IDENTIFICATION NO *	PERMIT/ REF NO	ANNUAL WATER ALLOCATION (mil gals)	DESCRIPTION OF USER AND WATER SOURCE
33	43-00541	55 19	C B. Myers III, GW use. Two wells, 275 gpm capacity
34	43-00544	1,000	Stuart Hatteras, GW use One well of 20 gpm capacity
35	82-393	100,000 ³ gpd	J Phares (Block 18A Farm), GW use. One well of 45 gpm capacity
36	82-394	100,000 gpd	Harry Green (Block 16A Farm), GW use One well of 45 gpm capacity
37	83-55	10,000 gpd	Indianwood (Pro Shop & Maint Bldg), GW use One well 50 gpm capacity
38	87-185	500 gpd	VFW Post 6023, GW use One well 15 gpm capacity
39	87-372	90,875 gpd	Indiantown Egg Prod. Facility, GW use 4 wells of 150 gpm capacity each
40	43-00270	--	Bay State Milling Company, GW use One well, 3" dia , casing 105' depth
41	87-451	50,000 gpd	Florida Steel (Indiantown Mill), GW use 3 wells, two of 50 gpm capacity and one of 600 gpm capacity
42	USGS M-191 ⁴		Norman Hales, GW use One well, 125 gpm capacity Location SW 1/4 NE 1/4 Sec 36, T39S R38E
43	USGS M-192 ⁴		Norman Hales, GW use. One well, 220 gpm capacity Location NE 1/4 NW 1/4 Sec 36, T39S R38E
44	USGS M-923 ⁴		Norman Hales, GW use One well, 300 gpm capacity Location NW 1/4 SW 1/4 Sec 25, T39S R38E

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Table 2.3.3-4 (Cont'd)
Page 5 of 8

IDENTIFICATION NO *	PERMIT/ REF NO	ANNUAL WATER ALLOCATION (mil gals)	DESCRIPTION OF USER AND WATER SOURCE
45	USGS M-30 ⁴		Norman Hales, GW use One well, 75 gpm capacity Location NW 1/4 SE 1/4 Sec 26, T39S R38E
46	USGS M-31 ⁴		Norman Hales, GW use One well, 200 gpm capacity Location NE 1/4 SE 1/4 Sec 36, T39S R38E
47	USGS M-32 ⁴		Norman Hales, GW use One well, 70 gpm capacity Location NE 1/4 SE 1/4 Sec 26, T39S R38E
48	USGS M-33 ⁴		Norman Hales, GW use One well, 45 gpm capacity Location SE 1/4 NE 1/4 Sec 26, T39S R38E
49	USGS M-34 ⁴		Norman Hales, GW use One well, 400 gpm capacity Location NW 1/4 NW 1/4 Sec 36, T39S R38E
50	USGS M-172 ⁴		Mr. Quinn, GW use. One well, 400 gpm capacity Location SE 1/4 SW 1/4 Sec 23, T39S R38E
51	USGS M-915 ⁴		Mr Quinn, GW use. One well, 160 gpm capacity Location NE 1/4 NW 1/4 Sec 26, T39S R38E
52	USGS M-2030 ⁴		Palmer Tudhill, GW Use. One well, 6" Dia Casing 1220' depth Location NE 1/4 NW 1/4 Sec 33, T39S R38E
53	USGS M-2036 ⁴		Holdbrook, GW use One well, 2" Dia Casing 105' depth Location SE 1/4 SW 1/4 Sec 22, T39S R38E

Table 2.3.3-4 (Cont'd)
Page 6 of 8

IDENTIFICATION NO *	PERMIT/ REF NO	ANNUAL WATER ALLOCATION (mil gals)	DESCRIPTION OF USER AND WATER SOURCE
54			Tropical Fruits, GW use. One well, 3" Dia Casing 50' depth Location SW 1/4 NW 1/4 Sec 2, T40S R38E
55			Bud Slay, GW use. One Well, 2" Dia Casing 105' depth Location NE 1/4 NE 1/4 Sec 2, T40S R38E
56			Chick Gaskin, GW use. One well, 2" Dia Casing 105' depth Location NE 1/4 NE 1/4 Sec 2, T40S R38E
57			Wilda Copeland, GW use One well, 2" Dia Casing 105' depth Location NE 1/4 NE 1/4 Sec 2, T40S R38E
58			Holdbrook, GW use. One well, 2" Dia Casing 105' depth Location NW 1/4 NE 1/4 Sec 4, T40S R38E
59			Owner unknown, GW use. One well, 2" Dia Casing 105' depth Location NW 1/4 SE 1/4 Sec 27, T39S R38E
60			Jim Roberts, GW use One well, 2" Dia Casing 105' depth Location NE 1/4 NE 1/4 Sec 2, T40S R38E
61			Bar-Nel Tree Farm, GW use. One well, 2" Dia Casing 105' depth Location NW 1/4 NW 1/4 Sec 26, T39S R38E
62			Roland Cope, GW use. One well, 30' depth Location SW 1/4 SW 1/4 Sec 35, T39S R38E

Table 2.3.3-4 (Cont'd)
Page 7 of 8

IDENTIFICATION NO *	PERMIT/ REF NO	ANNUAL WATER ALLOCATION (mil gals)	DESCRIPTION OF USER AND WATER SOURCE
63			James Slay, GW use. One well, 100' depth Location SE 1/4 SW 1/4 Sec 35, T39S R38E
64	BTW-1, 2, 3, 4		Florida Power and Light Corp , GW use 4 aquifer test wells, depth 145-168 ft
65			Florida Power and Light Corp., GW use Water supply well
66	MF-23 ⁵		Florida Power & Light Corp., GW use. SFWMD monitoring well, depth 1,119 ft Location SW 1/4, SW 1/4 Sec 17, 739S, R38E
67	LFM-1		Florida Power & Light Corp , GW use. Aquifer test well, depth 1,648 ft Location NW 1/4, NW 1/4 Sec 20, T39S, R38E
68	MF-25 ⁵		Florida Power & Light Corp., GW use. SFWMD monitoring well, depth 1,220 ft Location NW 1/4, SW 1/4, NW 1/4, Sec 33, T39S, R38E
69	MF-37 ⁵		Caulkins Indiantown Groves, GW use. SFWMD monitoring well, depth 1,260 Location SW 1/4, NW 1/4, NW 1/4, Sec 35, T39S, R38E
70	43-00233		Jack Phares, GW use. One well in Surficial aquifer for agricultural use
71	43-00232		J&R, GW use One well in Surficial aquifer for agricultural use

*See Figure 2 3 3-1 for location of corresponding number

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Table 2.3.3-4 (Cont'd)
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IDENTIFICATION NO *	PERMIT/ REF NO	ANNUAL WATER ALLOCATION (mil gals)	DESCRIPTION OF USER AND WATER SOURCE
1	GW - Groundwater Use		
2	SW - Surface Water Use		
3	Maximum Daily Allowance for General Use Permits		
4	U S Geological Survey Well Number		
5	SFWMD Well Number		

Source Bechtel, 1990
SFMMMD
USGS
FPL, 1989

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Table 2 3 3-5 The information shown on the table is based on the permit summary printout obtained from the SFWMD (1989b)

As seen from the table, two of the users are on the old section of Taylor Creek which is connected to Lake Okeechobee One potential user is on Canal L-63N (see Section 5 3 1 4) Primary water use from the Taylor Creek/Nubbin Slough is for agriculture use and no public water supply is obtained from this source

Groundwater Users

A total of 31 wells are located within approximately 1 mile of the site, and are described in more detail in Table 2 2 3-6 A well canvas was performed to verify and supplement the information available on public record regarding these wells This canvas consisted of an attempt to contact the appropriate well owner, both by telephone and by a site visit If the owner could not be contacted after several attempts, the term "no access" is shown in the comments column on Table 2 3 3-6 A local well driller responsible for drilling many of the wells in the area was able to provide information on some of the wells

Twelve of the wells nearest the site were identified as potable water wells These wells are reported to be typically 2 inches in diameter and 105 feet deep Fourteen of the remaining wells are Floridan Aquifer wells that extend to depths of 1,000 to 1,400 feet and are primarily used for agricultural irrigation Two industrial wells and one test well were also identified

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of
the
original
author
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the
document

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

Table 2.3.3-5
TAYLOR CREEK/NUBBIN SLOUGH WATER USERS
Page 1 of 1

IDENTIFICATION NO	PERMIT/ REF NO	ANNUAL WATER ALLOCATION (mil gals)	DESCRIPTION OF USER AND WATER SOURCE
1	47-00020-W	46 0	Q.J. Hazellieff/Citrus Grove, SW & GW use. Agriculture use Location T37S R35E Sec 24 & 25
2	47-00024-W	93 75	Martin Brown & Donald Brown, SW use Agriculture use Location T37S R35E Sec 27
3	47-00042-W	482 08	Norman Stokes, SW use. Agriculture use Location T37S R35E Sec 23

Source SFWMD, 1989b

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Table 2.3.3-6
1-MILE RADIUS WELL INVENTORY
Page 1 of 2

Well No ⁽¹⁾	Location	Permit/ Ref No	Owner	Use	Casing Diameter	Casing Depth	Well Depth	Casing Material	Production Rate	Active	Comments
49	NW 1/4 NW 1/4 Sec 36 T39S R38E	USGS M-34*	Norman Hales	Agricultural	6"	—	1,100'	—	400 gpm	—	No Access, property being sold to Indianwood Residential & Golf Course Development
46	NE 1/4 SE 1/4 Sec 36 T39S R38E	USGS M-31*	Norman Hales	Agricultural	6"	—	1,100'	—	200 gpm	—	No Access, property being sold to Indianwood Residential & Golf Course Development
47	NE 1/4 SE 1/4 Sec 26 T39S R38E	USGS M-32*	Norman Hales	Agricultural	4"	—	1,100'	—	70 gpm	—	No Access, property being sold to Indianwood Residential & Golf Course Development
33	N 1/4 SW 1/4 SE 1/4 Sec 33 T39S R38E	43-00541	C B Myers	Agricultural	6"	—	100'	—	275 gpm	Yes	2 wells
45	NW 1/4 SE 1/4 Sec 26 T39S R38E	USGS M-30*	Norman Hales	Agricultural	6"	450'	1,100'	—	75 gpm	—	No Access, property being sold to Indianwood Residential & Golf Course Development
51	NE 1/4 NW 1/4 Sec 26 T39S R38E	USGS M-915*	Mr Quinn	Agricultural	8"	—	1 120'	—	160 gpm	Yes	
23	SE 1/4 SW 1/4 Sec 26 T39S R38E	43-00362	Caulkins Citrus	Industrial	8"	129'	175'	—	60 gpm	Yes	Caulkins Plant 2 wells
23	SW 1/4 SW 1/4 Sec 26 T39S R38E	43-00362	Caulkins Citrus	Industrial	10"	400'	1,000'	—	300 gpm	Yes	Caulkins Plant
40	SE 1/4 SE 1/4 Sec 27 T39S R38E	43-00270	Bay State Milling Company	Potable	3"	105'	105'	Steel	—	Yes	Screened Well
22	SE 1/4 NE 1/4 Sec 27 T39S R38E	43-00351	Hatcher Citrus	Agricultural	8"	100'	160'	—	525 gpm	—	Not Found
64	NE 1/4 NE 1/4 Sec 33 T39S R38E	—	FPL	Test	8"	168'	168'	—	250 gpm	No	Screened Well
54	SW 1/4 NW 1/4 Sec 2 T40S R38E	—	Tropical Fruits	Potable	3"	50'	50'	Steel	—	Yes	Could be 2 Wells at Site Screened Well

Table 2.3.3-6
Page 2 of 2

Well No ⁽¹⁾	Location	Permit/ Ref No	Owner	Use	Casing Diameter	Casing Depth	Well Depth	Casing Material	Production Rate	Active	Comments
55	NE 1/4 NE 1/4 Sec 2 T40S R38E	—	Bud Slay	Potable	2"	105'	105'	Steel	—	Yes	Screened Well
56	NE 1/4 NE 1/4 Sec 2 T40S R38E	—	Chick Gaskin	Potable	2"	105'	105'	Steel	—	Yes	Screened Well
57	NE 1/4 NE 1/4 Sec 2 T40S R38E	—	Wilda Copeland	Potable	2"	105'	105'	Steel	—	Yes	Screened Well
59	NW 1/4 SE 1/4 Sec 27 T39S R38E	—	—	Potable	2"	105'	105'	Steel	—	Yes	Owner Unknown
60	NE 1/4 NE 1/4 Sec 2 T40S R38E	—	Jim Roberts	Potable	2"	105'	105'	Steel	—	Yes	Screened Well
61	NW 1/4 NW 1/4 Sec 26 T39S R38E	—	Bar-Nel Tree Farm	Potable	2"	105'	105'	Steel	—	Yes	Screened Well
62	SW 1/4 SW 1/4 Sec 35 T39S R38E	—	Roland Cope	Potable	—	—	30'	—	—	—	Well Inventoried in Florida Steel Report - No Access
63	SE 1/4 SW 1/4 Sec 35 T39S R38E	—	James Slay	Potable	—	—	100'	—	—	—	No Access
39	NE 1/4 SE 1/4 NW 1/4 Sec 27 T38N R39E	87-372	Indiantown Egg	Agricultural	4	100'	105'	—	—	Yes	4 wells
41	SW 1/4, NW 1/4 NE 1/4 Sec 35 T39N R38E	87-451	Florida Steel	Industrial/ Potable	6/2	130/105	—	—	600/50	No	3 wells, 1-6" 2-2"
69	SW 1/4, NW 1/4 NW 1/4, Sec 35 T39S R38W	MF-37	Caulkins Citrus	Monitoring Well	10	391'	1,260'	Steel	—	No	SFWMD Monitoring Well

⁽¹⁾See Figure 2.3.3-1 for location of corresponding number

*U S Geological Survey Well Number

**SFWMD Well Number

Source CH2M Hill, 1990

DEC 24 1990

BDW 07 1990

2.3.4 SURFICIAL HYDROLOGY

This section discusses the major water bodies in the vicinity of the site that may be affected by plant construction and operation. These effects include water withdrawal, storm water discharge, and changes in local runoff. Descriptions of the historical hydrologic characteristics of each water body including water level variation, flows, water quality, and water budget are included. The water bodies near the site which may be affected by the plant construction and operation are Lake Okeechobee, St. Lucie Canal, and Taylor Creek/Nubbin Slough.

The primary source of the plant water is Taylor Creek/Nubbin Slough about a mile upstream of the S-191 control structure. The release of the water from this source is into Lake Okeechobee through the S-191 control structure.

St. Lucie Canal conveys the water out of Lake Okeechobee to the Atlantic Ocean through two control structures. This canal passes about 2 miles south of the ICL site. Local runoff from the site and the surrounding areas may reach the St. Lucie Canal through drainage ditches.

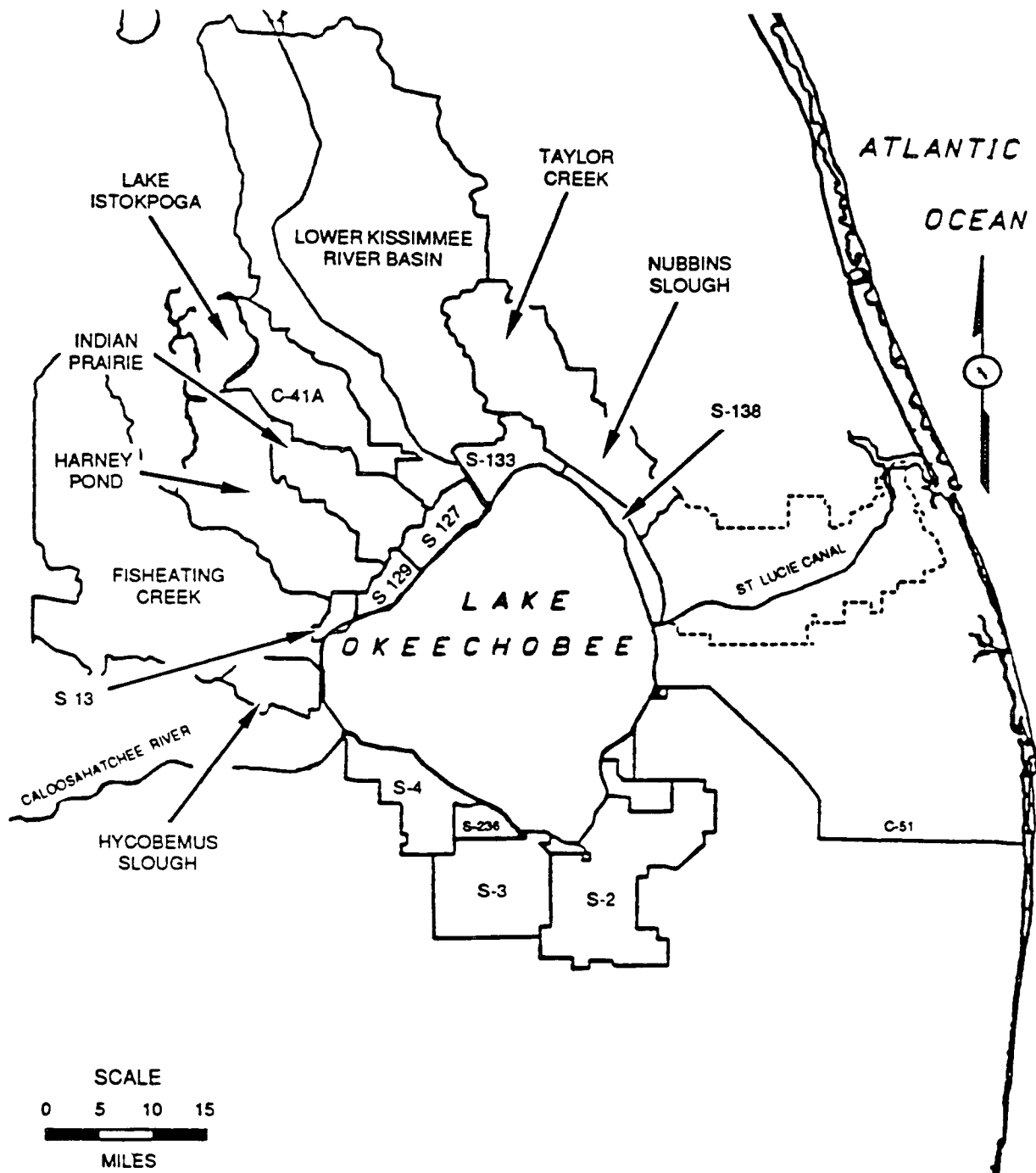
2.3.4.1 Hydrologic Characterization

Lake Okeechobee

Description

The principal source of surface water in southeast Florida is Lake Okeechobee, which is approximately 10 miles west of the project site. The lake receives inflow from several streams from the northeast, north, and west sides of the lake, in addition to direct rainfall. The estimated lake surface area is approximately 680 mi² at a water level of El. 14 feet MSL, and the total watershed is approximately 5,650 mi² (USGS, 1981). Figure 2.3.4-1 shows the watershed boundary contributing to the lake.

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Source SFWMD

Figure 2.3.4-1

LAKE OKEECHOBEE WATERSHED

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The lake is diked to form a reservoir, and is regulated by control structure gates at several outlets. The U S Army Corps of Engineers regulates the stages in the lake for navigation, municipal water supply, irrigation, and flood control. The present regulation schedule, established in 1978, varies from 15.5 feet MSL during the wet season to 17.5 feet MSL during the dry season. Figure 2.3.4-2 is a presentation of the regulation schedule. When the lake stage exceeds the maximum regulation schedule at any time, regulating releases are made in order to bring the lake stage down to the maximum level. When the lake level is in Zone C (see Figure 2.3.4-2), no regulating releases are made. Lake levels in Zone B are lowered by releases at three major outflows (North New River, Hillsboro, and Miami Canals). If additional releases are still needed they are made through the Caloosahatchee River and the St. Lucie Canal.

Water Levels and Storage

Historic water levels in Lake Okeechobee have been collected by the U S Geological Survey from October 1931 to the present time. However, because of the modifications made on the outlets which affected the regulation schedule, only historic data after the May 1978 implementation of the current regulation schedule (Figure 2.3.4-2) are presented and discussed in this section. These data are analyzed and presented in Table 2.3.4-1 as mean monthly, and maximum and minimum mean monthly water levels. All the minimum mean monthly water levels occurred in 1981 with the exception of April which occurred in 1982.

The lake is approximately circular in shape with an almost flat bottom. The maximum variation in the surface area between El. 13 and 16 feet MSL is approximately 12 percent. The elevation-area-storage curves are shown on Figure 2.3.4-3.

Water Budget

Lake Okeechobee receives its runoff from the surrounding drainage basins and from direct precipitation. The lake has nine major inflow streams and five major

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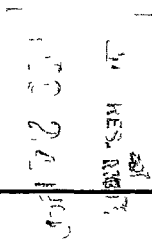


Figure 2 3.4-2.

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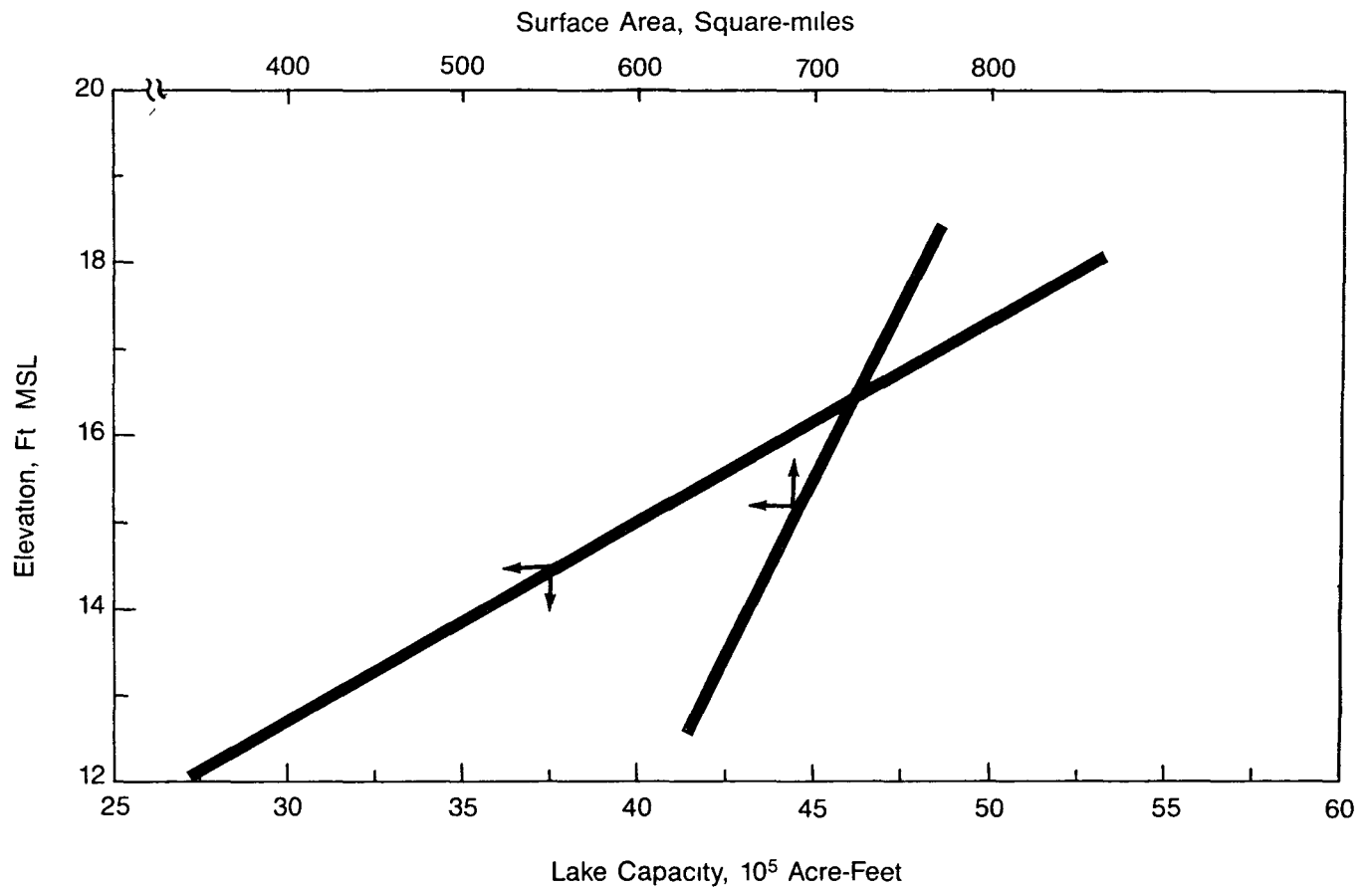


Figure 2 34-3

ELEVATION, AREA, AND CAPACITY CURVES OF LAKE OKEECHOBEE

Source Developed by Bechtel from data in the USGS Water Supply Papers for
Florida and SFWMD Studies

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Table 2.3.4-1
LAKE OKEECHOBEE WATER LEVELS, FT MSL (1978-1989*)

<u>Month</u>	<u>Average</u>	<u>Maximum Mean Monthly</u>	<u>Minimum Mean Monthly</u>
Oct	15 38	17 49	11 85
Nov	15 34	17 46	11 55
Dec	15 21	17 46	11 14
Jan	15 18	17 35	10 87
Feb	15 09	17 65	10.82
Mar	14 94	17 98	10 98
Apr	14 53	17 06	11 12
May	14 00	18 77	10 89
June	13 73	15 47	10 39
July	13 90	15 93	9 91
Aug	14 27	16 24	10 27
Sept	14 78	16 54	11 64

*These water levels are since the recent regulation started in May 1978 and are shown on Figure 2 3 4-2

Source USGS Water Supply Papers for Station 02-2764

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outflow canals (Figure 2 3 4-4) Inflows and outflows pass through control structures

The largest source of water to the lake is direct rainfall For an average annual precipitation of 48 inches, this volume amounts to about 1,900,000 acre-feet per year

A significant portion of the inflow occurs during the high rainfall season (June-October) The Kissimmee River is the largest surface inflow contributor to the lake The mean annual inflow from the Kissimmee River into the lake is approximately 1,600,000 acre-feet per year

A water budget study performed by SFWMD for the period 1973-1979 (SFWMD, May 1981), showed a mean annual inflow, including direct rainfall on the lake, of approximately 3,500,000 acre-feet per year During this period, direct rainfall contribution was 1,350,000 acre-feet per year The lake discharges into several canals through control structures The water budget study performed (SFWMD, May 1981) showed a mean annual outflow volume from the study period of approximately 3,100,000 acre-feet per year About 65 percent of the outflow is lost by evaporation from the lake

Lake Water Quality

A water sampling program was conducted by SFWMD at 40 stations in Lake Okeechobee between 1973 and 1979 These samples were collected to determine dissolved nutrients, anions, dissolved oxygen, temperature, specific conductor, and pH This program was implemented to determine the material budget into and out of the lake Inflows from major surface tributaries were monitored also The summary of the lake's water quality developed by SFWMD is presented in this report as Table 2 3 4-2

The inflow load to the lake varies considerably from one stream to another. The Kissimmee River and Taylor Creek/Nubbin Slough (at S-191) introduce the highest

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- LEGEND
- EMERGENT VEGETATION ZONE
 - PRIMARY DIRECTION(S) OF FLOW
 - > SECONDARY DIRECTION OF FLOW

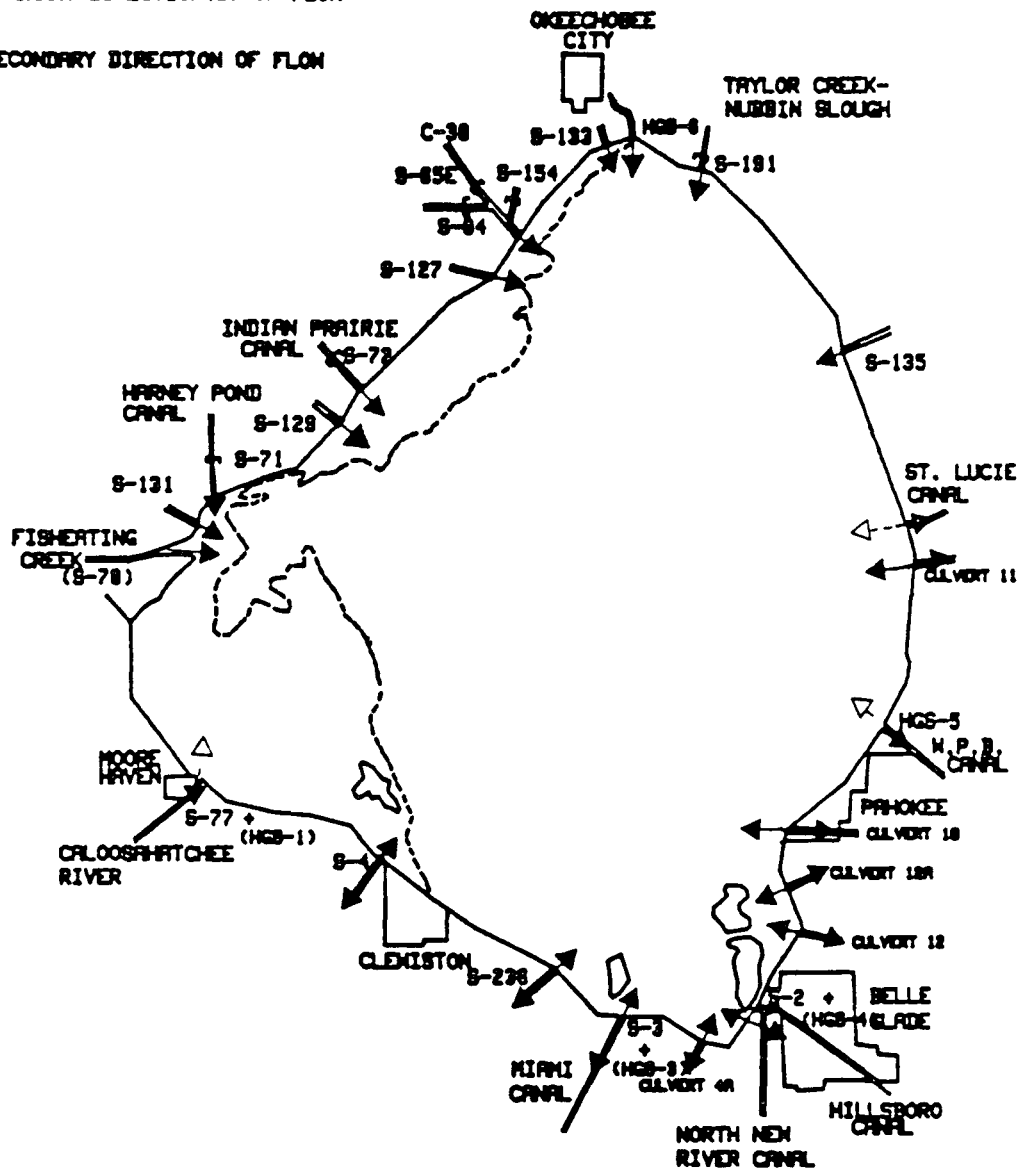


Figure 2.3.4-4
INFLOWS AND OUTFLOWS TO LAKE
OKEECHOBEE

Source SFWMD

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Table 2.3.4-2
SELECTED WATER QUALITY PARAMETERS OF LAKE OKEECHOBEE
(1973-1979)

<u>Parameter¹</u>	<u>Avg 1973-1979</u>
Ortho-Phosphate	0 018
Total Phosphate	0 063
Inorganic N	0 16
Organic N	1 57
Total N	1 73
Conductance (mhos/cm)	589
Cl	87 4
Na	56 3
K	4 4
Ca	45 1
Mg	17 3
Hardness(CaCO ₃)	184
SO ₄	54 6
SiO ₂	6 5
Alkalinity (meq/l)	2 5
Total Fe	0 44
Dissolved oxygen	8 6
Turbidity (JTU)	18 0
Color (Pt units)	43
Secchi Disc (M)	0 6
Cholorophyll <u>a</u> (g/L)	25 7

¹Units in mg/L unless otherwise noted

Source South Florida Water Management District (SFWMD, May 1981)

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loads of total phosphate, total nitrogen, and chloride The rainfall contribution to the total nitrogen was 24.3 percent of the total inflow to the lake

In connection with the Martin Project, Florida Power and Light performed a water quality monitoring program including Lake Okeechobee (FPL, December 1989) Data in the lake were collected at one station near the St. Lucie Canal inlet Temperature data at this location for 1978 to 1987 are presented in Figure 2.3.4-5

St. Lucie Canal

Description

The St. Lucie Canal (Figure 2.3.4-1) is a major outflow canal from Lake Okeechobee that receives water at the east side of the lake The canal (C-44) extends from the lake, west of Port Mayaca, to the South Fork of the St. Lucie River, for a total length of approximately 30 miles The canal is manmade with a trapezoidal cross section, ranging in bed width from 150 feet at Port Mayaca to 200 feet at the lock near Stuart (S-80) (FPL, December 1989) The bed level also varies from +4 feet MSL at Port Mayaca to -3 feet MSL at the lock near Stuart (S-80) Both locks are used to control the water level in the canal to facilitate navigation, flood control, or water supply

Water Levels

The design water depth for navigation in the canal is 8 feet (USGS, 1983) To maintain the depth, the optimum water level is maintained between El. 14 and 14.5 feet MSL (Veril, 1990) When the lake level drops below El. 14 feet MSL, the canal level is set to fluctuate with the lake

During severe drought, such as the condition during 1989 and 1990, the canal is maintained between 0.2 and 1.0 feet below the lake level These levels are for zero flow conditions in the canal When the two locks are open, the water level slopes from about El. 15 feet MSL near Port Mayaca to about El. 4 feet MSL at Lock S-80 near Stuart

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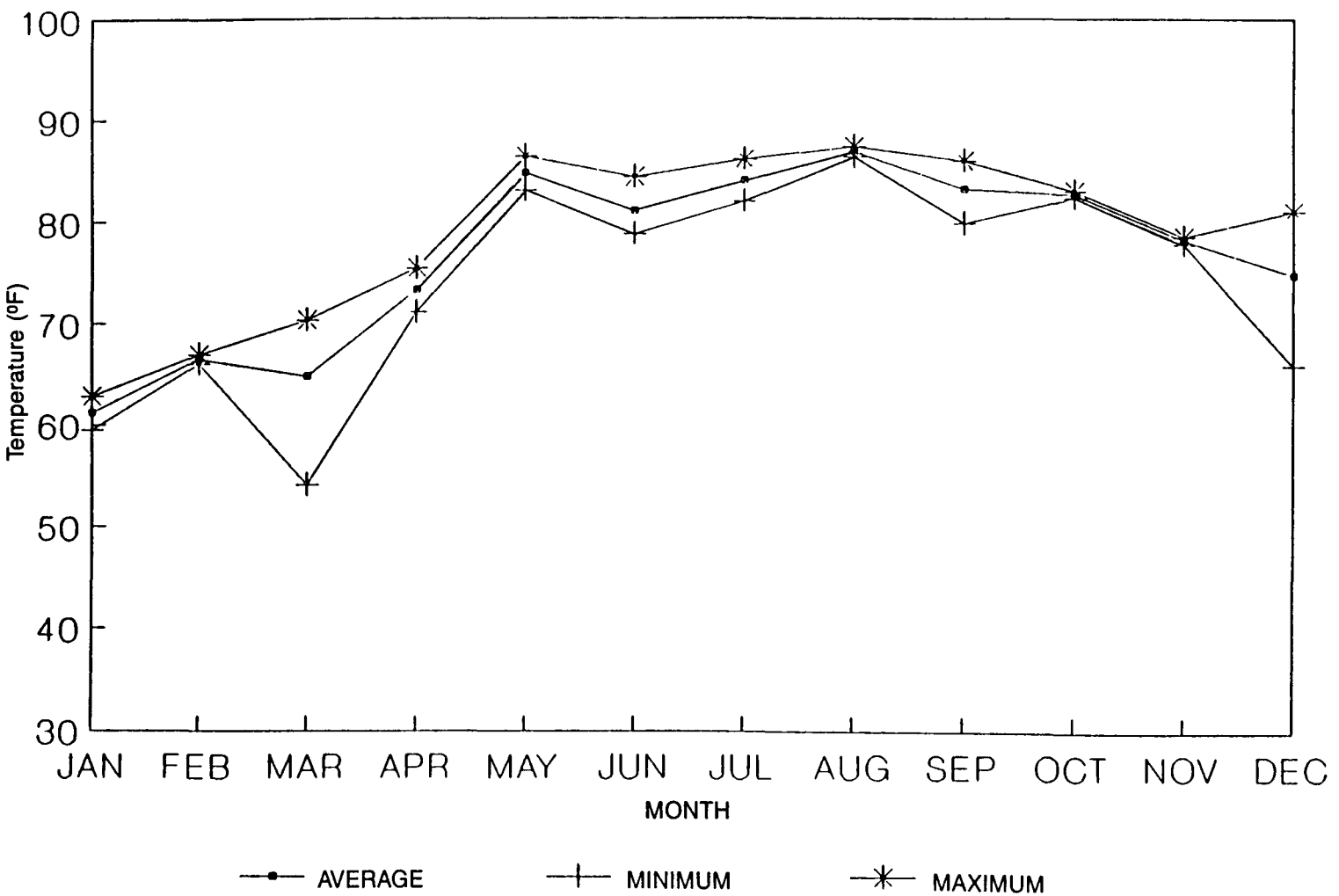


Figure 2.3.4-5.

WATER TEMPERATURES — LAKE OKEECHOBEE,
1978-1987

Source FPL, 1989

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Discharge

The St Lucie Canal receives its water from direct inflow from the watershed between Port Mayaca (S-308) and its outlet at Lock S-80 near Stuart, and from releases from Lake Okeechobee. The estimated watershed area of the canal is 140,772 acres (220 mi²) (SFWMD, May 1987). Under a normal year, releases from the lake are made for 1 month and, in 10-year drought, for 3 months to supplement the inflow to meet water users' demand from the canal. Correlation studies (SFWMD, May 1987) between the rainfall and the basin inflow into the canal showed that monthly inflow runoff to the canal is about 30 percent of the rainfall over the canal basin. Thus, for a mean annual rainfall of about 46.13 inches over the canal basin, the average annual runoff is 163,000 acre-feet which is equivalent to 223 cfs.

The flow in the St Lucie Canal is completely regulated by the locks at its upstream end at Port Mayaca and the downstream end near Stuart at its outlet. The USGS maintains flow records at each lock. A summary of these records for the period 1983-1989 is presented in Table 2.3.4-3.

Water Quality

The St Lucie Canal (C-44) is classified as a Class III surface water body as per the Water Quality Criteria in F.A.C. 17-302. This criteria are presented in Table 2.3.4-4.

Water quality samples have been collected and analyzed by SFWMD from January 1973 until the present time. These data are collected at Port Mayaca station (C44 S308). For the purpose of this application, these data are evaluated to determine seasonal and long-term trends. Particular emphasis is given to the years after 1981 to determine if there is a lowering trend in phosphorus level due to the implementation of Lake Okeechobee water quality management developed by SFWMD (SWIM Plan, SFWMD, January 1989). Data for the period of records are analyzed and summarized in Table 2.3.4-5. Figure 2.3.4-6 presents the maximum and minimum values of total phosphate, and Figure 2.3.4-7 presents specific conductance for the period 1981-1989. The data shown on these figures indicate

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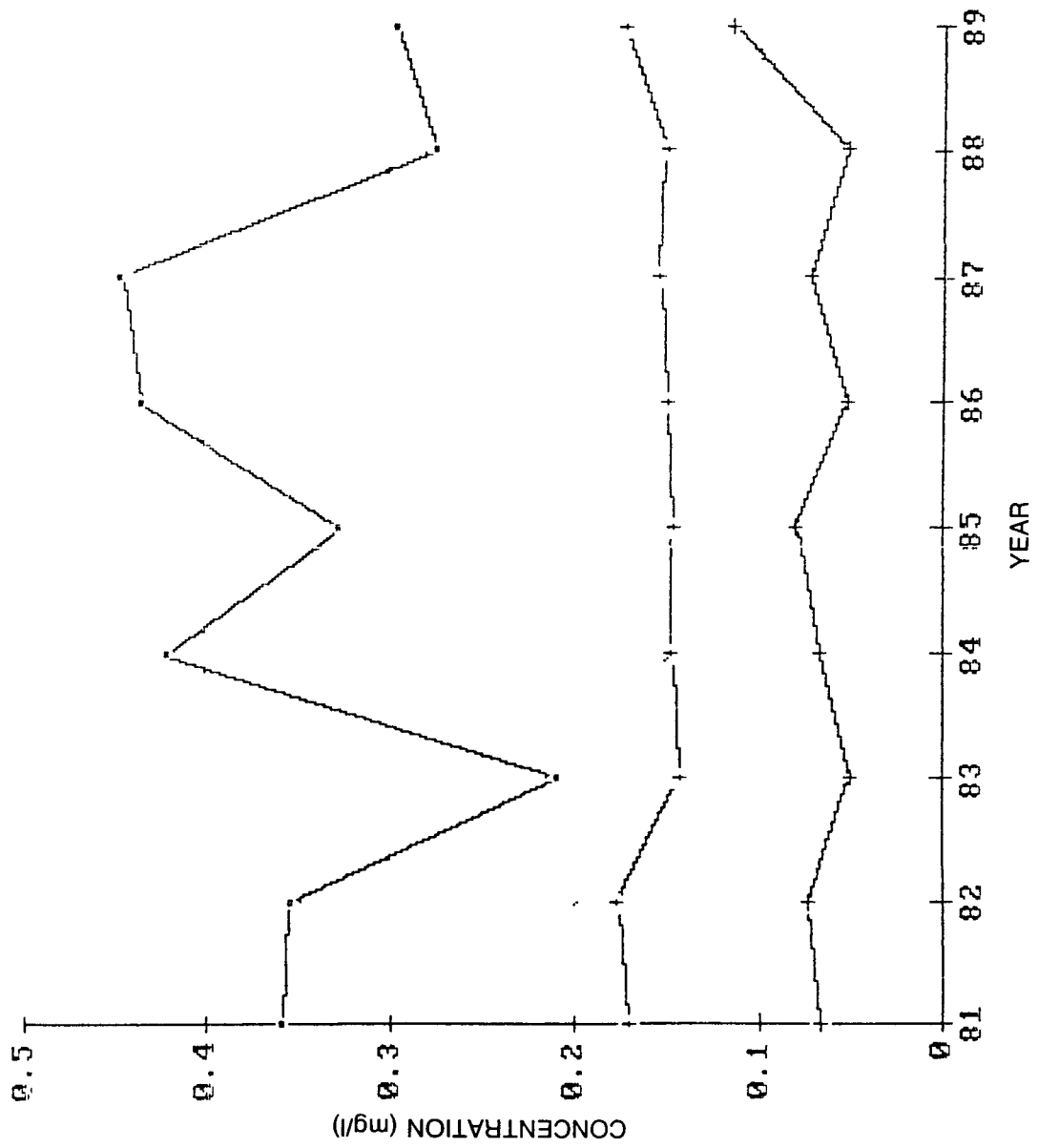


Figure 2.34-6

ST. LUCIE CANAL WATER TOTAL PHOSPHATE AT
S-308, 1981-1989

Source Data from SFWMD

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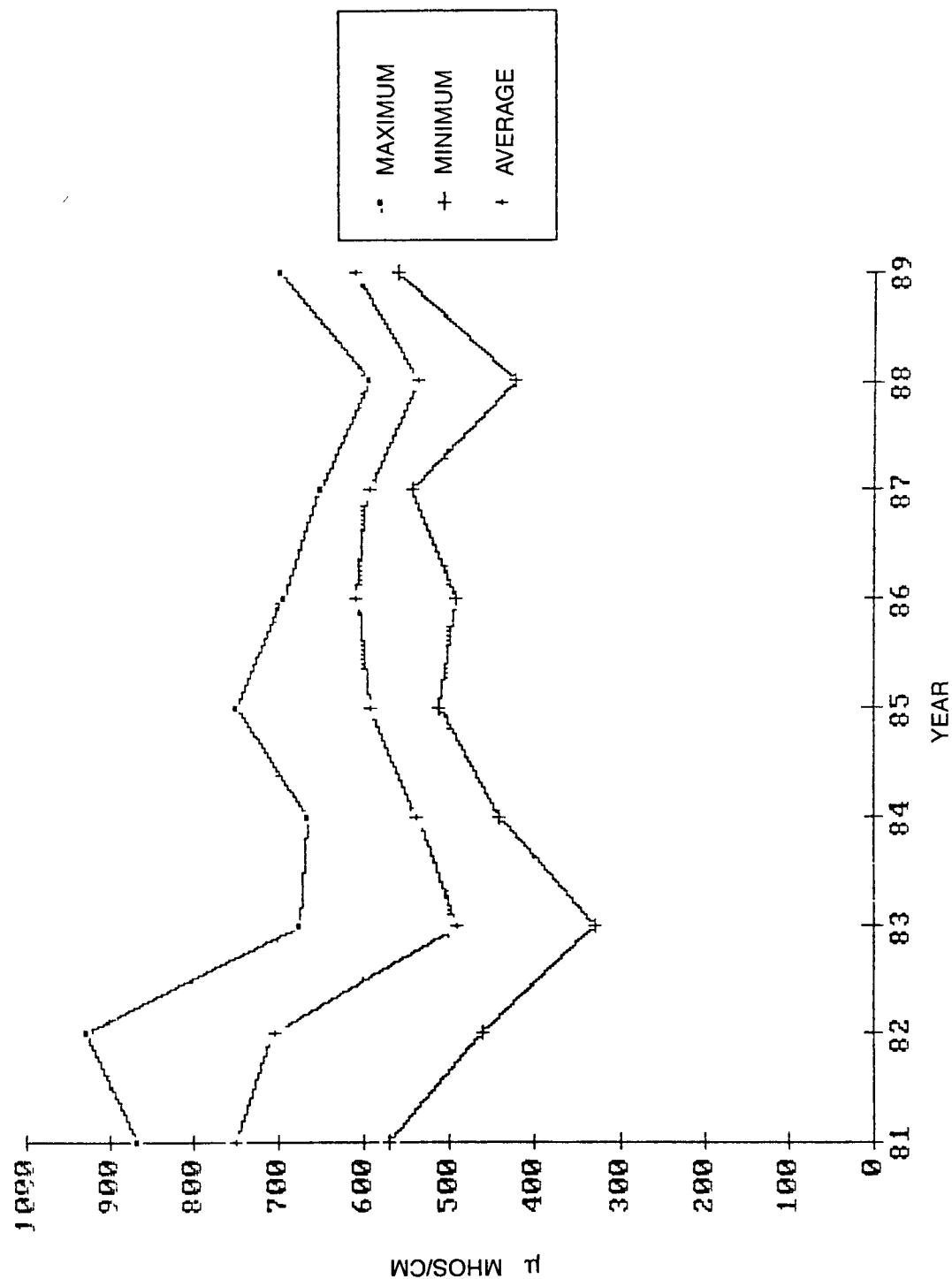


Figure 2.34-7

ST. LUCIE CANAL WATER SPECIFIC CONDUCTANCE AT S308, 1981-1989

Source Data from SFWMD

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Source USGS Water Supply Papers

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Table 2.3.4-4
APPLICABLE WATER QUALITY CRITERIA
(UNITS ARE MG/L UNLESS OTHERWISE NOTED)

<u>Parameter</u>	<u>Lake Okeechobee (Class I)</u> <u>and St. Lucie Canal (Class III)</u>
Alkalinity	20 (minimum)
Ammonia	0.02
Arsenic	0.05
Bacteria (Fecal Col.)	various limits
Beryllium	0.011 or 1.10 ⁽²⁾
Boron	--
Cadmium	0.0008 or 0.0012 ⁽²⁾
Chlorine	0.1
Chromium	0.5
Copper	0.03
Cyanide	0.0005
Detergent	0.5
D.O. (minimum)	5
Fluoride	5
Iron	1.0
Lead	0.03
Mercury	0.002
Nickel	0.1
Nutrients	non-numeric limits
Oil and Grease	
Dissolved	5.0
Free	0
Pesticides	extensive list
pH (standard units)	6-8.5 and ± 1
Phenols	0.0001
Phthalate Esters	0.0003
PCBs	0.000001
Radioactive Substances	
Radium (pc/l)	5
Alpha (pc/l)	15
Selenium	0.025
Silver	0.00007
Specific Conductance (micromho/cm)	1275 ⁽¹⁾
Total Dissolved Gases	110% Saturation
Turbidity (NTU)	29
Zinc	0.03

⁽¹⁾ Not to exceed 50 percent above background

⁽²⁾ Dependent on hardness

Source: F.A.C. 17-302, Part III, Water Quality Criteria - Surface Water

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Table 2.3.4-5
WATER QUALITY OF ST. LUCIE CANAL AT PORT MAYACA S-308 (1973-1989)

<u>Parameter</u>	<u>Units</u>	<u>Average</u>	<u>Minimum</u>	<u>Maximum</u>
Temperature	°C	24.7	14.8	32.8
D O	mg/l	7.4	1.8	12.1
Sp Conductance	µmhos	600.0	330.0	926.0
pH	units	7.88	6.95	9.09
NO ₂	mg/l	0.012	0.002	0.131
NH ₄	mg/l	0.06	0.01	0.44
Ortho-Phosphate	mg/l	0.058	0.002	0.345
Total Phosphate	mg/l	0.141	0.01	0.444
Cl	mg/l	84.2	36.50	198.10
Alkalinity	Meq/l	2.51	0.40	4.50

Source SFWMD

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that the average phosphorus concentration and specific conductance (a measure of TDS) are nearly the same for the long-term data

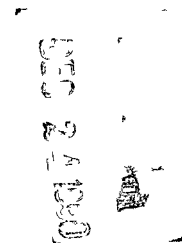
In addition to the measurements made at Port Mayaca by SFWMD, since 1978 FPL (FPL, December 1989) has maintained a water quality sampling program at various locations along the St. Lucie Canal, including a station at the Port Mayaca Lock and another station near Indiantown. A summary of water temperature measurements at these two locations for maximum, average, and minimum values are presented in Figures 2-3-4-8 and 2-3-4-9, respectively.

Taylor Creek/Nubbin Slough

Taylor Creek/Nubbin Slough (Class III) is the name commonly given to the basin that drains into Lake Okeechobee through a gated water control structure, Spillway Structure S-191, on the northeast shore of the Lake Okeechobee (Figure 2-3-4-10).

In 1973, the discharge from 104.5 square miles (upper Taylor Creek) was diverted into L-63N and L-63S, the new 10-mile long SFWMD canals that intercept Nubbin Slough and other tributaries (Mosquito Creek, Lettuce Creek, and Henry Creek). The L-63N and L-63S canal flows are then discharged into the Lake Okeechobee through a 1.1-mile canal (C-59) and the Structure S-191 (SFWMD, June 1986).

The basin formed by this diversion, the current Taylor Creek/Nubbin Slough basin, encompasses 188 square miles. The upper Taylor Creek portion of the basin is composed of four major tributaries: Williamson Main, Northwest Taylor Creek, Little Bimini Creek, and Otter Creek. Land uses in the basin, based on 1980 estimates, are primarily improved pasture (68 percent), forest and rangeland (22.3 percent), urban (3.2 percent), and citrus and miscellaneous (6.5 percent) (SFWMD, January 1989).



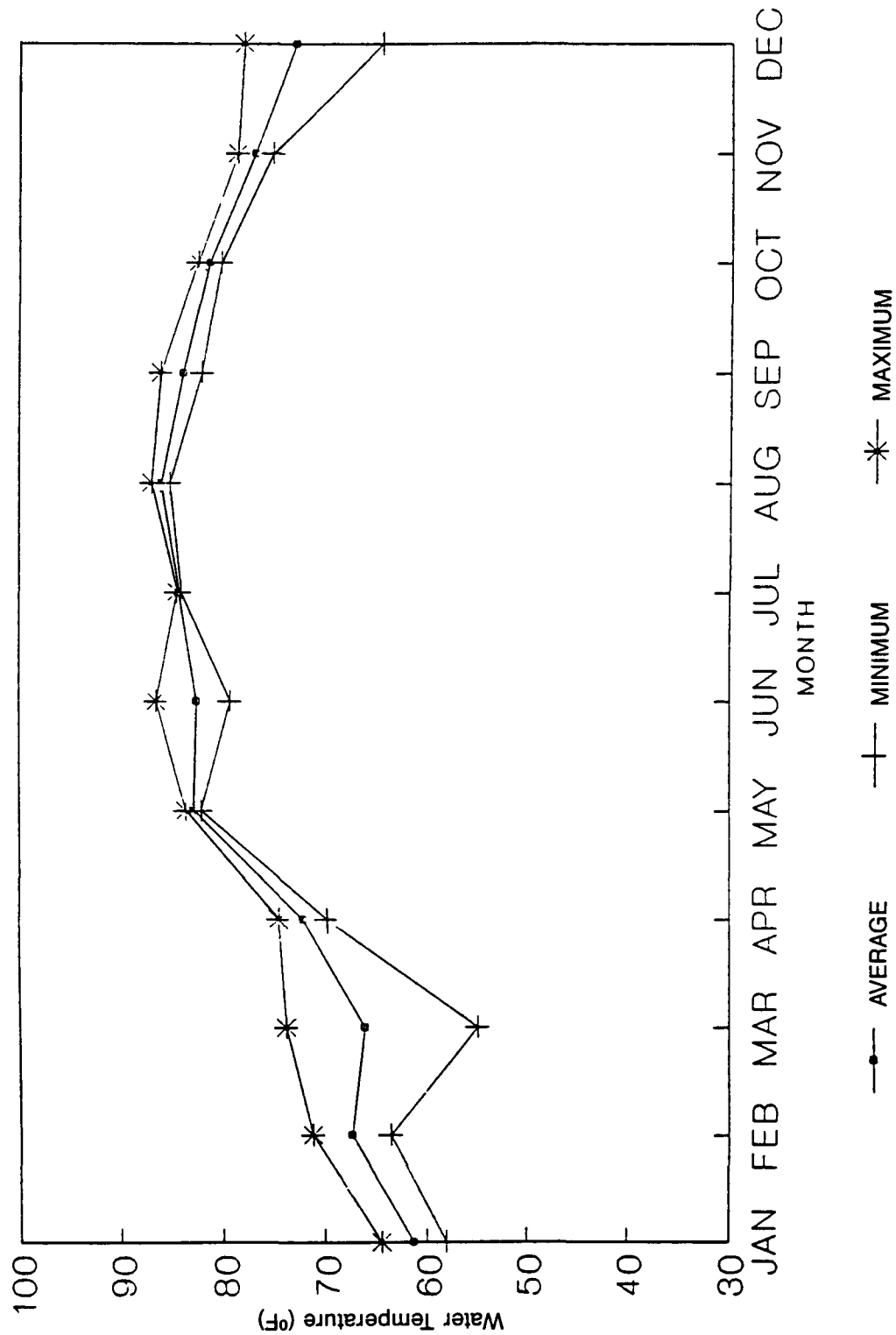


Figure 2.3.4-8
WATER TEMPERATURES — ST. LUCIE CANAL AT
PORT MAYACA, 1978-1987

Source FPL, 1989

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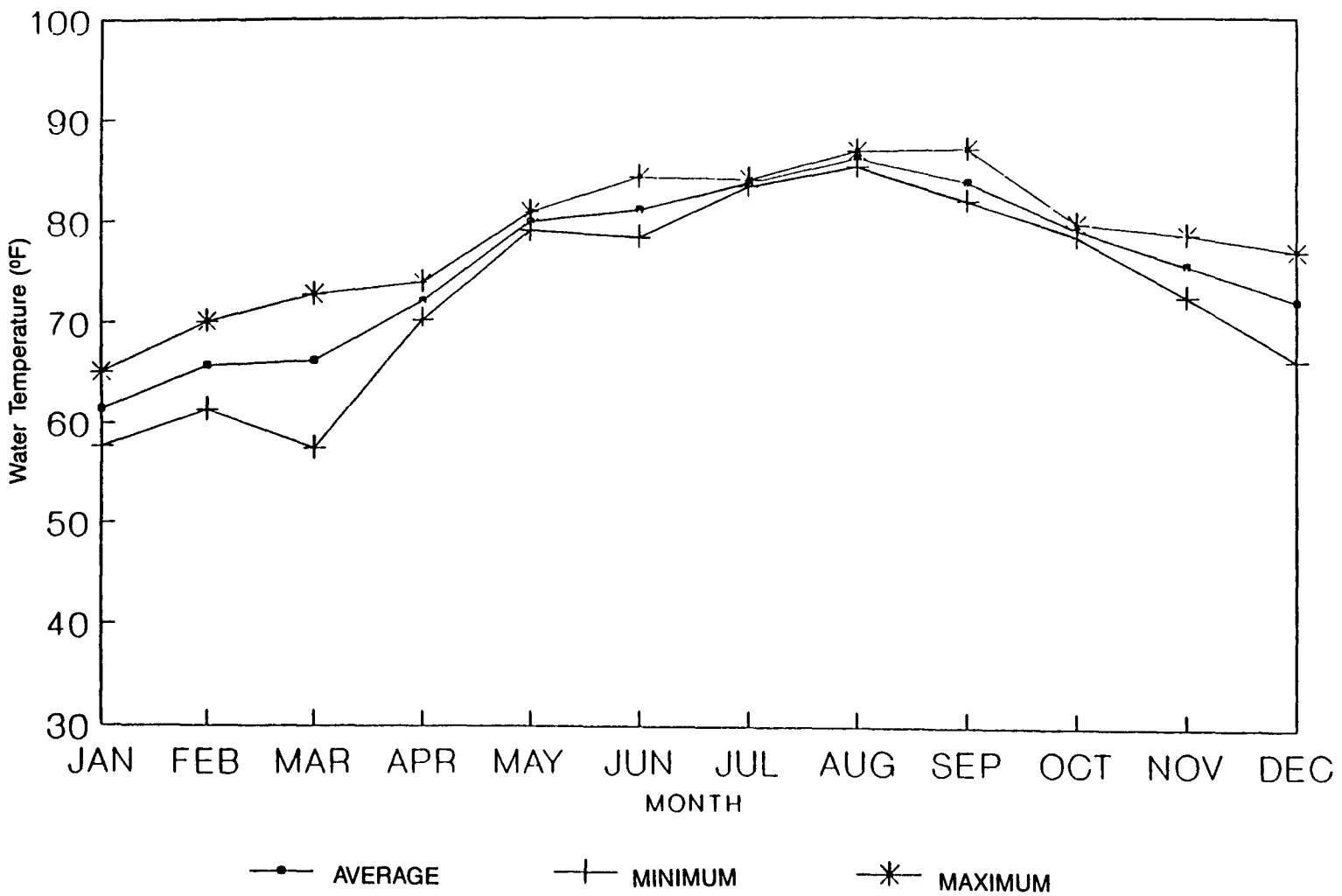


Figure 2.3.4-9
WATER TEMPERATURES — ST. LUCIE CANAL,
1978-1987

Source: FPL, 1990

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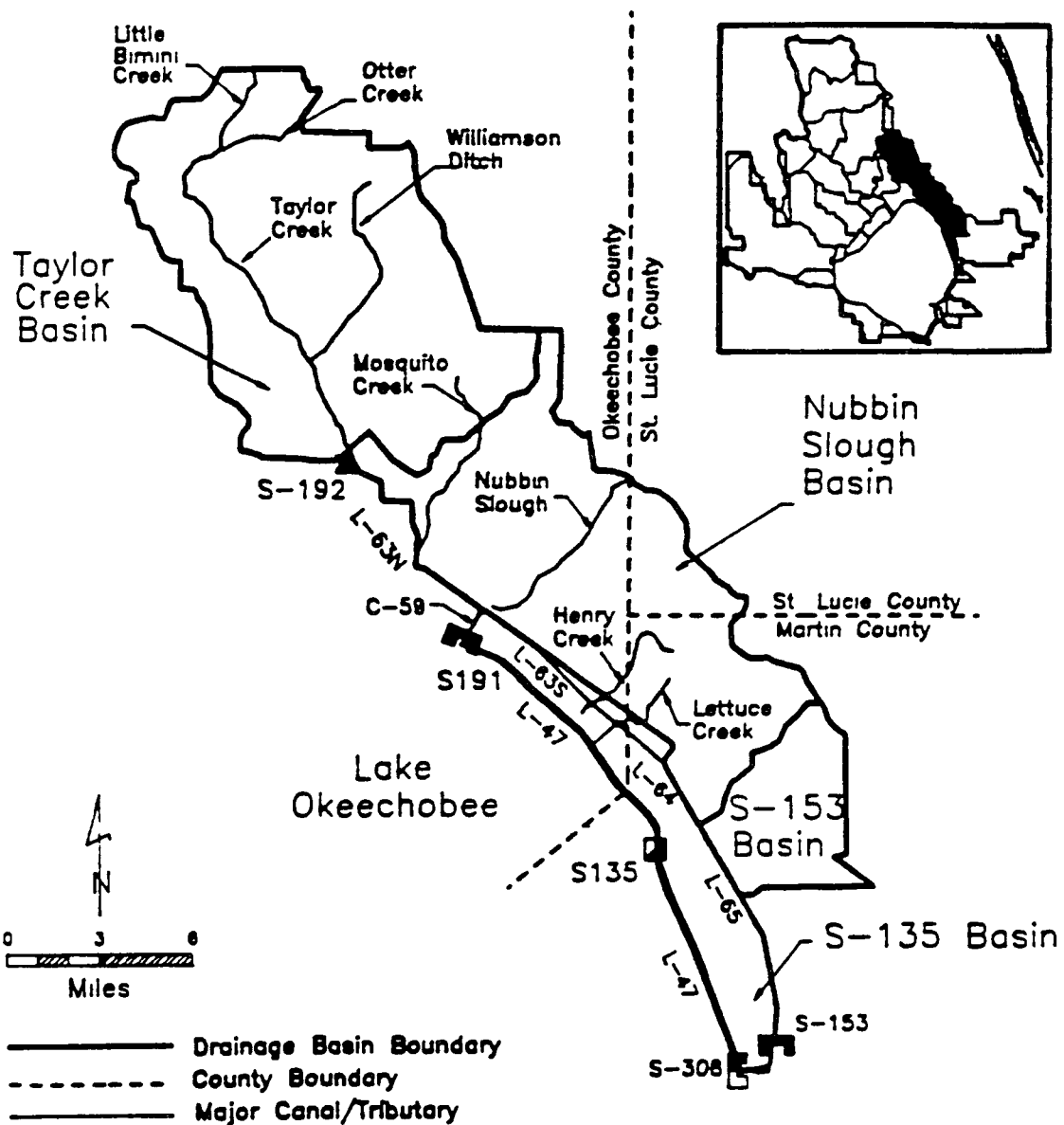


Figure 2.3 4-10
TAYLOR CREEK/NUBBIN SLOUGH WATERSHED
BOUNDARY

Source SWIM Plan for Lake Okeechobee, SFWMD, 1989

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Canal Cross Sections

Canal C-59 is about 1.1 miles long, connecting L-63 N&S to the S-191 structure. The design canal bed width is about 150 feet with invert at -4 feet MSL and side slopes of 2:1. This general information is obtained from design drawings developed by the U.S. Army Corps of Engineers and Garris Engineers, Inc. of 1971.

Canal L-63S (Nubbin Slough) is about 5.5 miles long with a variable bed width and level. The bed width ranges from 100 feet at its downstream end to about 10 feet at its upstream end near State Road 15B. The bed level changes from -4 to +20 feet MSL with side slopes of 2:1.

A bathymetric survey was performed at the junction of the three canals in connection with the base work for locating the plant water intake to supply water to the ICL site. The area surveyed is shown in Figure 2.3.4-11. The surveyed cross sections of Canals L-63N&S and C-59 are shown in Figure 2.3.4-12.

Water Levels

The water level in Canal C-59 is controlled by the operation of control structure S-191. This structure is a reinforced concrete, gated spillway with discharge controlled by three cable operated vertical lift gates. Operation of the gates is automatically controlled so that the gate hydraulic operating system opens or closes the gates in accordance with the seasonal operational criteria (SFWMD, June 1986).

This structure maintains optimum water control stages in the upstream agricultural area. It passes the 10-year design flood without exceeding upstream flood design stage, and restricts downstream flood stages and discharge velocities to non-damaging levels, it prevents flooding from hurricane tides on Lake Okeechobee, and it permits backflow up to 330 cfs to the north to meet agricultural water requirements.

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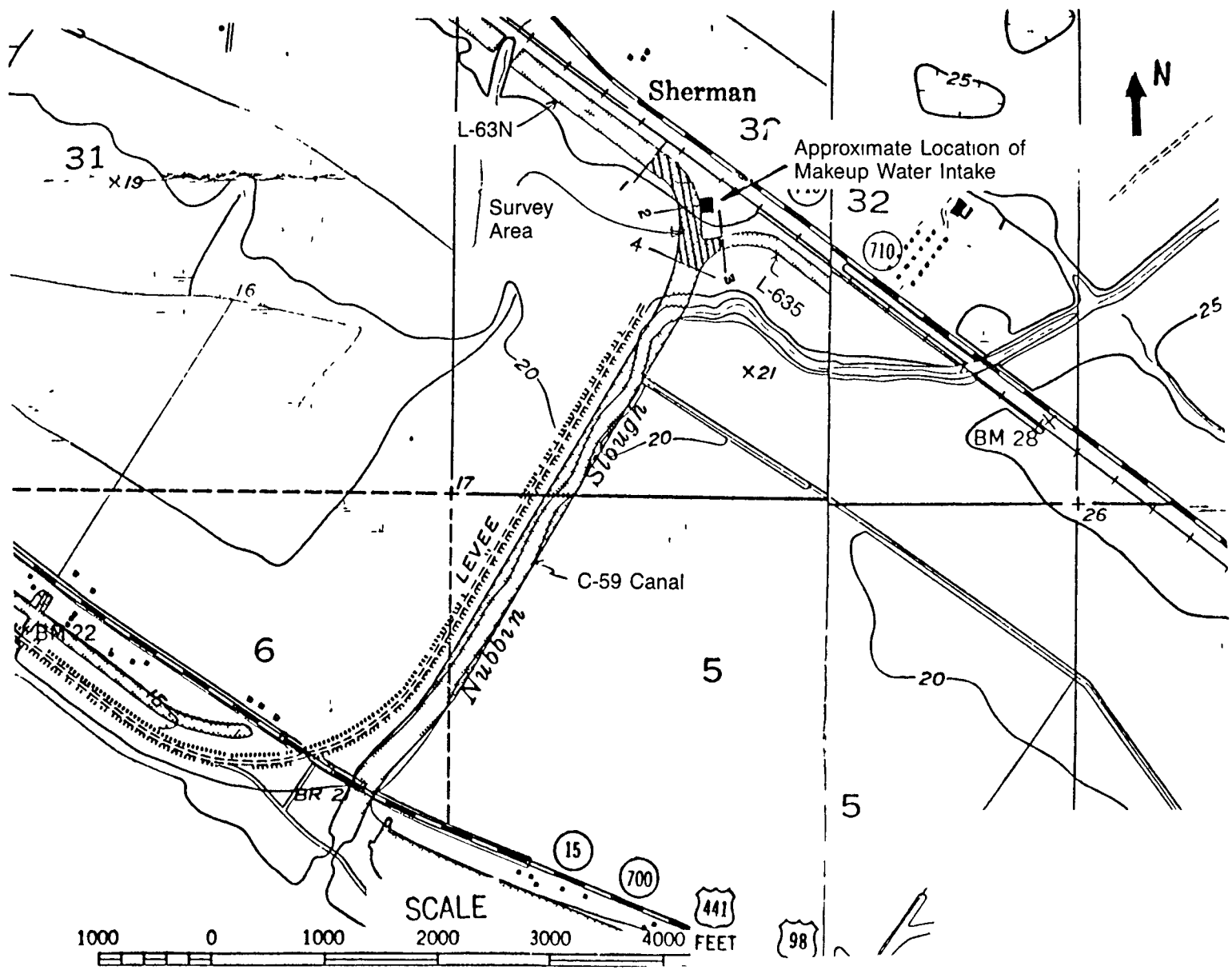


Figure 234-11
BATHYMETRIC SURVEY LOCATION

Source Bechtel 1990

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L-63N

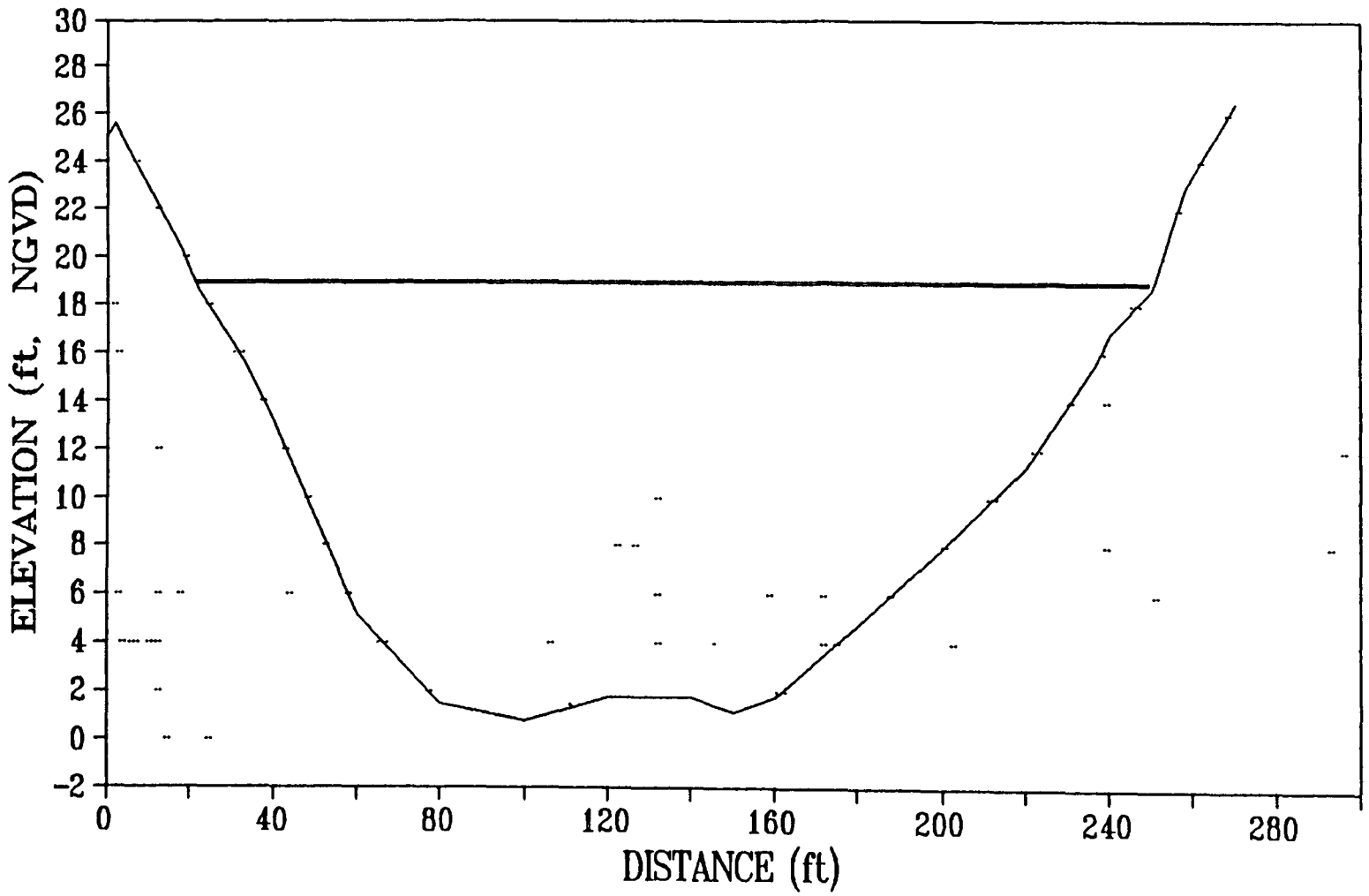


Figure 2.3.4-12 Sheet 1
CROSS SECTION OF L-63N CANAL NEAR
PLANT WATER INTAKE

Source ECT, 1990

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L-63S

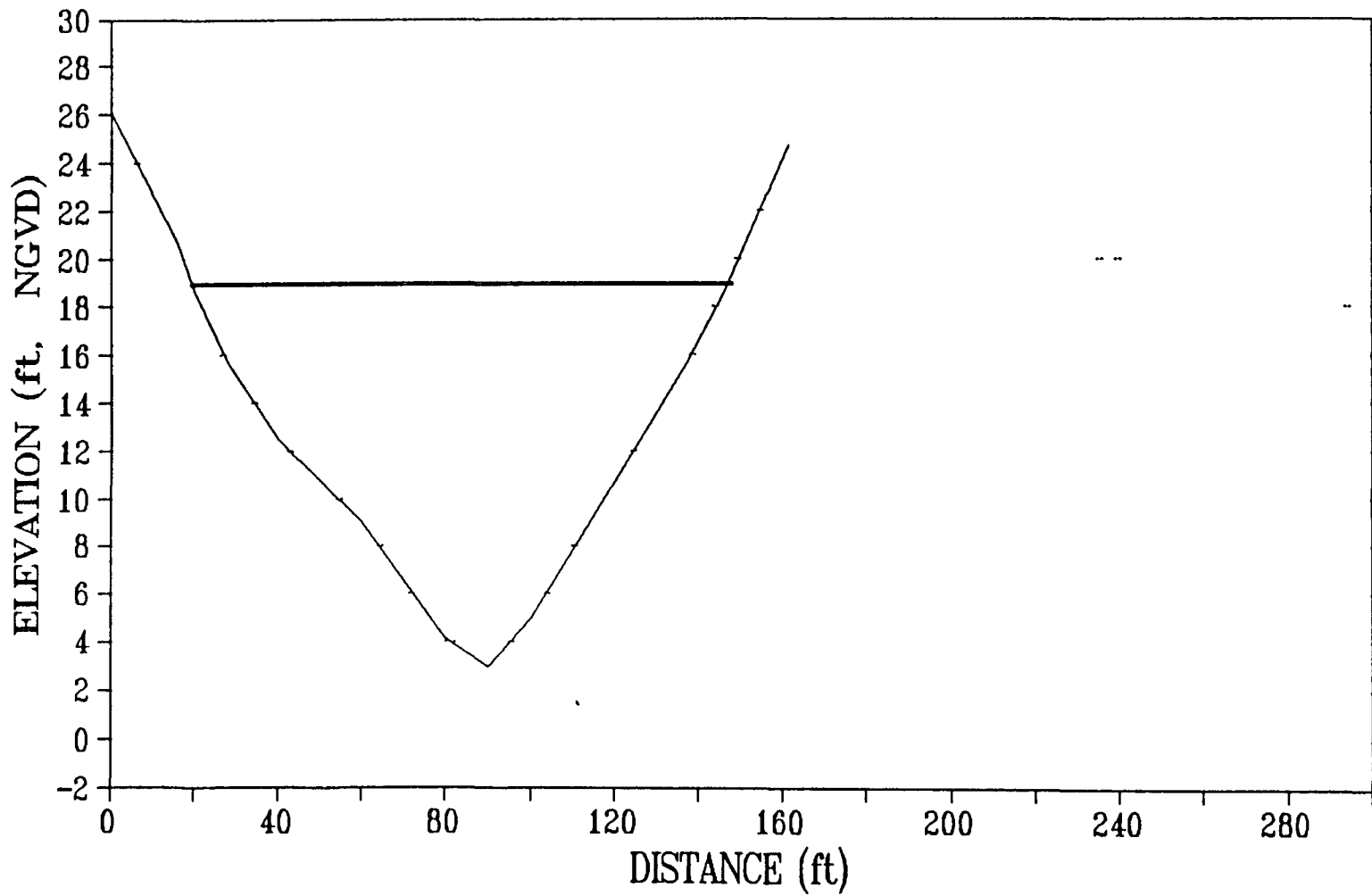


Figure 234-12 Sheet 2
CROSS SECTION OF L-63S CANAL NEAR THE
JUNCTION WITH C-59

Source ECT 1990

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C-59

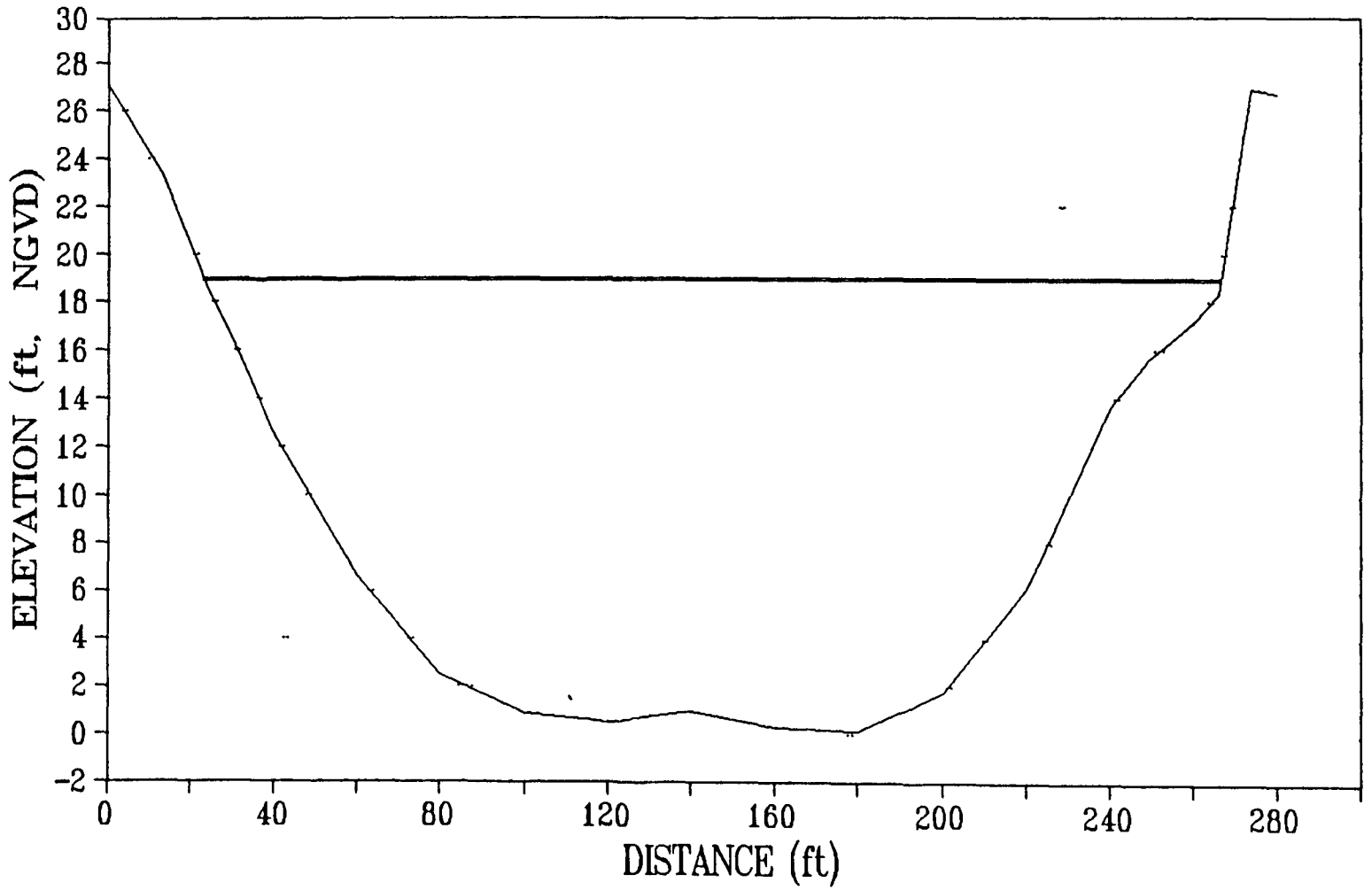


Figure 234-12 Sheet 3
CROSS SECTION OF C-59 UPSTREAM OF S-191

Source ECT, 1990

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This structure is operated to maintain, insofar as is possible, headwater elevations within 0.2 feet above design water level and 0.2 feet below the 19.0-foot optimum water level (SFWMD, June 1986). Four manually operated gates on overflow slots in the main gate control small discharges without raising the upstream stage. When the discharge exceeds the capacity of these gates, the automatic controls function as follows:

- When the headwater elevation rises to 19.7 feet, the gates will open at 6 inches per minute, but the gate opening will be governed by the Differential Head versus Gate Position Curve, and it will not exceed the maximum allowable opening position.
- When the headwater elevation rises or falls to 19.5 feet, the gates will become stationary.
- When the headwater elevation falls to 19.3 feet, the gates will close at 6 inches per minute.

Historical daily water levels at S-191 have been collected by SFWMD since 1973. The water level data are summarized to show monthly and maximum and minimum monthly averages, as presented in Table 2.3.4-6.

Discharges

Flow records at S-191 since July 1973 showed that the flow is not continuous and responds largely to the rainfall. During any given month, the flow can vary from several hundred cubic feet per second to zero within a few days. In general, the rainy season (April to October) exhibits large flow, both in magnitude and in duration. The winter months generally have very low discharge as a result of the low rainfall. In the water budget study performed by SFWMD for Lake Okeechobee for the period from 1973 to 1979 (SFWMD, May 1981), the mean annual discharge from S-191 into the lake amounted to about 154,000 acre feet per year, which

Table 2.3.4-6
HISTORIC WATER LEVELS OF TAYLOR CREEK/NUBBIN SLOUGH
AT S-191 (1974-1989)

<u>Month</u>	<u>Monthly Avg. ft</u>	<u>Daily Min. ft</u>	<u>Daily Max. ft</u>
January	19 10	18 55	19 58
February	19 11	18 57	19 93
March	19 11	18 76	19 58
April	19 07	18 27	19 70
May	19 02	18 50	19 55
June	19 05	18 14	19 58
July	19 12	18 34	20 65
August	19 14	18 11	19 57
September	19 10	18 01	20 34
October	19 10	17 70	19 59
November	19 14	18 80	19 59
December	19 12	18 37	19 58

Source South Florida Water Management District, Data Management Division,
Department of Research and Evaluation

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represents about 4 to 5 percent of the total inflow to the lake of about 3,500,000 acre feet

The daily flow records at S-191 obtained from the SFWMD were analyzed to determine seasonal and long-term variability. Table 2 3 4-7 presents the mean maximum and minimum monthly average discharges for each month for the period 1974 to 1989. Based on these data, the long-term mean annual flow at S-191 is 106,000 acre feet per year. This rate of inflow to the lake reflects the below average precipitation in 1981, 1986, and 1989.

Water Quality

The Taylor Creek/Nubbin Slough basin was singled out by the 1986 Lake Okeechobee Technical Advisory Committee as a priority basin in which to apply phosphorus controls. Approximately 143 tons of phosphorus are discharged from the basin to the Lake Okeechobee each year. This basin ranks as the number one phosphorus contributor to the lake with an annual flow-weighted concentration of 0.947 mg/l (USGS, 1981). Over the period of 1973 through 1987, the Taylor Creek/Nubbin Slough watersheds annually contributed about 21.2 percent of the phosphorus input into Lake Okeechobee, yet contributed only 3.7 percent of the lake's inflow water (SFWMD, January 1989).

Water quality samples have been collected and analyzed at S-191 by South Florida Water Management District since 1973. These data are presented in this section for two periods. The initial period covers 1973 to 1980 and the recent period, 1980 to 1989. This division is selected to show the effect of the water quality management and improvement program established by SFWMD. Table 2 3 4-8 presents a summary of the data collected by SFWMD (SFWMD, May 1981) in connection with Lake Okeechobee Water Quality Studies. These studies showed that Taylor Creek/Nubbin Slough at S-191 was the largest contributor of phosphorus (28.5 percent) with minor contribution to total nitrogen and chloride.

Table 2.3.4-7
HISTORIC MEAN DISCHARGES (csf) FROM TAYLOR CREEK/NUBBIN
SLOUGH AT S-191 (1974-1989)

<u>Month</u>	<u>Average</u>	<u>Minimum</u>	<u>Maximum</u>
January	103 5	8 2	597 3
February	105 0	3 1	583 9
March	91 9	3 4	379 2
April	44 3	0	226 1
May	62 7	0	339 0
June	151 2	0	878 6
July	181 5	4 7	744 9
August	275 3	7 2	693 7
September	396 9	6 6	1849 5
October	159 8	15 7	516 9
November	95 2	8 1	512 3
December	89 2	8 0	518 5

Source South Florida Water Management District, Data Management Division,
Department of Research and Evaluation

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Table 2.3.4-8
SELECTED WATER QUALITY PARAMETERS AT S-191
(APRIL 1973 - MARCH 1980)

<u>Parameter</u>	<u>Concentration</u>		<u>Units</u>
	<u>Mean</u>	<u>Range</u>	
TOC	20 50	8 9-35 9	mg/l
TSS	9 6	1 0-136 4	mg/l
Sp Conductance	60 3	130-1300	μmhos/cm
pH	7 06	5 7-8 51	
Na	61 94	70 0-151 20	mg/l
K	7 66	2 17-13 46	mg/l
Ca	35 56	7 00-74 47	mg/l
Mg	11 72	2 80-25 00	mg/l
Total Fe	0 48	0 02-1 37	mg/l
SO ₄	38 4	9 5-75 5	mg/l
Cl	111 1	15 6-355 8	mg/l
Silica	6 5	0 5-48 0	mg/l
Alkalinity	1 38	0 34-4 22	Meq/l
Hardness	137 0	29 0-276 1	mg/l
Ortho-Phosphate	0 749	0 577-0 992	mg/l
Total Phosphate	0 906	0 737-1 106	mg/l
Total Weighted Nitrogen	2 29*	1 95-2 74	mg/l

*Weighted mean annual average values 1973-1979

Source South Florida Water Management District (SFWMD, May 1981)

The data in Table 2 3 4-9 present the 1980 to 1989 average water quality data. Comparison of these tables shows a clear lower concentration of nitrate and phosphate in the most recent years. Other parameters remain approximately the same.

2.3.4.2 Measurement Programs

No independent measurement programs were undertaken for the SCA. Water quality data were obtained from historical sources.

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Table 2.3.4-9
WATER QUALITY OF TAYLOR CREEK/NUBBIN SLOUGH
AT S-191 (1980-1989)

<u>Parameter</u>	<u>Concentration</u>
pH	7.1
Alkalinity (Meq/l)	64
Total Dissolved Solids	380
Total Hardness (as CaCO ₃)	130
Silica	7.8
Ammonia	-
Calcium	34
Magnesium	11
Sodium	61
Potassium	8.1
Iron	0.50
Copper	-
Manganese	-
Sulfate	33
Chloride	110
Fluoride	-
Nitrate	0.46
Phosphate	0.81

NOTE Concentrations are in mg/l of the ion

Source South Florida Water Management District Water Quality Computer Printout
 Data Sheets

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2.3.5 VEGETATION/LAND USE

2.3.5.1 Site Description

The proposed ICL facility will be located south of SR 710, approximately 4 miles south-southeast of FPL's Martin plant site, and approximately 3 miles west-northwest of Indiantown, the nearest community. The site adjoins a highly developed area consisting of existing and former industrial facilities along SR 710. The ICL facility will also include an approximately 19-mile-long cooling water pipeline right-of-way between the site and a proposed cooling water intake located along Taylor Creek/Nubbin Slough.

The ICL site is located on level, undeveloped terrain bounded by an existing FPL transmission line, the Caulkins Indiantown Citrus Processing facility, and the FSC facility to the north, and by pine flatwoods habitat to the east, west, and south. The surrounding land uses are primarily industrial and agricultural, and include citrus, improved pasture, rangeland, truck crops, and sugarcane land categories.

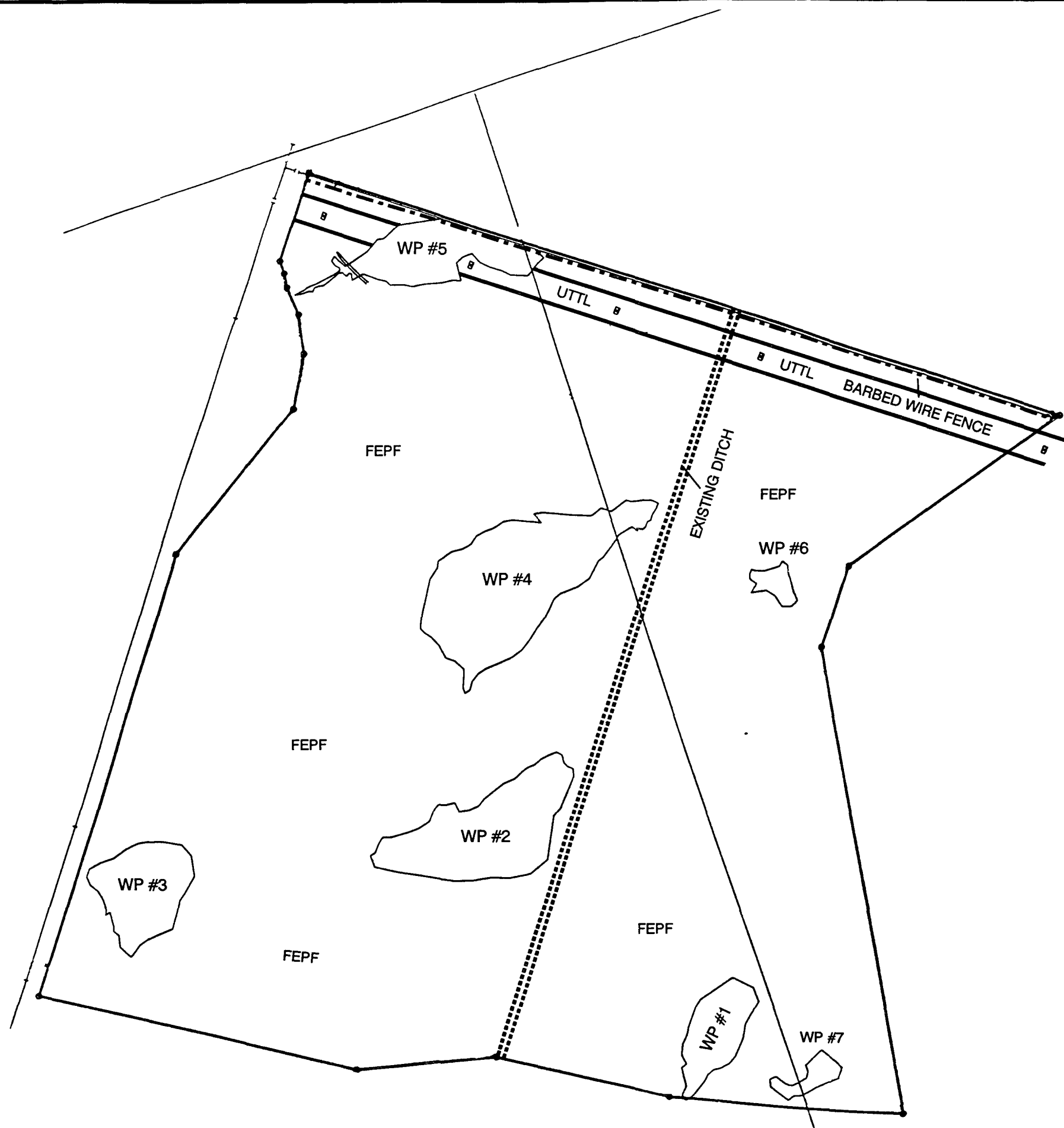
The predominant natural vegetation of the site consists of pine flatwoods with scattered shallow wet prairie wetlands containing herbaceous and shrub vegetation. Figure 2.2.3-1 is a land cover/land use map of the project area (project site and a 5-mile radius) as previously shown in Section 2.2.3.3. Figure 2.3.5-1 shows a more detailed vegetation and land use map of the approximately 232-acre project site.

The vegetation and land use components of the project site and the surrounding land located within a 5-mile radius were categorized using the Level III SFWMD Land Use and Land Cover Classification System. Since FDER approved mapping of land use and land cover classifications using the more detailed and regionally adapted SFWMD land use and land cover classification system for another recent power plant site certification application, this SFWMD system of classification was

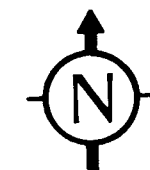
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Figure 2.3.5-1
VEGETATION/LAND USE MAP
OF THE ICL PROJECT SITE

Poor Original



- KEY
- FEPF - PINE FLATWOODS
 - WP - WET PRAIRIE
 - UTTL - MAJOR TRANSMISSION LINE



0 500 1000
SCALE IN FEET

SOURCE SOUTH FLORIDA WATER
MANAGEMENT DISTRICT LAND USE AND
LAND COVER CLASSIFICATION, n d ,
ENVIRONMENTAL CONSULTING &
TECHNOLOGY, INC , 1990

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also used in this application instead of the Florida Land Use and Cover Classification System (FLUCCS) (1976) A copy of SFWMD's Land Use and Land Cover Classification System is provided in Chapter 10

The following vegetation community types were identified on and within a 5-mile radius of the ICL project site

- **Agriculture (A)**
 - Improved pasture (APIM)
 - Citrus (AMCT)
 - Sugarcane (ACSC)
 - Truck crops (ACTC)
- **Rangeland (R)**
 - Grassland (RG)
 - Brushland (RSSB)
 - Palmetto prairies (RSPP)
- **Forested uplands (F)**
 - Pine flatwoods (FEPF)
 - Pine/cabbage palm (FMPC)
 - Cabbage palms/oaks (FMCO)
 - Forested old field (FMOF)
 - Mixed forested (FM)
- **Wetlands (W)**
 - Non-forested freshwater (WN)
 - Pine and wet prairies (WXPP)
 - Cypress swamp (WFCY)
 - Mixed forested (WFMX)

Acreages of each vegetation type on the project site are shown in Table 2 3 5-1 In addition to these acreage determinations, a qualitative evaluation of ecological quality is also provided for each community type, together with information on the level and principal source of existing ecological disturbances (see Table 2 3 5-1) The "low" quality designation is provided to reflect a highly altered and/or impacted condition Vegetation assigned a "moderate" level of ecological quality display evidence of some physical disturbance, but still retain a physiognomy associated with the representative natural community type A "high" quality classification refers to community types with little or no disturbances that appear to be in a relatively

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Table 2 3 5-1
SUMMARY OF VEGETATION COMMUNITIES AT THE INDIANTOWN COGENERATION PROJECT SITE, 1990

Vegetation Community Type*	Acreage (acres)	Relative Ecological Quality ⁺	Level of Ecological Disturbance	Principal Source of Disturbance
Pine and wet prairie	232	Moderate to high	Moderate	Periodic wildfires
Pine flatwoods--FEPF**	(200)	Moderate to high	Low	Cattle grazing, road construction
Wet prairie--WP	(24)	Moderate to high	Moderate	Drainage
Ruderal land--UTT	(8)	Low High		Construction and clearing operations
Total uplands	208			
Total wetlands	24			
Total area	232			

* Letters that represent the Level III SFWMD Land Use and Land Cover Classification Code and Vegetation Community Types shown on Figure 2 3 5-1

+ High = displays little or no physical disturbance, of a pristine quality

Moderate = evidence of physical disturbance present, but still retains representative structure and species composition

Low = poor quality, highly altered condition

**Vegetation types that reflect subcommunity designations used to further describe and delineate pine and wet prairie on the project site

Source ECT, 1990

undisturbed state Mapped data and descriptive accounts which follow reflect site conditions within 6 months of the filing date of this application

2.3.5.2 Vegetation Community Quality and Condition

The most significant alterations to the vegetation communities on the proposed ICL site are those related to drainage and use of the site as cattle rangeland Historical drainage patterns have been altered by the construction of a deep drainage ditch traversing the plant site in a north-south direction, by construction of a transmission line right-of-way along the northern boundary of the site, and by several off-road vehicle trails and access roads throughout the site

The effects of drainage alteration are most apparent in the wet prairies, changes to the pine flatwoods of the site are less apparent The changes in wetlands are manifested in the increase in upland plant species in the outer transition zone This is most obvious in wetlands adjacent to the ditch Even though species changes are obvious in all wet prairies, the functional values remain moderate to high

The pine flatwoods are relatively undisturbed except for road construction and minor effects of cattle grazing The greatest change observed is due to past wildfires (within the last 5 to 10 years) which destroyed extensive areas of the canopy and groundcover In some areas, areas of former canopy composed of mature south Florida slash pine were killed

The greatest effect of periodic fires is the destruction of invading oaks and other hardwoods within the pine flatwoods community Fire, a natural factor in the maintenance of flatwoods throughout Florida, is necessary to maintain the structural and functional integrity of pineland communities In general, the quality and condition of pine flatwoods on the site remains moderate to high due to such periodic burning

2.3.5.3 Dominant Indicator Vegetation

South Florida plant communities (i.e., wildlife habitats) exhibit characteristics of subtropical and temperate vegetation depending upon various edaphic, climatic, and topographic features. The classification of these uplands, wetlands, and aquatic systems is usually accomplished by the vegetative structure, plant species dominance and diversity, soil substrate, topographic relief, and hydroperiod.

The vegetation communities of the site and within a 5-mile radius of the ICL project site were qualitatively surveyed by plant ecologists/taxonomists in the spring (dry season) and summer-fall (wet season) of 1990. Natural vegetation communities on and within a 5-mile radius of the proposed project site consist of pine and wet prairie (WXPP), pine flatwoods (FEPF), pine/cabbage palms (FMPC), cabbage palm/oaks (FMCO), mixed-forested uplands (FM), non-forested freshwater wetlands (WN), cypress swamp (WFCY), mixed-forested swamp (WFMX), and palmetto prairie (RSPP). Slightly altered plant communities include forested old fields (FMOF), brushland (RSSB), and grassland (RG). Agricultural lands in which the original vegetation has been replaced with a cultivar(s) for the purpose of farming, includes improved pasture (APIM), citrus (AMCT), truck crops (ACTC), and sugarcane (ACSC). Pine and wet prairie is the dominant natural community type within the undeveloped portions of the project area.

As indicated previously, 16 natural, slightly altered, or agricultural plant community types have been identified as existing on or within 5 miles from the ICL site. All of these vegetation communities were divided into uplands and wetlands, and described in terms of vegetation, physical structure, and ecology.

A plant species inventory of the ICL site is provided in Table 2.3.5-2. The plant species are listed by three plant community types. From a vegetation perspective, the entire 232-acre plant site is designated as pine and wet prairie. However, to provide a more detailed species listing by plant association, three sub-community

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Table 2 3 5-2
Plant Species Inventory of the ICL Project Site
 (Page 1 of 6)

Scientific Name	Common Name	Plant Community Type (WXPP)*		
		PF	WP	RL
<u>Trees</u>				
<u>Acer rubrum</u>	Red maple			X
<u>Ilex cassine</u>	Dahoon holly	X		
<u>Magnolia virginiana</u>	Sweetbay magnolia	X		
<u>Melaleuca quinquenervia</u>	Punk tree	X		
<u>Persea palustris</u>	Swampbay	X		
<u>Pinus elliotii</u> var <u>densa</u>	South Florida slash pine	X		
<u>Quercus nigra</u>	Water oak	X		
<u>Quercus virginiana</u>	Live oak	X		
<u>Quercus laurifolia</u>	Laurel oak	X		
<u>Sabal palmetto</u>	Cabbage palm	X		
<u>Shrubs and Small Trees</u>				
<u>Annona glabra</u>	Pond apple			X
<u>Asimina reticulata</u>	Pawpaw	X		
<u>Baccharis halimifolia</u>	Groundsel bush	X		
<u>Befaria racemosa</u>	Tarflower	X		
<u>Callicarpa americana</u>	Beautybush	X		
<u>Cephalanthus occidentalis</u>	Buttonbush			X
<u>Gaylussacia dumosa</u>	Dwarf huckleberry	X		
<u>Hypericum fasciculatum</u>	St John's-wort			X
<u>Hypericum hypericoides</u>	St Andrew's-cross	X		
<u>Hypericum tetrapetalum</u>	St John's-wort	X		
<u>Hypericum reductum</u>	St John's-wort	X		
<u>Ilex glabra</u>	Gallberry	X		
<u>Ludwigia peruviana</u>	Primrose willow		X	X
<u>Lyonia fruticosa</u>	Staggerbush	X		
<u>Lyonia lucida</u>	Fetterbush	X		
<u>Myrica cerifera</u>	Wax myrtle	X	X	X
<u>Quercus minima</u>	Dwarf live oak	X		
<u>Rhus copallina</u>	Winged sumac	X		X
<u>Salix caroliniana</u>	Carolina willow		X	
<u>Schinus terebinthifolius</u>	Brazilian pepper		X	X
<u>Serenoa repens</u>	Saw palmetto	X		

Table 2 3 5-2
Plant Species Inventory of the ICL Project Site
(Page 2 of 6)

Scientific Name	Common Name	Plant Community Type (WXPP)*		
		PF	WP	RL
<u>Shrubs and Small Trees (Continued)</u>				
<u>Stillingia aquatica</u>	Corkwood		X	
<u>Vaccinium myrsinites</u>	Shiny blueberry	X		
<u>Herbs</u>				
<u>Aletris lutea</u>	Yellow colic-root	X		
<u>Ambrosia artemisiifolia</u>	Common ragweed			X
<u>Amphicarpum muhlenbergianum</u>	Blue maidencane		X	
<u>Andropogon brachystachyus</u>	Shortspike bluestem	X	X	
<u>Andropogon virginicus</u>	Broomsedge	X	X	
<u>Andropogon virginicus</u>	Chalky bluestem	X	X	
var glaucus				
<u>Aristida lanosa</u>	Longleaf threeawn		X	
<u>Aristida stricta</u>	Wiregrass	X		
<u>Aristida spiciformis</u>	Bottlebrush threeawn	X		
<u>Asclepias pedicellata</u>	Milkweed	X		
<u>Axonopus affinis</u>	Common carpetgrass	X		X
<u>Axonopus furcatus</u>	Big carpetgrass		X	
<u>Azolla caroliniana</u>	Mosquito fern			X
<u>Bacopa monnieri</u>	Hyssop		X	
<u>Balduina angustifolia</u>	Yellow buttons	X		
<u>Bidens alba</u>	Beggar-ticks			X
<u>Blechnum serrulatum</u>	Saw-toothed fern		X	X
<u>Boehmeria cylindrica</u>	False nettle		X	X
<u>Cassia chamaecrista</u>	Partridge-pea	X		
<u>Centella asiatica</u>	Coinwort		X	X
<u>Cladium jamaicense</u>	Sawgrass		X	
<u>Commelina diffusa</u>	Day-flower	X		X
<u>Conyza canadensis</u>	Dwarf horseweed			X
<u>Cuphea carthagenensis</u>	Cuphea		X	
<u>Cynodon dactylon</u>	Bermudagrass		X	
<u>Cyperus haspan</u>	Sedge		X	
<u>Cyperus polystachyos</u>	Sedge		X	
<u>Cyperus ligularis</u>	Sedge	X		
<u>Dichanthelium spp</u>	Dichanthelium grasses	X	X	

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Table 2 3 5-2
Plant Species Inventory of the ICL Project Site
 (Page 3 of 6)

Scientific Name	Common Name	Plant Community Type (WXPP)*		
		PF	WP	RL
<u>Herbs (Continued)</u>				
<u>Dichanthelium dichotomum</u> var <u>ensifolium</u>	Dichanthelium			
<u>Dichanthelium erectifolium</u>	Dichanthelium grass		X	
<u>Digitaria decumbens</u>	Pangolagrass			X
<u>Diodia virginiana</u>	Buttonweed	X		
<u>Eclipta alba</u>	Eclipta		X	X
<u>Eichhornia crassipes</u>	Water hyacinth			X
<u>Eleocharis baldwinii</u>	Clubrush	X	X	
<u>Elephantopus elatus</u>	Florida elephant's-foot	X		
<u>Emilia fosbergii</u>	Cupid's shavingbrush			X
<u>Eragrostis spectabilis</u>	Purple lovegrass	X		
<u>Erechtites hieracifolia</u>	Fireweed		X	
<u>Erianthus giganteus</u>	Sugarcane plumegrass		X	
<u>Eriocaulon compressum</u>	Pipewort		X	
<u>Eulophia alta</u>	Wild coco	X		
<u>Eupatorium capillifolium</u>	Dog fennel	X	X	X
<u>Eupatorium compositifolium</u>	Dog fennel	X	X	
<u>Eupatorium mohrii</u>	Dog fennel	X		
<u>Euthamia minor</u>	Bushy goldenrod	X		
<u>Fuirena scirpoidea</u>	Umbrellagrass		X	
<u>Gnaphalium obtusifolium</u>	Rabbit's tobacco	X		X
<u>Gratiola ramosa</u>	Gratiola	X	X	
<u>Hydrocotyle umbellata</u>	Marsh pennywort		X	X
<u>Juncus effusus</u>	Soft rush		X	
<u>Lachnanthes caroliniana</u>	Redroot		X	
<u>Lachnocaulon anceps</u>	Bog-buttons	X	X	
<u>Limnobiium spongia</u>	Frog's-bit		X	
<u>Lippia nodiflora</u>	Carpetweed			X
<u>Ludwigia maritima</u>	Ludwigia	X		
<u>Ludwigia microcarpa</u>	Ludwigia		X	
<u>Ludwigia suffruticosa</u>	Ludwigia	X		
<u>Osmunda regalis</u>	Royal fern		X	
<u>Oxalis corniculata</u>	Lady's sorrel			X
<u>Oxypolis filiformis</u>	Water dropwort		X	
<u>Panicum hemitomon</u>	Maidencane		X	
<u>Panicum repens</u>	Torpedograss		X	

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Table 2 3 5-2
Plant Species Inventory of the ICL Project Site
 (Page 6 of 6)

Scientific Name	Common Name	Plant Community Type (WXPP)*		
		PF	WP	RL

<u>Vines (Continued)</u>				
<u>Vitis munsoniana</u>	Southern Fox Grape	X		X
<u>Epiphytes</u>				
<u>Phlebodium aureum</u>	Golden polypody	X		X
<u>Tillandsia recurvata</u>	Ball moss	X		X
<u>Tillandsia usneoides</u>	Spanish moss	X		X

*WXPP Pine and Wet Prairies-PF and WP designations used for the natural upland and wetland components of pine and wet prairie, (i e , pine flatwoods and wet prairie, respectively) The RL designation is used to describe the species composition of ruderal land on the site, including roadsides, ditches, and the existing transmission line right-of-way

Source ECT, 1990

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types have been included under the pine and wet prairie designation [i.e., pine flatwoods (PF), wet prairie (WP), and ruderal land (RL)]

To further evaluate vegetation species composition and structure within the project site, a quantitative sampling of vegetation was conducted within the relatively undisturbed areas of pine and wet prairie in September 1990. Two hydrologically-isolated wet prairies and three separate locations within the pine flatwoods were surveyed using the quadrat method along five transects as described in Section 2.3.6.3. Data summaries of values generated from the sampling (i.e., dominance, frequency, relative dominance, relative frequency, and importance value and rank) are provided in Tables 2.3.5-3 through 2.3.5-6. Narratives of the sampling results are also presented in the pine and wet prairie community description provided in the following paragraphs.

Uplands

Agricultural Areas

Improved Pasture, Citrus, Sugarcane, and Truck Crops Agricultural lands do not exist on the proposed plant site, but occur within a 5-mile radius. The most commonly encountered agricultural land is pasture. These areas have been cleared of native vegetation and planted with native or introduced grasses (bahia grass, winter rye, etc.). In the absence of maintenance or cattle grazing, these areas become dominated by old field vegetation such as dog fennel, broomsedge, and various legumes. The citrus groves are planted primarily with sweet orange and grapefruit. Truck crops basically consist of vegetables that vary with the season as well as market demand. Because of specialized growing needs, areas designated as sugarcane are almost always planted as such, except for small plots of rice and/or sod, which are sometimes substituted.

Table 2 3 5-3

QUANTITATIVE VEGETATION DATA ON THE HERBACEOUS LAYER OF WET PRAIRIE NO. 1

Scientific Name	Frequency	Dominance	Relative Frequency	Relative Dominance	Project I V	I V Rank
<u>Amphicarpum muhlenbergianum</u>	0 5625	0 2000	8 49	20 00	28 49	1
<u>Axonopus furcatus</u>	0 6250	0 1606	9 43	16 06	25 49	2
<u>Andropogon brachystachyus</u>	0 5625	0 1281	8 49	12 81	21 30	3
<u>Panicum hemitomon</u>	0 3750	0 1156	5 66	11 56	17 22	4
Water	0 3750	0 0825	5 66	8 25	13 91	5
<u>Rhynchospora tracyi</u>	0 2500	0 0713	3 77	7 13	10 90	6
<u>Rhynchospora microcarpa</u>	0 4375	0 0250	6 60	2 50	9 10	7
<u>Pluchea rosea</u>	0 3750	0 0163	5 66	1 63	7 29	8
<u>Dichanthelium erectifolium</u>	0 3125	0 0175	4 72	1 75	6 47	9
<u>Hypericum fasciculatum</u>	0 3125	0 0113	4 72	1 13	5 85	10
<u>Aristida lanosa</u>	0 2500	0 0181	3 77	1 81	5 58	11
<u>Centella asiatica</u>	0 3125	0 0075	4 72	0 75	5 47	12
<u>Limnobiium spongia</u>	0 1875	0 0188	2 83	1 88	4 71	13
<u>Pontederia cordata</u>	0 0625	0 0375	0 94	3 75	4 69	14
<u>Eleocharis baldwinii</u>	0 1250	0 0188	1 89	1 88	3 77	15
<u>Euthemia minor</u>	0 1875	0 0081	2 83	0 81	3 64	16
<u>Andropogon virginicus</u> var glaucus	0 1250	0 0156	1 89	1 56	3 45	17
<u>Rhynchospora fascicularis</u>	0 1250	0 0125	1 89	1 25	3 14	18
<u>Ludwigia microcarpa</u>	0 1250	0 0056	1 89	0 56	2 45	19
<u>Myrica cerifera</u>	0 1250	0 0038	1 89	0 38	2 27	20
<u>Proserpinaca pectinata</u>	0 1250	0 0038	1 89	0 38	2 27	20
Bare ground	0 0625	0 0031	0 04	0 31	1 25	22
<u>Sacciolepis striata</u>	0 0625	0 0031	0 94	0 31	1 25	22
<u>Xyris ambigua</u>	0 0625	0 0031	0 94	0 31	1 25	22
<u>Xyris caroliniana</u>	0 0625	0 0031	0 94	0 31	1 25	22
<u>Gratiola ramosa</u>	0 0625	0 0025	0 94	0 25	1 19	23
<u>Psilocarga nitens</u>	0 0625	0 0025	0 94	0 25	1 19	23
<u>Rhexia mariana</u>	0 0625	0 0013	0 94	0 13	1 07	24
<u>Eupatorium compositifolium</u>	0 0625	0 0006	0 94	0 06	1 00	25
<u>Ludwigia suffruticosa</u>	0 0625	0 0006	0 94	0 06	1 00	25
TOTAL	6.6250	1.0001	99.98	100.01	199.99	

Table 2 3 5-4
QUANTITATIVE VEGETATION DATA ON THE HERBACEOUS LAYER OF WET PRAIRIE NO. 2

Scientific Name	Frequency	Dominance	Relative Frequency	Relative Dominance	Project I V	I V Rank
<u>Axonopus furcatus</u>	1 0000	0 4558	18 46	45 58	64 04	1
<u>Amphicarpum muhlenbergianum</u>	0 8333	0 1308	15 39	13 08	28 47	2
<u>Euthamia minor</u>	0 9167	0 1000	16 92	10 00	26 92	3
Bare ground	0 5000	0 1250	9 23	12 50	21 73	4
<u>Andropogon virginicus</u> var <u>glaucus</u>	0 4167	0 0750	7 69	7 50	15 19	5
<u>Rhynchospora microcarpa</u>	0 5000	0 0267	9 23	2 67	11 90	6
<u>Hypericum fasciculatum</u>	0 4167	0 02417	7 69	2 42	10 11	7
<u>Rhexia mariana</u>	0 3333	0 0100	6 15	1 00	7 15	8
<u>Xyris caroliniana</u>	0 1667	0 0250	3 08	2 50	5 58	9
<u>Eragrostis spectabilis</u>	0 1667	0 0025	3 08	0 25	3 33	10
<u>Aristida spiciformis</u>	0 0833	0 0167	1 54	1 67	3 21	11
<u>Sacciolepis striata</u>	0 0833	0 0083	1 54	0 83	2 37	12
TOTAL	5.4167	1.000	100.00	100.00	200.00	

Source ECT, 1990

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Table 2 3 5-5
QUANTITATIVE VEGETATION DATA ON THE HERBACEOUS LAYER OF PINE FLATWOODS
 (Page 1 of 2)

Scientific Name	Frequency	Dominance	Relative Frequency	Relative Dominance	Project I V	I V Rank
<u>Aristida stricta</u>	0 6000	0 3105	11 01	31 05	42 06	1
<u>Andropogon virginicus</u>	0 4500	0 1095	8 26	10 95	19 21	2
Open	0 4500	0 0845	8 26	8 45	16 71	3
<u>Aristida spiciformis</u>	0 4000	0 0695	7 34	6 95	14 29	4
<u>Dichanthelium dichotomus</u>	0 4000	0 0495	7 34	4 95	12 29	5
<u>Hypericum reductum</u>	0 3500	0 0450	6 42	4 50	10 92	6
<u>Ilex glabra</u>	0 3000	0 0310	5 50	3 10	8 60	7
Shrubs	0 1000	0 0620	1 83	6 20	8 03	8
<u>Rhynchospora</u> sp	0 1000	0 0515	1 83	5 15	6 98	9
<u>Euthemia minor</u>	0 2500	0 0130	4 59	1 30	5 89	10
Pine needles/shrubs	0 0500	0 0490	0 92	4 90	5 82	11
Bare ground	0 1000	0 0205	1 83	2 05	3 88	12
<u>Andropogon virginicus</u> var <u>glaucus</u>	0 1500	0 0090	2 75	0 90	3 65	13
<u>Vaccinium myrsinites</u>	0 1500	0 0070	2 75	0 70	3 45	14
Open/shrub	0 0500	0 0245	0 92	2 45	3 37	15
<u>Lyonia lucida</u>	0 1000	0 0125	1 83	1 25	3 08	16
<u>Dichanthelium sabularum</u>	0 1500	0 0020	2 75	0 20	2 95	17
<u>Hypericum tetrapetalum</u>	0 1500	0 0020	2 75	0 20	2 95	17
<u>Richardia scabra</u>	0 1500	0 0020	2 75	0 20	2 95	17
<u>Axonopus affinis</u>	0 1000	0 0055	1 83	0 55	2 38	18
<u>Lyonia fruticosa</u>	0 1000	0 0035	1 83	0 35	2 18	19
<u>Solidago chapmanii</u>	0 1000	0 0010	1 83	0 10	1 93	20
<u>Vitis munsoniana</u>	0 1000	0 0010	1 83	0 10	1 93	20
<u>Xyris caroliniana</u>	0 0500	0 0100	0 92	1 00	1 92	21
<u>Pterocarpion virgatum</u>	0 0500	0 0075	0 92	0 75	1 67	22
<u>Pinus elliotii</u>	0 0500	0 0050	0 92	0 50	1 42	23
<u>Panicum rigidulum</u>	0 0500	0 0025	0 92	0 25	1 17	24
<u>Solidago fistulosa</u>	0 0500	0 0025	0 92	0 25	1 17	24
Trunk	0 0500	0 0025	0 92	0 25	1 17	24
<u>Aster reticulatus</u>	0 0500	0 0010	0 92	0 10	1 02	25

Table 2 3 5-5
QUANTITATIVE VEGETATION DATA ON THE HERBACEOUS LAYER OF PINE FLATWOODS
 (Page 2 of 2)

Scientific Name	Frequency	Dominance	Relative Frequency	Relative Dominance	Project I V	I V Rank
<u>Eleocharis baldwinii</u>	0 0500	0 0010	0 92	0 10	1 02	25
<u>Gratiola dumosa</u>	0 0500	0 0010	0 92	0 10	1 02	25
<u>Polygala rugelii</u>	0 0500	0 0005	0 92	0 05	0 97	26
<u>Rhexia mariana</u>	0 0500	0 0005	0 92	0 05	0 97	26
<u>Rhexia nuttallii</u>	0 0500	0 0005	0 092	0 05	0 97	26
TOTAL	5.450	1.0000	99.99	100.00	199.99	

Source ECT, 1990

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Table 2 3 5-6

QUANTITATIVE VEGETATION DATA ON THE SHRUB AND CANOPY LAYERS OF PINE FLATWOODS

Scientific Name	Frequency	Dominance	Relative Frequency	Relative Dominance	Project I V	I V Rank
<u>SHRUB</u>						
<u>Serenoa repens</u>	1 000	0 4750	23 81	47 50	71 31	1
Open	0 8000	0 2720	19 05	27 20	46 25	2
<u>Ilex glabra</u>	0 7000	0 1725	16 67	17 25	33 92	3
<u>Lyonia fruticosa</u>	0 4500	0 0175	10 71	1 75	12 46	4
<u>Quercus minima</u>	0 3500	0 0295	8 33	2 95	11 28	5
<u>Lyonia lucida</u>	0 2500	0 0145	5 95	1 45	7 40	6
<u>Myrica cerifera</u>	0 2000	0 0050	4 76	0 50	5 26	7
<u>Asimina reticulata</u>	0 1000	0 0015	2 38	0 15	2 53	8
<u>Befaria racemosa</u>	0 1000	0 0010	2 38	0 10	2 48	9
<u>Vaccinium myrsinites</u>	0 1000	0 0010	2 38	0 10	2 48	9
Pine needles	0 0500	0 0075	1 19	0 75	1 94	10
<u>Pinus elliotii</u>	0 0500	0 0025	1 19	0 25	1 44	11
<u>Gaylussacia dumosa</u>	0 0500	0 0005	1 19	0 05	1 24	12
TOTAL SHRUB LAYER	4.200	1.0000	99.99	100.00	199.99	
<u>CANOPY</u>						
<u>Pinus elliotii</u>	0 5500	0 0476	100	100	300	1

Source ECT, 1990

Rangeland

Grassland/Brushland/Palmetto Prairies For convenience, grasslands, brushlands, and palmetto prairies are grouped together under rangeland reflecting the general usage of these areas for cattle grazing without maintenance procedures used for improved pasture

Grasslands occur on areas in which the native vegetation has been cleared. With no further maintenance, these areas have become vegetated by opportunistic, weedy species. Characteristic plants include broomsedge, goldenrods, several species of legumes, and sedges.

Brushlands probably were grasslands which have become overgrown with woody shrubs in the absence of fire or intense grazing. Common shrubs include wax myrtle, groundsel tree, oak saplings, and occasionally, saw palmetto. Herbs are abundant and similar in composition to those found in grasslands.

Palmetto prairie is the least disturbed of all rangeland categories. They are generally single-tiered communities dominated by saw palmetto and other shrubs characteristic of pine flatwoods. In some instances, a sparse canopy comprised of slash pine and cabbage palm is discernible. All rangeland associations were pine flatwoods communities prior to clearing or clear cutting in most instances.

Forested Uplands

Pine Flatwoods Pine flatwoods is the dominant plant community type within Florida. The flatwoods in the project study area are dominated by south Florida slash pine in the overstory and saw palmetto in the shrub layer. Other woody components of the understory stratum include trees (e.g., laurel oak, cabbage palm, live oak, and water oak) and shrubs (pawpaw, tarflower, dwarf huckleberry, gallberry, staggerbush, fetterbush, shiny blueberry, and dwarf live oak).

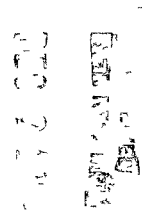
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The herb stratum is dominated by a variety of wiregrasses and other associated forbs, including yellow colic-root, milkweed, yellow buttons, partridge-pea, Florida elephant's-foot, purple lovegrass, bushy goldenrod, and rabbit's tobacco. These open woodlands are a fire-maintained association, characterized by a flat terrain supported by a sandy soil substrate.

Pine/Cabbage Palms Low areas of pine flatwoods that retain water for slightly longer periods of time create a somewhat mesic to hydric condition. Over time, non-flatwood plants become established, causing a shift or succession in community species composition and structure. Cabbage palms are one of the first species that invade wet pinelands. These pine/cabbage palm communities are typically small areas within slight depressions or along the lowland fringes of larger pine flatwoods. Other pine/cabbage palm associates include laurel oak, dahoon holly, wax myrtle, water oak, and bay trees.

Cabbage Palms/Oaks Another possible seral stage in a succession of flatwoods is the cabbage palm/oak association. This mesic to hydric community type has also been referred to as hammock and is typically thought to be a climax or preclimax stage of flatwood, resulting from the absence of fire. The cabbage palm/oak association is typically a closed-canopy forest type dominated by a diverse assortment of broad-leaved evergreen trees, including tropical trees and shrubs. These associations are typically small, circular in shape, and situated along swamp strands or within pine and wet prairies.

Forested Old Field After a native forest has been cleared and planted for agricultural purposes and then abandoned for a long period or time, forested old fields develop. These forests generally contain a diverse species composition of naturalized weedy opportunistic herbs, shrubs and trees, as well as native plants. Common old field associates include wax myrtle, groundsel tree, Brazilian pepper, punk tree, laurel oak, and Carolina willow.



Mixed Forested Upland Mixed forested refers to any generic, forested upland community that supports a mixture of upland trees. Typically, lower categories within the mixed forested designation define the community types by the presence of two or more dominant tree species. The mixed forested designation alone is provided when a community type does not fit within the nine subcategories provided in the SFWMD land use/land cover classification system or the dominant species are simply unknown.

Wetlands

Non-forested Freshwater Wetland

The non-forested freshwater wetland designation encompasses a rather heterogeneous group of herbaceous marshes whose structure and composition is based on the frequency of burning as well as the degree of flooding in the rainy season. These wetlands support a diverse herbaceous vegetation dominated by emergents such as sawgrass, sand cordgrass, maidencane, smartweed, spike rushes, pickerelweed, duck potato, and yellow-eyed grasses. Shrubs which may be found include primrose willow, buttonbush, St. John's wort, and corkwood. The predominance of shrubs is often correlated with frequency of fire.

These freshwater marshes usually exhibit zonation based upon elevational and environmental gradients. Typically, a diverse transitional area exists between the normal low-water stage and a high water contour that is delineated by upland species such as saw palmetto and wax myrtle.

Pine and Wet Prairie

This wetland/upland mosaic community type is one of the most dominant in south Florida. Pine and wet prairie are the predominant natural vegetation communities within the 5-mile radius of the site and completely dominate the plant site proper. Pine and wet prairies consist of upland pinelands interspersed with wet prairie wetlands. The pinelands are similar to the pine flatwoods description, except that

in some wetter areas saw palmetto and other flatwoods shrubs and herbs are replaced with wetland species. Wet prairies are seasonally-inundated systems, typically dependent upon seasonal rainfall and surface runoff for hydroperiod. The prairie basically consists of open lowlands dominated by a variety of water-tolerant grasses and other aquatic macrophytes. Typical herbaceous species associated with wet prairies include maidencane, dichanthelium grasses, blue maidencane, chalky and shortspike bluestem, longleaf threeawn, hyssop, arrowhead, saw-toothed fern, sedges, clubrush, pipewort, and redroot.

Wet prairies differ from freshwater marshes in hydroperiod, soils, and plant species composition. Typically, wet prairies exhibit a more shallow topographic relief, are underlain by poorly-drained sandy soils, and are dominated by transitional to hydric grasses, while freshwater marshes are relatively deep depressions that are inundated for a longer duration, have a well-developed organic layer, and support a diversity of obligate to facultative wet aquatic macrophytes.

Approximately 200 acres of pine flatwoods and 24 acres of wet prairie and ditch are present on the 232-acre site. An additional 8 acres of ruderal or disturbed land also occur within the proposed site as an existing transmission line right-of-way, clearings, roads, and trails. The ruderal land component of the project site contains a diverse array of opportunistic weedy plants, such as common ragweed, bahia grass, beggar's-ticks, and dropseeds.

The wet prairies/wetlands on the project site vary slightly in size, configuration, topographic relief, and hydroperiod. These natural features tend to regulate species composition and structure, together with other environmental factors such as drainage, rainfall, cattle/hog perturbations, edaphic conditions, and exotic species invasion. For comparative purposes, two hydrologically isolated wet prairies were sampled: a 0.45-acre, shallow depression located in the northeastern corner of the site (WP No. 6) and an 8.16-acre, deeper wetland located in the center of the property (WP No. 4).

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Both of the wet prairies sampled were relatively undisturbed. The smaller wet prairie was dominated by big carpetweed, blue maidencane, and bushy goldenrod, in order of magnitude. These three species are indicative of a transitional hydroperiod (i.e., dry most of the year with saturated to inundated conditions seasonally). The surface soil of the wet prairie within the depression was dry at the ground surface during the sampling period. Species composition was uniform across the relatively flat system.

During the September 1990 surveys, the larger wetland was wet at the upland/wetland interface (saw palmetto edge) and contained 6 to 14 inches of water in the center. Transitional wetland species during this stage of the wet or rainy season occurred in a somewhat homogeneous fashion along the more landward reaches of the wetland. However, the ponded center of the wetland supported more obligate hydrophytes such as pickerelweed, maidencane, frog's-bit, and mermaid's weed.

The zonation of obligate and facultative wetland species within the wetland conformed to the hydroperiod and soil types. The center of the wetland is ponded for 2 to 6 months in the rainy season and has a poorly drained, organic surface layer (Sanibel muck), while the wetland fringe is drier and is supported by a more sandy, poorly drained hydric soil (Lawnwood fine sand depressional).

The dominant wetland species of the wet prairie included blue maidencane, big carpetweed, shortspike bluestem, and maidencane, in order of magnitude.

The physiognomy of the pine flatwoods was rather homogeneous throughout. The herbaceous layer was dominated by wiregrass and other typical flatwoods species such as broomsedge, bottlebrush threeawn, dichanthelium grass, St. John's wort, and gallberry seedlings.

The shrub strata was dominated by the conspicuous saw palmetto. Woody components of the shrub layer in order of magnitude include gallberry,

staggerbush, dwarf liveoak, pawpaw, and tarflower. The canopy was open and consisted solely of south Florida slash pine. The south Florida slash pine sampled ranged in diameter-at-breast-height (dbh) from 4 to 16.5 inches.

The pine flatwoods onsite are underlain by three nearly level, poorly drained sandy soils including Lawnwood fine sand, Waveland sand, and Basinger fine sand. Under normal conditions, the water table is typically at a depth of less than 10 inches for 2 to 6 months and anywhere from 10 to 40 inches deep for 6 or more months.

Cypress Swamp

Cypress swamp is a closed-canopy wetland forest type dominated by cypress. This wetland association occurs as isolated, somewhat circular configurations with dome-like profiles or as strands along major drainageways. Other aquatic arboreal and shrubby associates of the cypress swamp include red maple, tupelo, sweetbay magnolia, swampbay, wax myrtle, Carolina willow, popash, and elm. Aquatic macrophytes that are typically associated with this seasonally-inundated wetland include pickerelweed, lizard's tail, water hyacinth, arrowhead, royal fern and smartweed.

Mixed Forested Swamp

The mixed forested designation includes all swamps that contain a mixture of hardwood trees and cypress. Hardwood species associated with the mixed forested swamp include red maple, tupelo, sweetbay magnolia, swampbay, hackberry, and Carolina willow. Barley Barber Swamp, located next to the FPL Martin power plant cooling ponds, is a good example of mixed forested swamp within a 5-mile radius of the proposed ICL site.

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2.3.5.4 Summary

The plant community types present within and adjacent to the proposed ICL site are regionally common. The wet prairies and pine flatwoods communities on the site have not, for the most part, been severely impacted by human-related activities. The wet prairies exhibit a shift to more upland plant species in the transition zones due to alterations to historical drainage patterns, yet retain basic wetland functional values. The pine flatwoods show some effects from cattle grazing and road/trail construction, but retain a natural aspect with regard to structure and function. The exceptions are several small disposal areas previously used for disposal of organic milling by-products. In contrast, surrounding areas have been greatly impacted by industrial and agricultural activities.

2.3.6 ECOLOGY

This section discusses species that are officially designated as endangered, threatened, or species of special or regional concern by the U S Fish and Wildlife Service (USFWS), Florida Game and Fresh Water Fish Commission (FGFWFC), Florida Department of Agriculture and Consumer Services (FDACS), Treasure Coast Regional Planning Council (TCRPC), and/or Florida Committee on Rare and Endangered Plants and Animals (FCREPA) and that, based on a literature survey, onsite habitat analysis, and consultations with state, regional, and local agencies, may reasonably be expected to occur in the vicinity of or on the ICL site This assessment also addresses the status of such species within a surrounding study area including sections of southwestern St Lucie, western Martin, and southern Okeechobee Counties

The TCRPC staff previously prepared a listing of plant and animal species of regional concern for review and comment for similar studies conducted in the project area Using the TCRPC species list as a base, project ecologists supplemented this list of species of regional concern with additional protected species from USFWS, FGFWFC, FCREPA, and FDACS lists The resulting list of species of regional concern is shown in Table 2 3 6-1 for vegetation, and Table 2 3 6-2 for wildlife species

For each listed species, the selection criteria which determined their inclusion in this application included their known or expected occurrence on the project site and surrounding study area as residents, migrants, or transients, their potential for occurrence in western Martin or southern Okeechobee and southwestern St Lucie Counties, potential for impacts due to site clearing and preparation, construction, and facility operation and maintenance, and other agency concerns such as the presence of unique or suitable habitat

The following sections include both individual discussions for endangered and threatened species and selected species of special or regional concern which

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Table 2.3.6-1
IMPORTANT PLANT SPECIES KNOWN OR SUSPECTED TO OCCUR IN MARTIN,
ST. LUCIE, AND OKEECHOBEE COUNTIES
(Page 1 of 2)

Common Name	Scientific Name	Designated Status*		
		FWS ⁺	FDACS**	FCREPA ⁺⁺
Giant leather fern	<u>Acrostichum danaeifolium</u>		T	
Venus-hair fern	<u>Adiantum capillus-veneris</u>		T	R
Curtiss milkweed	<u>Asclepias curtissii</u>		E	T
Four-petal pawpaw	<u>Asimina tetramera</u>	E	E	E
Wild birdnest fern	<u>Asplenium serratum</u>		E	E
Unnamed spleenwort fern	<u>Asplenium trichomanes-dentatum</u>		T	T
Black mangrove	<u>Avicennia germinans</u>			SSC
Silver palm	<u>Coccothrinax argentata</u>		C	T
Climbing dayflower	<u>Commelina gigas</u>	UR1	T	T
Large-flowered rosemary	<u>Conradina grandiflora</u>	UR2	E	
Lakela's mint	<u>Dicerandra immaculata</u>	E	E	
Butterfly orchid	<u>Encyclia tampensis</u>		T	
Beach creeper	<u>Ernodea littoralis</u>		T	T
Rein orchid	<u>Habenaria odontopetala</u>			T
Nodding pinweed	<u>Lechea cernua</u>	UR2	E	
Catesby lily	<u>Lilium catesbaei</u>		T	
Sea lavender	<u>Mallotonia gnaphalodes</u>		E	T
Scrub Indian pipes	<u>Monotropa brittonii</u>	UR2		
Boston fern	<u>Nephrolepis biserrata</u>		T	
Dancing-lady orchid	<u>Oncidium bahamense</u>		E	T
	(<u>O. variegatum</u>)			
Hand fern	<u>Ophioglossum palmatum</u>	UR5	E	E
Paper-like nailwort	<u>Paronychia chartacea</u>	T	E	
Golden polypody	<u>Phlebodium aureum</u>		T	
Star-scale fern	<u>Pleopeltis revoluta</u>		T	E
Tiny polygala	<u>Polygala smallii</u>	E	E	E
Wisk fern	<u>Psilotum nudum</u>		T	
Beach star	<u>Remirea maritima</u>		E	E
Red mangrove	<u>Rhizophora mangle</u>			SSC
Dwarf palmetto	<u>Sabal minor</u>		T	
Scrub palmetto	<u>Sabal etonia</u>		T	
Curly-grass fern	<u>Schizaea germanii</u>	UR2	E	R
Sand spikemoss	<u>Selaginella arenicola</u>		T	
Aspidium fern (unnamed)	<u>Thelypteris interrupta</u>		T	
Marsh fern	<u>Thelypteris palustris</u>		T	
Aspidium fern (unnamed)	<u>Thelypteris kunthii</u>		T	

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Table 2.3.6-1
IMPORTANT PLANT SPECIES KNOWN OR SUSPECTED TO OCCUR IN MARTIN,
ST. LUCIE, AND OKEECHOBEE COUNTIES
(Page 2 of 2)

Common Name	Scientific Name	<u>Designated Status*</u>		
		FWS ⁺	FDACS**	FCREPA ⁺⁺
Wild pine, air plant	<u>Tillandsia paucifolia</u>		T	
Wild pine, air plant	<u>Tillandsia balbisiana</u>		T	
Wild pine, air plant	<u>Tillandsia setacea</u>		T	
Twisted air plant	<u>Tillandsia flexuosa</u>		T	T
Vanilla orchid (unnamed)	<u>Vanilla mexicana</u>		T	
Shoestring fern	<u>Vittaria lineata</u>		T	
Carter's mustard	<u>Warea carteri</u>	E	E	
Florida coontie	<u>Zamia pumila</u>	UR5	C	T
	(<u>Z floridana</u> , <u>Z integrifolia</u>)			

* T = Threatened

R = Rare

SSC = Species of special concern

E = Endangered

C = Commercially exploited

UR1 = Under review for federal listing, with substantial evidence in existence indicating at least some degree of biological vulnerability and/or threat

UR2 = Under review for listing, but substantial evidence of the biological vulnerability and/or threat is lacking

UR5 = Still formally under review for testing, but no longer considered for listing because recent information indicates species is more widespread or abundant than previously believed

+ USFWS (list published in List of Endangered and Threatened Wildlife and Plants, 50 CFR 17 11-12)

** DACS (list published in Preservation of Native Flora of Florida Act, Section 581 185-187, Florida Statutes)

+ + FCREPA (1979)

Source ECT, 1990

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Table 2.3.6-2
ENDANGERED AND THREATENED FISH AND WILDLIFE SPECIES AND SPECIES OF
SPECIAL CONCERN KNOWN OR SUSPECTED TO OCCUR IN MARTIN, ST. LUCIE,
AND OKEECHOBEE COUNTIES
 (Page 1 of 3)

Common Name	Scientific Name	FCREPA	FGFWFC	USFWS
<u>Invertebrates</u>				
Scarab beetle	<u>Ataenius saramari</u>	RSU		
Scarab beetle	<u>Peltotrupes profundus</u>	RSU		
Mangrove tree crab	<u>Aratus pisonii</u>	T		
Colorful mangrove crab	<u>Goniopsis cruentata</u>	T		
Red widow spider	<u>Latrodectus bishopi</u>	SSC		
<u>Fishes</u>				
Opossum pipefish	<u>Oostethus lineatus</u>	R		
Common snook	<u>Centropomus undecimalis</u>		SSC	
<u>Amphibians</u>				
Gopher frog	<u>Rana areolata aesopus</u>	T	SSC	UR2
<u>Reptiles</u>				
Atlantic leatherback	<u>Dermochelys coriacea coriacea</u>	R	E	E
Gopher tortoise	<u>Gopherus polyphemus</u>	T	SSC	UR2
Atlantic green turtle	<u>Chelonia mydas mydas</u>	E	E	E
Atlantic hawksbill	<u>Eretmochelys imbricata</u>	E	E	E
Atlantic loggerhead	<u>Caretta caretta caretta</u>	T	T	T
Florida scrub lizard	<u>Sceloporus woodi</u>	R		
Eastern indigo snake	<u>Drymarchon corais couperi</u>	SSC	T	T
Florida pine snake	<u>Pituophis melanoleucus mugitus</u>		SSC	UR2
American alligator	<u>Alligator mississippiensis</u>	SSC	SSC	TSA
<u>Birds</u>				
Brown pelican	<u>Pelecanus occidentalis</u>	T	SSC	Magnificent
frigatebird	<u>Fregata magnificens</u>	T		
Least bittern	<u>Ixobrychus exilis</u>	SSC		
Great white heron	<u>Ardea herodias occidentalis</u>	SSC		
Great egret	<u>Casmerodius albus</u>	SSC		

Table 2.3.6-2
ENDANGERED AND THREATENED FISH AND WILDLIFE SPECIES AND SPECIES OF
SPECIAL CONCERN KNOWN OR SUSPECTED TO OCCUR IN MARTIN, ST. LUCIE,
AND OKEECHOBEE COUNTIES
 (Page 2 of 3)

Common Name	Scientific Name	FCREPA	FGFWFC	USFWS
<u>Birds (contd)</u>				
Snowy egret	<u>Egretta thula</u>	SSC	SSC	
Little blue heron	<u>Egretta caerulea</u>	SSC	SSC	
Tricolored heron	<u>Egretta tricolor</u>	SSC	SSC	
Reddish egret	<u>Egretta rufescens</u>	R	SSC	UR2
Black-crowned night heron	<u>Nycticorax nycticorax</u>	SSC		
Yellow-crowned night heron	<u>Nycticorax violaceus</u>	SSC		
White ibis	<u>Eudocimus albus</u>	SSC		
Glossy ibis	<u>Plegadis falcinellus</u>	SSC		
Roseate spoonbill	<u>Ajaja ajaja</u>	R	SSC	
Woodstork	<u>Mycteria americana</u>	E	E	E
Osprey	<u>Pandion haliaeetus</u>	T	SSC	
American swallow-tailed kite	<u>Elanoides forficatus</u>			UR2
Snail kite	<u>Rostrhamus sociabilis</u>	E	E	E
Southern bald eagle	<u>Haliaeetus leucocephalus</u>	T	T	E
Cooper's hawk	<u>Accipiter cooperii</u>	SSC		
Short-tailed hawk	<u>Buteo brachyurus</u>	R		
Crested caracara	<u>Polyborus plancus</u>	T	T	UR2
Southeastern American kestrel	<u>Falco sparverius paulus</u>	T	T	UR2
Merlin	<u>Falco columbarius</u>	SU		
Peregrine falcon	<u>Falco peregrinus</u>	E	E	T
Florida clapper rail	<u>Rallus longirostris scotti</u>	SU		
Limpkin	<u>Aramus guarauna</u>	SSC	SSC	
Florida sandhill crane	<u>Grus canadensis pratensis</u>	T	T	
Piping plover	<u>Charadrius melodus</u>	SSC	T	T
American oystercatcher	<u>Haematopus palliatus</u>	T	SSC	
Caspian tern	<u>Sterna caspia</u>	SSC		
Royal tern	<u>Sterna maxima</u>	SSC		
Sandwich tern	<u>Sterna sandvicensis</u>	SSC		
Least tern	<u>Sterna albifrons</u>	T	T	
Black skimmer	<u>Rhynchops niger</u>	SSC		
Burrowing owl	<u>Athene cunicularia floridana</u>	SSC	SSC	

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Table 2.3.6-2
ENDANGERED AND THREATENED FISH AND WILDLIFE SPECIES AND SPECIES OF
SPECIAL CONCERN KNOWN OR SUSPECTED TO OCCUR IN MARTIN, ST. LUCIE,
AND OKEECHOBEE COUNTIES
(Page 3 of 3)

Common Name	Scientific Name	FCREPA*	FGFWFC ⁺	USFWS**
<u>Birds (contd)</u>				
Hairy woodpecker	<u>Picoides villosus auduboni</u>	SSC		
Red-cockaded woodpecker	<u>Picoides borealis</u>	E	T	E
Florida scrub jay	<u>Aphelocoma coerulescens</u>	T	T	UR2
Migrant loggerhead shrike	<u>Lanius lydvicianus migrans</u>			UR2
Black-whiskered vireo	<u>Vireo altilogus</u>	R		
Bachman's warbler	<u>Vermivora bachmani</u>	E	E	E
Kirtland's warbler	<u>Dendroica kirtlandii</u>	E	E	E
Prairie warbler	<u>Dendroica discolor paludicola</u>	SSC		
Bachman's sparrow	<u>Aimophila aestivalis</u>			UR2
<u>Mammals</u>				
Sherman's fox squirrel	<u>Sciurus niger shermani</u>	T	SSC	UR2
Florida mouse	<u>Peromyscus floridanus</u>	T	SCC	UR2
Round-tailed muskrat	<u>Neofiber alleni</u>	SSC		
West Indian manatee	<u>Trichechus manatus latirostris</u>	T	E	E

Note E = Endangered
 T = Threatened
 TSA = Threatened by similarity of appearance
 SSC = Species of special concern
 R = Rare
 RSU = Rare or status undetermined
 C = Commercially exploited
 UR2 = Under review for listing, but substantial evidence of the biological vulnerability and/or threat is lacking

* FCREPA, 1979

+ FGFWFC, 1990

** USFWS (list published in List of Endangered and Threatened Wildlife and Plants, 50 CFR 17 11-12)

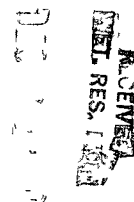
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occur or may be expected to occur in the study area, and general discussions for the remaining species which either share specific habitat types (e g , wetlands, pine flatwoods) or, for plants, are afforded collective protective status by FDACS due to their taxonomic affinities (e g , ferns and fern allies, palms, orchids, lilies, and bromeliads) Following the endangered species analysis, this section also addresses those species considered to be species of recreational or commercial importance, or fishery resources

The probability of occurrence for endangered and threatened species within the proposed ICL project site was based on field surveys, known locations for such species (e g , eagle nests, wading bird colonies), information provided by regulatory agency staff, recent and historical reports of occurrence in the scientific literature, and on the presence of suitable habitat as shown on the SFWMD land use and land cover maps (at 1 24,000 scale) and aerial photographs Results showed that no federally designated Critical Habitat or other habitat features important to endangered and threatened species exist in the vicinity of the proposed plant site For those vertebrates, particularly birds, which have extensive ranges and show significant daily and/or seasonal movement and distribution patterns between different habitat types, the probability of occurrence of these species was primarily based on the presence or absence of suitable habitat Similarly, the specific areas of occurrence of many plant species listed in Table 2 3 6-1 are not known or mapped for south Florida, and their probability of occurrence is based on habitat suitability and range of distribution

This ecology section is presented in four parts beginning with a review and discussion of species-environmental relationships The presence of pre-existing stress and its effect on area biota are subsequently discussed Methodologies used to obtain the baseline site characterization data are described Finally, the aquatic biology at the proposed intake in TC/NS is presented



2.3 6.1 Species-Environmental Relationships

Description of Site and Vicinity Habitat Types

Detailed descriptions of the project site and adjacent property (5-mile radius) vegetation community types, structure, and species composition were provided in Section 2.3.5. Two vegetative communities, i.e., wildlife habitat types, cover most of the project site's uplands and wetlands, and also comprise the dominant habitat types in areas surrounding the site.

Pine flatwoods cover most of the site's uplands. The flatwoods in the project study area are dominated by south Florida slash pine in the overstory and saw palmetto in the shrub layer. Other woody species of the understory include dahoon holly, laurel oak, cabbage palm, live oak, water oak, sweetbay magnolia, and swampbay, as well as shrubs such as pawpaw, tarflower, dwarf huckleberry, gallberry, staggerbush, fetterbush, shiny blueberry, and dwarf live oak. The associated herbaceous species are dominated by a variety of wiregrasses and associated forb species.

Pine flatwoods comprise approximately 200 acres on the project site. An additional 8 acres of ruderal or disturbed upland, also formerly pine flatwoods, occurs within the proposed site as existing transmission corridor, right-of-way clearings, and graded areas. The ruderal land component of the project site contains a diverse array of opportunistic weedy plants which, along with the pine flatwoods habitat, provides a diverse number of feeding and nesting niches for numerous vertebrate species characteristic of pine flatwoods, edge, and shrub habitats.

With the exception of a man-made drainage ditch traversing the center of the site in a north-south direction, open wet prairies comprise the principal wetland and aquatic habitats of the site. The site's wet prairie habitats are characteristic of wet prairie communities common in south Florida. The wet prairie associations

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basically consist of open lowlands, dominated by a variety of water-tolerant grasses and other aquatic macrophytes

Wet prairies are seasonally-inundated systems, typically dependent upon seasonal rainfall and surface runoff for hydroperiod. As a result, no fish or wading birds were located within the onsite wetlands during the May and July 1990 surveys. Only a few common species of fish occurred within the drainage ditch channeling effluent from the Caulkins' Indiantown Citrus Processing Plant's wastewater treatment facility across the project site. This ditch, which channels some effluent during the period of Caulkins' process operations, represents the principal aquatic habitat on the site.

Important Species

Protected species importance is based on species lists prepared by USFWS [50 Code of Federal Regulations (CFR) 17.11-12], FGFWFC (Section 39-27.003-005 FAC), FDACS (Preservation of Native Flora of Florida Act, Section 581.185-187, Florida Statutes), and TCRPC and Martin County species lists. Although not backed by federal law, state statute, or local ordinance, those plants, invertebrates, and vertebrates listed by FCREPA as endangered, threatened, special concern, or rare were also considered in this analysis.

Plant Species

Forty-three species of endangered, threatened, special concern, rare, or commercially exploited plants, or plants under federal review for inclusion on the endangered or threatened species list were determined to either occur or have a probability of occurrence within Martin, St. Lucie, and Okeechobee Counties. The 43 important plant species listed in Table 2.3.6-1 were evaluated for their potential of occurrence on the ICL site, and within a 5-mile radius of the project site. Field surveys for listed plant species were conducted on the project site in the spring and summer-fall of 1990. Individual discussions are provided for 11 plant species, while collective discussions are given for halophytes, ferns and fern allies, palms,

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bromeliads, lilies, and orchids. The scientific nomenclature of plant species listed in Table 2 3 6-1 follows Wunderlin (1982)

Halophytes Five species of halophytes or salt-tolerant plants were identified as species of regional concern in coastal Martin County. These species include red and black mangrove, beach star, sea lavender, and beach creeper. Red and black mangroves form forests along the coastal shorelines of Martin and St. Lucie Counties. Beach star, sea lavender, and beach creeper are herbaceous halophytes that are restricted to the dunes and coastal strands also situated along coastal Martin and St. Lucie Counties. Due to the inland location of the site and adjacent lands, and the lack of saline habitat, no halophytic vegetation, as described above, would be expected.

Ferns and Fern Allies Fifteen species of ferns, or fern allies, were identified as species of regional concern in Martin, St. Lucie, and Okeechobee Counties. Of the 15 species, only six were found to be listed by agencies other than FDACS. These were hand fern, curly-grass fern, venus-hair fern, wild birdnest fern, star-scale fern, and an unnamed spleenwort fern. The hand fern and wild birdnest fern are both listed as endangered by both FDACS and FCREPA. The hand fern is also under federal review for listing. Both species are found in tropical hammocks or deep swamps. While hand fern ranges into the study area, wild birdnest has only been reported for Monroe, Dade, Broward, and Collier Counties (FCREPA, 1979).

Due to the lack of suitable habitat and/or range, neither hand fern nor wild birdnest fern would be expected to occur on or within 5 miles of the site. Curly-grass fern and venus-hair fern are both listed as rare by FCREPA. Venus-hair fern and curly-grass fern are also listed as threatened and endangered by FDACS, respectively. In addition, curly-grass fern is under review for federal listing. Curly-grass fern is an extremely rare tropical fern that has been found in Pinellas, Palm Beach, and Dade Counties within wet pinelands, bay swamp islands, and hammock. Venus-hair fern is restricted to calcareous soil along sinks, ravines, and streams. Venus-hair fern has been found growing in Martin and Dade County. Neither of these

ferns would be expected to occur on or within 5 miles of the ICL project site due to unsuitable habitat and/or reported range of distribution. Star-scale fern is listed as endangered by FCREPA and threatened by FDACS. Since only a single station has been discovered in northeastern Broward County within a tropical hammock, star-scale fern is not expected to occur either on or in the vicinity of the ICL project site. Finally, an unnamed spleenwort fern, Asplenium trichomanes-dentatum, is listed as threatened by both FCREPA and FDACS. This fern species is one of the smallest terrestrial ferns in Florida. It occurs along limestone outcroppings and rocks within sinks and tropical hammocks within Broward and Dade Counties. Due to its extremely limited range and specific habitat requirements, the unnamed spleenwort would not be expected to occur on or within 5 miles of the site.

The remaining nine species of ferns and fern allies are listed as threatened by FDACS primarily to protect them from commercial exploitation. As such, the threatened designation does not reflect the true status (i.e., population levels or distribution) of the majority of these species throughout Florida. In fact, many of the fern species listed as threatened by FDACS are common throughout Florida. Several of the FDACS-listed fern and fern ally species either occur (Phlebodium aureum, Thelypteris kunthii, and T. palustris), or are expected to occur within the wetlands on the ICL project site and within 5 miles of the project on adjacent lands. However, local populations of these species will not be significantly affected by construction of the power plant.

Palms Three species of palm are listed in Table 2.3.6-1. Two of the palm species are listed as threatened only by FDACS. The third palm species, the silver palm, is listed as threatened by FCREPA and as commercially exploited by FDACS. Currently, the silver palm is considered to be limited to the rocky pinelands found in the Florida Keys and south Dade County (Wunderlin, 1990). However, historically the silver palm ranged in Florida from southeastern Palm Beach County to Key West. Because of its reported range, this species is unlikely to occur on or within 5 miles of the ICL site. The scrub palmetto does occur in Palm Beach, Martin, and St. Lucie Counties in sand pine scrub habitat, however, it is unlikely

that any disturbance to this species will occur as a result of this project because of the absence of scrub habitat on or within 5 miles of the site. The third species, dwarf palmetto, may occur in the study area. However, this species would be reaching its southernmost habitat boundary in Martin County, therefore, large populations of dwarf palmetto are not expected to occur on or within 5 miles of the ICL project site.

Bromeliads, Lilies, and Orchids Nine species of the listed plants are bromeliads, lilies, or orchids. Of these species, only the dancing-lady orchid (Oncidium bahamense, with O. variegatum a common synonym) is not expected to occur on or within 5 miles of the site. This species is commonly found in a sand pine scrub habitat, none of which has been found within the project vicinity. The remaining species are generally found in moist to wet hammocks, swamps, or wet pine flatwoods. Many are epiphytic, with the exception of the catesby lily, which is also found in wet savannas, and the rein orchid, which is found growing within the ground cover of hammocks. However, none of the remaining eight species of bromeliads, lilies, or orchids were discovered within the project vicinity during site walkovers in the spring and summer-fall of 1990.

Individual Species

The following 11 plant species, listed as threatened, endangered, rare, or species of special concern by FCREPA, FGFWFC, FDACS, and USFWS are described individually based on their status and/or potential for occurrence in the project area.

The Curtiss milkweed (Asclepias curtissii) is an endemic species in central peninsular Florida. This species is listed as threatened by FCREPA and endangered by FDACS. It is commonly found in upland areas having well drained soils, and its habitat includes sand pine scrub and mixed hardwood hammocks. This species is not expected to occur within 5 miles of the ICL project site due to the lack of suitable habitat.

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The four-petal pawpaw (Asimina tetramera) is a small shrub endemic to Martin and northern Palm Beach Counties. It is listed as endangered by FCREPA, USFWS, and FDACS. The preferred habitat of the four-petal pawpaw includes old coastal dunes and open stands of sand pine. The species presence in Martin County has been verified, however, the four-petal pawpaw is not expected to occur on or within 5 miles of the ICL project site due to the lack of required habitat.

The large-flowered rosemary (Conradina grandiflora) is a shrub found along the east coast of Florida from Volusia County to Dade County. This species, listed as endangered by FDACS, is currently under review by USFWS for inclusion on its protected plants list. This species prefers the sandy, well-drained soils commonly found associated with sand pine scrub habitat. The presence of the large-flowered rosemary on or within 5 miles from the ICL site is unlikely because of the lack of suitable habitat.

Nodding pinweed (Lechea cernua) is listed as endangered by FDACS. It is also under review by USFWS for inclusion on their protected plant species list. This species prefers a white sand scrub habitat located along the central Florida ridge and along the east and west coasts. The primary reason for this species' decline is the alteration of its preferred habitat for agriculture and development. The nodding pinweed is not expected to occur on the ICL site or within 5 miles of the site because of the lack of suitable sand pine scrub habitat.

Scrub Indian pipes (Monotropa brittonii) is currently under federal review for listing on the protected plant species list. This species is commonly found as a parasite on various trees in rich woodlands and scrub habitat of north and central Florida. The scrub Indian pipe is not expected to occur on or within 5 miles adjacent to the ICL site due to the lack of hardwood hammocks or scrub in these areas.

Paper-like nailwort (Paronychia chartacea) is a species endemic to central Florida. It is currently listed by USFWS as threatened and as endangered by FDACS. This species is found in sand pine scrub habitat. It is unlikely that this species will

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occur on or within 5 miles of the ICL site because the required habitat is not present and its occurrence in the study area was not verified in the literature

Tiny polygala (Polygala smallii) is listed as endangered by FDACS, FCREPA and USFWS. This small, biennial milkwort resembles and is clearly related to Polygala nana (Michx.) DC, which is a common milkwort in moist pinelands within northern and central peninsular Florida. However, tiny polygala is a distinctly separate species in terms of morphology and population location. Tiny polygala is an endemic to the rocky pinelands of south Florida, primarily eastern Broward and Dade Counties. Due to its very restrictive range and habitat requirements, it is not expected that tiny polygala occurs within the ICL site boundaries.

Carter's mustard (Warea carteri) is listed as endangered by both USFWS and FDACS. This endangered mustard inhabits sand hills and sand pine scrub and ranges as far south as Broward County and north to Brevard County on the eastern coast of Florida. Due to unsuitable habitat, Carter's mustard is not expected either on or within 5 miles from the ICL site.

Lakela's mint (Dicerandra immaculata) is listed as endangered by USFWS and FDACS. Lakela's mint is a rare endemic of sand pine scrub. It has only been found in St. Lucie and Indian River Counties. Due to range and suitability of habitat, Lakela's mint would not be expected to occur within 5 miles of the ICL project site.

The climbing dayflower (Commelina gigas) is a climbing herb with soft stems, fleshy, almost succulent leaves, and small, three-petaled blue flowers. Climbing dayflower is listed as threatened by both FCREPA and FDACS and under review for federal listing. This species is endemic to the area surrounding Lake Okeechobee. Climbing dayflower inhabits open swamp, wet hammocks, and banks associated with large open-water bodies. Climbing dayflower is not expected within the ICL site due to the absence of such habitats.

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The Florida coontie (Zamia pumila, with Z. floridana, Z. integrifolia, and Z. umbrosa as synonyms) was once very abundant throughout Florida from Taylor County south to the Florida Keys. It is listed by FCREPA as threatened and by FDACS as a commercially exploited plant. The coontie inhabits areas with well-drained soils which include the high pinelands and Indian mound communities. This species may potentially occur on or within 5 miles from the proposed site in areas of suitable upland habitat, however, this conspicuous perennial species was not observed during systematic site walkovers in the spring and summer-fall of 1990.

Invertebrate, Fish, and Wildlife Species

The presence, or potential for occurrence, of wildlife species listed in Table 2.3.6-2 on the ICL project site and surrounding study area is primarily related to the presence of suitable habitat for cover, feeding, and reproduction. In general, the type and quality of wildlife habitats vary with vegetation type and structure, surrounding land use, and hydrology.

Using the SFWMD vegetation community classification (see Section 2.3.5), the principal community systems identified on and adjacent to the project site which serve as the principal wildlife habitat types include pine flatwoods and wet prairies. Ruderal areas and a ditch comprise minor habitat types and are of insufficient acreage to support distinct and separate wildlife compositions. Habitats such as grassland, improved pasture, agricultural lands (truck crops, sugarcane fields, and citrus groves), transportation rights-of-way, and industrial facilities in the immediate vicinity of the site are of relatively lower value to wildlife due to the limited diversity of niches, which is reflected in the lower wildlife species diversities in such habitats. Surface waters on the site (e.g., seasonally inundated marshes and the drainage ditch) were also examined to determine their potential habitat suitability for the two fish species under special consideration.

Five invertebrate and 62 vertebrate species, including 4 mammal, 46 bird, 10 reptile and amphibian, and 2 fish species were identified as important species occurring or possibly occurring in the study area (Table 2.3.6-2). The status and potential



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The common snook (Centropomus undecimalis) is listed by FGFWFC as a species of special concern. Snook have specific habitat needs and prefer saline and estuarine mangrove shorelines and swamps. Potentially suitable habitat in the vicinity of the project site consists of manmade canals and spillways associated with St. Lucie Canal and Lake Okeechobee. However, aquatic communities in the western Martin, southwestern St. Lucie, and southeastern Okeechobee Counties study area do not include mangrove swamp systems or estuarine areas which serve as important spawning and nursery areas for snook.

Opossum pipefish (Oostethus lineatus) is listed as rare by FCREPA, but is not listed by other federal, state, or local agencies. Opossum pipefish inhabit shallow coastal areas and invade freshwater systems. This small pipefish is not a major forage or prey species, and is not expected to occur on or in canals and ditches in the vicinity of the site.

Amphibian Species Gopher frog (Rana areolata), the only amphibian listed by Martin County, is designated as a species of special concern by FGFWFC, listed as threatened by FCREPA, and under review by USFWS. The primary cause for concern is habitat loss resulting from clearing for residential, commercial, and industrial development. Suitable habitat for gopher frogs includes xeric uplands such as sandhill and sand pine scrub communities. Although occasionally found in mouse burrows, crayfish holes, and stump holes, the gopher frog is most often associated with gopher tortoise burrows. The occurrence of the gopher frog within the study area is limited to suitable xeric habitat. The principal onsite habitats have high water-table conditions which do not support xeric habitat preferred by this species. For this reason, no populations of gopher frogs are expected to occur within or adjacent to the ICL project site, and none were found during two seasonal biological surveys.

Reptile Species Nine reptile species are listed by Martin County. Four of these are marine turtles which do not occur in creeks and drainages of western Martin County. Three other species, including gopher tortoise, Florida scrub lizard, and

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Florida pine snake, occur primarily in xeric habitats such as scrub or sandhill habitat. As such, scrub lizards and pine snakes are not expected to occur in western Martin County. Only two inactive gopher tortoise burrows were located along raised rights-of-way on the eastern portion of the project site during the wildlife surveys. However, two gopher tortoises were observed at the southeastern corner of the site and just outside and near the center of the eastern property boundary. These two individuals may actually have their burrows located offsite, since the high water table throughout the wet prairie and flatwoods habitats, and the flat topography of the site, make the majority of the ICL site unsuitable for this species.

The two remaining species, alligator and indigo snake, are expected to occur in suitable habitat of the project site. American alligator (Alligator mississippiensis), federally classified as threatened through its similarity in appearance [T(S/A)] to the American crocodile (Crocodylus acutus) and a species of special concern in Florida, exists throughout the state, and is found in nearly all wetland and aquatic habitat types in southern Florida. Potential habitat for this species in the site area ranges from seasonally inundated marshes to the drainage ditch. Alligators were observed during both seasonal surveys in a drainage ditch along the northern boundary of Caulkins Indiantown Citrus processing plant property.

The eastern indigo snake (Drymarchon corais couperi), classified as threatened by Florida and USFWS, is generally found in Florida and southeastern Georgia. Preferred habitat includes dry sandy areas, as well as moist vegetation communities. The indigo snake frequently uses gopher tortoise burrows as shelter in xeric habitats. Potential onsite habitat for the indigo snake consists of pine flatwoods and wet prairies. No indigo snakes were observed at the site, but individuals are expected to occur onsite and in similar habitats in the vicinity of the site.

Bird Species

Forty-five species of endangered, threatened, rare, or special concern species of birds are listed by Martin County. Brown pelican, magnificent frigatebird, great

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white heron, reddish egret, roseate spoonbill, Florida clapper rail, piping plover, American oystercatcher, Caspian tern, royal tern, sandwich tern, least tern, black skimmer, black-whiskered vireo, Florida prairie warbler, migratory Bachman's warbler, and Kirtland's warbler represent listed bird species restricted to, or primarily occurring in, marine, coastal, and estuarine habitats of Martin County. As such, none of these 17 species resides or nests on, or is expected to occur, on the ICL project site or in surrounding areas. Similarly, no bald eagles, ospreys, or snail kites are expected to nest or reside onsite due to the absence of suitable open water habitat on or in the immediate vicinity of the site and based on a lack of historical records maintained by FGFWFC and USFWS. However, such species may occur as occasional transients in the vicinity of the site.

The southern bald eagle (Haliaeetus l. leucocephalus) is listed as endangered by USFWS and as threatened by FCREPA and FGFWFC. Eagles occurring in peninsular Florida include permanent residents and seasonally occurring migrants. The distribution, population, status, nest locations, and reproductive success of resident Florida eagles are closely monitored by FGFWFC and the National Audubon Society (NAS) through annual counts and aerial nest surveys. Based on two seasonal surveys of the study area and a review of known nest locations and agency data, no bald eagle nests are known to occur in the vicinity of the site. Most eagle nests are located in tall pines or cypress high above the surrounding forest, are large and conspicuous, and can be detected during ecological surveys. The closest bald eagle nests are located northwest and west of FPL's Martin power plant site and in Jonathan Dickinson State Park, located within 5 miles and 30 miles to the northwest and east, respectively.

The osprey (Pandion haliaeetus) is designated as threatened by FCREPA and as a species of special concern by FGFWFC. The osprey inhabits primarily wooded edges of open water bodies such as lakes, rivers, and bays. Nesting occurs in pine and cypress trees in addition to utility poles and navigation channel markers. Habitat loss and nest disturbance are the primary cause for recent population declines in Florida. Since the project site contains no suitable nesting and feeding

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areas, ospreys are not expected to occur on or in the vicinity of the site. No ospreys were recorded during the two seasonal biological surveys conducted May and July 1990. Ospreys, however, are common at Lake Okeechobee and the St. Lucie Canal.

Although the snail kite (Rostrhamus sociabilis) occurs in Martin County, it is restricted to very specific habitats and ranges. Habitat requirements include extensive areas of shallow open waters with interspersed sawgrass. This raptor is listed as endangered by USFWS, FCREPA, and FGFWFC. The Critical Habitat for the snail kite designated by USFWS lies outside of Martin County, and includes all of Conservation Areas 1 (the Arthur R. Marshall Loxahatchee National Wildlife Reserve) and 2A and a portion of Conservation Area 3A. The ICL project site or surrounding areas do not include suitable snail kite habitat and are situated far away from the major kite use areas located to the south and west. As such, kites are not expected to occur on or to cross the project site, as land use types immediately east or west of this area provide no areas of potential, high quality kite habitat. The nearest snail kite populations occur along Lake Okeechobee and within the Arthur R. Marshall Loxahatchee National Wildlife Refuge.

Twelve species of protected wading birds are known or expected to occur in the vicinity of the ICL project site. These species include woodstork, sandhill crane, limpkin, great egret, little blue heron, snowy egret, tricolored heron, white ibis, least bittern, black-crowned night heron, yellow-crowned night heron, and glossy ibis. All of these wading birds are designated as species of special concern by FCREPA with the exception of the woodstork which is considered endangered, and the Florida sandhill crane which is considered threatened.

The habitat requirements of these wading birds are generally similar in that they require wetlands such as marshes and shallow open water for feeding, and shrub swamp or cypress swamp habitats for roosting and nesting. Wetland habitats on the ICL site include non-forested freshwater wetlands and a man-made drainage ditch only, and are unsuitable for nesting or roosting. Individuals of all these

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species of wading birds may, however, be expected to seasonally occur in suitable wetlands during periods of inundation. As a result of the current drought conditions, only a few little blue herons and snowy egrets were recorded along the northern boundary drainage ditches during the July wet season survey, no wading birds were observed in wetlands of the site. A record search of USFWS and FGFWFC files showed that no nesting colonies are located on or in the vicinity of the ICL project site.

Wood storks (Mycteria americana) are listed as endangered by USFWS, FCREPA, and FGFWFC due to their continued population decline caused by the progressive loss of suitable feeding and nesting areas (Ogden and Nesbitt, 1979, Ogden et al , 1980). As a result, their population status, colony locations, and reproductive success are closely monitored by FGFWFC and NAS through annual counts and ground and aerial colony surveys.

A review of FGFWFC colony data compiled during annual aerial surveys indicates that no known wood stork colonies are located in the vicinity of the project site. Individual storks or small flocks may feed or occur as transients throughout the study area that is suitable feeding habitat. Such areas may include wet prairie onsite and in the vicinity of the site.

The Florida sandhill crane (Crus canadensis pratensis) is a nonmigratory resident and is listed as threatened by FGFWFC and FCREPA. Florida sandhill cranes nest and feed in shallow freshwater marshes and wet prairies throughout central and south Florida. Feeding also occurs in low-lying pastures, shallow marshes, and prairies. The primary reasons for their population decline are habitat loss and human encroachment on nesting and feeding areas. The range of the Florida sandhill crane includes the study area, and it may occur as transient over the site. However, it is not expected to nest onsite due to lack of suitable nesting habitat, and this species was not recorded during the 1990 biological surveys of the ICL site.

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The limpkin (Aramus guarauna) inhabits slow-moving freshwater habitats such as rivers, streams, marshes, and lake shores of Florida. Due to its dependence on wetland systems and the gradual loss of such wetlands, the limpkin is considered a species of special concern by FCREPA and FGFWFC. In the study area, limpkins may be expected to occur in suitable wetland systems in the vicinity of Lake Okeechobee and the water management areas. This species is not expected to feed or reside on the ICL project site due to the absence of suitable habitat, and no limpkins were recorded during the May and July 1990 site surveys.

Bird species such as Florida scrub jay, burrowing owl, and red-cockaded woodpecker have specific habitat requirements which determine their distribution and occurrence in Florida. These habitat requirements, and their probability of occurrence on the ICL project site, are discussed in the following sections.

Florida scrub jays (Aphelocoma c. coerulescens), listed as threatened by FGFWFC, FCREPA, and USFWS, occur in xeric scrub habitats in scattered locations along the central Florida ridge and along coastal ridges. Florida scrub jays have specific habitat requirements and prefer oak scrub with saw palmetto, scattered sandpine, and rosemary; they avoid wetlands and forested communities such as pine flatwoods. The decline of Florida scrub jays is apparently caused by the loss of scrub habitat which has been converted to residential developments, citrus groves, and pastureland. Based on a review of range maps, aerial photographs, and site-specific information collected during seasonal site surveys, no habitat suitable for scrub jays occurs onsite or within the study area, and no scrub jays are expected to occur onsite or in the vicinity of the site.

The burrowing owl (Athene cunicularia) inhabits prairies, sandhills, pastures, and maintained grasslands with sandy ground with sparse growth. During the breeding season, the burrowing owl requires soil that is fairly well drained. During the remainder of the year, xeric conditions are less critical. Due to habitat loss throughout its range, the burrowing owl is listed as a species of special concern.

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by FCREPA and FGFWFC The site lacks sufficient areas of xeric or well-drained soils, and burrowing owls were not recorded onsite during the 1990 site surveys

The red-cockaded woodpecker (Picoides borealis) is designated as endangered by USFWS and FCREPA and as threatened by FGFWFC The red-cockaded woodpecker is usually restricted to pine flatwoods containing overmature longleaf and/or slash pine stands where it nests in trees affected by red heart disease Although this habitat extends throughout the southeastern states, early harvesting of southern pine species has reduced the numbers of old, diseased trees preferred by these birds As such, the remaining populations are restricted to relatively few, well-monitored specific locations On the basis of these records and site surveys, red-cockaded woodpeckers are not known or expected to occur on or in the vicinity of the ICL site due to the absence of suitable nesting trees and colony sites

Although listed species such as caracara, least tern, short-tailed hawk, and swallow-tailed kite may occur as occasional transients over the project site, they are not expected to occur onsite since the Indiantown Cogeneration Project site lies outside their primary range and/or lacks suitable nesting habitat

The crested caracara (Polyborus plancus) is listed as threatened by FGFWFC, FCREPA, and USFWS Caracaras occur over dry prairies, palmetto rangelands, and, to a lesser degree, improved pastures of south-central Florida Reasons for this species' decline are not conclusively known, although habitat loss and encroachment by residential and agricultural developments appears to be the main cause The Florida breeding range of caracaras decreased during the 1970s, with the present center of distribution located to the north and west of Lake Okeechobee As such, crested caracaras may occur as occasional transients in the vicinity of the site Caracaras were not recorded during the May and July 1990 site surveys

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The least tern (Sterna antillarum) is a coastal bird of the southeastern Florida coast and inhabits open sandy beaches. The least tern is listed as threatened by FCREPA and FGFWFC. Natural nesting sites occur between the shoreline and vegetated areas on beaches and, to a lesser extent, landfills, parking lots, construction sites, and tar/stone roof tops. The reasons for the decline of this species have been nesting disturbances and destruction of beach habitat due to development. The least tern can range inland to Lake Okeechobee, and may be expected to occur as an occasional transient in the vicinity of the project site. However, the latter does not provide suitable nesting areas or feeding areas. No least terns were recorded on the ICL project site during the May and July 1990 surveys.

The Florida range of the short-tailed hawk (Buteo brachyurus), which is listed as rare by FCREPA, includes the southeastern two-thirds of the state during the breeding season and the southern one-third during the winter months. Preferred habitat consists of an association of mixed woodland and savannah systems which include mature cypress stands, riparian hardwoods, mangrove swamp, and stands of pines which are adjacent to open prairie marshland. Marginally suitable habitat within the study area includes expansive pine and wet prairie with interspersed cypress domes and strands, and forested drainages. Since no preferred habitat occurs onsite and no individuals were recorded during onsite surveys, this hawk is not expected to occur within or adjacent to the project site.

The American swallow-tailed kite (Elanoides forficatus) is not listed by FGFWFC, but is currently under review by USFWS. Its preferred habitat is similar to that of the short-tailed hawk. Since the site lacks mixed hardwood swamp or riparian hardwood forest, this species is not expected to reside onsite. It was not recorded during the May and July 1990 biological surveys of the ICL project site.

Several listed species of birds are expected to occur in the study area within the pine flatwood and surrounding rangeland habitats either as migrants, transients, or residents. For example, peregrine falcons may occur as accidentals during

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migratory seasons, but generally are more common along the coast. The site does not offer significant feeding habitat for this species, which does not nest in Florida.

Other species are opportunistic and range into a variety of habitats such as forested old field, rangeland, grasslands, rights-of-way, and agricultural lands. Such species include Cooper's hawk, Bachman's sparrow, merlin, southeastern kestrel, loggerhead shrike, and hairy woodpecker. Habitat features that make flatwoods, rangeland, and a number of other habitats valuable for these bird species are their relatively open stands of trees and shrubs which provide roosting, nesting, and feeding resources. The decline of several of these species is partially attributable to loss and alteration of pine flatwoods habitats, primarily for agricultural purposes. Because of the presence of flatwood and rangeland habitat in the project area, all six of these species may occur. Loggerhead shrike were commonly observed throughout the site during the July 1990 surveys, and Bachman's sparrows occurred in the pine flatwoods. None of these species are listed as endangered.

Mammal Species

Four species of mammals are listed by Martin County. These species include Sherman fox squirrel, Florida mouse, round-tailed muskrat, and West Indian manatee. Due to their endangered population status and public recognition, Florida panthers are also addressed.

Currently, Florida panthers (Felis concolor coryi) occur primarily in large tracts of undisturbed lands to the west and southwest of the SR 710 corridor. The only recent reports of panthers in the vicinity of the study area is from the areas west of FPL's Martin site and from Corbett WMA, both involving specimens which were killed in the mid-1980s (FGFWFC, 1988).

Florida panthers are listed as endangered by USFWS, FGFWFC, and FCREPA. The majority of verified panther sightings are from Big Cypress Swamp, located far

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west of the study area. A review of its status in the area to the immediate northwest of the ICL project site showed that FGFWFC does not expect this species to occur in the vicinity of the site (FGFWFC, 1990). Considering the low panther population estimates, the high degree of urban industrial and agricultural development in the immediate vicinity and to the north, south, and east of the site, the likelihood of panther occurrence on the site is considered unlikely.

The Florida mouse (Peromyscus floridanus) is listed as threatened by FGFWFC, as a species of special concern by FCREPA, and is currently under review for listing by USFWS. This burrowing species is confined to xeric scrub habitats of peninsular Florida, and the principal habitat of this Florida endemic is sand pine scrub in an early successional stage. It also occurs in xeric longleaf pine-turkey oak and scrubby flatwood associations. Because no xeric habitat is found in or adjacent to the project site, no Florida mice are expected to occur. No Florida mice were captured during a systematic small mammal trapping program conducted as part of the July 1990 biological survey of the Indiantown Cogeneration project site.

Sherman's fox squirrel (Sciurus niger shermani), which is designated as threatened by FCREPA, as a species of special concern by FGFWFC, and under review for listing by USFWS, inhabits much of peninsular Florida where suitable habitat such as sandhill and scrub oak communities exist. Alteration of its habitat is the major reason for the decline of Sherman's fox squirrel populations. Because of the absence of suitable xeric habitat on or near the project site, Sherman's fox squirrels are not expected to occur, and none were observed during the 1990 biological surveys.

The West Indian manatee (Trichechus manatus latirostris) is designated as endangered by USFWS and FGFWFC and threatened by FCREPA. Manatees may occur within streams and canals of Martin County. Areas of potential occurrence include the St. Lucie Canal, and seaward of dammed sections of canals connecting

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Lake Okeechobee with the Atlantic Ocean This species does not occur on or near the ICL project site

Round-tailed muskrats (Neofiber alleni) live in and around freshwater marshes composed of dense maidencane stands and pickerelweed Although this species is found throughout much of Florida and southeastern Georgia, the round-tailed muskrat is designated a species of special concern by FCREPA and is currently under review for listing by USFWS Because the muskrat is nocturnal and its presence is sporadic even in suitable habitat, accurate population estimates are difficult to obtain Due to the presence of wet prairies onsite, these wetlands were searched for muskrat nests and individuals No nests were found, and no muskrats were trapped or located during the May and July 1990 surveys of the site

Species of Recreational and Commercial Importance

Numerous species of potential recreational and commercial importance occur on and in the vicinity of the ICL project site Such species include white-tailed deer, eastern cottontail, gray squirrel, feral hog, wild turkey, bobwhite, mourning dove, white-winged dove, and several species of waterfowl as species of recreational importance, and raccoon, river otter, Virginia opossum, gray fox, striped skunk, and bobcat as species of commercial importance

Although onsite population levels for these species have not been quantified, common pine flatwoods species such as white-tailed deer, raccoon, opossum, bobcat, eastern cottontail, gray squirrel, gray fox, feral hog, bobwhite, and mourning dove appear to be common based on tracks, calls, and direct sightings In contrast, species such as river otter, waterfowl, white-winged dove, and wild turkey are not expected to reside onsite due to the absence of suitable habitat or existing impacts

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Indicator and Endemic Vertebrate Species

No vertebrate species endemic to Florida were observed on or in the vicinity of the ICL project site during the 1990 biological surveys. Indicator species recorded during these surveys included rice rat, southern leopard frog, southern cricket frog, and water moccasin in the freshwater marsh, and Bachman's sparrow, rufous-sided towhee, pine warbler, nuthatch, yellow-shafted flicker, bobwhite, oak toad, pinewoods treefrog, box turtle, eastern fence lizard, and eastern glass lizard in the pine flatwoods. Little green heron, mosquito fish, and flagfin molly comprised the dominant indicator species along the effluent drainage ditch.

2.3.6.2 Pre-Existing Stresses

The pre-existing stresses on the plant communities/wildlife habitats situated within the proposed site are discussed under Section 2.3.5.2. To summarize, the following conditions comprise the existing sources of stress to terrestrial habitats:

- Cattle grazing
- Fire
- Reduced hydroperiod due to local and regional drainage alterations
- Human activity (construction or roads, trails, and power line)

2.3.6.3 Measurement Program

The aquatic, wetland, and terrestrial resources within the project site and immediate vicinity were studied through field monitoring programs as part of the licensing effort.

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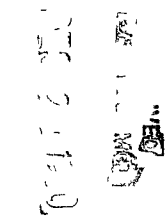
Data Search/Literature Survey

Prior to conducting the field studies, pertinent literature was obtained to review the ecological information available for use in developing the database required to assess the potential effects resulting from the construction and operation of the proposed project

A description of existing ecological and biological resources at the proposed ICL project site and along with associated facilities was developed from this database as well as from available literature. Such information sources also included extensive in-house data files compiled from prior ecological investigations in the area.

The information identified during the literature review included the following subjects:

- Regional vegetation descriptions, including successional patterns
- Plant species lists for the area of the proposed site
- Lists of birds, mammals, reptiles, amphibians, fish, and select invertebrates common to the proposed site
- Species checklists, reports of sightings, and abundance estimates
- Locations of rare, threatened, or endangered species or critical habitats for these species
- Occurrence of pre-existing stresses or perturbations such as fires, construction/clearing operations, overgrazing, drainage alterations, and exotic species invasions



Terrestrial and Wetlands Ecology

The objective of the field sampling program was to investigate the major vegetation communities and wildlife habitats within the proposed project site to quantitatively and qualitatively document important ecological features and biological resources, such as the presence of rare, threatened, or endangered biota or the potential for habitats to support significant wildlife populations. The terrestrial and wetlands ecology field studies were limited to two season samplings. The two seasons selected for sampling correspond to the spring dry season (May 1990) and the summer-fall wet season (July and September 1990). The field characterization programs for vegetation and wildlife are presented in Tables 2.3.6-3 and 2.3.6-4, respectively.

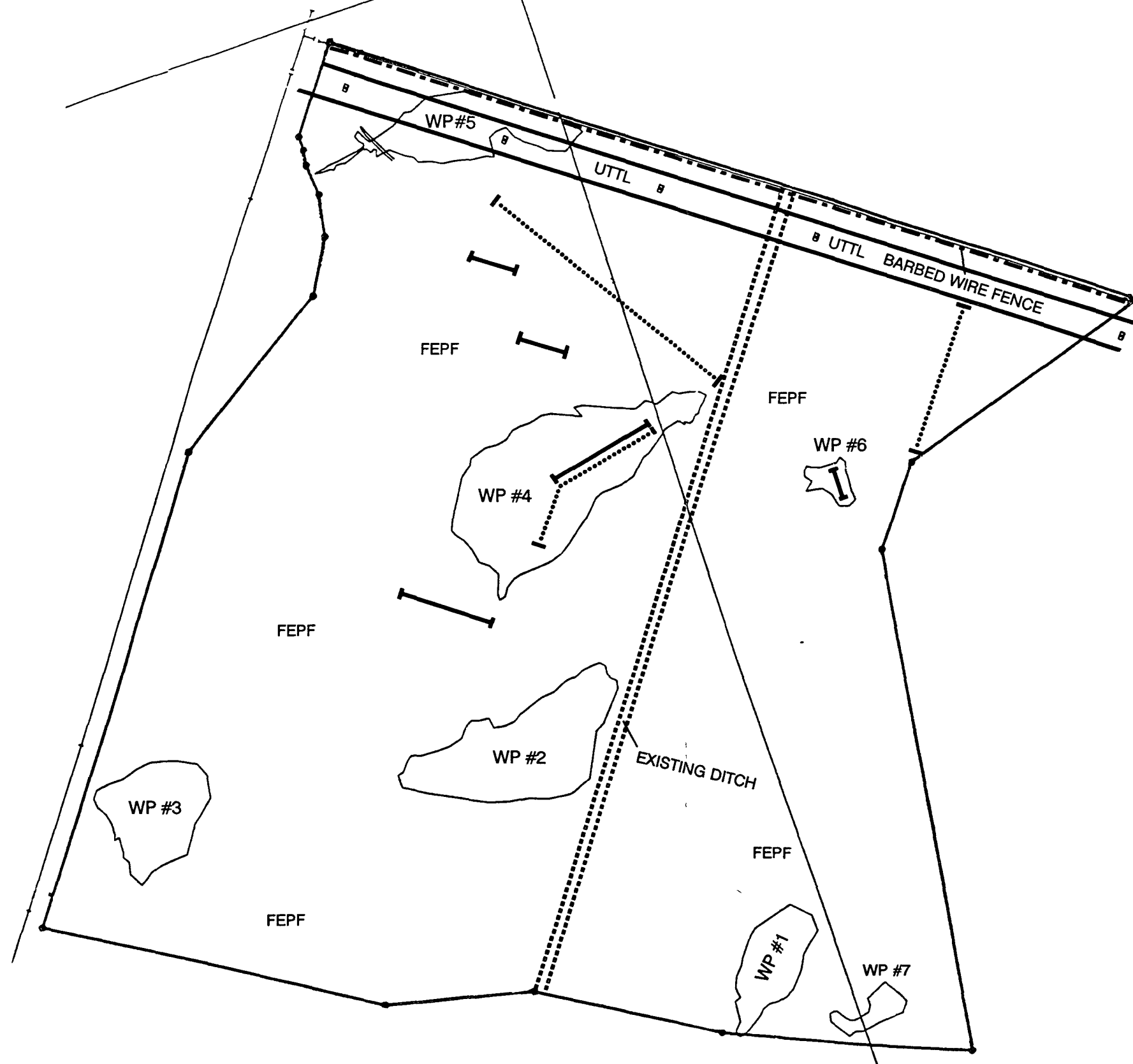
Sample locations were established in representative wildlife habitats or vegetation community types (Figure 2.3.6-1). Vegetation data were recorded from sampling areas located in representative communities selected on the basis of the following:

- Community size
- Community or species importance (wetlands, uniqueness, habitat for threatened or endangered species)
- Degree of habitat disturbance
- Potential effects from project development

Major natural vegetation types were delineated and mapped. Vegetation was sampled in the fall (September 1990) for all strata. A land cover map was prepared of the project site and for an area within a 5-mile radius of the project site using SFWMD land use and land cover maps, aerial photographs, and ground surveys. During the surveys, estimates of existing stress levels were made for communities.

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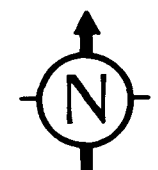
Figure 2.3.6-1
VEGETATION AND WILDLIFE
TRANSECT LOCATIONS ON
THE ICL PROJECT SITE



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KEY

- FEPF - PINE FLATWOODS
- WP - WET PRAIRIE
- UTTL - MAJOR TRANSMISSION LINE
- VEGETATION TRANSECTS
- WILDLIFE TRANSECTS



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SOURCE ENVIRONMENTAL
CONSULTING & TECHNOLOGY, INC., 1990

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Stratum	Method	Sampling Schedule	Sampling Frequency	Equipment	Data Analysis
Tree	Quadrat (100 m ²)	Fall	Once	Tape measure, DBH tape	Frequency, density, basal area, dominance, importance value
Shrub	Quadrat (25 m ²)	Fall	Once	Tape measure	Percent cover, dominance, frequency, importance value
Herb/ground	Quadrat (1 m ²)	Fall	Once	1 m ² quadrat (PVC frame)	Percent cover, dominance, frequency, importance value

Source ECT, 1990

Table 2.3.6-4
TERRESTRIAL AND WETLAND WILDLIFE MONITORING PROGRAM

Taxa	Method	Sampling Schedule	Sampling Frequency	Data Analysis
Large mammals	Direct sightings, tracks along transects, ground surveys across entire site	Spring/summer	Daily for 5 days	Onsite status, distribution, relative abundance
Small mammals	Live-trapping along transects	Summer	Daily for 5 days	Onsite status, distribution, relative abundance
Birds	Transects, ground surveys across entire site	Summer	Daily for 5 days	Onsite status, distribution, relative abundance
Reptiles/ amphibians	Incidental observations along mammal and bird transects	Spring/summer	Daily for 5 days	Onsite status, distribution, relative abundance
Fish	Dip-netting	Summer	2 days	Species composition

Source ECT, 1990

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located onsite. Specifically, evidence of fire, land clearing, cattle grazing, road construction, and drainage were recorded.

Wetland limits within the project site were delineated using joint application of USACE, FDER, and SFWMD wetland jurisdictional boundary determination methods. Wetland jurisdictional boundaries were then flagged and surveyed. The surveyed wetlands were then overlaid on the project site plan to ensure that the plant layout would avoid any possible encroachment. Natural upland buffers of 50 feet or greater were also identified along the wetland boundaries to ensure setback areas from project construction. Wildlife data were recorded from the same or nearby areas sampled for vegetation using quantitative techniques as shown on Table 2.3.6-4. Wildlife sampling areas were also selected based on the same criteria as indicated for vegetation. The terrestrial and wetlands field program

- Described plant communities/wildlife habitats onsite
- Identified major plant species and wildlife populations associated with habitats onsite
- Determined the presence or absence of state and federally protected animal and plant species that would potentially occur in the site area
- Estimated the size and occurrence status of dominant wildlife populations for the area

Surveying and sampling terrestrial and wetland habitats for wildlife and vegetation species began in May 1990, and were concluded in September 1990.



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dominance Since no tree or shrub layers occurred within the wet prairies, only herb quadrats were used in the wetland vegetation sampling effort

The herb quadrats were situated every 10 feet within the small wet prairie (WP No 6) and every 30 feet in the larger wetland (WP No 4) along each respective sampling transect Only one transect was established in each of the two wet prairie sites sampled The wetland transects crossed from one wetland/ upland interface boundary to the other through the center of each wet prairie The number of sampling stations/quadrats in a transect/community depended on a species area curve and the extent of the community type

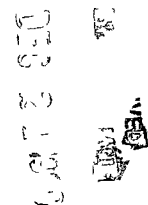
Species dominance and frequency were calculated for canopy, shrub, and herbaceous strata of the pine flatwoods and for the ground layer in the wet prairie sites

Tree density was also calculated for the pine flatwoods overstory Relative values were then determined and summed to evaluate species importance values and rank within each community/site

Vegetation/Land Use

The SFWMD Level III land use and land cover maps were modified where appropriate to reflect current land use and vegetation changes using aerial photography and ground truthing All major vegetation community types greater than 5 acres in size were mapped During site reconnaissance for the mapping effort, other data were collected to assess the relative quality of plant communities Evidence considered during site surveys of relative quality included

- Natural disturbances such as wildfires and severe storms
- Man-made or induced disturbances such as feral hog rooting, cattle grazing and trampling, ditching, draining, and controlled burning



- Invasion by exotic plant species such as punk tree, Brazilian pepper, and Australian pine
- Uniqueness and/or size
- Stage in ecological succession

Information obtained during the field efforts was used to identify dominant plant species and plant community structure and ecology

2.3.6.4 Aquatic Biology at Proposed Intake

The northern end of the proposed pipeline corridor ends at the south bank of Taylor Creek/Nubbin Slough

Infaunal and epifaunal macroinvertebrate communities were sampled along Taylor Creek/Nubbin Slough at three stations during May 1990. The epifaunal communities were sampled by allowing them to colonize Hester Dendy artificial substrate samplers. At each station, three samplers were suspended in the water column at mid-depth and allowed to incubate for 4 weeks. Infaunal communities were sampled with a petite Ponar grab. Ponar samples were collected along a transect to identify the populations inhabiting different substrate types. Four samples were analyzed from each of three stations.

Ninety-one taxa were identified during the present study. Sixty-two taxa were identified from artificial substrate samples, and 46 taxa were identified from the Ponar grab samples (Table 2.3.6-5). Individual species collected in each sample and their counts are shown in Section 10.7, Tables 10.7.1-1 through 10.7.1-6. Different species groups dominated the two sample types: the artificial substrate collected mostly insects while the Ponar collected tubificid worms (Tables 2.3.6-5 and 2.3.6-6). Insects were dominated by the family Chironomidae which is comprised of non-biting midge flies. Artificial substrate samplers collected species that typically inhabit vegetation. In fact, the dominant species collected in this

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Table 2.3.6-5
PHYLOGENETIC LISTING OF ALL TAXA IDENTIFIED FROM
TAYLOR CREEK, MAY/JUNE 1990
 (Page 1 of 5)

Phylum Class Order Family <u>Genus species</u>	<u>Sample Type</u>	
	Hester	
	Dendy	Ponar
Coelenterata		
Hydrozoa		
Hydroida		
Clavidae		
<u>Cordylophora lacustris</u>	X	
Hydridae		
<u>Hydra</u> sp	X	
Platyhelminthes		
Turbellaria		
Tricladida		
<u>Dugesia</u> sp	X	X
Bryozoa		
Phylactolaemata		
Plumatellidae		
<u>Hyalinella punctata</u>	X	
Nemertea		
<u>Prostoma rubrum</u>	X	
Nematoda		X
Annelida		
Oligochaeta		
Haplotaxida		
Naididae		
<u>Allonais paraguayensis</u>	X	
<u>Bratislavia bilongata</u>	X	
<u>Chaetogaster diaphanum</u>	X	
<u>Dero nivea</u>	X	
<u>D. pectinata</u>	X	
<u>Nais variabilis</u>	X	
<u>Pristina aequisetia</u>	X	
<u>P. leidy</u>	X	X
<u>P. synclites</u>		X

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Table 2.3.6-5
**PHYLOGENETIC LISTING OF ALL TAXA IDENTIFIED FROM
 TAYLOR CREEK, MAY/JUNE 1990**
 (Page 2 of 5)

Phylum Class Order Family <u>Genus species</u>	<u>Sample Type</u>	
	Hester	Ponar
	Dendy	
<u>Pristinella jenkiniae</u>		X
<u>Slavena appendiculata</u>		X
Tubificidae		
<u>Aulodrilus pigueti</u>		X
<u>Branchyura sowerbyi</u>		X
<u>Limnodrilus hoffmeisteri</u>		X
Immature with Capil Setae		X
Immature without Capil Setae		X
Hirudinea		
Rhynchobdellida		
Glossiphoniidae		
<u>Batrachobdella phalera</u>	X	
<u>Helobdella elongata</u>		X
<u>H. stagnalis</u>	X	X
<u>Placobdella pediculata</u>		X
<u>P. translucens</u>	X	
Arthropoda		
Crustacea		
Ostracoda	X	
Amphipoda		
Talitridae		
<u>Hyalella azteca</u>	X	X
Mysidacea		
<u>Taphromysis bowmani</u>		X
Insecta		
Collembola	X	
Ephemeroptera		
Baetidae		
<u>Baetis</u> sp		X
Caenidae		
<u>Caenis diminuta</u>	X	X

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Table 2.3.6-5
PHYLOGENETIC LISTING OF ALL TAXA IDENTIFIED FROM
TAYLOR CREEK, MAY/JUNE 1990
(Page 3 of 5)

Phylum	Class	Order	Family	<u>Genus species</u>	<u>Sample Type</u>	
					Hester	Ponar
					Dendy	
Odonata						
Zygoptera						
			Coenagruidae			
				<u>Enallagma</u> sp	X	
				<u>Ischnura</u> sp	X	
Homoptera						
Trichoptera						
			Hydroptilidae			
				<u>Hydroptila</u> sp	X	
				<u>Orthotrichia</u> sp	X	X
			Leptoceridae			
				<u>Oecetis</u> sp	X	X
			Psychomyidae			
				<u>Cyrnellus</u> sp	X	
				<u>Polycentropus</u> sp	X	
Lepidoptera					X	
Coleoptera						
			Dytiscidae		X	
Diptera						
			Ceratopogonidae		X	X
			Chaoboridae			
				<u>Chaoborus punctipennis</u>		X
			Chironomidae			
			Tanypodinae			
				<u>Ablabesmyia rhamphe</u>	X	X
				<u>Coelotanypus concinnus</u>		X
				<u>Labrundinia neopilosella</u>	X	X
				<u>Procladius</u> sp		X
				<u>Tanypus</u> sp		X
			Orthocladinae			
				<u>Cricotopus bicinctus</u> group	X	X
				<u>C. sylvestris</u> group	X	
				<u>Nanocladius</u> nr <u>distinctus</u>	X	X
				<u>Orthocladus</u> sp	X	

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Table 2.3.6-5
PHYLOGENETIC LISTING OF ALL TAXA IDENTIFIED FROM
TAYLOR CREEK, MAY/JUNE 1990
(Page 4 of 5)

Phylum	Class	Order	Family	<u>Genus species</u>	<u>Sample Type</u>	
					Hester	Ponar
					Dendy	
				Chironominae		
				<u>Asheum beckae</u>	X	
				Chironomini sp A Beck	X	X
				<u>Chironomus</u> sp		X
				<u>Cladotanytarsus</u> sp		X
				<u>Cryptochironomus fulvus</u> gr	X	
				<u>Dicrotendipes</u> sp		X
				<u>D modestus</u>	X	X
				<u>D nervosus</u>	X	
				<u>D neomodestus</u>	X	
				<u>D simpsoni</u>	X	
				<u>Endochironomus nigricans</u>	X	X
				<u>Glyptotendipes</u> sp	X	X
				<u>Goeldichironomus</u> sp	X	X
				<u>G carus</u>	X	
				<u>Parachironomus</u> sp	X	
				<u>P directus</u>	X	
				<u>P pectinatellae</u>	X	
				<u>Phaenopsectra</u> sp	X	
				<u>Polypedilum illinoense</u>		X
				<u>P scalaenum</u>		X
				<u>P simulans</u>		X
				<u>Pseudochironomus</u> nr <u>pseudoviridis</u>	X	
				<u>Tanytarsus glabrescens</u> gr	X	
				<u>T</u> sp X Rutter	X	X
				<u>T</u> sp XII Rutter	X	
				<u>T</u> sp XIII Rutter	X	
Mollusca						
	Gastropoda					
		Ancylidae				
				<u>Hebetancylus excentricus</u>	X	
				<u>Laevipex fuscus</u>	X	

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Table 2.3.6-5
PHYLOGENETIC LISTING OF ALL TAXA IDENTIFIED FROM
TAYLOR CREEK, MAY/JUNE 1990
(Page 5 of 5)

Phylum Class Order Family <u>Genus species</u>	<u>Sample Type</u>	
	Hester	Ponar
	Dendy	
Hydrobiidae		
<u>Pyrogophorus platyrachis</u>	X	
Planorbidae		
<u>Gyraulus parvus</u>	X	X
<u>Planorbella scalaris</u>	X	
Physidae		
<u>Physella hendersoni</u>	X	
Viviparidae		
<u>Viviparus georgianus</u>	X	X
Plecypoda		
Corbiculidae		
<u>Corbicula fluminea</u>		X
Unionidae		
<u>Anodonta couperiana</u>		X
<u>Elliptio buckleyi</u>		X
TOTAL	62	47
TOTAL TAXA IN STUDY: 91		

Source ECT, 1990

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Table 2.3 6-6
PERCENT COMPOSITION OF THE MACROINVERTEBRATE POPULATIONS
COLLECTED FROM TAYLOR CREEK/NUBBIN SLOUGH, MAY/JUNE 1990

Stations	<u>Oligochaeta</u>		<u>Crustacea</u>	<u>Insecta</u>		Molusca	Other Invertebrates
	Naididae	Tubificidae	Amphipoda	Chironomidae	Other		
<u>Artificial Substrates</u>							
Station 1	18		18	40	12	9	3
Station M	13		10	65	9	1	1
Station 2	<u>6</u>		<u>13</u>	<u>71</u>	<u>8</u>	<u><1</u>	<u>1</u>
Mean (all stations)	12		14	59	10	3	2
<u>Ponar grab</u>							
Station 1	7	31	7	35	7	12	
Station M	2	60		7	2	27	
Station 2	<u>14</u>	<u>48</u>	<u>6</u>	<u>19</u>	-	<u>13</u>	
Mean (all stations)	8	46	4	20	3	17	

Source ECT, 1990

study closely corresponded to those collected by Rudolph and Strom (1990) associated with macrophytes in Lake Okeechobee. The Ponar grab collected organisms that live on or in the substrate, in this case, deep layers of highly organic silt.

Although macroinvertebrate populations in the present study corresponded well with those collected by Rudolph and Strom (1990) from Lake Okeechobee, they did not reflect the composition of the benthos in the St. Lucie Canal as reported by FPL (1989). The organisms from the St. Lucie Canal were collected by the Ponar and no data were reported from artificial substrate samplers. The sediment of the St. Lucie Canal was different from that of Taylor Creek/Nubbin Slough canal. FPL (1989) reported the canal bottom to be a mixture of clays, silts, sands, and shell fragments. Although fine sand was the predominate substrate type, the second most predominate substrate was coarse gravel, primarily composed of shell fragments. These shell fragments obviously came from endemic populations, since mollusks comprised 67 percent of the benthic fauna. The substrate in Taylor Creek/Nubbin Slough was comprised of deep layers of silts and some detritus. Coarse sand and shell fragments were not observed. This sediment is more like that of Lake Okeechobee than the sediment in the St. Lucie Canal. The dissolved oxygen of the sediment was probably low in Taylor Creek/Nubbin Slough because of the low flow and highly organic sediment. Rudolph and Strom also reported low dissolved oxygen values at several stations in Lake Okeechobee during their spring and summer sampling. As typical for such a system, lower values occurred at the bottom of the water column.

Chironomidae comprised 59 percent of the invertebrates collected on all artificial substrate samplers (Table 2.3.6-6). Twenty chironomid taxa were collected: Dicortendipes spp., Goeldichironomus spp., Glyptotendipes spp., Parachironomus spp., and Asheum beckae dominated the chironomids and have been reported to tolerate high organics and associated low dissolved oxygen regimes (Beck, 1977, Simpson and Bode, 1980, Roback, 1974, and Rudolph and Strom, 1990). Rudolph and Strom (1990) found that most of the chironomids mentioned above also

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dominated the fauna in the lake and were common at all stations. Most chironomids feed on algae, periphyton, or detritus that is scraped from the substrate or filtered from the water (Oliver, 1971). Therefore, the Hester Dendy artificial substrate suspended in the water column provides excellent habitat for these invertebrates. Periphyton grows well on the samplers and provides a ready food source for scrapers. Other species that construct tubes to catch detritus and microorganisms find these samplers provide a stable substrate for attachment. Thus, in the presence of high organics these organisms proliferate.

The second most numerous invertebrate group on artificial substrate was the Crustacea. This group was comprised exclusively of the amphipod Hyaella azteca. This species also dominated many of the samples of Rudolph and Strom (1990).

Naidid worms comprised 12 percent of the fauna of artificial substrate and other insects comprised 10 percent. Dominant naidids were species of Dero and Pristina, other insects were dominated by the mayfly Caenis diminuta. Again these species are known to tolerate low dissolved oxygen (below 5 ppm) and were common in Lake Okeechobee.

The freshwater bryozoan, Hyalinella punctata, was collected on artificial substrate and recorded as one individual found or 8 organisms per square meter (hereafter 8 organisms/m²). This is a colonial organism, occurring in a colony of hundreds to thousands of individuals sometimes growing in several layers. Enumerating these organisms in this manner grossly underestimated the significance of these invertebrates to the epifaunal populations. In some cases, the colony covered 16 to 20 percent of the artificial substrate sampler. Another colonial organism, the hydrid Cordylophora lacustris, was also collected. This species was not as common or abundant as the bryozoan. During sample processing, the colonies broke up into pieces that were similar in size and each piece was enumerated.

The dominant group of benthic organisms collected by the Ponar grab was tubificid worms (46 percent). Five tubificid taxa were collected from the canal and four

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(Limnodrilus hoffmeisteri, Aulodrilus pigueti, Branchura sowerbyi, and immature tubificids without capilliform setae) occurred in large numbers. These tubificids are well-known for their tolerance to low dissolved oxygen associated with organic pollution (Brinkhurst and Cook, 1974)

Diptern families, Chironomidae, Chaoboridae, and Ceratopogonidae, comprised 20 percent of the benthos and were represented by 17 taxa. The diptera on artificial substrate consisted exclusively of Chironomidae, however, in Ponar samples, two related families of midges (Ceratopogonidae and Chaoboridae) were also collected and grouped in with the Chironomidae (Table 2 3 6-6). The phantom midge Chaoborus punctipennis dominated this group. These organisms can tolerate sediments of low oxygen concentrations. They live in the sediments during the day and migrate into the water column at night to feed. They are able to survive anoxic sediments by moving into water with higher oxygen concentrations at night.

Mollusca comprised 17 percent of Ponar samples. The dominant species was the Asiatic clam Corbicula fluminea. This is an introduced species which often becomes a biotic and economic problem. This species frequently occurs in extremely high densities out-competing the native fauna, it is also a well-known biofouling organism. Corbicula was particularly abundant at Station 2, occurring in all samples collected at that station. It was only found in one of the four Ponars collected from Station 1, but occurred in high densities in that sample. Freshwater mussels, Elliptio buckleyi and Anodonta couperiana were also collected in Ponar grab samples. Each station had at least one of these mussels present. These mussels do not live in severely stressed systems and their presence indicate conditions may be enriched but are not polluted (Fuller, 1974). In fact, a certain amount of eutrophication has been reported to be of service to mussels, by increasing the amount of available food. E. buckleyi had the bright green background coloration that they only get when in clean water (F G Thompson, Personal Communication).

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Naidid worms comprised 8 percent of the benthos and primarily consisted of Dero and Pristina. Naidids are reported to inhabit aquatic vegetation, but these genera are often associated with sediments. As with other invertebrate groups, the same genera dominated naidids in Lake Okeechobee.

Crustacea and other insects were rarely collected in Ponar samples as they only comprised 4 percent and 3 percent of the infauna, respectively.

Densities of invertebrates collected during the study ranged from 431 to 11,727 organisms/m² (Table 2 3 6-7 and Section 10 5, Tables 10 5 1 6-1 through 10 5 1 6-6). Greatest invertebrate densities were found on artificial substrate samplers. At Stations 2 and M, these samplers contained densities of 11,727 and 1,152 organisms/m², respectively, whereas, densities averaged 5,016 organisms/m² at Station 1. High densities on these samplers reflect the enriched conditions in the system.

Since the samplers were suspended in the water column where oxygen was greatest, the populations were able to proliferate in the presence of high quantities of food. Macroinvertebrate densities were lower in Ponar samples, ranging from 431 organisms/m² at Station M to 5,016 organisms/m² at Station 2. Infaunal samples averaged 1,755 organisms/m² at Station 1.

The Shannon Weaver diversity index as described by Wilhm and Dorris (1968) was used to calculate the species diversity ($\bar{d}$) on each sample and at each station (Table 2 3 6-7). Mean diversity at the stations ranged from 2.67 to 4.42. Diversity is influenced both by the number of taxa collected and the distribution of organisms among the taxa. The number of taxa collected at the stations ranged from 11 to 51. The lowest mean diversity (2.67) and lowest number of taxa (11) were found at in Ponar samples at Station M, thus, indicating more stress in the sediments at this station than at other sites.

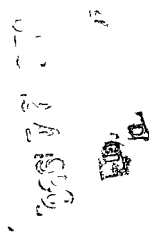


Table 2.3 6-7
DENSITY AND DIVERSITY FOR MACROINVERTEBRATES
COLLECTED FROM TAYLOR CREEK/NUBBIN SLOUGH, MAY/JUNE 1990

Station	Artificial Substrates			Ponar Grab		
	Mean Density*	Taxa ⁺	Diversity**	Mean Density	Taxa	Diversity
1	4,863	51	4.21	1,755	34	4.42
M	11,153	38	3.29	431	11	2.67
2	11,727	33	3.88	5,016	33	3.72

*Mean density reported in number of organisms per square meter

+Taxa represent the total number of taxa collected in all samples

**Shannon Weaver diversity calculation using the following formula

$$\bar{d} = - \sum_{i=1}^S \left(\frac{n_i}{n} \right) \log_2 \left(\frac{n_i}{n} \right)$$

where n_i = number of individuals in the i'th species (s), and
 n = total number of individuals collected

Source ECT, 1990

Except for Station M, mean diversity values were high, equaling 3.29 or greater at the stations. Wilhm and Dorris (1968) proposed a relationship between $\bar{d}$ and the pollutional status of the sampling stations. They rate stations with diversity values above 3 as having clean water, values from 1 to 3 as moderately polluted, and values less than 1 as heavily polluted. These guidelines were based on data from a variety of clean-water and polluted streams.

Based on the diversities, these stations (except for Station M) are considered to have clean water. Based on species composition and densities along with the diversities, the stations are assessed as undergoing various degrees of enrichment, but not enough to produce considerable stress on the macroinvertebrate communities.

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2.3.7 METEOROLOGY AND AMBIENT AIR QUALITY

2.3.7.1 Meteorology

Climatology

The proposed ICL site is located approximately 4.8 km (3 miles) northwest of the community of Indiantown and 14.4 km (9 miles) east of Lake Okeechobee, Florida. Meteorological data used in this climatological evaluation were obtained from National Weather Service (NWS) stations in Belle Glade (located 43 km [27 miles] south-southwest of the site), Okeechobee (located 37 km [23 miles] northwest), Port Mayaca (located 15 km [about 10 miles] west-southwest), and West Palm Beach (located 42 km [about 26 miles] south-southeast) (see Figure 2.3.7-1). Temperature and precipitation are measured at both the Belle Glade and Okeechobee stations, whereas only precipitation is measured at the Port Mayaca station. Due to the proximity of these stations to the ICL site, temperature and precipitation data collected at these stations are generally representative of the conditions observed at the proposed site.

West Palm Beach is a "first-order" weather station with a full range of surface and upper air observations. Terrain features between the West Palm Beach site and the ICL site are typified by low elevation and broad areas of flat relief. Based on similarity in terrain features, meteorological data collected at West Palm Beach are also considered representative for the dispersion conditions at the ICL site.

Thirty-year precipitation and temperature normals are available from both Okeechobee and Belle Glade. Temperature extremes are available from Belle Glade for the 49-year period from 1924 to 1972. Temperature data from these stations are summarized in Table 2.3.7-1. Monthly average temperatures during the winter are in the low sixties and during the summer are in the low eighties. The average annual ambient temperature of about 73 °F reflects the subtropical climate of the area. The highest temperature recorded for the area is 100 °F and the lowest is 24 °F.

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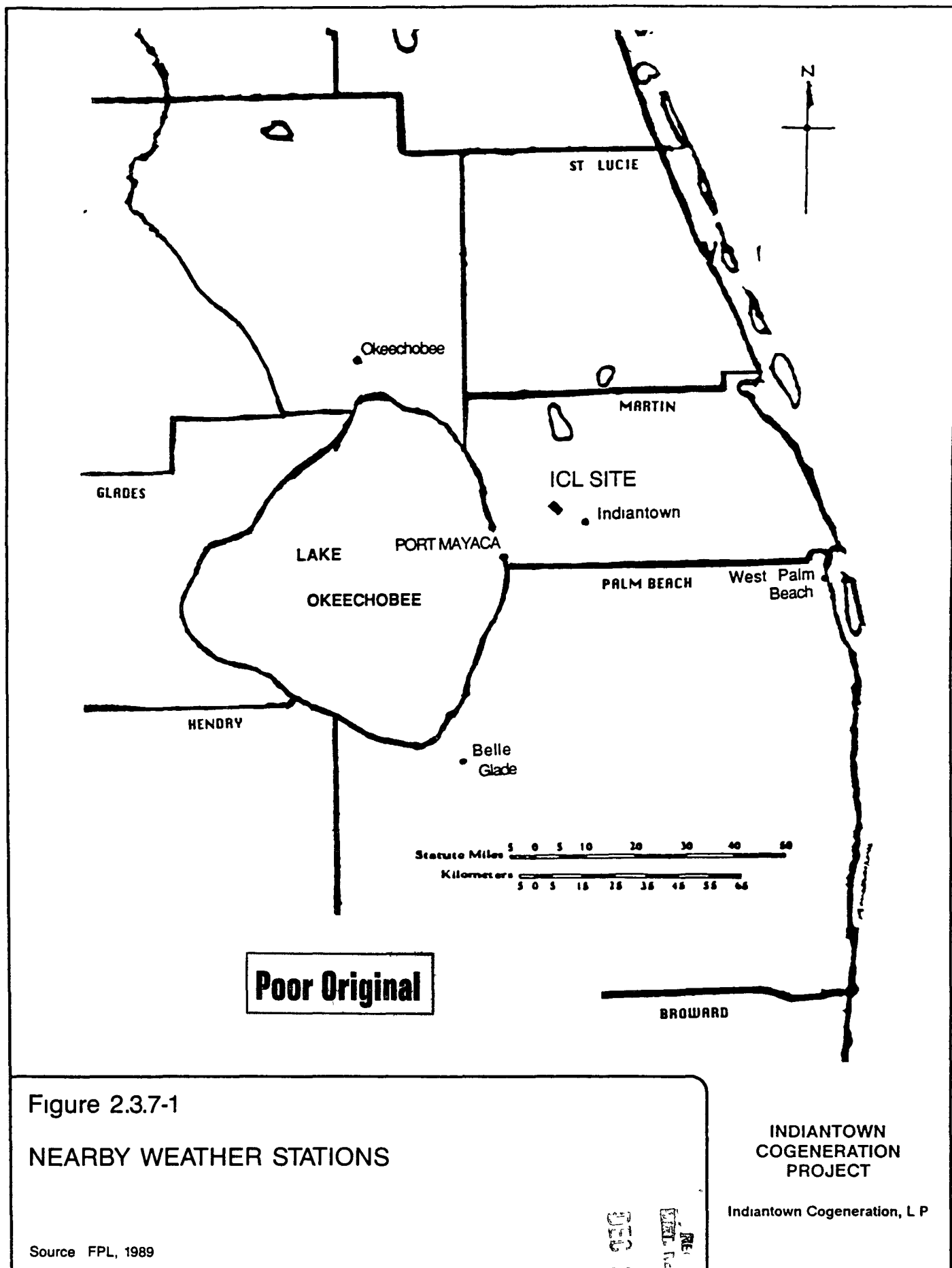


Table 2.3.7-1
MONTHLY TEMPERATURE MEANS AND EXTREMES (°F) REPRESENTATIVE OF THE ICL SITE

Month	Daily Maximum ⁽¹⁾	Daily Minimum ⁽¹⁾	Monthly Average ⁽²⁾		Highest Recorded ⁽¹⁾	Lowest Recorded ⁽¹⁾
			Belle Glade	Okeechobee		
January	75 5	54 2	62 8	62 3	89	24
February	76 9	53 8	63 7	63 3	92	27
March	79 5	56 3	67 3	67 4	93	27
April	82 9	60 3	71 3	72 4	95	33
May	86 5	64 7	75 1	76 6	95	44
June	88 5	70 1	78 8	79 9	98	54
July	90 5	72 1	80 3	81 2	100	62
August	90 5	72 8	80 7	81 6	99	61
September	85 3	69 4	79 7	80 5	96	60
October	84 4	68 5	75 1	75 7	94	40
November	78 7	60 6	68 6	69 0	91	32
December	76 0	55 6	64 0	63 6	89	25
Annual	82 9	63 2	72 3	72 8	100	24

(1) 49-year of data, 1924-1972, Belle Glade, Florida

(2) 30-year of data, 1941-1970

Sources National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Center, "Climatological Data for Florida, 1924-1978," Asheville, North Carolina

Table 2 3 7-2 presents relative humidity data from the West Palm Beach weather station. The day and night relative humidities show little variation throughout the year, with a mid-day reading close to 60 percent and an annual predawn maximum of 80 percent. The least humid month of the year is April, while the highest humidity occurs during mid-summer. Heavy fogs occur approximately 10 days per year, mostly in the cooler months, however, this condition rarely persists long after sunrise on any given day.

Port Mayaca is the nearest NWS weather observation station measuring precipitation. Table 2 3 7-3 presents a summary of precipitation data for Belle Glade and Port Mayaca. The data indicate the occurrence of a significant precipitation maximum in the area in summer. This phenomena is caused by heavy, short-duration convective showers and thundershowers. Sixty percent of the total annual average rainfall occurs from June through September.

Mesoscale influences of Lake Okeechobee can add to the convective instability at the ICL site in the summer. Over the lake, sinking air suppresses the convective action of the lowest layers, creating a higher air density. The diverging lowest layer of lake air induces the warmer air over the land to be lifted as it moves ashore, and cumulus cloud formation begins. The local effects from the lake increase the rainfall of the region as well as generating mid-afternoon winds originating from Lake Okeechobee. The lake breeze may extend for several miles inland on a warm summer day.

Thunderstorms occur with great frequency in the area and can be locally intense. They cause high winds, heavy rain, occasional hail, and frequent lightning. The site area experiences 80 to 90 thunderstorms per year, 65 percent of which occur in the summer season.

Hurricanes are tropical cyclones in which winds reach speeds of 74 miles per hour (mph) or more. Near the center (eye), hurricane winds may gust to more than 200 mph, and the entire storm dominates the ocean surface and lower atmosphere over tens of thousands of square miles. The fastest wind speed recorded at West

Table 2.3.7-2
DIURNAL RELATIVE HUMIDITY
REPRESENTATIVE OF THE ICL SITE

(Relative Humidity ⁽¹⁾ (%), West Palm Beach)

<u>Month</u>	<u>Daytime</u>	<u>Nighttime</u>
January	29	82
February	56	81
March	54	80
April	52	76
May	57	77
June	66	83
July	64	84
August	64	84
September	66	86
October	62	82
November	58	81
December	57	80
Annual	60	81

⁽¹⁾ 13-year averaged data, 1965-1977

Sources National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Center, "Climatological Data for West Palm Beach, Florida, 1925-1978," Asheville, North Carolina

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Table 2.3.7-3
PRECIPITATION MEANS AND EXTREMES REPRESENTATIVE OF THE ICL SITE

Month	Belle Glade Precipitation (Inches)			Port Mayaca ⁽³⁾ Precipitation (Inches)		
	Normal ⁽¹⁾	Maximum ⁽¹⁾	Minimum ⁽²⁾	Normal	Maximum	Minimum
January	1 99	8 53	0 11	1 54	7 06	0 00
February	1 97	5 55	0 03	2 13	5 79	0 22
March	3 21	15 01	0 33	2 44	14 65	0 09
April	2 96	9 05	0 01	2 32	6 88	0 03
May	4 74	9 61	1 08	4 95	10 27	0 45
June	9 08	24 11	0 59	7 62	14 75	1 95
July	8 58	15 30	1 78	6 72	13 48	1 97
August	8 21	16 38	2 65	5 97	10 22	1 65
September	8 82	19 50	1 99	6 21	11 67	1 15
October	5 65	15 84	0 49	5 23	11 15	1 31
November	1 74	12 44	0 13	1 24	5 33	0 06
December	1 80	7 09	0 05	1 61	5 69	0 02
Annual	58 75	84 68	40 99	47 98	60 65	28 38

(1) 30-year averaged data, 1941-1970

(2) 49-year averaged data, 1924-1972

(3) 28-year averaged data, 1951-1978

Sources National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Center, "Climatological Data for West Palm Beach, Florida, 1925-1978," Asheville, North Carolina

Palm Beach for the 28-year period ending 1977 was 86 mph in 1964, which was associated with Hurricane Dora. There were 14 hurricanes reaching the West Palm Beach area during 1886 to 1970 (NOAA Technical Memorandum NWS SR-58). Among those 14 hurricanes, 6 of them were with sustained winds of 125 mph or more.

Dispersion Meteorology

Wind Speed/Wind Direction

Based on the West Palm Beach data, the prevailing winds are from the east to east-southeast throughout most of the year. The 5-year annual and 5-year seasonal averaged wind roses for West Palm Beach for the period 1982 to 1986 are utilized to depict the ICL onsite wind patterns. Figure 2.3.7-2 shows the 5-year annual average wind rose for West Palm Beach, and Figures 2.3.7-3 through 2.3.7-6 show the 5-year seasonal averaged wind roses for West Palm Beach for the period 1982-1986.

The wind pattern at the ICL site is expected to be similar to that measured for West Palm Beach. However, in the warm summer season, the expected differences between the wind patterns for the proposed ICL facility and for West Palm Beach are mainly in the addition of westerly winds from Lake Okeechobee for the ICL site, and therefore, not quite as high a percentage of easterly winds is expected as is displayed by the West Palm Beach wind data. The 1-year (October 1988 to September 1989) meteorological data collected at the nearby Martin site confirms this prediction. Figure 2.3.7-7 shows the annual average wind rose for the Martin site which is approximately 2 miles west of the ICL site.

Stability

Atmospheric stability in conjunction with general wind patterns and mixing heights determines the potential of the atmosphere to disperse airborne pollutants. Atmospheric stability conditions are typically categorized as unstable, neutral, or stable. An unstable atmosphere is one in which rapid diffusion takes place in both the horizontal and vertical directions. In terms of temperature change with height,

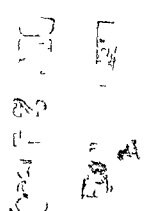


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WEST PALM BEACH (ANNUAL) (1982-86)

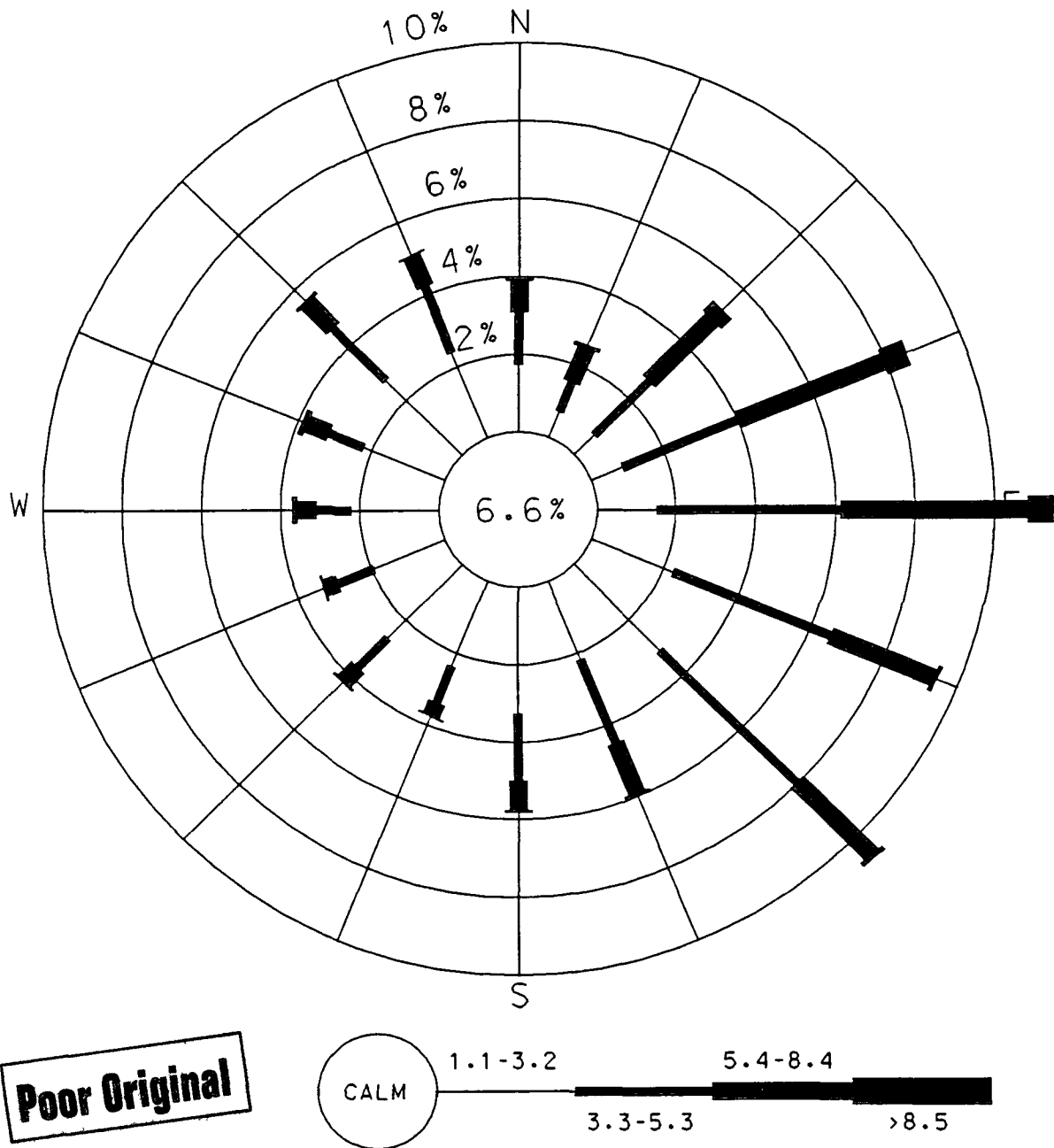


Figure 2.3.7-2

WINDROSE WEST PALM BEACH—ANNUAL

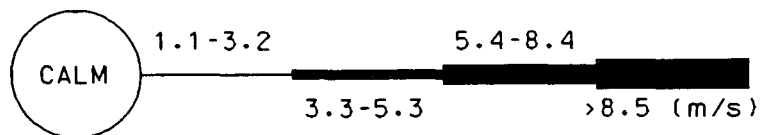
Source Bechtel, 1990

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WINDROSE WEST PALM BEACH—SPRING (1982-86)

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WEST PALM BEACH (SUMMER) (1982-86)

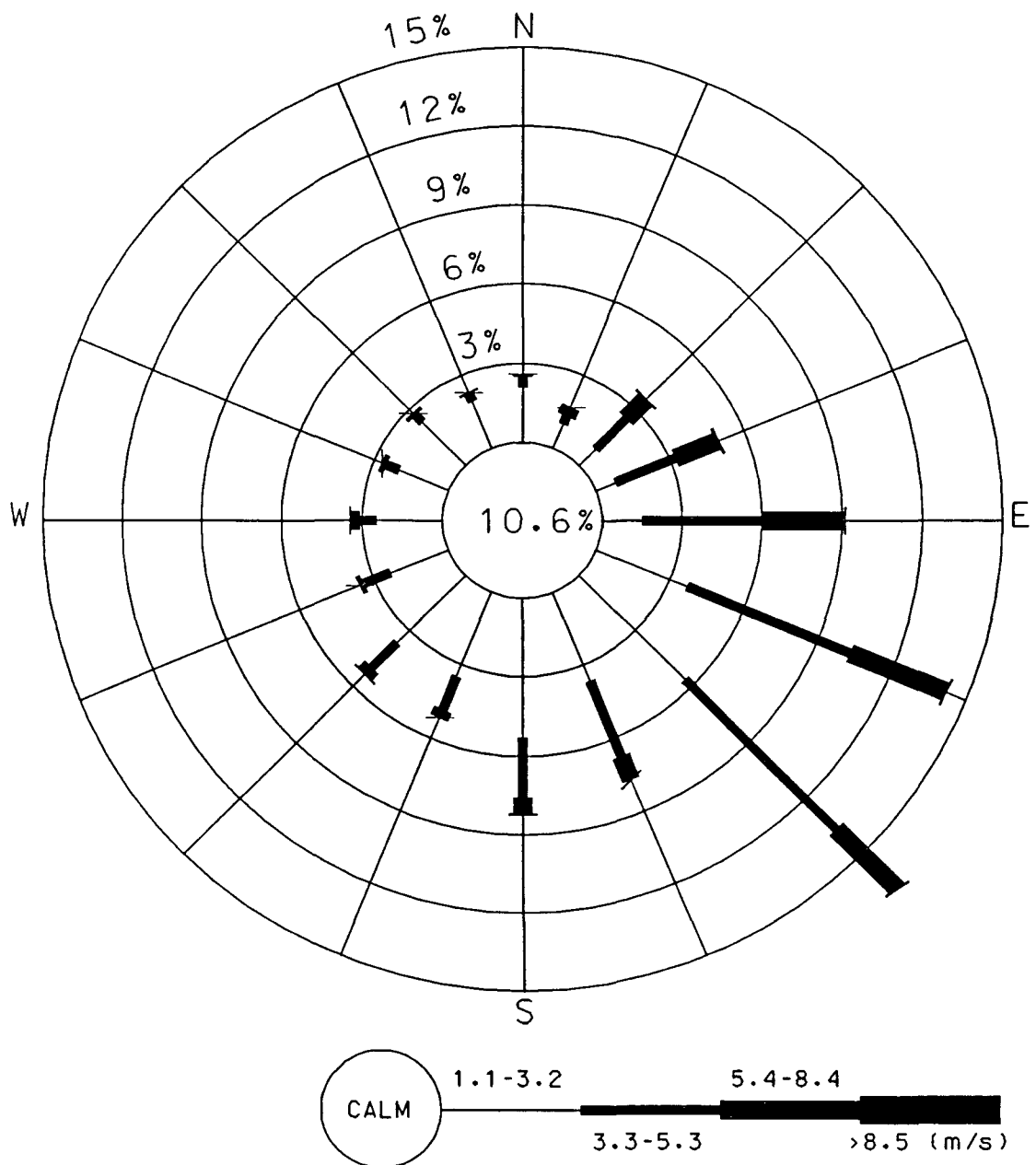


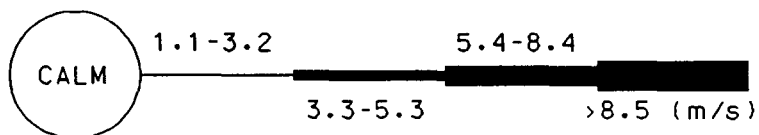
Figure 237-5

WINDROSE WEST PALM BEACH—SUMMER

Source Bechtel, 1990

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Indiantown Cogeneration, L P

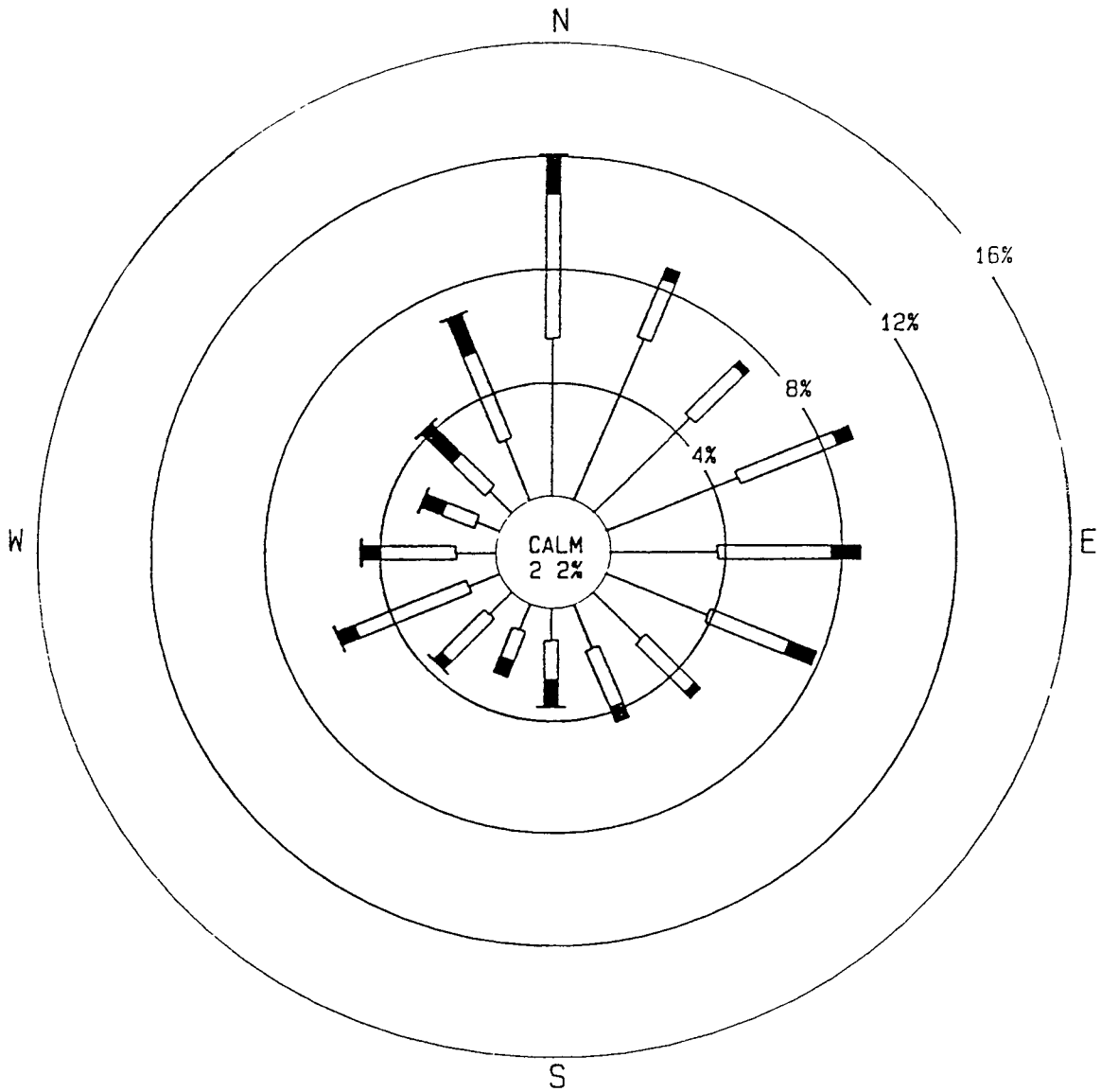


WINDROSE WEST PALM BEACH—FALL

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WIND SPEED CLASSES (MPH)

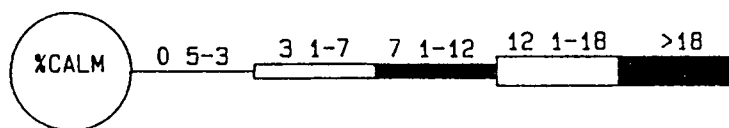


Figure 237-7

WINDROSE — MARTIN SITE OCT-1988 THROUGH
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Source Bechtel, 1990

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an unstable atmosphere is characterized by a sharp decrease in temperature with height. Neutral conditions, which are characterized by moderate decreases of temperature with height, are common in the atmosphere and are associated with moderate diffusion rates. A stable atmosphere is characterized by only slight decreases, or even increases in temperature with height and greatly reduced diffusion rates in comparison with unstable or neutral atmospheric conditions.

The stability classifications presented in this section are based on the Turner (1970) classification scheme, which assigns a stability on the basis of surface wind speed, cloud cover, and solar insolation. Table 2-3-7-4 contains a summary of the joint frequency of occurrence of wind speed and wind direction categories classified for all stability classes based on meteorological data for West Palm Beach for the period 1982 to 1986 (this is referred to as STAR program data). These data indicate a predominance of neutral to stable atmospheric stability conditions.

Mixing Height

An important parameter which describes the regional dispersion capability of the atmosphere is mixing height. Mixing height is the vertical extent of the surface layer within which relatively vigorous mixing of pollutants takes place. Holzworth (1972) has compiled statistical summaries for mixing height at various locations throughout the United States based on twice daily radiosonde measurements. The abundance of moisture from the ocean around southern Florida creates high humidities and low-level cloudiness that absorb heat and generally prevent the mixing height from subsiding below 500 m. Because mixing heights are dependent upon surface temperatures, afternoon levels reach above 1,400 m under intense solar isolation. Lesser diurnal mixing height fluctuations occur at coastal stations in Florida, as compared to inland locations, due primarily to moderating effects of the ocean.

Because of the proximity of the ICL site to Lake Okeechobee, mixing heights are expected to be moderated somewhat by onshore and offshore lake breezes during the warmer months. In the morning, generally high relative humidities and/or low-level cloudiness will inhibit the formation of intense radiation inversions, so that

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Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
(Page 1 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class A
 Surface Station No 12844 Time Period ANNUAL

<u>Direction</u>	<u>Speed (m/s)</u>						<u>Total</u>
	<u>1 5</u>	<u>2 5</u>	<u>4 5</u>	<u>7 0</u>	<u>9 5</u>	<u>>11</u>	
N	0023	0160	0000	0000	0000	0000	0183
NNE	0023	0091	0000	0000	0000	0000	0114
NE	0023	0114	0000	0000	0000	0000	0137
ENE	0000	0114	0000	0000	0000	0000	0114
E	0000	0251	0000	0000	0000	0000	0251
ESE	0068	0137	0000	0000	0000	0000	0205
SE	0091	0205	0000	0000	0000	0000	0297
SSE	0046	0114	0000	0000	0000	0000	0160
S	0046	0205	0000	0000	0000	0000	0251
SSW	0046	0205	0000	0000	0000	0000	0251
SW	0114	0205	0000	0000	0000	0000	0319
WSW	0023	0114	0000	0000	0000	0000	0137
W	0023	0228	0000	0000	0000	.0000	0251
WNW	0000	0023	0000	0000	0000	0000	0023
NW	0000	0114	0000	0000	0000	.0000	0114
NNW	0023	0183	0000	0000	0000	.0000	0205

Total	0548	2464	0000	0000	0000	0000	
Calms = 15 hours					Total Class Obs = 30%		

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
 (Page 2 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class B
 Surface Station No 12844 Time Period ANNUAL

<u>Direction</u>	<u>Speed (m/s)</u>						<u>Total</u>
	<u>1 5</u>	<u>2 5</u>	<u>4 5</u>	<u>7 0</u>	<u>9 5</u>	<u>>11</u>	
N	0228	1141	0593	0000	0000	0000	1962
NNE	0091	0776	0639	0000	0000	0000	1506
NE	0137	0730	1871	0023	0000	0000	2761
ENE	0183	0685	1666	0023	0000	0000	2556
E	0068	1255	3081	0023	0000	0000	4427
ESE	0114	1438	3354	0023	0000	0000	4929
SE	0228	1346	4290	0046	0000	0000	5910
SSE	0137	0867	1438	0023	0000	0000	2464
S	0342	0844	0730	0000	0000	0000	1917
SSW	0160	0844	0753	0000	0000	0000	1757
SW	0160	1187	0753	0000	0000	0000	2099
WSW	0274	0707	1141	0000	0000	0000	2122
W	0137	0776	0913	0000	0000	0000	1825
WNW	0205	0981	0616	0000	0000	0000	1803
NW	0205	0867	0639	0000	0000	0000	1711
NNW	0114	0936	0776	0000	0000	0000	1825
Total	2784	1 5380	2 3252	0160	0000	0000	
Calms = 35 hours				Total Class Obs = 4 16%			

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
 (Page 3 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class C
 Surface Station No 12844 Time Period ANNUAL

<u>Direction</u>	<u>Speed (m/s)</u>						<u>Total</u>
	<u>1 5</u>	<u>2 5</u>	<u>4 5</u>	<u>7 0</u>	<u>9 5</u>	<u>>11</u>	
N	0388	1506	3400	0867	0023	0023	6207
NNE	0137	0593	2350	1095	0023	0000	4199
NE	0228	0685	5796	3103	0205	0000	1 0017
ENE	0114	0958	6914	4404	0319	0023	1 2733
E	0091	1209	1 0382	6663	0183	0000	1 8529
ESE	0183	1050	1 2254	7211	0068	0000	2 0765
SE	0251	1460	1 5152	6458	0114	0000	2 3435
SSE	0228	1187	6366	2464	0114	0000	1 0360
S	0730	2191	4153	1118	0068	0000	8260
SSW	0502	1004	3126	0776	0000	0000	5408
SW	0388	1483	2989	0936	0046	.0000	5842
WSW	0205	0958	2487	0753	0068	0000	4472
W	0228	0936	2099	0844	0114	0068	4290
WNW	0297	0776	2556	0821	0000	0000	4450
NW	0297	1164	3537	0730	0091	0000	5819
NNW	0365	1346	3423	0753	0000	0000	5887
Total	4632	1 8506	8 6984	3 8997	1438	0114	
Calms = 99 hours							Total Class Obs = 15 07%

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Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
(Page 4 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class D
 Surface Station No 12844 Time Period ANNUAL

<u>Direction</u>	<u>Speed (m/s)</u>						<u>Total</u>
	<u>1 5</u>	<u>2 5</u>	<u>4 5</u>	<u>7 0</u>	<u>9 5</u>	<u>>11</u>	
N	0548	3674	6846	7142	0662	0023	1 8894
NNE	0388	1643	3491	8397	0936	0091	1 4946
NE	0137	1506	6777	1 8985	3126	0251	3 0782
ENE	0114	1438	1 1615	3 4798	5066	0707	5 3738
E	0274	2168	1 7114	4 0206	5454	0799	6 6014
ESE	0183	2738	1 4718	2 0765	0936	0000	3 9339
SE	0297	4472	1 7251	1 9784	0913	0160	4 2876
SSE	0365	3217	9675	1 1409	0730	0023	2 5420
S	0388	4267	7918	6731	0479	0000	1 9784
SSW	0434	2966	4404	2784	0297	0023	1 0907
SW	0548	3423	4587	3834	0479	0046	1 2915
WSW	0411	2373	3628	2715	0342	0091	9561
W	0411	2350	2921	4039	0844	0228	1 0793
WNW	0342	2761	3309	5089	1027	0319	1 2847
NW	0821	3605	7005	8466	0639	0046	2 0582
NNW	0479	3377	8329	7667	0274	0046	2 0172
Total	6138	4 5979	12 9587	20 2811	2 2202	2852	
Calms = 161 hours					Total Class Obs = 40 96%		

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Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
(Page 5 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class E
 Surface Station No 12844 Time Period ANNUAL

<u>Direction</u>	<u>Speed (m/s)</u>						<u>Total</u>
	<u>1 5</u>	<u>2 5</u>	<u>4 5</u>	<u>7 0</u>	<u>9 5</u>	<u>>11</u>	
N	0525	3286	2510	0023	0000	0000	6344
NNE	0251	1232	1689	0000	0000	0000	3172
NE	0114	1415	5203	0023	0000	0000	6754
ENE	0091	1574	1 0976	0137	0000	0000	1 2778
E	0183	3286	1 5243	0160	0000	0000	1 8871
ESE	0342	4632	1 2345	0114	0000	0000	1 7433
SE	0844	6982	1 1341	0137	0000	0000	1 9304
SSE	0434	4678	5568	0046	0000	0000	1 0725
S	0799	7142	4381	0000	0000	0000	1 2322
SSW	0616	4427	1734	0023	0000	0000	6800
SW	0730	4472	2350	0023	0000	0000	7576
WSW	0593	3286	2282	0000	0023	0000	6184
W	0548	3834	2829	0023	0000	0000	7233
WNW	0776	4199	2875	0046	0000	0000	7895
NW	0685	4723	7553	0000	0000	0000	1 2961
NNW	0753	5317	5636	0023	0023	0000	1 1752
Total	8283	6 4485	9 4514	0776	0046	0000	
Calms = 288 hours					Total Class Obs = 16 81%		

WEST PALM BEACH
 1982-86
 10-1-86

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
 (Page 6 of 7)

Frequency (%) of Wind Speed & Direction for Stability Class F
 Surface Station No 12844 Time Period ANNUAL

<u>Direction</u>	<u>Speed (m/s)</u>						<u>Total</u>
	<u>1 5</u>	<u>2 5</u>	<u>4 5</u>	<u>7 0</u>	<u>9 5</u>	<u>>11</u>	
N	2213	3834	0091	0000	0000	0000	6138
NNE	0844	1232	0000	0000	0000	0000	2076
NE	0502	1757	0023	0000	0000	0000	2282
ENE	0593	2829	0068	0023	0000	0000	3514
E	1050	5317	0068	0023	0000	0000	6458
ESE	1666	9949	0137	0000	0000	0000	1 1752
SE	3012	1 2162	0137	0000	0000	0000	1 5311
SSE	3788	6800	0091	0000	0000	0000	1 0679
S	4199	1 1318	0000	0000	0000	0000	1 5517
SSW	4381	7986	0068	0000	0000	0000	1 2436
SW	4450	9264	0023	0000	0000	0000	1 3737
WSW	3719	6777	0205	0000	0000	0000	1 0702
W	4336	8443	0000	0000	0000	0000	1 2778
WNW	3742	8123	0023	0000	0000	0000	1 1888
NW	5043	9858	0068	0000	0000	0000	1 4969
NNW	3537	7576	0114	0000	0000	0000	1 1227
Total	4 7075	11 3226	1118	0046	0000	0000	
Calms = 2277 hours					Total Class Obs = 16 15%		

Table 2.3.7-4
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES
(Page 7 of 7)

Frequency (%) of Wind Speed & Direction for Stability Classes
 Surface Station No 12844 Time Period ANNUAL

Direction	Speed (m/s)						Total
	1 5	2 5	4 5	7 0	9 5	>11	
N	3925	1 3600	1 3440	8032	0685	0046	3 9727
NNE	1734	5568	8169	9493	0958	0091	2 6013
NE	1141	6207	1 9670	2 2134	3332	0251	5 2734
ENE	1095	7599	3 1239	3 9385	5385	0730	8 5433
E	1666	1 3486	4 5888	4 7075	5636	0799	11 4549
ESE	2556	1 9943	4 2808	2 8112	1004	0000	9 4423
SE	4723	2 6629	4 8170	2 6424	1027	0160	10 7133
SSE	4997	1 6863	2 3138	1 3942	0844	0023	5 9807
S	6503	2 5968	1 7182	7850	0548	0000	5 8050
SSW	6138	1 7433	1 0086	3583	0297	0023	3 7559
SW	6389	2 0035	1 0702	4792	0525	0046	4 2488
WSW	5225	1 4216	9744	3468	0434	0091	3 3178
W	5682	1 6566	8762	4906	0958	0297	3 7171
WNW	5362	1 6863	9378	5956	1027	0319	3 8906
NW	7051	2 0331	1 8802	9196	0730	0046	5 6156
NNW	5271	1 8734	1 8278	8443	0297	0046	5 1068
Total	6 9460	26 0040	33 5455	24 2789	2 3686	2966	

Calms = 2875 hours

Missed Obs = 0 hours

Total Obs = 43824 hours

Total No of Days Counted = 1826

- Notes
- 1 Total observation includes calms
 - 2 The total days counted are for the entire data set
 - 3 NCDC Wind speed ranges (m/s) 1 5 (0-1 8), 2 5 (1 8-3 3), 4 5 (3 3-5 4), 7 0 (5 4-8 5), 9 5 (8 5-11)
 - 4 Calm is defined as wind speed at 1 m/s or less (for dispersion modeling purpose only)

Source Bechtel 1990

the layer of air closest to the ground is mixed to several hundred meters Table 2 3 7-5 presents the seasonally and annually averaged mixing heights for West Palm Beach area

2.3.7.2 Ambient Air Quality

Preconstruction Monitoring Exemption

Based on the preliminary design, the facility will be a major source of sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter and carbon monoxide (CO) (i.e., has a potential to emit more than 100 tons/year of each of these pollutants) Table 2 3 7-6 gives the emission estimates of the facility The emissions are based on conservative estimates of maximum exhaust concentrations at the stack

A preconstruction onsite meteorological/air quality monitoring program is required to satisfy Section 2 3 7 of the DER SCA Instruction Guide and is usually necessary as part of the PSD permit approval process Representative air quality monitoring data are needed to determine background levels for those pollutants with estimated significant impacts

Based on the emission estimates and the stack parameters as listed in Table 2 3 7-6, the predicted peak pollutant concentrations reported in Table 2 3 7-7 are well below their corresponding PSD increment limits and NAAQS Therefore, it is anticipated that the operation of the proposed facility will not exceed the allowable PSD increments for the area, and it also poses no threat to the NAAQS

A comparison of these peak pollutant concentrations to the de minimis pollutant levels for exemption from monitoring is also given in Table 2 3 7-7 As shown from the table, maximum pollutant concentrations resulting from the operation of the proposed facility are below their corresponding de minimis levels Therefore, preconstruction monitoring of these pollutants is not required under the regulations This finding was presented in the Plan of Study for the Indiantown Site Certification Application to the Florida Department of Environmental Regulation (FDER) Subsequent discussions with the FDER have established that the existing

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Table 2.3.7-5
MEAN SEASONAL AND ANNUAL MIXING HEIGHTS,
WEST PALM BEACH, FLORIDA

<u>Season</u>	<u>Morning</u>	<u>Afternoon</u>
Winter	700	1130
Spring	840	1380
Summer	970	1400
Autumn	880	1280
Annual	850	1250

Source Holzworth, G C , Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States Environmental Protection Agency, Office of Air Programs Research Triangle Park, N C
January 1972

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 PROTECTION AGENCY
 RESEARCH TRIANGLE PARK, N.C.



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Source Bechtel, 1990

Table 2.3.7-7
MODEL PREDICTED PEAK CONCENTRATIONS

Pollutant	Averaging Time	Max Conc from the Facility ($\mu\text{g}/\text{m}_3$)	Monitoring De Minimis Level ($\mu\text{g}/\text{m}_3$)
CO	8-hour	50.8	575
NO ₂	Annual	4.42	14
PM-10	24-hour	0.92	10
SO ₂	24-hour	11.6	13
Pb	24-hour	--	0.1

Source: Bechtel, 1990

TABLE 2.3.7-7
MODEL PREDICTED PEAK CONCENTRATIONS

monitoring data from FPL's Martin site is representative of the proposed ICL site area. Based on this information and the discretion of the FDER (FDER letter, July 23, 1990), the preconstruction ambient air quality monitoring requirement for the proposed ICL is exempted. Detailed discussion of the monitoring exception demonstration can be found in Sections 3.4, 5.2, and 5.3 of the PSD application.

Existing Representative Air Quality Monitoring Data

Per PSD Ambient Monitoring Guidelines, a proposed source, which will be in an area of multi-source emissions and basically flat terrain, may propose use of existing data at nearby monitoring sites to determine its background pollutant concentrations. The existing nearby monitors should be within 10 km of the points of proposed emissions. Air quality data (SO_2 , NO_2 , CO, TSP, and PM-10) have been collected by FPL and Florida DER in the vicinity of the ICL site.

Since the terrain between the proposed project site and the nearby existing monitors is basically flat, these data will be used to determine the background pollutant concentrations for the proposed site area. The following paragraphs briefly describe the available data.

Historical FPL Martin Site Air Quality Monitoring Network

Background sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and total suspended particulates (TSP) have been collected by FPL at four sites (Nos. 1, 2, 3, and 4) in the vicinity of the Martin Plant (approximately 3 miles northwest of the ICL site) on a once-every-sixth-day basis since October 1973. These data were supplemented in 1979 and 1980 with two sites (Nos. 5 and 6) monitoring SO_2 and NO_2 with continuous analyzers and a seventh site (No. 7) monitoring TSP. Only about 1 year of continuous SO_2 and NO_2 monitoring data exists at Site Nos. 5 and 6. The other once-every-sixth-day monitoring sites continue to operate with bubbler type samplers for SO_2 and NO_2 and standard high volume samplers for particulate matter. Figure 2.3.7-8 shows the location of the existing FPL air quality monitoring sites.

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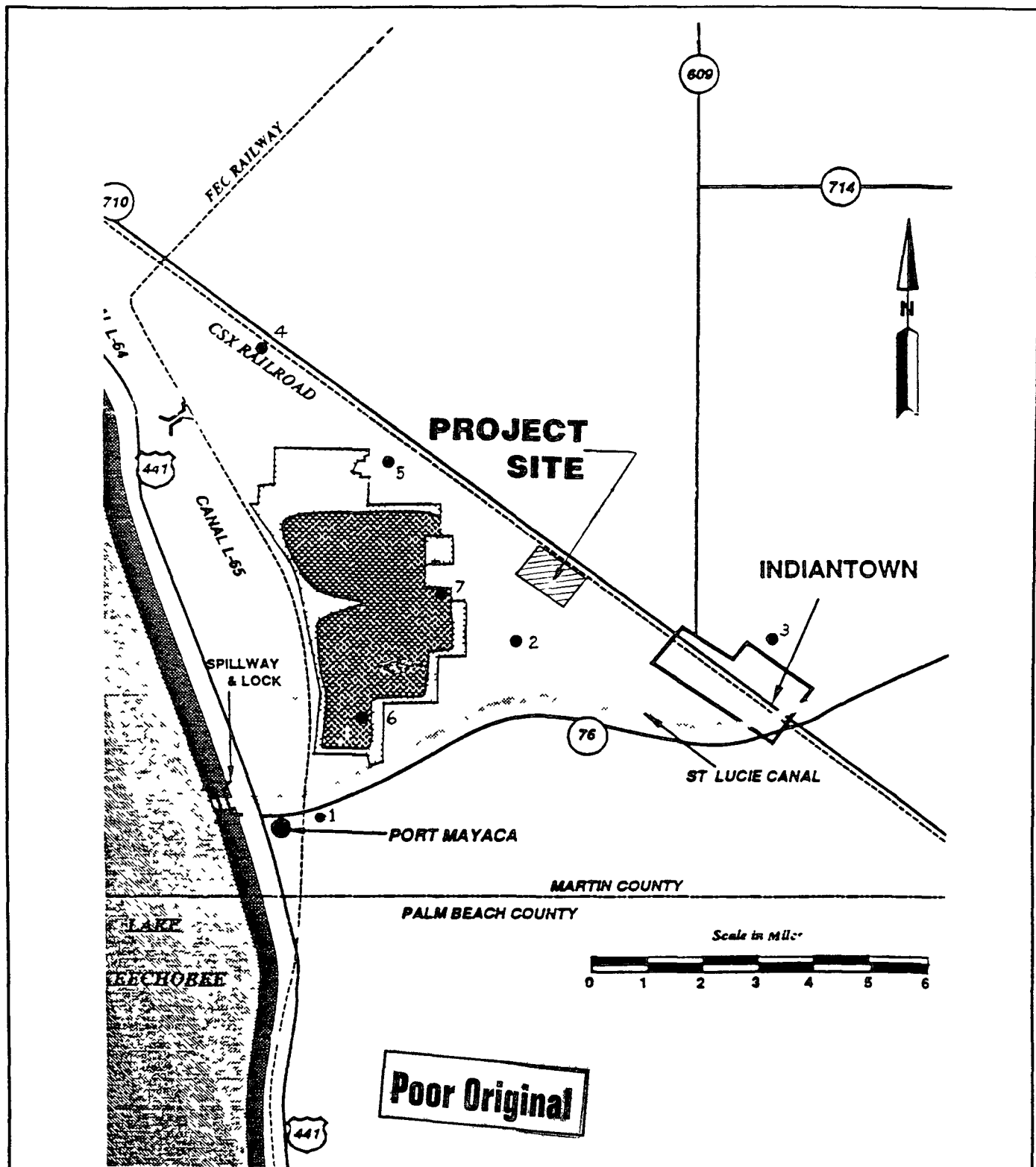


Figure 237-8

FPL AIR QUALITY MONITORING SITES

Source FPL, 1989

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L P

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FPL RES. M. 10/11

Florida DER Air Quality Monitoring Network

The area within a 50 km radius of the proposed ICL site (e g , Martin, Palm Beach, Hendry, Glades, Highlands, Okeechobee, and St Lucie Counties) has FDER ambient air quality monitoring coverage for particulate matter only The exception is Palm Beach County where ambient air quality data are also collected for CO, ozone (O_3), NO_2 and SO_2 The available FDER air quality monitoring sites located within this area are listed in Table 2 3 7-8 and shown in Figure 2 3 7-9

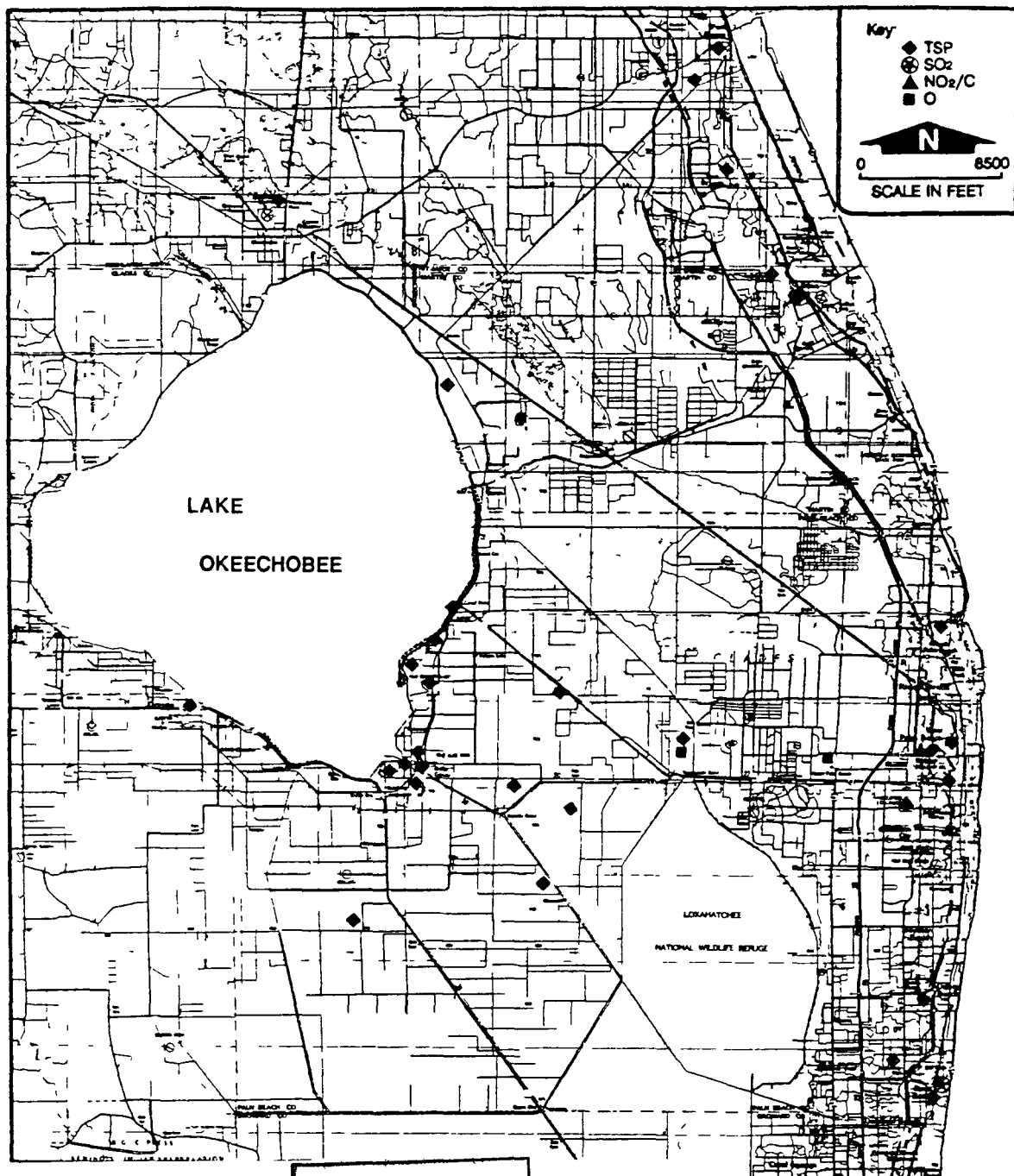
Martin Site Coal Gasification/Combined Cycle (CG/CC) Project Monitoring Data

An onsite PSD air quality monitoring program has been conducted by FPL for the Martin CG/CC project The monitoring program began in mid-September 1988 and continued for 1 year The monitoring network consists of two new monitoring sites (see Figure 2 3 7-10) at which SO_2 , NO_2 , and O_3 were continuously monitored Fine particulate matter (PM-10) were collected on a once-every-sixth-day basis at the two monitoring sites

Background Air Quality Level Determination

A summary of the FPL existing ambient air quality monitoring data collected for the Martin site for the period from 1973 through 1988 is presented in Table 2 3 7-9 The highest recorded SO_2 concentration for all applicable averaging period from these FPL stations does not exceed 24 percent of the more stringent Florida State standards The highest recorded annual average NO_2 concentration is only 16 percent of the applicable standard The highest TSP measurement ($200 \mu g/M^3$) is a bias value due to an isolated incident which was uncharacteristic of the overall data record for the Martin site area In general, the existing air quality monitoring data for the Martin site area indicate good background air quality However, the existing data for SO_2 and NO_2 are based primarily on "bubbler" type samplers and the 1 year of continuous analyzer monitoring data were collected in 1980 They are useful only for providing a general idea of the existing air quality levels in the vicinity of the Martin site

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Figure 237-9

FDER AIR QUALITY MONITORING SITES WITHIN
THE ICL SITE REGION

Source FPL, 1989

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L P

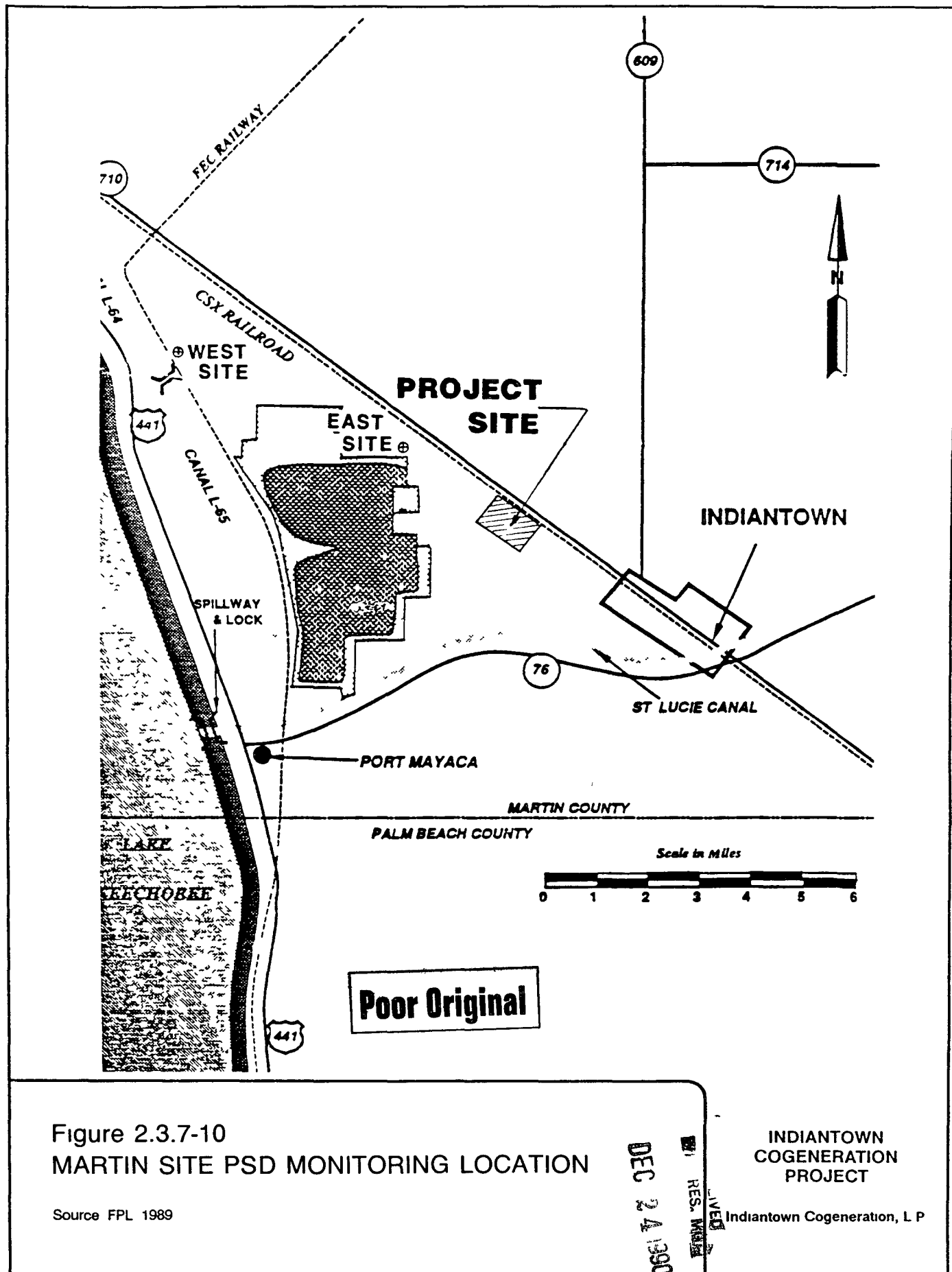


Figure 2.3.7-10
MARTIN SITE PSD MONITORING LOCATION

Source FPL 1989

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L P

DEC 24 1990

Table 2.3.7-8
FDER AIR QUALITY MONITORING SITES USED FOR THE ICL SITE VICINITY

County	Site I D	TSP	SO ₂	NO ₂	CO	O ₃
Palm Beach	017 J02		x			
	003 G02		x			
	004 G02		x			
	004 G01	x		x	x	
	006 G03					x
	007 G01					x
	004 J02	x				
	005 J02	x				
	006 J02	x				
	006 J09	x				
	007 G01	x				
	001 G01	x				
	002 G01	x				
	003 G01	x				
	001 G01	x				
	002 J03	x				
	005 G01	x				
	006 G01	x				
	008 J02	x				
	009 J02	x				
	010 J02	x				
	011 J02	x				
	012 J02	x				
	013 J02	x				
	014 J02	x				
	015 J02	x				
	001 G01	x				
	003 G01	x				
	002 J02	x				
Martin	004 F02	x				
	002 F01	x				
	002 G01	x				
	002 G09	x				
	003 G01	x				
Hendry	002 F01	x				
	002 J02	x				
Highlands	001 F03	x				
Okeechobee	002 F03	x				
St Lucie	004 F01	x				
	004 F09	x				
	009 F02	x				
	001 F01	x				
	001 F09	x				

Source FDER, 1987, 1988, 1989

DEC 24 1990
 FIC - WED
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Table 2.3.7-9
FPL HISTORICAL AIR QUALITY MONITORING DATA FOR THE
MARTIN SITE VICINITY (1973-1988)

Pollutant	Averaging Period	Station Number	Concen (a) ($\mu\text{g}/\text{M}^3$)	NAAQS ($\mu\text{g}/\text{M}^3$)	FAAQS ($\mu\text{g}/\text{M}^3$)
SO ₂	3-hr	5	105	1300	1300
	24-hr	5	61	365	260
	Annual	6	8	80	60
NO ₂	24-hr	1	158	-	-
	Annual	5	16	100	100
TSP	24-hr	3	200(c)	150(b)	150
	Annual	-	N/A	60(b)	60

(a) Highest concentration

(b) Federal secondary standard

(c) This exceedance occurred in 1986 and was found to be an isolated incident uncharacteristic of the overall TSP monitoring data recorded for the Martin site

Source FPL Martin CG/CC PSD Application, 1989

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The FDER air quality monitoring data for the ICL site vicinity for 1988 are summarized in Table 2 3 7-10. The highest recorded CO concentration is equivalent to 55.6 percent of the 8-hour averaging federal and state standards, while the annual average NO₂ recorded value is 25 percent of all the applicable standards. The highest SO₂ measurements for each of the required averaging periods are lower than those recorded by the FPL existing monitors. The highest 24-hour TSP concentration measured at the FDER monitor at Martin County is 103 µg/m³ which is 69 percent of the state standard.

One year (October 1988 to September 1989) of PSD air quality monitoring data was collected for the Martin CG/CC project. Results of the data are summarized in Table 2 3 7-11. As clearly shown in the table, data measured by the Martin CG/CC PSD program are in good agreement with those measured in the FPL existing monitoring network and the FDER monitors. The data reported in Table 2 3 7-11 are most current and meet the PSD monitoring data recovery rate and quality assurance requirements.

As shown in Figure 2 3 7-10, the two Martin PSD monitoring sites are approximately 4.2 km (2.5 miles) and 10.2 km (6 miles) west northwest of the proposed ICL site, respectively. Due to the proximity of these PSD monitoring stations to the proposed ICL site and the currentness of the data, the data collected by the Martin CG/CC project are considered to be the most representative data for the ICL site and have been used to determine the background air quality levels for the SO₂, NO₂, and PM-10 pollutants. Background air quality levels for the other criteria pollutants (CO, TSP, and O₃) were determined using the existing FDER monitoring data. Background concentration estimates based on data collected at the Palm Beach FDER station, Palm Beach (an urban setting) are considered to be conservative for the ICL site, which is in a rural setting with less area pollution sources. The background air quality levels determined for the proposed ICL site and their corresponding federal/state standards are reported in Table 2 3 7-12. As clearly indicated by the table, the air in the ICL site vicinity is relatively clean, with air pollutant levels well below the applicable ambient air quality standards.

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**Table 2.3.7-10
SUMMARY OF FDER AIR QUALITY DATA FOR THE ICL
SITE VICINITY**

Pollutant	County	Averaging Period	Maximum Concentration			NAAQS	FAAQs
			1987	1988	1989		
SO ₂ (a)	Palm Beach	3-hr	52	58	68	1300	1300
		24-hr	12	11	27	365	260
		Annual	3	3	8	80	60
NO ₂ (a)	Palm Beach	1-hr	152	137	117	-	-
		Annual	22	25	24	100	100
CO(b)	Palm Beach	1-hr	6	7	7	35	35
		8-hr	4	5	4	9	9
Ozone(b)	Palm Beach	1-hr	0 091	0 107	0 106	0 12	0 12
TSP(a)	Palm Beach	24-hr	251	250(e)	161	260(c)	150
		Annual	50	50	128	75(d)	60
	Hendry	24-hr	650	576(f)	73	260	150
		Annual	42	36	47	75	60
	Highlands	24-hr	50	143	35	260	150
		Annual	20	20	26	75	60
	Martin	24-hr	98	103	78	260	150
		Annual	39	39	40	75	60
	Okeechobee	24-hr	52	72	105	260	150
		Annual	26	26	28	75	60
	St Lucie	24-hr	457	189(g)	219	260	150
		Annual	72	67(g)	82	75	60
PM-10(a)	Palm Beach	24-hr	-	-	78	150	150
		Annual	-	-	33	50	50
	Hendry	24-hr	-	-	65	150	150
		Annual	-	-	23	50	50

(a) Concentration in $\mu\text{g}/\text{m}^3$

(b) Concentration in ppm

(c) Primary standard specified with a secondary standard of $150 \mu\text{g}/\text{m}^3$

(d) Primary standard specified with a secondary standard of $60 \mu\text{g}/\text{m}^3$

(e) FDER indicated that this exceedance was caused by a fugitive dust event associated with a sugar cane transfer station operated 12/17/88 (Source Martin CG/CC PSD Application, 1989)

(f) FDER indicated that this exceedance was caused by reentrained particulate matter due to sugar cane harvesting activities and occurred on 12/17/88 (Source Martin CG/CC PSD Application, 1989)

(g) FDER indicated that these exceedances were due to fugitive dust from a nearby cement plant and an asphalt plant and heavy vehicle traffic on 8/1/88 (Source Martin CG/CC PSD Application, 1989)

Source FDER, 1990

Table 2.3.7-11
FPL MARTIN CG/CC PROJECT ONSITE AIR QUALITY
MONITORING DATA (OCTOBER 1988 THROUGH SEPTEMBER 1989)

Pollutant	Averaging Period	Monitored Concen ($\mu\text{g}/\text{m}^3$)	Site	NAAQS ($\mu\text{g}/\text{m}^3$)	FAAQs ($\mu\text{g}/\text{m}^3$)
SO ₂	3-hr	61	East	1300	1300
	24-hr	12 6	East	365	260
	Annual	1 3	East	80	60
NO ₂	1-hr	62	West	-	-
	Annual	5 4	East	100	100
Ozone	1-hr	165	East	235	235
	Annual	47	Both	-	-
Particulate Matter (PM-10)	24-hr	39	East	150	150
	Annual	13 3	West	50	50

Sources FPL Martin CG/CC PSD Application, 1989
 Envirosphere Company, Final Data Report for Martin CG/CC, 1989

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Table 2.3.7-12
BACKGROUND AIR QUALITY LEVELS FOR THE ICL SITE VICINITY

Pollutant	Averaging Period	Monitored Concen ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	FAAQS ($\mu\text{g}/\text{m}^3$)
SO ₂ ⁽¹⁾	3-hr	61	1300	1300
	24-hr	12 6	365	260
	Annual	1 3	80	60
NO ₂ ⁽¹⁾	1-hr	62	--	--
	Annual	5 4	100	100
Ozone ⁽¹⁾	1-hr	165	235	235
	Annual	47	--	--
Particulate ⁽¹⁾ Matter (PM-10)	24-hr	39	150	150
	Annual	13 3	50	50
TSP ⁽²⁾	24-hr	105	260	150
	Annual	40	75	60
CO ⁽³⁾	1-hr	7	35	35
	8-hr	5	9	9

Sources

⁽¹⁾ FPL Martin CG/CC PSD Monitors, 1989
Envirosphere Company, Final Data Report for Martin CG/CC, 1989

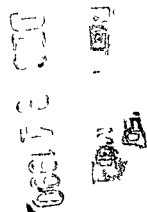
⁽²⁾ FDER monitors at Martin and Okeechobee, highest recorded among the two stations within three year period, 1987-1989

⁽³⁾ FDER monitor at Palm Beach, concentration in ppm

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2 3.7.3 Measurement Programs

As discussed in Section 2 3 7 2, preconstruction monitoring was not required because of the availability of representative air quality and meteorological data in the area. The data that were used and their sources are described in Section 2 3 7 1 and 2 3 7 2. This is discussed again in Section 5 6 2 1.



2.3.8 NOISE

2.3.8.1 Measurement Methods

Environmental noise by its nature varies with time. To quantify such a noise level, it is necessary to introduce two terms

The residual noise level is the quasi-constant noise level that exists in the absence of all identifiable sporadic or intermittent noise events such as automobile pass-bys, aircraft flyovers, dogs barking, etc. This level is usually composed of the cumulative sum of far-off indistinguishable road transportation sources in most environments. The residual level itself varies slowly with time as these sources increase or diminish, which explains the usual drop in residual level during the night and early morning hours when transportation activities are minimal. It has been found that the measurable sound level quantity, L_{90} in decibels (dB), or the level that is exceeded 90 percent of the time during an interval, serves well to quantify the residual level. The residual level is the best descriptor of community environmental quality.

The true energy average level over a given time interval is defined as $L_{\text{equivalent}}$, or L_{eq} . L_{eq} is the level over an interval that is equivalent to the perfectly constant level that would contain the same acoustic energy over the same interval. Hence, L_{eq} gives a measure of the true average range of levels, including sporadic and transient noise events.

There are numerous other measures and descriptions defining noise levels, but the two above are those commonly used to describe environmental noise. The common practice time interval for measuring environmental noise is an hour, but, since the level is changing from hour to hour and from day to day, it becomes necessary to measure over longer intervals.

For the ICL site, portable continuous monitors with digital data storage (Larson Davis Model 700) were installed at the two positions shown on Figure 2.3.8-1, and

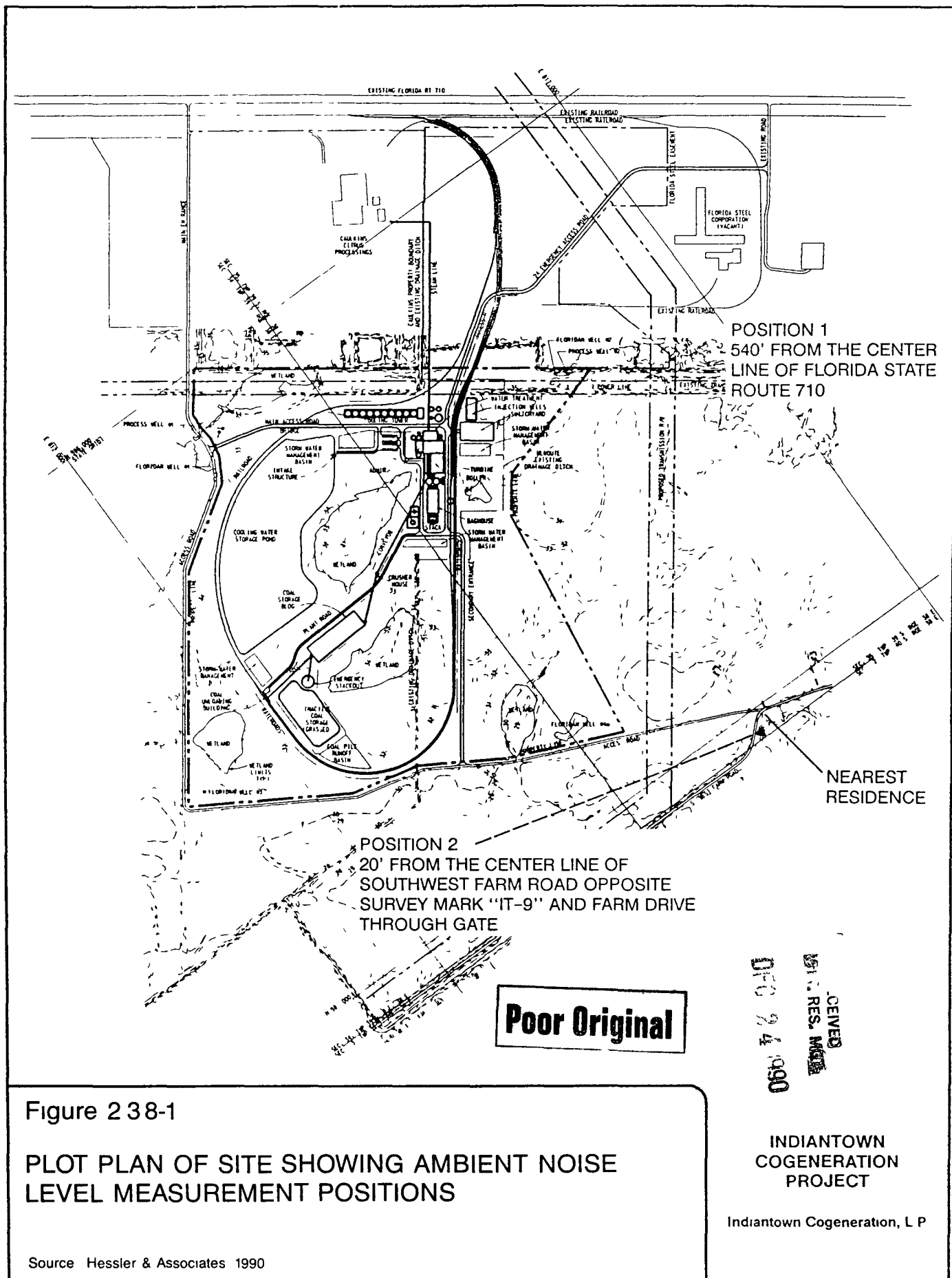


Figure 238-1

PLOT PLAN OF SITE SHOWING AMBIENT NOISE LEVEL MEASUREMENT POSITIONS

Source Hessler & Associates 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L P

operated over a 36-hour interval from 7 00 p m on July 19, 1990, to 7 00 a m on July 21, 1990. Additionally, shorter term measurements were made during calm and still weather conditions with a type 1 precision octave band sound level meter (Rion Model NA29E). Fifteen hundred spectra can be measured and stored to form the database to compute the residual L90 level.

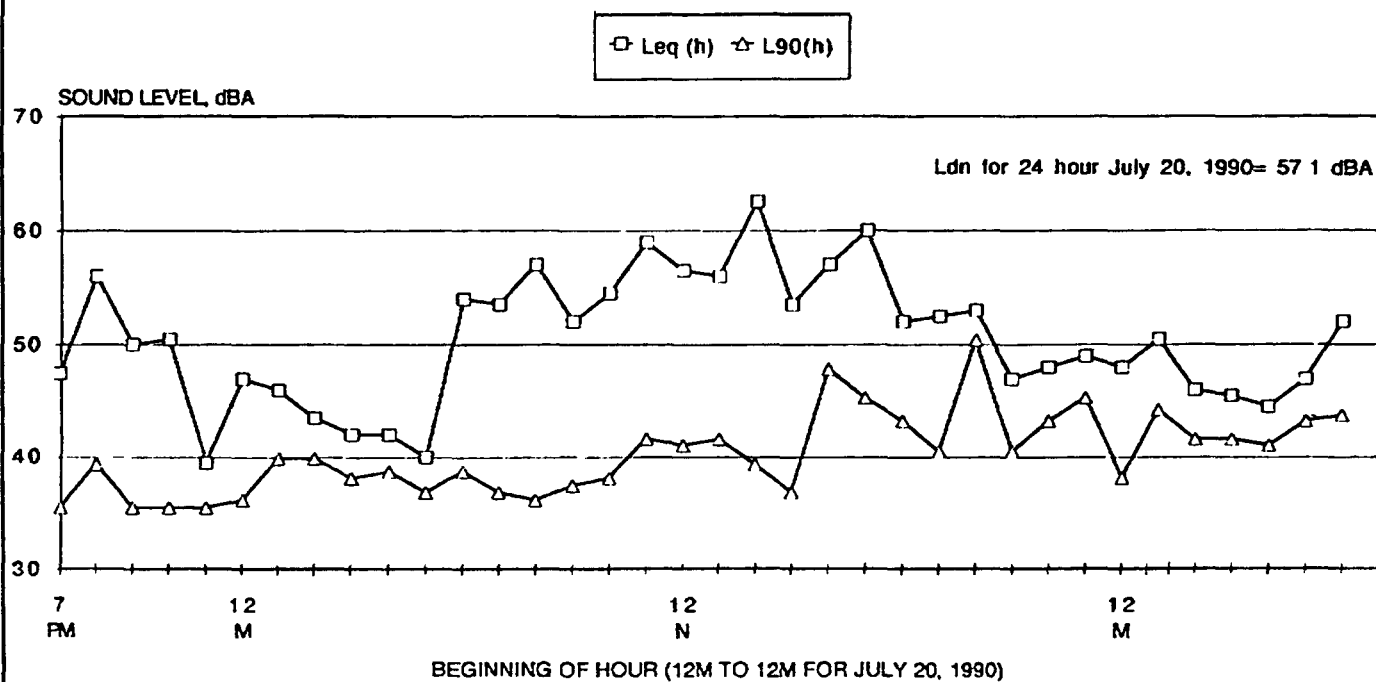
2.3.8.2 Ambient Levels

The positions shown on Figure 2 3 8-1 were chosen to characterize the entire project site from State Route 710 to South West Farm Road. State Route 710 is the dominant source of environmental noise in the area. Noise levels at the South West Farm Road position were very quiet, as one would expect in a rural farming land-use location.

The 36-hour data at position 2, South West Farm Road, are presented in graphic format on Figure 2 3 8-2. Residual levels are 35 dBA during calm wind conditions and higher during other times due to field grass and tree "rustle" and bird and insect activity. Mechanical farm equipment and road sounds could be observed at this position from sources many miles away.

Figure 2 3 8-3 is a plot of the frequency spectra at the two positions during calm weather conditions. The spectra are roughly parallel, again indicating that road noise from State Route 710 is the major source of noise in the area.

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Figure 2.3.8-2.

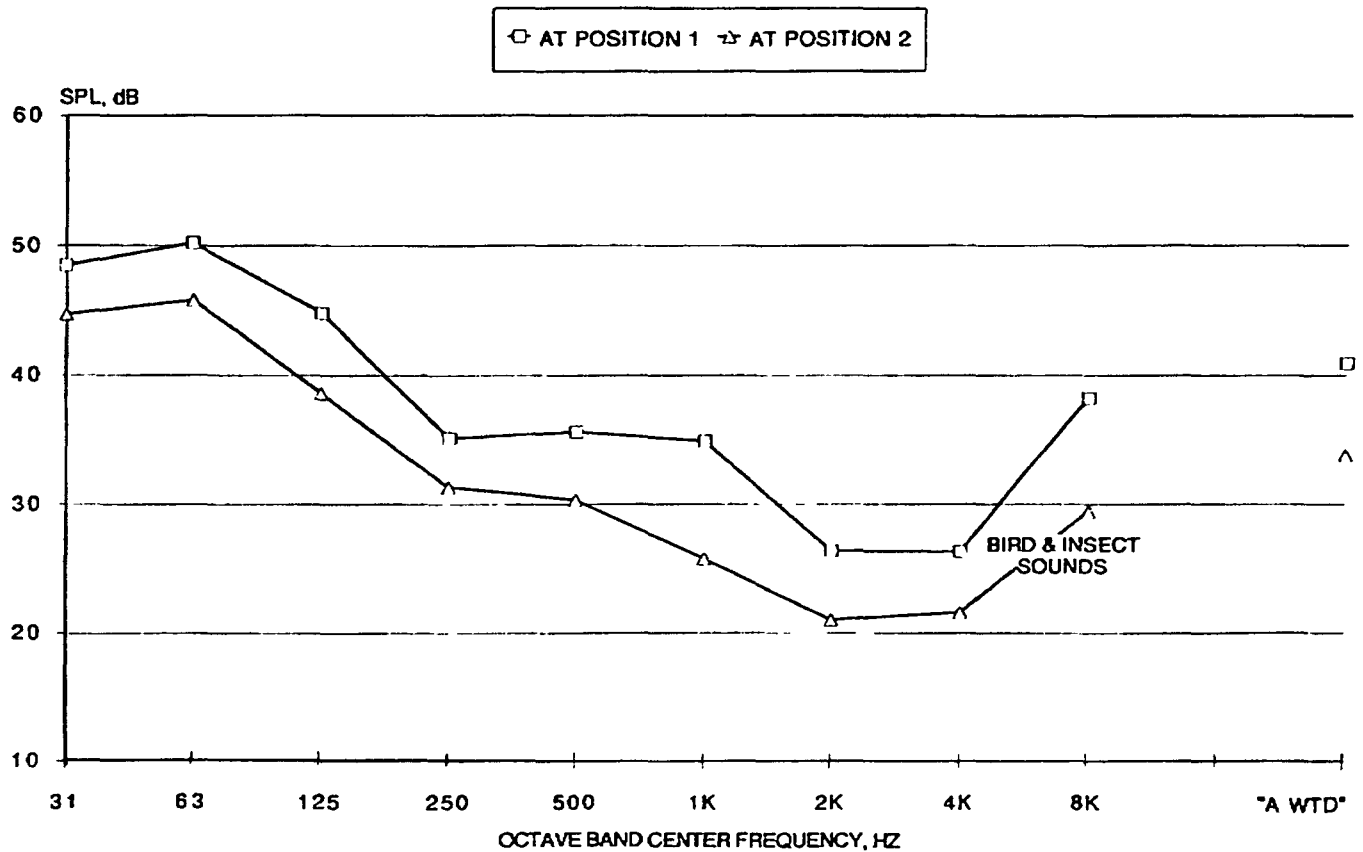
36 HOUR PLOT OF HOURLY RESIDUAL (L90) AND EQUIVALENT (Leq) ENVIRONMENTAL NOISE LEVEL AT MEASUREMENT POSITION 2 AT ICL SITE

Source Hessler Associates, 1990

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*DATA IS REPRESENTATIVE FOR CALM EARLY MORNING WEATHER CONDITIONS

Figure 2.3.8-3.

RESIDENTIAL (L90) SOUND PRESSURE LEVEL SPECTRA AT TWO POSITIONS AROUND THE ICL SITE*

Source Hessler Associates, 1990

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2.3.9 OTHER ENVIRONMENTAL FEATURES

No additional information is required

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3.0 THE PROJECT AND DIRECTLY ASSOCIATED FACILITIES

3.1 BACKGROUND

3.1.1 BACKGROUND

The Indiantown Cogeneration, L.P. (ICL) plans to build a 330 MW cogeneration plant off SR 710 near Indiantown. This project represents an important addition to the available power generation in southern Florida, where power demand is increasing rapidly.

The cogeneration plant will use low sulfur pulverized coal as its fuel to generate process steam to the Caulkins Citrus Processing plant, as well as to generate electrical power for sale to FPL. The arrangement of these facilities is shown in the site plan, Figure 3.1.1-1.

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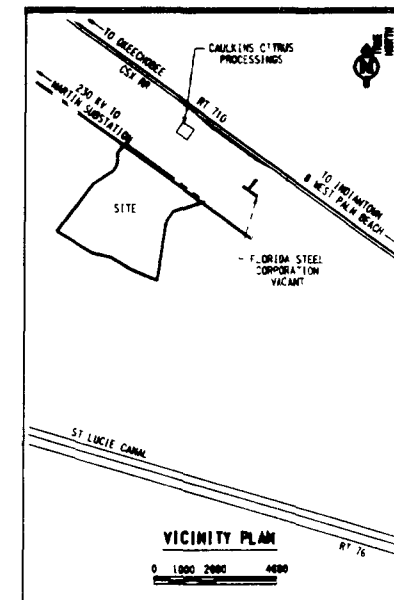
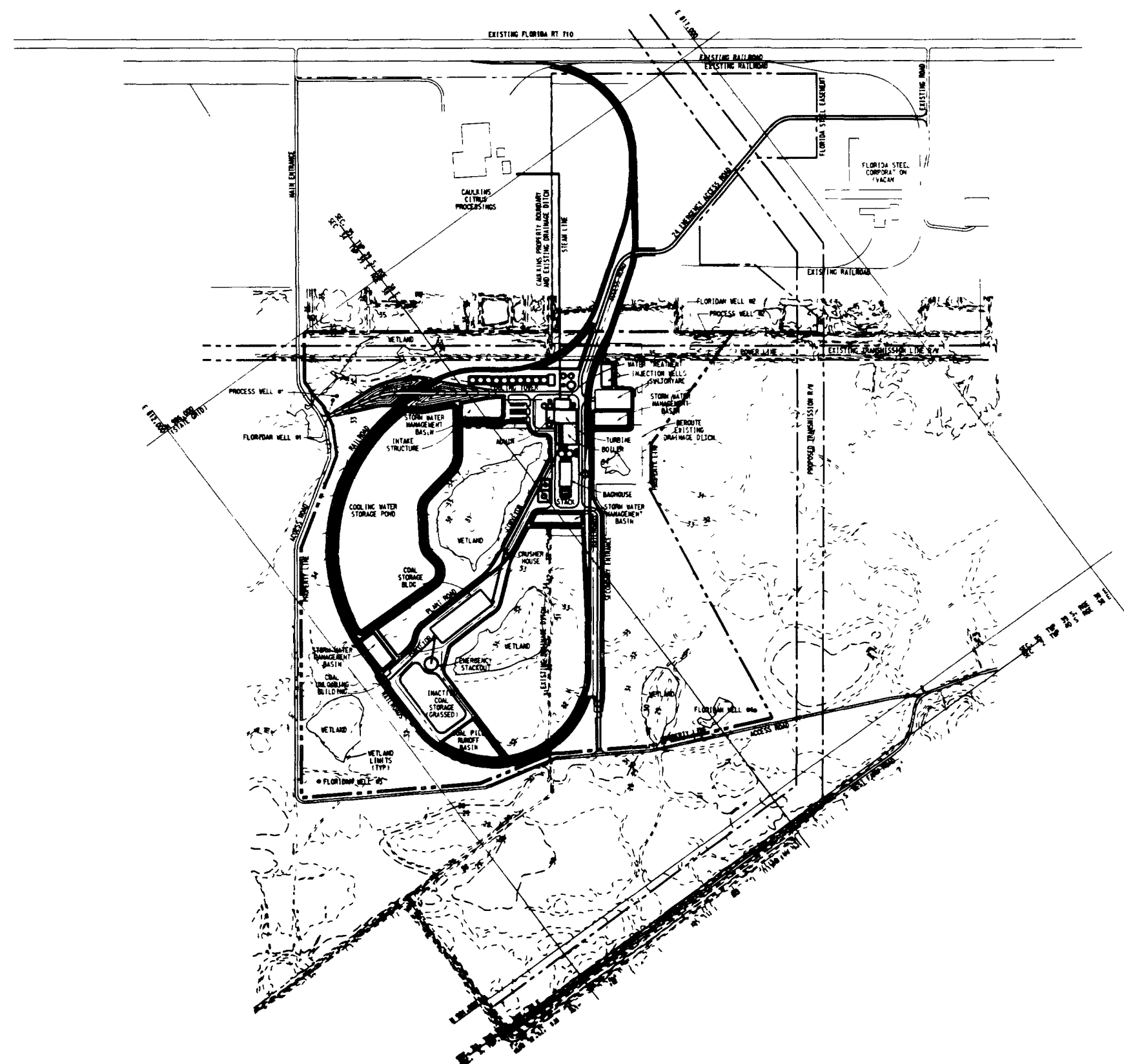


Figure 3.1.1-1.
SITE PLAN

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Indiantown Cogeneration, L.P.

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3.1.2 PLANT DESCRIPTION

The ICL cogeneration plant will generate approximately 330 MWe (net) of electrical output when not exporting process steam. Steam generation is accomplished by means of a pulverized coal (PC) reheat boiler, and electrical power generation is provided by means of an extraction-condensing turbine generator.

During the period from November to June, process steam will be supplied to the Caulkins Citrus Processing plant. At the peak of the processing season, up to 225,000 lb/hr of process steam can be supplied to the Caulkins plant. Condensate from the citrus facility will be returned to the plant for reuse. An auxiliary boiler, capable of firing either No. 2 fuel oil or natural gas, will provide startup steam needs for the cogeneration plant and export process steam if required.

The PC boiler will be an outdoor natural-circulation type boiler. The principal components of the boiler will include: water-cooled furnace, superheaters, reheaters, economizer, convection pass heat transfer elements, fans and blowers, air preheaters, and induced draft fans. In the furnace section of the PC boiler, the pulverized coal will be mixed with the hot combustion air and ignited in the coal burners. Combustion air will be preheated in an airheater using the exit flue gas to improve overall boiler efficiency.

In general, the boiler and air pollution control systems will be typical of outdoor construction and will not be totally enclosed. However, enclosed buildings will be provided for administration, control, maintenance, and warehousing, and the material handling facilities will be totally enclosed.

One outdoor, drum type, natural circulation PC boiler will generate a total of approximately 2,500,000 lb/hr of steam at 2535 psia and 1005 °F at the superheater outlet and 1005 °F at the reheater outlet.

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The boiler will utilize the latest in combustion controls to reduce nitrogen oxides formation. Nitrogen oxides that do form will be further reduced by a selective non-catalytic reduction (SNCR) process where reagent will be injected into the furnace. The reagent will reduce the nitrogen oxides to molecular nitrogen and water.

Flue gas from the air heater will enter the spray dryer absorber (SDA) system. A lime slurry will be injected into the SDA (dry scrubber to react with the hot flue gas. The hot gas will be humidified and cooled in the SDA by spraying with reactant slurry. The system will use calcium hydroxide ash slurry as the absorbing medium. Pebble lime will be slaked in the lime preparation system, diluted, and stored in the lime feed tanks. Feed slurry will be pumped to an atomizing system.

Acid gas concentrations will be reduced substantially during the initial evaporation and drying in the SDA. A smaller removal will occur in the filter cake in the baghouse. Reaction products, consisting of calcium sulfate, calcium sulfite, unreacted calcium hydroxide, and ash, will be removed from the flue gas at the SDA hopper and the baghouse hoppers. The reaction products and ash will be conveyed to a silo equipped with a bin-vent type filter to minimize fugitive dust emissions. Railcars will be loaded from the silo for transporting the ash back to the coal mine.

The bottom ash formed from the coal combustion will be removed from the furnace by a submerged drag chain conveyor for transfer to railcars for hauling back to the coal mine. The majority of the solid waste (bottom and fly ash and reaction products) will be removed by rail, and minor waste (water treatment filter cake) will be removed by truck for offsite disposal.

Lime will be delivered to the site by self-unloading pneumatic railcars or self-unloading trucks. The lime will be pneumatically conveyed to the lime silo which will be equipped with a bin-vent type filter to minimize fugitive dust emissions.

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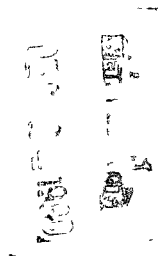
Coal will be delivered by rail, unloaded, and stored in an enclosed storage facility onsite. A grassed inactive pile, sized for 30 days storage at full load, also will be provided.

The exhaust steam from the turbine must be condensed for reuse in the boiler/turbine cycle. Circulating water will be used between the wet mechanical draft cooling tower and the condenser to cool the steam. A portion of this cooling water will be evaporated in the cooling tower and must be replenished along with the cooling tower blowdown which will be discharged from the circulating water system to prevent solids from building up in the tower.

This cooling tower makeup water will be supplied from the Taylor Creek/Nubbin Slough via a 19-mile pipeline routed along SR 710 in the CSX railway right-of-way (ROW). A cooling water storage pond will be used as a means to extend the use of the Taylor Creek/Nubbin Slough at times when the withdrawal of this water is not possible. The Floridan aquifer will also be used as a backup water source for cooling tower makeup during the dry periods when water from the Taylor Creek/Nubbin Slough is not available.

In order to minimize water use, the process is designed to recycle as much water as practical. The boiler blowdown will be reused in the cooling tower system and not just discharged. Clarifiers and other water treatment systems will be incorporated to cleanup waste streams such that they can be recycled. Even a portion of the wastewater will be injected in the SDA system, thus minimizing the amount of water going to the injection well.

An intake structure will be constructed at the Taylor Creek/Nubbin Slough Canal. Pumps at this structure will supply cooling tower makeup water via a pipeline to the site. The 19-mile long pipeline will have an approximate diameter in the range of 18 to 24 inches, will be buried, and will run along the railroad ROW.



A tie-in from the plant's switchyard will be made to the existing FPL 230 kV transmission line which crosses the northern portion of the site. Therefore, no additional ROWs or transmission line construction will be required.

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3.2 SITE LAYOUT

The Plot Plan, Figure 3.2.0-1, depicts the proposed layout of the ICL facilities as they are arranged on the 232-acre site. The site plan (Figure 3.1.1-1) shows that the plant will be located south of the Caulkins Citrus Processing Plant and the vacant Florida Steel Corporation (FSC) plant.

The proposed ICL project with its supporting equipment and facilities is shown on Figure 3.2.0-2. This figure is an architectural rendering of the proposed project.

A new rail spur will be added from the existing CSX railroad and will enter the site along an easement located through the western part of the Florida Steel Corporation property that abuts Caulkins property. This spur expands into a coal rail loop that encircles the majority of the site.

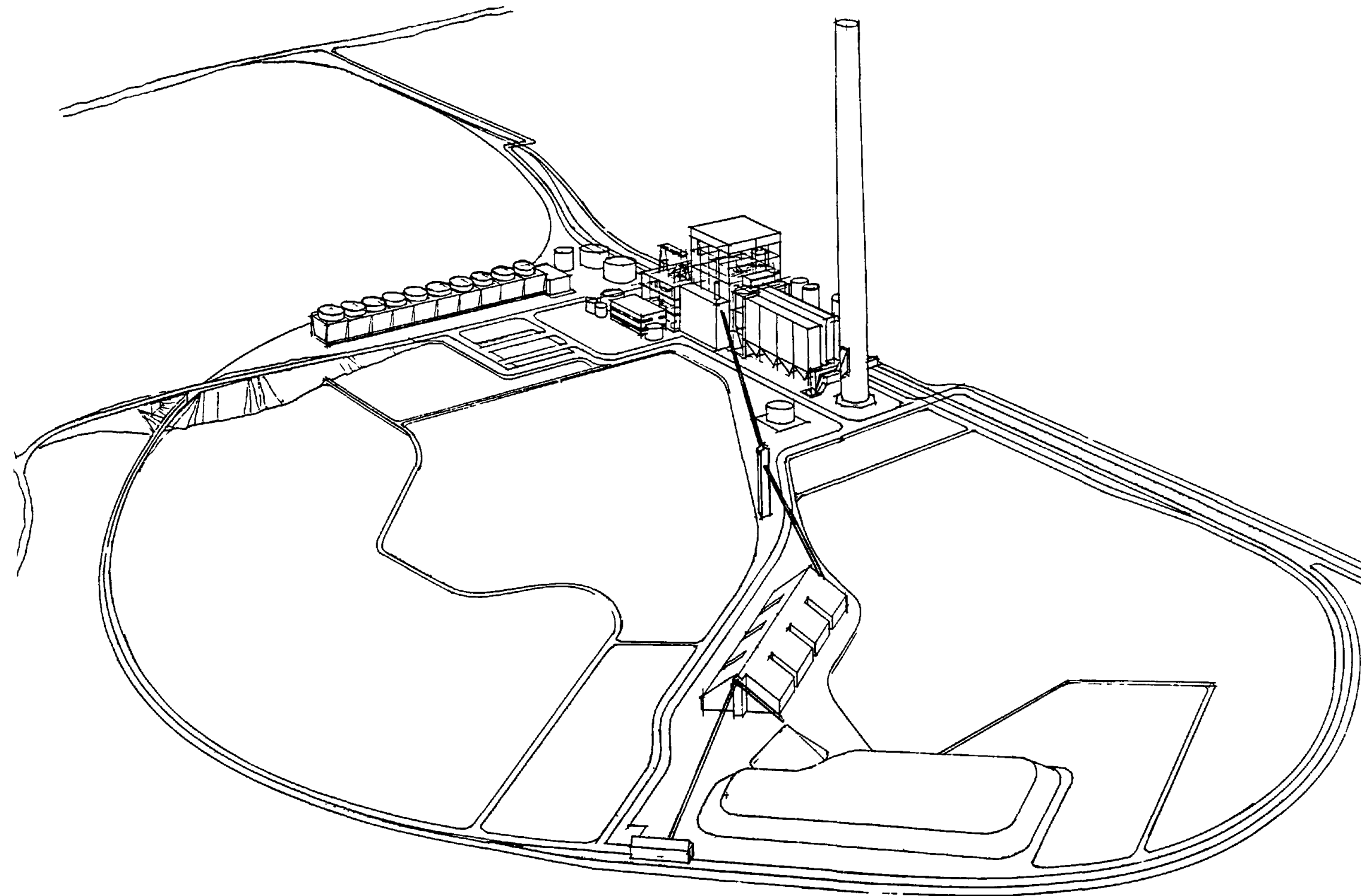
The main entrance to and from the site will be provided by an extension of the existing Caulkins access road from SR 710, southward along the west side of Caulkins and the new site boundary. This access road will extend along the west side and south perimeter of the site, connecting to South West Farm Road and serving as a public throughway between South West Farm Road and SR 710. A secondary access road will extend from this new road to the power block area of the site. An emergency access road will also be added along the railroad easement between Caulkins and Florida Steel, which connects to the existing FSC entrance road.

The power block area, encompassing the boiler, turbine, air pollution control equipment, administration building, warehouse/maintenance building, cooling tower and switchyard facilities, will be located on the northeastern portion of the site. The coal unloading and storage facilities will be located in the southwestern portion of the site. Figure 3.2.0-3, entitled Plant Elevation, is a cross sectional view of the power block area.

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Figure 3 2 0-2

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The Emission Point Diagram, Figure 3 2 0-4, indicates the potential gaseous and liquid wastes points from the plant. Fugitive dust from coal, lime, and ash handling transfer points will be captured by filters. The emissions from the main stack and the auxiliary boiler stack will be controlled per Best Available Control Technology (BACT) requirements. Sanitary wastes will be discharged to the Indiantown wastewater treatment facility. Process wastes will not be discharged from the site, but will be injected into deep wells.



3.3 FUEL

3.3.1 COAL

3.3.1.1 Coal Supply and Analysis

Coal will be delivered by rail to the ICL site and will serve as the primary fuel for the main boiler. The coal used for environmental licensing purposes is presented in Table 3.3.1-1. The main boiler will use approximately 3,480 tons of 11,800 Btu/lb coal per day at full load and at 80 °F, the design ambient temperature of the facility.

3.3.1.2 Coal Handling and Storage

Coal will be delivered by unit train consisting of approximately 64 standard and 22 special covered-top, 100-ton, bottom dump cars. Three unit trains per week are required. Figure 3.1.1-1 shows the onsite rail loop location.

The unit train locomotive will be used to stage the coal cars at the enclosed coal unloading building. A side-mounted car shaker will be located over the unloading hopper and will be used to enhance the discharge of coal from the cars.

Coal storage will be provided in both active and inactive piles. The active pile will be stored within an enclosed structure which will include a physical barrier (such as a concrete lining) below the pile to protect the groundwater. The pile will be sized for 7 days of coal at full power load. The inactive pile will contain 30 days of compacted coal. This inactive pile will be approximately 25 feet high and will be covered and seeded. A liner will be used under the inactive pile to prevent runoff and leachate from entering the groundwater.

Two 500-tph unloading feeders and one 1,000-tph conveying system will transport the coal from the unloading hopper in the unloading building to the coal storage.

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**Table 3.3.1-1
ULTIMATE ANALYSIS
(WORST CASE FUEL)**

<u>COMPONENT</u>	<u>% (AS FIRED)</u>
Carbon	65.37%
Hydrogen	4.63%
Oxygen	4.69%
Nitrogen	1.16%
Sulfur	2.00%
Chlorine	0.15%
Ash	12.00%
Water	<u>10.00%</u>
TOTAL	100.00%
HHV	11,800 Btu/lb

Source. ICL, 1990

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building At the transfer point before the storage building, coal may be diverted to either the storage building or the emergency stackout pile

The emergency stackout pile will also be lined and will be an outdoor type pile sized to accommodate up to 30 carloads of incoming coal

The active coal storage will consist of a 24,360-ton longitudinal pile enclosed in an A-frame building The pile capacity represents a 7-day plant requirement at design conditions. A belt conveyor equipped with a traveling tripper will stack coal on the pile Coal will be reclaimed from the pile and deposited on a reclaim conveyor at a rate of 800 tph Reclaimed coal will be conveyed to the crusher tower for size reduction

The coal reclaim conveyor and the crusher feed conveyor will transfer the coal to the crusher tower, where it will pass under a magnetic separator before being discharged into a surge bin The crusher feeders will transfer the coal from the surge bin into two crushers. The crushers will reduce the coal feed size from 2" x 0" to 1-1/4" x 0" The coal will then be transferred on the 800 tph plant transfer conveyor that conveys coal to the boiler building

An 800 tph silo feed conveyor equipped with a traveling tripper will supply coal to four operating coal silos and one spare silo The total volume of the four operating silos will accommodate approximately 24 hours of full load firing of the boiler

3.3.2 NATURAL GAS

3.3.2.1 Natural Gas Supply and Analysis

Natural gas supplied by pipeline will serve as one of two alternative fuels for both the auxiliary boiler and for the main boiler light-off and warmup (No. 2 fuel oil is the other alternative fuel). A typical fuel analysis for natural gas is presented in Table 3.3.2-1. The auxiliary boiler will use up to 350,000 cu ft per hour of natural gas (only) at full load.

3.3.2.2 Natural Gas Distribution

The natural gas system will consist of an onsite gas metering station and distribution system fed from a new pipeline that will tie into the main gas transmission line that parallels SR 710.

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Table 3.3.2-1
NATURAL GAS¹ ANALYSIS

Ultimate Analysis

<u>Element</u>	<u>Gravimetric Breakdown (%)</u>
Carbon	73.913
Hydrogen	24.047
Oxygen	1.249
Nitrogen	0.773
Sulfur	<u>0.018</u>
	100.000

Proximate Analysis

<u>Component</u>	<u>Gravimetric Breakdown (%)</u>
Volatile Matter	99.920
Fixed Carbon	0
Moisture ²	0
Ash	0
Sulfur	<u>0.018</u>
	100.000

¹The heat of combustion of the natural gas is estimated to be 950 Btu/cubic foot

²Actual value is 0.00138 percent.

Source. Bechtel, 1990

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3.3.3 FUEL OIL

3.3.3.1 Fuel Oil Supply and Analysis

No. 2 fuel oil will serve as one of two alternative fuels for both the auxiliary boiler and for the main boiler light-off and warmup (natural gas is the other alternative fuel). Very low sulfur oil will be used to provide SO₂ emissions control. A typical fuel oil analysis for very low sulfur oil is presented in Table 3.3.3-1. The auxiliary boiler will use up to 2,500 gph of No. 2 fuel oil (only) at full load. A startup of the main boiler is expected to use approximately 9,000 gallons of No. 2 fuel oil.

3.3.3.2 Fuel Oil Handling and Storage

The fuel oil system will consist of one fuel oil storage tank, filling pumps to transfer fuel from trucks to the tank, two 100-percent-capacity centrifugal pumps to provide fuel to the main or auxiliary boilers, and associated piping and controls. The fuel oil storage tank capacity is 200,000 gallons, which is sufficient for 3 days' operation of the auxiliary boiler.

The fuel oil transfer and storage system is designed in accordance with the National Fire Protection Association's 1987 Flammable and Combustible Liquids Code (NFPA-30). The fuel oil storage tank is designed in accordance with the Environmental Protection Agency (EPA) Standards of Performance for New Stationary Sources: Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels). Containment walls around the fuel oil storage tank (sized to contain the contents of the tank plus an allowance for precipitation) will be provided.

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Table 3.3.3-1
NO. 2 FUEL OIL ANALYSIS¹

Ultimate Analysis

<u>Element</u>	<u>Gravimetric Breakdown (%)</u>
Carbon	87.26
Hydrogen	12.67
Oxygen	0
Nitrogen	0.02
Sulfur	<u>0.05</u>
	100.00

Proximate Analysis

<u>Component</u>	<u>Gravimetric Breakdown (%)</u>
Volatile Matter	99.395
Fixed Carbon	0.425
Moisture	0.050
Ash	0.050
Sulfur	<u>0.050</u>
	100.000

¹The heat of combustion of the No. 2 fuel oil is estimated to be 19,130 Btu/lb

Source Bechtel, 1990

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The active coal pile will be located within a building and will have a physical barrier such as concrete or a liner. The emergency coal pile area will be lined to prevent groundwater contamination. It will be designed to be part of the runoff and leachate system that feeds the lined runoff collection basin.

3.3.5 ALTERNATIVE FUELS

The main boiler can only be fired at full load with coal. Both natural gas and No. 2 fuel oil are available, however, for startup of the main boiler and for 100 percent firing of the auxiliary boiler. The auxiliary boiler is sized to provide 100 percent of the process steam needs of the Caulkins Citrus Processing plant (225,000 pounds per hour maximum), in case the main boiler is down. The option to use either natural gas or No 2 fuel oil provides security against future unavailability or escalations in price of either gas or oil

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3.8 SITE DRAINAGE

3.8.1 EXISTING SITE DRAINAGE

The topography of the Indiantown Cogeneration, L.P. (ICL) project site varies between El. 35.0 and 31.0 feet, with the higher elevations in general occurring along the northern and western periphery of the site. The existing grade for the power block areas, including switchyard and cooling tower, varies between El. 35.0 and 33.0 feet. The prevailing grade along the existing transmission line corridor varies between El. 35.0 and 33.0 feet. The area to the north of the transmission line corridor has an existing grade elevation of approximately 35.0 feet. Due to the relatively flat gradient and limited topographic relief, the stormwater runoff has a low flow velocity. Much of the site area is heavily vegetated with pine and wet prairie. A drainage ditch traverses the entire site from north to south carrying the site surface runoff, as well as surface runoff from areas north of the site, to the St. Lucie Canal approximately 2.5 miles away. In general, the site drains in a southerly direction toward the ditch.

The ICL site is characterized by several isolated, naturally occurring nonforested, fresh water wetlands interspersed over the site. The boundaries of these shallow, wet prairie wetlands, as shown on the Plot Plan (Figure 3.2.0-1), were developed from the field survey performed in the Spring of 1990.

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3.8.2 DRAINAGE AREAS

The estimated areas for the developed ICL site, as shown on the Site Drainage Plan (Figure 3.8.2-1), are

- Power block area 21 acres
- Coal handling area 9 acres
- Inactive coal storage area 6 acres
- Cooling water storage pond 25 acres

The other areas of the project not disturbed by development are

- Wetland preserves, including ditch 24.4 acres
- Existing transmission power lines 8 acres
- Upland preserves, including wetland buffers 58.3 acres
- Miscellaneous areas north and west of rail loop: 22.7 acres

For reference and further discussion purpose, these areas are defined as follows

- Power Block Area

Includes areas housing turbine, boiler, water treatment system, administration building, stack, scrubbers and baghouse buildings, switchyard, various tanks, cooling tower, parking lot, oil storage tank, injection well, and three stormwater management basins.

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Figure 382-1 (Sheet 1 of 2)

PRELIMINARY DRAINAGE PLAN

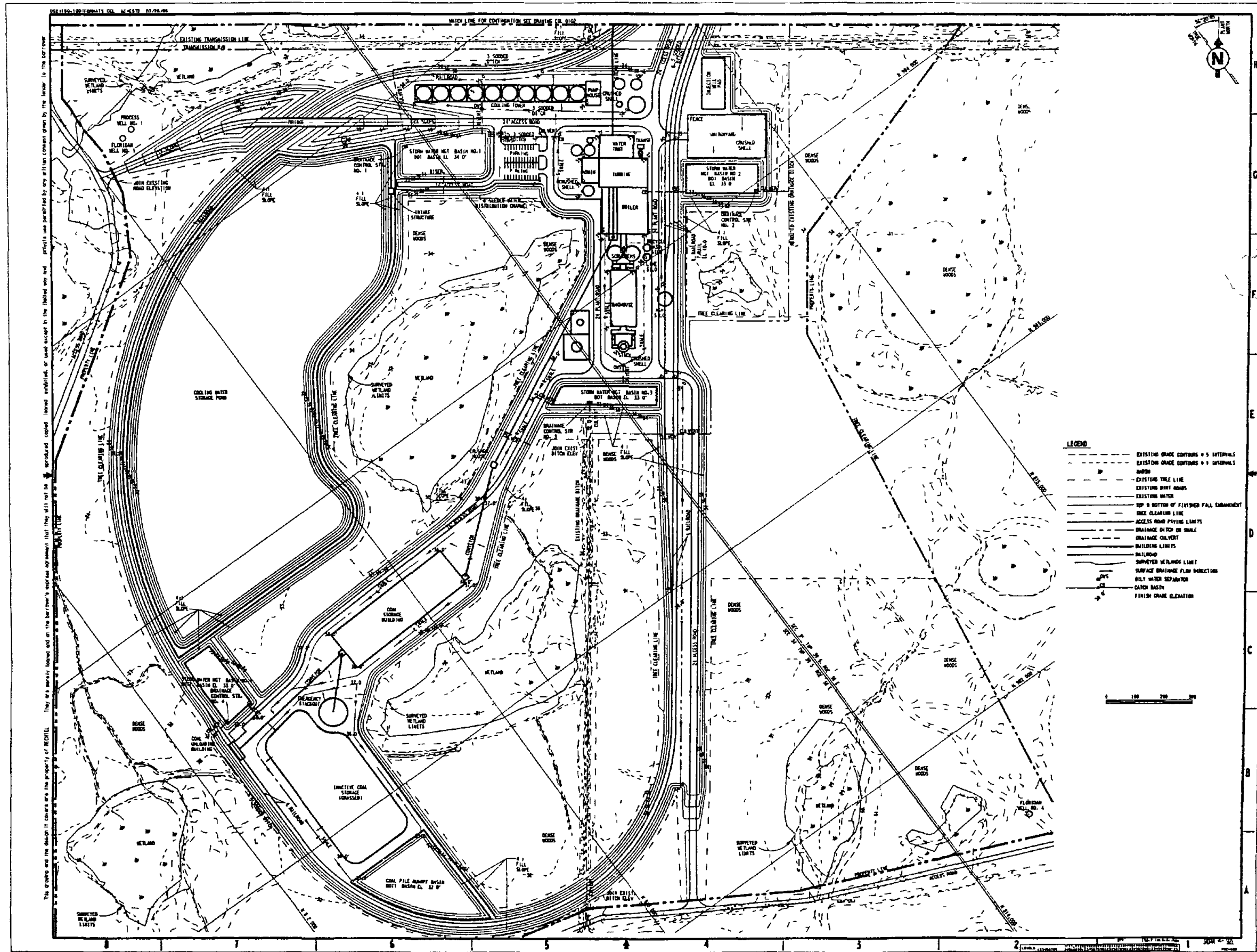
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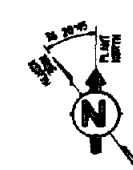


Figure 38 2-1 (Sheet 2 of 2)

PRELIMINARY DRAINAGE PLAN

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- LEGEND**
- EXISTING GRADE CONTOURS # 5 INTERVALS
 - - - EXISTING GRADE CONTOURS # 1 INTERVALS
 - MARSH
 - - - EXISTING TREE LINE
 - - - EXISTING DIRT ROADS
 - - - EXISTING WATER
 - TOP & BOTTOM OF FINISHED FILL EMBANKMENT
 - ACCESS ROAD PAVING LIMITS
 - DRAINAGE DITCH ON SHALE
 - DRAINAGE CULVERT
 - BUILDING LIMITS
 - PA LROAD
 - SURVEYED WETLANDS LINE
 - SURFACE DRAINAGE FLOW DIRECTION
 - CATCH BASIN
 - FINISH GRADE ELEVATION

REFERENCE DRAWINGS

CON 0001 SITE PLAN
COL 0 01 FINISH GRADING PLAN SHEET NO. 1



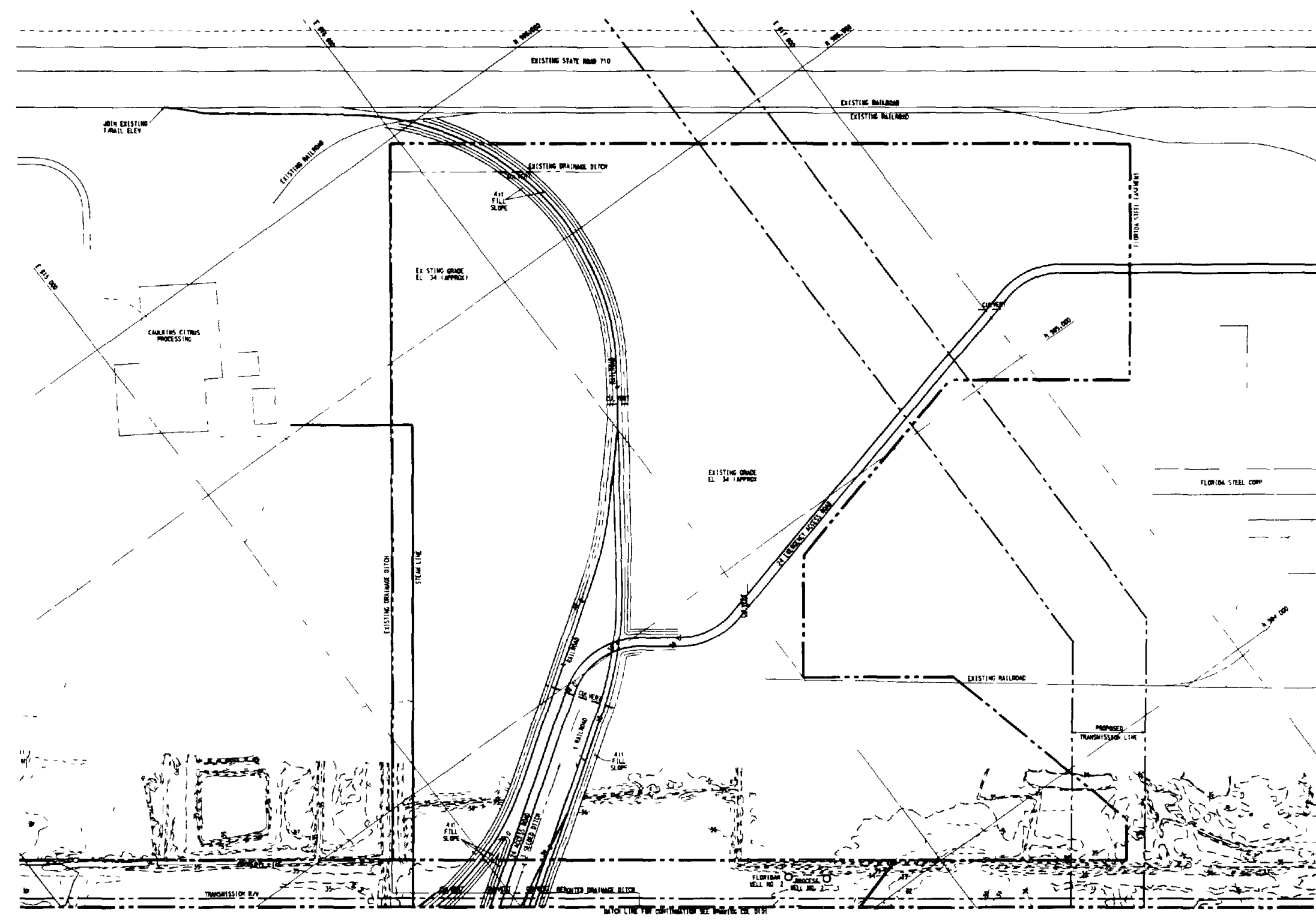
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- Coal Handling Area

Includes areas housing coal storage building, coal handling building, conveyors, and a stormwater management basin

- Inactive Coal Storage Area

Includes areas dedicated to coal storage, emergency stackout, and coal pile runoff basin

- Cooling Water Storage Pond

Includes area dedicated to the cooling water storage pond

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3 8 3 DESIGN CRITERIA AND APPLICABLE REGULATIONS

3 8 3 1 South Florida Water Management District Criteria

The surface water management system will be designed in accordance with the regulations and requirements of the South Florida Water Management District (SFWMD), which has been delegated authority under F A C 17-25 090. These regulations and requirements are outlined in the SFWMD Permit Manual (SFWMD, 1987).

The surface water management system for the project facilities located within the developed area will be designed such that the peak post-development discharges from the ICL site will not exceed the peak pre-development discharges into the existing onsite drainage ditch. Detention basins and discharge control structures will ensure that post-development peak discharges will not exceed the pre-development peak discharge. By virtue of the existing topography, the stormwater runoff from the undeveloped areas outside the developed area will continue to follow the existing course.

The following design criteria are specified in the SFWMD Permit Manual:

a Design Storms

- 100-year, 72-hour storm for emergency spillway elevations of detention basins and building elevations
- 25-year, 72-hour storm for principal spillway elevations of detention basins, permanent swales and ditches, and culverts
- 10-year, 72-hour storm for road crown elevations and temporary diversion ditches

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b Rainfall Frequencies for the Site Area

- 100-year, 24-hour 9 0 inches
72-hour 12 2 inches
- 25-year, 24-hour 7 0 inches
72-hour 9 5 inches
- 10-year, 24-hour 5 8 inches
72-hour 7 9 inches
- 3-year, 24-hour 4 3 inches
- Rainfall Distribution SCS-Type III

c Basin Outlet Structures

- V-notch bleeder (control structure) is to pass the first inch of runoff
- Combined discharge capacity of principal and emergency spillways to accommodate peak runoff from 100-year, 72-hour storm

3.8 3 2 Runoff Analysis

Power Block and Coal Handling Areas

SCS Technical Release No 55, (TR55), (USDA, 1986) was used to determine pre-developed as well as post-developed peak runoff discharges for the site. Weighted runoff coefficients were determined by percentage of impervious area due to development and soil type. Based on the soil types found in the site area, a site-

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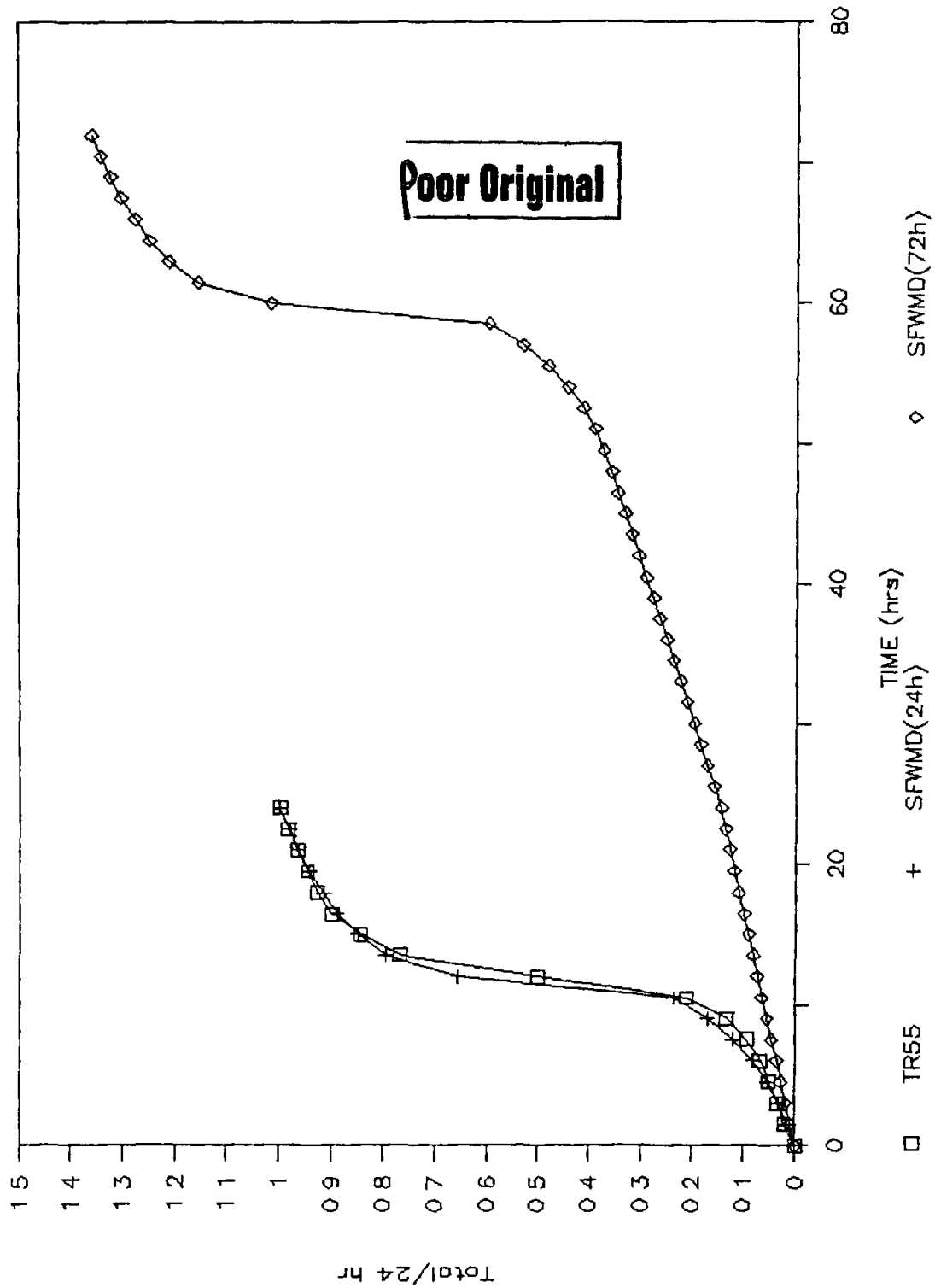


Figure 383-1

COMPARISON OF SFWMD AND TR-55 RAINFALL DISTRIBUTIONS

Source SFWMD and TR-55

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Wetland Runoff

Seven naturally occurring wetlands within the property boundary (23.4 acres) will be preserved. An additional 1 acre of wetland in the form of a man-made ditch, as shown on Figure 3.1.1-1 (Site Plan), will be rerouted and then maintained on the project site. A 50-foot buffer of pine flatwoods surrounding the three wetlands in the central portion of the property and a wetland on the northwest corner of the property will also be maintained. The other three wetlands are surrounded by preserved uplands and will not be disturbed. The impact of facility access road and railroad spurs will be minimized by incorporating the wetland areas into the project's surface water management plan such that excessive and unseasonal flooding or drying will be avoided.

For the wetland adjacent to the cooling water storage pond, a 3-year, 24-hour storm event (assumed to be equivalent to the mean annual) was used in pre- and post-development runoff assessments. The analysis was performed to determine the deficient mean annual peak discharge required to feed the wetland from a detention basin (see Section 3.8.5.2). This discharge to the wetland will be through a rip-rapped channel or grassed swale.

3 8 4 CONSTRUCTION DRAINAGE

Rerouting of a portion of the existing onsite drainage ditch and construction of the surface water runoff collection basins will be performed early in the project schedule. This will facilitate site drainage and the use of these basins as sedimentation basins during clearing, rough grading, excavation, and construction. A rough grading plan is shown in Figure 3 8 4-1.

The construction activities will result in disturbance of land in the following areas:

- Power block and switchyard area
- Construction laydown area
- Coal handling and storage areas, including the rail car unloading facility
- Plant roads and railroad
- Trenches for the circulating water piping system and other underground utilities
- Cooling water storage pond
- Runoff collection basins
- Drainage ditches, diversion ditches, and the wetland water distribution channel
- Rerouted portion of the existing north-south drainage ditch traversing the site

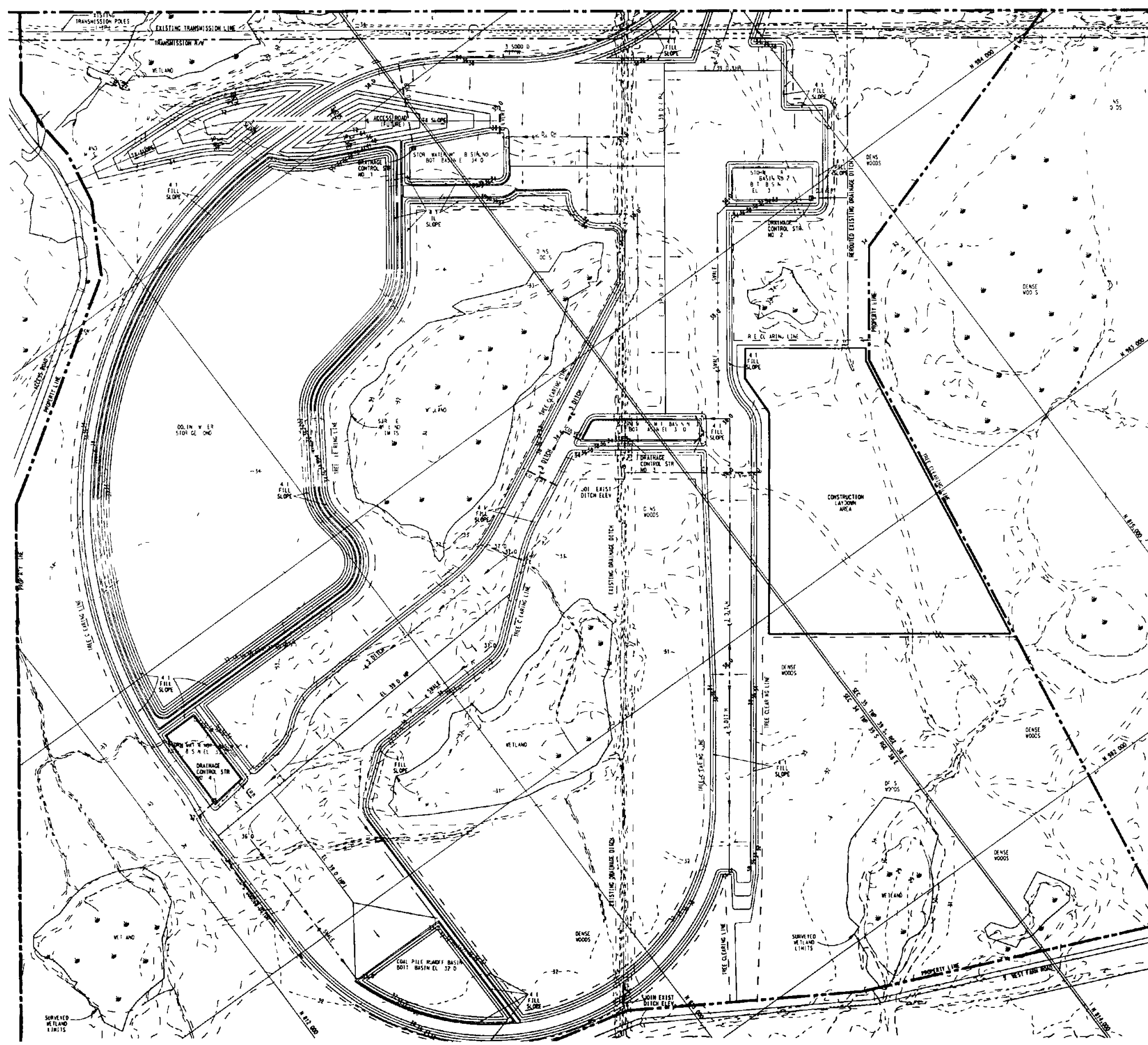


Figure 384-1
ROUGH GRADING PLAN

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- Additional temporary construction buildings including offices, warehouses, and shops

To collect the runoff water from these areas, a total of five collection basins will be built as shown on Figure 3 8 2-1. During construction, these basins will be used as sedimentation basins. The runoff water from these basins will be discharged to the existing drainage ditch, either directly or via perimeter ditches to the north and southwest of the plant area outside the railroad loop.

Natural characteristics affecting erosion and sediment transport include rainfall intensity, type of soil, topography, and vegetation cover. At the ICL site, several of these influences offset each other. Although rainfall intensity is high, the topography is relatively level, which will minimize the water flow velocity and sediment transport capacity. The flat slope of the land will tend to limit the amount of material that could be transported by runoff. Erosion control measures will include provision of diversion ditches, silt fences, straw bale dikes, and sediment traps. Hydroseeding and mulching will be used on all rough graded areas to establish a ground cover on slopes, drainage ditches, and swales.

The collection basins that will be provided early in construction will be used to allow considerable time for suspended solids to settle prior to discharge. They will remain in operation during construction and will be cleaned periodically to maintain their function. The mitigation measures used for the erosion and sedimentation control during construction are discussed below. The exact location, size, and number of these control features have been established for the construction planning phase. Considerations have been given to construction sequence, construction season, local topography, and final drainage scheme in establishing erosion and runoff control details. Additional measures, as required during construction, will be implemented by the construction superintendent.

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Vegetative Practices

The following vegetative practices for erosion and sedimentation control will be incorporated during construction

Temporary Seeding

The detention basin embankments, perimeter dikes, topsoil stockpiles, and areas to be rough graded during the initial phase of construction shall be seeded or sodded as per SFWMD requirements

Jute Mesh

Jute mesh or other degradable channel lining material shall be used to aid in establishing grass growth. It may also be applied on road and track side ditches, if required

Structural Practices

The structural practices to control and intercept sediment from runoff and to retain coarse sediment particles from reaching surrounding water bodies, will include provision of perimeter dikes, riprap outlet structures, straw bale dikes or barriers, silt fences, diversion dikes, graveled construction entrances, and detention basins

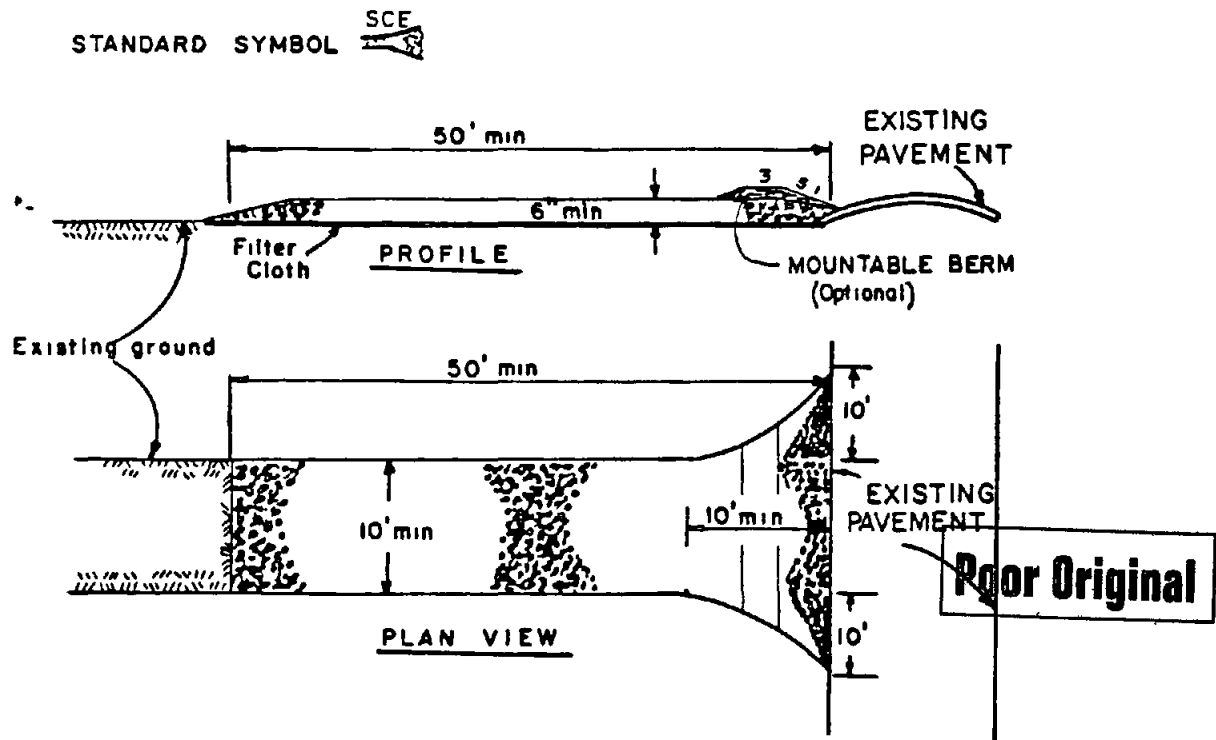
3 8 4 2 Description of the Control Facilities

Temporary Construction Entrance

Construction laydown and storage areas will be accessed via roads that will become permanent plant roads. Roads in the construction area will be upgraded with gravel to facilitate heavy truck traffic as needed. Typical details of the temporary construction entrance from the main road are shown on Figure 3 8 4-2

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STABILIZED CONSTRUCTION ENTRANCE not to scale



CONSTRUCTION SPECIFICATIONS

1. Stone Size - Use 2" stone, or reclaimed or recycled concrete equivalent.
2. Length - As required, but not less than 50 feet (except on a single residence lot where a 30 foot minimum length would apply).
3. Thickness - Not less than six (6) inches.
4. Width - Ten (10) foot minimum, but not less than the full width at points where ingress or egress occurs.
5. Filter Cloth - Will be placed over the entire area prior to placing of stone. Filter will not be required on a single family residence lot.
6. Surface Water - All surface water flowing or diverted toward construction entrances shall be piped across the entrance. If piping is impractical, a mountable berm with 5:1 slopes will be permitted.
7. Maintenance - The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spilled, dropped, washed or tracked onto public rights-of-way must be removed immediately.
8. Washing - Wheels shall be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with stone and which drains into an approved sediment trapping device.
9. Periodic inspection and needed maintenance shall be provided after each rain.

Figure 3 8 4-2
TYPICAL DETAILS OF
STABILIZED CONSTRUCTION ENTRANCE

Source USDAG SCS

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Sedimentation (Detention) Basins

Sedimentation (detention) basins will be developed as required by excavation to intercept the runoff from the construction area and to prevent coarse sediment particles from reaching the surrounding water bodies. The basin will have an outlet that permits draining at a slow rate during a storm, according to SFWMD requirements and as shown in Figure 3 8 4-3. These basins will remain in operation during construction, and will be mucked out periodically to maintain their function. Upon completion of construction, the basins will be cleaned and will be incorporated into the stormwater management plan. Typical features of the sedimentation basin are shown in Figure 3 8 4-4.

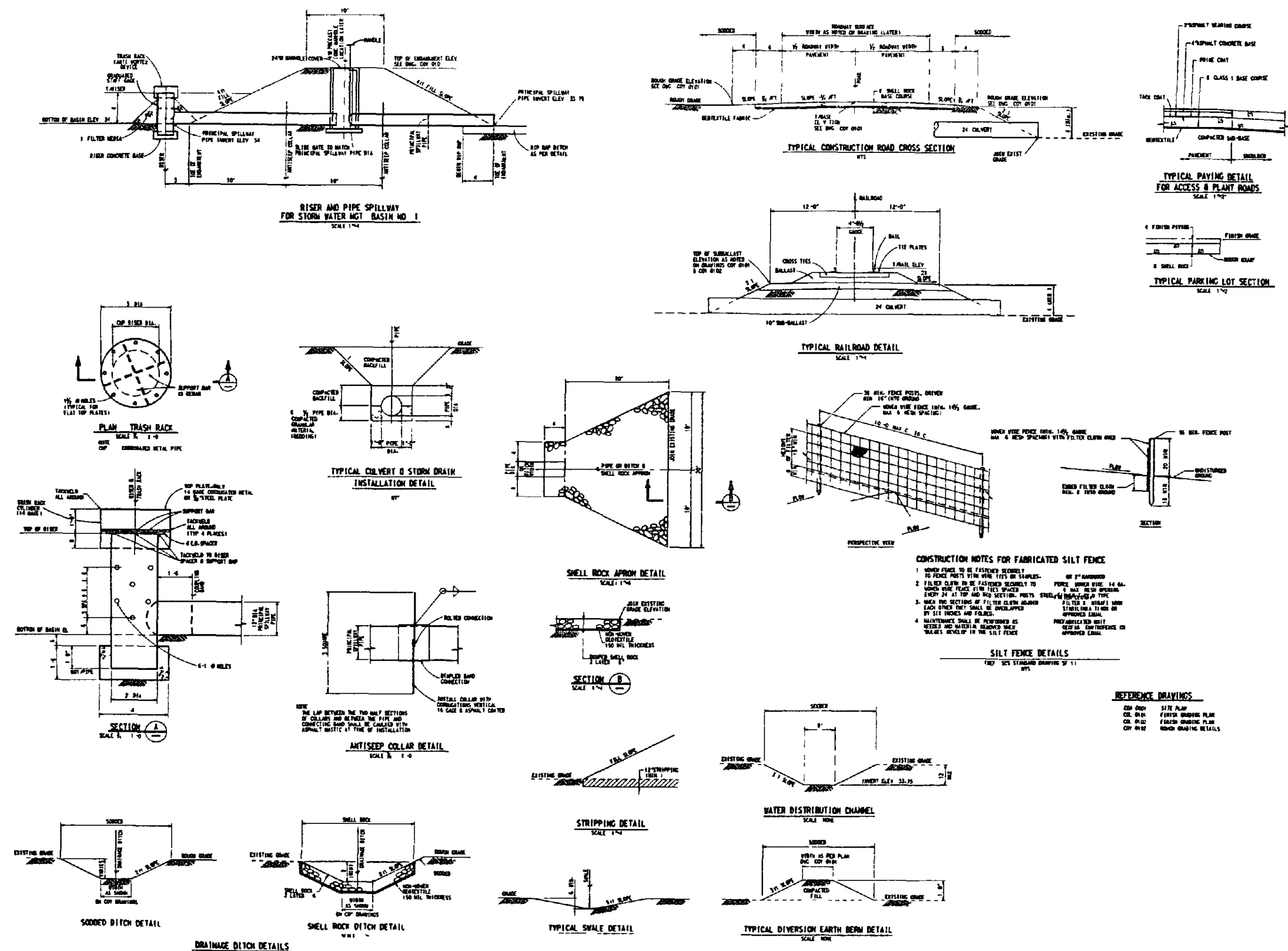
Swales and Ditches

Swales will be formed to direct the runoff to sedimentation basins. These swales will be excavated, graded, and stabilized with rock or by sodding or seeding. The cross section of the swales will be V-shaped or trapezoidal and designed to carry runoff from contributing area with a velocity of 2.0 fps or the allowed non-erosive velocity for the swale material. Typical details of the swales are shown in Figure 3 8 4-5.

Straw Bale Dikes and Silt Fences

Straw bale dikes will be constructed by placing the bale perpendicular to the flow. They will be keyed in and stacked as shown in Figure 3 8 4-6. Silt fences (Figure 3 8 4-7) will also be used to control the release of sediment laden runoff from the site.

Figure 3 8 4-3
 EROSION AND SEDIMENTATION
 CONTROL - TYPICAL DETAILS
 (SHEET 1)



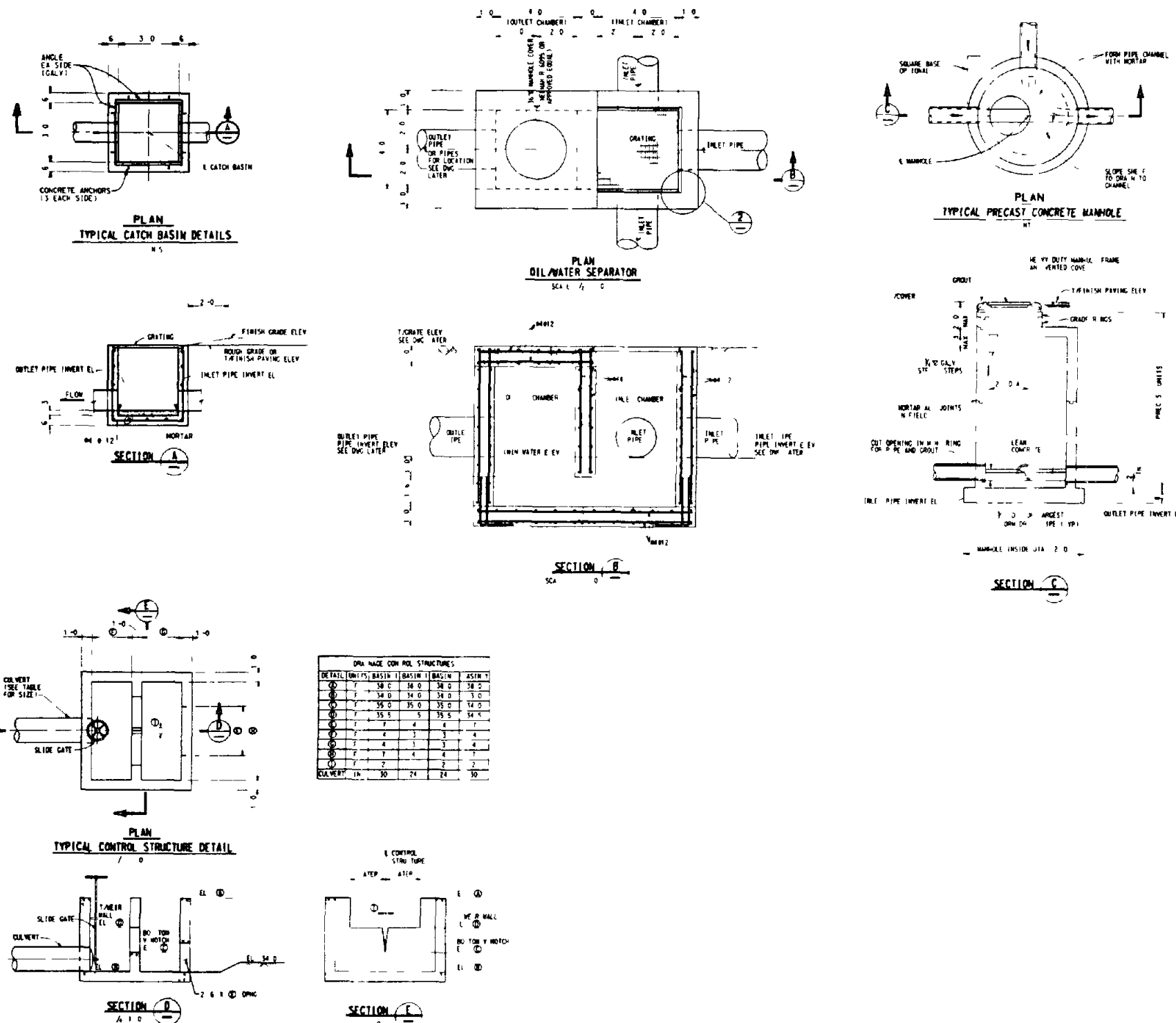
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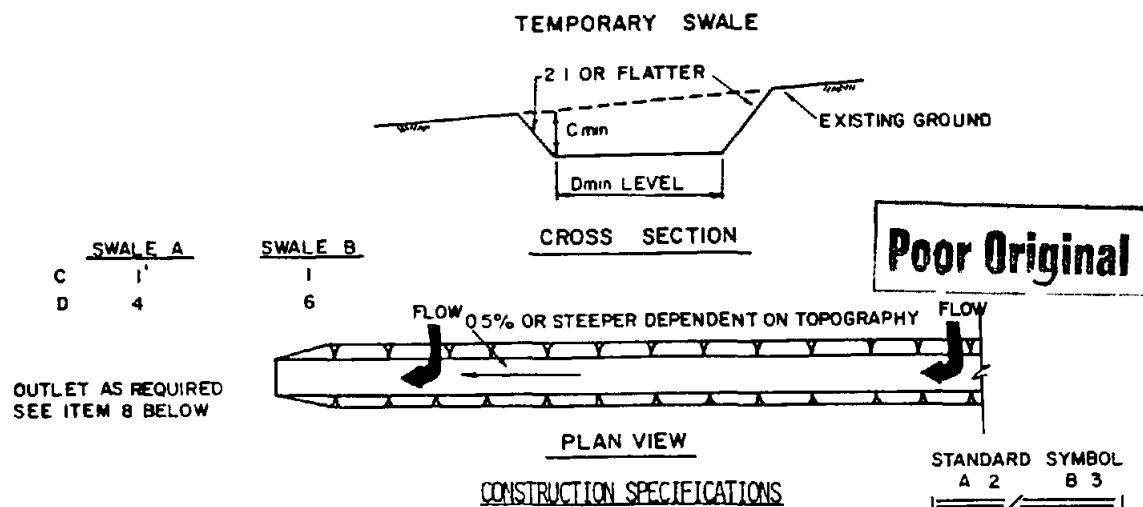
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Figure 3 8 4-4
EROSION AND SEDIMENTATION
CONTROL - TYPICAL DETAILS
(SHEET 2)



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1. ALL TEMPORARY SWALES SHALL HAVE UNINTERRUPTED POSITIVE GRADE TO AN OUTLET.
2. DIVERTED RUNOFF FROM A DISTURBED AREA SHALL BE CONVEYED TO A SEDIMENT TRAPPING DEVICE
3. DIVERTED RUNOFF FROM AN UNDISTURBED AREA SHALL OUTLET DIRECTLY INTO AN UNDISTURBED STABILIZED AREA AT NON-EROSIVE VELOCITY.
4. ALL TREES, BRUSH, STUMPS, OBSTRUCTIONS, AND OTHER OBJECTIONABLE MATERIAL SHALL BE REMOVED AND DISPOSED OF SO AS NOT TO INTERFERE WITH THE PROPER FUNCTIONING OF THE SWALE
5. THE SWALE SHALL BE EXCAVATED OR SHAPED TO LINE, GRADE, AND CROSS SECTION AS REQUIRED TO MEET THE CRITERIA SPECIFIED HEREIN AND BE FREE OF BANK PROJECTIONS OR OTHER IRREGULARITIES WHICH WILL IMPEDE NORMAL FLOW
6. FILLS SHALL BE COMPACTED BY EARTH MOVING EQUIPMENT.
7. ALL EARTH REMOVED AND NOT NEEDED ON CONSTRUCTION SHALL BE PLACED SO THAT IT WILL NOT INTERFERE WITH THE FUNCTIONING OF THE SWALE.
8. STABILIZATION SHALL BE AS PER THE CHART BELOW

FLOW CHANNEL STABILIZATION

TYPE OF TREATMENT	CHANNEL GRADE	A (5 AC OR LESS)	B (5 AC - 10 AC)
1	0.5-3.0%	SEED AND STRAW MULCH	SEED AND STRAW MULCH
2	3.1-5.0%	SEED AND STRAW MULCH	SEED USING JUTE OR EXCELSIOR
3	5.1-8.0%	SEED WITH JUTE OR EXCELSIOR, SOD	LINED RIP-RAP 4-8" RECYCLED CONCRETE EQUIVALENT
4	8.1-20%	LINED 4-8" RIP-RAP	ENGINEERED DESIGN
9	PERIODIC INSPECTION AND REQUIRED MAINTENANCE MUST BE PROVIDED AFTER EACH RAIN EVENT		

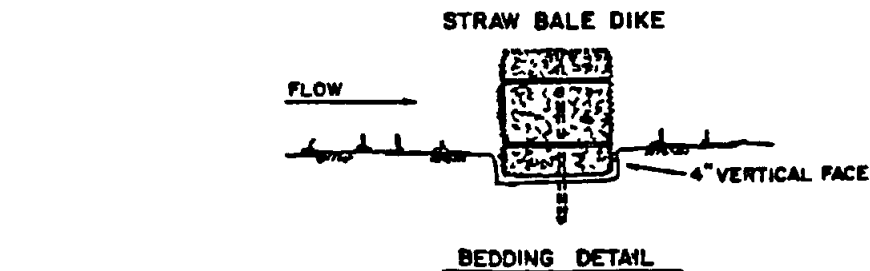
Figure 3 8 4-5
TYPICAL DETAILS OF TEMPORARY SWALE

Source: USDAG SCS

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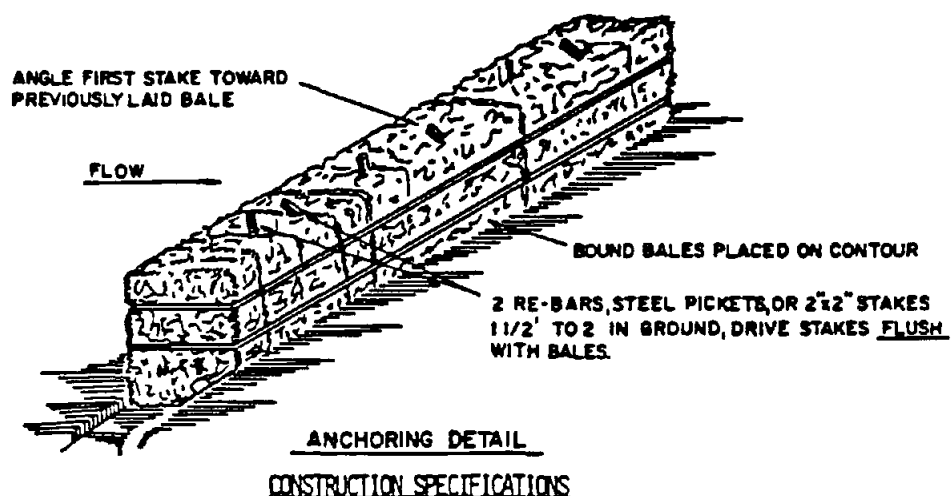
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EX. 1, RES. MOD.



STANDARD SYMBOL

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1. BALES SHALL BE PLACED AT THE TOE OF A SLOPE OR ON THE CONTOUR AND IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. EACH BALE SHALL BE EMBEDDED IN THE SOIL A MINIMUM OF (4) INCHES, AND PLACED SO THE BINDINGS ARE HORIZONTAL.
3. BALES SHALL BE SECURELY ANCHORED IN PLACE BY EITHER TWO STAKES OR RE-BARS DRIVEN THROUGH THE BALE. THE FIRST STAKE IN EACH BALE SHALL BE DRIVEN TOWARD THE PREVIOUSLY LAID BALE AT AN ANGLE TO FORCE THE BALES TOGETHER. STAKES SHALL BE DRIVEN FLUSH WITH THE BALE.
4. INSPECTION SHALL BE FREQUENT AND REPAIR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
5. BALES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFULNESS SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

Figure 3 8 4-6
 TYPICAL DETAILS OF STRAW BALE DIKE

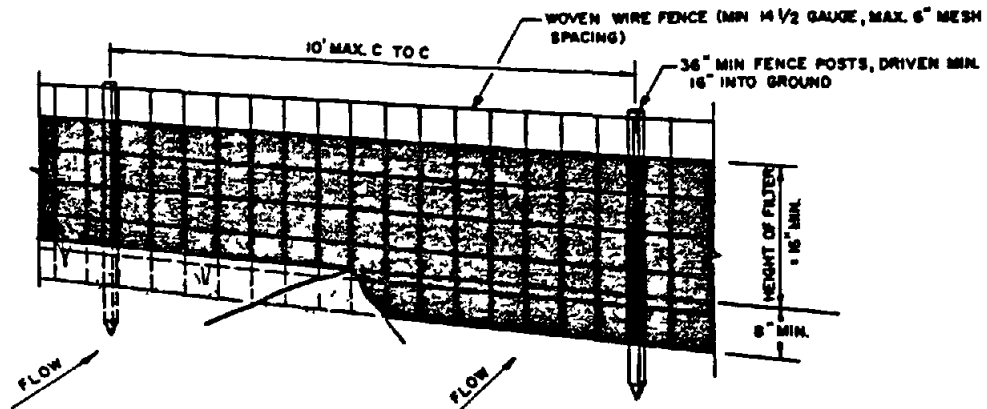
Source USDAG SCS

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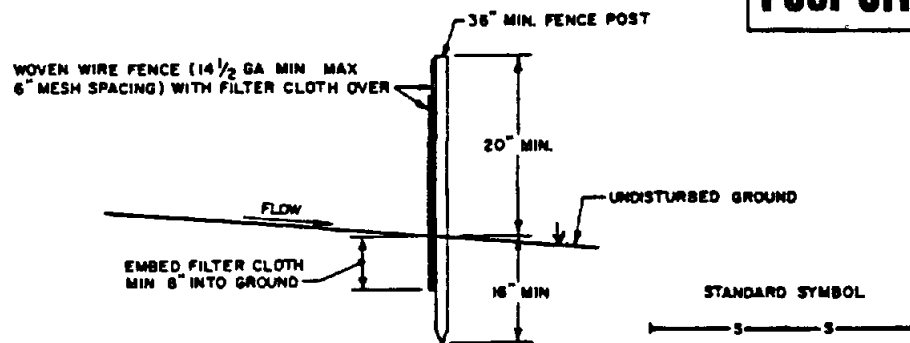
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SILT FENCE



PERSPECTIVE VIEW

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SECTION

CONSTRUCTION NOTES FOR FABRICATED SILT FENCE

1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES.
2. FILTER CLOTH TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID SECTION.
3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY SIX INCHES AND FOLDED.
4. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

POSTS: STEEL EITHER T OR U TYPE OR 2" HARDWOOD

FENCE WOVEN WIRE, 14 GA. 6" MAX. MESH OPENING

FILTER CLOTH FILTER X, MIRAFI 100X, STABI-LINKA T14CN OR APPROVED EQUAL

PREFABRICATED UNIT GEOTAB, ENVIROFENCE, OR APPROVED EQUAL.

Figure 3 8 4-7
TYPICAL DETAILS OF SILT FENCE

Source USDAG SCS

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P. 10/01/00

Dewatering During Construction

During construction, dewatering will probably be required inside the work area. Water will be pumped out of the excavation and diverted through a straw bale filter dike or silt fence or sedimentation basins prior to release.

3 8 4 3 Construction Monitoring and Maintenance

In general, all erosion and sedimentation control measures will be checked weekly and after each significant rainfall. The following items will be checked in particular:

- Sedimentation basins will be cleaned out when the level of sediment buildup reaches approximately 1 foot.
- Gravel or riprap outlets will be checked regularly for sediment buildup. If the gravel is clogged with silt, it will be removed and cleaned or replaced.
- Straw bale barriers or dikes will be checked regularly for undermining or deterioration of the bales.
- Seeded and sodded areas will be checked regularly. Areas will be fertilized and reseeded as needed.
- Silt fences and filter barriers shall be inspected after each rainfall and during prolonged rainfall. Required repairs will be made immediately.
- Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric will be replaced promptly.

- Sediment deposits at barriers will be removed after heavy storm events. They will be removed when deposits reach approximately one-half the height of the barrier.
- Sediment deposits remaining in place after the silt fence or silt barrier is no longer required will be dressed to conform with the existing grade, prepared, and seeded.

3 8 4 4 Permanent Stabilization

Areas disturbed by construction will be stabilized with permanent seeding immediately following finish grading. Finish grading will include regrading and seeding of the areas used by the construction facilities and perimeter dike system and return the areas to natural drainage. Vegetated areas will be re-established and stabilized with appropriate seed mixture. Discharge from the site during and after construction will be directed to the detention/stormwater management basins 1 through 5.

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3 8.5 PERMANENT SITE DRAINAGE

3 8 5 1 Introduction

The permanent drainage facilities will consist primarily of a series of open ditches and swales, catchbasins, oil/water separators, storm drainage piping, culverts, stormwater detention basins, and a wetland water distribution channel (Figure 3 8 2-1) The stormwater runoff from the developed area will be directed to the detention basins which will have bleeder type devices to control the discharge rate in compliance with the SFWMD surface water discharge requirements Discharge will be accomplished using a bleeder type v-notch weir contained in a two chambered structure as shown in Figure 3 8 4-3, and as recommended by the SFWMD The basins, installed early during construction to provide sediment and erosion control, will be cleaned upon construction completion and maintained thereafter to control site drainage or stormwater runoff

Stormwater runoff from the newly added non-porous surfaces (i e , paved roads, parking lots, roofs, yard area, etc) will be collected and conveyed to the detention basins utilizing a system of curbing, catch basins, and underground piping The system will also include design features (e g , oil/water separators) as necessary, to treat and/or remove any potential contaminants, and to maintain acceptable water quality conditions The detention basin outlet structure will be provided with a manual control valve, or sluice gate, to prevent discharge from the basins during contamination spills and, when needed, to control the release

The site drainage system will convey the onsite runoff to the existing drainage ditch, with some rerouting of its existing alignment With the exception of the runoff basin for the inactive coal storage area, all of the stormwater runoff from the detention basins will eventually be discharged into the existing drainage ditch traversing the central portion of the site The stormwater runoff from the inactive

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coal storage area will be detained and treated, and recycled for plant cooling and process water use

The following sections address the management of the stormwater runoff from the proposed developed areas located within the railroad loop. The site has been broken down into the following general areas for analysis:

- Power block area
- Coal handling area
- Inactive coal storage area

3 8 5 2 Proposed Power Block Area Drainage System

The total power block area is approximately 21 acres. This area will be elevated to a finished grade of approximately 39 feet NGVD. Stormwater runoff from the area will be directed to three permanent collection basins (Nos. 1, 2, and 3). Basins 1 and 2 lie to the west and east of the power block area, respectively. Basin 3 is located to the south of the power block area. These basins are shown on Figure 3 8 2-1.

The stormwater runoff from curbed areas (potentially contaminated areas) will be channelled to catch basins and oil/water separators before discharge to the basin. The following table lists some key figures for detention basins 1 through 3.

<u>Basin</u>	<u>Drainage Area (ac)</u>	<u>Peak Discharges</u>		<u>Basin Size</u>		<u>Max W E NGVD (ft)</u>
		<u>Pre (cfs)</u>	<u>Post (cfs)</u>	<u>Surface Area (ac)</u>	<u>Volume Req'd (ac-ft)</u>	
1	10.7	32	75	1.18	3.0	37
2	4.5	13	33	.80	1.5	36
3	5.6	17	44	.94	2.0	36

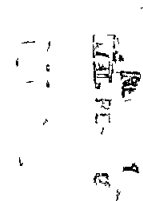
The depth of the basins below finish grade will be 5 feet. This includes a maximum water depth of 3 feet during emergency spillway operation and a minimum freeboard of 2 feet. The bottom of the basins will be above the existing groundwater level of the area. A total of 6.5 acre-feet of detention volume will be provided by these three basins in the power block area for stormwater management purposes.

Discharge from basins 2 and 3 will be directed to a rip-rapped apron and then conveyed to the existing drainage ditch. A perimeter ditch will convey the basin 1 discharge to the existing drainage ditch, as shown on Figure 3.8.2-1. A portion of the runoff from basin 1 will be diverted and distributed to the wetland immediately south of the basin.

The area draining to the wetland adjacent and east of the cooling water storage pond has a pre-developed drainage area of 21 acres. Due to the construction of the cooling water storage pond and plant layout, the contributing area is reduced to 11.5 acres. The existing pre- and post-peak discharges for the mean annual (3-year, 24-hour storm event as provided by the SFWMD, 1987) storm, are 20 and 13 cfs, respectively, as determined by SCS Technical Release No. 55 (USDA, 1986). As a result of this decreased contributing area, this wetland has a peak flow deficiency of 7 cfs for the 3-year 24-hour storm event. This deficiency will be compensated by providing runoff from basin 1 through a perforated vertical riser pipe surrounded by a rip-rap filter. The discharge will be distributed to the wetland by a rip-rapped discharge channel as shown on Figure 3.8.2-1.

3.8.5.3 Proposed Coal Handling Area Drainage System

The coal handling area for the unit is comprised of approximately 9 acres. The area will be elevated to a finished grade of approximately 38 feet NGVD at the center, sloping outward to swales, and eventually discharged to the reten-





storage area will be lined with a synthetic impervious liner to eliminate seepage of runoff

The stormwater runoff from the inactive coal storage is considered to be wastewater. Runoff collected from this area is treated to adjust pH and detained in the basin. Treated runoff is transferred to the cooling tower sidestream softener for cooling tower use.

3 8 5 5 Proposed Cooling Water Storage Pond Area

The cooling water storage pond will be sized to store water pumped from Taylor Creek/Nubbin Slough. The pond will be lined and the water will be used for plant cooling and process water make-up. The details of the cooling water pond are discussed in Section 3 5 1 2.



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INDIANTOWN COGENERATION PROJECT

SITE CERTIFICATION APPLICATION

APPENDIX BECHTEL DRAWINGS

April 9, 1991

**Appendix
Bechtel Drawings**

<u>Drawing No.</u>	<u>Title</u>
COA-0001	Site Plan, Rev. D
COA-003	Cross Section Location, Rev. A Sheet 1 of 3
COA-0091	Cross Sections, Rev. A Sheet 2 of 3
COA-0092	Cross Sections, Rev. A Sheet 3 of 3
COL-0101	Preliminary Drainage Plan, Rev. D Sheet 1
COY-0191	Erosion and Sedimentation Control - Typical Details, Rev. B
COY-0192	Rough Grading Details, Rev. A

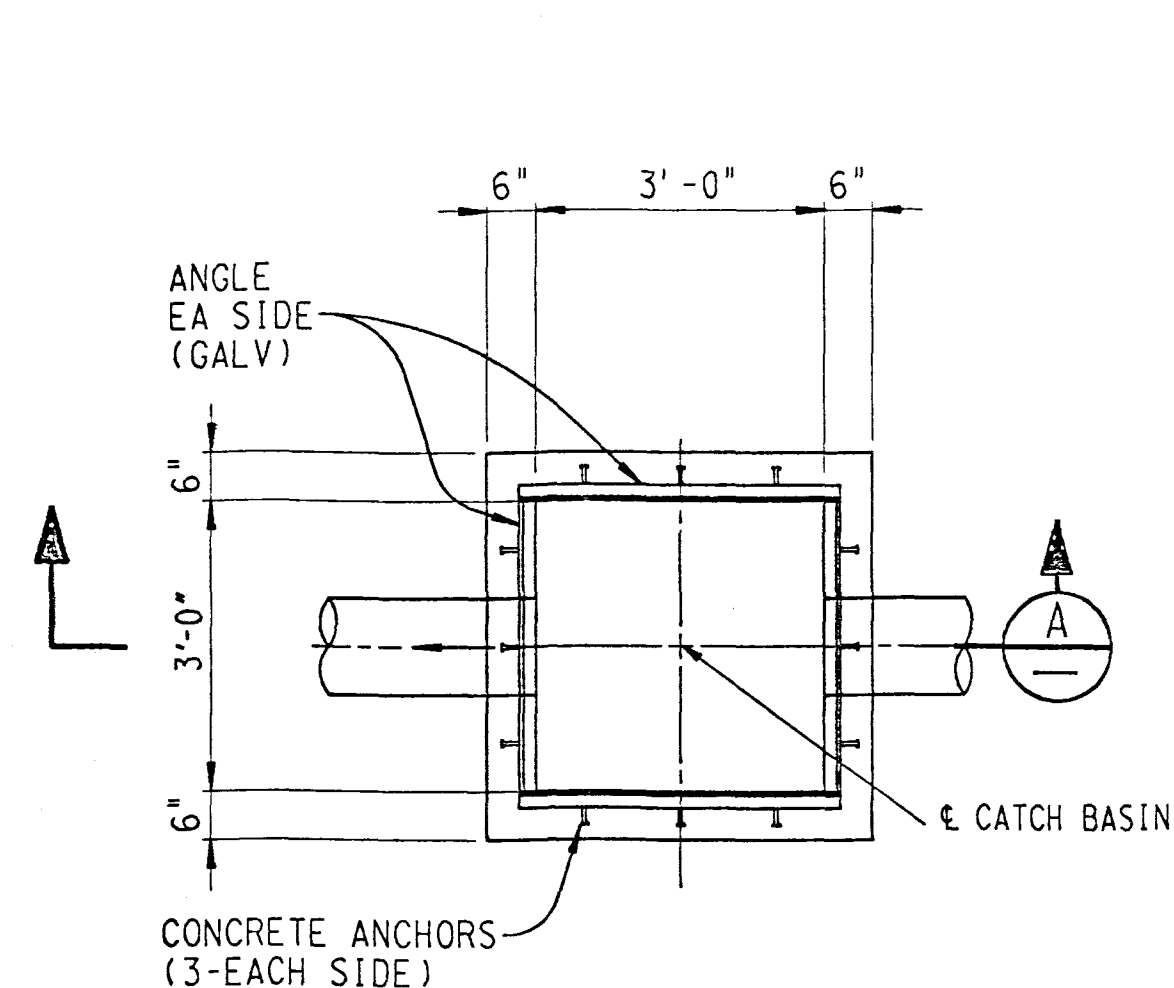
Volume 3

INDIANTOWN COGENERATION PROJECT

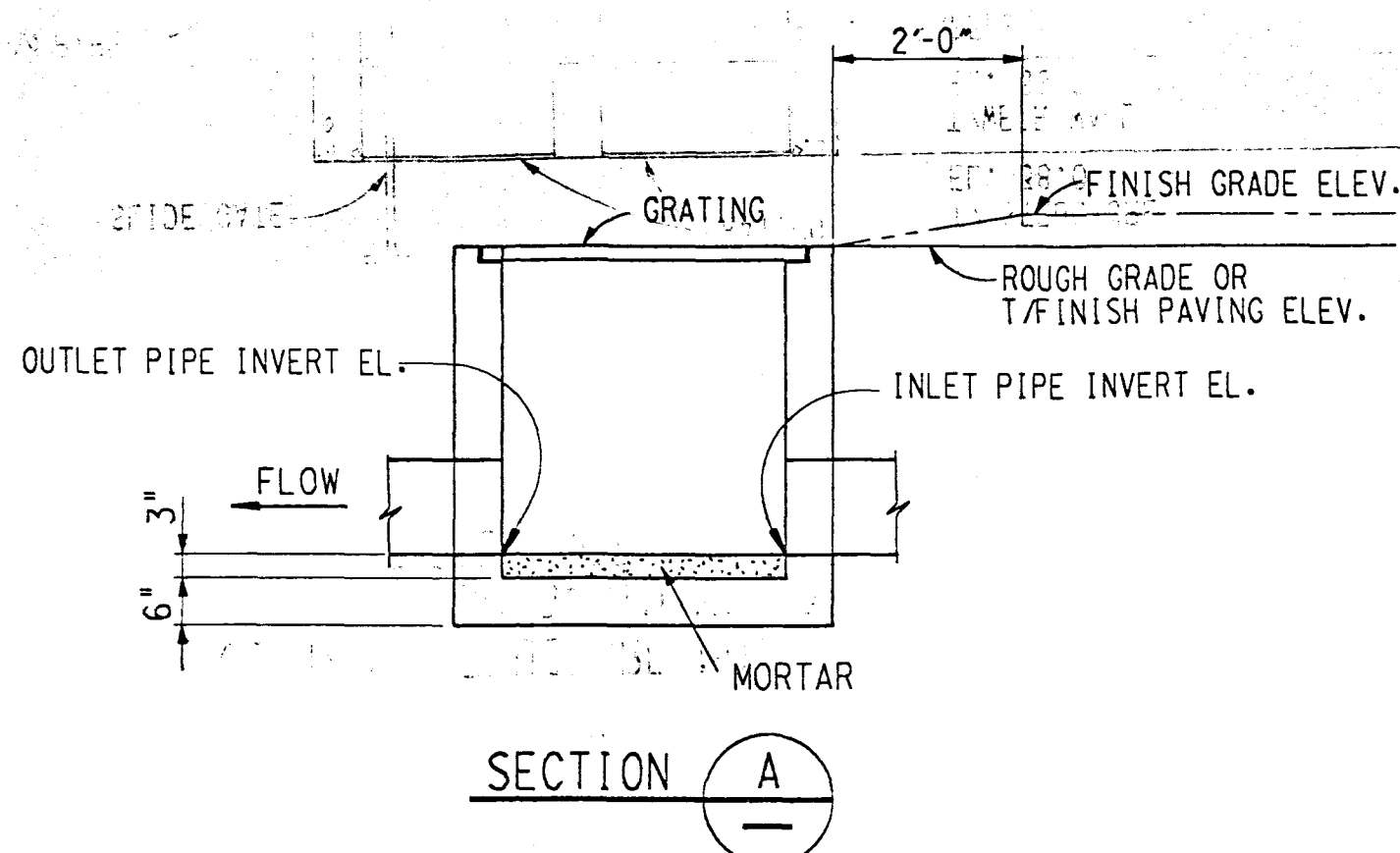
SITE CERTIFICATION APPLICATION SUFFICIENCY RESPONSES

April 1991

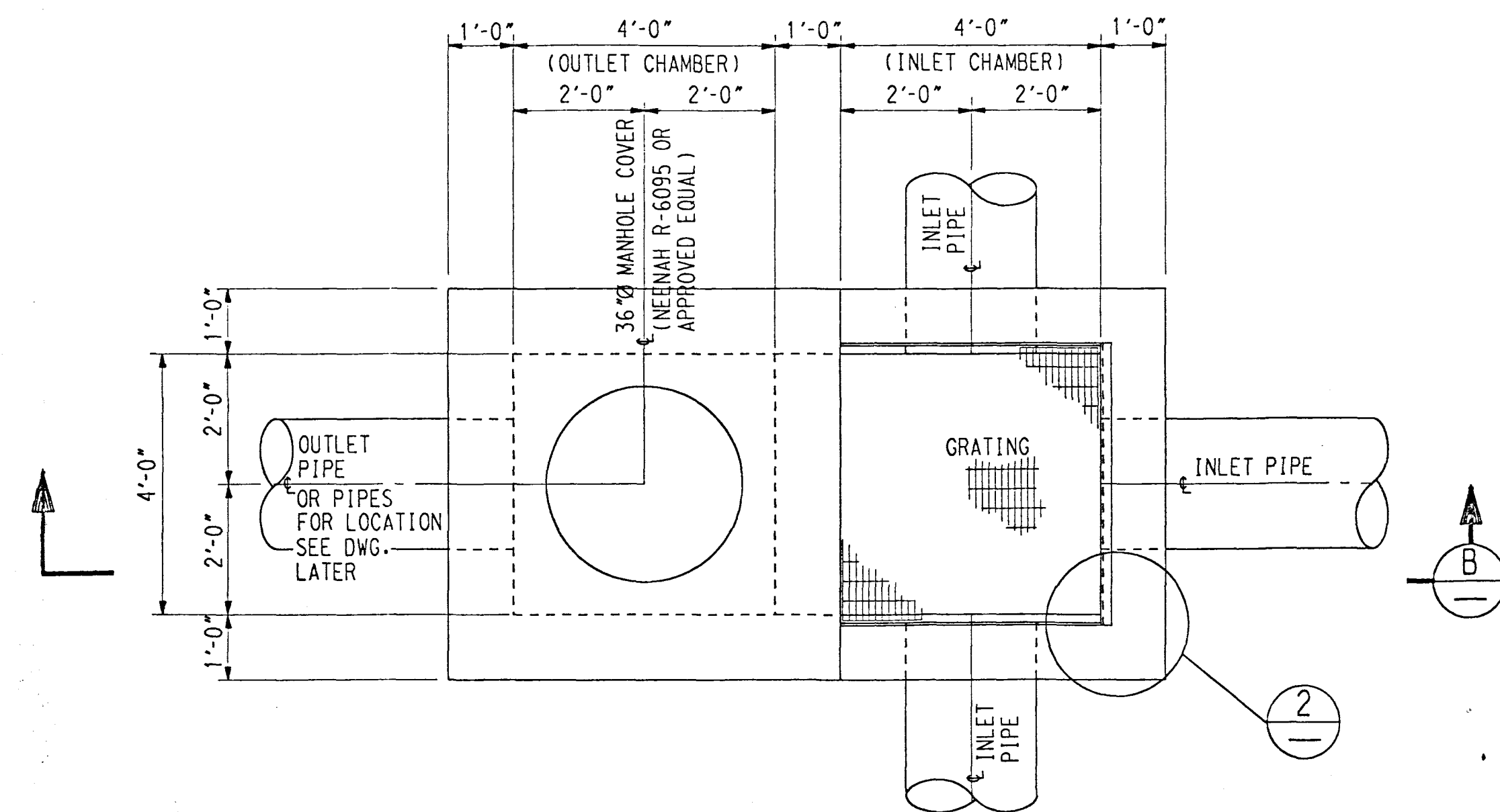
Submitted by Indiantown Cogeneration, L.P.



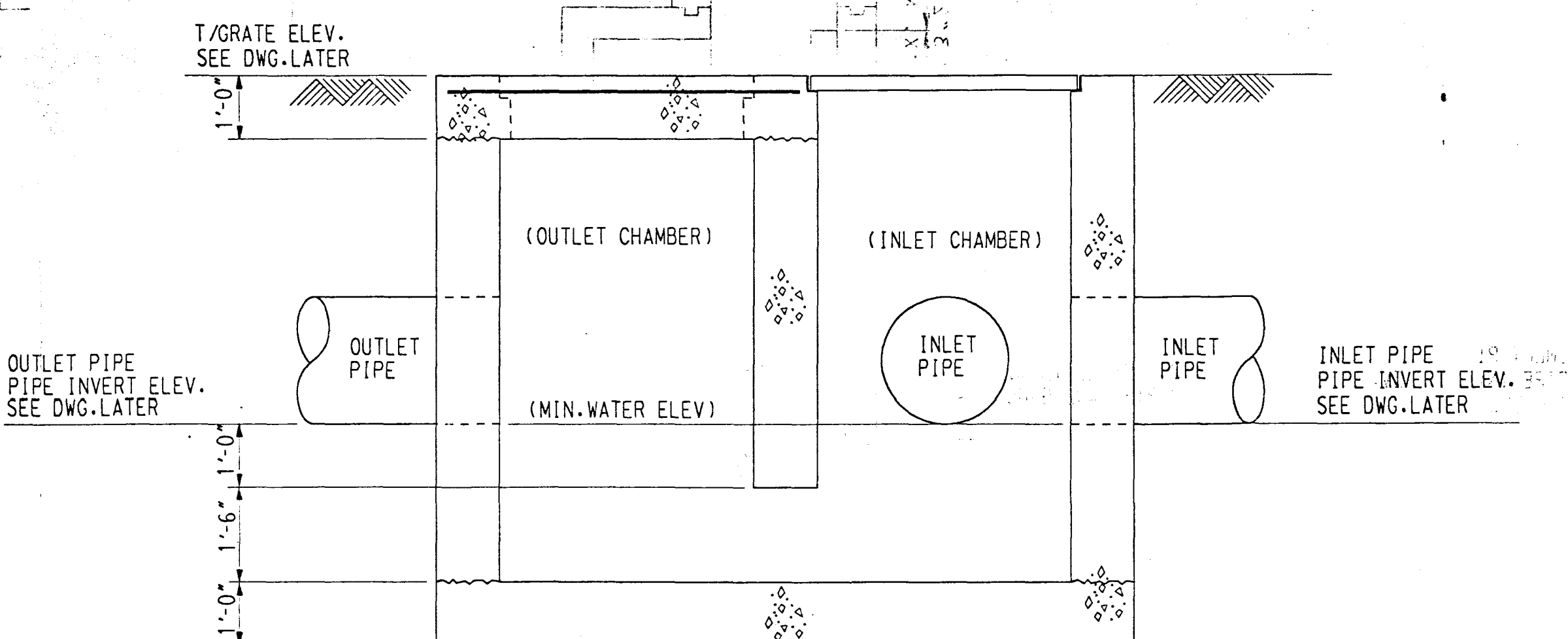
PLAN
TYPICAL CATCH BASIN DETAILS



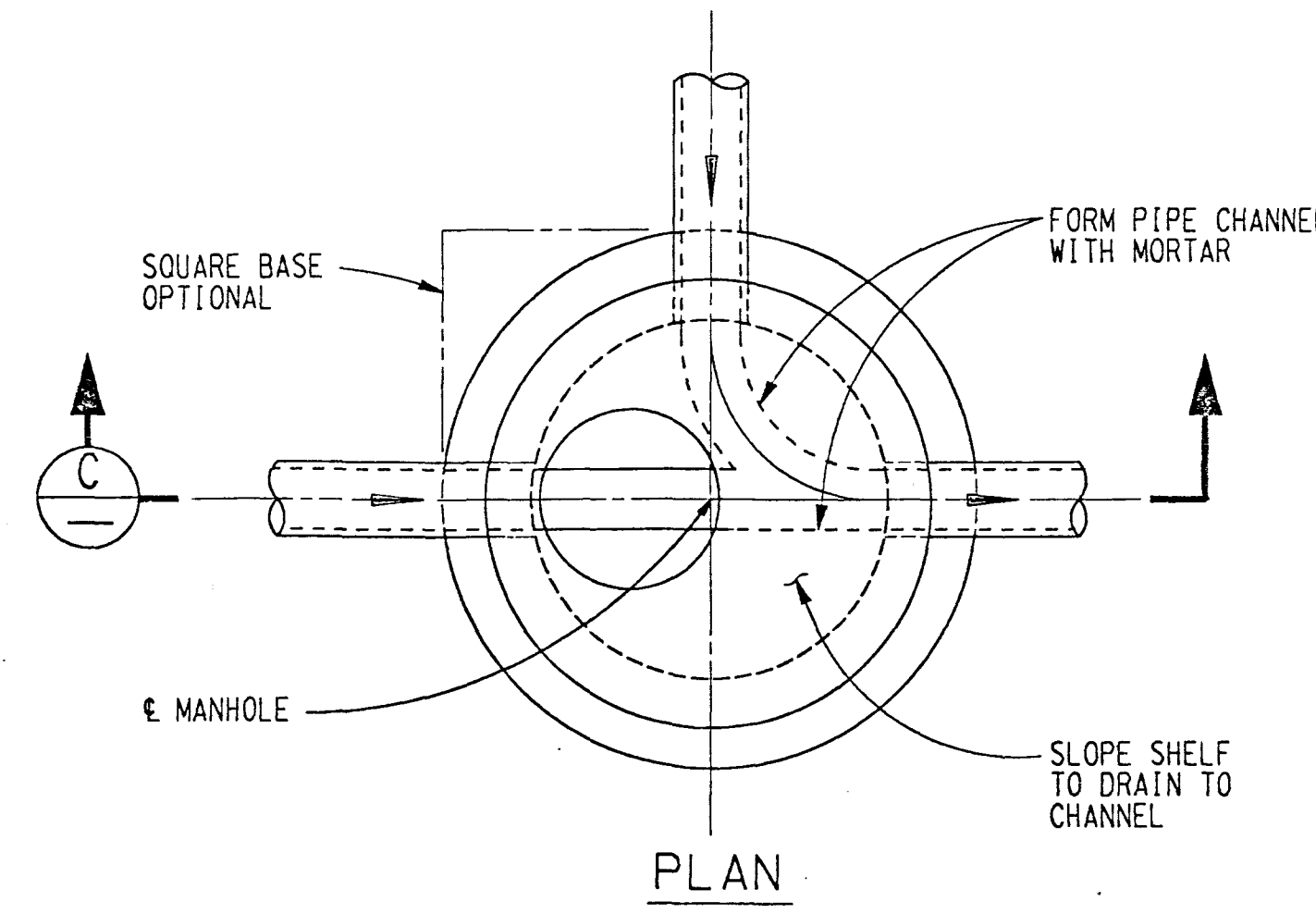
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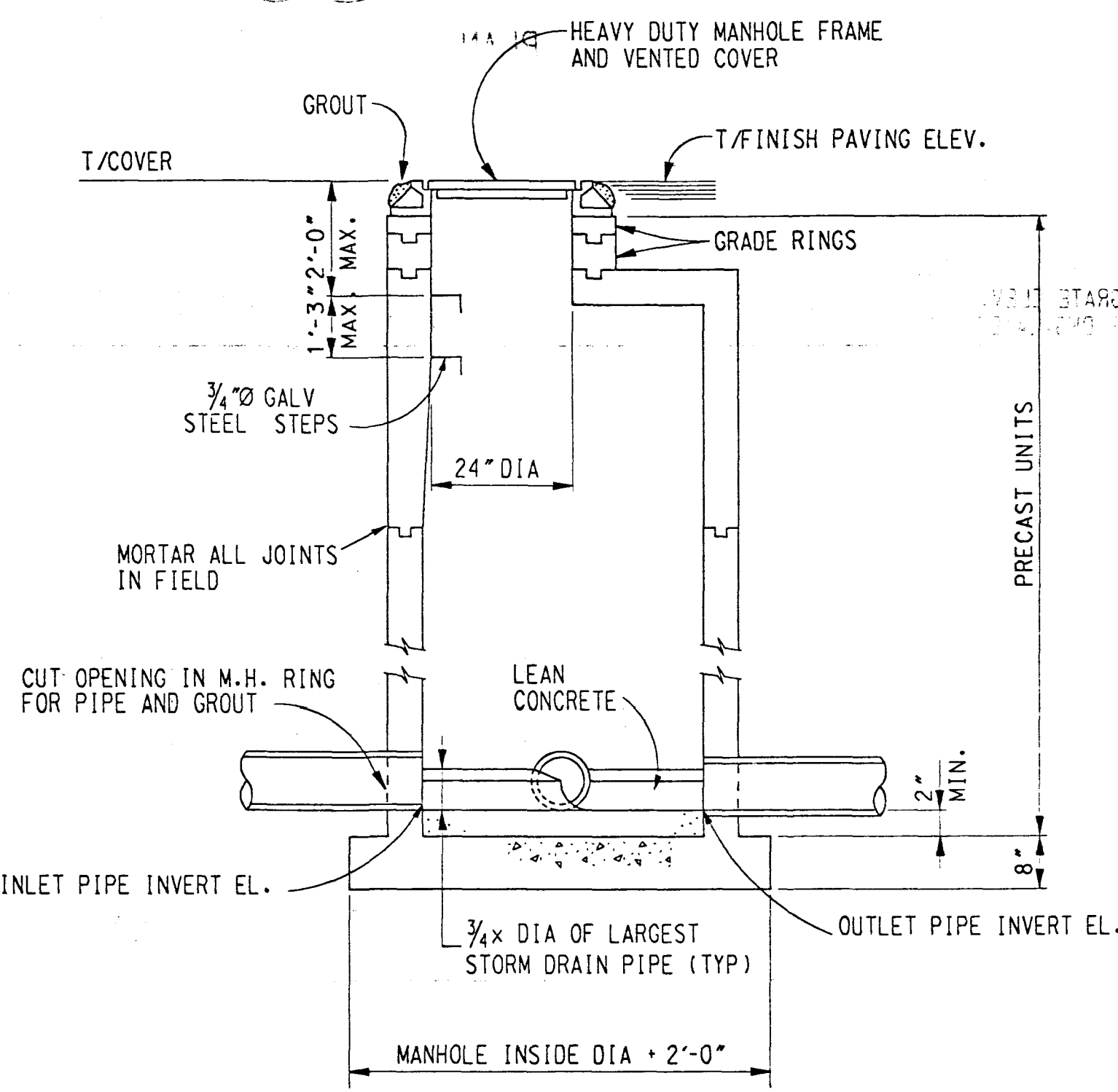
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TYPICAL OIL/WATER SEPARATOR



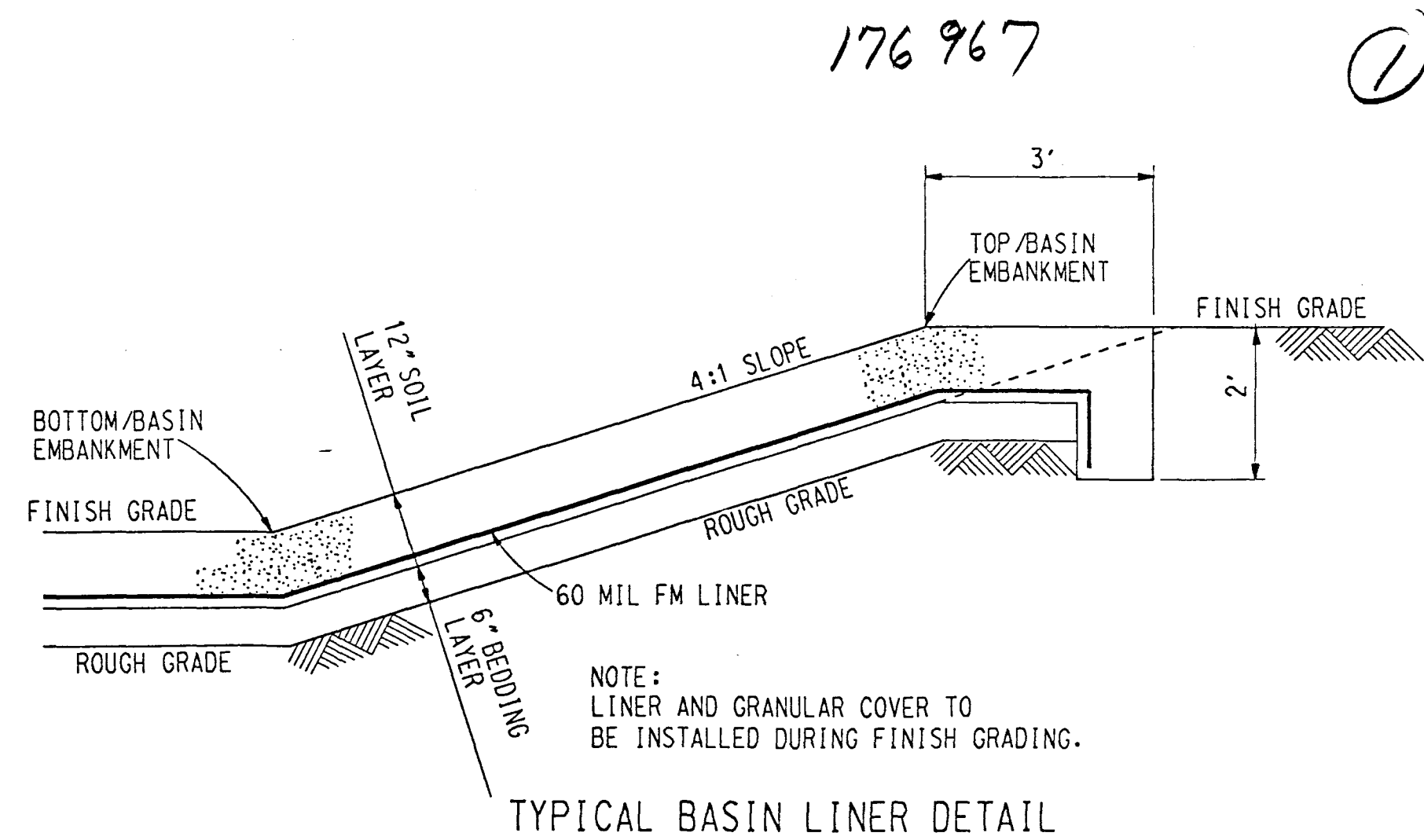
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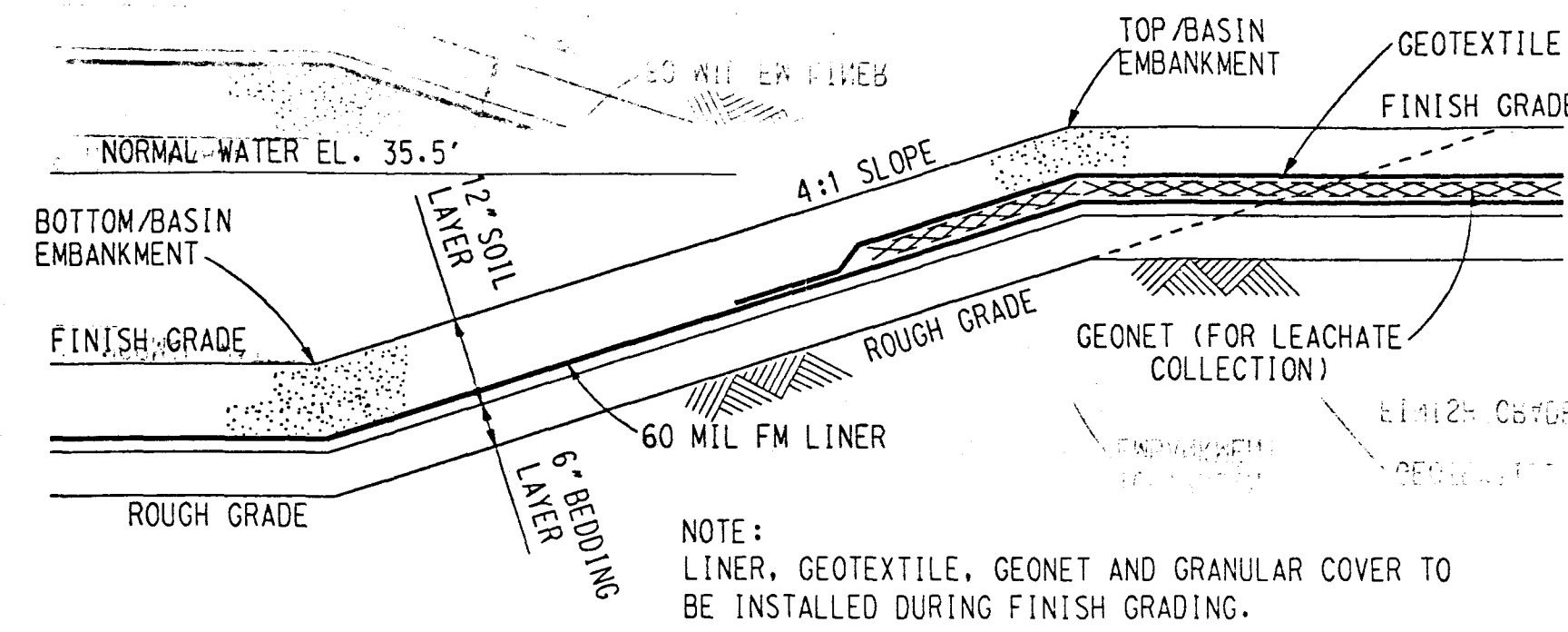
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TYPICAL PRECAST CONCRETE MANHOLE



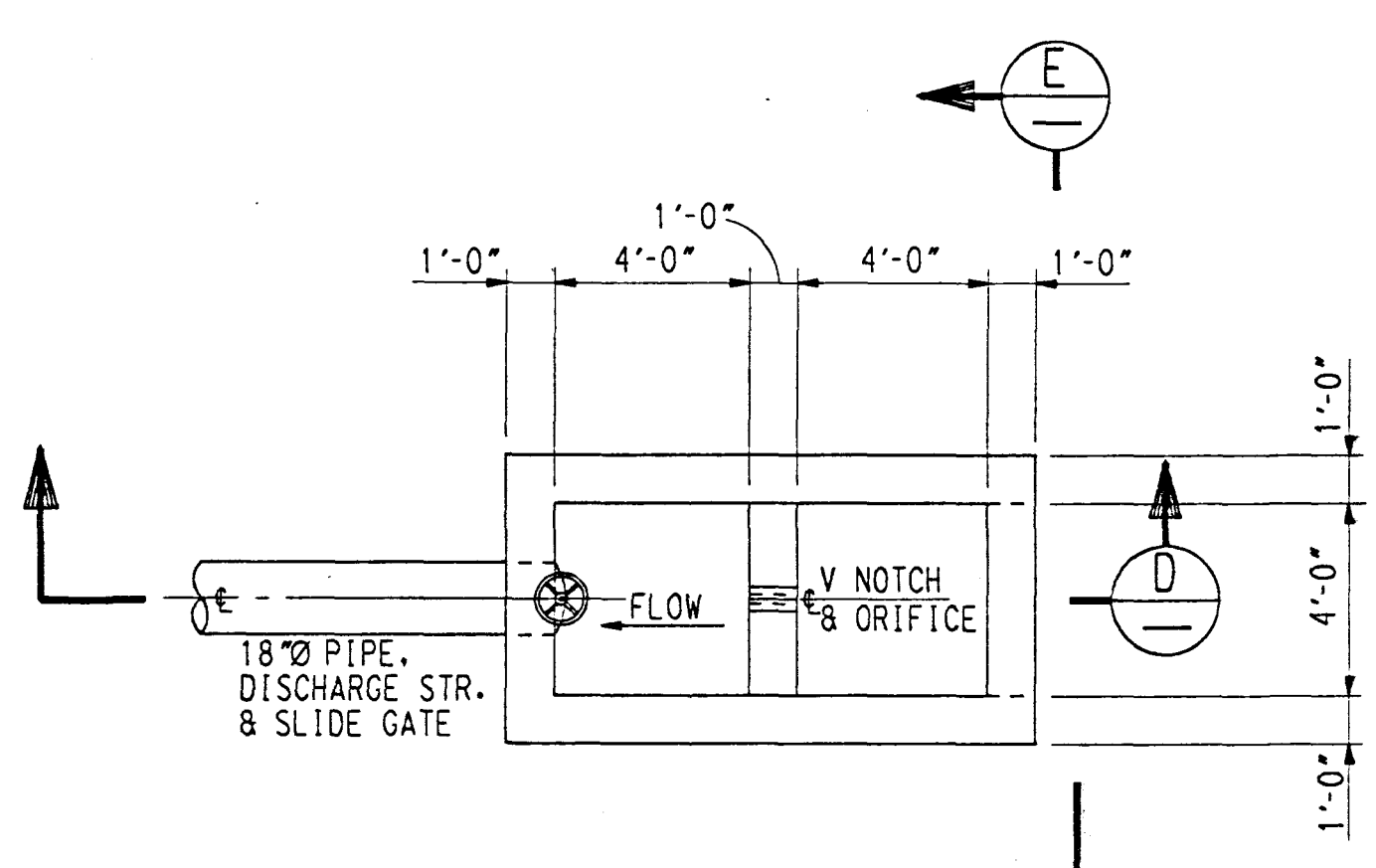
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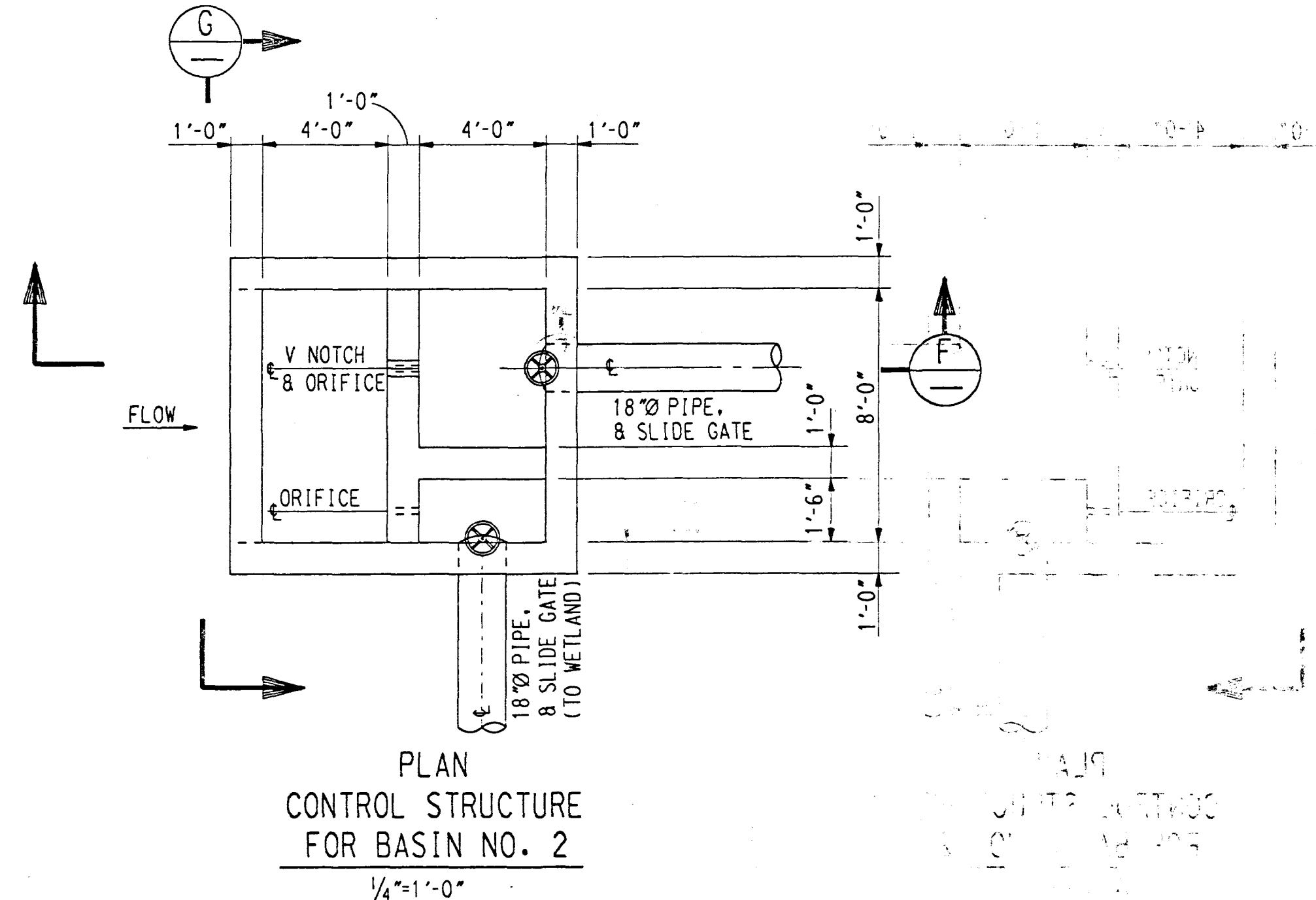
TYPICAL BASIN LINER DETAIL



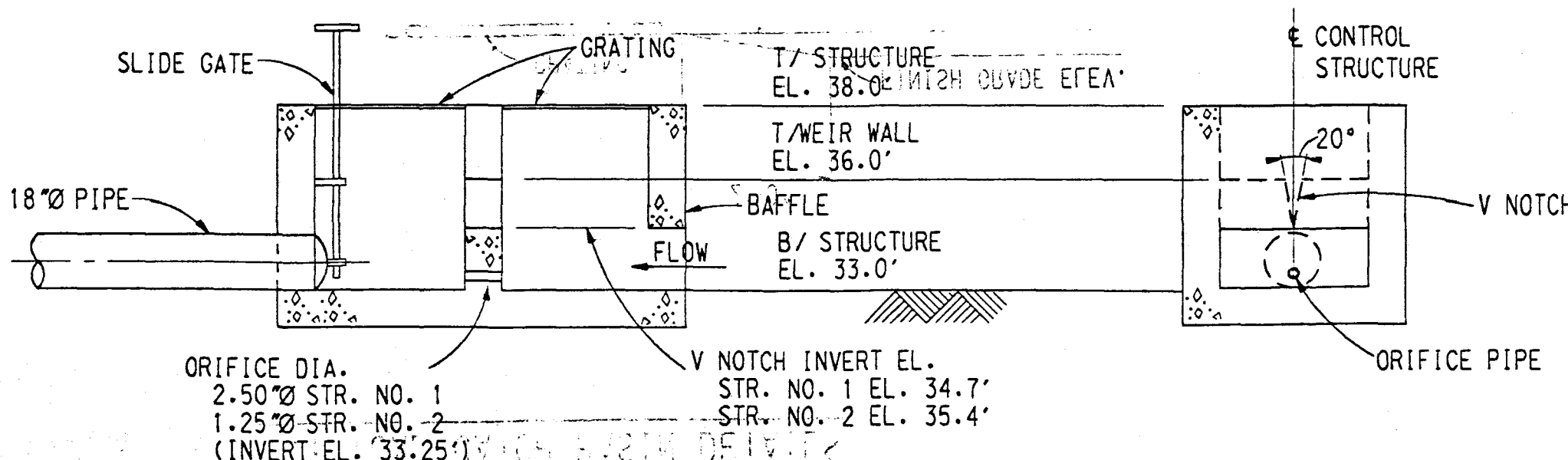
TYPICAL COAL PILE & COAL PILE BASIN LINER



PLAN
CONTROL STRUCTURE NO. 1 & 2
FOR BASIN NO. 3
(SEE DRAWING COL 0101)

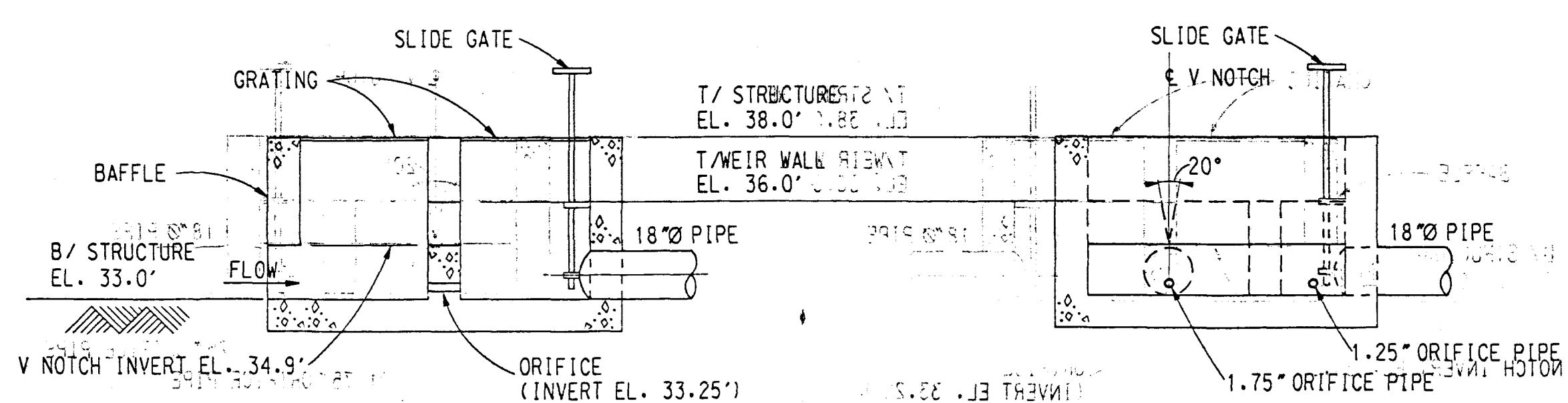


PLAN
CONTROL STRUCTURE
FOR BASIN NO. 2
1/4-1'-0"



SECTION D

SECTION E



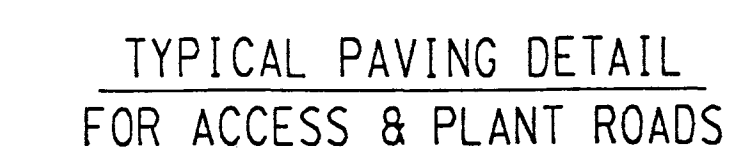
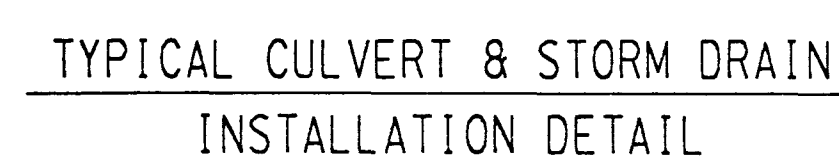
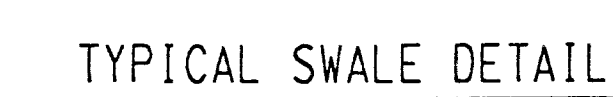
SECTION F

SECTION G

REFERENCE DRAWINGS

COA 0001	SITE PLAN
COL 0101	FINISH GRADING PLAN SHEET NO.1
COL 0102	FINISH GRADING PLAN SHEET NO.2
COY 0101	ROUGH GRADING, EROSION & SEDIMENTATION CONTROL MEASURES PLAN
COY 0191	EROSION & SEDIMENTATION CONTROL DETAILS SHT. NO.1

ISSUED FOR SUFFICIENCY RESPONSE	DATE	REVISIONS	BY	CHK	DES	ENGR	APPR
BECHTEL GAITHERSBURG, MARYLAND INDIANTOWN COGENERATION PROJECT INDIANTOWN, FLORIDA ROUGH GRADING DETAILS							
JOB NO.	DRAWING NO.	REV.					
20524-001	COY 0192	A					



- POSTS: STEEL EITHER T OR U TYPE
OR 2" HARDWOOD
FENCE: WOVEN WIRE, 14 GA.
6" MAX. MESH OPENING.
FILTER CLOTH:
FILTER X, MIRAFI 100X,
STABILINKA T140N OR
APPROVED EQUAL
PREFABRICATED UNIT:
GEOFAB, ENVIROFENCE OR
APPROVED EQUAL

(REF: SCS STANDARD DRAWING SF-1)

COA 0001	SITE PLAN
COL 0101	FINISH GRADING PLAN
COL 0102	FINISH GRADING PLAN
COY 0192	ROUGH GRADING DETAILS

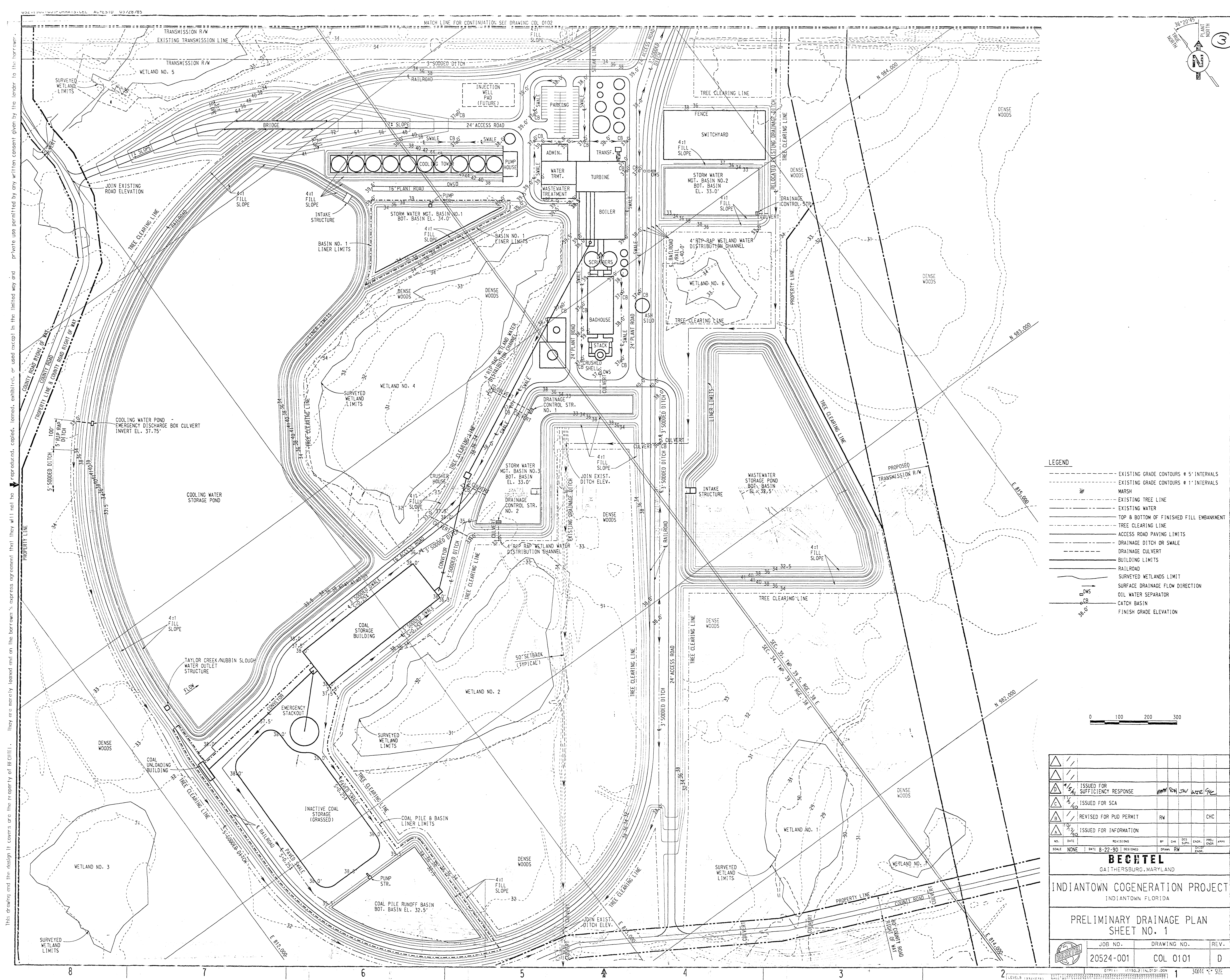
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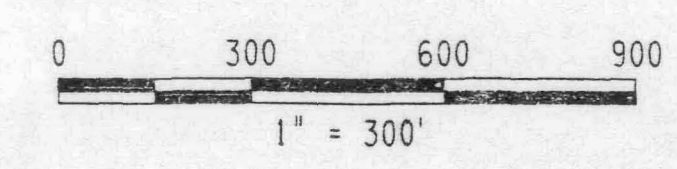
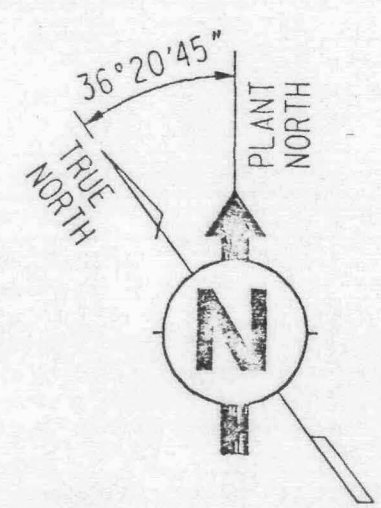
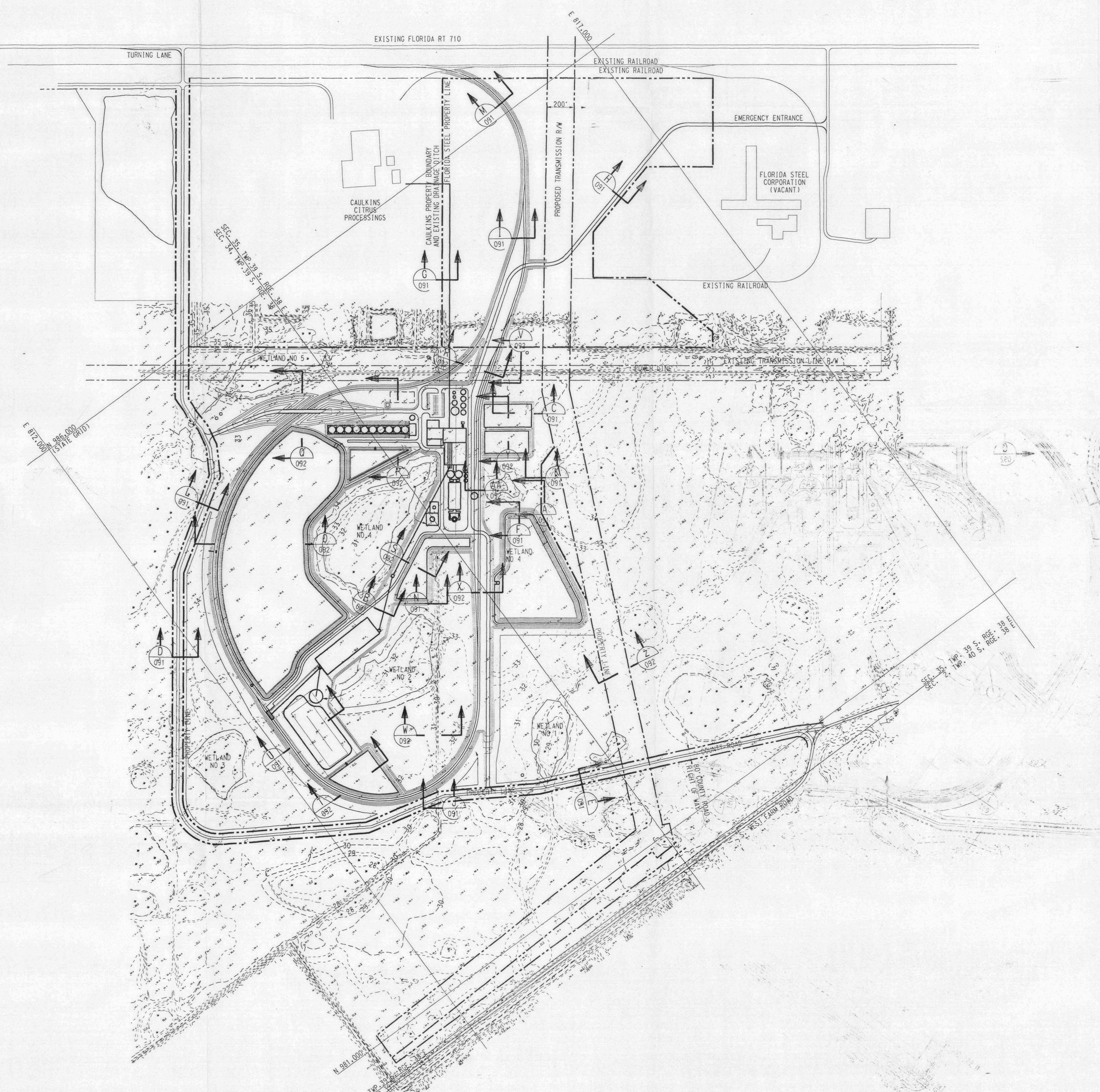
EROSION AND SEDIMENTATION CONTROL
TYPICAL DETAILS

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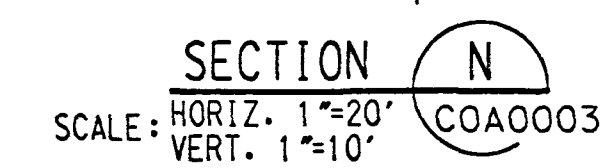
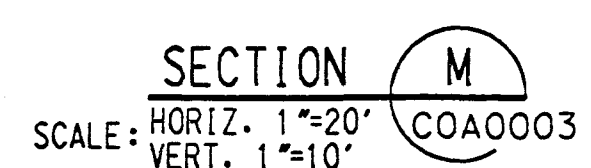
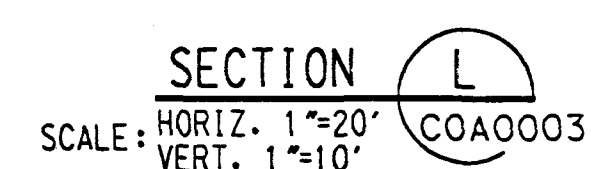
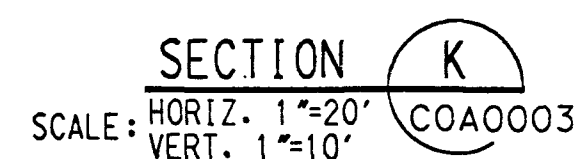
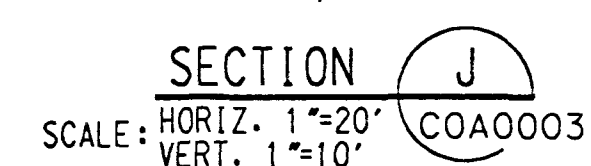
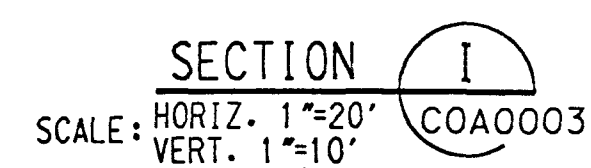
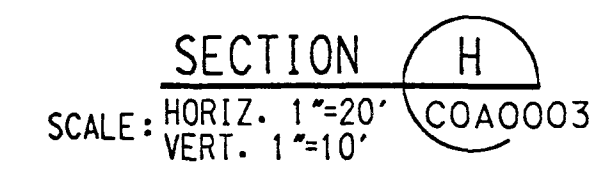
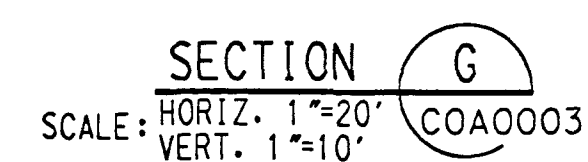
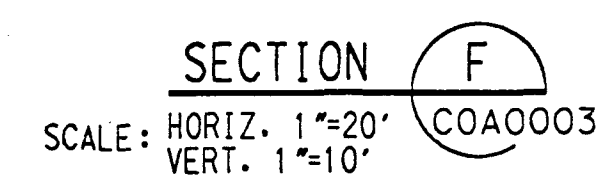
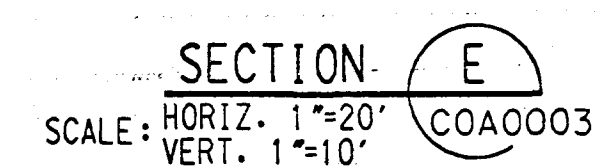
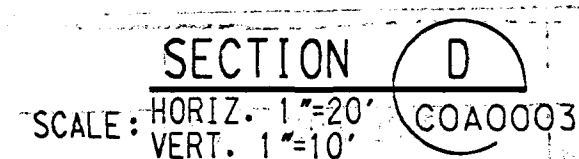
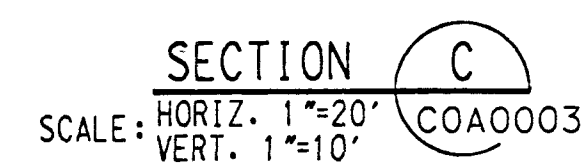
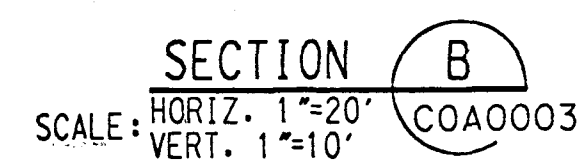
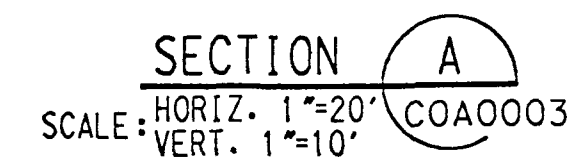
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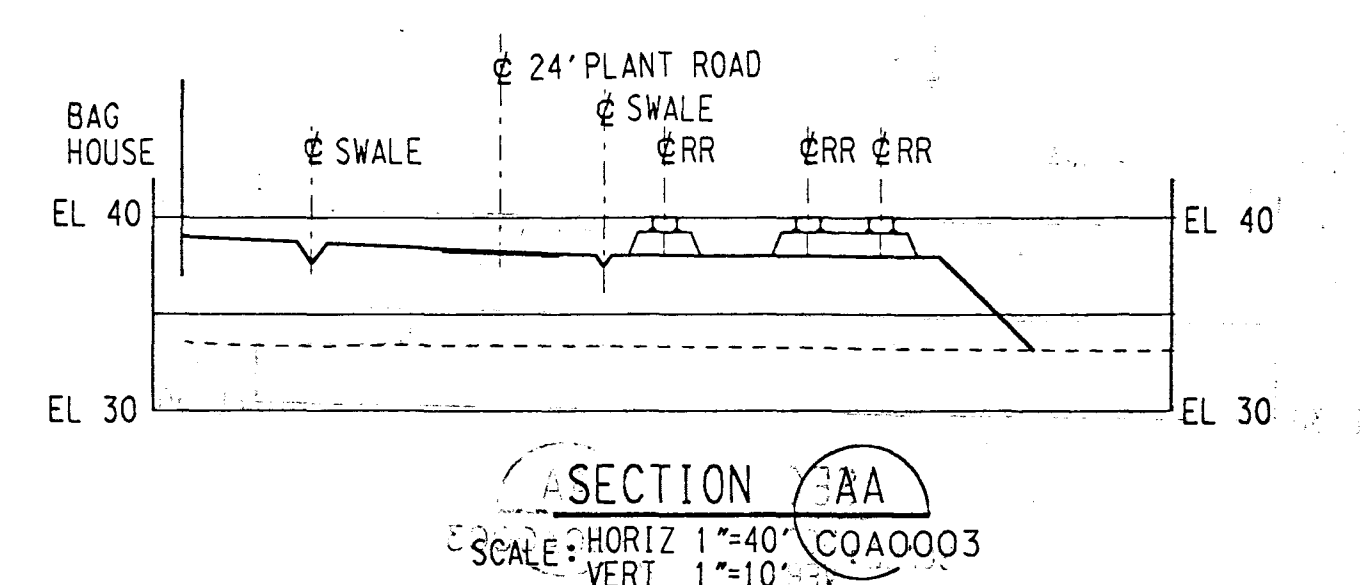
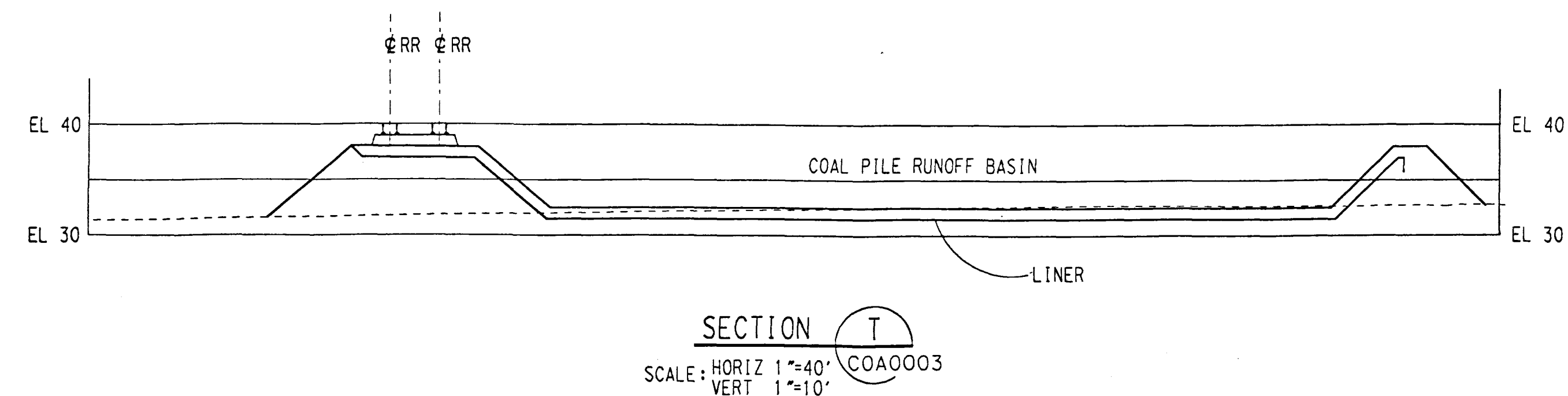


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4.0 EFFECTS OF SITE PREPARATION AND PROJECT AND ASSOCIATED FACILITIES CONSTRUCTION

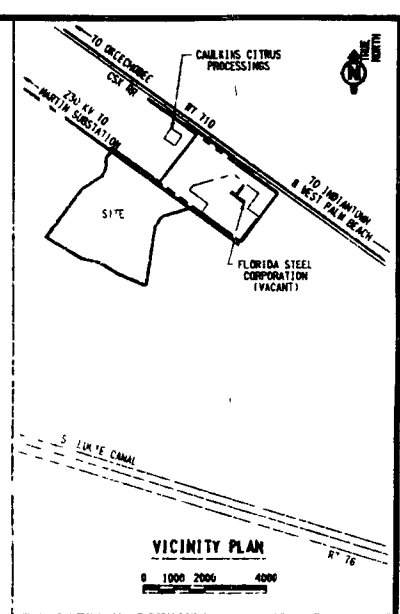
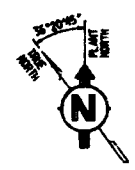
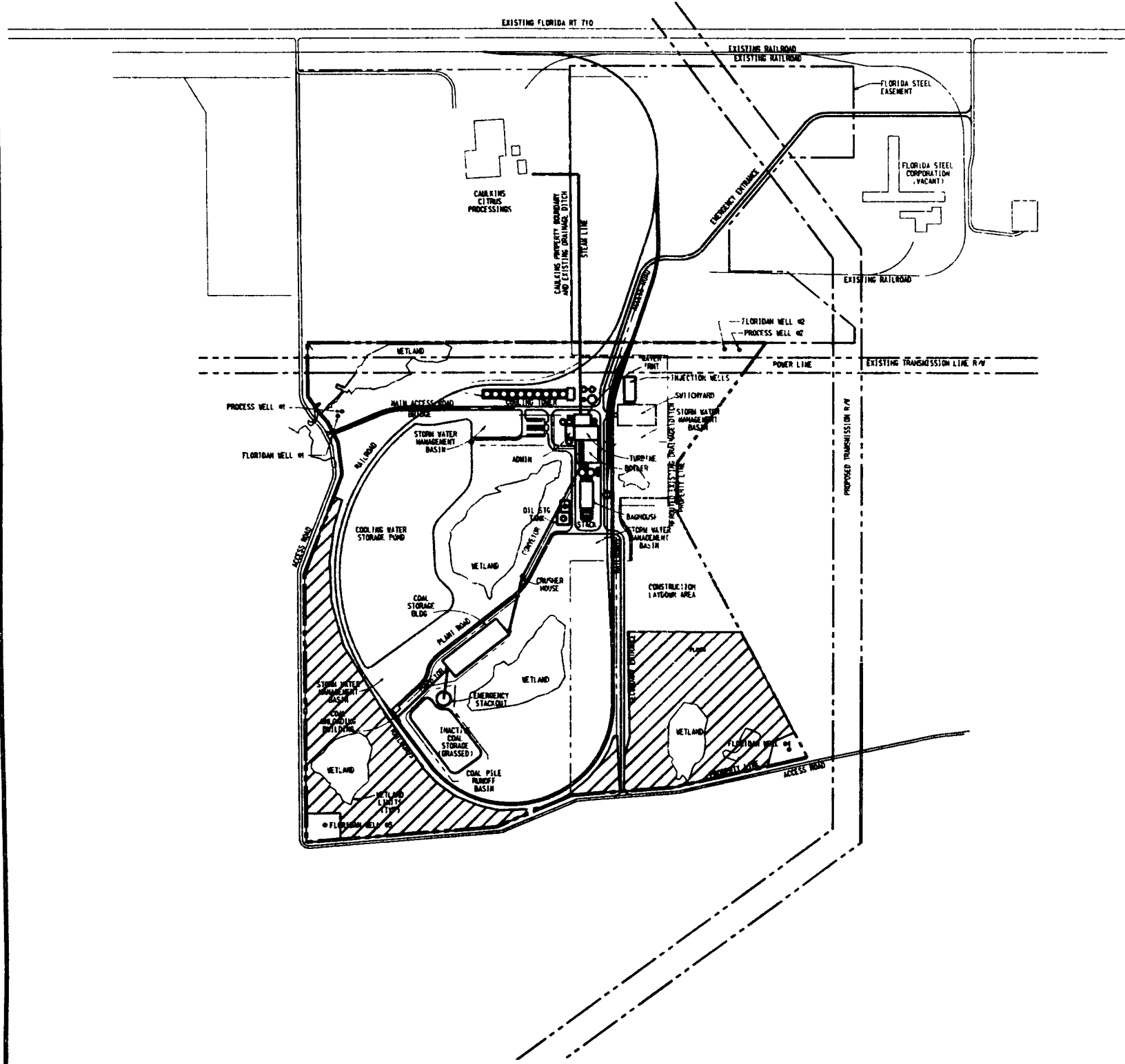
4.1 LAND IMPACT

4.1.1 GENERAL CONSTRUCTION IMPACTS

The Indiantown Cogeneration, L.P., project includes 232 acres within the property boundary of the site. A permanent easement of approximately 75 acres across the adjacent Florida Steel Corporation property will be used for a new rail spur. This easement will be between the Caulkins Citrus Plant and the abandoned Florida Steel Company properties. The only other land affected by the proposed ICL facility will be in the corridor for the cooling water pipeline routed along the CSX right-of-way (see Section 6.2).

In accordance with the Martin County Planned Unit Development (Industrial) Agreement (PUD(i)), 25 percent of the pine flatwoods, or 50.5 acres, of the land subject to the Agreement will be set aside as upland preserve and will not be disturbed. Designated upland preserve areas will be subject to an upland preserve and restoration management plan designed to remove exotic vegetation, revegetate in partially disturbed areas, and protect existing vegetation by using staking and barricading procedures during construction. The upland preserve areas that have been identified for the project are along the southern portion of the site on the exterior of the rail loop as shown on Figure 4.1.1-1.

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Figure 4.1.1-1.
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 Indiantown Cogeneration, L.P.

4.1.1.1 ICL Project Site

The following construction activities are associated with overall development of the project site:

- Runoff storage basins and drainage ditches will be constructed and used as sedimentation basins to collect runoff during grading, excavation, and construction.
- The operational site drainage system (inclusive of drainage swales, ditches, and runoff collection basins) will be developed.
- Earthwork will be performed (i.e., removal of topsoil as necessary for constructing foundations for plant facilities, construction of access roadways, grading to subgrades, excavating for placement of piping and conduit).
- In areas where it will be necessary, dewatering will occur using wells, well points, and sumps (see Section 4.3.1).
- The existing Caulkins entrance road from SR 710 will be extended to provide access to the ICL facility. Other onsite permanent roads as well as temporary construction roads, will be constructed.
- A new rail siding will be developed from the CSX railroad to the onsite rail loop across an easement on Florida Steel Corporation property. This development will include construction of the rail bed foundation which is composed of properly compacted sub-ballast (fill material) covered by crushed rock ballast. Suitable drainage openings in this foundation will be provided to maintain existing drainage patterns.

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- Temporary (construction power) and permanent underground electrical and utility piping systems will be installed.
- Temporary laydown and construction parking areas will be constructed by grading and adding gravel to certain areas. Once construction is completed, the area will be stabilized.
- The land disturbed by construction will be approximately 118.6 acres. Once construction is completed 106.6 acres will remain permanently disturbed due to buildings and operations.

4.1.1.2 Power Block Area

Construction of the proposed ICL power block area will require clearing, grubbing, and grading in order to raise the area approximately 4 feet to El. 39 ft NGVD. Where possible, fill will be obtained onsite; when brought in, it will be obtained from non-wetlands areas. The raising of this area minimizes the amount of dewatering that would be required due to the relatively high groundwater table. An existing drainage ditch traverses the site and will be relocated to the east of the power block; its final destination will remain unaltered.

No explosives are planned for use during construction in this area.

4.1.1.3 Coal Storage and Handling Areas

The area where the inactive coal pile and emergency coal pile are to be located will be cleared, grubbed, graded, and a liner installed to prevent any potential pollutants from entering the groundwater. A runoff pond will also be constructed with a liner to intercept any water draining from these two coal piles. A physical barrier (described in Section 3.3.4) will be constructed beneath the active coal pile to prevent groundwater contamination.

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The excavation of the coal car unloading hopper (approximately 40 feet deep) will encounter groundwater. A cofferdam of similar construction technique will be constructed around the perimeter of the unloading hopper to minimize the influent of groundwater and thereby minimizing any impact on the groundwater table and wetlands.

4.1.1.4 Construction Wastes

Waste materials will be disposed of in accordance with applicable rules and regulations. Construction wastes, such as scrap wood and metal, will be transferred to a specified storage area onsite where they will be separated and stockpiled for salvage. General waste materials (i.e., garbage) will be collected in appropriate waste collection containers for disposal at an approved offsite location.

Waste oil from construction vehicles and equipment will be collected in appropriate containers and transported offsite for recycling or disposal at an approved facility.

Individual subcontractors will be responsible for handling hazardous wastes resulting from their onsite activities. This responsibility includes the proper offsite disposal of such wastes.

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4.1.2 ROADS

Main access to and from the site will be provided by an extension of the existing Caulkins access road from SR 710, southward along the west side of Caulkins and the ICL site property as shown on the Plot Plan, Figure 3.2.0-1. This road will be constructed per Martin County standards. It will extend around the south perimeter of the site and intercept the South West Farm Road, providing a public thoroughway between South West Farm Road and SR 710.

A secondary access road will be provided from the southern perimeter road into the power block area. Other maintenance roads within the site boundary will be constructed to provide access to equipment and remote areas as necessary.

Construction access will be provided by a new road within the easement for the rail spur between Caulkins and Florida Steel Corporation. A portion of this easement may be used for construction parking along with the main laydown/parking area. Construction personnel may also use the secondary plant entrance for access into the construction parking/laydown area.

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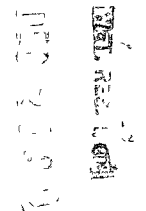
4.1.4 TOPOGRAPHY AND SOILS

The ICL site is relatively flat, with existing grade elevation ranging from approximately 32 to 35 feet mean sea level (MSL). The site is generally brush covered, with some lightly wooded areas, and is crossed by several surface runoff ditches. Some of these ditches contain standing water.

Excavations made on the site during construction will affect site runoff slightly in small, localized areas adjacent to the excavations. Existing ditches and ponds on the site currently collect stormwater; these elements will be maintained during construction. An existing ditch running north/south over the site will be relocated, but still maintained. More importantly, a detailed stormwater management plan will be implemented, involving construction of collection works and stormwater runoff ponds. The effect on runoff is, thus, expected to be minimal.

Site stripping operations will have an effect on percolation rates. Again, the effect will be on localized areas, since stripping will take place primarily where roads or structures are to be constructed. Consequently, percolation rates will be affected during construction only in these limited areas. After construction, open disturbed land not occupied by roads or structures will be planted with grass, restoring the previous percolation rates.

The site is currently vacant, removing any threat to existing structures from subsidence. Subsidence over the site, as a result of construction activity, will not likely occur due the lack of any significant causal mechanism. Pile driving can densify loose, upper deposits of sand, causing slight local settlement. The subsurface exploration shows that the upper sand deposits generally increase in



density with depth, typically becoming medium to dense at a depth of about 5 feet. This soil is too dense to settle significantly under pile driving operations.

Sink hole formation takes place below the ground surface, by the dissolving of carbonate soils and rock by acidic water. As stated in Section 2.3.2, sink hole formation is not expected to occur in the site area, nor will it be enhanced or affected by construction activities.

To lower a soil deposit's bearing strength, in-situ shear strength must be lowered. Typical construction activities such as dewatering, pile driving, and the travel of heavy construction equipment will frequently densify sand soils, causing an increase in shear strength. Since the site's subsurface soils are almost exclusively sands, construction will, therefore, not cause a reduction of bearing strength.

Excavations made during construction can potentially affect the stability of adjacent existing soils. The only significant excavation planned is for the rail car unloading facility. This excavation will require extensive dewatering, and sidewall sloping or shoring. The safety of personnel working in and around this excavation will be ensured by the careful, thorough, and proper design of the dewatering and excavation support systems. When the excavation is made according to this process, with rigorous inspection to ensure safe construction, stability will not be a problem.

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4.2 IMPACT ON SURFACE WATER BODIES AND USES

4.2.1 IMPACT ASSESSMENT

Possible surface water bodies affected by project development are the existing onsite drainage ditch, the St. Lucie Canal, seven wetland areas within the property boundary, and the TC/NS near the intake structure. It is the SFWMD's requirement that all drainage patterns return to pre-developed conditions and that peak discharges not be altered in the process.

Activities Within Surface Water Bodies

The only construction activities directly affecting surface water bodies are the rerouting of the existing drainage ditch and the construction of the intake structure. The drainage ditch rerouting will be completed very early in the project and care will be taken to maintain the existing water level, quantity, and quality of the discharge. Silt fences and straw bale dikes will be employed, as described in Section 3.8.4.2, where needed to filter runoff to the ditch. Velocities in the ditch will be at a minimum to deter sediment and erosion transport. Control measures will remain in place until the site runoff has stabilized in an acceptable manner in regard to sedimentation and erosion.

Rerouting of the existing drainage ditch will not have any significant impact on the offsite drainage. The rerouted portion of the existing drainage ditch will maintain existing hydraulic capacity. Post-development discharge from the site to the existing ditch will not exceed the pre-development peak discharge.

The underwater portion of the intake structure will be installed by constructing a temporary driven sheet pile cofferdam in the canal, excavating from within the cofferdam to install the intake pipes, and then backfilling to cover the pipes. Any leakage through the sheet pile wall will be into the cofferdam, and thus there will be no sediment flow to the outside of the cofferdam during construction.

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Activities Affecting Discharge to Surface Water Bodies

Due to the large amount of earthwork required to raise the plant and coal storage/handling area elevations, stormwater runoff quality may be affected. Management, vegetative, and structural practices, as described in Section 3.8.4.1, will be implemented to mitigate adverse impacts on water quality during construction. These will include the control of sedimentation (erosion) by minimizing exposure of erodible soils, minimizing water velocity through use of milder slopes and diversion, use of grass and riprap covers, and channelization of stormwater runoff into sedimentation basins.

Stormwater management plans (Section 3.8.5) and sedimentation and erosion control plans (Section 3.8.4) for the ICL have been developed and will be implemented prior to and during earthwork. The stormwater management plan will utilize five stormwater detention basins, shown on Figure 3.8.2-1 and described in Section 3.8.5, which will act as sedimentation basins during the construction phase. Approximately 9 acre-feet of detention volume will be provided in the power block and coal handling areas. An additional 3.6 acre-feet of detention volume for the inactive coal pile runoff basin will also be provided.

During installation of the stormwater management system, measures taken to minimize the impact of surface water management activities will include:

- Mulching and seeding, with quick germinating varieties of grass, in all areas not subject to construction activities for more than 30 days
- Treatment of runoff from active construction areas by silt fences, gravel or rock filtration, straw bales, or other temporary erosion control measures
- Diversion of runoff from undisturbed areas around construction areas

- Use of physical soil stabilizers such as straw, wood chips, netting, or hay to protect exposed soils
- Installation of sediment filter devices where appropriate

The methods described in Section 3.8.4 have incorporated control measures to prevent impacts to wetlands from sediment-laden runoff.

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4.2.2 MEASURING AND MONITORING PROGRAMS

No waters of the state will be affected during construction and/or operation of the facility as discussed in Section 4.2.1. Therefore, no measuring and/or monitoring programs are proposed.

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4.3 GROUNDWATER IMPACTS

4.3.1 IMPACT ASSESSMENT

Section 4 1.1 describes the construction operations for the proposed project. As discussed, wastes will be generated during construction. In general, these wastes will consist of building materials which represent no threat to the groundwater system beneath the site. Small amounts of garbage, waste oil, and other potentially harmful compounds will also be generated. These wastes will be disposed of offsite, as described in Section 4.1.1, and pose no threat to the Surficial aquifer system.

During construction, it may also be necessary to provide temporary onsite storage facilities for fuels, solvents, etc. Potentially hazardous fluids such as these will be provided with secondary containment to protect the Surficial aquifer in the event of an accidental spill on the ground surface.

Excavations will occur at several locations across the project site. The deeper excavations will intersect the water table and require dewatering systems. The SFWMD requires that no dewatering operation may reduce the capacity of any existing permitted water user by more than 10 percent. Furthermore, dewatering systems may not reduce the hydrostatic head beneath wetland areas by 1 foot or more.

There are two excavations at the site which will utilize dewatering operations that could conceivably impact the Surficial aquifer. These are systems which will withdraw groundwater at rates of more than 25 gpm. The coal unloading building

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will have the deepest excavation (Figure 3.1.1-1, Site Plan). The excavation will be 20 feet wide, 50 feet long, and 40 feet deep at its deepest point.

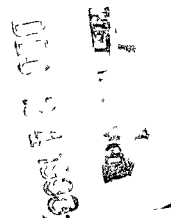
The other excavation site to utilize a dewatering operation will only be about 14 feet deep. At this excavation, circulating water lines will be installed below ground, running between the pump house and the administration building (Figure 3.1.1-1, Site Plan). These lines will be placed in an excavation that is 400 feet long, 26 feet across at its widest point, and 14 feet deep.

Groundwater Modeling

The geology of the site and the water-bearing layers which underlie the site are described fully in Sections 2.3.1.2 and 2.3.2.1. The Surficial aquifer occupies the upper 120 feet of sediments which underlie the site. Based on site-specific data and published data from nearby sites (FPL, 1989), the Surficial aquifer may be characterized for modelling purposes as a three-layer system composed of two water-bearing zones and one intervening confining layer with parameters as follows.

<u>LAYER</u>	<u>THICKNESS (feet)</u>	<u>TRANSMISSIVITY (gpd/ft)</u>	<u>STORATIVITY</u>	<u>V, PERMEABILITY (gpd/ft³)</u>
L1	30	3300	0.15	0.03
L2	55	1500	0.0004	0.002
L3	35	5600	0.00013	0.2

Dewatering operations to be conducted at the coal unloading excavation were simulated using the finite difference groundwater flow model, PLASM (Prickett and Lonquist, 1971). The model was calibrated against a 3-day aquifer performance



test conducted on the site (Section 2.3.2.1). The results of this simulation and a comparison with the aquifer performance test observations are included in Section 10.5.1. Section 10.5.1 contains a computer printout of all model input parameters as well as the simulation results.

The model assumes that grooved sheet piling (or similar construction techniques) will penetrate into layer 2 of the Surficial aquifer to a depth which is 6 to 8 feet below the bottom elevation of the excavation at the coal unloading location. The sheet piling will surround and completely enclose the excavation, thus preventing seepage from entering the excavation as horizontal flow from layer 1.

As shown on Figure 3.1.1-1, Site Plan, the coal unloading site is located about 200 feet northeast of a wetland. In order to minimize drawdowns within layer 1 and protect the wetland from measurable impacts, an infiltration gallery will be constructed midway between the wetland and the excavation site. Water from the dewatering system will be directed into the infiltration gallery to be discharged into layer 1 as seepage.

The dewatering system was simulated as one sump or well, placed at the center of the excavation and within the sheet piling perimeter. The bottom elevation of the excavation will be within layer 2 of the Surficial aquifer. When pumping begins, a cone of influence in layer 2 expands outward from the excavation until the total pumpage (approximately 65 gpm) is matched by an equal rate of leakage into layer 2 from layers 1 and 3.

Because layer 3 was excluded from the dewatering simulations, all seepage into layer 2 was assumed to be from layer 1, the unconfined aquifer, and therefore simulated drawdowns of the water table are actually greater than anticipated.

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Three scenarios were simulated. Scenarios 1 and 2 simulate continuous dewatering for 180 days, the anticipated period of excavation, during the dry and wet seasons when recharge as precipitation is available to layer 1. These simulations indicate that the water table will not be lowered more than about 0.5 feet within a radius of 200 feet of the excavation. Scenario 3 simulated 90 days of continuous dewatering with no recharge to layer 1 except for seepage from the infiltration gallery at a rate of 3 gpm. The simulation indicates that dewatering operations can continue through 90 days of drought without lowering the water table as much as 1 foot at any location. Computer printouts of the 3 scenario simulations, with model inputs and simulation results, are presented in Section 10.5.1.

Based on the results of the computer simulation, including the utilization of sheet piling and an infiltration gallery during the excavation period, no adverse impacts to wetlands are anticipated. The nearest existing permitted groundwater users are located several thousand feet from the excavation site (Section 2.3.3). At this distance, the wells will not experience any significant reduction in capacity approaching the regulatory limit of 10 percent.

Dewatering operations to be conducted at the circulating water lines excavation were simulated using the analytical methods developed by Theis (1935). Dewatering along the 400-foot ditch was simulated as three 15 gpm wells and one 20 gpm well, spaced at 100-foot intervals and screened within layer 1 of the Surficial aquifer. Water from the dewatering system will be directed into a nearby storm water collection basin (Figure 3.1.1-1). Infiltration into layer 1 from this basin was simulated as three 10 gpm recharge wells and two 5 gpm recharge wells. The dewatering operations were simulated for 45 days, the approximate time needed to excavate the ditch and bury the lines. Figure 4.3.1-1 displays the results of the

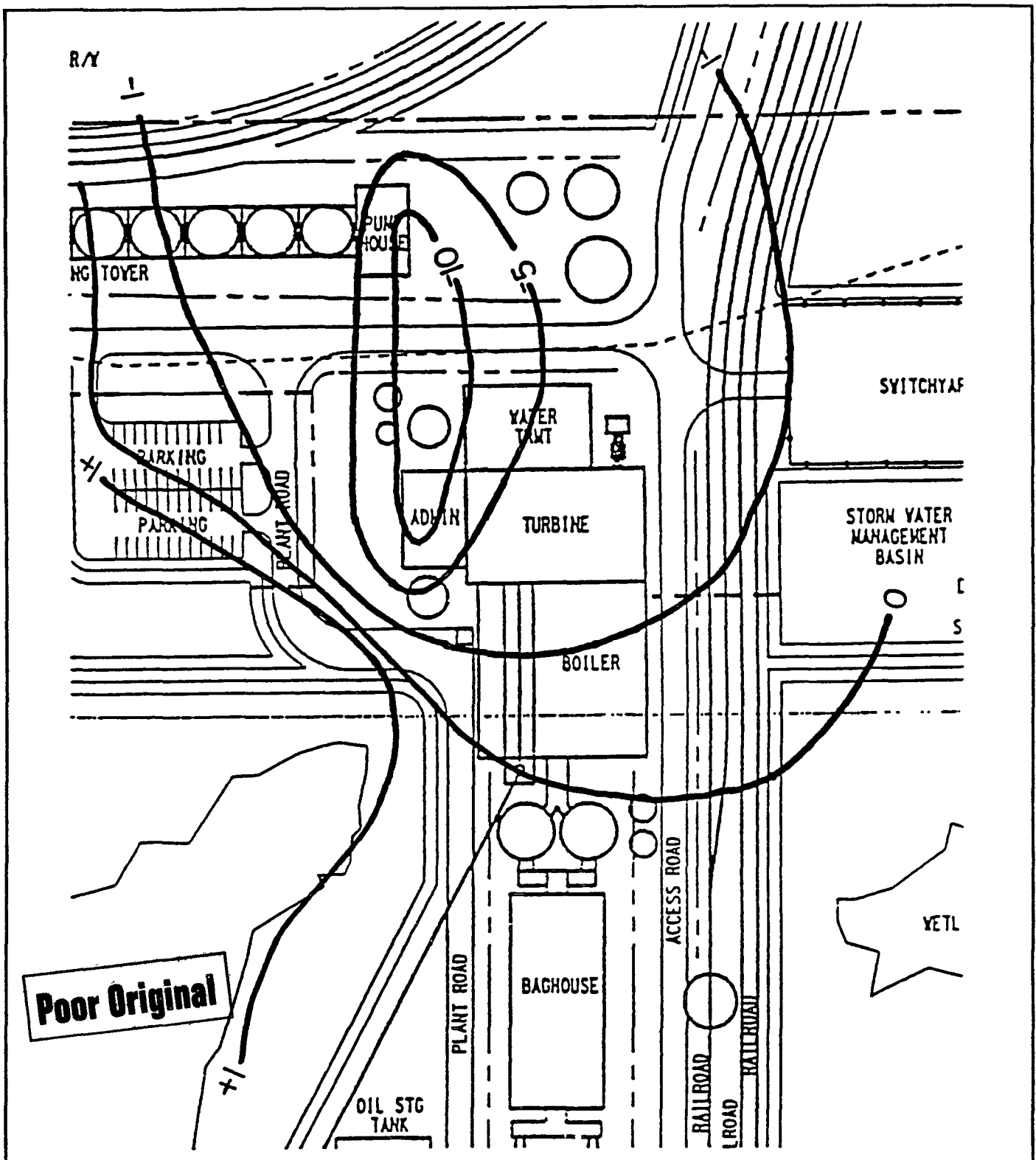


Figure 4.3.1-1.

PREDICTED CHANGE IN WATER TABLE ELEVATIONS AFTER 45 DAYS OF DEWATERING THE CIRCULATING WATER LINES EXCAVATION

Source A Campbell, 1990

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Indiantown Cogeneration, L.P.

simulation. As shown, no significant impacts to the nearest wetlands will occur during this brief dewatering period.

To summarize, a finite difference groundwater flow model and analytical methods were used to simulate the proposed dewatering operations and assess groundwater impacts. Based on SFWMD criteria, no adverse impacts to wetlands will occur because of dewatering operations at the site. Furthermore, no measurable impacts to existing users are anticipated.

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4.3.2 MEASURING AND MONITORING PROGRAMS

Dewatering activities are the only kind of construction operation that could possibly impact the Surficial aquifer in a measurable fashion. In addition to the existing onsite Surficial aquifer monitor wells located at the corners of the site (Section 2.3.2.1), additional observation wells will be placed between the proposed excavation sites to be dewatered and the nearest wetlands. Seasonal variations in the water table will be established before construction operations begin. Once construction has started, these observation points will be used to document that seasonal variations in the water table are not being affected by dewatering operations.

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4.4 ECOLOGICAL IMPACTS

4.4.1 IMPACT ASSESSMENT

4.4.1.1 Site Construction Plan

A technical engineering description of the operation and maintenance of the 330 MW Indiantown Cogeneration, L.P. (ICL) Project facility is provided in Section 3.0. The general description of construction of the facility and associated impacts are provided in Section 4.1.

The ICL facility will be constructed over a 42-month period. For the purposes of this ecological impact assessment, the project is divided into four components:

- Power block
- Coal storage/handling
- Temporary construction laydown
- Cooling water storage pond

It can be assumed for the purposes of this impact assessment that all of the natural vegetation cover within these areas will be completely cleared.

4.4.1.2 Acreage Requirements

Table 4.4.1-1 presents the acreage requirements for the construction and operation of the ICL facility, along with the vegetation community types affected. The power block will occupy approximately 21 acres of pine flatwoods. Coal handling and storage facilities will occupy approximately 15 acres of pine flatwoods.

Approximately 0.3 acre of pine flatwoods will be required for the fuel oil storage and handling facility. The switchyard will cover approximately 0.94 acre of pine flatwoods. The cooling tower will cover approximately 0.93 acre of flatwoods. The

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Table 4.4.1-1
ACREAGES OF VEGETATION COMMUNITIES TO BE IMPACTED, PRESERVED,
AND RESERVED FOR POTENTIAL FUTURE USE OF THE ICL

	Vegetation Community					
	Pine Flatwoods	Wet Prairie*	Ruderal Land+	Total Uplands	Total Wetlands	Total Acreage
Project site	199.6	24.4	8.0	207.6	24.4	232.0
Power block	21.0	--	--	21.0	--	21.0
Coal storage/handling	15.0	--	--	15.0	--	15.0
Roads, railroads, miscellaneous	45.6	--	--	45.6	--	45.6
Temporary construction laydown area	12.0	--	--	12.0	--	12.0
Cooling water storage pond	25.0	--	--	25.0	--	25.0
Total potential impact area	118.6	--	--	118.6	--	118.6
Total preserve area	58.3	24.4	--	58.3	24.4	82.7
Total remaining area	22.7	--	8.0	30.7	--	30.7

Notes: The remaining areas of land that will not be impacted by the proposed development or preserved include existing land uses such as the transmission line right-of-way and roads or pine flatwoods that are for potential future use.

*Wet prairie includes both the wetlands and the manmade ditch onsite. The ditch, which encompasses approximately 1 acre, will be rerouted and then maintained onsite.

+ Ruderal land includes the existing transmission line right-of-way, roads, and clearings.

Source: Bechtel, 1990

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temporary construction laydown area will cover approximately 12 acres of flatwoods. Finally, the cooling water storage pond located at the northwestern corner of the plant site will cover approximately 25 acres of pine flatwoods.

Approximately 8.3 acres of pine flatwoods will be preserved as natural, 50-foot contiguous buffers around three wet prairie areas located in the central portion of the development and another wet prairie site on the northwest corner of the property. The balance of the 50 acres of flatwoods will also be preserved onsite as visual screening and upland wildlife preserve. Approximately 23.4 acres of wet prairie within the project site environs will also be preserved. An additional acre of man-made ditch will be rerouted and then maintained on the project site. Figure 4.4.1-1 provides a map of the preserved uplands and wetlands on the ICL site.

The remaining acreage includes existing transmission line right-of-way and roads that will be maintained. Approximately 22.7 acres of pine flatwoods will also remain on the site for potential future plant use.

4.4.1.3 Environmental Management and Protection Plans for Construction

The following categories identify the environmental management protection procedures to be followed to protect or otherwise limit the impact to the surrounding ecological resources before, during, and after project construction:

- Clearing and grubbing
- Site restoration
- Soil erosion and sedimentation control measures
- Wetland protection

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Figure 4 4 1-1.

PRESERVED AREAS MAP OF
THE ICL SITE

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- FEPF - Pine Flatwoods
- WP - Wet Prairie
- UTTL - Major Transmission Line
- ↘ Wet Prairie Preservation Areas
- ▨ Pine Flatwoods Preservation Areas

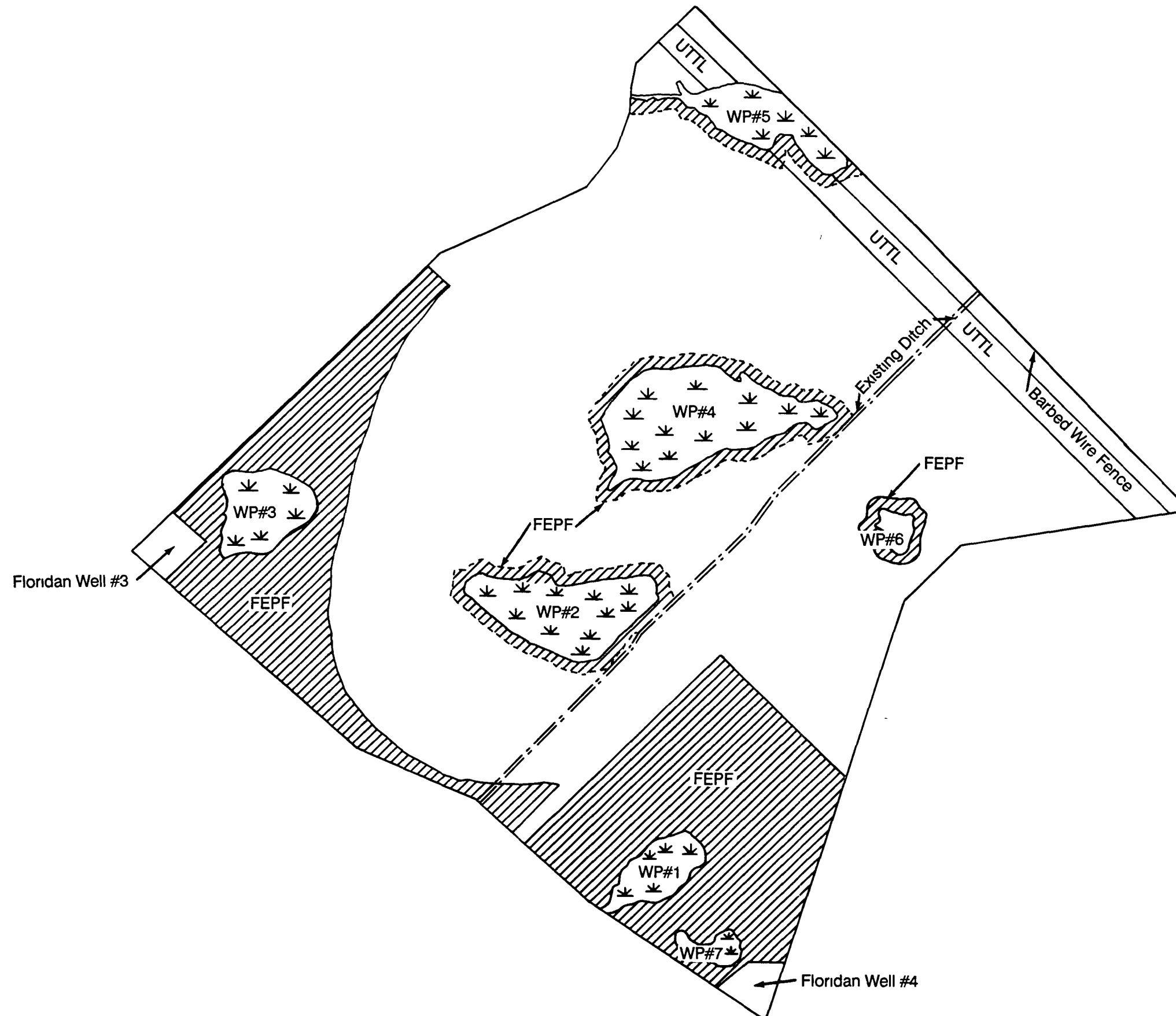
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Source ECT, 1990

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Clearing and Grubbing

- 1 A survey will be made of the area to be disturbed by project construction (i.e., the areal extent of clearing and grubbing as identified on project engineering drawings). The boundaries of this area will be clearly marked on site plans and in the field before any construction activity commences. Clearing and grubbing or other construction activities beyond this marked area will be prohibited.
- 2 The prevention of damage to vegetation outside construction areas will be emphasized in all construction operations, and careless or needless equipment operation will be avoided. Areas to be avoided by construction will have barricades installed to limit activities therein.
- 3 Debris derived from clearing and grubbing will be hauled offsite.
- 4 To ensure the least possible damage to the onsite vegetation, the use and storage of vehicles, equipment, and materials will be restricted to those areas which will be permanently disturbed by required designated construction activity or earthwork operations, or the temporary construction laydown area.

Site Restoration

- 1 ICL will require that contractors attain the following goals for site restoration after construction is completed:
 - Timely site stabilization of disturbed soil
 - Timely restoration of disturbed or altered areas through vegetative plantings appropriate to the season and soil type

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- 2 Fill slopes will be sodded or seeded and mulched

Soil Erosion and Sedimentation Control Measures

The soil erosion and control measures to be used during construction are discussed in detail in Section 3 8 4 1 Highlights of these measures include the following

- 1 Barriers are planned and will be maintained to serve a continuing functional role in erosion control before, during, and after construction until the areas are stabilized The proposed barriers will consist of bales of straw or other suitable filter material
- 2 Stabilization techniques will be used to establish a stabilized working surface for construction, where necessary
- 3 Contractors will be required to implement temporary stabilization measures to minimize loss of topsoil, excess sedimentation to the drainage ditch, and potential deterioration of water quality
- 4 Prior to construction, contractors will be required to submit plans for accomplishment of temporary and permanent erosion control work These plans will detail the erosion controls for clearing and grubbing, excavation, and final grading within access and haul roads, the work site, and the temporary construction laydown area
- 5 All disturbed areas not otherwise stabilized will be mulched and/or seeded within 15 days of exposure or as soon thereafter as seasonally practicable, except in areas where construction will resume within 30 days Areas to be seeded will employ quick-germinating varieties, such as winter rye grass, which provides temporary cover and soil retention properties

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- 6 All exposed drainages will be sodded or mulched and seeded immediately after each construction phase or disturbance
- 7 Physical soil stabilizers will be used, where appropriate, to protect exposed soil from falling or flowing water (e g , straw, wood chips, netting, hay, etc)
- 8 Sediment filter devices will be installed to prevent siltation, accumulation, or debris
- 9 Runoff from the disturbed areas will be conveyed to the detention basins prior to release to the natural runoff
- 10 After the completion of the construction, the detention basins will be cleaned, if necessary, and used for operations stormwater management

Wetland Protection

- 1 A 50-foot natural vegetation buffer will be established along the jurisdictional wetland boundary of three wet prairies centrally located close to project development and another wet prairie situated at the northwestern corner of the project site The 50-foot setbacks will be surveyed and a barricade installed along the surveyed lines
- 2 No disturbance of any kind will be allowed within the barricaded setback
- 3 The other wet prairie areas located further away from site development are situated within natural pine flatwoods that will be preserved There are significant expanses of upland preserved areas surrounding these wet prairies (i e , greater than 50 feet landward of wetland jurisdictional

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boundaries) Upland preserve areas surrounding these wetlands will also be barricaded

- 4 For more information regarding wetland and upland preserve protection, refer to Section 4 4 1 4, Vegetation Communities, under Preservation Program

4.4.1.4 Vegetation Communities

Project Impact

Project construction will remove all of the existing natural vegetation located in the areas to be cleared and grubbed Table 4 4 1-1 specifies the types and acreages of vegetation to be affected Of the 232 acres of project site, about one-half of the site's acreage will be impacted Of the approximately 118 6 acres to be affected by project construction, almost all of it consists of pine flatwoods (minor areas of less than 1 acre of clearings, trails, and roads were not subtracted from flatwoods acreage as ruderal land)

No wetlands, except the drainage ditch to be rerouted, will be encroached upon during construction and operation of the plant The remainder of the project area (49 percent or 113 4 acres) is comprised of either preserved pine flatwoods (50 acres) and preserved wet prairie/ditch (24 4 acres), or land left for potential future plant use (22 7 acres) An additional portion of the pine flatwoods will also be preserved (8 3 acres) consisting of natural upland buffers to three of the wet prairie areas located in the center and one wet prairie situated at the northwestern corner of the plant site The pine flatwoods to be developed on the ICL site are locally and regionally common in Martin County

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Preservation Program

The existing stresses to the vegetation on the project site have occurred as a result of cattle grazing, alteration of hydrologic regimes, and creation of disturbed areas by road and transmission line corridor construction and off-road vehicle trails. Though impacts to these natural communities are apparent, the existing communities can be considered to exhibit moderate to good ecological diversity and function. In addition, a significant portion of the site (82.7 acres or 36 percent) will be preserved. This includes all of the wetlands/ditch (23.9 acres) and the 58.3 acres (25 percent of the total pine flatwoods acreage) of the pine flatwoods (see Figure 4.4.1-1).

ICL also proposes to re-route portions of the existing drainage ditch (approximately 1 acre) traversing the central portion of the site. This should enhance the hydrology of the adjacent wet prairie by improving surface water overland flow. This wet prairie had some wetland plant elements displaced by upland species, and the re-routing of the ditch may result in a return of more desirable hydric species.

Exotic vegetation on the ICL site is neither widespread nor abundant. Some punk tree and Brazilian pepper were observed in the pine flatwoods. These will be removed. Exotic plants are scarce to non-existent in the wet prairies. Removal of exotic vegetation will not require revegetation with native flora due to the limited extent and numbers of these noxious plants.

A major goal of preservation management is maintenance of the existing natural condition of upland and wetland communities, particularly wetland hydroperiods. To do this, surface water and groundwater regimes must be artificially maintained or restored. To the extent feasible, or when necessary, the wetland areas will be incorporated into the project's surface water management plan. Through the use of Best Management Practices (BMPs), hydroperiods of affected wet prairies can be maintained without excessive, unseasonal flooding or drying.

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A potential post-construction impact to management of preserve areas is disposal of solid wastes and coal storage. All solid wastes generated by operation of the ICL facility will be removed for offsite disposal. Thus, no impacts to preserved areas onsite due to solid wastes will occur. The active coal pile will be stored in an enclosed facility and the coal conveyor to the plant will be totally enclosed to keep fugitive coal dust at a minimum. In addition, the inactive coal storage pile will be lined and grassed over. Any runoff and leachate from the pile will be collected in a lined basin, treated, and recycled for process water needs.

In addition, the following preservation program management guidelines will be adhered to:

- 1 All required grade changes (i.e., railroad and road) will be engineered so that any cut or fill will meet existing grade without encroaching into the preserve area.
- 2 All exotic vegetation will be removed. Stumps will be treated with a contact herbicide to prevent regrowth.
- 3 All of the preserve areas boundaries will be surveyed. The surveyed preserve areas will then be delineated/ protected in the field using barricades along the surveyed boundaries prior to any clearing activities.
- 4 Prior to any clearing, the barricades will be inspected to ensure proper placement and construction by the Martin County Growth Management Department.
- 5 Barricades will be constructed onsite and maintained intact for the duration of construction.

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- 6 Where areas are proposed for clearing (i.e., building envelope, utilities and drainage, road right-of-way, etc.), the barricades will be offset at least 10 feet outside the preserve areas or placed at the dripline of the canopy trees, whichever is greater
- 7 Individual trees or groups of vegetation that are to be saved will also be barricaded according to the previously mentioned guidelines
- 8 All native vegetation which is not located in areas requiring their removal as part of the development plans shall be retained in their undisturbed state
- 9 Advisory or warning signage will be posted
- 10 Contractors will be provided a set of the preservation program guidelines and warned that any violation of these guidelines and damage to, or destruction of the preservation areas will result in remedial action
- 11 Prohibited activities in the preserve areas will include removal or destruction of native vegetation, dumping of fill, trash, or building and construction materials and debris, excavation, recreational vehicle use, or any activities detrimental to drainage flood control erosion control, or wildlife habitat conservation

4.4.1.5 Aquatic Systems

All of the wet prairies on the project site will be preserved and protected from project construction impacts. Although the drainage ditch will be rerouted on the project site, the existing drainage pattern will be maintained and enhanced through a surface water management plan. During the ditch realignment, special

precautions will be taken to safeguard the downstream water quality from deterioration through proper erosion and sedimentation control practices

Since no aquatic systems will be significantly affected by the proposed project, no project impacts to aquatic ecological resources are expected before, during, or after construction

4.4.1.6 Wildlife Resources

The principal impact on wildlife associated with project development will be the loss of up to approximately 118.6 acres of onsite habitat. Because pine flatwoods are the only dominant habitat to be affected, and pine flatwoods are regionally common, the partial clearing of this habitat will have insignificant impacts on regional wildlife populations.

Although the more non-motile species will be lost during construction, mammals and birds are expected to be displaced to the surrounding natural pine and wet prairie areas. It is not expected that individuals of species populations which breed or winter onsite will be displaced. With the exception of the white-tailed deer, eastern cottontail, raccoon, opossum, bobcat, gray squirrel, gray fox, feral pig, mourning dove, and bobwhite, recreational and commercially important animal presence on the project site and vicinity is low. Because hunting is currently precluded on the site, project impacts on wildlife as a local recreational or commercial resource will not occur.

4.4.1.7 Threatened or Endangered Species

The ICL project will not affect known breeding populations of animal species which are listed as threatened, endangered, or species of special concern (Table 2.3.6-2). Wading birds visit the project area occasionally for feeding, however, no current breeding populations are known to occur in the project site area.

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Although alligators, indigo snakes, and gopher tortoises are expected to occur within the site environs, no significantly adverse impacts to these listed reptile species populations would be expected from project construction. Bachman's sparrows, loggerhead shrike, and other migratory birds that utilize site habitats will find suitable and abundant habitat adjacent to the project site during and after construction. No other listed animal species have been observed or are known to inhabit the project site or its immediate environs.

No endangered or threatened plant species listed by USFWS on Table 2.3.6-1 were located on the project site. Only three fern species listed as threatened by FDACS were discovered within the wet prairies and ditch on the project site. Although these fern species could also occur within the extremely small, wet weather depressions in the pine flatlands to be affected by development, no significant impacts to local species population are anticipated as a result of project construction. Even if some individuals of these listed fern species should be affected, it would not be considered to be a significant impact because of the following factors:

- 1 The fern species on Table 2.3.6-1 are listed as threatened by FDACS primarily to discourage commercial exploitation, rather than providing a designation of the current species population status.
- 2 The fern species are widespread in freshwater wetlands throughout Florida.
- 3 The fern species are common locally and, therefore, the loss of some individuals will not affect the status of regional populations.

The Florida coontie (Zamia pumila) may occur onsite based on habitat suitability and range of distribution. However, no sightings of this conspicuous cycad occurred during numerous surveys of the impact areas of the project site. Therefore, no impacts to the Florida coontie would be expected from project

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development In summary, protected species populations of wildlife and plants should not be significantly affected by project construction

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4.4.2 MEASURING AND MONITORING PROGRAMS

4.4.2.1 Project Area

No monitoring of the project area is planned

4.4.2.2 Preservation Area

Since project construction and operation should not result in direct or significant secondary impacts to the surrounding vegetation, monitoring of the pine and wet prairies to be preserved on the project site is not considered necessary

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5.0 Effects of Plant Operation

5.3 IMPACTS ON WATER SUPPLIES

5.3.1 SURFACE WATER

This section discusses the effects of plant water withdrawal from the Taylor Creek/Nubbin Slough (TC/NS) on the C-59, L-63N, and L-63S Canals water levels, Lake Okeechobee, other users, and the groundwater level.

5.3.1.1 Plant Water Withdrawal

As discussed in Sections 3.5 and 10.9, the annual average plant water requirement is about 7.5 cfs and the historic average flow in the TC/NS is 146.4 cfs. Therefore, the annual average plant withdrawal from the canal is about 5 percent of the TC/NS flow, and the impact on the flow is minimal.

The predicted water levels in the TC/NS canals caused by the plant water withdrawal are discussed comprehensively in Section 10.9. Based on that analysis for the selected minimum design water level criteria of 16 feet-MSL, the predicted water levels in the canal will not deviate significantly from the historical levels at S-191 during a normal year. Figures 5.3.1-1 through 5.3.1-16 compare the predicted water levels against the historic ones. During the drought conditions, the canal water level may drop 2 to 3 feet below its historic water levels.

Depending on the drought frequency, the duration of low water levels may last from a few days to 60 consecutive days. The effect of the canal water level drop on the adjacent groundwater is discussed further in Section 5.3.1.3.

5.3.1.2 Lake Okeechobee

As discussed in Section 2.3.4.I, the mean annual discharge from S-191 into Lake Okeechobee amounts to about 106,000 acre-feet per year, which represents about

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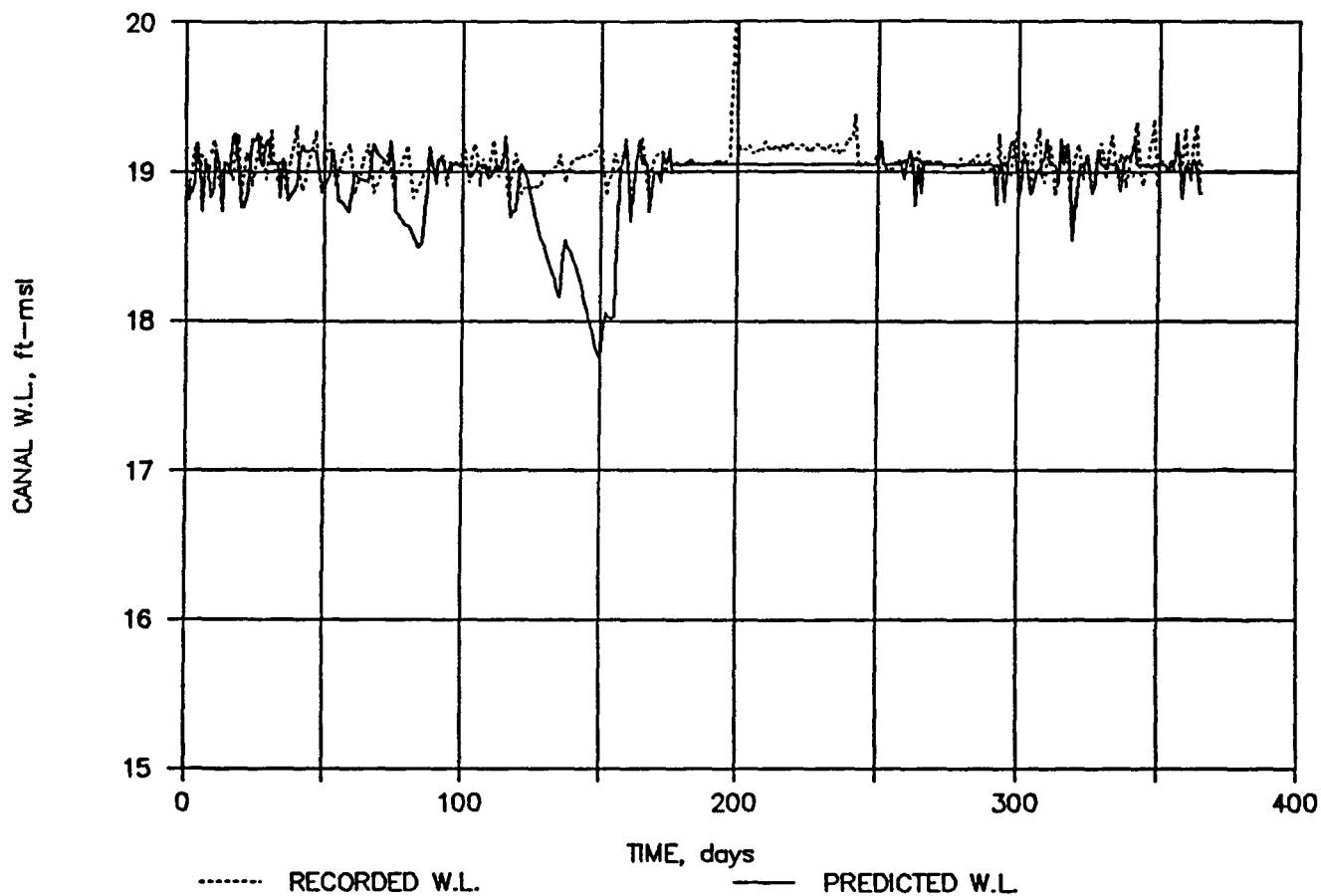


Figure 5.3.1-1.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1974

Source Bechtel, 1990

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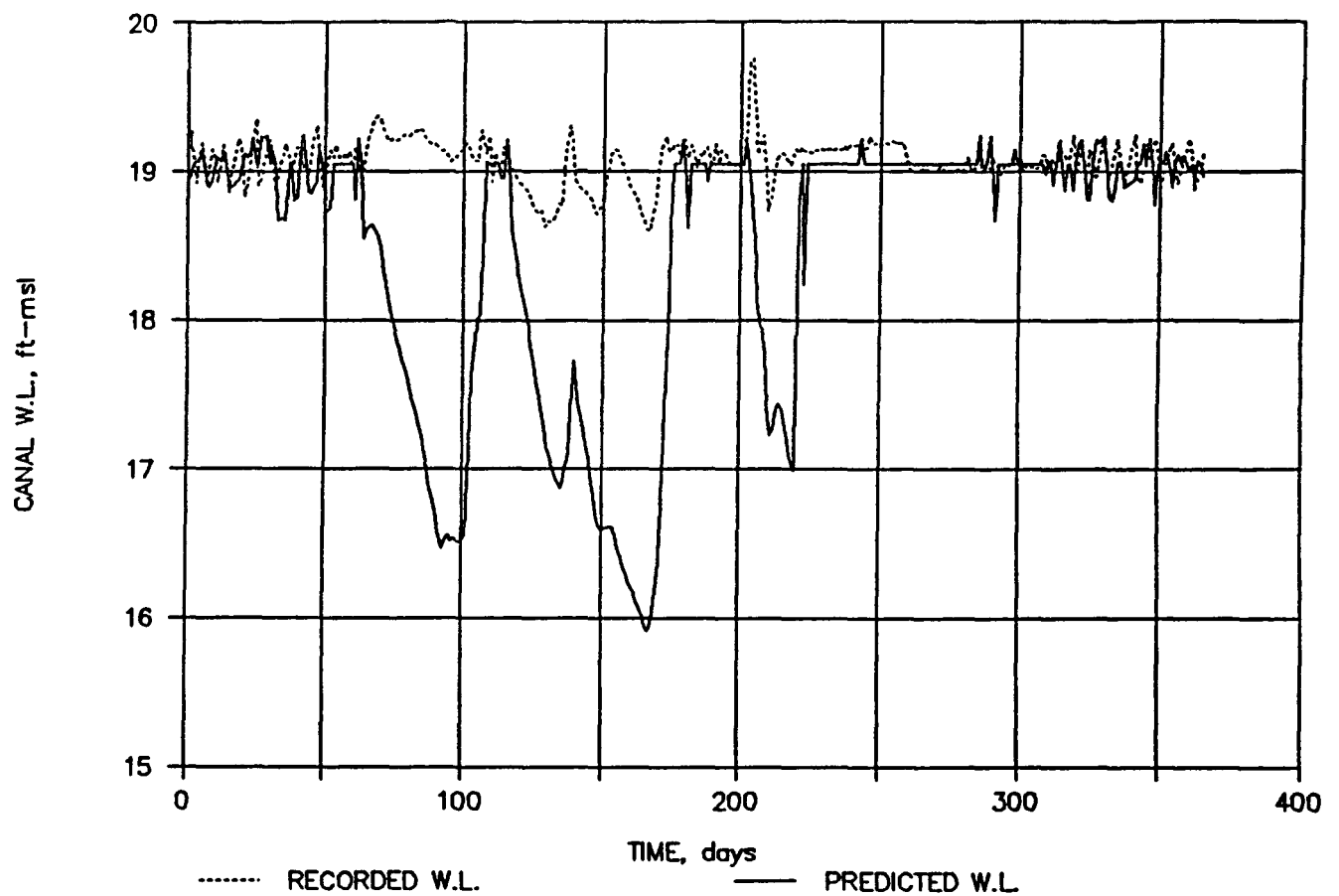


Figure 5.3.1-2.

MAKEUP AND PROCESS WATER WITHDRAWAL 1975

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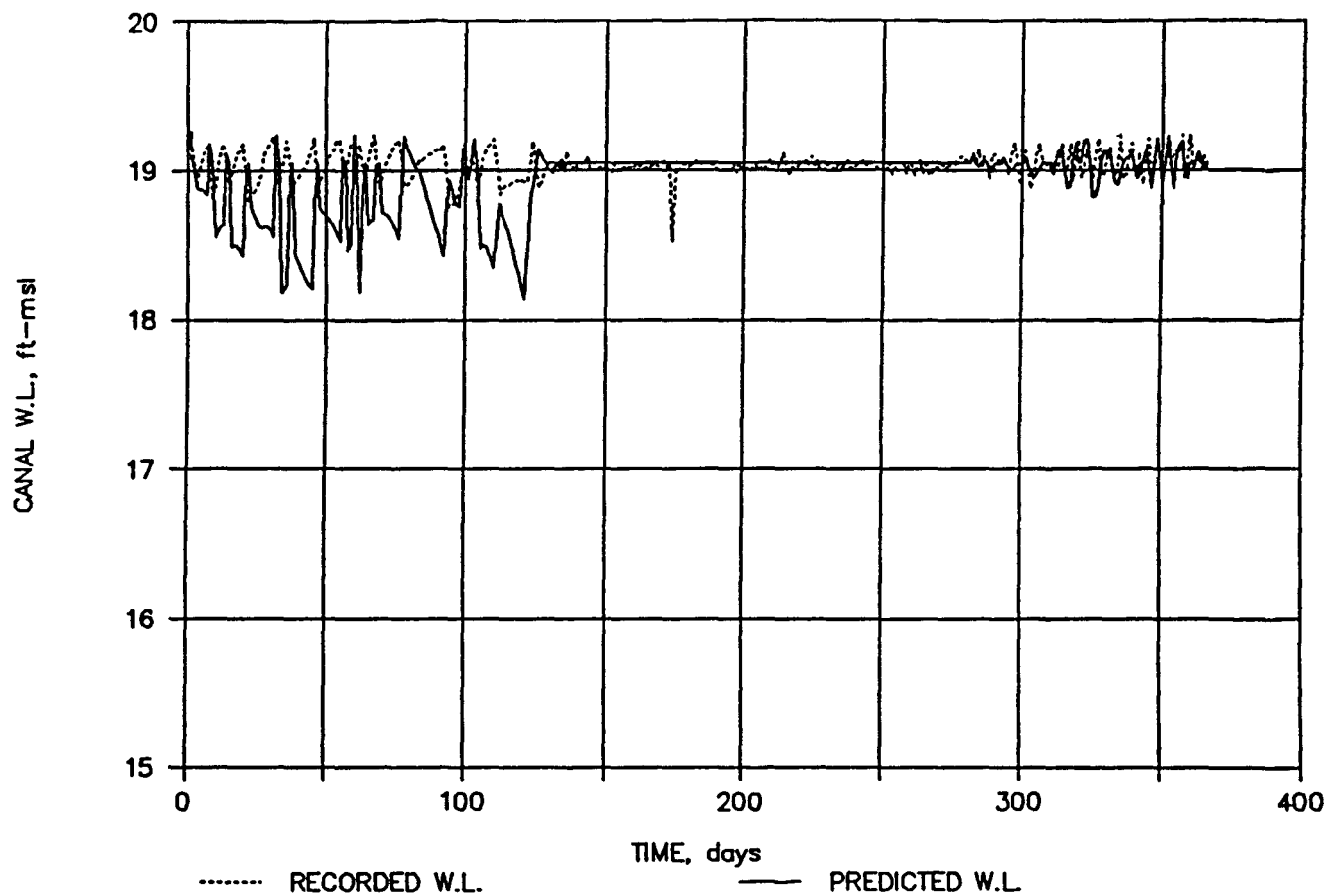


Figure 5.3.1-3.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1976

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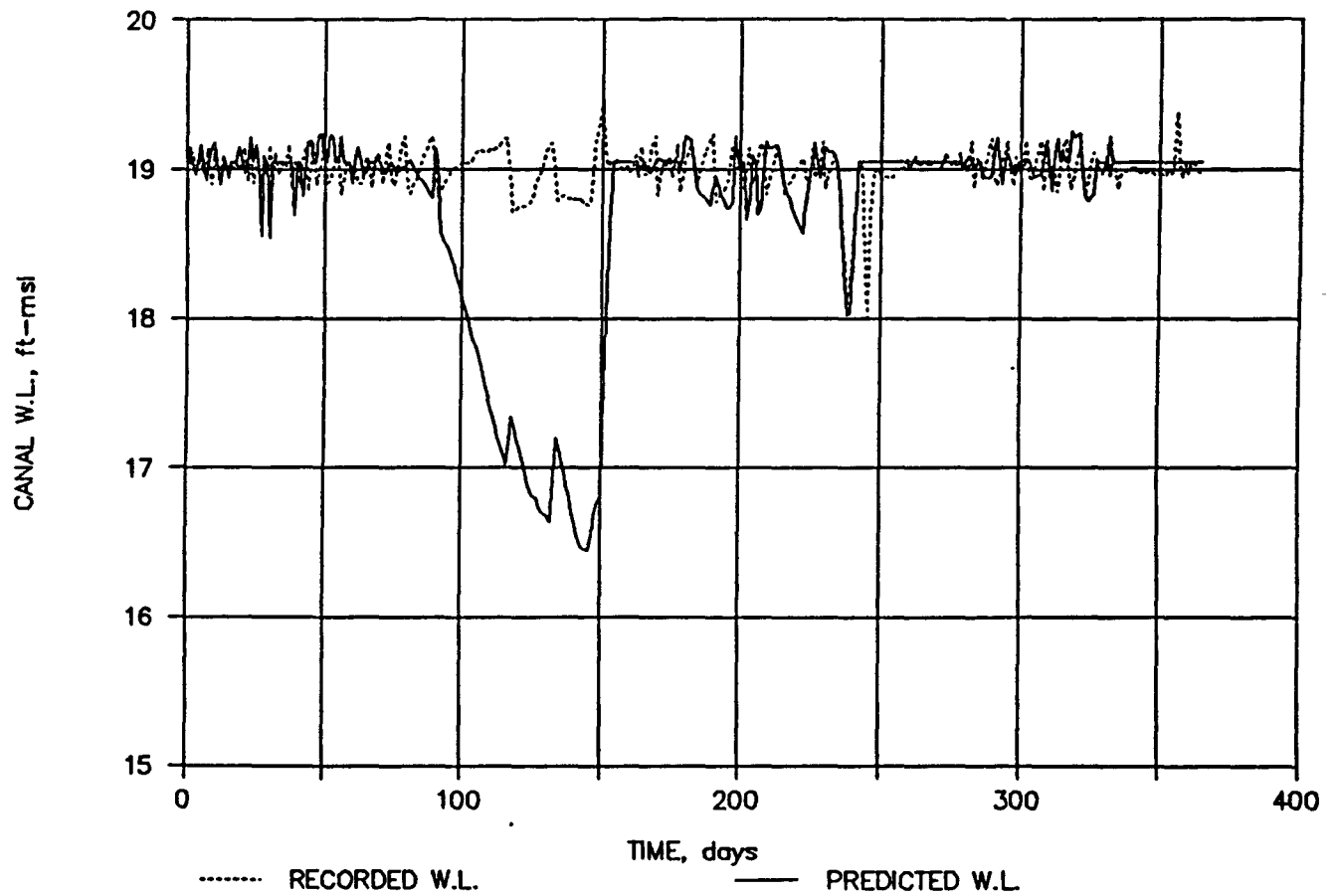


Figure 5.3.1-4.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1977

Source Bechtel, 1990

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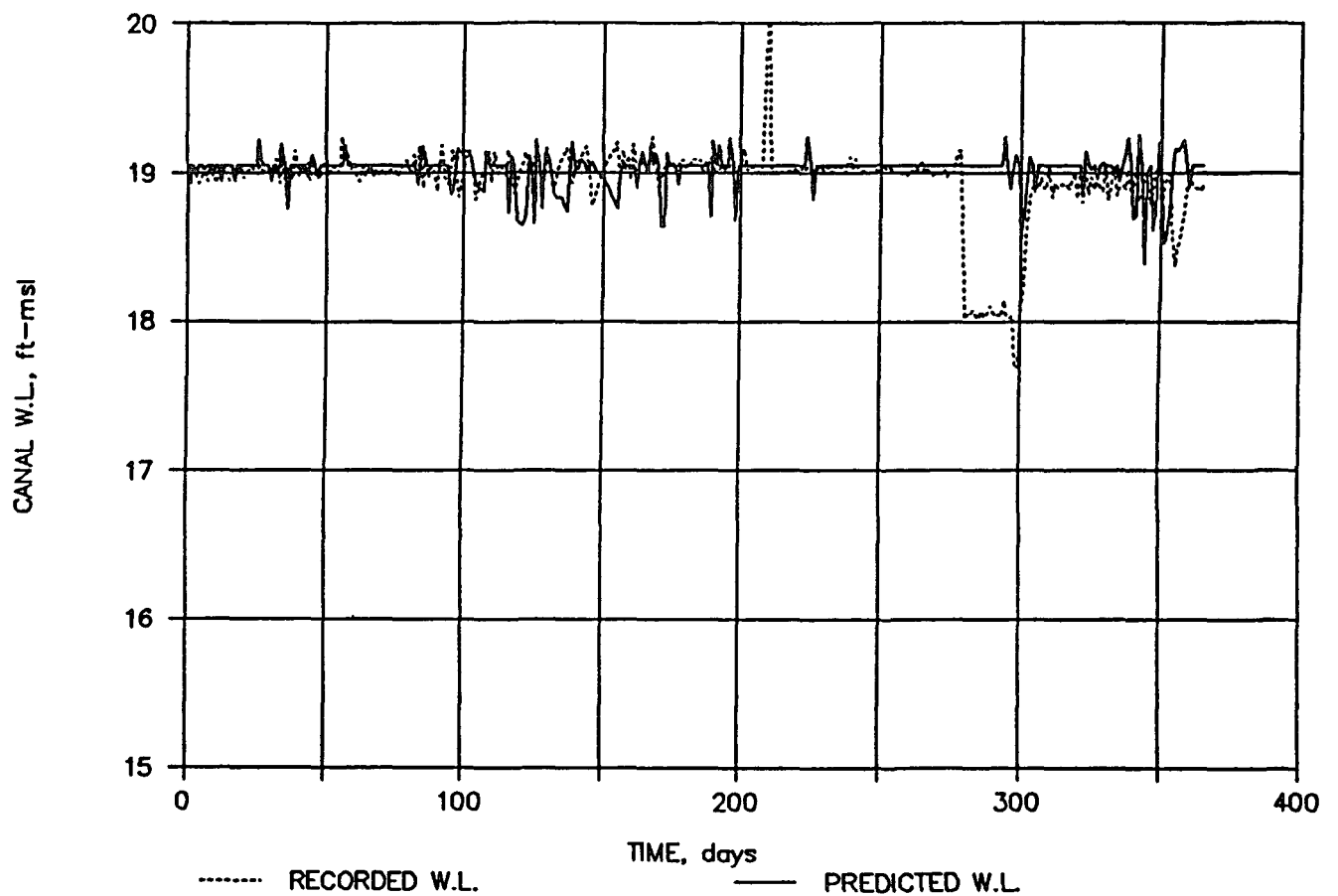


Figure 5.3.1-5.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1978

Source Bechtel, 1990

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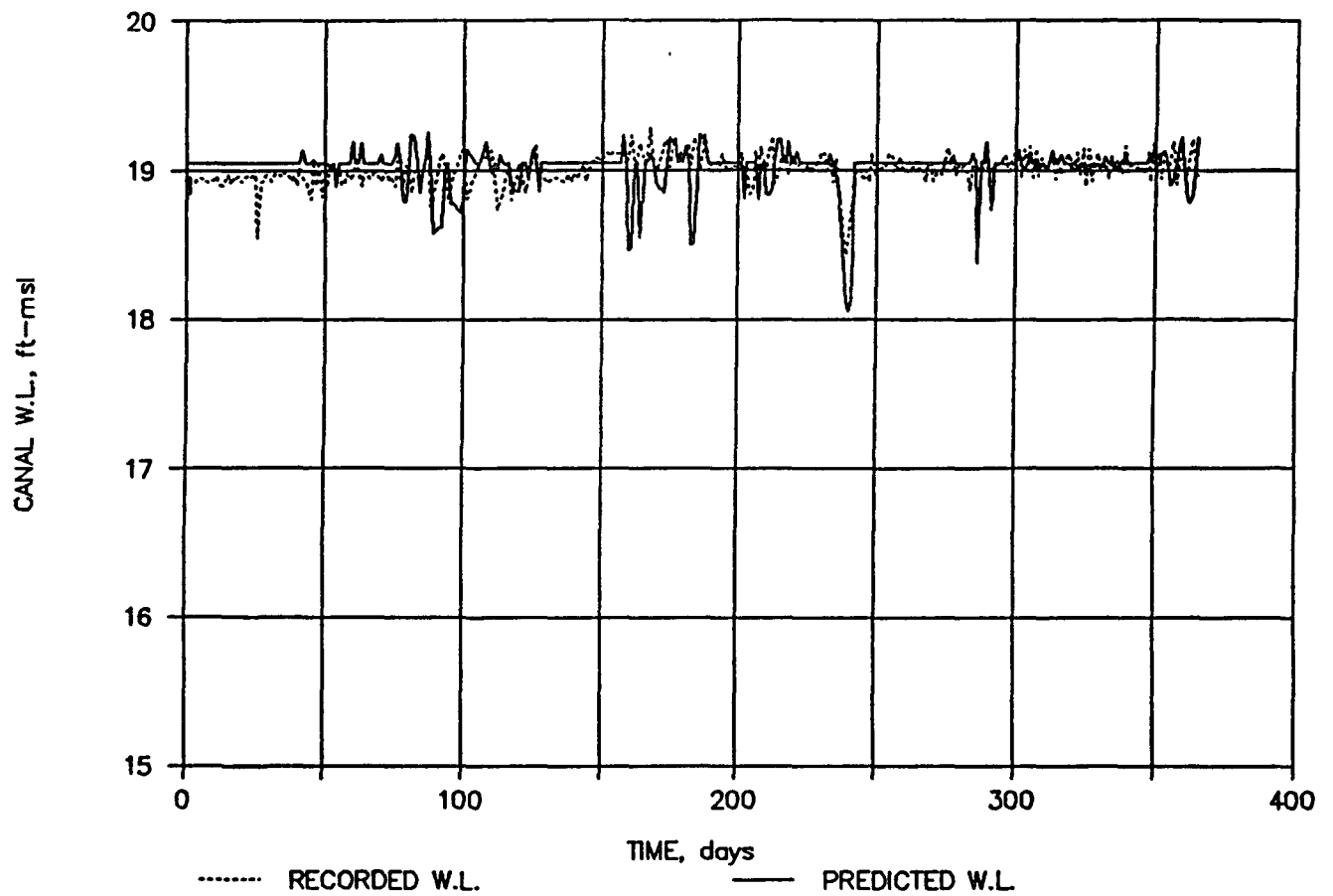


Figure 5.3.1-6.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1979

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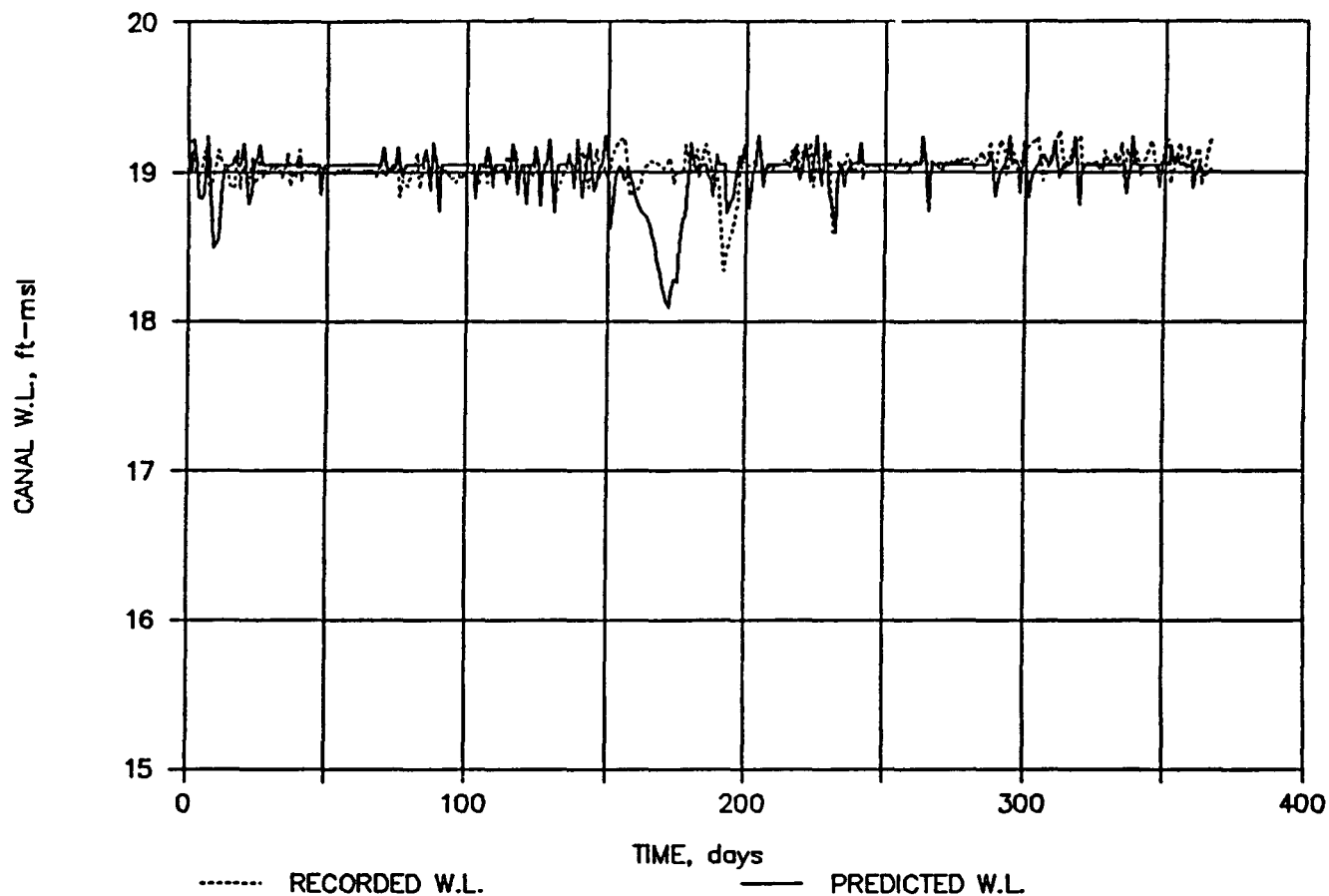


Figure 5.3.1-7.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1980

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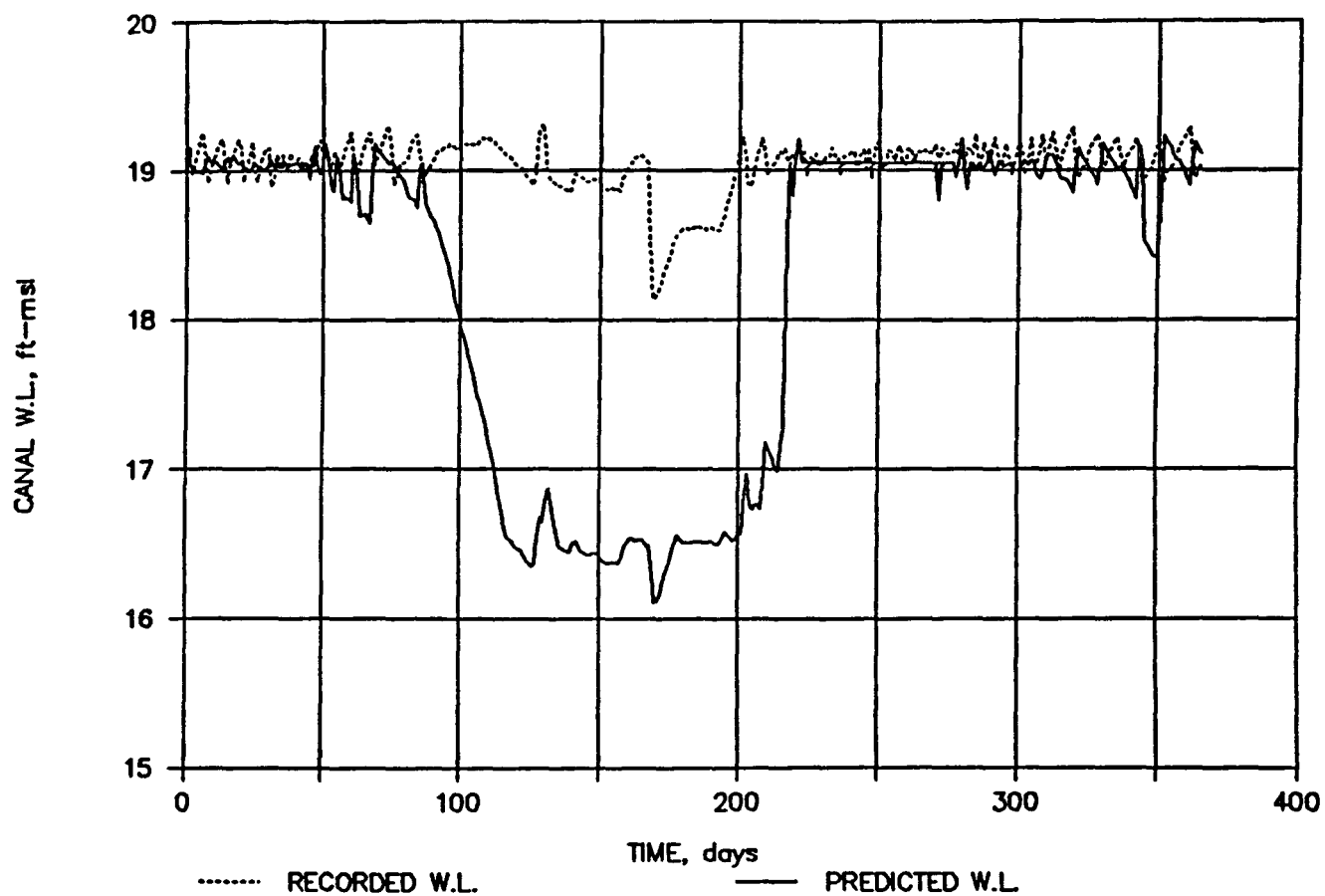


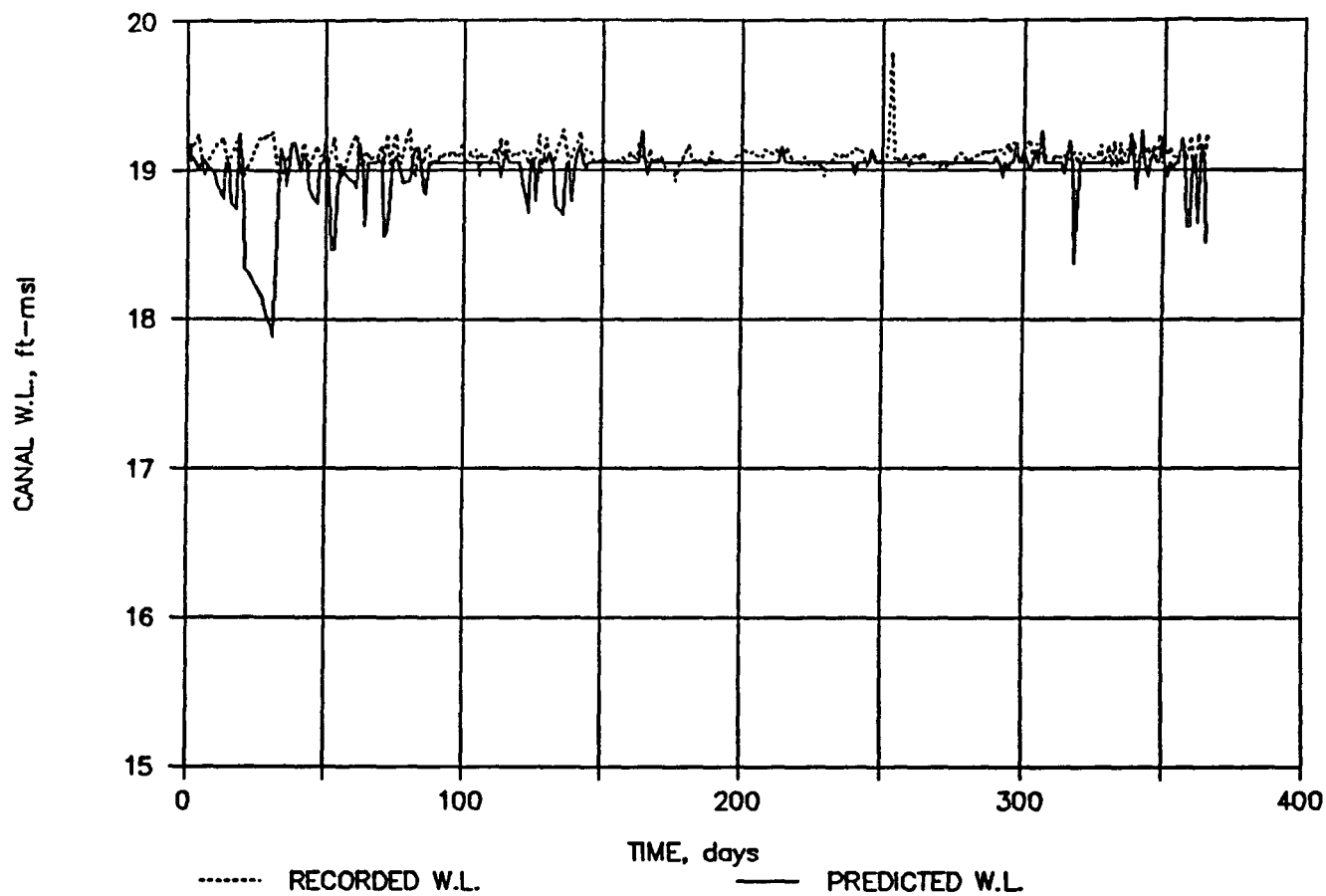
Figure 5.3.1-8.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1981

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Figure 5.3.1-9.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1982

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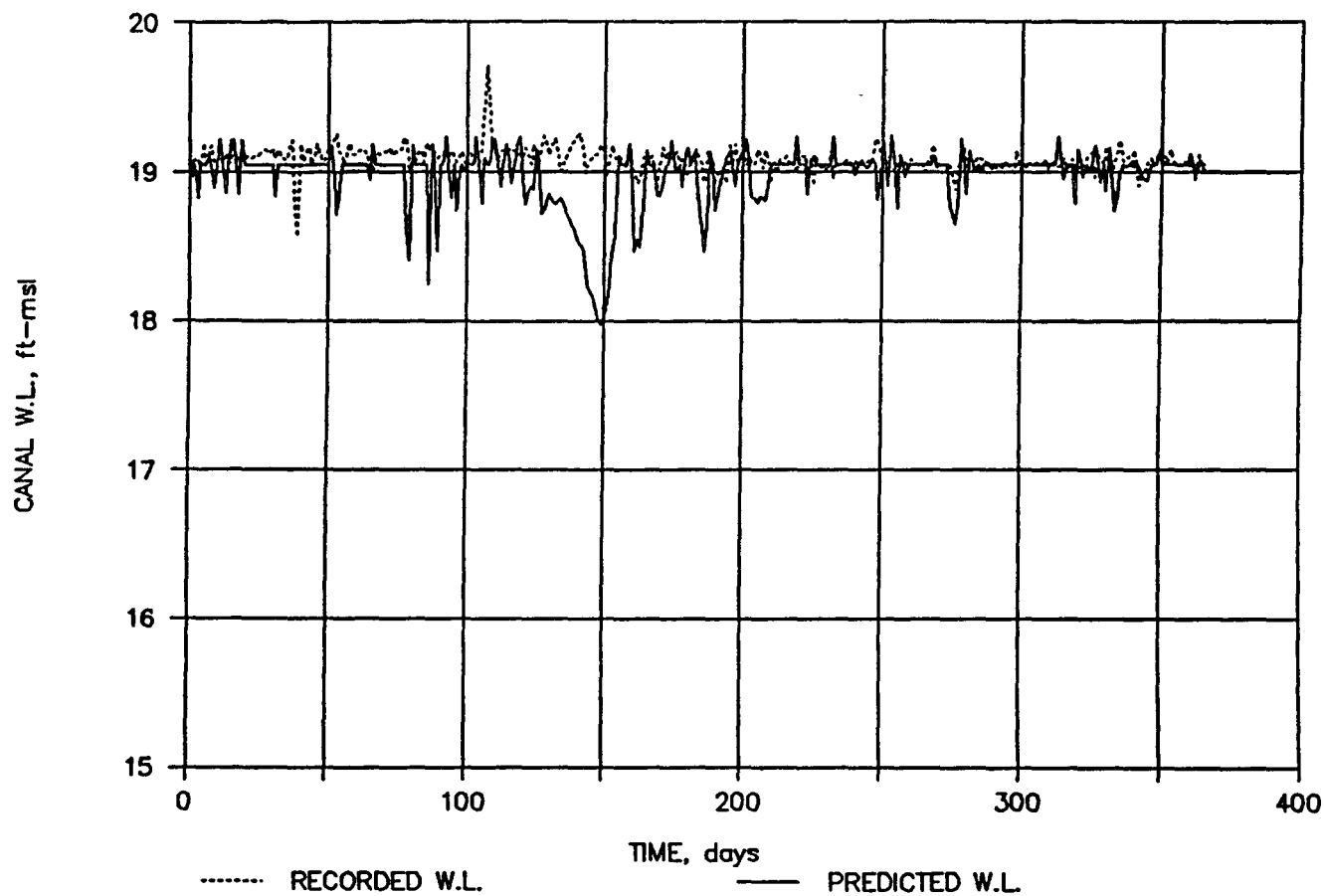


Figure 5.3.1-10.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1983

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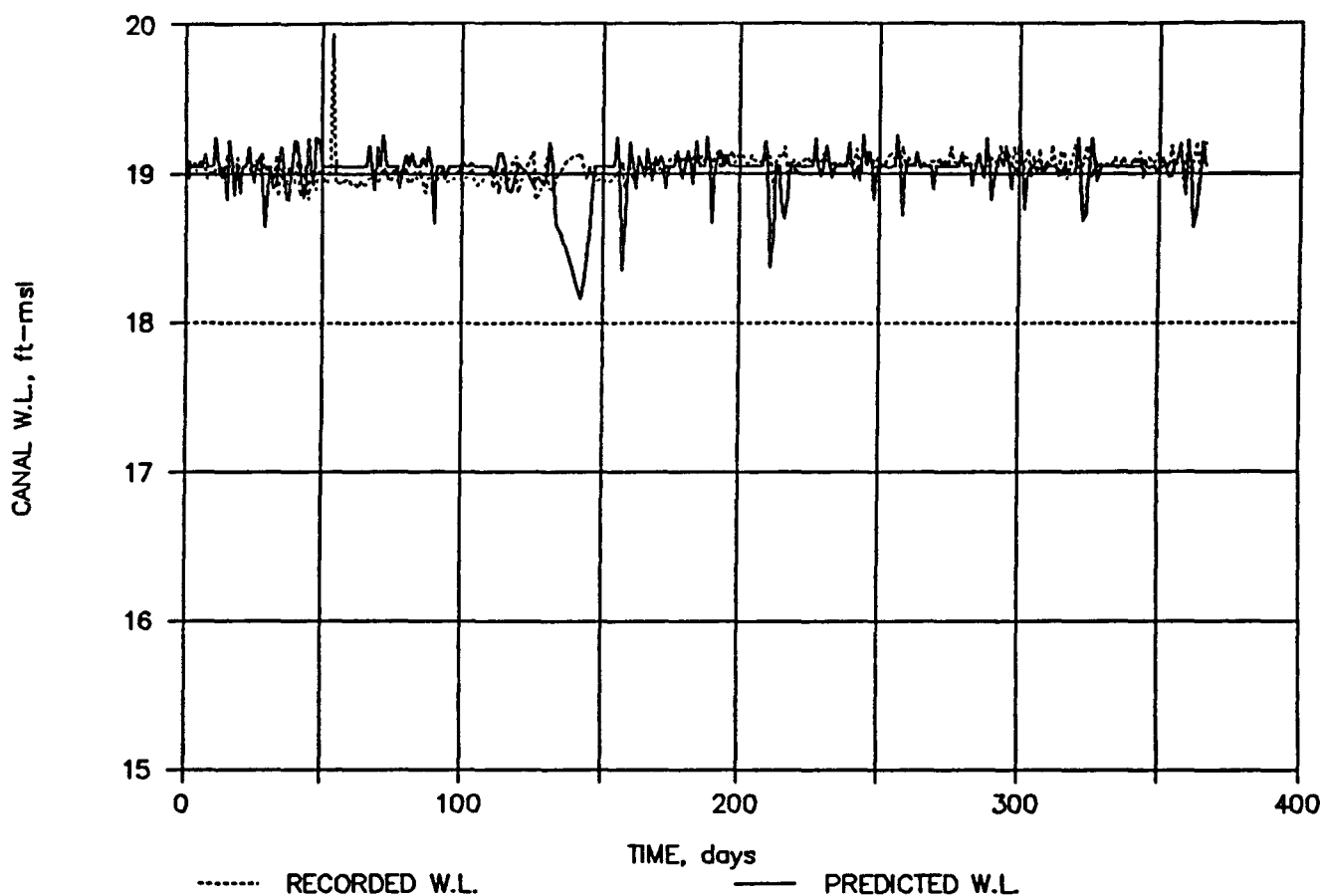


Figure 5.3.1-11.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1984

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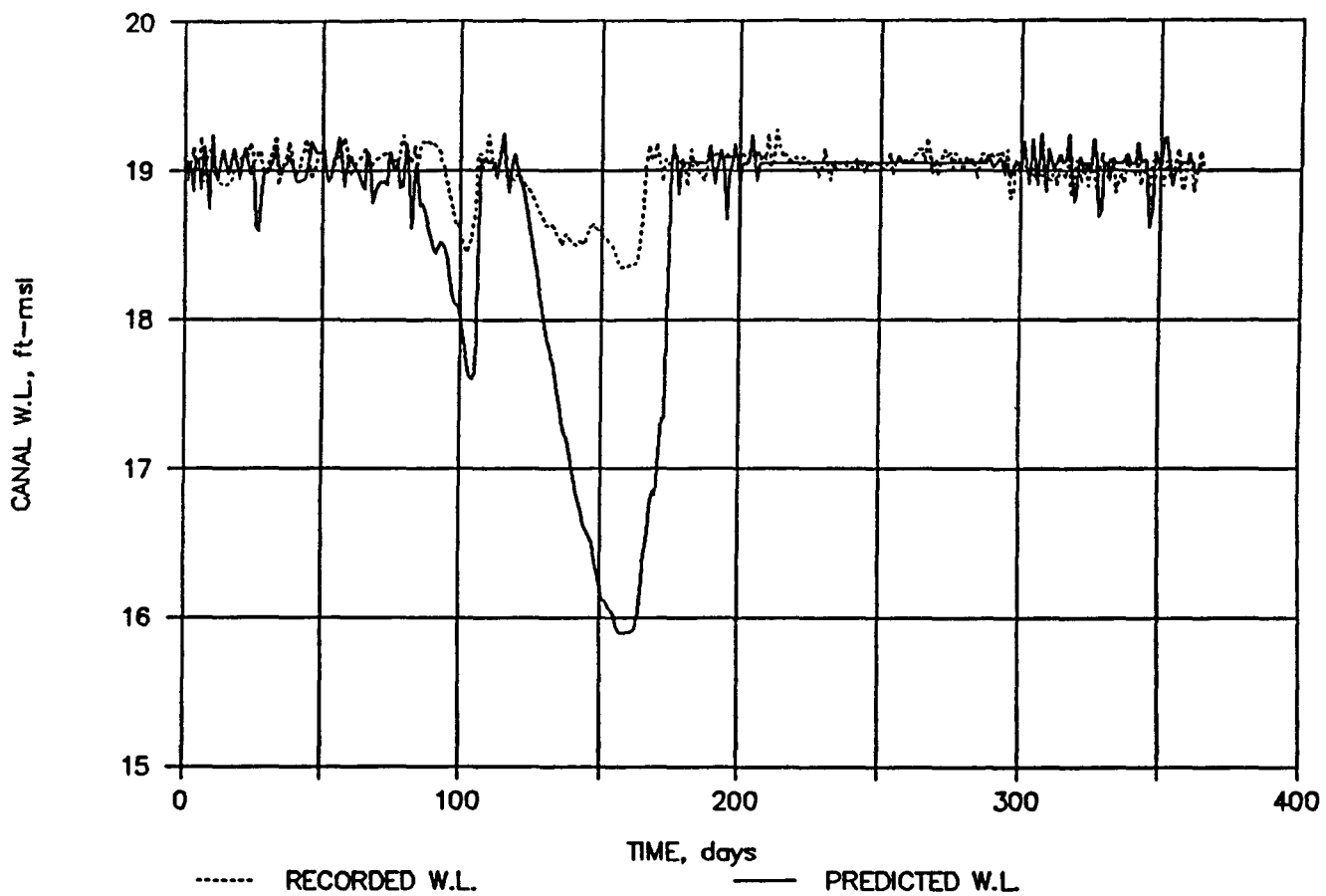


Figure 5.3.1-12.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1985

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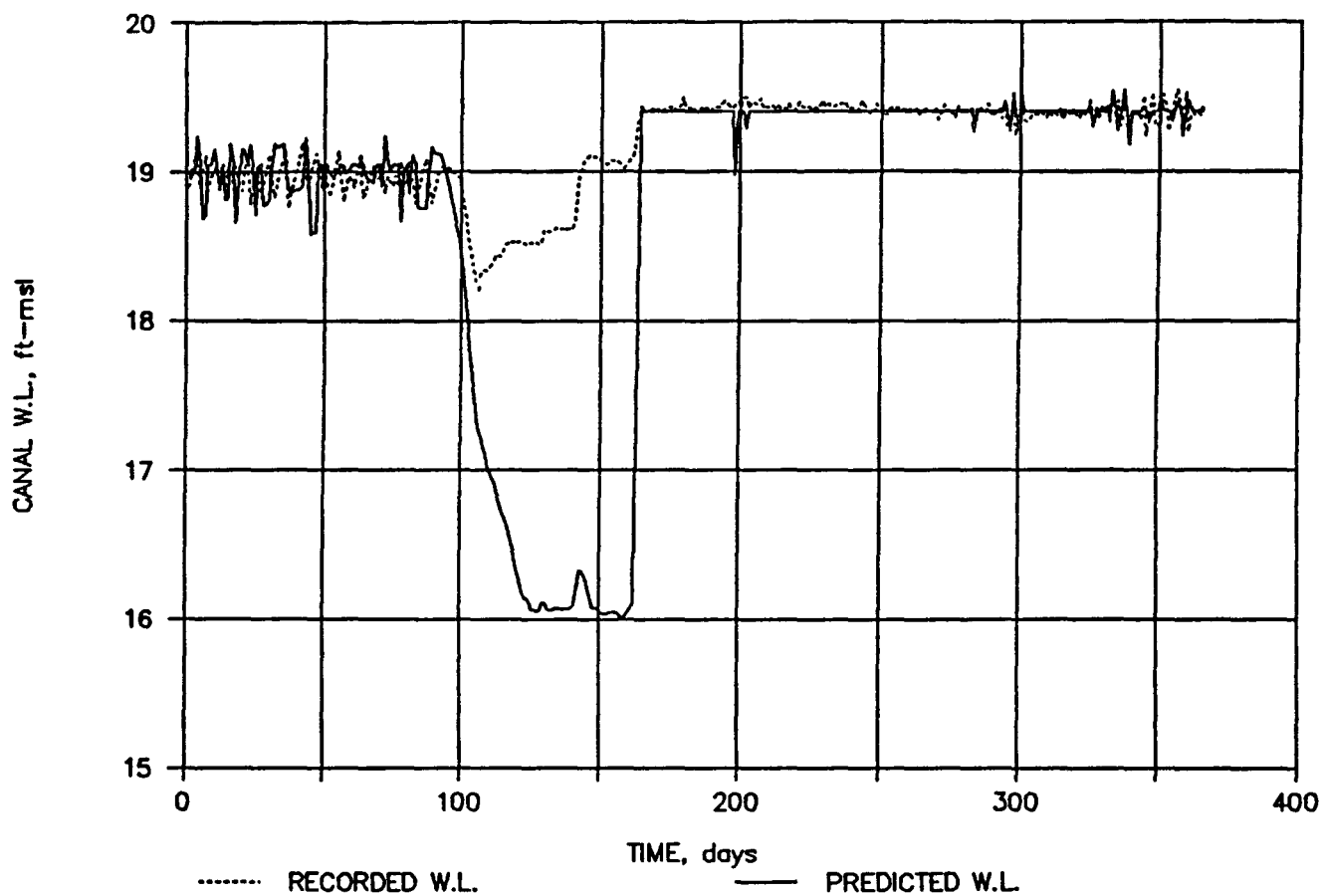


Figure 5.3.1-13.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1986

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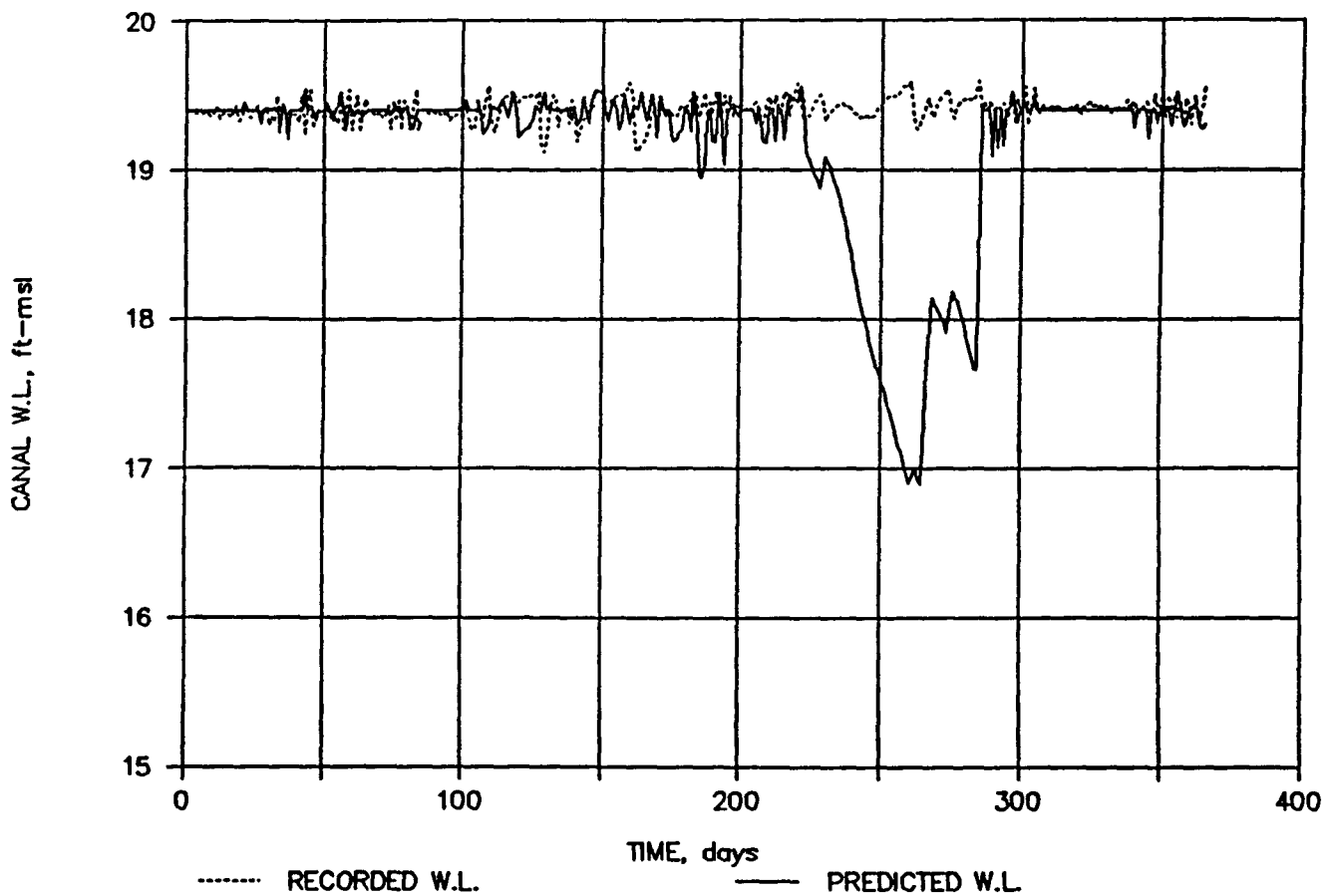


Figure 5.3.1-14.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1987

Source Bechtel, 1990

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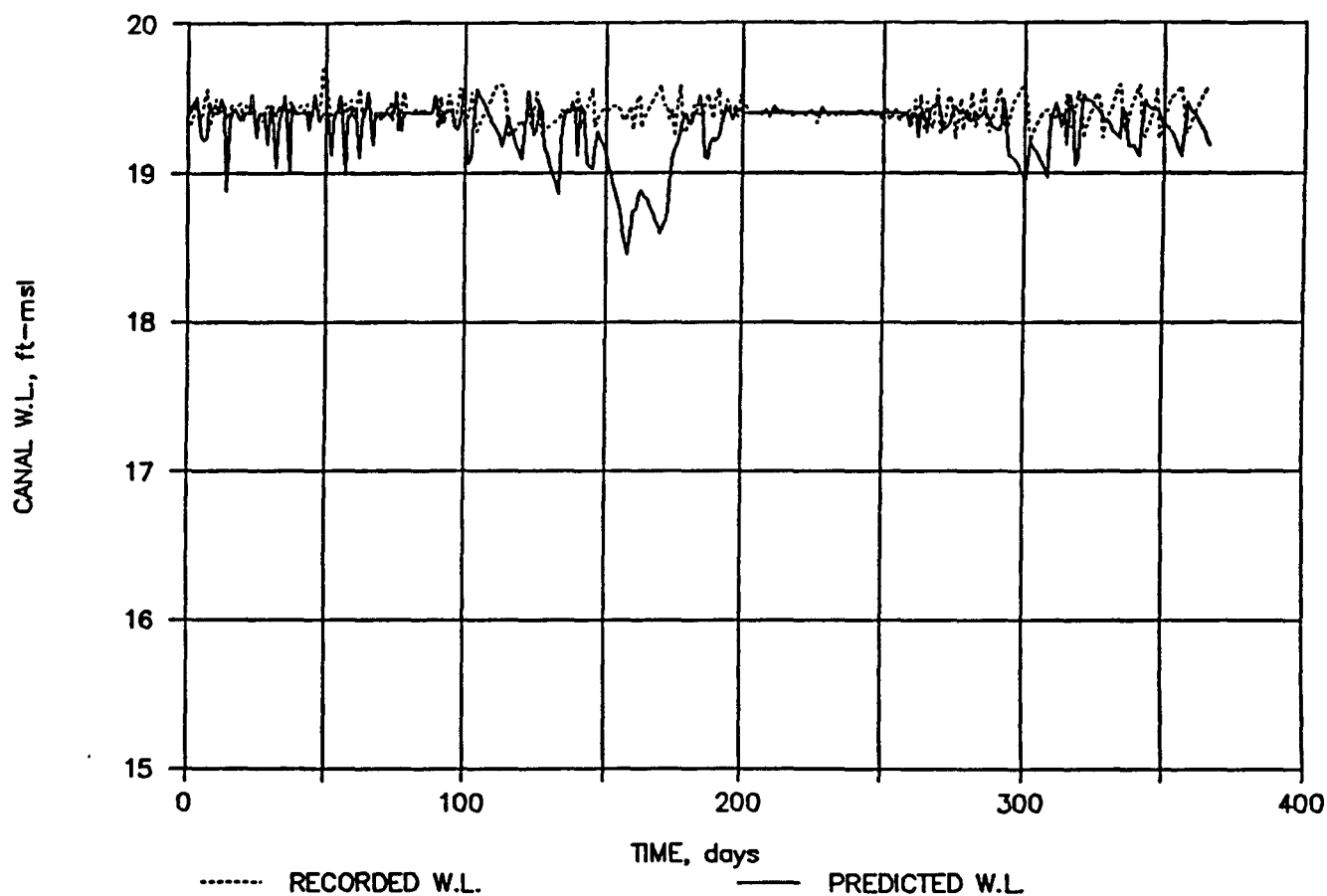


Figure 5.3.1-15.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1988

Source: Bechtel, 1990

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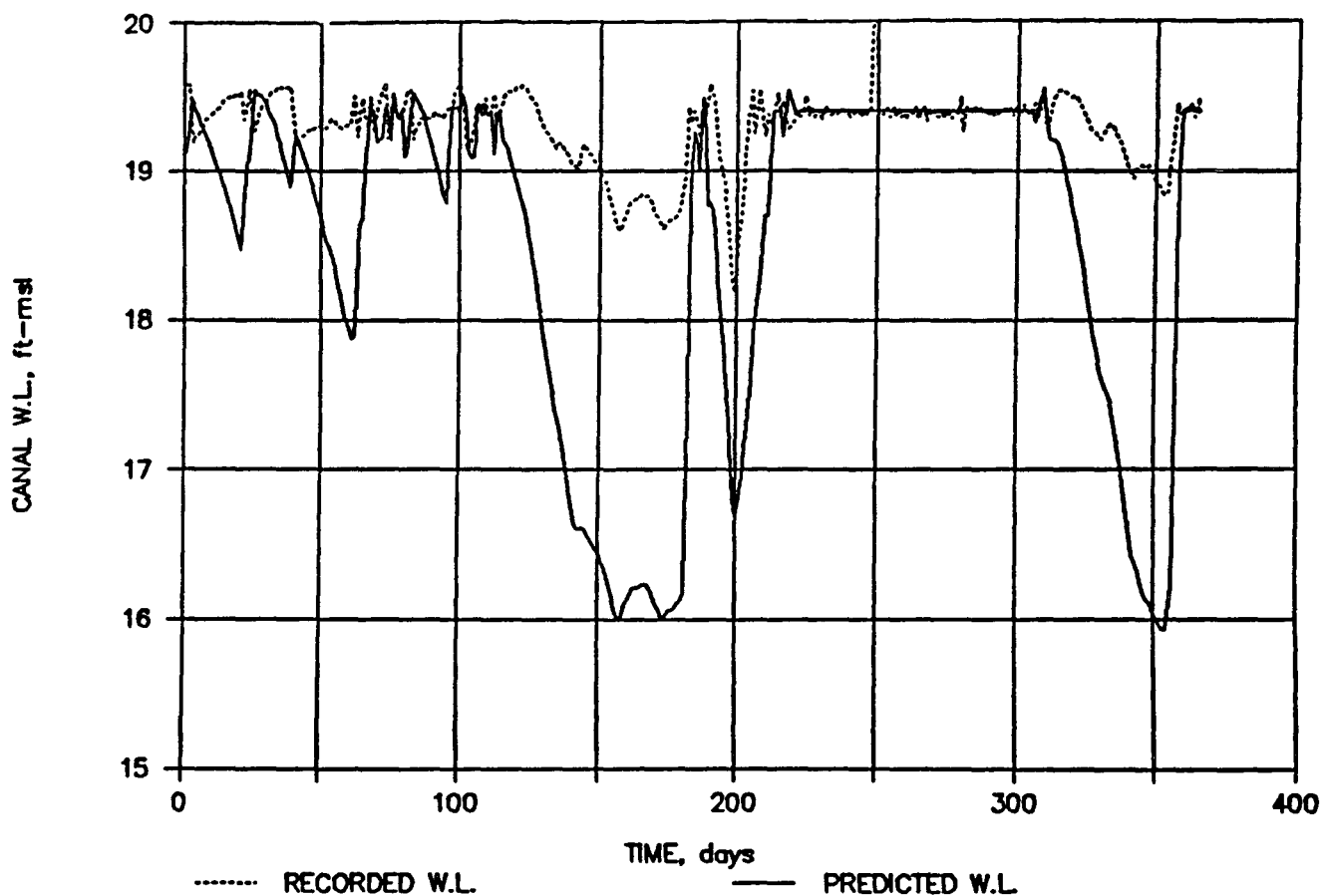


Figure 5.3.1-16.

MAKEUP AND PROCESS WATER WITHDRAWAL, 1989

Source Bechtel, 1990

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3 percent of the total annual inflow to the lake of approximately 3,500,000 acre-feet. The plant annual water withdrawal from TC/NS is 5,430 acre-feet. The plant withdrawal will cause a reduction in the total annual inflow to the lake by 0.16 percent. The effect of such withdrawal on the lake's annual water budget is negligible.

However, relative to the impact on the lake's annual water budget, the effect of plant water withdrawal on the reduction of phosphorous discharged to the lake from TC/NS is significant. Based on the data presented in the "Interim Surface Water Improvement and Management Plan" (SFWMD, 1989) and Section 2.3.4.1, approximately 143 tons of phosphorous are discharged from TC/NS to Lake Okeechobee annually. The plant water withdrawal of 7.5 cfs can reduce the annual discharge of phosphorous to the lake by 7.3 tons. This amounts to 1.2 percent reduction of total phosphorous to Lake Okeechobee annually.

5.3.1.3 Groundwater Level

During prolonged drought conditions, lowering the canal water levels can lower the adjacent connected water table of the Surficial aquifer and consequently affect any wells and wetlands located in the area influenced by the lowered water table. The extent of such an effect is mainly a function of canal water level drop and its duration.

To quantify such effects, an analysis was made to estimate the impact of lowering the canal water level caused by plant water withdrawal on the adjacent surficial water tables. The method of analysis was based on one-dimensional unsteady computerized groundwater flow in an unconfined aquifer as discussed by McWhorter and Sunada (1977).

The adjacent surficial aquifer properties are estimated from the reference materials (SFWMD, 1987; Ardaman & Associates, 1989; CH2M Hill, 1990; USDA, 1971 and 1981). The geological formation of surficial aquifer consists of shell, sandstone,

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limestone, and fine sand (SFWMD, 1987; USDA, 1971 and 1981). The estimated hydraulic conductivity of the top 30 feet of the Surficial aquifer at the vicinity of the TC/NS canals is about 5×10^{-3} cm/s (SFWMD, 1987; Ardaman & Associates, 1989; CH2M Hill, 1990; USDA, 1971 and 1981). The specific yield of the surficial aquifer is 0.2, within the normal range for this parameter (SFWMD, 1987).

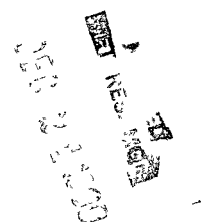
In the analysis, it was assumed the water level in the aquifer is initially the same level as the canal water level. A water level drop scenario representing a severe drought condition, was selected. The canal water level was dropped by 2.5 feet in 40 days and was maintained at that level for an additional 90 days. Then the canal water level was raised by 2.5 feet in 20 days, and was maintained at this final level for an additional 30 days (Figure 5.3.1-17). A total of 180 days was used for simulation.

From the analysis, the total number of days at which the groundwater level dropped more than 1 foot is found for selected distances from the canal. These are presented below:

<u>Distance from the Canal (ft)</u>	<u>Total No. of Days</u>
100	116
300	87
500	28
700	0

For the simulated drought scenario, the 1-foot drop in water table does not extend to a distance of 700 feet from the canal throughout the simulation time.

The simulated drought condition is more severe than the drought condition of 1981 (Figure 5.3.1-8). As discussed in Section 10.9, the drought condition of 1981 is the most severe during the available period of precipitation data. In addition, the annual precipitation during 1981 was the lowest of 34 years of record for Port



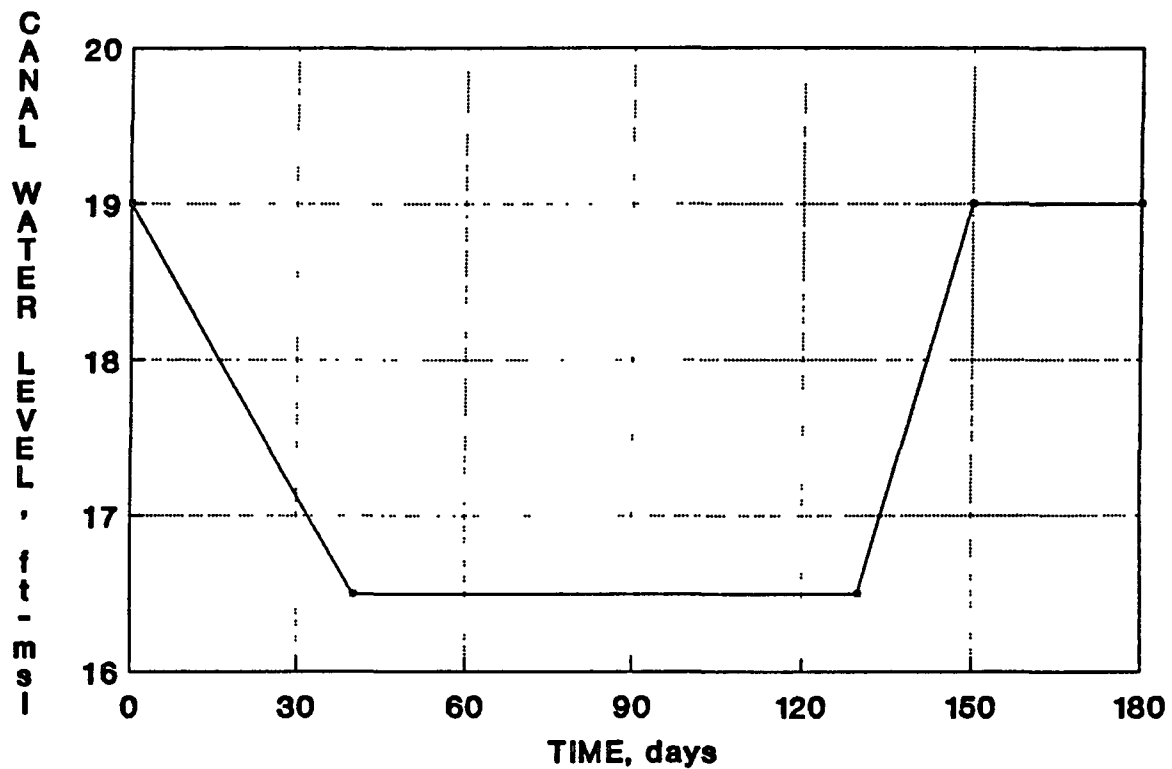


Figure 5.3.1-17.

CANAL WATER LEVEL SCENARIO USED FOR
GROUNDWATER LEVEL IMPACT ANALYSIS

Source: Bechtel, 1990

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Mayaca Station. Furthermore, since the pumping of the plant water from the canals will be stopped at the low water level of 16.5 feet-MSL, the impact of such a drought on the groundwater table should be minimal and the 1-foot lowering should be limited to a distance of about 500 feet from the canal.

5.3.1.4 Impact on Other Surface Water Users

Three existing agricultural water users from Taylor Creek are reported and are listed in Table 2.3.3-5. From this table, two of the users are on the old section of Taylor Creek, which is connected to Lake Okeechobee, and one potential user with annual allocation of 94 MG (180 gpm) is on Canal L-63N.

As discussed in Section 5.3.1.1, the canal water levels are not affected by the plant water consumption in a normal year. During severe drought conditions, the canal water level may drop 2 to 3 feet below normal operating water level, resulting in a lower head at the intake of the above potential user. However, since low water level periods last for a short period of time, the impact of such low water level on the water withdrawal capability of the user should be minimal.

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5.3.2 GROUND WATER

Both the Surficial and the Floridan aquifers are susceptible to potential impacts from operations at the ICL facility. The plant design was developed with an understanding of the aquifers' vulnerability, and, therefore, the proposed plan incorporates features to safeguard the aquifers and maintain pre-project water quality within the groundwater regime.

5.3.2.1 Surficial Aquifer Potential Contaminants

The Surficial aquifer occupies the upper 120 feet of sediments that underlie the site. The aquifer may be divided into two major water-bearing zones. An upper, unconfined or water table zone occurs within the layers of interbedded sand and silt which are exposed at the ground surface and extend to a depth of about 30 feet. A semi-confined zone, the major production interval of the Surficial aquifer, is composed of sand and shell layers which occupy an interval between 85 and 120 feet below the ground surface. These two water-bearing zones are separated by 55 feet of less permeable sand, silt and clay layers which restrict the vertical flow of groundwater between the two zones.

Throughout the site, the water levels within the upper, unconfined zone of the Surficial Aquifer are within 5 feet of the ground surface. During at least part of the year, the water table intersects portions of the ground surface, occurring as wetland ponds. The close proximity of the water table to the ground surface makes the Surficial Aquifer especially vulnerable to any contaminants that might enter the aquifer as seepage or leachate from the ground surface.

Potential sources of contamination would include the coal and lime stored onsite, the bottom ash and fly ash generated onsite, the cooling water storage pond, and any other solid or hazardous wastes generated onsite.

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Coal storage will consist of an active use facility and a grassed, inactive pile, sized to store enough coal for 30 days at full load. The active use coal storage facility will be completely enclosed. Because the coal will not be exposed to the elements, leachate and runoff problems are eliminated. Section 5.3.4 discusses impacts on the Surficial aquifer due to leachate and runoff from the inactive coal storage area.

Small quantities of lime will also be utilized onsite as part of the coal burning process. Lime will be delivered by rail and stored in an enclosed facility prior to usage. Once again, the enclosed facility will eliminate the problems associated with leachate and runoff.

Section 5.4 addresses the disposal of solid and hazardous wastes at the site.

The cooling water storage pond will contain water from Taylor Creek/Nubbin Slough. As discussed in Section 3.5, the quality of this water is comparable to background water within the Surficial aquifer. However, the pond will be lined to keep pond seepage from mixing with the potable water of the Surficial aquifer.

Potential leakage from the wastewater injection well also represents a source of contamination to the Surficial aquifer. As described in Section 3.5.1.5, the many precautions and casing integrity tests that are required as part of injection well installation provide reassurance that no leak in the well casing could go undetected, either prior to or during wastewater injection operations.

As shown on Figure 2.3.2-3, the water table gradient is generally to the south toward the St. Lucie Canal. Potential offsite receptors of a hypothetical plume generated onsite include the St. Lucie Canal and two Surficial aquifer wells to the southeast of the site (Figure 2.3.3-1). As discussed in Section 5.3.5, the positioning of monitor wells along the southern boundary of the site ensures that no contaminant plume could move offsite undetected.

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5.3.2.2 Floridan Aquifer Groundwater Withdrawals

As discussed in Section 3.5, the analysis of historic water levels in Taylor Creek/Nubbin Slough indicates an alternative source of cooling water will be required for a maximum of 90 continuous days during an extreme drought year. The lower permeable horizon of the upper Floridan aquifer, which lies about 1,400 feet below the ground surface at the site, is proposed as this alternative source of water. A withdrawal rate of 4,000 gpm will be necessary to meet cooling water demand.

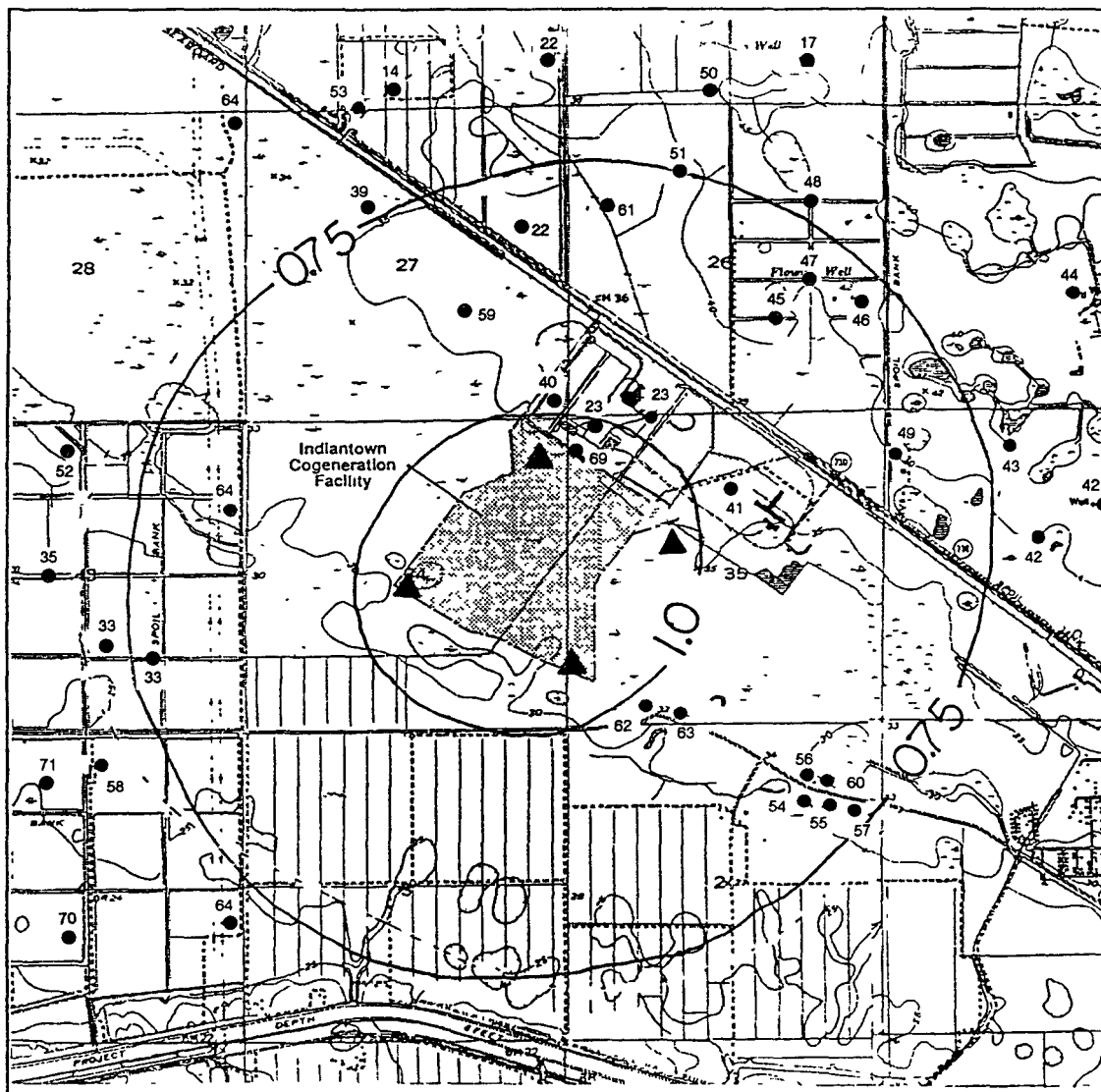
Figure 5.3.2-1 presents simulated drawdowns assuming 90 days of continuous flow from four 1,000 gpm wells, placed at the corners of the project site. Steady-state conditions are approached within the first day of withdrawal due to the extreme magnitude of transmissivity within this permeable horizon. Recovery rates will be just as fast. The projected drawdowns indicate negligible impacts upon the proposed FPL wells at the Martin Project Site.

Figure 5.3.2-2 presents the results of the 90-day simulation as they affect hydrostatic pressures within the uppermost permeable horizon of the Floridan aquifer. The model simulated drawdowns due to induced seepage of up to 0.9 foot in the immediate vicinity of the proposed wellfield.

The maximum capacity of free-flowing artesian wells is directly proportional to the height of the closed-in hydrostatic pressure above the well casing. In the project area, hydrostatic pressures are 15 feet above ground level. A decrease in hydrostatic head of about 1.5 feet equates to a 10 percent decrease in the maximum capacity of the well. The simulated maximum drawdown of 0.9 foot indicates that no existing well will experience a reduction of 10 percent in flow capacity.

To summarize, the plant design incorporates many features that will function to preserve the chemical quality of the Surficial aquifer. These features include totally

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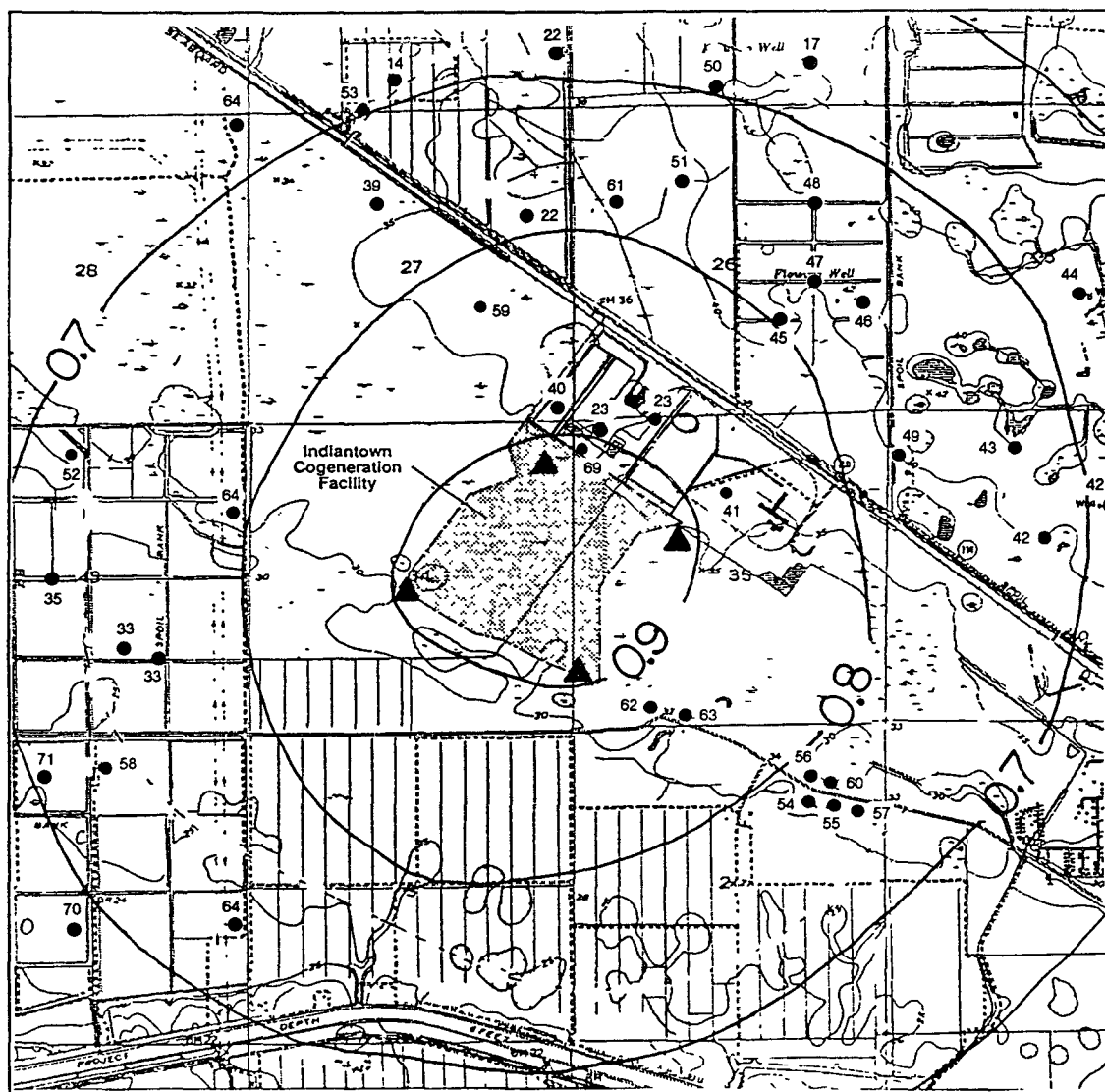
Figure 5.3.2-1
SIMULATED DRAWDOWNS WITHIN THE LOWER PERMEABLE HORIZON OF THE FLORIDAN AQUIFER AFTER 90 DAYS OF FLOWING FOUR 1000-GPM ARTESIAN WELLS

Source Bechtel, 1990, CH2M Hill

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Figure 5.3.2-2
SIMULATED DRAWDOWNS WITHIN THE UPPERMOST PERMEABLE HORIZON OF THE FLORIDAN AQUIFER AFTER 90 DAYS OF FLOWING FOUR 1000-GPM ARTESIAN WELLS (SCREENED ACROSS THE LOWER, PERMEABLE HORIZON)

Source Bechtel, 1990, CH2M Hill

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enclosed facilities for the active coal pile and lime storage areas, a lined inactive coal pile, a lined pond and basins, and procedures to remove wastes such as bottom ash and fly ash from the site. During normal dry and wet seasons, Taylor Creek/Nubbin Slough will provide plant cooling and process water.

When prolonged droughts occur, it will be necessary to withdraw water from the Floridan aquifer for cooling water at rates of 4,000 gpm for up to 90 days. Simulations of this withdrawal from the base of the upper Floridan aquifer indicate that induced seepage from the more heavily utilized parts of the upper Floridan will not exceed established criteria which protect existing users.

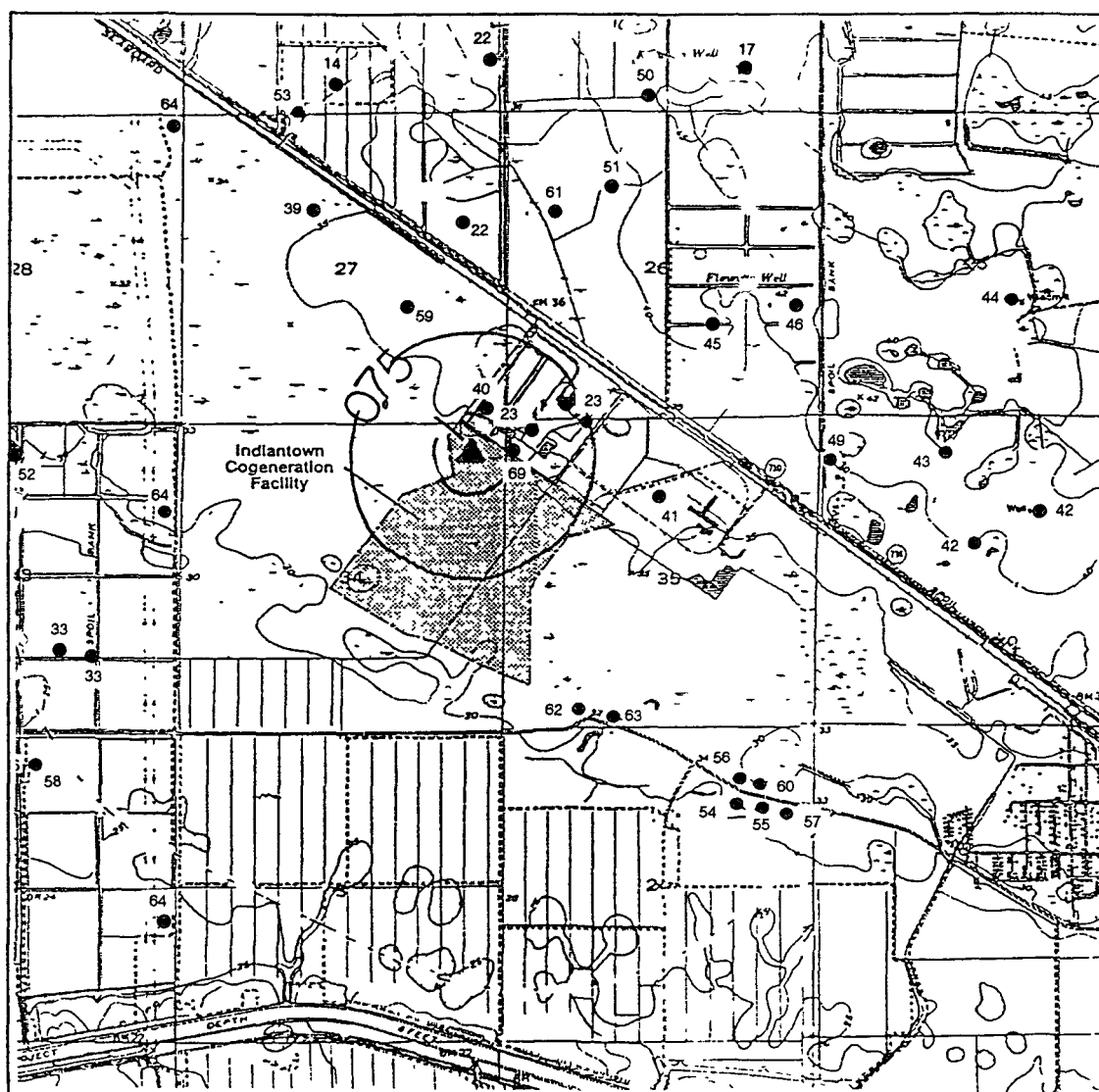
5.3.2.3 Alternative Source of Process Water During Drought Periods

As discussed previously, it is anticipated that there will be times when severe drought conditions cause water in Taylor Creek/Nubbin Slough to drop below the minimum intake level. It is also proposed to withdraw 300 gpm from the uppermost permeable horizon of the Floridan aquifer for process water purposes.

Withdrawals of 300 gpm for 90 days from the uppermost permeable horizon of the Floridan aquifer were simulated using analytical methods. The simulation results are included in Section 10.5.1 as a computer printout of input parameters and calculated drawdowns.

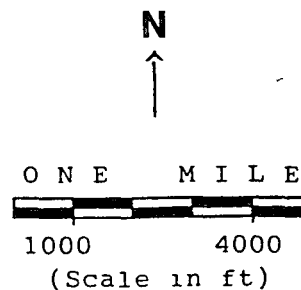
Figure 5.3.2-3 presents the simulated drawdowns caused by a single well, flowing at 300 gpm for 90 days. The figure shows that no existing Floridan aquifer wells will lose as much as 1 foot of hydrostatic head during the withdrawal period. As discussed in this section, the capacity of a free-flowing artesian well is directly proportional to the height that the hydrostatic head of the aquifer extends above the top of the well casing. At the project site, reductions of 1 foot in hydrostatic head would not reduce the flowing capacity of any existing well by as much as 10 percent. Therefore, withdrawals of 300 gpm for 90 days would not create drawdowns that would exceed SFWMD criteria for prohibitive well interference.

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Figure 5.3.2-3
SIMULATED DRAWDOWNS WITHIN THE UPPERMOST PERMEABLE HORIZON OF THE FLORIDAN AQUIFER AFTER 90 DAYS OF CONTINUOUS FLOW FROM ONE 300 GPM WELL

Source Bechtel, 1990, CH2M Hill

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5.3.3 DRINKING WATER

In the project area, the potable water supply is the Surficial aquifer. Figure 2.3.3-1 and Table 2.3.3-6 in Section 2.3.3 show the locations of wells within 1 mile of the site boundaries, and list well owners, permit numbers, well construction specifications, and purpose of the well (industrial, agricultural, potable use).

Because no water will be withdrawn from the Surficial aquifer for plant use, there will be no impacts on surrounding wells into the Surficial aquifer that withdraw water for drinking purposes.

The regional groundwater gradient is almost due south at 8 feet per mile. This results in seepage velocities of 20 to 80 feet per year, depending upon sediment porosity. It is conceivable that wells 62 and 63 on Figure 2.3.3-1 might intercept a hypothetical contaminant plume generated at the project site. However, the monitor wells installed into the Surficial aquifer on the site are positioned to detect any contaminant plume before it crosses property lines. Should an event such as a spill take place, these wells would be used to detect the plume in advance of it reaching an existing user, thereby allowing time for remedial action to be implemented.

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5.3.4 LEACHATE AND RUNOFF

The only source of leachate or runoff that could adversely impact the Surficial aquifer is the inactive coal storage area. The inactive coal storage area will be covered and lined as described in Section 3.3.1. In addition, runoff and leachate from rainfall will be treated and collected in the adjacent coal pile runoff basin, as described in Section 3.6.2. The active coal pile will be enclosed and a physical barrier to the groundwater will be installed beneath the coal pile.

The inactive coal storage area is grassed over. Approximately 25 to 30 percent of the rainfall percolates through the grass to contact the coal. The composition and characteristics of leachate from coal piles varies substantially depending on the source of the coal. The leachate from the coal storage area is estimated to contain 7500 mg/l of total dissolved solids, 5000 mg/l sulfate, 200 mg/l iron, and a pH in the range of 3 - 4. The quality of the runoff (which only contacts the grass) is much better than the quality of the leachate, effectively diluting the leachate. Runoff and leachate are treated to adjust the pH prior to entering the coal pile runoff basin, as described in Section 3.6.2. Treated runoff and leachate from the coal pile runoff basin are transferred to the sidestream softener of the cooling tower.

Runoff from other areas of the plant (as discussed in Section 3.8) are directed to the existing drainage ditch which eventually leads to the St. Lucie Canal.

Activities Affecting Discharge to Surface Water Bodies

Excess runoff due to an increase in impervious areas causes runoff quality and quantity changes. Due to a higher runoff coefficient caused by increased impervious area, onsite stormwater runoff will increase. In order to maintain the pre-developed peak flow in the existing drainage ditch, detention basins will be employed to store excess runoff. The runoff from the plant area to the ditch will be controlled by methods described in Sections 3.8.4. and 3.8.5. Since peak flows

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before and after site development will not be changed, no adverse impacts concerning quantity of flow are anticipated.

For paved areas and areas where grease or oil may be blended with the runoff (e.g., switchyard, oil storage tank, railroad, parking lot, and power block), catch basins will be used in conjunction with oil/water separators for removal of the oil/grease deposits.

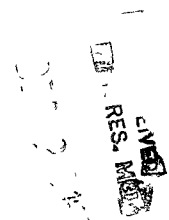
The runoff from the inactive coal storage area will be detained in the lined coal pile runoff basin and treated to adjust pH. Treated runoff will be transferred to the cooling tower sidestream softener and used in the cooling tower.

By detaining and treating water where needed, the quality and quantity of the water in the existing drainage ditch will be maintained. The existing drainage ditch in the plant area is a continuation of a drainage ditch extending from State Route 710 and extends 2.5 miles further to the St. Lucie Canal. Since the drainage ditch will not be adversely affected, the St. Lucie Canal likewise will be unaffected.

The mitigation measures to control impacts to the wetland adjacent to the cooling water storage pond are discussed in Section 3.8.5.2. The remaining six wetlands within the property boundaries have been analyzed, and it has been determined that no significant drainage pattern changes will be made. Based on the developed plan, it can be concluded that there will be no adverse impacts to the wetlands.

Flood Plain Encroachment

The ICL site is entirely within Zone B (100- to 500-year flood plain area) as defined by Insurance Rate Maps. Therefore, there will be no encroachment on the 100-year flood plain and offsite impacts on the 100-year flood level are precluded.



5.3.5 MEASUREMENT PROGRAMS

Section 3.5.1.5 describes the monitoring well that will be installed to detect changes caused by possible migration of the wastewater injected into the Boulder Zone of the lower Floridan aquifer upwards into the upper Floridan aquifer. Since there are no wastewater discharges to surface waters or to other groundwater aquifers, no other monitoring programs are proposed.

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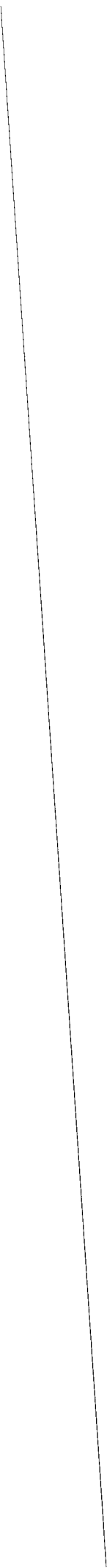
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6.0 LINEAR FACILITIES

6.1 TRANSMISSION LINE

There will be no transmission line constructed since the connection will be to the FPL 230 kV line that traverses the northern boundary of the site. Therefore, Section 6.1 is not applicable to the ICL project.

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6.2 WATER PIPELINE

6.2.1 PROJECT INTRODUCTION

The Indiantown Cogeneration, L. P. (ICL) facility will require a 19-mile, single, 18- to 24-inch diameter water pipeline in Okeechobee and Martin Counties to support its operations. The pipeline will originate at a new intake structure to be located at the junction of Taylor Creek/Nubbin Slough and the C-59 canal in Okeechobee County. From this new intake structure, the buried water supply pipeline will be run along SR 710 and the CSX Railroad line (within the railroad ROW) into Martin County, terminating at the ICL site. This railroad ROW varies between 100 and 200 feet in width. Since the pipeline is to be located within the railroad ROW, no new corridor is requested for this project.

6.2.2 CORRIDOR LOCATION AND LAYOUT

The location of the pipeline is within the CSX ROW extending laterally about 50 feet on each side of the rail line and is shown in Figure 6.2.2-1. The corridor for the water pipeline that is being licensed for the ICL project is the CSX ROW between the ICL site and the ICL water intake at Taylor Creek/Nubbin Slough.

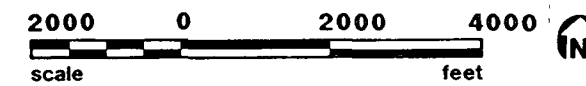
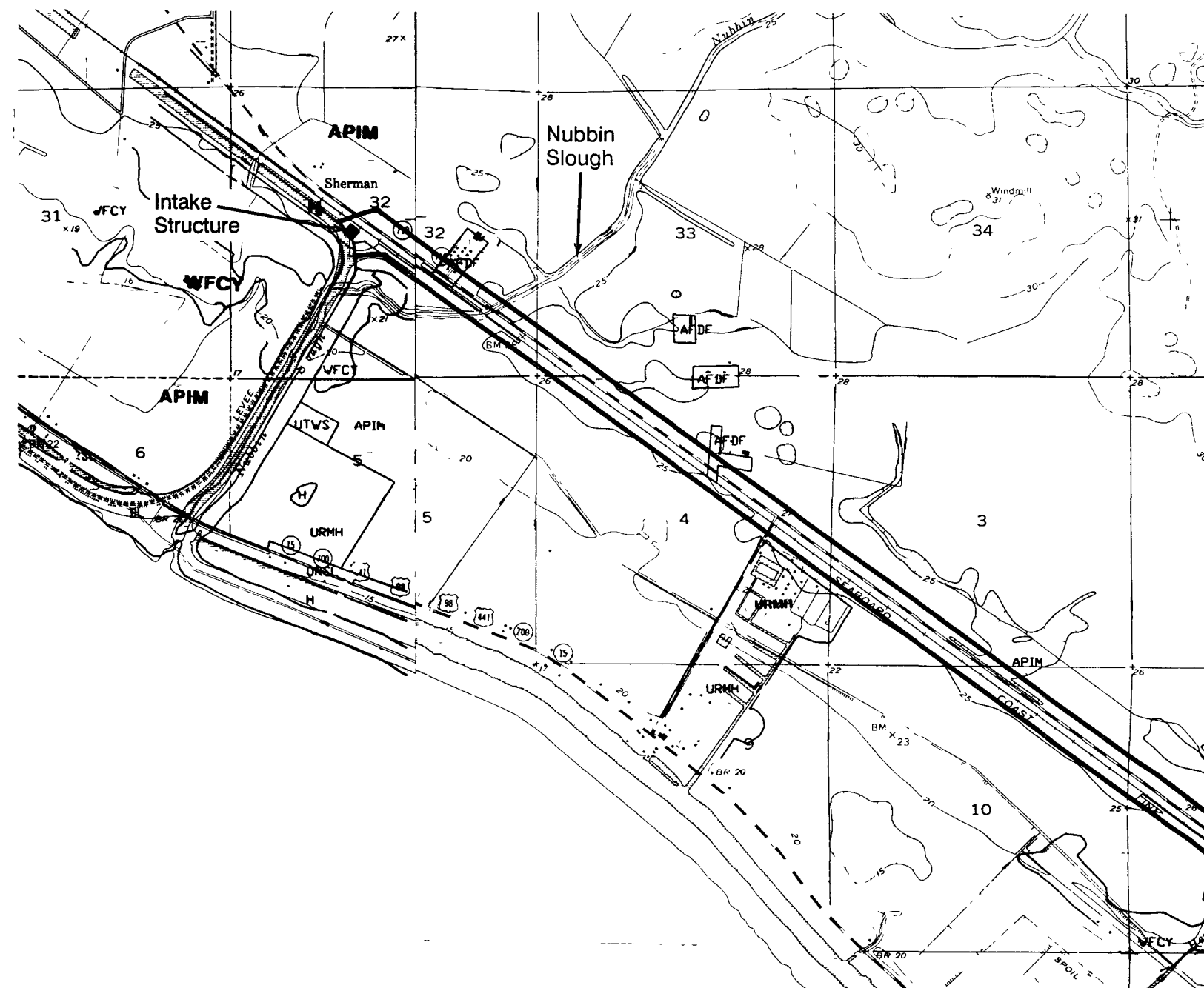
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IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
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QUALITY.**

Figure 6.2.2-1. (Page 1 of 5)

CSX RIGHT OF WAY



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LEGEND:

— Corridor Containing CSX ROW

CSX ROW varies from 200 feet to 100 feet about rail line within corridor.

Sources USGS, 1983 SFWMD, 1986 ECT, 1990

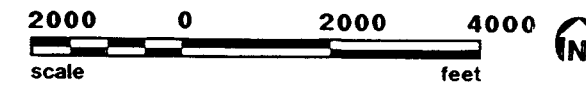
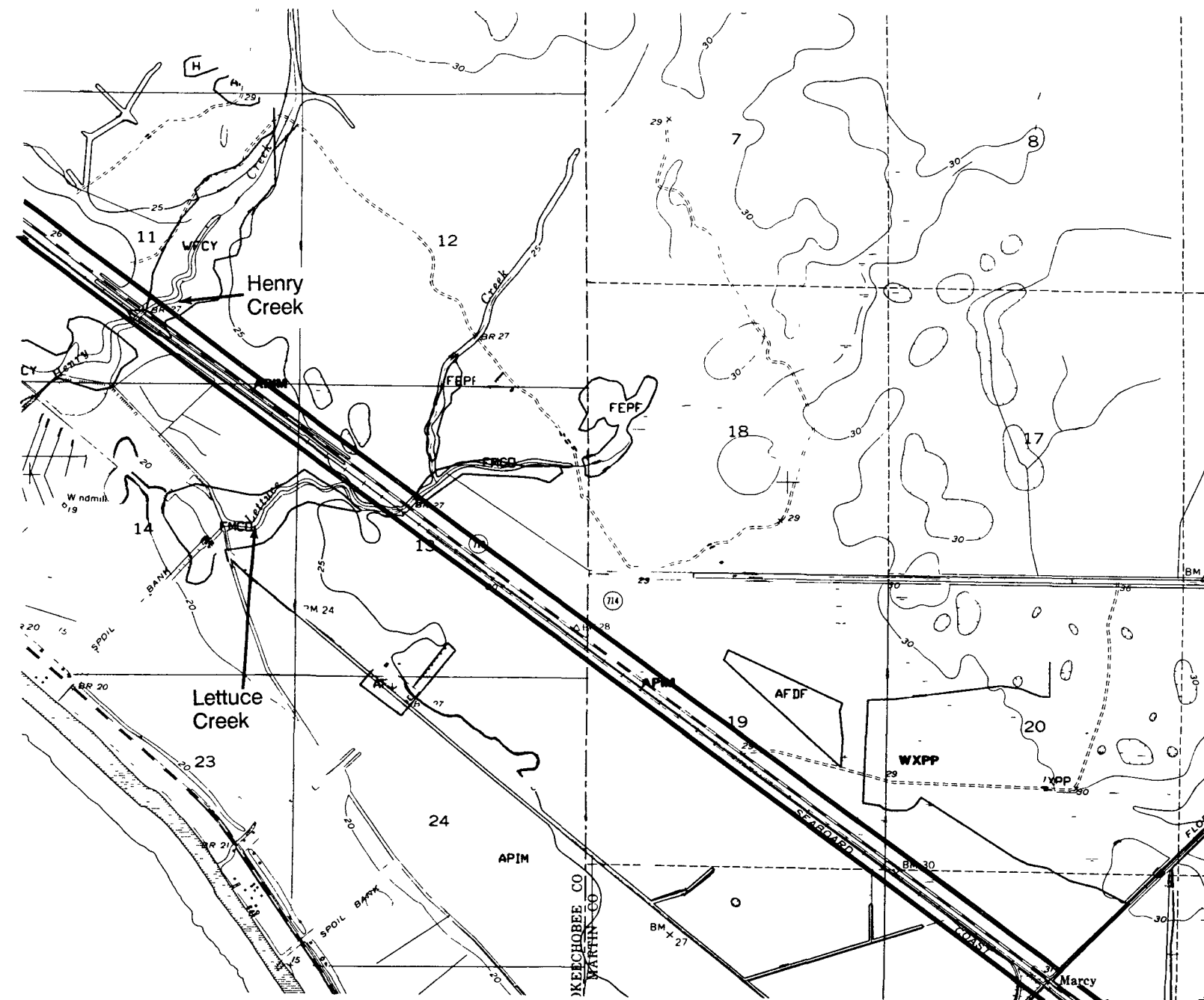
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Figure 6.2.2-1. (Page 2 of 5)

CSX RIGHT OF WAY



LEGEND:

— Corridor Containing CSX ROW

CSX ROW varies from 200 feet to 100 feet about rail line within corridor.

Sources USGS, 1983 SFWMD, 1986 ECT, 1990

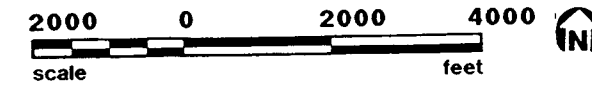
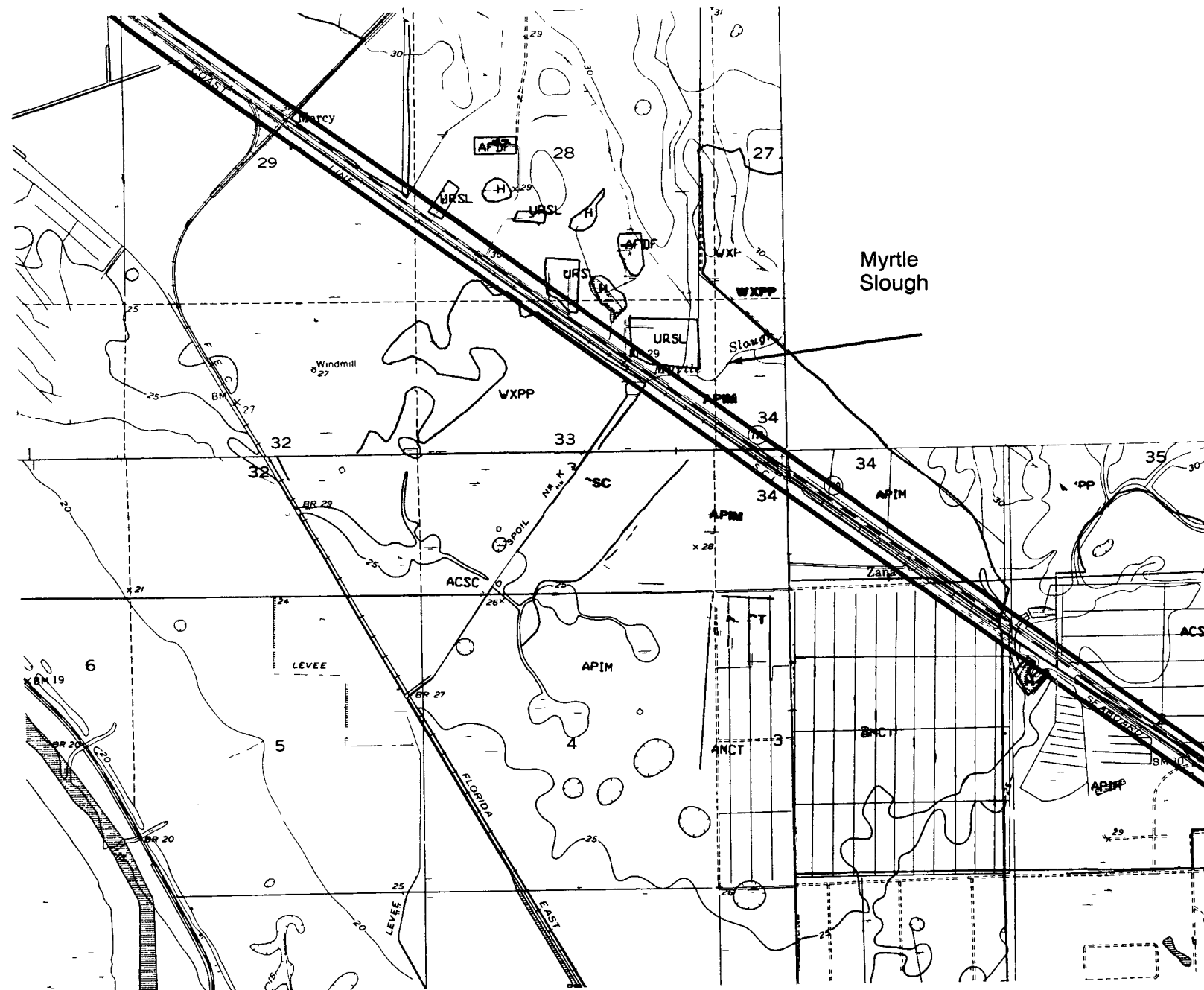
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Figure 6 2 2-1. (Page 3 of 5)

CSX RIGHT OF WAY



LEGEND

— Corridor Containing CSX ROW

CSX ROW varies from 200 feet to 100 feet about rail line within corridor

Sources USGS, 1983 SFWMD, 1986 ECT, 1990

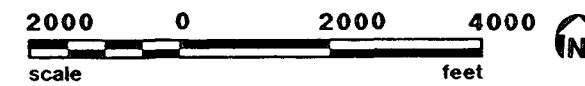
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Figure 6 2 2-1 (Page 4 of 5)

CSX RIGHT OF WAY



LEGEND

— Corridor Containing CSX ROW

CSX ROW varies from 200 feet to 100 feet about rail line within corridor

Sources USGS, 1983 SFWMD, 1986 ECT, 1990

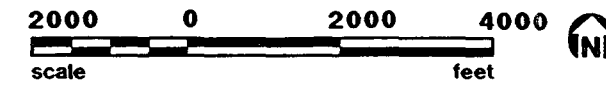
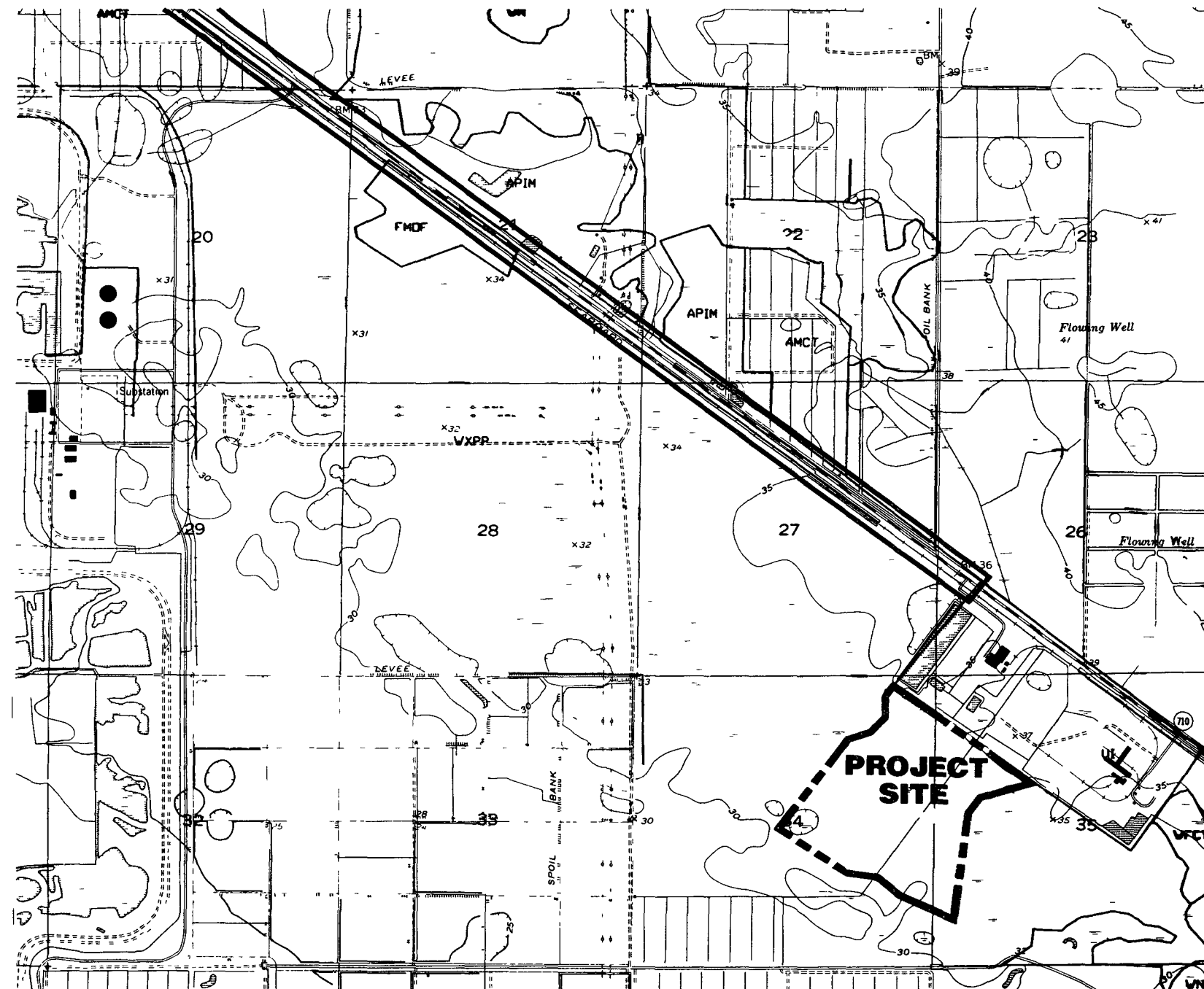
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Figure 6 2.2-1. (Page 5 of 5)

CSX RIGHT OF WAY



LEGEND

— Corridor Containing CSX ROW

CSX ROW varies from 200 feet to 100 feet about rail line within corridor

Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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6.2.3 WATER PIPELINE DESIGN CHARACTERISTICS

The pipe will be approximately 18- to 24-inch diameter carbon steel or polyethylene pipe manufactured according to American Water Works Association (AWWA) standards. The pipe sections will be hydrostatically tested to at least 125 percent of the design pressure to confirm the pipe integrity and check for leakage.

If the pipe is carbon steel, it will have a protective external coating. Such coating will be checked electrically for breaks in the coating prior to shipping and prior to installation in the ground. The pipe will be installed in accordance with the requirements of AWWA and the regulatory agencies with jurisdiction over crossings. A cathodic protection system will be installed if soils testing shows it is necessary to prevent corrosion.

Since the pipeline will be constructed within the CSX ROW, no new access roads or bridges will be required.

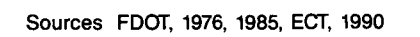
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6.2.5 CORRIDOR SELECTION

Since the CSX Railroad right-of-way runs adjacent to the Taylor Creek/Nubbin Slough and the Indiantown Cogeneration, L P site, it was the only corridor considered for the project. The use of an existing railroad ROW results in minimal impacts to the environment and to the general population. Since the ROW is for an operational rail line, no additional disturbance to the environment will occur for maintenance of the ROW or of the pipeline.

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GOVERNMENTAL JURISDICTIONS WITHIN ONE-HALF MILE ABOUT THE ICL WATER PIPELINE



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6.2.6 SOCIOPOLITICAL ENVIRONMENT OF THE CORRIDOR

6.2.6.1 Governmental Jurisdiction

The cooling water pipeline associated with the Indiantown Cogeneration, L P (ICL) project commences at the project site located in Section 34, Range 38E, Township 39S, and traverses northwesterly along SR 710 and the CSX Railroad line into Okeechobee County with its terminus located at Taylor Creek/Nubbin Slough. The location of this pipeline, with a 0.5-mile corridor extended laterally on each side of SR 710, is shown in Figure 6.2.6-1.

Lands within this corridor fall under the jurisdiction of several governmental agencies which include the following: Martin County, Okeechobee County, TCRPC, Central Florida Regional Planning Council (CFRPC), and SFWMD.

The pipeline corridor follows existing roadway and rail ROWs and does not cross any local, regional, state, or federally designated or protected lands as described in the FDER Instruction Guide for Certification Applications.

6.2.6.2 Zoning and Land Use Plans

The ICL cooling water pipeline corridor crosses lands under the jurisdiction of Martin and Okeechobee Counties. Each county has its own comprehensive plan and zoning regulations.

As previously described in Section 2.2.2, the Martin County Growth Management Department has prepared the Martin County CGMP in accordance with requirements of the Local Comprehensive Planning and Land Development Regulation Act, Chapter 163, Part II, FS, and FAC, Chapter 9J-5. The Martin County CGMP was adopted by the Martin County Board of County Commissioners on February 20, 1990 (Martin County CGMP, 1990).

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Land use designations crossed by the pipeline corridor within Martin County are shown in Figure 6 2 6-2, and primarily are agricultural in nature. The specific Martin County land use plan categories within the pipeline corridor are as follows:

- Agricultural (AG)
- Agricultural ranchette (AR)
- General commercial (CG)
- Industrial (IND)
- Public utilities (PU)

Summary descriptions of these categories are included in Section 10 3. The only policy identified in the Martin County CGMP which appears to be applicable to the cooling water pipeline corridor is Policy A 3 h included in Chapter 11, Potable Water Service. This policy states:

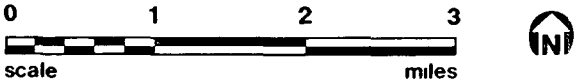
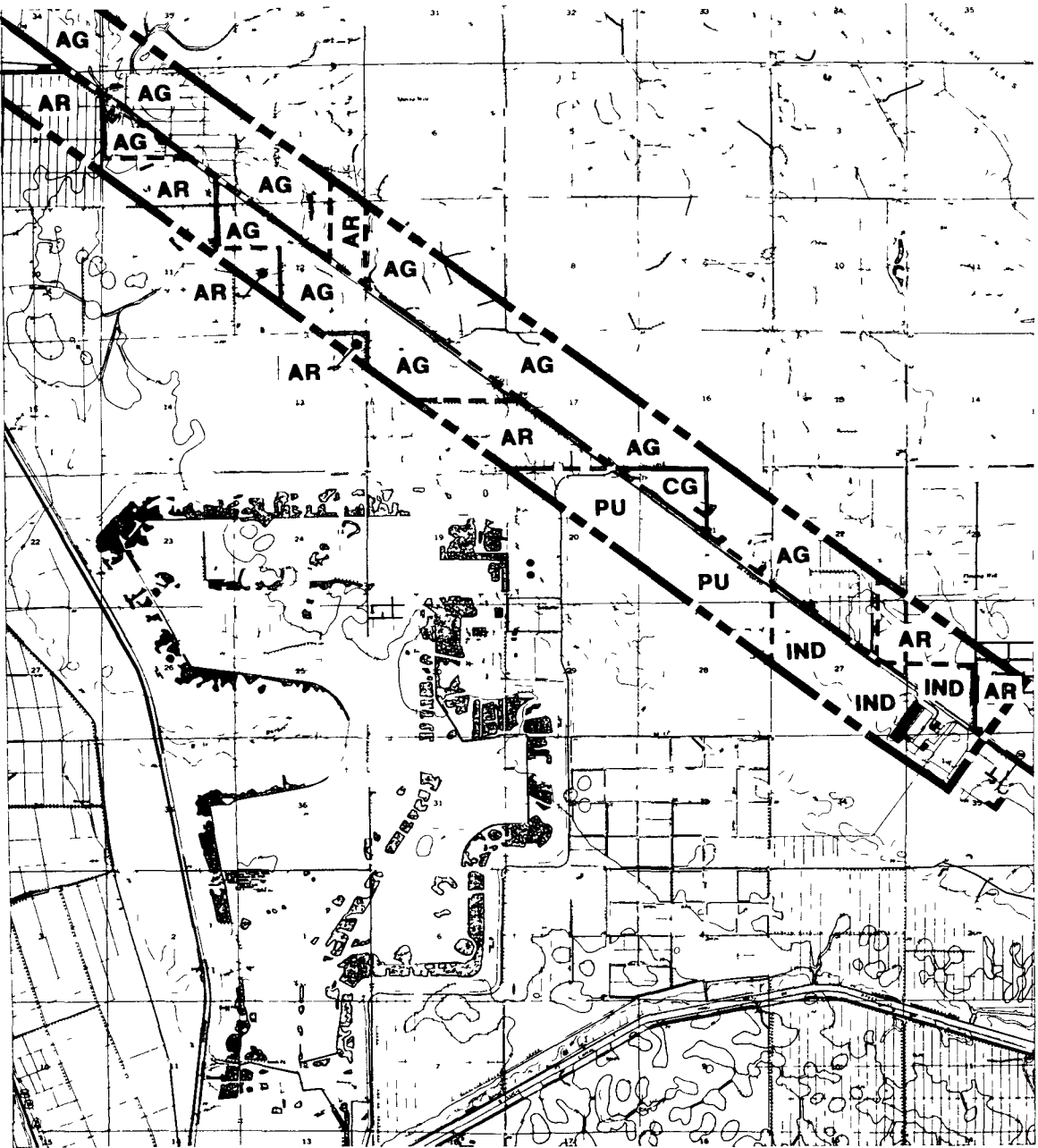
"All public and private water system improvements shall be located, designed, and installed in a manner which is cost-effective, functional, responsive to fire protection needs of existing and planned future development, and compatible with surrounding natural systems. The extension of water mains shall be aligned and installed in a manner which prevents undue loss of established tree canopies or soil through induced erosion. Existing features of land altered by construction shall be returned as close as is reasonably possible to the original condition. The timing and staging shall be scheduled in a manner that minimizes disruptive impacts, including impacts on residential quality of life and traffic flow." (Martin County CGMP, p. 11-19)

The location of the cooling water pipeline within an existing railroad ROW and employment of the construction methods described in Section 6 2 8 ensure that the pipeline will comply with the above policy.

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Figure 6.2 6-2 (Page 1 of 4)

LAND USE PLAN
DESIGNATIONS WITHIN
ONE-HALF MILE OF
THE INDIANTOWN
COGENERATION PROJECT
WATER PIPELINE



LEGEND

- Pipeline Corridor Boundary
- Land Use Designation Boundary

FUTURE LAND USE:

Martin County

- PU: Public Utilities
- IND: Industrial
- CG: General Commercial
- AR: Agricultural Ranchette (1 DU/5 Ac.)
- AG: Agricultural

Okeechobee County

- RLD: Residential Low Density
- A/OS: Agricultural/Open Space

Sources USGS, 1983 Martin County Growth
Management Department, 1990 Central Florida
Regional Planning Council, 1990 ECT, 1990

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Figure 6 2.6-2 (Page 2 of 4)

LAND USE PLAN
DESIGNATIONS WITHIN
ONE-HALF MILE OF
THE INDIANTOWN
COGENERATION PROJECT
WATER PIPELINE



LEGEND

- — — — — Pipeline Corridor Boundary**
- — — — — Land Use Designation Boundary**

FUTURE LAND USE:

Martin County

- PU: Public Utilities**
- IND: Industrial**
- CG: General Commercial**
- AR: Agricultural Ranchette (1 DU/5 Ac.)**
- AG: Agricultural**

Okeechobee County

- RLD: Residential Low Density**
- A/OS: Agricultural/Open Space**

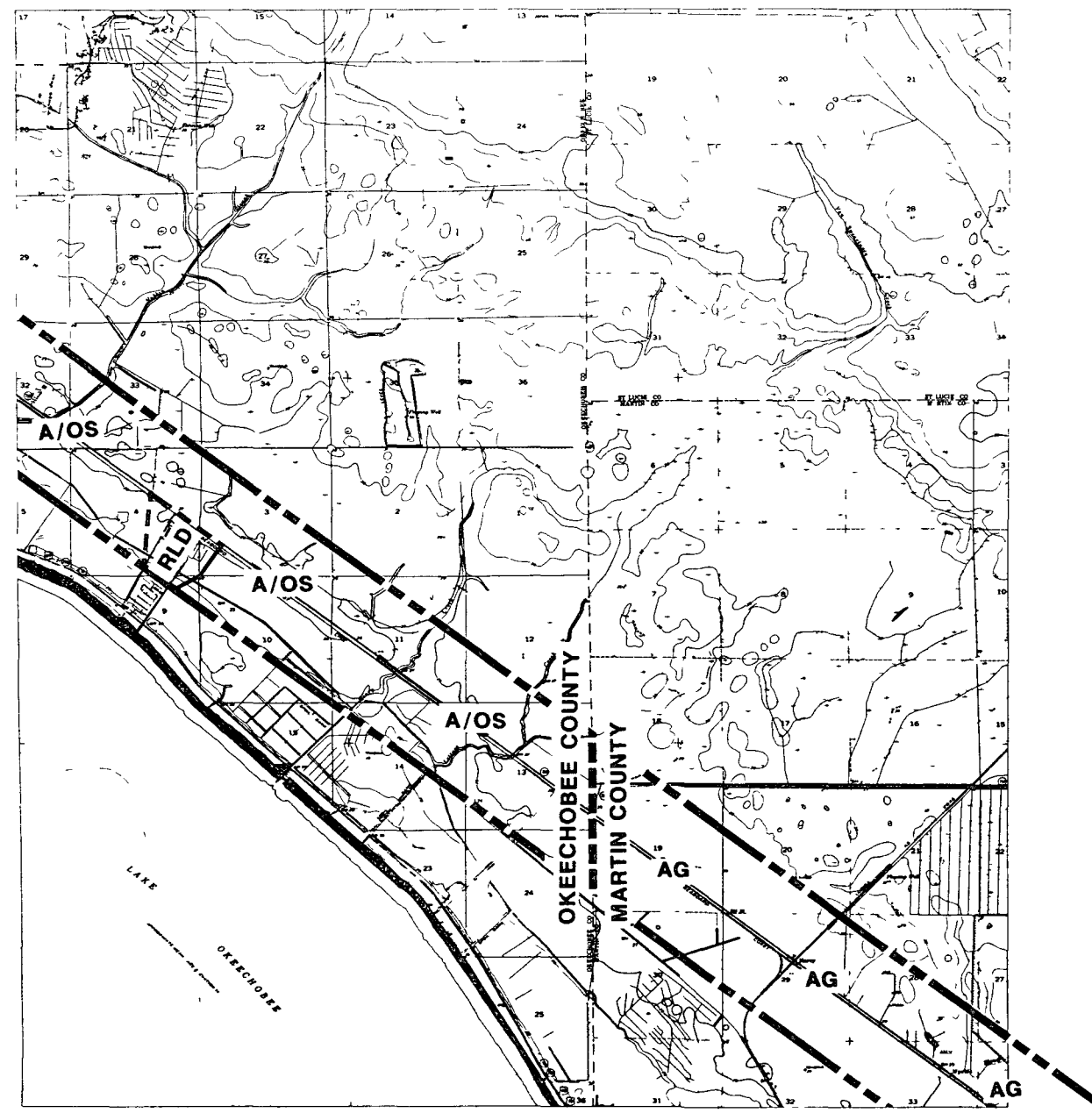
Sources USGS, 1983 Martin County Growth
Management Department, 1990 Central Florida
Regional Planning Council, 1990 ECT, 1990

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Figure 6 2 6-2. (Page 3 of 4)

LAND USE PLAN
DESIGNATIONS WITHIN
ONE-HALF MILE OF
THE INDIANTOWN
COGENERATION PROJECT
WATER PIPELINE



LEGEND

- Pipeline Corridor Boundary**
- Land Use Designation Boundary**

FUTURE LAND USE:

Martin County

- PU: Public Utilities**
- IND: Industrial**
- CG: General Commercial**
- AR: Agricultural Ranchette (1 DU/5 Ac.)**
- AG: Agricultural**

Okeechobee County

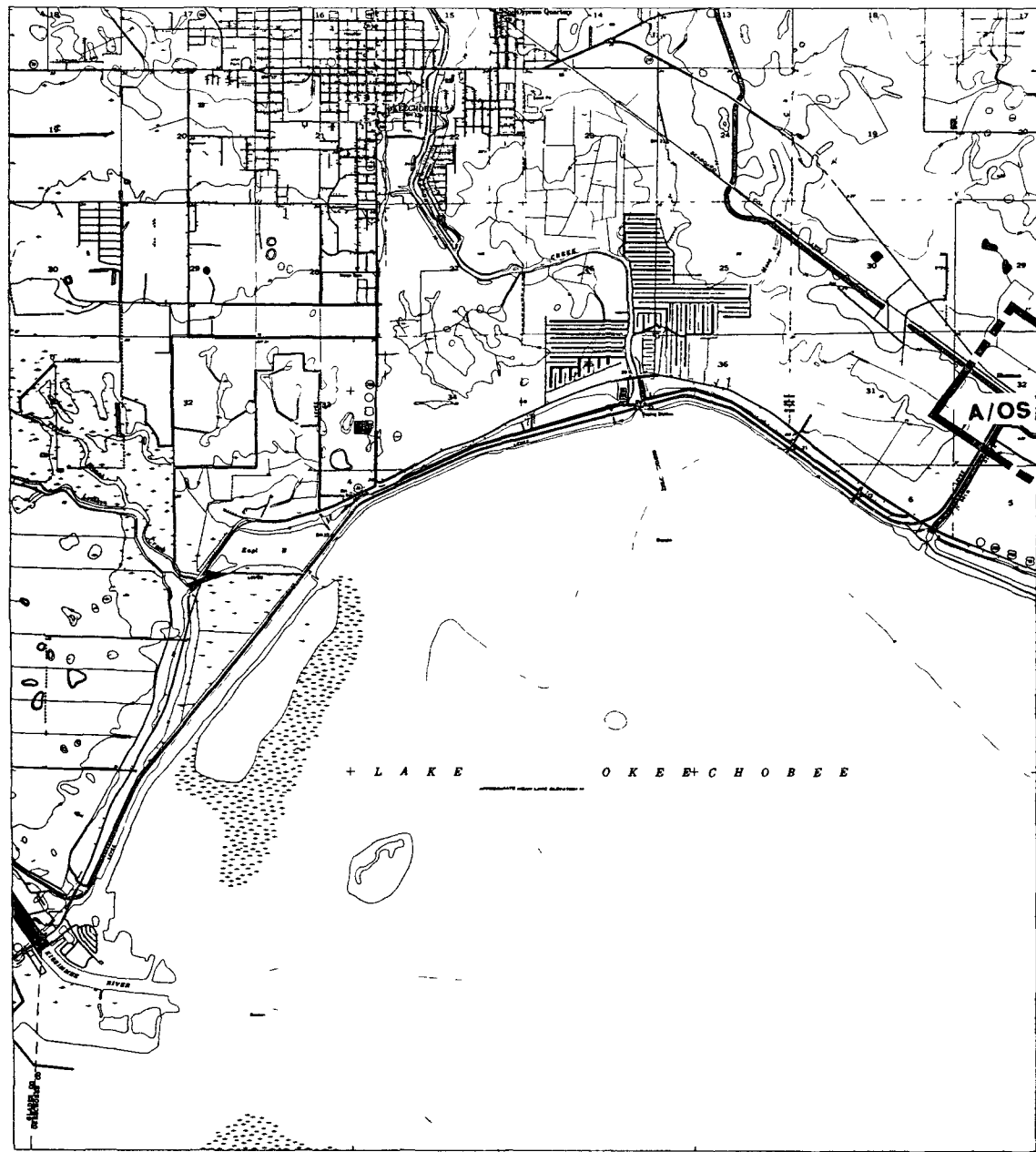
- RLD: Residential Low Density**
- A/OS: Agricultural/Open Space**

Sources USGS, 1983 Martin County Growth
Management Department, 1990 Central Florida
Regional Planning Council, 1990 ECT, 1990

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Figure 6 2.6-2. (Page 4 of 4)

LAND USE PLAN
DESIGNATIONS WITHIN
ONE-HALF MILE OF
THE INDIANTOWN
COGENERATION PROJECT
WATER PIPELINE



LEGEND

- Pipeline Corridor Boundary
- Land Use Designation Boundary

FUTURE LAND USE:

Martin County

- PU: Public Utilities
- IND: Industrial
- CG: General Commercial
- AR: Agricultural Ranchette (1 DU/5 Ac.)
- AG: Agricultural

Okeechobee County

- RLD: Residential Low Density
- A/OS: Agricultural/Open Space

Sources USGS, 1983 Martin County Growth
Management Department, 1990 Central Florida
Regional Planning Council, 1990 ECT, 1990

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Zoning districts crossed by the pipeline corridor in Martin County are shown in Figure 6 2 6-3 Utilities "with the exception of normal distribution and/or collection facilities (i.e., poles, lines, cable in trench, and associated equipment)" are regulated as advertised conditional uses in Martin County [Section 35-5 5(A)(9), Martin County Code] The water pipeline is considered a "normal distribution and/or collection facility," not subject to advertised conditional use review, and is, therefore, a permitted use within all zoning districts No other applicable zoning regulations have been identified

Okeechobee County has not yet adopted a comprehensive plan in accordance with the Local Government Comprehensive Planning and Land Development Regulation Act (Chapter 163, Part II, FS) and Chapter 9J-5, FAC The comprehensive plan currently in effect in Okeechobee County was adopted in 1980 According to the Future Land Use Plan, the pipeline corridor crosses the Agriculture/Open Space and Residential (low density) land use categories Although the plan does not define these categories, it does list general land use policies dealing with agricultural and residential land uses Excerpts from the plan are included in Section 10 3 There are no land use policies that appear to be applicable to a water pipeline However, the Utility Element of the adopted Okeechobee County comprehensive plan states

"Whatever support facilities are needed to provide electric utility service to existing land uses, to such future land uses as are authorized by other elements of this plan, and to such future land uses as may be lawfully authorized by the commission, shall be permitted in any use category and shall be deemed to be consistent with this comprehensive plan " (Okeechobee County Comprehensive Planning Program 1979 Update, p 143)

The intake water pipeline is a necessary support facility to the ICL project

As shown in Figure 6 2 6-3, the majority of the land crossed by the pipeline corridor in Okeechobee County is zoned AC, Agricultural Conservation. Other zoning districts crossed include the following:

- Residential general (RG)
- Residential rural (RR)
- Residential single-family (RSF)
- Residential mobile home (RMH)
- Commercial (C)

Section 7 9 of the Okeechobee County Zoning Ordinance states.

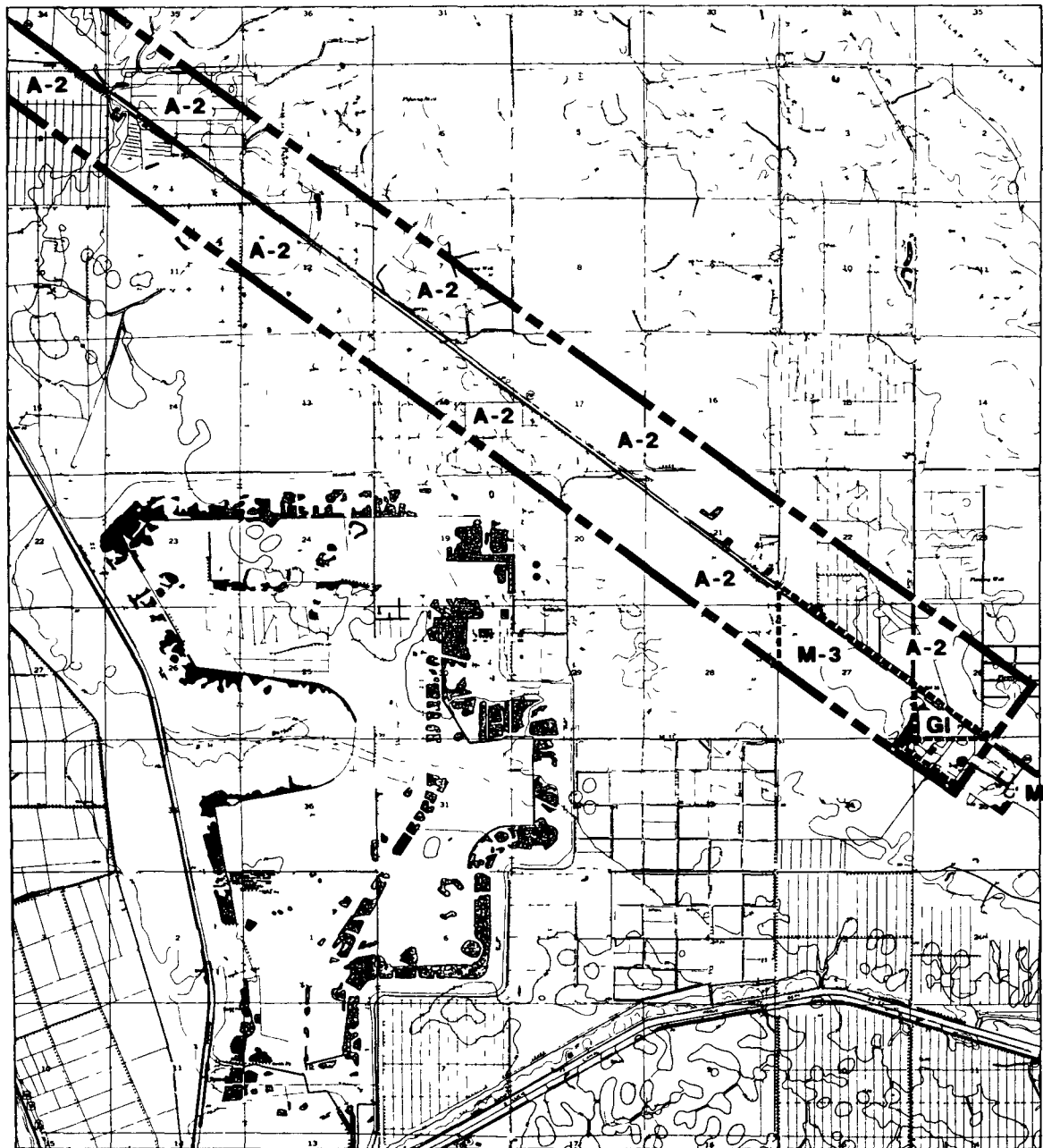
"9 Essential Services Essential services shall be permitted in any zoning district. Essential services are hereby defined to include and be limited to water, sewer, gas, telephone, and electrical systems, including sub-stations, lift stations, and similar installations necessary for the performance of these services, provided, however, that this subsection shall not be deemed to permit the location in a district of such establishments as electric or gas generating plants, sewage treatment plants, or water pumping or water aeration facilities from which they would otherwise be barred, and provided further that this subsection shall not be deemed to include the erection of structures for commercial activities such as sales or the collection of bills in districts from which such activities would be otherwise barred. Under this subsection, where structures are involved, such structures shall conform insofar as possible to the character of the district as to architecture and landscaping." (Zoning Ordinance, Okeechobee County, Florida, p. 18a)

The cooling water intake structure at Taylor Creek/Nubbin Slough, described in Section 3 5 1 1, is located in the AC zoning district. According to Section 6, Schedule of District Regulations, of the Okeechobee County Zoning Ordinance

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Figure 6 2.6-3 (Page 1 of 4)

ZONING DISTRICTS WITHIN
ONE-HALF MILE OF THE ICL
WATER PIPELINE



LEGEND

- Pipeline Corridor
- Zoning Designation Boundary

EXISTING ZONING:

Martin County

- GI General Industrial (Heavy)
- M-3 Heavy Industrial
- A-2: Agricultural (1 DU/5 Ac.)

(Note. All zoning designations except GI category are classified under the (old) Section 33 Ordinance.)

Okeechobee County

- C: Commercial
- RMH: Residential Mobile Home (5,000 S.F. min. lot size)
- RSF: Residential Single Family (8,000 S.F. min. lot size)
- RR: Residential Rural (8,000 S.F. min. lot size)
- RG: Residential General (1 DU/2 AC. - S.F.; 1 DU/5 AC. - MH)
- AC: Agricultural Conservation (1 DU/20 AC.)

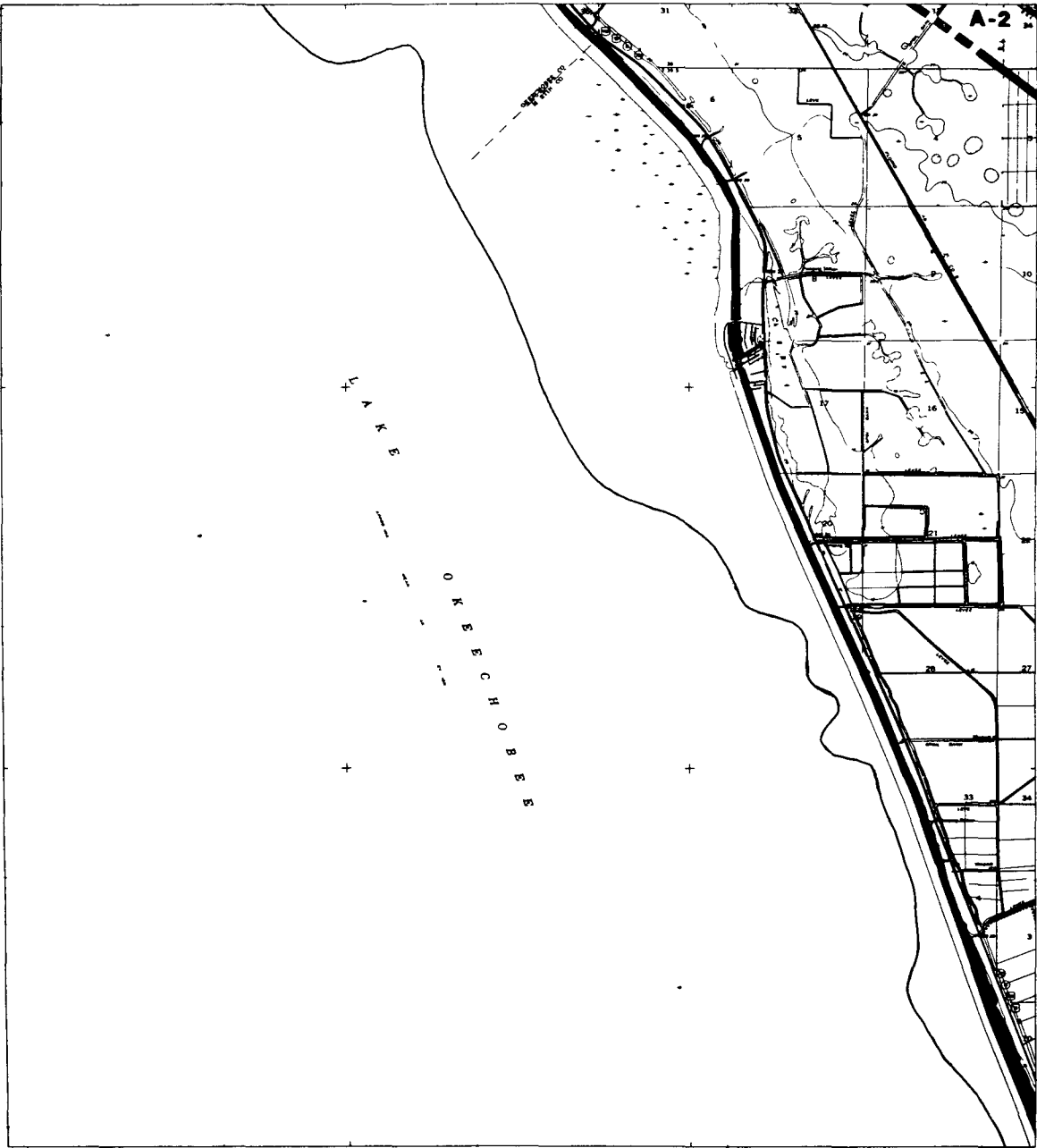
Sources USGS, 1983 Martin County Building and
Zoning Department, 1990 Okeechobee County
Building and Zoning Department, 1990 ECT, 1990

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Figure 6.2 6-3. (Page 2 of 4)

ZONING DISTRICTS WITHIN
ONE-HALF MILE OF THE ICL
WATER PIPELINE



LEGEND

- Pipeline Corridor
- - - - -** Zoning Designation Boundary

EXISTING ZONING:

Martin County

- GI:** General Industrial (Heavy)
- M-3:** Heavy Industrial
- A-2:** Agricultural (1 DU/5 Ac.)

(Note: All zoning designations except GI category are classified under the (old) Section 33 Ordinance.)

Okeechobee County

- C:** Commercial
- RMH:** Residential Mobile Home (5,000 S.F. min. lot size)
- RSF:** Residential Single Family (8,000 S.F. min. lot size)
- RR:** Residential Rural (8,000 S.F. min. lot size)
- RG:** Residential General (1 DU/2 AC. – S.F.; 1 DU/5 AC. – MH)
- AC:** Agricultural Conservation (1 DU/20 AC.)

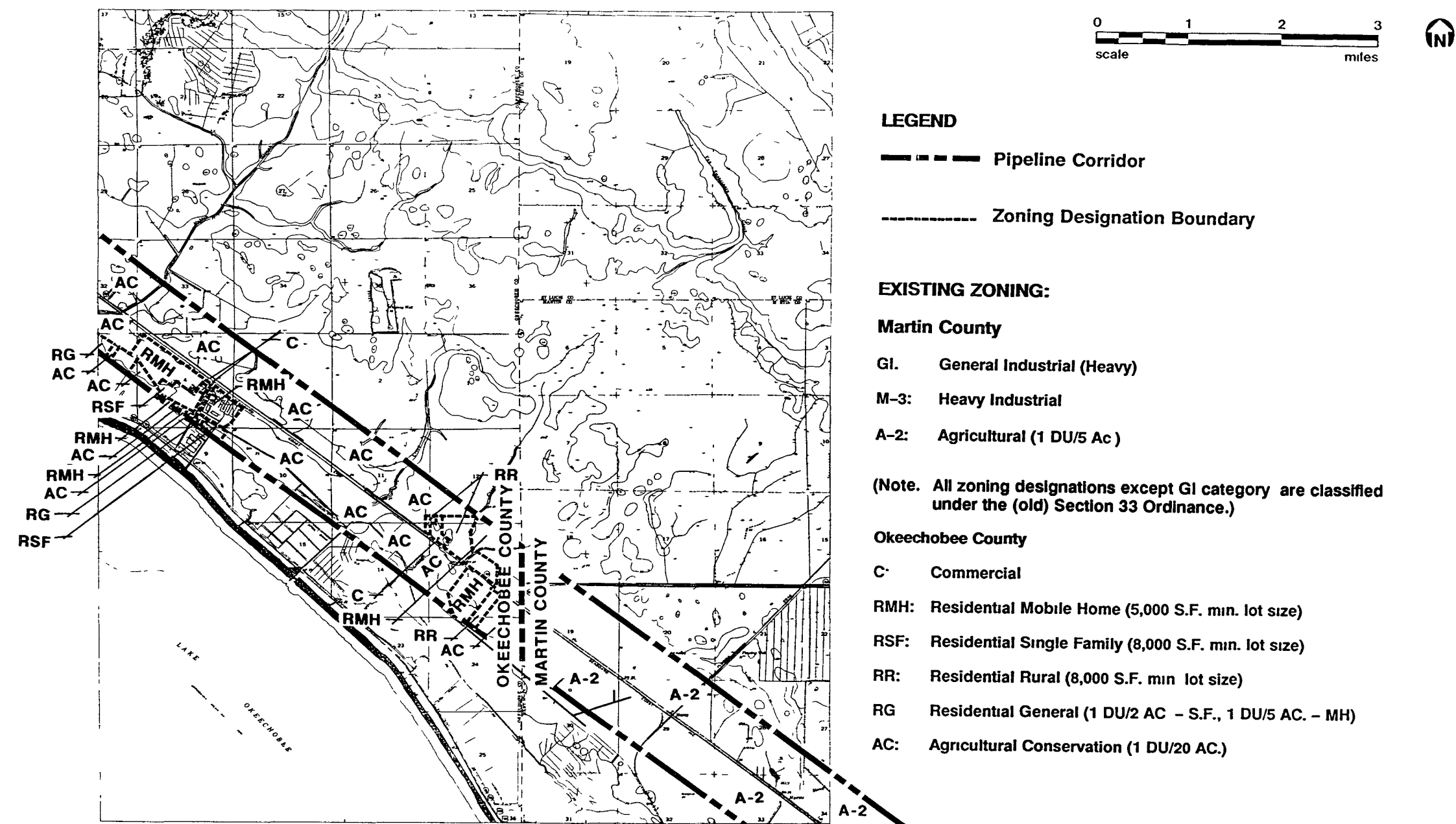
Sources USGS, 1983 Martin County Building and Zoning Department, 1990 Okeechobee County Building and Zoning Department, 1990 ECT, 1990

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Figure 6 2 6-3 (Page 3 of 4)

ZONING DISTRICTS WITHIN
ONE-HALF MILE OF THE ICL
WATER PIPELINE



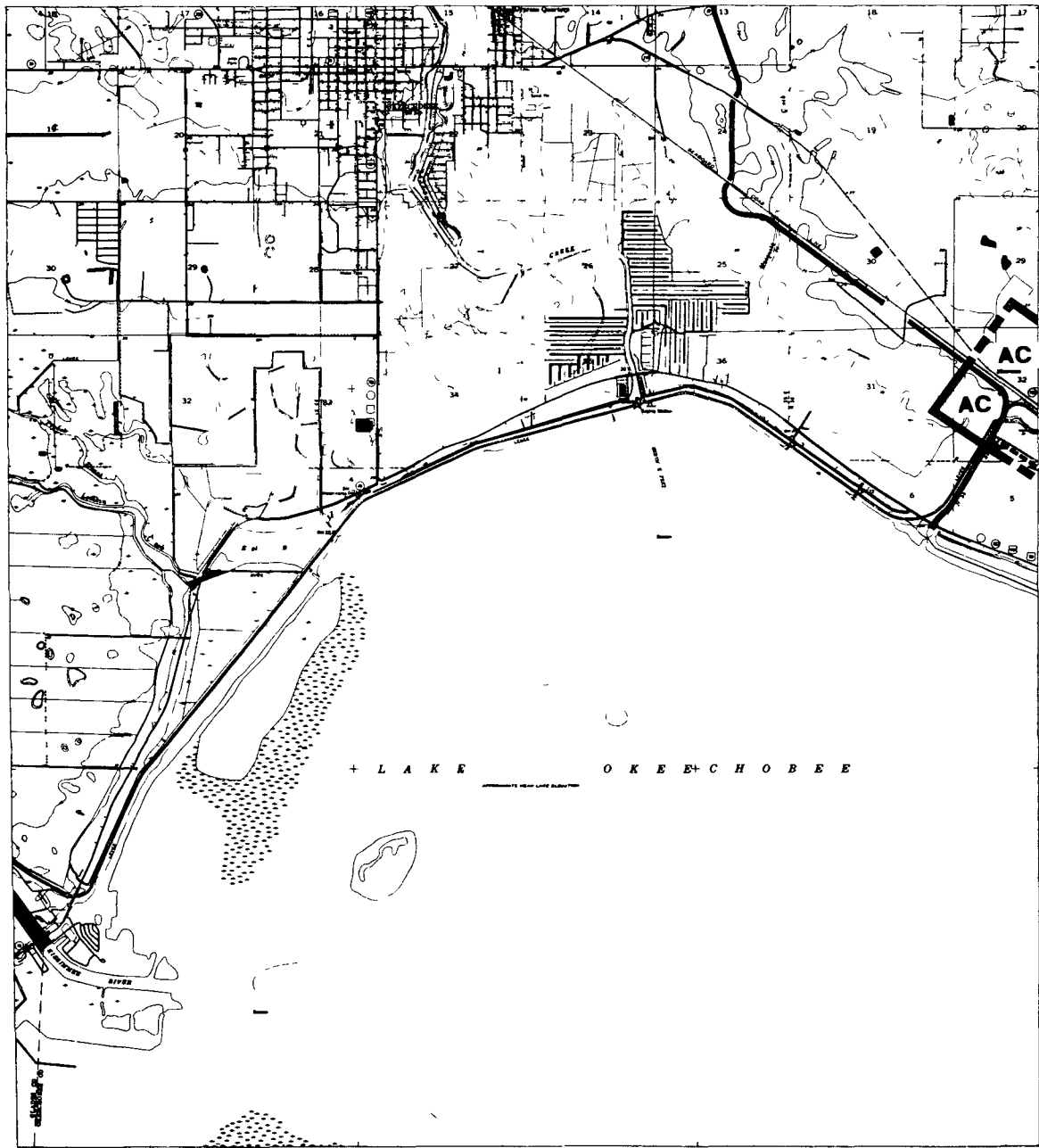
Sources USGS, 1983 Martin County Building and Zoning Department, 1990 Okeechobee County Building and Zoning Department, 1990 ECT, 1990

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Figure 6.2 6-3 (Page 4 of 4)

ZONING DISTRICTS WITHIN
ONE-HALF MILE OF THE ICL
WATER PIPELINE



LEGEND

- Pipeline Corridor
- Zoning Designation Boundary

EXISTING ZONING:

- Martin County**
 - AC General Industrial (Heavy)
 - M-3 Heavy Industrial
 - A-2: Agricultural (1 DU/5 Ac.)
- (Note: All zoning designations except GI category are classified under the (old) Section 33 Ordinance.)
- Okeechobee County**
 - C Commercial
 - RMH. Residential Mobile Home (5,000 S.F. min. lot size)
 - RSF: Residential Single Family (8,000 S.F. min. lot size)
 - RR: Residential Rural (8,000 S.F. min. lot size)
 - RG: Residential General (1 DU/2 AC. - S.F.; 1 DU/5 AC. - MH)
 - AC: Agricultural Conservation (1 DU/20 AC.)

Sources USGS, 1983 Martin County Building and Zoning Department, 1990 Okeechobee County Building and Zoning Department, 1990 ECT, 1990

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(1974), water pumping facilities are not barred from the AC district. Therefore, the cooling water pipeline and the intake structure are permitted uses under the Okeechobee County Zoning Ordinance.

6.2.6.3 Easements, Title, Agency Works

The pipeline ROW will be located within the existing CSX Railroad ROW located to the west of SR 710. The northern terminal of the pipeline ROW will cross a small portion of land belonging to SFWMD. Approval for crossing such state and county roads, easements, and agency works (e.g., county drainage districts) will be obtained as part of this SCA. Table 6.2.6-1 lists the facilities under title, easements, or agency works that will be crossed by the proposed pipeline.

6.2.6.4 Vicinity Scenic, Cultural, and Natural Landmarks

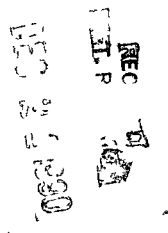
The pipeline corridor follows existing road and rail ROWs and does not cross any scenic, cultural, or natural landmarks.

6.2.6.5 Archaeological and Historic Sites

A comprehensive evaluation of archaeological and historic resources within the cooling water pipeline corridor was conducted by Piper Archaeological Research, Inc., and is located in Section 10.8.

This research revealed no previously recorded archaeological sites within the pipeline corridor, and a low probability of finding additional significant historical resources. During research and assessment, no archaeological or historic sites were found which would be eligible for inclusion on the National Register of Historic Places (Piper, 1990).

In an area south of the pipeline corridor in Section 2, Township 39 South, Range 27 East, a historic feature was found. Named the Zana Railroad Water Reservoir,



**Table 6.2.6-1
EASEMENTS, TITLE, OR CROSSING APPROVALS
NORMALLY REQUIRED FOR CONSTRUCTION OF THE
COOLING WATER PIPELINE**

Facility	Affected Agency	Type of Approval
CR 15A	Okeechobee County	Utility Permit
CR 15B	Okeechobee County	Utility Permit
FEC Railroad	FEC Railroad	Crossing Permit*
Myrtle Slough Lettuce Creek Henry Creek Nubbin Slough Unnamed streams	FDER, SFWMD, USACE*	General Permit (FDER) Industrial Wastewater Permit (FDER) Works of the District Permit (SFWMD) Section 404 Dredge- and Fill Permit (USACE)
Various unamed ditches and canals	Indiantown Drainage District Troup-Indiantown Drainage District Coquina Water Control District	Utility Permit

*Private permit not subject to local, county, or state jurisdiction

+ Permit may or may not be required depending on construction method of pipeline (i.e., attached to existing bridge structure versus buried under stream)

Sources FDOT, 1990
CSX, 1990
Okeechobee County, 1990
SFWMD, 1990
USACE, 1990

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the feature contains a small camping shack and an angular concrete structure. The research conducted by Piper Archaeological Research, Inc. speculated that this site may have been a water reservoir for steam locomotives. However, this feature was not found to be eligible for listing in the National Register of Historic Places (Piper, 1990).

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6.2.7 BIOPHYSICAL ENVIRONMENT OF THE CORRIDOR AREA

6.2.7.1 Land Use/Vegetation

The proposed pipeline will be located within the existing CSX Railroad right-of-way (ROW), with the exception of its northern terminus, which will cross a short section of maintained grassland belonging to SFWMD

Land use and vegetation along the 19-mile long cooling water pipeline corridor and within 1/2-mile of the ROW are presented in Figures 6 2 7-1a and 6 2 7-1 (pages 1 through 5) The mapped information is labeled using the Level III designations of the SFWMD Land Use and Land Cover Classification Code (see Chapter 10) The corridor was surveyed by plant ecologists/taxonomists in July and October 1990

The predominant agricultural land use type crossed by the corridor is improved pasture (APIM) Other conspicuous agricultural land use types occurring along the corridor are citrus groves (AMCT), sugar cane fields (ACSC), and dairy farms (AFDF) The corridor also crosses several areas classified as urban or built-up, which are primarily residential in nature The urban land uses located within the corridor consist of the following single-family residential (URSL), mobile home residential (URMH), industrial (UI), and water supply plants (UTWS) In addition, the corridor includes SR 710 and the CSX Railroad

Vegetation communities found in the corridor are included in the descriptions provided in Section 2 3 5 The dominant forest types are pine and wet prairie (WXPP), old fields/forested old fields (FMOF), and cypress swamp (WFCY) Other vegetation types occurring within the corridor include pine/cabbage palms (FMPC), cabbage palm/oaks (FMCO), pine flatwoods (FEPF), and levees (BL)

One land use type that occurs within 1/2-mile of the pipeline corridor and was not previously described for the ICL project site is levees Typically, levees have very

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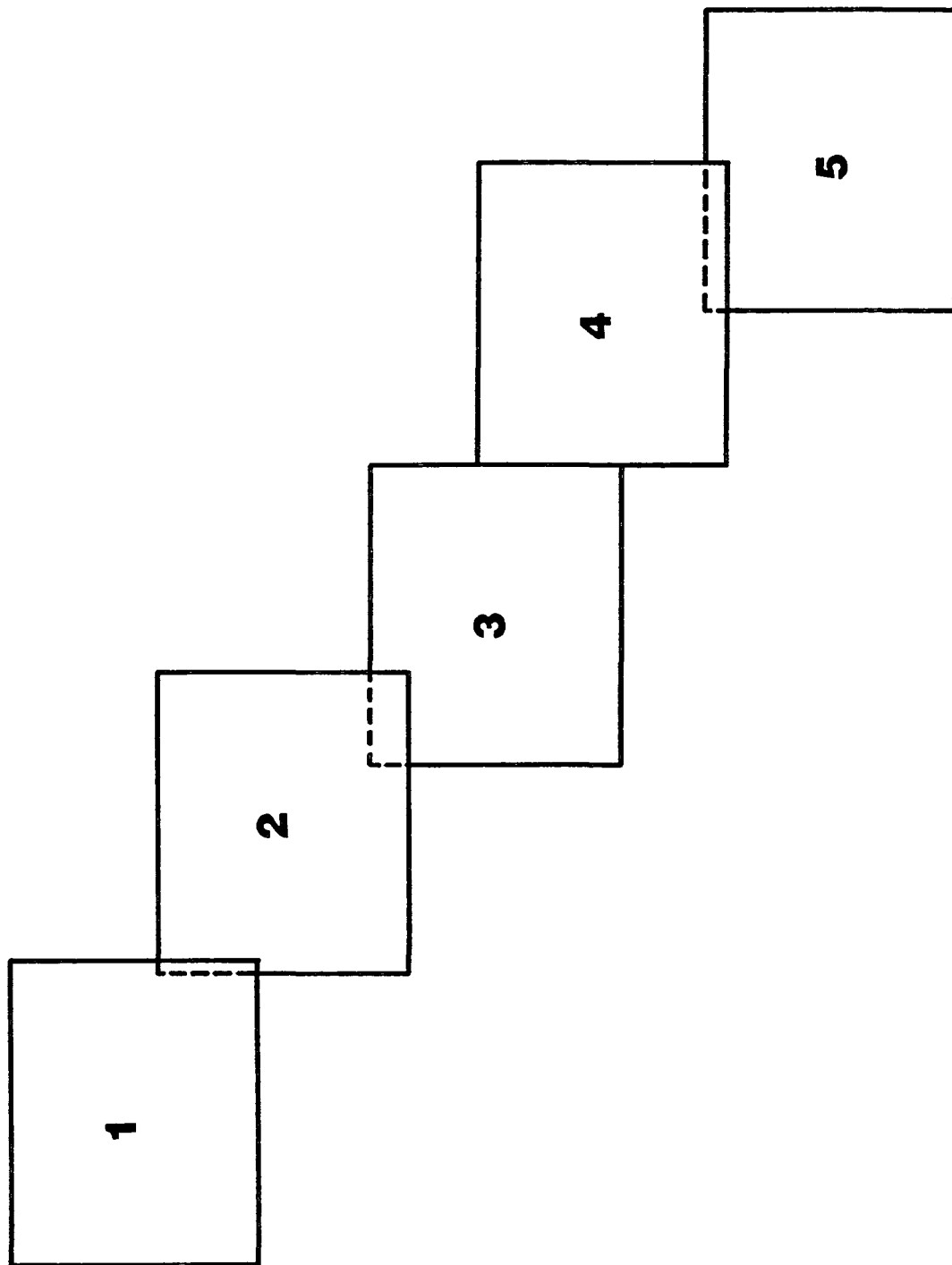


Figure 6.2.7-1a
LAND USE AND LAND COVER MAP KEY SHEET
FOR PIPELINE CORRIDOR AREA

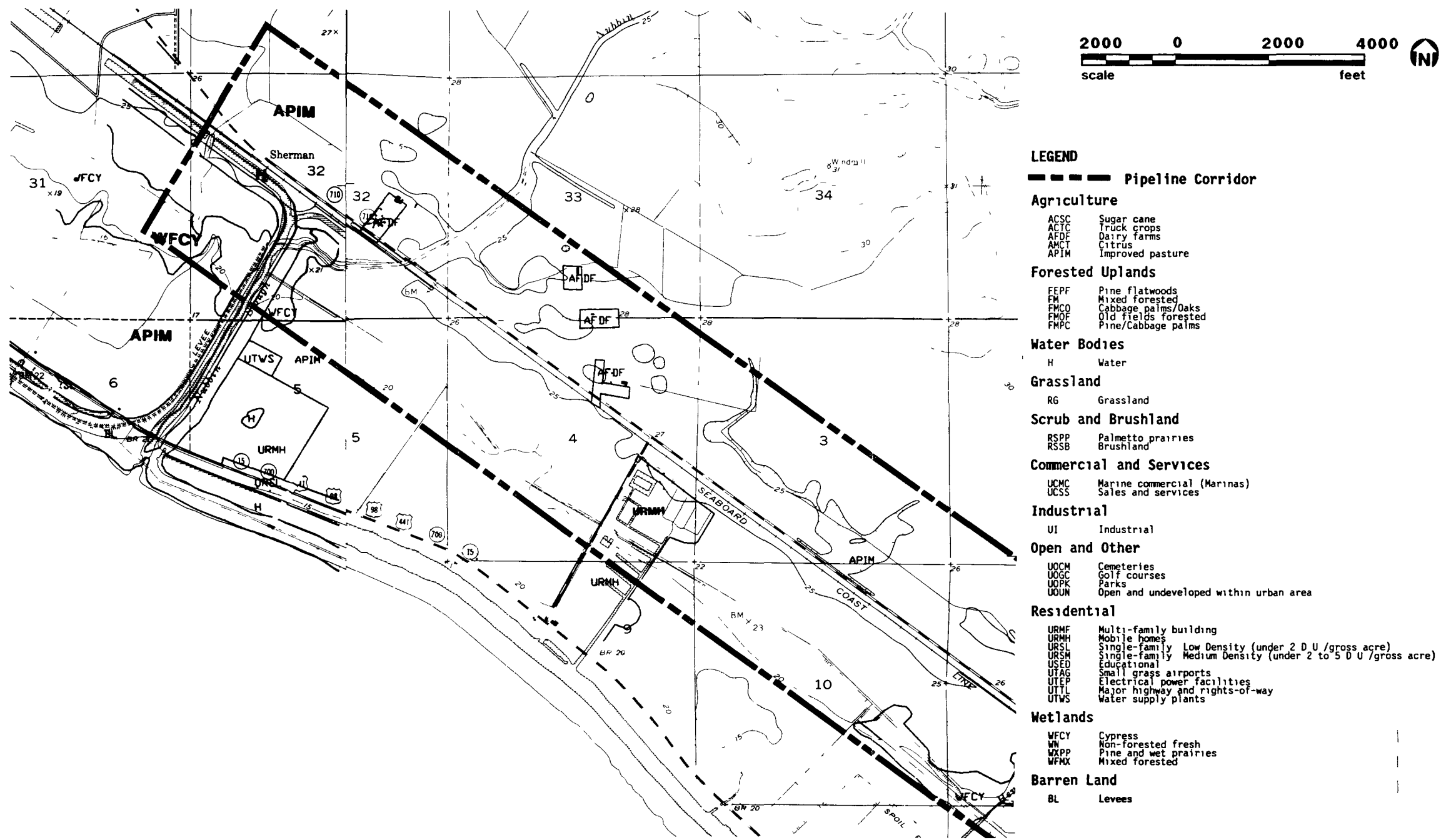
Source ECT, 1990

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Figure 6 2 7-1 (Page 1 of 5)
LAND USE AND LAND
COVER WITHIN ONE-HALF
MILE OF THE PIPELINE
CORRIDOR

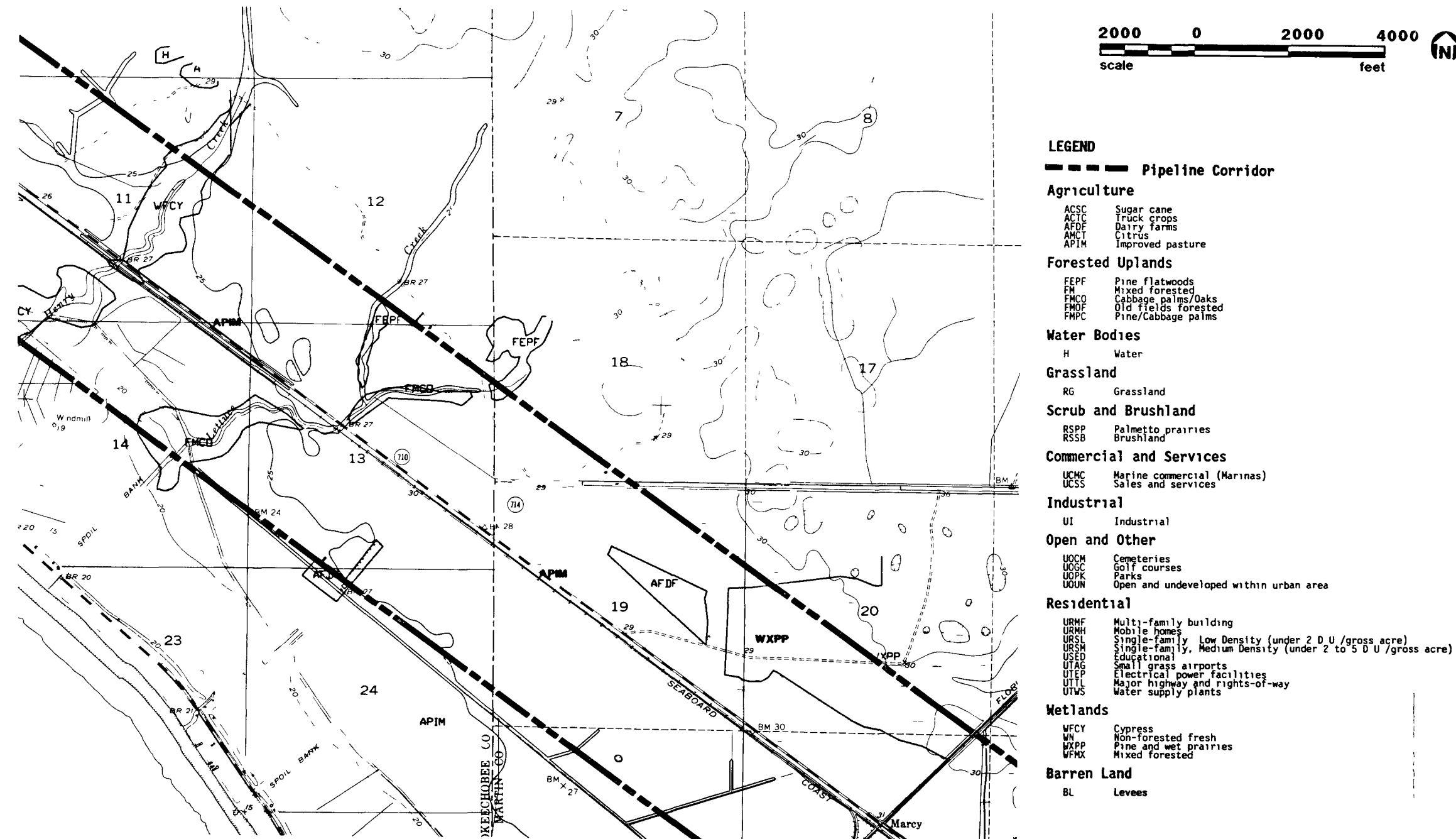


Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Figure 6.2 7-1 (Page 2 of 5)
LAND USE AND LAND
COVER WITHIN ONE-HALF
MILE OF THE PIPELINE
CORRIDOR



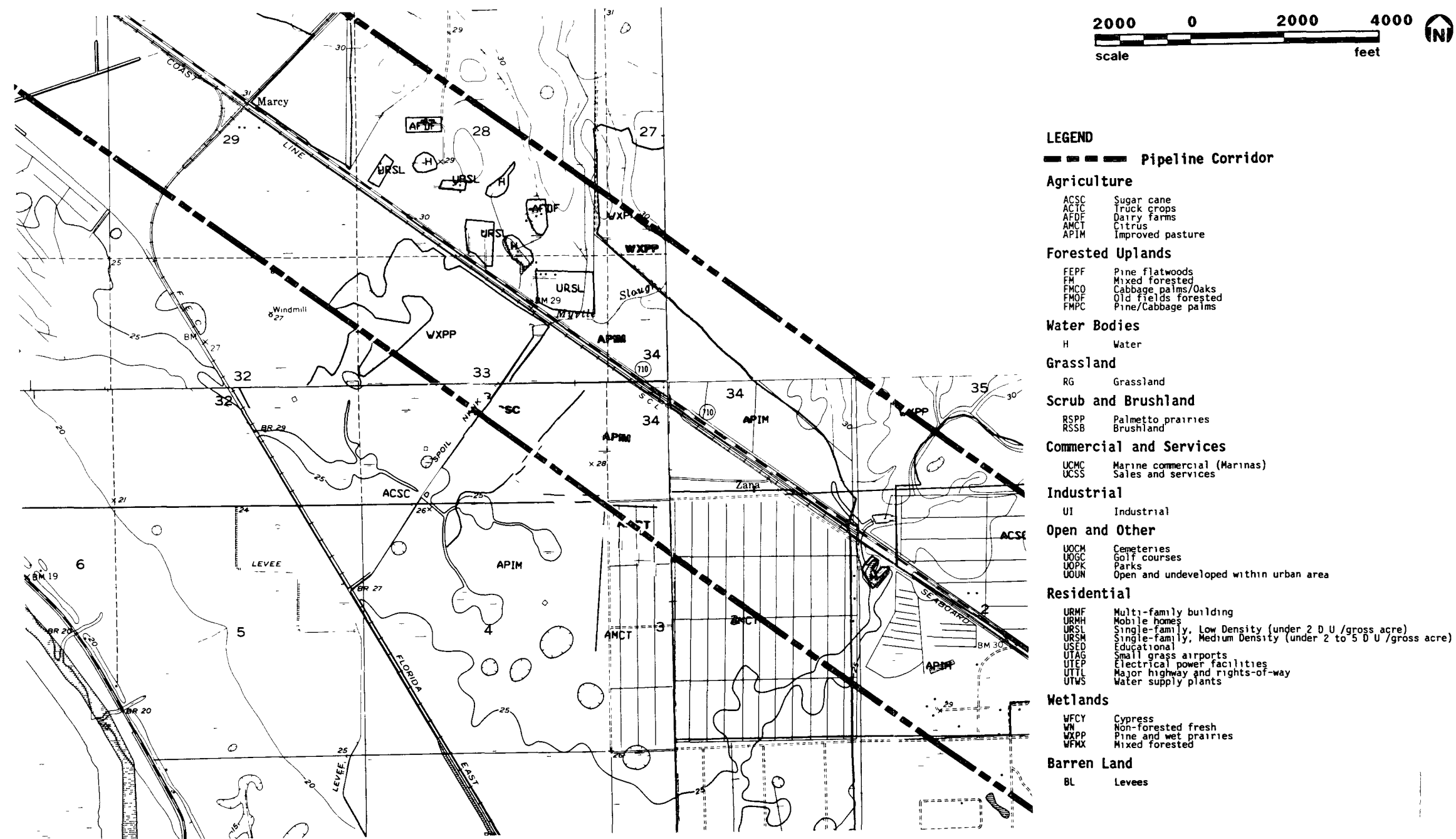
Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Figure 6.2.7-1 (Page 3 of 5)
LAND USE AND LAND
COVER WITHIN ONE-HALF
MILE OF THE PIPELINE
CORRIDOR



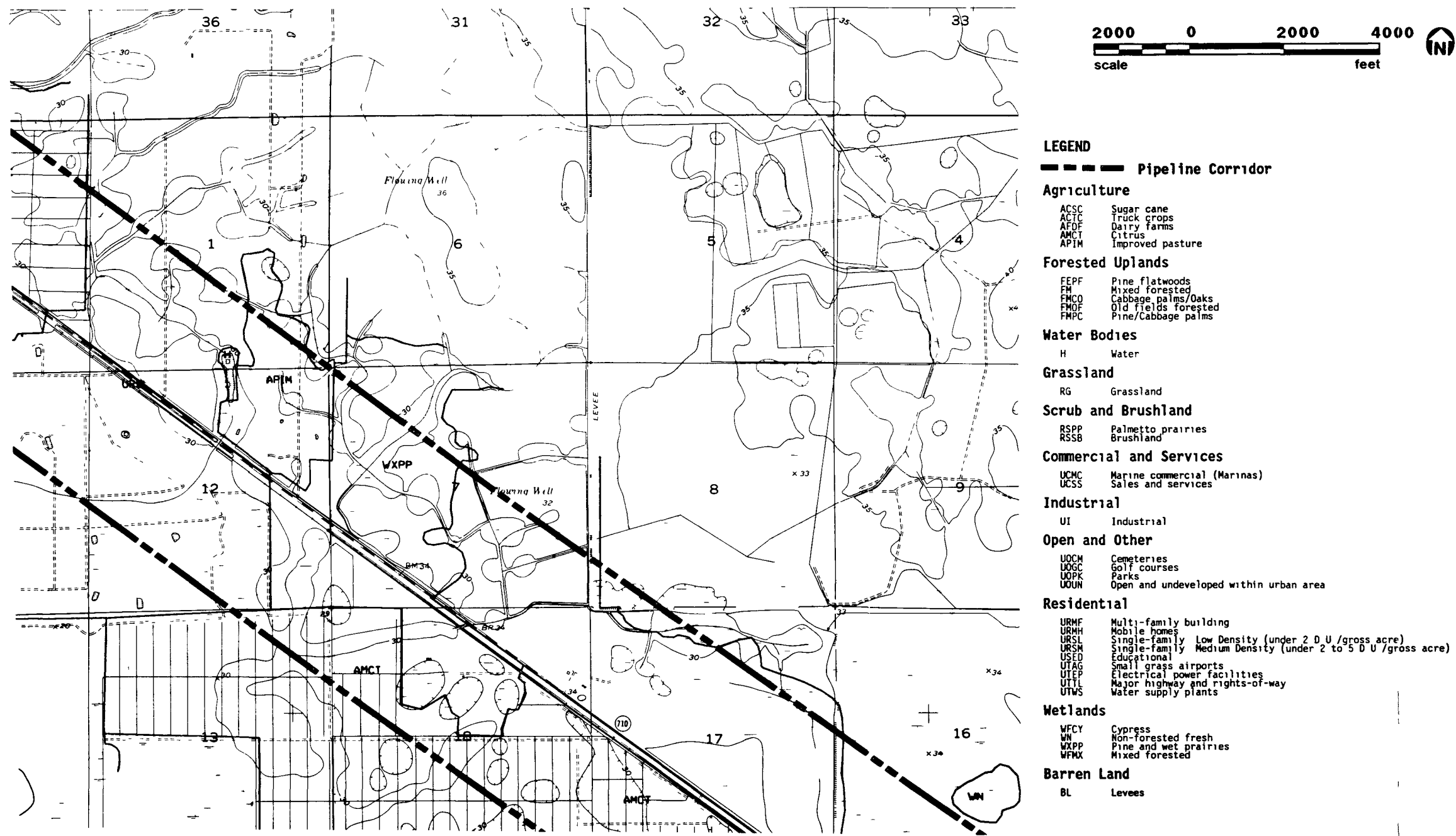
Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Figure 6.2.7-1 (Page 4 of 5)
LAND USE AND LAND
COVER WITHIN ONE-HALF
MILE OF THE PIPELINE
CORRIDOR

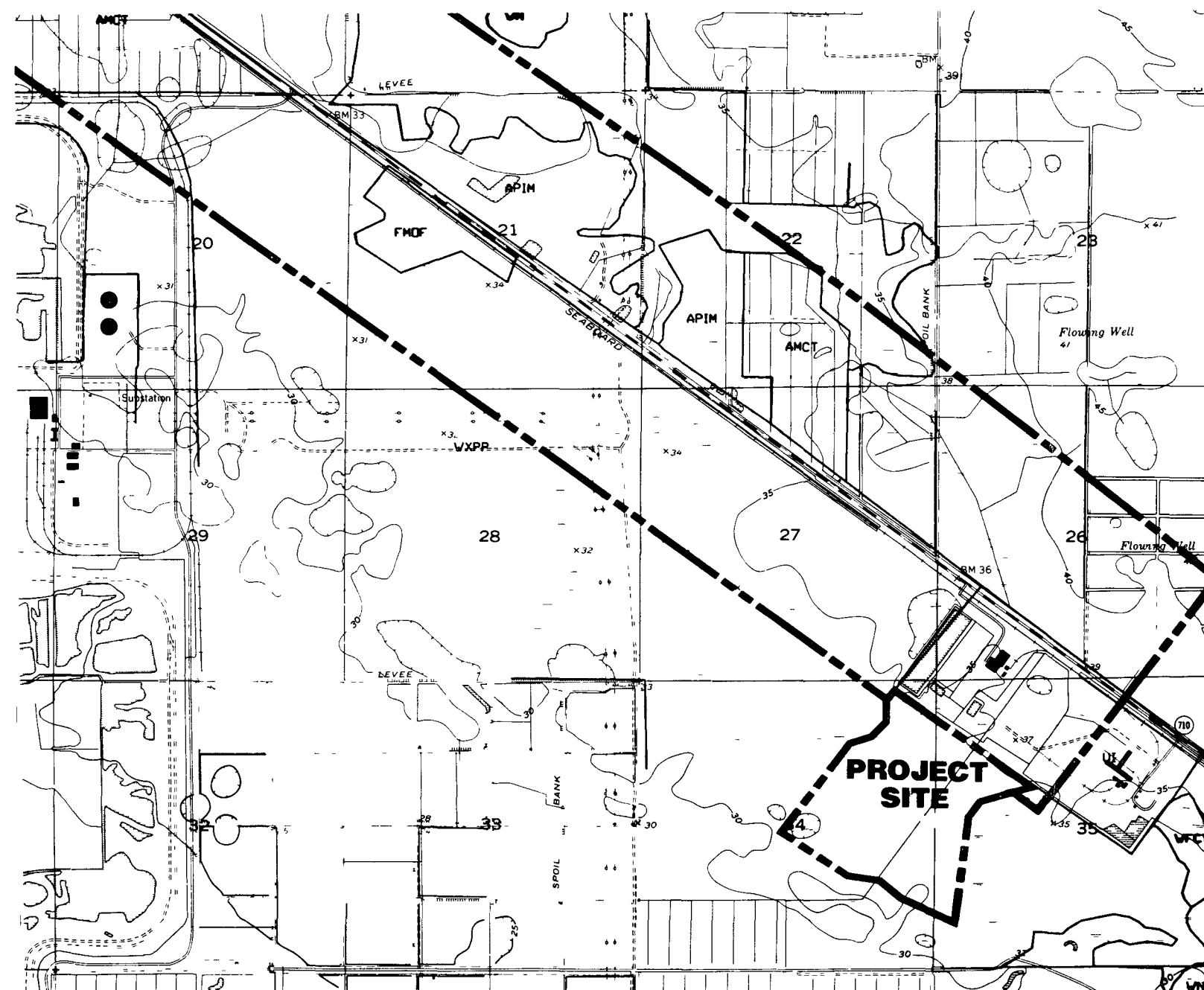


Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Figure 6.2 7-1 (Page 5 of 5)
LAND USE AND LAND
COVER WITHIN ONE-HALF
MILE OF THE PIPELINE
CORRIDOR



LEGEND

--- Pipeline Corridor

Agriculture

ACSC Sugar cane
ACTC Truck crops
AFDF Dairy farms
AMCT Citrus
APIM Improved pasture

Forested Uplands

FEPP Pine flatwoods
FM Mixed forested
FMCO Cabbage palms/Oaks
FMDF Old fields forested
FMPC Pine/Cabbage palms

Water Bodies

H Water

Grassland

RG Grassland

Scrub and Brushland

RSPP Palmetto prairies
RSSB Brushland

Commercial and Services

UCMC Marine commercial (Marinas)
UCSS Sales and services

Industrial

UI Industrial

Open and Other

UOCM Cemeteries
UOGC Golf courses
UOPK Parks
UOUN Open and undeveloped within urban area

Residential

URMF Multi-family building
URMH Mobile homes
URSL Single-family Low Density (under 2.0 U/gross acre)
URSH Single-family Medium Density (under 2 to 5.0 U/gross acre)
USED Educational
UTAG Small grass airports
UTAP Electrical power facilities
UTTL Major highway and rights-of-way
UTWS Water supply plants

Wetlands

WFCY Cypress
WN Non-forested fresh
WXPP Pine and wet prairies
WFMX Mixed forested

Barren Land

BL Levees

Sources USGS, 1983 SFWMD 1986 ECT, 1990

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The most important wetland types within 1/2-mile of the corridor are cypress swamps and wet prairie. Cypress swamps occur along drainageways and are dominated by bald cypress. Wet prairies are usually hydrologically isolated and occur in depressions within pine flatwoods (i.e., pine and wet prairie association) or in improved pasture.

6.2.7.2 Affected Waters and Wetlands

The area of the preferred corridor is characterized by previously disturbed soils and low, flat, sandy soils. Soils near the surface generally have high permeability and slow runoff rates. Runoff is channelled to an existing ditch paralleling the railroad ROW or to SR 710 drainage ditches. Drainage is toward TC/NS. The southern part of the corridor has similar types of drainage systems which drain runoff to the south, leading ultimately to the St. Lucie Canal.

The corridor crosses no major water bodies, only small canals and ditch systems which have generally been excavated for drainage of agricultural land located to the east of SR 710. Several such drainage ditches are shown within the corridor on USGS 7.5-minute quadrangle maps in Martin County, including Myrtle Slough. Lettuce Creek, Henry Creek, and Nubbin Slough are the major drainages crossed by the corridor in Okeechobee County.

6.2.7.3 Ecology

Terrestrial Biology

This section discusses the status and potential for occurrence of species identified as endangered, threatened, or species of special concern by USFWS, FGFWFC, TCRPC, FCREPA, and/or Martin County in and along the 19-mile cooling water pipeline ROW located within the existing CSX ROW. Thorough descriptions for these species, which potentially occur in Martin County and surrounding counties and which can occur at the project site, were previously presented in Section 2.3.6. Plant and animal species status listed in that section (Tables 2.3.6-1 and 2.3.6-2) apply, to a degree, to the cooling water pipeline corridor. The natural vegetation community types occurring in the corridor are similar to those occurring at the project site (i.e., pine flatwoods), but most of the corridor consists of ruderal roadside habitat in various stages of succession and maintenance.

The probability of occurrence of threatened and endangered species in the preferred corridor is based on seasonal ground surveys, habitat analyses, and discussions with agency personnel. Due to the high degree of habitat alteration and the disturbance caused by the use of the CSX rail line and adjoining SR 710, there are no records of nesting or breeding occurrences for any threatened or endangered animals in the corridor or its vicinity. Listed species such as herons, egrets, ibis, osprey, and alligator, for example, have been observed along TC/NS on the northernmost end of the ROW. The remaining ROW, offers no suitable

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habitat for species such as sandhill crane, woodstork, red-cockaded woodpecker, gopher frog, round-tailed muskrat, Sherman's fox squirrel, or Florida mouse.

The vegetation in the corridor is dominated by maintained right-of-way and other ruderal associations. With the exception of narrow wetland zones along watercourses, the corridor contains no mature, unimpacted vegetation communities.

No endangered plant species are known to occur within the corridor. Climbing dayflower may occur along the banks of TC/NS and other canals, creeks, and sloughs connected to Lake Okeechobee that cross the pipeline corridor. This plant is listed as threatened by both FCREPA and FDACS and is under review for federal listing.

6.2.7.4 Other Environmental Features

No additional information is required.

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6.2.8 EFFECTS OF RIGHT-OF-WAY PREPARATION AND PIPELINE CONSTRUCTION

6.2.8.1 Construction Techniques

Survey

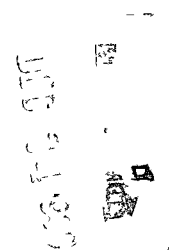
Following CSX approval of the right-of-way (ROW) application, the entire route will be surveyed. The centerline of the pipeline ROW will be marked at about 200-foot intervals.

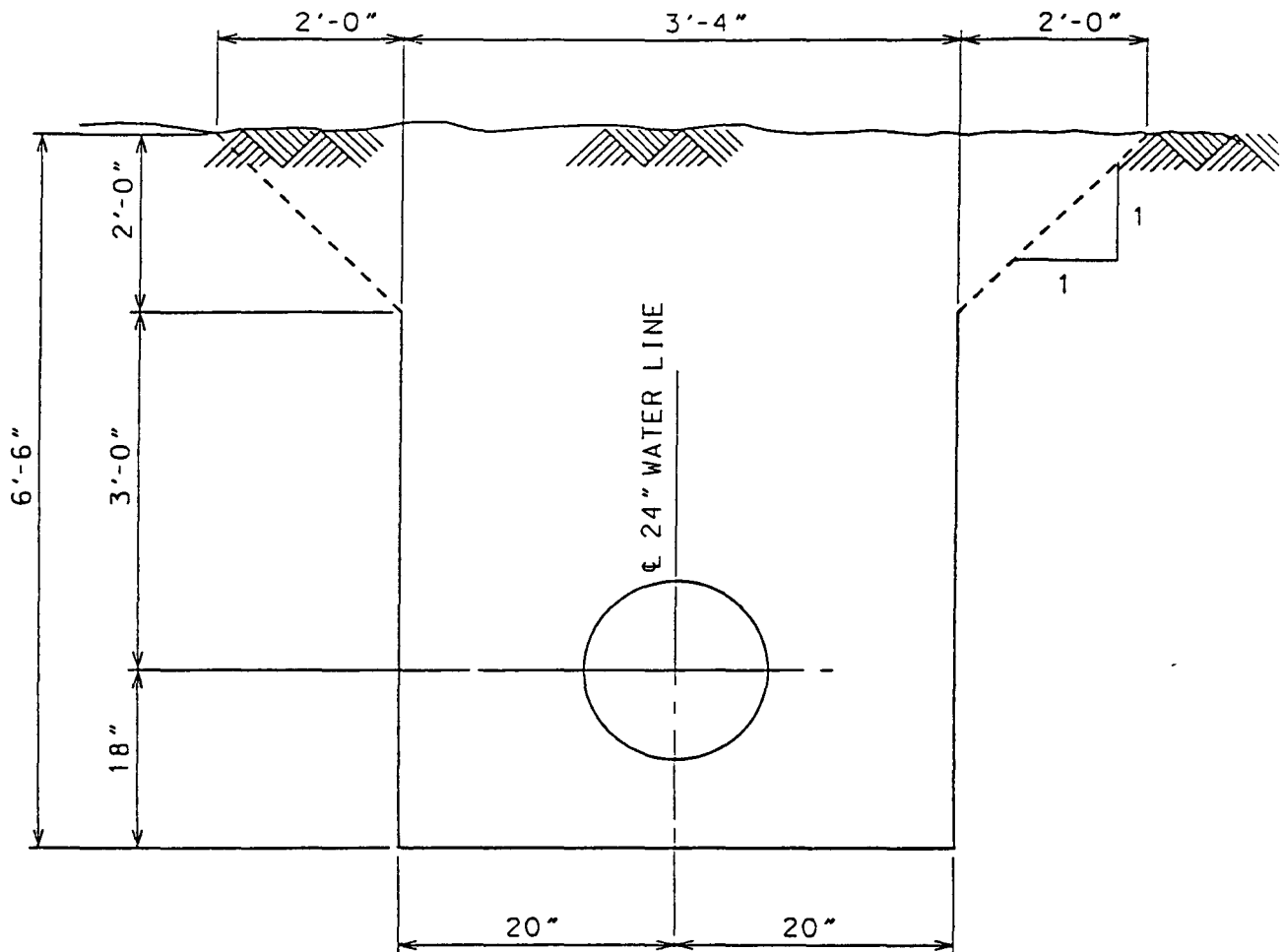
Right-of-Way Clearing, Grubbing, and Excavation

Prior to clearing, field personnel responsible for clearing activities will be made familiar with conditions of easements, permits, regulatory approvals, and CSX railroad requirements. Clearing will be restricted to those areas within the 50-foot ROW required for ditching, pipe laying, and related activities. Temporary gates and fences will be installed when necessary and removed following construction. The disturbed land surface will be graded, seeded, and returned to its initial contour.

Where clearing of trees and brush will be required, chain saws or bulldozer-type machinery with special cutting blades will be used. Slash and brush will be hauled offsite. Tree stumps and roots will be mechanically removed and disposed of in a similar manner.

The pipe trench will be excavated to a minimum width to provide clearance for the pipe and any buoyancy control devices as needed. Excavation of a minimum of 8 inches on either side of the pipe will be required. A typical trench is shown in Figure 6.2.8-1. A combination of backhoes, clamshells, and draglines will be used. Matting will be used to support heavy machinery in wetlands areas. Temporary ditch crossings for equipment will be provided where necessary.





NOTES

- 1 ANY SHORING REQUIREMENT FOR TRENCH DURING CONSTRUCTION WILL BE PROVIDED AS NEEDED
- 2 BEDDING AND BACKFILL MATERIAL WILL BE PLACED AND COMPACTED AROUND AND ABOVE THE PIPE

**Figure 6.2.8-1
TYPICAL SECTION OF WATER PIPELINE TRENCH**

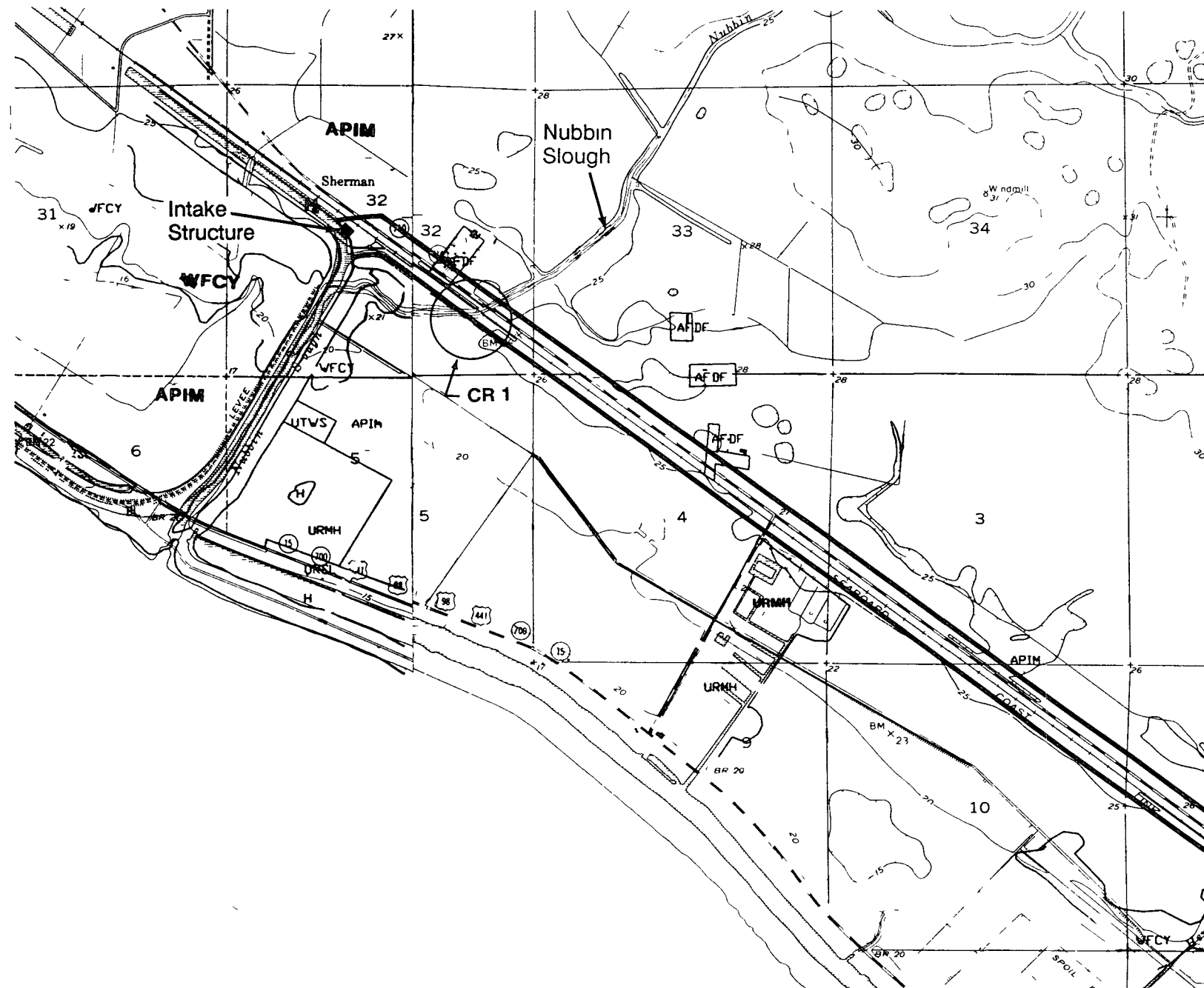
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ROUTING OF WATER PIPELINE



LEGEND

- Corridor Containing CSX ROW
- CR __ Pipeline Crossing No

Pipeline routed parallel to and approximately 18 feet from ϕ of railroad track on the south side

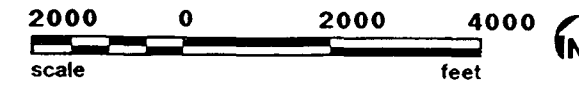
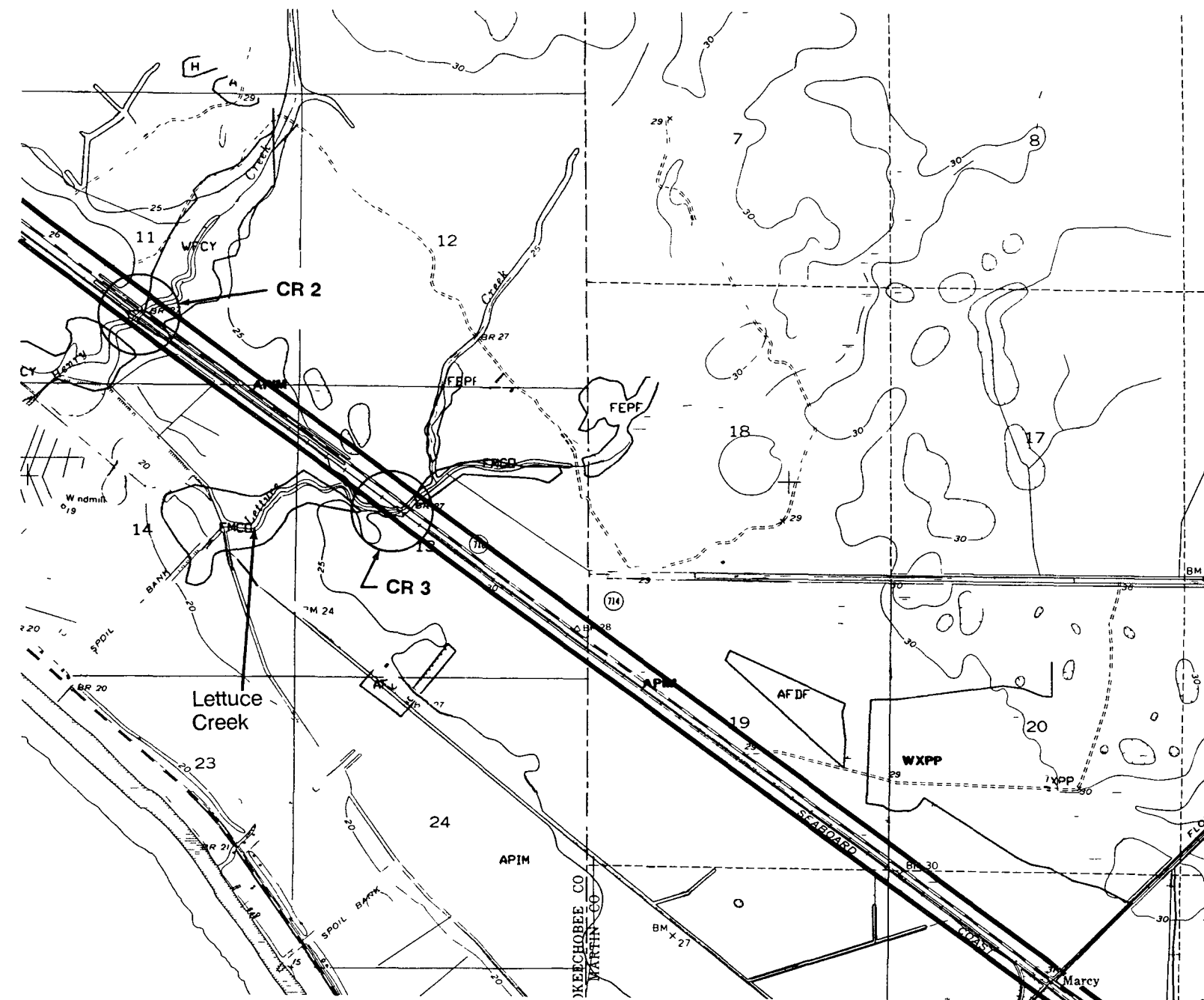
Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Figure 6.2 8-2 (Page 2 of 5)

ROUTING OF WATER PIPELINE



LEGEND.

- Corridor Containing CSX ROW
- CR __ Pipeline Crossing No.

Pipeline routed parallel to and approximately 18 feet from ϕ of railroad track on the south side

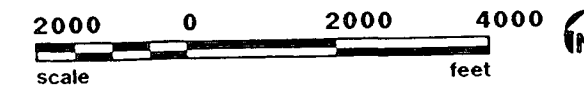
Sources USGS, 1983 SFWM, 1986 ECT, 1990

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ROUTING OF WATER PIPELINE



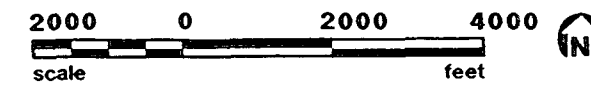
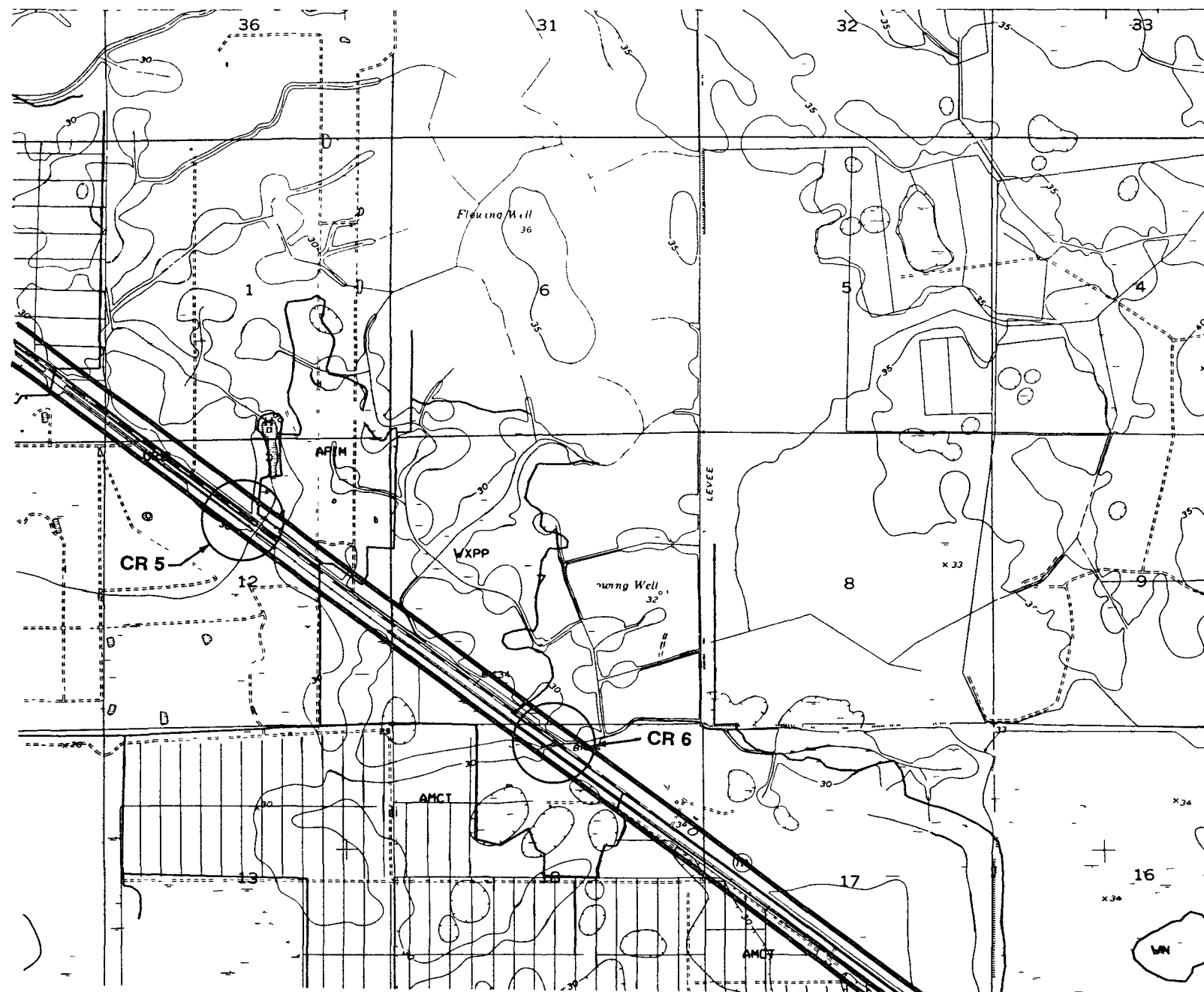
— Corridor Containing
CSX ROW

Pipeline routed parallel to and approximately 18 feet from C of railroad track on the south side

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ROUTING OF WATER PIPELINE



LEGEND

- Corridor Containing CSX ROW
- CR __ Pipeline Crossing No

Pipeline routed parallel to and approximately 18 feet from $\mathcal{Q}$ of railroad track on the south side

Sources USGS, 1983 SFWMD, 1986 ECT, 1990

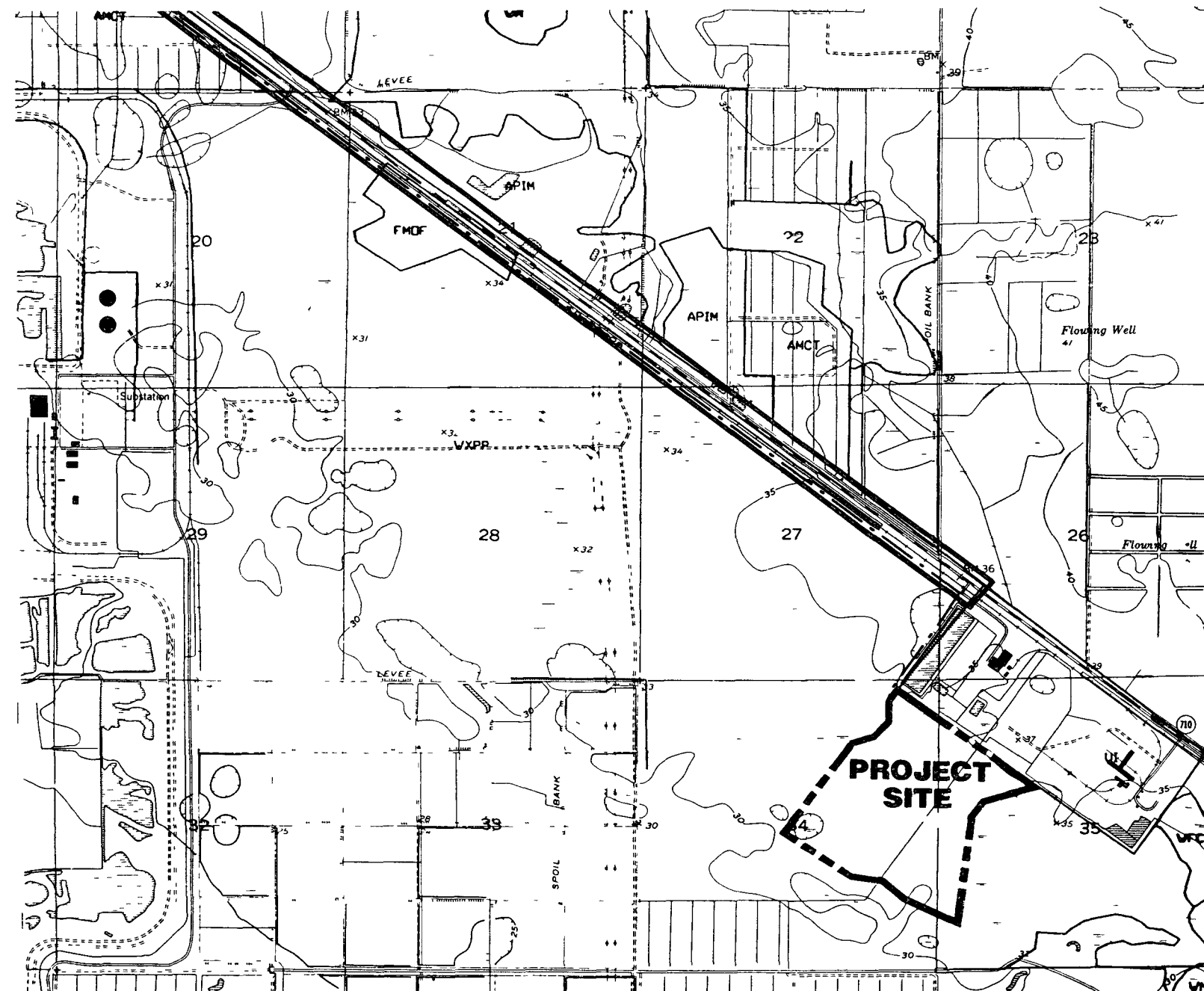
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Figure 6.2.8-2. (Page 5 of 5)

ROUTING OF WATER PIPELINE



2000 0 2000 4000
scale feet

LEGEND

- Corridor Containing CSX ROW
- CR — Pipeline Crossing No

Pipeline routed parallel to and approximately 18 feet from ϕ of railroad track on the south side

Sources USGS, 1983 SFWMD, 1986 ECT, 1990

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Pipe Installation

Trucks or all-terrain vehicles will be used to transport pipe to the ROW, where the pipe will be placed on the side of the trench. To cross wet areas, pipe will be fitted up on the adjacent ROW and pulled or floated into place. No additional staging areas will be required.

Bending and welding (if required) will take place within the ROW. Welding procedure qualification tests will be conducted in accordance with applicable codes. Welders will be qualified in accordance with applicable codes by completing test welds, using the approved welding procedures. The field weld and adjacent uncoated pipe will be coated with a material that is compatible with the existing coating. After beveling of the existing coating, the bare area will be machine cleaned to remove dirt, rust, etc., to obtain a clean surface for coating.

Construction involves the installation of pipeline segments at a depth of 3 to 5 feet per CSX requirements in the ROW. Bedding materials may be required in the pipeline trench in areas where the bottom is irregularly shaped or where the excavated spoil materials are unacceptable for backfilling around the pipe due to possible coating damage. To protect the pipe in these areas and for support, sand or gravel, crushed rock and screened spoil materials, or a combination of each may be used for bedding. This bedding material will be placed in the bottom of the trench to a minimum depth of 6 inches prior to lowering of the pipe into place.

Only soils excavated from the pipeline trench and imported bedding materials will be used for backfilling, no other soils from the ROW will be used. Soil removed from the trench line will be used to form a slight crown over the trench centerline to compensate for soil settlement. Openings will be left in the completed crown to permit lateral surface drainage.

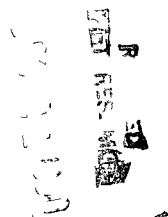
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When backfilling has been completed, accumulated construction debris will be removed from the ROW, and drainage ditches, terraces, roads and fences will be restored to their former condition. Potholes, ruts, and depressions will be filled, and the pipeline ROW will be left in a neat condition. Pipeline markers and warning signs will be erected and maintained at roads, watercourses, and other points in accordance with applicable regulations. All surplus materials and construction equipment will be removed.

Major highways and railroad crossings will be bored and casing installed if required. All crossings will be constructed in accordance with applicable regulations. A minimum of 3 feet of covering will be utilized over the top of the pipe or casing except at water crossings where the pipe is above grade.

On unsurfaced and lightly traveled rural roads, road crossings may be made using open cut, conventional trenching methods (where permitted). Provisions will be made for temporary passage of traffic by either a detour acceptable to jurisdictional agencies, by temporary bridging over the excavated trench, or a combination of both. Detour and warning signs, lights, flagmen, barricades, pilot vehicles, watchmen, and any other features required for maintaining safe passage of traffic will be supplied and maintained as necessary. Construction pipeline crossings, including repair, restoration, and cleanup operations, will be expeditiously conducted in a neat and orderly fashion to minimize any disturbances.

All canal crossings will be installed in accordance with industry practice and applicable regulatory specifications. Continuous concrete-coated pipe, concrete weights placed over the pipe, or screw anchors may be employed to overcome buoyant forces in wet area crossings. Concrete weights will be fabricated by concrete structure manufacturers located near the proposed pipeline route as needed. An acceptable pad will be used to protect the pipe and pipe coating from possible damage. Placement of the weights over the pipe will be accomplished by the use of sidebooms or cranes. Special care will be taken to ensure that no damage is done to the pipe coating. Excavation of the pipeline trench, stream



banks, and approaches will be performed by conventional trenching and grading equipment. Siltation from water disturbances will be held to a practical minimum. In addition, the following erosion control measures will be adhered to:

- Ditch and canal crossings will be made as close to perpendicular as possible.
- Cutting of banks and slope approaches will be held to a minimum.

Effort will be made to minimize suspended sediment release into watercourses during trench excavation. Backfill operations will be performed slowly to minimize agitation. In addition, silt curtains will be installed on each side of the ROW during construction to minimize turbidity effects. Pipe trenches at the banks will be backfilled with stable materials immediately after the pipe is laid so as to reduce erosion of fine materials from the trench immediately adjacent to the channel.

Hydrostatic Testing

The hydrostatic testing of the pipeline will be conducted in accordance with the regulations contained in AWWA or applicable ANSI standards. The pipeline will be pressure-tested to substantiate the proposed maximum allowable operating pressure and to locate any leaks. It is proposed that hydrostatic testing be employed with water as the testing medium. Where test sections are continuous, the quantity of water required will be held to a minimum by reusing the water, where feasible, from one tested section to the succeeding test section. The length of the test section will depend on factors such as elevation, availability of water, and scheduling. All manifold valving will have a working pressure, based on the maximum test pressure. The test heads and manifold pipe will be designed and fabricated so that no component will be stressed beyond its safe working strength. Water for this testing will be taken from local streams or trucked in as required.

Squeegees (pigs) will be positioned ahead of, as well as behind, the water fill connection for controlled filling and dewatering. In the filling process, the squeegee will be steadily pushed ahead by the water, forming a seal to eliminate air entrapment.

Erosion Sediment Control Measures

Unless otherwise noted, all management strategies, vegetative practices, and structural erosion and sediment control practices will be developed and maintained according to Florida standards and specifications.

Management Strategies

- Activities will be scheduled to minimize erosion of disturbed areas
- Excavated areas will not be exposed to construction traffic
- Protection measures will be implemented to prevent transport into any stream, wetland area, or adjacent storm water management system
- Stockpiling of excavated material will be away from the wetland areas, and surrounded by silt fence or hay bales
- Wetland banks and beds will be stabilized after construction
- Surface areas will be restored to at least original condition
- The construction superintendent will have overall responsibility for plan implementation. He shall also be responsible for seeing that appropriate construction workers and subcontractors are aware of the provisions of the plan.

Vegetative Practices

- Topsoil Stockpile Topsoil shall be stripped from areas to be graded, and stockpiled for later use. Stockpile locations shall be approved by the construction superintendent. They will, however, be placed away from wetland areas and contained by structural measures (i.e., silt fencing or hay bales), as determined by the construction superintendent.

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- Seeding After construction is complete any previously vegetated areas will be established by seeding with an approved mixture

Structural Practices

- Silt Fencing Silt fencing will be utilized in areas of high sediment transport potential. In general, fencing will be used to protect adjacent properties. It can be placed along the run of construction utilizing a minimum of space. Fencing can also be reused along the route, if properly maintained. Essentially, as a pipeline segment is excavated silt fencing is placed along the outside of the work area (See Figure 3.8.4-7). This creates an enclosed and controllable area.

Silt fence construction will be held to the following guidelines:

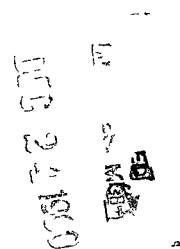
- The height of a silt fence shall not exceed 36 inches (higher fences may impound volumes of water sufficient to cause failure of the structure).
- The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.
- Posts shall be spaced a maximum of 10 feet apart at the barrier location and driven securely into the ground (minimum of 12 inches). When extra strength fabric is used without the wire support fence, post spacing shall not exceed 6 feet.
- A trench shall be excavated approximately 4 inches wide and 4 inches deep along the line of posts and upslope from the barrier.
- When standard strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least 1 inch long, tie wires, or hog rings. The wire shall extend into the trench a minimum of 2 inches and shall not extend more than 36 inches above the original ground surface.

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- The standard strength filter fabric shall be stapled or wired to the fence, and 8 inches of the fabric shall be extended into the trench. The fabric shall not extend more than 36 inches above the original ground surface. Filter fabric shall not be stapled to existing trees.
- When extra strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the posts with all other provisions of the item above applying.
- The trench shall be backfilled and the soil compacted over the filter fabric.
- Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.
- Posts of silt fences shall be either 4-inch diameter wood or 1 3/8 inches per linear foot steel with a minimum length of 5 feet. Steel posts shall have projections for fastening wire to them.
- Wire fence reinforcement for silt fences using standard strength filter cloth shall be a minimum of 42 inches in height, a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.

Dewatering During Construction

During construction it will probably be necessary to remove groundwater from inside the work area. That water will be pumped out of the excavation and diverted through a hay bale filter into the existing stream down slope of the activity.



Construction Monitoring and Maintenance

In general, all erosion and sediment control measures will be checked weekly and after each significant rainfall. The following items will be checked in particular:

- All seeded areas will be checked regularly to see that a good stand is maintained. Areas shall be fertilized and reseeded as needed.
- Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.
- Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.
- Sediment deposits should be removed after heavy storm events. They must be removed when deposits reach approximately one-half the height of the barrier.
- Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared, and seeded.

Permanent Stabilization

Prior to removal of the lateral silt fencing, the pipeline trench will be backfilled, compacted, graded over, and vegetation re-established. All vegetated areas will be re-established and stabilized by an approved seeding mixture.

6.2.8.2 Impact on Water Bodies and Uses

For almost the entire run of the pipeline from the Taylor Creek/Nubbin Slough to the project site, the pipeline will be located underground and in the CSX ROW, approximately parallel to and ($\pm$) 18 feet to the south of the center line of the railroad track. Except for the crossings at existing creeks, sloughs, and ditches,

as shown on Figure 6 2 8-2 and listed in Table 6 2 8-1, the pipeline will be entirely located in an area where it will not impact any waters of the state. Further, depending on the width of the creek being crossed, the pipeline at most locations will either be supported from existing railroad bridges in accordance with the requirements of the CSX railroad or from new supports placed on either side of the creek away from the shoreline (Figure 6 2 8-3). However, some of the large pipe spans over streams such as Nubbins Slough, Henry Creek, and Lettuce Creek may require the addition of a pre-cast pile support(s) to be placed in the stream. During the design phase of the project, the option of using the railroad bridges to support the pipe will be analyzed. If the bridges are suitable and CSX agrees with the approach, these mid-stream supports may be eliminated. Since with these types of crossings the pipeline will remain above the waterline of the creeks which are not navigable, the impact on the quality and quantity of the water will be precluded. In addition, the pipe crossing will not affect the water level in the creeks crossed by the pipeline.

At a location south of Myrtle Slough, the pipeline will be traversing the edge of an elongated swamp. Since the length of the swamp parallel to the pipe run is sufficiently large, it will require an additional intermediate support in the middle of the water crossing as shown in Figure 6 2 8-3. This support will be a 12-inch diameter round pre-cast concrete pile driven into the ground. Considering the size of the proposed support and its location (i.e., close to the edge of existing railroad), it is determined that this structure will have an insignificant impact on the existing swamp. The proposed construction will not require any dredging or building of cofferdams in the existing water body and will be made from the railroad ROW.

6.2.8.3 Solid Wastes

Construction solid wastes such as trees, tree stumps, roots, etc., will be minimal and will be hauled offsite to an approved landfill.

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6.2.8.7 Impact on Archeological and Historic Sites

No archaeological or historic resources were previously listed along the section of the CSX ROW where the water pipeline will be constructed (see Section 10.8). In addition, no archaeological or historic resources eligible for inclusion in the National Register of Historic Places were found during research and field assessment. Therefore, activities involved with the construction of the pipeline should have no impact on significant archaeological or historic resources.

Should construction activities cause the discovery of unanticipated archaeological materials, those activities which potentially would disturb such materials will be postponed until a professional archaeologist can evaluate their potential significance. In the event the materials are believed to be significant, the State Historic Preservation Office (SHPO) will be contacted to identify appropriate measures.

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6.2.9 POST-CONSTRUCTION IMPACTS AND EFFECTS OF MAINTENANCE

6.2.9.1 Maintenance Techniques

The pipeline is to be constructed in the CSX right-of-way (ROW), therefore, no additional maintenance techniques are proposed beyond current maintenance procedures

6.2.9.2 Multiple Uses

No multiple or joint uses, such as agriculture, are proposed for the lands within the CSX ROW, the proposed location of the ICL pipeline. Other linear facilities, such as optical fiber telephone lines, have been installed in this ROW. Use of this ROW is controlled by CSX.

6.2.9.3 Changes in Species Populations

The status and potential for occurrence of important species in and along the proposed pipeline ROW was discussed in Section 6.2.7. The avoidance of ecologically unique or valuable habitats was achieved through collocation of the pipeline with the existing CSX railroad ROW.

Changes in local species populations are not expected as a result of the pipeline presence and maintenance. Displacement of individuals from the immediate ROW area which might occur as a result of construction activities would be temporary. These displaced species are expected to re-inhabit or repopulate the ROW area. No animal or plant species is expected to be permanently displaced out of the project area as a result of construction in the pipeline ROW and subsequent maintenance. In a short time, ground cover over the disturbed land will be indistinguishable from surrounding vegetation except for those small areas that are forested. Here, a decrease in structural diversity (loss of canopy trees) will occur, however, due to collocation with the CSX ROW, only a narrow strip of canopy will

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be lost In these areas, clearing of overstory vegetation will not result in the loss of significant portions of regional wildlife habitat types

No threatened or endangered plants or animals are known to require land included within the pipeline ROW The current land use as ROW for the CSX railroad has resulted in habitat types poorly suited for habitation by such species In summary, there are expected to be no measurable changes to populations of important species after construction or as a result of maintenance activities

6.2.9.4 Effects of Public Access

No additional public access roads are proposed as part of the pipeline corridor Therefore, no additional exposure to the public by wildlife should result as part of maintenance of the pipeline corridor

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6.2.10 OTHER POST-CONSTRUCTION EFFECTS

Because the proposed pipeline will be buried underground, no additional post-construction effects are expected

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INDIANAPOLIS

References

REFERENCES

Section 6.2.6

Martin County Growth Management Department Martin County Comprehensive Growth Management Plan (Adopted) 1990

Piper Archaeological Research, Inc Cultural Resource Assessment Survey of the Proposed Martin County Power Plant Site and Pipeline Right-of-Way, Martin County, Florida (SCA Section 10 8) 1990

Section 6.2.8

Piper Archaeological Research, Inc Cultural Resource Assessment Survey of the Proposed Martin County Power Plant Site and Pipeline Right-of-Way Martin County, Florida (SCA Section 10 8) 1990

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**BATHYMETRIC AND WATER QUALITY
SURVEY OF TAYLOR CREEK/NUBBIN SLOUGH**

Submitted to:

**INDIANTOWN COGENERATION LIMITED PARTNERSHIP
Indiantown, Florida**

Submitted by:

ECT

Environmental Consulting & Technology, Inc.

Gainesville, Florida

October 1990

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APPENDICES

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1.0 INTRODUCTION

Indiantown Cogeneration Limited Partnership (ICL) is currently preparing a site certification application (SCA) for its 300-megawatt (MW) Indiantown cogeneration project (ICP) located approximately 3 miles northwest of Indiantown, Florida. The project will withdraw water from Taylor Creek/Nubbin Slough (TC/NS) for process water and cooling water makeup, which requires that an intake structure be designed and constructed on TC/NS. To aid in the engineering design and subsequent impact analysis, Environmental Consulting & Technology, Inc. (ECT) was contracted to complete a bathymetric survey and water quality and velocity measurements in the vicinity of the proposed intake structure. ECT was assisted by Lindahl, Browning, Ferrari & Hellstrom, Inc. (LBF&H) for the land surveying portion of the project.

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2.0 METHODS AND MATERIALS

2.1 LAND SURVEYING

Fourteen transects were established at approximately 100-foot (ft) intervals along TC/NS as shown in Figure 1. The positions (in state plan coordinates) and land elevations at the end of each transect were surveyed by LBF&H using standard surveying techniques. Concrete monuments located along the railroad were used for reference points and elevations were established in national geodetic vertical datum (NGVD) 1929. LBF&H also surveyed 11 bank profiles along the end of the transects located on the intake-side of the canal. An additional seven bank profiles were measured on the opposite side of the canal. Two concrete monuments were also established on the site to aid in subsequent surveying that might be required.

2.2 BATHYMETRY SURVEY

Bathymetric surveys were conducted along the established 14 transects on October 3, 1990. A Raytheon Model DE-719 acoustic fathometer was used to measure water depth along each transect. This instrument operates at 200 kilohertz (KHz) and can record 534 soundings per minute on chart paper. The fathometer is accurate to 0.5 percent ± 1 inch of the measured depth and can be resolved reliably to the nearest 0.2 foot (ft). The fathometer was calibrated three times during the survey with a target on a graduated line lowered beneath the transducer.

Navigation during the survey was accomplished by stringing a taut, graduated line between the end markers on each transect. As the survey vessel traversed each transect, a fix mark was recorded on the fathometer chart paper at 20-ft intervals by using markings on the taut line as a guide. The navigation fixes were then noted as distance from the end marker on each transect. The transect marker on the east side of the canal was assigned a distance of 0 ft for all transects.

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A water level staff was installed at the site to monitor water level variations during the survey. The staff was surveyed relative to the benchmarks at the site and its elevation was established in NGVD. The water level at the site was read from the staff during each bathymetry transect to assure the measured water depths could be properly adjusted to elevations in NGVD.

The strip charts from the fathometer were read and digitized by two individuals and compared to minimize errors. The digitized depths for each transect were then corrected for water level variations (from the staff readings) and adjusted to elevations in NGVD. The final bathymetry database consisted of data points expressed as distance along the transect and elevation in NGVD.

The bathymetry database was then merged with the bank profile database obtained during the land surveying. Since the bank profile surveys extended from each transect end marker to a water depth of approximately 3 ft, there was occasionally some overlap with the bathymetry survey. In cases where there was overlap, the land survey was given precedent because it was more accurate near the bank, and the bathymetry survey points near the edge of the bank were deleted. The final database for each transect consisted of both land survey points and bathymetry survey points expressed as distance from the transect marker and elevations in NGVD.

2.3 WATER QUALITY

Water quality measurements were made along transects 1, 6, 11, and 14 on October 4, 1990. Stations along each transect were occupied at 30-ft intervals (beginning at the water's edge). Measurements at each station were made at depths of 1 ft and subsequently at 2-ft intervals to the bottom. A taut, graduated line stretched between the transect markers was used to locate the stations. The bow of the survey vessel was tied to the taut line and the stern was anchored to minimize vessel movement during the survey.

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The water quality data measured during the surface water sampling consisted of pH, conductivity, dissolved oxygen (DO), oxidation/reduction potential, and temperature. All field measurements were made using a Hydrolab 4041 analytical instrument.

The Hydrolab 4041 instrument is an integrated analytical unit containing six analytical electrodes, pressure transducers, and associated electronics.

Instrument calibration were performed and recorded prior to and after the survey. The pH calibration consisted of testing three pH buffer standards (4, 7, and 10) and adjustment to the Hydrolab function to read the specified pH units. Three saline (potassium chloride) solutions of known conductivity (laboratory prepared) were measured using the conductivity function and adjusted to read the specified conductivity. Temperature values were calibrated (checked) against laboratory thermometers. DO functions were checked using temperature/DO tables.

In addition to water quality data, support meteorological data were collected during the survey. Wet and dry bulb air temperatures were obtained with a Taylor sling psychrometer and windspeed was measured with a Davis Instruments digital turbometer. Wind direction was estimated visually.

2.4 WATER VELOCITY

Water velocity was measured on October 4, 1990, at the same stations as the water quality measurements, described previously. Measurements were taken at 2-ft intervals to a maximum depth of 8 ft using a Gurley No. 625 Pygmy current meter. The current meter contained six 0.75-inch rotor cups capable of measuring currents in the range of 0.05 to 3.0 ft per second (ft/sec). The rotor counts at each depth were monitored for approximately 30 seconds. The rotor counts were then converted to water velocity in ft/sec for final presentation.

3.0 RESULTS AND DISCUSSION

3.1 LAND SURVEYING

Figure 2 (an attached oversized figure, 34 inches by 44 inches) presents the results of the land surveying completed by LBF&H. The figure is provided at a scale of 1 inch equals 50 ft and contains all the transect marker locations and monument locations on the site. Figure 2 also shows all state plane coordinates of the transect markers and monuments, as well as the bank profile data.

3.2 BATHYMETRY SURVEY

Appendix A provides the final elevation profile database prepared from the land survey and the bathymetry survey. Appendix B provides 14 channel profiles plotted from the database. Appendix C provides copies of the original fathometer strip charts used to measure the water depth. Table 1 provides the water level staff readings and the support meteorological data collected during the survey.

The water level during the study varied from a high of 19.44 ft NGVD to a low of 18.23 ft NGVD for a range of 1.21 ft. The water level in the canal is controlled by structure S-191 located approximately one mile downstream of the site. Personnel at South Florida Water Management District stated that when the water reaches a certain level, the gates at S-191 are opened. When the water recedes to a certain level, the gates are closed, which produced the large variations in the water level observed at the site. The recorded water levels in Table 1 were used to adjust the bathymetry values.

The final transect elevations were plotted on a land surveying base map (Figure 2) and the elevations were hand contoured in 1-ft intervals to provide a topographic map of the site. Figure 3 presents the results.

Table 1. Water Level and Meteorological Data

Date	Time	Water Level (ft NGVD)	Dry Bulb (°F)	Wet Bulb (°F)	Windspeed (mph)	Wind Direction
10/02/90	1520	18.59	90.0	78.8	6.0	NE
10/02/90	1630	18.23	-	-	-	-
10/02/90	1730	18.48	-	-	-	-
10/02/90	1800	18.62	85.0	76.0	8.2	E
10/03/90	0800	19.07	76.2	74.0	1.5	SE
10/03/90	0845	19.14	-	-	-	-
10/03/90	1100	19.30	90.5	79.5	6.5	SE
10/03/90	1130	19.36	-	-	-	-
10/03/90	1242	19.43	-	-	-	-
10/03/90	1250	19.44	-	-	-	-
10/03/90	1401	19.07	89.2	79.0	7.2	SE
10/03/90	1410	19.07	-	-	-	-
10/03/90	1445	18.86	-	-	-	-
10/03/90	1457	18.66	-	-	-	-
10/03/90	1517	18.49	-	-	-	-
10/03/90	1532	18.34	-	-	-	-
10/03/90	1620	18.33	-	-	-	-
10/03/90	1700	18.26	88.8	72.4	7.6	SE
10/03/90	1720	18.24	-	-	-	-
10/03/90	1733	18.33	-	-	-	-
10/03/90	1750	18.23	-	-	-	-
10/03/90	1810	18.41	-	-	-	-
10/04/90	0800	18.73	79.2	77.0	1.0	NNE
10/04/90	1100	18.73	-	-	-	-
10/04/90	1200	18.72	-	-	-	-
10/04/90	1209	18.72	90.8	82.2	4.8	E
10/04/90	1420	18.70	-	-	-	-
10/04/90	1600	18.67	84.1	78.0	7.4	S
10/04/90	1633	18.72	-	-	-	-
10/04/90	1800	18.73	74.2	73.8	5.8	NE
10/04/90	1835	18.75	-	-	-	-
10/04/90	1901	18.75	-	-	-	-
10/04/90	1925	18.79	-	-	-	-

Source: ECT, 1990.

The deepest points in L-63N occurred approximately mid-channel and averaged approximately 1.0 ft-NGVD; the deepest point was 0.5 ft-NGVD. Canal L-63S was not as deep with the midpoint depths averaging approximately 4.0 ft-NGVD. Canal C-59 was the deepest with values below sea level (deepest value -0.7 ft-NGVD). The depth contours are typical of a canal with the lines parallel to the banks. The steepest gradients are near the banks with relatively flat areas near the center of the channel.

3.3 WATER QUALITY

Table 2 presents the results of the water quality survey for the four transects measured. The temperature varied from a high of 30.21 degrees Fahrenheit (°F) to a low of 26.78°F. The coolest water was found along transect 14 in Canal L-63S. The temperature at all stations decreased with depth and there was typically a 1- to 2°F change in temperature from the surface to the bottom.

The pH measured was relatively constant and only varied between 6.98 and 5.62. The conductance was also relatively constant and averaged approximately 170 μ mhos/cm. The oxidation/reduction potential varied between 68 and 147 millivolts (mV) with the highest values near the bottom. The DO in most cases was below the Class III water quality standard of 5.0 parts per million (ppm). As expected, the DO decreased from the surface to the bottom with the lowest observed value being 2.60 ppm.

3.4 WATER VELOCITY

Table 2 presents the water velocity measurements with the water quality. Unlike the previous day (as observed during the bathymetry surveys), there was little change in the water level during the survey. Apparently, the gates at S-191 must have been closed which resulted in slow water velocities. At most points, the measured water velocity was less than 0.3 ft/sec. The highest value observed was 0.61 ft/sec. Because of the relatively stable water level on the day of the survey, it is probable

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Table 2. Water Quality and Water Velocity from TC/NS on October 4, 1990

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
TRANSECT 1-1A								
Water level at beginning of transect (12:20) = 18.72 ft. NGVD								
Water level at completion of transect (14:20) = 18.70 ft. NGVD								
10'	5.5	1.0	29.90	6.04	170	090	4.84	0.08
		3.0	29.31	6.01	170	109	4.42	0.09
		5.0	28.53	5.97	169	115	3.61	-
30'	9.0	1.0	30.21	6.34	168	088	4.45	0.29
		3.0	29.35	6.01	168	110	4.16	0.29
		5.0	28.33	6.02	169	114	4.01	0.24
		7.0	27.39	5.99	169	119	3.62	0.21
		9.0	27.43	6.38	170	106	3.50	-
60'	15.0	1.0	30.03	6.34	168	087	4.44	0.24
		3.0	28.47	6.05	169	106	4.42	0.22
		5.0	28.24	6.02	170	109	4.40	0.22
		7.0	27.44	6.00	170	113	4.05	0.06
		9.0	27.36	5.96	170	118	4.01	-
		11.0	27.28	5.94	171	120	3.60	-
		13.0	27.28	5.89	170	124	3.60	-
		15.0	27.31	5.89	170	129	3.51	-
90'	15.5	1.0	29.00	6.33	169	090	5.72	0.26
		3.0	28.47	5.95	169	119	5.24	0.33
		5.0	28.63	5.96	169	120	5.10	0.30
		7.0	27.72	5.94	169	125	4.06	0.34
		9.0	27.51	5.92	170	129	3.61	-
		11.0	27.30	5.91	170	134	3.55	-
		13.0	27.30	5.88	170	140	3.52	-
		15.0	27.31	5.88	170	143	3.13	-

Table 2. Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 2 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
TRANSECT 1-1A (contd.)								
120'	15.0	1.0	28.98	6.34	168	086	6.11	0.28
		3.0	28.67	5.91	168	114	5.69	0.22
		5.0	28.32	5.93	170	115	5.68	0.33
		7.0	27.59	5.95	170	117	4.17	0.28
		9.0	27.39	5.96	170	116	4.45	-
		11.0	27.33	5.93	170	119	3.71	-
		13.0	27.30	5.91	170	120	4.12	-
		15.0	27.30	5.85	170	126	3.60	-
150'	14.0	1.0	28.31	6.27	169	095	6.03	0.52
		3.0	27.96	6.26	169	098	5.62	0.22
		5.0	28.84	5.88	169	129	4.51	0.22
		7.0	27.61	5.85	168	129	4.43	0.22
		9.0	27.36	5.87	169	132	3.78	-
		11.0	27.36	5.83	170	139	3.10	-
		14.0	27.28	5.74	169	147	3.07	-
180'	12.0	1.0	29.00	6.02	168	119	7.22	0.09
		3.0	28.60	6.01	168	119	6.19	0.11
		5.0	28.20	6.30	167	108	6.17	0.06
		7.0	27.49	6.54	169	094	4.56	0.06
		9.0	27.50	6.48	169	099	4.17	-
		12.0	27.50	6.40	170	109	3.64	-
210'	6.0	1.0	29.40	6.98	168	072	4.17	0.29
		3.0	28.65	6.86	168	073	3.54	0.22
		5.5	28.40	6.74	167	070	3.64	0.29

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Table 2. Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 3 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
TRANSECT 6-6A								
Water level at beginning of transect (15:00) = 18.69 ft. NGVD								
Water level at completion of transect (17:20) = 18.71 ft. NGVD								
10'	6.5	1.0	29.75	6.15	169	091	4.53	0.12
		3.0	29.10	6.01	169	100	4.14	0.06
		5.0	28.51	5.93	171	108	3.67	-
		6.5	28.25	5.89	171	116	3.10	-
30'	12.0	1.0	29.15	6.31	169	084	5.61	0.29
		3.0	28.76	6.01	169	106	5.03	0.21
		5.0	28.30	6.01	170	111	5.15	0.18
		7.0	27.59	5.96	170	114	4.14	0.12
		9.0	27.56	5.95	169	120	3.49	-
		11.0	27.45	5.89	170	126	4.52	-
		12.0	27.43	5.91	170	129	3.13	-
60'	15.0	1.0	29.41	6.48	168	089	4.98	0.24
		3.0	28.61	6.06	168	101	4.91	0.22
		5.0	28.18	6.01	169	104	4.02	0.22
		7.0	27.40	6.00	170	110	4.17	0.19
		9.0	27.36	5.96	170	118	4.11	-
		11.0	27.32	5.94	170	119	3.96	-
		13.0	27.30	5.92	170	123	3.32	-
		15.0	27.30	5.91	171	126	3.15	-
90'	18.0	1.0	29.04	6.27	168	092	5.87	0.26
		3.0	28.82	6.11	170	101	6.08	0.33
		5.0	28.71	6.05	169	103	5.12	0.29
		7.0	28.14	6.00	170	104	4.91	0.21
		9.0	27.52	6.01	170	109	4.17	-

Table 2. Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 4 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
<u>TRANSECT 6-6A (continued)</u>								
3-7		11.0	27.36	5.93	170	109	5.01	-
		13.0	27.30	5.89	171	117	4.23	-
		15.0	27.30	5.91	171	119	3.36	-
		18.0	27.28	5.85	171	126	3.70	-
	120'	19.0						
		1.0	28.97	6.19	169	076	6.12	0.42
		3.0	28.70	5.94	170	100	5.81	0.35
		5.0	28.52	5.93	169	101	5.53	0.22
		7.0	28.11	5.91	170	105	4.90	0.22
		9.0	27.56	5.92	170	108	4.56	-
		11.0	27.34	5.91	170	109	4.36	-
		13.0	27.31	5.89	170	111	3.81	-
		15.0	27.30	5.89	170	115	4.06	-
		17.0	27.29	5.89	171	117	4.15	-
		19.0	27.29	5.88	171	121	3.32	-
	150'	17.0						
		1.0	28.70	6.02	169	081	5.90	0.42
		3.0	28.51	6.00	169	106	4.89	0.26
		5.0	28.36	5.99	168	110	4.57	0.27
		7.0	28.24	5.96	169	110	4.15	0.19
		9.0	27.81	5.94	169	114	3.98	-
		11.0	27.36	5.95	170	120	4.09	-
		13.0	27.29	5.92	170	125	3.72	-
		15.0	27.29	5.90	170	126	3.51	-
		17.0	27.28	5.91	170	131	3.31	-
	180'	13.0						
		1.0	28.77	6.10	168	089	5.20	0.16
		3.0	28.65	5.96	169	110	4.55	0.26
		5.0	28.35	5.97	169	118	3.35	0.21

Table 2. Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 5 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
<u>TRANSECT 6-6A (continued)</u>								
		7.0	28.27	5.95	169	120	4.17	0.16
		9.0	27.88	5.94	170	123	3.96	-
		11.0	27.33	5.92	170	126	4.70	-
		13.0	27.30	5.89	171	131	3.09	-
210'	7.5	1.0	29.30	6.37	170	073	4.75	0.21
		3.0	28.37	6.10	170	101	4.20	0.24
		5.0	28.01	6.08	170	107	3.57	0.06
		7.0	27.67	6.02	171	115	3.55	-
<u>TRANSECT 11-11A</u>								
Water level at beginning of transect (18:00) = 18.73 ft. NGVD								
Water level at completion of transect (19:25) = 18.79 ft. NGVD								
10'	8.0	1.0	29.30	6.43	168	083	4.08	0.11
		3.0	29.05	6.02	168	099	4.11	0.09
		5.0	28.51	5.94	170	112	3.82	-
		7.0	28.05	5.91	171	117	3.61	-
30'	11.0	1.0	29.33	6.55	168	075	5.01	0.17
		3.0	29.25	6.16	168	100	4.84	0.27
		5.0	28.80	6.09	170	106	4.06	0.19
		7.0	28.17	6.11	169	108	4.10	0.03
		9.0	27.55	6.06	171	114	3.55	-
		11.0	27.58	6.02	171	091	3.21	-
60'	18.0	1.0	29.33	6.58	168	069	6.12	0.35
		3.0	29.18	6.12	169	098	5.61	0.35
		5.0	28.70	6.07	170	103	5.01	0.27

Table 2. Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 6 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
<u>TRANSECT 11-11A (continued)</u>								
3-9		7.0	27.84	6.07	170	107	4.44	0.35
		9.0	27.62	6.06	170	110	4.57	-
		11.0	27.41	6.06	171	114	3.40	-
		13.0	27.29	6.05	172	118	3.18	-
		15.0	27.25	6.04	172	122	3.17	-
		18.0	27.25	6.06	172	125	3.06	-
	90'	20.0						
		1.0	28.99	6.24	168	074	6.10	0.32
		3.0	28.83	6.01	168	099	5.50	0.33
		5.0	28.70	6.00	169	099	4.76	0.30
		7.0	28.13	6.09	169	100	5.01	0.30
		9.0	27.55	6.06	171	101	4.15	-
		11.0	27.36	6.06	171	105	4.11	-
		13.0	27.27	6.07	172	106	3.57	-
		15.0	27.26	6.06	172	108	3.71	-
		17.0	27.28	6.01	172	112	3.16	-
		20.0	27.28	6.00	172	114	3.06	-
	120'	20.0						
		1.0	29.04	6.52	169	068	6.15	0.22
		3.0	28.96	6.00	172	098	6.00	0.31
		5.0	28.75	6.01	172	098	5.14	0.61
		7.0	28.03	6.09	170	099	4.76	0.52
		9.0	27.66	6.07	169	102	4.11	-
		11.0	27.37	6.06	171	104	3.89	-
		13.0	27.27	6.06	172	105	3.21	-
		15.0	27.26	6.02	172	109	3.17	-
		17.0	27.28	6.01	172	111	5.10	-
		19.0	27.28	6.01	172	113	3.00	-

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Table 2. Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 7 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
TRANSECT 11-11A (continued)								
150'	19.0	1.0	28.94	5.98	175	072	5.01	0.35
		3.0	28.82	5.98	175	100	4.72	0.52
		5.0	28.59	6.01	171	100	4.81	0.35
		7.0	28.33	6.06	169	101	4.71	0.35
		9.0	27.46	6.06	170	103	4.54	-
		11.0	27.33	6.04	170	104	4.01	-
		13.0	27.28	6.02	171	106	3.79	-
		15.0	27.28	5.98	171	110	3.56	-
		17.0	27.28	5.97	172	112	4.16	-
		19.0	27.28	5.96	171	114	3.16	-
180'	17.5	1.0	28.77	5.90	175	079	4.97	0.32
		3.0	28.66	5.88	176	106	5.09	0.29
		5.0	28.46	5.93	172	106	4.71	0.19
		7.0	28.31	5.98	170	106	4.33	0.22
		9.0	27.83	5.94	169	108	4.01	-
		11.0	27.41	5.99	170	110	3.96	-
		13.0	27.30	6.01	170	111	3.90	-
		15.0	27.30	5.95	170	114	3.52	-
		17.0	27.27	5.93	170	118	3.46	-
		210'	9.0	1.0	28.69	6.30	175	088
3.0	28.56			5.82	175	118	3.19	0.22
5.0	28.36			5.84	175	124	3.19	0.27
7.0	28.05			5.83	173	128	3.17	0.25
9.0	28.06			5.79	173	134	3.15	-

Table 2. Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 8 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
TRANSECT 14-14A								
Water level at beginning of transect (11:00) = 18.73 ft. NGVD								
Water level at completion of transect (12:00) = 18.72 ft. NGVD								
10'	6.0	3.0	27.01	5.80	169	088	2.60	0.09
		5.0	26.97	6.15	170	109	2.94	0.16
30'	9.0	3.0	26.99	5.80	171	092	4.67	0.21
		5.0	26.93	5.80	170	088	5.16	0.16
		7.0	26.86	5.79	170	083	3.36	0.06
		9.0	26.87	5.77	170	078	3.11	-
60'	12.5	1.0	27.80	5.88	171	099	5.28	0.44
		3.0	27.01	5.70	171	113	5.19	0.16
		5.0	26.95	5.79	171	115	4.61	0.19
		7.0	26.92	5.74	170	117	4.47	0.16
		9.0	26.90	5.81	170	119	4.13	-
		11.0	26.89	5.62	171	124	5.02	-
		12.5	26.78	5.65	172	126	3.51	-
90'	5.5	1.0	27.57	6.00	172	103	4.12	0.21
		3.0	27.15	5.93	171	119	4.00	0.09
		5.0	27.02	5.88	171	124	3.52	-
110'	3.0	1.0	27.66	6.01	171	100	3.20	0.09
		3.0	27.10	5.95	171	113	3.11	-

*Sample depths for water velocities are 1 ft greater than shown (e.g., for a sample depth shows as 1 ft, the water velocity was actually measured at 2 ft).

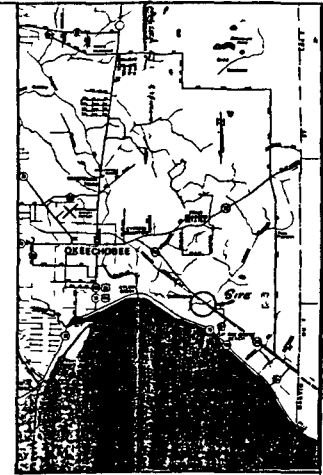
Source: ECT, 1990.

066 11-17-1990
RECEIVED
T. RES. MGR.

RECEIVED
FBI RES. MGT
OCT 24 1990

G-PGEB.1/BATHY.7
10/17/90

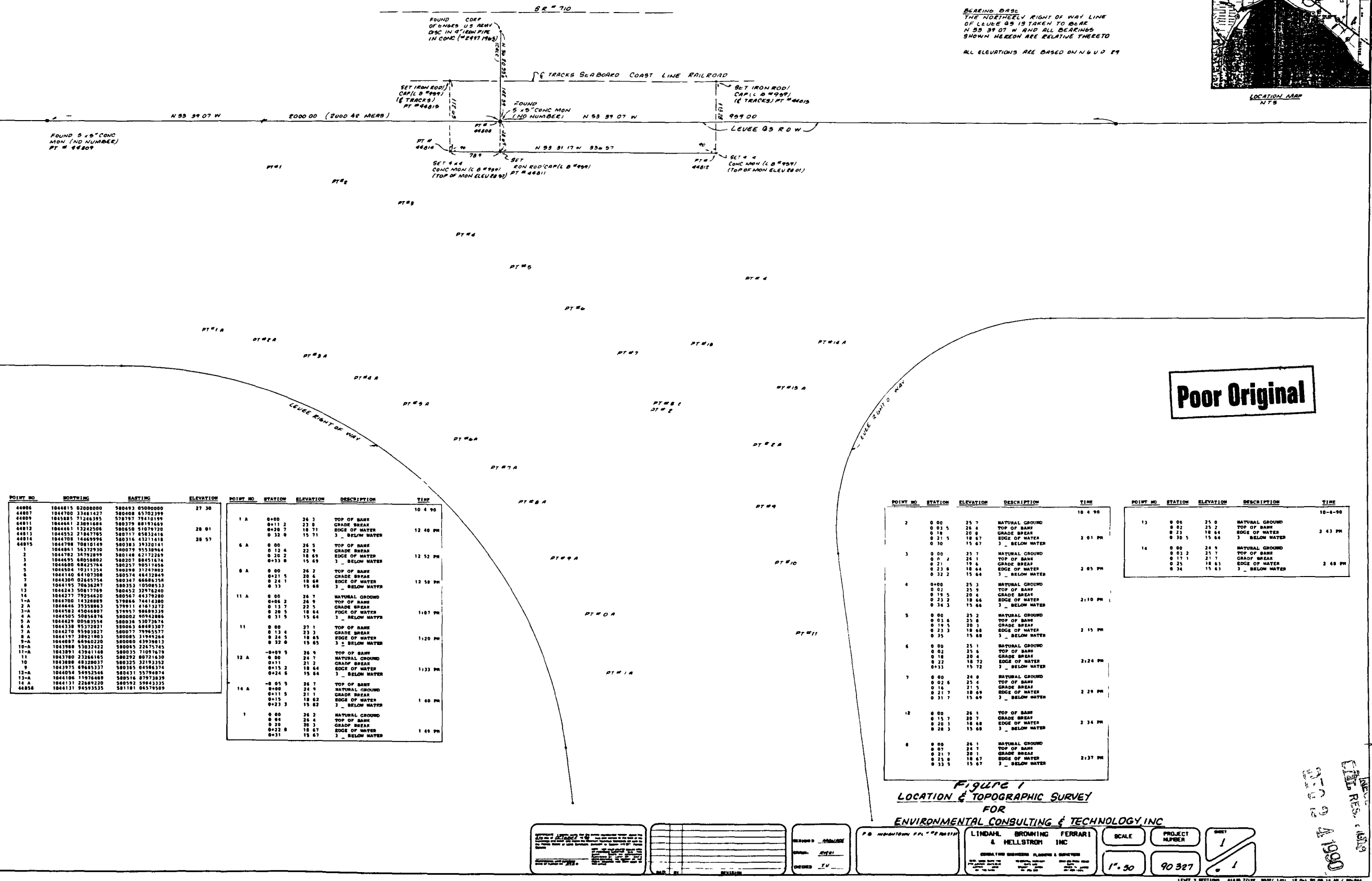
that the water velocities were much higher on the previous day when the water level dropped more than 1 ft in less than three hours.

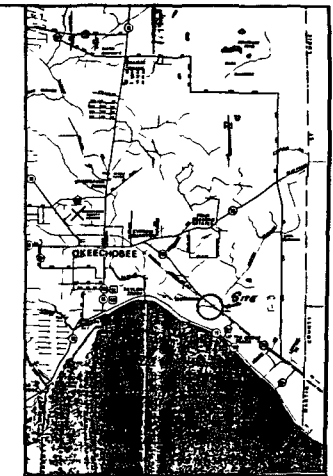


LOCATION MAP
NTS

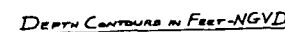
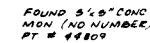
BEARING BASE
THE NORTHERLY RIGHT OF WAY LINE
OF LEUE 93 IS TAKEN TO BEAR
N 53 39 07 W AND ALL BEARINGS
SHOWN HEREON ARE RELATIVE THERETO

ALL ELEVATIONS ARE BASED ON N G U D 89





ALL ELEVATIONS ARE BASED ON N 6 U D 29



POINT NO.	STATION	ELEVATION	DESCRIPTION	TIME
				10-6-90
2	0+00	25.7	NATURAL GROUND	
	0+03.5	26.4	TOP OF BANK	
	0+10	20.8	GRADE BEAK	
	0+21.5	18.67	EDGE OF WATER	2:01 P
	0+36	15.67	3' BELOW WATER	
3	0+00	25.7	NATURAL GROUND	
	0+02.2	26.1	TOP OF BANK	
	0+21	19.6	GRADE BEAK	
	0+23.8	18.64	EDGE OF WATER	2:05 P
	0+32.2	15.64	3' BELOW WATER	
4	0+00	25.3	NATURAL GROUND	
	0+02	21.9	TOP OF BANK	
	0+19.5	20.4	GRADE BEAK	
	0+23.2	18.66	EDGE OF WATER	2:10 P
	0+34.3	15.66	3' BELOW WATER	
5	0+00	25.2	NATURAL GROUND	
	0+03.6	25.6	TOP OF BANK	
	0+18.5	20.3	GRADE BEAK	
	0+22.3	18.68	EDGE OF WATER	2:15 P
	0+35	15.68	3' BELOW WATER	
6	0+00	25.1	NATURAL GROUND	
	0+02	23.6	TOP OF BANK	
	0+16	20.4	GRADE BEAK	
	0+22	18.72	EDGE OF WATER	2:24 P
	0+33	15.72	3' BELOW WATER	
7	0+00	24.6	NATURAL GROUND	
	0+02.6	25.4	TOP OF BANK	
	0+16	21.5	GRADE BEAK	
	0+21.7	18.69	EDGE OF WATER	2:29 P
	0+31.7	15.69	3' BELOW WATER	
12	0+00	26.1	TOP OF BANK	
	0+15.7	20.7	GRADE BEAK	
	0+28.3	18.68	EDGE OF WATER	2:34 P
	0+28.3	15.68	3' BELOW WATER	
8	0+00	24.1	NATURAL GROUND	
	0+07	24.7	TOP OF BANK	
	0+22.7	20.1	GRADE BEAK	
	0+25.8	18.67	EDGE OF WATER	2:37 P
	0+33.5	15.67	3' BELOW WATER	

POINT NO.	STATION	ELEVATION	DESCRIPTION	TIME
13	0+00	25 0	NATURAL GROUND	10-4-91
	+002	35 2	TOP OF BANK	
	+012	18 4	EDGE OF WATER	2:43 PM
	+030 5	15 64	3' BELOW WATER	
14	0+06	24 9	NATURAL GROUND	
	+003 2	25 7	TOP OF BANK	
	0+17 1	21 1	GRADE ABOVE	
	+025	18 65	EDGE OF WATER	2:48 PM
	+034	15 63	3' BELOW WATER	

}

Poor Original

W. H. L. S. M. 1907

APPENDIX A--CHANNEL PROFILE DATABASE

RECEIVED
FBI RES. MGMT
DEC 24 1990

IMAGE QUALITY

**AS YOU REVIEW THE NEXT GROUP OF IMAGES, PLEASE NOTE
THAT THE ORIGINAL DOCUMENTS WERE OF POOR QUALITY.**

Transect: 1

Date: 03-Oct-89

Time: 10:30

Dist (ft)	Depth* (ft)	Staff (ft)	Depth- Staff (ft)	NGVD** Correction (ft)	Final Elevation (ft-NGVD)
0					26.2
4					26.4
20					20.3
23					18.7
24	2.1	1.52	0.58	17.78	17.2
31					15.7
40	8.4	1.52	6.88	17.78	10.9
60	11.6	1.52	10.08	17.78	7.7
80	13.7	1.52	12.18	17.78	5.6
100	15.0	1.52	13.48	17.78	4.3
120	16.0	1.52	14.48	17.78	3.3
140	16.7	1.52	15.18	17.78	2.6
160	16.0	1.52	14.48	17.78	3.3
180	16.1	1.52	14.58	17.78	3.2
200	14.7	1.52	13.18	17.78	4.6
220	9.3	1.52	7.78	17.78	10.0
235					15.7
240	3.0	1.52	1.48	17.78	16.3
247					18.7
254	0.0	1.52	-1.52	17.78	19.3
256					23.0
267					26.3

Transect: 2

Date: 03-Oct-89

Time: 11:30

0					25.7
4					26.4
18					20.8
20	0.0	1.58	-1.58	17.78	19.4
22					18.7
30					15.7
40	8.4	1.58	6.82	17.78	11.0
60	12.8	1.58	11.22	17.78	6.6
80	15.1	1.58	13.52	17.78	4.3
100	16.7	1.58	15.12	17.78	2.7
120	17.1	1.58	15.52	17.78	2.3
140	17.1	1.58	15.52	17.78	2.3
150	17.7	1.58	16.12	17.78	1.7
160	17.2	1.58	15.62	17.78	2.2
180	16.4	1.58	14.82	17.78	3.0
200	15.9	1.58	14.32	17.78	3.5
220	11.1	1.58	9.52	17.78	8.3
240	2.5	1.58	0.92	17.78	16.9
248	0.0	1.58	-1.58	17.78	19.4

* Rows without a depth value are provided from the land surveying.

**Bottom of water level staff was at elevation 17.78 ft NGVD.

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W.L. RES. MGMT
DEC 2 4 1989

Transect:

Date: 03-Oct-89

Time: 12:18

3
2
21
24
32
40
60
80
100
120
140
160
180
200
220
240
246

5.4
11.2
16.7
17.8
17.4
17.3
17.7
17.1
14.9
11.4
3.3
0.0

1.61
1.61
1.61
1.61
1.61
1.61
1.61
1.61
1.61
1.61
1.61
1.61

3.79
9.59
15.09
16.19
15.79
15.69
16.09
15.49
13.29
9.79
1.69
-1.61

17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78

25.7
26.1
19.6
18.6
15.6
14.0
8.2
2.7
1.6
2.0
2.1
1.7
2.3
4.5
8.0
16.1
19.4

Transect:

Date: 03-Oct-89

Time: 12:35

0
2
19
20
23
34
40
60
80
100
120
130
140
160
180
200
220
240
241

0.0
7.2
12.5
17.1
18.2
17.3
16.8
17.6
18.6
16.5
14.6
10.4
1.9
0.0

1.65
1.65
1.65
1.65
1.65
1.65
1.65
1.65
1.65
1.65
1.65
1.65
1.65
1.65

-1.65
5.55
10.85
15.45
16.55
15.65
15.15
15.95
16.95
14.85
12.95
8.75
0.25
-1.65

17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78
17.78

25.3
25.9
20.4
19.4
18.7
15.7
12.2
6.9
2.3
1.2
2.1
2.6
1.8
0.8
2.9
4.8
9.0
17.5
19.4

Transect:	5	Date:	03-Oct-89	Time:	12:42
0					25.2
4					25.8
19					20.3
23					18.7
35					15.7
40	6.2	1.65	4.55	17.78	13.2
60	10.7	1.65	9.05	17.78	8.7
80	16.2	1.65	14.55	17.78	3.2
100	18.5	1.65	16.85	17.78	0.9
120	18.2	1.65	16.55	17.78	1.2
140	17.2	1.65	15.55	17.78	2.2
160	18.9	1.65	17.25	17.78	0.5
180	16.9	1.65	15.25	17.78	2.5
200	13.7	1.65	12.05	17.78	5.7
220	7.9	1.65	6.25	17.78	11.5
240	1.8	1.65	0.15	17.78	17.6
242	0.0	1.65	-1.65	17.78	19.4

Transect:	6	Date:	03-Oct-89	Time:	12:50
0					25.1
2					25.6
18					20.4
20	0.0	1.66	-1.66	17.78	19.4
22					18.7
33					15.7
40	6.3	1.66	4.64	17.78	13.1
60	14.3	1.66	12.64	17.78	5.1
80	18.0	1.66	16.34	17.78	1.4
100	18.7	1.66	17.04	17.78	0.7
120	17.7	1.66	16.04	17.78	1.7
140	17.7	1.66	16.04	17.78	1.7
150	18.3	1.66	16.64	17.78	1.1
160	17.7	1.66	16.04	17.78	1.7
180	14.7	1.66	13.04	17.78	4.7
200	11.5	1.66	9.84	17.78	7.9
220	8.1	1.66	6.44	17.78	11.3
237					15.7
240	2.6	1.66	0.94	17.78	16.8
250					18.7
258					22.9
270					26.5

REC'D
2 OCT 1989
12:50

Transect:

Date: 03-Oct-89

Time: 14:10

0 24.8
 3 25.4
 16 21.5
 20 0.0 1.29 -1.29 17.78 19.1
 22 18.7
 32 15.7
 40 8.5 1.29 7.21 17.78 10.6
 60 14.5 1.29 13.21 17.78 4.6
 80 17.9 1.29 16.61 17.78 1.2
 100 18.2 1.29 16.91 17.78 0.9
 120 17.8 1.29 16.51 17.78 1.3
 140 17.9 1.29 16.61 17.78 1.2
 160 17.9 1.29 16.61 17.78 1.2
 180 15.2 1.29 13.91 17.78 3.9
 200 12.4 1.29 11.11 17.78 6.7
 220 8.7 1.29 7.41 17.78 10.4
 240 2.8 1.29 1.51 17.78 16.3
 245 0.0 1.29 -1.29 17.78 19.1

Transect: 8

Date: 03-Oct-89

Time: 14:45

0 26.1
 7 24.7
 22 20.1
 26 18.7
 34 15.7
 40 9.5 1.08 8.42 17.78 9.4
 60 13.6 1.08 12.52 17.78 5.3
 80 18.0 1.08 16.92 17.78 0.9
 100 18.0 1.08 16.92 17.78 0.9
 120 17.6 1.08 16.52 17.78 1.3
 140 17.2 1.08 16.12 17.78 1.7
 160 16.0 1.08 14.92 17.78 2.9
 180 14.1 1.08 13.02 17.78 4.8
 200 11.6 1.08 10.52 17.78 7.3
 220 7.8 1.08 6.72 17.78 11.1
 235 15.7
 244 18.7
 246 20.6
 268 26.2

Transect:	9	Date:	03-Oct-89	Time:	14:57
18	0.0	0.88	-0.88	17.78	18.7
20	1.0	0.88	0.12	17.78	17.7
40	8.7	0.88	7.82	17.78	10.0
60	11.8	0.88	10.92	17.78	6.9
80	16.5	0.88	15.62	17.78	2.2
100	18.2	0.88	17.32	17.78	0.5
120	18.2	0.88	17.32	17.78	0.5
140	18.5	0.88	17.62	17.78	0.2
160	18.5	0.88	17.62	17.78	0.2
180	18.3	0.88	17.42	17.78	0.4
200	17.0	0.88	16.12	17.78	1.7
220	14.5	0.88	13.62	17.78	4.2
240	11.0	0.88	10.12	17.78	7.7
260	5.2	0.88	4.32	17.78	13.5
280	0.0	0.88	-0.88	17.78	18.7

Transect:	10	Date:	03-Oct-89	Time:	15:17
56	0.0	0.71	-0.71	17.78	18.5
60	4.4	0.71	3.69	17.78	14.1
80	12.2	0.71	11.49	17.78	6.3
100	14.9	0.71	14.19	17.78	3.6
120	18.0	0.71	17.29	17.78	0.5
140	18.7	0.71	17.99	17.78	-0.2
160	17.3	0.71	16.59	17.78	1.2
180	18.0	0.71	17.29	17.78	0.5
200	19.2	0.71	18.49	17.78	-0.7
220	17.6	0.71	16.89	17.78	0.9
240	13.7	0.71	12.99	17.78	4.8
260	7.9	0.71	7.19	17.78	10.6
270	3.7	0.71	2.99	17.78	14.8
275	0.0	0.71	-0.71	17.78	18.5

RES. MCH
DEC 24 1990

Transect:	11	Date:	03-Oct-89	Time:	15:32
	0				27.1
	13				23.3
	24				18.7
	32				15.7
	40	5.9	0.56	5.34	17.78
	60	11.7	0.56	11.14	17.78
	80	15.9	0.56	15.34	17.78
	100	17.5	0.56	16.94	17.78
	120	17.8	0.56	17.24	17.78
	140	17.4	0.56	16.84	17.78
	160	18.1	0.56	17.54	17.78
	180	18.2	0.56	17.64	17.78
	200	16.6	0.56	16.04	17.78
	220	12.2	0.56	11.64	17.78
	240	4.7	0.56	4.14	17.78
	249				13.6
	260	1.2	0.56	0.64	17.78
	266	0.0	0.56	-0.56	17.78
	274				18.3
	280				26.9
					26.7

Transect:	12	Date:	03-Oct-89	Time:	17:20
	0				26.1
	16				20.7
	20				18.7
	28				15.7
	40	5.8	0.46	5.34	17.78
	60	9.2	0.46	8.74	17.78
	80	14.1	0.46	13.64	17.78
	90	15.3	0.46	14.84	17.78
	100	13.3	0.46	12.84	17.78
	120	7.5	0.46	7.04	17.78
	137				10.7
	146				15.6
	161				18.6
					24.7

Transect:	13	Date:	03-Oct-89	Time:	17:33
	0				25.0
	2				25.2
	23				18.6
	30				15.6
	40	7.1	0.55	6.55	17.78
	60	12.0	0.55	11.45	17.78
	80	14.0	0.55	13.45	17.78
	100	11.2	0.55	10.65	17.78
	120	3.8	0.55	3.25	17.78
	127	0.0	0.55	-0.55	17.78

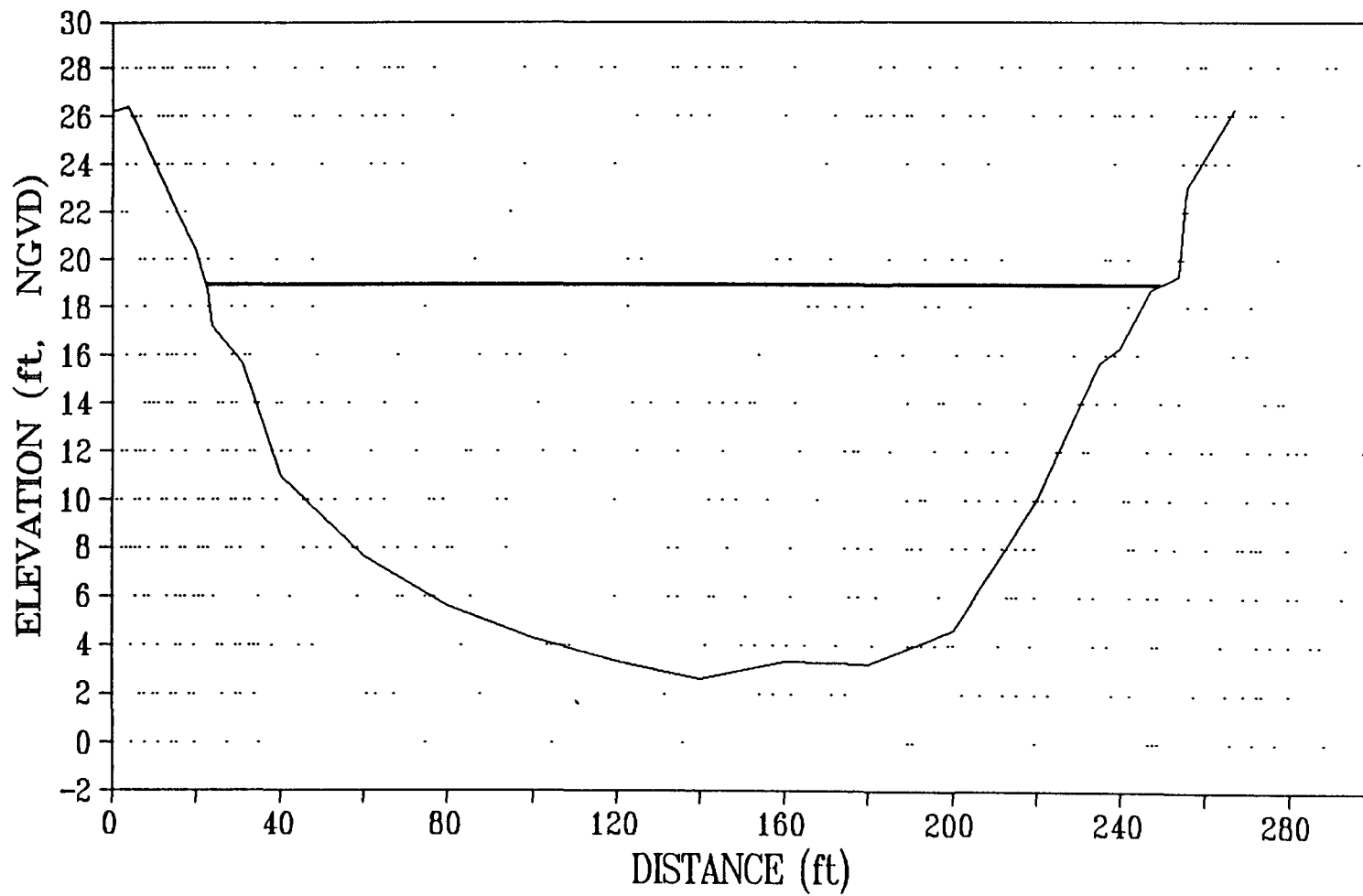
Transect:	14	Date:	03-Oct-89	Time:	17:50
	0				24.9
	3				25.7
	17				21.7
	25				18.6
	34				15.6
	40	5.9	0.45	5.45	17.78
	60	11.2	0.45	10.75	17.78
	80	14.2	0.45	13.75	17.78
	100	10.0	0.45	9.55	17.78
	120	4.7	0.45	4.25	17.78
	125				13.5
	134				15.6
	137				18.6
	149				21.1
					24.9

APPENDIX B--CHANNEL PROFILES

EX-105-100
SEP 3 1990

REC'D
LET. RES. MGT
DEC 2 1960

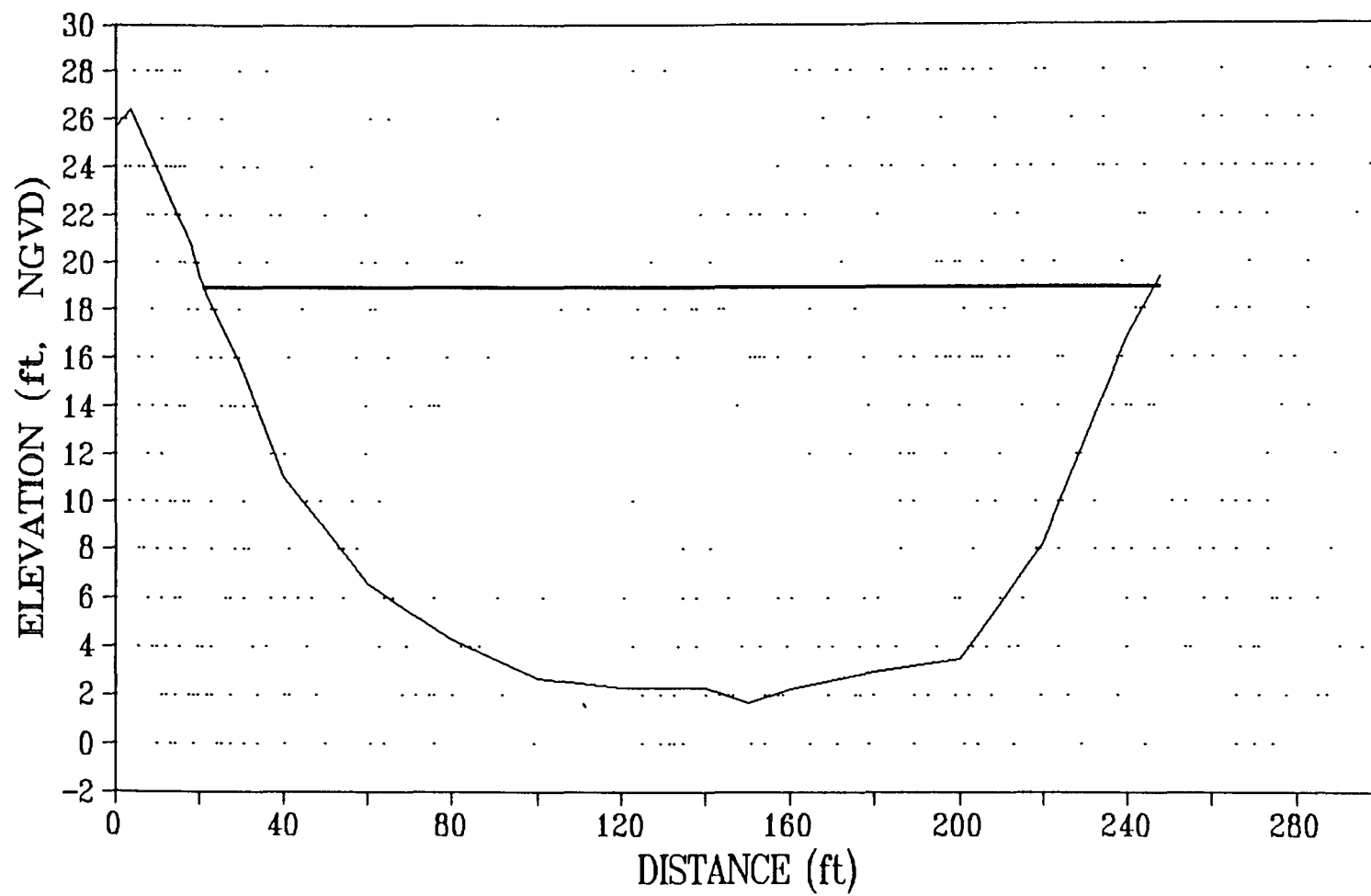
TRANSECT NO. 1
L63-N



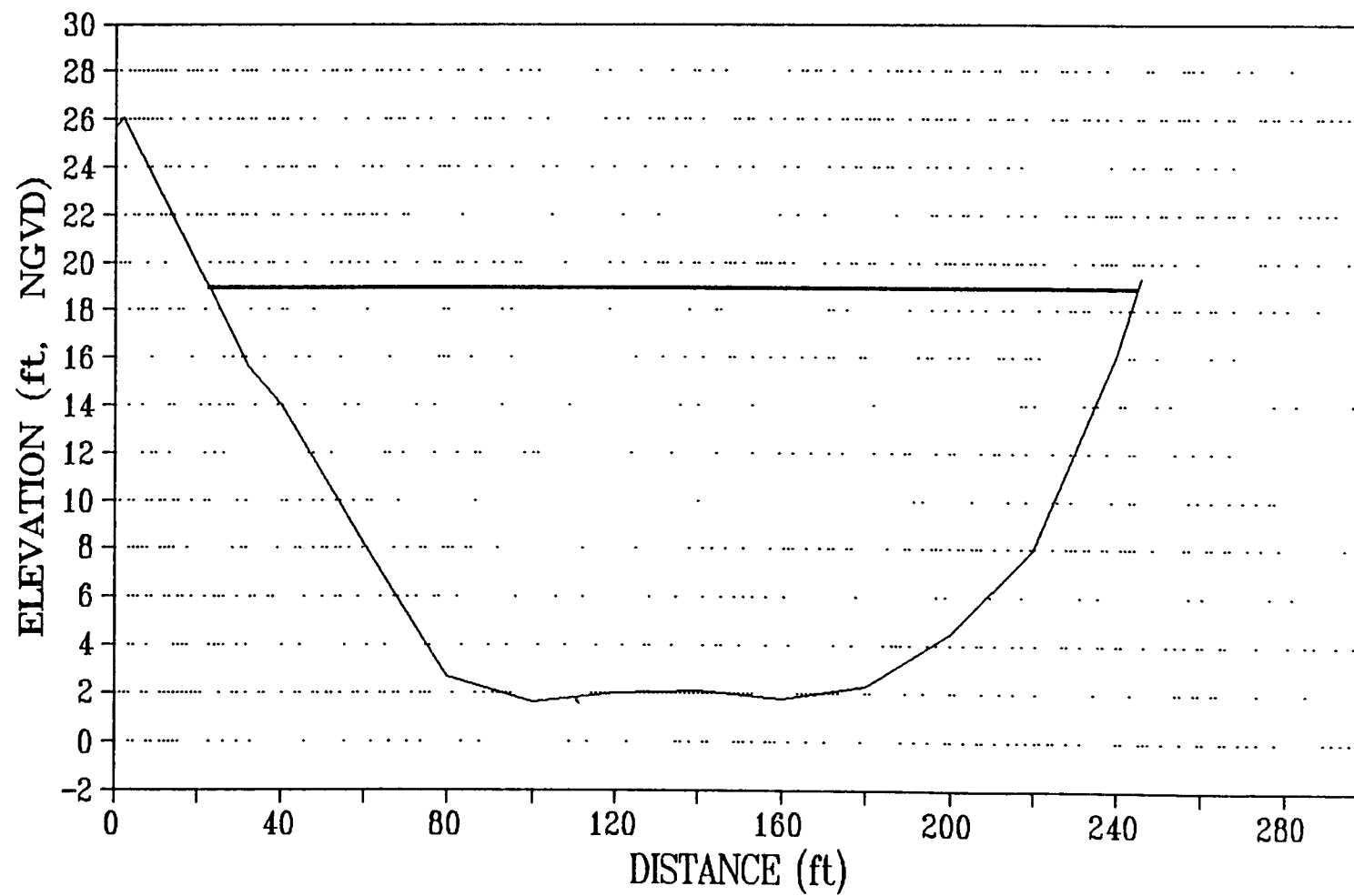
00001 8 110
RES. MGR
17-1037

TRANSECT NO. 2
L63-N

DEC 2 4 1990



TRANSECT NO. 3
L63-N



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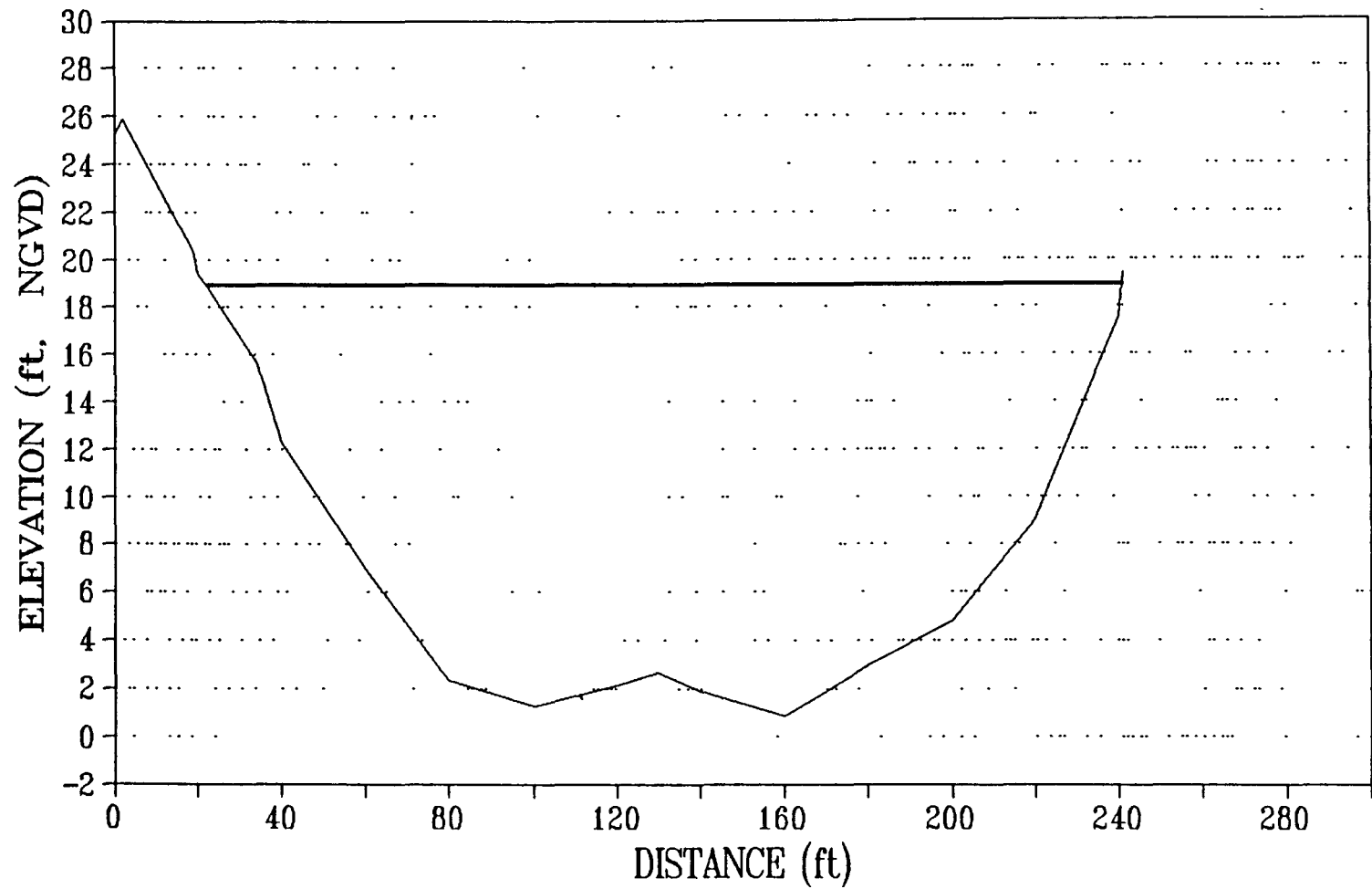
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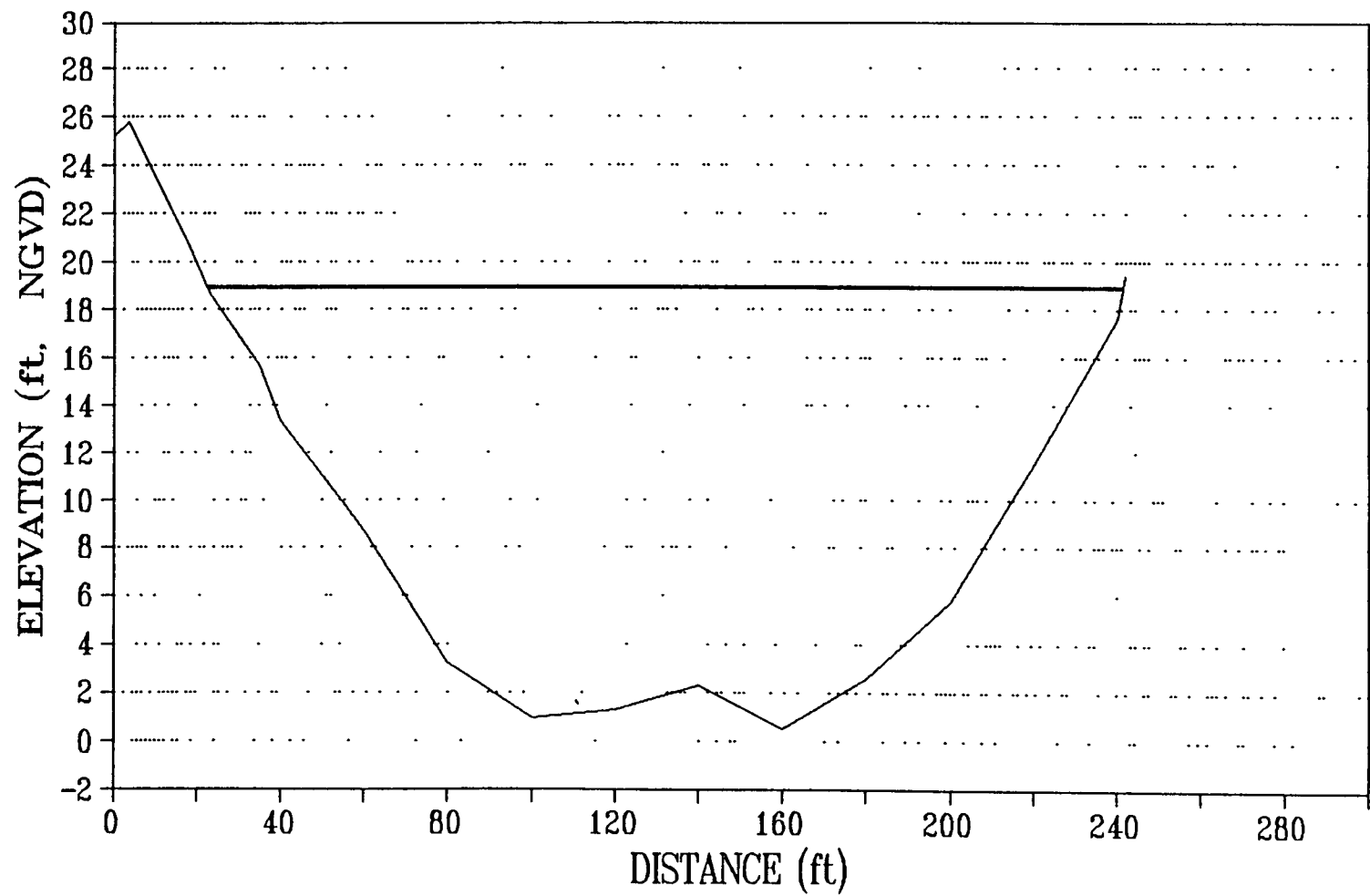
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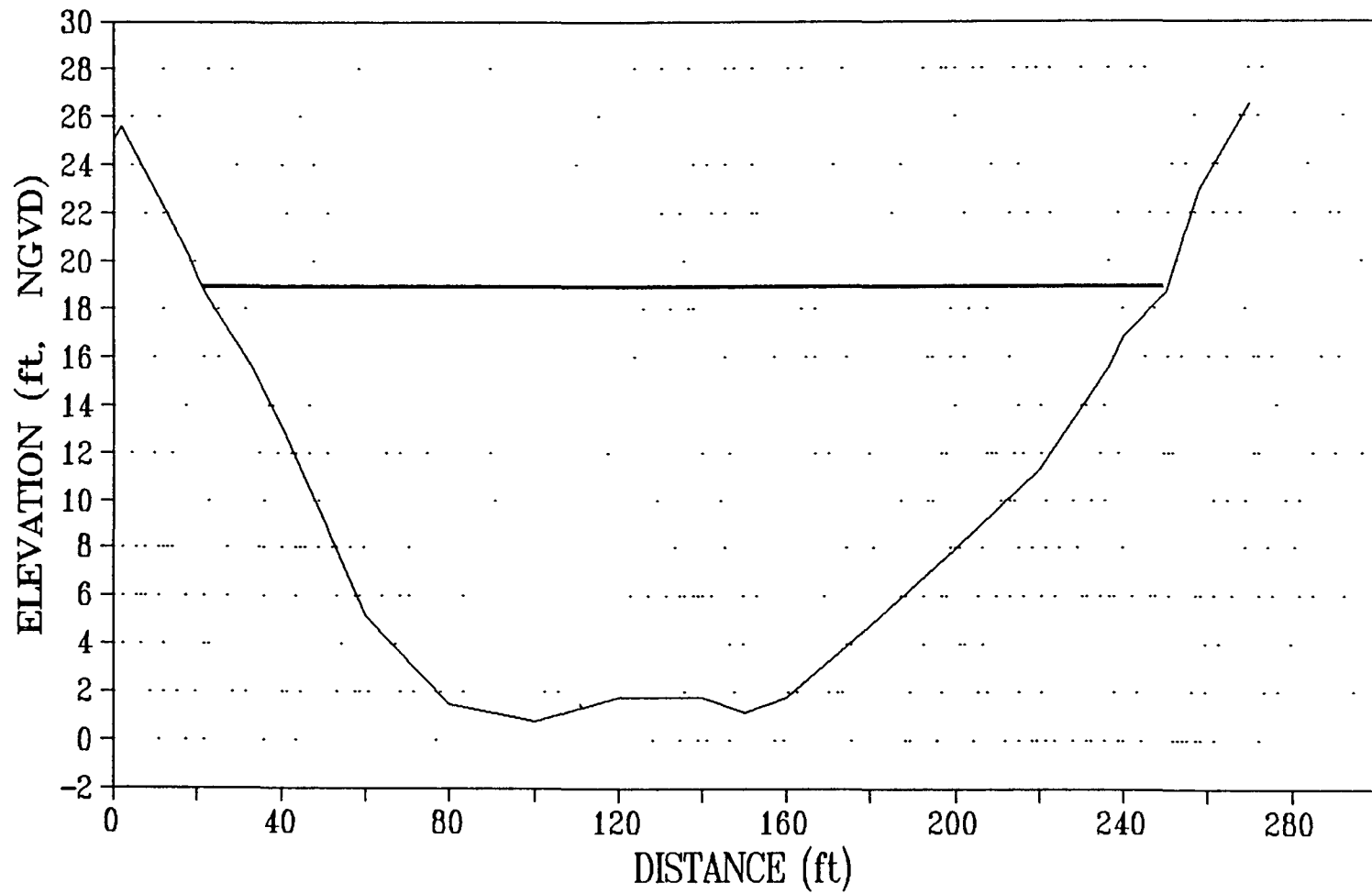


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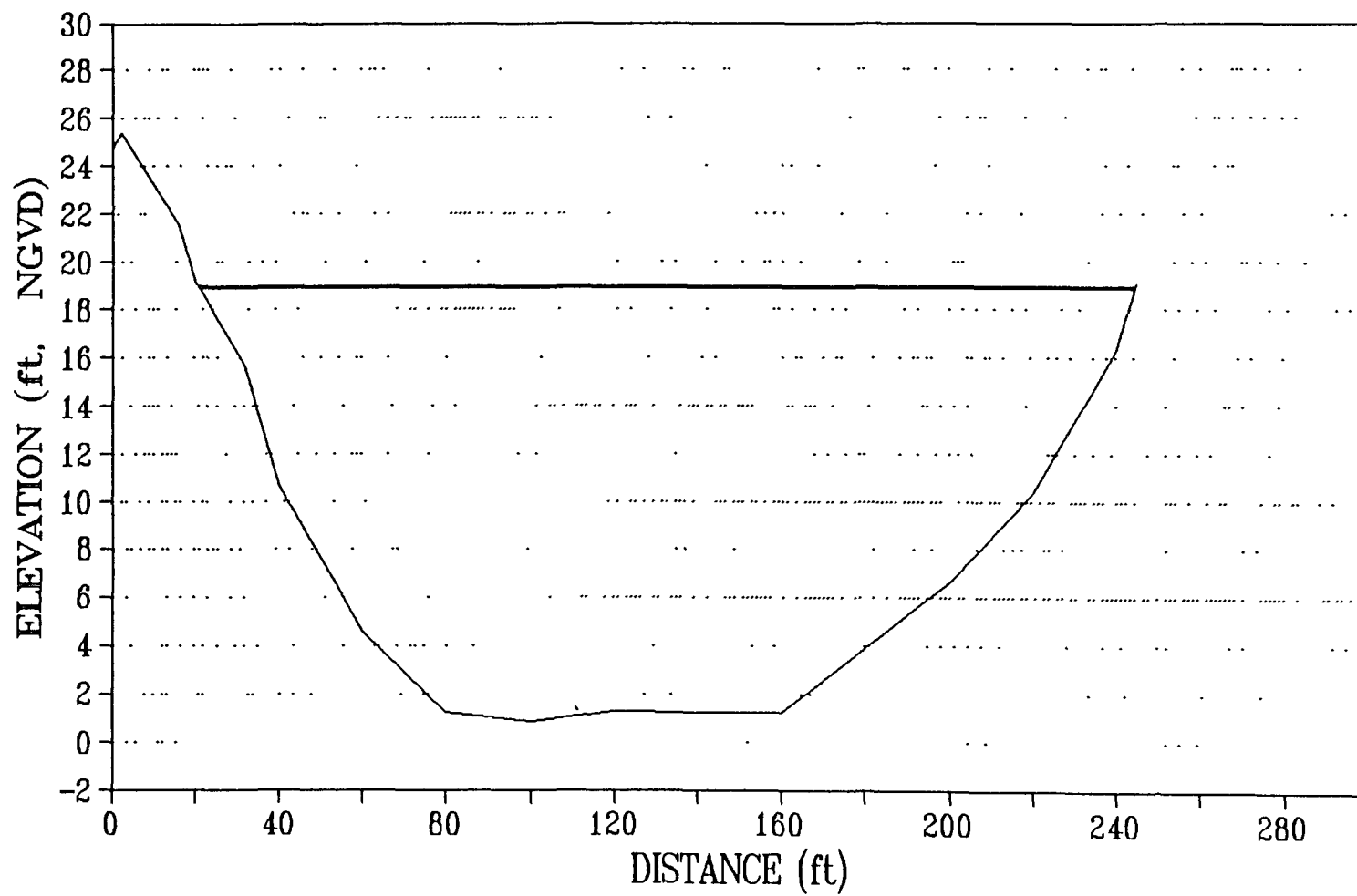
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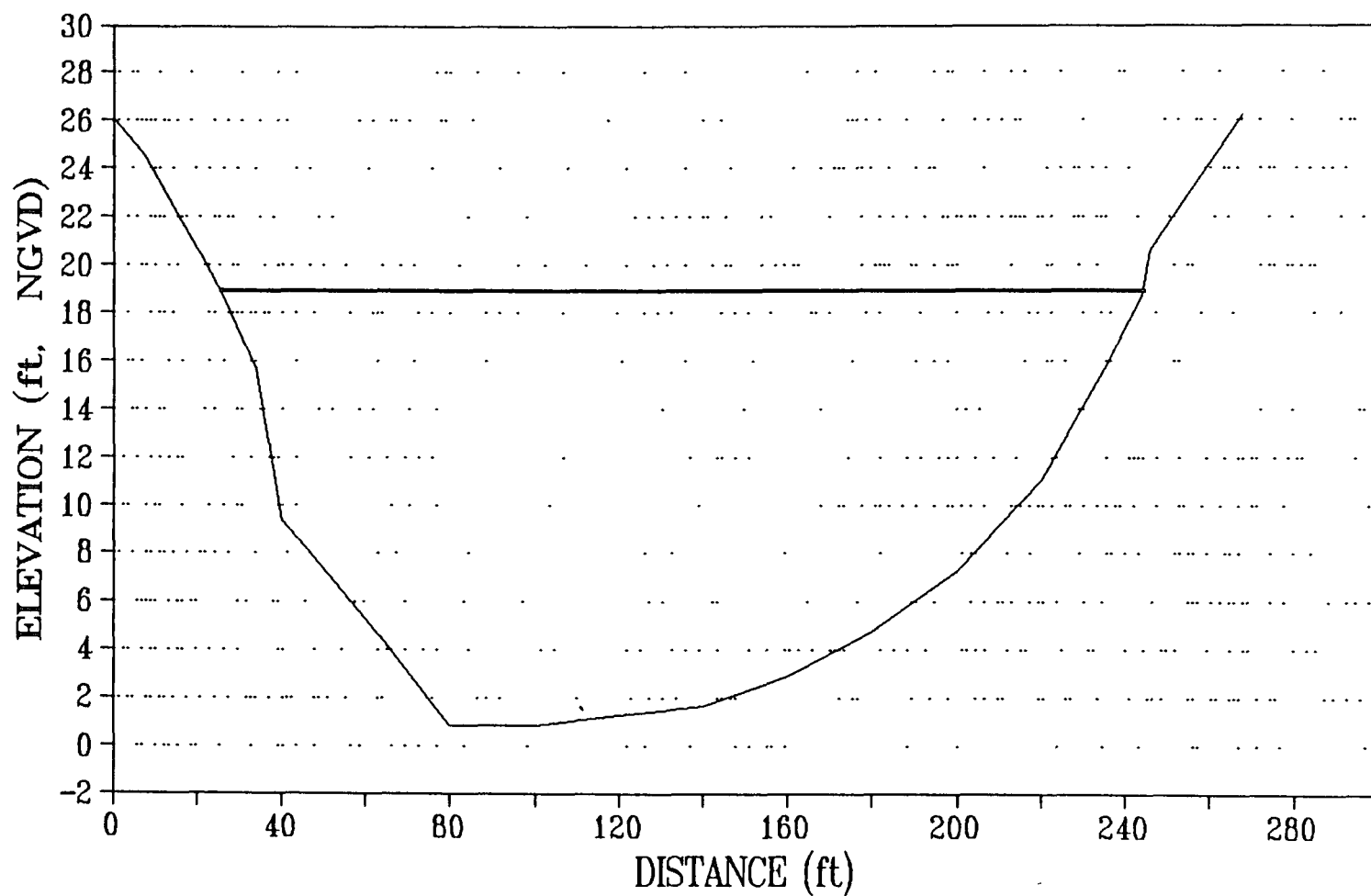
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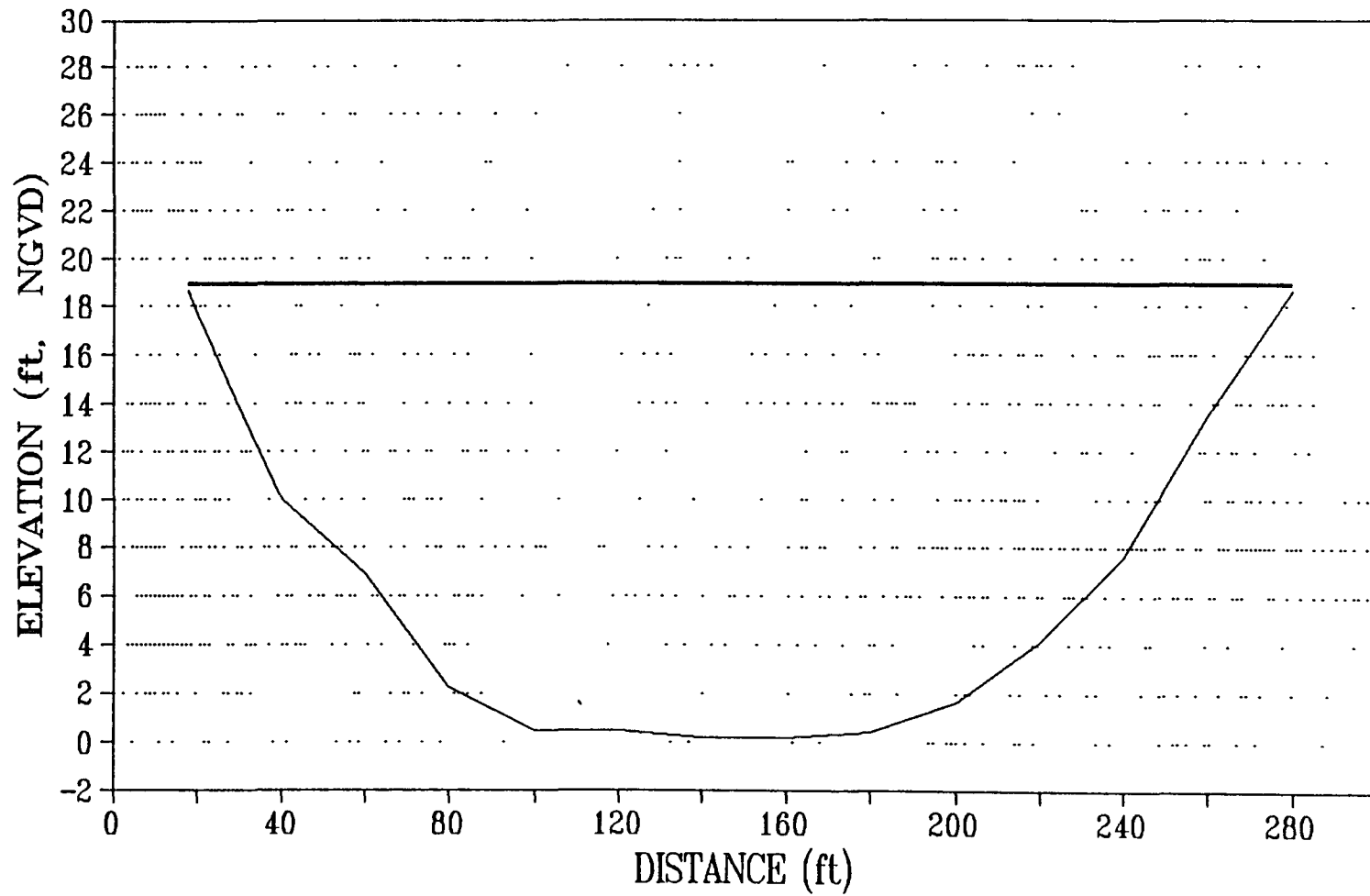
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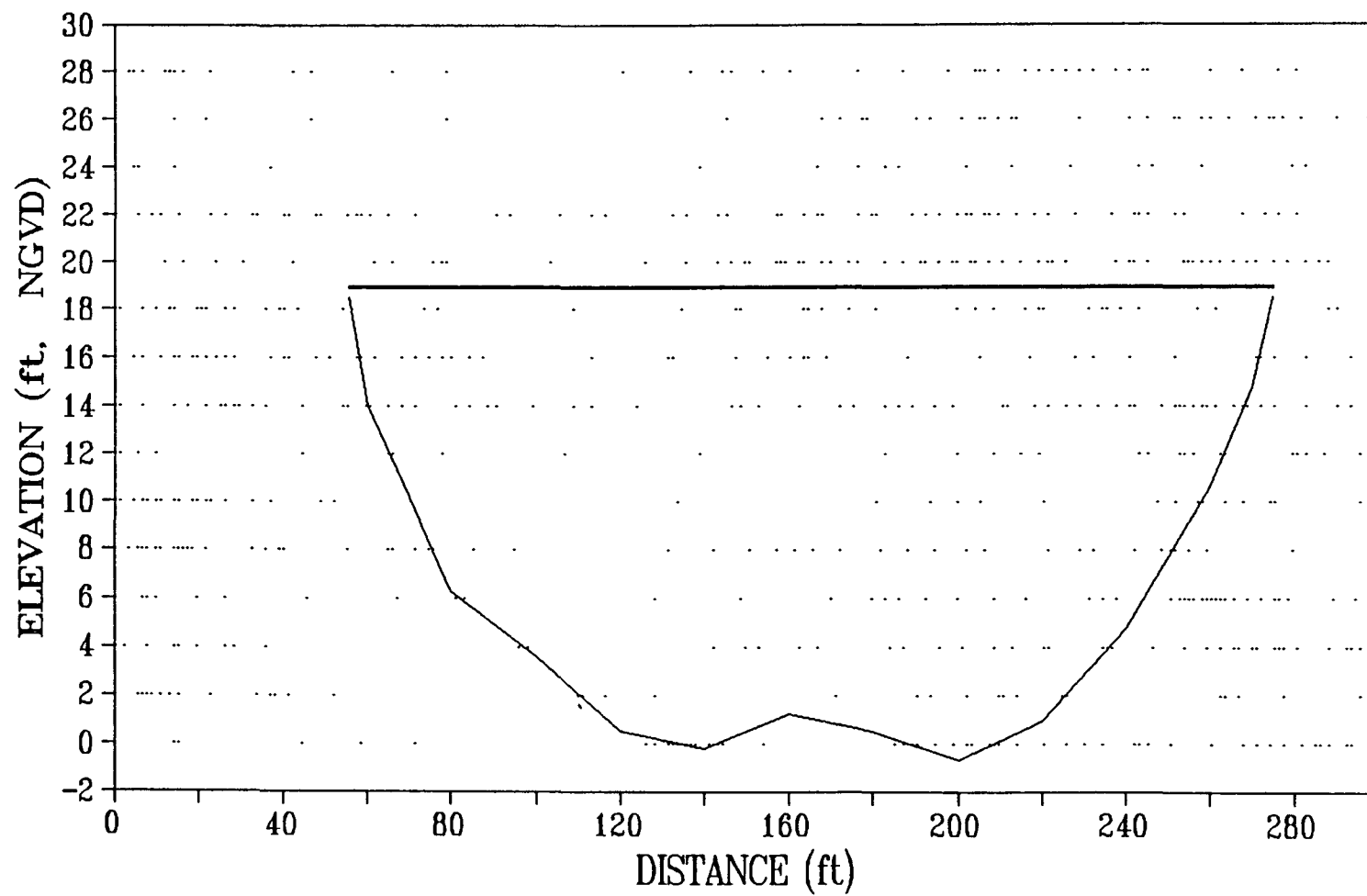
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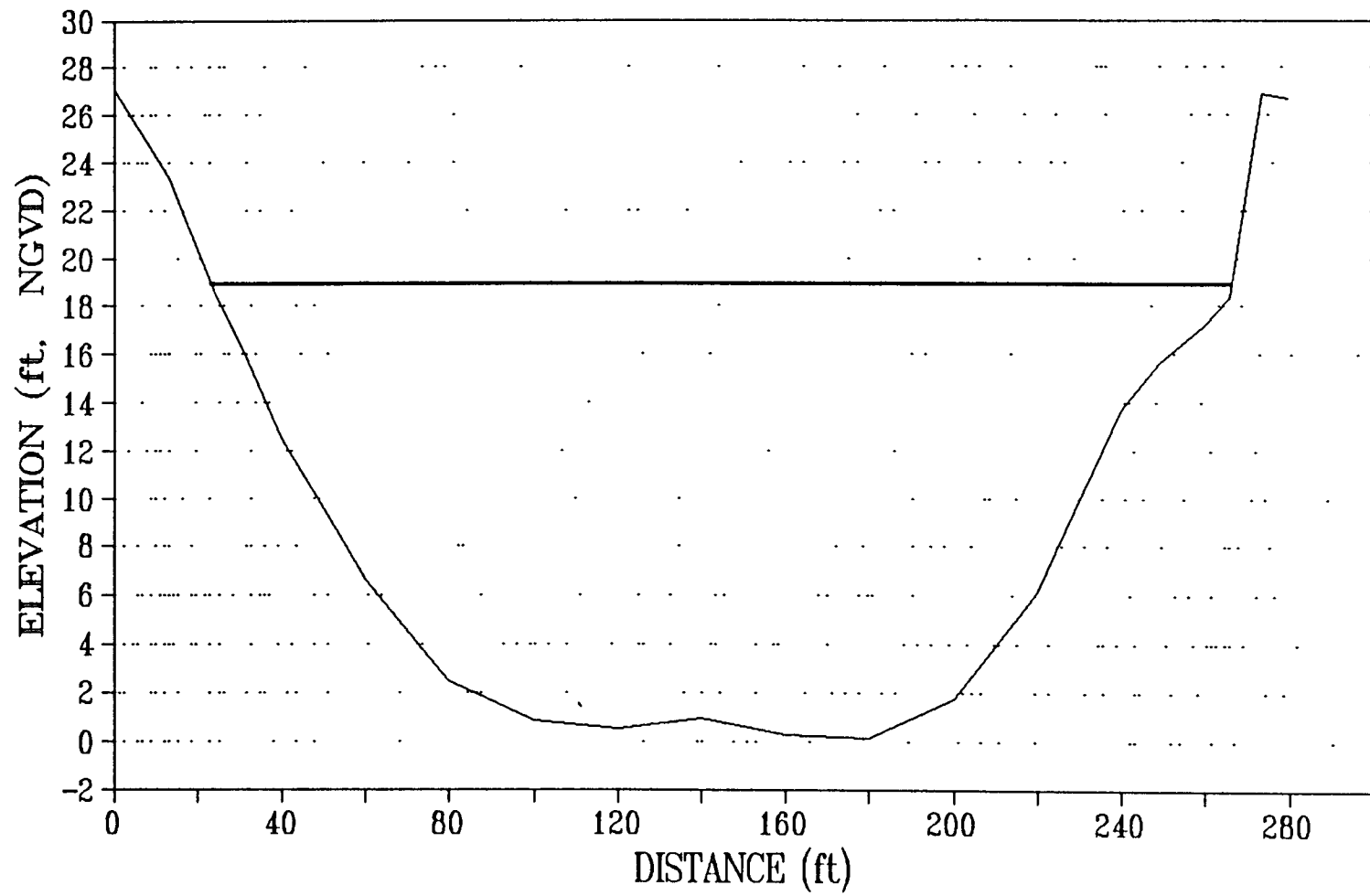
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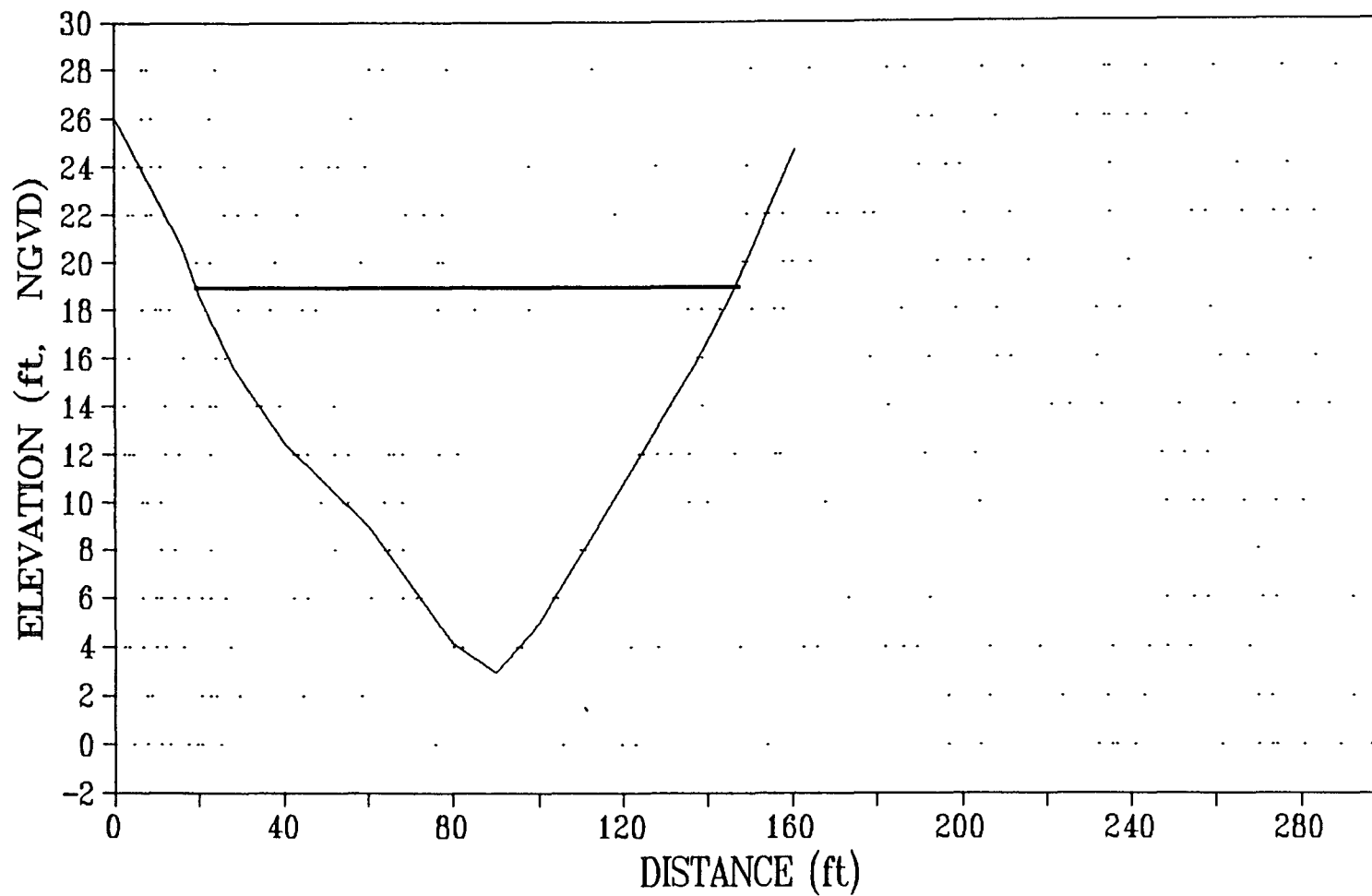


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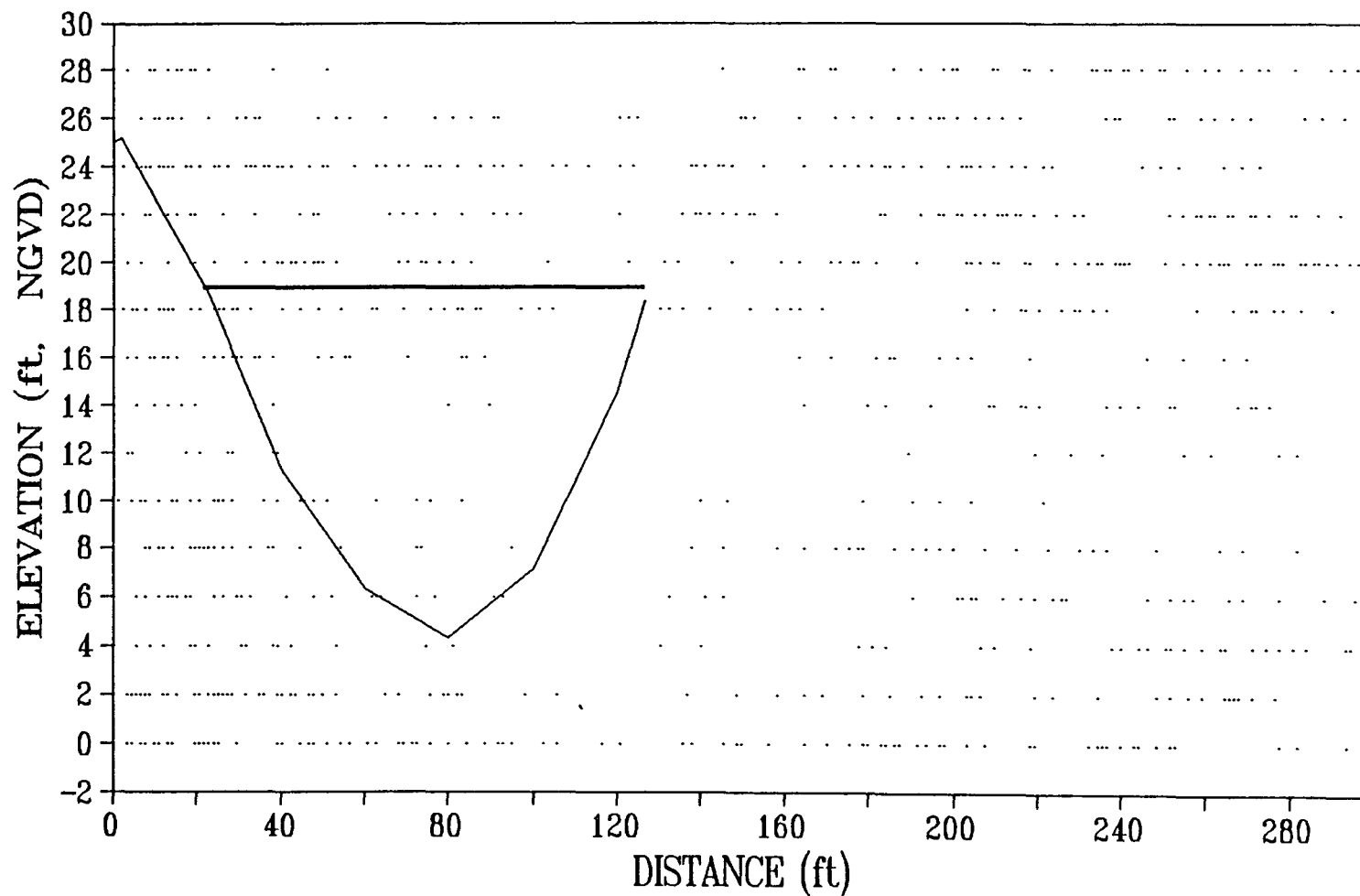
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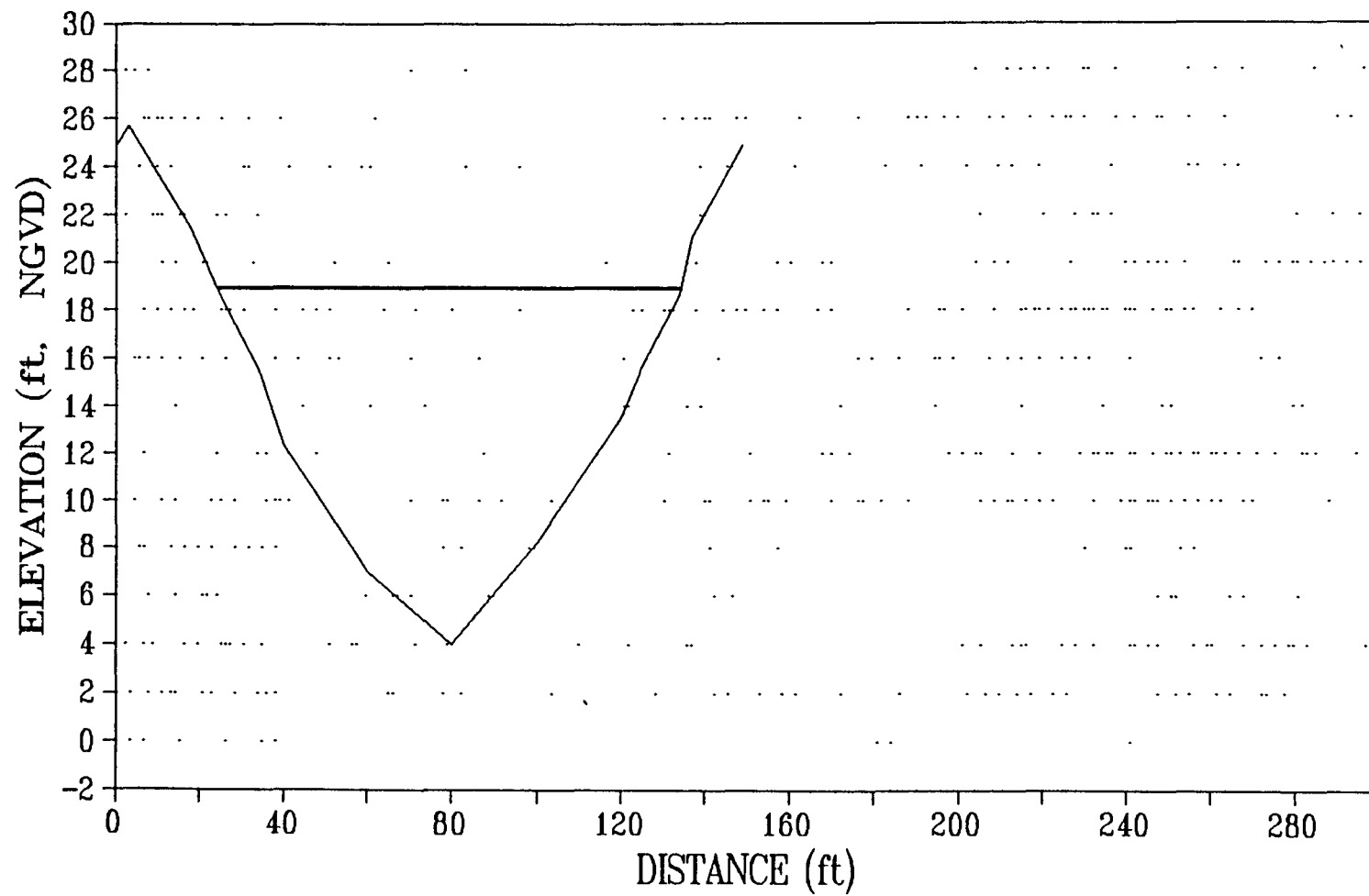


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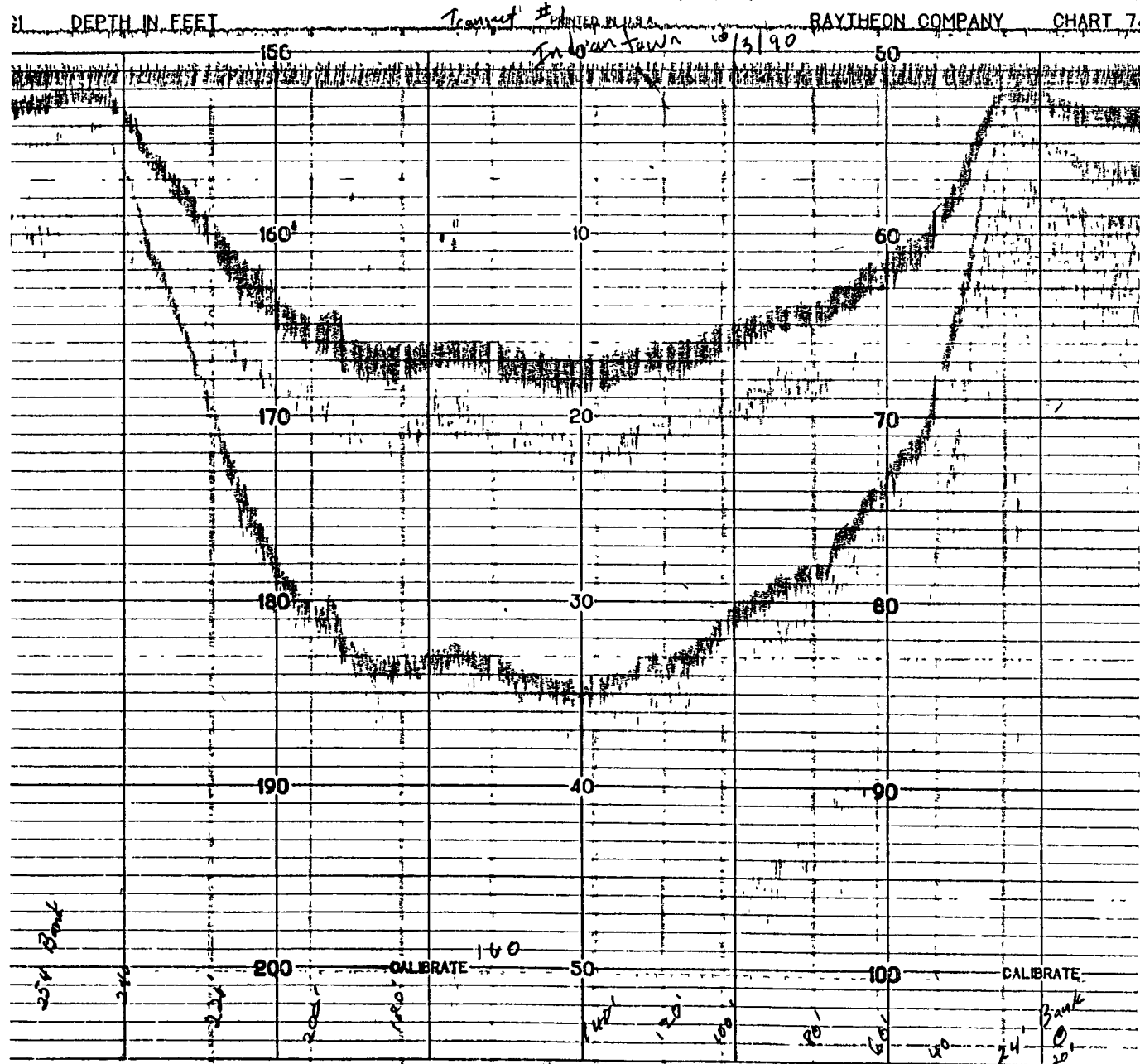
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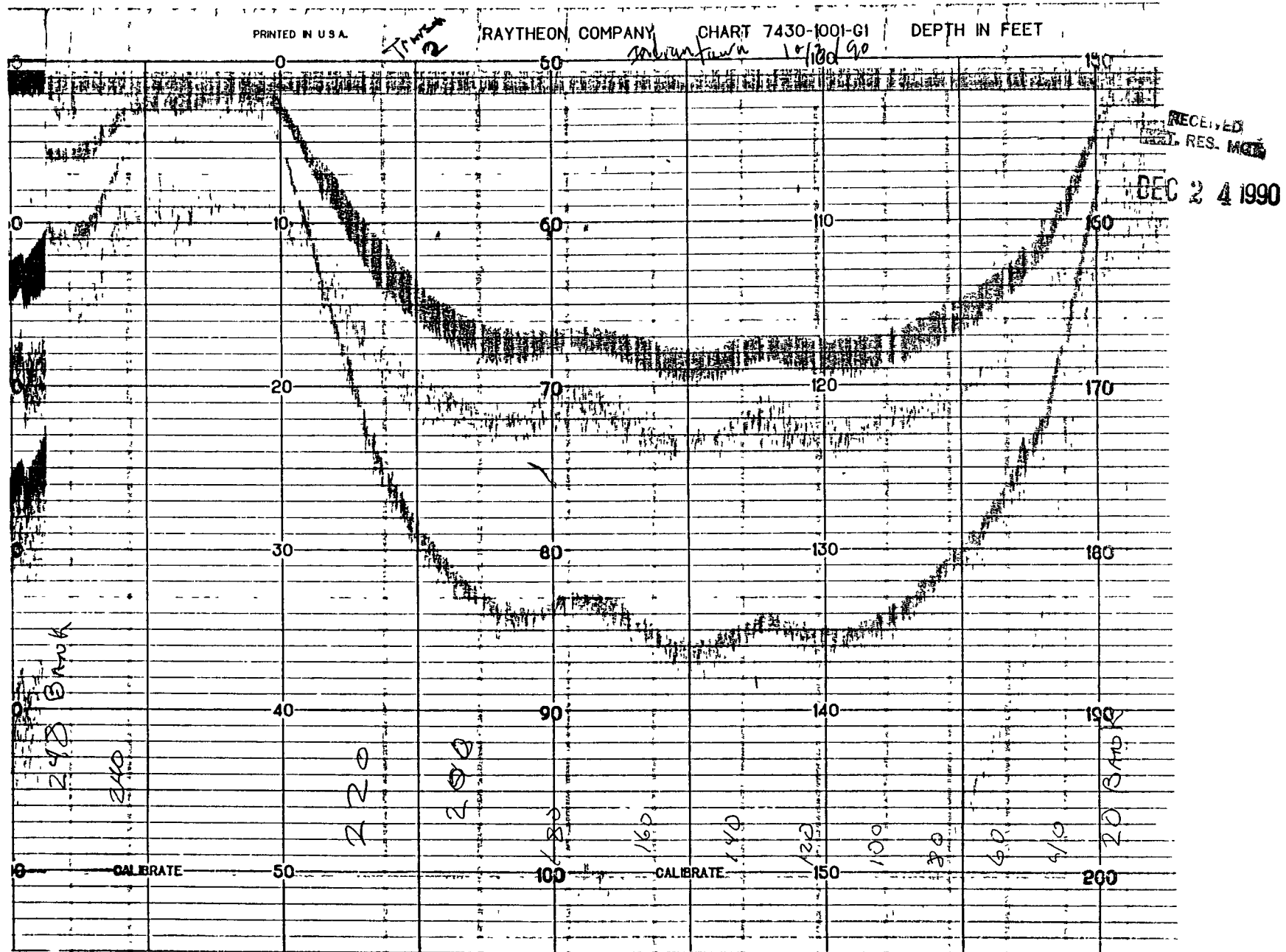
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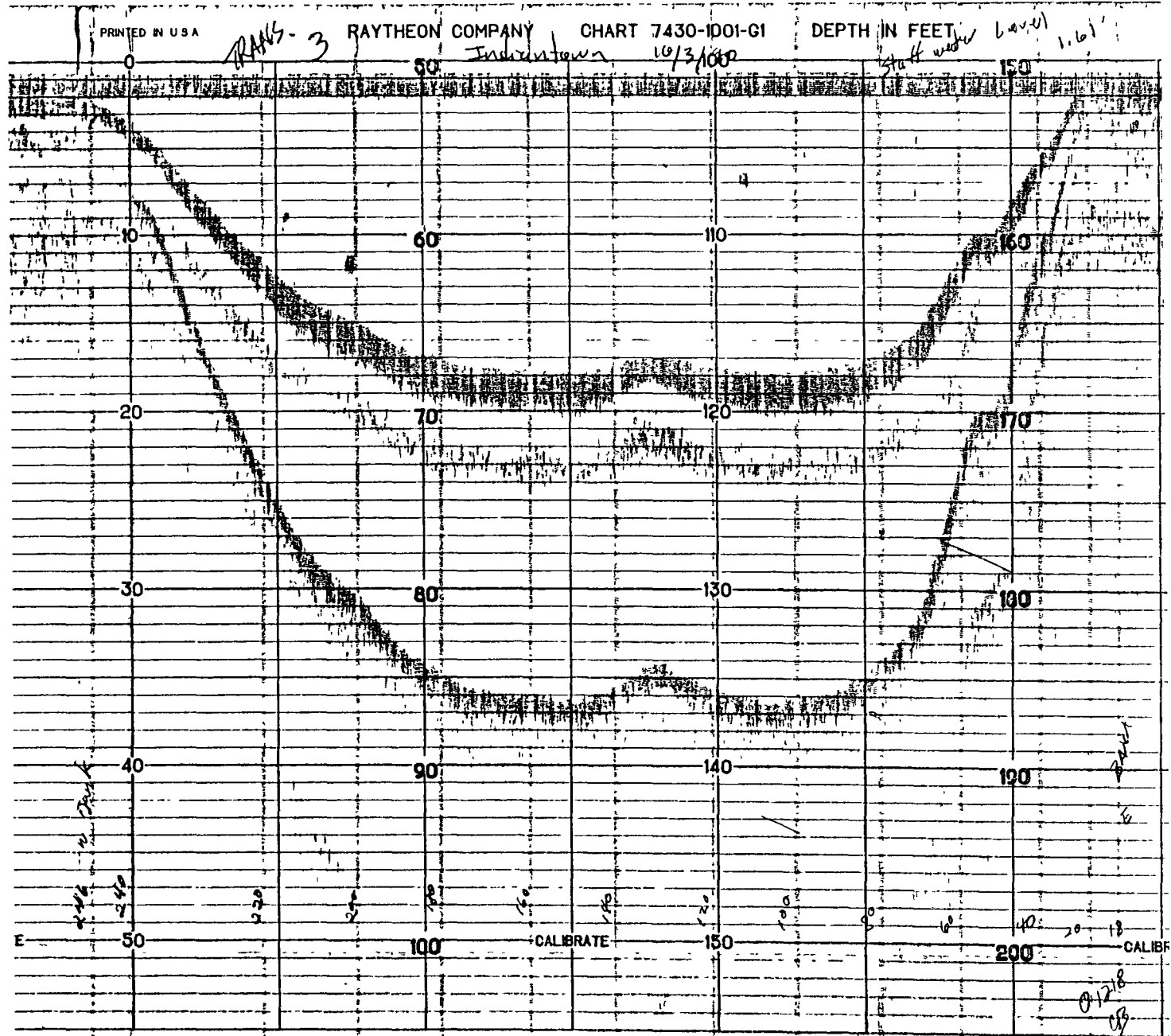


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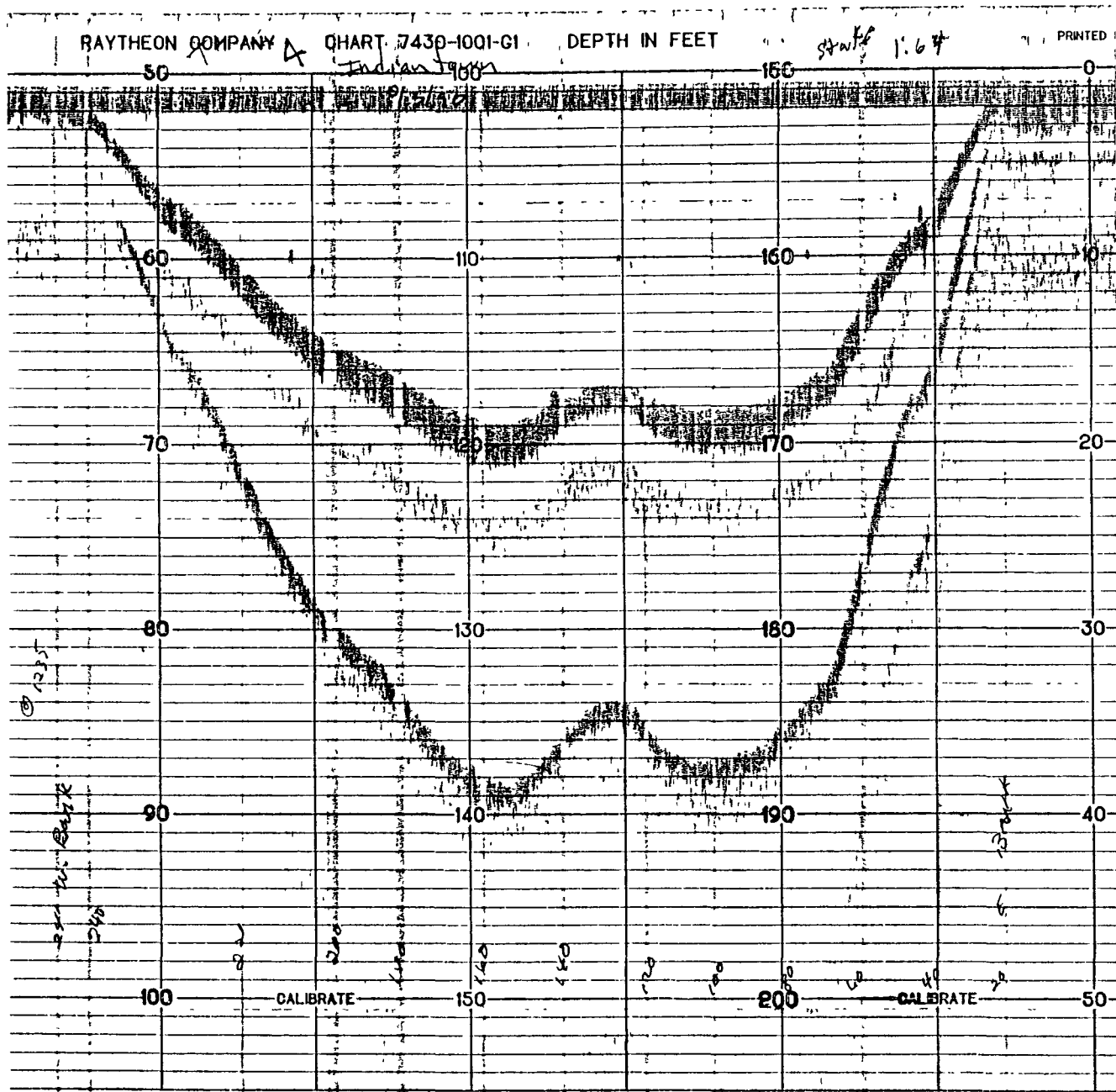


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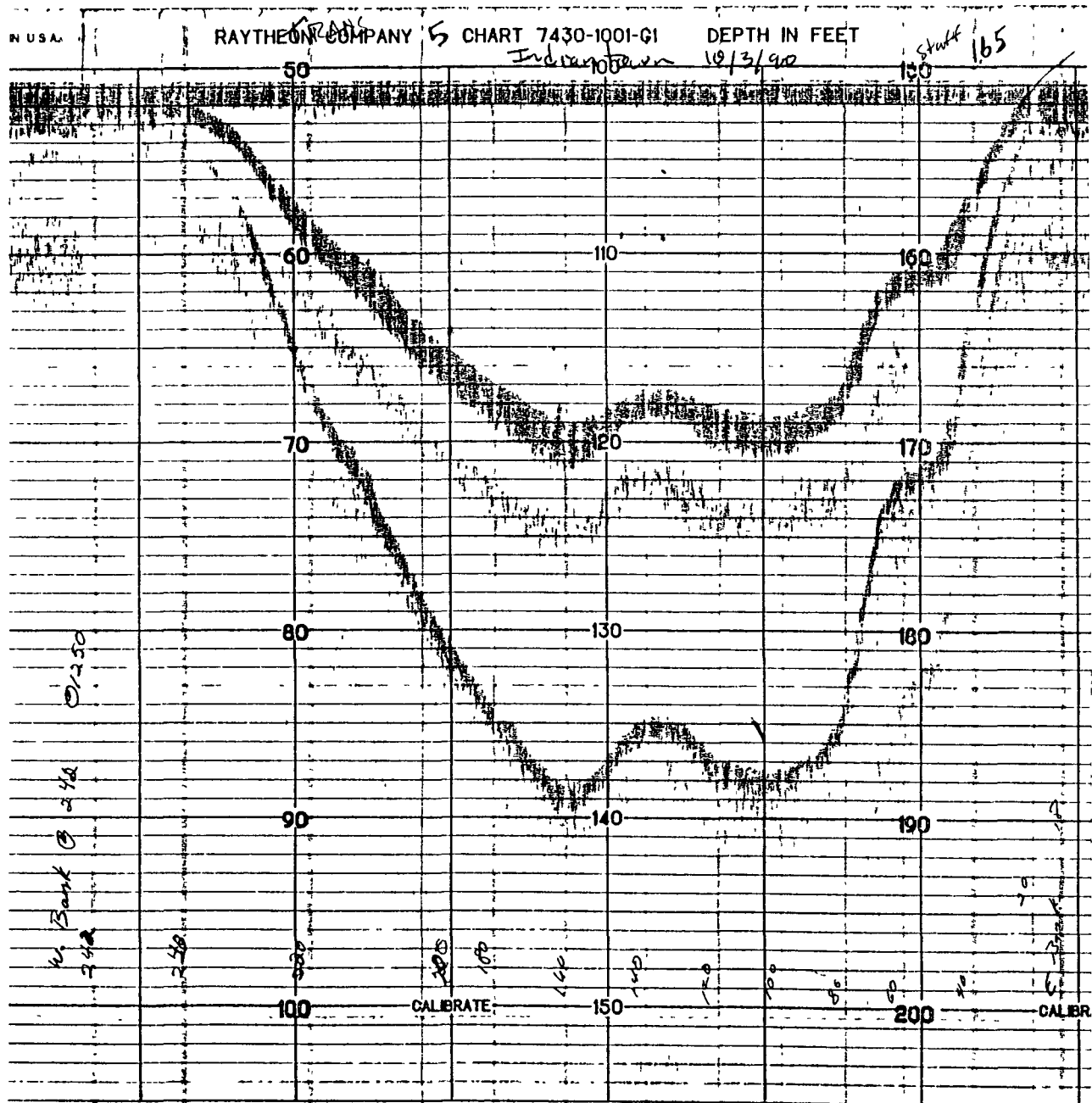
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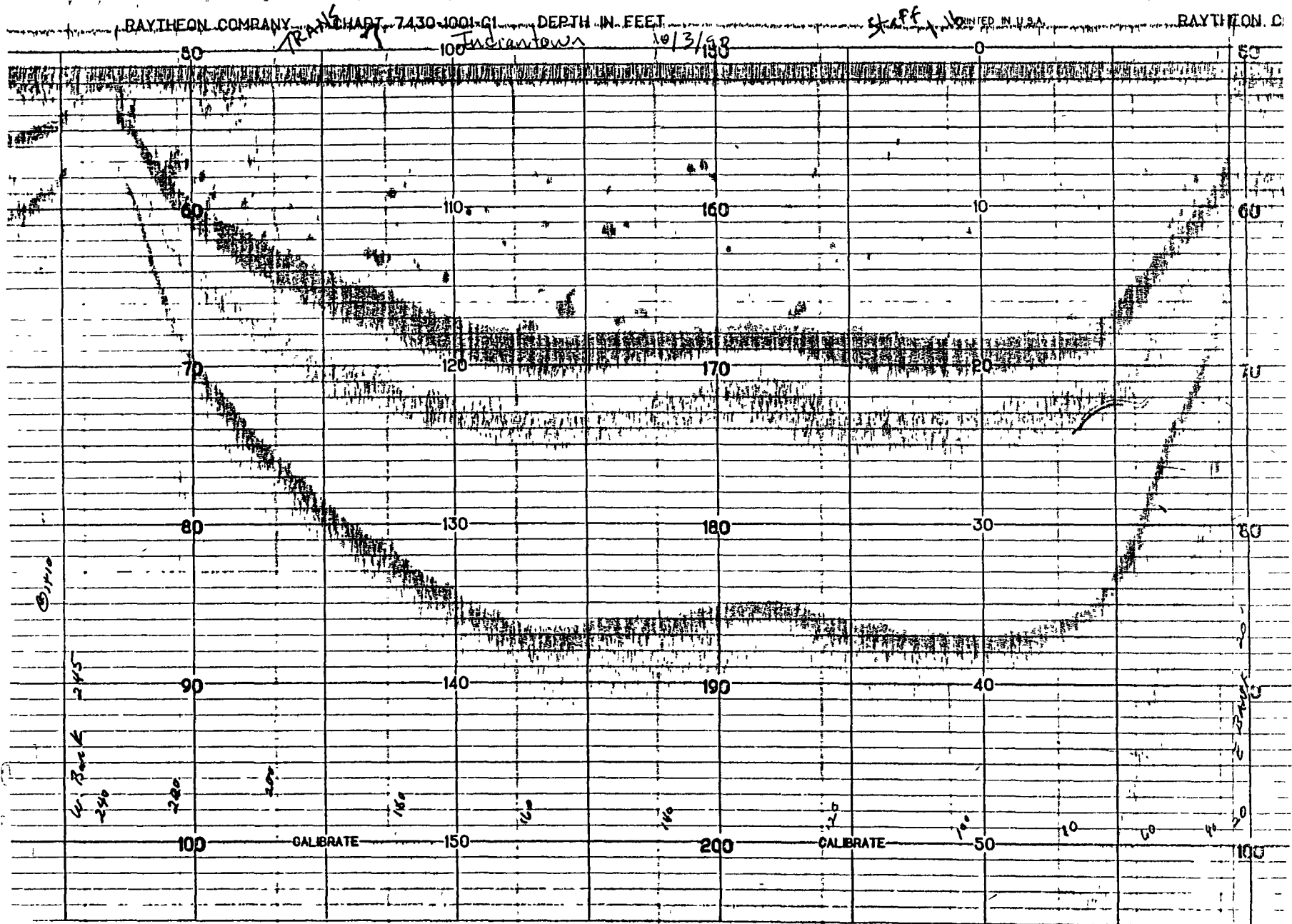
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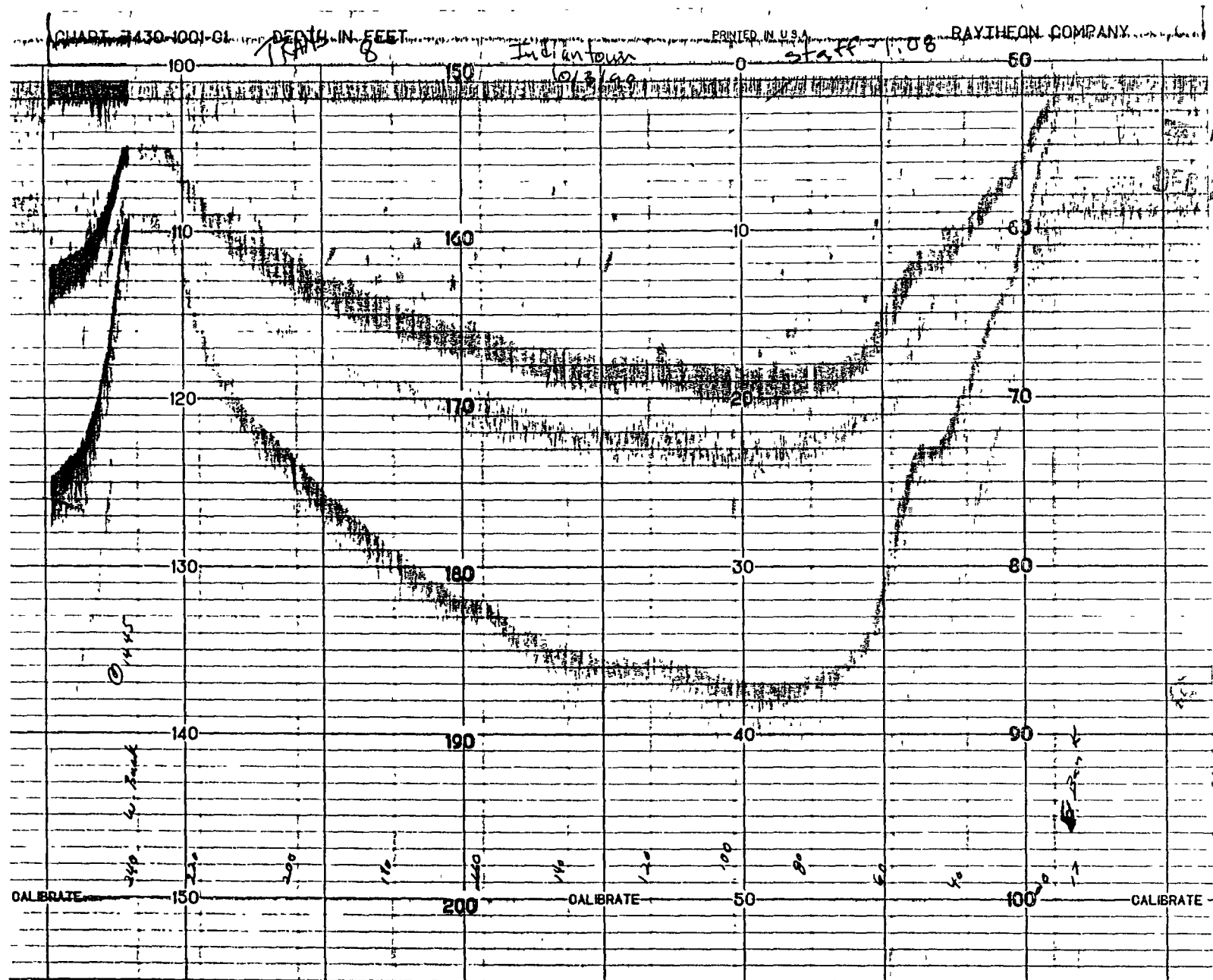


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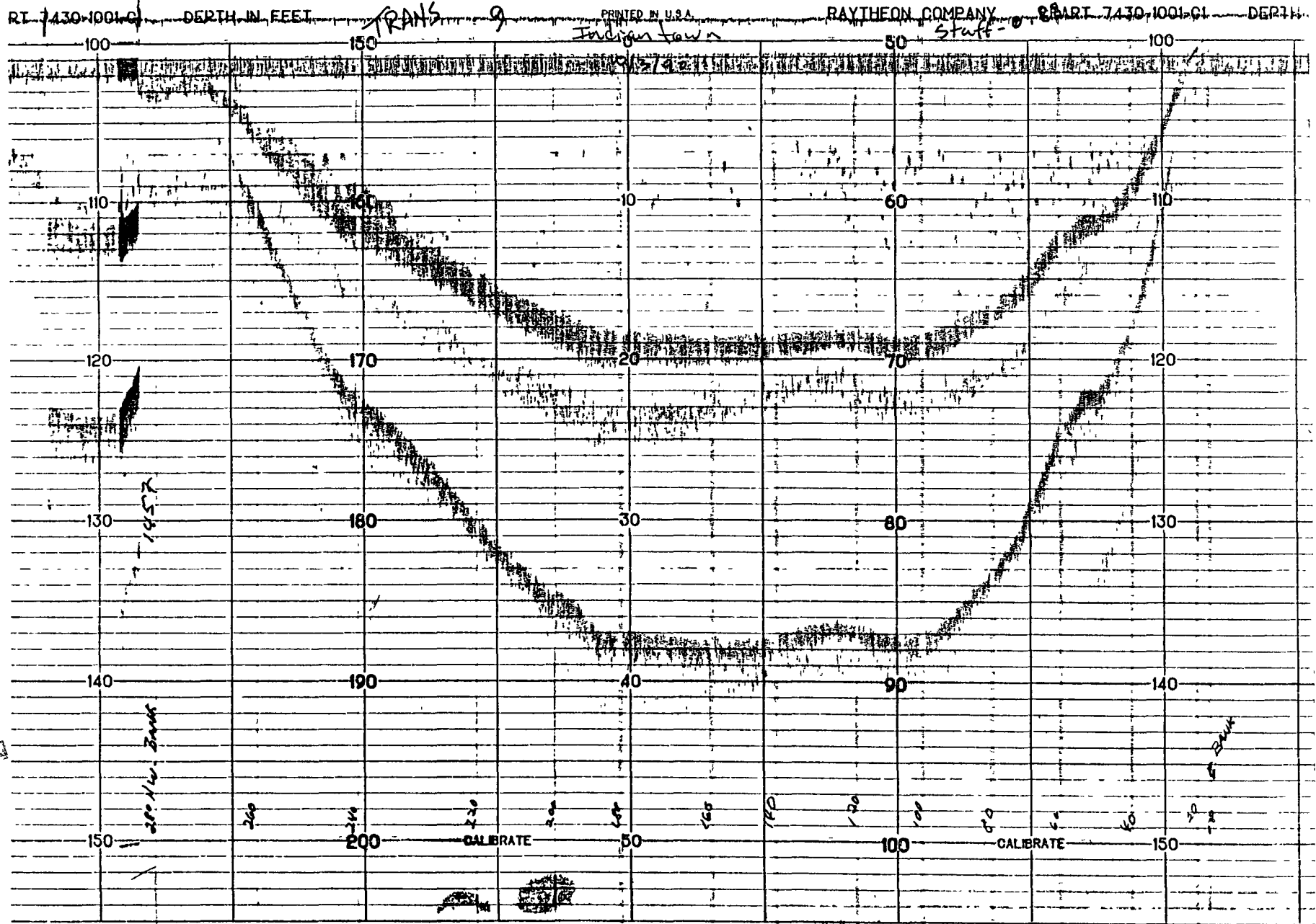
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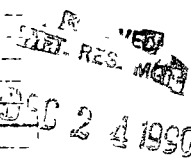


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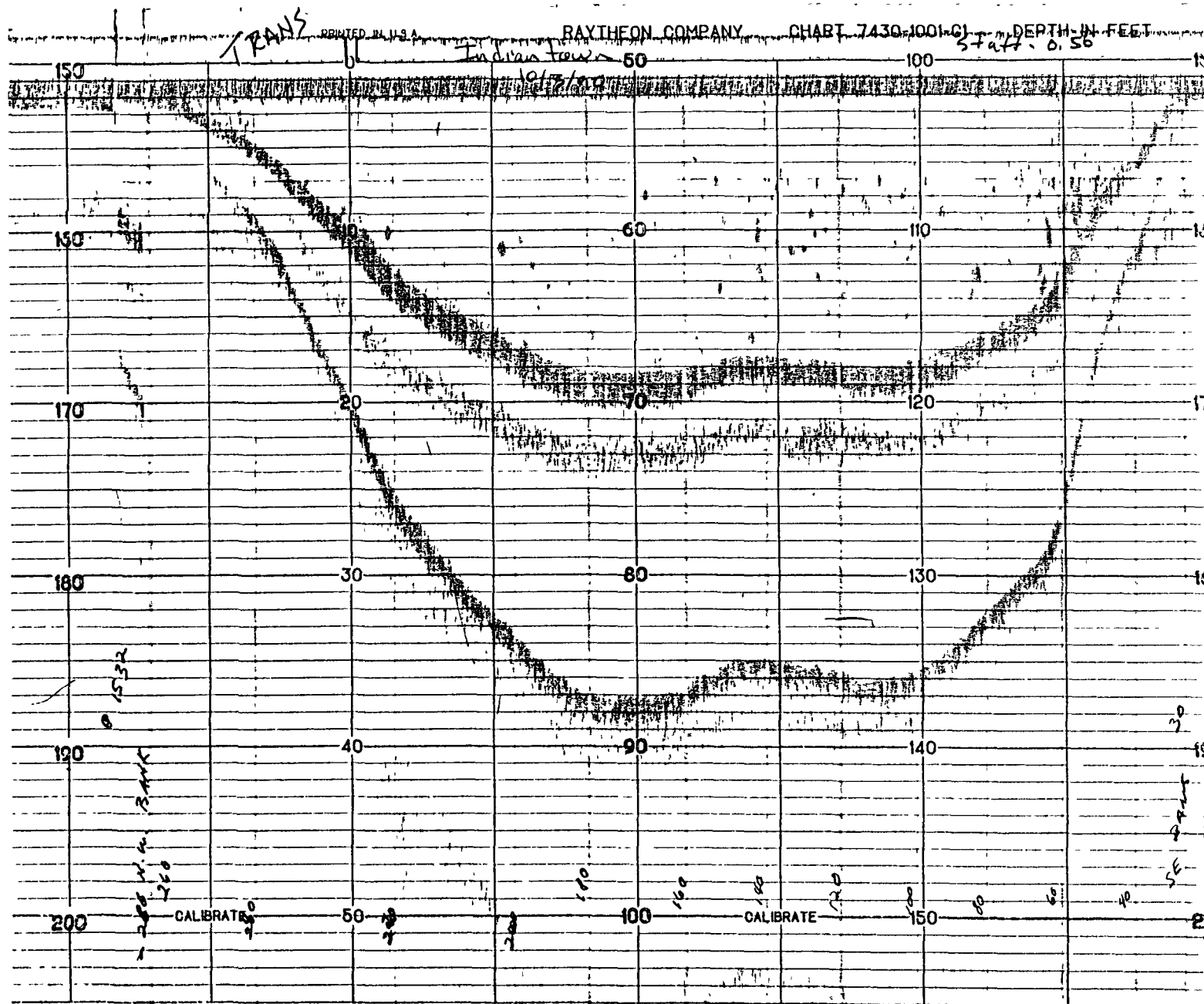


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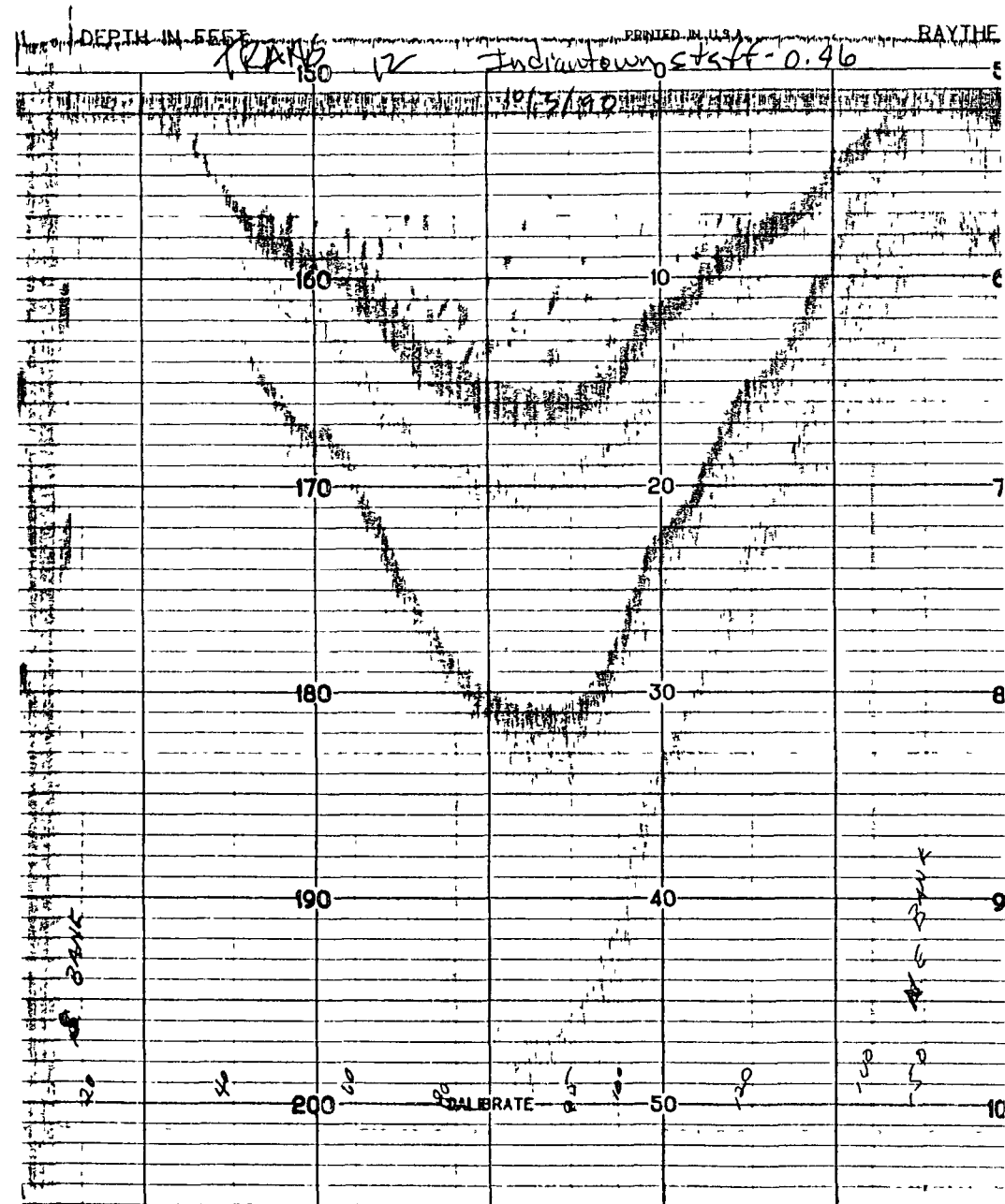
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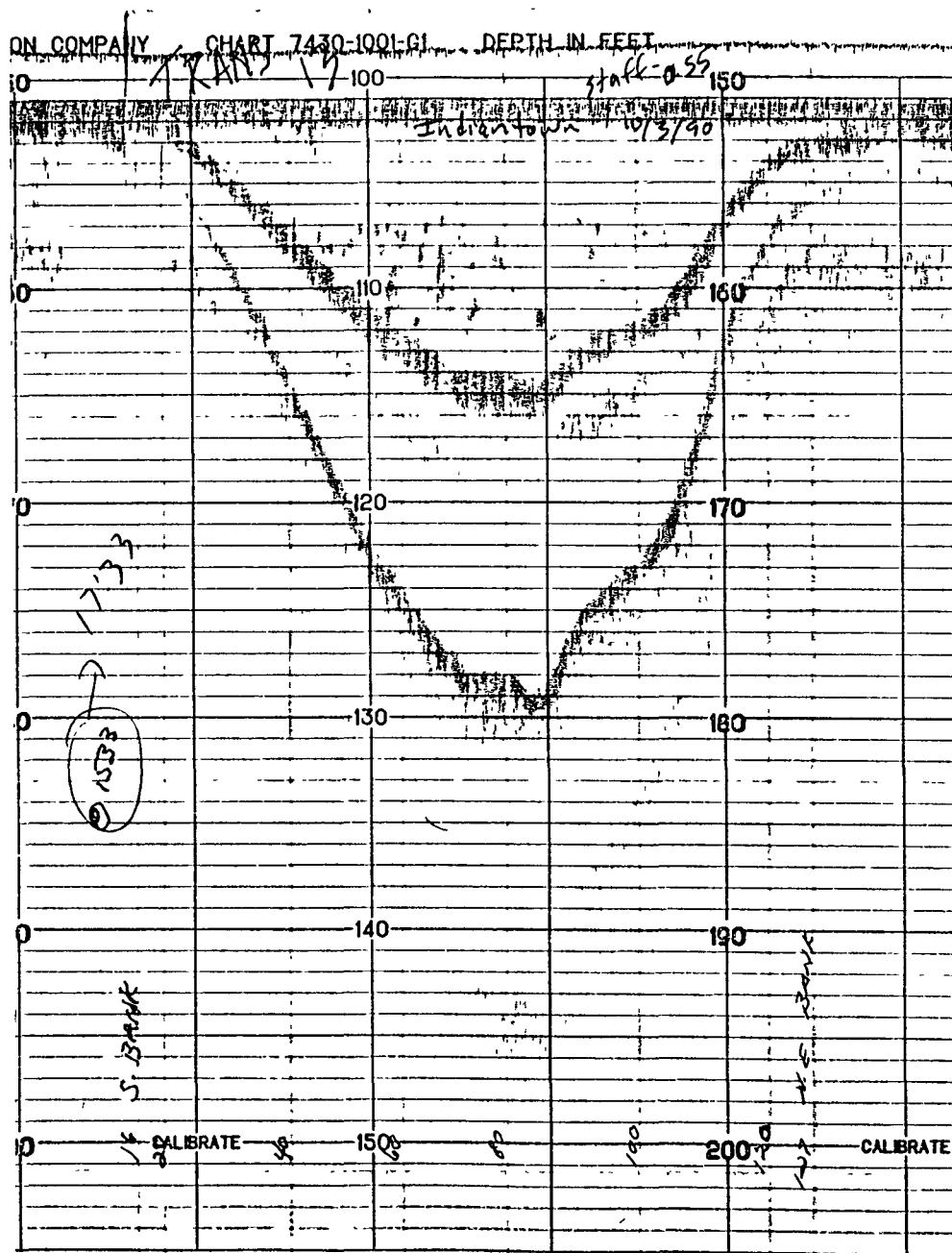
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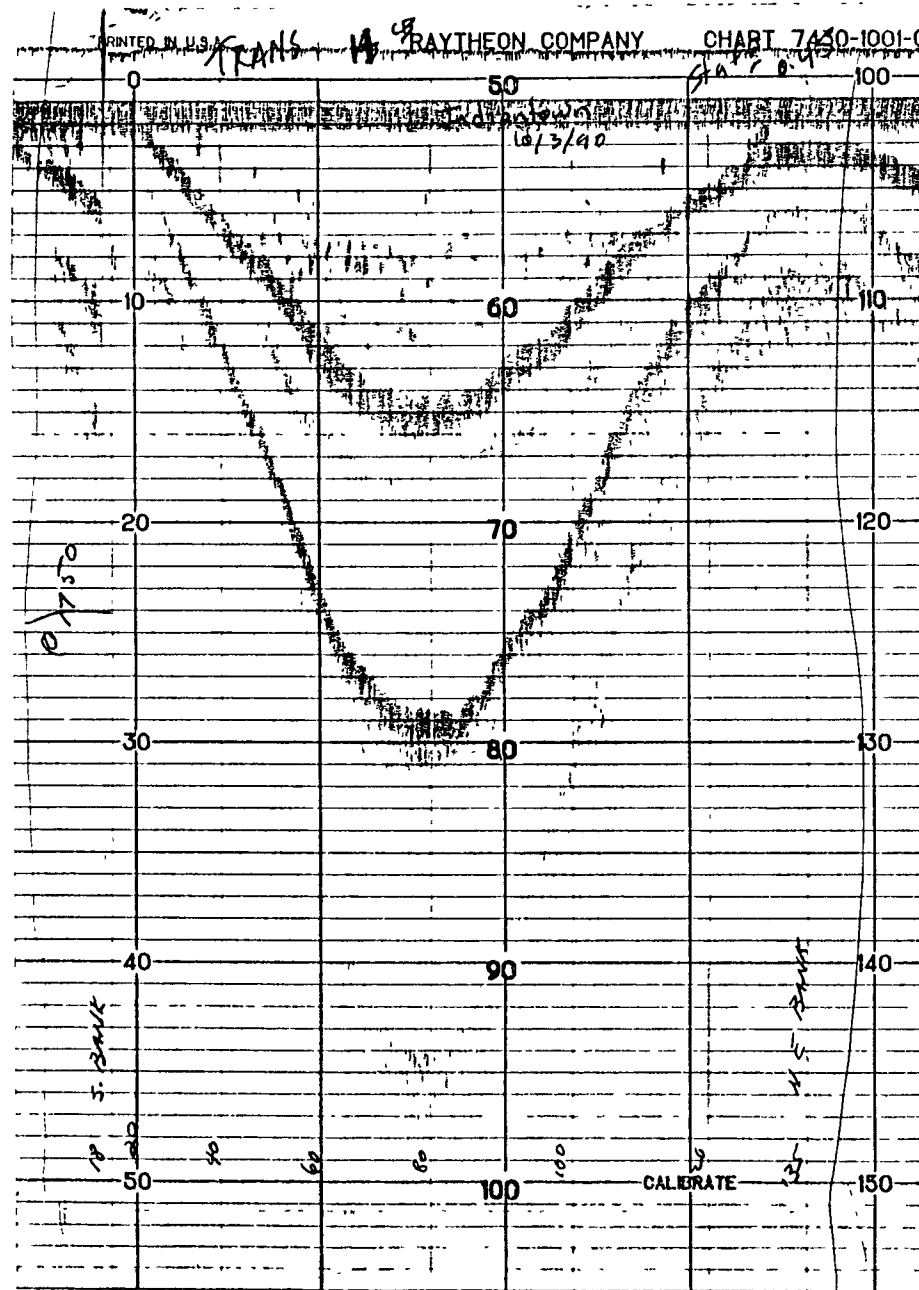
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**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION 1, MAY/JUNE, 1990
(PAGE 1 OF 2)**

Taxa	Replicates			Mean
	A	C	D	
<u>Cordylophora lacustris</u>		461	915	459
<u>Hydra</u> sp.	15	23		13
<u>Dugesia</u> sp.	8	46		18
<u>Hyalinella punctata</u>		8	8	5
<u>Ostracoda</u>	77	185	115	126
<u>Prostoma rubrum</u>	8		15	8
<u>Allonais paraguayensis</u>		15		5
<u>Chaetogaster diaphanus</u>			85	28
<u>Dero nivea</u>		77		26
<u>D. pectinata</u>		138		46
<u>Nais variabilis</u>			23	8
<u>Pristina aequisetia</u>	15	31	85	44
<u>P. leidy</u>	577	1,138	477	731
<u>Placobdella transucens</u>		8		3
<u>Hyalella azteca</u>	469	684	1,453	869
<u>Collembola</u>	8	8		5
<u>Caenis diminuta</u>	308	500	569	459
<u>Enallagma</u> sp.	23		54	26
<u>Homoptera</u>	8			3
<u>Hydroptila</u> sp.	54	15	38	36
<u>Orthotrichia</u> sp.	8	115	138	87
<u>Oecetis</u> sp.	8		8	5
<u>Ablabesmyia rhamphe</u>	8	38	23	23
<u>Labrundinia neopilosella</u>		8	31	13
<u>Cricotopus bicinctus</u> group	92	69	77	79
<u>C. sylvestris</u>	131			44
<u>Nanocladius distinctus</u>	8		15	8
<u>Orthocladius</u> sp.	354	331	215	300
<u>Asheum beckae</u>	8	31	8	15
<u>Dicrotendipes modestus</u>	223	8	62	97
<u>D. nervosus</u>	31	185	31	82
<u>D. neomodestus</u>		8	23	10
<u>D. simpsoni</u>	315	408	492	405
<u>Endochironomus nigricans</u>	23	62	38	41
<u>Glyptotendipes</u> sp.	231	331	400	320
<u>Goeldichironomus</u> sp.	215	254	185	218

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**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION 1, MAY/JUNE, 1990
(PAGE 2 OF 2)**

Taxa	A	Replicates C	D	Mean
<u>G. carus</u>		85	131	72
<u>Parachironomus</u> sp	92	115	54	87
<u>Phaenopsectra</u>			8	3
<u>Pseudochironomus</u> nr. <u>pseudoviridis</u>		8		3
<u>Tanytarsus glabrescens</u>	38			13
<u>T. sp. X</u>		23		8
<u>T. sp. XII</u>	8			3
<u>Chironomini</u> sp. A Beck	8	8		5
<u>Ceratopogonidae</u>	8		15	8
<u>Hebetancylus excentricus</u>	554	23	8	195
<u>Laevapex fuscus</u>	269			90
<u>Pyrogophorus platyrachis</u>	146	8		51
<u>Physella hendersoni</u>	138	8		49
<u>Planorbella scalaris</u>	8			3
<u>Gyraulus parvus</u>	38	108	15	54
<u>Viviparus georgianus</u>	54			18
Number of Species	38	37	33	51
Number of Macroinvertebrates	4,583	5,106	4,899	4,863
Diversity (d)	4.20	3.92	3.63	4.21

Source: _____

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION M, MAY/JUNE, 1990
(PAGE 1 OF 2)**

Taxa	Replicates			Mean
	A	C	D	
<u>Dugesia</u> sp.		8		3
<u>Hyalinella punctata</u>	8	8	8	8
<u>Bratislavia bilongata</u>	31		185	72
<u>Dero pectinata</u>	892		1,169	687
<u>Nais variabilis</u>	31			10
<u>Pristina aequisetula</u>			62	21
<u>P. leidy</u>	523	123	1,476	707
<u>Helobdella stagnalis</u>		8		3
<u>Hyalella azteca</u>	308	2,438	492	1,079
<u>Caenis diminuta</u>	154	2,061	308	841
<u>Enallagma</u> sp.		15		5
<u>Orthotrichia</u> sp.		200	185	128
<u>Cyrtellus</u>	92			31
<u>Polycentropus</u>	31			10
<u>Lepidoptera</u>	31			10
<u>Dytiscidae</u>			62	21
<u>Labrundinia neopilosella</u>			62	21
<u>Cricotopus bicornatus</u> group			185	62
<u>Orthocladus</u> sp.	92	185		92
<u>Asheum beckae</u>	338	677	554	523
<u>Dicrotendipes modestus</u>		62		21
<u>D. nervosus</u>	92	185	431	236
<u>D. simpsoni</u>	1,415	1,353	1,661	1,476
<u>Endochironomus nigricans</u>	31	123	123	92
<u>Glyptotendipes</u> sp.	3,691	5,783	2,645	4,040
<u>Goeldichironomus</u> sp.	338	492	185	338
<u>G. carus</u>	123			41
<u>Parachironomus</u> sp.	154	308	308	256
<u>Pseudochironomus</u> nr. <u>pseudoviridis</u>			62	21
<u>Tanytarsus glabrescens</u>	31			10
<u>T. sp. X</u>	31			10
<u>T. sp. XIII</u>	62			21
<u>Chironomus</u> sp. A Beck			62	21
<u>Ceratopogonidae</u>	62	185		82
<u>Hebetancylus excentricus</u>			62	21
<u>Physella hendersoni</u>	31			10

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**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION M, MAY/JUNE, 1990
(PAGE 2 OF 2)**

Taxa	A	Replicates	D	Mean
		C		
<u>Planorbella scalaris</u>		8		3
<u>Gyraulus parvus</u>			369	123
Number of Species	24	19	22	38
Number of Macroinvertebrates	8,590	14,219	10,651	11,153
Diversity (d)	2.93	2.70	3.48	3.29

Source: _____

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION 2, MAY/JUNE, 1990
(PAGE 1 OF 2)**

Taxa	Replicates			Mean
	A	C	D	
<u>Dugesia</u> sp.		62		21
<u>Hyalinella punctata</u>	8		8	5
<u>Ostracoda</u>	31			10
<u>Dero nivea</u>	46		369	138
<u>D. pectinata</u>	1,123	431	1,107	887
<u>Pristina leidy</u>	338	431	800	523
<u>Batracobdella phalera</u>		8		3
<u>Hyalella azteca</u>	800	492	923	738
<u>Caenis diminuta</u>	1,092	677	308	692
<u>Enallagma</u> sp.	15		62	26
<u>Cyrtellus</u> sp.	15			5
<u>Polycentropus</u> sp.	15	62		26
<u>Orthotrichia</u> sp.	138	308	185	210
<u>Ablabesmyia rhamph</u>	185	185	246	205
<u>Labrundinia neopilosella</u>	46	185	62	97
<u>Orthocladius</u> sp.			62	21
<u>Asheum beckae</u>	892	1723	677	1,097
<u>Dicrotendipes modestus</u>	123	62	431	205
<u>D. nervosus</u>	800	369	138	436
<u>D. simpsoni</u>	954	861	923	913
<u>Endochironomus nigricans</u>	185	62	246	164
<u>Glyptotendipes</u> sp.	2,245	2830	3,199	2,758
<u>Goeldichironomus</u> sp.	846	1600	923	1,123
<u>G. carus</u>	584	738	185	502
<u>Parachironomus directus</u>			431	144
<u>P. pectinatellae</u>	769	185	123	359
<u>Phaenopsectra</u> sp.	31			10
<u>Pseudochironomus</u> nr. <u>pseudoviridis</u>			185	62
<u>Tanytarsus</u> sp. X	15		185	67
<u>T. sp. XII</u>	15			5
<u>Chironomini</u> sp. A Beck	15	246	185	149

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION 2, MAY/JUNE, 1990
(PAGE 2 OF 2)**

Taxa	A	Replicates	D	Mean
		C		
<u>Ceratopogonidae</u>	77	62	185	108
<u>Physella hendersoni</u>		62		21
Number of Species	27	22	25	33
Number of Macroinvertebrates	11,405	11,635	12,143	11,727
Diversity (d)	3.73	3.56	3.83	3.87

Source: _____

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED IN PONAR GRAB SAMPLES FROM
TAYLOR CREEK STATION 1, MAY 1990
(PAGE 1 OF 2)**

Taxa	Replicates				Mean
	A	B	C	D	
<u>Dero nivea</u>		215	86		75
<u>Pristina leidy</u>		43			11
<u>P. syncytes</u>		86		43	32
<u>Aulodrilus pigueti</u>	86	43	86	43	65
<u>Branchuria sowerbyi</u>	86	129	86	258	140
Immature Tubificid with capilliform	86	990	86	43	301
Immature Tubificid without capilliforms		43	43	43	32
<u>Helobdella elongata</u>		43			11
<u>H. stagnalis</u>		43			11
<u>Placobdella pediculata</u>		43			11
<u>Taphromysis bowmani</u>		43			11
<u>Hyalella azteca</u>	86	344	43		118
<u>Baetis sp.</u>		43	43		22
<u>Caenis diminuta</u>		129			32
<u>Oecetis sp.</u>		129			32
<u>Orthotrichia sp.</u>	43	43		43	32
<u>Ceratopogonidae</u>	43	43	43	43	43
<u>Chaoborus punctipennis</u>	474			215	172
<u>Coelotanypus concinnus</u>		258	86		86
<u>Procladius sp.</u>				129	32
<u>Cricotopus bicinctus</u>	86				22
<u>Chironomus sp.</u>			43		11
<u>Cladotanytarsus sp.</u>		43			11
<u>Cryptochironomus fulvus</u> group	43	43	86		43
<u>Dicrotendipes modestus</u>	43	43			22
<u>Glyptotendipes sp.</u>		215		43	65
<u>Goeldichironomus sp.</u>		86			22
<u>Polypedilum scalaenum</u>		86			22
<u>P. simulans</u>		86			22
<u>Tanytarsus sp.</u> X Rutter		86	86		43
<u>Corbicula fluminea</u>		301			75
<u>Elliptio buckleyi</u>		43			11

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**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED IN PONAR GRAB SAMPLES FROM
TAYLOR CREEK STATION 1, MAY 1990
(PAGE 2 OF 2)**

Taxa	A	<u>Replicates</u>		D	Mean
		B	C		
<u>Gyraulius parvus</u>	43				11
<u>Viviparus georgianus</u>		431			108
Number of Species	11	29	12	10	34
Number of Macroinvertebrates	1,120	4,177	818	904	1,755
Diversity (d)	2.85	4.09	3.51	2.87	4.42

Source: _____.

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED IN PONAR GRAB SAMPLES FROM
TAYLOR CREEK STATION M, MAY 1990**

Taxa	A	Replicates		D	Mean
		B	C		
<u>Pristina leidy</u>				43	11
<u>Aulodrilus pigueti</u>	129			43	43
<u>Branchuria sowerbyi</u>	43				11
<u>Limnodrilus hoffmeisteri</u>	43				11
Immature tubificid w/o capilliforms	560			215	194
<u>Orthotrichia</u> sp.				43	11
<u>Nanocladius</u> nr. <u>distinctus</u>		43			11
<u>Polypedilum</u> <u>illinoense</u>			43	43	22
<u>Corbicula fluminea</u>		86	86	43	54
<u>Elliptio buckleyi</u>			86	43	32
<u>Viviparus georgianus</u>				129	32
Number of Species	4	2	3	8	11
Number of Macroinvertebrates	775	129	215	603	431
Diversity (d)	1.23	1.58	1.52	2.64	2.67

Source: _____.

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MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED IN PONAR GRAB SAMPLES FROM
TAYLOR CREEK STATION M, MAY 1990
(PAGE 1 OF 2)

Taxa	A	Replicates		D	Mean
		B	C		
<u>Nematoda</u>		86			22
<u>Dugesia</u> sp.		86			22
<u>Dero nivea</u>	560	947	86	86	420
<u>D. pectinata</u>		86			22
<u>Pristina syncytes</u>	388	301			172
<u>Pristinella jenkinsae</u>	43	172			54
<u>Slavena appendiculata</u>				43	11
<u>Aulodrilus pigueti</u>	517	388	431		334
<u>Limnodrilus hoffmeisteri</u>	646	86		301	258
Immature Tubificid without capilliforms	2,971	2,239	344	1,249	1,701
Immature Tubificid with capilliforms	86				22
<u>Helobdella stagnalis</u>		43			11
<u>Hyaella azteca</u>	258	775	258		323
<u>Caenis diminuta</u>	43				11
<u>Oecetis</u> sp.				86	22
<u>Ceratopogonidae</u>				86	22
<u>Chaoborus punctipennis</u>			775	603	344
<u>Ablabesmyia rhamphe</u>				43	11
<u>Coelotanytus concinnus</u>			43	86	32
<u>Procladius</u> sp.			86	43	32
<u>Tanytus</u> sp.				43	11
<u>Chironomini</u> sp A. Beck				43	11
<u>Cladotanytus</u> sp.	43			43	22
<u>Cryptochironomus fulvus</u> group		258		86	86
<u>Dicrotendipes</u> sp.	86	301	43	388	205
<u>D. modestus</u>	43	388		86	129
<u>Endochironomus nigricans</u>				86	22
<u>Polypedilum simulans</u>			43		11
<u>Tanytus</u> sp X Rutter			86		22
<u>Corbicula fluminea</u>	172	646	474	560	463

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED IN PONAR GRAB SAMPLES FROM
TAYLOR CREEK STATION M, MAY 1990
(PAGE 2 OF 2)**

Taxa	A	Replicates		D	Mean
		B	C		
<u>Anodonta couperiana</u>	86	43			32
<u>Elloptio buckleyi</u>		258			65
<u>Viviparus georgianus</u>	172	129	43	43	97
Number of Species	15	18	13	18	33
Number of Macroinvertebrates	6,115	7,234	2,765	3,962	5,016
Diversity (d)	2.66	3.65	3.00	3.35	3.69

Source: _____

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10.7 SOUTH FLORIDA WATER MANAGEMENT DISTRICT LAND USE AND
LAND COVER CLASSIFICATION CODE

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(U) Urban and built-up land

Urban or Built-up land consists of areas of intensive use, with much of the land covered by structures. Included in this category are cities, towns, villages, strip developments along highways, and such areas as those occupied by mills, shopping centers, industrial and commercial complexes, and institutions that may, in some instances, be isolated from urban areas.

As development progresses, small blocks of land of less intensive or nonconforming use may be isolated in the midst of built-up areas and will generally be included in this category. Agricultural, forest, or water areas on the fringe of urban and built-up areas will not be included except where they are part of low-density urban development.

The Urban or Built-up category takes precedence over others when the criteria for more than one category are met. For example, residential areas that have sufficient tree cover to meet Forested Upland criteria will still be classified as Residential in the Urban or Built-Up category.

(UR) Residential

(URSL)	Single-family, Low Density (under 2 D.U./gross acre)
(URSM)	Single-family, Medium Density (2 to 5 D.U./gross acre)
(URSH)	Single-family, High Density (over 5 D.U./gross acre)
(URMF)	Multi-family building
(URMH)	Mobile homes

(UC) Commercial and Services

(UCPL)	Parking lot
(UCSC)	Shopping center
(UCSS)	Sales and services
(UCCE)	Cultural and Entertainment
(UCMC)	Marine commercial (Marinas)
(UCHM)	Hotel-Motel

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(UI) Industrial

(UIJK)	Junkyard
(UILT)	Other light industrial
(UIHV)	Other heavy industrial

(US) Institutional

(USED)	Educational
(USMD)	Medical
(USRL)	Religious
(USMF)	Military
(USCF)	Correctional
(USGF)	Governmental (other than military or correctional)
(USSS)	Social services (Elks, Moose, Eagles)

(UT) Transportation

(UTAP)	Airports
(UTAG)	Small grass airports
(UTRR)	Railroad yards and terminals
(UTPF)	Port facilities
(UTEP)	Electrical power facilities
(UTTL)	Major transmission lines
(UTHW)	Major highway and rights-of-way
(UTWS)	Water supply plants
(UTSP)	Sewerage treatment plants
(UTSW)	Solid waste disposal
(UTRS)	Antenna arrays
(UTOG)	Oil and gas storage

(UO) Open and others

(UORC)	Recreational facilities
(UOGC)	Golf courses
(UOPK)	Parks
(UOCM)	Cemeteries
(UORV)	Recreational vehicle parks
(UOUD)	Open under development
(UOUN)	Open and undeveloped within urban area

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(A) Agriculture

Agricultural land may be defined as those lands which are cultivated to produce crops and livestock. The sub-categories of Agriculture are: Cropland, Pastureland, Orchards, Groves (except citrus), Vineyards, Nurseries, Ornamental Horticulture Areas, Citrus Groves, Confined Feeding Operations, Specialty Farms and Other Agriculture.

(AC) Cropland

(ACSC)	Sugar cane
(ACTC)	Truck crops
(ACRF)	Rice fields

(AP) Pasture

(APIM)	Improved pasture
(APUN)	Unimproved pasture

(AM) Groves, Ornamentals, Nurseries, Tropical fruits

(AMCT)	Citrus
(AMTF)	Tropical fruits
(AMSF)	Sod farms
(AMOR)	Ornamentals

(AF) Confined feeding operations

(AFFL)	Cattle feed lots
(AFDF)	Dairy farms
(AFFF)	Fish farms
(AFHT)	Horse training and stables
(AFPY)	Poultry

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(R) Rangeland

Historically, Rangeland has been defined as land where the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs, and is capable of being grazed. Management practices may include brush control, regulation of grazing intensity, and season of use. If revegetated to improve the forage cover, it is managed like native vegetation. Generally this land is not fertilized, cultivated, or irrigated.

The definition of Rangeland used in the CONSERVATION NEEDS INVENTORY by the U.S. Departments of Agriculture and Interior is used in this classification scheme and describes the natural potential (climax) plant cover as being composed of principally native grasses, forbs and shrubs valuable for forage. This category includes Grassland, Shrub and Brushland, and Mixed Rangeland.

(RG) Grassland

(RS) Scrub and brushland

(RSPP) Palmetto prairies

(RSSB) Brushland

(F) Forested uplands

Forestland includes uplands, basically the drier areas, which have a tree crown density (crown closure of 10 percent or more), and are dominated by trees and other woody vegetation.

Lands from which trees have been removed to less than 10 percent crown closure, but which have not been developed for other use, are also included in this category. For example, lands on which there are rotation cycles, involving clear-cutting and block planting, are part of the forested uplands category.

Since most naturally seeded forestlands are composed of a mixture of species, for purposes of classification a minimum of 66 2/3 percent stand dominance (by crown area measurement) of one species or species groups is necessary for inclusion into separate categories. Less than 66 2/3 percent stand dominance of one species or species groups is considered to be a mixed category. It should be noted that classification is based on overstory species composition, as interpreted from aerial photography. Forested uplands are classified as follows:

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(FE) Coniferous

(FEPF)	Pine flatwoods
(FESP)	Sand pine scrub
(FECF)	Commercial forest (pine)

(FO) Non-coniferous

(FOAP)	Australian pine
(FOBP)	Brazilian pepper
(FOPA)	Palms
(FOSO)	Scrub oak
(FOOK)	Oak
(FOCF)	Commercial forest

(FM) Mixed forested

(FMTW)	Temperate hardwoods
(FMCM)	Cabbage palms/Melaleuca
(FMCO)	Cabbage palms/Oaks
(FMPP)	Pine/Melaleuca
(FMPO)	Pine/Oak
(FMTH)	Tropical hammocks
(FMOF)	Old fields forested
(FMCD)	Coastal dunes
(FMPC)	Pine/Cabbage palms

(W) Wetlands

Wetlands are those areas where the water table is at, near, or above the land surface for a significant part of most years. The hydrologic regime is such that aquatic or hydrophytic vegetation usually is established, although alluvial and tidal flats may be nonvegetated. Wetlands are frequently associated with topographic lows. Examples of wetlands include marshes, mudflats, emergent vegetation areas, and swamps. Shallow water areas with submerged aquatic vegetation are classed as Water and are not included in the Wetlands category.

Extensive parts of some river floodplains qualify as Wetlands. These do not include agricultural land where seasonal wetness or short-term flooding may provide an important component of the total annual soil moisture necessary for crop production. But, uncultivated wetlands yielding products such as wood, or grazed by livestock, are retained in the Wetlands category.

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Wetlands areas drained for any purpose belong to other land use categories, whether they be Agriculture, Rangeland, or Forested. When the drainage is discontinued and such use ceases, classification reverts to Wetlands after characteristic vegetation is reestablished. Wetlands managed for wildlife purposes may show short-term changes in vegetation type and wetness condition as different management practices are used, but are properly classified Wetlands.

(WF) Forested fresh

(WFCM)	Cypress/Melaleuca
(WFCY)	Cypress
(WFWL)	Willow
(WFME)	Melaleuca
(WFSB)	Scrub and brushland
(WFMX)	Mixed forested

(WN) Non-forested fresh

(WNSG)	Sawgrass
(WNCT)	Cattail
(WNBR)	Bullrush
(WNWC)	Wire cordgrass
(WNAG)	Mixed aquatic grass
(WNWL)	Sloughs

(WS) Forested salt

(WSRM)	Red mangrove
(WSBW)	Black and White mangrove

(WM) Non-forested salt

(WX) Mixed forested and non-forested fresh

(WXPP)	Pine and wet prairies
(WXCP)	Cypress domes and wet prairies
(WXHM)	Hardwood marsh

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(H) Water

The delineation of water areas depends on the scale and resolution characteristics of the remote-sensor photography used for interpretation. One definition of water bodies, provided by the Bureau of Census, includes all areas within the land mass of the United States that are predominantly or persistently water covered, provided that, if linear, they are at least 1/8 mile (660 feet or 200 meters) wide, and if extended, cover at least 40 acres (16 hectares).

Defining water boundaries at Level III, minimum size has been established to less than 10 acres. In some instances, water bodies of one acre will be plotted and identified. Water bodies or those portions of the water body have emergent vegetation are placed in the Wetland category.

(B) Barren land

Barren land has very little or no vegetation and limited ability to support life. In general, it is an area with only soil, sand or rocks. Vegetation, if present is very widely spaced and scrubby. However, land also may be temporarily barren due to man's activities. Generally, this land is included in other land use categories. Vast areas of agricultural land are temporarily without vegetative cover due to tillage practices, and areas of extractive and industrial land use have dumps for wastes and tailings. Barren Land categories are beaches (areas exhibiting little or no evidence of human encroachment), Extractive operations, Spoil areas, and Levees.

(BB) Beaches

(BP) Extractive

(strip mines, quarries, and
gravel pits)

(BS) Spoil areas

(BL) Levees

* Documentation of major codes from "LAND USE, COVER AND FORMS CLASSIFICATION SYSTEM, A TECHNICAL MANUAL", Department of Transportation, State Topographic Office Remote Sensing Center, Kuyper, Becker and Shopmyer, February 1981

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10.8 CULTURAL RESOURCE ASSESSMENT SURVEY OF THE PROPOSED
MARTIN COUNTY POWER PLANT SITE AND PIPELINE RIGHT-OF-WAY

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**CULTURAL RESOURCE ASSESSMENT SURVEY OF THE
PROPOSED INDIANTOWN COGENERATION LIMITED PLANT SITE AND
PIPELINE CORRIDOR,
MARTIN COUNTY, FLORIDA**

Prepared for
Environmental Consulting and Technology, Inc
Gainesville, Florida

by
Kenneth W. Hardin and Charles Fuhrmeister

PIPER ARCHAEOLOGICAL RESEARCH, INC.
St. Petersburg, Florida

September 1990

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INTRODUCTION

This archaeological and historical survey of the proposed Indiantown Cogeneration Limited (ICL) plant site and pipeline corridor was conducted in order to satisfy state and federal cultural resource requirements. The purpose of the survey was to locate any archaeological and/or historic sites within the project area and to collect information necessary to assess their potential eligibility for the National Register of Historic Places.

For the purposes of this cultural resource assessment, the survey area consists of one parcel totaling approximately 232 acres in Martin County, Florida (Figures 1 and 2). The project area is located in portions of Sections 34 and 35, Township 39 South, Range 38 East. The proposed pipeline route begins in Section 35 of Township 39 South, Range 38 East and runs west-northwest, parallel to the CSX railroad, to Section 32 of Township 38 South, Range 36 East, in Okeechobee County. Agricultural lands are located to the north and south of the survey parcel. The nearest town is Indiantown located approximately three miles to the southeast of the project site.

The documentary search consisted of a review of the State of Florida Master Site File (FMSF), an examination of the historical and archaeological literature, and historic records. The FMSF search revealed no previously recorded archaeological sites on or in the vicinity of the project area. Four other prehistoric archaeological sites are located on FP&L property within five miles of the project area. These sites consist of two small sand mounds

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(8Mt28 and 29), a large mound with linear earthworks (8Mt19), and a small artifact scatter (8Mt31). All of the mounds are located along the Barley Barber Swamp approximately five miles northwest of the project site.

Prior to entering the field, areas of high archaeological site potential were identified using U.S.G.S. 7.5' quadrangle maps and 1"=400' aerial photographs flown in August 1988. The archaeological field survey included all of these areas plus areas identified in the field as having a potential to contain archaeological sites. The survey strategy called for an intensive, systematic cultural resource survey of these areas, and limited systematic and judgmental survey of the remaining areas.

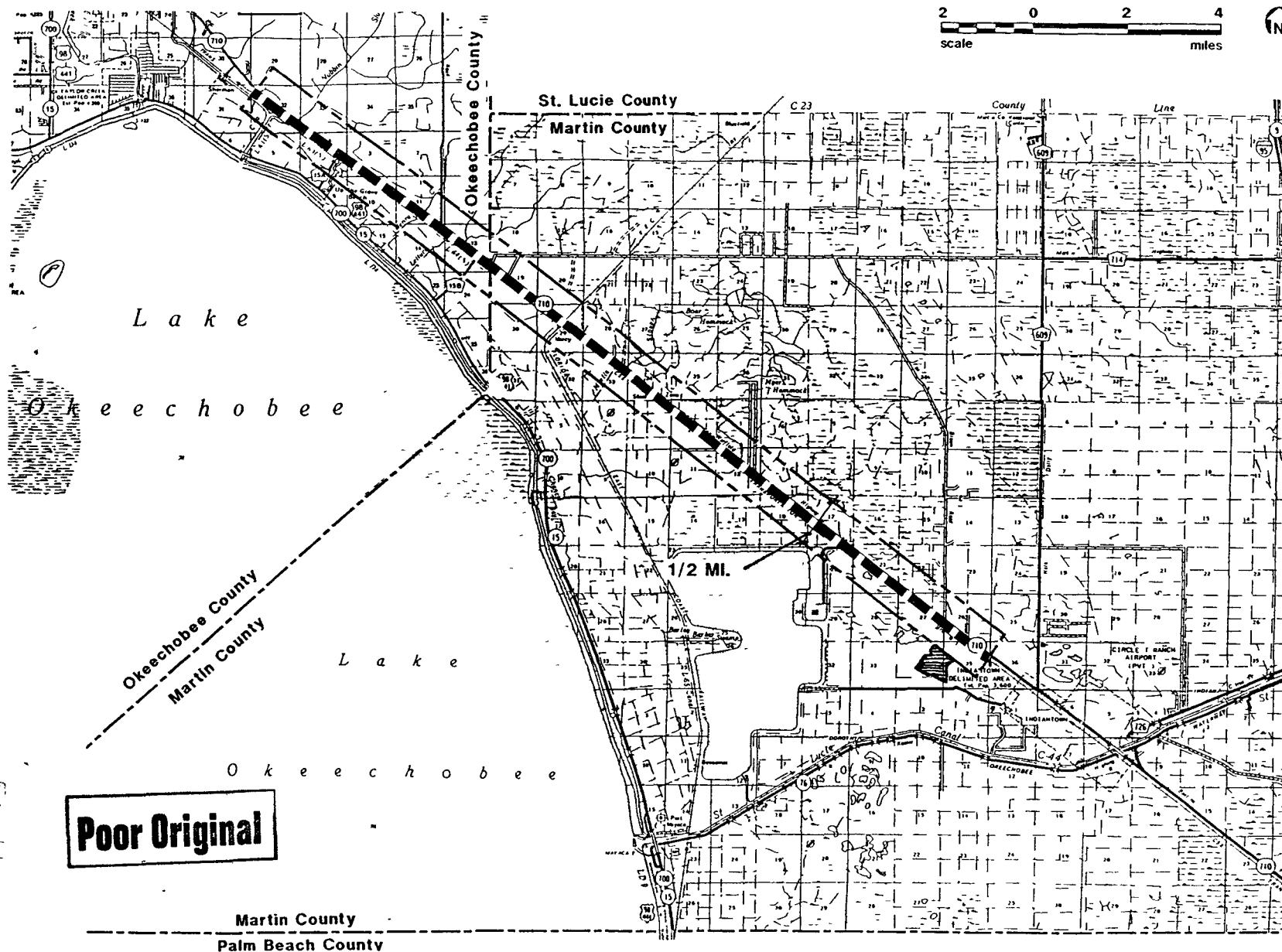


Figure 1 - General Site Location Map
indicating proposed ICL Plant Site (Hatched)
and Pipeline Corridor (Bold Dashed Line)
Source: FDOT 1976

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BACKGROUND RESEARCH

The following section provides a brief overview of the area's physical environment, as well as a discussion of the region's prehistoric and historic development, to provide a context for the evaluation of sites located during the survey.

Environmental Setting

Regional Environment

It has been assumed that environmental and ecological factors through time had a direct influence on the choice of sites for occupation by prehistoric populations and early historic settlers. Thus, geologic, hydrologic, and soil formation processes that may have affected the survey area and its biotic resources are important elements in the formulation of a settlement/subsistence model for prehistoric and early historic peoples. Present day environmental variables can be used to reconstruct past conditions that may have influenced early human occupation of the ICL project area, and so are included in this study.

The ICL project area is located within the Atlantic Coastal Lowlands physiographic province characterized by low, poorly drained flatland which represent the shallow, flat bottoms of ancient seas. The project area is located within the Eastern Valley, a physiographic feature within this province. Associated features include the Everglades to the south, the Atlantic Ocean to the east, Lake Okeechobee to the west, and the Okeechobee and

Osceola Plains to the northwest and north. The latter extends a toe southeastward into the Eastern Valley terminating at Indian-town. White (1970:139) feels that this narrow terrace represents a long spit or off-cape shoal formed during the Pleistocene when sea levels were much higher. The project area lies just to the southwest of this ridge.

The surface lithology of Martin County is composed of undifferentiated deposits of sand and clay of Pleistocene and Recent age, which are underlain by thick deposits of limestone and dolomite. Outcrops of silicified limestone, or chert, which were often exploited by prehistoric peoples as raw material sources for the manufacture of stone tools, do not occur near the project area (cf. Lane et al. 1980). The closest known outcrops lie to the west along the Peace River in the central part of the state (Scott 1978; Upchurch et al. 1982).

Water resources consist of both ground and surface water. The principal ground water aquifer is the Floridan which occurs under artesian conditions with slowly permeable clays and sands forming a confining layer that effectively prevents the vertical movement of water from the surficial aquifer to the Floridan aquifer (Lane 1980). Surface sand deposits contain the surficial aquifer, which is recharged through local rainfall. Because of low hydraulic gradients, movement of water within this zone is very slow. Water is discharged from the aquifer through lateral seepage to stream or lake, evapotranspiration, or movement downward to the Floridan aquifer where sinkhole development has breached the underlying

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confining layer of clay (Lane 1980; Lane et al. 1980).

Most of the county is drained by intermittent streams, sloughs, and creeks. The major water control system is an extensive network of canals that is used for both drainage and irrigation purposes. The dominant surface water feature is Lake Okeechobee in the western part of the county. Lake Okeechobee measures over 700 square miles in areal extent, but is very shallow with a maximum depth of about 10 feet.

Physical Environment of the Project area

The ICL site and pipeline corridor are located on low, poorly drained flatland characterized by some seasonal ponds, sloughs and intermittent creeks. The present natural land topography is fairly level and slopes toward the southwest.

The principal soil association for the project area is the Waveland-Lawnwood-Basinger series which is characterized as nearly level, poorly drained soils located in broad flatwoods with depressions. A second soil association is also found in the project area. It is the Floridana-Jupiter-Hilolo series and is characterized as nearly level, poorly drained soils located in broad sloughs interspersed with flatwoods and depressions (McCollum and Cruz 1981).

The drainage characteristics of soils have been used successfully by archaeologists throughout Florida in the formulation of predictive models for prehistoric site location (e.g. Almy 1978; Grange 1978; Deming 1980; Austin and Piper 1986; Estabrook 1989a, 1989b). Most of the soils within the survey area are poorly

drained on nearly level slopes. Major soil types include the following:

Lawnwood fine sand, 0 - 2% slopes, poorly drained
Waveland sand, 0 - 2% slopes, poorly drained
Basinger fine sand, depressional, poorly drained
Basinger fine sand, < 2% slopes, poorly drained
Sanibel muck, very poorly drained

Vegetation consists primarily of pine and saw palmetto which occur in large sections of the project area on slightly better drained soils, as well as over much of the seasonally wet areas. Herbaceous, shallow washes occupy the remaining area.

The vegetation of the ICL project area was probably stable during prehistoric times after the last major environmental change about 3000 to 5000 years ago (Watts 1971:687; Long 1974:30). Many of these plants could have been utilized as a food or shelter resource by prehistoric inhabitants. The freshwater fish and shellfish populations in nearby waters would also have provided an abundant source of food as well as the many large and small mammals which inhabited this area. Prior to 3000 B.C., however, surficial water would have been all but non-existent (cf. Clausen et al. 1979) and sea level would have been much lower thereby limiting the area's attractiveness to both animal and human populations.

Cultural Prehistory

Aboriginal peoples have inhabited Florida for at least 14,000 years. The earliest cultural stages are pan-Florida in extent while later cultures exhibited differing cultural traits in the various archaeological areas of the state. The project area is

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located in the Okeechobee Basin culture area (Figure 2) as defined by Milanich and Fairbanks (1980:22). This area is bounded by the Western Flatland (Davis 1943:43-48), the Allapattah Flats and the Big Cypress Swamp (DeLorme 1987). There is some evidence to suggest that the Lake Kissimmee and the Kissimmee River drainage should be included in this area. Cultural affinities represented in burial mounds, earthworks, and ceramics are found as far north as Lake Tohopekaliga (Milanich and Fairbanks 1980:26). Similarly, both areas are characterized by relatively poor, sandy soils (composed of quartzitic sands developed over calcareous marine deposits), relatively low elevations with little relief, and numerous ponds and sloughs which support a vegetation cover consisting primarily of pine and palmetto flatland, wet prairies and occasional hammocks of live oak usually mixed with cabbage palm.

Paleo-Indian Stage

The earliest stage of prehistoric cultural development, the Paleo-Indian, has not as yet been identified in the Okeechobee Basin. Evidence for Paleo Indian occupation along the Kissimmee River is also scant, consisting of rare surface finds of lanceolate-shaped projectile points (e.g. Austin 1987). The greatest density of known Paleo-Indian sites in Florida is associated with the rivers in the north central part of the state, although rising sea levels have probably inundated early coastal sites making their discovery difficult (Rouse 1951:21-30; Scholl et al. 1969; Ruppe 1980).

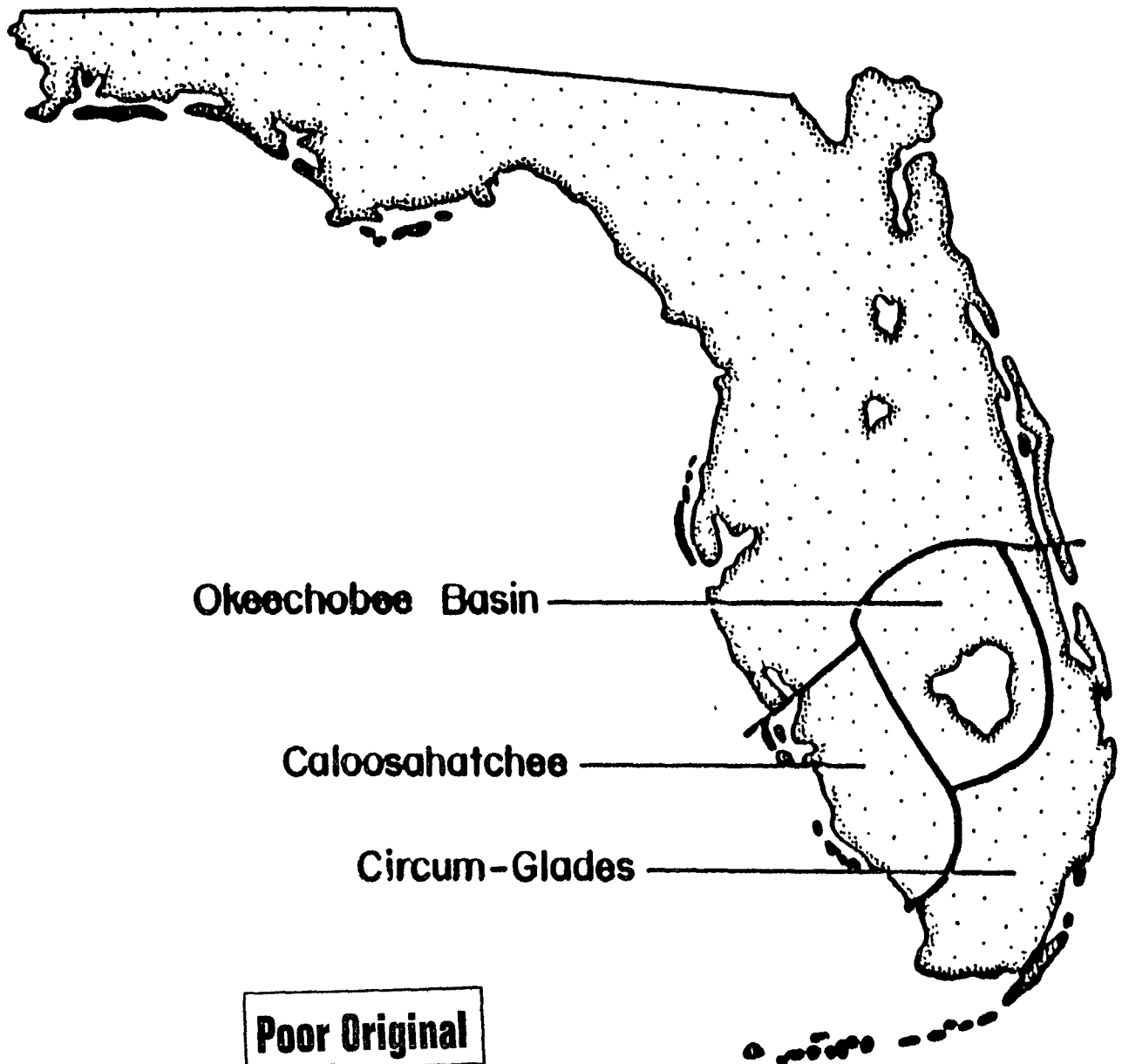


Figure 2:

Map of the Okeechobee Basin, Caloosahatchee,
and Circum-Glades archaeological regions
(after Milanich and Fairbanks 1980:22)

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The prevailing view of Paleo-Indian existence, based on the uniformity of the known tool kit and the small size of most sites, is that of a nomadic lifestyle with subsistence activities based on hunting and gathering of the now extinct Pleistocene megafauna (Milanich and Fairbanks 1980:35-42). Recent excavations in Hillsborough County, however, have contributed to the development of increasingly sophisticated models of early hunter-gatherer settlement (e.g. Daniel 1985; Chance 1983) which take into account the adaptive responses of human populations to both short and long term environmental change. These models suggest that some Paleo-Indian groups may have practiced a more sedentary lifestyle than had previously been believed (Daniel and Wisenbaker 1987).

Two controversial early man sites are located on the coastal strand outside of the project area, 8-Ir-9 in Vero Beach and 8-Br-44 in Melbourne. At both sites human remains were reported in association with the bones of extinct Pleistocene animals (Gidley and Loomis 1926; Sellards 1940), but the association was disputed by Hrdlicka (1907, 1918) and later by Rouse (1950, 1951:223) who felt the human remains were intrusive into the Pleistocene stratum. More recent examination of the human crania (Stewart in Milanich and Fairbanks 1980:5) and comparisons with those from the Warm Mineral Springs site in Sarasota County seem to support a Paleo-Indian period date for the Vero and Melbourne finds (Cockrell and Murphy 1978:7-8), although a final determination cannot as yet be made.

Clausen et al. (1978:10-11) have suggested the possibility of

wood

One of the more well known Archaic period sites on the East Coast of Florida is Windover Farms near Melbourne. This site, which has been radio-carbon dated to about 5000-6000 B.C., consists of a wetland cemetery where Archaic peoples interred their dead in a shallow pond. In addition to human skeletal remains, a wide variety of normally perishable items including wood and bone

artifacts, cordage, basketry and woven fiber cloth were found preserved under anaerobic conditions (Doran and Dickel 1988).

Another important early Archaic site is the Cutler site in Dade County (Carr 1986). This site contains human remains, early side-notched projectile points, and faunal remains including some extinct Pleistocene species. A radio-carbon dated of ca. 7800 B.C. was obtained from a hearth feature there making this one of the earliest sites found thus far in south Florida.

Mount Taylor Phase: By 4000 B.C. Archaic hunter/gatherers were spending much of the year in villages along the St. Johns River and its tributaries. This phase of Archaic development, known as the Mount Taylor phase after the type site in Volusia County (Goggin 1952a), is characterized by the dietary importance of freshwater snails (Cumbaa 1976), and the use of stemmed projectile points with triangular blades, as well as bone points and tools. Excavations at the Tick Island site, also in Volusia County, revealed a mass burial in a midden perhaps associated with a charnel house, an early instance of such a burial pattern (Jahn and Bullen 1978).

No Archaic period sites have been recorded in the Okeechobee Basin area, however, Archaic sites are known for the Kissimmee River valley (Austin 1987) and it is possible that Archaic groups may have made brief, intermittent forays into the area during periods of greater rainfall and available surface water. For the most part, however, it is assumed that the Okeechobee Basin was only rarely visited by Archaic groups.

Orange Phase: The introduction of a crude fiber-tempered pottery into the artifact assemblage of the Archaic aboriginal marks the beginning of the Orange phase around 2000 B.C. The basic hunting-foraging subsistence pattern of the Archaic stage continued, with a shift to marine shellfish occurring as the snail beds were gradually depleted. By Orange III times, ca. 1450-1250 B.C., occupation of the Atlantic Coastal strand had increased significantly and this shift in prehistoric settlement and subsistence strategies is documented at sites such as 8-Ir-41, the Summer Haven site and the Cotten site (Rouse 1951; Bullen 1972; Smith 1973:27).

The tool assemblage of the Orange phase resembles that of the Mount Taylor phase with the addition of pottery and evidence of basketry and matting as seen in the impressions on clay pot bottoms (Milanich and Fairbanks 1980:155). The earliest occupations come from sites exhibiting semi-fiber-tempered (i.e. sand and fiber) ceramics. The Fisheating Creek site (Goggin 1952b:58) and the Fort Center site (Griffin 1952; Sears and Sears 1976; Sears 1982) have yielded these artifacts in limited numbers. According to Sears (1977:7; 1982:192-193) this initial occupation is coeval with the construction of the earliest of the Okeechobee Basin's spectacular earthworks - i.e. the circular ditches.

Formative Stage

During the late Orange phase, also known as the Florida Transitional Period (1200-500 B.C.), changes in pottery and

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technology occurred in Florida which mark the beginning of the Formative Stage. Fiber-tempered wares were replaced by sand-tempered, limestone-tempered, and chalky temperless ceramics and three different projectile point styles, basally-notched, corner-notched, and stemmed, also occur in relatively contemporaneous contexts. This profusion of ceramic and tool traditions is suggestive of population movement and social interaction between culture areas. The earliest major occupations of South Florida known at the present time date to this period (Sears 1982; Bullen et al. 1968).

Belle Glade Phase: Following the Transitional Period is the Belle Glade Period, ca. 500 B.C. - A.D. 1700 (Milanich and Fairbanks 1980:23). During this period, activities in the Okeechobee Basin increase dramatically suggesting the greatest complexity in South Florida centered around this inland territory (Milanich and Fairbanks 1980:181). Several researchers have attempted to build a chronology for this area but the lack of comprehensive surveys coupled with very limited excavations leaves this area of Florida one of the most poorly known regions of the state.

To date, the most comprehensive chronology for the Belle Glade culture area has been developed by Sears (1971, 1974, 1977, 1982). His is a four period chronology beginning with his Period I and ending with his Period IV. These periods are roughly coeval with the Transitional Period as defined by Bullen (1959, 1970), and the

Belle Glade I and II Periods as defined by Willey (1949).

Sears' (1982:26,185) Period I from ca. 800 - 1000 B.C. to A.D. 200 most closely fits the Transitional Period definition. At the early end of Period I, Sears (1982:192-193) notes small populations of perhaps one or two families living along the riverbank on small house mounds with fish and turtle being particularly important to the diet. Only semi-fiber tempered pottery was in use during this time but by the end of this period most of the pottery was the sand-tempered plain ware. Distinguishing this period from the Transitional Period is the presence of the circular ditches. Sears (1982:193-194) believes they functioned as drained fields for maize cultivation.

Sears' (1982:26-31,186-189) Period II from A.D. 200 to about A.D. 600-800 most closely resembles the definition of the Belle Glade I Period except that there are no Glades decorated wares at Fort Center. According to Willey (1949:125), evidence for the Belle Glade I Period consists of Belle Glade Plain and Glades Plain ceramics with small percentages of Glades decorated wares (see also Widmer 1988:87-88). There are no defining dates associated with the Belle Glade I Period but, by inference, Widmer (1988:87) provides a terminal date at A.D. 900 - 1000.

The Belle Glade II Period is defined by the presence of Belle Glade Plain and Glades Plain ceramics coupled with a lack of Glades decorated wares and the appearance of Biscayne (St. Johns) Check Stamped (Willey 1949:125). Sears' (1982:27,31, 189-190) Periods III and IV most closely resemble this period. Period III lasts

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from A.D. 600/800 to A.D. 1200/1400 and is characterized as a period of time which experienced minimal cultural change (Sears 1982:199). Period IV, on the other hand, is described as a time of excelled craftsmanship, revived focus for authority, and participation in a larger social system than the one existing on the site. The introduction of linear embankments accompanies this period as well as the first appearance of European objects. Sears (1982:200) believes that during this period Fort Center was operating as a part of the sixteenth and seventeenth-century Calusa empire.

Acculturative Stage

Little is known about the terminus of Belle Glade culture. Few ethnohistoric accounts exist and only one is widely publicized. Fontaneda's (1945) account of the seventeenth century South Florida native groups refers to a people who lived around a large lake known as the Mayaimi. His narrative provides scanty information on population density, subsistence, environment, and political affiliations with the coastal Calusa. Archaeologically, many Belle Glade sites contain European artifacts and European-derived raw materials such as silver, iron, and gold. Thus, there exists ample evidence to indicate Belle Glade participation in a larger economy than existed solely in the Okeechobee Basin.

The demise of the Belle Glade peoples was surely linked to their participation in this larger economy. The introduction of European diseases is well documented throughout the Southeastern U.S. and is considered a major cause in the death of the South Florida native groups. It is thought by many researchers that by

the time the Seminoles arrived into this part of Florida, all of the South Florida aboriginal were extinct.

By the early 18th century, groups of Creek Indians who came to be known as Seminoles moved into Florida to escape the political and population pressures of the expanding American frontier. It is suspected that the village site occupied by the Seminole chief, Osceola, and his followers in 1836 was recently located in Citrus County near the east side of Tsala Apopka Lake. Seminole artifacts were recovered from South Indian Fields (8-Br-23) in Brevard County (Rouse 1951:94) and two villages are reported to have been in the general vicinity of West Palm Beach, but their exact locations are not known (Fairbanks 1978:185). The remains of Seminole men, women, and children were excavated from part of the original cemetery (ca. 1824-1846) of Fort Brooke, a Second Seminole War fort underlying present-day downtown Tampa (Piper and Piper 1982).

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Historical Review

The intent of this historical documentary review was to identify the possible locations of any historic sites within the project area and to determine the potential historical significance of any such sites. To that end, books, maps, and manuscripts located at the University of South Florida Special Collections Department; Florida Department of Natural Resources, Division of State Lands; Martin County Historical Society, the Elliott Museum; the Martin County Public Library; and Piper Archaeological Research, Inc. were examined and interviews with local informants were conducted.

In terms of permanent homesteads, Martin County was not settled until relatively late in the 19th century. In the course of early expeditions to Florida, some Spanish explorers came to the area in the 16th century but they did not establish permanent settlements. Ponce de Leon visited an area called Rio de la Cruz, now thought to be Jupiter Inlet, during his first voyage in 1513. Over the next several decades Spain sought to establish a foothold in Florida, but failed attempt followed failed attempt and in 1561, after expeditions produced neither a permanent settlement nor material gain, Spain closed the area to further exploration (Smith and Gottlob 1978:7).

Spanish policy promptly reversed when news reached Spain in 1562 of French attempts at colonization in Florida. Pedro Menendez de Aviles was dispatched to challenge French encroachment and build a permanent settlement. Menendez met with more success than his

compatriots and by 1565 St. Augustine was founded. A settlement at St. Augustine provided Spain the opportunity it needed to extend its sphere of influence to other parts of Florida and a policy of christianizing the Indians and building missions amongst the various tribes was instituted.

Menendez petitioned the Jesuits for more missionaries and put into action his "religious plan for Florida" (Lewis 1978:25). In 1565-1566, prior to the arrival of more friars, Menendez sailed along the Florida peninsula and up the Atlantic Coast placing crosses at various locations and leaving Spaniards "of marked religious zeal" to introduce Christianity to the native population (Gannon 1965:29). Three permanent settlements were established at St. Augustine, San Mateo (Ft. Caroline) and Santa Elena, and were served by priests. Outposts/forts were located in Ais, Tequesta, Calusa and Tocobaga territory (Gannon 1965:29).

The Jesuit missions in Florida met with failure and in 1572 the order's religious authorities recalled their priests (Gannon 1965:34). Undaunted, Menendez turned his attention to another order, the Franciscans, and entreated them to accomplish the religious conversion of the Indians of Florida. The Franciscans' first twenty years in Florida were not altogether successful as they encountered much the same problems as the Jesuits. But by the turn of the century significant gains were made and the period from 1606 to 1675 reflected "the Golden Age of the Florida Missions" (Gannon 1965).

The mission effort was more successful in the northern areas

of Florida than in the south. One researcher (Milanich 1978:68) has suggested that the failure of the Spanish missions among south Florida Indians was due partially to tribal subsistence patterns which required seasonal movement for maximum resource exploitation. In north-central Florida a long tradition of horticulture existed at least one thousand years before the historic period and with the introduction of better techniques and tools by the priests, mission villages in those areas were occupied year round (Milanich 1978:68). Consequently, south Florida was virtually ignored as the Spanish concentrated their efforts on the northern chain of missions.

Two settlements along the southeastern coast, at Ays and Santa Lucia, were established by Menendez during the first wave of missions/outposts. Ays is thought to have been located in the Ft. Pierce-Vero Beach area and Santa Lucia at Jupiter Inlet (Hutchinson 1987:14-15). Local lore originally placed Santa Lucia at a spot on the St. Lucie River, possibly because of the similarity in names, but Hutchinson (1987:15) asserts after reviewing historic documents that the more southern location is correct given the stability and good harbor associated with Jupiter Inlet. Like others in south Florida these two mission settlements were short-lived. Accounts from Spaniards at the Santa Lucia post attest to the difficult conditions in the winter of 1566 when "the garrison was reduced to chewing shoes, leather belts, snakes, rats and dwarf palmetto to stay alive" (Gannon 1965:44).

In 1696 Jonathan Dickinson, his family, and several others

were shipwrecked and came ashore in the vicinity of Jupiter Inlet where they encountered the Jeaga and Ais Indians. From Dickinson's account, the Indians appeared to be functioning without traces of colonization or Christianity and were not fluent in Spanish. The Jeaga and Ais seemed to be independent yet "allies of the Spanish," and Dickinson's group pretended to be Spanish in order to receive better treatment (Andrews and Andrews 1975; Rouse 1951:56-57).

With the subsequent heavy utilization of the Bahama Channel as a homeward route for Spanish treasure obtained in the Americas, shipwrecks along the Ais controlled coast were common. It is reported that the Indians not only actively salvaged these wrecks, but killed the survivors as well (Higgs 1942:29). The Spanish Plate Fleet of 1715 was destroyed in a hurricane near present-day Sebastian Inlet, however, the survivors of these wrecks apparently fared better at the hands of the Indians than did most of the others. Archaeological evidence from the Higgs Site (Smith 1949) and the McLarty Site (Burgess and Clausen 1976) suggests cooperation between the Indians and the survivors.

By the middle of the 18th century the indigenous population in the Indian River area had declined considerably as continued contact with the Spanish made the Jeaga and Ais prone to drinking and riddled with disease (Rouse 1951:59). Attacks by the English and their northern Indian allies further reduced their numbers.

During the Second Spanish Period in Florida (1783-1821) large land grants were awarded to Spanish loyalists. James Hutchinson became the first landowner in the St. Lucie-Martin County area

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when, in 1803, he petitioned for and received a grant of 2000 acres on the mainland west of the Indian River. Two Spanish land grants are located to the east of the project area. In 1813 John Hanson, Samuel Miles, John Hedrick and Bernardo Sequi were awarded approximately 18,000 acres in Township 38 South, Ranges 41 and 42 East (Florida Department of Natural Resources 1851a; Hutchinson 1987:25). To the south in Township 38 South, Range 42 East Euschiuz Gomez received a grant of ca. 12,000 acres in 1815 (Florida Department of Natural Resources 1851b; Hutchinson 1987:25).

Hutchinson (1987:25) states that Hanson and Gomez established plantations and raised crops which included sugarcane, coconuts and some citrus on their land grants, but there does not appear to be conclusive evidence as to whether or not the men themselves lived on their properties. By and large, the grants in the southern portion of Florida were unoccupied by their owners (e.g. the Fleming Grant, Sebastian, Florida [Hardin et al. 1983]) as the majority of Florida's nonaboriginal population was centered in the northern portion of the peninsula. If, however, farming or cattle ranching was conducted it was probably managed by overseers with an occasional visit from the owner. Even after the United States acquired Florida from Spain in 1821 the pattern of settlement remained much the same for a number of years and it was not until the Second Seminole War (1835-1842) that any appreciable number of white men began to travel to southern Florida.

The Seminole Indians, originally part of the Creek nation,

moved into Florida during the early 18th century but, once Florida became a U.S. Territory in 1821, pressure was brought to bear upon the government to remove them from the choice agricultural lands of north Florida. The Treaty of Moultrie Creek (1824) restricted the Seminoles to approximately 4 million acres of land in the middle of the state, running south from Micanopy to just north of the Peace River (Mahon 1967:Rear fold-out map). This treaty was unpopular with the Seminoles and they were reluctant to move from their established homes to an area which they felt could not be cultivated. Equally unpopular were the later treaties of Paynes Landing (1832) and Fort Gibson (1833) which called for Seminole emigration to the western territories (Mahon 1967:75-76, 82-83). The above treaties all served to foster Seminole resentment and outbreaks of hostility which finally culminated in the Second Seminole War in 1835.

The Lake Okeechobee area was not well explored until this time. Hutchinson (1987:19-20) indicates that as late as 1837, when John Lee Williams authored Territory of Florida, no mention of the lake is made nor does his map show any indication of its existence. Indeed, it was not until the United States Army moved into the interior in pursuit of the Seminoles that accurate maps and descriptions of the area became available.

At that time, the Lake Okeechobee Basin became the scene of Second Seminole War battles, but none occurred in the immediate vicinity of the survey area. The Battle of Okeechobee took place in December 1837 north of the lake and the Battle of Lockahatchee,

which occurred in January 1838, was fought near present day Jupiter Inlet (Mahon 1967:227-231, 234). A Military Map of Lake Okeechobee dating to 1838 (shown in Carr 1975:12) shows one military fort, Ft. McRae, in the vicinity of the project area. Early survey plat maps of the vicinity indicate that this camp was probably located in Sections 20 and 29 of Township 38 South, Range 38 East (Florida DNR 1853a). Indeed, the entire military trail connecting Camps Sebring and Andrew, called "Back Road" on the 1838 map, is shown east of the project area on these maps.

By the end of the Second Seminole War, the majority of Florida's Seminole Indians were relocated in the western territories. A few recalcitrants, under the leadership of Billy Bowlegs, sought refuge in the recesses of the Everglades and the U.S. Government, after considering the efficacy of prolonging the war to effect their removal, allowed them to stay. The peace was temporary, however, for in 1850 the U.S. Congress began to debate turning over to Florida the federally owned Everglades swamp (Tebeau 1957:43). Once again the Seminoles found themselves in competition with whites over land and in 1855 the Third Seminole War (often referred to as Billy Bowlegs War) broke out.

Ft. Capron was established 1850 during the Third Seminole War at the present location of the town of St. Lucie, directly across from Indian River Inlet. The fort was named after Captain Erastus Capron of the 1st Artillery and was in operation until 1859. A military trail known as the Capron Trail extended from Ft. Capron to Ft. Brooke (Tampa, Florida) and was for many years the only

connecting road between the east and west coasts of Florida (Van Landingham n.d.:9).

Following the Seminole Wars, the southern portion of Florida remained relatively unsettled with only a few Seminole Indians, homesteaders and fishermen as residents. The Armed Occupation Act was passed in 1842 as a means of encouraging homesteading in the uninhabited regions of Florida. Three hundred and seventy permits were issued for homesteaders to settle in the St. Johns Valley from Palatka to Sanford and along the east coast from New Smyrna to Biscayne Bay.

During the Civil War there was little military activity South Florida other than blockade runners using the Indian River as a haven from Federal ships. The war, however, hindered development and interrupted new agricultural endeavors creating an economic malaise that would exist for a number of years.

In the 1880's interest in the resources of southern Florida intensified, due in large part to men like Hamilton Disston and Henry Flagler. Disston contracted with the State of Florida in 1881 to drain swamp land in return for one-half of the acreage he could reclaim. When it appeared that this contract would be opposed by the court, Governor Bloxham persuaded Disston to purchase the land. Although it met with controversy, Disston's purchase of 4 million acres at 25 cents an acre did provide the funds necessary to clear the titles to state lands and managed to pave the way for the large drainage operation that changed both the topography and economy of the central and southern portions of

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Florida (Tebeau 1971:278).

The most influential developer in south Florida, especially on the east coast, was Henry Morrison Flagler. Flagler, a partner of John D. Rockefeller in the Standard Oil Company, was already a wealthy man when he first visited Florida in 1878. After his first wife died in 1881 he remarried and returned to the Jacksonville-St. Augustine area in 1883. During this visit, Flagler apparently began to set in motion plans for his new Florida railroad and hotel enterprises (Tebeau 1971:284). His interest first centered in the St. Augustine area and later spread to more southerly portions of Florida. In 1894 Flagler's Florida East Coast Railroad arrived at Ft. Pierce and with the advent of rail transportation, the area began to grow rapidly. Flagler wisely saw the need for a good transportation system along Florida's east coast if his planned hotels were to survive. He provided modern, public transportation to the coastal towns and a spur to the Lake Okeechobee area which helped the east coast area to prosper (McIver 1976:21). He was able to acquire vast land holdings from the state through the Internal Improvement Fund grants which were created to encourage railroad construction.

Prior to railroad construction, early settlers in the Martin County area depended on trade boats which ran along the Indian River to provide them with supplies. By the 1880's a prosperous trade network was underway and more families moved to the area every year. Pineapple and citrus cultivation became leading industries. The advent of the railroad was just the impetus the

burgeoning economy needed to thrive.

It was during the period of 1878-1882 that the first settlers began to arrive in what is today the eastern part of Martin County. However, it was not until the turn of the century that settlers began inhabiting the western part of the county. The first road was laid out between Indiantown and Stuart in 1902-1903 by Francis Marion Platt. He married Annie Mizell on October 22, 1868 at Pine Level in present day Manatee County. The couple joined the Seminole Indians living in the vicinity of present day Indiantown and named their own private town - Annie. The road, originally called the Stuart-to-Annie Road, is now State Road 76 (Hudson 1973).

About the same time, Joe Bowers gave up his store in Jupiter to establish a trading post with the Seminoles and, with his brother, he planted the now famous "Bowers Groves" in Annie. Rumor has it that some trees are still bearing fruit from the original planting.

In the early 1920s, shortly after the arrival of the Bowers brothers, a railroad line was established connecting the area with Coleman (in Central Florida) and West Palm Beach. It was known as the Seaboard Air Line Railway and was built as Martin County was being formed. The Baltimore banker who was the president of the Railway, S. Davies Warfield, had bought more than half of the land that was to be included in the new county. Noting the high elevation, and the temperature difference between the coast and the interior (the interior is 10 degrees cooler in the summer and 10

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degree warmer in the winter than the coast), he planned to build a model city at Indiantown. The idea was to make Indiantown the southern headquarters for his railroad (Hudson 1973).

Warfield had a depot, railroad yards, the Seminole Country Inn, and apartment houses built and the western part of the new county soon became the heart of the winter vegetable raising interests. However, this expansion did not last for long. The collapse of the Florida land boom and the near simultaneous death of Warfield left a sharp retrenchment in the prosperity of Indiantown (Hudson 1973).

Throughout the 20th century, the ICL plant site has remained relatively undeveloped. Based on the above historical documentary review, the survey area for the ICL plant site was considered to have a low probability for containing significant historical resources.

METHODS

The background and literature review, in conjunction with pertinent environmental variables, contributed to the formulation of project-specific field methods designed to locate and evaluate previously unrecorded archaeological sites within the survey area for the ICL plant site and pipeline corridor. The designation of probability zones and decisions regarding site significance were based on previous research conducted within the Okeechobee Basin area.

Archaeological Sites in the Vicinity of the Project

Evaluations of archaeological or historical site significance are ultimately based on the potential of a site to contribute to the understanding of the social processes at work in a region's prehistory or history; therefore, a consideration of these sites within the context of the larger, regional settlement system is essential. A first approximation of settlement variability through time can be obtained by reviewing information regarding the known sites in the area. A search of the pertinent literature and records of the surrounding region was conducted, including archaeological and historical assessments of other tracts of land in close proximity to the project area.

Other sites in the general vicinity of the ICL project area include the Barley Barber I, II, and III sites (8Mt19, 28, & 29) and a small unnamed site (8Mt31). The Barley Barber sites are mounds, one of which is associated with prehistoric earthen

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embankments. The latter is now protected within the Barley Barber Swamp Preserve while the former have been excavated (Williams 1975). These sites are located along Barley Barber Swamp about five miles west of the ICL project site. Site 8Mt31 consists of a few ceramic artifacts located along an unnamed slough about six miles southwest of the project area.

Other sites in the Okeechobee Basin include earthworks (Carr 1975, Sears 1982, Willey 1949, Allen 1948, McGoun 1987, 1988), burial mounds (Carr 1973, Sears 1982, Willey 1949, Williams 1975), and habitation mounds or middens (Sears 1982, Willey 1949, Goggin 1952). Among the more spectacular sites are the large earthworks found in the open savannah, often bordering creeks or major environmental zones (cf. Hale 1984:181). These include circular ditches, linear embankments, and combined mound and embankment complexes.

Sears (1982:185) provides evidence indicating that the circular ditches are the earliest earthworks at Fort Center site dating to at least 450 B.C. His research shows that some of the habitation middens are coeval with this structure. Habitation mounds are believed to have been built during his Periods I and II (1982:186,195-199) and again during his Period IV but the latter include linear embankments (1982:199-201). Burials in mounds date to his Period I, possibly II, and IV (1982:140-141,200-201). Willey (1949:125) is unable to ascertain the date of the burial mound at the Belle Glade site but believes it is coeval with a habitation mound. Williams (1975) obtained a radiocarbon date of

200 B.C. under one of the burials he excavated at Barley Barber Swamp but he believes the date is erroneous.

The combined mound and embankment complex known as Big Mound City (Willey 1949:73-77), located about 10 miles south of Indian-town, is thought to have been laid out according to a master plan, however no conclusions have been reached as to whether all of the features were constructed at the same time. An artifact collection from one of the mounds at the site indicates a coeval existence with a late period of occupation at the Belle Glade site located at the south end of Lake Okeechobee. Other mound and embankment complexes include the Big Circle Mounds, also known as Tony's Mound, (Allen 1948), the Boynton Mound Complex (McGoun 1987, 1988), and others (cf. Hale 1984:181; Carr 1975, 1985). The presence of European artifacts at sites such as the Ortona Mound in Glades County (Milanich 1988, personal communication), indicate a late Belle Glade IV occupation, however most of these sites are not dated.

Site Location Model

Cultural resource assessment surveys throughout Florida have demonstrated that certain environmental locales were preferred for prehistoric and early historic utilization. Predictive models enable the researcher to stratify the project area into probability zones based upon the co-occurrence of relevant environmental variables. The relative importance of each of these variables depends upon the composite environmental setting. In a sand hills

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environment, for example, a majority of the known sites are located near a water source on a ridge top or slope. If a water source is not located in the vicinity, the probability of site occurrence decreases dramatically. However, water will not be the determining factor if another resource with more limited distribution, such as lithic raw materials, is available for exploitation (Deming and Almy 1984:17). In environments of relatively low relief and abundant wetlands, areas of higher elevation relative to the surrounding terrain would be considered more likely to contain prehistoric sites (Wharton 1984; Piper and Piper 1980; Johnson 1986). In coastal areas, the availability of littoral resources, particularly fish and shellfish, was a major factor in site location.

The above site locational data suggests that the majority of sites in the area would be expected to be located adjacent to or near the freshwater sloughs which flow into Lake Okeechobee. Further, the present data available for the vicinity of the survey property suggests that the most likely type of prehistoric site to be discovered in these areas would be a late period midden or mound. Smaller, extractive type campsites, represented by small scatters of lithic, ceramic, or shell artifacts, would also be expected on elevated knolls or ridges in the flatwoods if a source of potable water is located nearby.

The environmental factors pertinent to the project area may be summarized as follows:

- a) most of the soils in the project area are poorly drained;

b) surficial water sources are ubiquitous in the region;

c) the topography of the project area is level, with few features other than a slight slope to the southwest. Although potable water is available, there are no areas of slightly higher elevation that may have been more desirable to prehistoric people.

Based on these environmental parameters, the project area was considered to have a low probability of producing evidence of activity sites associated with the prehistoric exploitation of locally available resources. Mounds and/or middens were a common adaptation to low, poorly drained land, but a labor intensive site such as a mound would usually be placed near additional resources such as stone quarries or riverine transportation. With no such resources on or near the project property, it was considered unlikely that a mound similar to the Barley Barber mounds would exist in the project area. During the field survey, special attention was paid to areas of higher elevation and mesic or xeric flora close to drainages and the larger ponds. Areas of low elevation relative to the surrounding terrain were considered less likely to contain evidence of prehistoric occupation because they are often seasonally filled with water.

Field Methods

Shovel tests were placed in areas of high site potential as defined above. For the ICL power block area, shovel tests were placed at 50 meter intervals along transects spaced at distances appropriate to the specific locale. In no case did the transect spacing exceed 100 meters. In addition to the systematic tests,

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judgementally placed shovel tests were also excavated when appropriate to adequately test an area.

All shovel tests measured approximately 40-50 centimeters in diameter and were excavated to a depth of one meter unless prevented by groundwater seepage, bedrock, or other soil conditions. All excavated soil was screened through 1/4" mesh hardware cloth. The location of each shovel test was plotted on a 1" = 400' aerial photograph and soil stratigraphy records were maintained for each test pit. Recordation of the soil profiles was carried out to the nearest half decimeter.

Good surface exposure was provided by the many dirt roads, recently cleared areas and trails, and animal burrows which are present throughout the property. These exposures were visually inspected for cultural material whenever possible. It is estimated that hundreds of such exposures were examined during the course of the survey.

The pipeline corridor is proposed to be within the existing CSX railroad right-of-way, immediately west of SR 710. During the construction of these two thoroughfares, the original ground surface has been subjected to substantial disturbance such as the construction of drainage ditches, deposition of fill dirt as a foundation bed for the roadway, and the burying of subterranean utilities (electrical, gas, and telephone lines). This left little soil within the proposed pipeline corridor intact enough to merit subsurface testing; indeed, most of the area has undergone secondary or tertiary redeposition and had standing water at the

time of inspection. The whole pipeline tract was subjected to extensive visual inspection and, where appropriate, subsurface testing.

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RESULTS AND RECOMMENDATIONS

The ICL plant site and pipeline corridor were surveyed by means of intensive surface inspection and subsurface testing where applicable. Sixty-three shovel tests were excavated. No prehistoric cultural materials were uncovered, but two historic areas of interest and a few scattered Herty cup fragments were found during the cultural resource assessment survey.

Neither the areas of historic interest, nor the Herty cup fragments are sufficiently noteworthy to merit the designation of an archaeological site. The Herty cup fragments, dating to the early 20th century, do indicate the existence of a turpentine or navel stores industry in the area. A brief description and evaluation of the other two areas of cultural interest are presented below. The locations of these two areas are shown in Figure 3.

The Trash Dump is located in Township 39S, Range 38E, Section 35, SW/SW/SE (USGS Okeechobee 4 SE, photorevised 1983). This historic feature is located outside of the ICL project boundary, 1200 feet to the southeast. Artifacts recovered consist of post Depression-era glass bottles for whiskey and ink; whiteware, stoneware, and porcelain ceramics; and brick fragments in a small surface pile that appears to have been recently moved.

There is no structure or other evidence of homesteading in the area. This site appears to be a 1940s or 1950s dump site, considering its seeming isolation and location near an improved

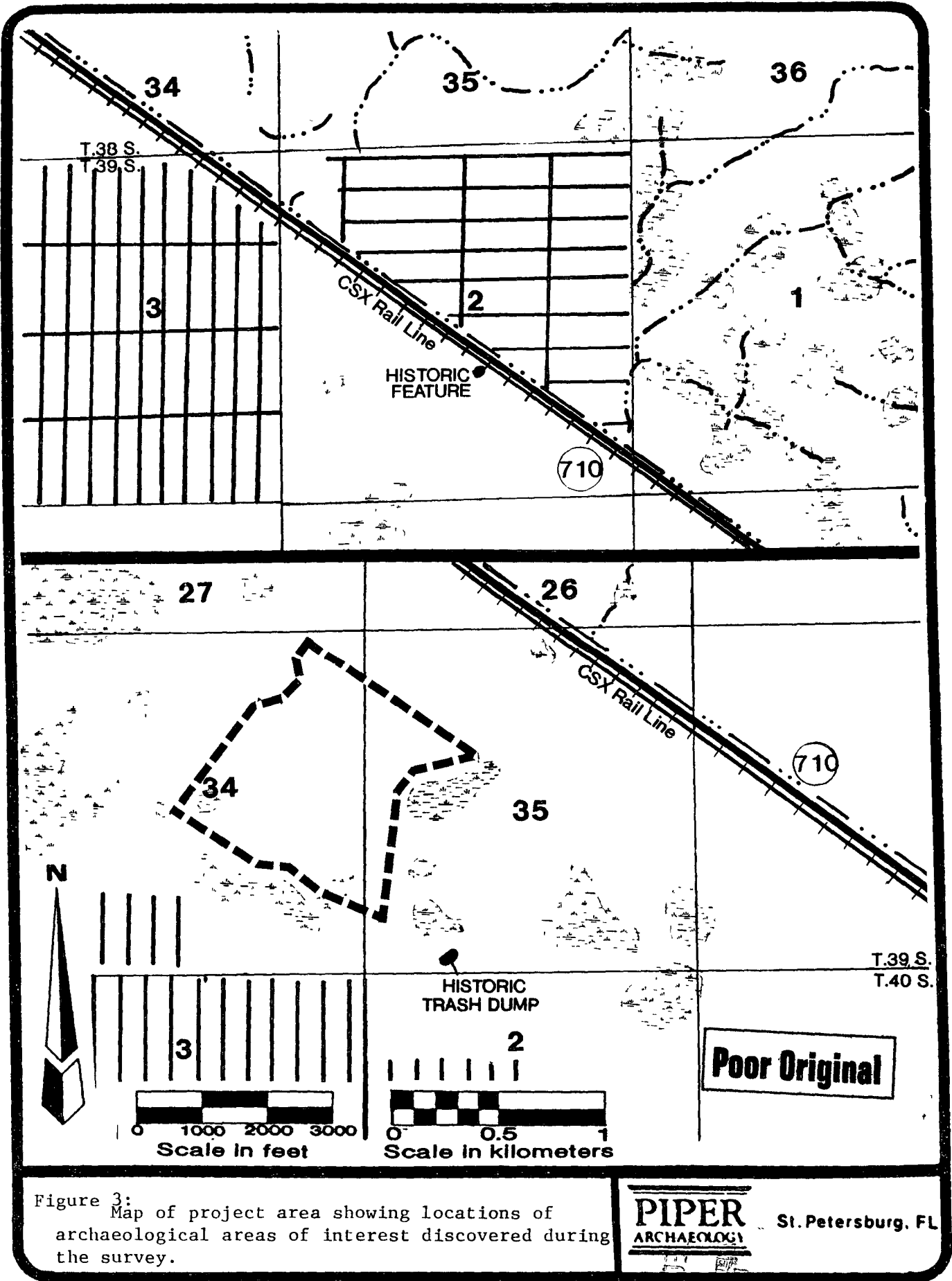


Figure 3:
Map of project area showing locations of
archaeological areas of interest discovered during
the survey.

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secondary road. Due to the limited and unexceptional nature of this dump site, the potential for more information to be recovered from further investigation is low. This dump is not considered regionally or locally significant, and not eligible for listing on the National Register of Historic Places. No further work is recommended for this feature.

The Zana Railroad Water Reservoir is located in Township 39S, Range 27E, section 2, SE/NW/SW (USGS Okeechobee 4 SW, photorevised 1983.) This feature consists of a small camping shack and a large, angular concrete structure with a line of tall, burnt pine poles on the south, extending toward the southeast. Field observations lead the archaeologists to speculate that this feature may have been a water reservoir for a steam powered tram or locomotive.

This feature lies immediately south of the pipeline corridor, outside the project area, and will not be adversely affected by the construction of the pipeline.

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SUMMARY

Two areas of historic period activity and no prehistoric sites were discovered during the cultural resource assessment survey of the ICL plant site and pipeline corridor. The trash dump, found immediately outside of the proposed ICL plant site is a surficial dumping area of little historic interest. The other area is an historic camp with a concrete water-retention structure and lies to the south of the railroad tracks, outside the pipeline corridor. Because this feature is located outside of the project area, its full evaluation is beyond the scope of this project.

In conclusion, no archaeological or historical sites eligible for inclusion in the National Register of Historic Places were found within the proposed project site boundaries or within the associated pipeline corridor.

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3.4

3.4 AIR EMISSIONS AND CONTROLS

3.4.1 AIR EMISSION TYPES AND SOURCES

3.4.1.1 Sources

The primary source of air emissions will be the main boiler, firing coal. There will be one main stack. The stack location has been previously identified in Figure 3.2.04, Emission Point Diagram. The Best Available Control Technology (BACT) for the primary source is addressed in Section 3.4.3.

The ICL project's secondary air emission sources will be as follows:

- Material handling systems
- Auxiliary boiler
- No. 2 fuel tank

The supporting dry bulk material handling systems (coal, lime, and ash) will be sources of fugitive dust. The BACT for these sources is addressed in Section 3.4.3.

The auxiliary boiler will operate normally only during startup of the main boiler or if the main boiler is down and process steam is required for Caulkins Citrus Processing. The auxiliary boiler would rarely operate concurrently with the main boiler under normal load operation. The auxiliary boiler will operate no more than 1,000 hours per year.

The cooling tower will also be a source of emissions. Solids formed in the cooling tower water treatment system can be carried out of the tower in water droplets (drift from the tower) and deposited on the surrounding area.

3.4.1.2 Emissions

The estimated maximum air pollutant emissions from the ICL project represent full load conditions from the boiler and flue gas treatment systems from suppliers currently under consideration. These emission rates are not inclusive of background ambient concentrations introduced into the combustion process. These emissions, as well as the auxiliary boiler emissions, are summarized in Table 3.4.1-1. A comparison of these emission rates with summary of significant emission rate thresholds (as defined in Florida Administrative Code, F.A.C.17-2310) given in Table 3.4.1-2 demonstrates that the project is subject to Prevention of Significant Deterioration (PSD)/BACT review for sulfur dioxide (SO₂), particulate matter (PM₁₀ and TSP), nitrogen dioxide (NO₂), carbon monoxide (CO), volatile organic compounds (VOC) beryllium, inorganic arsenic, and mercury. A complete PSD application is presented in Section 10.1.5.

3.4.1.3 Emissions Inventory

For emissions inventory purposes, DER Form 17-1.202(1), "Application to Operate/Construct Air Pollution Source," has been completed and is included in Section 10.1.5. These emissions are based on a 100 percent capacity factor.

Table 3.4.1-1
WORST CASE CONTROLLED EMISSION RATES
(Page 1 of 3)

Main Boiler Emissions (tons/year based on 100 percent capacity factor)

<u>POLLUTANT</u>	<u>FUEL</u>
Sulfur Dioxide	Coal
Particulates	2549
Nitrogen Dioxide	270
Carbon Monoxide	2549
Volatile Organic Compounds ¹	1647
Lead	54
Beryllium	0.28
Mercury	0.041
Inorganic Arsenic	0.172
Total Fluorides	0.765
	22.26

¹ No. 2 fuel oil tank will contribute a maximum of 180.6 pounds per year of VOC.

Source: Bechtel, 1990

Table 3.4.1-1
WORST CASE CONTROLLED EMISSION RATES
(Page 2 of 3)

Auxiliary Boiler Emissions (lb/hr)

Basis: One 225,000 lb/hr steam unit

<u>POLLUTANT</u>	<u>FUEL</u>	
	<u>Natural Gas</u>	<u>No. 2 Oil</u>
Sulfur Dioxide	6.16	17.8
Particulates	0.5	1.4
Nitrogen Dioxide	35.8	68.2
Carbon Monoxide	33.6	47.3
Volatile Organic Compounds	1.35	0.63
Lead	Negligible	Negligible

Source: Bechtel, 1990

**Table 3.4.1-1
FUGITIVE EMISSION RATES
(Page 3 of 3)**

Fugitive Emissions

<u>Source</u>	<u>Control Device</u>	<u>Hours of Operation</u>	<u>Maximum lb/hr</u>
Coal Unloading Area	Fabric Filter	4	0.34
Active Storage Area	Fabric Filter	4	0.696
Coal Reclaim Area	Fabric Filter	8	0.0007
Crusher Tower Area	Fabric Filter	8	0.2887
Silo Bay Area	Fabric Filter	8	0.0010
Ash Silo Area	Fabric Filter	12	0.2088
Ash Recycle Area	Fabric Filter	12	0.0588
Lime Handling Area	Fabric Filter	12	0.0132
Soda Ash Silo Area	Fabric Filter	12	0.0024
Cooling Tower Mist	--	24	43.0*

* Note: This is salt deposition where the other emissions are dust.

Source: Bechtel, 1990

Table 3.4.1-2
SIGNIFICANT EMISSION RATES
(FROM FLORIDA ADMINISTRATIVE CODE)

<u>Pollutant</u>	<u>Rate (tons per year)</u>
Carbon Monoxide	100
Nitrogen Oxides	40
Sulfur Dioxide	40
Particulate Matter (PM)	
TSP	25
PM ₁₀	15
VOC	40
Lead	0.6
Asbestos	0.007
Beryllium	0.0004
Mercury	0.1
Vinyl Chloride	1
Total Fluorides	3
Sulfuric Acid Mist	7
Hydrogen Sulfide	10
Total Reduced Sulfur	10
Reduced Sulfur Compounds	10

Source: 40 CFR 51.24 Prevention of Significant Deterioration of Air Quality and Table 500-2 contained in F.A.C. 17-2500(2)(e)(2).

3.4.2 AIR EMISSION CONTROLS

3.4.2.1 Nitrogen Oxides

Nitrogen oxides (NO_x) will be emitted from both the PC boiler and auxiliary boiler at the ICL facility. As with all combustion sources, NO_x emissions from these two units arise by either the thermal oxidation of nitrogen in the combustion air or the reduction and subsequent oxidation of fuel nitrogen.

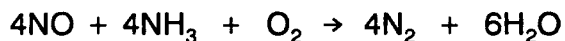
Control of NO_x emissions may be accomplished through either minimization of pollutant formation or by flue gas control devices.

PC Boiler

NO_x emissions from the PC boiler will be controlled by combustion controls and selective non-catalytic reduction (SNCR). The SNCR process is based on a gas phase homogeneous reaction, within a specified temperature range, between NO_x in the flue gas and reagent injected into the furnace to produce gaseous nitrogen and water vapor.

One commercially available ammonia-based SNCR process is Thermal DeNO_x®, a system patented by Exxon Corporation in 1976. In the Indiantown PC boiler, reagent will be injected into the furnace at a point specifically selected to provide optimum reaction temperature and residence time.

The chemical mechanism of the Thermal DeNO_x® process involves at least 31 significant chemical reactions. The main NO_x reduction chemical reaction, which must take place in a temperature range of 1600 to 2200 °F in order to be effective is:



The equipment that would comprise the Thermal DeNO_x® system includes the following items:

- Multiple rows of injection headers and nozzles (only one row utilized, but several provided to allow for process modifications required due to furnace temperature profile)
- Necessary piping for delivery of vaporized ammonia, carrier gas, and mixed gas into the injection headers
- Air compressors and reservoir to provide air for carrier gas and ammonia injection requirements (sufficient carrier gas pressure is necessary to achieve uniform distribution of ammonia throughout the combustion zone)
- Aqueous ammonia storage and vaporization facility
- Instrumentation and control system

Use of SNCR will limit NO_x emissions from the PC boiler to 0.17 lb/MMBtu, equivalent to 582 lb/hr at full load.

Auxiliary Boiler

For the auxiliary oil- and natural gas-fired boiler, NO_x emissions will be minimized through the use of combustion controls. Formation of NO_x is a function of excess air level, furnace temperature, and furnace residence time. Combustion controls seek to minimize NO_x formation by adjusting one or more of these variables. The auxiliary boiler will employ low excess air and low NO_x burners to maintain NO_x emissions below 0.2 lb/MMBtu when burning No. 2 fuel oil, which is equivalent to 68 lb/hr at full auxiliary boiler load.

3.4.2.2 Sulfur Dioxide and Acid Gases

PC Boiler

Control of sulfur dioxide (SO_2) and acid gases (H_2SO_4 and HF) in the PC boiler will be accomplished by a lime spray dryer system operating in conjunction with a fabric filter. In the spray dryer, an alkali reagent slurry will be injected into a reaction vessel. The SO_2 and acid gases formed in the combustion process will react with the alkali slurry to form liquid phase salts which are dried to about 1 percent free moisture by heat in the flue gas. Both the dry reaction products and coal fly ash will then be removed from the flue gas by the downstream fabric filter.

This control alternative will achieve a level of SO_2 emission similar to levels achieved with wet scrubbing alternatives, but without generating a wet scrubber sludge. Wet systems typically generate a sludge which contains 10 to 30 percent moisture. Therefore, the waste solids from wet scrubbing must be either handled wet, or dried further to be handled as a dry product. Spray dryer systems generate a product which is dry and, in the case of ICL facility, can be returned by rail with the fly ash to the coal mine for disposal.

Equipment for the spray dryer system will include absorber vessel(s), pebble lime receiving and storage equipment, a lime slaker, lime slurry feed and recirculation tanks, and spent reaction product storage and handling facilities. The SO_2 control system will have a maximum SO_2 emission level of 0.17 lb/MMBtu, which is equivalent to an emission rate of 582 lb/hr at full load.

Auxiliary Boiler SO_2 emissions from the auxiliary boiler will be controlled by burning only low sulfur fuel. Fuel oil will be purchased with a maximum sulfur content of 0.05 percent, which is equivalent to an emission rate of 0.052 lb/MMBtu or 17.8 lb/hr at full auxiliary boiler load. Natural gas is expected to have negligible

sulfur content and essentially zero emissions of SO₂ are anticipated during natural gas firing.

3.4.2.3 Particulate Matter and Trace Elements

PC Boiler

Emissions of particulate matter from the PC boiler will be controlled by a fabric filter (baghouse). Furnace flue gas, after passing through the spray dryer, will enter the baghouse at an inlet manifold and gas distributor. Gas will pass through the fabric bags from the inside to the outside; collected particulate will be retained on the inner surface of the bags. When the particulate buildup on the surface of the bags reaches a preset thickness, an automatic, off-line, reverse-air cleaning cycle will be initiated. Collected particulate will drop from the bags into collection hoppers and be conveyed to storage in the ash silo.

Features specified for the ICL facility baghouse system include:

- An air-to-cloth ratio of 2.0 feet/minute with one compartment cleaning and one compartment out of service for cleaning and maintenance (This configuration will minimize baghouse pressure drop and increase bag life.)
- Bypass ducting for boiler startup on fuel oil
- Continuous opacity monitoring
- An independent reverse air cleaning system, including controls, instrumentation, and reverse-air fan

Auxiliary Boiler

Emissions of particulate matter from the auxiliary boiler will be minimized by firing only fuels with low ash content: very low sulfur No. 2 fuel oil and natural gas.

3.4.2.4 Carbon Monoxide and Volatile Organic Compounds

Emissions of carbon monoxide (CO) and volatile organic compounds (VOC) will be minimized in both the PC boiler and the auxiliary boiler by providing conditions in each combustion unit to ensure complete combustion. These will include the use of proper excess air, monitored through advanced combustion controls, and design of the boiler furnace to provide maximum fuel-air mixing and turbulence.

3.4.3 BEST AVAILABLE CONTROL TECHNOLOGY

Best Available Control Technology (BACT) is discussed in detail in the PSD application (10.1.5).

3.4.3.1 Nitrogen Oxides

Formation

Nitrogen Oxides (NO_x) are formed in combustion sources by either the thermal oxidation of nitrogen in the combustion air or the reduction and subsequent oxidation of fuel nitrogen. Virtually all NO_x emissions originate as nitric oxide (NO) as both nitrogen and oxygen dissociate into atomic form at the high temperatures within the boiler and then recombine to form NO. A minor fraction of the NO is further oxidized in the flue gas system to form NO_2 . The coal planned for this project will contain some nitrogen compounds, which will primarily be in the form of aromatic nitriles, pyridines, and pyrroles. However, the bulk of the NO_x formation in this facility will be through thermal oxidation of nitrogen from the combustion air, referred to as thermal NO_x .

The rate of formation of thermal NO_x is a function of the residence time, free oxygen, and peak flame temperature. Therefore, most combustion control techniques for thermal NO_x are aimed at minimizing one or more of these variables. Other control methods, known as "tail gas" or "back-end" techniques, remove NO_x from the exhaust gas stream.

Alternative Controls

PC Boiler

The alternative NO_x controls which are applicable to the proposed PC boiler include combustion controls, selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR). It should be noted that the latter two alternatives, SNCR

and SCR, have not been demonstrated in the United States on a PC boiler firing domestic coals. They have, however, been applied to PC units in Japan and Europe, as detailed further in Section 10.1.5 (PSD Application).

Auxiliary Boiler

NO_x emissions from the oil- and natural gas-fired auxiliary boiler, as with the coal-fired PC boiler, can be controlled either through combustion modifications or add-on technology. Add-on controls include SCR and SNCR; combustion modifications include low excess air (LEA) firing, flue gas recirculation (FGR), and low NO_x burner (LNB) design.

Technical Considerations

For either the PC boiler or the auxiliary boiler, the two most stringent control alternatives are SCR and SNCR. For the auxiliary boiler, flue gas recirculation followed by low NO_x burners are the next most stringent alternatives.

The SCR process involves post-combustion removal of NO_x from the flue gas with a catalytic reactor. Ammonia (NH₃) is injected into the flue gas stream upstream of the catalyst bed, and NO_x and NH₃ combine at the catalyst surface, forming elemental nitrogen and water.

PC Boiler

For the PC boiler, the technical feasibility of applying SCR is questionable, since this alternative has never been demonstrated on domestic coal-fired sources. Although it has been applied to sources firing coal in both Japan and Europe, there are differences in the coals and boiler operating practices between these applications and domestic applications which result in SCR being technically infeasible in this application. There are unresolved technology-related issues relating to the use of this alternative in a US application, including lack of demonstration on pilot-scale units firing US fuels, differences between US and both Japanese and European fuels, as well as differences between the proposed ICL

equipment configuration and units where SCR has been applied. These considerations are discussed in detail in Section 10.1.5 (PSD Application).

The SNCR process is based on a gas phase homogeneous reaction, within a specified temperature range, between NO_x in the flue gas and injected reagent to produce gaseous nitrogen and water vapor. As the name implies, SNCR systems do not employ a catalyst, and consequently operate at higher temperatures than SCR systems.

The SNCR process is described in Section 3.4.2.1 and in greater detail in Section 10.1.5 (PSD Application). Technical factors related to application of this technology in the ICL facility include maintaining the appropriate temperature range, minimization of ammonium salt formation, and effect on downstream equipment. Reagent injection nozzles must be situated in locations within the boiler to ensure that the reagent reacts with flue gas at the appropriate temperature. This is best accomplished using multiple injection locations.

Ammonium salts are formed by the reaction of free ammonia with sulfur oxides. These salts tend to condense out of the flue gas at temperatures below 300 °F; in the ICL configuration these salts could plug the boiler, air preheater, and particulate control system. Minimization of ammonia slip (unreacted ammonia) represents the only means to control ammonium salt formation.

Auxiliary Boiler

For the auxiliary boiler, both SCR and SNCR have been applied to domestic sources firing both fuel oil and natural gas. However, for fossil fuel boilers with restricted operating hours, the use of flue gas recirculation or low NO_x burners is more common due to the high cost of add-on controls.

Flue gas recirculation involves extracting a portion of the flue gas from the stack and returning it to the furnace through the burner or windbox. NO_x formation is reduced via a reduction of the peak flame temperature and a lowering of the

oxygen concentration in the combustion zone. NO_x reduction potential is directly related to the flue gas recirculation rate. At rates greater than 25 to 30 percent, however, flame stability is compromised and the net thermal output of the combustion source is decreased. Therefore, the tradeoff between lower NO_x emissions and heat output generally limit flue gas recirculation rates to below 25 percent.

In low NO_x burners, NO_x control is accomplished by injecting part of the fuel into the bulk of the combustion air and the remainder of the fuel into primary and secondary combustion zones within the same burner. Thermal NO_x generation in the primary combustion zone is limited in this fuel-lean zone by the reduced peak flame temperature that results. The combustion products from this primary zone (hydrogen, carbon monoxide, and hydrocarbons) are carried into the secondary combustion zone, lowering the local oxygen concentration and reducing the peak flame temperature in this zone as well. Combustion products from the primary zone also provide reducing agents for NO_x reduction in the secondary zone. Finally, zoned combustion permits complete combustion with lower excess air levels than standard burners, which further enhances NO_x emission reductions.

Economic Considerations

PC Boiler

Capital and annual operating costs associated with operation of an SCR system and an SNCR system on the PC boiler were estimated from vendor information. These costs are presented in the cost format outlined in the EPA 1990 edition of the Office of Air Quality Planning and Standards "Control Cost Manual" in Tables 3.4.3-1 and 3.4.3-2. Since neither system has ever been installed on a PC boiler firing US coals, system designs have to be conservative and contain sufficient contingency to account for indeterminant process variables, including catalyst life, formation of ammonium salts, and effect on downstream equipment.

Table 3.4.3-1
CAPITAL COSTS FOR NO_x CONTROL ALTERNATIVES - PC BOILER

	<u>SCR</u>	<u>SNCR</u>
Purchased Equipment		
(a) Basic Equipment	9,900,000	3,000,000
(b) Auxiliaries	2,300,000	included
(c) Instrumentation and Controls	990,000	included
(d) Structural Support	990,000	300,000
(e) Freight & Taxes	1,134,000	264,000
Direct Installation	4,594,000	1,069,000
Total Direct Costs (TDC)	\$19,908,000	\$4,633,000
Indirect Installation		
(a) Engineering & Supervision	1,991,000	463,000
(b) Construction & Field Expense	1,991,000	463,000
(c) Construction Fee	995,000	232,000
(d) Contingencies	3,982,000	927,000
Other Indirect Costs		
(a) Startup & Performance Test	199,000	46,000
(b) Working Capital	241,000	207,000
(c) License Fee	-	1,137,000
Total Indirect Costs (TIC)	\$9,399,000	\$3,475,000
Total Capital Cost (TCC)	\$29,307,000	\$8,108,000
Annualized Capital Recovery	\$4,757,000	\$1,316,000

(ammortized over 10 years
straight line @ 10% interest rate)

Cost Factors: 1990 OAQPS Control Cost Manual

Table 3.4.3-2
ANNUAL COSTS FOR NO_x CONTROL ALTERNATIVES - PC BOILER

	<u>SCR</u>	<u>SNCR</u>
Direct Operating Costs		
Labor		
(a) Operating (8 hours/shift)	\$175,200	\$175,200
(b) Supervisory	26,000	26,000
Maintenance		
(a) Labor	214,200	214,200
(b) Supplies (50% Maint. Labor)	107,000	107,000
Replacement Parts		
(a) Catalyst	957,000	-
Utilities (2)(3)		
(a) Air	-	-
(b) Steam	47,000	-
(c) Electricity	1,193,000	1,567,000
Raw Materials - Ammonia (2)(3)	248,000	427,000
Catalyst Disposal (2)	13,000	-
Indirect Operating Costs		
Overhead	99,000	99,000
Taxes	293,000	81,000
Insurance	293,000	81,000
Administration	586,000	162,000
Annual Operating Costs	\$4,205,400	\$2,939,400
Annual Capital and Operating Costs	\$8,961,400	\$4,255,400
Annual Tons Removed (4)	1,499	1,499
Cost Effectiveness (\$/ton)	\$5,978	\$2,839

Table 3.4.3-2 (Continued)

Notes:

- (1) catalyst replacement at 100% in 5 years
- (2) per Bechtel Power
- (3) based on 100% capacity
- (4) based on 0.17 lb/MMBtu emission limit
-compared to boiler emission rate 0.27 lb/MMBtu

Estimated direct costs for the SCR system, including catalyst, catalyst housing, ammonia storage, piping and instrumentation are \$19,908,000. Considering installation charges and indirect charges, the total capital cost is estimated at \$29,307,000. Annual costs for SCR include operating labor charges (one additional operator/shift), replacement parts including catalyst replacement, additional electrical cost for fan power associated with increased pressure drop due to the catalyst, ammonia cost, catalyst disposal cost, and indirect operating costs. Total annualized cost, including capital recovery charges (based on 10 percent interest rate and 10-year equipment life), is estimated at \$8,961,400.

Estimated direct costs for SNCR, including injection nozzles, reagent storage and vaporization equipment, piping, and instrumentation are \$4,663,000. Considering installation charges and indirect charges, the total capital cost is estimated at \$8,108,000. Annual costs for SNCR include operating labor charges (one additional operator/shift), additional electrical cost for fan power associated with vaporization and pumping, reagent cost, and indirect operating costs. Total annualized cost is estimated at \$4,255,400.

Based on an emission limit of 0.17 lb NO_x/MMBtu, either PC control alternative would control an estimated 1,499 tons of NO_x per year more than the use of combustion controls (at 0.27 lb/MMBtu) alone. Cost effectiveness for SCR is thus estimated to be \$5,978/ton of NO_x controlled, which is not considered cost effective. For SNCR, cost effectiveness is estimated at \$2,839/ton, which is considered reasonable.

Auxiliary Boiler

SCR, SNCR and FGR capital and annual operating costs for the auxiliary boiler were estimated based on vendor information for a similar project. These costs are presented on Tables 3.4.3-3 and 3.4.3-4. Capital equipment for the SCR and SNCR alternatives would be the same as described above, although the size of the equipment would be reduced compared to the equipment designed for the PC

Table 3.4.3-3
CAPITAL COSTS FOR NO_x CONTROL ALTERNATIVES -
AUXILIARY BOILER

	<u>SCR</u>	<u>SNCR</u>	<u>FGR</u>
Purchased Equipment			
(a) Basic Equipment	675,000	470,000	318,000
(b) Auxiliaries	included	included	included
(c) Instrumentation and Controls	68,000	47,000	32,000
(d) Structural Support	68,000	47,000	32,000
(e) Freight & Taxes	65,000	45,000	31,000
Direct Installation	263,000	183,000	124,000
Total Direct Costs (TDC)	\$1,139,000	\$792,000	\$537,000
Indirect Installation			
(a) Engineering & Supervision	114,000	79,000	54,000
(b) Construction & Field Expense	114,000	79,000	54,000
(c) Construction Fee	57,000	40,000	27,000
(d) Contingencies	34,000	24,000	16,000
Other Indirect Costs			
(a) Startup & Performance Test	11,000	8,000	5,000
(b) Working Capital	31,000	26,000	14,000
(c) License Fee	-	175,000	-
Total Indirect Costs (TIC)	\$361,000	\$431,000	\$170,000
Total Capital Cost (TCC)	\$1,500,000	\$1,223,000	\$707,000
Annualized Capital Recovery (ammortized over 10 years straight line @ 10% interest rate)	\$243,000	\$198,000	\$115,000

Cost Factors: 1990 OAQPS Control Cost Manual

Table 3.4.3-4
ANNUAL COSTS FOR NO_x CONTROL ALTERNATIVES -
AUXILIARY BOILER

	<u>SCR</u>	<u>SNCR</u>	<u>FGR</u>
Direct Operating Costs			
Labor			
(a) Operating	\$87,600	\$87,600	-
(b) Supervisory	13,000	13,000	-
Maintenance			
(a) Labor	107,100	107,100	87,600
(b) Supplies (50% Maint. Labor)	54,000	54,000	44,000
Replacement Parts			
(a) Catalyst (1)	41,000	-	-
(b) Equipment	68,000	47,000	32,000
Utilities			
(a) Air	-	-	-
(b) Steam	-	4,000	-
(c) Electricity	7,100	600	4,400
Raw Materials - Ammonia	2,900	2,200	-
Catalyst Disposal	1,300	-	-
Indirect Operating Costs			
Overhead	50,000	50,000	16,000
Taxes	15,000	12,000	7,000
Insurance	15,000	12,000	7,000
Administration	30,000	24,000	14,000
Annual Operating Costs	\$492,000	\$413,500	\$212,000
Annual Capital and Operating Costs	\$735,000	\$611,500	\$327,000
Annual Tons Removed (2)	27.4	20.5	17.1
Cost Effectiveness (\$/ton)	\$26,864	\$29,800	\$19,123

Table 3.4.3-4 (Continued)

Notes:

- (1) catalyst replacement at 50 percent in 5 years
- (2) compared to NSPS 0.2 lb/MMBtu with 1000 annual operating hours

boiler. In addition, a different catalyst would be used for the oil- and gas-fired auxiliary boiler than would be employed for the PC boiler.

Total capital costs for the SCR alternative on the auxiliary boiler are \$1,500,000. Based on 1,000 hours/hr annual operation, the annual cost of this alternative is estimated at \$735,000/yr. Compared to the NSPS for this size unit, an SCR system designed for 80 percent control would reduce annual NO_x emissions by 27.4 ton/yr for a cost effectiveness in excess of \$26,864/ton, which is considered unreasonable and unrepresentative of BACT.

Total capital costs for the SNCR alternative on the auxiliary boiler are estimated at \$1,222,000; annual costs are estimated at \$611,500/yr. Based on a design control efficiency of 60 percent, this alternative would control 20.5 ton/yr and have a cost effectiveness of \$29,800/ton. This is also considered unrepresentative of BACT costs for similar sources.

Capital costs for the FGR alternative, including additional ductwork, recirculation fan, insulation and control instrumentation, are estimated at \$707,000. Annual costs are estimated at \$327,000/yr with 17.1 ton/yr controlled assuming a reduction efficiency of 50 percent. Cost effectiveness of FGR is thus \$19,123/ton; similarly this is considered excessive and unrepresentative of BACT.

There is no adverse economic impact associated with the use of low NO_x burners.

Environmental Considerations

Adverse environmental impacts associated with the use of SCR include disposal of spent catalyst and issues pertaining to emissions of unreacted ammonia. For SNCR, unreacted ammonia emissions are the only significant environmental consideration.

The SCR catalyst material will be subject to loss of activity and poisoning and will need to be periodically replaced. The disposal of spent catalyst, which contains various heavy metals and thus considered to be hazardous waste, is an environmental burden and potential liability. Certain catalyst formations must be washed annually in order to be cleaned and regenerated. Wastewater treatment and/or hazardous waste disposal of the wastewater treatment residues would pose additional adverse economic and environmental impacts with these SCR systems.

In light of the restricted water availability of Florida and stringent wastewater discharge requirements in this area, the generation of large amounts of hazardous wastewater represents a significant adverse impact for this potential application.

Not all the reactant ammonia will be consumed in the NO_x reduction reactions. Emissions of unreacted ammonia (ammonia slip) are thus another adverse environmental consideration in any application of SCR and SNCR. Vendors claim that the design and proper operation of the catalyst reactor will keep ammonia slip to less than 10 ppm. However, catalyst design is governed principally by NO_x removal required and allowable ammonia slip. Therefore, requiring either higher NO_x removal or lower residual ammonia requires greater amounts of catalyst, thereby increasing costs. Consequently, to a certain extent there is a tradeoff between NO_x and ammonia emissions in any application of SCR.

Conclusions

PC Boiler

SCR and SNCR are considered the most stringent NO_x control alternatives. SCR has been applied to commercial scale coal-fired sources in both Japan and Europe after intensive R&D and process development work on laboratory-scale and pilot-scale equipment. In transferring SCR technology from the commercial applications in Japan to European sources, technical problems arose which were not anticipated given the Japanese experience. SCR has never been applied, however, to a commercial-scale unit firing domestic coals, and has never been

applied to a commercial PC unit in either Japan or Europe using a baghouse for particulate control. Problems comparable to those encountered in European SCR applications are expected for US applications. However, pilot-scale studies to validate this technology on US coals are in their early stages. Therefore, SCR is not considered technically feasible at the present time, and thus not BACT, for Indiantown. Finally, the imposition of this technology would result in an increase in annual operating costs of \$9,806,000/yr, which is also considered unreasonable given the current developmental status of this alternative in the US on coal-fired sources.

SNCR has similarly never been applied on a commercial scale boiler firing domestic coals, and there are technical issues which must be addressed involving minimization of the condensation of ammonium salts, maintenance of system operating temperature during reduced load conditions, and compatibility of the system with downstream air pollution control equipment. The technology is currently in use at domestic coal-fired CFBs, and although these applications may be more favorable for the application of SNCR, the technical issues are considered manageable. Compared to the base case combustion controls, the application of SNCR to Indiantown with an emissions level of 0.17 lb/MMBtu results in an increase in capital and operating costs of \$3,369,000 and a cost effectiveness of \$2,248/ton of NO_x controlled.

Therefore, based on these technical and economic factors, the use of SNCR is concluded to be representative of BACT for control of NO_x for the PC boiler.

Auxiliary Boiler

For the auxiliary boiler, SCR is considered the most stringent control alternative; however, due to the limited operating hours of this source, this alternative would result in unreasonable annualized costs. SNCR, as the next-most stringent alternative, is similarly concluded to be economically infeasible. FGR would be the third-most stringent alternative; this control method is similarly concluded to be unreasonable based on excessive cost effectiveness.

The use of low NO_x burners, as the next alternative, would not have unreasonable annual economic or energy impacts, and use of this alternative would not result in adverse environmental impacts. It is therefore concluded to represent BACT for control of NO_x from the auxiliary boiler.

3.4.3.2 Sulfur Dioxide and Acid Gases

Formation

Emissions of sulfur oxides (SO_x) and acid gases (H₂SO₄ and HF) are generated in coal-fired sources from the release in the furnace of sulfur and fluorine present in the fuel. Sulfur compounds are formed when the organic and pyritic sulfur is oxidized, forming primarily sulfur dioxide (SO₂) with smaller quantities of sulfur trioxide (SO₃) and sulfates (SO₄). Sulfur trioxide further reacts with water present in the flue gas to form H₂SO₄.

Upon combustion, approximately 98 percent of the sulfur in bituminous coal is emitted as gaseous sulfur oxides. Uncontrolled emissions of SO₂ are thus affected only by the fuel sulfur content and not by the firing mechanism, boiler size, or operation.

Sulfuric acid (H₂SO₄) and hydrogen fluoride (HF) gas emissions are created in coal- and oil-fired combustion sources after sulfur and fluorine are released in the furnace from burning fuel containing trace levels of these elements.

Conversion of fluorine to HF depends on the air/fuel mixing, the combustion temperature, and the presence of other trace elements. The formation and emission of H₂SO₄, however, depends on the quantities of gaseous SO₃ and moisture in the flue gas. SO₃ reacts rapidly with water in the flue gas and stack vapor plume to form H₂SO₄.

The amount of SO_3 present in the flue gas depends on the fuel sulfur content as well as conditions supportive of secondary oxidation of sulfur dioxide to sulfur trioxide. Combustion temperature, alkali component concentration in the fuel, and excess oxygen level are a few of the factors governing SO_2/SO_3 conversion.

Alternative Controls

Control of SO_2 and acid gas emissions is primarily effected by removing these pollutants from the flue gas with either wet or dry scrubbing alternatives. Such systems are generally designed to reduce SO_2 and are referred to as flue gas desulfurization (FGD) devices.

In addition, limiting the fuel sulfur content is an applicable control alternative, particularly for fuel-oil fired sources.

Technical Considerations

PC Boiler

Wet scrubbing is a diffusion process in which pollutants (in the forms of gases or mists) are transferred from the gas stream to the scrubbing liquid under saturated conditions. Wet scrubbing contact devices include spray towers, baffle towers, tray towers, and packed towers.

In dry scrubbing systems, commonly referred to as spray dryers, an alkali reagent slurry is injected into a vessel sized for relatively long residence time. The SO_2 and acid gases react with the slurry to form liquid phase salts which are dried to about 1 percent free moisture by heat in the flue gas.

There are various types of wet FGD alternatives, although the most common in use are the limestone and wet lime processes. Like all wet scrubbing process, both of these processes generate a liquid wastewater effluent; wet scrubbing equipment

necessarily includes wastewater treatment and disposal systems in addition to the contact device.

Spray dryers, on the other hand, produce a dry reaction product which is collected in the baghouse filter. SO₂ collection efficiency is enhanced in a dry scrubbing system as the flue gas passes through collected unreacted reagent.

The flue gas emitted from wet scrubbing processes is generally 20 to 40°F cooler than from spray dryers. This causes less plume rise, and hence, increased ground level concentrations (GLC) of all emitted pollutants. These increased concentrations cause potentially greater health risk impacts. Significant corrosion, erosion, and scaling of wet scrubber equipment, piping, pumps, fans, and valves have been reported; thus, wet scrubbers require more frequent repairs, parts replacements, and general maintenance at the expense of high costs and reduced availability.

Spray dryers achieve levels of SO₂ removal that are comparable to levels achieved with wet scrubbing systems. Spray drying technology is less complex mechanically than wet scrubbing systems and does not generate a liquid waste; thus treatment and disposal problems and costs are not incurred. Compared to wet scrubbing, the stack gas is hotter, allowing for better plume dispersion and hence lower ground level concentrations.

Auxiliary Boiler

Control alternatives for the auxiliary boiler include wet scrubbing and fuel sulfur restrictions. According to the BACT/LAER Clearinghouse, dry scrubbing has not been applied to oil-fired sources. Since the use of a baghouse filter is not technically feasible for oil-fired sources (due to the sticky nature of oil particulate) and considering that spray dryers must be used in conjunction with a baghouse filter, the use of spray drying for control of SO₂ and acid gases is considered technically infeasible for the auxiliary boiler.

Economic Considerations

PC Boiler

Both wet scrubbing and spray drying are considered equivalent for the PC boiler in terms of emission level. Therefore, it is the difference in operating cost between the two technologies, rather than the cost effectiveness, which is the key economic issue.

Capital and annual operating cost information for these two control alternatives is shown on Tables 3.4.3-5 and 3.4.3-6, respectively. Limestone scrubbing is considered representative of wet scrubbing SO₂ control technology. The estimated equipment costs for this system, including spray tower, limestone storage, slurry preparation tankage, sludge dewatering and handling equipment, pumps, piping, and instrumentation are \$45,490,000. Considering installation charges and indirect charges, the total capital cost is estimated at \$67,828,000. Annual costs for wet scrubbing include operating labor charges, replacement parts, electrical cost both for fan power and pumping, limestone cost, sludge disposal cost, and indirect operating costs. Total annualized cost, including capital recovery charges (based on 10 percent interest rate and 10-year equipment life), is estimated at \$31,385,000.

Estimated equipment costs for spray drying, including absorber vessels (two in parallel), lime slurry preparation and storage, pumps, piping, dry solids handling and storage, and instrumentation are \$21,060,000. Considering installation charges and indirect charges, the total capital cost is estimated at \$32,271,000. Annual costs for spray drying include operating labor charges, additional electrical for fan power and associated pumping, lime cost, solids disposal cost, and indirect operating costs. Total annualized cost is estimated at \$25,383,000. This represents a cost savings of approximately \$6,000,000 compared to the wet scrubbing alternative.

As the more economic alternative to achieve the same emission level, the use of spray drying is thus more representative of BACT than wet scrubbing.

Auxiliary Boiler

The cost of installing a sodium-based wet scrubber (the most common wet scrubbing alternative for oil-fired sources), was estimated based on a cost quote for a similar installation. Capital and operating costs for this application are shown on Table 3.4.3-7 and 3.4.3-8, respectively. Total capital costs are estimated at \$810,000; total annualized costs (including capital recovery) are estimated at \$536,000/yr. Based on a 95 percent control efficiency and 1000 hours/yr of annual operation, this alternative would control 8.4 ton/yr compared to the use of low sulfur fuel for a cost effectiveness of over \$63,000/ton controlled. This is considered unreasonable and unrepresentative of BACT.

There are no adverse economic impacts associated with the use of low sulfur oil.

Environmental Considerations

For wet FGD systems, the most significant adverse environmental impact is that these systems generate a wet sludge which must be disposed of. On other sources where this SO₂ control alternative is utilized, the scrubber sludge is generally disposed of at onsite landfills. This practice, however, is not feasible at the ICL site. For the PC boiler, approximately 100,000 ton/yr of wet sludge would be generated, and this material would have to be sent to an offsite landfill for disposal.

Conclusions

PC Boiler

Both wet FGD and spray drying are proven SO₂ and acid gas control alternatives. Both are capable of meeting an emission limit of 0.17 lb SO₂/MMBtu, which is comparable to the most stringent emission limits among operating PC plants. The

use of wet scrubbing, however, would require disposal of large quantities of wet sludge in landfills, while the solids generated by the spray dryer will be dry and returned to the coal mine with the fly ash for disposal. Furthermore, the spray dryer is estimated to achieve the same emission rate as the wet scrubber at an annual operating cost saving of nearly \$6,000,000. Spray drying at an emission rate of 0.17 lb/MMBtu is thus concluded to be BACT for SO₂ and acid gas control.

Auxiliary Boiler

Alternative controls for this source consist of wet scrubbing and fuel sulfur limitations. The use of wet scrubbing is considered unreasonable economically due to the limited hours of operation. The use of low sulfur fuel, which will limit SO₂ emissions to 8.9 ton/yr from the auxiliary boiler is therefore concluded to represent BACT.

3.4.3.3 Particulate Matter and Trace Elements

Formation

The composition and amount of particulate matter emitted from coal-fired boilers are a function of firing configuration, boiler operation, and coal properties. Particulate matter will be emitted from the proposed pulverized coal boiler as a result of the entrainment of incombustible inert matter (ash), and condensable substances. Since PC systems attain almost complete combustion, very little unburned carbon is emitted as particulate matter.

Emissions of particulate matter in oil-fired boilers result from the ash in the fuel and incomplete fuel combustion. PM emissions vary in oil-fired sources with the sulfur content of the fuel, and are also dependent on boiler load, generally decreasing with decreasing load.

Three regulated trace metals, mercury (Hg), beryllium (Be), and arsenic (As) will potentially be emitted from the proposed ICL PC facility. The quantity and

Table 3.4.3-5
CAPITAL COSTS FOR SO₂/ACID GAS CONTROL ALTERNATIVES -
PC BOILER

	<u>WET FGD</u>	<u>SPRAY DRYER</u>
Purchased Equipment		
(a) Basic Equipment	27,000,000	12,500,000
(b) Auxiliaries	included	included
(c) Instrumentation and Controls	2,700,000	1,250,000
(d) Structural Support	2,700,000	1,250,000
(e) Freight & Taxes	2,592,000	1,200,000
Direct Installation	10,498,000	4,860,000
Total Direct Costs (TDC)	\$45,490,000	\$21,060,000
Indirect Installation		
(a) Engineering & Supervision	4,549,000	2,106,000
(b) Construction & Field Expense	4,549,000	2,106,000
(c) Construction Fee	2,275,000	1,053,000
(d) Contingencies	9,098,000	4,212,000
Other Indirect Costs		
(a) Startup & Performance Test	455,000	211,000
(b) Working Capital	1,412,000	1,523,000
Total Indirect Costs (TIC)	\$22,338,000	\$11,211,000
Total Capital Cost (TCC)	\$67,828,000	\$32,271,000
Annualized Capital Recovery (ammortized over 10 years straight line @ 10% interest rate)	\$11,008,000	\$5,238,000

Cost Factors: 1990 OAQPS Control Cost Manual

Table 3.4.3-6
ANNUAL COSTS FOR SO₂/ACID GAS CONTROL ALTERNATIVES -
PC BOILER

	<u>WET FGD</u>	<u>SPRAY DRYER</u>
Direct Operating Costs		
Labor		
(a) Operating (1)	\$787,000	\$524,000
(b) Supervisory	118,000	79,000
Maintenance		
(a) Labor	1,180,500	786,000
(b) Supplies (50% Maint. Labor)	590,000	393,000
Replacement Parts	1,350,000	625,000
Utilities (1)(2)		
(a) Air	-	-
(b) Steam	-	-
(c) Electricity	2,919,000	1,249,000
Raw Materials (1)(2)		
(a) Limestone	3,815,000	-
(b) Lime	-	8,726,000
Solid Disposal (1)(2)	6,421,000	6,150,000
Indirect Operating Costs		
Overhead	484,000	322,000
Taxes	678,000	323,000
Insurance	678,000	323,000
Administration	1,357,000	645,000
Annual Operating Costs	\$20,377,500	\$20,145,000
Annual Capital and Operating Costs	\$31,385,500	\$25,383,000

Notes:

- (1) per Bechtel Power
- (2) based on 100% capacity
- (3) compared to uncontrolled, based on 0.17 lb/MMBtu emission limit

Table 3.4.3-7
CAPITAL COSTS FOR SO₂ CONTROL ALTERNATIVES -
AUXILIARY BOILER

	<u>WET FGD</u>
Purchased Equipment	
(a) Basic Equipment	360,000
(b) Auxiliaries	included
(c) Instrumentation and Controls	36,000
(d) Structural Support	36,000
(e) Freight & Taxes	35,000
Direct Installation	140,000
Total Direct Costs (TDC)	\$607,000
Indirect Installation	
(a) Engineering & Supervision	61,000
(b) Construction & Field Expense	61,000
(c) Construction Fee	30,000
(d) Contingencies	18,000
Other Indirect Costs	
(a) Startup & Performance Test	6,000
(b) Working Capital	27,000
(c) License Fee	-
Total Indirect Costs (TIC)	\$203,000
Total Capital Cost (TCC)	\$810,000
Annualized Capital Recovery (ammortized over 10 years straight line @ 10% interest rate)	\$131,000

Cost Factors: 1990 OAQPS Control Cost Manual

Table 3.4.3-8
ANNUAL COSTS FOR SO₂ CONTROL ALTERNATIVES -
AUXILIARY BOILER

	<u>WET FGD</u>
Direct Operating Costs	
Labor	
(a) Operating	\$87,600
(b) Supervisory	13,000
Maintenance	
(a) Labor	107,100
(b) Supplies (50% Maint. Labor)	54,000
Replacement Parts	36,000
Utilities	
(a) Air	-
(b) Steam	2,900
(c) Electricity	20,200
Raw Materials - Sodium Hydroxide	2,300
Waste Disposal	500
Indirect Operating Costs	
Overhead	50,000
Taxes	8,000
Insurance	8,000
Administration	16,000
Annual Operating Costs	\$405,600
Annual Capital and Operating Costs	\$536,600
Annual Tons Removed (1)	8.4
Cost Effectiveness (\$/ton)	\$63,523

Notes:

(1) compared to 0.052 lb/MMBtu with 1000 annual operating hours

characteristics of these trace pollutant emissions depend on the coal composition, the chemical and physical properties of the trace metals, and performance of the control devices.

Heavy metal emissions from fossil fuel-fired boilers are created as a result of combustion of fuels containing metals. Due to the high temperatures and turbulence in the furnace, metals are released in both a particulate and vapor phase, often as metal oxides, chlorides, and sulfates. Depending on the metal compound involved and its condensation temperature, a vaporized metal begins to condense mostly on the surfaces of the fine solid particles in the flue gas (since that fraction has the greatest surface area) at normal stack temperatures (about 350 °F). Condensation occurs as the flue gases cool in the boiler and especially as condensation temperatures are achieved in a acid gas control device such as a spray dryer absorber.

Alternative Controls

PC Boiler

Alternative PM and trace metal control options for coal-fired boilers and other combustion sources include: electrostatic precipitators (ESPs), baghouse (fabric) filters, and venturi scrubbers. Since the most stringent emission levels listed in the BACT/LAER Clearinghouse are for fabric filters, and since the EPA has determined that they are superior to ESPs for control of PM₁₀, fabric filters are considered to represent the top technology for control of PM and PM₁₀ from the proposed project.

Auxiliary Boiler

The PM and trace metal control alternatives for the auxiliary boiler include using ESPs or firing fuels with low ash contents. Fabric filters are not technically feasible for oil-fired sources due to difficulty in dislodging the ash from the bags once it is collected.

Technical Considerations

PC Boiler

The basic components of a baghouse include a filter medium, in the form of cylindrical bags, a tube sheet to support the bags, a gas-tight enclosure, and a means to dislodge the accumulated dust from the bags. The particulate-laden gas stream enters the baghouse, passes through the bags and is then discharged to the stack. Particulate collection occurs through inertial impaction, diffusion, direct sieving, electrostatic attraction, and gravity settling. The first two mechanisms prevail during the early phases of filtration after the cleaning cycle before a "cake" of collected material has accumulated. Build-up of a cake is desirable, since this cake becomes the filter medium. Eventually the pressure drop across the cake increases and the accumulated material must be removed using one of various cleaning methods (i.e., mechanical shaking, reverse air cleaning, or pulse-jet cleaning). The collected particulate drops by gravity to the collection hoppers and is removed for disposal.

A wide range of actual operating performance has been reported for fabric filters. Some of the differences in design and operation which influence emission rates include fabric leaks, cleaning frequencies and techniques, maintenance quality, fabric type, air-to-cloth ratio, and flue gas characteristics.

The particular fabric selected for a given application is dependent on operating temperature and humidity, flue gas acidity, particulate size distribution, and required bag life. Bag materials may be woven, felted, or textured materials; woven fabric is the most commonly used bag material. For extremely low emission rates, Gore-Tex fabric, a laminated system manufactured by one vendor (W.L. Gore Associates), has been used.

Auxiliary Boiler

ESPs have been employed to remove particulate from oil-fired combustion sources such as the auxiliary boiler planned for Indiantown. A typical ESP consists of an

alternating array of negatively-charged wires or grids and positively-grounded collection plates. A high voltage is applied across the negative electrodes and the collection plates which produces an electrostatic field between the two elements. As the particulate-laden gas passes through the space between the elements, the field results in a buildup of electrostatic charge on dust particles, which migrate to the collection plates. Particulate removal is accomplished by rappers that vibrate the collection plates and dislodge the particles, which then drop into collection hoppers.

Energy demand is one of the most significant drawbacks for ESPs. For the auxiliary boiler, roughly 1.85×10^6 kWhr of electricity would be required annually.

Economic Considerations

PC Boiler

Budgetary cost estimates for installation of a fabric filter system for the ICL PC boiler were obtained based on data for similar projects, and are shown in Table 3.4.3-9. Basic equipment and auxiliaries for this system include the baghouse, filter bags, dampers, and ductwork. Conventional bags would be capable of achieving an emission limit of 0.018 lb/MMBtu, whereas Gore-Tex bags would be expected to meet a limit of 0.012 lb/MMBtu. Total installed cost of the 0.018 lb/MMBtu alternative is estimated at \$20,524,000. At an additional cost of \$180 per bag (\$270/bag for Gore-Tex versus \$90/bag for conventional bags), the 0.012 lb/MMBtu alternative is estimated to have a total capital cost of \$22,206,000.

Annualized operating costs for the baghouse systems are shown in Table 3.4.3-10. The conventional bag system is estimated to cost approximately \$5,999,000/yr; the additional cost of the Gore-Tex bag system would be approximately \$832,000/yr considering increased capital recovery charges and additional cost for replacement of the more expensive bags. The Gore-Tex system would control an additional 90 ton PM/yr compared to the conventional system; however this additional removal is not justifiable at more than \$9,244/incremental ton controlled.

Table 3.4.3-9
CAPITAL COSTS FOR PM CONTROL ALTERNATIVES - PC BOILER

	<u>.018 lb/mm Btu</u>	<u>.012 lb/mm Btu</u>
Purchased Equipment		
(a) Primary and Auxiliary	\$9,523,000	\$9,523,000
(b) Instrumentation & Control	952,000	952,000
(c) Structural Support	952,000	952,000
(d) Freight & Taxes	762,000	762,000
(e) Adder for Gore-tex Bags	-	1,300,000
Total Purchased Equipment Cost	\$12,189,000	\$13,489,000
Direct Installation	\$3,657,000	\$3,657,000
Total Direct Costs	\$15,846,000	\$17,146,000
Indirect Installation		
(a) Engineering & Supervision	\$1,585,000	1,715,000
(b) Construction & Field Expense	1,585,000	1,715,000
(c) Construction Fee	792,000	857,000
(d) Contingencies	475,000	514,000
Total Indirect Installation	\$4,437,000	4,801,000
Other Indirect Costs		
(a) Startup & Testing	158,000	171,000
(b) Working Capital	83,000	88,000
Total Other Indirect	\$241,000	\$259,000
Total Indirect Cost	\$4,678,000	\$5,060,000
Total Capital Costs	\$20,524,000	\$22,206,000
Capital Recovery Factor	\$3,345,000/yr	\$3,620,000/yr

Table 3.4.3-10
ANNUAL COSTS FOR PM CONTROL ALTERNATIVES - PC BOILER

	<u>.018 lb/mmBtu</u>	<u>.012 lb/mmBtu</u>
Direct Operating Costs		
Labor		
(a) Operating	\$175,000	\$175,000
(b) Supervisory	26,000	26,000
Maintenance	\$792,000	\$875,000
Replacement Parts	@\$90 ea 216,000	@270 ea \$648,000
Utilities		
(a) Electricity	657,000	657,000
Raw Materials		
(a) Ammonia	0	0
(b) Lime	0	0
(c) Limestone	0	0
Disposal Costs	NA	NA
Indirect Operating Costs		
Overhead	\$155,000	\$163,000
Property Taxes	158,000	171,000
Insurance	158,000	171,000
Administration	317,000	343,000
Capital Recovery	\$3,345,000/yr	3,620,000/yr
Total Annualized Cost	\$5,999,000/yr	\$6,831,000/yr
Uncontrolled Emission Rate	153,000 t/y	153,000 t/y
Controlled Emission Rate	270 t/y	180 t/y
Tons Controlled	152,730 t/y	90 t/y additional
Cost Effectiveness	\$39/ton	\$9,244/ton incremental

Auxiliary Boiler

Basic equipment costs for an ESP sized to control oil-fired particulate matter from the auxiliary boiler were estimated based on vendor data for a similar project. Basic equipment costs, shown in Table 3.4.3-11, are \$292,000. The total capital investment is estimated at \$918,000.

Annual ESP costs were estimated and are shown in Table 3.4.3-12. These costs are based on 1,000 hr/yr annual operation. The most significant annual cost is for electricity (\$131,000/yr). The total annualized cost (including capital recovery) is estimated at \$480,000/yr. However, due to the limited operating hours of this source, an ESP would only control 3.5 ton/yr of particulate for a cost effectiveness of over \$137,000/ton. This is clearly unreasonable and unrepresentative of BACT.

The use of low ash fuels (natural gas and No. 2 fuel oil), on the other hand, does not result in any adverse economic impacts.

Conclusions

PC Boiler

Baghouse filters represent the most stringent PM/PM₁₀ control technique which can be applied to PC boilers. Fabric filters represent a cost effective control technology for the proposed project, with no negative environmental impacts.

Therefore, the use of a baghouse filter to control PM emissions to 0.018 lb/MMBtu is representative of BACT.

Auxiliary Boiler

For the oil- and natural gas-fired auxiliary boiler, an ESP is a technically feasible control alternative; but, given the relatively small number of annual operating hours for this unit, would not be cost effective. As the next most stringent alternative, the use of low ash No. 2 fuel oil and natural gas as fuels in the auxiliary boiler is concluded to be representative of BACT.

Table 3.4.3-11
CAPITAL COSTS FOR PM CONTROL ALTERNATIVE - AUXILIARY BOILER

<u>Direct Costs</u>	<u>ESP</u>
Purchased Equipment	
(a) Basic Equipment	\$292,000
(b) Auxiliaries	\$102,000
(c) Instrumentation	\$29,000
(d) Structural Support	\$29,000
(e) Tax & Freight	\$36,000
Total Purchased Equipment Cost	\$488,000
Direct Installation	\$146,000
Total Direct Cost (TDC)	\$634,000
Indirect Costs	
Indirect Installation	
(a) Engineering Supervision	\$63,000
(b) Construction & Field Expenses	\$63,000
(c) Construction Fee	\$95,000
Total Indirect Installation Cost	\$221,000
Other Indirect Costs	
(a) Startup & Performance Tests	\$6,000
(b) Working Capital	\$8,000
(c) Interest During Construction	\$49,000
Total Indirect Costs (TIC)	\$63,000
Total Capital Cost (TCC)	\$284,000
CRF	\$159,000/yr

Table 3.4.3-12
ANNUAL COSTS FOR PM CONTROL ALTERNATIVE - AUXILIARY BOILER

<u>Direct Operating Costs</u>	<u>ESP</u>
Labor	
(a) Operating	\$55,000
(b) Supervisory	\$8,000
Maintenance	\$32,000
Replacement Parts	\$36,000
Utilities	
(a) Electricity	\$131,000
(b) Water	\$0
(c) Steam	\$0
(d) Compressed Air	\$0
(e) Fuel	\$0
Raw Materials	
(a) Ammonia	\$0
(b) Urea	\$0
(c) Lime	\$0
(d) Sodium hydroxide	\$0
(e) Soda Ash	\$0
Indirect Operating Costs	
Overhead	\$23,000
Property Tax	\$9,000
Insurance	\$9,000
Administration	\$18,000
Capital Recovery	\$159,000
Total Annualized Operating Cost	\$480,000
tpy removed	3.5
Cost Effectiveness \$/ton removed	\$137,000

Control of PM emissions is concluded to represent BACT for control of trace metal emissions as well for both the PC boiler and the auxiliary boiler.

3.4.3.4 Carbon Monoxide and Volatile Organic Compounds

Formation

Emissions of carbon monoxide (CO) and volatile organic compounds (VOCs) result from the incomplete combustion of carbon and organic compounds. CO and VOC emissions are a function of oxygen availability (excess air), flame temperature, residence time at flame temperature, boiler design, and turbulence.

Alternative Controls

Control of the emissions of CO and VOCs may be effected two ways: (1) combustion modifications to minimize the formation of the pollutants, and (2) flue gas catalytic oxidation of any CO and VOCs formed in the combustion process.

Technical Considerations

Catalytic oxidation has been the control alternative used to obtain the most stringent control level for CO and VOCs from fossil fuel-fired combustion units. The use of this alternative is well established for certain fuels and firing configurations, such as combustion turbines firing natural gas. This alternative has never been applied to a coal-fired unit, however.

An oxidation catalyst vendor (Englehard) was contacted to determine the technical feasibility and economic impacts of installing an oxidation catalyst on a coal-fired boiler. Due to the high particulate loading of the flue gas, trace element concentration, and SO₂ level, the vendor stated that they could not provide a catalyst system for this particular application. The vendor stated that flue gas

particulate will plug the catalyst, thereby restricting gas flow, masking the active sites and corroding the catalyst.

The vendor contacted also stated that they have never supplied an oxidation catalyst system for an oil-fired boiler. Although the sulfur, ash, and trace element concentrations in fuel oil are lower than the concentrations in coal, the presence of these constituents in fuel oil results in oxidation catalyst systems being technologically infeasible for the fuel oil-fired auxiliary boiler.

Therefore, the use of catalytic oxidation for control of CO and VOC from the proposed PC and auxiliary boiler is not considered technically feasible.

The next most stringent levels of control of CO and VOCs from fossil fuel-fired boilers have been achieved through the use of combustion controls. In general, a combustion control system seeks to maintain the proper fuel to oxygen ratio to ensure complete combustion of the fuel. Essential requirements are sufficient excess air, thorough mixing of fuel and air, and adequate furnace residence time. Advanced combustion controls accomplish this through the use of one or more of the following operational design features:

- Low excess air
- Staged combustion
- Overfire air

Economic Considerations

There are no adverse economic impacts associated with the use of combustion controls for minimization of CO and VOC emissions from either the PC boiler or the auxiliary boiler. Minimization of emissions of these pollutants represents a maximization of fuel use and therefore boiler thermal efficiency, as well as a requirement in terms of licensability and permitting. Such boiler design

considerations are therefore considered standard features of modern fossil fuel combustion units.

Environmental Considerations

There are no adverse environmental considerations in conjunction with the use of combustion controls in either the PC boiler or the auxiliary boiler for minimization of the formation of CO and VOC.

Conclusions

Combustion controls minimize the formation and emission of both CO and VOCs without adverse economic, energy, or environmental impacts. Such controls are the most stringent control alternative which has been demonstrated to be applicable to PC and fuel oil-fired units, and are concluded to be representative of BACT.

3.4.4 DESIGN DATA FOR CONTROL EQUIPMENT

Fuel properties were presented in Section 3.3. Main boiler flue gas data is presented in Table 3.4.4-1. These data are based on estimates derived from recent information provided by boiler and flue gas treatment suppliers.

Emission data for the auxiliary boiler are shown in Table 3.4.4-2.

The boiler will be designed to minimize NO_x formation by the use of combustion controls and low NO_x burners. In addition to the low NO_x burners, reagent will be injected into the boiler per the SNCR process to transform the NO_x to elemental nitrogen and water.

The control equipment for the removal of SO_x and other acid gases is the spray dryer absorber (SDA). The SDA injects a lime slurry into the flue gas stream where it reacts with the pollutants. The reaction of the lime with the pollutants produces a precipitate which falls out of the gas stream at either the SDA hopper or is removed at the baghouse.

A multi-compartmented baghouse is used to remove the fly ash and SDA reaction products that are entrained in the flue gas.

A diagram depicting the air emission control design for the unit is illustrated in Figure 3.4.4-1.

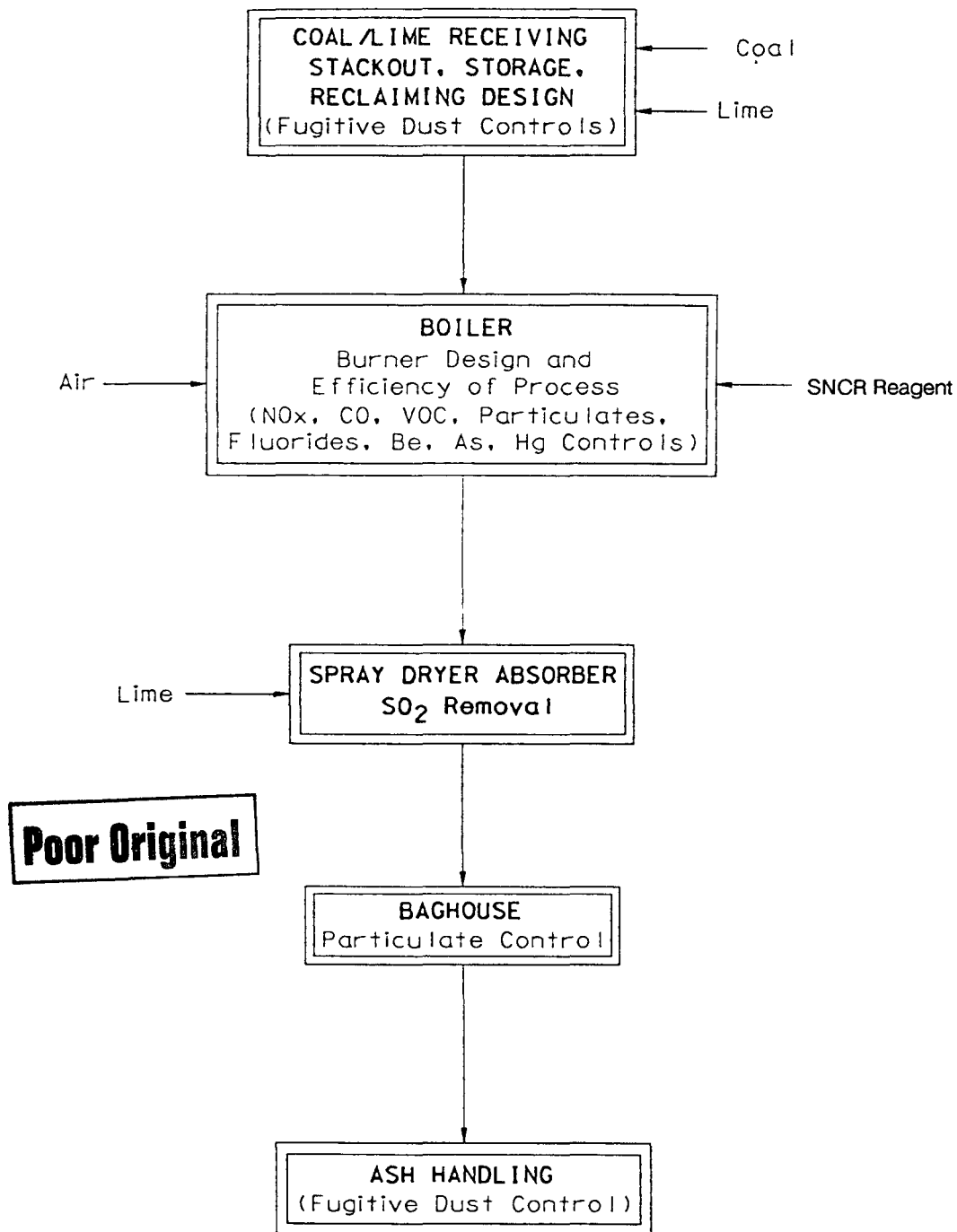


Figure 3.4.4-1.

AIR EMISSIONS CONTROL EQUIPMENT DIAGRAM

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Table 3.4.4-1
ESTIMATED PERFORMANCE WITH COAL - FULL LOAD

Conditions

Ambient Temperature (°F)	80
Relative Humidity (%)	60
Load Condition	Base (Full Load)
Elevation	34 ft NGVD

Emissions

NO _x (lb/hr)	582
SO ₂ (lb/hr)	582
Particulate (lb/hr)	61.6
CO (lb/hr)	376
VOC (lb/hr)	12.3

Exhaust Stack Temperature (°F)	140
Stack Height (ft)	495
Stack Diameter (ft)	16
Stack Gas Exit Velocity (fps)	100

Source: Bechtel, 1990

Table 3.4.4-2
ESTIMATED PERFORMANCE OF AUXILIARY BOILER

Emission Data (auxiliary boiler at 225,000 lb/hr)

	<u>Natural Gas</u>	<u>No. 2 Oil</u>
NO _x (lb/hr)	35.8	68.2
SO _x (lb/hr)	6.16	17.8
CO (lb/hr)	33.6	47.3
VOC (lb/hr)	1.35	0.63
Particulates (lb/hr)	0.5	1.4
Exhaust Stack Temperature (°F)	480	500
Stack Exit Velocity (fps)	102	103
Stack Height (ft)	90	90
Stack Exit Diameter (ft)	5.5	5.5

Source. Bechtel, 1990

3.4.5 DESIGN PHILOSOPHY

The design philosophy used for air emission control systems associated with the ICL project can be summarized as follows:

- Selection of an efficient electrical generating technology
- Selection of clean fuel(s)
- Development of conservative design parameters to envelop emissions obtained from potential pulverized coal fired boilers and flue gas treatment system vendors
- Selection of BACT
- Determination of Good Engineering Practice (GEP) stack height

The ICL project, which includes advanced combustion control, NO_x removal, SO₂ removal systems, and particulate removal, represents an efficient electric generating technology. Thus, by maximizing the power output per unit of fuel consumed, the air pollutant emissions are minimized relative to total power output.

Since a number of boiler and flue gas treatment suppliers are under consideration, the evaluations of the air emission control systems and related emission parameters consider design feature variations and envelop the worst case pollutant emission rates.

The application of top-down BACT (i.e., the evaluation of technical (engineering), economic, and environmental considerations) is used to determine appropriate air emission control technologies. The BACT process results in the selection of control technologies that limit pollution emission rates to levels far below state and federal NSPS. BACT for the ICL project is described in Section 3.4.3.

To prevent excessive ground level pollution concentrations resulting from aerodynamic effects from nearby structures, the ICL project will incorporate GEP guidance in the design of major stacks.

3.5

3.5 PROJECT WATER USE

General

The primary source of both cooling and process water for the Indiantown Cogeneration, L.P. (ICL) project is surface water from Taylor Creek/Nubbin Slough (TC/NS). During periods of extended drought when water is not available from TC/NS, cooling water will be withdrawn from the lower production zone of the upper Floridan aquifer and process water will be obtained from a mixture of TC/NS water (from the cooling water storage pond) and groundwater from the upper production zone of the upper Floridan aquifer. The water quality of the TC/NS, and upper and lower production zones of the upper Floridan aquifer are presented in Table 3.5.0-1. Potable water is obtained from the Indiantown Company water service.

The water and wastewater treatment system design incorporates wastewater recycle and reuse to minimize plant makeup water requirements. A sidestream softener is used in conjunction with the cooling tower to allow the cooling tower to operate at higher cycles of concentration. The boiler blowdown is recycled to the cooling tower, rather than being discharged. A portion of the wastewater is reused as dilution water in the spray dryer adsorption system, lowering both the amount of plant makeup water required and the volume of wastewater to be discharged via the injection well.

The availability of makeup water from TC/NS was investigated using a mathematical model developed for this purpose. The model is based on historical flow data and water levels at the S-191 structure on TC/NS. The method of approach, the analysis, and conclusions about water availability are presented in Section 10.9 and summarized in this section.

A summary of maximum daily, maximum monthly, and average annual water requirements from the different water sources is presented in Table 3.5.0-2. The

Image Quality

**As you review the next group of images,
Please note that the original documents
were of poor quality.**

**Table 3.5.0-1
WATER QUALITIES OF THE PLANT WATER SOURCES**

<u>Parameter</u>	<u>Taylor Creek/ Nubbin Slough (mg/l)</u>	<u>Upper Floridan Aquifer</u>	
		<u>Upper Production Zone (mg/l)</u>	<u>Lower Production Zone (mg/l)</u>
pH	7.1	7.8	7.4
Alkalinity	64	130	138
Total Dissolved Solids	380	2460	4750
Total Hardness (as CaCO ₃)	130	735	1310
Silica	7.8	17	15.7
Calcium	34	130	233
Magnesium	11	100	177
Sodium	61	600	1198
Potassium	8.1	18	31
Iron	0.50	<0.1	<0.02
Copper	-	<0.01	<0.06
Manganese	-	-	0.24
Sulfate	33	260	423
Chloride	110	1200	2490
Fluoride	-	0.85	1.02
Nitrate	0.46	0.13	-
Phosphate	0.81	0.05	<1.84

NOTES:

1. Concentrations are in mg/l of the ion.
2. Data for Taylor Creek/Nubbin Slough water quality are from the South Florida Water Management District testing from 1980 through 1989.
3. Data for the upper production zone of the upper Floridan aquifer are from test well #LMF-1 located on the adjacent Florida Power & Light, Martin site, July 6, 1990.
4. Data for the lower production zone of the upper Floridan aquifer are from test well #LMF-1 located on the adjacent Florida Power & Light, Martin site, March 1989.

Table 3.5.0-2
SUMMARY OF PROJECT WATER REQUIREMENTS

<u>Case:</u>	<u>Maximum Daily (MGD)</u>	<u>Maximum Monthly (MG/Mo)</u>	<u>Average Annual (MGY)</u>
Primary Source of Water			
Taylor Creek /Nubbin Slough	5.24	152	1740
Backup Sources of Water			
Taylor Creek/ Nubbin Slough (Storage Pond)	0.518	16.0	48.2
Upper Production Zone of the Upper Floridan Aquifer	0.432	13.4	40.2
Lower Production Zone of the Upper Floridan Aquifer	5.76	165	480
Total	6.71	194	568

NOTES:

1. Maximum daily water requirements are based on design flows through the cooling tower and 100 percent load factor for 24 hours.
2. Maximum monthly water requirements are based on the highest average monthly flows through the cooling tower at 100 percent load factor for 31 days.
3. Average annual water requirements for the primary source of water are based on the annual average flows through the cooling tower at 100 percent load factor for 365 days. Average annual water requirements for the backup sources of water are based on the annual average flows through the cooling tower at 100 percent load factor for 3 months.
4. Process water is always based on 100 percent load factor.

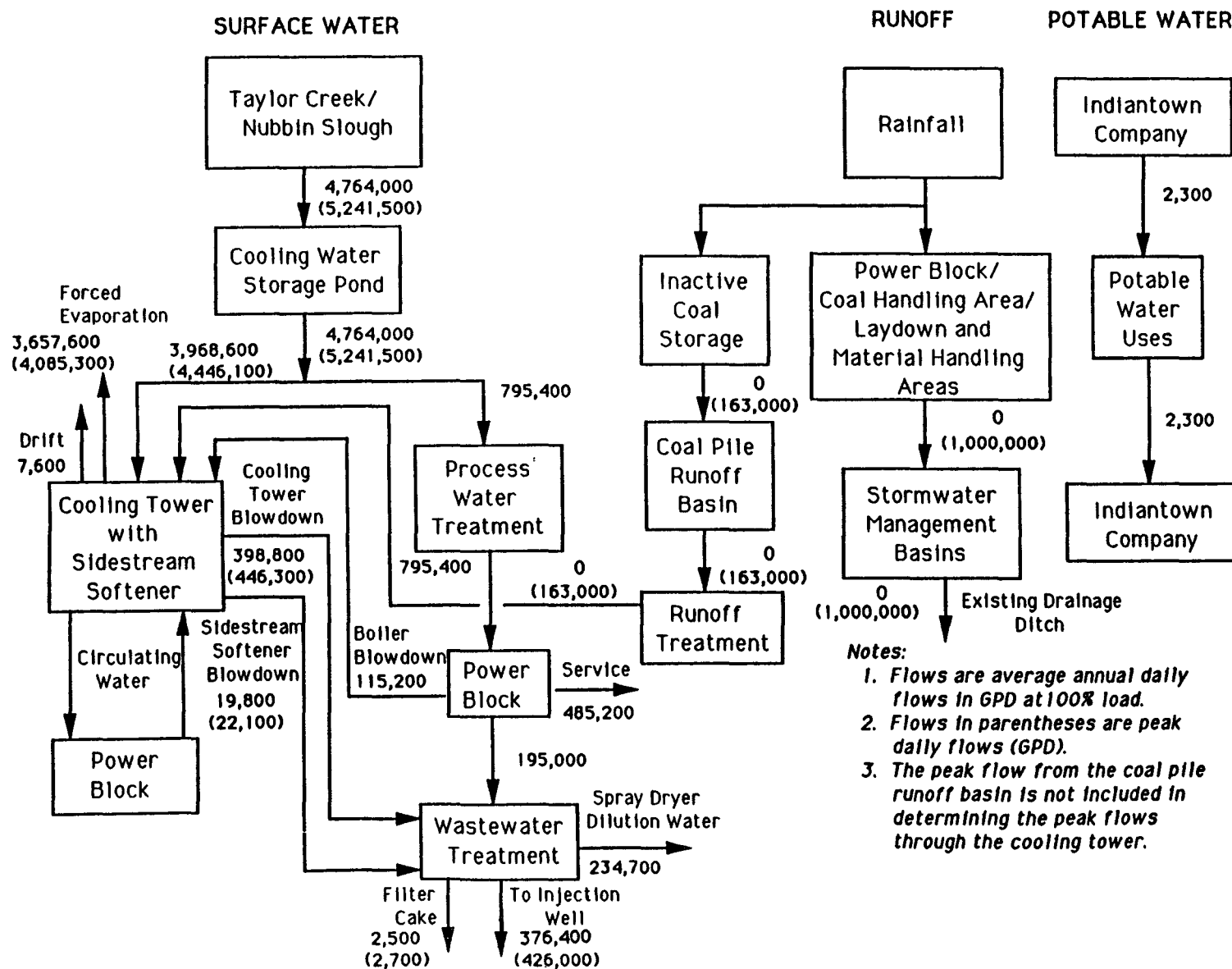
maximum daily requirements are based on the design meteorological conditions for operation of the cooling tower and 100 percent load factor for 24 hours. The maximum monthly requirements are based on the highest average monthly meteorological conditions for the cooling tower (presented in Tables 3.5.1-1 and 3.5.1-2), 100 percent load factor, 24 hours per day for 31 days. The average annual water requirements when using the primary source are based on the average annual meteorological conditions for the cooling tower, 100 percent load factor, 24 hours per day for 365 days. The average annual water requirements when using the backup water sources are based on the average annual meteorological conditions for the cooling tower, 100 percent load factor, 24 hours per day, for 3 months.

The plant consumes water for evaporative cooling in the cooling towers and to meet process water demands such as boiler water makeup, spray dryer lime slaking water, plant service water, etc. Average and maximum water flows for the plant are summarized in the site water budgets for the primary and backup sources of water (Figures 3.5.0-1 and 3.5.0-2). The cooling and process water flows presented are based on the average annual and design meteorological conditions for the cooling tower at 100 percent load factor. The maximum runoff flows are based on a 25-year, 72-hour storm. The potable water flows are based on a plant staff of 65 people per week day distributed over three shifts.

Flows within the water and wastewater treatment system (for both cooling and process water) when using TC/NS as the source of makeup water are presented in Figure 3.5.0-3. The flows are based on average annual conditions for the cooling tower operation at 100 percent load factor. Similarly, Figure 3.5.0-4 presents system flows when using the lower production zone of the upper Floridan aquifer and the mixture of TC/NS from the cooling water storage pond and the upper production zone of the upper Floridan aquifer to meet the plant makeup water requirements.

Figure 3.5.0-1.
SITE WATER BUDGET USING PRIMARY SOURCE
OF WATER

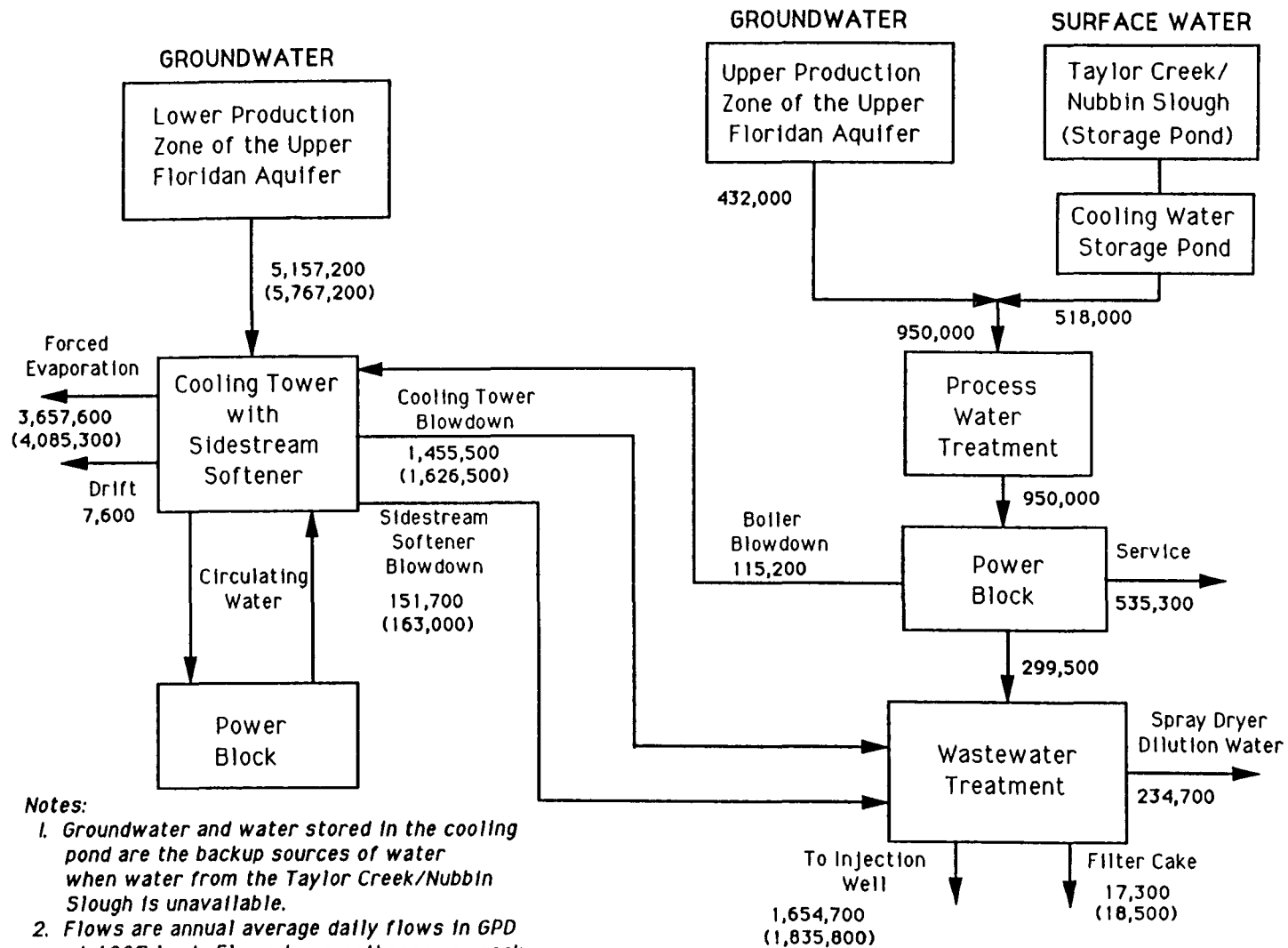
Source: Bechtel, 1990



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Figure 3.5.0-2.
SITE WATER BUDGET USING BACKUP SOURCE

Source: Bechtel, 1990



Notes:

1. Groundwater and water stored in the cooling pond are the backup sources of water when water from the Taylor Creek/Nubbin Slough is unavailable.
2. Flows are annual average daily flows in GPD at 100% load. Flows in parentheses are peak daily flows (GPD).
3. Runoff and potable water sources and flows the same as shown in Figure 3.5.0-1

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Figure 3.5.0-3. (Sheet 1)
PLANT WATER BALANCE USING PRIMARY SOURCE OF WATER

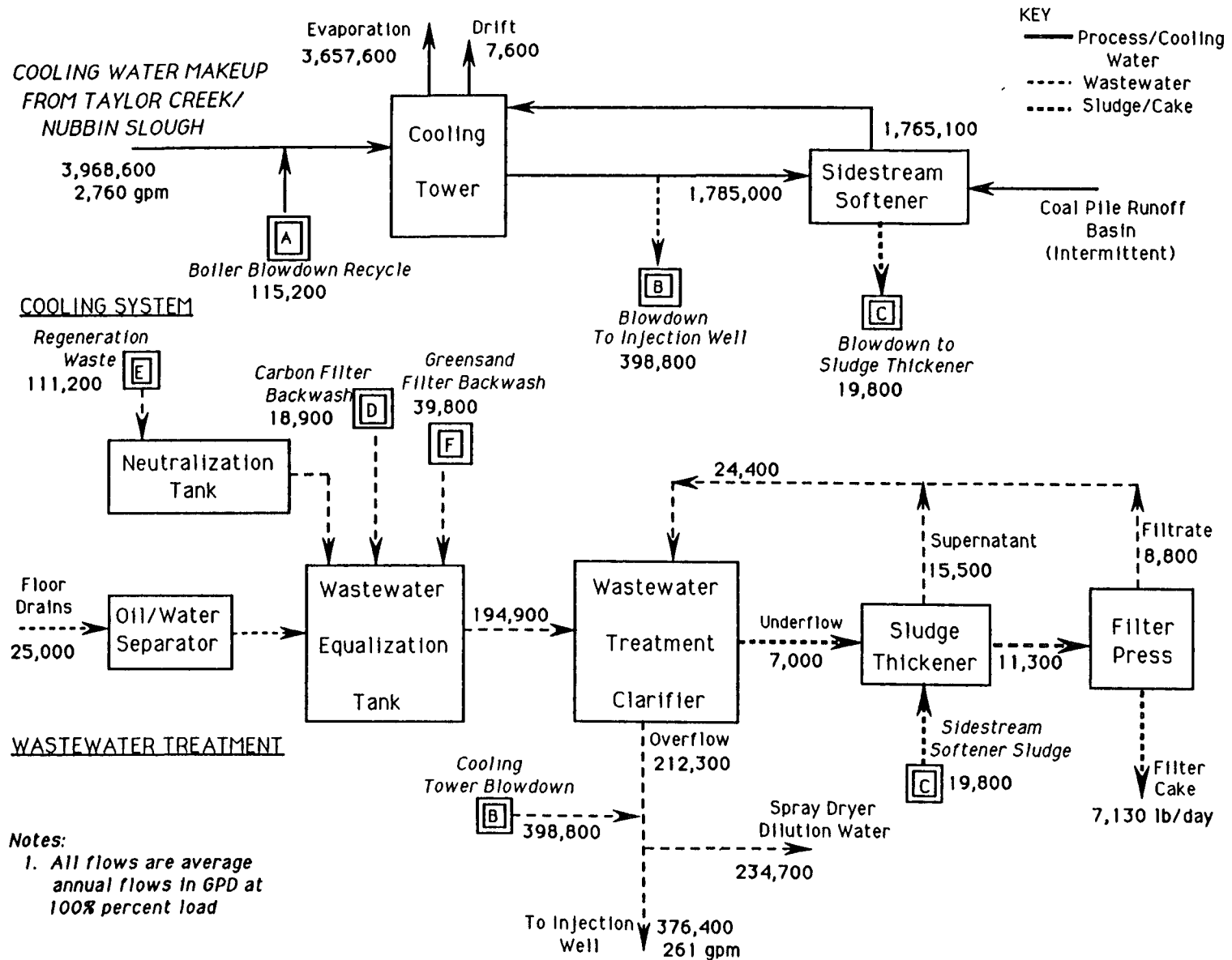
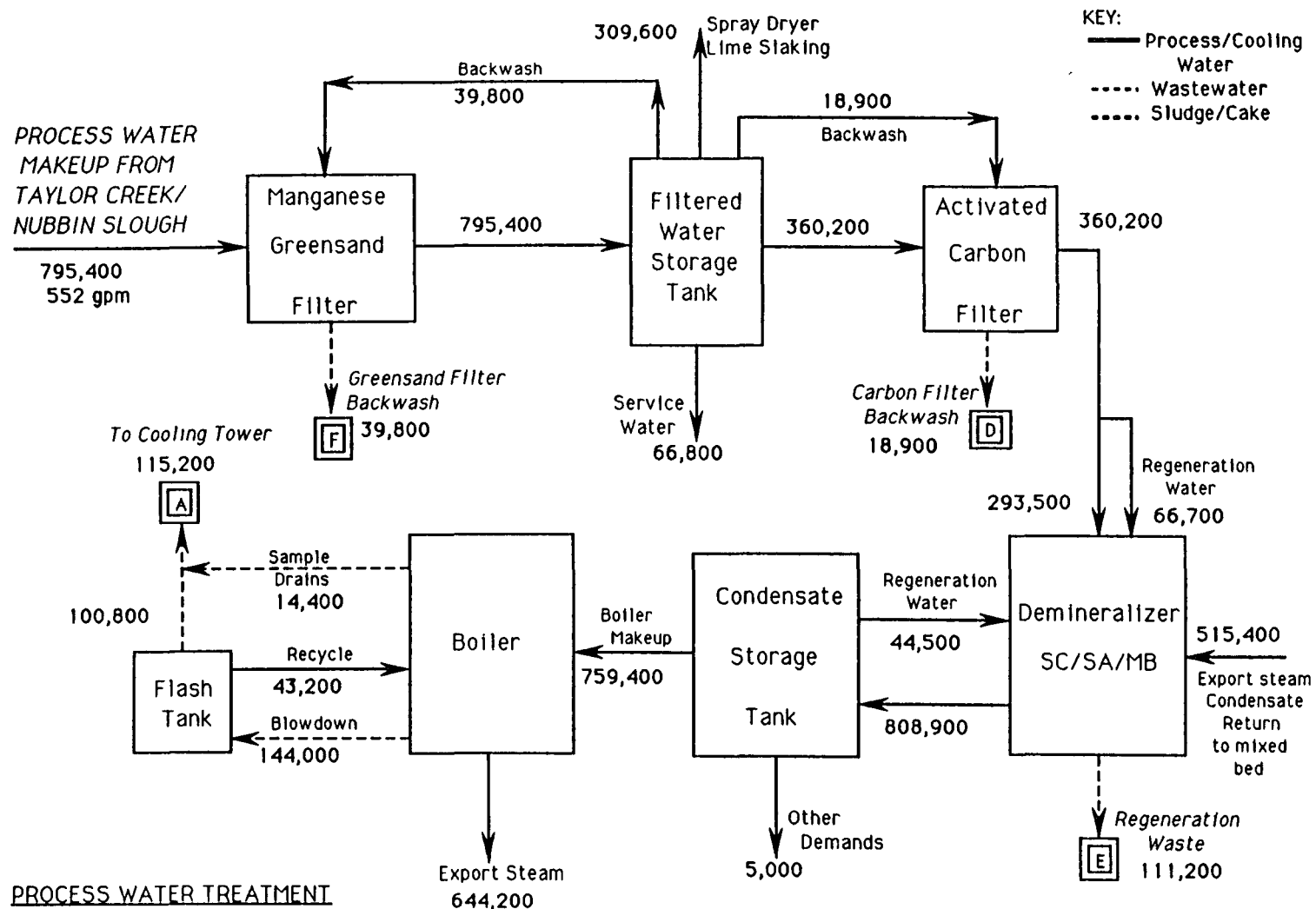


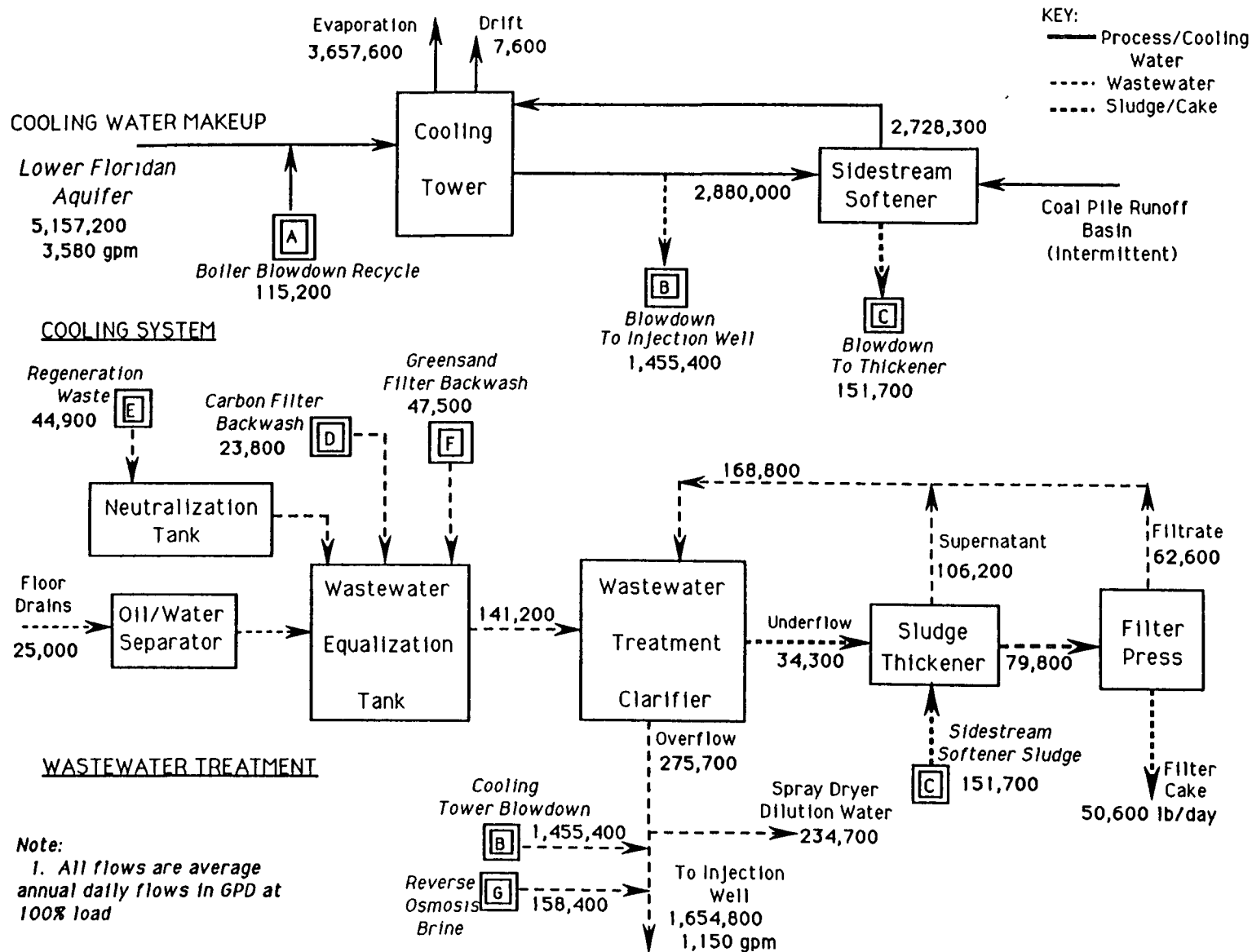
Figure 3.5.0-3. (Sheet 2)
 PLANT WATER BALANCE USING PRIMARY SOURCE
 OF WATER

Source: Bechtel, 1990



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Figure 3.5.0-4. (Sheet 1)
**PLANT WATER BALANCE USING BACKUP SOURCE
 OF WATER**

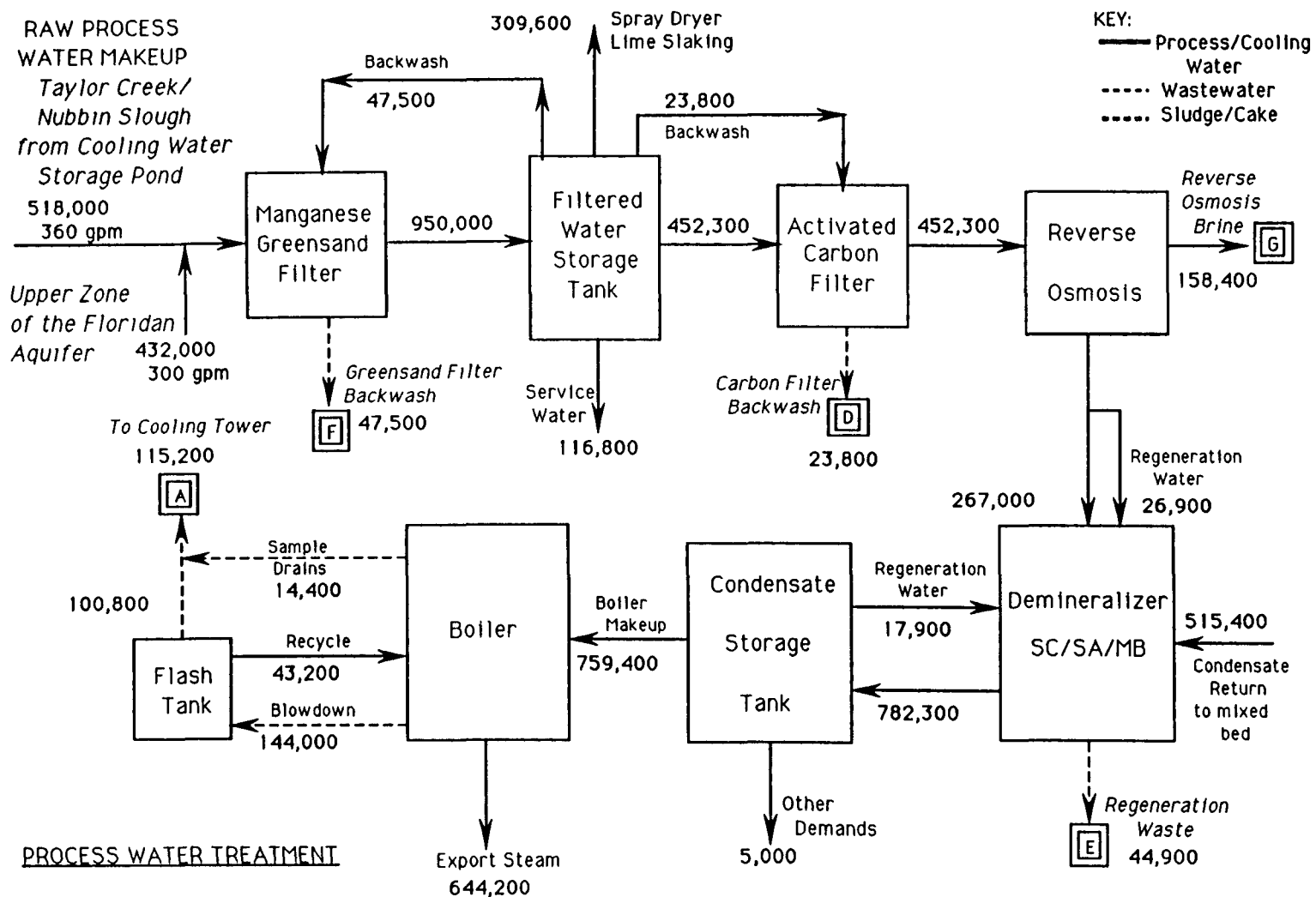


Source: Bechtel, 1990

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Figure 3.5.0-4. (Sheet 2)
**PLANT WATER BALANCE USING BACKUP SOURCE
 OF WATER**

Source: Bechtel, 1990



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Water Availability From Taylor Creek/Nubbin Slough

A water availability study was performed for the ICL project, using TC/NS basin surface runoff flows and Canals C-59, L-635, and L-63N storage. The main objectives of this study were to:

- Determine the availability of the plant water requirement (cooling tower makeup and process water) from TC/NS and the canals for canal water elevations above elevation 16 feet MSL.
- Identify the duration of the time in which withdrawal of plant water is assumed to be unavailable when the water level reaches El. 16 feet MSL.

The historic flow and water elevation data of TC/NS at control structure S-191 were used in this study. The makeup water requirements used in the study do not account for recycle of boiler blowdown to the cooling tower and the water removed with the sludge from the sidestream softener. The net effect is that the demands examined in the study and discussed here are about 2 percent higher than the demands presented in Table 3.5.0-2 and Figure 3.5.0-3. A complete description of the project, plant water requirements, basic data, methodology, assumptions, results, conclusions, and the recommendations is provided in Section 10.9.

Based on the characteristics of the TC/NS watershed and the surface water availability analysis performed, the following conclusions have been made:

1. Procedure of reverse routing, applied in the water availability study to calculate the net inflows, provided a good correlation between historic and predicted water levels and spillway discharges.
2. The average historic flow through the S-191 structure is about 146.4 cfs and average plant water requirements are 7.5 cfs. Therefore, on a mean annual

basis, there is an adequate supply of water. However, due to the rainfall pattern, the supply of water is not distributed evenly, therefore, a storage reservoir is required.

3. The mean annual plant water requirements of 7.5 cfs can be made available from the storage of the canals without lowering the lower level below elevation 16 feet MSL, except during the prolonged drought conditions, which may last a maximum of about 68 consecutive days. However, the total number of days during which the plant water requirements cannot be met in the numerical simulation period of 16 years is only 185 days.
4. During extreme drought months such as May and June of 1981 and 1989, obtaining the plant water requirements from the canals could lower the water level below 16 feet MSL.
5. The maximum drop in the canal water level from the historic water level is 2.5 feet. However, the drop in the adjacent groundwater level will be significantly less as discussed in Section 5.3.1.
6. Changing the criteria of minimum water level from 16 to 17 feet MSL could result in increasing the total number of consecutive days by a maximum of 14 days.

Based on the analysis and the above conclusions, the following features were incorporated into the design of the plant water intake structure described in Section 3.5.1.

1. The pump intake will be located on L-63N near the junction with Canal C-59 due to the water depth and large cross-sectional area.
2. The pump intake will be designed to operate with a minimum water level of 16 feet MSL.

3. To prevent the canal water level from dropping below elevation 16 feet MSL, the pumps' control system will be designed so that during prolonged drought conditions the pumps trip when the canal water level reaches approximately elevation 16.5 feet MSL.
4. Multi-pumps will be installed to facilitate withdrawal rates ranging from average annual flow of 3374 gpm (4.86 mgd) to maximum daily flow of 3642 gpm (5.24 mgd).
5. During prolonged drought in which the canal water level may reach elevation 16 feet MSL, makeup water to the plant will be provided from the Floridan aquifer. The estimated continuous duration of the supply is approximately 90 days.

Discussions with the SFWMD have indicated that the SFWMD prefers a drawdown elevation of 17.5 feet MSL. This was based on the SFWMD review of the water availability study as presented in Section 10.9. ICL will continue to work closely with SFWMD to ensure that their requirements on the drawdown level of the canal will be incorporated into the design of the intake structure and the operation of the facility.

3.5.1 HEAT DISSIPATION SYSTEM

3.5.1.1 System Design

Introduction

A portion of the thermal energy contained in the steam produced by the boiler is converted to electrical energy by the steam turbine generator. However, much of the thermal energy in the steam is absorbed by cooling water flowing through the condenser (circulating water). The heat absorbed by the circulating water is transferred to the atmosphere in a cooling tower. The quantity of heat dissipated in the cooling tower for the ICL plant is about 1.7×10^9 Btu/hr at 100 percent load.

The cooling water system consists of an intake structure, cooling water storage pond, cooling tower, condenser, and sidestream water softener. The location of this equipment on the site is shown in Figure 3.1.1-1. Figures 3.5.0-3 and 3.5.0-4 present the average flows through the cooling water system for the primary and backup water sources, respectively.

Plant Water Intake Structure

The plant makeup water intake structure, to be located on Taylor Creek (L-63N) at the junction with Canal C-59, is designed to provide an average flow rate of 3374 gpm (4.86 MGD) and a maximum flow rate of 3642 gpm (5.24 MGD). The location of the intake is shown on Figure 2.3.4-11.

In addition to the design features presented in Section 3.5, the following factors are also considered in selecting the location and type of intake structure:

- Water level variations in Canals L-63 N&S and C-59
- Flood flow in the canals
- Protection of aquatic life

- Dredging requirement in the canal
- Operation and maintenance

Based on these factors, the selected scheme consists of a pumphouse located on the canal bank and a wedge wire screen with a T-arrangement located in the canal. The wedge wire screen will be at a water depth of about 8 feet at the minimum design water level of 16 feet MSL, as discussed in Section 10.9, the water supply availability study.

A schematic of the layout is shown on Figure 3.5.1-1. The pumphouse includes three 50 percent capacity vertical pumps, air compressor for backwash of the wedge wire screens, and valves and piping for control of the operation.

Two screen assemblies, each with 100 percent capacity, will be installed. The screen will be at least 2 feet above the canal bottom and the top of the screen will be at least 4 feet below the design minimum water level of 16 feet MSL as shown in Figure 3.5.1-2. Each screen has a diameter of 42 inches with an overall length of 12 feet. The design velocity through the slots is less than 0.5 fps. The slot spacings is 1 mm. To prevent local scouring of the canal bottom during the air backwash, riprap will be placed in the vicinity of the screens.

The pump intake structure is located on the canal bank above the 100-year flood level on L-63N. This alternative minimizes the dredging required in L-63N Canal to only that needed to install the two pipes connecting the screens to the intake pumphouse.

This scheme does not lead to fish or larvae entrainment and impingement. Withdrawal of fish eggs by water is precluded due to the small width of the slots. The flow passage in the canal will not be affected by the facilities due to the location of the intake structure and since the screens are supported on piles as shown on Figure 3.5.1-2.

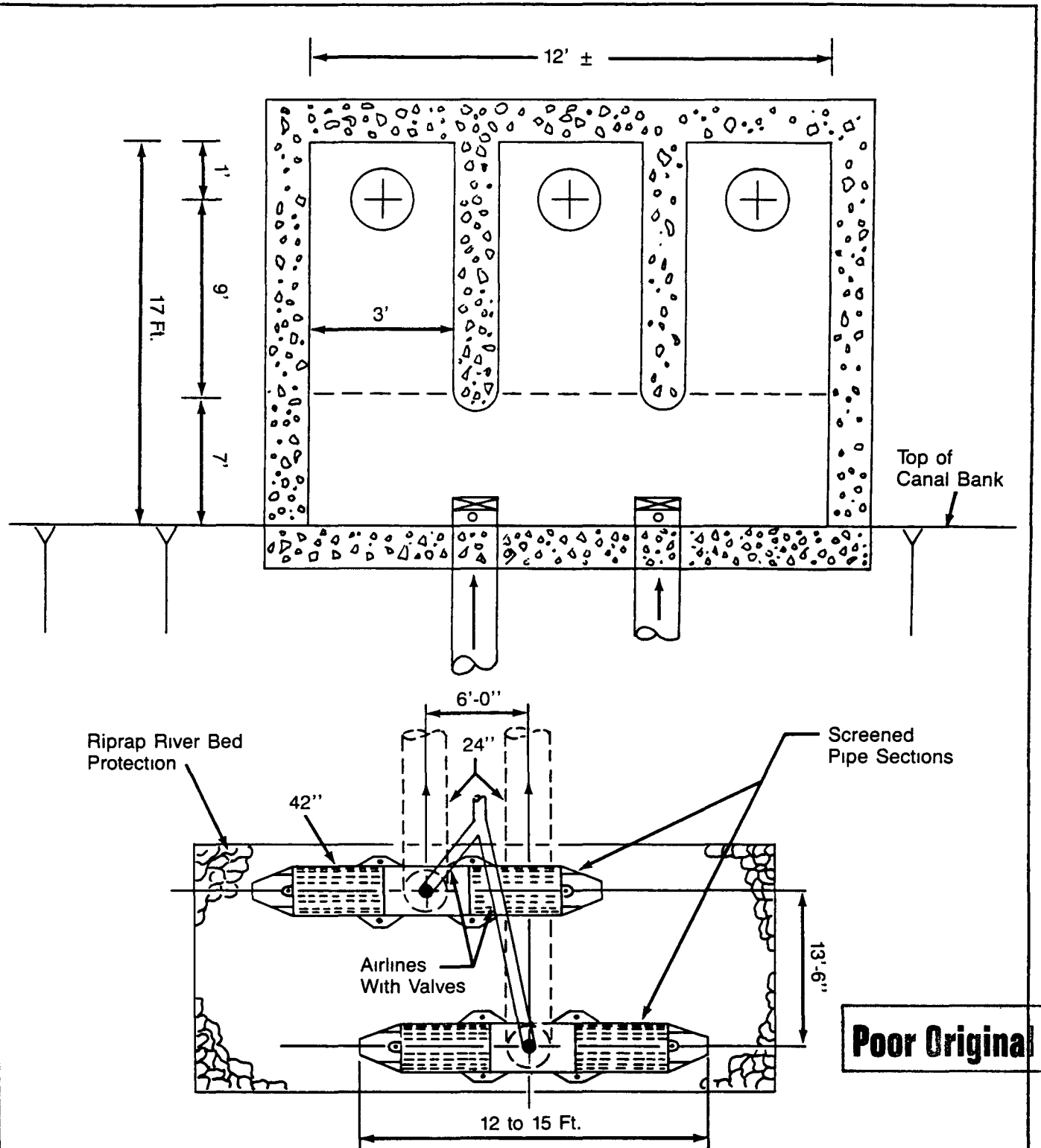


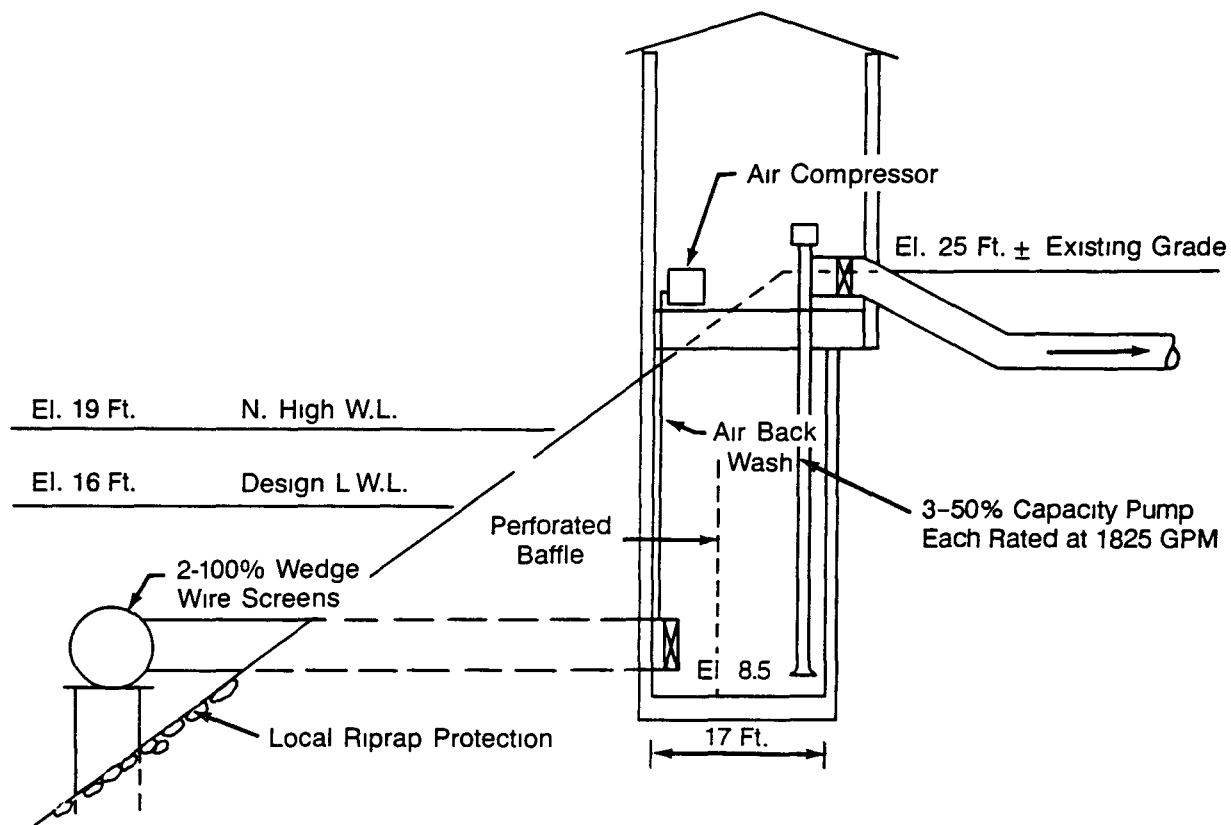
Figure 3.5.1-1.

TAYLOR CREEK/NUBBINS SLOUGH PLANT WATER INTAKE - GENERAL ARRANGEMENT

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Figure 3.5.1-2.

TAYLOR CREEK/NUBBIN SLOUGH PLANT WATER INTAKE

Source Bechtel, 1990

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Based on these factors, the selected concept of the intake is considered the best available technology.

Cooling Water Storage Pond

The plant water requirement will be pumped from TC/NS through an 18- to 24-inch diameter pipeline to the onsite storage pond. Riprap protection is provided to the dike slope and pond bottom at the discharge point.

The cooling water storage pond is designed to store water from TC/NS for use in the plant as cooling and process water during short periods of time when TC/NS is unable to supply water to the plant. During extended periods when TC/NS is unable to supply makeup water to the plant, the cooling water storage pond serves as a source to meet a portion of the process makeup water demands of the plant.

The onsite cooling water storage pond is designed to maintain a normal water depth of 6 feet with a bottom area of 22 acres. The pond bottom and the inside embankment side slope is lined with a synthetic liner to prevent seepage. The pond bottom is approximately 2 feet below existing grade; the normal water level is 4 feet above the existing grade. The embankment will be compacted fill with side slopes of 4H:1V

The pond area and depth are selected to provide approximately 9 to 10 days of cooling water at the average annual makeup requirement and 300,000 gallons of fire water reserve. This volume of fire water requires a water depth of about 1 inch.

As discussed in Section 2.3.3, there is a slight excess of average annual rainfall over evaporation at the ICL site. This excess is not sufficient to significantly lower the makeup water demand from TC/NS; hence, net rainfall into the storage pond is not included in the site water budgets presented in Figures 3.5.0-1 and 3.5.0-2.

The top of the pond embankment is determined considering the normal pond water level, precipitation of 9 inches from a 25-year, 72-hour storm event, and wind setup and wave runup caused by a 100 mph wind. Based on these considerations, a free board of 3 feet is selected. Assuming a normal water level in the pond at an elevation of 38 feet msl, the minimum top of the embankment is at elevation 41 feet msl. In order to pass excess pond storage to avoid overtopping during major storms, an emergency spillway is provided. The spillway crest elevation is approximately 9 inches above normal pond water level.

Cooling Tower

One counterflow, mechanical draft, multi-cell, wooden cooling tower is provided. During operation, 265,000 gpm of cooling water is circulated from the tower basin, through the condenser, and back to the tower. This heated water is distributed to the upper portion of the cells and flows down over a grid that enhances the heat transfer from the water to air. The water flows by gravity, countercurrent to the ambient air. Most of the heat is removed by evaporating a portion of the cooling water; the remainder is removed by sensible heat transfer to the air. Cooled water is collected at the bottom of the tower in a concrete basin.

Cooling water makeup is withdrawn from the cooling water storage pond and transferred to the basin when using the TC/NS source of water. When using the backup source of water, makeup water from the lower production zone of the upper Floridan aquifer is transferred directly to the cooling tower basin from the wells.

The air flowing up through the cooling tower entrains a small amount of the cascading water and carries this water out of the tower as drift. Mist eliminators and operator control of the air to water ratio in the tower minimize drift losses from the cells to 0.002 percent of the circulating water flowrate, or slightly more than 5.3 gpm.

The evaporation of water in the cooling tower concentrates dissolved solids in the circulating water. As a result, a portion of the circulating water is continuously discharged as a blowdown from the cooling system to maintain a solids balance. The ratio of the cooling tower makeup requirement to the sum of cooling tower blowdown and drift losses is called the cycles of concentration (COC). This ratio relates the blowdown and drift water quality to the makeup water quality.

Sidestream Softener

The cooling water system includes a sidestream softener. A portion of the circulating water is passed through a sidestream softener where the levels of dissolved iron and hardness ions in the water are lowered. The softener system consists of a flash mixing tank, a flocculation chamber, and a clarifier. The circulating water flows into a flash mixing tank where lime, soda-ash, and polymer are added to the water. The water then flows to a flocculation chamber where contact is induced between precipitates and suspended matter. Finally, the water flows to a large clarification zone that uses gravity to settle out the suspended solids. A long detention time is provided for settling of suspended solids. A rake circles the bottom of the clarifier to collect settled sludge and remove it through a sump.

Cooling Water Treatment

The cooling water system is designed to use two sources of cooling water. TC/NS is the primary source of cooling water makeup and the lower production zone of the upper Floridan aquifer serves as a backup when the TC/NS source is not available. A small wastewater stream from the boiler blowdown is also recycled to the cooling tower due to its relatively good quality. As shown in Table 3.5.0-2, the TC/NS source contains high levels of iron, calcium, and alkalinity while the lower production zone of the upper Floridan aquifer has a high total dissolved solids level and natural bicarbonate alkalinity. Due to the differences in quality of the two sources, the cooling tower will operate at different cycles of concentration (COC)

when using each source. The cooling tower is designed to allow the maximum possible cycles of concentration without causing scaling and corrosion. At higher COC, both the makeup and blowdown flowrates decrease. The high levels of iron, calcium, and alkalinity in TC/NS would cause scaling and corrosion problems above two COC without substantial use of inhibitors. Similarly, high levels of hardness ions, alkalinity, and total dissolved solids in the lower production zone of the upper Floridan aquifer limit the COC when this source is utilized. Therefore, a sidestream softener is provided to treat a portion of the circulating water to remove iron and hardness ions from the circulating water. This lowers their concentration in the circulating water and allows for higher COC. However, increasing the COC also increases the size of the sidestream softener. At 10 COC for the TC/NS cooling water source and 3.5 COC for the lower production zone of the upper Floridan aquifer, balances are reached between the makeup water demand, the size and chemical use of the sidestream softener, and the concentration of dissolved solids in the blowdown.

Thermal Performance of the Tower

Tables 3.5.1-1 and 3.5.1-2 present performance data for operation of the cooling tower at 10 COC and 3.5 COC, respectively, at a 100 percent load factor, circulating water flowrate of 265,000 gpm, drift losses of 0.002 percent of the circulating water flowrate, temperature rise of 12.6 °F across the condenser, and the average monthly temperatures listed in the tables.

The design conditions for the cooling tower, from which the maximum daily makeup water demands presented in Section 3.5 are determined, are a dry bulb temperature of 91 °F (which corresponds to a wet bulb temperature of 80 °F) and hot water and cold water temperatures of 102.6 °F and 90 °F, respectively.

Table 3.5.1-1
COOLING TOWER PERFORMANCE DATA AT 10 CYCLES OF CONCENTRATION

<u>Month</u>	<u>Dry Bulb Temp (°F)</u>	<u>Evaporation (GPM)</u>	<u>Blowdown (GPM)</u>	<u>Makeup (GPM)</u>
January	65.6	2418	268	2686
February	66.7	2435	270	2705
March	70.1	2478	275	2753
April	73.8	2570	285	2856
May	77.7	2597	288	2886
June	80.8	2612	290	2902
July	82.4	2620	291	2911
August	82.7	2626	291	2917
September	81.5	2600	288	2889
October	77.7	2597	288	2886
November	72.1	2481	275	2756
December	67.8	2441	271	2712
Annual Average	74.9	2540	282	2822

Notes:

1. Dry bulb temperatures are average monthly temperatures recorded by the National Weather Service at West Palm Beach, Florida between 1958 and 1987.
2. Cooling tower flows are based on 100 percent load factor, circulating water flowrate of 265,000 gpm, drift losses of 0.002 percent of circulating water flowrate, and a temperature rise across the condenser of 12.6 °F.

Source: Bechtel, 1990

Table 3.5.1-2
COOLING TOWER PERFORMANCE DATA AT 3.5 CYCLES OF CONCENTRATION

<u>Month</u>	<u>Dry Bulb Temp(°F)</u>	<u>Evaporation (GPM)</u>	<u>Blowdown (GPM)</u>	<u>Makeup (GPM)</u>
January	65.6	2418	967	3385
February	66.7	2435	974	3409
March	70.1	2478	991	3469
April	73.8	2570	1028	3598
May	77.7	2597	1039	3637
June	80.8	2612	1044	3657
July	82.4	2620	1048	3668
August	82.7	2626	1050	3676
September	81.5	2600	1040	3641
October	77.7	2597	1039	3637
November	72.1	2481	992	3473
December	67.8	2441	976	3417
Annual Average	74.9	2540	1015	3556

Notes:

1. Dry Bulb Temperatures are average monthly temperatures recorded by the National Weather Service at West Palm Beach, Florida between 1958 and 1987.
2. Cooling tower flows are based on 100 percent load factor, circulating water flowrate of 265,000 gpm, drift losses of 0.002 percent of circulating water flowrate, and a temperature rise across the condenser of 12.6 °F.

Source: Bechtel, 1990

3.5.1.2 Sources of Cooling Water

The primary source of cooling water for the ICL plant is surface water from TC/NS. During periods of extended drought when water from TC/NS is not available, cooling water will be withdrawn from the lower production zone of the upper Floridan aquifer. Section 10.9 presents the analysis of water availability from TC/NS. Based on the historic data records, the maximum estimated duration of withdrawal from the lower production zone of the upper Floridan aquifer is about 3 months. The volume of water required during that time is presented in Table 3.5.0-1. Qualities for the TC/NS and the lower production zone of the Floridan aquifer are provided in Table 3.5.0-1.

The design of the cooling water treatment equipment allows for significant variation in the water quality from TC/NS without severely impacting the operation of the cooling tower. As discussed in Section 3 5 1.1, the cooling water treatment system uses the sidestream softener to control the level of dissolved iron and hardness ions in the circulating water. The sizing of the sidestream softener is governed by use of the lower production zone of the Floridan aquifer as the cooling water source. When TC/NS is the source of cooling water, less sidestream softening is required to maintain the desired COC. Therefore, if the iron, calcium, magnesium, or alkalinity levels in the TC/NS source are higher, more circulating water can be treated in the sidestream softener to control the concentration of these ions.

The quality of aquifer waters does not generally fluctuate as does the quality of surface waters. The sizing of the sidestream softener when using the lower production zone of the upper Floridan aquifer is based on the cooling tower operating at the design meteorological conditions and the water quality. In addition, the design of the sidestream softener and chemical feed system are based on a conservative throughput rate, allowing treatment of higher flowrates, if necessary to maintain the COC.

3.5.1.3 Dilution System

No dilution of cooling water is needed because the ICL plant water and wastewater treatment scheme does not include a discharge to a surface water.

3.5.1.4 Blowdown, Screened Organisms, and Trash Disposal

Blowdown from the cooling tower is transferred to the wastewater treatment system where it is recycled as much as practicable with the remainder disposed of by injection to the Boulder Zone of the lower Floridan aquifer. Section 3.6 describes the incorporation of cooling tower blowdown into the wastewater treatment scheme.

The makeup water intake at TC/NS does not have trash collection since submerged wedge wire screens will be used. Compressed air is used to backwash the wedge wire screens when required. Organic debris and trash in the cooling water storage pond are collected by fixed screens at the intake structure on the pond. Any trash such as floating leaves or debris will be collected and disposed of according to Section 3.7.

3.5.1.5 Injection Wells

Injection wells are proposed for the disposal of cooling system and process wastewaters produced at the ICL plant. This section addresses the feasibility of injection of such industrial wastewater at the ICL site based on the known and expected hydrogeology. Conceptual designs for the injection and monitor wells are presented. The construction and testing program is outlined and the injected fluid is characterized. An injection system monitoring plan is presented.

The injection wells will be designed to comply with the requirements for underground injection control (FAC 17-28). As part of this regulation, a Technical Advisory Committee (TAC) is established for each application to ensure the system

is designed properly and will operate according to the design. The ICL TAC will consist of agency personnel from the DER's regional and main offices, the SFWMD, EPA Region IV, and the Fish and Wildlife

Background

The wastewater from the ICL facility is proposed to be injected into Class I injection wells. Class I wells inject wastewater beneath the lowermost formation containing an underground source of drinking water (USDW), defined as 10,000 mg/l TDS or less.

The wastewater from various sources will be collected in a wastewater collection tank. A portion of this wastewater will be recycled and used in the spray dryer dilution system. The remainder will be disposed of in the injection well. As discussed in Section 3.6, the wastewater from this facility is expected to be non-hazardous.

Maximum daily flow (MDF) to the injection wells at the ICL facility is anticipated to be 1,280 gallons per minute (gpm). The proposed location of the injection wells onsite is shown on Figure 3.1.1-1.

Feasibility of Injection Well Disposal

The feasibility of injection well disposal at the ICL site can be assessed from the performance of injection wells in St. Lucie, Martin, and Palm Beach Counties. Data were reviewed on the existing injection wells in those counties to evaluate the regional hydrogeology and to extrapolate the findings to the Indiantown area.

Within a 25-mile radius of the site, several injection wells have been operational for up to 13 years (North Port St. Lucie, 1988; South Port St. Lucie, 1983; City of Stuart, 1982; Pratt and Whitney, 1985; QO Chemicals, Inc., 1977; Seacoast Utilities,

1989). All of these wells inject into the lower Oldsmar Formation (Boulder Zone) at depths of 2,900 to 3,300 feet below land surface (bls).

In south Florida, sedimentary rock types such as dolomite and fractured limestone are potentially good injection zones. Injection zones must be adequate in thickness and areal extent to receive the proposed volume of injected fluid. Overlying formations should be essentially horizontal and without faults or fractures. The proposed injection zone also should have sufficient porosity and permeability to accommodate the proposed flow without undue pressure buildup

Typical confining strata in Florida include clays and unfractured limestones. Because of the potential for fractures or solution channels in the limestones and dolomites, site-specific demonstration of the adequacy of the proposed confining strata is required by state underground injection control regulations. Factors considered in demonstrating this adequacy include lithology, thickness, areal extent, structure, porosity, and permeability. The overlying rock unit proposed to provide confinement must be sufficiently thick and areally extensive, free of fractures or faults, and of sufficiently low porosity and permeability to retard the upward migration of injected fluids.

Regional Geology

Data were obtained on the existing injection and test wells in Martin and neighboring counties to evaluate the regional geology and extrapolate the findings to the Indiantown area. Table 3.5.1-3 is a summary of the well locations used. Figure 3.5.1-3 is a location map of the referenced wells, and Figure 3.5.1-4 is a cross section from A-A'. A lithologic log of the Amerada Cowles Magazines Inc. No. 1 well was obtained from the Florida Geological Survey files (Reference No. W-4086). This well is approximately 12 miles north-northeast from the site, and was drilled to over 5,000 feet in depth. Based on the data obtained from these

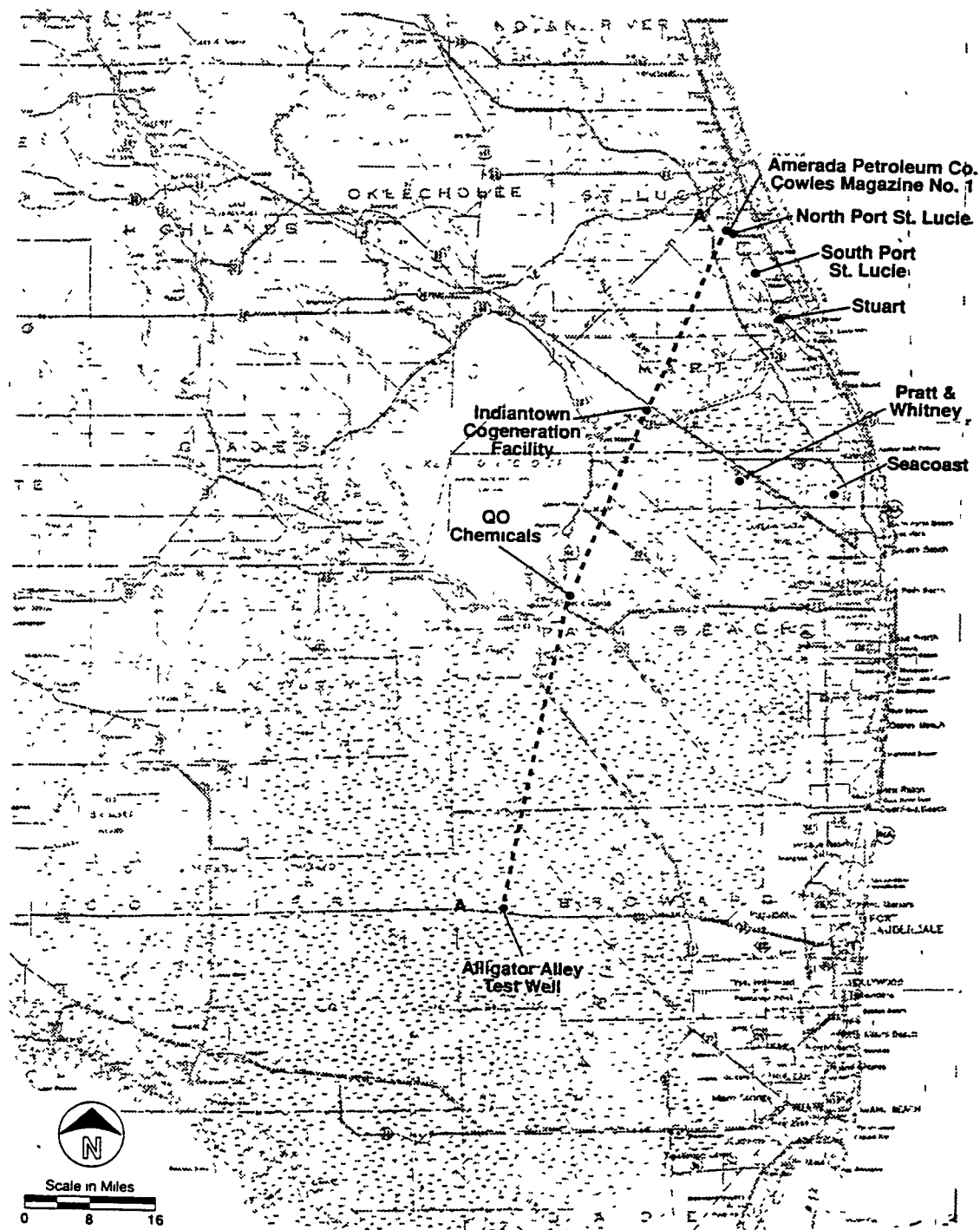


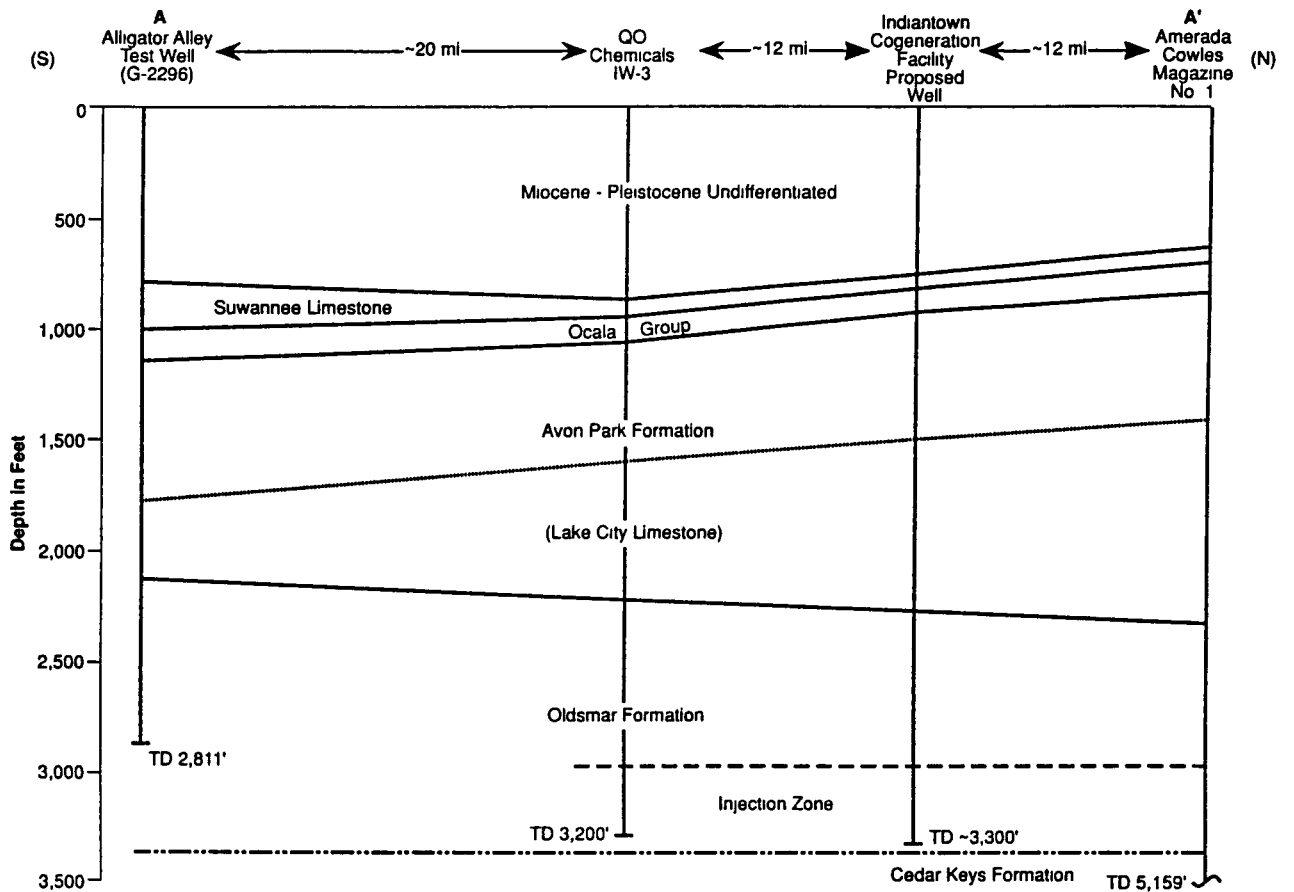
Figure 3.5.1-3
LOCATION OF GENERALIZED NORTH-SOUTH
GEOLOGIC CROSS SECTION AND ADJACENT
INJECTION WELLS

Source CH2M Hill, 1990

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Source: Chen, 1965, Pun and Winston, 1974, Meyer, 1988

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Figure 3.5.1-4
GENERALIZED NORTH-SOUTH GEOLOGIC
CROSS SECTION

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**Table 3.5.1-3
INJECTION AND TEST WELL LOCATIONS**

<u>Well</u>	<u>County</u>	<u>Section/ Township/Range</u>	<u>Depth (feet)</u>
Amerada Cowles Magazine No. 1	St. Lucie	Sec 19 T36S, R40E	5,159
Indiantown Cogeneration Facility (proposed)	Martin	Sec 35 T39S, R37E	3,300 (est)
North Port St Lucie	St. Lucie	Sec 20 T36S, R40E	3,324
South Port St Lucie	St. Lucie	Sec 13 T37S, R40E	3,418
Pratt & Whitney	Palm Beach	Sec. 14 T41S, R40E	3,320
Florida Power and Light	Martin	Sec 25 T39S, R37E	1,056*
QO Chemicals	Palm Beach	Sec. 28 T43S, R37E	3,156
Alligator Alley Test Well	Broward	Sec. (N/A) T50S, R35E	2,811
Stuart	Martin	Sec 1	3,305
Seacoast	Palm Beach	Sec. 4 T42S, R42E	3,320

*Test Well

wells, the Cedar Keys Formation is the oldest formation expected to be encountered during drilling of the injection wells, at an approximate depth of 3,200 feet.

Regional Hydrogeology

Injection Zone

The stratum most commonly used for injection in southeast Florida is the lower portion (Boulder Zone) of the Oldsmar Formation. Water quality in this zone typically exceeds 30,000 mg/l TDS. The principal overlying confining units are the upper Oldsmar Formation and the lower part of the Avon Park Limestone.

The dolomitic portions of the lower Oldsmar Formation are finely crystalline and sucrosic, with areas that are highly fractured and cavernous. Cavities in the lower Oldsmar Formation range in size from small vugs to large caverns. The caverns persist to the base of the formation, where interbedded dolomite and anhydrite of the Paleocene age Cedar Keys Formation are encountered. The existence of these formation characteristics in south Florida accounts for the success of injection wells there.

The areal extent of the lower Oldsmar Formation is well documented in the literature and well data. Chen (1965) postulates that during the early Tertiary age, Florida existed as a broad carbonate platform, with warm and shallow marine conditions similar to the present-day Bahamas and Compeche Bank. Carbonates were deposited throughout the Florida platform. The Oldsmar Formation is present in all of peninsular Florida and exhibits the greatest degree of dolomitization along the structural high of the Peninsular arch. The thickness of the Oldsmar Formation varies from approximately 400 feet along the crest of the Peninsular arch to as much as 1,200 feet in south Florida.

Puri and Winston (1974) identified areas suitable for injection in south Florida in their regional study. The Amerada Cowles Magazine Inc. No. 2 well adjacent to

No. 1 (referenced by Chen, 1965) in St. Lucie County has zones of high transmissivity in the middle to lower Oldsmar Formation that are approximately 2,300 to 3,200 feet in depth. The North Port St. Lucie well has injected successfully in the interval between 2,900 and 3,200 feet since 1988, while the QO Chemicals wells have successfully used that same interval since 1977.

Depth to Base of USDWs

The relationship of the location of the interface between fresh water and water containing greater than 10,000 mg/l of TDS to the injection and confining zones is one factor determining the feasibility of injection at a particular site. Ideally, the base of fresh water should occur near the top of the confining sequence.

Regionally, the 10,000 mg/l TDS interface occurs in the interval between 1,600 and 1,850 feet in depth. At the City of Stuart's injection well, the depth to the interface occurs in the 1,600- to 1,700-foot interval, while at the North Port St. Lucie well the interface occurs at approximately 1,700 feet in depth. At both the Pratt & Whitney and the QO Chemicals wells, the interface occurs at approximately 1,800 feet in depth.

Confining Zone

Eocene carbonates are the principal stratigraphic units providing confinement and have been found in every injection well drilled in southeast Florida. The structure contour maps and isopach-lithofacies maps Chen (1965) developed attest to the regional areal extent of the formations that provide confinement to the injection zone. An approximately 1,100-foot-thick confining sequence found at the North Port St. Lucie site increases to a thickness exceeding 1,300 feet at the City of Stuart.

Results of core analyses from the North Port St. Lucie well are shown in Table 3.5.1-4. The average permeability was found to be about 1.0×10^{-5} cm per second. This is consistent with permeability values found in other wells in the area.

Table 3.5.1-4
CORE ANALYSIS SUMMARY
NORTH PORT ST. LUCIE INJECTION WELL

<u>Depth (feet)</u>	<u>Orientation (Horizontal or Vertical)</u>	<u>Coefficient of Permeability (cm/sec)</u>	<u>Porosity (%)</u>
2101.0-2101.8	V	4.5×10^{-5}	35
2101.0-2101.8	H	5.4×10^{-5}	35
2108.2-2109.0	V	4.4×10^{-5}	32
2108.2-2109.0	H	3.3×10^{-5}	31
2249.0-2250.0	V	3.5×10^{-7}	13
2249.0-2250.0	H	1.4×10^{-7}	9
2253.5-2254.0	V	2.8×10^{-3}	37
2253.5-2254.0	H	1.2×10^{-3}	32
2425.0-2426.2	V	6.7×10^{-4}	35
2425.0-2426.2	H	5.7×10^{-4}	35
2430.0-2431.0	V	1.6×10^{-5}	34
2430.0-2431.0	H	3.4×10^{-4}	36
2449.0-2450.0	V	3.5×10^{-6}	35
2449.0-2450.0	H	8.9×10^{-5}	38
2451.0-2451.8	V	2.3×10^{-5}	31
2451.0-2451.8	H	1.1×10^{-5}	30
2628.0-2629.0	V	4.1×10^{-5}	25
2628.0-2629.0	H	1.9×10^{-4}	30
2632.5-2633.0	V	5.0×10^{-4}	31
2632.5-2633.0	H	1.5×10^{-4}	32

Note: Core analyses performed by Ardaman and Associates, Orlando, Florida.

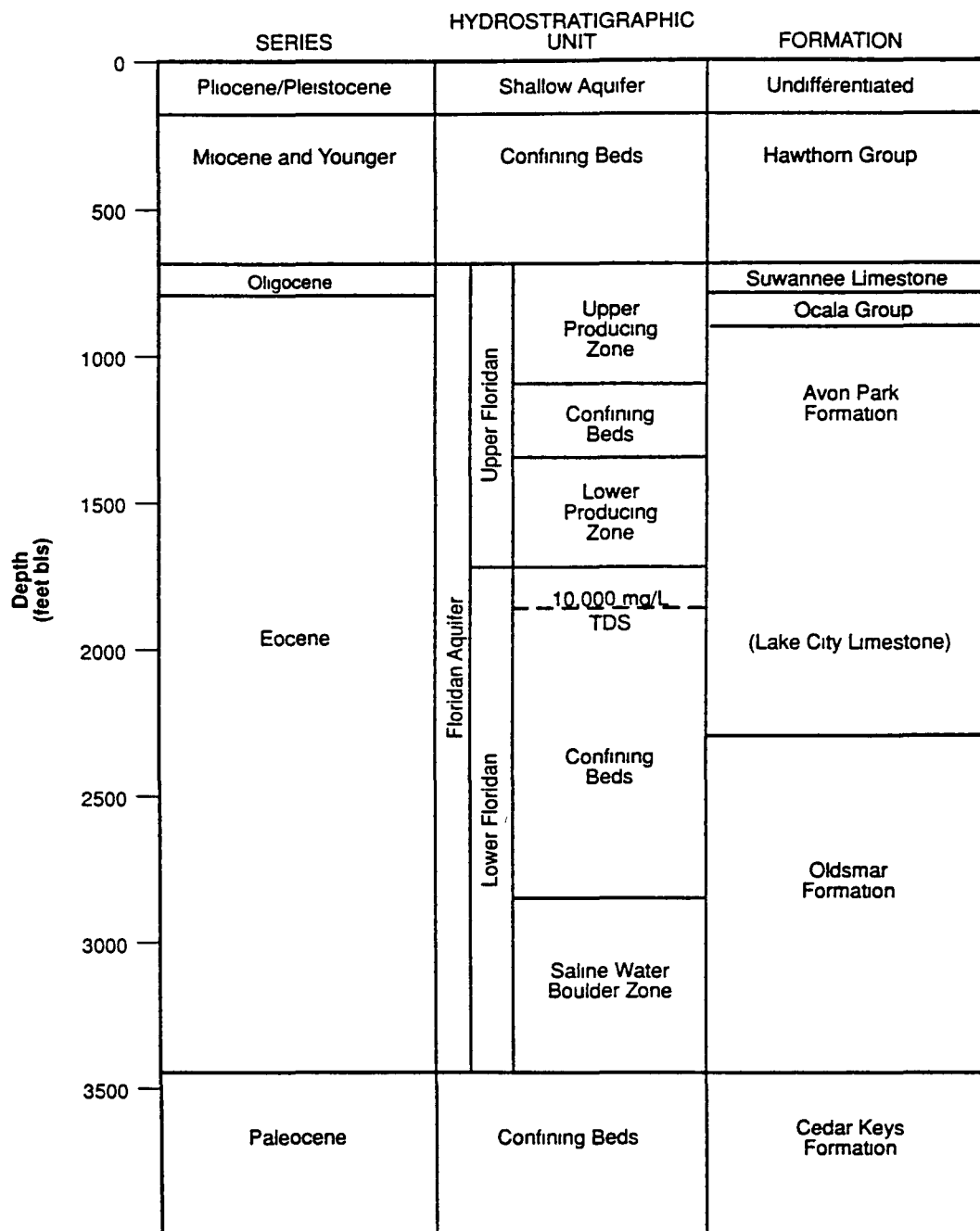
These data indicate that the confining beds above the injection zone are of sufficient thickness and areal extent to retard the upward migration of fluids and should be present at the ICL site.

Expected Hydrogeology at the Site

The hydrogeology in the vicinity of Indiantown is reasonably well documented from injection wells that have been drilled within a 25-mile radius, test oil wells that have been drilled in the vicinity, and from published regional studies. The data strongly suggest that the formations used in south Florida for injection and confinement will be encountered at the proposed ICL facility. Rock formations that are important to the injection process are found throughout the region. They dip gently seaward (Miller, 1986) and lack structural features that could affect their suitability for injection. It is expected that the hydrogeology and formation boundaries beneath the proposed site are similar to those beneath the Amerada Cowles and QO Chemicals sites.

In the cross section shown on Figure 3.5.1-4, the injection zone occurs at about the same depths from north to south, at approximately 2,900 feet. The injection zone at the Pratt & Whitney well also occurs at that depth.

Figure 3.5.1-5 shows the anticipated hydrogeology at the ICL site. The top of the injection zone is expected to occur at a depth of approximately 2,900 feet and extend to a depth of 3,200 feet. The confining sequence is expected to extend from a depth of about 1,850 feet to the top of the injection zone. It is anticipated, based on the location of the 10,000 mg/l TDS interface at the Pratt & Whitney, QO Chemicals, Stuart, and Port St. Lucie wells, that the 10,000 mg/l TDS interface at the ICL site will occur between 1,750 and 1,850 feet bls.



Source Chen, 1965, Lichtler, 1960, CH2M HILL files

Poor Original

Figure 3.5.1-5
GENERALIZED HYDROGEOLOGIC COLUMN AT
THE INDIANTOWN COGENERATION FACILITY

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L.P.

Conceptual Design

Injection System Plan

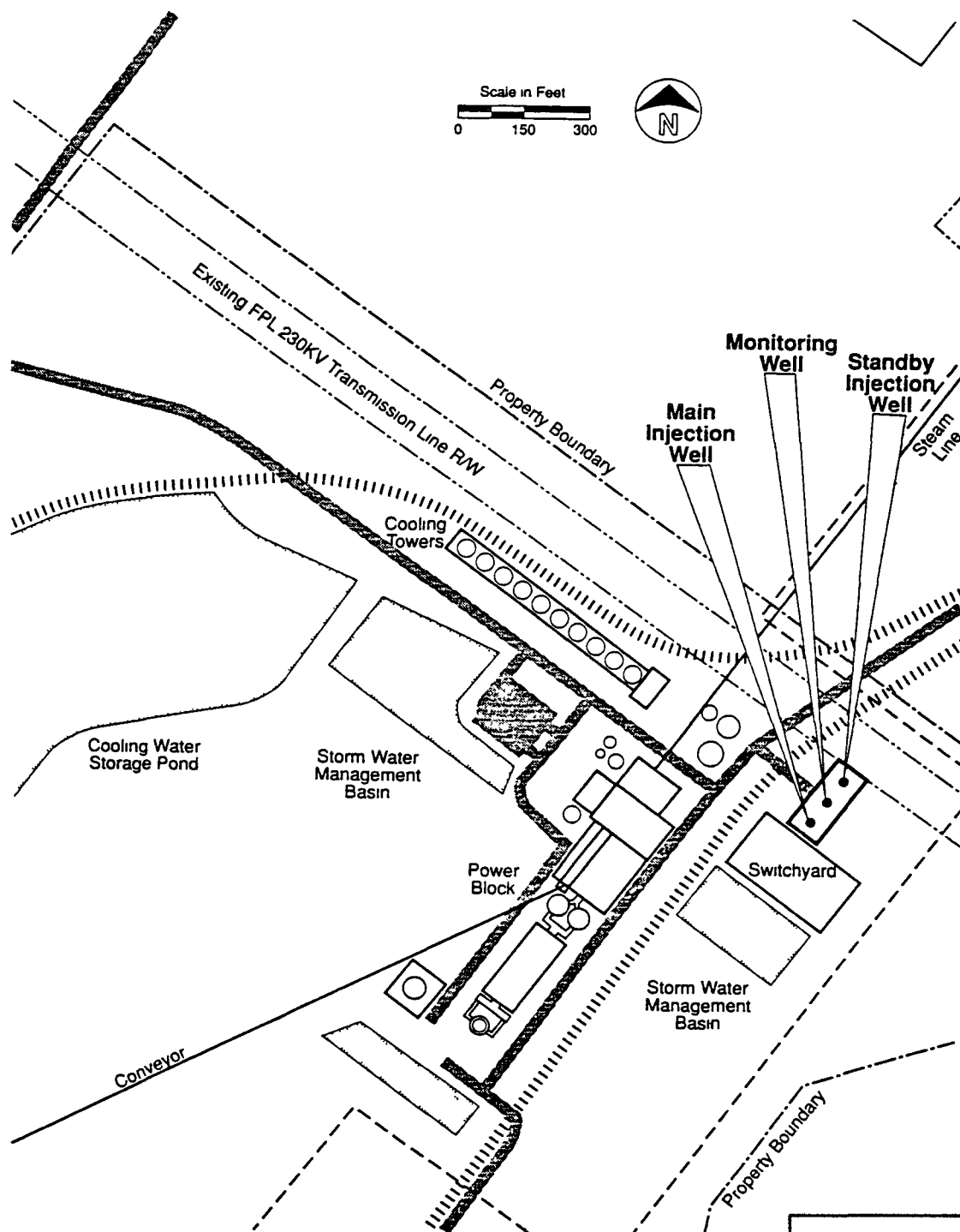
The injection and monitor wells will be located on a reinforced concrete pad, typically 8 to 12 inches thick and approximately 80 x 180 feet in size. The pad will protect the Surficial aquifer from spills and supports drilling loads during construction and workovers. The proposed location for the injection and monitor wells is shown on Figure 3.5.1-6.

The injection system will include a main injection well, standby injection well, a two-zone monitoring well, pumps, surge tank, and instrumentation and controls. The wastewater will be collected in a tank and level switches in the tank will control the injection pumps. The wastewater will normally be pumped to the main injection well. If the main injection well is out of service, the standby injection well will be used. The injection piping will be connected to the hydraulic surge control system.

The hydraulic surge control system will be designed to dissipate hydraulic surges caused by an increase or decrease in the flow velocity within the piping system. The surge control system will consist of a surge tank, air source, and a level control system. The system components will be sized based on actual flows and pressures. Figure 3.5.1-7 is a conceptual diagram of the injection system.

Water Supply

The primary water supply for cooling tower makeup will be Taylor Creek/Nubbin Slough, located approximately 19 miles northwest of the site. Occasionally, makeup water will be required to be withdrawn from the Floridan aquifer. Taylor Creek/Nubbin Slough will be used as long as specific hydraulic conditions are met in the canal system. During periods of extended drought, water will be required to be withdrawn from Floridan aquifer wells constructed at the facility.



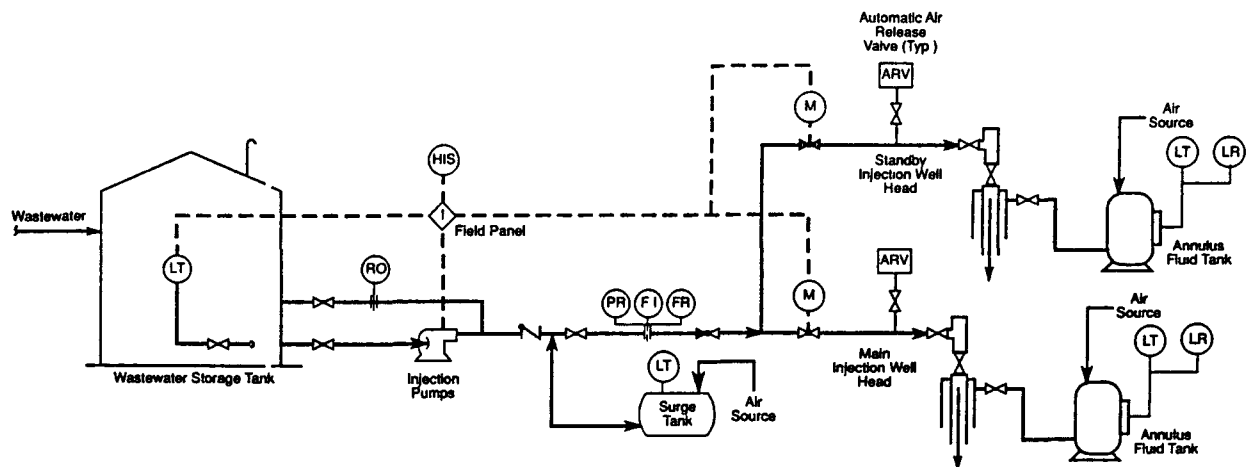
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Figure 3.5.1-6
DETAILED SITE PLAN OF THE INDIANTOWN
COGENERATION FACILITY

Source CH2M Hill, 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L.P.



LEGEND

(LT)	Level Transmitter	Gate Valve
(FI)	Flow Indicator	Globe Valve
(RO)	Restriction Orifice	Check Valve
(HIS)	Hand Indicating Switch	Throttle Valve
(M)	Motor	
(PR)	Pressure Recorder	
(FR)	Flow Recorder	
(LR)	Level Recorder	

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Figure 3.5.1-7
CONCEPTUAL INJECTION SYSTEM DIAGRAM,
INDIANTOWN COGENERATION FACILITY

Source: CH2M Hill, 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L.P.

The raw water quality of the two sources will result in different concentration cycles in the cooling tower. The resulting wastewater quality and quantity will be different depending on the raw water source. The estimated peak flow to the injection well when utilizing the canal source is 250 gallons per minute (gpm). The estimated peak flow to the well when utilizing the Floridan aquifer is 1,280 gpm.

Injection Tubing Size

The Florida Department of Environmental Regulation (FDER) has developed a limitation on the flow velocity of injected fluids in the injection casing or tubing. The maximum flow velocity allowed is 8 feet per second (fps). This criterion is typically the limiting factor in determining the capacity of an injection well.

The injected flow will reach rates up to 1,280 gpm when the Floridan aquifer is utilized for water supply. A 10-inch diameter injection tubing will be required to accommodate this flow. At 8 fps fluid velocity, the allowable flow in the 10-inch tubing will be about 1,714 gpm. Each injection well will be designed to accept the maximum wastewater flow, thereby providing 100 percent redundancy for the injection well system.

Material Selection Criteria

The intermediate casings of the injection wells will be carbon steel as is typically used on Class I injection wells. The injection tubing material will be selected to provide a reliable mechanical system for injection. The injected fluid will be slightly brackish when utilizing Taylor Creek/Nubbin Slough, and will be moderately brackish when the Floridan aquifer is used for supply. The tubing material will be selected to be compatible with the brackish nature of the wastewater. Possible tubing materials include carbon steel, internally coated carbon steel, fiberglass reinforced plastic, and other specialty metals.

Final material selection will be based on suitable mechanical properties, capital costs, operation and maintenance costs, and corrosion resistance.

Preliminary Design

The conceptual design of the injection wells is based on providing capacity for maximum daily flow without any storage and on the regulatory limitation on flow velocity of 8 fps. The preliminary design of the injection wells is presented on Figure 3.5.1-8. This design is based on the assumption that fiberglass reinforced plastic (FRP) tubing will be used for the injection tubing. The FRP couplings in this size have an outside diameter of 12 625 inches. If coated steel or alloy steel is used, the casing sizes may be reduced because the coupling dimensions are smaller than for a similar size FRP tubing.

A 10-inch-diameter tubing set with a packer will be required to accommodate the maximum 1,280 gpm flow. A 16-inch-diameter final casing, set to the top of the injection zone, will be required to provide adequate clearance for the packer and tubing couplings. The remaining casing sizes are proposed to be 26, 34, and 42 inches in diameter. Intermediate casings are included in injection well designs to facilitate construction and to protect overlying aquifers.

Construction and Testing Plan

Drilling Program for Injection Wells

The injection wells will be constructed by advancing the hole with a pilot hole, reaming the pilot hole, installing casing, and progressing with the pilot hole to install the next smaller-sized casing. Testing will occur throughout the drilling process. The proposed drilling and testing program for each injection well is described below.

1. Install by driving or drilling a minimum 42-inch-diameter surface casing to about 25 to 40 feet in depth; cement the annulus back to surface if drilled. Drill a 12-inch-diameter pilot hole through the Surficial aquifer and underlying clay into the consolidated limestone at an approximate depth of 500 feet. Run geophysical logs.

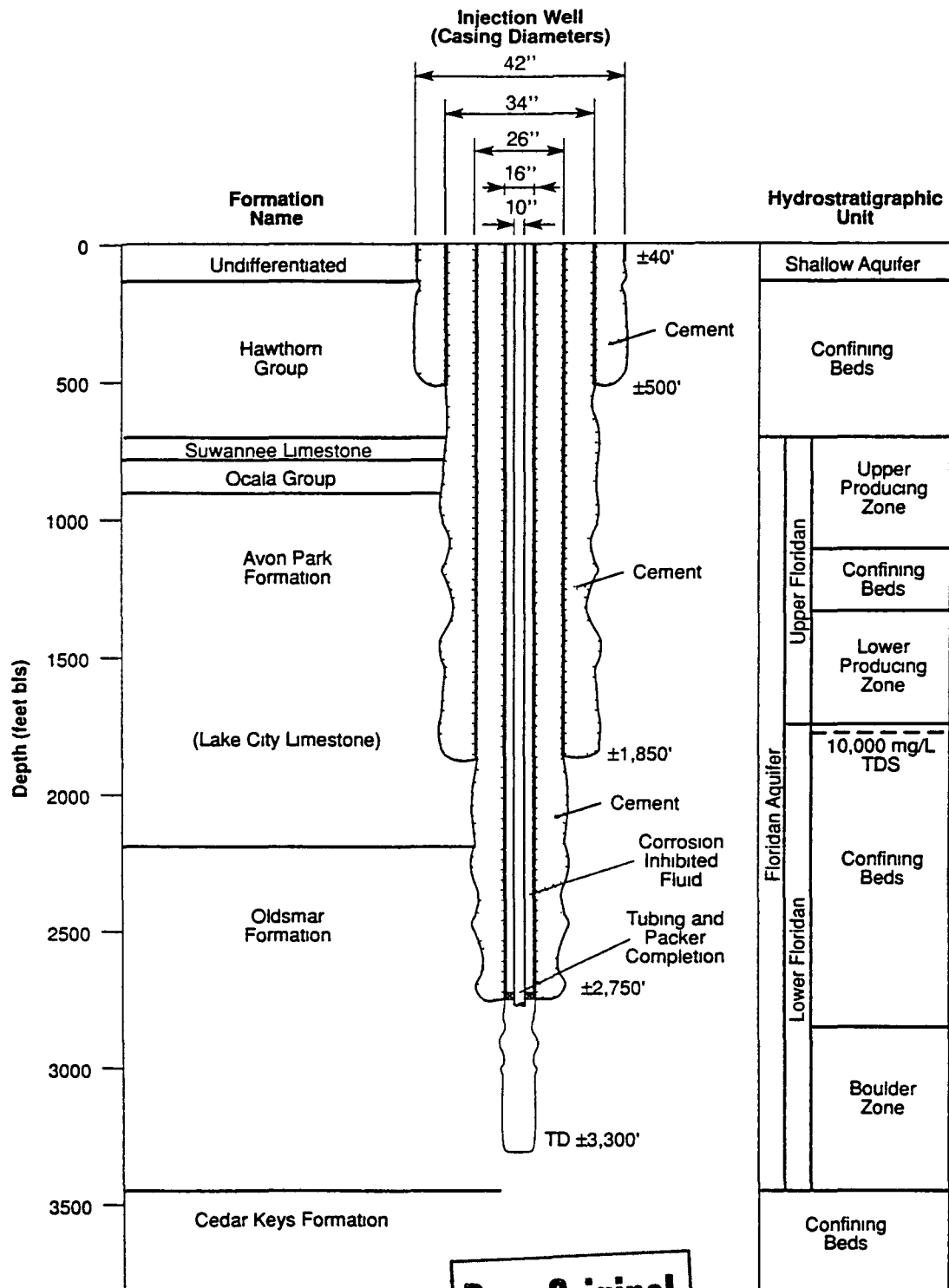


Figure 3.5.1-8.

PRELIMINARY DESIGN OF THE INDIANTOWN COGENERATION FACILITY INJECTION WELL

Source CH2M Hill, 1990

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PROJECT

Indiantown Cogeneration, L.P.

2. Ream the 500-foot pilot hole to about 42 inches in diameter; install approximately 500 feet of 34-inch-diameter casing and cement the annulus to ground surface. Advance the 12-inch-diameter pilot hole to approximately 1,850 feet. Run packer tests to identify the base of the USDW. Run a suite of geophysical logs.
3. Ream the pilot hole to total depth; install a 26-inch-diameter casing to about 1,850 feet and cement the annulus to surface. Drill the pilot hole to a depth of 3,300 feet. During pilot hole drilling for one of the injection wells, obtain five 10-foot rock cores from the 2,000- to 2,700-foot depth interval, run four packer tests in the same interval, and perform a suite of geophysical logs. Packer tests will be run to evaluate the confining beds and to select the lower monitoring zone.
4. Set a bridge plug in the final pilot hole to permit installation of the final 16-inch-diameter casing. The bridge plug will be set immediately below the intended casing installation depth of 2,750 feet. Ream the pilot hole to a depth of about 2,760 feet and install the 16-inch-diameter casing to an approximate depth of 2,750 feet. Cement the annulus to the surface in stages.
5. Run temperature and gamma logs inside the 16-inch-diameter casing after the first stage of cement to pick the top of that stage. Run a 1-hour pressure test and a cement bond log on the final casing.
6. Drill out the bridge plug and clean out the hole to a total depth of approximately 3,300 feet. Run geophysical logs to total depth.
7. Install the 10-inch-diameter tubing with a packer assembly set just above the bottom of the final casing.

8. Run a suite of geophysical logs, TV survey, and a radioactive tracer survey.

Drilling Program for Monitor Well

The current regulatory requirements for monitoring the aquifers above the injection zone are to monitor the first permeable zone above the injection zone and the base of the USDW. The first permeable zone above the injection zone typically occurs at a depth of about 2,000 to 2,100 feet and the water in this interval is salty. Because it is not a USDW, monitoring in this zone provides an early warning of injected fluid migration in the direction of the USDW. The 10,000 mg/l TDS isochlor is expected to occur between approximately 1,750 and 1,850 feet in depth at the ICL facility.

The monitor well is designed to monitor the two zones required by regulations. An open annulus between the 6- and 14-inch- diameter casings will be provided near the base of the USDW to monitor the interval from about 1,600 to 1,650 feet. The 6-inch diameter casing will be set to a depth of approximately 2,000 feet and the hole extended to monitor the interval from about 2,000 to 2,100 feet. Figure 3.5.1-9 shows the proposed monitor well design.

Drilling of the pilot hole, geophysical logging, and reaming and casing installation will be performed as follows.

1. Install an approximately 30-inch-diameter surface casing by driving or drilling to about 40 feet in depth; cement the annulus back to surface if drilled. Drill a 12-inch-diameter pilot hole through the Surficial aquifer and underlying clay into competent rock at an approximate depth of 500 feet. Run geophysical logs.
2. Ream the pilot hole to 500 feet in depth; install about 500 feet of 20-inch-diameter casing and cement the annulus back to surface.

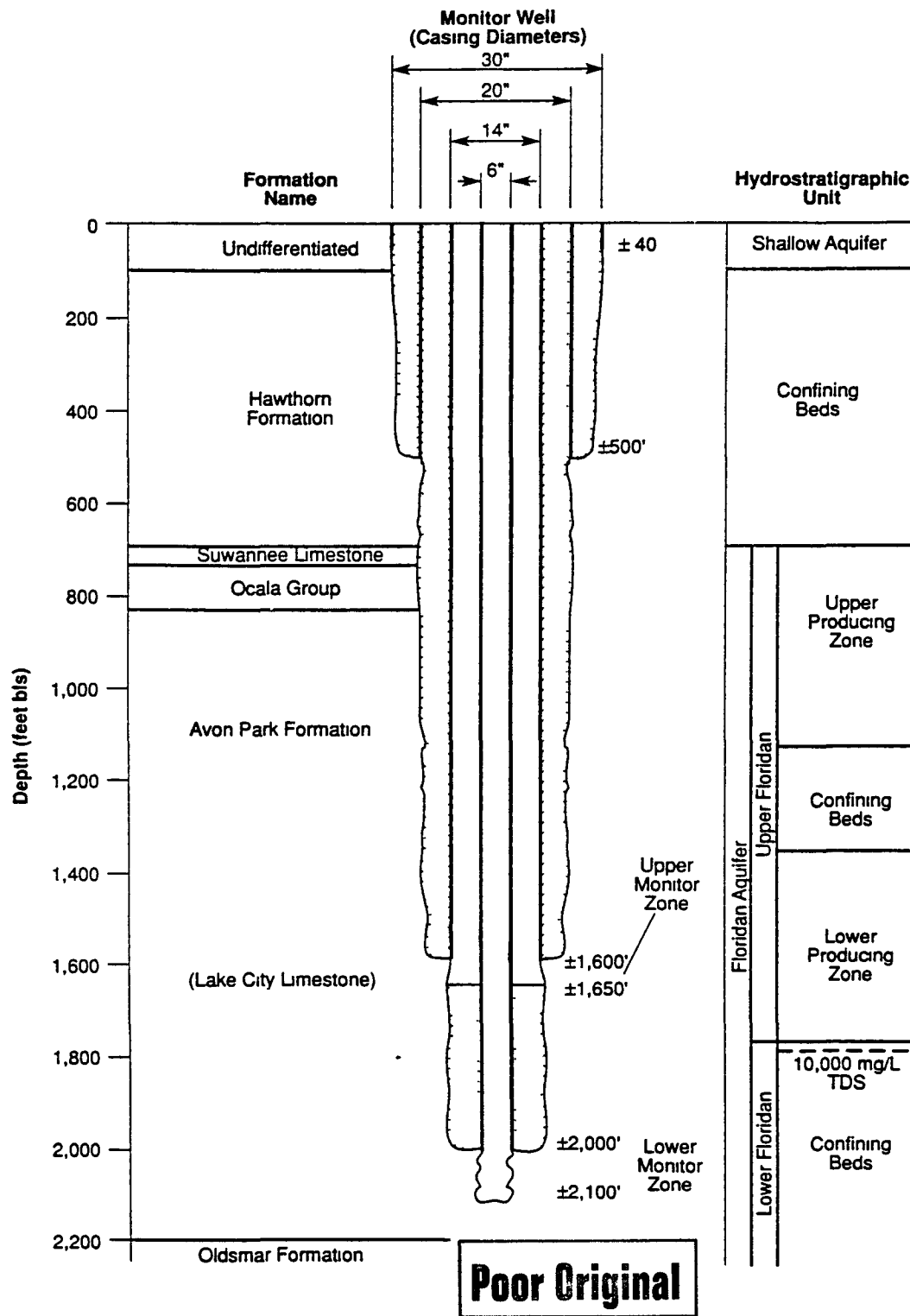


Figure 3.5.1-9.

PRELIMINARY DESIGN OF THE INDIANTOWN COGENERATION FACILITY MONITOR WELL

Source CH2M Hill, 1990

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L.P.

Continue pilot hole drilling to about 1,200 feet in depth. Run geophysical logs. Install a test pump and pump the well for the injection tests on the injection wells.

3. Resume drilling the 12-inch-diameter pilot hole to a depth of 1,600 feet. Run geophysical logs.
4. Ream the 1,600-foot pilot hole to about 20 inches in diameter; install approximately 1,600 feet of 14-inch-diameter casing and cement the annulus back to surface. Run geophysical logs. Advance the 12-inch-diameter pilot hole to approximately 2,000 feet and run a suite of geophysical logs.
5. Install a 6-inch-diameter casing to about 2,000 feet and cement the annulus up to about the 1,650-foot depth. Run a pressure test on the 6-inch diameter casing for 1 hour. Run geophysical logs.
6. Drill out the hole to a depth of 2,100 feet and run geophysical logs. Develop the lower zone by airlifting and allow the upper zone to flow until background conditions return and background water quality samples are taken.

Casing Grout Program

After each casing is set, it will be cemented in place by a multi-staged process using ASTM Type II neat cement mixed with 2 to 12 percent bentonite. A specific cementing program will be developed for each casing and modified as necessary in the field based on data obtained during drilling. The cement formulations are typically based on the fluid loss properties of the formations being cemented. Lighter formulations are used when highly permeable formations are encountered.

After each casing is positioned at the setting depth, a grout pipe is lowered inside the casing to within approximately 25 feet of the casing bottom and a header is

installed on the casing to seal the grout pipe and casing. The first stage of cement is pumped through the grout pipe, out the bottom of the casing, and upward into the annulus.

After the first-stage cement has set, the depth to the top of the cement will be determined by geophysical logging and tagging. Subsequent cement stages containing blends of from 2 to 12 percent bentonite will then be pumped through two grout pipes installed in the annulus. The cement will be pumped to the ground surface for all injection well casings and intermediate monitor well casings. The 6-inch-diameter casing for the monitor well will be cemented only up to a depth of about 1,650 feet to provide for the open annulus monitoring zone described previously.

Geophysical Logging Program

Geophysical logs will be run in each pilot hole before it is reamed. These logs will be used to evaluate the hydrogeology of the strata penetrated by the exploratory hole. The casing setting depths will be determined and cement calculations prepared based on these logs. The proposed logging program for both the injection and monitor wells is shown in Table 3.5.1-5.

Hydrogeologic Testing

Tests will be performed in both the injection and monitor wells to determine the depth to the 10,000 mg/l TDS interface, the permeability and thickness of the confining sequence, and the transmissivity of the injection zone. Testing will include taking drill cuttings, water quality samples, and rock cores, and performing geophysical logging, packer tests, and injection tests. Background water quality samples will be sent to a certified laboratory for analysis and will be analyzed for parameters specified by FDER.

Drill Cuttings - A sample of the drill cuttings will be taken every 10 feet, or at a formation change, during drilling and a lithologic description prepared from them. The drill cuttings will be used in conjunction with the geophysical logs to determine

**Table 3.5.1-5
GEOPHYSICAL LOGGING PROGRAM**

<u>Injection Wells</u>	<u>Interval (feet)</u>	<u>Geophysical Logs</u>
12-inch Pilot Hole	± 0 to 500	LSN, GR, CAL
12-inch Pilot Hole	± 500 to 1,850	CAL, GR, IL, FM-p, TEMP-s, FLRES-s, SON
12-inch Pilot Hole	$\pm 1,850$ to 3,300	CAL, GR, IL, FM-p, TEMP-s, FLRES-s, SON
26-inch Reamed Hole	$\pm 1,850$ to 2,750	CAL
16-inch Cemented Casing	± 0 to 2,750	TEMP, CBL, GR
16-inch Casing and Open Hole	± 0 to 3,300	TV, TEMP, CAL, RTS
10-inch Tubing	± 0 to 2,750	TV, CAL
<u>Monitor Well</u>	<u>Interval (feet)</u>	<u>Geophysical Logs</u>
12-inch Pilot Hole	± 0 to 500	LSN, GR, CAL
12-inch Pilot Hole	± 500 to 1,200	LSN, GR, CAL
12-inch Pilot Hole	± 500 to 1,600	LSN, GR, CAL, TEMP, FLRES
14-inch Casing	± 0 to 1,600	CBL
12-inch Pilot Hole	$\pm 1,600$ to 2,000	LSN, GR, CAL, TEMP, FLRES
6-inch Cemented Casing	± 0 to 2,000	TEMP, CBL
6-inch Casing and Open Hole	$\pm 2,000$ to 2,100	CAL, GR, ELEC

Key	ELEC	Single-Point Electric and Spontaneous Potential
	CAL	Caliper
	GR	Gamma Ray
	LSN	Long and Short Normal Electric and Spontaneous Potential
	TEMP	Temperature
	FM	Flowmeter
	FLRES	Fluid Resistivity
	IL	Induction Log
	SON	Acoustic Velocity Log
	TV	Color Video Survey
	p	Pumping
	s	Static
	RTS	Radioactive Tracer Survey
	CBL	Cement Bond Log

Source CH2M Hill, 1990

the depths at which each formation is encountered and to characterize the formations.

Rock Cores - The confining beds above the injection zone will be cored to characterize their lithology and hydraulic properties. Five cores will be obtained during drilling of the 12-inch-diameter pilot hole for the injection well. The cores will be obtained using a 10-foot-long core barrel. Representative portions of the cores will be sent to a geotechnical lab for determination of the vertical and horizontal coefficients of permeability and porosity. Laboratory results and the lithologic descriptions will be compared to the geophysical logs for confirmation of the confining nature of the beds overlying the injection zone.

Packer Testing - Straddle packer testing is proposed in the lowermost confining sequence to isolate a discrete interval in the confining zone and to test its hydraulic characteristics. Packer testing intervals will be selected after reviewing the cores and cuttings, the geophysical logs of the pilot hole, and the drilling rate. Dual inflatable packers will be set across the selected interval to be tested and the interval pumped while water levels are recorded. Time-drawdown curves will be prepared and the transmissivity of the tested interval will be calculated. Packer tests will also be run in the injection well to identify the base of the USDW and to help select the lower monitoring zone.

Injection Test - After installing the 16-inch-diameter casing, an injection test will be run to evaluate the hydraulic characteristics of the injection well. Brackish water from the monitor well will be used for the injection test. The injection rate in the 16-inch-diameter casing will be increased incrementally from 1,000 gpm to approximately 3,000 gpm, the duration of the test being approximately 8 to 12 hours. The maximum injection pressure and static head will be measured and the injection pressure caused by the formation will be calculated.

After installing the tubing and packer, a second injection test will be performed. The injection rate will be incrementally increased from 250 to 1,725 gpm.

Mechanical Integrity Testing

Tests to demonstrate the initial mechanical integrity of the injection wells will be run before the wells are placed in operation. The demonstration will be in two parts, the first requiring a showing that the casing has no leaks, and the second that no injected fluid can leak up around the outside of the casing into a USDW.

The integrity of the 16-inch-diameter casings will be demonstrated with a casing pressure test, which requires that 1.5 times the injection pressure be maintained for 1 hour with less than a 5-percent pressure drop. The absence of fluid movement behind the casings will be demonstrated with a radioactive tracer survey to satisfy the second part of the mechanical integrity demonstration. The 8-inch-diameter tubings will be pressure tested after installation by an annular pressure test.

Water Quality Testing

The water quality profile at the site will be developed through several means of data collection. Two primary purposes of water quality testing are to determine the depth to the 10,000 mg/l TDS interface and the background water quality of the injection and monitoring zones.

Reverse-air water samples will be collected every 30 feet while drilling the pilot hole in the injection and monitor wells. These samples will be analyzed in the field for temperature, specific conductance, and chloride concentration, and the results will be used to help define the 10,000 mg/l TDS interface. Water quality samples from the pilot hole packer tests also will be used to identify the base of the USDW and the water quality in the confining zone.

Background water quality samples of the injection and monitor zones will be taken. Water quality samples will be taken after the final casing is set and the well is developed to determine the background quality of the injection zone.

The monitoring zone will be allowed to flow for several days upon completion of construction to flush out all non-native water. To establish the background water quality in the monitoring zones, samples will be collected from the zones before injection begins and will be analyzed for the parameters shown in Table 3.5.1-6. The pre-injection monitoring zone water levels will also be measured to establish natural background water levels and fluctuation in the monitoring zones.

Characterization of the Injected Fluid

Volume

The volume of fluid to be injected will vary with the source of water used to supply the plant. When the Taylor Creek/Nubbin Slough source is used, a maximum injection volume of approximately 250 gpm will be generated. When the Floridan aquifer source is used, a maximum volume of approximately 1,280 gpm will be generated.

Chemistry

When using the primary source of water makeup for the plant, the wastewater disposed of via the injection well is only cooling tower blowdown. All process wastewater from the plant is reused as lime slurry dilution water for the spray dryer. When using the backup sources of water for the plant, the wastewater disposed of via the injection well is a mixture of cooling tower blowdown and excess process wastewater that cannot be reused. As discussed in Section 3.6, the wastewater from this facility is expected to be non-hazardous. Table 3.5.1-7 is a summary of the estimated wastewater quality from the raw water sources. The cooling tower blowdown will also contain some sulfuric acid and chlorine because these compounds are injected in the tower basin to control scaling, pH, slime, and algae growth. The pH of the wastewater will be maintained by adjustment during the treatment process.

Table 3.5.1-6
PARAMETER LIST FOR ESTABLISHING BACKGROUND WATER QUALITY

<u>Primary Drinking Water Standards</u>	<u>Secondary Drinking Water Standards</u>
Arsenic Barium Cadmium Chromium Fluoride Lead Mercury Nitrate (as N) Selenium Silver Sodium Endrin Lindane Methoxychlor Toxaphene 2,4-D 2,4,5-TP, Silvex Total trihalomethanes Trichloroethene Tetrachloroethene Carbon tetrachloride Vinyl chloride 1,1,1-trichloroethane 1,2-dichloroethane Benzene Ethylene dibromide p-dichlorobenzene 1,1-dichloroethene Turbidity Coliform bacteria Radionuclides	Chloride Color Copper Corrosivity Fluoride Foaming agents Iron Manganese Odor pH Sulfate Total dissolved solids Zinc <u>Others</u> Calcium Magnesium Potassium Ortho phosphate as P Total phosphorus as P Hardness, total Specific conductivity field Total organic carbon Specific gravity Bicarbonate Carbonate Nitrite nitrogen as N Ammonia nitrogen as N Total kjeldahl, nitrogen as N

EPA Methods 608, 624, 625

Source: CH2M Hill, 1990

Table 3.5.1-7
ESTIMATED WASTEWATER EFFLUENT QUALITY

<u>Parameter</u>	<u>Cooling Water Source</u>	
	<u>Taylor Creek/ Nubbin Slough (mg/l)</u>	<u>Floridan Aquifer (mg/l)</u>
pH	6 - 9	6 - 9
Alkalinity (as CaCO ₃)	153	118
Total Dissolved Solids	3240	14800
Silica	25	17
Calcium	103	285
Magnesium	26	207
Sodium	994	4820
Potassium	61	96
Iron	0.73	<0.06
Sulfate	1095	1480
Chloride	832	7700
Fluoride	-	3.2
Nitrate	3.4	-
Phosphate	1.9	<2.3

Note: Concentrations are in mg/l of the ion.

Source: Bechtel, 1990

Compatibility

The proposed fluids to be injected must be compatible with the injection zone rock material and the formation fluids contained within the pores of that rock material. Injected fluids incompatible with the formation fluids can cause plugging or may chemically react with the formation material, causing detrimental effects to the injection or confining strata. A fractured and cavernous injection zone precludes the need to remove suspended solids to within the range of 1 to 5 mg/l. Based on other high TDS wastewaters injected in south Florida and the fractured and cavernous nature of the injection zone, wastewater from the ICL facility is expected to be compatible with the formation and formation fluids.

Injection System Operation and Monitoring Plan

Injection system monitoring data will be collected to provide a record of system performance and to detect any movement of injected fluid into the USDW. The injection system monitoring plan will consist of monitoring the injection well capacity and the injection flow rate and pressure, the annular fluid tank levels, the water elevation in the upper and lower monitor zone, and the water quality of the two monitoring zones (Table 3.5.1-8).

Contingency Plan

Each of the two injection wells will have the capacity to accept the maximum anticipated wastewater flow. If one of the wells is out of service, the second well will be used for injection. This will provide 100 percent redundancy in the injection well system for reliability, maintenance, and testing.

Injection Well Operational Monitoring

Injection well operational monitoring will consist of continuous recording, indicating, and totalizing the injection flow rate, and reporting the total daily flow, monthly average flow, monthly maximum flow, and monthly minimum flow. The injection pressure will be recorded, indicated, and totalized, and daily minimum and maximum and average pressure (psig) will be reported (Table 3.5.1-8).

Table 3.5.1-8
MONITORING PARAMETERS
ICL FACILITY

<u>Monitoring Station</u>	<u>Parameter</u>	<u>Frequency</u>
Injection Well	Flow Pressure	Continuous Continuous
Monitoring Well	Pressure/water level Conductance Chloride Standard complete chemical	Continuous Monthly Monthly Annual
Wastewater	pH TDS	Weekly average Weekly average

Source: CH2M Hill, 1990

Continuous water level monitoring of the annular fluid between the tubings and the final casings will be provided, with an alarm for low level warning. Detection of leaks from the tubing, packer, or casing will be provided with this monitoring system.

On a quarterly basis, a specific injectivity test will be run on the active injection well. This test will evaluate the injection capacity of the well to detect any changes over time caused by plugging or other flow-restricting conditions. This test will typically require the well to be out of service for less than 15 minutes.

Monitoring Well Operational Monitoring

Every month, water quality samples will be collected from the two monitoring zones in the monitoring well and tested for comparison with the pre-injection water quality to detect changes caused by possible migration of the injected effluent. The samples will be collected after flowing a minimum of two casing volumes from both zones. The fluid produced from the monitor well will be pumped to the wastewater collection tank, from where it will be pumped into the injection well. The expected parameters to be analyzed for on a monthly basis are presented in Table 3.5.1-8.

In addition, continuous water level monitoring of the two monitoring intervals will be provided by recorders. Daily minimum and maximum levels and monthly minimum and maximum levels will be reported, along with the water quality data, on a monthly basis to the FDER.

Conclusions

Based on the literature and data from several operating injection wells in the vicinity of the proposed ICL facility, Class I well injection is feasible at this site. The injection zone used throughout south Florida for similar systems is expected to be encountered at a depth of approximately 2,900 feet. Adequate confinement is also expected to be demonstrated.

The conceptual design of the injection wells is dependent upon the type of material used for the tubing, as tubing material dictates tubing and subsequent casing sizes. Two injection wells with 10-inch-diameter FRP tubings and 16-inch-diameter final casings are anticipated at the ICL facility.

3.5.2 DOMESTIC/SANITARY WASTEWATER

Domestic/sanitary wastewaters are generated by wash basins, showers, toilets, water fountains, emergency showers and eyewash stations, etc. All sanitary wastewater generated at the ICL site will be transferred to the Indiantown Company water services sewer connection. The 2,300 gpd wastewater is less than 1 percent of the Indiantown Company's design capacity of 1.0 MGD. The existing daily flow is 0.41 MGD, therefore, no impact from the ICL facility is anticipated. There is no onsite treatment of sanitary wastewater.

3.5.3 POTABLE WATER SYSTEMS

Potable/drinking water for wash basins, showers, toilets, etc., is supplied via a connection to the Indiantown Company water services supply main. The Indiantown Company water service is designed for 1.30 MGD, while the average daily flow is 0.67 MGD. Therefore the ICL plant's requirements of 2300 gpd will have no impact on the available water supply. There is no onsite treatment to provide potable water.

3.5.4 PROCESS WATER SYSTEM

3.5.4.1 General

The primary source of process water for the ICL plant is surface water from TC/NS. During periods of extended drought when water is not available from TC/NS, process water will be obtained from a mixture of TC/NS water (from the cooling water storage pond) and groundwater from the upper production zone of the upper Floridan aquifer. Water qualities for the TC/NS and upper and lower production zones of the upper Floridan aquifer are provided in Table 3.5.0-1.

Process water is treated to meet the different water quantity and quality demands in the plant. Process water demands for large component cleaning such as air heater and boiler fireside and tube side cleaning occur when the plant is in an outage and are met with the treatment system augmented by the filtered water storage tank. Fire protection water is supplied from the cooling water storage pond. The process water treatment scheme and flowrates are shown in Figures 3.5.0-3 and 3.5.0-4 for the primary and backup water sources, respectively.

3.5.4.2 Process Water Demand/Uses

Filtered and demineralized water is used to meet the following plant water demands:

- Spray dryer lime slaking water is used to dissolve the lime used in the flue gas desulfurization system. The slaked lime is further diluted with reclaimed wastewater (as discussed in Section 3.6.2) prior to injection into the spray dryer.
- Filtered service water is provided throughout the plant for washdown purposes, pump and equipment gland seal flushes, dust suppression in the coal handling area, manganese greensand and activated carbon

filter backwashes, demineralizer regeneration, and dilution at chemical feed stations. The service water flow shown on Figure 3.5.0-4 is higher than the demand shown on Figure 3.5.0-3 to account for the significantly higher demand for lime and soda-ash slaking water at the sidestream softener when using the lower production zone of the upper Floridan Aquifer as the source of cooling water makeup.

- Demand for demineralized water in the plant consists of boiler makeup, ion-exchange resin regeneration, makeup of export steam losses, and other miscellaneous uses.

3.5.4.3 Process Water Treatment

With one exception, the use of TC/NS as the primary makeup water source dictates the approach to process water treatment for the plant. The equipment is then sized to accommodate use of the mixture of TC/NS water and groundwater from the upper production zone of the upper Floridan aquifer as a backup process water source. The exception (discussed in greater detail below) is that a reverse osmosis unit is utilized when using the backup sources of process water.

The following typical treatment description applies to either water source, unless otherwise noted. Raw process water is first chlorinated to destroy color, organics, bacteria, etc. Only the iron levels in the two sources precludes direct use of the water as service water. Therefore, the chlorinated water is pumped through a manganese greensand filter. The manganese greensand filter removes iron and manganese from the raw water and filters out suspended solids. Potassium permanganate solution is added continuously to regenerate the greensand filter bed which in turn oxidizes the iron and manganese. The iron and manganese precipitates are trapped in the filter, along with other suspended solids, and transferred to the wastewater equalization tank when the greensand filter is backwashed. The filtered effluent has a suspended solids level of less than 1 mg/l.

The filtered water is stored in the filtered water storage tank to provide for demands such as demineralizer makeup, plant service water, and spray dryer lime slaking water.

Water that requires demineralization is pumped from the filtered water storage tank through an activated carbon filter. The activated carbon filter removes residual chlorine and adsorbs organics. The activated carbon filter requires periodic backwashing. The backwash is transferred to the wastewater equalization tank.

When using the primary process makeup water source, product water from the activated carbon filter is transferred directly to the demineralizer system. However, as shown in Table 3.5.0-1, the sodium and chloride levels in the groundwater from the upper production zone of the upper Floridan aquifer are very high, and would place a significant burden on the demineralizer. Therefore, a reverse osmosis unit is used to treat the process makeup water when using the backup process water source. The reverse osmosis unit uses a high pressure differential to force water through a membrane, separating the dissolved ions from the water. Brine from the reverse osmosis unit is transferred to the injection well. Product water from the reverse osmosis unit is transferred to the demineralizer system.

The demineralizer system consists of two parallel trains, each with a strong cation, strong anion, and polishing mixed beds. The mixed bed has both anion resin and cation resin to remove residual ions. The return condensate from the Caulkins plant is treated in the mixed bed unit to remove ions picked up from the piping and leaks in the system. For this reason, the mixed bed units are sized substantially larger than the primary beds.

The demineralizer resin beds are exhausted by the ions in the water being treated. The demineralizer beds are regenerated periodically with acid (cation beds) or caustic (anion beds). The regeneration waste stream consists of a backwash, an injection of acid or caustic to restore the resin capacity (the actual regeneration process), a slow rinse, and a fast final rinse to remove excess regenerant. Wastes

from demineralizer regeneration are transferred to the neutralization tank for treatment.

Demineralized water is stored in the condensate storage tank. Water for boiler makeup, demineralizer regeneration, etc., is withdrawn from this tank.

3.6

3.6 CHEMICAL AND BIOCIDES WASTES

Operation of the Indiantown Cogeneration, L.P. (ICL) project requires the use of chemicals to treat or condition water, and results in the generation of wastewaters. These wastewaters are collected, treated, reused, or discharged. Figures 3.5.0-3 and 3.5.0-4 show the wastewater treatment equipment and average annual flows when using the two different plant makeup water sources.

The objective of the wastewater treatment scheme is to control pH, oil, and suspended solids levels; then discharge the wastewater to the Boulder Zone of the lower Floridan aquifer via an injection well (See Section 3.5.1.5).

Two wastewater streams are recycled within the plant. Boiler blowdown has a low total dissolved solids level and is recycled to the cooling tower sidestream softener. Runoff and leachate from the inactive coal pile is also recycled to the cooling tower sidestream softener. In addition, a portion of the plant wastewater is used as spray dryer lime slurry dilution water.

A summary of maximum daily, maximum monthly, and average annual wastewater discharges to the Boulder Zone of the lower Floridan aquifer when using the primary and backup sources of water is presented in Table 3.6.0-1. The wastewater effluent quality for the average annual conditions when using the primary water source and the wastewater effluent quality for the maximum daily conditions when using the backup water sources are presented in Table 3.6.0-2.

Table 3.6.0-1
SUMMARY OF PROJECT WASTEWATER DISCHARGES

<u>Case.</u>	<u>Maximum Daily (MGD)</u>	<u>Maximum Monthly (MG/Mo)</u>	<u>Average Annual (MGY)</u>
Primary Source of Water	0.426	12.3	137
Backup Sources of Water	1.84	52.9	154

Notes:

1. Wastewater from the ICL plant is discharged to the Boulder Zone of the lower Floridan aquifer via an injection well.
2. Maximum daily discharge flows are based on design flows through the cooling tower and 100 percent load factor for 24 hours.
3. Maximum monthly discharge flows are based on the highest average monthly flows through the cooling tower at 100 percent load factor for 31 days.
4. Average annual wastewater flows when using the primary water source are based on the annual average flows through the cooling tower at 100 percent load factor for 365 days. Average annual wastewater flows when using the backup water sources are based on the annual average flows through the cooling tower at 100 percent load factor for 3 months.

Source: Bechtel, 1990

**Table 3.6.0-2
SUMMARY OF PROJECT WASTEWATER QUALITY**

<u>Parameter</u>	<u>Avg. Annual Primary Water Source (mg/l)</u>	<u>Max Daily Backup Water Source (mg/l)</u>
pH	6-9	6-9
Total Dissolved Solids	3,240	14,800
Total Hardness (as CaCO ₃)	364	1,560
Oil/Grease	< 15	< 15
Residual Chlorine	< 1.0	< 1.0
Alkalinity (as CaCO ₃)	153	118
Silica	25	17
Calcium	103	285
Magnesium	26	207
Sodium	994	4,820
Potassium	61	96
Iron	0.73	< 0.06
Sulfate	1,095	1,480
Chloride	832	7,700
Fluoride	-	3.2
Nitrate	3.4	-
Phosphate	1.9	< 2.3

NOTES:

1. Concentrations are in mg/l of the ion.
2. The wastewater effluent quality for the primary water source (Taylor Creek/Nubbin Slough) is based on average annual flows through the water and wastewater treatment system. These flows are based on the average annual meteorological conditions for the cooling tower, 100 percent load factor and 24 hours per day for 365 days. The cooling tower operates at 10 cycles of concentration.
3. The wastewater effluent quality for the backup water source (lower production zone of the upper Floridan aquifer for cooling water makeup and mixture of Taylor Creek/Nubbin Slough and upper production zone of upper Floridan aquifer for process water makeup) is based on maximum daily flows through the water and wastewater treatment system. These flows are based on design meteorological conditions for operation of the cooling tower and 100 percent load factor for 24 hours. The cooling tower operates at 3.5 cycles of concentration.

Source: Bechtel, 1990

3.6.1 PLANT CHEMICAL AND BIOCIDES USE

A variety of chemicals and a biocide are used in the plant to obtain or maintain a desired quality of water as part of cooling water treatment, process water treatment, boiler water treatment, and wastewater treatment.

3.6.1.1 Chemical Use in Cooling Water Treatment

Cooling water is treated to control corrosion, scaling, and biofouling. These three processes are intertwined and, over a period of time, lead to heat transfer efficiency losses in both the condenser and cooling tower, adversely affecting the heat rate of the plant. Chemicals are used to control these processes. In addition, chemicals are used in the sidestream softener to allow the cooling tower to operate at higher cycles of concentration.

Scale is controlled by adding a polymeric form of organic phosphates. A residual of a few mg/l of a high molecular weight polymer keeps ions in suspension, preventing them from depositing on the heat transfer surfaces. There are a variety of anti-scalants available for cooling water treatment applications.

Corrosion inhibitors are added to control the formation of metal oxides on heat transfer surfaces. These inhibitors are non-metal based (unlike zinc and chromium based corrosion inhibitors of the past); therefore, the corrosion inhibitors do not add metals to the cooling tower blowdown.

Sulfuric acid is added to the circulating water to prevent the pH from rising above about 8.3. Sulfuric acid also converts calcium carbonate to calcium sulfate which has a much higher solubility and does not form scale on heat transfer surfaces.

The circulating water is chlorinated with sodium hypochlorite to kill bacteria and destroy organics which have the potential to foul the condenser and grow on the grid in the cooling tower. The sodium hypochlorite may be either fed into the

cooling tower basin or injected at the inlet to the condensers. The consumption (or chlorine demand) exhibited by the cooling water depends on the number of organisms in the cooling water, the degree of biological fouling of the condenser tubes, and the amount of ammonia in the cooling water. The rate, frequency, and duration of chlorination will be set by the operator in response to anticipated seasonal variations in these parameters and review of condenser performance to maintain adequate control without over-chlorinating.

Chlorination is only required for up to 2 hours per day. Free residual chlorine levels in the cooling tower blowdown are expected to be less than 1.0 mg/l.

As discussed in Section 3.5.1.1, a portion of the circulating water is passed through a sidestream softener to reduce hardness, silica, iron, manganese, organics, etc. In the sidestream softener, lime and soda-ash (sodium carbonate) are added to the water. This causes calcium carbonate, magnesium hydroxide, and ferrous hydroxide to precipitate out of the solution. Organic polymers are added to assist in settling the suspended solids and precipitates to the bottom of the softener. The sludge from the clarifier is transferred to the wastewater sludge thickener, while the clarified effluent rejoins the circulating water.

With the exception of the chemicals removed as precipitates in the sidestream softener underflow and the decay of sodium hypochlorite, all other chemicals utilized in the cooling water treatment leave with the cooling tower blowdown.

3.6.1.2 Chemical Use in Process Water Treatment

As discussed in Section 3.5.4, raw process water is treated to produce the quality required by different plant demands.

The raw process water is chlorinated with sodium hypochlorite prior to entering a small surge tank at the front end of the treatment system (prior to the manganese greensand filter). The sodium hypochlorite is used to kill bacteria and destroy

organics which have the potential to foul plant piping systems and ruin the ion-exchange resins in the demineralizer. Sodium hypochlorite is fed continuously to the raw water. The feed rate will be set by the operator in response to seasonal variations in organics levels in the raw water (especially from the Taylor Creek/Nubbin Slough source).

Iron is removed from the raw process water in a manganese greensand filter. The manganese greensand filter is regenerated either by a continuous or intermittent addition of a potassium permanganate solution to the process water upstream of the filter. The feed rate of potassium permanganate will be based on the iron and manganese content of the raw water. Excess potassium permanganate, beyond that required for iron and manganese removal, oxidizes other constituents in the raw water, such as organics or microorganisms. The potassium is ionized in the water, while the manganese in the permanganate forms insoluble manganese hydroxide and is removed by the filter.

The reverse osmosis unit will be used when the backup sources of process water are needed. The membranes of the reverse osmosis unit will require occasional acid cleaning (possibly as often as once per week when in use) to remove accumulated scale. The wash water will be directed to the neutralization tank.

The ion-exchange resins in the demineralizer beds require periodic regeneration. Sulfuric acid is used to regenerate the strong cation bed. Sodium hydroxide is used to regenerate the anion bed. The acidic and alkaline waste streams are transferred to the neutralization tank after passing through the beds.

3.6.1.3 Chemical Use in Boiler Water Treatment

Even though process water is treated to meet the boiler feedwater quality requirements, boiler water undergoes chemistry changes and acquires metals as it circulates through the steam cycle piping. Therefore, chemicals are added to maintain a desired water quality, to prevent corrosion and scaling in the steam cycle piping.

A sodium phosphate compound is injected into the boiler water to react with the hardness ions and form an insoluble compound called hydroxyapatite, which remains in suspension until it is removed in the boiler blowdown.

Phosphate based polymers, which keep the precipitates formed in suspension by modifying their structure, are added to the boiler water in a solution form. The suspensions are light weight and are flushed out with the boiler blowdown.

Neutralizing amines, which are nitrogen containing organic compounds, are added in the steam cycle. These amines are volatile in nature and provide pH control in the steam piping as well as the return condensate loop.

Passivating amines are also nitrogen containing organic compounds which, when introduced to the steam cycle, form a passivating (inert) film on the steam piping internals to help control corrosion of the boiler system.

Dissolved oxygen in the boiler water (which leads to corrosion of the boiler tubes) is controlled by the use of an oxygen scavenger. The chemical used is hydrazine or an equivalent. Hydrazine forms water and molecular nitrogen in controlling dissolved oxygen. The nitrogen is removed in the deaerator.

3.6.1.4 Chemical Use in Wastewater Treatment

Wastewater from demineralizer regeneration and chemical lab drains that may not have a neutral pH are directed to the neutralization tank where sulfuric acid or sodium hydroxide are used to adjust the pH to between 6 and 9.

Coagulants and filter aids are used in the wastewater treatment clarifier to aid in removing suspended solids from the plant effluent and in dewatering the resultant sludge. Coagulant aids and filter aids are high molecular weight compounds that overcome the electrical charges which cause suspended particulates to repel one

another. The dose is usually between 0.5 to 2 mg/l, and is optimized once the plant is in operation. Coagulant aids are added to the sludge thickener to produce a sludge with a higher solids content that dewateres more easily. Filter aids are used in the filter press for a better solids capture and to produce a clearer filtrate. These organic chemicals are removed with the dewatered sludge (filter cake).

Lime is used to adjust the pH of the runoff and leachate from the inactive coal pile before it is recycled to the cooling tower sidestream softener.

3.6.2 WASTEWATER TREATMENT DESCRIPTION

The objective of the wastewater treatment scheme is to control pH, oil, and suspended solids levels; then discharge the wastewater to the Boulder Zone of the lower Floridan aquifer via an injection well. Figures 3.5.0-3 and 3.5.0-4 show the wastewater treatment equipment and average annual flows when using the two different plant makeup water sources.

Section 3.5.1.5 discusses the compatibility of the injected fluids with the injection rock zone material. The wastewater to be injected is expected to be compatible with the formation and formation fluids of the Boulder Zone of the lower Floridan aquifer. The quality of the wastewater based on average annual flows using the primary source of water is presented in Table 3.6.0-2. The "worst case" effluent quality at design flow rates using the backup sources of water is also presented in Table 3.6.0-2. No hazardous materials may be injected into the well. Therefore, measures (e.g., oily water separators, good operational practices, training of personnel, dikes around chemical treatment areas, etc.) will be taken to ensure that hazardous solvents, degreasers, or other chemicals that may be used at the plant will not enter the floor drains or equipment drains connected to the wastewater equalization tank.

The use of the spray dryer as the flue gas desulfurization system provides an opportunity to dispose of wastewater in the spray dryer. The lime slurry dilution water can tolerate higher total dissolved solids levels than is found in the service water. Therefore wastewater is used to meet this demand.

When using the primary source of water for plant makeup, the wastewater flow from the plant (excluding cooling tower blowdown) does not provide sufficient quantity to meet the spray dryer dilution water demand. Therefore, cooling tower blowdown is used to supplement wastewater from the wastewater treatment clarifier. However, when using the backup water sources, the wastewater flow (again excluding cooling tower blowdown) is sufficient to meet the spray dryer dilution

water demand. The cooling tower blowdown when using the lower production zone of the upper Floridan aquifer for cooling water makeup is actually unsuitable for use as spray dryer dilution water because of the very high total dissolved solids and sulfate levels.

A small portion of the total steam flow is discharged from the boiler as a liquid blowdown to maintain a solids balance in the boiler water. This waste stream contains dispersants, phosphates, and trace amounts of iron and copper picked up from piping and equipment surfaces. Blowdown from the boiler is at an elevated temperature and pressure. A flash tank recovers a very pure vapor with a low total dissolved solids level which can be recycled directly to the boiler water deaerator (after recondensation). The boiler water treatment chemicals remain with the blowdown. The blowdown stream is recycled to the cooling tower sidestream softener.

The acidic and alkaline waste streams from demineralizer regeneration are transferred to the neutralization tank. Other plant waste streams with the potential of being acidic or basic, such as chemical lab drains, are also directed to the neutralization tank. In the tank, the acidic and caustic streams neutralize one another to a certain extent. Sodium hydroxide or sulfuric acid are used to adjust the final pH to between 6 and 9. The neutralized flows are then transferred to the wastewater equalization tank.

Brine reject from the reverse osmosis unit has a very high total dissolved solids level. The brine does not require pH adjustment or suspended solids removal; therefore, it is transferred directly to the wastewater collection tank at the injection well.

Equipment within the power block and the vicinity, such as transformers and motors, may contribute oil in small amounts during equipment washes. Potential oily wastes from floor drains are treated in an oil/water separator which uses the difference in specific gravity between oil and water to effect the separation. The

cleaned water is transferred to the wastewater equalization tank. The collected oil is held for disposal offsite by a licensed waste oil handler.

Periodically, the manganese greensand filter and activated carbon filter are backwashed to clean the filter media. The backwashes have a high suspended solids level and are transferred to the wastewater equalization tank.

Wastewater flows from the neutralization tank, oil/water separator, and filter backwashes are collected in the wastewater equalization tank to provide uniform flow and strength before being treated. The wastewater is then transferred to a wastewater treatment clarifier where it is mixed with a coagulant aid to assist in settling suspended solids. The underflow from the clarifier is transferred to the sludge thickener.

When the plant is operating using the primary water source, the clarified effluent is mixed with cooling tower blowdown, and a portion is used to meet the spray dryer dilution water requirements. The remaining wastewater is transferred to the wastewater collection tank at the injection well.

When the plant is operating using the backup water sources, the clarified effluent alone is used to meet the spray dryer dilution water demand. The excess clarifier effluent is transferred to the wastewater collection tank at the injection well.

The wastewater collection tank at the injection well serves as a surge tank for the well pumps. The collected water is injected into the Boulder Zone of the lower Floridan aquifer.

Underflow from the wastewater treatment clarifier and the sidestream softener underflow is transferred to a sludge thickener. The sludge thickener further concentrates the suspended solids by gravity. The result is a very low volume of thickened sludge which is next sent to a filter press for dewatering. The supernatant from the sludge thickener is recycled to the wastewater treatment clarifier.

Poor Original

MEMORANDUM

TO: The Honorable Lawton Chiles,
Governor

The Honorable Jim Smith,
Secretary of State

The Honorable Robert A. Butterworth,
Attorney General

The Honorable Bob Crawford,
Commissioner of Agriculture

The Honorable Betty Castor,
Commissioner of Education

The Honorable Gerald A. Lewis,
State Comptroller

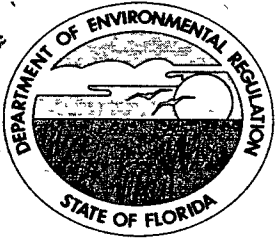
The Honorable Tom Gallagher,
State Treasurer and Insurance Commissioner

FROM: Carol M. Browner, Secretary

DATE: January 14, 1991

SUBJECT: AGENDA ITEM FOR SITING BOARD, JANUARY 22, 1991
CABINET MEETING -- AES CEDAR BAY, INC. POWER
PLANT SITE CERTIFICATION ORDER

Attached are the Department's agenda items for the January 22, 1991 Cabinet Meeting and supporting documents. For consideration by the Siting Board is a Recommended Order and Supplemental Recommended Order which would certify the AES Cedar Bay, Inc./Seminole Kraft Corporation's electrical cogenerating facility, located in Jacksonville, Florida, subject to the Conditions of Certification.



Florida Department of Environmental Regulation

Southeast District • 1900 S. Congress Ave., Suite A • West Palm Beach, Florida 33406

Lawton Chiles, Governor

Telephone 407/433-2650

Carol M. Browner, Secretary

Fax. 407/433-2666

JUL 12 1991

TO: Buck Oven

FROM: Linda McCarthy

SUBJECT: Sufficiency Response, Indiantown Cogeneration Plant

We don't have any more questions to ask, but we would like to be able to recommend conditions to the certification. Attached are a few that have been written by the SED's Waste Clean-up section that refer to the groundwater monitoring plan. The proposed conditions are more specific than those submitted by the SFWMD. I'll be sending a few more on the wetland impacts next week.

Poor Original

When the primary plant water source is being used, the filter press processes all of the sludge generated during the day during a single shift. However, a much larger quantity of sludge is generated when the backup plant water sources are used, requiring the filter press to be operated two shifts per day. A sludge holding tank is used upstream of the filter press to store the sludge. The filter press processes the thickened sludge to yield a cake of 35 to 50 percent solids by dry weight. Conditioning chemicals are usually added for better cake yield. The filtrate from the filter press is returned to the wastewater treatment clarifier, while the cake is taken offsite to an approved landfill for disposal.

Poor Original

Periodically, major equipment such as the air heater and the boiler tubes (fireside and tubeside) require cleaning to restore heat transfer areas. A large quantity of filtered water is used to flush the equipment, followed by use of chelating agent and acid cleaning or other similar process to dislodge and remove scale and corrosion products accumulated while the component was in service. Proprietary chemicals used for cleaning and the final cleaning agent are usually alkaline solutions. Such equipment cleaning will be performed by an outside vendor during a plant outage. Initial flush and final rinse waters will be transferred to the neutralization tank, as these wastewater streams are not strongly acidic or basic and do not contain high levels of metals. The wastewater from the actual acid cleaning and first rinse will be transported offsite for disposal by the contractor.

The inactive coal storage area is lined to prevent seepage of leachate into the groundwater. The storage area is grassed over to prevent fugitive particulate emissions and minimize impacts on runoff quality. Runoff and leachate from the inactive coal storage area are collected in a lined drainage ditch and directed to the coal pile runoff basin. The coal pile runoff basin is also lined to prevent seepage. Runoff and leachate are treated with lime in a flash mixing tank at the entrance to the runoff basin. The lime is used to adjust the pH of the runoff and leachate. The runoff basin serves as a surge tank and settling pond. The pH adjustment in the flash mixing tank causes some heavy metals to precipitate out and settle in the

basin with the suspended solids. The contents of the coal pile runoff basin are transferred to the cooling tower sidestream softener at a controlled flow rate. The relatively small peak flow rate at which the runoff stream is mixed into the circulating water minimizes the impact on the cooling tower operation. The lime and soda ash addition in the sidestream softener also ensures that the quality of the runoff stream is acceptable for incorporation with the circulating water.

3.1

3.7 SOLID AND HAZARDOUS WASTE

3.7.1 SOLID WASTES

3.7.1.1 General

The Indiantown Cogeneration, L.P. (ICL) project facility will generate solid waste from the operation of the combustion system, water and wastewater treatment system, and flue gas cleaning system (FGC) which includes the SDA system and the baghouse. In addition, miscellaneous solid waste, such as general office refuse and maintenance wastes, will be produced. These wastes are quantified in Table 3.7.1-1.

The quantities and chemical constituents of the combustion system wastes (bottom ash and fly ash, including reaction products generated in the FGC system) are primarily related to the characteristics of the fuel. The maximum expected percentages of ash and sulfur content, as well as the minimum heating value of coal were assumed in the calculations of by-product/solid waste quantities and composition. These estimates should be considered worst-case estimates. Actual quantities are expected to be less during normal operation.

Water/wastewater system wastes are generated during the water pretreatment (softening, clarification, filtering), wastewater neutralization and clarification, and demineralizer resin replacement. The water/wastewater system wastes will take the form of a filter sludge cake. Demineralizer resins will need to be replaced periodically.

The amount of filter sludge cake generated by the water treatment system is dependent on which source of water is used for cooling and process water for the plant. Taylor Creek/Nubbins Slough will be used as the primary source of both cooling and process water. During these times, filter sludge cake generation is expected to be a maximum of 115 tons per month (about 1380 tons/year). During

Table 3.7.1-1
ICL FACILITY SOLID WASTE QUANTITIES

<u>Source</u>	<u>Quantity</u>	<u>Disposal</u>
Combustion Facility		
Bottom Ash (tons/yr)	30,484 ⁽¹⁾	Return to Mine
Fly Ash plus SDA Solids (tons/yr)	283,150 ⁽¹⁾	Return to Mine
Water/Wastewater Treatment		
Treatment Solids (tons/yr)	3,435 ⁽²⁾	Offsite
Demineralizer Resin Beds (yd ³ /yr)	180 ⁽¹⁾	Offsite
Miscellaneous Wastes		
Office Refuse (yd ³ /yr)	2,500	Offsite
Maintenance (yd ³ /yr)	100 ⁽¹⁾	Offsite

(1) Assumes worst case of 100% capacity.

(2) Assumes worst case of 9 months per year using Taylor Creek/Nubbins Slough as water source and 3 months per year using Floridan aquifer as water source.

Source: Bechtel, 1990

drought conditions when the Taylor Creek/Nubbins Slough is not available, the Floridan aquifer must be used as the source of cooling water. Since the quality of water from this aquifer is not as good as the Taylor Creek/Nubbins Slough, a maximum of 800 tons per month of filter sludge cake is expected to be generated during drought conditions.

General office waste and maintenance waste are the typical consumable waste (paper, rags, etc.) found in any office or industrial facility.

3.7.1.2 Methods of Treatment, Handling, Interim Storage, and/or Disposal

Onsite Disposal

There will be no onsite disposal of solid waste.

Bottom Ash

Bottom ash is removed from the boiler hopper via a submerged drag conveyor. Bottom ash is transported by conveyor from the submerged drag conveyor to a silo sized for approximately 3 days' storage capacity. The bottom ash will be loaded from the silo into railcars for disposal at the coal mine.

Fly Ash and SDA Solids

Fly ash and SDA solids (ash) are conveyed to the recycle ash silo for addition to the lime slurry used in the flue gas cleanup system. When the recycle ash silo is filled, ash is bypassed to an ash storage silo having approximately 3 days' storage capacity. From the ash storage silo, the ash is loaded into rail cars with special covers (to prevent the generation of fugitive dust) for disposal at the coal mine.

Water/Wastewater

Operations of the water/wastewater treatment system will result in a nonhazardous sludge cake (from filter presses) composed primarily of calcium carbonates, hydroxides of metals (aluminum, magnesium), and inert solids. This filter cake will be placed in containers or bins and loaded on trucks for offsite disposal.

The nonhazardous wastes generated periodically from replacement of the demineralizer resin beds will be removed by their suppliers.

Miscellaneous

Miscellaneous office waste will be directed to licensed, offsite disposal areas. Spent air filters from the air inlet, damaged or used baghouse filter bags, etc., will be transferred to onsite storage-for-disposal areas prior to being transported to offsite disposal areas.

3.7.2 HAZARDOUS WASTE

Florida's hazardous waste management program is based on statutory provisions of Chapter 403 of the Florida Statutes and Rules, codified in F.A.C. Chapter 17-730. F.A.C. 17-730 tracks closely those regulations promulgated under 40 CFR Parts 260 through 266. These regulations address the identification and listing of hazardous waste, and apply to hazardous waste generators, transporters, and facility owners and operators.

3.7.2.1 Definition of Hazardous Wastes

A solid waste is a hazardous waste if it meets either of the following criteria:

- It exhibits any of the characteristics of hazardous wastes identified in 40 CFR 261 Subpart C.
- It is listed in 40 CFR 261 Subpart D.

Listed hazardous wastes are divided into five categories: non-specific sources, specific sources and discarded commercial products, off-specification species, container residues, and spill residues. Each listed hazardous waste has an EPA-assigned alphanumeric identifier.

3.7.2.2 Cogeneration Facility

The facility may generate both listed and characteristic wastes. Those wastes can be categorized as follows:

- Non-thermal waste

- Chemical product storage and transfer wastes (waste oils)
- Miscellaneous wastes

Non-Thermal Waste

The category of non-thermal wastes is broad, including various wastewaters resulting from operation of the facility. Although not hazardous by definition, these wastes can contain chemicals which make them hazardous. The following non-thermal wastes are produced:

- Wastewater treatment filter effluent
- Spent demineralizer regeneration solutions
- Boiler blowdown
- Demineralizer resin beds
- Metal cleaning wastes

The water/wastewater treatment effluent contains dissolved solids removed during water pretreatment (softening, clarification, filtering, and demineralizer solids treatment). Due to the absence of hazardous constituents in the raw process water, the water treatment effluent from the facility is not expected to be hazardous. This effluent is either used in the SDA system or injected through the deep well injection system.

Spent acidic and basic solutions that have regenerated the demineralizer resin bed ion exchangers will be routed to a neutralization tank for pH adjustment. Thus, these wastes will be treated to eliminate corrosivity. Since these wastes will be treated in a totally enclosed elementary neutralization unit, they will not represent

hazardous wastes according to Florida Hazardous Waste Rules (F.A.C. 17-730). Once treated, these wastes will be either used in the SDA system or injected through the deep well injection system.

Though it may contain trace amounts of an oxygen scavenger, boiler blowdown represents a high quality stream which can be directed for use in the cooling tower system or injected in the deep well injection system.

The boiler tubes may require infrequent cleaning. This will involve application of an organic solution or nonhazardous citric acid solution (e.g., Citrosolv) to dissolve scale, followed by a water rinse and final application of a neutralizing alkali agent. The spent acid solution will be neutralized and recycled in the lime slaking system or injected into the deep well. The remaining spent chemical products and associated liquid wastes are termed metal cleaning wastes and may be hazardous. If corrosive only, these wastes may be pumped to the neutralization tank (totally enclosed elementary neutralization unit) and treated to render them nonhazardous. In the alternative, or if deemed hazardous under another criterion, these wastes would be collected and removed by a licensed contractor for offsite disposal.

Chemical Product Storage and Transfer Wastes

Chemical product storage and transfer operations at the proposed facility could result in infrequent waste generation. Accidental spills will be contained (bermed areas) and impacted areas will be thoroughly washed and rinsed. Dissolved and suspended solids, acids, alkalies, and oils will represent the primary constituents of the wastes generated. With the exception of oily wastes, these wastes will be directed to the wastewater treatment facility where they will be treated and discharged as filter cake and processed wastewater. The oily wastes will be separated from this collected runoff and will be recycled or disposed of by an approved contractor.

Miscellaneous Wastes

Generation or use of potentially hazardous materials (paint, thinners, solvents, etc.) will be minimized through the judicious use of less hazardous or nonhazardous materials or systems and through good housekeeping practices. If hazardous spent materials or wastes are generated, they will be stored in appropriate containers in segregated storage areas for a period not to exceed 90 days. These wastes will be treated or disposed of offsite by a licensed hazardous-waste contractor.

3.7.2.3 Permanent Onsite Disposal and Storage

Hazardous wastes, as defined by F.A.C. 17-730, will not be treated or disposed of onsite, and will not be stored onsite for a period in excess of 90 days or such other period as the regulations may allow.

3.8

3.8 SITE DRAINAGE

3.8.1 EXISTING SITE DRAINAGE

The topography of the Indiantown Cogeneration, L.P. (ICL) project site varies between El. 35.0 and 31.0 feet, with the higher elevations in general occurring along the northern and western periphery of the site. The existing grade for the power block areas, including switchyard and cooling tower, varies between El. 35.0 and 33.0 feet. The prevailing grade along the existing transmission line corridor varies between El. 35.0 and 33.0 feet. The area to the north of the transmission line corridor has an existing grade elevation of approximately 35.0 feet. Due to the relatively flat gradient and limited topographic relief, the stormwater runoff has a low flow velocity. Much of the site area is heavily vegetated with pine and wet prairie. A drainage ditch traverses the entire site from north to south carrying the site surface runoff, as well as surface runoff from areas north of the site, to the St. Lucie Canal approximately 2.5 miles away. In general, the site drains in a southerly direction toward the ditch.

The ICL site is characterized by several isolated, naturally occurring nonforested, fresh water wetlands interspersed over the site. The boundaries of these shallow, wet prairie wetlands, as shown on the Plot Plan (Figure 3.2.0-1), were developed from the field survey performed in the Spring of 1990.

3.8.2 DRAINAGE AREAS

The estimated areas for the developed ICL site, as shown on the Site Drainage Plan (Figure 3.8.2-1), are:

- Power block area: 21 acres
- Coal handling area: 9 acres
- Inactive coal storage area: 6 acres
- Cooling water storage pond: 25 acres

The other areas of the project not disturbed by development are:

- Wetland preserves, including ditch: 24.4 acres
- Existing transmission power lines: 8 acres
- Upland preserves, including wetland buffers: 58.3 acres
- Miscellaneous areas north and west of rail loop: 22.7 acres

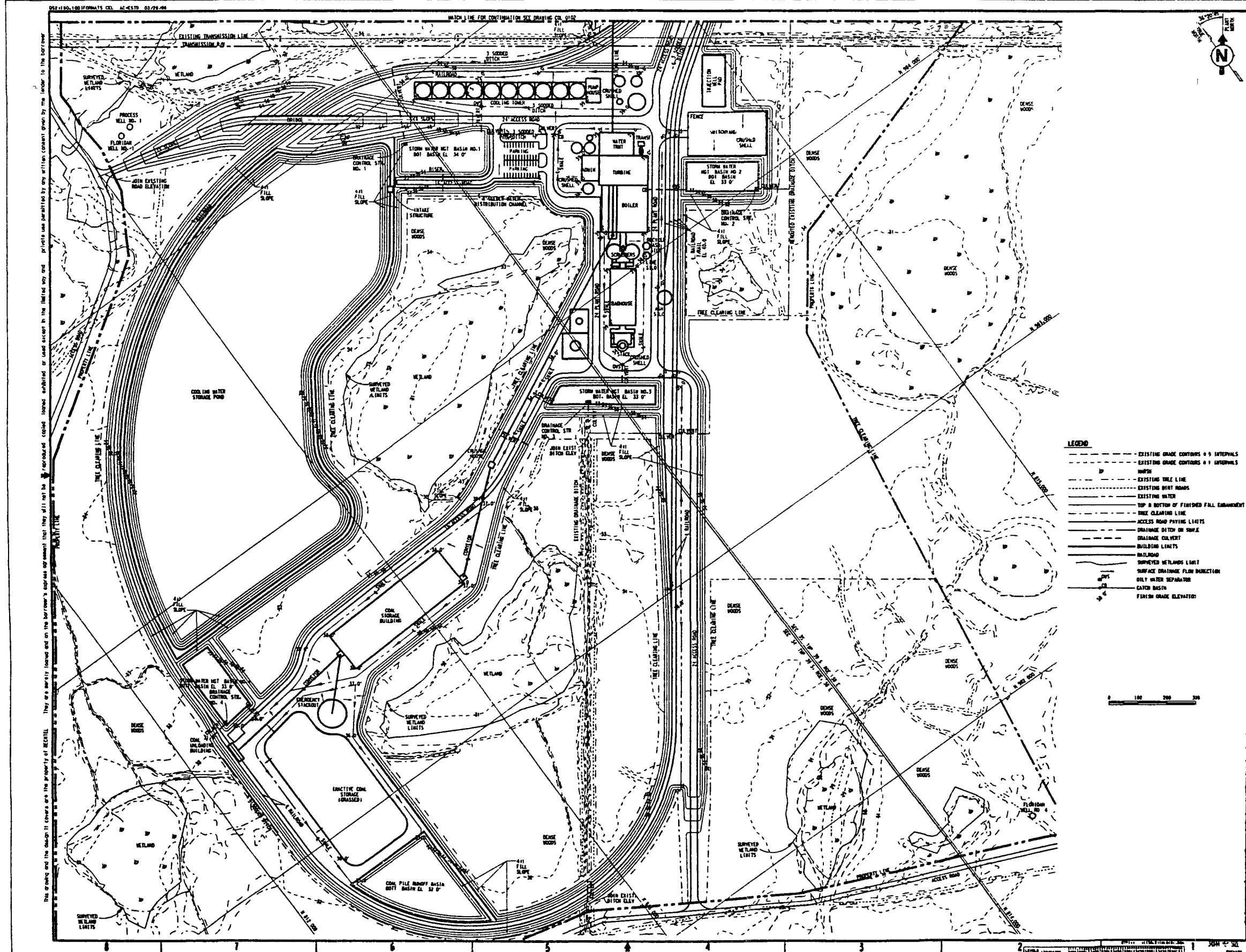
For reference and further discussion purpose, these areas are defined as follows:

- Power Block Area:

Includes areas housing turbine, boiler, water treatment system, administration building, stack, scrubbers and baghouse buildings, switchyard, various tanks, cooling tower, parking lot, oil storage tank, injection well, and three stormwater management basins.

Figure 3.8.2-1. (Sheet 1 of 2)

PRELIMINARY DRAINAGE PLAN

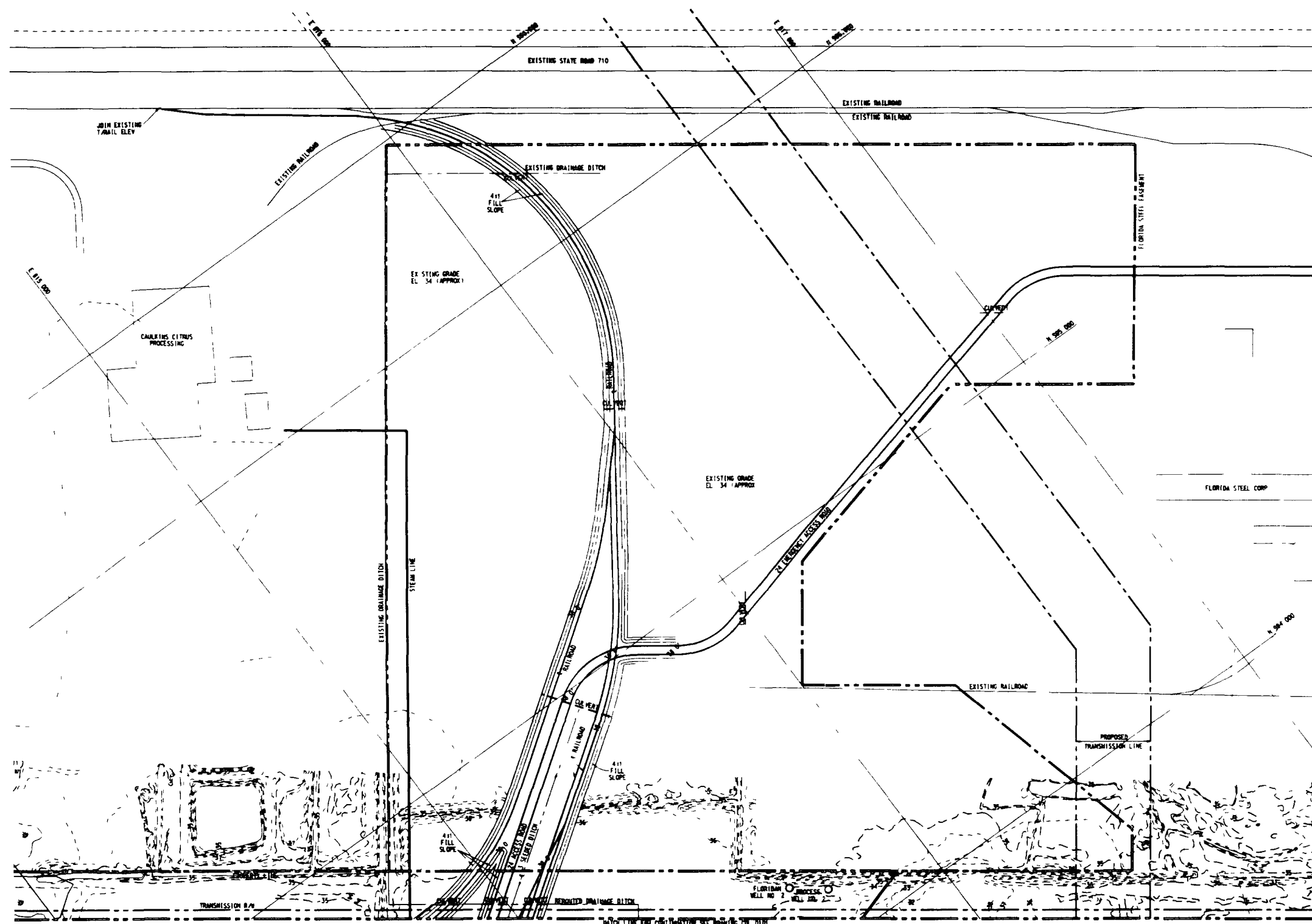


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- Coal Handling Area

Includes areas housing coal storage building, coal handling building, conveyors, and a stormwater management basin

- Inactive Coal Storage Area

Includes areas dedicated to coal storage, emergency stackout, and coal pile runoff basin

- Cooling Water Storage Pond

Includes area dedicated to the cooling water storage pond

3.8.3 DESIGN CRITERIA AND APPLICABLE REGULATIONS

3.8.3.1 South Florida Water Management District Criteria

The surface water management system will be designed in accordance with the regulations and requirements of the South Florida Water Management District (SFWMD), which has been delegated authority under F A C 17-25 090. These regulations and requirements are outlined in the SFWMD Permit Manual (SFWMD, 1987).

The surface water management system for the project facilities located within the developed area will be designed such that the peak post-development discharges from the ICL site will not exceed the peak pre-development discharges into the existing onsite drainage ditch. Detention basins and discharge control structures will ensure that post-development peak discharges will not exceed the pre-development peak discharge. By virtue of the existing topography, the stormwater runoff from the undeveloped areas outside the developed area will continue to follow the existing course.

The following design criteria are specified in the SFWMD Permit Manual:

a Design Storms

- 100-year, 72-hour storm for emergency spillway elevations of detention basins and building elevations
- 25-year, 72-hour storm for principal spillway elevations of detention basins, permanent swales and ditches, and culverts
- 10-year, 72-hour storm for road crown elevations and temporary diversion ditches

b Rainfall Frequencies for the Site Area

- 100-year, 24-hour 9 0 inches
72-hour 12 2 inches
- 25-year, 24-hour 7 0 inches
72-hour 9 5 inches
- 10-year, 24-hour 5 8 inches
72-hour 7 9 inches
- 3-year, 24-hour 4 3 inches
- Rainfall Distribution SCS-Type III

c Basin Outlet Structures

- V-notch bleeder (control structure) is to pass the first inch of runoff
- Combined discharge capacity of principal and emergency spillways to accommodate peak runoff from 100-year, 72-hour storm

3.8.3.2 Runoff Analysis

Power Block and Coal Handling Areas

SCS Technical Release No 55, (TR55), (USDA, 1986) was used to determine pre-developed as well as post-developed peak runoff discharges for the site. Weighted runoff coefficients were determined by percentage of impervious area due to development and soil type. Based on the soil types found in the site area, a site-

wide SCS classification of soil Type C was established (USDA, 1986). In conjunction with a particular storm event, runoff values were determined. Based on these values, stormwater detention basins, ditches, swales, and culverts were sized to prevent excess discharges and thus maintain the pre-developed flow rate of the existing drainage ditch.

The basin sizes in the analysis using TR-55 were determined for the maximum 24-hour storm, but additional volume has been provided to include the incremental runoff volume due to the 48-hour precipitation prior to the peak flow in the 72-hour storm, as defined by the SFWMD Permit Information Manual (SFWMD, 1987) and shown on Figure 3.8.3-1. The design criteria for basin sizing as addressed in Section 3.8.3.1 include the incremental volume storage up to the 25-year storm during principal spillway operation, and the 100-year storm during emergency spillway operation. The stormwater basins outlets have been sized to pass the peak flow from the 100-year, 24-hour storm.

Drainage ditches receiving water from detention basins are sized using the peak discharge from their respective basin. For swales and ditches receiving only overland flow, an average peak runoff per acre was established using SCS Technical Release No. 55 and a 25-year and 24-hour storm event. For runoff curve numbers (CN) spanning the possible range of CN from 89 to 93, a discharge of 4 cfs per acre was established.

Inactive Coal Storage Area

The inactive coal storage area basin was sized using a 100-year, 24-hour rainfall and a runoff coefficient of 0.73 (EPA, 1979). Additionally, direct rainfall on the pond itself was added to the volume required. Surface water runoff from the inactive coal pile area will be collected in a lined detention basin. The runoff will be pumped to a wastewater treatment facility for processing for possible use as process and cooling water needs.

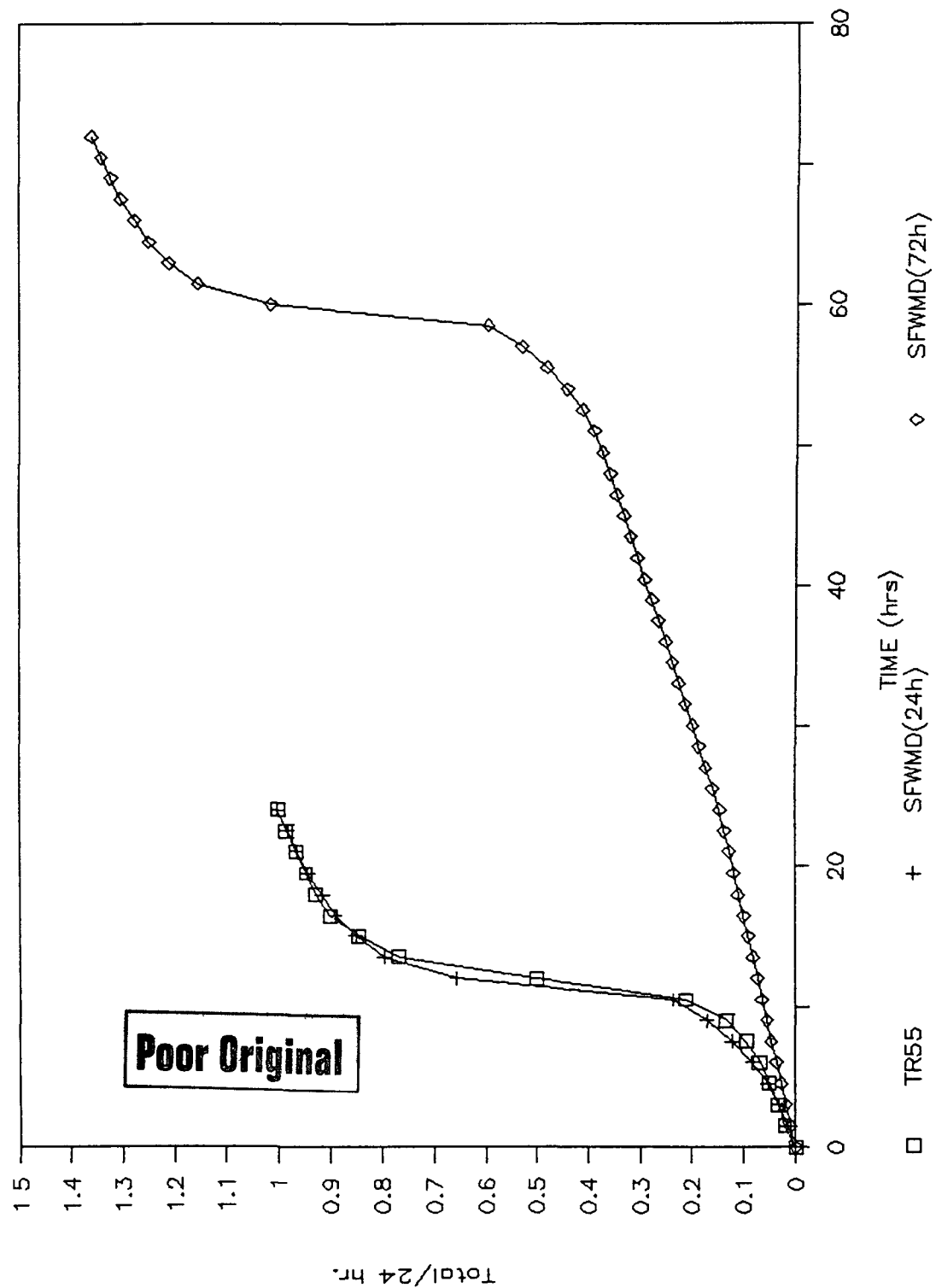


Figure 3.8.3-1

COMPARISON OF SFWMD AND TR-55 RAINFALL DISTRIBUTIONS

Source SFWMD and TR-55

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Wetland Runoff

Seven naturally occurring wetlands within the property boundary (23.4 acres) will be preserved. An additional 1 acre of wetland in the form of a man-made ditch, as shown on Figure 3.1.1-1 (Site Plan), will be rerouted and then maintained on the project site. A 50-foot buffer of pine flatwoods surrounding the three wetlands in the central portion of the property and a wetland on the northwest corner of the property will also be maintained. The other three wetlands are surrounded by preserved uplands and will not be disturbed. The impact of facility access road and railroad spurs will be minimized by incorporating the wetland areas into the project's surface water management plan such that excessive and unseasonal flooding or drying will be avoided.

For the wetland adjacent to the cooling water storage pond, a 3-year, 24-hour storm event (assumed to be equivalent to the mean annual) was used in pre- and post-development runoff assessments. The analysis was performed to determine the deficient mean annual peak discharge required to feed the wetland from a detention basin (see Section 3.8.5.2). This discharge to the wetland will be through a rip-rapped channel or grassed swale.

3.8.4 CONSTRUCTION DRAINAGE

Rerouting of a portion of the existing onsite drainage ditch and construction of the surface water runoff collection basins will be performed early in the project schedule. This will facilitate site drainage and the use of these basins as sedimentation basins during clearing, rough grading, excavation, and construction. A rough grading plan is shown in Figure 3.8.4-1.

The construction activities will result in disturbance of land in the following areas:

- Power block and switchyard area
- Construction laydown area
- Coal handling and storage areas, including the rail car unloading facility
- Plant roads and railroad
- Trenches for the circulating water piping system and other underground utilities
- Cooling water storage pond
- Runoff collection basins
- Drainage ditches, diversion ditches, and the wetland water distribution channel
- Rerouted portion of the existing north-south drainage ditch traversing the site

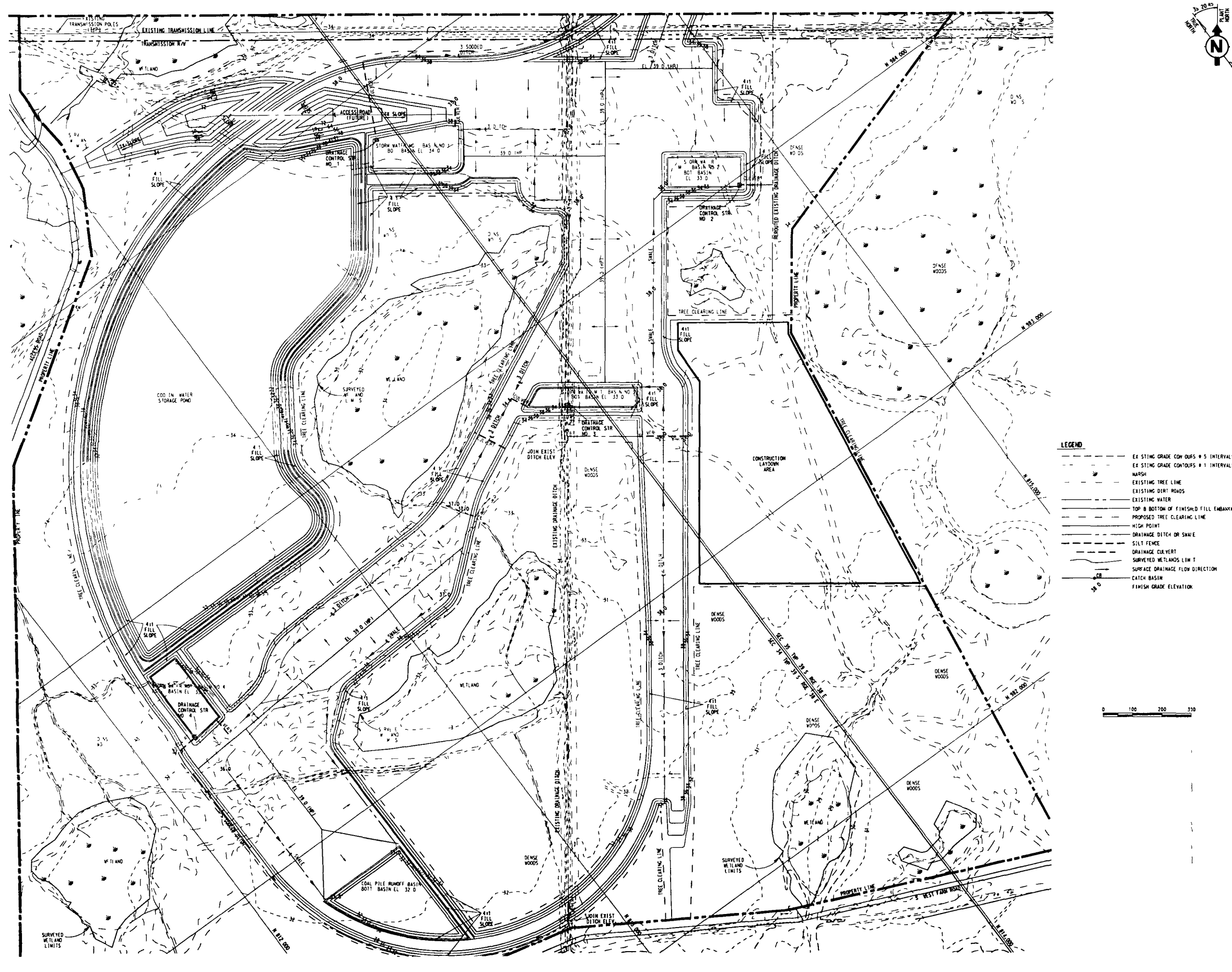


Figure 384-1
ROUGH GRADING PLAN

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- Additional temporary construction buildings including offices, warehouses, and shops

To collect the runoff water from these areas, a total of five collection basins will be built as shown on Figure 3 8 2-1. During construction, these basins will be used as sedimentation basins. The runoff water from these basins will be discharged to the existing drainage ditch, either directly or via perimeter ditches to the north and southwest of the plant area outside the railroad loop.

Natural characteristics affecting erosion and sediment transport include rainfall intensity, type of soil, topography, and vegetation cover. At the ICL site, several of these influences offset each other. Although rainfall intensity is high, the topography is relatively level, which will minimize the water flow velocity and sediment transport capacity. The flat slope of the land will tend to limit the amount of material that could be transported by runoff. Erosion control measures will include provision of diversion ditches, silt fences, straw bale dikes, and sediment traps. Hydroseeding and mulching will be used on all rough graded areas to establish a ground cover on slopes, drainage ditches, and swales.

The collection basins that will be provided early in construction will be used to allow considerable time for suspended solids to settle prior to discharge. They will remain in operation during construction and will be cleaned periodically to maintain their function. The mitigation measures used for the erosion and sedimentation control during construction are discussed below. The exact location, size, and number of these control features have been established for the construction planning phase. Considerations have been given to construction sequence, construction season, local topography, and final drainage scheme in establishing erosion and runoff control details. Additional measures, as required during construction, will be implemented by the construction superintendent.

3.8.4.1 Erosion and Sediment Control Measures

Sediment and erosion control measures will be strictly applied to limit the generation and transport of soil by runoff. The details of the erosion and sedimentation control plan for the project have been developed. The control measures noted below in the text and illustrated on attached figures have been used in developing these details. All management, vegetative, and structural erosion and sedimentation control practices have been designed, and will be constructed and maintained according to the requirements of the SFWMD.

Management Practices

The following management practices will be adhered to for erosion and sedimentation controls:

- A schedule of installation will be developed to minimize the disturbed area at any time.
- Construction traffic shall be limited to access easement roads and areas to be graded. Traffic will be prohibited from entering the drainage ditches and wetlands.
- Protective measures (e.g., silt fences) will be implemented to prevent transport of sediment into any wetland area or drainage course.
- The construction superintendent shall have overall responsibility for plan implementation. He shall also be responsible for ensuring that construction workers and subcontractors are aware of the provisions of the plan.

Vegetative Practices

The following vegetative practices for erosion and sedimentation control will be incorporated during construction

Temporary Seeding

The detention basin embankments, perimeter dikes, topsoil stockpiles, and areas to be rough graded during the initial phase of construction shall be seeded or sodded as per SFWMD requirements

Jute Mesh

Jute mesh or other degradable channel lining material shall be used to aid in establishing grass growth. It may also be applied on road and track side ditches, if required

Structural Practices

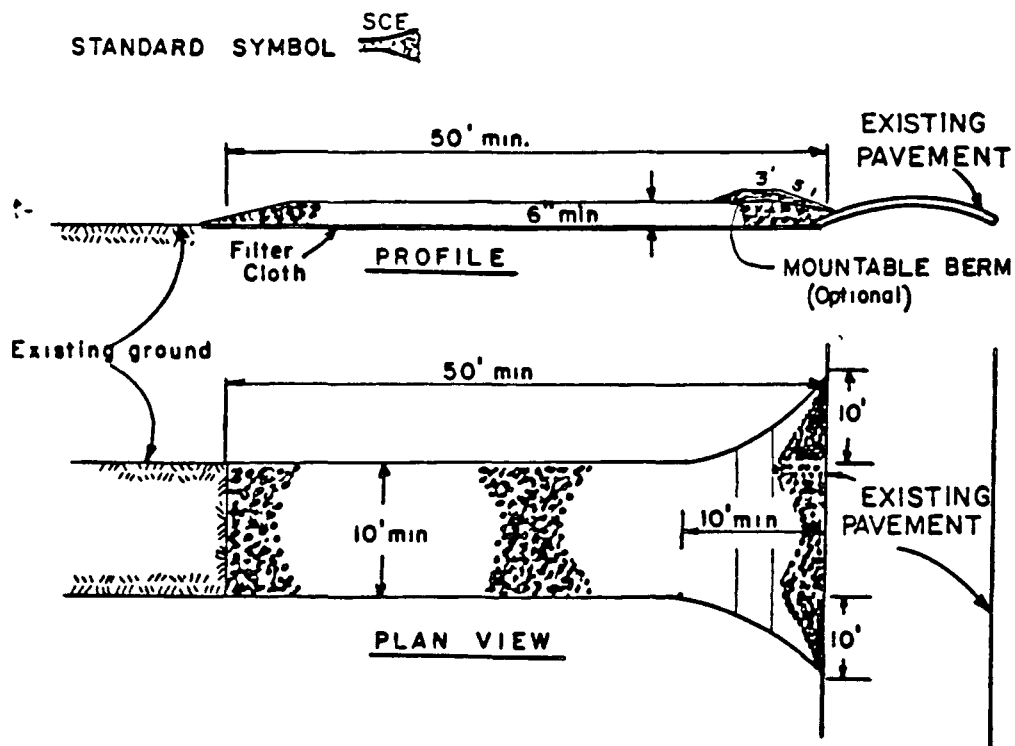
The structural practices to control and intercept sediment from runoff and to retain coarse sediment particles from reaching surrounding water bodies, will include provision of perimeter dikes, riprap outlet structures, straw bale dikes or barriers, silt fences, diversion dikes, graveled construction entrances, and detention basins

3.8.4.2 Description of the Control Facilities

Temporary Construction Entrance

Construction laydown and storage areas will be accessed via roads that will become permanent plant roads. Roads in the construction area will be upgraded with gravel to facilitate heavy truck traffic as needed. Typical details of the temporary construction entrance from the main road are shown on Figure 3.8.4-2

STABILIZED CONSTRUCTION ENTRANCE not to scale



CONSTRUCTION SPECIFICATIONS

1. Stone Size - Use 2" stone, or reclaimed or recycled concrete equivalent.
2. Length - As required, but not less than 50 feet (except on a single residence lot where a 30 foot minimum length would apply).
3. Thickness - Not less than six (6) inches.
4. Width - Ten (10) foot minimum, but not less than the full width at points where ingress or egress occurs.
5. Filter Cloth - Will be placed over the entire area prior to placing of stone. Filter will not be required on a single family residence lot.
6. Surface Water - All surface water flowing or diverted toward construction entrances shall be piped across the entrance. If piping is impractical, a mountable berm with 5:1 slopes will be permitted.
7. Maintenance - The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spilled, dropped, washed or tracked onto public rights-of-way must be removed immediately.
8. Washing - Wheels shall be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with stone and which drains into an approved sediment trapping device.
9. Periodic inspection and needed maintenance shall be provided after each rain.

Figure 3.8 4-2
TYPICAL DETAILS OF
STABILIZED CONSTRUCTION ENTRANCE

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Sedimentation (Detention) Basins

Sedimentation (detention) basins will be developed as required by excavation to intercept the runoff from the construction area and to prevent coarse sediment particles from reaching the surrounding water bodies. The basin will have an outlet that permits draining at a slow rate during a storm, according to SFWMD requirements and as shown in Figure 3 8 4-3. These basins will remain in operation during construction, and will be mucked out periodically to maintain their function. Upon completion of construction, the basins will be cleaned and will be incorporated into the stormwater management plan. Typical features of the sedimentation basin are shown in Figure 3 8 4-4.

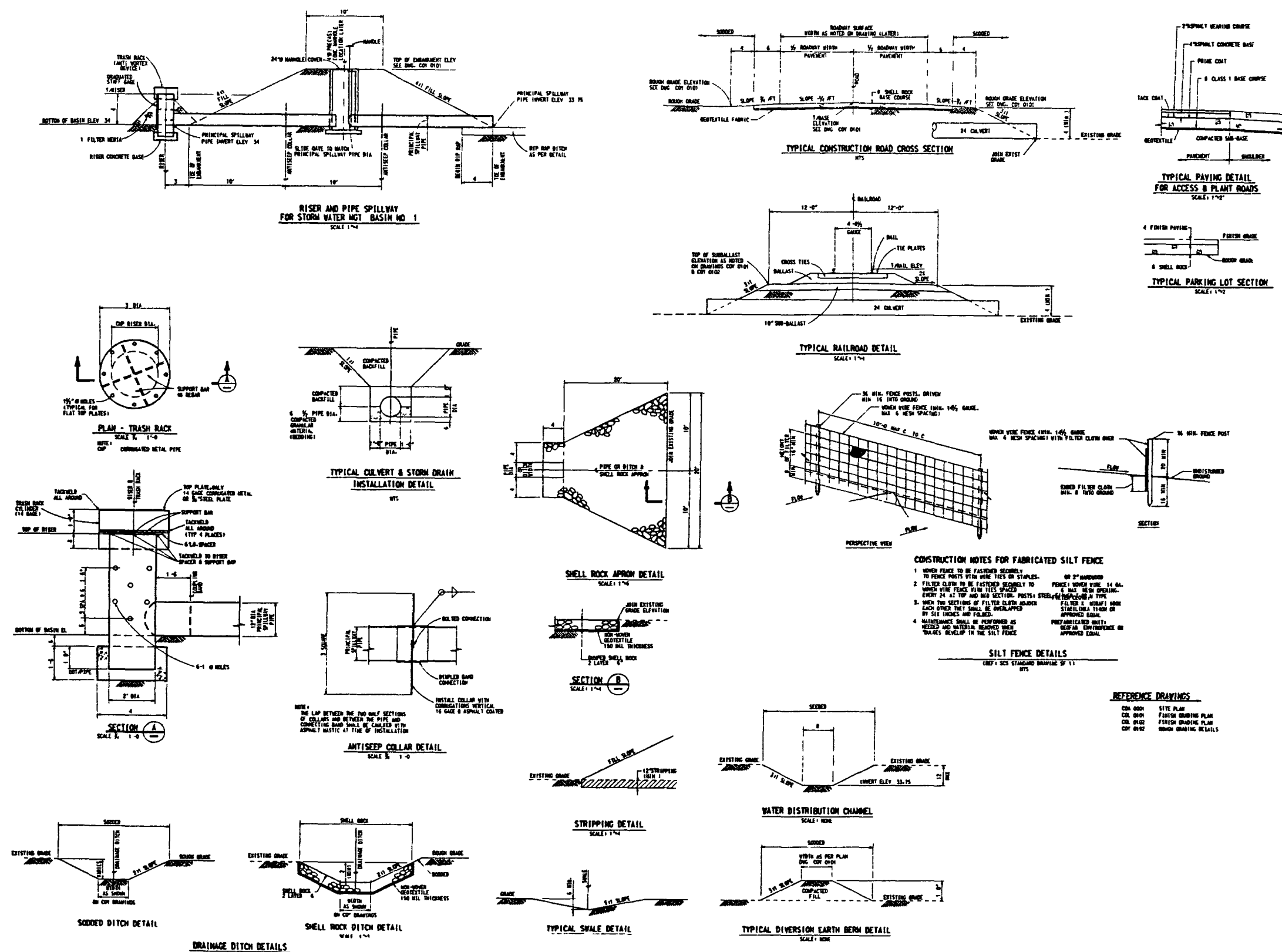
Swales and Ditches

Swales will be formed to direct the runoff to sedimentation basins. These swales will be excavated, graded, and stabilized with rock or by sodding or seeding. The cross section of the swales will be V-shaped or trapezoidal and designed to carry runoff from contributing area with a velocity of 2.0 fps or the allowed non-erosive velocity for the swale material. Typical details of the swales are shown in Figure 3 8 4-5.

Straw Bale Dikes and Silt Fences

Straw bale dikes will be constructed by placing the bale perpendicular to the flow. They will be keyed in and stacked as shown in Figure 3 8 4-6. Silt fences (Figure 3 8 4-7) will also be used to control the release of sediment laden runoff from the site.

Figure 3 8 4-3
EROSION AND SEDIMENTATION
CONTROL - TYPICAL DETAILS
(SHEET 1)



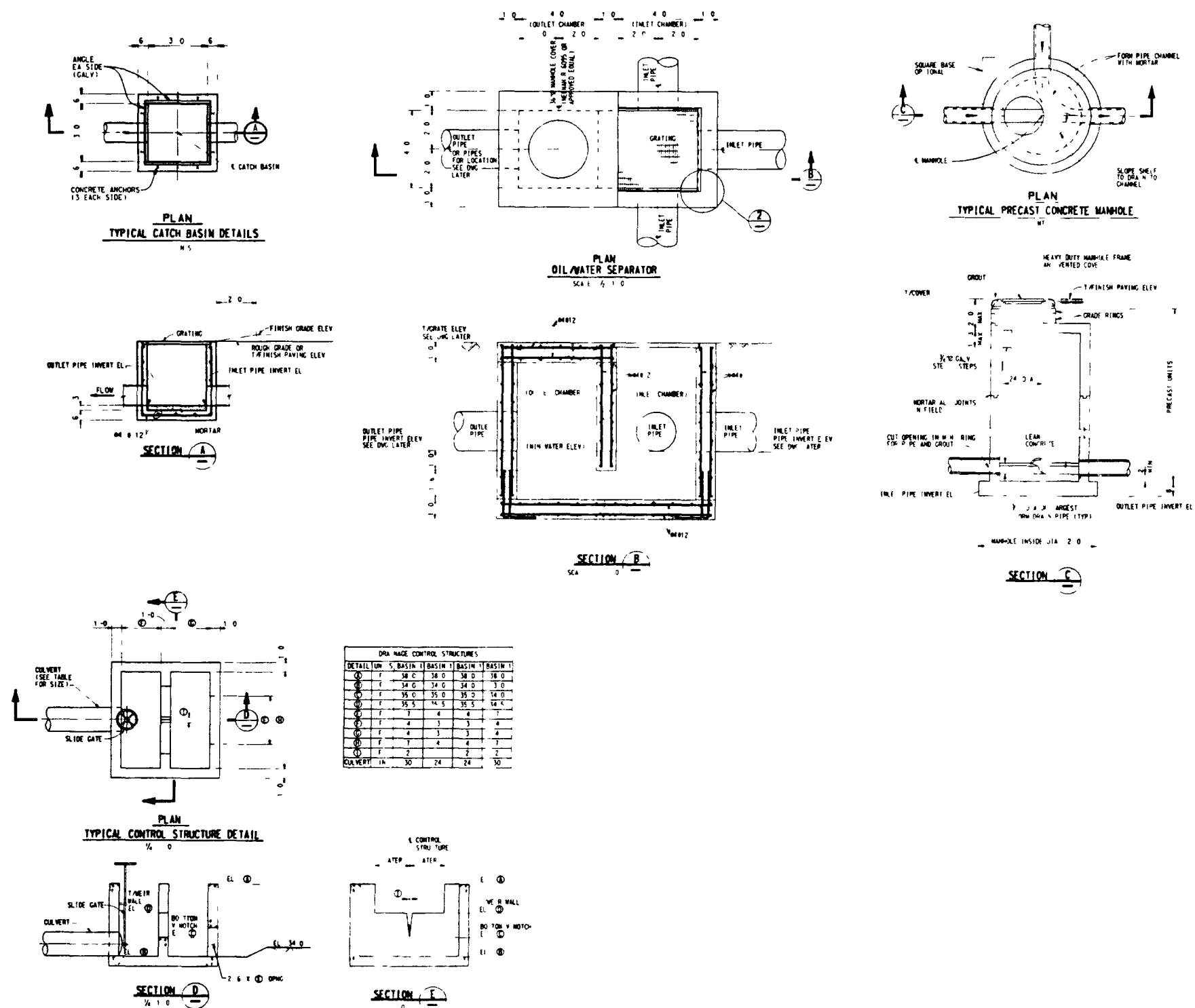
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Figure 3 8 4-4
EROSION AND SEDIMENTATION
CONTROL - TYPICAL DETAILS
(SHEET 2)

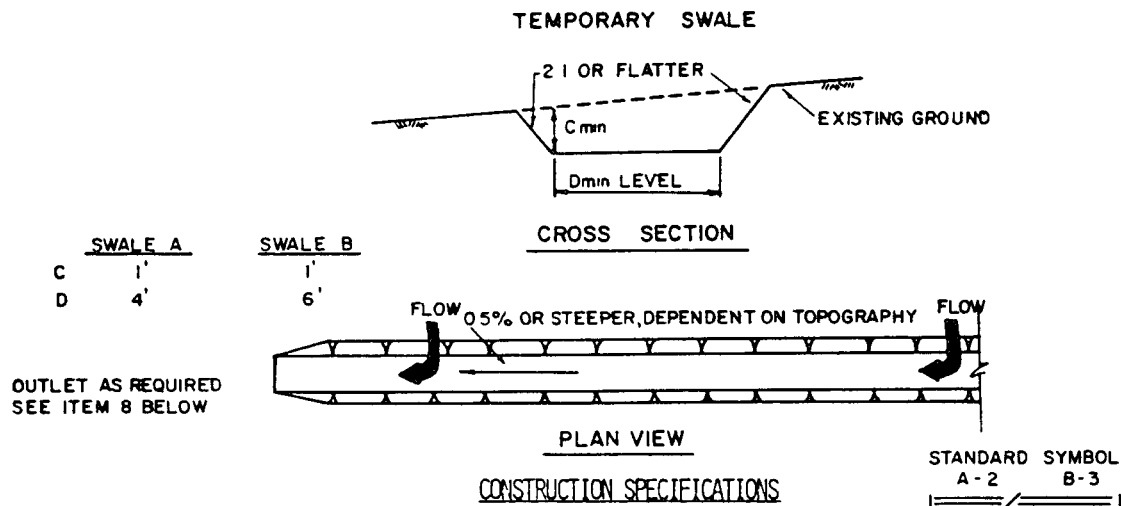


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OUTLET AS REQUIRED
SEE ITEM 8 BELOW

1. ALL TEMPORARY SWALES SHALL HAVE UNINTERRUPTED POSITIVE GRADE TO AN OUTLET.
2. DIVERTED RUNOFF FROM A DISTURBED AREA SHALL BE CONVEYED TO A SEDIMENT TRAPPING DEVICE.
3. DIVERTED RUNOFF FROM AN UNDISTURBED AREA SHALL OUTLET DIRECTLY INTO AN UNDISTURBED STABILIZED AREA AT NON-EROSIVE VELOCITY.
4. ALL TREES, BRUSH, STUMPS, OBSTRUCTIONS, AND OTHER OBJECTIONABLE MATERIAL SHALL BE REMOVED AND DISPOSED OF SO AS NOT TO INTERFERE WITH THE PROPER FUNCTIONING OF THE SWALE.
5. THE SWALE SHALL BE EXCAVATED OR SHAPED TO LINE, GRADE, AND CROSS SECTION AS REQUIRED TO MEET THE CRITERIA SPECIFIED HEREIN AND BE FREE OF BANK PROJECTIONS OR OTHER IRREGULARITIES WHICH WILL IMPEDE NORMAL FLOW.
6. FILLS SHALL BE COMPACTED BY EARTH MOVING EQUIPMENT.
7. ALL EARTH REMOVED AND NOT NEEDED ON CONSTRUCTION SHALL BE PLACED SO THAT IT WILL NOT INTERFERE WITH THE FUNCTIONING OF THE SWALE.
8. STABILIZATION SHALL BE AS PER THE CHART BELOW

FLOW CHANNEL STABILIZATION

<u>TYPE OF TREATMENT</u>	<u>CHANNEL GRADE</u>	<u>A (5 AC OR LESS)</u>	<u>B (5 AC - 10 AC)</u>
1	0.5-3.0%	SEED AND STRAW MULCH	SEED AND STRAW MULCH
2	3.1-5.0%	SEED AND STRAW MULCH	SEED USING JUTE OR EXCELSIOR
3	5.1-8.0%	SEED WITH JUTE OR EXCELSIOR, SOD	LINED RIP-RAP 4-8" RECYCLED CONCRETE EQUIVALENT
4	8.1-20%	LINED 4-8" RIP-RAP	ENGINEERED DESIGN

9. PERIODIC INSPECTION AND REQUIRED MAINTENANCE MUST BE PROVIDED AFTER EACH RAIN EVENT.

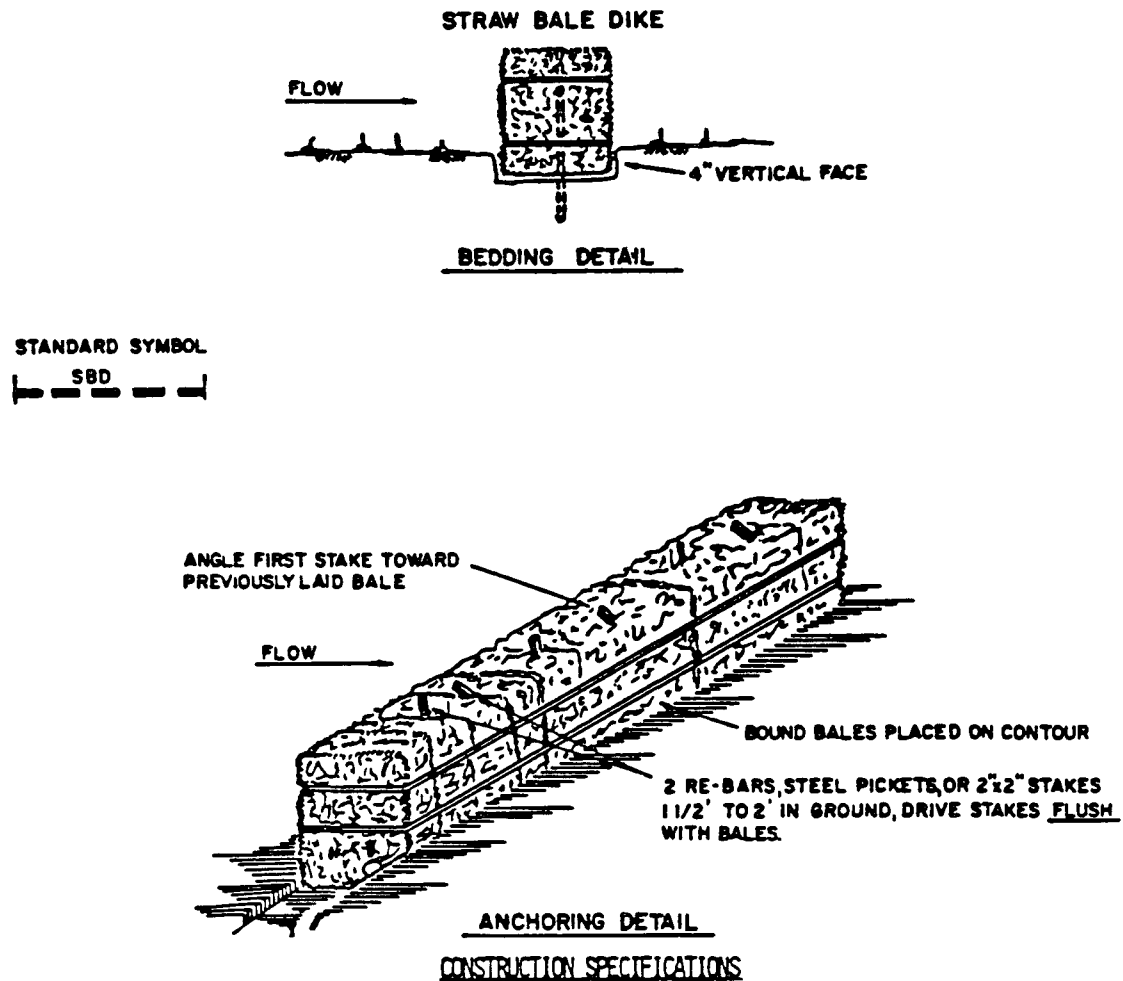
Figure 3 8 4-5
TYPICAL DETAILS OF TEMPORARY SWALE

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1. BALES SHALL BE PLACED AT THE TOE OF A SLOPE OR ON THE CONTOUR AND IN A ROW WITH ENDS TIGHTLY ABUTTING THE ADJACENT BALES.
2. EACH BALE SHALL BE EMBEDDED IN THE SOIL A MINIMUM OF (4) INCHES, AND PLACED SO THE BINDINGS ARE HORIZONTAL.
3. BALES SHALL BE SECURELY ANCHORED IN PLACE BY EITHER TWO STAKES OR RE-BARS DRIVEN THROUGH THE BALE. THE FIRST STAKE IN EACH BALE SHALL BE DRIVEN TOWARD THE PREVIOUSLY LAID BALE AT AN ANGLE TO FORCE THE BALES TOGETHER. STAKES SHALL BE DRIVEN FLUSH WITH THE BALE.
4. INSPECTION SHALL BE FREQUENT AND REPAIR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
5. BALES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFULNESS SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

Figure 3 8.4-6
TYPICAL DETAILS OF STRAW BALE DIKE

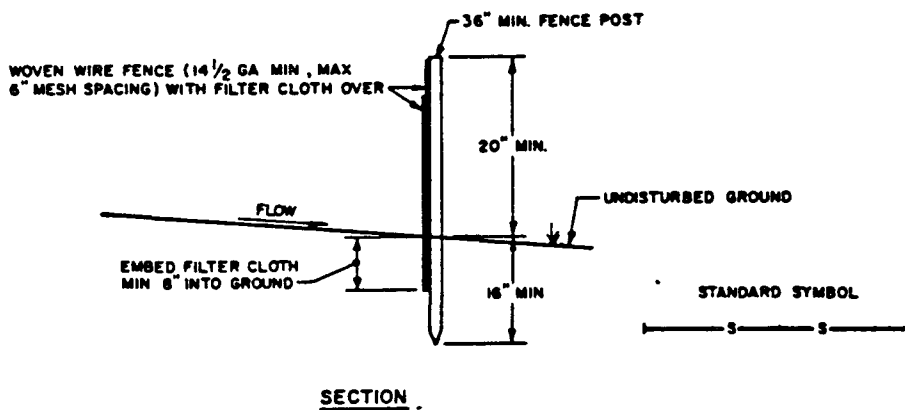
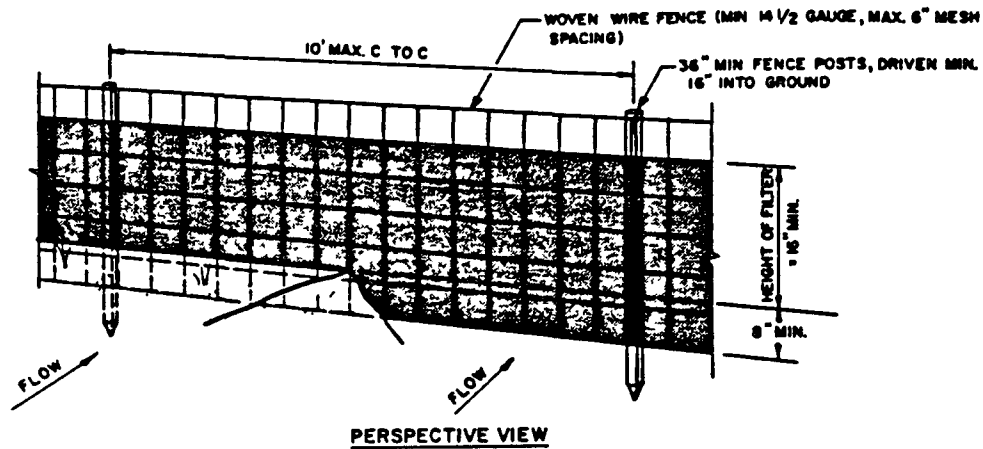
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SILT FENCE



CONSTRUCTION NOTES FOR FABRICATED SILT FENCE

1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES.
2. FILTER CLOTH TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID SECTION.
3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY SIX INCHES AND FOLDED.
4. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

POSTS: STEEL EITHER T OR U TYPE OR 2" HARDWOOD

FENCE: WOVEN WIRE, 14 GA, 6" MAX. MESH OPENING

FILTER CLOTH: FILTER X, MIRAFI 100X, STABI-LINKA T140N OR APPROVED EQUAL

PREFABRICATED UNIT: GEOFAB, ENVIROFENCE, OR APPROVED EQUAL.

Figure 3.8.4-7
TYPICAL DETAILS OF SILT FENCE

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Dewatering During Construction

During construction, dewatering will probably be required inside the work area. Water will be pumped out of the excavation and diverted through a straw bale filter dike or silt fence or sedimentation basins prior to release.

3.8.4.3 Construction Monitoring and Maintenance

In general, all erosion and sedimentation control measures will be checked weekly and after each significant rainfall. The following items will be checked in particular:

- Sedimentation basins will be cleaned out when the level of sediment buildup reaches approximately 1 foot.
- Gravel or riprap outlets will be checked regularly for sediment buildup. If the gravel is clogged with silt, it will be removed and cleaned or replaced.
- Straw bale barriers or dikes will be checked regularly for undermining or deterioration of the bales.
- Seeded and sodded areas will be checked regularly. Areas will be fertilized and reseeded as needed.
- Silt fences and filter barriers shall be inspected after each rainfall and during prolonged rainfall. Required repairs will be made immediately.
- Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric will be replaced promptly.

- Sediment deposits at barriers will be removed after heavy storm events
They will be removed when deposits reach approximately one-half the height of the barrier
- Sediment deposits remaining in place after the silt fence or silt barrier is no longer required will be dressed to conform with the existing grade, prepared, and seeded

3.8.4.4 Permanent Stabilization

Areas disturbed by construction will be stabilized with permanent seeding immediately following finish grading. Finish grading will include regrading and seeding of the areas used by the construction facilities and perimeter dike system and return the areas to natural drainage. Vegetated areas will be re-established and stabilized with appropriate seed mixture. Discharge from the site during and after construction will be directed to the detention/stormwater management basins 1 through 5.

3.8.5 PERMANENT SITE DRAINAGE

3.8.5.1 Introduction

The permanent drainage facilities will consist primarily of a series of open ditches and swales, catchbasins, oil/water separators, storm drainage piping, culverts, stormwater detention basins, and a wetland water distribution channel (Figure 3 8 2-1) The stormwater runoff from the developed area will be directed to the detention basins which will have bleeder type devices to control the discharge rate in compliance with the SFWMD surface water discharge requirements Discharge will be accomplished using a bleeder type v-notch weir contained in a two chambered structure as shown in Figure 3 8 4-3, and as recommended by the SFWMD The basins, installed early during construction to provide sediment and erosion control, will be cleaned upon construction completion and maintained thereafter to control site drainage or stormwater runoff

Stormwater runoff from the newly added non-porous surfaces (i e , paved roads, parking lots, roofs, yard area, etc) will be collected and conveyed to the detention basins utilizing a system of curbing, catch basins, and underground piping The system will also include design features (e g , oil/water separators) as necessary, to treat and/or remove any potential contaminants, and to maintain acceptable water quality conditions The detention basin outlet structure will be provided with a manual control valve, or sluice gate, to prevent discharge from the basins during contamination spills and, when needed, to control the release

The site drainage system will convey the onsite runoff to the existing drainage ditch, with some rerouting of its existing alignment With the exception of the runoff basin for the inactive coal storage area, all of the stormwater runoff from the detention basins will eventually be discharged into the existing drainage ditch traversing the central portion of the site The stormwater runoff from the inactive

coal storage area will be detained and treated, and recycled for plant cooling and process water use

The following sections address the management of the stormwater runoff from the proposed developed areas located within the railroad loop. The site has been broken down into the following general areas for analysis:

- Power block area
- Coal handling area
- Inactive coal storage area

3 8 5.2 Proposed Power Block Area Drainage System

The total power block area is approximately 21 acres. This area will be elevated to a finished grade of approximately 39 feet NGVD. Stormwater runoff from the area will be directed to three permanent collection basins (Nos. 1, 2, and 3). Basins 1 and 2 lie to the west and east of the power block area, respectively. Basin 3 is located to the south of the power block area. These basins are shown on Figure 3 8 2-1.

The stormwater runoff from curbed areas (potentially contaminated areas) will be channelled to catch basins and oil/water separators before discharge to the basin. The following table lists some key figures for detention basins 1 through 3.

<u>Basin</u>	<u>Drainage Area (ac)</u>	<u>Peak Discharges</u>		<u>Basin Size</u>		<u>Max W E NGVD (ft)</u>
		<u>Pre (cfs)</u>	<u>Post (cfs)</u>	<u>Surface Area (ac)</u>	<u>Volume Req'd (ac-ft)</u>	
1	10.7	32	75	1.18	3.0	37
2	4.5	13	33	.80	1.5	36
3	5.6	17	44	.94	2.0	36

The depth of the basins below finish grade will be 5 feet. This includes a maximum water depth of 3 feet during emergency spillway operation and a minimum freeboard of 2 feet. The bottom of the basins will be above the existing groundwater level of the area. A total of 6.5 acre-feet of detention volume will be provided by these three basins in the power block area for stormwater management purposes.

Discharge from basins 2 and 3 will be directed to a rip-rapped apron and then conveyed to the existing drainage ditch. A perimeter ditch will convey the basin 1 discharge to the existing drainage ditch, as shown on Figure 3.8.2-1. A portion of the runoff from basin 1 will be diverted and distributed to the wetland immediately south of the basin.

The area draining to the wetland adjacent and east of the cooling water storage pond has a pre-developed drainage area of 21 acres. Due to the construction of the cooling water storage pond and plant layout, the contributing area is reduced to 11.5 acres. The existing pre- and post-peak discharges for the mean annual (3-year, 24-hour storm event as provided by the SFWMD, 1987) storm, are 20 and 13 cfs, respectively, as determined by SCS Technical Release No. 55 (USDA, 1986). As a result of this decreased contributing area, this wetland has a peak flow deficiency of 7 cfs for the 3-year 24-hour storm event. This deficiency will be compensated by providing runoff from basin 1 through a perforated vertical riser pipe surrounded by a rip-rap filter. The discharge will be distributed to the wetland by a rip-rapped discharge channel as shown on Figure 3.8.2-1.

3.8.5.3 Proposed Coal Handling Area Drainage System

The coal handling area for the unit is comprised of approximately 9 acres. The area will be elevated to a finished grade of approximately 38 feet NGVD at the center, sloping outward to swales, and eventually discharged to the reten-

tion/detention basin 4 The following table lists some key features for detention basin 4

<u>Basin</u>	<u>Drainage Area (ac)</u>	<u>Peak Discharges</u>		<u>Basin Size</u>		<u>Max W E NGVD (ft)</u>
		<u>Pre (cfs)</u>	<u>Post (cfs)</u>	<u>Surface Area (ac)</u>	<u>Volume Req'd (ac-ft)</u>	
4	9.1	27	60	1.11	2.5	36

Basin 4 will detain a volume of 2.5 acre-feet for stormwater management purposes. The discharge from basin 4 will be from the same type outlet structure as mentioned in Section 3.8.5.2 to a rip-rapped apron and then via a perimeter ditch to the existing drainage ditch.

3.8.5.4 Proposed Inactive Coal Storage Area Drainage System

The inactive coal storage drainage area (Figure 3.8.2-1) for the plant is approximately 6 acres. This area will be elevated to a finished grade of approximately 37 feet NGVD at the center and slope outward to a collection basin. The collection basin will provide a detention volume of 3.6 acre-feet, as calculated according to methodology described in Section 3.8.3.2, for the stormwater runoff from the inactive coal storage area. This basin will be located adjacent to the inactive coal storage area and have an approximate surface area of 1.6 acres. The maximum water depth will be 3 feet with an additional 2 feet of freeboard provided. The basin will be 5 feet in depth below the final grading elevation.

During the construction phase, this collection basin will function as a sediment and erosion control basin and will thus require the same type of discharge structure as mentioned in Section 3.8.4.2. Upon completion of construction, this structure must be sealed to prevent discharge to the drainage ditch. Additionally, prior to the operation of the plant, the detention basin and the drainage swale in the coal

storage area will be lined with a synthetic impervious liner to eliminate seepage of runoff

The stormwater runoff from the inactive coal storage is considered to be wastewater. Runoff collected from this area is treated to adjust pH and detained in the basin. Treated runoff is transferred to the cooling tower sidestream softener for cooling tower use.

3.8.5.5 Proposed Cooling Water Storage Pond Area

The cooling water storage pond will be sized to store water pumped from Taylor Creek/Nubbin Slough. The pond will be lined and the water will be used for plant cooling and process water make-up. The details of the cooling water pond are discussed in Section 3.5.1.2.

3.9 MATERIALS HANDLING

3.9.1 CONSTRUCTION MATERIALS HANDLING

Major components for the cogeneration plant include

- Main steam turbine
- Turbine generator
- Pulverized coal-fired boiler
- Spray dryer absorber system
- Baghouse
- Cooling tower
- Transformers

The components are expected to be delivered by rail or truck. No offsite or onsite upgrading of road or rail facilities is expected, other than the new road and rail facilities required for normal operations. Once onsite, materials will be unloaded and transported by using portable cranes and trucks. Some of the heaviest items will require rail delivery and special rigging for onsite handling.

The proposed location for construction operations which include laydown areas, construction warehouses, fabrication shops, and equipment maintenance is shown in Figure 3.8.4-1, entitled "Rough Grading Plan."

Fugitive dust, surface water runoff, and waste disposal associated with material handling in these areas will be controlled as follows

- Dust suppression will be accomplished by watering the roads, parking lots, and laydown areas, as needed
- Runoff detention ponds will be used to settle suspended sediment from rainfall runoff
- Related trash and other nonhazardous organic debris will be collected for offsite disposal by a licensed contractor
- Commercial salvage of metal wastes will be considered. If salvage is not feasible, these wastes will be removed from the site by a licensed contractor

3.9.2 OPERATIONS MATERIALS HANDLING

The handling and storage of fuels (natural gas, No 2 oil, and coal) are discussed in Section 3.3. Handling and storage of flue gas desulfurization byproducts, wastewater treatment sludges, and other low volume waste streams are discussed in Section 3.7.

Other operations materials include lime, ammonia, water and wastewater treatment chemicals, lubrication oils, and turbine generator coolant and purge gases.

Water and wastewater treatment chemicals (e.g., acid, caustic, sodium hypochlorite, carbonylhydrazide) will be stored in or near the water treatment building.

Hydrogen and nitrogen gases will be stored in bottles on trailers or in sheds adjacent to the gas distribution system which serves the cogeneration plant.

Lime will be delivered to the site by self-unloading pneumatic railcars or self-unloading trucks. The lime will be pneumatically conveyed to the lime silo which will be equipped with a bin-vent type filter to minimize fugitive dust emissions. The silo will have a total capacity of 1500 tons, representing a 5-day storage capacity when continuously firing the design fuel at full load. The lime silo will be serviced by a dedicated track siding sized to allow lime delivery twice a week by train consisting of 14 pneumatic self-unloading railcars.

The SNCR reagent will be stored onsite in an appropriate storage facility located within appropriately sized containment walls.



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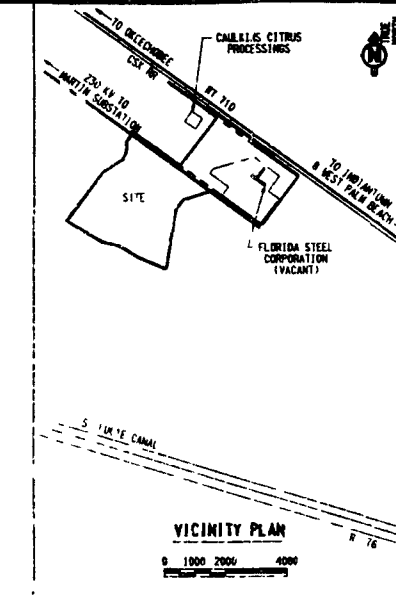
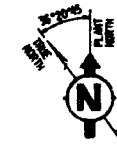
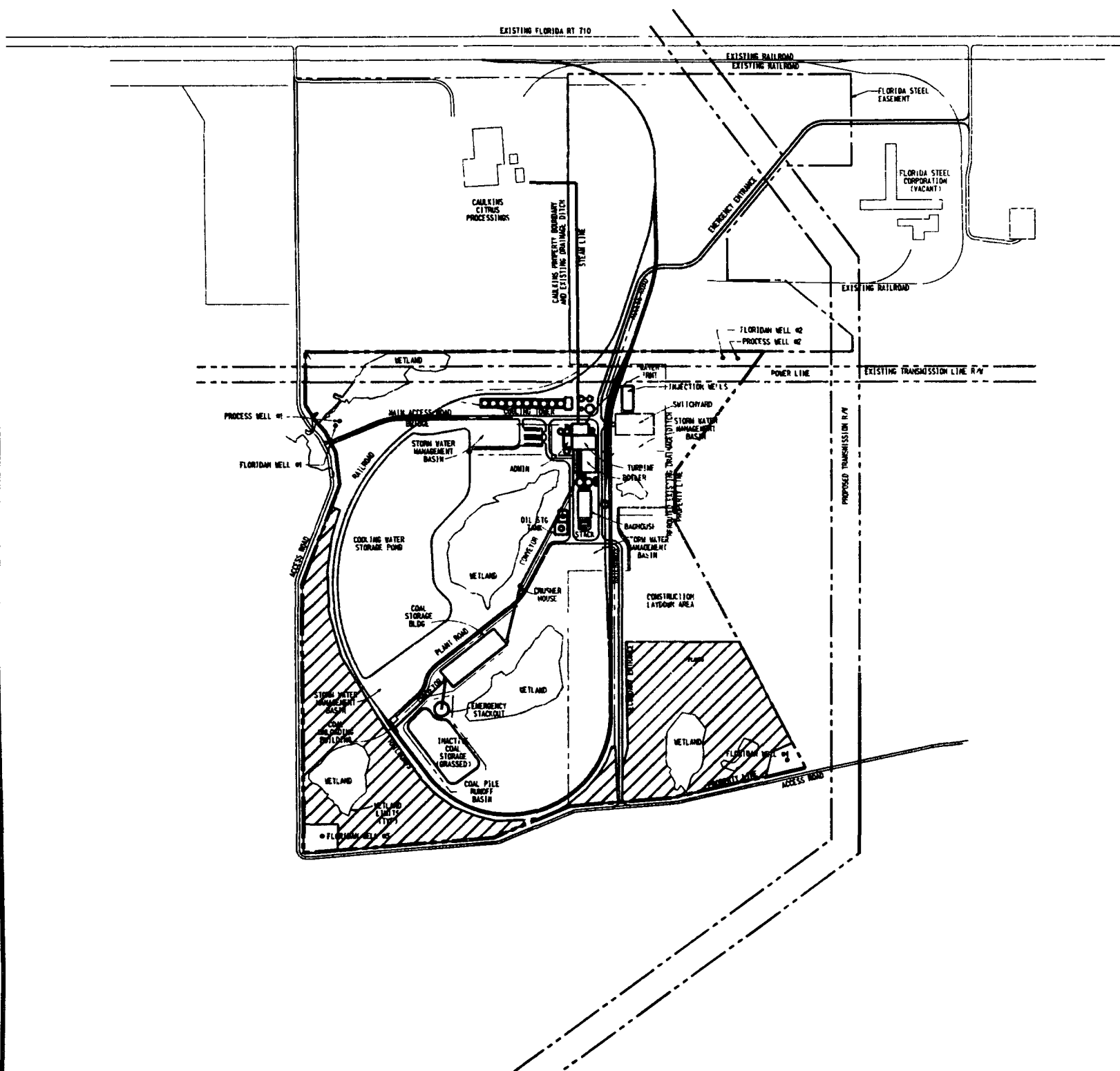
4.0 EFFECTS OF SITE PREPARATION AND PROJECT AND ASSOCIATED FACILITIES CONSTRUCTION

4.1 LAND IMPACT

4.1.1 GENERAL CONSTRUCTION IMPACTS

The Indiantown Cogeneration, L P , project includes 232 acres within the property boundary of the site. A permanent easement of approximately 75 acres across the adjacent Florida Steel Corporation property will be used for a new rail spur. This easement will be between the Caulkins Citrus Plant and the abandoned Florida Steel Company properties. The only other land affected by the proposed ICL facility will be in the corridor for the cooling water pipeline routed along the CSX right-of-way (see Section 6.2).

In accordance with the Martin County Planned Unit Development (Industrial) Agreement (PUD(i)), 25 percent of the pine flatwoods, or 50.5 acres, of the land subject to the Agreement will be set aside as upland preserve and will not be disturbed. Designated upland preserve areas will be subject to an upland preserve and restoration management plan designed to remove exotic vegetation, revegetate in partially disturbed areas, and protect existing vegetation by using staking and barricading procedures during construction. The upland preserve areas that have been identified for the project are along the southern portion of the site on the exterior of the rail loop as shown on Figure 4.1.1-1.



LEGEND
 UPLANDS



Figure 4.1.1-1.
 UPLAND PRESERVES

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Source: Bechtel, 1990

INDIANTOWN
 COGENERATION
 PROJECT

Indiantown Cogeneration, L.P.

4.1.1.1 ICL Project Site

The following construction activities are associated with overall development of the project site

- Runoff storage basins and drainage ditches will be constructed and used as sedimentation basins to collect runoff during grading, excavation, and construction
- The operational site drainage system (inclusive of drainage swales, ditches, and runoff collection basins) will be developed
- Earthwork will be performed (i.e., removal of topsoil as necessary for constructing foundations for plant facilities, construction of access roadways, grading to subgrades, excavating for placement of piping and conduit)
- In areas where it will be necessary, dewatering will occur using wells, well points, and sumps (see Section 4.3.1)
- The existing Caulkins entrance road from SR 710 will be extended to provide access to the ICL facility. Other onsite permanent roads as well as temporary construction roads, will be constructed
- A new rail siding will be developed from the CSX railroad to the onsite rail loop across an easement on Florida Steel Corporation property. This development will include construction of the rail bed foundation which is composed of properly compacted sub-ballast (fill material) covered by crushed rock ballast. Suitable drainage openings in this foundation will be provided to maintain existing drainage patterns

- Temporary (construction power) and permanent underground electrical and utility piping systems will be installed
- Temporary laydown and construction parking areas will be constructed by grading and adding gravel to certain areas. Once construction is completed, the area will be stabilized.
- The land disturbed by construction will be approximately 118.6 acres. Once construction is completed, 106.6 acres will remain permanently disturbed due to buildings and operations.

4.1.1.2 Power Block Area

Construction of the proposed ICL power block area will require clearing, grubbing, and grading in order to raise the area approximately 4 feet to El. 39 ft NGVD. Where possible, fill will be obtained onsite; when brought in, it will be obtained from non-wetlands areas. The raising of this area minimizes the amount of dewatering that would be required due to the relatively high groundwater table. An existing drainage ditch traverses the site and will be relocated to the east of the power block; its final destination will remain unaltered.

No explosives are planned for use during construction in this area.

4.1.1.3 Coal Storage and Handling Areas

The area where the inactive coal pile and emergency coal pile are to be located will be cleared, grubbed, graded, and a liner installed to prevent any potential pollutants from entering the groundwater. A runoff pond will also be constructed with a liner to intercept any water draining from these two coal piles. A physical barrier (described in Section 3.3.4) will be constructed beneath the active coal pile to prevent groundwater contamination.

The excavation of the coal car unloading hopper (approximately 40 feet deep) will encounter groundwater. A cofferdam of similar construction technique will be constructed around the perimeter of the unloading hopper to minimize the influent of groundwater and thereby minimizing any impact on the groundwater table and wetlands.

4.1.1.4 Construction Wastes

Waste materials will be disposed of in accordance with applicable rules and regulations. Construction wastes, such as scrap wood and metal, will be transferred to a specified storage area onsite where they will be separated and stockpiled for salvage. General waste materials (i.e., garbage) will be collected in appropriate waste collection containers for disposal at an approved offsite location.

Waste oil from construction vehicles and equipment will be collected in appropriate containers and transported offsite for recycling or disposal at an approved facility.

Individual subcontractors will be responsible for handling hazardous wastes resulting from their onsite activities. This responsibility includes the proper offsite disposal of such wastes.

4.1.2 ROADS

Main access to and from the site will be provided by an extension of the existing Caulkins access road from SR 710, southward along the west side of Caulkins and the ICL site property as shown on the Plot Plan, Figure 3 2 0-1. This road will be constructed per Martin County standards. It will extend around the south perimeter of the site and intercept the South West Farm Road, providing a public thoroughway between South West Farm Road and SR 710.

A secondary access road will be provided from the southern perimeter road into the power block area. Other maintenance roads within the site boundary will be constructed to provide access to equipment and remote areas as necessary.

Construction access will be provided by a new road within the easement for the rail spur between Caulkins and Florida Steel Corporation. A portion of this easement may be used for construction parking along with the main laydown/parking area. Construction personnel may also use the secondary plant entrance for access into the construction parking/laydown area.

4.1.3 FLOOD ZONES

The ICL site is located in Zone B (100- to 500-year floodplain) as defined by Flood Insurance Rate Maps (FEMA). No part of the ICL site is within the 100-year floodplain.

4.1.4 TOPOGRAPHY AND SOILS

The ICL site is relatively flat, with existing grade elevation ranging from approximately 32 to 35 feet mean sea level (MSL). The site is generally brush covered, with some lightly wooded areas, and is crossed by several surface runoff ditches. Some of these ditches contain standing water.

Excavations made on the site during construction will affect site runoff slightly in small, localized areas adjacent to the excavations. Existing ditches and ponds on the site currently collect stormwater; these elements will be maintained during construction. An existing ditch running north/south over the site will be relocated, but still maintained. More importantly, a detailed stormwater management plan will be implemented, involving construction of collection works and stormwater runoff ponds. The effect on runoff is, thus, expected to be minimal.

Site stripping operations will have an effect on percolation rates. Again, the effect will be on localized areas, since stripping will take place primarily where roads or structures are to be constructed. Consequently, percolation rates will be affected during construction only in these limited areas. After construction, open disturbed land not occupied by roads or structures will be planted with grass, restoring the previous percolation rates.

The site is currently vacant, removing any threat to existing structures from subsidence. Subsidence over the site, as a result of construction activity, will not likely occur due to the lack of any significant causal mechanism. Pile driving can densify loose, upper deposits of sand, causing slight local settlement. The subsurface exploration shows that the upper sand deposits generally increase in

density with depth, typically becoming medium to dense at a depth of about 5 feet. This soil is too dense to settle significantly under pile driving operations.

Sink hole formation takes place below the ground surface, by the dissolving of carbonate soils and rock by acidic water. As stated in Section 2.3.2, sink hole formation is not expected to occur in the site area, nor will it be enhanced or affected by construction activities.

To lower a soil deposit's bearing strength, in-situ shear strength must be lowered. Typical construction activities such as dewatering, pile driving, and the travel of heavy construction equipment will frequently densify sand soils, causing an increase in shear strength. Since the site's subsurface soils are almost exclusively sands, construction will, therefore, not cause a reduction of bearing strength.

Excavations made during construction can potentially affect the stability of adjacent existing soils. The only significant excavation planned is for the rail car unloading facility. This excavation will require extensive dewatering, and sidewall sloping or shoring. The safety of personnel working in and around this excavation will be ensured by the careful, thorough, and proper design of the dewatering and excavation support systems. When the excavation is made according to this process, with rigorous inspection to ensure safe construction, stability will not be a problem.

4.2

4.2 IMPACT ON SURFACE WATER BODIES AND USES

4.2.1 IMPACT ASSESSMENT

Possible surface water bodies affected by project development are the existing onsite drainage ditch, the St Lucie Canal, seven wetland areas within the property boundary, and the TC/NS near the intake structure. It is the SFWMD's requirement that all drainage patterns return to pre-developed conditions and that peak discharges not be altered in the process.

Activities Within Surface Water Bodies

The only construction activities directly affecting surface water bodies are the rerouting of the existing drainage ditch and the construction of the intake structure. The drainage ditch rerouting will be completed very early in the project and care will be taken to maintain the existing water level, quantity, and quality of the discharge. Silt fences and straw bale dikes will be employed, as described in Section 3.8.4.2, where needed to filter runoff to the ditch. Velocities in the ditch will be at a minimum to deter sediment and erosion transport. Control measures will remain in place until the site runoff has stabilized in an acceptable manner in regard to sedimentation and erosion.

Rerouting of the existing drainage ditch will not have any significant impact on the offsite drainage. The rerouted portion of the existing drainage ditch will maintain existing hydraulic capacity. Post-development discharge from the site to the existing ditch will not exceed the pre-development peak discharge.

The underwater portion of the intake structure will be installed by constructing a temporary driven sheet pile cofferdam in the canal, excavating from within the cofferdam to install the intake pipes, and then backfilling to cover the pipes. Any leakage through the sheet pile wall will be into the cofferdam, and thus there will be no sediment flow to the outside of the cofferdam during construction.

Activities Affecting Discharge to Surface Water Bodies

Due to the large amount of earthwork required to raise the plant and coal storage/handling area elevations, stormwater runoff quality may be affected. Management, vegetative, and structural practices, as described in Section 3.8.4.1, will be implemented to mitigate adverse impacts on water quality during construction. These will include the control of sedimentation (erosion) by minimizing exposure of erodible soils, minimizing water velocity through use of milder slopes and diversion, use of grass and riprap covers, and channelization of stormwater runoff into sedimentation basins.

Stormwater management plans (Section 3.8.5) and sedimentation and erosion control plans (Section 3.8.4) for the ICL have been developed and will be implemented prior to and during earthwork. The stormwater management plan will utilize five stormwater detention basins, shown on Figure 3.8.2-1 and described in Section 3.8.5, which will act as sedimentation basins during the construction phase. Approximately 9 acre-feet of detention volume will be provided in the power block and coal handling areas. An additional 3.6 acre-feet of detention volume for the inactive coal pile runoff basin will also be provided.

During installation of the stormwater management system, measures taken to minimize the impact of surface water management activities will include:

- Mulching and seeding, with quick germinating varieties of grass, in all areas not subject to construction activities for more than 30 days.
- Treatment of runoff from active construction areas by silt fences, gravel or rock filtration, straw bales, or other temporary erosion control measures.
- Diversion of runoff from undisturbed areas around construction areas.

- Use of physical soil stabilizers such as straw, wood chips, netting, or hay to protect exposed soils
- Installation of sediment filter devices where appropriate

The methods described in Section 3.8.4 have incorporated control measures to prevent impacts to wetlands from sediment-laden runoff

4.2.2 MEASURING AND MONITORING PROGRAMS

No waters of the state will be affected during construction and/or operation of the facility as discussed in Section 4.2.1. Therefore, no measuring and/or monitoring programs are proposed.

4.3 GROUNDWATER IMPACTS

4.3.1 IMPACT ASSESSMENT

Section 4.1.1 describes the construction operations for the proposed project. As discussed, wastes will be generated during construction. In general, these wastes will consist of building materials which represent no threat to the groundwater system beneath the site. Small amounts of garbage, waste oil, and other potentially harmful compounds will also be generated. These wastes will be disposed of offsite, as described in Section 4.1.1, and pose no threat to the Surficial aquifer system.

During construction, it may also be necessary to provide temporary onsite storage facilities for fuels, solvents, etc. Potentially hazardous fluids such as these will be provided with secondary containment to protect the Surficial aquifer in the event of an accidental spill on the ground surface.

Excavations will occur at several locations across the project site. The deeper excavations will intersect the water table and require dewatering systems. The SFWMD requires that no dewatering operation may reduce the capacity of any existing permitted water user by more than 10 percent. Furthermore, dewatering systems may not reduce the hydrostatic head beneath wetland areas by 1 foot or more.

There are two excavations at the site which will utilize dewatering operations that could conceivably impact the Surficial aquifer. These are systems which will withdraw groundwater at rates of more than 25 gpm. The coal unloading building

will have the deepest excavation (Figure 3 1 1-1, Site Plan) The excavation will be 20 feet wide, 50 feet long, and 40 feet deep at its deepest point

The other excavation site to utilize a dewatering operation will only be about 14 feet deep At this excavation, circulating water lines will be installed below ground, running between the pump house and the administration building (Figure 3 1 1-1, Site Plan) These lines will be placed in an excavation that is 400 feet long, 26 feet across at its widest point, and 14 feet deep

Groundwater Modeling

The geology of the site and the water-bearing layers which underlie the site are described fully in Sections 2 3 1 2 and 2 3 2 1 The Surficial aquifer occupies the upper 120 feet of sediments which underlie the site Based on site-specific data and published data from nearby sites (FPL, 1989), the Surficial aquifer may be characterized for modelling purposes as a three-layer system composed of two water-bearing zones and one intervening confining layer with parameters as follows

<u>LAYER</u>	<u>THICKNESS (feet)</u>	<u>TRANSMISSIVITY (gpd/ft)</u>	<u>STORATIVITY</u>	<u>V, PERMEABILITY (gpd/ft³)</u>
L1	30	3300	0 15	0 03
L2	55	1500	0 0004	0 002
L3	35	5600	0 00013	0 2

Dewatering operations to be conducted at the coal unloading excavation were simulated using the finite difference groundwater flow model, PLASM (Prickett and Lonquist, 1971) The model was calibrated against a 3-day aquifer performance

test conducted on the site (Section 2.3.2.1). The results of this simulation and a comparison with the aquifer performance test observations are included in Section 10.5.1. Section 10.5.1 contains a computer printout of all model input parameters as well as the simulation results.

The model assumes that grooved sheet piling (or similar construction techniques) will penetrate into layer 2 of the Surficial aquifer to a depth which is 6 to 8 feet below the bottom elevation of the excavation at the coal unloading location. The sheet piling will surround and completely enclose the excavation, thus preventing seepage from entering the excavation as horizontal flow from layer 1.

As shown on Figure 3.1.1-1, Site Plan, the coal unloading site is located about 200 feet northeast of a wetland. In order to minimize drawdowns within layer 1 and protect the wetland from measurable impacts, an infiltration gallery will be constructed midway between the wetland and the excavation site. Water from the dewatering system will be directed into the infiltration gallery to be discharged into layer 1 as seepage.

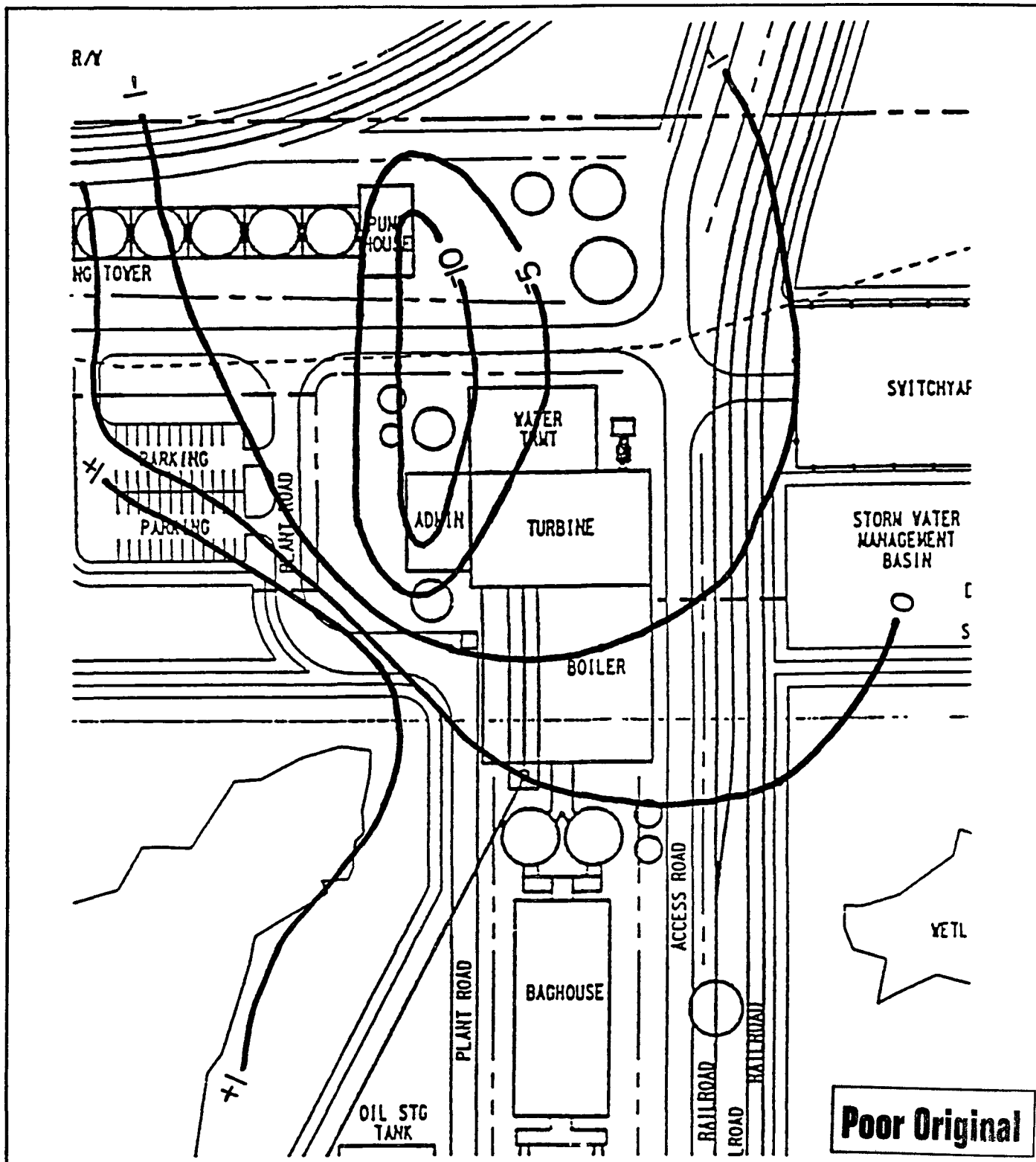
The dewatering system was simulated as one sump or well, placed at the center of the excavation and within the sheet piling perimeter. The bottom elevation of the excavation will be within layer 2 of the Surficial aquifer. When pumping begins, a cone of influence in layer 2 expands outward from the excavation until the total pumpage (approximately 65 gpm) is matched by an equal rate of leakage into layer 2 from layers 1 and 3.

Because layer 3 was excluded from the dewatering simulations, all seepage into layer 2 was assumed to be from layer 1, the unconfined aquifer, and therefore simulated drawdowns of the water table are actually greater than anticipated.

Three scenarios were simulated. Scenarios 1 and 2 simulate continuous dewatering for 180 days, the anticipated period of excavation, during the dry and wet seasons when recharge as precipitation is available to layer 1. These simulations indicate that the water table will not be lowered more than about 0.5 feet within a radius of 200 feet of the excavation. Scenario 3 simulated 90 days of continuous dewatering with no recharge to layer 1 except for seepage from the infiltration gallery at a rate of 3 gpm. The simulation indicates that dewatering operations can continue through 90 days of drought without lowering the water table as much as 1 foot at any location. Computer printouts of the 3 scenario simulations, with model inputs and simulation results, are presented in Section 10.5.1.

Based on the results of the computer simulation, including the utilization of sheet piling and an infiltration gallery during the excavation period, no adverse impacts to wetlands are anticipated. The nearest existing permitted groundwater users are located several thousand feet from the excavation site (Section 2.3.3). At this distance, the wells will not experience any significant reduction in capacity approaching the regulatory limit of 10 percent.

Dewatering operations to be conducted at the circulating water lines excavation were simulated using the analytical methods developed by Theis (1935). Dewatering along the 400-foot ditch was simulated as three 15 gpm wells and one 20 gpm well, spaced at 100-foot intervals and screened within layer 1 of the Surficial aquifer. Water from the dewatering system will be directed into a nearby storm water collection basin (Figure 3.1.1-1). Infiltration into layer 1 from this basin was simulated as three 10 gpm recharge wells and two 5 gpm recharge wells. The dewatering operations were simulated for 45 days, the approximate time needed to excavate the ditch and bury the lines. Figure 4.3.1-1 displays the results of the



Poor Original

Figure 4.31-1.

PREDICTED CHANGE IN WATER TABLE
ELEVATIONS AFTER 45 DAYS OF DEWATERING THE
CIRCULATING WATER LINES EXCAVATION

Source A Campbell 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L P

simulation As shown, no significant impacts to the nearest wetlands will occur during this brief dewatering period

To summarize, a finite difference groundwater flow model and analytical methods were used to simulate the proposed dewatering operations and assess groundwater impacts Based on SFWMD criteria, no adverse impacts to wetlands will occur because of dewatering operations at the site Furthermore, no measurable impacts to existing users are anticipated

4.3.2 MEASURING AND MONITORING PROGRAMS

Dewatering activities are the only kind of construction operation that could possibly impact the Surficial aquifer in a measurable fashion. In addition to the existing onsite Surficial aquifer monitor wells located at the corners of the site (Section 2.3.2.1), additional observation wells will be placed between the proposed excavation sites to be dewatered and the nearest wetlands. Seasonal variations in the water table will be established before construction operations begin. Once construction has started, these observation points will be used to document that seasonal variations in the water table are not being affected by dewatering operations.

4.4 ECOLOGICAL IMPACTS

4.4.1 IMPACT ASSESSMENT

4.4.1.1 Site Construction Plan

A technical engineering description of the operation and maintenance of the 330 MW Indiantown Cogeneration, L P (ICL) Project facility is provided in Section 3.0. The general description of construction of the facility and associated impacts are provided in Section 4.1.

The ICL facility will be constructed over a 42-month period. For the purposes of this ecological impact assessment, the project is divided into four components:

- Power block
- Coal storage/handling
- Temporary construction laydown
- Cooling water storage pond

It can be assumed for the purposes of this impact assessment that all of the natural vegetation cover within these areas will be completely cleared.

4.4.1.2 Acreage Requirements

Table 4.4.1-1 presents the acreage requirements for the construction and operation of the ICL facility, along with the vegetation community types affected. The power block will occupy approximately 21 acres of pine flatwoods. Coal handling and storage facilities will occupy approximately 15 acres of pine flatwoods.

Approximately 0.3 acre of pine flatwoods will be required for the fuel oil storage and handling facility. The switchyard will cover approximately 0.94 acre of pine flatwoods. The cooling tower will cover approximately 0.93 acre of flatwoods. The

Table 4.4.1-1
ACREAGES OF VEGETATION COMMUNITIES TO BE IMPACTED, PRESERVED,
AND RESERVED FOR POTENTIAL FUTURE USE OF THE ICL

	Vegetation Community					
	Pine Flatwoods	Wet Prairie*	Ruderal Land+	Total Uplands	Total Wetlands	Total Acreage
Project site	199.6	24.4	8.0	207.6	24.4	232.0
Power block	21 0	--	--	21 0	--	21 0
Coal storage/handling	15 0	--	--	15 0	--	15 0
Roads, railroads, miscellaneous	45 6	--	--	45 6	--	45 6
Temporary construction laydown area	12 0	--	--	12 0	--	12 0
Cooling water storage pond	25 0	--	--	25 0	--	25 0
Total potential impact area	118 6	--	--	118 6	--	118 6
Total preserve area	58 3	24 4	--	58 3	24 4	82 7
Total remaining area	22 7	--	8 0	30 7	--	30 7

Notes The remaining areas of land that will not be impacted by the proposed development or preserved include existing land uses such as the transmission line right-of-way and roads or pine flatwoods that are for potential future use

*Wet prairie includes both the wetlands and the manmade ditch onsite The ditch, which encompasses approximately 1 acre, will be rerouted and then maintained onsite

+ Ruderal land includes the existing transmission line right-of-way, roads, and clearings

Source Bechtel, 1990

temporary construction laydown area will cover approximately 12 acres of flatwoods. Finally, the cooling water storage pond located at the northwestern corner of the plant site will cover approximately 25 acres of pine flatwoods.

Approximately 8.3 acres of pine flatwoods will be preserved as natural, 50-foot contiguous buffers around three wet prairie areas located in the central portion of the development and another wet prairie site on the northwest corner of the property. The balance of the 50 acres of flatwoods will also be preserved onsite as visual screening and upland wildlife preserve. Approximately 23.4 acres of wet prairie within the project site environs will also be preserved. An additional acre of man-made ditch will be rerouted and then maintained on the project site. Figure 4.4.1-1 provides a map of the preserved uplands and wetlands on the ICL site.

The remaining acreage includes existing transmission line right-of-way and roads that will be maintained. Approximately 22.7 acres of pine flatwoods will also remain on the site for potential future plant use.

4.4.1.3 Environmental Management and Protection Plans for Construction

The following categories identify the environmental management protection procedures to be followed to protect or otherwise limit the impact to the surrounding ecological resources before, during, and after project construction.

- Clearing and grubbing
- Site restoration
- Soil erosion and sedimentation control measures
- Wetland protection

Figure 4 4 1-1

PRESERVED AREAS MAP OF
THE ICL SITE

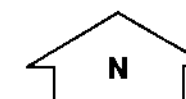
Poor Original

LEGEND

- FEPF - Pine Flatwoods
- WP - Wet Prairie
- UTTL - Major Transmission Line
- Wet Prairie Preservation Areas
- Pine Flatwoods Preservation Areas

0 500 1000

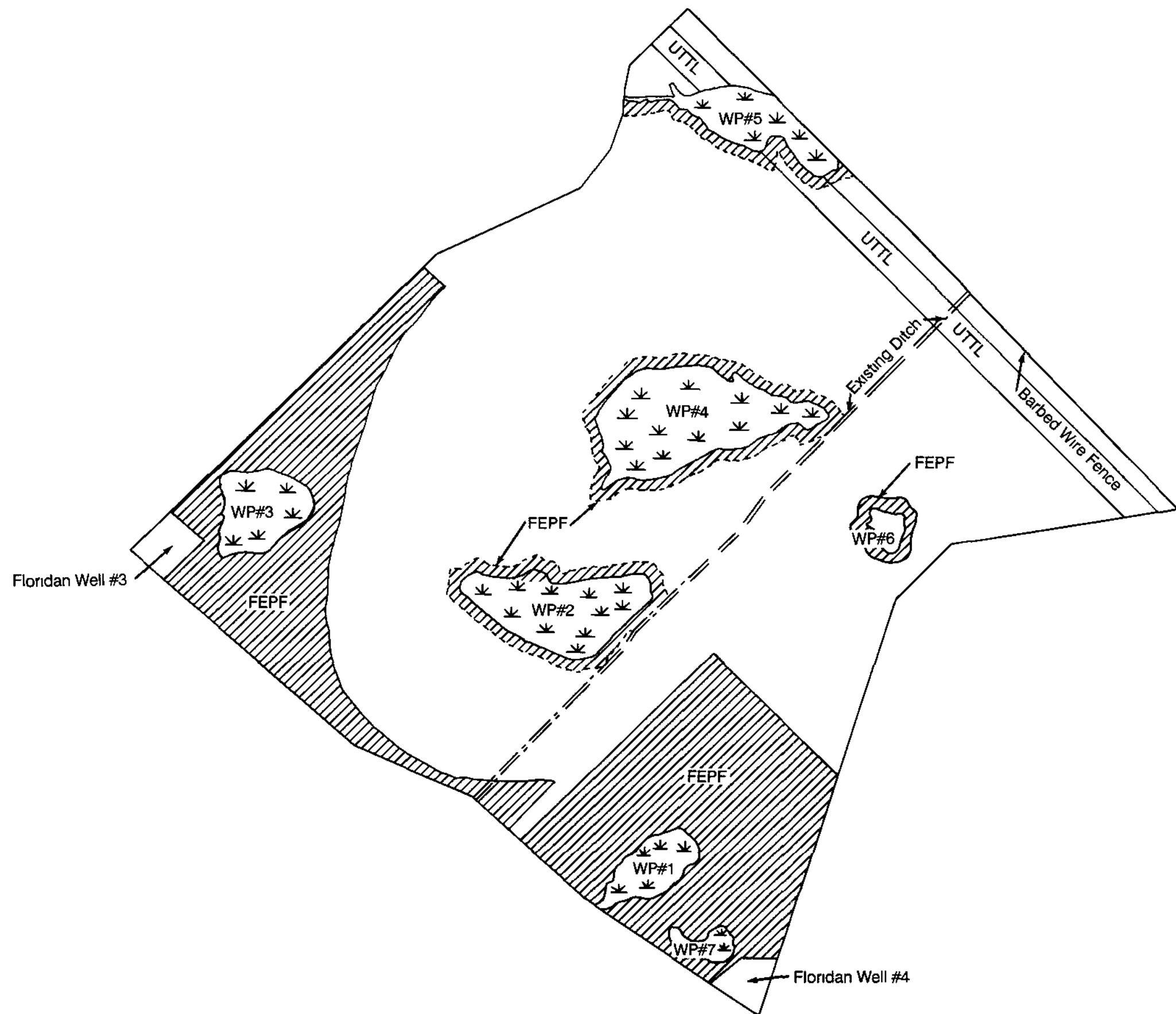
SCALE IN FEET



Source ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L.P



Clearing and Grubbing

- 1 A survey will be made of the area to be disturbed by project construction (i.e., the areal extent of clearing and grubbing as identified on project engineering drawings). The boundaries of this area will be clearly marked on site plans and in the field before any construction activity commences. Clearing and grubbing or other construction activities beyond this marked area will be prohibited.
- 2 The prevention of damage to vegetation outside construction areas will be emphasized in all construction operations, and careless or needless equipment operation will be avoided. Areas to be avoided by construction will have barricades installed to limit activities therein.
- 3 Debris derived from clearing and grubbing will be hauled offsite.
- 4 To ensure the least possible damage to the onsite vegetation, the use and storage of vehicles, equipment, and materials will be restricted to those areas which will be permanently disturbed by required designated construction activity or earthwork operations, or the temporary construction laydown area.

Site Restoration

- 1 ICL will require that contractors attain the following goals for site restoration after construction is completed:
 - Timely site stabilization of disturbed soil
 - Timely restoration of disturbed or altered areas through vegetative plantings appropriate to the season and soil type

- 2 Fill slopes will be sodded or seeded and mulched

Soil Erosion and Sedimentation Control Measures

The soil erosion and control measures to be used during construction are discussed in detail in Section 3.8.4.1. Highlights of these measures include the following:

- 1 Barriers are planned and will be maintained to serve a continuing functional role in erosion control before, during, and after construction until the areas are stabilized. The proposed barriers will consist of bales of straw or other suitable filter material.
- 2 Stabilization techniques will be used to establish a stabilized working surface for construction, where necessary.
- 3 Contractors will be required to implement temporary stabilization measures to minimize loss of topsoil, excess sedimentation to the drainage ditch, and potential deterioration of water quality.
- 4 Prior to construction, contractors will be required to submit plans for accomplishment of temporary and permanent erosion control work. These plans will detail the erosion controls for clearing and grubbing, excavation, and final grading within access and haul roads, the work site, and the temporary construction laydown area.
- 5 All disturbed areas not otherwise stabilized will be mulched and/or seeded within 15 days of exposure or as soon thereafter as seasonally practicable, except in areas where construction will resume within 30 days. Areas to be seeded will employ quick-germinating varieties, such as winter rye grass, which provides temporary cover and soil retention properties.

- 6 All exposed drainages will be sodded or mulched and seeded immediately after each construction phase or disturbance
- 7 Physical soil stabilizers will be used, where appropriate, to protect exposed soil from falling or flowing water (e g , straw, wood chips, netting, hay, etc)
- 8 Sediment filter devices will be installed to prevent siltation, accumulation, or debris
- 9 Runoff from the disturbed areas will be conveyed to the detention basins prior to release to the natural runoff
- 10 After the completion of the construction, the detention basins will be cleaned, if necessary, and used for operations stormwater management

Wetland Protection

- 1 A 50-foot natural vegetation buffer will be established along the jurisdictional wetland boundary of three wet prairies centrally located close to project development and another wet prairie situated at the northwestern corner of the project site The 50-foot setbacks will be surveyed and a barricade installed along the surveyed lines
- 2 No disturbance of any kind will be allowed within the barricaded setback
- 3 The other wet prairie areas located further away from site development are situated within natural pine flatwoods that will be preserved There are significant expanses of upland preserved areas surrounding these wet prairies (i e , greater than 50 feet landward of wetland jurisdictional

boundaries) Upland preserve areas surrounding these wetlands will also be barricaded

- 4 For more information regarding wetland and upland preserve protection, refer to Section 4 4 1 4, Vegetation Communities, under Preservation Program

4 4 1 4 Vegetation Communities

Project Impact

Project construction will remove all of the existing natural vegetation located in the areas to be cleared and grubbed Table 4 4 1-1 specifies the types and acreages of vegetation to be affected Of the 232 acres of project site, about one-half of the site's acreage will be impacted Of the approximately 118 6 acres to be affected by project construction, almost all of it consists of pine flatwoods (minor areas of less than 1 acre of clearings, trails, and roads were not subtracted from flatwoods acreage as ruderal land)

No wetlands, except the drainage ditch to be rerouted, will be encroached upon during construction and operation of the plant The remainder of the project area (49 percent or 113 4 acres) is comprised of either preserved pine flatwoods (50 acres) and preserved wet prairie/ditch (24 4 acres), or land left for potential future plant use (22 7 acres) An additional portion of the pine flatwoods will also be preserved (8 3 acres) consisting of natural upland buffers to three of the wet prairie areas located in the center and one wet prairie situated at the northwestern corner of the plant site The pine flatwoods to be developed on the ICL site are locally and regionally common in Martin County

Preservation Program

The existing stresses to the vegetation on the project site have occurred as a result of cattle grazing, alteration of hydrologic regimes, and creation of disturbed areas by road and transmission line corridor construction and off-road vehicle trails. Though impacts to these natural communities are apparent, the existing communities can be considered to exhibit moderate to good ecological diversity and function. In addition, a significant portion of the site (82.7 acres or 36 percent) will be preserved. This includes all of the wetlands/ditch (23.9 acres) and the 58.3 acres (25 percent of the total pine flatwoods acreage) of the pine flatwoods (see Figure 4.4.1-1).

ICL also proposes to re-route portions of the existing drainage ditch (approximately 1 acre) traversing the central portion of the site. This should enhance the hydrology of the adjacent wet prairie by improving surface water overland flow. This wet prairie had some wetland plant elements displaced by upland species, and the re-routing of the ditch may result in a return of more desirable hydric species.

Exotic vegetation on the ICL site is neither widespread nor abundant. Some punk tree and Brazilian pepper were observed in the pine flatwoods. These will be removed. Exotic plants are scarce to non-existent in the wet prairies. Removal of exotic vegetation will not require revegetation with native flora due to the limited extent and numbers of these noxious plants.

A major goal of preservation management is maintenance of the existing natural condition of upland and wetland communities, particularly wetland hydroperiods. To do this, surface water and groundwater regimes must be artificially maintained or restored. To the extent feasible, or when necessary, the wetland areas will be incorporated into the project's surface water management plan. Through the use of Best Management Practices (BMPs), hydroperiods of affected wet prairies can be maintained without excessive, unseasonal flooding or drying.

A potential post-construction impact to management of preserve areas is disposal of solid wastes and coal storage. All solid wastes generated by operation of the ICL facility will be removed for offsite disposal. Thus, no impacts to preserved areas onsite due to solid wastes will occur. The active coal pile will be stored in an enclosed facility and the coal conveyor to the plant will be totally enclosed to keep fugitive coal dust at a minimum. In addition, the inactive coal storage pile will be lined and grassed over. Any runoff and leachate from the pile will be collected in a lined basin, treated, and recycled for process water needs.

In addition, the following preservation program management guidelines will be adhered to:

- 1 All required grade changes (i.e., railroad and road) will be engineered so that any cut or fill will meet existing grade without encroaching into the preserve area.
- 2 All exotic vegetation will be removed. Stumps will be treated with a contact herbicide to prevent regrowth.
- 3 All of the preserve areas boundaries will be surveyed. The surveyed preserve areas will then be delineated/ protected in the field using barricades along the surveyed boundaries prior to any clearing activities.
- 4 Prior to any clearing, the barricades will be inspected to ensure proper placement and construction by the Martin County Growth Management Department.
- 5 Barricades will be constructed onsite and maintained intact for the duration of construction.

- 6 Where areas are proposed for clearing (i.e., building envelope, utilities and drainage, road right-of-way, etc.), the barricades will be offset at least 10 feet outside the preserve areas or placed at the dripline of the canopy trees, whichever is greater
- 7 Individual trees or groups of vegetation that are to be saved will also be barricaded according to the previously mentioned guidelines
- 8 All native vegetation which is not located in areas requiring their removal as part of the development plans shall be retained in their undisturbed state
- 9 Advisory or warning signage will be posted
- 10 Contractors will be provided a set of the preservation program guidelines and warned that any violation of these guidelines and damage to, or destruction of the preservation areas will result in remedial action
- 11 Prohibited activities in the preserve areas will include removal or destruction of native vegetation, dumping of fill, trash, or building and construction materials and debris, excavation, recreational vehicle use, or any activities detrimental to drainage flood control erosion control, or wildlife habitat conservation

4.4.1.5 Aquatic Systems

All of the wet prairies on the project site will be preserved and protected from project construction impacts. Although the drainage ditch will be rerouted on the project site, the existing drainage pattern will be maintained and enhanced through a surface water management plan. During the ditch realignment, special

precautions will be taken to safeguard the downstream water quality from deterioration through proper erosion and sedimentation control practices

Since no aquatic systems will be significantly affected by the proposed project, no project impacts to aquatic ecological resources are expected before, during, or after construction

4 4 1 6 Wildlife Resources

The principal impact on wildlife associated with project development will be the loss of up to approximately 118.6 acres of onsite habitat. Because pine flatwoods are the only dominant habitat to be affected, and pine flatwoods are regionally common, the partial clearing of this habitat will have insignificant impacts on regional wildlife populations.

Although the more non-motile species will be lost during construction, mammals and birds are expected to be displaced to the surrounding natural pine and wet prairie areas. It is not expected that individuals of species populations which breed or winter onsite will be displaced. With the exception of the white-tailed deer, eastern cottontail, raccoon, opossum, bobcat, gray squirrel, gray fox, feral pig, mourning dove, and bobwhite, recreational and commercially important animal presence on the project site and vicinity is low. Because hunting is currently precluded on the site, project impacts on wildlife as a local recreational or commercial resource will not occur.

4 4 1 7 Threatened or Endangered Species

The ICL project will not affect known breeding populations of animal species which are listed as threatened, endangered, or species of special concern (Table 2.3.6-2). Wading birds visit the project area occasionally for feeding, however, no current breeding populations are known to occur in the project site area.

Although alligators, indigo snakes, and gopher tortoises are expected to occur within the site environs, no significantly adverse impacts to these listed reptile species populations would be expected from project construction. Bachman's sparrows, loggerhead shrike, and other migratory birds that utilize site habitats will find suitable and abundant habitat adjacent to the project site during and after construction. No other listed animal species have been observed or are known to inhabit the project site or its immediate environs.

No endangered or threatened plant species listed by USFWS on Table 2.3.6-1 were located on the project site. Only three fern species listed as threatened by FDACS were discovered within the wet prairies and ditch on the project site. Although these fern species could also occur within the extremely small, wet weather depressions in the pine flatlands to be affected by development, no significant impacts to local species population are anticipated as a result of project construction. Even if some individuals of these listed fern species should be affected, it would not be considered to be a significant impact because of the following factors:

1. The fern species on Table 2.3.6-1 are listed as threatened by FDACS primarily to discourage commercial exploitation, rather than providing a designation of the current species population status.
2. The fern species are widespread in freshwater wetlands throughout Florida.
3. The fern species are common locally and, therefore, the loss of some individuals will not affect the status of regional populations.

The Florida coontie (Zamia pumila) may occur onsite based on habitat suitability and range of distribution. However, no sightings of this conspicuous cycad occurred during numerous surveys of the impact areas of the project site. Therefore, no impacts to the Florida coontie would be expected from project

development In summary, protected species populations of wildlife and plants should not be significantly affected by project construction

4 4 2 MEASURING AND MONITORING PROGRAMS

4 4 2 1 Project Area

No monitoring of the project area is planned

4 4 2 2 Preservation Area

Since project construction and operation should not result in direct or significant secondary impacts to the surrounding vegetation, monitoring of the pine and wet prairies to be preserved on the project site is not considered necessary



4.5

4.5 AIR IMPACT

4.5.1 EMISSION SOURCES

During the construction period, unavoidable air pollutant emissions are likely to occur from various construction-related activities. The most prevalent construction emissions are fugitive dust. However, minor emissions of nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter, and volatile organic compounds (VOCs) from equipment exhaust are also likely during construction.

Fugitive Dust

Fugitive dust is generally defined as natural and/or man-associated dusts that become airborne due to the forces of wind or human activity. Construction-phase fugitive dust emissions are generated during site clearing, grubbing and grading, excavation, and vehicular activities.

The quantity of fugitive dust emitted by the site construction vehicular traffic depends on a number of factors, including the frequency of operations, specific operations being conducted, weather, and soil conditions. Many of the construction operations, such as land clearing and foundation excavation, will be intermittent and of a temporary nature. Fugitive dust emissions due to concrete batching will not occur during construction. Concrete will be brought to the site from nearby commercial batching facilities.

Other Air Pollutant Emissions

It is anticipated that the total gaseous emissions released into the atmosphere during construction will be small. Potential sources of VOC emissions are evaporative losses associated with onsite painting, refueling of construction equipment, and the application of adhesives and waterproofing chemicals. The frequency and extent of these activities are limited.

Exhaust emissions from construction equipment will also contain small amounts of NO_x , SO_2 , CO, particulate matter, and VOCs resulting from incomplete combustion of fuel. However, due to the nature of heavy-duty, diesel-powered construction vehicles, which allow for more complete combustion and use less volatile fuels than spark-ignited engines, these emissions are relatively low.

4 5 2 AIR QUALITY CONTROL METHODS - BEST MANAGEMENT PRACTICE

The typical approach used to reduce fugitive dust emissions during construction activities of this type is water spraying. Reductions of 50 percent are readily achievable by watering paved surfaces, and this can be increased to about 75 percent when followed by mechanical sweeping. Emissions from unpaved roads can be reduced 50 to 75 percent by water spraying. In both cases, the degree of control achieved depends on the application intensity and the number of vehicle passes between applications, as well as climatological factors (e.g., rainfall, evaporation rate, time of year) (EPA, 1984). In addition, a speed reduction program may further reduce emissions from unpaved surfaces by 25 to 80 percent (Ohio EPA, 1980). Trucks can be covered or the material wetted to substantially reduce the amount of material blown from the trucks. In addition, wheel washing may be implemented to prevent tracking soil onto paved surfaces.

Emissions from the storage of excavated materials or backfill and associated traffic can be controlled by up to 90 percent (EPA, 1988) by either covering the storage piles or treatment with surfactants, and by the application of a watering program on the associated service roads.

Contractors will be instructed to comply with any applicable state or local regulations governing open burning. Areas disturbed during construction will be seeded to stabilize or restore the soil surface.

4 5 3 AIR IMPACT ASSESSMENT

Air quality impacts resulting from construction activities will tend to be short-term and localized. Fugitive dust created by construction activities is made of relatively large particles. Therefore, the majority of these particles will settle near the construction activity areas. Site grading and excavation activities are of short-term nature, thus, fugitive dust emissions created by these activities have very little threat to long-term ambient air quality levels in the proposed ICL site area. Numerous abatement measures as discussed in Section 4 5 2 can be taken if necessary, as part of best management practice to further minimize any of these minor short-term impacts from construction-related activities.

Similarly, gaseous pollutants generated by the diesel-powered construction equipment are also of short-term nature. Diesel-powered construction equipment is not a significant pollutant emitter in general, if it is properly maintained and periodically inspected.

In summary, air quality impacts during the construction phase of the proposed ICL project will be temporary and generally minor. The impacts will cease when construction activities are terminated for operation. Therefore, the proposed project is not expected to have any significant construction-related air quality impacts to the public health and welfare.

4 6 IMPACTS ON HUMAN POPULATIONS

4 6 1 PROXIMITY OF RESIDENTIAL AREAS

As previously discussed in Section 2 2 3 3, the majority of lands within the 5-mile study area are agricultural or undeveloped. The exceptions to these agricultural or undeveloped areas within the 5-mile study area include the existing FPL Martin power plant site, the existing industrial developments located in the immediate vicinity of the ICL site, and areas within the unincorporated community of Indiantown. Because the properties directly adjacent to the ICL site are either industrial or agricultural in nature, no residential developments are located directly adjacent to the site.

The majority of residential populations within the 5-mile study area are located in the unincorporated community of Indiantown, approximately 3 to 4 miles from the site. As previously described in Section 2 2 7 4, the Indiantown community contains a total of 1,627 dwelling units, of which 1,443 or, 88.7 percent, are considered to be in good condition. The largest residential district in Indiantown is the Indianwood mobile home development. Indianwood currently is planning to expand an additional 1,465 mobile home units on 565 acres (Indiantown Action Plan, 1990).

With the exception of the previously described residential areas within Indiantown, the remainder of the 5-mile study area contains relatively few residential structures. Utilizing 1989 tax roll data obtained from the Martin County Property Appraiser's Office, it was determined that there are 109 dwelling units within the 5-mile study area that are outside Indiantown. The population estimate for these 109 dwelling

units, based on the statewide average of 2.47 persons per household (U.S. Department of Commerce, 1988), is 269 persons.

Because the majority of residents live over 2 miles from the site, the noise from construction of the site will have very little impact on the community. For those residences that are closer to the site, the fact that construction is projected to occur during a normal 40-hour work week and that there will be no blasting onsite, will result in low impacts to this nearby area.

4 6 2 CONSTRUCTION WORKFORCE

Construction of the ICL facility is anticipated to cover a period of 42 months, commencing in July 1992, and ending in December 1995. The last 6 months of this time period will be concerned with startup activities for the plant.

Table 4 6 2-1 shows the projected construction schedule over its 42-month duration. This schedule is based on a single-shift operating 40-hour work weeks. However, due to unanticipated and uncontrollable delays due to weather and equipment deliveries, the temporary implementation of shift work may be required to keep the project's construction on schedule. The construction workforce is expected to peak at 800 persons for 4 to 6 months during the third year of construction.

The commuting distance for this construction workforce is anticipated to be between 30 and 60 miles. However, construction workers could possibly commute as far as 100 miles, which is not considered to be unusual. Thus, the construction workforce could be drawn from Martin, Okeechobee, St. Lucie, and Palm Beach Counties, but may also be drawn from the Fort Lauderdale and metropolitan Miami areas. However, the majority of the construction workforce is expected to be drawn from the urban areas within 60 miles.

Though this workforce is predicted to commute, ICL will encourage carpooling and will study the possibility of utilizing private transit bus service for construction workers to reduce the number of vehicles transporting construction workers to the ICL site.

Table 4 6 2-1
CONSTRUCTION WORKFORCE INVOLVED IN THE ICL PROJECT

Year of Construction	Time Period	Number of Construction Workers
1	07/92 - 12/92	200
2	12/92 - 12/93	400
3	12/93 - 12/94	600*
4	12/94 - 12/95	200

*Construction workforce is expected to peak at 800 employees for 4 to 6 months during this time period

Source ICL, 1990

4 6 3 CONSTRUCTION WORKFORCE IMPACTS ON HUMAN POPULATIONS

Because properties directly adjacent to the ICL site do not contain residential developments, no impacts to residential populations are predicted in the immediate vicinity of the ICL site

Impacts to human populations resulting from the construction workforce are expected to result from the influx of people and of the indirect population required to service and support the construction workforce. However, as stated previously, most of the construction workforce is expected to commute daily from their existing residences. Thus, in-migration to the local area due to the construction workforce is expected to be minimal and any impacts to human populations will also be minimal. A detailed analysis of economic, employment, transportation, housing, and community services impacts during construction of the ICL project is found in Section 7.0

4.7

4.7 IMPACT ON LANDMARKS

As previously described in Section 2.2.5, only one area valued for its natural, scenic, or cultural significance is located within the 5-mile study area of the ICL site. This natural feature, Barley Barber Swamp, is located at the extreme western portion of the 5-mile study area, adjacent to the existing FPL Martin power plant cooling pond, approximately 4.5 miles west of the ICL site.

Construction at the ICL site is not expected to have any effect on this natural feature. Surface water quality (see Section 4.2.1) will not be adversely affected during construction. Groundwater effects (see Section 4.3.1) should be limited to onsite dewatering during construction. Dust suppression measures which will be implemented during the construction at the ICL site (see Section 4.5) will be adequate to maintain state air quality standards. Construction activities will not be visible from Barley Barber Swamp, and access will not be affected.

4.8 IMPACTS ON ARCHAEOLOGICAL AND HISTORIC SITES

A summary of the evaluation of archaeological and historic sites within the boundaries of the ICL site was previously presented in Section 2.2.6, and a copy of the cultural resource assessment is appended in Section 10.8. This assessment found no previously recorded archaeological sites and a low probability of finding additional historically significant resources within the ICL site. No archaeological or historic sites eligible for registration in the National Register of Historic Places were found (Piper, 1990).

In the event that a potentially significant archaeological or historic resource is discovered during construction, those construction activities which may potentially disturb these finds will be halted until their potential significance can be determined by a professional archaeologist. If the materials are believed to be significant, the State Historic Preservation Office (SHPO) will be contacted to determine appropriate mitigation measures.

4 9 SPECIAL FEATURES

No special features as described in the FDER SCA guidelines are expected to be associated with the construction of this project

4 10 BENEFITS FROM CONSTRUCTION

Benefits resulting from the site preparation and construction at the ICL site are expected to include increased employment opportunities, and additional county revenues

The construction of the ICL project will provide many employment opportunities within Martin County, adjacent counties, and the region. As previously described in Section 4 6 2, the construction is scheduled to commence in July 1992, and end in December 1995. The construction workforce is expected to peak at 800 employees for 4 to 6 months during the third year of construction. Many of these construction positions will be relatively high-paying skilled positions. A detailed analysis of the socioeconomic benefits resulting from the construction of the ICL project is provided in Section 7 0.

4 11 VARIANCES

There are no variances from applicable standards due to construction activities



REFERENCES

Section 4 3 1

FPL, Martin Coal Gasification/Combined Cycle Project Site Certification Application and Sufficiency Responses, 1989

Prickett, T A , and C G Lonquist, Selected digital computer techniques for groundwater resource evaluation Illinois State Water Survey Bulletin 55, 1971

Theis, C V , The relationship between lowering of piezometric surface and the rate and duration of discharge of a well using ground-water storage Trans Am Geophy Union, Sixteenth Annual Meeting, Part 2, 1935

Section 4 5 2

U S Environmental Protection Agency (EPA) 1988 Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources, AP-42 Fourth Edition, Supplement A, Office of Air Quality Planning and Standards, Research Triangle Park, NC, October

U S Environmental Protection Agency (EPA), 1984 Cost Estimates for Selected Fugitive Dust Controls Applied to Unpaved and Paved Roads in Iron and Steel Plants, Final Report, prepared by Midwest Research Institute for EPA Region V, EPA Contract No 68-01-6314, April

Ohio Environmental Protection Agency (Ohio EPA), 1980 Reasonably Available Control Measures for Fugitive Dust Sources, Office of Air Pollution Control, September

Section 4 6 1

Hahn and Company 1990 Indiantown Action Plan Prepared for the Martin County Growth Management Department

U S Department of Commerce, 1988

Section 4 8

Piper Archaeological Research, Inc 1990 Cultural Resource Assessment Survey of the Proposed Martin County Power Plant Site and Pipeline Right-of-Way, Martin County, Florida

5 0 Effects of Plant Operation

5.1

5 0 EFFECTS OF PLANT OPERATION

5 1 EFFECTS OF THE OPERATION OF THE HEAT DISSIPATION SYSTEM

5 1 1 TEMPERATURE EFFECT ON RECEIVING BODY OF WATER

Since treated wastewater will be discharged to an injection well, this section is not applicable

5 1 2 EFFECTS ON AQUATIC LIFE

Since a heated effluent will not be released to a receiving body of water, this section is not applicable

5 1 3 BIOLOGICAL EFFECTS OF MODIFIED CIRCULATION

This section is not applicable since a heated effluent is not discharged to a receiving body of water. The design of the intake structure to minimize effects on the aquatic environment is discussed in Section 3 5 1 1.

5 1 4 EFFECTS OF OFFSTREAM COOLING

5 1 4 1 Proposed System

The heat dissipation system proposed for the Indiantown Cogeneration, L P (ICL) project will be a linear mechanical draft cooling tower

The proposed tower will be equipped with a bank of ten cells to meet the closed-loop cooling requirements of the plant. Tower design parameters are presented in Table 5 1 4-1

The drift loss rate of the proposed tower is 0.002 percent or 5.3 gallons per minute (gpm). Under normal operation, the total dissolved solids of the circulation water is about 2,800 milligram per liter (mg/l). During periods of extended drought (i.e., a once in 10-year frequency for a maximum of 3 months), the backup cooling water from the Floridan aquifer could result in a total dissolved solids concentration in the circulating water as high as 16,200 mg/l. For the cooling tower impact assessment, only the normal operating conditions were analyzed because the backup water source is used infrequently.

The analyses showed that

- There will be no impact on the visible plume on air traffic in the area
- There will be no impact from ground fogging on the visibility along nearby roads
- There will be no icing conditions associated with the freezing of vapor plume and drift deposition on surrounding areas
- The impact due to deposition of the drift on agricultural and citrus land and orchards will be minimal

Table 5 1 4-1
ICL MECHANICAL-DRAFT COOLING TOWER DESIGN PARAMETERS
USED IN MODEL

Number of Cells	10
Heat Load	1,655 MMBtu/Hr
Circulating Water Flow Rate	265,000 GPM
Design Wet Bulb Temperature	80 °F
Approach	10 °F
Range	90 °F - 102 °F
Air Flow Rate Per Cell	1,575,000 ACFM/Cell
Drift Loss Rate	0.002%
Tower Dimension	60'x 600'x 56'
Fan Diameter	32.8'

Source ICL, 1990

5 1 4 2 Identification of Potential Impacts

The proposed cooling tower will emit moisture into the atmosphere in the form of water vapor and water droplets, defined as drift loss for the facility. If the ambient air is cold and/or moist, a portion of the emitted water vapor will condense to form water droplets. This is seen as a visible white plume emanating from the cooling tower. Under most conditions, the plume evaporates as it moves downwind because of mixing with unsaturated air and from adiabatic heating. The frequency, persistence, and size of a visible plume depends on the type of cooling system and the local climate. An entire visible plume or a portion of a visible plume can be brought to the ground through high winds or turbulent eddies. Ground-level fogging can be produced from a cooling system plume when the visible plume reaches the ground.

As the normal service and circulating water flows through the fill section of the cooling tower, the impact of the falling water on the splash bars create small water droplets, some of which are carried away by the air stream moving through the tower. These entrained droplets, or drift which leave the cooling tower, contain dissolved solids that may cause a buildup of salt concentration in the soil and/or deposit on the surface of nearby vegetation. Therefore, operation of the cooling system has the potential to cause impacts on soil and vegetation in the surrounding areas. In addition, operation of a cooling system at sub-freezing temperatures can also produce ground-level icing.

5 1 4 3 Assessment Methodology

The EPRI-sponsored Seasonal/Annual Cooling Tower Plume Impact model (EPRI, 1984) was used to quantify the impacts. This computer code is an outgrowth of an earlier model evaluation study carried out by Argonne National Laboratory (ANL). Improved plume and drift models in the code have been calibrated with existing field and laboratory data and then subsequently verified with new data not included in the calibration process. This model has been widely used in preparing

environmental assessments of cooling towers by utilities and their consultants. This program can predict the seasonal and annual impacts of the cooling tower plume's potential for drift, icing, and fogging.

The SACTI model is used to calculate plume dispersion and drift deposition for the proposed cooling tower. The same 5-year set of meteorological data (1982-1986) collected at the West Palm Beach NWS station was used for the air quality analyses in Section 5.6 and with the SACTI model to estimate cooling tower impacts. The cooling tower parameters that are modeled to determine hours of fogging, hours of icing, and potential salt deposition are presented in Table 5.1.4-1.

The spatial variation of the drift deposition rate is strongly dependent on the droplet size distribution. The larger droplets in the plume fall to the ground closer to the tower than the smaller droplets. Since there are no drift droplet size distribution data available for the proposed cooling tower, the drift spectrum provided in the Users Manual of the SACTI model was used (see Table 5.1.4-2).

5.1.4.4 Impact Assessments

The following subsections discuss the assessment of environmental impacts associated with operation of the ICL plant cooling tower. Climatological effects addressed include enhanced frequencies of fogging and icing, their extent and duration, and potential obstruction to ground and airborne traffic. The potential for impacts to soils and vegetation in the site area, due to cooling tower salt drift deposition, is also discussed.

Fogging Potential

The visible plume may reduce visibility if it crosses the path of ground-based or air traffic. The only nearby public road is U.S. Route 710 (see Figure 5.1.4-1). Its closest approach to the plant site is at least 750 meters to the northeast. At this distance, the SACTI model predicts a plume height of about 150 meters above the

COOLING TOWER LOCATION



**INDIANTOWN
COGENERATION
PROJECT**

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TABLE 5 1 4-2

COMPOSITE COOLING TOWER DRIFT EMISSION SPECTRUM^a

<u>Interval</u>	<u>d_l</u> <u>(μm)</u>	<u>d_u</u> <u>(μm)</u>	<u>Mass</u> <u>Fraction(%)</u>
1	0	10	0.00
2	10	20	0.53
3	20	30	4.43
4	30	40	7.41
5	40	50	6.51
6	50	60	5.48
7	60	70	3.51
8	70	90	3.26
9	90	110	1.78
10	110	130	0.95
11	130	150	0.76
12	150	180	1.10
13	180	210	1.17
14	210	240	1.32
15	240	270	1.41
16	270	300	1.82
17	300	350	2.67
18	350	400	2.33
19	400	450	2.29
20	450	500	1.51
21	500	600	4.33
22	600	700	3.51
23	700	800	3.82
24	800	900	2.73
25	900	1000	1.71
26	1000	1200	3.19
27	1200	1400	3.32
28	1400	1600	6.43
29	1600	1800	2.21
30	1800	2000	3.07
31	2000	2200	15.4

a - Source: EPRI, 1984.

b - Droplet diameter lower (d_l) and upper (d_u) size range in microns (μ m) for given interval.

ground. Since terrain around the plant site is essentially flat, visibility on nearby roads is not expected to be degraded by the formation of this elevated visible plume.

Table 5.1.4-3 shows the frequency of elevated, visible plume formation and its length as a function of wind direction. The frequency of visible plume formation in all directions reduces to about 2 percent on an annual basis at 600 meters (0.38 mile) downwind of the tower. With respect to potential visibility impacts to air traffic, the nearest private airport is located 2.5 miles north of the plant site. At that distance, the visible plume is not expected to hinder the safe operation of aircraft during take-off or landing.

Induced ground-level fogging will occur during plume downwash conditions. However, this locally induced fog will be dissipated rapidly due to the high winds associated with such plume downwash conditions. Table 5.1.4-4 shows that most of the ground-level fogging exists within 300 meters of the plant. The south and south-southeast are the two directions for which plume fogging persists up to a distance of 1.25 kilometers for about an hour per year. Since the northwest-southeast oriented Route 710 is more than 750 meters to the northeast of the cooling tower, induced ground fog will not obstruct the traffic flow on Route 710.

Icing Potential

The SACTI model predicted no occurrence of induced icing in this subtropical area (see Table 5.1.4-4). Therefore, no icing potential exists as a direct result of cooling tower operations.

Salt Deposition Impacts on Soils

Seasonal and annual salt deposition rates were calculated out to a distance of 10 km downwind of the cooling tower. Annual salt deposition rates are presented in Table 5.1.4-5 in terms of $\text{kg}/\text{km}^2\text{-mo}$. These deposition rates can be converted

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

TABLE 5 1 4-3

VISIBLE PLUME FREQUENCY
Sheet 1 of 2

1 ***** PLUME LENGTH FREQUENCY TABLE *****
INDIANTOWN, 1982-86 WEST PALM BEACH NET DATA (LMDCT, 10 CYCLES)
SEASON-ANNUAL

DISTANCE FROM TOWER (M)	WIND FROM *****																*****	
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	SUM	
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM	
50	5 30	2 44	4 80	7 74	15 68	9 62	10 42	6 05	8 35	3 53	3 95	3 23	5 09	3 76	5 10	4.93	100 00	
100	.34	1.75	3 62	.81	1 02	.30	.39	.16	.22	2 17	2.57	.17	.40	.37	.40	.33	15 02	
150	.12	.44	.53	.77	.98	.13	.18	.13	.09	1 69	1 96	.05	.18	.30	.29	.05	7 89	
200	.02	.37	.61	.01	.04	.13	.18	.00	.00	1 51	1 79	.00	.00	.30	.29	.01	5 08	
250	.02	.25	.25	.01	.04	.13	.18	.00	.00	1.15	1 41	.00	.00	.30	.29	.01	4 05	
300	.00	.21	.19	.00	.00	.03	.03	.00	.00	.99	1.21	.00	.00	.20	.24	.00	3 10	
350	.00	.17	.15	.00	.00	.03	.03	.00	.00	.82	1 02	.00	.00	.20	.24	.00	2 67	
400	.00	.17	.15	.00	.00	.03	.03	.00	.00	.82	1 02	.00	.00	.20	.24	.00	2.67	
450	.00	.17	.15	.00	.00	.03	.03	.00	.00	.82	1.02	.00	.00	.20	.24	.00	2 67	
500	.00	.13	.12	.00	.00	.03	.03	.00	.00	.62	.73	.00	.00	.20	.24	.00	2 11	
550	.00	.13	.12	.00	.00	.03	.03	.00	.00	.62	.73	.00	.00	.20	.24	.00	2 11	
600	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
650	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
700	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
750	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
800	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
850	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
900	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
950	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1000	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1050	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1100	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1150	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1200	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1250	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1300	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1350	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1400	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1450	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1500	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1550	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1600	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1650	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1700	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1750	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1800	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1850	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1900	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
1950	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2000	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2050	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2100	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2.08	
2150	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2200	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2250	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2300	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2350	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2400	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2450	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2500	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	

TABLE 5 1 4-3

VISIBLE PLUME FREQUENCY
Sheet 2 of 2

***** PLUME LENGTH FREQUENCY TABLE *****																		
INDIAN TOWN, 1982-86 WEST PALM BEACH MET DATA (LMDCT, 10 CYCLES)																		
SEASON=ANNUAL																		
DISTANCE	WIND FROM																	
FROM	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	SUN	
TOWER	PLUME HEADED																	
(M)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUN	
2550.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2600.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2650.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2700.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2750.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2800.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2850.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2900.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
2950.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3000.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3050.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3100.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3150.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3200.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3250.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3300.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3350.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3400.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3450.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3500.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3550.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3600.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3650.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3700.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3750.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3800.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3850.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3900.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
3950.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4000.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4050.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4100.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4150.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4200.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4250.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4300.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4350.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4400.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4450.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4500.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4550.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4600.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4650.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4700.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4750.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4800.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4850.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4900.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
4950.	.00	.13	12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	
5000.	.00	.13	.12	.00	.00	.03	.02	.00	.00	.62	.73	.00	.00	.18	.24	.00	2 08	

Source Bechtel, 1990

TABLE 5 1 4-4
FOGGING AND ICING FREQUENCIES

1 ***** HOURS OF PLUME FOGGING TABLE *****
INDIANTOWN, 1982-86 WEST PALM BEACH NET. DATA (LMDCT)
SEASON=ANNUAL

DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
100.	4.7	6.7	8.4	10.2	14.9	.0	.0	.9	.9	.8	1.5	.8	1.3	.0	.0	.9	51.9
150	7.5	2.6	5.7	23.5	37.8	8.5	.5	2.5	2.5	.5	.4	.8	3.0	.8	.5	3.8	100.7
200	7.1	.4	.8	16.9	34.8	1.9	.1	2.1	2.1	.1	.0	.2	3.0	.2	.1	2.4	72.3
250.	6.3	.0	.0	13.0	29.4	.0	.0	1.7	1.7	.0	.0	.0	2.6	.0	.0	2.0	56.7
300	3.8	.0	.0	5.5	12.5	.0	.0	.7	.7	.0	.0	.0	1.1	.0	.0	2.0	26.4
350	2.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.0	4.0
400.	2.0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.0	4.0
450.	2.0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.0	4.0
500	2.0	0	.0	0	.0	0	.0	.0	.0	.0	.0	.0	.0	0	0	2.0	4.0
600.	1.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.5	3.0
750.	1.0	0	0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.0	2.0
1000.	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.0	2.0
1250	.7	.0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	.7	1.5
1500	.0	0	.0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1750	0	0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2000	.0	0	0	.0	.0	.0	0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0

1 ***** HOURS OF RIME ICING TABLE *****
INDIANTOWN, 1982-86 WEST PALM BEACH NET. DATA (LMDCT)
SEASON=ANNUAL

DISTANCE FROM TOWER (M)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
100	0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	0
150	.0	.0	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0
200	.0	0	0	0	.0	.0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	0
250.	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
300	0	0	0	0	0	.0	.0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0
350	.0	0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0
400	0	0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
450	.0	.0	0	.0	0	0	0	.0	0	.0	0	.0	.0	0	0	.0	.0
500	.0	0	0	.0	.0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	0	.0
600.	0	0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
750	0	.0	.0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1000	0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	0
1250	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1500	.0	.0	0	.0	.0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1750	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
2000	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

Source Bechtel, 1990

TABLE 5 1 4-5

COOLING TOWER SALT DEPOSITION
Sheet 1 of 2

***** PLUME SALT DEPOSITION TABLE (KG / (KM **2-MO)) *****																		
INDIANTOWN, 1982-86 WEST PALM BEACH NET DATA (LNDCT, 10 CYCLES)																		
SEASON=ANNUAL																		
DISTANCE	***** WIND FROM *****																	
FROM	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG	
TOWER	***** PLUME HEADED *****																	
(M)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG	
100	14275	9260	20325	29540	58567	32095	33592	19129	22912	8524	9615	8029	12659	9890	13048	11616	19567	
200	1220	811	1648	2432	4783	2309	2425	1618	2031	1135	1247	709	1132	752	989	1024	1642	
300	355	189	368	626	1222	641	681	424	552	306	332	210	338	212	274	317	440	
400	155 90	96 79	185 59	302 16	607 37	376 13	398 54	215.03	276 18	152 30	167 71	92 40	145 42	137 64	182 63	130 66	226 40	
500	112 58	44 19	84 58	150 72	307 94	187 54	205 79	132 92	197.61	72 64	80.82	70 61	111 35	48 03	62 36	106 76	123 53	
600	86 71	19 36	33 76	111 32	224 80	143 09	156 47	94 10	141.12	38.27	42 48	54 99	87 23	40 59	53 27	84 55	88 26	
700	40 49	14 31	25 33	68 80	137 59	111 68	121 19	50 23	67.68	24 14	27.51	23 41	36 79	32 73	41 81	34 50	53 64	
800	26.35	8 65	13 97	30 49	62 18	74 86	82 44	28 58	44 64	19 16	21 46	16 12	26 15	22 03	29 61	25 87	33 29	
900	17 79	5 45	8 69	21 67	42 54	46 63	53 01	16 99	24 76	11 74	13 02	9 95	16 54	18 80	25 19	16 77	21 85	
1000	15 45	3 94	6 25	20 88	40 77	44 66	50 22	15 49	21 44	8 49	9 47	8.33	13 74	17 80	23 43	14 02	19 65	
1100	18 58	3 21	4 99	18 81	37 24	40 36	44 53	15 44	27 17	7 17	7 95	12 08	20 93	14 30	18 10	18 99	19 37	
1200	23 52	4 59	5 93	16 86	32 89	36 44	40 44	15 73	36 24	14 22	15 35	17 48	31 64	12 28	15 42	26 54	21 60	
1300	10 34	3 75	4 78	12 42	24 36	26 30	29 60	9 37	14.34	11 93	12.80	5 62	9 62	7 83	10 04	10 25	12 71	
1400	21 07	1 63	2 84	20 06	47 09	18 41	19 82	30 39	41 71	2 80	3 24	11 69	17 61	3 89	5 52	13 51	16 3	
1500	14 12	1 48	2 68	15 65	35 62	18 36	19 75	21 52	28 55	2 47	2 82	7 66	11 43	3 87	5 50	8 51	12.50	
1600	3 34	.80	1 23	6 08	11 61	16 80	18 23	3 60	4 72	2 03	2 30	1 80	3 04	3 65	5 28	3 16	5 48	
1700	3 31	.51	.61	5 86	11 34	13 06	14 11	3 56	4 70	1 79	2 03	1 79	2 99	3 26	4 78	3 15	4 80	
1800	3 20	.49	.60	5 82	11 28	5 31	5 66	3 49	4 58	1 74	1 95	1.75	2 93	2 72	3.93	3.06	3 66	
1900	3 17	.48	.58	5 80	11 26	5 18	5 49	3 48	4 56	1 69	1 87	1.74	2 91	2 47	3 45	3 03	3 57	
2000	3 16	.46	.56	5 80	11 24	4 95	5 18	3 46	4 52	1 64	1 83	1 73	2 89	2 02	2 66	3 02	3 45	
2100	3 15	.41	.50	5 80	11 22	4 88	5 06	3 45	4 52	1 47	1 67	1 73	2 89	1.93	2 49	3 01	3.39	
2200	2 55	.37	.45	3 08	5 98	4 56	4 76	2.32	3.64	1 31	1 47	1 51	2 53	1 88	2 45	2 76	2 60	
2300	2 39	.34	.41	3 02	5 88	1 58	1 92	2 20	3 42	1 18	1.34	1 43	2 40	1 17	1 60	2 56	2 05	
2400	2 00	.29	.36	2 91	5 63	1 28	1 56	1 95	2 86	.94	1 09	1 18	2 00	.66	1 00	2.01	1 73	
2500	1 55	.26	.33	2 75	5 31	1 23	1 49	1.70	2.30	.80	.88	.85	1 43	.63	.97	1 38	1 49	
2600	1 27	.25	.32	2 68	5 17	1 05	1 25	1 59	2 01	.77	.83	.66	1 09	.59	.92	1 00	1 34	
2700	1 15	.23	.30	2 41	4 83	.76	.90	1 51	1 87	.74	.80	.57	.92	.46	.76	.87	1 19	
2800	1 10	.23	.30	2 40	4 80	.76	.90	1 48	1 79	.73	.80	.54	.86	.43	.73	.82	1 17	
2900	.95	.16	.21	2 34	4 63	.76	.90	1 36	1.51	.54	.62	.45	.69	.43	.73	.68	1 06	
3000	.73	.14	.19	1 63	3 18	.76	.89	.94	1 05	.47	.55	.34	.55	.43	.72	.57	.82	
3100	.40	.13	.17	.21	.44	.35	.46	.34	.58	.41	.49	.23	.37	.40	.68	.43	.38	
3200	.36	.12	.17	.19	.41	.33	.41	.31	.53	.39	.46	.21	.34	.38	.63	.39	.35	
3300	.34	.11	.15	.18	.40	.32	.40	.30	.52	.35	.40	.20	.33	.38	.62	.38	.34	
3400	.34	.11	.15	.18	.40	.32	.40	.30	.52	.35	.40	.20	.33	.38	.62	.38	.34	
3500	.34	.10	.13	.18	.40	.32	.40	.30	.52	.28	.35	.20	.33	.38	.62	.38	.33	
3600	.34	.09	.12	.18	.40	.32	.40	.30	.52	.21	.27	.20	.33	.38	.62	.38	.32	
3700	.34	.08	.10	.18	.40	.32	.40	.30	.52	.20	.26	.20	.33	.38	.62	.38	.31	
3800	.34	.04	.05	.18	.40	.32	.40	.30	.52	.11	.15	.20	.33	.38	.62	.38	.30	
3900	.34	.03	.04	.18	.40	.27	.32	.30	.52	.06	.07	.20	.33	.29	.46	.38	.26	
4000	.32	.02	.04	.16	.37	.24	.28	.28	.50	.06	.07	.20	.32	.23	.33	.36	.23	
4100	.30	.02	.04	.14	.34	.23	.27	.26	.48	.06	.07	.20	.31	.19	.28	.35	.22	
4200	.30	.02	.04	.14	.34	.22	.26	.26	.47	.06	.06	.19	.31	.19	.27	.35	.22	
4300	.30	.02	.03	.14	.34	.21	.24	.26	.47	.06	.06	.19	.31	.17	.25	.35	.21	
4400	.30	.02	.03	.14	.34	.17	.18	.26	.47	.05	.06	.19	.31	.13	.17	.35	.20	
4500	.24	.02	.03	.09	.21	.17	.18	.16	.34	.05	.06	.16	.26	.12	.17	.32	.16	
4600	.24	.02	.03	.09	.20	.16	.17	.16	.33	.05	.06	.16	.26	.12	.16	.32	.16	
4700	.24	.02	.03	.09	.20	.16	.17	.15	.32	.05	.06	.16	.25	.12	.16	.31	.16	
4800	.24	.02	.03	.09	.20	.16	.17	.15	.32	.05	.05	.16	.25	.12	.16	.31	.15	
4900	.24	.02	.03	.09	.20	.16	.17	.15	.32	.05	.05	.16	.25	.12	.16	.31	.15	
5000	.20	.02	.03	.08	.17	.16	.17	.13	.27	.05	.05	.13	.20	.12	.16	.25	.14	

TABLE 5 1 4-5

COOLING TOWER SALT DEPOSITION
Sheet 2 of 2

1 ***** PLUME SALT DEPOSITION TABLE (KG / (KM **2-MO)) *****
INDIANTOWN, 1982-86 WEST PALM BEACH NET DATA (LMDCT, 10 CYCLES)
SEASON=ANNUAL

DISTANCE FROM TOWER (M)	WIND FROM								PLUME HEADED								AVG
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
5100.	.20	.02	.03	.08	.17	.16	.17	.13	.27	.05	.05	.13	.20	.12	.16	.25	.14
5200.	.20	.02	.03	.08	.17	.16	.17	.13	.27	.05	.05	.13	.20	.12	.16	.25	.14
5300.	.19	.02	.02	.08	.17	.16	.17	.12	.25	.05	.05	.12	.19	.12	.16	.24	.13
5400.	.17	.02	.02	.07	.16	.16	.17	.10	.23	.05	.05	.11	.18	.12	.16	.21	.12
5500.	.16	.02	.02	.07	.15	.16	.17	.10	.22	.05	.05	.11	.17	.12	.16	.20	.12
5600.	.13	.02	.02	.06	.14	.16	.17	.09	.18	.05	.05	.08	.14	.12	.16	.16	.11
5700.	.12	.02	.02	.06	.13	.16	.17	.09	.18	.05	.05	.08	.13	.12	.16	.14	.10
5800.	.10	.02	.02	.06	.12	.16	.17	.08	.15	.05	.05	.07	.12	.12	.16	.12	.10
5900.	.09	.02	.02	.05	.12	.16	.16	.07	.14	.05	.05	.06	.11	.10	.14	.11	.09
6000.	.09	.02	.02	.05	.12	.15	.16	.07	.14	.05	.05	.06	.11	.09	.12	.11	.09
6100.	.09	.02	.02	.05	.12	.15	.16	.07	.14	.05	.05	.06	.11	.09	.12	.11	.09
6200.	.09	.02	.02	.05	.12	.15	.16	.07	.14	.05	.05	.06	.11	.09	.12	.11	.09
6300.	.09	.02	.02	.05	.12	.15	.16	.07	.14	.05	.05	.06	.11	.09	.12	.11	.09
6400.	.09	.02	.02	.05	.12	.15	.16	.07	.14	.05	.05	.06	.11	.09	.11	.11	.09
6500.	.09	.02	.02	.05	.11	.15	.16	.07	.14	.05	.05	.06	.11	.08	.11	.11	.09
6600.	.09	.02	.02	.05	.11	.14	.15	.07	.14	.05	.05	.06	.11	.07	.09	.10	.08
6700.	.09	.02	.02	.05	.11	.14	.15	.07	.14	.05	.05	.06	.11	.07	.09	.10	.08
6800.	.09	.02	.02	.05	.11	.14	.15	.07	.14	.05	.05	.06	.11	.07	.09	.10	.08
6900.	.09	.02	.02	.05	.11	.14	.15	.07	.14	.04	.05	.06	.11	.07	.09	.10	.08
7000.	.09	.02	.02	.05	.11	.14	.15	.07	.14	.04	.05	.06	.11	.07	.09	.10	.08
7100.	.09	.02	.02	.05	.11	.14	.15	.07	.14	.04	.05	.06	.11	.07	.09	.10	.08
7200.	.09	.02	.02	.05	.11	.14	.15	.07	.14	.04	.05	.06	.11	.07	.09	.10	.08
7300.	.09	.02	.02	.05	.11	.14	.15	.07	.14	.04	.05	.06	.11	.07	.09	.10	.08
7400.	.08	.02	.02	.05	.11	.14	.15	.06	.13	.04	.05	.06	.10	.07	.09	.09	.08
7500.	.07	.02	.02	.05	.11	.14	.15	.06	.12	.04	.05	.06	.09	.07	.10	.08	.08
7600.	.07	.02	.02	.05	.11	.14	.15	.06	.12	.04	.05	.06	.09	.07	.10	.08	.08
7700.	.07	.02	.02	.05	.11	.14	.15	.06	.12	.04	.05	.06	.09	.07	.10	.08	.08
7800.	.07	.02	.02	.05	.11	.14	.15	.06	.12	.04	.05	.06	.09	.07	.10	.08	.08
7900.	.07	.02	.02	.05	.11	.14	.15	.06	.12	.04	.05	.06	.09	.07	.10	.08	.08
8000.	.07	.02	.02	.05	.11	.14	.15	.06	.12	.04	.05	.06	.09	.07	.10	.08	.08
8100.	.07	.02	.02	.05	.11	.14	.15	.06	.12	.04	.05	.06	.09	.07	.10	.08	.08
8200.	.07	.02	.02	.05	.11	.14	.15	.06	.12	.04	.04	.05	.09	.07	.10	.08	.08
8300.	.06	.02	.02	.05	.10	.14	.15	.05	.11	.04	.04	.05	.09	.07	.10	.08	.07
8400.	.06	.02	.02	.05	.10	.14	.15	.05	.11	.04	.04	.05	.09	.07	.09	.08	.07
8500.	.06	.02	.02	.05	.10	.14	.15	.05	.11	.04	.04	.05	.09	.07	.09	.08	.07
8600.	.06	.02	.02	.05	.10	.14	.15	.05	.11	.04	.04	.05	.09	.07	.09	.08	.07
8700.	.06	.02	.02	.05	.10	.14	.14	.05	.11	.04	.04	.05	.09	.07	.09	.08	.07
8800.	.06	.02	.02	.05	.10	.14	.14	.05	.11	.04	.04	.05	.08	.06	.09	.07	.07
8900.	.06	.01	.02	.04	.10	.14	.14	.05	.10	.04	.04	.04	.07	.06	.08	.07	.07
9000.	.05	.01	.02	.04	.08	.13	.14	.04	.08	.03	.04	.04	.07	.06	.07	.06	.06
9100.	.05	.01	.02	.04	.08	.13	.13	.04	.08	.03	.04	.04	.07	.04	.05	.06	.06
9200.	.05	.01	.02	.04	.08	.13	.13	.04	.08	.03	.04	.04	.07	.04	.05	.06	.06
9300.	.05	.01	.02	.04	.07	.13	.13	.03	.07	.03	.03	.03	.05	.04	.05	.05	.05
9400.	.04	.01	.02	.03	.07	.11	.11	.03	.06	.03	.03	.03	.05	.04	.05	.05	.05
9500.	.04	.01	.02	.03	.07	.10	.10	.03	.06	.03	.03	.03	.05	.04	.05	.05	.05
9600.	.04	.01	.02	.03	.07	.10	.10	.03	.06	.03	.03	.03	.05	.04	.05	.05	.05
9700.	.04	.01	.02	.03	.07	.10	.10	.03	.06	.03	.03	.03	.05	.04	.05	.05	.05
9800.	.04	.01	.02	.03	.07	.10	.10	.03	.06	.03	.03	.03	.05	.04	.05	.05	.05
9900.	.04	.01	.02	.03	.07	.10	.10	.03	.06	.03	.03	.03	.05	.04	.05	.05	.05
10000.	.04	.01	.02	.03	.07	.10	.10	.03	.06	.03	.03	.03	.05	.04	.05	.05	.05

to units of lb/acre-mo by applying a multiplication factor of 0.0089. As shown in Table 5.1.4-5, most of the drift is deposited onsite within 100 meters of the cooling tower.

The maximum annual average offsite salt deposition rate is 18.1 lbs/acre-mo. This value occurred 200 m north of the tower on the property of the Caulkins Citrus processing facility. At 500 meters north of the cooling tower, the maximum deposition rate reduces to 1.8 lbs/acre-mo. At this same downwind distance, the minimum salt deposition rate of 0.4 lb/acre-mo occurred south-southwest of the tower.

One mechanism for the impact of saline drift on plants is through the absorption of salt accumulated in the soil. Accumulation will occur if the annual deposition of salt exceeds the rate at which salt is washed from the soil by rainfall. The results of studies (MPPSP, 1979, pp. 4-18 to 4-23) with sandy loam soil suggest that a deposition rate of about 89 lbs/acre-mo (100 kg/Ha-mo) of NaCl can cause some accumulation of salt in the soil. As stated above, the maximum annual average offsite salt deposition rate is 18.1 lbs/acre-mo. During the summer months, the SACTI model predicts a higher maximum deposition rate of 24.7 lbs/acre-mo. Since these values are lower than the monthly threshold value that could cause salt accumulation in soil, no significant soil impacts are expected.

Salt Deposition Impacts on Vegetation

An investigation of the potential effects of cooling tower drift on vegetation was conducted in which predicted salt deposition rates were compared to available known salt injury thresholds. A predicted salt deposition rate is presented as the amount of salt deposited over a unit area per season and year at a certain direction and "distance" away from the tower.

Near the proposed power plant site boundary, salt deposition rates on an annual basis range from 0.42 to 216.9 lbs/acre-year. These are obtained by multiplying

the predicted monthly deposition rates by 12. The greatest concentrations are located to the north and east of the proposed power plant, where existing industrial facilities are located.

A cautionary limit of 100 pounds of salt per acre-year can be used for agricultural areas based upon known salt injury thresholds to other crops (e.g., tobacco, 214 lbs/acre-year, corn, 107 lbs/acre-year, and soybean, 107-154 lbs/acre-year), (Mulchi, Wolf, and Armbruster, 1978).

Citrus, a potentially sensitive plant to salt deposition, is present in large groves from the south-southeast clockwise through the southwest, and to the northwest of the cooling tower. The closest groves are about 4,000 feet to the southwest and about 4,200 feet to the south of the cooling tower. At these locations, the highest levels of salt deposition over an annual period are about 0.6 lb/acre-yr and 1.1 lbs/acre-yr, respectively, which should not result in any significant foliar, shoot, or fruit damage or any long-term reductions in growth, yield, or photosynthesis.

Cooling tower drift will also deposit salt on the improved pasture, truck crops, dairy farms, and sugar cane agricultural land in the area around the proposed plant site, but at greater distances from the tower than the citrus groves. The agricultural land around the proposed plant should not be affected by these emissions, since the maximum amount of salt deposited will only amount to about 1 lb/acre-year at the closest distance of agricultural activities near the site (i.e., the citrus groves). That is, the proposed plant operation should not cause the cautionary limit for agriculture to be approached or exceeded within agricultural areas.

Based upon a literature review, one of the most sensitive native plant species to salt injury is flowering dogwood (Cornus florida). The lowest injury threshold for flowering dogwood is reported at 81 lbs/acre-year (Curtis, et al, 1978). Although flowering dogwood is only naturally occurring much further north of Martin County, a similar dogwood species, stiff cornell (Cornus foemina) would be expected within the mixed and cypress swamps in the immediate area (approximately 2,900 feet

southeast of the cooling tower) On the basis of the reported injury threshold and a predicted maximum annual salt deposition rate of 2.7 lbs/acre-year in the vicinity of forested wetlands offsite, no adverse effects to dogwood or other indigenous vegetation is expected offsite.

Native vegetation associated with pine and wet prairies occurs onsite and along the property boundaries. Salt deposition could, at a maximum, range from 172.8 to 216.9 lbs of salt per acre-year on the northern property boundaries, and at higher rates within the site. Such high levels could result in plant injury. However, the "units" of the modeling result in Table 5.1.4-5 imply that the deposition rate value applies over an area, a square-kilometer, for example. The value that is determined for each receptor point is calculated assuming that the rate of deposition is the same over the unit area. As the values in Table 5.1.4-5 show, close to the cooling tower there is a large gradient in deposition values between adjacent wind direction sectors and successive 100-meter increments of downwind distances which can only occur if the deposition rate varies significantly over the unit area. Therefore, the deposition rates for these close-in receptor points must be used with caution in evaluating potential effects on plants as they could greatly overestimate impacts.

Based upon the assumption that ambient salt deposition rates in the region are minimal, incremental salt deposited from the cooling towers should have no significant adverse effect on natural vegetation or crops just outside site boundaries or in the region of the proposed plant site.

5 1 5 MEASUREMENT PROGRAM

This section is not applicable since there will not be a heated effluent discharged to a receiving body of water. Ambient air quality monitoring is discussed in Section 5 6 2.

5 2 EFFECTS OF CHEMICAL AND BIOCIDES DISCHARGES

5 2 1 INDUSTRIAL WASTEWATER DISCHARGES

When using the primary source of water, Taylor Creek/Nubbin Slough (TC/NS), for process water makeup, wastewater from the plant (excluding cooling tower blowdown) is reused to meet the spray dryer lime slurry dilution water demand. When using the backup sources of water for process water makeup (mixture of TC/NS water from the cooling water storage pond and groundwater from the upper production zone of the upper Floridan aquifer), the majority of the wastewater from the plant (excluding cooling tower blowdown) is reused to meet the spray dryer lime slurry dilution water demand. The remainder is mixed with brine from the reverse osmosis unit and cooling tower blowdown and sent to the injection well. Table 5 2 1-1 summarizes the wastewater flows (both process wastewater and cooling tower blowdown) from the ICL plant.

Section 3 6 2 discusses the wastewater treatment scheme to control pH, oil, and suspended solids. Section 3 5 1 5 addresses the discharge of the wastewater into the Boulder Zone of the Floridan aquifer via the injection wells. There is no wastewater discharge from the plant to a surface receiving body of water.

Table 5 2 1-2 presents the quality of the wastewater discharged via the injection well for two cases: average annual flows using the primary source of water and maximum daily flows using the backup sources of water.

No hazardous materials may be discharged via the injection well. Therefore, the measures described in Section 3 5 1 5 will be taken to ensure that any hazardous solvents, degreasers, or other chemicals that may be used at the plant will not enter the floor drains or equipment drains connected to the wastewater equalization tank.

Table 5 2 1-1
SUMMARY OF WASTEWATER DISCHARGES FROM THE ICL PROJECT

<u>Case</u>	<u>Maximum Daily (MGD)</u>	<u>Maximum Monthly (MG/Mo)</u>	<u>Average Annual (MGY)</u>
Primary Source of Water			
Plant Wastewater	0 215	6 57	77 5
Cooling Tower Blowdown	0 446	13 0	145
Reuse as Spray Dryer Dilution	<u>-0 235</u>	<u>-7 28</u>	<u>-85 7</u>
TOTAL TO INJECTION WELL	0 426	12 3	137
Backup Sources of Water			
Plant Wastewater	0 444	13 5	40 4
Cooling Tower Blowdown	1 63	46 7	135
Reuse as Spray Dryer Dilution	<u>-0 235</u>	<u>-7 28</u>	<u>-21 8</u>
TOTAL TO INJECTION WELL	1 84	52 9	154

Notes

- 1 Wastewater from the ICL plant is discharged to the Boulder Zone of the lower Floridan aquifer via an injection well
- 2 Maximum daily discharge flows are based on design flows through the cooling tower and 100 percent load factor for 24 hours
- 3 Maximum monthly discharge flows are based on the highest average monthly flows through the cooling tower at 100 percent load factor for 31 days
- 4 Average annual wastewater discharge flows when using the primary source of water are based on the annual average flows through the cooling tower at 100 percent load factor for 365 days Average annual wastewater discharge flows when using the backup source of water are based on the annual average flows through the cooling tower at 100 percent load factor for 3 months

Source Bechtel, 1990

Table 5 2 1-2
SUMMARY OF THE ICL WASTEWATER QUALITY

<u>Parameter</u>	<u>Primary Water Source (mg/l)</u>	<u>Backup Water Source (mg/l)</u>
pH	6-9	6-9
Total Dissolved Solids	3,240	14,800
Total Hardness (as CaCO ₃)	364	1,560
Oil/Grease	< 15	< 15
Residual Chlorine	< 1 0	< 1 0
Alkalinity (as CaCO ₃)	153	118
Silica	25	17
Calcium	103	285
Magnesium	26	207
Sodium	994	4,820
Potassium	61	96
Iron	0 73	< 0 06
Sulfate	1,095	1,480
Chloride	832	7,700
Fluoride	-	3 2
Nitrate	0 69	-
Phosphate	0 68	< 2 3

NOTES

- 1 Concentrations are in mg/l of the ion
- 2 The wastewater effluent quality for the primary water source (Taylor Creek/Nubbin Slough) is based on average annual flows through the water and wastewater treatment system. These flows are based on the average annual meteorological conditions for the cooling tower, 100 percent load factor and 24 hours per day for 365 days. The cooling tower operates at 10 cycles of concentration.
- 3 The wastewater effluent quality for the backup water source (lower production zone of the upper Floridan aquifer for cooling water makeup and mixture of Taylor Creek/Nubbin Slough and upper production zone of upper Floridan aquifer for process water makeup) is based on maximum daily flows through the water and wastewater treatment system. These flows are based on design meteorological conditions for operation of the cooling tower and 100 percent load factor for 24 hours. The cooling tower operates at 3 5 cycles of concentration.

Source: Bechtel, 1990

The quality of the groundwater in the Boulder Zone of the Floridan aquifer (into which wastewater from the plant is being discharged) resembles that of seawater. A typical quality is shown in Table 5.2.1-3. The quality of the plant effluent will not degrade the quality of the groundwater in the Boulder Zone. There are no known users of groundwater from the Boulder Zone of the lower Floridan aquifer, either for industrial process water or for potable water. Therefore, there are no significant impacts due to the injection of wastewater from the ICL plant into the Boulder Zone of the lower Floridan aquifer.

Table 5 2 1-3
TYPICAL WATER QUALITY FOR LOWER FLORIDAN BOULDER ZONE

<u>Parameter</u>	<u>(mg/l)</u>
pH (Lab)	7.4
Total Dissolved Solids	38,200
Total Hardness	6,470
Alkalinity	100
Calcium	2,800
Magnesium	3,670
Iron	0.76
Sulfate	2,680
Chloride	19,400
Fluoride	0.62

NOTE

This analysis was of a sample taken from a 3,320-foot deep well approximately 24 miles from the ICL plant

Source CH2M Hill, 1990

5 2 2 COOLING TOWER BLOWDOWN

When using the primary source of water for cooling water makeup (Taylor Creek/Nubbin Slough), a portion of the cooling tower blowdown is reused to meet the spray dryer lime slurry dilution water demand. The remainder of the cooling tower blowdown is discharged to the Boulder Zone of the lower Floridan aquifer via the injection well. When using the backup source of water for cooling water makeup (lower production zone of the upper Floridan aquifer), all of the cooling tower blowdown is discharged to the Boulder Zone of the lower Floridan aquifer. Table 5 2 1-1 summarizes the cooling tower blowdown flows from the plant under various operating conditions.

The chemicals used to treat the circulating water are described in Section 3 6 1 1. Section 5 2 1 addresses impacts due to the discharge of wastewater into the Boulder Zone of the Floridan aquifer via the injection wells.

5 2 3 MEASUREMENT PROGRAMS

The injection well monitoring plan is fully described in Section 3 5 1 5. This plan includes measuring wastewater quality and measuring water quality in the monitoring well to detect changes caused by possible migration of the injected wastewater.

5.2

5 3 IMPACTS ON WATER SUPPLIES

5 3 1 SURFACE WATER

This section discusses the effects of plant water withdrawal from the Taylor Creek/Nubbin Slough (TC/NS) on the C-59, L-63N, and L-63S Canals water levels, Lake Okeechobee, other users, and the groundwater level

5 3 1 1 Plant Water Withdrawal

As discussed in Sections 3 5 and 10 9, the annual average plant water requirement is about 7 5 cfs and the historic average flow in the TC/NS is 146 4 cfs Therefore, the annual average plant withdrawal from the canal is about 5 percent of the TC/NS flow, and the impact on the flow is minimal

The predicted water levels in the TC/NS canals caused by the plant water withdrawal are discussed comprehensively in Section 10 9 Based on that analysis for the selected minimum design water level criteria of 16 feet-MSL, the predicted water levels in the canal will not deviate significantly from the historical levels at S-191 during a normal year Figures 5 3 1-1 through 5 3 1-16 compare the predicted water levels against the historic ones During the drought conditions, the canal water level may drop 2 to 3 feet below its historic water levels

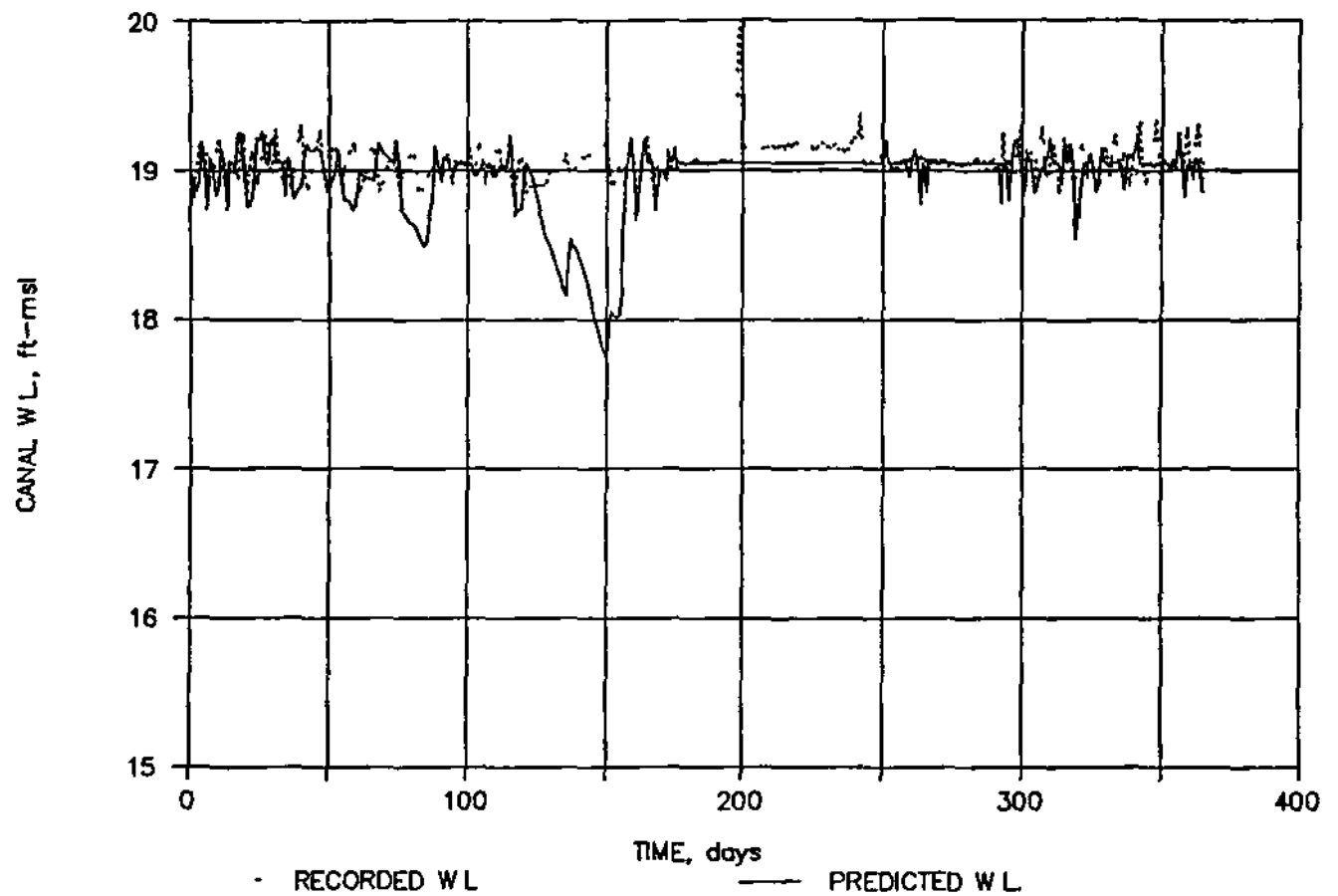
Depending on the drought frequency, the duration of low water levels may last from a few days to 60 consecutive days The effect of the canal water level drop on the adjacent groundwater is discussed further in Section 5 3 1 3

5 3 1 2 Lake Okeechobee

As discussed in Section 2 3 4 I, the mean annual discharge from S-191 into Lake Okeechobee amounts to about 106,000 acre-feet per year, which represents about

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**



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Figure 531-1

MAKEUP AND PROCESS WATER WITHDRAWAL, 1974

INDIANTOWN
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PROJECT

Indiantown Cogeneration L.P.

Source: Bechtel 1990

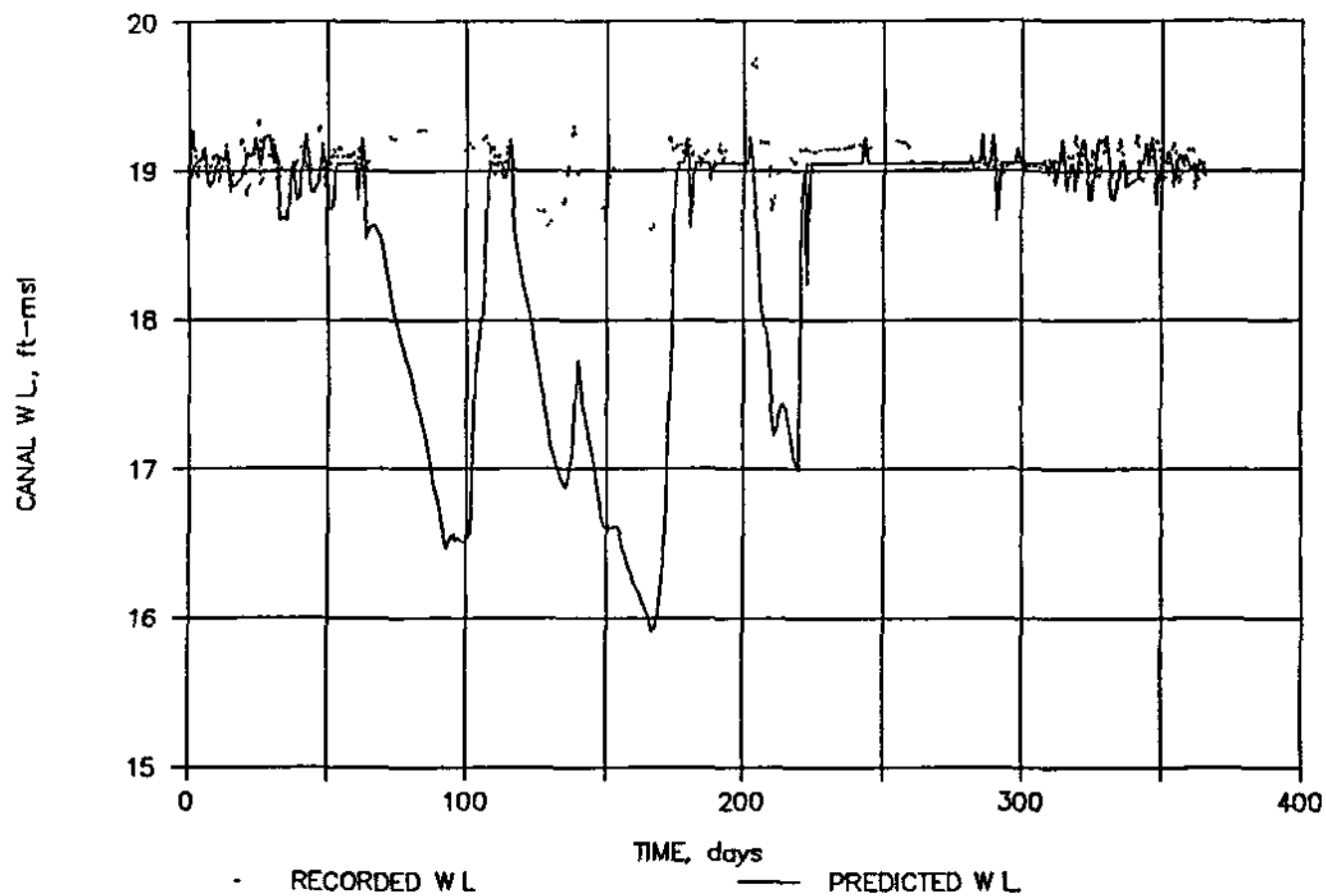


Figure 531-2

MAKEUP AND PROCESS WATER WITHDRAWAL, 1975

Source Bechtel 1990

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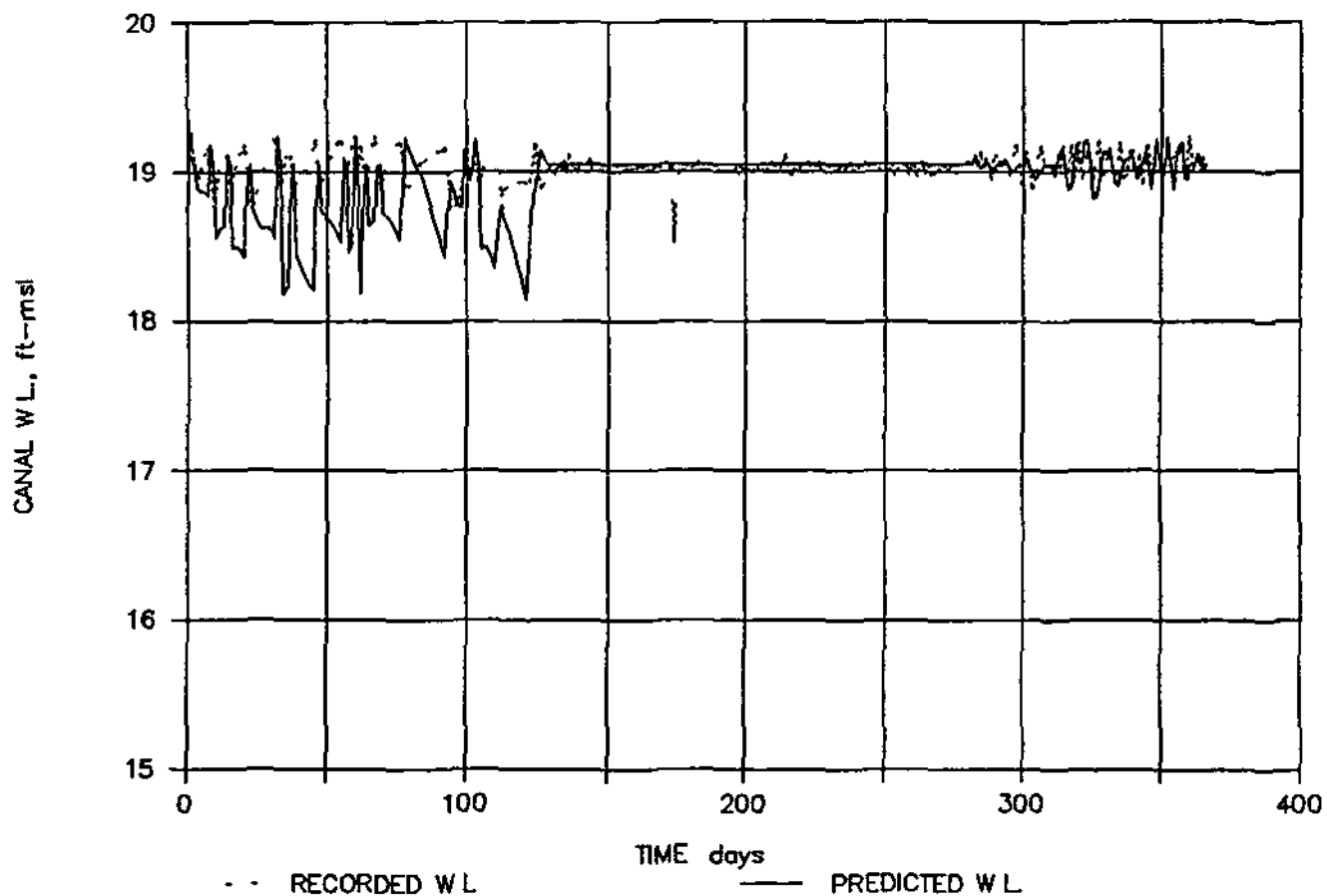


Figure 531-3

MAKEUP AND PROCESS WATER WITHDRAWAL, 1976

INDIANTOWN
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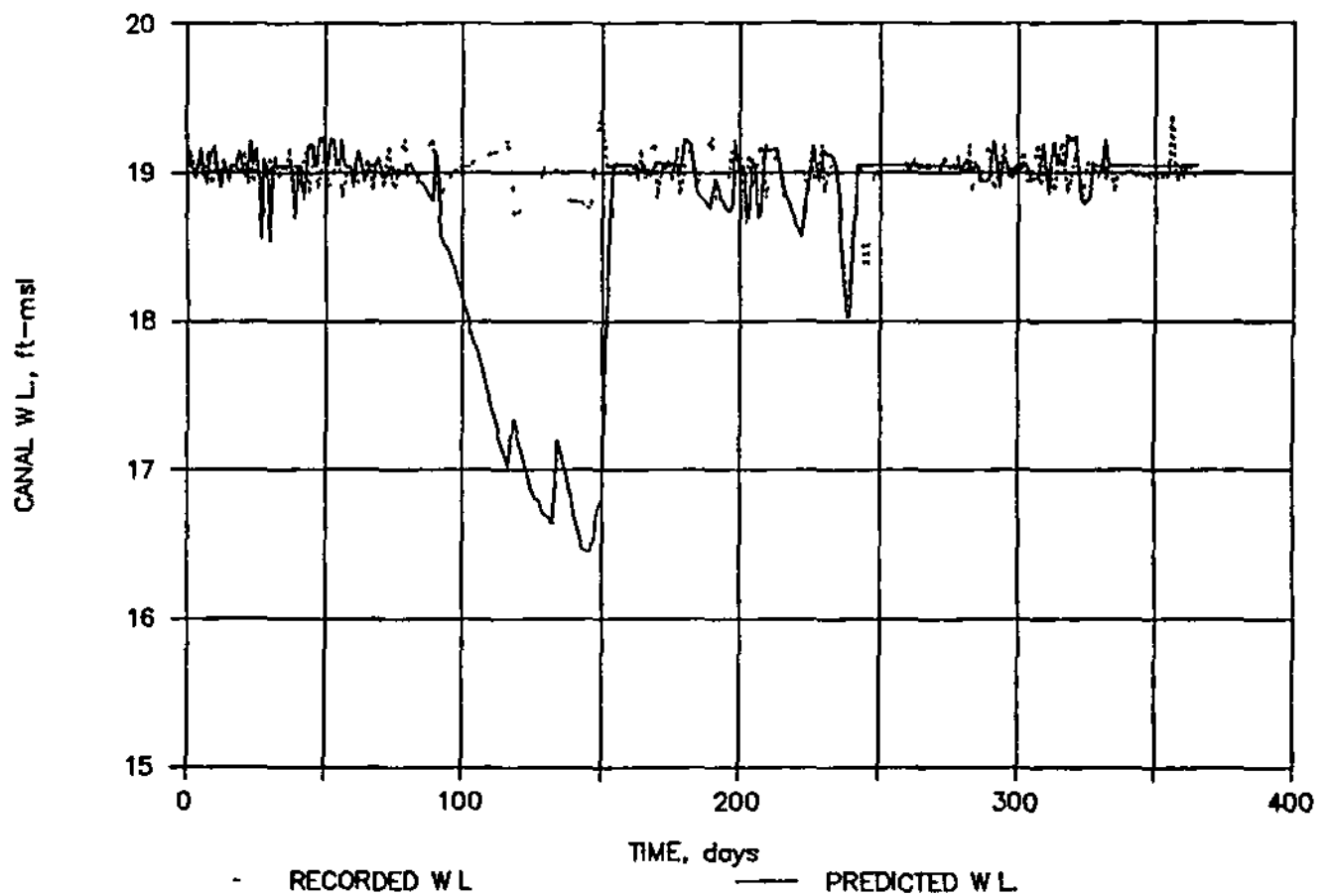


Figure 531-4

MAKEUP AND PROCESS WATER WITHDRAWAL, 1977

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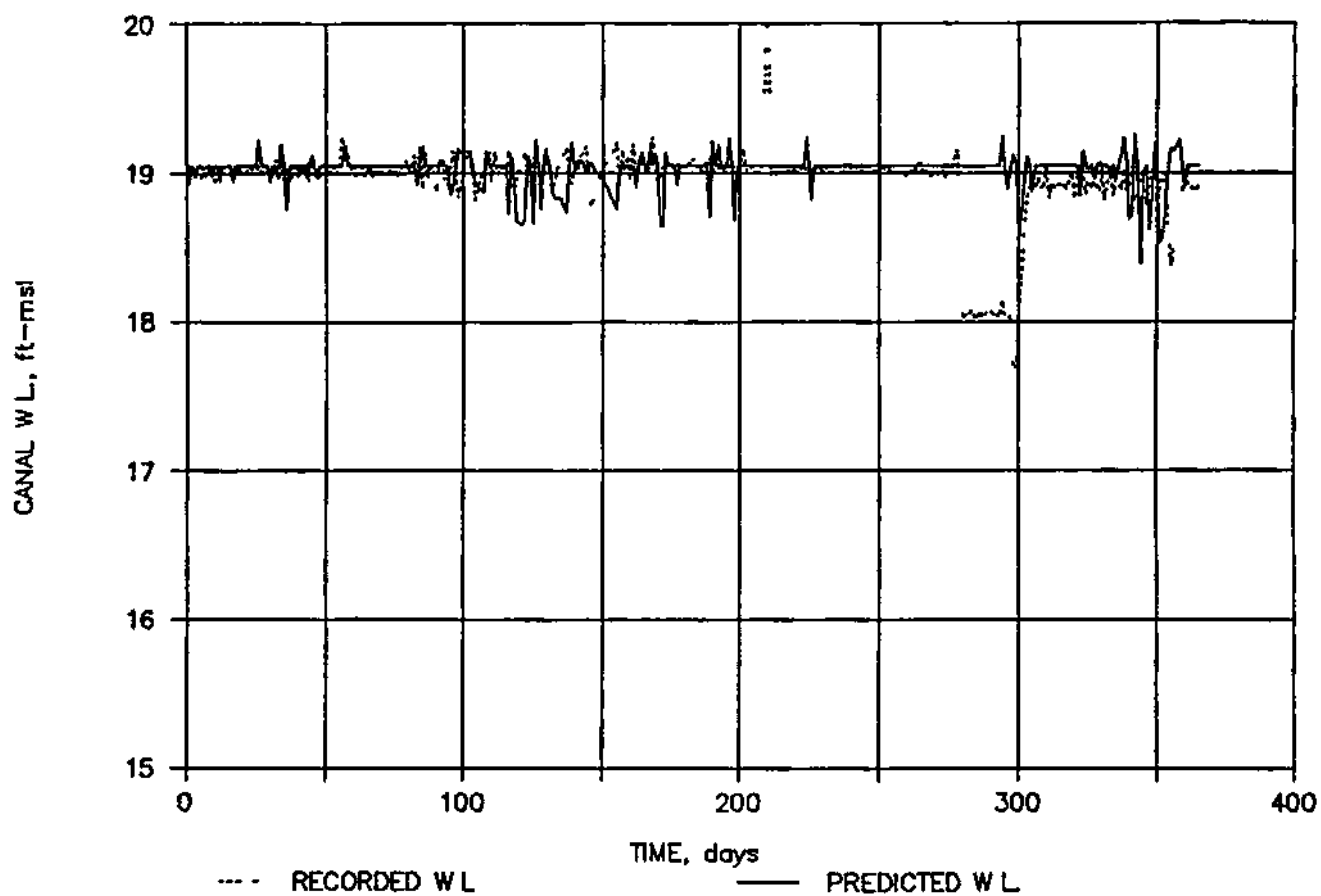


Figure 531-5

MAKEUP AND PROCESS WATER WITHDRAWAL, 1978

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L P

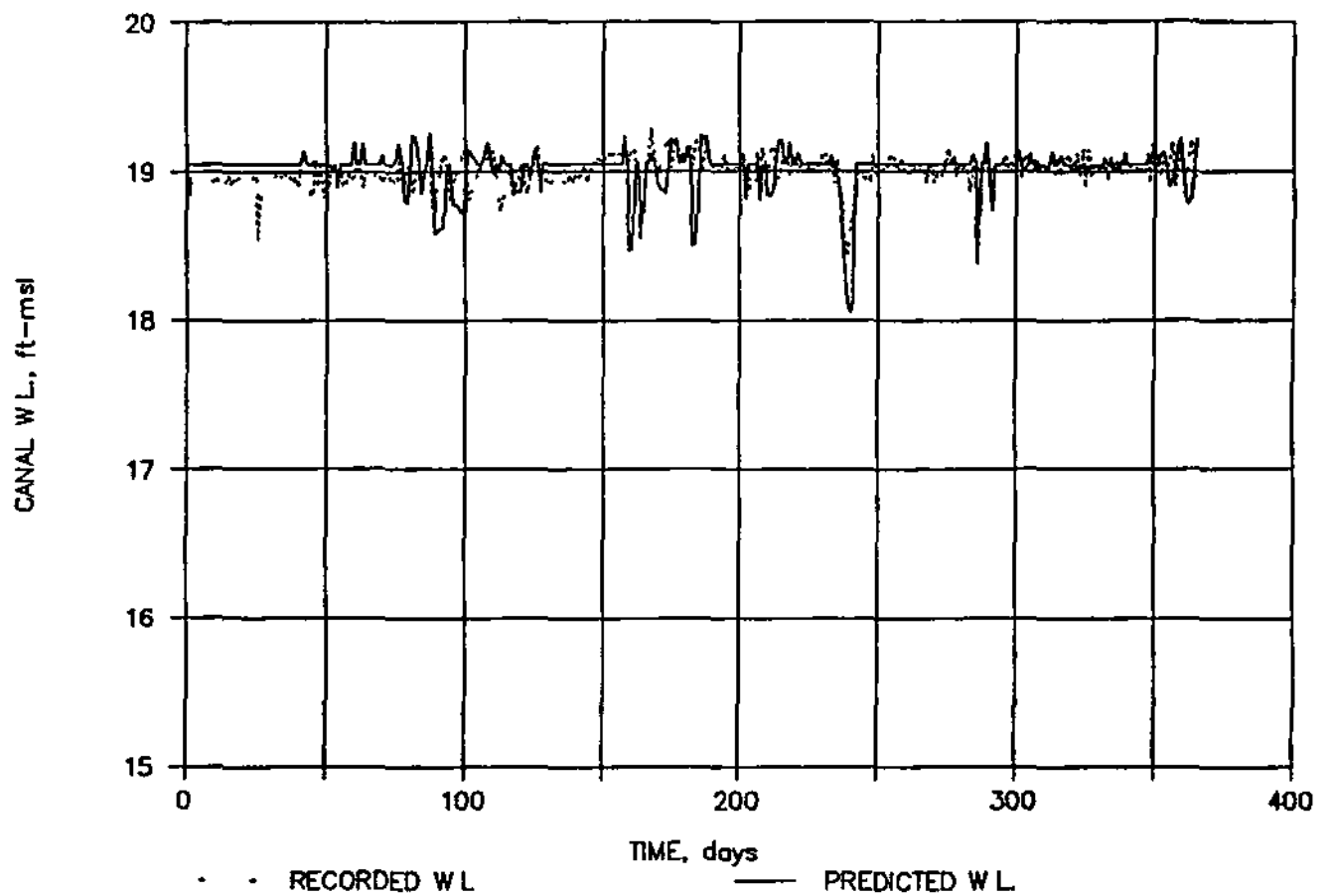


Figure 531-6

MAKEUP AND PROCESS WATER WITHDRAWAL, 1979

INDIANTOWN
COGENERATION
PROJECT

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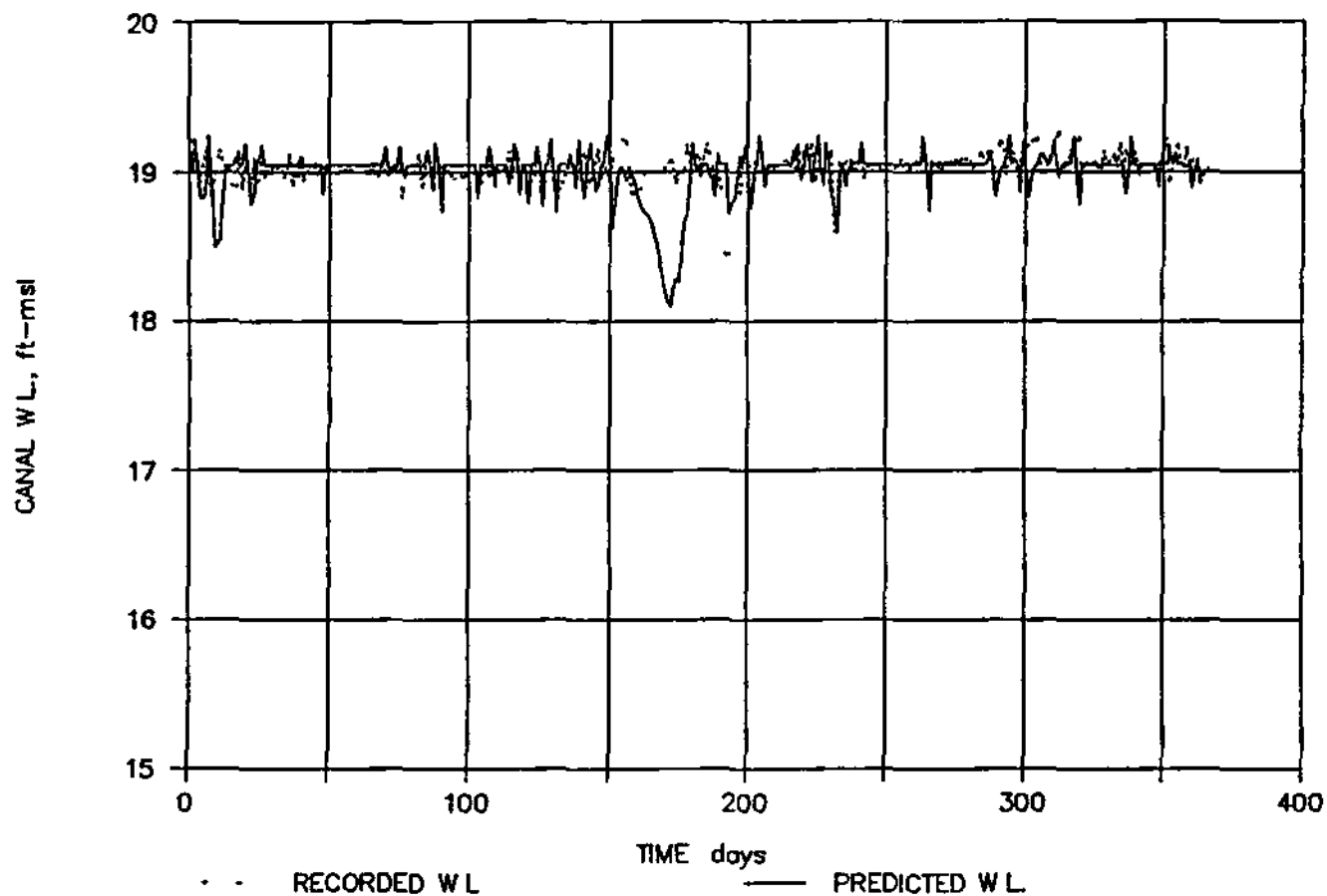


Figure 531-7

MAKEUP AND PROCESS WATER WITHDRAWAL, 1980

Source Bechtel 1990

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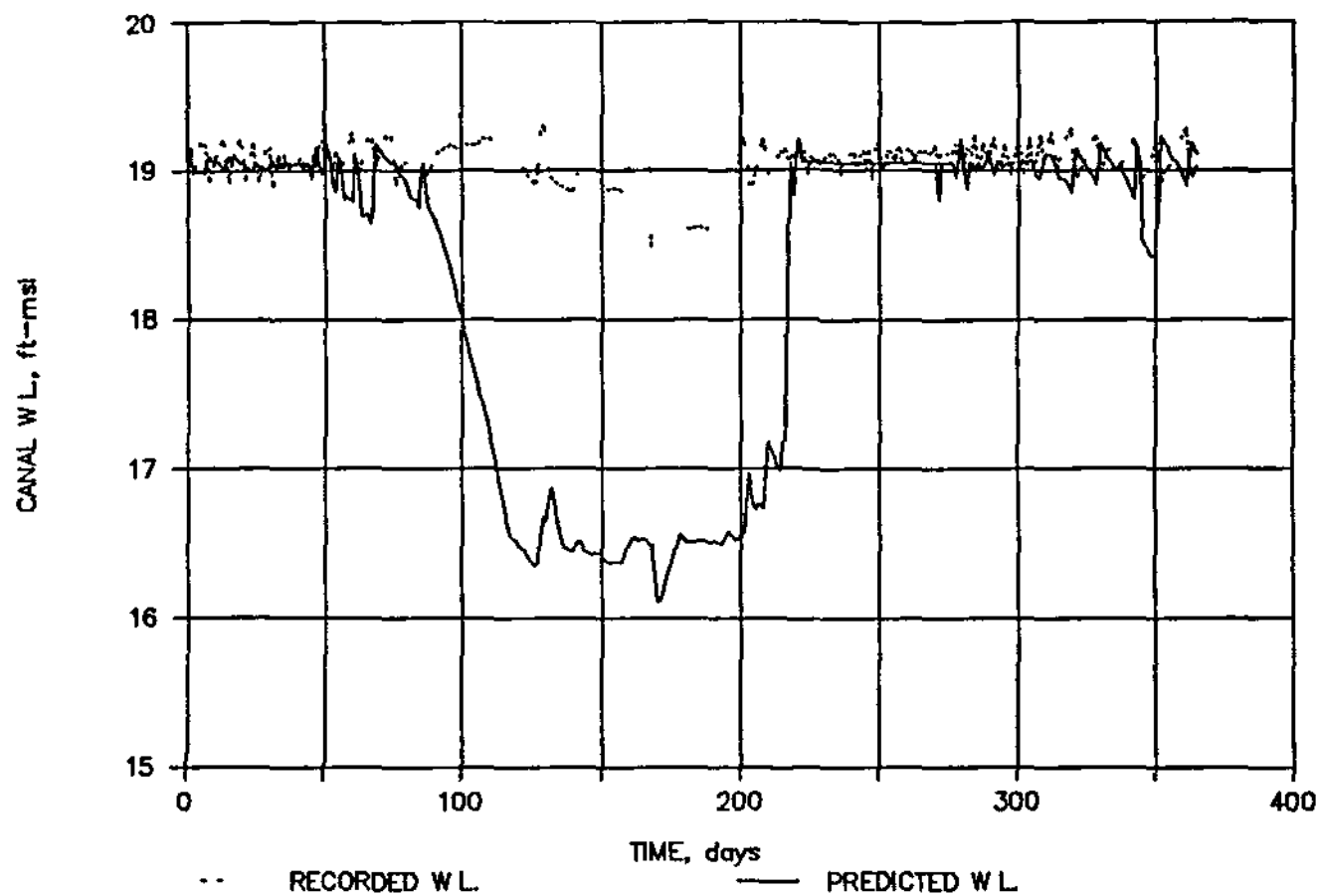


Figure 53 1-8

MAKEUP AND PROCESS WATER WITHDRAWAL, 1981

INDIANTOWN
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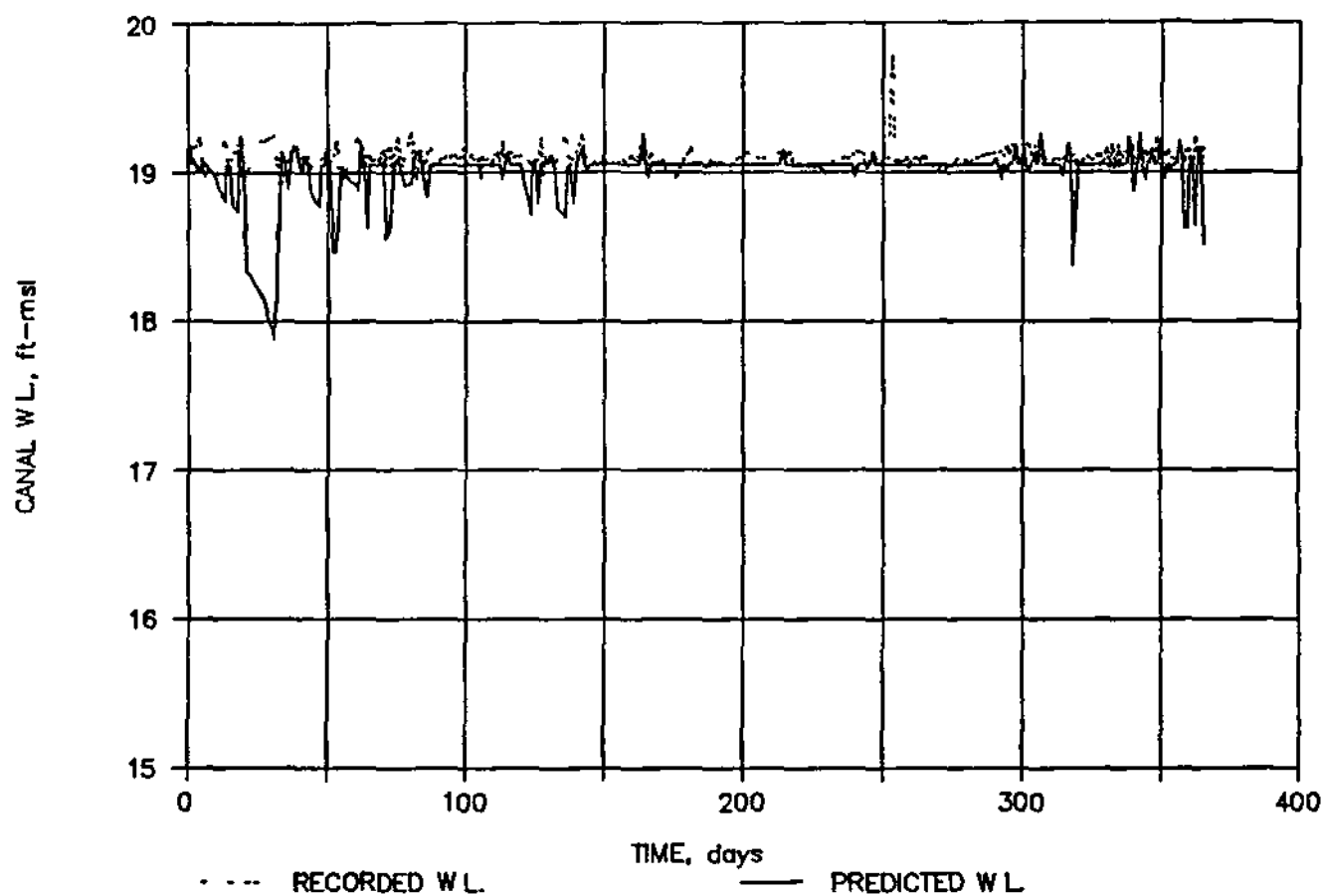


Figure 531-9

MAKEUP AND PROCESS WATER WITHDRAWAL, 1982

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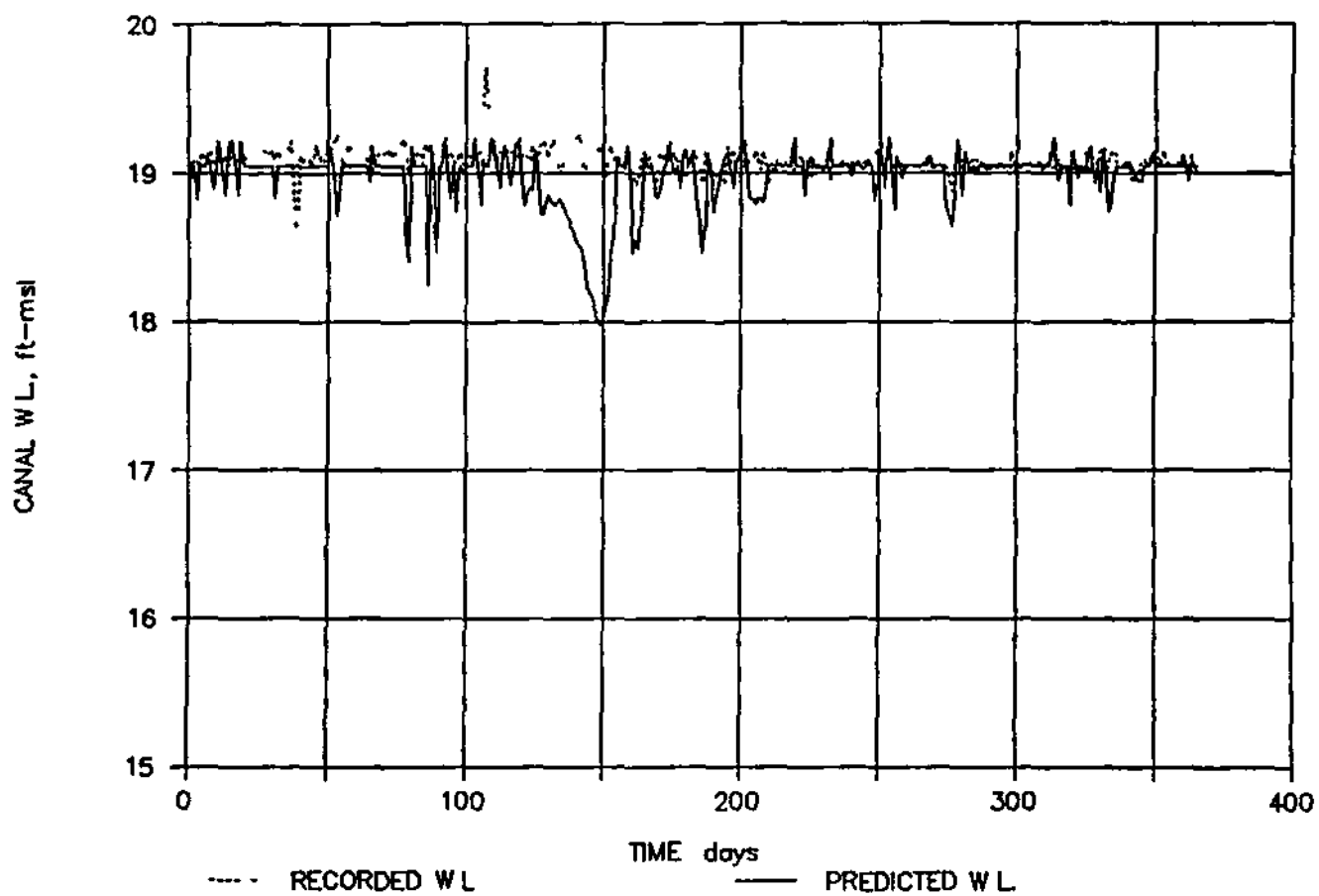


Figure 53 1-10

MAKEUP AND PROCESS WATER WITHDRAWAL, 1983

Source Bechtel 1990

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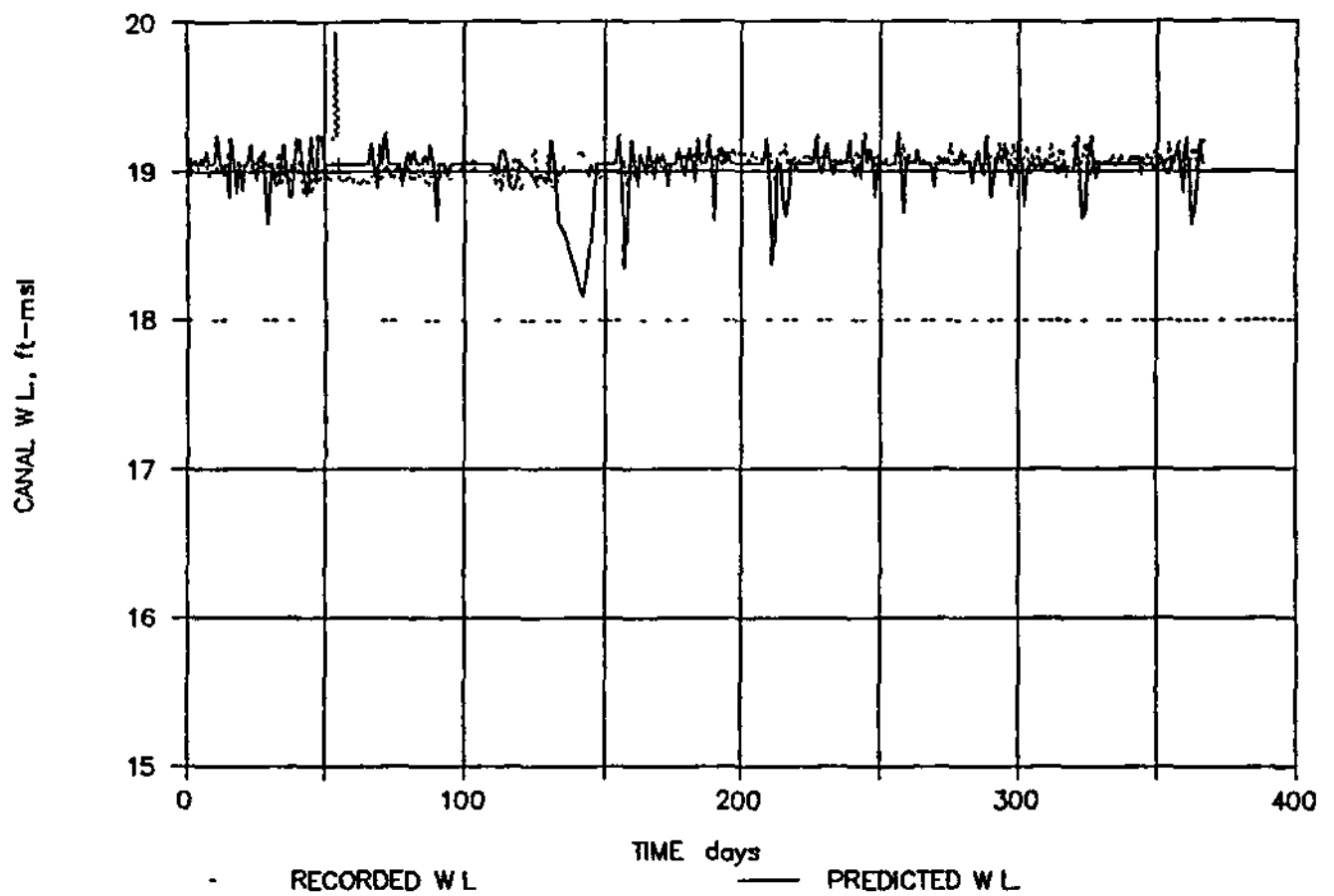


Figure 531-11

MAKEUP AND PROCESS WATER WITHDRAWAL, 1984

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Source Bechtel 1990

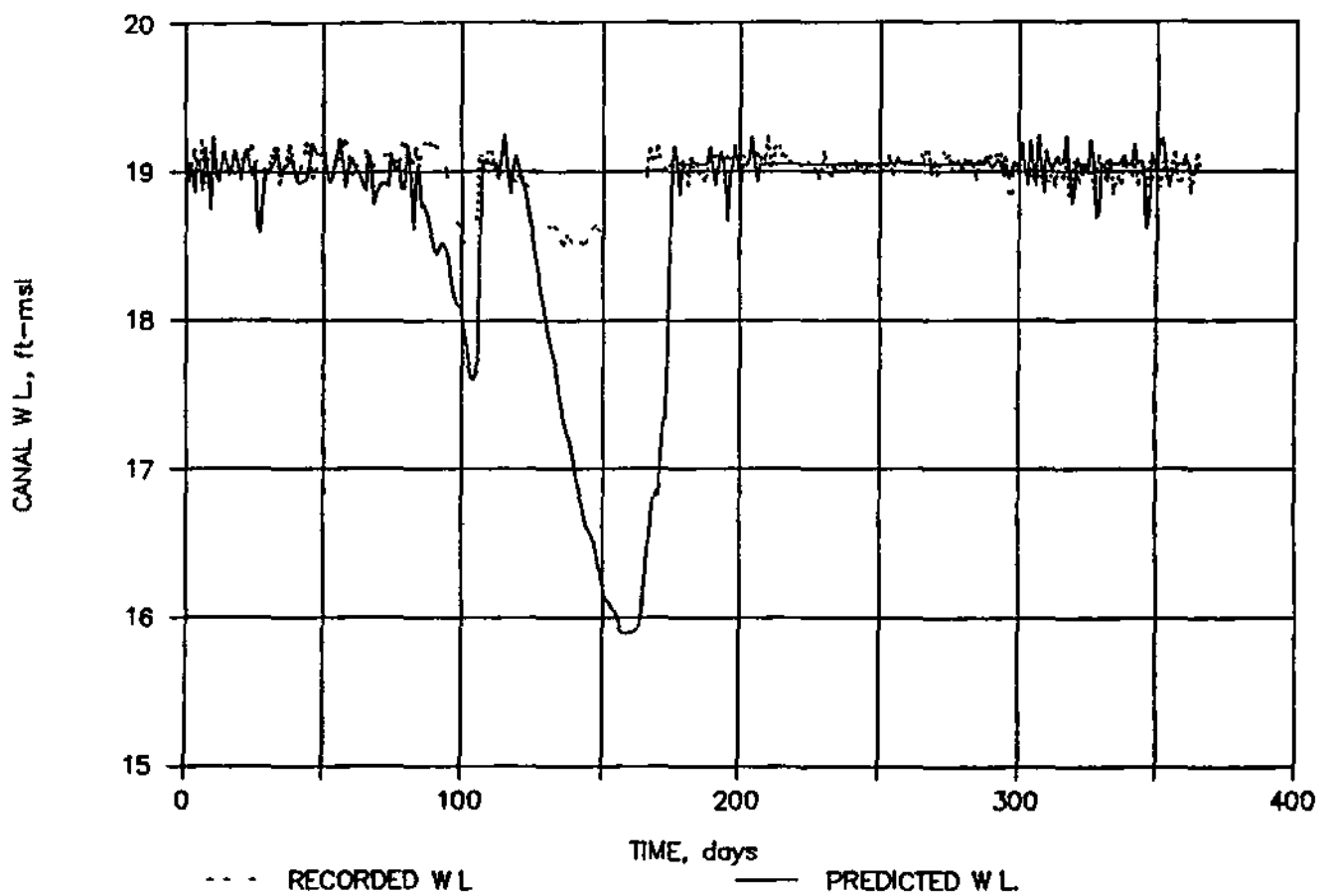


Figure 53 1-12

MAKEUP AND PROCESS WATER WITHDRAWAL, 1985

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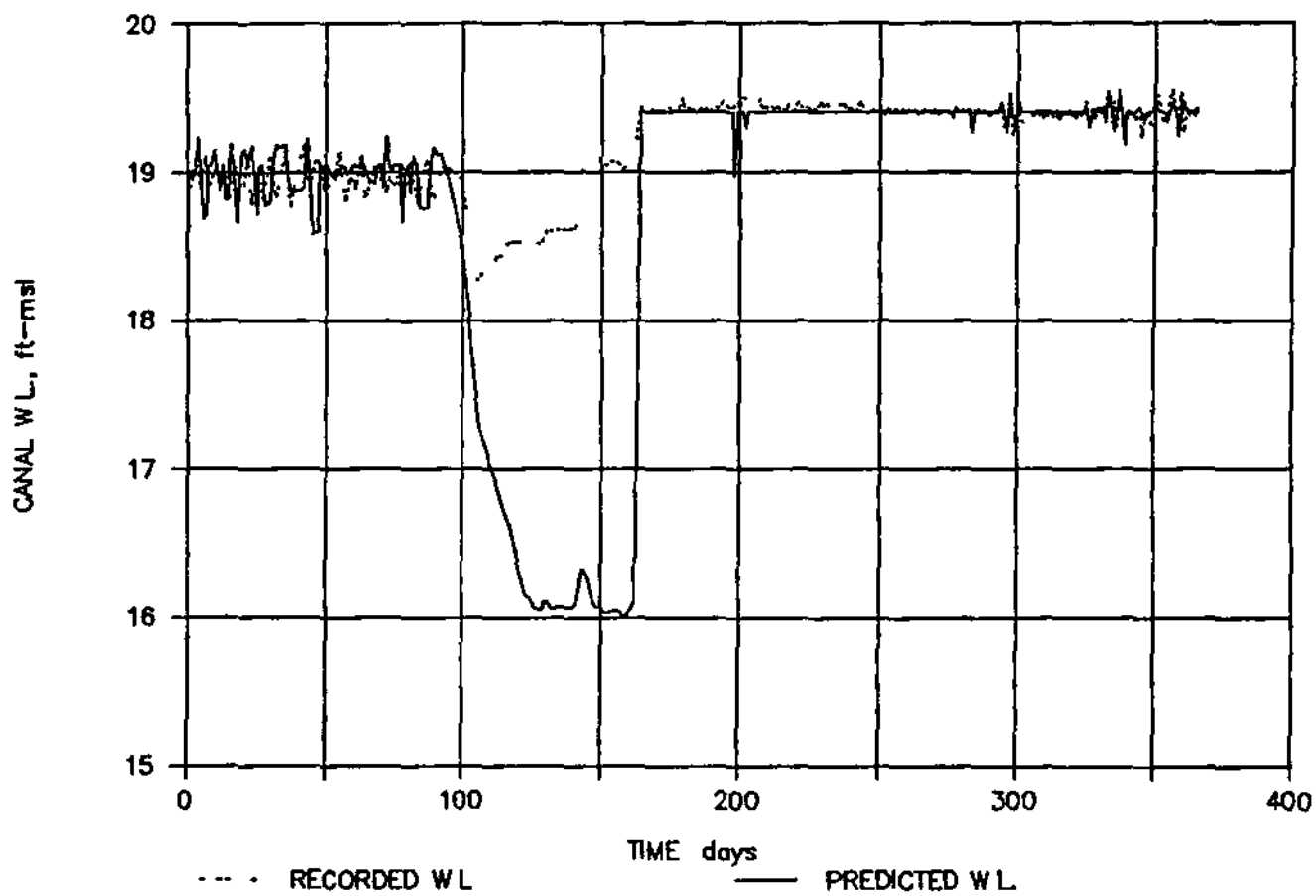


Figure 531-13

MAKEUP AND PROCESS WATER WITHDRAWAL, 1986

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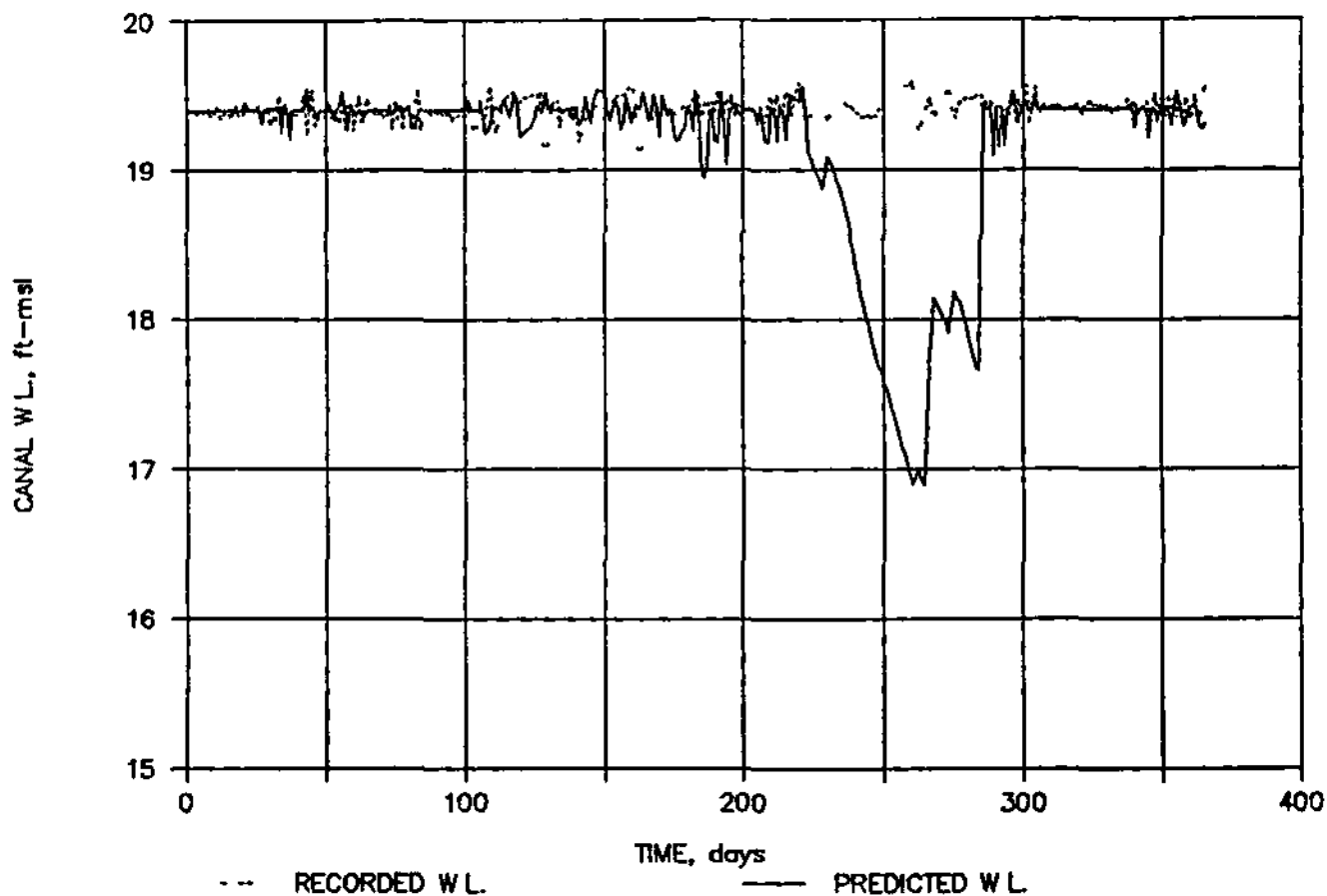


Figure 531-14

MAKEUP AND PROCESS WATER WITHDRAWAL, 1987

Source Bechtel 1990

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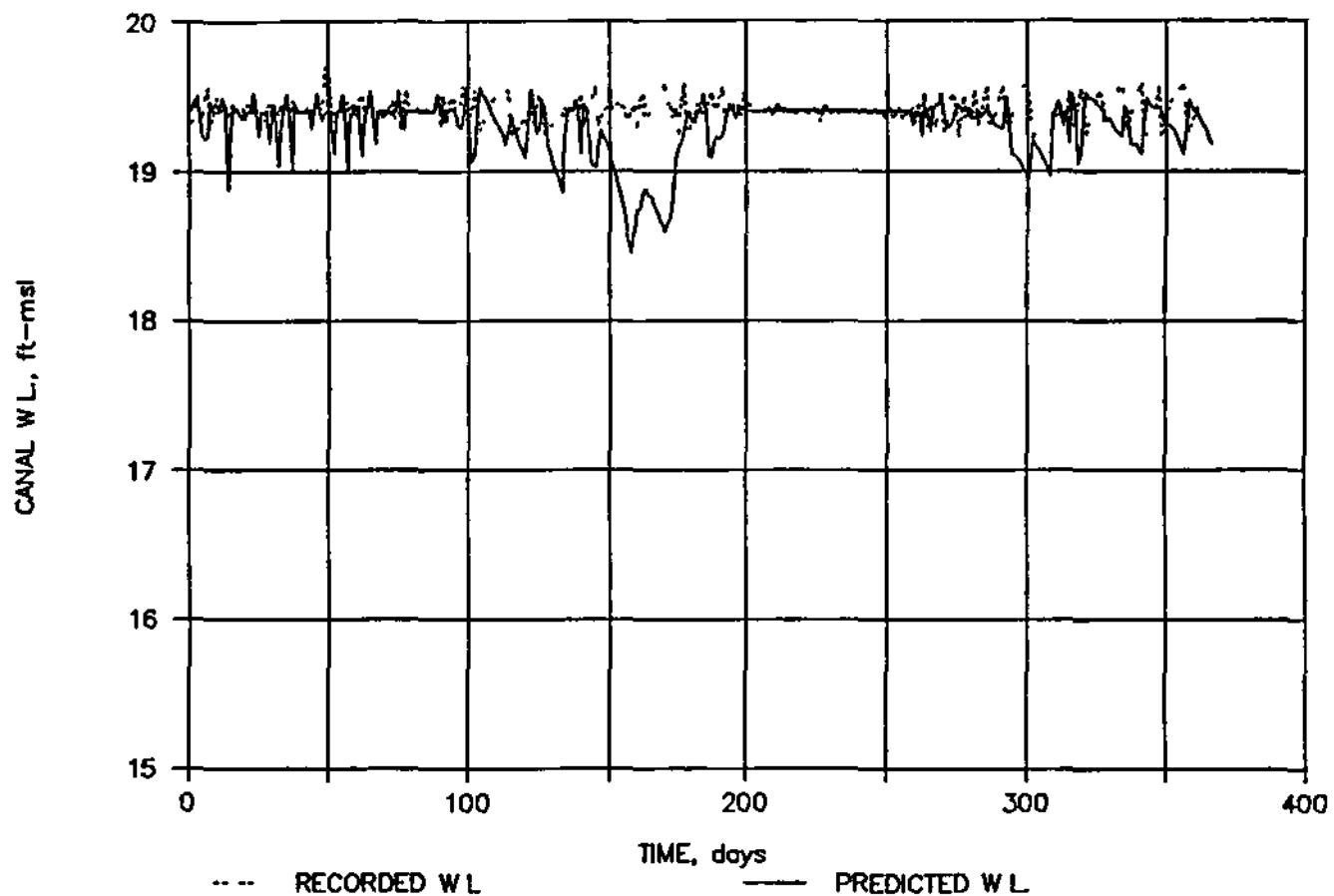


Figure 531-15

MAKEUP AND PROCESS WATER WITHDRAWAL, 1988

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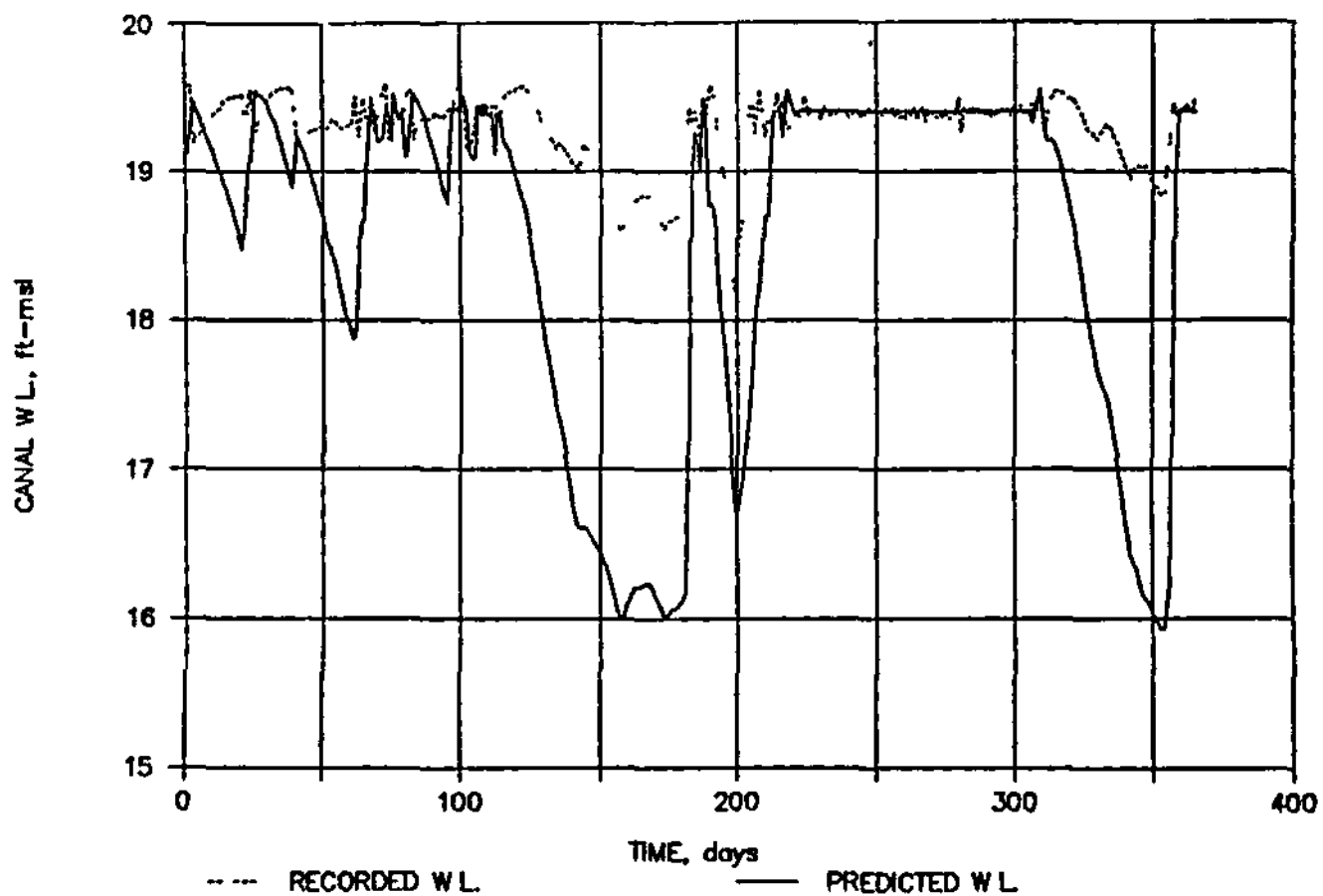


Figure 53 1-16

MAKEUP AND PROCESS WATER WITHDRAWAL, 1989

Source Bechtel 1990

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3 percent of the total annual inflow to the lake of approximately 3,500,000 acre-feet. The plant annual water withdrawal from TC/NS is 5,430 acre-feet. The plant withdrawal will cause a reduction in the total annual inflow to the lake by 0.16 percent. The effect of such withdrawal on the lake's annual water budget is negligible.

However, relative to the impact on the lake's annual water budget, the effect of plant water withdrawal on the reduction of phosphorous discharged to the lake from TC/NS is significant. Based on the data presented in the "Interim Surface Water Improvement and Management Plan" (SFWMD, 1989) and Section 2.3.4.1, approximately 143 tons of phosphorous are discharged from TC/NS to Lake Okeechobee annually. The plant water withdrawal of 7.5 cfs can reduce the annual discharge of phosphorous to the lake by 7.3 tons. This amounts to 1.2 percent reduction of total phosphorous to Lake Okeechobee annually.

5.3.1.3 Groundwater Level

During prolonged drought conditions, lowering the canal water levels can lower the adjacent connected water table of the Surficial aquifer and consequently affect any wells and wetlands located in the area influenced by the lowered water table. The extent of such an effect is mainly a function of canal water level drop and its duration.

To quantify such effects, an analysis was made to estimate the impact of lowering the canal water level caused by plant water withdrawal on the adjacent surficial water tables. The method of analysis was based on one-dimensional unsteady computerized groundwater flow in an unconfined aquifer as discussed by McWhorter and Sunada (1977).

The adjacent surficial aquifer properties are estimated from the reference materials (SFWMD, 1987; Ardaman & Associates, 1989; CH2M Hill, 1990; USDA, 1971 and 1981). The geological formation of surficial aquifer consists of shell, sandstone,

limestone, and fine sand (SFWMD, 1987, USDA, 1971 and 1981) The estimated hydraulic conductivity of the top 30 feet of the Surficial aquifer at the vicinity of the TC/NS canals is about 5×10^{-3} cm/s (SFWMD, 1987, Ardaman & Associates, 1989, CH2M Hill, 1990, USDA, 1971 and 1981) The specific yield of the surficial aquifer is 0.2, within the normal range for this parameter (SFWMD, 1987)

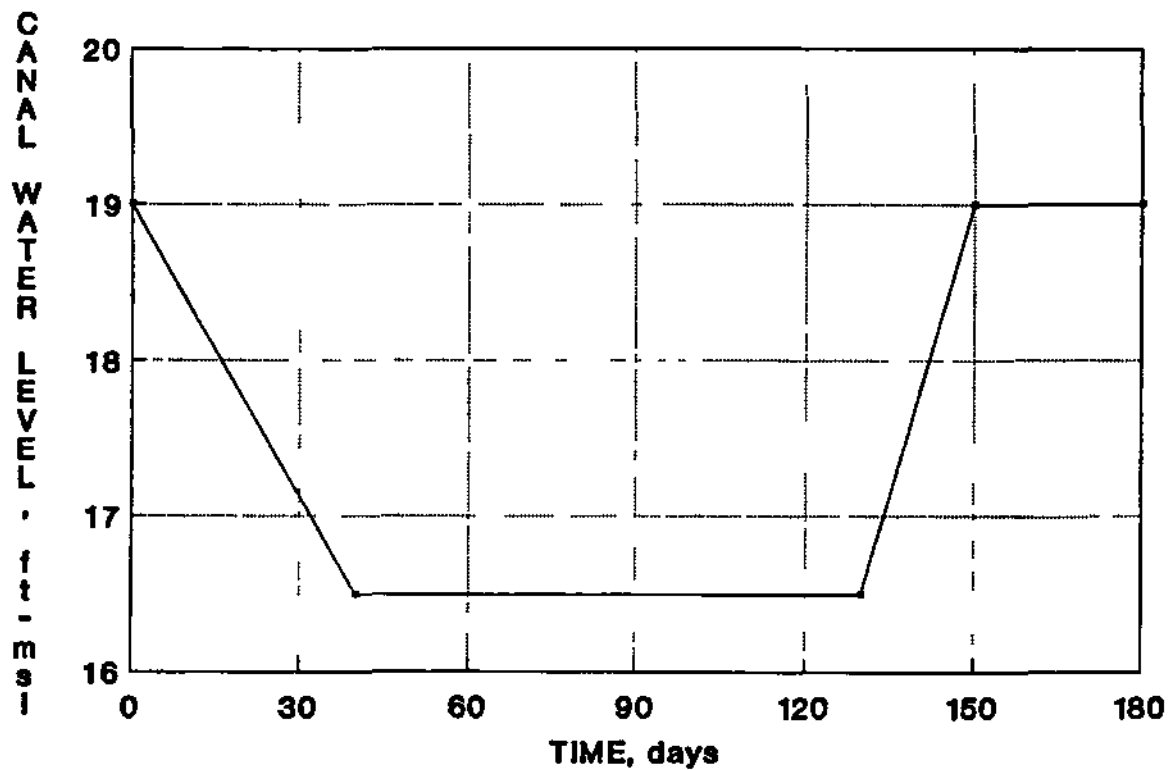
In the analysis, it was assumed the water level in the aquifer is initially the same level as the canal water level A water level drop scenario representing a severe drought condition, was selected The canal water level was dropped by 2.5 feet in 40 days and was maintained at that level for an additional 90 days Then the canal water level was raised by 2.5 feet in 20 days, and was maintained at this final level for an additional 30 days (Figure 5.3.1-17) A total of 180 days was used for simulation

From the analysis, the total number of days at which the groundwater level dropped more than 1 foot is found for selected distances from the canal These are presented below

<u>Distance from the Canal (ft)</u>	<u>Total No of Days</u>
100	116
300	87
500	28
700	0

For the simulated drought scenario, the 1-foot drop in water table does not extend to a distance of 700 feet from the canal throughout the simulation time

The simulated drought condition is more severe than the drought condition of 1981 (Figure 5.3.1-8) As discussed in Section 10.9, the drought condition of 1981 is the most severe during the available period of precipitation data In addition, the annual precipitation during 1981 was the lowest of 34 years of record for Port



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Figure 531-17

CANAL WATER LEVEL SCENARIO USED FOR
GROUNDWATER LEVEL IMPACT ANALYSIS

Source: Bechtel 1990

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Mayaca Station Furthermore, since the pumping of the plant water from the canals will be stopped at the low water level of 16.5 feet-MSL, the impact of such a drought on the groundwater table should be minimal and the 1-foot lowering should be limited to a distance of about 500 feet from the canal

5.3.1.4 Impact on Other Surface Water Users

Three existing agricultural water users from Taylor Creek are reported and are listed in Table 2.3.3-5. From this table, two of the users are on the old section of Taylor Creek, which is connected to Lake Okeechobee, and one potential user with annual allocation of 94 MG (180 gpm) is on Canal L-63N.

As discussed in Section 5.3.1.1, the canal water levels are not affected by the plant water consumption in a normal year. During severe drought conditions, the canal water level may drop 2 to 3 feet below normal operating water level, resulting in a lower head at the intake of the above potential user. However, since low water level periods last for a short period of time, the impact of such low water level on the water withdrawal capability of the user should be minimal.

5 3 2 GROUND WATER

Both the Surficial and the Floridan aquifers are susceptible to potential impacts from operations at the ICL facility. The plant design was developed with an understanding of the aquifers' vulnerability, and, therefore, the proposed plan incorporates features to safeguard the aquifers and maintain pre-project water quality within the groundwater regime.

5 3 2 1 Surficial Aquifer Potential Contaminants

The Surficial aquifer occupies the upper 120 feet of sediments that underlie the site. The aquifer may be divided into two major water-bearing zones. An upper, unconfined or water table zone occurs within the layers of interbedded sand and silt which are exposed at the ground surface and extend to a depth of about 30 feet. A semi-confined zone, the major production interval of the Surficial aquifer, is composed of sand and shell layers which occupy an interval between 85 and 120 feet below the ground surface. These two water-bearing zones are separated by 55 feet of less permeable sand, silt and clay layers which restrict the vertical flow of groundwater between the two zones.

Throughout the site, the water levels within the upper, unconfined zone of the Surficial Aquifer are within 5 feet of the ground surface. During at least part of the year, the water table intersects portions of the ground surface, occurring as wetland ponds. The close proximity of the water table to the ground surface makes the Surficial Aquifer especially vulnerable to any contaminants that might enter the aquifer as seepage or leachate from the ground surface.

Potential sources of contamination would include the coal and lime stored onsite, the bottom ash and fly ash generated onsite, the cooling water storage pond, and any other solid or hazardous wastes generated onsite.

Coal storage will consist of an active use facility and a grassed, inactive pile, sized to store enough coal for 30 days at full load. The active use coal storage facility will be completely enclosed. Because the coal will not be exposed to the elements, leachate and runoff problems are eliminated. Section 5.3.4 discusses impacts on the Surficial aquifer due to leachate and runoff from the inactive coal storage area.

Small quantities of lime will also be utilized onsite as part of the coal burning process. Lime will be delivered by rail and stored in an enclosed facility prior to usage. Once again, the enclosed facility will eliminate the problems associated with leachate and runoff.

Section 5.4 addresses the disposal of solid and hazardous wastes at the site.

The cooling water storage pond will contain water from Taylor Creek/Nubbin Slough. As discussed in Section 3.5, the quality of this water is comparable to background water within the Surficial aquifer. However, the pond will be lined to keep pond seepage from mixing with the potable water of the Surficial aquifer.

Potential leakage from the wastewater injection well also represents a source of contamination to the Surficial aquifer. As described in Section 3.5.1.5, the many precautions and casing integrity tests that are required as part of injection well installation provide reassurance that no leak in the well casing could go undetected, either prior to or during wastewater injection operations.

As shown on Figure 2.3.2-3, the water table gradient is generally to the south toward the St. Lucie Canal. Potential offsite receptors of a hypothetical plume generated onsite include the St. Lucie Canal and two Surficial aquifer wells to the southeast of the site (Figure 2.3.3-1). As discussed in Section 5.3.5, the positioning of monitor wells along the southern boundary of the site ensures that no contaminant plume could move offsite undetected.

5 3 2 2 Floridan Aquifer Groundwater Withdrawals

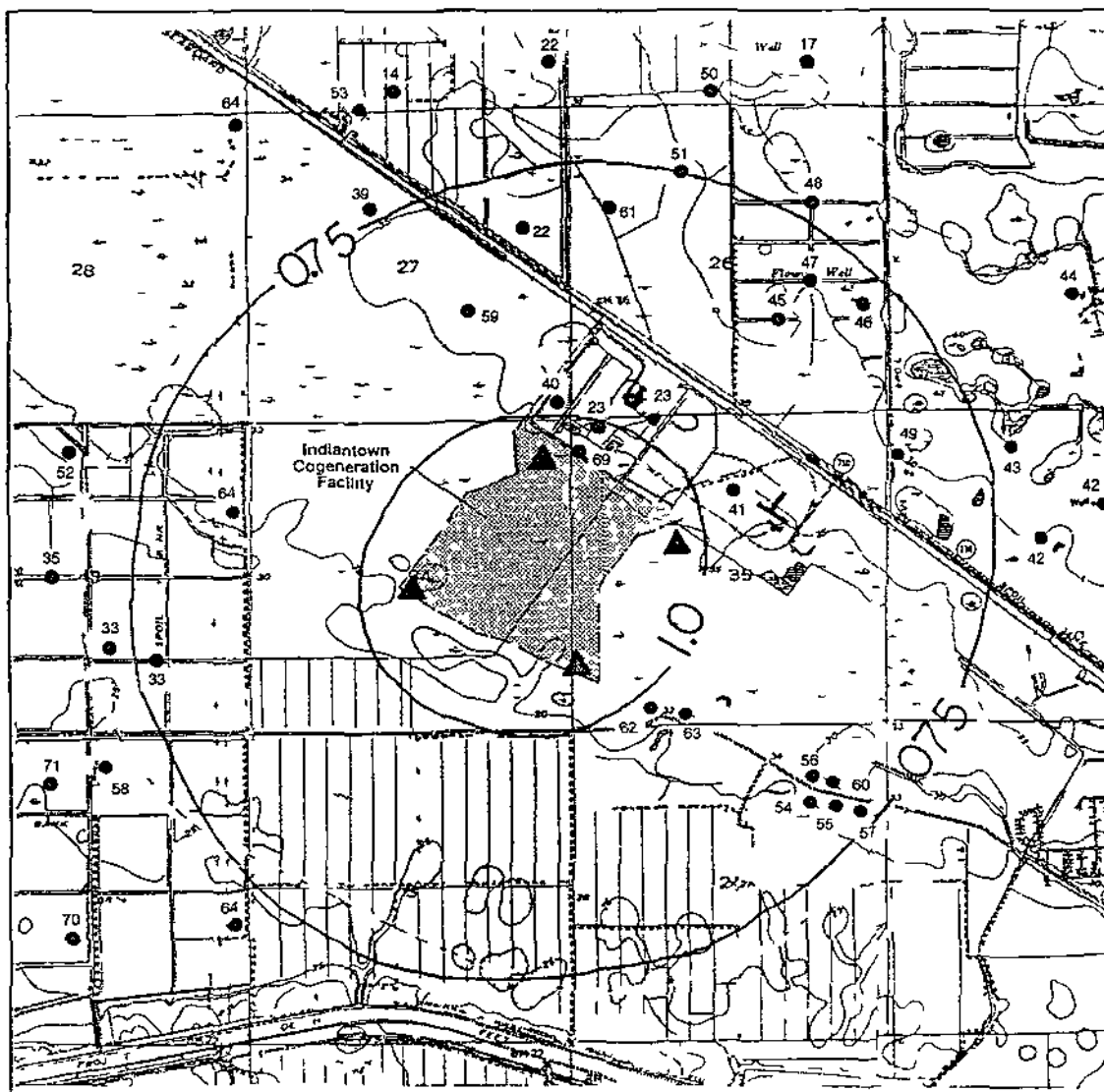
As discussed in Section 3.5, the analysis of historic water levels in Taylor Creek/Nubbin Slough indicates an alternative source of cooling water will be required for a maximum of 90 continuous days during an extreme drought year. The lower permeable horizon of the upper Floridan aquifer, which lies about 1,400 feet below the ground surface at the site, is proposed as this alternative source of water. A withdrawal rate of 4,000 gpm will be necessary to meet cooling water demand.

Figure 5.3.2-1 presents simulated drawdowns assuming 90 days of continuous flow from four 1,000 gpm wells, placed at the corners of the project site. Steady-state conditions are approached within the first day of withdrawal due to the extreme magnitude of transmissivity within this permeable horizon. Recovery rates will be just as fast. The projected drawdowns indicate negligible impacts upon the proposed FPL wells at the Martin Project Site.

Figure 5.3.2-2 presents the results of the 90-day simulation as they affect hydrostatic pressures within the uppermost permeable horizon of the Floridan aquifer. The model simulated drawdowns due to induced seepage of up to 0.9 foot in the immediate vicinity of the proposed wellfield.

The maximum capacity of free-flowing artesian wells is directly proportional to the height of the closed-in hydrostatic pressure above the well casing. In the project area, hydrostatic pressures are 15 feet above ground level. A decrease in hydrostatic head of about 1.5 feet equates to a 10 percent decrease in the maximum capacity of the well. The simulated maximum drawdown of 0.9 foot indicates that no existing well will experience a reduction of 10 percent in flow capacity.

To summarize, the plant design incorporates many features that will function to preserve the chemical quality of the Surficial aquifer. These features include totally



- EXISTING WELL
- ▲ SIMULATED WELL LOCATION

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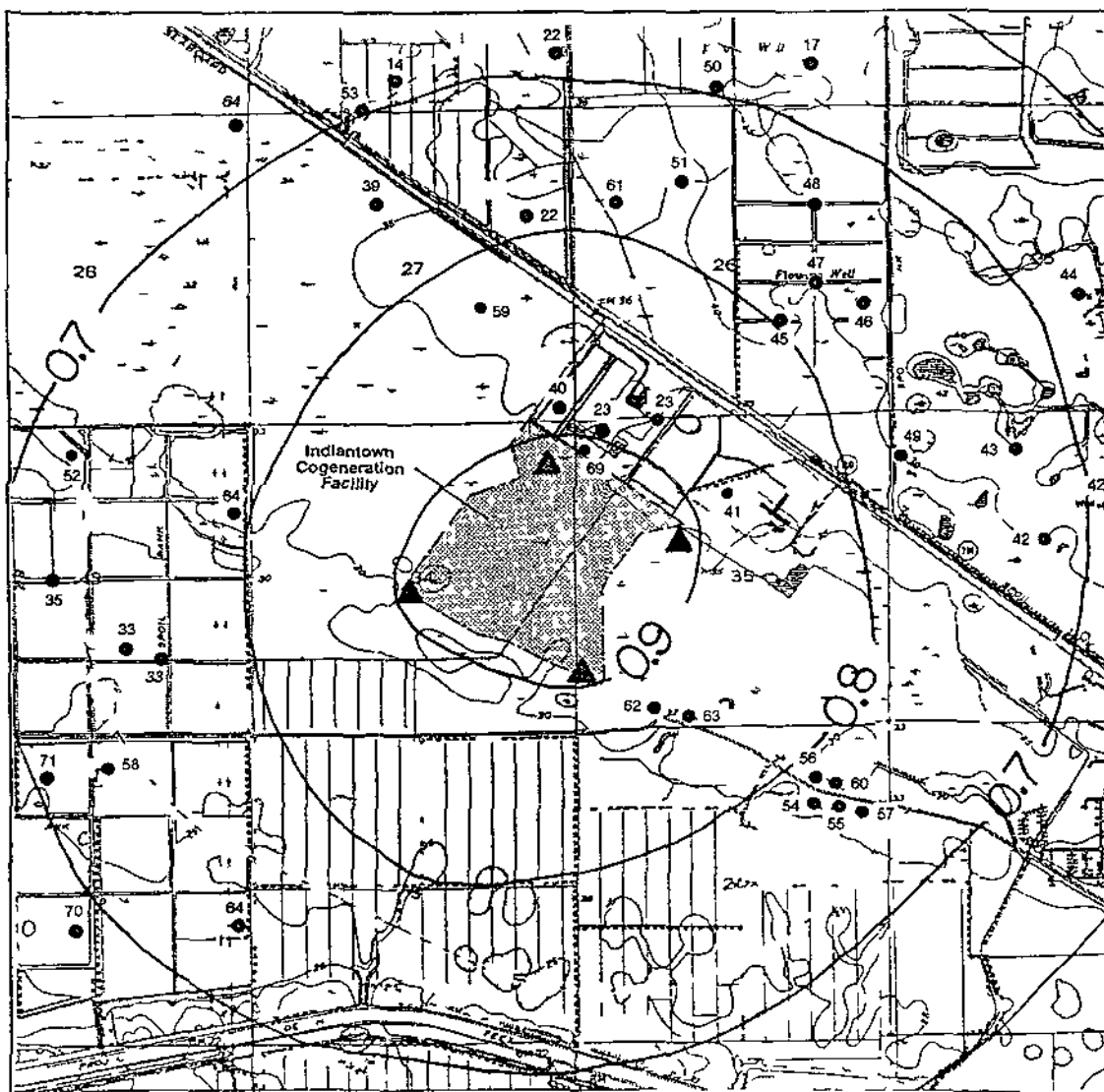
ONE MILE
1000 4000
(Scale in ft)

Figure 5 3 2-1
SIMULATED DRAWDOWNS WITHIN THE LOWER
PERMEABLE HORIZON OF THE FLORIDAN AQUIFER
AFTER 90 DAYS OF FLOWING FOUR 1000-GPM
ARTESIAN WELLS

Source Bechtel 1990 CH2M Hill

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- EXISTING WELL
- ▲ SIMULATED WELL LOCATION

Poor Original

ONE MILE
1000 4000
(Scale in ft)

Figure 5 3 2-2
SIMULATED DRAWDOWNS WITHIN THE UPPERMOST PERMEABLE HORIZON OF THE FLORIDAN AQUIFER AFTER 90 DAYS OF FLOWING FOUR 1000-GPM ARTESIAN WELLS (SCREENED ACROSS THE LOWER, PERMEABLE HORIZON)

Source Bechtel 1990 CH2M Hill

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PROJECT

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enclosed facilities for the active coal pile and lime storage areas, a lined inactive coal pile, a lined pond and basins, and procedures to remove wastes such as bottom ash and fly ash from the site. During normal dry and wet seasons, Taylor Creek/Nubbin Slough will provide plant cooling and process water.

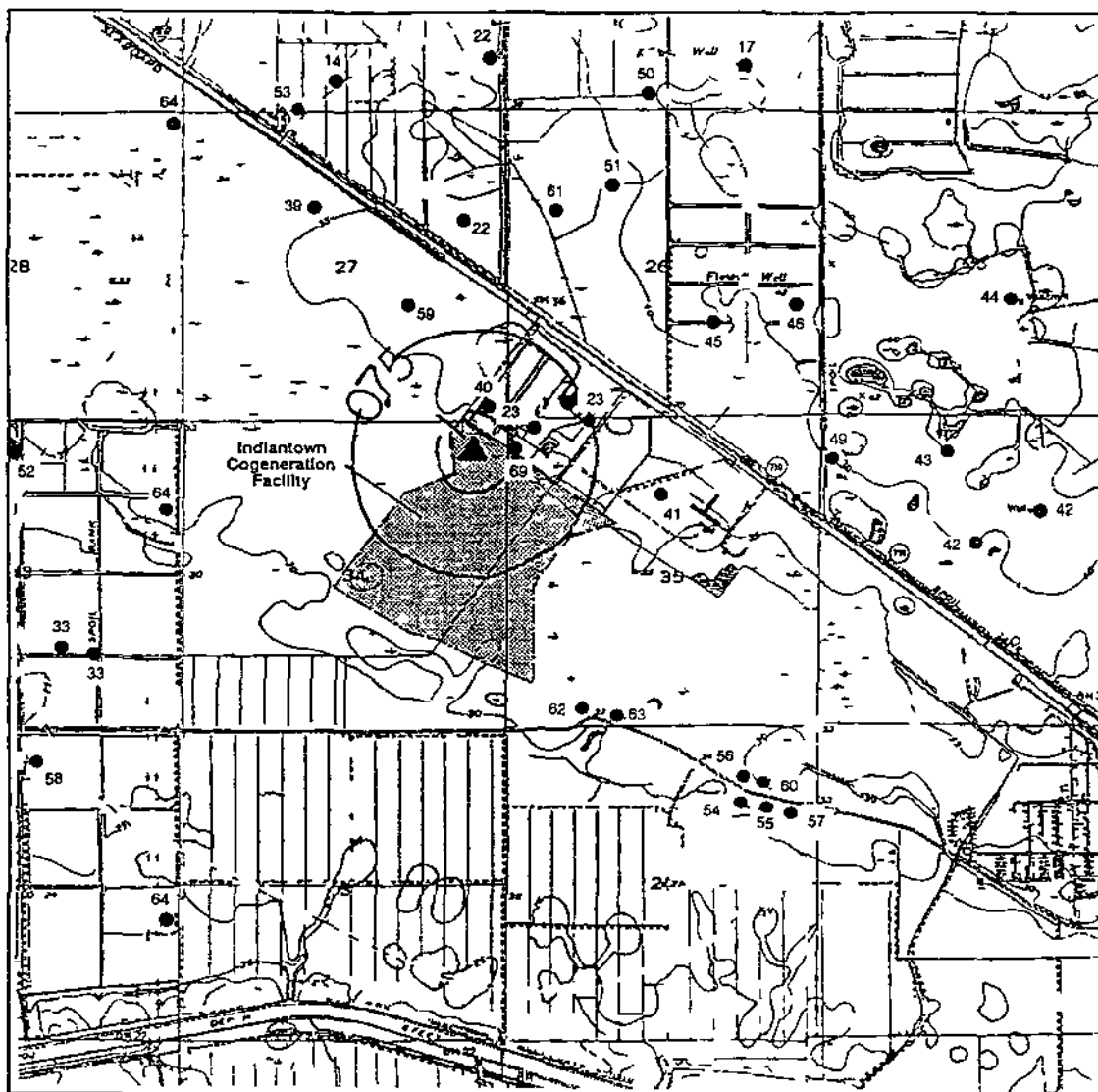
When prolonged droughts occur, it will be necessary to withdraw water from the Floridan aquifer for cooling water at rates of 4,000 gpm for up to 90 days. Simulations of this withdrawal from the base of the upper Floridan aquifer indicate that induced seepage from the more heavily utilized parts of the upper Floridan will not exceed established criteria which protect existing users.

5.3.2.3 Alternative Source of Process Water During Drought Periods

As discussed previously, it is anticipated that there will be times when severe drought conditions cause water in Taylor Creek/Nubbin Slough to drop below the minimum intake level. It is also proposed to withdraw 300 gpm from the uppermost permeable horizon of the Floridan aquifer for process water purposes.

Withdrawals of 300 gpm for 90 days from the uppermost permeable horizon of the Floridan aquifer were simulated using analytical methods. The simulation results are included in Section 10.5.1 as a computer printout of input parameters and calculated drawdowns.

Figure 5.3.2-3 presents the simulated drawdowns caused by a single well, flowing at 300 gpm for 90 days. The figure shows that no existing Floridan aquifer wells will lose as much as 1 foot of hydrostatic head during the withdrawal period. As discussed in this section, the capacity of a free-flowing artesian well is directly proportional to the height that the hydrostatic head of the aquifer extends above the top of the well casing. At the project site, reductions of 1 foot in hydrostatic head would not reduce the flowing capacity of any existing well by as much as 10 percent. Therefore, withdrawals of 300 gpm for 90 days would not create drawdowns that would exceed SFWMD criteria for prohibitive well interference.



- EXISTING WELL
- ▲ SIMULATED WELL LOCATION

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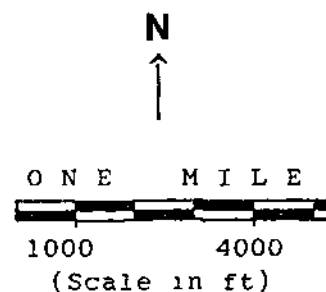


Figure 5 3 2-3
SIMULATED DRAWDOWNS WITHIN THE UPPERMOST PERMEABLE HORIZON OF THE FLORIDAN AQUIFER AFTER 90 DAYS OF CONTINUOUS FLOW FROM ONE 300 GPM WELL

Source Bechtel 1990 CH2M Hill

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5 3 3 DRINKING WATER

In the project area, the potable water supply is the Surficial aquifer. Figure 2 3 3-1 and Table 2 3 3-6 in Section 2 3 3 show the locations of wells within 1 mile of the site boundaries, and list well owners, permit numbers, well construction specifications, and purpose of the well (industrial, agricultural, potable use).

Because no water will be withdrawn from the Surficial aquifer for plant use, there will be no impacts on surrounding wells into the Surficial aquifer that withdraw water for drinking purposes.

The regional groundwater gradient is almost due south at 8 feet per mile. This results in seepage velocities of 20 to 80 feet per year, depending upon sediment porosity. It is conceivable that wells 62 and 63 on Figure 2 3 3-1 might intercept a hypothetical contaminant plume generated at the project site. However, the monitor wells installed into the Surficial aquifer on the site are positioned to detect any contaminant plume before it crosses property lines. Should an event such as a spill take place, these wells would be used to detect the plume in advance of it reaching an existing user, thereby allowing time for remedial action to be implemented.

5 3 4 LEACHATE AND RUNOFF

The only source of leachate or runoff that could adversely impact the Surficial aquifer is the inactive coal storage area. The inactive coal storage area will be covered and lined as described in Section 3 3 1. In addition, runoff and leachate from rainfall will be treated and collected in the adjacent coal pile runoff basin, as described in Section 3 6 2. The active coal pile will be enclosed and a physical barrier to the groundwater will be installed beneath the coal pile.

The inactive coal storage area is grassed over. Approximately 25 to 30 percent of the rainfall percolates through the grass to contact the coal. The composition and characteristics of leachate from coal piles varies substantially depending on the source of the coal. The leachate from the coal storage area is estimated to contain 7500 mg/l of total dissolved solids, 5000 mg/l sulfate, 200 mg/l iron, and a pH in the range of 3 - 4. The quality of the runoff (which only contacts the grass) is much better than the quality of the leachate, effectively diluting the leachate. Runoff and leachate are treated to adjust the pH prior to entering the coal pile runoff basin, as described in Section 3 6 2. Treated runoff and leachate from the coal pile runoff basin are transferred to the sidestream softener of the cooling tower.

Runoff from other areas of the plant (as discussed in Section 3 8) are directed to the existing drainage ditch which eventually leads to the St. Lucie Canal.

Activities Affecting Discharge to Surface Water Bodies

Excess runoff due to an increase in impervious areas causes runoff quality and quantity changes. Due to a higher runoff coefficient caused by increased impervious area, onsite stormwater runoff will increase. In order to maintain the pre-developed peak flow in the existing drainage ditch, detention basins will be employed to store excess runoff. The runoff from the plant area to the ditch will be controlled by methods described in Sections 3 8 4 and 3 8 5. Since peak flows

before and after site development will not be changed, no adverse impacts concerning quantity of flow are anticipated

For paved areas and areas where grease or oil may be blended with the runoff (e.g., switchyard, oil storage tank, railroad, parking lot, and power block), catch basins will be used in conjunction with oil/water separators for removal of the oil/grease deposits

The runoff from the inactive coal storage area will be detained in the lined coal pile runoff basin and treated to adjust pH. Treated runoff will be transferred to the cooling tower sidestream softener and used in the cooling tower

By detaining and treating water where needed, the quality and quantity of the water in the existing drainage ditch will be maintained. The existing drainage ditch in the plant area is a continuation of a drainage ditch extending from State Route 710 and extends 2.5 miles further to the St. Lucie Canal. Since the drainage ditch will not be adversely affected, the St. Lucie Canal likewise will be unaffected.

The mitigation measures to control impacts to the wetland adjacent to the cooling water storage pond are discussed in Section 3.8.5.2. The remaining six wetlands within the property boundaries have been analyzed, and it has been determined that no significant drainage pattern changes will be made. Based on the developed plan, it can be concluded that there will be no adverse impacts to the wetlands.

Flood Plain Encroachment

The ICL site is entirely within Zone B (100- to 500-year flood plain area) as defined by Insurance Rate Maps. Therefore, there will be no encroachment on the 100-year flood plain and offsite impacts on the 100-year flood level are precluded.

5 3 5 MEASUREMENT PROGRAMS

Section 3 5 1 5 describes the monitoring well that will be installed to detect changes caused by possible migration of the wastewater injected into the Boulder Zone of the lower Floridan aquifer upwards into the upper Floridan aquifer. Since there are no wastewater discharges to surface waters or to other groundwater aquifers, no other monitoring programs are proposed.

5.4

5 4 SOLID/HAZARDOUS WASTE DISPOSAL IMPACTS

5 4 1 SOLID WASTE

The Indiantown Cogeneration, L P (ICL) plant will generate solid waste from the combustion of coal, operation of the water and wastewater treatment system, and operation of the flue gas cleaning system. In addition, miscellaneous solid wastes such as general office refuse and maintenance wastes will be produced.

As discussed in Section 3 7 1, there will be no onsite disposal of solid waste.

5 4 1 1 Bottom Ash and Fly Ash

Bottom ash and fly ash will be removed from the site on rail cars for disposal at the coal mine. The ash will be disposed of in areas that have been worked out. These areas do not generally serve another purpose. Therefore, there will be no impact on usage of the disposal area.

5 4 1 2 Other Solid Wastes

All other solid wastes generated on the site (filter cake from the water and wastewater treatment system, office wastes, non-hazardous maintenance wastes) will be transported offsite for disposal in licensed solid waste facilities.

The Palm City Landfill No. 2 in Martin County has capacity to remain functional beyond the year 2000 (Martin County, 1989). The ICL plant will consume less than 1.5 percent of the available capacity at the landfill between the time the plant opens and the year 2000. As discussed in Section 3 7 1, the amount of water and wastewater treatment filter cake generated by the plant is greatly affected by the extent to which the backup water sources must be used. If the backup water

sources are not required before the year 2000, the solid waste from the plant will consume less than 0.2 percent of the capacity of the landfill.

Martin County is currently studying options to dispose of solid waste after the existing landfill capacity is reached (Martin County, 1990). Impacts of the continuing operation of the ICL plant beyond the year 2000 cannot be quantified until a solid waste management program is finalized by Martin County.

5 4 2 HAZARDOUS WASTE

The ICL plant may generate hazardous wastes in the form of chemical product storage and transfer wastes, or other miscellaneous wastes

As discussed in Section 3 7 2, there will be no treatment of hazardous wastes unless the treatment occurs in an "elementary treatment facility" or a "wastewater treatment unit" as defined by FDER and EPA hazardous waste regulations. In addition, hazardous wastes will not be stored onsite in excess of 90 days or such other period as FDER or EPA regulations allow.

Hazardous wastes generated onsite will be collected and stored in segregated storage areas, then transferred offsite by a licensed hazardous waste contractor for treatment or disposal. As discussed in Section 3 7 2, the volume of these wastes will be small and is not expected to result in significant impacts to treatment system capacity or land use.

5.5 SANITARY AND OTHER WASTE DISCHARGES

All other plant wastewater, other than sanitary, have been addressed in Section 5.2

All sanitary wastewater generated at the Indiantown Cogeneration, L.P. (ICL) plant are transferred to the Indiantown Company water services sewer connection. There is no onsite treatment of sanitary wastewater. The average daily discharge of sanitary wastewater is less than 2 gpm. No significant impact on the Indiantown Company wastewater treatment system is expected from this small flow since the system is designed for 1.0 MGD capacity.

5 6 AIR QUALITY IMPACTS

5 6 1 IMPACT ASSESSMENT

This section summarizes the air quality impact assessment for the proposed Indiantown Cogeneration, L P (ICL) facility, as documented in the Prevention of Significant Deterioration (PSD) of Air Quality permit application contained in Section 10 1 5

5 6 1 1 Regulatory Applicability and Scope of Analysis

The ICL site is located in Martin County, Florida, and is included in the Southeast Florida Intrastate Air Quality Control Region (AQCR) (40CFR81 49) The area immediately around the facility is in attainment or cannot be classified for all criteria air pollutants (i e , meets the ambient standards) (40CFR81 310) Palm Beach County, about 9 km south of the site, is the only non-attainment area (for ozone) in the vicinity of the proposed facility Martin County and the surrounding counties are designated as Class II PSD areas for SO₂, NO₂, and particulate matter (TSP) (40CFR 52 21(e)(3)) There are no Federal Class I PSD areas within 50 km of the proposed site The closest Class I PSD area is the Everglades National Park (40CFR81 407) located about 140 km to the south

The ICL facility is a fossil fuel-fired steam electric plant of more than 250 MMBtu/hr heat input and has the potential to emit more than 100 tons/year of any regulated pollutant It is therefore considered to be a new, major stationary source (40CFR52 21(b)(1))

New, major stationary sources proposed to be located in an attainment area are subject to the Federal PSD regulations, in this case, as implemented by the State of Florida PSD review is required for any regulated pollutant with a net emissions increase greater than specific levels considered to significant by EPA

Table 5.6.1-1 lists the maximum expected total emissions for the facility and the corresponding significant emission levels.

This review includes an analysis of air quality impacts to demonstrate that the ambient standards will be met and that incremental impacts due to the new source will not exceed specified amounts. Under PSD, a control technology must be selected and defended for all pollutants emitted at significant levels. The objective is to achieve the maximum reduction in emissions, using current technology, while taking into consideration energy requirements and environmental and economic impacts. This process is referred to as the Best Available Control Technology (BACT) analysis, and is discussed in Section 3.4.3. These controls must be applied when the plant becomes operational. Finally, an analysis of other air quality-related effects associated with the project must be performed, including impairment to visibility, cooling tower effects (Section 5.1.4), impacts from industrial/residential growth that may occur because of the project, impacts on soils and vegetation in the site area, and potential health risks due to trace element emissions from the facility. The following subsections summarize additional details, including the results of these analyses.

5.6.1.2 General Modeling Approach

The air quality impact assessment consisted of a determination of the significant impact area for the plant, a PSD increment consumption analysis, a demonstration of compliance with federal and state ambient air quality standards, and an evaluation of other air quality-related effects (see Section 5.6.1.1). Methodologies followed EPA and FDER modeling guidelines, as appropriate. An air quality modeling protocol was prepared by the applicant and approved by the FDER prior to conducting the various analyses. The following subsections summarize key elements of the analytical approach and input information. A detailed discussion is found in Sections 3 and 4 of the PSD permit application in Section 10.1.5 of this report.

TABLE 5 6 1 1
PSD SIGNIFICANT EMISSION RATES AND MAXIMUM TOTAL EMISSION
RATES FOR THE PROPOSED INDIANTOWN COGENERATION PROJECT

<u>Pollutant</u>	<u>Significant Emission Rate (tons/yr)^a</u>	<u>Maximum Total Emission Rate (tons/yr)^b</u>	<u>BACT and AQ Analysis Required?</u>
Particulate Matter (TSP)	25	306 1 ^c	Yes
PM-10	15	276 2 ^c	Yes
Sulfur Dioxide	40	2629 4	Yes
Nitrogen Oxides	40	2850 5	Yes
Volatile Organic Compounds	40	56 6	Yes
Carbon Monoxide	100	1858 4	Yes
Lead	0 6	0 152	No
Mercury	0 1	0 172	Yes
Beryllium	0 0004	0 041	Yes
Fluorides	3	22 26	Yes
Asbestos	0 007	0	No
Vinyl Chloride	1	0	No
Total Reduced Sulfur	10	0	No
Hydrogen Sulfide	10	0	No
Reduced Sulfur Compounds	10	0	No
Sulfuric Acid Mist	7	6 51	No
Any other pollutant regulated under Clean Air Act	Any rate	---	---
Benzene		0	No
Inorganic Arsenic		0 766	Yes
Each regulated pollutant	Any rate causing an impact of 1 (24-hr average) or greater in any Class I area within 10 km of source		No ^d

a - Source 40CFR52.21(b)

b - Maximum total emissions are based on the maximum hourly emission rate, 8760 hrs/yr and 1000 hrs/yr of operation for the main and auxiliary boilers respectively with an annual load factor of 100 percent for both boilers

c - Maximum total TSP and PM 10 emissions are conservatively assumed to be the same and include fugitive emission sources listed in Table 4-2

d - The closest Class I PSD area is the Everglades National Park located about 140 km south of the proposed ICL plant. Therefore, air quality analyses are not required on this basis

Source: Bechtel 1990

Dispersion Model Selection

The analysis referred to above required the use of three different dispersion models to estimate

- Incremental impacts due to the proposed and nearby sources
- Potential visibility impairment due to emissions from the ICL plant stack
- Cooling tower drift and deposition

Incremental air quality impacts were determined using the EPA Industrial Source Complex - Short Term (ISCST) dispersion model (EPA, 1987). The model was selected because of its ability to simulate the dispersion of emissions from multiple point and area sources. In addition, the model is capable of accounting for building wake effects on dispersion, allowing for variable emission rates with time and meteorological conditions (e.g., wind erosion), and considering the effects of particle deposition by gravitational settling. This latter phenomenon occurs with a significant fraction of the relatively large particle sizes found in fugitive dust emissions. These capabilities have resulted in EPA's designation of ISC as the preferred model for estimating concentrations from sources with these characteristics (EPA, 1986).

Potential visibility impairment on the distant Everglades National Park (140 km to the south) was estimated using the EPA Visibility Screening (VISCREEN) model. The algorithms are based on the technical guidance provided in the Workbook for Visual Plume Impact Screening and Analysis (EPA, 1988). The model evaluates particulate and NO_x stack emissions under hypothetical worst-case meteorological conditions. Visual impairment is quantified in terms of atmospheric discoloration from NO_x, particulate, and secondary aerosols, and visual range reduction (i.e.,

increased haze) from particulates and sulfates. Additional information is presented in Section 6 of the PSD permit application (see Section 10.1.5).

Emissions Data

Sources of airborne pollutants at the ICL plant consist of stack emissions from the coal-fired main boiler (under various load conditions), emissions from an auxiliary boiler fired by either No. 2 fuel oil or natural gas (and released from a separate stack), and fugitive dust emissions generated by material handling and storage activities. These activities include coal unloading, conveyance, transfer, and crushing, and ash and lime handling. Other nearby sources of air pollutants, either located within or having a significant impact on the modeled SO₂ and NO₂ impact areas caused by the plant, were determined in consultation with the FDER.

Maximum incremental impacts due to plant stack emissions were based on either SO₂ emissions from the main boiler at full (100 percent) load or the No. 2 oil-fired auxiliary boiler, also at full load. The respective SO₂ emission rates for these two operating scenarios are 582.6 lbs/hr and 17.73 lbs/hr. Impacts for other criteria and trace element pollutants were scaled in proportion to the respective emission rates for these pollutants to the SO₂ emissions. Detailed emissions information for the ICL plant (stack and fugitive) and other nearby sources is presented in Section 4 of the PSD permit application (see Section 10.1.5). Trace element emission rates are discussed in Section 5.1.4 of the PSD permit application.

Stack Height

A single stack will be used to exhaust emissions from fuel combustion in the main boiler. The height of the stack, approximately 495 feet, conforms to good engineering practice (GEP) regulations established by the EPA (1985). The regulations were promulgated to ensure that the emission control limitation required for any pollutant would not be affected (i.e., made less stringent) by the

increased dispersion (and decreased impacts) resulting from a stack which exceeds GEP height, or by any other dispersion technique. Section 123 of the Clean Air Act defines GEP stack height as

" the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, or wakes created by the source itself, nearby structures, or nearby terrain obstacles "

While a source may construct a stack to any height allowed under any other regulation, credit may be taken only up to the GEP height, if the actual height is greater than GEP. Therefore, construction of the ICL plant stack for the main boiler to GEP height will avoid downwash effects and the resulting "excessive concentrations" compared to a stack with a lower height.

On the other hand, a separate stack (90 feet high) will be used to vent emissions from the auxiliary boiler. This stack is adjacent to the main boiler building, which is a taller structure, and this stack is therefore less than GEP height. As a result, wake effects were considered in the dispersion analysis of auxiliary boiler emissions. This configuration does not lead to "excessive" impacts as the results in Section 5.6.1.3 demonstrate.

Meteorological Data

The air quality modeling analyses were based on sequential, hourly surface meteorological data and concurrent twice-daily upper air soundings from the National Weather Service (NWS) station at West Palm Beach, Florida, about 26 miles to the east-northeast. These data cover the 5-year period from 1982 to 1986 and were provided by the FDER.

In lieu of using onsite meteorological data, the EPA considers that use of a representative, offsite 5-year data set adequately reflects the range of dispersion conditions expected in the site area. Accordingly, highest second-highest, short-term modeled concentrations are used to determine total air quality impacts for comparison with ambient standards and for comparison against applicable PSD increment levels. Compliance with the ambient standards and PSD increments are written such that one exceedance of the corresponding numerical value is allowable during each calendar year. Use of the highest second-highest value presumes that one such an exceedance occurs. However, annual average total and incremental impacts are based on the use of the highest concentration from among the 5 years of modeled data because these long-term standards are not to be exceeded at any time.

Background Air Quality Levels

Total air quality impacts represent the sum of the incremental impact due to the proposed source, concentrations due to nearby emission sources (if expected to result in a significant concentration gradient within the impact area of the proposed source), and ambient background concentrations attributable to all other sources (e.g., natural sources, minor sources, and distant major sources). This third component, ambient background levels, may be determined by using site-specific monitoring data or measurements taken at nearby monitoring stations and demonstrated to be representative of conditions in the site area.

Site-specific monitoring data were not collected in the pre-construction phase of this project for two reasons. First, representative data from several nearby stations were available, and second, impacts due to the proposed source were estimated to be less than significance levels otherwise requiring monitoring to be conducted. An exemption from pre-construction monitoring was issued by the FDER for the ICL.

Three criteria are considered in determining whether data from existing monitoring stations are representative of conditions in the site area (1) monitor location, (2) data quality, and (3) currentness of data. The FDER has indicated that data from the 1-year (October 1988 to September 1989), pre-construction PSD monitoring program for the FPL Martin CG/CC project (SO_2 , NO_2 , and PM-10), and from FDER stations in Martin and Okeechobee Counties (TSP) and Palm Beach County (CO), from 1987 to 1989, generally meet these criteria and considers these data acceptable for estimating total air quality impacts (FDER letter, July 23, 1990).

Background SO_2 levels are assumed to be 61 ug/m^3 (3-hour), 12.6 ug/m^3 (24-hour), and 1.3 ug/m^3 (annual average). For NO_2 , a 1-hour average background value of 62 ug/m^3 and an annual average value of 5.4 ug/m^3 are used in the impact analysis. Short- and long-term ambient PM-10 levels are assumed to be 39 and 13.3 ug/m^3 on a 24-hour and annual average basis, respectively. Background TSP levels were based on the highest 24-hour average TSP concentration (105 ug/m^3) measured at the FDER site in Okeechobee County in 1989, and the highest annual average TSP value (40 ug/m^3) measured in Martin County, again in 1989. For CO, 1-hour and 8-hour average background values (8,001 and $5,766 \text{ ug/m}^3$, respectively) measured at the FDER station in Palm Beach County in 1988 were used.

The selection of these data is discussed further in Section 5.3.1 of the PSD permit application (see Section 10.1.5 of this report).

5.6.1.3 Incremental Impacts

This section summarizes the maximum incremental impacts due to emissions from the proposed ICL plant and other nearby sources. A PSD increment consumption analysis is required for SO_2 and NO_2 because the maximum concentrations attributable to the plant exceed the EPA significant impact levels. Maximum particulate impacts are below the corresponding significance levels and were not

considered further in that regard. Based on discussions with the FDER, other nearby sources of SO₂ and NO₂ emissions that consume available increment levels in the site area were included in the analysis. A demonstration is also made that total air quality impacts for SO₂, NO₂, TSP, PM-10, CO, and lead will not exceed or threaten to exceed the national and State of Florida Ambient Air Quality Standards (NAAQS/FAAQS). As mentioned before, total air quality impacts represent the sum of the modeled incremental impact due to the proposed source, modeled concentrations due to nearby emission sources, and measured ambient background concentrations attributable to all other sources. An inventory of the other sources to be considered was developed in consultation with the FDER.

Finally, maximum incremental concentrations of trace element emissions (i.e., beryllium, fluorides, inorganic arsenic, and mercury) are estimated and compared to the corresponding FDER "no-threat" levels.

A detailed discussion of all of the above incremental impacts is found in Section 5 of the PSD permit application (see Section 10.1.5).

Maximum Incremental Impacts

This subsection summarizes the maximum incremental impacts for the criteria pollutants (SO₂, NO₂, TSP, PM-10, CO, and lead), as well as the non-criteria trace element emissions (beryllium, fluorides, inorganic arsenic, and mercury). Where appropriate, these values are compared with corresponding significant impact values. In the case of the trace element emissions, values are compared with threshold levels specified by the FDER as posing no threat to the public health.

SO₂ Impacts

SO₂ impacts from the proposed facility were estimated by the ISCST model (see Section 5.1.6.2). For short-term impacts, the highest second-highest concentrations are reported because the analyses were based on the use of 5 years of

representative meteorological data. For long-term (annual) impacts, the overall maximum concentration estimated from among all 5 years was used.

Of the 5 years modeled, the maximum annual average concentration is $1.15 \mu\text{g}/\text{m}^3$, only slightly more than the significance level of $1 \mu\text{g}/\text{m}^3$. The maximum 24-hour average incremental value ($11.6 \mu\text{g}/\text{m}^3$) also occurs at the same location, 250 meters from the main stack. Emissions from the main boiler contribute nothing to these concentrations. These values are the result of building wake effects on the auxiliary boiler stack emissions that result when firing fuel oil. The 24-hour average value is above the $5 \mu\text{g}/\text{m}^3$ significant impact level, but still below the significant monitoring threshold level of $13 \mu\text{g}/\text{m}^3$. The maximum 3-hour average value ($24.7 \mu\text{g}/\text{m}^3$) occurs much farther downwind (about 2 km to the northwest). This concentration is due to auxiliary boiler emissions as well, but not the result of building downwash effects. This value is less than the corresponding 3-hour average significant impact level of $25 \mu\text{g}/\text{m}^3$.

Overall, these results indicate that maximum impacts are dominated by emissions from the auxiliary boiler stack. SO_2 emission rates are greater from the main boiler. However, the dispersion that occurs, before the maximum impact location for this source is reached, offsets the difference in emissions relative to the auxiliary boiler. Because the 24-hour and annual average concentrations are above their corresponding significant impact levels, a PSD increment consumption analysis is required.

Particulate Impacts

Maximum incremental particulate impacts are due to fugitive dust emissions from material handling activities, rather than from the main or auxiliary boilers. Fugitive dust is generated near ground level, is non-buoyant, and undergoes gravitational settling. As a result, these impacts occur at the plant property line. Building wake effects influence the dispersion of auxiliary boiler stack emissions such that these impacts overlap the fugitive dust impact area. The composite results indicate that

maximum incremental particulate concentrations are $3.3 \mu\text{g}/\text{m}^3$ (24-hour average) and $0.26 \mu\text{g}/\text{m}^3$ (annual average). The annual average value is a conservative estimate based on the sum of the maximum incremental concentrations from both source types, although the impact locations do not overlap.

These maximum short- and long-term values are below the corresponding significant impact levels ($5 \mu\text{g}/\text{m}^3$ for 24 hours, and $1 \mu\text{g}/\text{m}^3$ for annual average). Therefore, a determination of PSD increment consumption is not required for this pollutant.

During operations, fugitive dust could be produced by truck traffic, loadout of lime for the FGD system, loadout of collected fly ash, and exposure of material that can easily become windborne. However, measures are planned to minimize their occurrence. Plant roadways carrying truck traffic will be paved, and those trucks carrying readily suspendible material will be either covered or enclosed. Provisions are made for dustless loadout of the material indicated above (e.g., pneumatic conveyance from enclosed trucks or railcars). The active coal storage pile will be enclosed. The inactive coal storage pile will be covered with soil and seeded. Areas of the site that were disturbed during construction, but not utilized during operation, will be seeded or covered with gravel, as appropriate, and left as open space.

NO₂, CO, and Lead Impacts

The maximum annual average SO₂ concentration ($1.15 \mu\text{g}/\text{m}^3$) is the result of emissions from the auxiliary boiler stack when fuel oil is burned. The ratio of the maximum hourly NO_x emission rate for the auxiliary boiler (68.2 lbs/hr) to the corresponding SO₂ emission rate (17.73 lbs/hr) is 3.847. The resulting maximum annual average incremental NO₂ value is $4.42 \mu\text{g}/\text{m}^3$, which is greater than the $1 \mu\text{g}/\text{m}^3$ significant impact level, but more than three times below the corresponding monitoring exemption level of $14 \mu\text{g}/\text{m}^3$.

Maximum 1-hour and 8-hour average CO impacts were estimated directly by the ISCST model because of the disparity in the ratios of CO and SO₂ emission rates for the main and auxiliary boilers and the relative contribution of each source to the maximum modeled concentrations. The maximum 1-hour CO incremental impact is only 78.2 µg/m³, the maximum 8-hour average value is 50.9 µg/m³. Both of these impacts are due to auxiliary boiler emissions. The 1-hour value is about 25 times less than the corresponding significance level (2,000 µg/m³). The maximum 8-hour value is about 10 times lower than the 8-hour significance level (500 µg/m³).

Maximum estimated total lead emissions from the plant are less than the corresponding significant emission level (see Table 5.6-1), thus, no air quality analysis for lead is required.

Non-Criteria Pollutants

There are four non-criteria pollutants, which are trace elements, that will be emitted from the ICL main boiler in significant amounts. Maximum hourly emission rates for these pollutants are beryllium (0.0094 lb/hr), fluorides (5.08 lbs/hr), inorganic arsenic (0.175 lb/hr), and mercury (0.067 lb/hr). The ratios of these emission rates to the maximum hourly SO₂ emission rate from the main boiler (582.6 lbs/hr) were determined. In turn, these ratios were used to scale the maximum incremental 8-hour, 24-hour, and annual average SO₂ concentrations due to the main boiler alone to determine the equivalent concentrations for each of these non-criteria pollutants. The results were then compared to corresponding "no-threat" levels, developed by the Florida Air Toxics Working Group, to evaluate potential health effects because of these emissions.

Maximum incremental SO₂ impacts from the plant are due to emissions from the auxiliary boiler stack because of downwash effects on dispersion, as reported above. However, trace element emissions from the auxiliary boiler are, in general, three orders of magnitude lower than from the main boiler. The maximum

incremental SO_2 concentrations due to the main boiler only are $13.1 \mu\text{g}/\text{m}^3$ (8-hour), $5.7 \mu\text{g}/\text{m}^3$ (24-hour), and $0.56 \mu\text{g}/\text{m}^3$ (annual). Therefore, maximum trace element impacts will be due to emissions from the main boiler.

Maximum 8-hour, 24-hour, and annual average beryllium impacts are about two orders of magnitude less than the corresponding "no-threat" levels (0.02 , 0.005 , and $0.0004 \mu\text{g}/\text{m}^3$, respectively). A similar difference in magnitude is shown for fluorides. The maximum 8-hour and 24-hour incremental concentrations are about 220 and 120 times less than the respective "no-threat" levels ($25 \mu\text{g}/\text{m}^3$ for 8 hours, and $6 \mu\text{g}/\text{m}^3$ for 24 hours). A threshold level for fluoride has not been specified on an annual average basis.

Maximum 8-hour and 24-hour inorganic arsenic impacts are about two orders of magnitude less than the corresponding "no-threat" levels (2 and $0.54 \mu\text{g}/\text{m}^3$, respectively). The maximum annual average incremental impact is 84 percent of the annual threshold value ($0.0002 \mu\text{g}/\text{m}^3$). For mercury, maximum 8-hour and 24-hour impacts are also about two orders of magnitude less than the respective "no-threat" levels (0.1 and $0.024 \mu\text{g}/\text{m}^3$, respectively). Like fluorides, a threshold level for mercury has not been specified on an annual average basis.

Overall, it may be concluded that trace element emissions from the plant pose no significant health risk in the site area. A detailed discussion of this analysis is found in Section 5.1.4 of the PSD permit application (see Section 10.1.5).

PSD Increment Consumption Determination

As the previous subsection indicates, a determination of the amount of available PSD increment consumed by the ICL plant and other sources specified by the FDER is required for SO_2 and NO_2 . Since maximum particulate impacts were shown to be insignificant, such a determination was not necessary for that pollutant.

Maximum composite SO₂ impacts for the 3-hour, 24-hour, and annual average periods are 176.8 µg/m³, 49.4 µg/m³, and 3.98 µg/m³, respectively, and occur at distances greater than 3 km from the ICL stack to the west and northwest. These values are about 35, 54, and 20 percent of the corresponding maximum allowable PSD increment levels (i.e., 512, 91, and 20 µg/m³, respectively). The ICL plant contributes nothing to the combined maximum 3- and 24-hour incremental impacts, and only about 13 percent to the annual composite impact level. This demonstrates that operation of the facility poses very little threat of exceeding allowable increment levels.

For NO₂, the maximum composite annual average incremental impact is 6.53 µg/m³ and occurs adjacent to the eastern part of the ICL property line. Auxiliary boiler emissions contribute about 68 percent of this impact. However, this value is only about 26 percent of the corresponding maximum allowable increment level (25 µg/m³). As with SO₂, the composite results demonstrate that operation of the proposed facility poses very little threat of exceeding allowable increment levels.

Ambient Air Quality Compliance Demonstration

As a conservative approach, maximum incremental concentrations of criteria pollutants, due to emissions from the ICL plant and other nearby sources, were evaluated within the SO₂ significant impact area around the site. This impact area extends 4.25 km downwind.

Maximum SO₂ impacts within this study area are not significantly influenced by emissions from the ICL plant. On the contrary, maximum concentrations due to other nearby sources impacting the study area are 182.0 µg/m³ (3-hour), 48.5 µg/m³ (24-hour), and 6.77 µg/m³ (annual). When combined with the respective monitored ambient background levels (61.0, 12.6, and 1.3 µg/m³), the resulting total impacts are 243.0 µg/m³ (3-hour), 61.1 µg/m³ (24-hour), and 8.18 µg/m³.

(annual), respectively. All total impacts are well below the corresponding NAAQS/FAAQS.

Maximum particulate impacts within the study area are dominated by fugitive emission sources at the ICL site, and are $3.3 \mu\text{g}/\text{m}^3$ for 24 hours and $0.26 \mu\text{g}/\text{m}^3$ on an annual average basis. For this analysis, these concentrations are assumed to apply to particles in the TSP and PM-10 size ranges. Total TSP impacts, using the background values reported in Section 5.6.1.2, are 108.3 and $40.26 \mu\text{g}/\text{m}^3$ for 24-hour and annual average periods, respectively. These values are below the state primary and secondary TSP standards. For PM-10, measured background levels of 39.0 and $13.3 \mu\text{g}/\text{m}^3$ are used to determine 24-hour and annual average total impacts of 42.3 and $13.56 \mu\text{g}/\text{m}^3$, respectively. These values are below the corresponding ambient standards of $150 \mu\text{g}/\text{m}^3$ (24-hour) and $50 \mu\text{g}/\text{m}^3$ (annual average).

Total annual average NO_2 impacts within the study area are based on an incremental concentration of $4.42 \mu\text{g}/\text{m}^3$ from the ICL plant, $1.68 \mu\text{g}/\text{m}^3$ from other nearby sources, and a monitored ambient background level of $5.4 \mu\text{g}/\text{m}^3$. The total value ($11.5 \mu\text{g}/\text{m}^3$) is far below the federal and state ambient standard ($100 \mu\text{g}/\text{m}^3$).

Maximum incremental CO impacts for 1- and 8-hour averaging periods due to the ICL plant were determined to be 78.2 and $50.9 \mu\text{g}/\text{m}^3$, respectively. When combined with the assumed background CO levels (see Section 5.6.1.2), the total impacts ($8,079 \mu\text{g}/\text{m}^3$ for 1 hour, and about $5,766 \mu\text{g}/\text{m}^3$ for 8 hours) are well below the corresponding NAAQS/FAAQS of $40,000$ and $10,000 \mu\text{g}/\text{m}^3$.

Overall, it may be concluded from these results that emissions from the proposed facility alone or in combination with other nearby sources are well below the federal and state ambient air quality standards and pose no threat of causing an

exceedance. Section 5.3 of the PSD permit application provides more detail with respect to this compliance demonstration (see Section 10.1.5).

5.6.1.4 Potential Visibility Impairment

A Level-1 analysis was made to determine the potential for visibility impairment at the Everglades National Park, 140 km south of the ICL, the closest Class I PSD area to the site. The Level-1 analysis makes conservative assumptions with respect to meteorological conditions and maximum stack emission rates. The model generates critical indices for plume perceptibility and plume contrast against the sky or terrain and compares these values to threshold levels. An exceedance of these values indicates that some type of visibility impairment is possible and that a more refined analysis (e.g., incorporating more detailed emission characteristics and actual meteorological data) is necessary.

The results of the Level-1 VISCREEN analysis indicate that all indices for plume perceptibility and contrast are below these threshold levels. The screening results also demonstrate that the farthest distance at which the ICL stack plume might be observed is between 60 and 65 km away. Overall, these results are not unexpected, considering the source-receptor separation, that emissions will be controlled through the application of BACT, and that opacity of emissions from the facility will be limited to 20 percent or less. Therefore, it may be concluded that operation of the ICL plant will not impair visibility.

A more detailed discussion of the potential visibility impact analysis is found in Section 6 of the PSD permit application (see Section 10.1.5).

5.6.1.5 Other Air Quality-Related Effects

Several air quality-related effects have been addressed in previous sections: potential health risks of trace element emissions (Section 5.6.1.3), impairment to

visibility (Section 5.6.1.4), and cooling tower impacts (Section 5.1.4). This section addresses the other effects required to be evaluated under the PSD review process: impacts from industrial/residential growth that may occur because of the project, and impacts on soils and vegetation in the site area.

Potential Growth Impacts

The area surrounding the ICL site is currently zoned as agricultural and has been historically used for the same purposes. There are a few isolated rural industrial facilities, as evidenced by the Caulkins Citrus processing plant (the steam host facility for the project). No areas of special value, scenic vistas, or recreational areas exist within the immediate site area.

Minimal growth associated with the construction and operation of the plant is expected. An adequate work force currently exists in the site area to support construction without the need for importing workers, although some temporary relocations will occur. During operation, some additional relocation of plant personnel will be required. However, in both cases, these numbers will be within planned area growth projections and will not be the cause of any increased development.

Process steam will be consumed by the host facility and some will be used for electrical power generation. Some of the power is intended to satisfy in-house loads, most will be sold to FPL. Therefore, no direct effect of electrical or steam production on industrial or residential growth is expected in the site area.

As a result, no air quality-related impacts, directly attributable to the expected minimal growth associated with the proposed plant, are anticipated. Construction and operation of the plant will eliminate the cattle grazing that currently occurs on the site.

Potential Impacts on Soils and Vegetation

The primary effect of SO₂ and NO₂ deposition and absorption by soils is the resultant lowering of soil pH. Low soil pH will have an influence on most chemical and biological reactions in the soil: it accelerates mineral weathering and the release of phytotoxic ions to the soil solution, it affects the migration of clay and organic materials down through the soil-profile development process, and it will affect the level and availability of most plant nutrients in the soil. Based on the maximum incremental and total SO₂ and NO₂ impacts discussed in Section 5.6.1.3 and the fact that they are well below the NAAQS/FAAQS, adverse effects on soils in the site area are not anticipated.

Particulate deposition may affect soils by altering soil pH and by potentially increasing the availability of heavy metals in the soil for plant uptake. However, it has also been determined that uptake by vegetation will not increase dramatically unless the deposited trace elements are considerably more available than endogenous forms. Considering the results in Section 5.6.1.3, those levels are not expected to be surpassed.

Potential impacts to vegetation from SO₂ and NO₂ have been evaluated with respect to dose response curves that have been developed for various plant species and their sensitivity to these pollutants. Plants have been ranked as sensitive, intermediate, or resistant in this regard.

For SO₂, the lowest 3-hour concentration expected to cause injury or damage to sensitive vegetation is about 390 µg/m³. From Section 5.6.1.3, the highest incremental 3-hour average SO₂ impact is 24.7 µg/m³ due to the ICL plant alone, and 182.0 µg/m³ for the plant and other, nearby sources combined. The maximum total impact, which includes a background level of 61.0 µg/m³, is 243 µg/m³, or about two-thirds of the sensitive species threshold value for possible injury. It is reasonable to conclude that operation of the plant will not damage

vegetation in the site area based on SO₂ emissions from the proposed facility alone or in combination with other existing nearby sources

A similar conclusion is drawn with respect to potential injury to vegetation resulting from NO₂ emissions. Threshold levels of response for 3-hour and 24-hour averaging periods are 1,890 and 750 µg/m³, respectively. Maximum 3-hour and 24-hour incremental NO₂ impacts due to the ICL plant are 97.3 and 45.7 µg/m³, respectively. Ambient background levels are not routinely determined for NO₂ over these short-term periods because the federal and state standards are written on an annual average basis (i.e., 100 µg/m³). While it is recognized that short-term ambient background levels are likely to be higher than the annual average background concentration (5.4 µg/m³), the site area is in attainment for NO₂. The combined impact (maximum incremental plus short-term background) should be much less than the threshold injury levels which are at least an order of magnitude higher than either of the incremental or background components of the total.

Dose-response curves reflecting injury potential due to exposure to particulate matter have not been generated because this material varies greatly in size and chemical composition. Most data pertain to the effects of settleable dusts. Total short-term and long-term TSP and PM-10 impacts are less than the significance level (see Section 5.6.1.3). Therefore, plant injury is not expected as a result of these fugitive dust-related impacts.

In comparison to other pollutants, relatively little research has been done regarding the effects of CO on vegetation. Available information indicates that a potential for injury does exist, but only at concentration levels far in excess of those estimated to occur from operations at the ICL plant. The 1-hour maximum incremental value is 25 times less than the corresponding significant impact level, the 8-hour value is 10 times lower than the 8-hour significance level (see Section 5.6.1.3). At these levels, damage to vegetation by CO emissions from the plant is not anticipated.

A more detailed discussion of potential effects on vegetation is found in Section 7.2 of the PSD permit application, Section 10.1.5 of this report.

5 6 2 MONITORING PROGRAMS

This section discusses the applicability of air quality-related monitoring programs to the proposed ICL facility. Emission limitations are established through the air quality permitting process. These limits represent the measures used to ensure that ambient standards will be met and that acceptable impacts will result from a proposed action. Compliance with these limitations is established through an emissions monitoring program. Compliance with ambient air quality standards represents a test of the effectiveness of those controls and the acceptability of the resulting impacts after the facility is operating. Similarly, air quality measurements in the pre-construction phase of a project represent a means for defining ambient conditions prior to a project's development.

5 6 2 1 Pre-Construction Ambient Air Quality Monitoring

Background air quality data, representative of ambient conditions in the site area, were available from nearby monitoring stations to perform the required air quality impact analyses for the proposed facility. Furthermore, results of a preliminary modeling analysis were used to demonstrate that incremental impacts were below the threshold levels that would require ambient monitoring to take place. The FDER has agreed that sufficient background data are available and has issued an exemption from any pre-construction monitoring requirements, with the condition that emissions used in the final modeling will not exceed those used in the preliminary modeling.

5 6 2 2 Post-Construction Ambient Air Quality Monitoring

The EPA's Ambient Monitoring Guidelines for PSD (EPA, 1987) indicate that the permit granting authority may require post-construction air quality monitoring, if

- The proposed facility is a major source for the purposes of new source review
- There is an apparent threat to the ambient air quality standards
- The proposed source impact is uncertain or unknown (e g , the source is located in complex terrain or in the presence of fugitive emissions, or has uncertain source or emission characteristics)
- There is a potential adverse impact on a Class I PSD area

There are no plans to establish a post-construction ambient air quality monitoring program for the ICL plant. This rationale is discussed in the following subsections in the context of these four potential areas of concern to EPA

Major Source Concern

The proposed ICL plant is a major stationary source subject to PSD and new source review. However, the implementation of BACT, under the PSD program, will substantially mitigate emissions.

Threat to Ambient Air Quality Standards

The EPA considers the ambient air quality standards to be threatened if the impacts due to the proposed source are projected to be equal to or greater than 90 percent of the ambient standards when the source becomes operational. The

ICL site is located in an attainment area for all criteria air pollutants. Representative background monitoring data for the site area corroborate this designation and indicate that ambient conditions are well below the corresponding standards (see Section 5.6.1.5).

The results in Section 5.6.1.6 indicate that maximum incremental impacts for particulates and CO are well below the corresponding significant impact levels. Although maximum incremental SO₂ and NO₂ concentrations are above the significant impact levels, total impacts (which include the effects of other nearby sources of these emissions and measured background levels) are well below the corresponding NAAQS and FAAQS. Therefore, it is reasonable to conclude that emissions from the proposed facility pose no threat of exceeding either the ambient standards or available PSD increment levels.

Uncertainty of Emissions Characteristics

Emissions from the main and auxiliary boilers represent well-defined point sources based on known fuel-firing scenarios and vendor design specifications. Furthermore, emissions will be controlled both through the application of BACT. Fugitive emissions are not expected to be a major concern and will be controlled both through the application of traditional mitigation measures and non-traditional methods in that the material handling systems will be totally enclosed and vented through fabric filters. The dispersion model used to estimate impacts from these sources incorporates EPA-approved algorithms to account for the various characteristics of these releases. Therefore, it may be concluded that the emissions and resulting estimated impacts can be readily quantified using applicable regulatory guidance, with a reasonable degree of certainty.

Impact on Class I PSD Areas

The closest Class I PSD area to the ICL site is the Everglades National Park, about 140 km away. Given the distance from the proposed source, neither significant incremental air quality impacts nor unacceptable impairment to visibility is expected.

5.6.2.3 Air Emissions Monitoring

The proposed facility is subject to the New Source Performance Standards codified at 40 CFR Part 60, Subpart Da (Standards of Performance for Electric Utility Steam Generating Units). The Florida Air Pollution Rules for new sources (at F.A.C. 17-2.660) adopts Subpart Da by reference.

In accordance with these requirements, a continuous emissions monitoring system (CEMS) will be installed, calibrated, maintained, and operated for measuring opacity of visible emissions and SO₂ and NO₂ emissions discharged to the atmosphere. A CEMS will also be provided to measure the oxygen or carbon monoxide content of the flue gases.

Initial performance tests will be conducted after plant startup and testing in accordance with Florida Air Pollution Rule 17-2.700 F.A.C. for those pollutants for which a BACT analysis is required. Compliance determination test methods and procedures applicable to the ICL emissions monitoring program are specified in F.A.C. 17-2.700 (6), and by reference, where appropriate, in Section 60.48a of Subpart Da and Appendix A to 40 CFR Part 60.

5.7 NOISE

Noise levels have been calculated that could be expected along the perimeter of the site and at the nearest residence due to the operations of the Indiantown Cogeneration, L.P. (ICL) plant. The locations that were selected for impact assessment are shown on Figure 5.7.0-1. Locations B, C, and D were selected to be representative of noise levels at the plant boundary that are closest to the sources of greatest noise emissions. Locations A and R are considered to be representative of noise levels which would be expected to occur at the nearest residences.

Modeling of the noise impacts was performed using a spreadsheet model based on the Edison Electric Institute publication, "Electric Power Plant Environmental Noise Guide" (Vol. 1, 2nd edition, 1984). This model was used to predict noise levels at each of these locations using typical noise levels and spectra for each of the main sources of noise emissions. Ground sound absorption effects (draft ISO standard) were accounted for in assessing impacts from all low elevation sources. This accounts for the soft absorptive fields between the ICL plant and noise receptors.

There are no state or local noise regulations for the Indiantown area. Therefore, the EPA guideline (EPA, 1974) recommended to protect public health and welfare for outdoor activity in residential areas and farms with a margin of safety was used. This noise level, a day/night weighted average (Ldn) of 55 dBA, represents the sound energy averaged over a 24-hour period with a 10 dB nighttime weighting to account for the difference in noise perception during the nighttime hours as compared to the daytime hours. An Ldn of 55 dBA translates into a continuous 24-hour noise level of 49 dBA that would be allowed from the power plant from all noise sources that normally operate at the plant.

The 12 major sources of noise within the ICL plant are listed in Table 5.7.0-1. Each was analyzed to determine their individual contributions to the total noise impact.

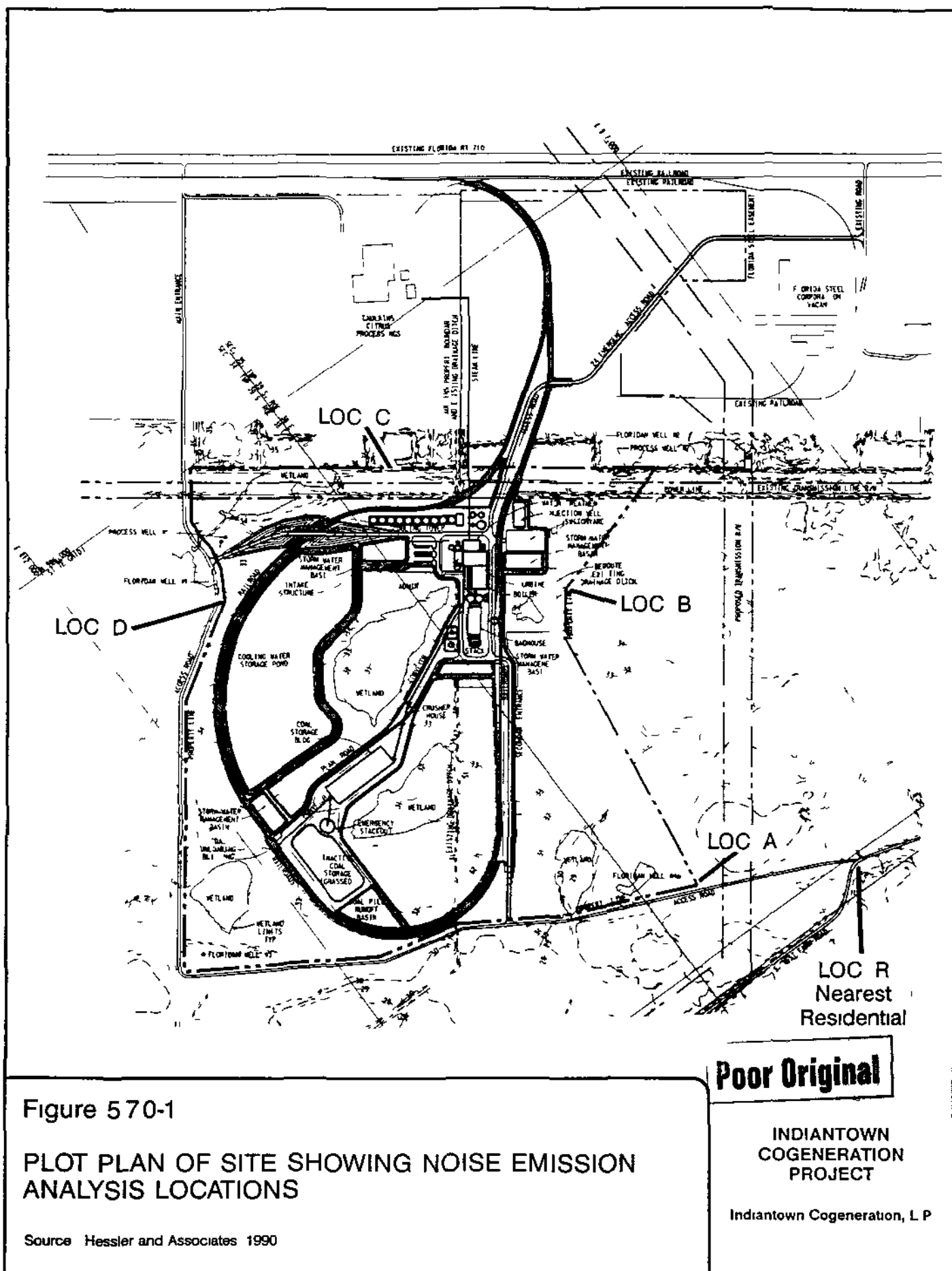


Figure 570-1

PLOT PLAN OF SITE SHOWING NOISE EMISSION ANALYSIS LOCATIONS

Source Hessler and Associates 1990

Poor Original

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L P

Table 5 7 0-1
MAJOR SOURCES OF NOISE WITHIN THE ICL PLANT

Induced Draft Fan Stack Outlet
Induced Draft Fan Ducting
Induced Draft Fan Housing
Forced Draft Inlet Opening
Forced Draft Fan ducting
Forced Draft Fan Housing
Cooling Towers
Main Boiler
Main Transformer
Coal Crusher
Steam Turbine Generator
Outdoor Fan Motors
Coal Unloader
Train

Source Bechtel, 1990

at each of the receptors. The results of the analysis are presented in Table 5.7.0-2 where the total impact at each receptor is listed, as well as the individual contributions from each of the sources. The impacts of the 12 major noise sources are ranked by magnitude of effect for each receptor on this table. Additionally, the octave band frequency analysis for each source is presented on this table.

The need for mitigation of any sources of emissions is determined from the sum of the contributions of all sources for any receptor and comparing this value to the Ldn of 55 dBA. The individual sources that need to be mitigated are then determined from the relative ranking of their contributions to the total impact at the receptor in question. The type of mitigation and the amount of noise level reduction that is achievable for each source is assessed through an analysis of the octave band frequency distribution and the height of emission of each source. Thus, at receptors A and R, which are representative of impacts that could be expected at the nearest residences, it was determined that noise abatement measures would be required for the ID fans and the FD inlets because the total impact exceeded the Ldn of 55 dBA. The required silencer insertion losses for the ID fan and FD inlet silencers were calculated for use in the analysis.

The plant is designed with extensive noise abatement measures to limit noise emissions at location R, the closest residence, to a level of 42 dBA (41.9 dBA, Table 5.7.0-2), and 44.6 dBA at Location A. This level is 7 dBA below the federal EPA guidelines of 49 dBA for 24-hour per day plant operation.

The designed-in margin of 7 dBA is based on measurements of the existing background sound levels. These measurements were found to range from a low of 34 dBA during early morning, calm and still wind conditions, to a more typical level range of 38 to 42 dBA. This range is typical of those found in rural and very quiet suburban residential areas.

Table 5 7 0-2

SUMMARY OF SOURCES AND IMPACTS AT RECEPTORS A THROUGH R

		OCTAVE BAND CENTER FREQUENCY HZ								OVERALL
DESCRIPTOR		31.5	63	125	250	500	1000	2000	4000	A'WTD
SUMMARY OF SOURCES AT POSITION A (RESIDENTIAL DIRECTION)										
SOURCE DESCRIPTION	NO.									
COOLING TOWERS	7	47	50	43	38	36	33	26	5	68
OUTDOOR FAN MOTORS	12	36	38	30	29	31	33	30	15	38
COAL CHRUSHER (1)	10	50	48	39	34	32	31	26	10	45
STEAM TURBINE GENERATOR	11	45	51	43	35	32	29	23	0	61
MAIN BOILER	8	51	50	39	31	31	30	25	11	43
FD INLET OPNG	4	50	51	41	34	26	27	25	24	33
ID FAN STACK OUTLET	1	57	52	42	33	29	26	25	18	34
FD FAN HOUSING	6	49	46	43	37	27	26	18	1	59
ID FAN HOUSING	3	52	46	40	33	20	20	13	3	56
MAIN TRANSFORMER	9	34	40	32	26	28	23	15	4	64
ID FAN DUCTING	2	43	39	35	27	17	16	9	6	59
FD FAN DUCTING	5	42	38	33	26	15	15	7	10	69
TOTAL Lp ALL SOURCES		61	59	51	44	41	39	35	26	0
SUMMARY OF SOURCES AT POSITION B										
SOURCE DESCRIPTION	NO.									
FD INLET OPNG	4	62	63	53	47	41	41	42	51	31
OUTDOOR FAN MOTORS	12	47	49	46	43	45	47	47	41	21
MAIN BOILER	8	65	64	56	46	46	47	48	42	31
STEAM TURBINE GENERATOR	11	59	65	60	50	48	46	43	31	12
COOLING TOWERS	7	56	59	59	55	50	43	37	26	7
MAIN TRANSFORMER	9	51	57	53	45	47	44	38	30	10
FD FAN HOUSING	6	61	58	59	50	42	41	36	27	8
ID FAN STACK OUTLET	1	66	61	51	43	39	36	37	38	17
COAL CHRUSHER (1)	10	57	55	48	41	40	40	36	25	10
ID FAN HOUSING	3	62	56	54	45	33	34	29	21	0
FD FAN DUCTING	5	54	50	49	39	30	30	26	18	2
ID FAN DUCTING	2	53	49	48	38	29	29	25	17	4
TOTAL Lp ALL SOURCES		72	71	66	59	55	54	51	52	34
SUMMARY OF SOURCES AT POSITION C										
SOURCE DESCRIPTION	NO.									
COOLING TOWERS	7	71	74	71	65	64	63	60	56	42
STEAM TURBINE GENERATOR	11	59	65	59	50	47	46	42	31	10
MAIN BOILER	8	62	61	53	43	43	44	41	37	22
FD FAN HOUSING	6	56	51	54	50	39	36	30	19	7
FD INLET OPNG	4	57	56	45	39	33	33	34	41	16
MAIN TRANSFORMER	9	47	53	48	40	42	39	33	24	1
OUTDOOR FAN MOTORS	12	42	44	37	35	36	38	36	27	5
COAL CHRUSHER (1)	10	55	53	46	39	38	37	34	21	20
ID FAN STACK OUTLET	1	61	56	46	38	34	31	31	28	2
ID FAN HOUSING	3	57	51	48	39	27	27	22	12	20
FD FAN DUCTING	5	49	43	44	39	27	26	20	11	14
ID FAN DUCTING	2	48	44	42	33	23	24	18	8	24
TOTAL Lp ALL SOURCES		73	75	72	65	65	63	60	56	42
SUMMARY OF SOURCES AT POSITION D										
SOURCE DESCRIPTION	NO.									
COOLING TOWERS	7	56	59	59	56	52	47	41	31	3
COAL CHRUSHER (1)	10	57	55	54	49	47	43	39	28	9
STEAM TURBINE GENERATOR	11	51	57	55	50	45	40	35	18	21
OUTDOOR FAN MOTORS	12	39	41	43	43	42	41	38	27	13
MAIN BOILER	8	56	55	50	43	41	38	34	26	7
FD INLET OPNG	4	54	55	45	38	33	32	31	35	5
FD FAN HOUSING	6	53	50	49	42	33	32	25	10	30
ID FAN STACK OUTLET	1	59	54	44	36	32	29	29	25	15
MAIN TRANSFORMER	9	41	47	40	33	35	31	24	11	29
ID FAN HOUSING	3	55	49	44	36	24	24	18	6	34
FD FAN DUCTING	5	46	42	39	31	21	21	15	2	37
ID FAN DUCTING	2	45	42	39	31	21	21	15	2	37
TOTAL Lp ALL SOURCES		65	64	62	58	54	50	46	38	0
SUMMARY OF SOURCES AT POSITION R (NEAREST RESIDENTIAL LOCATION)										
SOURCE DESCRIPTION	NO.									
COOLING TOWERS	7	46	49	41	36	34	31	22	1	85
STEAM TURBINE GENERATOR	11	43	49	41	33	30	27	19	6	78
MAIN BOILER	8	50	49	38	30	29	28	22	6	57
OUTDOOR FAN MOTORS	12	34	36	27	27	28	29	25	7	60
FD INLET OPNG	4	49	49	39	33	26	24	22	18	49
ID FAN STACK OUTLET	1	54	49	40	31	27	23	22	12	54
COAL CHRUSHER (1)	10	48	45	36	30	29	27	21	0	73
FD FAN HOUSING	6	47	44	41	34	25	23	14	9	81
MAIN TRANSFORMER	9	35	41	32	27	28	23	14	8	82
ID FAN HOUSING	3	50	44	37	30	17	17	9	11	77
ID FAN DUCTING	2	41	37	31	24	14	13	5	0	0
FD FAN DUCTING	5	40	36	31	23	13	12	4	17	88
TOTAL Lp ALL SOURCES		59	57	49	42	39	37	31	20	0

Poor Original

Source Hessler, 1990

(1) DAY TIME ONLY TOTAL Lp IS APPROXIMATELY 1/2 dBA QUIETER AT NIGHT W/O CHRUSHER

Subjectively, the ICL plant sound will be detectable and audible only during calm and still wind conditions. Such conditions occur about 5 percent of the time. At other times, the plant will be inaudible, as the plant sound is not greatly above the measured normal ambient sounds consisting of far-off road sources, rustling grasses, trees, bird, and insect sounds.

Based on the above analysis and discussion, ICL plant operational sound is not expected to have any impact on adjacent residences located on South West Farm Road.

The estimated noise levels at location R due to the ICL plant emissions are compared to the measured ambient levels at the site on Figure 5.7.0-2. The abatement measures discussed above are applied to the major sources of noise that impact this receptor. These abatement measures were mainly directed towards reducing the peaks that occurred in the 150 to 250 Hz octave band center frequencies.

Δ EST PLANT NOISE EMISSIONS X UPPER RANGE ABOUT 400 FROM RT 710 X LOWER RANGE REMOTE FROM RT 710 AT NEAREST RESIDENCE

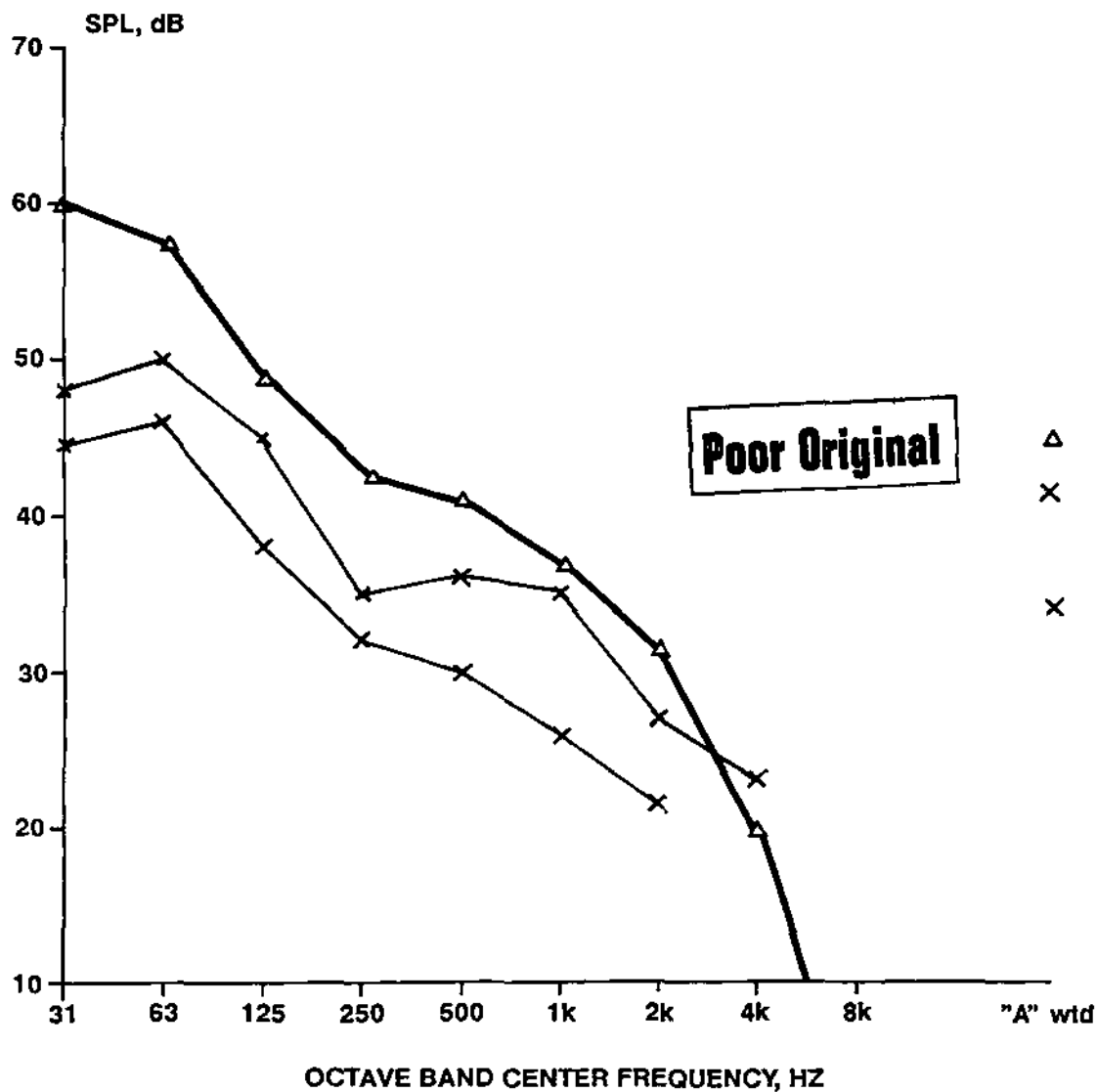


Figure 570-2

ESTIMATED NOISE EMISSIONS AT POSITION R
COMPARED TO AREA RESIDENTIAL (L90) AMBIENT
RANGE

Source Hessler and Associates 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L P

5 8 CHANGES IN NONAQUATIC SPECIES POPULATIONS

5 8 1 IMPACTS

The flatwoods vegetation and wildlife habitat situated on the ICL site are targeted for removal or modification, except for those areas set aside for upland and wetland preservation or future use (see Section 4.4). It is the biota associated with areas that are to remain on or near the project site that will be discussed in the following paragraphs in terms of potential long-term changes in species populations resulting from air emissions from the project operation.

The effects of long-term (chronic) exposures to concentrations of SO_2 , NO_x , O_3 , a mixture of SO_2 - NO_x , a mixture of SO_2 - O_3 , CO_2 , VOC, trace elements, and fugitive dust below those concentrations that result in acute injury symptoms, is not well documented in the literature. However, the literature does report that chronic injury symptoms do occur when plants are exposed to concentrations below injury threshold levels. Even if chronic injury symptoms were manifested by site vegetation, it is not anticipated that the injury will be severe enough to result in changes in species diversity and composition.

Factors, such as water availability, light, and soil nutrients, would tend to have a greater effect on species diversity and composition than exposure to low levels of air contaminants.

5 8 2 MONITORING

It is not expected that monitoring of site nonaquatic species will be necessary

5 9 OTHER PLANT OPERATION EFFECTS

Traffic impacts resulting from the operation of the ICL project are discussed in Section 7 0, and a complete traffic analysis is located in Section 10 0. A beneficial effect from the operation of the plant is the supplying of process steam to Caulkins Citrus and the availability of process steam to any operating or future requirements by light industry. All other effects resulting from the operation of the ICL plant are discussed within the appropriate sections of the SCA.

5 10 ARCHAEOLOGICAL SITES

As previously discussed in Section 2.2.6, and as discussed in detail in Section 10.8, no archaeological or historic resources were previously listed in the location of the Indiantown Cogeneration, L.P. (ICL) project site. In addition, no archaeological or historic resources eligible for inclusion in the *National Register of Historic Places* were found during research and field assessment. Therefore, activities involved with the operation of the plant should have no impact on significant archaeological or historic resources.

Should post-construction activities cause the discovery of unanticipated archaeological materials, those activities which potentially would disturb such materials will be postponed until a professional archaeologist can evaluate their potential significance. In the event the materials are believed to be significant, the State Historic Preservation Office (SHPO) will be contacted to identify appropriate measures.

5 11 RESOURCES COMMITTED

5 11 1 WATER RESOURCES

The ICL plant will utilize surface water from Taylor Creek/Nubbin Slough (TC/NS) as its primary water source. This will have the benefit of reducing the amount of phosphorous currently being discharged to Lake Okeechobee. The backup source of water will be the Floridan aquifer, which has a high TDS level. This will be used only during extended periods of drought when TC/NS water is unavailable.

No water will be withdrawn from the surficial aquifer, a source of potable water for residences. No wastewater will be discharged to a surface body of water. Wastewater will be reused within the plant to the extent practicable and the remainder will be discharged to the Boulder Zone of the Floridan aquifer.

5 11 2 BIOLOGICAL RESOURCES

Except for the flatwoods eliminated during construction, operation of the plant will not require the commitment of additional wildlife habitat or other terrestrial or wetland vegetation, and will have no measurable effect on wildlife species populations, including threatened or endangered species. The ICL plant emissions into the air are also not expected to have a measurable effect on the growth and productivity of surrounding vegetation, including agricultural crops.

5 11 3 ECONOMIC AND CULTURAL RESOURCES

Economic resources committed to the ICL plant are expected to include wages and labor, financial investment, and the displacement of other economic uses of the site. Specific characterization of the operational workforce is contained in Section 7.2, which describes a projected permanent workforce of 80 persons. These 80 positions represent a permanent commitment for the duration of the project, regardless of the tenure of individuals employed at the ICL plant. Therefore, the 80 individuals employed at the ICL project represent a permanent commitment of a workforce which will not be available for employment elsewhere.

Economic commitments are also discussed in detail in Section 7.0. As with labor, the financial investment represents an irreversible commitment which will not be available for other uses as long as the ICL plant remains in operation. Additional tax revenues and impact fees generated as a result of the project, as discussed in detail in Section 7.1.2, are expected to be sufficient to support additional public services and infrastructure required for the operation of the ICL plant. A detailed long-term, benefit-cost analysis is provided in Section 7.2. The need for commitment of additional governmental financial resources required to fund public services beyond those funded by the additional tax revenues and impact fees is not expected.

The displacement of current economic uses due to a change in land use are predicted to be relatively insignificant because the site is currently under-utilized for limited grazing purposes. Many alternative sites are available in the immediate area and within the region, and therefore, the loss of these grazing lands should not represent a significant impact on agricultural land uses in the area. There are no other existing or planned economic uses of the site.

Because no cultural resources are expected to be impacted on the project site, no commitment of archaeological resources is anticipated.



5 12 VARIANCES

At the present time, there are no variances from applicable standards of the state certification proceedings



REFERENCES

Section 5 1

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Section 5 3 1

Ardaman & Associates, Inc , October 17, 1989, Remedial Investigation Report, Phase II, Florida Steel Corporation, Indiantown Mill Site, Martin County, Florida, Volume I

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McWhorter, D B , Sunada, D K Ground-Water Hydrology and Hydraulics, Water Resources Publication, Fort Collins, CO 1977

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South Florida Water Management District Martin County Water Resource Assessment, S Trost and D Neilson Editors, Resource Planning Department 1987

U S Department of Agriculture Soil Conservation Service, Soil Survey, Martin County Area, Florida 1981

U S Department of Agriculture Soil Conservation Service, Soil Survey, Okeechobee County, Florida 1971

Section 5 4 1

Martin County Comprehensive Growth Management Plan (Adopted) Martin County Growth Management Department 1990

Section 5 6 1

U S Environmental Protection Agency Industrial Source Complex (ISC) Dispersion Model User's Guide-Second Edition (Revised), EPA-450/4-88-002a, Office of Air Quality Planning and Standards, Research Triangle Park, NC December, 1987

U S Environmental Protection Agency Workbook for Visual Plume Impact Screening and Analysis, EPA-450/4-88-015, Office of Air Quality Planning Standards, Research Triangle Park, NC September, 1988

Section 5 6 2

U S Environmental Protection Agency, Monitoring Guidelines for Prevention of Significant Deterioration (PSD), EPA-450/4-87-007, Office of Air Quality Planning and Standards, Research Triangle Park, NC May, 1987

Section 5 7

U S Environmental Protection Agency, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety EPA 550/9-74-004 1974



6.1

6 0 LINEAR FACILITIES

6 1 TRANSMISSION LINE

There will be no transmission line constructed since the connection will be to the FPL 230 kV line that traverses the northern boundary of the site. Therefore, Section 6 1 is not applicable to the ICL project.

Poor Original

Volume 3

INDIANTOWN COGENERATION PROJECT
Site Certification Application

Submitted by Indiantown Cogeneration, L P

Volume 3

INDIANTOWN COGENERATION PROJECT

Site Certification Application

Submitted by Indiantown Cogeneration, L P

Volume 3

INDIANTOWN COGENERATION PROJECT

Site Certification Application

**Submitted by
Indiantown Cogeneration, L.P.**

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- 10 9 Plan Water Requirements Availability Study from Taylor Creek/
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- 10 10 Traffic Analysis
- 10 11 UIC Permit Application
- References

6 2 WATER PIPELINE

6 2 1 PROJECT INTRODUCTION

The Indiantown Cogeneration, L P (ICL) facility will require a 19-mile, single, 18- to 24-inch diameter water pipeline in Okeechobee and Martin Counties to support its operations. The pipeline will originate at a new intake structure to be located at the junction of Taylor Creek/Nubbin Slough and the C-59 canal in Okeechobee County. From this new intake structure, the buried water supply pipeline will be run along SR 710 and the CSX Railroad line (within the railroad ROW) into Martin County, terminating at the ICL site. This railroad ROW varies between 100 and 200 feet in width. Since the pipeline is to be located within the railroad ROW, no new corridor is requested for this project.

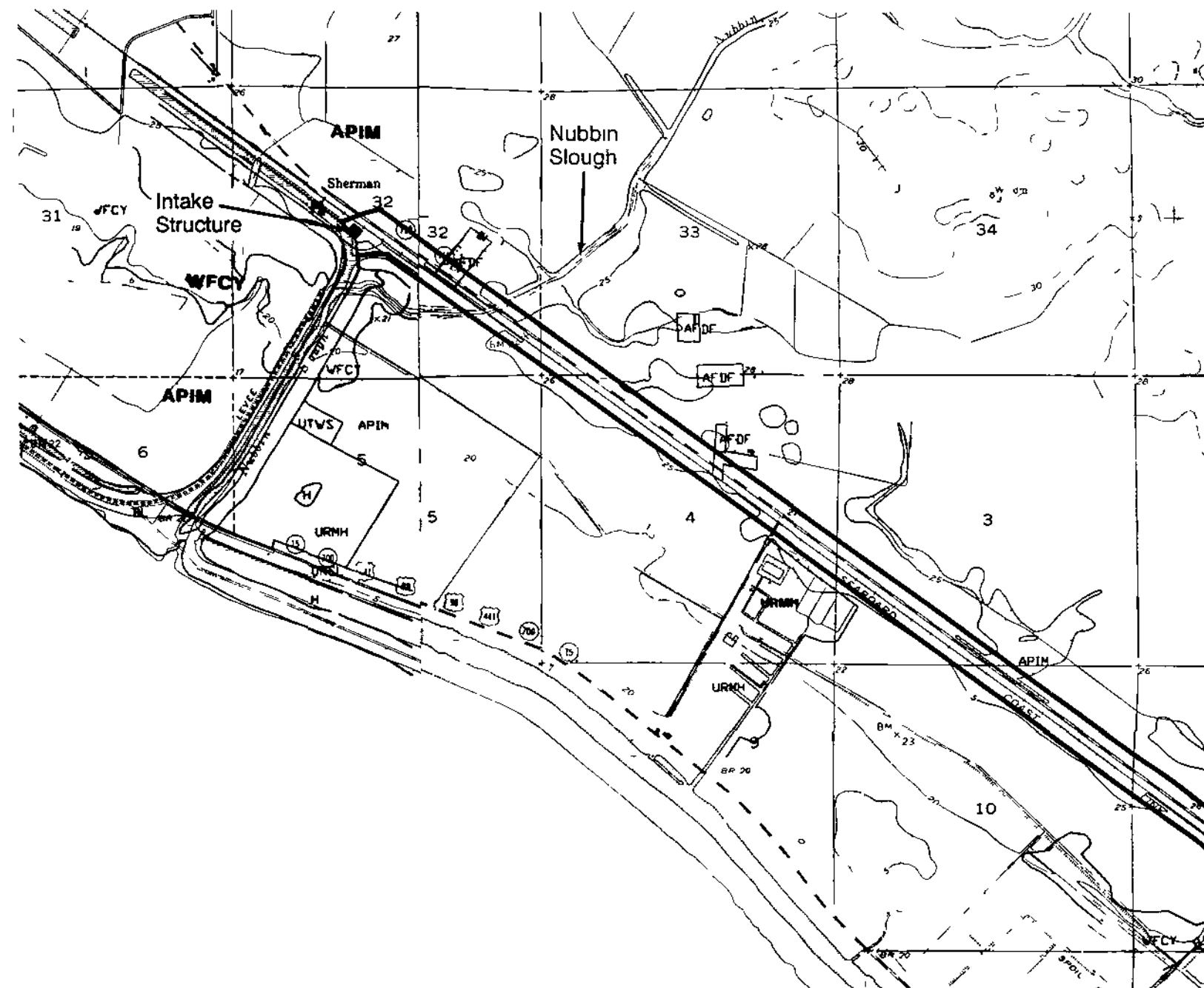
6 2 2 CORRIDOR LOCATION AND LAYOUT

The location of the pipeline is within the CSX ROW extending laterally about 50 feet on each side of the rail line and is shown in Figure 6 2 2-1. The corridor for the water pipeline that is being licensed for the ICL project is the CSX ROW between the ICL site and the ICL water intake at Taylor Creek/Nubbin Slough.

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

CSX RIGHT OF WAY



Poor Original

LEGEND

— Corridor Containing
CSX ROW

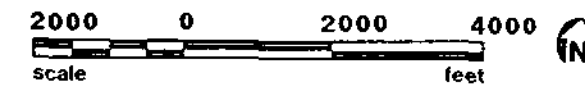
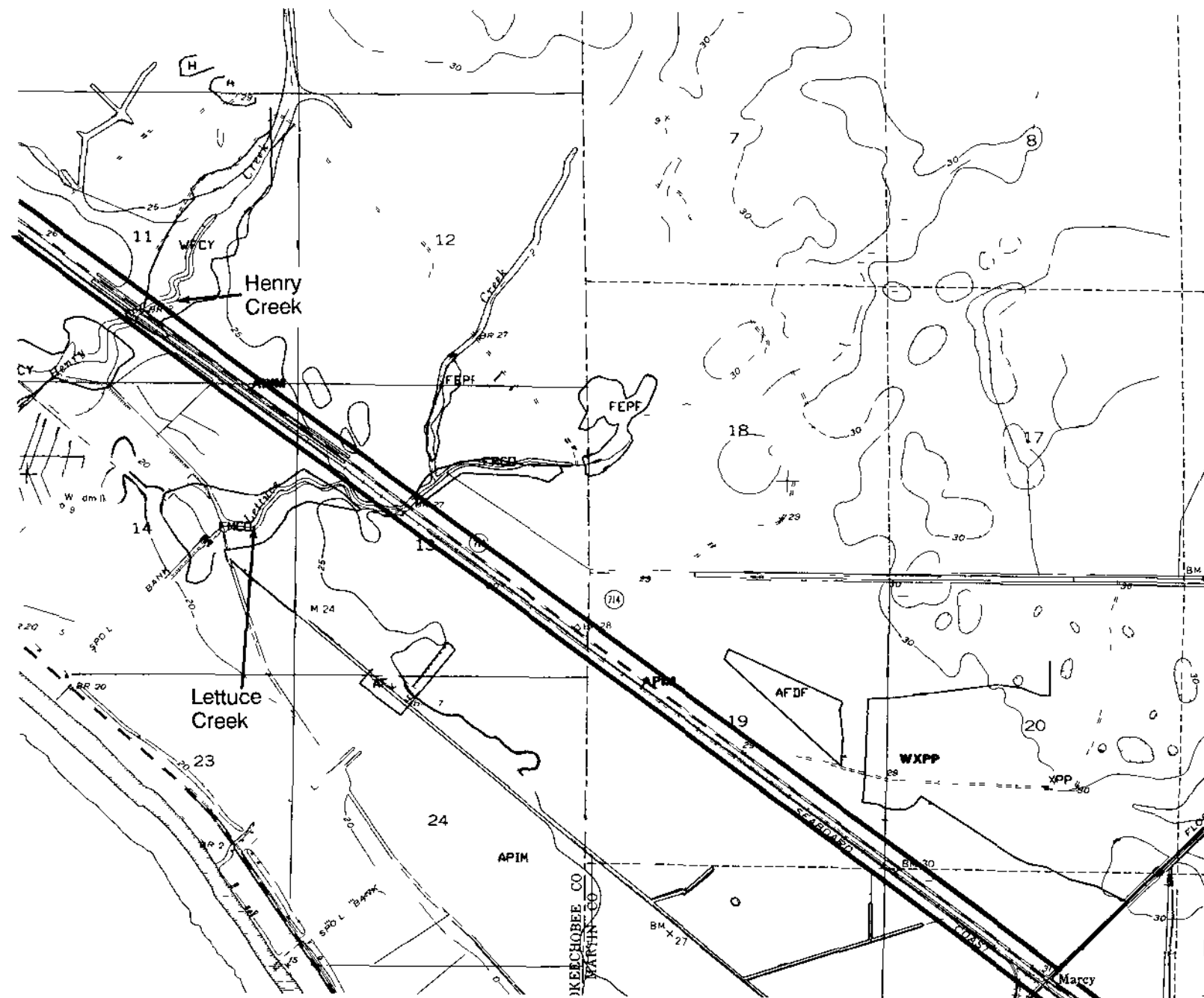
CSX ROW varies from 200 feet
to 100 feet about rail line within
corridor

Sources USGS 1983. SFWMD 1986. ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L P

CSX RIGHT OF WAY



LEGEND

Corridor Containing CSX ROW

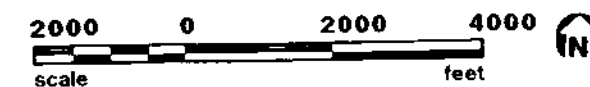
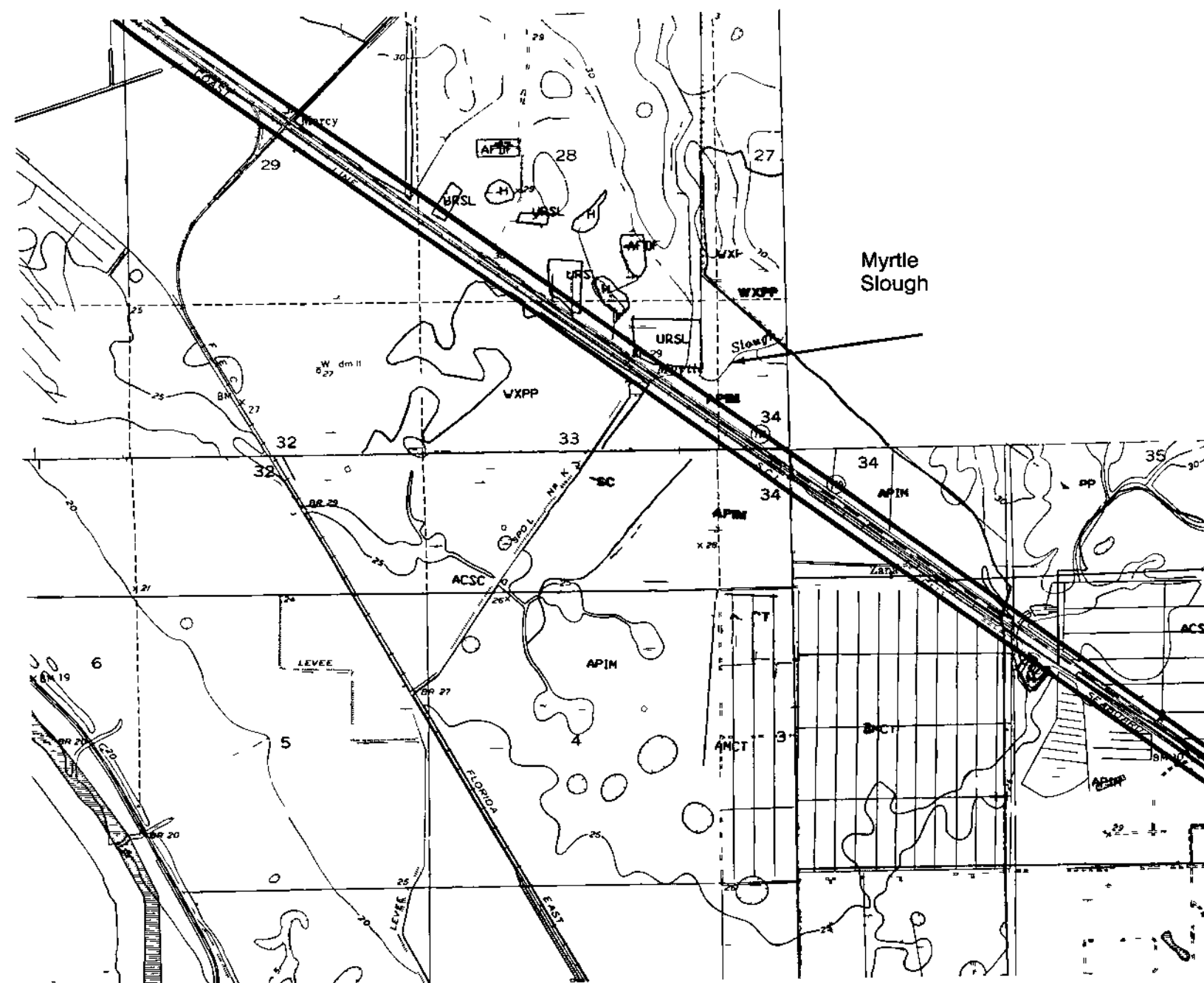
CSX ROW varies from 200 feet to 100 feet about rail line within corridor

Sources USGS 1983 SFWMD 1986 ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L.P

CSX RIGHT OF WAY



LEGEND

— Corridor Containing CSX ROW

CSX ROW varies from 200 feet to 100 feet about rail line within corridor

Sources USGS 1983. SFWMD 1986. ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L.P.

CSX RIGHT OF WAY

LEGEND

Corridor Containing
CSX ROW

CSX ROW varies from 200 feet
to 100 feet about rail line within
corridor

Sources USGS 1983 SFWMD 1986 ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L P

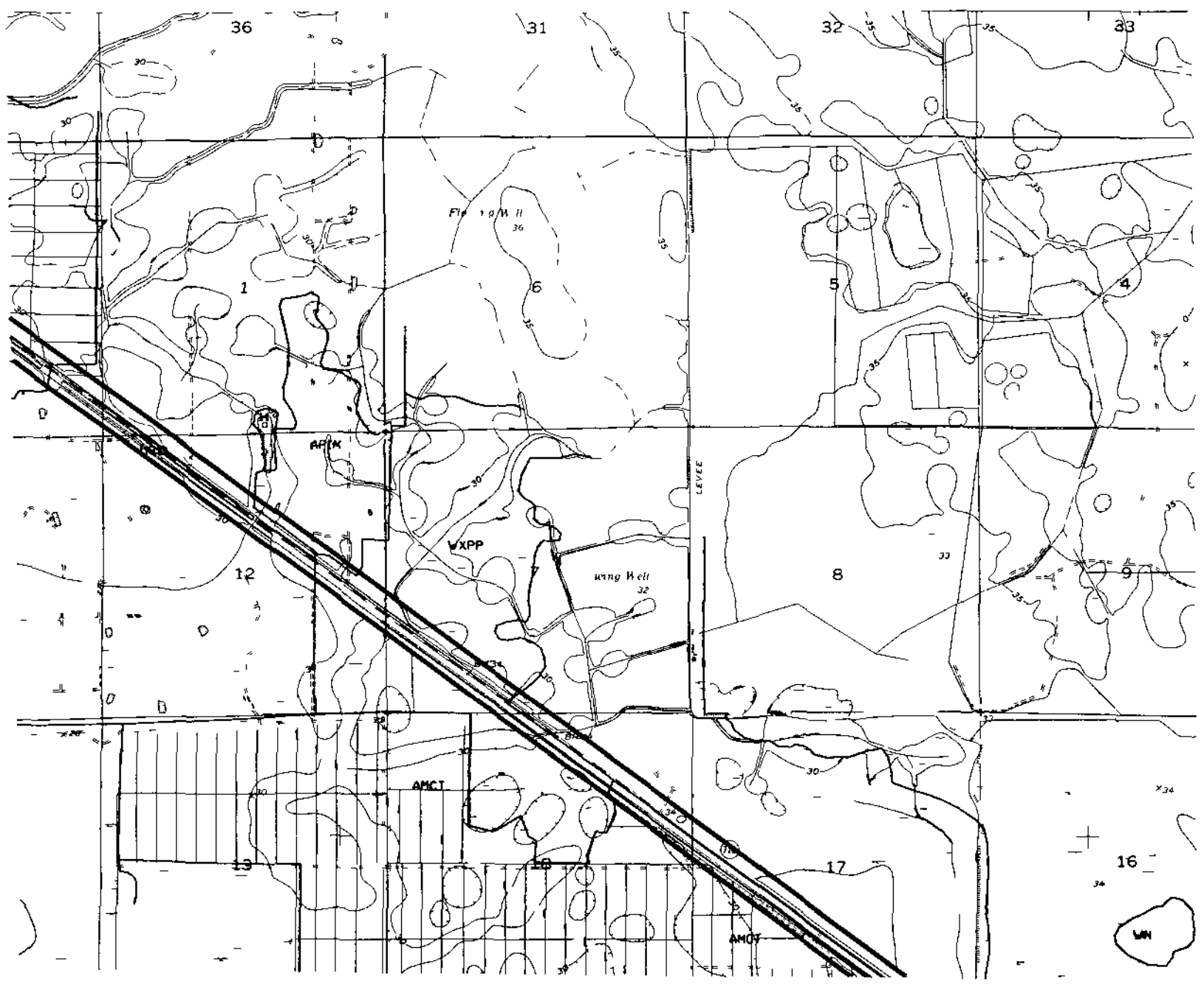
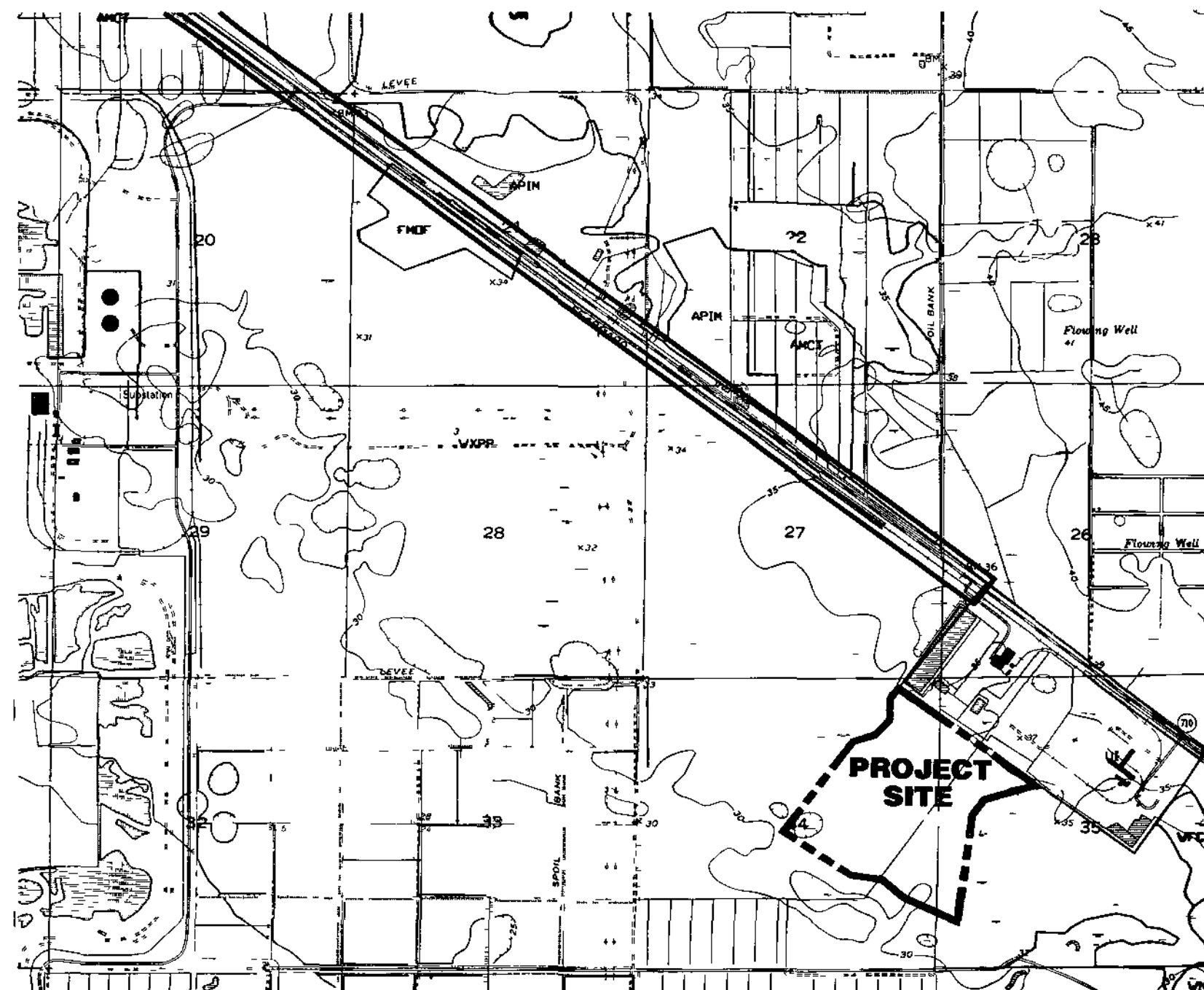


Figure 6 2 2-1 (Page 5 of 5)

CSX RIGHT OF WAY



LEGEND

— Corridor Containing
CSX ROW

CSX ROW varies from 200 feet to 100 feet about rail line within corridor

Sources USGS 1983 SFWMD 1986 ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L.P.

6 2 3 WATER PIPELINE DESIGN CHARACTERISTICS

The pipe will be approximately 18- to 24-inch diameter carbon steel or polyethylene pipe manufactured according to American Water Works Association (AWWA) standards. The pipe sections will be hydrostatically tested to at least 125 percent of the design pressure to confirm the pipe integrity and check for leakage.

If the pipe is carbon steel, it will have a protective external coating. Such coating will be checked electrically for breaks in the coating prior to shipping and prior to installation in the ground. The pipe will be installed in accordance with the requirements of AWWA and the regulatory agencies with jurisdiction over crossings. A cathodic protection system will be installed if soils testing shows it is necessary to prevent corrosion.

Since the pipeline will be constructed within the CSX ROW, no new access roads or bridges will be required.

6 2 4 COST PROJECTIONS

On a per mile basis, a 24-inch diameter pipeline is estimated to cost approximately \$368,400. The total cost of the 19 miles of pipeline is estimated at \$7,000,000 (Bechtel, 1990).

6 2 5 CORRIDOR SELECTION

Since the CSX Railroad right-of-way runs adjacent to the Taylor Creek/Nubbin Slough and the Indiantown Cogeneration, L P site, it was the only corridor considered for the project. The use of an existing railroad ROW results in minimal impacts to the environment and to the general population. Since the ROW is for an operational rail line, no additional disturbance to the environment will occur for maintenance of the ROW or of the pipeline.

6 2 6 SOCIOPOLITICAL ENVIRONMENT OF THE CORRIDOR

6 2 6 1 Governmental Jurisdiction

The cooling water pipeline associated with the Indiantown Cogeneration, L P (ICL) project commences at the project site located in Section 34, Range 38E, Township 39S, and traverses northwesterly along SR 710 and the CSX Railroad line into Okeechobee County with its terminus located at Taylor Creek/Nubbin Slough. The location of this pipeline, with a 0.5-mile corridor extended laterally on each side of SR 710, is shown in Figure 6 2 6-1.

Lands within this corridor fall under the jurisdiction of several governmental agencies which include the following: Martin County, Okeechobee County, TCRPC, Central Florida Regional Planning Council (CFRPC), and SFWMD.

The pipeline corridor follows existing roadway and rail ROWs and does not cross any local, regional, state, or federally designated or protected lands as described in the FDER Instruction Guide for Certification Applications.

6 2 6 2 Zoning and Land Use Plans

The ICL cooling water pipeline corridor crosses lands under the jurisdiction of Martin and Okeechobee Counties. Each county has its own comprehensive plan and zoning regulations.

As previously described in Section 2 2 2, the Martin County Growth Management Department has prepared the Martin County CGMP in accordance with requirements of the Local Comprehensive Planning and Land Development Regulation Act, Chapter 163, Part II, FS, and FAC, Chapter 9J-5. The Martin County CGMP was adopted by the Martin County Board of County Commissioners on February 20, 1990 (Martin County CGMP, 1990).

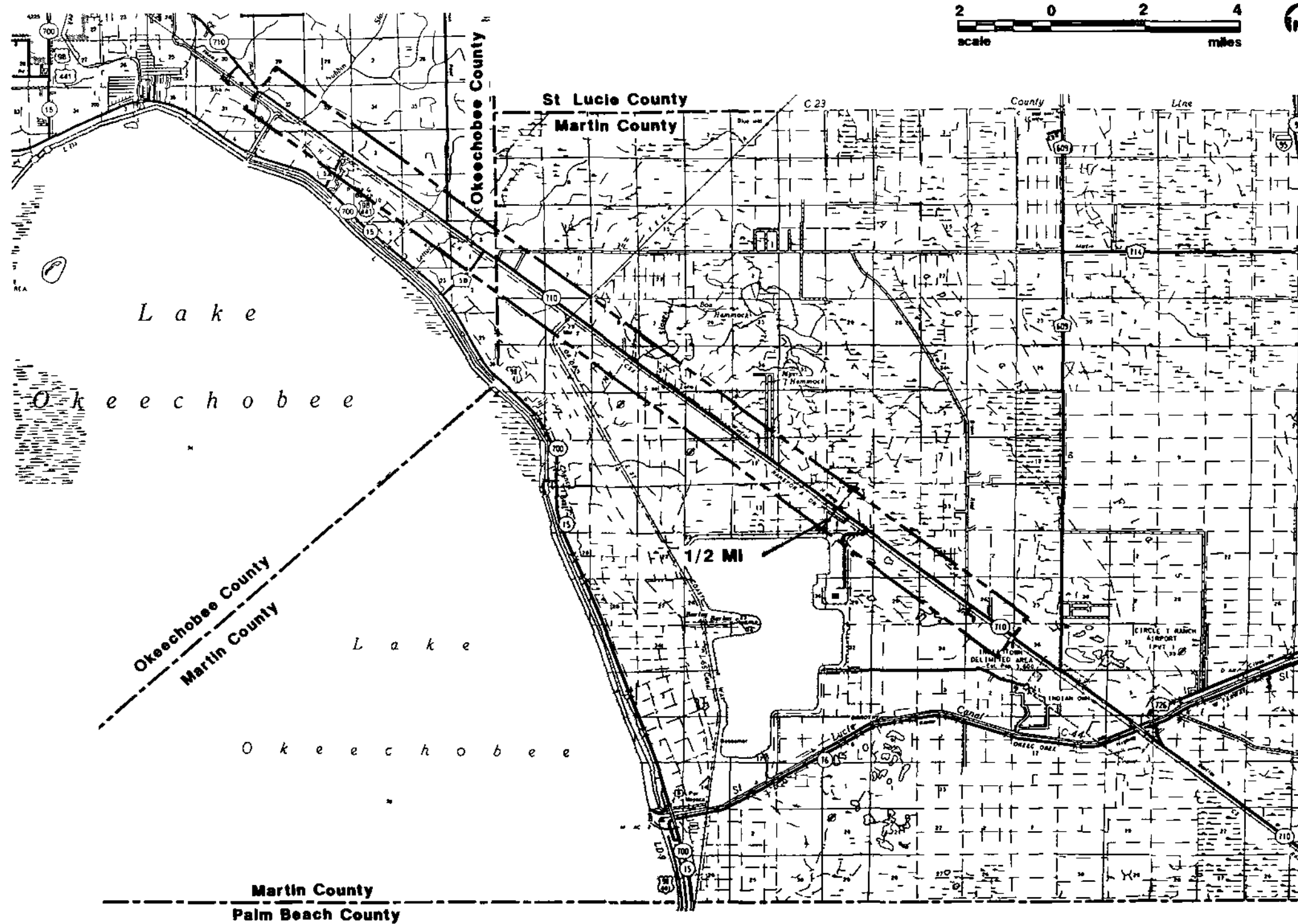


Figure 6 2 6-1

GOVERNMENTAL
JURISDICTIONS WITHIN
ONE-HALF MILE ABOUT THE
ICL WATER PIPELINE

Poor Original

Sources FDOT 1976 1985 ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration LP

Land use designations crossed by the pipeline corridor within Martin County are shown in Figure 6 2 6-2, and primarily are agricultural in nature. The specific Martin County land use plan categories within the pipeline corridor are as follows:

- Agricultural (AG)
- Agricultural ranchette (AR)
- General commercial (CG)
- Industrial (IND)
- Public utilities (PU)

Summary descriptions of these categories are included in Section 10 3. The only policy identified in the Martin County CGMP which appears to be applicable to the cooling water pipeline corridor is Policy A 3 h included in Chapter 11, Potable Water Service. This policy states:

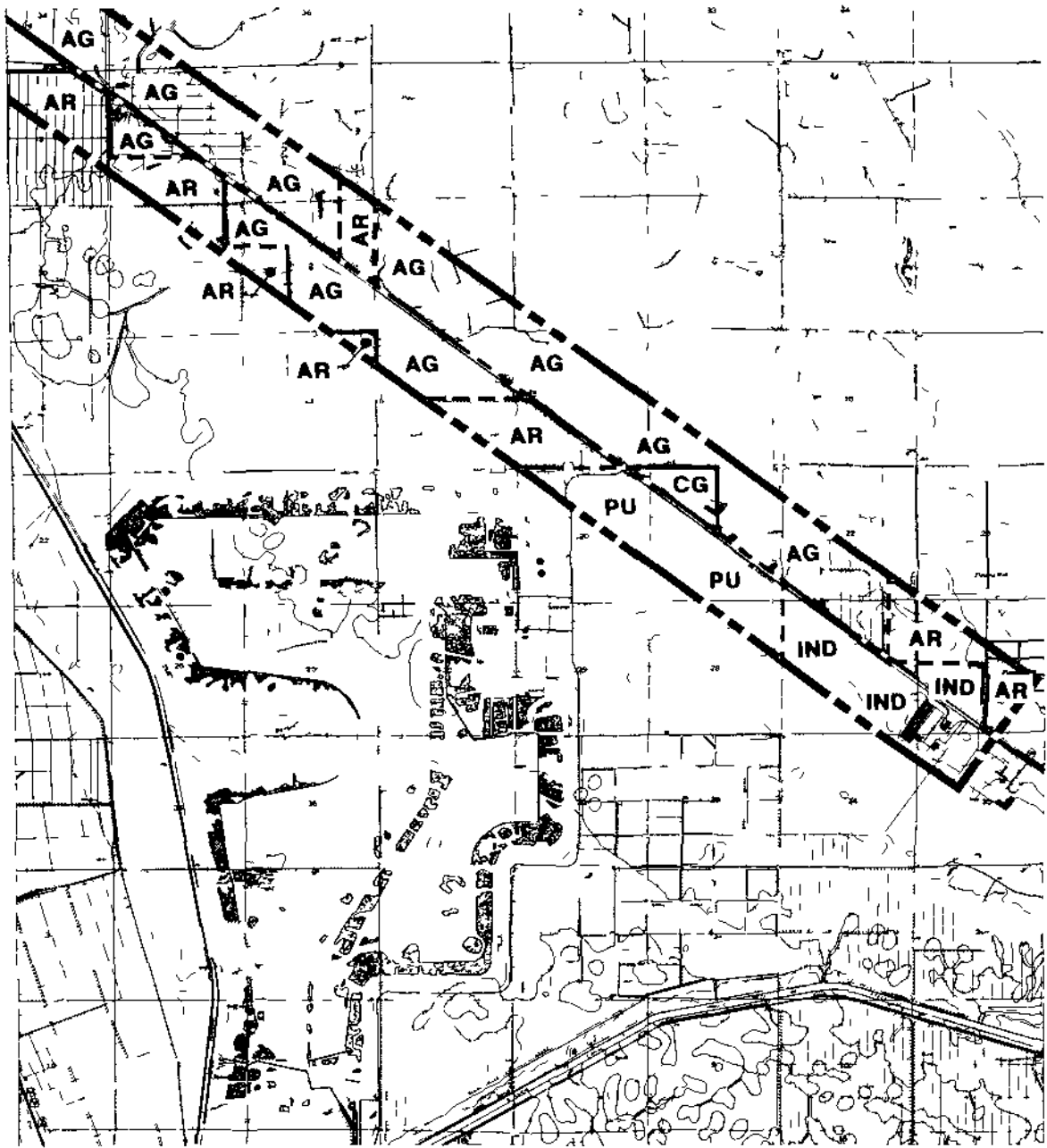
"All public and private water system improvements shall be located, designed, and installed in a manner which is cost-effective, functional, responsive to fire protection needs of existing and planned future development, and compatible with surrounding natural systems. The extension of water mains shall be aligned and installed in a manner which prevents undue loss of established tree canopies or soil through induced erosion. Existing features of land altered by construction shall be returned as close as is reasonably possible to the original condition. The timing and staging shall be scheduled in a manner that minimizes disruptive impacts, including impacts on residential quality of life and traffic flow." (Martin County CGMP, p. 11-19)

The location of the cooling water pipeline within an existing railroad ROW and employment of the construction methods described in Section 6 2 8 ensure that the pipeline will comply with the above policy.

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

LAND USE PLAN
DESIGNATIONS WITHIN
ONE-HALF MILE OF
THE INDIANTOWN
COGENERATION PROJECT
WATER PIPELINE



LEGEND

- == Pipeline Corridor Boundary
- Land Use Designation Boundary

FUTURE LAND USE:

Martin County

- PU Public Utilities
- IND Industrial
- CG General Commercial
- AR Agricultural Ranchette (1 DU/5 Ac.)
- AG Agricultural

Okeechobee County

- RLD Residential Low Density
- A/OS Agricultural/Open Space

Poor Original

Sources USGS 1983 Martin County Growth
Management Department 1990 Central Florida
Regional Planning Council 1990 ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L.P.

LAND USE PLAN
DESIGNATIONS WITHIN
ONE-HALF MILE OF
THE INDIANTOWN
COGENERATION PROJECT
WATER PIPELINE



LEGEND

- — — — Pipeline Corridor Boundary
- — — — Land Use Designation Boundary

FUTURE LAND USE:

Martin County

- PU Public Utilities
- IND Industrial
- CG General Commercial
- AR Agricultural Ranchette (1 DU/5 Ac.)
- AG Agricultural

Okeechobee County

- RLD Residential Low Density
- A/OS Agricultural/Open Space

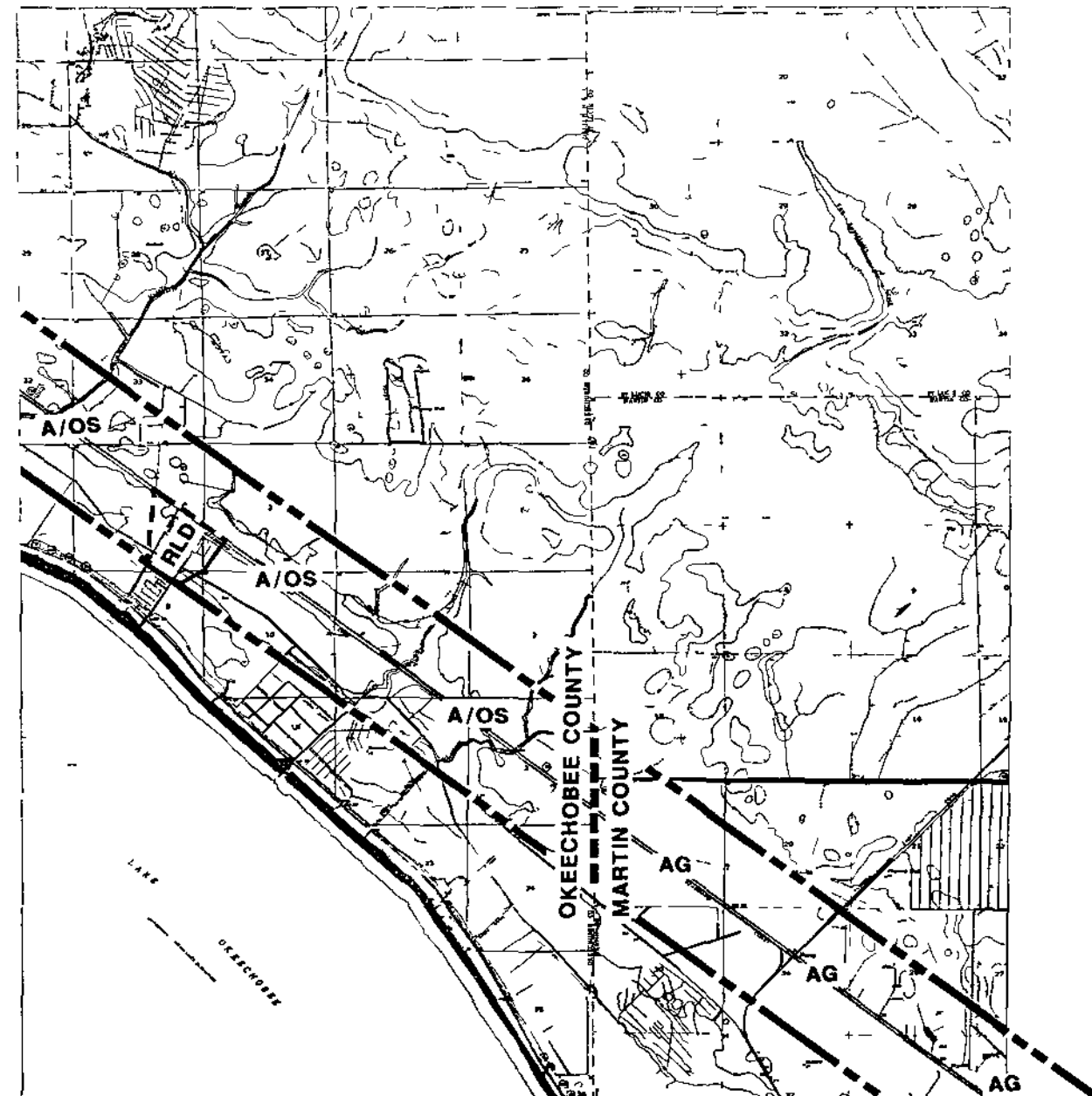
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Sources USGS 1983 Martin County Growth
Management Department 1990 Central Florida
Regional Planning Council 1990 ECT 1990

**INDIANTOWN
COGENERATION
PROJECT**

Indiantown Cogeneration, L.P.

LAND USE PLAN
DESIGNATIONS WITHIN
ONE-HALF MILE OF
THE INDIANTOWN
COGENERATION PROJECT
WATER PIPELINE



LEGEND

--- Pipeline Corridor Boundary

--- Land Use Designation Boundary

FUTURE LAND USE-

Martin County

- PU Public Utilities
- IND Industrial
- CG General Commercial
- AR Agricultural Ranchette (1 DU/5 Ac)
- AG Agricultural

Okeechobee County

- RLD Residential Low Density
- A/OS Agricultural/Open Space

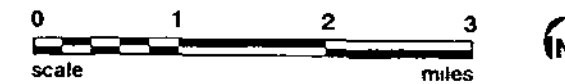
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Sources USGS 1983, Martin County Growth
Management Department 1990, Central Florida
Regional Planning Council 1990, ECT 1990

**INDIANTOWN
COGENERATION
PROJECT**

Indiantown Cogeneration L.P.

**LAND USE PLAN
DESIGNATIONS WITHIN
ONE-HALF MILE OF
THE INDIANTOWN
COGENERATION PROJECT
WATER PIPELINE**



 Pipeline Corridor Boundary
 Land Use Designation Boundary

Martin County

Okeechobee County

RLD Residential Low Density
A/OS Agricultural/Open Space

Poor Original

Sources USGS 1983 Martin County Growth Management Department 1990 Central Florida Regional Planning Council 1990 ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration LP

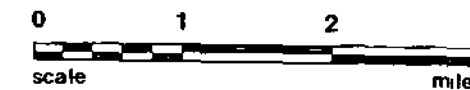
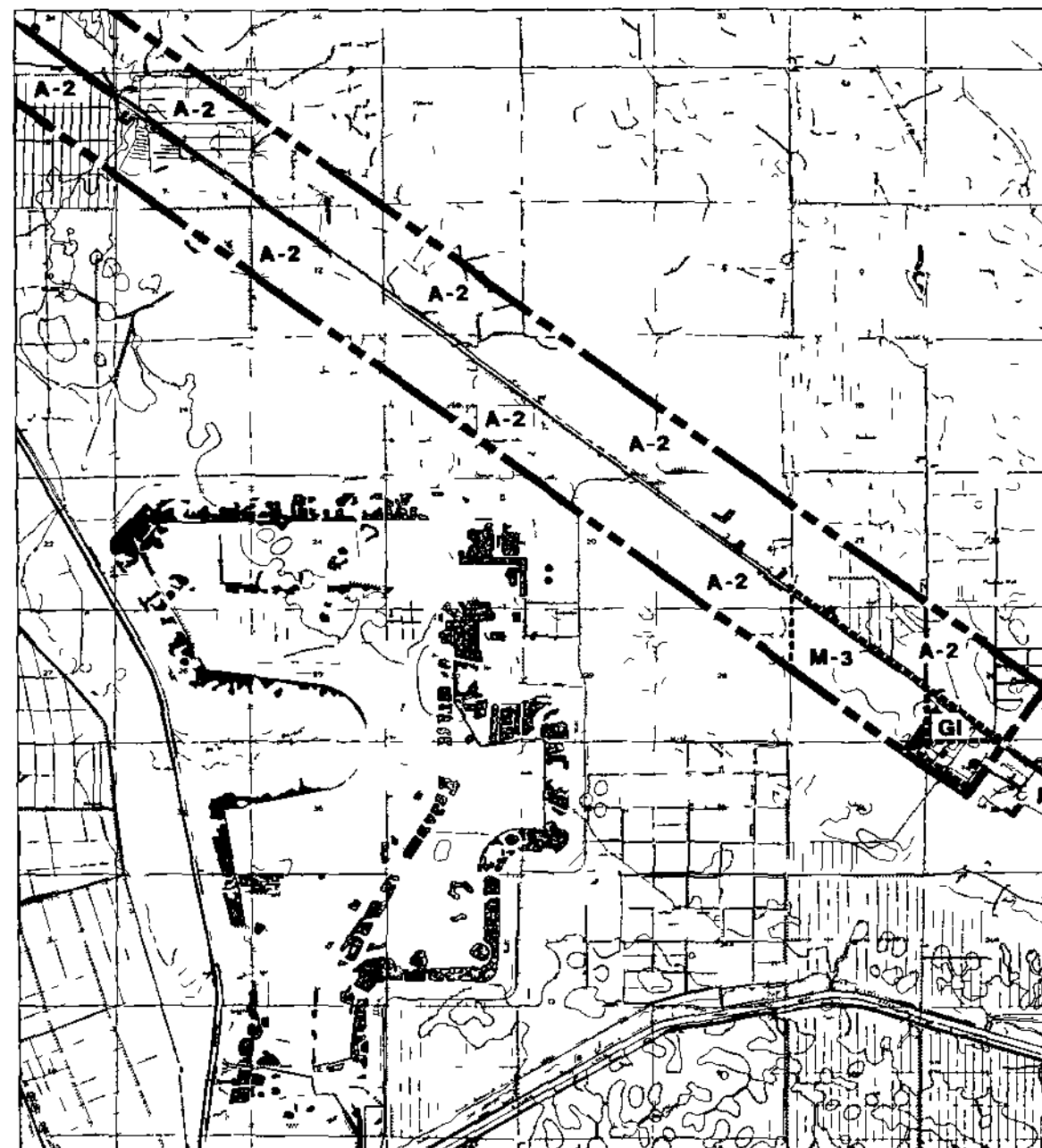
Zoning districts crossed by the pipeline corridor in Martin County are shown in Figure 6 2 6-3 Utilities "with the exception of normal distribution and/or collection facilities (i.e., poles, lines, cable in trench, and associated equipment)" are regulated as advertised conditional uses in Martin County [Section 35-5 5(A)(9), Martin County Code] The water pipeline is considered a "normal distribution and/or collection facility," not subject to advertised conditional use review, and is, therefore, a permitted use within all zoning districts No other applicable zoning regulations have been identified

Okeechobee County has not yet adopted a comprehensive plan in accordance with the Local Government Comprehensive Planning and Land Development Regulation Act (Chapter 163, Part II, FS) and Chapter 9J-5, FAC The comprehensive plan currently in effect in Okeechobee County was adopted in 1980 According to the Future Land Use Plan, the pipeline corridor crosses the Agriculture/Open Space and Residential (low density) land use categories Although the plan does not define these categories, it does list general land use policies dealing with agricultural and residential land uses Excerpts from the plan are included in Section 10 3 There are no land use policies that appear to be applicable to a water pipeline However, the Utility Element of the adopted Okeechobee County comprehensive plan states

"Whatever support facilities are needed to provide electric utility service to existing land uses, to such future land uses as are authorized by other elements of this plan, and to such future land uses as may be lawfully authorized by the commission, shall be permitted in any use category and shall be deemed to be consistent with this comprehensive plan " (Okeechobee County Comprehensive Planning Program 1979 Update, p 143)

The intake water pipeline is a necessary support facility to the ICL project

**ZONING DISTRICTS WITHIN
ONE-HALF MILE OF THE ICL
WATER PIPELINE**



LEGEND

- — — — — Pipeline Corridor**
- - - - - Zoning Designation Boundary**

EXISTING ZONING

Martin County

- GI General Industrial (Heavy)**
- M-3 Heavy Industrial**
- A-2 Agricultural (1 DU/5 Ac)**

(Note All zoning designations except GI category are classified under the (old) Section 33 Ordinance)

Okeechobee County

- C Commercial**
- RMH Residential Mobile Home (5,000 S F min lot size)**
- RSF Residential Single Family (8,000 S F min lot size)**
- RR Residential Rural (8,000 S F min. lot size)**
- RG Residential General (1 DU/2 AC - S F , 1 DU/5 AC - MH)**
- AC Agricultural Conservation (1 DU/20 AC.)**

Sources USGS 1983 Martin County Building and
Zoning Department 1990 Okeechobee County
Building and Zoning Department 1990 ECT 1990

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PROJECT**

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Figure 6 2 6-3 (Page 2 of 4)

ZONING DISTRICTS WITHIN
ONE-HALF MILE OF THE ICL
WATER PIPELINE



LEGEND

- Pipeline Corridor
- Zoning Designation Boundary

EXISTING ZONING:

Martin County

- GI General Industrial (Heavy)
- M-3 Heavy Industrial
- A-2 Agricultural (1 DU/5 Ac.)

(Note All zoning designations except GI category are classified under the (old) Section 33 Ordinance)

Okeechobee County

- C Commercial
- RMH Residential Mobile Home (5,000 S F min lot size)
- RSF Residential Single Family (8,000 S F min. lot size)
- RR Residential Rural (8,000 S F min. lot size)
- RG Residential General (1 DU/2 AC - S F , 1 DU/5 AC - MH)
- AC Agricultural Conservation (1 DU/20 AC.)

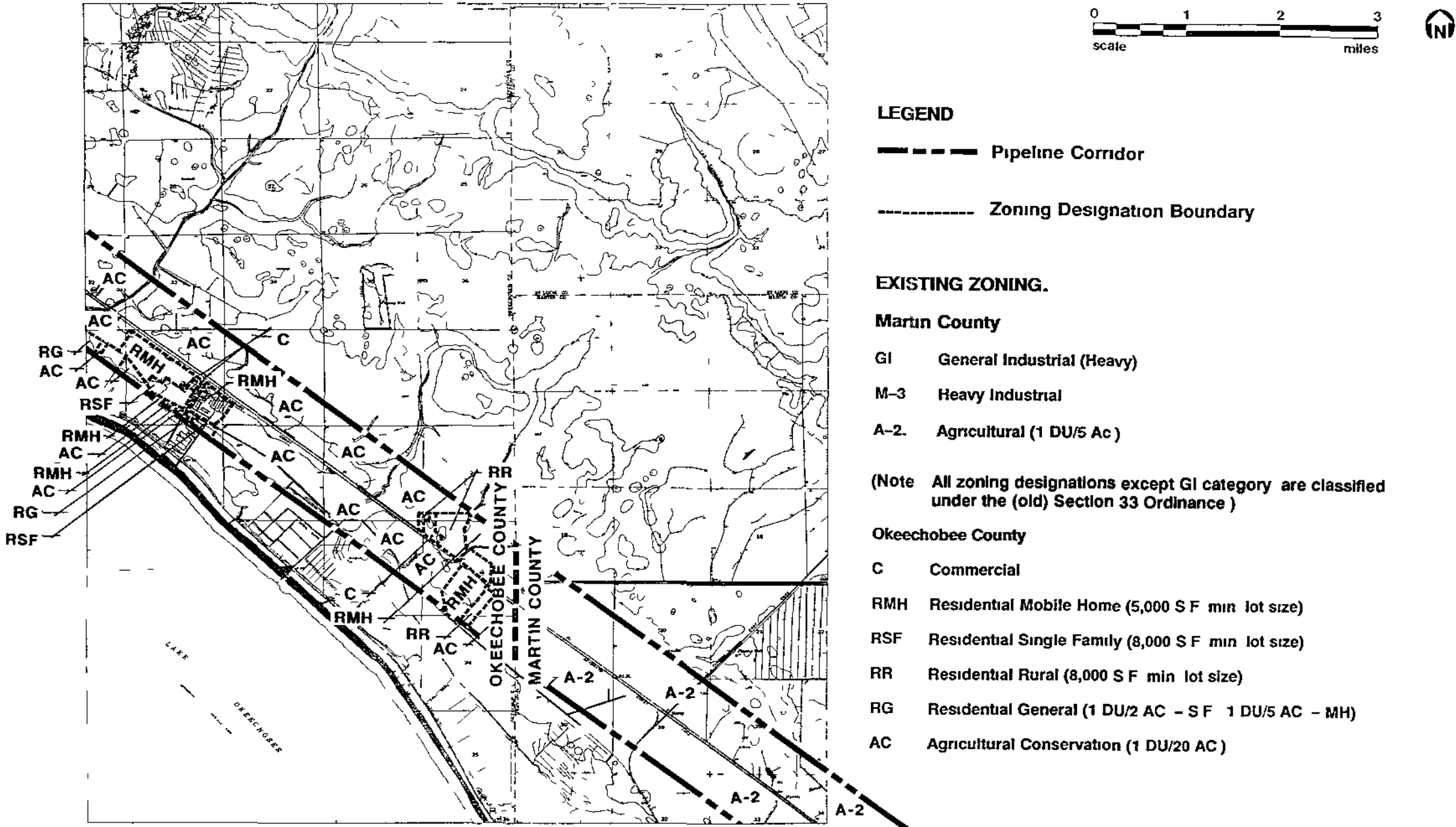
Sources USGS 1983 Martin County Building and Zoning Department 1990 Okeechobee County Building and Zoning Department 1990 ECT 1990

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Figure 6 2 6-3 (Page 3 of 4)

ZONING DISTRICTS WITHIN
ONE-HALF MILE OF THE ICL
WATER PIPELINE



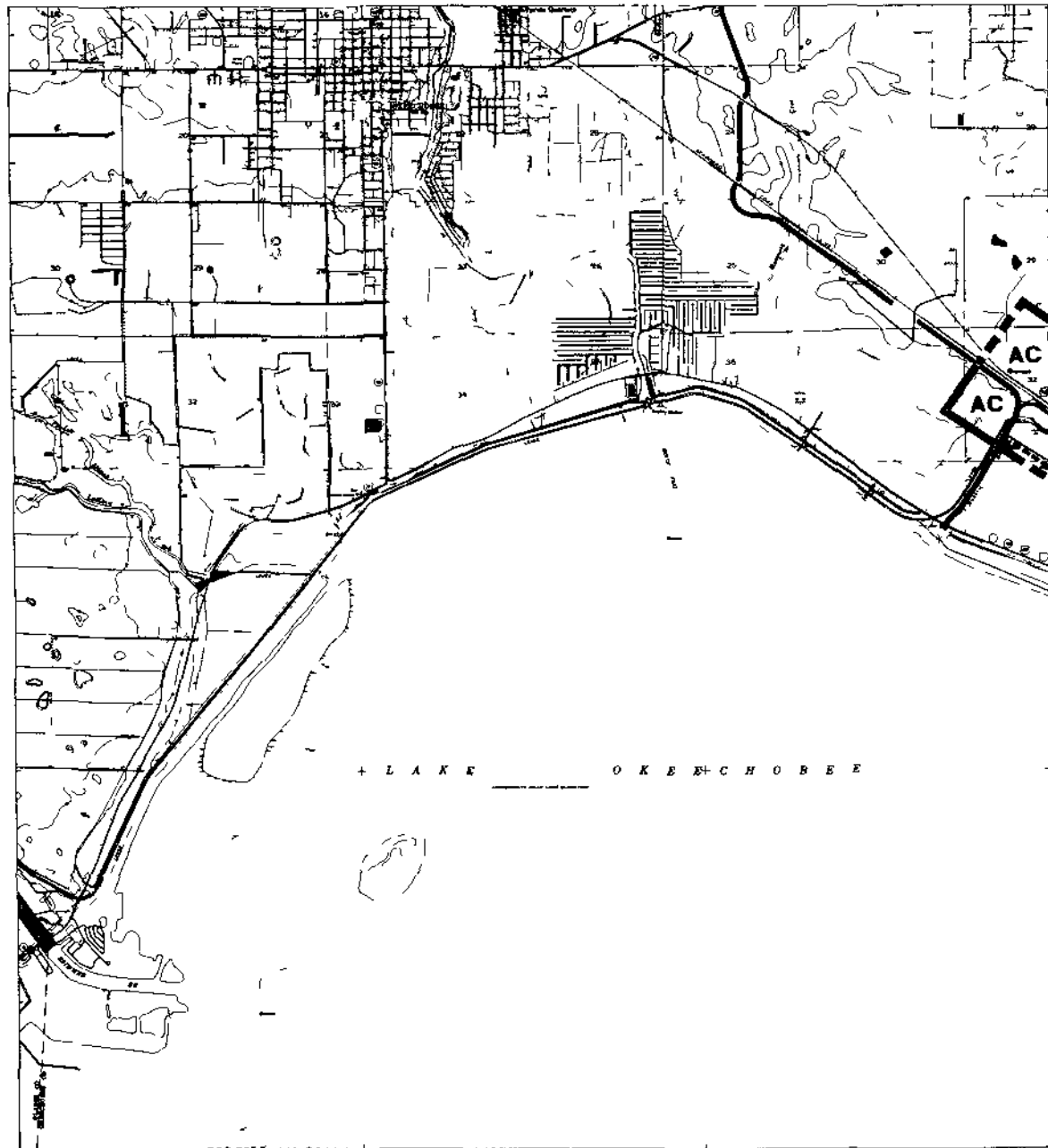
Sources USGS 1983 Martin County Building and
Zoning Department 1990 Okeechobee County
Building and Zoning Department 1990 ECT 1990

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Figure 6 2 6-3 (Page 4 of 4)

ZONING DISTRICTS WITHIN
ONE-HALF MILE OF THE ICL
WATER PIPELINE



LEGEND

- — — — — Pipeline Corridor
- Zoning Designation Boundary

EXISTING ZONING

- AC Martin County
 - RG
 - GI General Industrial (Heavy)
 - M-3 Heavy Industrial
 - A-2 Agricultural (1 DU/5 Ac)
- (Note All zoning designations except GI category are classified under the (old) Section 33 Ordinance)
- Okeechobee County**
- C Commercial
 - RMH Residential Mobile Home (5,000 S F min lot size)
 - RSF Residential Single Family (8 000 S F min lot size)
 - RR Residential Rural (8,000 S F min lot size)
 - RG Residential General (1 DU/2 AC. - S F , 1 DU/5 AC - MH)
 - AC Agricultural Conservation (1 DU/20 AC.)

Sources USGS 1983, Martin County Building and Zoning Department 1990 Okeechobee County Building and Zoning Department 1990 ECT 1990

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As shown in Figure 6 2 6-3, the majority of the land crossed by the pipeline corridor in Okeechobee County is zoned AC, Agricultural Conservation. Other zoning districts crossed include the following:

- Residential general (RG)
- Residential rural (RR)
- Residential single-family (RSF)
- Residential mobile home (RMH)
- Commercial (C)

Section 7 9 of the Okeechobee County Zoning Ordinance states:

"9 Essential Services Essential services shall be permitted in any zoning district. Essential services are hereby defined to include and be limited to water, sewer, gas, telephone, and electrical systems, including sub-stations, lift stations, and similar installations necessary for the performance of these services, provided, however, that this subsection shall not be deemed to permit the location in a district of such establishments as electric or gas generating plants, sewage treatment plants, or water pumping or water aeration facilities from which they would otherwise be barred, and provided further that this subsection shall not be deemed to include the erection of structures for commercial activities such as sales or the collection of bills in districts from which such activities would be otherwise barred. Under this subsection, where structures are involved, such structures shall conform insofar as possible to the character of the district as to architecture and landscaping." (Zoning Ordinance, Okeechobee County, Florida, p. 18a)

The cooling water intake structure at Taylor Creek/Nubbin Slough, described in Section 3 5 1 1, is located in the AC zoning district. According to Section 6, Schedule of District Regulations, of the Okeechobee County Zoning Ordinance

(1974), water pumping facilities are not barred from the AC district. Therefore, the cooling water pipeline and the intake structure are permitted uses under the Okeechobee County Zoning Ordinance.

6 2 6 3 Easements, Title, Agency Works

The pipeline ROW will be located within the existing CSX Railroad ROW located to the west of SR 710. The northern terminal of the pipeline ROW will cross a small portion of land belonging to SFWMD. Approval for crossing such state and county roads, easements, and agency works (e.g., county drainage districts) will be obtained as part of this SCA. Table 6 2 6-1 lists the facilities under title, easements, or agency works that will be crossed by the proposed pipeline.

6 2 6 4 Vicinity Scenic, Cultural, and Natural Landmarks

The pipeline corridor follows existing road and rail ROWs and does not cross any scenic, cultural, or natural landmarks.

6 2 6 5 Archaeological and Historic Sites

A comprehensive evaluation of archaeological and historic resources within the cooling water pipeline corridor was conducted by Piper Archaeological Research, Inc., and is located in Section 10.8.

This research revealed no previously recorded archaeological sites within the pipeline corridor, and a low probability of finding additional significant historical resources. During research and assessment, no archaeological or historic sites were found which would be eligible for inclusion on the National Register of Historic Places (Piper, 1990).

In an area south of the pipeline corridor in Section 2, Township 39 South, Range 27 East, a historic feature was found. Named the Zana Railroad Water Reservoir,

Table 6 2 6-1
EASEMENTS, TITLE, OR CROSSING APPROVALS
NORMALLY REQUIRED FOR CONSTRUCTION OF THE
COOLING WATER PIPELINE

Facility	Affected Agency	Type of Approval
CR 15A	Okeechobee County	Utility Permit
CR 15B	Okeechobee County	Utility Permit
FEC Railroad	FEC Railroad	Crossing Permit*
Myrtle Slough Lettuce Creek Henry Creek Nubbin Slough Unnamed streams	FDER, SFWMD, USACE*	General Permit (FDER) Industrial Wastewater Permit (FDER) Works of the District Permit (SFWMD) Section 404 Dredge- and Fill Permit (USACE)
Various unamed ditches and canals	Indiantown Drainage District Troup-Indiantown Drainage District Coquina Water Control District	Utility Permit

*Private permit not subject to local, county, or state jurisdiction

+ Permit may or may not be required depending on construction method of pipeline (i e, attached to existing bridge structure versus buried under stream)

Sources FDOT, 1990
CSX, 1990
Okeechobee County, 1990
SFWMD, 1990
USACE, 1990

the feature contains a small camping shack and an angular concrete structure. The research conducted by Piper Archaeological Research, Inc. speculated that this site may have been a water reservoir for steam locomotives. However, this feature was not found to be eligible for listing in the National Register of Historic Places (Piper, 1990).

6 2 7 BIOPHYSICAL ENVIRONMENT OF THE CORRIDOR AREA

6 2 7 1 Land Use/Vegetation

The proposed pipeline will be located within the existing CSX Railroad right-of-way (ROW), with the exception of its northern terminus, which will cross a short section of maintained grassland belonging to SFWMD

Land use and vegetation along the 19-mile long cooling water pipeline corridor and within 1/2-mile of the ROW are presented in Figures 6 2 7-1a and 6 2 7-1 (pages 1 through 5) The mapped information is labeled using the Level III designations of the SFWMD Land Use and Land Cover Classification Code (see Chapter 10) The corridor was surveyed by plant ecologists/taxonomists in July and October 1990

The predominant agricultural land use type crossed by the corridor is improved pasture (APIM) Other conspicuous agricultural land use types occurring along the corridor are citrus groves (AMCT), sugar cane fields (ACSC), and dairy farms (AFDF) The corridor also crosses several areas classified as urban or built-up, which are primarily residential in nature The urban land uses located within the corridor consist of the following single-family residential (URSL), mobile home residential (URMH), industrial (UI), and water supply plants (UTWS) In addition, the corridor includes SR 710 and the CSX Railroad

Vegetation communities found in the corridor are included in the descriptions provided in Section 2 3 5 The dominant forest types are pine and wet prairie (WXPP), old fields/forested old fields (FMOF), and cypress swamp (WFCY) Other vegetation types occurring within the corridor include pine/cabbage palms (FMPC), cabbage palm/oaks (FMCO), pine flatwoods (FEPP), and levees (BL)

One land use type that occurs within 1/2-mile of the pipeline corridor and was not previously described for the ICL project site is levees Typically, levees have very

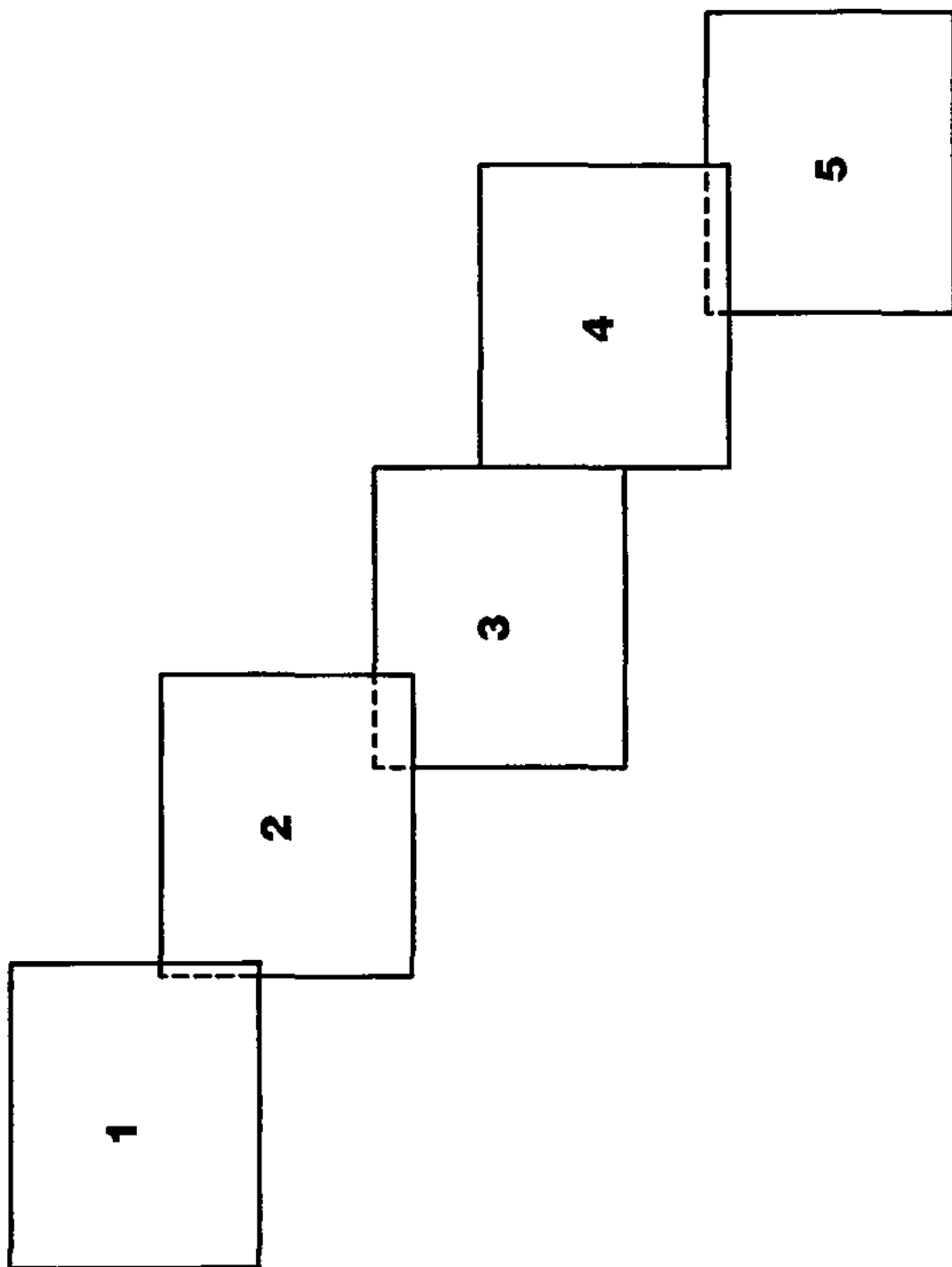


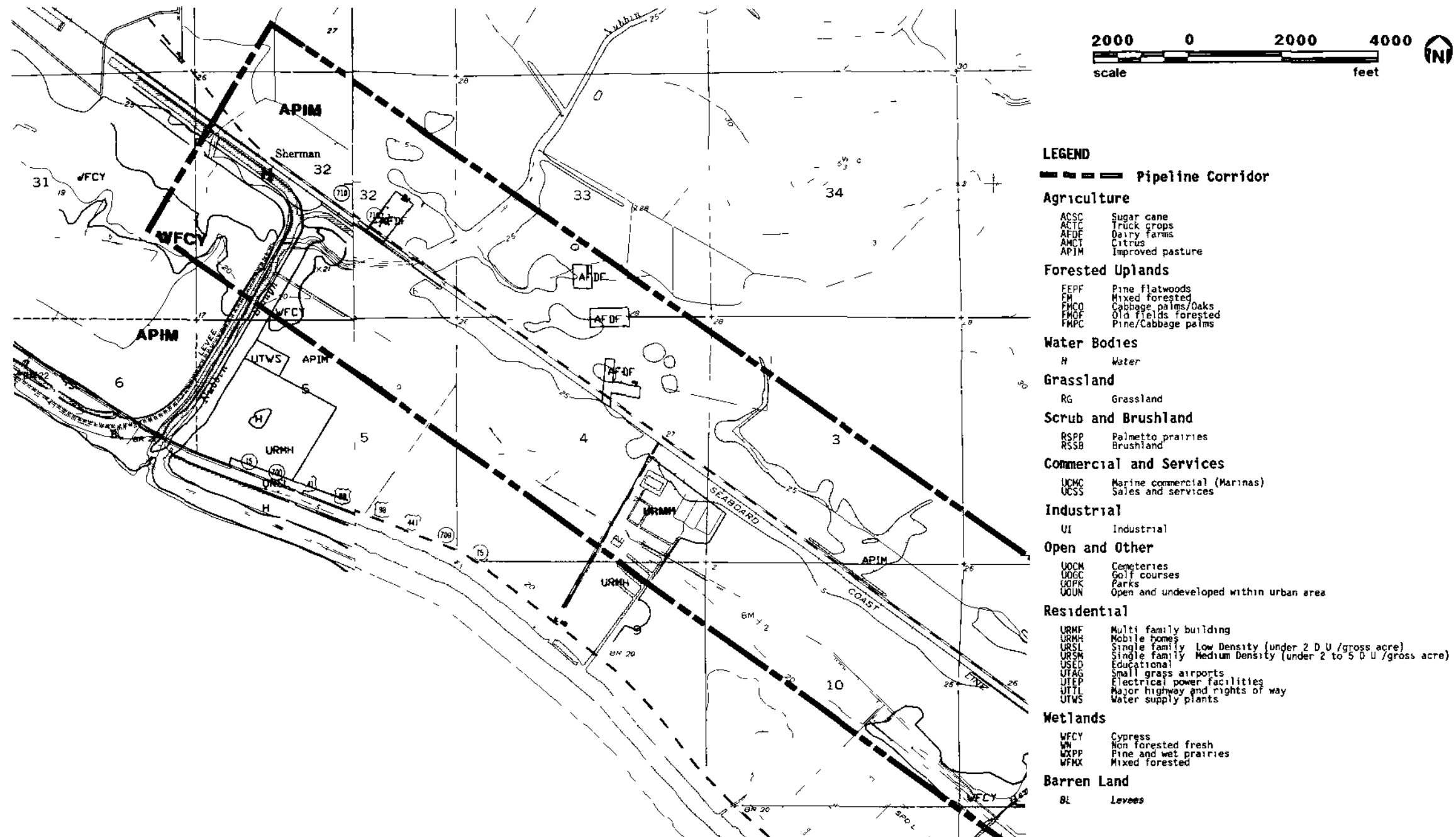
Figure 6 2 7-1a
LAND USE AND LAND COVER MAP KEY SHEET
FOR PIPELINE CORRIDOR AREA

Source ECT 1990

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Figure 6 2 7-1 (Page 1 of 5)
LAND USE AND LAND
COVER WITHIN ONE-HALF
MILE OF THE PIPELINE
CORRIDOR

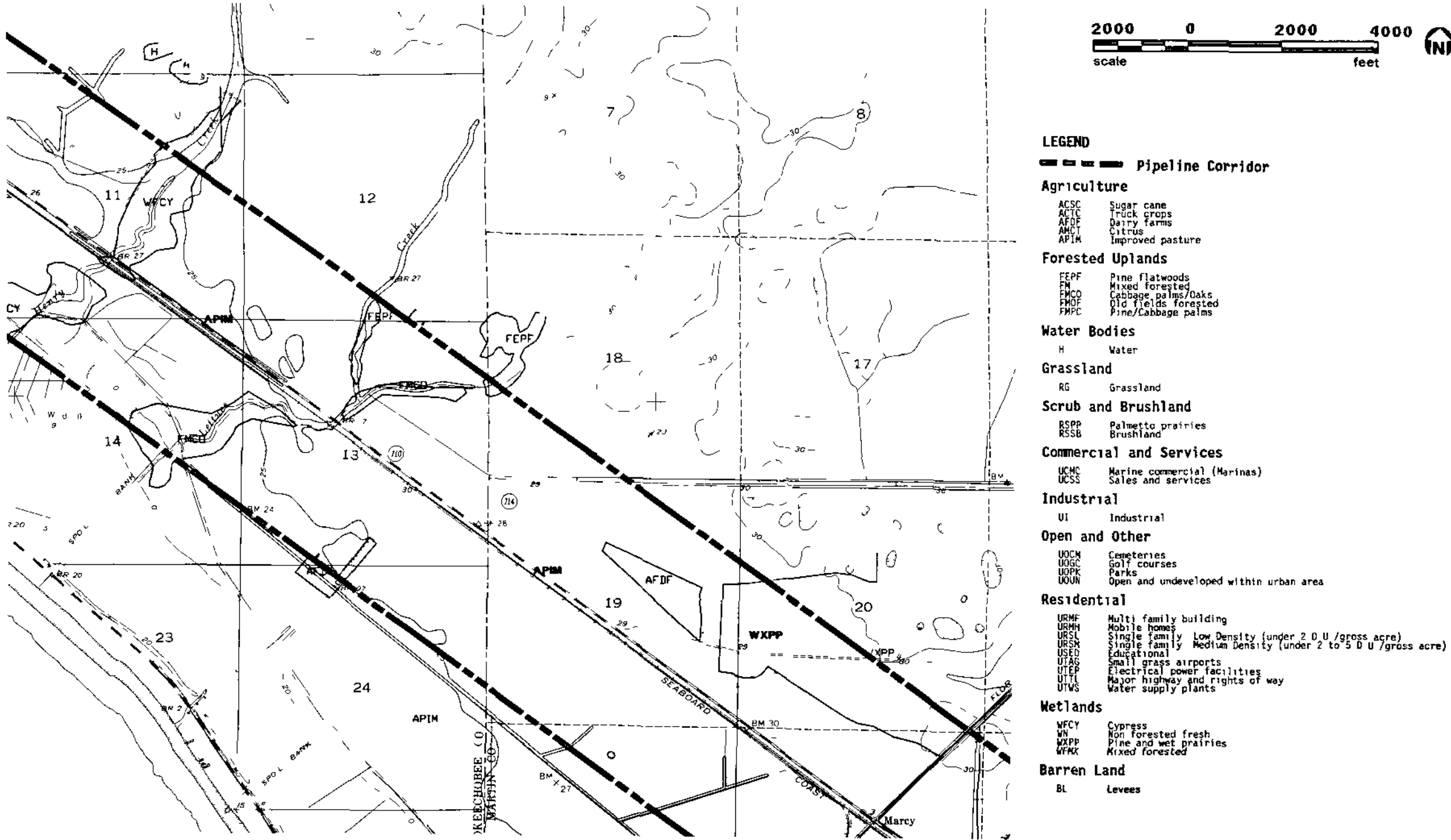


Sources USGS 1983 SFWMD 1986 ECT 1990

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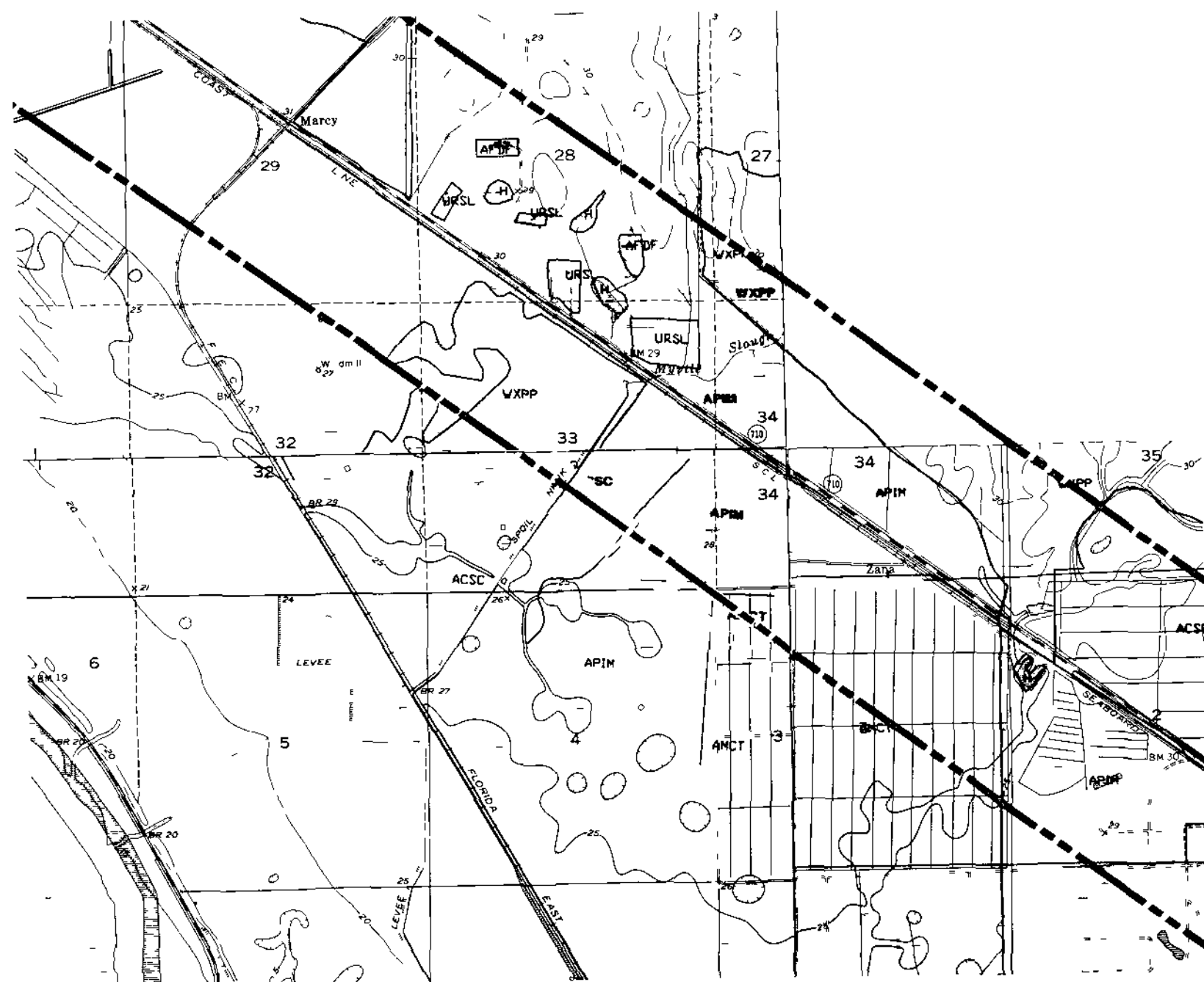
Figure 6 2 7-1 (Page 2 of 5)
LAND USE AND LAND
COVER WITHIN ONE-HALF
MILE OF THE PIPELINE
CORRIDOR



Sources USGS 1983. SFWMD 1986 ECT 1990

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Pipeline Corridor

Agriculture

ACSC	Sugar cane
ACTC	Truck crops
AFOF	Dairy farms
AMCT	Citrus
APIM	Improved pasture

Forested Uplands

FEFF	Pine flatwoods
FM	Mixed forested
FMCO	Cabbage palms/Oaks
FMOF	Old fields forested
FMPC	Pine/Cabbage palms

Water Bodies

Water	H
100	100
90	90
80	80
70	70
60	60
50	50
40	40
30	30
20	20
10	10
0	0

Grassland

RG	Grassland
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Scrub and Brushland

RSPB	Palmetto prairies
RSSB	Brushland

Commercial and Services

UCMC	Marine commercial (Marinas)
UCSS	Sales and services

Industrial

UI	Industrial
----	------------

Open and Other

UOCH	Cemeteries
UOGC	Golf courses
UOPK	Parks
UOUN	Open and undeveloped within urban area

Residential

URMF	Multi family building
URMH	Mobile homes
USRL	Single family Low Density (under 2 D.U./gross acre)
URSM	Single family Low Density (under 2 to 5 D.U./gross acre)
USEO	Educational
UTAG	Small grass airports
UTEP	Electrical power facilities
UTTL	Major highway and rights of way
UTWS	Water supply plants

Wetlands

WFCY	Cypress
WN	Non forested fresh
WXP	Pine and wet prairies
WMX	Mixed forested

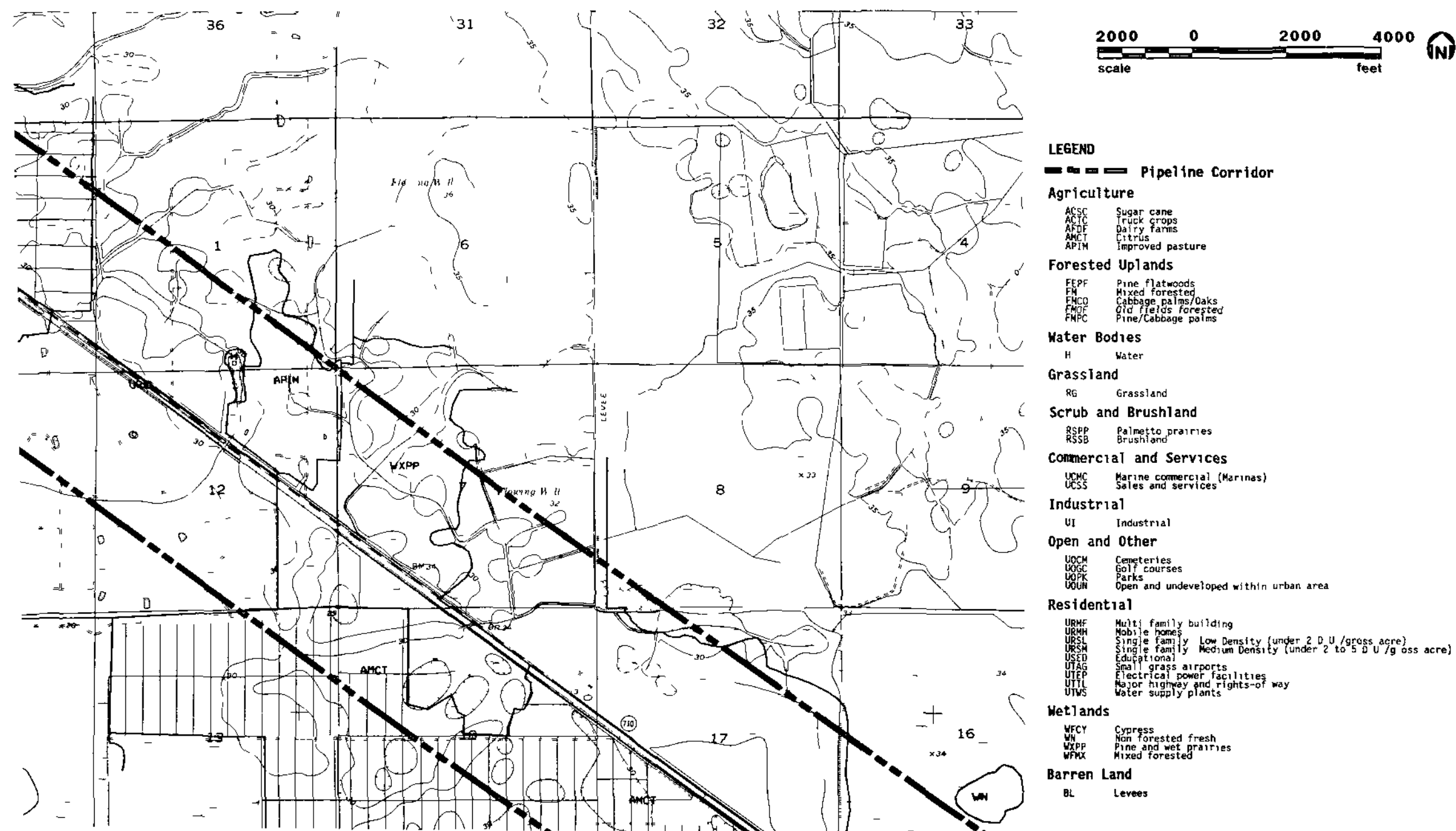
Barren Land

Bt	Levees
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Figure 6 2 7-1 (Page 4 of 5)
LAND USE AND LAND
COVER WITHIN ONE-HALF
MILE OF THE PIPELINE
CORRIDOR

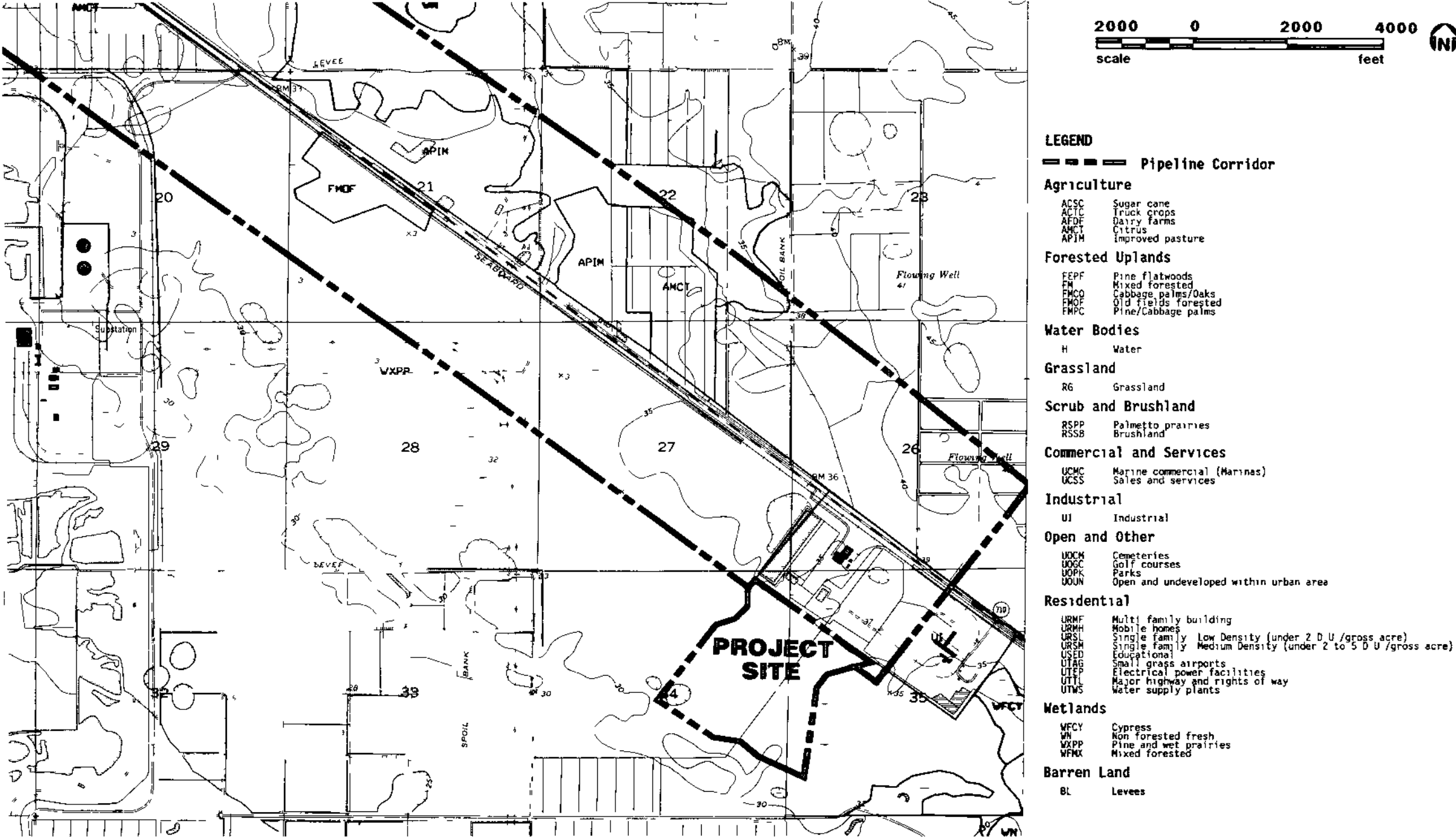


Sources USGS 1983 SFWMD 1986 ECT 1990

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Figure 6 2 7-1 (Page 5 of 5)
LAND USE AND LAND
COVER WITHIN ONE-HALF
MILE OF THE PIPELINE
CORRIDOR



Sources USGS 1983 SFWMD 1986 ECT 1990

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little or no vegetation and limited ability to support life. The only mapped levee within the pipeline corridor is a raised, earthen berm situated along the Taylor Creek/Nubbin Slough (TC/NS) waterway connected to Lake Okeechobee. Only opportunistic, ruderal herbs and shrubs such as beggar's tick, groundsel bush, Caesar's weed, partridge pea, and others would be expected along the levee.

The most important wetland types within 1/2-mile of the corridor are cypress swamps and wet prairie. Cypress swamps occur along drainageways and are dominated by bald cypress. Wet prairies are usually hydrologically isolated and occur in depressions within pine flatwoods (i.e., pine and wet prairie association) or in improved pasture.

Since the pipeline ROW is located within the CSX ROW, the land to be potentially affected by the pipeline has been previously altered and has low ecological value. Vegetation communities adjacent to the proposed corridor route (within 1/2-mile of either side) are common in the region.

6 2 7 2 Affected Waters and Wetlands

The preferred water pipeline corridor alignment was selected, in part, to minimize impacts to the environment including water bodies and wetlands. As a result, the corridor was collocated with existing linear facilities, and sited in a highly disturbed area located along existing railroad and road ROW. Because of the flat and low-lying physiography of the region and the linear nature of the proposed facility, the corridor cannot totally avoid wetlands along its 19-mile distance.

The area of the preferred corridor is characterized by previously disturbed soils and low, flat, sandy soils. Soils near the surface generally have high permeability and slow runoff rates. Runoff is channelled to an existing ditch paralleling the railroad ROW or to SR 710 drainage ditches. Drainage is toward TC/NS. The southern part of the corridor has similar types of drainage systems which drain runoff to the south, leading ultimately to the St. Lucie Canal.

The corridor crosses no major water bodies, only small canals and ditch systems which have generally been excavated for drainage of agricultural land located to the east of SR 710. Several such drainage ditches are shown within the corridor on USGS 7.5-minute quadrangle maps in Martin County, including Myrtle Slough, Lettuce Creek, Henry Creek, and Nubbin Slough. These are the major drainages crossed by the corridor in Okeechobee County.

6.2.7.3 Ecology

Terrestrial Biology

This section discusses the status and potential for occurrence of species identified as endangered, threatened, or species of special concern by USFWS, FGFWFC, TCRPC, FCREPA, and/or Martin County in and along the 19-mile cooling water pipeline ROW located within the existing CSX ROW. Thorough descriptions for these species, which potentially occur in Martin County and surrounding counties and which can occur at the project site, were previously presented in Section 2.3.6. Plant and animal species status listed in that section (Tables 2.3.6-1 and 2.3.6-2) apply, to a degree, to the cooling water pipeline corridor. The natural vegetation community types occurring in the corridor are similar to those occurring at the project site (i.e., pine flatwoods), but most of the corridor consists of ruderal roadside habitat in various stages of succession and maintenance.

The probability of occurrence of threatened and endangered species in the preferred corridor is based on seasonal ground surveys, habitat analyses, and discussions with agency personnel. Due to the high degree of habitat alteration and the disturbance caused by the use of the CSX rail line and adjoining SR 710, there are no records of nesting or breeding occurrences for any threatened or endangered animals in the corridor or its vicinity. Listed species such as herons, egrets, ibis, osprey, and alligator, for example, have been observed along TC/NS on the northernmost end of the ROW. The remaining ROW, offers no suitable

habitat for species such as sandhill crane, woodstork, red-cockaded woodpecker, gopher frog, round-tailed muskrat, Sherman's fox squirrel, or Florida mouse

The vegetation in the corridor is dominated by maintained right-of-way and other ruderal associations. With the exception of narrow wetland zones along watercourses, the corridor contains no mature, unimpacted vegetation communities.

No endangered plant species are known to occur within the corridor. Climbing dayflower may occur along the banks of TC/NS and other canals, creeks, and sloughs connected to Lake Okeechobee that cross the pipeline corridor. This plant is listed as threatened by both FCREPA and FDACS and is under review for federal listing.

6 2 7 4 Other Environmental Features

No additional information is required.

6 2 8 EFFECTS OF RIGHT-OF-WAY PREPARATION AND PIPELINE CONSTRUCTION

6 2 8 1 Construction Techniques

Survey

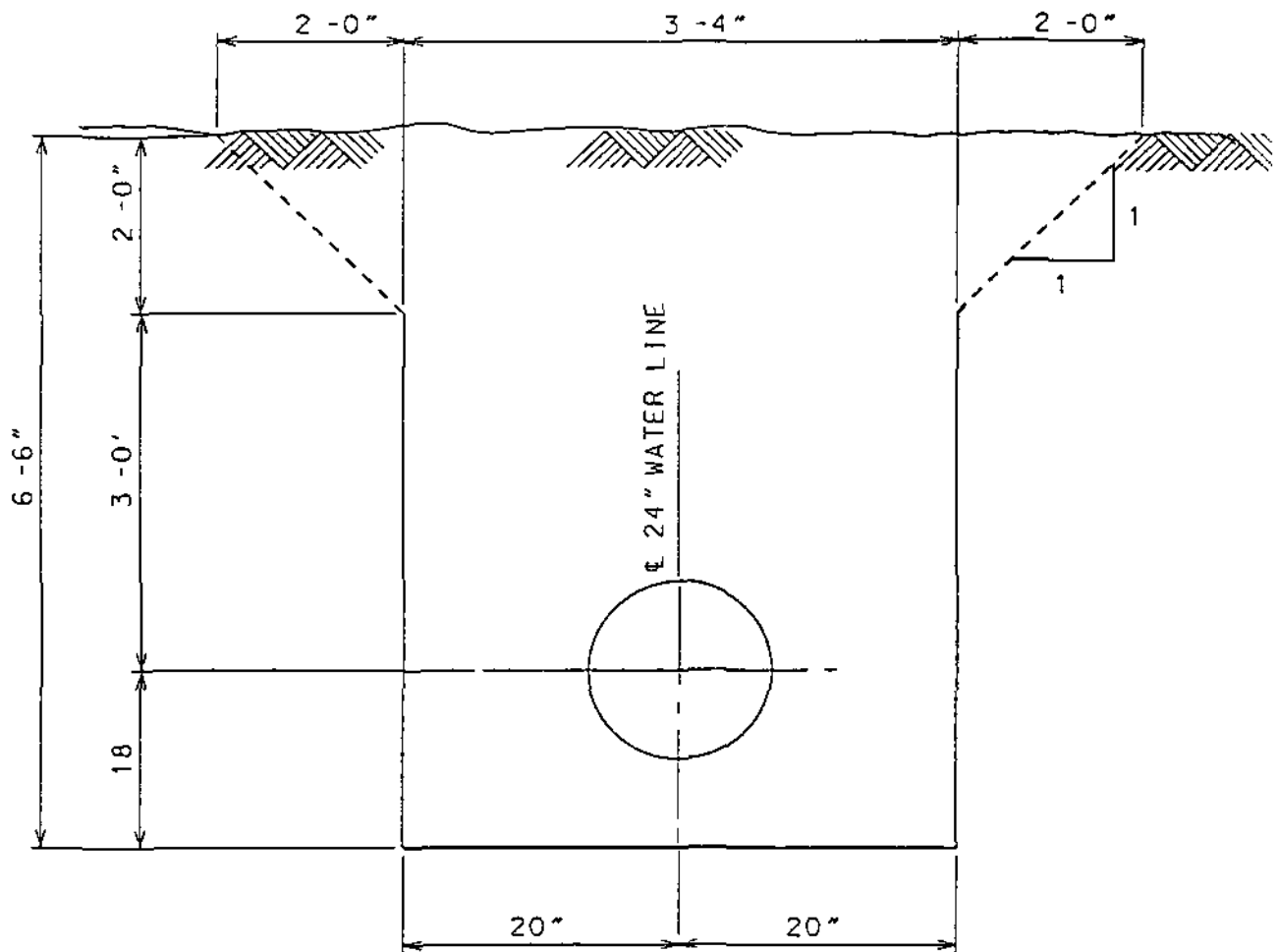
Following CSX approval of the right-of-way (ROW) application, the entire route will be surveyed. The centerline of the pipeline ROW will be marked at about 200-foot intervals.

Right-of-Way Clearing, Grubbing, and Excavation

Prior to clearing, field personnel responsible for clearing activities will be made familiar with conditions of easements, permits, regulatory approvals, and CSX railroad requirements. Clearing will be restricted to those areas within the 50-foot ROW required for ditching, pipe laying, and related activities. Temporary gates and fences will be installed when necessary and removed following construction. The disturbed land surface will be graded, seeded, and returned to its initial contour.

Where clearing of trees and brush will be required, chain saws or bulldozer-type machinery with special cutting blades will be used. Slash and brush will be hauled offsite. Tree stumps and roots will be mechanically removed and disposed of in a similar manner.

The pipe trench will be excavated to a minimum width to provide clearance for the pipe and any buoyancy control devices as needed. Excavation of a minimum of 8 inches on either side of the pipe will be required. A typical trench is shown in Figure 6 2 8-1. A combination of backhoes, clamshells, and draglines will be used. Matting will be used to support heavy machinery in wetlands areas. Temporary ditch crossings for equipment will be provided where necessary.



Poor Original

NOTES

- 1 ANY SHORING REQUIREMENT FOR TRENCH DURING CONSTRUCTION WILL BE PROVIDED AS NEEDED
- 2 BEDDING AND BACKFILL MATERIAL WILL BE PLACED AND COMPACTED AROUND AND ABOVE THE PIPE.

**Figure 6 2 8-1
TYPICAL SECTION OF WATER PIPELINE TRENCH**

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Source Bechtel 1990

Pipe Installation

Trucks or all-terrain vehicles will be used to transport pipe to the ROW, where the pipe will be placed on the side of the trench. To cross wet areas, pipe will be fitted up on the adjacent ROW and pulled or floated into place. No additional staging areas will be required.

Bending and welding (if required) will take place within the ROW. Welding procedure qualification tests will be conducted in accordance with applicable codes. Welders will be qualified in accordance with applicable codes by completing test welds, using the approved welding procedures. The field weld and adjacent uncoated pipe will be coated with a material that is compatible with the existing coating. After beveling of the existing coating, the bare area will be machine cleaned to remove dirt, rust, etc., to obtain a clean surface for coating.

Construction involves the installation of pipeline segments at a depth of 3 to 5 feet per CSX requirements in the ROW. Bedding materials may be required in the pipeline trench in areas where the bottom is irregularly shaped or where the excavated spoil materials are unacceptable for backfilling around the pipe due to possible coating damage. To protect the pipe in these areas and for support, sand or gravel, crushed rock and screened spoil materials, or a combination of each may be used for bedding. This bedding material will be placed in the bottom of the trench to a minimum depth of 6 inches prior to lowering of the pipe into place.

Only soils excavated from the pipeline trench and imported bedding materials will be used for backfilling, no other soils from the ROW will be used. Soil removed from the trench line will be used to form a slight crown over the trench centerline to compensate for soil settlement. Openings will be left in the completed crown to permit lateral surface drainage.

When backfilling has been completed, accumulated construction debris will be removed from the ROW, and drainage ditches, terraces, roads and fences will be restored to their former condition. Potholes, ruts, and depressions will be filled, and the pipeline ROW will be left in a neat condition. Pipeline markers and warning signs will be erected and maintained at roads, watercourses, and other points in accordance with applicable regulations. All surplus materials and construction equipment will be removed.

Major highways and railroad crossings will be bored and casing installed if required. All crossings will be constructed in accordance with applicable regulations. A minimum of 3 feet of covering will be utilized over the top of the pipe or casing except at water crossings where the pipe is above grade.

On unsurfaced and lightly traveled rural roads, road crossings may be made using open cut, conventional trenching methods (where permitted). Provisions will be made for temporary passage of traffic by either a detour acceptable to jurisdictional agencies, by temporary bridging over the excavated trench, or a combination of both. Detour and warning signs, lights, flagmen, barricades, pilot vehicles, watchmen, and any other features required for maintaining safe passage of traffic will be supplied and maintained as necessary. Construction pipeline crossings, including repair, restoration, and cleanup operations, will be expeditiously conducted in a neat and orderly fashion to minimize any disturbances.

All canal crossings will be installed in accordance with industry practice and applicable regulatory specifications. Continuous concrete-coated pipe, concrete weights placed over the pipe, or screw anchors may be employed to overcome buoyant forces in wet area crossings. Concrete weights will be fabricated by concrete structure manufacturers located near the proposed pipeline route as needed. An acceptable pad will be used to protect the pipe and pipe coating from possible damage. Placement of the weights over the pipe will be accomplished by the use of sidebooms or cranes. Special care will be taken to ensure that no damage is done to the pipe coating. Excavation of the pipeline trench, stream

banks, and approaches will be performed by conventional trenching and grading equipment. Siltation from water disturbances will be held to a practical minimum. In addition, the following erosion control measures will be adhered to:

- Ditch and canal crossings will be made as close to perpendicular as possible.
- Cutting of banks and slope approaches will be held to a minimum.

Effort will be made to minimize suspended sediment release into watercourses during trench excavation. Backfill operations will be performed slowly to minimize agitation. In addition, silt curtains will be installed on each side of the ROW during construction to minimize turbidity effects. Pipe trenches at the banks will be backfilled with stable materials immediately after the pipe is laid so as to reduce erosion of fine materials from the trench immediately adjacent to the channel.

Hydrostatic Testing

The hydrostatic testing of the pipeline will be conducted in accordance with the regulations contained in AWWA or applicable ANSI standards. The pipeline will be pressure-tested to substantiate the proposed maximum allowable operating pressure and to locate any leaks. It is proposed that hydrostatic testing be employed with water as the testing medium. Where test sections are continuous, the quantity of water required will be held to a minimum by reusing the water, where feasible, from one tested section to the succeeding test section. The length of the test section will depend on factors such as elevation, availability of water, and scheduling. All manifold valving will have a working pressure, based on the maximum test pressure. The test heads and manifold pipe will be designed and fabricated so that no component will be stressed beyond its safe working strength. Water for this testing will be taken from local streams or trucked in as required.

Squeegees (pigs) will be positioned ahead of, as well as behind, the water fill connection for controlled filling and dewatering. In the filling process, the squeegee will be steadily pushed ahead by the water, forming a seal to eliminate air entrapment.

Erosion Sediment Control Measures

Unless otherwise noted, all management strategies, vegetative practices, and structural erosion and sediment control practices will be developed and maintained according to Florida standards and specifications.

Management Strategies

- Activities will be scheduled to minimize erosion of disturbed areas.
- Excavated areas will not be exposed to construction traffic.
- Protection measures will be implemented to prevent transport into any stream, wetland area, or adjacent storm water management system.
- Stockpiling of excavated material will be away from the wetland areas, and surrounded by silt fence or hay bales.
- Wetland banks and beds will be stabilized after construction.
- Surface areas will be restored to at least original condition.
- The construction superintendent will have overall responsibility for plan implementation. He shall also be responsible for seeing that appropriate construction workers and subcontractors are aware of the provisions of the plan.

Vegetative Practices

- Topsoil Stockpile Topsoil shall be stripped from areas to be graded, and stockpiled for later use. Stockpile locations shall be approved by the construction superintendent. They will, however, be placed away from wetland areas and contained by structural measures (i.e., silt fencing or hay bales), as determined by the construction superintendent.

- Seeding After construction is complete any previously vegetated areas will be established by seeding with an approved mixture

Structural Practices

- Silt Fencing Silt fencing will be utilized in areas of high sediment transport potential. In general, fencing will be used to protect adjacent properties. It can be placed along the run of construction utilizing a minimum of space. Fencing can also be reused along the route, if properly maintained. Essentially, as a pipeline segment is excavated silt fencing is placed along the outside of the work area (See Figure 3.8.4-7). This creates an enclosed and controllable area.

Silt fence construction will be held to the following guidelines:

- The height of a silt fence shall not exceed 36 inches (higher fences may impound volumes of water sufficient to cause failure of the structure)
- The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.
- Posts shall be spaced a maximum of 10 feet apart at the barrier location and driven securely into the ground (minimum of 12 inches). When extra strength fabric is used without the wire support fence, post spacing shall not exceed 6 feet.
- A trench shall be excavated approximately 4 inches wide and 4 inches deep along the line of posts and upslope from the barrier.
- When standard strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least 1 inch long, tie wires, or hog rings. The wire shall extend into the trench a minimum of 2 inches and shall not extend more than 36 inches above the original ground surface.

- The standard strength filter fabric shall be stapled or wired to the fence, and 8 inches of the fabric shall be extended into the trench. The fabric shall not extend more than 36 inches above the original ground surface. Filter fabric shall not be stapled to existing trees.
- When extra strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the posts with all other provisions of the item above applying.
- The trench shall be backfilled and the soil compacted over the filter fabric.
- Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.
- Post of silt fences shall be either 4-inch diameter wood or 1 3/32 inch diameter steel with a minimum length of 5 feet. Steel posts shall have projections for fastening wire to them.
- Wire fence reinforcement for silt fences using standard strength filter cloth shall be a minimum of 42 inches in height, a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.

Dewatering During Construction

During construction it will probably be necessary to remove groundwater from inside the work area. That water will be pumped out of the excavation and diverted through a hay bale filter into the existing stream down slope of the activity.

Construction Monitoring and Maintenance

In general, all erosion and sediment control measures will be checked weekly and after each significant rainfall. The following items will be checked in particular:

- All seeded areas will be checked regularly to see that a good stand is maintained. Areas shall be fertilized and reseeded as needed.
- Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.
- Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.
- Sediment deposits should be removed after heavy storm events. They must be removed when deposits reach approximately one-half the height of the barrier.
- Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared, and seeded.

Permanent Stabilization

Prior to removal of the lateral silt fencing, the pipeline trench will be backfilled, compacted, graded over, and vegetation re-established. All vegetated areas will be re-established and stabilized by an approved seeding mixture.

6 2 8 2 Impact on Water Bodies and Uses

For almost the entire run of the pipeline from the Taylor Creek/Nubbin Slough to the project site, the pipeline will be located underground and in the CSX ROW, approximately parallel to and ($\pm$) 18 feet to the south of the center line of the railroad track. Except for the crossings at existing creeks, sloughs, and ditches,

as shown on Figure 6 2 8-2 and listed in Table 6 2 8-1, the pipeline will be entirely located in an area where it will not impact any waters of the state. Further, depending on the width of the creek being crossed, the pipeline at most locations will either be supported from existing railroad bridges in accordance with the requirements of the CSX railroad or from new supports placed on either side of the creek away from the shoreline (Figure 6 2 8-3). However, some of the large pipe spans over streams such as Nubbins Slough, Henry Creek, and Lettuce Creek may require the addition of a pre-cast pile support(s) to be placed in the stream. During the design phase of the project, the option of using the railroad bridges to support the pipe will be analyzed. If the bridges are suitable and CSX agrees with the approach, these mid-stream supports may be eliminated. Since with these types of crossings the pipeline will remain above the waterline of the creeks which are not navigable, the impact on the quality and quantity of the water will be precluded. In addition, the pipe crossing will not affect the water level in the creeks crossed by the pipeline.

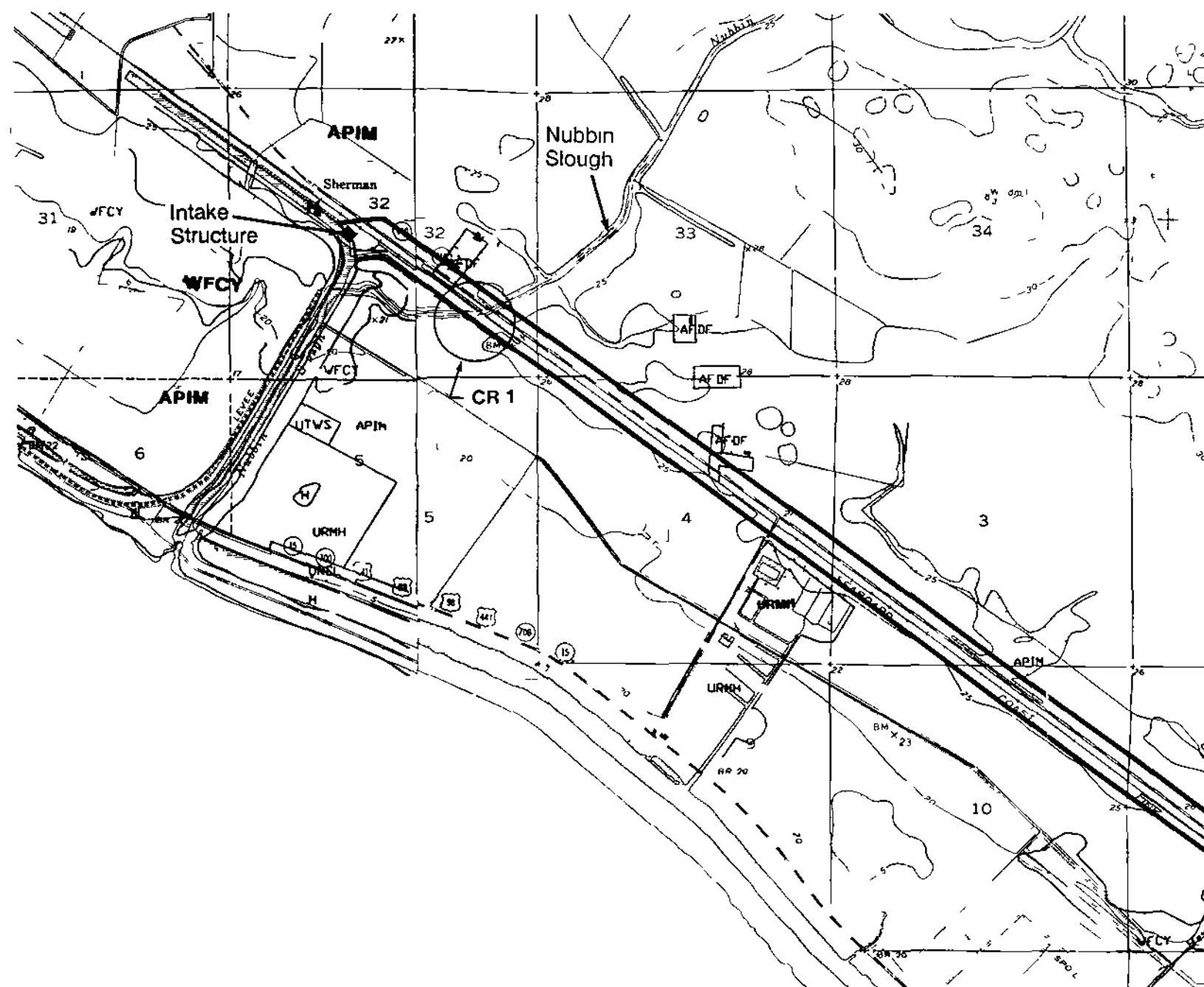
At a location south of Myrtle Slough, the pipeline will be traversing the edge of an elongated swamp. Since the length of the swamp parallel to the pipe run is sufficiently large, it will require an additional intermediate support in the middle of the water crossing as shown in Figure 6 2 8-3. This support will be a 12-inch diameter round pre-cast concrete pile driven into the ground. Considering the size of the proposed support and its location (i.e., close to the edge of existing railroad), it is determined that this structure will have an insignificant impact on the existing swamp. The proposed construction will not require any dredging or building of cofferdams in the existing water body and will be made from the railroad ROW.

6 2 8 3 Solid Wastes

Construction solid wastes such as trees, tree stumps, roots, etc., will be minimal and will be hauled offsite to an approved landfill.

Figure 6 2 8-2 (Page 1 of 5)

ROUTING OF WATER PIPELINE



LEGEND

-  Corridor Containing CSX ROW
- CR __ Pipeline Crossing No

Pipeline routed parallel to and approximately 18 feet from ϕ of railroad track on the south side

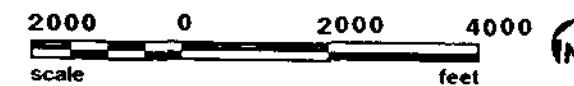
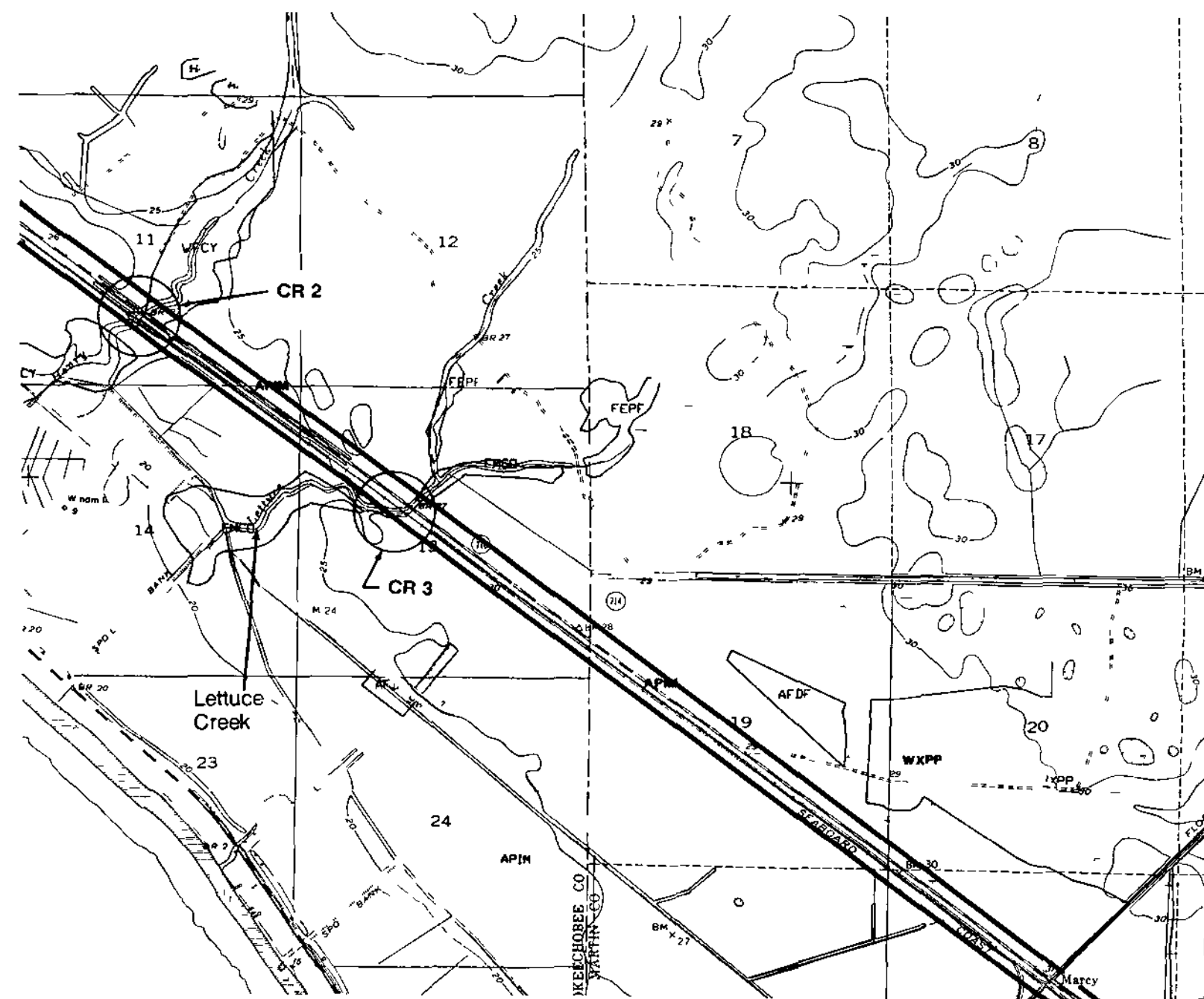
Sources USGS 1983 SFWMD 1986 ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L.P.

Figure 6 2 8-2 (Page 2 of 5)

ROUTING OF WATER PIPELINE



LEGEND

- Corridor Containing CSX ROW
- CR _ Pipeline Crossing No

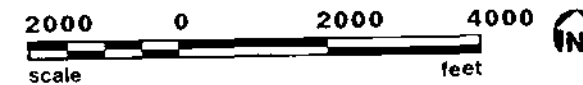
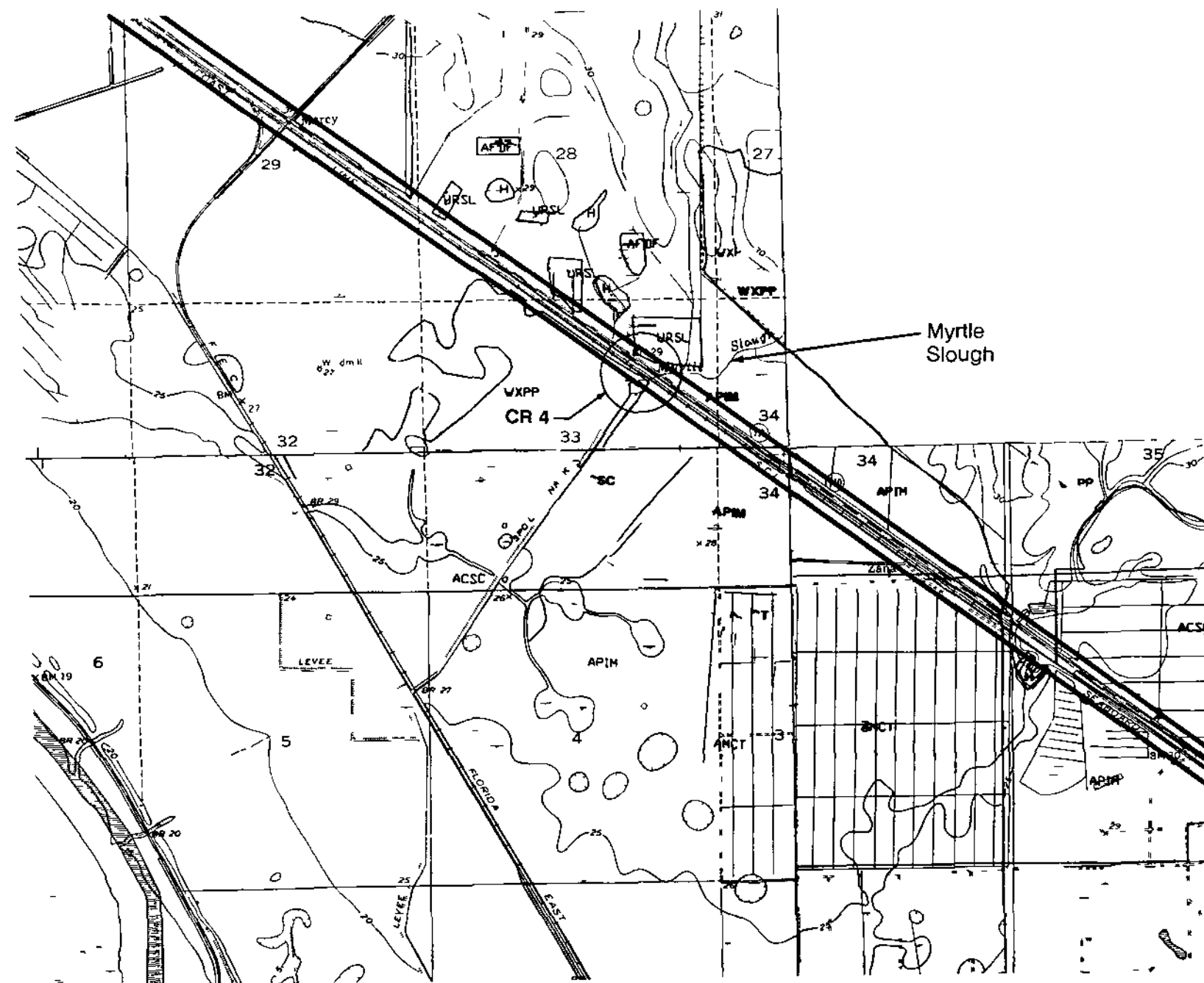
Pipeline routed parallel to and approximately 18 feet from ϕ of railroad track on the south side

Sources USGS 1983 SFWM 1986 ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L.P

ROUTING OF WATER PIPELINE



LEGEND

- Corridor Containing CSX ROW
- CR __ Pipeline Crossing No

Pipeline routed parallel to and approximately 18 feet from $\mathcal{Q}$ of railroad track on the south side

Sources USGS 1983 SFWMD 1986 ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L P

ROUTING OF WATER PIPELINE

LEGEND

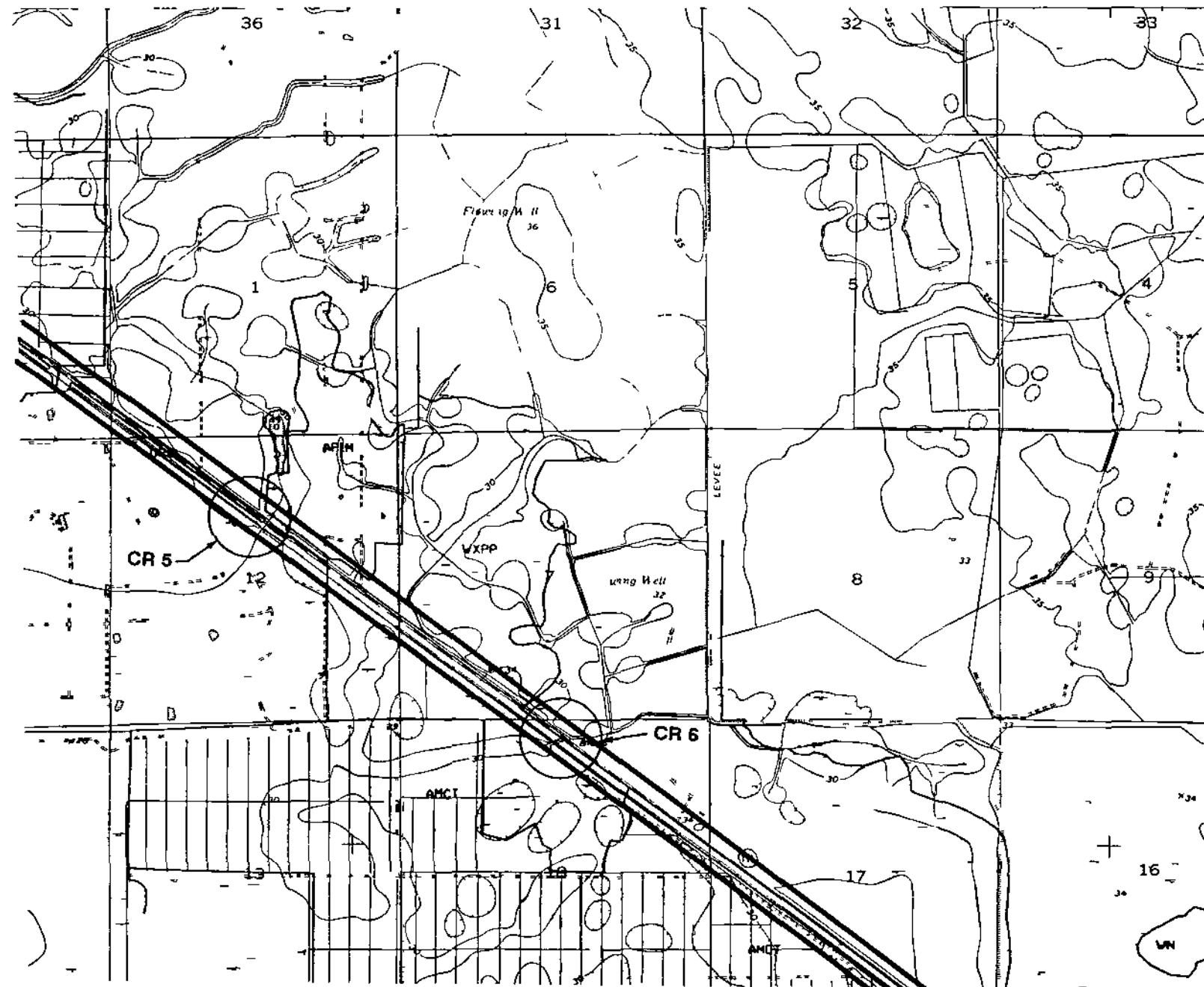
- Corridor Containing CSX ROW
- CR _ Pipeline Crossing No

Pipeline routed parallel to and approximately 18 feet from ϕ of railroad track on the south side

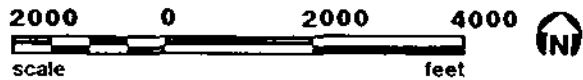
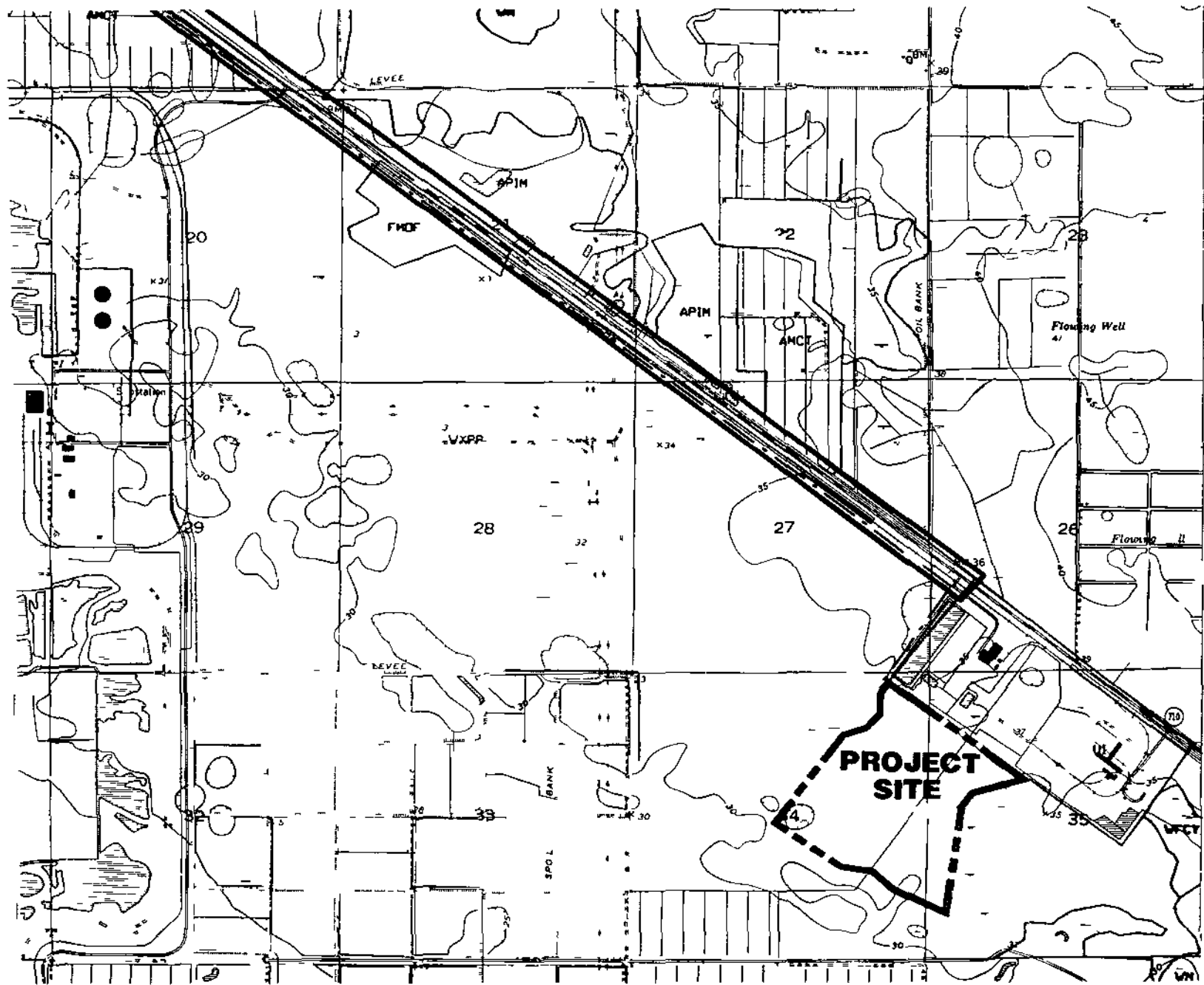
Sources USGS 1983. SFWMD 1986. ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L P



ROUTING OF WATER
PIPELINE



LEGEND

- Corridor Containing CSX ROW
- CR Pipeline Crossing No

Pipeline routed parallel to and approximately 18 feet from ϕ of railroad track on the south side

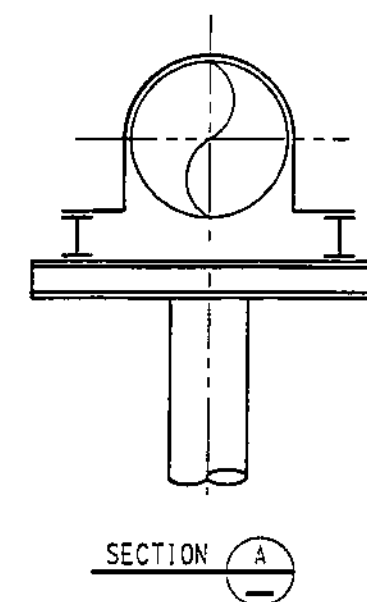
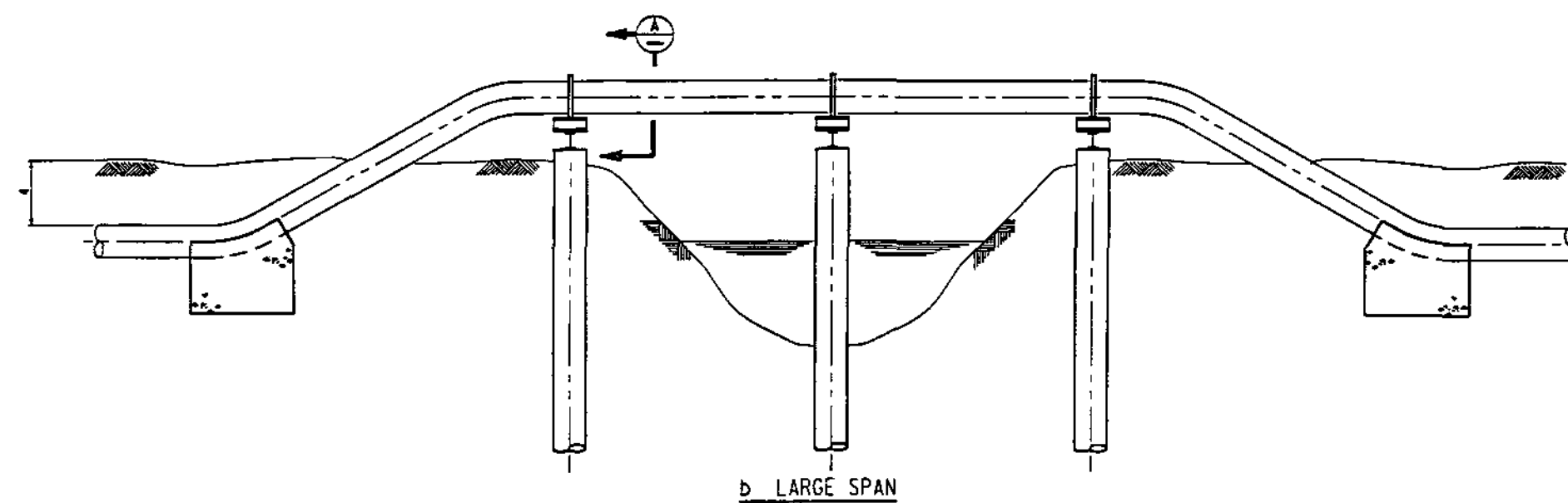
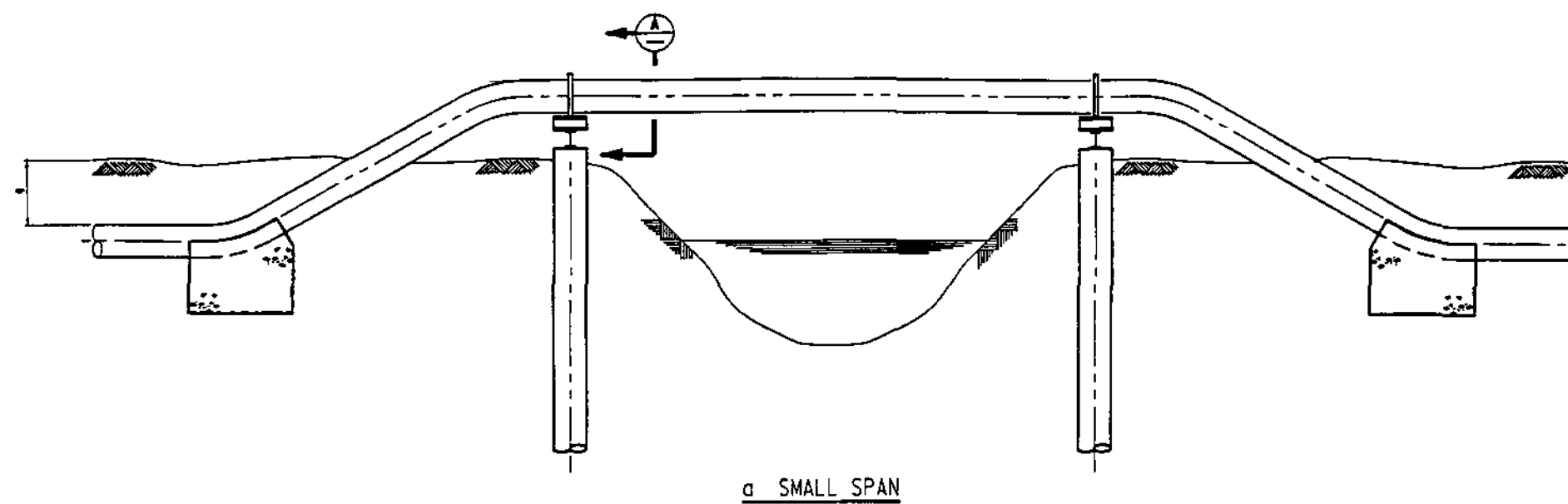
Sources USGS 1983 SFWMD 1986 ECT 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L P

Figure 6 2 8-3

PIPELINE SUPPORT OVER
WATERCROSSINGS



Source Bechtel 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L P

Table 6 2 8-1
LIST OF PIPELINE CROSSINGS

<u>NO</u>	<u>CROSSING DESCRIPTION</u>	<u>RAILROAD MARKER</u>	<u>WIDTH OF CROSSING</u>	<u>CROSSING DETAILS</u>
1	Nubbin Slough	915 0	93 ft	Fig 6 2 8-3
2	Henry Creek	918 3	129 ft	Fig 6 2 8-3
3	Lettuce Creek	919 7	100 ft	Fig 6 2 8-3
4	Myrtle Slough	923 7	26 ft	Fig 6 2 8-3
5	Swamp	927 0		Fig 6 2 8-3
6	BR-34 (*)	928 3	34 ft	Fig 6 2 8-3

(*) Per USGS 4SE Quadrangle 7 5 minute series

Note For crossing number, see Figure 6 2 8-2

6 2 8 4 Changes to Vegetation, Wildlife, and Aquatic Life

No significant permanent changes to animal and plant populations are expected. Most of the area around the corridor is currently in open land, as a result of the land being maintained in an early ecological successional state as part of the railroad ROW. Following construction, vegetation in these open areas, including wetlands, will be allowed to return to its original condition.

Forested areas, such as pine flatwoods, will be cleared only as required for construction.

No threatened and endangered animals or endangered plant species are known to occur in the area. No mitigation measures are planned beyond environmental protection procedures implemented during construction.

6 2 8 5 Impact on Human Populations

Construction will begin once final regulatory approval has been received, and is expected to take about 6 months to complete.

Population density in the vicinity of the proposed pipeline corridor is generally sparse. The impact of the pipeline on the surrounding human population will be negligible. The use of existing ROW and the short duration of construction activities will minimize any inconvenience which might occur.

6 2 8 6 Impact on Regional Scenic, Cultural, and Natural Landmarks

There are no areas identified in Section 6 2 6 1 as being valued specifically for their scenic, cultural, or natural significance within the proposed pipeline corridor, therefore, no impact needs to be assessed.

6 2 8 7 Impact on Archeological and Historic Sites

No archaeological or historic resources were previously listed along the section of the CSX ROW where the water pipeline will be constructed (see Section 10 8) In addition, no archaeological or historic resources eligible for inclusion in the National Register of Historic Places were found during research and field assessment Therefore, activities involved with the construction of the pipeline should have no impact on significant archaeological or historic resources

Should construction activities cause the discovery of unanticipated archaeological materials, those activities which potentially would disturb such materials will be postponed until a professional archaeologist can evaluate their potential significance In the event the materials are believed to be significant, the State Historic Preservation Office (SHPO) will be contacted to identify appropriate measures

6 2 9 POST-CONSTRUCTION IMPACTS AND EFFECTS OF MAINTENANCE

6 2 9 1 Maintenance Techniques

The pipeline is to be constructed in the CSX right-of-way (ROW), therefore, no additional maintenance techniques are proposed beyond current maintenance procedures

6 2 9 2 Multiple Uses

No multiple or joint uses, such as agriculture, are proposed for the lands within the CSX ROW, the proposed location of the ICL pipeline. Other linear facilities, such as optical fiber telephone lines, have been installed in this ROW. Use of this ROW is controlled by CSX.

6 2 9 3 Changes in Species Populations

The status and potential for occurrence of important species in and along the proposed pipeline ROW was discussed in Section 6 2 7. The avoidance of ecologically unique or valuable habitats was achieved through collocation of the pipeline with the existing CSX railroad ROW.

Changes in local species populations are not expected as a result of the pipeline presence and maintenance. Displacement of individuals from the immediate ROW area which might occur as a result of construction activities would be temporary. These displaced species are expected to re-inhabit or repopulate the ROW area. No animal or plant species is expected to be permanently displaced out of the project area as a result of construction in the pipeline ROW and subsequent maintenance. In a short time, ground cover over the disturbed land will be indistinguishable from surrounding vegetation except for those small areas that are forested. Here, a decrease in structural diversity (loss of canopy trees) will occur, however, due to collocation with the CSX ROW, only a narrow strip of canopy will

be lost. In these areas, clearing of overstory vegetation will not result in the loss of significant portions of regional wildlife habitat types.

No threatened or endangered plants or animals are known to require land included within the pipeline ROW. The current land use as ROW for the CSX railroad has resulted in habitat types poorly suited for habitation by such species. In summary, there are expected to be no measurable changes to populations of important species after construction or as a result of maintenance activities.

6.2.9.4 Effects of Public Access

No additional public access roads are proposed as part of the pipeline corridor. Therefore, no additional exposure to the public by wildlife should result as part of maintenance of the pipeline corridor.

6 2 10 OTHER POST-CONSTRUCTION EFFECTS

Because the proposed pipeline will be buried underground, no additional post-construction effects are expected

References

REFERENCES

Section 6 2 6

Martin County Growth Management Department Martin County Comprehensive Growth Management Plan (Adopted) 1990

Piper Archaeological Research, Inc Cultural Resource Assessment Survey of the Proposed Martin County Power Plant Site and Pipeline Right-of-Way, Martin County, Florida (SCA Section 10 8) 1990

Section 6 2 8

Piper Archaeological Research, Inc Cultural Resource Assessment Survey of the Proposed Martin County Power Plant Site and Pipeline Right-of-Way Martin County, Florida (SCA Section 10 8) 1990

7 0 ECONOMIC AND SOCIAL EFFECTS OF PROJECT CONSTRUCTION AND OPERATION

The development of the ICL project will have overall beneficial economic effects on Martin County, the surrounding region, and statewide. ICL will actively encourage the hiring of all operational employees from the local area or the relocation of new employees within Martin County. As such, operational-related economic and social effects are expected to be concentrated within Martin County. Construction-related economic and social effects are expected to be more widely distributed over a larger geographic area, due to the commuting nature of construction workers. This area may include Martin, Okeechobee, St. Lucie, and Palm Beach Counties, as well as the Fort Lauderdale and Miami metropolitan areas.

Any potential socioeconomic effects created by the development of the ICL site would primarily be the result of any population growth due to the construction and operations workers involved in the project. Discussions of the benefits and costs of the construction-related activities are found in Sections 7.1.1 and 7.2.1, respectively, discussions of the benefits and costs of the operational-related activities and workforce are found in Sections 7.1.2 and 7.2.2, respectively.

The projected size of the construction workforce, as previously described in Section 4.6.2, is expected to reach a peak of 800 individuals for 4 to 6 months during the third year of construction. The projected operational workforce is expected to total 80 persons. These operational workers will be employed after the construction is complete and startup of the unit is commenced which is expected in July 1995. The plant is expected to be placed in service in December 1995. The employment positions generated by the operation of the ICL plant will also create indirect positions required to service and support the direct operational workers.

The anticipated population growth resulting from the employment of the construction and operational workforce will have positive and, to a lesser extent, negative effects on the socioeconomic character of Martin County and the surrounding region. The positive impacts will include the additional payroll generated by these new employment positions and additional revenues generated by the taxes levied on capital investment in the plant and additional expenditures in the region.

The potential negative effects resulting from the construction and operation of the ICL plant revolve around any potential need to expand infrastructure and public services for this population. Elements of infrastructure typically include roads, parks, public landfills and solid waste management services, gas and electric utilities, potable water supply, and domestic wastewater treatment facilities. Public services which may be affected could include police and fire protection, education, and medical services.

The local supply of housing is another socioeconomic characteristic which may be impacted by the additional population. However, the potential effects on community services and housing are expected primarily to be involved with the long-term timeframe associated with the operation of the facility. Because of the commuting nature of the construction workforce, very few permanent relocations are anticipated during the construction period. Therefore, significant new residential construction and increased demands on the existing infrastructure and public services to support the construction workforce are not expected.

The following assumptions were made for the analysis of potential impacts caused by the construction and operation of the ICL plant:

- Most of the construction workers are expected to commute daily from their current residences. It is not uncommon for construction workers to commute up to 100 miles one-way, as opposed to relocating closer to the site. This 100-mile commuting distance therefore includes the urbanized areas of Miami, Fort Lauderdale, and West Palm Beach. This

construction workforce is characterized by those specialized craftsmen, technicians, and construction workers typically involved in the construction of power plants. Some workers may be expected to temporarily relocate (i.e., during weekdays only), without families, to available rental housing and mobile home units within the Martin County and surrounding region.

- For this analysis, it is assumed that all of the 80 projected operational workers are assumed to relocate to Martin County. ICL will actively encourage any employees hired from outside the county to relocate to the local area.
- Since ICL will actively encourage the hiring of local residents to the extent possible, it is likely that some of the 80 direct jobs will be filled by persons who currently live and work in Martin County. However, because these individuals are most likely currently employed in Martin County and will vacate existing positions for employment at the ICL plant, it is assumed that newcomers will fill those vacated positions. Therefore, the assumption that 80 positions will be filled by newcomers remains unaffected. In the event that new positions are filled by local residents that are currently unemployed, this assumption will slightly overstate the number of newcomers required to fill all positions.
- It is assumed that all indirect employment, or those positions in the service industry created to support the project-related workforce, will be filled by workers who migrate to the area. This assumption is validated by the historical pattern of in-migration accounting for 100 percent of the region's population growth (Bureau of Economic and Business Research, 1988). In the event that these indirect jobs are filled by local residents that are currently unemployed, this assumption will again overstate the number of newcomers to the area.

- The final assumption is that the average household of in-migrating workers will equal the statewide average of 2.47 persons per household, with 0.9 children per household (U.S. Department of Commerce, 1988). It is also assumed that 75 percent of the children are of school age.

7 1 SOCIOECONOMIC BENEFITS

A primary benefit resulting from the ICL facility will be the provision of a new, efficient, and reliable energy source. In addition to the provision of energy, the implementation of the ICL power plant will provide temporary economic benefits during construction and long-term benefits during its operation to the local, regional, and statewide economics.

Section 7 1 1 discusses the temporary benefits associated with construction, which may include the direct benefits of the employment and payrolls, and indirect benefits such as increased rent payments, spending within local and regional economies, and additional revenues generated through sales taxes.

Section 7 1 2 discusses the long-term benefits associated with the operation of the ICL facility. These benefits are expected to include increased employment and payrolls, and greater revenue sources through property and ad valorem taxes, and also through impact fees, primarily in Martin County. Some of these operational-related positive impacts are single-event benefits that will not accumulate over time, such as impact fees, while others, such as property taxes, will be cumulative over the 30-year life of the project.

7 1 1 CONSTRUCTION-RELATED BENEFITS

Socioeconomic benefits anticipated within Martin County and the surrounding region as related to the construction of the ICL facility include additional employment and payrolls, additional rents and increased levels of spending, and additional sales tax revenues on localized spending and investment in construction supplies and materials

Based on the size of the available workforce in the region (i.e., within a 100-mile commuting distance), most of the construction workers for the project are expected to commute daily from their current residences. Therefore, any relocation of construction workers to Martin County and the region is expected to be minimal, and any population growth and resulting demands on public services in the region during the construction activities are also expected to be minimal

This anticipated commuting and non-relocation pattern will result in minimizing any potential negative socioeconomic effects of the ICL project from direct and indirect population growth in the region during construction. However, the project construction activities will have positive effects on the local and regional economies by providing employment opportunities and associated payrolls which will maintain or increase (i.e., to the extent unemployed workers are hired) spending levels in Martin County and the region. The Martin County, regional, and statewide economies will also benefit from the purchase of supplies, materials, and services required for the construction of the project

Table 7 1 1-1 provides the estimated number of direct employment positions created due to the construction of the ICL plant and annual payrolls. The construction payroll is estimated to be as large as \$17.7 million during the third year of construction. This was determined by multiplying the projected number of employees by the total work hours in a year based on a 40-hour work week (2,080 hours), and multiplying that by the average heavy construction wage of \$14.21 as reported to the Florida Department of Labor and Employment Security

Table 7 1 1-1
ESTIMATED NUMBER OF DIRECT CONSTRUCTION EMPLOYMENT
POSITIONS AND ANNUAL PAYROLLS (IN 1989 DOLLARS) DURING
THE CONSTRUCTION OF THE ICL PROJECT

Construction Period	Average Annual Construc- tion Jobs	Change from Previous Year	Construction Payroll
7/92 - 12/92	200	+ 200	\$2,955,680
12/92 - 12/93	400	+ 200	\$11,822,720
12/93 - 12/94	600	+ 200	\$17,734,080
12/94 - 12/95	200	-400	\$5,911,360
12/95 - 12/96	0	-200	0
TOTAL	--	--	\$38,423,840

Sources Bechtel, 1990
Florida Department of Labor and Employment Security, 1990
ECT, 1990

for 1989 Over the 4 years of construction, the total estimated payroll is \$38 million

The construction-related workforce is also expected to create indirect economic benefits to the region through those individuals that temporarily relocate closer to the ICL site during weekdays These individuals will create positive economic impacts through rental payments for housing, such as multi-family and mobile home units, or recreational vehicle lots Since a few individuals may permanently relocate during construction, potential benefits may also be created by mobile home or single-family home purchases The existing housing stock within the region is adequate to meet the needs of the few expected permanent relocations Therefore, additional revenues in the form of ad valorem taxes and impact fees for new residential development are expected to be minimal

The construction workers commuting through the local area and those who temporarily live in the region during the weekdays should also increase levels of spending at retail establishments in the region This potential increase in spending will generate additional revenues to Martin and surrounding counties and the state through sales and gasoline taxes

Additional sales taxes will also be generated in the region and statewide from projected investment in construction materials and supplies Anticipated expenditures totaling \$4,264,215 for construction materials are estimated within the local area, equating to a total \$255,600 in sales taxes The use of heavy equipment for construction of the facility will also generate a personal property tax of approximately \$158,000 per year of construction

7 1 2 OPERATIONAL-RELATED BENEFITS

Socioeconomic benefits resulting from the operation of the ICL power plant are expected to take the form of additional employment and payroll, additional revenues from the capital investment in the plant facilities, land, and heavy equipment, additional ad valorem taxes associated with the anticipated residential relocations, and impact fees collected for the development of the ICL facility and for potential new residences associated with the anticipated relocations. These economic benefits are expected to occur primarily in Martin County.

The operational workforce will be 80 employees. Of this permanent operational workforce, 65 are expected to be employed during the weekdays, distributed in three shifts. The day shift, working 7 a.m. to 4 p.m., will be the largest and is expected to total 45 persons, with the remaining 20 individuals equally divided between evening and night shifts. The other 15 employees will work weekends, also divided in three shifts.

Table 7 1 2-1 contains the estimated annual payroll for the employees directly involved in the operation of the ICL facility. This estimate is based on the 1989 annual average salary of \$28,687 for all workers listed under the category of transportation, communication, and public utilities in Martin County by the Florida Department of Labor and Employment Security (FDLES, 1990). The estimated operational-related payroll for the ICL facility is therefore projected to be approximately \$2.3 million annually in 1989 dollars. Assuming that the operational wages remain constant in 1989 dollars, a total of \$68.8 million in direct wages would be generated as a long-term cumulative benefit primarily to Martin County over the 30-year life of the facility. The total number of operational workers is predicted to remain constant throughout the life expectancy of the project. Therefore, this estimated payroll is also predicted to remain relatively constant, with respective increases due to inflation and cost-of-living increases.

Table 7 1 2-1
ESTIMATED NUMBER OF DIRECT AND INDIRECT OPERATIONAL-RELATED
EMPLOYMENT POSITIONS AND ANNUAL PAYROLLS (IN 1989 DOLLARS)
CREATED BY THE OPERATION OF THE ICL PROJECT IN MARTIN COUNTY

Operational Period	Opera- tional Jobs	Indirect Jobs (1 93 multiplier)	Opera- tional Payroll	Indirect Payroll	Total
Annual	80	155	\$ 2,294,960	\$ 2,986,400	\$ 5,281,360
Cumulative (over 30-year life)	--	--	\$68,848,800	\$89,592,000	\$158,440,800

Sources Bechtel, 1990
Florida Department of Labor and Employment Security, 1990
ECT, 1990

The total estimated annual payroll for the 155 indirect jobs created by the operational workforce is also shown on Table 7 1 2-1, and is estimated to be approximately \$3 0 million annually. This estimate was first calculated by multiplying the projected 80 operational employees by a 1 93 indirect multiplier as used in the U S Department of Commerce, Bureau of Economic Analysis RIMS II economic model to determine the estimated indirect employment positions (U S Department of Commerce, 1989). This estimate of indirect employment was then multiplied by the average annual 1989 wage for all industries in Martin County as reported to the Florida Department of Labor and Employment Security (\$19,267). Assuming that the indirect wages remain constant at 1989 levels, total long-term economic benefits of \$89 6 million in wages would be generated over the life of the facility.

Operation of the ICL project is also expected to generate considerable public revenues in Martin County. These revenues are expected to be generated in the form of additional property taxes levied on the ICL facility once it is fully improved, ad valorem taxes levied against home purchases made by operational employees relocating to the area, and impact fees paid to develop the ICL facility and for new home purchases. The total projected revenues for Martin County in 1996, the first year of plant operation, are shown in Table 7 1 2-2.

The largest source of revenue generated by the ICL facility will be through property taxes levied against the property and facilities once fully improved and operational. As shown in Table 7 1 2-2, using the 1989 millage rate applied to a capital investment forecasted in 1996 dollars, an estimated \$4 0 million in property taxes will be paid to Martin County annually in 1996 dollars by ICL. The revenues generated through property taxes will be cumulative. Over the 30-year life of the project (based on 1996 dollars and 1989 millage rate), the ICL facility itself would generate approximately \$120 0 million in property tax revenues to Martin County.

Additional revenues for Martin County will also be generated from residential property taxes. Based on the assumption that all operational workers will purchase

a home instead of renting, and using the assumption that the residences purchased will be new homes, an estimated 80 new home purchases may occur in Martin County. If this occurs, the estimated residential property tax revenues generated within Martin County is shown in Table 7 1 2-2. Because it is assumed that all operational employees will purchase a new home, the figures shown in Table 7 1 2-2 represent the maximum tax benefit. The potential residential property tax revenues are calculated by using the estimated 1996 selling price less a \$25,000 homestead exemption and Martin County's 1989 millage rates. The estimated residential values were calculated for 1996 using a 5 percent annual escalation rate applied towards the average 1989 home value. The total annual property tax revenue for Martin County is estimated to be approximately \$138,000 for the direct employees associated with the operation of the ICL project.

Since ICL will encourage the operational workforce to be hired from or relocate to Martin County, it is reasonable to assume that population growth resulting from new indirect service jobs created to support the operational employees and their families will also occur in Martin County. Based on 1989 Florida Department of Labor and Employment Security data, lower annual incomes are typical for retail or service-related occupations. Due to estimated lower incomes for this indirect population, it is likely that a lower percentage would be able to afford new homes. Data from the Bureau of the Census and U.S. Department of Housing and Urban Development's Annual Housing Survey for Florida Households (Bureau of Economic and Business Research, 1988) indicates that 55 percent of those individuals earning between \$10,000 and \$19,888 annually live in owner-occupied homes. The remaining 45 percent of these individuals within this income range occupy rental units. Table 7 1 2-2 shows the predicted tax revenues to be generated by those indirect employees purchasing homes, as based on the assumption of 55-percent owner-occupied households. The total property tax revenues generated within Martin County from indirect employment is estimated to be \$56,625. This is based on 1989 existing market home values escalated 5 percent annually to an average 1996 home value.

Impact fees are assessed by local governments to offset the costs of providing additional capital facilities and public services such as roads, parks, and police and fire services as necessitated by new developments. Industrial development, such as the ICL facility, is subject to both road and public facility impact fees in Martin County. As shown in Table 7.1.2-2, the total impact fee on the plant facilities collected by Martin County is \$28,770, using a constant 1989 impact fee rate. The estimated road impact fee generated by the development of the ICL facility is \$25,240, and the estimated public facilities impact fees generated by the ICL facility is \$3,530.

Impact fees within Martin County are also assessed against residential developments, and include a park impact fee in addition to the road and public capital facilities impact fees. Because it is estimated that all of the direct employment population will in-migrate to the area, impact fees from new residential development attributable to the project-related population growth can be calculated. A total of \$73,680 in impact fees is estimated to be generated by residential development as related to the ICL plant, as shown in Table 7.1.2-2. This impact fee calculation assumed 1989 rates would remain constant. This total is estimated to be broken down as follows: \$50,160 in road impact fees, \$15,200 in public capital facilities impact fees, and \$8,320 in park impact fees. These projected residential impact fees related to operational workforce relocations would be single-event economic benefits that would not reoccur over the life of the facilities.

Table 7.1.2-2 also summarizes several other sources of increased revenues to Martin County. These other revenues include shared state revenues and education funds. Local school districts receive state educational funds which are distributed based on population and need. Jurisdictional need for funds is determined by the student population and by availability of local revenues from ad valorem taxes and impact fees. For the 1989-1990 school year, Martin County received \$1,087 per full-time equivalent student (Martin County School Board, 1990). The additional revenues generated by new student population attributable to the ICL project is shown on Table 7.1.2-2.

7 1 3 OTHER BENEFITS

Another economic benefit of cogeneration is the production of waste steam as a supplementary source of energy for a secondary user. A significant rationale for siting the ICL plant in this particular location is because of the cogeneration opportunities available, due to the proximity of the Caulkins Citrus processing plant. Excess steam is expected to be sold to the Caulkins facility as a source of energy, thus offsetting a portion of the facility's energy requirements.

Table 7 1 2-2
PROJECTED PUBLIC REVENUES IN MARTIN COUNTY IN 1996 ASSOCIATED
WITH THE ICL PROJECT (1996 DOLLARS)

Revenue Source	1996
Property tax ¹ --plant facilities	4,000,000
Impact fees ² --plant facilities (combined county-wide average)	28,770
Residential ad valorem taxes ³ (operational employees)	137,824 ⁶
Residential ad valorem taxes ³ (indirect employment)	56,625 ⁶
State revenue sharing ⁴ (\$80 84 per capita)	12,530
State educational funds ⁵ (\$1,087 per full-time equivalent student)	173,920
Impact fees--new residential development from operational workforce home purchases (road impact fee portion of total represents a per-dwelling unit county-wide average)	73,680
TOTAL	4,483,349

Note ¹Cumulative value of capital investment

²Calculated at build-out

³1989 millage rates

⁴Florida Department of Banking and Finance, 1990

⁵Calculated for 160 students

⁶Values escalated 5 percent annually for estimated 1996 values Millage rates, impact fee rates, revenue sharing, and educational funds were assumed to be constant at 1989 rates

Sources ICL, 1990
ECT, 1990

7 2 SOCIOECONOMIC COSTS

It is projected that both short- and long-term socioeconomic costs associated with the ICL facility will not be significant and will be offset by the anticipated project benefits. These projected benefits are expected to come in the form of additional payrolls due to the related population growth, enhanced tax base, and increased revenues, primarily within Martin County.

As previously described in Section 5 11 3, the ICL site is currently used for limited cattle grazing purposes. This is the only land use that will be displaced due to the proposed power plant development, and is not expected to represent a significant economic loss to Martin County, or the region in general.

Section 7 2 1 discusses the temporary costs associated with the construction of the ICL facility. Section 7 2 2 addresses the long-term costs primarily associated with the operation of the plant. These costs are primarily confined to offsite considerations associated with the projected population growth due to in-migration, and the movement of the workforce, materials, and machinery. Some of these long-term operational-related economic costs are considered to be single-event impacts that will only initially occur upon completion of the ICL facility.

These initial, single-event impacts may include any required expansions to roadways and recreational areas. The long-term operational-related costs associated with educational and public services represent initial expansions to support the operational workforce and their families. However, once the additional manpower has been incorporated, those associated additional costs will remain constant, and the expanded employment will be absorbed in the existing workforce.

Section 7 3 compares the benefits and costs within Martin County and is primarily concerned with comparing the projected additional costs of providing the

necessary services required to support the project-related population growth, to the additional revenues generated by the development of the project

7 2 1 TEMPORARY EXTERNAL COSTS

Temporary external costs are those costs impacting persons and local governments within the defined region of influence. In this analysis, the term temporary is defined as the 42-month period during which construction takes place, from July 1992 to December 1995.

Construction is anticipated to commence in July 1992, with an estimated workforce of 200. During the first year and a half of the construction schedule, the activities anticipated will include heavy civil engineering and construction work which will include clearing and grubbing existing vegetation, hauling fill material, and pouring ready mix concrete, and later, deliveries of steel and plant facilities machinery (ICL, 1990). The construction workforce is anticipated to reach peak employment of 800 during the third year of construction. The construction schedule is based on a single shift operating 40-hour workweeks.

As discussed previously, it is assumed that most of the construction workforce will commute daily to and from the site, with a few workers temporarily (i.e., during weekdays) occupying various forms of rental housing available within Martin County and the region. The available workforce within a reasonable commuting distance (i.e., up to 100 miles) is of sufficient size to provide the construction employment requirements of the ICL project. In addition to Martin County and the surrounding counties of Palm Beach, Okeechobee, and St. Lucie, the construction workforce could also be drawn from the large metropolitan areas of Miami and Fort Lauderdale.

Since most of the construction workforce is expected to commute daily from their current residences, the impacts on publicly supplied facilities and services such as schools and hospitals in Martin County and in the surrounding region are not expected to be significant. The small portion of the construction workforce expected to temporarily relocate to Martin County or the region during the weekdays would be expected to occupy existing rental housing or mobile home

stock within the region. As such, the commuting pattern and temporary or potential minor permanent relocations of the construction workforce are not expected to create the need for new residential construction, which would in turn require expansion of the infrastructure in Martin County or the region.

Temporary impacts on public potable water and sanitary sewer services due to the construction workforce are not expected to be significant. Temporary potable water and sanitary sewer services will be supplied at the site by ICL, and therefore, will not create any impacts on those existing services. Temporary impacts on other public services and facilities in Martin County, such as police and fire protection services, educational facilities, and medical services, are also expected to be insignificant due to the commuting nature of the construction workforce.

Land use impacts on adjacent properties are also not expected due to the developed nature of adjacent facilities. Because of the proximity of this project to existing power generating and industrial and previous industrial developments, potential land use impacts are expected to be minimal.

Visual impacts resulting from the construction of the ICL facility are expected to be minimal, due to a lack of directly adjacent residential populations, the set-back distance of the site to SR 710, and limited access to the site. In addition, a screen of vegetation will be preserved along the west side of the CSX railroad to visually buffer the proposed power plant from travellers on SR 710.

Primary access to the ICL site will be provided by an existing intersection on SR 710. A secondary entrance on Southwest Farm Road is also proposed. An emergency entrance will also be provided on SR 710 via the existing FSC entrance road. For conservative traffic analysis purposes, it was assumed that all of the project trips will be generated through the main entrance.

During the peak of the construction schedule, it is estimated that 800 construction workers will be employed at the site for 4 to 6 months during the third year of

construction. It is also assumed that the entire construction workforce would be employed in a single daytime shift during the weekdays. A complete traffic analysis, conducted in accordance with criteria established in the Martin County CGMP Traffic Impact Study Guidelines, is provided in Section 10.10. A vehicle occupancy rate of 1.3 is anticipated at a trip generation rate of 2.0. This equates to a peak of a total of 1,200 peak construction daily trips to the site. These 600 inbound a.m. peak hour trips and 600 outbound p.m. peak trips, in addition to a total of 20 daily construction vehicle trips yield an estimated 1,240 total daily trips during the peak of construction. When these trips are combined with a 5.6-percent annual average growth rate of background traffic in 1994, the level of service on SR 710 in northwest and southeast directions during morning and evening rush hours is expected to be at LOS C or better. LOS C is the accepted Martin County standard for level of service on roadways outside the urban service boundary (Martin CGMP, 1990). Based on the traffic analysis, the construction of a southbound right-turn lane on SR 710 at the project entrance is recommended to assist traffic operations, prior to the initiation of construction of the ICL facility (Kimley-Horn, 1990). Due to the remoteness of the site, a vehicle occupancy rate higher than 1.3 may result, equating to even lower construction-related traffic impacts.

In an additional attempt to minimize construction-related traffic impacts and improve the efficiency of construction workforce transportation, ICL is currently examining means of providing private transit transportation of construction workers by bus to the site. In the event that this busing program is implemented, construction-related traffic impacts will be greatly reduced.

Construction-related recreational impacts are expected to be insignificant since the commuting workforce are expected to utilize recreational facilities in relation to their existing residences.

7 2 2 LONG-TERM EXTERNAL COSTS

Long-term external costs are those costs which may accrue to the local government resulting from the permanently employed operational workers and their families, and the populations filling the indirect employment positions created to service and support the additional operational-related populations

Within Martin County, the project-related population growth may necessitate some additional public services, at an additional cost to the county government. These additional services may include education, police and fire protection, recreation, and transportation. The projected costs for providing these additional services to Martin County are shown in Table 7 2 2-1

Population growth in Martin County is expected to result from the direct workforce involved in the operation of the ICL plant, and the projected indirect population required to service and support the direct employees and their families. A total of 80 operational employees is anticipated for the ICL plant. The in-migration of these workers to Martin County is expected to create an additional 155 indirect jobs in the county.

The educational system in Martin County is experiencing growth in nearly all grade levels. The projected additional costs due to population growth associated with the ICL project for additional educational services in Martin County are shown on Table 7 2 2-1. Table 7 2 2-1 shows that approximately 10 new teachers would be required in Martin County to maintain existing teacher-to-student ratios.

Projected long-term transportation impacts resulting from the operation of the ICL plant are expected to be caused by the additional vehicles accessing the site as occupied by the plant's operational workforce, and also by rail deliveries of coal. A copy of comprehensive operational traffic analysis study is provided in Section 10 7.

Table 7 2 2-1
INCREASED COSTS TO MARTIN COUNTY FOR 1996 ASSOCIATED WITH THE
OPERATION OF THE ICL PROJECT

Item	Martin County
Total number of workers (direct and indirect)	235
Total associated population growth ¹ (2 47 persons per household)	581
<u>Education</u>	
1989-1990 average teacher/student ratio ²	1 16
Additional school-age children (0 68 per household) ¹	160
Additional teachers required	10 0
Additional teachers salaries required ³	\$386,390 ⁸
Additional capital outlay required ³	\$126 640
<u>Public Safety</u>	
Officers per 1,000 population ⁴	1 2 70
Additional officers required	0 64
Additional officers salaries	\$19 642 ⁸
Firefighters per 1 000 population ⁵	1 3 60
Additional firefighters required	0 85
Additional firefighters salaries required ⁵	\$23,215 ⁸
<u>Transportation</u>	
Additional new dwelling units	80
Additional lane miles per dwelling unit ⁶ (0 003128 per dwelling unit)	0 25
Cost (\$372 882 per lane mile)	\$93 220 ⁸
<u>Recreation</u>	
Level of service standard (AC per 1,000 population) ⁷	2
Additional recreational acreage required	0 48
Acquisition and development costs ⁶	\$47 279 ⁸
<u>General Governmental Service⁷</u>	\$39,950
TOTAL ANNUAL	\$736,336
PER CAPITA EXPENDITURE	\$3,133

- Sources ¹ U S Department of Commerce 1990
² Florida Department of Education, 1990
³ Martin County Board of Education 1990
⁴ Martin County Sheriff's Department, 1990
⁵ Martin County Fire Department 1990
⁶ Treasure Coast Regional Planning Council 1989
⁷ Bureau of Economic and Business Research 1988
⁸ Calculated by using 1988 values applied against a 5 percent annual escalation rate to estimate a value on 1996 dollars

The analysis of the projected traffic volumes generated with the proposed power plant operating show that roadway links and intersections within the study area are expected to operate at acceptable levels of service (Kimley-Horn, 1990). The acceptable LOS rating for roadways outside the Martin County Urban Service Boundary is LOS C (Martin CGMP, 1990). Because the projected increase in operational traffic is not expected to lower the existing capacity of roadway segments within the study area, no improvements are warranted. However, for the benefit of traffic operations, it is recommended that a southbound right-turn lane on SR 710 at the project entrance be constructed prior to the initiation of construction of the proposed ICL facility.

As previously discussed in Section 2.2.7.6, FDOT currently has an improvement scheduled on SR 710 within Indiantown, with construction commencing in 1993 (FDOT, 1990). This improvement will consist of widening SR 710 to a five-lane facility with continuous-turn center lane for a length of approximately 2.2 miles. This programmed roadway improvement is expected to reduce traffic congestion through Indiantown. Also, FDOT has committed to a maintenance improvement of resurfacing and repaving essentially the entire length of SR 710 in Martin County (FDOT, 1990). This maintenance improvement should address any deteriorating conditions of SR 710.

As shown on Table 7.2.2-1, new lane miles as projected to be required for new residential development associated with residential relocations within Martin County are expected to be minimal. Less than one-fourth mile of new lanes would be potentially required for new residential roads.

Additional minor transportation impacts associated with the operation of the ICL facility may result as part of weekly rail deliveries of coal. It is estimated that between two and three 90-car unit trains per week will deliver coal to the site from mines in Appalachia. This averages to 130 coal deliveries per year, which is not expected to result in a significant impact on transportation systems in the area.

Long-term impacts on public potable water and sanitary sewer services due to the operation of the ICL facility are expected to be minimal due to the existing available capacities at the Indiantown Utilities Company and other water and wastewater services in Martin County. The operation of the ICL facility and residential relocations resulting from the operational workforce are not expected to increase demand beyond these existing capacities.

Impacts on public safety services such as police and fire protection associated with the projected population growth resulting from the operation of the ICL plant are not expected to be significant. As shown on Table 7.2.2-1, less than one additional police officer and firefighter are projected to be required to maintain current service ratios per 1,000 population. Impacts on medical facilities are also expected to be minimal. Public safety services to the ICL facility will be provided by sheriff's and fire stations located in Indiantown. EMS facilities are located in the Indiantown station, and response time for both police and fire service is projected to be between 8 and 10 minutes.

Because of the amount of existing parks and recreational facilities, new additional acreage for parks required to support the population growth resulting from the operation of the ICL facility is expected to be minimal. As shown on Table 7.2.2-1, using Martin County's recreational LOS standard would result in required additions of less than 1 acre of recreational land.

Visual impacts resulting from the operation of the ICL facility affecting the aesthetic character of the region are expected to be minimal. The immediate vicinity of the proposed ICL plant contains existing industrial development, and the addition of a cogeneration facility should not be in visual conflict with the character of existing development. Dense vegetation exists along SR 710, which should effectively screen the view to the ICL site from travellers on SR 710. The existing screen of pine trees along the west side of the CSX rail line will be preserved to act as a visual buffer to the site.

Within the ICL site, Martin County landscape requirements will be satisfied for areas surrounding the administration building and employee parking areas. A 30-day inactive coal pile will be grassed over to minimize visual impact and fugitive dust emissions. Also, as part of the PUD(i) submittal requirements, significant wetlands and uplands habitats will be preserved onsite, which will represent a positive visual impact.

7 3 BENEFIT/COST ANALYSIS

Table 7 3 0-1 provides a summary of the benefits and costs within Martin County resulting from the operation of the ICL facility for the year 1996, the first year of operation. The figures shown in Table 7 3 0-1 are based on those calculations previously presented in Tables 7 1 2-2 and 7 2 2-1. This table illustrates a significant net benefit to Martin County. As shown on Table 7 3 0-1, the net benefit to Martin County is projected to be \$3,747,013 in 1996, the first year of operation of the ICL facility.

In summary, primarily because of additional revenues associated with its operation, the ICL facility is expected to have net positive economic benefits for Martin County in 1996 and will continue to provide positive economic benefits to the county over the 30-year life of the facility.

Table 7 3 0-1
BENEFIT/COST SUMMARY FOR MARTIN COUNTY IN 1996 AS
ASSOCIATED WITH THE OPERATION OF THE ICL PROJECT

	Martin County (\$)
Benefits	4,483,349
Costs	736,336
Net benefit	3,747,013

Source ECT, 1990

REFERENCES

Section 7 0

Bureau of Economic and Business Research Florida Statistical Abstract, University of Florida, Gainesville, FL 1988

U S Department of Commerce Personal Communication 1988

Indiantown Cogeneration Limited Personal Communication 1990

Section 7 1 2

Bureau of Economic and Business Research, Florida Statistical Abstract, University of Florida, Gainesville, FL 1988

Florida Department of Labor and Employment Security, Bureau of Labor Market Information Quarterly County Reports on Employment and Wages Covered Under the Florida Unemployment Compensation Law and Unemployment for Federal Employees, Martin County, Florida 1990

Martin County Board of Education, Martin County, Florida 1990

U S Department of Commerce, Unpublished RIMS II Output for Martin County, Florida U S Department of Commerce, Bureau of Economic Analysis, Washington, DC 1989

Section 7 2 1

Indiantown Cogeneration Limited Personal Communication 1990

Kimley-Horn Indiantown Cogeneration Project, Construction Traffic Analysis (SCA Section 10 10) 1990

Martin County Comprehensive Growth Management Plan (Adopted) Martin County Growth Management Department 1990

Section 7 2 2

Florida Department of Transportation Martin County Five-Year Work Program 1990-1991 (FY91) Through 1994-1995 (FY95) Fort Lauderdale, FL 1990

Hahn and Company, Inc Indiantown Action Plan Submitted to the Martin County Growth Management Department 1990

Kimley-Horn Indiantown Cogeneration Project, Construction Traffic Analysis
(SCA Section 10 10) 1990

Martin County Comprehensive Growth Management Plan (Adopted) Martin
County Growth Management Department 1990

8 0 SITE AND PLANT DESIGN ALTERNATIVES

The proposed Indiantown Cogeneration, L P plant is designed to generate and export steam to the Caulkins Citrus Processing Facility which is located to the north of the site. It is necessary for a cogeneration plant (steam supplier) to be within a close proximity of the receiving processing facility (steam user), which in this case is the Caulkins Citrus Processing Facility. Therefore, alternative site locations and plant designs are not applicable.

9 0 COORDINATION

The following table lists people within federal, state, regional, and local government agencies who were contacted to provide input to this project

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

Table 9 0-1
**LIST OF CONTACTS WITHIN FEDERAL, STATE, REGIONAL AND LOCAL
 GOVERNMENT AGENCIES CONCERNING INDIANTOWN COGENERATION PROJECT**
 (Page 1 of 8)

Date	Project Rep	Subject	Agency	Contact
5/9/89 5/16/89	Bechtel	Cross Sections of C-59, L63 N&S	COE	J Vearl
5/23/89	Bechtel	S-191 & St Lucie Water Quality Data	SFWMD	B Jones
7/26/89	Bechtel	Operation Procedure of S-191 Structure	SFWMD	J Lane
1/11/90	Bechtel	S-191 Water Level and Flow Data	SFWMD	S Coughanour
1/16/90	Bechtel	Evaporation Data of Okeechobee Field Station	SFWMD	T Morris
2/23/90	Bechtel	Rainfall/Evaporation Data - Martin and Okeechobee Counties	SFWMD	E Gallego
4/6/90	ICL	Project Introduction	FDER	H Oven
4/17/90	ICL	Water Resources	SFWMD	S Coughanour
4/26/90	Bechtel	Ash Rules (draft)	DER	J Reese
4/26/90	Bechtel	UIC List of Contractors	DER	K Conrardy
5/10/90	Bechtel	UIC Permit Process	DER	A Mueller

Table 9 0-1
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Date	Project Rep	Subject	Agency	Contact
5/10/90	Bechtel	SFWMD Permit Files	SFWMD	S Coughanour
5/23/90	ICL	PSC Overview of Project	PSC	J Dean
6/7/90	Bechtel	Amendments to PPSA	DER	H Oven
6/7/90	Bechtel	Floridan/Surficial Aquifers	SFWMD	S Coughanour
6/19/90	Bechtel	Use of Caulkins Floridan Aquifer Well	SWFMD	S Coughanour
7/5/90	Bechtel	Air Modeling Protocol	DER	T Rogers
7/6/90	ICL	Water Resources Update	SFWMD	S Coughanour
7/6/90	ICL	S-191 Operations	SFWMD	R Mireau
7/16/90	Bechtel	Pipeline Aerials	DER	H Oven
7/19/90	Bechtel	Canal Modeling	SFWMD	S Lin
7/26/90	Bechtel	S-191 Operations Procedure	SFWMD	J Lane
8/3/90	ICL	BACT Meeting	DER	B Andrews
8/17/90	Bechtel	POS Comments/Aquifers	SWFMD	S Coughanour
8/20/90	Bechtel	Use of FPL's APT	SFWMD	J Giddings

Table 9 0-1
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Date	Project Rep	Subject	Agency	Contact
9/27/90	Bechtel	Field Work in ROW	SFWMD	T Fratz
9/28/90	Bechtel	St Lucie Canal Water Levels	COE	J Vearil
10/4/90	ICL	PUD(i) Pre-Ap Meeting	Martin County	H Epstein
10/8/90	Bechtel	Fire Protection	Martin County	T Seawell
10/8/90	Bechtel	Potable Water Supply	Indiantown Water Co	W Hanna
10/9/90	Bechtel	Groundwater Analyses	SFWMD	G Rawl
10/11/90	GYS	PUD(i) Submittal	Martin County	H Epstein
10/16/90	Bechtel	TC/NS Water Users	SWFMD	P Bomgardner
10/16/90	Bechtel	Impact Analysis	SFWMD	S Coughanour
10/18/90	Bechtel	Deepwell Injection Permit	DER	H Oven
10/23/90	Bechtel	Deepwell Injection TAC Meeting	DER	A Mueller
11/2/90	GYS	PUD(i) Sufficiency	Martin County	H Epstein
11/6/90	ICL	Surface Water Analysis	DER	S Coughanour
7/10/90	ECT	Future land use designations and maps, status of comprehensive plan	Martin County Growth Management Department	C Honig

Table 9 0-1
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Date	Project Rep	Subject	Agency	Contact
7/10/90	ECT	Zoning designations and maps	Martin County Zoning Department	N Ihle
7/11/90	ECT	Regional policy plan	Treasure Coast Regional Planning Council	B St Hill
7/11/90	ECT	Future land use designations and maps, status of comprehensive plan	Martin County Growth Management Department	C Honig
7/16/90	ECT	Labor force and employment	Florida Department of Labor and Employment Security	S Connell
7/16/90	ECT	Population growth, housing statistics, building activity, income	University of Florida, Bureau of Economic and Business Research	C McLarty
7/16/90	ECT	Future land use designations and maps, status of comprehensive plan	Martin County Growth Management Department	C Honig
7/16/90	ECT	School and student characteristics	Martin County School Board	R Madison
7/16/90	ECT	Educational characteristics and teacher-to-student ratios	Florida Department of Education, Division of Public Schools	L Harageones

Table 9 0-1
(Page 5 of 8)

Date	Project Rep	Subject	Agency	Contact
7/16/90	ECT	Revenues and expenditures	Florida Department of Banking and Finance, Bureau of Local Government Financing	H Foy
7/17/90	ECT	Sheriff's department characteristics	Martin County Sheriff's Department	Sgt Bates
7/18/90	ECT	Capacity of public utilities	Martin County Utilities Department	E Falken
7/18/90	ECT	Capacity of landfill	Palm City Landfill	L Yates
7/19/90	ECT	Medical facilities characteristics	Martin County Medical Society	C Coffee
7/19/90	ECT	Martin County medical facilities characteristics	Department of Health and Rehabilitative Services, Monitoring Department	R Pannell
7/25/90	ECT	Aerial photographs	Martin County Property Appraiser's Office	D Souza
7/25/90	ECT	Aerial photographs	Okeechobee County Property Appraiser's Office	L Chandler
7/30/90	ECT	Population growth, housing statistics, building activity, income	University of Florida, Bureau of Economic and Business Research	C McLarty

Table 9 0-1
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Date	Project Rep	Subject	Agency	Contact
7/30/90	ECT	Population growth, housing statistics, building activity, income	University of Florida, Bureau of Economic and Business Research	C McLarty
8/8/90	ECT	Future land use designations and status of comprehensive plan	Central Florida Regional Planning Council	J Hopper
8/16/90	ECT	PUD(i) requirements	Martin County (Growth Management Department)	D Saskowsky
8/17/90	ECT	Future land use designations and status of comprehensive plan	Central Florida Regional Planning Council	J Hopper
8/29/90	ECT	Wetlands jurisdiction verification	Martin County	M Goralski
9/5/90	ECT	Zoning designation boundaries	Martin County Zoning Department	L Eule
9/10/90	ECT	Zoning designation boundaries	Martin County Zoning Department	L Eule
9/13/90	ECT	Sheriff's department characteristics	Martin County Sheriff's Department	Lt Atchison
9/13/90	ECT	Fire department characteristics	Martin County Fire Department	Chief Billington

**Table 9 0-1
(Page 7 of 8)**

Date	Project Rep	Subject	Agency	Contact
9/18/90	ECT	Zoning maps	Okeechobee County Building and Zoning Department	E Hrapchak
9/26/90	ECT	Revenues and expenditures per capita	Florida Department of Banking and Finance	E Maninero
10/4/90	ECT	Zoning ordinance	Okeechobee County Building and Zoning Department	L Turner
10/4/90	ECT	Future land use designations and status of comprehensive plan	Central Florida Regional Planning Council	J Hopper
10/5/90	ECT	Programmed turnpike improvements	Florida Turnpike Authority	S Daniels
10/5/90	ECT	Programmed roadway improvements in Martin County	Florida Department of Transportation, District 4 Office	M DeRosa
10/15/90	ECT	Future land use designations and status of comprehensive plan	Central Florida Regional Planning Council	J Hopper
10/15/90	ECT	Future land use designations and maps, status of comprehensive plan	Martin County Growth Management Department	C Honig
10/17/90	ECT	County millage rate	Martin County Tax Assessor	L Lyon

Table 9 0-1
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Date	Project Rep	Subject	Agency	Contact
10/19/90	ECT	Impact fees and impact fee ordinances	Martin County Growth Management Department	R Steiner
10/19/90	ECT	Population growth, housing statistics, building activity, income	University of Florida, Bureau of Economic and Business Research	C McLarty
10/19/90	ECT	Average construction wage	Florida Department of Labor and Unemployment Compensation	E McRanie
10/25/90	ECT	Educational state matching funds, per student capital outlay	Martin County School Board	Mr Pearson
11/27/90	ECT	PUD(i) requirements	Martin County (Growth Management Department)	D Saskowsky
11/27/90	ECT	Zoning ordinance	Okeechobee County Building and Zoning Department	L Turner

Source ECT, 1990

10 0 APPENDICES

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10 1 FEDERAL PERMIT APPLICATIONS OR APPROVAL

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- 10 1 5 PSD Applications/Permits
- 10 1 6 Coastal Zone Management Certifications
- 10 1 7 FAA Permit Application

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- 10 2 1 Excerpts From Chapter 33 Zoning of the Martin County Code
- 10 2 2 Excerpts From the Martin County Land Development Code
 - 10 2 2 1 Okeechobee County Zoning Ordinances
- 10 2 3 Article VIII of Chapter 23 of the Martin County Code
- 10 2 4 Resolution Number 86 8 34 of the Board of County Commissioners, Martin County, Florida
- 10 2 5 Excerpts From the Okeechobee County Zoning Ordinance
 - Section 7 9 - Essential Services
- 10 2 6 Excerpts From the Okeechobee County Zoning Ordinance
 - Schedule of District Regulations

10 3 LAND USE PLAN DESCRIPTIONS

- 10 3 1 Excerpts From the Martin County Comprehensive Growth Management Plan
- 10 3 2 Excerpts from the Martin County Comprehensive Growth Management Plan Pertaining to Goal K
- 10 3 3 Excerpts From the Martin County Comprehensive Growth Management Plan Pertaining to Goal M
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1980, Pertaining to Land Use Element
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- 10 5 MONITORING PROGRAMS
 - 10 5 1 Geology/Subsurface Hydrology
 - 10 5 1 1 Detailed Site Lithologic Description
 - 10 5 1 2 Subsurface Hydrologic Data for the Site
 - 10 5 1 3 Groundwater Impacts
 - 10 5 1 4 Impacts on Water Supplies - Groundwater
 - 10 5 1 5 Bathymetric Studies
 - 10 5 1 6 Aquatic Biology Studies
- 10 6 PROGRAMMED TRANSPORTATION IMPROVEMENTS
 - 10 6 1 Martin County
 - 10 6 1 1 Martin County County Road Elements of the Capital
Improvements Element of the Comprehensive Growth
Management Plan
 - 10 6 1 2 FDOT Martin County Five-Year Work Program, 1990-
1991 (FY 91) Through 1994-1995 (FY 95)
 - 10 6 1 3 Florida Turnpike Authority (Martin County)
- 10 7 SOUTH FLORIDA WATER MANAGEMENT DISTRICT LAND USE AND
LAND COVER CLASSIFICATION CODE
- 10 8 CULTURAL RESOURCE ASSESSMENT SURVEY OF THE PROPOSED
MARTIN COUNTY POWER PLANT SITE AND PIPELINE RIGHT-OF-WAY
- 10 9 PLAN WATER REQUIREMENTS AVAILABILITY STUDY FROM TAYLOR
CREEK/NUBBIN SLOUGH
- 10 10 TRAFFIC ANALYSIS
- 10 11 UIC PERMIT APPLICATION
- REFERENCES

10.1

10 1 FEDERAL PERMIT APPLICATIONS OR APPROVAL

10 1 1 316 DEMONSTRATIONS

No 316 demonstrations are required because the wastewater will be discharged into an injection well and the intake structure location, design, construction, and capacity reflect the best available technology

10 1 2 NPDES APPLICATIONS/PERMITS

NPDES permits/applications are not applicable to the Indiantown Cogeneration Project since pollutant discharges are not released to the surface waters

10 1 3 HAZARDOUS WASTE DISPOSAL APPLICATIONS/PERMITS

Since the disposal of hazardous wastes will not occur on site, applications and/or permits are not applicable

10 1 4 SECTION 10 OR 404 APPLICATIONS/PERMITS

Any required Section 10 or 404 application will be provided in early 1991, per discussion with Hamilton Owen, DER Siting Coordinator, on December 14, 1990

10 1 5 PSD APPLICATIONS/PERMITS

A BACT Analysis

B Air Quality Impact Analysis

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

TWIN TOWERS OFFICE BUILDING
2800 BLAIR STONE ROAD
TALLAHASSEE, FLORIDA 32399-2400



BOB MARTINEZ
GOVERNOR
DALE TWACHTMANN
SECRETARY

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE. Power Generation Facility ☒ New ☐ Existing¹

APPLICATION TYPE ☒ Construction ☐ Operation ☐ Modification

COMPANY NAME. Indiantown Cogeneration, Ltd Partnership COUNTY Martin

Identify the specific emission point source(s) addressed in this application (i.e. Lime
Kiln No. 4 with Venturi Scrubber; Peaking Unit No. 2, Gas Fired) See Table I

SOURCE LOCATION Street SR 710 City Indiantown

UTM East 548 019 Km North 2990 692 Km

Latitude 27 ° 2' 20"N Longitude 80 ° 30' 45"W

APPLICANT NAME AND TITLE _____

APPLICANT ADDRESS _____

SECTION I. STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Indiantown Cogeneration, Limited Partnership

I certify that the statements made in this application for a permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permit establishment.

*Attach letter of authorization

Signed _____

Name and Title (Please Type)

Date _____ Telephone No. _____

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that

¹ See Florida Administrative Code Rule 17-2.100(57) and (104)

the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed _____

Name (Please Type)

Company Name (Please Type)

Mailing Address (Please Type)

Florida Registration No. _____ Date: _____ Telephone No. _____

SECTION II: GENERAL PROJECT INFORMATION

- A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

See Attached

- B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction 7/92 Completion of Construction 12/95

- C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

	Capital	O & M
Selected Non-Catalytic Reduction System	\$ 8,108,000	\$ 2,939,400
Spray Dryer Absorber System	\$32,271,000	\$20,145,000/year
Baghouse	\$20,524,000	\$ 5,999,000/year

- D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

No previous permits have been issued

TABLE I

INDIANTOWN COGENERATION EMISSION SOURCES

Main Boiler Stack

Auxiliary Boiler Stack

Coal Handling Areas

Ash Handling Areas

Cooling Tower

Lime Handling Areas

II.A. The Indiantown Cogeneration Plant will generate 330 MWe (net) of electrical power (with zero export process steam) using a pulverized coal reheat boiler and an extraction-condensing turbine generator. During the period from November to June, approximately 225,000 pounds per hour of export process steam can be supplied to the Caulkins citrus processing plant.

The pollution control equipment for the project is noted below. The project will result in full compliance with all applicable federal, state and local air quality regulations.

Pollution Control Equipment

Selected Non-Catalytic Reduction System

Spray Dryer Absorber System

Baghouse

Requested permitted equipment operating time hrs/day 24, days/wk 7, wks/yr 52,
if power plant, hrs/yr 8760, if seasonal, describe _____

F. If this is a new source or major modification, answer the following questions
(Yes or No)

- 1 Is this source in a non-attainment area for a particular pollutant? No
 - a If yes, has "offset" been applied? N/A
 - b If yes, has "Lowest Achievable Emission Rate" been applied? N/A
 - c If yes, list non-attainment pollutants N/A
 - 2 Does best available control technology (BACT) apply to this source?
If yes, see Section VI Yes
 - 3 Does the State "Prevention of Significant Deterioration" (PSD)
requirement apply to this source? If yes, see Sections VI and VII Yes
 - 4 Do "Standards of Performance for New Stationary Sources" (NSPS)
apply to this source? Yes
 5. Do "National Emission Standards for Hazardous Air Pollutants"
(NESHAP) apply to this source? No
- H Do "Reasonably Available Control Technology" (RACT) requirements apply
to this source? No
- a If yes, for what pollutants? N/A
 - b If yes, in addition to the information required in this form,
any information requested in Rule 17-2 650 must be submitted

Attach all supportive information related to any answer of "Yes" Attach any justifi-
cation for any answer of "No" that might be considered questionable

Refer to PSD Permit Application Documentation

III. C.

Name of Contaminant	Emission		Allowed Emission Rate	Allowable Emission #/Hr.	Potential Emission		Relate to Flow Dia T/Yr. (Loc.#)
	Max. #/Hr.	Actual T/Yr.			#/Hr.	T/Yr.	
=====							
Main Stack (continued):							
Lead	0.064	0.28	None	None	3.19	13.97	12
Beryllium	0.0094	0.041	None	None	0.46	2.03	12
Mercury	0.040	0.172	None	None	0.08	0.34	12
Arsenic	0.175	0.765	None	None	5.81	25.47	12
Fluorides	5.09	22.3	None	None	25.38	111.14	12
Auxiliary Boiler:							
Sulfur Dioxide	17.8	8.9	0.80	27.3	17.8	8.9	11
Particulates	1.4	0.7	0.03	10.2	1.4	0.7	11
Nitrogen Dioxide	68.2	34.1	0.3	102.5	68.2	34.1	11
Carbon Monoxide	47.3	23.7	None	None	47.3	23.7	11
VOC	0.63	0.32	None	None	0.63	0.32	11
Fugitive Emissions:							
Particulate	0.34	1.49	None	None	34.5	151.1	1
Particulate	0.696	3.05	None	None	3.78	16.6	2
Particulate	0.0007	0.0031	None	None	0.352	1.54	3
Particulate	0	0	None	None	0	0	4
Particulate	0.288	1.26	None	None	144.4	632.3	5
Particulate	0.001	0.0044	None	None	0.51	2.26	6
Particulate	0.209	0.915	None	None	104.4	457.3	7
Particulate	0.059	0.26	None	None	29.4	128.8	8
Particulate	0.0012	0.053	None	None	6	26.3	9
Particulate	0.0012	0.0053	None	None	0.6	2.63	10
Particulate	0.0024	0.011	None	None	1.2	5.26	13
Salt	43	188	None	None	43	188	15

III. C

INDIANTOWN FUGITIVE DUST EMISSIONS TABLE

SOURCE NUMBER	EMISSION POINT	CONTROL METHOD	DISCHARGE FLOW CFM	DISCH ELEV ABOVE GRADE FT
1	COAL UNLOAD AREA	FABRIC FILTER	30000	25
2	STORAGE/TRANS TOWER AREA	FABRIC FILTER	30000	60
3	COAL RECLAIM AREA	FABRIC FILTER	20000	25
4	EMERG RECLAIM AREA	FABRIC FILTER	20000	25
5	CRUSHER TOWER AREA	FABRIC FILTER	10000	75
6	SILO BAY AREA	FABRIC FILTER	10000	180
7	ASH SILO AREA	FABRIC FILTER FABRIC FILTER	3000 5000	120 120
8	ASH RECYCLE SILO	FABRIC FILTER	3000	75
9	LIME SILO AREA	FABRIC FILTER	3000	120
10	LIME SLURRY PLANT	FABRIC FILTER	3000	60
	SODA ASH SILO	FABRIC FILTER	3000	75

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No)	Contaminant	Efficiency	Range of Particles Size Collected (in microns) (If applicable)	Basis for Efficiency (Section V Item 5)
Selected Non-Catalytic Reduction System	Nitrogen Oxides	37%	N/A	Vendor Quote
Spray Dryer Absorber	Sulfur Dioxide	95%	N/A	Vendor Quote
Baghouse	Particulate	99+%	> 0.1	Vendor Data

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max /hr	
Coal	290,000 #/hr	-	3422
Natural Gas	350,000 Ft ³ /hr	-	358
Fuel Oil	2500 gal/hr	-	341.6

*Units: Natural Gas--MMCF/hr, Fuel Oils--gallons/hr, Coal, wood, refuse, other--lbs/hr

Fuel Analysis: Coal

Percent Sulfur 2% Percent Ash 12%
 Density: 45 #/Ft³ lbs/gal Typical Percent Nitrogen 1.16
 Heat Capacity: 11,800 (min) BTU/lb -- BTU/gal

Other Fuel Contaminants (which may cause air pollution):

F. If applicable, indicate the percent of fuel used for space heating. N/A

Annual Average _____ Maximum _____

G. Indicate liquid or solid wastes generated and method of disposal

Attached

H Emission Stack Geometry and Flow Characteristics (Provide data for each stack)

Main Boiler Stack Stack Height 495 ft Stack Diameter 16 ft
 Gas Flow Rate: 1123665 ACFM 978063 DSCFM Gas Exit Temperature 140 °F
 Water Vapor Content 15 % Velocity 100 FPS
 Auxiliary Boiler Stack (see attached table)

SECTION IV: INCINERATOR INFORMATION - N/A

Type of Waste	Type I (Plastics)	Type II (Rubbish)	Type III (Refuse)	Type IV (Garbage)	Type V (Pathological)	Type VI (Liq & Gas By-prod)	Type VII (Solid By-prod)
Actual lb/hr Incinerated							
Uncontrolled (lbs/hr)							

Description of Waste _____

Total Weight Incinerated (lbs/hr) _____ Design Capacity (lbs/hr) _____

Approximate Number of Hours of Operation per day _____ day/wk _____ wks/yr _____

Manufacturer _____

Date Constructed _____ Model No _____

	Volume (ft) ³	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber					
Secondary Chamber					

Stack Height _____ ft Stack Diameter _____ Stack Temp _____

Gas Flow Rate _____ ACFM _____ DSCFM* Velocity _____ FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air

Type of pollution control device ☐ Cyclone ☐ Wet Scrubber ☐ Afterburner

☐ Other (specify) _____

III. G. Liquid and Solid Waste Generation and Disposal

Liquid Wastes

Disposal

Sanitary Wastes
Wastewater

Sent to Indiantown Municipal System
Treated, then reused in process
where possible remainder to deep
well injection

Spent Solvents
Coal Pile Runoff/Leachate

Off-site disposal
Treated and sent to cooling tower

Solid Wastes

Office Wastes
Air Filters
Resin Beds
Bottom Ash

Off-site disposal
Off-site disposal
Off-site disposal

Fly Ash and Reaction Products

Off-site disposal at coal mine
Off-site disposal at coal mine

III. H

INDIANTOWN

AUXILIARY BOILER STACK PARAMETERS

	AUXILIARY BOILER	
	No 2 FUEL OIL	NATURAL GAS
EXHAUST STACK TEMP	500°F	480°F
STACK EXIT VELOCITY	103 FT/SEC	102 FT/SEC
STACK HEIGHT	90 FT	90 FT
STACK EXIT DIAMETER	5 5 FT	5 5 FT

Brief description of operating characteristics of control devices _____

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc) _____

NOTE Items 2, 3, 4, 6, 7, 8, and 10 in Section V must be included where applicable

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application

- N/A 1. Total process input rate and product weight -- show derivation [Rule 17-2 100(127)]
2. To a construction application, attach basis of emission estimate (e g , design calculations, design drawings, pertinent manufacturer's test data, etc.) and attach proposed methods (e g , FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made later
3. Attach basis of potential discharge (e g , emission factor, that is, AP42 test) Refer to PSD Permit Application Documents
4. With construction permit application, include design details for all air pollution control systems (e g , for baghouse include cloth to air ratio, for scrubber include cross-section sketch, design pressure drop, etc.) Refer to PSD Permit Application Documents
5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3 and 5 should be consistent. actual emissions = potential (1-efficiency) Refer to PSD Permit Application Documents
6. An 8 1/2" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained. Attached (Fig. 3 4 4-1)
7. An 8 1/2" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map) Attached (Fig. 2 1 0-1)
8. An 8 1/2" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram. Attached (Fig. 3 2-4)

ER Form 17-1 202(1)

Effective November 30, 1982

9. The appropriate application fee in accordance with Rule 17-4 05 The check should be made payable to the Department of Environmental Regulation
10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

- A. Are standards of performance for new stationary sources pursuant to 40 C F R Part 60 applicable to the source?

☒ Yes ☐ No 40 CFR 60 Subpart Da

Contaminant

Rate or Concentration

See tables in PSD Permit Application

Documents

- B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy)

☐ Yes ☒ No

Contaminant

Rate or Concentration

Refer to PSD Permit Application Documents

- C. What emission levels do you propose as best available control technology?

Contaminant

Rate or Concentration

See Table in PSD Permit Application

Documents

- D Describe the existing control and treatment technology (if any)

1. Control Device/System

2. Operating Principles

3. Efficiency *

4 Capital Costs

*Explain method of determining

5 Useful Life

6 Operating Costs

7 Energy

8 Maintenance Cost

9 Emissions

Contaminant

Rate or Concentration

10 Stack Parameters

a	Height	ft	b	Diameter	ft
c	Flow Rate	ACFM	d	Temperature	°F
e	Velocity	FPS			

E Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary) Refer to PSD Permit Application Documents

1

a.	Control Device	b	Operating Principles
c.	Efficiency ¹	d	Capital Cost
e	Useful Life	f	Operating Cost
g	Energy ²	h	Maintenance Cost
i	Availability of construction materials and process chemicals		
j.	Applicability to manufacturing processes		
k.	Ability to construct with control device, install in available space, and operate within proposed levels		

2

a	Control Device	b	Operating Principles
c	Efficiency ¹	d	Capital Cost
e	Useful Life	f	Operating Cost
g	Energy ²	h	Maintenance Cost
i.	Availability of construction materials and process chemicals		

¹Explain method of determining efficiency

²Energy to be reported in units of electrical power - KWH design rate

j Applicability to manufacturing processes

k Ability to construct with control device, install in available space, and operate within proposed levels

3

a Control Device

b Operating Principles

c Efficiency ¹

d Capital Cost

e Useful Life

f Operating Cost

g Energy ²

h Maintenance Cost

i Availability of construction materials and process chemicals

j Applicability to manufacturing processes

k Ability to construct with control device, install in available space, and operate within proposed levels

4

a Control Device

b Operating Principles

c. Efficiency ¹

d Capital Costs

e. Useful Life

f Operating Cost

g Energy ²

h Maintenance Cost

i Availability of construction materials and process chemicals

j Applicability to manufacturing processes

k. Ability to construct with control device, install in available space, and operate within proposed levels

F Describe the control technology selected See BACT for PSD Permit Application

1 Control Device

2 Efficiency ¹

3 Capital Cost

4 Useful Life

5 Operating Cost

6 Energy ²

7 Maintenance Cost

8 Manufacturer

9 Other locations where employed on similar processes

a (1) Company

(2) Mailing Address

(3) City

(4) State

¹Explain method of determining efficiency

²Energy to be reported in units of electrical power - KWH design rate

(5) Environmental Manager

(6) Telephone No

(7) Emissions ¹

Contaminant

Rate or Concentration

(8) Process Rate ¹

b (1) Company

(2) Mailing Address

(3) City

(4) State

(5) Environmental Manager

(6) Telephone No

(7) Emissions ¹

Contaminant

Rate or Concentration

(8) Process Rate ¹

10 Reason for selection and description of systems

¹Applicant must provide this information when available Should this information not be available, applicant must state the reason(s) why

SECTION VII - PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data Air quality impact below the level requiring monitoring (see attached PSD application documents)

1 _____ no sites _____ TSP _____ () SO₂* _____ Wind spd/dir

Period of Monitoring _____ / _____ / _____ to _____ / _____ / _____
month day year month day year

Other data recorded _____

Attach all data or statistical summaries to this application

*Specify bubbler (B) or continuous (C)

2 Instrumentation, Field and Laboratory

a Was instrumentation EPA referenced or its equivalent? ☐ Yes ☐ No

b Was instrumentation calibrated in accordance with Department procedures?

☐ Yes ☐ No ☐ Unknown

B Meteorological Data Used for Air Quality Modeling

1 5 Year(s) of data from 1 / 1 / 82 to 12 / 31 / 86
month day year month day year

2 Surface data obtained from (location) West Palm Beach, FL

3 Upper air (mixing height) data obtained from (location) West Palm Beach, FL

4 Stability wind rose (STAR) data obtained from (location) West Palm Beach, FL

C Computer Models Used

1 ISCST (version 88348) Modified? If yes, attach description

2 (no modifications) Modified? If yes, attach description

3 _____ Modified? If yes, attach description

4 _____ Modified? If yes, attach description

Attach copies of all final model runs showing input data, receptor locations, and principle output tables Attached to DER AQ submittal only

D Applicants Maximum Allowable Emission Data

Pollutant (Main Stack)	Emission Rate
TSP	<u>78</u> grams/sec
SO ₂	<u>73</u> grams/sec

E Emission Data Used in Modeling

Attach list of emission sources Emission data required is source name, description of point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time See PSD Application Documents

F Attach all other information supportive to the PSD review See PSD Application Documents

G Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.) Include assessment of the environmental impact of the sources

see BACT

H Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology

see BACT

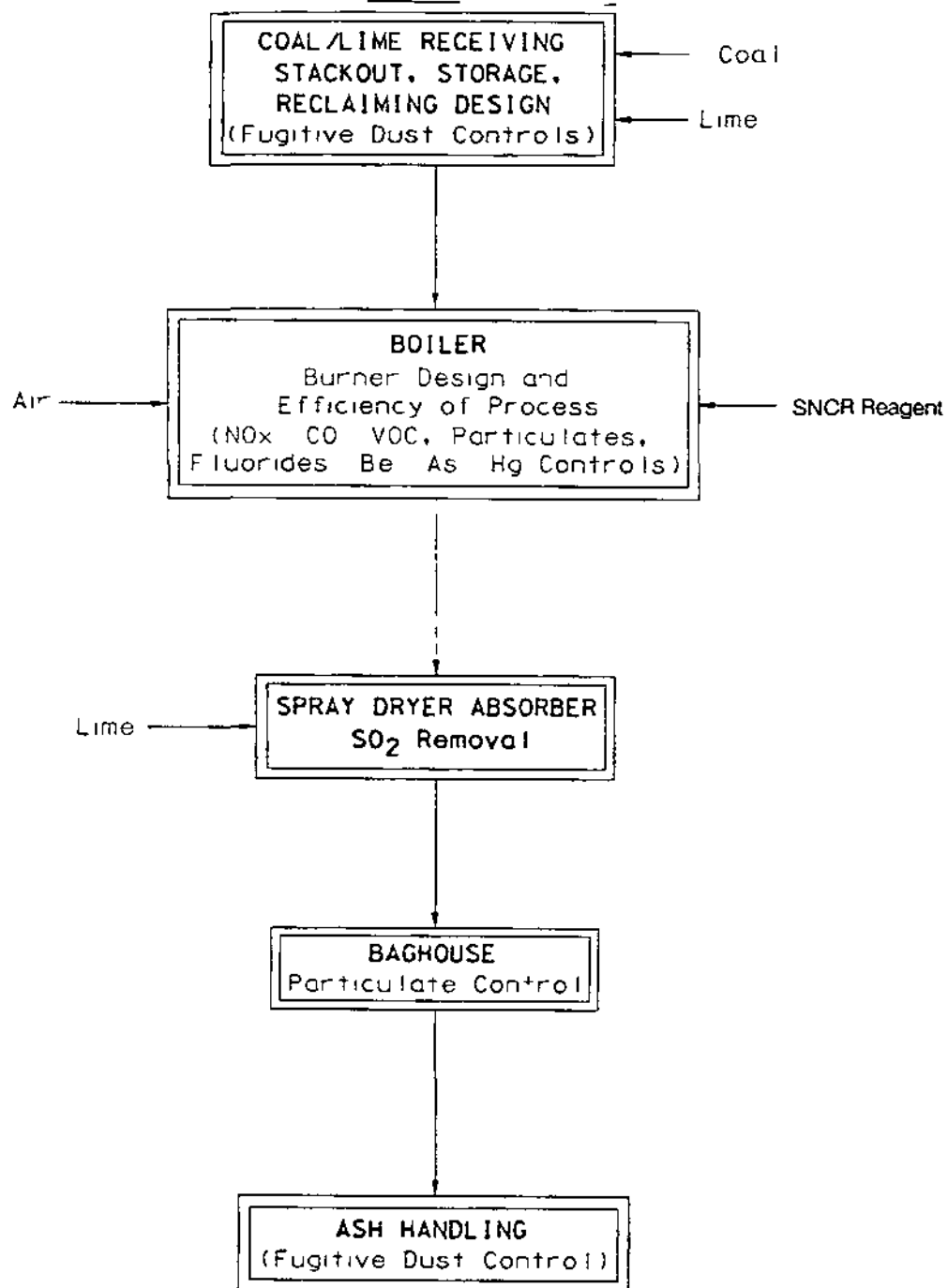


Figure 3 4 4-1

AIR EMISSIONS CONTROL EQUIPMENT DIAGRAM

Source Bechtel 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L.P.

Figure 3 2 0-4

EMISSION POINT DIAGRAM

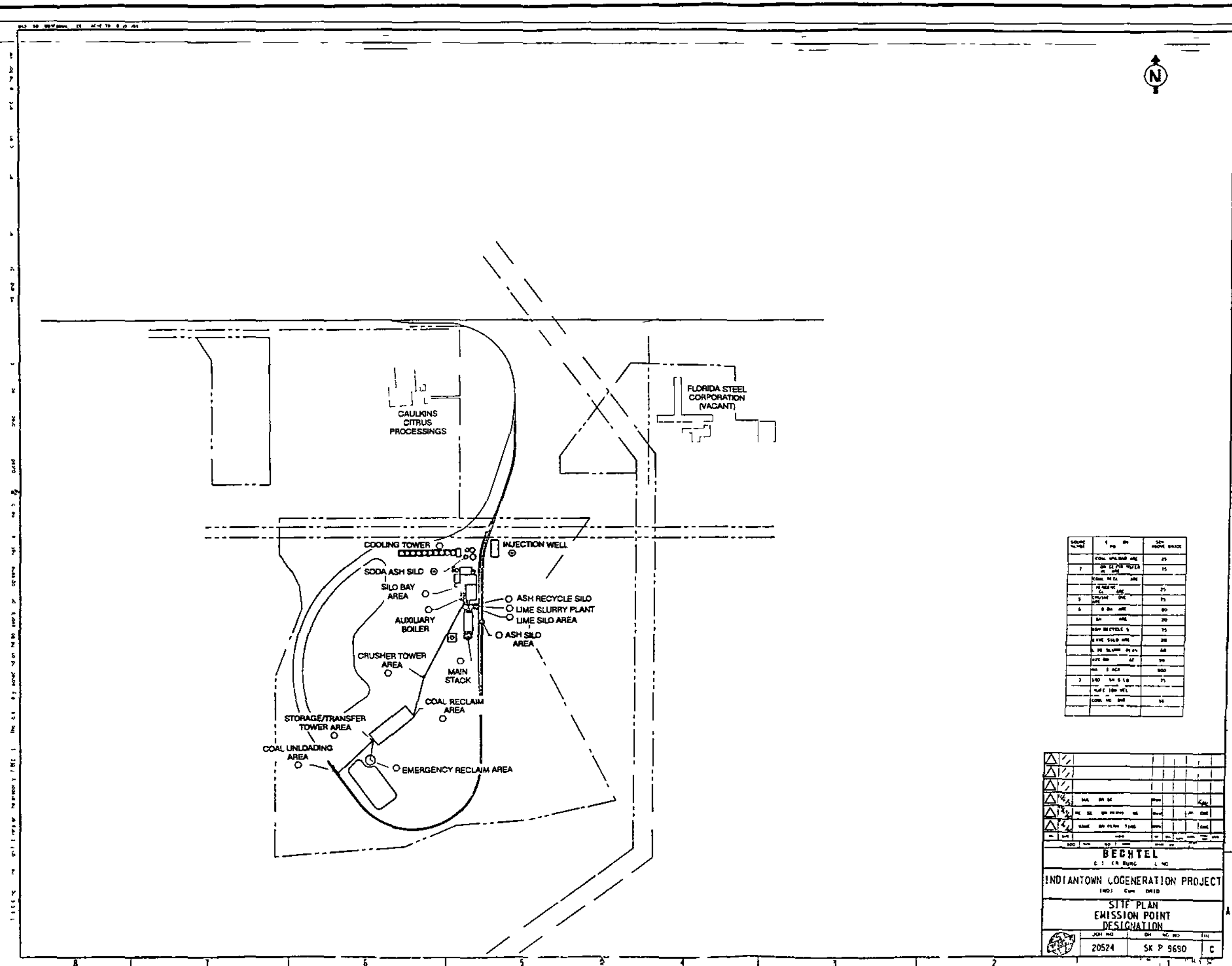


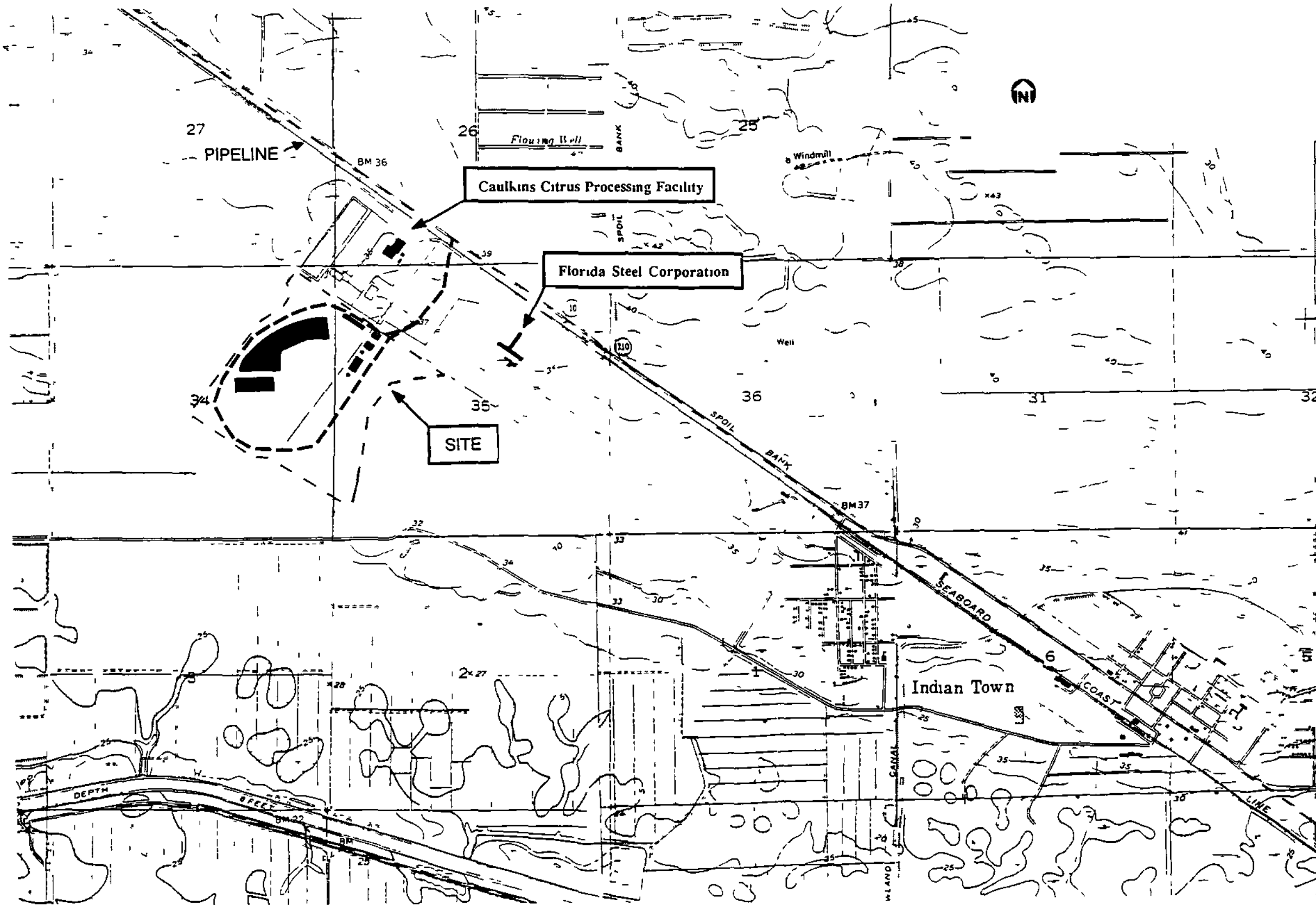
Figure-2 10-1

SITE VICINITY PLAN

LEGEND

--- SITE BOUNDARY

Scale 1 Inch = 2000 Ft



Source Bechtel 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L.P

A BACT Analysis

**INDIANTOWN
COGENERATION, L.P.**

**Indiantown Cogeneration
Facility**

ENSR

BACT Analysis

ENSR Consulting and Engineering

December 1990

Document Number 5402-008



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**INDIANTOWN
COGENERATION, L.P.**

**Indiantown Cogeneration
Facility**

BACT Analysis

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1 0 INTRODUCTION

1 1 Project Description

PG&E/Bechtel Generating Company is proposing to install and operate a coal-fired cogeneration facility near Indiantown FL capable of generating 330 net megawatts (MW) of power from a PC boiler-based generating plant. During the period from November to June, 225,000 lb/hr of process steam will be supplied to Caulkins Citrus Processing, during these periods the plant will supply a nominal 310 MW of electrical power to the local utility grid.

Major equipment for the facility will consist of a pulverized coal boiler, an extraction-condensing turbine electrical power generator, air pollution control equipment, a water-cooled surface condenser, boiler feedwater systems (including condensate and feedwater pumps, feedwater heaters and a deaerator), a circulating water system (including circulating water pumps, a mechanically-induced draft cooling tower, a water supply pipeline, and a water storage pond), coal unloading and storage facilities, ash handling equipment, water treatment facilities, an auxiliary fuel-oil or natural gas fired boiler, as well as plant support equipment including HVAC, fire protection, plant air, potable water and sanitary sewer lines.

The main boiler heat input at full load is estimated at 3,422 MMBtu/hr. The heat input of the auxiliary boiler firing #2 fuel oil is estimated at 342 MMBtu/hr (358 MMBtu/hr firing natural gas). The auxiliary boiler will operate an estimated 1,000 hours per year.

The flue gas cleanup system for the PC boiler will consist of spray dryer absorbers (SDAs) for desulfurization and acid gas control, and a baghouse for particulate matter (including trace metals) control.

Flue gas from the air heater will enter the two 50-percent capacity SDAs, where it will be humidified and cooled by spraying with lime slurry. Simultaneously, the flue gas will provide drying energy to the atomized slurry. The cooled gas, along with the entrained reaction products and fly ash, will flow to the fabric filter where solids will be separated from the gas.

The system will use lime (calcium hydroxide) slurry as the absorbing medium. Pebble lime will be slaked in the lime preparation system, diluted and stored in the lime feed tanks. Lime slurry will be pumped from the feed tank to the agitated atomizer head tank, from which the slurry will be pumped to the absorbers.

Lime will be delivered to the site by rail or self-unloading truck and stored in a totally enclosed structure to eliminate fugitive emissions

Flue gas from the FGD system will enter the baghouse through an inlet manifold, which will distribute the gas to the bag filter compartments. Gas will pass through the fabric of the bags from the inside to the outside, collected particulate will be retained on the inside surface of the bags. When the particulate buildup on the surface of the bags produces a preset flue gas pressure drop, an automatic reverse-air cleaning cycle will be initiated.

Hoppers below the bags will collect the particulate released from the bags during the cleaning cycle. A pneumatic transfer system will transport the particulate ash from the hoppers to the ash storage silo, in preparation for off site disposal.

1.2 Emission Estimates

The facility will be an emission source of nitrogen oxides, sulfur dioxide (SO₂), particulate matter (PM), carbon monoxide (CO), and unburned hydrocarbons (UBHC's) and other regulated pollutants. Peak hourly and annual average emission rates are shown in Table 1-1. Total facility emission rates are shown in Table 1-2.

1.3 Proposed BACT

1.3.1 PC Boiler

For the pulverized coal boiler, the proposed BACT level for NO_x is 0.17 lb/MMBtu, which will be achieved through the use of Selective Non-Catalytic Reduction (SNCR) and advanced combustion controls. The proposed BACT level of SO₂ is 0.17 lb/MMBtu, which will be achieved through the use of lime spray drying. The proposed BACT for particulate matter is 0.018 lb/MMBtu, which will be achieved with a fabric filter. For CO and VOC, the proposed BACT levels are 0.11 and 0.0036 lb/MMBtu, respectively, achieved through advanced combustion controls. For beryllium, mercury and arsenic, the proposed BACT levels are 2.73×10^{-6} , 11.4×10^{-6} , and 51.1×10^{-6} lb/MMBtu, respectively. Control of particulate matter through fabric filtration will simultaneously achieve control of beryllium and arsenic, while control of SO₂ with spray drying will also control mercury emissions.

TABLE 1-1
FACILITY EMISSION RATES

<u>Pollutant</u>	<u>lb/MMBtu</u>	<u>Full Load 100% Capacity</u>	
		<u>(lb/hr)</u>	<u>(ton/yr)</u>
PC BOILER			
Nitrogen Oxides	0.17	582	2549
Carbon Monoxide	0.11	376	1647
Hydrocarbons	0.0036	12.3	54
Particulate Matter	0.018	61.6	270
Sulfur Dioxide	0.17	582	2549
Lead	18.7×10^{-6}	0.064	0.28
Beryllium	2.73×10^{-6}	0.0093	0.041
Mercury	11.4×10^{-6}	0.039	0.172
Arsenic	51.1×10^{-6}	0.175	0.765
AUXILIARY BOILER			
(based on #2 oil firing)			
Nitrogen Oxides	0.20	68.4	34.2
Carbon Monoxide	0.14	47.3	23.7
Hydrocarbons	0.0018	0.63	0.31
Particulate Matter	0.0041	1.4	0.7
Sulfur Dioxide	0.052	17.8	8.9
Lead	10.5×10^{-5}	3.6×10^{-2}	1.8×10^{-2}
Beryllium	12.0×10^{-8}	4.1×10^{-5}	2.0×10^{-5}
Mercury	149×10^{-8}	5.1×10^{-4}	2.6×10^{-4}
Arsenic	19.9×10^{-6}	6.8×10^{-3}	3.4×10^{-3}

TABLE 1 2
TOTAL FACILITY EMISSIONS

	<u>Annual Tons</u>	<u>PSD Significance</u>
Nitrogen Oxides	2549	40
Carbon Monoxide	1647	100
Hydrocarbons	54	40
Particulate Matter	270	25
Sulfur Dioxide	2549	40
Lead	0 28	0 6
Beryllium	0 041	0 0004
Mercury	0 172	0 1
Arsenic	0 765	0

1 3 2 Auxiliary Boiler

For the #2 fuel oil- and natural gas-fired auxiliary boiler, the proposed BACT level for NO_x is 0.2 lb/MMBtu, achieved through the use of low NO_x burners. The proposed BACT levels for SO_2 and particulate matter are 0.052 and 0.0041 lb/MMBtu, respectively, achieved using very low sulfur fuels. For CO and VOC, the proposed BACT levels are 0.14 and 0.0018 lb/MMBtu, achieved through the use of combustion controls. The proposed BACT levels for beryllium, mercury and arsenic from the auxiliary boiler are 12.0×10^{-6} , 149×10^{-6} , and 19.9×10^{-6} lb/MMBtu, respectively. Control of particulate matter emissions through low sulfur fuel firing will also simultaneously control emissions of these trace elements.

2.0 BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS - METHODOLOGY

2.1 Introduction

The Prevention of Significant Deterioration (PSD) rules of the Florida DER require a determination of Best Available Control Technology (BACT) for each regulated pollutant potentially emitted from a new or modified major stationary source in excess of the emission significance levels in Table 1-2. Based on the emission estimates shown in Section 1.2, the proposed cogeneration facility is subject to BACT with respect to nitrogen oxides (NO_x), carbon monoxide (CO), hydrocarbons (VOC), particulate matter (PM₁₀), sulfur dioxide (SO₂), beryllium, arsenic, mercury, and radionuclides.

BACT is defined in the Florida Air Pollution Rules as

"An emission limitation, including a visible emissions standard, based on the maximum degree of reduction of each pollutant emitted which the Department, on a case by case basis, taking into account energy, environmental and economic impacts, and other costs, determines is achievable through application of production processes and available methods, systems and techniques (including fuel cleaning or treatment or innovative fuel combustion techniques) for control of each such pollutant."

The BACT requirements are intended to insure that a proposed facility will incorporate control systems that reflect the latest techniques used in a particular industry, allow for future growth in the vicinity of the proposed facility, and comply with National Ambient Air Quality Standards. Compliance with New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP), or state regulations may be considered application of BACT. Nevertheless, an evaluation of the air pollution control techniques and systems is required, taking into account energy, environmental and economic impacts. This analysis may require the documentation of performance levels, technical limitations, and the materials, energy, and economic penalties associated with the technically achievable alternative control systems, as well as the environmental benefits derived from these systems.

2.2 Cost Determination Methodology

An economic analysis of certain BACT alternatives may have to be performed, which compares their capital and operating costs in terms of cost effectiveness, i.e. dollars per ton of pollutant removed.

In this analysis, both capital and annual costs are analyzed. Capital costs include both the initial cost of various components intrinsic to the complete control system (the actual control technology hardware reactors, piping, rotating equipment, instrumentation, monitoring equipment, and supports) and installation costs. The annual operating costs consist of the financial requirements to operate the control system on an annual basis, including overhead, maintenance, labor, raw materials, and utilities.

This BACT analysis utilizes the cost estimating methodology outlined in the most recent EPA Guidance document on the subject, the OAQPS Control Cost Manual (EPA 1990).

2.2.1 Capital Costs

A number of methods with varying degrees of accuracy are available for estimating capital costs. The estimating technique used in this analysis is based on a factored method of determining direct and indirect installation costs. This technique is a modified version of the "Lang Method" whereby installation costs are expressed as a function of known equipment costs.

The capital costs estimation factors, shown in Table 2-1, represent the delivered equipment costs for the basic control equipment and all auxiliary equipment, plus direct and indirect installation costs for a turnkey, ready-to-operate installation. These costs are comprised of purchased equipment costs, installation costs, and indirect costs.

Purchased equipment costs represent the delivered cost of the control equipment, auxiliary equipment, and instrumentation. Auxiliary equipment consists of all structural, mechanical, and electrical components required for efficient operation of the device. These include such items as fuel storage and supply piping and exhaust gas ductwork. Auxiliary equipment costs are taken as a straight percentage of the basic control equipment costs, the percentage being based on the average requirements of typical systems and their auxiliary equipment (Vatavuk 1980). Instrumentation and controls are usually not included in the basic equipment cost, typical cost factors range from 10 to 15% of the basic equipment cost, depending on the specific application. The purchased equipment costs, which include the FOB equipment cost, auxiliaries, instrumentation and controls, taxes and freight, are then the basis for determining the direct and indirect installation costs.

Installation costs consist of the direct expenditures for materials and labor for site preparation, foundations, structural steel, erection, piping, electrical, painting, and facilities, and the indirect costs for contractor's engineering and supervision, construction and field expenses, construction fees, contingencies, start-up and performance tests, working capital, and interest during construction. Direct installation costs are expressed as a function of the basic equipment cost,

TABLE 2-1
CAPITAL COST ESTIMATION FACTORS

Direct Costs	
(1) Purchased Equipment	
(a) Basic Equipment	Vendor Data
(b) Auxiliaries	Vendor Data
(c) Instrumentation	0 10(1a)
(d) Structural Support	0 10(1a)
(e) Tax and Freight	0 08(1a -> 1d)
(2) Direct Installation	0 30(1a -> 1e)
Total Direct Cost (TDC)	(1) + (2)
Indirect Costs	
(3) Indirect Installation	
(a) Engineering & Supervision	0 1(TDC)
(b) Construction & Field Expenses	0 1(TDC)
(c) Construction Fee	0 05(TDC)
(d) Contingencies	0 20(TDC)
(4) Other Indirect Costs	
(a) Startup & Testing	0 01(TDC)
(b) Working Capital	30 days O&M Costs
Total Indirect Cost (TIC)	(3) + (4)
Total Capital Costs	TDC + TIC

Source EPA OAQPS (1990)

based on average installation requirements of typical systems. Indirect costs are designated as a percentage of the total direct cost (purchased equipment cost plus the direct installation cost) of the system. The factors are based on the assumption that the installation is performed by an outside contractor and not by plant personnel.

2.2.2 Annualized Costs

Annualized costs, as shown in Table 2-2, are comprised of the direct costs of materials and labor for maintenance and operation, utilities, and waste disposal, and the indirect charges including plant overhead, general administration, taxes, insurance and capital charges.

Labor and material costs for operation and maintenance will vary depending on the system operating mode and the operating time. The maintenance requirement is 5% of the total direct cost. A 40/60 split on labor/materials is applied to the maintenance cost estimate. Overhead is applied to operating and maintenance labor.

Utility costs are based on the estimated total annual consumption and unit costs. The latter were supplied by PG&E/Bechtel and are based on current (second quarter 1990) prices.

Indirect operating costs include the cost of plant overhead, general administration, taxes, insurance, and capital charges. These costs are a direct function of the total capital cost. Capital charges are based on the operation life of the system, interest and capital depreciation rates, and total capital cost. These charges are based on the capital recovery factor (CRF), defined as

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

where i is the annual interest rate and n is the equipment life (years). The estimated equipment life of each alternative is 10 years, and the average interest rate is assumed to be 10%.

2.2.3 Cost Effectiveness

The cost effectiveness of an alternative control approach is based on the annualized cost of the system and its annual pollutant emission reduction. It is determined by dividing the annualized operating cost of an alternative by the tons of pollutant removed by that alternative per year. The basis for determining the uncontrolled tons, control effectiveness, and controlled tons of each pollutant are summarized within each appropriate section of this report.

TABLE 2-2
ANNUALIZED COST FACTORS

Direct Operating Costs

(1) Operating Labor Supervisor	\$20.00/man-hour 15% of operating labor
(2) Maintenance	5% of Direct Costs
(3) Replacement Parts	As Required
(4) Raw Materials	
(a) Ammonia	\$175/Ton
(b) Limestone	25/Ton
(c) Lime	70/Ton
(5) Utilities	
(a) Electricity	\$0.071/kwhr
(b) Water	2.00/1000 gal
(c) Fuel Oil	7.00/MMBtu
(d) Steam Generation	8.00/ton
(6) Disposal Costs	
(a) Spent Catalyst	\$300/yd ³
(b) Solid Waste	\$28.60/ton
(c) Wastewater	0.05/gal

Indirect Operating Costs

(7) Overhead	30% Labor + 12% Maintenance
(8) Property Tax	1% Total Capital Cost
(9) Insurance	1% Total Capital Cost
(10) Administration	2% Total Capital Cost
(11) Capital Recovery	16.3% Total Capital Cost
Total Annualized Cost	(1) -> (11)
Cost Effectiveness	Annual Cost/Tons Removed

2.3 Organization of Analysis

The following sections discuss the applicable alternative control techniques and devices available for the proposed cogeneration facility and provide an analysis of the impacts of these alternative control technologies

3 0 BACT FOR NITROGEN OXIDES

3 1 Introduction

3 1 1 Formation

Nitrogen Oxides (NO_x) are formed in combustion sources by either the thermal oxidation of nitrogen in the combustion air or the reduction and subsequent oxidation of fuel nitrogen. Virtually all NO_x emissions originate as nitric oxide (NO) as both nitrogen and oxygen dissociate into atomic form at the high temperatures within the boiler and then recombine to form NO. A minor fraction of the NO is further oxidized in the flue gas system to form NO_2 . As can be seen from the analysis of the coal proposed for this project (Table 3-1), the fuel will contain some nitrogen compounds. In typical domestic coals, these take the form of aromatic nitriles, pyridines, and pyrroles (EST 1984). However, the bulk of the NO_x formation in this facility will be through thermal oxidation of nitrogen from the combustion air, referred to as thermal NO_x .

The rate of formation of thermal NO_x is a function of the residence time, free oxygen, and peak flame temperature. Therefore, most NO_x control techniques for thermal NO_x are aimed at minimizing one or more of these variables. Other control methods, known as "tail gas" or "back-end" techniques, remove NO_x from the exhaust gas stream.

3 2 NO_x Emissions from PC Boiler

The design and operation of a coal-fired boiler has a significant impact on both the formation and subsequent emission of NO_x , as well as the potential application of add-on back-end NO_x control equipment. The various alternative coal-fired boiler configurations, including PC, circulating fluidized bed (CFB), and spreader stoker, each exhibit unique design and operational characteristics which affect the technical feasibility of certain NO_x control alternatives. Spreader stoker and CFB boilers are not available in the size range being considered for the Indiantown Cogeneration Facility.

3 2 1 Permitted Control Levels

The Federal New Source Performance Standard (NSPS) for coal-fired steam generating units greater than 100 MMBtu/hr heat input is 0.6 lb/MMBtu (40 CFR Part 60, Subpart Db). Appendix A contains a list of the coal-fired boilers included in the EPA's BACT/LAER Clearinghouse. Of the recently-permitted boilers (post-1980), the predominant design listed in

TABLE 3.1
COAL ULTIMATE ANALYSIS

<u>Component</u>	<u>% (As Fired)</u>
Carbon	65.37%
Hydrogen	4.63%
Oxygen	4.69%
Nitrogen	1.16%
Sulfur	2.00%
Chlorine	0.15%
Ash	12.00%
Water	10.00%
TOTAL	100.00%

the Clearinghouse is circulating fluidized bed (CFB) including Applied Energy Services, Scrubgrass Power Corp, Cambria Cogen, Inc, Goodyear United Development, North Branch Energy Partners, Inc, United Development Group, Fort Howard Paper, Northeastern Power Co, Edensburg Power Co, Tennessee Valley Authority, Panther Creek Energy, and GWF Power Systems Co, Inc. Since there are differences between the PC and CFB in terms of operating temperature and NO_x emission rates, these CFB permit limits are not applicable to the proposed PC boiler design.

The alternative NO_x controls which are applicable to the proposed PC boiler include combustion controls, selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR). It should be noted that the latter two alternatives, SNCR and SCR, have not been demonstrated on a US PC boiler firing domestic coals. They have, however, been applied to PC units in Japan and Europe, as detailed further in subsequent sections of this analysis. For the purposes of providing a complete review, they are included in this analysis.

3.2.2 Selective Catalytic Reduction

3.2.2.1 Technical Analysis

The NO_x control alternative that has been demonstrated to achieve the greatest potential for NO_x reduction on certain combustion sources is SCR. However, this technology has never been applied to domestic coal-fired sources. Although it has been applied to sources firing coal in both Japan and Europe, there are differences in the coals and boiler operating practices between these applications and domestic applications which may hinder the use of SCR in the US on coal. There are unresolved technology-related issues relating to the use of this alternative in a US application, including lack of demonstration on pilot-scale units firing US fuels, differences between US and either Japanese or European fuels, as well as differences between the proposed Indiantown equipment configuration and units where SCR has been applied. As described in greater detail below, for these and other reasons SCR is not commercially applicable, and thus not BACT, at the present time.

Description

The SCR process involves postcombustion removal of NO_x from the flue gas with a catalytic reactor. Ammonia (NH₃) is injected into the flue gas stream upstream of the catalyst bed, and NO_x and NH₃ combine at the catalyst surface, forming elemental nitrogen and water. The function of the catalyst is to effectively lower the activation energy of the NO_x decomposition reaction.

Catalyst Types

There are several commercially available SCR catalysts, including platinum-based, vanadium-based, zeolite, and ceramic molecular sieve-based. Each catalyst type exhibits advantages and disadvantages in terms of operating temperature, reducing agent/ NO_x ratio, and optimum oxygen concentration. A characteristic common to all types is the narrow "window" of temperatures in which the reactions will proceed. Below the lower operating temperature limit, the reduction reactions do not take place. Operation above the maximum temperature results in oxidation of NH_3 to either nitrogen oxides (thereby actually increasing the NO_x emissions) or the formation of ammonium nitrate and ammonium nitrite, both of which are explosive compounds.

Optimum operating temperature for most catalyst systems has been shown to be in the range of 500-850°F. For combustion sources such as the proposed PC boiler, a prime concern is the location of the catalyst bed to insure that this temperature is maintained.

Catalyst Deactivation

The SCR process is subject to loss of catalyst activity over time. Since the catalyst itself is the most costly part of the process, steps to prevent catalyst deactivation must be taken to effect economical operation of the process. Catalyst deactivation occurs through two primary mechanisms: physical deactivation and chemical poisoning. The former is generally the result either of prolonged exposure to excessive temperatures or masking of the catalyst due to entrainment of particulate. Chemical poisoning is caused by the irreversible reaction of the catalyst with a contaminant in the gas stream and is a permanent condition. Catalyst suppliers generally assign a two to three-year lifetime to catalyst systems, thus a loss of 33% per year is to be expected.

During initial trials with Japanese technology in Europe, it was discovered that for certain coals and firing configurations, the activity of the catalyst decreased markedly after only a few hundred hours of operation (Schonbucher 1989). After extensive laboratory and pilot scale investigations (Kuroda et al 1989), the reason for this decline was identified as catalyst poisoning by arsenic (Balling and Hein 1989, Goldschmidt 1987, Kuroda et al 1989, Necker 1989, Schonbucher 1989). Gaseous arsenic trioxide (As_2O_3), formed by oxidation of elemental arsenic in coal, condenses within the catalyst pores and adsorbs onto active sites, thereby blocking the adsorption of NO_x and ammonia and preventing the NO_x reduction reaction from taking place (Kuroda et al 1989).

Although the Japanese had performed extensive testing of the SCR process on laboratory- and pilot-scale equipment prior to full commercial application (Kuroda et al, 1989), the phenomena

of catalyst poisoning by gaseous arsenic was not observed until SCR was tried in Europe (Goldschmidt 1987)

Fuel Sulfur

The sulfur content of the coal proposed for Indiantown is an additional concern. Catalyst systems will promote oxidation of sulfur dioxide (SO_2) to sulfur trioxide (SO_3), which combines with water to form sulfuric acid. Corrosion of flue gas piping and heat transfer surfaces, as well as catalyst deactivation, is thus a concern for using SCR with sulfur-containing fuels. In addition, SO_3 combines with unreacted ammonia to form ammonium bisulfate, which condenses out in the low temperature section of the unit and fouls the air heater, as described further below.

Another irreversible decline in catalyst activity is related to acidic attack of catalyst materials. Damon presented a technical review of the potential applicability of SCR to US coal-fired sources, and identified SO_3 adsorption as a potential problem area. For low and medium sulfur coals, he states that catalyst activity will be reduced if the reaction temperature falls below 580°F (below 650°F for high sulfur coals) (Damon et al, 1989).

Cichanowicz and Offen note that catalyst poisoning by sulfur compounds is aggravated by constituents of fuel which promote high SO_2 and SO_3 concentration, including fuel sulfur, high fly ash iron content (which may catalyze the oxidation of SO_2 to SO_3), and low ash alkalinity (which neutralizes SO_3) (Cichanowicz and Offen 1987).

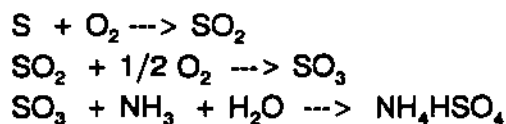
Thus differences in coal sulfur, alkalinity and trace element concentration may present unexpected difficulties in applying the European experience directly to domestic fuel firing.

Indiantown Configuration

As described in more detail in subsequent sections, sulfur dioxide and particulate matter will be controlled in the proposed facility with a spray dryer/fabric filter. SCR has never been used in conjunction with a spray dryer/fabric filter before, based on the European experience and preliminary information from one US pilot study, there are unresolved technical issues. In particular the effect that SCR will have on the fabric filter is of concern.

When SCR is applied to sources firing fuels containing sulfur, various ammonium salts are formed, including ammonium bisulfate (NH_4HSO_4) and ammonium sulfate ($[(\text{NH}_4)_2\text{SO}_4]$) (Damon 1987, Novak and Rych 1989, Lowe 1989, Robie 1989). The amount of each of these salts formed in a given source is dependent on the coal sulfur, the coal alkalinity, and the level of ammonia slip (Damon 1987). Ammonium bisulfate is a hygroscopic solid at room temperature,

but has a melting point of 300°F (CRC 1975) It is formed according to the following series of reactions



Thus all other factors being equal, the greater the coal sulfur content, the greater the formation of ammonium bisulfate. Similarly, the greater the ammonia slip (hence the greater the amount of free ammonia in the flue gas) the greater the formation of ammonium bisulfate. Finally, the higher the concentration of alkaline components of coal (calcium, magnesium, sodium, potassium), the greater the tendency for acidic SO_3 to be neutralized, thereby lower its concentration in the flue gas and lowering the formation of ammonium bisulfate. These factors are variable and interrelated, thus it is difficult to predict what the formation and subsequent condensation rate of ammonium bisulfate will be for a new application.

In order to estimate the range of the amount of ammonium bisulfate which would be formed in the Indiantown boiler, two major assumptions were made. If it is assumed that ammonia slip is the rate-limiting reactant, approximately 95 lb/hr of ammonium bisulfate will be formed. If, however, it is assumed that the formation of SO_3 is rate-limiting, then based on the anticipated coal properties, more than 290 lb/hr of bisulfate would be formed. Based on full load operation for 8760 hrs/yr, this represents a loading of between 416 and 1,270 ton/yr of additional particulate matter.

The relatively low melting point of this material results in its condensing on the cooler portions of the boiler backend equipment, including air preheater and flue gas ductwork. In the proposed Indiantown configuration, it would tend to condense in the spray dryer and fabric filter as well.

As a hygroscopic material, ammonium bisulfate will tend to absorb water and become sticky once it has condensed. The EPRI pilot study at Arapaho found that high levels of ammonia slip resulted in an increase in pressure drop across the baghouse, which was the result of fouling of the bags by ammonium bisulfate (EPRI 1986). It was also found that this material was not removed by normal bag operation (reverse-jet cleaning) and that a unit shutdown was required in order to clean the equipment (EPRI 1986).

European installations equipped with SCR have also found that ammonium bisulfate fouling increases the pressure drop across the air preheater (Damon 1987, Robie 1989). In some installations, additional ductwork is installed to route the flue gas around the economizer to prevent the flue gas temperature at the inlet to the SCR reactor from dropping low enough to

allow formation and condensation of ammonium bisulfate, however this practice is not effective at low loads (Koppius-Odink 1989). The material has proven difficult to dislodge with conventional air sootblowers (Damon 1987), and in some installations daily washing of the air preheater with hot water is recommended (Necker 1989).

Table 3-2 summarizes the information contained in Appendix A comparing the Japanese and European coal-fired boilers equipped with SCR with the proposed Indiantown boiler. None of the European or Japanese installations utilize SCR in conjunction with a baghouse filter. Thus the effect of SCR system operation on baghouse performance in general, and ammonium bisulfate formation in particular, is not well known. Therefore SCR technology from Japanese and European coal-fired sources, none of which are equipped with the type of particulate control which Indiantown will employ, may not be directly transferrable in this application.

Ammonia Injection System

Specific problems have been associated with the design and operation of the ammonia injection system. Two considerations affecting the breakthrough of unreacted NH_3 from the catalytic reactor ("ammonia slip") are the control of the NO_x/NH_3 ratio for variable load conditions, and location and operation of the NH_3 injection nozzles. SCR manufacturers typically estimate less than 10 ppm of ammonia slip, however, improper system operation will result in higher emissions.

To achieve high (greater than 90%) NO_x reduction rates, SCR vendors suggest a higher ammonia injection rate than stoichiometrically required, to overcome the effects of incomplete mixing. The net result is that a larger fraction of the injected ammonia will pass through the SCR system unreacted (increased ammonia slip). Thus an emissions trade-off between NO_x and ammonia occurs in high NO_x reduction applications.

Other Considerations

In addition to the problems which arose with catalyst poisons, other features unique to European sources became evident during initial pilot studies and early commercial applications of Japanese technology. Necker noted that the type of coal being fired influences the level of NO_x generated by a particular boiler. This factor in turn influences the performance of the SCR system in any given application, such that "unrestricted use of all coal types available on the German market was not possible" (Necker 1989).

Another consideration is the degree of NO_x control required by the SCR system. According to Lowe, et al, in Japan the utility boiler NO_x control approach is based on applying extreme

**TABLE 3-2
COAL-FIRED SCR EXPERIENCE**

Japanese Utility Boilers

CUSTOMER	PLANT	SIZE	EFFICIENCY (%)	COMMERCIAL OPERATION	SCR Location	SO2 Control	Particulate Control
HOKKAIDO	TOMATO ATSUMA 1	280 000 nM3/hr	80	1980	High Dust	NA	NA
E P D C	TAKEHARA 1	399 500 nM3/hr	80	1981	NA	NA	NA
E P D C	TAKEHARA 3	2 320 000 nM3/hr	80	1983	NA	NA	NA
TOHOKU	SENDAI 3	599 000 nM3/hr	80	1983	NA	NA	NA
TOHOKU	SENDAI 2	599 000 nM3/hr	80	1983	NA	NA	NA
CHUGOKU	MIZUSHIMA 1	450 000 nM3/hr	80	1984	NA	NA	NA
CHUGOKU	MIZUSHIMA 2	540 000 nM3/hr	80	1984	NA	NA	NA
TOYAMA JOINT	TOYAMA SHINKO 1	629 000 nM3/hr	53	1984	NA	NA	NA
TOYAMA JOINT	TOYAMA SHINKO 2	629 000 nM3/hr	53	1984	NA	NA	NA
E P D C	WAKAMATSU	188 700 nM3/hr	80	1987	NA	NA	NA
E P D C	MATSUURA 1	3 100 000 nM3/hr	80	1990	NA	NA	NA
CHUBU	HEKINAN 2	(700 MW)	80	1992*	NA	NA	NA
SOMA JOINT	SHINCHI 1	(1000 MW)	—	1994*	NA	NA	NA
CHUGOKU	SHIMONOSEKI 1	175 MW	NA	1980	NA	NA	NA
CHUGOKU	SHIN-UBE 1	75 MW	NA	1981	NA	NA	NA
CHUGOKU	SHIN-UBE 2	75 MW	NA	1981	NA	NA	NA
CHUGOKU	SHIN-UBE 3	156 MW	NA	1981	NA	NA	NA
KYUSHU	MINATO	600 MW	NA	1983	NA	NA	NA
SHIKOKU	SAIJO	156 MW	NA	1983	NA	NA	NA
SAKATA	SAKATA 1	350 MW	NA	1983	NA	NA	NA
SAKATA	SAKATA 2	350 MW	NA	1984	NA	NA	NA
TOKYO	YOKOSUKA 1	265 MW	NA	1985	NA	NA	NA
TOKYO	YOKOSUKA 2	265 MW	NA	1985	NA	NA	NA
KYUSHU	MATSUURA 1	700 MW	NA	1989	NA	NA	NA
HOKURIKU	TSURUGA 1	500 MW	NA	1990*	NA	NA	NA
CHUBU	HEKINAN 1	700 MW	NA	1991	NA	NA	NA

Japanese Industrial Boilers

CUSTOMER	PLANT	SIZE	EFFICIENCY (%)	COMMERCIAL OPERATION	SCR Location	SO2 Control	Particulate Control
IDEMITSU KOUSAN	HYOGO	NA	80	1986	NA	NA	NA
YOSHINO SEKKO	CHIBA	NA	86	1987	NA	NA	NA
SUMITOMO METAL INDUSTRIES		NA	NA	1985	NA	NA	NA
SUMITOMO CHEMICAL CO		NA	NA	1985	NA	NA	NA
TAKEDA CHEMICAL INDUSTRIES		NA	NA	1986	NA	NA	NA
DAICEL CHEMICAL CO		NA	NA	1989	NA	NA	NA
PROPOSED ICL	INDIANTOWN	330 MW	—	—	—	SPRAY D	BAGHOUSE

* not currently in operation

TABLE 3-2 (CONTINUED)

Poor Original

European Boilers

CUSTOMER	PLANT	SIZE	EFFICIENCY (%)	COMMERCIAL OPERATION	SCR Location	SO ₂ Control	Particulate Control
VKG/DURNROHR 1	(AUSTRIA)	(405 MW)	80	1986	NA	NA	NA
EVN/DURNROHR 2	(AUSTRIA)	(320 MW)	80	1986	NA	NA	NA
VKR/KNEPPER C	(FRG)	(370 MW x 1/4)	90	1986	High Dust	NA	NA
IAW/LEININGERWERK	(FRG)	(450 MW)	70	1988	NA	NA	NA
KW MEHRUM/MEHRUM 3	(FRG)	(700 MW)	75	1988	NA	NA	NA
STEAG/WALSUM-7	(FRG)	(150 MW)	90	1988	Low Dust	Wet Scrub	NA
STW FRANKFURT/WEST-2	(FRG)	(90 MW)	80	1989	NA	NA	NA
STW FRANKFURT/WEST-3	(FRG)	(90 MW)	80	1989	NA	NA	NA
BAYERWERK/SCHWANDOR	(FRG)	(100 MW)	80	1989	NA	NA	NA
PREUSSENELEKTRA/HEYDE	(FRG)	(800 MW)	75	1989	NA	NA	NA
VKR/KNEPPER C	(FRG)	280 000 nM ³ /hr	—	1988	High Dust	NA	NA
VKR/KNEPPER C	(FRG)	(370 MW x 1/2)	90	1989	High Dust	NA	NA
WESER/VELTHEIM 1	(FRG)	(100 MW)	82	1989	NA	NA	NA
IAW/LEININGERWERK 5	(FRG)	(450 MW)	70	1990	NA	NA	NA
STEAG/BERGKAMEN	(FRG)	750 MW	NA	1989	High Dust	Wet Scrub	NA
STEAG/VOERDE A	(FRG)	710 MW	NA	1989	High Dust	Wet Scrub	NA
STEAG/VOERDE B	(FRG)	710 MW	NA	1989	High Dust	Wet Scrub	NA
STEAG/HERNE 1	(FRG)	150 MW	NA	1989	Tail End	Wet Scrub	NA
STEAG/HERNE 2	(FRG)	150 MW	NA	1989	Tail End	Wet Scrub	NA
STEAG/HERNE 3	(FRG)	300 MW	NA	1989	Tail End	Wet Scrub	NA
STEAG/LUNEN 10	(FRG)	150 MW	NA	1989	Tail End	Wet Scrub	NA
STEAG/LUNEN 11	(FRG)	350 MW	NA	1989	Tail End	Wet Scrub	NA
STEAG/WALSUM 9	(FRG)	410 MW	NA	1989	High Dust	Wet Scrub	NA
STEAG/WEST 1	(FRG)	350 MW	NA	1989	Tail End	Wet Scrub	NA
STEAG/WEST 2	(FRG)	350 MW	NA	1988	Tail End	Wet Scrub	NA
TWS MUNSTER 15		50 MW	NA	1986	High Dust	NA	ESP
EVS HEILBRONN		700 MW	NA	1986	High Dust	NA	ESP
TWS MUNSTER 12		50 MW	NA	1988	High Dust	NA	ESP
TWS MUNSTER 25		NA	NA	1988	High Dust	NA	ESP
GKM NO 18		NA	NA	1986	High Dust	NA	ESP
STEAG MELLACH		280 MW	NA	1987	High Dust	NA	ESP
PGEM CENTRALE GELDERLAND		130 MW	NA	1989	High Dust	NA	ESP
SAARBERGWERKE BEXBACH		740 MW	NA	1988	High Dust	NA	ESP
STADWERKE DUISBURG		140 MW	NA	1989	Low Dust	NA	ESP
CHEMISCHE WERKE HULS-3		75 MW	NA	1990*	High Dust	NA	ESP
GOBKRAFTWERKE FRANKEN-2		200 MW	NA	1990*	High Dust	NA	ESP
STODTWERKE BREMEN-15		NA	NA	1990*	High Dust	NA	ESP
BAYERNEWERKE ASCHAFFENBURG-21		150 MW	NA	1990*	High Dust	NA	ESP
BAYERNEWERKE ASCHAFFENBURG-31		150 MW	NA	1990*	High Dust	NA	ESP
STADTWERKE BREMEN KRAFTWERK HAFEN-8		NA	NA	1990	High Dust	NA	ESP
ODK VOITSBERG		320 MW	NA	1990*	High Dust	NA	ESP
GOBKRAFTWERKE FRANKEN-1		200 MW	NA	1990	High Dust	NA	ESP
STADTWERKE BREMEN KRAFTWERK HAFEN-5		NA	NA	1991*	High Dust	NA	ESP
BAYERNWERK MUNCHEN INGOLSTADT-4		NA	NA	1991	High Dust	NA	ESP
GKW MANNEHEIM-9		NA	NA	1992	High Dust	NA	ESP
EPON-NIJMEGEN	(NETHLS)	NA	80	1987	High Dust	NA	ESP
NECKARWERKE/ALTBACH-DEIZ/SAU		420	NA	1987	High Dust	Wet Scrub	ESP
NECKARWERKE/WALHEIM		150	NA	1987	High Dust	Wet Scrub	ESP
PROPOSED ICL	INDIANTOWN	330 MW	—	—	—	SPRAY D	BAGHOUSE

* - not currently in operation

combustion modifications to remove 200-300 ppm of NO_x (compared to uncontrolled emissions), followed by SCR to remove an additional 70-100 ppm. This is often not clearly stated in literature presented by SCR manufacturers, who reference system performance as a percentage of the NO_x that enters the SCR reactor, and not as the percentage reduction of the uncontrolled emissions.

Additionally, even though the Japanese systems are designed for NO_x removals of 70% or greater, they are frequently only required by permit to achieve much lower levels of removal (Lowe 1989). In particular, utility boilers located in urban areas do not push their SCR systems to the maximum degree of reduction possible. In general, such sources are concerned with excess ammonia slip and crowded plant sites in addition to NO_x reduction requirement. Since lower ammonia slip is achieved at the expense of space (more catalyst required) and/or less NO_x control (lower ammonia injection rate), urban utility boilers which are retrofit with SCR are allowed by regulators to operate at lower NO_x removal rates than design, avoiding potential SCR problems and not restricting plant power capacity or availability (Lowe 1989).

Execution of Pilot-Scale Studies

Japanese and European Studies Prior to the full-scale commercialization of the SCR process in both Japan and Europe, the process underwent a considerable degree of development and trials on small scale equipment. In Japan, the process was thoroughly studied in both laboratory and pilot-scale equipment for many years prior to commercialization (Kuroda 1989, Kobayashi 1987).

Kuroda noted that twenty pilot studies were conducted by Babcock-Hitachi in West Germany, Austria, Denmark and Sweden between 1984 and 1989 (Kuroda 1989). Schonbucher states that seventy pilot plants were operated within the same time frame (Schonbucher 1989). These studies were carried out prior to construction of the first commercial unit in order to determine important design and operating parameters such as optimum space velocity, effect of European fuel supplies on SCR system performance, variability of ammonia slip, process control alternatives and others. From a process development standpoint, these pilot studies were an important step in the transfer of Japanese SCR technology to European sources.

Domestic Studies The US utility industry has concluded that "Applicability of SCR to coal-fired power plants in the US burning domestic coals can be determined only with representative pilot plant testing" (Cichanowicz 1988), and "Since SCR suppliers in the US have not undertaken pilot or demonstration programs such as was done in Japan and Germany in order to qualify SCR designs for the specific fuels and operating conditions that are anticipated, the level of risk at a US application is greater than that from a Japanese application" (Lowe 1989).

The Electric Power Research Institute (EPRI) has been conducting pilot-scale demonstration studies for the US utility industry on SCR systems on domestic coal supplies. In 1982, EPRI began testing a Babcock-Hitachi SCR system on the 2.5 MW pilot plant at the Arapahoe Test Facility in Denver, Co. The objective of this testing program was "to evaluate the technical feasibility and increase in electricity costs attributable to selective catalytic reduction NO_x control on coal-fired power plants" (EPRI 1986).

In a recent communication between Bechtel Power Corporation and EPRI, it was learned that six additional coal-fired SCR pilot projects are planned for 1990. These pilot efforts will be conducted by EPRI and Southern Company Services, and will study the effect of fuel composition on catalyst aging, system performance, and ammonia slip (Bechtel 1990). According to the project manager of these EPRI studies, critical issues to be resolved include catalyst lifetimes, impact on air heater, FGD, liquid- and solid-waste management, process control and catalyst replacement strategies (Cichanowicz 1989).

Given the early stage of progression of these pilot studies, the US utility industry and PG&E/Bechtel do not feel that SCR is commercially applicable, and thus not BACT, at the present time.

3.2.2.2 Environmental and Energy Analysis

Environmental Considerations

Adverse environmental impacts associated with the use of SCR include disposal of spent catalyst, storage and handling of ammonia, and issues pertaining to emissions of unreacted ammonia.

Spent Catalyst Disposal - The SCR catalyst material will be subject to loss of activity and poisoning and will be periodically replaced. The disposal of spent catalyst is complicated by the fact that many SCR catalysts contain various heavy metals, including titanium and vanadium, which are considered to be hazardous wastes. Thus, use of SCR entails hazardous waste handling and disposal, an environmental burden and potential liability.

Certain catalyst formations must be washed annually in order to be cleaned and regenerated. Mitsubishi estimates that the wastewater resulting from cleaning their catalyst could be ten times the catalyst volume and contain 250 ppm V₂O₅, a listed hazardous waste. Wastewater treatment and secure discharge and/or hazardous waste disposal of the wastewater treatment residues or the untreated wastewater to a licensed treatment facility would pose additional adverse economic and environmental impacts with certain SCR systems.

In light of the water availability restrictions and stringent wastewater discharge requirements in the area surrounding the proposed Indiantown facility, the generation of large amounts of hazardous wastewater represents a significant adverse impact for this potential application

Ammonia Storage - An additional adverse environmental impact associated with SCR is the onsite storage of anhydrous ammonia. Ammonia is a designated "Extraordinarily Hazardous Substance" (EHS) under the Federal SARA Title III requirements set out in the Federal Register, 52 FR 13397, April 22, 1987. The quantity of on-site ammonia storage required for the SCR process at Indiantown will exceed the 100 pound threshold for reportable quantities under the Federal program.

Facilities employing the process must review the process to define specific safety features necessary for operation of the SCR process. Technical guidelines were developed by the American National Standards Institute, ANSI, K61.1-1981 "Safety Requirements for the Storage and Handling of Anhydrous Ammonia". Additionally, specific ongoing maintenance procedures would have to be developed to ensure proper operation of the safety features selected.

Anhydrous ammonia is purified ammonia gas, liquified under pressure. Acute human exposure to this material may threaten life or cause permanent physical impairment. Because it is stored under pressure, an accidental release would result in the sudden escape of large quantities of toxic ammonia gas, with the accompanying risk to human health and welfare.

Some SCR systems now employ aqueous ammonia, which is stored as a water based solution. This material does not present the acute accident potential of anhydrous ammonia, however the use of this material is not widespread.

Ammonia Slip - As with any chemical process, not all the reactant ammonia will be consumed in the NO_x reduction reactions. Emissions of unreacted ammonia ("ammonia slip") are thus another adverse environmental consideration in any application of SCR. Although vendors claim that the design and proper operation of the catalyst reactor will keep ammonia slip to less than 10 ppm, catalyst design is governed principally by NO_x removal required and allowable ammonia slip, among other considerations. Therefore, requiring either higher NO_x removal or lower residual ammonia requires greater amounts of catalyst, thereby increasing costs. Consequently, to a certain extent there is a tradeoff between NO_x and ammonia emissions in any application of SCR.

Increased Particulate Loading - As discussed above, the operation of an SCR system on a source firing sulfur-bearing fuels will result in the formation of ammonium bisulfate and ammonium sulfate. These salts will condense out in the cooler portions of the boiler, in the air

preheater, and the spray dryer, resulting in increased particulate loading on the fabric filter. The maximum estimated increase in loading is 290 lb/hr, which translates to a maximum increase in annual loading of 1,270 ton/yr to the particulate control device.

Energy Considerations

Energy requirements for the SCR alternative for the PC boiler consist of increased fan power to overcome the pressure drop of the catalyst, electrical power for pumping aqueous ammonia from storage to the injection nozzles, and steam for ammonia vaporization. Total additional electrical power requirements are approximately 1,678 kw, or 9,806 kw-hr/ton NO_x controlled.

3 2 2 3 Economic Analysis

Capital and annual operating costs associated with operation of an SCR system on the PC boiler were estimated from vendor information. These costs are presented in Tables 3-3 and 3-4. Since no SCR system has ever been installed on a PC boiler firing US coals, the design of the equipment, including amount of catalyst included, has to be conservative and contain sufficient contingency to account for indeterminant process variables, including catalyst life, formation of ammonium salts, and effect operation of the SCR system may have on downstream equipment such as the spray dryer absorber and fabric filter.

Estimated direct costs for the SCR system, including catalyst, catalyst housing, ammonia storage, piping and instrumentation are \$19,908,000. Considering indirect charges, the total capital cost is estimated at \$29,307,000. Annual costs for SCR include operating labor charges (one additional operator/shift), replacement parts including catalyst replacement (based on a three-year catalyst life), additional electrical cost for fan power associated with increased pressure drop due to the catalyst, ammonia cost, catalyst disposal cost, and indirect operating costs. Total annualized cost, including capital recovery charges (based on 10% interest rate and 10 year equipment life), is estimated at \$8,961,400.

Based on an emission limit of 0.17 lb NO_x/MMBtu, the SCR alternative would control an estimated 1,499 tons of NO_x per year more than the use of advanced combustion controls (which would have an estimated emission rate of 0.27 lb/MMBtu). Cost effectiveness for SCR is thus estimated to be \$5,978/ton of NO_x controlled, which is not considered cost effective.

TABLE 3-3
CAPITAL COSTS FOR NO_x ALTERNATIVES, PC BOILER

	<u>SCR</u>	<u>SNCR</u>
(1) Purchased Equipment		
(a) Basic Equipment	9,900,000	3,000,000
(b) Auxiliaries	2,300,000	included
(c) Instrumentation and Controls	990,000	included
(d) Structural Support	990,000	300,000
(e) Freight & Taxes	1,134,000	264 000
(2) Direct Installation	4,594,000	1,069,000
Total Direct Costs (TDC)	\$19 908,000	\$4,633,000
(3) Indirect Installation		
(a) Engineering & Supervision	1,991,000	463,000
(b) Construction & Field Expense	1,991,000	463,000
(c) Construction Fee	995,000	232 000
(d) Contingencies	3 982,000	927,000
(4) Other Indirect Costs		
(a) Startup & Performance Test	199,000	46,000
(b) Working Capital	241,000	207,000
(c) License Fee	-	1,137,000
Total Indirect Costs (TIC)	\$9,399,000	\$3 475,000
Total Capital Cost (TCC)	\$29 307,000	\$8,108,000
(5) Annualized Capital Recovery	\$4,757,000	\$1 316 000
(amortized over 10 years straight line @ 10% interest rate)		

Cost Factors 1990 OAQPS Control Cost Manual

TABLE 3-4
ANNUAL COSTS FOR NO_x ALTERNATIVES, PC BOILER

	<u>SCR</u>	<u>SNCR</u>
Direct Operating Costs		
(1) Labor		
(a) Operating (8 hours/shift)	\$175,200	\$175 200
(b) Supervisory	26,000	26,000
(2) Maintenance		
(a) Labor	214,200	214,200
(b) Supplies (50% Maint Labor)	107,000	107 000
(3) Replacement Parts		
(a) Catalyst	957 000	-
(4) Utilities - Electricity (2)(3)	1,193,000	1,567 000
(5) Raw Materials - Ammonia (2)(3)	248,000	427,000
(6) Catalyst Disposal (2)	13,000	-
Indirect Operating Costs		
(7) Overhead	99,000	99,000
(8) Taxes	293,000	81,000
(9) Insurance	293,000	81,000
(10) Administration	586,000	162,000
Annual Operating Costs	\$4,204 400	\$2,939 400
Annual Capital and Operating Costs	\$8,961,400	\$4,255 400
Annual Tons Removed (4)	1,499	1,499
Cost Effectiveness (\$/ton)	\$5,978	\$2,839

Notes

- (1) catalyst replacement at 100% in five years
- (2) per Bechtel Power
- (3) based on 100% capacity
- (4) based on 0.17 lb/MMBtu emission limit
-compared to boiler emission rate 0.27 lb/MMBtu

Poor Original

3.2.2.4 Conclusion

Selective Catalytic Reduction has been applied to commercial scale coal-fired sources in both Japan and Europe. The application of this technology, however, took place as a result of intensive R&D and process development work on laboratory-scale and pilot-scale equipment. In transferring SCR technology from the commercial applications in Japan to European sources, technical problems arose which were not anticipated given the Japanese experience.

Furthermore, the Japanese philosophy regarding NO_x control for coal-fired boilers is to achieve the maximum degree of reduction possible using advanced combustion controls, followed by application of SCR to "trim" emissions. In urban areas, regulatory agencies allow SCR systems to be operated so as to avoid excessive levels of ammonia slip and ammonium bisulfate formation.

SCR has never been applied to a commercial-scale unit firing domestic coals, and has never been applied to a commercial PC unit in either Japan or Europe using a baghouse for particulated control. Since problems comparable to those encountered in European SCR applications are expected for US applications, pilot-scale studies to validate this technology on US coals are in their early stages. Therefore, SCR is not considered technically feasible, and thus not BACT, for Indiantown.

The imposition of this technology would result in an increase in annual operating costs of \$8,961,400/yr and \$5,978 ton/ NO_x controlled, which is also considered unreasonable given the current developmental status of this alternative in the US on coal-fired sources.

3.2.3 Selective Non-catalytic Reduction (SNCR)

The SNCR process is based on a gas phase homogeneous reaction, within a specified temperature range, between NO_x in the flue gas and either injected NH_3 or urea to produce gaseous nitrogen and water vapor. As the name implies, these systems do not employ a catalyst, and therefore operate at higher temperatures than SCR systems. Although SNCR, like SCR, has never been installed on a domestic PC boiler, there are fewer technical uncertainties associated with this alternative. SNCR at an emission level of 0.17 lb NO_x /MMBtu is thus proposed as BACT.

3.2 3 1 Technical Analysis

Process Description - There are two commercially available SNCR processes, including EPRI's NO_xOUT process and Thermal DeNO_x®, a system patented by Exxon Corporation in 1976. In general, aqueous or anhydrous NH₃ or urea is injected into the hot flue gas as an atomized aqueous solution or by means of air or steam carrier gas at a point in the flue specifically selected to provide optimum reaction temperature and residence time.

SNCR has been applied to numerous petroleum heaters, as well as to a limited number of utility and industrial boilers fired with natural gas or oil. Most of the existing applications are in the United States and Japan, with a few installations in Europe. Table 3-5 is a summary table of coal-fired SNCR installations (Exxon, 1990). NO_x reductions ranging from 30 to 80 percent have been tested on these units (SCAQMD). The highest NO_x removal efficiency ever tested, 85 percent, was achieved on a coal-fired utility boiler in West Germany. Although Exxon literature (Lyon, 1987) claims that 90 percent reductions have been achieved, further contact with Exxon shows that 85 percent was the absolute maximum NO_x reduction achieved using Thermal DeNO_x®, with 80 percent being the maximum reduction ever tested on more than one unit.

The actual chemical mechanism of the SNCR process is complex, involving at least 31 significant chemical reactions in conventional combustion applications. The chemical reactions typically governing the DeNO_x control process are



The NO_xOUT process using urea (CO(NH₂)₂) is similar to the DeNO_x process except that CO₂ is generated along with N₂ and H₂O. Critical to the successful reduction of NO_x in these applications is the prevailing temperature of the flue gas at the injection point. In conventional combustion processes at flue gas temperatures of 1600°F to approximately 1740°F, the first reaction dominates, reducing NO and limiting further NO production. As temperatures increase above 1740°F, reaction (2) becomes more significant, limiting NO reduction efficiency, and at temperatures above 2200°F, reaction (2) dominates, creating more NO, a counterproductive situation. At flue gas temperatures below 1600°F, the rate of both reactions slows down, such that some of the ammonia does not react and passes through the system into the ambient atmosphere. The optimum temperature depends upon a number of factors including flue gas composition, but is typically below 2,000°F. Research efforts have succeeded in understanding the chemical kinetics to the point where computer modeling are used to predict the removal efficiency.

**Table 3-5
Coal-Fired Boilers Equipped with SNCR**

<u>Project Name</u>	<u>Location</u>	<u>Boiler Type</u>	<u>Output (MW)</u>	<u>Pollution Control Devices</u>	<u>SNCR Vendor</u>	<u>Fuel</u>	<u>Operating History</u>
Stockton Cogen (previous name = Corn Products)	San Joaquin County CA	CFB	49.9	NH ₃ & limestone inj. Baghouse	Other	Coal Coke	Start-up in 1988
Cogeneration Nat'l (POSDEF) - 2 units	San Joaquin County CA	CFB	23.2 each	NH ₃ & limestone inj. Baghouse	CPC	Coal	Start-up on coal in early February 1988
RWE A G	Weisweiler W. Germany	PC	75	Urea Injection Unspecified PM Control	Fuel Tech	Brown Coal (0.2% S)	Installed in 1988. Not currently operating
Kerr McGee	Trona CA	PC	75	Urea Injection ESP	Fuel Tech	Coal (0.5% S)	Started as a full-scale demonstration unit in 1989. commercial oper- ation to commence soon
KMW (2 units)	Mainz W. Germany	CY	45	NH ₃ Injection ESP FGD - Unspecified	Exxon	Coal (1% S)	Start-up in 1989. due to success of 1st unit. 2nd unit was installed with NO _x control. NO _x removals of 83%
STEAG	Herne W. Germany	PC	500	NH ₃ Injection ESP FGD - Unspecified	Exxon	Coal (1.5% S)	Start-up in 1989. NO _x removals of 55%
Mount Poso	Kern County CA	CFB	49.9	NH ₃ & limestone inj. Baghouse	Other	Coal	Start-up March 20, 1989. NO _x reductions of 80%
Rio Bravo (2 projects)	Poso & Jasmín CA	CFB	36 each	NH ₃ & limestone inj. Baghouse	Exxon	Coal	Start-up February 2, 1990
BIOGEN	Ivanpah CA	CFB	15	NH ₃ & limestone inj. Baghouse	CPC	Coal	Start-up in 1989
BAPS (3 units)	Antioch & Pittsburg CA	CFB	16.6 each	NH ₃ & limestone inj. Baghouse	CPC	Coal	Start-up in 1990
Proposed Indiantown	Indiantown FL	PC	330	SNCR Spray Dryer/Baghouse	NA	Coal (2% S)	

Notes

CFB - Circulating Fluidized Bed

PC - Pulverized Coal

CY - Cyclone-fired

BH - Baghouse

SD - Spray Dryer

Because the NO_x reduction reactions occur within a narrow window of temperature, the location in the furnace at which the ideal reaction temperature is found to exist is difficult to predict with absolute certainty and is not considered to remain constant. The furnace temperature profile varies with boiler load, fuel composition, and combustion air temperature. This variability in the temperature profile through time means that the flue gas at the ammonia injector nozzles will not always be at the optimum temperature for the reactions which control NO_x emissions to occur. This problem generally results in provision of more than onset of injection nozzles.

Generally, the equipment that comprises a De NO_x system includes the following items:

- multiple rows of injection headers and nozzles for each combustion unit (only one row utilized, but two provided to allow for process modifications required due to furnace temperature profile)
- necessary piping for delivery of aqueous ammonia (or urea), carrier gas, and mixed gas into the injection headers
- air compressors and reservoir to provide air for carrier gas and ammonia injection requirements (sufficient carrier gas pressure is necessary to achieve uniform distribution of ammonia throughout the combustion zone)
- aqueous ammonia storage facility

Additional Technical Considerations - Operating/maintenance problems with SNCR may arise in new applications, such as the proposed PC boiler, because of operating/maintenance problems with the combustion unit itself. For example, the Commerce Resource Recovery facility in California, the first resource recovery facility in the United States to be equipped with SNCR, had operating and maintenance problems with the combustor such that the performance of the SNCR system was affected. Because of the problems in the combustion unit, reduction of the level of excess air was necessary, resulting in greater furnace temperatures. Because of the higher temperatures and the associated decrease in the NO_x removal efficiency of the SNCR system, the ammonia injectors had to be relocated to accommodate the new temperature profile within the boiler (Exxon 1988), a costly interruption which could not be foreseen. This risk is a major concern for all new boiler applications where the actual flue gas temperatures, flowrates and composition may vary considerably from the theoretical values developed during the design stages.

Achievable NO_x Reduction Level - Based on the fact that there are currently no commercial PC units operating on domestic coals using SNCR to control NO_x , it is difficult to predict precisely

what control level can be attained for the Indiantown unit. There are currently only two PC units in the world operating with Thermal DeNO_x, both units are located in West Germany and differ significantly than the proposed Indiantown unit.

The first unit, a cyclone-fired wet bottom boiler, was first tested with Thermal DeNO_x in 1986. The system was designed for NO_x reductions of 80% with less than 10 ppm of ammonia slip. Due to its wet bottom design, however, the uncontrolled NO_x concentration (840 ppm) is much higher than the proposed Indiantown unit (250 ppm). This difference is important as SNCR is "sensitive to initial NO_x concentration" (Hurst 1981) and "it's easier to get more reduction if the initial level of NO_x is high" (Hofmann, 1990).

In addition, the system was designed as a development and demonstration project with multiple ammonia injection ports to attempt to match temperature variations expected with changing loads.

The second full scale application is a 500 MW commercial unit designed for 50% NO_x removal with an ammonia slip level of 5 ppm (Fellows, 1990). This unit was tested in January 1990 and met all design criteria (Fellows, 1990), although long-term confirmation of these results has not yet been obtained.

Neither of these units, nor any of the operating domestic CFB boilers currently employing SNCR for NO_x control has the same air pollution control train (spray dryer/fabric filter) proposed for Indiantown.

Therefore, the degree of actual NO_x reduction which can be expected for this alternative at Indiantown is not well defined. Application of this technology thus involves a degree of risk and uncertainty. Based on data from the two German boilers using SNCR (NO_x reductions 50-80%), from the major equipment supplier (Exxon 40-60% reductions for PC units), and the baseline NO_x emission from the boiler without controls (0.27 lb/MMBtu), the anticipated control level for SNCR is 0.17 lb/MMBtu based on a maximum ammonia slip of 5 ppm.

3.2.3.2 Environmental and Energy Analysis

Environmental Considerations

The potential adverse environmental impacts associated with the use of SNCR are effects of residual ammonia in the flue gas ("ammonia slip"), and safety related issues due to ammonia storage.

Ammonia Slip Emissions - As with SCR, emissions of unreacted ammonia represent an adverse environmental consideration with SNCR. However, stack concentrations of ammonia can generally be maintained below 10 ppmv. At this level, the estimated ground level ammonia concentration would be well below the threshold limit value of $18,000 \mu\text{g}/\text{m}^3$ established by the American Conference of Governmental Industrial Hygienists.

Ammonium Salt Formation - As discussed above, ammonium salts are formed in sources employing ammonia injection NO_x control. The use of SNCR will therefore encounter similar technical difficulties and environmental impacts involving ammonium salts than would be expected with the use of SCR since both techniques emit unreacted ammonia (ammonia slip).

For the proposed Indiantown boiler firing 2.0% sulfur coal, the estimated SO_3 formation rate is 1.65 lbmol/hr, which would generate 209 lb/hr of ammonium bisulfate if availability of SO_3 is assumed to be rate limiting (see calculation in Appendix B). For a CFB with the same heat input firing the same 2.0% sulfur fuel, in-bed limestone SO_2 control would reduce the SO_3 formation rate to 0.17 lbmol/hr, equivalent to 19 lb/hr of ammonium bisulfate.

As discussed in Section 3.2.3.1, the effect on fabric filters of the higher formation rate of ammonium bisulfate is not well known. In fact, a paper from Exxon states, "there is minimal experience on the effect of ammonia or ammonium salts on scrubbers and baghouses and thus this is a problem area" (Hurst and White 1986).

Compared to SCR, however, the formation and subsequent condensation rate of ammonium bisulfate is expected to be lower with SNCR. SCR systems have been shown to catalytically oxidize SO_2 to SO_3 by as much as 1% (Damon 1987). SO_3 is thus formed both through high-temperature oxidation of SO_2 in the boiler as well as catalytically in the SCR unit. For SNCR, the only SO_3 available to participate in the formation reaction will arise from furnace oxidation of SO_2 .

Odors - Ammonia is an odorous compound. Kirk-Othmer's Encyclopedia of Chemical Substances shows that ammonia is first perceptible at 20 ppm, another source lists the odor threshold as 46.8 ppmv (Cheresiminoff, 1975). Exxon estimates that the ammonia slip concentrations in the stack for resource recovery applications could be as high as 50 ppm as reported for Commerce (McDannel, et al., 1988b) for ammonia - NO_x mole ratios of 2.5. Ground level concentrations, however, will be much lower because of ambient air dilution, such that odors should not be detected. No odor complaints have been lodged against the Commerce facility. It is interesting to note, however, that several odor complaints have been lodged in California by residents living near gas turbine applications equipped with selective catalytic reduction (Fogman, 1988), a NO_x control technique which should emit less ammonia slip than Thermal De NO_x .

Ammonia Storage - Application of SNCR requires the storage and handling of ammonia, which in anhydrous form is classified as an "Extraordinarily Hazardous Substance," requiring specific storage and handling practices to insure safety. Accidental release of this material could potentially result in severe environmental impacts. However, these safety and adverse environmental concerns can be eliminated by using aqueous ammonia rather than anhydrous ammonia as the reducing agent in the SNCR process.

Energy Considerations

Energy requirements for the SNCR alternative for the PC boiler consist of electrical power for pumping aqueous ammonia from storage to the injection nozzles. Total additional electrical power requirements are estimated at approximately 775 kw, or 4,529 kw-hr/ton NO_x controlled.

3 2 3 3 Economic Analysis

Capital and annual operating costs associated with operation of an SNCR system on the PC boiler were estimated from vendor information, and are presented in Tables 3-3 and 3 4. Total direct costs for SNCR, including injection nozzles, ammonia storage, piping and instrumentation are \$4,633,000. Considering installation charges and indirect charges, the total capital cost is estimated at \$8,108,000. Annual costs for SNCR include operating labor charges (one additional operator/shift), additional electrical cost for fan power associated with ammonia vaporization and pumping, ammonia cost, and indirect operating costs. Total annualized cost is estimated at \$4,255,400.

Based on an emission limit of 0.17 lb NO_x/MMBtu, SNCR would control an estimated 1,499 tons of NO_x per year more than the use of advanced combustion controls at 0.27 lb/MMBtu. Cost effectiveness for SNCR is thus estimated to be \$2,839/ton, which is considered reasonable.

3 2 3 4 Conclusions

SNCR has never been applied on a commercial scale to a PC boiler firing domestic coals, although there are coal-fired units operating with the technology. In addition, there are several domestic CFB facilities employing SNCR. These facilities, however, differ from the proposed Indiantown boiler in terms of air pollution control train design. CFB unit in particular exhibits inherently different furnace temperatures, flue gas mixing characteristics, and potential flue gas SO₃ levels than the Indiantown design. There are, therefore, a number of unresolved technical issues which result in uncertainties concerning application of this technology in this instance, in particular the degree of NO_x reduction which can be expected and the level of ammonia slip which can be tolerated. Based on vendor information and SNCR systems operating on CFB's

and in Europe, the appropriate emission level for SNCR on Indiantown is 0.17 lb/MMBtu. At this level, this alternative would have a cost effectiveness of \$2,839/ton controlled, compared to the use of advanced combustion controls, which is considered reasonable.

This emission level is consistent with the most stringent emission level for PC units, and is thus concluded to be representative of BACT.

3.3 NO_x Emissions from Auxiliary Boiler

3.3.1 Control Alternatives

NO_x emissions from the oil- and natural gas-fired auxiliary boiler, as with the coal-fired PC boiler, can be controlled either through combustion modifications or add-on control technology. Add-on controls include SCR and SNCR, combustion modifications include low excess air (LEA) firing, flue gas recirculation (FGR) and low NO_x burner (LNB) design.

3.3.1.1 Add-on NO_x Controls

Both SCR and SNCR have been applied to oil- and gas-fired boilers in previous applications. In Japan, SCR has been applied to more than fifty boilers firing oil (Nakabayashi and Abe, 1987), and the Exxon Thermal DeNO_x SNCR process has been installed on several domestic oil-fired industrial boilers and petroleum heaters (Hurst and White, 1986).

Burner design and boiler modifications, however, are more commonly applied to oil- and gas-fired boilers in the size range proposed for Indiantown, particularly for standby or auxiliary boilers used only for startup and shutdown heat requirements.

Technical descriptions of the SCR and SNCR control alternatives are discussed extensively in Sections 3.2.3 and 3.2.4. SCR catalysts designed for oil firing will be different than catalysts designed for coal firing. In particular, the lower particulate grain loading associated with oil and gas firing allows for a smaller pitch size, and the lower sulfur content of the fuel results in less of a consideration of formation and condensation of ammonia salts.

Thus the feasibility for utilizing either SCR or SNCR on in an application such as the Indiantown auxiliary boiler becomes a question of economics, as detailed in Section 3.3.2.

3 3 1 2 Combustion Controls

NO_x controls involving burner design, boiler design, or operational considerations aim to reduce NO_x emissions through minimization of NO_x formation. Such controls can be classified as flue gas recirculation (FGR), various types of low NO_x burners (LNB's) or low excess air (LEA) operation, as described further below.

Flue Gas Recirculation

This NO_x control technique involves extracting a portion of the flue gas from the boiler and returning it to the furnace through the burner or windbox. The primary effect of FGR is a reduction of the peak flame temperature through absorption of the combustion heat by the relatively inert flue gas. Furthermore, the addition of flue gas reduces the oxygen concentration in the combustion air, effecting a reduction in NO_x formation by decreasing the available oxygen.

The effectiveness of this alternative depends to a large degree on the fuel being fired. Since FGR reduces NO_x formation by targeting peak flame temperature, it has little effect on fuel NO_x formation. FGR is thus less effective on fuels with a high nitrogen content, such as residual oils.

NO_x removal efficiency is directly related to the flue gas recirculation rate; an increase in the recirculation rate results in a decrease in thermally generated NO_x. At recirculation rates greater than 25-30%, however, flame stability becomes compromised. In addition, decreasing the peak flame temperature by increasing the recirculation rate lowers the thermal output of the boiler. Therefore the tradeoff between lower NO_x emissions and heat output generally limits FGR recirculation rates to below 25%.

Implementation of FGR requires a capital expense associated with the required additional ductwork and fan capacity. The recirculation fan must be designed to operate in a high temperature environment, necessitating the use of more expensive materials of construction.

Low NO_x Burners

LNB design falls into one of two general categories: staged air design, and staged fuel design.

Staged Air Combustion - The staged air design involves diverting a portion of the combustion air from the burner(s) and injecting it into the furnace beyond the burner. By reducing the amount of air fed to the burners to the stoichiometric requirement, NO_x formation is reduced through promotion of a localized fuel-rich combustion region. Complete combustion is then

effected downstream of the burners in a fuel-lean environment, resulting in lower overall NO_x formation

Maintaining proper air flow represents the major operational consideration for effective NO_x control. Commercially available air flow controls can be used to maintain the required separate air rates, but careful control of operating parameters is necessary to avoid feeding too much air at low load conditions, resulting in ineffective NO_x removal and reduced boiler efficiency.

Staged Fuel Combustion - In the staged fuel design, or reburning, the fuel is fired in primary and secondary combustion zones similar to staged air combustion. In this method, however, the fuel is diverted to the two zones.

NO_x control is accomplished by injecting part of the fuel into the bulk of the combustion air and the remainder of the fuel into primary and secondary combustion zones. Thermal NO_x generation in the primary combustion zone is limited in this fuel-lean zone by the reduced peak flame temperature that results. The combustion products from this primary zone (hydrogen, carbon monoxide and hydrocarbons) are carried into the secondary combustion zone, lowering the local oxygen concentration and reducing the peak flame temperature in this zone as well. Combustion products from the primary zone also provide reducing agents for NO_x reduction in the secondary zone. Finally, zoned combustion permits complete combustion with lower excess air levels than standard burners, which further enhances NO_x emission reductions.

Potential adverse impacts with this technique are increased smoke, CO and HC emissions associated with incomplete combustion caused by incomplete mixing of the secondary air with the primary combustion products. Improper mixing of secondary air is also associated with flame carryover to the boiler section, potentially causing tube failure.

Low Excess Air

Boilers are designed to operate with the lowest air level consistent with complete combustion and safe operation. In practice, however, boilers are commonly operated with a greater amount of excess air than recommended, primarily to avoid smoke emissions during sudden load surges. This additional air is detrimental to efficient system operation since it both reduces the thermal efficiency by increasing the volume of heated gas released to the atmosphere, and promotes an increase in NO_x emissions.

With Low Excess Air (LEA) firing, the amount of primary combustion air is reduced, thereby reducing the formation of NO_x by decreasing the availability of oxygen in the primary combustion

zone The technique is applicable to all types of fuels and combustion sources, but the greatest potential NO_x reductions are on existing sources not specifically designed for LEA operation

Maintaining the correct air flow rate is crucial to effective NO_x control with LEA and requires the use of an oxygen trim system Primary air flow is adjusted based on the flue gas oxygen content A minimum excess air level must be maintained, however, to insure complete combustion and avoid formation of carbon monoxide (CO) and hydrocarbons (HC) This minimum level varies with the fuel used, furnace design, and boiler load, oxygen trim control systems are generally field adjusted during the initial break-in period to achieve the optimum excess air level for each particular application

3 3 1 3 Permitted Control Levels

The NSPS for #2 fuel oil-fired steam generating units with heat inputs greater than 100 MMBtu/hr is 0.2 lb/MMBtu (40 CFR 60, Subpart Db) A list of the oil fired boilers in the BACT/LAER Clearinghouse with limits on NO_x emissions is included in Appendix A Although there are no facilities listed in the Clearinghouse employing SCR for NO_x control, one facility (Hopco) is listed as utilizing SNCR to achieve 0.12 lb/MMBtu Other facilities employing LNBs and FGR are also listed as having limits of 0.12 lb/MMBtu

3 3 2 Economic Analysis

SCR, SNCR and FGR capital and annual operating costs for the auxiliary boiler were estimated based on vendor information for a similar project These costs are presented on Tables 3-6 and 3-7 Capital equipment for the SCR and SNCR alternatives would be the same as described in Sections 3 2 3 and 3 2 4 (above), although the size of the equipment would be reduced in size compared to the equipment designed for the PC boiler In addition, a different catalyst would be used for the oil- and gas-fired auxiliary boiler than would be employed for the PC boiler

Total capital costs for the SCR alternative on the auxiliary boiler are \$1,500,000 Based on 1,000 hours/yr annual operation, the annual cost of this alternative is estimated at \$735,000/yr Compared to the NSPS for this size unit, an SCR system designed for 80% control would reduce annual NO_x emissions by 27.4 ton/yr for a cost effectiveness in excess of \$26,864/ton, which is considered unreasonable and unrepresentative of BACT

Total capital costs for the SNCR alternative on the auxiliary boiler are estimated at \$1,222,000, annual costs are estimated at \$611,500/yr Based on a design control efficiency of 60%, this alternative would control 20.5 ton/yr and have a cost effectiveness of \$29,800/ton This is also considered unrepresentative of BACT costs for similar sources

TABLE 3-6
Capital Costs for NO_x Control Alternatives Auxiliary Boiler

	<u>SCR</u>	<u>SNCR</u>	<u>FGR</u>
(1) Purchased Equipment			
(a) Basic Equipment	675,000	470,000	318,000
(b) Auxiliaries	included	included	included
(c) Instrumentation and Controls	68 000	47,000	32,000
(d) Structural Support	68,000	47,000	32,000
(e) Freight & Taxes	65,000	45,000	31,000
(2) Direct Installation	263,000	183,000	124,000
Total Direct Costs (TDC)	\$1,139 000	\$792,000	\$537,000
(3) Indirect Installation			
(a) Engineering & Supervision	114,000	79,000	54,000
(b) Construction & Field Expense	114,000	79,000	54,000
(c) Construction Fee	57,000	40,000	27,000
(d) Contingencies	34,000	24,000	16,000
(4) Other Indirect Costs			
(a) Startup & Performance Test	11,000	8,000	5 000
(b) Working Capital	31,000	26,000	14,000
(c) License Fee	-	175,000	-
Total Indirect Costs (TIC)	\$361,000	\$431,000	\$170 000
Total Capital Cost (TCC)	\$1,500,000	\$1,223,000	\$707,000
(5) Annualized Capital Recovery	\$243,000	\$198,000	\$115,000
(amortized over 10 years straight line @ 10% interest rate)			

Cost Factors 1990 OAQPS Control Cost Manual

TABLE 3-7
Annual Costs for NO_x Control Alternatives, Auxiliary Boiler

	<u>SCR</u>	<u>SNCR</u>	<u>FGR</u>
Direct Operating Costs			
(1) Labor			
(a) Operating	\$87,600	\$87,600	-
(b) Supervisory	13,000	13,000	-
(2) Maintenance			
(a) Labor	107,100	107,100	87,600
(b) Supplies (50% Maint Labor)	54,000	54,000	44,000
(3) Replacement Parts			
(a) Catalyst (1)	41,000	-	-
(b) Equipment	68,000	47,000	32,000
(4) Utilities			
(a) Air	-	-	-
(b) Steam	-	4,000	-
(c) Electricity	7,100	600	4,400
(5) Raw Materials - Ammonia	2,900	2,200	-
(6) Catalyst Disposal	1,300	-	-
Indirect Operating Costs			
(7) Overhead	50,000	50,000	16,000
(8) Taxes	15,000	12,000	7,000
(9) Insurance	15,000	12,000	7,000
(10) Administration	30,000	24,000	14,000
Annual Operating Costs	\$492,000	\$413,500	\$212,000
Annual Capital and Operating Costs	\$735,000	\$611,500	\$327,000
Annual Tons Removed (2)	27.4	20.5	17.1
Cost Effectiveness (\$/ton)	\$26,864	\$29,800	\$19,123

Notes

(1) catalyst replacement at 50% in five years
(2) compared to NSPS 0.2 lb/MMBtu with

1000 annual operating hours

Capital costs for the FGR alternative, including additional ductwork, recirculation fan, insulation and control instrumentation, are estimated at \$707,000. Annual costs are estimated at \$327,000/yr with 17.1 ton/yr controlled assuming a reduction efficiency of 50%. Cost effectiveness of FGR is thus \$19,123/ton, similarly this is considered excessive and unrepresentative of BACT.

There are no adverse economic impacts associated with the use of Low NO_x Burners.

3.3.3 NO_x Control for Auxiliary Boiler - Conclusion

For the auxiliary boiler, SCR is considered the most stringent control alternative, however due to the limited operating hours of this source, this alternative would result in unreasonable annualized costs. SNCR, as the next-most stringent alternative, is similarly concluded to be economically infeasible. FGR would be the third-most stringent alternative, this control method is similarly concluded to be unreasonable based on excessive cost effectiveness.

The use of Low NO_x Burners, as the next alternative, would not have unreasonable annual economic or energy impacts, and use of this alternative would not result in adverse environmental impacts. It is therefore concluded to represent BACT for control of NO_x from the auxiliary boiler.

3.4 BACT for Nitrogen Oxides - Conclusions

3.4.1 PC Boiler

Nitrogen oxides are formed in combustion sources via the thermal oxidation of nitrogen in combustion air, or the reduction and subsequent oxidation of nitrogen compounds in the fuel. For coal-fired sources such as the proposed PC boiler, control alternatives consist of SCR, SNCR and combustion controls.

SCR has been applied to commercial scale coal-fired sources in both Japan and Europe after intensive R&D and process development work on laboratory-scale and pilot-scale equipment. In transferring SCR technology from the commercial applications in Japan to European sources, technical problems arose which were not anticipated given the Japanese experience.

SCR has never been applied to a commercial-scale unit firing domestic coals, and has never been applied to a commercial PC unit in either Japan or Europe using a baghouse for particulate control. Since problems comparable to those encountered in European SCR

applications are expected for US applications, pilot-scale studies to validate this technology on US coals are in their early stages. Therefore, SCR is not considered technically feasible, and thus not BACT, for Indiantown. Finally, the imposition of this technology would result in an increase in annual operating costs of \$9,806,900/yr, which is also considered unreasonable given the current developmental status of this alternative in the US on coal-fired sources.

SNCR has similarly never been applied on a commercial scale boiler firing domestic coals, and there are technical issues which must be addressed involving minimization of the condensation of ammonium salts, handling and transportation of ammonia, maintenance of system operating temperature during reduced load conditions, and compatibility of the system with downstream air pollution control equipment. The technology is currently in use at domestic coal-fired CFBs, and although these applications may be more favorable for the application of SNCR, the technical issues can be addressed in the system design. Compared to the base case combustion controls, the application of SNCR to Indiantown with an emissions level of 0.17 lb/MMBtu results in a cost effectiveness of \$2,248/ton.

Therefore, based on these technical and economic factors, the use of SNCR is concluded to be representative of BACT for control of NO_x for the PC boiler.

3.4.2 Auxiliary Boiler

The use of Low NO_x Burners is considered representative of BACT for NO_x control from the auxiliary boiler. The imposition of SCR, SNCR or FGR would have unreasonable annual economic impacts based on the limited annual operating hours of this source.

4 0 BACT DETERMINATION FOR SULFUR DIOXIDE AND ACID GASES

4 1 Introduction

In the following analysis, the compounds SO_2 , HF and H_2SO_4 are discussed together since removal methods and are common for each

4 1 1 Formation

Emissions of sulfur oxides (SO_x) and acid gases (H_2SO_4 and HF) are generated in fossil-fuel-fired sources from the release in the furnace of sulfur and fluorine present in the fuel. Sulfur compounds are formed when the organic and pyritic sulfur is oxidized, forming primarily sulfur dioxide (SO_2) with smaller quantities of sulfur trioxide (SO_3) and sulfates (SO_4). Sulfur trioxide further reacts with water present in the flue gas to form H_2SO_4 .

4 1 1 1 SO_2 Formation

Approximately 98% of the sulfur in bituminous coal is emitted on combustion as gaseous sulfur oxides (EPA 1985a). Uncontrolled emissions of SO_2 are thus affected only by the fuel sulfur content and not by the firing mechanism, boiler size or operation.

4 1 1 2 Acid Gas Formation

Sulfuric acid (H_2SO_4) and hydrogen fluoride (HF) gas emissions are created in coal and oil-fired combustion sources (such as the proposed PC boiler and auxiliary boiler) after sulfur, and fluorine are released in the furnace from burning fuel containing these elements. "Acidic" emissions can also result when nitrogen and other nonmetallic elements (principally carbon) are oxidized in the furnace. NO_x emissions, however, have been discussed in a separate section.

Conversion of fluorine to HF depends on air/fuel mixing, combustion temperature, and the presence of other trace elements. The formation and emission of H_2SO_4 , however, depends on the quantities of gaseous SO_3 and moisture in the flue gas. SO_3 reacts rapidly with water in the flue gas and stack vapor plume to form H_2SO_4 ; further reaction between H_2SO_4 and water may occur and result in the formation of sulfate salt aerosols.

The amount of SO_3 present in the flue gas depends on the fuel sulfur content as well as conditions supportive of secondary oxidation of sulfur dioxide to sulfur trioxide. Combustion

temperature, alkali component concentration in the fuel and excess oxygen level are a few of the factors governing SO_2/SO_3 conversion

4 1.2 Control Alternatives

Control of SO_2 and acid gas emissions is primarily effected by removing these pollutants from the flue gas with either wet or dry scrubbing alternatives. Such systems are generally designed to reduce SO_2 and are referred to as flue gas desulfurization (FGD) devices.

In addition, limiting the fuel sulfur content is an applicable control alternative, particularly for fuel-oil fired sources.

4 1 2 1 Wet Scrubbing

General Description

Wet scrubbing is a diffusion process in which pollutants (in the forms of gases or mists) are transferred from the gas stream to the scrubbing liquid under water saturated conditions. The conventional wet scrubbing processes, therefore, generate a liquid slurry wastewater effluent and must be accompanied by wastewater treatment and disposal system.

The types of wet scrubbing systems may be generally classified as sodium-based scrubbers, calcium-based scrubbers, and dual-alkali scrubbers. The classification occurs mainly because the calcium-based reagents produce insoluble salts (calcium sulfite and calcium sulfate), which some scrubbing systems cannot handle well, while the sodium-based reagents produce soluble reaction products (sodium sulfite, sodium bisulfite, and sodium sulfate). For example, packed tower absorbers normally use a sodium reagent, such as sodium hydroxide (NaOH) or soda ash (Na_2CO_3), since the soluble reaction products will not foul the packing. Spray towers, on the other hand, are not affected by the presence of salts, and therefore can take advantage of the less expensive calcium-based reagents such as pebble lime (CaO) or limestone (CaCO_3).

Regardless of the reagent, the waste effluent can be recycled to reduce water consumption and reagent use, but a blowdown stream must be handled prior to discharge. In calcium-based systems, waste products (calcium salts, water, and unreacted reagent) may be pretreated using clarifiers to remove suspended solids, followed by a filter press to remove the solids for subsequent landfilling. The clarified liquid is returned to the scrubber system for reuse. In sodium-based systems, no solid waste product is formed. Larger quantities of liquid waste containing dissolved salts must be disposed of. Disposal practices for this waste stream include wastewater treatment, holding ponds for evaporation and deep well injection.

Favorable Impacts of Wet Scrubbing

Wet scrubbing systems achieve levels of SO_2 /acid gas removal that are comparable with dry scrubbing. An advantage to wet scrubbing is that because of the low operating temperatures favoring absorption, and the ease with which reagent can be recycled, reagent/acid gas ratios approaching stoichiometric can be used. Dry scrubbing systems require more reagent, and thus incur higher reagent costs.

Because less reagent is used in wet scrubbing systems, less solid waste is produced than by spray dryer absorber/fabric filter (or ESP) systems. If treated, some of the scrubber waste solids may be saleable as by-product (e.g. gypsum).

Adverse Impacts of Wet Scrubbing

Technical concerns and numerous adverse environmental, energy and economic impacts reflect the disadvantages using wet scrubbing systems on coal-fired units.

Wastewater Treatment and Disposal - Some wet scrubbers produce acidic, high-chloride wastewater requiring treatment. Several treatments are available, including percolation of the wastewater through limestone beds, evaporation ponds, and deep well injection. More sophisticated and more costly treatment alternatives include reverse osmosis, electrodialysis, and flash evaporation/crystallization. If organics removal is required, carbon filters, UV-ozonation, or other organic treatment methods may be considered.

If a sodium reagent is used, large quantities of wastewater containing dissolved sodium salts (reaction products) must be purged to minimize the percent of dissolved solids in the system discharge.

In calcium-based systems, water losses still occur because of moisture present in the discharged solids, only the amount is less.

Disposal of Wet Sludge - Wet scrubbing alternatives produce a sludge containing the products of the SO_2 removal reactions. For calcium-based processes, including the wet limestone and wet lime scrubbing alternatives, these products consist of the salts calcium sulfate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) and calcium sulfite ($\text{CaSO}_3 \cdot 1/2\text{H}_2\text{O}$) which precipitate out of the scrubbing solution in the recycle tank. These solids are removed from the process by clarification and vacuum filtration, however the sludge contains from 10 to 30% water. Therefore the waste solids from wet scrubbing alternatives must be either handled wet, or dried prior to disposal.

Visible Stack Gas Plumes and Fogging - The use of wet FGD systems causes a low scrubber outlet temperature (about 120°F to 130°F). The flue gas exiting the stack at these temperatures would therefore cause visible moisture plumes. Several different techniques may be employed to minimize these effects. The flue gas can be reheated after it leaves the scrubber using a variety of heat exchangers, steam coils, or direct reheat with combustion of fossil fuel. Even after reheat, however, experience has shown that plumes are visible most of the year (Gengos, 1986). In Europe, some facilities are trying the use of subcooling, in which a heat exchanger is included downstream of the wet scrubber to condense water vapor from the saturated, cleaned flue gas. This practice reduces the visible steam plume, but also results in a cooler flue gas, which presents a separate set of concerns, as discussed below.

Increased Ground Level Concentrations - The flue gas emitted from wet scrubbing processes is generally cooler than from other control processes. This causes less plume rise, and hence, increased ground level concentrations (GLC) of all emitted pollutants. These increased concentrations cause potentially greater health risk impacts.

Corrosion, Erosion and Scaling - Significant corrosion, erosion and scaling of wet scrubber equipment, piping, pumps, fans, and valves have been reported, thus, wet scrubbers require more frequent repairs, parts replacements, and general maintenance at the expense of high costs and reduced availability. These problems can be minimized by selecting corrosion-resistant materials, better controlled recycle and blowdown rates to prevent accumulation of halide salts, better instrumentation for optimized reagent feeding, and proper equipment design to best prevent the cementing and poor dewatering tendencies of calcium sulfite sludges. Many modern FGD systems operate without these problems (Jordan, 1987, Moser and Simko, 1990).

Costs - Wet scrubbers are generally more expensive than spray dryer scrubbers to purchase and operate, regardless of whether or not the systems are designed for zero-water discharge. The capital costs are higher because corrosion-resistant materials of construction must be employed, numerous peripheral equipment must be supplied and state-of-the-art process controls must be incorporated. Operating costs are generally the highest among alternative SO₂/acid gas controls because of energy and water management requirements. Flue gas reheat and fan power associated with the high pressure drops in some wet scrubbers translate into especially large operating costs.

4.1.2.2 Spray Dryer Absorption

The other predominant SO₂/acid gas control system uses spray dryer absorbers (SDA) located upstream of particulate removal devices.

General Description

In spray dryers, an alkali reagent slurry is injected into a vessel sized for relatively long gas residence time. The SO_2 and acid gases react with the alkali solution or slurry to form liquid phase salts which are dried to about one percent free moisture by heat in the flue gas. Flue gas temperatures remain 20-30 °F above the dew point, compared to wet FGD systems operating at the dew point.

Spray dryer design can be affected by the choice of the downstream particulate collection device. Fabric filters have an advantage over ESPs in that unreacted alkaline material collected in the filter cake can further react with SO_2 and acid gases. Thus, for a given SO_2 /acid gas removal level, SDA/fabric filter systems require less reagent than SDA/ESP systems.

Favorable Impacts of Spray Dryer Absorber/Fabric Filter Systems

The system achieves levels of SO_2 /acid gas removal that are comparable with levels achieved with wet scrubbing systems. Spray drying technology is less complex mechanically than wet scrubbing systems and does not generate a liquid waste, thus treatment and disposal problems and costs are less. Compared to wet scrubbing, the stack gas is hotter, allowing for better plume dispersion and hence lower ground level concentrations.

No flue gas reheat is required, a requirement which presents significant energy and economic penalties to wet scrubber-equipped facilities.

Adverse Impacts of Spray Dryer Absorber/Fabric Filter Systems

Reagent Requirements - Spray dryer systems require greater amounts of reagent than for wet scrubbing systems because the flue gas temperatures are higher and the absorption process is not taking place at saturated conditions.

Solid Waste Generation - Spray dryer systems generate larger quantities of solid waste than wet systems because relatively larger amounts of reagent must be injected to achieve the same removal efficiencies. This is offset, however, by the fact that the solid waste is virtually free of moisture and can thus be transported directly to disposal without further dewatering or drying. For Indiantown, the dry waste may be returned to the coal mine directly by rail.

4 1 3 Permitted Emission Control Levels

The NSPS for coal-fired boilers is both a 90% reduction in potential SO₂ emissions and a maximum emission limit of 1.2 lb/MMBtu (40 CFR Part 60 Subpart Db). Listings of the coal-fired boilers contained in the BACT/LAER Clearinghouse with limits on SO₂ and acid gas emissions are contained in Appendix A. Four types of emission controls are included in this list: wet FGD systems, spray dryer FGD systems, limestone injection, and fuel sulfur limitations. Limestone injection is employed with CFB boilers and is not technically applicable to the proposed PC boiler. Both wet and spray dryer FGD systems have more emissions reduction potential than fuel sulfur limitations, however the maximum degree of SO₂ and acid gas reduction which is possible with either type of FGD alternative is subject to many factors, including activity of reagent, contacting device design and operation, and system reliability.

4 2 BACT for SO₂ and Acid Gases - PC Boiler

4 2 1 Most Stringent Control - 0.17 lb/MMBtu

4 2 1 1 Technological Feasibility of 0.17 lb/MMBtu

An emission rate of 0.17 lb/MMBtu is considered representative of the most stringent emission rate permitted. For Indiantown, this level would be achieved utilizing a 95% efficient FGD while firing coal with a maximum sulfur content of 2%. The BACT/LAER Clearinghouse lists eleven coal-fired facilities with a permitted SO₂ control efficiency of 94% or greater. Nine of these facilities, however, are fluidized bed boilers where the control method is lime or limestone injection. The permitted emission rate of these (Pyropower, Rio Bravo Revining Co. [two listings], BMCP, Westwood Energy Properties, Cogeneration National, and American Lignite Production Co. [two listings]) facilities are thus not applicable to the proposed Indiantown PC unit.

The other two facilities with permitted SO₂ control levels of 94% and greater are Deseret Generation and Transmission's Moon Lake, UT unit and Kentucky Power's Carr unit. Neither of these units were ever built. Thus 95% SO₂ control is more stringent than the highest permitted control efficiency for a non-CFB boiler.

There are a number of non CFB coal-fired units in current operation, however, with FGD devices designed for and achieving 95% control of SO₂. Table 4-1 contains a listing of the FGD facilities in current operation on domestic utility boilers. This listing, compiled from the 1989 PEI Associates "Utility FGD Survey" (DOE 1989) covers all FGD types, including the limestone, wet

Image Quality

**As you review the next group of images,
Please note that the original documents
were of poor quality.**

TABLE 4-1
Flue Gas Desulfurization Units in Operation

	<u>Unit</u>	<u>Size (MW)</u>	<u>% S</u>	<u>FGD Type</u>	<u>Year Start</u>	<u>Control Efficiency Design</u>	<u>Actual</u>	<u>System Availability</u>
Alabama Electric								
	Tombigbee 2	255	1.61	limestone	1978	59.5	85	96.9
	Tombigbee 3	255	1.61	limestone	1979	59.5	85	91.2
Alamito Co								
	Springerville 1	400	0.61	SD	1985	70	61	99
Applied Energy Service								
	Deepwater 1	165	4.00	limestone	1986	NA	NA	92
Arizona Electric Power								
	Apache 2	195	0.70	limestone	1978	85	97	85.7
	Apache 3	195	0.70	limestone	1979	85	97	84
Arizona Public Service								
	Cholla 1	126	0.50	limestone	1973	55	92	
	Cholla 2	250	0.50	limestone	1978	75	98	99
	Cholla 4	380	0.50	limestone	1981	95	95	87
	Four Corners 1	186	0.75	wet lime	1979	50	67.5	
	Four Corners 2	186	0.75	wet lime	1979	50	67.5	
	Four Corners 3	244	0.75	wet lime	1979	50	67.5	
	Four Corners 4	786	0.75	wet lime	1984	80	67.5	99.2
	Four Corners 5	786	0.75	wet lime	1985	80	90	
Associated Electric								
	Thomas Hill 3	670	4.80	limestone	1982	91.5	92	84
Basin Electric Power								
	Antelope Valley 1	490	0.68	SD	1983	60	62	100
	Antelope Valley 2	490	0.68	SD	1985	78	78	
	Laramie River 1	600	0.54	limestone	1980	90	95	
	Laramie River 2	600	0.54	limestone	1986	90	90	
	Laramie River 3	600	0.54	SD	1982	82.5	85	
Big Rivers Electric								
	D. B. Wilson 1	440	3.75	limestone	1986	NA	NA	
	Green 1	250	3.91	wet lime	1979	90	90	92.5
	Green 2	242	3.91	wet lime	1980	90	90	92.5
Central Illinois Light								
	Duck Creek 1	396	3.40	limestone	1976	85.3	85.3	96.3
Central Illinois Public Service								
	Newton 1	500	3.00	Dual Alkali	1979	90	90	100
Cincinnati Gas & Electric								
	East Bend 2	643	2.60	wet lime	1981	87	87	
City Utilities of Springfield								
	Southwest 1	195	3.50	limestone	1977	80	85	69.3
Colorado Ute Electric								
	Craig 1	454	0.45	limestone	1980	85	85	83.5
	Craig 2	454	0.45	limestone	1980	85	85	86.5
	Craig 3	421	0.45	SD	1985	85	90	
Columbus & Southern Ohio Electric								
	Conesville 5	405	4.50	wet lime	1977	89.5	92	87.7
	Conesville 6	405	4.50	wet lime	1978	89.5	92	81.8
Cooperative Power Association								
	Coal Creek 1	550	0.63	wet lime	1979	54	90	
	Coal Creek 2	550	0.63	wet lime	1980	54	90	
Delmarva Power & Light								
	Delaware City 1	28	7.00	Wellman-Lord	1980	90	90	81.1
	Delaware City 2	28	7.00	Wellman-Lord	1980	90	90	81.6
	Delaware City 3	75	7.00	Wellman-Lord	1980	90	90	90.2
Desert Gen & Trans								
	Bonanza 1	430	0.50	limestone	1988	95	95	
Duquesne Light								

Source: PEI 1987 Survey of Operating Utility FGD Plants

TABLE 4-1 (Continued)

Unit	Size (MW)	% S	FGD Type	Year Start	Control Efficiency		System Availability
					Design	Actual	
Elrama 1-4	510	2.05	wet lime	1975	83	94	
Phillips 1-6	408	2.05	wet lime	1974	83	84	
East Kentucky Power							
Spurlock 2	550	3.50	wet lime	1983	79.4	90	
Grand Haven Board of Light and Power							
J R Sims 3	65	2.75	wet lime	1983	90	90	100
Grand River Dam Authority							
GRDA 2	575	0.95	wet lime	1986	85	85	
Hoosier Energy							
Merom 1	490	3.80	limestone	1982	90	90	88
Merom 2	490	3.80	limestone	1982	90	90	86.5
Houston Lighting & Power							
Limestone 1	780	1.08	limestone	1986	90	90	
Limestone 2	780	1.08	limestone	1986	90	90	
W A Parish 8	570	0.41	limestone	1982	70	85	
Indianapolis Power and Light							
Petersburg 3	532	3.25	limestone	1986	85	80	87
Petersburg 4	526	3.50	limestone	1986	80	90	80.4
Jacksonville Electric Authority							
St Johns River 1	612	2.50	limestone	1987	NA	90	
Kansas City Power & Light							
La Cygne 1	740	5.39	limestone	1973	80	80	
Kansas Power & Light							
Jeffrey 1	650	0.32	limestone	1978	80	80	
Jeffrey 2	650	0.32	limestone	1980	80	80	
Jeffrey 3	650	0.32	limestone	1983	80	80	
Lawrence 4	119	0.55	limestone	1977	73	73	
Lawrence 5	355	0.55	limestone	1978	52	70	
Kentucky Utilities							
Green River 1-3	60	2.23	wet lime	1976	98	80	83.8
Lakeland Utilities							
McIntosh 3	364	2.56	limestone	1982	85	85	
Los Angeles Department of Water & Power							
Intermountain 1	841	0.79	limestone	1986	90	90	
Louisville Gas & Electric							
Cane Run 4	170	3.87	wet lime	1977	85	87	
Cane Run 5	181	3.80	wet lime	1978	85	85	
Cane Run 6	280	4.80	Dual Alkali	1979	95	94.2	
Mill Creek 1	321	3.75	wet lime	1981	85	86.6	
Mill Creek 2	339	3.75	wet lime	1991	85	86.6	
Mill Creek 3	412	3.87	wet lime	1979	85	85.7	83.5
Mill Creek 4	496	3.75	wet lime	1982	85	85	
Marquette Board of Light & Power							
Shiras 3	44	0.30	SD	1983	80	80	96.75
Michigan So. Central Power Agency							
Endicott 1	55	2.25	limestone	1983	90	90	96
Minnesota Power & Light							
Clay Boswell 4	554	0.94	wet lime	1980	89	89	86.56
Minnkota Power							
Milton R. Young 2	440	0.60	wet lime	1978	78	85	82.8
Monongahela Power							
Pleasants 1	684	3.00	wet lime	1980	90	90	
Pleasants 2	684	3.00	wet lime	1980	90	90	
Montana Power							
Colstrip 1	358	0.78	wet lime	1975	80	80	97.27
Colstrip 2	358	0.78	wet lime	1976	80	80	93.6

Source: PEI 1987 Survey of Operating Utility FGD Plants

TABLE 4-1 (Continued)

	Unit	Size (MW)	% S	FGD Type	Control Efficiency		System Availability
					Year Start	Design Actual	
	Colstrip 3	778	0.70	wet lime	1984	95	95.7
	Colstrip 4	778	0.70	wet lime	1986	95	95.7
Montana-Dakota Utilities							
	Coyote 1	427	0.87	SD	1981	70	75
Muscatine Power & Water							
	Muscatine 9	172	3.21	limestone	1983	94	94
Nevada Power							
	Reid Gardner 1	125	0.50	sodium	1974	90	90
	Reid Gardner 2	125	0.50	sodium	1974	90	91.2
	Reid Gardner 3	125	0.50	sodium	1976	85	91.2
	Reid Gardner 4	285	0.75	sodium	1983	85	85
New York State Electric & Gas							
	Somerset 1	680	2.70	limestone	1984	90	90
Northern Indiana Public Service							
	R M Schahfer 17	379	3.20	Dual Alkali	1983	90	90
	R M Schahfer 18	376	3.20	Dual Alkali	1986	90	90
Northern States Power							
	Riverside 6-7	150	1.20	SD	1980	90	90
	Sherburne Co 1	750	0.80	limestone	1978	50	50
	Sherburne Co 2	750	0.80	limestone	1977	50	50
	Sherburne Co 3	850	1.00	SD			
Orlando Utilities Commission							
	C H Stanton 1	480	0.80	limestone			
Pacific Power and Light							
	Jim Bridger 2	508	0.56	sodium	1986	NA	NA
	Jim Bridger 4	508	0.56	sodium	1980	91	91
	Wyodak 1	320	0.55	SD	1986	NA	NA
Pennsylvania Power							
	Bruce Mansfield 1	835	3.50	wet lime	1976	92.1	92.1
	Bruce Mansfield 2	835	3.50	wet lime	1977	92.1	92.1
	Bruce Mansfield 3	835	4.30	wet lime	1980	92.2	92.5
Philadelphia Electric							
	Cromby 1	188	2.00	mag ox	1983	92	92
	Eddystone 1	354	2.00	mag ox	1982	92	92
	Eddystone 2	354	2.00	mag ox	1982	92	92
Plains Electric G & T							
	Plains Escalante 1	233	0.80	limestone	1984	75	75
Platte River Power Authority							
	Rawhide 1	278	0.34	SD	1984	80	80
Public Service Indiana							
	Gibson 5	667	3.30	limestone	1983	86	95
Public Service of New Mexico							
	San Juan 1	361	0.80	Wellman-Lord	1978	90	90
	San Juan 2	550	0.80	Wellman-Lord	1978	90	90
	San Juan 3	544	0.80	Wellman-Lord	1979	90	90
	San Juan 4	544	0.80	Wellman-Lord	1982	90	90
Salt River Project							
	Coronado 1	400	0.56	limestone	1979	82	98
	Coronado 2	400	0.56	limestone	1981	82	98
San Miguel Electric							
	San Miguel 1	410	2.39	limestone	1981	88	88
Seminole Electric							
	Seminole 1	650	2.75	limestone	1984	86	86
	Seminole 2	650	2.75	limestone	1985	86	86
Sierra Pacific Power							
	North Valmy 2	288	0.50	SD	1985	70	70

Source: PEI 1987 Survey of Operating Utility FGD Plants

TABLE 4-1 (Continued)

<u>Unit</u>	<u>Size (MW)</u>	<u>% S</u>	<u>FGD Type</u>	<u>Year Start</u>	<u>Control Efficiency Design</u>	<u>Actual</u>	<u>System Availability</u>
Sikeston Board of Municipal Utilities							
Sikeston 1	235	2 80	limestone	1981	80	80	
South Carolina Public Service							
Cross 2	510	1 80	limestone	1984	85 8	85 8	94 4
Winyah 2	315	1 00	limestone	1977	45	69	97 3
Winyah 3	315	1 00	limestone	1980	90	90	94 5
Winyah 4	315	1 70	limestone	1981	80	80	90 8
South Mississippi Electric Power							
R D Morrow Sr 1	215	1 64	limestone	1978	85	85	99 7
R D Morrow Sr 2	215	1 64	limestone	1979	85	85	90 4
Southern Illinois Power							
Marion 4	184	3 75	limestone	1979	89 4	89 4	97
Southern Indiana Gas & Electric							
A B Brown 1	265	3 35	Dual Alkali	1979	85	85	84 3
A B Brown 2	265	3 35	Dual Alkali	1986	90	90	71
Southwestern Electric Power							
Dolet Hills 1	720	0 70	limestone	1986	76	76	
Henry W Pirkey 2	720	0 80	limestone	1985	85	76	
Springfield Water Light and Power							
Dallman 3	192	3 05	limestone	1981	95	95	76 3
Sunflower Electric							
Holcomb 1	319	0 34	SD	1983	80	80	100
Tampa Electric							
Big Bend 4	455	3 50	limestone	1985	90	90	
Tennessee Valley Authority							
Paradise 1	704	3 20	limestone	1983	84	84 2	100
Paradise 2	704	3 20	limestone	1983	84	84 2	100
Widows Creek 7	575	3 70	limestone	1981	80	80	
Widows Creek 8	550	3 30	limestone	1978	80	70	
Texas Municipal Power Agency							
Gibbons Creek 1	443	1 06	limestone	1983	87 3	87 3	
Texas Power & Light							
Sandow 4	595	1 60	limestone	1981	75	75	
Texas Utilities							
Martin Lake 1	793	0 90	limestone	1977	71	95	
Martin Lake 2	793	0 90	limestone	1978	71	95	
Martin Lake 3	793	0 90	limestone	1979	71	95	
Monticello 3	791	0 50	limestone	1978	74	74	
United Power Association							
Stanton 1A	60	0 77		1982	72 7	91	
Utah Power & Light							
Hunter 1	430	0 52	wet lime	1979	80	80	
Hunter 2	430	0 52	wet lime	1980	80	80	
Hunter 3	424	0 55	limestone	1983	90	90	
Huntington 1	426	0 43	wet lime	1978	80	80	77 2
Naughton 3	346	0 55	sodium	1981	70	70	95
West Penn Power							
Mitchell 3	296	2 80	wet lime	1982	95	95	
West Texas Utilities							
Oklaunion 1	720	0 34	limestone	1986	70	70	

Source: PEI 1987 Survey of Operating Utility FGD Plants

lime, sodium, magnesium oxide, Wellman-Lord and dual-alkali wet scrubbing processes as well as limestone spray drying

The PEI listing indicates that there are nine operating units with wet limestone scrubbing systems, four units with wet lime scrubbing systems, and one unit with a dual-alkali system which average greater than 94% SO₂ control

Therefore, even though there are no PC units with a permit limit as stringent as 95% control, this level of control is considered technologically feasible for both wet scrubbing and spray drying based on data from operating systems

The control efficiency of acid gases (HF, H₂SO₄) associated with this level of SO₂ control will be greater than 50%. This level would be achieved using either wet scrubbing or spray drying

4 2 1 2 Economic Analysis of 0 17 lb/MMBtu

Capital and annualized operating costs for the limestone scrubbing and spray drying control alternatives were estimated. As the most common FGD system in use currently, the limestone scrubbing process is considered to be most representative of wet scrubbing FGD processes in general capable of achieving 95% control

For the limestone scrubbing alternative, capital equipment includes flue gas handling equipment (parallel ID fans, ductwork, dampers and steam coil flue gas reheat system), scrubbing equipment (three absorber towers in parallel [one spare], reagent recirculation pumps, recirculation and reaction tanks, pH control equipment and system controls), reagent feed preparation equipment (limestone storage hoppers, ball mills and slurry tanks), waste handling equipment (thickener, rotary drum vacuum filter, pug mill and sludge transportation and storage equipment), and support equipment (seal water system, instrument air compressor, makeup water system and control room)

Equipment for the spray dryer system includes two parallel absorber vessels, pebble lime receiving and storage equipment, a lime slaker, lime slurry feed and recirculation tanks, and spent reaction product storage and handling facilities

Capital and annual costs for the alternative SO₂ and acid gas controls for the proposed 330 MW Indiantown PC unit are shown on Tables 4-2 and 4-3

Total capital cost to achieve 0 17 lb/MMBtu is estimated at \$67,828,000 and \$32,271,000 for the limestone and spray drying process, respectively. Total annual costs are estimated at \$31,385,000/yr and \$25,383,000/yr for the two processes

TABLE 4-2
Costs for SO₂ /Acid Gas Control Alternatives, PC Boiler

	<u>WET FGD</u>	<u>SPRAY DRYER</u>
(1) Purchased Equipment		
(a) Basic Equipment	27,000,000	12,500,000
(b) Auxiliaries	included	included
(c) Instrumentation and Controls	2,700,000	1,250,000
(d) Structural Support	2,700,000	1,250,000
(e) Freight & Taxes	2,592,000	1,200,000
(2) Direct Installation	10,498,000	4,860,000
Total Direct Costs (TDC)	\$45,490,000	\$21,060,000
(3) Indirect Installation		
(a) Engineering & Supervision	4,549,000	2,106,000
(b) Construction & Field Expense	4,549,000	2,106,000
(c) Construction Fee	2,275,000	1,053,000
(d) Contingencies	9,098,000	4,212,000
(4) Other Indirect Costs		
(a) Startup & Performance Test	455,000	211,000
(b) Working Capital	1,412,000	1,523,000
Total Indirect Costs (TIC)	\$22,338,000	\$11,211,000
Total Capital Cost (TCC)	\$67,828,000	\$32,271,000
(5) Annualized Capital Recovery	\$11,008,000	\$5,238,000
(amortized over 10 years straight line @ 10% interest rate)		

Cost Factors 1990 OAQPS Control Cost Manual

TABLE 4-3
Annual Costs for SO₂/Acid Gas Control Alternatives, PC Boiler

	<u>WET FGD</u>	<u>SPRAY DRYER</u>
Direct Operating Costs		
(1) Labor		
(a) Operating (1)		
(b) Supervisory	\$787 000	\$524,000
(2) Maintenance	118,000	79,000
(a) Labor		
(b) Supplies (50% Maint Labor)	1,180,500	786 000
(3) Replacement Parts	590,000	393 000
(4) Utilities (1)(2)	1,350,000	625,000
(a) Air	-	-
(b) Steam	-	-
(c) Electricity	-	-
(5) Raw Materials (1)(2)	2,919,000	1,249 000
(a) Limestone		
(b) Lime	3,815,000	-
(6) Solid Disposal (1)(2)	-	8,726,000
Indirect Operating Costs	6 421,000	6 150,000
(7) Overhead		
(8) Taxes	484,000	322,000
(9) Insurance	678,000	323,000
(10) Administration	678,000	323 000
Annual Operating Costs	1,357,000	645,000
Annual Capital and Operating Costs	\$20 377,500	\$20,145 000
	\$31,385,500	\$25,383,000

Notes

- (1) per Bechtel Power
(2) based on 100% capacity

4 2 1 3 Environmental and Energy Analysis

Makeup Water Requirements

Based on information supplied by Bechtel Power, the dry scrubbing alternative would require 378 GPM of water makeup, while the wet scrubbing alternative would require 444 GPM. Based on the stringent water availability limitations at the site, the spray drying alternative is preferred since it requires less water.

Sludge Disposal Requirements

The primary difference between the wet scrubbing and spray drying alternatives in terms of solids disposal is related to the moisture content of the sludge. Spray drying produces a solid material for disposal which is essentially free of moisture. Wet scrubbing, on the other hand, generates a sludge which may contain up to 30% water. For Indiantown, the dry solid material will be returned to the coal mine for disposal, whereas for this to be done with the wet scrubber sludge, it must be dried to 10% moisture or lower, which would entail increased capital and operating costs.

The quantity of material to be disposed of in either case is similarly related to the moisture. Based on information supplied by Bechtel Power, the dry scrubbing alternative will generate approximately 145,000 ton/yr of dry material for disposal, the wet scrubbing alternative would generate approximately 151,000 ton/yr of sludge.

Thus, both in terms of ease of disposal and quantity of material to be disposed, the spray drying alternative is preferred over the wet scrubbing alternative.

Facility Energy Balance

The spray drying alternative will result in lower facility energy impacts when compared to the wet limestone process. Bechtel Power estimates that the system power requirements (to operate slurry pumps, grinders, and sludge handling equipment) are 2,150 kw and 3,470 kw for the spray dryer and wet scrubbing alternatives, respectively. Thus the spray dryer is more energy efficient than the wet scrubbing alternative.

4 2 1 4 Conclusion

The use of either wet scrubbing or dry lime spray drying is concluded to be technically feasible for the proposed Indiantown PC boiler. Annualized cost for the wet scrubbing alternative is estimated at \$31,385,000/yr, cost of the dry scrubbing alternative is estimated at \$25,383,000/yr, representing an annual cost reduction of \$6,000,000.

The use of the wet scrubbing alternative would result in the production of large amounts of wet sludge which must be disposed of. In addition, the wet scrubbing alternatives require more makeup water than the dry scrubbing alternative, which is a significant concern given the water constraints in the Indiantown project area. The wet scrubbing alternative also requires more energy than the dry scrubbing alternative.

Finally, there is no clear evidence that the wet scrubbing alternative would result in better control of trace metal emissions. Therefore, the spray dryer alternative, at an emission limit of 0.17 lb/MMBtu, is considered representative of BACT for the PC boiler based on economic, energy and environmental considerations.

4 3 BACT for SO₂ and Acid Gases - Auxiliary Boiler

4 3 1 Control Alternatives

As with the PC boiler, the available alternatives for control of SO₂ and acid gases from the auxiliary boiler include various flue gas desulfurization techniques and limiting the fuel sulfur content.

In developing standards of performance for new oil-fired steam generating units, EPA stated that sodium scrubbing, lime spray drying and the use of low sulfur oil were all "considered demonstrated" in terms of their ability to meet the proposed 90% reduction requirement (EPA 1986b).

4 3 1 1 Flue Gas Desulfurization Alternatives

As extensively discussed in Section 4.1.2, alternative FGD processes consist of wet and dry systems. For oil-fired sources, dry scrubbing is not technically feasible due to the difficulty in dislodging oil-fired particulate matter from the bags of the fabric filter employed with this control alternative. In general, the most common FGD system applied to oil-fired boilers has been sodium scrubbing (EPA 1986b). Five oil-fired boilers are listed in the BACT/LAER Clearinghouse as utilizing sodium scrubbers for control of SO₂.

4 3 1 2 Fuel Sulfur Limitations

The alternative to FGD controls for SO₂ and acid gases for oil-fired boilers is the use of low sulfur oil. Since virtually all of the sulfur introduced in the fuel becomes oxidized in the furnace and released to the atmosphere as SO₂, the lower the fuel sulfur content, the lower the SO₂ emissions. Limiting the sulfur content also limits acid gas formation, low sulfur content fuels will have release correspondingly lower amounts of SO₃, thereby forming lower levels of sulfuric acid mist.

EPA recognized that fuel sulfur limitations were effective in limiting SO₂ emissions from oil-fired sources when proposing NSPS for fossil fuel-fired steam generators (EPA 1986b). In fact, EPA noted that "for oil-fired steam generating units operating at low capacity utilization factors, it is generally less costly to fire a very low sulfur oil to meet [the proposed emission limit]" than to employ FGD.

4 3 1 3 Permitted Control Levels

The NSPS for #2 fuel oil-fired steam generators with heat inputs greater than 100 MMBtu/hr is 0.3 lb/MMBtu. A list of oil-fired sources in the BACT/LAER Clearinghouse with limits on SO₂ is included in Appendix A. The most stringent emission limit in the Clearinghouse is achieved at four crude oil production facilities in Kern County, CA employing a wet scrubber (0.034-0.05 lb/MMBtu). Therefore the use of sodium-based wet scrubbing to achieve 0.034 lb/MMBtu is considered demonstrated.

Oil-fired facilities employing fuel sulfur limitations (7 of 12 listed) have limits 0.5 lb/MMBtu and higher. The new NSPS for steam generating units with heat inputs greater than 100 MMBtu/hr concludes that the use of very low sulfur oil to meet an emission limit of 0.5 lb/MMBtu is technically feasible. In addition, PG&E-Bechtel Generating Company has determined that fuel suppliers are able to provide oil with a sulfur content of 0.05%, which will have a corresponding emission rate of 0.052 lb SO₂/MMBtu.

Thus the most stringent alternative is concluded to be the use of sodium-based wet scrubbing to achieve 0.034 lb/MMBtu, followed by the use of low sulfur oil to meet 0.052 lb/MMBtu.

4 3 2 Economic Analysis

4 3 2 1 Flue Gas Desulfurization Alternative

The economics of employing a sodium based wet scrubber for control of SO₂ and acid gas emissions on the Indiantown auxiliary boiler were estimated from a vendor equipment quote and are shown on Tables 4-4 and 4-5. Equipment costs are estimated at \$360,000, and total installed cost and capital recovery costs are estimated at \$810,000 and \$131,000/yr, respectively. Operating costs consist mainly of fixed costs for capital recovery and overhead, as well as variable costs for reagent and equipment maintenance. At the proposed 1000 hours/yr of auxiliary boiler firing, the total annualized costs are \$536,000, and for a cost effectiveness (compared to low sulfur oil firing) of \$63,523/ton. This is not considered cost effective, and therefore unrepresentative of BACT.

4 3 2 2 Fuel Sulfur Limitations

There are no adverse economic impacts associated with firing fuel oil with 0.05% sulfur.

4 3 3 Environmental and Energy Impacts Analysis

For the wet scrubbing alternative, the most significant adverse environmental impacts are the disposal of the scrubber waste and obtaining the necessary makeup water for the system. At the proposed 1,000 hours/yr of auxiliary boiler firing, this alternative would generate approximately 34,000 lb/yr of dissolved sodium compounds.

There are no adverse environmental impacts associated with the use of low sulfur oil.

Energy impacts associated with the use of a sodium-based wet scrubber to control SO₂ and acid gas emissions from the Indiantown auxiliary boiler are related to increased fan power required to overcome scrubber pressure drop and power required to run circulation pumps. Total power requirement is estimated to be 8,500 kwhr/yr, for a energy effectiveness of 1000 kw/ton SO₂ controlled. There are no adverse energy impacts associated with the use of low sulfur oil.

4 3 4 Conclusion

Both the use of sodium-based wet scrubbers and firing very low sulfur oil are considered demonstrated alternatives for control of SO₂ and acid gases from the proposed oil-fired auxiliary boiler. The use of wet scrubbing, however, would result in significant economic and energy impacts, and is thus concluded to be unrepresentative of BACT.

TABLE 4-4
Capital Costs for SO₂ Control Alternatives, Auxiliary Boiler

	<u>Wet FGD</u>
(1) Purchased Equipment	
(a) Basic Equipment	360 000
(b) Auxiliaries	included
(c) Instrumentation and Controls	36,000
(d) Structural Support	36,000
(e) Freight & Taxes	35,000
(2) Direct Installation	140,000
Total Direct Costs (TDC)	\$607,000
(3) Indirect Installation	
(a) Engineering & Supervision	61,000
(b) Construction & Field Expense	61,000
(c) Construction Fee	30,000
(d) Contingencies	18,000
(4) Other Indirect Costs	
(a) Startup & Performance Test	6 000
(b) Working Capital	27,000
(c) License Fee	-
Total Indirect Costs (TIC)	\$203,000
Total Capital Cost (TCC)	\$810 000
(5) Annualized Capital Recovery	\$131,000
(amortized over 10 years straight line @ 10% interest rate)	

Cost Factors 1990 OAQPS Control Cost Manual

TABLE 4-5
Annual Costs for SO₂ Control Alternatives, Auxiliary Boiler

	<u>Wet FGD</u>
Direct Operating Costs	
(1) Labor	
(a) Operating	\$87 600
(b) Supervisory	13 000
(2) Maintenance	
(a) Labor	107,100
(b) Supplies (50% Maint Labor)	54,000
(3) Replacement Parts	36 000
(4) Utilities	
(a) Air	-
(b) Steam	2 900
(c) Electricity	20 200
(5) Raw Materials – Sodium Hydroxide	2 300
(6) Waste Disposal	500
Indirect Operating Costs	
(7) Overhead	50,000
(8) Taxes	8 000
(9) Insurance	8,000
(10) Administration	16,000
Annual Operating Costs	\$405,600
Annual Capital and Operating Costs	\$536,600
Annual Tons Removed (1)	8.4
Cost Effectiveness (\$/ton)	\$63,523

Notes
(1) compared to 0.052 lb/MMBtu with 1000 annual operating hours

Therefore firing very low sulfur oil to meet an emission limitation of 0.052 lb SO₂/MMBtu is considered representative of BACT for the auxiliary boiler

5 0 BACT DETERMINATION FOR CO AND VOC

5 1 Introduction

Emissions of carbon monoxide (CO) and volatile organic compounds (VOCs) result from the incomplete combustion of carbon and organic compounds. CO and VOC emissions are a function of oxygen availability (excess air), flame temperature, residence time at flame temperature, boiler design, and turbulence. The baseline emissions of CO and VOC from the Indiantown coal-fired boiler are estimated to be 400 ton/yr and 70 ton/yr, respectively. For the auxiliary boiler, worst-case CO and VOC emissions (assuming oil firing for CO and gas firing for VOC) are estimated at 23.7 and 0.31 ton/yr, respectively.

Control of the emissions of CO and VOCs may be effected two ways: (1) combustion modifications to minimize the formation of the pollutants, and (2) flue gas catalytic oxidation of any CO and VOCs formed in the combustion process.

Lists of coal- and oil-fired boilers with limits on CO and VOC emissions in the BACT/LAER Clearinghouse is included in Appendix A. Combustion controls are listed as the predominant control technology utilized.

5 2 Catalytic Oxidation

5 2 1 Description

Catalytic oxidation has been the control alternative used to obtain the most stringent control level for CO and VOCs from fossil fuel-fired combustion units. The use of this alternative is well established for certain fuels and firing configurations, such as combustion turbines firing natural gas. This alternative has never been applied to a coal-fired unit, however.

As with the use of SCR for the control of NO_x , catalytic oxidation is a process which employs a catalyst material containing active sites on which the reactant species (CO, VOCs and O_2) are adsorbed. This adsorption lowers the activation energy of the oxidation reaction and permits combination of the reactants species at lower gas temperatures than would be required for uncatalyzed oxidation.

The effective temperature range of the flue gas for catalytic oxidation is between 600 and 1150°F. CO oxidation occurs at any temperature above 600°F, VOC oxidation requires a higher temperature (900-1000°F).

The overall reaction rate for catalytic oxidation is subject to the following factors

- rate of diffusion of oxygen to unoccupied active sites
- rate of diffusion of oxidizable species (CO or VOC) to oxygen-occupied sites
- rate of oxidation reaction on active sites
- rate of desorption of reaction products (CO₂ and H₂O) from active sites

The rate of diffusion of oxidizable species to active sites on the catalyst surface is the rate-controlling step, the other three steps, for low concentrations of CO and VOC in the presence of excess oxygen, are not significant contributors to the overall rate. Therefore, catalysts are designed so as to maximize active site activity and stability, number of active sites, and ease of access of oxidizable species to active sites.

The main advantage of the oxidation catalyst alternative is the high removal efficiency (up to 90% for gas-fired sources with little sulfur present in the fuel). In addition, a catalytic oxidation system occupies little space, is relatively easy to operate, and requires no reagents other than what is present in the flue gas.

For sulfur containing fuels, such as coal and fuel oil, the main disadvantage of an oxidation catalyst is the lack of catalyst selectivity; catalysts will promote oxidation of SO₂ to SO₃ in addition to CO and VOCs. The amount of SO₂ conversion is a strong function of temperature and catalyst design, however under the proper conditions, formation of SO₃ can be minimized to 20-23% of inlet SO₂. This level of conversion would result in unacceptable levels of corrosion to the air preheater and ductwork.

5.2.2 Applicability to Coal Firing

ENSR contacted an oxidation catalyst vendor to determine the technical feasibility and economic impacts of installing an oxidation catalyst on a coal-fired boiler. Due to the high particulate loading of the flue gas, trace element concentration, an SO₂ level, the vendor stated that they could not provide a catalyst system for this particular application. The vendor stated that flue gas particulate will plug the catalyst, thereby restricting gas flow, masking the active sites and corroding the catalyst. Generally, oxidation catalysts are designed for a maximum particulate loading of 50 mg/Nm³ (Englehard, 1990). The proposed Indiantown boiler will have a particulate loading upstream of the baghouse in excess of 2,000 mg/Nm³.

In addition, trace elements present in coal, in particular chlorine, are poisonous to oxidation catalysts

Although the catalyst could be installed downstream of the spray dryer/fabric filter, the flue gas temperature at that point will be approximately 150°F, which is below the minimum temperature required (600°F). The flue gas would thus have to be reheated, resulting in significant unfavorable energy and economic impacts. For these reasons, as well as the generally low level of CO and VOC in coal-fired units, no PC boilers have been equipped with oxidation catalysts

5.2.3 Applicability to Oil Firing

Catalyst vendors contacted stated that they have never supplied an oxidation catalyst system for an oil-fired boiler. Although the sulfur, ash and trace element concentrations in fuel oil are lower than the concentrations in coal, the presence of these constituents in fuel oil result in oxidation catalyst systems being technologically infeasible for the fuel oil-fired auxiliary boiler.

5.2.4 Conclusion

Use of an oxidation catalyst system in either the proposed Indiantown PC boiler or fuel oil-fired auxiliary boiler is thus considered technically infeasible. There are no catalysts developed that have or can be applied to coal- or oil-fired boilers due to the high levels of particulate matter and trace elements present in the flue gas. Thus, this alternative cannot be considered to represent BACT for control of CO and VOCs from either of the proposed boilers.

5.2.5 Combustion Controls

The next most stringent levels of control of CO and VOCs from fossil fuel-fired boilers have been achieved through the use of modifications to the boiler design and operation intended to limit the formation of these pollutants. Such controls are commonly referred to as combustion controls. In general, a combustion control system seeks to maintain the proper fuel to oxygen ratio to ensure complete combustion.

For the PC boiler, the estimated CO and VOC emission rates of 0.11 and 0.0036 lb/MMBtu, respectively, are based on the use of combustion controls. Similarly, the estimated emission rates for the auxiliary boiler (0.14 lb CO/MMBtu and 0.0018 lb VOC/MMBtu) reflect the use of combustion controls.

5.2 6 Description

In general, a combustion control system seeks to maintain the proper fuel to oxygen ratio to ensure complete combustion of the fuel. Essential requirements are sufficient excess air, thorough mixing of fuel and air, and adequate furnace residence time. Advanced combustion controls accomplish this through the use of one or more of the following operational design features:

- Low excess air
- Staged combustion
- Overfire air

5 2 7 Economic, Environmental and Energy Considerations

There are no adverse economic impacts associated with the use of combustion controls for minimization of CO and VOC emissions from either the PC boiler or the auxiliary boiler. Minimization of emissions of these pollutants represents a maximization of fuel use and therefore boiler thermal efficiency, as well as a requirement in terms of licensability and permitting. Such boiler design considerations are therefore considered standard features of modern fossil fuel combustion units.

There are no adverse environmental considerations in conjunction with the use of combustion controls in either the PC boiler or the auxiliary boiler for minimization of the formation of CO and VOC.

5 2 8 Conclusion

Combustion controls minimize the formation and emission of both CO and VOCs without adverse economic, energy or environmental impacts. Such controls are the most stringent control alternative which has been demonstrated to be applicable to PC and fuel oil-fired units, and should therefore be concluded to be representative of BACT for both the PC boiler and the auxiliary boiler.

6 0 BACT FOR STACK EMISSIONS OF PARTICULATE MATTER (PM) AND PM₁₀

6 1 Introduction

The composition and amount of particulate matter (PM) emitted from coal fired boilers are a function of firing configuration, boiler operation and coal properties (U S EPA, 1985a) Particulate matter (as total suspended particulates or TSP) will be emitted from the proposed pulverized coal boiler as a result of the entrainment of uncombustible inert matter (ash), and condensible substances Since PC systems attain almost complete combustion, very little unburned carbon should be present (U S EPA, 1985a)

Based on a 12% coal ash content, the uncontrolled emissions of PM will be approximately 153,000 tpy Due to the fine nature of the coal particles combusted in the boiler, it is conservatively assumed that all particles emitted will be less than 10 microns in diameter or PM 10 Thus, the uncontrolled emissions of PM-10 would also be ~153,000 tpy

6 1 1 Available Control Options

A review of EPA's BACT/LAER Clearinghouse was conducted to identify available control technologies, and to determine the level of particulate control which has been determined to represent BACT for pulverized coal fired boilers

Data for coal fired boilers from the BACT/LAER Clearinghouse is presented in Appendix A and summarized in Table 6-1 As shown in Table 6-1, all of the entries for coal fired boilers for the last three years have been permitted with fabric filters (baghouses) for PM control Twenty utility sized generating station entries are listed with ESPs, these are assumed to represent pulverized coal fired units Only four of the baghouse equipped entries are assumed to represent PC boilers The rest are mostly spreader stokers or fluidized bed boilers

A review of vendor offerings and the technical literature identified several wet control techniques which have been applied to combustion sources in general These include venturi scrubbers, tray towers, the Calvert® collision scrubber, and wet ESPs such as the Cielcote® ionizing wet scrubber No examples of the application of wet particulate control to PC boilers are listed in Table 6-1

The control options which were identified for the potential control of PM from PC boilers, coal fired boilers in general, and from other types of combustion sources are listed as follows

TABLE 6 1
Coal Fired Boilers BACT/LAER Clearinghouse Listings for PM
(1980 - Present)

Name	Type	Size MMBtu/hr	Reviewing Agcy	Date of Issuance	BACT for PM
Applied Energy Services	CFB	2150	Hawaii DOH	1/25/90	32.2 lb/hr (0.007 gr/dscf) - Baghouse (99.9%) - ~0.018 lb/MMBtu
A E S Thames Inc	FB	923	Connecticut DEP	8/9/89	0.02 lb/MMBtu - Baghouse (99.9%)
A E S Thames Inc	FB	923	Connecticut DEP	8/9/89	0.02 lb/MMBtu - Baghouse (99.9%)
Cogentrix Rocky Mount (4 units)	SS	375	North Carolina DEM	7/20/89	0.0200 lb/MMBtu - Fabric Filter
Cambria Cogen Inc (2 units)	CFB	559	Pennsylvania BAQC	5/28/89	16.8 lb/hr (0.03 lb/MMBtu) - Fabric Filter (99.9% eff)
Scrubgrass Power Corp (2 units)	CFB	599	Pennsylvania BAQC	1/18/89	0.0300 lb/MMBtu - Fabric Collector (99.96% eff)
Goodyear United Development	FB	577	New York State DEC	10/14/88	0.022 lb/MMBtu - Fabric Filter (99% eff)
North Branch Energy Partners LP	CFB	563	Pennsylvania BAQC	9/28/88	0.03 (PM) 0.028 (PM10) lb/MMBtu - FF (99% eff)
United Development Group	FB	577	New York State DEC	9/25/88	0.022 lb/MMBtu - Pulse Jet Baghouse (99.8% eff)
Fort Howard Corp	CFBC	505	Wisconsin DNR	9/21/88	0.05 lb/MMBtu - Baghouse
Northeastern Power Co	CFB	513	Pennsylvania BAQC	6/17/88	0.028 lb/MMBtu - Fabric Filter (99% eff)
Edensburg Power Co	FB	817	Pennsylvania BAQC	6/6/88	0.0300 lb/MMBtu - Baghouse (99.98% eff)
TVA - Shawnee	AFBC	1579	Kentucky DAQ	5/4/88	0.03 lb/MMBtu - Baghouse (99% eff)
Panther Creek Energy	CFB	1170	Pennsylvania DER	2/17/88	0.03 lb/MMBtu - Baghouse (99% eff)
GWF Power Systems Co Inc	CF	202	Bay Area AQMD (CA)	2/11/88	30 lb/d Baghouse Pulse Jet
City of Wyandotte Dept Mun Svcs	CFBC	369	Wayne Co APC	12/07/87	0.011 lb/MMBtu - baghouse (99.9%)
Cogentrix Michigan Leasing Corp	SS	214	Michigan DNR	7/31/87	0.03 lb/MMBtu - Baghouse (99.1% eff)
Fort Drum Heating Plant	CFB	190	New York State DEC	4/1/87	0.05 lb/MMBtu - Baghouse
Wm H Zimmer Generating Sta	NS	11968	Southwest Ohio APCA	2/5/87	0.025 lb/MMBtu - ESP (99.5% eff)
Archbald Power Corp	CFB	240	Pennsylvania DER	1/16/87	0.05 lb/MMBtu - Fabric Filter
Mt Poso Cogeneration Co	CFB	50 MW	EPA Region IX	1/12/87	0.01 gr/dscf - baghouse - ~0.02 lb/MMBtu
Foster Wheeler Power (2 units)	NS	283	Pennsylvania DER	12/29/86	0.03 lb/MMBtu - Baghouse (99.9% eff)
Tultex Corp	NS	12	Virginia APCB	12/18/86	0.43 lb/MMBtu - settling chamber (35%)
Sheridan Coal Co	NS	550	Pennsylvania DER	12/1/86	0.03 lb/MMBtu - Baghouse/Cyclone
Pyropower Corp	CFB	640	Kern County APCD	12/1/86	0.012 lb/MMBtu - fabric filter (99.9%)
J Pagnotti Enterprises	NS	1082	Pennsylvania DER	11/1/86	0.03 lb/MMBtu - Baghouse/Cyclone
Utah Power & Light Co	NS	4000	Utah BAQ	10/1/86	0.1 lb/MMBtu - ESP (99% eff)
Cogentrix Carolina Leasing Corp	NS	202	North Carolina DEM	7/7/86	0.03 lb/MMBtu - bagfilter (99.1%)
Northeastern Power Co	NS	540	Pennsylvania DER	6/27/86	0.028 lb/MMBtu - Fabric Filter
BMCP	CFB	220	Kern County APCD	6/20/86	0.0156 gr/dscf - fabric collector (99%) - ~0.03 lb/MMBtu
Cogentrix Hopewell	NS	200	Virginia APCB	6/12/86	0.03 lb/MMBtu - baghouse (99.1%)
Cogentrix Carolina Leasing Corp	NS	202	North Carolina DEM	5/28/86	0.03 lb/MMBtu - baghouse (99.1%)
TVA - Shawnee	AFBC	1430	Kentucky DAPC	4/15/86	0.03 lb/MMBtu - FF (99%)
Westwood Energy Properties	NS	425	Pennsylvania DER	1/6/86	0.03 lb/MMBtu - FF (99.92%)
Cogeneration National Corp	CFB	279.6	San Joaquin Cty APCD	12/13/85	0.036 lb/MMBtu - baghouse
TVA - Paducah	CFB	200	Kentucky DAPC	12/13/85	0.1 lb/MMBtu - baghouse (98.85%)
Signal Frackville Energy	NS	NS	Pennsylvania DER	12/2/85	0.012 lb/MMBtu - Baghouse (99.9% eff)
Corn Products	CFB	620	San Joaquin Cty APCD	10/29/85	0.016 lb/MMBtu - baghouse
White Pine Power Project	NS	750	Nevada DEP	8/6/85	0.02 lb/MMBtu - baghouse (99.6%)
Central State University	NS	68	Dayton RAPCA	7/1/85	0.1 lb/MMBtu - baghouse (99%)
Union Camp - Franklin	NS	245	Virginia APCB	7/1/85	0.05 lb/MMBtu - ESP (99%)

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker PC - pulverized coal NS-not specified

TABLE 6-1 (Continued)

Name	Type	Size MMBtu/hr	Reviewing Agcy	Date of Issuance	BACT for PM
Biogen Power Project	CFBC	212	EPA Region IX	4/26/85	0 01 gr/dscf @3%O ₂ (~0 03 lb/MMBtu) - baghouse (99 9%)
Wisc Electric Power Co	PFBC	825	Wisconsin DNR	1985	0 02 lb/MMBtu - ESP
3M Co	NS	120	Alabama DEM	11/29/84	0 1 lb/MMBtu - baghouse (98 7%)
Amalgamaize Co	NS	179 7	Alabama DEM	11/29/84	0 05 lb/MMBtu - baghouse (98%)
Puget Sound Naval Shipyard	NS	NS	Puget Sound APCA	9/25/84	0 02 gr/scf (~0 04 lb/MMBtu) - baghouse (99 9%)
Cogentrix - Lumberton	NS	202	North Carolina DEM	9/10/84	0 03 lb/MMBtu - baghouse (99 1%)
Alabama Power Co	NS	248	Alabama DEM	9/10/84	0 05 lb/MMBtu - baghouse (99 6%)
Virginia Power - Portsmouth	PC	1129	Virginia APCB	7/27/84	0 03 lb/MMBtu - ESP (99 3%)
Cogentrix - Kenansville	NS	202	North Carolina DEM	6/25/84	0 03 lb/MMBtu - baghouse (99 1%)
Cogentrix - Hamilton	NS	202	North Carolina DEM	4/3/84	0 03 lb/MMBtu - baghouse (99 1%)
American Lignite Products	CFB	571	EPA Region IX	1/10/84	0 013 lb/MMBtu - baghouse (99 9%)
Lower Colorado River Authority	LIG	4735	Texas ACB	12/22/83	0 03 lb/MMBtu - ESP (99 96%)
American Lignite Prod Co	FB	240	Amador Cty APCD	12/21/83	0 0156 gr/dscf (~0 03 lb/MMBtu) - baghouse (99 93%)
Intermountain Power Project	NS	8352	Utah BAQ	10/17/83	0 02 lb/MMBtu - FF (99 8%)
Basin Electric Power Coop	PC	6278	North Dakota SHD	1/12/83	0 03 lb/MMBtu - baghouse (99 86%)
Eastman Kodak Co	PC	670	New York DEC	12/20/82	0 035 lb/MMBtu - ESP (99 57%)
Washington Water Power Co	PC	2080	EPA Region X	11/17/82	0 03 lb/MMBtu
Iowa Electric Light & Power Co	PC	400	EPA Region VII	10/29/82	0 03 lb/MMBtu - ESP
Holyoke Water Power - Mt Tom	PC	1447	Massachusetts DEQE	10/27/82	0 08 lb/MMBtu - ESP (99 51%)
B F Goodrich	CFB	150	Illinois EPA	9/16/82	0 06 lb/MMBtu - cyclone & baghouse (99%)
Cincinnati Gas & Elect	PC	6313	Kentucky DAPC	5/14/82	0 7 lb/MMBtu -
West Texas Utilities Co	NS	6 8	Texas ACB	5/20/82	0 03 lb/MMBtu - ESP (99 7%)
Kentucky Utilities	PC	6650	Kentucky DAPC	4/15/82	0 03 lb/MMBtu - ESP (99 8%)
Jacksonville Elec Auth	PC	600 MW	Florida DER	1/1/82	0 03 lb/MMBtu - ESP (99 78%)
SC Public Svc - Cross	PC	500 MW	South Carolina DHEC	12/3/81	0 03 lb/MMBtu - ESP (99 8%)
Houston Lighting & Power	PC	5729	EPA Region VI	11/12/81	0 03 lb/MMBtu - FF (99 72%)
Central Power & Light	PC	6781	EPA Region VI	10/19/81	0 03 lb/MMBtu - ESP (99 6%)
Tampa Elect Co	PC	425 MW	Florida DER	10/15/81	0 03 lb/MMBtu - ESP (99%)
Oklahoma Gas & Elect	PC	5250	EPA Region VI	10/5/81	0 03 lb/MMBtu - ESP or baghouse (99 6%)
Delmarva Power & Light	PC	5702	EPA Region III	9/30/81	0 03 lb/MMBtu - ESP (99 65%)
Panorama Enercorp Inc	NS	37 MW	EPA Region X	9/22/81	0 007 gr/dscf (~0 018 lb/MMBtu) - ESP (99%)
SW Elect Power	PC	720 MW	EPA Region VI	9/1/81	0 1 lb/MMBtu - ESP (99 8%)
Pennsylvania Elect Co	PC	6280	EPA Region III	8/18/81	0 03 lb/MMBtu - ESP (99 7%)
NY State Elect - Cyuga	PC	1750	EPA Region II	6/29/81	0 03 lb/MMBtu - ESP
Iowa-Illinois Gas & Elect	PC	7000	EPA Region VII	6/16/81	0 03 lb/MMBtu - ESP
Idaho Nat Engineering Lab	NS	82 5	EPA Region X	6/5/81	0 05 gr/dscf (~0 05 lb/MMBtu) - baghouse (99%)
Plains Elect Gen & Trans	PC	2471	EPA Region VI	5/27/81	0 03 lb/MMBtu - baghouse (99 9%)
Nevada Power Co	PC	580 MW	EPA Region IX	4/13/81	0 015 lb/MMBtu - baghouse
Big Rivers Elect - D B Wilson	PC	4585	Kentucky DAPC	3/11/81	0 03 lb/MMBtu - ESP (99 8%)
AL Elect Coop Inc	LIG	4805	Alabama APCD	2/24/81	0 03 lb/MMBtu - ESP
SW Elect Power	PC	6821	EPA Region VI	2/23/81	0 03 lb/MMBtu - ESP (99 8%)

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker PC - pulverized coal NS-not specified

TABLE 6-1 (Continued)

Name	Type	Size MMBtu/hr	Reviewing Agcy	Date of Issuance	BACT for PM
Container Corp of America	PC	NS	Philadelphia AMS	1/20/81	0.08 lb/MMBtu
Nebraska Public Power Dist	NS	650 MW	Nebraska DEC	12/16/80	0.03 lb/MMBtu - FF (99.9%)
New England Power - Brayton Pt	NS	10625	Massachusetts DEQE	11/1/80	0.08 lb/MMBtu - ESP (99.3%)
E Kentucky Power	NS	6760	Kentucky DAPC	8/21/80	0.03 lb/MMBtu - ESP (99.8%)
City of Wilkes-Barre	NS	92.5	EPA Region III	7/1/80	0.086 lb/MMBtu - baghouse/cyclone (99.7%)
Curtis Wright Corp	NS	137	EPA Region II	6/13/80	none
Intermountain Power Project	NS	3000	EPA Region VIII	6/8/80	0.02 lb/MMBtu - ESP (99.8%)
Utah Power & Light	NS	860	EPA Region VIII	6/2/80	0.03 lb/MMBtu - FF (90%)
Deseret Gen & Trans Moon Lake	NS	800	EPA Region VIII	2/4/80	0.03 lb/MMBtu - FF (99.8%)

Pulverized Coal Boilers

- Electrostatic precipitator (ESP), twenty entries in BACT/LAER clearinghouse
- Fabric filter (FF/baghouse) eleven entries in BACT/LAER clearinghouse

Coal Fired Boilers

- Fabric filter (FF/Baghouse) fifty-four entries in BACT/LAER clearinghouse
- Electrostatic precipitator (ESP), twenty five in BACT/LAER clearinghouse

Combustion Sources in General

- Electrostatic precipitator (ESP)
- Fabric filter (FF/baghouse)
- Venturi scrubber (no listings in BACT/LAER clearinghouse)
- Tray tower (no listings in BACT/LAER clearinghouse)
- Calvert® collision scrubber (no listings in BACT/LAER clearinghouse)
- wet ESPs (no listings in BACT/LAER clearinghouse)

6 1 2 Technical Feasibility Analysis

Electrostatic precipitators clearly represent a technically feasible option for the control of PM from pulverized coal fired boilers. While few installations of fabric filters are listed in the BACT/LAER clearinghouse for PC boilers, this technology is considered to be applicable due to commercial availability, and the large number of coal fired applications with similar flue gas characteristics.

The various wet control techniques are not considered to represent feasible control options for the Indiantown project due to the limited availability of additional clean water and the lack of treatment and disposal capability for wastewater at the Indiantown site. Further, wet control techniques do not represent a demonstrated control technique for large pulverized coal fired boilers, nor do they offer more stringent levels of control than do ESPs and fabric filters. Wet particulate controls will not, therefore, be considered further in this analysis.

6 1 3 Ranking of Technically Feasible Alternatives

Since fabric filters and ESPs are both capable of PM control levels in excess of 99%, performance is compared on a lb/MMBtu of PM emitted basis. This convention allows straightforward comparison with the emission levels listed in the BACT/LAER Clearinghouse.

Of the control options identified, fabric filters are capable of achieving the most stringent levels of PM control available. While other control technologies such as ESP may rival the performance of fabric filters, none were identified as being able to exceed this performance for control of PM and PM₁₀.

Fabric filters are deemed the superior fine particulate (PM-10) removal device because their performance is not as sensitive to particle size distribution as an ESP. According to Appendix C 2 of Supplement A of AP-42 (U.S. EPA, 1985a), fabric filters are more efficient than ESPs at controlling fine particulates (i.e., those with diameters less than 6 microns).

Typical Collection Efficiencies for the Following
Range of Particle Sizes

Control Device	Particle Size (μm)		
	0 - 2.5	2.5 - 6	6 - 10
ESP	95 percent	99 percent	99.5 percent
Fabric Filter	99 percent	99.5 percent	99.5 percent

Since the most stringent emission levels listed in the BACT/LAER Clearinghouse are for fabric filters, and since they are superior to ESPs for control of PM₁₀, fabric filters are considered to represent the top technology for control of PM and PM₁₀ from the proposed project.

The NSPS for control of PM from coal fired steam generating units with heat inputs greater than 100 MMBtu/hr is 0.05 lb/MMBtu (40 CFR 60 Subpart Db). The most recent entry in the BACT/LAER Clearinghouse for fabric filter control of PM from a coal fired boiler lists an emission rate of 0.18 lb/MMBtu (Applied Energy Services). Of the remaining eighty-two listings in the BACT/LAER clearinghouse, only five are listed with emission rates less than 0.18 lb/MMBtu, the most recent of these is a 1987 determination for City of Wyandotte.

ENSR contacted Mr. Barry Andrews at the Florida DER to determine if any coal fired boilers were currently being permitted in the State. The only coal fired unit to obtain a permit in Florida in the

last five years is a project in Jacksonville (Cedar Bay Cogeneration) which is currently awaiting federal PSD approval. This 225 MW CFB project will control PM with fabric filters, to a level of 0.2 lb/MMBtu.

It was therefore concluded that the most stringent method of particulate control for the Indiantown project can be achieved with fabric filters. Two levels of particulate control were considered for fabric filters - 0.18 lb/MMBtu which is representative of the most recent BACT/LAER clearinghouse listings, and 0.12 lb/MMBtu which is representative of the five most stringent listings. The 0.3 lb/MMBtu new source performance standard (NSPS) would equate to a stack emission of 450 tons/year. 0.18 lb/MMBtu would result in a stack emission of 270 tons/year. 0.12 lb/MMBtu would result in a stack emission of 180 tons/year.

6.2 Fabric Filters

6.2.1 Technical Analysis

6.2.1.1 Introduction

The basic components of a baghouse include a filter medium, in the form of cylindrical bags, a tube sheet to support the bags, a gas-tight enclosure, and a means to dislodge accumulated dust from the bags.

The particulate-laden gas stream normally enters the lower portion of the baghouse near the collection hoppers. The gas then passes upward on the outside or inside of the bags, depending on the type of device used. Particulate collection occurs through inertial impaction, diffusion, direct sieving, electrostatic attraction, and gravity settling. The first two mechanisms prevail during the early phases of filtration after the cleaning cycle, while the sieving action of the accumulated particle layer soon predominates, especially at high loadings (Roeck, 1979). The baghouse mainly serves as the support structure for the accumulated particles, or filter cake. Build-up of a porous and dry filter cake is desirable since the filter cake becomes a filter medium which exhibits an extremely fine pore structure. Eventually the pressure drop across the filter cake increases, the differential pressure sensors initiate changeover to a standby filter chamber and the off line chamber is cleaned. The accumulated filter cake is periodically removed from the bags using various cleaning methods, i.e., mechanical shaking, reverse air cleaning, or pulse-jet cleaning. The collected particulate drops by gravity to the collection hoppers and is removed for disposal.

There are three general types of fabric filter designs, categorized based on the cleaning method: reverse air, shaker, and pulse jet units. Reverse air fabric filters use low A/C ratios and collect

PM on the inside of the filter bags. The flue gas is first introduced through a manifold into the hopper section of the bag compartments. The gas then flows upward and into the inside of the filter bags to the outside. Once the collected material builds up to a point where the resistance to flow (pressure drop) is too great, the filter bags are cleaned using a low energy reverse air cleaning process. The gas flow is periodically reversed, causing the bag to collapse, this fractures the filter cake and allows the particulate to fall into the collection hoppers for disposal. A portion of the cleaned flue gas serves as the reverse air during the cleaning process.

Shaker units also use low A/C ratios and collect the PM on the inside of the bags. To clean the filter bags, a portion of the baghouse is isolated to prevent gas flow and is then mechanically shaken for about one minute to dislodge the dust cake. The shaking is accomplished by a drive linkage which vibrates and shakes the bags at an optimum frequency and amplitude to facilitate efficient dust removal. The shaking can cause increased stress on the bags and may shorten bag life because of reduced structural integrity.

Pulse jet units employ A/C ratios (4:1) which are usually about twice those of reverse air and shaker units (2:1). In contrast to reverse air and shaker units, the gas flow in a pulse jet baghouse flows from the outside of the filter bag to the inside, so that the PM is collected on the outside of the filter bags. The cleaning cycle may be initiated automatically by either a timer or pressure drop activation signal, and typically occurs when the pressure drop across the fabric filter reaches between 6 to 8 in W.C. When the cleaning process is initiated, a module is taken off line and bags are cleaned one row at a time with a high pressure burst (pulse jet) of compressed air into the open end of the bag. This action causes the bag to flex away from the supporting cage releasing the PM on the outside of the bag. The dust then falls into the collection hoppers.

6.2.1.2 Factors Which May Effect Operating Performance

A wide range of actual operating performance has been reported for fabric filters. One study reviewed a data base of over 50 operating fabric filters in an effort to examine the influence of design and operating variables on particulate emissions (Lane, 1988). One conclusion drawn from this review of operating units was "the design of a fabric filter for ultra low emissions is not a well understood science, [and is] not even a black art". Some of the differences in design and operation examined in this study which were thought to influence baghouse emissions include the following:

- 1 fabric leaks
- 2 bypass damper leakage
- 3 cleaning frequencies and techniques

- 4 fuel and combustion characteristics
- 5 maintenance quality
- 6 fabric weight and design
- 7 height to diameter ratio
- 8 air to cloth ratio
- 9 gas temperature, humidity, and SO₃ content
- 10 fabric filter vendor-specific features

Fabric leaks yield elevated emission levels by allowing a portion of dust laden flue gas to bypass the filtration process. The impact of small amounts of leakage can dominate the performance of units which attempt to achieve extremely low outlet emission levels. The control of fabric leakage becomes more difficult as the fabric filter installation becomes larger. For example, a project such as Indiantown may employ 7,200 individual bags in twenty separate baghouse modules. A small tear in one of these bags would result in elevated emissions, yet locating the source of a minor bypass would be like finding a needle in a haystack. The probability of encountering a defective bag is statistically higher when such a large number of individual bags is required.

Bypass damper leakage can similarly affect outlet emissions. Bypass dampers are required to divert flue gas around the baghouse during startup conditions, when temperatures have not yet reached the acid dew point. Dampers are also required to remove the module from service for cleaning. During normal operation, any leakage of the damper seals will allow a portion of the particulate laden flue gas to bypass the filter medium. Large units such as Indiantown require large dampers with large seal areas. It is more difficult to maintain a good perimeter seal with large dampers than it is with smaller ones.

The cleaning frequencies and techniques employed in operation of a fabric filter may also influence baghouse emissions. More frequent cleaning may result in higher average emissions since the high filtration filter cake is removed more often, exposing the inferior filtration fabric of the bag itself. The frequency of cleaning required is dependant on a number of variables which affect baghouse pressure drop. For instance, the particle size of the ash being collected, which may be finer for a PC than for a CFB, could impact pressure drop by tending to clog the open pores of the filter medium.

As stated previously, the particulate size distribution resulting from the combustion of pulverized coal, as opposed to various other types of combustion sources, may yield lower baghouse collection efficiencies. The particulate size distribution resulting from an upstream SO₂ removal process may also impact collection efficiency. For instance, the lime introduced with a spray

dryer such as that proposed for Indiantown is much finer than that employed in a fluidized bed unit

Baghouse maintenance includes carefully monitoring the performance of each module, the routine changout of bags as wear becomes a factor, and the maintenance of damper seals, etc. Such maintenance becomes more difficult for large facilities.

The particular fabric selected for a given application may influence baghouse performance. Some of the criteria which affect fabric selection are operating temperature and humidity, SO_2 content of the flue gas, particulate size distribution, and required bag life. These factors influence the material and weave selection for each individual application. Table 6-2 lists some of the commercially available bag materials and their relative properties. These materials are generally available as woven, textured, or felted materials, woven fabric is the most commonly used bag material. Highly textured fabrics minimize voids by incorporating a tighter weave and "tangled" fibers. Felts virtually eliminate weave voids with layers of randomly oriented fibers. Many case specific factors influence bag selection, which may yield differing emission rates from one installation to another. This factor is thought to contribute to the variability in reported emissions from various operating facilities.

Two other design and operational parameters which govern baghouse performance are air-to-cloth ratio and pressure drop. The air-to-cloth (A/C) ratio is the ratio of the actual volumetric flow rate of the gas stream (acfm) to the surface area of the fabric (ft^2). In general, lower air-to-cloth ratios are used in the collection of fine particles which have a tendency to become permanently entrapped in the filter media, thereby clogging or "blinding" the bag. The pressure drop across the filter media is a function of the face velocity of the gas stream through the filter and the combined resistance of the fabric and accumulated dust layer. To avoid operational problems and excessive power requirements, the maximum pressure drop across the filter media should be limited to approximately 6.0 to 8.0 in. water column (W.C.).

Other factors which may affect fabric filter performance are bag height to diameter ratio and specific features of a given product line, such as the Staclean diffuser described by Lucas et al (Lucas 1980).

TABLE 6-2**Commercially Available Fabric Filter Materials**

	Temp	Acid Resistance	Fine Particulate Collection
Woven Fiberglass	550 °f	Good	Very Good
Woven Fiberglass with Teflon®	450 °f	Excellent	Very Good
Highly Texturized Woven Fiberglass	350 °f	Good	Excellent
RYTON®	375 °	Excellent	Very Good
GORE TEX®/Acrylic (Felt)	260 °f	Very Good	Excellent
CORE TEX®/NOMEX (Felt)	400 °f	Fair	Excellent
GORE TEX®/Fiberglass (Felt)	500 °f	Good	Excellent
GORE TEX®/PTFE (Felt)	500 °f	Excellent	Excellent
Polypropylene (Felt)	200 °f	Excellent	Excellent
NOMEX® (Felt)	400 °f	Fair	Excellent
TEFAIRE® (glas/teflon Felt)	450 °f	Excellent	Excellent
TEFLON®	425 °f	Excellent	Very Good

6 2 1 3 Advantages of Fabric Filters vs ESP's

Fabric filters exhibit several advantages over electrostatic precipitators for a pulverized coal fired cogeneration project such as Indiantown

Some of the major advantages of baghouses are as follows

- improved SO₂ removal (lime content of filtercake)
- ability to attain high collection efficiencies,
- particle electrical resistivity has no effect on collection efficiency, and
- uniform collection efficiency over a wide range of particle sizes and particulate loadings

The use of fabric filters can enhance the capture of SO₂ in the flue gas stream due to the filtercake buildup on the baghouse bags. The Indiantown project will utilize a lime spray dryer for SO₂ control. Reacted and unreacted lime are ultimately collected in the baghouse filter. The unreacted lime which becomes part of the filter cake continues to capture SO₂ as flue gas continues to permeate the filter media. This additional desulfurization capability would not be experienced with an ESP.

The fabric filter is more effective at capturing fine particulate than an ESP, because ESPs tend to selectively collect larger particles. Large particles have a high mass to surface area ratio which allows a charged particle to be efficiently dragged through the flue gas stream for collection on a charged plate. Ultra fine particles have a low terminal velocity and cannot carry a strong enough electrical charge to result in complete collection.

6 2 2 Environmental and Energy Analysis

No negative environmental impacts have been identified for use of a fabric filter to control particulate emissions from pulverized coal boilers. There is, however, a significant energy demand for this system. Energy is required to overcome the complete system's (fabric filter and associated ductwork) 8-12 in W.C. pressure drop, and miscellaneous loads such as electric hopper heating. The total annual energy expenditure to operate a fabric filter for a 300 MW pulverized coal fired boiler is estimated to be approximately 1,250 KW (Bechtel).

6 2 2 1 Economic Analysis

A budgetary cost estimate for the total capital investment for a fabric filter system was obtained by Bechtel for a similar project. The cost factors were then used to calculate the basic equipment and total purchased equipment costs. The basic equipment and auxiliaries for a fabric filter system includes the baghouse, filter bags, dampers and ductwork. These items were estimated to be \$9.5 million as presented in Table 6-3. The total equipment cost, which includes instrumentation, taxes and freight is estimated at \$12.1 million. Direct installation cost (foundations, structural supports, handling and erection, piping and insulation) totals \$3.7 million. Indirect costs are also summarized in Table 6-3, and are estimated at \$4.7 million. Therefore, the total capital investment (TCI) of the system is approximately \$20.5 million. A second economic analysis was prepared for the same system equipped with Gore-Tex bags, to achieve an emission level of 0.12 lb/MMBtu. Gore-Tex bags were estimated at \$270 ea, for an additional equipment cost of \$1,300,000.

Annual operating costs for the baghouse systems are shown in Table 6-4. Operating labor is estimated at 8 hours per shift for an annual expense of \$175,000. Power is required to overcome the system's pressure drop. Approximately 10.9×10^6 kWh is required for this purpose annually, totalling over \$657,000. Another significant expense, at roughly \$216,000/yr, is bag replacement. A bag life of 3 years was assumed in this assessment. The replacement cost if Gore-Tex bags were specified, was estimated at \$648,000.

The total annualized cost of the baghouse system is thus estimated at over \$5,990,000. For the control of 152,730 tpy of PM this technology would have a cost effectiveness of less than \$100 per ton of particulate removed. The use of Gore-Tex bags would increase the annualized cost by \$832,000/yr and would control an additional 90 t/y, for an incremental cost effectiveness of \$9,244/ton. The incremental cost effectiveness for Gore-Tex bags is thought to be excessive. BACT for the Indiantown project is therefore concluded to be fabric filters with conventional bags to achieve an emission level of 0.18 lb/MMBtu.

6 3 Conclusions

Baghouse filters are thought to represent the most stringent PM/PM-10 control technique which can be applied to PC boilers. Fabric filters at 0.18 lb/MMBtu were found to represent a cost effective control technology for the proposed project, with no negative environmental impacts. Although the large pressure drop incurs an annual energy expense of \$657,000 MMBtu, the high PM/PM-10 removal efficiency compensates such that the overall energy effectiveness is reasonable.

TABLE 6-3

Capital Costs For Fabric Filter

	.018 lb/mm Btu	.012 lb/mm Btu
(1) Purchased Equipment		
(a) Primary and Auxiliary	\$9,523 000	\$9,523,000
(b) Instrumentation & Control	952 000	952 000
(c) Structural Support	952 000	952 000
(d) Freight & Taxes	762 000	762 000
(e) Adder for Gore-tex Bags		1 300,000
Total Purchased Equipment Cost	\$12,189,000	\$13,489,000
(2) Direct Installation	\$3 657 000	\$3 657,000
Total Direct Cost	\$15 846 000	\$17 146,000
(3) Indirect Installation		
(a) Engineering & Supervision	\$1,585 000	1,715,000
(b) Construction & Field Expense	1,585,000	1,715 000
(c) Construction Fee	792 000	857 000
(d) contingencies	475 000	514 000
Total Indirect Installation	\$4,437,000	4,801,000
(4) Other Indirect Costs		
(a) Startup & Testing	158 000	171,000
(b) Working Capital	83,000	88 000
Total Other Indirect	\$241,000	\$259 000
Total Indirect Cost	\$4,678,000	\$5 060,000
Total Capital Costs	\$20 524 000	\$22 206,000
Capital Recovery Factor	\$3,345,000/yr	\$3,620,000/yr

TABLE 6-4

Annual Costs for Fabric Filter

	.018 lb/mmBtu	012 lb /mmBtu
Direct Operating Costs		
(1) Labor		
(a) Operating	\$175,000	\$175,000
(b) Supervisory	26,000	26,000
(2) Maintenance	\$792,000	\$875 000
(3) Replacement Parts	@\$90 ea 216 000	@270 ea \$648,000
(4) Utilities		
(a) Electricity	657,000	657,000
(5) Raw Materials		
(a) Ammonia	0	0
(b) Lime	0	0
(c) Limestone	0	0
(6) Disposal Costs	NA	NA
Indirect Operating Costs		
(7) Overhead	\$155 000	\$163,000
(8) Property Taxes	158,000	171 000
(9) Insurance	158,000	171 000
(10) Administration	317,000	343,000
(11) Capital Recovery	\$3,345,000/yr	3 620,000/yr
Total Annualized Cost	\$5,999,000/yr	\$6,831,000/yr
Uncontrolled Emission Rate	153,000 t/y	153 000 t/y
Controlled Emission Rate	270 t/y	180 t/y
Tons Controlled	152,730 t/y	90 t/y additional
Cost Effectiveness	\$39/ton	\$9,244/ton incremental

Baghouse filters are therefore considered to represent BACT for PM/PM-10 by controlling emissions to a level of 0.018 lb/MMBtu (270 tpy). This level is equivalent to that proposed as BACT for PM and PM₁₀ for recently permitted coal-fired boilers listed in the BACT/LAER Clearinghouse, and is significantly lower than the NSPS emission level (0.3 lb/MMBtu) for pulverized coal fired boilers.

6.4 BACT Determination for Auxiliary Boiler PM

6.4.1 Introduction

Emissions of particulate matter (PM) in oil fired boilers result from the ash in the fuel and incomplete fuel combustion. PM emissions vary with the sulfur content of the fuel (EPA, 1982). They are also dependent on boiler load, generally decreasing with decreasing load.

In order to determine the emissions of PM₁₀ (particulates with diameters less than 10 microns), the particle size distribution was estimated using data from AP-42 for oil-fired units equipped with a cyclone (EPA, 1985). As shown in Table 6.5, essentially all PM will be less than 15 microns in diameter. Emissions of PM₁₀ are expected to be 95% of the total emission rate.

Several technologies are available for the control of PM and PM₁₀. Since almost all of the particulates emitted from the boilers are less than 15 microns, it is assumed that the BACT determination for PM₁₀ will be the same as that for PM. Available control technologies include electrostatic precipitators (ESP) and fabric filters (FF).

6.4.2 Technical Feasibility of Control Options

Fabric Filter

The most effective PM control technology for combustion sources in general is a fabric filter, which can achieve removal efficiencies of greater than 99%, including submicron particles. Fabric filter technology has been described previously in Section 6.2. One limitation for fabric filters is potential blinding of the bags resulting from oil soot. Soot buildup can adhere to the bags preventing filter cake removal for proper operation.

ENSR contacted several fabric filter vendors for information on the technical feasibility and economic impacts of controlling PM emissions from an oil fired boiler with a fabric filter. The vendors contacted, however, said they do not provide fabric filters for oil-fired boilers (Lemaire, 1989). None of the entries for oil-fired boilers in the Clearinghouse or Supplements (EPA 1985, 1986, 1987a, 1988) deem fabric filter technology BACT for PM. Based on these factors, this

TABLE 6-5

**Particle Size Distribution for Residual
Oil Fired Boilers Equipped with a Cyclone**

Particle Size (μm)	Cumulative Mass % < Stated Size
15	100
10	95
6	72
2.5	22
1.25	21
1	21
0.625	21
Source U S EPA, 1985	

technology is not considered available or technically feasible for control of PM emissions from the auxiliary boilers

Electrostatic Precipitators (ESPs)

A particulate control device which is applicable to oil fired boilers and can remove 99+% of inlet particulate loadings is an electrostatic precipitator (ESP). The following discussion assumes a removal efficiency of 99%, including submicron particles, to achieve a controlled emission rate of 03 lb/MMBtu.

Electrostatic precipitators are generally used for the removal of particulate matter from gas streams which can be easily ionized. A typical ESP consists of an alternating array of negatively-charged discharge electrode wires and grounded collection plates. Particulate collection takes place in several steps. A high voltage is applied to the discharge electrodes and the collection plates which produces an electrostatic field between the two elements. In the interelectrode space, a corona is established around the negatively-charged electrode. As the particulate laden gas passes through the interelectrode space, the corona ionizes molecules of electronegative gases (i.e., oxygen, CO₂, SO₂) present in the gas stream. Particles larger than 1-2 micrometers are charged by field charging, ions are driven onto the particles by the electric fields. Submicron particles are charged by diffusion charging, ions are carried to the particles by their kinetic energy. The charged particles migrate to the collection plates, and are deposited. The strong electrostatic field and adhesive properties of the particulate inhibit re-entrainment. Particulate removal is accomplished by rappers that vibrate the collection plates and dislodge the particles, which then drop into collection hoppers.

ESPs may be designed for highly efficient performance in excess of 99 percent PM removal. The collection efficiency is a function of many factors. The most important factors are particle electrical resistivity, specific collection area of the collection electrodes, flue gas velocity, humidity, temperature, and particle size distribution.

Particulate collection efficiency of an ESP is highly dependent on fly ash electrical resistivity. Particle resistivities in the range of 10^4 to 10^{10} ohm-cm have been shown to be the most suitable for electrostatic precipitation (Oglesby, 1970). Particles with resistivities less than 10^4 ohm-cm will give up their charge too easily when they contact the collection plates and may be re-entrained in the flue gas, whereas particles with resistivities greater than 10^{10} ohm-cm will adhere to the collection plates and be difficult to dislodge. These particles may then act as an insulator, reducing the ability of the electrode to further collect particulate matter.

Two major factors influence the resistivity of the fly ash (1) fuel characteristics, and, (2) flue gas stream characteristics (e.g., temperature and moisture) (CARB, 1984). Fuel characteristics, such as the quantity of ash, chloride and metals greatly determine the resistivity of the resultant fly ash.

Particle size distribution also affects performance. A high density of fine particles reduces the corona discharge which, if sufficiently reduced, prevents charging of flyash and reduces particulate collection efficiency. In general, reduction in ESP collection efficiency occurs in the 0.1 to 1.0 micron diameter particle size range.

The overall collection efficiency of an ESP can be estimated by the Deutsch-Anderson equation (White, 1977)

$$\text{Efficiency} = 1 - \exp(-AW/Q)^K$$

where A is the collection plate area (ft²),
Q is the gas flow rate (ft³/sec), and
W is the particle migration velocity (ft/sec)
K factor equal to 0.5 - 1.0

The migration velocity is the rate at which charged fly ash particles travel towards the ESP collection plates. It is defined as the terminal velocity of a particle of a given size when the gas drag and electrical forces acting on the particle are equal, and is dependent on electric field intensity at the charging electrode and collection plate, particle size, gas viscosity, and aerodynamic slip.

The migration velocity is the parameter that most affects the design specifications of an ESP. A slow migration velocity indicates less particle capture per area of collection plate. Small particles usually have lower migration velocities than large particles. The collecting electrode surface area would therefore have to be increased for applications with larger quantities of small fly ash (CARB, 1984).

ESP performance may be evaluated by comparing the specific collection area (SCA) needed to achieve a specified collection efficiency or outlet concentration of particulate matter. SCA is defined as the surface area of the ESP where the particulates may be collected, divided by the flowrate (K acfm).

ESPs may be preferred, for some applications, over other particulate control devices such as fabric filters and high energy scrubbers for the following reasons:

- relatively low pressure drop across the system (typically <1.0 in. water column),
- ability to treat relatively humid gas streams,
- collected particles are in a dry state which reduces corrosion and freeze-up and presents lesser environmental impacts than sludge, an end product of wet scrubbing,
- oil-firing applications

Although ESPs are accepted as efficient particulate control devices they have certain drawbacks. Disadvantages with ESPs include the following:

- changes in fuel characteristics, gas properties and particle size distribution may change collection efficiency,
- inorganic particles with low resistivities are difficult to collect, - unburnt carbon may pass through because of premature loss of charge,
- high capital cost

Energy demand is one of the most significant impacts of ESPs. For this application, roughly 1.85×10^6 kwh of electricity would be required annually. None of the oil-fired boilers listed in the Clearinghouse, Supplements or BLIS (EPA, 1985, 1986, 1987, 1988, 1989) consider ESP's BACT for PM.

6.4.3 Economic and Energy Analysis for ESP

Basic equipment costs for an ESP were estimated from vendor data obtained from another project. Basic equipment costs of \$292,000 and are shown in Table 6-6. Total capital costs for this option are estimated at \$918,000.

Annual ESP costs were estimated assuming 1000 hrs/yr operation. ESPs have significant electricity requirements. Based on a pressure drop of 1 inch of water and a power requirement of 200 kWh, the annual electrical expense for this option is \$131,000. Due to the complexity of this technology, 2 hours of operating labor is required per shift resulting in an annual expense of \$55,000. Supervisory labor is calculated as 15% of the operating labor and totals \$5,000 per year. As shown in Table 6-7, the total annualized cost for operation of an ESP is estimated at \$480,000. The ESP would control 3.5 tpy of PM resulting in a cost effectiveness of \$137,150/ton PM removed. Although this technique is the most efficient for PM control, it is not cost-effective. Therefore, it is not considered to represent BACT for PM from the Indiantown auxiliary boiler. No negative energy or environmental impacts were identified for ESPs.

TABLE 6-6

Capital Cost Components for an Electrostatic Precipitator (ESP)

Direct Costs	ESP
(1) Purchased Equipment	
(a) Basic Equipment	\$292,000
(b) Auxiliaries	\$102,000
(c) Instrumentation	\$29,000
(d) Structural Support	\$29,000
(e) Tax & Freight	\$36,000
Total Purchased Equipment Cost	\$488,000
(2) Direct Installation	\$146,000
TOTAL DIRECT COST (TDC)	\$634,000
INDIRECT COSTS	
(4) Indirect Installation	
(a) Engineering Supervision	\$63,000
(b) Construction & Field Expenses	\$63,000
(c) Construction Fee	\$95,000
Total Indirect Installation Cost	\$221,000
(5) Other Indirect Costs	
(a) Start-up & Performance Tests	\$6,000
(b) Working Capital	\$8,000
(c) Interest During Construction	\$49,000
TOTAL INDIRECT COST (TIC)	\$63,000
TOTAL CAPITAL COST (TCC)	\$284,000
CRF	\$159,000/yr

TABLE 6-7**Annual Cost Components for an Electrostatic Precipitator (ESP)**

Direct Operating Costs	ESP
(1) Labor	
(a) Operating	\$55,000
(b) Supervisory	\$8,000
(2) Maintenance	\$32,000
(3) Replacement Parts	\$36,000
(4) Utilities	
(a) Electricity	\$131,000
(b) Water	\$0
(c) Steam	\$0
(d) Compressed Air	\$0
(e) Fuel	\$0
(5) Raw Materials	
(a) Ammonia	\$0
(b) Urea	\$0
(c) Lime	\$0
(d) Sodium hydroxide	\$0
(e) Soda Ash	\$0
INDIRECT OPERATING COSTS	
(7) Overhead	\$23,000
(8) Property Tax	\$9,000
(9) Insurance	\$9,000
(10) Administration	\$18,000
(11) Capital Recovery	\$159,000
TOTAL ANNUALIZED OPERATING COST	\$480,000
tpy removed	3.5
Cost Effectiveness \$/ton removed	\$137,000

6 4 4 BACT for PM Control Of Auxilliary Boiler

ESPs are highly effective PM control devices and are routinely used on coal-fired boilers and resource recovery facilities. None of the entries for oil-fired (crude, distillate or residual) boilers in the Clearinghouse, Supplements or on-line BLIS (U S EPA, 1985, 1986, 1987a, 1988, 1989), however, proposed an ESP as BACT for PM. The use of an ESP on the auxiliary boilers to control a maximum of 3.5 tons/year of particulate was found to be not cost effective. BACT for PM from the auxiliary boiler at the Indiantown project is therefore concluded to be the use of a high quality fuel such as natural gas or distillate oil with a maximum emission limit of 0.2 lb/MMBtu. This level of control will result in the emission of a maximum of 0.70 tons/yr for PM and PM₁₀.

7 0 BACT FOR FUGITIVE PM

7 1 Introduction

Fugitive emissions are generated as a result of delivery, storage and handling of coal, pebble lime and ash. These emissions can be characterized as either windblown dust from outdoor storage piles, or dust emissions released during unloading and conveying operations. The following analysis will evaluate BACT for storage of coal, pebble lime, bottom ash and flyash, and the materials handling systems for each.

7 1 1 BACT/LAER Clearinghouse

The BACT/LAER Clearinghouse contains no entries for fugitive dust emissions from coal fired boiler projects.

7 1 2 Alternative Control Technologies/Best Available Control Technology

7 1 2 1 Inactive Coal Storage Pile

Fugitive dust from the inactive coal storage pile may be controlled by enclosing the pile with a protective structure, covering the pile with turf, or coating with a crusting agent. Each of these methods is thought to be equally effective since fugitive emissions are essentially eliminated by these techniques, and are considered to represent BACT.

7 1 2 2 Active Coal Storage Pile

Fugitive dust from the active coal storage pile may be controlled by enclosing the pile within a protective structure, or by wetting the pile with water sprays, oil, or various other surfactants. Of these techniques, enclosing the pile altogether is thought to be the superior technique since fugitive emissions are essentially eliminated, and is considered to represent BACT.

7 1 2 3 Pebble Lime Storage

Pebble lime will be stored on site in an enclosed structure ventilated with fabric filters. Since fabric filters are capable of controlling outlet emissions to 0.001 gr/DSCF or less, this level of control is considered to represent BACT.

7 1 2 4 Bottom Ash Storage

Bottom ash will be stored in storage hoppers prior to rail loading for ultimate disposal. The storage of bottom ash in open top hoppers does not represent a source of fugitive emissions, since bottom ash is handled wet and since it does not contain fine particles which can become entrained due to wind conditions.

7 1 2 5 Fly Ash Storage

Fly ash is characterized by very fine particles which would yield high fugitive emissions if stored in outdoor piles. This material is therefore handled in enclosed silos, which results in essentially no emissions of fugitive dust, and is considered to represent BACT.

7 1 2 6 Coal and Lime Delivery

The generation of fugitive dust may result from rail unloading of coal and pebble lime. Fugitive emissions may be controlled with water sprays, by enclosing the unloading area within a structure, and by collecting airborne dust within the structure by use of a fabric filter. Since fabric filters for room ventilation systems can control emissions to 0.001 gr/DSCF or less, this level of control is considered to represent BACT.

7 1.2 7 Coal and Lime Conveyors

Coal and pebble lime will be handled at the Indiantown facility with various mechanical conveyors which reclaim bulk materials from storage, crush and size coal and lime, and transport the materials to silos local to the boilers. Each of these handling steps results in a potential source of fugitive emissions. Such emissions may be controlled with water sprays, or by utilizing enclosed conveyors, transfer towers, and crushing stations. Further fugitive emission control may be obtained by maintaining a slight negative pressure in these enclosures so that fresh air will leak in rather than dust being able to leak out. The air evacuated from the enclosures can be cleaned by fabric filters at various points along the conveying system. Since fabric filters from the various conveying segments can control emissions to 0.001 grains/DSCF or less, this level of control is considered to represent BACT.

7 1 2 8 Flyash Conveyors

Flyash consists of very fine ash and lime particles which exhibit a high potential for fugitive dust emissions during handling. Wetting of the ash to improve handling characteristics or handling in totally enclosed conveying systems represent alternatives to control fugitive emissions. For

the Indiantown project, flyash will be conveyed from the baghouse hoppers to a storage silo within a totally enclosed pneumatic conveying system. Exhaust from the pneumatic conveying system will be discharged through a fabric filter. Flyash will be loaded via dustless conveyor from the silo into dedicated fully enclosed railcars for transport and off site disposal. Since bin vent filters can control emissions to 0.01 grains/DSCF or less, this level of control is considered to represent BACT.

7.2 Conclusion

The Indiantown project will incorporate BACT for the control of fugitive PM emissions resulting from the storage and handling of coal, lime and ash. Inactive coal storage piles will be covered so as to prevent fugitive emissions. The active coal pile will be enclosed in a structure ventilated with bin vent filters. Coal, lime, and ash will be conveyed and handled within enclosed negative draft conveyors equipped with fabric filters. Flyash will be conveyed with a pneumatic conveying system exhausting through bin vent filters. Flyash will be transported in enclosed railcars to prevent the emission of dust during transportation. These methods of control will result in minimal emissions of fugitive dust from the Indiantown project.

8 0 BACT DETERMINATION FOR TRACE METALS

8 1 Formation of Metals Emissions

Three regulated trace metals, mercury (Hg), beryllium (Be), and arsenic (As) will potentially be emitted from the proposed Indiantown PC facility in greater than PSD significance levels. The quantity and characteristics of these trace pollutant emissions depend on the coal composition, the chemical and physical properties of the trace metals and performance of the control devices. Operational features of the combustion process do not significantly effect metal emissions.

Heavy metal emissions from fossil fuel-fired boilers are created as a result of combustion of fuels containing metals. Due to the high temperatures and turbulence in the furnace, metals are released in both a particulate and vapor phase, often as metal oxides, chlorides and sulfates. Depending on the metal compound involved and its condensation temperature, a vaporized metal begins to condense mostly on the surfaces of the fine solid particles in the flue gas (since that fraction has the greatest surface area) at normal stack temperatures (about 350°F and below) and almost totally at temperatures below 212°F (Hasselriis, 1985). Condensation occurs as the flue gases cool in the boiler and especially as condensation temperatures are achieved in an acid gas control device such as a spray dryer absorber. Many of the metal compounds emitted from coal-fired boilers, for instance lead and beryllium, condense at temperatures above 572°F. Thus the probability of removing these metals using a particulate control device is quite high (Clarke, 1986). On the other hand, mercury condenses at lower temperatures and is, therefore, more difficult to extract.

8 2 Trace Metal Control Alternatives

There are eight coal-fired facilities listed in the BACT/LAER Clearinghouse with limits for trace metal emissions, in each listing the limits are for beryllium, mercury or both. In cases where the control technology is specified (5 of 8 listings), the predominant method is concurrent with particulate control. For beryllium, emission limits listed in the Clearinghouse range from 1.0×10^{-6} to 6.5×10^{-6} lb/MMBtu. For mercury, the limits range from 1.5×10^{-6} to 7.9×10^{-6} lb/MMBtu.

Programs to assess the relative advantages and disadvantages of alternative pollution control devices on trace metal collection from coal combustion have only recently begun. However, test data is available from programs to determine the best system of trace metals control from municipal waste combustors (MWCs), in conjunction with the proposed new source performance standard for these sources, these data are currently more complete than any other data available.

in the published literature and as such are considered the best representation of trace metal control from combustion sources in general

Various test data show improved trace metal collection at lower temperatures. Results from the Quebec City pilot plant incineration testing (Klucius, 1986) reported that over 99.5% of the heavy metals, excluding mercury, were removed between test temperatures of 230°F and 399°F. Removal efficiencies of mercury were reported to be greater than 90 percent at temperatures less than 284°F from tests on a dry scrubbing system (including fabric filter) and 95 percent at 284°F for a spray dryer/fabric filter system. At test temperatures of 399°F, the mercury removal efficiency was poor.

These pilot plant studies support the theory that trace metal control relies, at least in part, on sufficient particulate control and flue gas temperature.

There is currently no NSPS for control of trace metals from coal combustion. In the proposed NSPS for MWCs, however, emissions of trace metals would be regulated as a component of "MWC emissions." The background material for these standards thus reflects the most current and accurate information available for control of trace metals, and provides insight as to current Agency positions on alternative controls.

In general, EPA has concluded that efficient particulate matter control serves as a surrogate for control of MWC metal emissions (EPA, 1989b).

In the preamble to the proposed NSPS for MWCs, the EPA has basically stated that adequate PM controls are adequate for trace metal controls. The EPA endorsed use of spray dryer absorbers and fabric filters for PM and SO₂ control from MWC's.

Therefore, BACT for all trace metals is proposed to be use of the proposed particulate matter emission rate to perform better than 0.018 lb/MMBtu.

In light of the fact that mercury is more volatile and therefore more difficult to control than the other heavy metals emitted from coal combustion, mercury control is discussed in more detail below.

8 3 Mercury

8 3 1 Formation Mechanism

Trace quantities of mercury are present in coal. Most of this mercury is expected to volatilize during combustion in the furnace. Approximately two-thirds of the mercury content in the flue gas exits as solid mercuric chloride (HgCl_2), the other third is exhausted as elemental mercury vapor (Flakt, 1990). Volatile mercury is expected to condense upon submicron particles contained in the flue gas and exit as either condensed aerosol or solid mercuric chloride and be controlled by the fabric filter. Some of the vapor is expected to be emitted uncontrolled.

8 3 2 Available Control Technologies

Potential control alternatives for mercury include

- Sodium sulfide injection upstream of SDA/fabric filter (or ESP)
- Activated carbon injection upstream, within, or downstream of SDA and upstream of fabric filter
- Wet scrubbing techniques
- Spray dryer followed by a fabric filter
- Flue gas cooling

At this time, it is not absolutely clear to the EPA which control alternative best reduces mercury emissions from any combustion process (Porter, 1990) or which operating variables in the combustor influence alternative controls' performance. Recognizing this, the EPA stated in the preamble to the proposed NSPS for MWCs that a joint EPA/industry task force is being established to investigate mercury emissions and controls, and that the findings would be considered in development of the final standards (54 FR 52251).

As part of the effort of the joint task force, two meetings were held at Research Triangle Park in February 1990 to discuss both "precombustion" controls of mercury emissions and add-on control of mercury emissions. It is evident from the meetings' transcripts that there are not only numerous unknowns regarding mercury formation and control, but there are some valid side issues that must also be resolved before the subject can be understood and the MWC NSPS for Hg fairly promulgated.

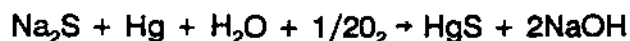
Some of the key issues raised in the meetings were

- the potential of NO_x controls by ammonia injection to reduce mercury control efficiencies of SDA/FF systems,
- inadequate emissions data to set a mercury limit,
- the relationship between the amount of carbon in the flue gas and the amount of mercury control, and whether this is more influential on mercury emissions than NO_x controls,
- whether 70 percent mercury control is typically achieved by SDA/FF systems,
- the conversion of mercuric chloride on the filter cake to mercury vapor over time,
- reliability of current test methods,
- the inconsistencies in test data between the U S and European facilities (which use different test methods)
- lack of data on mercury content of ash, effects of add-on mercury control to ash toxicity and possible outgassing,
- contradictory data and general variability of data,
- the overemphasis on mercury control from MWCs,
- establishing which mercury control systems are "demonstrated",
- whether an emission limit is supportable and what the limit would be, and
- how to handle all the work activities at the U S EPA prior to promulgation with limited resources

The following provides more information on the controls discussed by the EPA/industry task force

Sodium Sulfide Injection

Sodium sulfide (Na_2S) can be sprayed into the gas stream as a 10 percent water solution, either upstream of or in the spray dryer. Na_2S is a soluble crystalline industrial chemical commonly used in the leather and dye industry. The mercury vapor is converted to solid mercuric sulfide according to the following reaction:



The resulting solids are collected in the baghouse or ESP as particulate (Buschmann, 1990).

The technology was developed (patent pending) and is marketed by Flakt, an air pollution control device vendor. The technology has been tested at several new MSW incinerators, but has not been utilized on a coal-fired facility.

The limited data available for this process suggests that Na_2S injection may reduce Hg emissions, although there are some inherent problems with the available data. For instance, mercury emissions were not reported in the literature for times during test periods when the Na_2S injection system was not operating. In fact, data for some MWC facilities equipped with SDA/FF shows considerable Hg removal without Na_2S injection. Removal efficiencies at the Linköping facility in Sweden and the Quebec City incinerator were 94 and 95 percent, respectively, using only a spray dryer and fabric filter (EPA, 1987a).

The Na_2S injection system may present concerns. Na_2S is similar to lime or sodium hydroxide in terms of personnel protection equipment. Personnel handling sodium hydroxide require skin and eye protection, however, Na_2S is not considered to be very toxic. HgS , one of the reaction products, is toxic, but will compose less than 0.01 percent of the ash collected in the system and thus will not contribute greatly to overall toxicity (Flakt, 1990). EPA's task force on mercury also recognizes that the effects of transferring the mercury to the ash need to be studied further.

A potential disadvantage is cost, considering that no PC units have installed the control system and considering that the amount of additional Hg removal possible has yet to be fully quantified. Flakt estimated that the cost of adding the sodium sulfide system to a typical Flakt air pollution control device train is 2 percent of the capital and operating costs. As more experience is gained with the technology, these costs will become more defined.

Activated Carbon Injection

Activated carbon or a modified activated carbon material may be injected upstream of the spray dryer or in the spray dryer to achieve mercury reductions. There are currently no PC units operating which employ activated carbon injection.

Activated carbon injection systems are listed as being offered commercially by A/S Niro Atomizer of Denmark and Research Cottrell. According to the Niro patent, powdery activated carbon is continuously fed into the flue gas upstream or downstream of the spray dryer absorber. The choice of injection location is influenced to some extent by the choice of particulate controls. If an ESP is used, the benefit of added retention time and, hence, reaction potential within the filter cake (which is unique to fabric filter use), is missing. To increase overall reaction time and thus achieve high removal efficiencies, the carbon is introduced upstream of the spray dryer/ESP. If a fabric filter is employed, the preferable injection location is downstream of the spray tower, since the lower temperatures promote greater adsorptivity. Although the reaction time is less when injected upstream of the control device, the additional contact between Hg and carbon in the filter cake compensates.

Fine powdery activated carbon is preferred over coarse or granulated carbon because it has a higher adsorptive capacity and is less expensive. According to the Niro patent, fine powdery activated carbon (including any fine powdery carbonaceous material such as coal or coke) was once suspected to cause plugging in fabric filters and unacceptably high pressure drops.

Carbon injection may achieve sizeable Hg reductions, as shown by two sets of test data in the Niro patent. In three pilot-test runs, injection of 80 mg/Nm³ in flue gas at a location between the SDA and fabric filter resulted in overall Hg reductions of 89 percent (230°F run), 95 percent (230°F run), and 91 percent (284°F run). Hg reductions with no carbon injection were still sizeable, however, at about 69 percent.

On full-size MWCs tests, 78 to 93 percent Hg reductions were achieved with carbon injection (with injection upstream of SDA/ESP). However, data from these tests indicate Hg removals of 66 to 27 percent with the carbon injection system off.

Carbon injection systems are not considered to be demonstrated on PC boilers. In addition, costs are not well defined but, as with Na₂S injection, may add about 2 percent to capital and operating costs of the SO₂/particulate control device. More importantly, a significant amount of carbon is used and discarded on a continuous basis. None of the vendor literature discusses the solid waste generated, however, if rates of 50 to 80 mg/Nm³ are required for successful operation, then 50 to 80 mg/Nm³ of additional waste will be generated.

Considering that (1) the reductions achieved with Na_2S or carbon injection above that achieved with the SDA/FF alone are questionable, (2) true system costs are not well defined, and (3) no one else in the U S has installed them, activated carbon and Na_2S injection are considered unrepresentative of BACT

Wet Scrubbing Techniques

There is a general opinion that because of the saturated operating conditions and cooler flue gas temperatures in wet scrubbing, better mercury condensation and collection should occur than in SDA/FF systems. The NJDEP tested the efficiency of mercury removal at the small scale resource recovery facility in Ft Dix, New Jersey, which uses a baghouse upstream of a wet scrubber. Using EPA Test Method 101A, the removal efficiency ranged over three test runs between 16.6 percent and 74.9 percent (average 42.8 percent). Not only was the variability in test results similar to that observed in SDA/FF-equipped MWC facilities, the removals were actually lower. This is only one set of test data, but it does not support use of wet scrubbers as BACT for control of mercury from coal-fired facilities.

Flue Gas Cooling

Flue gas cooling has been considered essential for Hg removal because Hg typically enters the control equipment as a vapor. Test data available for MWCs both support and refute this theory. Env. Canada and Flakt reported Hg reduction of 40 percent when flue gas was cooled to 289°F (Env. Canada, 1987). Environment Canada also reported (1986) data that are more inconclusive. Over two test runs for each temperature, mercury reductions were 90.9% (230°F), 97.3% (257°F) and, 93.7% (284°F). The lowest flue gas temperature achieved the lowest percent mercury control. Tests conducted in June 1989 at Ogden Martin's Indianapolis Resource Recovery Facility, which uses a spray dryer/fabric filter control system, indicate that measured emissions of mercury were well below the expected levels. Mercury removal efficiency was measured at spray dryer outlet temperatures of 265 and 295°F. The Indiantown facility should exhibit correspondingly low Hg emissions since the outlet temperature of the spray dryer of the proposed facility is anticipated to be 150°F.

Conclusion

There are many issues yet to be settled with mercury emissions control. However, a well-operated and maintained spray dryer absorber/fabric filter control train (a control train providing high mercury removal efficiencies) is proposed as the BACT for Hg control since no clear evidence exists that there is a more stringent control alternative available.

9.0 BACT DETERMINATION FOR RADIONUCLIDES

Coal-fired facilities release trace amounts of radioactive elements to the atmosphere from naturally occurring radionuclides present in the fuel. These radionuclides are primarily those that have existed since primordial times and their daughter products which have not completely decayed due to their long half-lives. The primordial radionuclides that are associated with emissions from coal combustion are potassium-40 (K^{40}), uranium-235 (U^{235}) and decay products, uranium-238 (U^{238}) and decay products, and thorium-232 (Th^{232}) and decay products.

K^{40} is present as a fixed proportion of naturally occurring potassium. The U^{235} decay series contributes only a small fraction of the radioactivity of the U^{238} and Th^{232} decay series, most of the radioactive emissions from a coal fired plant come from the U^{238} and Th^{232} series.

Only one facility, the Mt. Poso FBC cogeneration facility in Kern County, CA is listed in the BACT/LAER Clearinghouse as having a limit on radionuclides. The listing denotes that BACT for radionuclides for this facility is the same as BACT for particulate matter fabric filter.

For the proposed Indiantown boiler, it is estimated that approximately 6.6×10^{-4} curies/year of Th^{232} and 1.5×10^{-3} curies/year of U^{238} will be emitted (EPA 1989a). Since radionuclides will be emitted as particulate matter, these emissions estimates are based on the projected controlled PM emissions.

A study by McBride (1973) used a 1,000 MW coal-fired plant to develop dose contributions from the ingestion, inhalation and external pathways (e.g. dermal absorption). The radiation dose due to emissions from the large coal plant was shown to be much lower than from natural background. The dose from the proposed Indiantown facility, approximately one-third the size of that used by McBride, is also expected to be less than the natural background.

On December 15, 1989, EPA released the final rule for the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) for radionuclides (54 FR 51654). The emissions of radionuclides from coal-fired power plants were excluded from this ruling since they pose a risk below the assumed safe level.

Since the emissions of radionuclides from coal combustion are emitted as PM and PM₁₀, the particulate control device (fabric filter) will also control radionuclide emissions. Use of a fabric filter to control emissions of radionuclides incurs no additional economic impact, has no adverse energy or environmental impacts, and is technologically demonstrated. Fabric filtration

thus can be concluded to be representative of BACT for radionuclide emissions from the Indiantown facility

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IMAGE QUALITY

**PLEASE NOTE
THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD
WERE OF POOR QUALITY.**

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR PM (1980 - PRESENT)**

Name	Type	Size MMBtu/hr	Reviewing Agcy	Date of Issuance	BACT for PM
Container Corp of America	PC	NS	Philadelphia AMS	1/20/81	0 06 lb/MMBtu
Nebraska Public Power Dist	NS	650 MW	Nebraska DEC	12/16/80	0 03 lb/MMBtu - FF (99 9%)
New England Power - Brayton Pt	NS	10625	Massachusetts DEQE	11/1/80	0 06 lb/MMBtu - ESP (99 3%)
E Kentucky Power	NS	6760	Kentucky DAPC	8/21/80	0 03 lb/MMBtu - ESP (99 8%)
City of Wilkes-Barre	NS	92 5	EPA Region III	7/1/80	0 086 lb/MMBtu - baghouse/cyclone (99 7%)
Curtiss Wright Corp	NS	137	EPA Region II	6/13/80	none
Intermountain Power Project	NS	3000	EPA Region VIII	6/8/80	0 02 lb/MMBtu - ESP (99 8%)
Utah Power & Light	NS	860	EPA Region VIII	6/2/80	0 03 lb/MMBtu - FF (90%)
Deseret Gen & Trans Moon Lake	NS	600	EPA Region VIII	2/4/80	0 03 lb/MMBtu - FF (99 8%)

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR SO₂ (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for SO ₂
Applied Energy Services	CFB	2150	Hawaii DOH	1/25/90	645 lb/hr (48 ppm) - limestone bed (90%)
A E S Thames Inc	FB	923	Connecticut DEP	8/9/89	0.32 lb/MMBtu - limestone injection (70%)
A E S Thames Inc	FB	923	Connecticut DEP	8/9/89	0.32 lb/MMBtu - limestone injection (70%)
Cogentrix Rocky Mount (4 units)	SS	375	North Carolina DEM	7/20/89	0.31 lb/MMBtu - Dry Lime FGD
Cambria Cogen Inc (2 units)	CFB	559	Pennsylvania BAQC	5/26/89	558 lb/hr - limestone inj (2.1 Ca S)
Scrubgrass Power Corp (2 units)	CFB	599	Pennsylvania BAQC	1/18/89	0.45 lb/MMBtu - limestone inj
Goodyear United Development	FB	577	New York State DEC	10/14/88	0.6 lb/MMBtu - limestone bed (90%)
North Branch Energy Partners LP	CFB	563	Pennsylvania BAQC	9/26/88	0.91 lb/MMBtu - limestone inj (90%)
United Development Group	FB	577	New York State DEC	9/25/88	0.6 lb/MMBtu - limestone inj
Fort Howard	CFB	505	Wisconsin DNR	9/21/88	0.7 lb/MMBtu - limestone inj (90%)
Northeastern Power Co	CFB	513	Pennsylvania BAQC	8/17/88	0.32 lb/MMBtu - limestone inj
Edensburg Power Co	FB	617	Pennsylvania BAQC	8/06/88	1 lb/MMBtu - limestone inj (90%)
Tennessee Valley Authority	FB	1579	Kentucky DAQ	5/04/88	1.2 lb/MMBtu - limestone inj (90%)
Panther Creek Energy	CFB	1170	Pennsylvania DER	2/17/88	0.33 lb/MMBtu -
GWF Power Systems Co Inc	CFB	202	Bay Area AQMD (CA)	2/11/88	0.109 lb/MMBtu - limestone inj
City of Wyandotte Dept Mun Svcs	CFB	369	Wayne Co APC (MI)	12/07/87	0.496 lb/MMBtu - limestone inj
Cogentrix Michigan Leasing Corp	SS	214	Michigan DNR	7/31/87	1.67 lb/MMBtu - lime spray dryer (90%)
Fort Drum Heating Plant	CFB	190	New York State DEC	4/01/87	1.2 lb/MMBtu - limestone inj (90%)
Wm H Zimmer Generating Station	CFB	11968	Southwest Ohio APCA	2/5/87	0.548 lb/MMBtu - Mg enhanced lime FGD
GWF Power Systems Co	FB	274	EPA Region IX	1/28/87	20 ppm - limestone inj
Archbald Power Corp	NS	240	Pennsylvania DER	1/16/87	0.15 lb/MMBtu - limestone inj (90%)
Mt Poso Cogeneration Co	CFB	50 MW	EPA Region IX	1/12/87	0.04 lb/MMBtu - limestone inj (90%)
Foster Wheeler Power (2 units)	CFB	283	Pennsylvania DER	12/29/86	0.24 lb/MMBtu - limestone inj
Sheridan Coal Co	CFB	550	Pennsylvania DER	12/1/86	0.25 lb/MMBtu - limestone inj
Pyropower Corp	CFB	640	Kern County APCD	12/1/86	0.039 lb/MMBtu - limestone inj (95.2%)
J Pagnotti Enterprises	CFB	1082	Pennsylvania DER	11/1/86	0.22 lb/MMBtu - limestone inj
Rio Bravo Refining Co	FB	389	EPA Region IX	10/22/86	0.036 lb/MMBtu - limestone inj (95%)
Utah Power & Light Co (#2 unit)	NS	4000	Utah BAQ	10/1/86	1.2 lb/MMBtu - (80%)
Rio Bravo Refining Co	FB	36 MW	EPA Region IX	8/19/86	0.036 lb/MMBtu - limestone inj (95%)
Cogentrix Carolina Leasing Co	NS	202	North Carolina DEM	7/7/86	1.84 lb/MMBtu - low S coal
Northeastern Power Co	NS	540	Pennsylvania DER	6/27/86	0.32 lb/MMBtu -
BMCP	CFB	230	Kern County APCD	6/20/86	0.039 lb/MMBtu - limestone inj (96%)
Cogentrix of Virginia Inc	NS	200	Virginia APCB	6/12/86	1.52 lb/MMBtu -
TVA - Shawnee Steam Plant	FB	1430	Kentucky DAPC	4/15/86	0.88 lb/MMBtu - limestone inj (90%)
Westwood Energy Properties	NS	425	Pennsylvania DER	1/08/86	0.2 lb/MMBtu - limestone inj (93.8%)
Wisc Electric Power Co	FB	825	Wisconsin DNR	1985	1.2 lb/MMBtu - limestone inj (90%)
Cogeneration National Corp	FB	300	EPA Region IX	12/31/85	0.087 lb/MMBtu - lime inj (95%)
Corn Products	FB	49.9 MW	EPA Region IX	12/16/85	59 lb/hr - limestone inj (90%)
Cogeneration National Corp	NS	279.6	San Joaquin Cty APCD	12/13/85	0.046 lb/MMBtu - limestone inj (95%)
Tennessee Valley Authority	FB	200	Kentucky DAPC	12/13/85	1.2 lb/MMBtu - limestone inj (93.9%)
Signal Frackville Energy	NS	NS	Pennsylvania DER	12/2/85	0.21 lb/MMBtu - limestone inj

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker NS-not specified

APPENDIX A
BACT/LAER CLEARINGHOUSE LISTINGS

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR PM (1980 - PRESENT)**

Name	Type	Size MMBtu/hr	Reviewing Agcy	Date of Issuance	BACT for PM
Applied Energy Services	CFB	2150	Hawaii DOH	1/25/90	32.2 lb/hr (0.007 gr/decf) - Baghouse (99.9%)
A E S Thames Inc	FB	923	Connecticut DEP	8/9/89	0.02 lb/MMBtu - Baghouse (99.9%)
A E S Thames Inc	FB	923	Connecticut DEP	8/9/89	0.02 lb/MMBtu - Baghouse (99.9%)
Cogentrix Rocky Mount (4 units)	SS	375	North Carolina DEM	7/20/89	0.0200 lb/MMBtu - Fabric Filter
Cambria Cogen Inc (2 units)	CFB	559	Pennsylvania BAQC	5/26/89	16.8 lb/hr - Fabric Filter (99.9% eff)
Scrubgrass Power Corp (2 units)	CFB	599	Pennsylvania BAQC	1/18/89	0.0300 lb/MMBtu - Fabric Collector (99.98% eff)
Goodyear United Development	FB	577	New York State DEC	10/14/88	0.022 lb/MMBtu - Fabric Filter (99% eff)
North Branch Energy Partners LP	CFB	563	Pennsylvania BAQC	9/26/88	0.03 (PM) 0.028 (PM10) lb/MMBtu - FF (99% eff)
United Development Group	FB	577	New York State DEC	9/25/88	0.022 lb/MMBtu - Pulse Jet Baghouse (99.8% eff)
Fort Howard Corp	CFBC	505	Wisconsin DNR	9/21/88	0.05 lb/MMBtu - Baghouse
Northeastern Power Co	CFB	513	Pennsylvania BAQC	6/17/88	0.028 lb/MMBtu - Fabric Filter (99% eff)
Edensburg Power Co	FB	617	Pennsylvania BAQC	6/8/88	0.0300 lb/MMBtu - Baghouse (99.98% eff)
TVA - Shawnee	AFBC	1579	Kentucky DAQ	5/4/88	0.03 lb/MMBtu - Baghouse (99% eff)
Panther Creek Energy	NS	1170	Pennsylvania DER	2/17/88	0.03 lb/MMBtu - Baghouse (99% eff)
GWF Power Systems Co Inc	CF	202	Bay Area AQMD (CA)	2/11/88	30 lb/d Baghouse Pulse Jet
City of Wyandotte Dept Mun Svcs	CFBC	369	Wayne Co APC	12/07/87	0.011 lb/MMBtu - baghouse (99.9%)
Cogentrix Michigan Leasing Corp	SS	214	Michigan DNR	7/31/87	0.03 lb/MMBtu - Baghouse (99.1% eff)
Fort Drum Heating Plant	CFB	190	New York State DEC	4/1/87	0.05 lb/MMBtu - Baghouse
Wm H Zimmer Generating Sta	NS	11968	Southwest Ohio APCA	2/5/87	0.025 lb/MMBtu - ESP (99.5% eff)
Archbald Power Corp	NS	240	Pennsylvania DER	1/18/87	0.05 lb/MMBtu - Fabric Filter
Mt Pease Cogeneration Co	CFB	50 MW	EPA Region IX	1/12/87	0.01 gr/decf - baghouse
Foster Wheeler Power (2 units)	NS	283	Pennsylvania DER	12/29/86	0.03 lb/MMBtu - Baghouse (99.9% eff)
Tultex Corp	NS	12	Virginia APCB	12/18/86	0.43 lb/MMBtu - settling chamber (35%)
Sheridan Coal Co	NS	550	Pennsylvania DER	12/1/86	0.03 lb/MMBtu - Baghouse/Cyclone
Pyropower Corp	CFB	840	Kern County APCD	12/1/86	0.012 lb/MMBtu - fabric filter (99.9%)
J Pagnotti Enterprises	NS	1082	Pennsylvania DER	11/1/86	0.03 lb/MMBtu - Baghouse/Cyclone
Utah Power & Light Co	NS	4000	Utah BAC	10/1/86	0.1 lb/MMBtu - ESP (99% eff)
Cogentrix Carolina Leasing Corp	NS	202	North Carolina DEM	7/7/86	0.03 lb/MMBtu - bagfilter (99.1%)
Northeastern Power Co	NS	540	Pennsylvania DER	6/27/86	0.028 lb/MMBtu - Fabric Filter
BMCP	CFB	220	Kern County APCD	6/20/86	0.0156 gr/decf - fabric collector (99%)
Cogentrix Hopewell	NS	200	Virginia APCB	6/12/86	0.03 lb/MMBtu - baghouse (99.1%)
Cogentrix Carolina Leasing Corp	NS	202	North Carolina DEM	5/28/86	0.03 lb/MMBtu - baghouse (99.1%)
TVA - Shawnee	AFBC	1430	Kentucky DAPC	4/15/86	0.03 lb/MMBtu - FF (99%)
Westwood Energy Properties	NS	425	Pennsylvania DER	1/8/86	0.03 lb/MMBtu - FF (99.92%)
Cogeneration National Corp	CFB	279.6	San Joaquin Cty APCD	12/13/85	0.036 lb/MMBtu - baghouse
TVA - Paducah	CFB	200	Kentucky DAPC	12/13/85	0.1 lb/MMBtu - baghouse (98.85%)
Signal Frackville Energy	NS	NS	Pennsylvania DER	12/2/85	0.012 lb/MMBtu - Baghouse (99.9% eff)
Corn Products	CFB	620	San Joaquin Cty APCD	10/29/85	0.016 lb/MMBtu - baghouse
White Pine Power Project	NS	750	Nevada DEP	8/6/85	0.02 lb/MMBtu - baghouse (99.6%)
Central State University	NS	66	Dayton RAPCA	7/1/85	0.1 lb/MMBtu - baghouse (99%)
Union Camp - Franklin	NS	245	Virginia APCB	7/1/85	0.05 lb/MMBtu - ESP (99%)

CFB-circulating fluidized bed FB-fluidized bed LIG-Ilgite SS-spreader stoker PC - pulverized coal NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR PM (1980 - PRESENT)**

Name	Type	Size MMBtu/hr	Reviewing Agcy	Date of Issuance	BACT for PM
Biogen Power Project	CFBC	212	EPA Region IX	4/26/85	0.01 gr/dscf @3%O ₂ (4.5 lb/hr) - baghouse (99.9%)
Wisc. Electric Power Co	PFBC	825	Wisconsin DNR	1985	0.02 lb/MMBtu - ESP
3M Co	NS	120	Alabama DEM	11/29/84	0.1 lb/MMBtu - baghouse (98.7%)
Amalgamaize Co	NS	179.7	Alabama DEM	11/29/84	0.05 lb/MMBtu - baghouse (98%)
Puget Sound Naval Shipyard	NS	NS	Puget Sound APCA	9/25/84	0.02 gr/scf - baghouse (99.9%)
Cogentrix - Lumberton	NS	202	North Carolina DEM	9/10/84	0.03 lb/MMBtu - baghouse (99.1%)
Alabama Power Co	NS	248	Alabama DEM	9/10/84	0.05 lb/MMBtu - baghouse (99.6%)
Virginia Power - Portsmouth	NS	1129	Virginia APCB	7/27/84	0.03 lb/MMBtu - ESP (99.3%)
Cogentrix - Kenansville	NS	202	North Carolina DEM	6/25/84	0.03 lb/MMBtu - baghouse (99.1%)
Cogentrix - Hamilton	NS	202	North Carolina DEM	4/3/84	0.03 lb/MMBtu - baghouse (99.1%)
American Lignite Products	CFB	571	EPA Region IX	1/10/84	0.013 lb/MMBtu - baghouse (99.9%)
Lower Colorado River Authority	LIG	4735	Texas ACB	12/22/83	0.03 lb/MMBtu - ESP (99.96%)
American Lignite Prod. Co	FB	240	Amador City APCD	12/21/83	0.0156 gr/dscf - baghouse (99.93%)
Intermountain Power Project	NS	8352	Utah BAQ	10/17/83	0.02 lb/MMBtu - FF (99.8%)
Basin Electric Power Coop	NS	6278	North Dakota SHD	1/12/83	0.03 lb/MMBtu - baghouse (99.86%)
Eastman Kodak Co	NS	670	New York DEC	12/20/82	0.035 lb/MMBtu - ESP (99.57%)
Washington Water Power Co	NS	2080	EPA Region X	11/17/82	0.03 lb/MMBtu
Iowa Electric Light & Power Co	NS	400	EPA Region VII	10/29/82	0.03 lb/MMBtu - ESP
Holyoke Water Power - Mt. Tom	NS	1447	Massachusetts DEQE	10/27/82	0.08 lb/MMBtu - ESP (99.51%)
B. F. Goodrich	CFB	150	Illinois EPA	9/16/82	0.06 lb/MMBtu - cyclone & baghouse (99%)
Cincinnati Gas & Elect	NS	6313	Kentucky DAPC	5/14/82	0.7 lb/MMBtu -
West Texas Utilities Co	NS	6.8	Texas ACB	5/20/82	0.03 lb/MMBtu - ESP (99.7%)
Kentucky Utilities	NS	6650	Kentucky DAPC	4/15/82	0.03 lb/MMBtu - ESP (99.8%)
Jacksonville Elec. Auth.	NS	600 MW	Florida DER	1/1/82	0.03 lb/MMBtu - ESP (99.78%)
SC Public Svc - Cross	NS	600 MW	South Carolina DHEC	12/3/81	0.03 lb/MMBtu - ESP (99.8%)
Houston Lighting & Power	NS	5729	EPA Region VI	11/12/81	0.03 lb/MMBtu - FF (99.72%)
Central Power & Light	NS	6781	EPA Region VI	10/19/81	0.03 lb/MMBtu - ESP (99.6%)
Tampa Elect. Co	NS	425 MW	Florida DER	10/15/81	0.03 lb/MMBtu - ESP (99%)
Oklahoma Gas & Elect	NS	5250	EPA Region VI	10/5/81	0.03 lb/MMBtu - ESP or baghouse (99.6%)
Delmarva Power & Light	NS	5702	EPA Region III	9/30/81	0.03 lb/MMBtu - ESP (99.65%)
Panorama Enercorp. Inc.	NS	37 MW	EPA Region X	9/22/81	0.007 gr/dscf - ESP (99%)
SW Elect. Power	NS	720 MW	EPA Region VI	9/1/81	0.1 lb/MMBtu - ESP (99.8%)
Pennsylvania Elect. Co.	NS	6280	EPA Region III	8/18/81	0.03 lb/MMBtu - ESP (99.7%)
NY State Elect. - Cyuga	NS	1750	EPA Region II	6/29/81	0.03 lb/MMBtu - ESP
Iowa-Illinois Gas & Elect	NS	7000	EPA Region VII	6/18/81	0.03 lb/MMBtu - ESP
Idaho Nat. Engineering Lab.	NS	82.5	EPA Region X	6/5/81	0.05 gr/dscf - baghouse (99%)
Plains Elect. Gen. & Trans.	NS	2471	EPA Region VI	5/27/81	0.03 lb/MMBtu - baghouse (99.9%)
Nevada Power Co	NS	660 MW	EPA Region IX	4/13/81	0.015 lb/MMBtu - baghouse
Big Rivers Elect. - D. B. Wilson	NS	4585	Kentucky DAPC	3/11/81	0.03 lb/MMBtu - ESP (99.8%)
AL Elect. Coop. Inc.	LIG	4805	Alabama APCD	2/24/81	0.03 lb/MMBtu - ESP
SW Elect. Power	NS	6821	EPA Region VI	2/23/81	0.03 lb/MMBtu - ESP (99.6%)

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker PC-pulverized coal NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR SO₂ (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for SO ₂
Corn Products	CFB	620	San Joaquin Cty APCD	10/29/85	0 01 lb/MMBtu - limestone inj (90%)
White Pine Power	NS	750 MW	Nevada DEP	8/8/85	0 19 lb/MMBtu - lime spray drying (84%)
Central State University	NS	66	Dayton RAPCA	7/1/85	1 6 lb/MMBtu - low S coal
Union Camp Franklin	NS	245	Virginia APCB	7/1/85	1 5 lb/MMBtu - 1% S coal
SCE - Biogen Power Project	CFB	212	EPA Region IX	4/26/85	0 44 lb/MMBtu - limestone inj (92%)
3M Co	NS	120	Alabama DEM	11/29/84	1 5 lb/MMBtu - low S coal
Amalgamaize Co	NS	180	Alabama DEM	11/29/84	2 27 lb/MMBtu - low S coal
Puget Sound Naval Shipyard	NS	NS	PUGET Sound APCA	9/25/84	0 23 lb/MMBtu - spray dryer
Cogentrix of NC Lumberton	NS	202	North Carolina DEM	9/10/84	1 6 lb/MMBtu - low S coal
Alabama Power Co	NS	248	Jefferson Cty HD	9/10/84	1 17 lb/MMBtu - low S coal
Virgina Power - Portsmouth	NS	1129	Virginia APCB	7/27/84	1 52 lb/MMBtu - low S coal
Cogentrix of NC Kenanville	NS	202	North Carolina DEM	9/10/84	1 6 lb/MMBtu - low S coal
Cogentrix of NC Hamilton	NS	202	North Carolina DEM	9/10/84	1 6 lb/MMBtu - low S coal
American Lignite Products	FB	590	EPA Region IX	1/10/84	65 lb/hr - limestone inj (94 3%)
Lower Colorado River Auth	LIG	4735	Texas ACB	12/22/83	1 lb/MMBtu - limestone scrubber (90%)
American Lignite Prod Co	FB	240	Amador Cty APCD	12/21/83	115 ppm - limestone inj (94 25%)
Intermountain Power Project	NS	6352	Utah BAQ	10/17/83	0 015 lb/MMBtu - limestone scrubber (90%)
Basin Electric Power Coop	NS	6278	North Dakota SHD	1/12/83	0 6 lb/MMBtu - spray dryer
Eastman Kodak	NS	670	New York DEC	12/20/82	1 2 lb/MMBtu - low S coal
Washington Water Power Co	NS	2080 MW	EPA Region X	11/17/82	0 22 lb/MMBtu - limestone scrubber
Iowa Electric Light & Power	NS	10000	EPA Region VII	10/29/82	0 6 lb/MMBtu - limestone scrubber
B F Goodrich	CFB	150	Illinois EPA	9/16/82	1 2 lb/MMBtu - limestone inj (85%)
Cincinnati Gas & Electric	NS	6313	Kentucky DAPC	5/14/82	1 2 lb/MMBtu - wet scrubber (91 5%)
West Texas Utilities Co	NS	6 8	Texas ACB	5/20/82	0 5 lb/MMBtu - limestone scrubber (70%)
Tacoma City Light	NS	1800	EPA Region X	5/11/82	0 23 lb/MMBtu - dry scrubber (85%)
Kentucky Utilities - Hancock	NS	6650	Kentucky DAPC	5/15/82	1 2 lb/MMBtu - wet scrubber (91 8%)
Jacksonville Elec Auth	NS	600	Florida DER	1/1/82	0 76 lb/MMBtu - lime/limestone FGD
SC Pub Svc - Cross Site	NS	500 MW	South Carolina DHEC	2/3/82	0 41 lb/MMBtu - low S coal
Houston Lighting & Power	NS	5729	EPA Region VI	11/12/81	0 36 lb/MMBtu - limestone scrubber (70%)
Holyoke Water Power - Mt Tom	NS	1447	Massachusetts DEQE	10/27/81	1 6 lb/MMBtu -
Central Power & Light	NS	6781	EPA Region VI	10/19/81	0 39 lb/MMBtu - FGD
Tampa Elect Co	NS	425 MW	Florida DER	10/15/81	0 82 lb/MMBtu - limestone scrubber
Oklahoma Gas & Elect	NS	5250	EPA Region VI	10/5/81	0 46 lb/MMBtu - FGD
Delmarva Power & Light	NS	5702	EPA Region III	9/30/81	0 6 lb/MMBtu - scrubber (70%)
SW Elect Power	NS	720 MW	EPA Region VI	9/1/81	1 2 lb/MMBtu - FGD
Pennsylvania Elect Co	NS	6280	EPA Region III	8/16/81	0 62 lb/MMBtu - lime scrubbing (77%)
NYS Elect & Gas - Cyuga Stat	NS	1750	EPA Region II	8/29/81	0 6 lb/MMBtu - FGD
Iowa-Illinois Gas & Elect	NS	7000	EPA Region VII	8/16/81	0 86 lb/MMBtu - low S coal
Idaho Nat Engineering Lab	NS	82 5	EPA Region X	6/5/81	1 2 lb/MMBtu - fluidized bed
Plains Elect Gen & Trans	NS	2471	EPA Region VI	5/27/81	0 2 lb/MMBtu - FGD (90%)
Nevada Power Co	NS	560 MW	EPA Region IX	4/13/81	0 1 lb/MMBtu - wet lime scrubber

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR SO₂ (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for SO ₂
Big Rivers Elect - D B Wilson	NS	4585	Kentucky DAPC	3/11/81	1 2 lb/MMBtu - wet scrubber
AL Elect Coop Inc	LIG	4805	Alabama APCD	2/24/81	0 8 lb/MMBtu - FGD (90%)
SW Elect Power	NS	6821	EPA Region VI	2/23/81	0 9 lb/MMBtu - wet limestone FGD (87 4%)
Container Corp of America	PC	NS	Philadelphia AMS	1/20/81	0 5 lb/MMBtu - spray dryer
Nebraska Public Power Dist	NS	650 MW	Nebraska DEC	12/16/80	0 38 lb/MMBtu - dry scrubber (70%)
New England Power - Brayton Pt	NS	10625	Massachusetts DEQE	11/1/80	1 21 lb/MMBtu -
E Kentucky Power - J K Smith	NS	6760	Kentucky DAPC	8/21/80	1 2 lb/MMBtu - wet scrubber (90%)
City of Wilkes-Barre	NS	92 5	EPA Region III	7/1/80	1 6 lb/MMBtu - low S coal
Curtiss-Wright Corp	FB	137	EPA Region II	6/13/80	0 3 lb/MMBtu - limestone inj (93%)
Intermountain Power Project	NS	750 MW	EPA Region VIII	6/8/80	0 15 lb/MMBtu - scrubber
Utah Power & Light - Hunter	NS	880 MW	EPA Region VIII	6/2/80	0 12 lb/MMBtu - scrubber (90%)
Platte River Pwr - Rawhide	NS	250 MW	EPA Region VIII	5/22/80	0 13 lb/MMBtu - dry scrubber (80%)
Sunflower Elect Coop - Holcomb	NS	3389	EPA Region VII	5/19/80	0 48 lb/MMBtu - dry scrubber (80%)
Michigan S Central Pwr Agcy	NS	NS	Michigan DNR	5/16/80	limestone scrubber (90%)
Kentucky Power - Carr s Fac	NS	11943	Kentucky DAPC	4/18/80	0 6 lb/MMBtu - FGD (95%)
TVA Shawnee Pilot Plant	FB	200	Kentucky DAPC	4/14/80	1 2 lb/MMBtu - fluidized bed
Tucson Elec Power Co	NS	350 MW	EPA Region IX	4/11/80	0 218 lb/MMBtu - dry scrubber (85%)
Marquette Lt & Pwr - Shiras	NS	517 6	Michigan DNR	4/1/80	0 4 lb/MMBtu - spray lime FGD (70%)
N Indiana Public Service	NS	3967	EPA Region V	3/31/80	0 62 lb/MMBtu - scrubber (90%)
Colorado Ute-Craig	NS	5350	EPA Region VIII	3/27/80	0 2 lb/MMBtu - dry scrubber (90%)
Cajun Elec Power Coop	LIG	6507	EPA Region VI	3/25/80	1 08 lb/MMBtu - lime/limestone scrubber (80%)
Grand Haven Lt & Pwr	NS	710	Michigan DNR	3/18/80	0 8 lb/MMBtu - lime slurry scrubber (90%)
Deeriet Gen & Trans Moon Lake	NS	400 MW	EPA Region VIII	2/4/80	0 055 lb/MMBtu - wet scrubber (94%)
Muscataine Power & Water	NS	166 MW	EPA Region VII	1/24/80	0 45 lb/MMBtu - wet limestone scrubber

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR SULFURIC ACID (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for H ₂ SO ₄
Applied Energy Services	CFB	2150	Hawaii DOH	1/26/90	49.5 lb/hr (0.023 lb/MMBtu) -
Cogentrix Rocky Mount	SS	375	North Carolina DEM	7/20/89	0.0021 lb/MMBtu - Dry Lime FGD
Cogentrix Southport	NS	202	North Carolina DEM	7/7/88	0.021 lb/MMBtu - low S coal
Cogentrix Roxboro	NS	202	North Carolina DEM	5/28/86	0.021 lb/MMBtu - no controls
White Pine Power Project	NS	750 MW	Nevada DEP	8/6/85	35.6 lb/hr - boiler operation
Lower Colorado River Authority	LIG	4735	Texas ACB	12/22/83	0.046 lb/MMBtu
Washington Water Power Co	NS	2080 MW	EPA Region IX	11/17/82	80.8 lb/hr

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR NOx (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for NOx
Applied Energy Services	CFB	2150	Hawaii DOH	1/25/90	236 lb/hr (25 ppm) - SNCR (62%)
A E S Thames Inc	FB	923	Connecticut DEP	8/9/89	0.36 lb/MMBtu - fluidized bed combustion
A E S Thames Inc	FB	923	Connecticut DEP	8/9/89	0.36 lb/MMBtu - fluidized bed combustion
Cogentrix Rocky Mount (4 units)	SS	375	North Carolina DEM	7/20/89	0.6000 lb/MMBtu - Control of Excess Air
Scrubgrass Power Corp (2 units)	CFB	599	Pennsylvania BAQC	1/18/89	0.3000 lb/MMBtu - Combustion Control
Cambria Cogen Inc (2 units)	CFB	559	Pennsylvania BAQC	5/26/89	335.5 lb/hr - Combustion Control
Goodyear United Development	FB	577	New York State DEC	10/14/88	0.5 lb/MMBtu - Combustion Control (90% eff)
North Branch Energy Partners LP	CFB	563	Pennsylvania BAQC	9/26/88	0.6 lb/MMBtu
United Development Group	FB	577	New York State DEC	9/25/88	0.5 lb/MMBtu - Combustion Control (65% eff)
Fort Howard	CFB	505	Wisconsin DNR	9/21/88	0.49 lb/MMBtu - Proper Bed Operation
Northeastern Power Co	CFB	513	Pennsylvania BAQC	6/17/88	0.6 lb/MMBtu
Edensburg Power Co	FB	617	Pennsylvania BAQC	6/6/88	0.6 lb/MMBtu
Tennessee Valley Authority	FB	1579	Kentucky DAQ	5/4/88	0.6 lb/MMBtu
Panther Creek Energy	CFB	1170	Pennsylvania DER	2/17/88	0.42 lb/MMBtu
GWF Power Systems Co Inc	CFB	202	Bay Area AQMD (CA)	2/11/88	0.074 lb/MMBtu - Ammonia Inj System
City of Wyandotte Dept Mun Svcs	CFB	389	Wayne Co APC (MI)	12/07/87	0.4 lb/MMBtu - temp 1450-1850 F - Equip Design
Cogentrix Michigan Leasing Corp	SS	214	Michigan DNR	7/31/87	0.6 lb/MMBtu - design and operating practices
Fort Drum Heating Plant	CFB	190	New York State DEC	4/01/87	0.6 lb/MMBtu - Combustion Control
Wm H Zimmer Generating Station	CFB	11988	Southwest Ohio APCA	2/5/87	0.6 lb/MMBtu - Low NOx Burners (35% eff (est))
GWF Power Systems Co	FB	274	EPA Region IX	1/28/87	28 ppm - staged combustion ammonia inj
Archbald Power Corp	NS	240	Pennsylvania DER	1/16/87	0.25 lb/MMBtu
Mt Poso Cogeneration Co	CFB	50 MW	EPA Region IX	1/12/87	0.1 lb/MMBtu - SNCR
Foster Wheeler Power (2 units)	CFB	283	Pennsylvania DER	12/29/86	0.6 lb/MMBtu
Sheridan Coal Co	CFB	550	Pennsylvania DER	12/1/86	0.6 lb/MMBtu
Pyropower Corp	CFB	640	Kern County APCD	12/1/86	0.092 lb/MMBtu (LAER) - SNCR
J Pagnotti Enterprises	CFB	1082	Pennsylvania DER	11/1/86	0.4 lb/MMBtu
Rio Bravo Refining Co	FB	389	EPA Region IX	10/22/86	0.1 lb/MMBtu - SNCR
Utah Power & Light Co (#2 unit)	NS	4000	Utah BAQ	10/1/86	0.49 lb/MMBtu - Low NOx Burn (35% eff)
Rio Bravo Refining Co	FB	36 MW	EPA Region IX	8/19/86	78 ppm - SNCR
Cogentrix Carolina Leasing Co	NS	202	North Carolina DEM	7/7/86	0.6 lb/MMBtu - control of excess air
Northeastern Power Co	NS	540	Pennsylvania DER	6/27/86	0.6 lb/MMBtu
BMCP	CFB	230	Kern County APCD	6/20/86	0.039 lb/MMBtu - SNCR (80%)
Cogentrix of Virginia Inc	NS	200	Virginia APCB	6/12/86	0.6 lb/MMBtu
TVA - Shawnee Steam Plant	FB	1430	Kentucky DAPC	4/15/86	0.6 lb/MMBtu
Westwood Energy Properties	NS	425	Pennsylvania DER	1/6/86	0.6 lb/MMBtu
Wisc Electric Power Co	FB	825	Wisconsin DNR	1985	0.5 lb/MMBtu - Proper Combustion
Cogeneration National Corp	FB	300	EPA Region IX	12/31/85	30 ppm - (LAER) SNCR
Corn Products	FB	49.9 MW	EPA Region IX	12/16/85	50 ppm - SNCR (80%)
Cogeneration National Corp	NS	279.8	San Joaquin Cty APCD	12/13/85	30 ppm - SNCR
Tennessee Valley Authority	FB	200	Kentucky DAPC	12/13/85	0.56 lb/MMBtu
Signal Frackville Energy	NS	NS	Pennsylvania DER	12/2/85	0.6 lb/MMBtu

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR NOx (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for NOx
Corn Products	CFB	620	San Joaquin Cty APCD	10/29/85	30 ppm - SNCR
White Pine Power	NS	750 MW	Nevada DEP	8/8/85	0.45 lb/MMBtu - design & combustion
Central State University	NS	66	Dayton RAPCA	7/1/85	0.6 lb/MMBtu
Union Camp Franklin	NS	245	Virginia APCB	7/1/85	843.86 ton/yr - engineering design
SCE - Biogen Power Project	CFB	212	EPA Region IX	4/28/85	34 ppm (0.043 lb/MMBtu) - SNCR (80%)
Rio Bravo Refining Co	CFB	37.5 MW	Kern County APCD	2/28/85	0.2 lb/MMBtu (LAER) - CFB combustion
3M Co	NS	120	Alabama DEM	11/29/84	0.7 lb/MMBtu
Amalgamaize Co	NS	180	Alabama DEM	11/29/84	0.57 lb/MMBtu
Cogentrix of NC Lumberton	NS	202	North Carolina DEM	9/10/84	0.7 lb/MMBtu - control of excess air
Alabama Power Co	NS	248	Jefferson City HD	9/10/84	0.6 lb/MMBtu - operating practices
Virginia Power - Portsmouth	NS	1129	Virginia APCB	7/27/84	0.6 lb/MMBtu - combustion design
Cogentrix of NC Kenansville	NS	202	North Carolina DEM	9/10/84	0.7 lb/MMBtu - control of excess air
Cogentrix of NC Hamilton	NS	202	North Carolina DEM	9/10/84	0.7 lb/MMBtu - control of excess air
American Lignite Products	FB	590	EPA Region IX	1/10/84	61.5 lb/hr - cfb
Lower Colorado River Auth	LIG	4735	Texas ACB	12/22/83	0.6 lb/MMBtu - burner design
American Lignite Products	FB	240	Amador Cty APCD	12/21/83	150 ppm - staged combustion
Intermountain Power Project	NS	6352	Utah BAQ	10/17/83	0.55 lb/MMBtu - combustion control
Basin Electric Power Coop	NS	6278	North Dakota SHD	1/12/83	0.45 lb/MMBtu - combustion controls
Eastman Kodak	NS	670	New York DEC	12/20/82	0.7 lb/MMBtu - combustion control
Washington Water Power Co	NS	2080 MW	EPA Region X	11/17/82	0.5 lb/MMBtu
Iowa Electric Light & Power	NS	10000	EPA Region VII	10/29/82	0.5 lb/MMBtu - combustion design
B F Goodrich	CFB	150	Illinois EPA	9/16/82	0.6 lb/MMBtu - equipment design
Cincinnati Gas & Electric	NS	6313	Kentucky DAPC	5/14/82	0.7 lb/MMBtu
West Texas Utilities Co	NS	6.8	Texas ACB	5/20/82	0.5 lb/MMBtu
Tacoma City Light	NS	1600	EPA Region X	5/11/82	0.5 lb/MMBtu
Kentucky Utilities - Hancock	NS	6650	Kentucky DAPC	5/15/82	0.6 lb/MMBtu
Jacksonville Elec Auth	NS	600	Florida DER	1/1/82	0.6 lb/MMBtu
SC Pub Svc - Cross Site	NS	500 MW	South Carolina DHEC	2/3/82	0.6 lb/MMBtu - equip design
Houston Lighting & Power	NS	5729	EPA Region VI	11/12/81	0.5 lb/MMBtu - O2 controls
Holyoke Water Power - Mt Tom	NS	1447	Massachusetts DEQE	10/27/81	not specified
Central Power & Light	NS	6781	EPA Region VI	10/19/81	0.5 lb/MMBtu - fire box design
Tampa Electric Co	NS	425 MW	Florida DER	10/15/81	0.6 lb/MMBtu - equip design
Oklahoma Gas & Electric	NS	5250	EPA Region VI	10/5/81	0.5 lb/MMBtu - excess air
Delmarva Power & Light	NS	5702	EPA Region III	9/30/81	0.6 lb/MMBtu - burner design
Panorama Enercorp Inc	NS	37 MW	EPA Region X	9/22/81	0.17 lb/MMBtu
SW Electric Power	NS	720 MW	EPA Region VI	9/1/81	0.6 lb/MMBtu - low NOx burners
Pennsylvania Electric Co	NS	6280	EPA Region III	8/18/81	0.6 lb/MMBtu
NYS Electric & Gas - Cygus Stat	NS	1750	EPA Region II	8/29/81	0.6 lb/MMBtu - good design
Iowa-Illinois Gas & Electric	NS	7000	EPA Region VII	8/16/81	0.6 lb/MMBtu - boiler design
Idaho Nat Engineering Lab	NS	62.5	EPA Region X	6/5/81	0.5 lb/MMBtu - combustion controls
Plains Electric Gen & Trans	NS	2471	EPA Region VI	5/27/81	0.45 lb/MMBtu - fire box design

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR NOx (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for NOx
Nevada Power Co	NS	560 MW	EPA Region IX	4/13/81	0.44 lb/MMBtu - design
Big Rivers Elect - D B Wilson	NS	4585	Kentucky DAPC	3/11/81	0.6 lb/MMBtu - boiler design & oper
AL Elect Coop Inc	LIG	4806	Alabama APCD	2/24/81	0.6 lb/MMBtu - boiler design & operation
SW Elect Power	NS	6821	EPA Region VI	2/23/81	0.6 lb/MMBtu - LNB & FGR
Nebraska Public Power Dist	NS	660 MW	Nebraska DEC	12/16/80	0.5 lb/MMBtu
New England Power - Brayton Pt	NS	10625	Massachusetts DEQE	11/1/80	not specified
E Kentucky Power - J K Smith	NS	6760	Kentucky DAPC	8/21/80	0.6 lb/MMBtu - boiler design
Curtiss-Wright Corp	FB	137	EPA Region II	6/13/80	none
Intermountain Power Project	NS	750 MW	EPA Region VIII	6/8/80	0.55 lb/MMBtu - design
Utah Power & Light - Hunter	NS	860 MW	EPA Region VIII	6/2/80	0.55 lb/MMBtu - boiler design
Platte River Pwr - Rawhide	NS	260 MW	EPA Region VIII	5/22/80	0.5 lb/MMBtu - design
Sunflower Elect Coop - Holcomb	NS	3389	EPA Region VII	5/19/80	0.6 lb/MMBtu - staged comb LEA
Michigan S Central Pwr Agcy	NS	NS	Michigan DNR	5/16/80	0.6 lb/MMBtu - control excess air
Kentucky Power - Carr & Fac	NS	11943	Kentucky DAPC	4/18/80	0.6 lb/MMBtu - boiler design
Tucson Elec Power Co	NS	350 MW	EPA Region IX	4/11/80	0.44 lb/MMBtu - combustion modifications
Marquette Lt & Pwr - Shiras	NS	517.6	Michigan DNR	4/1/80	0.5 lb/MMBtu
N Indiana Public Service	NS	3967	EPA Region V	3/31/80	0.6 lb/MMBtu
Colorado Ute-Craig	NS	5350	EPA Region VIII	3/27/80	0.5 lb/MMBtu
Cajun Elec Power Coop	LIG	6507	EPA Region VI	3/25/80	0.6 lb/MMBtu - O2 Control
Grand Haven Lt & Pwr	NS	710	Michigan DNR	3/16/80	0.6 lb/MMBtu
Deseret Gen & Trans Moon Lake	NS	400 MW	EPA Region VIII	2/4/80	0.55 lb/MMBtu
Muscataine Power & Water	NS	166 MW	EPA Region VII	1/24/80	0.6 lb/MMBtu

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR CO (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agcy	Date of issuance	BACT for CO
Applied Energy Services	CFB	2150	Hawaii DOH	1/25/90	408 lb/hr (70 ppm) -
Cogentrix Rocky Mount (4 units)	SS	375	North Carolina DEM	7/20/89	0 0200 lb/MMBtu - Combustion Control
A E S Thames Inc	FB	923	Connecticut DEP	8/9/89	0 11 lb/MMBtu
A E S Thames Inc	FB	923	Connecticut DEP	8/9/89	0 11 lb/MMBtu
Cambria Cogen Inc (2 units)	CFB	559	Pennsylvania BAQC	5/28/89	83 9 lb/hr - Combustion Control
Scrubgrass Power Corp (2 units)	CFB	599	Pennsylvania BAQC	1/18/89	0 1000 lb/MMBtu
Goodyear United Development Group	FB	577	New York DEC	10/14/88	0 2 lb/MMBtu - Combustion Controls
North Branch Energy Partners LP	CFB	563	Pennsylvania BAQC	9/26/88	0 15 lb/MMBtu
United Development Group	FB	577	New York State DEC	9/25/88	0 2 lb/MMBtu - Combustion Control
Fort Howard Corp	CFBC	505	Wisconsin DNR	9/21/88	0 2 lb/MMBtu - Proper Bed Operation
Edensburg Power Co	FB	617	Pennsylvania BAQC	6/6/88	0 18 lb/MMBtu
TVA - Shawnee Steam Plant	AFBC	1579	Kentucky DAQ	5/4/88	0 4 lb/MMBtu
GWF Power Systems Co Inc	CF	202	Bay Area AQMD (CA)	2/11/88	0 09 lb/MMBtu - Best Engineering Practices
City of Wyandotte Dept Mun Svcs	CFBC	389	Wyane Co APC (MI)	12/7/87	0 14 lb/MMBtu - Temp 1450-1650 F - equip design
Cogentrix Michigan Leasing Corp	SS	214	Michigan DNR	7/31/87	0 2 lb/MMBtu - design and operation
Fort Drum Heating Plant	CFB	190	New York State DEC	4/1/87	0 25 lb/MMBtu - Combustion Control
GWF Power Systems Co	FB	274	EPA Region IX	1/28/87	200 ppm - AFBC
Mt Poso Cogeneration Co	CFB	50 MW	EPA Region IX	1/12/87	50 lb/hr - control of overfire air
Foster Wheeler Power (2 units)	NS	283	Pennsylvania DER	12/29/86	0 5 lb/MMBtu
Rio Bravo Refining Co	FB	389	EPA Region IX	10/22/86	0 27 lb/MMBtu - combustion controls
Rio Bravo Refining Co	FB	38 MW	EPA Region IX	8/19/86	0 27 lb/MMBtu - combustion controls
Cogentrix Carolina Leasing Co	NS	202	North Carolina DEM	7/7/86	0 6 lb/MMBtu - control of excess air
Cogentrix of Virginia Inc	NS	200	Virginia APCB	6/12/86	0 6 lb/MMBtu
TVA - Shawnee Steam Plant	FB	1430	Kentucky DAPC	4/15/86	0 4 lb/MMBtu
Northern Energy Group	WF	250	New York State DEC	12/11/85	0 35 lb/MMBtu - Combustion Control
Cogeneration National Corp	NS	279 6	San Joaquin Cty APCD	12/13/85	limit to be set - staged combustion
Tennessee Valley Authority	FB	200	Kentucky DAPC	12/13/85	none
Corn Products	CFB	820	San Joaquin Cty APCD	10/29/85	none listed
White Pine Power	NS	750 MW	Nevada DEP	8/8/85	383 lb/hr
SCE - Biogen Power Project	CFB	212	EPA Region IX	4/26/85	0 12 lb/MMBtu - boiler combustion controls
Rio Bravo Refining Co	CFB	37 5 MW	Kern County APCD	2/28/85	0 27 lb/MMBtu - circulating bed combustion
Wisconsin Electric Power Co	PFBC	825	Wisconsin DNR	1985	0 09 lb/MMBtu - Proper Combustion
3M Co	NS	120	Alabama DEM	11/29/84	0 2 lb/MMBtu - boiler design & operating practices
Amalgamize Co	NS	180	Alabama DEM	11/29/84	0 2 lb/MMBtu - boiler design & operating practices
Cogentrix of NC Lumberton	NS	202	North Carolina DEM	9/10/84	0 6 lb/MMBtu - control of excess air
Virginia Power - Portsmouth	NS	1129	Virginia APCB	7/27/84	0 02 lb/MMBtu - combustion design parameters
Cogentrix of NC Kenansville	NS	202	North Carolina DEM	9/10/84	0 6 lb/MMBtu - control of excess air
Cogentrix of NC Hamilton	NS	202	North Carolina DEM	9/10/84	0 6 lb/MMBtu - control of excess air
American Lignite Products	FB	590	EPA Region IX	1/10/84	24 2 lb/hr - circulating fluid bed
Lower Colorado River Auth	LIG	4735	Texas ACB	12/22/83	0 12 lb/MMBtu -
American Lignite Products	FB	240	Amador Cty APCD	12/21/83	138 ppm - staged combustion

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR CO (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for CO
Eastman Kodak	NS	670	New York DEC	12/20/82	0.045 lb/MMBtu - combustion control
Washington Water Power Co	NS	2080 MW	EPA Region X	11/17/82	332 lb/hr
B F Goodrich	CFB	150	Illinois EPA	9/18/82	400 ppm - equipment design
Kentucky Utilities - Hancock	NS	6650	Kentucky DAPC	4/15/82	0.048 lb/MMBtu
SC Pub Svc - Cross Site	NS	500 MW	South Carolina DHEC	12/3/81	0.04 lb/MMBtu - equipment design and operation
Houston Lighting & Power	NS	5729	EPA Region VI	11/12/81	0.059 lb/MMBtu - O2 controls
Central Power & Light	NS	6781	EPA Region VI	10/19/81	0.06 lb/MMBtu - O2 control optimal with NOx
Tampa Elect Co	NS	425 MW	Florida DER	10/15/81	0.014 lb/MMBtu - equipment design & operation
Oklahoma Gas & Elect	NS	5250	EPA Region VI	10/5/81	0.04 lb/MMBtu - com controls & proper operation
Delmarva Power & Light	NS	5702	EPA Region III	9/30/81	0.04 lb/MMBtu - burner design
Panorama Enercorp Inc	NS	37 MW	EPA Region X	9/22/81	107.3 lb/hr
SW Elect Power	NS	720 MW	EPA Region VI	9/1/81	0.08 lb/MMBtu - efficient combustion
Pennsylvania Elect Co	NS	6280	EPA Region III	8/18/81	0.04 lb/MMBtu
NYS Elect & Gas - Cyuga Stat	NS	1750	EPA Region II	6/29/81	- good combustion practices
Plains Elect Gen & Trans	NS	2471	EPA Region VI	5/27/81	0.063 lb/MMBtu - fire box design & com control
Nevada Power Co	NS	580 MW	EPA Region IX	4/13/81	50 ppm - design & excess air control
AL Elec Coop Inc	LIG	4805	Alabama APCD	2/24/81	0.098 lb/MMBtu - boiler design & operation
SW Elect Power	NS	6821	EPA Region VI	2/23/81	0.1 lb/MMBtu - low excess air
Nebraska Public Power Dist	NS	650 MW	Nebraska DEC	12/16/80	50 ppm
Curtiss-Wright Corp	FB	137	EPA Region II	6/13/80	none
Intermountain Power Project	NS	750 MW	EPA Region VIII	6/8/80	1248 lb/hr
Sunflower Elect Coop - Holcomb	NS	3389	EPA Region VII	5/19/80	0.064 lb/MMBtu -
Colorado Ute-Craig	NS	5350	EPA Region VIII	3/27/80	no control
Cajun Elec Power Coop	LIG	6507	EPA Region VI	3/25/80	0.09 lb/MMBtu - O2 control
Deseret Gen & Trans Moon Lake	NS	400 MW	EPA Region VIII	2/4/80	no control

CFB-circulating fluidized bed FB-fluidized bed LIG-ignite SS-spreader stoker NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR VOC (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agcy	Date of Issuance	BACT for VOC
Applied Energy Services	CFB	2150	Hawaii DOH	1/25/90	32.2 lb/hr (3.5 ppm) -
AES Thames Inc	FB	923	Connecticut DEP	8/9/89	0.02 lb/MMBtu
AES Thames Inc	FB	923	Connecticut DEP	8/9/89	0.02 lb/MMBtu
Cambria Cogen Inc (2 units)	CFB	559	Pennsylvania BAQC	5/26/89	Combustion Control
Scrubgrass Power Corp (2 units)	CFB	599	Pennsylvania BAQC	1/18/89	0.0050 lb/MMBtu
Fort Howard Corp	CFBC	505	Wisconsin DNR	9/21/88	2.21 lb/h
North Branch Energy Partners LP	CFB	563	Pennsylvania BAQC	9/26/88	0.02 lb/MMBtu
City of Wyandotte Dept Mun Svcs	CFBC	369	Wyandotte Co APC (MI)	12/7/87	8.86 lb/h
Cogentrix of Virginia Inc	NS	200	Virginia APCB	6/12/86	0.003 lb/MMBtu
TVA - Shawnee Steam Plant	FB	1430	Kentucky DAPC	4/15/86	none
Tennessee Valley Authority	FB	200	Kentucky DAPC	12/13/85	none
Virginia Power - Portsmouth	NS	1129	Virginia APCB	7/27/84	0.004 lb/MMBtu - combustion design parameters
Lower Colorado River Auth	LIG	4735	Texas ACB	12/22/83	0.0081 lb/MMBtu
Washington Water Power Co	NS	2080 MW	EPA Region X	11/17/82	3.32 lb/hr
Delmarva Power & Light	NS	5702	EPA Region III	9/30/81	0.001 lb/MMBtu - burner design
Panorama Enercorp Inc	NS	37 MW	EPA Region X	9/22/81	36.5 lb/hr
Nevada Power Co	NS	560 MW	EPA Region IX	4/13/81	- proper boiler design
Intermountain Power Project	NS	750 MW	EPA Region VIII	6/8/80	375 lb/hr -
Colorado Ute-Craig	NS	5350	EPA Region VIII	3/27/80	no control
Deseret Gen & Trans Moon Lake	NS	400 MW	EPA Region VIII	2/4/80	no control

CFB-circulating fluidized bed FB-fluidized bed LIG-lignite SS-spreader stoker NS-not specified

**COAL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR TRACE METALS (1980 - PRESENT)**

Name	Type	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT Limits
Applied Energy Services	CFB	2150	Hawaii DOH	1/25/90	Pb - 0.003 lb/MMBtu
Port Washington Power Plant	NS	825	Wisconsin DNR	1988	Be - 6.5e-6 lb/MMBtu - ESP Hg - 1 ug/m3 Pb - 1.9e-4 lb/MMBtu - ESP
Fort Howard	CFB	505	Wisconsin DNR	9/21/88	Be - 9e-4 lb/hr Hg - 0.04 lb/hr Pb - 0.03 lb/hr
White Pine Power	NS	750 MW	Nevada DEP	8/6/85	Hg - 0.05 lb/hr - proper boiler operation
Lower Colorado River Authority	NS	4735	Texas ACB	12/22/83	Hg - 0.13 tpy
Washington Water Power Co	NS	2080 MW	EPA Region IX	11/17/82	Be - 0.02 lb/hr Hg - 0.03 lb/hr Pb - 0.27 lb/hr
Eastman Kodak Co	NS	670	New York DEC	12/20/82	Be - 0.001 lb/hr - ESP
NY State E&G - Cyuga	NS	1750	EPA Region II	5/29/81	Be - no limit - ESP/FGD Hg - no limit - ESP/FGD Pb - no limit - ESP/FGD
Nevada Power Co	NS	560 MW	EPA Region IX	4/13/81	Be - no limit Hg - no limit - PM controls Pb - no limit

CFBC - circulating fluidized bed NS - not specified

OIL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR NO_x

Name	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for NO _x
Wisconsin Tissue Mills Inc	146.4	Wisconsin DNR	10/10/88	0.38 lb/MMBtu - low excess air
Georgia Pacific Corp	118	Southwest OH APCA	1986	0.3 lb/MMBtu - low excess air
Owens-Illinois Inc	10.3	Toledo Env Svcs	11/26/86	0.145 lb/MMBtu - gas/oil firing
Berry Holding Co	62.5	Kern County APCD	10/2/85	0.12 lb/MMBtu - LNB & FGR
Petro-Lewis Corp	50	EPA Region IX	8/7/84	0.12 lb/MMBtu - LNB
Hopco	62.5	Kern County APCD	12/4/84	0.12 lb/MMBtu - SNCR
Angus Petroleum	62.5	Kern County APCD	11/29/83	0.13 lb/MMBtu - LNB
Houston Lighting & Power	185	EPA Region IV	1/16/80	0.3 lb/MMBtu

**OIL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR SO₂**

Name	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for SO ₂
Wisconsin Tissue Mills Inc	146.4	Wisconsin DNR	10/10/88	1.1 lb/MMBtu - 1% S oil
Georgia Pacific Corp	118	Southwest OH APCA	1986	1.06 lb/MMBtu - 1% S oil
GMC-CPC Hamilton-Fairfield	27	Southwest OH APCA	12/31/86	1.1 lb/MMBtu - limit S content
Owens-Illinois Inc	10.3	Toledo Env Svcs	11/26/86	0.52 lb/MMBtu - gas/oil firing
Unical	82.5	Kern County APCD	12/27/85	0.0365 lb/MMBtu - flue gas scrubber
Berry Holding Co	82.5	Kern County APCD	10/2/85	0.07 lb/MMBtu - caustic scrubber
Delco Moraine Div GMC	144	Dayton RAPCA	7/1/85	1.3 lb/MMBtu
Petro-Lewis Corp	50	EPA Region IX	8/7/84	0.052 lb/MMBtu - scrubber
Hopco	82.5	Kern County APCD	12/4/84	0.034 lb/MMBtu - scrubber
Angus Petroleum	82.5	Kern County APCD	11/29/83	0.04 lb/MMBtu - scrubber
Houston Lighting & Power	185	EPA Region IV	1/16/80	0.5 lb/MMBtu - low S oil
Hooker Chemical & Plastics Corp	81.9	EPA Region III	7/3/79	4.33 lb/MMBtu - 1/3% S oil

OIL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR CO

Name	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for CO
Owens-Illinois Inc	10.3	Toledo Env Svcs	11/26/88	0.04 lb/MMBtu - gas/oil firing

**OIL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR VOC**

Name	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for VOC
Owens-Illinois Inc	10.3	Toledo Env Svcs	11/26/88	0.003 lb/MMBtu – gas/oil firing
Hopco	82.5	Kern County APCD	12/4/84	0.000 lb/hr – vapor collection and incineration

OIL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR PM

Name	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for PM
Wisconsin Tissue Mills Inc	146.4	Wisconsin DNR	10/10/88	0.09 lb/MMBtu - 1% S oil
Georgia Pacific Corp	118	Southwest OH APCA	1988	0.09 lb/MMBtu - 1% S oil
Owens-Illinois Inc	10.3	Toledo Env Svcs	11/28/86	0.02 lb/MMBtu - gas/oil firing
Delco Moraine Div GMC	144	Dayton RAPCA	7/1/85	0.08 lb/MMBtu
Hopco	62.5	Kern County APCD	12/4/84	0.0272 lb/MMBtu - wet scrubber
Houston Lighting & Power	185	EPA Region IV	1/16/80	0.1 lb/MMBtu

**OIL FIRED BOILERS
BACT/LAER CLEARINGHOUSE
LISTINGS FOR TRACE METALS**

Name	Size (MMBtu/hr)	Reviewing Agency	Date of Issuance	BACT for Trace Metals
Wisconsin Tissue Mills Inc GMC-CPC Hamilton-Fairfield	148.4 27	Wisconsin DNR Southwest OH APCA	10/10/88 12/31/86	Be - no limit - 1% S oil As - 5 ppm in oil Cd - 2 ppm in oil Cr - 10 ppm in oil Pb - 100 ppm in oil

APPENDIX B
CALCULATIONS

PG+E - BECHTEL / INDIANTOWN

AMMONIUM BISULFITE CALCULATION

PLANT DATA

COAL SULFUR 2%
COAL HEAT 11,800 BTU/lb
PC HEAT INPUT 3430 MM BTU/hr

COAL FIRING RATE

$$\frac{(3430 \times 10^6 \text{ BTU/HR})}{(11800 \text{ BTU/lb})} = 290,700 \text{ lb/hr}$$

SULFUR RELEASE RATE

$$\left(290,700 \frac{\text{lb COAL}}{\text{hr}} \right) \left(\frac{0.02 \text{ lb S}}{\text{lb COAL}} \right) = 5814 \text{ lb/hr}$$

STACK RATE 100 FT/SEC @ 16 FT DIA

$$\left(\frac{100 \text{ FT}}{\text{SEC}} \right) \left(\frac{60 \text{ SEC}}{\text{MIN}} \right) \frac{\pi}{4} (16 \text{ FT})^2 = 1,206,300 \text{ ACFT}$$

EXIT TEMP = 140 OF

$$\left(\frac{1,206,300 \text{ FT}^3}{\text{MIN}} \right) \left(\frac{528 \text{ OF}}{140 + 460 \text{ OF}} \right) \left(\frac{1 \text{ lb mol}}{385 \text{ FT}^3} \right) \left(\frac{30 \text{ lb}}{1 \text{ lb mol}} \right) \left(\frac{60 \text{ MIN}}{\text{HR}} \right) = 4,963,000 \text{ lb/HR}$$

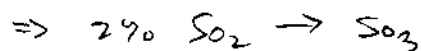
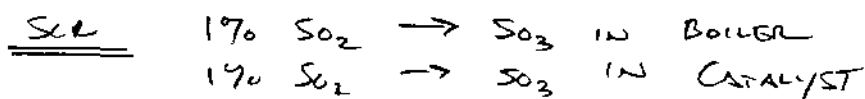
AMMONIA SLIP RATE @ 5 PPM

$$\frac{(4,963,000 \text{ lb/HR})}{(30 \text{ lb/lb mol})} \left(\frac{5 \text{ PPM}}{10^6} \right) \left(\frac{17 \text{ lb NH}_3}{1 \text{ lb mol}} \right) = 14 \text{ lb NH}_3 / \text{HR}$$

AMMONIUM BISULFATE EMISSIONS

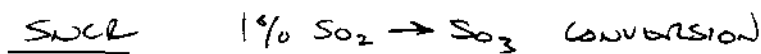
- IF NH_3 IS RATE LIMITING

$$(14 \text{ lb/hr}) \left(\frac{115 \text{ lb } \text{NH}_4 \text{HSO}_4}{17 \text{ lb } \text{NH}_3} \right) = \underline{\underline{95 \text{ lb/hr}}}$$

- IF SO_3 IS RATE LIMITING

$$\left(\frac{5814 \text{ lb S}}{\text{hr}} \right) \left(\frac{0.02 \text{ lb S IN } \text{SO}_3}{\text{TOTAL S}} \right) \left(\frac{80 \text{ lb } \text{SO}_3}{32 \text{ lb S}} \right) = 290.7 \text{ lb } \text{SO}_3 \text{ / hr}$$

$$\left(\frac{290.7 \text{ lb } \text{SO}_3}{\text{hr}} \right) \left(\frac{115 \text{ lb } \text{NH}_4 \text{HSO}_4}{80 \text{ lb } \text{SO}_3} \right) = \underline{\underline{413 \text{ lb } \text{NH}_4 \text{HSO}_4 \text{ / hr}}}$$



$$\left(\frac{5814 \text{ lb S}}{\text{hr}} \right) \left(\frac{0.01 \text{ lb S IN } \text{SO}_3}{\text{TOTAL S}} \right) \left(\frac{115 \text{ lb } \text{NH}_4 \text{HSO}_4}{32 \text{ lb S}} \right) = \underline{\underline{209 \text{ lb } \text{NH}_4 \text{HSO}_4 \text{ / hr}}}$$

B Air Quality Impact Analysis

**AIR QUALITY IMPACT ANALYSIS
IN SUPPORT OF A
PREVENTION OF SIGNIFICANT DETERIORATION (PSD) PERMIT APPLICATION
FOR THE PROPOSED
INDIANTOWN COGENERATION PROJECT**

**Prepared by
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**Prepared for
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December 1990

1 0 INTRODUCTION

The Indiantown Cogeneration L P (ICL) Project is proposed to be constructed at a site along Highway 710 approximately 3 miles northwest of the community of Indiantown and 9 miles east of Lake Okeechobee, Florida. The proposed site is southwest of and abuts the Caulkins Citrus Processing facility and the Florida Steel Corporation Indiantown steel mill property. The site occupies the central portion of Section 35, Township 39 South, Range 38 East, Martin County, Florida.

The U S Environmental Protection Agency (EPA) has promulgated Prevention of Significant Deterioration (PSD) regulations (40 CFR 52.21) which require a permit review and approval for new or modified existing sources which emitted criteria pollutants in amount greater than the significant emission levels. Since the proposed source will have emissions which exceed the significant levels, the proposed ICL plant is subject to PSD review. Based on the Florida Administration Code (FAC, 17-2.510), the State of Florida has the PSD authority through the Florida Department of Environmental Regulation (FDER). A completed FDER Form 17-1 202(1) for Application to Operate/Construct Air Pollution Sources is attached.

Although part of the SCA process, this document is prepared as a complete PSD permit application. Therefore, design information and analysis required by the federal and state regulations are included in this document. The following sections include:

- o A discussion of the regulatory rationale as it applies to the project (Section 2.0)
- o A description of the technical approaches used for the various air quality impact analyses (Section 3.0)
- o A description of the development of dispersion model input parameters, including model options, emission data, meteorological data, and other relevant parameters (Section 4.0)
- o Results of the dispersion modeling (Section 5.0)
- o A summary of the visibility impact analysis (Section 6.0)
- o The analyses of other air quality related effects, including effects on soil and vegetation, cooling tower impacts, and a health effects evaluation for the state regulated air toxics (Section 7.0)

2 0 REGULATORY RATIONALE

This section provides an overview of the project and summarizes the basis for identifying the air quality regulations with which the project must comply

2 1 PROJECT DESCRIPTION

The proposed plant will be a 330 MW net pulverized-coal-fired facility. The facility includes one boiler and one steam generator. Lightoff and startup will be with natural gas or No. 2 fuel oil. Extracting steam will be supplied to the adjacent Caulkins Citrus Processing Plant. The flue gas desulfurization (FGD) system for sulfur dioxide (SO₂) removal is proposed to be a dry scrubber. Particulate emissions will be removed from the flue gas by means of multi-compartment fabric filter (baghouse) before discharging from the plant stack. The stack will meet good engineering practice (GEP) stack height specifications.

Solid waste will be removed by rail or truck for off-site disposal. Cooling at the plant will be achieved by means of a mechanical draft cooling tower.

2 1 1 FUEL

The proposed primary fuel will be eastern bituminous coal having a sulfur content of 2.0 percent. Natural gas and No. 2 fuel oil will be used for lightoff and startup. A representative fuel analysis for these fuels is presented in Table 2-1.

Coal will be delivered by rail, unloaded, and stored in an enclosed storage facility on site. A grassed inactive coal pile, sized for 30 days storage at full load, is also provided. Lime used for sulfur capture in the flue gas cleanup system will be delivered by train or in enclosed, self-unloading trucks and stored in an enclosed structure.

Fuel oil is stored in aboveground tanks located within a diked area. No. 2 fuel oil will be delivered by truck or rail.

An emission inventory for the proposed ICL plant has been developed based on applicable New Source Performance Standards (NSPS) as well as vendor-supplied data or appropriate EPA AP-42 emission factors. The total plant flue gas discharge will be based on the following:

Pollutant	<u>Main Boiler, Coal</u>		<u>Aux. Boiler, Oil</u>	
	<u>lb/hr</u>	<u>lb/MMBtu</u>	<u>lb/hr</u>	<u>lb/MMBtu</u>
SO ₂	582.6	0.17	17.73	0.05
NO _x	582.6	0.17	68.2	0.20

Pollutant	<u>Main Boiler, Coal</u>		<u>Aux. Boiler, Oil</u>	
	<u>lb/hr</u>	<u>lb/MMBtu</u>	<u>lb/hr</u>	<u>lb/MMBtu</u>
CO	377	0.11	150(a)	47.3
Particulate	61.7	0.018	1.4	-
VOC	12.3	0.0036	0.63	-
Pb	0.035	0.00003	0.00083	-

Note (a) Unit is ppm

The ICL emissions with respect to regulated criteria and non-criteria air pollutants for full load (100 percent) and partial loads (75 percent and 50 percent) are presented in Section 4.0. Fugitive emissions resulting from coal handling, storage and ash handling are presented in Section 4.0.

Five scenarios were examined to determine the worst-case air quality impacts based on the emissions and the associated stack parameters. Scenarios considered are

<u>Case</u>	<u>Fuel</u>	<u>Load (%)</u>
1	Coal	100
2	Coal	75
3	Coal	50
4	Gas	100
5	Oil	100

Cases 4 and 5 involve an auxiliary boiler, usually during lightoff and startup stages. However, the auxiliary boiler may be operated continuously for several months if necessary. Thus, long-term impact analysis is also performed for these two cases.

2.1.2 EMISSION CONTROL

The flue gas cleanup system consists of an FGD system and a baghouse for particulate control. The proposed FGD system for SO₂ removal will consist of a spray dryer absorber using lime slurry as the reagent. The system is designed to have a sulfur removal efficiency of 95 percent for coal with a sulfur content of 2.0 percent. Particulate emissions are removed from the flue gas by means of a multi-compartment bag filter before discharging from the plant stack. NO_x emissions from the stack are controlled by advanced combustion controls and a selective noncatalytic reduction (SNCR) technology. The emission control system proposed for the ICL plant represents the best available control technology (BACT). The BACT analysis, which is based on the "top-down" approach, is also presented.

Fugitive emissions from coal storage and material handling are controlled by enclosing most of these operations and venting through fabric filters. A summary description of emission controls for these fugitive dust sources is presented in Section 4.2.1.

2.1.4 PROJECTED CONSTRUCTION SCHEDULE

The construction schedule is preliminary, based on information available at this time. Construction is projected to take place in a single phase. Site preparation work could be initiated as early as July 1992. It is anticipated that commercial operation of the facility will begin in December 1995.

2.2 AIR QUALITY REVIEW REQUIREMENTS AND APPLICABLE REGULATIONS

The applicability of three federal regulations promulgated as a result of passage of the Clean Air Act amendments of 1977 must be considered in the evaluation of the regulatory requirements and their applicability to the proposed ICL plant.

2.2.1 PREVENTION OF SIGNIFICANT DETERIORATION

Sources that are "major stationary sources" and "major modifications" located in areas designated as attainment or unclassifiable for National Ambient Air Quality Standards (NAAQS) are subject to the PSD regulations. Since Martin County and the surrounding counties are designated as "in attainment or cannot be classified" for all criteria pollutants (40 CFR 81.310), the task at hand is to determine whether the proposed facility would be classified as a major source under the PSD regulations. A "major stationary source" is defined as any one of 28 specified sources which has a potential to emit 100 tons per year or more, or any other stationary source which has the potential to emit 250 tons per year or more of any regulated pollutant (40 CFR 52.21).

The proposed facility is listed as a 100-ton per year source (fossil-fuel-fired steam electric plants of more than 250 million Btu/hr heat input) and has the potential to emit more than 100 tons of a criteria pollutant (see Section 2.1.2). Therefore, the proposed facility is subject to PSD review.

Under PSD, each pollutant emitted from a major source in significant quantities, as defined in Table 2-2, and for which the area is designated as "in attainment" for the pollutant, must undergo a PSD analysis. The PSD analysis involves the following:

- o BACT analysis
- o PSD Increment Consumption Analysis, including other increment-consuming sources in the area (if applicable)
- o NAAQS impact analysis, including other significant sources in the area (if applicable)

- o Nonattainment area impact analysis
- o Class I PSD area impact analysis
- o Other air quality-related impact analyses

Each of these is briefly described in the following paragraphs

BACT Analysis For all pollutants emitted at significant levels (see Table 2-2), a control technology must be selected and defended that will result in the maximum reduction in pollutant emissions considered achievable for the source using current technology. Energy requirements, environmental impacts, and economic impacts must be considered in the BACT analysis

PSD Increment Consumption An ambient air quality analysis must be conducted for total suspended particulate matter (TSP), SO₂, and nitrogen dioxide (NO₂) for those pollutants with a resultant significant impact due to the proposed facility. If required, the analysis must demonstrate that the PSD ambient air quality increments, shown in Table 2-3, are not exceeded by the proposed project. Since the facility will be located in a Class II area, only those increments apply to this project. Finally, since there are a number of other known increment-consuming sources in the site area, the increment consumption analysis for the proposed facility must include these other sources if they produce overlapping significant air quality impacts

National and Florida Ambient Air Quality Standards The ambient air quality analysis must also demonstrate that the project's air quality impact, plus applicable background levels, does not exceed the NAAQS and Florida Ambient Air Quality Standards (FAAQS) shown in Table 2-4. As before, the analysis is required only for those pollutants emitted in significant quantities (see Table 2-2) with a resultant significant impact due to the facility. Other major sources of the applicable pollutants (i.e., with emissions greater than 100 tons per year) must also be included if those sources produce overlapping significant impacts

Nonattainment Area Impact Analysis A demonstration that the proposed source will not significantly impact designated nonattainment areas must be included in the ambient air quality analysis

Palm Beach County, about 9 kilometers south of the site, is the only nonattainment area (for ozone) in the vicinity of the proposed facility. The proposed source has VOC emissions that are greater than the PSD significant emission rate. However, as stated in the air quality modeling protocol for the proposed ICL plant submitted to FDER in July 1990, the U.S. EPA Guideline on Air Quality Models (EPA, 1986a) indicates that "the use of models incorporating complex chemical mechanisms should be considered only in a case-by-case basis with proper demonstration of applicability. These are generally regional models not designed for the evaluation of individual sources but used primarily for region-wide evaluations." This statement and the fact that the proposed facility is not located in an ozone

nonattainment area preclude subjecting the proposed ICL plant to a VOC emissions impact assessment

Impacts on Class I PSD Areas Any source within 100 kilometers of a Class I area must also demonstrate insignificant levels for air quality impacts at that area. Since the proposed facility is approximately 145 kilometers north of the Everglades National Park (a Class I area), the proposed facility is not subject to this provision of the PSD review process.

Additional Impacts Analysis Any source subject to the PSD regulations must also provide an analysis of any adverse air quality-related impacts to

- o Visibility
- o Soils
- o Vegetation
- o Commercial, residential, and industrial growth that the project might cause

2.2.2 NEW SOURCE PERFORMANCE STANDARDS

The NSPS apply to new, modified, and reconstructed sources of emissions for which the U.S. EPA has promulgated standards. The EPA promulgated NSPS for fossil-fuel-fired steam generators (40 CFR 60, Subpart D) with a heat input greater than 250 MMBtu per hour in 1971. Since its promulgation, the EPA has proposed revisions and amendments to Subpart D a number of times. One of the amendments, Subpart Da, would apply to the proposed ICL plant. Subpart Da was proposed in 1978 and promulgated in 1979 and specifically applies to electric utility steam generating units.

Electric utility steam generating units are subject to NSPS Subpart Da provided they meet all three of the following criteria. If the plant does not meet any one of the criteria, it may still be subject to NSPS (e.g., the promulgated and proposed emission limits in Subpart Db). Subpart Da is applicable to electric steam generating units that

- o Are capable of combusting more than 73 MW (250 MMBtu/hr) heat input of fossil fuel either alone or in combination with any other fuel
- o Supply more than 25 MW electricity to any utility power distribution system for sale
- o Supply more than one-third of their potential electric output capacity to any utility power distribution system for sale

The proposed project meets these three criteria and thus is subject to the NSPS requirements set forth in Subpart Da. These requirements are summarized specifically for coal-fired boilers in Table 2-5.

Section 60.46a(c), Compliance Provisions, provides that the standards for particulate matter, nitrogen oxides (NO_x), and SO_2 apply at all times, except during periods of startup, shutdown, or malfunction, or when emergency conditions exist.

2.2.3 FLORIDA AIR TOXICS NO-THREAT LEVELS

The Florida air toxics "no-threat" levels were developed by the Florida Air Toxics Working Group for controlling toxic emissions from stationary sources to levels which will not endanger public health. The impact of all toxic air contaminants emitted by new sources must be evaluated based on the air toxics permitting guidelines (Florida Air Toxics Permitting Strategy, draft, 1990). Air toxics emitted by the proposed ICL plant will be evaluated and compared with the appropriate "no-threat" levels regulated by the FDER.

**Table 2-1
FUEL ANALYSIS**

Ultimate Analysis

Gravimetric Breakdown (%)

<u>Element</u>	<u>Coal^a</u>	<u>No. 2 Oil</u>	<u>Natural Gas</u>
Carbon	65.37	87.26	73.913
Hydrogen	4.63	12.67	24.047
Oxygen	4.69	0.00	1.249
Nitrogen	1.16	0.02	0.773
Sulfur	2.00	0.05	0.018
Chlorine	0.15	--	--
Ash	12.00	--	--
Water	10.00	--	--
Total	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

Proximate Analysis

Component

Volatile Matter	99.395	99.92
Fixed Carbon	0.425	0.00
Moisture	0.05	0.00138
Ash	0.05	0.00
Sulfur	0.05	0.018
Total	<u>100.00</u>	<u>100.00</u>

The heat of combustion of coal, No. 2 fuel oil, and natural gas are estimated to be 11,800 Btu/lb, 19,130 Btu/lb, and 950 Btu/ft³, respectively

a - Worst case fuel

Table 2-2
PSD SIGNIFICANT EMISSION RATES AND MAXIMUM TOTAL EMISSION RATES FOR THE PROPOSED INDIANTOWN COGENERATION PROJECT

Pollutant	Significant Emission Rate (tons/yr) ^a	Maximum Total Emission Rate (tons/yr) ^b	Air Quality Analysis Required?
Particulate Matter (TSP)	25	306 1 ^c	Yes
PM 10	15	276 2 ^c	Yes
Sulfur Dioxide	40	2629 4	Yes
Nitrogen Oxides	40	2850 5	Yes
Volatile Organic Compounds	40	56 6	Yes
Carbon Monoxide	100	1858 4	Yes
Lead	0 6	0 152	No
Mercury	0 1	0 172	Yes
Beryllium	0 0004	0 041	Yes
Fluorides	3	22 26	Yes
Asbestos	0 007	0	No
Vinyl Chloride	1	0	No
Total Reduced Sulfur	10	0	No
Hydrogen Sulfide	10	0	No
Reduced Sulfur Compounds	10	0	No
Sulfuric Acid Mist	7	6 51	No
Any other pollutant regulated under Clean Air Act	Any rate	-	--
Benzene		0	No
Inorganic Arsenic		0 766	Yes
Each regulated pollutant	Any rate causing an impact of 1 µg/m ³ (24-hr average) or greater in any Class I area within 10 km of source		No ^d

a - Source 40 CFR 52.21(b)

b - Maximum total emissions are based on the maximum hourly emission rate 8,760 hrs/yr and 1,000 hrs/yr of operation for the main and auxiliary boilers respectively, with an annual load factor of 100 percent for both boilers

c - Maximum total TSP and PM-10 emissions are conservatively assumed to be the same and include fugitive emission sources listed in Table 4-2

d - The closest Class I PSD area is the Everglades National Park located about 145 km south of the proposed ICL. Therefore, air quality analyses are not required on this basis

Table 2-3
MAXIMUM ALLOWABLE PSD INCREMENTS
($\mu\text{g}/\text{m}^3$)

	Class I	Class II	Class III
<u>Sulfur Dioxide</u>			
Annual	2	20	40
24-hour	5	91	182
3-hour	25	512	700
<u>Total Suspended Particulate Matter</u>			
Annual	5	19	37
24-hour	10	37	75
<u>Nitrogen Dioxide</u>			
Annual	25	25	50

Source 40 CFR 52.21(c)

Table 2-4
STATE OF FLORIDA AND NATIONAL
AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	Federal NAAQS ($\mu\text{g}/\text{m}^3$)	Florida AAQS ($\mu\text{g}/\text{m}^3$)
PM ⁽¹⁾	24-Hour	150	150
	Annual	50	50
SO ₂	3-Hour	1,300 ⁽²⁾	1,300 ⁽²⁾
	24-Hour	365	260
	Annual	80	60
NO ₂	Annual	100	100
CO	1-Hour	40,000	40,000
	8-Hour	10,000	10,000
Ozone	1-Hour	235	235
Lead	Calendar Quarter	1.5	1.5

⁽¹⁾ Ambient air quality standards are based on PM₁₀, and PSD increments are based on TSP until such time as EPA promulgates PSD increments for PM₁₀. Compliance with PM₁₀ ambient standard and PSD increments for TSP were evaluated based on TSP modeled impacts.

⁽²⁾ The 3-hour average SO₂ ambient air quality standard is a secondary (welfare-related) standard. All of the other Federal and Florida ambient air quality standards are primary (health-related) standards.

Sources: 40 CFR 50
FDER, Title 17, Part III, Chapter 17-2.300

Table 2-5
NSPS FOR ELECTRIC UTILITY STEAM GENERATING UNITS

Affected Facility	Pollutant	Emission Level	Requirement
Coal-fired boilers (and coal-derived fuels)	Particulate Opacity	0.03 lb/million Btu 20% (27% for 6 min/hr)	Continuous Compliance
	SO ₂	1.20 lb/million Btu and 90% reduction except 70% reduction when emissions are less than 0.6 lb/million Btu	Continuous
	NO _x		Continuous Compliance
	Anthracite, bituminous, and specified lignites	0.60 lb/million Btu	
	Subbituminous coal, coal derived fuels and shale oil More than 25% (wt) coal refuse	0.50 lb/million Btu Exempt	

Source: 40 CFR 60 Subpart Da Proposed 19 September 1987 (43FR 42154) promulgated 11 June 1979 (44FR 33613)

3 0 TECHNICAL APPROACH

The purpose of this section is to present the technical approach for addressing the key elements of the various air quality impact analyses discussed in this report. These key elements include (1) determining GEP stack height, (2) defining air quality impact areas, (3) establishing the emission inventories to be analyzed, (4) estimating background air quality conditions, (5) describing the dispersion modeling methodologies to be used to estimate PSD increment consumption and compliance with ambient standards, and (6) evaluating other air quality-related impacts (e.g., visibility impairment, source growth, effects on soils and vegetation, cooling tower impacts, and the potential for adverse health effects).

3 1 GOOD ENGINEERING PRACTICE STACK DETERMINATION

A stack built to GEP height will avoid atmospheric downwash effects and eliminate this from having to be considered for dispersion modeling.

The GEP stack height (H_g) is defined by the following equation (EPA, 1985)

$$H_g = H_b + 1.5 (L)$$

where H_b = the height of nearby structures
 L = the lesser dimension of the height or projected width of nearby structures

The length, width, and height dimensions of the adjacent boiler building and coal storage-silo bay, which are the tallest buildings on the site, and other nearby structures with the potential to cause building downwash have been considered in this evaluation. The downwind distance to which a nearby structure is presumed to have a significant influence on the stack emissions is limited to $5(L)$.

For the proposed ICL plant, a GEP stack height of 500 feet was determined from the above formula. This GEP stack height was calculated based on the height of the boiler building (200 feet) and the maximum projected width of the boiler building (209.3 feet). Since ICL intends to use a sub-GEP stack height of 495 feet (above grade), the dispersion modeling analyses were based on this sub-GEP stack height.

3 2 DEFINING THE IMPACT AREAS

As a conservative approach, the impact areas for each criteria pollutant, (i.e., SO_2 , TSP, PM-10, NO_2 , and CO) are defined as a circular area whose radius is equal to the greatest distance to which dispersion modeling shows that the proposed emissions will have a significant impact. These significant ambient air quality impact levels are given in Table 3-1 (EPA, 1987a).

Impact area determinations for each averaging period applicable to these pollutants were made using the dispersion modeling approach discussed in Section 3.5. The circle enclosing the farthest radial distance to which significant impacts are predicted defines the "modeling area" for a specific pollutant and averaging time. If there is no significant impact area for a given pollutant emitted by the proposed facility, no further modeling is needed for that pollutant. Based on the modeling results in Section 5.1, significant impact areas for the criteria pollutants subject to PSD review for the proposed ICL plant are summarized in Table 3-2. Impact areas extend to 4.25 km and 4.5 km for SO₂ (24-hour average) and NO₂ (annual average), respectively. Other pollutants have no significant impact areas calculated. The following section addresses the development of the modeled emission inventory on the basis of these results.

3.3 ESTABLISHING THE EMISSION INVENTORY

The emission inventory for the proposed ICL plant is presented in Section 2.1.2. Generally, when a proposed facility has a significant air quality impact for one or more criteria pollutants, it is necessary to identify those other sources in the area that emit those pollutants in significant amounts (i.e., 100 tons per year) or that consume available PSD increment levels. The procedure for developing these interactive and PSD increment consuming emission inventories is to identify any sources of these two types that are located in or have a significant impact on the impact area of the proposed source.

The modeling results show that there are significant SO₂ and NO₂ impacts, therefore, other sources of these pollutants need to be identified.

Emission parameters for the proposed ICL plant under different operating loads are presented in Section 4.2.

3.4 BACKGROUND AIR QUALITY DETERMINATION

Representative air quality monitoring data are needed to determine background levels for those pollutants with estimated significant impacts. EPA guidance specifies that generally 1 year of onsite air quality and meteorological monitoring data is required to support the PSD permit application (EPA, 1987a). However, the use of existing, representative data is acceptable if the impacts of the applicable pollutants (1) are below the monitoring de minimis levels (see Table 3-3), (2) do not threaten the PSD increment or the NAAQS, or (3) do not significantly impact the nearest Class I PSD area.

The impacts of all criteria pollutants are well below the de minimis monitoring levels and do not pose a threat to either the PSD increments or the NAAQS (see Section 5.2 and 5.3). Therefore, an onsite monitoring program is not required, and existing air quality data collected adjacent to the ICL site will be used to demonstrate compliance with the air quality standards (FDER letter, July 23, 1990, see Attachment A).

Existing air quality data are available from monitoring stations operated by Florida (FDER, 1987-1989) for the criteria pollutants and by Florida Power & Light (FPL) (October 1988 - October 1989) for SO₂, NO₂, PM-10, and ozone for the Martin Coal Gasification/Combined Cycle (CG/CC) project in the immediate vicinity (within about 3 miles) of the proposed ICL plant. The criteria for determining data representativeness consider monitor location, data quality, and how current the data are (EPA, 1987a). Section 5.3.1 discusses the evaluation of data representativeness and identifies the background levels to be used.

Since recent monitoring data are available, the FDER considers it appropriate to define 3- and 24-hour average background levels based on the highest of the second-highest concentrations over the most recent 3-year measurement period. Annual average background levels are determined from the highest of the annual average values measured over the 3-year period. Total impacts are calculated as the sum of the incremental modeled concentration (see Section 3.5) and the corresponding background level. This is a conservative approach because (1) the day associated with the incremental modeled concentration does not coincide with the day of maximum background measurement, (2) the greater of the background values, determined as above from among the regional stations considered, was used, and (3) for PM-10, incremental TSP concentrations were used.

3.5 DISPERSION MODELING ANALYSIS

3.5.1 PSD INCREMENT CONSUMPTION

TSP impacts (see Section 5.1.2) due to emissions from the ICL stacks and fugitive sources are less than the significant levels specified for annual and 24-hour averaging periods and are, therefore, not considered in the PSD incremental analysis.

As indicated in Section 3.2, significant impact areas were identified for SO₂ and NO₂. Therefore, PSD increment consuming sources which emit SO₂ and NO₂ and are located in or have significant impacts on the significant impact area of the proposed source are included in the PSD incremental analysis.

3.5.2 AMBIENT AIR QUALITY STANDARD COMPLIANCE

Compliance with the applicable federal and state ambient air quality standards listed in Table 2-5 will be demonstrated through the dispersion modeling results presented in Section 5.1. These modeled concentrations were combined with representative background air quality levels determined in accordance with the technical approach outlined in Section 3.4 to determine the total impact. Again, because SO₂ and NO₂ emissions from the proposed ICL plant have their significant impact areas established, other major SO₂ interactive sources located in or having a significant impact on the impact areas of the proposed source are considered in evaluating the total combined impacts to the ambient air quality. TSP and PM-10 impacts were based on emissions only from the proposed facility for the reasons given above. Results from the separate analyses of fugitive and stack emissions

were included. Lead and other pollutants that have health-related no-threat levels established by the FDER are also addressed.

SO₂ is the primary pollutant of concern for this project. Short-term impacts for other pollutants were scaled from SO₂ modeling results in proportion to their respective emission rates. Annual average NO₂, TSP, and PM-10 impacts were scaled directly from the SO₂ modeling output.

The ratios between CO and SO₂ emissions are 0.65 and 2.67 for the main boiler and the auxiliary boiler stacks, respectively. Thus, the maximum CO 1- and 8-hour impact locations do not necessarily occur at the same locations as those based on the SO₂ emissions. Consequently, 1- and 8-hour average CO impacts were modeled independently.

According to EPA modeling guidance (EPA, 1986a), it is appropriate to use the highest second-highest modeled concentration for short-term averaging periods (i.e., 1-, 3-, 8-, and 24-hour) when the analysis is based on the use of 5 years of offsite meteorological data (see Section 4.3). Annual average impacts are to be based on the maximum modeled value over the 5-year period. This guidance was followed in presenting the results given in Section 5.1.

3.5.3 MODEL SELECTION

The air quality dispersion modeling analyses required to support this PSD permit application are identified in the sections above and are described in more detail in Section 4.0. The EPA Industrial Source Complex - Short Term (ISCST) dispersion model (EPA, 1987b) was selected for these analyses because of its ability to simulate the dispersion of emissions from multiple point and area sources. In addition, the model is capable of accounting for building wake effects on dispersion, allowing for variable emission rates with time and with meteorological conditions (e.g., wind erosion), and considering the effects of particle deposition by gravitational settling. This latter phenomenon occurs with a significant fraction of the relatively large particle sizes found in fugitive dust emissions. These capabilities have resulted in EPA's designation of ISC as the preferred model for estimating concentrations from sources with these characteristics (EPA, 1986a).

The current version of the ISCST model (dated 88348) was used. This version incorporates the Schulman-Scire direction-dependent building wake algorithm and other enhancements. Current EPA guidance suggests that the ISCLT (Long Term) model not be used because of several inaccuracies in the code. As a result, annual average concentrations in these analyses were based on the "N-Days" averaging option in the ISCST model.

Output results for these dispersion modeling analyses are presented in Section 5.1.

3 6 VISIBILITY IMPACT ANALYSIS

A visibility impact analysis is one of three additional analyses required to be made in support of the air quality portion of a PSD permit application

There are no Federal PSD Class I areas within 100 km of the proposed site. The closest PSD Class I area is the Everglades National Park located about 145 km south of the proposed site. A visibility screening analysis was performed to determine the potential visibility impairment. The FDER-suggested VISCREEN model (EPA, 1988c) was used to perform this analysis.

3 7 OTHER AIR QUALITY RELATED IMPACTS

Besides the visibility impact analysis discussed in the previous section, two additional impact analyses are required to support this PSD permit application. They are a soils and a vegetation impact analysis. In addition, two other analyses were performed. The first of these analyses addresses the potential for enhanced fogging and icing conditions resulting from the operation of the heat dissipation system (cooling tower) at the plant. The second analysis addresses the potential for adverse health effects due to the emission of air toxics from the facility.

3 7 1 GROWTH ANALYSIS

The typical elements of the growth analysis include 1) a projection of the associated industrial, commercial, and residential growth that will occur in the area, 2) an estimate of the air pollution emissions generated by associated permanent growth, and 3) an air quality analysis which includes these estimates.

The availability of residential, commercial, and industrial services in the area was assessed first. Next, new growth which must occur to support the proposed source was predicted. The amount of residential growth depends on the size of the available work force, the number of new employees, and the availability of housing in the area. Industrial growth is growth in those industries providing goods and services, maintenance facilities, and other large industries necessary for the operation of the proposed facility. Based on the predicted growth, an estimate of the air pollution which likely would evolve from permanent residential, commercial, and industrial growth was developed. Excluded from consideration were emissions from temporary sources associated with construction activities at the ICL plant and mobile sources. Using the developed air pollution estimates for the area, a qualitative air quality impact assessment for these minor sources was performed. Section 7 1 presents the results of this analysis.

3 7 2 EFFECTS ON SOILS AND VEGETATION

For most soil classifications and vegetation found in the area, ambient air concentrations of criteria pollutants below the NAAQS and FAAQS will not result in detrimental effects. As discussed in Section 3 2, maximum ground-level concentrations of all the criteria pollutants emitted from the facility are insignificant.

and well below the aforementioned standards. Section 7.2 outlines potential impacts associated with the major criteria pollutants. These impacts are based on published sensitivity levels compared to the modeled impacts discussed in Section 5.1.

3.7.3 COOLING TOWER IMPACTS

A linear, mechanical draft, counter-flow cooling tower (with a bank of 10 cells) is proposed to meet the closed-loop cooling requirements of the ICL plant. The cooling tower is designed to handle a heat load of 1,655 MMBtu per hour, with a circulating water flow rate of 265,000 gallons per minute (gpm) and an air flow rate of 1,575,400 cubic feet per minute (cfm) per cell at the design condition of 80 °F ambient wet bulb temperature, a cold water temperature of 90 °F, and a hot water temperature of 103 °F.

The operation of the cooling tower could affect the vegetation in terms of salt deposition and the local climatology in terms of visible plumes, icing, and fogging in the immediate vicinity of the proposed facility.

Cooling Tower Impact Model The environmental impacts due to operation of the proposed cooling tower were evaluated using the Seasonal/Annual Cooling Tower Plume Impact model (SACTI), which is sponsored by Electric Power Research Institute (EPRI, 1984). This numerical model is an extension of an earlier model evaluation study carried out by Argonne National Laboratory. The SACTI model uses the cooling tower effluent release parameters to determine a series of combinations of the meteorological variables that represents the full range of atmospheric conditions affecting plume dispersion and deposition. The model calculates salt deposition rate from the plume drift, visible plume length/height, and fogging/icing for the determined meteorological conditions.

3.7.4 HEALTH EFFECTS EVALUATION FOR AIR TOXICS

The health effect evaluation for releases of air toxics to the atmosphere from this facility follows that described in the "Florida Air Toxics Permitting Strategy" (FDER, draft 1990). Only pollutants that do not have an NAAQS have been examined, since the primary NAAQS is a health-based standard. A demonstration of compliance with the primary NAAQS (i.e., for lead) is considered to adequately provide the health risk assessment. For each emitted toxic air contaminant, the model-predicted concentrations are compared to the "no-threat" levels which may be associated with various (i.e., 8-hour, 24-hour, or annual) averaging times. A set of the "no-threat" levels has been provided by the FDER. If a source does not meet the no-threat levels for each toxic air contaminant, a number of measures suggested by the FDER may be used for reevaluation.

Table 3-1
PSD SIGNIFICANT AMBIENT AIR QUALITY IMPACT LEVELS

<u>Pollutant</u>	<u>Averaging Time</u>				
	<u>Annual</u>	<u>24-Hour</u>	<u>8-Hour</u>	<u>3-Hour</u>	<u>1-Hour</u>
SO ₂	1 µg/m ³	5 µg/m ³	--	25 µg/m ³	--
TSP/PM ₁₀	1 µg/m ³	5 µg/m ³	--	--	--
NO ₂	1 µg/m ³	--	--	--	--
CO	--	--	0.5 µg/m ³	--	2 mg/m ³

Source EPA, 1987a

Note This table does not apply to Class I areas. A significant impact for Class I areas is 1 µg/m³ on a 24-hour basis for PM₁₀ and SO₂.

Table 3-2
SIGNIFICANT IMPACT RADII FOR THE ICL SOURCES

Pollutant	Radius (km)	Averaging Time
SO ₂	0.5	Annual
	4.25	24-hr
	0	3-hr
NO ₂	4.5	Annual
TSP/PM-10	0	Annual
	0	24-hr
CO	0	8-hr
	0	1-hr

Source: Bechtel, 1990

Note: Stack emissions from the main boiler and the oil-fired auxiliary boiler are both considered in the impact radius determination.

Table 3-3
PSD SIGNIFICANT MONITORING CONCENTRATIONS

Pollutant	Air Quality Concentration ($\mu\text{g}/\text{m}^3$) and Averaging Time
Carbon monoxide	575 (8-hour)
Nitrogen dioxide	14 (Annual)
Sulfur dioxide	13 (24-hour)
Particulate matter (TSP)	10 (24-hour)
Particulate matter (PM-10)	10 (24-hour)
Ozone	a
Lead	0.1 (3-month)
Asbestos	b
Beryllium	0.001 (24-hour)
Mercury	0.25 (24-hour)
Vinyl chloride	15 (24-hour)
Fluorides	0.25 (24-hour)
Sulfuric acid mist	b
Total reduced sulfur (including H_2S)	c
Reduced sulfur (including H_2S)	c
Hydrogen sulfide	0.2 (1-hour)

Source: EPA, 1987a

a No specific air quality concentration for ozone is prescribed. Exemptions are granted when a source's VOC emissions are 100 tons/year.

b No acceptable monitoring techniques available at this time. Therefore, monitoring is not required until acceptable techniques are available.

c No acceptable monitoring techniques available at this time. However, techniques are expected to be available shortly.

4 0 DISPERSION MODEL INPUTS

Various features of the ISCST dispersion model were used to estimate air quality impacts from the proposed facility in two distinct analyses. The model was run

- o With constant emission rates to evaluate ambient concentrations for all the receptors
- o With variable emission rates and particle settling characteristics to simulate dispersion of fugitive particulate emissions

The purpose of this section is to describe the various model inputs required for these analyses, including model options, emissions data, meteorological data, receptor grids, and other relevant information. Since SO_2 is the primary pollutant of interest for this project, the model was run using SO_2 emission rates. Concentration values for other pollutants were scaled from these results in proportion to the respective emission rates for each pollutant.

Model input information for the visibility impact assessment is presented separately in Section 6.1. Likewise, the analysis of cooling tower impacts, which includes the dispersion of particulate material in the cooling tower drift, is discussed in Section 7.3.

4 1 MODEL OPTIONS

Each of the two modeling analyses identified above used different features of the ISCST model to estimate air quality impacts at various receptor locations. Model options were selected to meet applicable EPA criteria, to account for different pollutant dispersion characteristics, and to provide results based on different averaging durations, as required.

Model options that were selected include 1-, 3-, 8-, and 24-hour and annual averages and rural mode (see Section 4.5). Buoyancy-induced dispersion was used because the proposed sources involve fuel combustion (EPA, 1986a). Since sub-GEP stack heights were used for the proposed sources, the gradual plume rise option was selected in conjunction with the building downwash option (EPA, 1986a). The stack tip downwash option was not used because the building downwash option was already selected (PDER, 1983, MDAQC, 1984), and the calm processing routine was used to calculate concentrations during calm periods (EPA, 1986a). The equivalent regulatory default options associated with the meteorological input data are discussed in Section 4.3.

The resultant SO_2 concentration values were used to scale 24-hour and annual average TSP and PM-10 impacts, annual average NO_2 concentrations, 1-hour and 8-hour CO concentrations, and quarterly average lead impacts.

There are numerous sources of fugitive particulate emissions within the proposed facility. They include among others storage silos, coal unloading and reclaim hoppers, coal conveyors, crusher tower, and an inactive storage pile. Section 4.2.1 describes the emission rate characteristics of these sources in more detail. From a modeling standpoint, vent emissions were treated as point sources. Furthermore, emissions from certain sources were variable as a function of operating schedule. The physical characteristics of the emissions were also considered for some of the sources in order to account for the effects of gravitational particle settling. These aspects of the analysis, as well as the selection of other options, are discussed further in this section.

For fugitive particulate emissions, two of the more general options selected include flat terrain (see Section 4.4) and rural mode (see Section 4.5). The regulatory default option was not chosen because several of the default values were not applicable. Specifically, stack tip downwash does not apply since, by definition, fugitive emissions are those which do not pass through a stack. Likewise, since these emissions are released at ambient temperatures, buoyancy induced dispersion did not have to be accounted for. The arbitrary selection of final plume rise has essentially no effect on the dispersion calculations since all of the emissions are at ambient conditions with virtually no exit velocity. The release height of the fugitive source was used as the point source stack height. To simulate fugitive emissions without plume rise, the stack exit velocity, diameter, and temperature were assumed to be 0.001 m/s, 1 m, and 0 °C (273 °K), respectively (TACB, 1988). In the ISCST model, a stack temperature of 0 °C is a default value which sets the stack and ambient temperature (read from the sequential hourly data) to the same value for model calculations if the ambient temperature is greater than 0 °C. Since it is rare for the ambient temperature to be lower than 0 °C at West Palm Beach, the selection of 0 °C as the stack temperature will ensure that no thermal plume rise is permitted for modeling fugitive particulate sources. Processing of concentrations under calm wind conditions was also accounted for.

The inactive coal storage pile, which is covered with soil and seeded to minimize emission, has a capacity to store a 30-day supply. It will be used only if there is an interruption of supply, thus, no normal operational schedule is planned. Since the pile will not be disturbed under normal operational conditions, fugitive emissions from the inactive coal storage pile were not included in the modeling.

Emissions for the remaining fugitive sources were assumed to vary as a function of time of day. Schedules were based on typical operating experience at maximum material handling rates. An operational day of 8 hours was assumed to extend from 7 A.M. through 3 P.M., represented in the model by hours 7 through 14. This is a conservative approach from a dispersion standpoint, since relatively more stable conditions occur earlier in the day.

Finally, gravitational settling of particulate emissions was accounted for by distinguishing the amount of material in the 30- and 10-micron size ranges (i.e., the nominal TSP and PM-10 size categories, respectively). Size categories were

defined based on information in the technical literature. Other settling parameters (i.e., settling velocity and reflection coefficients) were developed in accordance with ISC model users guidance (EPA, 1987b).

4.2 EMISSIONS INVENTORIES

The purpose of this section is to identify the emission characteristics of the sources included in the various modeling analyses described above. For the proposed ICL plant, both stack and fugitive emission sources are described. Characteristics of the particulate emissions resulting from operation of the plant cooling tower are discussed in Section 7.3.2.

4.2.1 PROPOSED SOURCE

Air pollutants will be emitted from a single stack at the proposed facility. Fugitive particulate emissions from a variety of material handling and storage sources will also occur. The following subsections describe these sources in more detail.

Stack Emissions For the purpose of the modeling analyses described in this section and in Section 5.0, emissions from the ICL main stack are based on coal-firing. Emission rates and characteristics at three operating loads were considered (i.e., full or 100 percent load, 75 percent, and 50 percent). Operating parameters are presented in Table 4-1, as well as emission rates for SO₂, NO_x, particulates, lead, and CO. To be conservative, PM-10 emissions, which are a subset of TSP emissions from the stack, are assumed to be the same in these analyses. Emission rates and stack parameters for the oil/gas-fired auxiliary boiler are presented in Table 4-2. Figure 4-1 identifies the ICL plant main and auxiliary boiler stacks as Items 12 and 11, respectively.

Fugitive Emissions Fugitive particulate emissions will occur at the proposed plant from various material (i.e., coal and lime) handling and storage (coal) operations. Figure 4-2 depicts a flow diagram for these coal operations. Emission parameters for these sources are listed in Table 4-3. Emission rates based on maximum material throughput were input to the model.

A brief description of these sources follows. Plot plan identification numbers corresponding to Figure 4-1 are also given.

- o Coal Unloading Hopper and Feeder (1) Coal arrives on site via bottom-dump rail cars. The unloading facility will be enclosed with dust collection and suppression equipment and includes a side-mounted car shaker. The hopper is located below ground level.
- o Coal Unloading Conveyor (2) A belt conveyor, enclosed in a tubular gallery, is provided between the unloading structure and tripper conveyor. A belt scale is also provided. The unloading conveyor will have a dust collector.

- o Stacking Tripper Conveyor (3) A tripper conveyor is provided in the coal storage building. The conveyor is equipped with a traveling carriage and discharge chute in order to form a longitudinal coal pile.
- o Active Coal Storage Pile (3) The active coal pile is rectangular in shape, about 35 feet high. It is enclosed by an A-frame building, with the stacking conveyor entering at one end. Dust collection equipment is provided for transfer points in the enclosure.
- o Inactive Coal Storage Pile The inactive storage pile (coal storage yard) is about 45 feet high, with a 30 degree slope. The inactive pile is built up in compacted layers. The pile will be covered with soil and seeded to minimize fugitive dust.
- o Emergency Reclaim Hopper (3) The emergency reclaim hopper, located inside the coal storage building, will be used to reclaim coal from the inactive coal pile via mobile equipment.
- o Reclaim Conveyor (3) Normal reclaim is by a portal scraper reclaimer which removes coal from the side of the active pile and deposits it in the reclaim conveyor, located inside the coal storage building.
- o Emergency Reclaim Pile (4) This is an outdoor "come-and-go" type of pile sized to accommodate up to 30 carloads of incoming coal.
- o Emergency Stackout Conveyor (4) A dust collector and "lowering well" will be provided at the discharge end.
- o Crusher Feed Conveyor (Transfer Conveyor) (3,5) This conveyor, enclosed in a tubular gallery, transfers coal from the coal storage building to the crusher tower.
- o Crusher and Transfer Building (5) The crusher transfer building houses equipment to reduce the coal in size and transfer it to a conveyor system leading to the day storage silos. The building is enclosed with dust collection systems at the crusher and all transfer points.
- o Plant Feed Conveyor (5,6) This conveyor transports the crushed coal to the storage silo feed tripper. The conveyor is enclosed in a tubular gallery.
- o Silo Distribution Tripper (6) Located inside the boiler building, this system directs the crushed coal to four operating storage silos and one spare silo serving the boiler unit at the plant. A dust collection system covers all silos and coal transfer points between conveyors.

- o Coal Silos (6) These silos hold coal prior to feeding it to the boiler burner system. The silos are covered except for the opening to receive coal from the silo distribution tripper.
- o Ash Storage Silo (7) Fly ash collected from the baghouse hoppers is stored in an elevated silo. The silo has filters to collect dust as ash is loaded into the silo and from dust collected in the silo cyclone separator baghouse.
- o Recycle Ash Silo (8) Fly ash collected from the baghouse hoppers is conveyed to the recycle ash silo for use in the lime slurry plant. The silo has a vent filter. The recycle ash slurry plant below the silo is enclosed.
- o Lime Silo (9) and Lime Slurry Plant (10) Lime is pneumatically transferred from rail car or truck to silo. The silo is equipped with a filter and dust collector. The dust collector is also used for the lime feed system. The reagent pre-operation area is enclosed.
- o Soda Ash Silo (13) Soda ash for use in the circulating water system sidestream softener is stored in the soda ash silo. The silo is equipped with a vent filter. The reagent preparation area below the silo is enclosed.

4.2.2 PSD INCREMENT CONSUMING SOURCES

Sections 3.3 and 3.5.1 relate the fact that because there are significant SO_2 and NO_2 impacts due to stack emissions from the proposed ICL, a PSD increment consumption analysis is necessary. PSD sources are those sources which commenced construction after the base line date for a specific pollutant. The base line establishes which sources in the area of the proposed ICL plant will consume PSD increments. Based on the FPL Martin CG/CC Project Site Certification Application (1989), it was indicated that the base line dates established by the FDER for SO_2 are January 6, 1975 for sources greater than 100 tons/year and December 27, 1977 for sources less than 100 tons/year. For NO_2 , the base line date is February 8, 1988.

A summary of the increment-consuming sources within and/or affecting the ICL plant's significant impact areas has been extracted from the SCA for the Martin CG/CC project. The Martin CG/CC project has an SO_2 significant impact area at a distance of 50 km from the Martin site. Thus, the emission inventories provided by the FDER to that project approximately covered a 50 km radius of the Martin site. The Martin CG/CC project in its SCA also applied the "Screening Threshold" method (North Carolina DNR, 1985), which is approved by both EPA and FDER, to objectively eliminate those sources in the emission inventory which are not likely to have a significant interaction with the source undergoing evaluation. The source screening procedure was applied such that sources emitting more than 25 tons/year of an applicable pollutant and located within 15 km of the Martin site and

sources emitting more than 100 tons/year and located between 15 and 50 km from the Martin site were included both in the PSD increment impact and ambient background analyses. Since the proposed ICL plant is located only about 3 miles from the Martin site, the PSD-consuming sources that have been identified by the Martin CG/CC project are considered to be applicable for the ICL plant as well. Additionally, the SO₂ and NO₂ significant impact areas of the ICL plant are within distances of 4.25 km and 4.5 km, respectively from the stack, however, the significant impact areas for the Martin CG/CC project cover radii of 50 km and 7.5 km from the Martin site. Because of the short distance between the proposed ICL site and the Martin CG/CC site, it is conservative to include source inventories identified in the Martin CG/CC project in the ICL plant's impact analysis.

Furthermore, the FDER indicated in July 1990 that there are no other new PSD-increment-consuming sources in the vicinity of the ICL plant site since the submittal of Martin's SCA in 1989. Multiple-stack background facility emissions were combined and assumed to be emitted from the stack with the highest emission rate using that stack's emission parameters. A summary of the PSD increment-consuming sources for the proposed ICL impact analysis is presented in Table 4-4.

4.2.3 BACKGROUND SOURCES

A background interactive source analysis is required based on the same reason stated above. Similarly, a summary of the base line interactive sources within and/or affecting the ICL plant's significant impact area has been extracted from the SCA for the Martin CG/CC project. In the Martin CG/CC project, the screening threshold method was applied in identifying the background sources within a radius about 50 km of the Martin site (see Table 4-5). Again, since this set of base line interactive sources covers a radius of about 50 km, the use of these data is conservative for the proposed ICL plant.

4.3 METEOROLOGICAL DATA

Onsite meteorological data are not required for the proposed ICL plant. In this case, EPA modeling guidance requires modeling analyses to be based on the use of 5 years of meteorological data from the nearest monitoring location with conditions representative of the site area (EPA, 1986a).

The closest first-order National Weather Service (NWS) station is located in West Palm Beach, Florida, about 26 miles east-northeast of the proposed facility. Sequential, hourly meteorological data and twice-daily upper air soundings collected at West Palm Beach for the years 1982-1986 were provided by the FDER for use in the air quality analysis. Joint frequency distributions of wind speed, wind direction and stability are presented in Table 4-6. Five-year composite seasonal and annual wind roses are presented in Figures 4-3(a) through 4-3(e).

Default wind speed profile exponents and vertical potential temperature gradients, equivalent to those selected under the regulatory default option of ISCST, were also chosen.

4.4 RECEPTOR GRIDS

This section describes each of the receptor grids used for the two phases involved in the air quality impact analysis made with the ISCST model.

The significant impact area and the screening analyses used a polar receptor grid centered on the plant stack. The grid system consists of 36 direction radials, each separated by 10° increments. As suggested by the FDER, receptors were placed at ground level at successive 250-meter intervals. The coarse-mesh receptor grid provides sufficient resolution and downwind coverage to determine the extent of the significant impact area for each pollutant and the locations of all critical receptors to be evaluated in the refined phase of the analysis.

The refined phase of the air quality impact analysis used a fine-grid (100 m grid resolution) centered over each critical receptor identified in the screening phase analysis, such that two rings were added to either side of the critical receptor.

Impacts due to fugitive particulate emissions were estimated using Cartesian coordinate receptor grids. Fugitive dust tends to be released near ground level with insignificant plume rise. As a result, higher particulate concentrations are expected to occur at the plant property line. Therefore, discrete receptors were placed along the irregularly shaped ICL property line at each 10° azimuth direction using the main stack as the origin. In order to evaluate the expected decrease in particulate concentrations with increasing downwind distance, one downwind ring distance (100 m) was placed beyond the ICL property line. The closest site boundary is to the east-southeast of the main stack. Receptors near this section of the site boundary were selected in the same manner as in modeling TSP impact from the ICL stacks in order to assess the maximum combined impact. All receptors in the fence line and other grid points were assumed to be at ground level. Figure 4-4 shows the locations of the discrete receptors input to the model, as well as the plant stacks. Receptor identifications are shown in Figure 4-4, and their corresponding coordinates are presented in Table 4-7.

4.5 LAND USE CLASSIFICATION

An evaluation to determine whether the area is considered to be urban or rural, for the purposes of atmospheric dispersion modeling, was made based on land use characteristics and topographic features in the site area. The evaluation considers the Auer land use classification method (Auer, 1978) referenced in Section 8.2.8 of the Guideline on Air Quality Models (EPA, 1986a).

Approximately 95 percent of the area within a 3-km radius of the proposed facility has land use characteristics ascribed to a rural setting. Marshlands (Type A3) take up about 45 percent of the area. From the south of these Type A3 areas to the west of the Indiantown township, the land use is predominantly orchard (Type A2, agricultural rural). This accounts for about 35 percent of the total area evaluated. Interspersed within these two areas are woodlands, classified as A4 (undeveloped rural) and characterized as heavily wooded and having greater than 95 percent

vegetation. These Type A4 areas make up about 15 percent of the entire area evaluated.

The only substantial area considered to be characteristic of an urban environment is located on the north and east-northeast of the ICL plant. The Caulkins Citrus Processing Plant and Florida Steel Corporation located here can be classified as Type I1 (heavy industrial), but make up only about 4 percent of the total area. Part of the Indiantown residential area is located about 3 km to the east-southeast of the ICL. The land use type may be classified as R2 (compact residential). However, this residential area accounts for a minimal portion (less than 1 percent) of the total area. Thus, for air quality impact modeling, the overall area is considered as rural.

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

Table 4-1
MAIN STACK EMISSION PARAMETERS INPUT TO ISCST

Parameter	100%	Coal-Firing 75%	50%
Stack Height (ft)	495	495	495
Stack Diameter (ft)	16	16	16
Flow Rate (acfm)	1,206,400	892,700	615,250
Exit Temperature (°F)	140	140	140
Exit Velocity (ft/sec)	100	74	51
Stack Base Elevation (ft)	12	12	12
Emission Rates (lb/hr)			
SO ₂	582.6	461.5	310.2
NO _x	582.6	461.5	310.2
Particulate ^a	61.7	48.9	32.8
CO	377.0	298.6	200.7
Lead	0.034	0.027	0.018

NOTE

a - TSP and PM-10 particulate emission rates are assumed to be the same for this analysis

Table 4-2
AUXILIARY BOILER STACK PARAMETERS INPUT TO ISCST

Parameter	No. 2 Fuel Oil	Natural Gas
Stack Height (ft)	90	90
Stack Diameter (ft)	5.5	5.5
Exit Temperature (°F)	500	480
Exit Velocity (ft/sec)	103	102
Emission Rates (lb/hr)		
SO ₂	17.7	0.61
NO _x	68.2	35.8
Particulate ^a	1.4	0.5
CO	47.3	33.6
VOC	0.63	1.35
Lead	4.155 x 10 ⁻³	*

NOTES

a - TSP and PM-10 particulate emission rates are assumed to be the same for this analysis

* - Not applicable

**Table 4-3
FUGITIVE EMISSIONS**

Source Point	Emission Point	Discharge Height (ft)	Control Eff (%)	Maximum Emission (lb/hr)	Hours at Max Rate (per day)
<u>Coal Handling</u>					
1	Coal Unloading Area				
	Unloading Hopper ^C	25	99	0.34	4
	Unloading Hopper Pit ^D	25	99.8	0.00098	4
2	Storage/Trans Tower Area				
	Stackout Conveyor ^D	75	75	0.695	4
		75	99.8	0.00112	4
	Transfer Conveyor ^D	75	99.8	0.00088	4
3	Coal Reclaim Area ^D	75	99.8	0.000704	8
4	Emergency Reclaim Area	25	-	-	
5	Crusher Tower Area				
	Crusher ^E	75	99.8	0.288	8
	Transfer Conveyor ^D	75	99.8	0.000704	8
6	Silo Bay Area				
	Coal Silo ^F	180	99.8	0.00032	8
	Transfer Conveyor ^D	180	99.8	0.000710	8
<u>Ash Handling</u>					
7	Ash Silo Area				
	Discharge ^B	120	99.8	0.0648	12
	Unloading ^B	120	99.8	0.144	8
8	Ash Recycle Silo ^B	75	99.8	0.0588	12
<u>Lime Handling</u>					
9	Lime Silo Area ^A	120	99.8	0.012	16
10	Lime Slurry Plant ^A	60	99.8	0.0012	12
13	Soda Ash Silo ^A	75	99.8	0.0024	12

References A = EPRI 3-59, B = UARG, 3-69 C = EPRI 3.13 D = AP-42 11.2.3
E = EPRI, 3-78, F = EPRI, 3-45
EPRI = EPRI, 1984 AP-42 = EPA 1986, UARG = UARG, 1981

Table 4-4
BACKGROUND SOURCE EMISSIONS INVENTORY - PSD SOURCES

Source No. & ID	UTM Coords. (km)		Stack Parameters				Emission Rates (g/s)			Distance From Indiantown (km)
	East	North	H _s (m)	T _s (K)	V _s (m/s)	D _s (m)	SO ₂	PM	NO ₂	
1 Power Ventures	569 4	2975 9	19 2	422	22 6	0 9	6 8	(1)	88 1	25 8
2 Fort Pierce Util	566 8	3036 3	45 7	408	12 5	2 4	77 9	(1)	(1)	49 2
3 U S Sugar Corp	506 1	2956 9	45 7	340	25 2	2 2	85 7	14 7	(1)	54 0
4 Atlantic Sugar	552 9	2945 2	27 4	339	9 7	2 0	11 8	4 8	(1)	45 7
5 Osceola Farms	544 2	2968 0	27 4	341	16 9	1 9	33 4	7 2	(1)	23 1
6 Sugar Cane Growers	534 9	2953 3	47 2	344	10 6	3 0	71 2	12 0	15 5	39 7
7 U S Sugar Bryant Plant	538 8	2968 1	30 5	344	22 4	2 1	32 5	11 0	17 5	24 5
8 Pratt & Whitney	558 1	2979 1	4 6	644	13 4	3 4	23 4	(1)	(1)	15 2
9 Palm Beach	585 8	2960 2	76 2	505	24 9	2 0	44 1	(1)	(1)	48 4
10- FPL Martin CT ⁽²⁾	542 9	2992 4	65 0	411	18 8	6 1	463 6	30 4	232 4	5 6
11 FPL Martin CT ⁽²⁾	543 2	2992 4	65 0	411	18 8	6 1	463 6	30 4	232 4	5 3
12 FPL Martin AB ⁽³⁾	543 0	2992 5	18 3	535	15 2	1 1	6 5	0 2	1 4	5 5
13- FPL Martin AB ⁽³⁾	543 2	2992 5	18 3	535	15 2	1 1	6 5	0 2	1 4	5 5
14 FPL Martin DG ⁽⁴⁾	543 0	2992 5	7 6	786	39 6	0 3	0 3	0 3	3 9	5 4
15- FPL Martin DG ⁽⁴⁾	543 2	2992 5	7 6	786	39 6	0 3	0 3	0 3	3 9	5 4

H_s = Stack Height T_s = Stack Exit Temperature V_s = Stack Exit Velocity D_s = Stack Exit Diameter

(1) No emissions data are available from FDER

(2) Each source contains 4 units emissions shown are the total amount (No 2 oil @ 40 °F)

(3) Auxiliary boiler

(4) Diesel generator

Source FPL Martin PSD 1989

Table 4-5
BACKGROUND SOURCE EMISSIONS INVENTORY - BACKGROUND
SOURCES

Source No. & ID	UTM Coords (km)		Stack Parameters				Emission Rates (g/s)			Distance From Indiantown (km)
	East	North	H _s (m)	T _s (K)	V _s (m/s)	D _s (m)	SO ₂	PM	NO ₂	
14- FPL Martin 1&2	543.1	2992.9	152.1	421	21.1	8.0	1743.8	218.0	654.0	5.64
15- Everglades Sugar	509.6	2954.2	21.9	477	10.1	1.1	40.5	(1)	(1)	53.16
16- U.S. Sugar Corp	506.1	2956.9	22.9	344	25.3	1.9	68.3	51.6	(1)	54.0
17- Atlantic Sugar	552.9	2945.2	27.4	342	13.0	1.9	30.9	32.8	(1)	45.7
18- Osceola Farms	544.2	2968.0	27.4	341	23.6	1.9	56.4	30.1	(1)	23.1
19- Sugar Cane Growers	534.9	2953.3	24.4	336	14.4	1.6	51.6	52.8	17.1	39.7
20- U.S. Sugar Bryant Plant	538.8	2968.1	19.8	342	36.4	1.6	35.5	47.0	(1)	24.5
21- Pratt & Whitney	559.2	2978.3	15.2	533	40.2	0.9	74.0	(1)	60.5	16.5
22- FPL Riviere Plant	594.2	2960.6	90.8	408	18.9	4.9	2238.5	(1)	454.6	54.9
23- Caulkins Citrus Co	548.1	2911.5	28.7	343	11.9	1.0	(1)	3.5	(1)	0.8

H_s = Stack Height T_s = Stack Exit Temperature V_s = Stack Exit Velocity D_s = Stack Exit Diameter
 (1) No emissions data are available from FDER
 Source: FPL Martin PSD 1989

Table 4-6
WEST PALM BEACH 1982-86 JOINT FREQUENCY TABLES

Frequency (%) of Wind Speed & Direction for Stability Class A

Surface Station No 12844				Time Period	ANNUAL		
	Speed (m/s)						
Direction	1 5	2 5	4 5	7 0	9 5	>11	Total
N	0023	0160	0000	0000	0000	0000	0183
NNE	0023	0091	0000	0000	0000	0000	0114
NE	0023	0114	0000	0000	0000	0000	0137
ENE	0000	0114	0000	0000	0000	0000	0114
E	0000	0251	0000	0000	0000	0000	0251
ESE	0068	0137	0000	0000	0000	0000	0205
SE	0091	0205	0000	0000	0000	0000	0297
SSE	0046	0114	0000	0000	0000	0000	0160
S	0046	0205	0000	0000	0000	0000	0251
SSW	0046	0205	0000	0000	0000	0000	0251
SW	0114	0205	0000	0000	0000	0000	0319
WSW	0023	0114	0000	0000	0000	0000	0137
W	0023	0228	0000	0000	0000	0000	0251
WNW	0000	0023	0000	0000	0000	0000	0023
NW	0000	0114	0000	0000	0000	0000	0114
NNW	0023	0183	0000	0000	0000	0000	0205
Total	0548	2464	0000	0000	0000	0000	
Calms = 15 hours				Total Class Obs = 30%			

Frequency (%) of Wind Speed & Direction for Stability Class B

Surface Station No 12844			Time Period ANNUAL				
	Speed (m/s)						
Direction	1 5	2 5	4 5	7 0	9 5	>11	Total
N	0228	1141	0593	0000	0000	0000	1962
NNE	0091	0776	0639	0000	0000	0000	1506
NE	0137	0730	1871	0023	0000	0000	2761
ENE	0183	0685	1666	0023	0000	0000	2556
E	0068	1255	3081	0023	0000	0000	4427
ESE	0114	1438	3354	0023	0000	0000	4929
SE	0228	1346	4290	0046	0000	0000	5910
SSE	0137	0867	1438	0023	0000	0000	2464
S	0342	0844	0730	0000	0000	0000	1917
SSW	0160	0844	0753	0000	0000	0000	1757
SW	0160	1187	0753	0000	0000	0000	2099
WSW	0274	0707	1141	0000	0000	0000	2122
W	0137	0776	0913	0000	0000	0000	1825
WNW	0205	0981	0616	0000	0000	0000	1803
NW	0205	0867	0639	0000	0000	0000	1711
NNW	0114	0936	0776	0000	0000	0000	1825
Total	2784	1 5380	2 3252	0160	0000	0000	
Calms = 35 hours				Total Class Obs = 4 16%			

Table 4-6 (Contd)

Frequency (%) of Wind Speed & Direction for Stability					Class C		
Surface Station No 12844					Time Period ANNUAL		
Direction	1 5	2 5	Speed (m/s)		9 5	>11	Total
			4 5	7 0			
N	0388	1506	3400	0867	0023	0023	6207
NNE	0137	0593	2350	1095	0023	0000	4199
NE	0228	0685	5796	3103	0205	0000	1 0017
ENE	0114	0958	6914	4404	0319	0023	1 2733
E	0091	1209	1 0382	6663	0183	0000	1 8529
ESE	0183	1050	1 2254	7211	0068	0000	2 0765
SE	0251	1460	1 5152	6458	0114	0000	2 3435
SSE	0228	1187	6366	2464	0114	0000	1 0360
S	0730	2191	4153	1118	0068	0000	8260
SSW	0502	1004	3126	0776	0000	0000	5408
SW	0388	1483	2989	0936	0046	0000	5842
WSW	0205	0958	2487	0753	0068	0000	4472
W	0228	0936	2099	0844	0114	0068	4290
WNW	0297	0776	2556	0821	0000	0000	4450
NW	0297	1164	3537	0730	0091	0000	5819
NNW	0365	1346	3423	0753	0000	0000	5887
Total	4632	1 8506	8 6984	3 8997	1438	0114	
Calms = 99 hours					Total Class Obs = 15 07%		

Frequency (%) of Wind Speed & Direction for Stability					Class D		
Surface Station No 12844					Time Period ANNUAL		
Direction	1 5	2 5	Speed (m/s)		9 5	>11	Total
			4 5	7 0			
N	0548	3674	6846	7142	0662	0023	1 8894
NNE	0388	1643	3491	8397	0936	0091	1 4946
NE	0137	1506	6777	1 8985	3126	0251	3 0782
ENE	0114	1438	1 1615	3 4798	5066	0707	5 3738
E	0274	2168	1 7114	4 0206	5454	0799	6 6014
ESE	0183	2738	1 4718	2 0765	0936	0000	3 9339
SE	0297	4472	1 7251	1 9784	0913	0160	4 2876
SSE	0365	3217	9675	1 1409	0730	0023	2 5420
S	0388	4267	7918	6731	0479	0000	1 9784
SSW	0434	2966	4404	2784	0297	0023	1 0907
SW	0548	3423	4587	3834	0479	0046	1 2915
WSW	0411	2373	3628	2715	0342	0091	9561
W	0411	2350	2921	4039	0844	0228	1 0793
WNW	0342	2761	3309	5089	1027	0319	1 2847
NW	0821	3605	7005	8466	0639	0046	2 0582
NNW	0479	3377	8329	7667	0274	0046	2 0172
Total	6138	4 5979	12 9587	20 2811	2 2202	2852	
Calms = 161 hours					Total Class Obs = 40 96%		

Table 4-6 (Contd)

Frequency (%) of Wind Speed & Direction for Stability

Class E

Surface Station No 12844					Time Period		ANNUAL
Direction	Speed (m/s)				9 5	>11	Total
	1 5	2 5	4 5	7 0			
N	0525	3286	2510	0023	0000	0000	6344
NNE	0251	1232	1689	0000	0000	0000	3172
NE	0114	1415	5203	0023	0000	0000	6754
ENE	0091	1574	1 0976	0137	0000	0000	1 2778
E	0183	3286	1 5243	0160	0000	0000	1 8871
ESE	0342	4632	1 2345	0114	0000	0000	1 7433
SE	0844	6982	1 1341	0137	0000	0000	1 9304
SSE	0434	4678	5568	0046	0000	0000	1 0725
S	0799	7142	4381	0000	0000	0000	1 2322
SSW	0616	4427	1734	0023	0000	0000	6800
SW	0730	4472	2350	0023	0000	0000	7576
WSW	0593	3286	2282	0000	0023	0000	6184
W	0548	3834	2829	0023	0000	0000	7233
WNW	0776	4199	2875	0046	0000	0000	7895
NW	0685	4723	7553	0000	0000	0000	1 2961
NNW	0753	5317	5636	0023	0023	0000	1 1752
Total	8283	6 4485	9 4514	0776	0046	0000	
Calms = 288 hours					Total Class Obs = 16 81%		

Frequency (%) of Wind Speed & Direction for Stability

Class F

Surface Station No 12844					Time Period		ANNUAL
Direction	Speed (m/s)				9 5	>11	Total
	1 5	2 5	4 5	7 0			
N	2213	3834	0091	0000	0000	0000	6138
NNE	0844	1232	0000	0000	0000	0000	2076
NE	0502	1757	0023	0000	0000	0000	2282
ENE	0593	2829	0068	0023	0000	0000	3514
E	1050	5317	0068	0023	0000	0000	6458
ESE	1666	9949	0137	0000	0000	0000	1 1752
SE	3012	1 2162	0137	0000	0000	0000	1 5311
SSE	3788	6800	0091	0000	0000	0000	1 0679
S	4199	1 1318	0000	0000	0000	0000	1 5517
SSW	4381	7986	0068	0000	0000	0000	1 2436
SW	4450	9264	0023	0000	0000	0000	1 3737
WSW	3719	6777	0205	0000	0000	0000	1 0702
W	4336	8443	0000	0000	0000	0000	1 2778
WNW	3742	8123	0023	0000	0000	0000	1 1888
NW	5043	9858	0068	0000	0000	0000	1 4969
NNW	3537	7576	0114	0000	0000	0000	1 1227
Total	4 7075	11 3226	1118	0046	0000	0000	
Calms = 2277 hours					Total Class Obs = 16 15%		

Table 4-6 (Contd)

Frequency (%) of Wind Speed & Direction for Stability Classes

Surface Station No 12844					Time Period ANNUAL		Total
Direction	1 5	2 5	Speed (m/s)		9 5	>11	
			4 5	7 0			
N	3925	1 3600	1 3440	8032	0685	0046	3 9727
NNE	1734	5568	8169	9493	0958	0091	2 6013
NE	1141	6207	1 9670	2 2134	3332	0251	5 2734
ENE	1095	7599	3 1239	3 9385	5385	0730	8 5433
E	1666	1 3486	4 5888	4 7075	5636	0799	11 4549
ESE	2556	1 9943	4 2808	2 8112	1004	0000	9 4423
SE	4723	2 6629	4 8170	2 6424	1027	0160	10 7133
SSE	4997	1 6863	2 3138	1 3942	0844	0023	5 9807
S	6503	2 5968	1 7182	7850	0548	0000	5 8050
SSW	6138	1 7433	1 0086	3583	0297	0023	3 7559
SW	6389	2 0035	1 0702	4792	0525	0046	4 2488
WSW	5225	1 4216	9744	3468	0434	0091	3 3178
W	5682	1 6566	8762	4906	0958	0297	3 7171
WNW	5362	1 6863	9378	5956	1027	0319	3 8906
NW	7051	2 0331	1 8802	9196	0730	0046	5 6156
NNW	5271	1 8734	1 8278	8443	0297	0046	5 1068
Total	6 9460	26 0040	33 5455	24 2789	2 3686	2966	

Calms = 2875 hours

Missed Obs = 0 hours

Total Obs = 43824 hours

Total No of Days Counted = 1826

Notes 1 Total observation includes calms

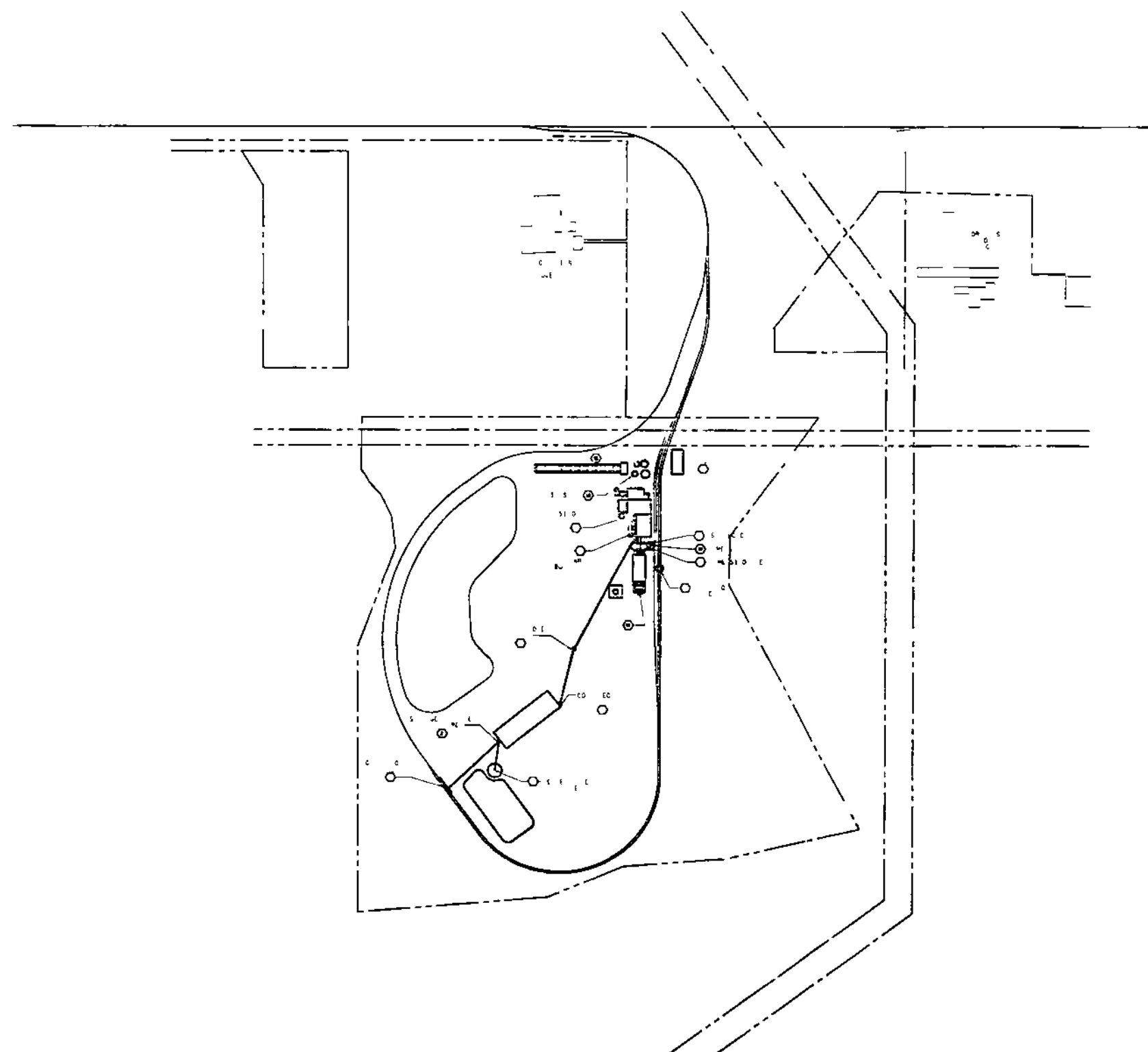
2 The total days counted are for the entire data set

3 NCC wind speed ranges (m/s) 1 5 (0 1 8), 2 5 (1 8 3 3), 4 5 (3 3-5 4) 7 0 (5 4-8 5), 9 5 (8 5-11)

4 Calm is defined as wind speed at 1 m/s or less (for dispersion modeling purpose only)

Table 4-7
DISCRETE RECEPTORS FOR FUGITIVE PARTICULATE ANALYSIS

ID	X (m)	Y (m)	ID	X (m)	Y (m)
1	74 3	388 6	40	251 5	-34 3
2	182 9	384 0	41	236 8	-77 1
3	201 2	342 9	42	223 1	-117 0
4	256 0	297 2	43	200 3	-154 4
5	310 9	256 9	44	165 5	-188 4
6	374 9	217 2	51	91 4	588 9
7	451 7	160 0	52	177 4	477 3
8	540 4	100 6	53	248 7	422 9
9	279 8	0 0	54	320 0	377 2
10	220 4	-28 6	55	388 9	320 0
11	194 3	-40 1	56	457 2	268 8
12	171 5	-96 9	57	548 6	188 4
13	160 0	-125 7	58	640 1	111 6
14	154 4	-177 4	59	383 1	0 0
15	142 9	-245 1	65	197 5	-331 5
16	131 5	-342 9	66	168 2	-434 3
17	102 9	-539 5	67	119 8	-640 1
18	0 0	-674 4	68	0 0	-777 2
19	-108 6	-634 6	69	-125 7	-731 5
20	-214 0	-582 9	70	-251 5	-680 3
21	-308 6	-531 3	71	-354 3	-617 2
22	-406 0	-474 4	72	-468 6	-554 1
23	-530 4	-449 0	73	-605 8	-511 1
24	-668 4	-377 2	74	-754 4	-426 1
25	-820 2	-285 8	75	-919 0	-320 0
26	-863 2	-137 2	76	-960 1	-157 3
27	-760 1	0 0	77	-857 3	0 0
28	-674 4	114 3	78	-777 2	131 7
29	-605 8	211 2	79	-697 2	240 0
30	-514 4	297 2	80	-599 8	342 9
31	-422 9	320 0	81	-497 4	417 0
32	-354 3	422 9	82	-411 5	497 4
33	-325 5	565 8	83	-371 2	651 5
34	-223 1	645 6	84	-256 9	743 0
35	-91 4	548 6	85	-102 9	645 6
36	0 0	485 5	86	0 0	582 9



Poor Original

5	1	8	2	55	1	200
25	3	10	5	1	1	1
25	3	10	5	1	1	1
25	3	10	5	1	1	1
25	3	10	5	1	1	1
25	3	10	5	1	1	1
25	3	10	5	1	1	1
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25	3	10	5	1	1	1
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25	3	10	5	1	1	1
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25	3	10	5	1	1	1
25	3	10	5	1	1	1
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25	3	10	5	1	1	1
25	3	10	5	1	1	1
25	3	10	5	1	1	1
25	3	10	5	1	1	1
25	3	10	5	1	1	1
25	3	10	5	1	1	1
25	3	10	5	1	1	1
25	3					

Figure 4-1
EMISSION POINT DIAGRAM

INDIANTOWN
COGENERATION
PROJECT
Indiantown Cogeneration L.P

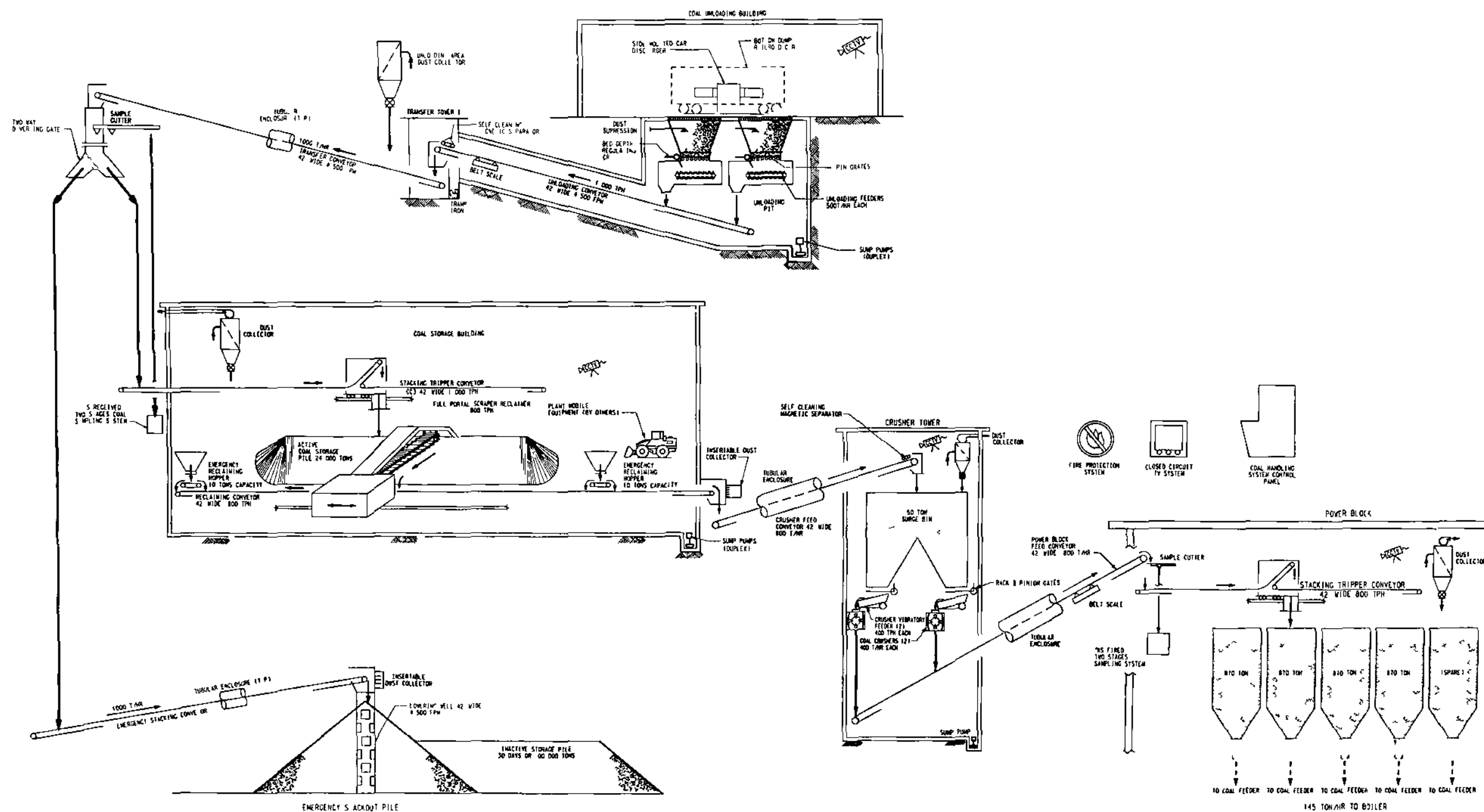


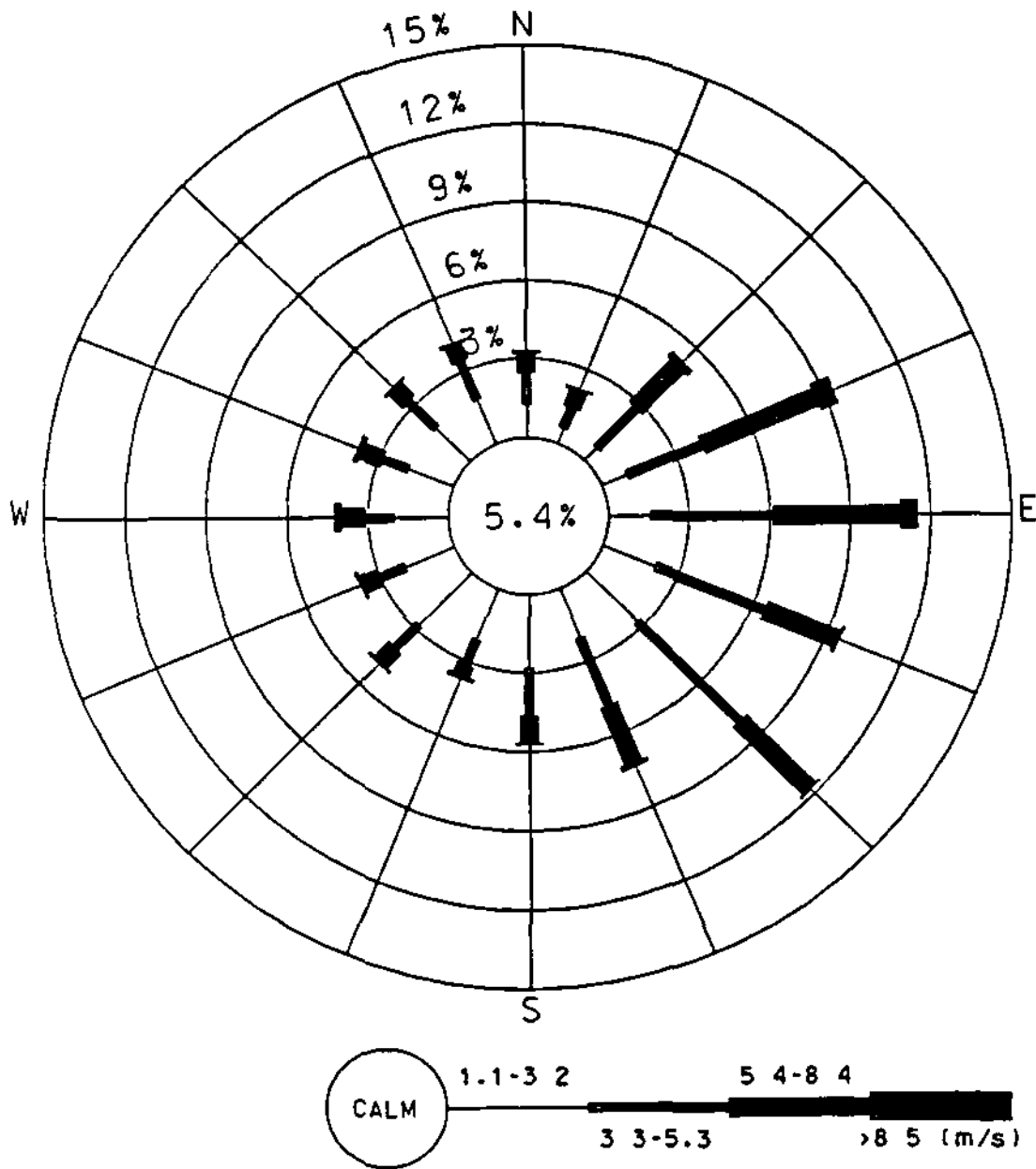
Figure 4-2

COAL AND LIME HANDLING AND STORAGE OPERATIONS

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L P

WEST PALM BEACH (SPRING) (1982-86)

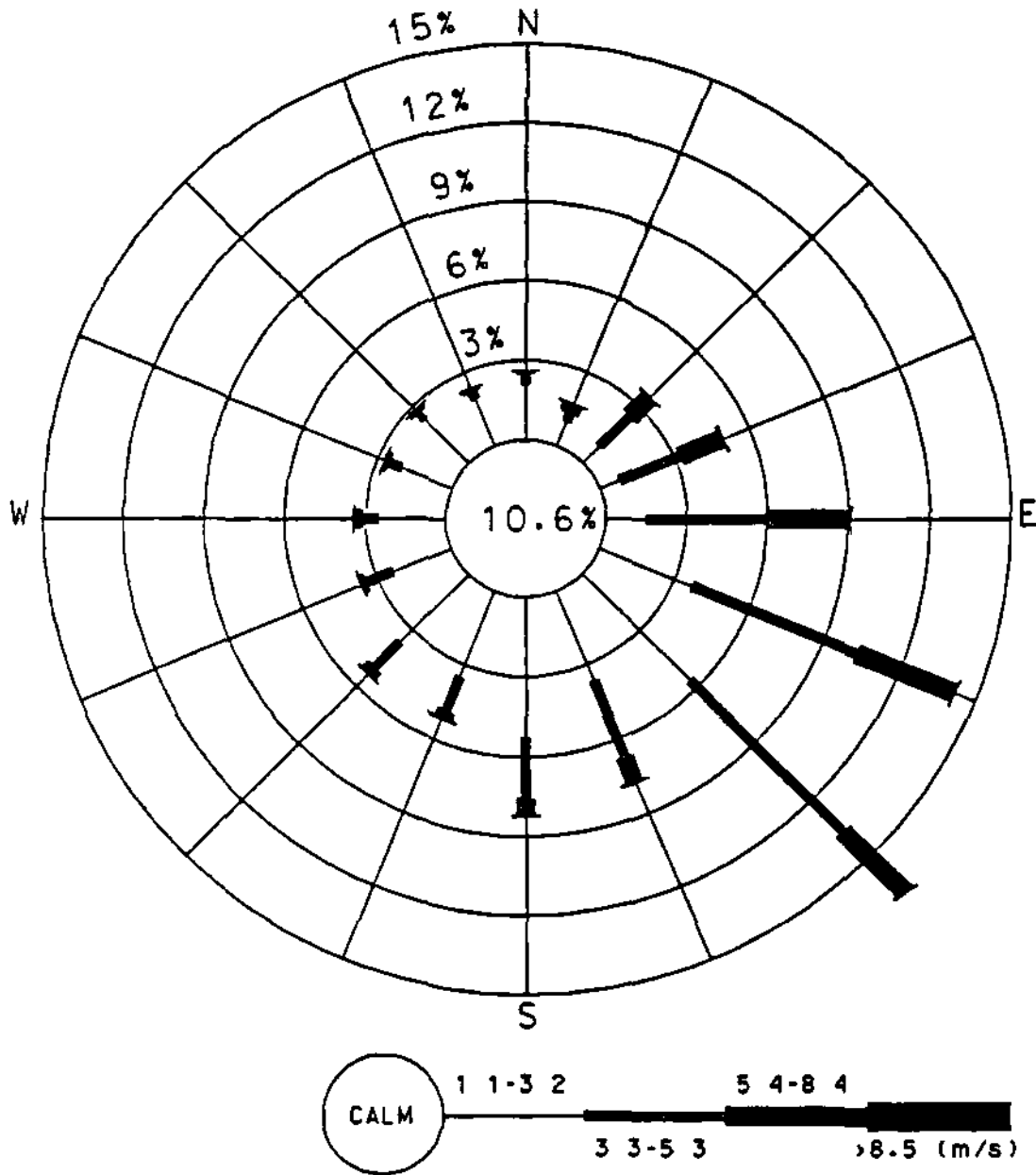


INDIANTOWN COGENERATION PROJECT

Figure 4-3(a)

SPRING WIND ROSE

WEST PALM BEACH (SUMMER) (1982-86)

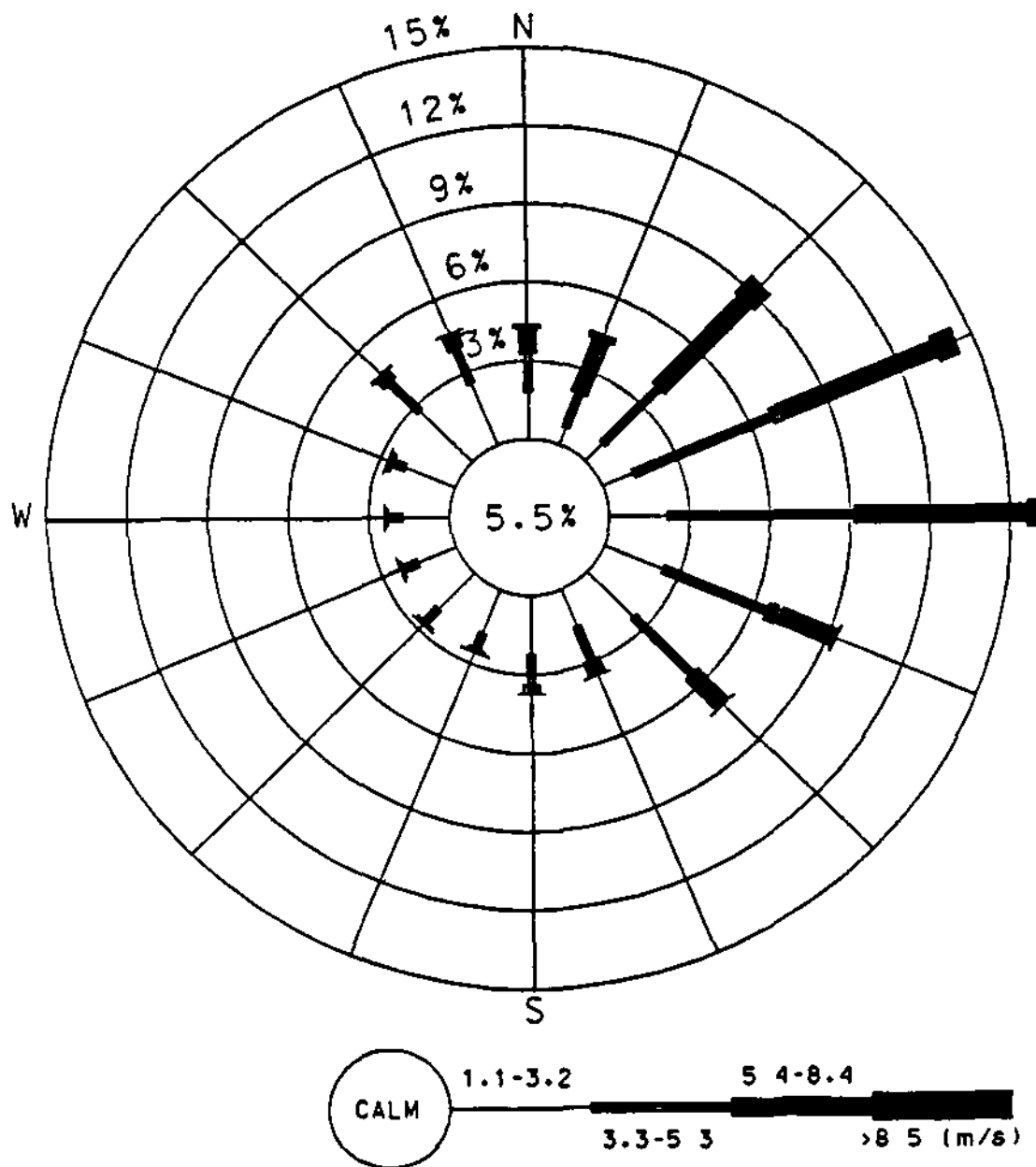


INDIANTOWN COGENERATION PROJECT

Figure 4-3(b)

SUMMER WIND ROSE

WEST PALM BEACH (FALL) (1982-86)

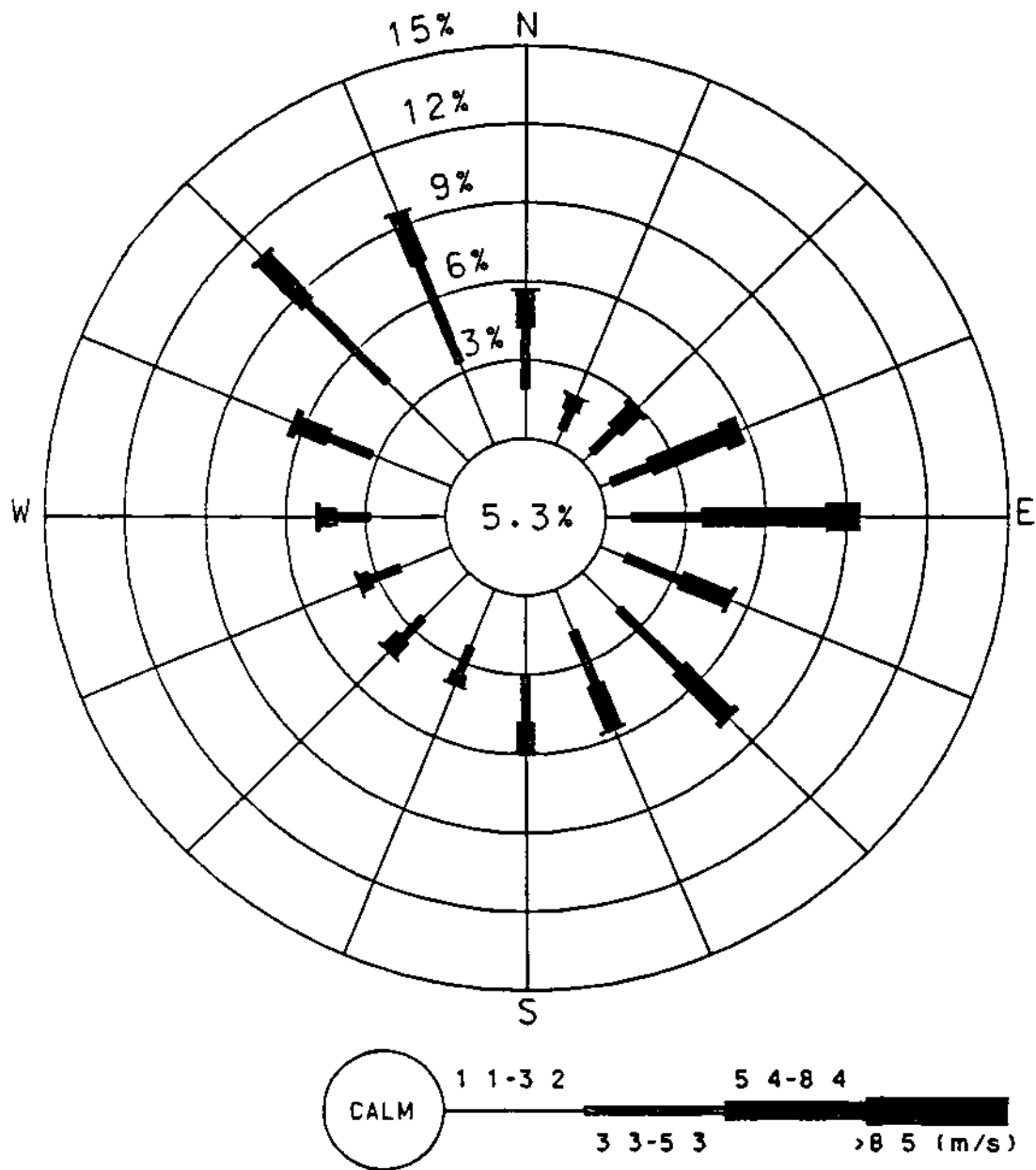


INDIANTOWN COGENERATION PROJECT

Figure 4-3(c)

FALL WIND ROSE

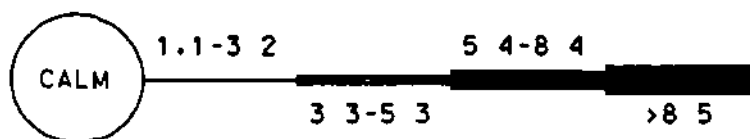
WEST PALM BEACH (WINTER) (1982-86)



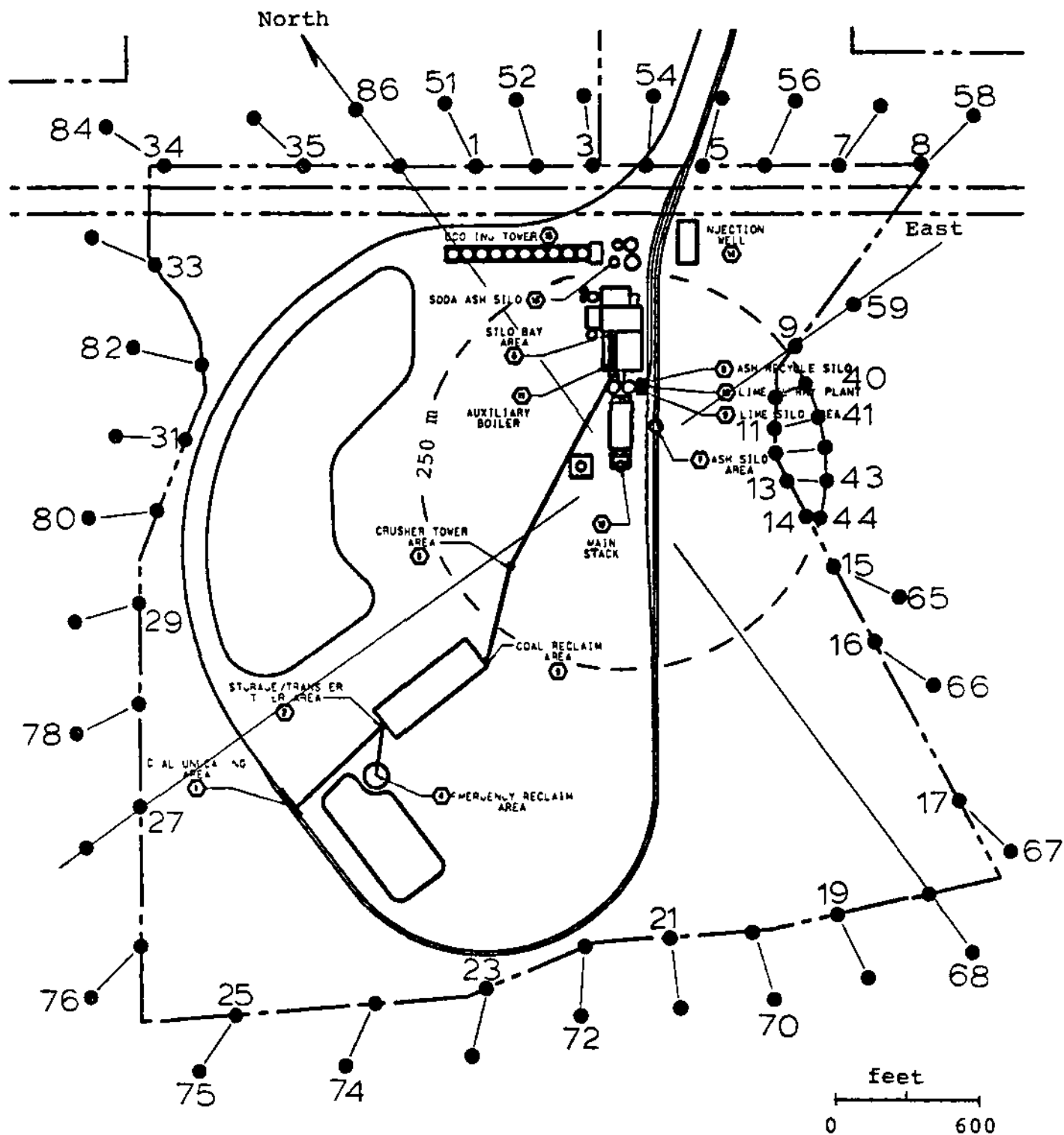
INDIANTOWN COGENERATION PROJECT

Figure 4-3(d)

WINTER WIND ROSE



ANNUAL WIND ROSE



INDIANTOWN COGENERATION PROJECT

Figure 4-4
ISCST Receptor Grids for Fugitive
Particulate Impact Analysis

5.0 DISPERSION MODEL RESULTS

The purpose of this section is to present the results of the ISCST dispersion modeling analyses described in Sections 3.0 and 4.0. These analyses are used to demonstrate impacts (1) within significant impact areas of the proposed facility due to stack emissions from the ICL plant (for all criteria and certain noncriteria pollutants) and (2) adjacent to the proposed facility due to sources of fugitive particulate emissions from material handling and storage activities. The results of a modeling analysis to evaluate particulate impacts due to cooling tower drift from the plant's cooling system are presented in Section 7.3.

5.1 IMPACTS DUE TO PROPOSED FACILITY

This section discusses the air quality impacts due to stack and fugitive emission sources at the ICL plant. The analyses consider facility operation (stack emissions) at full (100 percent) load and at partial loads of 75 and 50 percent for receptors within a 5-km radius of the facility. Results are based on the use of 5 years of meteorological data collected from the West Palm Beach NWS station (see Section 4.3), as required by the FDER.

SO₂ is the primary pollutant of concern for this project. Impacts presented for NO₂, TSP, PM-10, and lead were scaled from the modeled SO₂ concentrations in proportion to their respective emission rates. Likewise, concentrations of noncriteria pollutants released in amounts above threshold significant emission levels (i.e., beryllium and fluorides) were scaled from the SO₂ modeling results.

5.1.1 SO₂ IMPACTS

Impacts from SO₂ emissions were analyzed by the ISCST model. For short-term impacts, the highest second-highest concentrations are reported because the analyses were based on the use of 5 years of representative meteorological data. For long-term (annual) impact, the maximum concentration estimated for each year was used.

Table 5-1 presents annual, 24-hour, and 3-hour average SO₂ impacts due to the proposed ICL main boiler operating at full (100 percent) and partial (75 and 50 percent) loads. These results are based on the screening modeling for receptors within 5 km of the facility. The purpose of these screening modeling studies is to determine the worst-load case. Results indicate that impacts at partial loads are less than that at full load. The tradeoff between dispersion due to a lower exit flow rate and lower emissions at these reduced loads was apparently dominated by the latter.

Impacts from the oil/gas-fired auxiliary boiler were also analyzed to determine which fuel would have more impact to the ambient air. Table 5-2 shows that oil firing resulted in higher concentrations than gas firing for all the averaging periods considered. Therefore, the oil-firing auxiliary boiler was considered together with

the coal-firing main boiler to estimate the maximum combined impacts from the proposed ICL stacks. This approach is conservative because the auxiliary boiler is only planned to be operated on a part-time basis in support of the main boiler.

Screening analyses were made using a coarse-grid (250-m interval) within 4.25 km of the facility. The screening analyses revealed that due to the relatively short auxiliary boiler stack, building downwash effects induced by the boiler building were evident near the proposed plant. Therefore, for the refined-grid (100-m interval) analyses, the receptors were placed much closer to the site. In the refined-grid analyses, the receptors were placed around the maximum impact locations predicted by the screening modeling. The closest site boundary is located to the east of the main stack, slightly more than 200 m away. In order to identify the maximum concentrations induced by building downwash, instead of 100 m, an interval of 50 m was used between the first and the second rings of the polar receptor network. Thus, the first ring distance was set at 250 m, instead of 300 m. The ICL site boundary has an irregular shape. Concentrations predicted at the receptors located on-site were excluded in the analyses. Table 5-3 presents the refined-grid modeling results for annual 1-, 3-, 8-, and 24-hour average SO₂ concentrations due to the combined impacts from the main boiler stack and the auxiliary boiler stack.

Of the 5 years modeled, the maximum annual average concentration is 1.15 µg/m³ (occurring in 1985), only slightly more than the significance level of 1 µg/m³. This value occurs to the east-southeast of the proposed facility (100° radial) at a distance of 250 m. The maximum 24-hour average SO₂ value (11.6 µg/m³) also occurs at this receptor and in the same year. It should be noted that this 24-hour average value is less than the monitoring exemption level (13 µg/m³). The maximum 3-hour average is 24.7 µg/m³ and occurs on the 310° radial at a distance of 2 km. The maximum 8-hour and 1-hour concentrations are 19 and 61.2 µg/m³, respectively.

As mentioned in Section 3.5.2 and elsewhere, SO₂ concentration values will be used to scale NO₂, TSP, PM-10, and lead impacts due to stack emissions and for selected non-criteria pollutants as presented in the following subsections. The ISCST-modeled results also indicated that the main boiler stack has no impacts at 250 m downwind for 3-, 8-, and 24-hour and annual averaging periods (see Table 5-4). For these averaging periods, all the impacts at this distance are due to the building downwash affecting the auxiliary boiler plume. Thus, the auxiliary boiler SO₂ emission rate was used to scale impacts of other pollutants at this distance. For the 1-hour averaging time, the main boiler and the auxiliary boiler contribute 94 percent and 6 percent to the maximum impact location (800 m downwind), respectively.

5.1.2 PARTICULATE IMPACTS

As stated in Section 5.1.1, the maximum impacts for 24-hour and annual averaging periods were contributed by the auxiliary boiler stack alone. The ratio of the hourly auxiliary stack particulate emission (1.4 lb/hr) to SO₂ emissions (17.73 lb/hr) is

about 0.079. Scaling the highest annual average SO_2 concentration reported above ($1.15 \mu\text{g}/\text{m}^3$, within 4.25 km) by this ratio yields a maximum incremental annual particulate concentration of only $0.09 \mu\text{g}/\text{m}^3$. Likewise, scaling the highest 24-hour average SO_2 concentration ($11.6 \mu\text{g}/\text{m}^3$) yields a maximum incremental 24-hour particulate concentration of only $0.92 \mu\text{g}/\text{m}^3$. Clearly, the incremental impacts of stack-emitted particulates are well below the corresponding significance levels ($1 \mu\text{g}/\text{m}^3$ - annual, $5 \mu\text{g}/\text{m}^3$ - 24 hour).

The highest particulate impacts due to the proposed ICL plant are a result of fugitive dust emissions from material handling and storage activities. The highest annual and 24-hour average incremental concentrations are 0.17 and $3.3 \mu\text{g}/\text{m}^3$, respectively (see Table 5-5). The maximum 24-hour fugitive particulate impact is less than the significant impact level ($5 \mu\text{g}/\text{m}^3$). This value occurs at the ICL property line, 600 feet from the coal unloading area, and decreases farther downwind of the boundary.

As stated in Section 5.1.1, the main boiler stack has no contribution to receptors located at the property line for 24-hour or annual averaging periods. Therefore, the combined impacts of fugitive and auxiliary boiler stack emissions were analyzed. The maximum 24-hour particulate impact from these stack emissions is $0.92 \mu\text{g}/\text{m}^3$, which occurred on Julian day 10 in 1982 (see Table 5-4). The impact of fugitive emissions on this date and at the same location was estimated by the ISCST model to be only $0.075 \mu\text{g}/\text{m}^3$. Similarly, based on the maximum 24-hour particulate impact produced by the fugitive emissions, the stack impact at the same location and date was also analyzed. The resultant combined impacts are presented below.

<u>Year</u>	<u>Julian Day</u>	<u>Fugitive ($\mu\text{g}/\text{m}^3$)</u>	<u>Aux. Boiler ($\mu\text{g}/\text{m}^3$)</u>	<u>Total ($\mu\text{g}/\text{m}^3$)</u>
1982	10	0.075	0.916	0.991
1986	164	3.33	0.014	3.347

The results show that the maximum combined 24-hour impact ($3.3 \mu\text{g}/\text{m}^3$) is below the significant level of $5 \mu\text{g}/\text{m}^3$. It is also less than the monitoring exemption level of $10 \mu\text{g}/\text{m}^3$. For annual particulate impacts, the highest values for stack and fugitive sources are 0.09 (see Table 5-4) and $0.17 \mu\text{g}/\text{m}^3$ (see Table 5-5), respectively. These two maximum impacts do not overlap. However, since they are relatively small, it is conservative to use their sum ($0.26 \mu\text{g}/\text{m}^3$) as the total maximum annual incremental impact. This sum is less than the significant level of $1 \mu\text{g}/\text{m}^3$.

5.1.3 NO_2 , CO, AND LEAD IMPACTS

As stated above, the main boiler stack has no contribution to the maximum 8-hour, 24-hour, and annual impact locations. The ratio of maximum hourly auxiliary boiler stack emissions of NO_2 (68.2 lb/hr) to SO_2 (17.73 lb/hr) is about 3.847. Scaling

the highest annual average SO_2 concentration reported above ($1.15 \mu\text{g}/\text{m}^3$) by this ratio yields a maximum incremental annual NO_2 concentration of $4.42 \mu\text{g}/\text{m}^3$. This value is below the corresponding monitoring exemption level ($14 \mu\text{g}/\text{m}^3$) for NO_2 .

As stated in Section 3.5.2, for the auxiliary boiler stack, the CO emission rate is about 2.7 times of the SO_2 emission. However, for the main boiler stack, the CO emission rate is only about 0.65 times the SO_2 emission. Therefore, the maximum 1- and 8-hour CO impacts do not necessarily occur at the same locations as those predicted by the SO_2 emissions. As a result, ISCST modeling was independently made for 1-hour and 8-hour CO impact analyses. The modeling results showed that the maximum 1-hour CO impact is $78.2 \mu\text{g}/\text{m}^3$, which occurred on Julian day 11, 1983. The maximum 8-hour CO impact is $50.9 \mu\text{g}/\text{m}^3$, which occurred on Julian day 21, 1985. Both of these maximum impacts occurred at 250 m downwind from the main boiler stack. It is evident that these values are contributed by the auxiliary boiler stack due to plume downwash. The maximum 1-hour value is about 25 times less than the 1-hour significant impact level ($2,000 \mu\text{g}/\text{m}^3$). The maximum 8-hour value is about 10 times less than the 8-hour significant impact level ($500 \mu\text{g}/\text{m}^3$). As stated in Section 5.1.1, the maximum 1-hour SO_2 impact occurred at 800 meters, instead of 250 meters, downwind from the main stack. This confirmed the necessity for modeling CO impacts independently.

The total lead emission of the ICL stacks is less than the significant emission level (see Table 2-2), thus, no air quality analysis for lead is required.

5.1.4 NON-CRITERIA POLLUTANTS

In addition to the air quality impacts of criteria pollutants (i.e., those for which an NAAQS has been established) discussed in the previous subsections, an impact analysis is also required for noncriteria pollutants. Table 2-2 identified the following noncriteria pollutants which are trace elements emitted by the ICL plant in significant amounts: beryllium, fluorides, inorganic arsenic, and mercury.

Significant ambient air quality impact levels have not been established for these pollutants. However, as mentioned in Sections 2.2.3 and 3.7.4, the Florida Air Toxics Working Group, composed of FDER and local county air toxics staff, has developed a list of "no-threat" levels that can be used for a health-effects evaluation. As stated earlier, the main boiler stack has no contribution at the locations of maximum 8-hour, 24-hour, and annual averaging periods. The trace element emissions of the main stack are in general two orders of magnitude greater than those of the auxiliary stack, except SO_3 mist, which is only one-and-one-half times greater. As a result, for the health-effects analysis, the main stack SO_2 emission rate should be used to scale emissions of trace elements in predicting their maximum concentrations. Results of the maximum impacts produced by the main boiler stack alone are presented in Table 5-6. The maximum SO_2 8-hour, 24-hour, and annual impacts from the main boiler stack are 13.1, 5.7, and $0.56 \mu\text{g}/\text{m}^3$, respectively.

The ratio of the estimated hourly main boiler stack emission rate for beryllium (0.0094 lb/hr) to SO₂ (582.6 lb/hr) is about 1.61×10^{-5} . Scaling the maximum 8-hour, 24-hour, and annual average SO₂ concentrations (see Table 5-6) by this ratio yields 2.11×10^{-4} , 9.20×10^{-5} , and 9.04×10^{-6} µg/m³, respectively. These values are two orders of magnitude less than the corresponding FDER "no-threat" levels of 0.02, 0.005, and 0.0004 µg/m³.

The ratio of the main boiler stack fluoride emission rate (5.08 lb/hr) to SO₂ (582.6 lb/hr) is about 0.0087. Scaling the maximum 8-hour and 24-hour average SO₂ concentrations by this ratio yields 0.114 and 0.050 µg/m³, respectively. These values are much less than their corresponding FDER "no-threat" levels of 25 and 6 µg/m³, respectively. No annual fluoride "no-threat" level is available.

The ratio of the main boiler stack emission rate for inorganic arsenic (0.175 lb/hr) to the corresponding SO₂ emission level is 3.00×10^{-4} . Scaling the maximum 8-hour, 24-hour, and annual average SO₂ impacts by this ratio yields 3.93×10^{-3} , 1.50×10^{-3} , and 1.68×10^{-4} µg/m³, respectively. The 8-hour and 24-hour values are two orders less than the corresponding FDER "no-threat" levels of 2 and 0.5 µg/m³. The annual value is 84 percent of its corresponding "no-threat" level (0.0002 µg/m³).

The ratio of the main boiler stack emission for mercury (0.067 lb/hr) to the corresponding SO₂ emission level is 1.15×10^{-4} . Scaling 8-hour and 24-hour average SO₂ impacts by this ratio yields 1.51×10^{-3} and 6.56×10^{-4} µg/m³, respectively. These values are two orders of magnitude less than the corresponding FDER "no-threat" levels of 0.1 and 0.024 µg/m³. No annual "no-threat" level is available for this pollutant.

As indicated in Table 2-2, since sulfuric acid mist emissions (6.35 tons/year) are less than the significant emission level (7 tons/year), no air quality analysis is required for this pollutant.

5.2 PSD INCREMENT CONSUMPTION DETERMINATION

A PSD increment consumption analysis is required for the proposed ICL on the basis of significant impacts due to stack SO₂ and NO₂ emissions (see Sections 3.5.1 and 5.1). However, TSP impacts are below the significance levels for both annual and 24-hour averaging periods. As a result, a TSP increment consumption analysis was not required.

5.2.1 SO₂ INCREMENT CONSUMPTION

PSD sources of SO₂ emissions in the vicinity of the ICL plant have been established and presented in Table 4-4. The Martin CG/CC project has eight combustion turbines, and each of them ducts to a separate stack. These eight stacks are about 530 m apart and are grouped into two combined sources, instead of a single co-located source, in order to simulate them more accurately in dispersion modeling. These two combined sources are shown in Table 4-4 as

Sources 10 and 11 Two auxiliary boiler stacks for the same project are separated by about 230 m and are modeled as two separate sources (Sources 12 and 13 in Table 4-4) Similarly, two diesel generator stacks are about 230 m apart and are modeled as two sources (Sources 14 and 15 in Table 4-4) Thus, for modeling purposes, there are 15 SO₂ PSD interactive sources for the proposed ICL plant Results of the SO₂ PSD increment consumption analysis are presented in Table 5-7 The 3-hour, 24-hour, and annual average SO₂ combined incremental concentrations are about 35 percent, 54 percent, and 20 percent of the corresponding maximum allowable PSD increment levels The proposed ICL plant has no contribution to the combined 3-hour and 24-hour maximum impact locations and contributes only about 13 percent to the annual combined maximum impact location This is an indication that the proposed ICL sources emit relatively small amounts of SO₂ compared to other nearby interactive SO₂ sources

5 2 2 NO₂ INCREMENTAL CONSUMPTION

In Section 4 2 2, PSD sources of NO₂ emissions in the vicinity of the ICL plant have been established and presented in Table 4-4 Similar to the SO₂ increment consumption analysis, eight combustion turbines, two auxiliary boilers, and two diesel generators at the Martin CG/CC project were also included as NO₂ interactive sources Thus, for modeling purposes, there are 11 NO₂ PSD interactive sources for the proposed ICL plant Results of the NO₂ increment consumption analysis are presented in Table 5-7 The highest annual NO₂ combined incremental concentration (6 53 µg/m³) is about 26 percent of the corresponding PSD incremental allowable (25 µg/m³) The proposed ICL plant contributes about 68 percent to the annual combined maximum impact location

5 3 AMBIENT AIR QUALITY COMPLIANCE DEMONSTRATION

It is necessary for the project to demonstrate compliance with the federal and state air quality standards shown in Table 2-4 For SO₂ this determination is based on the combination of ambient background concentrations (see Section 5 3 1), impacts due to background interactive sources, and the incremental impacts due to the proposed facility (see Section 5 1) Interactive source analyses are required because the facility has been shown to produce significant air quality impacts for SO₂ and NO₂ For TSP, PM-10, CO and lead, only the combination of ambient background levels and the ICL concentrations were considered to demonstrate compliance with the appropriate air quality standards

5 3 1 BACKGROUND AIR QUALITY

As mentioned in Section 3 4, on-site monitoring is not required because the estimated impacts for all pollutants requiring an air quality analysis are well below the corresponding significant monitoring concentrations Based on the ISCST modeling results, a summary of this finding is presented in Table 5-8 Additionally, the FDER indicated that the existing monitoring data from the adjacent FPL Martin site are representative of the proposed ICL area (see Appendix A, FDER letter) For the purpose of compliance demonstration in this permit application, ambient

air quality data collected by the FDER for the ICL site vicinity and those collected by the Martin CG/CC project and by the nearby historical Martin site monitoring network are considered to establish background air quality levels

FDER Air Quality Monitoring Network

Most of the state-run monitoring stations within a 50 km radius of the ICL site measure particulate matter only. In Palm Beach County, ambient CO, O₃, NO₂, and SO₂ data are also collected. The available state-operated air quality monitoring sites located within this area are presented in Table 5-9. A summary of the FDER air quality monitoring data collected during the most recent 3 years (1987-89) is presented in Table 5-10. Values presented in the table are the highest second-highest measured concentrations for short-term averages and the highest measured concentrations for the annual average.

The highest recorded 8-hour CO level (5 ppm) is about 56 percent of the federal and state standard (9 ppm), while the highest annual NO₂ level (25 µg/m³) is 25 percent of the applicable standards (100 µg/m³). The highest SO₂ measurements for short-term averaging periods are lower than those recorded by FPL existing monitors, while the highest annual average is equal to that recorded by FPL (see Table 5-11). The highest 24-hour TSP level measured at the FDER monitor at Martin County is 103 µg/m³ (see Table 5-10), 69 percent of the state standard (150 µg/m³). This value is also lower than that recorded by the FPL monitors (see Table 5-11).

Historical Martin Site Monitoring Network

The historical Martin site monitoring program as described in the Martin CG/CC PSD permit application is briefly discussed. Background SO₂, NO₂, and TSP measurements have been made by FPL at four sites (Nos. 1, 2, 3, and 4) in the vicinity of the Martin Plant on a once-every-sixth-day basis since October 1973. These data were supplemented in 1979-1980 with two sites (Nos. 5 and 6) monitoring SO₂ and NO₂ with continuous analyzers and a seventh site (No. 7) monitoring TSP. Only about 1 year of continuous SO₂ and NO₂ monitoring data exists at Site Nos. 5 and 6. A summary of FPL historical ambient air quality monitoring data for the Martin site vicinity for the period available (1973-1988) is presented in Table 5-11. Figure 5-1 shows the location of these historical monitoring sites. However, the historical SO₂ and NO₂ data were based primarily on "bubbler" type samplers, and 1 year of continuous analyzer monitoring data were collected in 1980. Therefore, they render only a general idea of the existing air quality levels in the vicinity of the ICL site.

Martin CG/CC Project Monitoring Network

The Martin CG/CC project conducted a 12-month (October 1988 through September 1989) on-site monitoring program. Four pollutants (SO₂, NO₂, O₃, and particulate matter) were measured. This monitoring program consists of two sites. One was located east of the Martin Plant location, and the other was located to the

west. Nine months (October 1988 through June 1989) of the measurements were presented in the Martin CG/CC PSD permit application. Measurements for the rest of the 3 months (July 1989 through September 1989) were presented in the Final Data Report for the Martin CG/CC project. A summary of the 12-month measurements is presented in Table 5-12. Figure 5-1 shows the locations of these air quality monitoring sites. As shown in the table, data collected by the Martin CG/CC PSD program are in good agreement with those measured in the FPL existing monitoring network and the FDER monitors. Data reported in Table 5-12 are most current and meet the PSD monitoring data recovery rate and quality assurance requirements.

Background Determination

The two Martin CG/CC PSD monitoring sites are approximately 4.2 and 10.2 km west-northwest of the proposed ICL site, respectively. Because of the proximity of these monitoring stations to the proposed site and the currentness of the data, measurements for the Martin CG/CC project are considered to be the most representative data for the ICL site area. These data have been used to determine the background air quality levels for SO₂, NO₂, and PM-10. Background air quality levels for other criteria pollutants (CO and TSP) were determined using the existing FDER monitoring data. The background air quality levels determined for the proposed ICL site and their corresponding federal/state standards are presented in Table 5-13.

The following section presents total impacts for TSP, PM-10, SO₂, and NO₂ based on the modeled incremental concentrations in Section 5.1 and the assumed background values above.

5.3.2 INTERACTIVE BACKGROUND SOURCES

Interactive background sources are described in Section 4.2.3 and presented in Table 4-5. As stated in Section 3.5.2, SO₂ and NO₂ have significant impacts on the ambient air. Thus, SO₂ and NO₂ interactive background sources were included in the ISCST modeling to estimate the maximum background levels. Background levels estimated by modeling were added to the measured background levels established in Section 5.3.1 to determine the total background levels. Since the measured background levels already include impacts from these interactive background sources, the approach of using the total background levels (measured background + modeled background) is conservative. The combined maximum interactive impacts (ICL stack sources + background interactive sources) are presented in Tables 5-14 and 5-15 for SO₂ and NO₂, respectively.

5.3.3 CRITERIA AIR POLLUTANTS

From Section 5.1.1, based on the ICL stack emissions, the highest PSD incremental SO₂ concentrations were 1.15 µg/m³, 11.6 µg/m³, and 24.7 µg/m³ for annual, 24-hour, and 3-hour averaging periods, respectively (see Table 5-3). However, detailed modeling has shown that the ICL SO₂ stack emissions have no

contribution to the maximum interactive background impact locations for both 3-hour and 24-hour averaging periods within a study area of 4.25 km radius centered at the ICL main stack. On an annual basis, the ICL stack emissions contribute only about 1.6 percent ($0.11 \mu\text{g}/\text{m}^3$) to the maximum interactive background impact location within the studied area. When combined with the corresponding monitored background values identified in Table 5-16, the resultant total impacts are $8.18 \mu\text{g}/\text{m}^3$, $61.1 \mu\text{g}/\text{m}^3$, and $243 \mu\text{g}/\text{m}^3$ for annual, 24-hour, and 3-hour averaging periods, respectively. These values are all well below the respective federal and state ambient air quality standards (see Table 5-16).

The highest modeled TSP impacts due to the combination of the ICL stacks and fugitive particulate emissions are $0.26 \mu\text{g}/\text{m}^3$ (annual) and $3.3 \mu\text{g}/\text{m}^3$ (24-hour) within 4.25 km of the proposed facility (see Section 5.1.2). The corresponding background values from the previous subsection are $13.3 \mu\text{g}/\text{m}^3$ and $39 \mu\text{g}/\text{m}^3$, respectively. Total impacts are $13.56 \mu\text{g}/\text{m}^3$ and $42.3 \mu\text{g}/\text{m}^3$ for annual and 24-hour averaging periods, respectively. These values are likewise well below the primary and secondary state TSP standards. For this analysis, it has been assumed that both modeled and monitored TSP data would conservatively represent PM-10 impacts. Thus, the total "particulate (PM-10)" annual ($13.56 \mu\text{g}/\text{m}^3$) and 24-hour ($42.3 \mu\text{g}/\text{m}^3$) impacts are still below the corresponding primary and secondary NAAQS of $50 \mu\text{g}/\text{m}^3$ and $150 \mu\text{g}/\text{m}^3$, respectively. The conservatism lies in the assumed background level, in that it is a value for TSP, the PM-10 value would be less.

Total annual NO_2 impact is $11.5 \mu\text{g}/\text{m}^3$ (Table 5-16) based on the modeling results in Section 5.1.3 and the monitored background value. This concentration is only about 11% of the corresponding federal and state standard ($100 \mu\text{g}/\text{m}^3$).

Incremental CO impacts reported in Section 5.1.3 were several orders of magnitude below the corresponding federal and state standards. The maximum 1- and 8-hour concentrations which occur near the site boundary (250 m downwind of the main stack) are contributed solely by the downwash plume from the auxiliary boiler stack.

The maximum incremental 24-hour lead concentration was shown above to be $0.015 \mu\text{g}/\text{m}^3$. This maximum 24-hour value is so far below the quarterly average lead standard ($1.5 \mu\text{g}/\text{m}^3$) that compliance is unquestionable.

Overall, it has been demonstrated that compliance with the federal and state ambient air quality standards will occur during operation of the proposed ICL for all criteria air pollutants.

Table 5-1
FULL AND PARTIAL LOAD SO₂ IMPACTS FROM MAIN STACK

Averaging Period	Year	Load (%)	Concen ^a ($\mu\text{g}/\text{m}^3$)	Location ^b (Dist, Dir)
Annual	1982	100	0.56	3.0, 310
		75	0.52	3.0, 310
		50	0.42	2.5, 310
	1983	100	0.46	3.0, 310
		75	0.43	3.0, 310
		50	0.35	2.5, 310
	1984	100	0.36	3.5, 300
		75	0.34	3.0, 310
		50	0.27	2.5, 310
	1985	100	0.45	3.0, 310
		75	0.42	3.0, 310
		50	0.34	2.5, 310
	1986	100	0.41	3.5, 270
		75	0.37	3.0, 270
		50	0.30	3.0, 270
24-Hour	1982	100	5.6	3.0, 310
		75	5.2	3.0, 310
		50	4.0	3.0, 310
	1983	100	4.4	1.0, 350
		75	4.0	2.0, 300
		50	3.2	2.5, 300
	1984	100	4.8	2.5, 280
		75	4.4	2.5, 280
		50	3.6	2.0, 280
	1985	100	4.6	3.5, 290
		75	4.2	3.0, 290
		50	3.4	3.0, 290
	1986	100	4.4	2.0, 250
		75	3.9	2.0, 250
		50	3.0	1.5, 260
3-Hour	1982	100	19.8	3.0, 300
		75	17.8	2.5, 300
		50	14.2	2.5, 300
	1983	100	19.9	2.0, 300
		75	19.4	1.0, 320
		50	15.7	2.0, 300
	1984	100	22.2	2.0, 310
		75	20.7	2.0, 310
		50	16.4	1.5, 310

Table 5-1 (Continued)

Averaging Period	Year	Load (%)	Concen ^a ($\mu\text{g}/\text{m}^3$)	Location ^b (Dist, Dir)
	1985	100	19.7	2.0, 270
		75	18.7	2.0, 270
		50	14.9	2.0, 270
	1986	100	20.5	1.5, 250
		75	17.8	1.5, 250
		50	13.8	1.0, 270

a - Maximum annual concentration, or highest second-highest average concentration from ISCST (3- and 24-hr)

b - Receptor coordinates: distance in kilometers, direction in degrees relative to ICL main stack

Table 5-2
AUXILIARY BOILER SO₂ IMPACTS

Year	Fuel	Annual ($\mu\text{g}/\text{m}^3$)	3-Hour ($\mu\text{g}/\text{m}^3$)	24-Hour ($\mu\text{g}/\text{m}^3$)
1982	Oil	1.09 (0.5, 330)	13.9 (0.75, 350)	6.3 (0.5, 320)
	Gas	0.04 (0.5, 330)	0.5 (0.75, 350)	0.2 (0.5, 320)
1983	Oil	0.81 (0.5, 320)	14.0 (0.5, 50)	7.2 (0.5, 330)
	Gas	0.03 (0.5, 320)	0.5 (0.5, 50)	0.3 (0.5, 330)
1984	Oil	0.82 (0.5, 320)	14.1 (0.5, 360)	7.0 (0.5, 350)
	Gas	0.03 (0.5, 320)	0.5 (0.5, 360)	0.2 (0.5, 350)
1985	Oil	0.80 (0.5, 320)	14.8 (0.5, 360)	6.7 (0.5, 330)
	Gas	0.03 (0.5, 280)	0.5 (0.5, 280)	0.2 (0.5, 330)
1986	Oil	0.87 (0.5, 280)	14.7 (0.5, 310)	6.1 (0.5, 320)
	Gas	0.03 (0.5, 280)	0.5 (0.5, 310)	0.2 (0.5, 320)

Notes: Concentrations are in $\mu\text{g}/\text{m}^3$

Shown within parentheses are distance (km) and direction (degree) relative to the main boiler stack

Table 5-3
ANNUAL AND SHORT-TERM AVERAGE SO₂ IMPACTS
(MAIN BOILER AND AUXILIARY BOILER COMBINED)

Averaging Period	Year	Concen ^a ($\mu\text{g}/\text{m}^3$)	Location ^b (Dist, Dir)
Annual	1982	0.92	0.6, 320
	1983	1.06	0.25, 110
	1984	0.85	0.25, 120
	1985	1.15	0.25, 100
	1986	1.04	0.25, 110
24-Hour	1982	11.6	0.25, 110
	1983	9.9	0.25, 110
	1984	11.1	0.25, 120
	1985	11.3	0.25, 110
	1986	9.0	0.25, 100
8-Hour	1982	17.1	0.25, 100
	1983	17.0	0.25, 110
	1984	16.2	0.25, 120
	1985	19.0	0.25, 110
	1986	16.8	0.25, 100
3-Hour	1982	24.7	0.25, 100
	1983	22.2	0.25, 110
	1984	23.7	2.0, 310
	1985	22.5	0.25, 110
	1986	22.4	0.25, 110
1-Hour	1982	57.6	0.8, 100
	1983	59.9	0.8, 30
	1984	57.8	0.8, 250
	1985	61.2	0.8, 80
	1986	58.1	0.8, 270

a - Maximum annual concentration, or highest second-highest concentrations (1-, 3-, 8-, and 24-hr)

b - Receptor coordinates distance in kilometers, direction in degrees relative to ICL main boiler stack

Table 5-4
RELATIVE CONTRIBUTIONS AT MAXIMUM IMPACT LOCATIONS
(ICL STACK SOURCES ONLY)

Pollutant	Averaging Period	Main Boiler	Aux Boiler	Total	Year	Dist (km)	Dir (deg)	Julian Day
SO ₂	1-Hour	57.6	3.5	61.2	1985	0.8	80	201
	3-Hour	0.0	24.7	24.7	1982	0.25	100	15
	8-Hour	0.0	19.04	19.04	1985	0.25	110	21
	24-Hour	0.0	11.6	11.6	1982	0.25	110	10
	Annual	0.0	1.15	1.15	1985	0.25	100	-
PM	24-Hour	0.0	0.92	0.92	1982	0.25	110	10
	Annual	0.0	0.09	0.09	1985	0.25	100	-
NO ₂	Annual	0.0	4.42	4.42	1985	0.25	100	-
CO	8-Hour	0.0	50.9	50.9	1985	0.25	110	21
	1-Hour	0.0	78.2	78.2	1983	0.25	100	11

Notes: Concentrations are in $\mu\text{g}/\text{m}^3$
Distance and direction shown are in km and degree, respectively, relative to the ICL main stack

Table 5-5
PARTICULATE IMPACTS DUE TO ICL FUGITIVE EMISSION SOURCES

Year	Annual ^a ($\mu\text{g}/\text{m}^3$)	Location ^b (x, y)	24-Hour ^c ($\mu\text{g}/\text{m}^3$)	Location ^b (x, y)
1982	0.17	-760 1, 0	2.6	-760 1, 0
1983	0.16	-760 1, 0	2.4	-760 1, 0
1984	0.14	-760 1, 0	1.6	-674 4, 114 3
1985	0.13	-760 1, 0	1.3	-863 2, -137 2
1986	0.17	-760 1, 0	3.3	-760 1, 0

a - Maximum annual average concentration

b - x, y coordinates in meters relative to ICL plant stack

c - Highest second-highest 24-hour average concentration

Table 5-6
MAIN BOILER STACK MAXIMUM SO₂ IMPACTS

Year	Annual ($\mu\text{g}/\text{m}^3$)	3-Hour ($\mu\text{g}/\text{m}^3$)	8-Hour ($\mu\text{g}/\text{m}^3$)	24-Hour ($\mu\text{g}/\text{m}^3$)
1982	0 56 (3 2, 310)	20 3 (2 9, 300)	12 1 (2 6, 310)	5 7 (3 2, 310)
1983	0 46 (3 1, 310)	20 1 (2 75, 300)	12 2 (0 9, 350)	4 8 (0 9, 350)
1984	0 36 (3 2, 300)	22 2 (2 0, 310)	10 7 (2 6, 280)	4 8 (2 6, 280)
1985	0 44 (3 1, 310)	19 8 (2 1, 270)	10 6 (3 6, 290)	4 6 (3 4, 290)
1986	0 41 (3 4, 270)	20 5 (1 5, 250)	13 1 (2 1, 250)	4 4 (2 1, 250)
Maximum	0 56	22 2	13 1	5 7

Note Shown within parentheses are distance (km) and direction (degrees) of impact relative to the ICL main boiler stack

Table 5-7
PREDICTED PSD INCREMENT CONSUMPTION

Pollutant	Averaging Time	ICL Incremental Concentration	Combined Incremental Concentration	Maximum Allowable PSD Increment
SO ₂	3-Hour	0 (3 6, 310)	176 8 (3 6, 310)	512
	24-Hour	0 (3 0, 280)	49 4 (3 0, 280)	91
	Annual	0 527 (3 5, 270)	3 98 (3 5, 270)	20
NO ₂	Annual	4 42 (0 25, 100)	6 53 (0 25, 100)	25

Notes All concentrations are in $\mu\text{g}/\text{m}^3$

Shown within parentheses are distance (km) and direction (degrees)
relative to ICL main boiler stack

Table 5-8
PSD SIGNIFICANT MONITORING CONCENTRATIONS FOR EXEMPTION AND
CORRESPONDING MODELED IMPACTS FOR THE PROPOSED ICL PLANT

Pollutant	Averaging Time	Significant Concentration ^a ($\mu\text{g}/\text{m}^3$)	Modeled Concentration ^b ($\mu\text{g}/\text{m}^3$)
Carbon Monoxide	8-Hour	575	50.9
Nitrogen Dioxide	Annual	14	4.42
Sulfur Dioxide	24-Hour	13	11.6
TSP	24-Hour	10	3.3
PM-10	24-Hour	10	3.3
Ozone	d	--	--
Lead	3-Month	0.1	0.0003 ^{e,f}
Asbestos	g	--	0.0 ^h
Beryllium	24-Hour	0.001	< 0.001 ⁱ
Mercury	24-Hour	0.25	< 0.001 ^{f,j}
Vinyl Chloride	24-Hour	15	0.0 ^h
Fluorides	24-Hour	0.25	0.05
Sulfuric Acid Mist	24-Hour ⁹	--	0.014 ^f
Total Reduced Sulfur	k	--	0.0 ^h
Reduced Sulfur	k	--	0.0 ^h
Hydrogen Sulfide	1-Hour	0.2	0.0 ^h
Benzene	l	--	0.0 ^h
Radionuclides	l	--	--
Radon 222	l	--	--
Arsenic	8-Hour ^l	--	0.0039

Table 5-8 (Continued)

- a - Source PSD Monitoring Guidelines (Table A-2) (EPA, 1987)
- b - Except as noted, based on maximum annual average concentration, or highest second-highest 24-hour average, or maximum 1-hour average
- d - No specific concentration for ozone is prescribed. Exemptions are granted when a source's VOC are < 100 tons/year
- e - The 3-month average concentration for lead was not estimated because the maximum 24-hour average value was about 300 times less than the corresponding 3-month significance level
- f - Under the PSD regulations, an air quality impact analysis is not required for this pollutant because its emission is below the applicable significance level
- g - No acceptable monitoring techniques available at this time. Therefore, monitoring is not required until acceptable techniques are available
- h - No impacts. There are no emissions expected for this pollutant
- i - The maximum 24-hour average concentration for beryllium is 4.75×10^{-5} ug/m³, about 20 times less than the corresponding significance level
- j - The maximum 24-hour average concentration for mercury is 1.44×10^{-4} ug/m³, about 10 times less than the corresponding significance level
- k - No acceptable monitoring techniques available at this time. However, techniques are expected to be available shortly
- l - No monitoring techniques, significant concentration, or averaging period specified in the PSD Monitoring Guidelines

Table 5-9
FDER AIR QUALITY MONITORING SITES USED FOR THE
ICL PLANT VICINITY

County	Site ID	TSP	SO ₂	NO ₂	CO	O ₃
Palm Beach	017 J02		x			
	003 G02		x			
	004 G02		x			
	004 G01	x		x	x	
	006 G03					x
	007 G01					x
	004 J02	x				
	005 J02	x				
	006 J02	x				
	006 J09	x				
	007 G01	x				
	001 G01	x				
	002 G01	x				
	003 G01	x				
	001 G01	x				
	002 J03	x				
	005 G01	x				
	006 G01	x				
	008 J02	x				
	009 J02	x				
	010 J02	x				
	011 J02	x				
	012 J02	x				
	013 J02	x				
	014 J02	x				
	015 J02	x				
	001 G01	x				
	003 G01	x				
	002 J02	x				
Martin	004 F02	x				
	002 F01	x				
	002 G01	x				
	002 G09	x				
Hendry	003 G01	x				
	002 F01	x				
Highlands	002 J02	x				
	001 F03	x				
Okeechobee	002 F03	x				
St Lucie	004 F01	x				
	004 F09	x				
	009 F02	x				
	001 F01	x				
	001 F09	x				

Source FDER, 1987, 1988, 1989

Table 5-10
SUMMARY OF FDER AIR QUALITY DATA FOR THE ICL SITE VICINITY

Pollutant	County	Averaging Period	Maximum Concentration			NAAQS	FAAQS
			1987	1988	1989		
SO ₂ (a)	Palm Beach	3-hr	52	58	68	1300	1300
		24-hr	12	11	27	365	260
		Annual	3	3	8	80	0
	Palm	1-hr	152	137	117	-	-
		Annual	22	25	24	100	100
CO(b)	Palm Beach	1-hr	6	7	7	35	35
		8-hr	4	5	4	9	9
Ozone(b)	Palm Beach	1-hr	0 091	0 107	0 106	0 12	0 12
TSP(a)	Palm Beach	24-hr	251	250(e)	161	260(c)	150
		Annual	50	50	128	75(d)	60
	Hendry	24-hr	650	576(f)	73	260	150
		Annual	42	36	47	75	60
	Highlands	24-hr	50	143	35	260	150
		Annual	20	20	26	7560	
	Martin	24-hr	98	103	78	260	150
		Annual	39	39	40	75	60
	Okeechobee	24-hr	52	72	105	260	150
		Annual	26	26	28	75	60
	St Lucie	24-hr	457	189(g)	219	260	150
		Annual	72	67(g)	82	75	60
PM-10(a)	Palm Beach	24-hr	-	-	78	150	150
		Annual	-	-	33	50	50
		24-hr	-	-	65	150	150
		Annual	-	-	23	50	50

(a) Concentration in $\mu\text{g}/\text{m}^3$

(b) Concentration in ppm

(c) Primary standard specified with a secondary standard of $150 \mu\text{g}/\text{m}^3$

Table 5-10 (Continued)

- (d) Primary standard specified with a secondary standard of $60 \mu\text{g}/\text{m}^3$
- (e) FDER indicated that this exceedance was caused by a fugitive dust event associated with a sugar cane transfer station operated 12/17/88 (Source Martin CG/CC PSD Application, 1989)
- (f) FDER indicated that this exceedance was caused by reentrained particulate matter due to sugar cane harvesting activities and occurred on 12/17/88 (Source Martin CG/CC PSD Application, 1989)
- (g) FDER indicated that these exceedances were due to fugitive dust from a nearby cement plant and an asphalt plant and heavy vehicle traffic on 8/1/88 (Source Martin CG/CC PSD Application, 1989)

Table 5-11
FPL HISTORICAL AIR QUALITY MONITORING DATA FOR THE
MARTIN SITE VICINITY (1973-1988)

Pollutant	Averaging Period	Station Number	Concen (a) ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	FAAQS ($\mu\text{g}/\text{m}^3$)
SO ₂	3-Hour	5	105	1,300	1,300
	24-Hour	5	61	365	260
	Annual	6	8	80	60
NO ₂	24-Hour	1	158	-	-
	Annual	5	16	100	100
TSP	24-Hour	3	200(c)	150(b)	150
	Annual	-	N/A	60(b)	60

(a) Highest concentration

(b) Federal secondary standard

(c) This exceedance occurred in 1986 and is considered uncharacteristic of the overall TSP monitoring data recorded for the Martin site

Source FPL Martin CG/CC PSD Application, 1989

Table 5-12
FPL MARTIN CG/CC PROJECT ON-SITE AIR QUALITY
MONITORING DATA (OCTOBER 1988 THROUGH SEPTEMBER 1989)

Pollutant	Averaging Period	Monitored Concen ($\mu\text{g}/\text{m}^3$)	Site	NAAQS ($\mu\text{g}/\text{m}^3$)	FAAQS ($\mu\text{g}/\text{m}^3$)
SO ₂	3-Hour	61	East	1300	1300
	24-Hour	12 6	East	365	260
	Annual	1 3	East	80	60
NO ₂	1-Hour	62	West	-	-
	Annual	5 4	East	100	100
Ozone	1-Hour	165	East	235	235
	Annual	47	Both	-	-
PM-10	24-Hour	39	East	150	150
	Annual	13 3	West	50	50

Sources

FPL Martin CG/CC PSD Application, 1989

Envirosphere Company, Final Data Report for Martin CG/CC, 1989

Table 5-13
BACKGROUND AIR QUALITY LEVELS FOR THE ICL SITE
VICINITY

Pollutant	Averaging Period	Monitored Concen ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	FAAQS ($\mu\text{g}/\text{m}^3$)
$\text{SO}_2^{(1)}$	3-Hour	61	1,300	1,300
	24-Hour	12 6	365	260
	Annual	1 3	80	60
$\text{NO}_2^{(1)}$	1-Hour	62	-	-
	Annual	5 4	100	100
$\text{PM-10}^{(1)}$	24-Hour	39	150	150
	Annual	13 3	50	50
$\text{TSP}^{(2)}$	24-Hour	105	260	150
	Annual	40	75	60
$\text{CO}^{(3)}$	1-Hour	7	35	35
	8-Hour	5	9	9

Sources

- (1) FPL Martin CG/CC PSD Monitors, 1989
- (2) FDER monitors at Martin and Okeechobee, highest recorded among the two stations within 3 years (1987-1989)
- (3) FDER monitor at Palm Beach, concentration in ppm

Table 5-14
INTERACTIVE BACKGROUND SO₂ IMPACTS
(Including ICL Stack Sources)

Year	Annual	3-hour	24-hour
1982	6.88 (4.25, 170)	182.0 (4.1, 300)	43.5 (0.6, 310)
1983	5.98 (0.25, 110)	179.5 (4.2, 300)	48.5 (4.25, 180)
1984	6.27 (4.25, 180)	167.1 (4.25, 290)	37.7 (4.2, 180)
1985	6.21 (0.25, 100)	162.4 (4.0, 310)	37.6 (4.25, 150)
1986	5.71 (4.25, 180)	159.9 (0.8, 270)	37.0 (1.0, 240)

Notes: Concentrations are in $\mu\text{g}/\text{m}^3$

Shown within parentheses are distance (km) and direction (degree) relative to ICL main boiler stack

Table 5-15
INTERACTIVE BACKGROUND NO₂ IMPACTS
(Including ICL Stack Sources)

Year	Annual	Distance (m)	Direction (degree)
1982	5 58	600	320
1983	5 71	250	110
1984	5 07	250	120
1985	6 10	250	100
1986	5 33	250	110

Notes Concentrations are in $\mu\text{g}/\text{m}^3$

**Table 5-16
SUMMARY OF AIR QUALITY ANALYSIS**

Pollutant	Averaging Period	Year (Julian Day, Period)	ICL Sources	Interactive Background Sources	Monitored Background ($\mu\text{g}/\text{m}^3$)	Total Impact ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	FAAQS ($\mu\text{g}/\text{m}^3$)
SO ₂	3-Hour	1982 (164,4)	0 0	182 0	61 0	243	1,300	1,300
	24-Hour	1983 (96)	0 0	48 5	12 6	61 1	365	260
	Annual	1982	0 11	6 77	1 3	8 18	80	60
NO ₂	Annual	1985	4 42	1 68	5 4	11 5	100	100
PM ^a	24-Hour	1986 (164)	3 3	None	39 0	42 3	150	150
	Annual	1982	0 26	None	13 3	13 56	50	50
CO	1-Hour	1983 (11,11)	78 2	None	8,001	8,079 2	40,000	40,000
	8-Hour	1985 (21,1)	50 9	None	5,715	5,765 9	10,000	10,000

a - Stack and fugitive emissions combined

6 0 VISIBILITY IMPACT ANALYSIS

An analysis was performed to assess the degree of visibility impairment to the nearest PSD Class I Area (Everglades National Park) associated with operation of the proposed ICL. The analysis was made in accordance with technical guidance provided in the Workbook For Plume Visual Impact Screening and Analysis (EPA, 1988b), as discussed in Section 3.6. Specifically, this evaluation quantified the visual impairment in terms of atmospheric discoloration from NO_x , particulates, and secondary aerosols and the visual range reduction (increased haze) from particulates and sulfates.

6 1 MODEL INPUT

The VISCREEN model was used to assess visibility impacts. Model inputs include particulate and NO_x stack emissions, distance from the ICL plant to the impact area, source-observer distance, the typical background visual range, and the hypothetical worst case meteorological conditions. These inputs are summarized as follows:

- | | |
|-----------------------------|----------------------------|
| o Maximum Stack Emissions | |
| Particulates | 61.65 lb/hr |
| NO_x | 582.6 lb/hr |
| o Background Visual Range | 40 km (EPA, 1980, p. 59) |
| o Distance to Everglades NP | 140 km (minimum distance) |
| o Meteorological Conditions | Pasquill Stability Class F |
| | Wind Speed = 1 m/s |

6 2 IMPACT ASSESSMENT

Using the data described above, the Level-1 model generates critical indexes for plume perceptibility (Delta E) and plume contrast against the sky or terrain.

If the absolute value of any one of these indexes is greater than 2 or 0.5 for Delta E or plume contrast, respectively, the emission source fails the Level-1 visibility screening test and continued evaluation using the Level-2 procedure is necessary. Results of the Level-1 visibility screening test are discussed in this section.

Emissions from the proposed ICL plant will be reduced by pollution control equipment such that only SO_2 and NO_2 have significant impact areas within 4.25 km and 4.5 km radii from the main stack, respectively. In addition, the opacity of emissions from the facility are limited to 20 percent. Therefore, impairment to visibility in the Everglades National Park, which is about 145 km to the south of the proposed facility, is expected to be minimal. However, the Class I visibility analysis has been made to demonstrate that no significant effects will be observed.

Various VISCREEN runs were also made to identify the optimum source-observer distance so that maximum visual impacts inside and outside the Class I area do not exceed the screening criteria. Two screening runs shown in Tables 6-1(a) and (b) are with different source-observer distances, 60 and 65 km, respectively. Table 6-1(b) shows that the optimum source-observer distance is 65 km. Since all of the indexes are below the corresponding screening limits, the proposed ICL plant passes the Level-1 visibility screening test. This indicates that, when operational, the facility will have insignificant visibility impairment during the worst meteorological conditions and that no significant visibility impairment will be observed in the Everglades National Park.

Table 6-1(a)
VISUAL EFFECTS SCREENING ANALYSIS FOR
SOURCE INDIANTOWN COGENERATION
CLASS I AREA EVERGLADES NATIONAL PARK

*** Level-1 Screening ***

Input Emissions for

Particulates	61 65	lb/hr
NO _x (as NO ₂)	582 60	lb/hr
Primary NO ₂	00	lb/hr
Soot	00	lb/hr
Primary SO ₄	00	lb/hr

**** Default Particle Characteristics Assumed

Transport Scenario Specifications

Background Ozone	04 ppm
Background Visual Range	40 00 km
Source-Observer Distance	60 00 km
Min Source-Class I Distance	140 00 km
Max Source-Class I Distance	145 00 km
Plume-Source-Observer Angle	11 25 degrees
Stability	6
Wind Speed	1 00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
 Screening Criteria ARE NOT Exceeded

Backgrnd	Theta	Azi	Distance	Alpha	<u>Delta E</u>		<u>Contrast</u>	
					Crit	Plume	Crit	Plume
SKY	10	161	140 0	8	2 00	002	05	000
SKY	140	161	140 0	8	2 00	001	05	000
TERRAIN	10	161	140 0	8	2 00	006	05	000
TERRAIN	140	161	140 0	8	2 00	002	05	000

Table 6-1(a) (Continued)

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE Exceeded

Backgrnd	Theta	Azi	Distance	Alpha	<u>Delta E</u>		<u>Contrast</u>	
					Crit	Plume	Crit	Plume
SKY	10	60	54.9	109	2.00	2.480*	05	-004
SKY	140	60	54.9	109	2.00	862	05	-017
TERRAIN	10	45	51.0	124	2.00	508	05	008
TERRAIN	140	45	51.0	124	2.00	156	05	007

Table 6-1(b)
VISUAL EFFECTS SCREENING ANALYSIS FOR
SOURCE INDIANTOWN COGENERATION
CLASS I AREA EVERGLADES NATIONAL PARK

*** Level-1 Screening ***

Input Emissions for

Particulates	61 65	lb/hr
NO _x (as NO ₂)	582 60	lb/hr
Primary NO ₂	00	lb/hr
Soot	00	lb/hr
Primary SO ₄	00	lb/hr

**** Default Particle Characteristics Assumed

Transport Scenario Specifications

Background Ozone	04 ppm
Background Visual Range	40 00 km
Source-Observer Distance	60 00 km
Min Source-Class I Distance	140 00 km
Max Source-Class I Distance	145 00 km
Plume-Source-Observer Angle	11 25 degrees
Stability	6
Wind Speed	1 00 m/s

R E S U L T S

Asterisks (*) indicate plume impacts that exceed screening criteria

Maximum Visual Impacts INSIDE Class I Area
 Screening Criteria ARE NOT Exceeded

Backgrnd	Theta	Azi	Distance	Alpha	<u>Delta E</u>		<u>Contrast</u>	
					Crit	Plume	Crit	Plume
SKY	10	159	140 0	9	2 00	003	05	000
SKY	140	159	140 0	9	2 00	002	05	000
TERRAIN	10	159	140 0	9	2 00	008	05	000
TERRAIN	140	159	140 0	9	2 00	002	05	000

Table 6-1(b) (Continued)

Maximum Visual Impacts OUTSIDE Class I Area
Screening Criteria ARE NOT Exceeded

Backgrnd	Theta	Azi	Distance	Alpha	<u>Delta E</u>		<u>Contrast</u>	
					Crit	Plume	Crit	Plume
SKY	10	65	60.6	104	2.00	1.971	05	-003
SKY	140	65	60.6	104	2.00	.682	05	-013
TERRAIN	10	50	56.8	119	2.00	.374	05	006
TERRAIN	140	50	56.8	119	2.00	.113	05	005

7 0 OTHER AIR-QUALITY-RELATED IMPACTS

7 1 POTENTIAL GROWTH IMPACTS

7 1 1 CURRENT LAND USE IN THE AREA

The proposed site is to be located 9 miles east of Lake Okeechobee within Indiantown Township, Martin County, Florida. The site is southwest of and abuts the Caulkins Citrus Processing Plant and the Florida Steel Corporation Indiantown steel mill property.

The site is currently zoned as industrial but has historically been used for agricultural purposes (grazing cows). This is consistent with the area surrounding the site as well. An aerial survey of the site area revealed patterns associated with a rural agricultural land use, multiple wetlands, and a few isolated rural residential pockets and industrial facilities. No areas of special value, scenic vistas, or recreational areas exist within the immediate site area.

7 1 2 PROJECTED GROWTH

The proposed facility will be capable of producing up to 225,000 pounds per hour of steam that will be sold to the Caulkins Citrus Processing Plant for use in its facility immediately to the northeast. The electric power that will be produced will be sold to FPL.

Construction of the proposed facility will require a work force averaging approximately 800 workers over an approximately 42-month period. An adequate work force now exists in an area of about 60-100 miles around the site to support this construction without importation of workers. As a result, there is very little projected influx of workers into any adjacent communities. A few workers will be expected to relocate temporarily during construction, and there will be some permanent relocation associated with operation. However, these numbers will be within planned area growth projections and will not be the cause of any increased development.

7 1 3 POTENTIAL IMPACTS

Minimal associated growth is anticipated as a result of the construction and eventual operation of the ICL plant and is within the growth projected to occur within the area. As a result, no air-quality-related impacts directly attributable to the growth associated with the proposed plant are anticipated. Conversely, the construction and operation of the plant will eliminate the agricultural activity that currently occurs on the site.

7 2 POTENTIAL IMPACTS ON SOILS AND VEGETATION

Section 7 1 1 briefly discusses existing land use patterns found in the site area. As is stated in that section, the area is relatively rural and exhibits a mixed pattern of agricultural use for grazing and citrus groves, rural residential, industrial development and undeveloped woodland, open field, and wetland.

The 232-acre site is characterized by three vegetation communities: pine flatwoods, freshwater marsh (wet prairie), and ruderal lands (disturbed). Pine flatwoods occupy approximately 200.7 acres (87 percent), freshwater marsh and ditch occupy 23.3 acres (10 percent), ruderal lands (roads, trails, clearings, and existing transmission corridor) are found on approximately 8 acres (3 percent of the site).

7 2 1 SOILS

Soils are capable of removing sulfur dioxide and nitrogen dioxide directly from the atmosphere (Abeles, et al., 1971, Ghiorse and Alexander, 1976). Calculations indicate that soils in the United States have the capacity to accommodate the total sulfur dioxide and nitrogen oxide production rate current in the United States (Mudd and Kozlowski, 1975). Sulfur dioxide, when absorbed by the soil, is primarily converted to sulfite and sulfate, however, some may also be converted to organic sulfur. Nitrogen dioxide absorbed by the soil is likewise converted to nitrite and nitrates. This conversion, in contrast to that occurring with the sulfur compounds, may be aided by nitrifying micro-organisms in the soil (Ghiorse and Alexander, 1976). Nitrogen, in contrast to sulfur, is also a primary plant nutrient.

The primary effect of sulfur dioxide and nitrogen dioxide deposition and absorption by soils is the resultant lowering of the soil pH. Low soil pH will have an influence on most chemical and biological reactions in the soil. It accelerates mineral weathering and the release of phytotoxic ions to the soil solution. It will affect the migration of clay and organic materials down through the soil-profile development process, and it will affect the level and availability of most plant nutrients in the soil solution.

Aluminum and manganese mobility is also a primary area of concern, relative to heightened soil acidity. The presence of soluble aluminum in the soil is generally a result of acid weathering of clay materials. The solubility of soil minerals at low pH is of considerable importance to plant growth and is also a consideration when assessing the potential for the transport of ions to aquatic systems. Heavy metals that may be present in the soil will also be more readily available for uptake by vegetation at lower soil pH levels.

Trace elements absorbed to particulates emitted from coal-fired power plants reach soils by direct deposition, the washing of plant or any other particulate intercepting surfaces by rainfall, and the decomposition of plant litter. The potential for toxicity from particulate deposition on soils depends on the specific elements present and whether or not those elements are present in the soil in states that can be readily absorbed and assimilated by rooted growing plants. This availability is dependent

on a variety of factors, including the physicochemical properties of the trace elements, the soil chemistry, the vegetation present, the biological characteristics of the soil, and any other affecting environmental parameter, such as temperature and precipitation

Considerable work has been done on the effects of carbon monoxide on man and animals, however, little has been done in regard to potential impacts to soils and vegetation. It is known that soil micro-organisms will use carbon monoxide as a carbon source (Bennett and Hill, 1950)

Site Soils

According to the Martin County Soil Survey, soils on the proposed ICL site include Lawnwood fine sand, Lawnwood fine sand, depressional, Waveland sand, Waveland sand, depressional, Basinger fine sand, Basinger fine sand, depressional, Sanibel muck, and Placid sand

The three most common soil types are Waveland sand, Lawnwood fine sand, and Basinger fine sand. All are nearly level, poorly drained soils supporting pine flatwoods. The remaining soil types are hydric soils associated with the wet prairies. These are nearly level, poorly drained soils of depressions in the flatwoods. These soils are ponded for 6 or more months of the year.

Potential Impacts to Soils

Particulate deposition may affect soils by altering pH and by potentially increasing the availability of heavy metals in the soil for plant uptake. It has also been determined that uptake by vegetation will not increase dramatically unless the deposited trace elements were considerably more available than the endogenous forms. Those levels are projected not to be surpassed. In regard to the sizes of the deposited particles and the relationship of that particle size distribution to potential impacts, if it can be determined that the impact to soils of the total particulate deposition is insignificant, then the related impact of a portion of that total (particles less than 10 microns in diameter, or PM-10) would likewise be insignificant.

As to the potential for impact from emissions of carbon monoxide, the levels expected from the proposed plant (see Section 5.1.3) will not result in the potential for any significant adverse impacts to soils in the site area.

7.2.2 VEGETATION

This section discusses the potential for detrimental effects to vegetation associated with operation of the proposed ICL plant. General information concerning the variability of plant response to air pollution, types of injury, and characteristics of injury is presented to establish a background for consideration of the results of the analysis. Background land use and vegetational data are discussed to establish

which plant species are to be considered in the analysis. Specific data relating to the sensitivity of important plants to SO₂, NO₂, and particulates is also provided.

The response of individual plant species to air pollutants varies not only with the concentration to which they are exposed and the duration of exposure, but with a wide range of environmental, physiological, and genetic factors as well. For example, SO₂ injury may be less likely for a plant's growth in sulfur-deficient soils. Under these conditions, SO₂ may even have a fertilizing effect (EPA, 1976). In general, factors which enhance plant growth may also increase injury.

The effects of air pollutants on vegetation can be placed into three broad categories: acute, chronic, and long-term. In the first case, injury is due to exposure to high concentrations over a relatively short period of time. Chronic injury is the result of exposure to relatively low concentrations over a longer period of time, whereas long-term injury includes abnormal changes in ecosystems and subtle physiological alterations of plants. Effects can be caused by both direct exposure to air pollutants and secondary factors such as changes in soil pH (FWS, 1978).

Air pollution may also affect entire ecosystems, as well as individual plants (Smith, 1974). Effects will, of course, vary, depending upon the pollutant load to which the system is subjected and the ecosystem in question.

Site Vegetation

Approximately 200 acres of pine flatwoods and 24 acres of wet prairie and ditch are present on the proposed plant site. An additional 8 acres of ruderal or disturbed land also occur within the proposed site as an existing transmission line right-of-way, clearings, roads, and trails. The ruderal land component of the proposed site contains a diverse array of opportunistic weedy plants, such as common ragweed, bahia grass, beggar's ticks, and dropseeds.

The wet prairies/wetlands on the project site vary slightly in size, configuration, topographic relief, and hydroperiod. These natural features tend to regulate species composition and structure, together with other environmental factors such as drainage, rainfall, cattle/hog perturbations, edaphic conditions, and exotic species invasion. For comparative purposes, two hydrologically isolated wet prairies were sampled: a 0.45-acre, shallow depression located in the northeastern corner of the site and an 8.16-acre, deeper wetland located in the center of the property.

Both of the wet prairies sampled were relatively undisturbed. The smaller wet prairie was dominated by big carpetweed, blue maidencane, and bushy goldenrod, in order of magnitude. These three species are indicative of a transitional hydroperiod (i.e., dry most of the year with saturated to inundated conditions seasonally). The surface soil within the depression was dry at the ground surface during the sampling period. Species composition was uniform across the relatively flat system.

The larger wetland was moist at the upland/wetland interface (saw palmetto edge) and contained 6 to 14 inches of water in the center. Transitional wetland species occurred in a somewhat homogeneous fashion along the more landward reaches of the wetland. However, the ponded center of the wetland supported more obligate hydrophytes, such as pickerelweed, maidencane, frog's-bit, and mermaid's weed.

The zonation of obligate and facultative wetland species within the wetland conformed to the hydroperiod and soil types. The center of the wetland is ponded for 2 to 6 months in the rainy season and has a poorly drained, organic surface layer (Sanibel muck), while the wetland fringe is drier and is supported by a more sandy, poorly drained hydric soil (Lawnwood fine sand, depressionnal). The dominant wetland species of the larger wet prairie included blue maidencane, big carpetweed, shortspike bluestem, and maidencane, in order of magnitude.

The physiognomy of the pine flatwoods was rather homogeneous throughout. The herbaceous layer was dominated by wiregrass and other typical flatwoods species such as broomsedge, bottlebrush threeawn, dichanthelium grass, St. John's wort, and gallberry seedlings.

The shrub strata was dominated by the conspicuous saw palmetto. Woody components of the shrub layer in order of magnitude include gallberry, staggerbush, dwarf live oak, pawpaw, and tarflower. The canopy was open and consisted solely of south Florida slash pine. The south Florida slash pine sampled ranged in diameter-at-breast-height from 4 to 16.5 inches.

Potential Impacts to Vegetation from SO₂ Emissions

Since research on acute effects of SO₂ on vegetation has been carried out for a number of years, it is possible to classify various plants with respect to their sensitivity to this pollutant (FWS, 1978). Plants have been ranked as sensitive, intermediate, or resistant in this regard. Table 7-1 lists the sensitivity of 47 plants, trees, and important agricultural crops which have been identified as sensitive to SO₂ emission. Dose-response curves have been presented for each sensitivity class and may be used to determine the possibility of SO₂ injury (see Figures 7-1 to 7-3). As noted in the figures, the lowest 3-hour concentration expected to cause injury or damage to sensitive vegetation is about 0.15 ppm (390 µg/m³).

The highest second-highest incremental 3-hour ground-level SO₂ concentration predicted to result from operation of the ICL plant is 24.7 µg/m³, occurring 0.25 km east of the site (see Section 5.3.2). Since this concentration is well below threshold values for sensitive species, it is not expected to result in vegetation injury. Even considering the combined 3-hour maximum impact (ICL + interactive background sources + monitored background), the concentration is 242 µg/m³ which is only about 62 percent of the injury threshold level (390 µg/m³) for sensitive vegetation.

Potential Impacts to Vegetation from NO₂ Emissions

Of the various oxides of nitrogen, NO and NO₂ are important air pollutants. In relation to air pollution injury to vegetation, NO₂ is of primary concern, since NO is oxidized to NO₂ in the atmosphere. While the database is not as extensive for NO₂ as for SO₂, plant sensitivity ratings have nonetheless been developed for this pollutant (EPA, 1976). As with SO₂ response, plants have been ranked as sensitive, intermediate, or resistant with respect to their susceptibility to injury from NO₂. Table 7-2 categorizes plants which are important agricultural or forest species, with respect to NO₂ sensitivity.

A dose-response curve has also been developed for NO₂, this may be used to determine the possibility of injury to vegetation (Figure 7-4). As shown in the figure, threshold levels for 3-hour and 24-hour exposures are about 1.0 and 0.4 ppm (1,890 and 750 µg/m³), respectively. The maximum 3-hour and 24-hour NO₂ impacts calculated for the ICL area are 95 and 44.5 µg/m³, respectively. Since the maximum expected levels are several orders of magnitude below the threshold levels, no injury to vegetation from this pollutant is expected.

Potential Impacts to Vegetation from Particulate Emissions (TSP/PM₁₀)

In comparison with the effects of SO₂ and NO₂ on plants, less is known concerning particulate matter. Particulate matter varies greatly in size and chemical composition. However, most studies fail to define one or both of these parameters when discussing effects on vegetation. Thus, dose-response curves, such as those utilized for SO₂ and NO₂, have not been generated.

Studies relating to particulates have addressed a number of pollutant sources and specific particles, however, most data pertain primarily to the effects of settleable dusts. Studies have shown that cement kiln dust, which is higher in lime than coal combustion particulates (Jones, et al., 1979), does have an effect on both fir trees and bean plants (Mudd and Kozlowski, 1975; Darley, 1966). Limestone dust in concentrations averaging 824 µg/m³ has also been shown to affect tree growth, disease susceptibility of plants, and forest composition (Brandt and Rhodes, 1972, 1973; Manning, 1971). This average concentration, however, is several times greater than either of the applicable federal or state particulate standards to which the plant will be held (see Table 2-5). The highest second-highest predicted 24-hour ground level concentration from the ICL facility is 3.3 µg/m³ (for TSP) at the site boundary (42.3 µg/m³ with background) (see Section 5.3.2). It can therefore be concluded that particulate emissions from the ICL plant are not anticipated to cause injury in vegetation.

As with impacts to soils, the fact that impacts to vegetation are expected to be insignificant from deposition of all potential particulate emissions supports the expectation that impacts from the deposition particles in the PM-10 size range will likewise be insignificant.

Potential Impacts to Vegetation from CO Emissions

In comparison with other pollutants, relatively little research has been accomplished regarding the effects of CO on vegetation. Available information indicates that a potential does exist for impacts to vegetation, but only at levels of concentration far in excess of those expected from operation of the ICL. The maximum incremental 1-hour CO concentration expected is $78.2 \mu\text{g}/\text{m}^3$. At this level, vegetation damage is not anticipated. Furthermore, soil micro-organisms can use carbon monoxide as a carbon source (Bennett and Hill, 1950).

7.3 COOLING TOWER IMPACTS

This section addresses impacts associated with the operation of the ICL cooling tower. Potential effects of long-term salt deposition, due to cooling tower drift, on nearby soils and vegetation are discussed. Additionally, climatological impacts (i.e., enhanced potential for fogging and icing conditions) in the site vicinity are also summarized.

General tower design and performance data are provided, as well as input to the cooling tower drift model used for these analyses (see Section 3.7.3). The results from these analyses are summarized in the following subsections.

7.3.1 COOLING TOWER DESIGN

A mechanical draft, counter-flow cooling tower with a bank of 10 cells is proposed to meet the closed-loop cooling requirements of the ICL plant. Design data for the cooling tower are presented in Table 7-3. The drift rate of the proposed cooling tower is 0.002 percent, or 5.3 gpm. The total dissolved solids of the system is about 2,800 milligrams per liter (mg/l).

7.3.2 MODEL INPUT

The SACTI mathematical model (see Section 3.7.3) incorporates the tower performance, which relates exit air temperature to ambient wet bulb temperature, and drift rate, which is expressed as a percentage of the total circulating water flow, as discussed above. The model also requires a drift droplet size distribution. The distribution input to the model is based on a study of mathematical models that characterize plume and drift behavior from cooling towers (EPRI, 1980), and is listed in Table 7-4.

Meteorological data used by the model were from the NWS station in West Palm Beach, (see Section 4.3). To assess the impacts of cooling tower operation with respect to salt deposition rates and enhanced fogging and icing conditions in the site vicinity, a 5-year composite meteorological data set (1982-1986) from West Palm Beach was used.

The SACTI model calculations used a polar coordinate receptor grid system. The grid system was centered on the center cell of the proposed cooling tower.

Receptors were placed at 22.5-degree intervals at downwind distances ranging from 0.1 to 10 km at successive 100-meter intervals for salt deposition estimates. For the visible plume analysis, receptors ranged from 50 to 5,000 m at successive intervals of 50 meters.

7.3.3 IMPACT ASSESSMENTS

The environmental impacts addressed include an assessment of the potential effects on nearby soils and vegetation from salt drift deposition. Climatological impacts are discussed in terms of the potential for enhanced fogging and icing in the vicinity of the plant and possible related impacts to traffic.

Soil/Vegetation Impacts

Seasonal and annual salt deposition rates were calculated in units of $\text{kg}/\text{km}^2/\text{month}$. By applying a factor of 0.0089, this unit can be converted to $\text{lb}/\text{acre}/\text{month}$. Table 7-5 shows that the majority of the drift is deposited on site, within 100 meters of the cooling tower on an annual basis. The maximum off-site salt deposition rate is about 18.1 $\text{lb}/\text{acre}/\text{month}$. This value occurs 200 m north of the cooling tower during the summer season. The Caulkins Citrus Processing Plant and Florida Steel Corporation are located to the north and east of the ICL cooling tower, respectively, thus, the maximum off-site salt deposition rate occurs within the Caulkins Citrus property. Beyond the property boundaries of the neighboring facilities, the maximum salt deposition rate in all directions is 2.8 $\text{lb}/\text{acre}/\text{month}$, occurring 600 m to the west of the cooling tower. This maximum impact occurred during the fall season.

One mechanism for the impact of saline drift on plants is through the absorption of salt accumulated in the soil. Accumulation will occur if the annual deposition of salt exceeds the rate at which salt is washed from the soil by rainfall. The results of studies (MPPSP, 1979, pp. 4-18 to 4-23) with sandy loam soil suggest that a deposition rate of about 89 $\text{lb}/\text{acre}/\text{month}$ (100 $\text{kg}/\text{Ha}/\text{month}$) of NaCl can cause some accumulation of salt in the soil. As stated above, the maximum off-site salt deposition rate is 18.1 $\text{lb}/\text{acre}/\text{month}$. This value is much lower than the monthly threshold value that causes salt accumulation in soil. Therefore, no significant soil impacts are expected. The annual average rainfall rate at the ICL site area is considerably higher than the Chalk Point, Maryland area in the quoted study. Therefore, the threshold value used in the analysis is conservative.

Direct salt damage to vegetation is due to the absorption of salt from drift that is deposited on a plant's leaves. The absorbed salt can cause immediate damage or accumulate in the woody tissue of perennial plants until it reaches toxic levels.

An investigation of the potential effects of cooling tower drift on vegetation was conducted in which predicted salt deposition rates (i.e., an estimated amount of salt deposited over a unit area per season and year at a certain direction and "distance" away from the tower) were compared to available salt injury thresholds.

Near the edge of the proposed power plant site boundary, salt deposition rates on an annual basis (i.e., the equivalent rate in lb/acre/month times 12 months per year) range from 0.42 to 216.9 lb/acre/year. The greatest concentrations are generally located to the north and east of the proposed power plant, where existing industrial facilities are located. Citrus, a potentially sensitive plant to salt deposition, is present in large groves from the south-southeast clockwise through the southwest and also to the northwest of the cooling tower. The closest groves are about 4,000 feet to the southwest and about 4,200 feet to the south of the cooling tower. At these locations the highest levels of salt deposition over an annual period are about 0.6 lb/acre/year and 1.1 lb/acre/year, respectively, this should not result in any significant foliar, shoot, or fruit damage or any long-term reductions in growth, yield, or photosynthesis.

Cooling tower drift will also deposit salt on the surrounding improved pasture, truck crops, dairy farms, and sugar cane agricultural land and in the area around the proposed cogeneration plant site, but at distances from the tower much greater than to the citrus groves. The agricultural land around the proposed plant should not be affected by these emissions, since the maximum amount of salt deposited will only amount to about 1 lb/acre/year at the closest distance to agriculture near the site (i.e., the citrus groves). A cautionary limit of 100 lb/acre/year can be used for agricultural areas based upon known salt injury thresholds to crops, e.g., tobacco, 214 lb/acre/year, corn, 107 lb/acre/year, and soybean, 107-154 lb/acre/year (Mulchi, Wolf, and Armbruster, 1978). Therefore, the proposed plant operation would not cause the cautionary limit to be approached or exceeded within agricultural areas.

Based upon a literature review, one of the most sensitive native plant species to salt injury is flowering dogwood (*Cornus florida*). The lowest injury threshold for flowering dogwood is reported at 81 lb/acre/year (Curtis, *et al.*, 1978). Although flowering dogwood is only naturally occurring much further north of Martin County, a similar dogwood species, stiff cornell (*Cornus foemina*) would be expected within the mixed and cypress swamps in the immediate area (approximately 2,900 feet southeast of the cooling tower).

On the basis of the reported injury threshold and a predicted maximum annual salt deposition rate of 2.7 lb/acre/year in the vicinity of forested wetlands offsite, no adverse effects to dogwood or other indigenous vegetation is expected at this location. Native vegetation associated with pine and wet prairies does occur on the site and along property boundaries. Salt deposition could, at a maximum, range from 172.8 to 216.9 lb/acre/year on the northern property boundary and at higher rates within the site, possibly resulting in plant injury. Furthermore, the "units" of the modeling results shown in Table 7-5 (whether kg/km²/month or lb/acre/month) imply that the deposition rate value applies uniformly over the entire unit area, for example, a square kilometer. However, the value is actually determined for the specific receptor point, if the rate of deposition at the point were the same over the entire unit area, then the reported value would result. But, as the values in Table 7-5 show, there is a large gradient in deposition rates between adjacent direction sectors and successive downwind distances. Therefore, the

numerical results are generally conservative, and so it is not known to what degree and over what period any adverse effects to plant physiology would be evidenced

Based upon the assumption that ambient salt deposition rates in the region are minimal, salt deposited from the cooling towers should have no significant adverse effect on natural vegetation or crops just outside site boundaries or in the region of the proposed cogeneration plant

Climatological Impacts

Local climatological data from the West Palm Beach NWS station were used to characterize ambient fogging and icing conditions in the absence of the proposed cooling tower (DOC, 1972). On average, heavy fog conditions (i.e., with visibility at 1/4 mile or less), which are generally in response to synoptic-scale meteorological conditions, occur about 8 days per year. Because of the prevailing subtropical conditions, no snow was observed during the 29-year period.

In this study, 5 years of hourly surface data and twice-daily mixing height data for the NWS station at West Palm Beach (1982 to 1986) were input to the model to describe ambient atmospheric conditions. The model sorts the hourly meteorological data into classes defined by wet-bulb temperature, relative humidity, and wind speeds for the 16 compass directions (i.e., north, north-northeast, northeast, etc.). The maximum downwind horizontal extent of the elevated visible cooling tower plume is more than 5 km at a height of 1 km above the ground. The highest frequency of this condition occurred 0.73 percent of the time in the northeast direction. The frequency and vertical extent of visible plume occurrence resulting from the operation of the cooling tower is presented in Table 7-6 for all 16 directions out to 5 km.

In view of the small frequency of the occurrence (64 hours/year) of the visible plume in any given direction, the impact of the cooling tower on local climatology is expected to be insignificant.

Potential Traffic Impacts

The visible plume may reduce visibility if it crosses the path of ground-based or air traffic. The only nearby public road is U.S. Route 710. Its closest approach to the plant site is at least 750 meters to the northeast. At this distance, the plume height is about 150 meters above the ground (see Table 7-6(c)). Since terrain around the plant site is essentially flat, visibility on nearby roads is not expected to be degraded by the formation of this elevated visible plume. With respect to potential visibility impacts to air traffic, the Circle T Ranch airport, located about 5 miles to the east-northeast of the plant site, is the closest airport to the proposed facility that is open to the general public. The visible plume length in the ENE direction of the ICL cooling tower is only 150 meters. Therefore, the visible plume will not hinder the safe operation of aircraft during takeoff or landing at the Circle T Ranch airport. The nearest private airport is located 2.5 miles north of the plant site. The visible plume length in the north direction of the ICL cooling tower is only 150

meters. Thus, the visible plume will not have adverse impact on the safe operation of aircraft during takeoff or landing. Two major airports, West Palm Beach and Stuart, are more than 20 miles away from the ICL site. No significant visible plume impacts are expected at these distant airports.

Induced ground-level fogging will occur during plume downwash conditions. This locally induced fog will be dissipated rapidly due to the high winds associated with plume downwash conditions. Most of the plume fogging events occurred within 300 meters of the cooling tower (see Table 7-7). Plume fogging is estimated to occur up to 1.25 kilometers from the tower for the south and south-southeast directions only. Since the northwest-southeast oriented Route 710 is more than 750 meters from the plant, the building-induced ground fog occurred in the south and south-southeast directions will never obstruct the traffic flow on that road. Similar to the climatological data, the SACTI model predicted no occurrence of icing in this subtropical area. The frequency of fogging and icing occurrences resulting from the operation of the cooling tower is presented in Table 7-7.

Table 7-1
RELATIVE SENSITIVITY TO SO₂ OF PLANTS IDENTIFIED ON SITE
AND OF IMPORTANT AGRICULTURAL CROPS AND FOREST TREES^a

SPECIES	SENSITIVITY RATING ^b
Poor Original	
<u>Trees and Shrubs</u>	
Blackberry	S
Black willow	S
Blueberry	S
Green ash	S
Large-toothed aspen	S
Staghorn sumac	S
Tulip poplar	S
Virginia pine	S
Cottonwood	I
Red maple	I
Rose	I
White oak	I
Beech	R
Black gum	R
Black locust	R
Pin oak	R
Red oak	R
Smooth sumac	R
White dogwood	R
<u>Herbaceous Plants</u>	
Bindweed	S
Black mustard	S
Broomgrass	S
Cocklebur	S
Dandelion	S
Goldenrod	S
Iris	S
Lambs quarters	S
Nightshade	S
Orchard grass	S
Prickly lettuce	S
Ragweed	S
Sour dock	S
Sweet clover	S, I ^c

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

Table 7-1 (Continued)

SPECIES	SENSITIVITY RATING ^b
Violet	S
Cordgrass	I
Milkweed	I
Deptford pink	R
Barley	S
Cucumber	S
<u>Herbaceous Plants</u> (Continued)	
Lima bean	S
Pea	S, I ^c
Rye	S
<u>Crops and Vegetables</u>	
Soybean	S
Spinach	S
Wheat	S
Irish potato	I
Corn	R

NOTES

a - Sources (Anderson, 1979, Ghiorse and Alexander, 1976)

b - S = sensitive, I = intermediate, R = resistant

c - This species is noted in two categories since the source list was compiled from the data of numerous researchers

Table 7-2
RELATIVE SENSITIVITY TO NO₂ OF PLANTS IDENTIFIED
IN THE SITE AREA AND OF IMPORTANT AGRICULTURAL
CROPS AND FOREST TREES^a

SPECIES	SENSITIVITY RATING ^b
<u>Trees and Shrubs</u>	
Black locust	R
Hornbeam	R
Oak	R
Pine	R
<u>Herbaceous Plants</u>	
Black mustard	S
Dandelion	I
Lamb's quarters	R
Pigweed	R
<u>Crops and Vegetables</u>	
Apple tree	S
Barley	S
Bean	S, I ^c
Pea	S
Corn	I
Tomato	I
Wheat	I
Asparagus	R

a - Source EPA, 1976

b - S = sensitive, I = intermediate, R = resistant

c - This species is rated in two categories since several varieties are involved

Table 7-3
ICL MECHANICAL-DRAFT COOLING TOWER DESIGN PARAMETERS

Number of Cells	10
Heat Load	1,655 MMBtu/hr
Circulating Water Flow Rate	265,000 gpm
Design Wet Bulb Temperature	80 °F
Approach	10 °F
Range	83 °F - 108 °F
Air Flow Rate Per Cell	1,575,000 acfm/cell
Drift Rate	0.002%
Tower Dimension	60 ft x 600 ft x 56 ft
Fan Diameter	32.8 ft

Table 7-4
COMPOSITE COOLING TOWER DRIFT EMISSION SPECTRUM^a

Interval	d _l (μm)	d _u (μm)	Mass Fraction(%)
1	0	10	0 00
2	10	20	0 53
3	20	30	4 43
4	30	40	7 41
5	40	50	6 51
6	50	60	5 48
7	60	70	3 51
8	70	90	3 26
9	90	110	1 78
10	110	130	0 95
11	130	150	0 76
12	150	180	1 10
13	180	210	1 17
14	210	240	1 32
15	240	270	1 41
16	270	300	1 82
17	300	350	2 67
18	350	400	2 33
19	400	450	2 29
20	450	500	1 51
21	500	600	4 33
22	600	700	3 51
23	700	800	3 82
24	800	900	2 73
25	900	1000	1 71
26	1000	1200	3 19
27	1200	1400	3 32
28	1400	1600	6 43
29	1600	1800	2 21
30	1800	2000	3 07
31	2000	2200	15 4

a - Source EPRI, 1984

b - Droplet diameter lower (d_l) and upper (d_u) size range in microns (μm) for given interval

1

DISTANCE FROM TOWER (M)	***** WIND FROM *****																
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG
	***** PLUME HEADED *****																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG
100	14275	9260	20325	29540	58567	32095	33592	19129	22912	8524	9615	8029	12659	9890	13048	11616	19567
200	1220	811	1648	2432	4783	2309	2425	1618	2031	1135	1247	709	1132	752	989	1024	1642
300	355	189	368	626	1222	641	681	424	552	306	332	210	338	212	274	317	440
400	155 90	96 79	185 59	302 16	607 37	376 13	398 54	215 03	276 18	152 30	167 71	92 40	145 42	137 64	182 63	130 66	226 40
500	112 58	44 19	84 58	150 72	307 94	187 54	205 79	132 92	197 61	72 64	80 82	70 61	111 35	48 03	62 36	106 76	123 53
600	86 71	19 36	33 76	111 32	224 80	143 09	156 47	94 10	141 12	38 27	42 48	54 99	87 23	40 59	53 27	84 55	88 26
700	40 49	14 31	25 33	68 80	137 59	111 68	121 19	50 23	67 68	24 14	27 51	23 41	36 79	32 73	41 81	34 50	53 64
800	26 35	8 65	13 97	30 49	62 18	74 86	82 44	28 58	44 64	19 16	21 46	16 12	26 15	22 03	29 61	25 87	33 29
900	17 79	5 45	8 69	21 67	42 54	46 63	53 01	16 99	24 76	11 74	13 02	9 95	16 54	18 80	25 19	16 77	21 85
1000	15 45	3 94	6 25	20 88	40 77	44 66	50 22	15 49	21 44	8 49	9 47	8 33	13 74	17 80	23 43	14 02	19 65
1100	18 58	3 21	4 99	18 81	37 24	40 36	44 53	15 44	27 17	7 17	7 95	12 08	20 93	14 30	18 10	18 99	19 37
1200	23 52	4 59	5 93	16 86	32 89	36 44	40 44	15 73	36 24	14 22	15 35	17 48	31 64	12 28	15 42	26 54	21 60
1300	10 34	3 75	4 78	12 42	24 36	26 30	29 60	9 37	14 34	11 93	12 80	5 62	9 62	7 83	10 04	10 25	12 71
1400	21 07	1 63	2 84	20 06	47 09	18 41	19 82	30 39	41 71	2 80	3 24	11 69	17 61	3 89	5 52	13 51	16 33
1500	14 12	1 48	2 68	15 65	35 62	18 36	19 75	21 52	28 55	2 47	2 82	7 66	11 43	3 87	5 50	8 51	12 50
1600	3 34	80	1 23	6 08	11 61	16 80	18 23	3 60	4 72	2 03	2 30	1 80	3 04	3 65	5 28	3 16	5 48
1700	3 31	51	61	5 86	11 34	13 06	14 11	3 56	4 70	1 79	2 03	1 79	2 99	3 26	4 78	3 15	4 80
1800	3 20	49	60	5 82	11 28	5 31	5 66	3 49	4 58	1 74	1 95	1 75	2 93	2 72	3 93	3 06	3 66
1900	3 17	48	58	5 80	11 26	5 18	5 49	3 48	4 56	1 69	1 87	1 74	2 91	2 47	3 45	3 03	3 57
2000	3 16	46	56	5 80	11 24	4 95	5 18	3 46	4 52	1 64	1 83	1 73	2 89	2 02	2 66	3 02	3 45
2100	3 15	41	50	5 80	11 22	4 88	5 06	3 45	4 52	1 47	1 67	1 73	2 89	1 93	2 49	3 01	3 39
2200	2 55	37	45	3 08	5 98	4 56	4 76	2 32	3 64	1 31	1 47	1 51	2 53	1 88	2 45	2 76	2 60

TABLE 7 5 COOLING TOWER SALT DEPOSITION (Contd)

1 ***** PLUME SALT DEPOSITION TABLE (KG / (KM **2 MO)) *****

INDIANTOWN, 1982 86 WEST PALM BEACH MET DATA (LMDCT, 10 CYCLES)

SEASON=ANNUAL

DISTANCE FROM TOWER (M)	WIND FROM										PLUME HEADED										AVG
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	AVG				
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	AVG				
5100	20	02	03	08	17	16	17	13	27	05	05	13	20	12	16	25	14				
5200	20	02	03	08	17	16	17	13	27	05	05	13	20	12	16	25	14				
5300	19	02	02	08	17	16	17	12	25	05	05	12	19	12	16	24	13				
5400	17	02	02	07	16	16	17	10	23	05	05	11	18	12	16	21	12				
5500	16	02	02	07	15	16	17	10	22	05	05	11	17	12	16	20	12				
5600	13	02	02	06	14	16	17	09	18	05	05	08	14	12	16	16	11				
5700	12	02	02	06	13	16	17	09	18	05	05	08	13	12	16	14	10				
5800	10	02	02	06	12	16	17	08	15	05	05	07	12	12	16	12	10				
5900	09	02	02	05	12	16	16	07	14	05	05	06	11	10	14	11	09				
6000	09	02	02	05	12	15	16	07	14	05	05	06	11	09	12	11	09				
6100	09	02	02	05	12	15	16	07	14	05	05	06	11	09	12	11	09				
6200	09	02	02	05	12	15	16	07	14	05	05	06	11	09	12	11	09				
6300	09	02	02	05	12	15	16	07	14	05	05	06	11	09	12	11	09				
6400	09	02	02	05	12	15	16	07	14	05	05	06	11	09	11	11	09				
6500	09	02	02	05	11	15	16	07	14	05	05	06	11	08	11	11	09				
6600	09	02	02	05	11	14	15	07	14	05	05	06	11	07	09	10	08				
6700	09	02	02	05	11	14	15	07	14	05	05	06	11	07	09	10	08				
6800	09	02	02	05	11	14	15	07	14	05	05	06	11	07	09	10	08				
6900	09	02	02	05	11	14	15	07	14	04	05	06	11	07	09	10	08				
7000	09	02	02	05	11	14	15	07	14	04	05	06	11	07	09	10	08				
7100	09	02	02	05	11	14	15	07	14	04	05	06	11	07	09	10	08				
7200	09	02	02	05	11	14	15	07	14	04	05	06	11	07	09	10	08				
7300	09	02	02	05	11	14	15	07	14	04	05	06	11	07	09	10	08				
7400	08	02	02	05	11	14	15	06	13	04	05	06	10	07	09	09	08				
7500	07	02	02	05	11	14	15	06	12	04	05	06	09	07	10	08	08				
7600	07	02	02	05	11	14	15	06	12	04	05	06	09	07	10	08	08				
7700	07	02	02	05	11	14	15	06	12	04	05	06	09	07	10	08	08				
7800	07	02	02	05	11	14	15	06	12	04	05	06	09	07	10	08	08				
7900	07	02	02	05	11	14	15	06	12	04	05	06	09	07	10	08	08				
8000	07	02	02	05	11	14	15	06	12	04	05	06	09	07	10	08	08				
8100	07	02	02	05	11	14	15	06	12	04	05	06	09	07	10	08	08				
8200	07	02	02	05	11	14	15	06	12	04	04	05	09	07	10	08	08				
8300	06	02	02	05	10	14	15	05	11	04	04	05	09	07	10	08	07				
8400	06	02	02	05	10	14	15	05	11	04	04	05	09	07	09	08	07				
8500	06	02	02	05	10	14	15	05	11	04	04	05	09	07	09	08	07				
8600	06	02	02	05	10	14	15	05	11	04	04	05	09	07	09	08	07				
8700	06	02	02	05	10	14	14	05	11	04	04	05	09	07	09	08	07				
8800	06	02	02	05	10	14	14	05	11	04	04	05	08	06	09	07	07				
8900	06	01	02	04	10	14	14	05	10	04	04	04	07	06	08	07	07				
9000	05	01	02	04	08	13	14	04	08	03	04	04	07	06	07	06	06				
9100	05	01	02	04	08	13	13	04	08	03	04	04	07	04	05	06	06				
9200	05	01	02	04	08	13	13	04	08	03	04	04	07	04	05	06	06				
9300	05	01	02	04	07	13	13	03	07	03	03	03	05	04	05	05	05				
9400	04	01	02	03	07	11	11	03	06	03	03	03	05	04	05	05	05				
9500	04	01	02	03	07	10	10	03	06	03	03	03	05	04	05	05	05				
9600	04	01	02	03	07	10	10	03	06	03	03	03	05	04	05	05	05				
9700	04	01	02	03	07	10	10	03	06	03	03	03	05	04	05	05	05				
9800	04	01	02	03	07	10	10	03	06	03	03	03	05	04	05	05	05				
9900	04	01	02	03	07	10	10	03	06	03	03	03	05	04	05	05	05				
10000	04	01	02	03	07	10	10	03	06	03	03	03	05	04	05	05	05				

TABLE 7-6(a) VISIBLE PLUME FREQUENCY

1

***** PLUME LENGTH FREQUENCY TABLE *****

INDIANTOWN, 1982-86 WEST PALM BEACH MET DATA (LMDCT, 10 CYCLES)

SEASON=ANNUAL

DISTANCE	***** WIND FROM *****																
FROM	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	SUM
TOWER	***** PLUME HEADED *****																
(M)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM
50	5 30	2 44	4 80	7 74	15 68	9 62	10 42	6 05	8 35	3 53	3 95	3 23	5 09	3 76	5 10	4 93	100 00
100	34	1 75	3 62	81	1 02	30	39	16	22	2 17	2 57	17	40	37	40	33	15 02
150	12	44	53	77	98	13	18	13	09	1 69	1 96	05	18	30	29	05	7 89
200	02	37	41	01	04	13	18	00	00	1 51	1 79	00	00	30	29	01	5 08
250	02	25	25	01	04	13	18	00	00	1 15	1 41	00	00	30	29	01	4 05
300	00	21	19	00	00	03	03	00	00	99	1 21	00	00	20	24	00	3 10
350	00	17	15	00	00	03	03	00	00	82	1 02	00	00	20	24	00	2 67
400	00	17	15	00	00	03	03	00	00	82	1 02	00	00	20	24	00	2 67
450	00	17	15	00	00	03	03	00	00	82	1 02	00	00	20	24	00	2 67
500	00	13	12	00	00	03	03	00	00	62	73	00	00	20	24	00	2 11
550	00	13	12	00	00	03	03	00	00	62	73	00	00	20	24	00	2 11
600	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
650	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
700	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
750	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
800	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
850	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
900	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
950	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1000	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1050	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1100	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1150	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1200	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1250	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1300	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1350	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1400	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1450	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1500	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1550	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1600	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1650	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1700	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1750	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1800	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1850	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1900	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1950	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2000	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2050	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2100	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2150	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2200	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2250	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2300	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2350	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2400	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2450	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
2500	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08

TABLE 7 6(b) VISIBLE PLUME FREQUENCY (Contd)

***** PLUME LENGTH FREQUENCY TABLE *****																		
INDIANTOWN 1982 86 WEST PALM BEACH MET DATA (LMDCT 10 CYCLES)																		
SEASON=ANNUAL																		
DISTANCE	***** WIND FROM *****								***** PLUME HEADED *****									
FROM	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	SUM	
TOWER	***** PLUME HEADED *****								***** PLUME HEADED *****									
(M)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM	
2550	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
2600	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
2650	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
2700	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
2750	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
2800	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
2850	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
2900	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
2950	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3000	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3050	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3100	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3150	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3200	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3250	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3300	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3350	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3400	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3450	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3500	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3550	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3600	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3650	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3700	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3750	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3800	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3850	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3900	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
3950	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4000	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4050	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4100	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4150	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4200	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4250	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4300	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4350	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4400	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4450	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4500	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4550	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4600	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4650	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4700	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4750	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4800	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4850	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4900	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
4950	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	
5000	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08	

TABLE 7 6(c) VISIBLE PLUME FREQUENCY

1

***** PLUME HEIGHT FREQUENCY TABLE *****

INDIANTOWN, 1982-86 WEST PALM BEACH MET DATA (LMDCT, 10 CYCLES)

SEASON=ANNUAL

HEIGHT FROM TOWER (M)	***** WIND FROM *****								*****								SUM
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	
10	5 30	2 44	4 80	7 74	15 68	9 62	10 42	6 05	8 35	3 53	3 95	3 23	5 09	3 76	5 10	4 93	100 00
20	5 30	2 30	4 37	7 74	15 67	9 62	10 42	6 05	8 35	3 48	3 89	3 23	5 09	3 76	5 10	4 93	99 30
30	42	45	53	06	13	55	73	11	45	1 69	1 96	31	55	1 01	1 20	54	10 70
40	22	41	44	03	04	03	03	03	13	1 65	1 91	12	21	20	24	28	5 96
50	00	41	44	00	00	03	03	00	00	1 65	1 91	00	00	20	24	00	4 91
60	00	33	33	00	00	03	03	00	00	1 44	1 73	00	00	20	24	00	4 32
70	00	28	29	00	00	03	02	00	00	1 31	1 60	00	00	18	24	00	3 95
80	00	25	25	00	00	03	02	00	00	1 15	1 41	00	00	18	24	00	3 53
90	00	21	19	00	00	03	02	00	00	99	1 21	00	00	18	24	00	3 07
100	00	17	15	00	00	03	02	00	00	82	1 02	00	00	18	24	00	2 64
110	00	17	15	00	00	03	02	00	00	82	1 02	00	00	18	24	00	2 64
120	00	17	15	00	00	03	02	00	00	82	1 02	00	00	18	24	00	2 64
130	00	17	15	00	00	03	02	00	00	82	1 02	00	00	18	24	00	2 64
140	00	17	15	00	00	03	02	00	00	82	1 02	00	00	18	24	00	2 64
150	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
160	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
170	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
180	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
190	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
200	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
210	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
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230	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
240	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
250	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
260	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
270	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
280	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
290	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
300	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
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490	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
500	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08

TABLE 7-6(d) VISIBLE PLUME FREQUENCY (Contd)

HEIGHT FROM TOWER (M)	***** PLUME HEIGHT FREQUENCY TABLE *****																
	INDIANTOWN, 1982 86 WEST PALM BEACH MET DATA (LMDCT, 10 CYCLES)																
	SEASON=ANNUAL																
	***** WIND FROM *****								***** PLUME HEADED *****								
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	SUM
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM
510	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
520	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
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540	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
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590	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
600	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
610	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
620	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
630	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
640	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
650	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
660	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
670	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
680	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
690	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
700	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
710	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
720	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
730	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
740	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
750	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
760	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
770	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
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800	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
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830	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
840	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
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970	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
980	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
990	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08
1000	00	13	12	00	00	03	02	00	00	62	73	00	00	18	24	00	2 08

TABLE 7-7 FOGGING AND ICING FREQUENCIES

1

***** HOURS OF PLUME FOGGING TABLE *****

INDIANTOWN, 1982 86 WEST PALM BEACH MET DATA (LMDCT, 10 CYCLES)

SEASON=ANNUAL

[illegible]

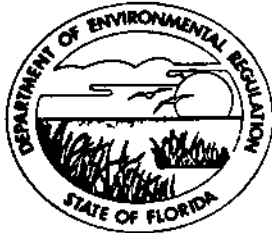
1

***** HOURS OF RIME ICING TABLE *****

INDIANTOWN, 1982 86 WEST PALM BEACH NET DATA (LMDCT, 10 CYCLES)

SEASON=ANNUAL

[illegible]



Florida Department of Environmental Regulation

Twin Towers Office Bldg • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

Bob Martinez Governor

Dale Twachtman Secretary

John Shearer Assistant Secretary

July 23, 1990

Ms. Mary E. Coffey
Bechtel
15740 Shady Grove Rd.
Gaithersbury, Maryland 20877-1454

Re: Preconstruction Monitoring Exemption Request

Dear Ms. Coffey.

The preliminary modeling provided in your Plan of Study for the Indiantown Site Certification Application shows that the maximum air quality impacts are less than the pollutant-specific "de minimus" concentrations for each pollutant. In addition, as we discussed, the existing monitoring data from the Martin site of Florida Power and Light is representative of the proposed source area.

Based on this information and the discretion of the Department, the preconstruction ambient air quality monitoring requirement for the preliminary Indiantown Cogeneration Project is exempted.

If you have any questions, please call me at (904)488-1344.

Sincerely,

Alex Meng
Meteorologist
Air Modeling and Assessment
Bureau of Air Monitoring & Assessment

cc: Tom Rogers

8.0 REFERENCES

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10 1 6 COASTAL ZONE MANAGEMENT CERTIFICATIONS

The Coastal Management Act of 1978 (Section 380 21-380 25, Florida Statutes) requires that the Coastal Zone Management Section of FDER be responsible for certification of consistency with the Florida Coastal Management Program (FCMP) for all federal licenses, permits, activities, and projects listed in Section 380 23 (3) (C), Florida Statutes, when such activities are subject to federal consistency review and affect land or water use, are seaward of the jurisdiction of state, or there is no state agency with sole jurisdiction for such consistency review

In accordance with FCMP consistency evaluation procedures, copies of the following documents are included in Section 10 1 of this Site Certification Application

- Combined applications for construction in, and discharge of dredge or fill materials to, waters of the United States, Section 404 of the Water Pollution Control Act of 1972, as amended),
- Notice of Proposed Construction or Alteration (required by Part 77 of the Federal Aviation Regulations [14 CFR Part 77] pursuant to Section 1011 of the Federal Aviation Act of 1958, amended)

Federal Consistency Evaluation Procedures (15 CFR 930 50) require these permit applications and the FAA Notice to be accompanied by a consistency certification attachment which includes

- A written and pictorial description of the project,
- An assessment of probable impacts relevant to applicable FCMP statutes, and
- A signed statement by the applicant regarding consistency of the project with FCMP statutes

Each application included with this Site Certification Application is accompanied by such consistency certification

10 1 7 FAA PERMIT APPLICATION

FCMP CONSISTENCY CERTIFICATION
INDIANTOWN COGENERATION, L.P.

DESCRIPTION OF THE PROJECT

Indiantown Cogeneration, L.P. (ICL) proposes to construct and operate a cogeneration project in Martin County, Florida, approximately 3 miles northwest of Indiantown. This project is a pulverized coal fired steam unit that will produce approximately 330 MW of electricity for sale to Florida Power and Light Company, and up to 225,000 lb/hour of process steam for sale to the Caulkins Citrus Processing plant. The anticipated commercial operation date for the facility is December 1, 1995. The project will be a qualifying facility (QF) as defined by the Public Utility Regulatory Policies Act of 1978.

The ICL plant will occupy a 232 acre industrially zoned site, north of Indiantown. To the north of the site is the Caulkins Citrus Processing plant and an abandoned Florida Steel Corporation plant. The site is bounded on the west by Tampa Farm Products and on the south and east by vacant industrially zoned land. The site will be designed to accommodate all the facilities necessary to generate power from coal while maintaining the wetlands and a significant portion of the uplands on the site as required by Martin County regulations. These facilities will include the power block, coal and ash handling equipment, a rail loop and a water storage pond. The figure attached to this notice provides a conceptual layout for the proposed cogeneration project.

Assessment of Probable Project Impacts

As part of the Federal Consistency Evaluation Procedures, an assessment of the probable impacts of the project on the coastal zone were determined in relation to the Florida Coastal Management Program (FCMP) statutes.

Flood Zones - The ICL plant will be within Zone B (100 to 500 year flood plain area) as defined by flood insurance rate maps. All ICL facilities will be at or above the 100 year flood elevation of 31 ft. NGVD. In addition, all ICL facilities will be designed to comply with all applicable South Florida Water Management District (SFWMD) and Florida Department of Natural Resources (FDNR) requirements regarding flood protection control. Installation and operation of the ICL facility is expected to have no adverse impact on the 100 year flood elevations or flood flows. Since the plant will be entirely above the limits of the 100 year flood, adjacent properties owners will not be adversely affected.

Air and Water Impacts - These concerns will be addressed by obtaining the appropriate facility operation and discharge permits and using pollution control measures to abate impacts from facility construction and operations. All construction and

operation permits will be obtained through the Power Plant Siting Act process in accordance with requirements established in the Prevention of Significant Deterioration (PSD) air quality regulations and the air quality regulations governing New Sources. An Underground Injection Control permit will be obtained for discharge of wastewater to the Boulder Zone of the Floridan aquifer.

Stormwater retention basins will be used to collect runoff waters from the site. The discharge from these basins will comply with all DER and SFWMD requirements for protection of surface and ground waters.

Archaeological and Historical Resources Impacts - A comprehensive evaluation of archaeological and historic resources within the ICL site and along the proposed water pipeline was conducted by Piper Archaeological Research, Inc. with the conclusion that no archaeological or historical resources occur onsite. This study will be submitted to the State Historic and Preservation Office for concurrence with the findings as part of the licensing effort for the ICL plant.

Water Resource Impacts - The SFWMD will review the project for water resources impacts. Consumptive use of water is anticipated, therefore, permits for such use will be obtained from SFWMD. Stormwater management practices will be employed to mitigate impacts to water resources from runoff.

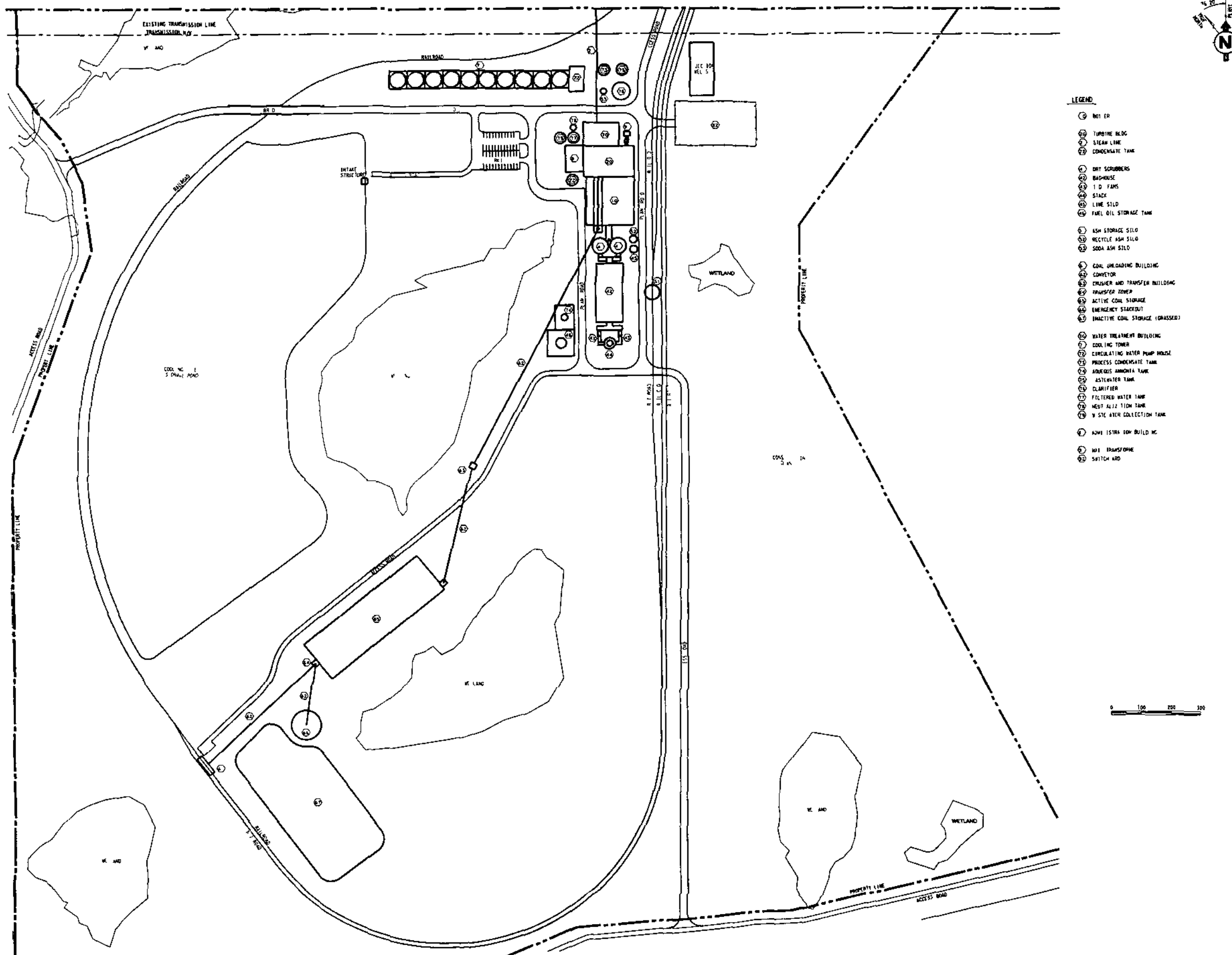
Power Plant Siting Act - An application is being filed with the Florida Department of Environmental Regulation (FDER) under the Power Plant Siting Act. This application will present information discussing the conditions resulting from construction, and the anticipated impacts from facility operation, in order to provide assurance that all applicable state, regional and local regulations are met and that the project will be consistent with the FCMP.

Consistency Determination

The proposed project complies with Florida's approved coastal management program and will be conducted in a manner consistent with such program.

Figure 3 2 0-1

PLOT PLAN



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Source Bechtel 1990

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration L P

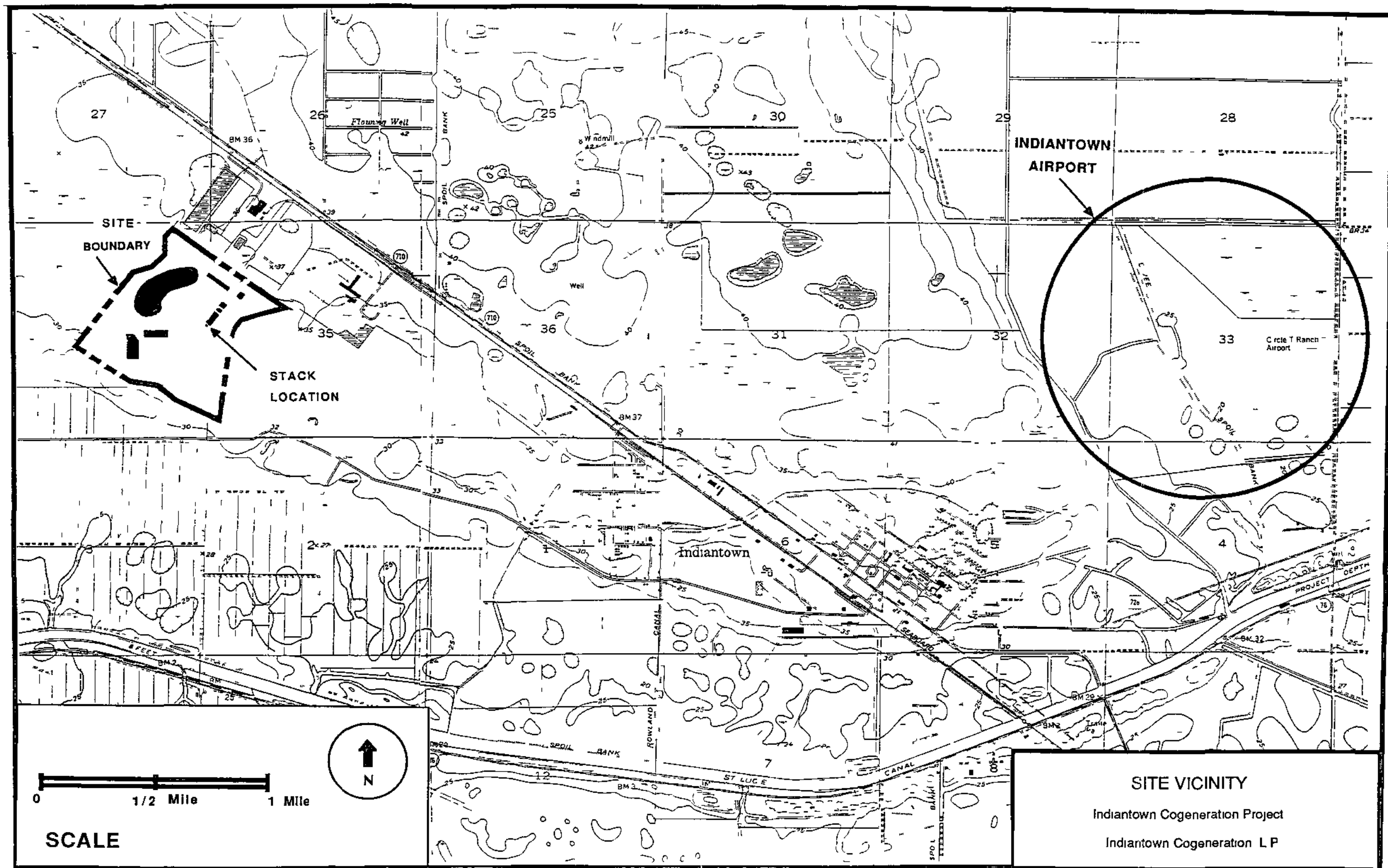
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DO NOT REMOVE CARBONS

Form Approved OMB No. 2120-

U.S. Department of Transportation Federal Aviation Administration			Aeronautical Study Number	
NOTICE OF PROPOSED CONSTRUCTION OR ALTERATION				
1. Nature of Proposal			2. Complete Description of Structure	
A. Type ☒ New Construction ☐ Alteration	B. Class ☒ Permanent ☐ Temporary (Duration _____ months)	C. Work Schedule Dates Beginning _____ End _____	A. Include effective radiated power and assigned frequency of all existing proposed or modified AM, FM, or TV broadcast stations utilizing this structure. B. Include size and configuration of power transmission lines and their supporting towers in the vicinity of FAA facilities and public airports. C. Include information showing site orientation, dimensions and construction materials of the proposed structure.	
3A. Name and address of individual, company, corporation, etc. proposing the construction or alteration (Number, Street, City, State and Zip Code) () _____ area code Telephone Number Mr. Stephen A. Sorrentino Indiantown Cogeneration, L.P. 7475 Wisconsin Avenue Bethesda, MD 20814-3422			One (1) power facility stack	
B. Name, address and telephone number of proponent's representative if different than 3A above			(if more space is required, continue on a separate sheet)	
4. Location of Structure			5. Height and Elevation (Complete for the nearest DC)	
A. Coordinates (to nearest second) 27° 2' 20" Latitude 80° 30' 45" Longitude	B. Nearest City or Town and State Indiantown, FL Three (3) Miles	C. Name of nearest airport, heliport, light park Indiantown (1) Distance from structure to nearest point of nearest runway 4 1/4 miles (2) Direction from structure to airport East (83°)	A. Elevation of site above mean sea level 39	B. Height of structure, not using air obstructions and lighting (if any) above ground or water if so situated 495' C. Overall height above mean sea level A + B 534'
D. Description of location of site with respect to highways, streets, airports, prominent terrain features, existing structures, etc. Attach a U.S. Geological Survey quadrangle map or equivalent showing the relationship of construction site to nearest airport(s). (if more space is required, continue on a separate sheet of paper and attach to this notice.) The proposed stack location is approximately 3500 feet SW of SR 710 and about 2000 feet SSW of the existing Caulkins Citrus Processing Plant. The area is basically flat. See Attached Figure				
Notice is required by Part 77 of the Federal Aviation Regulations (14 C.F.R. Part 77) pursuant to Sec. 11101 of the Federal Aviation Act of 1958 as amended (49 U.S.C. 1110). Persons who knowingly and willfully violate the Notice requirements of Part 77 are subject to a civil penalty of not more than \$500 for the first offense and not more than \$2,000 for subsequent offenses pursuant to Section 902(a) of the Federal Aviation Act of 1958 as amended (49 U.S.C. 1472(a)).				
I HEREBY CERTIFY that all of the above statements made by me are true, complete, and correct to the best of my knowledge. In addition, I agree to obstruction mark and/or light the structure in accordance with established marking & lighting standards if necessary.				
Date	Typed Name/Title of Person Filing Notice		Signature	
FOR FAA USE ONLY				
EAA will either return this form or issue a separate acknowledgment.				
The Proposal ☐ Does not require a notice to FAA. ☐ Is not identified as an obstruction under any standard of FAR, Part 77, Subpart C, and would not be a hazard to air navigation. ☐ Is identified as an obstruction under the standards of FAR, Part 77, Subpart C, but would not be a hazard to air navigation. ☐ Should be obstruction marked. ☐ lighted per FAA Advisory Circular 70/7460-1, Chapter(s) _____ ☐ Obstruction marking and lighting are not necessary.				
Supplemental Notice of Construction FAA Form 7460-2 is required any time the project is abandoned. ☐ At least 48 hours before the start of construction. ☐ Within five days after the construction reaches its greatest height. This determination expires on _____ unless: (a) extended, revised or terminated by the issuing office. (b) the construction is subject to the licensing authority of the Federal Communications Commission and an application for a construction permit is made to the FCC on or before the above expiration date. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or on the date the FCC denies the application. NOTE: Request for extension of the effective period of this determination must be postmarked or delivered to the issuing office at least 15 days prior to the expiration date. If the structure is subject to the licensing authority of the FCC, a copy of this determination will be sent to that Agency.				
Remarks				
Issued In	Signature		Date	

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10 2 ZONING DESCRIPTIONS

**10 2 1 EXCERPTS FROM CHAPTER 33 ZONING OF THE MARTIN COUNTY
CODE RELATED TO**

- **ARTICLE XXXVIA PUD PLANNED UNIT DEVELOPMENT
DISTRICTS**
- **ARTICLE LX AMENDMENTS**

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

MARTIN COUNTY CODE

Art	XXVIII	A 1 Small Farms District §§ 33-456—33-469
Art	XXIX	A 2 Agricultural District §§ 33-470—33-483
Art	XXX	A-3 Conservation District §§ 33-484—33-497
Art	XXXI	HB-1A Hotel and Motel District §§ 33-498—33-515
Art	XXXII	HB-1AA Hotel and Motel District §§ 33-516—33-524
Art	XXXIII	HB-1 Limited Business District, §§ 33-525—33-539
Art	XXXIV	B-1 Business District, §§ 33-540—33-553
Art	XXXV	B-2 Business-Wholesale Business District, §§ 33-554—33-567
Art	XXXVI	B-3 Rural Business District, §§ 33-568—33-570
Art	XXXVIA	PUD Planned Unit Development Districts §§ 33-571—33-581 75
		Div 1 General §§ 33-571—33-581 10
		Div 2 PUD(R) Planned Unit Development (Residential) Sub-District, §§ 33-581 11—33-581 20
		Div 3 PUD(C) Planned Unit Development (Commercial) Sub-District, §§ 33-581 21—33-581 40
		Div 4 PUD(I) Planned Unit Development (Industrial) Sub-District, §§ 33-581 41—33-581 61
		Div 5 PUD(MH) Planned Unit Development (Mobile Home) Sub-District, §§ 33-581 62—33-581 75
Art	XXXVII	M-1 Industrial District, §§ 33-582—33-595
Art	XXXVIII	M-2 Industrial District, §§ 33-596—33-609
Art	XXXIX	M-3 Industrial District, §§ 33-610—33-623
Art	XL	PS Public Servicing District, §§ 33-624—33-635
Art	XLI	SY Salvage Yards, §§ 33-636—33-651
Art	XLII	IZ Interim Zoning, §§ 33-652—33-666
Art	XLIII	Building and Construction, §§ 33-667—33-683
Art	XLIV	Regulations for Construction and Operation of Mobile Homes or Trailer Parks, §§ 33-684—33-711
Art	XLV	Regulations for the Construction and Operation of Drive-In Theatres and Outdoor Theatres §§ 33-712—33-722
Art	XLVI	Sign Regulations §§ 33-723—33-800
Art	XLVII	Excavations and Fills, §§ 33-801—33-854
Art	XLVIII—LIX	Reserved.
Art	LX	Amendments, §§ 33-855—33-874
Art	LXI	Legal Provisions §§ 33-875—33-980

(b) Minimum width along front property lines shall be one hundred (100) feet.

(c) There shall be no limit on the maximum height, except where adjacent to a residential district, in which case the maximum height is limited to three (3) stories.

(d) The height of any structure shall not be such so as to intrude into a gliding angle where adjacent to air fields.

(e) When located upon streets or highways carrying a large volume of traffic, tracts located in this district shall provide for a marginal access road with a minimum of access and egress points. There shall be a ten-foot planter strip between such access road, the right-of-way of the street or highway, and parking areas within the tract shall be accessible only from the marginal access road. (Res. of 5-9-67, Art. XXVIII, § 28.1)

Sec. 33-570. Minimum yards required.

(a) *Front:* 30 feet.

(b) *Rear and side:*

1 story—10 feet.

2 stories—12 feet.

3 stories and over—15 feet.

(c) No structure shall be built within 50 feet of the center line of any public platted right-of-way not a designated through-traffic highway.

(d) No structure shall be built within 65 feet of the center line of a designated through-traffic highway (Res. of 5-9-67, Art. XXVIII, § 28.2)

**ARTICLE XXXVIA. PUD PLANNED UNIT
DEVELOPMENT DISTRICTS***

DIVISION 1 GENERAL

Sec. 33-571. Purpose and intent.

(a) The purpose of this district is to provide an alternative zoning procedure that may be used to establish Planned

*Cross reference—Special requirements for Hutchinson Island, Long Island and Jupiter Island, §§ 33-72.

Unit Development Districts at appropriate locations in accordance with the planning and development objectives of the county

(b) Although planned developments produced in compliance with the terms and provisions of this article may depart from the strict application of use setback, height, and minimum lot requirements of standard zoning districts such developments are to be in keeping with the overall planning and development goals and objectives of the county as set forth in the general plan. Planned Unit Development Districts will further serve to guide the resource development of Martin County as defined by adopted specific area plans. The intent of this article is to provide standards by which such flexibility may be accomplished, while maintaining and protecting the public health, safety and welfare

(c) A further purpose of this article is to encourage the establishment of a more complete living environment through the application of enlightened and imaginative approaches to community planning and shelter design. The planned unit development alternative should provide for a variety of architectural solutions, provide for the preservation of natural features and scenic areas, provide for the efficient use of open space, promote high standards in development layout, design and construction, reduce land consumption by roads, separate vehicular and pedestrian circulation systems, originate approaches to a meaningful intergration of common open area networks and developed recreation areas, help establish neighborhood identity and focus, encourage projects that will be designed to fit the natural conditions of the property, and ideally provide for the compatible co-existence of man with his environment.

(d) It is also the purpose and intent of the Planned United Development District to encourage development to occur in accordance with a coordinated and planned extension of existing and programmed community facilities (Ord No. 35, Part 1, 6-28-74)

Sec. 33-572. "Planned unit development" definition.

(a) A 'planned unit development' (also hereinafter referred to as 'PUD') is a land area under unified control which is planned and programmed in a single development operation or by a series of prescheduled development phases according to an officially approved final development plan such planned unit development does not necessarily correspond to property development and use regulations of the standard zoning district in which the property was previously placed.

(b) A 'major planned unit development' is defined as a residential PUD of greater than fifty (50) residential dwelling units or greater than ten (10) acres in area.

(c) A "minor planned unit development" is defined as a residential PUD of fifty (50) residential dwelling units or less or ten (10) acres or less in area. (Ord. No 35, Part 1, 6-28-74)

Sec. 33-573. Relation of planned unit development regulations to general zoning, subdivision or other applicable regulations.

(a) The following provisions shall apply generally to the creation and regulation of all PUD Districts, regardless of any conflicts therein with general zoning, subdivision, or other applicable regulations

- (1) Application and review of the preliminary development plan shall be in lieu of sketch plan review under Ordinance No 25 [section 33-73] for multiple-family developments and preliminary plat review under the subdivision regulations for subdivision lots. Application and review of the final development plan shall be in lieu of site and construction plan review under Ordinance No 25 [section 33-73] for multiple-family dwellings and final plat review under the subdivision regulations for subdivision lots except that for subdivision lots a final plat must be submitted and reviewed simultaneously

- (2) The planned unit development guidelines and standards adopted as part of this zoning ordinance shall apply to the creation of PUD Districts and to the issuance of building permits and certificates of occupancy in such districts (Ord. No 35 Part 1 6-28-74)

Sec. 33-574. Location; plan.

(a) PUD Districts may be established anywhere in the county regardless of the existing zoning districts wherever there are tracts of land suitable in location size and character for the structures and uses proposed to be planned and developed under unified control pursuant to this article. In addition to the particular requirements of this article all PUD Districts shall require an amendment of the official zoning map as it affects the property in question to show the change from the existing zoning district to the PUD District, and a redistricting or rezoning of the property in question from its existing zoning district to the PUD District.

(b) PUD District zoning must be based either upon a county general plan or upon a specific area plan (Ord. No 35, Part 1, 6-28-74)

Sec. 33-575. Effect of planned unit development zoning.

When the board of county commissioners grants final approval to a proposed PUD zoning application, the final development plan including all related information, agreements and supporting materials required pursuant to this article shall be adopted as an amendment to the PUD Zoning District and shall become the standards of development for the subject PUD. Thenceforth, development in the area delineated as a PUD District on the official zoning map shall proceed only in accord with the adopted plan and standards for said district. Such development shall conform to any order of staging or set of priorities or limitations or time table of development in the amendment or elsewhere in this article. (Ord. No 35, Part 1, 6-28-74)

Sec. 33-576. Uses authorized in planned unit development districts

All uses authorized in PUD Districts as set out in the general plan or a specific area plan are conditional uses subject to approval of a final development plan by the board of county commissioners. All review agencies, boards and commissions shall consider whether the proposed uses are compatible with the general plan and/or the specific area plan and whether any adverse fiscal, physical and community service impacts of the development on the county will be adequately provided for (Ord. No. 35, Part 1 6-28-74)

Sec. 33-577. Planned unit development standards.

All PUD applications submitted shall conform to the purpose and intent of this article and be in compliance with the following development standards:

(1) *General standards*

- (a) A PUD shall conform to the appropriate provisions of the general plan or specific area plan.
- (b) Scenic assets and natural features such as trees, dunes, intertidal areas, areas of archeological or historical significance, natural marine and terrestrial biotic communities, floodplains, streams, aquifer recharge areas, and topographic features should be protected and preserved to the extent feasible.
- (c) A PUD site shall be developed in such a manner as to prevent substantial injury to the use and value of existing surrounding development, and shall not hinder, deter, or impede development of surrounding undeveloped properties in accordance with the general plan or a specific area plan. More specifically, such development shall not create undue hazards to persons or property, on or off the tract, from possible flooding, wind or water erosion, subsidence of buildings or other structures or facilities. The condition and type of soil, ground

water level, tidal fluctuations drainage and topography shall be appropriate to both type and pattern of use intended. The site shall also contain sufficient width and depth to adequately accommodate its proposed use and design.

- (d) Structures and common areas should be arranged in such a way as to best serve the needs of occupants and/or other users of the PUD and minimize any adverse effects on neighboring properties.
- (e) Integrated architectural design for buildings structures, landscaping and common open areas will be encouraged.
- (f) The public health, safety, and general welfare, and the purpose and intent of this article and the general plan, or a specific area plan shall be maintained and preserved.
- (g) All land included for purposes of development within a PUD District shall be owned or under control of the petitioner for such zoning designation.
- (h) All proposed PUD's must be in accordance with the adopted capital improvements program, if any.
- (i) If a PUD contains a mixture of land uses, such as residential and commercial or some other combination, the schedule of development shall provide for coordination of these mixed uses.
- (j) Underground utilities will be encouraged wherever possible. Control and maintenance of any privately owned utilities provided by the applicant shall be governed by section 33-577(9)
- (k) County standards for roads, streets, drainage and other such items shall be adhered to unless otherwise provided in this article.
- (l) Those parts of development or construction plans involving engineering, architecture, landscape

architecture or land surveying shall be prepared and certified respectively by an engineer or architect, landscape architect, or land surveyor duly licensed by the state

(2) *Public facility and public safety standards*

- (a) A PUD shall be located in an area in which police and fire protection and other public facilities are available and adequate for the uses proposed provided, however, that the applicant may provide such facilities which are not presently available, and written assurance of such provision shall be included as a part of the approved final development plan. The criteria under which such applicant-provided facilities will be accepted shall include consideration of facility timing as outlined in the general plan or specific area plan, or capital improvements program, if any as well as other applicable county standards for such construction.
- (b) Within a PUD, there must be adequate space to permit accessibility to all structures by fire-fighting and similar emergency equipment.
- (c) The applicant shall install fire hydrants within a PUD so that there are no more than six hundred (600) feet between hydrants
- (d) All residential buildings of two (2) or more stories shall incorporate a heat and smoke detection device in each living unit. All buildings of three (3) or more stories shall incorporate sprinkler systems for enclosed hallways and stairwells
- (e) Where water pressure or lack thereof in a project is considered by the county to present a potential problem, the applicant may be required to install and maintain booster pumps or a system of wet standpipes in all buildings of three or more stories in height.
- (f) The applicant may also be required to provide and maintain power packs for emergency lighting in the event of fire or similar conflagration.

- (g) Elevators and passageways provided in residential structures shall be capable of accommodating a stretcher

(3) *Fill and excavation.*

- (a) The applicant's plans should minimize the hauling of fill along county rights-of way
- (b) The applicant should avoid placing fill in natural floodplains to the extent possible
- (c) Any artificial lake created for the purposes of storm water containment or for fill material is expected to meet all applicable county standards
- (d) The applicant is encouraged to utilize naturally existing high and dry land for higher density residential uses.

(4) *Vehicular and pedestrian movement*

- (a) Principal vehicular access to a PUD shall be from streets and roads that meet county standards and are capable of supporting existing and anticipated volumes of traffic, as well as traffic that will be generated by the PUD. Access points shall be designed to provide smooth flow, controlled turning movements and minimum hazard to vehicular or pedestrian traffic. Merging lanes, deceleration lanes, left turn stacking lanes and traffic dividers shall be provided where existing or anticipated heavy flows of traffic indicate such need. Where present or potential traffic loads indicate a need, traffic signals shall be provided. No streets or roads within a planned unit development shall connect to exterior streets in such a way as to encourage use of minor local streets for through traffic. Dedication to the public of internal streets may be required by the board of county commissioners, if necessary, and internal as well as external PUD circulation patterns shall be coordinated with the adopted county thoroughfare plan, if any

- (b) Traffic visibility, both automobile and pedestrian shall be preserved as follows. No impediment to visibility within the right-of-way between two and one-half ($2\frac{1}{2}$) and seven (7) feet above centerline grades may exist at the intersection of any street or road internal to or at the perimeter of a PUD within a triangle beginning at the junction of right-of-way lines (projected if round corners exist), thence fifty (50) feet along said lines, thence along the line connecting those two (2) points.
- (c) Project entrances from a PUD to arterial and collector roads should not be closer than one-quarter ($\frac{1}{4}$) of a mile from the next entrance along an arterial or collector road.
- (d) Jog-type and nonright angle intersections shall be avoided.
- (e) Commercial truck traffic should be separated from other vehicles to the maximum extent feasible.

(5) *Parking.*

- (a) The applicant is encouraged to provide attractive, landscaped, well-lighted storage and loading areas for all types of motor vehicles, as appropriate to the development.
- (b) Minimum off-street parking space requirements for residential uses shall be related to the number of bedrooms provided by the applicant as follows.

Efficiency apartments, 1.50 parking spaces per unit;

One-bedroom units, 1.75 parking spaces per unit;

Two or more bedroom units, 2.0 parking spaces per unit.

- (c) Commercial parking standards. The applicant shall provide a minimum of five and five-tenths (5.5) off-street parking spaces per one thousand

(1 000) square feet of gross leasable commercial floor area except that the applicant may provide information to justify anticipated multiple use or off-street parking areas. If such multiple use or parking areas will not create parking problems or traffic hazards a reduction in the number of required off-street commercial parking spaces may be authorized.

- (d) Subgrade parking accommodations are encouraged where feasible.
- (e) Residentially oriented parking areas should be designed for no more than a sixty (60) vehicle storage capacity, and for a maximum of fifteen (15) vehicular spaces unbroken by landscaping.
- (f) Parking areas are encouraged to be within one hundred fifty (150) feet of any residence served by such areas.
- (g) Entrances to parking areas should be identified by appropriate lighting.
- (h) Parking spaces shall be not less than ten (10) by twenty (20) feet in dimension, and parking aisles should be at least twenty-five (25) feet in width. Angle and parallel parking shall meet standards set forth in the American Institute of Architects' "Architectural Graphic Standards, Sixth Edition" (New York, 1970).

(6) *Drainage.*

- (a) The applicant shall meet all applicable state, federal, and county standards for the design of drainage facilities, including on-site containment of storm water runoff.
- (b) The applicant, wherever possible, shall utilize skimmers and other mechanical devices to remove undesirable pollutants, especially from water runoff from pavement areas.
- (c) The applicant shall take particular care in the design of drainage facilities to preserve or

enhance the quality of any adjacent bodies of water in accordance with federal state and county guidelines

(7) *Screening*

- (a) Fences walls and/or vegetative screening should be provided at the perimeter of PUD's where necessary to reduce noise glare, or other influences having an adverse impact either on the PUD or on adjacent property Screening should be of sufficient height to eliminate the impact of such adverse elements on the first floor of any use located either within or adjacent to the PUD
- (b) Such screening requirements may also be necessary to separate different land uses within the PUD such as residential uses from commercial uses, developed recreation areas utility facilities or outdoor loading and/or storage areas

(8) *Open space*

- (a) There should be reasonably convenient access from all occupied structures to common open spaces
- (b) Contiguous and interrelated open spaces are desired.
- (c) Open space plans should attempt to preserve valuable site amenities such as trees natural land forms topography, dunes, etc.
- (d) Open spaces should not be physically altered except for the addition of landscaping and except as necessary to further one or more specific development objectives of the applicant.
- (e) If a proposed PUD is to be constructed in a timed series of development phases and if such phases include provisions for either common or dedicated open spaces including developed recreation space the total area of common or dedicated open space including developed recreation space provided at

the end of any phase of development shall bear substantially the same relationship or greater to the total open space to be provided in the entire PUD as the structures or units completed or under development bear to the entire PUD

(9) *Management and care of common elements*

- (a) The applicant shall provide for and establish a property owners' association organization or other legal entity for the ownership and maintenance of any common elements such as open spaces or utilities designated on the development plans. The power and authority of such organization shall be insured and protected by covenants running with the land, and such covenants shall be included as part of the development plans subject to approval by the county attorney and board of county commissioners. The established organization shall not be dissolved nor shall it dispose of any common elements, by sale or otherwise (except to an organization conceived and organized to own and maintain the common elements) without first receiving approval from the board of county commissioners. The board as a condition precedent to the dissolution or disposal of common elements, may require dedication of common open areas or utilities to the public as deemed necessary.
- (b) Such covenants shall further provide that if the organization established to own and maintain common elements (or any successor organization) fails at any time to maintain the common elements in reasonable order and condition in accordance with the approved final development plan, then the board of county commissioners can serve written notice by certified mail, return receipt requested, upon such organization and upon each owner of real property within the PUD which notice shall set forth the manner in which the organization has failed to maintain the

common elements in reasonable order and condition and shall demand that such failure be remedied within thirty (30) days of the sending of such notice or in the alternative that such organization appear before the board at a specified time (at least ten (10) days but not more than thirty (30) days after the sending of such notice) either to contest the alleged failure to maintain the common elements or to show cause why it cannot remedy such failure within the thirty-day period. If such failure has not been remedied within the thirty-day period or such longer period as the board may have allowed, then the board, in order to preserve the taxable values of the real property within the development and to prevent the common elements from becoming a public nuisance shall hold a public hearing to consider the advisability of the county entering upon such common elements and maintaining them for a period of one year. Notice of such hearing shall be sent by certified mail, return receipt requested, to the organization involved and to each owner of real property within the PUD and shall be published one time in a newspaper of general circulation published in the county. Such notice shall be sent and published at least fifteen (15) days in advance of the hearing. At such hearing the board may determine that it is or is not advisable for the county to enter upon such common elements take possession of them and maintain them for one year. The covenants running with the land occupied by the PUD shall grant to the county such right of entry, possession and maintenance, provided that the above procedures have been followed and shall provide that such entry, possession and maintenance shall not constitute a trespass. Such entry, possession and maintenance shall not give the public any right to use the common elements.

- (c) The covenants running with the land occupied by the PUD shall further specify that the board may,

upon public hearing with notice given and published in the same manner as above return possession and maintenance of such common elements to the organization or successor organization, abandon such possession and maintenance, or continue such possession and maintenance for additional one-year periods

- (d) The covenants creating such organization shall further provide that the cost of such maintenance by the county shall be assessed ratably against the properties within the development that have a right to enjoyment of the common elements and shall become a charge or lien on said properties and such charge shall be paid by the owners of said properties within thirty (30) days after receipt of a statement therefor
- (10) *Fees* Each petitioner for a PUD District shall pay a fee to the county for the examination of development plans or an amendment thereto and the inspection of all required improvements shown on such plans. Such fees shall be determined by the board of county commissioners, which by resolution shall establish or change from time to time a schedule of said fees for the examination of preliminary and final development plans and plan amendments, as well as the inspection of all required improvements included in these plans. Such fees shall be payable to the Martin County Board of County Commissioners and deposited to the credit of the general fund. (Ord No 35 Part 1, 6-28-74)

Sec. 33-578. Planned unit development general procedures.

Petitions for PUD zoning shall be submitted and processed in the same manner as for zoning changes generally and in accordance with the following general procedures

- (1) *Preapplication conference.* Prior to submitting a formal application for PUD zoning, the petitioner is

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required to jointly confer not less than once with representatives of the planning and zoning department and such other agencies or staffs of the county as may be involved in the review and processing of such applications. The applicant shall be notified in advance as to which other county agencies will be involved in such meeting. The petitioner is encouraged to consider at least two (2) alternative plan concepts to discuss with staff members. The staff will advise the applicant on the feasibility of various possible design alternatives and also provide information regarding any projected plans, programs or other matters that may affect the proposed PUD. The required preapplication conference shall address the following matters:

- (a) Physical characteristics of the site for the proposed development.
- (b) The relation between the anticipated project and surrounding uses, and the effect of the proposed development on the general plan or specific area plan and/or stated planning and development objectives of the county.
- (c) The status of existing and proposed streets, utilities, or other public and private facilities to serve the development, specifically as the development relates to the county's capital improvements program, if any.
- (d) The nature, design, efficiency and appropriateness of the proposed streets, utilities and other common facilities planned to service occupants and users of the PUD.
- (e) Common open areas proposed by the applicant.
- (f) Maintenance mechanisms and procedures designed to guarantee the care and upkeep of common elements.
- (g) The applicability of Chapters 380.05 and 380.06, Florida Statutes, dealing respectively with areas of critical state concern, and developments of regional impact (DRIs).

- (h) Regional, state or federal permits required if any
- (2) *Application form.* The application form for a change of zoning to a PUD District shall include the following information
 - (a) Name, address, and telephone number of the owner of record of the property to be rezoned
 - (b) Name, address and telephone number of the developer if different from the owner and an explanation for the difference.
 - (c) Name address and telephone number of the project liaison.
 - (d) Names addresses and telephone numbers of the professionals involved with the PUD
 - (e) Exact location of the proposed project, with project boundaries clearly marked, as shown on a copy of current county assessment maps
 - (f) Proposed name of project, which name is subject to acceptance by the board of county commissioners and which must comply with the spirit and intent of Chapter 177 051, Florida Statutes.
- (3) *Filing of applications* Any application required under this article shall be filed with the planning and zoning department, where it shall be reviewed for general completeness and for compliance with this article before being sent to reviewing departments agencies and officials. Except as directed by the board of county commissioners, the following requirements shall be adhered to by the planning and zoning department in processing a PUD application.
 - (a) A PUD application including the preliminary development plan with supporting documents as identified in this article shall be submitted to the planning and zoning department on an official application form together with a check payable to the "Martin County Board of County Commissioners" in an amount equal to the proper processing fee

- (b) All written correspondence concerning the application either between the applicant and the county, between the applicant and the various individual review staffs, or between these various staffs shall be submitted through the planning and zoning department. Both the applicant and the planning and zoning department shall designate a liaison for purposes of such communication.
- (c) The application shall be reviewed by the planning and zoning department for any items requiring correction or completion. If the application is incomplete, or if corrections are required, it will be returned to the applicant with a list of deficiencies within ten (10) working days from the date of submission. After submission of a corrected application, the planning and zoning department shall have ten (10) working days in which to determine that all deficiencies have been corrected.
- (4) *Application materials—Evidence of unified control.*
The applicant shall present with the application form, evidence of unified control of the entire area within the proposed PUD district. This shall include a title insurance policy or attorney's certificate of title or other evidence acceptable to the county attorney for the subject property, and a covenant of unified control as described in section 33-581.2(F).
- (5) *Same—PUD agreement.*
 - (a) The applicant shall provide a proposed agreement wherein it is stipulated that the proposed development, if initiated, will be undertaken and carried out in accordance with.
 - 1. The preliminary and final development plans as officially adopted.
 - 2. The regulations existing when the amendments creating the PUD were approved.

- 3 Such other conditions or modifications as may be attached to the PUD District in the process of the zoning change
- (b) Following approval of a PUD application the applicant shall provide a final agreement stipulating to the specific conditions under which the PUD will be constructed
- (6) *Same—Preliminary development plan for a major PUD*
 - (a) Development site information to be submitted with a major PUD application shall include the following information
 - 1 Vicinity map at a scale of not less than one inch equals two thousand (2,000) feet.
 - 2 Recent (less than twelve (12) months old) vertical aerial photograph of the site, with project boundaries clearly marked.
 - 3 Boundary survey related to true meridian or U.S. Coast and Geodetic Survey state grid north.
 - 4 Full legal description of the property with attached copies of any instruments referred to such as deeds, plats, covenants or restrictions etc.
 - 5 Names of owners, zoning district classification and uses of the tract to be rezoned, the same for any contiguous holdings of the applicant (disregarding intervening roadways easements, etc.), and the same for each adjoining tract in separate ownership. If the proposed PUD does not cover all of the contiguous holdings of applicant, said PUD must be distinctly identified and an explanation of the reason for such difference provided.
 - 6 All adjoining property owners within three hundred (300) feet must be identified by name

- and address Where there is ownership by a condominium only the condominium association need be listed.
- 7 Total area of the tract.
- 8 Topographic map with contour intervals of one foot at a scale of not less than one inch equals one hundred (100) feet
- 9 The location of the following existing items within or immediately adjacent to the property Buildings structures or other improvements utilities drainageways ditches swales coastal construction setback line, anti-mosquito ditches, easements of any kind whether used or not abutting streets and roads including width and route numbers railways, culverts burial grounds and property lines and recorded plats docks jetties, boat ramps, bulkheads or other water related structures.
- 10 The location and approximate area of the following existing items within or immediately adjacent to the property Watercourses, water surfaces, wooded areas, and wetlands by types (i.e., fresh water swamp, salt water marsh, intertidal area wet prairie or savanna) unless such information is otherwise available to the county
- 11 Detailed soils analysis with associated vegetation types, unless such information is otherwise available to the county
- 12. Wet and dry season water tables unless such information is otherwise available to the county
- 13. Evidence of unified control per section 33-578(4)

(b) Preliminary development design information for a major PUD shall include

- 1 Statement of intended market indicating probable occupant characteristics
- 2 Land use plan or plans showing the location arrangement and dimensions of all proposed land uses including the number of floors and height of all buildings above finished grade or above the first floor living elevation, building setbacks from the development boundaries and from adjacent streets roads alleys and ways the proposed traffic circulation pattern including the location and width of all streets driveways, walkways, bikeways, and entrances to parking spaces all proposed off-street parking and loading areas, all proposed common elements including common open spaces and dedicated open space and developed recreation areas
- 3 A plan or statement showing the location and design of all landscaped buffers or other screening and indicating the type of materials proposed and height of such screening
- 4 A plan or statement detailing the manner of improving common or dedicated open spaces including developed recreation areas, together with all covenants including lease-hold interests, restrictions and conditions pertaining to the use, maintenance, and operation of common elements
- 5 A statement in tabular form of the anticipated residential density (if any), the total number of dwelling units by type, size number of bedrooms and site location and gross leasable floor area for commercial as well as other nonresidential uses, as appropriate
- 6 Percentage of the site to be covered with buildings, sidewalks parking areas, roofed structures, and other impervious surfaces, percentage of the site to be covered with water

bodies percentage of the site to be in golf course use (if any) percentage of the site to be landscaped and percentage of the site to be left in a natural undisturbed condition

- 7 An engineer's statement detailing preliminary proposals for providing drainage outfall and on-site retention conforming with such county regulations and ordinances as are in force and effect, including calculations size of storm water retention areas methods for pollutant removal location of berms swales, culverts storm water sewers finished grades and proposed slopes and grades adjacent to bodies of water
- 8 A plan or statement detailing preliminary proposals for connection with existing water supply and sanitary sewer systems or an alternative means of supplying water for drinking and irrigating and of supplying sanitary waste treatment and disposal.
9. Architectural sketches of typical proposed structures including exterior lighting systems, signs and landscaping.
- 10 When a development is to be constructed in phases or units, a sequence of development schedule showing the construction of each principal functional element of such phases or units, the approximate completion date for each phase or unit and the extent, timing, and estimated costs of all improvements or items to be dedicated, such as roads, sewerage drainage, and other public or private facilities, required to construct the proposed PUD
11. Location of temporary perimeter stakes and a temporary sign three (3) by five (5) feet in size located at the front of the property identifying the project by number in order for county personnel, members of review agencies, plan-

ning and zoning commissioners and county commissioners to locate the project and to make site inspections, such sign to be erected within ten (10) days of application submission.

12. If the PUD contains subdivision lots a preliminary plat of such lots or parcels
13. A statement illustrating the relation of the PUD to the general plan and the specific area plan.
14. When a proposed PUD contains fifty-one (51) or more dwelling units or more than twenty thousand (20,000) square feet of gross leasable commercial floor area, the following additional materials will be provided.
 - a. A plan or statement detailing the ecology of the site in its existing state, including a description of the flora and fauna (including aquatic communities) normally found there, and assessing the impact of the proposed development on these natural resources.
 - b. A plan or report discussing costs and benefits that will accrue to Martin County as a result of the PUD including a brief evaluation of police, fire protection, ambulance service, emergency rescue service water, sewerage, solid waste schools transportation facilities, health and welfare service, parks, recreation, open space and cultural facilities, and other public facilities.

(7) *Same--Preliminary development plan for a minor PUD* Preliminary development site and design information to be submitted with a minor PUD application shall include

- (a) Items 2 through 9 both inclusive and item 13 of section 33-578 (6)(a)

- (b) Item 2, items 4 through 8 both inclusive, and items 11 and 12 of section 33-578 (6)(b)
- (8) *Same—Final development plan for a major PUD*
Final detailed information for a proposed major PUD or phase thereof shall include
 - (a) Detailed plans showing the exact location, arrangement and dimensions of all proposed land uses including the number of floors and height of all buildings above finished grade and above the first floor living elevation; building setbacks from the development boundaries and adjacent streets, roads, alleys and ways, exact location of the traffic circulation pattern including the location and width of all streets, driveways, walkways, bikeways, and entrances to parking spaces, final design of off-street parking and loading areas with exact dimensions final design for all common areas including common open areas, dedicated open space and developed recreation areas.
 - (b) A detailed plan showing the location and design of landscaped buffers and other screening, indicating the type of materials proposed and the height of such screening.
 - (c) A detailed plan or document indicating the exact manner of improving developed recreation areas and all covenants including lease-hold interests, restrictions and conditions pertaining to the use, maintenance, and operation of common areas
 - (d) An exact statement in tabular form, summarized by phases, of the approved residential density (if any), total number of dwelling units by type, size, site location, and number of bedrooms and total floor area (gross leasable) for commercial as well as nonresidential uses.
 - (e) The exact percentage of the site to be covered with buildings, sidewalks, parking areas, roofed structures, and other impervious surfaces areas to be

covered by water bodies, or by golf courses (if any), areas to be landscaped, and those to be left in natural undisturbed condition

- (f) A detailed engineer's statement and working drawings for providing drainage outfall and on-site retention conforming with such county regulations and ordinances as are in force and effect, including appropriate calculations exact size of storm water retention areas final diagrams of pollutant removal structures exact location of berms, swales culverts, storm water sewers, and finished slopes and grades.
- (g) Final working drawings and details for providing water supplies for drinking and irrigating and for providing sanitary sewer systems with all applicable permits.
- (h) Architectural drawings of the proposed structures including front, side and rear elevations, precise building layout (external and internal), exact site design, including exterior lighting systems signs and landscaping
- (i) A final plan or report indicating extent, timing and estimated cost of all improvements such as roads, sewerage, drainage, and other public and private facilities required to construct the PUD or applicable phase thereof, including proposed form of bonds and other instruments as needed, which plan or report will relate to the sequence of development schedule if the PUD is to be constructed in phases or units.
- (j) A final plan showing street and house numbers and names in the PUD or phase thereof, in compliance with Ordinance No 23 [Chapter 30 Article II], which plan must have been presented to and approved by the county office administering Ordinance No 23 [Chapter 30, Article II].
- (k) If the PUD or phase thereof contains subdivision, lots, a final plat for recording with the office of

the county clerk, which plat meets all applicable provisions of the subdivision regulations

- (l) All necessary regional, state and federal permits or approvals in writing
- (9) *Same—Final development plan for a minor PUD* Final detailed information for a proposed minor PUD shall include item (a), items (c) through (g), both inclusive, and items (j), (k) and (l) of section 33-578(8)
- (10) *Same—Number of copies* In addition to information generally required for change of zoning petitions, the applicant shall submit that material or information as herein described in sufficient copies for necessary referrals and records
 - (a) Upon submission of a preliminary development plan application, twelve (12) copies of all plans, reports, maps, documents, and other related information must be supplied to the planning and zoning department.
 - (b) Upon submission of an application for final development plan review, twelve (12) copies of all final plans, reports, maps, documents and other related information must be submitted to the planning and zoning department.
 - (c) Documents reflecting changes or amendments to previously submitted plans shall be furnished in sufficient copies to satisfy the requirements of subparagraphs (a) and (b) above
 - (d) If the proposed PUD is a development of regional impact (DRI) as defined in Section 380.06, Florida Statutes, six (6) copies of all plans, reports, maps, documents and other related information required by the regional reviewing agency (in addition to the normal requirements of this article) shall be submitted to the planning and zoning department.
- (11) *Other general provisions.*
 - (a) The submission of building construction plans and applications for building permits and certifi-

cates of occupancy and other such administrative requirements shall be accomplished in accordance with established county regulations and policy except as herein provided.

- (b) No building permit or certificate of occupancy shall be issued in or for development in a PUD District except in conformity with all provisions of the rezoning to the PUD District.
- (c) Anything in this article to the contrary notwithstanding, the board of county commissioners may by resolution shorten or extend the time period for review of PUD applications generally and may direct such shortening or extension for an/ given application, if the board determines that such shortening or extension is necessary and proper to the orderly and efficient processing of such plans (Ord. No. 35, Part 1, 6-28-74, Ord. No 161, Part 1 8-12-80)

Sec. 33-579. Procedures for preliminary plan review.

(A) *Development review committee (DRC)*

- (1) Applications for a preliminary development plan for a major PUD shall be reviewed within sixty (60) working days of the date on which said application is accepted as complete by the planning and zoning department. Applications for preliminary development plan for a minor PUD shall be reviewed within thirty (30) working days of the date on which said application is accepted as complete by the planning and zoning department. Every effort shall be made to complete the review within a shorter period of time. Extensions of the review time period may be specifically authorized by the applicant. Notification of such authorized extension shall be transmitted to the board of county commissioners by the planning and zoning department.

- (2) A review of the application shall be conducted by the individual staffs of the development review committee (hereinafter called the DRC) and consolidated into a

written report. The DRC shall consist of the department head (or the department head's designee) of the following

- (a) Planning department
 - (b) Zoning department.
 - (c) Engineering department
 - (d) Building department.
 - (e) County (or tri-county) health department.
- (3) The legal department shall provide the DRC such legal counsel as may be required
- (4) In addition, other staffs or agencies (local, regional state or federal) may be requested to review the application. Notification in writing of such other staff or agency reviews shall be given to the applicant by the planning and zoning department.
- (5) Serious problems or difficulties with the application that occur during the review period shall be brought to the attention of the applicant at the earliest possible date so as to allow time to amend the application without undue delay. If the applicant agrees to amend the application as deemed necessary, said applicant shall notify the planning and zoning department in writing. If the amendment is significant and would change the conclusions that might be reached, processing of the application will cease pending receipt of the amendment and the applicant will be notified of such action. When the application is resubmitted, the time period of section 33-578 (3) (c), shall begin again. After acceptance of the revised or amended application, the unexpired balance of the DRC review (sixty (60) or thirty (30) working days as appropriate) period shall apply
- (B) *Prehearing conference.*
- (1) The purpose of the prehearing conference shall be to assist in bringing the application for PUD zoning as nearly as possible into conformity with the intent and

provisions of this article or other applicable regulations and/or to define specifically any justifiable variations from the application of such regulations

- (2) At the end of the aforesaid sixty (60) or thirty (30) working day review period as appropriate (sooner if the various staffs complete their review in less time later if the applicant requests an extension but in no case later than fifteen (15) days prior to the public hearing of the planning and zoning commission at which time the application is scheduled to be discussed), the applicant and/or his representatives shall meet with the DRC during a regularly scheduled public meeting to review the application.
 - (3) The summary report prepared by the DRC pursuant to section 33-579 (A) (2) shall be made available to the applicant at least five (5) working days prior to the regularly scheduled prehearing conference with the DRC, and shall become a part of the public record of the matter.
 - (4) The applicant shall, in writing, not later than five (5) days before the scheduled public hearing of the petition before the planning and zoning commission submit to the planning and zoning department an indication of agreement or disagreement with the recommendations of the DRC. Reasons for disagreement should be clearly stated. All such responses by the petitioner shall be included in the public record of the matter.
- (C) *Review by the water management advisory board.*
- (1) Applicants for preliminary development plan review shall be furnished a copy of the county standards on water management. If the county engineer determines that the preliminary development plan conforms to these standards, or if the applicant amends his plan within the sixty (60) or thirty (30) working day review period, as appropriate, such that the standards are met, the application will not require review by the water management advisory board.

- (2) If the county engineer determines that the application for preliminary development plan does not meet such standards as determined during the DRC review the application shall be scheduled for the next available public meeting of the water management advisory board.
 - (3) The scope of the water management advisory board review may include any development issues concerning ground and/or surface water resources and management, however specific reasons for referral of the application to the board shall be clearly stated on the public agenda.
 - (4) Written recommendations of the water management advisory board should be submitted to the planning and zoning department and to the applicant at least five (5) days prior to the date of the scheduled public meeting before the DRC, and shall be included in the public record of the matter.
 - (5) The applicant shall, in writing, not later than five (5) days before the scheduled public hearing of the application before the planning and zoning commission, submit to the planning and zoning department an indication of agreement or disagreement with any recommendations of the water management advisory board, with reasons for disagreement clearly stated, said correspondence shall be included in the public record of the matter.
- (D) *Hearing before the planning and zoning commission.*
- (1) Upon completion of the DRC review and conditional upon the applicant's compliance with all applicable provisions of this article appropriate public notice shall be given and a public hearing shall be held before the planning and zoning commission on the application for preliminary development plan approval. Advertised public notice shall be given in a newspaper of general circulation published in the county at least fifteen (15) days prior to the public hearing. Notice shall be mailed by certified mail,

return receipt requested, to all property owners within three hundred (300) feet of the subject property at least fifteen (15) days prior to the public hearing. When a property owner consists of a condominium association, notice need only be given to the condominium association. If a proposed PUD is within one mile of a municipality of another county, notification by certified mail return receipt requested must also be given to such municipality or county at least fifteen (15) days prior to the public hearing.

- (2) The planning and zoning commission shall consider whether the county has the capabilities to accept the proposed PUD without adverse fiscal, physical or community service impacts pursuant to the general standards of this district.
- (3) In support of its recommendations the planning and zoning commission shall make determinations as to the
 - (a) Suitability of the locale for the type and pattern of development proposed in relation to
 - 1. Physical characteristics of the site and of surrounding areas.
 - 2. Existing and probable future development, traffic patterns and volumes, drainage sewerage, water availability
 - 3. The proposed PUD relative to the capital improvements program, if any
 - (b) Ability of the proposed development design to achieve the general and specific PUD standards of this article.
 - (c) Adequacy of evidence of unified control and the suitability of any proposed agreements contracts or other instruments, or the need for such instruments (or for amendments in those proposed), particularly as they reflect arrangements or provisions to be made for the continuing

operation and maintenance of such common areas and facilities as are not to be provided and maintained at public expense Determinations and recommendations of this type shall be made only after consultation with the county attorney

(4) The planning and zoning commission shall take one of the following actions

(a) Recommend approval to the board of county commissioners of the preliminary development plan conditional upon submission of an acceptable final development plan and pertinent documents

(b) Recommend approval to the board of county commissioners of the preliminary development plan conditional upon.

1 Modifications to the plan clearly stated.

2 Submission of an acceptable final development plan and pertinent documents

3. Such other provisions as may be determined by the planning and zoning commission.

(c) Recommend disapproval to the board of county commissioners of the preliminary development plan, clearly stating the reasons therefor

(d) Table one time only for lack of information.

(5) The action and minutes of the planning and zoning commission shall become a part of the public record of the matter

(E) *Hearing before the board of county commissioners*

(1) Upon completion of the planning and zoning commission review, and unless the petition is withdrawn by the applicant or unless an additional prehearing conference has been scheduled, the board of county commissioners shall schedule the application for public hearing at the next available commission meeting Advertisd public notice shall be given in a newspaper of general circulation published in the

county at least fifteen (15) days prior to the public hearing. Notice shall be mailed by certified mail return receipt requested, to all property owners within three hundred (300) feet, at least fifteen (15) days prior to the public hearing, except that when a property owner consists of a condominium, notice need only be given to the condominium association. If a proposed PUD is within one mile of a municipality or another county, notice must also be given to such municipality or county by certified mail, return receipt requested, at least fifteen (15) days prior to the public hearing.

- (2) When a development proposal is a development of regional impact (DRI) as defined by Section 380.06, Florida Statutes, the additional public hearing requirements for a DRI shall be followed simultaneously.
- (3) The board of county commissioners shall consider the written recommendations of the DRC, water management advisory board, planning and zoning commission, and presentations by the public in arriving at a decision on the preliminary development plan.
- (4) The board of county commissioners shall consider whether the county has the capabilities to accept the proposed PUD without adverse fiscal, physical, or community service impacts pursuant to the general standards outlined in this article.
- (5) The board of county commissioners may approve a preliminary development plan; approve it with conditions; disapprove the plan, or take any other action it deems necessary. When an application is adopted with conditions, the board should specify what actions must be taken by the applicant in order to fulfill such conditions. When an application is disapproved, the board should state the reasons for the disapproval and indicate what further actions, if any, by the applicant or modifications to the proposed plan, if any, might be undertaken in order to secure the board's approval.
- (6) If a preliminary development plan is disapproved by the board of county commissioners, no further

applications or reviews regarding the property in question will be allowed within twelve (12) months from the date of disapproval except by specific authorization from the board, unless the applicant has incorporated into a revised application all changes or modifications necessary to meet the expressed conditions of the board of county commissioners. The submission of an amended application under the conditions of this subparagraph shall be processed as a new application for preliminary development plan review, subject to the provisions set forth elsewhere in this article, except as directed by the board of county commissioners; and there shall be no presumption that any such amended application for preliminary development plan review will necessarily or automatically be approved by the board of county commissioners.

- (7) Following adoption of a preliminary development plan by the board of county commissioners, the planning and zoning department shall change the official zoning map of Martin County to reflect the change of zoning to a PUD District for the subject property. If a preliminary development plan is adopted with conditions, the planning and zoning department shall change the official zoning map to reflect the PUD Zoning District only after the board of county commissioners has received sufficient documents and/or guarantees from the applicant that the required conditions have been or are being fulfilled. The change of zoning district will normally, but need not necessarily, precede adoption of the final development plan. (Ord. No 35, Part 1, 6-28-74)

Sec. 33-580. Procedures for final development plan review.

(a) The purpose of the final development plan review is to provide a mechanism for the county to examine the applicant's detailed construction plans, legal documents and other related materials required to bind the agreements

made during preliminary development plan review and approval. The final development plan for all of the proposed PUD, or any designated phase thereof, including all agreements, provisions documents maps and other pertinent information, shall be adopted as an amendment to the PUD Zoning District by resolution of the board of county commissioners, and shall control development of the entire PUD or applicable phase(s) thereafter

(b) Upon receipt of an application for final development plan review, the planning and zoning department shall have ten (10) working days to ascertain if any items require correction or completion, as described in section 33-578(3)

(c) Completed applications for a final development plan for a major PUD shall be reviewed by the DRC within thirty (30) working days from the date of acceptance of the completed application. Completed applications for a final development plan for a minor PUD shall be reviewed by the DRC within fifteen (15) working days from the date of acceptance of the completed application. Every effort shall be made to complete the review within a shorter period of time. Extensions of the review time period may be specifically authorized by the applicant. If the completed applications are found satisfactory with respect to form, content, accuracy, and other such requirements including any conditions as attached to the preliminary development plan by the board of county commissioners, such applications shall be scheduled for final development plan review at the next available regularly scheduled public meeting of the board of county commissioners.

(d) Serious problems or difficulties that occur during the final development plan review shall be brought to the attention of the applicant at the earliest possible date. Failure of the applicant and the DRC to resolve such issues, or questions as to the intent of the board of county commissioners in approving the preliminary development plan, shall cause the application to be returned to the next available public meeting of the board of county commissioners for clarification. (Ord. No 35, Part 1, 6-28-74)

Sec. 33-581. Procedure upon breach of PUD agreement.

(a) In the event that an applicant has received final development plan approval and has not sought building permits within six (6) months from the date of such approval, or has fallen behind the agreed development construction schedule by twelve (12) months or more the board of county commissioners shall serve notice to the applicant in writing of the date and place of a public hearing on the planned unit development at which time the applicant will be given an opportunity to explain the reasons for the scheduling delays and to propose a method of fulfilling his obligations under the planned unit development zoning agreement. The board may at its discretion allow the applicant time to demonstrate his willingness to meet the county's conditions

(b) If at the end of a reasonable period of time the applicant is clearly unable or unwilling to abide by the PUD zoning agreement, or if the conditions of the zoning agreement have in some other manner been clearly violated the board of county commissioners shall advertise for a public hearing on the PUD, the purpose of which shall be to cause the property to revert to its immediately pre-existing zoning classification.

(c) In the event of such breach of a PUD agreement, and the reversion of the property to its prior zoning classification, no further building permits shall be issued to the applicant (or to his successors in interest) based upon the final development plan. Those portions of the property which may have buildings or structures constructed upon them in conformity with the final development plan shall thenceforth be regarded as nonconforming uses with respect to the revised zoning classification. (Ord. No 35, Part 1 6-28-74)

Sec. 33-581.1. Procedures for amending a PUD.

(a) Upon application by owner, the board of county commissioners may amend the preliminary development plan or final development plan of a PUD. Minor amend-

ments may be reviewed and approved or disapproved by the board of county commissioners after being placed on an agenda for a regularly scheduled meeting. Any amendment to a PUD district other than a minor change shall be processed with the necessary data to be determined by the DRC and shall meet all other substantive and procedural requirements of this article except that the letter notice shall only be sent to all property owners within three hundred (300) feet of the building(s) structure(s) or other improvement(s) to be amended. The DRC shall determine whether a proposed amendment is minor or major and in making that determination the DRC shall consider the following:

- (1) The extent, if any, to which the amendment would affect the cubic volume of any building, the number of structures, the number of dwelling units;
- (2) The extent, if any, to which the proposed amendment would affect the location of any lot, block, building, structure, setback or common open area;
- (3) The extent, if any, to which the proposed amendment would affect the location or amounts of land devoted to specified land uses;
- (4) The extent, if any, to which the proposed amendment would affect the PUD agreement or any of its exhibits;
- (5) The extent, if any, to which the proposed amendment would affect the intent of the preliminary development plan or final development plan;
- (6) Any change of the perimeter boundary of the PUD district shall be considered to be a major change.

(b) Any determination by the DRC that an amendment is minor may be reversed by the board of county commissioners. Any determination by the DRC that a proposed amendment is major may be appealed by the applicant to the board of county commissioners and may be reviewed by the board after being placed on the agenda of any regularly scheduled meeting. In making a determination as to

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whether an amendment is minor or major the board of county commissioners shall use the criteria established in subsection (a) above

(c) In the event the construction of any building, structure or other improvement does not comply with the preliminary or final development plan, the developer shall be ordered by the planning and zoning department to cease all such construction and no further building permits shall be issued until the construction has been reviewed as a major or minor amendment by the board of county commissioners in accordance with paragraph (a) above. At such public meeting it shall be the applicant's responsibility to justify to the board of county commissioners any variation from the preliminary or adopted final development plan. The board may, at its discretion, authorize any necessary modifications to the original PUD agreement or preliminary or final development plan. If the applicant is unable to justify such modifications to the board, the provisions of section 33-581, paragraphs (b) and (c) shall apply (Ord. No. 35, Part 1, 6-28-74, Ord. No. 161 Part 1, 8-12-80)

Sec. 33-581.2. Planned unit development—Definitions

(a) *Common elements* Lands, structures and facilities whose ownership or use is shared by all owners or occupants within the PUD. Common elements may include but are not limited to open space, recreation facilities, water bodies, private streets and roads, utility systems, and joint parking or loading provisions.

(b) *Common open areas* Any lands under common ownership and control that are not covered by buildings, roofed structures or impervious surfaces, specifically excluding golf courses and natural water bodies. Also referred to as open space or common open space.

(c) *Developed recreation areas* Lands, structures and facilities under common ownership and control that have been improved to accommodate active recreational activity.

ties including but not limited to play areas ball fields and courts, golf courses, artificially created water bodies recreational or social clubhouses, buildings and structures bike trails and other paved recreational areas

(d) *Property owners association*. A nonprofit organization legally recognized by the laws of the State of Florida and operated according to recorded land agreements through which private landowners share the direct and indirect expenses of maintaining common areas Also referred to as home owners' association

(e) *Applicant*. Any owner, developer or individual legally authorized by the owner(s) of property to represent such owner(s)' interest in the development of the property

(f) *Covenant of unified control*. In order to preserve the integrity of the development plan and insure its execution, the owner or owners shall provide a covenant of unified control to be recorded that stipulates that all of the subject property within the PUD will not be transferred, conveyed, sold or divided in any unit other than its entirety, except that individual fully constructed units and subdivision lots, if any, may be conveyed to individual purchasers. The covenant of unified control may also provide, upon approval by the board of county commissioners, for the following conveyances.

- (1) If the PUD is designed and planned to be developed in phases or portions of phases, and each phase or portion of a phase complies with the requirements contained within the PUD agreement, then each phase or portion of phases may be conveyed separately upon final development plan approval of that phase or portion of a phase, unless otherwise provided for in the PUD agreement.
- (2) Common elements, common open areas and developed recreation areas, if any, may be conveyed to a property owners' association or other legal entity so long as such conveyance shall be subject to the express restriction that the subject property will never

be used for any purpose other than as common elements, common open areas or developed recreation areas as applicable

- (3) Other portions of the subject property that will be used or maintained by governmental, environmental, charitable or other organizations or agencies for such purposes as the board of county commissioners may deem appropriate
- (4) Any amendment to an existing PUD agreement that affects the covenant of unified control shall be considered a major amendment and letter notice shall be provided to all residents within the development.

(g) *Parking area.* A land area devoted to the storage and maneuvering of motor vehicles, whether such area is of pavement or grassed surface, including automobile storage spaces, parking aisles and other streets and roads permitting ingress and egress to parking spaces and associated landscaped areas and structures

(h) *Gross leasable floor area.* The total floor area within buildings designed for nonresidential use, which area is or might be leased to tenants

(i) *Total residential floor area.* The total floor area within the exterior walls of all buildings devoted to residential purposes, excluding only garages, carports, covered parking structures, breezeways, open porches, open balconies and storage or utility rooms not accessible from the interior of a building. For single-family lots upon which the purchaser will eventually build a dwelling structure a figure of two thousand (2,000) square feet may be used to calculate total floor area. (Ord. No. 35, Part 1, 6-28-74, Ord. No. 161, Part 1, 8-12-80)

Secs. 33-581.3—33-581.10. Reserved.

**DIVISION 4. PUD (I) PLANNED UNIT DEVELOPMENT
(INDUSTRIAL) SUB-DISTRICT**

Sec. 33-581.41. Purpose and intent.

(A) The purpose of this sub-district is to provide a district that may be used at the option of the developer to establish industrial planned unit developments at appropriate locations.

(B) Industrial planned unit developments, which are approved in accordance with the terms and provisions of this sub-district, may depart from the strict application of use, setback, height and lot requirements of standard zoning districts, provided that such developments do not conflict with the public health, safety and general welfare.

(C) A further purpose of this sub-district is to provide for broad discretionary authority by the board of county commissioners to approve or disapprove industrial planned unit development applications based upon the health, safety and general welfare of the present and future residents of Martin County.

(D) It is also the purpose and intent of the industrial planned unit development sub-district to encourage developments that meet most, but not necessarily all, of the following criteria:

- (1) A location with frontage on an arterial highway;
- (2) An integrated circulation and parking plan with provision for adequate parking and delivery access;
- (3) The provision of management, maintenance and/or promotional services to individual occupants;
- (4) Unified architectural design and landscaping. (Ord No. 164, Part 1, 4-14-81)

Sec. 33-581.42. PUD(I) Definitions.

Editor's note—Part 1 of Ord. No. 164 enacted the catchline of § 33-581.42, as set forth above, with no substantive provisions. At the request of the county, said section is included herein as enacted.

Sec 33-581.43 Uses authorized in the industrial PUD(I) district

All uses authorized within a PUD(I) district as stipulated by this article shall be conditional uses subject to approval of a PUD development plan by the board of county commissioners. No use, location of use, intensity of use or condition of use shall be approved if it is found by the board of county commissioners to be contrary to the adopted planning and development policies and objectives of Martin County or contrary to the health, safety and general welfare of the present and future residents of the county.

Subject to the above, the following uses may be permitted:

- (a) Uses permitted in the public service district and any industrial use other than those uses permitted in the M-3 industrial district.
- (b) Utility plants and substations to include wastewater, potable water, electricity, telephone and natural gas services.
- (c) General office, retail, service and wholesale commercial activities which are compatible with the industrial usage.
- (d) Residential uses not to exceed fifty (50) per cent of the total developed area.
- (e) Off-street parking areas, garages and structures, as accessory to any of the permitted uses (Ord. No. 164, Part 1, 4-14-81).

Sec 33-581.44 Development standards

(A) All PUD(I) projects shall conform to the standards for planned unit developments as set forth in section 33-577 of this Code except where in conflict with the provisions of this division.

(B) All PUD(I) projects shall conform to federal, state and local codes, and all applicable permits and approvals shall be obtained from the appropriate agencies prior to approval of the final development plan.

(C) Circulation

- (1) No permanent entrance to a PUD(I) shall be permitted within five hundred (500) feet of an existing or designated arterial or collector highway intersection, unless there exists a parallel road system for the arterial highway or some other traffic arrangement designated to accommodate additional vehicular traffic without congestion at the intersection
- (2) The use of parallel service or reverse frontage roads for access to large PUD(I) projects with high rates of traffic generation is recommended
- (3) Parking areas shall have pedestrian walkways, striped and signed pedestrian crosswalks, raised curbs, bumper stops, landscaped areas and traffic signs located in accordance with good safety practice

(D) Off-street parking

- (1) Parking spaces should be located within walking distance of the buildings they are intended to serve
- (2) Parking area designs shall conform to Martin County's landscape ordinance (section 23-52 of this Code)
- (3) Parking areas shall contain outdoor lighting (at appropriate intervals and levels of illumination in accordance with county lighting policies)
- (4) No parking shall be allowed immediately in front of building entry driveways.
- (5) Within a parking aisle or parking area, the design shall not mix right-angle (ninety (90) degree) spaces with diagonal parking
- (6) Consideration shall be given to allowing credit for on site multiple uses and required parking spaces
- (7) Parking shall be provided for handicapped persons as required by the Florida Statutes and this Code
- (8) The following are minimum standards for the design of parking areas (excluding loading areas)

ZONING

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	<i>90-Degree Parking Two Way</i>	<i>60-Degree Parking One-Way</i>	<i>45-Degree Parking One Way</i>
Aisle width	23	18	15
Stall width	10	12'	14 2"
Stall depth	20'	25'9"	30
Stall depth when confined with- in walls (nested)	20	18'	17'
Overhang	2	2'3"	2 6"

- (9) The following minimum standards shall be used to determine the required number of parking spaces for various uses within an industrial PUD
- (a) *General industrial usage* One (1) space for each fifty (50) square feet of customer service area, plus one (1) space for each five hundred (500) square feet of gross floor area.
 - (b) *Research/Development Laboratory* One (1) space for each fifty (50) square feet of customer service area, plus one (1) space for each five hundred (500) square feet of gross floor area.
 - (c) *Warehouse* One (1) space for each fifty (50) square feet of customer service area, plus one (1) space for each one thousand (1,000) square feet gross floor area.
 - (d) *Wholesale trade* One (1) space for each four hundred (400) square feet of gross floor area
 - (e) *Retail trade* One (1) space for each two hundred (200) square feet of gross floor area.
 - (f) *Restaurants (sit-down)* One (1) space for each one hundred fifty (150) square feet of gross floor area
 - (g) *Bars/lounges* One (1) space for each one hundred (100) square feet of gross floor area.
 - (h) *Financial institutions* One (1) space for each two hundred (200) square feet of gross floor area, plus sufficient area for eight (8) stacking spaces for the first drive-in window and five (5) stacking spaces for each additional window

- (i) *Hotels and motels* One (1) space for each guest room or suite, plus one (1) space for each three (3) seats of any restaurant lounge, or convention center that is part of the hotel and motel
 - (j) *Medical dental or veterinary office or clinic* Five (5) spaces plus one (1) space for each one hundred fifty (150) square feet of gross floor area
 - (k) *Professional or business office* One (1) space for each two hundred (200) square feet of gross floor area.
 - (l) *Residential* Minimum off street parking space requirements for residential uses shall be related to the number of bedrooms provided by the applicant as follows Efficiency apartments, one and five-tenths (1.5) parking spaces per unit, one-bedroom units, one and seventy-five-hundredths (1.75) parking spaces per unit, two (2) or more bedroom units, two (2) parking spaces per unit.
 - (m) *Utility plants and substations for waste water, potable water, electricity, telephone and natural gas services* One (1) space for each five hundred (500) square feet of office and work area floor space
 - (n) *Other uses not specifically set forth above* One (1) space for each two hundred (200) square feet of gross floor area
- (10) Designated grassed areas with stabilized sub-base for overflow parking purposes may be used to provide up to ten (10) per cent of the required number of parking spaces
- (11) Areas shall be provided for the delivery and storage of goods, truck parking and the storage and collection of refuse and such areas shall be screened appropriately
- (E) Utilities, including drainage
- (1) Consideration should be made to having electrical, water and sewer, and communication utility lines

placed underground Utilities shall conform to all applicable federal state and local codes

- (2) Parking area lighting fixtures within three hundred (300) feet of any adjacent private residence or public road shall be designed or shielded or be of nonglare lighting so as to eliminate glare to residents and to users of the road
- (3) Any areas used for the storage or collection of refuse shall be screened from view, except that self-contained trash collection systems may be utilized
- (4) Drainage plans shall retain on-site the standard design year rainfall Drainage shall be provided in accordance with subsections 30½-43(II and III) of this Code and Chapter 14 (Flood Damage Prevention) of this Code All developments shall retain the stormwater runoff attributable to the ten-year, one-hour storm, except for lots less than thirty thousand (30,000) square feet, for which on-site retention shall be a five-year, one-hour storm Runoff shall be directed to percolation areas prior to introduction into the storm sewer or other receiving facilities Adequate filtration of runoff from impervious surface areas shall be provided, drainage plans shall take into consideration the drainage of surrounding private or public property and shall not adversely impact such property; and the existing water table of the site shall not be lowered if by so doing there would be damage to the county's natural water sources

(F) Open spaces

- (1) A minimum of fifteen (15) per cent of the total site shall be open space and shall be landscaped by the developer in accordance with the landscape ordinance, sections 23-49 to 23-56 Additional open space that may be required in order to satisfy the Martin County on-site storm drainage detention policies shall be similarly landscaped with appropriate shrubs and trees Landscaping plans shall meet the minimum

requirements of the county landscape ordinance (Code section 23-52)

- (2) The maximum permitted building coverage shall be fifty (50) per cent.
- (3) The use of semipermeable pavement to reduce the volume of surface water runoff may be considered in appropriate site locations

(G) Performance standards

- (1) No smoke of a density greater than No 1, according to Ringelmann's scale, shall be emitted except [that] smoke not in the excess of No 2, Ringelmann's scale shall be permitted for not more than six (6) minutes of any one hour
- (2) No particle from any flue or smokestack exceeding two-tenths (0.2) graphics per cubic foot of flue gas at stack temperature of five hundred (500) degrees Fahrenheit shall be permitted
- (3) Industrial uses shall present detailed plans and programs for the elimination of odors, dust and dirt to the planning and zoning director before a permit shall be granted.
- (4) No processes which result in the escape of obnoxious gases or fumes in concentrations dangerous to plant or animal life or damaging to property as defined by state and federal regulations shall be permitted
- (5) Operations creating glare shall be so shielded that the glare cannot be seen from outside the plant site
- (6) Where processes involve disposal of industrial sewage wastes, approval of the proposed method of disposal by the county health officer and the county engineer shall be secured before a permit shall be issued

(H) Other standards.

- (1) All PUD(I) projects shall provide for fire prevention and fire extinguishment (to include a unified water system for the entire project) that meets or exceeds the

requirements of the National Fire Codes, Volumes 1 through 16, 1980 Edition, together with Supplements A and B for that edition.

- (2) The maximum height of any building or structure shall be forty (40) feet above the finished grade, except within one hundred (100) feet of a residential use where the maximum height shall be thirty (30) feet.
- (3) All PUD(I) projects shall provide a fifty-foot wide buffer which shall be walled, fenced or densely landscaped adjacent to any residential use or district. Said wall, fence or landscaping shall be a minimum of six (6) feet high. Any residential uses within the PUD(I) shall be suitably buffered by fences or dense landscaping. No roads, buildings or other structures shall be placed within the buffer area unless specifically authorized by the board of county commissioners.
- (4) All industrial uses and activities shall be conducted entirely within enclosed structures and the adequacy of outside open air assembly, storage, display or sale of equipment, products or materials, shall be made a part of the planned unit development agreement.
- (5) All residential uses shall be suitably buffered by fences, walls or dense landscaping so as to eliminate adverse impacts from incompatible nonresidential uses.
- (6) Details regarding sign control, lighting and maintenance responsibilities proposed for the owners or tenants association documents shall be considered by the planning and zoning board and approved by the board of county commissioners.

(I) It is the intention of the board of county commissioners that these development standards shall be considered to be minimums for the development of a PUD(I) project and that there shall be no presumption that any PUD(I) project that meets these minimums will necessarily or automatically be

approved by the board of county commissioners (Ord No 164, Part 1, 4-14-81)

Sec 33-581 45 PUD(I) procedures

Procedures for review of preliminary and final development plans and for amending or voiding industrial PUD agreements shall be as specified in sections 33-579, 33 580 and 33-581, Code of Laws and Ordinances of Martin County, Florida (Ord No 164, Part 1, 4-14-81)

Secs 33-581 46—33-581 61 Reserved

**DIVISION 5 PUD (MH) PLANNED UNIT
DEVELOPMENT (MOBILE HOME)
SUB-DISTRICT**

Sec 33-581 62 General provisions

(a) The purpose of this division is to provide a district that may be used at the option of a developer to establish mobile home planned unit developments at appropriate locations in keeping with the planning and development objectives of Martin County, Florida

(b) A further purpose of this sub-district is to provide for broad discretionary authority by the board of county commissioners to approve or disapprove mobile home planned unit development applications based upon the health, safety and general welfare of the present and future residents of Martin County. Prior to approval of a development plan the board of county commissioners shall make a finding of fact that the proposed mobile home planned unit development is in accordance with the general or comprehensive plan, the specific area plan, if such plan has been adopted, the capital improvements program, if any, or other coordinated and planned extension of existing community facilities, and other development policies and objectives as may be in force and effect. Such findings of fact shall take precedence over any other rules and regulations of Martin County with which they may be in

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Sec 33-812 Penalties

(a) Violations of this article is a misdemeanor pursuant to Section 125.69 Florida Statutes and is punishable under said section by imprisonment for up to sixty (60) days or a fine of up to five hundred dollars (\$500.00) or both such imprisonment and fine.

(b) In addition to the above the construction industry licensing board may, pursuant to Chapter 7-3/4 of this Code, investigate the actions of any person holding a Martin County contractor's license or qualifying agent who is believed to have deliberately or willfully violated the provisions of this article or who is believed to have aided and abetted any uncertified person to evade any provision of this article and if said contractor or agent is found guilty take appropriate disciplinary action as set forth in Chapter 7-3/4 (Ord. No. 257 Part 1, § 12.6.25-85).

Secs 33-813—33-954 Reserved

ARTICLE XLVIII—LIX. RESERVED**ARTICLE LX. AMENDMENTS****Sec. 33-955 General.**

Whenever the public necessity, convenience, general welfare or good zoning practice requires the board of county commissioners may by resolution amend, supplement or change the regulations, district boundaries or classifications of property now or hereafter established by this chapter or amendments thereto (Res. of 5-9-67, Art. XXXIX, § 39.1).

Sec. 33-956. Area for rezoning.

In case of a petition for a change in the zoning of property, the zoning board shall consider whether the area described in the original petition should be enlarged in order to reflect the interests of the county and to correspond with the county plan. The zoning board shall study and

recommend to the commission such enlargement if any, as it may deem desirable. (Res of 5-9-67, Art XXXIX, § 39 2)

Sec. 33-957 Board initiation.

The zoning board shall carry on a continual study of zoning zoning techniques and the relation of zoning to private developments and public improvements and any pertinent parts of any county plan for the orderly growth of the county, and may from time to time submit recommendations on the amendments of this chapter (Res of 5-9-67, Art. XXXIX, § 39 3)

Sec. 33-958 Basis for recommendations.

In reviewing and formulating recommendations to the commission on requested or proposed changes in this chapter the zoning board shall consider and evaluate the changes in relation to all pertinent factors, including the following

- (1) The character of the district and its peculiar suitability for particular uses.
- (2) Conservation of the value of buildings and encouraging the most appropriate use of land and water throughout the county
- (3) The applicable portions of any current county plans and programs, such as land use, trafficways, recreation, schools, neighborhoods, drainage and housing
- (4) The needs of the county for land areas for specific purposes to serve population and economic activities
- (5) Whether there have been substantial changes in the character or development of areas in or near an area under consideration for rezoning
- (6) The facts and opinions presented to the zoning board through hearings. (Res. of 5-9-67, Art. XXXIX, § 39 4)

Sec. 33-959 Action by commission

If a petition or recommendation for a change or amendment to this chapter is not acted upon finally by the commission within six (6) months of the date upon which the report of the zoning board is filed with the commission said petition shall be deemed to have been denied (Res of 5-9-67, Art. XXXIX § 39.5)

Sec. 33-960 Conditional rezoning

No amendment to this chapter to rezone property shall contain conditions, limitations or requirements not applicable to all other property in the zoning district to which the particular property is rezoned (Res of 5-9-67 Art XXXIX § 39.6)

Sec. 33-961 Limit on petitions

(a) Whenever the zoning board has taken action to recommend denial of a petition for rezoning property, the zoning board shall not consider any further petition for the same rezoning of any part of the same property for a period of two (2) years from the date of such action.

(b) Whenever the commission has changed the zoning of property by an amendatory resolution the zoning board shall not consider any petition for rezoning of any part of the same property for a period of two (2) years from the effective date of the amendatory resolution.

(c) The above time limits for zoning board consideration may be waived by the commission by the affirmative vote of four (4) commissioners, when the commission deems such action necessary to prevent an injustice or to facilitate the proper development of the county (Res of 5-9-67, Art. XXXIX, § 39.7)

Sec. 33-962. Procedure for amendments.

(a) A petition for a change of district regulations may be filed by any citizen or owner of land in Martin County

(b) Petitions for change of zoning or district regulations shall be addressed to the zoning board and shall be filed with the county planning department. Such petitions shall contain or be accompanied by all pertinent information which may be required by the zoning board for its proper consideration of the matter including in the case of petitions for rezoning of land with any improvements located thereon at least one photograph. Petitions shall also be accompanied by a fee to be set from time to time by resolution of the board of county commissioners.

(c) After consideration of a petition for a change in zoning classification or in a district regulation the zoning board shall transmit the petition and the board's recommendations thereon to the commission.

(d) No recommendation for a change in zoning district classification or in district regulations shall be made by the zoning board to the commission unless and after a public hearing as hereinafter prescribed has been held by the zoning board.

(e) Proposals originating with the commission or initiated by the zoning board shall be processed in the same manner as provided for petitions in the preceding sections (Res. of 5-9-67 Art. XXXIX, § 39 8, Ord. No. 138, Part I, § B, 4-10-79 Ord. No. 184, Part IV 9-22 81).

Cross reference—Procedure for enactment of zoning regulations restrictions boundaries § 23-16

Sec. 33-963. Hearings before zoning board

(a) Notice of hearings before the zoning board in connection with changes in zoning district classification or changes in district regulations under this chapter shall be published in a newspaper of general circulation in Martin County at least fifteen (15) days prior to the date of the hearing. Such notice shall specify the time and place of the hearing and the matter to be considered at such hearing.

(b) In connection with hearings on petitions for change in the zoning district classification all owners of property in the area proposed for zoning change and all owners of property within three hundred (300) feet of the land subject to such petition, shall be given notice of such hearing by

mail Such notice shall be mailed at least ten (10) days prior to the date of the hearing For the purposes of such notification an owner of property shall be deemed to be the person who, with his address, is so shown on the tax rolls of the Martin County Tax Collector (Res of 5-9-67 Art XXXIX, § 39.9)

Secs. 33-964—33-974 Reserved.

ARTICLE LXI LEGAL PROVISIONS

Sec. 33-975 Interpretation, purpose and conflict.

In interpreting and applying the provisions of this chapter, they shall be held to be a minimum requirement for the promotion of the health, safety, morals and general welfare of the county It is not intended by this chapter to interfere with, abrogate or annul any easements, covenants or agreements between parties, provided, however, where the regulations of this chapter on the same point as contained in any other law or resolution are more restrictive the provisions of this chapter shall govern, and where the regulations of the other law or resolution are more restrictive than those of this chapter, the other shall govern. (Res of 5-9-67, Art. XL, § 40.1)

Sec. 33-976. Validity.

Should any article, section, paragraph, sentence clause phrase or other part of this chapter be declared by a court of competent jurisdiction to be invalid such decisions shall not affect the validity of the chapter as a whole or any part thereof, other than the part so declared to be invalid (Res of 5-9-67, Art. XL, § 40.2)

Sec. 33-977. Saving clause.

Any prosecution arising from a violation of any resolution repealed by this chapter, which prosecution may be pending at the time this chapter becomes effective or any prosecution which may be started within one year after the

**10 2 2 EXCERPTS FROM THE MARTIN COUNTY LAND DEVELOPMENT
CODE RELATED TO**

- **SECTION 35-2 26 PUD (I), INDUSTRIAL PLANNED UNIT
DEVELOPMENT**
- **SECTION 35-4 3 HEIGHT EXCEPTIONS**
- **SECTION 35-5 5 SPECIFIC CRITERIA REGULATING
ADVERTISED CONDITIONAL USES**

Conditional Uses.

All conditional uses permitted in the COR, LC, GC, WRC and WGC districts except townhouse cluster dwellings
Any community and public service uses found appropriate

(D) *Additional Uses.* In addition to the permitted and conditional uses allowed in this district, expressway-oriented transient commercial service centers may be permitted subject to compliance with the performance specified in section 4-2(E)(5) of the comprehensive plan (Ord. No. 293, Part 1, 4-29-86)

Sec 35-2.26 PUD(I) industrial planned unit development

(A) *Purpose and Intent.* The PUD(I) district is established to provide an alternative zoning procedure that may be used to encourage the establishment of desirable industrial parks containing complete employment centers through the application of enlightened and imaginative design approaches at appropriate locations in accordance with the planning and development objectives of the comprehensive plan. Appropriate locations for the establishment of PUD(I) districts shall be limited to those areas that are designated for industrial uses in the comprehensive plan.

(B) *Permitted Uses.* In this district as a permitted use a building or premises may be used for the below uses. All applicable provisions of this code shall be satisfied including site plan review and performance criteria.

Permitted Uses.

Limited impact industries
Trades and skilled services
Wholesale trades and services

(C) *Conditional Uses.* In this district as a conditional use a building or premises may be used for only the following conditional uses upon compliance with applicable conditions stated in article V and all other applicable provisions of this code, including site plan review and performance criteria.

Conditional Uses

Any acceptable community and public service uses
 General industrial uses
 Utilities
 Protective and emergency services

(D) *Additional Uses.* In addition to the permitted and conditional uses allowed in this district, business and professional offices, general retail sales and services, limited commercial activities, private parking and recreation areas, private protective and emergency services, restaurants (excluding drive-ins), and vehicular service and maintenance uses may be permitted provided that such uses are internally located and oriented to the principal industrial uses within the PUD(I) project, serving needs not otherwise served in the general area of the project (Ord No 293, Part 1 4 29 86)

ARTICLE III CATEGORY "B" DISTRICT REGULATIONS

This article describes the zoning district regulations in effect at the time of adoption of this code Existing zoning district regulations as established in Chapter 33 of the Code of Laws and Ordinances will remain in full effect (Ord No 293, Part 1, 4 29 86)

ARTICLE IV SUPPLEMENTARY REGULATIONS

Sec 35-4 1 Fences, walls and hedges

(A) *General Requirements* Screening and buffer zone requirements of section 23-49, the Martin County landscape ordinance No 285, must be met

- (1) All salvage operations shall be visually screened with a fence or wall of not less than eight (8) feet in height, which shall be of masonry or wood construction and shall be without openings, except for entrance and exit Such opening shall be equipped with gates forming a visual obstruction.
- (2) The director of community development may require the screening of any use or condition considered detrimental to

(B) *Allowable Encroachments.* In all districts, structural and mechanical overhangs such as roof extensions or cantilevered balconies, sills, gutters, window air conditioners and awnings may extend up to three (3) feet into required setbacks

(C) *Center Line Setbacks.*

- (1) No structure shall be built within fifty (50) feet of the center line of any public or private right-of way designated as a local street
- (2) No structure shall be built within sixty five (65) feet of the center line of any public or private right-of way designated as a collector arterial street or highway
- (3) No structure shall be built within one hundred (100) feet of the center line of the existing median strip of U S Highway 1 (Ord. No 293, Part 1, 4 29-86)

Sec 35-4 3 Height exceptions

(A) Church steeples, spires and belfries may exceed district height limitations after approval by the community development director. However, the heights of these structures shall not exceed sixty (60) feet from ground level and shall be a part of a principal building and not used for human occupancy

(B) Roof structures, including chimneys, parapet walls not over four (4) feet high, tanks and supports, elevator machinery or shafts, penthouses used solely to enclose stairways and ventilation or air conditioning apparatus may exceed district height regulations provided that such structures do not exceed ten (10) percent of the roof structure measured on a horizontal plane, provided that such structures are not used for human occupancy and provided that the use of such structure does not increase the district height requirements by more than eight (8) feet

(C) Agricultural structures, communication towers, permanent installations for utilities or industrial processes, and protective and emergency service installations can be exempt from district height restrictions subject to the following criteria

- (1) Utility poles and support structures are exempt from height restrictions

- (2) Unmanned structures in conjunction with agricultural uses, industrial uses and associated towers may exceed the district height limitation up to fifty (50) percent over the standard
- (3) Any use, structure or tower in this category in excess of sixty (60) feet in height must be authorized by the board of county commissioners following the advertising requirements of section 35-5 8 (public hearing notification requirements for special exceptions), must not be occupied and must comply with fire code requirements (Ord No 293, Part 1, 4 29-86)

Sec 35-4 4 Model dwelling units

In any residential district where there is active development of ten (10) or more residential units, a developer or his agent may operate a sales office within a model dwelling unit or other temporary facility. All model dwelling units and sales offices shall meet all district requirement and be subject to the following restrictions

The sales office, if not in a model dwelling unit, may be permitted as an accessory use on the same lot, but shall not be used except solely in connection with the development in which located

Model dwelling units may be used as a means to sell similar homes for a period of up to one (1) year. Extensions may be granted by the code enforcement administration, however, each such extension shall not exceed a period of one (1) year

The sales office, if not in a model dwelling unit, may be used as an office for one (1) year, and thereafter shall either be removed or used in accordance with regulations generally applicable within the district. Extensions may be granted by the code enforcement administrator, however, each such extension shall not exceed a period of one (1) year

At least five (5) off street parking spaces shall be provided on the same lot as the sales office or model dwelling unit or on contiguous lots, and shall be maintained as long as the model

fifty (50) feet of the front street property line, or within thirty (30) feet of any side or rear property line

- (c) The storage of inoperative vehicles or any other junk or scrap shall not exceed a height of twelve (12) feet
- (d) The site plan shall comply with the supplemental screening requirements of article IV including a berm and a fence (Ord No 293, Part 1, 4 29-86)

Sec 35-5.4 Appeal of the decision of the community development director

Any appeal of the decision of the community development director to approve or deny a request for a conditional use approval under this section must be filed in writing with the county administrator within fifteen (15) calendar days of the decision. Said appeal will be placed on the next available agenda of the planning and zoning board for consideration of the appeal. The planning and zoning board shall not request to waive or alter the criteria established in this section. Any further appeal of the request for conditional use shall be filed with the circuit court (Ord No 293, Part 1, 4 29-86)

Sec 35-5.5 Specific criteria regulating advertised conditional uses

In addition to satisfaction of the general provisions cited in section 35-5.2, an advertised conditional use shall be permitted only upon a finding by the board of county commissioners at a regular scheduled meeting that the proposed use complies with the requirements for the respective advertised conditional use as specified below. The board's decision regarding the advertised conditional use shall be rendered after the public hearing notification requirements of section 35-5.6 are met.

(A) *Advertised Conditional Community Land Use Activities.*

(1) *Airfield facilities.* Within the AG and PS districts

- (a) A plan sealed by a registered engineer shall be presented which indicates the landing and take-off corridors comprising the airfield. Such plan

- shall satisfy all requirements of the Federal Aviation Administration including conformance with appropriate flight hazard criteria which may hereinafter be imposed. The airfield plan shall include land use considerations within a five-thousand foot radius of the boundaries of the proposed facility
- (b) No area used by aircraft under its own power shall be located within two hundred (200) feet from any boundary line of the facility
 - (c) No runway primary surface shall be closer than three hundred (300) feet from any property line and one hundred (100) feet from any residential structure
- (2) *Child care facilities* Within the AG, RR-5A, RE 2A, RE 1A, RE-0 5A, RS-15, RS-10, RS-7 5, RM 5, RM-8, RM 15, COR and LC districts
- (a) Site shall be located on a paved public road with sufficient width to accommodate pedestrian and vehicular traffic generated by the use. The facility should be located near a major thoroughfare or collector street so as to discourage traffic along residential streets in the impacted area
 - (b) No such facility shall be permitted on a zone lot unless it contains a minimum of fifteen thousand (15,000) square feet
 - (c) One (1) accessory off street parking space shall be provided for each five (5) children accommodated in the child care facility
 - (d) Special passenger loading and unloading facilities shall be provided on the same lot for vehicles to pick up or deliver clientele. Such facilities shall include driveways that do not require any backup movements by vehicles to enter or exit the premises.
 - (e) All regulations of the State of Florida that pertain to the use shall be satisfied
 - (f) A fenced area stabilized and maintained with suitable ground cover of not less than three thousand (3,000) square feet of usable outdoor recreation area shall be provided for the first twenty (20) children at any one time. One hundred fifty (150)

square feet of usable outdoor recreation area shall be required for each such child over twenty (20). Such area shall be delineated on the site plan submitted at the time the application is filed. For the purpose of this provision usable outdoor recreation area shall be limited to

- (i) That area not covered by building or required off street parking spaces and shall be fenced and screened from adjacent property lines
 - (ii) That area outside the limits of the required front yard
 - (iii) Only that area which is developable for active outdoor recreational purposes
 - (iv) An area which occupies no more than eighty (80) percent of the combined total areas of the rear and side yards
 - (g) The site plan shall comply with supplemental screening requirements of article IV
- (3) *Public or private not-for-profit clubs and cultural or civic activities.* Within the RM-8, RM 15 and WRC districts
- (a) No building shall be located closer than fifty (50) feet to any lot line which abuts a residential district.
 - (b) No off street parking or loading space shall be located closer than twenty five (25) feet to any property line abutting a residential district
 - (c) The site plan shall comply with supplemental screening requirements of article IV
- (4) *Educational institutions.* Within the AG, RR 5A, RE 2A, RE 1A, RE 0 5A, RS-15, RS-10, RS 7 5, RM 5, RM 8, RM 15, MHP, COR and PS districts
- (a) Sites shall be located near major thoroughfares so as to discourage traffic along local residential streets in residential subdivisions
 - (b) Depending on the type facility proposed, the minimal special requirements for the site shall be similar to standards utilized by the Martin County School Board and the State of Florida
 - (c) No main or accessory building shall be located within one hundred (100) feet of any property line

- (d) The applicant shall demonstrate a program of systematic instruction and site development plan reasonably conforming with customary standards for respective forms of similar instruction
- (e) The applicant shall submit a description of anticipated service area and projected enrollment by stages if appropriate and relate the same to a development plan explaining
 - (i) Area to be developed by construction phase
 - (ii) Adequacy of site to accommodate anticipated facilities enrollment, recreation areas, off-street parking and pedestrian and vehicular circulation on site including loading, unloading and queing of school bus traffic
 - (iii) Safety features of development plan
 - (iv) Landscaped areas especially treatment of property lines abutting residential properties which shall meet screening requirements established in article IV
- (5) *Nursing homes, including rest homes and convalescent homes* Within the RM 5, RM 8, RM 15, and COR districts
 - (a) No building or structure shall be located closer than fifty (50) feet to any lot line abutting a residential district.
 - (b) No off street parking shall be located closer than twenty five (25) feet to any lot line abutting a residential district
 - (c) A description of the program of services shall be submitted with the application and the applicant shall demonstrate that the method of operation and delivery of such health services and daily care shall be in compliance with all relevant state and federal standards for operation of nursing homes.
 - (d) The site plan shall comply with supplemental screening requirements of article IV
- (7) *Group housing, foster housing and adult congregate facilities.* Within all agricultural and residential districts (AG, RR 5A, RE 2A, RE 1A, RE 0 5A, RS-15, RS 10 RS-7 5 RM 5 RM-8 and RM 15)

- (a) All applicable regulations of the State of Florida shall be satisfied
 - (b) There shall not be more than twelve (12) unrelated residents in any living unit
 - (c) The intensity of care shall be low, providing an environment that approximates family living
 - (d) Subject to review and acceptance of traffic impacts to adjacent properties
- (8) *Places of worship* Within the RE 2A, RE 1A, RE 0 5A, RS-15, RS-10, RS-7 5, RM 5, RM-8, RM 15, MHP and MHS districts
- (a) The minimum site for places of worship in residential districts shall be twenty thousand (20,000) square feet with a minimum width of one hundred (100) feet
 - (b) Sites shall be located near major thoroughfares in order to discourage traffic along local residential streets within residential neighborhoods
 - (c) No building or structure shall be located closer than thirty (30) feet to any property line abutting a residential district and no off street parking shall be located closer than twenty-five (25) feet to any lot line abutting a residential district
 - (d) The site plan shall comply with supplemental screening requirements of article IV
- (9) *Utilities with the exception of normal distribution and/or collection facilities (i.e., poles, lines, cable in trench and associated equipment)* Within all districts
- (a) Site plan proposed shall show the proposed utility together with an existing system of which the proposed system will be an integral part. A statement shall be submitted which explains the function of the proposed improvement and its consistency with any overall utility system plan as well as the comprehensive plan
 - (b) All equipment, machinery, and facilities not located within an enclosed building shall be screened from any abutting residential district pursuant to article IV

- (c) The proposed location of the utility shall be demonstrated necessary relative to the other sites for effective service to consumers within the applicant's service area
- (10) *Communication towers.* Within the AG and PS districts
 - (a) Such structures shall comply with applicable FAA and FCC regulations
 - (b) Such structures shall maintain a minimum one hundred foot setback from adjacent properties
 - (c) A site plan for such structures shall comply with the supplemental screening requirements of article IV
- (11) *Congregating housing for agricultural farm workers.* Within the AG district after review and recommendation by the planning and zoning commission at a regularly scheduled meeting
 - (a) The minimum area to be used shall not be less than sixty (60) acres of productive agricultural land
 - (b) The total number of dwelling units cannot exceed the number of dwelling units that would be normally permitted in the AG district.
 - (c) There shall be a twenty foot open space maintained between structures
 - (d) The housing shall be inhabited solely by families who work on the agricultural lands identified in (a), above
 - (e) Once the agricultural activities have been abandoned, the residential units must be vacated and demolished or converted to a use conforming to the AG district
 - (f) Must be consistent with the provisions of the comprehensive plan
- (B) *Advertised Conditional Commercial Use Activities.*
 - (1) *Recreational vehicle park.* Within all AG, mobile home and commercial districts (AG, RR-5A, MHP MHS, COR, WRC, WGC, LC and GC)
 - (a) Submit to the development criteria for a mobile home planned unit development as per section 35 2 24

- (b) Document that the mix of uses is justified and consistent with the characteristics of the immediate community
- (2) *Rifle ranges* Within the AG district
 - (a) Such use shall require a minimum twenty acre site
 - (b) No structure, building or mechanical equipment associated with the range shall be located within three hundred (300) feet of any property line
 - (c) The applicant shall demonstrate compliance with all applicable regulations of the State of Florida. The applicant shall also demonstrate how safety and noise factors have been addressed through the site plan and other special features of the proposed development
- (3) *Limited commercial activities and restaurant uses (excluding fast food and drive-in service)* Within the COR district after the planning and zoning commission has been satisfied that the following criteria and standards have been met
 - (a) The nature and scale of the retail use are consistent and compatible with the principal residential or principal office development
 - (b) Previous or concurrent residential or office development on the subject site provides an on site buffer from abutting property which is designated for residential use, including COR
 - (c) A plan for the entire parcel is submitted for review and approval in an advertised public hearingDuly approved offices and shops located within COR designated areas as of the effective date of this chapter shall be deemed permitted uses within the COR area
- (4) *Vehicle and automotive fuel and lubricant retail sales.* Within the LC District
 - (a) A minimum lot area of ten thousand (10,000) square feet with a minimum lot frontage of one hundred (100) feet on each of two (2) separate and intersecting arterial roads as identified on the Martin County Major Thoroughfare Plan (Article V of the Comprehensive Plan)

- (b) No building or structure including signs, gasoline pumps, tank, vents, pump islands or canopies shall be located within twenty five (25) feet of any right-of way line
- (c) The minimum buffer standards for the site must comply with general commercial district buffer types as established in section 23 56(f), Landscape Regulatory Zones, of the Martin County Landscape Ordinance, as revised
- (d) Any parcel proposed for this use must maintain the physical separation of all buildings, structures, signs, gasoline pumps, tanks, vents, pump islands or canopies associated with fuel sales from abutting properties zoned for residential use by a minimum of fifty (50) feet Where the parcel abuts a public road or natural water body, having a minimum width of fifty (50) feet, the parcel shall be considered as abutting residentially zoned property as defined by section 23 56(f)(4) of the Martin County Landscape Ordinance
- (e) The internal traffic circulation system and parking areas shall conveniently provide for safe and efficient on-site maneuvering of all vehicles using the site The separation of parking areas for the convenience store/limited commercial retail use from the pump islands and stacking lanes for fuel sales must be maintained Access to the site shall be from arterial roads only, unless the board of county commissioners specifically determines that access from a collector or local road would be beneficial to the surrounding neighborhoods
- (f) Special fuel storage requirements
 - (i) All receptacles, tanks or facilities for the storage of combustible products in excess of two hundred-gallon quantities shall be located underground and within all required setbacks Flammable materials shall be stored within the building setback lines and in a manner satisfactory to the county fire marshal and

the director of the department of community development

- (ii) All gasoline and petroleum product storage tanks shall be permitted and monitored for potential leakages in accordance with the applicable regulations of the State of Florida, as amended
- (iii) When an active site dispensing flammable materials becomes vacant for a period exceeding one (1) year, the property owner shall be required to remove or treat, in a manner approved by the State of Florida, all flammable materials or storage tanks on site (Ord No 293, Part 1, 4-29-86, Ord No 312, Part 1, 11 18-86)

Sec 35-5 6. Public hearing notification requirements for advertised conditional use

Prior to granting approval for any use identified as an advertised conditional use, the board of county commissioners shall hold a public hearing on the subject request. Said public hearing shall be scheduled for any regularly scheduled meeting of the board after the following notification requirements are met

(A) *Advertised Conditional Uses in the AG, RR-5A, and RE-2A Districts*

- (1) Public notice in newspaper of general circulation at least fifteen (15) days prior to the hearing
- (2) Notification by the owner of the subject property by return receipt mail of the requested advertised conditional use at least ten (10) days prior to the hearing to all property owners within six hundred (600) feet of the proposed advertised conditional use as determined by the most recent tax roll maintained by the property appraiser

(B) *Advertised Conditional Uses in All the Residential Districts and COR LC GC, WRC WRC, LI GI and PS Districts.*

- (1) Public notice in newspaper of general circulation at least fifteen (15) days prior to the hearing

10 2 3 ARTICLE VIII OF CHAPTER 23 OF THE MARTIN COUNTY CODE

- **DEVELOPMENT APPROVAL PROCEDURES**

trator on any matter relating to the administration of this article shall constitute a violation thereof (Ord No 267, § 13, 9 10-85, Ord No 358, § 1(14), 1-10-89)

Secs 23-165—23-170 Reserved

ARTICLE VIII DEVELOPMENT APPROVAL PROCEDURES*

Sec 23-171 Development review committee

(a) There shall be a committee known as the development review committee (DRC) of Martin County, Florida, which shall consist of the department director or his designee from the following departments

- (1) Community development department,
- (2) Public works department,
- (3) County administrator,
- (4) Health department,
- (5) Public safety department

(b) The county attorney or his designee shall serve as legal advisor to the DRC

(c) The county administrator shall appoint the chairman of the DRC

(d) The Martin County school district shall appoint an advisory nonvoting member of the DRC

(e) The director of public utilities shall be an advisory, nonvoting member of the DRC (Ord No 297 Part 1(I), 6 24 86)

Sec 23-172 Approval procedures—Optional preapplication conference

(a) *Applicability* This section shall apply to all applications for master plan or final approval as specified in sections 23 173 and 23 174, below, at the sole option of the applicant

*Editor's note—Ord No 297 Part 1 adopted June 24 1986 effective Sept 1 1986 added an Art VII to Ch 23 To avoid duplicate numbering the editor has added the material as Art VIII §§ 23 171—23 175

(b) *Intent.* The preapplication conference is intended to provide the applicant with the opportunity to jointly confer with members of the development review committee (hereinafter referred to as the DRC) prior to submitting a final formal application. The DRC will advise the applicant on the feasibility of various possible design alternatives, will generally advise the applicant as to which areas of the land development code and comprehensive plan are applicable and also provide the applicant information regarding any projected plans, programs or other matters that may affect the project. The opinions expressed at the preapplication conference are intended to be solely for the general assistance of the applicant and to provide general direction to the applicant and are in no event to be considered binding on the county staff, the county commission or the applicant.

(c) *Procedure*

- (1) Any person may submit a written request for a preapplication conference to the community development department together with the required application fee. The form and content of the application and the amount of the fee shall be as set from time to time by resolution of the county commission.

- (2) The application shall be reviewed by the members of the DRC and their comments orally presented to the applicant at a meeting arranged for that purpose. The meeting shall take place within fifteen (15) calendar days after submission of the written request (Ord No 297, Part 1(IIA), 6-24-86)

Sec 23-173 Same—Master plan approvals

(a) *Applicability* This section shall apply to all applications for master plan approval, unless otherwise specified, including but not limited to

- (1) Preliminary plats for all subdivisions
- (2) Preliminary development plans for all planned unit developments
- (3) Master plan approval of major site plans, which for purposes of this article are defined as residential developments of fifty (50) units or more, or nonresidential development which contains fifty thousand (50,000) square feet or more gross leasable area, or mixed developments wherein the percentage of the above threshold amounts together total one hundred (100) percent or more (e.g., 25 units (50%) + 25,000 sq feet (50%) = 100%, 15 units (30%) + 40,000 sq feet (80%) = 110%)
- (4) Minor site plans, which for purposes of this article are defined as residential developments of less than fifty (50) units or nonresidential, development which contains less than fifty thousand (50,000) square feet gross leasable area, are not required to obtain master plan approval but should instead apply for final approval as set forth below
- (5) At the applicant's option, and solely at the applicant's risk, an application for final approval may be submitted concurrent with or at anytime after application for master plan approval, and may be reviewed concurrent with the master plan. In that event the following provisions also apply

- a No final plan approval shall be granted until master plan approval has been granted
- b DRC comments regarding the final plan request are conditional and may be revised as a result of the master plan approval
- c The maximum time frames for DRC review of the final plan as set forth in section 23-174 shall be waived, and the final plans shall be reviewed generally concurrent with review of the master plan.
- d Although a final plan application may be submitted concurrent with the master plan application, each application must contain all required materials and stand on its own merits

(b) *Procedure*

- (1) The following persons may apply for master plan approval of developments to real property
 - a. The owner of the property or his authorized agent
 - b The lessee of the property with the written consent of the owner
 - c A person under contract to purchase the property, with the written consent of the owner
 - d A person having an option to purchase the property with the written consent of the owner
- (2) An application shall be submitted to the community development department together with the required application fee. The purpose of the application is to demonstrate compliance with all applicable laws and regulations, including the comprehensive plan, and to provide a basis for decision making by the development review committee (hereinafter referred to as the DRC) the planning and zoning commission (hereinafter referred to as P&Z) and the board of county commissioners. The form and content of the application, and the amount of the fee shall be as set from time to time by resolution of the county commission.
- (3) The director of community development shall review the application within two (2) working days of submittal, to determine whether all necessary materials have been sub-

mitted, and may refuse to accept any application which is not complete. For the following applications the period for staff determination of completeness shall be five (5) working days

- a Preliminary plats for all subdivisions having more than fifty (50) lots
- b Preliminary development plans for planned unit developments
- c Site plans for residential developments with fifty (50) or more units
- d Site plans for nonresidential developments with fifty thousand (50,000) square feet or more of building area
- e Major amendments to approved planned unit developments which are also developments of regional impact.

A determination of completeness is for the purpose of allowing a review of the material only and is not to be construed as approval of any of the materials submitted. After a determination of completeness, the applicant shall, within ten (10) calendar days, cause to be placed on the property a sign notifying interested persons that an application for development has been made. The size, location and content of the sign shall be as approved by resolution of the county commission.

- (4) After a determination of completeness, the members of the DRC shall have no more than forty (40) calendar days to review the application and prepare preliminary reports and recommendations, unless an extension of this time period is agreed to in writing by the applicant. For the following applications the period for staff review and recommendations shall be no more than ninety (90) days after a determination of completeness

- a. Preliminary plats for all subdivisions having more than fifty (50) lots
- b. Preliminary development plans for planned unit developments
- c. Site plans for residential developments with fifty (50) or more units
- d. Site plans for nonresidential developments with fifty thousand (50,000) square feet or more of building area

- e Major amendments to approved planned unit developments which are also developments of regional impact.

In preparing their reports, the members of the DRC shall request assistance as needed from any other departments or agencies. A copy of the preliminary reports and recommendations shall be made available to the applicant no later than at the end of the review period. The applicant shall, within ten (10) calendar days of the availability of the DRC's preliminary report and recommendations, submit to the community development department a written response as to whether he agrees or disagrees with each of the DRC comments. No later than ten (10) calendar days after receipt of the applicant's written response, the DRC shall meet to discuss the preliminary reports and recommendations with the applicant. The applicant may elect to respond to any deficiencies noted in the preliminary reports. Every effort shall be made to notify the applicant of serious deficiencies discovered before the expiration of the review period. If the applicant elects to respond to any deficiencies noted in the preliminary reports, an intent to do so must be submitted in writing to the community development department within ten (10) calendar days after the DRC meeting. The response must be submitted within ninety (90) calendar days of the filing of the notice of intent. After submittal of a response, the members of the DRC shall have at least seven (7) but no more than thirty (30) calendar days to amend their reports and recommendations, if needed. For the following applications the period for staff amendment of reports and recommendations shall be at least thirty (30) days but not more than forty (40) days.

- a Preliminary plats for all subdivisions having more than fifty (50) lots
- b Preliminary development plans for planned unit developments
- c Site plans for residential developments with fifty (50) or more units
- d Site plans for nonresidential developments with fifty thousand (50,000) square feet or more of building area

- e Major amendments to approved planned unit developments which are also developments of regional impact.

Any further request to respond to deficiencies shall be processed in the same manner as the first request. Once the applicant has elected not to respond to the preliminary reports and recommendations, the reports and recommendations shall be determined to be final. No additional information or material shall be submitted after the reports and recommendations have been determined to be final.

- (5) The matter shall then be scheduled for consideration by the P&Z at its next available meeting. The P&Z may take any of the following actions:
 - a Recommend approval
 - b Recommend approval, subject to conditions clearly stated.
 - c Recommend disapproval with reasons clearly stated
 - d Table once or more, but for no more than a total of forty-five (45) calendar days for further information or review as determined by the P&Z
 - e Table at the applicant's request. If tabled more than twice, the applicant must renotify the public in the same manner as required for the original hearing.

When considering items tabled from a prior meeting, the P&Z may choose to dispense with hearing material which has been presented at the prior meeting.

- (6) After recommendation of approval, approval subject to conditions, or disapproval, the matter shall be considered by the board of county commissioners at its next available meeting. The applicant may elect to respond to any conditions imposed by the P&Z. An intent to do so must be submitted in writing to the community development department with ten (10) calendar days after the action by the P&Z. The response must be submitted to the community development department within thirty (30) calendar days of the notice of intent. The members of the DRC shall have fourteen (14) calendar days to review the response and to comment on that response, as they deem appropriate. If the applicant elects to respond to any conditions imposed by the P&Z then the matter shall be considered

by the board of county commissioners at its next available meeting after DRC review of the response. The board of county commissioners may take any of the following actions:

- a Approve
 - b Approve subject to conditions clearly stated
 - c Disapprove with reasons clearly stated
 - d Table twice but for no longer than a total of sixty (60) calendar days for further information or review as determined by the board of county commissioners
 - e Table at the applicant's request. If tabled more than twice, the applicant must renotify the public in the same manner as required for the original hearing.
- (7) In all cases, applications which are not brought before the board of county commissioners within one (1) year from determination of completeness will be considered withdrawn. This provision may be waived by the board of county commissioners upon a showing that the applicant has made a good faith effort to diligently proceed in obtaining the development order requested.

(c) *Additional requirements for PUD's and DRI's.*

- (1) In the case of applications for PUD preliminary development plans, the additional public notice requirements for rezoning petitions as set forth in Chapter 33, Article LX must be met.
- (2) In the case of applications for master plan approval of a development of regional impact, as defined by Section 380.06, Florida Statutes, the additional public notice requirements of that section must be met. The time periods set forth in this article may be extended to the extent necessary to accommodate the requirements of Section 380.06, Florida Statutes (Ord. No. 297, Part 1(IIB), 6-24-86; Ord. No. 360, Part 1, 3-28-89).

Sec. 23-174 Same—Final approvals

(a) *Applicability.* This section shall apply to all applications for final approval unless otherwise specified, including but not limited to:

- (1) Final development plans for subdivisions, including the final plat
- (2) Final development plans submitted pursuant to planned unit development zoning agreements
- (3) Minor site plans, which for purposes of this article are defined as residential developments of less than fifty (50) units or nonresidential developments containing less than fifty thousand (50,000) square feet gross leasable area
- (4) Major site plans, which for purposes of this article are defined as residential developments of fifty (50) units or more, or nonresidential development which contain fifty thousand (50,000) square feet or more gross leasable area, or mixed developments wherein the percentage of the above threshold amounts together total one hundred (100) per cent or more (e g , 25 units (50%) + 25,000 sq feet (50%) = 100%, 15 units (30%) + 40,000 sq feet (80%) = 100%)

(b) *Procedure.*

- (1) The following persons may apply for final approval of developments to real property
 - a The owner of the property or his authorized agent
 - b The lessee of the property with the written consent of the owner
 - c A person under contract to purchase the property, with the written consent of the owner
 - d A person having an option to purchase the property with the written consent of the owner
- (2) An application shall be submitted to the community development department together with the required application fee. The purpose of the application is to demonstrate compliance with all applicable laws and regulations, including the comprehensive plan and to provide a basis for decision making by the DRC and the board of county commissioners. The application shall also contain a statement that any conditions which were imposed at the time of master plan approval have been met. The form and content of the application and the amount of the fee shall be

as set from time to time by resolution of the county commission

- (3) The director of community development shall review the application within two (2) working days of submittal, to determine whether all necessary materials have been submitted, and may refuse to accept any application which is not complete. A determination of completeness is for the purpose of allowing a review of the material only and is not to be construed as approval of any of the materials submitted. After a determination of completeness in the case of minor site plans only, the applicant shall, within ten (10) calendar days, cause to be placed on the property, a sign notifying interested persons that an application for development has been made. The size, location and content of the sign shall be as approved by resolution of the county commission.
- (4) a After a determination of completeness (where no change from an approved master plan is proposed) or after a determination of minor change by the DRC, and confirmed by the county commission pursuant to section 23 175, below, the members of the DRC shall have no more than forty (40) calendar days to review the application and prepare preliminary reports and recommendations, unless an extension of this time period is agreed to in writing by the applicant. In preparing their reports, the members of the DRC shall request assistance as needed from any other departments or agencies. A copy of the preliminary reports and recommendations shall be made available to the applicant no later than at the end of the specified review period. The applicant shall, within ten (10) calendar days of the availability of the DRC's preliminary reports and recommendations, submit to the community development department a written response as to whether he agrees or disagrees with each of the DRC comments. No later than ten (10) calendar days after receipt of the applicant's written response, the DRC shall meet to discuss the preliminary reports and recommendations with the applicant. The applicant may elect to

respond to any deficiencies noted in the preliminary reports. Every effort shall be made to notify the applicant of serious deficiencies discovered before the expiration of the review period. If the applicant elects to respond to any deficiencies noted in the preliminary reports, an intent to do so must be submitted in writing to the community development department within ten (10) calendar days after the DRC meeting. The response must be submitted within ninety (90) calendar days of the notice of intent. After submittal of a response, the members of the DRC shall have no more than thirty (30) calendar days to amend their preliminary reports and recommendations, if needed. Any further request to respond to deficiencies shall be processed in the same manner as the first request. Once the applicant has elected not to respond to the preliminary reports and recommendations, the reports and recommendations shall be determined to be final. No additional information or material shall be submitted after a report and recommendation has been determined to be final. Within seven (7) calendar days of the final report and recommendation, the DRC shall issue a written memorandum of approval or disapproval based on that report.

- b Except in the case of final plats, the final DRC report and recommendation shall be considered to be the final determination by Martin County, and no further action will be taken on this application. If an applicant is in disagreement with the final DRC determination, then he may appeal this determination to the board of county commissioners by filing a written notice of appeal with the county administrator within thirty (30) calendar days of that determination.

- (5) Final plats together with any required contracts and security documents shall be scheduled for consideration by the board of county commissioners at its next available meeting after issuance of the final DRC reports and recommendations. The board of county commissioners may take any of the following actions:

- a Approve
 - b Approve, subject to conditions clearly stated
 - c Disapprove with grounds clearly stated
 - d Table twice, but for no longer than a total of sixty (60) calendar days for further information or review as determined by the board of county commissioners
 - e Table at the applicant's request
- (6) Within ten (10) calendar days after county commission approval, or within ten (10) calendar days after meeting all conditions of approval, the original record plat and original contracts and security documents shall be executed by county officials and the original plat submitted to the clerk of the circuit court for filing
- (7) In all cases, applications which have not received final DRC action, and final plats which are not brought before the board of county commissioners within one (1) year from determination of completeness will be considered withdrawn.

(c) *Additional requirements for DRI's.* In the case of changes to the development plan approval for a development of regional impact, as defined by Section 380.06, Florida Statutes, the additional procedures and requirements of that section must be met. The time periods set forth in this article may be extended to the extent necessary to accommodate the requirements of Section 380.06, Florida Statutes (Ord No 297, Part 1(IIIC), 6-24-86)

Sec 23-175 Same—Amendments and modifications

(a) *Applicability.* This section shall apply to all applications for amendment or modification to a previously approved master or final plan

(b) *Procedure.*

- (1) The following persons may apply for amendments or modifications to master or final plan approvals
- a The owner of the property or his authorized agent
 - b The lessee of the property with the written consent of the owner
 - c A person under contract to purchase the property with the written consent of the owner

- d A person having an option to purchase the property with the written consent of the owner
- (2) An application shall be submitted to the community development department together with the required application fee. The purpose of the application is to demonstrate compliance with all applicable laws and regulations, including the comprehensive plan, and to provide a basis for decision making by the DRC and the board of county commissioners. The application shall contain a brief summary of the changes being requested. The form and content of the application and the amount of the fee shall be as set from time to time by resolution of the county commission.
- (3) The director of community development shall review the application within two (2) working days of submittal, to determine whether all necessary materials have been submitted, and may refuse to accept any application which is not complete. A determination of completeness is for the purpose of allowing a review of the material only and is not to be construed as approval of any of the materials submitted.
- (4) The DRC and the applicant shall meet within twenty (20) calendar days of the determination of completeness, (unless an extension of this time period is agreed to in writing by the applicant) to determine whether the modification is major or minor. If any member of the DRC is of the opinion that a change constitutes a major change within his area of responsibility, then the revised project must be submitted to the community development department to be reviewed in accordance with the master plan procedures. All determinations of major or minor modification shall be reported to the board of county commissioners at its next regularly scheduled meeting, which board shall have power to reverse the determination of the DRC.
- (5) All applications containing major modifications must be submitted to the community development department for revised master plan approval in accordance with the procedures set forth in this article. Minor modifications may

proceed forward in the final approval process for appropriate recommendations by the DRC

(c) *Major or minor change criteria.* In determining whether a modification constitutes a major or minor change, the following criteria shall be used

- (1) The extent to which the modification would affect the height of any building, the number of structures the number of dwelling units, or square footage of any building
- (2) The extent to which the proposed modification would affect the location of any lot, block, building, structure, setback or common open area
- (3) The extent to which the proposed modification would affect the location or amounts of land devoted to specified land uses
- (4) The extent to which the proposed modification would affect the intent of the master development plan or final development plan and the extent to which it impacts the surrounding land uses and community facilities
- (5) The extent to which the proposed modification affects the total land area, the perimeter boundaries or the covenant of unified control In the case of PUD s only, any change affecting the perimeter boundary of the PUD zoning district or the covenant of unified control must be considered a major change (Ord No 297, Part 1(II), 6 24-86)

**10 2 4 RESOLUTION NUMBER 86-8 34 OF THE BOARD OF COUNTY
COMMISSIONERS, MARTIN COUNTY, FLORIDA, REGARDING THE
ESTABLISHMENT OF THE FORM AND CONTENT OF SUBMITTAL
MATERIALS FOR REQUESTS FOR MASTER PLAN APPROVAL AND
FINAL PLAN APPROVAL**

[1700]

BEFORE THE BOARD OF COUNTY COMMISSIONERS

MARTIN COUNTY, FLORIDA

RESOLUTION NUMBER 86-8.34

[REGARDING THE ESTABLISHMENT OF THE FORM AND CONTENT
OF SUBMITTAL MATERIALS FOR REQUESTS FOR MASTER PLAN
APPROVAL AND FINAL PLAN APPROVAL]

WHEREAS, Chapter 23, Article VII, of the Martin County Code of Laws and Ordinances provides for a development approval procedure,

WHEREAS, said Section provides that petitions for such approvals shall be accompanied by an application in a form and content to be set from time to time by resolution of the Martin County Board of County Commissioners,

WHEREAS, such a consolidated list of submittal materials does not currently exist,

WHEREAS, the Board of County Commissioners has reviewed the form and content of submittal materials for such petitions as proposed by its staff as shown in Exhibits "A" and "B" of this resolution, and

WHEREAS, the Board of County Commissioners has determined that the proposed form and content of submittal materials as shown in Exhibits "A" and "B" is reasonable and is necessary to document the compliance of such petitions complying with requirements of the Code of Laws and Ordinances

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF COUNTY COMMISSIONERS OF MARTIN COUNTY, FLORIDA, THAT:

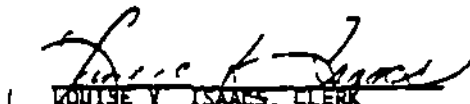
A Exhibit "A" (Master Plan Submittal Materials), as attached to this resolution, is hereby approved pursuant to the Martin County Code of Laws and Ordinances, and

B Exhibit "B" (Final Plan Approval Submittal Materials), as attached to this resolution, is hereby approved pursuant to the Martin County Code of Laws and Ordinances

DULY PASSED AND ADOPTED THIS 12TH DAY OF AUGUST, 1986

ATTEST

BOARD OF COUNTY COMMISSIONERS
MARTIN COUNTY, FLORIDA


LOUISE V. ISAACS, CLERK

BY


THOMAS G. KENNY, III, CHAIRMAN

APPROVED AS TO FORM AND CORRECTNESS

Official Records Book 687

BY


GREEN S. DREYER, COUNTY ATTORNEY

EXHIBIT "A"

MASTER PLAN APPROVAL SUBMITTAL MATERIALS

(For Developments of 50 or More Residential Units
or More Than 50,000 Square Feet of Non-Residential Use)

I Development Site Information Shall Include

A Tract/Developer Information

1. Name and location of proposed development.
2. Name, address and telephone number of developer and project representative liaison.
3. Name, address and telephone number of attorney, engineer, surveyor, and land planner.
4. Present zoning and land use designation of subject parcel and abutting properties.
5. A full legal description of the property with attached copies of any instruments referred to, such as deeds, plats, covenants or restrictions, etc.
6. A vicinity map at a scale of not less than one inch equals two thousand (2,000) feet.
7. The most recent vertical aerial photograph available from the County Property Appraiser or, alternatively, a less than 12 month old vertical aerial photograph at a scale of not less than one inch equals two hundred feet (200') and providing coverage at least 200' outside the project boundaries of the project site with the project boundaries clearly marked.

B Site Information

1. A boundary survey related to true meridian or U.S. Coast and Geodetic Survey state grid north.
2. A topographic map with contour intervals of one foot (minimum) to two feet (maximum) at a minimum scale of not less than one inch equals two hundred (200) feet. Spot elevations shall be used in flat areas.
3. A graphic or aerial illustration of the location of the following items existing on and within 200 feet adjacent to the property:
 - buildings, structures or other improvements,
 - utilities drainageways, ditches, swales, any applicable coastal construction control lines or easements of any kind,
 - abutting streets and roads including width, route numbers and railways,
 - fill disposal grounds, docks, jetties, boat ramps, bulkheads or other water-related structures,
 - property lines and recorded plats,
 - Wetland areas by type, soils analysis, unique vegetation communities, and the seasonal high water tables as analyzed by the Martin Soil and Water Conservation District on the basis of the most accurate environmental documentation available.

II Application Materials

A Evidence of Unified Control

The Applicant shall provide evidence of unified control of the entire area subject to the application. This evidence shall include a title insurance policy or attorney's certificate of title or other evidence acceptable to the County Attorney for the subject property.

B Development Information, Master Plan Site Data

- 1 A statement indicating probable residential unit types or non-residential uses as applicable
- 2 Land use plan or plans which documents compliance with Comprehensive Plan Performance Standards identified in Section II.C below and which show the location, arrangement and dimensions of all proposed land uses, including the number of floors and height of all buildings above finished grade or above the first floor living elevation, building setbacks from the development boundaries and from adjacent streets, roads, alleys, and ways, the proposed traffic circulation pattern including the location and width of all streets, driveways, walkways, bikeways, and entrances to parking spaces, all proposed off-street parking and loading areas, all proposed common elements including common open spaces, all wetland and other natural areas preserved in compliance with established ordinances, and dedicated open space and developed recreation areas.
- 3 A plan showing the location and compliance with the established Landscape Code and providing landscaped buffers and indicating the type of materials proposed and height of such screening
- 4 A statement in tabular form of the anticipated residential density (if any), the total number of dwelling units by type, size, and site location, and gross leasable floor area for commercial or other nonresidential uses, as appropriate
- 5 Percentage of the site to be covered with buildings, sidewalks, parking areas, roofed structures, and other impervious surfaces, percentage of the site to be covered with water bodies, percentage of the site to be in golf course use (if any), percentage of the site to be landscaped, and percentage of the site to be left in a natural undisturbed condition
- 6 An engineer's statement recognizing the South Florida Water Management District permitting requirements, and detailing preliminary proposals for providing drainage outfall and on-site retention conforming with such county regulations and ordinances as are in force and effect, including preliminary calculations, size of storm water retention areas, methods for pollutant removal, location of berms, swales, culverts, storm water sewers, finished grades, and proposed slopes and grades adjacent to bodies of water
- 7 A plan or statement detailing preliminary proposals for connection with existing water supply and sanitary sewer systems or an alternative means of supplying water for drinking and irrigating and of supplying sanitary waste treatment and disposal
- 8 Location of typical proposed structures including exterior lighting systems, signs and landscaping, not to be construed to require actual footprint.

- 9 When a development is to be constructed in phases or units, a sequence of development schedule showing the construction of each principal functional element of such phases or units, the approximate completion date for each phase or unit and the extent, timing, and estimated costs of all improvements or items to be dedicated, such as roads, sewerage, drainage, and other public or private facilities, required to construct the proposed development
 - 10 Location of temporary perimeter stakes and a temporary sign three (3) by five (5) feet in size located at the front of the property identifying the project by number and name in order for the public, county personnel, members of review agencies, planning and zoning commissioners and county commissioners to locate the project and to make site inspections, such sign to be erected within ten (10) days of application submission
 - 11 If the development contains subdivision lots, a preliminary plat of such lots or parcels.
 - 12 Identify existing land as unplatted or platted, if platted, state subdivision name, plat book and page number
 - 13 Any other reasonable information which may be required from time to time by the Community Development, Public Works or Legal Departments which is commensurate with the intent and purpose of this Exhibit "A"
- C Comprehensive Plan Performance Standards - Documentation of Compliance
- 1 Section 4-3(A) - Tabular statement and graphic representation of the density/intensity transition areas and buffer zones
 2. Section 4-3(B) - Description and representation of wetland vegetative cover identified on the master plan.
 3. Section 4-3(C) - Tabular description and area calculations documenting open space by phase.
 - 4 Section 4-3(D) - Relate the preliminary drainage plan with the master plan.
 - 5 Section 4-3(E) - Completion of the approved Park and Recreation Land Dedication Worksheet.
 6. Section 4-3(F) - a professionally prepared traffic impact analysis, meeting the specifications of Section 5-2.
 - 7 Section 4-3(G) and (H) - Basic solution to the water supply and sewage disposal systems prepared by a registered engineer, letter of service capability from the applicable provider
 8. Section 4-3(I) - A Soil Erosion and Sedimentation Control Plan which protects developed and natural preserve areas during the construction and completed development phases of the project.
 9. Section 4-3(J) - Layout of the roadway sections to illustrate the internal circulation and parking system coordinated with pedestrian and bicycle systems.
 10. Section 4-3(K) - A fire and emergency services proposal to meet the standards of the Director of the Department of Public Safety
 - 11 Other standards
 - Statement as to the mix of housing types.
 - Letter of service capability from the Sheriff and Emergency Medical Services.
 - Letter of service capability from the Martin County School Board.

D A Proposed PUD Agreement Including the Covenant of Unified Control
(When Required)

III Number of Copies. In addition to information generally required for any required change of zoning petitions, the applicant shall submit that material or information as herein described in sufficient copies for necessary referrals and records

- A Upon submission of a master development plan application, ten (10) copies of all plans, reports, maps, documents, and other related information must be supplied to the Community Development Department.
- B Documents reflecting changes or amendments to previously submitted plans shall be furnished in sufficient copies to satisfy the requirements of subparagraphs I(A) and I(B) above.
- C. If the proposed PUD is a development of regional impact (DRI) as defined in Section 380.06, Florida Statutes, six (6) copies of all plans, reports, maps, documents and other related information required by the regional reviewing agency (in addition to the normal requirements of this article) shall be submitted to the Community Development Department.

EXHIBIT "B"

FINAL PLAN APPROVAL SUBMITTAL MATERIALS

(Unless Previously Supplied in a Request for Master Plan Approval, Application for Final Plan Approval Must Supply the Documentation in Exhibit "A" Plus the Following)

- I. Final Detailed Information for a Proposed Development or a Phase Thereof Shall Include
 - A. Detailed plans showing the exact location, arrangement and dimensions of all proposed land uses, including the number of floors and height of all buildings above finished grade and the first floor living elevation, building setbacks from the development boundaries and adjacent streets, roads, alleys and ways, location of the traffic circulation pattern including the width of all streets, driveways, walkways, bikeways, and entrances to parking spaces, final design of off-street parking and loading areas in accordance with current Martin County standards, final design for all common areas including dedicated open space and developed recreation areas, exact location and notation of all preserved wetland and other natural preserve areas. When project is to be phased, a complete phasing plan will be provided.
 - B. A detailed plan showing the location and design of landscaped buffers. It shall indicate the materials proposed and the height and proposed degree of opaqueness of such screening.
 - C. A detailed plan indicating the exact manner of improving developed recreation areas. It will include covenants including lease-hold interests, restrictions and conditions pertaining to the use, maintenance, and operation of common areas.
 - D. An exact statement in tabular form, summarized by phases, of the approved residential density (if any), and total number of dwelling units by type, size and site location. For all nonresidential uses the total gross leaseable floor area shall be summarized.
 - E. The exact percentages of the site to be covered with buildings or structures, sidewalks, paved areas, and other impervious surfaces, areas to be covered by water bodies, or by golf courses (if any), areas to be landscaped, and those to be left in natural undisturbed condition.
 - F. A detailed engineer's plan and working drawings for providing drainage outfall and on-site retention conforming with such county and state regulations and ordinances as are in force and effect. It shall include calculations of the size of storm water retention areas, final diagrams of pollutant removal structures and the configurations of outfall control structures, pollution control and filtration facilities and on-site retention systems such as berms, swales, culverts, storm sewers and all finished slopes and grades.
 - G. Final working drawings and details for construction of grading, paving, drainage and all appurtenances required to develop a complete project.
 - H. Final working drawings and details for providing water supplies for drinking and irrigating and for providing sanitary sewer systems, with all applicable permits and executed service agreements, including, as applicable, agreement with the County for interim systems.

- I. Architectural drawings of the proposed structures including front, side and rear elevations, precise building layout (external and internal), exact site design, including exterior lighting systems, signs, and landscaping
- J. A final plan or report indicating extent, timing and estimated cost of all improvements such as roads, sewerage, drainage, and other public and private facilities required to construct the Development or applicable phase thereof, including proposed contracts for construction of required improvements and/or landscaping, along with appropriate security for same and other instruments as needed, which plan or report will relate to the sequence of development schedule if the Development is to be constructed in phases or units
- K. A final plan showing tentative street names and house numbers and names in the Development or phase thereof.
- L. If the Development or phase thereof contains subdivision lots, a final plat for recording with the office of the county clerk, which plat meets all applicable provisions of the Florida State Chapter 177, Part I (see attached Plat Law Checklist), along with a completed Subdivision Plat Filing Form.
- M. All necessary regional, state and federal permits or approvals in writing prior to final action.
- N. Any other reasonable information which may be required from time to time by the Community Development, Public Works or Legal Departments which is commensurate with the intent and purpose of this Exhibit "B"

References (May be revised from time to time)

- 1. Martin County reviewer's list, (Part I not attached)
- 2. Guidelines to items anticipated on working drawings,
- 3. Standard details as may be issued,
- 4. Inspection requirements to be attached to final working plans, and
- 5. Project certification requirements

II Other General Provisions

- A. Upon submission of an application for final plan review, ten (10) copies of all final plans, reports, maps, documents and other related information must be submitted to the Community Development Department
- B. The submission of building construction plans and applications for building permits and certificates of occupancy and other such administrative requirements shall be accomplished in accordance with established county regulations and policy, except as herein provided
- C. No building permit or certificate of occupancy shall be issued in or for development except in conformity with all provisions of the applicable zoning district.

**10 2 5 EXCERPTS FROM THE OKEECHOBEE COUNTY ZONING ORDINANCE
PERTAINING TO**

- **SECTION 7 9 - ESSENTIAL SERVICES**

1 deemed to be met where the owner of such land can demonstrate to the
2 Administrative Official that he has legal access or established
3 access to such lands.

4 No building permit shall be issued in violation of these
5 requirements

6 7 Parking and Storage of Certain Vehicles Automotive
7 vehicles, mobile homes or trailers of any type without current
8 license plates shall not be parked or stored on any residentially
9 zoned property other than in completely enclosed buildings pro-
10 vided, this regulation shall not prohibit the parking of a mobile
11 home in current use for dwelling purposes in an RMH district

12 8 Moving of Buildings or Structures No building or struc-
13 ture shall be moved from one lot to another lot or moved to another
14 location on the same lot unless such building or structure shall
15 thereafter conform to all of the applicable provisions of these
16 zoning regulations and all other applicable regulations of the
17 County of Okeechobee

18 9 Essential Services Essential services shall be per-
19 mitted in any zoning district Essential services are hereby
20 defined to include and be limited to water sewer gas telephone
21 and electrical systems including sub-stations lift stations and
22 similar installations necessary for the performance of these ser-
23 vices provided however that this subsection shall not be deemed

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**10 2 6 EXCERPTS FROM THE OKEECHOBEE COUNTY ZONING ORDINANCE
PERTAINING TO**

- **SCHEDULE OF DISTRICT REGULATIONS**

SCHEDULE OF DISTRICT REGULATIONS
OKEECHOBEE COUNTY, FLORIDA

See Also Supplementary District Regulations, Section 7

1
AC

DISTRICT & INTENT

AC - AGRICULTURE CONSERVATION -- These districts are composed of large, open land areas. It is intended by the use of these districts to retain and preserve, insofar as desirable and practicable, the open character of the land. To that end, permitted and permissible uses are basically limited to conservation, agriculture, recreation, and, with certain limitations, other uses not contrary to the character of these districts. 'It is intended that this classification basically serve three purposes: (1) to preserve for agricultural uses those lands with agricultural development potential, to the end that man's future needs for food and fiber will be met, (2) to preserve and protect marsh lands, water sheds and water recharge areas, wilderness areas, open spaces, scenic areas, and park areas (where not otherwise zoned GU); (3) to serve as a "holding classification" for lands which may be eventually be required for more intensive uses. In the case of (3) it is the intention of these zoning regulations that such lands not be rezoned for more intensive uses without a clear showing of the public need, availability of services consistent with the more intensive uses proposed, and insurance that, upon rezoning, the development will not result in undue added financial burden to the residents of the County.

The regulations for the AC districts discourage or prohibit non-agriculturally oriented residential development, prohibit all commercial or industrial development except for certain agriculturally related commercial or industrial activity permissible by special exception and certain recreational activities not inappropriate for the districts. The regulations are intended to protect life and property in areas subject to periodic flooding and to conserve fish and wildlife.

PERMITTED PRINCIPAL USES and STRUCTURES - AC

1. Agricultural uses, including accessory structures and uses incident to agricultural activity.
2. Roadside stands of a temporary nature for sale of fruit, vegetables, or other agricultural products.
3. Railroad right of way, electric power or natural gas line right of way.
4. Publicly owned and operated parks, campgrounds, recreation areas, and uses and structures appropriate to such activities.
5. Permanent housing for agricultural labor employed on the premises located not closer than 200 ft. to any other property under separate ownership and with a ratio not greater than one dwelling unit for each 20 acres of land contained in the premises on which the labor is employed. Mobile homes may be used for this purpose subject to Section 8.15(b).
6. Cemetery, columbarium, or mausoleum, provided no grave, monument, or building shall be closer than 25 ft. to any boundary line of the property.
7. Public and private game preserves and wildlife management areas; fish hatcheries and refuges, private hunting and fishing camps.
8. Water conservation areas, water reservoirs and control structures, water and drainage wells.
9. Boarding stable, provided no structure for the housing of animals shall be located within 200 ft. of any property line in separate ownership.
10. House of worship (including temporary revival and gospel establishments), provided minimum parcel size shall not be less than 5 acres.
11. Private camps sponsored by religious or non-profit organizations (including day camps) for young people, such as boy or girl scout camp or church group.
12. Golf course and country club meeting requirements as for RSF, Special Exceptions.
13. Radio or television transmitting or receiving station, line of sight relay towers or devices.

14. Public or private elementary and high schools with conventional academic curriculums.
15. Monasteries, convents, and the like.
16. Off-site signs (See also this Schedule, Limitations on Signs)

PERMITTED ACCESSORY USES AND STRUCTURES -- AC

Uses and structures which are customarily accessory and clearly incidental and subordinate to permitted or permissible principal uses and structures. Residential structures shall be permitted as accessory uses only when such buildings are for the residence of the owner, operator, or employees of agricultural, conservation, or other permitted or permissible activities. Such dwellings where located in flood prone areas, shall have a floor elevation of not less than 2 ft. above flood height based on a 25 year frequency storm.

PROHIBITED USES AND STRUCTURES -- AC

Any use or structure not specifically or provisionally permitted herein. Listed permitted or permissible uses do not include as a principal or an accessory use any of the following which are listed only for purposes of emphasis.

1. Manufacturing, or industrial establishments; commercial establishments or activities, except as specifically provided.
2. Wholesale warehouse or storage establishments.
3. Junkyard or automobile wrecking yard.
4. Contractor, construction, or equipment yard.
5. Residential and institutional uses, except as specifically provided.
6. All uses not specifically listed as permitted or permissible uses.

SPECIAL EXCEPTIONS -- Permissible by Board of Adjustment After Public Notice and Hearing and Subject to Appropriate Conditions and Safeguards (See Section 13.3)

1. Commercial campgrounds (see Section 8.12) or recreation areas; commercial hunting or fishing camps, commercial fishery; marina. All buildings or parking for such facilities must be at least 50 ft. from any property line in separate ownership or ~~ownership~~.

2. Airports and landing fields.
3. Housing for agricultural labor when such labor is not employed on the same premises upon which the housing is located, when housing has a greater capacity than one dwelling unit for each 20 acres of land contained in the premises, or when proposed structures are to be located closer than 200 ft. to any other property in separate ownership. Mobile homes may be used for this purpose subject to Section 8 and particularly Section 8.15(b).
4. Garbage dump or sanitary landfill.
5. Race track or training course for animals or vehicles.
6. Animal hospital, (veterinary clinic, animal boarding place,) or fur-farm provided no building for the housing of animals shall be located within 75 ft. of any property line in separate ownership.
7. Outdoor or indoor rifle, shotgun, or pistol range, field archery range, golf driving range; par three golf course.
8. Commercial packing house for fruits or vegetables, but not citrus concentrate plant.
9. Milk processing plant or milk receiving station, poultry slaughtering and dressing, but not livestock slaughtering; sawmills. No structure to be located within 200 ft. of any residentially zoned property.
10. Livestock auction.
11. Prisons or prison farms.
12. Quarries, mines, and borrow pits, subject to meeting all other applicable governmental regulations.
13. Drive-in theaters.
14. Electrical generating facilities, well fields, water or sewerage treatment plant.
15. Riding academy; dude ranch.
16. Rodeo arena.
17. Flea Markets
18. Residential Child Care Facility A residential child care facility is a child care program licensed by the Department of Health & Rehabilitative Services to provide 24-hour care and services to minors in either a group home or outdoor living program.

MINIMUM LOT REQUIREMENTS -- AC (Area & Width)

Residential buildings as accessory to principal agricultural uses

20 acres; provided, a single residential structure may be erected as an accessory use on a parcel of lesser size where such parcel is classified under Ch. 193.461, Fla. Stats., as in agricultural use.

For all other uses, except as otherwise specified or as necessary to meet all other requirements herein set out:

None.

MAXIMUM LOT COVERAGE BY ALL BUILDINGS -- AC

Unrestricted

MINIMUM YARD REQUIREMENTS -- AC (Depth of front & rear yards, width, of side yards)

All buildings, except where a greater distance for yard or set-back is required for the particular use involved.

Front: 50 ft..

Side and rear: 35 ft.

7.

MAXIMUM HEIGHT OF STRUCTURES NO PORTION SHALL EXCEED -- AC

Un-restricted

LIMITATIONS ON SIGNS -- AC (See Also Section 10) No Signs Intended to be Read From off the Premises Except

As for RSF for uses permitted or permissible in RSF, and in addition

1. Identification signs for dairies, farms, groves, ranches, nurseries, or other permitted or permissible agricultural uses, such signs not/exceed ^{to} 25 ft. in height above ground or road grade level, whichever is highest.
2. For permitted principal uses not otherwise herein specified, on-site identification and directional signs, provided no single sign shall exceed 16 sq. ft. in area and that no activity for profit shall display more than 2 such signs at each entrance, and 2 additional such signs elsewhere on the premises.

3. For uses permissible by special exception and not otherwise specified to be determined at time of grant of special exception, provided that where uses permissible as special exceptions in AC districts are permitted or permissible uses in other districts, the limitations on signs for such uses in other districts shall not be exceeded in the grant of special exception in the AC district.
4. Riding academy, dude ranch, or boarding stable 2 ground signs each not to exceed 32 sq. ft. in area.
5. Temporary roadside stands 2 temporary ground signs each not to exceed 10 sq. ft. in area.
6. Off-site directional signs to activities permitted or permissible in the district and located in the district, provided no such sign (1) shall exceed 16 sq. ft. in area, (2) shall contain any matter beyond the name of the facility and the directions to it, and (3) no such sign shall be closer than 2000 ft. to any other such sign, or closer than one mile to any other sign advertising the same facility and location.
7. Off-site advertising signs, providing no such sign shall be greater than 500 sq. ft. in area, or be closer than 2,500 ft. to any other off-site advertising sign.

MINIMUM OFFSTREET PARKING REQUIREMENTS -- AC (See also Section 7.13)

For Off-street loading requirements see Section 7.13, m-p)

Unrestricted; provided (1) no offstreet parking or loading shall at any time be on public rights of way and (2) for uses permitted or permissible in RSP, offstreet parking requirements shall be as for RSE.

10 3 LAND USE PLAN DESCRIPTIONS

**10 3 5 EXCERPTS FROM THE MARTIN COUNTY COMPREHENSIVE
GROWTH MANAGEMENT PLAN PERTAINING TO**

- **SECTION 4-6 IMPLEMENTATION STRATEGIES**

Technical Standards

- 1 Screening and Mechanical Equipment Mechanical equipment or other utility hardware other than antennas and stacks on roofs shall be harmonious with the building or they shall be located and/or screened so as not to be visible from any public way within the impacted area, except within industrial districts. Utilities in or adjacent to residential areas shall be designed in a manner which minimizes nuisance impacts, such as noise and odor, and shall be landscaped and screened in order to minimize adverse visual impacts and enhance their general appearance and to preserve the stability and integrity of adjacent residential areas.
- 2 Maintenance of Activities within Enclosed Building All businesses, services or manufacturing or processing shall be conducted within completely enclosed buildings in all zoning districts excepting industrial districts. If the Planning and Zoning Commission determines that a demonstrated necessity exists for outside storage or display due to the impracticality and unreasonableness of enclosure requirements, in which case service, storage, display areas or yard shall be screened to the greatest reasonable and practical extent.
- 3 Exterior Lighting Exterior lighting shall be so arranged as to shield or deflect the light from adjoining properties and public streets.

L Fire Service and Height of Structures

The height of structures is regulated pursuant to the Martin County Zoning Code. In addition to the zoning policy, and consistent with the objectives and policies for fire service contained in this Plan, no application for a structure with habitable floor space over two stories or twenty-five feet (whichever is lesser) shall be permitted unless the Board of County Commissioners and the applicant has provided assurance of the availability of a fire company equipped to service the structure together with an available water supply which satisfies fire flow requirements of the National Fire Prevention Association Code adopted or as may hereinafter be amended.

SECTION 4-6 IMPLEMENTATION STRATEGIES

The implementation of the Martin County Comprehensive Growth Management Plan (GMP) must be an integrated, coordinated and dynamic program. The need to amend such development regulations as the Land Development Code (zoning regulations), subdivision and platting regulations, landscape code and environmental regulations, while providing for the creation of the concurrency management system shall establish the priority work program of the Board of County Commissioners, Local Planning Agency, County Administrator and the Growth Management Department.

Subsequent to the adoption of implementing regulations the County shall establish a formal Evaluation and Appraisal Report (EAR) beginning with the fifth (5) year after adoption of the Plan. Less formal but no less systematic written critiques of the Plan implementation shall be reported by the Growth Management Department to the Local Planning Agency at least every two and one half (2 1/2) year after the

Plan Adoption In both instances, implementation of the Comprehensive Growth Management Plan goals shall be evaluated against the established, objectives, policies, measures and thresholds established in each of the Plan Elements. Each operating Department responsible for the particular Element shall file a written report in a form established by the Growth Management Department to detail the efforts underway to implement the Comprehensive Growth Management Plan.

The continuing Evaluation, process established in Section 1-8 shall be used to establish the success of the County in providing for the development standards established for public and private land use activities established in this section. At a minimum evaluation of the Comprehensive Growth Management Plan shall be based on the following implementation strategies for each land use activity.

A Strategies for Residential Development

- 1 Plan and Design for Residential Quality Sufficient space provided for residential development and required community facilities to adequately meet the housing needs of the present and expected future population of the County shall be measured in accordance with Section 4-4, I

(Residential Land Use) and Section 4-4, D (Eliminate Inconsistent Uses). Residential development shall be planned and designed to create and perpetuate stable living areas and protect investments in land and land improvements. Part II, Data, Inventory and Analysis, Comprehensive Growth Management Plan presents supportive statistical analysis of population, land use and housing which shall be updated annually as part of the Concurrency Management and Capital Improvement System of CIE Plan Element, Chapter 14.

- 2 Protect Residential Areas from Encroachment by Incompatible Development Existing and future residential areas shall be protected from encroachment by commercial or industrial development or other non-residential uses which exhibit characteristics which would be incompatible with residential development. This objective does not preclude necessary community facilities and compatible uses established in planned communities from locating within residential areas when such activities satisfy established zoning criteria. Non-residential land uses other than community facilities, houses of worship, and certain not-for-profit public or quasi public institutions or clubs shall be expressly excluded from exclusively residential areas, except as provided for in the Land Development Code. No commercial land uses shall be permitted in residential areas delineated on the Land Use Map unless such uses are approved by the County as a home occupation or approved as an incidental commercial use which is supportive to residential units located within a Residential Planned Unit Development pursuant to the Martin County Code of Laws and Ordinances. No industrial use may be permitted within any exclusively residential areas as denoted on the Land Use Map. The elimination of inconsistent uses shall follow the provisions established in Section 4-4, D.

Any non-residential use proposed as part of a Residential Planned Unit Development is to be designed principally to support and shall be incidental to the residential units contained within the subject Residential Planned Unit Development. No land area used for commercial, industrial, other non-residential purposes including parking, access ways, open space, or utilities principally supporting the non-residential development shall be used in calculating residential density. The maximum size of the non-residential use shall be determined by a formula as provided in the Land Development Code.

This formula may be adjusted by the Board of County Commissioners upon an acceptable demonstration by the applicant that a larger non-residential allocation is a necessary convenience for a larger market area. Such demonstration by the applicant shall include a market feasibility report which shall analyze 1) all existing competing commercial facilities within a six (6) mile radius of the site, including delineation of estimated market areas and projected number of users assigned to each respective primary and secondary market area, 2) impacts of the proposed commercial facility on land resources designated on the Future Land Use map for future non-residential development and 3) impact of the proposed non-residential development on the quality and character of existing and anticipated future residential development within the neighborhood, including traffic impacts. The Planning and Zoning Commission shall recommend to the Board of County Commissioners whether the demonstrated need exists for additional non-residential area beyond the maximum allowable gross leasable floor area (as determined in the Land Development Code) after reviewing the applicant's plan and supportive market feasibility report. The Board of County Commissioners shall make the final determination as to whether a net beneficial public use is served by the proposal.

- 3 Promote Mixed Use Development The Board of County Commissioners shall establish by way of the Traditional Neighborhood District (TND) Goal (Section 4-4, C) mechanisms for mixed use development to encourage diversification for neighborhood development, provide for natural and historic resource protection (Section 4-4, E and F), encourage urban mixed use development in urban areas (Section 4-4, G) and energy efficiency (Section 4-4, H). The measure of success of the Traditional Neighborhood District will revolve around the integration of neighborhood plan to the development of the whole community. The County shall endeavor to assist in the planning for such neighborhoods with both capital facilities and physical planning to support neighborhood development as provided by Section 4-4(C).
- 4 Promote Orderly Land Use Transitions Where it is physically not feasible to separate residential from non-residential land uses, buffering shall be required to promote a smooth land use transition. Buffering may take the form of 1) physical barriers, such as berms, hedges or other landscape cover, walls or fences aesthetically designed for screening purposes, or, indigenous densely vegetated open space, or 2) the development of a transitional use between the incompatible uses (such as low intensity office development between general retail commercial centers and residential areas). Development regulations are to be established to provide for transition performance standards as provided in Section 4-5(A).

5 Promote Orderly Transition in Residential Densities Highest residential densities generally continue to be allocated to sites highly accessible to major urban thoroughfares or urban collector streets and adjacent to existing development with the same or higher density or less restrictive zoning districts. Residential densities are to be allocated in manner compatible with available public services, natural features of land and existing and anticipated future development. Existing residential development, particularly single-family residential subdivisions shall be protected from negative impacts of new development proposals as specified in Sections 4-3, D (Policies for Allocating Residential Development) and Section 4-4, I, 4, Policy for orderly transition of land use intensity in the Residential Land Use Goal.

6 Reinforce and Enhance Appearance of Residential Areas and Provide Amenities Scenic vistas, especially along the ocean, the intracoastal waterway, St. Lucie River, Loxahatchee River, Indian River, Savannas, and along major transportation corridors shall be enhanced by preservation of open space, by installation and maintenance of landscape and by application of community appearance criteria which reinforces good principles of design as noted in Section 4-4(E).

B Strategies for Commercial Development

1 General Considerations in Locating Commercial Development Commercial development, comprised of a wide range of business activities in Section 4-3(E), is to be allocated land resources considering the locational and space requirements of commercial activities and potential fiscal and environmental impacts to Martin County. The location and distribution of specific types of commercial activities shall be determined based on the following considerations:

- a Trip generation characteristics, impact on existing and planned transportation facilities and ability to achieve a functional internal circulation and landscaped off-street parking system,
- b Location and site requirements based on specific needs of respective commercial activities, their market area, anticipated employment generation and floor area requirements,
- c Compatibility with and impact on other surrounding commercial activities,
- d Relationship to surrounding land uses and natural systems,
- e Impact on existing and planned community services and utilities.

2 General Pattern of Commercial Land Use In order to promote efficient flow of traffic along thoroughfares, achieve orderly development and minimize adverse impact on residential quality, commercial development is concentrated in strategically located areas having location characteristics which best accommodate specific land area, site, public facilities and market location requirements of respective commercial uses. Sites that comply with these locational criteria and strategies may be considered for commercial designation in addition to the existing sites illustrated in Section 4-3, E, Future Land Use Map.

However, proliferation of strip commercial development shall not be extended. The existence of commercial areas on one corner of an intersection shall not dictate the development of all corners with the same or similar use, nor does the existence of commercial development on a major thoroughfare dictate that all frontage must be similarly used.

- 3 Encourage Improved Design of the Commercial Core Areas which Serve as the Focal Point of Major Unincorporated Communities in the County Commercial development is to be used as a focal point to promote the improved design of the central commercial core areas within the communities of Jensen Beach, Palm city, Port Salerno, Hobe Sound and Indiantown. Improvements in the physical design of these centers shall reinforce and improve their role as community centers of office and institutional activity, retail trade, and civic and cultural enrichment. Design strategies shall provide for innovative themes and approaches to designs that are consistent with the purpose and unique character of these areas. Development shall accommodate and encourage pedestrian circulation while vehicular traffic flow and parking shall be designed to reinforce and improve pedestrian mobility.
- 4 Provide for the Various Commercial Uses The implementation of policies for the variety of commercial uses specified in Section 4-3(E), shall be assured through the development regulations that provide for the unique needs supporting each of the zoning districts, of the Land Development Code. Martin County shall evaluate the success of these policies and the Goal in Section 4-4(J) regularly.

C Strategies for Industrial Development

- 1 General Considerations in Locating Industrial Development Sufficient land shall be allocated to accommodate industrial development. The allocation of land resources for industrial development shall reflect the location and space requirements of industrial activities and potential fiscal and environment impacts on Martin County. The location and distribution of specific types of industrial activities shall be determined based on the following consideration:
 - a Trip generation characteristics and impact on existing and planned transportation systems, including dependency on rail, air, or trucking for distribution of materials and goods,
 - b Anticipated employment generation, floor area requirements, and market area,
 - c Ability to meet established performance standards for preventing or minimizing nuisance impacts, such as emission of air pollutants, glare, noise or odor,
 - d Impact on established or planned development and natural systems, and
 - e Impact on existing and planned public services, utilities, water resources, and energy resources
 - f Ability to connect to a regional water and wastewater treatment system

- 2 Policies for Allocating Industrial Development The Land Use map policies in Section 4-3(F) allocates land resources for existing and anticipated future industrial development needs. The allocation process provides a high priority to industries frequent need for strategically located lands accessible to rail facilities, major arterials or interchanges, labor markets, and the requisite urban services planned for Urban Development Areas (Figure 4-7)
- 3 Pursue Selective Industrial Expansion Policy Martin County shall pursue a strategy of selective expansion of its industrial base and diversification of the employment opportunities as established in Chapter 15, the Economic Element. Examples of such economic opportunities include but are not limited to
 - a Generating high levels of employment with higher than average wage and salaries, and relative independence from cyclical changes in economy,
 - b Producing services and/or products which complement the needs and resources of existing industry within Martin County,
 - c Providing basic industry which is likely to serve as a desirable priming action for attracting additional industry compatible with the County's economic goals and objectives as well as the County's growth management and resource conservation policies,
 - d Contributing a net revenue to the Martin County government and thus enhancing the fiscal capacity of the County, and
 - e Conserving the County's natural resource and public facilities by generating minimal adverse impacts on either groundwater or potable water resources, the transportation system, solid waste system or other costly impacts to either natural resources or community facilities
- 4 Prevent Nuisance Impacts of Industry The County shall prevent nuisance impacts frequently associated with industrial activities by incorporating performance standards for managing emission of noise, air pollutants, odor, vibration, fire or explosive hazard, and glare into the Land Development Code. Similarly, land shall be allocated to industrial uses in a manner which allows for separation and co-location of industrial activities capable of complying with the most restrictive performance standards and exhibiting minimal adverse impacts on surrounding development
- 5 Evaluation of Industrial Lands Lands allocated for Industrial Use by the Future Land Use Maps (Section 4-3) shall be evaluated periodically to assure their utility for said use and the potential for expansion to meet the future demands
- D Strategies for Urban and Rural Supportive Facilities and Services and Fiscal Capacity

- 1 Achieve and Maintain an Efficient System of Urban and Rural Facilities and Services Martin County shall assure the equitable provision of facilities and services required to support urban and rural development. Deficiencies in necessary supportive facilities and service for urban and rural development shall be satisfied through equitable fiscal contributions prior to issuing permits for such development. Support facilities for urban services shall be assured by the implementation of Section 4-4(G), Encourage Urban Development in Urban Service Areas. Similarly, areas of rural development as defined by the Urban Services District Boundary Map, Figure 4-7, shall be encouraged for rural services provided. Allowances for Housing Service Zones in the Housing Element, Section 6-4, A, 4, c, shall assure that the full complement of urban facilities and services is assured prior to any change to the Urban Service District Map.

- 2 Manage the Location, Timing, Intensity and Design of Future Urban and Rural Development Martin County shall closely coordinate the location, timing, intensity and design of future development. Development permits shall be only after the owner/applicant has provided plans and requisite assurances that all requirements for road improvements, potable water service, wastewater disposal, drainage, recreation areas, schools and protective services shall be satisfied prior to the issuance of a development order as provided in the Capital Improvement Element, Chapter 14.

The Martin County Board of County Commissioners shall, in accordance with Section 1-9 of the Comprehensive Growth Management Plan, review each element every five (5) years. The evaluation shall include analysis of evolving trends in land development on the outer fringe of urban areas, depicted on the Urban Services Boundary Map, Figure 4-7.

- 3 Concentrate Urban Development within Strategically Located Urban Centers Urban development shall be restricted to the primary and secondary urban service districts delineated in Figure 4-7. The Primary Urban Service District includes areas located within the planned expansion area of public and private utilities certified and regulated by the Public Service Commission or by Martin County. Urban Development shall be defined as commercial, office or industrial as well as residential development exceeding a density of one-half unit per gross acre. The Local Planning Agency and the Board of County Commissioners may consider a waiver of this requirement if the location and use proposed is demonstrated by the applicant to 1) generate a net beneficial public purpose, 2) be necessary due to the unique location and supportive service requirements of the use, 3) meet all Plan policies with regard to cost-efficient provision of necessary urban services, LOS standards, and funding of needed capital improvements, 4) provide a net beneficial fiscal contribution to the short and long term fiscal capacity of the County, and 5) generate no significant negative impacts to the growth management and resource conservation policies of Martin County. Housing Service Zones per Section 6-4, A, 4, c, of the Housing Element could be an important component of criteria number 1 and would have to meet criteria number 4 above only to the maximum extent feasible. Large industrial areas removed from central urban service districts shall be contained within individual urban service districts which supply all applicable urban services such as fire, water, sewer, and emergency services.

- 4 Development Outside the Urban Services District Shall be Restricted to Low Intensive Development in order to Promote Cost-Effective Practices in the Delivery of Public Services Outside Urban Service Districts development options shall be restricted to low intensity uses including agriculture and agricultural ranchettes, not exceeding one unit per five (5) gross acres, and small scale service establishments necessary to support rural and agricultural uses as provided by Section 6-4, A, 5, c, Housing Service Zones in the Housing Element
- 5 Congregate Housing for Agricultural Farm Workers as a Conditional Use Outside the Urban Services District Special conditional use permits granted for development of congregate housing for families employed on productive farms, having a minimum of sixty (60) acres shall be deemed consistent with the above stated paragraph. However, the granting of such permit must be approved by the Board of County Commissioners after review by the Planning and Zoning Commission. Prior to the granting of such permit the Board of County Commissioners shall find that applicant provides legal assurances that
- a The congregate housing and the land on which the housing is located shall be under common ownership with a contiguous producing farm,
 - b The housing shall be inhabited solely by families who work on the farm, and the facilities shall satisfy the Southern Building Code and the County's Housing Code
 - c The County Commission may require removal of such facilities if after due process such facilities are found to be unsafe, unsanitary, or inconsistent with the adopted code, standards and/or regulations of Martin County
 - d The development plan shall satisfy all requirements of the Martin County Code of Laws and Ordinances
- 6 Provisions of Adequate Capital Facilities Land development shall not be permitted unless adequate capital facilities exist or are ensured at the Level of Service adopted by the Board of County Commissioners. Prior to granting a development approval, Martin County shall assure that adequate capital facilities and public services are available to support the new development as specified in the Concurrency Management System provided in Chapter 14, the Capital Improvement Element. Land development shall bear a full share of the cost of the provision of the new or expanded capital facilities required by such development. The imposition of impact fees and dedication requirements is a preferred method of regulating land development in order to ensure that it bears a proportionate share of the cost of capital facilities necessary to accommodate that development and to promote and protect the public health, safety, and general welfare. Development approvals requiring dedications of land, capital improvements or equitable contributions of fees, or any combination of the foregoing, shall be granted appropriate credit for said dedications, capital improvements or equitable contributions at the time of the collection of an impact fee

E Strategies for Agricultural Land Resources Preservation

- 1 Provide Land and Water Management Policies that Encourage Agricultural Productivity on the County's Most Productive Farmlands Martin County strongly urges the preservation of agricultural lands within the County, realizing that these resources are valuable due to soil attributes and local climatic conditions which render the land especially productive for agriculture and silviculture. The Future Land Use Map denotes agricultural farmlands within Martin County. The agricultural lands shall be encouraged to remain in productive use through implementation of incentives addressed in Section 4-4, C. In addition, land and water management policies, including the Land Use Map, strategies for locating and timing public and private improvements, subdivision controls and other relevant land use controls shall be directed to preserving the agrarian character of the agricultural lands, especially those outside the Urban Service District Boundaries, Figure 4-5.
- 2 Monitor and Evaluate Best Management Practices and New Innovations Preserving Agricultural Farmlands While Protecting Private Property Rights of the Farmer Martin County shall continue to preserve agricultural lands by restricting urban service expansion to areas centrally located to urban cores. While attaining economy and fiscal conservancy in the delivery of public services, this policy will provide maximum protection to the farmer from encroachment by urban uses. In addition, the special housing policy stated in Section 4-6 (D)(5) shall permit necessary flexibility in land management policies to assure adequate on-site housing for large farm owners requiring such facilities. As additional issues unfold, the County shall continue to apply innovative concepts to reconcile the need for agricultural land preservation and the need to protect and preserve the farmers' property rights.

**10 3 6 EXCERPTS FROM THE OKEECHOBEE COUNTY COMPREHENSIVE
PLAN, 1980, PERTAINING TO**

- **LAND USE ELEMENT**

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

Woodlands and Vacant Land

This category accounts for 8.03% of the land area of the county. Nearly 1,000 acres of the vacant land is considered to be barren land. That is land that is unusable for any purpose. This land is best left in its present state.

There are no rare species of woodland or much timber that is marketable. To the extent possible the woodlands within the county should be left untouched for aesthetic reasons. They provide habitat for wildlife as well as active and passive recreation areas.

LAND USE OBJECTIVES AND POLICIES

The purpose of a Future Land Use Plan is to guide the county's future development. To give direction to this plan basic objectives need be established. Policies giving direction to the attainment of the objectives also need to be established. The 1974 plan contains such objectives and policies. For the most part these are still valid. Those which are still valid are listed below and objectives and policies necessary to alter undesirable growth or to encourage desirable development have been added.

OBJECTIVE 1

Increase employment opportunities within the County by encouraging new industrial and commercial development.

POLICY

Encourage commercial, residential, industrial and recreational development within Okeechobee County.

EFFECT

Industrial and commercial location within the County can provide jobs for County residents, add to the tax base, encourage housing rehabilitation and construction and add to general economic well being. Industry can also pollute the environment, over tax existing circulation and refuse disposal systems and deplete natural resources.

OBJECTIVE 2

Restrict development to those areas that are ecologically, physically, and economically best situated to provide for a visually pleasing as well as a safe and healthy environment

POLICY

Update subdivision, zoning and building codes and ordinances as well as other legislation to properly guide the type and placement of development

EFFECT

Damage to the environment can be avoided, optimum use of circulation facilities, natural resources and suitable land can be achieved. Developments must be required to be made safe and hazard-free as well as attractive and substantial

OBJECTIVE 3

Increase the amount of commercial services and facilities within the County

POLICY

Encourage local retailers and businesses to remain within the County and to expand their facilities. Encourage new commercial enterprise to establish themselves within the County in general

EFFECT

Expanding existing commercial facilities and establishing new business in the community will provide additional jobs thus additional income for the County and its residents. This objective will also permit a greater percentage of the County residents' income to be spent and kept in the County as well as providing the opportunity for tourists, travelers and non-residents to add to the County's economy through their expenditures within the County. Increased commercial facilities and services should also help attract additional residential, recreational and industrial development while providing more convenient and extensive services for existing residents

OBJECTIVE 4

Encourage intensive development in areas which are proposed for sanitary sewer and water services

POLICY

Accept the recently adopted 201 Facilities Plan as a guideline for highest density residential and intensive commercial and industrial development

EFFECT

By concentrating development in areas where vital utility services are proposed, the cost of these services will be considerably lower than if scattered development continues as it has in the past

OBJECTIVE 5

Discourage development in floodplains and other environmentally sensitive areas

POLICY

Any new development in floodplains and sensitive areas must adhere to all Federal and State regulations

EFFECT

Flood damage will be minimized and polluting effects on both ground and surface water will be eliminated or greatly reduced

The above general objectives and policies will be given greater detail in the following Future Land Use Plan. As development occurs in the County, the objectives and policies must be constantly reevaluated to determine if they are giving County growth and development proper direction. They should be reconsidered in light of development patterns taking place, effects on natural and human resources, ecological factors and the physical, social and economic environment being produced. It is mandated by Florida Statutes that this reconsideration should take place at the end of five year periods. Modifications and adjustments should be made to the objectives and policies as needed.

FUTURE LAND USE PLAN

This element presents County land use policies in visual as well as verbal terms in order to provide direction to future public and private land development. The Future Land Use Plan is basically represented by Exhibit 1, Future Land Use Map, and by specific policies that expand upon the general objectives and policies previously outlined.

Most of the tracts of land in the County are undeveloped. These tracts should be developed in a progressive manner or left in a natural state as indicated on Exhibit 1. Based upon the population forecasts for 2,000 which predict a continuing increase in population, the emphasis on changes in land use must be placed on providing land for possible residential, industrial and commercial development and at the same time preserve agriculture. Land must also be made available for upgrading community facilities and services for the present and future residents of the County. To implement the Future Land Use Plan, the following specific policies are recommended:

THE DEVELOPMENT OF RESIDENTIAL LAND USE SHOULD BE ENCOURAGED IN CERTAIN AREAS OF THE COUNTY

The use of land for agricultural-rural residential purposes constitutes the largest area of the County. The present trends forecast that there will be a further increase in the agricultural use of land accompanied by an increase in homes located in the agricultural areas. This trend needs to be modified to concentrate residential development in the areas indicated on the Future Land Use Plan Map. Many of the needed services such as fire, police, sanitary sewer, schools and recreation can then be offered to the residents at an economically feasible level. Also, the best agricultural lands will be available for continued agricultural uses. On the Land Use Plan Map, low density residential land use (no more than 4 dwelling units per gross acre) is designated for large areas where the topography, ecology and existing and potential services may easily and economically be provided for the residents. Within these areas, future residential uses should be harmoniously arranged within neighborhood units, and high standards of development should be strongly encouraged for these future residential neighborhoods. Further development of these areas, grouped around the County's presently developed areas would strengthen existing commercial and other specialized activities found in these core areas and provide incentive for additional development.

The clustering of residential uses makes the provision of community utilities more economical. This will also allow for better utilization of existing or proposed community facilities, such as schools and playgrounds. This proposed future pattern of growth is a logical continuation of a present, desirable development trend.

The Future Land Use Plan Map also shows areas for medium density residential (no more than eight (8) dwelling units per gross acre). It is proposed

that these areas shown as medium density be developed for residential and supporting service commercial development. Possible development might include condominium houses and recreational service development. Because of the nature of the soils and topography, it will be extremely important that proper development controls be enforced.

DEVELOPMENT WHICH CAN OCCUR ON THE FLOOD PRONE AREAS IN THE COUNTY WHERE UNSUITABLE SOILS EXIST SHOULD BE LIMITED.

The classification of land as flood prone is designated as such because of the susceptibility to and the danger of flooding. The erection of permanent dwellings should be prohibited but temporary recreational residences might be permitted. These restrictions are intended to prevent damage to permanent structures as well as to create open-space compatible with natural features. A basic purpose of the Future Land Use Plan is to use foresight in the arrangement of land uses. The creation of flood plains provides the individual property owners in the County protection against natural phenomenon which are incompatible with their property. The Future Land Use Map shows the areas of the County that have soils with very severe development constraints and that are subject to flooding. These areas are proposed on the Exhibit 8 as "conservation and recreational" lands. Some areas indicated for this category are presently developed.

FURTHER DEVELOPMENT OF COMMERCIAL AREAS SHOULD BE ENCOURAGED WITHIN THE COUNTY.

The location of existing commercial land uses in Okeechobee County should remain essentially the same as today. It is proposed that they be intensified and regulated to reinforce a more harmonious development pattern. The future land use plan indicates an increase in the acreage devoted to commercial land use. This is necessary to more adequately service the needs and desires of the inhabitants of the existing and future residential areas. As these commercial areas develop, the residents can be expected to spend more of their disposable income at commercial enterprises within the County rather than traveling to other areas.

Commercial development should be controlled and guided to minimize adverse influences on adjacent roads or land values. Activities such as gas stations, restaurants, motels, and other highway and tourist-oriented commercial enterprises, usually develop along major highway routes. These activities should be encouraged to locate in appropriate areas such as adjacent to small communities and to recreation areas. Such commercial development should be concentrated in clusters. This would avoid many ingress and egress points as well as preserve the integrity of the County's highways.

Expanded commercial usage is essential to the County's overall economy and would help strengthen the County's tax base.

ENCOURAGE THE DEVELOPMENT OF INDUSTRY AT SPECIFIC LOCATIONS IN THE COUNTY

Industrial development should be encouraged in areas where adequate transportation is available. Such development should be directed to areas already zoned for industry.

The development of industry in the County will help strengthen the tax base as well as improve the overall economy.

THE COUNTY SHOULD DESIGNATE THE LOCATION OF FUTURE COMMUNITY FACILITIES AND SERVICES SO THE NECESSARY LAND CAN BE OBTAINED

The land used for community facilities and services will necessarily increase with the population. Much of this land is non-revenue producing, but it is needed to increase services to the residents of the County.

THE COUNTY SHOULD OFFER SUPPORT FOR THE DEVELOPMENT OF MAJOR RECREATION FACILITIES IN THE COUNTY

Since Okeechobee County has very little land in recreational use other than that surrounding its schools, it is recommended that the County establish or support the State in establishing sizeable areas for regional recreation activities. It is suggested that such acreage could be created in a manner as to help control or minimize damage from flooding along Lake Okeechobee.

The private sector of the County's economy should be encouraged to participate in the development of various forms of recreation and open-space consisting of the flood plains which can be developed for recreation purposes. As urban growth continues, there will be an increasing demand for recreational areas in less developed sections. Okeechobee County is in a favorable position being located in a rapidly growing region with the opportunity to create an expanded recreational industry serving the needs of the urban population outside the County. The County must plan for such expansion and reserve the land which is necessary for new facilities.

Exhibit 1, Future Land Use Plan portrays the land use objectives and policies in graphic terms. This plan is schematic in that it gives only generalized locations. It should be utilized to provide a basis for an updated zoning map. As needs and community desires change, the Future Land Use Plan should be evaluated and if need be revised.

In keeping with the 201 Facilities Plan, the Future Land Use Plan indicates areas for medium density residential, commercial, and industrial uses within those areas

proposed to be sewerred by the year 2000. The one exception to this is the location of low density residential areas north and east of the airport. These areas are to be sewerred. However, because of the close proximity to the airport and considering the flight patterns, these areas should be developed at a lower density to reduce hazards and noise problems.

Low density residential development, in addition to the areas mentioned above, are shown adjacent to and near areas which are scheduled for sanitary sewers. These locations are on lands which should be capable of accommodating on-lot systems. Low density development is also shown in outlying rural areas. These are extensions of existing developing patterns.

Within the area intended for intense development are areas shown for conservation/recreation. These are areas which should be held for development after the proposed sewerred areas are fully developed. Within these areas, the soils are not capable of accommodating on-lot sewerage systems. Therefore, they should not be developed until public sewer can be provided.

Conservation areas are also shown for the most critical floodplains and sensitive head waters areas. These are further discussed in the conservation element.

10 3 7 OKEECHOBEE COUNTY COMPREHENSIVE PLAN 1980

- **UTILITY ELEMENT**

UTILITY ELEMENT

The following is submitted as the Utility Element

In conformance with the requirements of section 163 3177, F S , this utility element shall at all times be consistent with the current 10-year site plan submitted by Florida Power and Light Company to the Department of Community Affairs

Consistent with the requirement that the utility element conform to Florida Power & Light Company's 10-year site plan, the projections and proposals of that plan as it is amended from time to time by the utility and found to be suitable by the Division of State Planning are hereby adopted by reference and made a part of this comprehensive plan

Whatever support facilities are needed to provide electric utility service to existing land uses, to such future land uses as are authorized by other elements of this plan and to such future land uses as may be lawfully authorized by the commission, shall be permitted in any use category and shall be deemed to be consistent with this comprehensive plan

To assure that Florida Power & Light Company is able to continue to meet the requirements imposed upon it by law, to provide a reliable and economical supply of electrical power to its customers, the maximum amount of flexibility possible consistent with sound planning shall be maintained in locating future generating and substation sites and transmission line corridors

Decisions regarding the need for and proposed location of future electrical power facilities shall recognize Florida Power & Light Company's legal requirement to provide electrical power to customers in its service area irrespective of geographical location

Section 163 3177 (2), F S , requires that all elements of the local Government Comprehensive Plan be economically feasible Land use and other regulations adopted pursuant to the comprehensive plan shall weight the economic costs involved for customers of Florida Power & Light Company

In order for Florida Power & Light to provide reliable and economic electrical power to its customers in the face of fluctuating growth trends and patterns of energy use, it is necessary to maintain flexibility for as long as possible. It is recognized that the ability to provide reliable electric service to existing and future customers and developments at the lowest practical cost necessitates flexibility in location, configuration and operation of all facilities required to provide such service as mandated by law. Every effort shall be made by the commission and Florida Power & Light Company to work together to insure that the future energy needs of the county will be met as they arise.

Nothing in the Comprehensive Plan is in conflict with or will interfere with any of the items in the foregoing element or the Power Company's ten year plan.

It is the County's policy that all utilities should utilize existing road rights of way and existing drainage and utility rights of way whenever practical. Also, utilities should follow section lines when placing power lines, poles, etc, whenever practical. The Utility Element and the policies provided herein do not exclude Glades Electric Coop or other applicable utilities.

Technical Standards

- 1 Screening and Mechanical Equipment Mechanical equipment or other utility hardware other than antennas and stacks on roofs shall be harmonious with the building or they shall be located and/or screened so as not to be visible from any public way within the impacted area, except within industrial districts. Utilities in or adjacent to residential areas shall be designed in a manner which minimizes nuisance impacts, such as noise and odor, and shall be landscaped and screened in order to minimize adverse visual impacts and enhance their general appearance and to preserve the stability and integrity of adjacent residential areas.
- 2 Maintenance of Activities within Enclosed Building All businesses, services or manufacturing or processing shall be conducted within completely enclosed buildings in all zoning districts excepting industrial districts. If the Planning and Zoning Commission determines that a demonstrated necessity exists for outside storage or display due to the impracticality and unreasonableness of enclosure requirements, in which case service, storage, display areas or yard shall be screened to the greatest reasonable and practical extent.
- 3 Exterior Lighting Exterior lighting shall be so arranged as to shield or deflect the light from adjoining properties and public streets.
- L Fire Service and Height of Structures

The height of structures is regulated pursuant to the Martin County Zoning Code. In addition to the zoning policy, and consistent with the objectives and policies for fire service contained in this Plan, no application for a structure with habitable floor space over two stories or twenty-five feet (whichever is lesser) shall be permitted unless the Board of County Commissioners and the applicant has provided assurance of the availability of a fire company equipped to service the structure together with an available water supply which satisfies fire flow requirements of the National Fire Prevention Association Code adopted or as may hereinafter be amended.

SECTION 4-6 IMPLEMENTATION STRATEGIES

The implementation of the Martin County Comprehensive Growth Management Plan (GMP) must be an integrated, coordinated and dynamic program. The need to amend such development regulations as the Land Development Code (zoning regulations), subdivision and platting regulations, landscape code and environmental regulations, while providing for the creation of the concurrency management system shall establish the priority work program of the Board of County Commissioners, Local Planning Agency, County Administrator and the Growth Management Department.

Subsequent to the adoption of implementing regulations the County shall establish a formal Evaluation and Appraisal Report (EAR) beginning with the fifth (5) year after adoption of the Plan. Less formal but no less systematic written critiques of the Plan implementation shall be reported by the Growth Management Department to the Local Planning Agency at least every two and one half (2 1/2) year after the

- a Construction of a single family dwelling in accordance with the other applicable provisions of this Plan and the Code of Laws and Ordinances
- b Construction of a duplex when the lot of record includes at least one-half acre and will be serviced by a major or interim water supply system and in accordance with the other applicable provisions of this Plan and the Code of Laws and Ordinances
- c Construction of a duplex when the following criteria are met
 - (1) The duplex will be serviced by public water
 - (2) The duplex is located in a subdivision, or all that portion of a subdivision, which is zoned for duplex use and is designated for medium density or high density use on the future land use map of the Comprehensive Plan, and which was three-fourth (3/4) developed in duplex use on the effective date of the Comprehensive Growth Management Plan
 - (3) Public sewage treatment service is not available within 1000 feet of the subject duplex lot
 - (4) An agreement is executed with the County to connect to a public sewage treatment service within one year from the date the service is available to the duplex
 - (5) The Health Department reviews the request and finds that all requirements for septic systems are met without any need for State of Florida variance
 - (6) The duplex is located in an area where the Health Department has determined that groundwater or surface water contamination or a high failure rate for septic systems does not exist

The intent of this subsection is to permit infilling of duplex units in existing duplex subdivisions where most of the lots are occupied by duplex units

- 3 The above subsection 1 shall not apply to remodeling, rebuilding or reconstruction
- 4 The above subsection 1 shall not apply to replacement or repair of septic tanks
- 5 This section shall not be interpreted to deny the use of individual sewage disposal systems other than septic tanks when provided for in the Code of Laws and Ordinances
- 6 Development shall not be approved pursuant to this Section unless the Martin County Health Department has approved the septic tank or other individual wastewater treatment system based on soil conditions and all rules of the Florida Department of Health and Rehabilitative Services

- 7 For purposes of this section, the term "unit" shall mean one single family dwelling, one-half of a duplex, one-third of a triplex and one-fourth of a quadraplex
- 8 When a regional wastewater system is not available, non-residential uses generating less than 2,000 gpd per establishment shall be allowed to use septic tanks except when uses are judged by the Health Department to constitute a high expected failure level

I Soil Erosion and Sedimentation Control

The Land Development Code shall address methods of controlling soil erosion and sedimentation

Technical Standards In order to prevent both soil erosion and sedimentation, a soil erosion and sedimentation control plan shall be required as a part of an application for site plan review whenever a development shall involve any clearing, grading, transporting, or other form of disturbing land by the movement of earth, including the mining of minerals, sand and gravel

All measures necessary to minimize soil erosion and to control sedimentation in the disturbed land area shall be implemented. The following protection shall be provided for all disturbed areas: minimize velocities of water runoff, and retain sedimentation within the development site as early as possible following disturbances

J Parking, Internal Circulation, and Access to Public or Private Streets

Driveways and areas for the parking and internal circulation of vehicles shall be located, designed and controlled so as to provide for safe and convenient circulation within the site and safe and convenient access from adjoining streets

Technical Standards Parking requirements of the Zoning Ordinance shall be applied for calculating required off-street parking. Among factors to be considered shall be the number and location of access drives from adjacent streets, the location and width of driveways and access aisles to parking spaces, the arrangement of parking areas and means of access to building for fire-fighting apparatus and other emergency vehicles. All non-residential development and all residential development, except for single-family homes, shall be required to provide adequate off-site parking and facilities for on-site back-up and turn-around movements

Parking areas and driveways shall be clearly identified and separated from principal pedestrian routes and recreation areas by curbs, pavement markings, planting areas, fences or similar features designed to promote pedestrian safety

K Appearance and Nuisances

Subdivision and site plan reviews shall assure that nuisance impacts of sight, sound, and smell shall be minimized. No standards on appearance shall be enforced unless adopted as part of the Land Development Code

G Available Potable Water

All future applications for new development shall be required to connect to a regional water system as defined in Chapter 11, Potable Water Service Element. The system shall have sufficient allocation of water supply from the South Florida Water Management District.

In rural developments outside the urban service district and in residential subdivisions with minimum lot sizes of 1/2 acre or more, the County Public Health Director and Director of Public Works may approve the use of private wells. In low density residential development, when connection to a regional public utility is not presently feasible, the applicant shall provide an interim water system, approved by the Director of Public Works subject to the following conditions:

- 1 Assurance in writing from the utility that extension of lines to the development is part of their 10-year expansion plans, and
- 2 Agreement by the developer that the system will be connected to the regional utility at no cost when service becomes available.

Where a regional system for water service is unavailable, the applicant shall provide an interim water system approved by the Director of Engineering and shall agree that the system will be connected to a regional utility at no cost to the County when service becomes available. The water source, supply and system design shall satisfy performance standards of the South Florida Water Management District, the DER, other applicable regional, state or federal standards, or standards which may hereafter be adopted by the Board of County Commissioners. However, where a well is required to be permitted by the South Florida Water Management District, (SFWMD) the permit granted by the SFWMD shall be filed by the applicant with the County which may exercise its power to monitor withdrawal rates to assure applicants adhere to established regulations protecting surrounding wellfields. Furthermore, in order to prevent abuse of County water resources, the installation and operation of wells not covered by the South Florida Water Management District regulations shall be subject to County permitting and monitoring regulations using standards which may hereafter be adopted by the Board of County Commissioners.

The intent of this permitting procedure is:

- 1 To maintain a comprehensive data base concerning water supply and quality,
- 2 To discourage unregulated proliferation of private water systems, and
- 3 To achieve a subsystem design which can be effectively and economically integrated into a regional public utility system certified and regulated by the Public Service Commission or by Martin County at a later point in time and to encourage a compact urban development pattern by managing the location, timing and scale of land development to assure that new development can be efficiently served by public facilities without adversely impacting the County's fiscal capacity.

In addition, the County shall undertake any necessary action to prevent or remedy water supply and water quality problems.

The County may require analysis of water quality and supply of all permitted private wells based on evolving problems and issues associated with water resources. The private well owner may be assessed by the County after due public hearings for needed water quality, supply problems, requisite testing, laboratory analysis, and improvements deemed necessary and fiscally equitable.

H Wastewater Service

All applicants for development within the urban service district shall be required to connect to a regional utility as defined in the Sanitary Sewer Service Element, Chapter 10. Where a regional system for wastewater service is unavailable, the applicant shall provide an interim wastewater system approved by the Director of Public Works and shall agree that the system will be connected to a major regional at no cost when service becomes available.

The intent of this provision is

- 1 To discourage unregulated proliferation of private package treatment plants,
- 2 To achieve a subsystem design which can be effectively and economically integrated into a regional wastewater system at a future point in time which would be certified and regulated by the Public Service Commission or by Martin County, and
- 3 To encourage a compact urban development pattern by managing the location, timing, and scale of land development to assure that new development can be efficiently served by public facilities without adversely impacting the County's fiscal capacity.

The system shall be designed to satisfy performance standards of the Department of Environmental Regulation (DER), other applicable regional, state, or federal standards, or standards which shall be hereafter adopted as part of the Land Development Code. The standards in the Land Development Code shall address such issues as demonstration of need, service area, system design and specification, required easements, maintenance and operation considerations, screening, security, right of entry provision, future dedication to a regional public utility when deemed appropriate, and notice and procedure.

- 1 Notwithstanding any other provisions of this Plan, when a septic tank is the only means of individual sewage disposal, the following standards shall apply to residential development:
 - a Each septic tank shall be located on a lot
 - b Each lot shall have a usable minimum area of one-half acre per unit when the development is serviced by a private well
 - c Each lot shall have a usable minimum area of one-third acre per unit when the development is serviced by a public water system
- 2 The above subsection 1 shall not apply to a lot of record (as described in Section 4-5 (A)) in the following instances

- 2 Land Development shall bear a proportionate share of the cost of the provision of the new or expanded park and recreation capital facilities required by such development
- 3 The imposition of impact fees and dedication requirements is a preferred method of regulating land development in order to ensure that it bears a proportionate share of the cost of park and recreation capital facilities necessary to accommodate that development and to promote and protect the public health, safety, and general welfare
- 4 Dedication of Lands for Parks and Recreation All residential development shall provide an equitable dedication of land for public park purposes and/or fees in lieu thereof pursuant to the standards below stated. The standards provided herein are stipulated to implement policies within the parks and recreation element. The standards shall apply to all residential applications for subdivision approval or site plan review. No property shall be assessed twice for respective subdivision plat applications and subsequent site plan applications
 - a Requirements As a condition of development, the developer shall dedicate land to Martin County, pay a fee in lieu thereof, or a combination thereof, at the option of the County, for park and recreational purposes at the time and according to the standards and formula to follow in this section
 - b General Standard The public interest, convenience, health, welfare and safety require that two (2) acres of public developed community park for each one thousand (1,000) persons residing in the County be devoted for park and recreational purposes. To determine park and recreational land dedication requirement and the mandatory level of service, see Section 7-7, 1,a, Recreation Goal.
 - c Fees in Lieu of Land Dedication If it is demonstrated by the applicant to the satisfaction of the Board of County Commissioners that no park or recreation facility can be located in whole or part within the proposed development to serve the immediate and future needs of the residents of the development, or if the proposed development is estimated to have an ultimate population resulting in a public recreation demand of less than 5 acres, the developer may, in lieu of dedicating land, pay a fee equal to the fair market value of the land which would have been required to be dedicated as defined in Section 4-5(E)(4)
 - d Use of Fees. The money collected be paid to Martin County and placed in a reserve account within the special taxing district fund. Monies within the reserve account shall be used and expended solely for the acquisition, improvement, expansion or implementation of parks and recreational facilities of the County. The monies and accrued interest from fees paid for any given development shall be used solely for acquisition of parkland or facilities reasonably related to serving said development. The service area shall generally correspond to Planning Areas as illustrated in Figure 4-8

- e Requirement of Both Land Dedication and Fee A developer shall both dedicate to Martin County land and pay a fee whenever only a portion of the land calculated by the formula for park and recreational use is to be dedicated, in which case that portion shall be dedicated for park and recreational purposes and a fee shall be paid in lieu of dedicating the remainder of the land that would otherwise have been required to be dedicated. Development approvals requiring dedications of land, capital improvements or equitable contributions of fees, or any combination of the foregoing, shall be granted appropriate credit for said dedications, capital improvements or equitable contributions at the time of the collection of an impact fee. The development regulations shall stipulate the mechanism by which impact fee credits may be granted.
- f Determination of Fair Market Value Where a fee is required to be paid in lieu of land dedication, the recreation impact fee ordinance shall specify the method for determining the appropriate fee to assure that new development will pay for necessary public park lands.
- g Beach Impact Fee in Connection With Recreational Impact Assessments The County shall include in the Land Development Code beach impact fees in conjunction with recreation impact fees for all developments. Development approvals requiring dedications of land, capital improvements or equitable contributions of fees, or any combination of the foregoing, shall be granted appropriate credit for said dedications, capital improvements or equitable contributions at the time of the collection of an impact fee. The development regulations shall stipulate the mechanism by which impact fee credits may be granted.

5 Technical Standards for Subdivision and Site Plan Approvals

- a Technical standards for subdivision and site plan approval shall be consistent with those established for the recreation level of service (LOS) standard in Section 7-7, A,1,a, Objectives for Mandatory Level of Service.
- b By 1990, the County shall establish recreational impact fees for land and facilities. All such fees and credits shall be designed to assure that new growth pays for itself but is not required to pay for existing deficiencies.

F Transportation Impact Analysis

A transportation impact report shall be required for subdivision and site plan reviews that meet the criteria established in the Traffic Circulation Sub-element, Chapter 5A.

The transportation impact analysis is designed to achieve objectives stipulated in the Transportation Element and is discussed in Appendix 5a-3. The nature and standards of the transportation impact analysis is set forth in the Transportation Element.

- d The increase in net residential density created by density transfer may not create unreasonable impacts or incompatibility with adjacent properties unless such impacts are mitigated to the satisfaction of the Board of County Commissioners
- e Whenever density transfers are proposed, the provisions in Section 9-4, A 7 b notwithstanding, the net buildable residential area of all plans shall include a minimum of 50 percent permeable open space. A golf course may account for no more than 60 percent of the required open space.

(Net buildable density is defined as the allowable number of residential units divided by the net buildable upland area, net buildable upland area is defined as the gross land area less all wetlands)

C Open Space Requirements

Open space shall be comprised of permeable open surfaces, excluding principle structures and impermeable surfaces. No parking areas shall be included as open area. All residential development shall preserve a minimum of 50% of the gross land area as open space. Wetlands and landlocked water bodies may be used in calculating open space as long as a minimum of 40% of the upland property is comprised of open space.

Golf courses should be encouraged to retain and preserve native vegetation over thirty (30) percent of the total upland area of the course due to their characteristically high water and heavy nutrient loads, and may be used in calculating open space as long as 30% of the residential area is comprised of open space. This section shall not apply to construction of a single-family home on a lot of record.

Non-residential development shall provide a minimum of the following, or as adopted in the Land Development Code, whichever is greater:

- 1 Fifty (50) percent open space in any areas designated on the Land Use Map for agricultural uses,
- 2 Forty (40) percent open space in any areas designated on the Land Use Map for commercial office/residential (COR), or institutional use,
- 3 Thirty (30) percent open space in any areas designated on the Land Use Map for limited commercial and marine waterfront commercial uses, and
- 4 Twenty (20) percent open space in any areas designated on the Land Use Map for general commercial and industrial.

D. Surface Water Management

All development permits shall be reviewed to assure adequate drainage and flood protection consistent with the Drainage and Storm Water Management Elements of this Plan.

Storm Water Management Criteria The surface water management criteria of the South Florida Water Management District (S F W M D , August, 1980, or as may be hereinafter amended) shall be used as a basis for reviewing development of surface water management plans. Surface water management plans shall be submitted by the applicant as part of the site plan review procedure and shall be approved by Martin County Director of Engineering prior to the release of a building permit for any construction including construction incidental to a new or changed use or major expansion. The Director of Engineering may waive the requirement for minor construction including construction incidental to a new or changed use or major expansion. The Director of Engineering may waive the requirement for minor construction projects as shall be defined in departmental operations policy within six (6) months after adoption of this Comprehensive Growth Management Plan. All publications incorporated in the S F W M D criteria by reference and herein cited below are to be used in planning and reviewing surface water management plans.

- 1 Florida State Road Department, Drainage Manual 2nd Ed , revised 1978
- 2 U S Department of Agriculture, Soil Conservation Service, Technical Paper No 149, A method of Estimating Volume and Rate of Runoff in Small Watersheds, 1973
- 3 U S Department of Agriculture, Soil Conservation Service, Technical Release No 55, Urban Hydrology for Small Watersheds, 1975
- 4 U S Department of Agriculture, Soil Conservation Service, NEH-4, National Engineering Handbook, Section 4 Hydrology, 1972
- 5 U S Department of Agriculture, Soil Conservation Service, Rainfall Frequency Atlas of Alabama, Florida, Georgia and South Carolina for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years, 1973
- 6 U S Weather Bureau, Technical Paper No 40, Rainfall Frequency Atlas of the United States for Duration of 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years, 1961
- 7 U S Weather Bureau, Technical Paper No 49, Two-to-Ten Day Precipitation for Return Periods of 2 to 100 Years in the Contiguous United States, 1964

The Martin County Director of Engineering coordinate the review process with the S F W M D to prevent unnecessary duplication of effort. The County shall, notwithstanding S.F.W.M.D. policy, exercise County review functions on all projects with less than two (2) acres of impervious surface (S F W M D exempts such development from District review)

E Provision of Adequate Park and Recreation Capital Facilities

- 1 Land development shall not be permitted unless adequate park and recreation capital facilities exist or are ensured at the Level of Service adopted by the Board of County Commissioners

- d All wetland areas defined here and in Section 9-4 A,7, Natural Systems, of the Conservation and Open Space Element shall be managed as required in Section 9-4, A,7,b(4) and (5)
- 4 Violations Where evidence indicates that drainage, clearing, or other development has taken place subsequent to the adoption of the Comprehensive Growth Management Plan, and in violation of standards established in Section 9-4, A,7(b),(6), restoration shall be required before any development permits are issued
- 5 Waivers No exceptions or waivers shall be granted to these standards except pursuant to procedures established below
 - a As outlined in Section 9-4, A,8,a,(4),(c) to provide riparian access,
 - b Where applicant demonstrates that encroachment of the wetlands or wetland buffers is necessary for access and no reasonable upland alternative exists In such cases an exemption shall be granted only when appropriate environmental agencies, including the Martin County Soil and Water Conservation District, certify in writing that it is the least damaging alternative and that the applicant has submitted a proposal for mitigation which will minimize damage to the extent technically feasible
 - c When a plan has been approved by the Growth Management Department for the removal and continued management of undesirable exotic vegetation (including revegetation with appropriate native plant material)
 - d On existing parcels of record where there is insufficient adjacent upland property to make any reasonable use of the land, one single family home shall be allowed subject to the requirements of procedure b above
 - e Where the applicant demonstrates that encroachment of the wetlands or wetland buffers, as defined above, is necessary for the construction and/or maintenance of a public utility, as defined in Section 366 02 F S (1983), an exemption may be granted subject to the following conditions
 - (1) The utility has demonstrated that the encroachment is necessary and that no reasonable upland alternative exists
 - (2) The activity is designed and located in such a manner that the least amount of damage to the wetland is assured
 - (3) The applicant has submitted a proposal for reforestation and/or mitigation, to offset the impact
 - (4) Permits have been received from the appropriate State and Federal Environmental Agencies and copies of those permits have been supplied to Martin County, prior to issuance of the County permit

- (5) The Martin County Soil and Water Conservation District has reviewed the application and has determined in writing that the proposed encroachment is the least damaging alternative
 - (6) The applicant has provided proof of ownership or easement over the property to be encroached
 - (7) A plan has been approved by the Growth Management Department for the removal of undesirable exotic vegetation as part of the reforestation and/or mitigation proposed in Item C
 - (8) The applicant has demonstrated that the construction and/or maintenance activity will maximize the preservation of native indigenous vegetation
 - (9) The utility will demonstrate that, should fill be required, the minimum necessary is used, to assure reasonable access to the property or construction activity
 - f When a plan has been approved by the Growth Management Department and applicable state and federal agencies for shoreline boardwalks, docks and marina facilities, provided they are consistent with the policies and criteria of the Coastal Management and Conservation Elements
- 6 Density Transfer All property owners shall have the right to transfer density to the upland area on any site which contains functional wetland properties pursuant to the following stipulations
- a This development must be submitted for review as either a planned unit development or a clustered multi-family project in one of the multiple family residential zoning districts
 - b In addition, the following equations shall apply
 - (1) The resulting residential density of the upland property shall be no greater than 10 units per acre
 - (2) The total number of units allowed in any development using this density transfer formula shall be equal to or less than the allowed maximum density for the entire parcel as shown on the Future Land Use Map,
 - (3) Density transferred must be equal to or less than the wetland acreage multiplied by gross density, and
 - (4) For parcels with wetlands that occupy 50 percent or more of the total site, the gross residential density of the upland property, must be equal to or less than two times the gross residential density of the entire parcel
 - c All performance standards including upland preservation requirements shall apply to all upland development

- c No land areas proposed to be allocated to non-residential uses shall be included under this definition except for contiguous land areas for
 - (1) Utilities under common ownership and principally supporting the residential use,
 - (2) Recreational facilities for the primary use of on-site residents,
 - (3) Dedication to the County or other County approved agencies or not-for-profit corporations
- d Maximum gross density is defined as maximum allowable units divided by gross land areas as herein defined

2 Density Allocations and Intensity

In considering density allocation in site plan approvals, the County shall consider the following

- a Projects directly adjacent to lands used or designated for higher intensity use may be given maximum density
 - (1) Such projects must comply with the provisions of the concurrency management system (Section 4-3) to assure all required services are available
 - (2) Design of the new project shall assure that comparable density and dwelling unit types are planned for the area of the project abutting the existing development
- b Projects immediately adjacent to lands used or designated for lower intensity use should be given lesser density
 - (1) For that portion of said project abutting the existing development or area of lesser density, a density transition zone of comparable density and compatible dwelling unit types shall be established in the new project for a depth from the shared property line that is equivalent to the depth of the first tier of the adjoining development's lower density (i.e., the depth of the first block of single-family lots)
 - (2) The new development project shall comply with all current regulations for concurrency management to assure the adequate provision of public services
- c Height limits for all structures shall be specified in the Land Development Code. In all instances the maximum height limit of 4-stories shall be followed

- B Wetland Areas Wetland Protection Requirements are detailed in the Conservation and Open Space Element

- 1 Wetland Areas Wetland areas are defined as land that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under natural circumstances does support a prevalence of native vegetation typically adapted for life in saturated soil conditions. Wetland areas are generally typified in Martin County as forested saltwater areas, forested and mixed forested freshwater areas and non-forested freshwater areas. The soils listed below shall be used as guides in determining wetland areas.

	<u>Type of Wetland Area</u>	<u>Associated Soil Types</u>
a	Forested Saltwater	30, 40, 50, 67, 79
b	Non-Forested Freshwater	3, 5, 10, 12, 19, 49, 54, 56, 57, 70, 74
c	Forested and Mixed Forested Freshwater	13, 22, 38, 40, 51, 58, 60, 62, 69, 73

Source - Soil Survey of Martin County Area (Florida, Martin County Soil and Water Conservation District, U S D A Soil Conservation Service, 1981, Florida Division of Forestry, 1981)

This data shall be maintained in the Growth Management Department

- 2 Wetland Development Restrictions No negative impacts shall be allowed in a wetland area unless
- a The data from the Soils Potential Study from the Martin Soil and Water Conservation District indicates that the specific soil has characteristics supportive to the proposed development, and
 - b The area no longer functions as a wetland and failure to function was not caused by clearly evident illegal activities in violation of the Comprehensive Plan as adopted on April 1, 1982
- 3 Vegetation and Drainage Considerations This subsection 4-5(B) is not intended to prohibit development in areas that no longer function as wetlands, when "competent evidence" indicates that
- a Dominant vegetation is no longer comprised of wetland types normally found in the specified soil, and
 - b The water regime has been permanently altered artificially or naturally in a manner to preclude its associated watershed areas from functioning as wetlands
 - c Applicants for site plan review shall have an opportunity to so demonstrate that any wetland designations within the confines of their property no longer function as wetlands as explained above. The Martin County Soil and Water Conservation District or the Growth Management Department shall be made a part of the site plan review process to assist in identifying and delineating wetlands

g Policies (Institutional Development)

The Land Use Map provides for Institutional Development on publicly owned active recreation and passive open space sites. This designation also accommodates public and semi-public not-for-profit facilities such as the larger schools, government buildings, civic centers, public cemeteries, fire and emergency operation center facilities, active parks and recreation areas, and extensive open space/passive recreation areas comprising major committed public and semi-public open spaces. The future land use maps shall identify the facilities as to type without limiting the Institutional use. Active County operated recreation sites/parks are identified by either a picnic table or star symbol in addition to the Institutional land use designation. Other recreation/passive open space areas are identified by name (i.e., Jonathan Dickinson State Park). Public conservation areas such as the White Belt Ranch and the Savannas State Preserve are designated by a double star symbology over the Institutional land use pattern. The Land Development Code will provide for two or more zoning districts to allow for the differentiation of recreation sites from the more intense Institutional uses which may be inappropriate adjacent to residential areas.

h Policies (Public Utilities - Major Power Generation Facilities)

Land uses in this category are confined to major power generation sites and related facilities. Currently, the only such designated area is the Florida Power and Light Martin Plant site and cooling reservoir west of Indiantown. This designation is required for all power generation sites of ten acres or more in size which contribute electricity to the power grid in Martin County. Such land uses are subject to the same locational and compatibility considerations as required of industrial development.

i Policies (Potential Private Conservation)

By 1991, Martin County will evaluate environmentally sensitive lands in the County and consider the designation of a Private Conservation land use category which would be appropriate for very low density residential uses such as one unit per 20 acres to one unit per 40 acres and/or various types of low intensity agricultural uses, such as ranch land.

SECTION 4-5 PERFORMANCE STANDARDS

This section contains basic standards applicable to future land use development approvals and conservation proposals within Martin County. Performance standards are coordinated with the various other Elements and specified as requirements for development approvals in accordance with Martin County Land Development Code requirements.

The Code of Laws and Ordinances of Martin County, as it exists or may hereafter be amended, specifies the procedure for review and approval of all development proposals. For purposes of this Comprehensive Growth Management Plan, the term "development" shall mean the carrying out of any building activity, mining operation, the making of any material change in the redevelopment or modification of an existing use or appearance of any structure or land, which creates additional impacts or the dividing of land into three (3) or more lots, tracts or parcels, including PUD's and acknowledging all exceptions to subdivisions.

Remodeling, renovation, restoration to improved real estate to a former, better condition (as by cleaning, repairing or rebuilding), shall be exempt from the performance standards of this plan. Any proposed man-made change to improved real estate shall meet the requirements of this plan but only to the extent of such man-made change.

Minor accessory uses (such as a swimming pool, fences, screened enclosures, etc.) and as further defined by the Land Development Code shall be exempt from provisions of Section 4-5 (E, F, G, H, I, J, and L) and Section 4-4 (A, 3, a), Concurrency Management System.

The Code of Laws and Ordinances of Martin County, as it exists or may hereafter be amended, establishes a legal requirement of obtaining development permits and orders for various development activity and specifies the procedure for review and approval of all development permits and orders.

A Density

The following density provisions are herein incorporated as performance standards. Notwithstanding, the density provisions herein shall not prevent the owner of a lot of record created prior to the adoption of subdivision regulations of Martin County on November 7, 1972, in accordance with the codes and ordinances of Martin County, or the owner of a lot of record created pursuant to the subdivision regulations subsequent to November 7, 1972, and in conformance with the Zoning Code, from constructing one single-family unit in accordance with the other provisions of this plan and the Code of Laws and Ordinances of Martin County.

- 1 Gross Density The permitted densities stipulated in Section 4-4 or the Land Use Map designations shall be gross residential densities and the gross land area of which this density is applied is described as follows:

Those contiguous land areas under common ownership with the following provisions and exceptions:

- a In cases where land abuts the waters of the Atlantic Ocean, St. Lucie River, Indian River, Loxahatchee River, Intracoastal Waterway, Lake Okeechobee, and all tributaries and man-made canals thereof, the boundary of the land shall be delineated as established by State Statutes (Chapter 177, Part II, Coastal Mapping or as may be amended).
- b No submerged land areas waterward of the boundary above described shall be included under this definition.

**10 3 4 EXCERPTS FROM THE MARTIN COUNTY COMPREHENSIVE
GROWTH MANAGEMENT PLAN PERTAINING TO**

- **SECTION 4-5 PERFORMANCE STANDARDS**

g Policies (Institutional Development)

The Land Use Map provides for Institutional Development on publicly owned active recreation and passive open space sites. This designation also accommodates public and semi-public not-for-profit facilities such as the larger schools, government buildings, civic centers, public cemeteries, fire and emergency operation center facilities, active parks and recreation areas, and extensive open space/passive recreation areas comprising major committed public and semi-public open spaces. The future land use maps shall identify the facilities as to type without limiting the Institutional use. Active County operated recreation sites/parks are identified by either a picnic table or star symbol in addition to the Institutional land use designation. Other recreation/passive open space areas are identified by name (i.e., Jonathan Dickinson State Park). Public conservation areas such as the White Belt Ranch and the Savannas State Preserve are designated by a double star symbology over the Institutional land use pattern. The Land Development Code will provide for two or more zoning districts to allow for the differentiation of recreation sites from the more intense Institutional uses which may be inappropriate adjacent to residential areas.

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i Policies (Potential Private Conservation)

By 1991, Martin County will evaluate environmentally sensitive lands in the County and consider the designation of a Private Conservation land use category which would be appropriate for very low density residential uses such as one unit per 20 acres to one unit per 40 acres and/or various types of low intensity agricultural uses, such as ranch land.

SECTION 4-5 PERFORMANCE STANDARDS

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a "black diamond" symbology on the Year 2005 Future Land Use Maps. The area around the subject interchange which is eligible for this land use category is specified in subsections (f) and (g) below. Parcels at the I-95/Palm City Interchange may be eligible for formal amendment to the Comprehensive Growth Management Plan in accordance with Section I-12(A) of the Comprehensive Growth Management Plan. Transient Lodging and Service Commercial Centers are subject to compliance with the following performance standards:

- (a) Any application must be submitted and processed as a Commercial Planned Unit Development, PUD(c)
- (b) Any application must be compatible with the surrounding land use designation to comply with the performance standards in Section 4-5 of the Comprehensive Growth Management Plan
- (c) A market feasibility analysis, acceptable to Martin County, that demonstrates a need must be submitted to document that the uses proposed are warranted by the traveling public they are intended to serve
- (d) Uses permitted within the PUD(c) allowed by this policy are limited to the following:
 - 1) Convenience Stores
 - 2) Gift Shops
 - 3) Hotels and Motels, excluding permanent residential units
 - 4) Restaurants, including drive-ins and fast food service
 - 5) Vehicular service and maintenance (gas stations)
- (e) Direct access to the property upon which the PUD(c) is proposed must be from a major arterial. The requirements of this paragraph shall be deemed to have been met for parcels immediately adjacent to the limited access facility which have had their direct legal access to a major arterial replaced by the F.D.O.T. in the form of a newly created access road. Such parcels are typically located between the limited access facility and the newly created access road. Should the PUD(c) require improvements to the newly created access road, those improvements shall be completed at the developer's expense
- (f) All the property upon which the PUD(c) is proposed must be within 1320 feet of any access ramp to the limited access facility and within 1320 feet of the intersecting arterial
- (g) The access point to any property upon which the PUD(c) is proposed shall not be located closer than 660 feet to any access ramp to the limited access facility unless it can be specifically proven by a traffic study performed by a registered Florida engineer that a shorter distance would allow for a continuing function of the road system and not be detrimental to the health, safety and welfare of the public

- (h) Applicant must successfully demonstrate how the full range of urban services needed by the PUD(c) will be funded and provided in a cost-efficient manner consistent with the adopted facility level-of-service standards in this Plan and the Capital Improvements Element

f Policies (Industrial Development)

The Land Use Map allocates land resources for existing and anticipated future industrial development needs. The allocation process provides a high priority to industry's frequent need for strategically located lands accessible to rail facilities, major arterials or interchanges, labor markets, and requisite urban services located within planned Urban Service Districts (Figure 4-5)

The locational criteria for Industrial Development require that all development within Industrial designated areas shall provide assurances that central water distribution and wastewater collection utilities shall be provided by a regional public utility system, as described in the Comprehensive Growth Management Plan, Data, Inventory and Analysis (Part II, Chapter 10, Sanitary Sewer and Chapter 11, Potable Water Elements). Those areas of the County, where free standing urban services (ie, central public utility system) can be provided by a group of industrial land uses, may be considered as independent or free-standing Urban Service Districts and may be illustrated as such on Figure 4-7 in conjunction with formal amendments to the Future Land Use Map as provided in Section 1-11, Amendment Procedures. All independent or freestanding USD's must comply with the adopted level-of-service standards in this Plan and the Capital Improvements Element.

Industrially designated areas are not generally adaptive to residential use and such uses shall not be located in areas designated for residential development unless planned for within mixed use developments allowed under the Traditional Neighborhood Goal (Section 4-4, C) or in large scale PUD's. This provision shall not prohibit residences for night watchmen or custodians whose presence on industrial sites is necessary for security purposes. Such a use may be permitted as a conditional use through appropriate zoning procedures.

Based on the extensive impacts which industrial development frequently generates, industrial development requiring future plan amendment or rezoning shall be encouraged to develop under provisions of a planned unit development petition in order to allow maximum flexibility in design to the applicant and to avoid any major adverse impacts which may not be anticipated during a less in-depth plan review.

The Zoning Ordinance shall be amended to include performance standards for regulating the nuisance impacts sometimes associated with intense commercial and industrial development. Salvage yards shall be considered as an industrial use due to the potential intensity and nature of the use, acreage requirements, aesthetic impact, and the heavy truck traffic associated with the use.

Commercial development within the limited commercial district shall be restricted pursuant to the provisions of the Code of Laws and Ordinances

Areas designated for limited commercial development are not intended to accommodate large scale retail sales, service, and trade activities, generally serving a larger market area. Such stores would usually require a larger floor area, carry a relatively larger inventory, and require a substantially greater parking area.

- (3) General Commercial Development The general commercial areas are designated on the Land Use Map for purposes for accommodating general retail sales and services, highway oriented sales and services, commercial amusement, and trade and warehousing facilities. These areas are principally located in highly accessible areas of the urban service district within areas compatible with the unique location and market requirements of the respective uses. The sites are located on major or minor arterials. The zoning policy allocated to areas within the general commercial service district stipulates the land allocation for the specific uses defined above. This area is not intended to accommodate businesses, trades, or services which generate any significant amounts of nuisance impacts, including glare, smoke or other air pollutants, noise vibration, major fire hazards, need for extensive outside storage and display, or other impacts associated with more intensive industrial uses. Automotive sales and services shall be located within the general commercial land use classification on sites appropriately designated for highway oriented commercial uses within the Land Development Code.

The areas designated for general commercial development are specifically not adaptive to permanent residential housing and such uses shall be located in other areas designated for residential development. On the other hand, transient residential facilities including hotels and motels, timesharing or fractional fee residential complexes, or other transient quarters should be located in areas designated for commercial use. Areas planned for mixed use developments as allowed by the Traditional Neighborhood Goal, Section 4-4, C, are considered compatible for mixed use.

Amendments to the Land Use Map for added general commercial designations shall be favorably considered by the Board of County Commissioners only after a finding that the proposed amendment

- (a) Satisfies at least an additional need for general commercial land use within the area to be served, and
- (b) The site should generally be removed from single family residential development and able to be buffered and screened pursuant to performance standards requiring appropriate landscaping and screening including vegetative berm systems where feasible, plant material and/or aesthetic decorative fence or walls to assure compatibility with less intensive uses existing or anticipated on adjacent sites.

Prior to approval of a development plan, all applicants for development within the general commercial designated area shall provide assurances that central water distribution and wastewater collection utilities shall be provided by a regional public utility system, as described in the Comprehensive Growth Management Plan Data Inventory and Analysis, Part II (Chapter 10, Sanitary Sewer and Chapter 11, Potable Water Elements)

If in the future a general commercial service is proposed in a dispersed rural area located outside of the Primary Urban Service District and the applicant adequately demonstrates to the satisfaction of the Board of County Commissioners that a need for such a service exists for the population within the area and that the required water and wastewater services are unavailable, the Board of County Commissioners may permit the use and waive the required urban service based on unique and compelling factors, including cost-efficient provision of all required urban services consistent with adopted LOS standards and the Capital Improvements Element, successfully demonstrated by the applicant to the Board of County Commissioners

- (4) Marine Waterfront Commercial The Land Use Map designates marine waterfront commercial areas which shall accommodate marine resort, marina and water related services along the more highly accessible waterfront sites with the potential to satisfy the unique location, market, and resource needs of the water dependent more intense marine service/industrial uses. Generally, waterfront commercial uses are either water dependent or water related. Specific zoning district regulations shall be drafted and adopted to regulate the nature of marine waterfront commercial operations, and to assist in maintaining the stability of adjacent and nearby residential areas through use restrictions, landscaping and screening, and nuisance abatement standards. The regulations shall also guard against environmentally adverse impacts to biologically active and environmentally sensitive habitats in a manner consistent with the coastal and natural resource protection performance standards of this Plan. The Land Development Code shall provide for several marine waterfront commercial districts which accommodate the variety of waterfront commercial activities, including transient residential facilities, other marine resort oriented facilities such as restaurants and shops, as approved as a conditional use by the Planning and Zoning Board, and the more intense marine service uses which have their own unique locational criteria to assure compatibility with human and natural resources identified in Section 8-4, A,5, of the Coastal Management Element
- (5) Expressway Oriented Transient Commercial Service Centers. This special land use designation is established to recognize the immediate and unique needs of the through traffic traveling public. The areas immediately adjacent to the interchanges of the limited access facilities, as defined in Chapter 334.03, Florida Statutes, with major arterials identified in the Traffic Circulation Element, with the exclusion of the I-95/Palm City Interchange, are the subject of this policy. The subject interchange locations are designated by

Due to the unique hazards associated with mobile home residences in hurricane storm events, and notwithstanding the density allocations provided for on the Land Use Map for Hutchinson Island, any property designated for residential use on Hutchinson Island must be not be developed for any mobile home use

e Policies (Commercial Development)

The Land Use Map identifies the allocation of commercial land for office use, limited commercial, general commercial and marine waterfront commercial activities. The allocation is compatible with goals and objectives identified in the Comprehensive Growth Management Plan and consistent with supportive research and analysis

- (1) Commercial Office/Residential Development (COR) Commercial office/residential development is allocated to accessible sites adjacent to major thoroughfares and also can serve as a transitional use separating more intensive general commercial uses from residential development assuming all performance standards and zoning criteria are met. Office and residential development is also allocated along the outer fringe of core commercial areas where such development opportunities may encourage reinvestment in declining residential areas adjacent to commercial core areas

Development within the commercial office/residential area shall be restricted to professional and business offices and financial institutions and multiple-family residential development. This land use classification expressly excludes freestanding retail sales and service establishments. However, restaurants, certain service commercial uses, and limited commercial uses, as identified in the Land Development Code, may locate in this district as advertised conditional uses. These advertised conditional uses must be initially approved by the Planning and Zoning Commission. The Planning and Zoning Commission's determination shall be based on a finding that initial residential or office development has provided an on-site buffer pursuant to zoning regulations restricting the nature and scale of the retail uses. The Board of County Commissioners may approve the advertised conditional use following action by the Planning and Zoning Commission. Duly approved offices and shops located within COR designated areas as of the effective date of this ordinance shall be deemed permitted uses within the COR area.

Residential storage facilities may be approved as a conditional use by the Planning and Zoning Commission in areas designated "COR" or "Limited Commercial". The Zoning Ordinance shall establish criteria for review of such use which may, notwithstanding the above paragraph, be located in a freestanding building. However, the building shall be restricted to structures with small modules adaptive exclusively to storage of personal household accessory items of residential clients. Commercial tenants shall be expressly prohibited. The facility shall be designated in appearance to blend harmoniously with residential structures. The cumulative impacts of

any non-residential conditional uses must be evaluated and criteria allowing for these uses must be expressed in the Land Development Code. Multiple-family residential uses are encouraged to develop within areas designated for office development at densities compatible with criteria cited in Section 4-4M 1 (5) for high density residential development with a designated maximum density of 10 units per gross acre. Performance standards shall require appropriate landscape and screening including vegetative berm system where feasible, plant material and/or aesthetic decorative fence or walls to assure compatibility among established residential uses and office developments. Facilities for transient lodging catering to the seasonal resident and generally having kitchen facilities to accommodate occupants for visiting periods exceeding the general motel trip duration of one to four nights are permitted as a conditional use in this land use classification when approved by the Planning and Zoning Commission pursuant to criteria to be established in the Zoning Ordinance. Duly approved transient lodging facilities existing as of the effective date of the Comprehensive Growth Management Plan shall be deemed to be permitted in such area.

Review of specific residential densities shall be directed toward preserving the stability and integrity of, and maintaining compatibility with, established residential development and toward providing equitable treatment of lands with similar characteristics.

Design techniques of landscaping, screening and buffering shall be employed to assure smooth transition in residential structure types and densities. Generally, where single family structures comprise the dominant structure type within these areas, new development on undeveloped abutting lands shall be required to include compatible structure types on the lands immediately adjacent to existing single family development.

- (2) Limited Commercial Development Limited commercial development is allocated to commercial sites accessible to major thoroughfares near residential neighborhoods. Commercial uses accommodated within limited commercial areas shall have a scale and intensity compatible with adjacent residential neighborhoods. Sites within this designation are intended to accommodate shops with limited inventory or goods as well as transient lodging facilities meeting performance standards of the Comprehensive Growth Management Plan and the zoning code. This designation is not intended to accommodate residential development. Duly approved residential uses existing at the effective date of the Comprehensive Growth Management Plan shall be deemed permitted uses. In addition, such shops cater to the following markets:
- (a) Neighborhood residential markets within the immediate vicinity as opposed to county-wide or regional markets,
 - (b) A specialized market with customized market demands, or
 - (c) A tourist oriented market in the immediate vicinity

types on lands immediately adjacent to existing single-family development. Existing agricultural uses within this land use designation shall be allowed to continue in a non-conforming status.

- (3) Low Density Residential Development. The low density residential designation is reserved for land accessible to existing urban service centers or located in the immediate expansion area. Densities permitted in this area shall not exceed five (5) units per gross acre. Review of specific densities shall be directed toward preserving the stability and integrity of established residential development and toward providing equitable treatment to lands sharing similar characteristics. Design techniques such as landscaping, screening and buffering shall be employed to assure smooth transition in residential structure types and densities. Generally, where single family structures comprise the dominant structure type within these areas, new development on undeveloped abutting lands shall be required to include compatible structure types on the lands immediately adjacent to existing single family development.
- (4) Medium Density Residential Development. The medium density residential designation is reserved for land within the core of urban service districts and accessible to employment centers. Medium density ranges upward to a maximum of eight (8) units per gross acre. Review of specific densities shall be directed toward preserving the stability of established residential areas. Design techniques of landscaping, screening and buffering shall be employed to assure smooth transition in residential structure types and densities. Generally, where single family structures comprise the dominant structure type within these areas, new development on undeveloped abutting lands shall be required to include compatible structure types on the lands immediately adjacent to existing single family development.
- (5) High Density Residential Development. The high density residential development designation is reserved for land within the core of an urban service district adjacent to a less restrictive land use and on a site serviced by a full complement of urban facilities. High density ranges upward to a maximum of ten (10) units per gross acre. However, sites shall be approved for a maximum of fifteen (15) units per gross acre, assuming compliance with all of the following criteria:
 - (a) Density bonus will be granted to development sites committing to rental to households meeting the definition of very low, and low income and complying with the criteria being studied and accepted by the Affordable Housing Task Force called for in Section 6-4, A,10,k, of the Housing Element.
 - (b) Site location on a major or minor arterial or major collector street as defined in the Traffic Circulation Element, Chapter 5 of the Comprehensive Growth Management Plan.
 - (c) Site location shares a common zoning district boundary with commercial or industrial district or a high density residential area as reflected on the Land Use Plan.

- (d) Site location does not share a common zoning district boundary with a single family zoning district
- (e) Site is serviced by a full complement of urban services including water and wastewater service from a regional public utility as defined in the Comprehensive Growth Management Plan Data Inventory and Analysis (Part II of the Potable Water Element and Wastewater Element)
- (f) Applicant provides significant open space buffer, natural landscape including a landscaped berm where appropriate, plant material and/or an aesthetic wall or fence to effectively shield the residential use from any existing or potential adjacent non-residential use or from any single family use
- (g) Applicant provides assurances that all performance standards shall be met

Review of specific densities shall be directed toward preserving the stability and integrity of, and maintaining compatibility with, established residential development and toward providing equitable treatment of lands with similar characteristics. Design techniques of landscaping, screening and buffering shall be employed to assure smooth transition in residential structure types and densities. Generally, where single family structures comprise the dominant structure type within these areas, new development on undeveloped abutting lands shall be required to include compatible structure types on the lands immediately adjacent to existing single family development.

- 6 Mobile Home Development Mobile home residential development shall be permitted on sites appropriately zoned for mobile home development. However, all development applications for mobile home parks and subdivisions for which site plan approval has not been granted, shall be encouraged to develop under provisions of the mobile home planned unit development district. The density of the mobile home parks or subdivisions shall be permitted up to a maximum of eight (8) units per gross acre, however, specific site densities must be consistent with the policy, map and standards of the Comprehensive Growth Management Plan and Zoning Code. The more restrictive density provision shall rule where any inconsistency may exist. Review of specific densities shall be directed toward preserving the established residential development. Replacement of existing mobile homes in existing mobile home plats and sites of record, as of the effective date of this ordinance, shall be permitted and shall not be deemed inconsistent with the Comprehensive Growth Management Plan. Mobile homes shall be reviewed as reasonable development options but the applicant shall provide plans for mobile home development which assure the development contains a significant open space buffer. Natural landscaping, including a landscaped berm where appropriate, plant material, and/or an aesthetic wall or fence to effectively screen the mobile home development from adjacent residential development which exists or may potentially exist in the future.

agricultural operations and open space, and, therefore, assigns reasonable development options consistent with the existing and anticipated agricultural character in the area. A density of one (1) unit per five (5) gross acres shall be permitted within the areas designated for agricultural ranchettes. However, residential development on these lands should be related to agricultural uses. Five (5) acre lots with this land use designation shall meet this requirement. This plan recognizes the need to concentrate urban development on lands closer to the urban core communities where urban facilities may be more economically provided, maintained and operated. These areas still require minimal levels of urban services, such as fire and emergency medical, thus ranchette areas should be located adjacent to the Secondary Urban Service District.

The zoning regulations which shall govern the future development options within the areas designated for agricultural ranchette development shall be consistent with the Comprehensive Growth Management Plan. Development standards of the Land Development Code shall assure that future development within the area is compatible with established uses sharing common lot lines in order to provide for smooth transition in use and densities.

Standards governing agricultural land conversion in Policy M 1 a (2) shall also be used as criteria in evaluating future plan amendment requests within areas designated for agricultural rural ranchettes.

c Policies (Rural Development)

The Land Use Map identifies those lands within Martin County which are allocated for rural development. This designation is intended to protect and preserve the value of rural suburban lands which are located outside the normal economical service radius of intensive (primary) urban service systems including regional potable water distribution and wastewater collection systems. In general, the County cannot economically provide, maintain and operate the full complement of intensive services in these areas.

The rural lands shall develop at a density not exceeding one (1) dwelling unit per two (2) gross acres. This density allocation recognizes the need to concentrate urban development on lands closer to the urban core communities where intensive urban facilities and services can be provided in a manner compatible with the objectives of fiscal conservancy. This policy also provides reasonable development options to landowners whose property is located within the fringe of secondary urban development in sparsely developed rural or rural suburban areas. Zoning regulations shall provide standards for these areas which are designed to permit development compatible with the need for preserving the rural character. These standards shall reflect the high value placed on open space, the need to preserve wetland areas, the function and value of recharge areas, and the need to minimize changes in the natural hydrology of the area. Standards governing agricultural land conversion of in Policy M 1 a (2) shall also be used as criteria in evaluating future plan amendment requests within areas designated for rural development.

d Policies (Residential Development)

The Land Use Map allocates residential density based on population trends, housing needs, past trends in the character, magnitude, and distribution of residential land consumption patterns, and, pursuant to goals, objectives, and policies of the Comprehensive Growth Management Plan, including the need to provide and maintain quality residential environments, preserve unique land and water resource and plan for fiscal conservancy

- (1) Residential Estate Densities (RE-1A) Residential estate densities are primarily assigned to established stable residential areas and those transitional areas having a density up to one (1) unit per gross acre. These areas are generally on the fringe of the urban service districts and generally are not accessible to a full complement of urban services. The Plan also assigns estate densities to selected areas near existing estate development where the lands so designated, share similar characteristics to existing residential estates and to areas within the urban service district which require density limitations because of unique problems of urban services. Review of specific densities shall be directed toward preserving the stability and integrity of established residential development and toward providing equitable treatment to lands sharing similar characteristics. Design techniques of landscaping, screening and buffering shall be employed to assure smooth transition in residential structure types and densities. Where single family structures comprise the dominant structure type within these areas, new development on undeveloped abutting lands shall be required to include compatible structure types on lands immediately adjacent to existing single-family development. Existing agricultural uses within this land use designation shall be allowed to continue in a non-conforming status. This land use designation differs from the RE-0 5A category in that lot sizes are generally larger and the areas are more compatible to rural settings.
- (2) Residential Estate Densities (RE-0 5A) Residential estate densities are primarily assigned to established stable residential areas, having a density up to two (2) units per gross acre. These areas are generally on the fringe of the urban service districts and generally are not accessible to a full complement of urban services. The Plan also assigns estate densities to selected areas near existing estate development where the lands so designated, share similar characteristics to existing residential estates and to areas within the urban service district which require density limitations because of unique problems of urban services. Review of specific densities shall be directed toward preserving the stability and integrity of established residential development and toward providing equitable treatment to lands sharing similar characteristics. Design techniques of landscaping, screening and buffering shall be employed to assure smooth transition in residential structure types and densities. Where single family structures comprise the dominant structure type within these areas, new development on undeveloped abutting lands shall be required to include compatible structure

a Policy At a minimum, the following innovations shall be investigated

- (1) Fiscal incentives such as differential assessments for reducing burdensome property taxes
- (2) Transferable development rights (TDR's) which compensate the owners of preserved land for the loss of their rights to develop
- (3) Voluntary agricultural districts coupled with benefits and assurances to improve the conditions of farming

11 GOAL (ALLOCATION OF LAND USE)

Martin County shall allocate land use indicated on the Year 2005 Land Use Map in order to provide for compatibility with existing development, consistency with the Capital Improvements Element, protection of natural resources, and implementation of the adopted level-of-service standards

1 OBJECTIVE

By July, 1990, Martin County will revise the Land Development Regulations as necessary to implement the policies for land use allocation

a Policies (Agricultural Development)

The Land Use Map identifies those lands within Martin County which are allocated for agricultural development. This designation is intended to protect and preserve areas of agricultural soils for agriculturally related uses realizing that food and commodity production is an essential industry and basic to the economic diversity of the County. In addition, the major portion of agricultural lands are far removed from urban service districts and cannot be converted to urban use without substantial increases in cost of providing, maintaining, and operating dispersed supportive services. The allocation of agricultural land is furthered by Goal L in this Section.

The further intent of the agricultural designation is to protect agricultural land from encroachment by urban or even low density residential development. Such development impacts the natural environment and may cause such potential adverse impacts as erosion, run-off, sedimentation and flood damage, all of which render the impacted land less adaptive to agricultural productivity. In order to avoid activities that adversely impact agricultural productivity on agricultural lands as designated on the Land Use Map, no development shall be permitted which divides landholdings into lots, parcels or other units of less than twenty (20) gross acres. While acreage may be split for bona fide agricultural uses, this is not intended to allow 20 acre residential subdivisions without platting and provision of necessary services.

Within agriculturally designated lands, the agriculture zoning districts shall provide definitive policy regarding development options. All such provisions of agricultural zoning districts shall be consistent with the Comprehensive Growth Management Plan. Limited residential and other uses directly related and supportive to agriculture or which would not jeopardize the integrity of the agricultural purpose of the district are permitted.

- (1) Congregate Housing for Farmworkers Residential development for housing farmworkers is provided for as a conditional use pursuant to Section 4-4, L,1,(c) of this Element. Agricultural zoning shall provide a policy for implementing this provision.
- (2) Conversion of Land Designated Agricultural on the Land Use Map Agriculturally designated land may be redesignated only by an amendment to the Comprehensive Growth Management Plan. The intent of this section is to permit such amendment upon a finding by the Board of County Commissioners that the applicant has demonstrated that
 - (a) The proposed development shall not adversely impact hydrology of the area or in any other manner adversely impact the productive capacity of adjacent farmlands not included in the amendment application,
 - (b) The proposed land conversion is a logical and timely extension of a more intense land use designation in a nearby area, considering existing and anticipated land use development patterns, consistency with goals and objectives of the Comprehensive Growth Management Plan, availability of supportive services, including improved roads, recreation amenities, adequate school capacity, satisfactory allocations of water and wastewater facilities and other needed supportive facilities. Such findings shall be based on soil potential analysis as well as on agricultural site assessment for the proposed land use conversion.

b. Policies (Agricultural Ranchette Development)

The Land Use Map identifies those lands within Martin County which are allocated for agricultural ranchette development. These lands are primarily located West of the Sunshine State Parkway, which serves as a major barrier to transportation and the provisions of fiscally sound systems for the delivery of many urban services. This condition is a major rationale supportive to the growth policy and development pattern established in the Comprehensive Growth Management Plan. The above mentioned designation is intended to protect and preserve areas of Martin County which are generally located between the fringe of the agricultural heartland and outer fringe of urban development. These areas are situated in locations removed from urban services, have developed at very sparse densities, and maintain their original agricultural and rural character. The Plan recognizes the primary value of these lands for small

**10 3 3 EXCERPTS FROM THE MARTIN COUNTY COMPREHENSIVE
GROWTH MANAGEMENT PLAN PERTAINING TO**

- **GOAL M (ALLOCATION OF LAND USE)**

- (2) Sites for industrial development are accessible to the essential public and private facilities and services at the levels of service adopted in this Growth Management Plan for transportation, potable water, solid waste, drainage, and sanitary sewer
- (3) Sites for industrial development are located with convenient access to the major roadway transportation corridors and are encouraged to locate with convenient access to air, water, and rail transportation facilities
- (4) Sites for industrial land uses are encouraged to locate with convenient access to the labor supply, raw material sources, energy resources, and market areas
- (5) A need for industrial land use is demonstrated either on a project basis or in a county wide assessment, when industrial proposals are considered by the Board of County Commissioners

3 OBJECTIVE

By July 1990, Martin County's Land Development Regulations shall minimize the "nuisance" effects or other negative impacts of industrial land uses

- a Policy Performance standards shall be established for managing, at a minimum noise, air pollutants, odor, vibration, fire or explosive hazard, and glare Location and design of industrial activities shall be based on the activity's ability to comply with these standards
- b Policy Natural vegetation and other appropriate buffers shall be required where appropriate to minimize adverse impacts of the activity on nearby land uses

4 OBJECTIVE

Beginning in January 1991, Martin County shall develop a program and prepare an annual report to selectively expand its industrial base consistent with the economic assumptions and limitations presented in the Economic Element of the Growth Management Plan

- a Policy The County shall encourage industries that contribute optimally to the County's economy and which
 - (1) Generate high levels of employment with higher than average wage and salaries, and relative independence from cyclical changes in economy
 - (2) Produce services and/or products which complement the needs and resources of existing industry within Martin County
 - (3) Provide basic industry which is likely to serve as a desirable priming action for attracting additional industry compatible with the County's economic goals and objectives as in the Economic Element of this Growth Management Plan

- (4) Contribute a net revenue to the Martin County government and thus enhancing the fiscal capability of the County
- (5) Conserve the County's natural resources and public facilities by generating minimal adverse impacts on groundwater and potable water resources, the transportation system, the solid waste system, or other natural resources or community facilities

L GOAL (AGRICULTURAL LANDS)

Martin County shall fairly and equitably preserve agricultural lands by enhancing and protecting appropriate and productive lands for agricultural uses

1 OBJECTIVE

By July 1990, Martin County's Land Development Regulations shall set forth procedures to ensure that the agrarian character of agricultural lands is preserved and that other methods are provided to maintain the economic viability of agriculture

- a Policy The County shall restrict expansion of urban public facilities and services to the urban service districts designated within this Growth Management Plan in order to preserve agricultural lands and provide maximum protection to the farmer from encroachment by urban uses

This policy will be accomplished by the implementation of Primary and Secondary Urban Service Districts and the careful evaluation of residential and non-residential land use applications during the planning period in order to prevent an unreasonable surplus of such uses and to protect agricultural lands

- b Policy The County shall encourage the use of management practices for soil conservation which best minimize erosion and protect those attributes which make the soil productive
- c Policy The County shall permit congregate housing for agricultural farm workers, as consistent with the Housing Element of this Growth Management Plan. This congregate housing for agricultural farm workers would be considered in conjunction with Housing Service Zones, Section 6-4, A, 4, c of the Housing Element. Development regulations shall be established to accommodate this use in areas established as Housing Service Zones

2 OBJECTIVE

Martin County shall monitor and evaluate new innovations and management practices for preserving agricultural farmlands while protecting the property rights of farmers, and prepare an annual report, beginning in January 1991, for the purpose of determining the applicability of these concepts to Martin County

a Policy The County's design guidelines shall, at a minimum

- (1) Explain means by which physical design improvements can reinforce and improve the role of these areas as a focal point for office and institutional activity, retail trade, and civic and cultural enrichment
- (2) Illustrate means by which development can encourage pedestrian circulations while accommodating vehicular traffic flow and parking in a manner to reinforce and improve pedestrian mobility
- (3) Promote innovative themes and approaches to designs that are consistent with the purpose and unique character of these areas

5 OBJECTIVE

By July 1990, Martin County shall establish, within the Land Development Regulations, performance standards requiring appropriate landscaping and screening to assure compatibility and smooth transitions between commercial and non-commercial land uses

- a Policy Office development may serve as transitional uses separating more intensive commercial uses from residential development
- b Policy Office use is encouraged along the outer fringe of core commercial areas in order to encourage reinvestment in declining residential areas adjacent to commercial core areas

K GOAL (INDUSTRIAL LAND USE)

Martin County shall provide for adequate and appropriate lands for the location of industrial land uses to support the role of industry in the County's economy

1 OBJECTIVE

By July 1990, Martin County's Land Development Regulations shall provide adequate zoning classifications for industrial land uses to accommodate a diversity of industrial development as desired by the community

2 OBJECTIVE

By July 1990, the County's Land Development Regulations shall recognize the locational criteria for industrial land in the Land Use Element and ensure that space requirement factors are satisfied when determining the distribution of specific types of industrial activities

a Policy The development review process shall ensure that, at a minimum

- (1) Industrial activities are compatible with surrounding land uses, established or planned development, and natural systems and resources

- a Policy At a minimum, the development review process shall evaluate potential commercial development for
 - (1) Trip generation characteristics, impact on existing and planned transportation facilities, and ability to achieve a functional internal circulation and landscaped parking system
 - (2) Specific needs of respective commercial activities, such as market area, anticipated employment generation, and floor area requirements
 - (3) Compatibility with and impact on other surrounding commercial activities
 - (4) Relationship to surrounding land uses and natural systems
 - (5) Impact on existing and planned community services and utilities
- b Policy Commercial development shall be strategically directed into areas having location characteristics which best accommodate specific land area, site, public facilities, and market location requirements in order to promote efficient traffic flow along thoroughfares, achieve orderly development, and minimize adverse impacts on residential quality
- c Policy Zoning and land use designation changes shall not be granted if a finding by the Board of County Commissioners upon review by the Planning and Zoning Board is made that the change will lead or contribute to a proliferation of strip commercial development. The existence of commercial areas on one corner shall not dictate the development of all corners with the same or similar use nor shall the existence of commercial development on a major thoroughfare dictate that all frontage must be similarly used

3 OBJECTIVE

In an effort to limit unnecessary commercial shopping center development, Martin County shall conduct a study, by January 1993, of innovative, fiscally sound techniques which may be utilized to encourage redevelopment or adaptive reuse of existing shopping centers or other existing commercial core areas

- a Policy The County shall identify those commercial properties which are currently vacant or under utilized, especially within commercial core areas and along U S Highway 1
- b Policy Possible techniques to be investigated shall include 1) tax incentives to encourage reuse of existing centers, and 2) in areas where high commercial vacancy rates currently exist, creation of incentives for the reuse and redevelopment of existing centers rather than the creation of new developments

4 OBJECTIVE

By January 1993, the County shall encourage improved design of commercial core areas which serve as the focal point of major unincorporated communities in the county by producing design guidelines to assist development or redevelopment decisions

**10 3 2 EXCERPTS FROM THE MARTIN COUNTY COMPREHENSIVE
GROWTH MANAGEMENT PLAN PERTAINING TO**

- **GOAL K (INDUSTRIAL LAND USE)**

- a Policy The investigation of the long term future of the undeveloped areas in southern and western Martin County would establish that a Coordination Study with the Treasure Coast Regional Planning Council by July, 1990, would evaluate the potential of an area-wide Development of Regional Impact under provisions of Chapter 380.06 (25), Florida Statutes, to study these hinterland areas outside the urbanized areas of Martin and Palm Beach County
- b Policy In 1992 the County shall have completed an evaluation of the potential urban uses in the vicinity of I-95 interchanges with CR 708 and CR 714
- c Policy In 1991, Martin will update current plans in the Indiantown area by developing an Indiantown Future Community Development Plan. The Board of County Commissioners shall appoint an Indiantown Planning Task Force in order to assist County staff and the Local Planning Agency in plan development and implementation. This Community Plan will address land use capacity concerns as well as other community issues, such as housing, roads, urban design, water, sewer, and recreation, consistent with prevailing State guidelines and future community goals

H GOAL (ENERGY EFFICIENCY)

Martin County shall encourage energy conservation and promote energy efficient land use and development

1 OBJECTIVE

By July 1990, Martin County's Land Development Regulations shall establish standards to ensure that development and redevelopment activities maximize the conservation of energy through effective and cost efficient land use and design

- a Policy Land Development Regulations shall be established to, at a minimum
 - (1) Encourage the location and scale of land use activities to minimize long-term energy commitments for construction, operation, maintenance, and replacement
 - (2) Encourage the design, siting, and orientation of buildings to utilize natural solar resources, wind conditions, tree canopy, and plant materials for the purpose of reducing the demand for artificial heating, cooling, ventilation, and lighting
 - (3) Ensure efficient energy conservation in building, heating, and cooling systems

2 OBJECTIVE

By January 1992, Martin County shall develop in cooperation with the Treasure Coast Regional Planning Council an energy information program to ensure that the latest information concerning energy efficiency is readily available

- (3) Boundary extensions or the creation of a new Primary Urban Service District may be considered by the Board of County Commissioners in conjunction with land use map changes which require concurrent amendment to the Primary Urban Services boundary.
- g Policy Martin County shall maximize the use of existing public facilities by encouraging the rehabilitation and adaptive reuse of existing structures as an in-fill strategy
- h The County shall investigate, through the Affordable Housing Task Force established under guidelines in the Housing Element (Section 6-4A, 10, k) fiscally sound means to encourage infill development on vacant lands within Primary Urban Service Districts where private reinvestment and development may not be appealing without public encouragement.
- i Policy Freestanding Expressway Oriented Transient Commercial Service Centers and industrial parcels must be contained within a Primary Urban Service District unless a waiver is obtained pursuant to Implementation Strategy D 3 (p 4-80) Such freestanding districts must also meet the criteria for that land use type contained within this Element and be consistent with the Capital Improvements Element
- j Policy Martin County recognizes the following detached, outlying areas which meet the use and/or density criteria of the Primary Urban Service District but are either subject to the waiver provisions contained in the Future Land Use Element or were in existence prior to the adoption of the 1982 Comprehensive Plan These area will not receive the same level of urban services as provided for the (contiguous) areas in the main Primary Urban Service District of the County
- (1) County Landfill area north of C R 714 and east of I-95,
 - (2) Mobile Home Park area south of C R 714 between I-95 and S R 76A,
 - (3) Mobile Home Park area east of S R 76A immediately north of the intersection of S R 76A and Citrus Blvd (S R 726),
 - (4) Triangular industrial site northeast of the Circle T Ranch (Indiantown) Airport

2 OBJECTIVE

Martin County shall concentrate rural and estate densities not exceeding one unit per gross acre within the Secondary Urban Service Districts where a reduced level of public facility needs are programmed to be available at the base level of service adopted in the Capital Improvements Element

- a Policy Martin County shall designate land uses within the Secondary Urban Services District in order to provide for the use and extension of urban services in an efficient and economical manner, and consistent with the reduced intensity of urban services, particularly the need to not provide central water and sewer facilities normally associated with rural and estate densities equal to or less than one unit per gross acre

- b Policy Martin County shall require that residential development shall be located within Secondary Urban Service Districts at densities no higher than that specified in Policy 2 a above unless a waiver is obtained pursuant to Implementation Strategy D 3 (p 4-80) The inclusion of lands within the Secondary Urban Service District shall be based upon consistency with the County's growth management policies and Capital Improvements Element, as well as maintenance of all applicable level-of-service standards in a cost efficient manner
- c Policy The Secondary Urban Service Districts shall be delineated on the Urban Services Boundary Map for areas that meet the density criteria and are contiguous to the Primary Urban Service District In areas where a tract that would normally qualify for Secondary Urban Service District designation is surrounded, on at least three (3) sides, by Primary Urban Service District areas, then the subject area will be included in the Primary Urban Service District.
- d Policy In areas designated as Secondary Urban Service Districts, where development is proposed that would contain one-half acre or smaller lots, or commercial and industrial uses, a change to a Primary Urban Service District designation must be approved by the Board of County Commissioners as part of a land use amendment and must meet all of the policies listed under Objective G 1 relating to Primary Urban Service Districts unless a waiver is obtained pursuant to Implementation Strategy D 3 (4-80)
- e Policy Martin County recognizes the following detached, outlying areas which meet the use and/or density criteria of the Secondary Urban Service District but are either subject to the waiver provisions contained in the Future Land Use Element or were in existence prior to the adoption of the 1982 Comprehensive Plan These areas will not receive the same level of urban services as provided for the main Secondary Urban Service Districts located contiguous to the Primary USD of the County
 - (1) Country Place Subdivision located on the east side of S R 76A just south of I-95,
 - (2) Linear area located between Citrus Blvd (S R 726) and the Okeechobee Waterway, from Indiantown to S R 76A

3 OBJECTIVE

Martin County shall initiate an investigation, in conjunction with the Treasure Coast Regional Planning Council and other interested organizations, the possibility of and potential for new land use map plans and programs for the long term future of the undeveloped areas in southern and western Martin county, to include large land holdings and the areas around I-95 interchanges at CR 708 and CR 714 This objective will also include the study and analysis of industrial and residential land use and other community issues in the Indiantown area

a Policy At a minimum, the Historic Preservation Ordinance shall

- (1) Provide protection for the resources locally defined to have historic significance as well as those listed on the national Register of Historic Places, the Florida Master Site File, the Local Register of Historic Places, and those to be discovered in the future
- (2) Outline standards for the identification and evaluation of historic resources
- (3) Utilize the Standards for Rehabilitation established by the United States Department of the Interior shall be used in the review of alterations to historic buildings
- (4) Encourage rehabilitation and adaptive reuse of historic properties through incentives, and regulate activities that would harm or destroy the historic value of such resources

4 OBJECTIVE

By December, 1991, Martin County shall aid and cooperate with the Treasure Coast Regional Planning Council in identifying and mapping significant historical, archaeological, and paleontological resources within the County

- a Policy Access to these resources shall be evaluated and increased when appropriate, for scientific, educational, and recreational purposes
- b Policy Historic resources and their environments shall be included in public acquisition programs for recreation, open space, and conservation areas which, at a minimum
- (1) Ensure that development or activities planned for such sites are passive in nature and do not endanger the integrity and character of the resource
 - (2) Encourage the incorporation of these sites into educational programs
- c Policy Development proposals on or near such sites will be required to preserve these areas or necessary buffer zones adjacent to them

G GOAL (ENCOURAGE URBAN DEVELOPMENT IN URBAN SERVICE AREAS)

Martin County shall regulate urban sprawl tendencies by directing growth in a timely and efficient manner to those areas where urban public facilities and services are available, or are programmed to be available, at the levels of service adopted in this Growth Management Plan

1 OBJECTIVE

Martin County shall concentrate higher densities and intensities of development within strategically located Primary Urban Service Districts, as delineated including commercial or industrial uses as well as residential development exceeding a density of two (2) units per acre, by this Growth Management Plan, where all forms of public facilities are available or are programmed to be available, at the base levels of service adopted in the Capital Improvement Element

- a Policy Martin County shall designate land uses within the Primary Urban Service District so as to provide for the use and extension of all necessary urban services and needs in an efficient and economical manner
- b Policy Martin County shall require that new residential development, containing one-half acre or smaller lots, commercial uses and industrial uses shall be located within the Primary Urban Service District unless a waiver is obtained pursuant to Implementation Strategy D 3 (p 4-80)

The inclusion of lands within the Primary Urban Service District shall be based upon consistency with the County's growth management policies and Capital Improvements Element, as well as documentation that the Plan level-of-service standards will be provided and maintained in a cost-efficient manner

- c Policy Martin County shall require future development necessitating access or connection to all public urban facilities, including water and sewer, to be located within Primary Urban Service Districts
- d Policy Martin County shall discourage the proliferation of small, individual water treatment, waste water disposal, and solid waste disposal facilities
- e Policy Martin County shall provide reasonable and equitable options for development outside of Primary Urban Service Districts, including agriculture and small scale service establishments necessary to support rural and agricultural uses
- f Policy The Primary Urban Service boundaries delineated on the Urban Services Boundary Map are not intended to be rigid delineations of land areas and the application of the urban services boundaries should be based upon the following
 - (1) Boundaries may extend beyond the established delineation to a distance of 660 feet, providing such extensions are consistent with the policies of this Growth Management Plan
 - (2) Boundaries may extend to major physical boundaries, such as railroads, water bodies, or transportation corridors, providing such extensions do not exceed 1,320 feet and are consistent with the policies of this Growth Management Plan

**10 3 1 EXCERPTS FROM THE MARTIN COUNTY COMPREHENSIVE
GROWTH MANAGEMENT PLAN RELATED TO**

- **GOAL G (ENCOURAGE URBAN DEVELOPMENT IN URBAN
SERVICE AREAS)**

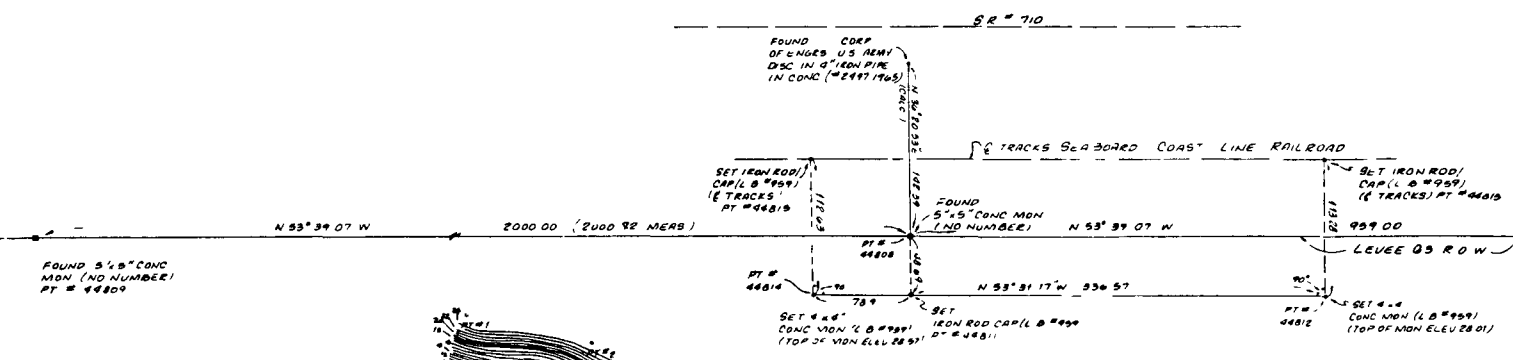
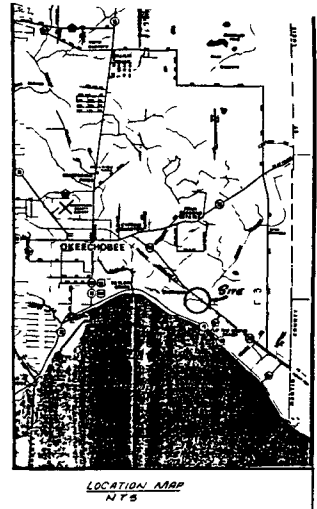
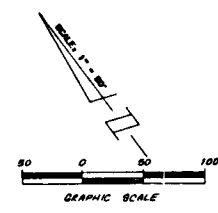
10-4

10 4 EXISTING STATE PERMITS

There are no existing state permits

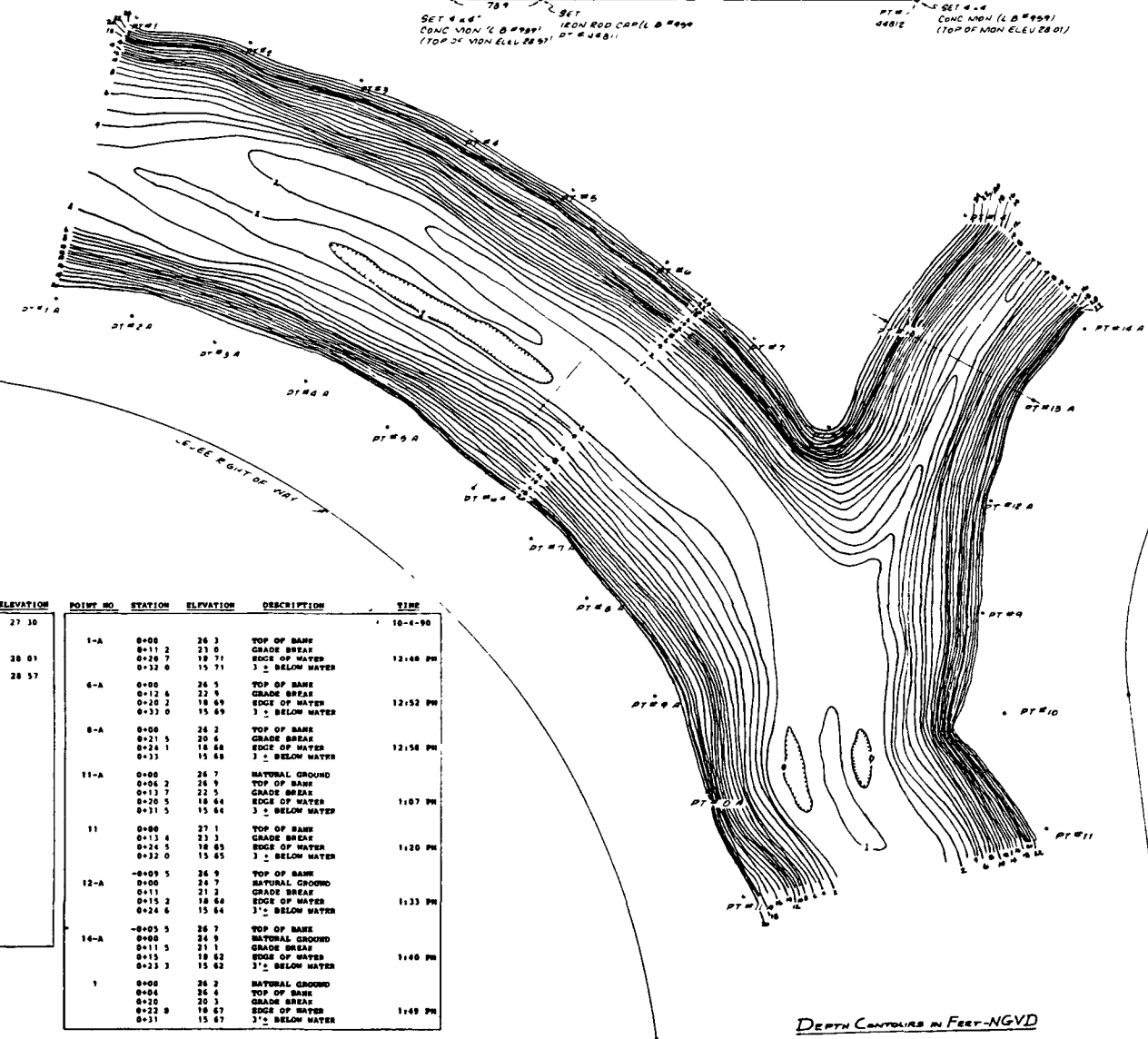
1247 9 SECTIONS 41410 7/199, 8032/ 1/0: 12-Oct 80 08:18 AM / 80-244 1

Vertical & Horizontal Control Reference Point - PC# 2697
Published Elevation 27.38 ± 0.05
State Plane
Coordinates 7, 344, 155.02
Located in Greenbush County along State Road 8710 and the RR
Railroad 1.5 miles northwest of Greenbush
To Reach From the intersection of S. 8. 84th and State Road
8710 go southwest on State Road 8710 1.5 miles then along State
Road 8710 0.5 miles to station location
Station is located 25.02 feet on a bearing of 83°00' from a nail
and 100 feet on a bearing of 83°00' from the west end of State
Road 8710 pavement. PC# is also 10.75 feet on a bearing of
81°15' to a telephone pole also 75.00 feet on a bearing of
83°30' to the east end of the main line track also 45.00 feet
on a bearing of 83°15' to a power pole also 115.00 feet on a
bearing of 83°30' to a telephone pole
Mark is a standard bronze corner of Engineer's class set in top of a
4" pipe with concrete collar 2.50 feet above ground stamped PC#
2697 1983



BLANKING BASE
THE NORTHERLY RIGHT OF WAY LINE
OF LEVEE 8518 TAKEN TO BE
N 55° 39' 07" W. ALL BEARINGS
SHOWN HEREON ARE RELATIVE THERETO
ALL ELEVATIONS ARE BASED ON NAD 83

Poor Original



POINT NO.	NORTHING	EASTING	ELEVATION
44806	1044815	0200000	580493 0500000
44807	1044780	3246147	580408 6570239
44808	1044885	7124395	578797 7941019
44809	1044661	2309144	580779 8619744
44810	1044467	3224504	580450 5107920
44811	1044552	2186785	580717 8563216
44812	1044708	1446598	580316 4321148
44813	1044798	7081014	580383 3520161
44814	1044861	5637930	580079 9553894
44815	1044782	3679299	580148 6217269
1	1044695	4805802	580207 8845174
2	1044608	6825764	580257 9051745
3	1044504	10311554	580298 3124782
4	1044100	6107308	580574 4443284
5	1044300	02465754	580347 4646058
6	1044195	7063628	580353 1050853
7	1044263	5081789	580452 3257424
8	1044277	7925420	580567 4437920
9	1044700	1432889	579846 7441430
10	1044446	3530883	579811 4161322
11	1044582	4504480	579957 9848933
12	1044505	5054676	580002 9848204
13	1044429	6058554	580336 5307364
14	1044338	9537202	580063 6848330
15	1044270	9580207	580077 7896357
16	1044197	3892183	580085 3194924
17	1044087	6846220	580080 4393803
18	1043988	5103242	580065 2267545
19	1043891	4334148	580035 7189167
20	1043780	2326165	580292 4072130
21	1043888	4832007	580325 3219352
22	1043795	6846337	580365 0658134
23	1044054	5495244	580431 5579474
24	1044106	1197444	580516 9797103
25	1044131	22489220	580592 5844335
26	1044131	9459355	581181 0657959

POINT NO.	STATION	ELEVATION	DESCRIPTION	TIME
1-A	0+00	26.3	TOP OF BANK	10-4-90
	0+11.2	23.0	GRADE BREAK	
	0+20.7	18.7	EDGE OF WATER	12:48 PM
	0+32.0	15.71	3' ± BELOW WATER	
4-A	0+00	26.5	TOP OF BANK	
	0+12.4	22.9	GRADE BREAK	12:52 PM
	0+20.2	18.69	EDGE OF WATER	
	0+33.0	15.69	3' ± BELOW WATER	
8-A	0+00	26.2	TOP OF BANK	
	0+21.5	20.6	GRADE BREAK	12:58 PM
	0+24.1	18.68	EDGE OF WATER	
	0+33	15.68	3' ± BELOW WATER	
11-A	0+00	26.7	NATURAL GROUND	
	0+06.2	26.9	TOP OF BANK	
	0+13.7	22.5	GRADE BREAK	1:07 PM
	0+20.5	18.64	EDGE OF WATER	
	0+31.5	15.64	3' ± BELOW WATER	
11	0+00	27.1	TOP OF BANK	
	0+13.4	23.3	GRADE BREAK	
	0+26.5	18.65	EDGE OF WATER	1:20 PM
	0+32.0	15.65	3' ± BELOW WATER	
12-A	-0+09.5	26.9	TOP OF BANK	
	0+00	24.7	NATURAL GROUND	
	0+11	21.2	GRADE BREAK	1:33 PM
	0+15.2	18.68	EDGE OF WATER	
	0+24.6	15.64	3' ± BELOW WATER	
14-A	-0+05.5	26.7	TOP OF BANK	
	0+00	24.9	NATURAL GROUND	
	0+11.5	21.1	GRADE BREAK	1:40 PM
	0+15	18.62	EDGE OF WATER	
	0+23.3	15.62	3' ± BELOW WATER	
1	0+00	26.2	NATURAL GROUND	
	0+04	26.4	TOP OF BANK	
	0+20	20.3	GRADE BREAK	1:49 PM
	0+22.8	18.67	EDGE OF WATER	
	0+31	15.67	3' ± BELOW WATER	

POINT NO.	STATION	ELEVATION	DESCRIPTION	TIME
2	0+00	25.7	NATURAL GROUND	10-4-90
	0+01.5	25.4	TOP OF BANK	
	0+18	20.8	GRADE BREAK	
	0+21.6	18.67	EDGE OF WATER	2:01 PM
	0+30	15.67	3' ± BELOW WATER	
3	0+00	25.7	NATURAL GROUND	
	0+02.2	26.1	TOP OF BANK	
	0+21	19.6	GRADE BREAK	
	0+23.8	18.64	EDGE OF WATER	2:05 PM
	0+32.2	15.64	3' ± BELOW WATER	
4	0+00	25.3	NATURAL GROUND	
	0+02	25.9	TOP OF BANK	
	0+19.5	20.4	GRADE BREAK	
	0+23.2	18.66	EDGE OF WATER	2:10 PM
	0+34.3	15.66	3' ± BELOW WATER	
5	0+00	25.2	NATURAL GROUND	
	0+03.4	25.8	TOP OF BANK	
	0+19.5	20.3	GRADE BREAK	
	0+23.3	18.68	EDGE OF WATER	2:15 PM
	0+35	15.68	3' ± BELOW WATER	
6	0+00	25.1	NATURAL GROUND	
	0+02	25.6	TOP OF BANK	
	0+18	20.0	GRADE BREAK	
	0+22	18.72	EDGE OF WATER	2:24 PM
	0+33	15.72	3' ± BELOW WATER	
7	0+00	24.8	NATURAL GROUND	
	0+02.4	25.4	TOP OF BANK	
	0+16	21.5	GRADE BREAK	
	0+21.7	18.69	EDGE OF WATER	2:29 PM
	0+31.7	15.69	3' ± BELOW WATER	
12	0+00	25.1	TOP OF BANK	
	0+15.7	20.7	GRADE BREAK	
	0+20.3	18.68	EDGE OF WATER	2:34 PM
	0+28.3	15.68	3' ± BELOW WATER	
8	0+00	26.1	NATURAL GROUND	
	0+07	24.7	TOP OF BANK	
	0+21.7	20.1	GRADE BREAK	
	0+25.2	18.67	EDGE OF WATER	
	0+33.5	15.67	3' ± BELOW WATER	2:37 PM

POINT NO.	STATION	ELEVATION	DESCRIPTION	TIME
11	0+00	25.0	NATURAL GROUND	10-4-90
	0+02	25.2	TOP OF BANK	
	0+23	18.64	EDGE OF WATER	2:43 PM
	0+30.5	15.64	3' ± BELOW WATER	
14	0+00	24.9	NATURAL GROUND	
	0+03.2	25.7	TOP OF BANK	
	0+17.1	21.7	GRADE BREAK	
	0+25	18.63	EDGE OF WATER	2:48 PM
	0+34	15.63	3' ± BELOW WATER	

FIGURE 2
LOCATION & TOPOGRAPHIC SURVEY
FOR
ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC.

Project Information and Client Details section containing fields for project name, location, date, and client contact information.

APPENDIX A--CHANNEL PROFILE DATABASE

Transect: 1

Date: 03-Oct-89

Time: 10:30

Dist (ft)	Depth* (ft)	Staff (ft)	Depth- Staff (ft)	NGVD** Correction (ft)	Final Elevation (ft-NGVD)
0					26.2
4					26.4
20					20.3
23					18.7
24	2.1	1.52	0.58	17.78	17.2
31					15.7
40	8.4	1.52	6.88	17.78	10.9
60	11.6	1.52	10.08	17.78	7.7
80	13.7	1.52	12.18	17.78	5.6
100	15.0	1.52	13.48	17.78	4.3
120	16.0	1.52	14.48	17.78	3.3
140	16.7	1.52	15.18	17.78	2.6
160	16.0	1.52	14.48	17.78	3.3
180	16.1	1.52	14.58	17.78	3.2
200	14.7	1.52	13.18	17.78	4.6
220	9.3	1.52	7.78	17.78	10.0
235					15.7
240	3.0	1.52	1.48	17.78	16.3
247					18.7
254	0.0	1.52	-1.52	17.78	19.3
256					23.0
267					26.3

Transect: 2

Date: 03-Oct-89

Time: 11:30

0					25.7
4					26.4
18					20.8
20	0.0	1.58	-1.58	17.78	19.4
22					18.7
30					15.7
40	8.4	1.58	6.82	17.78	11.0
60	12.8	1.58	11.22	17.78	6.6
80	15.1	1.58	13.52	17.78	4.3
100	16.7	1.58	15.12	17.78	2.7
120	17.1	1.58	15.52	17.78	2.3
140	17.1	1.58	15.52	17.78	2.3
150	17.7	1.58	16.12	17.78	1.7
160	17.2	1.58	15.62	17.78	2.2
180	16.4	1.58	14.82	17.78	3.0
200	15.9	1.58	14.32	17.78	3.5
220	11.1	1.58	9.52	17.78	8.3
240	2.5	1.58	0.92	17.78	16.9
248	0.0	1.58	-1.58	17.78	19.4

* Rows without a depth value are provided from the land surveying.

**Bottom of water level staff was at elevation 17.78 ft NGVD.

Transect:	3	Date:	03-Oct-89	Time:	12:18
0					25.7
2					26.1
21					19.6
24					18.6
32					15.6
40	5.4	1.61	3.79	17.78	14.0
60	11.2	1.61	9.59	17.78	8.2
80	16.7	1.61	15.09	17.78	2.7
100	17.8	1.61	16.19	17.78	1.6
120	17.4	1.61	15.79	17.78	2.0
140	17.3	1.61	15.69	17.78	2.1
160	17.7	1.61	16.09	17.78	1.7
180	17.1	1.61	15.49	17.78	2.3
200	14.9	1.61	13.29	17.78	4.5
220	11.4	1.61	9.79	17.78	8.0
240	3.3	1.61	1.69	17.78	16.1
246	0.0	1.61	-1.61	17.78	19.4

Transect:	4	Date:	03-Oct-89	Time:	12:35
0					25.3
2					25.9
19					20.4
20	0.0	1.65	-1.65	17.78	19.4
23					18.7
34					15.7
40	7.2	1.65	5.55	17.78	12.2
60	12.5	1.65	10.85	17.78	6.9
80	17.1	1.65	15.45	17.78	2.3
100	18.2	1.65	16.55	17.78	1.2
120	17.3	1.65	15.65	17.78	2.1
130	16.8	1.65	15.15	17.78	2.6
140	17.6	1.65	15.95	17.78	1.8
160	18.6	1.65	16.95	17.78	0.8
180	16.5	1.65	14.85	17.78	2.9
200	14.6	1.65	12.95	17.78	4.8
220	10.4	1.65	8.75	17.78	9.0
240	1.9	1.65	0.25	17.78	17.5
241	0.0	1.65	-1.65	17.78	19.4

Transect:	5	Date:	03-Oct-89	Time:	12:42
0					25.2
4					25.8
19					20.3
23					18.7
35					15.7
40	6.2	1.65	4.55	17.78	13.2
60	10.7	1.65	9.05	17.78	8.7
80	16.2	1.65	14.55	17.78	3.2
100	18.5	1.65	16.85	17.78	0.9
120	18.2	1.65	16.55	17.78	1.2
140	17.2	1.65	15.55	17.78	2.2
160	18.9	1.65	17.25	17.78	0.5
180	16.9	1.65	15.25	17.78	2.5
200	13.7	1.65	12.05	17.78	5.7
220	7.9	1.65	6.25	17.78	11.5
240	1.8	1.65	0.15	17.78	17.6
242	0.0	1.65	-1.65	17.78	19.4

Transect:	6	Date:	03-Oct-89	Time:	12:50
0					25.1
2					25.6
18					20.4
20	0.0	1.66	-1.66	17.78	19.4
22					18.7
33					15.7
40	6.3	1.66	4.64	17.78	13.1
60	14.3	1.66	12.64	17.78	5.1
80	18.0	1.66	16.34	17.78	1.4
100	18.7	1.66	17.04	17.78	0.7
120	17.7	1.66	16.04	17.78	1.7
140	17.7	1.66	16.04	17.78	1.7
150	18.3	1.66	16.64	17.78	1.1
160	17.7	1.66	16.04	17.78	1.7
180	14.7	1.66	13.04	17.78	4.7
200	11.5	1.66	9.84	17.78	7.9
220	8.1	1.66	6.44	17.78	11.3
237					15.7
240	2.6	1.66	0.94	17.78	16.8
250					18.7
258					22.9
270					26.5

Transect:	7	Date:	03-Oct-89	Time:	14:10
0					24.8
3					25.4
16					21.5
20	0.0	1.29	-1.29	17.78	19.1
22					18.7
32					15.7
40	8.5	1.29	7.21	17.78	10.6
60	14.5	1.29	13.21	17.78	4.6
80	17.9	1.29	16.61	17.78	1.2
100	18.2	1.29	16.91	17.78	0.9
120	17.8	1.29	16.51	17.78	1.3
140	17.9	1.29	16.61	17.78	1.2
160	17.9	1.29	16.61	17.78	1.2
180	15.2	1.29	13.91	17.78	3.9
200	12.4	1.29	11.11	17.78	6.7
220	8.7	1.29	7.41	17.78	10.4
240	2.8	1.29	1.51	17.78	16.3
245	0.0	1.29	-1.29	17.78	19.1

Transect:	8	Date:	03-Oct-89	Time:	14:45
0					26.1
7					24.7
22					20.1
26					18.7
34					15.7
40	9.5	1.08	8.42	17.78	9.4
60	13.6	1.08	12.52	17.78	5.3
80	18.0	1.08	16.92	17.78	0.9
100	18.0	1.08	16.92	17.78	0.9
120	17.6	1.08	16.52	17.78	1.3
140	17.2	1.08	16.12	17.78	1.7
160	16.0	1.08	14.92	17.78	2.9
180	14.1	1.08	13.02	17.78	4.8
200	11.6	1.08	10.52	17.78	7.3
220	7.8	1.08	6.72	17.78	11.1
235					15.7
244					18.7
246					20.6
268					26.2

Transect:	9	Date:	03-Oct-89	Time:	14:57
	18	0.0	0.88	-0.88	17.78
	20	1.0	0.88	0.12	17.78
	40	8.7	0.88	7.82	17.78
	60	11.8	0.88	10.92	17.78
	80	16.5	0.88	15.62	17.78
	100	18.2	0.88	17.32	17.78
	120	18.2	0.88	17.32	17.78
	140	18.5	0.88	17.62	17.78
	160	18.5	0.88	17.62	17.78
	180	18.3	0.88	17.42	17.78
	200	17.0	0.88	16.12	17.78
	220	14.5	0.88	13.62	17.78
	240	11.0	0.88	10.12	17.78
	260	5.2	0.88	4.32	17.78
	280	0.0	0.88	-0.88	17.78

Transect:	10	Date:	03-Oct-89	Time:	15:17
	56	0.0	0.71	-0.71	17.78
	60	4.4	0.71	3.69	17.78
	80	12.2	0.71	11.49	17.78
	100	14.9	0.71	14.19	17.78
	120	18.0	0.71	17.29	17.78
	140	18.7	0.71	17.99	17.78
	160	17.3	0.71	16.59	17.78
	180	18.0	0.71	17.29	17.78
	200	19.2	0.71	18.49	17.78
	220	17.6	0.71	16.89	17.78
	240	13.7	0.71	12.99	17.78
	260	7.9	0.71	7.19	17.78
	270	3.7	0.71	2.99	17.78
	275	0.0	0.71	-0.71	17.78

Transect:	11	Date:	03-Oct-89	Time:	15:32
	0				27.1
	13				23.3
	24				18.7
	32				15.7
	40	5.9	0.56	5.34	17.78
	60	11.7	0.56	11.14	17.78
	80	15.9	0.56	15.34	17.78
	100	17.5	0.56	16.94	17.78
	120	17.8	0.56	17.24	17.78
	140	17.4	0.56	16.84	17.78
	160	18.1	0.56	17.54	17.78
	180	18.2	0.56	17.64	17.78
	200	16.6	0.56	16.04	17.78
	220	12.2	0.56	11.64	17.78
	240	4.7	0.56	4.14	17.78
	249				13.6
	260	1.2	0.56	0.64	17.78
	266	0.0	0.56	-0.56	17.78
	274				18.3
	280				26.9
					26.7

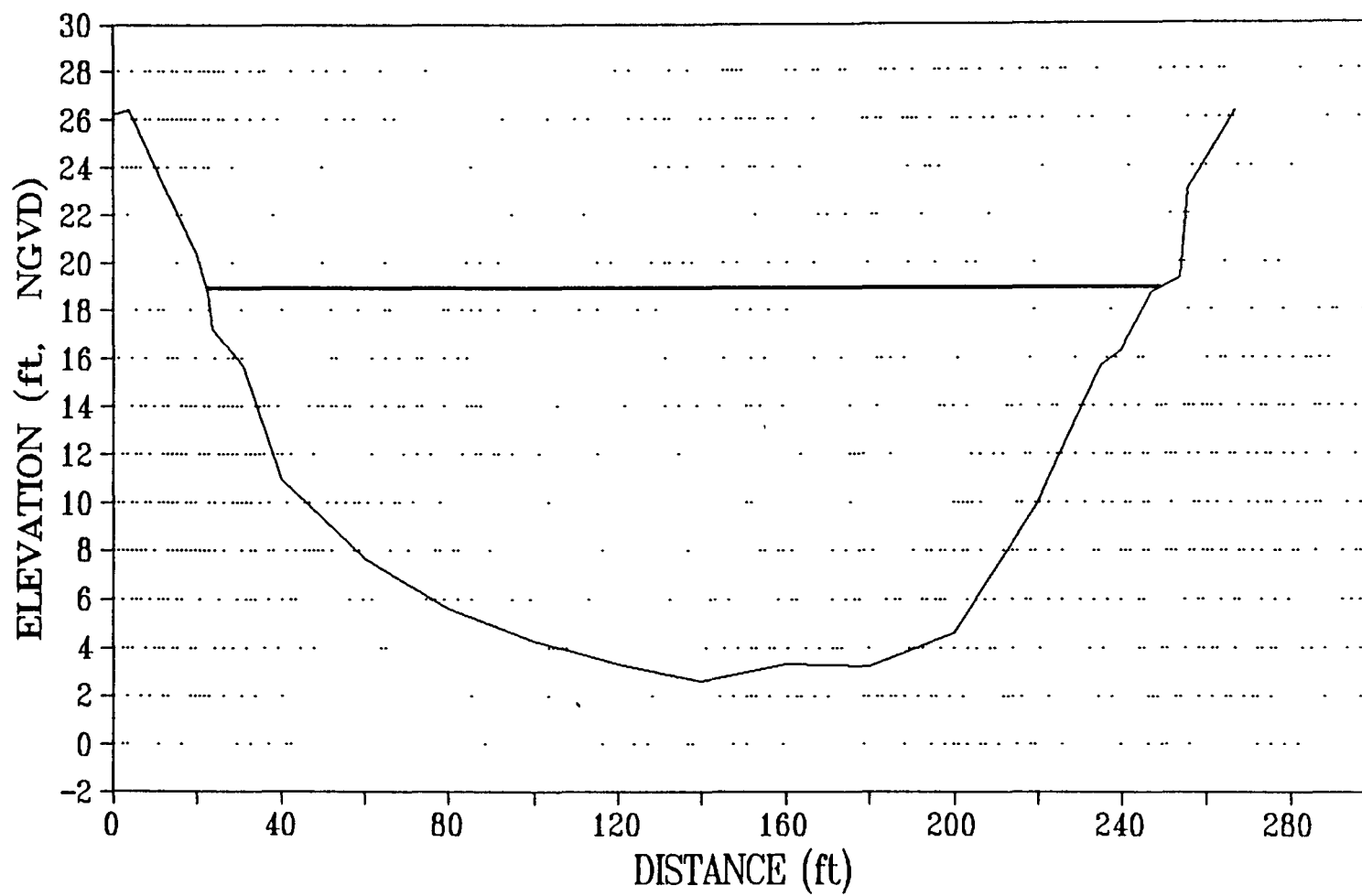
Transect:	12	Date:	03-Oct-89	Time:	17:20
	0				26.1
	16				20.7
	20				18.7
	28				15.7
	40	5.8	0.46	5.34	17.78
	60	9.2	0.46	8.74	17.78
	80	14.1	0.46	13.64	17.78
	90	15.3	0.46	14.84	17.78
	100	13.3	0.46	12.84	17.78
	120	7.5	0.46	7.04	17.78
	137				10.7
	146				15.6
	161				18.6
					24.7

Transect:	13	Date:	03-Oct-89	Time:	17:33
	0				25.0
	2				25.2
	23				18.6
	30				15.6
	40	7.1	0.55	6.55	17.78
	60	12.0	0.55	11.45	17.78
	80	14.0	0.55	13.45	17.78
	100	11.2	0.55	10.65	17.78
	120	3.8	0.55	3.25	17.78
	127	0.0	0.55	-0.55	17.78

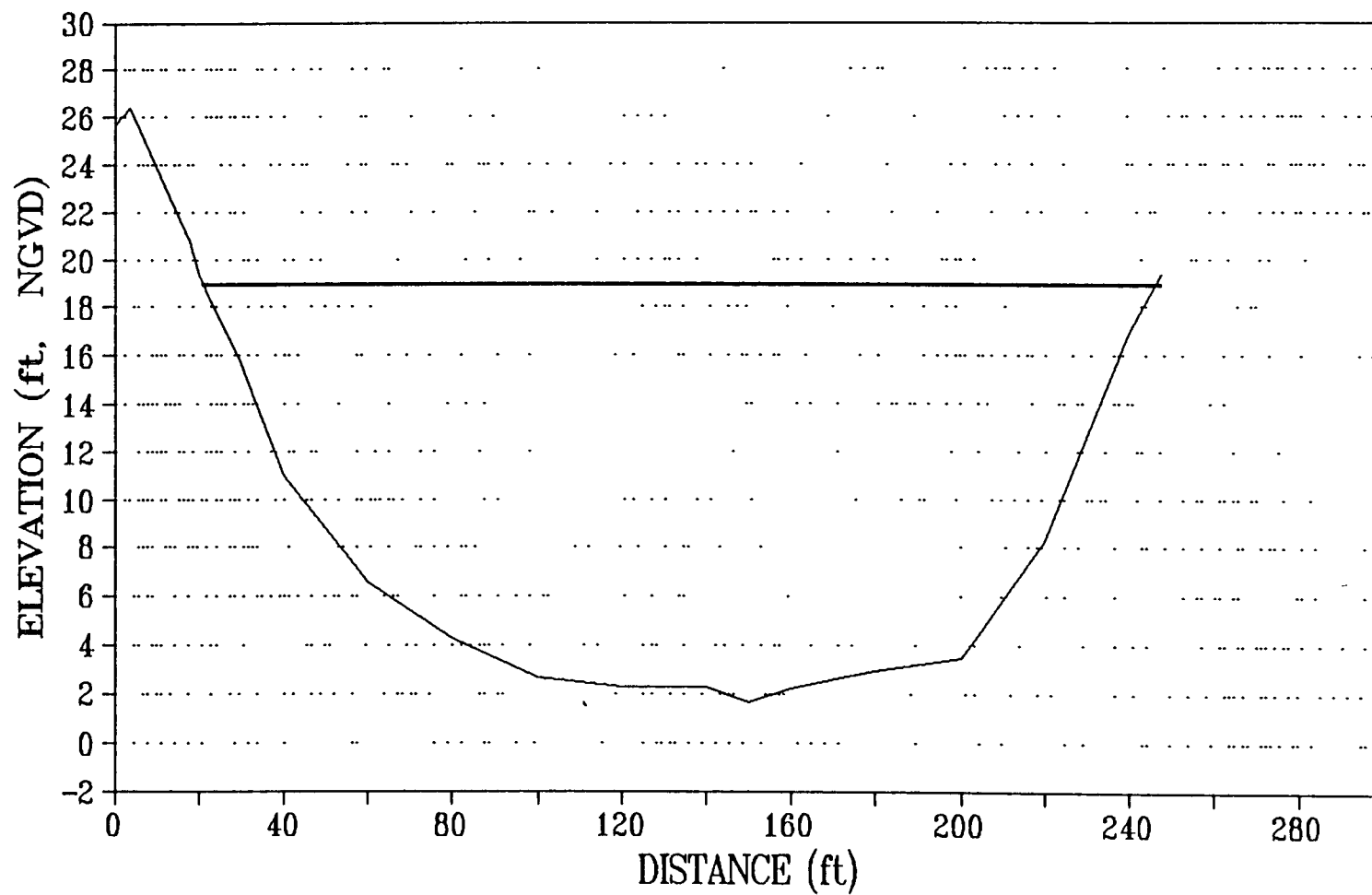
Transect:	14	Date:	03-Oct-89	Time:	17:50
	0				24.9
	3				25.7
	17				21.7
	25				18.6
	34				15.6
	40	5.9	0.45	5.45	17.78
	60	11.2	0.45	10.75	17.78
	80	14.2	0.45	13.75	17.78
	100	10.0	0.45	9.55	17.78
	120	4.7	0.45	4.25	17.78
	125				13.5
	134				15.6
	137				18.6
	149				21.1
					24.9

APPENDIX B--CHANNEL PROFILES

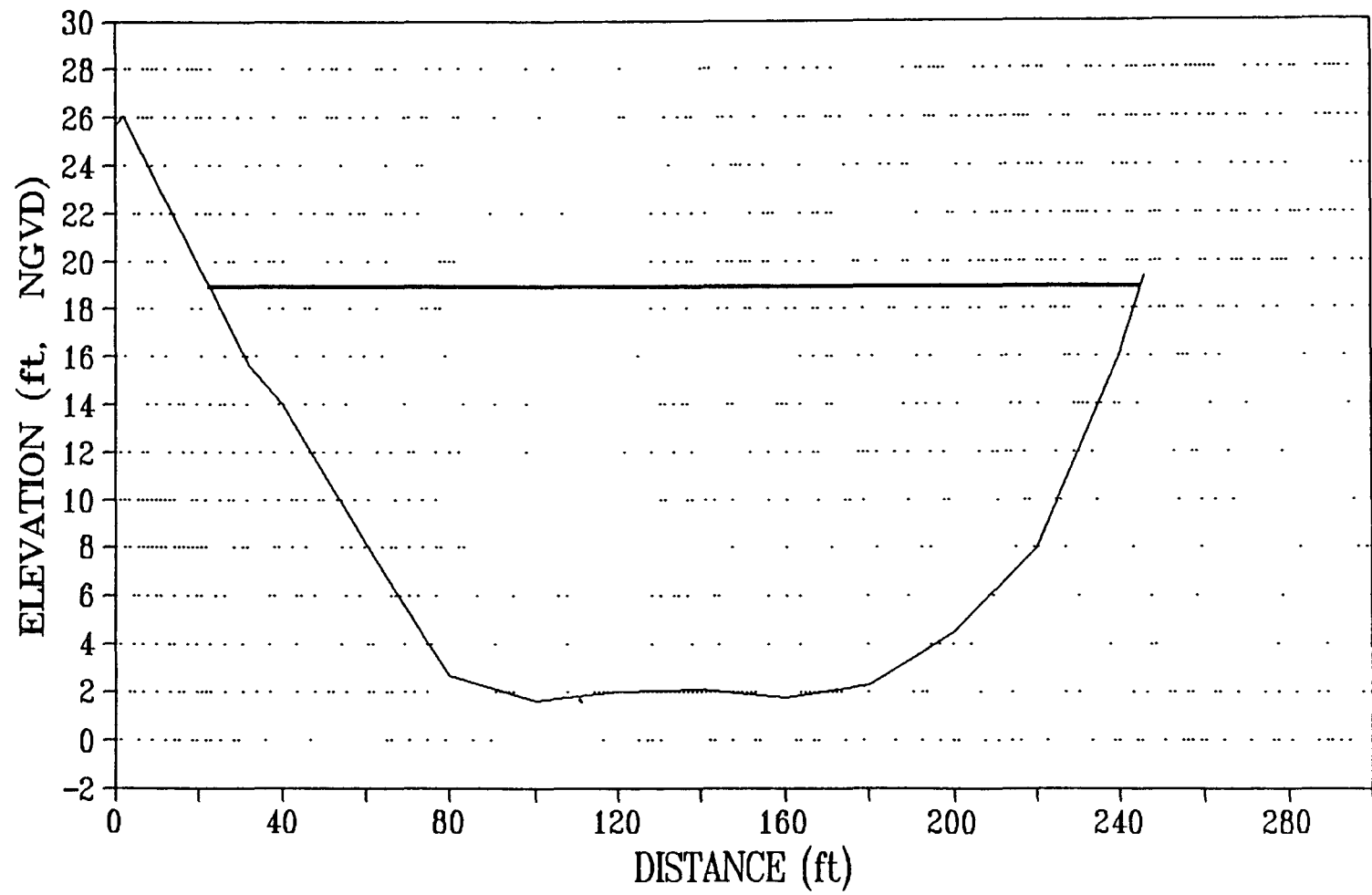
TRANSECT NO. 1
L63-N



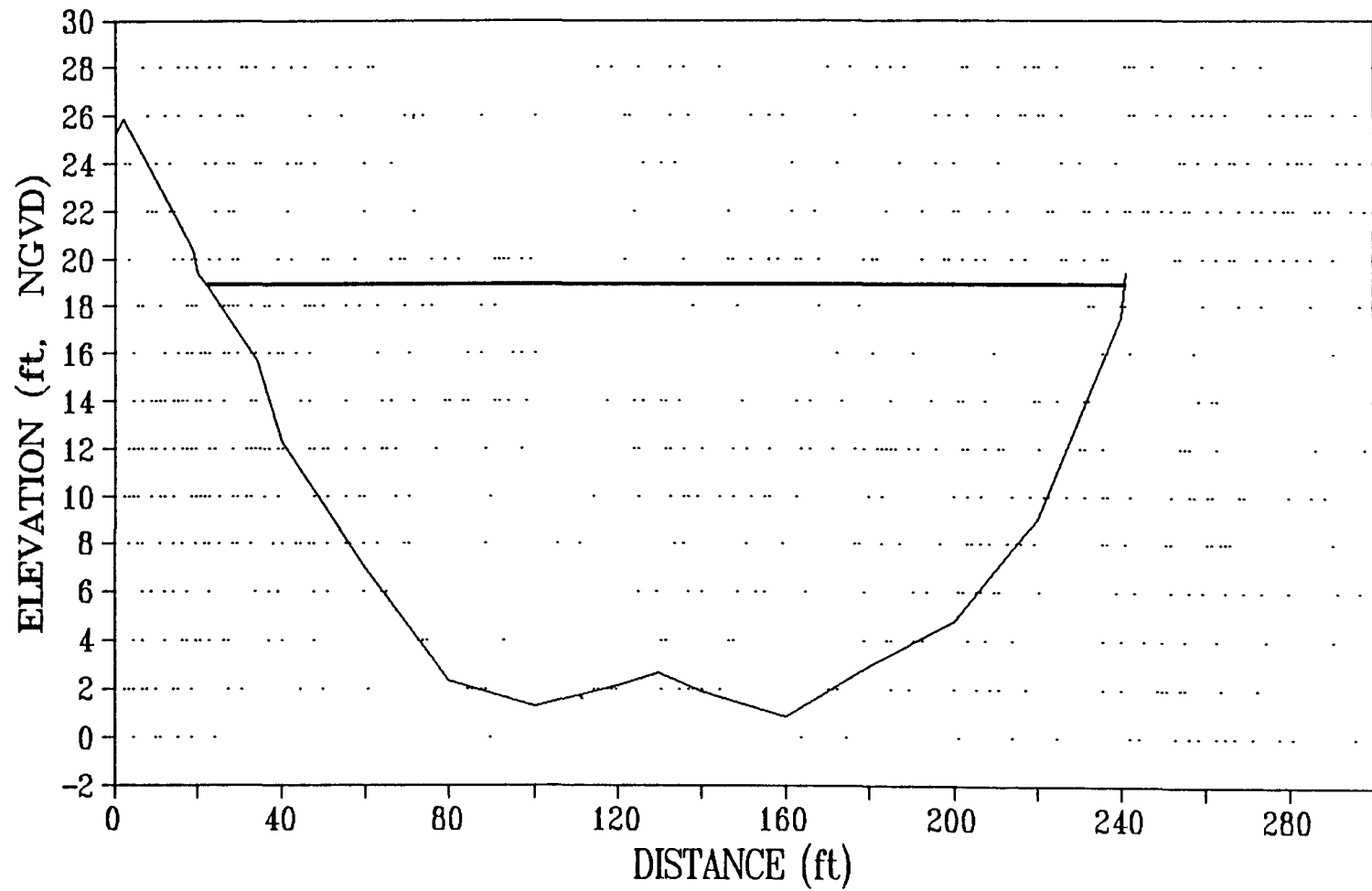
TRANSECT NO. 2
L63-N



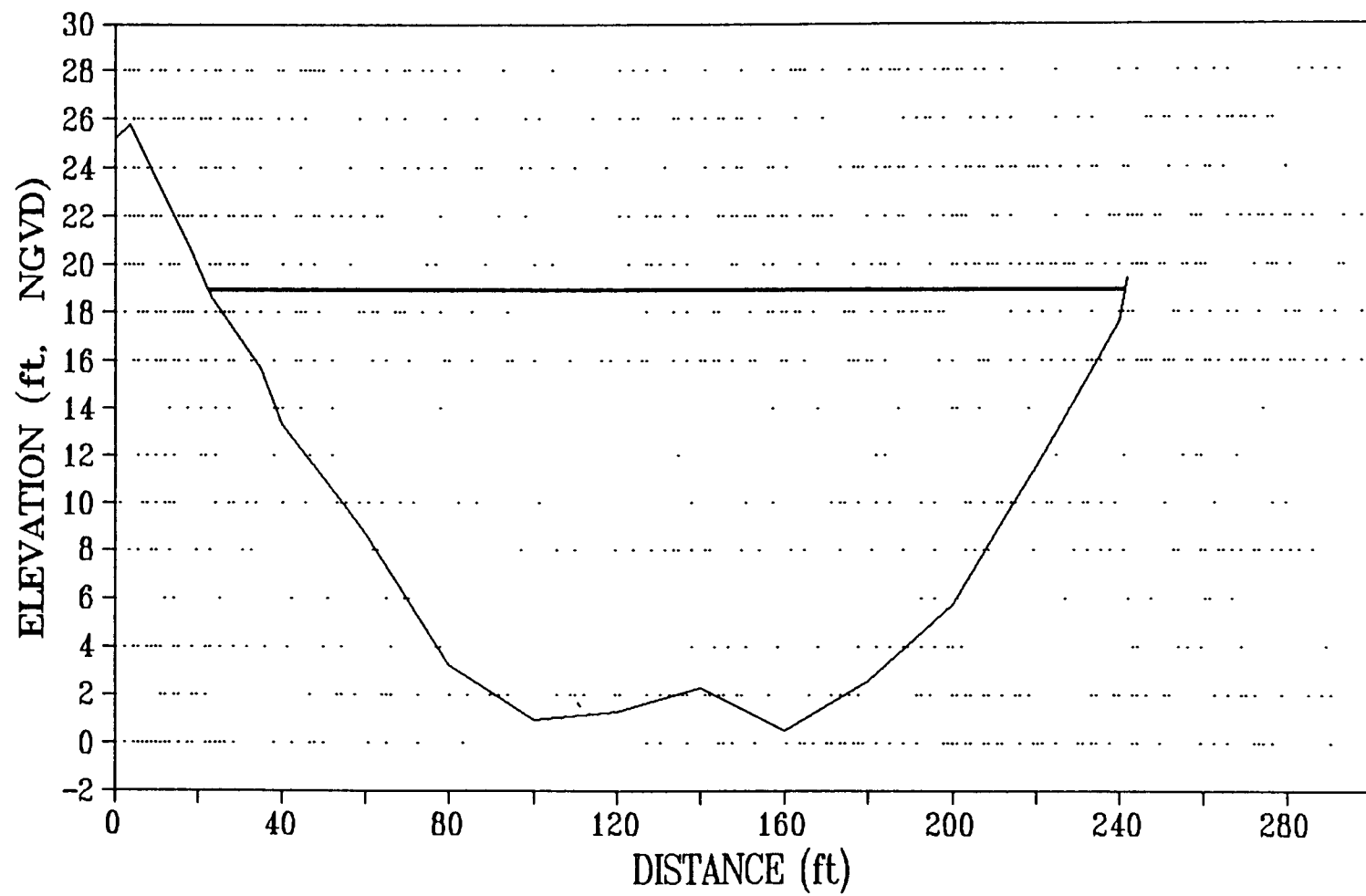
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L63-N



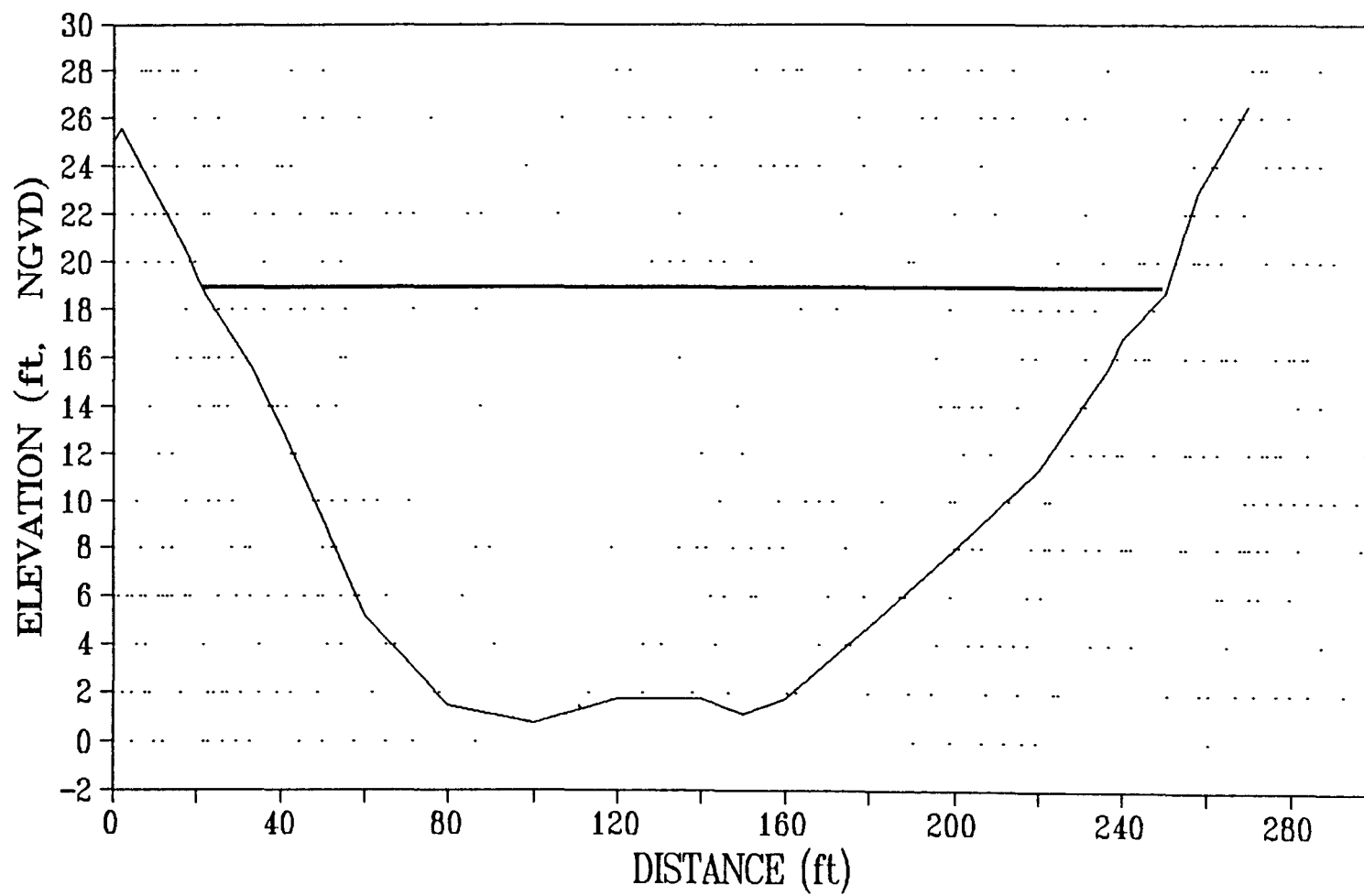
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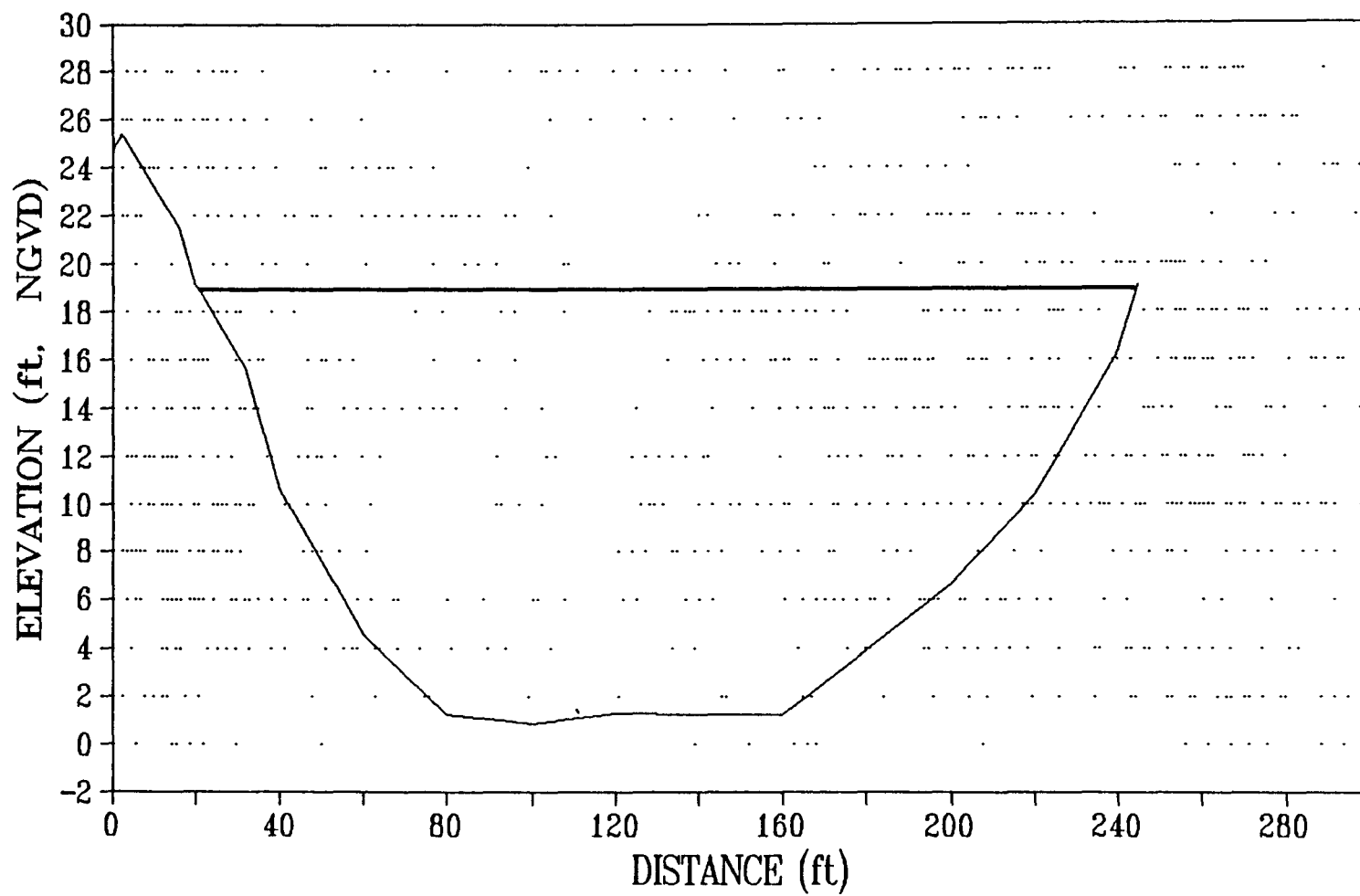
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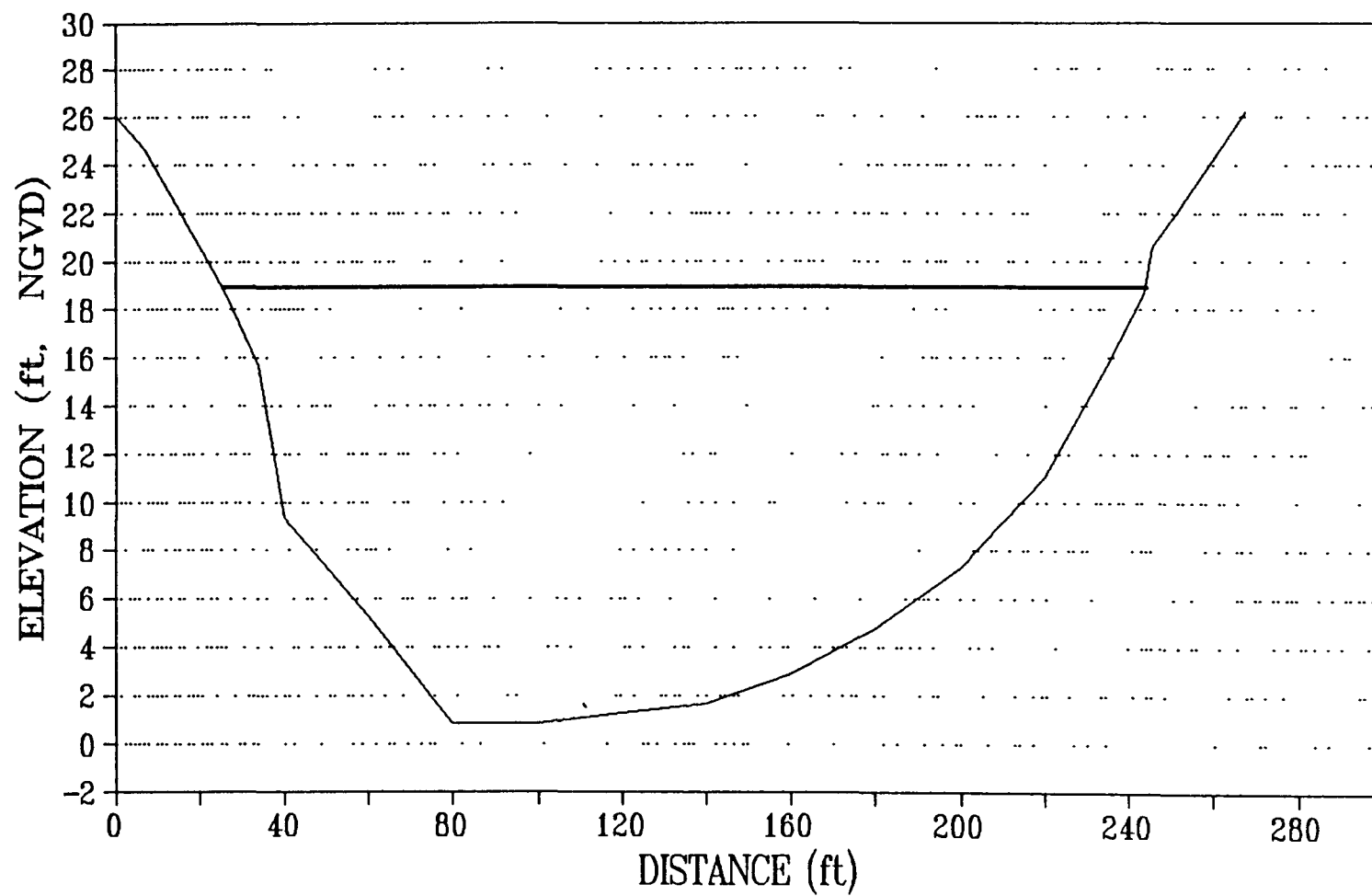
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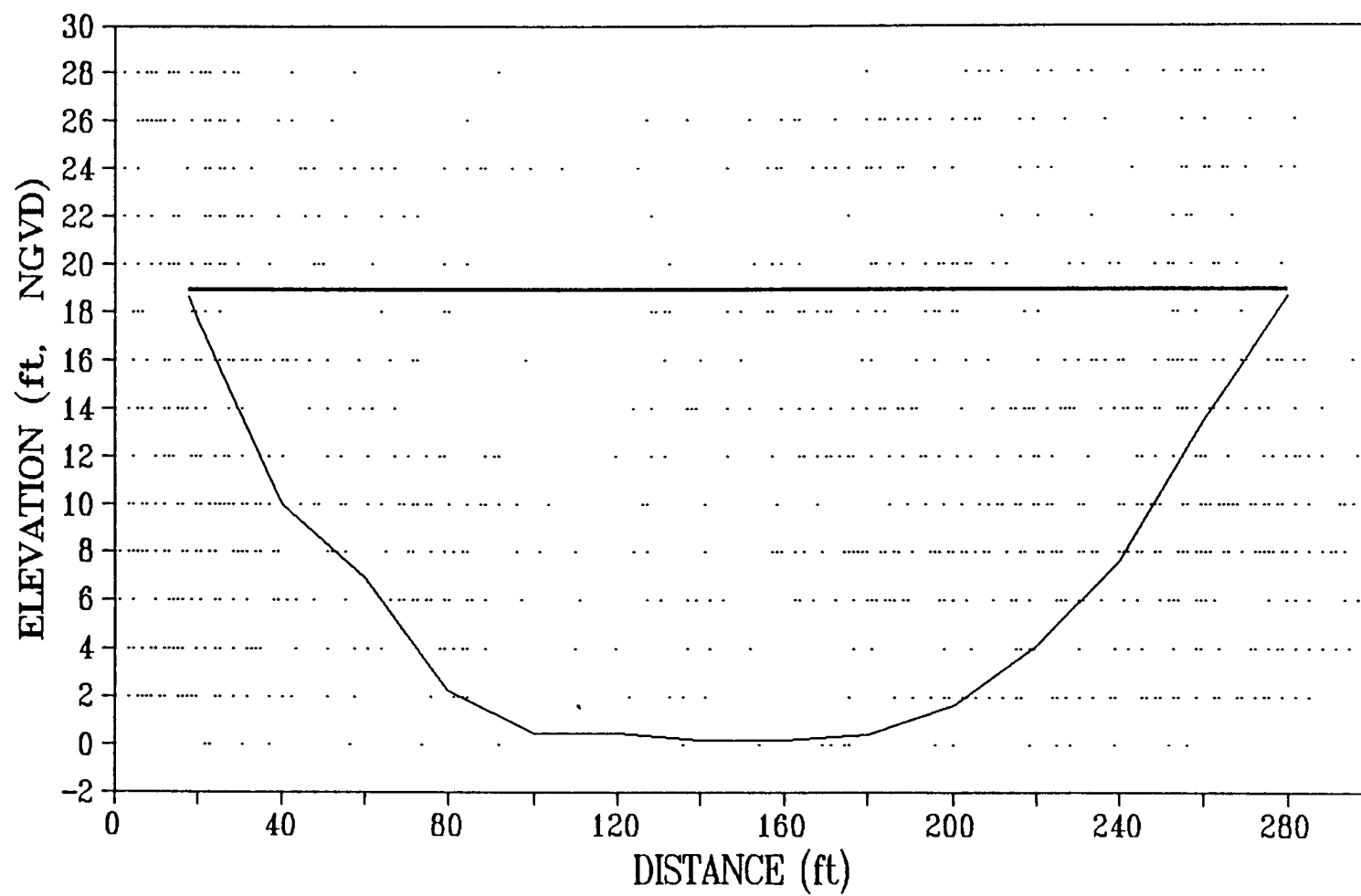
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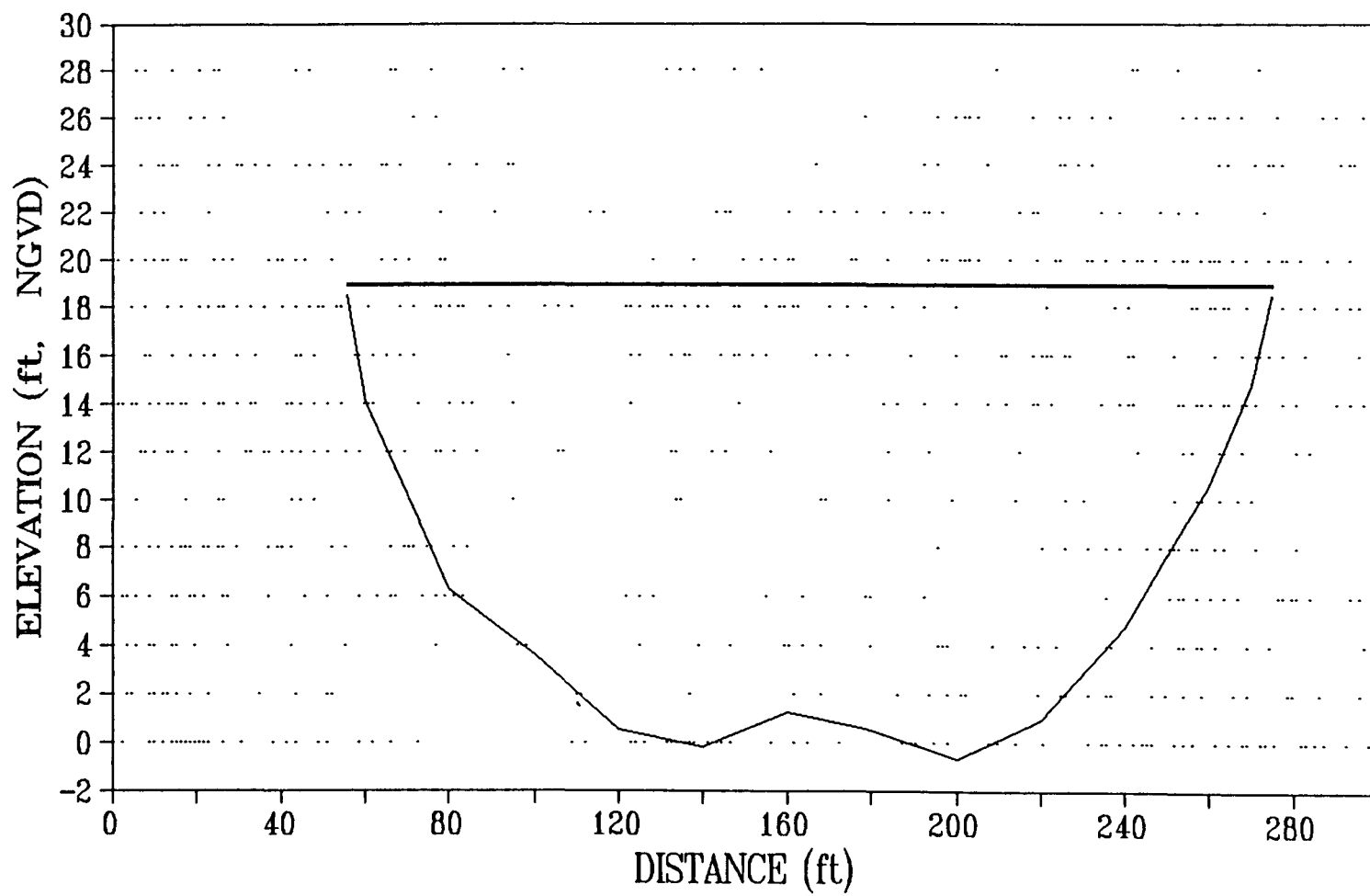
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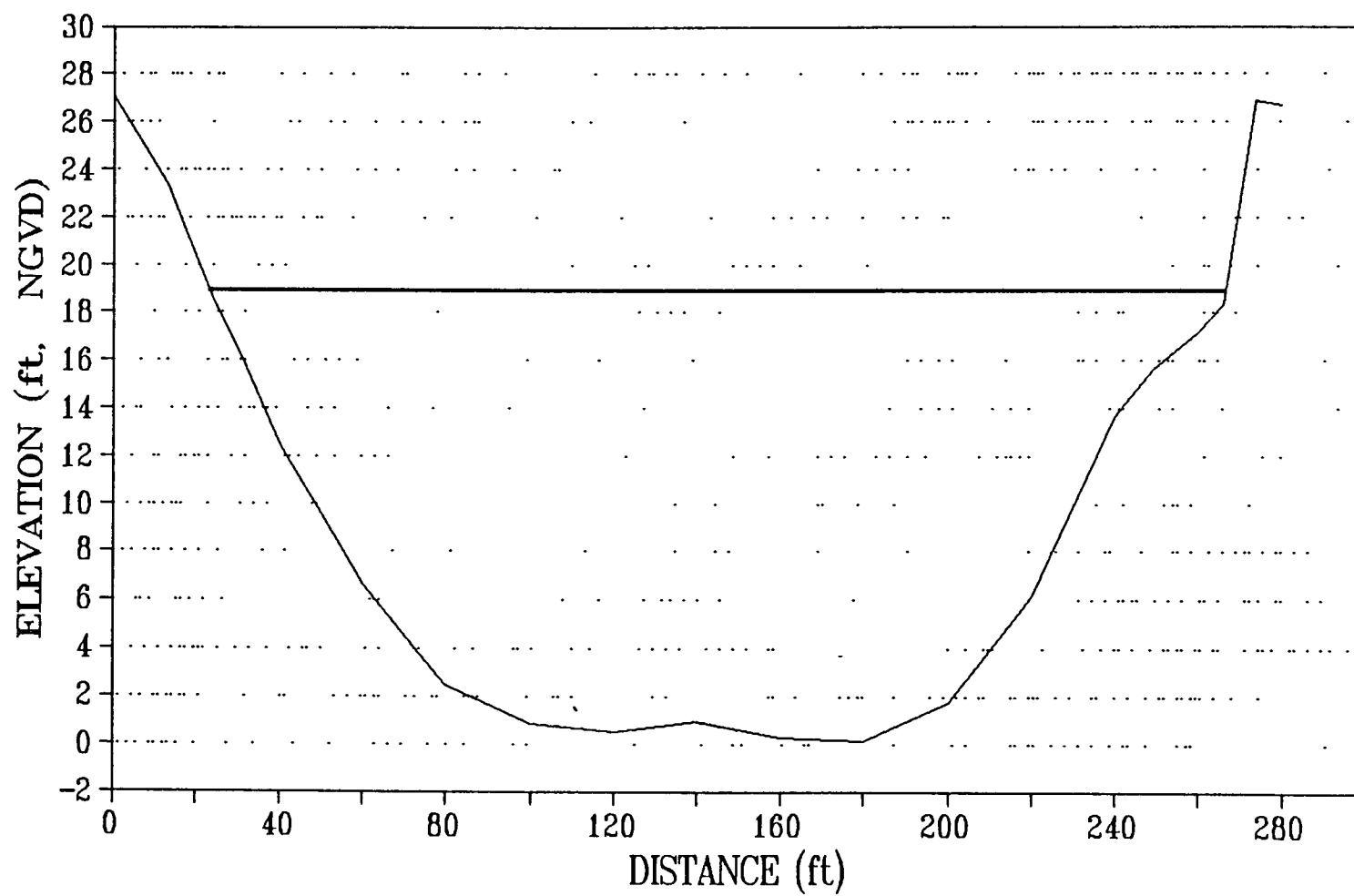
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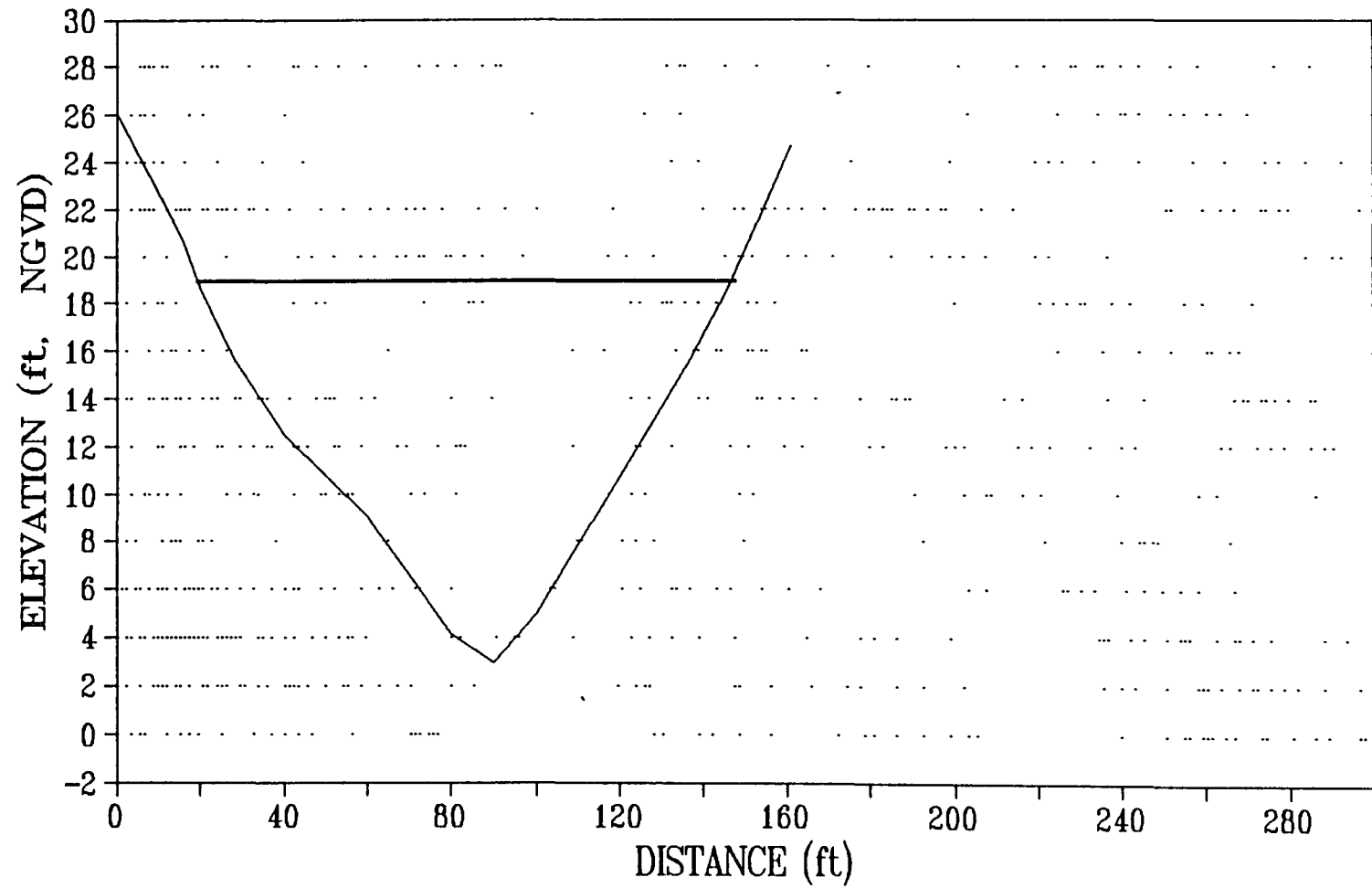
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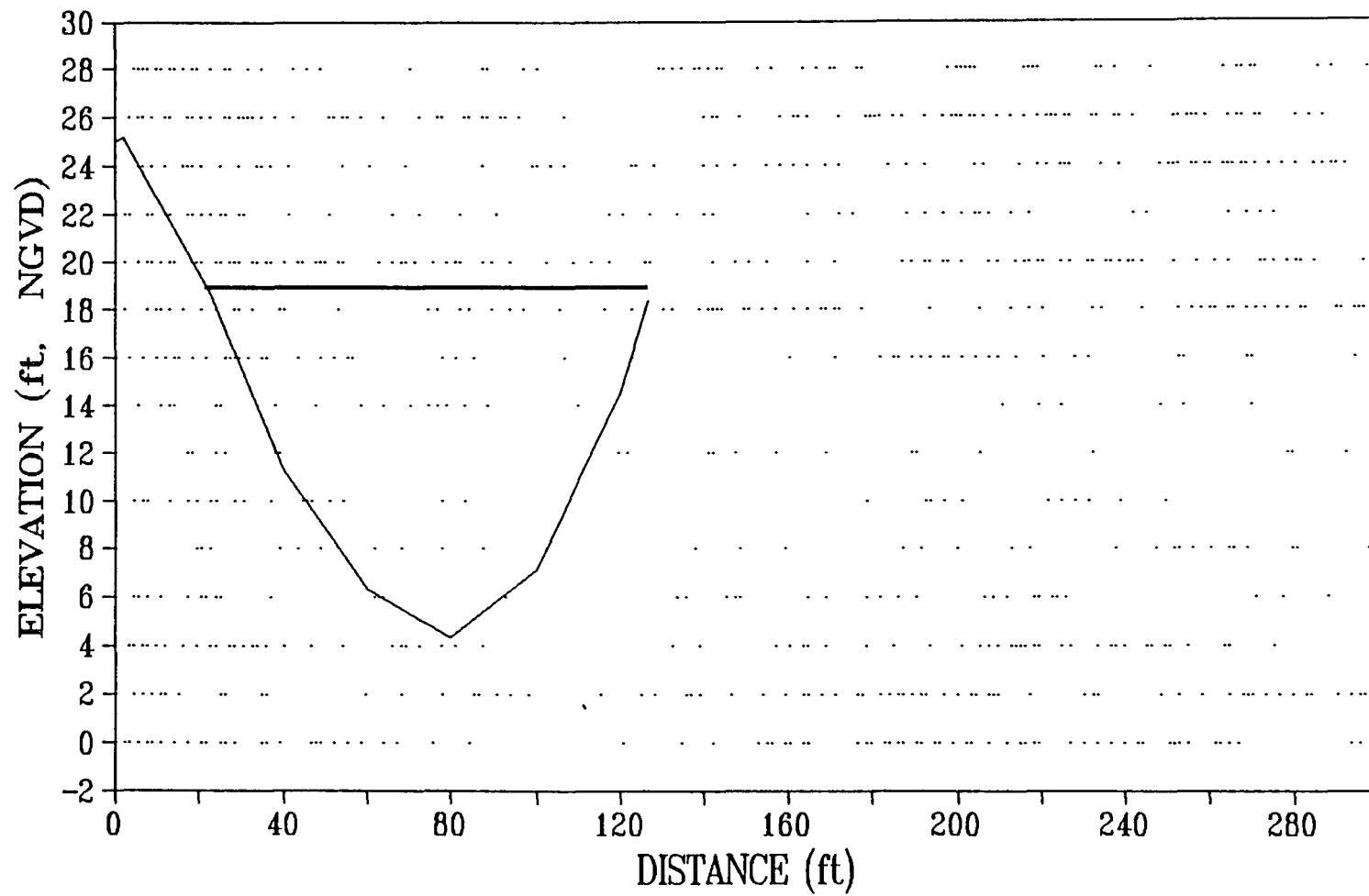
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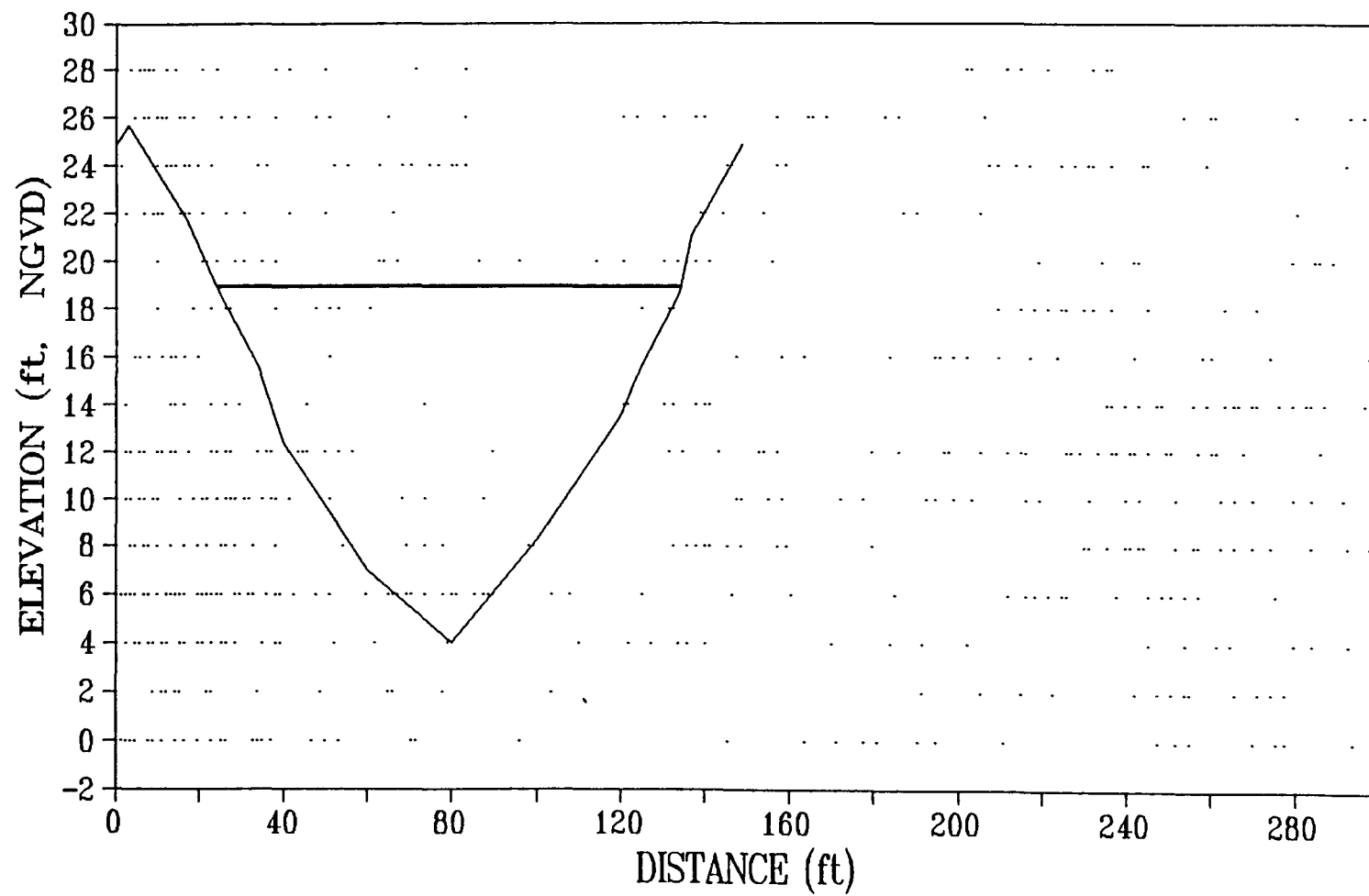
TRANSECT NO. 12
L63-S



TRANSECT NO. 13
L63-S



TRANSECT NO. 14
L63-S

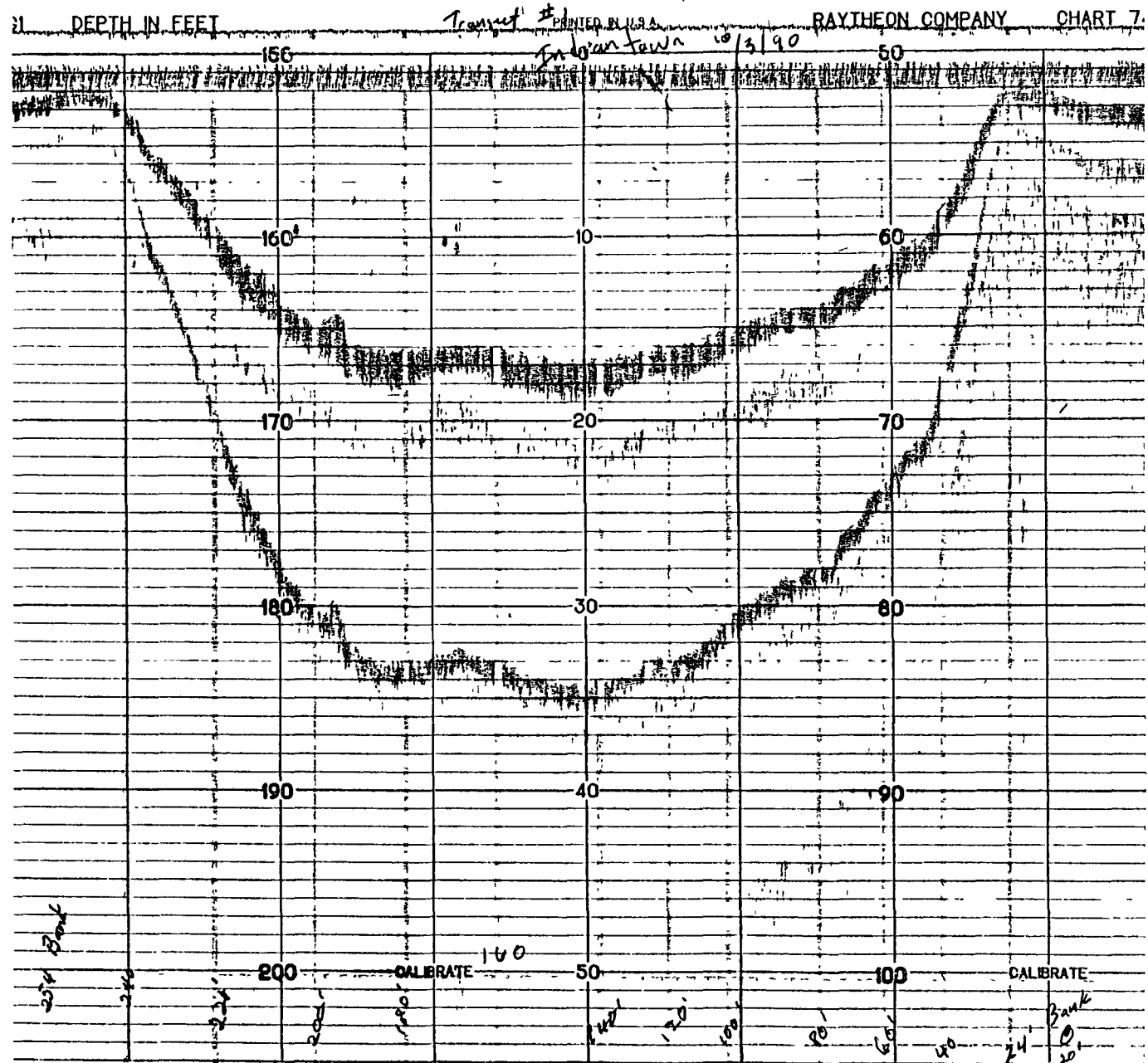


APPENDIX C--FATHOMETER CHARTS

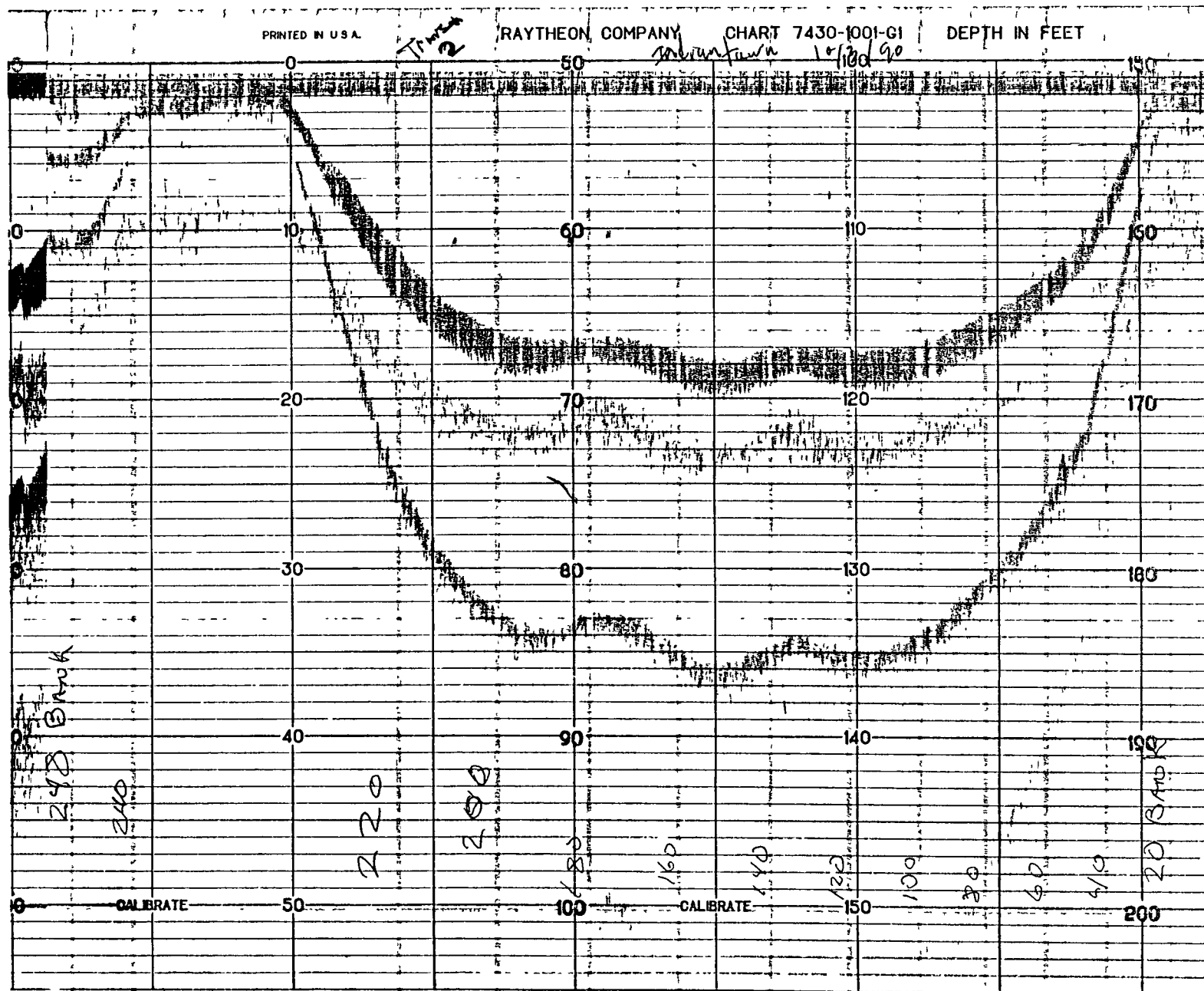
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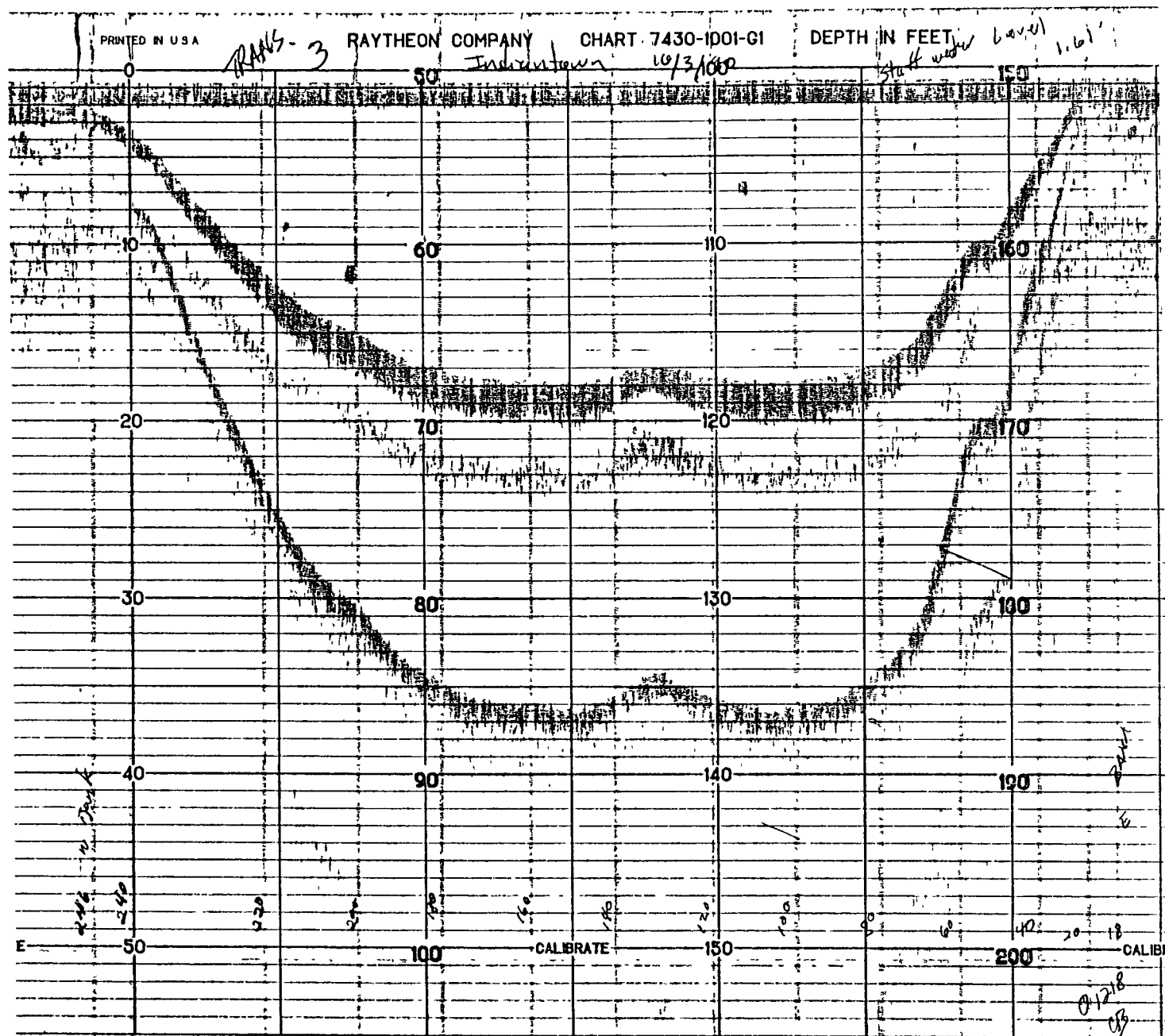
**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

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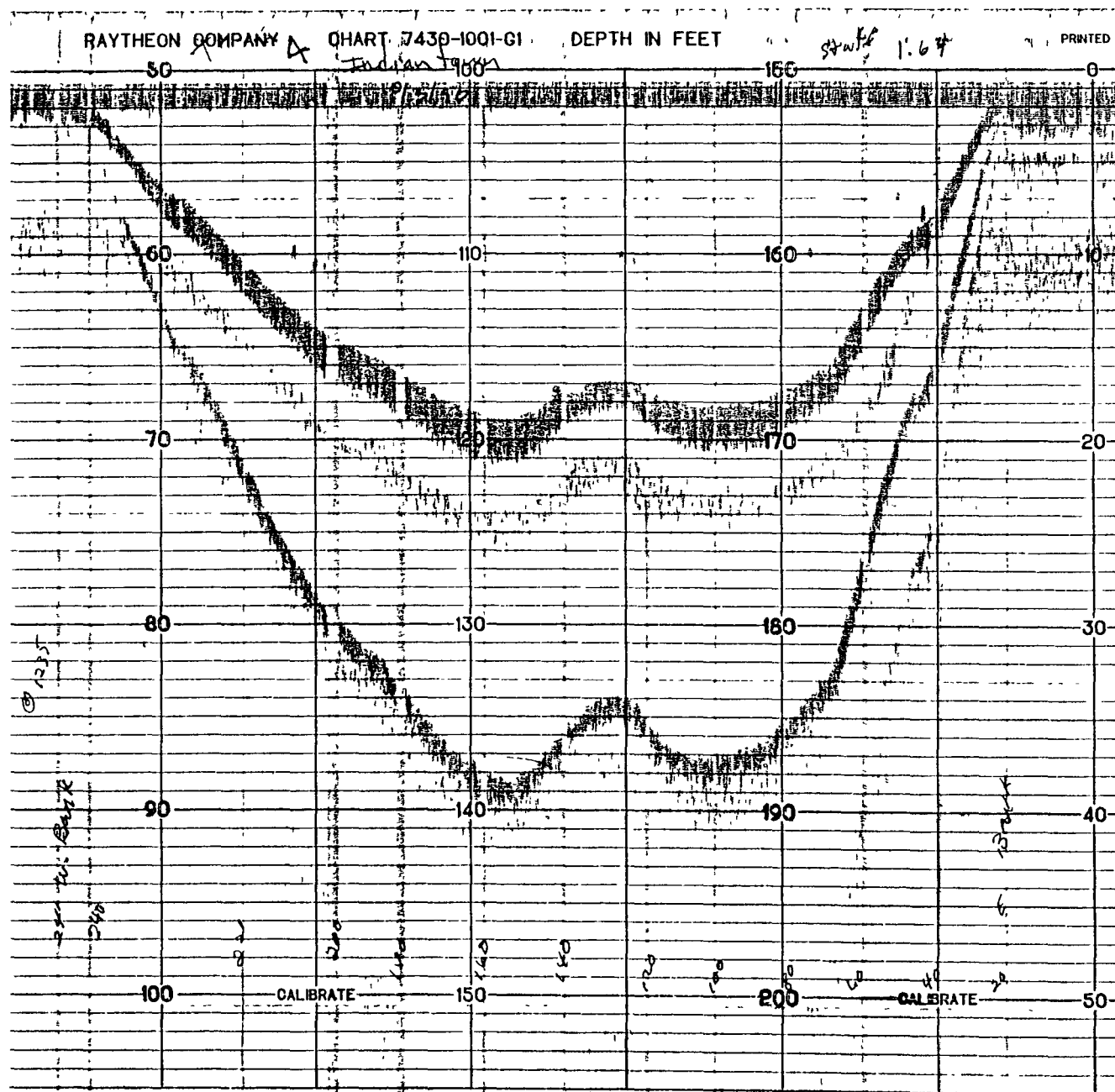


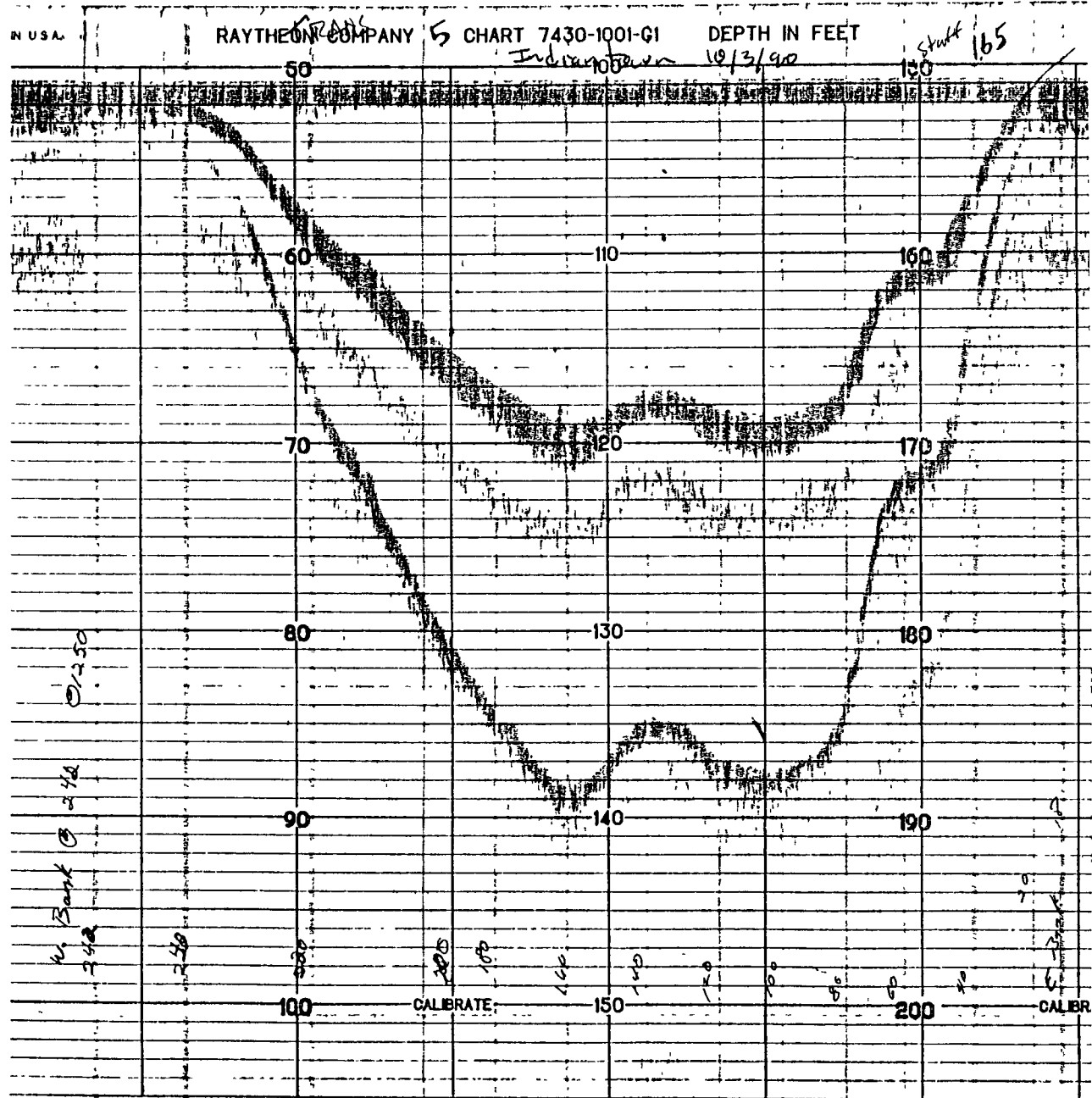
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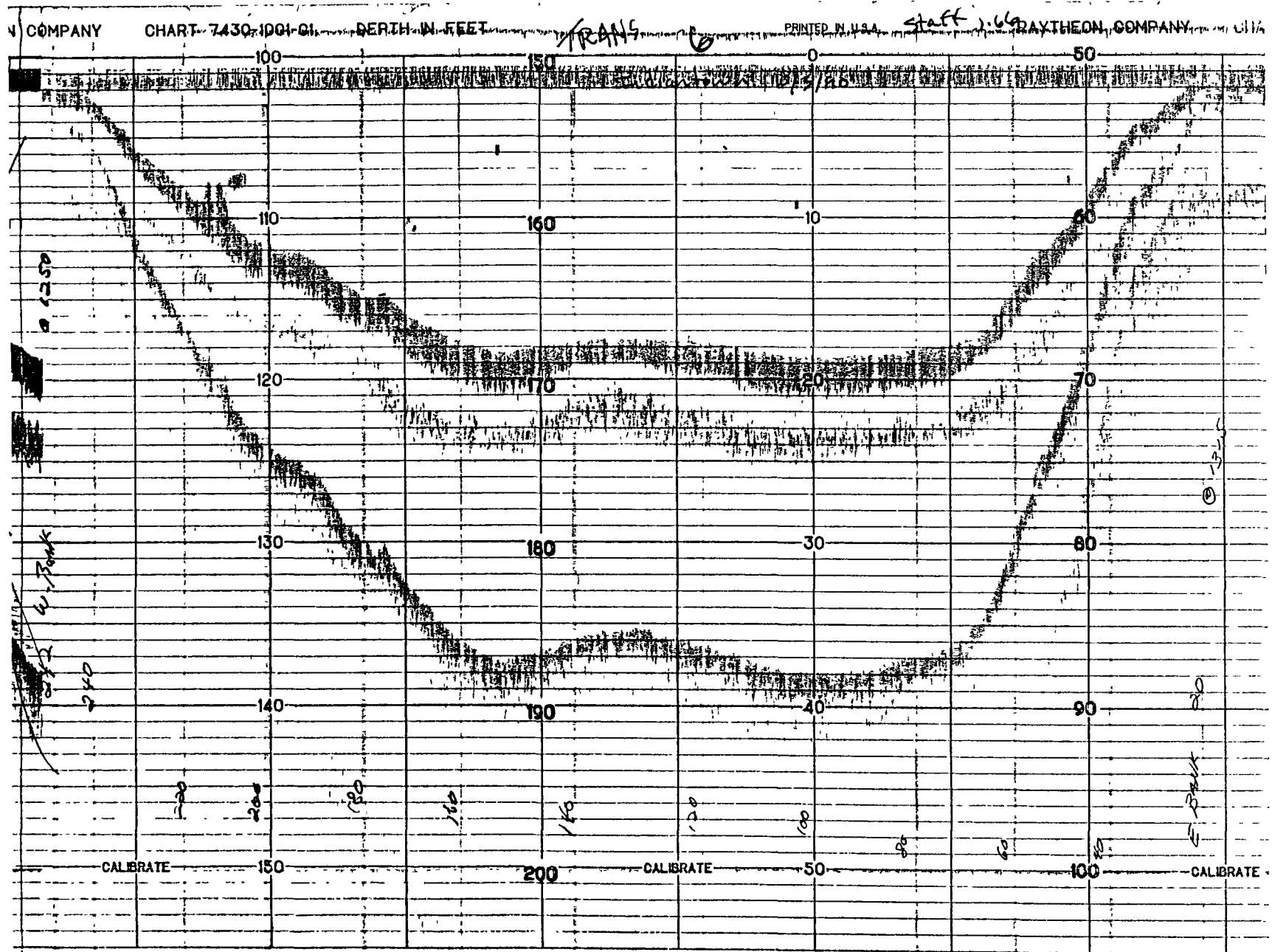


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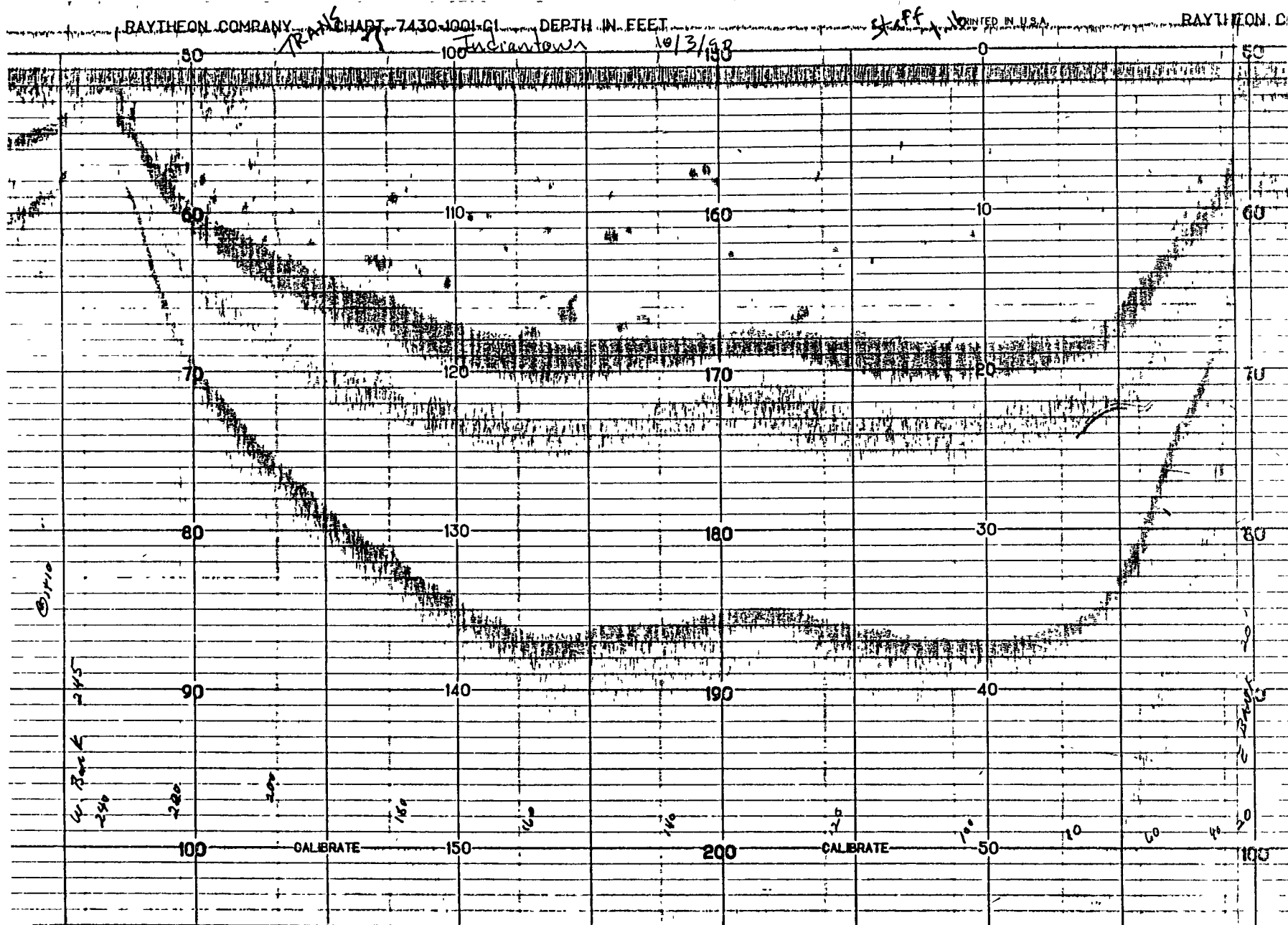




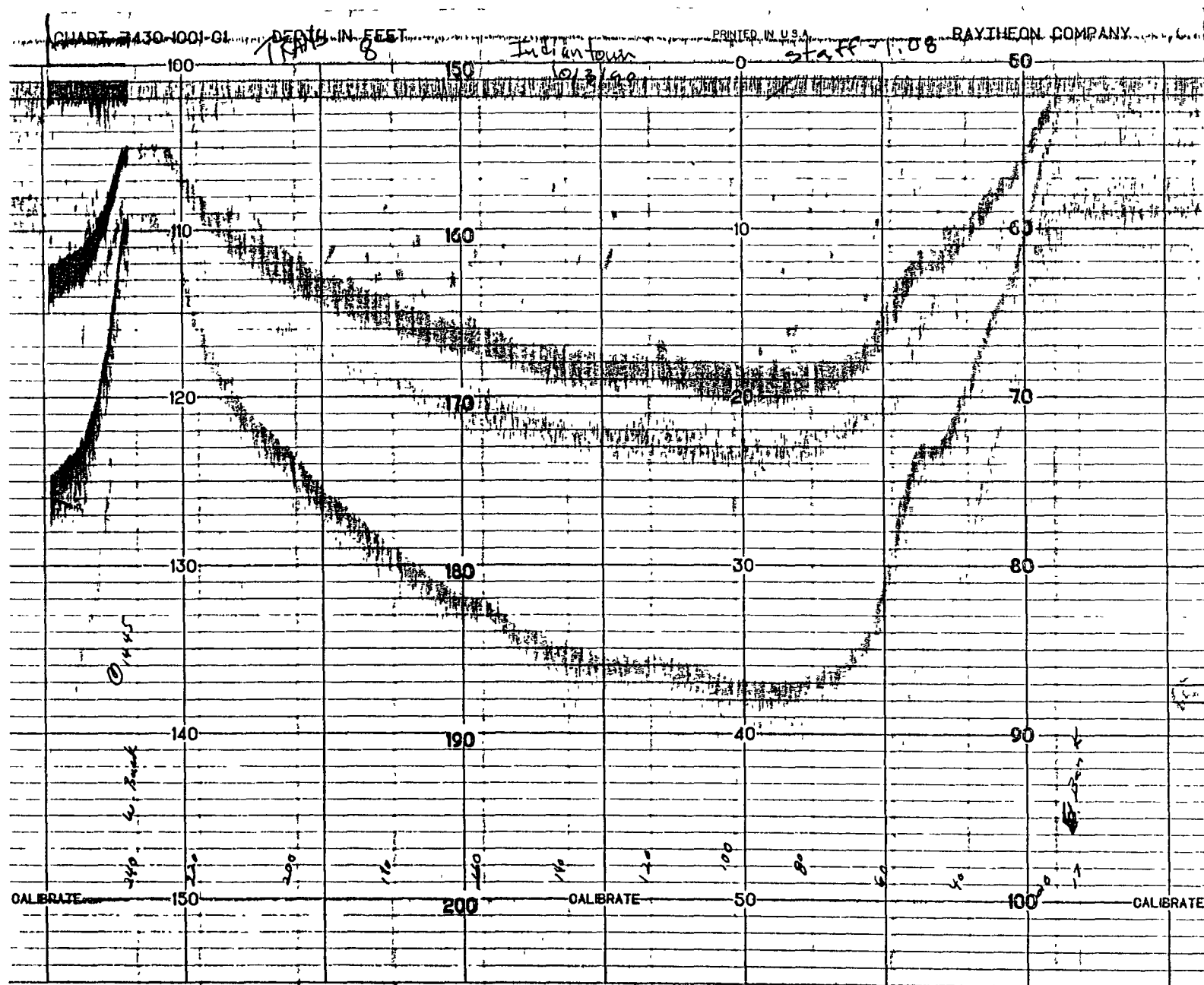
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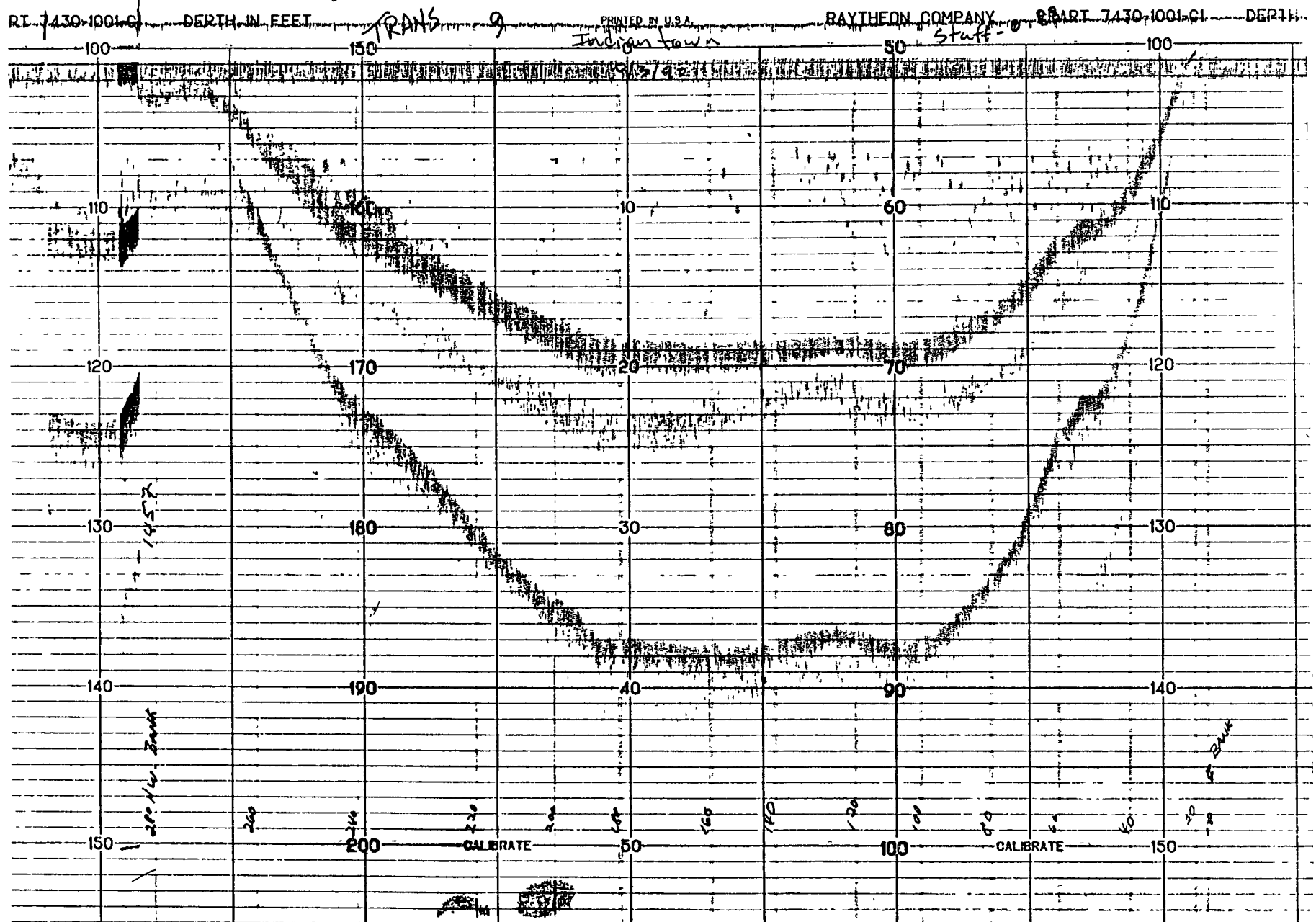
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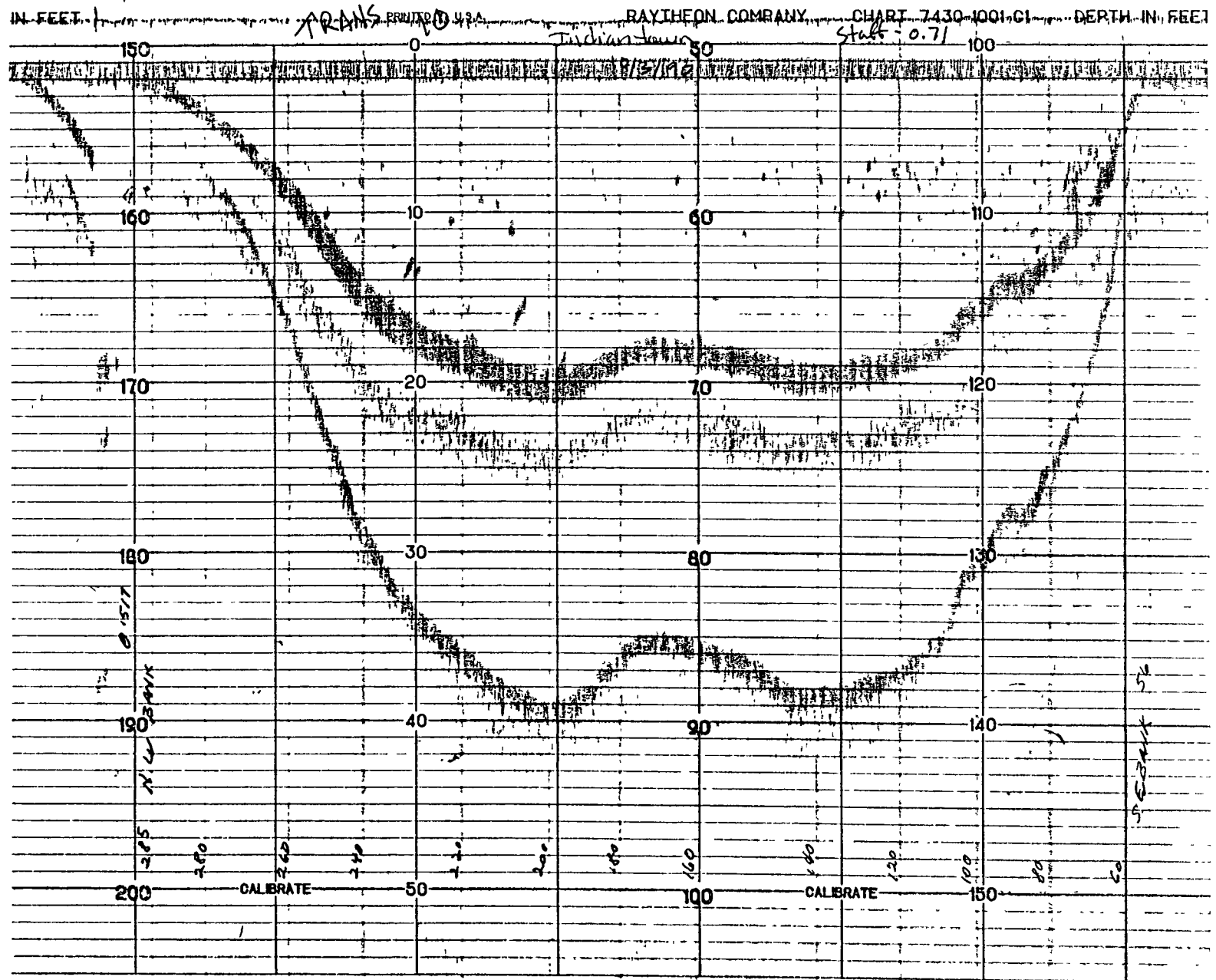
TRANSECT 8



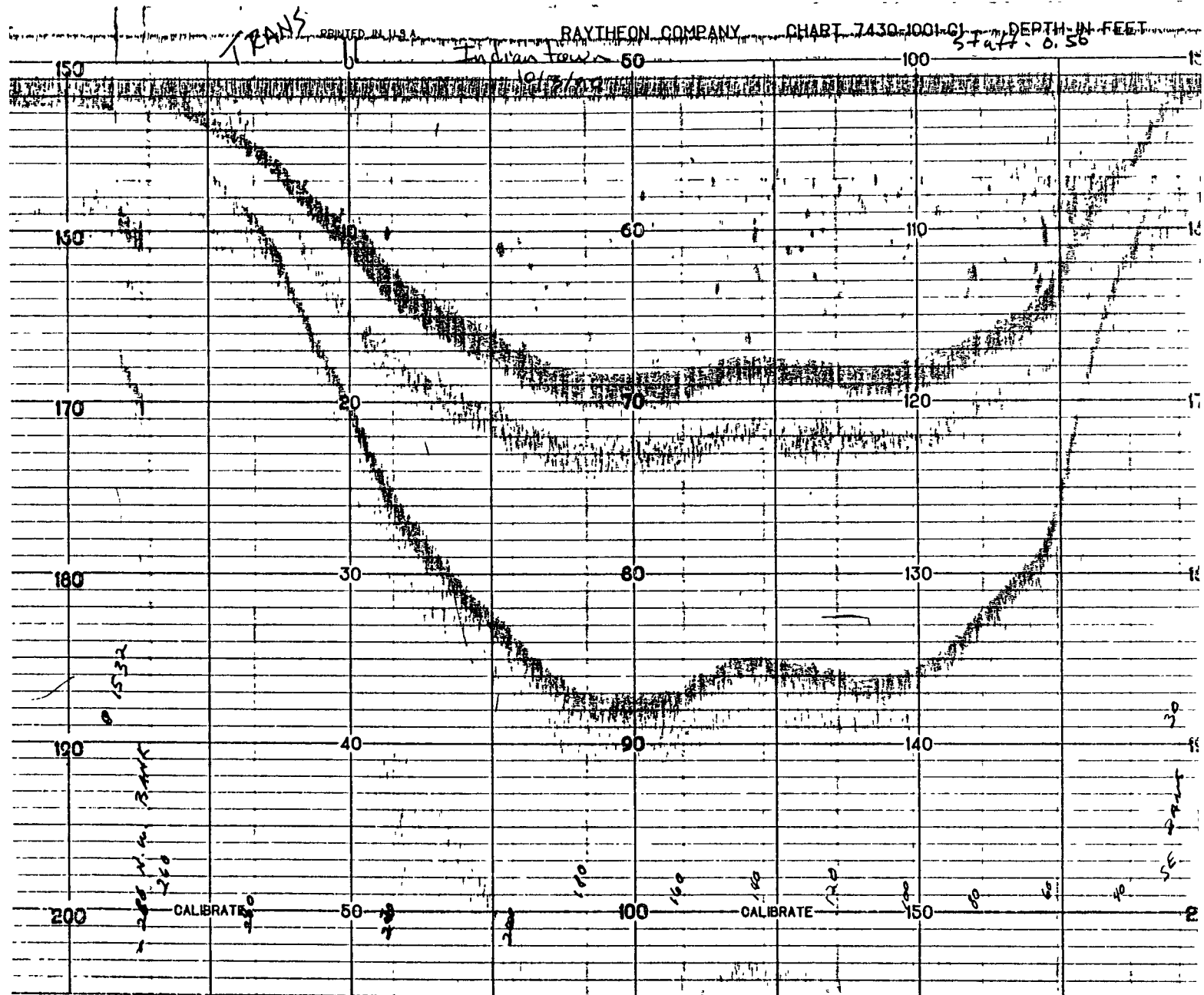
TRANSECT 9



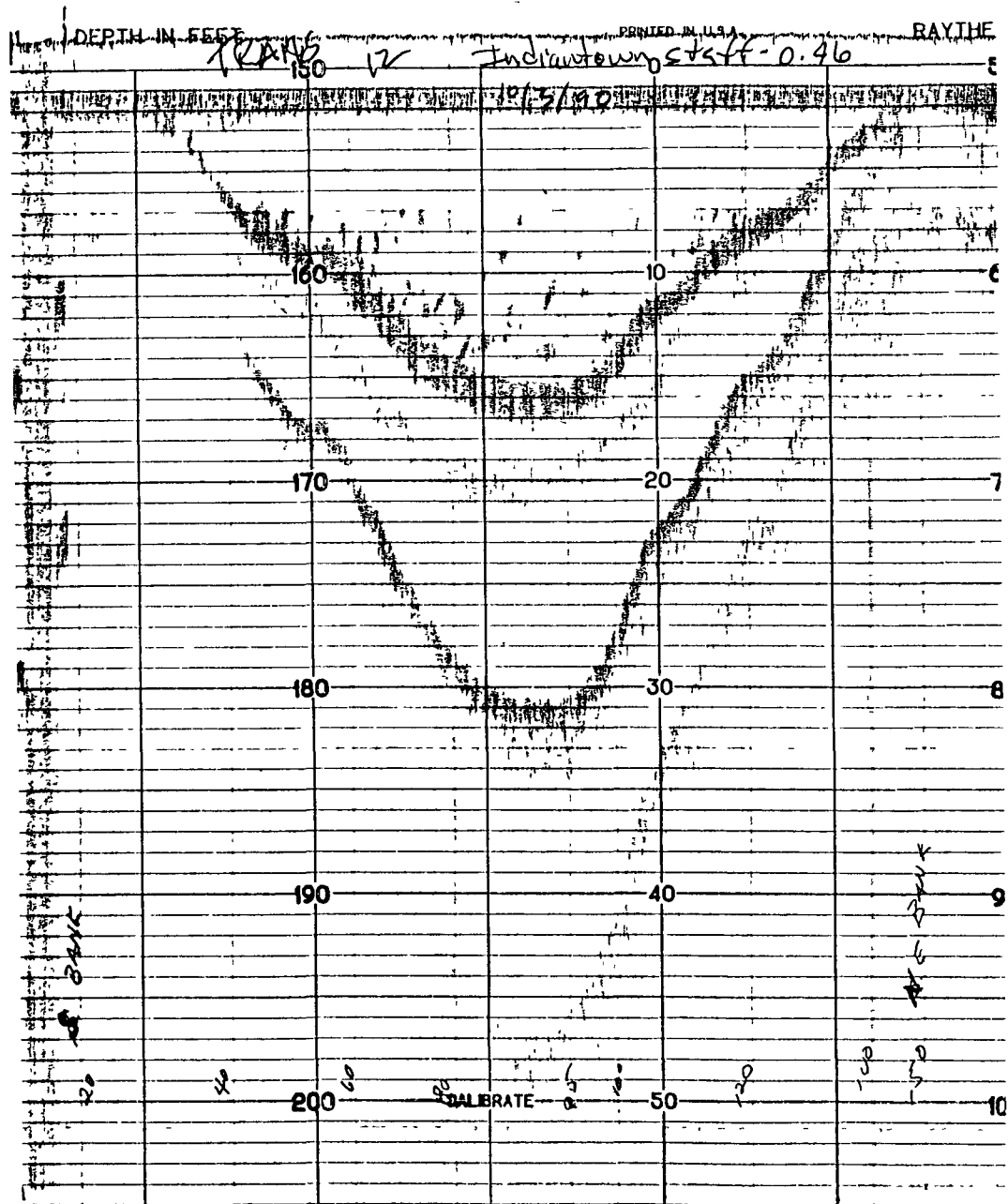
TRANSECT 10



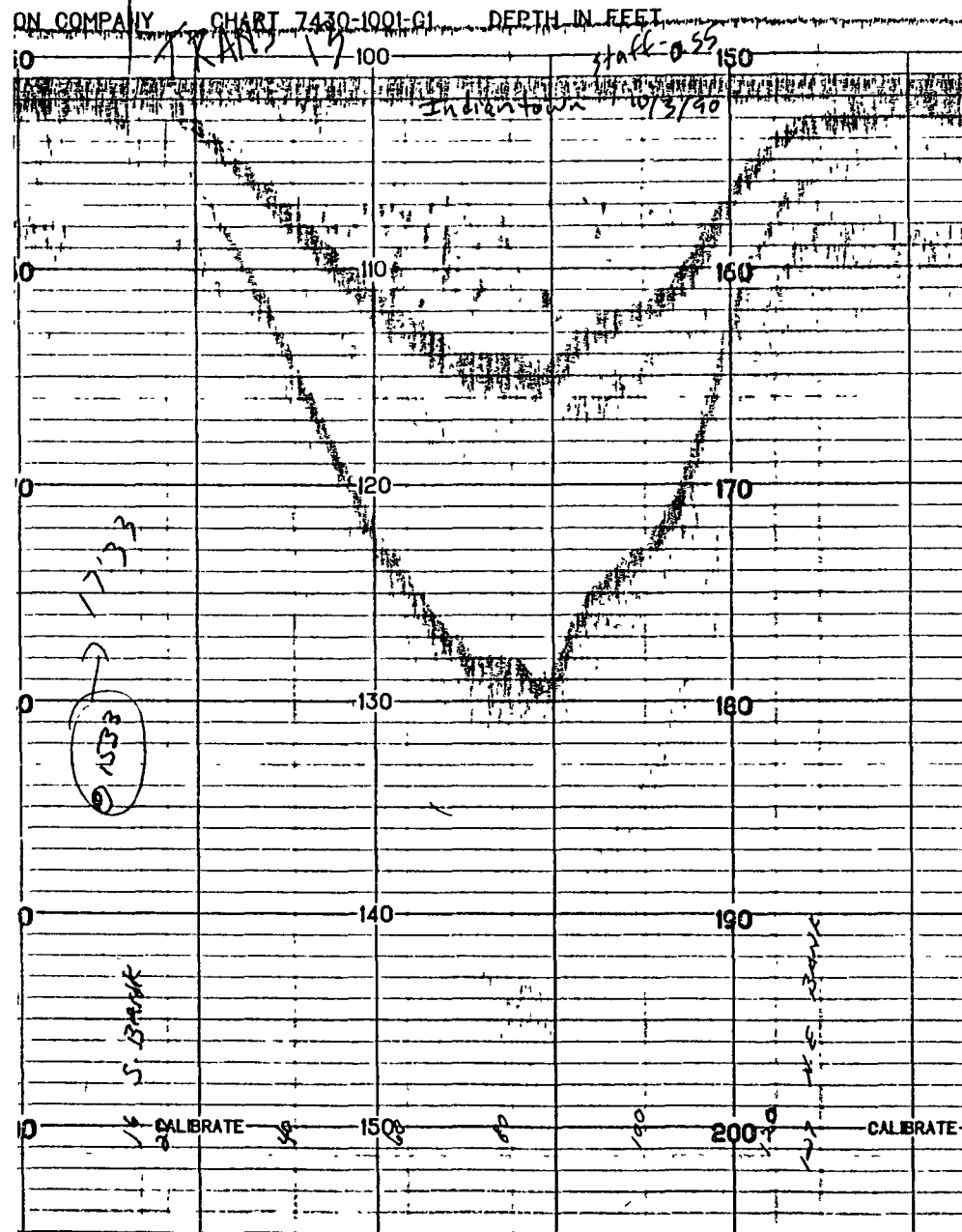
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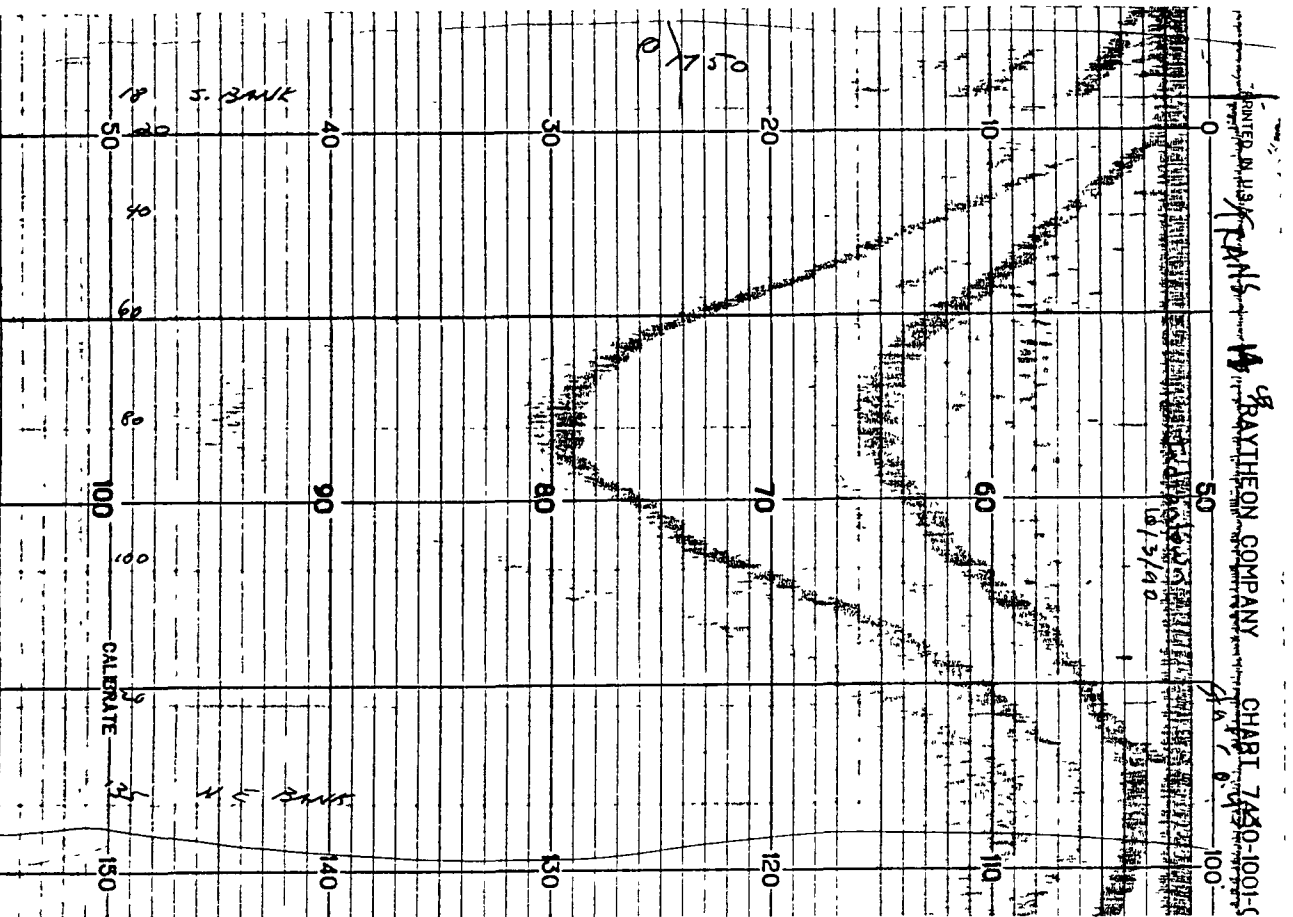
TRANSECT 12



TRANSECT 13



TRANSECT 14



10.5.1.6 Aquatic Biology Studies

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION 1, MAY/JUNE, 1990
(PAGE 1 OF 2)**

Taxa	Replicates			Mean
	A	C	D	
<u>Cordylophora lacustris</u>		461	915	459
<u>Hydra</u> sp.	15	23		13
<u>Dugesia</u> sp.	8	46		18
<u>Hyalinella punctata</u>		8	8	5
<u>Ostracoda</u>	77	185	115	126
<u>Prostoma rubrum</u>	8		15	8
<u>Allonais paraguayensis</u>		15		5
<u>Chaetogaster diaphanus</u>			85	28
<u>Dero nivea</u>		77		26
<u>D. pectinata</u>		138		46
<u>Nais variabilis</u>			23	8
<u>Pristina aequisetia</u>	15	31	85	44
<u>P. leidy</u>	577	1,138	477	731
<u>Placobdella transucens</u>		8		3
<u>Hyalella azteca</u>	469	684	1,453	869
<u>Collembola</u>	8	8		5
<u>Caenis diminuta</u>	308	500	569	459
<u>Enallagma</u> sp.	23		54	26
<u>Homoptera</u>	8			3
<u>Hydroptila</u> sp.	54	15	38	36
<u>Orthotrichia</u> sp.	8	115	138	87
<u>Oecetis</u> sp.	8		8	5
<u>Ablabesmyia rhamphe</u>	8	38	23	23
<u>Labrundinia neopilosella</u>		8	31	13
<u>Cricotopus bicinctus</u> group	92	69	77	79
<u>C. sylvestris</u>	131			44
<u>Nanocladius distinctus</u>	8		15	8
<u>Orthocladius</u> sp.	354	331	215	300
<u>Asheum beckae</u>	8	31	8	15
<u>Dicrotendipes modestus</u>	223	8	62	97
<u>D. nervosus</u>	31	185	31	82
<u>D. neomodestus</u>		8	23	10
<u>D. simpsoni</u>	315	408	492	405
<u>Endochironomus nigricans</u>	23	62	38	41
<u>Glyptotendipes</u> sp.	231	331	400	320
<u>Goeldichironomus</u> sp.	215	254	185	218

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION 1, MAY/JUNE, 1990
(PAGE 2 OF 2)**

Taxa	A	Replicates C	D	Mean
<u>G. carus</u>		85	131	72
<u>Parachironomus</u> sp.	92	115	54	87
<u>Phaenopsectra</u>			8	3
<u>Pseudochironomus</u> nr. <u>pseudoviridis</u>		8		3
<u>Tanytarsus glabrescens</u>	38			13
<u>T. sp. X</u>		23		8
<u>T. sp. XII</u>	8			3
<u>Chironomini</u> sp. A Beck	8	8		5
<u>Ceratopogonidae</u>	8		15	8
<u>Hebetancylus excentricus</u>	554	23	8	195
<u>Laevapex fuscus</u>	269			90
<u>Pyrogophorus platyrachis</u>	146	8		51
<u>Physella hendersoni</u>	138	8		49
<u>Planorbella scalaris</u>	8			3
<u>Gyraulus parvus</u>	38	108	15	54
<u>Viviparus georgianus</u>	54			18
Number of Species	38	37	33	51
Number of Macroinvertebrates	4,583	5,106	4,899	4,863
Diversity (d)	4.20	3.92	3.63	4.21

Source: _____

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION M, MAY/JUNE, 1990
(PAGE 1 OF 2)**

Taxa	Replicates			Mean
	A	C	D	
<u>Dugesia</u> sp.		8		3
<u>Hyalinella punctata</u>	8	8	8	8
<u>Bratislavia bilongata</u>	31		185	72
<u>Dero pectinata</u>	892		1,169	687
<u>Nais variabilis</u>	31			10
<u>Pristina aequisetia</u>			62	21
<u>P. leidy</u>	523	123	1,476	707
<u>Helobdella stagnalis</u>		8		3
<u>Hyalella azteca</u>	308	2,438	492	1,079
<u>Caenis diminuta</u>	154	2,061	308	841
<u>Enallagma</u> sp.		15		5
<u>Orthotrichia</u> sp.		200	185	128
<u>Cyrtellus</u>	92			31
<u>Polycentropus</u>	31			10
<u>Lepidoptera</u>	31			10
<u>Dytiscidae</u>			62	21
<u>Labrundinia neopilosella</u>			62	21
<u>Cricotopus bicinctus</u> group			185	62
<u>Orthocladus</u> sp.	92	185		92
<u>Asheum beckae</u>	338	677	554	523
<u>Dicrotendipes modestus</u>		62		21
<u>D. nervosus</u>	92	185	431	236
<u>D. simpsoni</u>	1,415	1,353	1,661	1,476
<u>Endochironomus nigricans</u>	31	123	123	92
<u>Glyptotendipes</u> sp.	3,691	5,783	2,645	4,040
<u>Goeldichironomus</u> sp.	338	492	185	338
<u>G. carus</u>	123			41
<u>Parachironomus</u> sp.	154	308	308	256
<u>Pseudochironomus</u> nr. <u>pseudoviridis</u>			62	21
<u>Tanytarsus glabrescens</u>	31			10
<u>T. sp. X</u>	31			10
<u>T. sp. XIII</u>	62			21
<u>Chironomini</u> sp. A Beck			62	21
<u>Ceratopogonidae</u>	62	185		82
<u>Hebetancylus excentricus</u>			62	21
<u>Physella hendersoni</u>	31			10

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION M, MAY/JUNE, 1990
(PAGE 2 OF 2)**

Taxa	A	Replicates	D	Mean
		C		
<u>Planorbella scalaris</u>		8		3
<u>Gyraulus parvus</u>			369	123
Number of Species	24	19	22	38
Number of Macroinvertebrates	8,590	14,219	10,651	11,153
Diversity (d)	2.93	2.70	3.48	3.29

Source: _____

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION 2, MAY/JUNE, 1990
(PAGE 1 OF 2)**

Taxa	A	Replicates C	D	Mean
<u>Dugesia</u> sp.		62		21
<u>Hyalinella punctata</u>	8		8	5
<u>Ostracoda</u>	31			10
<u>Dero nivea</u>	46		369	138
<u>D. pectinata</u>	1,123	431	1,107	887
<u>Pristina leidy</u>	338	431	800	523
<u>Batracobdella phalera</u>		8		3
<u>Hyalella azteca</u>	800	492	923	738
<u>Caenis diminuta</u>	1,092	677	308	692
<u>Enallagma</u> sp.	15		62	26
<u>Cyrtellus</u> sp.	15			5
<u>Polycentropus</u> sp.	15	62		26
<u>Orthotrichia</u> sp.	138	308	185	210
<u>Ablabesmyia rhamphe</u>	185	185	246	205
<u>Labrundinia neopilosella</u>	46	185	62	97
<u>Orthocladus</u> sp.			62	21
<u>Asheum beckae</u>	892	1723	677	1,097
<u>Dicrotendipes modestus</u>	123	62	431	205
<u>D. nervosus</u>	800	369	138	436
<u>D. simpsoni</u>	954	861	923	913
<u>Endochironomus nigricans</u>	185	62	246	164
<u>Glyptotendipes</u> sp.	2,245	2830	3,199	2,758
<u>Goeldichironomus</u> sp.	846	1600	923	1,123
<u>G. carus</u>	584	738	185	502
<u>Parachironomus directus</u>			431	144
<u>P. pectinatellae</u>	769	185	123	359
<u>Phaenopsectra</u> sp.	31			10
<u>Pseudochironomus</u> nr. <u>pseudoviridis</u>			185	62
<u>Tanytarsus</u> sp. X	15		185	67
<u>T. sp. XII</u>	15			5
<u>Chironomini</u> sp. A Beck	15	246	185	149

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED ON ARTIFICIAL SUBSTRATES FROM
TAYLOR CREEK STATION 2, MAY/JUNE, 1990
(PAGE 2 OF 2)**

Taxa	A	<u>Replicates</u>		Mean
		C	D	
<u>Ceratopogonidae</u>	77	62	185	108
<u>Physella hendersoni</u>		62		21
Number of Species	27	22	25	33
Number of Macroinvertebrates	11,405	11,635	12,143	11,727
Diversity (d)	3.73	3.56	3.83	3.87

Source: _____

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED IN PONAR GRAB SAMPLES FROM
TAYLOR CREEK STATION 1, MAY 1990
(PAGE 1 OF 2)**

Taxa	Replicates				Mean
	A	B	C	D	
<u>Dero nivea</u>		215	86		75
<u>Pristina leidy</u>		43			11
<u>P. syncytes</u>		86		43	32
<u>Aulodrilus pigueti</u>	86	43	86	43	65
<u>Branchuria sowerbyi</u>	86	129	86	258	140
Immature Tubificid with capilliform	86	990	86	43	301
Immature Tubificid without capilliforms		43	43	43	32
<u>Helobdella elongata</u>		43			11
<u>H. stagnalis</u>		43			11
<u>Placobdella pediculata</u>		43			11
<u>Taphromysis bowmani</u>		43			11
<u>Hyalella azteca</u>	86	344	43		118
<u>Baetis</u> sp.		43	43		22
<u>Caenis diminuta</u>		129			32
<u>Oecetis</u> sp.		129			32
<u>Orthotrichia</u> sp.	43	43		43	32
<u>Ceratopogonidae</u>	43	43	43	43	43
<u>Chaoborus punctipennis</u>	474			215	172
<u>Coelotanypus concinnus</u>		258	86		86
<u>Procladius</u> sp.				129	32
<u>Cricotopus bicinctus</u>	86				22
<u>Chironomus</u> sp.			43		11
<u>Cladotanytarsus</u> sp.		43			11
<u>Cryptochironomus fulvus</u> group	43	43	86		43
<u>Dicrotendipes modestus</u>	43	43			22
<u>Glyptotendipes</u> sp.		215		43	65
<u>Goeldichironomus</u> sp.		86			22
<u>Polypedilum scalaenum</u>		86			22
<u>P. simulans</u>		86			22
<u>Tanytarsus</u> sp. X Rutter		86	86		43
<u>Corbicula fluminea</u>		301			75
<u>Elliptio buckleyi</u>		43			11

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED IN PONAR GRAB SAMPLES FROM
TAYLOR CREEK STATION 1, MAY 1990
(PAGE 2 OF 2)**

Taxa	A	<u>Replicates</u>		D	Mean
		B	C		
<u>Gyraulus parvus</u>	43				11
<u>Viviparus georgianus</u>		431			108
Number of Species	11	29	12	10	34
Number of Macroinvertebrates	1,120	4,177	818	904	1,755
Diversity (d)	2.85	4.09	3.51	2.87	4.42

Source: _____.

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED IN PONAR GRAB SAMPLES FROM
TAYLOR CREEK STATION M, MAY 1990**

Taxa	A	Replicates		D	Mean
		B	C		
<u>Pristina leidy</u>				43	11
<u>Aulodrilus piqueti</u>	129			43	43
<u>Branchuria sowerbyi</u>	43				11
<u>Limnodrilus hoffmeisteri</u>	43				11
Immature tubificid w/o capilliforms	560			215	194
<u>Orthotrichia</u> sp.				43	11
<u>Nanocladius</u> nr. <u>distinctus</u>		43			11
<u>Polypedilum illinoense</u>			43	43	22
<u>Corbicula fluminea</u>		86	86	43	54
<u>Elliptio buckleyi</u>			86	43	32
<u>Viviparus georgianus</u>				129	32
Number of Species	4	2	3	8	11
Number of Macroinvertebrates	775	129	215	603	431
Diversity (d)	1.23	1.58	1.52	2.64	2.67

Source: _____.

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED IN PONAR GRAB SAMPLES FROM
TAYLOR CREEK STATION M, MAY 1990
(PAGE 1 OF 2)**

Taxa	A	Replicates		D	Mean
		B	C		
<u>Nematoda</u>		86			22
<u>Dugesia</u> sp.		86			22
<u>Dero nivea</u>	560	947	86	86	420
<u>D. pectinata</u>		86			22
<u>Pristina synclites</u>	388	301			172
<u>Pristinella jenkiniae</u>	43	172			54
<u>Slavena appendiculata</u>				43	11
<u>Aulodrilus pigueti</u>	517	388	431		334
<u>Limnodrilus hoffmeisteri</u>	646	86		301	258
Immature Tubificid without capilliforms	2,971	2,239	344	1,249	1,701
Immature Tubificid with capilliforms	86				22
<u>Helobdella stagnalis</u>		43			11
<u>Hyaella azteca</u>	258	775	258		323
<u>Caenis diminuta</u>	43				11
<u>Oecetis</u> sp.				86	22
<u>Ceratopogonidae</u>				86	22
<u>Chaoborus punctipennis</u>			775	603	344
<u>Ablabesmyia rhamphe</u>				43	11
<u>Coelotanypus concinnus</u>			43	86	32
<u>Procladius</u> sp.			86	43	32
<u>Tanypus</u> sp.				43	11
<u>Chironomini</u> sp A. Beck				43	11
<u>Cladotanytarsus</u> sp.	43			43	22
<u>Cryptochironomus fulvus</u> group		258		86	86
<u>Dicrotendipes</u> sp.	86	301	43	388	205
<u>D. modestus</u>	43	388		86	129
<u>Endochironomus nigricans</u>				86	22
<u>Polypedilum simulans</u>			43		11
<u>Tanytarsus</u> sp. X Rutter			86		22
<u>Corbicula fluminea</u>	172	646	474	560	463

**MACROINVERTEBRATES (NUMBER PER SQUARE METER)
COLLECTED IN PONAR GRAB SAMPLES FROM
TAYLOR CREEK STATION M, MAY 1990
(PAGE 2 OF 2)**

Taxa	A	Replicates		D	Mean
		B	C		
<u>Anodonta couperiana</u>	86	43			32
<u>Elliptio buckleyi</u>		258			65
<u>Viviparus georgianus</u>	172	129	43	43	97
Number of Species	15	18	13	18	33
Number of Macroinvertebrates	6,115	7,234	2,765	3,962	5,016
Diversity (d)	2.66	3.65	3.00	3.35	3.69

Source: _____

10-6

10.6 PROGRAMMED TRANSPORTATION IMPROVEMENTS

10.6.1 MARTIN COUNTY

**10.6.1.1 Martin County County Road Elements of the Capital Improvements
Element of the Comprehensive Growth Management Plan**

COUNTY ROADS

			Costs (\$000)							
NAME OF PROJECT	Added Capacity	* D-G-C-R	1989- 1990	1990- 1991	1991- 1992	1992- 1993	1993- 1994	1994- 1995	TOTAL	
Projects for Level of Service										
CR A1A Indian to Jefferson 5-Lane Existing 2-Lane	3.63	C	1,590						\$ 1,590	
Green River Parkway County Line to SR 707		C					2,500		2,500	
Monterey Rd. SR 76 to US 1	-	C	2,210						2,210	
Indian St. SR 76 to US 1	-	C	50	50	50	50	50	50	300	
Indian St. U.S. 1 to A1A	-	C	2,050						2,050	
A1A - So. of Monterey**	-	C		150	970				1,120	
A1A - Jefferson to Cove Rd.		C	350	1,785		1,125	2,020		5,280	
Commerce Ave. Extend to Salerno		C	475						475	
Subtotal: LOS Projects	3.63		6,725	1,985	1,020	1,175	4,570	50	15,525	

*D-G-C-R: D = project needed for Deficiency for present population
 G = project needed for Growth for future population
 C = project needed for Combination of deficiency and growth
 R = project is for repair, remodeling, renovation or replacement
 of existing public facility

** Includes improvement to Monterey Road-Palm Beach Road to C.R. A1A-segment.

COUNTY ROADS (continued)

NAME OF PROJECT	Added Capacity	* D-G-C-R	Costs (\$000)						TOTAL
			1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	
Projects Not Related to Level of Service									
Baker Rd. Present end to Savanna Extend Existing Rd.	1.09	C	710						\$ 710
Indian Street Extension (Bridge, r-o-w and design)		G	100	100	100	100	100	100	600
Cove Road S.R. 76 to U.S. 1		R & C	400	170	1,050	895			2,515
Gaines Ave. Bridge		R	125						125
Willoughby Corridor		C	135	150	150	150	150	150	885
Jensen Beach Corridor		C	50	75	75	75	75	75	425
High Meadows Extension CR 714 to I-95 Interchange Build New Road	6.12		2,000						2,000
Evans Crary Bridge		C	100	300	300	300	300	300	1,600
South Co. Connector		D			200				200

*D-G-C-R: D = project needed for Deficiency for present population
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 of existing public facility

COUNTY ROADS (continued)

		*	Costs (\$000)						
NAME OF PROJECT	Added Capacity	D-G-C-R	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	TOTAL
<u>Projects Not Related to Level of Service</u>									
Martin Grade		R	165	315	400	400	400	400	\$ 2,080

Project Related to Level of Service

Mass Transit (Paratransit Support of COA Program)	C	131	138	145	153	161	169	\$		897
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*D-G-C-R: D = project needed for Deficiency for present population
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 of existing public facility

COUNTY ROADS (continued)

		*	-	-	-	-	Costs (\$000)		-	-	-	-	-
NAME OF PROJECT	Added Capacity	D-G-C-R	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995					TOTAL
<u>Projects Not Related to Level of Service</u>													
Fixed Costs		R**	625	500	500	500	500	500	\$				3,125
Signalizations		C	85	85	85	85	85	85					510
Resurfacing		R	850	750	750	750	750	750					4,600
Intersection Improvements		C	375	375	175	375	375	375					2,050
Subtotal:	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Non-LOS Projects	8.91		5,720	2,820	3,785	3,630	2,735	2,735					21,425
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
TOTAL	12.54		12,445	4,805	4,805	4,805	7,305	2,785					36,950

**Annual Fixed Costs of \$500,000 Include the Following:

FEC LEASE/MAINTENANCE	\$ 25,000 YEARLY
RIGHT-OF-WAY MAPPING DIGITIZED	\$ 25,000 YEARLY
STRIPING/PAVEMENT MARKINGS	\$ 75,000 YEARLY
SALARIES/INTERNAL BILL	\$100,000 YEARLY
CONTINGENCIES	\$125,000 YEARLY
RIGHT-OF-WAY ACQUISITION	\$150,000 YEARLY

*D-G-C-R: D = project needed for Deficiency for present population
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STATE ROADS

NAME OF PROJECT	Added Capacity	* D-G-C-R	Costs (\$000)					TOTAL	
			1989-1990	1990-1991	1991-1992	1992-1993	1993-1994		1994-1995
SR A1A - Railroad to Palm Beach Rd.		C					2,300		2,300
SR 76 - Cove to M.C. High School		**		1,200					1,200
SR 714 Palm City Bridge		C		8,600					8,600
Roosevelt Bridge (US 1)		C			40,900				40,900
=====									
TOTAL				9,800	40,900		2,300	0	53,000

**Total Only Reflects Right-of-Way Acquisition and FDOT Administrative Costs in Current TIP.

*D-G-C-R: D = project needed for Deficiency for present population
 G = project needed for Growth for future population
 C = project needed for Combination of deficiency and growth
 R = project is for repair, remodeling, renovation or replacement of existing public facility

10.6.1.2 FDOT Martin County Five-Year Work Program, 1990-1991 (FY 91)
Through 1994-1995 (FY 95)

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

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MARTIN COUNTY STATUS - ADOPTED PLAN PROJECT PHASE PROGRAMMED AMOUNT (\$1000) BY FUND, BY FY

WORK ITEMNO	USNO. SRNO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIA	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
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STATE HIGHWAY CONSTRUCTION COMPONENT

4116124	75	SR-76/KANVER HIGHWAY FM-1.4 MI W OF SCL RR TO 1.3 MI E OF SCL RR	2.747 MI RURAL	ROAD RECONSTRUC- TION - 2 LANE	PE 50 DIH ROW LND 220 RB RELOC 5 RB					CST 2,012 RB CEI 201 RB R/R CST 92 RB	FY94/95
4116129	76	SR-76/KANVER HIGHWAY FM-1-95 TO-MONTEREY ROAD	4.100 MI RURAL	MULTI-LANE RECO- NSTRUCTION	PE 50 DS ROW 44 DIH 440 BND 433 DDR ROW LND 2,152 BND DS RELOC 82 BND						
4116145	707	SR-707 BRIDGE #940 FM-BRIDGE #990940 TO OVER STORM CREEK	.500 MI RURAL	CONST. BRIDGE LOW LEVEL	ROW 4 DS						
4116190	A1A	E OCEAN BLVD/SR-A1A FM-PALM BEACH RD TO-EVANS CRARY BR	.527 MI URBAN	ROAD RECONSTRUC- TION - 2 LANE	ROW 2 DIH 5 DS ROW LND 29 DS						

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WORK ITEMNO	USNO. SRNO.	MARTIN COUNTY PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
STATE HIGHWAY CONSTRUCTION COMPONENT										
4116186	707	SR-707/BRIDGE #941 FM-BRIDGE 890941 OVER TO-WARNER CREEK	.250 MI RURAL	CONST. BRIDGE -- PE LOW LEVEL	50 DIH 8 DIH 50 DS 166 DS 731 BRT 103 BRT					FY90/91
4116208	707	SR-707 FM-SR-5/US-1 TO-BR#890040/STORM CREK	.469 MI URBAN	STATE RESURFACE- /REPAVE	CST 10 DS DPE					FY90/91
4116209	732	SR-732/JENSEN BCH CW FM-BRIDGE #890006 OVER TO-ICMW	.230 MI RURAL	CONST. BRIDGE -- LOW LEVEL	ROW LND DS					
4116228	732	SR-732/BRIDGE#890005 FM-JENSEN BEACH CSEWAY TO-OVER ICMW	.303 MI RURAL	REPLACE MOVABLE- SPAN BRIDGE	PE DIH					
4116229	1 5	SR-5/US-1/BRIDGE FM-ROOSEVELT BRIDGE #9 TO-890003 & 890023	2.218 MI	CONSTRUCT BRIDGE- E - HIGH LEVEL	PE 367 BRT 367 CP ROW 191 DIH 1,403 UMCP ROW LND 1,585 DDR 1,654 UMCP RELOC	ROW LND 50 UMCP UTIL 50 UMCP PST DES 77 BRT 77 CP CEI 2,179 BRT 2,179 CP	21,788 BRT 21,788 UMCP			FY92/93

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WORK ITEMNO	USNO. SRNO.	MARTIN COUNTY PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
STATE HIGHWAY CONSTRUCTION COMPONENT										
4116230	710	SR-710/BEELINE HWY FM-S OF BR. 2 SR-76 TO-PALM BCH CO/LINE	5.483 MI	FEDERAL AID RES- URFACE/REPAVE	CST	35 UMCP				FY90/91
					CEI	5 CP				
						118 CP				
4116243	1 5	SR-5/ROOSEVELT BR. FM-TEST LOAD CONTRACT TO-BR#890003 & 890023.	.230 MI	CONSTRUCT BRIDG- E - HIGH LEVEL	CST		559 BRT			FY91/92
					CEI		78 BRT			
4116244	710	SR-710/WARFIELD BLVD FM-WEST OF 5TH ST TO-N. OF SR-76CONNECTOR	2.205 MI	SAFETY PROJECT	PE	102 DIH	ROW 10 DIH 40 DDR ROW LND 244 DDR	CST 1,484 DDR 1,484 HRE CEI 149 DIH 149 HRE R/R CST 70 DDR		FY93/94
4116248	1 5	SR-5/US-1 FM-PALM BCH COUNTY LINE TO-FEC RR BRIDGE	5.049 MI	FEDERAL AID RES- URFACE/REPAVE	PE	100 DIH		CST 2,748 CP CEI 275 CP R/R CST 49 CP		FY93/94

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WORK ITEMNO	USNO. SRNO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
STATE HIGHWAY CONSTRUCTION COMPONENT										
4116249	98 15	SR15/700 FM-PALM BCH CO/L TO-BRIDGE#890050	3.869 MI	FEDERAL AID RES- URFACE/REPAVE	PE	124 DIH CEI	CST 832 CP 116 CP			FY91/92
4115259	75	SR-76 BRIDGES FM BRIDGE# 890026 TO-BRIDGE#890036	8.123 MI	REPLACE LOW LEV- EL BRIDGE	PE	1 DIH				
4116250	714	SR-714/PALM CITY BR. FM-BRIDGE#890038 TO-E APPROACHES	.598 MI	WIDEN BRIDGE	CST CEI MSC	433 BRP 742 DIH 25 DS				FY90/91
4116251	76	SR-76 FM-1.3MI E OF SR-710 TO-3.1 MI E. OF SR-710	1.700 MI	STATE RESURFACE- /REPAVE	CST	2 DS				FY90/91
4116264	A1A	SR-A1A/EAST OCEAN BV FM-MP 0.570 TO-MP 0.970	.400 MI	MISC. CONSTRUCT- ION	ROW CST CEI	10 DIH 117 DS 23 DIH				FY90/91
4116271	1 5	US-1/FEDERAL HWY FM-S. OF MARINER SANDS TO-N. OF SALERNO RD.		ADD LANES & REC- ONSTRUCT	PE	250 DIH	PE 350 DDR	PE 500 DDR		
4116272	1 5	US-1/FEDERAL HWY FM-N. OF SALERNO TO-N. OF MONTEREY	3.386 MI	ADD LANES & REC- ONSTRUCT	PE	107 DIH	ROW 500 DIH ROW LND 1,400 DDR	CST 2,000 CP 1,000 DDR CEI 300 CP		FY94/95

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WORK ITEMNO	USNO. SRNO.	MARTIN COUNTY PROJECT DESCRIPTION	LENGTH LOCALE	STATUS - ADOPTED PLAN	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
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TATE HIGHWAY CONSTRUCTION COMPONENT

4116277	A1A	SR-A1A/EAST OCEAN BV FM E. OF CONFUSION COR. TO W. OF PALM BCH RD.		ADD LANES & RECONSTRUCT	PE	40 DIH					
4116278	1 5	SR-5/US-1/APPROACHES FM ROOSEVELT BR#3&23 TO ROADWAY CAPPROACHES		CONSTRUCT BRIDGE - HIGH LEVEL	ROW	200 DIH 765 UMCP	ROW LND 2,672 BRT ROW 807 BRT ROW LND 2,028 UTIL DDR 2,159 UMCP	ROW LND 50 CP CST 2,862 BRT 2,862 CP CEI 286 BRT 286 CP			FY92/93
4116280	710	SR 710 FM OCKEECHOBEE C/L TO HALE DAIRY RD.	14.682 MI	FEDERAL AID RESURFACE/REPAVE	PE	100 DIH		CST 4,895 CP CEI 489 CP R/R CST 40 CP			FY92/93
4116281		MARTIN CO/STUART FM SIGNAL SYSTEM TO FEASIBILITY DESIGN		TRAFFIC CONTROL DEVICES	PE	5 DIH 50 DOC					
4116282		MARTIN COUNTY BOX FM TRAFFIC OPS TD		MISC. CONSTRUCTION			CST 100 DS				FY91/92
4116293	710	SR-710 FM END OF BRIDGE TO SR-76 RAMP	.622 MI	FEDERAL AID RESURFACE/REPAVE	PE	40 DIH		CST 328 CP CEI 59 CP			FY92/93

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WORK ITEMNO	USNO. SRNO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
STATE HIGHWAY CONSTRUCTION COMPONENT										
4115294	1 5	SR-5/US-1 FM-BRIDGE#890003/23 TO-ROOSEVELT BRIDGE		BRIDGE REHABILI- TATION	CEI	38 DIH				
4116295		MARTIN COUNTY BOX FM-FOR PE,R/W,CST &CEI TO-		PRELIMINARY ENG- INEERING	PE	58 DIH	PE 455 DIH	PE 375 DIH	PE 106 DIH	PE 574 DIH
				ROW	DIH	ROW 169 DIH	ROW DIH	ROW 1,023 DIH	ROW 285 DIH	
				CEI	11 DIH	CEI DIH	CEI 251 DIH	CEI 262 DIH	CEI 150 DIH	
4116290		MARTIN COUNTY FM-CORRIDOR STUDIES TO-		PRELIMINARY ENG- INEERING		PE 50 DIH	PE 200 DDR			
4116291		SR-AIA/EVANS' CARRY FM-BRIDGE#890058 TO-OVER ST LUCIE RIVER		REPLACE HIGH LE- VEL BRIDGE	PE	100 DIH		PE 800 BRT		
4116292		SR-707 FM-CORRIDOR STUDY TO-S. OF JENSEN BCH CWY		P. D. & E. STUD- Y	PE	100 DIH				
4116293		SR-714/MARTIN HWY FM-I-95 TO-FLA TURNPIKE		ADD LANES & REC- ONSTRUCT				PE 400 DIH		
4116294		SR-5/US-1 FM-SMI S OF CR-708 TO-MARINIER SANDS		ADD LANES & REC- ONSTRUCT			PE 100 DIH 300 DDR			
PRIMARY COMPONENT TOTAL ALL FUNDS					18,089	6,504	63,720	8,999	7,114	

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WORK ITEMNO	USNO. SRNO.	MARTIN COUNTY PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	PROJECT PHASE PROGRAMMED AMOUNT (\$1000) 9Y FUND, BY FY	BEGIN CONST.
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T SUPPORTED-OFF ST HWY SYSTEM COMPONENT

4126114		BRIDGE #894008 FM-LEIGHTON FARMS ROAD TO-IN MARTIN COUNTY	.300 MI RURAL	REPLACE LOW LEV- EL BRIDGE	ROW LND						
						LF					
4126128		INDIAN STREET FM-BRIDGE#894012 TO-IN PORT SALERNO	.190 MI RURAL	CONST. BRIDGE -- LOW LEVEL	CST						
						671 BRTZ					FY90/91
						CEI					
						94 BRTZ					
COMPONENT TOTAL ALL FUNDS						765					

INTERSTATE HWY. CONSTRUCTION COMPONENT

4146406	95 9	I-95/SR-9, MARTIN FM-REST AREA TO-(BUILDING)	URBAN	REST AREA (DUAL - CST		40 IR					FY90/91
4146410	95 9	SR-9/I-95 FM-PALM BEACH CO LINE TO-N. OF CYPRESS CREEK	3.500 MI RURAL	MULTI-LANE NEW - CONSTRUCTION	ROW LND	8 I					
4146411	95 9	SR-9/I-95 FM-N. OF CYPRESS CREEK TO-N OF SR-708	5.100 MI RURAL	MULTI-LANE NEW - CONSTRUCTION	ROW LND	2,406 I					
					ROW	31 DS					
4146413	95 9	SR-9/I-95 FM-S OF SR-76 TO-E OF TURNPIKE	2.500 MI RURAL	MULTI-LANE NEW - CONSTRUCTION	ROW	5 DS					
4146414	95 9	SR-9/I-95 FM-EAST OF TURNPIKE TO-EAST OF CR-76A	2.200 MI RURAL	NEW ROAD CONSTR- UCTION 2 LANE	ROW LND	1 I					
4146415	95 9	SR-9/I-95 FM-EAST OF CR-76A TO-S OF SR-714	4.500 MI RURAL	MULTI-LANE NEW - CONSTRUCTION	ROW LND	15 I					
					ROW	2 DS					

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WORK ITEMNO	USNO. SRNO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
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INTERSTATE HWY. CONSTRUCTION COMPONENT

4146416	95 9	I-95/FULL INTERCHNG FM PALM CITY/MAPP CREEK TO INTERCHANGE	.275 MI	INTERCHANGE (MA- JOR)	ROW	9 IR 412 DS				FY90/91
					ROW LND	526 IR				
					CST	2,519 UMIR				
					CEI	251 UMIR				
					UTIL	106 IR				
4146420		I-95/SR-9 FM SR-76 ECR-708 TO INTERCHANGE LIGHTING		LIGHTING			CST 813 UMIR			FY92/93
							CEI 114 UMIR			
COMPONENT TOTAL ALL FUNDS					6,330		927			

PTQ-TRANSIT DEVELOPMENT COMPONENT

4816374		MARTIN COUNTY COA		OPERATING/ADMIN- ASSISTANCE	MSC	45 DU 45 LF				
4816375		MARTIN COUNTY COA		OPERATING/ADMIN- ASSISTANCE	MSC	45 DU 45 LF				

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MARTIN COUNTY

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PROJECT PHASE PROGRAMMED AMOUNT (\$1000) BY FUND, BY F

WORK ITEMNO	USNO. SRNO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
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PTO-TRANSIT DEVELOPMENT

COMPONENT

4816376	FM- TO-	MARTIN COUNTY COA		OPERATING/ADMIN- • ASSISTANCE				MSC	45 DU 45 LF	
4816377	FM- TO-	MARTIN COUNTY COA		OPERATING/ADMIN- • ASSISTANCE				MSC	45 DU 45 LF	
4816384	FM- TO-	MARTIN COUNTY COA		OPERATING/ADMIN- • ASSISTANCE	MSC	102 DU 102 LF				
4816417	FM- TO-	MARTIN COUNTY COA		TRANSPORTN.DISA- DVANTAGED-PTO	MSC	2 DU 18 DU 2 LF				
4816418	FM- TO-	MARTIN COUNTY COA		TRANSPORTN.DISA- DVANTAGED-PTO	MSC	2 DU 18 DU 2 LF				
4816421	FM- TO-	MARTIN CO SEC 16B2		TRANSPORTN.DISA- DVANTAGED-PTO				MSC	6 DU 23 DU 4 LF	

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MARTIN COUNTY HIGHWAYS & PTO STATUS - ADOPTED PLAN PROJECT PHASE PROGRAMMED AMOUNT (\$1000) BY FUND, BY FY

WORK ITEMNO	USNO. SRVO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
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PTO-TRANSIT DEVELOPMENT COMPONENT

4816423	FM- TO-	MARTIN COUNTY-COA		PURCHASE VEHIC- ES/EQUIPMENT					MSC	2 DS 18 DU 2 LF
4816428	FM- TO-	MARTIN COUNTY		OPERATING/ADMIN- • ASSISTANCE		MSC	5 D 34 DU 4 LF			
4816429	FM- TO-	MARTIN COUNTY-COA		TRANSPORTN.DISA- DVANTAGED-PTO			MSC	2 DS 18 DU 2 LF		
4816430	FM- TO-	MARTIN COUNTY-COA		TRANSPORTN.DISA- DVANTAGED-PTO			MSC	2 DS 18 DU 2 LF		
COMPONENT TOTAL ALL FUNDS					225	155	112	112	150	

PTO-AVIATION DEVELOPMENT COMPONENT

4825109	FM-BLAST PAD CONST. TO-RW 11 & RW 29	WITHAM FIELD-STUART		PORT OF ENTRY F- ACILITY CONST.					MSC	6 D 99 FAA 6 LF
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PROJECT PHASE PROGRAMMED AMOUNT (\$1000) BY FUND, BY FY

WORK ITEMNO	USNO. SRVO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
PTO-AVIATION DEVELOPMENT COMPONENT										
4825110	FM- TO-	WITHAM FIELD-STUART		V.O.R. INSTALLA- TION					MSC 100 D 100 LF	
4826111	FM- TO-	WITHAM FIELD-STUART		CONSTRUCT APRON		MSC	5 D 95 FAA S LF			
4826113	FM- TO-	WITHAM FIELD-STUART		RUNWAY LIGHTING		MSC	10 D 180 FAA 10 LF			
4826114	FM- TO-	WITHAM FIELD-STUART		CONSTRUCT SECUR- ITY FENCE		MSC	9 D 162 FAA 9 LF			
4826120	FM- TO-	WITHAM FIELD APT FM-MASTER PLAN		AIRPORT MASTER - PLAN		MSC	4 D 68 FAA 4 LF			
4826121	FM-EA/DRI TO-	WITHAM FIELD APT		AIRPORT MASTER - PLAN					MSC 6 D 108 FAA 6 LF	

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MARTIN COUNTY		STATUS - ADOPTED PLAN		PROJECT PHASE PROGRAMMED AMOUNT (\$1000) BY FUND, BY FY						
WORK ITEMNO	USNO. SRNO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
PTD-AVIATION DEVELOPMENT COMPONENT										
4826123	FM- TO-	INDIANTOWN AIRPORT		AIRPORT LAND AC- QUISITION				MSC	2,625 D 875 LF	
4826124	FM- TO-	INDIANTOWN AIRPORT		AIRPORT LAND AC- QUISITION		38 D 13 LF		MSC		
4826125	FM- TO-	WITHAM FIELD-STUART		SEAL RUNWAY		38 D 38 LF		MSC		
COMPONENT TOTAL ALL FUNDS					201	285	200	3,500	430	
TRANSPORTATION DISADVANTAGED COMPONENT										
4895300	FM-T. D. COMMISSION TO-PLANNING GRANT	MARTIN COUNTY		TRANSPORTN.DISA- DVANTAGED-PTO	MSC	MSC	MSC	MSC	MSC	
					9 LF 26 TDTE	5 LF 15 TDTE	5 LF 15 TDTE	5 LF 16 TDTE	5 LF 16 TDTE	
4895354	FM-T. D. COMMISSION TO-OPERATIONS GRANT	MARTIN COUNTY		TRANSPORTN.DISA- DVANTAGED-PTO	MSC	MSC	MSC	MSC	MSC	
					17 LF 50 TDTE	20 LF 61 TDTE	21 LF 63 TDTE	23 LF 69 TDTE	25 LF 76 TDTE	
COMPONENT TOTAL ALL FUNDS					102	101	104	113	122	

09/24/90

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
FIVE YEAR WORK PROGRAM 1990-91 (FY91) THRU 1994-95 (FY95)

PAGE 99
WPA0300

MARTIN COUNTY STATUS - ADOPTED PLAN PROJECT PHASE PROGRAMMED AMOUNT (\$1000) BY FUND, BY FY

WORK ITEMNO	USNO. SRNO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
----------------	----------------	------------------------	------------------	----------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------

COUNTY TOTALS

PE	2,061	ALL	PE	506	ALL	PE	1,325	ALL	PE	1,306	ALL	PE	1,074	ALL
ROW	4,013	ALL	ROW	1,025	ALL	ROW	500	ALL	ROW	1,023	ALL	ROW	285	ALL
ROW LND	12,949	ALL	ROW LND	2,966	ALL	ROW LND	1,450	ALL						
UTIL	106	ALL	UTIL	100	ALL									
RELOC	122	ALL												
CST	4,528	ALL	CST	1,491	ALL	CST	55,335	ALL	CST	5,716	ALL	CST	5,012	ALL
			R/R CST	220	ALL	R/R CST	40	ALL	R/R CST	119	ALL	R/R CST	92	ALL
						PST DES	154	ALL						
CEI	1,380	ALL	CEI	195	ALL	CEI	5,843	ALL	CEI	835	ALL	CEI	651	ALL
MSC	553	ALL	MSC	542	ALL	MSC	416	ALL	MSC	3,725	ALL	MSC	702	ALL
ALL	25,712	ALL	ALL	7,045	ALL	ALL	65,063	ALL	ALL	12,724	ALL	ALL	7,816	ALL

10.6.1.3 Florida Turnpike Authority (Martin County)

09/20/90

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
 FIVE YEAR WORK PROGRAM 1990-91 (FY91) THRU 1994-95 (FY95)
 TURNPIKE PLAN
 STATUS - ADOPTED PLAN
 FUND ALLOC TYPE - FUNDED

PAGE 29
 WPA0300

MARTIN COUNTY

PROJECT PHASE PROGRAMMED AMOUNT (\$1000) BY FUND, BY FY

WORK ITEMNO	USNO. SRNO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
PARKWAY CONSTRUCTION COMPONENT										
4156424	91	REPLACE BRIDGES FM- 890063 & 80 TO-890064 & 81	.414 MI	REPLACE MEDIUM - LEVEL BRIDGE	PE 153 PKYI	CST 2,185 P89A CEI 224 P89A 219 PKCA				FY91/92
4156425	91	WIDEN BRIDGES-MARTIN FM-890069,85,71 & 83 TO-MP 91.743 & 94.170		WIDEN BRIDGE	CST 7 P89A					FY90/91
4156428	91	RESURFACE&MEDIAN BAR FM-PALM BEACH C/L TO-M.P.127; NB&SB	9.860 MI	STATE RESURFACE- /REPAVE	PE PKYI CST 3,847 PKYR CEI 751 PKYR					FY90/91
4156429	91	RESURFACE&MEDIAN BAR FM-M.P. 127 N.B & S.B TO-ST. LUCIE C/L	10.427 MI	STATE PAVE SHOUL- LDERS & RESURF.	PE PKYI CST 4,056 PKYR PST DES 10 PKYI CEI 822 PKYR					FY90/91
COMPONENT TOTAL ALL FUNDS					9,645	2,628				

Poor Original

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
FIVE YEAR WORK PROGRAM 1990-91 (FY91) THRU 1994-95 (FY95)09/20/90
WPA0300

MARTIN

COUNTY

TURNPIKE PLAN
STATUS - ADOPTED PLAN
FUND ALLOC TYPE - FUNDED

PROJECT PHASE PROGRAMMED AMOUNT (\$1000) BY FUND, BY FY

WORK ITEMNO	USNO. SRNO.	PROJECT DESCRIPTION	LENGTH LOCALE	WORK MIX	FISCAL 90/91	FISCAL 91/92	FISCAL 92/93	FISCAL 93/94	FISCAL 94/95	BEGIN CONST.
----------------	----------------	------------------------	------------------	----------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------

COUNTY TOTALS

				PE	153 ALL					
				CST	7,910 ALL	CST	2,185 ALL			
				PST DES	10 ALL					
				CEI	1,573 ALL	CEI	442 ALL			
				ALL	9,645 ALL	ALL	2,628 ALL			

Poor Original

10.7

10.7

**10.7 SOUTH FLORIDA WATER MANAGEMENT DISTRICT LAND USE AND
LAND COVER CLASSIFICATION CODE**

S.F.W.M.D. LAND USE AND LAND COVER CLASSIFICATION CODE

(U) Urban and built-up land

Urban or Built-up land consists of areas of intensive use, with much of the land covered by structures. Included in this category are cities, towns, villages, strip developments along highways, and such areas as those occupied by mills, shopping centers, industrial and commercial complexes, and institutions that may, in some instances, be isolated from urban areas.

As development progresses, small blocks of land of less intensive or nonconforming use may be isolated in the midst of built-up areas and will generally be included in this category. Agricultural, forest, or water areas on the fringe of urban and built-up areas will not be included except where they are part of low-density urban development.

The Urban or Built-up category takes precedence over others when the criteria for more than one category are met. For example, residential areas that have sufficient tree cover to meet Forested Upland criteria will still be classified as Residential in the Urban or Built-Up category.

(UR) Residential

(URSL)	Single-family, Low Density (under 2 D.U./gross acre)
(URSM)	Single-family, Medium Density (2 to 5 D.U./gross acre)
(URSH)	Single-family, High Density (over 5 D.U./gross acre)
(URMF)	Multi-family building
(URMH)	Mobile homes

(UC) Commercial and Services

(UCPL)	Parking lot
(UCSC)	Shopping center
(UCSS)	Sales and services
(UCCE)	Cultural and Entertainment
(UCMC)	Marine commercial (Marinas)
(UCHM)	Hotel-Motel

S.F.W.M.D. LAND USE AND LAND COVER CLASSIFICATION CODE

(UI) Industrial

(UIJK)	Junkyard
(UILT)	Other light industrial
(UIHV)	Other heavy industrial

(US) Institutional

(USED)	Educational
(USMD)	Medical
(USRL)	Religious
(USMF)	Military
(USCF)	Correctional
(USGF)	Governmental (other than military or correctional)
(USSS)	Social services (Elks, Moose, Eagles)

(UT) Transportation

(UTAP)	Airports
(UTAG)	Small grass airports
(UTRR)	Railroad yards and terminals
(UTPF)	Port facilities
(UTEP)	Electrical power facilities
(UTTLL)	Major transmission lines
(UTHW)	Major highway and rights-of-way
(UTWS)	Water supply plants
(UTSP)	Sewerage treatment plants
(UTSW)	Solid waste disposal
(UTRS)	Antenna arrays
(UTOG)	Oil and gas storage

(UO) Open and others

(UORC)	Recreational facilities
(UOGC)	Golf courses
(UOPK)	Parks
(UOCM)	Cemeteries
(UORV)	Recreational vehicle parks
(UOUD)	Open under development
(UOUN)	Open and undeveloped within urban area

S.F.W.M.D. LAND USE AND LAND COVER CLASSIFICATION CODE

(A) Agriculture

Agricultural land may be defined as those lands which are cultivated to produce crops and livestock. The sub-categories of Agriculture are: Cropland, Pastureland, Orchards, Groves (except citrus), Vineyards, Nurseries, Ornamental Horticulture Areas, Citrus Groves, Confined Feeding Operations, Specialty Farms and Other Agriculture.

(AC) Cropland

(ACSC)	Sugar cane
(ACTC)	Truck crops
(ACRF)	Rice fields

(AP) Pasture

(APIM)	Improved pasture
(APUN)	Unimproved pasture

(AM) Groves, Ornamentals, Nurseries, Tropical fruits

(AMCT)	Citrus
(AMTF)	Tropical fruits
(AMSF)	Sod farms
(AMOR)	Ornamentals

(AF) Confined feeding operations

(AFFL)	Cattle feed lots
(AFDF)	Dairy farms
(AFFF)	Fish farms
(AFHT)	Horse training and stables
(AFPY)	Poultry

S.F.W.M.D. LAND USE AND LAND COVER CLASSIFICATION CODE

(R) Rangeland

Historically, Rangeland has been defined as land where the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs, and is capable of being grazed. Management practices may include brush control, regulation of grazing intensity, and season of use. If revegetated to improve the forage cover, it is managed like native vegetation. Generally this land is not fertilized, cultivated, or irrigated.

The definition of Rangeland used in the CONSERVATION NEEDS INVENTORY by the U.S. Departments of Agriculture and Interior is used in this classification scheme and describes the natural potential (climax) plant cover as being composed of principally native grasses, forbs and shrubs valuable for forage. This category includes Grassland, Shrub and Brushland, and Mixed Rangeland.

(RG) Grassland

(RS) Scrub and brushland

(RSPP) Palmetto prairies
(RSSB) Brushland

(F) Forested uplands

Forestland includes uplands, basically the drier areas, which have a tree crown density (crown closure of 10 percent or more), and are dominated by trees and other woody vegetation.

Lands from which trees have been removed to less than 10 percent crown closure, but which have not been developed for other use, are also included in this category. For example, lands on which there are rotation cycles, involving clear-cutting and block planting, are part of the forested uplands category.

Since most naturally seeded forestlands are composed of a mixture of species, for purposes of classification a minimum of 66 2/3 percent stand dominance (by crown area measurement) of one species or species groups is necessary for inclusion into separate categories. Less than 66 2/3 percent stand dominance of one species or species groups is considered to be a mixed category. It should be noted that classification is based on overstory species composition, as interpreted from aerial photography. Forested uplands are classified as follows:

S.F.W.M.D. LAND USE AND LAND COVER CLASSIFICATION CODE

(FE) Coniferous

(FEPP)	Pine flatwoods
(FESP)	Sand pine scrub
(FECF)	Commercial forest (pine)

(FO) Non-coniferous

(FOAP)	Australian pine
(FOBP)	Brazilian pepper
(FOPA)	Palms
(FOSO)	Scrub oak
(FOOK)	Oak
(FOCF)	Commercial forest

(FM) Mixed forested

(FMTW)	Temperate hardwoods
(FMCM)	Cabbage palms/Melaleuca
(FMCO)	Cabbage palms/Oaks
(FMPP)	Pine/Melaleuca
(FMPO)	Pine/Oak
(FMTH)	Tropical hammocks
(FMOF)	Old fields forested
(FMCD)	Coastal dunes
(FMPC)	Pine/Cabbage palms

(W) Wetlands

Wetlands are those areas where the water table is at, near, or above the land surface for a significant part of most years. The hydrologic regime is such that aquatic or hydrophytic vegetation usually is established, although alluvial and tidal flats may be nonvegetated. Wetlands are frequently associated with topographic lows. Examples of wetlands include marshes, mudflats, emergent vegetation areas, and swamps. Shallow water areas with submerged aquatic vegetation are classed as Water and are not included in the Wetlands category.

Extensive parts of some river floodplains qualify as Wetlands. These do not include agricultural land where seasonal wetness or short-term flooding may provide an important component of the total annual soil moisture necessary for crop production. But, uncultivated wetlands yielding products such as wood, or grazed by livestock, are retained in the Wetlands category.

S.F.W.M.D. LAND USE AND LAND COVER CLASSIFICATION CODE

Wetlands areas drained for any purpose belong to other land use categories, whether they be Agriculture, Rangeland, or Forested. When the drainage is discontinued and such use ceases, classification reverts to Wetlands after characteristic vegetation is reestablished. Wetlands managed for wildlife purposes may show short-term changes in vegetation type and wetness condition as different management practices are used, but are properly classified Wetlands.

(WF) Forested fresh

(WFCM)	Cypress/Melaleuca
(WFCY)	Cypress
(FWWL)	Willow
(WFME)	Melaleuca
(WFSB)	Scrub and brushland
(WFMX)	Mixed forested

(WN) Non-forested fresh

(WNSG)	Sawgrass
(WNCT)	Cattail
(WNBK)	Bullrush
(WNWC)	Wire cordgrass
(WNAG)	Mixed aquatic grass
(WNWL)	Sloughs

(WS) Forested salt

(WSRM)	Red mangrove
(WSBW)	Black and White mangrove

(WM) Non-forested salt

(WX) Mixed forested and non-forested fresh

(WXPP)	Pine and wet prairies
(WXCP)	Cypress domes and wet prairies
(WXHM)	Hardwood marsh

S.F.W.M.D. LAND USE AND LAND COVER CLASSIFICATION CODE

(H) Water

The delineation of water areas depends on the scale and resolution characteristics of the remote-sensor photography used for interpretation. One definition of water bodies, provided by the Bureau of Census, includes all areas within the land mass of the United States that are predominantly or persistently water covered, provided that, if linear, they are at least 1/8 mile (660 feet or 200 meters) wide, and if extended, cover at least 40 acres (16 hectares).

Defining water boundaries at Level III, minimum size has been established to less than 10 acres. In some instances, water bodies of one acre will be plotted and identified. Water bodies or those portions of the water body have emergent vegetation are placed in the Wetland category.

(B) Barren land

Barren land has very little or no vegetation and limited ability to support life. In general, it is an area with only soil, sand or rocks. Vegetation, if present is very widely spaced and scrubby. However, land also may be temporarily barren due to man's activities. Generally, this land is included in other land use categories. Vast areas of agricultural land are temporarily without vegetative cover due to tillage practices, and areas of extractive and industrial land use have dumps for wastes and tailings. Barren Land categories are beaches (areas exhibiting little or no evidence of human encroachment), Extractive operations, Spoil ares, and Levees.

(BB) Beaches

(BP) Extractive

(strip mines, quarries, and
gravel pits)

(BS) Spoil areas

(BL) Levees

* Documentation of major codes from "LAND USE, COVER AND FORMS CLASSIFICATION SYSTEM, A TECHNICAL MANUAL", Department of Transportation, State Topographic Office Remote Sensing Center, Kuyper, Becker and Shopmyer, February 1981

10.8

**10.8 CULTURAL RESOURCE ASSESSMENT SURVEY OF THE PROPOSED
MARTIN COUNTY POWER PLANT SITE AND PIPELINE RIGHT-OF-WAY**

**CULTURAL RESOURCE ASSESSMENT SURVEY OF THE
PROPOSED INDIANTOWN COGENERATION LIMITED PLANT SITE AND
PIPELINE CORRIDOR,
MARTIN COUNTY, FLORIDA**

Prepared for
Environmental Consulting and Technology, Inc
Gainesville, Florida

by
Kenneth W. Hardin and Charles Fuhrmeister

PIPER ARCHAEOLOGICAL RESEARCH, INC.
St. Petersburg, Florida

September 1990

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INTRODUCTION

This archaeological and historical survey of the proposed Indiantown Cogeneration Limited (ICL) plant site and pipeline corridor was conducted in order to satisfy state and federal cultural resource requirements. The purpose of the survey was to locate any archaeological and/or historic sites within the project area and to collect information necessary to assess their potential eligibility for the National Register of Historic Places.

For the purposes of this cultural resource assessment, the survey area consists of one parcel totaling approximately 232 acres in Martin County, Florida (Figures 1 and 2). The project area is located in portions of Sections 34 and 35, Township 39 South, Range 38 East. The proposed pipeline route begins in Section 35 of Township 39 South, Range 38 East and runs west-northwest, parallel to the CSX railroad, to Section 32 of Township 38 South, Range 36 East, in Okeechobee County. Agricultural lands are located to the north and south of the survey parcel. The nearest town is Indiantown located approximately three miles to the southeast of the project site.

The documentary search consisted of a review of the State of Florida Master Site File (FMSF), an examination of the historical and archaeological literature, and historic records. The FMSF search revealed no previously recorded archaeological sites on or in the vicinity of the project area. Four other prehistoric archaeological sites are located on FP&L property within five miles of the project area. These sites consist of two small sand mounds

(8Mt28 and 29), a large mound with linear earthworks (8Mt19), and a small artifact scatter (8Mt31). All of the mounds are located along the Barley Barber Swamp approximately five miles northwest of the project site.

Prior to entering the field, areas of high archaeological site potential were identified using U.S.G.S. 7.5' quadrangle maps and 1"=400' aerial photographs flown in August 1988. The archaeological field survey included all of these areas plus areas identified in the field as having a potential to contain archaeological sites. The survey strategy called for an intensive, systematic cultural resource survey of these areas, and limited systematic and judgmental survey of the remaining areas.

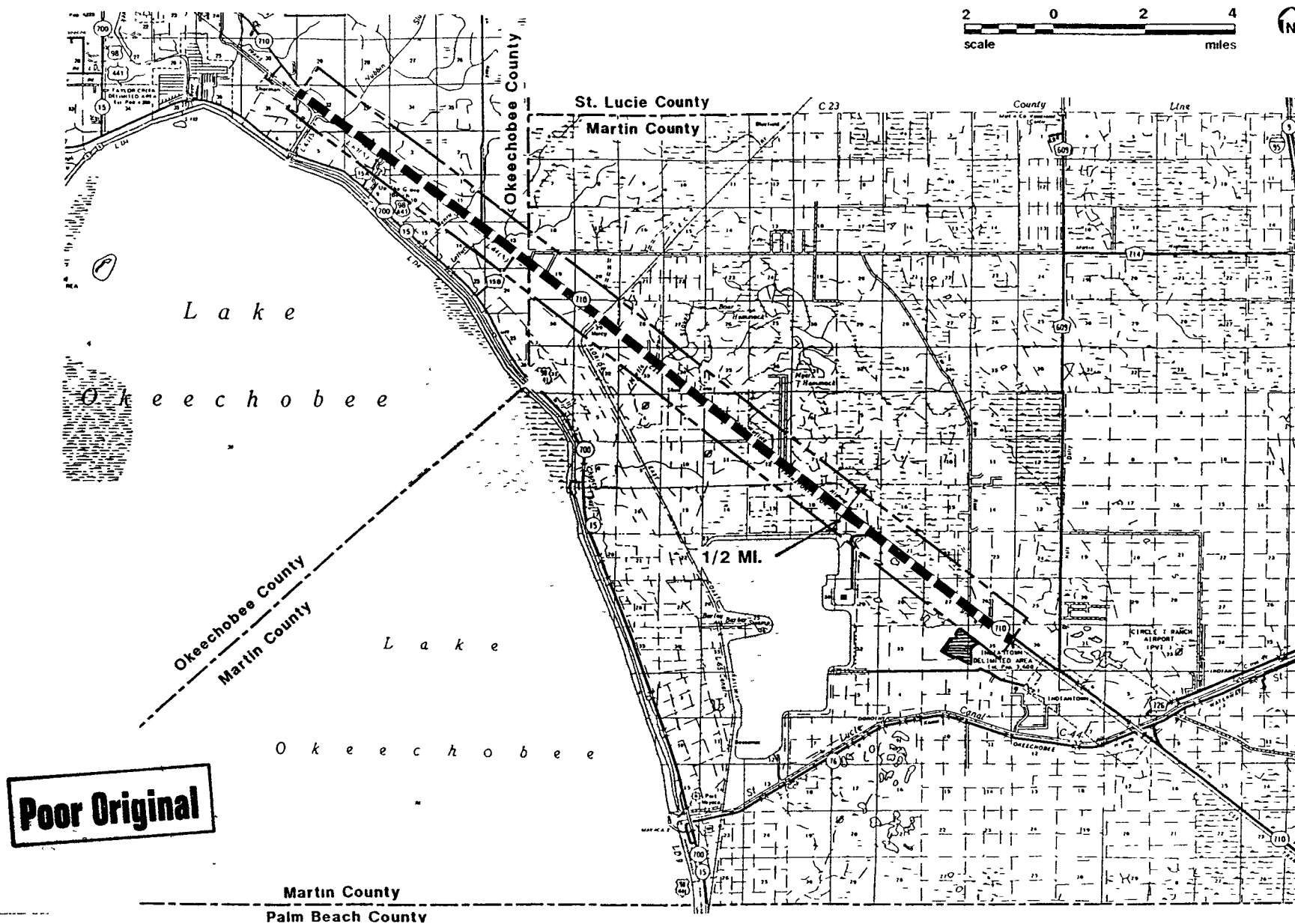


Figure 1 - General Site Location Map
indicating proposed ICL Plant Site (Hatched)
and Pipeline Corridor (Bold Dashed Line)
Source: FDOT 1976

BACKGROUND RESEARCH

The following section provides a brief overview of the area's physical environment, as well as a discussion of the region's prehistoric and historic development, to provide a context for the evaluation of sites located during the survey.

Environmental Setting

Regional Environment

It has been assumed that environmental and ecological factors through time had a direct influence on the choice of sites for occupation by prehistoric populations and early historic settlers. Thus, geologic, hydrologic, and soil formation processes that may have affected the survey area and its biotic resources are important elements in the formulation of a settlement/subsistence model for prehistoric and early historic peoples. Present day environmental variables can be used to reconstruct past conditions that may have influenced early human occupation of the ICL project area, and so are included in this study.

The ICL project area is located within the Atlantic Coastal Lowlands physiographic province characterized by low, poorly drained flatland which represent the shallow, flat bottoms of ancient seas. The project area is located within the Eastern Valley, a physiographic feature within this province. Associated features include the Everglades to the south, the Atlantic Ocean to the east, Lake Okeechobee to the west, and the Okeechobee and

Osceola Plains to the northwest and north. The latter extends a toe southeastward into the Eastern Valley terminating at Indian-town. White (1970:139) feels that this narrow terrace represents a long spit or off-cape shoal formed during the Pleistocene when sea levels were much higher. The project area lies just to the southwest of this ridge.

The surface lithology of Martin County is composed of undifferentiated deposits of sand and clay of Pleistocene and Recent age, which are underlain by thick deposits of limestone and dolomite. Outcrops of silicified limestone, or chert, which were often exploited by prehistoric peoples as raw material sources for the manufacture of stone tools, do not occur near the project area (cf. Lane et al. 1980). The closest known outcrops lie to the west along the Peace River in the central part of the state (Scott 1978; Upchurch et al. 1982).

Water resources consist of both ground and surface water. The principal ground water aquifer is the Floridan which occurs under artesian conditions with slowly permeable clays and sands forming a confining layer that effectively prevents the vertical movement of water from the surficial aquifer to the Floridan aquifer (Lane 1980). Surface sand deposits contain the surficial aquifer, which is recharged through local rainfall. Because of low hydraulic gradients, movement of water within this zone is very slow. Water is discharged from the aquifer through lateral seepage to stream or lake, evapotranspiration, or movement downward to the Floridan aquifer where sinkhole development has breached the underlying

confining layer of clay (Lane 1980; Lane et al. 1980).

Most of the county is drained by intermittent streams, sloughs, and creeks. The major water control system is an extensive network of canals that is used for both drainage and irrigation purposes. The dominant surface water feature is Lake Okeechobee in the western part of the county. Lake Okeechobee measures over 700 square miles in areal extent, but is very shallow with a maximum depth of about 10 feet.

Physical Environment of the Project area

The ICL site and pipeline corridor are located on low, poorly drained flatland characterized by some seasonal ponds, sloughs and intermittent creeks. The present natural land topography is fairly level and slopes toward the southwest.

The principal soil association for the project area is the Waveland-Lawnwood-Basinger series which is characterized as nearly level, poorly drained soils located in broad flatwoods with depressions. A second soil association is also found in the project area. It is the Floridana-Jupiter-Hilolo series and is characterized as nearly level, poorly drained soils located in broad sloughs interspersed with flatwoods and depressions (McCollum and Cruz 1981).

The drainage characteristics of soils have been used successfully by archaeologists throughout Florida in the formulation of predictive models for prehistoric site location (e.g. Almy 1978; Grange 1978; Deming 1980; Austin and Piper 1986; Estabrook 1989a, 1989b). Most of the soils within the survey area are poorly

drained on nearly level slopes. Major soil types include the following:

Lawnwood fine sand, 0 - 2% slopes, poorly drained
Waveland sand, 0 - 2% slopes, poorly drained
Basinger fine sand, depressional, poorly drained
Basinger fine sand, < 2% slopes, poorly drained
Sanibel muck, very poorly drained

Vegetation consists primarily of pine and saw palmetto which occur in large sections of the project area on slightly better drained soils, as well as over much of the seasonally wet areas. Herbaceous, shallow washes occupy the remaining area.

The vegetation of the ICL project area was probably stable during prehistoric times after the last major environmental change about 3000 to 5000 years ago (Watts 1971:687; Long 1974:30). Many of these plants could have been utilized as a food or shelter resource by prehistoric inhabitants. The freshwater fish and shellfish populations in nearby waters would also have provided an abundant source of food as well as the many large and small mammals which inhabited this area. Prior to 3000 B.C., however, surficial water would have been all but non-existent (cf. Clausen et al. 1979) and sea level would have been much lower thereby limiting the area's attractiveness to both animal and human populations.

Cultural Prehistory

Aboriginal peoples have inhabited Florida for at least 14,000 years. The earliest cultural stages are pan-Florida in extent while later cultures exhibited differing cultural traits in the various archaeological areas of the state. The project area is

located in the Okeechobee Basin culture area (Figure 2) as defined by Milanich and Fairbanks (1980:22). This area is bounded by the Western Flatland (Davis 1943:43-48), the Allapattah Flats and the Big Cypress Swamp (DeLorme 1987). There is some evidence to suggest that the Lake Kissimmee and the Kissimmee River drainage should be included in this area. Cultural affinities represented in burial mounds, earthworks, and ceramics are found as far north as Lake Tohopekaliga (Milanich and Fairbanks 1980:26). Similarly, both areas are characterized by relatively poor, sandy soils (composed of quartzitic sands developed over calcareous marine deposits), relatively low elevations with little relief, and numerous ponds and sloughs which support a vegetation cover consisting primarily of pine and palmetto flatland, wet prairies and occasional hammocks of live oak usually mixed with cabbage palm.

Paleo-Indian Stage

The earliest stage of prehistoric cultural development, the Paleo-Indian, has not as yet been identified in the Okeechobee Basin. Evidence for Paleo Indian occupation along the Kissimmee River is also scant, consisting of rare surface finds of lanceolate-shaped projectile points (e.g. Austin 1987). The greatest density of known Paleo-Indian sites in Florida is associated with the rivers in the north central part of the state, although rising sea levels have probably inundated early coastal sites making their discovery difficult (Rouse 1951:21-30; Scholl et al. 1969; Ruppe 1980).

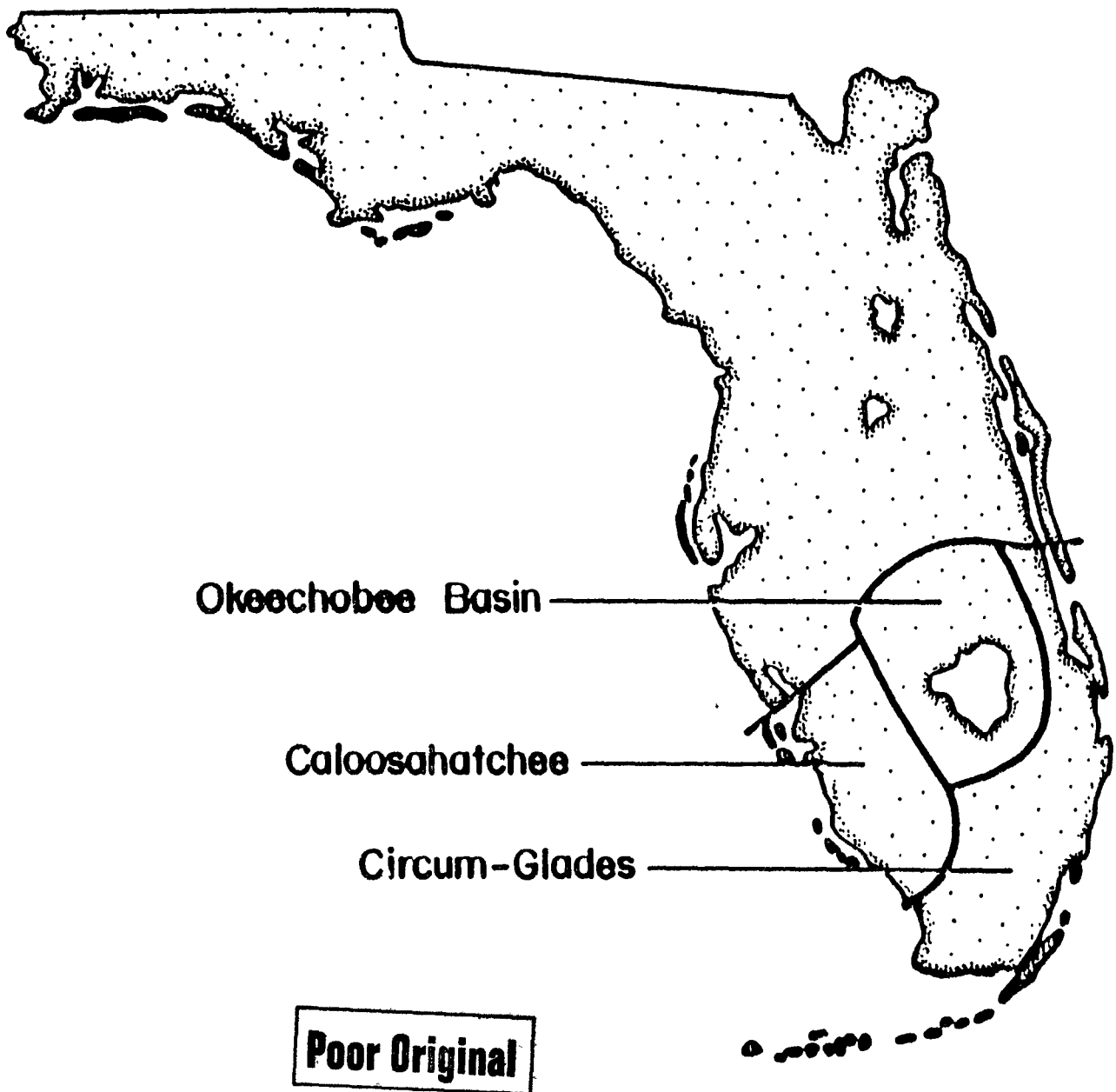


Figure 2:

Map of the Okeechobee Basin, Caloosahatchee,
and Circum-Glades archaeological regions
(after Milanich and Fairbanks 1980:22)

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ARCHAEOLOGY

St. Petersburg, FL

The prevailing view of Paleo-Indian existence, based on the uniformity of the known tool kit and the small size of most sites, is that of a nomadic lifestyle with subsistence activities based on hunting and gathering of the now extinct Pleistocene megafauna (Milanich and Fairbanks 1980:35-42). Recent excavations in Hillsborough County, however, have contributed to the development of increasingly sophisticated models of early hunter-gatherer settlement (e.g. Daniel 1985; Chance 1983) which take into account the adaptive responses of human populations to both short and long term environmental change. These models suggest that some Paleo-Indian groups may have practiced a more sedentary lifestyle than had previously been believed (Daniel and Wisenbaker 1987).

Two controversial early man sites are located on the coastal strand outside of the project area, 8-Ir-9 in Vero Beach and 8-Br-44 in Melbourne. At both sites human remains were reported in association with the bones of extinct Pleistocene animals (Gidley and Loomis 1926; Sellards 1940), but the association was disputed by Hrdlicka (1907, 1918) and later by Rouse (1950, 1951:223) who felt the human remains were intrusive into the Pleistocene stratum. More recent examination of the human crania (Stewart in Milanich and Fairbanks 1980:5) and comparisons with those from the Warm Mineral Springs site in Sarasota County seem to support a Paleo-Indian period date for the Vero and Melbourne finds (Cockrell and Murphy 1978:7-8), although a final determination cannot as yet be made.

Clausen et al. (1978:10-11) have suggested the possibility of

inundated "early man" sites near St. Lucie Inlet based on the presence of mineralized skeletal remains, including Pleistocene fauna and a human crania, recovered from dredged material during the salvage of several Spanish shipwrecks. Their interpretations remain speculative, albeit thought-provoking, due to a lack of contextual association of the fauna and crania.

Archaic Stage

The Archaic stage of cultural development was characterized by a shift in adaptive strategies stimulated by the onset of the Holocene and the establishment of increasingly modern climate and biota. It is generally believed to have begun in Florida around 6500 B.C. (Milanich and Fairbanks 1980:48). This stage is further characterized by an efficient, seasonal exploitation of a wider range of food resources including deer and other small game, hardwood nuts, and mollusks, and a larger but less carefully worked tool kit. Archaic Indian groups are thought to have utilized a more restricted territory than their Paleo-Indian predecessors, with some groups leading at least a semi-sedentary existence. Archaic site types include base camps, hunting camps, butchering sites, quarries, and cemeteries.

One of the more well known Archaic period sites on the East Coast of Florida is Windover Farms near Melbourne. This site, which has been radio-carbon dated to about 5000-6000 B.C., consists of a wetland cemetery where Archaic peoples interred their dead in a shallow pond. In addition to human skeletal remains, a wide variety of normally perishable items including wood and bone

artifacts, cordage, basketry and woven fiber cloth were found preserved under anaerobic conditions (Doran and Dickel 1988).

Another important early Archaic site is the Cutler site in Dade County (Carr 1986). This site contains human remains, early side-notched projectile points, and faunal remains including some extinct Pleistocene species. A radio-carbon dated of ca. 7800 B.C. was obtained from a hearth feature there making this one of the earliest sites found thus far in south Florida.

Mount Taylor Phase: By 4000 B.C. Archaic hunter/gatherers were spending much of the year in villages along the St. Johns River and its tributaries. This phase of Archaic development, known as the Mount Taylor phase after the type site in Volusia County (Goggin 1952a), is characterized by the dietary importance of freshwater snails (Cumbaa 1976), and the use of stemmed projectile points with triangular blades, as well as bone points and tools. Excavations at the Tick Island site, also in Volusia County, revealed a mass burial in a midden perhaps associated with a charnel house, an early instance of such a burial pattern (Jahn and Bullen 1978).

No Archaic period sites have been recorded in the Okeechobee Basin area, however, Archaic sites are known for the Kissimmee River valley (Austin 1987) and it is possible that Archaic groups may have made brief, intermittent forays into the area during periods of greater rainfall and available surface water. For the most part, however, it is assumed that the Okeechobee Basin was only rarely visited by Archaic groups.

Orange Phase: The introduction of a crude fiber-tempered pottery into the artifact assemblage of the Archaic aboriginal marks the beginning of the Orange phase around 2000 B.C. The basic hunting-foraging subsistence pattern of the Archaic stage continued, with a shift to marine shellfish occurring as the snail beds were gradually depleted. By Orange III times, ca. 1450-1250 B.C., occupation of the Atlantic Coastal strand had increased significantly and this shift in prehistoric settlement and subsistence strategies is documented at sites such as 8-Ir-41, the Summer Haven site and the Cotten site (Rouse 1951; Bullen 1972; Smith 1973:27).

The tool assemblage of the Orange phase resembles that of the Mount Taylor phase with the addition of pottery and evidence of basketry and matting as seen in the impressions on clay pot bottoms (Milanich and Fairbanks 1980:155). The earliest occupations come from sites exhibiting semi-fiber-tempered (i.e. sand and fiber) ceramics. The Fisheating Creek site (Goggin 1952b:58) and the Fort Center site (Griffin 1952; Sears and Sears 1976; Sears 1982) have yielded these artifacts in limited numbers. According to Sears (1977:7; 1982:192-193) this initial occupation is coeval with the construction of the earliest of the Okeechobee Basin's spectacular earthworks - i.e. the circular ditches.

Formative Stage

During the late Orange phase, also known as the Florida Transitional Period (1200-500 B.C.), changes in pottery and

technology occurred in Florida which mark the beginning of the Formative Stage. Fiber-tempered wares were replaced by sand-tempered, limestone-tempered, and chalky temperless ceramics and three different projectile point styles, basally-notched, corner-notched, and stemmed, also occur in relatively contemporaneous contexts. This profusion of ceramic and tool traditions is suggestive of population movement and social interaction between culture areas. The earliest major occupations of South Florida known at the present time date to this period (Sears 1982; Bullen et al. 1968).

Belle Glade Phase: Following the Transitional Period is the Belle Glade Period, ca. 500 B.C. - A.D. 1700 (Milanich and Fairbanks 1980:23). During this period, activities in the Okeechobee Basin increase dramatically suggesting the greatest complexity in South Florida centered around this inland territory (Milanich and Fairbanks 1980:181). Several researchers have attempted to build a chronology for this area but the lack of comprehensive surveys coupled with very limited excavations leaves this area of Florida one of the most poorly known regions of the state.

To date, the most comprehensive chronology for the Belle Glade culture area has been developed by Sears (1971, 1974, 1977, 1982). His is a four period chronology beginning with his Period I and ending with his Period IV. These periods are roughly coeval with the Transitional Period as defined by Bullen (1959, 1970), and the

Belle Glade I and II Periods as defined by Willey (1949).

Sears' (1982:26,185) Period I from ca. 800 - 1000 B.C. to A.D. 200 most closely fits the Transitional Period definition. At the early end of Period I, Sears (1982:192-193) notes small populations of perhaps one or two families living along the riverbank on small house mounds with fish and turtle being particularly important to the diet. Only semi-fiber tempered pottery was in use during this time but by the end of this period most of the pottery was the sand-tempered plain ware. Distinguishing this period from the Transitional Period is the presence of the circular ditches. Sears (1982:193-194) believes they functioned as drained fields for maize cultivation.

Sears' (1982:26-31,186-189) Period II from A.D. 200 to about A.D. 600-800 most closely resembles the definition of the Belle Glade I Period except that there are no Glades decorated wares at Fort Center. According to Willey (1949:125), evidence for the Belle Glade I Period consists of Belle Glade Plain and Glades Plain ceramics with small percentages of Glades decorated wares (see also Widmer 1988:87-88). There are no defining dates associated with the Belle Glade I Period but, by inference, Widmer (1988:87) provides a terminal date at A.D. 900 - 1000.

The Belle Glade II Period is defined by the presence of Belle Glade Plain and Glades Plain ceramics coupled with a lack of Glades decorated wares and the appearance of Biscayne (St. Johns) Check Stamped (Willey 1949:125). Sears' (1982:27,31, 189-190) Periods III and IV most closely resemble this period. Period III lasts

from A.D. 600/800 to A.D. 1200/1400 and is characterized as a period of time which experienced minimal cultural change (Sears 1982:199). Period IV, on the other hand, is described as a time of excelled craftsmanship, revived focus for authority, and participation in a larger social system than the one existing on the site. The introduction of linear embankments accompanies this period as well as the first appearance of European objects. Sears (1982:200) believes that during this period Fort Center was operating as a part of the sixteenth and seventeenth-century Calusa empire.

Acculturative Stage

Little is known about the terminus of Belle Glade culture. Few ethnohistoric accounts exist and only one is widely publicized. Fontaneda's (1945) account of the seventeenth century South Florida native groups refers to a people who lived around a large lake known as the Mayaimi. His narrative provides scanty information on population density, subsistence, environment, and political affiliations with the coastal Calusa. Archaeologically, many Belle Glade sites contain European artifacts and European-derived raw materials such as silver, iron, and gold. Thus, there exists ample evidence to indicate Belle Glade participation in a larger economy than existed solely in the Okeechobee Basin.

The demise of the Belle Glade peoples was surely linked to their participation in this larger economy. The introduction of European diseases is well documented throughout the Southeastern U.S. and is considered a major cause in the death of the South Florida native groups. It is thought by many researchers that by

the time the Seminoles arrived into this part of Florida, all of the South Florida aboriginal were extinct.

By the early 18th century, groups of Creek Indians who came to be known as Seminoles moved into Florida to escape the political and population pressures of the expanding American frontier. It is suspected that the village site occupied by the Seminole chief, Osceola, and his followers in 1836 was recently located in Citrus County near the east side of Tsala Apopka Lake. Seminole artifacts were recovered from South Indian Fields (8-Br-23) in Brevard County (Rouse 1951:94) and two villages are reported to have been in the general vicinity of West Palm Beach, but their exact locations are not known (Fairbanks 1978:185). The remains of Seminole men, women, and children were excavated from part of the original cemetery (ca. 1824-1846) of Fort Brooke, a Second Seminole War fort underlying present-day downtown Tampa (Piper and Piper 1982).

Historical Review

The intent of this historical documentary review was to identify the possible locations of any historic sites within the project area and to determine the potential historical significance of any such sites. To that end, books, maps, and manuscripts located at the University of South Florida Special Collections Department; Florida Department of Natural Resources, Division of State Lands; Martin County Historical Society, the Elliott Museum; the Martin County Public Library; and Piper Archaeological Research, Inc. were examined and interviews with local informants were conducted.

In terms of permanent homesteads, Martin County was not settled until relatively late in the 19th century. In the course of early expeditions to Florida, some Spanish explorers came to the area in the 16th century but they did not establish permanent settlements. Ponce de Leon visited an area called Rio de la Cruz, now thought to be Jupiter Inlet, during his first voyage in 1513. Over the next several decades Spain sought to establish a foothold in Florida, but failed attempt followed failed attempt and in 1561, after expeditions produced neither a permanent settlement nor material gain, Spain closed the area to further exploration (Smith and Gottlob 1978:7).

Spanish policy promptly reversed when news reached Spain in 1562 of French attempts at colonization in Florida. Pedro Menendez de Aviles was dispatched to challenge French encroachment and build a permanent settlement. Menendez met with more success than his

compatriots and by 1565 St. Augustine was founded. A settlement at St. Augustine provided Spain the opportunity it needed to extend its sphere of influence to other parts of Florida and a policy of christianizing the Indians and building missions amongst the various tribes was instituted.

Menendez petitioned the Jesuits for more missionaries and put into action his "religious plan for Florida" (Lewis 1978:25). In 1565-1566, prior to the arrival of more friars, Menendez sailed along the Florida peninsula and up the Atlantic Coast placing crosses at various locations and leaving Spaniards "of marked religious zeal" to introduce Christianity to the native population (Gannon 1965:29). Three permanent settlements were established at St. Augustine, San Mateo (Ft. Caroline) and Santa Elena, and were served by priests. Outposts/forts were located in Ais, Tequesta, Calusa and Tocobaga territory (Gannon 1965:29).

The Jesuit missions in Florida met with failure and in 1572 the order's religious authorities recalled their priests (Gannon 1965:34). Undaunted, Menendez turned his attention to another order, the Franciscans, and entreated them to accomplish the religious conversion of the Indians of Florida. The Franciscans' first twenty years in Florida were not altogether successful as they encountered much the same problems as the Jesuits. But by the turn of the century significant gains were made and the period from 1606 to 1675 reflected "the Golden Age of the Florida Missions" (Gannon 1965).

The mission effort was more successful in the northern areas

of Florida than in the south. One researcher (Milanich 1978:68) has suggested that the failure of the Spanish missions among south Florida Indians was due partially to tribal subsistence patterns which required seasonal movement for maximum resource exploitation. In north-central Florida a long tradition of horticulture existed at least one thousand years before the historic period and with the introduction of better techniques and tools by the priests, mission villages in those areas were occupied year round (Milanich 1978:68). Consequently, south Florida was virtually ignored as the Spanish concentrated their efforts on the northern chain of missions.

Two settlements along the southeastern coast, at Ays and Santa Lucia, were established by Menendez during the first wave of missions/outposts. Ays is thought to have been located in the Ft. Pierce-Vero Beach area and Santa Lucia at Jupiter Inlet (Hutchinson 1987:14-15). Local lore originally placed Santa Lucia at a spot on the St. Lucie River, possibly because of the similarity in names, but Hutchinson (1987:15) asserts after reviewing historic documents that the more southern location is correct given the stability and good harbor associated with Jupiter Inlet. Like others in south Florida these two mission settlements were short-lived. Accounts from Spaniards at the Santa Lucia post attest to the difficult conditions in the winter of 1566 when "the garrison was reduced to chewing shoes, leather belts, snakes, rats and dwarf palmetto to stay alive" (Gannon 1965:44).

In 1696 Jonathan Dickinson, his family, and several others

were shipwrecked and came ashore in the vicinity of Jupiter Inlet where they encountered the Jeaga and Ais Indians. From Dickinson's account, the Indians appeared to be functioning without traces of colonization or Christianity and were not fluent in Spanish. The Jeaga and Ais seemed to be independent yet "allies of the Spanish," and Dickinson's group pretended to be Spanish in order to receive better treatment (Andrews and Andrews 1975; Rouse 1951:56-57).

With the subsequent heavy utilization of the Bahama Channel as a homeward route for Spanish treasure obtained in the Americas, shipwrecks along the Ais controlled coast were common. It is reported that the Indians not only actively salvaged these wrecks, but killed the survivors as well (Higgs 1942:29). The Spanish Plate Fleet of 1715 was destroyed in a hurricane near present-day Sebastian Inlet, however, the survivors of these wrecks apparently fared better at the hands of the Indians than did most of the others. Archaeological evidence from the Higgs Site (Smith 1949) and the McLarty Site (Burgess and Clausen 1976) suggests cooperation between the Indians and the survivors.

By the middle of the 18th century the indigenous population in the Indian River area had declined considerably as continued contact with the Spanish made the Jeaga and Ais prone to drinking and riddled with disease (Rouse 1951:59). Attacks by the English and their northern Indian allies further reduced their numbers.

During the Second Spanish Period in Florida (1783-1821) large land grants were awarded to Spanish loyalists. James Hutchinson became the first landowner in the St. Lucie-Martin County area

when, in 1803, he petitioned for and received a grant of 2000 acres on the mainland west of the Indian River. Two Spanish land grants are located to the east of the project area. In 1813 John Hanson, Samuel Miles, John Hedrick and Bernardo Sequi were awarded approximately 18,000 acres in Township 38 South, Ranges 41 and 42 East (Florida Department of Natural Resources 1851a; Hutchinson 1987:25). To the south in Township 38 South, Range 42 East Euschiuz Gomez received a grant of ca. 12,000 acres in 1815 (Florida Department of Natural Resources 1851b; Hutchinson 1987:25).

Hutchinson (1987:25) states that Hanson and Gomez established plantations and raised crops which included sugarcane, coconuts and some citrus on their land grants, but there does not appear to be conclusive evidence as to whether or not the men themselves lived on their properties. By and large, the grants in the southern portion of Florida were unoccupied by their owners (e.g. the Fleming Grant, Sebastian, Florida [Hardin et al. 1983]) as the majority of Florida's nonaboriginal population was centered in the northern portion of the peninsula. If, however, farming or cattle ranching was conducted it was probably managed by overseers with an occasional visit from the owner. Even after the United States acquired Florida from Spain in 1821 the pattern of settlement remained much the same for a number of years and it was not until the Second Seminole War (1835-1842) that any appreciable number of white men began to travel to southern Florida.

The Seminole Indians, originally part of the Creek nation,

moved into Florida during the early 18th century but, once Florida became a U.S. Territory in 1821, pressure was brought to bear upon the government to remove them from the choice agricultural lands of north Florida. The Treaty of Moultrie Creek (1824) restricted the Seminoles to approximately 4 million acres of land in the middle of the state, running south from Micanopy to just north of the Peace River (Mahon 1967:Rear fold-out map). This treaty was unpopular with the Seminoles and they were reluctant to move from their established homes to an area which they felt could not be cultivated. Equally unpopular were the later treaties of Paynes Landing (1832) and Fort Gibson (1833) which called for Seminole emigration to the western territories (Mahon 1967:75-76, 82-83). The above treaties all served to foster Seminole resentment and outbreaks of hostility which finally culminated in the Second Seminole War in 1835.

The Lake Okeechobee area was not well explored until this time. Hutchinson (1987:19-20) indicates that as late as 1837, when John Lee Williams authored Territory of Florida, no mention of the lake is made nor does his map show any indication of its existence. Indeed, it was not until the United States Army moved into the interior in pursuit of the Seminoles that accurate maps and descriptions of the area became available.

At that time, the Lake Okeechobee Basin became the scene of Second Seminole War battles, but none occurred in the immediate vicinity of the survey area. The Battle of Okeechobee took place in December 1837 north of the lake and the Battle of Lockahatchee,

which occurred in January 1838, was fought near present day Jupiter Inlet (Mahon 1967:227-231, 234). A Military Map of Lake Okeechobee dating to 1838 (shown in Carr 1975:12) shows one military fort, Ft. McRae, in the vicinity of the project area. Early survey plat maps of the vicinity indicate that this camp was probably located in Sections 20 and 29 of Township 38 South, Range 38 East (Florida DNR 1853a). Indeed, the entire military trail connecting Camps Sebring and Andrew, called "Back Road" on the 1838 map, is shown east of the project area on these maps.

By the end of the Second Seminole War, the majority of Florida's Seminole Indians were relocated in the western territories. A few recalcitrants, under the leadership of Billy Bowlegs, sought refuge in the recesses of the Everglades and the U.S. Government, after considering the efficacy of prolonging the war to effect their removal, allowed them to stay. The peace was temporary, however, for in 1850 the U.S. Congress began to debate turning over to Florida the federally owned Everglades swamp (Tebeau 1957:43). Once again the Seminoles found themselves in competition with whites over land and in 1855 the Third Seminole War (often referred to as Billy Bowlegs War) broke out.

Ft. Capron was established 1850 during the Third Seminole War at the present location of the town of St. Lucie, directly across from Indian River Inlet. The fort was named after Captain Erastus Capron of the 1st Artillery and was in operation until 1859. A military trail known as the Capron Trail extended from Ft. Capron to Ft. Brooke (Tampa, Florida) and was for many years the only

connecting road between the east and west coasts of Florida (Van Landingham n.d.:9).

Following the Seminole Wars, the southern portion of Florida remained relatively unsettled with only a few Seminole Indians, homesteaders and fishermen as residents. The Armed Occupation Act was passed in 1842 as a means of encouraging homesteading in the uninhabited regions of Florida. Three hundred and seventy permits were issued for homesteaders to settle in the St. Johns Valley from Palatka to Sanford and along the east coast from New Smyrna to Biscayne Bay.

During the Civil War there was little military activity South Florida other than blockade runners using the Indian River as a haven from Federal ships. The war, however, hindered development and interrupted new agricultural endeavors creating an economic malaise that would exist for a number of years.

In the 1880's interest in the resources of southern Florida intensified, due in large part to men like Hamilton Disston and Henry Flagler. Disston contracted with the State of Florida in 1881 to drain swamp land in return for one-half of the acreage he could reclaim. When it appeared that this contract would be opposed by the court, Governor Bloxham persuaded Disston to purchase the land. Although it met with controversy, Disston's purchase of 4 million acres at 25 cents an acre did provide the funds necessary to clear the titles to state lands and managed to pave the way for the large drainage operation that changed both the topography and economy of the central and southern portions of

Florida (Tebeau 1971:278).

The most influential developer in south Florida, especially on the east coast, was Henry Morrison Flagler. Flagler, a partner of John D. Rockefeller in the Standard Oil Company, was already a wealthy man when he first visited Florida in 1878. After his first wife died in 1881 he remarried and returned to the Jacksonville-St. Augustine area in 1883. During this visit, Flagler apparently began to set in motion plans for his new Florida railroad and hotel enterprises (Tebeau 1971:284). His interest first centered in the St. Augustine area and later spread to more southerly portions of Florida. In 1894 Flagler's Florida East Coast Railroad arrived at Ft. Pierce and with the advent of rail transportation, the area began to grow rapidly. Flagler wisely saw the need for a good transportation system along Florida's east coast if his planned hotels were to survive. He provided modern, public transportation to the coastal towns and a spur to the Lake Okeechobee area which helped the east coast area to prosper (McIver 1976:21). He was able to acquire vast land holdings from the state through the Internal Improvement Fund grants which were created to encourage railroad construction.

Prior to railroad construction, early settlers in the Martin County area depended on trade boats which ran along the Indian River to provide them with supplies. By the 1880's a prosperous trade network was underway and more families moved to the area every year. Pineapple and citrus cultivation became leading industries. The advent of the railroad was just the impetus the

burgeoning economy needed to thrive.

It was during the period of 1878-1882 that the first settlers began to arrive in what is today the eastern part of Martin County. However, it was not until the turn of the century that settlers began inhabiting the western part of the county. The first road was laid out between Indiantown and Stuart in 1902-1903 by Francis Marion Platt. He married Annie Mizell on October 22, 1868 at Pine Level in present day Manatee County. The couple joined the Seminole Indians living in the vicinity of present day Indiantown and named their own private town - Annie. The road, originally called the Stuart-to-Annie Road, is now State Road 76 (Hudson 1973).

About the same time, Joe Bowers gave up his store in Jupiter to establish a trading post with the Seminoles and, with his brother, he planted the now famous "Bowers Groves" in Annie. Rumor has it that some trees are still bearing fruit from the original planting.

In the early 1920s, shortly after the arrival of the Bowers brothers, a railroad line was established connecting the area with Coleman (in Central Florida) and West Palm Beach. It was known as the Seaboard Air Line Railway and was built as Martin County was being formed. The Baltimore banker who was the president of the Railway, S. Davies Warfield, had bought more than half of the land that was to be included in the new county. Noting the high elevation, and the temperature difference between the coast and the interior (the interior is 10 degrees cooler in the summer and 10

degree warmer in the winter than the coast), he planned to build a model city at Indiantown. The idea was to make Indiantown the southern headquarters for his railroad (Hudson 1973).

Warfield had a depot, railroad yards, the Seminole Country Inn, and apartment houses built and the western part of the new county soon became the heart of the winter vegetable raising interests. However, this expansion did not last for long. The collapse of the Florida land boom and the near simultaneous death of Warfield left a sharp retrenchment in the prosperity of Indiantown (Hudson 1973).

Throughout the 20th century, the ICL plant site has remained relatively undeveloped. Based on the above historical documentary review, the survey area for the ICL plant site was considered to have a low probability for containing significant historical resources.

METHODS

The background and literature review, in conjunction with pertinent environmental variables, contributed to the formulation of project-specific field methods designed to locate and evaluate previously unrecorded archaeological sites within the survey area for the ICL plant site and pipeline corridor. The designation of probability zones and decisions regarding site significance were based on previous research conducted within the Okeechobee Basin area.

Archaeological Sites in the Vicinity of the Project

Evaluations of archaeological or historical site significance are ultimately based on the potential of a site to contribute to the understanding of the social processes at work in a region's prehistory or history; therefore, a consideration of these sites within the context of the larger, regional settlement system is essential. A first approximation of settlement variability through time can be obtained by reviewing information regarding the known sites in the area. A search of the pertinent literature and records of the surrounding region was conducted, including archaeological and historical assessments of other tracts of land in close proximity to the project area.

Other sites in the general vicinity of the ICL project area include the Barley Barber I, II, and III sites (8Mt19, 28, & 29) and a small unnamed site (8Mt31). The Barley Barber sites are mounds, one of which is associated with prehistoric earthen

embankments. The latter is now protected within the Barley Barber Swamp Preserve while the former have been excavated (Williams 1975). These sites are located along Barley Barber Swamp about five miles west of the ICL project site. Site 8Mt31 consists of a few ceramic artifacts located along an unnamed slough about six miles southwest of the project area.

Other sites in the Okeechobee Basin include earthworks (Carr 1975, Sears 1982, Willey 1949, Allen 1948, McGoun 1987, 1988), burial mounds (Carr 1973, Sears 1982, Willey 1949, Williams 1975), and habitation mounds or middens (Sears 1982, Willey 1949, Goggin 1952). Among the more spectacular sites are the large earthworks found in the open savannah, often bordering creeks or major environmental zones (cf. Hale 1984:181). These include circular ditches, linear embankments, and combined mound and embankment complexes.

Sears (1982:185) provides evidence indicating that the circular ditches are the earliest earthworks at Fort Center site dating to at least 450 B.C. His research shows that some of the habitation middens are coeval with this structure. Habitation mounds are believed to have been built during his Periods I and II (1982:186,195-199) and again during his Period IV but the latter include linear embankments (1982:199-201). Burials in mounds date to his Period I, possibly II, and IV (1982:140-141,200-201). Willey (1949:125) is unable to ascertain the date of the burial mound at the Belle Glade site but believes it is coeval with a habitation mound. Williams (1975) obtained a radiocarbon date of

200 B.C. under one of the burials he excavated at Barley Barber Swamp but he believes the date is erroneous.

The combined mound and embankment complex known as Big Mound City (Willey 1949:73-77), located about 10 miles south of Indian-town, is thought to have been laid out according to a master plan, however no conclusions have been reached as to whether all of the features were constructed at the same time. An artifact collection from one of the mounds at the site indicates a coeval existence with a late period of occupation at the Belle Glade site located at the south end of Lake Okeechobee. Other mound and embankment complexes include the Big Circle Mounds, also known as Tony's Mound, (Allen 1948), the Boynton Mound Complex (McGoun 1987, 1988), and others (cf. Hale 1984:181; Carr 1975, 1985). The presence of European artifacts at sites such as the Ortona Mound in Glades County (Milanich 1988, personal communication), indicate a late Belle Glade IV occupation, however most of these sites are not dated.

Site Location Model

Cultural resource assessment surveys throughout Florida have demonstrated that certain environmental locales were preferred for prehistoric and early historic utilization. Predictive models enable the researcher to stratify the project area into probability zones based upon the co-occurrence of relevant environmental variables. The relative importance of each of these variables depends upon the composite environmental setting. In a sand hills

environment, for example, a majority of the known sites are located near a water source on a ridge top or slope. If a water source is not located in the vicinity, the probability of site occurrence decreases dramatically. However, water will not be the determining factor if another resource with more limited distribution, such as lithic raw materials, is available for exploitation (Deming and Almy 1984:17). In environments of relatively low relief and abundant wetlands, areas of higher elevation relative to the surrounding terrain would be considered more likely to contain prehistoric sites (Wharton 1984; Piper and Piper 1980; Johnson 1986). In coastal areas, the availability of littoral resources, particularly fish and shellfish, was a major factor in site location.

The above site locational data suggests that the majority of sites in the area would be expected to be located adjacent to or near the freshwater sloughs which flow into Lake Okeechobee. Further, the present data available for the vicinity of the survey property suggests that the most likely type of prehistoric site to be discovered in these areas would be a late period midden or mound. Smaller, extractive type campsites, represented by small scatters of lithic, ceramic, or shell artifacts, would also be expected on elevated knolls or ridges in the flatwoods if a source of potable water is located nearby.

The environmental factors pertinent to the project area may be summarized as follows:

- a) most of the soils in the project area are poorly drained;

b) surficial water sources are ubiquitous in the region;

c) the topography of the project area is level, with few features other than a slight slope to the southwest. Although potable water is available, there are no areas of slightly higher elevation that may have been more desirable to prehistoric people.

Based on these environmental parameters, the project area was considered to have a low probability of producing evidence of activity sites associated with the prehistoric exploitation of locally available resources. Mounds and/or middens were a common adaptation to low, poorly drained land, but a labor intensive site such as a mound would usually be placed near additional resources such as stone quarries or riverine transportation. With no such resources on or near the project property, it was considered unlikely that a mound similar to the Barley Barber mounds would exist in the project area. During the field survey, special attention was paid to areas of higher elevation and mesic or xeric flora close to drainages and the larger ponds. Areas of low elevation relative to the surrounding terrain were considered less likely to contain evidence of prehistoric occupation because they are often seasonally filled with water.

Field Methods

Shovel tests were placed in areas of high site potential as defined above. For the ICL power block area, shovel tests were placed at 50 meter intervals along transects spaced at distances appropriate to the specific locale. In no case did the transect spacing exceed 100 meters. In addition to the systematic tests,

judgementally placed shovel tests were also excavated when appropriate to adequately test an area.

All shovel tests measured approximately 40-50 centimeters in diameter and were excavated to a depth of one meter unless prevented by groundwater seepage, bedrock, or other soil conditions. All excavated soil was screened through 1/4" mesh hardware cloth. The location of each shovel test was plotted on a 1" = 400' aerial photograph and soil stratigraphy records were maintained for each test pit. Recordation of the soil profiles was carried out to the nearest half decimeter.

Good surface exposure was provided by the many dirt roads, recently cleared areas and trails, and animal burrows which are present throughout the property. These exposures were visually inspected for cultural material whenever possible. It is estimated that hundreds of such exposures were examined during the course of the survey.

The pipeline corridor is proposed to be within the existing CSX railroad right-of-way, immediately west of SR 710. During the construction of these two thoroughfares, the original ground surface has been subjected to substantial disturbance such as the construction of drainage ditches, deposition of fill dirt as a foundation bed for the roadway, and the burying of subterranean utilities (electrical, gas, and telephone lines). This left little soil within the proposed pipeline corridor intact enough to merit subsurface testing; indeed, most of the area has undergone secondary or tertiary redeposition and had standing water at the

time of inspection. The whole pipeline tract was subjected to extensive visual inspection and, where appropriate, subsurface testing.

RESULTS AND RECOMMENDATIONS

The ICL plant site and pipeline corridor were surveyed by means of intensive surface inspection and subsurface testing where applicable. Sixty-three shovel tests were excavated. No prehistoric cultural materials were uncovered, but two historic areas of interest and a few scattered Herty cup fragments were found during the cultural resource assessment survey.

Neither the areas of historic interest, nor the Herty cup fragments are sufficiently noteworthy to merit the designation of an archaeological site. The Herty cup fragments, dating to the early 20th century, do indicate the existence of a turpentine or navel stores industry in the area. A brief description and evaluation of the other two areas of cultural interest are presented below. The locations of these two areas are shown in Figure 3.

The Trash Dump is located in Township 39S, Range 38E, Section 35, SW/SW/SE (USGS Okeechobee 4 SE, photorevised 1983). This historic feature is located outside of the ICL project boundary, 1200 feet to the southeast. Artifacts recovered consist of post Depression-era glass bottles for whiskey and ink; whiteware, stoneware, and porcelain ceramics; and brick fragments in a small surface pile that appears to have been recently moved.

There is no structure or other evidence of homesteading in the area. This site appears to be a 1940s or 1950s dump site, considering its seeming isolation and location near an improved

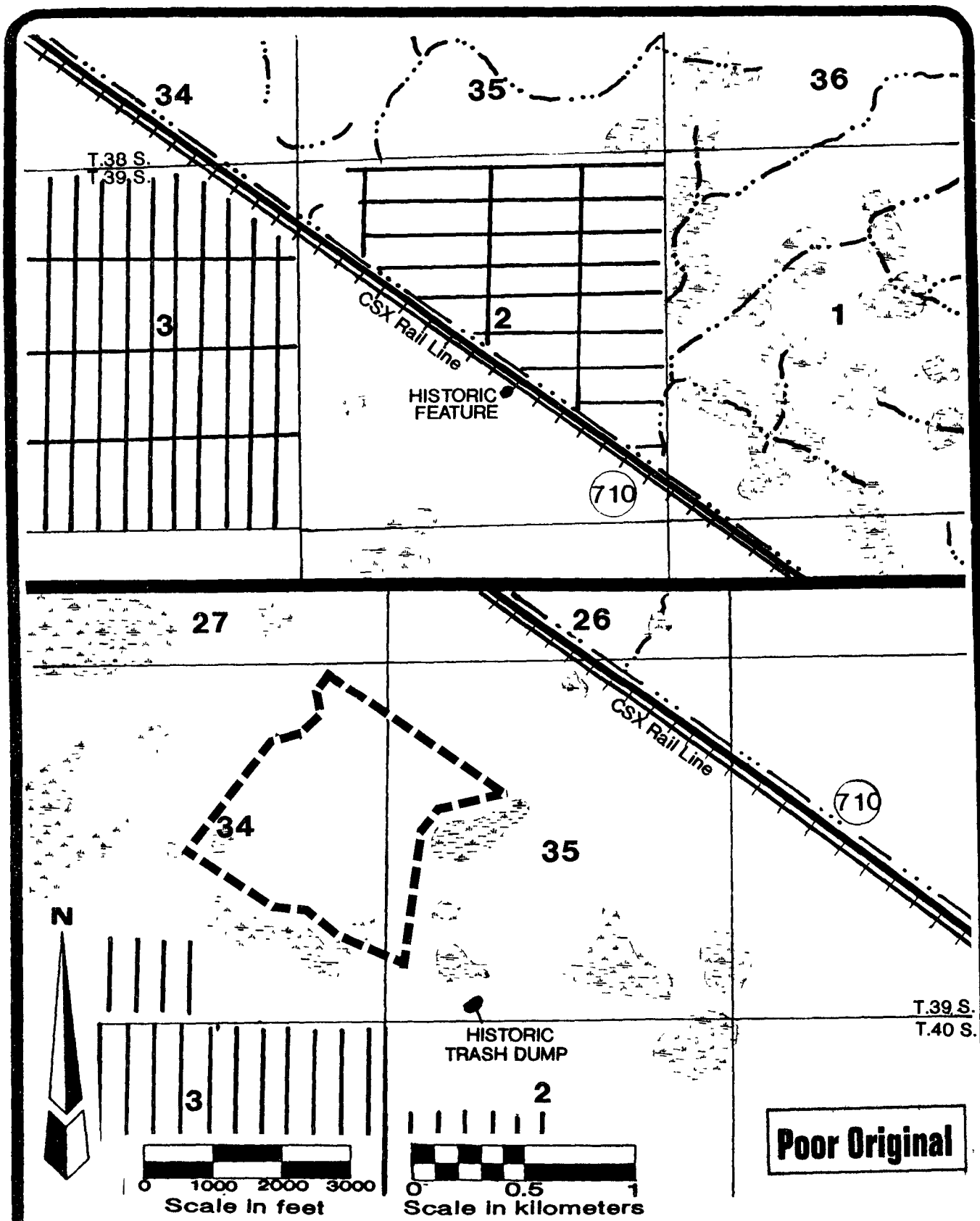


Figure 3: Map of project area showing locations of archaeological areas of interest discovered during the survey.

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secondary road. Due to the limited and unexceptional nature of this dump site, the potential for more information to be recovered from further investigation is low. This dump is not considered regionally or locally significant, and not eligible for listing on the National Register of Historic Places. No further work is recommended for this feature.

The Zana Railroad Water Reservoir is located in Township 39S, Range 27E, section 2, SE/NW/SW (USGS Okeechobee 4 SW, photorevised 1983.) This feature consists of a small camping shack and a large, angular concrete structure with a line of tall, burnt pine poles on the south, extending toward the southeast. Field observations lead the archaeologists to speculate that this feature may have been a water reservoir for a steam powered tram or locomotive.

This feature lies immediately south of the pipeline corridor, outside the project area, and will not be adversely affected by the construction of the pipeline.

SUMMARY

Two areas of historic period activity and no prehistoric sites were discovered during the cultural resource assessment survey of the ICL plant site and pipeline corridor. The trash dump, found immediately outside of the proposed ICL plant site is a surficial dumping area of little historic interest. The other area is an historic camp with a concrete water-retention structure and lies to the south of the railroad tracks, outside the pipeline corridor. Because this feature is located outside of the project area, its full evaluation is beyond the scope of this project.

In conclusion, no archaeological or historical sites eligible for inclusion in the National Register of Historic Places were found within the proposed project site boundaries or within the associated pipeline corridor.

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10.9

**10.9 PLANT WATER REQUIREMENTS AVAILABILITY STUDY FROM TAYLOR
CREEK/NUBBIN SLOUGH**

INDIANTOWN COGENERATION LIMITED

**PLANT WATER REQUIREMENTS AVAILABILITY STUDY
FROM
TAYLOR CREEK/NUBBIN SLOUGH**

**INDIANTOWN COGENERATION PROJECT
INDIANTOWN, MARTIN COUNTY, FLORIDA**

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1. INTRODUCTION AND OBJECTIVES

1.1 Objectives

A water availability study is performed for the Indiantown Cogeneration Project in Martin County, Florida using Taylor Creek/Nubbbin Slough (TC/NS) basin surface runoff flows and Canal C-59 storage. The main objectives of this study were:

- o Determine the availability of the plant water requirement (cooling tower makeup and process water) from TC/NS and Canal C-59 for canal water elevations above elevation 16 ft-msl.
- o Identify the duration of the time in which withdrawal of makeup water is assumed to be unavailable when the water level reaches elevation 16 ft-msl.

The historic flow and water elevation data of TC/NS at control Structure S-191 are used in the study. The plant water requirements, are of those reported in Section 2, is 3374 gpm (average 7.50 cfs). The following sections of this report provide a description of the project, plant water requirements, basic data, methodology, assumptions, results, conclusions, and the recommendations.

1.2 Project Location and Description

The proposed Indiantown Cogeneration Project is a 330 MW pulverized coal-fired power plant in southwestern Martin County, Florida. Figure 1 illustrates the general location of the project site. The site is located nine miles east of Lake Okeechobee and about three miles northwest of Indiantown. To the north of the site is the Caulkins Citrus Processing Facility and the Florida Steel Corporation. Both facilities border State Road 710 and the CSX Railroad. The site is bounded on the west by Tampa Form Products and unimproved agricultural lands; on the south and on the east by unimproved industrially zoned land.

2. PLANT WATER REQUIREMENTS

The monthly averaged, water requirements for 100% load factor are as follows:

<u>MONTH</u>	<u>MAKEUP WATER (gpm)</u>	<u>PROCESSING WATER (gpm)</u>
January	2686	552
February	2705	552
March	2753	552
April	2856	552
May	2886	552
June	2902	552
July	2911	552
August	2917	552
September	2889	552
October	2886	552
November	2758	552
December	2712	552

The yearly average plant cooling tower makeup water requirements is 2822 gpm (6.3 cfs). The plant mean annual process water is about 552 gpm (1.2 cfs). Hence, the total average plant water requirement is 3374 gpm (7.50 cfs). Plant makeup and process water is to be withdrawn from Taylor Creek/Nubbin Slough, upstream of control structure S-191 as shown on Figures 2 and 3, approximately 19 miles northwest of the project site.

3. TAYLOR CREEK/NUBBIN SLOUGH

Taylor Creek/Nubbin Slough discharges into Lake Okeechobee through S-191, a gated spillway control structure, on the northeast shore of Lake Okeechobee, Figure 2.

In 1973 the discharge from 104.5 square miles (upper Taylor Creek) was diverted into L-63N and L-63S, the new 10 mile long SFWMD canals that intercepts Nubbin Slough and other tributaries (Mosquito Creek, Lettuce Creek, and Henry Creek). The L-63N and L-63S canal flows are then discharged into the Lake Okeechobee through a 1.1 mile Canal (C-59) and the Structure S-191 (Reference 1).

The basin formed by this diversion, the current Taylor Creek/Nubbin Slough basin, encompasses 188 square miles. The upper Taylor Creek portion of the basin is composed of four major tributaries as follows: Williamson Main, Northwest Taylor Creek, Little Bimini Creek, and Otter Creek. Land uses in the basin, based on 1980 estimates, are primarily: improved pasture 68%, forest and range land 22.3%, urban 3.2%, and citrus and miscellaneous 6.5%.

This basin was singled out by the 1986 Lake Okeechobee Technical Advisory Committee as a priority basin in which to apply phosphorus controls. Approximately 143 tons of phosphorus are discharged from the basin to the Lake Okeechobee each year. This basin ranks as the number one phosphorus contributor to the lake with an annual flow-weighted concentration of 0.947 gmP/l. Over the period of 1973 through 1987, the TC/NS watersheds annually contributed about 21.2% of the phosphorus input into Lake Okeechobee yet contributed only 3.7% of the lakes inflow water (Reference 1).

3.1 Historic Flow And Water Level Data

The historic Spillway Structure S-191 flow and related Canal C-59 water level data immediately upstream of S-191 are available for the period of January 1973 through the December 1989. These data are obtained from the SFWMD and they are in daily averaged form (Reference 2).

No data for the period of June 13-July 31 of 1973 was collected, therefore, the 1973 data is not used. Consequently, the data record of January 1974-December 1989 only

are used for the analysis. Appendix A provides the recorded daily averaged water levels and the associated daily averaged spillway flow data.

3.2 Precipitation and Evaporation Data

The annual precipitation and pan evaporation data for TC/NS watershed are obtained from SFWMD (Reference 5). These data are for the Raulerson-3 gauging station on Taylor Creek and they are presented in Tables 2b and 3.

The mean annual precipitation of Raulerson-3 Station for the period of 1956-1984 is 48.8 inches (Table 2b). The mean annual pan evaporation for the period of 1957-1976 is 59.44 inches (Table 2b).

For completion of annual precipitation data through the 1989 period, the precipitation data of a nearby gauging station, Port Mayaca Station, approximately 25 miles southeast of Raulerson - 3 Station are used as shown in Table 3 (Reference 6). The annual precipitation of Port Mayaca Station has a similar trend as the Raulerson-3 Station.

3.3 Canals C-59, L-63N, and L-63S Geometry

The confluence of Taylor Creek (Canal L-63N) and Nubbin Slough (Canal L-63S) streams forms Canal C-59 which extends about 1.1 miles before discharging into the Lake Okeechobee through the spillway Structure S-191, Figure 3. Canal L-63N extends northward in the Taylor Creek upstream direction about 5.0 miles, and L-63S extends southward in the Nubbin Slough upstream direction at a similar distance. These distances are less than the actual lengths of 6.4 miles and 5.5 miles of the water courses of Taylor Creek and Nubbin Slough respectively. They are conservatively assumed for the purpose of this study to be 5 miles long each.

The stage-storage capacity data of the C-59, L-63N, and L-63S canals (the Canals) are obtained from the US Corps of Engineers drawings, Reference 3. From these drawings, the stage-area relation for the combined canals is determined and it is shown in Figure 4.

From stage-area data, the combined storage capacity of the Canals at some selected elevation intervals are as follows:

<u>Elevation Range (ft)</u>	<u>Storage Volume (acre-ft)</u>
16-17	178
17-18	183
18-19	190

3.4 Spillway Structure S-191

The spillway Structure S-191 is located on the Canal C-59 at its junction with levee D4 on the north shore of Lake Okeechobee, Figure 4.

This structure is a reinforced concrete, gated spillway, with discharge controlled by three cable operated vertical lift gates. Operation of the gates is automatically controlled so that the gate hydraulic operating system opens or closes the gates in accordance with the seasonal operational criteria (Reference 4).

The purpose of the Structure S-191 is to maintain optimum water control stages in the upstream area, to pass the 10-year frequency flood without exceeding the upstream design flood stage, and to restrict downstream flood stages and discharge velocities to non-damaging levels. It also prevents upstream flooding from Lake Okeechobee hurricane tides, and it permits back flows up to 330 cfs to the north to meet agricultural water requirements.

The Structure S-191 operation procedure (Reference 4), is to maintain, insofar as possible, headwater elevations within 0.2 feet above and 0.2 feet below the 19.0 ft-msl optimum water level (Reference 4). Four manually operated gates on overflow slots in the main gate, control small discharges without raising the upstream stage. When the discharge exceeds the capacity of these gates, the automatic gate controls function as follows: When the headwater elevation rises to 19.7 feet, the gates will open at six inches per minute; but the gate opening will be governed by the Differential Head versus Gate Position curve, and it will not exceed the maximum allowable opening position. When the headwater elevation rises or falls to 19.5 feet, the gates will become stationary; when the headwater elevation falls to 19.3 feet, the gates will close at six inches per minute.

In addition to maintaining optimum upstream control, as described above, the automatic controls on this structure have an over-riding control which closes the gates, regardless of the upstream water level in the rare event that the tailwater pool elevation reaches or exceeds the headwater elevation (Reference 4).

Due to operation of spillway structure gates for maintaining an optimum water level, no conventional spillway rating curve is available for the Spillway Structure S-191. Such system of operation is clearly shown in Figure 5 where a wide range of spillway flows are reported for a very narrow range of water levels. From Figure 5 and inspection of recorded water level data, it was observed that while the operating optimum water level of approximately 19.0 ft-msl was used for the data period of 1974-1985, the optimum water level for the data period of 1986-1989 is about 19.4 ft-msl. By rearranging the historic water level and flow data of the Figure 5 in Figures 6 and 7, this change in mode of operation is clearly demonstrated. In addition at some isolated events, the spillway structure gates have operated at water level elevations other than those described above. As examples, for the data period of October 22-24, 1978 (see Appendices A and C), the water level in the canal is dropped about 1 foot in two days below its normal operating water level of 19.0 ft-msl. A different spillway gate operating procedure is

also recorded for July 23 where the water level is maintained at elevation 19.75 ft-msl without any spillway discharge. Such infrequent gate operations can also be seen during July 9-12, 1980, June 18-19, 1981, or some other data periods (see Appendices A and C).

The spillway gates operation procedure will be discussed further in Section 4.1.2 during calibration of numerical model for plant water availability study.

3.5 Flow Regime at S-191 Spillway

The flow regime over spillway structure S-191 with about one month delay closely follows the seasonal precipitation pattern of the TC/NS watershed, Tables 1, 2, and 3 (References 5 and 6). As is shown in Tables 1 and 2, the flow period over spillway S-191 is from June through November while the rainfall is from May through October.

The historic average flow over spillway S-191 is about 146.4 cfs which is about 20 times the plant average plant water requirements of 7.5 cfs. However, as is shown in Tables 1 and 2, such flow is not continuously available year round. Considering this flow regime, a storage pond becomes necessary to store the flows at high flow periods for use in low flow periods. The main aim of this study is to assess the technical feasibility of using Canals C-59, L-63N, and L-63S as the storage reservoir without affecting the purposes for which these Canals and associated discharge structure were designed for.

4. PLANT WATER AVAILABILITY STUDY

A plant water availability study utilizing the storage capacity in the Canals is performed to identify the effect of the plant makeup and process water withdrawal on the Canals water levels and to determine the duration for which the water level will be at Elevation

16-ft-msl. The canal historic flow and water elevation data are used for this purpose. A water balance computer program is developed and used in this study.

4.1 Computer Model Development

Based on the historic flow and water level data at the S-191 structure, the net inflows to the Canals are first determined. Then by applying the calculated net inflows and without plant water withdrawal, the computer model is calibrated and then the water withdrawal from the canal is simulated. The details of this process are as follows.

4.1.1 Net Inflow Determination

The net daily averaged inflows to the canal are determined applying the mass balance equation, the historic daily averaged flow, and the historic daily averaged water level data. The mass balance equation is (Reference 7):

$$I = O + \Delta S/\Delta t \quad (1)$$

where I is the net inflow to the Canals, O the spillway outflow, and $\Delta S/\Delta t$ is the daily change in the canal storage.

The net inflow to the Canals is a combination of several parameters including:

- o Taylor Creek watershed inflow to the canal
- o Nubbin Slough watershed inflow to the canal
- o Evaporation from the canal
- o Rainfall on the canal
- o Groundwater flow to or from the canal walls
- o Spillway gates leakage to Lake Okeechobee
- o Consumption of water by other users

Although the mean annual evaporation from the Canals and consumptive use by others are known, no data is available to quantify the remainder of the above parameters, hence, a reverse routing technique is used to determine the net inflow.

Applying the Equation (1), and using the daily canal water level and spillway flows at S-191, the daily averaged net inflows to the canal are determined. From the calculated net inflows, it was found that during the periods with flows over spillway, false negative inflows are encountered after the spillway releases, see Figure 8. This may be due to the time lag between the recorded spillway flow and its associated water level data (since the data are daily averages), resulting in false negative inflow calculations.

Since such negative inflows were causing artificial drop in the water level predictions, an adjustment to the inflows has been made without violating the mass balance equation. This adjustment is simply made through the subtraction of the negative inflow from the previous day calculated positive inflow, thereby forcing the negative inflow to become zero, to indicate gate closure, see Figure 9. The calculated net inflows for the data record period of 1974 through 1989 are shown in Appendix B.

4.1.2 Calibration and Verification

Applying the calculated net inflows, the Canals geometry relation, the spillway operating procedure, and the application of Equation (1), one theoretically should be able to calculate identical water levels and spillway flows as those recorded. However, as is shown in the Figures 5, 6, and 7, a definite spillway rating curve does not exist and the triggering water level for the opening of the spillway gates has varied from time to time.

Based on the spillway gates operation procedure given in Section 3.3, and observation of spillway flow and water level data in Figures 6 and 7, a unified triggering water level for opening, and a reference water level for closing the gates were sought for use in the

computer model simulation. By trial and error, the spillway gates operating procedure selected for numerical simulation is as follows:

<u>Data Period</u>	<u>Gate Opening El. (ft-msl)</u>	<u>Gate Closing El. (ft-msl)</u>
1974-1985	19.25	19.05
1986-1989	19.55	19.40

By applying the above spillway operation procedure, the calculated net inflows, and the Canals stage-storage, the canal daily water levels and spillway flows are predicted using Equation (1).

The predicted daily water levels are compared against the historic water levels and they are shown in Appendix C and Figure 10. The predicted total monthly spillway flows are also compared to the total monthly historic spillway flow data and they are shown in Figure 11. As is seen from the Figures 10, 11, and Appendix C, the numerical simulation fairly well predicts the canal water levels and the spillway flows. As a result, the procedure of reverse routing used to calculate net inflows is a valid approach and the good correlations substantiates the applicability of the computer model.

The historic deviant S-191 spillway water levels (i.e., isolated historic water levels above and below normal operating water levels) described in Section 3.4 are not simulated in the computer model. However, as is shown through Appendix C, generally such abnormal operating procedures have little effect on the predicted water levels.

4.1.2.1 Low Flow Correlations

During low flow periods and for no rainfall over TC/NS watershed and for no spillway flows, the positive inflows to the Canals will consist of the base flows from TC/NS.

The negative inflows from the Canals for this period will be evaporation losses, leakage through the spillway gates, and consumption of the Canals water by other users.

Attempts were made to quantify the seasonal net base inflows to the canal and to see if there is a seasonal behavior in the net inflows and the canal water levels. Some typical dry months were selected and their net inflows to the canal and their associated water levels were analyzed. From this analysis it was found that there is no seasonal trend in net inflows and there is no correlation between canal water levels and the calculated net inflows.

From comparison of calculated net inflows with the evaporation data it was also found that, generally, the magnitude of the net inflows are higher than the net evaporation losses. This is mainly due to the leakage through the spillway gates and the consumption of the canal water by other users.

Based on the above findings, no adjustments are made to the calculated net inflows as a result of lowering the water level.

4.1.3 Cooling Tower Makeup and Process Water Withdrawal Simulation

For numerical simulation of plant water requirements from the Canals storage, the mass balance equation (1) is rewritten in the following form:

$$O + \Delta S/\Delta t = I - Q_m \quad (2)$$

where Q_m represents the makeup water requirements, which is a known value.

4.3 Analysis

With application of the Canals geometry, spillway operation procedure, the calculated net inflows, and the plant water requirements, the new canal water elevations and the spillway flows are determined by using Equation 2.

The analysis is made using the calculated daily net inflows and the mean monthly makeup and mean annual process water requirements. The makeup water requirements are assumed to be constant during a specific month.

The analysis is performed to determine the plant water availability from the canals when the water level is above elevation 16 ft-msl, and to estimate the number of days when the water level reaches 16 ft-msl. During that condition, no makeup and process water is assumed to be available. To assess the effect of changing the water level on plant water availability, the same analysis is performed for a minimum water level of 17 ft-msl.

In the numerical simulation, to prevent the canal water level from lowering below the water level criteria, the plant water withdrawal from the canal is stopped about 0.5 feet above the water level criteria (i.e., 16.5 and 17.5 ft-msl). This approach is followed to account for lowering of the water level by evaporation and leakage through the gates during the long drought periods.

From this analysis, the new daily canal water levels and daily spillway flows are determined and they are presented in Appendices D and E. From the analysis, the minimum water level calculated for every period is determined and they are presented in the following table:

MINIMUM WATER LEVEL (ft-msl)

<u>YEAR</u>	<u>Criteria 16 ft-msl</u>	<u>Criteria 17 ft-msl</u>
1974	17.75	17.75
1975	15.91	16.96
1976	18.14	17.91
1977	16.45	17.08
1978	18.39	18.33
1979	18.05	18.05
1980	18.09	18.09
1981	16.10	17.09
1982	17.88	18.38
1983	17.97	17.98
1984	18.16	18.18
1985	15.89	17.08
1986	16.01	17.01
1987	16.90	17.10
1988	18.45	18.57
1989	15.93	16.94

For most of the periods, the minimum water levels in the Canals stayed above the minimum water level criteria of 16 or 17 ft-msl. However, for some dry years the criteria water levels are reached. The maximum drop in the canal water level with the 16 ft-msl criteria is approximately 2.5 ft below the historic water levels which occurred in 1981 and 1989.

From the analysis, for the period of 1974-1989, the maximum number of consecutive days and total number of days in which the water level may reach elevations 16 or 17 ft-msl are as follows:

	W.L. @ 17 ft-msl		W.L. @ 16 ft-msl	
DATA PERIOD	No. of Consecutive Days	Total No. of Days	No. of Consecutive Days	Total No. of Days
1974	0	0	0	0
1975	25	42	16	22
1976	0	0	0	0
1977	5	11	4	4
1978	0	0	0	0
1979	0	0	0	0
1980	0	0	0	0
1981	75	75	68	68
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	27	27	14	14
1986	45	45	32	32
1987	3	3	0	0
1988	0	0	0	0
1989	50	72	36	45

During these conditions it is assumed that withdrawal of makeup and process water from the Canals will not be made to minimize the impact on the groundwater level.

The maximum number of days in which the water level may reach the criteria level of 16 ft-msl are during 1981 and 1989. The annual precipitation of 1981 at Raulerson-3 Station was 34.4 inches and for Port Mayaca was 26.03 inches which again is well below the average precipitation of these two stations.

The effect of changing the criteria water level from elevation 16 to 17 ft-msl resulted in increasing the duration of the consecutive days of low water level by a maximum of 14 days. However, the total number of days where plant water withdrawal from the

canal is not permitted is increased from 185 days for water level 16 ft-msl to 275 days for water level 17 ft-msl as obtained from Appendices D and E.

5. CONCLUSIONS

Based on the characteristics of the TC/NS watershed and the surface water availability analysis performed, the following conclusions have been made:

1. Procedure of reverse routing used to calculate the net inflows provided a good correlation between historic and predicted water levels and spillway discharges.
2. The average historic flow through the S-191 structure is about 146.4 cfs and average makeup and process requirements is 7.5 cfs. Therefore, on a mean annual basis, there is an adequate supply of water. However, due to the rainfall pattern, the supply of water is not distributed evenly, therefore, a storage reservoir is required.
3. The mean annual makeup and process water requirements of 7.5 cfs can be made available from the storage of the Canals without lowering the lower level below elevation 16 ft-msl, except during the prolonged drought conditions, which may last a maximum of about 68 consecutive days. However, the total number of days during which the plant water requirements cannot be met in the numerical simulation period of 16 years is only 185 days.
4. During extreme drought months such as May and June of 1981 and 1989, obtaining the plant water requirements from the canals could lower the water level below 16 ft-msl.

5. The maximum drop in the Canals water level from the historic water levels is 2.5 ft. However, the drop in the groundwater level will be significantly less as discussed in SCA Section 5.3.1.
6. The effect of changing the criteria of minimum water level from 16 to 17 ft-msl could result in increasing the total number of consecutive days by a maximum of 14 days.

6. RECOMMENDATIONS

Based on the analysis made and conclusions reached, it is recommended that:

1. The pump intake be located on L-63N near the junction with Canal C-59 due to the large water depth and cross-sectional area.
2. The pump intake should be designed to operate with a minimum water level of 16 ft-msl.
3. To prevent the canal water level from dropping below elevation 16 ft-msl, the pump's control system should be designed so that during prolonged drought conditions the pumps trip when the water level reaches approximately elevation 16.5 ft-msl.
4. Multi-pumps should be installed to facilitate withdrawal rates ranging from average annual flow 3374 gpm (4.86 mgd) to maximum daily flow of 3642 gpm (5.24 mgd).
5. During prolonged drought in which the canal water level may reach elevation 16 ft-msl, makeup water to the plant must be provided from the Floridan Aquifer. The estimated continuous duration of the supply is approximately 90 days.

7. **REFERENCES**

1. SFWMD, "Draft Interim Surface Water Improvement and Managements (SWIM) Plan from Lake Okeechobee Part I: Water Quality, January 1989.
2. SFWMD, Spillway Flow and Water Elevation Data of Structure S-191.
3. US Army Corps of Engineers and Garris Engineers Inc. Drawings, July 1971.
4. SFWMD, S-191 Spillway Structure Operation Handbook, June 1986.
5. SFWMD, Rainfall and Evaporation Data for Raulerson-3 Station on Taylor Creek.
6. NOAA, Precipitation Data of Port Mayaca
7. Ponce, M., 1989, Engineering Hydrology, Principles and Practices, Prentice Hall, Englewood Cliffs, NJ.

Poor Original

Table 1. Monthly Average Spillway Flows in cfs at S-191 Spillway Structure

[illegible]

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

**Table 2a. Monthly Average Number of Days with Flow and
Monthly Average Spillway Flows at S-191**

Month	Average No. of Days with Flow Over Spillway	Average Spillway Flow (cfs)
January	15.8	103.5
February	16.2	105.0
March	17.2	91.9
April	12.5	44.3
May	10.5	62.7
June	16.5	151.2
July	22.0	181.5
August	28.4	275.3
September	27.4	396.9
October	23.6	159.8
November	18.4	95.2
December	18.4	89.2

**Table 2b. Monthly Average Precipitation and Pan Evaporation
Data at Raulerson-3 Station on Taylor Creek**

Month	Precipitation (inches)	Pan Evaporation (inches)
January	1.84	3.01
February	2.58	3.73
March	3.30	5.43
April	1.98	6.51
May	4.41	7.03
June	7.08	6.21
July	6.78	6.25
August	6.56	5.71
September	6.60	4.94
October	3.71	4.40
November	1.61	3.34
December	1.63	2.88

TABLE 3. Annual Precipitation Data at Raulerson-3 and Port Mayaca Gauging Stations

YEAR	PRECIPITATION (inches)	
	Raulerson-3	Port Mayaca
1956	48.45	31.13
1957	60.73	44.66
1958	51.40	45.98
1959	60.28	52.74
1960	65.38	40.88
1961	31.63	28.38
1962	54.75	38.14
1963	34.95	41.08
1964	44.52	51.25
1965	45.86	50.26
1966	56.82	53.84
1967	51.01	50.93
1968	60.55	52.42
1969	66.63	60.65
1970	52.07	59.52
1971	59.84	47.00
1972	28.49	49.76
1973	34.65	42.75
1974	53.67	42.19
1975	30.56	41.88
1976	42.55	42.54
1977	36.90	52.05
1978	51.50	57.12
1979	60.40	48.10
1980	38.80	-
1981	34.40	26.03
1982	61.90	51.38
1983	61.00	-
1984	35.40	-
1985	-	41.87 *
1986	-	46.18
1987	-	37.32 **
1988	-	48.34
1989	-	37.21
Average	48.80	45.60

* Month of June is estimated from Belle Glade Hurricane Station.

** Month of June is estimated from Belle Glade Hurricane Station an month of April is assumed zero.

TABLE 4. Monthly Total Historic Spillway Flow Data at S-191 Structure

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1974	654.	375.	404.	679.	143.	3683.	23091.	21505.	6540.	5630.	1379.	1949.
1975	858.	1028.	106.	600.	88.	1100.	3578.	6201.	9750.	4702.	1904.	1810.
1976	506.	807.	368.	522.	10508.	26358.	9561.	14785.	7342.	2381.	1477.	1976.
1977	2680.	1595.	758.	92.	284.	1919.	556.	1208.	13465.	1538.	3161.	16074.
1978	5953.	4930.	11755.	1382.	781.	2501.	8472.	10182.	11401.	8202.	2669.	3905.
1979	18515.	4224.	2963.	601.	9207.	1720.	3684.	3927.	55486.	6290.	1370.	1974.
1980	2224.	4568.	4042.	3824.	1732.	317.	2854.	1080.	7380.	1664.	2269.	3004.
1981	761.	1180.	368.	0.	68.	53.	146.	17703.	22028.	1132.	492.	383.
1982	428.	789.	4254.	6784.	3310.	19688.	11942.	13606.	9827.	10481.	4826.	2544.
1983	4311.	16348.	5972.	1367.	234.	1442.	870.	3414.	3076.	8534.	2071.	2969.
1984	2978.	6666.	5430.	1549.	3094.	1814.	5166.	2708.	4245.	1909.	2051.	1406.
1985	1856.	554.	629.	702.	8.	917.	3035.	7185.	18499.	4918.	1327.	1506.
1986	818.	561.	928.	0.	0.	9768.	12089.	13948.	10993.	2410.	4572.	2016.
1987	7019.	1259.	4193.	2168.	910.	960.	1637.	222.	198.	2937.	15368.	1629.
1988	1522.	2565.	2822.	430.	719.	319.	2611.	14710.	2422.	485.	685.	248.
1989	253.	87.	601.	561.	0.	0.	725.	4143.	7878.	16024.	244.	846.

TABLE 5. Monthly Total Predicted Spillway Flow Data Without Plant Water Requirements

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1974	656.	377.	414.	668.	97.	3725.	23100.	21492.	6542.	5642.	1402.	1908.
1975	868.	999.	161.	593.	85.	1044.	3716.	6111.	9748.	4691.	1892.	1863.
1976	475.	789.	384.	510.	10494.	26364.	9593.	14751.	7342.	2409.	1475.	1955.
1977	2635.	1629.	746.	102.	303.	1928.	561.	1196.	13470.	1531.	3149.	16100.
1978	5971.	4882.	11784.	1376.	796.	2455.	8475.	10237.	11397.	8170.	2663.	3889.
1979	18555.	4193.	3019.	574.	9217.	1656.	3770.	3934.	55482.	6273.	1371.	1943.
1980	2231.	4572.	4018.	3837.	1753.	285.	2929.	1029.	7397.	1621.	2303.	2998.
1981	750.	1218.	322.	42.	65.	0.	177.	17691.	22031.	1136.	506.	366.
1982	434.	817.	4233.	6782.	3255.	19750.	11934.	13610.	9820.	10476.	4838.	2534.
1983	4307.	16359.	5970.	1393.	214.	1446.	866.	3471.	3000.	8545.	2055.	2972.
1984	3026.	6642.	5401.	1552.	3133.	1802.	5142.	2709.	4249.	1871.	2041.	1488.
1985	1834.	549.	629.	685.	0.	903.	3112.	7158.	18534.	4880.	1305.	1497.
1986	778.	588.	947.	0.	0.	9838.	12089.	13911.	10947.	2506.	4539.	1989.
1987	6970.	1316.	4143.	2218.	904.	962.	1645.	216.	204.	2976.	15350.	1603.
1988	1519.	2528.	2890.	351.	789.	261.	2647.	14708.	2424.	504.	616.	317.
1989	261.	74.	604.	555.	0.	0.	725.	4148.	7873.	16009.	253.	819.

SITE VICINITY PLAN

— — SITE BOUNDARY

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PROJECT

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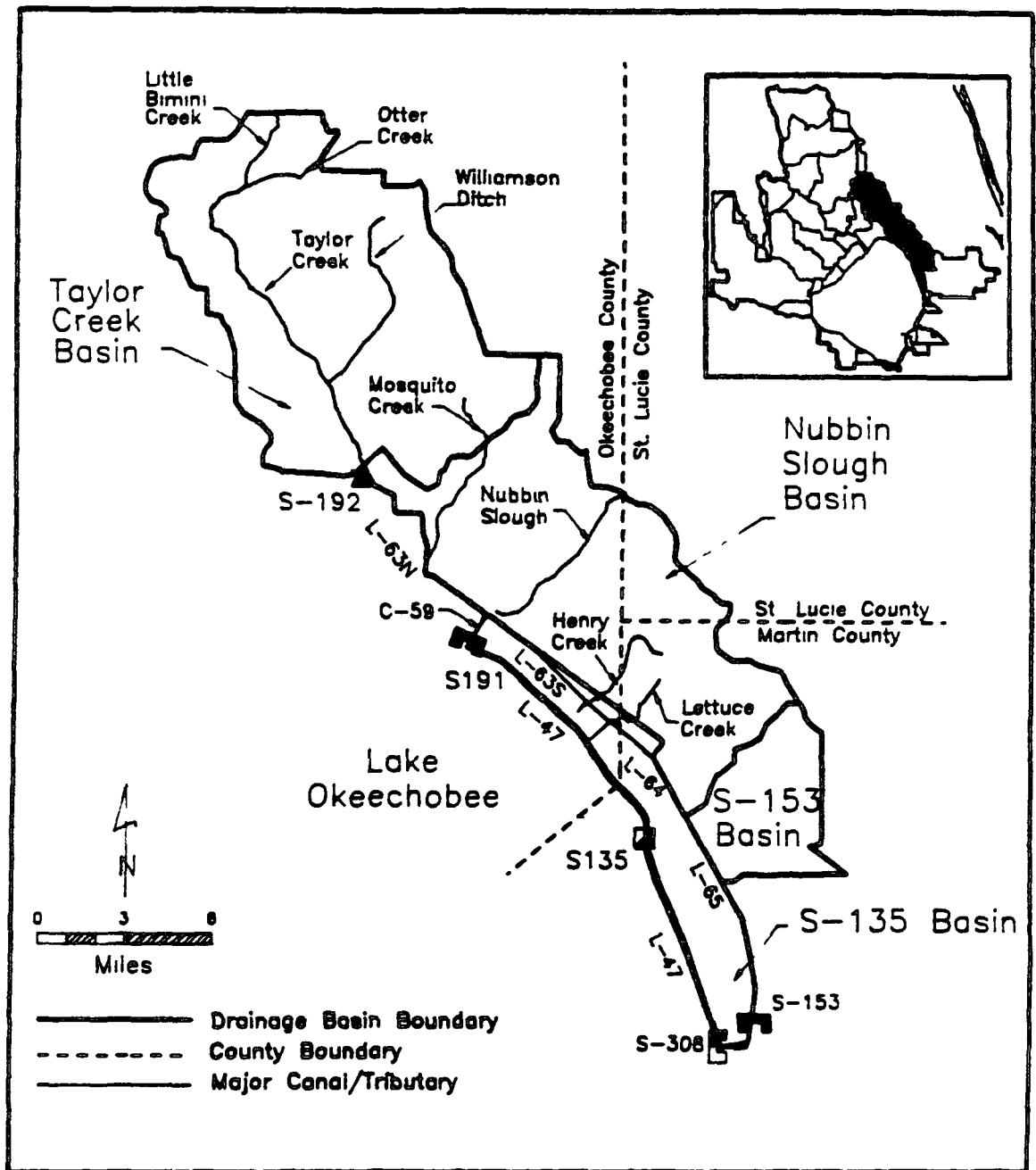


Figure 2. Taylor Creek / Nubbin Slough Watershed Boundary
(Reference. SWIM Plan for Lake Okeechobee, SFWMD, 1989)

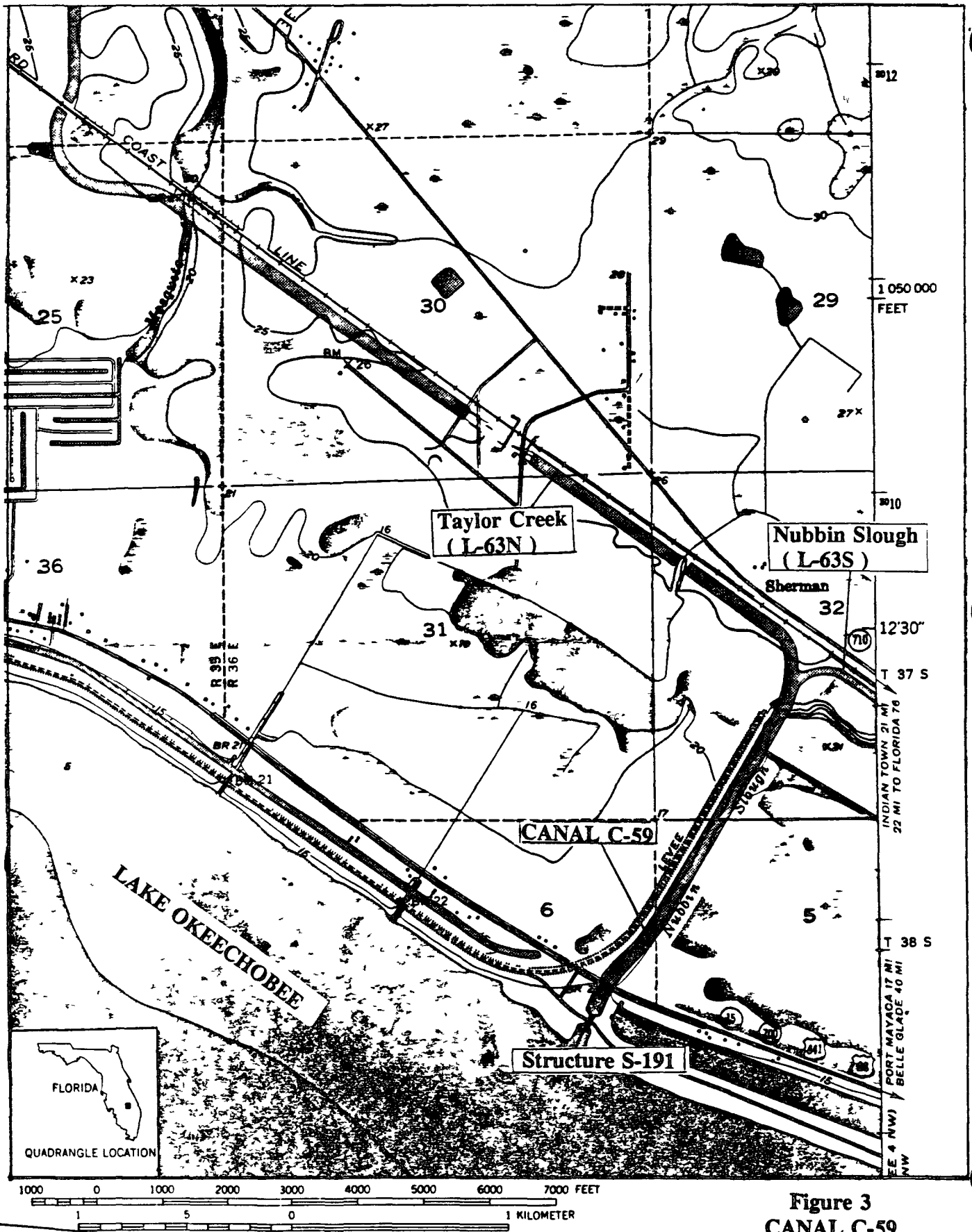
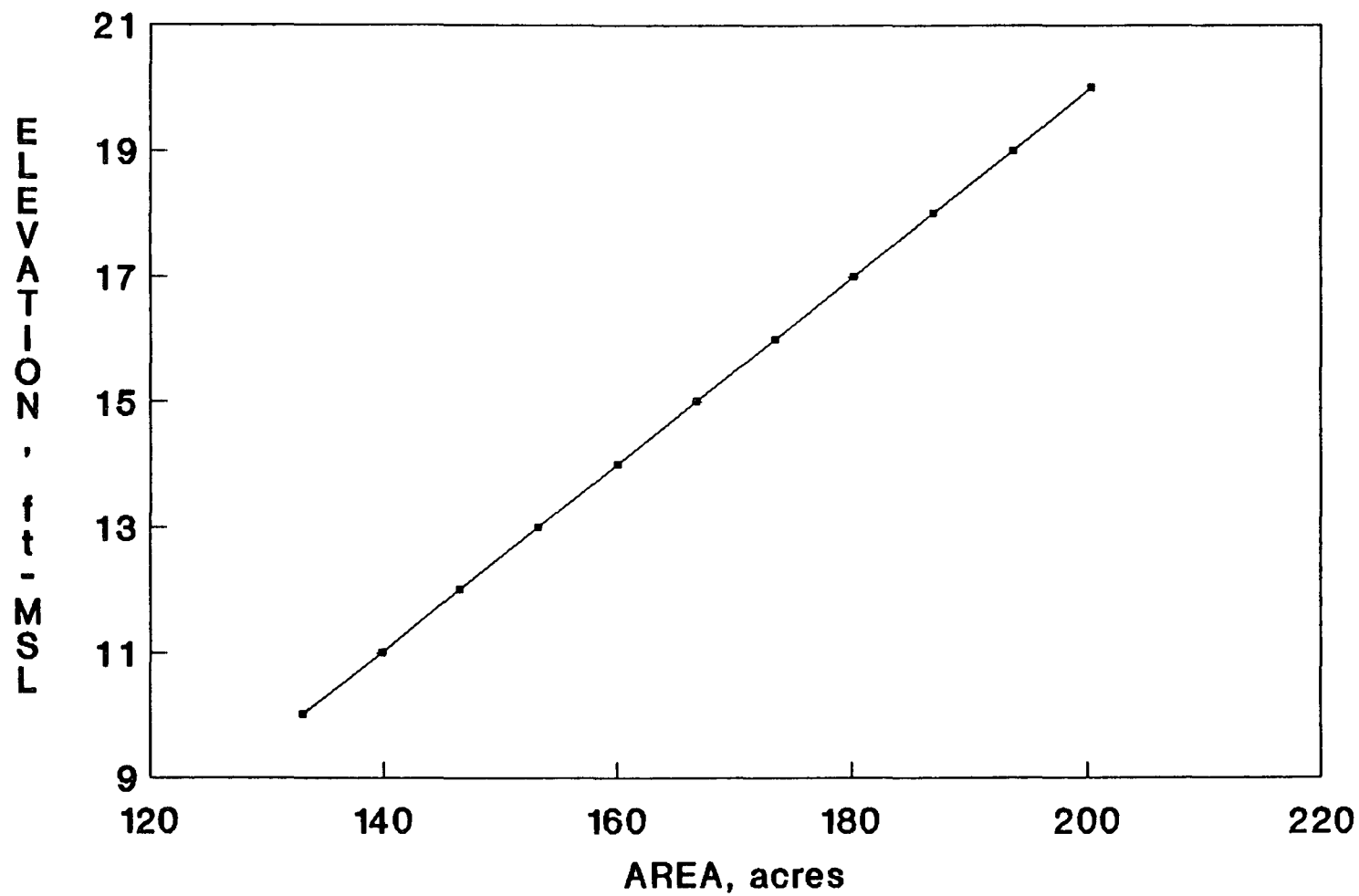
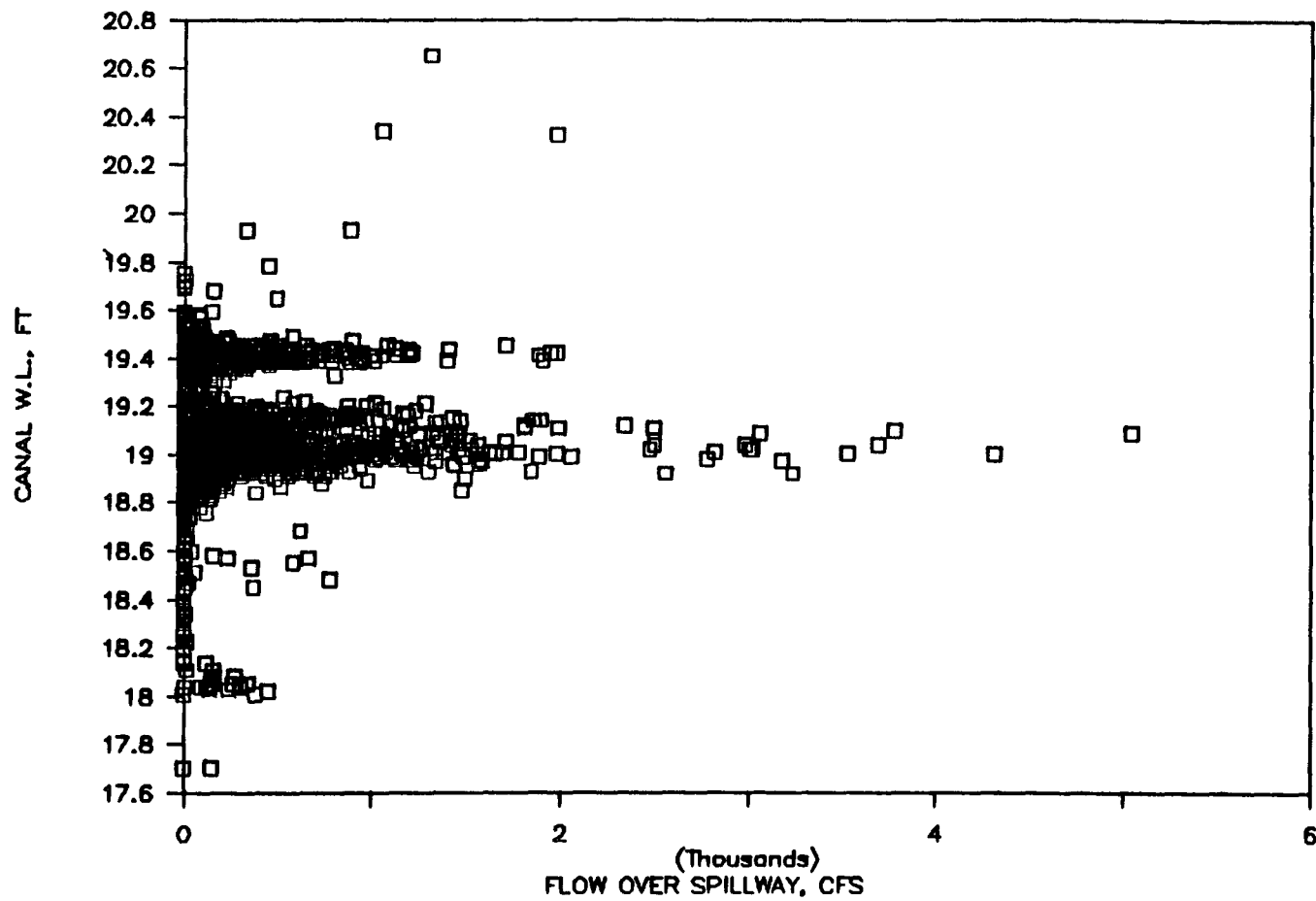
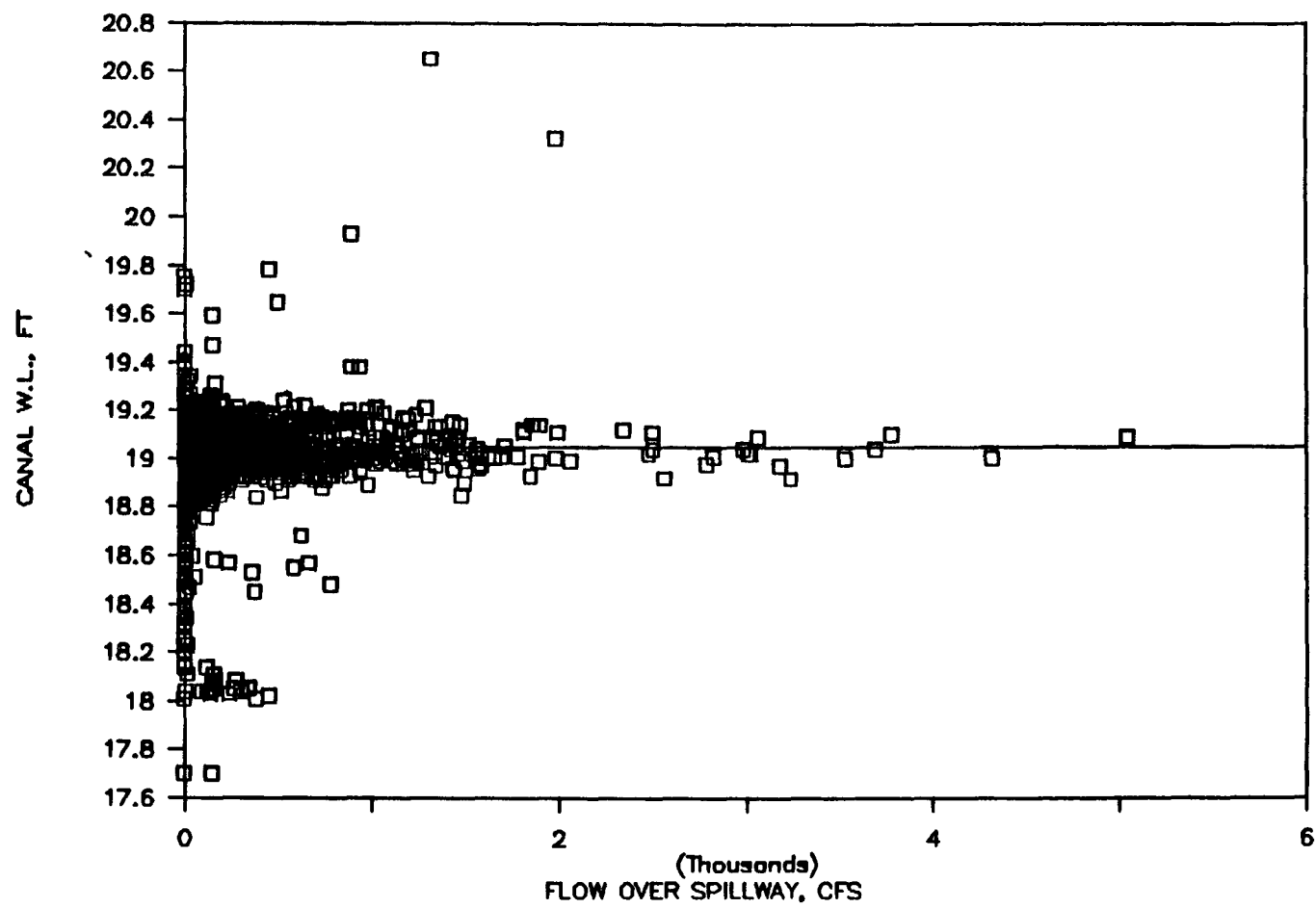


Figure 3
CANAL C-59
GENERAL LOCATION

**FIGURE 4, Combined Stage-Area Relation for
Canals C-59, L-63N, and L-63S**







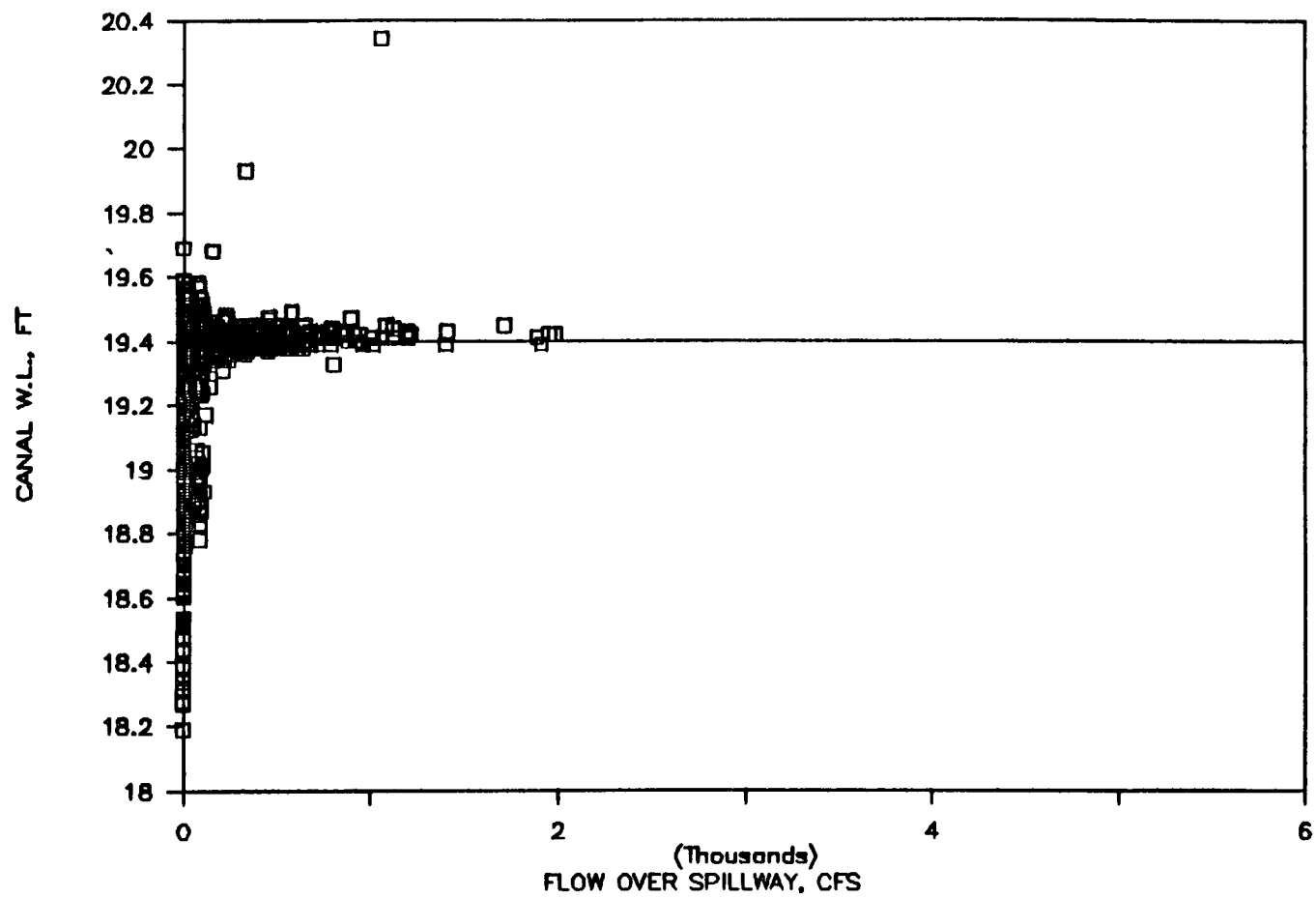


FIGURE 7. Historic Spillway Flows and Water Levels for Period of 1986-1989

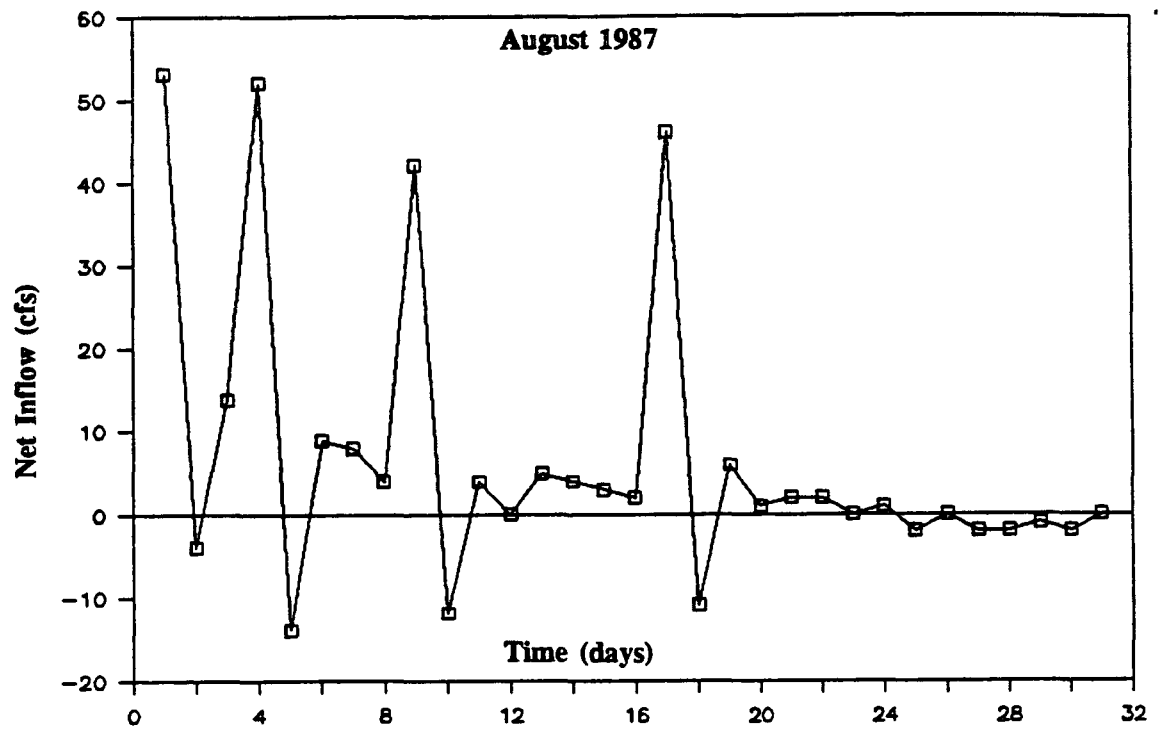


Figure 8. Typical Calculated False Negative Net Inflows at Positive Spillway Flow Durations

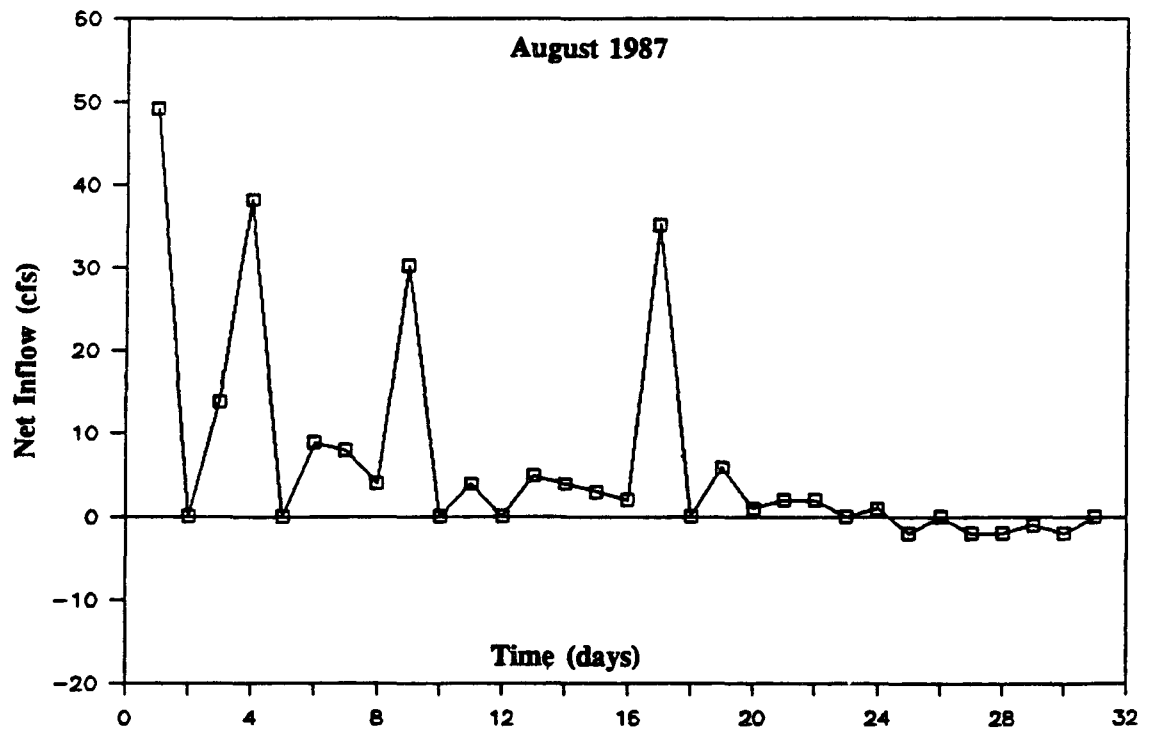


Figure 9. Typical Adjustment to the False Negative Net Inflows at Positive Spillway Flow Durations

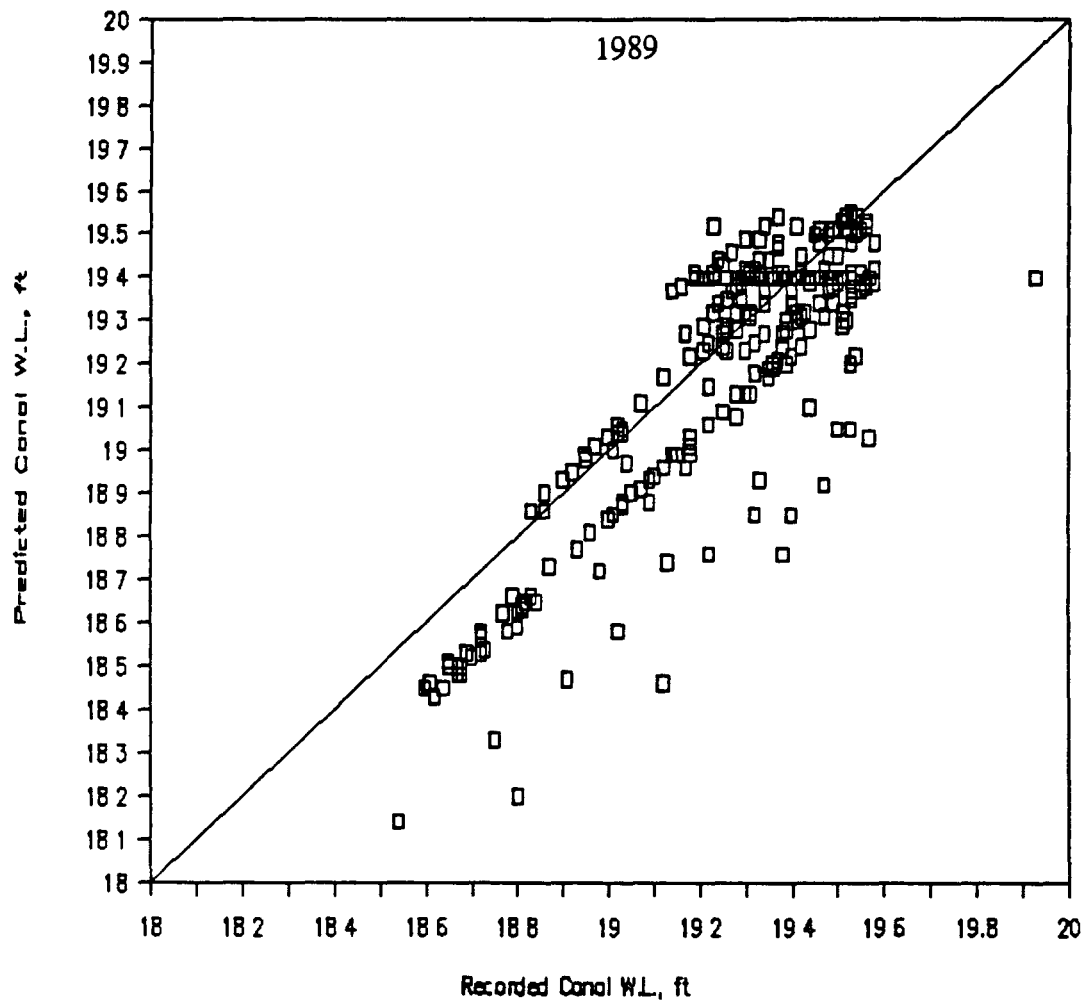


FIGURE 10 Typical Correlation Between Canal Predicted Water Elevations and Historic Data

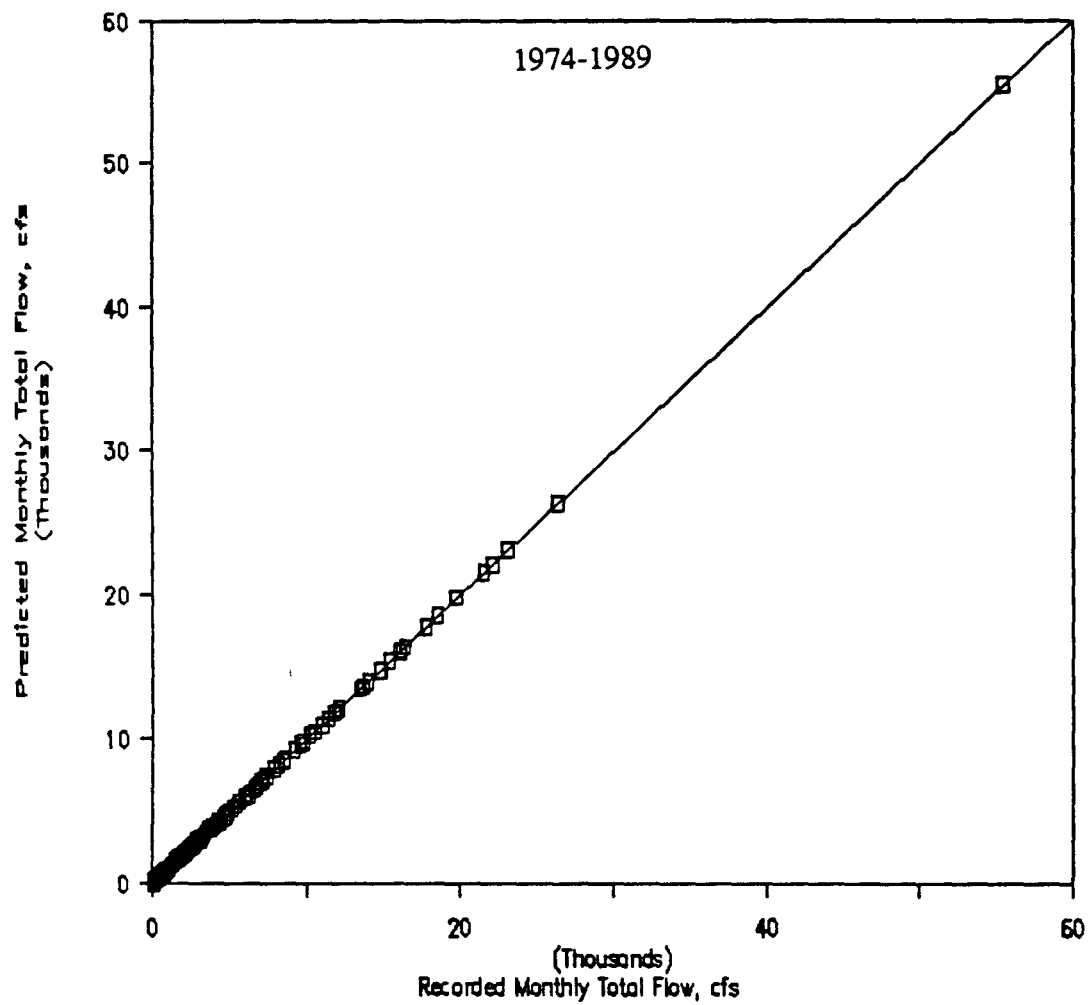


FIGURE 11 Correlation Between Recorded and Predicted Monthly Total Spillw

APPENDIX A

Historic Flow and Water Level Data

*** STATION 5191 ***
 LATITUDE 1 271131
 LONGITUDE 1 004347

3-181 SPILLWAY ON CANAL C-52 AT LAKE OKEECHOBEE
 UPSTREAM STAGE FEET
 MEAN DAILY VALUE

8/7/05/04.

AGENCY WMD
 COUNTY OKEEL

	1974					1974					1974					1974					1974					
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY													
1	18.97	19.01	19.05L	19.06	18.85	18.84	19.03	19.16	19.04	19.04	19.05	18.96	1													
2	19.00	18.93	18.85L	19.10	18.89	18.74	19.09	19.17	19.07	19.04	19.18	19.11	2													
3	19.16	19.06	18.92L	19.10	18.89	18.78	19.03	19.14	19.05	19.07	19.29	19.06	3													
4	19.11	19.03	18.98L	18.91	18.89	19.12	19.04	19.17	19.05	19.05	18.99	18.90	4													
5	18.95	18.87	19.06L	19.06	18.91	19.09	19.06	19.15	19.04	19.02	18.93	19.02	5													
6	19.11	18.96	19.13L	19.03L	18.96	18.93	19.04	19.16	19.10	19.09	19.07	19.12	6													
7	19.06	19.07	19.18L	19.06L	18.90	19.08	19.04	19.19	19.02	19.05	19.18	19.22	7													
8	18.94	19.18	19.04	19.07	18.91	19.22	19.05	19.16	19.03	19.05	19.08	19.32	8													
9	19.08	19.30L	18.86	19.02L	18.98	19.11	19.05	19.15	19.07	19.04	18.85	19.04	9													
10	19.21	19.02L	18.91	19.20L	18.99	18.86	19.05	19.17	19.01	19.09	18.95	18.91	10													
11	19.11	19.07L	18.96	19.11	18.99	18.95	19.07	19.17	19.02	19.07	19.06	19.00	11													
12	18.90	18.94	19.03L	18.93	19.02	19.06	19.08	19.17	19.02	19.11	19.17	19.10	12													
13	19.02	19.02	19.06L	19.07	19.03	19.14	19.05	19.13	19.06	19.07	19.07	19.22	13													
14	19.02	19.10	19.12L	19.18	19.03	19.23	19.06	19.14	19.08	19.01	18.87	19.34	14													
15	18.98	19.17	19.02L	19.09	19.11	19.08	19.07	19.17	19.04	19.05	18.98	18.90	15													
16	19.01	19.26	18.84L	18.91	19.02	19.07	19.04	19.16	19.09	19.12	19.09	19.06	16													
17	18.94	19.00L	18.96L	19.08	18.93	19.08	19.39	19.17	19.07	19.00	19.16	19.07	17													
18	19.12	18.86	19.00L	19.01	18.99	19.03	20.32	19.16	19.03	19.02	19.09	19.05	18													
19	19.24	18.94	19.04	18.95L	19.04	19.09	19.20	19.15	19.09	19.01	18.95	19.02	19													
20	18.84	19.11	19.10	19.09L	19.07	19.12	19.14	19.16	19.06	19.25	19.10	19.08	20													
21	18.98	19.19	19.17	19.21L	19.09	19.14	19.15	19.17	19.13	18.90	19.05	19.01	21													
22	19.12	19.09	19.08	19.00	19.09	19.12	19.15	19.13	19.01	19.10	18.87	19.25	22													
23	19.06	18.84L	18.82	18.96	19.10	18.99	19.17	19.18	19.08	18.98	18.94	18.97	23													
24	18.91	18.98L	18.87	19.09	19.10	19.16	19.12	19.12	19.06	18.98	19.10	19.07	24													
25	19.03	19.05L	18.90	19.01L	19.11	18.99	19.14	19.14	19.08	19.15	19.19	19.28	25													
26	19.14	19.10L	18.95	18.82L	19.11	19.05	19.14	19.14	19.05	19.26	19.11	19.04	26													
27	19.23	19.13L	18.99	18.93L	19.14	19.06	19.16	19.22	19.04	18.87	18.95	19.01	27													
28	19.12	19.18	19.01	19.02L	19.13	19.04	19.15	19.21	19.06	19.05	19.12	19.19	28													
29	18.95	19.04L	19.12	19.16	19.05	19.05	19.20	19.24	19.06	19.20	19.24	19.31	29													
30	19.14	19.06L	19.02	19.02	19.21	19.07	19.16	19.39	19.02	19.12	19.05	18.89	30													
31	19.27	19.05L	19.05L	19.05	19.05	19.05	19.14	19.03	18.90	18.90	19.05	19.05	31													
MAX	19.27	19.30L	19.10L	19.21L	19.21	19.23	20.32	19.38	19.13	19.26	19.29	19.34														
MIN	18.84	18.86	18.82	18.82L	18.85	18.74	19.03	19.03	19.01	18.87	18.85	18.84														
SUM	590.64	593.31	589.06	571.21	584.62	571.39	593.85	594.20	571.65	590.77	571.80	591.57														

DATA TAG LEGEND

M - MISSING DATA
 S - UNUSUAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 ! - SMALL AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A

5-12 SEPTEMBER 1964 ON CANAL C-57 AT LAKE KALIKOTHAH
UPSTREAM STATION 1111
AGRIALY AND
MEAN DAILY VALUE
CUMULATIVE TOTAL

[illegible]

5461

ANN 100

0.01	0.01	0.01
0.01	0.01	0.01

1-81	20-81	18
1-81	10-81	26

0'61	60'61	77
0'147	00'147	70

0°A1	10°A1	1A
0001	10010	2

1000 1000 1000

0.61 66.01 76

2'61	20'61	19
------	-------	----

1-81	90-81	6
0-81	80-81	2

86-41	86-41	0
30147	30147	0

0°61	60°61	1
50°61	60°61	1

0'61 60'61 0

201 64.91 0

00'61

10' 01" 20' 01" 0

0.61	60.61	0
3.11	31.11	3

716 460000 6

CONFIDENTIAL RECORD

WILLIAM SAVO

1. 010051 140214

*** STATION: 5191 ***
 LATITUDE 1 271131
 LONGITUDE 1 804547

S-171 SPILLWAY ON CANAL C-52 AT LAKE UKELEHUI
 UPLAND STAGE FEET
 MEAN DAILY VALUE
 AGENCY: WMO
 COUNTY: UKELE

8/7/04

	1976			1976			1976			1976			1976			
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY			
1	19.21	19.11	18.97	19.17L	18.93	17.04	17.07	19.11	19.05	18.99	19.17L	18.94	1			
2	19.10	18.88L	19.17	19.01L	19.07	18.99	19.04	19.01	19.03	19.06	19.07	18.97	2			
3	18.99	18.99	19.00	18.75	19.19	19.02	19.04	18.96	19.02	19.08	19.04	19.09L	3			
4	18.98	19.09L	18.95L	18.77	18.98L	19.01	19.04	19.02	19.01	19.09	19.03	19.18	4			
5	19.05	19.20	19.06L	18.78	18.84L	19.02	19.04	19.00	19.00	19.07	19.05	19.01	5			
6	19.11	19.03	19.14	18.84	18.93	19.01	19.03	19.02	19.01	19.06	19.04	18.94	6			
7	19.16	18.90L	19.24	18.92	18.98	19.02	19.03	19.04	18.99	19.05	19.06	19.11	7			
8	19.03	18.92L	19.11	18.97L	19.02	19.01	19.01	19.05	19.05	19.11	19.02L	18.91L	8			
9	18.81L	18.95L	18.88L	19.16L	19.00	19.03	18.98	19.06	18.97	19.03	19.16L	19.07	9			
10	18.89L	18.98	18.95	18.93L	18.78	19.01	19.00	19.03	19.02	19.13	19.00	19.21	10			
11	19.01	19.01	19.02L	19.10	19.05	19.04	19.02	19.04	19.01	19.00	19.00	18.91	11			
12	19.12	19.05	19.07	19.03	19.02	19.01	19.00	19.02	19.04	19.09	19.17	19.10	12			
13	19.18	19.09	19.11	18.87	19.08	19.01	18.98	19.06	19.04	19.05	18.93	19.00	13			
14	19.08	19.16	19.16	18.98L	18.99	19.02	19.04	19.00	18.97	18.95	19.06	19.03	14			
15	18.88	19.22	19.19	19.07L	19.12	19.03	18.98	18.94	19.04	19.10	19.21	19.06	15			
16	18.96	18.87	19.21L	19.13L	19.02	19.03	19.05	19.01	19.03	19.11	18.95	19.04	16			
17	19.04L	18.92	19.09L	19.16L	19.02	19.02	19.00	19.04	19.06	19.07	18.99	19.12	17			
18	19.10L	18.96	18.89L	19.19L	18.99	19.03	18.99	19.00	19.05	19.03	19.13	19.01	18			
19	19.13	19.02	18.90	19.21L	19.04	19.06	19.01	19.02	19.06	19.06	19.07	19.11	19			
20	19.18	19.08	18.93	19.06	19.05	19.01	18.97	19.02	18.98	19.05	18.91	19.13	20			
21	19.03	19.11	18.96	18.84	19.03	19.03	19.03	19.03	19.06	18.97L	19.07	19.10L	21			
22	18.79L	19.15L	18.99L	18.87	19.09	18.53	19.01	19.01	18.97	19.10L	19.21L	19.24	22			
23	18.82	19.20L	19.06L	18.89	19.01	19.01	18.97	19.03	18.98	19.18L	18.96	18.94	23			
24	18.85	19.20	19.06L	18.90	19.00	19.00	19.01	19.01	19.01	19.11	18.96	19.09	24			
25	18.88	19.09	19.08	18.91	19.00	19.01	18.99	19.01	19.01	18.90	19.06	19.23	25			
26	18.93	18.91	18.89	18.92	19.00	19.03	19.03	19.01	19.03	19.03	19.16	19.01	26			
27	19.00	19.07L	19.11	18.93	19.02	19.03	19.06	19.02	19.03	19.13	19.06	19.03	27			
28	19.10L	19.17L	19.12	18.93	19.00	19.02	19.03	19.05	19.00	19.05	18.92	19.09	28			
29	19.15L	19.18	19.13	18.93L	19.03	19.03	19.05	19.04	19.05	18.89	19.04	19.00	29			
30	19.19L		19.14	18.92	18.99	19.04	19.02	19.07	19.02	18.96	19.19	19.09	30			
31	19.23		19.14		18.98		19.05	19.02		19.08		18.99	31			
MAX	19.23	19.22	19.24	19.21L	19.19	19.06	19.07	19.11	19.06	19.16L	19.21	19.24				
MEAN	19.03	19.05	19.06	18.97	19.02	19.01	19.02	19.03	19.02	19.05	19.06	19.06				
MIN	18.79L	18.87	18.88L	18.75	18.88L	18.53	18.98	18.96	18.96	18.88	18.91	18.91L				
SUM	589.88	552.51	590.92	569.13	589.49	570.15	589.61	589.90	570.53	590.58	571.71	590.75				

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 T - TRAIL AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH R
 R - INCLUDED IN NEXT AMOUNT TAGGED A

*** STATION: 5161 ***
 LATITUDE 1 271131
 LONGITUDE 1 804547

5-161 SPILLWAY ON CANAL C-54 AT LAKE DICKINSON
 UPSTREAM STAGE FEET
 MEAN DAILY VALUE

84703704.

AGENCY: WMD
 COUNTY: DICKINSON

	1977			1977			1977			1977			1977			
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY			
1	19.09	19.10L	19.01L	18.82	18.74L	18.99	19.16	19.16	18.45	19.06	19.03	18.67	1			
2	19.11	19.06	19.01L	18.85	18.75L	19.05	19.06	19.04	18.01	19.02	19.10	18.98	2			
3	19.02L	19.04	18.91L	18.99L	18.76L	19.02	18.90	18.83L	18.68	19.04	19.14	19.00L	3			
4	19.01	19.02L	18.91	18.93L	18.77L	19.06	18.97	18.80L	18.99	19.01	18.86	18.98	4			
5	19.00L	19.02L	18.94	18.96L	18.40	19.03	19.03	18.91L	18.98	19.10L	19.05	19.00	5			
6	18.98	19.16L	19.08	18.99L	18.69	19.00	19.10	18.93L	18.99	18.99L	18.95	19.01	6			
7	19.03L	18.87L	19.04L	19.01L	18.94	19.00	19.15	18.97L	18.92	19.02L	19.03	19.01	7			
8	19.13L	19.05L	18.88L	19.01L	18.96L	19.02	19.21	19.00	18.95	19.00	18.99	18.98	8			
9	18.90	19.02L	19.00L	19.03L	19.02L	18.98	19.23	19.04	18.95	19.19	18.65	18.98	9			
10	19.10L	18.99L	19.10	19.05L	19.09	19.01	18.78	19.07L	18.93	18.88	19.01	18.99	10			
11	19.00L	19.06L	19.07	19.04L	19.15L	19.09L	18.81L	18.75L	18.95	19.07	19.14L	18.98	11			
12	18.95L	19.15L	18.91	19.04L	19.17L	18.95	18.84L	18.87L	19.00	19.01	19.20L	18.99	12			
13	19.09L	18.86	19.05	19.05L	19.00L	19.15	18.86L	19.13	19.00	18.93L	18.95L	18.98	13			
14	19.03	19.03	19.17	19.08L	18.79L	18.76L	18.92	18.94L	19.00	19.03L	18.87L	18.96	14			
15	18.94	19.18	18.95L	19.12L	18.61	18.96	19.03	19.01	19.01	19.10	18.96L	19.00	15			
16	19.01	18.90L	18.89	19.13L	18.82L	19.07	19.16	19.03L	19.06	19.20L	19.04L	18.97	16			
17	19.01L	18.96L	18.97	19.12L	18.82L	19.16	19.96	19.16	19.00	18.97L	19.13	18.96	17			
18	19.04	19.07	19.07L	19.12L	18.81L	19.22	19.04L	18.87	19.05	18.89	19.09	18.95	18			
19	19.00L	19.20	19.15L	19.12L	18.81L	18.82	19.16L	18.97	19.08	18.97L	18.82L	18.93	19			
20	19.10	18.91L	19.22	19.13L	18.80L	18.96	18.85L	19.03	19.02	19.05L	18.92L	18.97	20			
21	19.14L	18.93L	18.88	19.13L	18.80L	19.04	18.99	19.08	19.03	19.10	19.02L	19.02	21			
22	18.93L	19.02L	18.84L	19.14L	18.80L	19.02	19.14	19.06	19.05	19.18	19.11L	19.38	22			
23	19.13	19.09	18.90L	19.15	18.78	19.06	18.90L	18.83	19.04	18.97	19.07L	19.01	23			
24	18.91	19.03L	18.92L	19.17	18.77	18.95	18.96L	18.66	19.01	18.89	19.01	18.95	24			
25	19.05L	18.84L	18.98L	19.20L	18.76	19.04	19.07L	18.34	19.04	19.08	18.97	19.03	25			
26	19.04L	18.94	19.05L	19.20L	18.78	19.16	19.17	18.11L	19.03	19.02	19.00L	18.97	26			
27	18.93	19.05	19.04L	18.99L	19.02	18.85	19.10	18.23L	19.05	18.94L	19.108	19.04	27			
28	19.08	19.03	19.13L	18.72L	19.20	18.95	18.83	18.47L	19.01	19.08L	18.94	19.04	28			
29	18.95L	19.16L	19.16L	18.73	19.31	19.05	18.91	18.74	19.05	19.19	19.09	19.02	29			
30	19.16L		19.22	18.74L	19.44	19.10	19.00	19.02	19.10	18.94	18.98	18.97	30			
31	18.90L		19.06		19.22		19.08	19.05		18.93L		18.96	31			
MAX	19.16L	19.20	19.22	19.20L	19.44	19.22	19.23	19.18	19.10	19.20L	19.20L	19.38				
MEAN	19.03	19.01	19.02	19.02	18.92	19.02	19.01	18.86	18.95	19.03	19.02	19.00				
MIN	18.88L	18.84L	18.84L	18.72L	18.75L	18.82	18.78	18.11L	18.01	18.88	18.82L	18.87				
SUM	589.82	532.39	589.58	570.66	586.59	570.72	589.37	585.34	568.43	589.84	570.47	588.94				

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 ! - TRAIL AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A

*** STATION: 5141 ***
 LATITUDE: 1 271131
 LONGITUDE: 1 804547

S-121 SPILLWAY ON CANAL C-52 AT LAKE OKTCHUMET
 UPSTREAM STAGE FEET
 MEAN DAILY VALUE
 AGENCY: WMD
 COUNTY: UNLEC

6/7/05/04.

	1978				1978				1978				1978				
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY				
1	18.49	18.04	18.06	18.04	18.05	18.04	18.04	18.49	18.01	18.00	18.43L	18.40	1				
2	18.04	18.43	18.47	18.18	18.13L	18.13	18.04	18.01	18.00	18.00	18.44	18.42	2				
3	18.48	18.08	18.44	18.47	18.01	18.15	18.08	18.00	18.00	18.06	18.46L	18.87	3				
4	18.43L	18.40	18.04L	18.42	18.44	18.20	18.08	18.49	18.02	18.15	18.40	18.02	4				
5	18.46	18.03	18.40L	18.04	18.10	18.42	18.47	18.01	18.02	18.15	18.40	18.86	5				
6	18.03	18.48	18.02	18.15	18.12L	18.15	18.07	18.01	18.01	18.49	18.05	18.87	6				
7	18.44L	18.45	18.04	18.02	18.01	18.42	18.05	18.01	18.49	18.02	18.84	18.04	7				
8	18.04	18.15	18.48	18.84	18.49	18.11	18.10	18.03	18.03	18.05	18.42	18.81L	8				
9	18.03L	18.48	18.02	18.43	18.47	18.45	18.48	18.49	18.02	18.05	18.40	18.87L	9				
10	18.43L	18.04L	18.48	18.02	18.16L	18.19	18.04	18.03L	18.04L	18.08	18.42	18.47	10				
11	18.49	18.01	18.01	18.10	18.03L	18.46	18.02	18.01	18.00	18.49	18.42	18.47	11				
12	18.05	18.06	18.49	18.15	18.86	18.02L	18.05	18.04	18.00	18.04	18.42	18.74L	12				
13	18.00	18.45	18.00	18.06	18.46	18.08L	18.05	18.01	18.00	18.07	18.89	18.86L	13				
14	18.44L	18.10L	18.02	18.82	18.05L	18.45	18.02L	18.02	18.49	18.03	18.44	18.01L	14				
15	18.45L	18.47L	18.49	18.49	18.09L	18.49	18.05	18.05	18.00	18.05	18.00	18.03L	15				
16	18.48	18.01	18.01	18.46	18.12	18.13	18.06	18.03	18.48	18.11	18.83	18.76	16				
17	18.47	18.46	18.48	18.01	18.16	18.24L	18.00	18.03	18.01	18.08	18.02	18.86	17				
18	18.01	18.06	18.02	18.03	18.01	18.07L	18.05	18.01	18.01	18.04	18.80	18.47	18				
19	18.03	18.07	18.05	18.14	18.43L	18.89	18.05	18.03	18.00	18.05	18.01	18.44	19				
20	18.46	18.46	18.06	18.44	18.01L	18.46	18.16	18.04	18.05	18.04	18.86	18.48	20				
21	18.49	18.03	18.02	18.13	18.47	18.04	18.02	18.00	18.07	18.14	18.47	18.47	21				
22	18.02	18.03L	18.49	18.49	18.11	18.00	18.01	18.05	18.00	18.04	18.84	18.40	22				
23	18.04	18.00L	18.12	18.04	18.14	18.06	18.04	18.03	18.02	18.03	18.47	18.60	23				
24	18.00	18.03	18.42	18.02	18.17	18.06	18.02	18.04	18.00	18.04	18.40	18.70	24				
25	18.49	18.24	18.17	18.47	18.48	18.03	18.00	18.00	18.48	17.70	18.86L	18.86	25				
26	18.03L	18.14	18.48	18.15L	18.48	18.05L	18.02	18.04	18.00	17.70L	18.04L	18.02	26				
27	18.01L	18.13	18.14	18.04L	18.84	18.08	18.05	18.10	18.00	18.01L	18.82	18.42	27				
28	18.02L	18.02	18.47	18.86	18.84	18.08	18.65	18.62	18.49	18.26	18.84	18.91L	28				
29	18.01L		18.04	18.43	18.46	18.03	20.65	18.49	18.02	18.54	18.03	18.84	29				
30	18.03L		18.01	18.00	18.02	18.04	18.49	18.63	18.47	18.82L	18.85	18.88	30				
31	18.00		18.88		18.05		18.02	18.01		18.41		18.41	31				
MAX	18.05L	18.24	18.17	18.18	18.17	18.24L	20.65	18.10	18.07	18.15	18.05	18.04					
MEAN	18.00	18.03	18.01	18.01	18.02	18.06	18.12	18.02	18.01	18.28	18.42	18.86					
MIN	18.43L	18.40	18.88	18.82	18.76	18.49	18.48	18.44	18.97	17.70	18.60	18.37					
SUM	548.48	532.92	544.34	570.34	544.73	571.77	542.60	544.75	570.23	566.77	567.64	564.61					

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 ! - TRACE AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A

64/35/04.

DATA TAG LEGEND

V - NO DATA COLLECTED
P - SUMMARY COMPUTED FROM PARTIAL RECORD
E - ESTIMATED
L - LESS THAN
X - INCLUDES PREVIOUS DAYS WITH X
A - INCLUDED IN NEXT ANNUAL TAGGED A

*** STATION: SE/L ***
 LATITUDE 1 271131
 LONGITUDE 1 804547

5-191 SPEEDWAY ON CANAL C-59 AT LAKE HICKCHURCH
 UPSTREAM STAGI FILE
 MEAN DAILY VALUE
 AGENCY: WMD
 COUNTY: WKEEC

84/05/04.

	1980		1980		1980		1980		1980		1980		
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	19.07	19.03	19.00	19.01	19.01	19.16	19.05E	19.06	19.04	19.04	19.04	19.15	1
2	19.16	19.02	19.00	19.01	19.06	19.21	19.10E	19.02	19.03	19.04	19.00	19.09L	2
3	19.08	19.06	19.02	19.05	19.10	19.22	19.10E	19.14	19.03	19.08	19.06	19.03L	3
4	19.03	19.03	19.08	19.06	19.02	19.22	19.11E	19.07	19.01	19.08	19.12	19.15	4
5	19.06L	19.12	19.02	19.03	19.00	19.01	19.03E	19.18	19.05	19.08	19.1E	19.10	5
6	19.14L	19.01	19.01	19.08	19.00L	19.04	19.05E	19.07	19.04	19.08	19.23	19.08	6
7	19.00	19.09L	19.07	19.05	19.06	19.06	19.01E	19.13	19.04	19.02	19.27	19.05	7
8	19.05	19.07	19.08	19.00	19.13	19.06	19.00E	19.04	19.04	19.04	19.04	19.10	8
9	19.05	19.15	19.07	19.07	19.05	19.08	19.05	19.06	19.02	19.04	19.04	19.16	9
10	19.06	19.04	19.08	19.08	19.01	19.02	19.14	19.14	19.05	19.13	19.06	19.21	10
11	19.15	19.00	19.08	19.00	19.07	19.02	19.05	19.00	19.00	19.07	19.14L	19.00L	11
12	19.07	19.05	19.01	19.01	19.03	19.05	19.05	19.07	19.04	19.07	19.14L	19.06L	12
13	19.03	19.09	19.01	19.01	19.07	19.07	19.03	19.01	19.07	19.20	19.21	19.04	13
14	19.05	19.07	19.01	19.01	19.02	19.06	19.04	19.00	19.01	19.05	19.23	19.11	14
15	19.02	19.07	19.16	19.09	19.12	19.06	19.02	19.10	19.04	19.02	19.09	19.19	15
16	19.09	19.03	19.04	19.03	19.01	19.05	19.07	19.08	19.06	19.12	19.06	19.22	16
17	19.01	19.03	19.04	19.12	19.04	19.04	19.06	19.14	19.07	19.21	19.06	19.03	17
18	19.14	19.01	19.02	19.04	19.04	19.02	19.05	19.00	19.08	19.14	19.05	19.03	18
19	19.09	19.04	19.01	19.02	19.05	19.04	19.03	19.08	19.07	19.08	19.06	19.10	19
20	19.05	19.03	19.09	19.00	19.13	19.09	19.05	19.06	19.04	19.08	19.07	19.19	20
21	19.01	19.00	19.03	19.02	19.01	19.02	19.08	19.09	19.06	19.18	19.01	19.07	21
22	19.02	19.08	19.12	19.00	19.09	19.02	19.04	19.05	19.07	19.08	19.02	19.09	22
23	19.04	19.01	19.04	19.13	19.08	19.04	19.03	19.12	19.05	19.05	19.14	19.16	23
24	19.02	19.02	19.04	19.04	19.07	19.04	19.04	19.06	19.05	19.07	19.06	19.06	24
25	19.05	19.02	19.13	19.08	19.15	19.09	19.00	19.06	19.01	19.13	19.07	19.02	25
26	19.11	19.04	19.07	19.13	19.05	19.17	19.04	19.01	19.01	19.15	19.06	19.14	26
27	19.06	19.02	19.07	19.06	19.08	19.06	19.01	19.04	19.06	19.17	19.12	19.15	27
28	19.01	19.00	19.10	19.03	19.00	19.08	19.05	19.04	19.05	19.19	19.03	19.02	28
29	19.04	19.00	19.04	19.01	19.05	19.07	19.04	19.05	19.07	19.21	19.14	19.03L	29
30	19.03		19.04	19.05	19.05	19.15	19.06	19.03	19.04	19.23	19.06	19.13	30
31	19.01		19.02		19.13		19.07	19.04		19.10		19.22L	31
MAR													
MEAN													
MIN													
SUM													
MAR													
MEAN													
MIN													
SUM													

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 ! - FULL AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A

*** STATION: 5141 ***
 LATITUDE 1 271131
 LONGITUDE 1 804347

5-141 SPILLWAY IN CANAL C-54 AT LAKE OKEECHOBEE
 UPSTREAM STAGE FILE
 MEAN DAILY VALUE

09/03/04.

	1981		1981		1981		1981		1981		1981		1981	
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY	
1	19.10	18.94	19.25	19.11	19.02	18.87	18.60	19.06	19.13	19.11	19.04	19.22	1	
2	18.96L	19.10	19.11	19.14	19.01L	18.87	18.61	19.12	19.01	19.12	19.05L	19.11	2	
3	19.05	19.01L	18.94L	19.14	18.97L	18.88	18.62	19.11	19.15	19.12	19.14L	19.02L	3	
4	19.12L	19.10L	19.01	19.16	18.92L	18.87	18.62	19.14	19.14	19.17	19.23L	19.07L	4	
5	19.20L	19.05	19.10	19.16	18.93	18.88	18.61	19.06	19.12	19.05L	19.07	19.11L	5	
6	19.25	19.00	19.17L	19.14L	18.90	18.86	18.61	19.07	19.19	19.22	19.10L	19.14L	6	
7	19.09	19.12	19.22L	19.16L	18.97	18.94	18.60	19.11	19.12	19.01	19.19	19.16	7	
8	18.92	19.05	19.25	19.15L	19.22	18.97	18.62	19.07	19.01	19.15	19.25	19.21L	8	
9	19.00	19.05	19.14	19.15L	19.30	19.01	18.62	19.19	19.02	19.13	19.12	19.08L	9	
10	19.08L	19.08	19.03	19.16L	19.31	19.04	18.60	19.04	19.13	19.10	19.00	18.91L	10	
11	19.13L	19.06	19.11	19.17	19.02	19.08	18.60	19.12	19.12	19.24	19.09	18.94L	11	
12	19.18L	19.00	19.15L	19.17	18.93	19.09	18.60	18.96	19.06	19.01L	19.15L	18.97L	12	
13	19.21	19.03L	19.20	19.18L	18.92	19.10	18.67	19.06	19.13	19.07L	19.21L	19.01	13	
14	19.07	18.03L	19.27L	19.17L	18.91	19.09	18.75	19.05	19.16	19.18L	19.24	19.06L	14	
15	18.92	19.11L	19.30	19.16L	18.69	19.07	18.80	19.10	19.05	19.11	19.28	19.15	15	
16	19.02	18.94L	19.07L	19.17L	18.89	19.05	18.87	19.02	19.03	19.04L	19.06	19.22L	16	
17	19.11L	19.15	18.91	19.21	18.87	18.91	18.93	19.06	19.14	19.13	18.94L	19.00	17	
18	19.15L	19.20	18.95L	19.21	18.87	18.14	19.06	19.06	19.14	19.22	18.98L	18.92	18	
19	19.20	19.05	19.04L	19.21	18.85	18.13	19.14	19.09	19.05	19.08	19.03	18.94L	19	
20	19.15	19.17L	19.05L	19.21	18.87	18.19	19.22	19.09	19.11	19.00L	19.07	19.02L	20	
21	18.93L	19.09	19.06	19.20	18.97L	18.25	19.09	19.15	19.12	19.08	19.13L	19.03L	21	
22	19.01L	19.01	19.09	19.19L	18.97L	18.32	18.90	19.09	19.11	19.17	19.17	19.08	22	
23	19.03L	19.13L	19.14L	19.16	18.95	18.38	18.84	19.08	19.13	19.07	19.21	19.16	23	
24	19.19	19.06L	19.22L	19.15	18.94	18.43	18.94	19.07	19.10	19.06	19.24L	19.18	24	
25	18.99	18.97	19.24L	19.13	18.92	18.50L	19.09	19.09	19.12	19.05	19.13L	19.22	25	
26	18.93	18.07	19.09L	19.10	18.92	18.56	19.15	19.08	19.12	19.13	19.00L	19.25	26	
27	19.02	19.14	18.92L	19.09	18.93	18.58	19.21	19.10	19.17	19.21	19.06L	19.28	27	
28	19.09	19.19	18.96L	19.08	18.94	18.60	19.11	19.12	19.05	19.11	19.10	19.09	28	
29	19.15		19.00L	19.06	18.93	18.61	18.96	19.11	19.15	18.97	19.15	18.94	29	
30	19.15		19.03	19.04	18.91	18.61L	19.02	18.94	19.12	19.07	19.19	19.00L	30	
31	18.84L		19.08		18.89		19.04	19.09		19.21L		19.04	31	
MAX	19.25	19.20	19.30	19.21	19.31	19.10	19.22	19.19	19.19	19.24	19.28	19.28		
MIAN	19.08	19.07	19.10	19.15	18.96	18.72	18.85	19.08	19.10	19.11	19.12	19.09		
MIN	18.84L	18.94	18.91	19.04	18.85	18.14	18.60	18.96	18.94	18.96	18.94L	18.91L		
SUM	591.37	593.45	592.15	574.57	587.87	561.50	584.20	591.47	573.00	592.29	573.62	591.66		

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 ! - TRAIL AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A

64/05/04.

DATA TAG LEGEND

V - NO DATA COLLECTED
P - SUMMARY COMPUTED FROM PARTIAL RECORD
E - ESTIMATED
C - LESS THAN
X - INCLUDES PREVIOUS DAYS WITH X
A - INCLUDED IN NEXT AMOUNT TAGGED A

*** STATION 5191

LATITUDE : 271131
LONGITUDE : 804547

5-191 SPILLWAY ON CANAL C-57 AT LAKE OKELCHINTI
UPSTREAM STAG
FEET

MEAN DAILY VALUE
COUNTRY: U.S.A.
AGENCY: WMD

84/05/04

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	19.01	19.15	19.12	19.11	19.16	19.11	19.10	19.08	19.06	19.03	19.06	19.21	1
2	19.08	19.09	19.14	19.12	19.11	19.17	19.15	19.05	19.08	19.05	19.05	19.07	2
3	19.08	19.10	19.15	19.10	19.10	19.08	19.08	19.07	19.07	19.08	19.08	19.10	3
4	19.03	19.09	19.14	19.12	19.14	19.08	19.05	19.07	19.07	19.07	19.07	19.10	4
5	19.14	19.14	19.12	19.09	19.09	19.09	19.09	19.05	19.05	19.07	19.07	19.07	5
6	19.03	19.12	19.08	19.08	19.07	19.07	19.13	19.13	19.11	19.11	19.11	19.15	6
7	19.17	19.17	19.15	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	7
8	19.17	19.17	19.15	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	8
9	19.06	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	9
10	19.08	19.10	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	10
11	19.07	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	11
12	19.07	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	12
13	19.12	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	13
14	19.10	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	14
15	19.00	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	15
16	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	16
17	19.02	19.07	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	17
18	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	18
19	19.10	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	19
20	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	20
21	19.10	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	21
22	19.09	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	22
23	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	23
24	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	24
25	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	25
26	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	26
27	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	27
28	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	28
29	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	29
30	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	30
31	19.14	19.14	19.12	19.11	19.11	19.11	19.07	19.07	19.07	19.07	19.07	19.10	31

O A T A T A C L E E N D

M - MISSING DATA
S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
L - LINE-ADAPTABLE
7 - UNESTIMABLE
2 - GREATEST THAN
1 - EXACT AMOUNT

O A T A T A C L E E N D

A - NO DATA COLLECTED
P - SUMMARY COMPUTED FROM PARTIAL RECORD
E - ESTIMATED
C - LESS THAN
A - INCLUDES PREVIOUS DAYS WITH A
X - INCLUDE IN NEXT AMOUNT TABLE

*** STATION: 5141 ***
 LATITUDE : 271131
 LONGITUDE : 804547

S-141 SPILLWAY ON CANAL C-52 AT LAKE OKEECHUBEE
 UPSTREAM STAGE FEET
 MEAN DAILY VALUE

69/05/64.

AGENCY: WMD
 COUNTY: OKEEC

	1964	1964	1964	1964	1964	1964	1964	1964	1964	1964	1964	1964	
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	19.03	18.93	18.92	18.97	19.02	18.95	19.11	19.12	19.04L	19.17L	19.00L	19.07L	1
2	19.07	19.12	18.93	19.04	19.07	18.96	19.09	19.10	19.15	19.08	19.16	19.10	2
3	19.07	18.95	18.91	18.94	19.10	19.02	19.04	19.17	19.11	19.07	18.99	19.04	3
4	19.02	19.03	18.95	18.95	19.14	18.98	19.12	18.96	19.03	19.08	19.05	19.07	4
5	19.08	18.92	18.93	18.96	19.02	19.07	19.06	19.07	19.10	19.08	19.08	19.07	5
6	19.04	18.92L	18.93	18.96	18.95	18.91	19.14	19.09	19.03	19.11	19.05L	19.10	6
7	19.03	19.04	18.97	18.99	18.89	18.99	19.11	18.99	19.07	19.10	19.18L	19.06	7
8	18.97	18.97	18.98L	19.04	18.97	19.04	19.03L	19.07	19.06	19.06L	19.05	19.14	8
9	19.01	18.94	18.98	18.98	19.10	18.95	19.12	19.08	19.11	19.06L	19.01	18.97	9
10	19.00	19.08	18.94	18.97	18.90	19.01	19.15	19.09	19.13	19.06L	19.14	19.08	10
11	19.03	18.95	18.96	18.97	18.89	19.02	19.00	19.11	19.09	19.14L	19.13	19.10	11
12	19.04	18.91	19.04	19.05	18.94	19.03	19.13	19.07	19.17	19.06L	18.96L	19.07	12
13	19.04	19.06	19.01	18.96	18.99	19.04	19.07	19.09L	18.97	19.02L	19.05L	19.07	13
14	18.97	18.83	18.95	18.92	19.02	19.02	19.10	19.06	19.17	19.15	19.12L	19.13	14
15	19.13	19.02	18.96	19.04	19.05	19.05	19.15	19.09	19.00	19.02	19.19L	19.01	15
16	19.05	18.91	19.03	18.95	19.08	19.07	19.07	19.07	19.11	19.10	19.05	19.05	16
17	19.08	18.89	18.95	18.98	19.09	19.00	19.12	19.13	19.05	19.09	18.97L	19.07	17
18	18.96	19.02	18.98	18.97	19.11	19.01	19.07	19.07	19.08	19.04	19.08	19.03	18
19	19.10	19.06	18.97	19.03	19.12	19.05	19.12	19.06	19.09	19.18	19.18	19.18	19
20	18.97	18.94	18.94	18.91	19.12	18.98	19.07	19.06	19.03	19.07	19.06	19.02	20
21	19.03	18.94	18.94L	19.07	19.13	19.03	19.07	19.07	19.07	19.09	18.98	19.07	21
22	19.06	19.03	18.95	18.97	19.00	19.08	19.12	19.06	19.05	19.13	19.09	19.20	22
23	19.09	19.03	19.01	19.03	18.96	19.11	19.06	19.06	19.04	19.03	19.03	18.96	23
24	18.99	18.94	18.96L	18.94	19.04	19.12	19.09	19.05	19.08	19.17L	19.06	19.09	24
25	19.05	18.94	19.02	18.90	18.99	19.12	19.07	19.06	19.08	18.98L	19.05	19.22	25
26	19.09	18.94	18.85	19.01	19.00	19.06	19.10P	19.07	19.04L	19.16	19.06	18.95	26
27	19.02	18.95	18.87	19.09	18.95	19.11	19.09	19.04	19.10	19.03	19.06	19.08	27
28	19.14L	18.96	18.97	19.11	18.96	19.08L	19.15	19.09	19.05	19.07	19.06	19.21	28
29	18.99	18.95L	18.97L	18.87	18.94	19.09	19.08	19.16	19.08	19.16	19.10	18.95	29
30	19.06		19.00	18.95	18.95	19.06	18.90P	19.00	19.06	18.98L	19.03	19.09	30
31	18.96		18.96		18.95L		19.09	19.15		19.11L		19.20	31
MAX	19.14L	19.05	19.04	19.11	19.14	19.12	19.15	19.17	19.17	19.18	19.19L	19.22	
MEAN	19.04	19.00	18.97	18.97	19.00	19.03	19.09	19.08	19.07	19.08	19.07	19.08	
MIN	18.96	18.83	18.87	18.87	18.82	18.91	18.90P	18.98	18.97	18.98L	18.96L	18.95	
SUM	590.19	590.87	587.93	589.24	589.14	571.01	591.71	571.42	572.24	591.62	572.02	591.45	

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 ! - TRAIL AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A

*** STATION: 5141 ***
 LATITUDE 1 271131
 LONGITUDE 1 804547

S-191 SPILLWAY (ON CANAL C-5) AT LAKE JOELHURST
 UPSTREAM STAGE FEET
 MEAN DAILY VALUE
 AGENCY: WMD
 COUNTY: UNKFL

84/05/04.

	1985			1985			1985			1985			1985			
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY	JAN	FEB	MAR
1	18.44	19.14	18.96	19.16	18.47	18.54	17.13	19.26	18.98	19.11	18.44	18.42	1	18.44	19.14	18.96
2	19.04	19.23	19.01	19.14	18.42	18.51	19.02	19.16	19.03	19.01	19.05	18.47	2	19.04	19.23	19.01
3	19.15	18.71	19.05	19.07	18.84	18.44	19.05	19.08	19.02	19.11	18.46	18.41	3	19.15	18.71	19.05
4	19.00	18.48	19.07	19.01	18.87	18.44	18.48	19.10	19.05	19.09	18.45	19.09	4	19.00	18.48	19.07
5	19.02	19.04	19.04	18.40	18.84	18.34	19.06	19.07	19.04	19.04	19.04	19.00	5	19.02	19.04	19.04
6	19.22	19.10	19.14	18.83	18.80	18.35	18.43	19.06	19.03	18.59	18.44	19.00	6	19.22	19.10	19.14
7	18.92	19.18	19.04	18.73	18.76	18.35	18.44	19.06	19.01	19.08	18.43	18.46	7	18.92	19.18	19.04
8	19.03	19.08	18.44	18.65	18.72	18.36	19.12	19.06	19.01	19.07	19.03	19.08	8	19.03	19.08	18.44
9	19.13	18.44	19.04	18.65	18.68	18.36	19.04	19.03	19.01	19.07	18.90	18.90	9	19.13	18.44	19.04
10	19.04	18.44	19.07	18.50	18.64	18.37	19.10	19.06	19.10	19.05	19.01	18.44	10	19.04	18.44	19.07
11	18.44	19.04	19.04	18.50	18.64	18.37	19.12	19.06	19.07	19.04	19.00	19.05	11	18.44	19.04	19.04
12	18.45	19.15	19.04	18.45	18.64	18.37	19.11	19.06	19.07	19.04	18.44	18.87	12	18.45	19.15	19.04
13	18.41	19.21	19.11	18.44	18.61	18.50	19.05	19.04	19.06	19.11	19.10	19.06	13	18.41	19.21	19.11
14	18.40	19.07	19.12	18.56	18.57	18.77	19.11	19.02	19.07	19.05	18.62	18.43	14	18.40	19.07	19.12
15	18.40	18.44	19.12	18.74	18.54	19.01	19.08	19.02	19.06	19.10	18.92	19.00	15	18.40	18.44	19.12
16	18.41	18.44	19.04	19.10	18.50	19.16	19.10	18.45	19.06	19.10	19.06	19.08	16	18.41	18.44	19.04
17	18.43	19.05	19.07	19.10	18.57	19.07	19.11	19.02	19.05	19.06	18.44	18.84	17	18.43	19.05	19.07
18	18.48	19.11	19.05	19.01	18.57	19.08	19.10	19.13	19.08	19.10	19.02	19.06	18	18.48	19.11	19.05
19	19.03	19.17	19.13	19.13	18.53	19.17	19.08	19.02	19.11	19.11	19.05	18.45	19	19.03	19.17	19.13
20	19.07	19.08	19.23	19.23	18.51	19.05	19.12	18.43	19.14	19.12	18.44	18.91	20	19.07	19.08	19.23
21	19.04	18.43	19.13	19.06	18.50	18.42	19.03	19.05	19.14	19.01	18.97	19.03	21	19.04	18.43	19.13
22	19.08	18.47	19.11	18.96	18.53	19.07	19.11	19.01	19.06	19.13	18.99	19.13	22	19.08	18.47	19.11
23	19.11	19.02	19.05	18.46	18.51	19.03	19.13	19.04	19.21	18.81	18.87	18.93	23	19.11	19.02	19.05
24	19.18	19.07	19.16	18.79	18.51	19.08	19.05	19.05	19.10	18.85	18.44	18.86	24	19.18	19.07	19.16
25	19.06	19.12	19.01	18.94	18.58	19.17	19.13	19.04	18.48	19.04	19.11	19.00	25	19.06	19.12	19.01
26	19.07	19.17	19.15	18.97	18.62	19.03	19.07	19.02	19.07	19.00	18.98	19.10	26	19.07	19.17	19.15
27	19.13	19.22	19.19	18.46	18.64	19.04	19.10	19.01	18.46	19.02	18.95	19.00	27	19.13	19.22	19.19
28	19.09	19.10	19.19	18.95	18.62	19.07	19.07	19.01	19.07	18.44	19.07	18.86	28	19.09	19.10	19.19
29	18.45		19.14	18.43	18.66	19.02	19.24	19.07	19.13	19.04	19.06	18.44	29	18.45		19.14
30	19.01		19.18	18.97	18.57	18.89	18.44	19.01	19.04	18.91	18.85	19.12	30	19.01		19.18
31	19.07		19.17		18.56		19.12	19.04		19.02		19.02	31	19.07		19.17
MAX	19.22	19.23	19.23	19.23	18.97	19.17	19.24	19.26	19.21	19.13	19.11	19.13		19.22	19.23	19.23
MEAN	19.03	19.07	19.10	18.84	18.65	18.77	19.08	19.05	19.06	19.04	18.98	18.44		19.03	19.07	19.10
MIN	18.40	18.41	18.46	18.45	18.50	18.35	18.43	18.43	18.46	18.81	18.82	18.86		18.40	18.41	18.46
SUM	589.95	534.00	542.88	566.74	578.00	563.04	541.39	546.62	571.76	540.24	569.24	588.66		589.95	534.00	542.88

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 ! - TRACE AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A

*** STATION: 5171 ***
 LATITUDE 1 271131
 LONGITUDE 1 804547

5-101 SPILLWAY ON CANAL C-54 AT LAKE UKELEHUE
 UPSTREAM STAGE FEET
 MEAN DAILY VALUE
 AGENCY: WMD
 COUNTY: UKELE

8/7/57/04.

	1986		1986		1986		1986		1986		1986		1986	
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY	
1	18.89	18.83	18.94	18.94	18.53	19.04	19.42	19.44	19.42	19.41	19.38	19.47	1	
2	19.00	18.93	18.89	19.01	18.52	19.06	19.41	19.42	19.39	19.38	19.38	19.30	2	
3	19.10	19.01	19.00	19.03	18.51	19.07	19.39	19.42	19.38	19.36	19.40	19.44	3	
4	19.04	19.09	19.12	19.02	18.53	19.07	19.42	19.41	19.40	19.43	19.38	19.38	4	
5	18.89	19.13	18.83	17.02	18.52	19.06	19.42	19.45	19.45	19.39	19.36	19.35	5	
6	19.00	18.76	18.85	19.00	18.52	19.04	19.42	19.42	19.40	19.42	19.40	19.40	6	
7	19.10	18.85	18.92	18.99	18.52	19.02	19.42	19.40	19.40	19.40	19.37	19.38	7	
8	18.87	18.93	18.98	18.97	18.51	19.04	19.42	19.43	19.38	19.42	19.39	19.40	8	
9	18.96	19.01	19.03	18.96	18.53	19.06	19.40	19.46	19.38	19.41	19.37	19.34	9	
10	18.99	19.09	18.94	18.92	18.60	19.09	19.43	19.43	19.42	19.38	19.41	19.50	10	
11	19.03	19.17	18.96	18.77	18.60	19.14	19.43	19.42	19.41	19.41	19.34	19.24	11	
12	18.88	19.01	19.02	18.63	18.60	19.31	19.45	19.43	19.42	19.42	19.39	19.38	12	
13	19.06	18.88	18.86	18.51	18.61	19.43	19.47	19.42	19.42	19.40	19.39	19.52	13	
14	18.84	18.96	18.96	18.39	18.62	19.39	19.45	19.42	19.40	19.39	19.37	19.31	14	
15	19.02	19.05	18.93	18.27	19.62	19.40	19.43	19.42	19.41	19.45	19.41	19.30	15	
16	19.02	19.12	18.90	18.28	18.61	19.39	19.42	19.43	19.39	19.37	19.37	19.42	16	
17	18.84	19.05	18.97	18.32	18.61	19.41	19.44	19.47	19.41	19.38	19.36	19.51	17	
18	19.03	18.69	18.90	18.34	18.61	19.41	19.46	19.43	19.40	19.39	19.39	19.44	18	
19	18.73	19.00	19.06	18.34	18.61	19.41	19.43	19.45	19.41	19.41	19.38	19.26	19	
20	18.87	18.96	18.90	18.35	18.61	19.40	19.49	19.42	19.38	19.35	19.40	19.37	20	
21	19.00	18.83	18.95	18.38	18.65	19.41	19.49	19.43	19.39	19.46	19.47	19.47	21	
22	19.12	18.92	19.07	18.43	18.92	19.40	19.42	19.44	19.41	19.30	19.30	19.54	22	
23	18.78	19.01	18.95	18.44	19.01	19.43	19.46	19.45	19.41	19.36	19.43	19.42	23	
24	18.89	19.13	18.79	18.43	19.06	19.43	19.45	19.45	19.40	19.52	19.36	19.34	24	
25	18.99	19.00	18.86	18.47	19.09	19.41	19.45	19.45	19.39	19.24	19.43	19.52	25	
26	18.96	18.80	18.93	18.51	19.10	19.40	19.48	19.41	19.41	19.34	19.40	19.26	26	
27	18.82	18.86	19.01	18.52	19.10	19.43	19.43	19.42	19.34	19.49	19.44	19.42	27	
28	18.90	18.97	19.08	18.53	19.09	19.44	19.43	19.41	19.39	19.34	19.33	19.37	28	
29	18.99		18.98	18.53	19.09	19.43	19.43	19.40	19.44	19.33	19.50	19.39	29	
30	19.11		18.79	18.53	19.06	19.42	19.44	19.42	19.40	19.35	19.32	19.37	30	
31	18.96		18.87		19.06		19.42	19.47		19.38		19.43	31	

MAX	19.12	19.19	19.12	19.03	19.10	19.49	19.49	19.47	19.45	19.52	19.50	19.54
MEAN	18.97	18.97	18.94	18.63	18.73	19.28	19.44	19.43	19.40	19.39	19.39	19.39
MIN	18.78	18.76	18.74	18.27	18.51	19.02	19.39	19.40	19.34	19.24	19.30	19.24
SUM	587.42	531.26	587.24	554.83	580.62	578.49	602.52	602.34	582.05	601.03	581.62	601.24

***** DATA IS PROVISIONAL AFTER 12/31/1799 *****

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 T - TRACE AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A

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But

AGENCY: WFO

44/05/06

1987				1987				1987				1987			
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY		
1	19.39	19.32	19.26	19.39	19.48	19.45	19.47	19.42	19.36	19.40	19.41	19.39	1		
2	19.39	19.49	19.38	19.37	19.48	19.45	19.36	19.38	19.35	19.34	19.38	19.41	2		
3	19.38	19.25	19.49	19.36	19.49	19.48	19.49	19.57	19.35	19.41	19.43	19.46	3		
4	19.38	19.45	19.25	19.40	19.50	19.44	19.35	19.50	19.36	19.45	19.40	19.40	4		
5	19.37	19.37	19.38	19.33	19.50	19.50	19.41	19.36	19.39	19.46	19.41	19.44	5		
6	19.38	19.37	19.47	19.35	19.40	19.50	19.51	19.45	19.42	19.47	19.42	19.44	6		
7	19.39	19.40	19.40	19.36	19.52	19.52	19.36	19.53	19.44	19.47	19.41	19.38	7		
8	19.38	19.37	19.40	19.37	19.17	19.54	19.45	19.57	19.47	19.47	19.42	19.38	8		
9	19.36	19.37	19.38	19.41	19.12	19.58	19.37	19.44	19.48	19.46	19.41	19.42	9		
10	19.39	19.32	19.36	19.31	19.18	19.49	19.51	19.32	19.40	19.49	19.39	19.45	10		
11	19.42	19.50	19.39	19.43	19.36	19.14	19.44	19.36	19.49	19.54	19.39	19.40	11		
12	19.34	19.24	19.35	19.32	19.50	19.12	19.32	19.36	19.49	19.39	19.41	19.37	12		
13	19.38	19.39	19.36	19.26	19.46	19.16	19.50	19.41	19.51	19.45	19.41	19.50	13		
14	19.37	19.53	19.43	19.28	19.29	19.18	19.34	19.45	19.55	19.40	19.40	19.34	14		
15	19.37	19.28	19.27	19.46	19.40	19.21	19.49	19.48	19.55	19.45	19.43	19.45	15		
16	19.35	19.35	19.45	19.37	19.39	19.30	19.36	19.50	19.36	19.41	19.39	19.49	16		
17	19.37	19.39	19.32	19.34	19.41	19.37	19.43	19.43	19.58	19.40	19.37	19.33	17		
18	19.43	19.33	19.46	19.45	19.31	19.39	19.42	19.32	19.34	19.43	19.42	19.49	18		
19	19.33	19.33	19.27	19.55	19.46	19.40	19.45	19.38	19.26	19.40	19.44	19.36	19		
20	19.36	19.43	19.46	19.36	19.42	19.41	19.39	19.39	19.29	19.44	19.45	19.48	20		
21	19.41	19.35	19.42	19.25	19.19	19.40	19.41	19.41	19.34	19.38	19.43	19.34	21		
22	19.39	19.39	19.28	19.33	19.27	19.40	19.39	19.43	19.43	19.36	19.43	19.44	22		
23	19.35	19.35	19.40	19.36	19.33	19.40	19.43	19.43	19.47	19.40	19.42	19.30	23		
24	19.40	19.31	19.53	19.45	19.36	19.37	19.45	19.44	19.38	19.31	19.41	19.47	24		
25	19.40	19.50	19.26	19.49	19.39	19.36	19.43	19.42	19.35	19.46	19.40	19.43	25		
26	19.43	19.27	19.36	19.50	19.41	19.36	19.31	19.42	19.42	19.39	19.42	19.30	26		
27	19.34	19.40	19.36	19.52P	19.43	19.40	19.32	19.40	19.46	19.39	19.40	19.48	27		
28	19.37	19.53	19.38	19.47P	19.44	19.43	19.46	19.38	19.49	19.55	19.38	19.40	28		
29	19.42		19.37	19.											

0000 DATA IS PROVISIONAL AFTER 12/31/1999 0000

DATA TAG LEGEND

M - MISSING DATA
S - UNUSUAL MAG MORE THAN 4 SIG DIGITS
L - LIMIT-AVAILABLE
? - QUESTIONABLE
> - GREATER THAN
T - TRACE AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
P - SUMMARY COMPUTED FROM PARTIAL RECORD
E - ESTIMATED
C - LESS THAN
A - INCLUDES PREVIOUS DAYS WITH X
X - INCLUDED IN NEXT AMOUNT TAGGED A

*** STATION: 5141 ***
 LATITUDE 1 271131
 LONGITUDE 1 804347

5-141 SPILLWAY ON CANAL C-54 AT LAKE OKLECHUBET
 UPSTREAM STAGE FEET
 MEAN DAILY VALUE
 AGENCY: WMO
 COUNTY: OKLEL

09/05/64.

	1968		1968		1968		1968		1968		1968		
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	19.32	19.38	19.41	19.33	19.44	19.44	19.38	19.42	19.42	19.23	19.34	19.28	1
2	19.36	19.43	19.36	19.37	19.30	19.44	19.39	19.34	19.38	19.33	19.41	19.37	2
3	19.51	19.41	19.36	19.52	19.41	19.41	19.37	19.39	19.39	19.49	19.42	19.44	3
4	19.38	19.51	19.43	19.43	19.53	19.36	19.45	19.38	19.40	19.29	19.38	19.50	4
5	19.36	19.31	19.45	19.33	19.46	19.36	19.52	19.41	19.36	19.42	19.36	19.53	5
6	19.47	19.47	19.41	19.44	19.24	19.39	19.45	19.40	19.42	19.35	19.37	19.58	6
7	19.55	19.47	19.38	19.56	19.28	19.44	19.36	19.40	19.42	19.53	19.43	19.29	7
8	19.29	19.39	19.37	19.42	19.30	19.29	19.37	19.40	19.35	19.31	19.38	19.24	8
9	19.38	19.42	19.39	19.31	19.31	19.46	19.55	19.38	19.38	19.35	19.35	19.31	9
10	19.44	19.45	19.35	19.40	19.33	19.51	19.34	19.40	19.42	19.47	19.52	19.36	10
11	19.40	19.41	19.39	19.53	19.34	19.30	19.37	19.41	19.35	19.36	19.31	19.41	11
12	19.41	19.46	19.43	19.40	19.36	19.38	19.48	19.40	19.37	19.33	19.30	19.56	12
13	19.44	19.35	19.46	19.27	19.41	19.41	19.44	19.33	19.39	19.27	19.43	19.23	13
14	19.36	19.45	19.35	19.33	19.40	19.44	19.34	19.34	19.40	19.36	19.54	19.28	14
15	19.40	19.44	19.53	19.38	19.42	19.40	19.45	19.44	19.42	19.41	19.51	19.37	15
16	19.45	19.42	19.29	19.41	19.39	19.51	19.37	19.34	19.32	19.49	19.23	19.42	16
17	19.41	19.42	19.44	19.44	19.45	19.34	19.52	19.38	19.48	19.56	19.30	19.48	17
18	19.44	19.69	19.53	19.48	19.34	19.58	19.45	19.40	19.30	19.34	19.37	19.51	18
19	19.46	19.68	19.40	19.53	19.53	19.45	19.45	19.34	19.51	19.27	19.43	19.53	19
20	19.35	19.46	19.40	19.57	19.30	19.45	19.40	19.36	19.28	19.35	19.49	19.55	20
21	19.45	19.37	19.40	19.58	19.36	19.36	19.39	19.36	19.47	19.41	19.53	19.57	21
22	19.41	19.39	19.42	19.58	19.44	19.41	19.40	19.40	19.38	19.48	19.44	19.32	22
23	19.34	19.42	19.40	19.52	19.44	19.24	19.40	19.38	19.30	19.51	19.24	19.26	23
24	19.42	19.40	19.41	19.23	19.55	19.45	19.38	19.41	19.43	19.55	19.36	19.31	24
25	19.40	19.38	19.42	19.26	19.31	19.57	19.41	19.34	19.55	19.57	19.39	19.37	25
26	19.40	19.46	19.34	19.27	19.34	19.29	19.42	19.39	19.25	19.59	19.43	19.41	26
27	19.34	19.37	19.40	19.29	19.40	19.26	19.37	19.34	19.31	19.37	19.48	19.44	27
28	19.42	19.48	19.40	19.33	19.42	19.32	19.40	19.41	19.43	19.21	19.55	19.49	28
29	19.45	19.35	19.50	19.35	19.41	19.37	19.45	19.42	19.51	19.26	19.54	19.53	29
30	19.34		19.38	19.31	19.41	19.45	19.40	19.38	19.47	19.32	19.43	19.55	30
31	19.44		19.50		19.44		19.39	19.39		19.35		19.56	31
MEAN	19.39	19.69	19.36	19.58	19.35	19.38	19.35	19.44	19.55	19.59	19.59	19.58	
MIN	19.29	19.31	19.29	19.23	19.24	19.24	19.34	19.33	19.25	19.21	19.23	19.23	
SUM	601.69	563.66	601.07	582.19	601.07	582.36	601.97	601.21	581.86	601.33	582.36	602.05	

**** DATA IS PROVISIONAL AFTER 12/31/1999 ****

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 T - TRACE AMOUNT

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A

STATION 5191
 LAT 2711.1
 LONG 803247
 5-191 SPILLWAY ON CANAL C-59 AT LAKE UNDECHURRE
 BASIN 1 UNCE
 QUAD SHEET 27000324 UNDECHURRE 4 NW
 LAND SURFACE 16.00 FT MSL
 AGENCY QUALITY CODES
 AVAL
 ALT TO 60630361
 WMD
 90/08/20

*** STATION 5191
 LATITUDE 2711.1
 LONGITUDE 803247
 5-191 SPILLWAY ON CANAL C-59 AT LAKE UNDECHURRE
 AGENCY WMD
 COUNTRY MEXICO
 1989 1989

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	19.56	19.53	19.51	19.49	19.50	19.53	19.47	19.37	19.36	19.40	19.41	19.40	1
2	19.57	19.54	19.52	19.51	19.57	19.57	19.52	19.51	19.40	19.35	19.36	19.27	2
3	19.58	19.55	19.53	19.50	19.55	19.55	19.50	19.40	19.37	19.39	19.39	19.28	3
4	19.59	19.56	19.54	19.51	19.56	19.56	19.51	19.40	19.37	19.39	19.39	19.29	4
5	19.60	19.57	19.55	19.52	19.57	19.57	19.52	19.41	19.38	19.40	19.40	19.30	5
6	19.61	19.58	19.56	19.53	19.58	19.58	19.53	19.42	19.39	19.41	19.41	19.31	6
7	19.62	19.59	19.57	19.54	19.59	19.59	19.54	19.43	19.40	19.42	19.42	19.32	7
8	19.63	19.60	19.58	19.55	19.60	19.60	19.55	19.44	19.41	19.43	19.43	19.33	8
9	19.64	19.61	19.59	19.56	19.61	19.61	19.56	19.45	19.42	19.44	19.44	19.34	9
10	19.65	19.62	19.60	19.57	19.62	19.62	19.57	19.46	19.43	19.45	19.45	19.35	10
11	19.66	19.63	19.61	19.58	19.63	19.63	19.58	19.47	19.44	19.46	19.46	19.36	11
12	19.67	19.64	19.62	19.59	19.64	19.64	19.59	19.48	19.45	19.47	19.47	19.37	12
13	19.68	19.65	19.63	19.60	19.65	19.65	19.60	19.49	19.46	19.48	19.48	19.38	13
14	19.69	19.66	19.64	19.61	19.66	19.66	19.61	19.50	19.47	19.49	19.49	19.39	14
15	19.70	19.67	19.65	19.62	19.67	19.67	19.62	19.51	19.48	19.50	19.50	19.40	15
16	19.71	19.68	19.66	19.63	19.68	19.68	19.63	19.52	19.49	19.51	19.51	19.41	16
17	19.72	19.69	19.67	19.64	19.69	19.69	19.64	19.53	19.50	19.52	19.52	19.42	17
18	19.73	19.70	19.68	19.65	19.70	19.70	19.65	19.54	19.51	19.53	19.53	19.43	18
19	19.74	19.71	19.69	19.66	19.71	19.71	19.66	19.55	19.52	19.54	19.54	19.44	19
20	19.75	19.72	19.70	19.67	19.72	19.72	19.67	19.56	19.53	19.55	19.55	19.45	20
21	19.76	19.73	19.71	19.68	19.73	19.73	19.68	19.57	19.54	19.56	19.56	19.46	21
22	19.77	19.74	19.72	19.69	19.74	19.74	19.69	19.58	19.55	19.57	19.57	19.47	22
23	19.78	19.75	19.73	19.70	19.75	19.75	19.70	19.59	19.56	19.58	19.58	19.48	23
24	19.79	19.76	19.74	19.71	19.76	19.76	19.71	19.60	19.57	19.59	19.59	19.49	24
25	19.80	19.77	19.75	19.72	19.77	19.77	19.72	19.61	19.58	19.60	19.60	19.50	25
26	19.81	19.78	19.76	19.73	19.78	19.78	19.73	19.62	19.59	19.61	19.61	19.51	26
27	19.82	19.79	19.77	19.74	19.79	19.79	19.74	19.63	19.60	19.62	19.62	19.52	27
28	19.83	19.80	19.78	19.75	19.80	19.80	19.75	19.64	19.61	19.63	19.63	19.53	28
29	19.84	19.81	19.79	19.76	19.81	19.81	19.76	19.65	19.62	19.64	19.64	19.54	29
30	19.85	19.82	19.80	19.77	19.82	19.82	19.77	19.66	19.63	19.65	19.65	19.55	30
31	19.86	19.83	19.81	19.78	19.83	19.83	19.78	19.67	19.64	19.66	19.66	19.56	31

**** DATA IS PROVISIONAL AFTER 12/31/1989 ****

U A T A T A G L E N D
 U A T A T A G L E N D
 1 - MISSING DATA
 2 - ORIGINAL DATA MORE THAN 4 SIG DIGITS
 3 - LINE-AVAILABLE
 4 - LINE-AVAILABLE
 5 - SUSPECTIBLE
 6 - GREATER THAN
 7 - LESS THAN
 8 - ESTIMATED
 9 - SUMMARY COMPUTED FROM PARTIAL RECORD
 0 - NO DATA COLLECTED
 1 - PREVIOUS DAYS WITH A
 2 - PREVIOUS DAYS WITH A

*** STATION: 5191 ***
 LATITUDE: 271131
 LONGITUDE: 804547

S-151 SPILLWAY LN CANAL C-56 AT LAKE OKEECHOBEE
 FLOW CFS AGENCY: WMD
 MEAN DAILY VALUE COUNTY: UNLEC

50/01/11.

	1974			1974			1974			1974			1974			1974		
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1	76.00	87.00	71.00L	13.00	.00	.00	536.00	734.00	445.00	749.00	5.00	27.00	1					
2	.00	.00	.00L	.00	.00	.00	1007.00	583.00	245.00	611.00	.00	11.00L	2					
3	.00	.00	.00L	84.00	.00	.00	1036.00	454.00	234.00	326.00	.00	102.00	3					
4	69.00	69.00	.00L	.00	.00	.00	891.00	472.00	259.00	163.00	154.00	.00	4					
5	.00	.00	.00L	.00	.00	47.00	876.00	775.00	47.00	280.00	10.00	.00	5					
6	.00	.00	.00L	66.00L	.00	36.00	611.00	1230.00	126.00	282.00	13.00	.00	6					
7	74.00	.00	.00L	.00L	.00	37.00	908.00	1034.00	262.00	571.00	7.00	13.00	7					
8	.00	.00	.00L	63.00	.00	37.00	636.00	898.00	114.00	520.00	110.00	14.00	8					
9	.00	.00L	.00	.00L	.00	124.00	106.00	885.00	170.00	312.00	26.00	245.00L	9					
10	.00	76.00L	.00	.00L	.00	36.00	291.00	871.00	462.00	298.00	26.00	41.00	10					
11	83.00	.00L	.00	71.00	.00	37.00	253.00	861.00	527.00	165.00	26.00	41.00	11					
12	.00	.00	.00L	.00	.00	37.00	304.00	714.00	244.00	156.00	27.00	41.00	12					
13	.00	.00	.00L	.00	.00	37.00	841.00	638.00	219.00	133.00	124.00	26.00	13					
14	70.00	.00	.00L	.00	.00	25.00	391.00	503.00	231.00	130.00	1.00	29.00	14					
15	.00	.00	65.00L	84.00	.00	100.00	275.00	349.00	265.00	106.00	13.00	144.00	15					
16	63.00	.00	.00L	.00	63.00	18.00	179.00	386.00	125.00	.00	13.00	27.00	16					
17	.00	75.00L	.00L	.00	.00	18.00	148.00	364.00	110.00	124.00	23.00	203.00	17					
18	.00	.00	.00L	85.00	.00	18.00	1477.00L	573.00	132.00	47.00	126.00	154.00L	18					
19	78.00	.00	.00	.00L	.00	3.00	970.00	628.00	85.00	.00	14.00	27.00	19					
20	.00	.00	.00	.00L	.00	.00	725.00	917.00	45.00	156.00	11.00	140.00	20					
21	.00	.00	.00	.00L	.00	.00	659.00	559.00	107.00	.00	45.00	18.00	21					
22	.00	68.00	39.00	76.00	.00	.00	783.00	547.00	.00	.00	7.00	14.00	22					
23	67.00	.00L	.00	.00	.00	18.00	1165.00	435.00	104.00	123.00	14.00	177.00	23					
24	.00	.00L	.00	.00	.00	57.00	1096.00	614.00	237.00	.00	25.00	14.00	24					
25	.00	.00L	.00	70.00L	.00	336.00	814.00	1029.00	240.00	.00	36.00	15.00	25					
26	.00	.00L	16.00	.00L	.00	517.00	873.00	968.00	234.00	137.00	164.00	161.00	26					
27	.00	.00L	17.00	.00L	.00	356.00	647.00	633.00	234.00	12.00	48.00	14.00	27					
28	74.00	.00	32.00	.00L	.00	640.00	656.00	583.00	371.00	13.00	42.00	14.00	28					
29	.00	.00	32.00L	.00	.00	562.00	868.00	529.00	244.00	13.00	34.00	164.00	29					
30	.00	.00	32.00L	67.00	.00	448.00	1183.00	880.00	372.00	127.00	173.00	.00	30					
31	.00	.00	32.00L	.00	78.00	.00	964.00	764.00	.00	13.00	.00	.00	31					
MAX	83.00	87.00	71.00L	89.00	78.00	640.00	1977.00L	1230.00	527.00	799.00	173.00	245.00L						
MEAN	21.10	13.36	13.03	22.63	4.61	122.77	744.07	693.71	216.00	181.61	45.47	62.87						
MIN	.00	.00	.00L	.00	.00	.00	148.00	364.00	.00	.00	.00	.00						
SUM	659.00	375.00	404.00	679.00	143.00	3683.00	23041.00	21505.00	6540.00	5630.00	1375.00	1945.00						

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 1 - TRACE AMOUNT
 6 - AMOUNT ACCUMULATED WAS GREATER THAN

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATE
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH P
 X - INCLUDED IN NEXT AMOUNT TAGGED A
 R - RAINFALL WAS RECORDED

*** STATION: 5161 ***
 LATITUDE : 271131
 LONGITUDE : 804547

S-191 SPILLWAY ON CANAL C-54 AT LAKE OREICHIEET
 FLOW LIS AGENCY: NMD
 MEAN DAILY VALUE CUIS COUNTY: OREEL

90/01/11.

	1975		1975		1975		1975		1975		1975		
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	.00	.00	.00	.00	.00E	.00	267.00	10.00	13.00	315.00E	216.00E	13.00	1
2	143.00	.00	.00	.00	.00	.00	124.00	4.00E	135.00E	360.00E	232.00E	129.00E	2
3	.00	.00	106.00E	.00E	.00	.00	222.00	.00	200.00E	283.00E	131.00E	.00	3
4	.00	.00	.00	27.00	.00	.00	137.00	.00	246.00E	257.00E	112.00	.00	4
5	.00	.00	.00	.00	.00	.00	121.00	.00	240.00E	124.00E	.00	.00E	5
6	124.00	91.00	.00	.00	.00	.00	131.00	.00	244.00E	242.00E	135.00	.00	6
7	.00	.00	.00	.00	.00	.00	17.00	.00	256.00E	223.00E	107.00	.00	7
8	.00	.00	.00	.00	.00	.00E	102.00	.00	246.00E	68.00E	.00	168.00	8
9	.00	.00	.00	.00	.00	.00	78.00	353.00E	154.00E	202.00E	124.00	40.00	9
10	92.00E	122.00	.00	.00	.00	.00	76.00	242.00E	464.00E	124.00E	.00	45.00E	10
11	.00E	.00	.00	.00E	.00	.00	56.00	146.00E	375.00E	137.00E	117.00	54.00	11
12	.00E	85.00	.00	114.00	.00	.00E	148.00	166.00E	435.00E	96.00E	.00	107.00	12
13	.00	.00	.00E	.00	.00	.00	222.00	344.00E	221.00E	.00	113.00	126.00E	13
14	124.00	.00	.00	52.00	.00	.00	333.00	416.00E	261.00E	119.00E	.00E	81.00E	14
15	.00	.00	.00	.00	.00E	.00	205.00E	373.00E	250.00E	.00E	.00	164.00	15
16	.00	.00	.00	.00	.00	.00	102.00E	185.00E	410.00E	157.00E	163.00E	28.00	16
17	.00E	40.00	.00	119.00	.00	.00E	390.00	362.00E	266.00	.00E	.00E	45.00	17
18	.00	.00	.00	.00	.00E	.00	279.00	152.00E	364.00	115.00E	.00	45.00	18
19	.00	.00	.00E	143.00	88.00	.00	335.00	321.00E	506.00	251.00E	150.00	47.00	19
20	115.00	.00E	.00	.00	.00	.00	223.00	357.00E	373.00	136.00E	.00	31.00	20
21	.00	.00	.00	.00	.00	51.00	1.00	624.00E	321.00	145.00E	.00	208.00	21
22	.00	127.00	.00	84.00E	.00E	.00	7.00	433.00E	225.00	145.00E	121.00	30.00E	22
23	.00	.00E	.00	.00E	.00	102.00	.00	450.00E	434.00	125.00E	.00	30.00	23
24	.00	113.00E	.00	.00E	.00E	110.00	.00E	257.00E	246.00	136.00E	.00	31.00	24
25	.00E	152.00	.00E	56.00E	.00	224.00	.00	241.00E	278.00	.00E	.00	30.00E	25
26	162.00	123.00	.00	.00E	.00	214.00	.00	238.00E	588.00	136.00E	.00	31.00E	26
27	.00	.00	.00E	.00E	.00	77.00	.00	87.00	527.00	.00E	164.00E	122.00E	27
28	.00	125.00	.00	.00E	.00	101.00	.00E	163.00E	440.00	123.00E	.00	30.00	28
29	.00	.00	.00E	.00E	.00	113.00	.00E	48.00	440.00	123.00E	1.00	30.00	29
30	.00	.00	.00E	.00E	.00	66.00	.00	198.00E	400.00	368.00E	16.00E	27.00	30
31	96.00	.00	.00	.00	.00	.00	.00	24.00	.00	150.00E	.00	15.00	31
MAR													
MEAN													
MIN													
SUM													

DATA TAG LEGEND

M - MISSING DATA
 S/- ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 ! - TRACE AMOUNT
 E - AMOUNT ACCUMULATED WAS GREATER THAN

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 A - INCLUDED IN MEAN AMOUNT TAGGED A
 M - RAINFALL WAS RECORDED

*** STATION: 5191 ***
 LATITUDE : 271131
 LONGITUDE : 804547

S-191 SPILLWAY ON CANAL C-54 AT LAKE UKELECHIBEE
 FLOW LIS
 MEAN DAILY VALUE

9C/01/11.

AGENCY: WMD
 COUNTY: ONEEC

	1976		1976		1976		1976		1976		1976		
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	9.00	176.00	.00	.00L	75.00	2987.00L	273.00	126.00	57.00	454.00	.00L	167.00	1
2	123.00	.00L	.00	103.00L	.00	1103.00	428.00	122.00	129.00	279.00	116.00	.00	2
3	.00	.00	147.00	.00	.00	660.00	127.00	125.00	134.00	188.00	165.00	.00L	3
4	.00	.00L	.00L	.00	109.00L	625.00	247.00	303.00	258.00	135.00	149.00	.00	4
5	.00	.00	.00L	.00	.00	1254.00	165.00	446.00	575.00	153.00	122.00	186.00	5
6	.00	169.00	.00	.00	.00	1024.00	122.00	283.00	365.00	126.00	.00	.00	6
7	.00	.00L	.00	.00	.00	1048.00	491.00	289.00	323.00	45.00	116.00	.00	7
8	110.00	.00L	110.00	81.00L	.00	626.00	442.00	115.00	214.00	.00	.00L	110.00L	8
9	.00L	.00L	.00L	28.00L	93.00	613.00	604.00	271.00	165.00	161.00	.00L	.00	9
10	.00L	.00	.00	106.00L	.00	2817.00L	563.00	374.00	94.00	.00	156.00	135.00	10
11	.00	.00	.00L	.00	272.00	2448.00L	362.00	264.00	110.00	112.00	.00	.00	11
12	.00	.00	.00	114.00	176.00	1332.00L	360.00	110.00	111.00	.00	.00	110.00	12
13	.00	.00	.00	.00	.00	741.00	341.00	281.00	155.00	95.00	209.00	.00	13
14	131.00	.00	.00	.00L	140.00	500.00	247.00	1154.00	157.00	.00	.00	132.00	14
15	.00	145.00	.00	.00L	245.00	345.00	112.00	1486.00	265.00	.00	.00	.00	15
16	.00	.00	.00L	.00L	346.00	413.00	122.00	910.00	176.00	120.00	105.00	143.00	16
17	.00L	.00	111.00L	.00L	605.00	408.00	394.00	1417.00	233.00	.00	.00	.00	17
18	.00L	.00	.00L	.00L	273.00	273.00	527.00	414.00	298.00	110.00	.00	150.00	18
19	.00	.00	.00	.00L	267.00	263.00	533.00	444.00	368.00	.00	66.00	.00	19
20	.00	.00	.00	90.00	115.00	425.00	256.00	678.00	82.00	106.00	.00	60.00	20
21	133.00	.00	.00	.00	163.00	270.00	277.00	487.00	321.00	.00L	.00	.00L	21
22	.00L	.00L	.00L	.00	74.00	356.00	273.00	387.00	668.00	.00L	.00L	.00	22
23	.00	.00L	.00L	.00	917.00	920.00	243.00	374.00	430.00	.00L	146.00	144.00	23
24	.00	.00	.00L	.00	1656.00L	549.00	421.00	237.00	374.00	127.00	.00	.00	24
25	.00	151.00	.00	.00	456.00	852.00	432.00	603.00	301.00	.00	.00	73.00	25
26	.00	.00	.00	.00	917.00	517.00	300.00	627.00	157.00	.00	.00	65.00	26
27	.00	.00L	.00	.00	595.00	255.00	287.00	358.00	151.00	.00	121.00	140.00	27
28	.00L	.00L	.00	.00	248.00	464.00	130.00	265.00	162.00	116.00	.00	.00	28
29	.00L	166.00	.00	.00L	400.00	438.00	156.00	266.00	133.00	.00	.00	134.00	29
30	.00L	.00	.00	.00	651.00	366.00	117.00	323.00	274.00	.00	.00	.00	30
31	.00	.00	.00	.00	1210.00		129.00	104.00		.00		163.00	31
MAX	133.00	176.00	147.00	114.00	1656.00L	2987.00L	604.00	1486.00	668.00	454.00	209.00	186.00	
MEAN	16.32	27.83	11.87	17.40	336.47	878.60	308.42	476.44	244.73	76.81	44.23	62.74	
MIN	.00	.00L	.00	.00L	.00	255.00	165.00	104.00	82.00	.00	.00L	.00	
SUM	506.00	807.00	368.00	522.00	10508.00	26358.00	9561.00	14789.00	7342.00	2381.00	1427.00	1976.00	

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 ! - TRACE AMOUNT
 G - AMOUNT ACCUMULATED WAS GREATER THAN

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A
 R - RAINFALL WAS RECORD

*** STATION: 5191 ***
 LATITUDE : 271131
 LONGITUDE : 804547

S-191 SPILLWAY ON CANAL C-54 AT LAKE OKEECHOBEE
 FLUM CFS
 MEAN DAILY VALUE

90/01/11.

AGENCY: WPL
 COUNTY: LEE

	1977				1977				1977				1977															
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY		
1	.00	12.00L	10.00L	.00	.00L	.00L	.00	.00	368.00	124.00	.00	112.00	1	.00	12.00L	10.00L	.00	.00L	.00L	.00	.00	368.00	124.00	.00	112.00	1		
2	239.00	181.00	140.00L	.00L	.00L	69.00L	72.00	127.00	374.00L	147.00	.00	440.00L	2	239.00	181.00	140.00L	.00L	.00L	69.00L	72.00	127.00	374.00L	147.00	.00	440.00L	2		
3	12.00L	13.00	.00L	.00L	.00L	120.00	.00	.00L	617.00L	113.00	.00L	318.00L	3	12.00L	13.00	.00L	.00L	.00L	120.00	.00	.00L	617.00L	113.00	.00L	318.00L	3		
4	150.00	182.00L	48.00	.00L	.00L	116.00	.00	.00L	1841.00L	111.00	117.00L	327.00	4	150.00	182.00L	48.00	.00L	.00L	116.00	.00	.00L	1841.00L	111.00	117.00L	327.00	4		
5	.00L	.00L	.00	.00L	.00	131.00	.00	.00L	1572.00L	87.00L	.00	170.00	5	.00L	.00L	.00	.00L	.00	131.00	.00	.00L	1572.00L	87.00L	.00	170.00	5		
6	173.00	178.00L	.00	.00L	.00	145.00	.00	.00L	1043.00L	.00L	160.00L	883.00	6	173.00	178.00L	.00	.00L	.00	145.00	.00	.00L	1043.00L	.00L	160.00L	883.00	6		
7	.00L	.00L	108.00L	.00L	.00	112.00L	.00	.00L	745.00L	102.00L	.00	134.00L	7	.00L	.00L	108.00L	.00L	.00	112.00L	.00	.00L	745.00L	102.00L	.00	134.00L	7		
8	136.00L	.00L	.00L	.00L	.00L	103.00	.00	.00	509.00	.00	97.00	756.00	8	136.00L	.00L	.00L	.00L	.00L	103.00	.00	.00	509.00	.00	97.00	756.00	8		
9	.00	182.00L	.00L	.00L	.00L	100.00	71.00	.00	267.00	124.00	4.00	416.00	9	.00	182.00L	.00L	.00L	.00L	100.00	71.00	.00	267.00	124.00	4.00	416.00	9		
10	.00L	17.00L	.00	.00L	.00	116.00	1.00	.00L	276.00	.00	15.00	575.00	10	.00L	17.00L	.00	.00L	.00	116.00	1.00	.00L	276.00	.00	15.00	575.00	10		
11	123.00L	5.00L	84.00	.00L	.00L	114.00L	.00L	66.00L	280.00	.00	26.00L	651.00	11	123.00L	5.00L	84.00	.00L	.00L	114.00L	.00L	66.00L	280.00	.00	26.00L	651.00	11		
12	18.00L	148.00L	.00	.00L	.00L	.00	.00L	.00L	138.00	43.00	.00L	378.00	12	18.00L	148.00L	.00	.00L	.00L	.00	.00L	.00L	138.00	43.00	.00L	378.00	12		
13	12.00L	.00	.00	.00L	102.00L	.00	.00L	134.00	252.00	.00L	143.00L	183.00	13	12.00L	.00	.00	.00L	102.00L	.00	.00L	134.00	252.00	.00L	143.00L	183.00	13		
14	139.00	.00	.00	.00L	.00L	97.00L	.00	12.00L	131.00	.00L	.00L	328.00L	14	139.00	.00	.00	.00L	.00L	97.00L	.00	12.00L	131.00	.00L	.00L	328.00L	14		
15	.00	.00	130.00L	.00L	.00	.00L	.00	134.00L	132.00	.00	.00L	163.00	15	.00	.00	130.00L	.00L	.00	.00L	.00	134.00L	132.00	.00	.00L	163.00	15		
16	169.00	148.00L	.00	.00L	.00L	.00L	.00	.00L	210.00	.00L	.00L	509.00	16	169.00	148.00L	.00	.00L	.00L	.00L	.00L	.00L	.00L	.00L	.00L	509.00	16		
17	156.00L	.00L	.00	.00L	.00L	.00L	107.00	115.00	146.00	164.00L	.00	1425.00L	17	156.00L	.00L	.00	.00L	.00L	.00L	.00L	107.00	115.00	146.00	164.00L	.00	1425.00L	17	
18	226.00	.00	.00L	.00L	.00L	116.00	.00L	.00	128.00	29.00	150.00	1215.00	18	226.00	.00	.00L	.00L	.00L	.00L	116.00	.00L	.00	128.00	29.00	150.00	1215.00	18	
19	.00L	.00L	.00L	.00L	.00L	.00	121.00L	.00	214.00	15.00L	.00L	530.00	19	.00L	.00L	.00L	.00L	.00L	.00L	.00L	.00	121.00L	.00	214.00	15.00L	.00L	530.00	19
20	156.00	181.00L	.00	.00L	.00L	.00	2.00L	.00	648.00	16.00L	.00L	788.00	20	156.00	181.00L	.00	.00L	.00L	.00L	.00L	.00	2.00L	.00	648.00	16.00L	.00L	788.00	20
21	.00L	.00L	119.00L	.00L	.00L	101.00	.00	.00L	461.00	14.00	.00L	452.00	21	.00L	.00L	119.00L	.00L	.00L	.00L	101.00	.00	.00L	461.00	14.00	.00L	452.00	21	
22	198.00L	.00L	.00L	.00L	.00L	250.00	.00	.00	466.00	.00	.00L	433.00	22	198.00L	.00L	.00L	.00L	.00L	.00L	250.00	.00	.00	466.00	.00	.00L	433.00	22	
23	.00	8.00	.00L	.00	.00	.00L	94.00L	.00	435.00	158.00	154.00L	182.00	23	.00	8.00	.00L	.00	.00	.00L	.00	.00	94.00L	.00	435.00	158.00	154.00L	182.00	23
24	206.00	174.00L	.00L	.00	.00	106.00L	.00L	.00	161.00	.00	322.00	372.00	24	206.00	174.00L	.00L	.00	.00	.00	106.00L	.00L	.00	161.00	.00	322.00	372.00	24	
25	60.00L	27.00L	.00L	.00L	.00	.00	.00L	7.00	310.00	.00	131.00	165.00	25	60.00L	27.00L	.00L	.00L	.00	.00	.00L	.00L	7.00	310.00	.00	131.00	165.00	25	
26	181.00L	28.00	.00L	.00L	.00	91.00	.00	15.00L	580.00	98.00	110.00L	408.00	26	181.00L	28.00	.00L	.00L	.00	.00	91.00	.00	15.00L	580.00	98.00	110.00L	408.00	26	
27	.00	28.00	.00L	92.00L	.00	.00	88.00	16.00L	356.00	.00L	143.00L	216.00	27	.00	28.00	.00L	92.00L	.00	.00	.00	88.00	16.00L	356.00	.00L	143.00L	216.00	27	
28	104.00	105.00	.00L	.00L	.00L	22.00	.00L	20.00L	334.00	.00L	3.00	265.00	28	104.00	105.00	.00L	.00L	.00L	.00L	22.00	.00L	20.00L	334.00	.00L	3.00	265.00	28	
29	20.00L	.00L	.00	.00	.00	.00	.00	32.00	173.00	.00	388.00	140.00	29	20.00L	.00L	.00	.00	.00	.00	.00	.00	32.00	173.00	.00	388.00	140.00	29	
30	7.00L	.00	.00	.00L	.00	.00	.00	306.00L	173.00	142.00	1150.00	231.00	30	7.00L	.00	.00	.00L	.00	.00	.00	.00	306.00L	173.00	142.00	1150.00	231.00	30	
31	195.00L		114.00		182.00		.00L	228.00L		.00L		246.00	31	195.00L		114.00		182.00		.00L		228.00L		.00L		246.00	31	
MAX	239.00	182.00L	140.00L	92.00L	182.00	250.00	121.00L	300.00L	1891.00L	164.00L	1190.00	1429.00L		MAX	239.00	182.00L	140.00L	92.00L	182.00	250.00	121.00L	300.00L	1891.00L	164.00L	1190.00	1429.00L		
MEAN	80.45	56.46	24.45	3.07	4.16	63.47	17.94	38.67	448.63	49.61	105.37	511.52		MEAN	80.45	56.46	24.45	3.07	4.16	63.47	17.94	38.67	448.63	49.61	105.37	511.52		
MIN	.00	.00L	.00L	.00	.00L	.00L	.00	.00	126.00	.00L	.00	164.00		MIN	.00	.00L	.00L	.00	.00L	.00L	.00	.00	126.00	.00L	.00	164.00		
SUM	2680.00	1545.00	758.00	92.00	284.00	1919.00	556.00	1208.00	13465.00	1538.00	3161.00	16074.00		SUM	2680.00	1545.00	758.00	92.00	284.00	1919.00	556.00	1208.00	13465.00	1538.00	3161.00	16074.00		

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
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 T - TRACE AMOUNT
 G - AMOUNT ACCUMULATED WAS GREATER THAN

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A
 R - RAINFALL WAS RECORDED

*** STATION: S151 ***
 LATITUDE : 271131
 LONGITUDE : 864547

S-151 SPILLWAY ON CANAL C-34 AT LAKE CHEROKEE
 FLOW LIS AGRICULTURAL
 MEAN DAILY VALUE COUNTRY CANAL

90/01/11.

	1970			1970			1970			1970			1970			
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY	JAN	FEB	MAR
1	216.00	31.00	26.00	77.00	.00	.00	121.00	923.00	382.00	670.00	.00	1.00	1	216.00	31.00	26.00
2	250.00	273.00	173.00	79.00	10.00	.00	172.00	634.00	345.00	644.00	118.00	164.00	2	250.00	273.00	173.00
3	23.00	41.00	120.00	204.00	48.00	.00	109.00	654.00	221.00	1122.00	15.00	.00	3	23.00	41.00	120.00
4	184.00	229.00	461.00	23.00	.00	.00	240.00	741.00	464.00	865.00	122.00	22.00	4	184.00	229.00	461.00
5	109.00	14.00	166.00	.00	.00	85.00	44.00	386.00	341.00	539.00	4.00	133.00	5	109.00	14.00	166.00
6	.00	206.00	173.00	.00	107.00	116.00	112.00	282.00	347.00	774.00	83.00	.00	6	.00	206.00	173.00
7	191.00	41.00	149.00	229.00	104.00	141.00	117.00	302.00	220.00	447.00	47.00	.00	7	191.00	41.00	149.00
8	180.00	137.00	163.00	.00	89.00	.00	.00	192.00	164.00	343.00	211.00	126.00	8	180.00	137.00	163.00
9	.00	133.00	101.00	.00	.00	161.00	121.00	375.00	193.00	283.00	122.00	10.00	9	.00	133.00	101.00
10	190.00	209.00	2760.00	.00	.00	145.00	131.00	186.00	88.00	267.00	152.00	3.00	10	190.00	209.00	2760.00
11	184.00	210.00	1692.00	.00	74.00	41.00	173.00	146.00	473.00	136.00	106.00	124.00	11	184.00	210.00	1692.00
12	.00	25.00	551.00	.00	.00	151.00	190.00	136.00	766.00	303.00	155.00	7.00	12	.00	25.00	551.00
13	210.00	200.00	556.00	184.00	.00	.00	184.00	231.00	598.00	146.00	133.00	11.00	13	210.00	200.00	556.00
14	367.00	14.00	417.00	.00	.00	116.00	189.00	133.00	414.00	241.00	127.00	8.00	14	367.00	14.00	417.00
15	195.00	221.00	335.00	.00	.00	14.00	209.00	292.00	399.00	150.00	30.00	106.00	15	195.00	221.00	335.00
16	183.00	20.00	368.00	.00	.00	22.00	163.00	398.00	336.00	151.00	148.00	.00	16	183.00	20.00	368.00
17	8.00	244.00	226.00	.00	.00	13.00	181.00	397.00	371.00	159.00	122.00	.00	17	8.00	244.00	226.00
18	186.00	202.00	232.00	61.00	76.00	167.00	144.00	230.00	236.00	125.00	31.00	.00	18	186.00	202.00	232.00
19	214.00	229.00	224.00	.00	5.00	.00	252.00	356.00	312.00	162.00	55.00	36.00	19	214.00	229.00	224.00
20	486.00	486.00	234.00	192.00	18.00	.00	767.00	492.00	91.00	134.00	154.00	145.00	20	486.00	486.00	234.00
21	441.00	219.00	61.00	.00	18.00	.00	432.00	266.00	142.00	118.00	60.00	.00	21	441.00	219.00	61.00
22	372.00	495.00	189.00	145.00	2.00	108.00	365.00	203.00	206.00	8.00	159.00	.00	22	372.00	495.00	189.00
23	144.00	176.00	194.00	.00	.00	115.00	312.00	245.00	344.00	133.00	40.00	.00	23	144.00	176.00	194.00
24	296.00	225.00	44.00	130.00	.00	215.00	155.00	474.00	405.00	91.00	124.00	.00	24	296.00	225.00	44.00
25	147.00	197.00	167.00	.00	175.00	206.00	237.00	331.00	1221.00	146.00	37.00	.00	25	147.00	197.00	167.00
26	57.00	40.00	54.00	.00	.00	64.00	241.00	221.00	961.00	.00	27.00	.00	26	57.00	40.00	54.00
27	285.00	261.00	51.00	98.00	.00	99.00	308.00	111.00	526.00	.00	139.00	109.00	27	285.00	261.00	51.00
28	255.00	172.00	232.00	.00	.00	157.00	492.00	187.00	328.00	.00	14.00	641.00	28	255.00	172.00	232.00
29	251.00	.00	77.00	.00	.00	224.00	1313.00	75.00	324.00	.00	20.00	473.00	29	251.00	.00	77.00
30	72.00	.00	205.00	.00	.00	164.00	613.00	278.00	264.00	.00	130.00	731.00	30	72.00	.00	205.00
31	263.00	.00	76.00	.00	.00	.00	395.00	416.00	.00	63.00	.00	552.00	31	263.00	.00	76.00
MAX	486.00	495.00	2760.00	229.00	175.00	224.00	1313.00	923.00	1221.00	1122.00	211.00	473.00				
MEAN	192.03	176.07	374.14	46.07	25.14	13.37	273.24	328.45	380.03	264.58	88.47	125.47				
MIN	.00	14.00	26.00	.00	.00	.00	.00	75.00	88.00	.00	.00	.00				
SUM	5953.00	4930.00	11755.00	1382.00	761.00	2501.00	8472.00	10182.00	11461.00	8202.00	2665.00	3405.00				

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
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DATA TAG LEGEND

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 R - RAINFALL WAS RECORDED

*** STATION: 5191 ***
 LATITUDE 1 271131
 LONGITUDE 1 004547

S-191 SPILLWAY ON CANAL C-54 AT LAKE CRECHLEBII
 FLOW CIS AGENCY: WMD
 MEAN DAILY VALUE COUNTY: GREEK

00/01/11.

	1979	1979	1979	1979	1979	1979	1979	1979	1979	1979	1979	1979	1979
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	LAY
1	477.00	353.00	5.00	.00	133.00	134.00	67.00	126.00	247.00	1517.60	.00	151.00	1
2	564.00	343.00	131.00	.00	23.00	210.00	.00	.00	160.00	851.00	80.00	.00	2
3	694.00	171.00	105.00	107.00	12.00	97.00	.00	.00	645.00	569.00	.00	162.00	3
4	650.00	195.00	.00	.00	12.00	277.00	98.00	129.00	2512.00	66.00	95.00	.00	4
5	424.00	176.00	125.00	.00	7.00	59.00	.00	62.00	3774.00	268.00	.00	.00	5
6	373.00	301.00	166.00	.00	123.00	111.00	.00	14.00	3160.00	394.00	76.00	110.00	6
7	313.00	164.00	398.00	.00	17.00	62.00	.00	70.00	3045.00	416.00	.00	117.00	7
8	328.00	166.00	410.00	.00	177.00	61.00	114.00	81.00	1777.00	257.00	77.00	274.00	8
9	267.00	156.00	380.00	.00	548.00	.00	347.00	.00	1462.00	260.00	.00	168.00	9
10	409.00	192.00	128.00	85.00	675.00	.00	112.00	134.00	2473.00	88.00	64.00	97.00	10
11	197.00	50.00	.00	.00	640.00	128.00	185.00	544.00	2445.00	171.00	72.00	164.00	11
12	746.00	164.00	177.00	.00	516.00	.00	20.00	543.00	3058.00	166.00	.00	56.00	12
13	1492.00	208.00	134.00	.00	283.00	.00	119.00	192.00	3684.00	75.00	85.00	94.00	13
14	1843.00	37.00	9.00	.00	427.00	74.00	342.00	245.00	4315.00	155.00	51.00	3.00	14
15	1332.00	39.00	126.00	1.00	1300.00	.00	379.00	124.00	5043.00	71.00	.00	166.00	15
16	714.00	221.00	13.00	12.00	645.00	.00	369.00	105.00	3525.00	95.00	105.00	2.00	16
17	504.00	203.00	7.00	12.00	344.00	.00	153.00	251.00	2061.00	152.00	74.00	113.00	17
18	436.00	37.00	188.00	12.00	424.00	118.00	150.00	395.00	1237.00	68.00	.00	.00	18
19	344.00	41.00	.00	16.00	125.00	.00	91.00	318.00	1645.00	74.00	166.00	.00	19
20	267.00	201.00	.00	25.00	117.00	.00	112.00	107.00	536.00	71.00	103.00	123.00	20
21	453.00	39.00	125.00	152.00	102.00	.00	.00	15.00	626.00	56.00	.00	.00	21
22	357.00	170.00	7.00	24.00	109.00	.00	219.00	116.00	1237.00	73.00	.00	.00	22
23	467.00	19.00	.00	25.00	74.00	162.00	374.00	.00	635.00	.00	40.00	133.00	23
24	673.00	114.00	141.00	25.00	303.00	.00	132.00	.00	875.00	64.00	.00	.00	24
25	794.00	37.00	21.00	19.00	388.00	.00	110.00	.00	676.00	88.00	88.00	.00	25
26	578.00	193.00	22.00	86.00	269.00	.00	28.00	.00	517.00	.00	6.00	137.00	26
27	570.00	30.00	23.00	.00	202.00	92.00	28.00	.00	765.00	93.00	81.00	.00	27
28	784.00	190.00	53.00	.00	261.00	51.00	90.00	.00	1126.00	.00	.00	.00	28
29	544.00	.00	115.00	.00	137.00	.00	.00	.00	1016.00	85.00	95.00	.00	29
30	526.00	.00	.00	.00	91.00	84.00	.00	156.00	1580.00	.00	.00	138.00	30
31	283.00	.00	.00	.00	233.00	.00	.00	125.00	.00	85.00	.00	.00	31

MAX	1843.00	353.00	410.00	192.00	1300.00	277.00	389.00	594.00	5043.00	1517.00	108.00	274.00	
MEAN	547.26	150.66	95.58	20.03	297.00	57.33	116.64	126.68	1845.53	262.90	45.67	65.66	
MIN	197.00	19.00	.00	.00	7.00	.00	.00	.00	166.00	.00	.00	.00	
SUM	18515.00	4224.00	2963.00	601.00	9267.00	1720.00	3684.00	3927.00	55486.00	6290.00	1370.00	1974.00	

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAS MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 T - TRACE AMOUNT
 G - AMOUNT ACCUMULATED WAS GREATER THAN

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A
 R - RAINFALL WAS RECORDED

*** STATION: 5191 ***
 LATITUDE 1 271131
 LONGITUDE 1 804547

S-191 SPILLWAY ON CANAL C-59 AT LAKE UKEICHUET
 FLOW CFS
 MEAN DAILY VALUE
 AGENCY: WMD
 COUNTY: GRILE

6/6/11.

	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980	1980
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
1	.00	179.00	142.00	254.00	114.00	17.00	98.00	97.00	126.00	156.00	.00	7.00	1
2	.00	44.00	255.00	510.00	68.00	6.00	6.00	29.00	276.00	60.00	.00	137.00	2
3	138.00	186.00	375.00	352.00	62.00	.00	61.00	32.00	616.00	106.00	.00	24.00	3
4	.00	155.00	328.00	270.00	149.00	.00	13.00	7.00	844.00	122.00	9.00	24.00	4
5	.00	144.00	133.00	111.00	20.00	57.00	9.00	33.00	600.00	100.00	17.00	215.00	5
6	.00	33.00	144.00	142.00	57.00	.00	4.00	4.00	562.00	165.00	24.00	242.00	6
7	110.00	125.00	134.00	248.00	46.00	.00	74.00	4.00	346.00	91.00	31.00	266.00	7
8	.00	18.00	118.00	172.00	47.00	.00	.00	32.00	243.00	27.00	112.00	287.00	8
9	.00	41.00	102.00	139.00	133.00	.00	231.00	4.00	302.00	46.00	31.00	288.00	9
10	.00	104.00	14.00	204.00	46.00	.00	7.00	18.00	192.00	27.00	28.00	282.00	10
11	.00	116.00	121.00	115.00	47.00	.00	7.00	41.00	200.00	92.00	14.00	276.00	11
12	70.00	6.00	19.00	21.00	47.00	.00	.00	16.00	100.00	27.00	16.00	14.00	12
13	86.00	146.00	96.00	113.00	47.00	.00	5.00	51.00	124.00	28.00	10.00	20.00	13
14	16.00	11.00	7.00	114.00	47.00	.00	16.00	45.00	222.00	107.00	2.00	20.00	14
15	119.00	147.00	21.00	121.00	48.00	.00	17.00	17.00	390.00	14.00	142.00	26.00	15
16	107.00	119.00	143.00	.00	111.00	.00	62.00	36.00	112.00	9.00	275.00	149.00	16
17	7.00	24.00	31.00	85.00	44.00	.00	64.00	9.00	170.00	6.00	234.00	24.00	17
18	14.00	162.00	402.00	.00	36.00	.00	29.00	34.00	258.00	65.00	244.00	36.00	18
19	126.00	661.00	432.00	122.00	36.00	.00	30.00	6.00	113.00	27.00	150.00	30.00	19
20	8.00	726.00	160.00	90.00	27.00	.00	28.00	36.00	170.00	27.00	143.00	30.00	20
21	82.00	254.00	133.00	111.00	82.00	47.00	47.00	9.00	84.00	28.00	154.00	150.00	21
22	6.00	209.00	44.00	97.00	33.00	.00	61.00	22.00	71.00	90.00	29.00	29.00	22
23	12.00	143.00	171.00	.00	20.00	.00	59.00	.00	62.00	40.00	137.00	30.00	23
24	114.00	123.00	31.00	109.00	6.00	56.00	60.00	25.00	80.00	37.00	28.00	182.00	24
25	.00	112.00	24.00	.00	.00	.00	205.00	47.00	31.00	29.00	126.00	17.00	25
26	9.00	114.00	105.00	76.00	146.00	.00	557.00	21.00	158.00	29.00	6.00	10.00	26
27	235.00	186.00	34.00	2.00	24.00	96.00	410.00	44.00	181.00	19.00	116.00	114.00	27
28	275.00	167.00	32.00	110.00	80.00	26.00	265.00	46.00	197.00	14.00	7.00	.00	28
29	268.00	100.00	86.00	89.00	29.00	20.00	151.00	81.00	207.00	14.00	164.00	.00	29
30	180.00	20.00	.00	16.00	16.00	26.00	76.00	176.00	65.00	2.00	11.00	.00	30
31	262.00		166.00		17.00		102.00	43.00		48.00		.00	31

MAX	275.00	728.00	432.00	510.00	149.00	57.00	557.00	176.00	844.00	158.00	275.00	242.00	
MEAN	71.74	157.52	130.39	127.47	55.87	10.57	42.06	34.64	246.00	53.68	75.83	46.40	
MIN	.00	6.00	7.00	.00	.00	.00	.00	.00	31.00	2.00	.00	.00	
SUM	2224.00	4268.00	4052.00	3824.00	1732.00	317.00	2054.00	1080.00	7380.00	1664.00	2265.00	3004.00	

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 T - TRACE AMOUNT
 G - AMOUNT ACCUMULATED WAS GREATER THAN

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATE
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A
 R - RAINFALL WAS RECORDED

*** STATION: S141 ***
 LATITUDE : 271131
 LONGITUDE : R04547

S-191 SPILLWAY IN CANAL C-59 AT LAKE DRILLCHURCH
 FLOW LIS
 MEAN DAILY VALUE
 AGENCY: WMD
 COUNTY: DREEL

50701711.

	1981	1981	1981	1981	1981	1981	1981	1981	1981	1981	1981	1981	1981	1981	1981
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY		
1	162.00	.00	.00	.00	.00	.00	.00	.00	1331.00	78.00	113.00	.00	1		
2	2.00	.00	98.00	.00	.00	.00	.00	.00	922.00	102.00	.00	34.00	2		
3	.00	136.00	.00	.00	.00	.00	.00	34.00	714.00	77.00	.00	.00	3		
4	.00	.00	.00	.00	.00	.00	.00	.00	577.00	.00	.00	.00	4		
5	.00	109.00	.00	.00	.00	.00	.00	260.00	470.00	102.00	94.00	.00	5		
6	.00	.00	.00	.00	.00	.00	.00	85.00	532.00	.00	.00	.00	6		
7	124.00	.00	.00	.00	.00	.00	.00	106.00	656.00	101.00	.00	.00	7		
8	.00	88.00	.00	.00	.00	.00	.00	37.00	697.00	.00	.00	.00	8		
9	.00	76.00	85.00	.00	.00	.00	.00	82.00	428.00	78.00	96.00	102.00	9		
10	.00	143.00	.00	.00	.00	.00	.00	36.00	934.00	26.00	.00	.00	10		
11	.00	.00	.00	.00	68.00	.00	.00	221.00	2341.00	11.00	.00	.00	11		
12	.00	131.00	.00	.00	.00	.00	.00	436.00	1420.00	102.00	.00	.00	12		
13	.00	77.00	.00	.00	.00	.00	.00	175.00	1360.00	.00	.00	.00	13		
14	95.00	.00	.00	.00	.00	.00	.00	204.00	935.00	.00	.00	.00	14		
15	.00	99.00	.00	.00	.00	.00	.00	194.00	635.00	106.00	.00	.00	15		
16	.00	.00	90.00	.00	.00	.00	.00	122.00	460.00	27.00	75.00	.00	16		
17	.00	54.00	.00	.00	.00	53.00	.00	173.00	663.00	18.00	.00	116.00	17		
18	.00	.00	.00	.00	.00	.00	.00	664.00	1466.00	8.00	.00	.00	18		
19	.00	100.00	.00	.00	.00	.00	.00	1455.00	1358.00	127.00	.00	.00	19		
20	131.00	.00	.00	.00	.00	.00	.00	1321.00	855.00	.00	.00	.00	20		
21	.00	103.00	.00	.00	.00	.00	69.00	1429.00	861.00	.00	.00	.00	21		
22	.00	.00	.00	.00	.00	.00	.00	1414.00	540.00	.00	.00	.00	22		
23	.00	.00	.00	.00	.00	.00	.00	282.00	646.00	73.00	.00	.00	23		
24	.00	64.00	.00	.00	.00	.00	.00	452.00	468.00	.00	.00	.00	24		
25	147.00	.00	.00	.00	.00	.00	.00	186.00	147.00	.00	107.00	.00	25		
26	.00	.00	95.00	.00	.00	.00	.00	749.00	141.00	.00	.00	.00	26		
27	.00	.00	.00	.00	.00	.00	.00	1155.00	215.00	.00	.00	.00	27		
28	.00	.00	.00	.00	.00	.00	77.00	1809.00	86.00	90.00	.00	123.00	28		
29	.00	.00	.00	.00	.00	.00	.00	1808.00	41.00	.00	.00	.00	29		
30	100.00	.00	.00	.00	.00	.00	.00	1463.00	103.00	.00	.00	.00	30		
31	.00	.00	.00	.00	.00	.00	.00	1239.00	.00	.00	.00	.00	31		
MAX	162.00	143.00	98.00	.00	68.00	53.00	77.00	1809.00	2341.00	127.00	113.00	123.00			
MEAN	24.55	42.14	11.67	.00	2.14	1.77	4.71	571.06	734.27	36.52	16.40	12.35			
MIN	.00	.00	.00	.00	.00	.00	.00	.00	86.00	.00	.00	.00			
SUM	761.00	1180.00	360.00	.00	68.00	53.00	146.00	17703.00	22028.00	1132.00	442.00	343.00			

DATA TAG LEGEND

M - MISSING DATA
 S - UNUSUAL MAG MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 T - TRAIL AMOUNT
 G - AMOUNT ACCUMULATED WAS GREATER THAN

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 C - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDES IN NEXT AMOUNT TAGGED A
 W - RAINFALL WAS RECORDED

46/01/11.

DATA TAG LEGEND

DATA TAG LEGEND

V - NO DATA COLLECTED
P - SUMMARY COMPUTED FROM PARTIAL RECORDS
E - ESTIMATE
L - LESS THAN
A - INCLUDES PREVIOUS DAYS WITH X
X - INCLUDED IN NEXT AMOUNT TAGGED A
R - RAINFALL WAS RECORDED

*** STATION: 5191 ***
 LATITUDE: 1 271131
 LONGITUDE: 1 804547

S-191 SPILLWAY ON CANAL C-54 AT LAKE OKLECHUPEL
 FLOW (CFS)
 MEAN DAILY VALUE
 AGENCY: WMD
 COUNTY: OKLEL

5/01/11.

	1983	1983	1983	1983	1983	1983	1983	1983	1983	1983	1983	1983	1983	1983
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY	
1	126.00	103.00	258.00	59.00	.00	33.00	34.00	135.00	42.00	1.00	243.00	17.00	1	
2	.00	759.00	563.00	111.00	32.00	.00	41.00	96.00	54.00	12.00	167.00	75.00	2	
3	63.00	1447.00	234.00	104.00	.00	44.00	.00	211.00	43.00	6.00	143.00	3.00	3	
4	.00	1051.00	279.00	100.00	.00	63.00	.00	96.00	.00	34.00	111.00	71.00	4	
5	.00	863.00	51.00	39.00	65.00	64.00	.00	153.00	.00	34.00	94.00	1.00	5	
6	126.00	1276.00	.00	.00	.00	232.00	44.00	12.00	53.00	.00	75.00	.00	6	
7	16.00	1476.00	60.00	59.00	.00	41.00	50.00	46.00	31.00	40.00	74.00	64.00	7	
8	70.00	661.00	195.00	44.00	.00	112.00	36.00	22.00	56.00	38.00	174.00	.00	8	
9	15.00	646.00	165.00	49.00	36.00	114.00	.00	167.00	30.00	53.00	55.00	.00	9	
10	83.00	560.00	54.00	47.00	.00	44.00	35.00	136.00	47.00	52.00	60.00	.00	10	
11	6.00	266.00	301.00	115.00	.00	.00	.00	45.00	.00	34.00	66.00	5.00	11	
12	134.00	206.00	393.00	44.00	.00	.00	30.00	30.00	35.00	32.00	62.00	64.00	12	
13	.00	1011.00	296.00	57.00	34.00	49.00	.00	.00	51.00	47.00	96.00	116.00	13	
14	132.00	749.00	65.00	61.00	.00	26.00	.00	91.00	111.00	54.00	63.00	76.00	14	
15	.00	373.00	125.00	45.00	.00	46.00	38.00	91.00	53.00	282.00	.00	2.00	15	
16	.00	658.00	116.00	.00	.00	41.00	.00	175.00	141.00	392.00	81.00	44.00	16	
17	63.00	1342.00	243.00	.00	.00	41.00	42.00	83.00	164.00	433.00	.00	105.00	17	
18	.00	724.00	48.00	146.00	.00	.00	.00	247.00	91.00	447.00	92.00	158.00	18	
19	75.00	161.00	.00	50.00	.00	.00	.00	143.00	166.00	678.00	.00	276.00	19	
20	201.00	45.00	.00	.00	.00	.00	39.00	57.00	193.00	376.00	58.00	184.00	20	
21	437.00	37.00	172.00	76.00	.00	38.00	.00	212.00	226.00	178.00	11.00	172.00	21	
22	304.00	.00	74.00	.00	19.00	44.00	17.00	146.00	351.00	73.00	46.00	163.00	22	
23	342.00	47.00	198.00	40.00	.00	63.00	.00	95.00	216.00	570.00	11.00	77.00	23	
24	444.00	132.00	378.00	.00	.00	62.00	.00	117.00	145.00	525.00	76.00	69.00	24	
25	433.00	100.00	549.00	42.00	.00	62.00	26.00	134.00	37.00	1094.00	11.00	45.00	25	
26	320.00	71.00	357.00	.00	.00	.00	.00	154.00	117.00	1023.00	4.00	.00	26	
27	166.00	291.00	54.00	41.00	.00	34.00	.00	121.00	217.00	817.00	77.00	162.00	27	
28	246.00	1145.00	139.00	.00	.00	34.00	34.00	61.00	166.00	476.00	.00	5.00	28	
29	195.00	.00	246.00	33.00	.00	.00	84.00	124.00	161.00	231.00	5.00	162.00	29	
30	211.00	.00	55.00	.00	43.00	75.00	159.00	94.00	94.00	240.00	11.00	116.00	30	
31	71.00	.00	233.00	.00	.00	.00	156.00	85.00	.00	166.00	.00	676.00	31	
MAX	444.00	1476.00	599.00	146.00	65.00	232.00	159.00	247.00	351.00	1094.00	243.00	670.00		
MEAN	134.06	503.56	162.65	45.57	7.55	48.07	28.06	110.13	102.53	275.24	64.03	45.77		
MIN	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00		
SUM	4311.00	16348.00	5972.00	1367.00	234.00	1442.00	870.00	3414.00	3076.00	8534.00	2071.00	2464.00		

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 T - TRACE AMOUNT
 G - AMOUNT ACCUMULATED WAS GREATER THAN

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDE IN NEXT AMOUNT TAGGED A
 N - RAINFALL WAS RECORDED

*** STATION: 5191 ***
 LATITUDE : 271131
 LONGITUDE : 804547

S-191 SPELLWAY ON CANAL C-59 AT LAKE UKEICHONIT
 FLOW CFS
 MEAN DAILY VALUE

40/01/11.

	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984	1984
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY		
1	733.00	2.00	604.00	85.00	.00	313.00L	32.00E	84.00L	87.00L	315.00P	.00P	61.00L	1		
2	472.00	.00	354.00	98.00L	.00	226.00L	36.00E	.00	64.00	240.00P	.00	142.00	2		
3	205.00	116.00	296.00	21.00	.00	101.00L	107.00L	.00L	45.00	156.00P	82.00	100.00	3		
4	141.00	.00	164.00	123.00	.00	51.00L	180.00	53.00L	56.00	142.00P	.00	64.00	4		
5	138.00	112.00	174.00	73.00	49.00	.00	88.00	109.00L	57.00	61.00P	74.00	60.00	5		
6	165.00	.00L	160.00	81.00	.00	65.00L	94.00	257.00	94.00L	61.00P	.00L	64.00	6		
7	.00	.00	70.00	69.00	.00	42.00L	58.00L	114.00	66.00	83.00P	1.00L	82.00	7		
8	88.00	104.00L	162.00L	81.00	.00	.00	72.00L	171.00L	86.00	35.00P	72.00	88.00	8		
9	66.00	.00	66.00	.00L	.00	54.00L	64.00	99.00L	4.00	60.00P	4.00	.00	9		
10	1.00	.00L	7.00	71.00	72.00	.00	.00	57.00	61.00L	71.00P	4.00	66.00	10		
11	48.00	105.00	95.00	73.00L	.00	50.00L	34.00	76.00	80.00	50.00P	83.00	.00	11		
12	.00	.00	54.00L	3.00	.00	.00	74.00L	66.00	41.00	.00P	4.00L	70.00	12		
13	81.00	.00	423.00L	63.00L	.00	51.00L	59.00L	61.00L	43.00	53.00P	1.00L	61.00	13		
14	.00	91.00	257.00	148.00L	.00	.00	230.00L	31.00L	4.00	5.00P	.00L	.00	14		
15	.00	.00	196.00L	59.00	.00	44.00L	733.00	35.00L	77.00	97.00P	.00L	60.00	15		
16	84.00	90.00	180.00	76.00L	.00	.00	443.00L	51.00	.00	.00P	71.00	.00	16		
17	2.00	.00	74.00	70.00	.00	50.00E	474.00	31.00	73.00	45.00P	3.00L	75.00	17		
18	84.00	.00	75.00	77.00L	.00	58.00E	307.00L	64.00	78.00	.00P	4.00	.00	18		
19	87.00	76.00	94.00L	76.00	.00	62.00E	222.00L	185.00	66.00	.00P	.00	.00	19		
20	.00	172.00	57.00	.00	.00	41.00E	204.00L	69.00	162.00	52.00P	78.00	80.00	20		
21	96.00	177.00	51.00L	80.00	.00	44.00E	248.00	92.00	167.00	47.00P	.00	4.00	21		
22	79.00	219.00	92.00	.00	52.00	96.00E	167.00	182.00L	374.00	.00P	77.00	11.00	22		
23	74.00	683.00	362.00L	.00L	.00	47.00E	145.00	181.00L	268.00	54.00P	20.00P	67.00	23		
24	.00	611.00	605.00L	72.00	.00	51.00L	12.00E	195.00	165.00L	248.00	49.00P	.00	24		
25	64.00	500.00	133.00	.00	.00	38.00E	195.00L	150.00L	74.00	2.00P	502.00P	55.00	25		
26	.00	257.00	129.00	.00	171.00L	52.00E	156.00L	83.00	156.00E	61.00P	271.00	30.00	26		
27	72.00	247.00	76.00	.00	359.00	35.00E	100.00	78.00	234.00E	4.00P	176.00	4.00	27		
28	70.00L	1567.00L	148.00	50.00	132.00	38.00E	2.00	84.00L	473.00E	42.00P	161.00	1.00	28		
29	.00L	1432.00L	78.00L	.00	934.00	41.00E	.00	.00	463.00E	6.00P	152.00	73.00	29		
30	54.00	.00	100.00	.00	772.00	39.00E	69.00L	72.00L	406.00P	67.00P	94.00	.00	30		
31	65.00	.00	64.00L	.00	502.00L	.00	318.00	3.00	.00	44.00P	.00	.00	31		

MAX	733.00	1567.00L	685.00L	148.00L	934.00	313.00L	733.00	257.00	463.00L	315.00P	465.00P	146.00			
MEAN	46.06	224.06	175.16	51.63	44.81	60.47	166.65	67.35	141.50	61.50	63.41H	45.35			
MIN	.00	.00	7.00	.00L	.00	.00	.00	.00	.00	.00P	.00P	.00			
SUM	2978.00	8686.00	5430.00	1249.00	5094.00	1814.00	5166.00	2708.00	4245.00	1409.00	1639.00H	1506.00			

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 T - TRAIL AMOUNT
 G - AMOUNT ACCUMULATED WAS GREATER THAN

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPILED FROM PARTIAL RECORD
 E - ESTIMATED
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 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A
 R - RAINFALL WAS RECORDED

*** STATION: 5191 ***
 LATITUDE: 1 271131
 LONGITUDE: 1 804347

S-191 SPILLWAY ON CANAL C-53 AT LAKE UKEICHILLI
 FLUM CFS
 MEAN DAILY VALUE

AGENCY: WML
 COUNTY: UKELE

50/01/11.

	1983			1983			1983			1983			1983			
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY			
1	67.00	6.00	7.00	12.00	8.00	.00E	38.60	5.00	364.00E	320.00	56.00	110.00	1			
2	3.00	9.00	.00	16.00	.00	.00E	68.00	144.00E	369.00E	358.00	.00	211.00	2			
3	.00	87.60	.00	13.00	.00	.00E	286.00	168.00E	514.00E	469.00	75.00	6.00	3			
4	63.00	12.00E	.00	9.00	.00	.00	231.00	202.00E	343.00E	548.00	71.00	.00	4			
5	.00	2.00	.00	5.00	.00	.00	65.00	205.00E	436.00E	531.00	71.00E	14.00	5			
6	.00	4.00E	.00	1.00	.00	.00	196.00	181.00E	474.00	382.00	.00E	95.00	6			
7	81.00	6.00E	63.00	10.00	.00	.00	7.00	286.00E	1068.00	329.00	64.00	105.00	7			
8	4.00	74.00	16.00	16.00	.00	.00	69.00	152.00E	72.00	265.00	.00	19.00	8			
9	3.00	12.00	13.00	5.00	.00	.00	167.00	264.00E	467.00	252.00E	72.00	72.00	9			
10	100.00	6.00	.00	.00E	.00	.00	75.00	487.00E	374.00	204.00	.00	70.00	10			
11	102.00	1.00	10.00	.00E	.00	.00	82.00	298.00E	263.00	134.00	61.00	72.00	11			
12	106.00E	.00	5.00	.00	.00	.00	66.00	243.00E	156.00	72.00	28.00	.00	12			
13	102.00	.00	5.00	.00E	.00	.00	101.00	136.00E	64.00	76.00	10.00	17.00	13			
14	100.00	61.00	3.00	.00	.00	.00	1.00	476.00E	72.00	152.00	74.00	66.00	14			
15	99.00	.00	61.00	.00	.00	.00	67.00	462.00E	266.00	76.00	.00	.00	15			
16	97.00	.00	.00	89.00	.00	.00	79.00	342.00E	173.00	77.00	.00	68.00	16			
17	95.00	.00	51.00	36.00	.00	42.00	68.00	380.00E	167.00	85.00	56.00E	.00	17			
18	94.00	2.00	65.00	121.00	.00	.00	154.00	131.00E	553.00	80.00	23.00E	.00	18			
19	93.00	3.00	.00	31.00	.00	.00	64.00	411.00E	1986.00E	81.00	26.00E	104.00	19			
20	91.00	74.00	.00	32.00	.00	83.00	65.00	236.00E	1844.00E	16.00	65.00E	22.00	20			
21	94.00E	17.00	70.00	108.00	.00	.00	94.00	263.00E	1853.00E	86.00E	.00	.00	21			
22	95.00E	14.00	156.00	26.00	.00	.00	68.00	286.00E	1444.00	75.00E	61.00	.00	22			
23	94.00	11.00	4.00	23.00	.00	170.00	67.00	255.00E	1018.00	66.00E	.00	15.00	23			
24	92.00	10.00	89.00	21.00	.00	77.00	5.00	129.00E	751.00	.00	.00	.00	24			
25	100.00	13.00	.00	21.00	.00	15.00	70.00	135.00E	564.00	.00	.00	.00	25			
26	.00E	15.00	.00	21.00	.00	60.00	179.00	108.00E	413.00	71.00E	77.00	.00	26			
27	.00E	17.00	.00	21.00	.00	.00	185.00	125.00E	362.00	.00E	28.00	89.00	27			
28	89.00	91.00	.00	21.00	.00	148.00	93.00	150.00E	299.00	63.00E	24.00	16.00	28			
29	.00	.00	.00	21.00	.00	64.00	149.00	35.00E	314.00	.00E	122.00	1.00	29			
30	4.00	.00	.00	23.00	.00	210.00	72.00	226.00E	320.00	74.00	166.00	.00	30			
31	5.00	.00	.00	.00	.00	.00	49.00	205.00E	.00	.00	.00	45.00	31			
MAX	106.00E	91.00	156.00	121.00	8.00	210.00	286.00	487.00E	1986.00E	548.00	186.00	211.00				
MEAN	59.87	16.74	20.24	23.40	.26	30.57	47.40	231.77	616.63	158.65	44.23	48.58				
MIN	.00	.00	.00	.00E	.00	.00E	1.00	5.00	64.00	.00	.00	.00				
SUM	1656.00	554.00	629.00	702.00	8.00	917.00	3035.00	7185.00	18449.00	4918.00	1327.00	1506.00				

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAS MORE THAN 4 SIG. DIGITS
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DATA TAG LEGEND

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*** STATION: 5191 ***
 LATITUDE : 271131
 LONGITUDE : 604547

S-141 SPILLWAY ON CANAL C-54 AT LAKE ELMCHOLLI
 FLOW LFS
 MEAN DAILY VALUE
 AGENCY: WND
 COUNTY: ELMER

50/01/11.

	1986			1986			1986			1986			1986		
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
1	.00	.00	71.00	.00	.00	.00	442.00	253.00	241.00	107.00	313.00	24.00	1	.00	.00
2	.00	.00	.00	.00	.00	.00	567.00	371.00	308.00	85.00	455.00	45.00	2	.00	.00
3	.00	.00	.00	.00	.00	.00	474.00	400.00	247.00	46.00	196.00	21.00	3	.00	.00
4	69.00	.00	.00	.00	.00	.00	714.00	280.00	256.00	104.00	183.00	105.00	4	.00	.00
5	.00	82.00	84.00	.00	.00	.00	934.00	308.00	242.00	71.00	161.00	24.00	5	.00	.00
6	.00	5.00	.00	.00	.00	.00	856.00	226.00	617.00	118.00	163.00	46.00	6	.00	.00
7	.00	1.00	.00	.00	.00	.00	722.00	212.00	516.00	15.00	340.00	26.00	7	.00	.00
8	91.00	.00	.00	.00	.00	.00	675.00	225.00	477.00	44.00	328.00	44.00	8	.00	.00
9	.00	.00	.00	.00	.00	.00	636.00	208.00	493.00	101.00	200.00	25.00	9	.00	.00
10	82.00	.00	86.00	.00	.00	.00	454.00	236.00	1212.00	16.00	110.00	23.00	10	.00	.00
11	.00	.00	76.00	.00	.00	.00	515.00	334.00	1141.00	84.00	164.00	47.00	11	.00	.00
12	90.00	97.00	1.00	.00	.00	205.00	419.00	242.00	911.00	15.00	47.00	20.00	12	.00	.00
13	66.00	.00	86.00	.00	.00	450.00	457.00	271.00	617.00	83.00	116.00	26.00	13	.00	.00
14	18.00	.00	86.00	.00	.00	451.00	407.00	321.00	452.00	21.00	289.00	102.00	14	.00	.00
15	.00	.00	104.00	.00	.00	360.00	320.00	396.00	366.00	164.00	235.00	25.00	15	.00	.00
16	79.00	.00	3.00	.00	.00	314.00	173.00	1183.00	298.00	95.00	164.00	26.00	16	.00	.00
17	.00	102.00	66.00	.00	.00	315.00	114.00	694.00	204.00	45.00	164.00	24.00	17	.00	.00
18	.00	52.00	4.00	.00	.00	267.00	94.00	641.00	169.00	94.00	106.00	46.00	18	.00	.00
19	70.00	42.00	1.00	.00	.00	316.00	65.00	1080.00	81.00	28.00	48.00	24.00	19	.00	.00
20	.00	87.00	77.00	.00	.00	419.00	78.00	907.00	214.00	99.00	105.00	33.00	20	.00	.00
21	.00	2.00	.00	.00	.00	721.00	.00	857.00	230.00	28.00	76.00	35.00	21	.00	.00
22	12.00	.00	.00	.00	.00	874.00	220.00	793.00	177.00	101.00	57.00	35.00	22	.00	.00
23	86.00	.00	60.00	.00	.00	837.00	91.00	646.00	212.00	17.00	94.00	112.00	23	.00	.00
24	.00	.00	.00	.00	.00	756.00	174.00	446.00	160.00	24.00	30.00	24.00	24	.00	.00
25	.00	91.00	.00	.00	.00	764.00	155.00	373.00	234.00	102.00	45.00	102.00	25	.00	.00
26	83.00	.00	.00	.00	.00	614.00	223.00	202.00	206.00	24.00	25.00	24.00	26	.00	.00
27	.00	.00	.00	.00	.00	677.00	179.00	208.00	243.00	18.00	93.00	109.00	27	.00	.00
28	.00	.00	.00	.00	.00	577.00	312.00	281.00	169.00	24.00	23.00	111.00	28	.00	.00
29	.00	.00	79.00	.00	.00	341.00	580.00	308.00	147.00	107.00	21.00	104.00	29	.00	.00
30	.00	.00	.00	.00	.00	465.00	571.00	255.00	85.00	180.00	46.00	116.00	30	.00	.00
31	72.00	.00	.00	.00	.00	503.00	232.00	232.00	164.00	164.00	203.00	203.00	31	.00	.00
MAX	91.00	102.00	104.00	.00	.00	874.00	939.00	1183.00	1212.00	104.00	355.00	203.00			
MEAN	26.39	20.04	24.44	.00	.00	325.60	329.47	449.44	366.43	77.74	152.46	65.63			
MIN	.00	.00	.00	.00	.00	.00	.00	206.00	85.00	15.00	21.00	20.00			
SUM	810.00	561.00	920.00	.00	.00	9760.00	12089.00	13448.00	10943.00	2416.00	4572.00	2016.00			

**** DATA IS PROVISIONAL AFTER 12/31/1799 ****

DATA PAGE LEGEND

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*** STATION: S191 ***
 LATITUDE : 271131
 LONGITUDE : 804547

S-191 SPILLWAY ON CANAL C-54 AT LAKE CREECHMIRE
 FLUM CFS
 MEAN DAILY VALUE
 AGENCY: BMD
 COUNTY: ORLEC

90/01/11.

	1987		1987		1987		1987		1987		1987		
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	1067.00	25.00	83.00	434.00	7.00	18.00	.00	60.00	.00	54.00	214.00	177.00	1
2	780.00	56.00	2.00	299.00	9.00	12.00	75.00	.00	.00	.00	386.00	66.00	2
3	445.00	20.00	79.00	185.00	9.00	16.00	58.00	.00	.00	.00	386.00	57.00	3
4	460.00	27.00	.00	163.00	8.00	12.00	3.00	54.00	.00	.00	914.00	150.00	4
5	712.00	47.00	.00	140.00	18.00	5.00	6.00	.00	.00	.00	1114.00	74.00	5
6	548.00	17.00	.00	104.00	18.00	21.00	8.00	.00	.00	.00	908.00	2.00	6
7	370.00	93.00	349.00	101.00	21.00	26.00	73.00	.00	.00	.00	715.00	64.00	7
8	277.00	13.00	449.00	86.00	117.00	30.00	81.00	.00	.00	.00	552.00	74.00	8
9	265.00	86.00	262.00	11.00	19.00	25.00	2.00	55.00	.00	.00	333.00	80.00	9
10	190.00	17.00	.00	99.00	4.00	111.00	.00	.00	.00	.00	312.00	83.00	10
11	194.00	75.00	177.00	14.00	22.00	50.00	85.00	.00	.00	.00	286.00	.00	11
12	106.00	33.00	74.00	90.00	25.00	35.00	2.00	.00	.00	469.00	170.00	84.00	12
13	105.00	17.00	86.00	91.00	112.00	36.00	.00	.00	.00	509.00	161.00	23.00	13
14	106.00	22.00	75.00	32.00	13.00	39.00	87.00	.00	.00	347.00	174.00	49.00	14
15	103.00	45.00	12.00	19.00	107.00	43.00	17.00	.00	.00	287.00	97.00	87.00	15
16	98.00	17.00	74.00	87.00	13.00	43.00	93.00	.00	.00	283.00	149.00	.00	16
17	98.00	43.00	8.00	6.00	95.00	44.00	88.00	53.00	.00	184.00	47.00	61.00	17
18	109.00	4.00	84.00	4.00	13.00	37.00	80.00	.00	55.00	166.00	737.00	72.00	18
19	28.00	93.00	12.00	3.00	19.00	35.00	77.00	.00	.00	83.00	1120.00	.00	19
20	107.00	7.00	9.00	83.00	115.00	21.00	162.00	.00	.00	68.00	1711.00	80.00	20
21	23.00	88.00	75.00	5.00	26.00	39.00	137.00	.00	.00	88.00	1403.00	.00	21
22	99.00	4.00	2.00	4.00	14.00	42.00	193.00	.00	76.00	82.00	765.00	73.00	22
23	104.00	83.00	3.00	1.00	16.00	18.00	156.00	.00	.00	.00	544.00	.00	23
24	109.00	9.00	8.00	12.00	21.00	4.00	47.00	.00	67.00	76.00	472.00	.00	24
25	107.00	9.00	87.00	20.00	16.00	7.00	46.00	.00	.00	.00	432.00	80.00	25
26	102.00	87.00	85.00	22.00	18.00	12.00	.00	.00	.00	73.00	364.00	.00	26
27	24.00	11.00	270.00	7.00	10.00	9.00	.00	.00	.00	.00	242.00	.00	27
28	111.00	7.00	309.00	26.00	6.00	4.00	.00	.00	.00	.00	243.00	16.00	28
29	103.00	.00	312.00	8.00	5.00	74.00	58.00	.00	.00	76.00	182.00	.00	29
30	26.00	.00	474.00	8.00	8.00	62.00	.00	.00	.00	7.00	173.00	.00	30
31	96.00	.00	556.00	14.00	.00	.00	.00	.00	.00	.00	.00	.00	31

MAX	1007.00	98.00	556.00	434.00	117.00	111.00	143.00	60.00	76.00	509.00	1711.00	177.00
MEAN	226.42	44.56	135.26	72.27	29.35	32.00	52.81	7.16	6.60	94.74	512.27	12.55
MIN	23.00	7.00	.00	1.00	4.00	4.00	.00	.00	.00	.00	47.00	.00
SUM	7019.00	1254.00	4193.00	2168.00	910.00	960.00	1637.00	224.00	148.00	2937.00	15304.00	1625.00

**** DATA IS PROVISIONAL AFTER 12/31/1999 ****

DATA TAG LEGEND

M - MISSING DATA
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DATA TAG LEGEND

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 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A
 R - RAINFALL WAS RECORDED

*** STATION: S191 ***
 LATITUDE: 271131
 LONGITUDE: 804547

S-191 SPILLWAY ON CANAL C-34 AT LAKE UKEICHUMEL
 FLUM CFS
 MEAN DAILY VALUE
 AGENCY: WMD
 COUNTY: UKEEC

40/01/11.

	1988		1988		1988		1988		1988		1988		1988	
DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
1	80.00	80.00	80.00	87.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
2	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
3	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
4	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
5	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
6	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
7	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
8	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
9	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
10	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
11	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
12	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
13	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
14	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
15	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
16	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
17	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
18	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
19	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
20	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
21	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
22	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
23	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
24	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
25	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
26	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
27	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
28	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
29	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
30	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
31	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
MAX	87.00	488.00E	454.00E	87.00	169.00	54.00	411.00	1007.00	272.00	82.00	92.00E	86.00		
MEAN	49.10	88.45	41.63	14.33	23.14	10.63	84.23	474.52	80.73	15.65	22.83	6.00		
MIN	00	00	00	00	00	00	00	163.11	00	00	00	00		
SUM	1522.00	2565.00	2822.00	430.00	719.00	314.00	2611.00	14711.00	2422.00	485.00	685.00	241.00		

**** DATA IS PROVISIONAL AFTER 12/31/1999 ****

DATA TAG LEGEND

M - MISSING DATA
 S - ORIGINAL HAD MORE THAN 4 SIG DIGITS
 L - LINE-AVERAGE
 ? - QUESTIONABLE
 > - GREATER THAN
 T - TRACE AMOUNT
 G - AMOUNT ACCUMULATED WAS GREATER THAN

DATA TAG LEGEND

V - NO DATA COLLECTED
 P - SUMMARY COMPUTED FROM PARTIAL RECORD
 E - ESTIMATED
 < - LESS THAN
 A - INCLUDES PREVIOUS DAYS WITH X
 X - INCLUDED IN NEXT AMOUNT TAGGED A
 B - RAINFALL WAS RECORDED

APPENDIX B

Calculated Net Inflows

Image Quality

**As you review the next group of images,
Please note that the original documents
were of poor quality.**

NET INFLOW TO THE CANAL
YEAR: 1974

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	76.0	53.7	38.8	14.0	.0	.0	534.1	741.0	446.0	801.0	19.6	18.2
2	12.7	.0	.0	3.9	3.9	9.7	1012.9	584.0	297.9	611.0	12.7	25.7
3	15.7	12.7	6.8	65.5	.0	3.9	1032.1	456.1	232.0	328.9	10.8	81.5
4	48.5	50.5	5.8	.0	.0	13.7	890.0	474.9	259.0	181.0	124.6	.0
5	.0	.0	7.8	14.6	1.0	94.1	828.0	773.0	96.0	277.1	12.2	11.7
6	15.6	8.8	6.9	63.1	.0	20.4	609.0	1232.9	131.9	288.8	26.7	9.8
7	57.4	10.7	4.9	2.9	.0	51.6	908.0	1060.0	194.2	568.1	17.8	22.8
8	.0	10.8	36.8	59.1	1.0	50.7	657.0	895.1	120.0	519.0	100.2	23.8
9	13.7	11.8	.0	.0	6.8	113.2	306.0	884.0	173.9	311.0	3.6	217.5
10	12.7	33.9	4.9	17.6	1.0	11.6	291.0	873.0	456.1	300.9	35.7	28.3
11	52.7	.0	4.9	44.6	.0	45.8	255.0	861.0	528.0	103.0	36.7	49.8
12	.0	6.8	6.8	.0	2.9	47.7	310.0	718.0	249.0	159.9	37.8	50.8
13	11.7	7.8	4.9	13.7	1.0	44.8	838.1	634.1	222.9	129.1	95.7	39.8
14	66.1	7.8	3.9	10.8	.0	33.8	392.0	504.0	233.0	124.1	.0	40.8
15	.0	6.9	41.6	57.6	7.8	82.8	276.0	401.9	201.1	109.9	23.7	142.9
16	59.1	8.8	.0	.0	47.4	.0	181.0	387.0	129.9	6.9	23.7	42.6
17	.0	35.9	7.8	16.6	.0	28.7	197.4	363.0	114.0	117.3	31.8	204.0
18	17.6	.0	3.9	72.3	5.8	22.9	2050.6	572.0	128.1	98.0	117.2	152.0
19	50.7	7.8	3.9	.0	4.9	8.9	857.8	627.0	94.9	.0	4.3	24.1
20	.0	16.6	5.9	13.7	2.9	2.9	719.1	918.0	92.1	145.3	25.7	145.9
21	13.6	7.8	6.9	11.8	2.0	2.0	660.0	560.0	102.1	.0	79.6	11.2
22	13.7	38.7	4.9	51.5	.0	47.0	783.0	543.1	.0	19.5	.0	37.5
23	46.5	.0	.0	.0	1.0	5.3	1167.0	439.9	110.8	111.3	25.7	149.6
24	.0	8.8	4.9	12.7	.0	73.6	1091.1	608.1	235.0	.0	35.8	23.8
25	11.7	6.8	2.9	43.7	1.0	319.4	816.0	1031.0	242.0	16.6	44.8	34.6
26	10.8	4.9	20.9	.0	.0	522.9	873.0	968.0	231.1	121.7	156.2	167.4
27	8.8	2.9	20.9	10.7	2.0	397.0	649.0	640.9	233.0	.0	32.4	11.1
28	46.6	4.9	34.0	8.8	.0	638.0	895.0	582.0	374.9	30.5	58.6	31.6
29	.0	.0	34.9	9.8	2.9	563.0	872.9	532.0	242.0	27.7	45.8	134.7
30	18.6	.0	34.0	40.7	4.9	450.0	1179.1	899.8	368.1	110.7	154.4	.0
31	12.8	.0	31.0	.0	41.9	.0	967.0	729.6	.0	.0	.0	15.6

NET INFLOW TO THE CANAL
YEAR: 1975

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	15.7	.0	.0	-1.0	-1.9	7.8	275.8	19.8	17.9	316.0	216.0	20.9
2	114.6	8.8	16.6	-2.0	-1.9	8.8	121.1	7.9	136.0	378.0	233.0	97.7
3	.0	8.8	78.7	.0	-3.9	4.9	210.3	1.0	206.9	283.0	133.9	.0
4	13.7	5.9	.0	19.2	-3.9	-1.0	145.8	-2.0	241.1	259.0	116.9	8.8
5	12.7	6.9	14.6	.0	-4.8	-4.9	119.0	-3.9	249.0	125.0	.0	8.8
6	95.7	70.5	11.7	2.0	-1.9	-4.9	136.9	-2.0	241.1	240.0	127.2	7.8
7	.0	.0	7.9	1.0	-1.0	-4.9	20.0	5.9	257.0	225.9	111.9	8.8
8	10.7	10.7	7.9	2.9	1.0	-4.9	93.2	4.9	248.0	93.9	1.0	140.6
9	13.7	7.8	3.9	2.0	-9.6	-4.9	75.1	350.1	196.0	194.2	120.1	36.1
10	70.5	108.3	2.0	1.0	2.9	-2.9	89.7	245.9	468.0	123.0	3.9	52.8
11	.0	.0	-3.0	3.9	.0	-3.9	43.3	145.1	377.0	139.9	119.9	62.9
12	10.7	80.1	-4.9	108.2	1.0	-3.9	156.8	166.0	434.0	92.1	.0	110.9
13	12.7	.0	-4.9	.0	3.9	-5.8	220.0	343.0	221.0	.0	106.2	133.9
14	93.7	12.7	-3.9	51.0	5.8	-4.8	329.1	418.0	261.0	122.9	5.9	88.9
15	.0	10.8	1.0	.0	.0	-5.8	200.1	373.0	249.0	4.9	13.7	152.2
16	9.7	8.9	.0	19.6	23.3	-1.0	104.0	184.0	400.2	150.2	137.5	36.5
17	8.8	49.9	.0	103.3	15.7	6.7	388.0	364.0	262.1	7.8	4.9	52.8
18	8.8	.0	1.0	.0	12.8	10.6	279.0	151.0	361.1	110.1	14.7	53.8
19	7.9	6.8	2.0	125.4	78.2	13.6	333.0	322.0	407.0	249.0	131.4	54.8
20	76.9	7.8	1.0	.0	-25.4	21.5	225.0	357.0	373.0	132.1	.0	36.9
21	.0	9.8	-1.0	18.6	-2.9	94.9	23.6	623.0	382.0	149.9	14.7	195.3
22	8.7	122.1	1.0	72.3	-2.9	4.9	52.7	434.0	285.0	147.0	101.5	16.3
23	15.6	7.8	1.0	.0	-1.0	92.2	3.0	450.0	440.0	123.0	.0	37.8
24	13.7	106.1	1.0	15.7	-1.9	112.0	-35.8	257.0	294.0	138.0	10.7	37.8
25	11.8	147.1	1.0	50.1	-1.9	226.9	-27.6	243.0	278.0	.0	9.8	36.9
26	119.9	126.9	-1.0	-4.9	-2.9	213.0	6.9	235.1	588.0	132.1	7.9	38.9
27	3.9	.0	-3.9	-3.9	-5.8	66.2	5.9	89.9	586.0	10.8	136.6	178.2
28	8.8	115.2	-2.9	-2.9	-2.9	107.9	-21.6	164.0	443.9	113.2	.0	6.6
29	8.8	.0	-1.0	-3.9	3.9	120.9	-28.2	47.0	438.0	125.9	9.8	35.8
30	7.9	.0	.0	-1.9	7.7	55.3	8.7	199.0	399.0	367.0	24.8	34.8
31	64.8	.0	-2.0	.0	9.7	.0	14.6	21.2	.0	151.0	.0	23.8

NET INFLOW TO THE CANAL
YEAR: 1976

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	18.8	141.8	.0	2.9	76.0	2992.9	275.9	131.9	99.9	451.1	8.8	142.5
2	91.7	.0	19.6	62.1	13.7	1098.1	425.1	112.2	127.0	281.8	106.2	2.9
3	.0	10.7	125.5	.0	11.8	662.9	127.0	120.1	138.0	190.0	162.1	11.7
4	8.8	9.8	.0	1.9	78.7	824.0	247.0	308.9	257.0	136.0	148.0	8.8
5	6.8	10.8	10.7	1.0	.0	1255.0	105.0	446.0	574.0	151.0	123.0	164.5
6	5.9	139.7	7.8	5.8	4.9	1623.0	121.0	285.0	386.0	125.0	.0	.0
7	4.9	.0	9.8	7.8	4.9	1049.0	491.0	291.0	321.0	94.0	116.0	16.6
8	75.9	1.9	74.8	85.9	3.9	625.0	440.0	116.0	219.9	5.9	.0	98.5
9	.0	2.9	.0	46.6	89.1	615.0	601.1	272.0	101.2	153.2	15.7	15.6
10	7.8	2.9	6.8	83.5	.0	2815.0	585.0	376.1	98.9	9.8	140.4	119.4
11	11.7	2.9	6.8	16.6	278.8	2500.9	364.0	289.9	112.9	100.3	.0	.0
12	10.8	3.9	4.9	91.6	173.1	1329.1	378.0	103.2	110.0	7.8	16.6	123.8
13	5.9	3.9	3.9	.0	5.9	791.0	389.0	284.9	199.0	81.3	185.5	.0
14	101.7	6.9	4.9	10.7	131.2	501.0	252.9	1153.1	150.2	.0	12.7	134.9
15	.0	116.7	2.9	8.8	257.7	400.0	106.1	1485.0	295.8	14.7	14.7	2.9
16	7.8	.0	2.0	5.9	336.2	413.0	128.8	912.0	195.0	117.1	79.6	141.0
17	7.8	4.9	79.7	2.9	605.0	407.0	389.1	1419.9	226.2	.0	3.9	7.8
18	5.9	3.9	.0	2.0	270.1	274.0	526.0	915.1	306.8	114.1	13.7	148.2
19	2.9	5.9	1.0	2.9	271.9	265.9	535.0	851.0	369.0	2.9	46.5	9.8
20	4.9	5.9	2.9	53.9	116.0	420.1	254.0	678.0	74.2	97.2	.0	79.0
21	95.0	2.9	2.9	.0	161.0	272.0	279.0	488.0	328.8	.0	15.6	.0
22	.0	3.9	2.9	2.9	84.9	307.6	275.0	385.0	659.2	12.7	13.7	13.7
23	2.9	4.9	6.8	1.9	909.2	966.5	289.1	376.0	431.0	7.8	121.5	114.6
24	2.9	.0	.0	1.0	1655.0	998.0	423.0	239.9	381.9	99.6	.0	14.6
25	2.9	122.6	2.0	1.0	956.0	853.0	430.0	798.1	301.0	.0	9.8	86.7
26	4.9	.0	1.0	1.0	917.0	559.0	303.9	627.0	159.0	12.7	9.8	63.4
27	6.8	15.6	2.0	1.0	597.0	255.0	289.9	359.0	151.0	9.8	97.5	142.0
28	9.8	9.8	1.0	.0	246.0	463.0	127.1	267.9	159.1	91.6	.0	5.9
29	4.9	146.4	1.0	.0	402.9	439.0	158.0	265.0	137.9	.0	11.7	125.2
30	3.9	.0	1.0	-1.0	647.1	389.0	114.1	325.9	271.1	7.8	14.7	8.8
31	3.9	.0	.0	.0	1209.0	.0	131.9	99.1	.0	11.7	.0	153.2

NET INFLOW TO THE CANAL
YEAR: 1977

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	9.8	33.5	8.0	.0	1.0	.0	5.9	7.8	310.0	120.1	9.8	501.3
2	241.0	167.3	130.3	2.9	.0	94.9	46.6	94.8	337.2	143.1	6.8	456.7
3	3.2	20.8	.0	3.9	1.0	117.1	.0	.0	680.9	115.0	8.8	320.0
4	149.0	180.0	48.0	3.9	1.0	119.9	6.8	4.9	1921.1	108.1	84.8	325.0
5	6.8	.0	2.9	2.9	2.9	128.1	5.9	2.9	1571.0	85.0	18.5	182.0
6	163.2	163.4	13.7	2.9	8.7	142.1	6.8	1.9	1044.0	.0	150.2	884.0
7	4.9	.0	88.5	2.0	4.9	112.0	4.9	3.9	738.2	106.0	7.8	1384.0
8	123.3	17.5	.0	.0	1.9	105.0	5.9	2.9	511.9	.0	88.5	753.1
9	.0	159.1	11.7	2.0	5.9	96.1	30.0	3.9	267.0	112.3	.0	488.0
10	19.5	5.3	9.8	1.0	6.8	118.9	.0	2.9	274.1	.0	30.6	580.0
11	113.2	20.6	70.5	.0	5.9	98.1	2.9	48.5	281.9	18.5	41.7	650.0
12	13.1	128.5	.0	.0	2.0	.0	2.9	.0	142.9	79.3	5.9	379.0
13	25.7	.0	13.7	1.0	64.9	19.6	1.9	152.8	252.0	.0	110.8	182.0
14	124.4	16.6	11.8	2.9	.0	78.4	5.8	.0	131.0	9.8	.0	326.1
15	.0	14.7	102.6	3.9	1.9	.0	10.7	140.8	133.0	6.8	8.8	186.9
16	175.8	118.6	.0	1.0	1.0	10.7	12.7	2.0	214.9	9.8	7.8	502.1
17	156.0	5.8	7.8	-1.0	.0	8.8	87.4	99.4	140.1	141.5	8.8	1428.0
18	225.0	10.7	9.8	.0	-1.0	82.8	7.8	.0	132.9	21.2	119.8	1214.0
19	.0	12.7	7.8	.0	.0	.0	104.5	9.7	216.9	22.8	.0	933.9
20	165.8	152.6	6.9	1.0	-1.0	13.6	.0	5.9	692.1	23.8	9.7	786.0
21	3.9	1.9	81.9	.0	.0	108.8	13.6	4.9	462.0	18.9	9.7	456.9
22	177.5	8.8	.0	1.0	.0	248.0	14.7	-2.0	488.0	7.8	8.8	968.4
23	19.5	14.8	5.8	1.0	-1.9	3.9	70.6	-22.4	434.0	129.7	150.1	145.6
24	184.5	168.1	1.9	2.0	-1.0	95.3	5.8	-22.2	158.1	.0	316.1	366.1
25	73.7	8.5	5.8	2.9	-1.0	8.8	10.7	-17.9	312.9	18.5	127.1	176.8
26	169.3	37.7	6.8	.0	1.9	72.5	9.8	-6.8	579.0	82.3	112.9	402.1
27	.0	38.7	3.9	45.2	23.3	.0	54.8	27.4	358.0	.0	140.2	222.8
28	118.6	103.0	3.9	.0	17.6	31.7	.0	42.9	330.1	13.7	.0	205.0
29	7.3	.0	4.9	1.0	10.8	9.8	7.8	58.0	176.9	10.8	402.6	188.0
30	27.5	.0	3.9	1.0	12.9	4.9	8.8	327.2	177.9	116.6	1179.3	233.1
31	167.7	.0	74.9	.0	137.8	.0	7.8	230.9	.0	.0	.0	245.0

NET INFLOW TO THE CANAL
YEAR: 1978

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	218.9	39.8	29.9	92.6	4.9	3.9	125.9	920.1	382.0	672.9	1.9	5.9
2	254.9	257.4	164.2	92.7	17.8	3.9	172.0	641.0	344.0	644.0	114.1	103.0
3	17.1	55.6	117.1	183.5	79.4	2.0	108.0	653.0	231.0	1127.9	21.8	.0
4	179.1	211.4	410.8	18.1	.0	4.9	240.0	740.0	406.0	873.8	116.2	34.7
5	111.9	26.7	160.1	11.7	15.6	57.6	85.2	388.0	341.0	539.0	9.0	117.4
6	6.8	201.1	176.9	10.8	109.0	138.5	119.8	282.0	346.0	709.0	97.6	1.0
7	182.2	38.1	151.0	198.8	93.2	128.3	115.0	302.0	218.0	403.3	26.5	16.6
8	189.8	156.6	157.1	.0	85.1	8.8	4.9	194.0	107.9	345.8	218.8	103.6
9	1.0	116.4	1013.9	8.7	.0	145.4	109.3	371.1	192.0	263.0	120.1	15.8
10	178.3	214.9	2776.1	8.8	18.6	168.5	141.7	183.9	90.0	269.8	153.9	14.7
11	189.8	207.1	1694.9	7.8	51.7	18.5	166.2	138.0	469.1	131.3	100.0	116.6
12	5.9	29.9	949.0	4.9	.0	156.9	192.9	140.9	768.0	303.9	155.0	.0
13	205.1	189.3	557.0	151.8	7.8	5.9	184.0	228.1	598.0	148.8	130.1	19.7
14	366.0	28.7	419.0	.0	8.8	113.1	186.1	134.0	488.0	237.2	131.9	20.7
15	191.1	208.3	332.1	6.8	3.9	13.1	211.9	294.9	400.0	151.9	35.8	83.7
16	185.9	23.9	370.0	6.8	2.9	35.7	104.0	396.0	334.0	156.7	131.5	.0
17	7.0	239.1	223.1	4.9	3.9	23.8	175.1	397.0	373.9	156.2	140.5	11.6
18	183.9	211.8	235.9	63.0	58.5	72.8	148.9	228.0	238.0	121.2	9.6	8.8
19	216.0	230.0	225.9	10.8	.0	.0	252.0	358.0	311.0	162.9	59.4	40.0
20	479.2	457.2	236.9	132.5	25.8	6.8	777.8	393.0	95.9	133.1	139.4	89.2
21	443.9	223.9	55.1	18.6	23.9	7.8	418.3	262.1	144.0	126.0	70.7	.0
22	374.9	495.0	186.1	131.3	5.9	104.1	364.0	207.9	199.2	.0	147.2	12.4
23	146.0	173.1	211.7	4.9	2.9	120.9	314.9	243.0	346.0	132.1	47.8	9.6
24	292.1	227.9	29.5	123.2	2.9	215.0	153.0	475.0	403.0	91.9	122.2	9.6
25	146.0	217.6	191.4	.0	137.0	205.1	235.0	327.1	1219.0	116.1	35.1	17.4
26	62.9	30.2	27.6	17.6	.0	96.0	243.0	224.9	963.0	.0	42.6	13.6
27	281.1	260.0	74.4	69.7	5.8	101.9	310.9	116.9	526.0	29.0	117.6	99.3
28	256.0	161.2	215.4	.0	4.9	157.0	551.3	179.2	327.0	23.7	20.8	690.0
29	250.0	.0	83.8	6.8	6.8	219.1	1414.5	81.8	331.9	26.8	33.6	971.1
30	74.0	.0	202.1	6.8	5.9	165.0	446.4	272.1	204.1	27.0	112.5	730.0
31	260.1	.0	63.3	.0	2.9	.0	397.9	408.0	.0	71.7	.0	554.9

NET INFLOW TO THE CANAL
YEAR: 1979

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	476.0	357.9	11.9	8.8	124.2	137.9	80.2	95.7	245.0	1525.8	16.6	146.2
2	566.9	343.0	142.7	6.8	13.3	207.1	.0	3.9	155.1	859.8	59.5	5.9
3	693.0	169.1	86.5	76.8	20.8	99.9	18.6	11.7	849.9	499.2	19.6	94.2
4	651.9	198.9	.0	.0	18.8	276.0	76.4	131.0	2545.2	70.9	76.4	.0
5	430.0	167.1	132.8	8.7	12.9	99.0	.0	82.0	3791.6	275.3	11.7	17.6
6	372.0	300.0	168.0	6.8	119.5	110.0	9.8	1.3	3167.3	399.9	69.2	93.4
7	312.0	161.1	343.1	4.9	.0	83.0	10.8	82.7	3009.9	414.0	1.0	120.9
8	327.0	168.9	411.0	4.9	190.6	53.2	98.3	74.2	1776.0	259.0	78.0	275.0
9	368.0	150.2	382.9	6.9	543.1	4.9	345.0	.0	1463.0	257.1	7.8	106.0
10	410.0	202.7	122.2	53.8	672.1	14.7	112.0	136.0	2473.0	75.3	67.4	96.0
11	198.9	44.1	.0	.0	641.0	109.4	187.0	589.1	2503.8	186.6	75.9	104.0
12	743.1	182.1	179.9	5.8	517.0	1.0	14.1	544.0	3056.0	171.9	.0	55.1
13	1491.0	203.1	137.9	5.8	284.0	11.8	129.8	194.9	3684.1	69.1	90.9	92.1
14	1845.9	30.2	2.2	4.9	927.0	59.3	335.2	240.1	4311.1	159.9	54.9	.0
15	1335.9	63.3	127.0	5.9	1298.1	.0	376.1	132.9	5051.8	66.1	2.9	107.0
16	709.1	202.5	8.1	15.9	644.0	13.7	389.0	106.0	3516.2	102.8	93.3	.0
17	505.9	221.5	23.6	13.0	395.9	11.8	155.9	253.9	2060.0	142.2	79.9	114.9
18	436.0	13.6	171.4	13.0	426.9	87.6	149.0	400.9	1237.0	70.0	6.9	.0
19	345.9	65.3	.0	18.0	121.1	.0	91.0	317.0	1007.9	76.0	93.3	18.6
20	263.1	183.4	13.6	27.0	120.9	6.8	104.2	96.2	536.0	71.0	96.2	109.3
21	455.9	54.6	114.5	133.4	100.1	5.9	.0	23.8	623.1	58.0	.0	3.9
22	358.0	165.1	.0	4.6	112.9	5.9	228.8	99.4	1239.9	74.0	23.4	15.7
23	466.0	15.1	14.6	28.9	77.9	88.3	359.5	14.6	633.0	3.9	69.5	105.6
24	674.0	118.9	137.1	31.8	293.2	.0	133.9	-16.6	868.2	53.2	10.7	11.7
25	800.0	27.3	12.2	33.6	394.8	10.8	135.4	-16.5	681.7	90.0	91.1	15.7
26	537.4	194.0	31.7	66.6	273.9	7.9	13.3	-17.3	516.0	9.8	.0	115.5
27	605.8	35.8	32.8	.0	203.0	76.3	45.6	-11.5	754.3	78.3	82.0	.0
28	785.0	186.1	60.8	8.7	203.0	52.0	74.3	13.4	1130.9	17.6	2.9	11.7
29	547.9	.0	77.0	4.9	136.0	2.0	.0	17.4	1016.0	66.4	85.2	10.8
30	524.1	.0	8.7	9.8	93.0	86.0	12.7	175.4	1579.0	18.6	13.7	114.5
31	281.1	.0	9.7	.0	232.0	.0	9.8	130.9	.0	70.3	.0	.0

NET INFLOW TO THE CANAL
YEAR: 1980

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	10.7	181.0	142.0	293.0	110.1	19.9	78.4	98.0	186.0	162.9	.0	25.6
2	8.8	48.0	255.0	510.0	63.1	10.9	20.7	23.1	275.0	75.1	5.8	131.1
3	115.5	180.1	377.0	346.1	82.7	1.0	68.8	34.1	616.0	109.9	5.9	23.1
4	.0	161.8	324.1	271.0	141.2	.0	6.1	.0	842.0	122.0	14.9	40.7
5	12.7	157.8	136.9	108.1	48.3	19.9	1.2	42.0	603.9	100.0	22.9	210.1
6	7.8	12.5	143.0	146.9	66.7	.0	-3.8	.0	501.0	105.0	28.9	280.3
7	81.7	132.8	130.1	245.1	51.9	1.9	70.1	24.6	346.0	85.1	34.9	294.8
8	.0	16.0	119.0	176.9	53.9	.0	8.8	28.1	283.0	33.8	94.3	291.9
9	9.7	58.6	110.8	136.1	125.2	1.9	174.3	6.1	300.0	96.0	21.2	293.9
10	10.7	83.5	10.2	210.0	22.6	3.9	.0	30.7	194.9	30.9	34.8	286.9
11	8.8	123.8	121.0	117.0	52.8	9.7	17.5	12.7	202.9	86.1	26.8	263.3
12	62.2	10.9	21.9	22.0	52.8	2.0	9.6	34.6	96.1	27.0	20.9	2.3
13	82.1	140.1	96.0	103.3	50.9	2.0	12.7	45.1	126.9	40.7	12.0	27.8
14	18.0	18.8	7.0	123.7	51.9	.0	21.8	44.0	216.1	92.3	4.0	26.8
15	106.3	137.2	35.7	113.2	57.8	.0	29.6	26.8	392.9	11.1	118.5	27.8
16	104.1	124.9	111.8	.0	100.2	-1.0	106.3	34.0	314.0	18.8	281.8	151.9
17	8.9	29.0	40.7	81.1	33.3	-1.0	63.0	14.9	171.0	14.8	234.0	.6
18	36.5	160.0	400.1	.0	44.8	-2.0	28.0	-18.5	259.0	58.1	247.0	39.8
19	101.6	679.0	431.0	134.7	41.9	2.0	28.0	6.1	112.0	11.4	151.0	36.8
20	23.6	728.0	167.8	88.0	34.8	4.9	30.0	76.5	167.1	36.8	144.0	38.8
21	75.3	255.0	136.9	113.0	70.3	30.4	49.9	2.2	86.0	37.8	148.1	138.2
22	.0	207.0	52.8	95.0	21.3	.0	52.2	27.9	72.0	80.2	30.0	21.2
23	28.6	145.9	148.6	12.7	28.8	11.7	62.9	6.9	80.0	28.3	148.7	46.6
24	97.4	124.0	40.7	90.4	14.8	51.1	61.0	19.1	80.0	47.7	20.2	172.2
25	2.9	112.0	42.7	13.7	7.8	.0	281.1	41.1	27.1	34.9	127.0	13.1
26	24.6	111.1	99.1	68.3	126.4	17.6	560.9	22.0	158.0	31.0	7.0	21.7
27	220.3	162.9	29.2	.0	36.7	45.2	407.1	46.9	185.9	21.0	118.1	92.5
28	279.9	165.0	44.7	116.8	72.2	18.2	268.9	50.9	196.0	16.0	.0	.0
29	266.0	100.0	87.0	87.0	24.1	34.8	150.0	67.3	209.0	16.0	168.2	10.7
30	163.9	.0	10.2	3.9	25.8	33.8	78.0	185.8	80.1	4.0	.0	9.8
31	260.0	.0	170.9	.0	24.8	.0	103.0	44.0	.0	19.6	.0	8.8

NET INFLOW TO THE CANAL
YEAR: 1981

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	140.5	4.9	5.9	2.9	-2.0	-1.9	-1.0	2.0	1334.9	77.0	96.3	2.9
2	.0	15.6	67.6	2.9	-1.0	.0	1.0	5.9	910.3	109.0	1.0	14.4
3	6.8	127.2	.0	.0	-3.9	1.0	1.0	38.0	727.7	77.0	8.8	.0
4	6.9	8.8	6.8	2.0	-1.9	-1.0	.0	2.9	556.5	4.9	8.8	4.9
5	7.9	99.2	8.8	.0	-1.9	1.0	-1.0	252.2	487.6	90.2	83.3	3.9
6	4.9	.0	6.9	2.0	-2.9	-1.9	.0	86.0	538.9	16.7	2.9	2.9
7	91.7	11.7	4.9	-2.0	6.8	7.8	-1.0	109.9	649.1	80.4	8.8	2.0
8	.0	81.1	3.0	-1.0	24.5	2.9	1.9	33.1	686.2	13.7	5.9	4.9
9	7.8	76.0	63.4	.0	7.9	3.9	.0	93.8	429.0	76.0	73.5	78.7
10	7.8	144.0	.0	1.0	1.0	2.9	-1.9	21.3	944.8	23.1	.0	.0
11	4.9	.0	7.8	1.0	39.5	3.9	.0	228.8	2340.0	24.7	8.8	2.9
12	4.9	125.1	3.9	.0	-8.8	1.0	.0	422.4	1414.1	79.5	5.9	2.9
13	2.9	79.9	4.9	1.0	-1.0	1.0	6.7	186.7	1366.9	5.9	5.9	3.9
14	66.6	.0	6.9	-1.0	-1.0	-1.0	7.7	281.1	937.9	10.8	3.0	4.9
15	.0	95.1	3.0	-1.0	-1.9	-2.0	4.8	203.9	624.2	99.1	3.9	8.8
16	9.7	.0	51.8	1.0	.0	-2.0	6.8	114.2	478.0	20.2	41.7	6.9
17	8.8	69.7	.0	3.9	-1.9	.7	5.8	176.9	673.8	26.8	.0	88.7
18	3.9	4.9	3.9	.0	.0	-35.3	12.7	664.0	1468.0	16.8	3.9	.0
19	4.9	85.3	8.8	.0	-1.9	.9	7.8	1457.9	1349.2	105.4	4.9	6.8
20	104.6	11.8	1.0	.0	1.9	3.8	7.9	1321.0	864.9	.0	3.9	2.9
21	.0	87.3	1.0	-1.0	9.7	5.7	56.2	1434.9	602.0	7.8	5.9	1.0
22	7.8	.0	2.9	-1.0	.0	6.7	-18.5	1408.1	579.0	8.8	3.9	4.9
23	7.8	11.7	9.8	-2.9	-1.9	5.7	-1.0	281.0	698.0	52.5	3.9	7.8
24	9.8	48.4	2.9	-1.0	-1.0	4.8	9.7	441.3	465.1	.0	3.0	2.0
25	121.6	.0	2.0	-2.0	-1.9	6.7	9.8	197.7	199.0	8.8	83.5	3.9
26	.0	9.8	63.7	-2.9	.0	5.8	5.9	748.0	191.0	7.8	.0	3.0
27	8.8	6.9	.0	-1.0	1.0	1.9	5.9	1157.0	239.9	7.9	5.9	3.0
28	6.8	4.9	3.9	-1.0	1.0	1.9	52.5	1811.0	74.2	66.5	3.9	89.7
29	5.9	.0	3.9	-2.0	-1.0	1.0	.0	1807.0	100.8	.0	4.9	.0
30	74.6	.0	2.9	-2.0	-1.9	.0	5.9	1471.3	100.1	9.8	3.9	5.8
31	.0	.0	4.9	.0	-1.9	.0	2.0	1248.8	.0	13.7	.0	3.9

NET INFLOW TO THE CANAL
YEAR: 1982

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	6.8	106.3	4.9	291.9	2.0	412.0	254.2	121.1	105.2	1082.0	81.1	165.3
2	4.9	17.5	2.9	337.0	-2.0	423.0	312.0	72.9	166.9	903.0	71.0	9.8
3	2.9	35.8	68.5	423.0	-7.8	449.0	158.0	68.0	71.9	725.9	95.0	158.1
4	3.9	26.8	.0	120.0	177.8	309.0	226.0	133.9	71.0	502.0	679.1	.0
5	94.6	21.9	10.8	151.9	168.1	193.0	261.1	100.1	132.2	476.0	799.0	180.1
6	.0	23.9	157.0	170.0	39.9	249.0	1137.0	424.1	165.8	1236.1	507.0	.0
7	6.8	12.9	432.1	168.1	120.7	179.0	1135.0	579.0	145.0	1703.1	261.9	175.0
8	4.9	3.9	315.0	118.0	50.5	73.1	1203.9	473.0	158.0	978.0	209.0	4.0
9	4.9	105.2	91.1	136.8	31.7	93.8	869.1	529.1	290.8	528.0	205.0	176.0
10	2.9	17.1	90.9	27.2	20.8	85.0	613.0	439.9	511.5	339.0	95.0	23.9
11	2.0	21.7	73.2	164.0	52.4	94.0	629.0	648.1	153.7	274.0	123.1	123.2
12	1.0	52.3	.0	189.9	.0	90.8	583.0	983.0	145.0	249.0	107.0	17.8
13	3.9	.0	20.6	149.1	7.8	51.2	657.0	926.0	233.1	166.9	74.9	181.1
14	154.4	4.9	42.5	249.9	5.9	75.0	649.0	767.0	161.0	143.0	2.9	170.7
15	.0	3.9	12.7	161.4	5.9	72.0	445.0	951.0	160.9	135.0	96.2	16.4
16	5.9	4.9	10.8	303.7	4.9	49.8	340.0	1082.0	70.2	82.0	110.8	239.7
17	4.9	119.1	104.4	477.0	76.2	191.2	268.0	820.2	85.9	90.0	168.1	28.2
18	4.9	2.0	.0	255.0	26.2	496.0	194.0	693.8	98.0	88.0	82.0	185.0
19	106.6	94.2	6.8	347.1	23.9	550.0	223.0	729.0	83.0	79.0	103.0	.0
20	.0	.0	8.8	106.9	22.9	569.0	134.9	671.0	74.1	85.1	115.1	199.0
21	5.8	8.8	6.9	108.9	19.9	1519.2	168.1	523.9	130.9	49.9	102.0	32.1
22	4.9	8.8	71.7	95.1	6.9	1211.0	178.0	347.0	381.1	124.1	89.0	52.7
23	2.9	64.6	.0	24.7	101.4	1586.0	128.0	354.0	456.0	90.9	108.8	168.3
24	4.9	.0	16.6	102.3	19.8	1982.0	162.1	240.0	768.0	.0	5.2	.0
25	3.9	5.8	86.2	16.7	73.1	3228.2	153.0	234.0	550.0	87.1	177.9	14.7
26	5.9	4.9	.0	228.1	136.0	3029.7	155.0	186.9	943.0	78.0	13.8	88.5
27	.0	4.9	10.8	764.1	690.1	1560.0	145.9	164.0	1204.0	6.9	149.3	8.8
28	1.0	6.9	112.0	462.0	468.0	472.9	168.0	73.9	747.0	82.0	15.7	15.7
29	1.0	.0	978.3	410.0	308.0	193.0	106.0	78.0	871.0	11.9	157.3	98.3
30	1.0	.0	686.9	230.0	260.0	209.9	163.0	131.0	686.0	81.3	20.7	3.9
31	1.0	.0	822.0	.0	395.0	.0	119.9	59.1	.0	16.8	.0	14.7

NET INFLOW TO THE CANAL
YEAR: 1983

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	103.5	108.9	258.0	58.0	9.8	47.7	35.0	143.8	43.0	.0	244.0	23.9
2	6.8	753.1	565.0	112.0	21.2	5.9	45.9	93.1	56.0	4.2	165.0	61.3
3	58.1	1446.0	235.0	102.0	.0	35.2	-6.9	215.9	42.0	1.2	144.0	5.0
4	.0	1052.0	278.0	103.9	12.7	83.0	-2.9	93.1	13.7	52.5	120.9	66.1
5	15.7	869.9	35.4	31.2	54.2	85.0	-14.6	151.0	.0	34.0	88.1	.0
6	110.3	1282.9	.0	.0	.0	228.1	66.5	14.0	43.2	8.8	77.9	11.7
7	25.8	1440.8	61.0	63.9	9.8	38.1	43.1	38.2	27.1	27.3	80.0	60.6
8	73.9	634.0	204.8	46.0	6.9	119.8	22.3	36.7	54.0	44.8	177.0	.0
9	4.2	755.3	187.9	41.2	23.2	108.1	.0	183.1	33.9	49.1	54.0	5.8
10	85.0	569.2	59.0	55.8	.0	32.3	35.0	136.0	48.0	52.0	63.9	4.9
11	7.0	271.9	302.0	115.0	5.9	.0	.0	34.2	.0	42.9	70.0	8.9
12	137.0	208.9	394.0	39.2	4.9	2.9	30.0	22.2	27.2	30.0	75.2	86.9
13	4.9	1000.2	297.0	64.8	17.4	62.7	.0	.0	59.8	48.0	100.0	105.1
14	126.1	753.9	61.1	60.0	.0	29.9	24.4	108.6	95.1	96.1	77.1	80.9
15	.0	380.8	127.0	48.9	4.9	39.1	26.2	85.1	54.0	282.0	.0	6.9
16	15.7	652.1	119.0	24.6	3.9	44.9	12.7	173.0	137.1	387.1	84.9	81.3
17	43.4	1337.1	244.0	29.8	4.9	18.6	29.3	86.9	174.9	435.0	5.9	113.8
18	9.8	725.0	54.9	123.1	2.9	.0	3.9	242.1	89.0	446.0	88.1	154.1
19	75.0	189.8	.0	16.5	2.9	15.6	11.8	153.8	159.0	680.0	4.9	286.8
20	198.1	46.1	-22.5	.0	2.9	12.7	22.3	41.4	191.0	368.0	60.9	180.2
21	438.0	44.9	182.8	71.1	2.0	30.2	4.9	222.7	230.0	182.9	12.0	173.0
22	307.0	3.0	70.1	5.9	11.1	48.9	13.1	144.0	346.1	71.0	73.4	180.1
23	344.0	35.2	204.9	39.0	-17.6	59.1	.0	97.0	216.8	566.1	25.7	79.0
24	444.0	129.1	378.0	.0	4.9	84.0	9.8	117.0	146.0	523.0	73.1	90.0
25	435.0	183.1	592.1	43.0	3.9	77.1	13.3	141.0	45.8	1107.7	8.1	91.1
26	321.0	80.8	369.7	.0	2.0	.0	.0	152.0	101.3	1013.2	14.8	2.0
27	188.0	254.9	50.1	40.0	1.0	36.0	11.7	120.0	219.9	812.1	56.5	100.0
28	247.0	1142.1	141.9	.0	2.0	22.3	26.2	63.0	167.0	479.9	.0	1.2
29	194.0	.0	234.1	26.1	3.9	.0	75.3	125.1	161.0	234.9	16.7	117.6
30	213.0	.0	52.1	.0	22.5	87.7	172.7	103.9	93.0	289.0	17.9	110.2
31	65.1	.0	235.9	.0	.0	.0	149.2	82.1	.0	166.0	.0	668.0

NET INFLOW TO THE CANAL
YEAR: 1984

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	735.0	.0	601.1	86.0	6.8	313.0	36.9	85.0	76.2	325.8	.0	84.9
2	475.9	18.6	355.0	104.8	4.9	227.0	34.0	.0	74.8	231.2	15.7	148.9
3	205.0	89.7	296.1	11.2	2.9	106.9	102.1	6.9	95.1	195.0	65.4	94.1
4	136.1	17.5	167.9	124.0	3.9	47.1	187.8	34.4	48.2	143.0	5.9	71.9
5	143.9	101.3	172.1	74.0	17.8	8.8	82.1	117.8	63.8	61.0	74.0	80.0
6	161.1	.0	160.0	81.0	2.9	49.4	101.8	259.0	87.2	63.9	.0	86.9
7	1.0	11.7	73.9	71.9	3.9	49.8	55.1	104.2	89.9	82.0	13.7	78.1
8	80.2	99.2	183.0	71.3	7.8	4.9	64.2	178.8	85.0	31.1	59.3	79.2
9	69.9	.0	68.0	.0	12.7	45.2	72.8	100.0	8.9	60.0	.1	.0
10	.0	13.7	3.1	78.8	51.5	5.9	2.9	58.0	63.0	71.0	16.7	76.7
11	50.9	82.6	96.9	73.0	.0	51.0	19.3	78.0	76.1	50.0	69.4	2.0
12	1.0	5.8	66.8	11.8	4.9	1.0	91.7	62.1	48.8	.0	.0	67.1
13	74.2	14.6	420.1	53.2	4.9	50.0	53.1	63.0	23.4	49.1	9.8	61.0
14	.0	68.6	251.1	144.1	2.9	.0	232.9	28.1	23.6	17.7	6.9	5.9
15	15.6	18.5	197.0	60.9	2.9	50.9	737.9	37.9	60.4	44.3	6.9	68.3
16	76.2	77.3	186.8	77.0	2.9	2.0	435.2	49.0	10.8	7.8	52.5	3.9
17	4.9	.0	66.2	72.9	1.0	43.2	483.9	36.9	67.1	39.1	.0	73.0
18	72.3	12.7	77.9	76.0	2.0	59.0	302.1	60.1	80.9	.0	14.7	.0
19	88.0	79.9	83.0	70.2	1.0	65.9	226.9	182.1	87.0	13.7	9.8	14.7
20	.0	160.3	63.8	.0	.0	34.2	199.1	69.0	156.1	41.2	58.4	64.3
21	101.9	177.0	41.2	76.1	1.0	48.9	248.0	93.0	170.9	49.0	.0	8.9
22	81.9	227.8	93.0	.0	35.4	100.9	171.9	181.0	372.0	3.9	87.7	23.7
23	72.2	972.3	367.9	15.6	.0	99.9	191.1	181.0	287.0	44.2	14.1	43.5
24	.0	512.9	600.1	59.3	53.9	83.0	196.0	164.0	251.9	46.1	214.9	12.7
25	73.9	400.0	138.9	.0	.0	38.0	193.0	152.9	74.0	.0	404.0	66.8
26	3.9	257.0	118.2	10.7	172.0	86.1	158.9	82.0	154.1	67.0	272.0	3.6
27	65.2	248.0	68.2	7.8	354.1	39.9	99.0	75.1	239.9	.0	178.0	16.7
28	67.1	1568.0	152.7	28.5	133.0	35.1	1.0	93.9	468.1	48.8	161.0	13.7
29	.0	1431.0	78.0	.0	932.1	42.0	.0	6.9	485.9	16.8	155.9	47.6
30	60.8	.0	102.9	7.8	773.0	36.1	51.4	56.3	406.0	49.4	87.2	13.7
31	54.3	.0	80.1	.0	502.0	.0	336.5	17.7	.0	51.0	.0	10.8

NET INFLOW TO THE CANAL
YEAR: 1985

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	46.4	12.9	.0	11.0	8.0	-1.9	61.4	18.8	358.1	322.0	50.2	186.8
2	7.9	17.8	4.9	14.0	-4.9	-2.9	57.2	134.2	373.9	348.2	10.7	215.9
3	10.8	55.7	3.9	6.1	-2.9	-1.9	288.9	160.2	518.0	478.8	70.2	2.2
4	48.3	18.8	2.0	3.1	-1.9	-4.8	224.2	204.0	345.9	546.0	70.0	17.6
5	2.0	7.9	2.0	-5.7	-2.9	-5.7	63.1	202.1	435.0	526.1	70.0	75.2
6	19.6	9.9	4.9	-5.8	-3.9	-2.9	193.1	180.0	973.0	377.1	.0	95.0
7	51.7	13.8	58.1	.3	-3.9	.0	12.8	288.0	1066.0	337.8	83.0	101.1
8	14.7	67.5	6.2	8.3	-3.9	1.0	81.7	152.0	723.0	264.0	9.8	50.7
9	12.8	.0	17.9	5.0	-3.9	.0	164.1	264.1	467.0	252.0	79.3	54.4
10	96.1	10.9	12.9	-6.7	-3.9	1.0	76.0	491.9	380.8	202.0	10.7	78.8
11	87.4	5.9	11.0	-7.7	-1.0	.0	84.0	298.0	190.3	123.3	80.0	60.3
12	107.0	10.8	7.0	-4.8	1.0	1.9	65.0	241.0	167.8	86.6	22.2	.0
13	101.1	5.9	7.0	3.8	-2.9	18.5	95.1	134.0	63.0	72.0	25.6	35.5
14	99.0	34.6	4.0	6.7	-3.8	26.0	6.9	476.0	73.0	146.1	46.7	55.3
15	99.0	.0	53.2	17.4	-2.9	23.3	64.1	462.0	205.0	80.9	9.7	6.8
16	98.0	4.9	.0	124.0	-3.8	14.7	81.0	385.2	173.0	77.0	13.7	57.3
17	96.9	5.9	53.9	36.0	6.7	33.2	69.0	386.8	186.0	83.0	49.2	.0
18	98.9	7.9	63.0	112.2	.0	1.0	158.0	141.8	555.9	82.0	16.2	16.6
19	97.9	10.9	7.8	42.7	-3.8	8.8	62.0	400.2	1988.9	82.0	38.7	98.3
20	94.9	65.2	9.8	41.8	-1.9	58.6	68.9	227.2	1896.9	11.0	53.4	18.1
21	96.0	2.4	60.2	91.3	-1.0	.0	85.2	274.7	1853.0	69.2	7.8	11.7
22	94.0	17.9	152.2	16.2	1.0	14.6	75.8	282.1	1436.2	86.7	51.3	9.8
23	96.9	15.9	.0	24.9	.0	166.1	66.1	257.9	1032.7	28.8	.0	58.7
24	98.9	14.9	85.1	22.0	.0	81.9	.0	130.0	740.2	3.9	11.7	.0
25	88.2	17.9	.0	21.0	6.7	23.8	77.8	134.0	577.3	18.5	11.7	13.6
26	1.0	19.9	13.7	19.0	3.8	66.3	173.1	106.0	421.8	67.1	64.3	9.8
27	5.9	21.9	3.9	20.0	1.9	1.0	187.9	124.0	351.3	2.0	25.1	79.2
28	51.4	72.5	.0	20.0	-1.9	150.9	90.1	150.0	309.7	60.1	40.7	2.4
29	.0	.0	.0	19.1	-1.9	79.1	165.7	40.9	324.9	4.9	123.0	13.7
30	9.9	.0	-1.0	26.9	-2.9	197.3	47.5	222.1	316.1	61.3	165.6	12.7
31	10.9	.0	-1.0	.0	-1.0	.0	111.7	207.9	.0	10.7	.0	72.6

NET INFLOW TO THE CANAL
YEAR: 1986

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	.0	.0	63.2	6.8	.0	-2.0	442.0	255.0	236.0	108.0	313.0	38.8
2	10.7	9.7	.0	6.8	-1.0	2.0	506.0	369.0	305.0	82.0	355.0	78.2
3	9.8	7.8	10.7	1.0	-1.0	1.0	477.0	400.0	246.0	94.0	200.0	41.8
4	48.5	7.8	11.7	.0	1.0	.0	717.0	279.0	298.0	110.9	181.0	99.1
5	.0	54.9	55.7	.0	.0	-1.0	939.0	312.0	287.0	67.0	179.0	26.0
6	10.7	.0	1.9	-2.0	.0	-2.0	850.0	223.0	612.0	121.0	187.0	100.9
7	9.8	9.7	6.8	-1.0	.0	-2.0	722.0	210.0	510.0	13.0	337.0	26.0
8	68.6	7.8	5.8	-2.0	-1.0	2.0	675.0	228.0	475.0	101.0	330.0	101.0
9	8.8	7.8	4.9	-1.0	1.9	2.0	636.0	211.0	493.0	100.0	198.0	19.1
10	84.9	7.8	77.2	-3.9	6.7	2.9	462.0	233.0	1216.0	10.1	114.0	38.8
11	3.9	9.8	77.9	-14.6	.0	4.9	515.0	333.0	1195.0	91.9	157.1	71.3
12	75.4	66.7	6.9	-13.5	.0	221.7	421.0	243.0	911.0	20.0	101.9	33.8
13	80.1	.0	72.4	-11.5	1.0	461.9	459.0	269.0	607.0	81.0	118.0	39.9
14	.0	7.8	95.7	-11.5	1.0	447.0	405.0	321.0	450.0	20.0	287.0	81.2
15	17.5	8.8	101.1	-11.4	.0	361.0	318.0	398.0	307.0	109.9	239.0	24.0
16	65.4	6.9	.1	1.0	-1.0	308.0	172.0	1184.0	296.0	87.1	160.0	39.9
17	.0	95.1	92.0	3.8	.0	307.0	106.0	898.0	211.0	96.0	183.0	37.9
18	14.6	36.4	.0	1.9	.0	287.0	96.0	837.0	168.0	95.0	109.0	91.1
19	54.4	52.7	16.6	.0	.0	316.0	82.0	1082.0	87.0	30.0	97.0	11.2
20	.0	72.5	61.4	1.0	.0	418.0	83.9	904.0	211.0	93.1	111.0	43.9
21	12.7	.0	4.9	2.9	3.9	722.0	.0	858.0	231.0	38.9	84.9	44.9
22	23.7	8.7	11.7	4.8	26.2	873.0	213.1	794.0	179.0	85.2	40.2	42.0
23	52.9	8.8	52.7	1.0	8.8	840.0	95.0	647.0	212.0	22.9	111.8	100.1
24	10.7	11.7	.0	-1.0	4.9	796.0	177.0	446.0	159.0	39.9	23.1	21.1
25	9.7	58.8	6.8	3.8	2.9	762.0	155.0	373.0	233.0	74.3	101.9	119.8
26	66.5	.0	6.8	3.8	1.0	613.0	226.0	278.0	208.0	33.9	22.0	3.3
27	.0	5.8	7.8	1.0	.0	680.0	174.0	289.0	236.1	32.8	97.0	124.8
28	7.8	10.7	6.8	1.0	-1.0	582.9	312.0	280.0	173.9	74.2	12.1	106.1
29	8.8	.0	50.8	.0	.0	335.1	580.0	307.0	151.9	106.0	37.8	106.0
30	11.7	.0	.0	.0	-2.9	464.0	572.0	255.0	81.0	182.0	78.2	106.0
31	44.7	.0	7.8	.0	.0	.0	501.0	237.0	.0	187.0	.0	208.9

NET INFLOW TO THE CANAL
YEAR: 1987

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	1003.0	21.1	56.3	434.0	10.0	17.0	4.0	49.1	1.0	40.2	201.1	175.0
2	780.0	111.1	13.8	298.0	9.0	12.0	64.1	.0	-1.0	.0	385.0	88.0
3	444.0	.0	66.2	184.0	10.0	19.0	60.0	13.9	.0	6.9	390.9	102.0
4	460.0	46.8	.0	167.0	9.0	13.0	.0	38.1	1.0	4.0	911.0	144.1
5	713.0	89.1	12.8	133.1	16.0	6.0	11.9	.0	3.0	1.0	1120.0	83.0
6	547.0	17.0	8.9	110.0	16.0	21.0	17.9	8.9	3.0	1.0	909.0	2.0
7	371.0	96.0	322.1	102.0	25.0	28.0	58.1	7.9	2.0	.0	714.0	78.1
8	276.0	10.0	449.0	87.0	82.4	32.0	84.0	4.0	3.0	.0	553.0	74.0
9	263.0	88.0	280.0	15.0	14.1	29.0	.0	30.2	1.0	-1.0	332.0	84.0
10	199.0	12.1	170.0	89.1	9.9	102.1	13.9	.0	1.0	3.0	310.0	81.0
11	197.0	92.8	180.0	25.9	41.7	15.5	68.2	3.9	.0	9.9	286.0	.0
12	98.1	7.3	70.0	79.1	36.9	33.0	.0	.0	.0	479.2	172.0	81.0
13	109.0	31.8	87.0	85.1	104.2	39.9	17.8	4.9	2.0	514.9	161.0	35.9
14	105.0	35.9	78.1	34.0	.0	41.0	71.2	4.0	4.0	392.0	173.0	33.2
15	103.0	70.3	.0	36.8	117.9	45.9	31.8	3.0	.0	292.0	100.0	97.9
16	96.0	23.9	91.9	78.1	12.0	51.9	80.1	2.0	1.0	279.0	145.0	4.0
17	102.0	97.0	.0	3.0	97.0	50.9	94.9	35.2	2.0	183.0	95.0	65.2
18	113.0	9.0	91.1	14.9	3.1	39.0	79.0	.0	23.3	169.0	741.9	75.0
19	18.1	87.1	.0	12.9	33.8	36.0	80.0	5.9	.0	80.0	1122.0	.0
20	110.0	16.9	23.8	58.3	108.4	32.0	156.1	1.0	3.0	72.0	1712.0	78.0
21	27.9	80.1	59.2	.0	.0	38.0	139.0	2.0	4.9	82.1	1401.0	.0
22	92.0	13.0	.0	11.9	21.9	42.0	191.0	2.0	84.9	80.0	765.0	69.1
23	105.0	79.0	14.8	5.9	21.9	18.0	163.0	.0	4.0	11.9	543.0	.0
24	109.9	5.1	20.9	18.9	24.0	1.0	49.0	1.0	55.1	59.2	471.0	16.8
25	107.0	27.8	60.3	24.0	19.0	6.0	32.2	-2.0	.0	14.8	431.0	63.2
26	105.0	64.3	98.9	23.0	20.0	12.0	.0	.0	6.9	66.1	371.0	.0
27	20.1	23.8	270.0	9.0	12.0	13.0	1.0	-2.0	4.0	.0	240.0	17.8
28	114.0	19.9	311.0	21.0	7.0	7.0	13.8	-2.0	3.0	15.9	241.0	73.2
29	107.9	.0	311.0	5.0	6.0	72.0	49.1	-1.0	2.0	51.2	184.0	.0
30	14.1	.0	476.0	9.0	9.0	84.0	.0	-2.0	2.0	18.9	174.0	11.9
31	101.9	.0	555.0	.0	14.0	.0	11.9	.0	.0	11.9	.0	9.9

NET INFLOW TO THE CANAL
YEAR: 1988

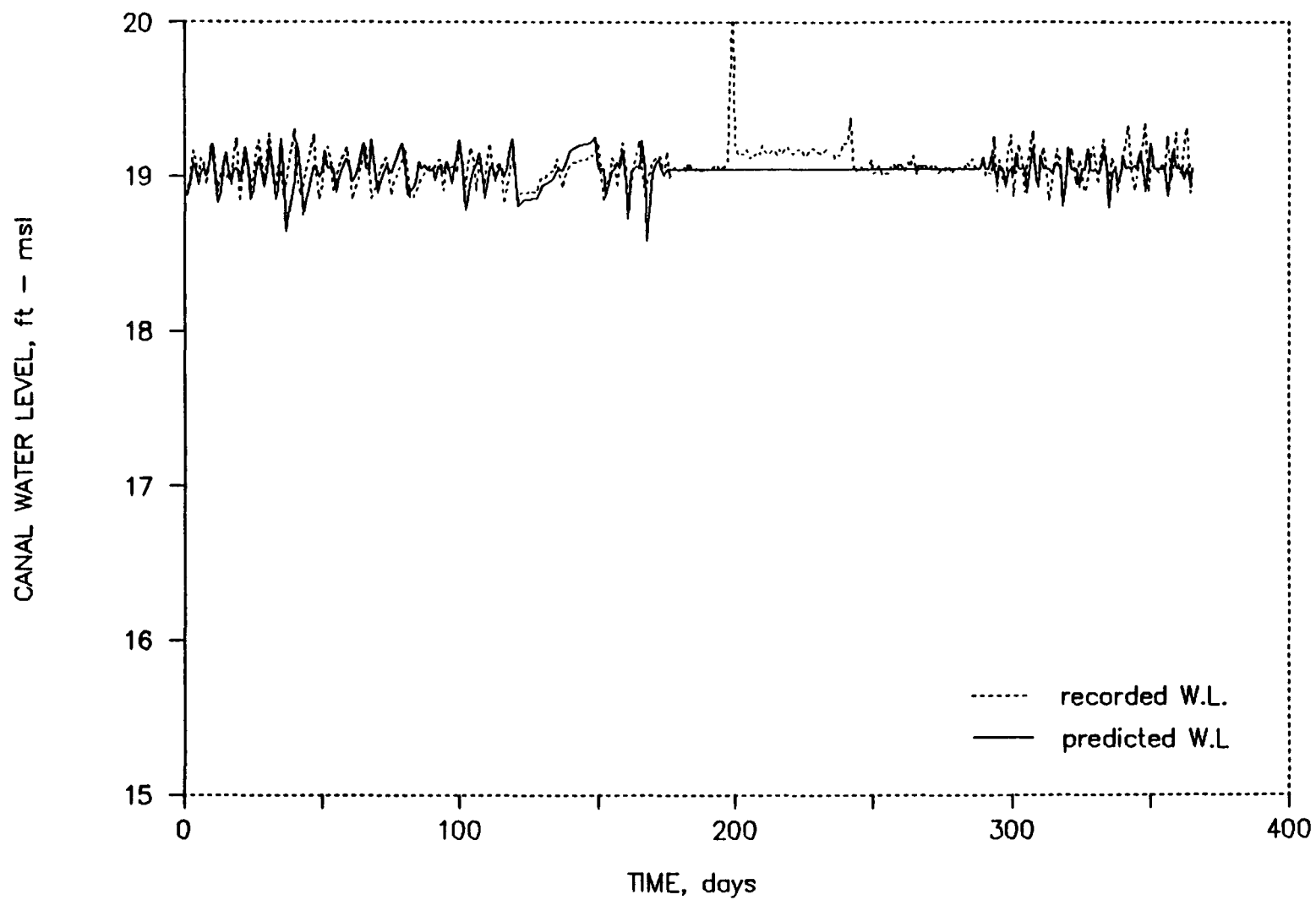
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	57.2	.0	5.9	70.2	12.9	.0	47.1	241.0	190.0	.0	4.0	.0
2	3.9	72.0	14.9	5.9	67.2	.0	47.0	656.0	268.0	9.9	2.0	8.9
3	14.9	.0	51.2	12.9	10.9	-3.0	.0	616.0	176.0	70.8	1.0	6.9
4	72.1	75.1	6.9	48.2	11.9	-4.9	7.9	457.0	173.0	12.2	88.0	6.0
5	.0	.0	68.0	.0	38.3	.0	6.9	289.0	92.0	87.9	90.0	3.0
6	10.9	15.8	22.0	10.9	.0	3.0	25.1	462.0	89.9	.0	87.0	5.0
7	7.9	85.0	51.0	11.9	3.9	42.1	.0	409.0	76.0	17.8	5.9	48.3
8	52.3	192.1	69.0	46.2	2.0	.0	11.9	217.0	168.1	60.2	78.1	.0
9	8.9	190.0	81.0	.0	1.0	16.8	7.0	221.0	180.0	3.9	.0	6.9
10	97.9	491.0	64.0	8.9	2.0	20.2	25.2	453.0	176.0	11.9	16.8	4.9
11	70.1	152.0	88.0	12.9	1.0	.0	8.0	1008.0	84.1	8.9	60.2	4.9
12	84.0	169.0	78.0	53.3	2.0	7.9	10.9	926.0	88.0	48.3	.0	14.9
13	75.1	73.1	3.0	.0	83.0	3.0	76.0	794.1	76.0	.0	12.8	53.4
14	.0	89.9	65.1	5.9	.0	3.0	4.1	955.9	88.0	8.9	10.9	4.9
15	91.0	76.0	17.8	4.9	86.0	4.0	69.0	563.9	2.0	4.9	51.3	8.9
16	5.0	86.0	55.2	3.0	166.0	3.0	.0	499.1	73.1	7.9	.0	4.9
17	72.0	89.0	14.8	3.0	60.9	3.0	14.9	402.0	80.0	7.0	6.9	5.9
18	3.0	26.9	102.9	4.0	29.1	4.0	93.1	308.0	.0	47.3	6.9	3.0
19	68.1	154.0	313.1	5.0	18.8	23.1	97.0	394.0	79.0	.0	5.9	2.0
20	.0	34.1	454.0	4.0	62.2	.0	406.0	299.0	.0	7.9	5.9	2.0
21	90.9	23.1	290.0	1.0	7.9	40.1	185.0	476.0	18.8	5.9	4.0	2.0
22	.0	86.0	247.0	.0	5.9	28.2	181.0	554.0	67.2	6.9	57.3	49.3
23	82.0	78.0	164.0	34.4	5.0	.0	178.0	460.0	.0	3.0	.0	.0
24	84.0	67.0	85.0	.0	6.0	20.7	88.0	799.0	12.8	4.0	11.8	4.9
25	75.0	74.0	84.0	3.0	35.2	11.9	94.0	522.0	11.9	2.0	3.0	5.9
26	74.0	7.9	82.0	1.0	3.0	21.3	86.0	612.0	57.3	2.0	4.0	4.0
27	81.1	75.1	76.0	2.0	5.9	.0	85.1	357.0	5.9	43.4	5.0	3.0
28	82.9	10.9	85.0	3.9	1.0	5.9	87.0	262.0	11.9	.0	7.0	5.0
29	3.0	69.1	12.9	2.0	.0	4.9	139.0	164.0	7.9	4.9	4.0	4.0
30	62.1	.0	65.2	53.1	.0	61.9	267.0	165.0	53.3	5.9	48.3	2.0
31	76.0	.0	19.8	.0	3.0	.0	258.0	168.0	.0	3.0	.0	1.0

NET INFLOW TO THE CANAL
YEAR: 1989

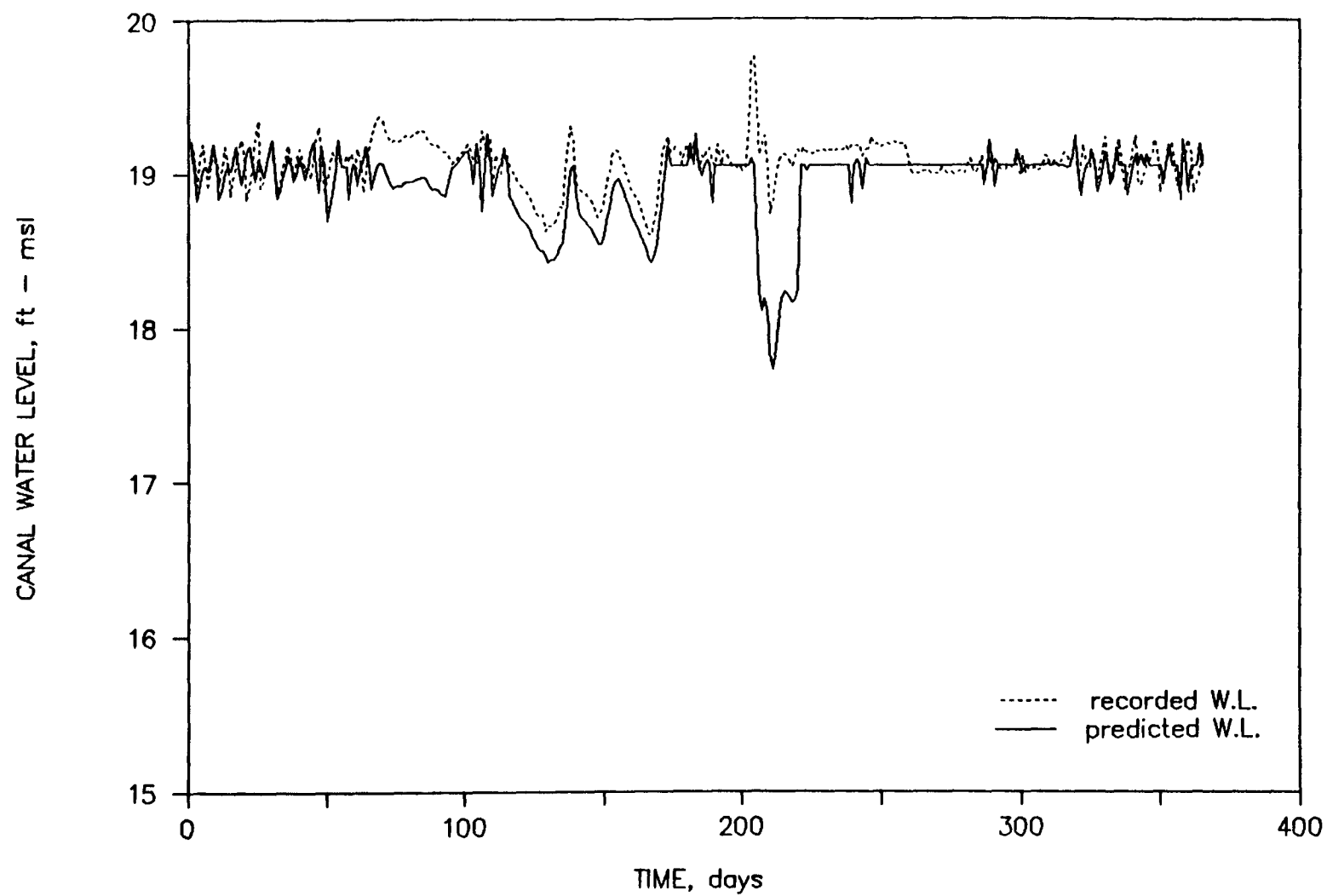
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	2.0	3.0	1.0	1.0	1.0	-2.9	220.2	5.9	78.0	109.9	78.0	-3.9
2	48.4	1.0	1.0	.0	1.0	-5.8	77.1	102.9	334.0	210.1	4.0	-3.9
3	.0	1.0	17.8	.0	-2.0	-7.8	7.9	72.1	300.0	94.0	81.1	-3.9
4	3.9	1.0	68.3	-1.0	-2.0	-6.8	-7.9	7.9	287.0	93.0	5.9	-5.9
5	1.0	.0	14.8	4.0	-4.0	-6.8	-9.8	72.2	383.9	82.0	12.9	-4.9
6	3.0	.0	9.9	77.0	-2.0	-4.8	120.7	.0	1094.6	96.9	56.2	-4.9
7	3.0	.0	65.2	.0	-3.0	1.9	82.1	2.0	511.5	114.3	.0	-4.9
8	3.9	.0	.0	12.9	-5.9	5.8	11.9	2.0	343.0	1995.8	8.9	-1.9
9	2.0	48.5	48.8	4.0	-5.9	3.9	9.9	6.9	304.0	1902.0	7.9	5.9
10	2.0	.0	35.3	2.0	-3.9	5.8	-7.0	87.0	188.0	1886.0	4.0	2.0
11	1.0	3.9	10.9	35.5	-3.0	1.9	-16.8	1.0	178.1	1953.0	2.0	.0
12	2.0	2.0	8.9	.0	-3.0	1.0	-19.7	78.9	164.9	1394.0	-1.0	-1.0
13	2.0	1.0	6.9	2.0	-3.9	.0	-10.8	72.1	85.1	1061.0	-1.0	1.0
14	3.0	2.0	45.4	2.9	-2.9	1.9	-10.7	185.0	108.9	673.0	-1.0	-2.9
15	2.0	1.0	.0	13.8	2.9	.0	-15.5	83.1	83.1	666.0	-2.0	-4.9
16	1.0	1.0	7.9	92.9	.0	.0	-20.2	99.0	92.0	631.0	1.0	-2.9
17	1.0	1.0	68.9	.0	-3.9	-1.0	-21.0	87.0	153.0	338.0	-2.0	-1.9
18	.0	1.0	31.0	71.1	-2.0	-4.8	-12.4	86.1	202.0	447.0	-2.0	-3.9
19	1.0	.0	81.0	14.8	-2.9	-4.8	18.1	122.9	186.0	333.0	-4.0	-2.9
20	-1.0	-1.0	.0	74.1	-3.9	-2.9	21.1	385.0	186.0	406.0	-4.0	2.9
21	3.0	.0	9.9	82.0	-2.0	-3.9	19.3	325.0	93.1	308.0	-4.0	17.5
22	64.2	3.9	8.9	10.9	-2.0	-3.9	31.2	317.0	90.9	190.0	-5.9	17.6
23	7.9	2.0	50.4	56.2	7.8	2.9	25.6	306.0	90.0	277.0	-2.0	215.7
24	11.9	-2.0	.0	5.9	7.8	2.9	31.9	227.0	94.1	95.0	-1.0	85.1
25	55.3	-3.0	6.9	8.9	-2.0	.0	41.3	291.0	637.9	165.0	-3.0	118.0
26	.0	-1.0	3.0	5.0	-2.9	1.0	16.8	185.0	575.0	86.9	-1.0	184.0
27	7.9	.0	3.9	2.0	-2.0	1.9	11.9	306.0	318.0	168.0	3.9	87.0
28	5.9	1.0	1.0	.0	-2.9	2.9	57.3	197.0	318.0	87.0	3.0	.0
29	4.0	.0	-1.0	.0	-3.9	6.8	.0	185.0	204.0	16.9	3.0	85.1
30	3.0	.0	.0	2.0	-2.9	17.5	14.8	91.0	189.0	64.1	-1.0	5.9
31	3.0	.0	1.0	.0	-3.9	.0	90.1	163.0	.0	82.0	.0	91.9

APPENDIX C

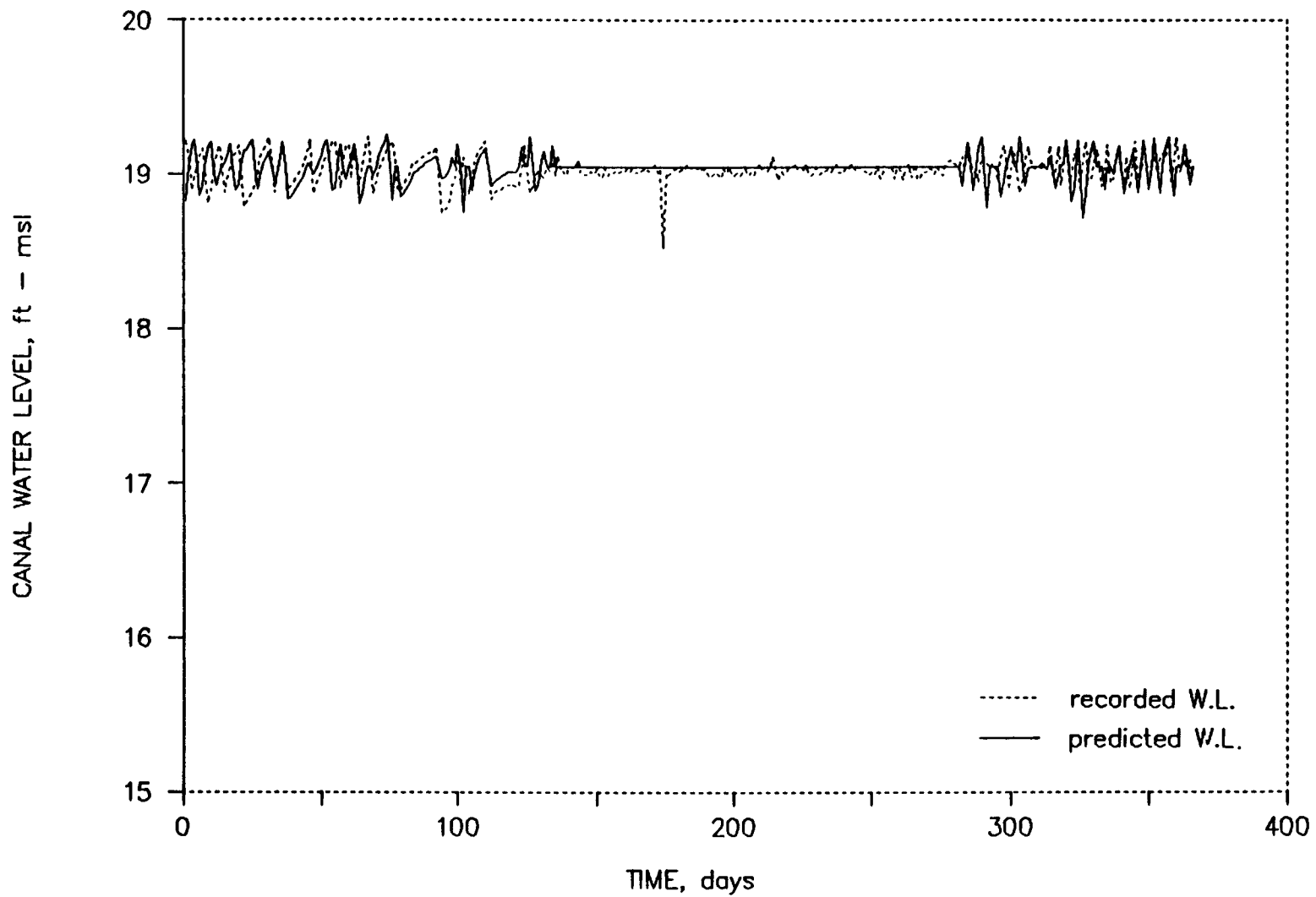
**Comparison of Historic and Predicted Canal Water Levels
for the Period of 1974 - 1989**



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1974



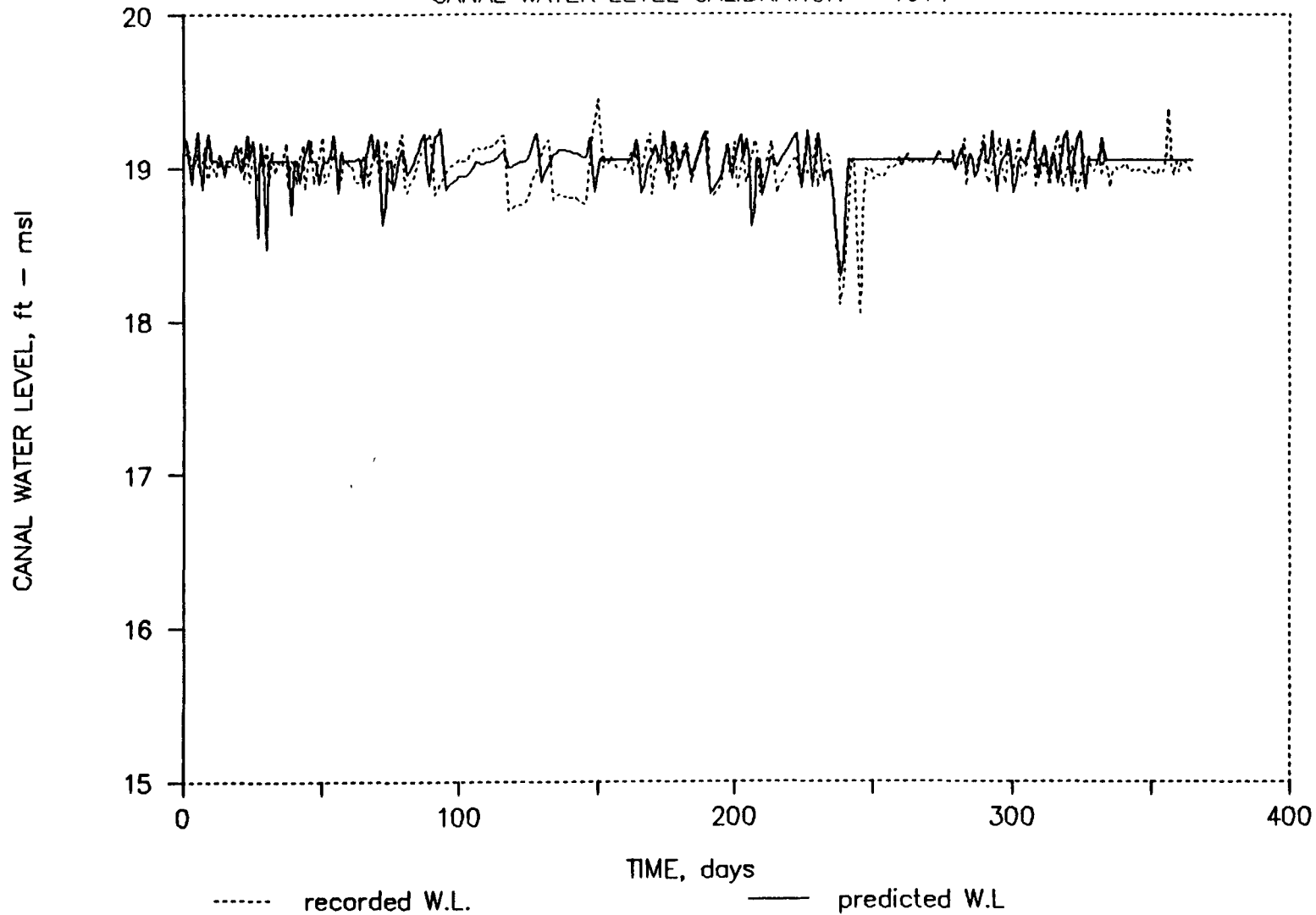
Comparison of Recorded and Predicted Canal Water Levels for the Period of 1975



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1976

INDIANTOWN PROJECT

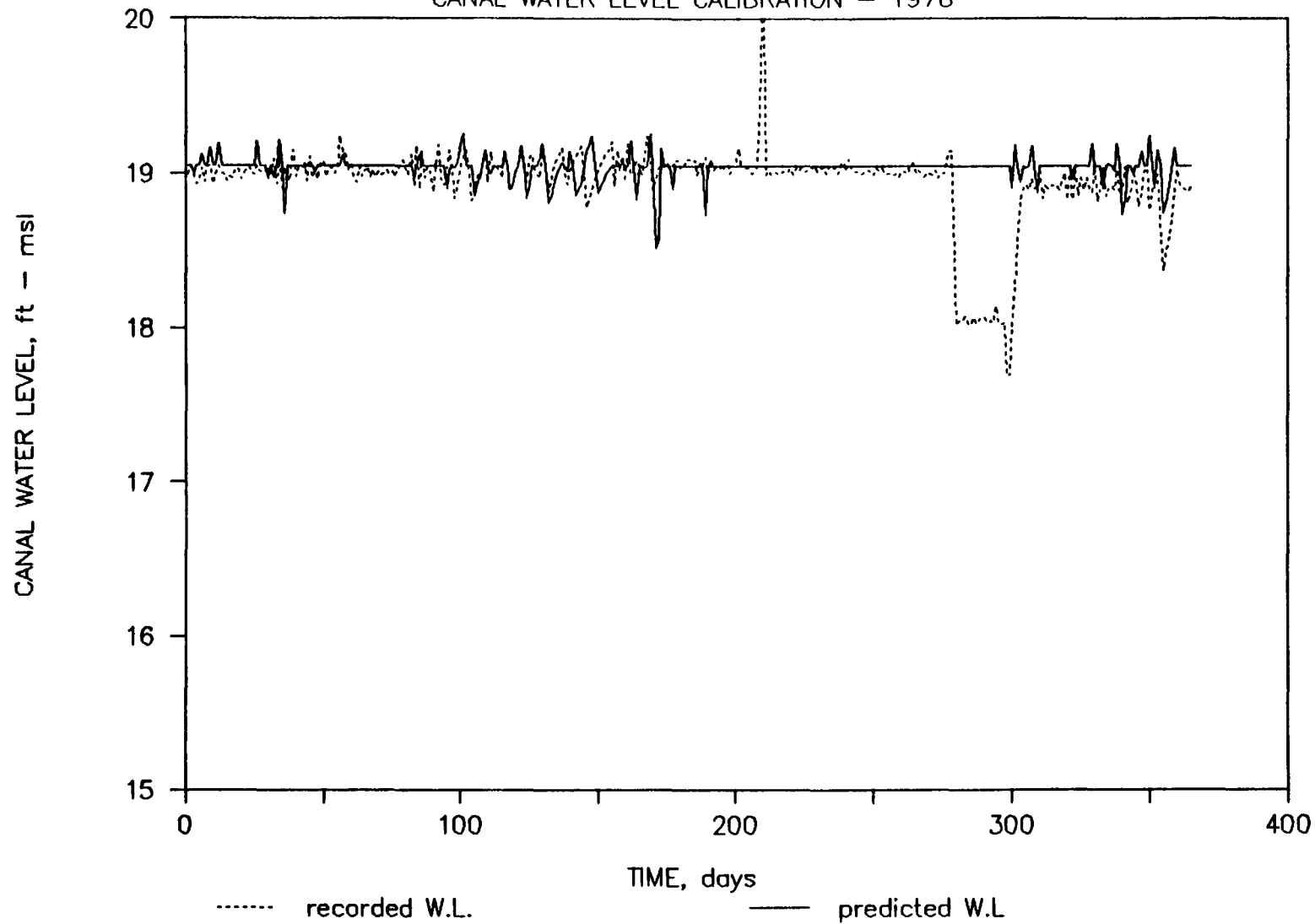
CANAL WATER LEVEL CALIBRATION - 1977



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1977

INDIANTOWN PROJECT

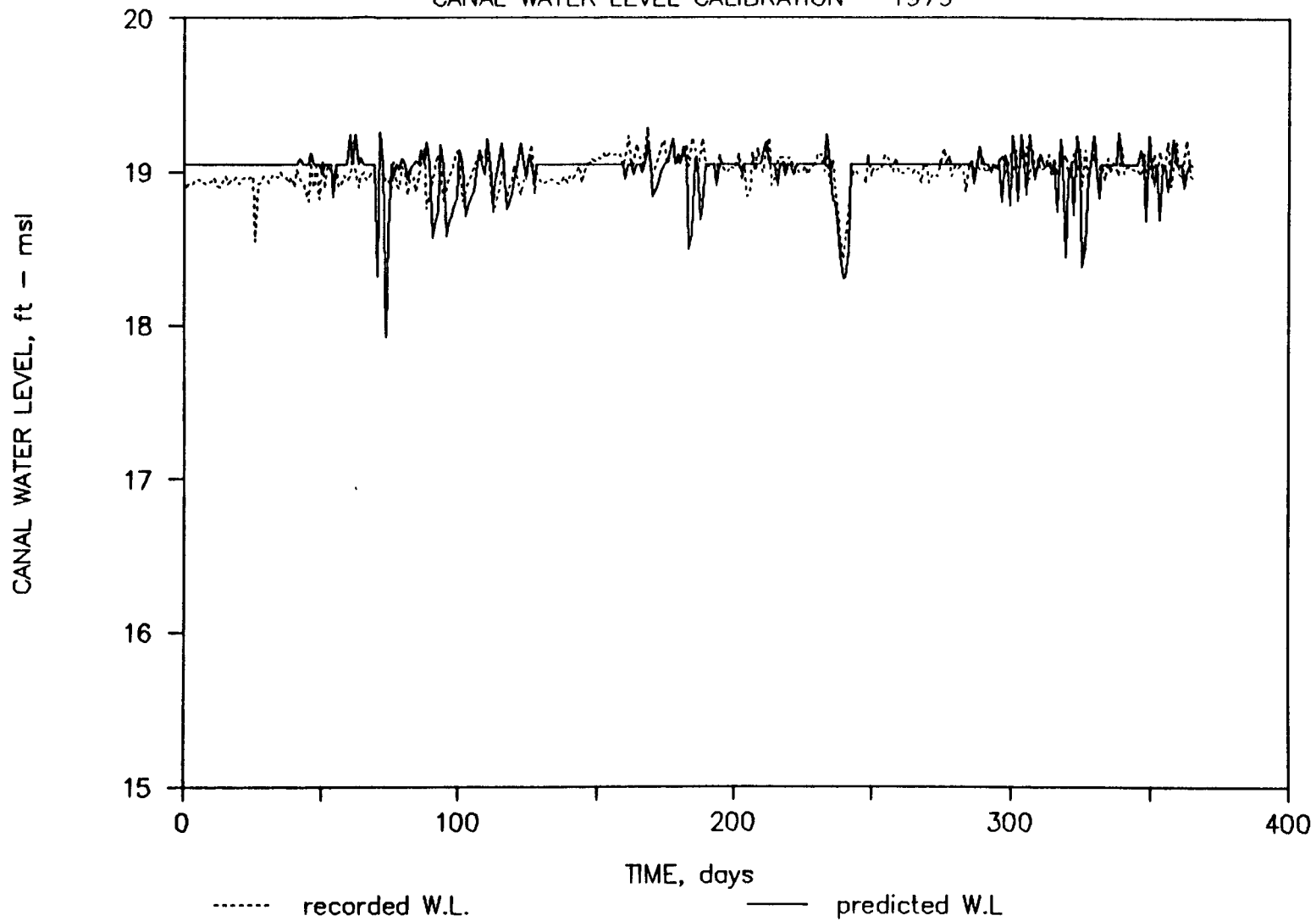
CANAL WATER LEVEL CALIBRATION - 1978



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1978

INDIANTOWN PROJECT

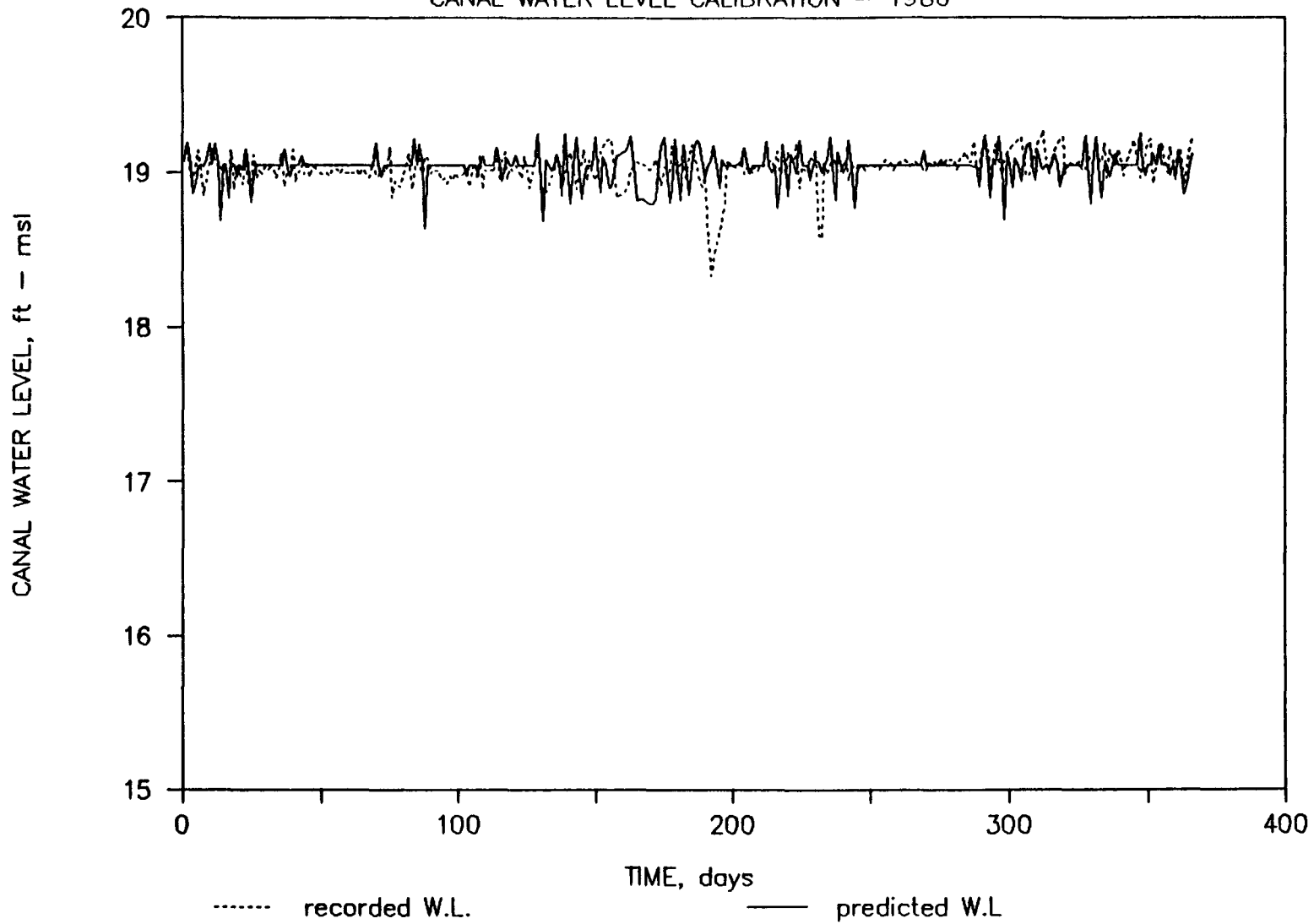
CANAL WATER LEVEL CALIBRATION — 1979



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1979

INDIANTOWN PROJECT

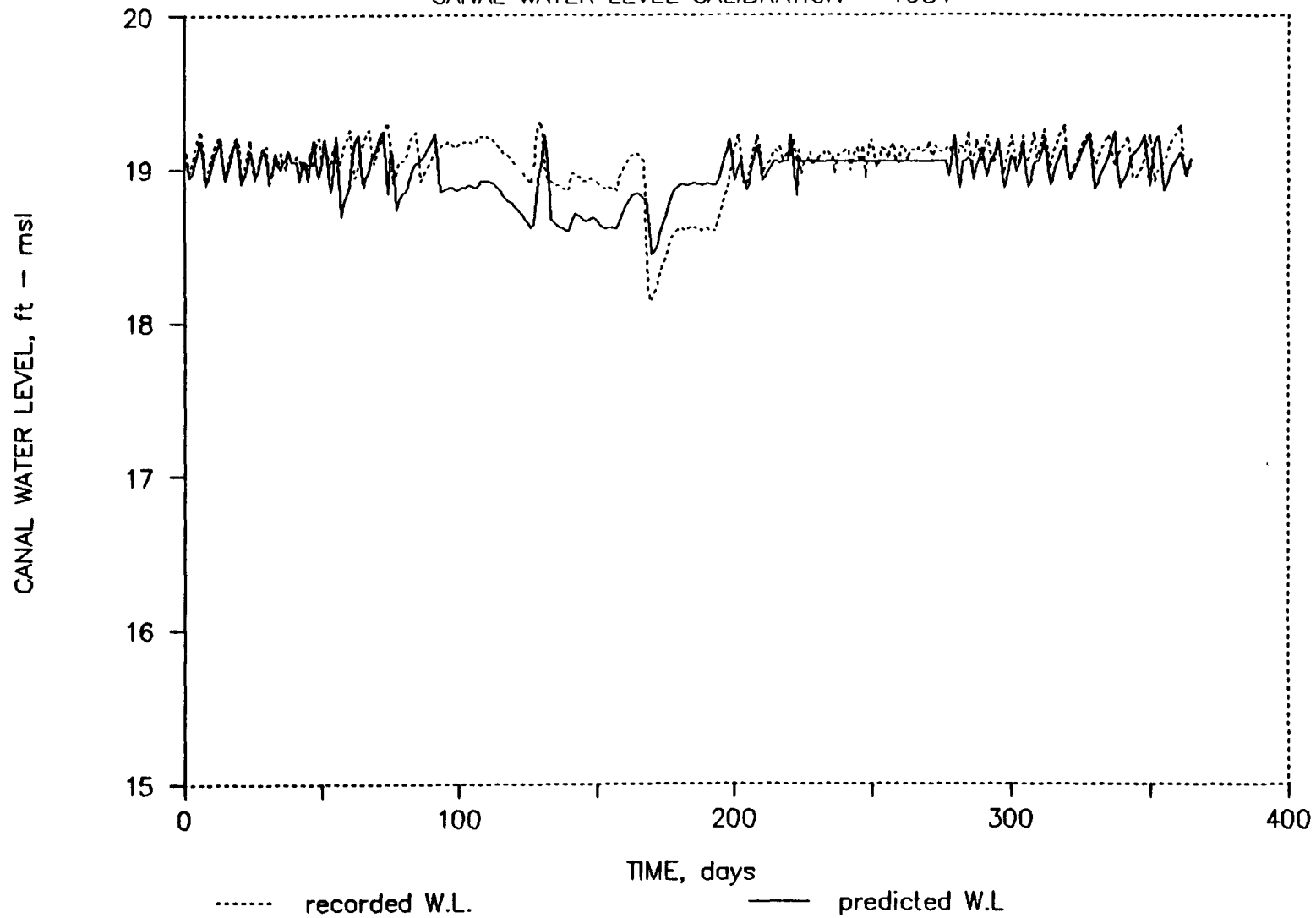
CANAL WATER LEVEL CALIBRATION - 1980



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1980

INDIANTOWN PROJECT

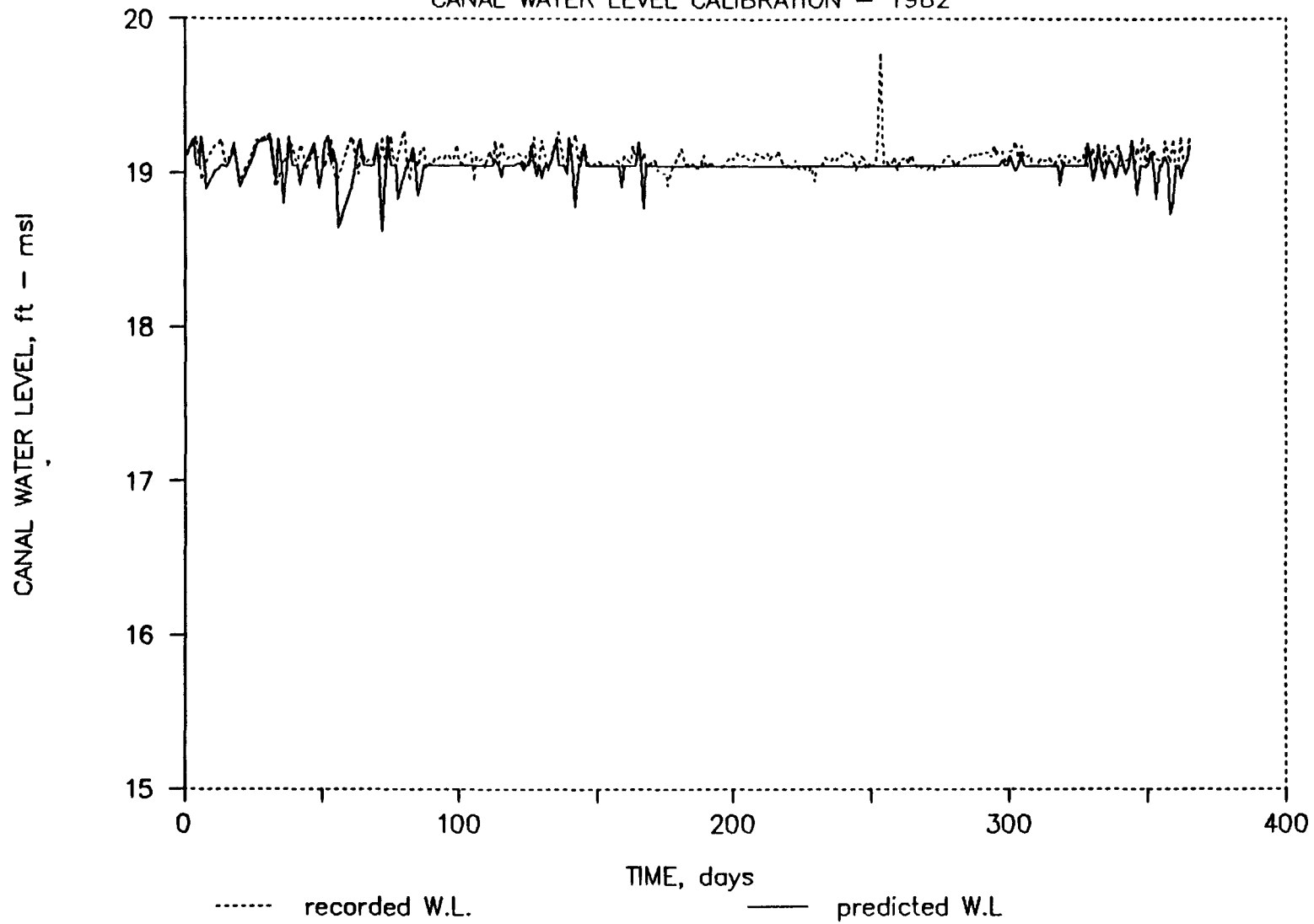
CANAL WATER LEVEL CALIBRATION — 1981



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1981

INDIANTOWN PROJECT

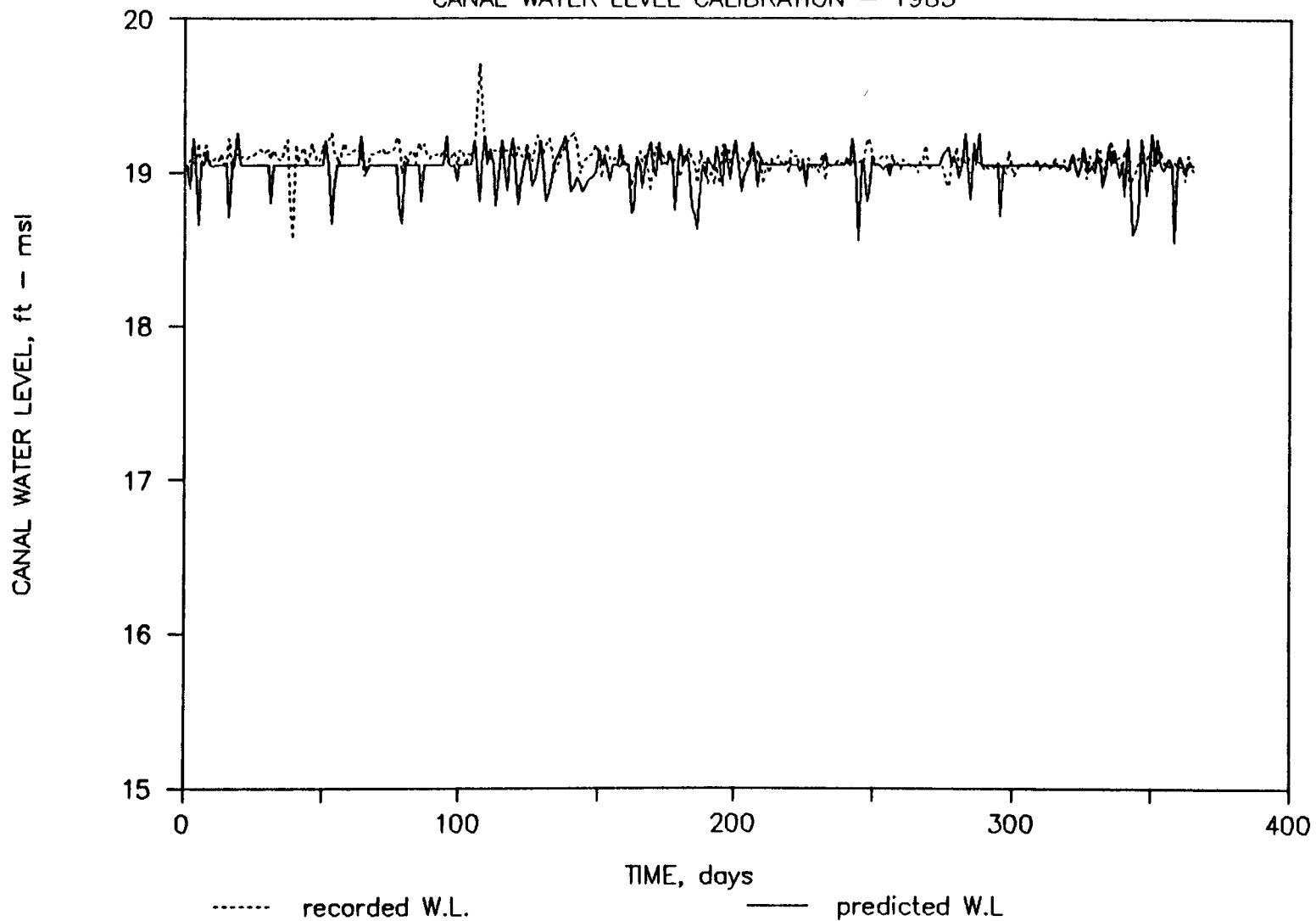
CANAL WATER LEVEL CALIBRATION - 1982



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1982

INDIANTOWN PROJECT

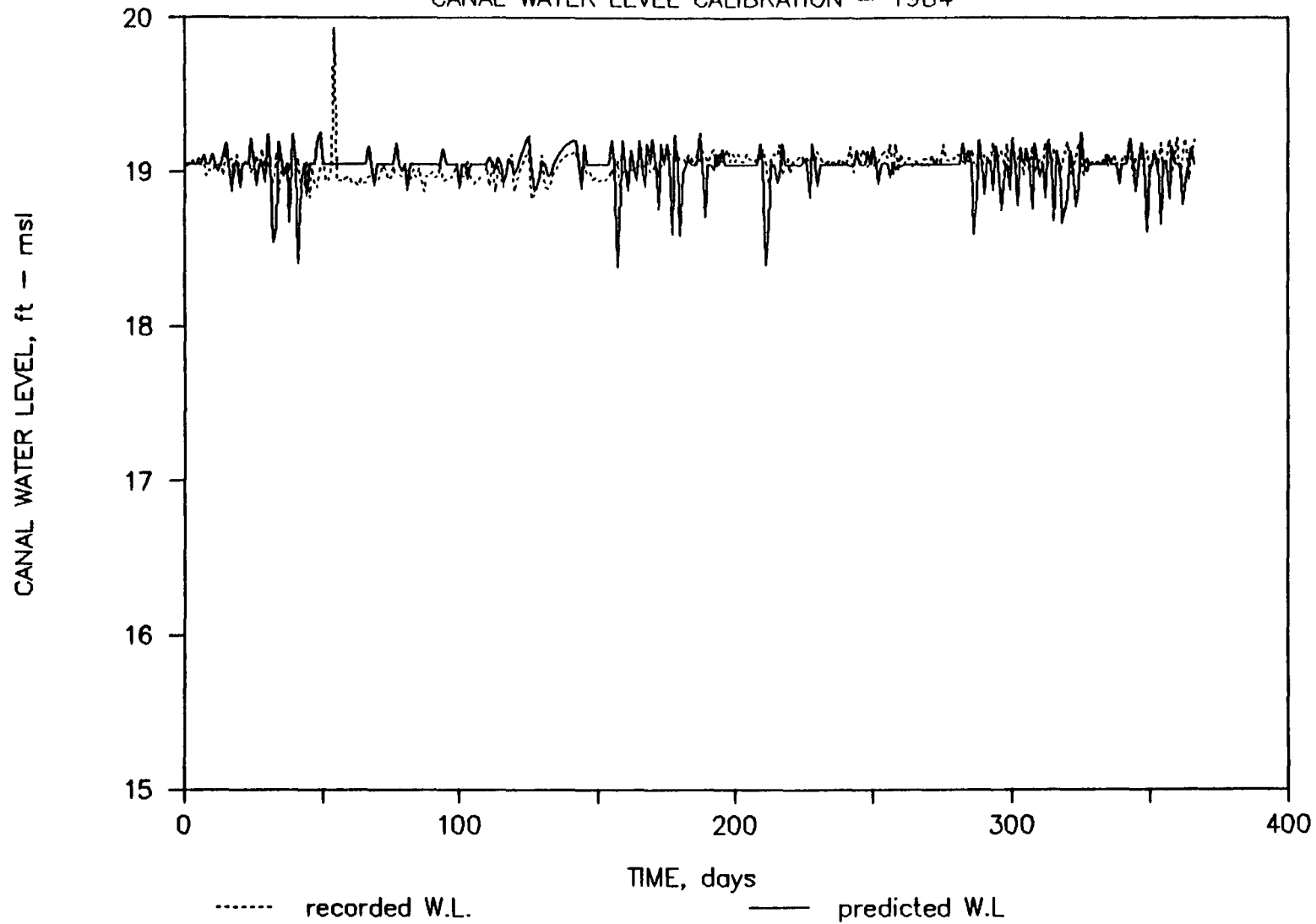
CANAL WATER LEVEL CALIBRATION — 1983



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1983

INDIANTOWN PROJECT

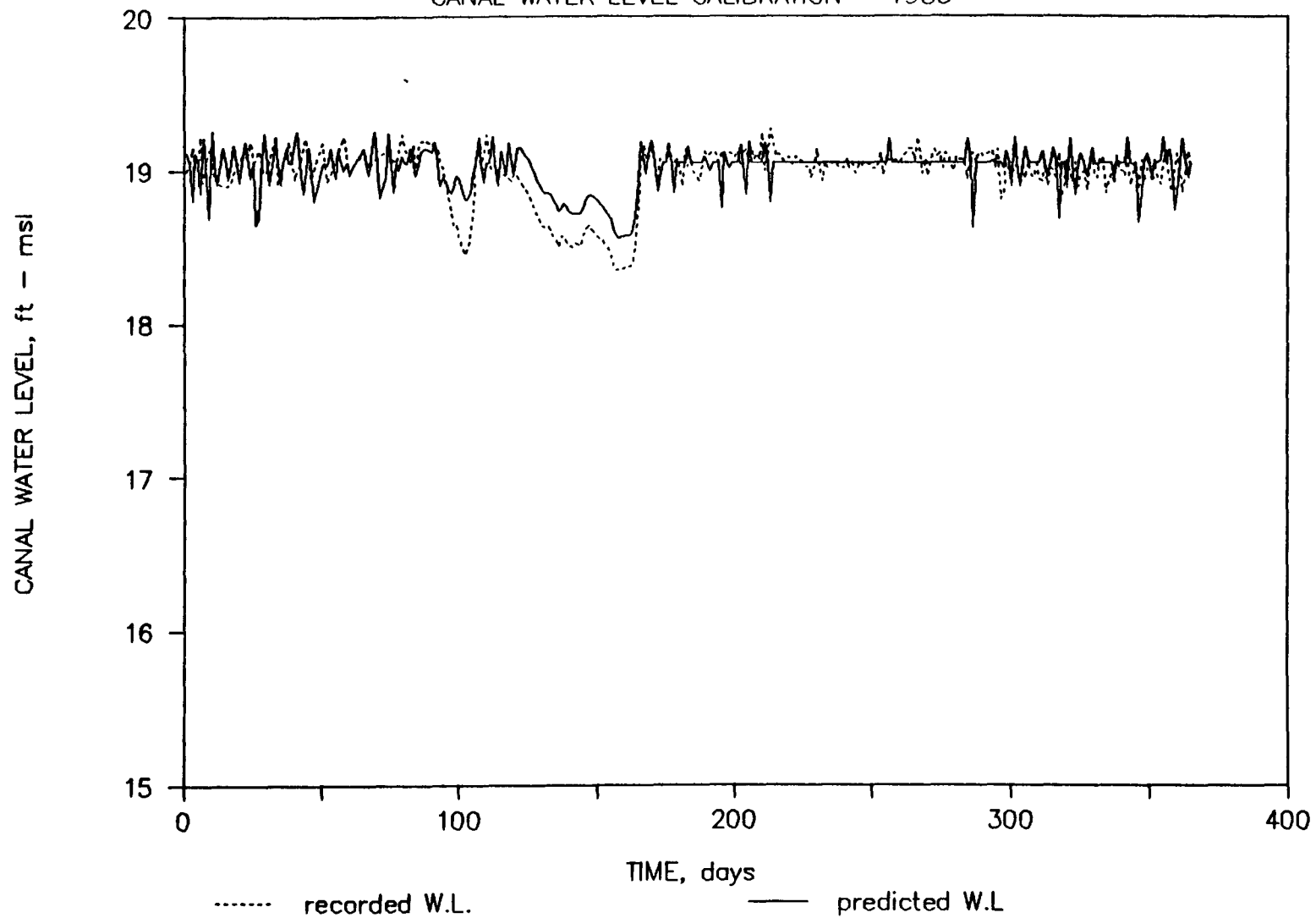
CANAL WATER LEVEL CALIBRATION — 1984



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1984

INDIANTOWN PROJECT

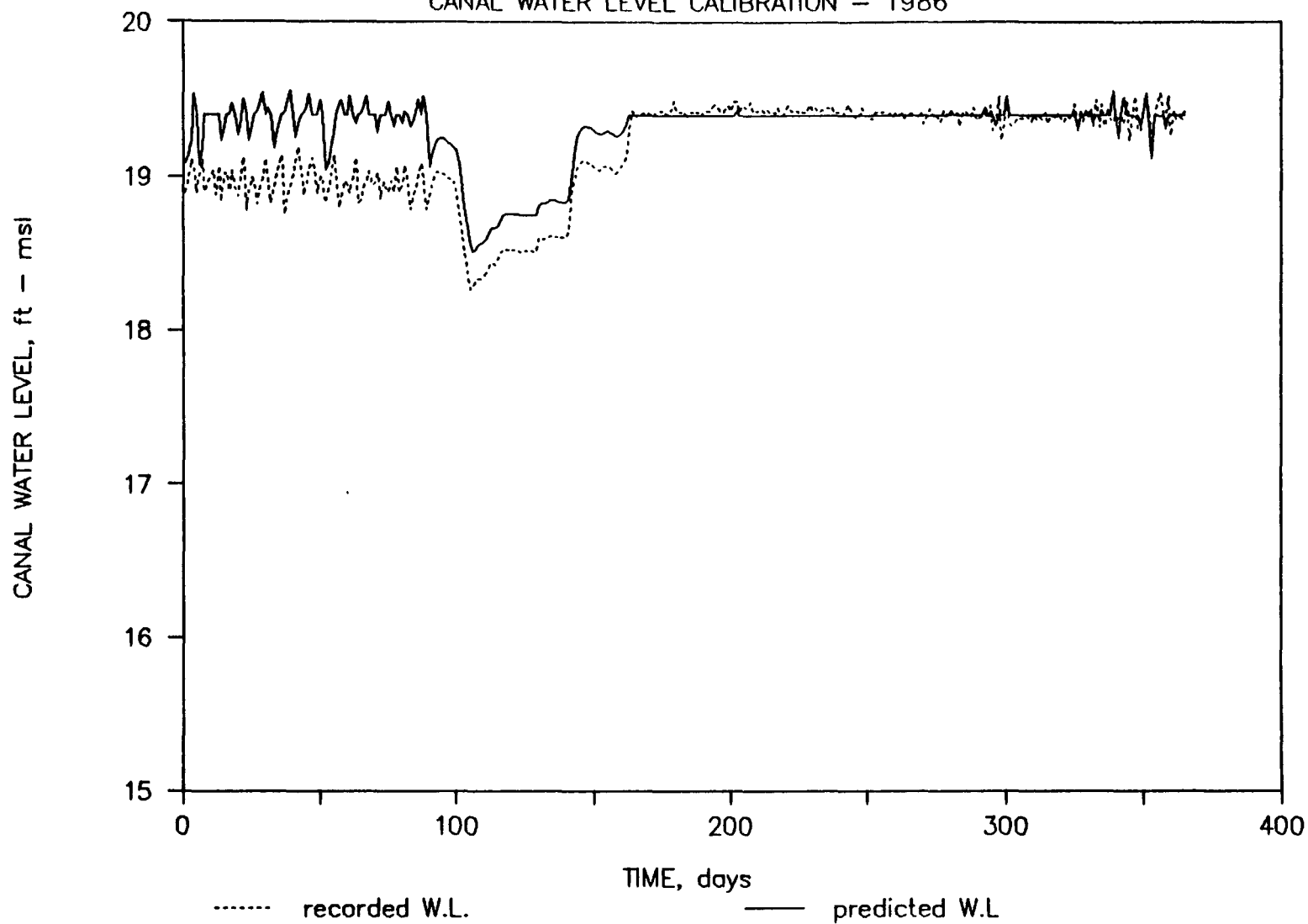
CANAL WATER LEVEL CALIBRATION — 1985



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1985

INDIANTOWN PROJECT

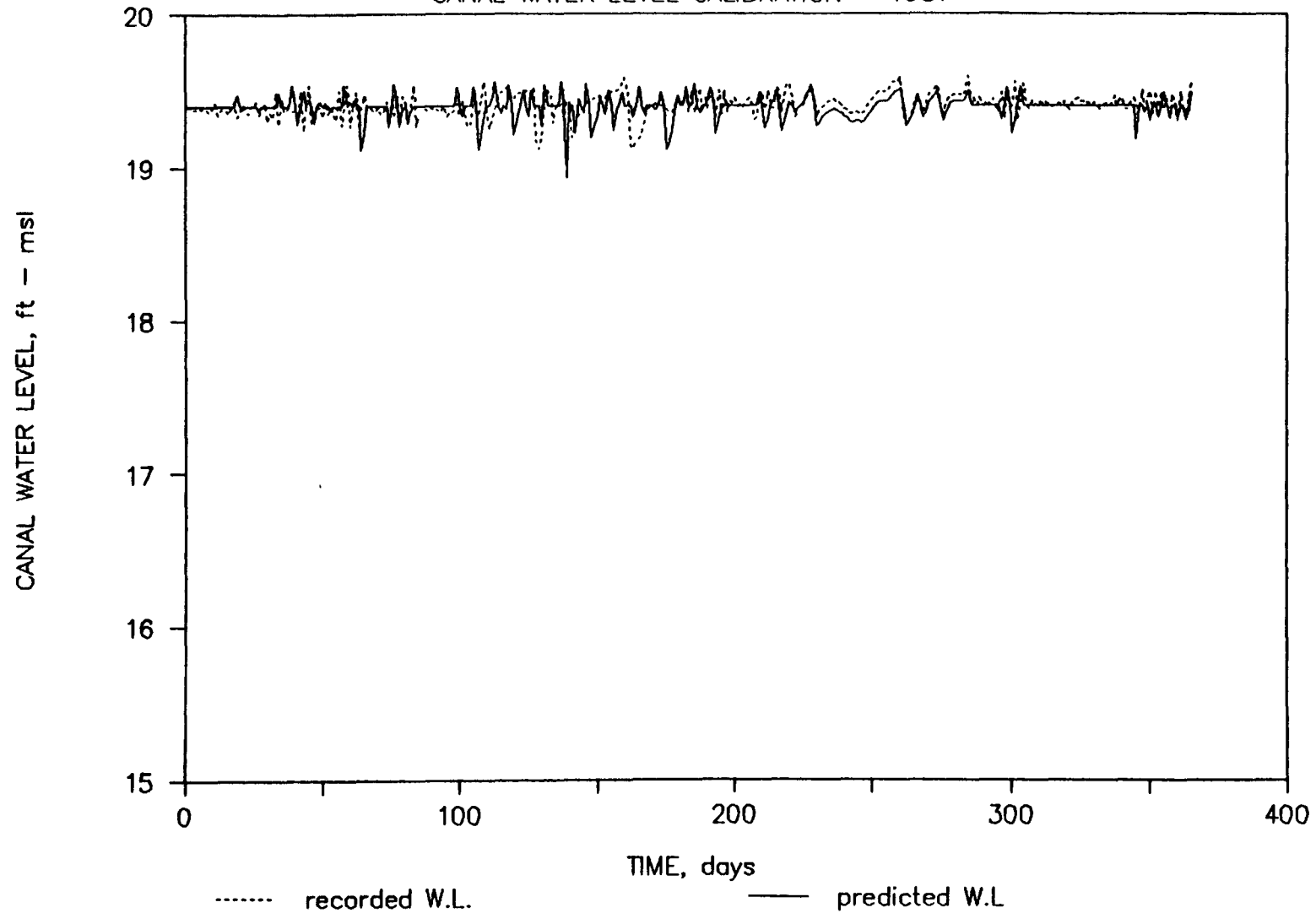
CANAL WATER LEVEL CALIBRATION - 1986



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1986

INDIANTOWN PROJECT

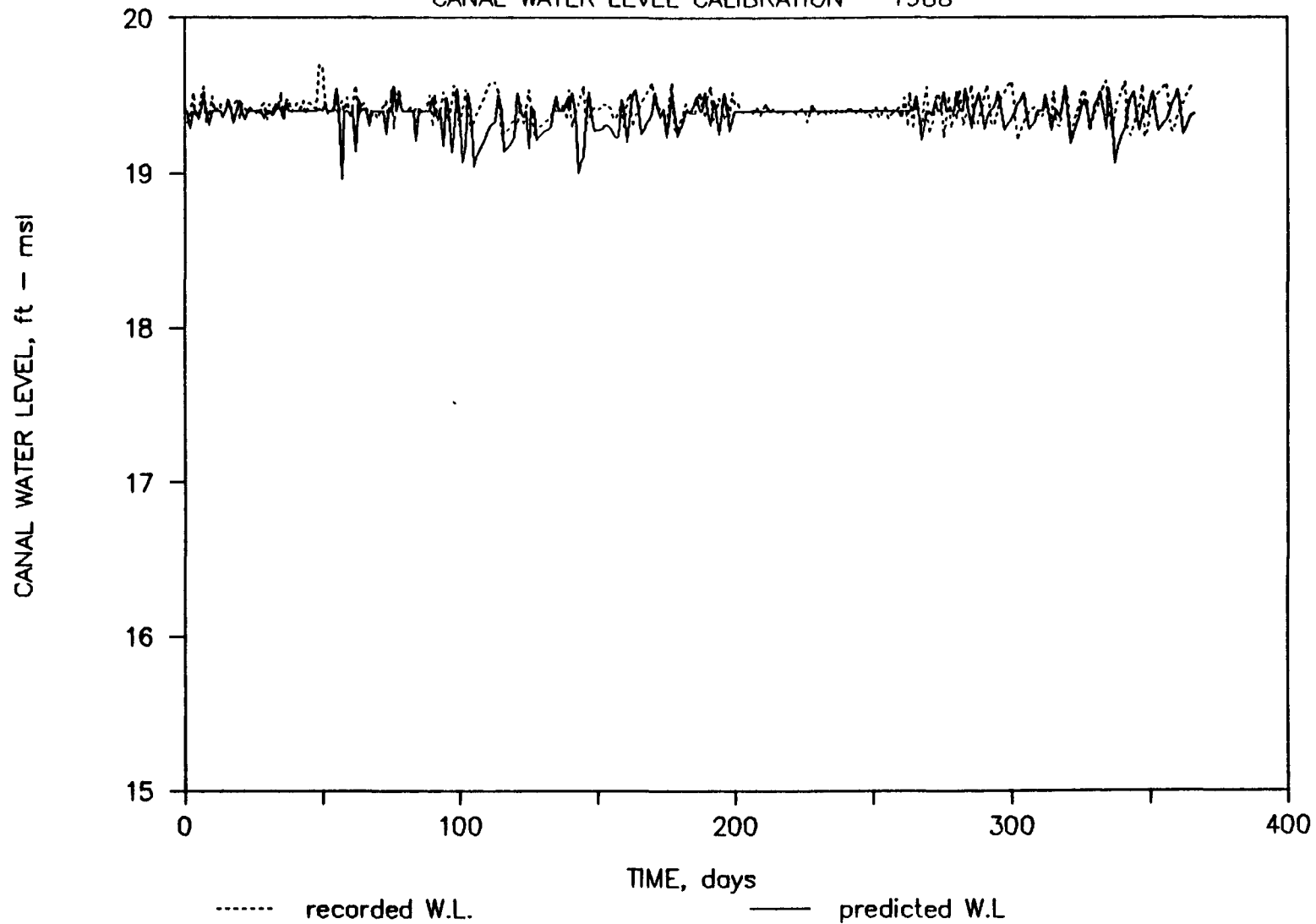
CANAL WATER LEVEL CALIBRATION — 1987



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1987

INDIANTOWN PROJECT

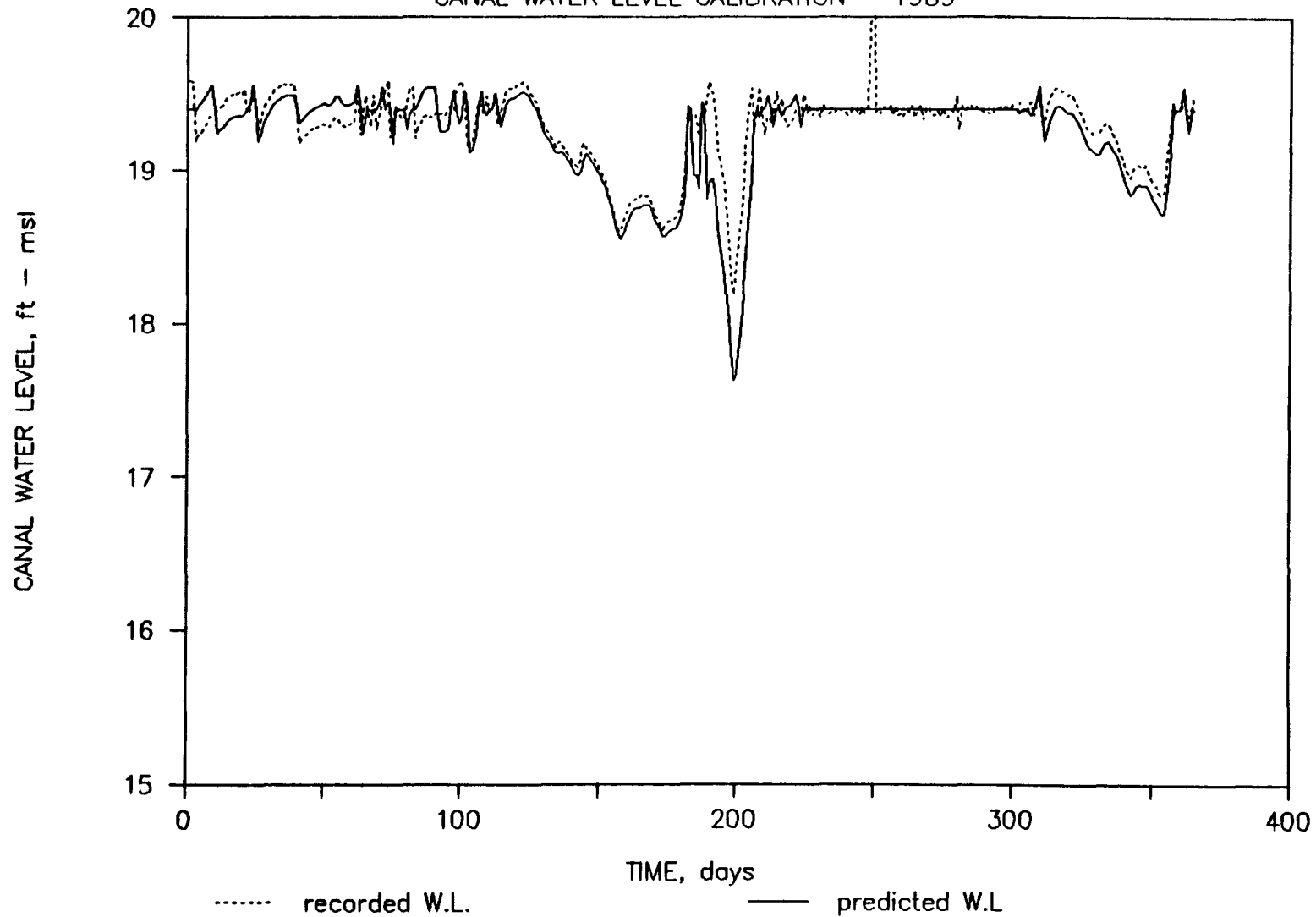
CANAL WATER LEVEL CALIBRATION — 1988



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1988

INDIANTOWN PROJECT

CANAL WATER LEVEL CALIBRATION — 1989



Comparison of Recorded and Predicted Canal Water Levels for the Period of 1989

APPENDIX D

**Simulated Canal Water Elevations and Spillway Flows
for Canal Water Levels Above 16 ft-msl**

YEARS OF DATA = 16, (1974-1989)

Qmakeup (gpm)= 3238. 3257. 3305. 3408. 3438. 3454. 3463. 3469. 3441. 3438. 3308. 3264.

Sum of Qsp (cfs)= 855786. (historic data)

Sum of Storage (cfs)= 52.

Sum of Qin (cfs)= 855848. (historic data)

Sum of New Qsp (cfs)= 813278. (after makeup and process water withdrawal)

Sum of Qmakeup and Process Water (cfs)= 42519.

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1974

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	18.87	19.06	18.88	19.08	19.05	18.06	19.05	19.05	19.05	19.05	18.87	19.05
2	18.86	19.05	19.00	19.09	19.00	18.03	19.05	19.05	19.05	19.05	18.97	18.87
3	18.93	18.83	18.96	19.05	18.94	18.02	19.05	19.05	19.05	19.05	19.01	19.05
4	19.19	19.08	18.95	18.99	18.86	18.03	19.05	19.05	19.05	19.05	19.05	19.10
5	19.05	19.05	18.94	18.99	18.78	18.52	19.05	19.05	19.05	19.05	19.10	19.08
6	18.74	18.81	18.94	19.05	18.71	19.03	19.05	19.05	19.05	19.05	19.22	19.12
7	19.05	18.83	18.93	19.05	18.63	19.05	19.05	19.05	19.05	19.05	19.05	19.21
8	19.05	18.87	19.06	19.05	18.56	19.22	19.05	19.05	19.20	19.05	19.05	19.05
9	18.83	18.91	19.18	19.03	18.52	19.05	19.05	19.05	19.05	19.05	19.05	19.05
10	18.89	19.07	19.13	19.05	18.48	18.67	19.05	19.05	19.05	19.05	18.93	19.05
11	19.15	19.17	19.10	19.05	18.40	18.89	19.05	19.05	19.05	19.05	19.22	19.03
12	19.05	19.13	19.09	18.96	18.34	19.05	19.05	19.05	19.05	19.05	19.05	19.05
13	18.74	19.13	19.07	18.96	18.28	19.21	19.05	19.05	19.05	19.05	19.18	19.02
14	19.06	19.14	19.04	19.00	18.20	19.05	19.05	19.05	19.05	19.05	19.05	19.05
15	19.05	19.14	19.20	19.05	18.16	19.09	19.05	19.05	19.05	19.05	18.55	19.05
16	19.00	19.14	19.05	19.04	18.37	19.05	19.05	19.05	18.95	19.05	18.72	19.05
17	19.23	19.05	18.73	19.05	18.54	18.73	19.05	19.05	19.05	19.05	18.93	19.05
18	19.25	18.91	18.71	19.05	18.49	18.92	19.05	19.05	19.14	19.05	19.05	19.05
19	19.05	18.88	18.68	18.97	18.47	19.00	19.05	19.05	19.05	18.78	19.03	19.00
20	18.76	18.93	18.65	18.96	18.43	18.99	19.05	19.05	18.77	19.05	19.11	19.05
21	18.76	18.98	18.64	19.01	18.37	18.93	19.05	19.05	19.05	19.05	19.05	19.04
22	18.82	19.14	18.63	19.05	18.30	19.10	19.05	19.05	18.86	18.80	18.86	19.21
23	19.06	19.05	18.57	19.03	18.23	19.05	19.05	19.05	19.05	19.05	18.92	19.05
24	19.22	18.80	18.52	19.02	18.15	19.13	19.05	19.05	19.05	19.20	19.15	18.82
25	19.21	18.81	18.49	19.23	18.08	19.05	19.05	19.05	19.05	19.21	19.05	19.04
26	19.25	18.79	18.53	19.05	18.00	19.05	19.05	19.05	19.05	19.05	19.05	19.05
27	19.05	18.76	18.67	18.70	17.93	19.05	19.05	19.05	19.05	18.81	19.05	18.94
28	19.03	18.73	18.88	18.73	17.86	19.05	19.05	19.05	19.05	18.89	19.06	19.08
29	19.20	.00	19.16	18.74	17.79	19.05	19.05	19.05	19.05	19.11	19.05	19.05
30	19.22	.00	19.05	18.92	17.75	19.05	19.05	19.05	19.05	19.05	19.05	18.86
31	19.05	.00	18.92	.00	17.92	.00	19.05	19.05	.00	18.85	.00	18.86

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1975

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	18.95	19.05	19.05	16.62	18.17	16.61	19.05	17.37	19.05	19.05	19.05	19.06
2	19.05	18.67	18.81	16.52	18.07	16.62	19.05	17.44	19.05	19.05	19.05	19.05
3	19.07	18.68	19.22	16.47	17.96	16.61	19.05	17.41	19.05	19.05	19.05	18.93
4	19.07	18.68	19.05	16.53	17.83	16.55	19.05	17.32	19.05	19.05	19.05	18.90
5	19.13	18.67	18.55	16.56	17.71	16.47	19.05	17.20	19.05	19.05	18.98	18.92
6	19.05	19.00	18.61	16.52	17.59	16.41	19.05	17.08	19.05	19.05	19.05	18.93
7	18.90	19.05	18.63	16.54	17.49	16.36	18.93	17.02	19.05	19.05	19.05	18.94
8	18.89	18.80	18.64	16.52	17.41	16.30	19.05	16.99	19.05	19.05	18.91	19.05
9	18.94	18.82	18.62	16.51	17.28	16.25	19.05	18.80	19.05	19.05	19.05	19.05
10	19.05	19.05	18.58	16.52	17.15	16.20	19.05	19.05	19.05	19.05	19.20	19.18
11	19.09	19.24	18.50	16.55	17.09	16.17	19.05	18.24	19.05	19.05	19.05	19.05
12	19.07	19.05	18.38	17.13	17.01	16.12	19.05	19.05	19.05	19.24	18.87	19.22
13	19.12	18.86	18.25	17.63	16.95	16.07	19.05	19.05	19.05	19.05	19.05	19.05
14	19.05	18.85	18.12	17.83	16.92	16.01	19.05	19.05	19.05	19.01	19.05	18.77
15	18.91	18.89	18.03	18.02	16.87	15.94	19.05	19.05	19.05	19.05	18.87	19.05
16	18.89	18.92	17.96	18.04	16.91	15.91	19.05	19.05	19.05	19.23	19.05	19.06
17	18.91	19.15	17.88	18.61	17.04	15.94	19.05	19.05	19.05	19.05	19.18	19.05
18	18.93	19.05	17.81	19.06	17.11	16.04	19.05	19.05	19.05	18.67	19.21	19.13
19	18.94	18.73	17.74	19.05	17.52	16.18	19.05	19.05	19.05	19.05	19.05	19.05
20	19.05	18.73	17.68	19.04	17.73	16.38	19.05	19.05	19.05	19.05	18.81	18.89
21	19.12	18.75	17.60	19.06	17.49	16.98	19.19	19.05	19.05	19.05	18.81	19.05
22	19.09	19.05	17.52	19.05	17.38	17.44	19.05	19.05	19.05	19.05	19.05	19.11
23	19.14	19.05	17.45	18.95	17.27	17.88	18.80	19.05	19.05	19.05	19.21	19.05
24	19.22	19.05	17.38	18.95	17.17	18.87	18.55	19.05	19.05	19.05	19.19	19.10
25	19.05	19.05	17.31	19.21	17.07	19.05	18.14	19.05	19.05	19.15	19.22	19.05
26	19.05	19.05	17.23	19.05	16.96	19.05	17.95	19.05	19.05	19.05	19.23	19.00
27	19.23	19.05	17.13	18.61	16.82	19.05	17.94	19.05	19.05	19.00	19.05	19.05
28	19.23	19.05	17.01	18.50	16.69	19.21	17.77	19.05	19.05	19.05	18.82	18.93
29	19.24	.00	16.90	18.38	16.61	19.05	17.42	19.05	19.05	19.05	18.80	19.07
30	19.05	.00	16.82	18.27	16.59	18.62	17.23	19.05	19.05	19.05	18.90	19.05
31	19.14	.00	16.72	.00	16.60	.00	17.27	19.22	.00	19.05	.00	18.96

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1976

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.11	19.24	19.05	18.43	18.46	19.05	19.05	19.05	19.05	19.05	19.00	19.05
2	19.05	19.05	18.19	18.69	18.84	19.05	19.05	19.05	19.05	19.05	19.05	19.08
3	18.90	18.18	18.87	18.93	18.90	19.05	19.05	19.05	19.05	19.05	19.05	19.08
4	18.87	18.21	19.05	18.86	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.11
5	18.87	18.24	18.64	18.80	19.14	19.05	19.05	19.05	19.05	19.05	19.05	19.05
6	18.86	18.95	18.66	18.76	19.09	19.05	19.05	19.05	19.05	19.05	18.97	18.94
7	18.84	19.05	18.67	18.75	19.06	19.05	19.05	19.05	19.05	19.05	19.05	18.96
8	19.18	18.44	19.03	19.15	19.03	19.05	19.05	19.05	19.05	19.10	19.13	19.05
9	19.05	18.39	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.14	19.14
10	18.56	18.35	18.72	18.94	19.05	19.05	19.05	19.05	19.05	19.02	19.05	19.05
11	18.59	18.30	18.71	19.05	19.05	19.05	19.05	19.05	19.05	19.05	18.88	18.88
12	18.63	18.26	18.70	19.21	19.05	19.05	19.05	19.05	19.05	19.07	18.89	19.05
13	18.64	18.23	18.67	19.05	19.00	19.05	19.05	19.05	19.05	19.05	19.05	19.22
14	19.12	18.21	18.64	18.48	19.05	19.05	19.05	19.05	19.05	18.99	19.19	19.05
15	19.05	18.77	18.60	18.50	19.05	19.05	19.05	19.05	19.05	18.99	19.05	18.90
16	18.49	19.05	18.55	18.49	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
17	18.50	18.75	18.90	18.46	19.05	19.05	19.05	19.05	19.05	19.04	19.20	19.23
18	18.49	18.72	19.23	18.41	19.05	19.05	19.05	19.05	19.05	19.05	19.21	19.05
19	18.47	18.70	19.16	18.35	19.05	19.05	19.05	19.05	19.05	19.08	19.05	18.88
20	18.43	18.68	19.10	18.57	19.05	19.05	19.05	19.05	19.05	19.05	18.82	19.05
21	18.87	18.65	19.06	18.77	19.05	19.05	19.05	19.05	19.05	19.01	18.82	19.17
22	19.05	18.61	19.01	18.71	19.05	19.05	19.05	19.05	19.05	18.99	18.90	19.17
23	18.75	18.58	18.99	18.65	19.05	19.05	19.05	19.05	19.05	19.02	19.05	19.05
24	18.71	18.53	18.95	18.59	19.05	19.05	19.05	19.05	19.05	19.05	19.13	18.94
25	18.66	19.09	18.88	18.52	19.05	19.05	19.05	19.05	19.05	19.04	19.11	19.05
26	18.63	19.05	18.82	18.45	19.05	19.05	19.05	19.05	19.05	19.03	19.13	19.05
27	18.62	18.46	18.76	18.38	19.05	19.05	19.05	19.05	19.05	19.06	19.05	19.05
28	18.63	18.51	18.70	18.31	19.05	19.05	19.05	19.05	19.05	19.05	18.92	19.12
29	18.63	19.24	18.63	18.23	19.05	19.05	19.05	19.05	19.05	18.99	18.90	19.05
30	18.60	.00	18.57	18.14	19.05	19.05	19.05	19.05	19.05	18.95	18.96	19.00
31	18.56	.00	18.49	.00	19.05	.00	19.05	19.05	.00	18.97	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1977

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.11	19.05	18.91	19.05	17.12	18.21	19.19	19.16	19.05	19.05	18.95	19.05
2	19.05	19.05	19.05	18.58	17.04	18.62	19.05	19.05	19.05	19.05	18.96	19.05
3	18.96	19.05	19.15	18.54	16.96	19.05	18.88	18.90	19.05	19.05	18.96	19.05
4	19.05	19.05	19.05	18.50	16.89	19.05	18.84	18.85	19.05	19.05	19.05	19.05
5	19.16	19.05	18.97	18.46	16.83	19.05	18.82	18.81	19.05	19.05	19.19	19.05
6	19.05	19.05	18.98	18.41	16.81	19.05	18.81	18.75	19.05	19.02	19.05	19.05
7	18.93	19.05	19.05	18.35	16.80	19.05	18.79	18.70	19.05	19.05	18.86	19.05
8	19.05	18.70	19.05	18.29	16.75	19.05	18.76	18.66	19.05	19.08	19.05	19.05
9	19.14	19.05	19.04	18.22	16.71	19.05	18.87	18.61	19.05	19.05	19.20	19.05
10	19.17	19.05	19.07	18.15	16.69	19.05	18.94	18.57	19.05	19.02	19.05	19.05
11	19.05	18.82	19.05	18.08	16.68	19.05	18.88	18.76	19.05	19.04	19.11	19.05
12	18.90	19.05	18.98	18.00	16.64	18.99	18.83	18.93	19.05	19.05	19.05	19.05
13	19.02	19.18	18.97	17.92	16.92	19.01	18.78	19.05	19.05	18.96	19.05	19.05
14	19.05	19.19	19.03	17.86	17.20	19.05	18.74	19.17	19.05	18.94	19.25	19.05
15	18.95	19.05	19.05	17.82	17.12	18.99	18.74	19.05	19.05	18.94	19.22	19.05
16	19.05	19.05	19.01	17.76	17.05	18.97	18.78	18.94	19.05	18.95	19.23	19.05
17	19.05	19.23	18.98	17.68	16.98	18.99	19.22	19.05	19.05	19.05	19.24	19.05
18	19.05	19.24	18.99	17.59	16.89	19.05	19.05	19.15	19.05	19.21	19.05	19.05
19	19.15	19.05	19.01	17.51	16.80	19.07	18.97	19.12	19.05	19.05	18.82	19.05
20	19.05	19.05	19.01	17.43	16.70	19.06	19.05	19.12	19.05	18.90	18.79	19.05
21	18.97	19.23	19.05	17.36	16.61	19.05	18.66	19.10	19.05	19.04	18.81	19.05
22	19.05	19.21	19.06	17.28	16.53	19.05	18.73	19.04	19.05	19.10	18.83	19.05
23	19.21	19.05	19.01	17.21	16.47	19.07	19.09	18.83	19.05	19.05	19.05	19.05
24	19.05	19.05	18.98	17.14	16.46	19.05	19.05	18.52	19.05	18.96	19.05	19.05
25	19.16	19.22	18.94	17.08	16.45	19.05	18.70	18.23	19.05	18.97	19.05	19.05
26	19.05	19.05	18.93	17.02	16.45	19.05	18.73	18.02	19.05	19.05	19.05	19.05
27	18.56	19.03	18.91	17.18	16.55	19.00	18.98	18.04	19.05	19.03	19.05	19.05
28	19.09	19.05	18.87	17.34	16.69	19.08	19.18	18.33	19.05	19.02	19.22	19.05
29	19.05	.00	18.84	17.27	16.77	19.22	19.14	18.78	19.05	19.07	19.05	19.05
30	18.54	.00	18.81	17.19	16.81	19.21	19.15	19.05	19.05	19.05	19.05	19.05
31	19.05	.00	19.14	.00	17.55	.00	19.16	19.05	.00	18.98	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1978

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.05	18.99	19.05	19.05	18.65	18.89	19.05	19.05	19.05	19.05	18.87	18.94
2	19.05	19.05	19.05	19.05	18.69	18.85	19.05	19.05	19.05	19.05	19.05	19.05
3	18.97	19.19	19.05	19.05	19.11	18.80	19.05	19.05	19.05	19.05	19.05	19.13
4	19.05	19.05	19.05	19.05	19.05	18.76	19.05	19.05	19.05	19.05	19.05	19.23
5	19.05	18.76	19.05	18.85	18.66	19.00	19.05	19.05	19.05	19.05	19.05	19.05
6	19.02	19.05	19.05	18.88	19.22	19.05	19.05	19.05	19.05	19.05	19.05	18.69
7	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	18.71
8	19.05	19.05	19.05	19.16	18.76	19.05	18.71	19.05	19.05	19.05	19.05	19.25
9	18.98	19.05	19.05	19.13	19.12	19.05	19.21	19.05	19.05	19.05	19.05	19.05
10	19.05	19.05	19.05	19.14	19.13	19.05	19.05	19.05	19.05	19.05	19.05	18.39
11	19.05	19.05	19.05	19.15	19.05	18.90	19.18	19.05	19.05	19.05	19.05	18.99
12	18.94	18.97	19.05	19.13	18.87	19.05	19.05	19.24	19.05	19.05	19.05	19.05
13	19.05	19.05	19.05	19.05	18.83	19.14	19.02	19.05	19.05	19.05	19.05	18.61
14	19.05	19.12	19.05	18.94	18.84	19.05	19.05	18.82	19.05	19.05	19.05	18.74
15	19.05	19.05	19.05	18.90	18.83	19.00	19.23	19.05	19.05	19.05	19.05	19.20
16	19.05	18.96	19.05	18.89	18.78	19.17	19.05	19.05	19.05	19.05	19.05	19.05
17	18.94	19.05	19.05	18.87	18.74	19.05	18.68	19.05	19.05	19.05	19.05	18.52
18	19.05	19.05	19.05	19.14	18.98	19.12	19.05	19.05	19.05	19.05	18.86	18.55
19	19.05	19.05	19.05	19.05	19.20	19.05	19.05	19.05	19.05	19.05	19.14	18.73
20	19.05	19.05	19.05	19.05	19.05	18.64	19.05	19.05	19.05	19.05	19.05	19.05
21	19.05	19.05	19.05	19.05	19.02	18.64	19.05	19.05	19.05	19.24	19.02	19.16
22	19.05	19.05	19.05	19.05	19.09	19.13	19.05	19.05	19.05	19.05	19.05	19.15
23	19.05	19.05	19.05	19.05	19.06	19.05	19.05	19.05	19.05	18.89	18.96	19.19
24	19.05	19.05	18.92	19.05	19.01	19.05	19.05	19.05	19.05	19.05	19.05	19.22
25	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.12	19.07	19.05
26	19.22	19.18	19.17	18.73	19.07	18.92	19.05	19.05	19.05	19.05	19.05	18.90
27	19.05	19.05	19.05	19.10	19.02	19.05	19.05	19.05	19.05	18.53	19.05	19.05
28	19.05	19.05	19.05	19.05	19.00	19.05	19.05	19.05	19.05	18.72	19.05	19.05
29	19.05	.00	19.05	18.68	18.98	19.05	19.05	19.05	19.05	18.90	19.02	19.05
30	18.94	.00	19.05	18.67	18.97	19.05	19.05	19.05	19.05	19.10	19.05	19.05
31	19.05	.00	19.05	.00	18.93	.00	19.05	19.05	.00	19.05	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1979

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.05	19.05	19.19	18.62	19.05	19.05	19.05	19.05	19.05	19.05	19.10	19.05
2	19.05	19.05	19.05	18.62	19.05	19.05	18.50	19.20	19.05	19.05	19.05	19.00
3	19.05	19.05	19.05	18.98	18.94	19.05	18.51	19.20	19.05	19.05	19.02	19.05
4	19.05	19.05	19.18	19.05	19.06	19.05	18.93	19.05	19.05	19.05	19.05	19.07
5	19.05	19.05	19.05	18.77	19.14	19.05	19.24	19.05	19.05	19.05	19.04	19.09
6	19.05	19.05	19.05	18.78	19.05	19.05	19.21	19.19	19.05	19.05	19.05	19.05
7	19.05	19.05	19.05	18.76	18.89	19.23	19.23	19.05	19.05	19.05	19.00	19.05
8	19.05	19.05	19.05	18.73	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
9	19.05	19.05	19.05	18.71	19.05	18.46	19.05	19.12	19.05	19.05	19.13	19.05
10	19.05	19.05	19.05	18.95	19.05	18.48	19.05	19.05	19.05	19.05	19.05	19.05
11	19.05	19.13	19.10	19.14	19.05	19.04	19.05	19.05	19.05	19.11	19.05	19.05
12	19.05	19.05	19.05	19.10	19.05	19.05	19.05	19.05	19.05	19.05	19.10	19.05
13	19.05	19.05	19.05	19.08	19.05	18.55	19.05	19.05	19.05	18.38	19.05	19.05
14	19.05	19.05	19.04	19.05	19.05	18.84	19.05	19.05	19.05	19.05	19.05	19.10
15	19.05	19.07	19.05	19.03	19.05	19.07	19.05	19.05	19.05	19.05	19.04	19.05
16	19.05	19.05	19.09	19.07	19.05	19.06	19.05	19.05	19.05	19.19	19.05	19.00
17	19.05	19.05	19.18	19.14	19.05	19.11	19.05	19.05	19.05	19.05	19.05	19.05
18	19.05	19.05	19.05	19.19	19.05	19.05	19.05	19.05	19.05	18.74	19.01	19.10
19	19.05	19.04	18.80	19.05	19.05	18.93	19.05	19.05	19.05	19.05	19.05	19.13
20	19.05	19.05	18.79	18.98	19.05	18.88	19.05	19.05	19.05	19.05	19.05	19.05
21	19.05	19.01	19.05	19.05	19.05	18.87	18.81	19.10	19.05	19.05	18.97	18.90
22	19.05	19.05	19.24	19.01	19.05	18.85	19.05	19.05	19.05	19.05	19.01	18.93
23	19.05	18.89	19.23	19.10	19.05	19.05	19.05	18.95	19.05	19.04	19.05	19.05
24	19.05	19.05	19.05	19.05	19.05	19.22	19.05	18.86	19.05	19.05	19.02	19.15
25	19.05	19.05	18.85	19.03	19.05	19.19	19.05	18.61	19.05	19.05	19.05	19.22
26	19.05	19.05	19.00	19.05	19.05	19.21	18.80	18.35	19.05	19.03	19.02	19.05
27	19.05	19.05	19.05	18.90	19.05	19.05	19.02	18.12	19.05	19.05	19.05	18.80
28	19.05	19.05	19.25	18.87	19.05	19.12	19.05	18.05	19.05	19.11	19.09	18.78
29	19.05	.00	19.05	18.86	19.05	19.05	18.84	18.13	19.05	19.05	19.05	18.83
30	19.05	.00	18.58	18.86	19.05	19.16	18.83	19.05	19.05	19.00	19.06	19.05
31	19.05	.00	18.60	.00	19.05	.00	18.87	19.05	.00	19.05	.00	19.22

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1980

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.20	19.05	19.05	19.05	19.05	18.95	19.05	19.05	19.05	19.05	19.11	18.86
2	19.22	19.05	19.05	19.05	19.05	19.03	19.05	19.05	19.05	19.05	19.07	19.05
3	19.05	19.05	19.05	19.05	19.16	19.01	19.05	19.06	19.05	19.05	19.05	19.23
4	18.83	19.05	19.05	19.05	19.05	18.94	18.98	19.16	19.05	19.05	19.08	19.05
5	18.82	19.05	19.05	19.05	18.77	18.96	18.94	19.05	19.05	19.05	19.20	19.05
6	18.85	19.05	19.05	19.05	19.05	18.99	18.84	19.05	19.05	19.05	19.05	19.05
7	19.24	19.05	19.05	19.05	19.05	18.92	19.11	18.99	19.05	19.05	18.96	19.05
8	19.05	19.05	19.05	19.05	19.21	18.85	19.05	19.18	19.05	19.05	19.05	19.05
9	18.49	19.10	19.05	19.05	19.05	18.78	19.05	19.05	19.05	19.05	19.07	19.05
10	18.52	19.05	19.16	19.05	18.73	18.73	19.05	18.93	19.05	19.05	19.05	19.05
11	18.55	19.05	19.05	19.05	19.04	18.72	18.72	19.08	19.05	19.05	19.06	19.05
12	18.84	19.05	19.00	18.82	19.05	18.70	18.78	19.24	19.05	19.05	19.23	19.05
13	19.05	19.05	19.05	19.05	19.05	18.64	18.82	19.05	19.05	19.11	19.05	18.90
14	19.03	19.05	19.02	19.05	19.05	18.57	18.92	18.91	19.05	19.05	18.78	19.10
15	19.05	19.05	19.16	19.05	19.08	18.49	19.10	19.19	19.05	18.84	19.05	19.05
16	19.05	19.05	19.05	19.16	19.05	18.41	19.05	19.05	19.05	18.91	19.05	19.05
17	19.10	18.85	18.96	19.05	18.89	18.32	19.17	18.85	19.05	19.01	19.05	19.17
18	19.05	19.05	19.05	18.94	19.21	18.22	19.05	18.75	19.05	19.05	19.05	19.05
19	19.05	19.05	19.05	19.05	19.05	18.14	18.75	18.60	19.23	19.08	19.05	19.12
20	19.19	19.05	19.05	19.05	18.83	18.09	18.97	18.95	19.05	19.24	19.05	19.05
21	19.05	19.05	19.05	19.05	19.05	18.20	19.05	19.05	18.74	19.05	19.05	19.05
22	18.79	19.05	19.05	19.05	19.19	18.28	19.24	18.90	19.05	19.08	19.05	19.05
23	18.86	19.05	19.05	18.92	19.05	18.26	19.05	19.00	19.05	19.05	19.05	19.03
24	19.05	19.05	19.05	19.05	18.87	18.51	18.90	19.05	19.05	18.86	19.05	19.05
25	19.10	19.05	19.15	19.18	18.91	18.69	19.05	19.05	19.06	19.20	19.05	18.89
26	19.17	19.05	19.05	19.05	19.05	18.70	19.05	19.06	19.05	19.05	19.05	19.00
27	19.05	19.05	18.88	18.85	19.05	18.95	19.05	19.05	19.05	18.83	19.05	19.05
28	19.05	19.05	19.19	19.05	19.24	19.19	19.05	19.19	19.05	18.94	19.05	18.99
29	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.02	19.05	18.97
30	19.05	.00	18.74	18.79	18.62	18.99	19.05	19.05	19.05	19.05	19.05	19.00
31	19.05	.00	19.05	.00	18.80	.00	19.05	19.05	.00	19.09	.00	19.02

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1981

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.05	19.02	18.79	18.63	16.47	16.38	16.51	17.02	19.05	19.05	19.05	19.00
2	19.03	19.05	19.09	18.58	16.46	16.37	16.51	16.98	19.05	19.05	18.97	19.02
3	18.99	19.05	19.05	18.52	16.43	16.38	16.52	17.14	19.05	19.05	18.94	19.02
4	18.99	19.02	18.70	18.45	16.39	16.38	16.52	17.28	19.05	18.95	18.96	18.97
5	18.99	19.05	18.70	18.38	16.37	16.38	16.52	18.55	19.05	19.05	19.05	18.94
6	18.98	19.04	18.71	18.31	16.35	16.37	16.51	19.05	19.05	19.21	19.11	18.90
7	19.05	19.03	18.69	18.23	16.37	16.40	16.51	18.82	19.05	19.05	19.10	18.85
8	19.09	19.05	18.65	18.13	16.54	16.47	16.51	19.05	19.05	18.87	19.10	18.81
9	19.06	19.05	18.92	18.05	16.68	16.50	16.52	19.20	19.05	19.05	19.05	19.16
10	19.06	19.05	19.17	17.97	16.65	16.54	16.51	19.05	19.05	19.05	18.97	19.05
11	19.06	19.01	19.13	17.90	16.79	16.54	16.50	19.05	19.05	18.99	18.94	18.54
12	19.03	19.05	19.12	17.83	16.87	16.52	16.50	19.05	19.05	19.05	18.94	18.50
13	19.00	19.05	19.09	17.75	16.73	16.53	16.54	19.05	19.05	19.01	18.93	18.46
14	19.05	18.94	19.07	17.67	16.64	16.53	16.58	19.05	19.05	19.02	18.90	18.43
15	19.09	19.05	19.05	17.58	16.53	16.52	16.56	19.05	19.05	19.05	18.85	18.42
16	19.06	19.16	19.05	17.50	16.48	16.49	16.54	19.05	19.05	19.13	19.01	18.43
17	19.08	19.05	19.04	17.44	16.47	16.49	16.52	19.05	19.05	19.05	19.15	18.85
18	19.08	18.97	18.98	17.38	16.46	16.29	16.54	19.05	19.05	18.96	19.10	19.23
19	19.05	19.05	18.97	17.30	16.45	16.10	16.57	19.05	19.05	19.05	19.07	19.19
20	19.05	19.17	18.94	17.21	16.45	16.12	16.57	19.05	19.05	19.06	19.04	19.16
21	19.03	19.05	18.88	17.13	16.51	16.18	16.84	19.05	19.05	19.02	19.01	19.11
22	18.99	18.87	18.82	17.03	16.52	16.25	16.97	19.05	19.05	19.03	18.98	19.07
23	19.00	18.86	18.81	16.93	16.47	16.32	16.77	19.05	19.05	19.05	18.95	19.06
24	19.02	19.09	18.80	16.82	16.45	16.38	16.73	19.05	19.05	19.03	18.91	19.03
25	19.05	19.05	18.75	16.72	16.44	16.44	16.76	19.05	19.05	19.00	19.05	18.99
26	19.03	18.81	19.01	16.61	16.43	16.51	16.76	19.05	19.05	19.00	19.18	18.95
27	19.00	18.82	19.05	16.54	16.43	16.56	16.74	19.05	19.05	19.00	19.13	18.90
28	19.01	18.81	18.78	16.53	16.44	16.53	16.98	19.05	18.80	19.05	19.11	19.05
29	19.00	.00	18.74	16.52	16.44	16.51	17.18	19.05	19.05	19.06	19.07	19.18
30	19.05	.00	18.70	16.49	16.43	16.51	17.13	19.05	19.05	19.03	19.04	19.14
31	19.07	.00	18.67	.00	16.40	.00	17.09	19.05	.00	19.07	.00	19.11

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1982

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.09	18.37	18.92	19.05	18.92	19.05	19.05	19.05	19.05	19.05	19.05	19.05
2	19.08	18.94	18.88	19.05	18.84	19.05	19.05	19.15	19.05	19.05	19.25	19.05
3	19.04	19.14	19.17	19.05	18.71	19.05	19.05	19.05	19.13	19.05	19.05	19.05
4	19.01	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.23
5	19.05	18.89	18.63	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
6	19.07	19.05	19.05	19.05	18.79	19.05	19.05	19.05	19.05	19.05	19.05	18.87
7	19.04	19.17	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
8	19.02	19.18	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.25
9	19.00	19.05	19.05	19.05	19.08	19.05	19.05	19.05	19.05	19.05	19.05	19.05
10	18.96	18.99	19.07	19.05	19.05	19.05	19.05	19.05	19.05	19.05	18.97	18.95
11	18.91	19.11	19.05	19.05	19.12	19.05	19.05	19.05	19.05	19.05	19.05	19.05
12	18.86	19.05	18.56	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.19	19.11
13	18.81	18.88	18.59	19.05	18.75	19.25	19.05	19.05	19.05	19.05	19.05	19.05
14	19.05	18.83	18.84	19.05	18.74	19.05	19.05	19.05	19.05	19.05	18.37	19.05
15	19.05	18.80	19.04	19.05	18.72	18.96	19.05	19.05	19.05	19.05	18.81	19.21
16	18.78	18.77	19.09	19.05	18.70	19.05	19.05	19.05	19.05	19.05	19.05	19.05
17	18.76	19.05	19.05	19.05	19.04	19.05	19.05	19.05	19.04	19.09	19.05	18.95
18	18.74	19.05	18.96	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
19	19.24	19.20	18.91	19.05	18.79	19.05	19.05	19.05	19.05	18.95	19.05	19.01
20	19.05	19.05	18.92	19.05	18.96	19.05	19.05	19.05	19.05	19.05	19.05	19.05
21	18.34	18.46	18.92	19.05	19.10	19.05	19.05	19.05	19.05	19.00	19.05	19.05
22	18.32	18.47	19.05	19.05	19.16	19.05	19.05	19.05	19.05	19.05	19.05	19.20
23	18.28	18.78	19.14	18.95	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
24	18.25	19.04	19.15	19.05	19.01	19.05	19.05	19.05	19.05	19.17	19.05	18.62
25	18.22	18.99	19.05	19.11	19.05	19.05	19.05	19.05	19.05	19.05	19.05	18.62
26	18.19	18.97	18.86	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.08
27	18.15	18.95	18.84	19.05	19.05	19.05	19.05	19.05	19.05	19.13	19.05	19.05
28	18.08	18.93	19.05	19.05	19.05	19.05	19.05	18.96	19.05	19.05	19.05	18.64
29	18.01	.00	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.00	19.05	19.16
30	17.95	.00	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
31	17.88	.00	19.05	.00	19.05	.00	19.05	19.05	.00	19.13	.00	18.51

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1983

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.05	19.05	19.05	19.05	18.78	18.24	19.12	19.05	19.02	18.76	19.05	18.98
2	19.05	19.05	19.05	19.23	18.86	18.44	19.05	19.05	19.05	18.70	19.05	19.05
3	18.82	19.05	19.05	19.05	18.90	18.57	18.76	19.05	19.08	18.65	19.05	19.03
4	19.05	19.05	19.05	18.82	18.88	19.10	18.63	19.05	19.05	18.85	19.05	19.05
5	19.05	19.05	19.05	19.05	19.15	19.05	18.46	19.05	18.81	19.22	19.05	19.05
6	19.05	19.05	18.94	18.74	19.05	19.05	18.65	19.04	18.95	19.05	19.05	19.03
7	19.10	19.05	19.18	18.99	18.72	19.05	19.13	19.23	19.23	18.85	19.05	19.05
8	19.05	19.05	19.05	19.05	18.73	19.18	19.05	19.05	19.05	19.14	19.05	19.01
9	18.89	19.05	19.05	18.99	18.81	19.05	18.74	19.05	18.90	19.05	19.23	18.96
10	19.05	19.05	19.05	19.05	18.85	18.46	18.85	19.05	19.24	19.00	19.05	18.94
11	19.22	19.05	19.05	19.05	18.80	18.55	18.95	18.85	19.05	19.05	18.95	18.94
12	19.05	19.05	19.05	19.05	18.78	18.49	19.02	19.06	18.75	18.99	19.05	19.05
13	18.86	19.05	19.05	19.23	18.81	18.75	19.10	19.10	19.11	19.05	19.05	19.05
14	19.05	19.05	19.05	19.05	18.82	19.14	19.14	19.05	19.05	19.05	19.05	19.05
15	19.21	19.05	19.05	18.79	18.77	19.05	19.05	19.05	18.96	19.05	18.79	19.15
16	19.22	19.05	19.05	19.09	18.74	19.03	18.90	19.05	19.05	19.05	19.15	19.05
17	19.05	19.05	19.05	19.05	18.70	19.05	19.03	19.05	19.05	19.05	19.05	19.05
18	18.85	19.05	19.05	19.05	18.66	18.84	19.12	19.05	19.05	19.05	18.96	19.05
19	19.21	19.05	18.61	19.22	18.62	18.84	19.13	19.05	19.05	19.05	19.05	19.05
20	19.05	19.17	18.41	19.22	18.57	18.90	19.22	19.23	19.05	19.05	19.00	19.05
21	19.05	19.05	19.17	19.05	18.51	19.04	19.05	19.05	19.05	19.05	19.05	19.05
22	19.05	18.71	19.05	18.90	18.50	19.05	18.83	19.05	19.05	19.05	19.17	19.05
23	19.05	18.83	19.05	19.06	18.39	19.20	18.82	19.05	19.05	19.05	19.05	19.05
24	19.05	19.05	19.05	19.18	18.24	19.05	18.79	19.05	19.05	19.05	18.93	19.05
25	19.05	19.05	19.05	19.05	18.20	18.99	18.83	19.05	19.10	19.05	19.05	19.05
26	19.05	19.05	19.05	18.92	18.16	19.05	18.82	19.05	19.05	19.05	18.87	19.12
27	19.05	19.05	18.25	19.05	18.09	18.90	18.80	19.05	19.05	19.05	19.16	19.05
28	19.05	19.05	19.17	19.17	18.02	19.12	18.91	18.98	19.05	19.05	19.05	18.97
29	19.05	.00	19.05	19.23	17.97	19.16	19.05	19.05	19.05	19.05	18.74	19.05
30	19.05	.00	18.47	19.05	18.03	19.05	19.05	19.05	19.05	19.05	18.84	19.05
31	18.84	.00	19.05	.00	18.07	.00	19.05	19.05	.00	19.05	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1984

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.05	18.90	19.05	19.05	19.02	19.05	18.93	19.05	19.05	19.05	19.03	19.05
2	19.05	18.92	19.05	19.05	19.00	19.05	19.21	18.75	19.15	19.05	19.03	19.05
3	19.05	19.05	19.05	18.96	18.97	19.24	19.05	18.70	19.05	19.05	19.05	19.05
4	19.05	19.17	19.05	19.05	18.92	19.05	19.05	18.84	18.82	19.05	19.02	19.05
5	19.05	19.05	19.05	19.05	18.95	18.35	19.05	19.05	19.05	19.14	19.05	19.05
6	19.05	18.83	19.05	19.05	18.98	18.57	19.24	19.05	19.05	19.05	19.05	19.05
7	19.13	18.82	19.18	19.05	18.94	19.00	19.05	19.05	19.05	19.07	19.05	19.05
8	19.05	19.05	19.05	19.05	18.92	19.20	18.67	19.05	19.05	19.05	19.05	19.05
9	19.05	19.22	18.89	19.08	18.95	19.05	19.05	19.05	19.03	18.92	18.98	19.08
10	19.06	19.21	19.17	19.05	19.20	18.90	19.12	19.05	19.05	19.05	18.99	19.05
11	19.24	19.05	19.05	19.05	19.05	19.11	19.15	19.05	19.05	19.13	19.05	19.03
12	19.05	18.84	19.25	19.07	18.66	19.05	19.05	19.05	19.25	19.05	19.02	19.05
13	18.97	18.87	19.05	19.05	18.63	18.98	19.12	19.05	19.05	18.97	18.99	19.05
14	19.05	19.23	19.05	19.05	18.59	19.16	19.05	19.23	18.72	19.23	19.00	18.99
15	18.83	19.05	19.05	19.05	18.54	19.05	19.05	19.05	19.07	19.05	19.00	19.05
16	19.22	18.92	19.05	19.05	18.50	18.95	19.05	18.98	19.05	18.82	19.23	19.10
17	19.05	19.24	19.05	19.05	18.44	19.10	19.05	19.05	19.06	18.98	19.05	19.05
18	18.86	19.23	18.91	19.05	18.37	19.05	19.05	19.18	19.05	19.10	18.68	18.98
19	19.05	19.05	19.05	19.05	18.31	19.11	19.05	19.05	19.14	19.10	18.73	18.98
20	18.87	19.05	19.12	18.97	18.23	19.05	19.05	18.97	19.05	19.05	19.00	19.05
21	19.05	19.05	19.05	19.05	18.16	18.90	19.05	19.05	19.05	19.18	19.23	19.09
22	19.05	19.05	19.13	19.13	18.27	19.05	19.05	19.05	19.05	19.05	19.05	19.18
23	19.17	19.05	19.05	19.13	18.37	19.05	19.05	19.05	19.05	18.89	18.95	19.05
24	19.05	19.05	19.05	19.05	18.57	19.05	19.05	19.05	19.05	19.05	19.05	18.86
25	18.94	19.05	19.05	18.89	18.77	19.15	19.05	19.05	18.89	18.98	19.05	19.20
26	19.05	19.05	19.10	18.87	19.05	19.05	19.05	19.20	19.05	19.25	19.05	19.05
27	19.11	19.05	19.05	18.89	19.05	18.96	19.21	19.05	19.05	19.05	19.05	18.64
28	19.05	19.05	19.17	19.00	19.05	19.05	19.05	18.96	19.05	18.76	19.05	18.73
29	18.65	19.05	19.05	19.06	19.05	19.15	18.37	19.05	19.05	19.02	19.05	18.97
30	18.89	.00	18.67	19.03	19.05	19.05	18.56	18.95	19.05	19.05	19.05	19.21
31	19.05	.00	19.05	.00	19.05	.00	19.05	19.25	.00	19.05	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1985

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.06	19.06	19.09	18.44	18.94	16.11	19.05	19.05	19.05	19.05	19.05	19.05
2	19.05	19.14	19.04	18.50	18.88	16.08	19.06	19.05	19.05	19.05	18.90	19.05
3	18.86	19.05	19.01	18.52	18.76	16.05	19.05	19.05	19.05	19.05	19.24	19.07
4	19.09	18.97	18.97	18.49	18.66	16.01	19.05	19.05	19.05	19.05	19.05	19.10
5	19.05	19.03	18.91	18.40	18.55	15.95	19.05	19.05	19.05	19.05	18.86	19.05
6	18.87	19.05	18.87	18.26	18.44	15.90	19.05	19.05	19.05	19.05	19.14	19.05
7	19.16	19.09	19.12	18.15	18.32	15.89	19.05	19.05	19.05	19.05	19.05	19.05
8	19.05	19.05	19.05	18.11	18.19	15.89	19.16	19.05	19.05	19.05	19.01	19.17
9	18.74	18.94	18.78	18.10	18.07	15.90	19.05	19.05	19.05	19.05	19.05	19.05
10	19.23	18.92	18.86	18.01	17.95	15.90	18.91	19.05	19.05	19.05	19.10	19.07
11	19.05	18.93	18.91	17.86	17.84	15.91	19.05	19.05	19.05	19.05	19.05	19.05
12	18.93	18.94	18.92	17.71	17.76	15.92	19.13	19.05	19.05	19.05	19.06	18.62
13	19.05	18.95	18.92	17.62	17.67	16.04	19.05	19.05	19.09	19.05	19.23	18.73
14	19.13	19.08	18.90	17.60	17.55	16.25	18.67	19.05	19.05	19.05	19.05	19.12
15	19.05	19.19	19.12	17.64	17.43	16.44	18.95	19.05	19.05	19.09	18.79	19.05
16	18.97	19.14	19.05	18.32	17.31	16.57	19.05	19.05	19.05	19.05	18.83	18.99
17	19.05	19.12	18.99	19.07	17.24	16.75	19.17	19.05	19.05	19.02	19.08	19.21
18	19.14	19.11	19.05	19.05	17.20	16.85	19.05	19.05	19.05	19.05	19.05	19.22
19	19.05	19.14	18.88	19.07	17.09	16.82	18.89	19.05	19.05	19.08	18.97	19.05
20	18.94	19.05	18.89	19.05	16.98	17.11	19.05	19.05	19.05	19.05	19.05	18.89
21	19.05	18.92	19.17	19.05	16.87	17.34	19.05	19.05	19.05	18.96	18.98	18.97
22	19.15	18.95	19.05	19.05	16.79	17.34	19.05	19.05	19.05	19.05	19.20	19.00
23	19.05	19.05	18.61	18.94	16.71	18.22	19.23	19.05	19.05	18.94	19.05	19.05
24	18.97	19.13	18.98	19.10	16.62	19.05	19.05	19.05	19.05	19.02	18.69	19.05
25	19.05	19.22	19.05	19.24	16.58	19.14	18.93	19.05	19.05	19.06	18.74	19.04
26	18.63	19.05	18.76	19.05	16.55	19.05	19.05	19.05	19.05	19.05	19.05	19.09
27	18.59	18.89	18.77	18.85	16.50	18.84	19.05	19.05	19.05	18.95	19.05	19.05
28	18.81	19.05	18.71	18.98	16.41	19.05	19.05	19.05	19.05	19.19	18.93	18.98
29	19.00	.00	18.64	19.10	16.30	19.05	19.05	19.05	19.05	19.05	19.05	18.98
30	18.98	.00	18.56	19.05	16.19	19.05	19.05	19.05	19.05	18.91	19.05	19.04
31	19.01	.00	18.47	.00	16.12	.00	19.05	19.05	.00	19.20	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1986

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	18.99	19.18	19.05	19.12	16.29	16.03	19.40	19.40	19.40	19.40	19.40	19.27
2	18.97	19.16	19.05	19.11	16.19	16.03	19.40	19.40	19.40	19.40	19.40	19.40
3	19.00	19.17	19.03	19.07	16.14	16.05	19.40	19.40	19.40	19.40	19.40	19.54
4	19.23	19.18	19.07	19.00	16.14	16.05	19.40	19.40	19.40	19.40	19.40	19.40
5	19.05	19.05	19.05	18.92	16.10	16.05	19.40	19.40	19.40	19.40	19.40	19.18
6	18.68	18.88	18.98	18.83	16.06	16.03	19.40	19.40	19.40	19.40	19.40	19.40
7	18.71	18.86	18.95	18.74	16.06	16.01	19.40	19.40	19.40	19.40	19.40	19.40
8	19.04	18.87	18.94	18.65	16.05	16.01	19.40	19.40	19.40	19.40	19.40	19.40
9	19.05	18.88	18.92	18.55	16.06	16.03	19.40	19.40	19.40	19.40	19.40	19.40
10	19.15	18.88	19.05	18.45	16.11	16.06	19.40	19.40	19.40	19.26	19.40	19.43
11	19.05	18.90	19.05	18.27	16.10	16.10	19.40	19.40	19.40	19.40	19.40	19.40
12	18.90	19.22	18.90	18.04	16.06	17.32	19.40	19.40	19.40	19.40	19.40	19.34
13	19.05	19.05	19.23	17.83	16.06	19.40	19.40	19.40	19.40	19.40	19.40	19.40
14	18.81	18.58	19.05	17.63	16.07	19.40	19.40	19.40	19.40	19.40	19.40	19.40
15	18.82	18.59	19.01	17.42	16.08	19.40	19.40	19.40	19.40	19.40	19.40	19.40
16	19.18	18.59	19.05	17.28	16.07	19.40	19.40	19.40	19.40	19.40	19.40	19.49
17	19.05	19.05	19.04	17.22	16.07	19.40	18.97	19.40	19.40	19.40	19.40	19.40
18	18.66	19.05	19.05	17.17	16.07	19.40	19.40	19.40	19.40	19.40	19.40	19.40
19	18.94	18.84	18.67	17.10	16.07	19.40	19.40	19.40	19.40	19.39	19.40	19.40
20	19.15	19.05	19.00	17.02	16.07	19.40	19.40	19.40	19.40	19.40	19.40	19.33
21	19.14	18.99	19.05	16.96	16.09	19.40	19.29	19.40	19.40	19.46	19.40	19.40
22	19.05	18.96	18.85	16.92	16.22	19.40	19.40	19.40	19.40	19.40	19.31	19.46
23	19.17	18.98	19.10	16.86	16.33	19.40	19.40	19.40	19.40	19.26	19.40	19.40
24	19.05	19.01	19.05	16.78	16.32	19.40	19.40	19.40	19.40	19.50	19.40	19.24
25	18.71	19.05	18.76	16.71	16.28	19.40	19.40	19.40	19.40	19.40	19.40	19.40
26	19.03	19.03	18.75	16.67	16.21	19.40	19.40	19.40	19.40	19.27	19.39	19.47
27	19.05	18.99	18.75	16.61	16.13	19.40	19.40	19.40	19.40	19.53	19.40	19.40
28	18.77	19.00	18.75	16.54	16.08	19.40	19.40	19.40	19.40	19.40	19.36	19.40
29	18.78	.00	18.97	16.46	16.08	19.40	19.40	19.40	19.40	19.40	19.53	19.40
30	18.81	.00	19.16	16.37	16.06	19.40	19.40	19.40	19.40	19.40	19.40	19.40
31	19.03	.00	19.12	.00	16.04	.00	19.40	19.40	.00	19.40	.00	19.40

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1987

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.40	19.42	19.40	19.40	19.24	19.32	19.25	19.42	17.99	18.05	19.40	19.40
2	19.40	19.40	19.36	19.40	19.26	19.39	19.52	19.40	17.91	18.18	19.40	19.40
3	19.40	19.27	19.40	19.40	19.28	19.47	19.40	19.20	17.83	18.14	19.40	19.40
4	19.40	19.44	19.37	19.40	19.30	19.40	18.96	19.38	17.75	18.12	19.40	19.40
5	19.40	19.40	19.36	19.40	19.35	19.26	18.94	19.50	17.69	18.06	19.40	19.40
6	19.40	19.21	19.39	19.40	19.43	19.32	19.01	19.47	17.64	17.99	19.40	19.28
7	19.40	19.40	19.40	19.40	19.40	19.49	19.32	19.47	17.58	17.91	19.40	19.40
8	19.40	19.40	19.40	19.40	19.40	19.40	19.40	19.45	17.53	17.83	19.40	19.40
9	19.40	19.40	19.40	19.39	19.51	19.31	19.19	19.55	17.46	17.74	19.40	19.40
10	19.40	19.40	19.40	19.40	19.40	19.40	19.18	19.40	17.39	17.67	19.40	19.40
11	19.40	19.40	19.40	19.46	19.43	19.42	19.51	19.12	17.31	17.66	19.40	19.21
12	19.40	19.54	19.40	19.40	19.40	19.40	19.40	19.06	17.23	19.40	19.40	19.40
13	19.40	19.40	19.40	19.40	19.40	19.51	19.03	19.00	17.16	19.40	19.40	19.40
14	19.40	19.41	19.40	19.40	19.40	19.40	19.40	18.97	17.11	19.40	19.40	19.31
15	19.40	19.40	19.37	19.39	19.40	19.32	19.40	18.93	17.04	19.40	19.40	19.40
16	19.40	19.33	19.40	19.40	19.40	19.40	19.44	18.87	16.96	19.09	19.40	19.34
17	19.40	19.40	19.43	19.24	19.40	19.50	19.40	18.98	16.90	19.40	19.40	19.40
18	19.40	19.39	19.40	19.25	19.40	19.40	19.35	19.08	16.95	19.15	19.40	19.40
19	19.40	19.40	19.37	19.31	19.33	19.22	19.40	19.04	17.00	19.40	19.40	19.29
20	19.40	19.45	19.41	19.40	19.40	19.49	19.40	18.99	16.93	19.16	19.40	19.40
21	19.45	19.40	19.40	19.42	19.30	19.40	19.40	18.93	16.89	19.40	19.40	19.51
22	19.40	19.33	19.27	19.40	19.33	19.36	19.40	18.87	17.29	19.40	19.40	19.40
23	19.40	19.40	19.27	19.42	19.48	19.40	19.40	18.80	17.69	19.51	19.40	19.29
24	19.40	19.43	19.38	19.47	19.40	19.23	19.30	18.73	17.93	19.40	19.40	19.30
25	19.40	19.52	19.40	19.40	19.31	19.19	19.40	18.64	18.14	19.31	19.40	19.40
26	19.40	19.40	19.40	19.35	19.43	19.20	19.26	18.55	18.09	19.40	19.40	19.41
27	19.31	19.26	19.40	19.44	19.51	19.25	19.18	18.46	18.07	19.42	19.40	19.43
28	19.40	19.41	19.40	19.51	19.53	19.27	19.18	18.36	18.02	19.42	19.40	19.40
29	19.40	.00	19.40	19.40	19.52	19.40	19.42	18.26	17.97	19.40	19.40	19.28
30	19.41	.00	19.40	19.22	19.52	19.40	19.40	18.16	17.91	19.39	19.40	19.27
31	19.40	.00	19.40	.00	19.40	.00	19.19	18.07	.00	19.47	.00	19.30

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1988

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.40	19.03	19.40	19.40	19.54	18.91	19.40	19.40	19.40	19.44	19.06	19.40
2	19.47	19.33	19.10	19.40	19.40	18.83	19.51	19.40	19.40	19.41	19.02	19.18
3	19.49	19.40	19.36	19.42	19.25	18.74	19.40	19.40	19.40	19.40	18.96	19.18
4	19.40	19.49	19.40	19.40	19.28	18.62	19.10	19.40	19.40	19.40	19.34	19.18
5	19.23	19.40	19.53	19.31	19.46	18.51	19.09	19.40	19.40	19.40	19.40	19.15
6	19.22	19.01	19.40	19.29	19.40	18.45	19.18	19.40	19.40	19.34	19.46	19.11
7	19.24	19.45	19.19	19.33	19.17	18.60	19.23	19.40	19.40	19.35	19.40	19.31
8	19.47	19.40	19.40	19.55	19.12	18.74	19.21	19.40	19.40	19.40	19.30	19.48
9	19.40	19.40	19.40	19.40	19.05	18.75	19.23	19.40	19.40	19.38	19.40	19.44
10	19.40	19.40	19.40	19.06	18.99	18.86	19.31	19.40	19.40	19.38	19.19	19.43
11	19.40	19.40	19.40	19.10	18.93	18.88	19.40	19.40	19.40	19.41	19.51	19.41
12	19.49	19.40	19.40	19.36	18.86	18.84	19.42	19.40	19.40	19.40	19.40	19.43
13	19.40	19.29	19.37	19.55	19.22	18.82	19.40	19.40	19.40	19.34	19.05	19.40
14	18.88	19.40	19.40	19.50	19.40	18.77	19.35	19.40	19.40	19.31	19.10	19.32
15	19.27	19.52	19.50	19.48	19.40	18.73	19.40	19.40	19.31	19.30	19.34	19.31
16	19.40	19.40	19.40	19.44	19.40	18.68	19.43	19.40	19.40	19.29	19.52	19.31
17	19.43	19.34	19.28	19.40	19.47	18.64	19.43	19.40	19.40	19.29	19.48	19.29
18	19.40	19.40	19.40	19.35	19.40	18.59	19.40	19.40	19.24	19.49	19.48	19.26
19	19.35	19.40	19.40	19.32	19.12	18.65	19.40	19.40	19.40	19.40	19.47	19.21
20	19.40	19.40	19.40	19.29	19.45	18.69	19.40	19.40	19.40	19.11	19.45	19.16
21	19.40	19.12	19.40	19.24	19.40	18.82	19.40	19.40	19.26	19.11	19.43	19.11
22	19.40	19.40	19.40	19.17	19.06	19.09	19.40	19.40	19.40	19.09	19.40	19.29
23	19.52	19.40	19.40	19.26	19.04	19.16	19.40	19.40	19.45	19.06	19.35	19.47
24	19.40	19.51	19.40	19.36	19.02	19.18	19.40	19.40	19.44	19.02	19.34	19.42
25	19.24	19.40	19.40	19.30	19.15	19.27	19.40	19.40	19.48	18.97	19.34	19.40
26	19.40	18.99	19.40	19.24	19.27	19.36	19.40	19.40	19.40	18.92	19.30	19.38
27	19.40	19.34	19.40	19.18	19.23	19.39	19.40	19.40	19.29	19.07	19.27	19.34
28	19.40	19.40	19.40	19.13	19.19	19.34	19.40	19.40	19.30	19.21	19.25	19.31
29	19.19	19.43	19.51	19.09	19.12	19.32	19.40	19.40	19.32	19.16	19.23	19.28
30	19.45	.00	19.40	19.29	19.04	19.40	19.40	19.40	19.40	19.14	19.42	19.23
31	19.40	.00	19.33	.00	18.98	.00	19.40	19.40	.00	19.10	.00	19.18

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1989

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.12	19.36	17.94	19.08	18.86	16.36	17.40	19.40	19.40	19.40	19.40	17.34
2	19.30	19.31	17.87	19.00	18.79	16.31	18.89	19.40	19.40	19.40	19.32	17.22
3	19.47	19.24	17.89	18.92	18.71	16.23	19.25	19.40	19.40	19.40	19.40	17.09
4	19.42	19.18	18.27	18.84	18.61	16.15	19.17	19.23	19.40	19.40	19.48	16.96
5	19.37	19.11	18.63	18.78	18.50	16.07	19.00	19.40	19.40	19.40	19.51	16.82
6	19.32	19.04	18.68	19.12	18.39	16.01	19.48	19.53	19.40	19.40	19.40	16.68
7	19.27	18.96	18.99	19.43	18.28	15.99	19.40	19.46	19.40	19.40	19.23	16.55
8	19.24	18.89	19.25	19.42	18.15	16.03	18.76	19.41	19.40	19.40	19.20	16.43
9	19.19	19.06	19.42	19.43	18.01	16.09	18.79	19.37	19.40	19.40	19.21	16.37
10	19.14	19.23	19.40	19.38	17.88	16.14	18.73	19.40	19.40	19.40	19.19	16.33
11	19.08	19.18	19.19	19.49	17.76	16.19	18.52	19.40	19.40	19.40	19.15	16.26
12	19.02	19.14	19.21	19.40	17.64	16.21	18.25	19.40	19.40	19.40	19.08	16.17
13	18.97	19.08	19.22	19.14	17.52	16.21	18.01	19.40	19.40	19.40	18.99	16.13
14	18.92	19.02	19.41	19.08	17.40	16.22	17.81	19.40	19.40	19.40	18.91	16.12
15	18.87	18.96	19.40	19.09	17.32	16.23	17.59	19.40	19.40	19.40	18.82	16.07
16	18.81	18.89	19.20	19.40	17.25	16.23	17.31	19.40	19.40	19.40	18.74	16.03
17	18.75	18.83	19.51	19.40	17.15	16.23	17.00	19.40	19.40	19.40	18.65	16.00
18	18.68	18.76	19.40	19.45	17.03	16.19	16.73	19.40	19.40	19.40	18.56	15.97
19	18.61	18.69	19.35	19.40	16.92	16.14	16.68	19.40	19.40	19.40	18.45	15.93
20	18.53	18.61	19.40	19.37	16.80	16.10	16.81	19.40	19.40	19.40	18.33	15.93
21	18.47	18.53	19.09	19.40	16.68	16.06	16.95	19.40	19.40	19.40	18.21	16.05
22	18.74	18.48	19.11	19.11	16.61	16.01	17.14	19.40	19.40	19.40	18.08	16.21
23	19.04	18.43	19.34	19.37	16.60	16.01	17.37	19.40	19.40	19.40	17.96	17.42
24	19.07	18.36	19.52	19.40	16.61	16.04	17.59	19.40	19.40	19.40	17.87	18.93
25	19.34	18.26	19.48	19.19	16.60	16.06	17.90	19.40	19.40	19.40	17.77	19.40
26	19.54	18.16	19.45	19.18	16.57	16.06	18.13	19.40	19.40	19.40	17.67	19.40
27	19.51	18.08	19.42	19.14	16.54	16.08	18.20	19.40	19.40	19.40	17.60	19.40
28	19.51	18.00	19.37	19.07	16.51	16.11	18.48	19.40	19.40	19.40	17.56	19.44
29	19.48	.00	19.29	18.99	16.47	16.12	18.70	19.40	19.40	19.41	17.51	19.40
30	19.45	.00	19.21	18.93	16.44	16.17	18.70	19.40	19.40	19.40	17.45	19.39
31	19.40	.00	19.14	.00	16.40	.00	19.16	19.40	.00	19.40	.00	19.40

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1974

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	76.	0.	0.	0.	0.	0.	608.	651.	520.	748.	0.	65.
2	0.	41.	0.	0.	0.	0.	923.	658.	208.	649.	0.	0.
3	0.	0.	0.	62.	0.	0.	1106.	366.	306.	276.	0.	57.
4	0.	0.	0.	0.	0.	0.	800.	549.	169.	219.	113.	0.
5	61.	42.	0.	0.	0.	0.	902.	683.	170.	224.	0.	0.
6	0.	0.	0.	50.	0.	0.	519.	1307.	42.	326.	0.	0.
7	0.	0.	0.	0.	0.	53.	982.	970.	269.	515.	63.	0.
8	42.	0.	0.	47.	0.	0.	567.	969.	0.	557.	40.	64.
9	0.	0.	0.	0.	0.	183.	380.	794.	309.	258.	49.	163.
10	0.	0.	0.	0.	0.	0.	201.	947.	306.	338.	0.	68.
11	0.	0.	0.	46.	0.	0.	329.	771.	663.	50.	0.	0.
12	58.	0.	0.	0.	0.	47.	220.	792.	99.	197.	93.	81.
13	0.	0.	0.	0.	0.	0.	912.	544.	358.	76.	0.	0.
14	0.	0.	0.	0.	0.	94.	302.	578.	83.	162.	106.	61.
15	54.	0.	0.	44.	0.	0.	350.	312.	336.	57.	0.	108.
16	0.	0.	56.	0.	0.	75.	91.	461.	0.	44.	0.	63.
17	0.	48.	0.	0.	0.	0.	272.	273.	208.	64.	0.	169.
18	0.	0.	0.	73.	0.	0.	1961.	646.	0.	136.	110.	172.
19	93.	0.	0.	0.	0.	0.	932.	537.	226.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	629.	992.	0.	77.	0.	145.
21	0.	0.	0.	0.	0.	0.	734.	470.	124.	53.	102.	0.
22	0.	0.	0.	41.	0.	0.	693.	617.	0.	0.	0.	0.
23	0.	42.	0.	0.	0.	47.	1241.	350.	58.	67.	0.	204.
24	0.	0.	0.	0.	0.	0.	1001.	682.	273.	0.	0.	0.
25	0.	0.	0.	0.	0.	394.	890.	941.	189.	0.	86.	0.
26	0.	0.	0.	63.	0.	433.	783.	1042.	269.	153.	100.	186.
27	44.	0.	0.	0.	0.	471.	723.	551.	180.	0.	74.	0.
28	0.	0.	0.	0.	0.	548.	805.	656.	412.	0.	0.	0.
29	0.	0.	0.	0.	0.	637.	947.	442.	189.	0.	92.	158.
30	0.	0.	75.	0.	0.	360.	1089.	974.	406.	134.	93.	0.
31	50.	0.	0.	0.	0.	0.	1041.	640.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1975

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	69.	49.	0.	0.	0.	232.	0.	56.	355.	202.	0.
2	96.	0.	0.	0.	0.	0.	149.	0.	82.	324.	232.	106.
3	0.	0.	0.	0.	0.	0.	167.	0.	245.	322.	120.	0.
4	0.	0.	97.	0.	0.	0.	174.	0.	187.	205.	116.	0.
5	0.	0.	0.	0.	0.	0.	75.	0.	288.	164.	0.	0.
6	110.	0.	0.	0.	0.	0.	165.	0.	187.	186.	99.	0.
7	0.	46.	0.	0.	0.	0.	0.	0.	296.	265.	126.	0.
8	0.	0.	0.	0.	0.	0.	74.	0.	194.	40.	0.	113.
9	0.	0.	0.	0.	0.	0.	79.	0.	235.	233.	79.	49.
10	48.	56.	0.	0.	0.	0.	71.	532.	414.	69.	0.	0.
11	0.	0.	0.	0.	0.	0.	47.	0.	416.	179.	139.	127.
12	0.	103.	0.	0.	0.	0.	138.	139.	380.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	224.	355.	260.	115.	57.	263.
14	106.	0.	0.	0.	0.	0.	310.	391.	207.	0.	40.	0.
15	0.	0.	0.	0.	0.	0.	204.	385.	288.	105.	0.	172.
16	0.	0.	0.	0.	0.	0.	85.	157.	346.	0.	101.	0.
17	0.	0.	0.	0.	0.	0.	392.	376.	301.	177.	0.	77.
18	0.	54.	0.	0.	0.	0.	260.	124.	307.	0.	0.	0.
19	0.	0.	0.	112.	0.	0.	337.	334.	446.	269.	163.	109.
20	49.	0.	0.	0.	0.	0.	206.	330.	319.	97.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	635.	421.	170.	0.	186.
22	0.	58.	0.	77.	0.	0.	88.	407.	231.	112.	55.	0.
23	0.	57.	0.	0.	0.	0.	0.	462.	479.	143.	0.	51.
24	0.	43.	0.	0.	0.	0.	0.	230.	240.	103.	0.	0.
25	44.	196.	0.	0.	0.	289.	0.	255.	317.	0.	0.	70.
26	73.	63.	0.	61.	0.	136.	0.	208.	534.	137.	0.	0.
27	0.	49.	0.	0.	0.	128.	0.	102.	625.	0.	166.	193.
28	0.	52.	0.	0.	0.	0.	0.	137.	390.	99.	0.	0.
29	0.	0.	0.	0.	0.	244.	0.	59.	477.	125.	0.	0.
30	40.	0.	0.	0.	0.	0.	0.	172.	345.	353.	0.	61.
31	0.	0.	0.	0.	0.	0.	0.	0.	0.	150.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1976

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	0.	170.	0.	0.	2974.	257.	135.	81.	432.	0.	125.
2	107.	164.	0.	0.	0.	1101.	428.	94.	130.	285.	90.	0.
3	0.	0.	0.	0.	0.	644.	108.	123.	119.	171.	164.	0.
4	0.	0.	76.	0.	45.	827.	250.	290.	260.	139.	132.	0.
5	0.	0.	0.	0.	0.	1236.	86.	449.	555.	132.	125.	171.
6	0.	0.	0.	0.	0.	1626.	124.	266.	389.	128.	0.	0.
7	0.	105.	0.	0.	0.	1030.	472.	294.	302.	75.	85.	0.
8	0.	0.	0.	0.	0.	628.	443.	97.	223.	0.	0.	82.
9	88.	0.	56.	137.	73.	596.	582.	275.	83.	153.	0.	0.
10	0.	0.	0.	0.	0.	2818.	588.	357.	102.	0.	159.	138.
11	0.	0.	0.	63.	264.	2482.	345.	293.	94.	90.	0.	0.
12	0.	0.	0.	0.	173.	1332.	381.	85.	113.	0.	0.	76.
13	0.	0.	0.	107.	0.	772.	370.	288.	180.	77.	156.	0.
14	0.	0.	0.	0.	113.	504.	256.	1134.	153.	0.	0.	153.
15	101.	0.	0.	0.	261.	381.	88.	1488.	277.	0.	40.	0.
16	0.	49.	0.	0.	318.	416.	132.	893.	198.	105.	40.	99.
17	0.	0.	0.	0.	608.	388.	370.	1423.	208.	0.	0.	0.
18	0.	0.	0.	0.	251.	277.	529.	896.	310.	96.	0.	177.
19	0.	0.	0.	0.	275.	247.	516.	854.	350.	0.	77.	0.
20	0.	0.	0.	0.	97.	423.	257.	659.	77.	91.	0.	41.
21	0.	0.	0.	0.	164.	253.	260.	491.	310.	0.	0.	0.
22	46.	0.	0.	0.	66.	311.	278.	366.	662.	0.	0.	0.
23	0.	0.	0.	0.	912.	948.	270.	379.	412.	0.	91.	136.
24	0.	0.	0.	0.	1636.	1001.	426.	221.	385.	86.	0.	0.
25	0.	0.	0.	0.	959.	834.	411.	801.	282.	0.	0.	65.
26	0.	116.	0.	0.	898.	562.	307.	608.	162.	0.	0.	70.
27	0.	0.	0.	0.	600.	236.	271.	362.	132.	0.	109.	120.
28	0.	0.	0.	0.	227.	466.	130.	249.	162.	89.	0.	0.
29	0.	0.	0.	0.	406.	420.	139.	268.	119.	0.	0.	129.
30	0.	0.	0.	0.	629.	392.	117.	307.	274.	0.	0.	0.
31	0.	0.	0.	0.	1212.	0.	113.	102.	0.	0.	0.	138.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1977

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	105.	0.	78.	0.	0.	0.	0.	300.	110.	0.	520.
2	247.	81.	96.	0.	0.	0.	64.	108.	332.	138.	0.	424.
3	0.	93.	0.	0.	0.	113.	0.	0.	670.	105.	0.	339.
4	120.	94.	52.	0.	0.	108.	0.	0.	1916.	103.	62.	292.
5	0.	72.	0.	0.	0.	124.	0.	0.	1561.	75.	0.	201.
6	177.	77.	0.	0.	0.	130.	0.	0.	1039.	0.	181.	851.
7	0.	72.	73.	0.	0.	108.	0.	0.	728.	86.	0.	1403.
8	91.	0.	0.	0.	0.	93.	0.	0.	507.	0.	44.	720.
9	0.	93.	0.	0.	0.	93.	0.	0.	257.	102.	0.	507.
10	0.	57.	0.	0.	0.	107.	0.	0.	269.	0.	45.	547.
11	142.	0.	70.	0.	0.	95.	0.	0.	272.	0.	0.	669.
12	0.	89.	0.	0.	0.	0.	0.	0.	138.	81.	45.	346.
13	0.	0.	0.	0.	0.	0.	0.	113.	242.	0.	57.	201.
14	130.	0.	0.	0.	0.	75.	0.	0.	126.	0.	0.	293.
15	0.	43.	95.	0.	0.	0.	0.	150.	123.	0.	0.	206.
16	141.	75.	0.	0.	0.	0.	0.	0.	210.	0.	0.	469.
17	176.	0.	0.	0.	0.	0.	0.	64.	130.	116.	0.	1447.
18	190.	0.	0.	0.	0.	64.	113.	0.	128.	0.	151.	1181.
19	0.	46.	0.	0.	0.	0.	0.	0.	207.	60.	0.	953.
20	172.	105.	0.	0.	0.	0.	73.	0.	687.	0.	0.	753.
21	0.	0.	66.	0.	0.	109.	0.	0.	452.	0.	0.	475.
22	151.	0.	0.	0.	0.	233.	0.	0.	483.	0.	0.	935.
23	0.	40.	0.	0.	0.	0.	0.	0.	424.	132.	102.	164.
24	222.	128.	0.	0.	0.	88.	69.	0.	153.	0.	349.	333.
25	0.	0.	0.	0.	0.	0.	0.	0.	303.	0.	79.	195.
26	251.	66.	0.	0.	0.	67.	0.	0.	574.	71.	146.	369.
27	0.	0.	0.	0.	0.	0.	0.	0.	348.	0.	92.	241.
28	0.	124.	0.	0.	0.	0.	0.	0.	325.	0.	0.	172.
29	120.	0.	0.	0.	0.	0.	0.	0.	166.	0.	421.	207.
30	0.	0.	0.	0.	0.	0.	0.	317.	173.	116.	1146.	200.
31	81.	0.	0.	0.	0.	0.	0.	226.	0.	0.	0.	264.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1978

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	186.	0.	70.	41.	0.	0.	182.	1008.	292.	583.	0.	0.
2	274.	271.	109.	129.	0.	0.	101.	537.	418.	718.	67.	73.
3	0.	0.	157.	132.	0.	0.	164.	741.	141.	1038.	54.	0.
4	166.	280.	356.	54.	77.	0.	169.	636.	480.	948.	69.	0.
5	111.	0.	200.	0.	0.	0.	141.	476.	251.	449.	41.	173.
6	0.	156.	122.	0.	0.	171.	48.	178.	420.	783.	51.	0.
7	168.	68.	191.	162.	220.	80.	171.	390.	128.	314.	59.	0.
8	189.	112.	102.	0.	0.	41.	0.	90.	182.	420.	172.	0.
9	0.	147.	1054.	0.	0.	97.	0.	459.	102.	173.	152.	144.
10	152.	170.	2721.	0.	0.	201.	268.	80.	164.	344.	107.	0.
11	202.	237.	1735.	0.	71.	0.	0.	226.	379.	42.	132.	0.
12	0.	0.	894.	0.	0.	130.	368.	0.	842.	378.	108.	91.
13	176.	190.	597.	158.	0.	0.	0.	391.	508.	59.	162.	0.
14	381.	0.	364.	0.	0.	120.	348.	0.	562.	312.	85.	0.
15	162.	236.	372.	0.	0.	0.	0.	369.	310.	62.	68.	0.
16	201.	0.	315.	0.	0.	0.	335.	306.	408.	231.	84.	99.
17	0.	230.	263.	0.	0.	68.	0.	471.	284.	66.	173.	0.
18	154.	206.	181.	0.	0.	0.	237.	138.	312.	196.	0.	0.
19	231.	221.	266.	76.	0.	71.	148.	432.	221.	73.	0.	0.
20	450.	452.	182.	52.	40.	0.	866.	303.	170.	207.	201.	52.
21	459.	215.	95.	84.	0.	0.	315.	336.	54.	0.	0.	0.
22	345.	489.	131.	51.	0.	0.	452.	118.	274.	147.	198.	0.
23	161.	164.	252.	70.	0.	226.	211.	317.	256.	0.	0.	0.
24	263.	222.	0.	42.	0.	94.	241.	385.	477.	178.	138.	0.
25	161.	209.	181.	66.	117.	310.	131.	401.	1129.	0.	0.	45.
26	0.	0.	0.	0.	0.	0.	331.	135.	1037.	115.	68.	0.
27	363.	300.	111.	0.	0.	158.	207.	191.	436.	0.	78.	70.
28	160.	106.	164.	63.	0.	86.	639.	89.	401.	0.	46.	705.
29	332.	0.	120.	0.	0.	275.	1311.	156.	242.	0.	0.	942.
30	0.	0.	151.	0.	0.	94.	535.	182.	278.	0.	125.	745.
31	297.	0.	100.	0.	0.	0.	294.	482.	0.	93.	0.	526.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1979

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	491.	329.	0.	0.	81.	91.	172.	54.	70.	1351.	0.	148.
2	538.	358.	168.	0.	41.	238.	0.	0.	315.	1020.	70.	0.
3	708.	140.	47.	0.	0.	53.	0.	0.	675.	324.	0.	75.
4	623.	214.	0.	47.	0.	307.	0.	157.	2705.	231.	75.	0.
5	445.	138.	143.	0.	0.	52.	0.	40.	3616.	100.	0.	0.
6	343.	315.	143.	0.	136.	141.	0.	0.	3327.	560.	64.	104.
7	327.	132.	353.	0.	0.	0.	0.	96.	2835.	239.	0.	96.
8	298.	184.	386.	0.	144.	157.	130.	45.	1936.	419.	55.	286.
9	383.	121.	393.	0.	574.	0.	298.	0.	1288.	82.	0.	81.
10	381.	217.	97.	0.	625.	0.	144.	134.	2633.	235.	76.	107.
11	214.	0.	0.	0.	672.	0.	140.	576.	2329.	0.	52.	79.
12	714.	227.	175.	0.	470.	93.	46.	542.	3216.	355.	0.	66.
13	1506.	144.	128.	0.	315.	0.	83.	182.	3509.	0.	85.	67.
14	1817.	75.	0.	0.	880.	0.	367.	238.	4471.	85.	46.	0.
15	1351.	0.	112.	0.	1329.	0.	329.	120.	4877.	126.	0.	103.
16	680.	256.	0.	0.	597.	0.	421.	104.	3676.	0.	79.	0.
17	521.	154.	0.	0.	427.	0.	109.	241.	1885.	258.	80.	90.
18	407.	67.	206.	0.	380.	96.	181.	399.	1397.	0.	0.	0.
19	361.	0.	0.	43.	152.	0.	44.	304.	833.	70.	78.	0.
20	234.	232.	0.	0.	74.	0.	136.	94.	696.	62.	97.	128.
21	471.	0.	63.	132.	131.	0.	0.	0.	448.	52.	0.	0.
22	329.	197.	0.	0.	66.	0.	166.	118.	1400.	65.	0.	0.
23	481.	0.	0.	0.	109.	40.	407.	0.	458.	0.	71.	82.
24	645.	88.	173.	55.	247.	0.	71.	0.	1028.	40.	0.	0.
25	815.	43.	0.	0.	426.	0.	182.	0.	506.	88.	81.	0.
26	508.	164.	0.	80.	227.	0.	0.	0.	676.	0.	0.	150.
27	621.	52.	40.	0.	234.	100.	0.	0.	579.	69.	62.	0.
28	756.	156.	0.	0.	156.	0.	99.	0.	1291.	0.	0.	0.
29	563.	0.	161.	0.	167.	51.	0.	0.	841.	80.	81.	0.
30	495.	0.	0.	0.	46.	0.	0.	0.	1739.	0.	0.	67.
31	296.	0.	0.	0.	263.	0.	0.	291.	0.	63.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1980

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	132.	117.	344.	48.	0.	84.	66.	109.	134.	0.	0.
2	0.	82.	266.	444.	110.	0.	0.	39.	337.	89.	0.	105.
3	144.	132.	352.	397.	0.	0.	73.	0.	539.	81.	0.	0.
4	0.	196.	335.	205.	230.	0.	0.	0.	904.	136.	0.	84.
5	0.	109.	112.	159.	0.	0.	0.	48.	527.	71.	0.	153.
6	0.	47.	154.	81.	44.	0.	0.	0.	563.	119.	67.	323.
7	0.	84.	105.	296.	59.	0.	0.	0.	269.	56.	0.	237.
8	104.	50.	130.	111.	0.	0.	74.	0.	345.	48.	97.	335.
9	0.	0.	85.	187.	195.	0.	93.	44.	223.	67.	0.	236.
10	0.	138.	0.	144.	0.	0.	66.	0.	257.	45.	45.	330.
11	0.	55.	137.	168.	0.	0.	0.	0.	126.	57.	0.	206.
12	0.	65.	0.	0.	88.	0.	0.	0.	158.	41.	0.	45.
13	89.	71.	94.	66.	0.	0.	0.	101.	50.	0.	53.	0.
14	0.	73.	0.	146.	88.	0.	0.	0.	278.	129.	0.	0.
15	106.	69.	0.	76.	0.	0.	0.	0.	316.	0.	56.	50.
16	90.	179.	155.	0.	149.	0.	131.	73.	376.	0.	330.	115.
17	0.	0.	0.	88.	0.	0.	0.	0.	94.	0.	171.	0.
18	40.	135.	409.	0.	0.	0.	99.	0.	321.	49.	295.	49.
19	84.	690.	407.	97.	103.	0.	0.	0.	0.	0.	88.	0.
20	0.	703.	177.	110.	0.	0.	0.	0.	298.	0.	192.	74.
21	111.	266.	113.	76.	48.	0.	49.	44.	0.	97.	86.	88.
22	0.	182.	62.	117.	0.	0.	0.	0.	82.	0.	78.	56.
23	0.	157.	125.	0.	63.	0.	138.	0.	55.	99.	86.	0.
24	75.	99.	50.	64.	0.	0.	0.	0.	90.	0.	68.	201.
25	0.	123.	0.	0.	0.	0.	297.	45.	0.	0.	64.	0.
26	0.	86.	146.	92.	91.	0.	529.	0.	172.	80.	55.	0.
27	254.	174.	0.	0.	56.	0.	423.	56.	157.	0.	56.	90.
28	231.	140.	0.	63.	0.	0.	237.	0.	210.	0.	48.	0.
29	300.	111.	144.	126.	118.	66.	166.	129.	180.	0.	106.	0.
30	115.	0.	0.	0.	0.	0.	46.	108.	94.	0.	48.	0.
31	294.	0.	105.	0.	0.	0.	119.	106.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1981

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	129.	0.	0.	0.	0.	0.	0.	0.	1443.	87.	99.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	787.	84.	0.	0.
3	0.	128.	61.	0.	0.	0.	0.	0.	836.	87.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	433.	0.	0.	0.
5	0.	87.	0.	0.	0.	0.	0.	0.	596.	60.	59.	0.
6	0.	0.	0.	0.	0.	0.	0.	226.	416.	0.	0.	0.
7	69.	0.	0.	0.	0.	0.	0.	0.	757.	114.	0.	0.
8	0.	74.	0.	0.	0.	0.	0.	82.	563.	0.	0.	0.
9	0.	69.	0.	0.	0.	0.	0.	0.	537.	39.	74.	0.
10	0.	136.	0.	0.	0.	0.	0.	129.	821.	44.	0.	87.
11	0.	0.	0.	0.	0.	0.	0.	105.	2448.	0.	0.	0.
12	0.	104.	0.	0.	0.	0.	0.	530.	1291.	77.	0.	0.
13	0.	87.	0.	0.	0.	0.	0.	63.	1475.	0.	0.	0.
14	45.	0.	0.	0.	0.	0.	0.	389.	815.	0.	0.	0.
15	0.	59.	0.	0.	0.	0.	0.	81.	732.	89.	0.	0.
16	0.	0.	40.	0.	0.	0.	0.	222.	355.	0.	0.	0.
17	0.	77.	0.	0.	0.	0.	0.	54.	782.	47.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	772.	1345.	0.	0.	0.
19	0.	59.	0.	0.	0.	0.	0.	1335.	1457.	89.	0.	0.
20	94.	0.	0.	0.	0.	0.	0.	1429.	742.	0.	0.	0.
21	0.	108.	0.	0.	0.	0.	0.	1312.	710.	0.	0.	0.
22	0.	0.	0.	0.	0.	0.	0.	1516.	456.	0.	0.	0.
23	0.	0.	0.	0.	0.	0.	0.	158.	806.	41.	0.	0.
24	0.	0.	0.	0.	0.	0.	0.	549.	342.	0.	0.	0.
25	110.	42.	0.	0.	0.	0.	0.	74.	307.	0.	44.	0.
26	0.	0.	0.	0.	0.	0.	0.	856.	68.	0.	0.	0.
27	0.	0.	42.	0.	0.	0.	0.	1034.	348.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.	0.	1919.	0.	50.	0.	50.
29	0.	0.	0.	0.	0.	0.	0.	1684.	111.	0.	0.	0.
30	57.	0.	0.	0.	0.	0.	0.	1579.	75.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	1125.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1982

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	0.	0.	248.	0.	400.	200.	159.	50.	1000.	98.	116.
2	0.	0.	0.	366.	0.	420.	350.	0.	207.	970.	0.	44.
3	0.	0.	0.	379.	0.	437.	104.	145.	0.	644.	190.	109.
4	0.	65.	78.	149.	88.	306.	264.	42.	144.	569.	569.	0.
5	75.	0.	0.	108.	243.	181.	207.	177.	44.	394.	894.	200.
6	0.	0.	71.	199.	0.	246.	1175.	332.	239.	1303.	397.	0.
7	0.	0.	503.	124.	96.	167.	1081.	656.	57.	1621.	357.	126.
8	0.	0.	229.	147.	60.	70.	1242.	381.	231.	1045.	99.	0.
9	0.	120.	162.	93.	0.	82.	815.	606.	203.	446.	300.	204.
10	0.	0.	0.	56.	44.	82.	651.	348.	584.	406.	0.	0.
11	0.	0.	154.	120.	0.	82.	575.	725.	66.	192.	188.	114.
12	0.	72.	0.	219.	51.	87.	621.	891.	218.	316.	0.	0.
13	0.	0.	0.	105.	0.	0.	603.	1003.	145.	85.	194.	197.
14	96.	0.	0.	279.	0.	150.	687.	675.	234.	210.	0.	140.
15	43.	0.	0.	117.	0.	0.	391.	1028.	73.	53.	0.	0.
16	0.	0.	0.	333.	0.	88.	378.	990.	143.	149.	145.	274.
17	0.	55.	108.	433.	0.	137.	214.	897.	0.	0.	119.	0.
18	0.	52.	0.	284.	84.	534.	232.	602.	166.	170.	116.	178.
19	0.	0.	0.	303.	0.	496.	169.	806.	0.	0.	54.	0.
20	129.	109.	0.	136.	0.	607.	173.	579.	141.	130.	150.	177.
21	0.	0.	0.	65.	0.	1465.	114.	601.	48.	0.	53.	40.
22	0.	0.	39.	124.	0.	1249.	216.	255.	448.	148.	124.	0.
23	0.	0.	0.	0.	114.	1532.	74.	431.	374.	52.	60.	237.
24	0.	0.	0.	92.	0.	2020.	200.	148.	835.	0.	40.	0.
25	0.	0.	108.	0.	70.	3175.	99.	311.	468.	96.	129.	0.
26	0.	0.	0.	241.	124.	3068.	193.	95.	1010.	54.	48.	0.
27	0.	0.	0.	736.	687.	1506.	92.	241.	1122.	0.	100.	89.
28	0.	0.	68.	475.	456.	511.	206.	0.	814.	89.	50.	0.
29	0.	0.	1008.	382.	305.	139.	52.	118.	789.	0.	108.	0.
30	0.	0.	643.	243.	248.	248.	201.	75.	753.	67.	55.	109.
31	0.	0.	851.	0.	392.	0.	66.	99.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1983

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	118.	265.	119.	0.	0.	0.	144.	0.	0.	226.	0.
2	95.	730.	543.	0.	0.	0.	80.	77.	77.	0.	169.	56.
3	0.	1455.	242.	235.	0.	0.	0.	216.	0.	0.	126.	0.
4	0.	1029.	256.	0.	0.	0.	0.	77.	46.	0.	124.	52.
5	0.	879.	42.	76.	0.	163.	0.	151.	0.	0.	70.	0.
6	112.	1260.	0.	0.	58.	134.	0.	0.	0.	60.	81.	0.
7	0.	1450.	0.	0.	0.	116.	0.	0.	0.	0.	62.	55.
8	95.	611.	276.	84.	0.	0.	66.	94.	101.	0.	181.	0.
9	0.	764.	102.	0.	0.	239.	0.	110.	0.	96.	0.	0.
10	43.	546.	130.	70.	0.	0.	0.	194.	0.	0.	139.	0.
11	0.	281.	216.	86.	0.	0.	0.	0.	71.	69.	0.	0.
12	164.	186.	465.	53.	0.	0.	0.	0.	0.	0.	111.	59.
13	0.	1009.	211.	0.	0.	0.	0.	0.	0.	51.	50.	118.
14	80.	731.	132.	145.	0.	0.	0.	102.	152.	78.	113.	53.
15	0.	390.	41.	0.	0.	72.	53.	76.	0.	285.	0.	0.
16	0.	629.	190.	0.	0.	0.	0.	167.	157.	369.	0.	94.
17	77.	1346.	158.	46.	0.	45.	0.	78.	139.	438.	96.	87.
18	0.	702.	126.	91.	0.	0.	0.	236.	109.	427.	0.	166.
19	0.	199.	0.	0.	0.	0.	0.	145.	123.	683.	61.	260.
20	291.	0.	0.	0.	0.	0.	0.	0.	211.	349.	0.	193.
21	331.	99.	0.	90.	0.	0.	45.	284.	194.	186.	48.	146.
22	400.	0.	261.	0.	0.	63.	0.	68.	366.	52.	0.	192.
23	237.	0.	0.	0.	0.	0.	0.	158.	181.	569.	107.	52.
24	536.	108.	568.	0.	0.	158.	0.	41.	166.	504.	0.	102.
25	328.	190.	388.	53.	0.	0.	0.	202.	0.	1111.	43.	64.
26	413.	59.	559.	0.	0.	50.	0.	76.	142.	995.	0.	0.
27	81.	262.	0.	0.	0.	0.	0.	181.	164.	815.	0.	102.
28	339.	1121.	0.	0.	0.	0.	0.	0.	208.	461.	63.	0.
29	87.	0.	384.	0.	0.	0.	60.	159.	105.	238.	0.	89.
30	305.	0.	0.	46.	0.	93.	173.	54.	134.	270.	0.	124.
31	0.	0.	160.	0.	0.	0.	133.	116.	0.	169.	0.	640.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1984

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	749.	0.	553.	57.	0.	244.	0.	128.	117.	282.	0.	91.
2	448.	0.	388.	119.	0.	281.	0.	0.	0.	259.	0.	128.
3	219.	68.	248.	0.	0.	0.	152.	0.	173.	152.	63.	101.
4	108.	0.	201.	102.	0.	176.	122.	0.	0.	171.	0.	51.
5	158.	129.	124.	80.	0.	0.	132.	95.	51.	0.	59.	86.
6	133.	0.	193.	59.	0.	0.	0.	266.	84.	127.	0.	66.
7	0.	0.	0.	78.	0.	0.	178.	82.	77.	0.	0.	85.
8	82.	52.	268.	50.	0.	0.	0.	186.	82.	101.	58.	58.
9	54.	0.	0.	0.	0.	65.	48.	77.	0.	0.	0.	0.
10	0.	0.	0.	70.	0.	0.	0.	65.	53.	90.	0.	69.
11	0.	114.	110.	67.	65.	0.	0.	55.	71.	0.	61.	0.
12	76.	0.	0.	0.	0.	49.	115.	69.	0.	50.	0.	50.
13	0.	0.	511.	53.	0.	0.	0.	40.	96.	0.	0.	64.
14	45.	0.	145.	129.	0.	0.	285.	0.	0.	0.	0.	0.
15	0.	107.	288.	61.	0.	57.	671.	86.	0.	82.	0.	48.
16	0.	0.	81.	62.	0.	0.	487.	0.	60.	0.	0.	0.
17	100.	0.	157.	72.	0.	0.	417.	56.	0.	0.	72.	72.
18	0.	0.	0.	61.	0.	97.	354.	0.	135.	0.	0.	0.
19	108.	113.	118.	70.	0.	0.	160.	252.	0.	0.	0.	0.
20	0.	112.	0.	0.	0.	97.	251.	0.	245.	48.	0.	51.
21	53.	210.	104.	46.	0.	0.	181.	130.	66.	0.	0.	0.
22	117.	180.	0.	0.	0.	105.	224.	128.	461.	64.	108.	0.
23	0.	1006.	461.	0.	0.	81.	124.	218.	182.	0.	0.	78.
24	81.	465.	492.	75.	0.	87.	248.	111.	341.	44.	194.	0.
25	0.	433.	232.	0.	0.	0.	126.	190.	0.	0.	410.	0.
26	42.	209.	0.	0.	103.	127.	211.	0.	182.	0.	251.	84.
27	0.	281.	182.	0.	408.	0.	0.	171.	196.	90.	184.	0.
28	130.	1520.	0.	0.	64.	43.	116.	0.	496.	0.	140.	0.
29	0.	1464.	240.	0.	986.	0.	0.	68.	443.	0.	162.	0.
30	0.	0.	0.	0.	704.	82.	0.	0.	434.	45.	66.	0.
31	69.	0.	94.	0.	556.	0.	278.	0.	0.	40.	0.	41.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1985

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	0.	0.	0.	0.	0.	100.	58.	304.	250.	76.	189.
2	42.	0.	0.	0.	0.	0.	0.	80.	413.	405.	0.	199.
3	0.	76.	0.	0.	0.	0.	334.	199.	464.	407.	0.	0.
4	0.	0.	0.	0.	0.	0.	164.	149.	385.	602.	162.	0.
5	43.	0.	0.	0.	0.	0.	108.	241.	381.	454.	0.	88.
6	0.	0.	0.	0.	0.	0.	133.	126.	1012.	433.	0.	68.
7	0.	0.	0.	0.	0.	0.	57.	327.	1012.	266.	87.	114.
8	73.	75.	63.	0.	0.	0.	0.	98.	762.	320.	0.	0.
9	0.	0.	0.	0.	0.	0.	252.	303.	413.	180.	66.	114.
10	0.	0.	0.	0.	0.	0.	0.	437.	420.	258.	0.	0.
11	203.	0.	0.	0.	0.	0.	117.	337.	136.	52.	86.	129.
12	0.	0.	0.	0.	0.	0.	0.	187.	207.	143.	0.	0.
13	170.	0.	0.	0.	0.	0.	161.	173.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	422.	129.	203.	92.	0.
15	199.	0.	0.	0.	0.	0.	0.	501.	133.	0.	0.	62.
16	0.	0.	51.	0.	0.	0.	110.	331.	229.	151.	0.	0.
17	164.	0.	0.	0.	0.	0.	0.	426.	114.	0.	0.	0.
18	0.	0.	90.	136.	0.	0.	236.	87.	612.	143.	57.	0.
19	200.	0.	0.	0.	0.	0.	0.	439.	1917.	0.	0.	133.
20	0.	78.	0.	73.	0.	0.	85.	173.	1953.	83.	61.	0.
21	155.	0.	0.	45.	0.	0.	54.	314.	1781.	0.	0.	0.
22	0.	0.	222.	47.	0.	0.	91.	228.	1492.	123.	0.	0.
23	197.	0.	0.	0.	0.	0.	0.	297.	961.	0.	67.	45.
24	0.	0.	0.	0.	0.	73.	86.	75.	796.	0.	0.	0.
25	157.	0.	56.	0.	0.	0.	0.	173.	506.	0.	0.	0.
26	0.	58.	0.	63.	0.	92.	212.	52.	478.	72.	0.	0.
27	0.	0.	0.	0.	0.	0.	133.	163.	280.	0.	75.	81.
28	0.	50.	0.	0.	0.	96.	129.	96.	366.	0.	0.	0.
29	0.	0.	0.	0.	0.	118.	111.	80.	253.	78.	125.	0.
30	0.	0.	0.	41.	0.	143.	87.	168.	372.	0.	149.	0.
31	0.	0.	0.	0.	0.	0.	57.	247.	0.	0.	0.	70.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1986

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	0.	49.	0.	0.	0.	252.	218.	258.	130.	356.	0.
2	0.	0.	0.	0.	0.	0.	681.	391.	268.	45.	297.	77.
3	0.	0.	0.	0.	0.	0.	287.	363.	268.	116.	243.	0.
4	0.	0.	0.	0.	0.	0.	892.	301.	261.	74.	123.	155.
5	69.	73.	56.	0.	0.	0.	749.	275.	309.	89.	222.	0.
6	0.	0.	0.	0.	0.	0.	1025.	245.	575.	84.	129.	68.
7	0.	0.	0.	0.	0.	0.	532.	173.	532.	35.	380.	44.
8	0.	0.	0.	0.	0.	0.	850.	250.	438.	64.	272.	68.
9	60.	0.	0.	0.	0.	0.	446.	174.	515.	122.	241.	37.
10	0.	0.	42.	0.	0.	0.	637.	255.	1179.	0.	56.	0.
11	93.	0.	98.	0.	0.	0.	325.	296.	1217.	60.	200.	102.
12	0.	0.	0.	0.	0.	0.	596.	265.	874.	37.	44.	0.
13	113.	85.	0.	0.	0.	272.	269.	232.	629.	49.	161.	48.
14	0.	0.	190.	0.	0.	622.	580.	343.	413.	37.	229.	58.
15	0.	0.	0.	0.	0.	171.	128.	361.	329.	78.	282.	32.
16	0.	0.	79.	0.	0.	483.	347.	1206.	259.	104.	102.	0.
17	75.	0.	0.	0.	0.	117.	0.	861.	233.	64.	226.	80.
18	0.	116.	76.	0.	0.	462.	102.	859.	131.	112.	51.	34.
19	0.	0.	0.	0.	0.	126.	60.	1045.	109.	0.	140.	54.
20	0.	69.	0.	0.	0.	593.	90.	926.	174.	106.	53.	0.
21	0.	0.	41.	0.	0.	532.	0.	821.	253.	0.	128.	61.
22	39.	0.	0.	0.	0.	1048.	176.	816.	142.	120.	0.	0.
23	0.	0.	0.	0.	0.	650.	117.	610.	234.	0.	120.	139.
24	72.	0.	49.	0.	0.	971.	140.	468.	122.	0.	0.	0.
25	0.	48.	0.	0.	0.	572.	177.	336.	255.	119.	111.	94.
26	0.	0.	0.	0.	0.	788.	189.	300.	171.	0.	0.	0.
27	48.	0.	0.	0.	0.	490.	196.	252.	258.	0.	103.	128.
28	0.	0.	0.	0.	0.	758.	275.	302.	137.	117.	0.	89.
29	0.	0.	0.	0.	0.	145.	602.	270.	174.	48.	0.	109.
30	0.	0.	0.	0.	0.	639.	535.	277.	44.	225.	128.	88.
31	0.	0.	0.	0.	0.	0.	523.	200.	0.	129.	0.	212.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1987

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	986.	0.	63.	418.	0.	0.	0.	0.	0.	0.	212.	186.
2	783.	122.	0.	299.	0.	0.	0.	38.	0.	0.	359.	62.
3	427.	0.	58.	168.	0.	0.	132.	0.	0.	0.	402.	113.
4	463.	0.	0.	168.	0.	31.	0.	0.	0.	0.	885.	118.
5	695.	128.	0.	117.	0.	0.	0.	0.	0.	0.	1131.	94.
6	550.	0.	0.	111.	0.	0.	0.	0.	0.	0.	883.	0.
7	353.	62.	315.	86.	32.	0.	0.	0.	0.	0.	725.	42.
8	279.	30.	441.	88.	60.	62.	111.	0.	0.	0.	527.	96.
9	246.	54.	273.	0.	0.	0.	0.	0.	0.	0.	343.	47.
10	202.	32.	162.	88.	30.	99.	0.	44.	0.	0.	284.	103.
11	179.	58.	173.	0.	0.	0.	0.	0.	0.	0.	297.	0.
12	101.	0.	62.	102.	70.	37.	76.	0.	0.	140.	146.	30.
13	91.	52.	80.	47.	56.	0.	0.	0.	0.	839.	172.	72.
14	108.	0.	70.	57.	33.	87.	0.	0.	0.	53.	147.	0.
15	86.	93.	0.	0.	70.	0.	88.	0.	0.	616.	111.	99.
16	99.	0.	70.	98.	45.	67.	0.	0.	0.	0.	119.	0.
17	84.	93.	0.	0.	49.	0.	168.	0.	0.	386.	106.	43.
18	116.	0.	83.	0.	36.	94.	0.	0.	0.	0.	716.	82.
19	0.	80.	0.	0.	0.	0.	134.	0.	0.	184.	1133.	0.
20	114.	0.	0.	39.	113.	0.	87.	0.	0.	0.	1686.	42.
21	0.	92.	70.	0.	0.	72.	193.	0.	0.	91.	1412.	0.
22	115.	0.	0.	0.	0.	0.	122.	0.	0.	55.	739.	76.
23	68.	64.	0.	0.	0.	37.	217.	0.	0.	0.	554.	0.
24	133.	0.	0.	0.	46.	0.	0.	0.	0.	77.	445.	0.
25	70.	0.	62.	41.	0.	0.	45.	0.	0.	0.	442.	46.
26	128.	101.	83.	0.	0.	0.	0.	0.	0.	47.	345.	0.
27	0.	0.	271.	0.	0.	0.	0.	0.	0.	0.	251.	0.
28	103.	0.	295.	0.	0.	0.	0.	0.	0.	0.	215.	82.
29	105.	0.	312.	33.	0.	39.	0.	0.	0.	56.	195.	0.
30	0.	0.	460.	0.	0.	102.	38.	0.	0.	0.	148.	0.
31	104.	0.	556.	0.	31.	0.	0.	0.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1988

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	33.	0.	66.	60.	0.	0.	58.	246.	170.	0.	0.	38.
2	0.	0.	0.	0.	93.	0.	0.	636.	273.	0.	0.	0.
3	0.	43.	0.	0.	0.	0.	53.	621.	156.	68.	0.	0.
4	90.	0.	35.	50.	0.	0.	0.	437.	178.	0.	0.	0.
5	0.	78.	0.	0.	0.	0.	0.	294.	72.	85.	151.	0.
6	0.	0.	101.	0.	35.	0.	0.	442.	95.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	414.	56.	0.	90.	0.
8	0.	272.	63.	0.	0.	0.	0.	197.	173.	53.	0.	0.
9	61.	96.	72.	60.	0.	0.	0.	226.	160.	0.	43.	0.
10	32.	571.	58.	0.	0.	0.	0.	433.	181.	0.	0.	0.
11	122.	58.	79.	0.	0.	0.	0.	1013.	64.	0.	0.	0.
12	0.	249.	72.	0.	0.	0.	0.	906.	93.	44.	67.	0.
13	162.	0.	0.	0.	0.	0.	75.	799.	56.	0.	0.	60.
14	0.	127.	48.	0.	32.	0.	0.	935.	93.	0.	0.	0.
15	0.	0.	0.	0.	38.	0.	47.	569.	0.	0.	0.	0.
16	56.	172.	79.	0.	198.	0.	0.	479.	41.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	407.	96.	0.	0.	0.
18	67.	90.	79.	0.	88.	0.	98.	288.	0.	0.	0.	0.
19	0.	76.	322.	0.	0.	0.	77.	399.	32.	49.	0.	0.
20	43.	97.	431.	0.	0.	0.	411.	279.	32.	0.	0.	0.
21	33.	0.	299.	0.	65.	0.	165.	481.	0.	0.	0.	0.
22	43.	40.	223.	0.	0.	0.	186.	534.	42.	0.	52.	0.
23	0.	110.	173.	0.	0.	0.	158.	465.	0.	0.	0.	0.
24	176.	0.	61.	0.	0.	0.	93.	779.	0.	0.	0.	0.
25	0.	147.	93.	0.	0.	0.	74.	527.	0.	0.	0.	0.
26	103.	0.	59.	0.	0.	0.	91.	592.	70.	0.	0.	0.
27	37.	0.	85.	0.	0.	0.	65.	362.	0.	0.	0.	0.
28	112.	60.	62.	0.	0.	0.	92.	242.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	119.	169.	0.	0.	0.	0.
30	0.	0.	85.	0.	0.	36.	272.	145.	30.	0.	0.	0.
31	133.	0.	0.	0.	0.	0.	238.	173.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1989

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	0.	0.	0.	0.	0.	0.	32.	63.	95.	82.	0.
2	0.	0.	0.	0.	0.	0.	0.	61.	333.	210.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	99.	285.	79.	55.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	286.	92.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	31.	369.	67.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	1094.	96.	75.	0.
7	0.	0.	0.	0.	0.	0.	204.	0.	497.	99.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	342.	1995.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	289.	1887.	0.	0.
10	0.	0.	73.	0.	0.	0.	0.	73.	187.	1885.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	163.	1938.	0.	0.
12	0.	0.	0.	39.	0.	0.	0.	64.	164.	1394.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	72.	70.	1046.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	170.	108.	673.	0.	0.
15	0.	0.	33.	0.	0.	0.	0.	82.	68.	651.	0.	0.
16	0.	0.	0.	31.	0.	0.	0.	84.	91.	630.	0.	0.
17	0.	0.	0.	47.	0.	0.	0.	86.	138.	323.	0.	0.
18	0.	0.	108.	0.	0.	0.	0.	71.	201.	446.	0.	0.
19	0.	0.	0.	80.	0.	0.	0.	122.	171.	318.	0.	0.
20	0.	0.	56.	0.	0.	0.	0.	370.	185.	405.	0.	0.
21	0.	0.	0.	135.	0.	0.	0.	324.	78.	293.	0.	0.
22	0.	0.	0.	0.	0.	0.	0.	302.	90.	189.	0.	0.
23	0.	0.	0.	0.	0.	0.	0.	305.	75.	262.	0.	0.
24	0.	0.	0.	42.	0.	0.	0.	212.	94.	94.	0.	0.
25	0.	0.	0.	0.	0.	0.	0.	290.	623.	150.	0.	96.
26	0.	0.	0.	0.	0.	0.	0.	170.	574.	86.	0.	191.
27	0.	0.	0.	0.	0.	0.	0.	305.	303.	153.	0.	65.
28	0.	0.	0.	0.	0.	0.	0.	182.	318.	87.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	184.	189.	0.	0.	78.
30	0.	0.	0.	0.	0.	0.	0.	76.	189.	68.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	162.	0.	63.	0.	82.

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1974

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1975

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	.0	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1976

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1977

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1978

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1979

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1980

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1981

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	.0	.0	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	.0	.0	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	.0	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	.0	.0	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	.0	.0	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	.0	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1982

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1983

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1984

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1985

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	.0	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1986

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	.0	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1987

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1988

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1989

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
14	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
15	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
16	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
17	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
18	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
19	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
20	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
21	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
22	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	.0	.0	7.7	7.7	.0	7.7	.0	7.3

APPENDIX E

**Simulated Canal Water Elevations and Spillway Flows
for Canal Water Levels Above 17 ft-msl**

YEARS OF DATA = 16, (1974-1989)

Qmakeup Water (gpm)= 3238. 3257. 3305. 3408. 3438. 3454. 3463. 3469. 3441. 3438. 3308. 3264.

Sum of Qsp (cfs)= 855786. (historic data)

Sum of Storage (cfs)= 52.

Sum of Qin (cfs)= 855848. (historic data)

Sum of New Qsp (cfs)= 813970. (after makeup and process water withdrawal)

Sum of Qmakeup and = 41829.

Process Water (cfs)

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1974

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	18.87	19.06	18.88	19.08	19.05	18.06	19.05	19.05	19.05	19.05	18.87	19.05
2	18.86	19.05	19.00	19.09	19.00	18.03	19.05	19.05	19.05	19.05	18.97	18.87
3	18.93	18.83	18.96	19.05	18.94	18.02	19.05	19.05	19.05	19.05	19.01	19.05
4	19.19	19.08	18.95	18.99	18.86	18.03	19.05	19.05	19.05	19.05	19.05	19.10
5	19.05	19.05	18.94	18.99	18.78	18.52	19.05	19.05	19.05	19.05	19.10	19.08
6	18.74	18.81	18.94	19.05	18.71	19.03	19.05	19.05	19.05	19.05	19.22	19.12
7	19.05	18.83	18.93	19.05	18.63	19.05	19.05	19.05	19.05	19.05	19.05	19.21
8	19.05	18.87	19.06	19.05	18.56	19.22	19.05	19.05	19.20	19.05	19.05	19.05
9	18.83	18.91	19.18	19.03	18.52	19.05	19.05	19.05	19.05	19.05	19.05	19.05
10	18.89	19.07	19.13	19.05	18.48	18.67	19.05	19.05	19.05	19.05	18.93	19.05
11	19.15	19.17	19.10	19.05	18.40	18.89	19.05	19.05	19.05	19.05	19.22	19.03
12	19.05	19.13	19.09	18.96	18.34	19.05	19.05	19.05	19.05	19.05	19.05	19.05
13	18.74	19.13	19.07	18.96	18.28	19.21	19.05	19.05	19.05	19.05	19.18	19.02
14	19.06	19.14	19.04	19.00	18.20	19.05	19.05	19.05	19.05	19.05	19.05	19.05
15	19.05	19.14	19.20	19.05	18.16	19.09	19.05	19.05	19.05	19.05	18.55	19.05
16	19.00	19.14	19.05	19.04	18.37	19.05	19.05	19.05	18.95	19.05	18.72	19.05
17	19.23	19.05	18.73	19.05	18.54	18.73	19.05	19.05	19.05	19.05	18.93	19.05
18	19.25	18.91	18.71	19.05	18.49	18.92	19.05	19.05	19.14	19.05	19.05	19.05
19	19.05	18.88	18.68	18.97	18.47	19.00	19.05	19.05	19.05	18.78	19.03	19.00
20	18.76	18.93	18.65	18.96	18.43	18.99	19.05	19.05	18.77	19.05	19.11	19.05
21	18.76	18.98	18.64	19.01	18.37	18.93	19.05	19.05	19.05	19.05	19.05	19.04
22	18.82	19.14	18.63	19.05	18.30	19.10	19.05	19.05	18.86	18.80	18.86	19.21
23	19.06	19.05	18.57	19.03	18.23	19.05	19.05	19.05	19.05	19.05	18.92	19.05
24	19.22	18.80	18.52	19.02	18.15	19.13	19.05	19.05	19.05	19.20	19.15	18.82
25	19.21	18.81	18.49	19.23	18.08	19.05	19.05	19.05	19.05	19.21	19.05	19.04
26	19.25	18.79	18.53	19.05	18.00	19.05	19.05	19.05	19.05	19.05	19.05	19.05
27	19.05	18.76	18.67	18.70	17.93	19.05	19.05	19.05	19.05	18.81	19.05	18.94
28	19.03	18.73	18.88	18.73	17.86	19.05	19.05	19.05	19.05	18.89	19.06	19.08
29	19.20	.00	19.16	18.74	17.79	19.05	19.05	19.05	19.05	19.11	19.05	19.05
30	19.22	.00	19.05	18.92	17.75	19.05	19.05	19.05	19.05	19.05	19.05	18.86
31	19.05	.00	18.92	.00	17.92	.00	19.05	19.05	.00	18.85	.00	18.86

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1975

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	18.95	19.05	19.05	16.99	18.27	17.35	19.05	17.36	18.85	19.05	19.05	19.23
2	19.05	18.67	18.81	16.98	18.17	17.44	19.05	17.43	19.05	19.05	19.05	19.05
3	19.07	18.68	19.22	16.97	18.05	17.51	19.05	17.39	19.05	19.05	19.05	18.76
4	19.07	18.68	19.05	17.07	17.93	17.53	19.05	17.30	19.05	19.05	19.05	18.73
5	19.13	18.67	18.55	17.13	17.80	17.50	19.05	17.19	19.05	19.05	19.22	18.74
6	19.05	19.00	18.61	17.10	17.68	17.45	19.05	17.11	19.05	19.05	19.05	18.75
7	18.90	19.05	18.63	17.12	17.59	17.39	18.76	17.14	19.05	19.05	19.05	18.76
8	18.89	18.80	18.64	17.14	17.50	17.34	19.05	17.15	19.05	19.05	19.15	19.05
9	18.94	18.82	18.62	17.13	17.37	17.29	19.05	18.95	19.05	19.05	19.05	19.05
10	19.05	19.05	18.58	17.10	17.25	17.24	19.24	19.05	19.05	19.05	18.97	19.01
11	19.09	19.24	18.50	17.13	17.19	17.21	19.05	18.08	19.05	19.05	19.05	19.05
12	19.07	19.05	18.38	17.70	17.11	17.16	19.20	19.05	19.05	19.05	19.11	19.05
13	19.12	18.86	18.25	18.19	17.09	17.11	19.05	19.05	19.05	19.15	19.05	19.05
14	19.05	18.85	18.12	18.38	17.10	17.05	19.05	19.05	19.05	19.05	19.02	19.05
15	18.91	18.89	18.03	18.57	17.09	16.99	19.05	19.05	19.05	18.97	19.04	19.05
16	18.89	18.92	17.96	18.59	17.18	16.96	18.62	19.05	19.05	19.05	19.05	19.01
17	18.91	19.15	17.88	19.14	17.31	16.99	19.05	19.05	19.05	19.14	19.01	19.05
18	18.93	19.05	17.81	19.05	17.38	17.09	19.05	19.05	19.05	19.05	19.04	19.18
19	18.94	18.73	17.74	19.07	17.79	17.22	19.05	19.05	19.05	19.05	19.05	19.05
20	19.05	18.73	17.68	19.05	17.99	17.41	19.05	19.05	19.05	19.05	18.99	18.83
21	19.12	18.75	17.60	18.48	17.75	17.99	19.20	19.05	19.05	19.05	18.99	19.05
22	19.09	19.05	17.52	18.87	17.64	18.44	19.05	19.05	19.05	19.05	19.05	19.16
23	19.14	19.05	17.45	19.16	17.54	18.86	18.79	19.05	19.05	19.05	19.04	19.05
24	19.22	19.05	17.38	19.16	17.44	19.05	18.54	19.05	19.05	19.05	19.02	19.05
25	19.05	19.05	17.31	19.05	17.33	19.05	18.13	19.05	19.05	18.92	19.05	19.05
26	19.05	19.05	17.23	18.83	17.22	19.05	17.94	19.05	19.05	19.05	19.06	19.05
27	19.23	19.05	17.13	18.71	17.13	19.11	17.92	19.05	19.05	19.24	19.05	19.05
28	19.23	19.05	17.05	18.59	17.09	19.05	17.76	19.05	19.05	19.05	19.00	18.88
29	19.24	.00	17.03	18.48	17.09	19.05	17.41	19.05	19.05	19.05	18.97	19.02
30	19.05	.00	17.02	18.37	17.15	19.05	17.22	19.05	19.05	19.05	19.08	19.05
31	19.14	.00	17.01	.00	17.25	.00	17.26	19.05	.00	19.05	.00	19.02

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1976

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.16	19.05	19.05	17.91	18.49	19.05	19.05	19.05	19.05	19.05	18.96	19.05
2	19.05	19.09	18.87	18.18	18.88	19.05	19.05	19.05	19.05	19.05	19.05	18.96
3	18.84	19.07	19.05	18.42	18.93	19.05	19.05	19.05	19.05	19.05	19.05	18.96
4	18.81	19.10	19.13	18.35	19.05	19.05	19.05	19.05	19.05	19.05	19.05	18.99
5	18.82	19.13	19.11	18.29	19.11	19.05	19.05	19.05	19.05	19.05	19.05	19.05
6	18.81	19.05	19.13	18.25	19.06	19.05	19.05	19.05	19.05	19.05	18.93	19.06
7	18.79	18.91	19.14	18.24	19.03	19.05	19.05	19.05	19.05	19.05	19.05	19.08
8	19.13	18.85	19.05	18.65	19.00	19.05	19.05	19.05	19.05	19.06	19.17	19.05
9	19.05	18.80	18.91	19.25	19.05	19.05	19.05	19.05	19.05	19.05	19.17	19.02
10	18.62	18.75	18.87	19.05	19.08	19.05	19.05	19.05	19.05	19.06	19.05	19.05
11	18.64	18.71	18.86	18.70	19.05	19.05	19.05	19.05	19.05	19.05	18.85	19.00
12	18.68	18.67	18.84	19.17	19.05	19.05	19.05	19.05	19.05	19.03	18.86	19.05
13	18.69	18.63	18.81	19.05	19.04	19.05	19.05	19.05	19.05	19.05	19.05	19.10
14	19.17	18.61	18.78	18.51	19.05	19.05	19.05	19.05	19.05	19.03	19.22	19.05
15	19.05	19.18	18.75	18.53	19.05	19.05	19.05	19.05	19.05	19.02	19.05	19.02
16	18.44	19.05	18.70	18.53	19.05	19.05	19.05	19.05	19.05	19.05	19.22	19.05
17	18.45	18.34	19.04	18.50	19.05	19.05	19.05	19.05	19.05	19.00	19.05	19.11
18	18.44	18.31	19.05	18.44	19.05	19.05	19.05	19.05	19.05	19.05	18.54	19.05
19	18.41	18.29	18.65	18.39	19.05	19.05	19.05	19.05	19.05	19.11	18.77	19.00
20	18.38	18.27	18.60	18.60	19.05	19.05	19.05	19.05	19.05	19.05	18.94	19.05
21	18.82	18.24	18.55	18.80	19.05	19.05	19.05	19.05	19.05	18.97	18.94	19.05
22	19.23	18.20	18.50	18.74	19.05	19.05	19.05	19.05	19.05	18.96	19.02	19.05
23	19.18	18.17	18.48	18.69	19.05	19.05	19.05	19.05	19.05	18.99	19.05	19.05
24	19.13	18.12	18.44	18.62	19.05	19.05	19.05	19.05	19.05	19.05	19.01	19.06
25	19.09	18.69	18.37	18.56	19.05	19.05	19.05	19.05	19.05	19.07	18.99	19.05
26	19.05	19.24	18.31	18.49	19.05	19.05	19.05	19.05	19.05	19.06	19.01	19.05
27	19.04	19.25	18.25	18.42	19.05	19.05	19.05	19.05	19.05	19.10	19.05	19.05
28	19.05	19.05	18.18	18.34	19.05	19.05	19.05	19.05	19.05	19.05	19.04	19.00
29	19.05	19.05	18.12	18.26	19.05	19.05	19.05	19.05	19.05	18.95	19.02	19.05
30	19.02	.00	18.05	18.18	19.05	19.05	19.05	19.05	19.05	18.91	19.08	19.12
31	18.99	.00	17.98	.00	19.05	.00	19.05	19.05	.00	18.94	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1977

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	18.99	19.24	18.88	19.05	17.24	18.80	19.04	18.78	19.05	19.01	19.07	19.05
2	19.05	19.05	19.05	18.62	17.16	19.20	19.23	19.23	19.05	19.05	19.08	19.05
3	19.08	18.80	19.18	18.57	17.12	19.05	19.05	19.05	19.05	19.06	19.08	19.05
4	19.05	19.05	19.05	18.53	17.13	19.02	18.66	18.40	19.05	19.05	19.05	19.05
5	19.04	19.19	18.94	18.49	17.11	19.05	18.65	18.36	19.05	18.89	19.07	19.05
6	19.05	19.05	18.94	18.44	17.13	19.19	18.63	18.31	19.05	19.24	19.05	19.05
7	19.05	18.90	19.05	18.39	17.17	19.05	18.61	18.26	19.05	19.05	18.98	19.05
8	19.05	18.92	19.08	18.32	17.12	18.72	18.59	18.21	19.05	18.86	19.05	19.05
9	19.02	19.05	19.07	18.25	17.12	19.05	18.70	18.17	19.05	19.05	19.08	19.05
10	19.05	19.12	19.10	18.18	17.15	19.05	18.77	18.12	19.05	19.24	19.16	19.05
11	19.05	19.18	19.05	18.11	17.13	19.05	18.71	18.31	19.05	19.05	19.05	19.05
12	19.02	19.05	18.95	18.03	17.14	18.84	18.66	18.48	19.05	19.05	18.81	19.05
13	19.14	18.82	18.94	17.95	17.46	18.86	18.60	19.19	19.05	19.16	19.05	19.05
14	19.05	18.83	19.00	17.89	17.73	19.05	18.56	19.05	19.05	19.14	19.05	19.05
15	18.83	18.91	19.05	17.85	17.65	19.14	18.57	18.85	19.15	19.14	18.81	19.05
16	19.05	19.05	19.04	17.79	17.59	19.11	18.61	19.05	19.05	19.15	18.82	19.05
17	19.05	19.14	19.01	17.71	17.51	19.13	19.05	19.04	18.98	19.05	18.83	19.05
18	19.05	19.15	19.02	17.62	17.42	19.05	19.05	19.05	19.05	19.01	19.05	19.05
19	19.05	19.20	19.04	17.54	17.33	18.92	19.14	18.60	19.05	19.16	19.23	19.05
20	19.05	19.05	19.04	17.47	17.24	18.91	19.05	18.60	19.05	19.05	19.20	19.05
21	19.05	18.85	19.05	17.39	17.16	19.05	18.49	18.57	19.05	18.92	19.22	19.05
22	19.05	18.83	19.03	17.31	17.11	19.05	18.56	18.51	19.05	18.98	19.24	19.05
23	19.05	18.88	18.98	17.24	17.10	18.92	18.92	18.30	19.05	19.05	19.05	19.05
24	19.05	19.05	18.95	17.17	17.09	19.05	19.23	17.98	19.05	19.08	19.05	19.05
25	19.05	19.19	18.91	17.12	17.08	19.20	19.23	17.68	19.05	19.09	19.05	19.05
26	19.05	19.05	18.90	17.09	17.08	19.05	19.05	17.47	19.05	19.05	19.05	19.05
27	19.05	19.06	18.88	17.30	17.18	18.85	19.09	17.49	19.05	18.91	19.05	19.05
28	19.05	19.05	18.84	17.46	17.32	18.94	19.05	17.79	19.05	18.90	18.81	19.05
29	19.05	.00	18.81	17.38	17.39	19.07	18.77	18.24	19.05	18.95	19.05	19.05
30	18.89	.00	18.78	17.31	17.43	19.07	18.77	19.05	19.05	19.05	19.05	19.05
31	19.05	.00	19.11	.00	18.16	.00	18.78	19.05	.00	19.10	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1978

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.05	18.74	19.05	19.05	18.92	18.93	19.05	19.05	19.05	19.05	18.87	18.94
2	19.05	19.05	19.05	19.05	18.96	18.89	19.05	19.05	19.05	19.05	19.05	19.05
3	19.05	19.05	19.05	19.05	19.05	18.84	19.05	19.05	19.15	19.05	19.05	19.13
4	19.05	19.05	19.05	19.05	19.05	18.80	19.05	19.05	19.05	19.05	19.05	19.23
5	19.05	19.05	19.05	18.90	19.05	19.04	19.05	19.05	19.05	19.05	19.05	19.05
6	18.77	19.05	19.05	18.93	19.05	19.05	19.05	19.05	19.05	19.05	19.05	18.69
7	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	18.88	19.05	19.05	18.71
8	19.05	19.05	19.05	19.11	19.05	19.05	18.67	19.12	19.05	19.05	19.05	19.25
9	18.74	19.05	19.05	19.08	18.97	19.05	19.18	19.05	19.08	19.05	19.05	19.05
10	19.05	19.05	19.05	19.09	18.99	19.05	19.05	18.93	19.05	19.05	19.05	18.39
11	19.05	19.05	19.05	19.10	19.05	18.86	19.21	19.05	19.05	19.05	19.05	18.99
12	18.70	19.03	19.05	19.08	19.02	19.05	19.05	18.95	19.05	19.05	19.05	19.05
13	19.05	19.05	19.05	19.05	18.98	19.17	18.98	19.05	19.05	19.05	19.05	18.61
14	19.05	19.07	19.05	18.99	18.99	19.05	19.05	19.11	19.05	19.05	19.05	18.74
15	19.05	19.05	19.05	18.95	18.97	18.96	19.05	19.05	19.05	19.05	19.05	19.20
16	19.05	19.01	19.05	18.94	18.93	19.13	19.05	19.05	19.05	19.05	19.05	19.05
17	18.69	19.05	19.05	18.92	18.89	19.05	19.08	19.05	19.05	19.05	19.05	18.52
18	19.05	19.05	19.05	19.19	19.13	19.16	19.05	19.05	19.05	19.05	18.86	18.55
19	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.14	18.73
20	19.05	19.05	19.05	19.05	18.80	18.60	19.05	19.05	19.05	19.05	19.05	19.05
21	19.05	19.05	19.05	19.05	18.98	18.60	19.05	19.05	18.77	19.24	19.02	19.16
22	19.05	19.05	19.05	19.05	19.06	19.10	19.05	19.05	19.05	19.05	19.05	19.15
23	19.05	19.05	19.05	19.05	19.02	19.05	19.05	19.05	19.05	18.89	18.96	19.19
24	19.05	19.05	18.97	19.22	18.97	19.05	19.05	19.05	19.05	19.05	19.05	19.21
25	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.12	19.07	19.05
26	18.97	19.12	19.12	18.33	19.11	18.96	19.05	19.05	19.05	19.05	19.05	18.90
27	19.05	19.05	19.05	18.71	19.06	19.05	19.05	19.05	19.05	18.53	19.05	19.05
28	19.05	19.05	19.05	18.99	19.04	19.05	19.05	19.22	19.05	18.72	19.05	19.05
29	19.05	.00	19.05	18.95	19.02	19.05	19.05	19.05	19.05	18.90	19.02	19.05
30	19.18	.00	19.05	18.94	19.01	19.05	19.05	19.05	19.05	19.10	19.05	19.05
31	19.05	.00	19.05	.00	18.97	.00	19.05	19.05	.00	19.05	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1979

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.05	19.05	19.19	18.62	19.05	19.05	19.05	19.05	19.05	19.05	19.10	19.05
2	19.05	19.05	19.05	18.62	19.05	19.05	18.50	19.20	19.05	19.05	19.05	19.00
3	19.05	19.05	19.05	18.98	18.94	19.05	18.51	19.20	19.05	19.05	19.02	19.05
4	19.05	19.05	19.18	19.05	19.06	19.05	18.93	19.05	19.05	19.05	19.05	19.07
5	19.05	19.05	19.05	18.77	19.14	19.05	19.24	19.05	19.05	19.05	19.04	19.09
6	19.05	19.05	19.05	18.78	19.05	19.05	19.21	19.19	19.05	19.05	19.05	19.05
7	19.05	19.05	19.05	18.76	18.89	19.23	19.23	19.05	19.05	19.05	19.00	19.05
8	19.05	19.05	19.05	18.73	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
9	19.05	19.05	19.05	18.71	19.05	18.46	19.05	19.12	19.05	19.05	19.13	19.05
10	19.05	19.05	19.05	18.95	19.05	18.48	19.05	19.05	19.05	19.05	19.05	19.05
11	19.05	19.13	19.10	19.14	19.05	19.04	19.05	19.05	19.05	19.11	19.05	19.05
12	19.05	19.05	19.05	19.10	19.05	19.05	19.05	19.05	19.05	19.05	19.10	19.05
13	19.05	19.05	19.05	19.08	19.05	18.55	19.05	19.05	19.05	18.38	19.05	19.05
14	19.05	19.05	19.04	19.06	19.05	18.84	19.05	19.05	19.05	19.05	19.05	19.10
15	19.05	19.07	19.05	19.03	19.05	19.07	19.05	19.05	19.05	19.05	19.03	19.05
16	19.05	19.05	19.09	19.07	19.05	19.06	19.05	19.05	19.05	19.19	19.05	19.00
17	19.05	19.05	19.18	19.14	19.05	19.11	19.05	19.05	19.05	19.05	19.05	19.05
18	19.05	19.05	19.05	19.19	19.05	19.05	19.05	19.05	19.05	18.74	19.01	19.10
19	19.05	19.04	18.80	19.05	19.05	18.93	19.05	19.05	19.05	19.05	19.05	19.12
20	19.05	19.05	18.79	18.98	19.05	18.88	19.05	19.05	19.05	19.05	19.05	19.05
21	19.05	19.01	19.05	19.05	19.05	18.87	18.81	19.10	19.05	19.05	18.97	18.90
22	19.05	19.05	19.24	19.01	19.05	18.85	19.05	19.05	19.05	19.05	19.01	18.93
23	19.05	18.89	19.23	19.10	19.05	19.05	19.05	18.95	19.05	19.04	19.05	19.05
24	19.05	19.05	19.05	19.05	19.05	19.22	19.05	18.86	19.05	19.05	19.02	19.15
25	19.05	19.05	18.85	19.03	19.05	19.19	19.05	18.61	19.05	19.05	19.05	19.22
26	19.05	19.05	19.00	19.05	19.05	19.21	18.80	18.35	19.05	19.03	19.02	19.05
27	19.05	19.05	19.05	18.90	19.05	19.05	19.02	18.12	19.05	19.05	19.05	18.80
28	19.05	19.05	19.25	18.87	19.05	19.12	19.05	18.05	19.05	19.11	19.09	18.78
29	19.05	.00	19.05	18.86	19.05	19.05	18.84	18.13	19.05	19.05	19.05	18.83
30	19.05	.00	18.58	18.86	19.05	19.16	18.83	19.05	19.05	19.00	19.06	19.05
31	19.05	.00	18.60	.00	19.05	.00	18.87	19.05	.00	19.05	.00	19.22

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1980

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.20	19.05	19.05	19.05	19.05	18.95	19.05	19.05	19.05	19.05	19.11	18.86
2	19.22	19.05	19.05	19.05	19.05	19.03	19.05	19.05	19.05	19.05	19.07	19.05
3	19.05	19.05	19.05	19.05	19.16	19.02	19.05	19.06	19.05	19.05	19.05	19.23
4	18.83	19.05	19.05	19.05	19.05	18.94	18.98	19.16	19.05	19.05	19.08	19.05
5	18.82	19.05	19.05	19.05	18.77	18.96	18.94	19.05	19.05	19.05	19.20	19.05
6	18.85	19.05	19.05	19.05	19.05	18.99	18.84	18.94	19.05	19.05	19.05	19.05
7	19.24	19.05	19.05	19.05	19.05	18.92	19.11	18.99	19.05	19.05	18.96	19.05
8	19.05	19.05	19.05	19.05	19.21	18.85	19.05	19.18	19.05	19.05	19.05	19.05
9	18.49	19.10	19.05	19.05	19.05	18.78	19.05	19.05	19.05	19.05	19.07	19.05
10	18.52	19.05	19.16	19.05	18.73	18.73	19.05	18.93	19.05	19.05	19.05	19.05
11	18.55	19.05	19.05	19.05	19.04	18.72	18.72	19.08	19.05	19.05	19.06	19.05
12	18.84	19.05	19.00	18.82	19.05	18.70	18.78	19.24	19.05	19.05	19.23	19.05
13	19.05	19.05	19.05	19.05	19.05	18.64	18.82	19.05	19.05	19.11	19.05	18.90
14	19.03	19.05	19.02	19.05	19.05	18.57	18.92	18.91	19.05	19.05	18.78	19.10
15	19.05	19.05	19.16	19.05	19.08	18.49	19.10	19.19	19.05	18.84	19.05	19.05
16	19.05	19.05	19.05	19.16	19.05	18.41	19.05	19.05	19.05	18.91	19.05	19.05
17	19.10	18.85	18.96	19.05	18.89	18.32	19.17	18.85	19.05	19.01	19.05	19.17
18	19.05	19.05	19.05	18.94	19.21	18.22	19.05	18.75	19.05	19.05	19.05	19.05
19	19.05	19.05	19.05	19.05	19.05	18.14	18.75	18.60	19.23	19.08	19.05	19.12
20	19.19	19.05	19.05	19.05	18.83	18.09	18.97	18.95	19.05	19.24	19.05	19.05
21	19.05	19.05	19.05	19.05	19.05	18.20	19.05	19.05	18.74	19.05	19.05	19.05
22	18.79	19.05	19.05	19.05	19.20	18.28	19.24	18.90	19.05	19.08	19.05	19.05
23	18.86	19.05	19.05	18.92	19.05	18.26	19.05	19.00	19.05	19.05	19.05	19.03
24	19.05	19.05	19.05	19.05	18.87	18.51	18.90	19.05	19.05	18.86	19.05	19.05
25	19.11	19.05	19.15	19.18	18.91	18.69	19.05	19.05	19.06	19.20	19.05	18.89
26	19.17	19.05	19.05	19.05	19.05	18.70	19.05	19.06	19.05	19.05	19.05	19.00
27	19.05	19.05	18.88	18.85	19.05	18.95	19.05	19.05	19.05	18.83	19.05	19.05
28	19.05	19.05	19.19	19.05	19.24	19.19	19.05	19.19	19.05	18.94	19.05	18.99
29	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.02	19.05	18.97
30	19.05	.00	18.73	18.79	18.62	18.99	19.05	19.05	19.05	19.05	19.05	19.00
31	19.05	.00	19.05	.00	18.80	.00	19.05	19.05	.00	19.09	.00	19.02

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1981

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.05	19.02	18.79	18.63	17.39	17.47	17.09	17.60	19.05	19.05	19.05	18.67
2	19.03	19.05	19.09	18.58	17.38	17.46	17.09	17.55	19.05	19.05	19.20	18.68
3	18.99	19.05	19.05	18.52	17.35	17.47	17.10	17.71	19.05	19.05	19.17	18.68
4	18.99	19.02	18.70	18.45	17.32	17.47	17.11	17.84	19.05	19.17	19.19	18.63
5	18.99	19.05	18.70	18.38	17.30	17.47	17.10	19.10	19.05	19.05	19.05	18.60
6	18.98	19.04	18.71	18.31	17.27	17.46	17.10	19.05	19.05	18.99	18.88	18.56
7	19.05	19.02	18.69	18.23	17.29	17.50	17.09	18.27	19.05	19.05	18.87	18.51
8	19.09	19.05	18.65	18.14	17.46	17.55	17.10	18.93	19.05	19.09	18.86	18.47
9	19.06	19.05	18.92	18.05	17.60	17.59	17.11	19.05	19.05	19.05	19.20	18.83
10	19.06	19.05	19.17	17.97	17.60	17.59	17.10	19.11	19.05	19.06	19.05	19.16
11	19.05	19.01	19.13	17.90	17.78	17.58	17.09	19.05	19.05	19.22	18.57	19.10
12	19.03	19.05	19.12	17.83	17.86	17.61	17.09	19.05	19.05	19.05	18.57	19.05
13	19.00	19.05	19.09	17.75	17.73	17.58	17.12	19.05	19.05	18.78	18.55	19.01
14	19.05	18.94	19.07	17.67	17.64	17.53	17.16	19.05	19.05	18.78	18.52	18.99
15	19.09	19.05	19.05	17.58	17.58	17.52	17.14	19.05	19.05	19.05	18.48	18.98
16	19.06	19.16	19.05	17.54	17.57	17.50	17.12	19.05	19.05	19.05	18.64	18.99
17	19.08	19.05	19.04	17.56	17.56	17.49	17.11	19.05	19.05	18.90	18.78	19.05
18	19.08	18.97	18.98	17.59	17.55	17.30	17.12	19.05	19.05	19.04	18.73	19.08
19	19.05	19.05	18.97	17.59	17.54	17.12	17.15	19.05	19.05	19.05	18.69	19.04
20	19.05	19.17	18.94	17.59	17.54	17.14	17.15	19.05	19.05	18.97	18.66	19.01
21	19.03	19.05	18.88	17.58	17.60	17.19	17.42	19.05	19.05	18.93	18.64	18.96
22	18.99	18.87	18.82	17.57	17.61	17.26	17.54	19.05	19.05	18.94	18.61	18.91
23	19.00	18.86	18.81	17.55	17.56	17.29	17.35	19.05	19.05	19.17	18.58	18.91
24	19.02	19.09	18.80	17.53	17.54	17.26	17.31	19.05	19.05	19.05	18.54	18.88
25	19.05	19.05	18.75	17.51	17.53	17.24	17.34	19.05	19.05	18.70	18.91	18.84
26	19.03	18.81	19.01	17.48	17.52	17.22	17.34	19.05	19.05	18.71	19.05	18.80
27	19.00	18.82	19.05	17.46	17.52	17.18	17.32	19.05	19.05	18.71	18.79	18.75
28	19.01	18.81	18.78	17.45	17.53	17.12	17.55	19.05	19.05	19.01	18.77	19.15
29	19.00	.00	18.74	17.44	17.53	17.09	17.75	19.05	19.05	19.05	18.74	19.05
30	19.05	.00	18.70	17.42	17.52	17.10	17.70	19.05	19.05	18.79	18.71	18.51
31	19.07	.00	18.67	.00	17.50	.00	17.66	19.05	.00	18.84	.00	18.49

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1982

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	18.47	19.03	18.81	19.05	19.05	19.05	19.05	19.05	18.80	19.05	19.05	19.05
2	18.45	19.05	18.77	19.05	18.64	19.05	19.05	18.88	19.05	19.05	19.25	19.05
3	18.42	18.71	19.07	19.05	18.51	19.05	19.05	19.05	19.13	19.05	19.05	19.05
4	18.38	18.95	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.23
5	18.82	19.13	18.74	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
6	19.23	19.05	19.05	19.05	18.60	19.05	19.05	19.05	19.05	19.05	19.05	18.87
7	19.19	18.92	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
8	19.18	18.94	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.25
9	19.15	19.05	19.05	19.05	18.89	19.05	19.05	19.05	19.05	19.05	19.05	19.05
10	19.12	19.23	19.18	19.23	19.08	19.05	19.05	19.05	19.05	19.05	18.97	18.95
11	19.07	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
12	19.01	19.05	18.45	19.05	18.91	19.05	19.05	19.05	19.05	19.05	19.19	19.12
13	18.96	19.24	18.48	19.05	18.87	19.13	19.05	19.05	19.05	19.05	19.05	19.05
14	19.05	19.19	18.73	19.05	18.86	19.05	19.05	19.05	19.05	19.05	18.37	19.05
15	19.12	19.16	18.94	19.05	18.84	19.08	19.05	19.05	19.05	19.05	18.81	19.22
16	19.07	19.14	18.98	19.05	18.82	19.05	19.05	19.05	19.05	19.05	19.05	19.05
17	19.06	19.05	19.05	19.05	19.16	19.05	19.05	19.05	19.04	19.09	19.05	18.94
18	19.03	18.95	19.06	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
19	19.05	19.05	19.02	19.05	18.67	19.05	19.05	19.05	19.04	18.95	19.05	19.01
20	19.04	19.14	19.03	19.05	18.83	19.05	19.05	19.05	19.05	19.05	19.05	19.05
21	19.00	19.11	19.03	19.05	18.97	19.05	19.05	19.05	19.05	19.00	19.05	19.05
22	18.98	19.13	19.05	19.22	19.03	19.05	19.05	19.05	19.05	19.05	19.05	19.21
23	18.95	19.05	19.03	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05
24	18.91	18.93	19.04	18.92	19.13	19.05	19.05	19.05	19.05	19.17	19.05	18.62
25	18.88	18.88	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	18.62
26	18.86	18.86	18.97	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.05	19.08
27	18.82	18.84	18.95	19.05	19.05	19.05	19.05	19.05	19.05	19.13	19.05	19.05
28	18.75	18.82	19.05	19.05	19.05	19.05	19.05	19.22	19.05	19.05	19.05	18.65
29	18.68	.00	19.05	19.05	19.05	19.05	19.19	19.05	19.05	18.99	19.05	19.16
30	18.62	.00	19.05	19.05	19.05	19.05	19.05	19.17	19.05	19.05	19.05	19.05
31	18.55	.00	19.05	.00	19.05	.00	18.98	19.05	.00	19.13	.00	18.51

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1983

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.04	19.05	19.05	19.05	18.78	18.24	19.13	19.05	19.01	18.76	19.05	18.98
2	19.05	19.05	19.05	19.23	18.86	18.44	19.05	19.05	19.05	18.71	19.05	19.05
3	18.82	19.05	19.05	19.05	18.89	18.58	18.76	19.05	19.08	18.65	19.05	19.02
4	19.05	19.05	19.05	18.82	18.88	19.11	18.63	19.05	19.05	18.85	19.05	19.05
5	19.05	19.05	19.05	19.05	19.14	19.05	18.46	19.05	18.80	19.22	19.05	19.05
6	19.05	19.05	18.94	18.74	19.05	19.05	18.65	19.04	18.95	19.05	19.05	19.04
7	19.10	19.05	19.17	18.99	18.73	19.05	19.13	19.23	19.23	18.85	19.05	19.05
8	19.05	19.05	19.05	19.05	18.73	19.18	19.05	19.05	19.05	19.14	19.05	19.00
9	18.89	19.05	19.05	18.99	18.81	19.05	18.75	19.05	18.91	19.05	19.23	18.96
10	19.05	19.05	19.05	19.05	18.85	18.46	18.85	19.05	19.25	19.00	19.05	18.94
11	19.22	19.05	19.05	19.05	18.80	18.55	18.95	18.85	19.05	19.05	18.95	18.93
12	19.05	19.05	19.05	19.05	18.78	18.49	19.02	19.06	18.74	18.99	19.05	19.05
13	18.87	19.05	19.05	19.23	18.82	18.75	19.10	19.09	19.11	19.05	19.05	19.05
14	19.05	19.05	19.05	19.05	18.83	19.14	19.14	19.05	19.05	19.05	19.05	19.05
15	19.21	19.05	19.05	18.79	18.77	19.05	19.05	19.05	18.96	19.05	18.79	19.15
16	19.21	19.05	19.05	19.09	18.74	19.03	18.90	19.05	19.05	19.05	19.15	19.05
17	19.05	19.05	19.05	19.05	18.71	19.05	19.03	19.05	19.05	19.05	19.05	19.05
18	18.85	19.05	19.05	19.05	18.67	18.84	19.12	19.05	19.05	19.05	18.96	19.05
19	19.21	19.05	18.61	19.22	18.62	18.84	19.12	19.05	19.05	19.05	19.05	19.05
20	19.05	19.17	18.42	19.23	18.57	18.91	19.22	19.23	19.05	19.05	19.00	19.05
21	19.05	19.05	19.17	19.05	18.51	19.05	19.05	19.05	19.05	19.05	19.05	19.05
22	19.05	18.71	19.05	18.90	18.50	19.05	18.83	19.05	19.05	19.05	19.16	19.05
23	19.05	18.83	19.05	19.05	18.39	19.20	18.82	19.05	19.05	19.05	19.05	19.05
24	19.05	19.05	19.05	19.18	18.24	19.05	18.79	19.05	19.05	19.05	18.93	19.05
25	19.05	19.05	19.05	19.05	18.21	18.99	18.83	19.05	19.10	19.05	19.05	19.05
26	19.05	19.05	19.05	18.92	18.16	19.05	18.82	19.05	19.05	19.05	18.87	19.13
27	19.05	19.05	18.25	19.05	18.09	18.90	18.80	19.05	19.05	19.05	19.16	19.05
28	19.05	19.05	19.17	19.18	18.03	19.12	18.92	18.98	19.05	19.05	19.05	18.97
29	19.05	.00	19.05	19.23	17.98	19.15	19.05	19.05	19.05	19.05	18.74	19.05
30	19.05	.00	18.46	19.05	18.03	19.05	19.05	19.05	19.05	19.05	18.84	19.05
31	18.83	.00	19.05	.00	18.07	.00	19.05	19.05	.00	19.05	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1984

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.05	18.90	19.05	19.23	18.99	19.05	19.16	19.05	19.05	19.05	19.05	19.05
2	19.05	18.92	19.05	19.05	18.98	19.05	19.05	18.86	19.05	19.05	18.68	19.05
3	19.05	19.05	19.05	18.49	18.94	19.05	19.05	18.81	19.05	19.05	19.02	19.05
4	19.05	19.17	19.05	19.11	18.89	19.05	19.05	18.94	19.12	19.05	19.05	19.06
5	19.05	19.05	19.05	19.05	18.93	18.77	19.17	19.05	19.05	19.12	19.12	19.05
6	19.05	18.84	19.05	18.77	18.95	18.99	19.05	19.05	19.18	19.05	19.05	19.12
7	19.13	18.82	19.18	19.05	18.91	19.05	18.79	19.05	19.05	19.09	18.67	19.05
8	19.05	19.05	19.05	19.05	18.89	18.88	19.05	19.05	18.91	19.05	18.97	18.94
9	19.05	19.22	18.88	19.11	18.92	19.06	19.05	19.05	19.05	18.90	19.20	19.05
10	19.06	19.21	19.17	19.05	19.17	19.24	19.01	19.05	19.08	19.05	19.21	19.15
11	19.25	19.05	19.05	19.05	19.05	19.05	19.04	19.05	19.05	19.15	19.05	19.05
12	19.05	18.85	19.05	19.09	18.69	18.83	19.05	19.05	18.95	19.05	18.80	18.90
13	18.97	18.88	19.05	19.05	18.66	19.01	19.23	19.05	19.24	18.94	18.78	19.05
14	19.05	19.23	19.05	19.05	18.62	19.19	19.05	19.12	19.05	19.21	18.79	18.88
15	18.83	19.05	19.05	19.05	18.57	19.05	19.05	19.05	19.05	19.05	18.78	19.19
16	19.22	18.92	19.05	19.05	18.52	18.92	19.05	19.08	19.05	18.84	19.01	19.05
17	19.05	19.24	19.05	19.05	18.47	19.07	19.05	19.05	19.08	19.00	19.21	18.94
18	18.86	19.23	19.05	19.05	18.40	19.05	19.05	19.07	19.05	19.12	19.21	19.24
19	19.05	19.05	19.05	19.05	18.34	19.14	19.05	19.05	19.12	19.12	19.05	19.24
20	18.87	19.05	19.24	18.95	18.26	19.05	19.05	19.07	19.05	19.05	19.12	19.05
21	19.05	19.05	19.05	19.05	18.18	18.87	19.05	19.05	19.05	19.16	19.05	18.83
22	19.05	19.05	19.01	19.15	18.30	19.05	19.05	19.05	19.05	19.05	19.13	18.93
23	19.17	19.05	19.05	19.16	18.40	19.05	19.05	19.05	19.05	18.91	19.05	19.19
24	19.05	19.05	19.05	19.05	18.60	19.05	19.05	19.05	19.05	19.05	19.05	19.05
25	18.94	19.05	19.05	18.86	18.80	19.18	19.05	19.05	18.92	18.96	19.05	19.02
26	19.05	19.05	19.22	18.84	19.05	19.05	19.05	19.09	19.05	19.23	19.05	19.05
27	19.12	19.05	19.05	18.86	19.05	18.93	19.11	19.05	19.05	19.05	19.05	18.82
28	19.05	19.05	19.06	18.97	19.05	19.24	19.05	19.07	19.05	18.78	19.05	18.90
29	18.65	19.05	19.05	19.03	19.05	19.05	18.48	19.05	19.05	19.04	19.05	19.14
30	18.89	.00	18.78	19.00	19.05	18.87	18.67	18.84	19.05	19.05	18.96	19.05
31	19.05	.00	19.05	.00	19.05	.00	19.05	19.14	.00	19.23	.00	18.77

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1985

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	18.99	19.05	19.10	18.44	18.94	17.29	19.05	19.14	19.05	19.05	19.05	19.05
2	19.19	19.13	19.05	18.49	18.87	17.27	18.99	19.05	19.05	19.05	18.95	19.05
3	19.22	19.05	19.02	18.51	18.75	17.24	19.05	19.05	19.05	19.05	19.05	19.05
4	19.05	18.97	18.97	18.48	18.65	17.20	19.05	19.05	19.05	19.05	19.05	19.08
5	18.84	19.04	18.92	18.39	18.54	17.15	19.05	19.05	19.05	19.05	19.05	19.05
6	18.88	19.05	18.88	18.25	18.43	17.10	19.05	19.05	19.05	19.05	19.09	19.05
7	19.17	19.10	19.12	18.14	18.31	17.08	19.05	19.05	19.05	19.05	19.05	19.05
8	19.05	19.05	19.05	18.11	18.19	17.09	19.23	19.05	19.05	19.05	19.06	19.19
9	18.73	18.93	18.77	18.10	18.06	17.09	19.05	19.05	19.05	19.05	19.05	19.05
10	19.22	18.91	18.85	18.01	17.94	17.10	18.84	19.05	19.05	19.05	19.05	19.05
11	19.05	18.92	18.90	17.85	17.84	17.10	19.05	19.05	19.05	19.05	19.05	19.05
12	18.94	18.93	18.91	17.70	17.75	17.11	19.20	19.05	19.05	18.98	19.11	18.64
13	19.05	18.94	18.91	17.61	17.66	17.18	19.05	19.05	19.05	19.05	19.05	18.75
14	19.12	19.08	18.89	17.59	17.54	17.34	18.59	19.05	19.19	19.05	19.11	19.14
15	19.05	19.18	19.11	17.64	17.42	17.53	18.88	19.05	19.05	19.05	19.05	19.05
16	18.97	19.13	19.05	18.31	17.34	17.65	19.05	19.05	19.05	19.07	18.82	18.97
17	19.05	19.11	19.00	19.06	17.36	17.82	19.24	19.05	19.05	19.05	19.06	19.19
18	19.13	19.11	19.05	19.05	17.40	17.92	19.05	19.05	19.05	19.06	19.05	19.20
19	19.05	19.13	18.87	19.08	17.38	17.89	18.82	19.05	19.05	19.05	18.98	19.05
20	18.95	19.05	18.88	19.05	17.34	18.17	19.05	19.05	19.05	18.68	19.05	18.91
21	19.05	18.93	19.17	19.05	17.33	18.40	19.05	19.05	19.05	19.01	18.96	18.99
22	19.15	18.96	19.05	19.05	17.33	18.39	19.05	19.05	19.05	19.05	19.18	19.02
23	19.05	19.06	18.62	18.93	17.33	19.24	19.05	19.05	19.05	18.88	19.05	19.05
24	18.98	19.14	18.99	19.09	17.33	19.05	19.06	19.05	19.05	18.97	18.71	19.03
25	19.05	19.23	19.05	19.24	17.37	18.11	19.05	19.05	19.05	19.01	18.76	19.02
26	18.62	19.05	18.75	19.05	17.43	18.50	19.05	19.05	19.05	19.05	19.07	19.07
27	18.58	18.89	18.76	18.86	17.42	18.77	19.05	19.05	19.05	19.01	19.05	19.05
28	18.80	19.05	18.71	18.99	17.38	19.05	19.05	19.05	19.05	19.25	18.91	18.99
29	18.99	.00	18.63	19.11	17.36	19.05	19.05	19.08	19.05	19.05	19.05	19.00
30	18.97	.00	18.55	19.05	17.33	19.05	19.05	19.05	19.05	18.86	19.05	19.06
31	19.00	.00	18.46	.00	17.31	.00	19.05	19.05	.00	19.15	.00	19.05

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1986

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	18.97	19.16	19.05	18.75	17.11	17.07	19.40	19.40	19.40	19.40	19.40	19.40
2	18.95	19.14	19.03	18.74	17.10	17.07	19.40	19.40	19.40	19.40	19.40	19.40
3	18.98	19.15	19.01	18.70	17.09	17.09	19.40	19.40	19.40	19.40	19.40	19.40
4	19.21	19.16	19.05	18.63	17.09	17.09	19.40	19.40	19.40	19.40	19.40	19.40
5	19.05	19.05	19.05	18.55	17.10	17.09	19.40	19.40	19.40	19.40	19.40	19.40
6	18.70	18.90	19.00	18.46	17.10	17.07	19.40	19.40	19.40	19.40	19.40	19.40
7	18.73	18.88	18.97	18.36	17.10	17.05	19.40	19.40	19.40	19.49	19.40	19.40
8	19.06	18.89	18.96	18.27	17.09	17.05	19.40	19.40	19.40	19.40	19.40	19.40
9	19.05	18.90	18.94	18.17	17.10	17.07	19.40	19.40	19.40	19.40	19.40	19.40
10	19.13	18.90	19.05	18.07	17.10	17.10	19.40	19.40	19.40	19.53	19.40	19.43
11	19.05	18.92	19.05	17.89	17.10	17.14	19.40	19.40	19.40	19.40	19.40	19.40
12	18.92	19.23	18.92	17.66	17.10	18.32	19.40	19.40	19.40	19.32	19.40	19.34
13	19.05	19.05	19.05	17.44	17.10	19.40	19.40	19.40	19.40	19.40	19.40	19.40
14	18.79	18.56	19.05	17.23	17.11	19.40	19.40	19.40	19.40	19.48	19.40	19.40
15	18.81	18.57	19.05	17.06	17.12	19.40	19.40	19.40	19.40	19.40	19.40	19.40
16	19.16	18.58	19.14	17.01	17.11	19.40	19.40	19.40	19.40	19.40	19.40	19.49
17	19.05	19.03	19.05	17.03	17.11	19.40	19.40	19.40	19.40	19.40	19.40	19.40
18	18.68	19.05	18.96	17.06	17.11	19.40	19.40	19.40	19.40	19.40	19.40	19.40
19	18.96	18.86	18.97	17.07	17.11	19.40	19.40	19.40	19.40	19.40	19.40	19.40
20	19.17	19.05	19.05	17.08	17.11	19.40	19.40	19.40	19.40	19.40	19.40	19.33
21	19.16	18.97	19.07	17.10	17.13	19.40	19.38	19.40	19.40	19.40	19.40	19.40
22	19.05	18.94	19.08	17.10	17.25	19.40	19.40	19.40	19.40	19.40	19.40	19.46
23	19.15	18.96	19.05	17.09	17.36	19.40	19.40	19.40	19.40	19.40	19.40	19.40
24	19.05	18.99	18.96	17.09	17.35	19.40	19.40	19.40	19.40	19.42	19.40	19.24
25	18.73	19.05	18.92	17.11	17.31	19.40	19.40	19.40	19.40	19.40	19.40	19.40
26	19.05	19.05	18.91	17.11	17.25	19.40	19.40	19.40	19.40	19.35	19.40	19.47
27	19.05	19.00	18.91	17.09	17.17	19.40	19.40	19.40	19.40	19.40	19.40	19.40
28	18.75	19.01	18.91	17.10	17.12	19.40	19.40	19.40	19.40	19.40	19.50	19.40
29	18.76	.00	19.13	17.11	17.11	19.40	19.40	19.40	19.40	19.40	19.40	19.40
30	18.79	.00	19.05	17.11	17.10	19.40	19.40	19.40	19.40	19.40	19.40	19.40
31	19.01	.00	18.75	.00	17.08	.00	19.40	19.40	.00	19.40	.00	19.40

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1987

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.40	19.42	19.40	19.40	19.40	19.40	19.27	19.44	18.01	18.31	19.40	19.40
2	19.40	19.40	19.34	19.40	19.26	19.24	19.53	19.40	17.93	18.44	19.40	19.40
3	19.40	19.27	19.40	19.40	19.28	19.32	19.40	19.18	17.84	18.40	19.40	19.40
4	19.40	19.43	19.39	19.40	19.30	19.41	18.94	19.37	17.76	18.37	19.40	19.40
5	19.40	19.40	19.38	19.40	19.34	19.43	18.92	19.48	17.70	18.32	19.40	19.40
6	19.40	19.22	19.42	19.40	19.43	19.48	19.00	19.45	17.65	18.25	19.40	19.35
7	19.40	19.40	19.40	19.40	19.40	19.40	19.30	19.46	17.60	18.17	19.40	19.40
8	19.40	19.55	19.40	19.40	19.40	19.37	19.40	19.44	17.54	18.09	19.40	19.40
9	19.40	19.40	19.40	19.42	19.50	19.40	19.20	19.53	17.48	18.01	19.40	19.40
10	19.40	19.26	19.40	19.40	19.55	19.40	19.19	19.40	17.41	17.93	19.40	19.40
11	19.40	19.40	19.40	19.44	19.40	19.53	19.53	19.13	17.33	17.92	19.40	19.28
12	19.40	19.51	19.40	19.40	19.39	19.40	19.40	19.07	17.25	19.40	19.40	19.40
13	19.40	19.40	19.40	19.40	19.40	19.39	19.01	19.02	17.17	19.40	19.40	19.40
14	19.40	19.43	19.40	19.40	19.22	19.40	19.39	18.99	17.12	19.40	19.40	19.38
15	19.40	19.40	19.39	19.42	19.40	19.44	19.40	18.94	17.10	19.40	19.40	19.40
16	19.40	19.31	19.40	19.40	19.40	19.40	19.46	18.89	17.11	19.34	19.40	19.28
17	19.40	19.40	19.41	19.21	19.40	19.38	19.40	19.00	17.12	19.40	19.40	19.40
18	19.40	19.41	19.40	19.23	19.40	19.40	19.34	19.10	17.22	18.90	19.40	19.40
19	19.40	19.40	19.39	19.29	19.32	19.34	19.40	19.05	17.26	19.40	19.40	19.22
20	19.40	19.43	19.43	19.40	19.40	19.40	19.40	19.01	17.20	19.41	19.40	19.54
21	19.45	19.40	19.40	19.44	19.31	19.47	19.40	18.94	17.16	19.40	19.40	19.40
22	19.40	19.35	19.25	19.43	19.34	19.40	19.40	18.88	17.56	19.43	19.40	19.21
23	19.40	19.40	19.25	19.44	19.49	19.23	19.40	18.82	17.95	19.40	19.40	19.49
24	19.40	19.41	19.35	19.49	19.40	19.25	19.31	18.74	18.19	19.26	19.40	19.50
25	19.40	19.50	19.40	19.40	19.30	19.20	19.40	18.66	18.39	19.40	19.40	19.40
26	19.40	19.40	19.40	19.33	19.42	19.22	19.24	18.56	18.35	19.40	19.40	19.22
27	19.31	19.28	19.40	19.42	19.50	19.27	19.17	18.47	18.33	19.48	19.40	19.23
28	19.40	19.43	19.40	19.49	19.52	19.29	19.16	18.37	18.28	19.49	19.40	19.40
29	19.40	.00	19.40	19.55	19.51	19.40	19.40	18.28	18.23	19.40	19.40	19.48
30	19.41	.00	19.40	19.54	19.51	19.40	19.40	18.18	18.17	19.33	19.40	19.46
31	19.40	.00	19.40	.00	19.54	.00	19.21	18.09	.00	19.41	.00	19.50

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1988

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.40	18.96	19.42	19.31	19.13	18.89	19.40	19.40	19.40	19.49	19.02	19.45
2	19.27	19.26	19.45	19.40	19.46	18.81	19.48	19.40	19.40	19.46	18.97	19.42
3	19.29	19.55	19.40	19.20	19.40	18.71	19.40	19.40	19.40	19.40	18.91	19.43
4	19.40	19.40	19.30	19.43	19.06	18.59	19.12	19.40	19.40	19.35	19.29	19.42
5	19.43	19.25	19.40	19.40	19.23	18.49	19.12	19.40	19.40	19.40	19.40	19.39
6	19.41	19.26	19.40	19.18	19.35	18.42	19.20	19.40	19.40	19.38	19.51	19.36
7	19.44	19.40	19.52	19.22	19.29	18.58	19.25	19.40	19.40	19.40	19.40	19.40
8	19.40	19.40	19.40	19.43	19.25	18.72	19.23	19.40	19.40	19.40	19.25	19.42
9	19.37	19.40	19.43	19.40	19.18	18.72	19.25	19.40	19.40	19.33	19.40	19.38
10	19.40	19.40	19.40	19.18	19.12	18.83	19.33	19.40	19.40	19.33	19.24	19.36
11	19.40	19.40	19.41	19.21	19.06	18.86	19.42	19.40	19.40	19.36	19.40	19.34
12	19.40	19.40	19.40	19.47	18.99	18.82	19.44	19.40	19.40	19.40	19.47	19.37
13	19.40	19.40	18.96	19.40	19.35	18.80	19.40	19.40	19.40	19.39	19.46	19.40
14	19.34	19.40	19.23	19.09	19.40	18.75	19.32	19.40	19.40	19.36	19.51	19.38
15	19.40	19.40	19.40	19.07	19.47	18.70	19.40	19.40	19.28	19.35	19.40	19.38
16	19.48	19.40	19.52	19.03	19.40	18.66	19.45	19.40	19.40	19.34	19.23	19.37
17	19.40	19.40	19.40	18.98	19.21	18.61	19.45	19.40	19.40	19.34	19.19	19.36
18	19.30	19.40	19.52	18.94	19.40	18.57	19.40	19.40	19.22	19.53	19.19	19.33
19	19.40	19.40	19.40	18.91	19.38	18.63	19.40	19.40	19.54	19.40	19.18	19.28
20	19.48	19.40	19.40	18.88	19.40	18.67	19.40	19.40	19.40	19.06	19.17	19.23
21	19.40	19.38	19.40	18.82	19.36	18.80	19.40	19.40	18.95	19.06	19.14	19.17
22	19.32	19.40	19.40	18.75	19.36	19.07	19.40	19.40	19.31	19.04	19.38	19.36
23	19.40	19.40	19.40	18.85	19.33	19.13	19.40	19.40	19.40	19.02	19.40	19.53
24	19.40	19.40	19.18	18.95	19.31	19.16	19.40	19.40	19.21	18.97	19.19	19.49
25	19.40	19.40	19.40	18.89	19.44	19.25	19.40	19.40	19.26	18.93	19.19	19.47
26	19.40	19.46	19.40	18.83	19.40	19.34	19.40	19.40	19.53	18.87	19.15	19.44
27	19.40	19.40	19.40	18.77	19.21	19.37	19.40	19.40	19.40	19.02	19.12	19.40
28	19.40	19.35	19.40	18.72	19.17	19.32	19.40	19.40	19.04	19.17	19.11	19.37
29	19.26	19.40	19.40	18.67	19.09	19.30	19.40	19.40	19.06	19.11	19.09	19.34
30	19.52	.00	19.51	18.88	19.02	19.40	19.40	19.40	19.29	19.09	19.28	19.30
31	19.40	.00	19.40	.00	18.95	.00	19.40	19.40	.00	19.06	.00	19.24

CALCULATED
CANAL WATER ELEVATIONS
YEAR: 1989

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	19.18	19.01	17.57	19.04	18.83	17.51	18.35	19.40	19.26	19.40	19.40	17.53
2	19.36	18.95	17.50	18.97	18.76	17.46	19.40	19.40	19.40	19.40	19.50	17.41
3	19.54	18.89	17.52	18.89	18.68	17.39	19.36	19.40	19.40	19.40	19.40	17.32
4	19.48	18.82	17.90	18.81	18.58	17.31	19.28	19.18	19.40	19.40	19.31	17.27
5	19.44	18.76	18.27	18.75	18.47	17.23	19.11	19.50	19.40	19.40	19.33	17.21
6	19.38	18.68	18.32	19.08	18.35	17.17	19.40	19.40	19.40	19.40	19.40	17.16
7	19.34	18.60	18.63	19.40	18.25	17.16	19.40	18.94	19.40	19.40	19.40	17.10
8	19.30	18.53	18.89	19.39	18.12	17.20	19.04	18.88	19.40	19.40	19.38	17.07
9	19.26	18.71	19.07	19.39	17.98	17.25	19.08	18.84	19.40	19.40	19.39	17.09
10	19.20	18.88	19.42	19.35	17.88	17.30	19.01	19.25	19.40	19.40	19.37	17.13
11	19.15	18.83	19.40	19.46	17.85	17.35	18.81	19.40	19.40	19.40	19.33	17.14
12	19.09	18.78	19.25	19.40	17.81	17.36	18.54	19.51	19.40	19.40	19.26	17.14
13	19.03	18.72	19.25	19.17	17.78	17.37	18.30	19.40	19.40	19.40	19.17	17.14
14	18.99	18.66	19.44	19.12	17.74	17.38	18.11	19.40	19.40	19.40	19.09	17.13
15	18.94	18.60	19.40	19.12	17.74	17.39	17.89	19.40	19.40	19.40	19.00	17.08
16	18.88	18.54	19.17	19.40	17.76	17.39	17.61	19.39	19.40	19.40	18.92	17.04
17	18.81	18.47	19.48	19.40	17.74	17.38	17.31	19.40	19.40	19.40	18.83	17.01
18	18.74	18.41	19.40	19.48	17.70	17.35	17.08	19.35	19.40	19.40	18.74	16.98
19	18.68	18.33	19.38	19.40	17.68	17.30	17.11	19.40	19.40	19.40	18.63	16.94
20	18.60	18.25	19.40	19.34	17.64	17.26	17.28	19.40	19.40	19.40	18.51	16.94
21	18.54	18.17	19.06	19.40	17.61	17.18	17.42	19.40	19.40	19.40	18.39	17.06
22	18.81	18.12	19.08	19.14	17.59	17.09	17.61	19.40	19.40	19.40	18.27	17.21
23	19.10	18.07	19.31	19.41	17.62	17.09	17.83	19.40	19.40	19.40	18.15	18.38
24	19.13	17.99	19.49	19.40	17.70	17.12	18.05	19.40	19.40	19.40	18.05	19.40
25	19.40	17.89	19.45	19.15	17.74	17.13	18.36	19.40	19.40	19.40	17.95	19.40
26	19.40	17.79	19.42	19.15	17.71	17.14	18.58	19.40	19.40	19.40	17.85	19.40
27	19.16	17.71	19.38	19.11	17.68	17.11	18.65	19.40	19.40	19.40	17.79	19.40
28	19.16	17.64	19.33	19.04	17.66	17.10	18.93	19.40	19.40	19.40	17.75	19.41
29	19.13	.00	19.26	18.96	17.62	17.11	19.14	19.40	19.40	19.23	17.70	19.40
30	19.09	.00	19.18	18.89	17.58	17.16	19.14	19.48	19.40	19.40	17.63	19.42
31	19.05	.00	19.11	.00	17.55	.00	19.40	19.40	.00	19.40	.00	19.40

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1974

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	76.	0.	0.	0.	0.	0.	608.	651.	520.	748.	0.	65.
2	0.	41.	0.	0.	0.	0.	923.	658.	208.	649.	0.	0.
3	0.	0.	0.	62.	0.	0.	1106.	366.	306.	276.	0.	57.
4	0.	0.	0.	0.	0.	0.	800.	549.	169.	219.	113.	0.
5	61.	42.	0.	0.	0.	0.	902.	683.	170.	224.	0.	0.
6	0.	0.	0.	50.	0.	0.	519.	1307.	42.	326.	0.	0.
7	0.	0.	0.	0.	0.	53.	982.	970.	269.	515.	63.	0.
8	42.	0.	0.	47.	0.	0.	567.	969.	0.	557.	40.	64.
9	0.	0.	0.	0.	0.	183.	380.	794.	309.	258.	49.	163.
10	0.	0.	0.	0.	0.	0.	201.	947.	306.	338.	0.	68.
11	0.	0.	0.	46.	0.	0.	329.	771.	663.	50.	0.	0.
12	58.	0.	0.	0.	0.	47.	220.	792.	99.	197.	93.	81.
13	0.	0.	0.	0.	0.	0.	912.	544.	358.	76.	0.	0.
14	0.	0.	0.	0.	0.	94.	302.	578.	83.	162.	106.	61.
15	54.	0.	0.	44.	0.	0.	350.	312.	336.	57.	0.	108.
16	0.	0.	56.	0.	0.	75.	91.	461.	0.	44.	0.	63.
17	0.	48.	0.	0.	0.	0.	272.	273.	208.	64.	0.	169.
18	0.	0.	0.	73.	0.	0.	1961.	646.	0.	136.	110.	172.
19	93.	0.	0.	0.	0.	0.	932.	537.	226.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	629.	992.	0.	77.	0.	145.
21	0.	0.	0.	0.	0.	0.	734.	470.	124.	53.	102.	0.
22	0.	0.	0.	41.	0.	0.	693.	617.	0.	0.	0.	0.
23	0.	42.	0.	0.	0.	47.	1241.	350.	58.	67.	0.	204.
24	0.	0.	0.	0.	0.	0.	1001.	682.	273.	0.	0.	0.
25	0.	0.	0.	0.	0.	394.	890.	941.	189.	0.	86.	0.
26	0.	0.	0.	63.	0.	433.	783.	1042.	269.	153.	100.	186.
27	44.	0.	0.	0.	0.	471.	723.	551.	180.	0.	74.	0.
28	0.	0.	0.	0.	0.	548.	805.	656.	412.	0.	0.	0.
29	0.	0.	0.	0.	0.	637.	947.	442.	189.	0.	92.	158.
30	0.	0.	75.	0.	0.	360.	1089.	974.	406.	134.	93.	0.
31	50.	0.	0.	0.	0.	0.	1041.	640.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1975

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	69.	49.	0.	0.	0.	199.	0.	0.	336.	249.	0.
2	96.	0.	0.	0.	0.	0.	183.	0.	100.	343.	186.	140.
3	0.	0.	0.	0.	0.	0.	133.	0.	227.	303.	166.	0.
4	0.	0.	97.	0.	0.	0.	207.	0.	206.	223.	70.	0.
5	0.	0.	0.	0.	0.	0.	42.	0.	269.	145.	0.	0.
6	110.	0.	0.	0.	0.	0.	199.	0.	206.	205.	145.	0.
7	0.	46.	0.	0.	0.	0.	0.	0.	277.	246.	79.	0.
8	0.	0.	0.	0.	0.	0.	41.	0.	212.	58.	0.	79.
9	0.	0.	0.	0.	0.	0.	112.	0.	216.	214.	125.	83.
10	48.	56.	0.	0.	0.	0.	0.	561.	432.	87.	0.	0.
11	0.	0.	0.	0.	0.	0.	155.	0.	397.	160.	93.	93.
12	0.	103.	0.	0.	0.	0.	0.	110.	398.	57.	0.	67.
13	0.	0.	0.	0.	0.	0.	391.	384.	241.	0.	103.	164.
14	106.	0.	0.	0.	0.	0.	142.	362.	225.	128.	0.	44.
15	0.	0.	0.	0.	0.	0.	371.	414.	269.	0.	0.	182.
16	0.	0.	0.	0.	0.	0.	0.	128.	365.	124.	135.	0.
17	0.	0.	0.	0.	0.	0.	394.	405.	282.	0.	0.	67.
18	0.	54.	0.	106.	0.	0.	258.	95.	326.	121.	0.	0.
19	0.	0.	0.	0.	0.	0.	339.	363.	427.	223.	129.	119.
20	49.	0.	0.	114.	0.	0.	204.	301.	337.	143.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	664.	402.	124.	0.	176.
22	0.	58.	0.	0.	0.	0.	90.	378.	249.	158.	89.	0.
23	0.	57.	0.	0.	0.	0.	0.	491.	460.	97.	0.	61.
24	0.	43.	0.	0.	0.	152.	0.	201.	259.	149.	0.	0.
25	44.	196.	0.	73.	0.	172.	0.	284.	298.	0.	0.	60.
26	73.	63.	0.	0.	0.	253.	0.	179.	552.	91.	0.	0.
27	0.	49.	0.	0.	0.	0.	0.	131.	606.	0.	132.	203.
28	0.	52.	0.	0.	0.	170.	0.	108.	408.	145.	0.	0.
29	0.	0.	0.	0.	0.	44.	0.	88.	458.	78.	0.	0.
30	40.	0.	0.	0.	0.	117.	0.	143.	363.	399.	0.	51.
31	0.	0.	0.	0.	0.	0.	0.	62.	0.	103.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1976

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	120.	40.	0.	0.	2981.	264.	129.	88.	439.	0.	149.
2	118.	0.	0.	0.	0.	1095.	422.	100.	124.	279.	83.	0.
3	0.	0.	95.	0.	0.	651.	115.	117.	126.	178.	170.	0.
4	0.	0.	0.	0.	51.	821.	244.	297.	254.	133.	125.	0.
5	0.	0.	0.	0.	0.	1243.	93.	443.	562.	139.	131.	147.
6	0.	152.	0.	0.	0.	1620.	118.	273.	383.	122.	0.	0.
7	0.	0.	0.	0.	0.	1037.	479.	288.	309.	82.	79.	0.
8	0.	0.	88.	0.	0.	622.	437.	104.	217.	0.	0.	106.
9	78.	0.	0.	0.	67.	603.	589.	269.	89.	146.	0.	0.
10	0.	0.	0.	154.	0.	2812.	582.	364.	96.	0.	165.	114.
11	0.	0.	0.	0.	270.	2489.	352.	287.	101.	96.	0.	0.
12	0.	0.	0.	0.	166.	1326.	375.	91.	107.	0.	0.	100.
13	0.	0.	0.	100.	0.	779.	377.	282.	187.	71.	150.	0.
14	0.	0.	0.	0.	119.	498.	250.	1141.	147.	0.	0.	130.
15	111.	0.	0.	0.	255.	388.	94.	1482.	284.	0.	46.	0.
16	0.	127.	0.	0.	324.	410.	126.	900.	192.	111.	0.	123.
17	0.	0.	0.	0.	602.	395.	377.	1417.	214.	0.	102.	0.
18	0.	0.	63.	0.	258.	271.	523.	903.	304.	89.	0.	153.
19	0.	0.	0.	0.	269.	254.	523.	848.	357.	0.	0.	0.
20	0.	0.	0.	0.	104.	417.	251.	666.	71.	97.	0.	65.
21	0.	0.	0.	0.	158.	260.	267.	485.	317.	0.	0.	0.
22	0.	0.	0.	0.	73.	304.	272.	373.	656.	0.	0.	0.
23	0.	0.	0.	0.	906.	954.	277.	373.	419.	0.	114.	113.
24	0.	0.	0.	0.	1643.	995.	420.	228.	379.	80.	0.	0.
25	0.	0.	0.	0.	953.	841.	418.	795.	289.	0.	0.	89.
26	0.	0.	0.	0.	905.	556.	301.	615.	156.	0.	0.	47.
27	0.	0.	0.	0.	594.	243.	278.	356.	139.	0.	85.	144.
28	0.	50.	0.	0.	234.	460.	124.	256.	156.	95.	0.	0.
29	0.	92.	0.	0.	400.	427.	146.	262.	126.	0.	0.	106.
30	0.	0.	0.	0.	635.	386.	111.	314.	268.	0.	0.	0.
31	0.	0.	0.	0.	1206.	0.	120.	96.	0.	0.	0.	161.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1977

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	0.	0.	72.	0.	0.	0.	0.	197.	0.	0.	440.
2	224.	223.	90.	0.	0.	0.	0.	0.	435.	241.	0.	503.
3	0.	0.	0.	0.	0.	227.	67.	114.	568.	0.	0.	259.
4	144.	137.	59.	0.	0.	0.	0.	0.	2019.	210.	85.	372.
5	0.	0.	0.	0.	0.	227.	0.	0.	1458.	0.	0.	121.
6	153.	177.	0.	0.	0.	0.	0.	0.	1142.	0.	157.	931.
7	0.	0.	67.	0.	0.	266.	0.	0.	625.	128.	0.	1323.
8	114.	0.	0.	0.	0.	0.	0.	0.	610.	0.	67.	800.
9	0.	137.	0.	0.	0.	121.	0.	0.	154.	59.	0.	427.
10	0.	0.	0.	0.	0.	78.	0.	0.	372.	0.	0.	627.
11	118.	0.	76.	0.	0.	123.	0.	0.	169.	41.	80.	589.
12	0.	159.	0.	0.	0.	0.	0.	0.	241.	42.	0.	426.
13	0.	0.	0.	0.	0.	0.	0.	0.	139.	0.	55.	121.
14	154.	0.	0.	0.	0.	46.	0.	165.	229.	0.	41.	373.
15	0.	0.	89.	0.	0.	0.	0.	0.	0.	0.	0.	126.
16	118.	92.	0.	0.	0.	0.	0.	87.	352.	0.	0.	549.
17	200.	0.	0.	0.	0.	0.	0.	0.	0.	155.	0.	1367.
18	167.	0.	0.	0.	0.	93.	79.	82.	245.	0.	71.	1261.
19	44.	0.	0.	0.	0.	0.	0.	0.	90.	0.	0.	873.
20	108.	179.	0.	0.	0.	0.	107.	0.	804.	52.	0.	833.
21	48.	0.	72.	0.	0.	80.	0.	0.	335.	0.	0.	396.
22	119.	0.	0.	0.	0.	261.	0.	0.	600.	0.	0.	1015.
23	63.	0.	0.	0.	0.	0.	0.	0.	307.	109.	182.	84.
24	126.	134.	0.	0.	0.	59.	0.	0.	270.	0.	269.	413.
25	117.	0.	0.	0.	0.	0.	0.	0.	186.	0.	159.	115.
26	111.	59.	0.	0.	0.	96.	41.	0.	691.	94.	66.	449.
27	44.	0.	0.	0.	0.	0.	0.	0.	231.	0.	172.	162.
28	60.	130.	0.	0.	0.	0.	47.	0.	442.	0.	0.	252.
29	51.	0.	0.	0.	0.	0.	0.	0.	50.	0.	341.	127.
30	0.	0.	0.	0.	0.	0.	0.	214.	290.	92.	1226.	280.
31	150.	0.	0.	0.	0.	0.	0.	329.	0.	0.	0.	184.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1978

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	266.	0.	60.	51.	0.	0.	189.	1085.	170.	583.	0.	0.
2	194.	223.	119.	119.	0.	0.	93.	460.	540.	718.	67.	73.
3	64.	76.	147.	142.	64.	0.	171.	818.	0.	1038.	54.	0.
4	118.	177.	366.	44.	0.	0.	161.	559.	641.	948.	69.	0.
5	159.	47.	190.	0.	0.	0.	149.	553.	91.	449.	41.	173.
6	0.	166.	132.	0.	109.	179.	41.	101.	581.	783.	51.	0.
7	120.	58.	181.	172.	78.	73.	179.	467.	0.	314.	59.	0.
8	237.	122.	112.	0.	85.	49.	0.	0.	278.	420.	172.	0.
9	0.	137.	1044.	0.	0.	90.	0.	563.	0.	173.	152.	144.
10	104.	180.	2731.	0.	0.	209.	260.	0.	273.	344.	107.	0.
11	250.	227.	1725.	0.	43.	0.	0.	283.	271.	42.	132.	0.
12	0.	0.	904.	0.	0.	123.	376.	0.	951.	378.	108.	91.
13	128.	200.	587.	148.	0.	0.	0.	334.	400.	59.	162.	0.
14	429.	0.	374.	0.	0.	128.	340.	0.	671.	312.	85.	0.
15	114.	226.	362.	0.	0.	0.	42.	426.	202.	62.	68.	0.
16	249.	0.	325.	0.	0.	0.	258.	249.	517.	231.	84.	99.
17	0.	240.	253.	0.	0.	60.	0.	528.	176.	67.	173.	0.
18	106.	196.	191.	0.	0.	0.	314.	81.	421.	196.	0.	0.
19	279.	231.	256.	86.	58.	78.	71.	489.	113.	73.	0.	0.
20	402.	442.	192.	42.	0.	0.	943.	246.	279.	207.	201.	52.
21	507.	225.	85.	94.	0.	0.	238.	393.	0.	0.	0.	0.
22	297.	479.	141.	41.	0.	0.	529.	61.	273.	147.	198.	0.
23	209.	174.	242.	80.	0.	218.	134.	374.	256.	0.	0.	0.
24	214.	212.	0.	0.	0.	102.	318.	328.	477.	178.	138.	0.
25	209.	219.	191.	140.	110.	303.	54.	458.	1129.	0.	0.	45.
26	0.	0.	0.	0.	0.	0.	408.	78.	1037.	115.	68.	0.
27	315.	290.	101.	0.	0.	165.	130.	248.	436.	0.	78.	70.
28	208.	116.	174.	0.	0.	78.	716.	0.	401.	0.	46.	705.
29	284.	0.	110.	0.	0.	283.	1234.	278.	242.	0.	0.	942.
30	0.	0.	161.	0.	0.	86.	612.	60.	278.	0.	125.	745.
31	345.	0.	90.	0.	0.	0.	217.	604.	0.	93.	0.	526.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1979

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	491.	329.	0.	0.	81.	91.	172.	54.	70.	1351.	0.	148.
2	538.	358.	168.	0.	41.	238.	0.	0.	315.	1020.	70.	0.
3	708.	140.	47.	0.	0.	53.	0.	0.	675.	324.	0.	75.
4	623.	214.	0.	47.	0.	307.	0.	157.	2705.	231.	75.	0.
5	445.	138.	143.	0.	0.	52.	0.	40.	3616.	100.	0.	0.
6	343.	315.	143.	0.	136.	141.	0.	0.	3327.	560.	64.	104.
7	327.	132.	353.	0.	0.	0.	0.	96.	2835.	239.	0.	96.
8	298.	184.	386.	0.	144.	157.	130.	45.	1936.	419.	55.	286.
9	383.	121.	393.	0.	575.	0.	298.	0.	1288.	82.	0.	81.
10	381.	217.	97.	0.	625.	0.	144.	134.	2633.	235.	76.	107.
11	214.	0.	0.	0.	672.	0.	140.	576.	2329.	0.	52.	79.
12	714.	227.	175.	0.	470.	94.	46.	542.	3216.	355.	0.	66.
13	1506.	144.	128.	0.	315.	0.	83.	182.	3509.	0.	85.	67.
14	1817.	75.	0.	0.	880.	0.	367.	238.	4471.	85.	46.	0.
15	1351.	0.	112.	0.	1329.	0.	329.	120.	4877.	126.	0.	103.
16	680.	256.	0.	0.	597.	0.	421.	104.	3676.	0.	79.	0.
17	521.	154.	0.	0.	427.	0.	109.	241.	1885.	258.	80.	90.
18	407.	67.	206.	0.	380.	96.	181.	399.	1397.	0.	0.	0.
19	361.	0.	0.	43.	152.	0.	44.	304.	833.	70.	78.	0.
20	234.	232.	0.	0.	74.	0.	136.	94.	696.	62.	97.	128.
21	471.	0.	63.	132.	131.	0.	0.	0.	448.	52.	0.	0.
22	329.	197.	0.	0.	66.	0.	166.	118.	1400.	65.	0.	0.
23	481.	0.	0.	0.	109.	40.	407.	0.	458.	0.	71.	82.
24	645.	88.	173.	55.	247.	0.	71.	0.	1028.	40.	0.	0.
25	815.	43.	0.	0.	426.	0.	182.	0.	507.	88.	81.	0.
26	508.	164.	0.	80.	227.	0.	0.	0.	676.	0.	0.	150.
27	621.	52.	40.	0.	234.	100.	0.	0.	579.	69.	62.	0.
28	756.	156.	0.	0.	156.	0.	99.	0.	1291.	0.	0.	0.
29	563.	0.	162.	0.	167.	51.	0.	0.	841.	80.	81.	0.
30	495.	0.	0.	0.	46.	0.	0.	0.	1739.	0.	0.	67.
31	296.	0.	0.	0.	263.	0.	0.	291.	0.	63.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1980

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	132.	117.	344.	48.	0.	84.	66.	109.	134.	0.	0.
2	0.	82.	266.	444.	110.	0.	0.	39.	337.	89.	0.	105.
3	144.	132.	352.	397.	0.	0.	73.	0.	539.	81.	0.	0.
4	0.	196.	335.	205.	229.	0.	0.	0.	904.	136.	0.	84.
5	0.	109.	112.	159.	0.	0.	0.	48.	527.	71.	0.	152.
6	0.	47.	154.	81.	44.	0.	0.	0.	563.	119.	67.	323.
7	0.	84.	105.	296.	59.	0.	0.	0.	269.	56.	0.	237.
8	104.	50.	130.	111.	0.	0.	74.	0.	345.	47.	97.	335.
9	0.	0.	86.	187.	195.	0.	93.	44.	223.	67.	0.	236.
10	0.	138.	0.	144.	0.	0.	66.	0.	257.	45.	45.	330.
11	0.	55.	137.	168.	0.	0.	0.	0.	126.	57.	0.	206.
12	0.	65.	0.	0.	88.	0.	0.	0.	158.	41.	0.	45.
13	89.	72.	94.	66.	0.	0.	0.	101.	50.	0.	53.	0.
14	0.	73.	0.	146.	88.	0.	0.	0.	278.	130.	0.	0.
15	106.	69.	0.	76.	0.	0.	0.	0.	316.	0.	56.	50.
16	90.	179.	155.	0.	149.	0.	131.	73.	376.	0.	330.	115.
17	0.	0.	0.	88.	0.	0.	0.	0.	94.	0.	171.	0.
18	40.	135.	409.	0.	0.	0.	99.	0.	321.	49.	295.	49.
19	84.	690.	407.	97.	103.	0.	0.	0.	0.	0.	88.	0.
20	0.	703.	177.	110.	0.	0.	0.	0.	298.	0.	192.	74.
21	111.	266.	113.	76.	48.	0.	49.	44.	0.	97.	86.	88.
22	0.	182.	62.	117.	0.	0.	0.	0.	82.	0.	78.	56.
23	0.	157.	125.	0.	63.	0.	138.	0.	55.	99.	86.	0.
24	75.	99.	50.	63.	0.	0.	0.	0.	90.	0.	68.	201.
25	0.	123.	0.	0.	0.	0.	297.	45.	0.	0.	64.	0.
26	0.	86.	146.	92.	91.	0.	529.	0.	172.	80.	55.	0.
27	254.	174.	0.	0.	57.	0.	423.	56.	157.	0.	56.	90.
28	231.	140.	0.	63.	0.	0.	237.	0.	210.	0.	48.	0.
29	300.	111.	144.	126.	118.	66.	166.	129.	180.	0.	106.	0.
30	115.	0.	0.	0.	0.	0.	46.	108.	94.	0.	48.	0.
31	294.	0.	105.	0.	0.	0.	119.	106.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1981

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	129.	0.	0.	0.	0.	0.	0.	0.	1302.	44.	53.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	928.	127.	0.	0.
3	0.	128.	61.	0.	0.	0.	0.	0.	695.	44.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	574.	0.	0.	0.
5	0.	87.	0.	0.	0.	0.	0.	0.	455.	102.	105.	0.
6	0.	0.	0.	0.	0.	0.	0.	331.	557.	0.	0.	0.
7	69.	0.	0.	0.	0.	0.	0.	0.	616.	71.	0.	0.
8	0.	73.	0.	0.	0.	0.	0.	0.	704.	0.	0.	0.
9	0.	69.	0.	0.	0.	0.	0.	88.	396.	82.	0.	0.
10	0.	136.	0.	0.	0.	0.	0.	0.	962.	0.	87.	0.
11	0.	0.	0.	0.	0.	0.	0.	246.	2307.	0.	0.	0.
12	0.	104.	0.	0.	0.	0.	0.	389.	1432.	123.	0.	0.
13	0.	87.	0.	0.	0.	0.	0.	204.	1334.	0.	0.	0.
14	45.	0.	0.	0.	0.	0.	0.	248.	956.	0.	0.	0.
15	0.	59.	0.	0.	0.	0.	0.	221.	591.	43.	0.	0.
16	0.	0.	40.	0.	0.	0.	0.	81.	496.	61.	0.	0.
17	0.	76.	0.	0.	0.	0.	0.	194.	641.	0.	0.	69.
18	0.	0.	0.	0.	0.	0.	0.	631.	1486.	0.	0.	0.
19	0.	59.	0.	0.	0.	0.	0.	1476.	1316.	106.	0.	0.
20	95.	0.	0.	0.	0.	0.	0.	1288.	883.	0.	0.	0.
21	0.	108.	0.	0.	0.	0.	0.	1452.	569.	0.	0.	0.
22	0.	0.	0.	0.	0.	0.	0.	1375.	597.	0.	0.	0.
23	0.	0.	0.	0.	0.	0.	0.	299.	665.	0.	0.	0.
24	0.	0.	0.	0.	0.	0.	0.	408.	483.	61.	0.	0.
25	110.	42.	0.	0.	0.	0.	0.	215.	166.	0.	0.	0.
26	0.	0.	0.	0.	0.	0.	0.	715.	209.	0.	41.	0.
27	0.	0.	42.	0.	0.	0.	0.	1175.	207.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.	0.	1778.	92.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	1825.	68.	44.	0.	95.
30	57.	0.	0.	0.	0.	0.	0.	1438.	118.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	1266.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1982

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	0.	0.	269.	63.	376.	176.	211.	0.	1000.	99.	116.
2	0.	106.	0.	345.	0.	444.	374.	0.	208.	970.	0.	45.
3	0.	0.	0.	400.	0.	413.	80.	93.	0.	644.	190.	108.
4	0.	0.	57.	128.	51.	330.	288.	94.	143.	569.	569.	0.
5	0.	0.	0.	129.	280.	157.	183.	125.	44.	394.	894.	201.
6	0.	47.	92.	178.	0.	270.	1199.	384.	238.	1303.	397.	0.
7	0.	0.	482.	145.	58.	143.	1057.	604.	57.	1621.	357.	125.
8	0.	0.	250.	126.	98.	94.	1266.	433.	230.	1045.	99.	0.
9	0.	72.	141.	114.	0.	58.	791.	554.	203.	446.	300.	204.
10	0.	0.	0.	0.	0.	106.	675.	400.	584.	406.	0.	0.
11	0.	60.	175.	211.	64.	58.	551.	673.	66.	192.	189.	113.
12	0.	0.	0.	128.	0.	111.	645.	943.	217.	316.	0.	0.
13	0.	0.	0.	196.	0.	0.	579.	951.	145.	85.	194.	197.
14	127.	0.	0.	188.	0.	126.	711.	727.	233.	210.	0.	140.
15	0.	0.	0.	208.	0.	0.	367.	976.	73.	53.	0.	0.
16	0.	0.	0.	241.	0.	112.	402.	1042.	143.	149.	146.	274.
17	0.	126.	87.	524.	0.	113.	190.	845.	0.	0.	118.	0.
18	0.	0.	0.	193.	108.	558.	256.	653.	167.	171.	117.	178.
19	94.	62.	0.	394.	0.	472.	145.	754.	0.	0.	53.	0.
20	0.	0.	0.	45.	0.	631.	197.	631.	141.	130.	150.	177.
21	0.	0.	0.	156.	0.	1441.	90.	549.	49.	0.	52.	40.
22	0.	0.	61.	0.	0.	1273.	240.	307.	448.	149.	124.	0.
23	0.	74.	0.	138.	90.	1508.	50.	379.	374.	51.	59.	237.
24	0.	0.	0.	0.	0.	2044.	224.	200.	835.	0.	40.	0.
25	0.	0.	86.	78.	94.	3150.	75.	259.	468.	96.	128.	0.
26	0.	0.	0.	151.	100.	3092.	217.	147.	1010.	54.	49.	0.
27	0.	0.	0.	826.	711.	1482.	68.	189.	1122.	0.	100.	88.
28	0.	0.	89.	385.	432.	535.	230.	0.	814.	89.	51.	0.
29	0.	0.	986.	471.	329.	115.	0.	170.	789.	0.	108.	0.
30	0.	0.	664.	153.	224.	272.	282.	0.	753.	67.	56.	109.
31	0.	0.	830.	0.	416.	0.	0.	198.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1983

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	117.	265.	119.	0.	0.	0.	144.	0.	0.	226.	0.
2	95.	730.	543.	0.	0.	0.	80.	78.	77.	0.	168.	57.
3	0.	1454.	242.	235.	0.	0.	0.	216.	0.	0.	126.	0.
4	0.	1029.	256.	0.	0.	0.	0.	78.	46.	0.	124.	51.
5	0.	878.	43.	76.	0.	164.	0.	151.	0.	0.	70.	0.
6	112.	1260.	0.	0.	57.	134.	0.	0.	0.	60.	81.	0.
7	0.	1449.	0.	0.	0.	117.	0.	0.	0.	0.	62.	55.
8	95.	611.	275.	83.	0.	0.	66.	95.	101.	0.	180.	0.
9	0.	764.	103.	0.	0.	238.	0.	110.	0.	96.	0.	0.
10	44.	546.	130.	70.	0.	0.	0.	194.	0.	0.	139.	0.
11	0.	280.	217.	85.	0.	0.	0.	0.	71.	70.	0.	0.
12	163.	186.	465.	54.	0.	0.	0.	0.	0.	0.	110.	59.
13	0.	1009.	212.	0.	0.	0.	0.	0.	0.	51.	50.	119.
14	81.	731.	132.	145.	0.	0.	0.	102.	152.	78.	112.	53.
15	0.	389.	42.	0.	0.	72.	54.	77.	0.	285.	0.	0.
16	0.	629.	190.	0.	0.	0.	0.	166.	158.	369.	0.	94.
17	77.	1346.	159.	47.	0.	45.	0.	78.	139.	438.	96.	86.
18	0.	702.	125.	91.	0.	0.	0.	235.	110.	428.	0.	167.
19	0.	198.	0.	0.	0.	0.	0.	145.	123.	683.	61.	259.
20	291.	0.	0.	0.	0.	0.	0.	0.	212.	350.	0.	193.
21	331.	99.	0.	91.	0.	0.	45.	283.	194.	186.	48.	146.
22	400.	0.	261.	0.	0.	63.	0.	68.	367.	53.	0.	193.
23	237.	0.	0.	0.	0.	0.	0.	157.	181.	569.	107.	52.
24	537.	107.	567.	0.	0.	157.	0.	41.	167.	505.	0.	103.
25	328.	190.	388.	53.	0.	0.	0.	201.	0.	1111.	44.	64.
26	414.	59.	559.	0.	0.	50.	0.	76.	142.	995.	0.	0.
27	81.	262.	0.	0.	0.	0.	0.	180.	164.	815.	0.	102.
28	340.	1120.	0.	0.	0.	0.	0.	0.	207.	462.	63.	0.
29	87.	0.	385.	0.	0.	0.	60.	160.	105.	238.	0.	89.
30	306.	0.	0.	47.	0.	93.	173.	54.	133.	271.	0.	125.
31	0.	0.	160.	0.	0.	0.	134.	117.	0.	169.	0.	639.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1984

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	749.	0.	554.	0.	0.	249.	0.	107.	96.	278.	72.	141.
2	447.	0.	388.	210.	0.	275.	77.	0.	39.	264.	0.	79.
3	219.	69.	249.	0.	0.	43.	43.	0.	115.	147.	0.	150.
4	107.	0.	201.	0.	0.	95.	231.	0.	0.	175.	52.	0.
5	158.	128.	125.	194.	0.	0.	0.	116.	110.	0.	0.	139.
6	132.	0.	193.	0.	0.	0.	192.	245.	0.	123.	73.	0.
7	0.	0.	0.	84.	0.	72.	0.	102.	188.	0.	0.	164.
8	82.	52.	269.	44.	0.	0.	53.	165.	0.	105.	0.	0.
9	54.	0.	0.	0.	0.	0.	68.	98.	50.	0.	0.	43.
10	0.	0.	0.	76.	0.	0.	0.	44.	0.	86.	0.	0.
11	0.	114.	109.	61.	59.	79.	0.	76.	130.	0.	102.	83.
12	76.	0.	40.	0.	0.	0.	94.	48.	0.	54.	0.	0.
13	0.	0.	433.	58.	0.	0.	0.	61.	0.	0.	0.	85.
14	45.	0.	224.	124.	0.	0.	306.	0.	68.	0.	0.	0.
15	0.	108.	209.	66.	0.	63.	650.	65.	0.	78.	0.	0.
16	0.	0.	160.	57.	0.	0.	508.	0.	56.	0.	0.	84.
17	101.	0.	79.	78.	0.	0.	396.	77.	0.	0.	0.	0.
18	0.	0.	51.	56.	0.	91.	375.	0.	139.	0.	0.	0.
19	108.	113.	95.	75.	0.	0.	139.	231.	0.	0.	40.	0.
20	0.	113.	0.	0.	0.	103.	272.	0.	241.	53.	0.	101.
21	53.	210.	127.	41.	0.	0.	160.	151.	71.	0.	57.	0.
22	116.	180.	0.	0.	0.	99.	245.	108.	457.	60.	0.	0.
23	0.	1005.	439.	0.	0.	87.	103.	239.	187.	0.	103.	0.
24	81.	466.	515.	81.	0.	81.	269.	91.	337.	48.	111.	70.
25	0.	433.	210.	0.	0.	0.	105.	211.	0.	0.	493.	0.
26	42.	210.	0.	0.	108.	133.	232.	0.	186.	0.	168.	51.
27	0.	281.	204.	0.	402.	0.	0.	150.	192.	86.	267.	0.
28	131.	1521.	0.	0.	69.	0.	96.	0.	500.	0.	57.	0.
29	0.	1464.	218.	0.	980.	98.	0.	89.	438.	0.	245.	0.
30	0.	0.	0.	0.	709.	0.	0.	0.	438.	49.	0.	64.
31	69.	0.	117.	0.	550.	0.	299.	0.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1985

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	0.	0.	0.	0.	0.	114.	0.	389.	407.	65.	185.
2	0.	0.	0.	0.	0.	0.	0.	154.	328.	248.	0.	203.
3	0.	75.	0.	0.	0.	0.	320.	125.	549.	563.	47.	0.
4	77.	0.	0.	0.	0.	0.	178.	224.	300.	446.	78.	0.
5	0.	0.	0.	0.	0.	0.	94.	166.	466.	611.	47.	84.
6	0.	0.	0.	0.	0.	0.	147.	200.	927.	277.	0.	72.
7	0.	0.	0.	0.	0.	0.	44.	252.	1097.	422.	77.	110.
8	75.	77.	64.	0.	0.	0.	0.	172.	677.	164.	0.	0.
9	0.	0.	0.	0.	0.	0.	266.	229.	498.	337.	76.	118.
10	0.	0.	0.	0.	0.	0.	0.	512.	335.	102.	0.	0.
11	202.	0.	0.	0.	0.	0.	103.	262.	221.	208.	75.	125.
12	0.	0.	0.	0.	0.	0.	0.	261.	122.	0.	0.	0.
13	172.	0.	0.	0.	0.	0.	175.	98.	94.	130.	45.	0.
14	0.	0.	0.	0.	0.	0.	0.	496.	0.	73.	0.	0.
15	198.	0.	0.	0.	0.	0.	0.	426.	290.	139.	54.	65.
16	0.	0.	50.	0.	0.	0.	97.	405.	73.	0.	0.	0.
17	165.	0.	0.	0.	0.	0.	0.	351.	271.	148.	0.	0.
18	0.	0.	92.	135.	0.	0.	249.	162.	456.	0.	53.	0.
19	198.	0.	0.	0.	0.	0.	0.	365.	2073.	150.	0.	129.
20	0.	77.	0.	75.	0.	0.	71.	247.	1797.	0.	64.	0.
21	157.	0.	0.	43.	0.	0.	68.	239.	1938.	0.	0.	0.
22	0.	0.	220.	49.	0.	0.	78.	302.	1336.	133.	0.	0.
23	196.	0.	0.	0.	0.	0.	49.	222.	1117.	0.	63.	49.
24	0.	0.	0.	0.	0.	271.	0.	150.	640.	0.	0.	0.
25	159.	0.	58.	0.	0.	0.	64.	98.	662.	0.	0.	0.
26	0.	59.	0.	61.	0.	0.	171.	126.	322.	62.	0.	0.
27	0.	0.	0.	0.	0.	0.	174.	88.	436.	0.	79.	78.
28	0.	48.	0.	0.	0.	83.	88.	170.	210.	0.	0.	0.
29	0.	0.	0.	0.	0.	132.	152.	0.	409.	88.	121.	0.
30	0.	0.	0.	42.	0.	129.	46.	253.	216.	0.	152.	0.
31	0.	0.	0.	0.	0.	0.	98.	162.	0.	0.	0.	73.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1986

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	0.	52.	0.	0.	0.	438.	235.	240.	112.	290.	57.
2	0.	0.	0.	0.	0.	0.	495.	373.	285.	62.	363.	46.
3	0.	0.	0.	0.	0.	0.	473.	380.	250.	98.	177.	60.
4	0.	0.	0.	0.	0.	0.	706.	283.	278.	91.	189.	67.
5	65.	70.	53.	0.	0.	0.	935.	292.	291.	71.	156.	44.
6	0.	0.	0.	0.	0.	0.	839.	227.	592.	101.	195.	68.
7	0.	0.	0.	0.	0.	0.	718.	190.	514.	0.	314.	44.
8	0.	0.	0.	0.	0.	0.	664.	232.	455.	116.	338.	69.
9	64.	0.	0.	0.	0.	0.	632.	191.	497.	70.	175.	37.
10	0.	0.	46.	0.	0.	0.	451.	237.	1196.	0.	122.	0.
11	90.	0.	95.	0.	0.	0.	511.	313.	1199.	112.	134.	102.
12	0.	0.	0.	0.	0.	0.	410.	247.	891.	0.	110.	0.
13	116.	88.	40.	0.	0.	458.	455.	249.	611.	70.	95.	48.
14	0.	0.	114.	0.	0.	436.	394.	325.	430.	0.	295.	59.
15	0.	0.	69.	0.	0.	357.	314.	378.	311.	130.	216.	32.
16	0.	0.	0.	0.	0.	297.	161.	1188.	276.	52.	168.	0.
17	72.	0.	95.	0.	0.	303.	102.	878.	215.	116.	160.	81.
18	0.	113.	0.	0.	0.	276.	85.	841.	148.	60.	117.	34.
19	0.	0.	0.	0.	0.	312.	78.	1062.	91.	50.	74.	54.
20	0.	73.	47.	0.	0.	407.	73.	908.	191.	58.	119.	0.
21	0.	0.	0.	0.	0.	718.	0.	838.	235.	59.	62.	61.
22	43.	0.	0.	0.	0.	862.	193.	798.	159.	50.	49.	0.
23	0.	0.	56.	0.	0.	836.	99.	627.	216.	43.	89.	139.
24	68.	0.	0.	0.	0.	785.	157.	450.	139.	0.	31.	0.
25	0.	45.	0.	0.	0.	758.	159.	353.	237.	103.	79.	94.
26	0.	0.	0.	0.	0.	602.	206.	282.	188.	0.	30.	0.
27	52.	0.	0.	0.	0.	676.	178.	269.	240.	41.	74.	128.
28	0.	0.	0.	0.	0.	572.	292.	284.	154.	51.	0.	88.
29	0.	0.	0.	0.	0.	331.	584.	287.	156.	114.	56.	109.
30	0.	0.	52.	0.	0.	453.	552.	259.	61.	159.	46.	88.
31	0.	0.	0.	0.	0.	0.	505.	217.	0.	195.	0.	212.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1987

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	985.	0.	67.	422.	32.	44.	0.	0.	0.	0.	199.	173.
2	783.	122.	0.	295.	0.	0.	0.	41.	0.	0.	372.	75.
3	426.	0.	53.	172.	0.	0.	135.	0.	0.	0.	389.	100.
4	463.	0.	0.	164.	0.	0.	0.	0.	0.	0.	898.	131.
5	695.	128.	0.	121.	0.	0.	0.	0.	0.	0.	1118.	81.
6	550.	0.	0.	107.	0.	0.	0.	0.	0.	0.	896.	0.
7	353.	62.	320.	90.	31.	50.	0.	0.	0.	0.	712.	55.
8	279.	0.	437.	84.	61.	0.	108.	0.	0.	0.	540.	83.
9	245.	113.	278.	0.	0.	40.	0.	0.	0.	0.	330.	61.
10	202.	0.	158.	92.	0.	76.	0.	41.	0.	0.	297.	90.
11	179.	63.	177.	0.	66.	0.	0.	0.	0.	0.	284.	0.
12	102.	0.	58.	98.	0.	60.	78.	0.	0.	189.	159.	43.
13	91.	47.	84.	51.	124.	0.	0.	0.	0.	790.	159.	59.
14	108.	0.	66.	53.	0.	64.	0.	0.	0.	102.	160.	0.
15	85.	97.	0.	0.	68.	0.	85.	0.	0.	567.	98.	112.
16	99.	0.	75.	103.	47.	90.	0.	0.	0.	0.	132.	0.
17	84.	89.	0.	0.	47.	0.	171.	0.	0.	435.	93.	30.
18	116.	0.	79.	0.	38.	72.	0.	0.	0.	0.	729.	95.
19	0.	84.	0.	0.	0.	0.	131.	0.	0.	135.	1120.	0.
20	114.	0.	0.	35.	111.	41.	90.	0.	0.	0.	1699.	0.
21	0.	87.	75.	0.	0.	0.	190.	0.	0.	140.	1399.	92.
22	115.	0.	0.	0.	0.	79.	125.	0.	0.	0.	752.	0.
23	68.	69.	0.	0.	0.	0.	214.	0.	0.	83.	541.	0.
24	133.	0.	0.	0.	48.	0.	0.	0.	0.	0.	458.	0.
25	69.	0.	57.	45.	0.	0.	48.	0.	0.	31.	429.	85.
26	128.	97.	87.	0.	0.	0.	0.	0.	0.	34.	358.	0.
27	0.	0.	267.	0.	0.	0.	0.	0.	0.	0.	238.	0.
28	102.	0.	299.	0.	0.	0.	0.	0.	0.	0.	228.	43.
29	105.	0.	308.	0.	0.	42.	0.	0.	0.	69.	182.	0.
30	0.	0.	464.	0.	0.	99.	35.	0.	0.	0.	161.	0.
31	104.	0.	552.	0.	0.	0.	0.	0.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1988

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	72.	0.	0.	0.	0.	0.	62.	251.	165.	0.	0.	0.
2	0.	0.	0.	43.	0.	0.	0.	631.	278.	0.	0.	0.
3	0.	0.	62.	0.	75.	0.	48.	626.	151.	77.	0.	0.
4	51.	90.	0.	0.	0.	0.	0.	432.	183.	0.	0.	0.
5	0.	0.	41.	40.	0.	0.	0.	299.	67.	76.	141.	0.
6	0.	0.	34.	0.	0.	0.	0.	437.	100.	0.	0.	0.
7	0.	58.	0.	0.	0.	0.	0.	419.	51.	0.	99.	30.
8	53.	204.	130.	0.	0.	0.	0.	192.	178.	62.	0.	0.
9	0.	163.	0.	38.	0.	0.	0.	231.	155.	0.	34.	0.
10	86.	503.	136.	0.	0.	0.	0.	428.	186.	0.	0.	0.
11	68.	125.	0.	0.	0.	0.	0.	1018.	59.	0.	31.	0.
12	72.	181.	153.	0.	0.	0.	0.	901.	98.	35.	0.	0.
13	73.	46.	0.	52.	0.	0.	80.	804.	51.	0.	0.	47.
14	0.	102.	0.	0.	57.	0.	0.	931.	98.	0.	0.	0.
15	65.	49.	35.	0.	0.	0.	43.	574.	0.	0.	69.	0.
16	0.	98.	0.	0.	250.	0.	0.	474.	37.	0.	0.	0.
17	79.	62.	79.	0.	0.	0.	0.	412.	101.	0.	0.	0.
18	0.	39.	0.	0.	36.	0.	103.	283.	0.	0.	0.	0.
19	38.	127.	426.	0.	0.	0.	72.	404.	0.	58.	0.	0.
20	0.	46.	327.	0.	62.	0.	416.	274.	91.	0.	0.	0.
21	92.	0.	403.	0.	0.	0.	160.	486.	0.	0.	0.	0.
22	0.	91.	120.	0.	0.	0.	191.	529.	0.	0.	0.	0.
23	52.	59.	277.	0.	0.	0.	153.	470.	35.	0.	38.	0.
24	100.	72.	0.	0.	0.	0.	98.	774.	0.	0.	0.	0.
25	45.	55.	112.	0.	0.	0.	69.	532.	0.	0.	0.	0.
26	90.	0.	39.	0.	31.	0.	96.	587.	0.	0.	0.	0.
27	51.	81.	104.	0.	0.	0.	60.	367.	74.	0.	0.	0.
28	99.	0.	42.	0.	0.	0.	97.	237.	0.	0.	0.	0.
29	0.	56.	41.	0.	0.	0.	114.	174.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	31.	277.	140.	0.	0.	0.	0.
31	147.	0.	93.	0.	0.	0.	233.	178.	0.	0.	0.	0.

CALCULATED
SPILLWAY FLOW DATA
YEAR: 1989

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	0.	0.	0.	0.	0.	0.	0.	43.	0.	60.	47.	0.
2	0.	0.	0.	0.	0.	0.	78.	51.	368.	244.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	109.	251.	44.	90.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	321.	127.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	334.	32.	0.	0.
6	0.	0.	0.	0.	0.	0.	39.	77.	1129.	131.	41.	0.
7	0.	0.	0.	0.	0.	0.	148.	0.	462.	65.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	377.	2030.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	254.	1853.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	222.	1920.	0.	0.
11	0.	0.	36.	0.	0.	0.	0.	42.	129.	1903.	0.	0.
12	0.	0.	0.	32.	0.	0.	0.	0.	199.	1428.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	158.	36.	1011.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	84.	143.	707.	0.	0.
15	0.	0.	39.	0.	0.	0.	0.	169.	34.	616.	0.	0.
16	0.	0.	0.	37.	0.	0.	0.	0.	126.	665.	0.	0.
17	0.	0.	0.	41.	0.	0.	0.	168.	103.	288.	0.	0.
18	0.	0.	102.	0.	0.	0.	0.	0.	236.	481.	0.	0.
19	0.	0.	0.	86.	0.	0.	0.	183.	136.	283.	0.	0.
20	0.	0.	62.	0.	0.	0.	0.	310.	220.	440.	0.	0.
21	0.	0.	0.	129.	0.	0.	0.	385.	44.	258.	0.	0.
22	0.	0.	0.	0.	0.	0.	0.	242.	125.	224.	0.	0.
23	0.	0.	0.	0.	0.	0.	0.	366.	40.	227.	0.	0.
24	0.	0.	0.	48.	0.	0.	0.	152.	128.	129.	0.	88.
25	0.	0.	0.	0.	0.	0.	0.	351.	588.	116.	0.	101.
26	41.	0.	0.	0.	0.	0.	0.	110.	609.	121.	0.	187.
27	0.	0.	0.	0.	0.	0.	0.	366.	268.	119.	0.	70.
28	0.	0.	0.	0.	0.	0.	0.	122.	352.	121.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	245.	154.	0.	0.	73.
30	0.	0.	0.	0.	0.	0.	0.	0.	223.	33.	0.	0.
31	0.	0.	0.	0.	0.	0.	38.	254.	0.	98.	0.	87.

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1974

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1975

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	.0	7.7	.0	7.7	.0	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	.0	7.7	.0	7.7	.0	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	.0	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	.0	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	.0	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	.0	.0	.0	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1976

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1977

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1978

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1979

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1980

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1981

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	.0	.0	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	.0	7.7	.0	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	.0	.0	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	.0	.0	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	.0	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	.0	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	.0	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	.0	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1982

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1983

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1984

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1985

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	.0	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1986

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	.0	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	.0	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	.0	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	.0	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	.0	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	.0	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1987

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	.0	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	.0	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	.0	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1988

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
4	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
5	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
6	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
7	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
8	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
9	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
10	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
11	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
12	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
13	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
14	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
15	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
16	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
17	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
18	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
19	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
20	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
21	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
22	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	7.3	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	7.7	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	7.7	.0	7.7	7.7	.0	7.7	.0	7.3

MAKEUP+PROCESS WATER FROM THE CANAL
YEAR: 1989

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DEC.
1	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
2	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	7.3
3	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
4	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
5	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
6	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
7	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
8	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
9	7.2	7.3	7.4	7.6	7.7	.0	7.7	7.7	7.7	7.7	7.4	.0
10	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	.0
11	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	.0
12	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	.0
13	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	.0
14	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	.0
15	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	.0
16	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	.0
17	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	.0
18	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	.0
19	7.2	7.3	7.4	7.6	.0	.0	.0	7.7	7.7	7.7	7.4	.0
20	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	.0
21	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	.0
22	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
23	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
24	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
25	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
26	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
27	7.2	7.3	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
28	7.2	7.3	7.4	7.6	.0	.0	7.7	7.7	7.7	7.7	7.4	7.3
29	7.2	.0	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
30	7.2	.0	7.4	7.6	.0	7.7	7.7	7.7	7.7	7.7	7.4	7.3
31	7.2	.0	7.4	.0	.0	.0	7.7	7.7	.0	7.7	.0	7.3

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10-10

10.10 TRAFFIC ANALYSIS

- A. Construction Traffic Analysis**
- B. Martin County Requirements**
- C. TCRPC Requirements**
- D. FDOT Requirements**

A. Construction Traffic Analysis

Kimley-Horn

Kimley-Horn and Associates, Inc
ENGINEERS • PLANNERS • SURVEYORS

4431 Embarcadero Drive West Palm Beach, Florida 33407 407 845-0665 Facsimile 407 863-8175

October 23, 1990
4241T.00(07)

Mr. Stephen A. Sorrentino
PG&E/Bechtel Generating Company
7475 Wisconsin Avenue
Bethesda, Maryland 20814-3422

Re: Indiantown Co-generation Project
Northwest of Indiantown, Martin County, Florida
(Construction Traffic Analysis)

Dear Steve:

We have conducted a revised evaluation of the traffic impact associated with the construction traffic of the proposed electrical power generating plant located approximately two miles northwest of Indiantown on the south side of State Road 710 in Martin County, Florida (see Figure 1 attached). The following presents the methodology and the findings of this evaluation. Please replace the report that we sent to you on October 10, 1990 with this evaluation.

Construction Traffic

Information about construction was provided by PG&E/Bechtel Generating Company. It is expected that the manpower will peak to about 800 employees during the year 1994 and would stay at that level for about four to six months. In order to determine traffic impact due to construction of the proposed plant, the year 1994 traffic was analyzed with 800 employees. The analysis included State Road 710, north and south of the PG&E/Bechtel site.

Project Traffic

Presently no shift work is contemplated. Proposals and the construction schedules are based on working 40 hours per week with a single day-shift. Since most of the employees will be commuting from the surrounding West Palm Beach, Stuart, and Okeechobee areas, it is anticipated that construction workers will car pool. Based on the information provided by PG&E/Bechtel, the traffic generation potential of the construction workers will be approximately 1,200 trips per day. The total trip generation for the proposed project follows.

DAILY TRIP GENERATION

<u>Units</u>	<u>Trip Rate</u>	<u>Vehicle Occupancy Rate</u>	<u>Trips</u>
800 Employees	2/employee	1-1/3 employees/vehicle	1,200
20 Trucks	2/truck		<u>40</u>
Total Daily Trips			1,240

AM PEAK HOUR TRIP GENERATION (GENERATOR)

<u>Units</u>	<u>Trip Rate</u>	<u>Vehicle Occupancy Rate</u>	<u>Inbound Trips</u>
800 Employees	1/employee	1-1/3 employees/vehicle	600

PM PEAK HOUR TRIP GENERATION (GENERATOR)

<u>Units</u>	<u>Trip Rate</u>	<u>Vehicle Occupancy Rate</u>	<u>Outbound Trips</u>
800 Employees	1/employee	1-1/3 employees/vehicle	600

The project buildout traffic distribution and assignment was used to estimate the traffic impact of construction-related traffic.

Link Evaluation

The radius of impact for buildout year was used for the construction traffic impact analysis. Background traffic for year 1994 was determined using a growth factor of 5.6 percent per year. Construction traffic was added to background traffic to determine total traffic. It is anticipated that the construction traffic will generate its peak traffic at off-peak periods on the adjacent roadway network. Therefore, only daily traffic impact was analyzed for the construction traffic. Table 1 depicts project traffic, total traffic, and the corresponding level of service.

Driveway Evaluation

The generator AM and PM peak hour construction traffic at the main entrance is depicted in Figures 2 and 3 attached.

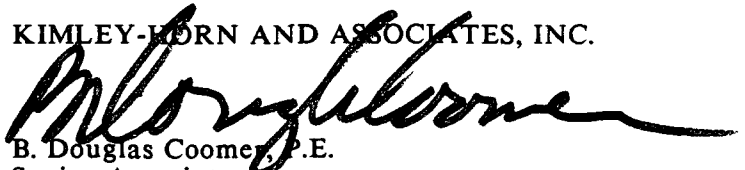
Conclusions and Recommendations

Analyses of projected 1995 traffic volumes with the proposed power plant in operation indicated that a southbound right-turn lane on State Road 710 at the project entrance will benefit the traffic operation. It is recommended that this improvement be implemented prior to initiation of construction so that it can serve construction traffic.

If you have any questions, please give me a call.

Very truly yours,

KIMLEY-HORN AND ASSOCIATES, INC.



B. Douglas Coomey, P.E.
Senior Associate

BDC/LCL:map
Enclosures

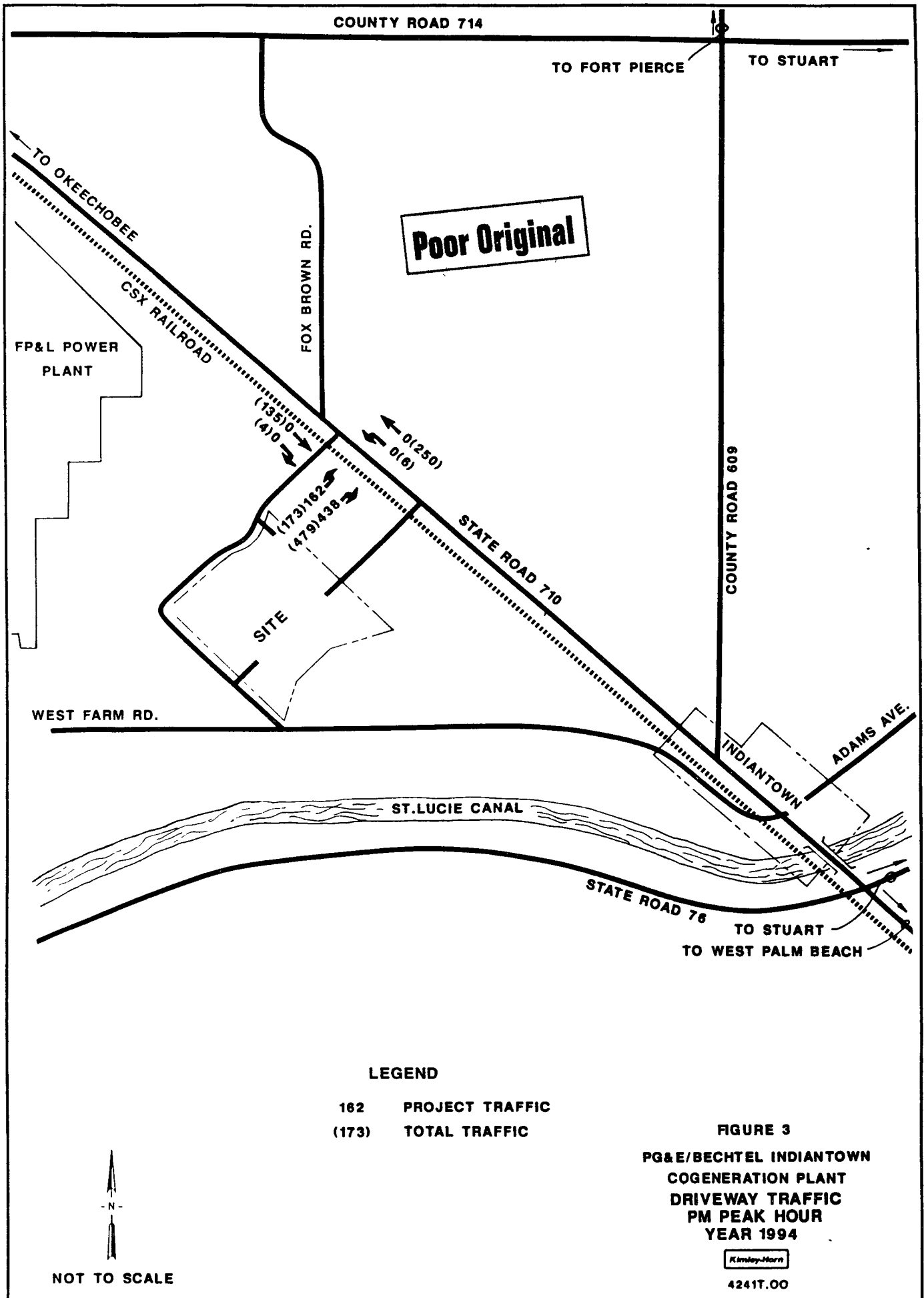
Copy to:
Mary Coffey, Bechtel Power Corporation

Florida Registration
Number 21783

TABLE 1
1994 CONSTRUCTION TRAFFIC ANALYSIS

ANNUAL AVERAGE DAILY TRAFFIC (AADT)

<u>Segment</u>	<u>Committed Lanes</u>	<u>1990 Existing Volume</u>	<u>Service Volume "C"</u>	<u>1994 Background Traffic</u>	<u>Project Traffic</u>	<u>1994 Total Traffic</u>	<u>Level of Service</u>
State Road 710 North of Project Entrance	2L	6,053	13,100	7,527	335	7,862	A
State Road 710 South of Project Entrance	2L	6,053	13,100	7,527	905	8,432	A



B. Martin County Requirements

Kimley-Horn

Kimley-Horn and Associates, Inc
ENGINEERS • PLANNERS • SURVEYORS

4431 Embarcadero Drive West Palm Beach, Florida 33407 407 845-0665 Facsimile 407 863-8175

October 23, 1990
4241T.00(07)

Mr. Stephen A. Sorrentino
PG&E/Bechtel Generating Company
7475 Wisconsin Avenue
Bethesda, Maryland 20814-3422

Re: Indiantown Co-generation Project
Northwest of Indiantown, Martin County, Florida
(Martin County Requirements)

Dear Steve:

We have conducted a revised evaluation of the traffic impact associated with the proposed electrical power generating plant located approximately two miles northwest of Indiantown on the south side of State Road 710 in Martin County, Florida (see Figure 1 attached). The following presents the methodology and the findings of this evaluation. Please replace the report that we sent you on September 13, 1990 with this evaluation.

Methodology

The traffic impact analysis was conducted in accordance with the requirements of the Martin County Comprehensive Growth Management Plan. The analysis used current data available from Martin County, that was supplemented with data collected in the field and also includes assumptions concerning the similar characteristics between the proposed project and the adjacent Florida Power and Light Company (FP&L) power plant. The FP&L power plant existing traffic pattern was used as a basis of this analysis.

Trip Generation

The subject project will require 65 employees (80 employees total for 7 workdays per week) by the buildout year. Three different work shifts are planned for the employees. Forty-five employees will work the day shift from 7:00 AM to 4:00 PM, while 10 employees work the evening shift and 10 employees work the night shift. It is anticipated that the plant will be 100 percent built out and in operation by the end of 1995.

The trip generation potential of the proposed project was determined by using the trip generation rates of the adjacent existing FP&L power plant. Turning movement counts were made at the existing power plant entrance to determine the trip generation rates.

The traffic generation potential for the proposed project was calculated using the FP&L power plant existing daily trip rate of 2.35 trips per employee, resulting in 153 daily trips. The AM and PM peak hour trip generation during the peak traffic hour on the adjacent street follows.

**PEAK HOUR TRIP GENERATION
(VEHICLES PER HOUR)**

AM PEAK HOUR				PM PEAK HOUR			
<u>Trip Rate</u>	<u>Trips</u>	<u>In</u>	<u>Out</u>	<u>Trip Rate</u>	<u>Trips</u>	<u>In</u>	<u>Out</u>
0.71/employee	46	38	8	0.40/employee	26	5	21

Traffic Distribution and Assignment

Existing turning movement counts performed by Kimley-Horn and Associates, Inc. were the basis for determining traffic distribution and assignment for the proposed project. The data collected in the field indicates a split of 27 percent of the FP&L power plant generated traffic traveling northwest of the site and the remaining 73 percent of the traffic travelling southeast. The same split has been used in the analysis of the proposed project.

Driveway Analysis

Access to the development will be provided through a main entrance on State Route 710 and a secondary entrance on West Farm Road. An emergency entrance will also be provided on State Route 710. It is anticipated that approximately 100 percent of the project trips will travel through the main entrance. This assumption presents a conservative approach for traffic analysis purposes.

The AM and PM peak hour traffic at the main entrance is depicted in Figures 2 and 3 attached.

Link Evaluation

The traffic study area was identified based on criteria included in the Martin County Comprehensive Growth Management Plan Traffic Impact Study Guidelines. The study area identified for the analyses includes State Road 710, one-half (½) mile north and one-half (½) mile south of the site.

Traffic volumes were developed for the anticipated buildout year of 1995.

A 5.6 percent background growth rate was used based on rates included in Martin County's Comprehensive Growth Management Plan five-year traffic volume tables.

Site-related traffic was added to the background traffic to develop total traffic for the buildout year. Table 1 (attached) shows State Route 710 will operate at Level of Service "A" for daily and peak hours in the buildout year after full operation is initiated.

Intersection Analysis

The only intersection analysis required within the one-half mile radius is the project entrance road at State Road 710. An analysis of turning movement volumes projected for 1995 indicates that this intersection will operate at an acceptable level of service with the capacity provided on the existing streets. However, due to the railroad crossing and the characteristics of traffic anticipated to use this entrance road, an operational improvement is recommended. This improvement would be a right-turn lane on State Road 710 with sufficient storage length to accommodate traffic during closures of the at-grade crossing due to train movements.

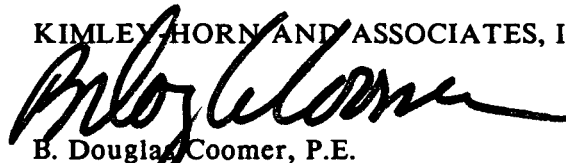
Conclusions and Recommendations

Analyses of projected 1995 traffic volumes with the proposed power plant in operation show that roadway links and the intersection within the study area will operate at acceptable levels of service. Therefore, no improvements are warranted or recommended for roadway segments. However, for the benefit of traffic operations, it is recommended that a southbound right-turn lane on State Road 710 at the project entrance be implemented prior to operation of the proposed power plant.

If you have any questions, please give me a call.

Very truly yours,

KIMLEY HORN AND ASSOCIATES, INC.



B. Douglas Coomer, P.E.
Senior Associate

BDC/LCL:map
Enclosures

Florida Registration
Number 21783

TABLE 1
STATE ROAD 710 TRAFFIC ANALYSIS

ANNUAL AVERAGE DAILY TRAFFIC (AADT)

<u>Segment</u>	<u>Committed Lanes</u>	<u>1990 Existing Volume</u>	<u>Service Volume "C"</u>	<u>1995 Background Traffic</u>	<u>Project Traffic</u>	<u>1995 Total Traffic</u>	<u>Level of Service</u>
North of Project Entrance	2L	6,053	13,100	7,948	41	7,989	A
South of Project Entrance	2L	6,053	13,100	7,948	112	8,060	A

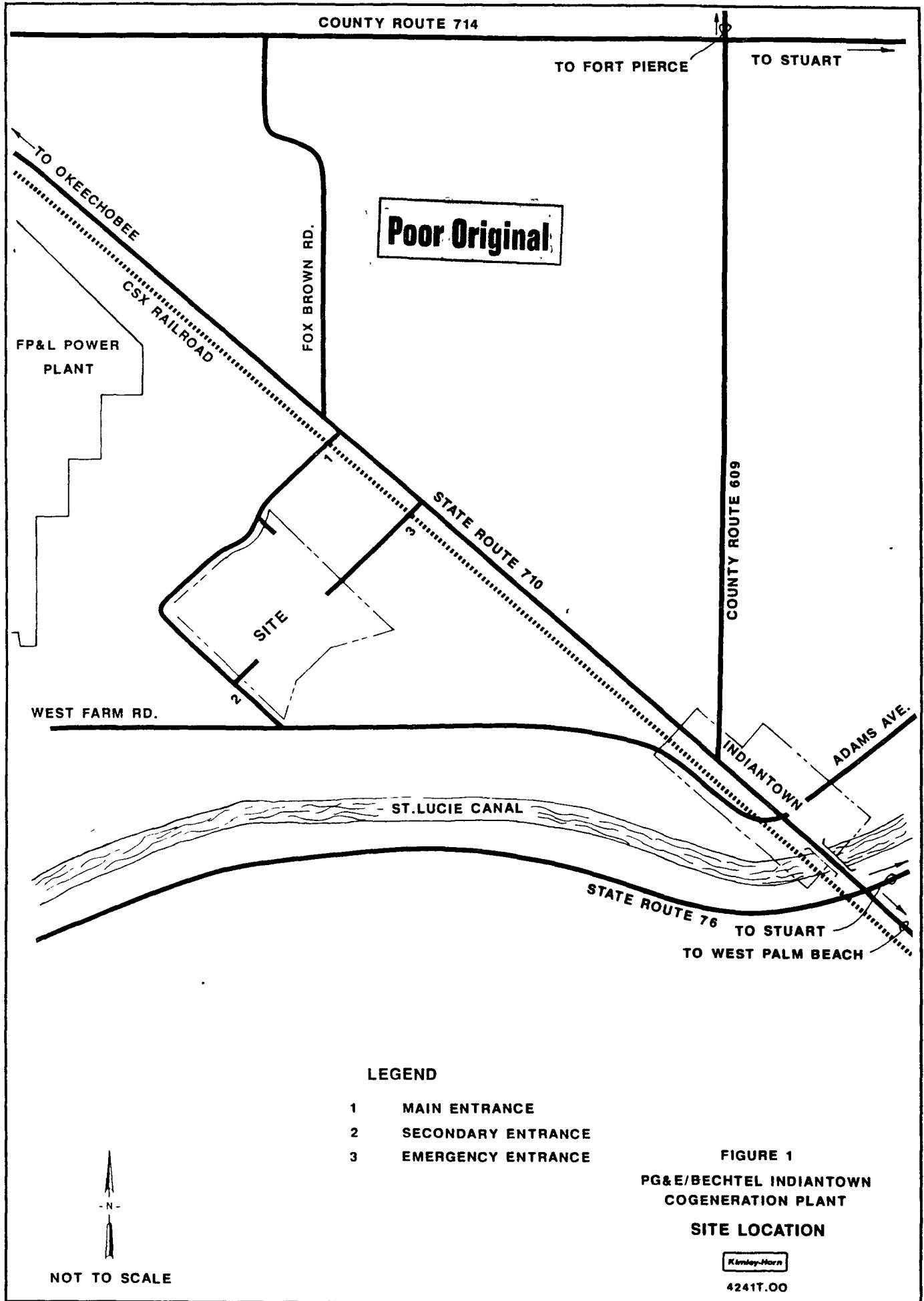
AM PEAK HOUR TRAFFIC

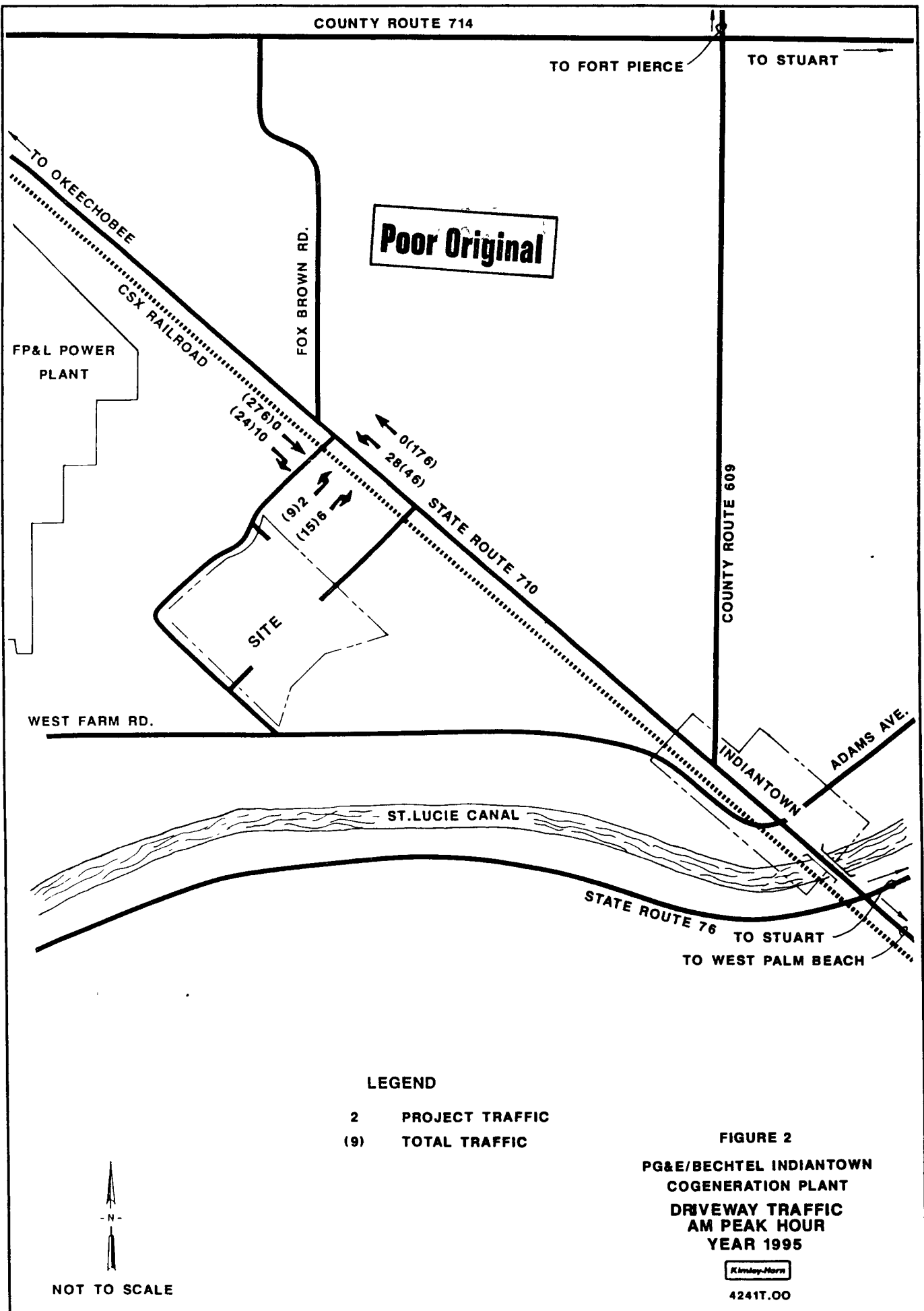
<u>Segment</u>	<u>Committed Lanes</u>	<u>1990 Existing Volume</u>	<u>Service* Volume "C"</u>	<u>1995 Background Traffic</u>	<u>Project Traffic</u>	<u>1995 Total Traffic</u>	<u>Level of Service</u>
North of Project Entrance	2L	456	1,179	599	12	611	A
South of Project Entrance	2L	456	1,179	599	34	633	A

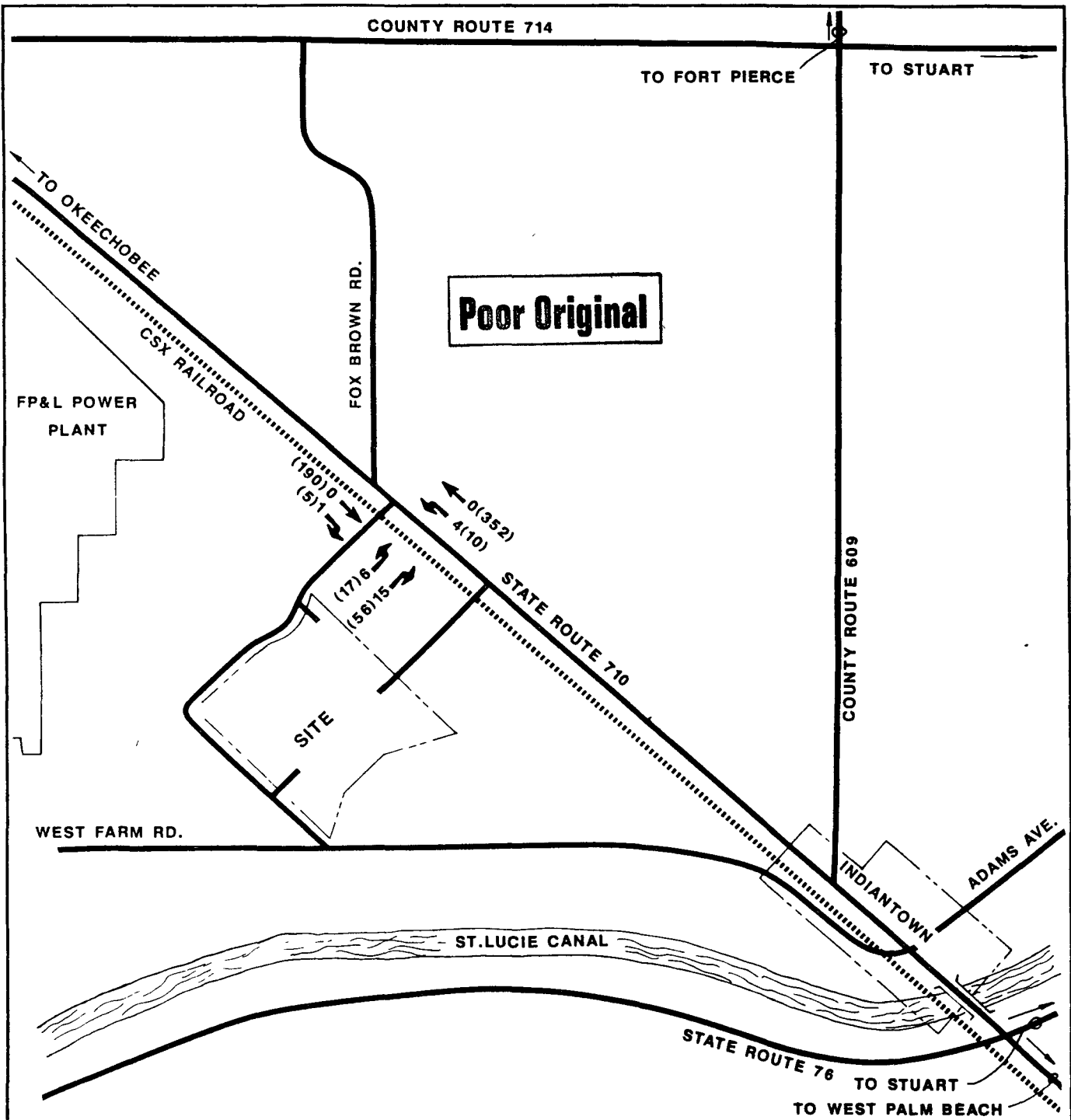
PM PEAK HOUR TRAFFIC

<u>Segment</u>	<u>Committed Lanes</u>	<u>1990 Existing Volume</u>	<u>Service Volume "C"</u>	<u>1995 Background Traffic</u>	<u>Project Traffic</u>	<u>1995 Total Traffic</u>	<u>Level of Service</u>
North of Project Entrance	2L	472	1,179	620	7	627	A
South of Project Entrance	2L	472	1,179	620	19	639	A

*Source: "The roadway link capacity standards for the peak hour" in the Treasure Coast Regional Comprehensive Policy Plan, Policy 19.2.1.6.

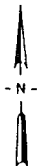






LEGEND

- 4 PROJECT TRAFFIC
- (10) TOTAL TRAFFIC



NOT TO SCALE

FIGURE 3
PG&E/BECHTEL INDIANTOWN
COGENERATION PLANT
DRIVEWAY TRAFFIC
PM PEAK HOUR
YEAR 1995

Kimley-Horn

42417.00

C. TCRPC Requirements

Kimley-Horn

Kimley-Horn and Associates, Inc.
ENGINEERS • PLANNERS • SURVEYORS

4431 Embarcadero Drive West Palm Beach, Florida 33407 407 845-0665 Facsimile 407 863-8175

October 23, 1990
4241T.00(07)

Mr. Stephen A. Sorrentino
PG&E/Bechtel Generating Company
7475 Wisconsin Avenue
Bethesda, Maryland 20814-3422

Re: Indiantown Co-generation Project
Northwest of Indiantown, Martin County, Florida
(TCRPC Requirements)

Dear Steve:

As requested, we have conducted an evaluation of the traffic impact associated with the proposed electrical power generating plant as referenced above. The project is to be located approximately two miles northwest of Indiantown on the south side of State Road 710 in Martin County, Florida (see Figure 1 attached). The following presents the methodology and the findings of this evaluation.

Methodology

The traffic impact analysis was conducted in accordance with the requirements of the Treasure Coast Regional Comprehensive Policy Plan. The analysis used current data available from Martin County, that was supplemented with data collected in the field and also includes assumptions concerning the similar characteristics between the proposed project and the adjacent Florida Power and Light Company (FP&L) power plant. The FP&L power plant existing traffic pattern was used as a basis of this analysis.

Trip Generation

The subject project will require 65 employees per day (80 employees total for 7 workdays per week) by the buildout year. Three different work shifts are planned for the employees. Forty-five employees will work the day shift from 7:00 AM to 4:00 PM, while 10 employees work the evening shift and 10 employees work the night shift. It is anticipated that the plant will be 100 percent built out and in operation by the end of 1995.

The trip generation potential of the proposed project was determined by using the trip generation rates of the adjacent existing FP&L power plant. Turning movement counts were made at the existing power plant entrance to determine the trip generation rates.

The traffic generation potential for the proposed project was calculated using the FP&L power plant existing daily trip rate of 2.35 trips per employee, resulting in 153 daily trips. The AM and PM peak hour trip generation during the peak traffic hour on the adjacent street follows.

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Raleigh • San Diego • Stuart • Tampa • Vero Beach • Virginia Beach • West Palm Beach

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**PEAK HOUR TRIP GENERATION
(VEHICLES PER HOUR)**

<u>AM PEAK HOUR</u>				<u>PM PEAK HOUR</u>			
<u>Trip Rate</u>	<u>Trips</u>	<u>In</u>	<u>Out</u>	<u>Trip Rate</u>	<u>Trips</u>	<u>In</u>	<u>Out</u>
0.71/employee	46	38	8	0.40/employee	26	5	21

Traffic Distribution and Assignment

Existing turning movement counts performed by Kimley-Horn and Associates, Inc. were the basis for determining traffic distribution and assignment for the proposed project. The data collected in the field indicates a split of 27 percent of the FP&L power plant generated traffic traveling northwest of the site and the remaining 73 percent of the traffic travelling southeast. The same split has been used in the analysis of the proposed project.

Driveway Analysis

Access to the development will be provided through a main entrance on State Route 710 and a secondary entrance on West Farm Road. An emergency entrance will also be provided on State Route 710. It is anticipated that approximately 100 percent of the project trips will travel through the main entrance. This assumption presents a conservative approach for traffic analysis purposes.

The AM and PM peak hour traffic at the main entrance is depicted in Figures 2 and 3 attached.

Link Evaluation

The traffic study area was identified based on criteria included in the Treasure Coast Regional Comprehensive Policy Plan. Policy 19.2.1.11. states "the threshold for determining significance of impact shall be as a minimum five percent of the service volume of the appropriate level of service (i.e., LOS C/D) of roadways and intersections under existing peak hour conditions."

It is found that the proposed project will not generate more than five percent of the service volume of Level of Service "C" on the roadway network during the peak hours. However, to depict the traffic impact of the proposed project, State Road 710 one-half (½) mile north and one-half (½) mile south of the project entrance were evaluated since it is the project's direct access to the adjacent roadway network.

Traffic volumes were depicted for the anticipated buildout year of 1995.

A 5.6 percent background growth rate was used based on rates included in Martin County's Comprehensive Growth Management Plan five-year traffic volume tables.

Site-related traffic was added to the background traffic to develop total traffic for the buildout year. Table 1 (attached) shows State Route 710 will operate at Level of Service "A" for daily and peak hours in the buildout year after full operation is initiated.

Intersection Analysis

The only intersection analysis required within the one-half mile radius is the project entrance road at State Road 710. An analysis of turning movement volumes projected for 1995 indicates that this intersection will operate at an acceptable level of service with the capacity provided on the existing streets. However, due to the railroad crossing and the characteristics of traffic anticipated to use this entrance road, an operational improvement is recommended. This improvement would be a right-turn lane on State Road 710 with sufficient storage length to accommodate traffic during closures of the at-grade crossing due to train movements.

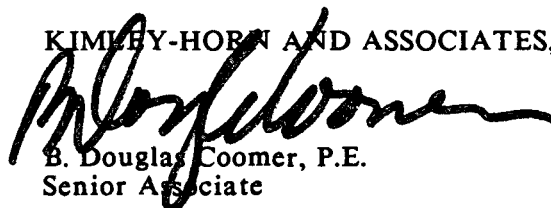
Conclusions and Recommendations

Analyses of projected 1995 traffic volumes with the proposed power plant in operation show that roadway links and the intersection within the study area will operate at acceptable levels of service. Therefore, no improvements are warranted or recommended for roadway segments. However, for the benefit of traffic operations, it is recommended that a southbound right-turn lane on State Road 710 at the project entrance be implemented prior to operation of the proposed power plant.

If you have any questions, please give me a call.

Very truly yours,

KIMBLEY-HORN AND ASSOCIATES, INC.



B. Douglas Coomer, P.E.
Senior Associate

BDC/LCL:map
Enclosures

Florida Registration
Number 21783

TABLE 1
STATE ROAD 710 TRAFFIC ANALYSIS

ANNUAL AVERAGE DAILY TRAFFIC (AADT)

<u>Segment</u>	<u>Committed Lanes</u>	<u>1990 Existing Volume</u>	<u>Service Volume "C"</u>	<u>1995 Background Traffic</u>	<u>Project Traffic</u>	<u>1995 Total Traffic</u>	<u>Level of Service</u>
North of Project Entrance	2L	6,053	13,100	7,948	41	7,989	A
South of Project Entrance	2L	6,053	13,100	7,948	112	8,060	A

AM PEAK HOUR TRAFFIC

<u>Segment</u>	<u>Committed Lanes</u>	<u>1990 Existing Volume</u>	<u>Service* Volume "C"</u>	<u>1995 Background Traffic</u>	<u>Project Traffic</u>	<u>1995 Total Traffic</u>	<u>Level of Service</u>
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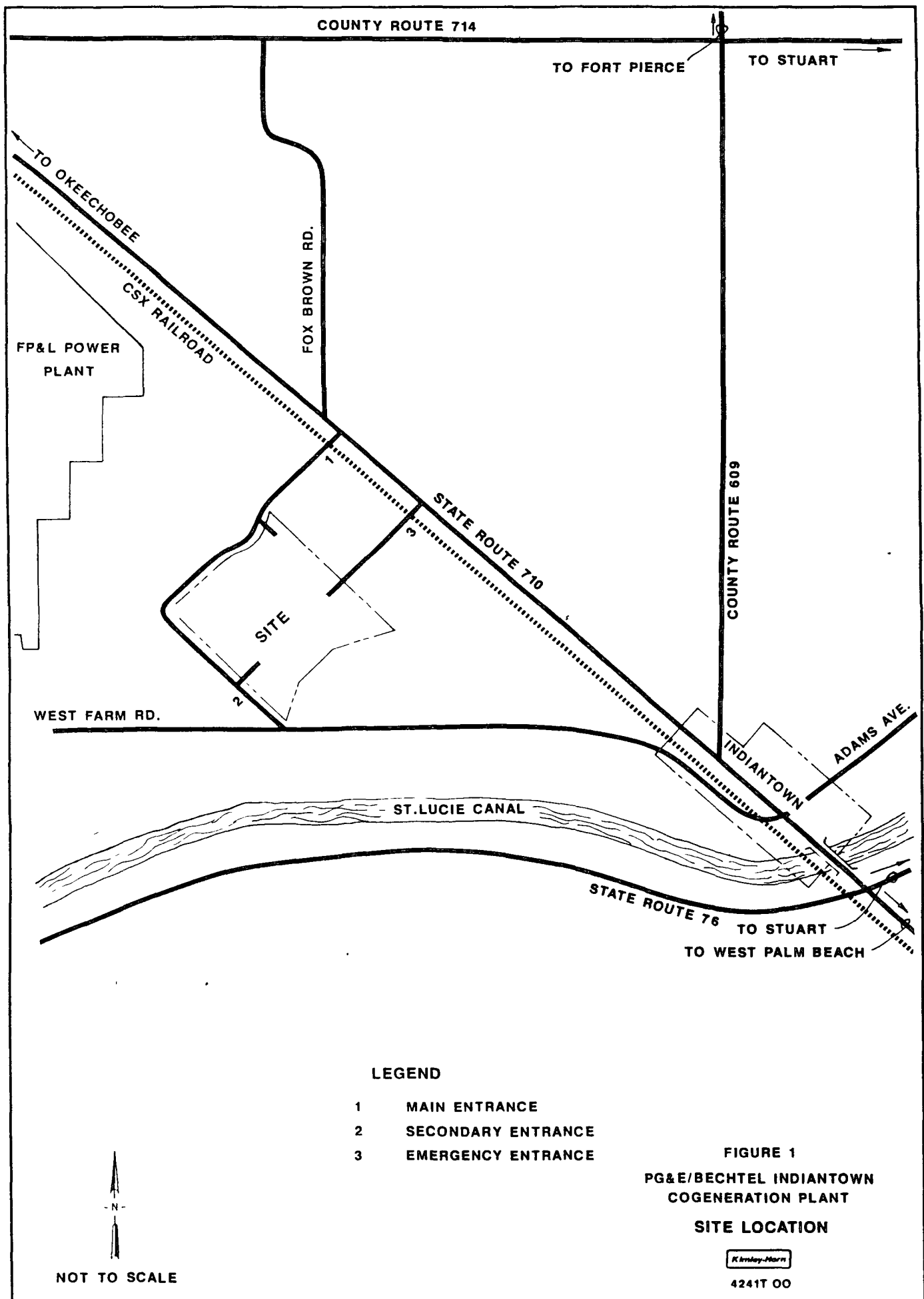
PM PEAK HOUR TRAFFIC

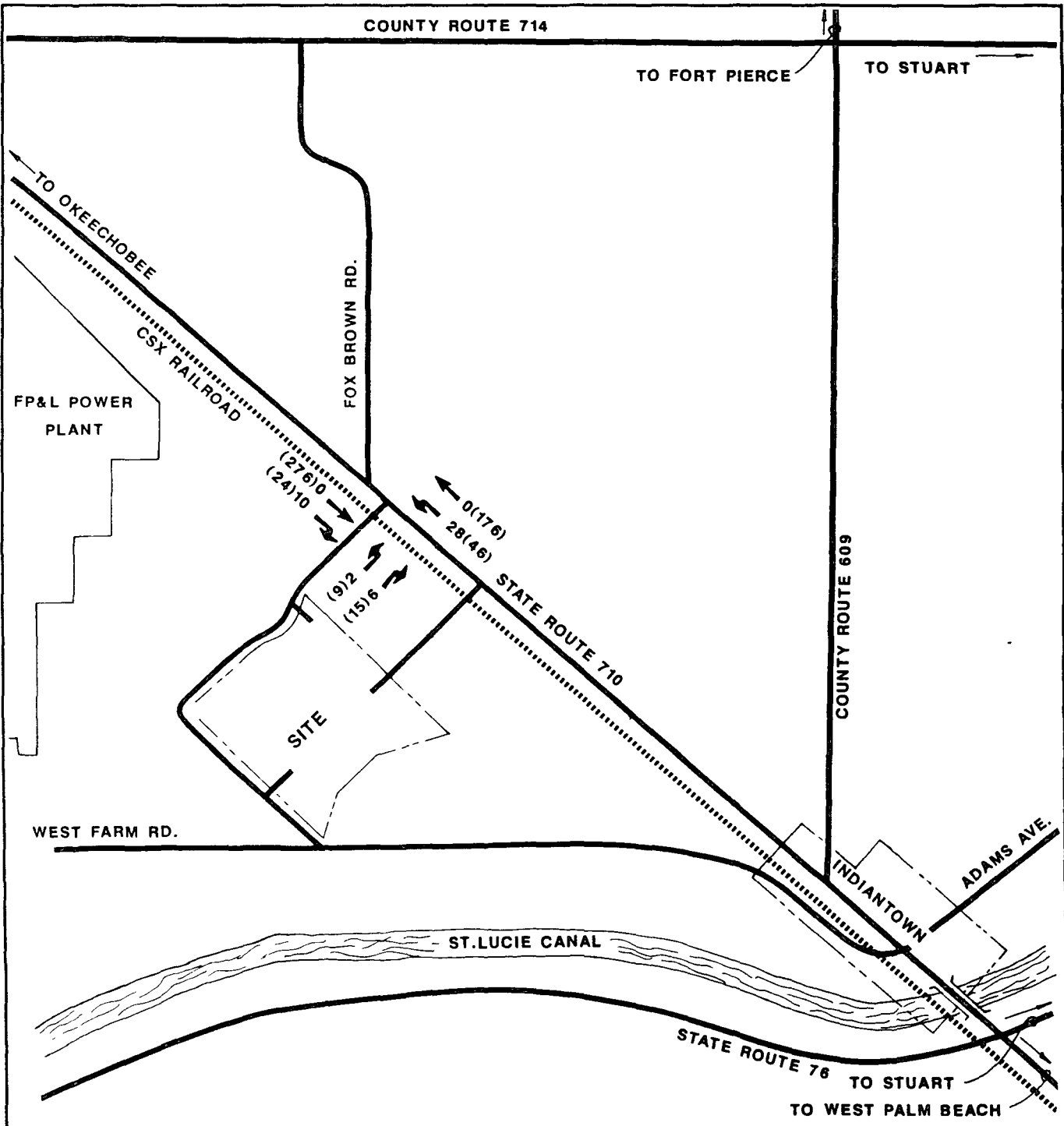
<u>Segment</u>	<u>Committed Lanes</u>	<u>1990 Existing Volume</u>	<u>Service Volume "C"</u>	<u>1995 Background Traffic</u>	<u>Project Traffic</u>	<u>1995 Total Traffic</u>	<u>Level of Service</u>
North of Project Entrance	2L	472	1,179	620	7	627	A
South of Project Entrance	2L	472	1,179	620	19	639	A

*Source: "The roadway link capacity standards for the peak hour" in the Treasure Coast Regional Comprehensive Policy Plan, Policy 19.2.1.6.

IMAGE QUALITY

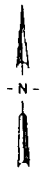
**PLEASE NOTE:
THE ORIGINAL DOCUMENT WHICH
WERE SCANNED FOR THIS RECORD
WERE OF POOR QUALITY.**





LEGEND

- 2 PROJECT TRAFFIC
- (9) TOTAL TRAFFIC



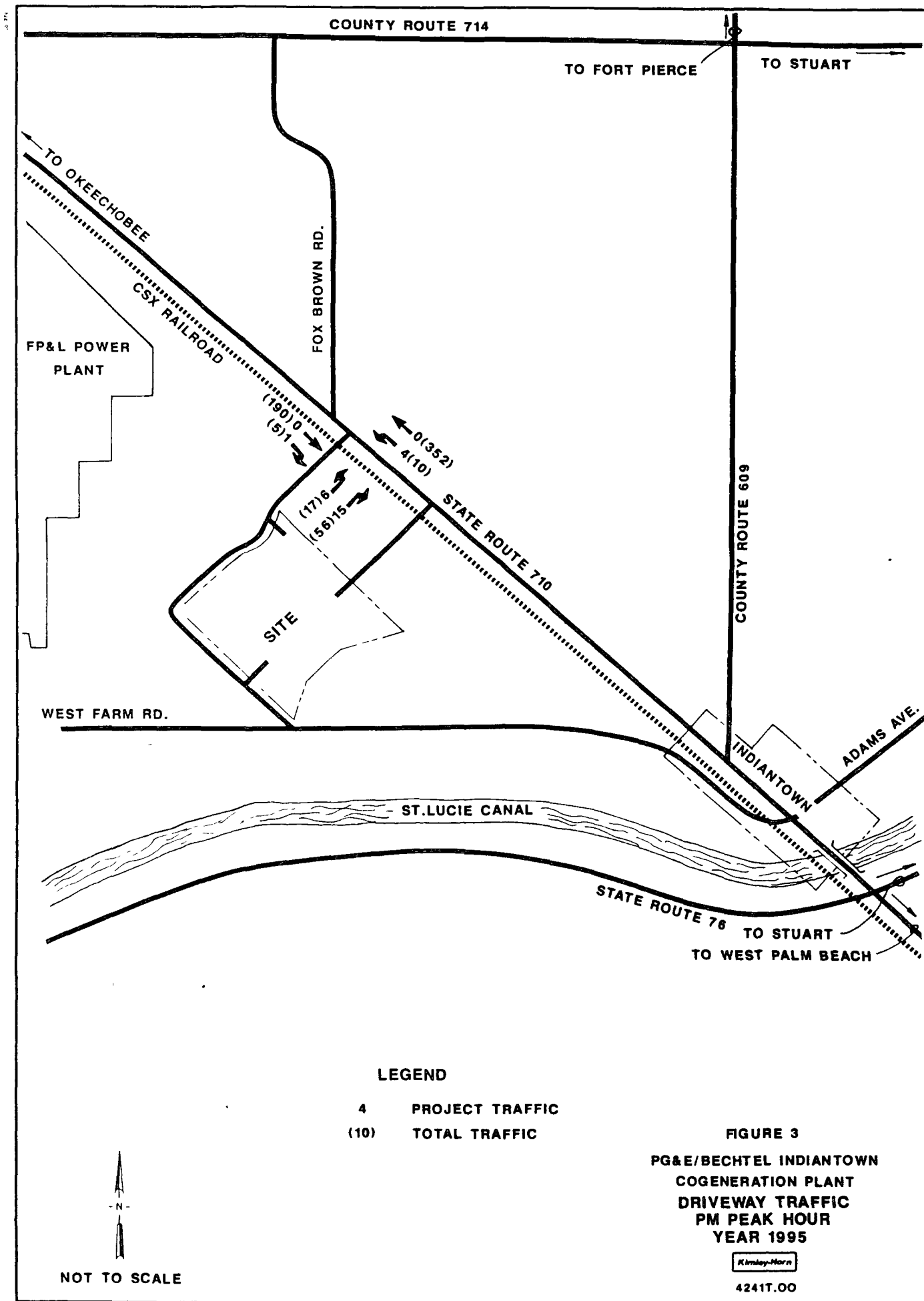
NOT TO SCALE

FIGURE 2

**PG&E/BECHTEL INDIANTOWN
COGENERATION PLANT
DRIVEWAY TRAFFIC
AM PEAK HOUR
YEAR 1995**

Kimley-Horn

4241T.00



D. FDOT Requirements

Kimley-Horn

Kimley-Horn and Associates, Inc
ENGINEERS • PLANNERS • SURVEYORS

4431 Embarcadero Drive West Palm Beach, Florida 33407 407 845-0665 Facsimile 407 863-8175

October 23, 1990
4241T.00(07)

Mr. Stephen A. Sorrentino
PG&E/Bechtel Generating Company
7475 Wisconsin Avenue
Bethesda, Maryland 20814-3422

Re: Indiantown Co-generation Project
Northwest of Indiantown, Martin County, Florida
(FDOT Requirements)

Dear Steve:

As requested, we have conducted an evaluation of the traffic impact associated with the proposed electrical power generating plant as referenced above. The project is to be located approximately two miles northwest of Indiantown on the south side of State Road 710 in Martin County, Florida (see Figure 1 attached). The following presents the methodology and the findings of this evaluation.

Methodology

The project traffic impact was analyzed using the 1985 Highway Capacity Manual as required by the Florida Department of Transportation (FDOT). The analysis used current data available from Martin County, that was supplemented with data collected in the field and also includes assumptions concerning the similar characteristics between the proposed project and the adjacent Florida Power and Light Company (FP&L) power plant. The FP&L power plant existing traffic pattern was used as a basis of this analysis.

Trip Generation

The subject project will require 65 employees per day (80 employees total for 7 workdays per week) by the buildout year. Three different work shifts are planned for the employees. Forty-five employees will work the day shift from 7:00 AM to 4:00 PM, while 10 employees work the evening shift and 10 employees work the night shift. It is anticipated that the plant will be 100 percent built out and in operation by the end of 1995.

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The traffic generation potential for the proposed project was calculated using the FP&L power plant existing daily trip rate of 2.35 trips per employee, resulting in 153 daily trips. The AM and PM peak hour trip generation during the peak traffic hour on the adjacent street follows.

**PEAK HOUR TRIP GENERATION
(VEHICLES PER HOUR)**

<u>AM PEAK HOUR</u>				<u>PM PEAK HOUR</u>			
<u>Trip Rate</u>	<u>Trips</u>	<u>In</u>	<u>Out</u>	<u>Trip Rate</u>	<u>Trips</u>	<u>In</u>	<u>Out</u>
0.71/employee	46	38	8	0.40/employee	26	5	21

Traffic Distribution and Assignment

Existing turning movement counts performed by Kimley-Horn and Associates, Inc. were the basis for determining traffic distribution and assignment for the proposed project. The data collected in the field indicates a split of 27 percent of the FP&L power plant generated traffic traveling northwest of the site and the remaining 73 percent of the traffic travelling southeast. The same split has been used in the analysis of the proposed project.

Driveway Analysis

Access to the development will be provided through a main entrance on State Route 710 and a secondary entrance on West Farm Road. An emergency entrance will also be provided on State Route 710. It is anticipated that approximately 100 percent of the project trips will travel through the main entrance. This assumption presents a conservative approach for traffic analysis purposes.

The AM and PM peak hour traffic at the main entrance is depicted in Figures 2 and 3 attached.

Link Evaluation

The traffic study area was identified based on criteria included in the Martin County Comprehensive Growth Management Plan Traffic Impact Study Guidelines. The study area identified for the analyses includes State Road 710, one-half (½) mile north and one-half (½) mile south of the site.

Traffic volumes were developed for the anticipated buildout year of 1995.

A 5.6 percent background growth rate was used based on rates included in Martin County's Comprehensive Growth Management Plan five-year traffic volume tables.

Site-related traffic was added to the background traffic to develop total traffic for the buildout year. Link analysis, using the 1985 Highway Capacity Manual for two-lane highways, shows State Route 710 will operate at Level of Service "C" during peak hours in the buildout year after full operation is initiated.

Intersection Analysis

The only intersection analysis required within the one-half mile radius is the project entrance road at State Road 710. An analysis of turning movement volumes projected for 1995 indicates that this intersection will operate at an acceptable level of service with the capacity provided on the existing streets. However, due to the railroad crossing and the characteristics of traffic anticipated to use this entrance road, an operational improvement is recommended. This improvement would be a right-turn lane on State Road 710 with sufficient storage length to accommodate traffic during closures of the at-grade crossing due to train movements.

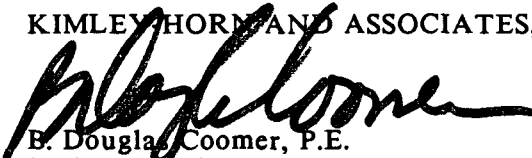
Conclusions and Recommendations

Analyses of projected 1995 traffic volumes with the proposed power plant in operation show that roadway links and the intersection within the study area will operate at acceptable levels of service. Therefore, no improvements are warranted or recommended for roadway segments. However, for the benefit of traffic operations, it is recommended that a southbound right-turn lane on State Road 710 at the project entrance be implemented prior to operation of the proposed power plant.

If you have any questions, please give me a call.

Very truly yours,

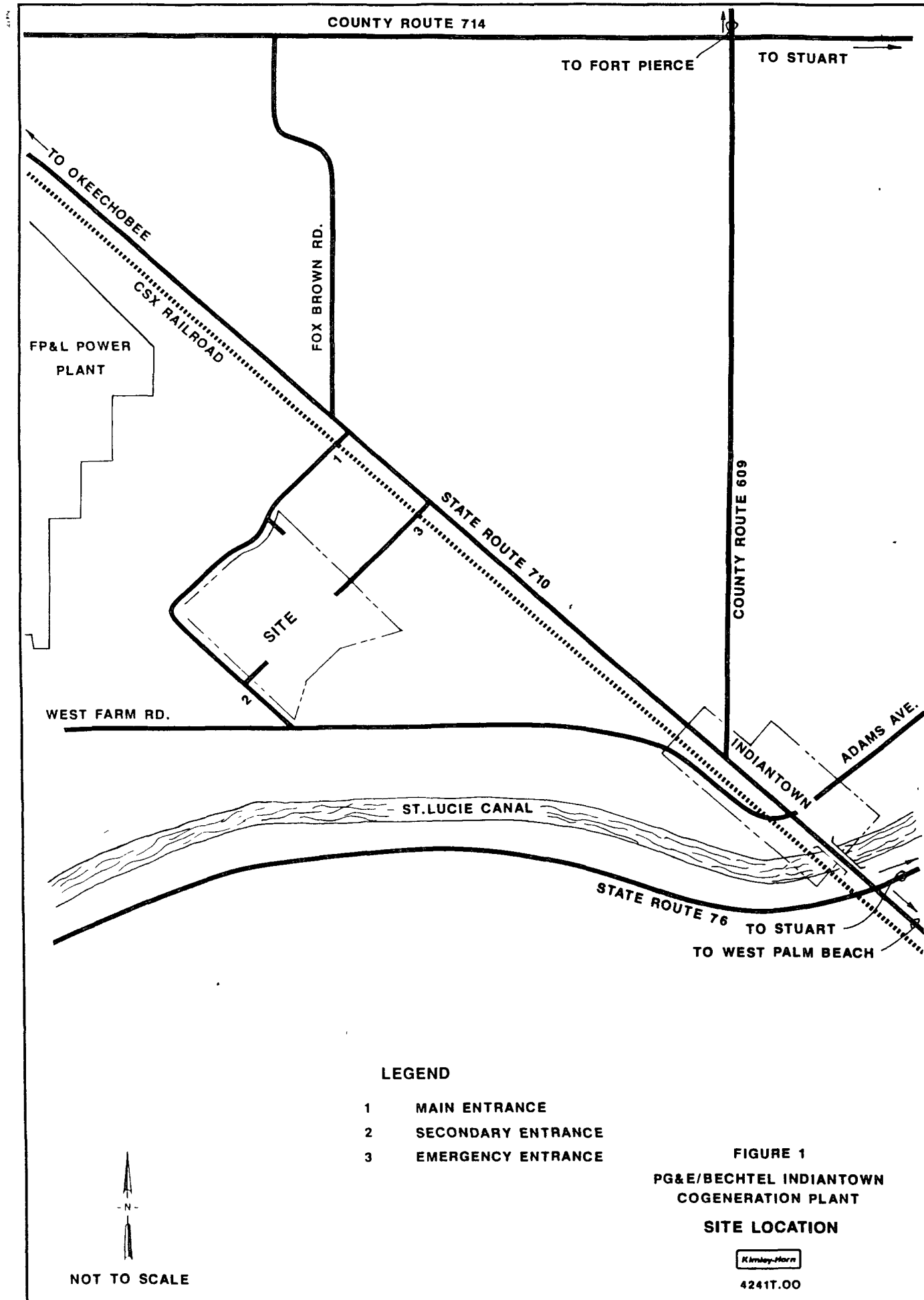
KIMLEY HORN AND ASSOCIATES, INC.

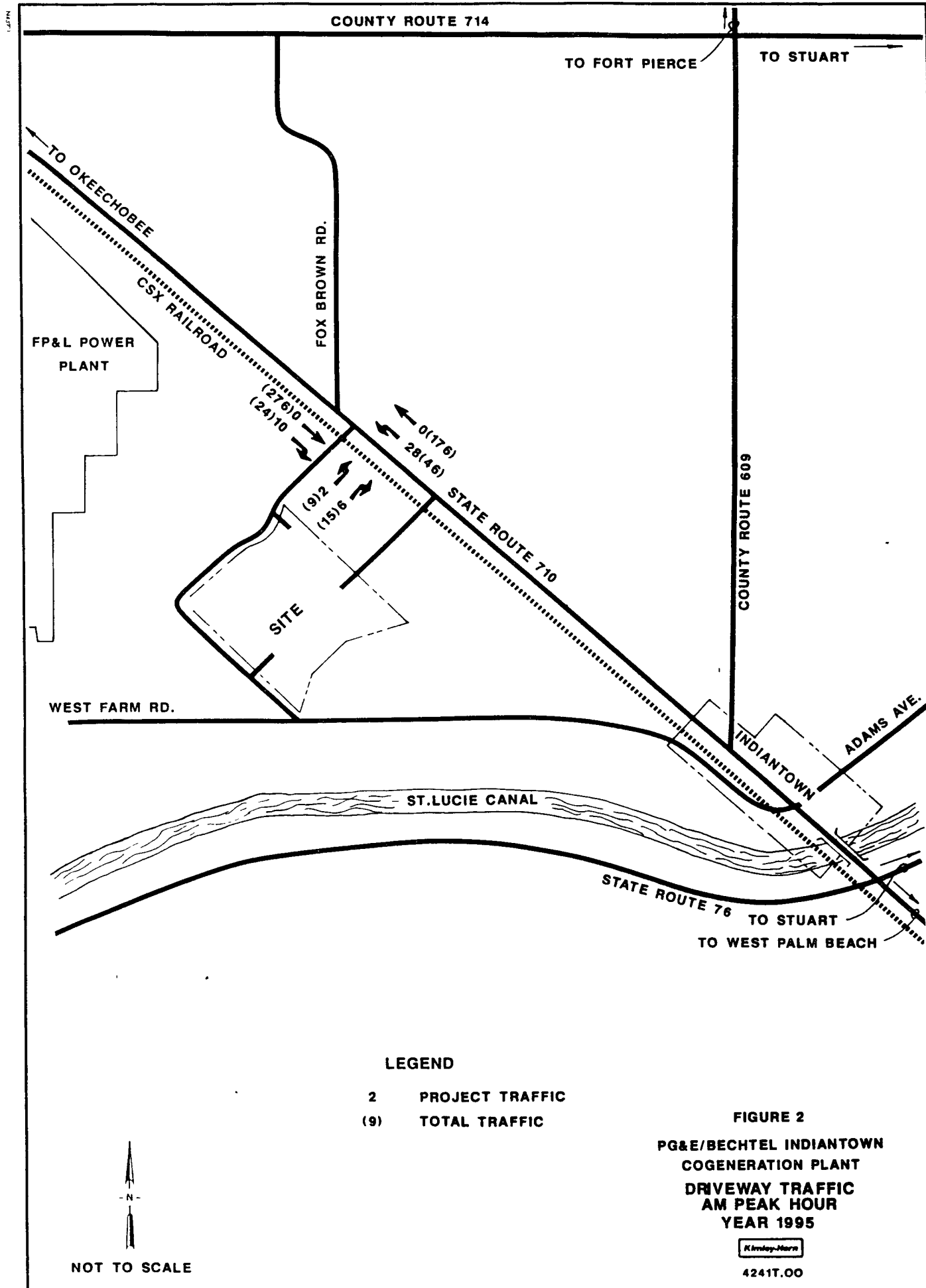


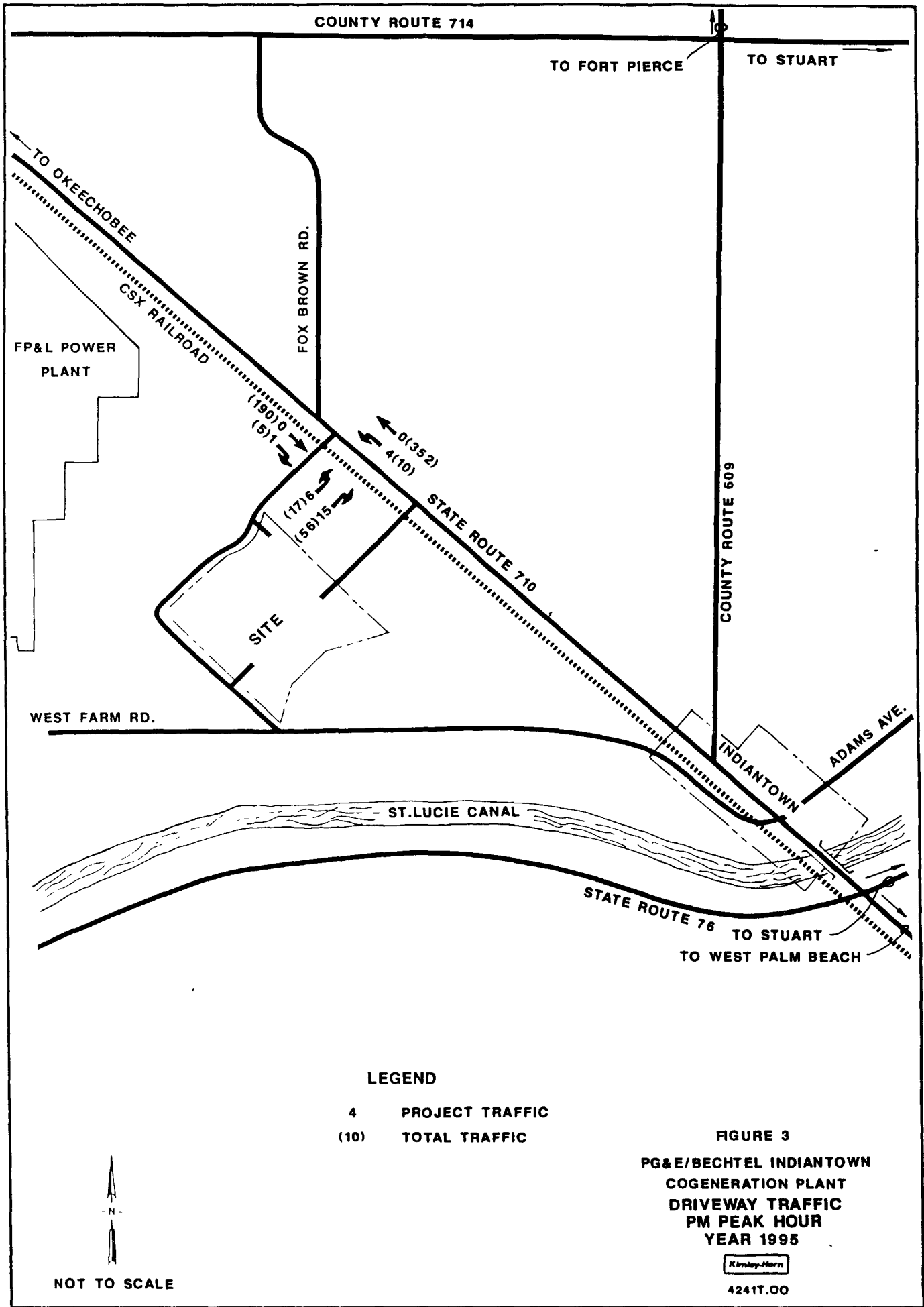
B. Douglas Coomer, P.E.
Senior Associate

BDC/LCL:map
Enclosures

Florida Registration
Number 21783







1985 HCM:TWO-LANE HIGHWAYS

FACILITY LOCATION.... SR 710 NORTH OF PG&E BECHTEL PLANT
 ANALYST..... LCL
 TIME OF ANALYSIS..... AM PEAK HOUR
 DATE OF ANALYSIS..... 09-27-1990
 OTHER INFORMATION.... 1995 TOTAL TRAFFIC

A) ADJUSTMENT FACTORS

 PERCENTAGE OF TRUCKS..... 12
 PERCENTAGE OF BUSES..... 0
 PERCENTAGE OF RECREATIONAL VEHICLES..... 0
 DESIGN SPEED (MPH)..... 60
 PEAK HOUR FACTOR..... .93
 DIRECTIONAL DISTRIBUTION (UP/DOWN)..... 57 / 43
 LANE WIDTH (FT)..... 12
 USABLE SHOULDER WIDTH (AVG. WIDTH IN FT.)... 6
 PERCENT NO PASSING ZONES..... 30

B) CORRECTION FACTORS

 LEVEL TERRAIN

LOS	E T	E B	E R	f w	f d	f HV
A	2	1.8	2.2	1	.96	.89
B	2.2	2	2.5	1	.96	.87
C	2.2	2	2.5	1	.96	.87
D	2	1.6	1.6	1	.96	.89
E	2	1.6	1.6	1	.96	.89

C) LEVEL OF SERVICE RESULTS

 INPUT VOLUME(vph): 611
 ACTUAL FLOW RATE: 657

LOS	SERVICE FLOW RATE	V/C
A	287	.12
B	563	.24
C	914	.39
D	1485	.62
E	2395	1

LOS FOR GIVEN CONDITIONS: C

1985 HCM:TWO-LANE HIGHWAYS

FACILITY LOCATION.... SR 710 NORTH OF PG&E BECHTEL PLANT
 ANALYST..... LCL
 TIME OF ANALYSIS..... PM PEAK HOUR
 DATE OF ANALYSIS..... 09-27-1990
 OTHER INFORMATION.... 1995 TOTAL TRAFFIC

A) ADJUSTMENT FACTORS

 PERCENTAGE OF TRUCKS..... 12
 PERCENTAGE OF BUSES..... 0
 PERCENTAGE OF RECREATIONAL VEHICLES..... 0
 DESIGN SPEED (MPH)..... 60
 PEAK HOUR FACTOR..... .93
 DIRECTIONAL DISTRIBUTION (UP/DOWN)..... 41 / 59
 LANE WIDTH (FT)..... 12
 USABLE SHOULDER WIDTH (AVG. WIDTH IN FT.)... 6
 PERCENT NO PASSING ZONES..... 30

B) CORRECTION FACTORS

 LEVEL TERRAIN

LOS	E T	E B	E R	f w	f d	f HV
---	---	---	---	---	---	---
A	2	1.8	2.2	1	.95	.89
B	2.2	2	2.5	1	.95	.87
C	2.2	2	2.5	1	.95	.87
D	2	1.6	1.6	1	.95	.89
E	2	1.6	1.6	1	.95	.89

C) LEVEL OF SERVICE RESULTS

 INPUT VOLUME(vph): 627
 ACTUAL FLOW RATE: 674

LOS	SERVICE FLOW RATE	V/C
---	---	---
A	284	.12
B	556	.24
C	903	.39
D	1466	.62
E	2365	1

LOS FOR GIVEN CONDITIONS: C

1985 HCM:TWO-LANE HIGHWAYS

FACILITY LOCATION.... SR 710 SOUTH OF PG&E BECHTEL PLANT
 ANALYST..... LCL
 TIME OF ANALYSIS..... AM PEAK HOUR
 DATE OF ANALYSIS..... 09-27-1990
 OTHER INFORMATION.... 1995 TOTAL TRAFFIC

A) ADJUSTMENT FACTORS

 PERCENTAGE OF TRUCKS..... 12
 PERCENTAGE OF BUSES..... 0
 PERCENTAGE OF RECREATIONAL VEHICLES..... 0
 DESIGN SPEED (MPH)..... 60
 PEAK HOUR FACTOR..... .93
 DIRECTIONAL DISTRIBUTION (UP/DOWN)..... 57 / 43
 LANE WIDTH (FT)..... 12
 USABLE SHOULDER WIDTH (AVG. WIDTH IN FT.)... 6
 PERCENT NO PASSING ZONES..... 30

B) CORRECTION FACTORS

LEVEL TERRAIN

LOS	E T	E B	E R	f w	f d	f HV
A	2	1.8	2.2	1	.95	.89
B	2.2	2	2.5	1	.95	.87
C	2.2	2	2.5	1	.95	.87
D	2	1.6	1.6	1	.95	.89
E	2	1.6	1.6	1	.95	.89

C) LEVEL OF SERVICE RESULTS

 INPUT VOLUME(vph): 633
 ACTUAL FLOW RATE: 681

LOS	SERVICE FLOW RATE	V/C
A	285	.12
B	558	.24
C	907	.39
D	1473	.62
E	2375	1

LOS FOR GIVEN CONDITIONS: C

1985 HCM:TWO-LANE HIGHWAYS

FACILITY LOCATION.... SR 710 SOUTH OF PG&E BECHTEL PLANT
 ANALYST..... LCL
 TIME OF ANALYSIS..... PM PEAK HOUR
 DATE OF ANALYSIS..... 09-27-1990
 OTHER INFORMATION.... 1995 TOTAL TRAFFIC

A) ADJUSTMENT FACTORS

 PERCENTAGE OF TRUCKS..... 12
 PERCENTAGE OF BUSES..... 0
 PERCENTAGE OF RECREATIONAL VEHICLES..... 0
 DESIGN SPEED (MPH)..... 60
 PEAK HOUR FACTOR..... .93
 DIRECTIONAL DISTRIBUTION (UP/DOWN)..... 41 / 59
 LANE WIDTH (FT)..... 12
 USABLE SHOULDER WIDTH (AVG. WIDTH IN FT.)... 6
 PERCENT NO PASSING ZONES..... 30

B) CORRECTION FACTORS

LEVEL TERRAIN

LOS	E T	E B	E R	f w	f d	f HV
A	2	1.8	2.2	1	.95	.89
B	2.2	2	2.5	1	.95	.87
C	2.2	2	2.5	1	.95	.87
D	2	1.6	1.6	1	.95	.89
E	2	1.6	1.6	1	.95	.89

C) LEVEL OF SERVICE RESULTS

 INPUT VOLUME(vph): 639
 ACTUAL FLOW RATE: 687

LOS	SERVICE FLOW RATE	V/C
A	285	.12
B	558	.24
C	907	.39
D	1473	.62
E	2375	1

LOS FOR GIVEN CONDITIONS: C

IDENTIFYING INFORMATION

AVERAGE RUNNING SPEED, MAJOR STREET.. 45

PEAK HOUR FACTOR..... .9

AREA POPULATION..... 150000

NAME OF THE EAST/WEST STREET..... SR 710

NAME OF THE NORTH/SOUTH STREET..... PLANT ENTRANCE ROAD

NAME OF THE ANALYST..... LCL

DATE OF THE ANALYSIS (mm/dd/yy)..... 09-27-1990

TIME PERIOD ANALYZED..... AM PEAK HOUR

OTHER INFORMATION..... 1995 TOTAL TRAFFIC

INTERSECTION TYPE AND CONTROL

INTERSECTION TYPE: T-INTERSECTION

MAJOR STREET DIRECTION: EAST/WEST

CONTROL TYPE NORTHBOUND: STOP SIGN

TRAFFIC VOLUMES

	EB	WB	NB	SB
	----	----	----	----
LEFT	0	46	9	--
THRU	276	176	0	--
RIGHT	24	0	15	--

NUMBER OF LANES

	EB	WB	NB	SB
	----	----	----	----
LANES	1	1	1	--

ADJUSTMENT FACTORS

Page-2

	PERCENT GRADE	RIGHT TURN ANGLE	CURB RADIUS (ft) FOR RIGHT TURNS	ACCELERATION LANE FOR RIGHT TURNS
EASTBOUND	0.00	90	20	N
WESTBOUND	0.00	90	20	N
NORTHBOUND	0.00	90	20	N
SOUTHBOUND	-----	---	---	-

VEHICLE COMPOSITION

	% SU TRUCKS AND RV'S	% COMBINATION VEHICLES	% MOTORCYCLES
EASTBOUND	0	0	0
WESTBOUND	0	0	0
NORTHBOUND	0	0	0
SOUTHBOUND	---	---	---

CRITICAL GAPS

	TABULAR VALUES (Table 10-2)	ADJUSTED VALUE	SIGHT DIST. ADJUSTMENT	FINAL CRITICAL GAP
MINOR RIGHTS				
NB	6.10	6.10	0.00	6.10
MAJOR LEFTS				
WB	5.30	5.30	0.00	5.30
MINOR LEFTS				
NB	7.40	7.40	0.00	7.40

IDENTIFYING INFORMATION

NAME OF THE EAST/WEST STREET..... SR 710
NAME OF THE NORTH/SOUTH STREET.... PLANT ENTRANCE ROAD
DATE AND TIME OF THE ANALYSIS..... 09-27-1990 ; AM PEAK HOUR
OTHER INFORMATION.... 1995 TOTAL TRAFFIC

CAPACITY AND LEVEL-OF-SERVICE

Page-3

MOVEMENT	FLOW- RATE v(pcph)	POTEN- TIAL CAPACITY c (pcph) p	ACTUAL MOVEMENT CAPACITY c (pcph) M		SHARED CAPACITY c (pcph) SH		RESERVE CAPACITY c = c - v R SH		LOS
MINOR STREET									
NB LEFT	11	359	344	>	344	>	333	>	B
				>	497	>	467	>	A
RIGHT	18	678	678	>	678	>	659	>	A
MAJOR STREET									
WB LEFT	56	799	799		799		743		A

IDENTIFYING INFORMATION

NAME OF THE EAST/WEST STREET..... SR 710
NAME OF THE NORTH/SOUTH STREET.... PLANT ENTRANCE ROAD
DATE AND TIME OF THE ANALYSIS..... 09-27-1990 ; AM PEAK HOUR
OTHER INFORMATION..... 1995 TOTAL TRAFFIC

IDENTIFYING INFORMATION

AVERAGE RUNNING SPEED, MAJOR STREET.. 45
PEAK HOUR FACTOR..... .9
AREA POPULATION..... 150000
NAME OF THE EAST/WEST STREET..... SR 710
NAME OF THE NORTH/SOUTH STREET..... PLANT ENTRANCE ROAD
NAME OF THE ANALYST..... LCL
DATE OF THE ANALYSIS (mm/dd/yy)..... 09-27-1990
TIME PERIOD ANALYZED..... PM PEAK HOUR
OTHER INFORMATION.... 1995 TOTAL TRAFFIC

INTERSECTION TYPE AND CONTROL

INTERSECTION TYPE: T-INTERSECTION
MAJOR STREET DIRECTION: EAST/WEST
CONTROL TYPE NORTHBOUND: STOP SIGN

TRAFFIC VOLUMES

	EB	WB	NB	SB
	----	----	----	----
LEFT	0	10	17	--
THRU	190	352	0	--
RIGHT	5	0	56	--

NUMBER OF LANES

	EB	WB	NB	SB
	----	----	----	----
LANES	1	1	1	--

ADJUSTMENT FACTORS

Page-2

	PERCENT GRADE	RIGHT TURN ANGLE	CURB RADIUS (ft) FOR RIGHT TURNS	ACCELERATION LANE FOR RIGHT TURNS
EASTBOUND	0.00	90	20	N
WESTBOUND	0.00	90	20	N
NORTHBOUND	0.00	90	20	N
SOUTHBOUND	-----	---	---	-

VEHICLE COMPOSITION

	% SU TRUCKS AND RV'S	% COMBINATION VEHICLES	% MOTORCYCLES
EASTBOUND	0	0	0
WESTBOUND	0	0	0
NORTHBOUND	0	0	0
SOUTHBOUND	---	---	---

CRITICAL GAPS

	TABULAR VALUES (Table 10-2)	ADJUSTED VALUE	SIGHT DIST. ADJUSTMENT	FINAL CRITICAL GAP
MINOR RIGHTS				
NB	6.10	6.10	0.00	6.10
MAJOR LEFTS				
WB	5.30	5.30	0.00	5.30
MINOR LEFTS				
NB	7.40	7.40	0.00	7.40

IDENTIFYING INFORMATION

NAME OF THE EAST/WEST STREET..... SR 710
NAME OF THE NORTH/SOUTH STREET.... PLANT ENTRANCE ROAD
DATE AND TIME OF THE ANALYSIS..... 09-27-1990 ; PM PEAK HOUR
OTHER INFORMATION..... 1995 TOTAL TRAFFIC

CAPACITY AND LEVEL-OF-SERVICE

Page-3

MOVEMENT	FLOW- RATE v (pcph)	POTEN- TIAL CAPACITY c (pcph) p	ACTUAL MOVEMENT CAPACITY c (pcph) M		SHARED CAPACITY c (pcph) SH		RESERVE CAPACITY c = c - v R SH		LOS
MINOR STREET									
NB LEFT	21	330	328	>	328	>	307	>	B
				>	585	>	496	>	A
RIGHT	68	768	768	>	768	>	700	>	A
MAJOR STREET									
WB LEFT	12	912	912		912		899		A

IDENTIFYING INFORMATION

NAME OF THE EAST/WEST STREET..... SR 710
NAME OF THE NORTH/SOUTH STREET.... PLANT ENTRANCE ROAD
DATE AND TIME OF THE ANALYSIS..... 09-27-1990 ; PM PEAK HOUR
OTHER INFORMATION.... 1995 TOTAL TRAFFIC

10-11

10.11 UIC PERMIT APPLICATION

IMAGE QUALITY

AS YOU REVIEW THE NEXT GROUP OF IMAGES,
PLEASE NOTE THAT THE ORIGINAL
DOCUMENTS WERE OF POOR QUALITY.



Florida Department of Environmental Regulation

Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

DER Form #	_____
Form Title	_____
Effective Date	_____
DER Application No.	_____
Filed in by DER	

APPLICATION TO CONSTRUCT/OPERATE/ABANDON CLASS I, III, OR V INJECTION WELL SYSTEMS

PART I. Directions

- A. All applicable items must be completed in full in order to avoid delay in processing this application. Where attached sheets or other technical documentation are utilized in lieu of the blank space provided, indicate appropriate cross-reference in the space and provide copies to the department in accordance with (C) below. Where certain items do not appear applicable to the project, indicate N/A in the appropriate spaces. When this form is used in conjunction with DER Form 17-1.205(1), duplicative information requests need to be completed only once.
- B. All information is to be typed or printed in ink.
- C. Four (4) copies of this application and four (4) copies of supporting information such as plans, reports, drawings and other documents shall be submitted to the appropriate District/Subdistrict office. An engineering report is also required to be submitted to support this application pursuant to the applicable sections of Florida Administrative Code Rule 17-28. The attached lists* shall be used to determine completeness of supporting data submitted or previously received. A check for the application fee in accordance with Florida Administrative Code Rule 17-4.05 made payable to the Department shall accompany the application.
- D. For projects involving construction, this application is to be accompanied by four (4) sets of engineering drawings, specifications and design data as prepared by a Professional Engineer registered in Florida, where required by Chapter 471, Florida Statutes.
- E. Attach 8 1/2" x 11" USGS site location map indicating township, range and section and latitude/longitude for the project.

PART II. General Information

- A. Applicant: Name _____ Title _____
Address _____
City _____ Zip _____
Telephone Number _____
- B. Project Status: ☒ New ☐ Existing
 ☐ Modification (specify) _____

*"Engineering and Hydrogeologic Data Required for Support of Application to Construct, Operate and Abandon Class I, III, or V Injection Wells"

DER FORM 17-1.209(9)

Effective November 30, 1982

Page 1 of 10

Protecting Florida and Your Quality of Life

Northwest District
180 Government Center
Panama, Florida 32301 5794

Northwest District
3420 S.W. Rd.
Jacksonville, Florida 32207

Central District
3319 Maguire Blvd. Suite 232
Orlando, Florida 32803-3767
407.864.7644

Southwest District
4520 Oak Park Blvd
Tampa, Florida 33610-7347
813-623 5861

South District
2268 Bay St
Fort Myers, Florida 33901-2896
813 573 3627

Southeast District
1900 S Congress Ave. Suite A
West Palm Beach, Florida 33411
407 964-9668

C. Well Type:

() Exploratory Well ☒ Test/Injection Well

D. Type of Permit Application:

- () Class I Exploratory Well Construction and Testing Permit
(X) Class I Test/Injection Well Construction and Testing Permit
() Class I Well Operating Permit
() Class I Well Plugging and Abandonment Permit
() Class III Well Construction/Operation/Plugging and Abandonment Permit
() Class V well Construction Permit
() Class V Well Operating Permit
() Class V Well Plugging and Abandonment Permit

E. Facility Identification:

Name: Indiantown Cogeneration Project

Facility Location: Street: Route 710

City: Indiantown County: Martin

SIC Code: 4911

F. Proposed facility located on Indian Lands: Yes _____ No X

G. Well Identification:

Well No. 1 of 2 Wells
(total #)

Purpose (Proposed Use): Disposal of treated wastewater

Well Location: Latitude: 27° 2' 25" Longitude 80° 30' 44"

(attach separate sheet, if necessary, for multiple wells.)

Subpart B. General Projection Description:

- (1) Describe the nature, extent and schedule of the injection well project. Refer to existing and/or future pollution control facilities, expected improvement in performance of the facilities and state whether the project will result in full compliance with the requirements of Chapter 403, Florida Statutes, and all rules and regulations of the Department. Attach additional sheet(s) if necessary or cross-reference the engineering report.

See Attachment "A"

PART III Statement by Applicant and Engineer

A. Applicant

I, the owner/authorized representative* of _____, certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. I understand that this certification also applies to all subsequent reports submitted pursuant to this permit. Where construction is involved, I agree to retain the design engineer, or other professional engineer registered in Florida, to provide inspection of construction in accordance with Florida Administrative Code Rule 17-28.34(1)(c).

Signed

Date

Name and Title (Please Type)

Telephone Number

*Attach a Letter of Authorization.

B. Professional Engineer Registered in Florida

This is to certify that the engineering features of this injection well have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgement, that the well, when properly maintained and operated, will discharge the effluent in compliance with all applicable statutes of the State of Florida and the rules and regulations of the Department. It is also agreed that the undersigned will furnish the applicant a set of instructions for proper maintenance and operation of the well.

Signed: _____

Name (Please Type)

Company Name (Please Type)

Mailing Address (Please Type)

(Please Affix Seal)

FLORIDA REGISTRATION NUMBER _____ Date: _____ Phone No. _____

**ENGINEERING AND HYDROLOGIC DATA
REQUIRED FOR SUPPORT OF APPLICATION
TO CONSTRUCT, OPERATE, AND ABANDON
CLASS I, III, OR V INJECTION WELL SYSTEMS**

The following information shall be provided for each type of permit application.

(A) CLASS I EXPLORATORY WELL CONSTRUCTION AND TESTING PERMIT

- (1) Conceptual plan of the injection project. Include number of injection wells, proposed injection zone, nature and volume of injection fluid, and proposed monitoring program.
- (2) Preliminary Area of Review Study. Include the proposed radius of the area of review with justification for that radius. Provide a map showing the location of the proposed injection well or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to the applicant is required to be included on this map.
- (3) Proposed other uses of the exploratory well.
- (4) Drilling and testing plan for the exploratory well. The drilling plan must specify the proposed drilling program, sampling, coring, and testing procedures.
- (5) Abandonment Plan.

(B) CLASS I TEST/INJECTION WELL CONSTRUCTION AND TESTING PERMIT

- (1) A map showing the location of the proposed injection wells or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to the applicant is required to be included on this map.
- (2) A tabulation of data on all wells within the area of review which penetrate into the proposed injection zone, confining zone, or proposed monitoring zone. Such data shall include a description of each well's type, construction, data drilled, location, depth, record of plugging and/or completion, and any additional information the Department may require.
- (3) Maps and cross sections indicating the general vertical and lateral limits within the area of review of all underground sources of drinking water, their position relative to the injection formation and the direction of water movement, where known, in each underground source of drinking water which may be affected by the proposed injection.



Florida Department of Environmental Regulation

Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

DER Form #	_____
Form Title	_____
Effective Date	_____
DER Application No.	_____ Filed in by DER

APPLICATION TO CONSTRUCT/OPERATE/ABANDON CLASS I, III, OR V INJECTION WELL SYSTEMS

PART I. Directions

- A. All applicable items must be completed in full in order to avoid delay in processing this application. Where attached sheets or other technical documentation are utilized in lieu of the blank space provided, indicate appropriate cross-reference in the space and provide copies to the department in accordance with (C) below. Where certain items do not appear applicable to the project, indicate N/A in the appropriate spaces. When this form is used in conjunction with DER Form 17-1.205(1), duplicative information requests need to be completed only once.
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- D. For projects involving construction, this application is to be accompanied by four (4) sets of engineering drawings, specifications and design data as prepared by a Professional Engineer registered in Florida, where required by Chapter 471, Florida Statutes.
- E. Attach 8 1/2" x 11" USGS site location map indicating township, range and section and latitude/longitude for the project.

PART II. General Information

- A. Applicant: Name _____ Title _____
Address _____
City _____ Zip _____
Telephone Number _____
- B. Project Status: ☒ New ☐ Existing
 ☐ Modification (specify) _____

*"Engineering and Hydrogeologic Data Required for Support of Application to Construct, Operate and Abandon Class I, III, or V Injection Wells"

DER FORM 17-1.209(9)

Effective November 30, 1982

Page 1 of 10

Protecting Florida and Your Quality of Life

C. Well Type:

☐ Exploratory Well ☒ Test/Injection Well

D. Type of Permit Application:

- ☐ Class I Exploratory Well Construction and Testing Permit
☒ Class I Test/Injection Well Construction and Testing Permit
☐ Class I Well Operating Permit
☐ Class I Well Plugging and Abandonment Permit
☐ Class III Well Construction/Operation/Plugging and Abandonment Permit
☐ Class V well Construction Permit
☐ Class V Well Operating Permit
☐ Class V Well Plugging and Abandonment Permit

E. Facility Identification:

Name: Indiantown Cogeneration Project

Facility Location: Street: Route 710

City: Indiantown County: Martin

SIC Code: 4911

F. Proposed facility located on Indian Lands: Yes _____ No X

G. Well Identification:

Well No. 2 of 2 Wells
(total #)

Purpose (Proposed Use): Backup to primary well for disposal of treated wastewater

Well Location: Latitude: 27° 2' 23" Longitude 80° 30' 46"

(attach separate sheet, if necessary, for multiple wells.)

Subpart B. General Projection Description:

- (1) Describe the nature, extent and schedule of the injection well project. Refer to existing and/or future pollution control facilities, expected improvement in performance of the facilities and state whether the project will result in full compliance with the requirements of Chapter 403, Florida Statutes, and all rules and regulations of the Department. Attach additional sheet(s) if necessary or cross-reference the engineering report.

See Attachment "A"

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A. Applicant

I, the owner/authorized representative* of _____, certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. I understand that this certification also applies to all subsequent reports submitted pursuant to this permit. Where construction is involved, I agree to retain the design engineer, or other professional engineer registered in Florida, to provide inspection of construction in accordance with Florida Administrative Code Rule 17-28.34(1)(c).

Signed _____

Date _____

Name and Title (Please Type) _____

Telephone Number _____

*Attach a Letter of Authorization.

B. Professional Engineer Registered in Florida

This is to certify that the engineering features of this injection well have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgement, that the well, when properly maintained and operated, will discharge the effluent in compliance with all applicable statutes of the State of Florida and the rules and regulations of the Department. It is also agreed that the undersigned will furnish the applicant a set of instructions for proper maintenance and operation of the well.

Signed: _____

Name (Please Type)

Company Name (Please Type)

Mailing Address (Please Type)

(Please Affix Seal)

FLORIDA REGISTRATION NUMBER _____ Date: _____ Phone No. _____

**ENGINEERING AND HYDROLOGIC DATA
REQUIRED FOR SUPPORT OF APPLICATION
TO CONSTRUCT, OPERATE, AND ABANDON
CLASS I, III, OR V INJECTION WELL SYSTEMS**

The following information shall be provided for each type of permit application.

(A) CLASS I EXPLORATORY WELL CONSTRUCTION AND TESTING PERMIT

- (1) Conceptual plan of the injection project. Include number of injection wells, proposed injection zone, nature and volume of injection fluid, and proposed monitoring program.
- (2) Preliminary Area of Review Study. Include the proposed radius of the area of review with justification for that radius. Provide a map showing the location of the proposed injection well or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to the applicant is required to be included on this map.
- (3) Proposed other uses of the exploratory well.
- (4) Drilling and testing plan for the exploratory well. The drilling plan must specify the proposed drilling program, sampling, coring, and testing procedures.
- (5) Abandonment Plan.

(B) CLASS I TEST/INJECTION WELL CONSTRUCTION AND TESTING PERMIT

- (1) A map showing the location of the proposed injection wells or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to the applicant is required to be included on this map.
- (2) A tabulation of data on all wells within the area of review which penetrate into the proposed injection zone, confining zone, or proposed monitoring zone. Such data shall include a description of each well's type, construction, data drilled, location, depth, record of plugging and/or completion, and any additional information the Department may require.
- (3) Maps and cross sections indicating the general vertical and lateral limits within the area of review of all underground sources of drinking water, their position relative to the injection formation and the direction of water movement, where known, in each underground source of drinking water which may be affected by the proposed injection.

- (4) Maps and cross sections detailing the hydrology and geologic structures of the local area.
- (5) Generalized maps and cross sections illustrating the regional geologic setting.
- (6) Proposed operating data.
 - a. Average and maximum daily rate and volume of the fluid to be injected;
 - b. Average and maximum injection pressure; and,
 - c. Source and an analysis of the chemical, physical, radiological and biological characteristics of injection fluids.
- (7) Proposed formation testing program to obtain an analysis of the chemical, physical and radiological characteristics of and other information on the injection zone.
- (8) Proposed stimulation program.
- (9) Proposed injection procedure.
- (10) Engineering drawings of the surface and subsurface construction details of the system.
- (11) Contingency plans to cope with all shut-ins or well failures, so as to protect the quality of the waters of the State as defined in Florida Administrative Code Rule 17-3, including alternate or emergency discharge provisions.
- (12) Plans (including maps) and proposed monitoring data to be reported for meeting the monitoring requirements in Florida Administrative Code Rule 17-28.25.
- (13) For wells within the area of review which penetrate the injection zone but are not properly completed or plugged, the corrective action proposed to be taken under Florida Administrative Code Rule 17-28.13(5).
- (14) Construction procedures including a cementing and casing program, logging procedures, deviation checks, proposed methods for isolating drilling fluids from surficial aquifers, proposed blowout protection (if necessary), and a drilling, testing and coring program.
- (15) A certification that the applicant has ensured, through a performance bond or other appropriate means, the resources necessary to close, plug or abandon the well as required by Florida Administrative Code Rule 17-28.27(9).

(C) CLASS I INJECTION WELL OPERATING PERMIT

- (1) A report shall be submitted with each application for a Class I well operation permit, which shall include, but not be limited to, the following information:
 - a. Results of the information obtained under the construction permit described in (B)-CLASS I TEST/INJECTION WELL CONSTRUCTION AND TESTING PERMIT, including:
 - 1. All available logging and testing program data and construction data on the well or well field;
 - 2. A satisfactory demonstration of mechanical integrity for all new wells pursuant to Florida Administrative Code Rule 17-28.13(6)(b);

3. The actual operating data, including injection pressures versus pumping rates where feasible, or the anticipated maximum pressure and flow rate at which the permittee will operate, if approved by the Department;
 4. The actual injection procedure;
 5. The compatibility of injected waste with fluids in the injection zone and minerals in both the injection zone and the confining zone; and,
 6. The status of corrective action on defective wells in the area of review.
- b. Record drawings, based upon inspections by the engineer or persons under his direct supervision, with all deviations noted;
 - c. Certification of completion submitted by the engineer of record;
 - d. If requested by the Department, operation manual including emergency procedures;
 - e. Proposed monitoring program and data to be submitted;
 - f. Proof that the existence of the well has been recorded on the surveyor's plan at the county courthouse.
 - g. Proposed plugging and abandonment plan pursuant to Florida Administrative Code Rule 17-28.27(2).

(D) CLASS I WELL PLUGGING AND ABANDONMENT PERMIT

- (1) The reasons for abandonment.
- (2) A proposed plan for plugging and abandonment describing the preferred and alternate methods, and justification for use.
 - a. The type and number of plugs to be used;
 - b. The placement of each plug including the elevation of the top and bottom;
 - c. The type and grade and quantity of cement or any other approved plugging material to be used;
 - d. The method for placement of the plugs.
- (3) The procedure to be used to meet the requirements of Rule 17-28.27.

(E) CLASS III WELL CONSTRUCTION/OPERATION/PLUGGING AND ABANDONMENT PERMIT

Construction Phase

- (1) A map showing the location of the proposed injection wells or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to applicant is required to be included on this map.

- (2) A tabulation of data on all wells within the area of review which penetrate into the proposed injection zone, confining zone, or proposed monitoring zone. Such data shall include a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the Department may require.
- (3) Maps and cross sections indicating the general vertical and lateral limits within the area of review of all underground sources of drinking water, their position relative to the injection formation and the direction of water movement, where known, in each underground source of drinking water which may be affected by the proposed injection.
- (4) Maps and cross sections detailing the hydrology and geologic structures of the local area.
- (5) Generalized maps and cross sections illustrating the regional geologic setting.
- (6) Proposed operating data:
 - a. Average and maximum daily rate and volume of the fluid to be injected;
 - b. Average and maximum injection pressure; and,
 - c. Source and an analysis of the chemical, physical, radiological and biological characteristics of injection fluids, including any additives.
- (7) Proposed formation testing program to obtain an analysis of the chemical, physical and radiological characteristics of and other information on the injection zone.
- (8) Proposed stimulation program.
- (9) Proposed injection procedure.
- (10) Engineering drawings of the surface and subsurface construction details of the system.
- (11) Contingency plans to cope with all shut-ins or well failures or catastrophic collapse, so as to protect the quality of the waters of the state as defined in Florida Administrative Code Rule 17-3, including alternate or emergency discharge provisions.
- (12) Plans (including maps) and proposed monitoring data to be reported for meeting the monitoring requirements in Florida Administrative Code Rule 17-28.25.
- (13) For wells within the area of review which penetrate the injection zone but are not properly completed or plugged, the corrective action proposed to be taken under Florida Administrative Code Rule 17-28.13(5).
- (14) Construction procedures including a cementing and casing program, logging procedures, deviation checks, proposed methods for isolating drilling fluids from surficial aquifers, and a drilling, testing and coring program.
- (15) A certificate that the applicant has ensured, through a performance bond or other appropriate means, the resources necessary to close, plug or abandon the well as required by Florida Administrative Code Rule 17-28.27(9).

- (16) Expected changes in pressure, native fluid displacement, direction of movement of injection fluid.
- (17) A proposed monitoring plan, which includes a plan for detecting migration of fluids into underground sources of drinking water, a plan to detect water quality violation in the monitoring wells, and the proposed monitoring data to be submitted.

Operation Phase

- (1) The following information shall be provided to the Department prior to granting approval for the operation of the well or well field:
 - a. All available logging and testing program data and construction data on the well or well field;
 - b. A satisfactory demonstration of mechanical integrity for all new wells pursuant to Florida Administrative Code Rule 17-28.13(6)(b);
 - c. The actual operating data, including injection pressure versus pumping rate where feasible, or the anticipated maximum pressure and flow rate at which the permittee will operate, if approved by the Department;
 - d. The results of the formation testing program;
 - e. The actual injection procedure;
 - f. The status of corrective action on defective wells in the area of review.

Plugging and Abandonment Phase

- (1) The justification for abandonment.
 - (2) A proposed plan for plugging and abandonment describing the preferred and alternate methods.
 - a. The type and number of plugs to be used;
 - b. The placement of each plug including the elevation of the top and bottom;
 - c. The type and grade and quantity of cement or any other approved plugging material to be used;
 - d. The method for placement of the plugs.
 - (3) The procedure to be used to meet the requirements of Florida Administrative Code Rule 17-28.27.
- (F) CLASS V WELL CONSTRUCTION PERMIT. (This form should be used for Class V wells instead of Form 17-1.209(1) when there is a need for a Technical Advisory Committee and an engineering report.)

- (1) Type and number of proposed Class V Wells:

Wells Receiving Domestic Waste _____	Salt-water Intrusion Barrier Wells _____
Cooling Water Return Flow Wells, Open-looped System _____	Subsidence Control Wells _____
	Sand Backfill Wells _____

Experimental Technology Wells _____	_____
Radioactive Waste Disposal Wells* _____	Wells used to inject spent brine after halogen recovery _____
Other non-hazardous Industrial or Commercial Disposal Wells (explain) _____	Borehole Slurry Mining Wells _____
	Other (explain) _____

*Provided the concentrations of the waste do not exceed drinking water standards contained in Chapter 17-22, F.A.C.

(2) Project Description:

- a. Description and use of proposed injection system;
- b. Nature and volume of injected fluid (The Department may require an analysis (including bacteriological analysis) in accordance with Florida Administrative Code Rule 17-4.27(2)(c));
- c. Proposed pretreatment.

(3) Water well contractor's name, title, state license number, address, phone number and signature.

(4) Well Design and Construction Details. (For multi-casing configurations or unusual construction provisions, an elevation drawing of the proposed well should be attached.)

- a. Proposed total depth;
- b. Proposed depth and type of casing(s);
- c. Diameter of well;
- d. Cement type, depth, thickness;
- e. Injection pumps (if applicable): _____ gpm @ _____ psi
Controls: _____

(5) Water Supply Wells - When required by Florida Administrative Code Rule 17-4.27, attach a map section showing the locations of all water supply wells within a one (1) mile radius of the proposed well. The well depths and casing depths should be included. When required by Rule 17-4.27(2)(g), results of bacteriological examinations of water from all water supply wells within one (1) mile and drilled to approximate depth of proposed well should be attached.

(6) Area of Review (may be required at Department's discretion).

Include the proposed radius of the area of review with justification for that radius. Provide a map showing the location of the proposed injection well or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and

subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to the applicant is required to be included on this map.

(G) CLASS V WELL OPERATION PERMIT (Final report of the construction that includes the following information may be submitted with the application to operate.)

(1) Permit Number of Class V Construction Permit: _____

(2) Owner's Name: _____

(3) Type of Well: _____

(4) Construction and Testing Summary:

a. Actual Dimensions:

Diameter _____ inches; Well Depth _____ feet; Casing Depth _____ feet.

b. Results of Initial Testing.

(5) Proposed Operating Data:

a. Injection Rate (GPM);

b. Description of injected waste;

c. Injection pressure and pump controls.

(6) Proposed Monitoring Plan (If any):

a. Number of monitoring wells;

b. Depth(s);

c. Parameters;

d. Frequency of sampling;

e. Instrumentation (if applicable) Flow _____

Pressure _____

(H) CLASS V WELL PLUGGING AND ABANDONMENT PERMIT

(1) Permit number of Class V construction or operating permit.

(2) Type of well.

(3) Proposed plugging procedures, plans and specifications.

(4) Reasons for abandonment.

ATTACHMENT A

SUBPART B. GENERAL PROJECT DESCRIPTION

DER FORM 17-1.209 (9)

The Indiantown Cogeneration Project is a new facility which will produce 330MW of electricity when not exporting steam. The facility has a single pulverized coal boiler, turbine generator, mechanical draft cooling tower and associated support equipment. The main boiler will be equipped with a SNCR system for NOx control. A spray dryer absorber and baghouse will be used for SO₂ and particulate control. An auxiliary boiler is provided to supply emergency steam up to 225,000 pound per hour and will burn either natural gas or #2 fuel oil.

The project is expected to start construction in March of 1992 and be commercially operating in December 1995.

The project is being designed to be in accordance with Chapter 403, Florida Statutes, and rules and regulations of the Florida DER.

REFERENCE DOCUMENT

The following document is referenced in this permit and contains the information developed to support preliminary design of the injection wells:

Indiantown Cogeneration, L. P. 1990. Indiantown
Cogeneration Project, Site Certification Application.

CLASS I TEST/INJECTION WELL CONSTRUCTION AND TESTING PERMIT

- (1) A map showing the location of the proposed injection wells or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to the applicant is required to be included on this map.**

For the location of the proposed injection wells, see Figure 3.1.1-1 (attached) and Figure 3.5.1-6 (Detailed Site Plan) in the attached SCA Section 3.5.1.5. The area of review for the injection wells has been determined to be a minimum one-mile radius in accordance with the criteria set forth in Rule 17-28.130(4), FAC. For the location of all wells within the one-mile area of review, see Figure 2.3.3-1 (attached). Please note that this figure shows additional wells within a 5-mile radius of the proposed plant site, developed to support other information requirements for the SCA.

Volume 4

INDIANTOWN COGENERATION PROJECT
Site Certification Application

Submitted by Indiantown Cogeneration, L.P

Volume 4

INDIANTOWN COGENERATION PROJECT

Site Certification Application

Submitted by Indiantown Cogeneration, L P

Volume 4

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Site Certification Application

**Submitted by
Indiantown Cogeneration, L P**

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SOIL BORING LOGS

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

BORING LOG										PROJECT		JOB NO	SHEET-NO	HOLE NO
										INDIANTOWN COGENERATION		20524	1 OF 2	B-101
SITE					COORDINATES					ANGLE FROM HORIZ		BEARING		
Car Dumper					N 5931, E 7830					Vertical		-----		
BEGUN	COMPLETED	DRILLER			DRILL MAKE AND MODEL			SIZE	OVERBURDEN	ROCK (FT)	TOTAL DEPTH			
7-31-90	7-31-90	Ardaman & Associates			CME 45			4 in	50 5	0 0	50 5			
CORE RECOVERY (FT /%)		CORE BOXES	SAMPLES	EL TOP CASING	GROUND EL		DEPTH/EL GROUND WATER		DEPTH/EL TOP OF ROCK					
0 0/0		0	18		31 8		3 5/28 3 ws							
SAMPLE HAMMER WEIGHT/FALL			CASING LEFT IN HOLE DIA /LENGTH			LOGGED BY								
140lb/30in			none			Scott Newhouse								
SAMP TYPE AND DIAM	SAMP ADV LEN CORE	SAMPLE REC CORE REC	SAMPLE BLOWS "N" X CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
SS	1.5		6	1	2	4		31.8			1	Gray & gray/black, very loose, medium SAND, trace roots (SP)	Begin drilling with mud	
SS	1.5		6	6	3	3		30.3			2	Black loose fine SAND with silt trace roots (SM)		
SS	1.5		7	3	3	4		27.3			3	Grades dark brown no roots		
SS	1.5		8	3	4	4			5		4	Gray/brown loose medium SAND with silt (SP-SM)		
SS	1.5		13	3	2	11					5	Becomes black medium to dense medium to fine		
SS	1.5		19	7	7	12					6			
SS	1.5		30	10	15	15			10		7			
SS	1.5	1.0	20	10	11	9					8			
SS	1.5	0.5	13	5	7	6					9			
SS	1.5	1.0	10	4	4	6					10			
									15					
								14.8						
SS	1.5	0.8	7	3	3	4					11	Light brown loose fine SAND, trace silt (SP)		
SS	1.5	0.0	6	5	4	2		6.8			12			
									25			Gray to light gray dense silty medium to fine SAND slightly cemented trace shell fragments (SM to SP)		
SS	1.5	1.5	49	22	26	23					13			
												Becomes light gray, with shell fragments trace silt and black peppering (SP)		
SS	1.5	1.0	38	12	16	22					14			

SS = SPLIT SPOON, ST = SHELBY TUBE,
D = DENNISON, P = PITCHER O = OTHER

SITE

Car Dumper

HOLE NO

B-101

BORING LOG										PROJECT INDIANTOWN COGENERATION		JOB NO 20524	SHEET NO 2 OF 2	HOLE NO B-101
SAMP TYPE AND DIAM	SAMP. ADV. LEN CORE	SAMP REC CORE REC	SAMP BLOWS "N" X CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
SS	1.5	1.0	42	10	19	23			40		15	Less shell from 38 (trace shell fragments)		
SS	1.5		50	14	21	29			45		16			
SS	1.5		44	19	25	19		18.7	50		17			
												End of boring Observation well set		

SS = SPLIT SPOON, ST = SHELBY TUBE,
D = DENNISON, P = PITCHER, O = OTHER

SITE

Car Dumper

HOLE NO
B-101

BORING LOG										PROJECT		JOB NO	SHEET-NO	HOLE NO
										INDIANTOWN COGENERATION		20524	1 OF 4	B-102
SITE					COORDINATES					ANGLE FROM HORIZ		BEARING		
Waste Pond					N 6997, E 9074					Vertical		-----		
BEGUN	COMPLETED	DRILLER			DRILL MAKE AND MODEL			SIZE	OVERBURDEN	ROCK (FT)	TOTAL DEPTH			
8-1-90	8-2-90	Ardaman & Associates			CME 45			4 in	145 5	0 0	145 5			
CORE RECOVERY (FT /%)		CORE BOXES	SAMPLES	EL TOP CASING	GROUND EL	DEPTH/EL GROUND WATER			DEPTH/EL TOP OF ROCK					
0 0/0		0	34		34 5	2 0/32 5 ws			/					
SAMPLE HAMMER WEIGHT/FALL			CASING LEFT IN HOLE DIA /LENGTH			LOGGED BY								
140lb/30in			none			Scott Newhouse								
SAMP TYPE AND DIAM	SAMP ADV LEN CORE	SAMPLE REC CORE REC	SAMPLE BLOWS "N" / CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO.	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
SS	1 5		8	1	4	4		34.5			1	Gray/brown, loose, medium to fine SAND, trace silt and roots (SP-SM)	Large root in spoon tip Driller notes hard pan	
SS	1 5	1 0	11	3	5	6		33 0			2	Light gray medium medium SAND trace silt (SP SM)		
SS	1 5	2 0	20	7	8	12		30 5			3	Grades light brown with depth		
SS	1 5	2 0	79	20	29	30/1"			5		4	Dark brown to black medium to extremely dense silty fine SAND trace large root fragments (SM)		
SS	1 5	1 0	36	23	19	17					5			
SS	1 5	1 0	16	9	9	7					6	Less silt from 7 5 (with silt)		
SS	1 5	1 0	11	4	5	6		25 5			7	Brown, medium medium to fine SAND trace silt (SP)		
SS	1 5	1 0	13	4	7	6			10		8			
SS	1 5	1 0	12	4	5	7					9	Becomes light gray/brown with silt lenses		
SS	1 5	0 5	14	4	6	8					10	Becomes finer, no lenses		
									15					
SS	1 5	0 8	32	8	15	17					11			
SS	1 5	0 0	21	11	10	11					12			
								8 0						
												Gray medium, fine to medium SAND with shell fragments trace clay (SM)	Driller notes soft at 26 5	
SS	1 5	1 5	12	9	5	7					13			
SS	1 5	1 0	29	24	22	7					14		Driller notes harder at 33	

SS = SPLIT SPOON, ST = SHELBY TUBE
D = DENNISON, P = PITCHER, O = OTHER

SITE

Waste Pond

HOLE NO

B-102

BORING LOG										PROJECT INDIANTOWN COGENERATION		JOB NO 20524	SHEET NO 2 OF 4	HOLE NO B-102
SAMP TYPE AND DIAM	SAMP ADV. LEN CORE	SAMP REC CORE REC	SAMP "N" BLOWS 7" CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
								-3.5						
SS	1.5	1.0	43	12	16	27			40		15	Gray dense fine SAND with black peppering trace shell fragments (SP)		
SS	1.5	1.0	40	13	18	22			45		16			
SS	1.5	1.0	36	10	14	22			50		17			
SS	1.5	1.0	43	20	21	22			55		18			
SS	1.5	0.7	33	10	11	22			60		19			
SS	1.5	1.2	34	15	16	18			65		20			
SS	1.5	1.5	27	10	13	14			70		21	Less shell with depth		
								37.5				Gray, very stiff, silty CLAY trace shell fragments (CL)		
SS	1.5	1.5	16	3	5	11		-40.5			22			

SS = SPLIT SPOON, ST = SHELBY TUBE
D = DENNISON, P = PITCHER, O = OTHER

SITE
Waste Pond

HOLE NO
B-102

BORING LOG

PROJECT

INDIANTOWN COGENERATION

JOB NO

20524

SHEET NO

3 OF 4

HOLE NO

B-102

SAMP TYPE AND DIAM	SAMP ADV. LEN CORE	SAMP REC CORE REC	SAMPLE BLOWS "N" X CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC
				1st 6"	2nd 6"	3rd 6"	4th 6"						
								-43.5				Gray, medium, silty, fine to medium silty SAND, trace clay and shell (SM)	
SS	1.5			wor	18			-46.0	80		23	Gray, very soft sandy CLAY, with silt and shell fragments (CL)	
SS	1.5	2.0	14	5	6	8		-48.5			24	Gray, medium, clayey, fine SAND with silt and shell (SC)	
SS	1.5	1.5	22	22	12	10			85		25	Gray, medium silty fine to medium SAND with silt and shell fragments slightly cemented (SM)	
								53.5					
SS	1.5	1.0	11	11	6	5			90		26	Gray medium SHELL FRAGMENTS & fine SAND with silt	
								57.5					
									95			Gray dense clayey fine SAND, with silt and shell fragments (SC)	
SS	1.5	2.0	36	12	12	24		-63.5			27		Sample depth disturbed while drilling thru cave-in
SS	1.5	1.5	37	16	18	19			100		28	Gray dense, fine SAND with silt trace clay and black peppering (SM)	
SS	1.5	1.0	38	18	21	17			105		29	no clay from 104	
SS	1.5	1.0	27	15	14	13			110		30	less shell from 109	
SS	1.5	1.5	23	wor	9	14					31	Becomes clayey (SC)	go to 10 ft samples

SS = SPLIT SPOON, ST = SHELBY TUBE
D = DENNISON, P = PITCHER O = OTHER

SITE

Waste Pond

HOLE NO

B-102

BORING LOG										PROJECT INDIANTOWN COGENERATION		JOB NO 20524	SHEET NO 4 OF 4	HOLE NO B-102
SAMP TYPE AND DIAM	SAMP ADV LEN CORE	SAMP REC CORE REC	SAMPLE BLOWS "N" % CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO.	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
SS	1.5	2.0	37	8	13	24			120					
									125		32	More clay from 124, grading to sandy CLAY		
								95.5	130			Gray medium to dense silty, medium to coarse SAND, with clay trace shell slightly cemented (SM)		
SS	1.5	1.5	13	wor	7	6			135		33			
									140					
SS	1.5		41	15	19	22		111.0	145		34			
												End of boring @ 145.5 Observation well set		

SS = SPLIT SPOON, ST = SHELBY TUBE,
D = DENNISON, P = PITCHER, O = OTHER

SITE

Waste Pond

HOLE NO
B-102

BORING LOG										PROJECT		JOB NO	SHEET-NO	HOLE NO
										INDIANTOWN COGENERATION		20524	1 OF 3	B-104
SITE					COORDINATES					ANGLE FROM HORIZ		BEARING		
Covered Storage					N 5955, E 8921					Vertical		-----		
BEGUN	COMPLETED	DRILLER			DRILL MAKE AND MODEL		SIZE	OVERBURDEN	ROCK (FT)	TOTAL DEPTH				
7-30-90	7-31-90	Ardaman & Associates			CME 45		4 in	75 5	0 0	75 5				
CORE RECOVERY (FT /%)		CORE BOXES	SAMPLES	EL TOP CASING	GROUND EL	DEPTH/EL GROUND WATER		DEPTH/EL TOP OF ROCK						
0 0/0		0	22		32 9	2 0/30 9 ws								
SAMPLE HAMMER WEIGHT/FALL			CASING LEFT IN HOLE DIA /LENGTH			LOGGED BY								
140lb/30in			none			Scott Newhouse								
SAMP. TYPE AND DIA	SAMP. ADV. LEN	CORE REC	SAMPLE BLOWS "N" 7 CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
SS	1.5		6	1	3	3		32.9			1	Gray and black, loose silty fine SAND with silt, trace roots (SM)		
SS	1.5		13	4	6	7					2	Grades to black and brown very loose to medium, no roots		
SS	1.5		8	6	4	4					3			
SS	1.5		6	3	3	3			5		4			
SS	1.5		2	2	1	1					5			
SS	1.5		5	2	2	3					6			
SS	1.5		13	4	6	7			10		7			
SS	1.5	1.5	14	7	8	6					8			
SS	1.5	1.0	7	2	3	4		20.9			9	Light brown to gray/brown loose fine SAND trace silt (SP)		
SS	1.5	0.0	6	2	3	3					10			
									15					
												Becomes gray/brown		
SS	1.5								20		11			
								10.9						
												Gray loose silty fine SAND trace clay (SM)		
SS	1.5		2	wor	1	1			25		12		(24-27) sampled in one drive	
SS	1.5	2.0	8	1	3	5		6.4						
								4.9				Gray loose sandy SILT, with shell fragments (ML)		
SS	1.5	1.5	7	1	2	5			30		13	Gray loose silty fine SAND and SHELL FRAGMENTS cemented		
								0.9						
												Gray to gray/brown very dense, fine SAND with silt trace shell fragments and black peppering (SM)		
SS	1.5	1.5	19	19	32	47					14			

SS = SPLIT SPOON, ST = SHELBY TUBE, SITE
D = DENNISON P = PITCHER, O = OTHER

Covered Storage

HOLE NO
B-104

BORING LOG										PROJECT INDIANTOWN COGENERATION		JOB NO 20524	SHEET NO 2 OF 3	HOLE NO B-104
SAMP TYPE AND DIA	SAMP. ADV LEN CORE	SAMPLE REC CORE REC	SAMPLE BLOWS "N" % CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
SS	1.4	1.0	83	21	33	50/5			40		15			
SS	1.5		54	10	20	34			45		16	Less silt (trace silt) (SP)		
SS	1.5	1.2	61	15	24	37			50		17			
SS	1.5	1.0	60	19	30	30			55		18			
SS	1.5	1.0	51	20	29	22			60		19	Becomes light gray with more shell		
SS	1.5	1.2	108	34	52	56			65		20	Grades medium no silt or shell		
SS	1.5	2.0	8	wor	3	3	5	35.1			21	Green/gray medium sandy CLAY with silt, trace shell (CL) Grades to slightly varved silty CLAY		
SS	1.5		7	3	4	3					22			
SS = SPLIT SPOON, ST = SHELBY TUBE, SITE D = DENNISON P = PITCHER O = OTHER										Covered Storage			HOLE NO B-104	

BORING LOG										PROJECT		JOB NO	SHEET NO	HOLE NO
										INDIANTOWN COGENERATION		20524	3 OF 3	B-104
SAMP TYPE AND DIAM.	SAMP ADU LEN CORE	SAMP REC CORE REC	SAMP BLOWS "N" X CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO.	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
								-42.6				Green/gray, medium, silty CLAY, slightly varved (CL)		
												End of boring @ 75.5 Grouted upon completion		

SS = SPLIT SPOON, ST = SHELBY TUBE,
D = DENNISON, P = PITCHER, O = OTHER

SITE

Covered Storage

HOLE NO
B-104

BORING LOG										PROJECT INDIANTOWN COGENERATION		JOB NO 20524	SHEET NO 1 OF 3	HOLE NO B-107
SITE Cooling Towers					COORDINATES N 6935, E 9908					ANGLE FROM HORIZ Vertical		BEARING -----		
BEGIN	COMPLETED	DRILLER			DRILL MAKE AND MODEL		SIZE	OVERBURDEN	ROCK (FT)	TOTAL DEPTH				
7-30-90	7-30-90	Ardaman & Associates			CME 45		4 in	75 5	0 0	75 5				
CORE RECOVERY (FT /%)		CORE BOXES	SAMPLES	EL TOP CASING	GROUND EL	DEPTH/EL GROUND WATER		DEPTH/EL TOP OF ROCK						
0 0/0		0	22		34 8	7 2 0/32 8 ws		/						
SAMPLE HAMMER WEIGHT/FALL		CASING LEFT IN HOLE DIA /LENGTH			LOGGED BY									
140lb/30in		none			Scott Newhouse									
SAMP TYPE AND DIAM	SAMP ADV LEN CORE	SAMPLE REC CORE REC.	SAMPLE BLOWS "N" CORE % RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
SS	1.5		6	1	2	4		34.8			1	Gray & brown loose, medium SAND with silt, trace roots (SM)		
SS	1.5		11	4	7	4		33.3			2	Dark brown to black medium to very dense fine to medium SAND with silt (SP-SM)		
SS	1.5		22	4	7	15					3			
SS	1.5	1.0	49	16	22	27			5		4	Becomes silty with cemented lenses		
SS	1.5	1.0	43	17	17	26					5			
SS	1.5	1.5	54	20	26	29					6	No cementation		
SS	1.5	1.0	34	15	18	16					7			
SS	1.5	1.0	27	10	12	15			10		8	Grades to light brown less silt with depth (SP)		
SS	1.5	1.0	20	8	9	11					9			
SS	1.5	1.0	19	6	9	10					10	Becomes gray/brown fine		
									15					
SS	1.5	1.0	15	7	8	7					11	Lense of clayey SAND at 19 (SC)		
												Becomes light brown		
SS	1.5	1.0	12	3	5	7					12			
								7.8				Gray very loose silty fine SAND (SM)		
SS	1.5	1.0	4	2	2	2					13			
									30					
SS	1.5	1.0	8	wor	3	5					14			

SS = SPLIT SPOON, ST = SHELBY TUBE,
 D = DENNISON, P = PITCHER, O = OTHER

SITE
Cooling Towers

HOLE NO
B-107

BORING-LOG

PROJECT

INDIANTOWN COGENERATION

JOB NO

20524

SHEET NO

2 OF 3

HOLE NO

B-107

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN. CORE	SAMP. REC. CORE REC.	SAMP. BLOWS "N" X CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC
				1st 6"	2nd 6"	3rd 6"	4th 6"						
												With large shell fragments, trace clay	
								-3.2					
SS	1.4	1.0	83	13	31	52		-4.7			15	Gray, very dense SHELL FRAGMENTS & fine SAND, slightly cemented	
									40			Gray, dense to very dense fine SAND, trace silt black peppering (SP)	
SS	1.5		42	19	23	19			45		16		
SS	1.5		65	19	30	35			50		17		
SS	1.5		43	9	21	22			55		18	Trace shell fragments more fragments with depth	
SS	1.5		28	12	12	16			60		19	Becomes medium	
SS	1.5	1.0	76	20	44	32			65		20	Becomes very dense	
SS	1.5		75	24	31	44			70		21		
								37.2				Gray very stiff silty CLAY with medium sand lenses (CL)	
SS	1.5		19	6	8	11					22		

SS = SPLIT SPOON, ST = SHELBY TUBE, SITE
D = DENNISON, P = PITCHER, O = OTHER

Cooling Towers

HOLE NO
B-107

BORING LOG

PROJECT
INDIANTOWN COGENERATION

JOB NO
20524

SHEET NO
3 OF 3

HOLE NO
B-107

SAMP. TYPE AND DIAM	SAMP. ADJ. LEN CORE	SAMPLE REC CORE REC	SAMPLE BLOWS 'N' > CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC
				1st 6"	2nd 6"	3rd 6"	4th 6"						
								-40.7				Gray CLAY, with sand lenses (CL)	
												End of boring @ 75.5 Grouted upon completion	

SS = SPLIT SPOON, ST = SHELBY TUBE,
D = DENNISON, P = PITCHER, O = OTHER

SITE

Cooling Towers

HOLE NO
B-107

BORING LOG										PROJECT INDIANTOWN COGENERATION		JOB NO 20524	SHEET NO 1 OF 2	HOLE NO B-108
SITE Power Block					COORDINATES N 6175, E 9604					ANGLE FROM HORIZ Vertical		BEARING -----		
BEGUN 7-24-90	COMPLETED 7-25-90	DRILLER Ardaman & Associates			DRILL MAKE AND MODEL CME 45		SIZE 4 in	OVERBURDEN 75 0	ROCK (FT) 0 0	TOTAL DEPTH 75 0				
CORE RECOVERY (FT /%) 0 0/0		CORE BOXES 0	SAMPLES 22	EL TOP CASING		GROUND EL 33 6	DEPTH/EL GROUND WATER 4 0/29 6 WS		DEPTH/EL TOP OF ROCK /					
SAMPLE HAMMER WEIGHT/FALL 140lb/30in			CASING LEFT IN HOLE DIA /LENGTH none			LOGGED BY Scott Newhouse								
SAMP TYPE AND DIAM.	SAMP ADV. LEN CORE	SAMP REC CORE REC	SAMP BLOWS "N" X CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
1st 6"	2nd 6"	3rd 6"	4th 6"											
SS	1.5		8	1	3	5		33.6			1	Gray/black, loose medium to fine SAND trace silt and roots (SP)	Driller notes hard pan	
SS	1.5		17	5	7	10		31.1			2			
SS	1.5		15	8	7	8					3	Light gray/black medium silty fine SAND (SP-SM)		
SS	1.5	1.0	14	3	5	9					4	Grades dark brown		
SS	1.5	1.0	18	8	8	10					5	More silt, with silt lenses More silt with depth		
SS	1.5	1.5	11	5	6	5					6	Grades to SM trace roots and peat		
SS	1.5	1.0	18	9	10	8					7	Less silt (SM)		
SS	1.5	1.0	9	2	4	5					8	Becomes light brown		
SS	1.5	1.0	11	3	5	6					9			
SS	1.5	1.0	7	3	3	4					10			
								15						
SS	1.5	1.0	15	5	7	8					11	Less silt (SM/SP)	Driller notes soft @ 28	
SS	1.5	1.0	20	6	9	11					12			
								5.6						
SS	1.5	1.0	9	wor	12	9					13	Dark gray loose silty fine SAND trace shell fragments and cemented particles (SM)	Driller notes soft @ 28	
												Becomes gray/brown dense, with shell fragments and cemented particles		
SS	1.5	1.0	46	12	17	29					14			

SS = SPLIT SPOON, ST = SHELBY TUBE,
 D = DENNISON, P = PITCHER, O = OTHER

SITE
Power Block

HOLE NO
B-108

BORING LOG										PROJECT INDIANTOWN COGENERATION		JOB NO 20524	SHEET NO 2 OF 2	HOLE NO B-108
SAMP TYPE AND DIA	SAMP ADJ. LEN CORE	SAMP REC CORE REC.	SAMP N° BLOWS 7 CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
								-4.4						
SS	1.5	1.0	70	27	30	40			40		15	Gray very dense medium SAND with silt and shell fragments (SM)		
												Less silt and shell with depth (SM/SP)		
SS	1.5		50	29	30.5				45		16			
SS	1.5		78	29	40	38			50		17			
SS	1.5		63	19	31	32			55		18			
SS	1.5		45	18	23	22			60		19	More silt and shell dense (SM)		
SS	1.5	1.0	34	18	23	31			65		20			
SS	1.5		26	9	8	18			70		21	Becomes medium with silt lenses		
								38.4						
SS	1.5		22	4	10	12		-41.4			22	Gray, hard silty CLAY, with shell fragments (CH) End of boring @ 75 Grouted upon completion		

SS = SPLIT SPOON, ST = SHELBY TUBE,
D = DENNISON P = PITCHER, O = OTHER

SITE
Power Block

HOLE NO
B-108

BORING LOG										PROJECT		JOB NO	SHEET-NO	HOLE NO
										INDIANTOWN COGENERATION		20524	1 OF 2	B-110
SITE					COORDINATES					ANGLE FROM HORIZ		BEARING		
Power Block					N 6849, E 10079					Vertical		-----		
BEGUN	COMPLETED	DRILLER			DRILL MAKE AND MODEL			SIZE	OVERBURDEN	ROCK (FT)	TOTAL DEPTH			
7-27-90	7-27-90	Ardaman & Associates			CME 45			4 in	74 4	0 0	74 4			
CORE RECOVERY (FT /%)		CORE BOXES	SAMPLES	SEL	TOP CASING	GROUND EL	DEPTH/EL	GROUND WATER		DEPTH/EL		TOP OF ROCK		
0 0/0		0	22			33 9	3 0/30	9 WS				/		
SAMPLE HAMMER WEIGHT/FALL			CASING LEFT IN HOLE DIA /LENGTH			LOGGED BY								
140lb/30in			none			Scott Newhouse								
SAMP TYPE AND DIAM	SAMP ADU LEN CORE	SAMP REC CORE REC	SAMPLE BLOWS "N" X CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV.	DEPTH	GRAPHICS	SAMPLE NO.	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
SS	1.5		5	1	2	3		33.9			1	Gray & gray/brown, loose fine to medium SAND trace roots (SP)		
SS	1.5	1.5	15	4	5	10		32.4			2	Black medium to dense silty, fine to medium SAND (SM)		
SS	1.5	1.5	44	16	20	24		29.4			3	Becomes orange/brown		
SS	1.5	1.0	12	4	7	5			5		4	Black, medium to dense medium SAND with silt and gray fine sand lenses (SP SM)		
SS	1.5	1.5	37	12	18	19					5	Becomes dark brown no lenses		
SS	1.5	1.0	20	10	11	9					6	Grades to brown less silt (with silt)		
SS	1.5	1.0	23	7	11	12		24.9			7	Gray/brown medium fine SAND trace silt (SP)		
SS	1.5	1.0	24	6	13	11			10		8	Becomes light brown medium		
SS	1.5	1.0	16	5	7	9					9			
SS	1.5	1.0	11	5	5	6					10	Becomes gray/brown to gray		
									15					
SS	1.5	1.5	17	8	9	8					11	Becomes light brown, medium to loose		
SS	1.5		11	4	4	7					12			
SS	1.5		4	2	1	3					13			
								1.9				Dark gray very loose, silty, fine SAND (SM)		
SS	2.5	2.0	1	2	wor	1					14			

SS = SPLIT SPOON, ST = SHELBY TUBE, SITE

D = DENNISON, P = PITCHER, O = OTHER

Power Block

HOLE NO

B-110

BORING LOG

PROJECT
INDIANTOWN COGENERATION

JOB NO
20524

SHEET NO
2 OF 2

HOLE NO
B-110

SAMP. TYPE AND DIAM	SAMP. ADV LEN CORE	SAMPLE REC CORE REC	SAMPLE BLOWS "N" / CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO.	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC
				1st 6"	2nd 6"	3rd 6"	4th 6"						
SS	15	10	73	25	36	37			40		15	Becomes gray very dense to extremely dense with silt	
SS	15	10	78	24	34	44			45		16		
SS	15	10	98	24	48	50/5			50		17		
SS	15	10	4	2	1	3			55		18	Becomes very loose	Driller notes soft @ 53
								24 1					
SS	15	10	32	13	17	15			60		19	Light gray dense to very dense SAND with shell fragments trace silt (SP)	
SS	15	13	70	23	27	43			65		20		
								34 1					
SS	15	12	73	24	40	33			70		21	Light gray very dense silty medium SAND trace shell fragments (SM)	
								38 1					
SS	09	20	50	33	50/5				74 1		22	Light gray extremely dense medium SAND trace shell fragments (SP)	
												End of Boring at 74 4' Grouted upon completion	
SS = SPLIT SPOON, ST = SHELBY TUBE, D = DENNISON, P = PITCHER, O = OTHER										SITE Power Block		HOLE NO B-110	

BORING LOG										PROJECT -INDIANTOWN COGENERATION-		JOB NO 20524	SHEET NO 1 OF 4	HOLE NO B-115
SITE Power Block					COORDINATES N 6170, E 10249					ANGLE FROM HORIZ Vertical		BEARING ---		
BEGIN 7-20-90	COMPLETED 7-23-90	DRILLER Ardaman & Associates			DRILL MAKE AND MODEL CME 45		SIZE 4 in	OVERBURDEN 150 0	ROCK (FT) 0 0	TOTAL DEPTH 150 0				
CORE RECOVERY (FT /%) 0 0/0		CORE BOXES 0	SAMPLES 38	TOP CASING	GROUND EL 34 2	DEPTH/EL GROUND WATER 3 8/30 4 WS		DEPTH/EL TOP OF ROCK /						
SAMPLE HAMMER WEIGHT/FALL 140lb/30in			CASING LEFT IN HOLE DIA /LENGTH none			LOGGED BY Scott Newhouse								
SAMP TYPE AND DIAM.	SAMP ADU LEN CORE	SAMP REC CORE REC	SAMP BLOWS "N" % CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
1st 6"	2nd 6"	3rd 6"	4th 6"											
SS	15		4	1	2	2		34.2			1	Dark gray/brown very loose silty SAND (SM)		
SS	15		10	4	5	5					2	Becomes black loose to medium		
SS	15		11	5	6	5					3			
SS	15	15	7	4	4	3		29 7 1/2	5		4	Dark brown loose to medium medium SAND (SP)		
SS	15	20	14	2	3	11					5			
SS	15	15	22	15	10	12					6			
SS	15	15	26	9	11	15			10		7	Grades to dark brown and black medium to dense		
SS	15	15	36	6	16	20					8			
SS	15	12	30	6	13	17					9			
SS	15	10	16	6	8	8		20 2			10	Grades to orange/brown		
									15			Gray/brown, medium fine SAND & SILT (SM/ML)		
SS	15	15	9	5	4	5			20		11	Less silt becomes (SP)		
SS	15	20	6	3	3	3			25		12			
SS	15		3	2	1	3			30		13	More silt Becomes light brown and gray mottled	(29-32) sampled in one drive	
SS	15	20	9	4	5	4								
								1 2						
SS	15	18	6	4	3	3					14	Dark gray very loose, silty, fine to medium SAND trace silt (SP-SM)		

SS = SPLIT SPOON, ST = SHELBY TUBE,
D = DENNISON, P = PITCHER, O = OTHER

Power Block

HOLE NO
B-115

BORING LOG

PROJECT
INDIANTOWN COGENERATION

JOB NO
20524

SHEET NO
2 OF 4

HOLE NO
B-115

SAMP TYPE AND DIAM	SAMP. ADV. LEN CORE	SAMP. REC CORE REC	SAMP. BLOWS "N" X CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC
				1st 6"	2nd 8"	3rd 6"	4th 6"						
SS	1.5	1.5	55	15	25	30			40		15	Becomes light gray very dense	
SS	1.5	1.2	68	21	26	42			45		16	More silt becomes SAND & SILT (SM/ML)	
SS	1.5	2.0	58	16	26	32		13.8	50		17	Gray very dense medium SAND trace silt (SP/SM)	
SS	1.5	1.0	54	18	26	29			55		18		
SS	1.5	1.5	14	5	6	8			60		19	Becomes medium, with silt (SM)	Driller notes after at 58
SS	1.5	1.5	51	18	21	30			65		20	Becomes very dense trace shell fragments	
SS	1.5	1.0	57	24	30	27			70		21	Less silt (trace silt) (SP)	
SS	1.5	1.0	100	45	50	50					22	More shell fragments	

SS = SPLIT SPOON, ST = SHELBY TUBE,
D = DENNISON, P = PITCHER, O = OTHER

SITE

Power Block

HOLE NO
B-115

BORING-LOG

PROJECT

INDIANTOWN COGENERATION

JOB NO

20524

SHEET-NO

3 OF 4

HOLE-NO

B-115

SAMP TYPE AND DIAM.	SAMP ADV LEN CORE	SAMP REC CORE REC.	SAMP BLOWS "N" X CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC
				1st 6"	2nd 6"	3rd 6"	4th 6"						
SS	1.5	1.0	17	9	7	10		-43.8			23	Gray/brown, medium, silty, fine to medium SAND with shell fragments and round fine gravel slightly cemented (SM)	
SS	1.5		31	13	15	16		-47.8			24	Gray dense, silty fine to medium SAND with shell fragments, trace clay (SM)	
SS	1.5		52	17	26	26			90		25	Shell fragments larger with depth	
	1.5		43	18	19	24			95		26		
SS	1.5		56	28	28	28			100		27		
SS	1.5		32	12	16	16			105		28		
SS	1.5	1.5	15	7	7	8			110		29	Becomes medium	
SS	1.5	2.0	14	5	6	8					30	Light gray less shell	

SS = SPLIT SPOON, ST = SHELBY TUBE,
D = DENNISON, P = PITCHER, O = OTHER

SITE

Power Block

HOLE NO

B-115

BORING LOG										PROJECT INDIANTOWN COGENERATION		JOB NO 20524	SHEET NO 4 OF 4	HOLE NO B-115
SAMP TYPE AND DIAM.	SAMP ADV LEN CORE	SAMP REC. CORE REC.	SAMPLE BLOWS N" / CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
				1st 6"	2nd 6"	3rd 6"	4th 6"							
SS	1.5	2.0	20	6	8	12			120		31	Trace cemented particles, trace shell fragments		
SS	1.5	2.0	30	7	10	20			125		32	Becomes dense		
SS	1.5	1.5	19	6	8	11			130		33	Becomes medium		
SS	1.5	1.5	60	24	24	36			135		34	Becomes very dense, trace clay		
SS	1.5	2.0	27	14	14	13			140		35	Becomes medium to very dense fine to medium, mostly cemented		
SS	1.5		54	8	22	32			145		36			
								111.8				Light gray hard silty CLAY, with fine slightly cemented sand (CL)		
SS	1.5		33	7	10	23		115.8	150		37			
												End of boring @ 150 Grouted upon completion		

SS = SPLIT SPOON, ST = SHELBY TUBE,
 D = DENNISON, P = PITCHER O = OTHER

SITE
Power Block

HOLE NO
B-115

BORING LOG										PROJECT INDIANTOWN COGENERATION		JOB NO 20524	SHEET-NO 1 OF 2	HOLE-NO B-116	
SITE Power Block					COORDINATES N 6497, E 10503					ANGLE FROM HORIZ BEARING Vertical					
BEGUN 7-19-90		COMPLETED 7-19-90		DRILLER Ardaman & Associates		DRILL MAKE AND MODEL CME 45		SIZE 4 in		OVERBURDEN 75 0		ROCK (FT) 0 0		TOTAL DEPTH 75 0	
CORE RECOVERY (FT / %) 0 0/0			CORE BOXES 0		SAMPLES EL TOP CASING 22		GROUND EL 34 8		DEPTH/EL GROUND WATER 1 5/33 3 ws			DEPTH/EL TOP OF ROCK /			
SAMPLE HAMMER WEIGHT/FALL 140lb/30in					CASING LEFT IN HOLE DIA /LENGTH none					LOGGED BY Scott Newhouse					
SAMP TYPE AND DIAM.	SAMP ADV. LEN CORE	SAMP REC CORE REC	SAMPLE BLOWS "N" % CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC		
				1st 6"	2nd 6"	3rd 6"	4th 6"								
SS	1.5		7	1	3	4		34.8			1	Gray, loose to medium fine SAND, trace roots (SP)	Driller notes hardpan		
SS	1.5		11	4	6	5					2				
SS	1.5		12	5	6	6					3				
SS	1.5		20	4	8	12		29.3	5		4				
SS	1.5		22	9	11	11					5	Dark brown to gray medium to very dense silty fine SAND (SM)			
SS	1.5		86	3	36	50					6				
SS	1.5		85	25	35	50			10		7				
SS	1.5		42	25	21	21					8	Becomes dark orange/brown			
SS	1.5		24	6	10	14		22.8			9	Light gray/brown, medium to dense fine SAND little silt (SP)			
SS	1.5		38	13	18	20					10				
									15						
SS	1.5		32	11	15	17					11				
SS	1.5		24	8	10	14					12				
									25						
SS	1.5		16	4	9	7		5.3			13	Dark gray medium silty fine SAND with clay lenses (SM)			
									30						
SS	1.5		16	7	8	8					14				

SS = SPLIT SPOON, ST = SHELBY TUBE
 O = DENNISON, P = PITCHER 0 = OTHER

Power Block

HOLE NO
B-116

BORING LOG										PROJECT INDIANTOWN COGENERATION		JOB NO 20524	SHEET NO 2 OF 2	HOLE NO B-116
SAMP TYPE AND DIAM	SAMP ADV LEN CORE	SAMP REC CORE REC	SAMP BLOWS "N" CORE RECOVERY	STANDARD PENETRATION TESTS				ELEV	DEPTH	GRAPHICS	SAMPLE NO	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC	
				1st 8"	2nd 8"	3rd 8"	4th 8"							
									3 2					
SS	1 4		40	19	19	21			40		15	Gray medium fine SAND trace silt (SP)		
SS	1 5		100	35	30	50/5			9 2		16	Gray medium to extremely dense silty fine SAND (SM)		
SS	1 5		56	25	21	35			50		17			
SS	1 5		20	8	10	10			55		18			
SS	1 5		26	10	13	13			60		19	Less silt (SP)		
												With shell fragments and black peppering		
SS	1 5		51	20	21	30			65		20			
SS	1 5		43	25	18	25			70		21			
									37 2					
SS	1 4		106	45	56	50/5					22	Gray extremely dense silty, fine SAND trace shell fragments slightly cemented (SM)		
									-40 1			End of boring @ 74 9 Grouted upon completion		

SS = SPLIT SPOON, ST = SHELBY TUBE,
D = DENNISON, P = PITCHER O = OTHER

SITE
Power Block

HOLE NO
B-116

SOIL BORING LOG

PROJECT Indiantown Cogeneration Facility LOCATION Northeast Corner of Site, Indiantown, FL
ELEVATION -32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE START 14 30 8/13/90 FINISH 8/15/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
				6'-6" (N)			
5	0-1.5	S-1	ND	1-3-6 (9)	SAND (SP) very fine fine grained moderately sorted light gray (N7) quartz subangular-subrounded ~20% roots organics		
	1.5-3.0	S-2	ND	5-7-7 (14)	SAND (SP) fine-medium grained moderate-well sorted pinkish gray (5 YR 8/1) to white quartz organics		
	3-4.5	S-3	ND	7-8-9 (17)	SAND (SW) very fine-medium grained poor moderately sorted pale yellowish brown (10 YR 6/2) quartz organics		
	4.5-6	S-4	ND	8-23-45 (68)	HARDPAN & SAND (SM) very fine grained somewhat silty dusky yellowish brown (10 YR 2/2) quartz		
	6-7.5	S-5	ND	8-8-6 (14)	As Above no hardpan		
	7.5-9	S-6	ND	4-5-5 (10)	SAND (SP) fine-medium grained moderately sorted slightly silty moderate brown (5 YR 4/4) quartz		
10	9-10.5	S-7	ND	2-2-3 (5)	As Above		
	10.5-12	S-8	0.8	2-3-5 (8)	SAND (SP) fine-grained well sorted moderate yellowish brown (10 YR 5/4) subrounded rounded predominantly quartz trace black phosphonite grains		
	12-13.5	S-9	1.0	4-5-8 (13)	As Above moderate brown (5 YR 3/4) fine-coarse grained poor moderately sorted		
15	13.5-15	S-10	1.5	7-9-19 (28)	As Above rounded well rounded		
20	19-20.5	S-11	1.2	5-7-12 (19)	SAND (SP) fine-grained well sorted light brown (5 YR 5/4) subangular rounded quartz trace black phosphonite grains		
25	24-25.5	S-12	1.2	7-6-7 (13)	SAND (SP) very fine-fine grained moderately well sorted light olive gray (5 Y 5/2) quartz trace silty stringers subrounded rounded		
	29-30.5	S-13	1.0	15-10-15 (25)	CEMENTED SAND AND SHELL medium light gray (N6) 30% coralline material pelecypod shell fragments, poorly consolidated limestone fragments		Harder drilling at 28.5'



PROJECT NUMBER
SEF30619 A0

BORING NUMBER
TB-1

SHEET 2 OF 5

SOIL BORING LOG

PROJECT Indiantown Cogeneration Facility LOCATION Northeast Corner of Site, Indiantown, FL
ELEVATION -32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE START 14 30 8/13/90 FINISH 8/15/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6'-6" (N)	SOIL DESCRIPTION SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
35	34 35 5	S-14	1 2	8-7 5 (12)	SHELLY SAND, (SW), very fine grained, somewhat silty yellowish gray (5 Y 7/2) ~10% very fine black phosphorite ~40-50% pelecypod shells and fragments Trace limestone fragments Trace various gastropods		
40	39 40 5	S 15	1 0	7-34-7 (41)	As Above		
45	44- 45 5	S-16	1 2	18 34-45 (79)	SHELLY SILTY SAND (SM), very fine grained light olive gray (5 Y 5/2), ~20% shell (pelecypods, trace gastropods) predominantly quartz, ~30% black phosphorite grains		
50	49- 50 5	S 17	0 8	31 50/5" (81)	SILTY SAND (SM) very fine grained, medium light gray (N6) ~15% pelecypod shell fragments grading to none Predominantly quartz, ~30% black phosphorite grains		
55	54 55 5	S 18	1 0	11-13 18 (31)	As Above		
	59- 60 5	S-19	1 2	13 16-22 (38)	SHELLY SAND, (SP), very fine grained, moderate-well sorted, light olive gray (5 Y 5/2) Predominantly quartz ~20% to very fine black phosphorite ~20% pelecypod shells and fragments (fine-coarse grained) subangular-subrounded		



PROJECT NUMBER	BORING NUMBER
SEF30619 A0	TB-1
SHEET 3 OF 5	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Northeast Corner of Site, Indiantown, FL
ELEVATION -32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE START 14 30 8/13/90 FINISH 8/15/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
				6"-6"-6" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
65	64 65.5	S-20	0.5	17-19-22 (41)	As Above		
70	69- 70.5	S-21	1.0	14-12-9 (21)	SANDY SHELL HASH light olive gray (5 Y 6/1), predominantly pale yellowish orange (10 YR 8/6) pelecypod shells and fragments, poor-moderately sorted (fine-coarse grained shell) 10% medium light gray shell fragments ~20-30% very fine sand predominantly quartz, ~10% black phosphonite		
75	74- 75.5	S-22	1.2	13-33-50/5" (83)	SILTY SAND, (SM) very fine grained light olive gray (5 Y 5/2), trace fine shell fragments trace-medium quartz grains, ~10% black phosphonite grains		
80	79 80.5	S-23	2.0	2 3-5 (8)	SANDY SHELLY CLAY (SC), low plasticity, greenish gray (5 GY 6/1), ~15% pelecypod and indistinguishable shell fragments		Attempted Shelby tube Pushed 1.5' No Recovery
85	84- 85.5	S-24	ND	10 9-9 (18)	SHELLY SAND (SW) very fine-medium grained poor-moderately sorted, light olive gray (5 Y 6/1) to yellowish gray (5 Y 8/1) 40% carbonate shell fragments, 60% quartz sand Trace poorly cemented sand		Harder drilling at 87' to 89'
	89 90.5	S-25	1.4	11 10 13 (23)	As Above, slightly silty		



PROJECT NUMBER
SEF30619 A0

BORING NUMBER
TB-1

SHEET 4 OF 5

SOIL BORING LOG

PROJECT Indiantown Cogeneration Facility LOCATION Northeast Corner of Site, Indiantown, FL

ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL

DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning

WATER LEVEL AND DATE START 14 30 8/13/90 FINISH 8/15/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6" (N)	SOIL DESCRIPTION SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	INTERVAL	TYPE AND NUMBER	RECOVERY (Ft)				
95	94-95 5	S-26	1 4	16 14 11 (25)	SHELLY SILTY SAND (SM), very fine grained greenish gray (5 GY 6/1), 10-20% black phosphonite grains, ~25% coarse shell (pelecypod) fragments		
100	99-100 5	S 27	1 4	20 26 26 (52)	As Above		
105	104-105 5	S 28	1 4	28 26-23 (49)	SHELLY SAND (SW) very fine-medium grained poor-moderately sorted light olive gray (5 Y 6/1) to yellowish gray (5 Y 8/1) for shell fraction, subangular-subrounded sand grains, predominantly quartz, ~20% shell fragments ~10% black phosphonite grains		
110	109-110 5	S 29	1 2	16 18-17 (35)	SHELLY SILTY SAND, (SM), very fine grained, light olive gray (5 Y 6/1) to yellowish gray (5 Y 8/1), subangular-subrounded sand grains Predominantly quartz ~20% pelecypod shell fragments ~10% black phosphonite grains		
115	114-115 5	S 30	1 4	7-9-10 (19)	SHELLY CLAYEY SAND, (SC), very fine grained low plasticity, light olive gray (5 Y 6/1) to greenish gray (5 GY 6/1), ~20% pelecypod shell fragments, ~10% black phosphonite grains		
	119-120 5	S 31	1 6	6-11 12 (23)	As Above, less clay, more silt		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-1	SHEET 5 OF 5
SOIL BORING LOG		

PROJECT Indiantown Cogeneration Facility LOCATION Northeast Corner of Site, Indiantown, FL
ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE _____ START 14 30 8/13/90 FINISH 8/15/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
125	124-125 5	S-32	1 8	8-16-24 (40)	SILTY CLAY, (CL) low plasticity, greenish gray (5 GY 6/1) ~10% shell fragments trace cemented silt and shell Trace black phosphonite, very fine grained		
130	129-130 5	S-33	1 8	9 18-28 (46)	As Above		
135	134-135 5	S-34	1 8	6-5-12 (17)	CLAYEY SHELLY SILT (ML), low plasticity, light greenish gray (5 GY 8/1), ~30% medium-coarse shells and fragments ~10% very fine black phosphonite		
140	139-140 5	S-35	1 4	14-12-19 (31)	As Above		
145	144-145 5	S-36	1 6	6-13-11 (24)	As Above, some cemented sand		
149	149-150 5	S-37	1 6	15-12-19 (31)	As Above		
					END OF BORING		Boring cemented with neat cement from bottom to land surface



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-2	SHEET 1 OF 5
SOIL BORING LOG		

PROJECT Indiantown Cogeneration Facility LOCATION Southwest Corner of Site, Indiantown, FL
ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE DTW = 5 15 ft 8/13/90 START 12 30 8/9/90 FINISH 8/10/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6'-6" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
5	0-15	S-1	10	1-3-5 (8)	SAND (SP) fine-medium grained light brownish gray (5 YR 6/1) quartz organics roots dry		
	15-30	S-2	12	4 6-7 (13)	SAND (SP) very fine-fine grained some silt moderate-well sorted quartz moist		
	3-45	S-3	12	7 8-8 (16)	SAND (SP) fine-medium grained light brownish gray (5 YR 6/1) quartz wet		
	45-6	S-4					
	6-75	S-5	10	5 10-9 (19)	SAND (SP) very fine-fine grained some silt moderately sorted quartz wet		
	75-9	S-6	10	2 3-4 (7)	SAND (SP) fine-medium grained light brownish gray (5 YR 6/1) quartz moderate-well sorted		
10	9-105	S-7	12	5-6-8 (14)	SAND (SW) very fine-medium grained moderately sorted dusky brown (5 YR 2/2) quartz		
	105-12	S-8	08	2-4 5 (9)	SAND (SP) fine medium moderate well sorted moderate brown (5 YR 3/4) quartz		
	12-135	S-9	08	3-3-4 (7)	SAND (SP) fine-medium grained well sorted pale yellowish brown (10 YR 6/2) quartz subangular subrounded		
	135-15	S-10	06	4 4 5 (9)	SAND (SP) fine medium grained moderate-well sorted grayish brown (5 YR 3/2) quartz trace silt		
15	15-19	S-11	06	5 8-8 (16)	SAND (SP) medium grained well sorted yellowish gray (5 Y 7/2) quartz subangular rounded		
	19-205						
20	205-24	S-12	10	4 5-5 (10)	SAND (SP) fine-medium grained well sorted pale brown (5 YR 5/2) quartz		
	24-255						
25	255-29	S-13	20	3 2-2 (4)	SILTY SAND (SM) very fine grained brownish gray (5 YR 4/1) quartz		
	29-305						
	305-29	S-14	20	3 1-1 (2)	SILTY SAND (SM) very fine grained medium dark gray (N4) quartz		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-2
SHEET 2 OF 5	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Southwest Corner of Site, Indiantown, FL
 ELEVATION -32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
 DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
 WATER LEVEL AND DATE DTW = 5.15 ft 8/13/90 START 12:30 8/9/90 FINISH 8/10/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
				6"-8" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
35	34 35.5	S-15	1.2	3-4 5 (9)	SAND, (SP), very fine-fine grained moderate-well sorted olive gray (5 Y 4/1) slightly silty, quartz		
40	39 40.5	S-16	1.0	17 19 19 (38)	SAND, (SP), very fine grained, well sorted, medium light gray (N6) Predominantly quartz, ~25% black phosphonite (very fine)		
45	44- 45.5	S-17	1.0	6 5-7 (12)	SAND, (SP), very fine-fine grained, moderate-well sorted, medium light gray (N6) Predominantly quartz ~25% very fine black phosphonite		
50	49- 50.5	S-18	1.2	17-23-22 (45)	SHELLY SAND (SP) very fine-fine grained, moderate-well sorted medium light gray (N6) ~30% grayish orange pink (5 YR 7/2) pelecypod shell fragments, fine-coarse fragments Predominantly quartz, 25% very fine black phosphonite		
55	54- 55.5	S-19	1.2	19-18-18 (36)	As Above, with thin, low plasticity clay lenses		
	59- 60.5	S-20	2.0	24-27-29 (56)	SHELLY SAND, (SP), fine grained well sorted light brownish gray (5 YR 6/1) quartz trace black phosphonite		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-2
SHEET 4 OF 5	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Southwest Corner of Site, Indiantown, FL
 ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
 DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
 WATER LEVEL AND DATE DTW = 5.15 ft 8/13/90 START 12 30 8/9/90 FINISH 8/10/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6'-6 (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
95	94 95.5	S-27	1.4	20-23-20 (43)	As Above, cemented sands (~15%)		
100	99 100.5	S-28	1.0	16-9-10 (19)	As Above no cemented sands		
105	104 105.5	S-29	1.0	18-15-17 (32)	SILTY SAND (SM) very fine grained, some clay (20%), low plasticity, greenish gray (5 GY 6/1), ~10-15% shell fragments		
110	109 110.5	S-30	1.8	6-13-14 (27)	As Above <10% shell fragments		
115	114- 115.5	S-31	2.0	7-8-15 (23)	SILTY CLAY (CL), low plasticity greenish gray (5 GY 6/1), 10-20% cemented sand, trace pelecypod shell fragments trace black phosphonite		
	119- 120.5	S-32	1.8	7-9-17 (26)	As Above no cemented sand		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-2
SHEET 5 OF 5	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Southwest Corner of Site Indiantown FL
 ELEVATION -32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
 DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
 WATER LEVEL AND DATE DTW = 5 15 ft 8/13/90 START 12 30 8/9/90 FINISH 8/10/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6-6-6 (N)	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)		SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
125	124-125 5	S-33	0 5	5-5 6 (11)	SANDSTONE (SS) poorly cemented, some clay light olive gray (5 Y 6/1) ~10% shell fragments		Drill rod chatter at 126'
130	129-130 5	S-34	1 2	20-26-13 (39)	As Above		
135	134-135 5	S-35	1 8	15-36-40 (76)	SILTY CLAY, (CL), low plasticity light olive gray (5 Y 6/1), trace poorly cemented sand very dense		
140	139-140 5	S-36	1 6	22-27 31 (58)	CLAYEY SANDSTONE (SS), poorly cemented, yellowish gray (5 Y 8/1), poorly cemented, dark gray (N3) phosphate-replaced shell fragments		Drill rod chatter at 141' to 143'
145	144-145 5	S-37	1 8	8 13-12 (25)	As Above more clay less cemented sand		
	149-150 5	S-38	ND	ND	As Above		Boring cemented with neat cement from bottom to land surface
					END OF BORING		

PROJECT-NUMBER
SEF30619 A0BORING NUMBER
TB-3

SHEET 1 OF 5

SOIL BORING LOG

PROJECT Indiantown Cogeneration Facility LOCATION Southeast Corner of Site, Indiantown, FL

ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL

DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning

WATER LEVEL AND DATE DTW = 5.93 ft 8/13/90 START 13 00 8/6/90 FINISH 8/8/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
5	0-2	S-1	ND	2-3-4-4 (7)	SAND (SW), very fine-medium grained poor-moderately sorted light olive gray (5 Y 6/1) quartz roots and organics		
	2-4	S-2 S-3	ND	7-13-13 20 (26)	SAND, (SW) very fine grained black very organic rich hard pan		
	4-6	S-4	ND	10-11-10 10 (21)	As Above dark reddish brown (10 YR 3/4) Not as well cemented		
	6-8	S-5	ND	4-5 5 5 (10)	SAND (SW) fine-coarse grained poorly sorted yellowish gray (5 Y 7/2) quartz composition		
	8-10	S-6	ND	9-9 10 11 (19)	As Above		
10	10-12	S-7	ND	5-6-6 7 (12)	SILTY SAND (SM) very fine grained moderate well sorted yellowish gray (5 Y 7/2) predominantly quartz trace black phosphorite		
	12-14	S-8	ND	5-7 6-8 (13)	As Above		
	14-16	S-9	10	3-5-2-1 (7)	SAND, (SP) very fine-fine grained well sorted light olive gray (5 Y 6/1) predominantly quartz trace black phosphorite slightly silty		
20	19-21	S-10	12	2-50/5" (52)	SILTY SAND (SM) very fine-fine grained moderately sorted, light gray (N7) to light olive gray (5 Y 6/1) thin clay lens @ 20 bis Cemented shell and sand at 20.5 bis		Drill rods chatter at 21'
25	24-26	S-11	18	48-48-19-47 (67)	SANDY SHELLY LIMESTONE, (LI) moderately friable (especially shelly material), medium light gray (N6) to pinkish gray (5 YR 8/1) for the shells (predominantly pelecypods) trace gastropods		As above



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB 3	SHEET 2 OF 5
SOIL BORING LOG		

PROJECT Indiantown Cogeneration Facility LOCATION Southeast Corner of Site, Indiantown, FL
ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE DTW = 5.93 ft 8/13/90 START 13 00 8/6/90 FINISH 8/8/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6 - 6 - 6" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	29-31	S-12	1 2	20-14-18 22 (32)	SAND, (SP), very fine-fine, moderate-well sorted light olive gray (5 Y 5/2) predominantly quartz, ~20% black phosphonite grains, 10-20% shell and limestone fragments		
35	34-36	S-13	1 0	20 30-50/5" (80)	As Above trace shell		
40	39-41	S-14	0 6	25 40 50/5" (90)	As Above		
45	44-46	S-15	1 4	24 25 24 32 (49)	SAND (SW) very fine-medium grained, poor moderate sorted light olive gray (5 Y 5/2) predominantly quartz ~20% black phosphonite angular subrounded ~20% pelecypod shell fragments trace greenish gray (5 G 6/1) clay lens at 46' bls		
50	49-51	S-16	1 2	18 28 38-28 (66)	As Above		
55	54-56	S-17	2 0	15-12 16-9 (28)	SHELLY SAND, (SW), very fine-medium grained, poorly sorted, light olive gray (5 Y 5/2) quartz Shell is 50% of sample, predominantly pelecypods some gastropods pale yellowish orange (10 YR 8/6) to white (N9)		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-3	SHEET 3 OF 5
SOIL BORING LOG		

PROJECT Indiantown Cogeneration Facility LOCATION Southeast Corner of Site, Indiantown, FL
ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE DTW = 5.93 ft 8/13/90 START 13 00 8/6/90 FINISH 8/8/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6" (N)	SOIL DESCRIPTION SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
	59-61	S-18	0.8	16-18-35-50/5" (53)	SAND, (SP), very fine-fine grained, moderate-well sorted yellowish gray (5 Y 7/2) predominantly quartz, 10-20% black phosphonite ~10% shell fragments		
65	64-66	S-19	1.0	30-40-39-39 (79)	As Above		
70	69-71	S-20	1.0	5-4-6 8 (10)	SILTY SHELLY CLAY, (CL), low plasticity, greenish gray (5 GY 6/1), abundant (30-40%) pelecypod shells (up to 1-inch dia) and fragments		
	71-73.5	ST-1	2.5	NA			Pushed Shelby tube 6" drove 2'
75	74-76	S-21	0.5	18 38-33-30 (71)	SAND, (SP), very fine-fine grained moderate-well sorted greenish gray (5 GY 6/1) predominantly quartz ~10-20% black phosphonite, ~10% shell fragments		
80	79-81	S-22	1.2	23 26-33-45 (59)	As Above, more shell (~20%)		
85	84-86	S-23	1.8	17-15 13-17 (28)	SANDY SHELL HASH, predominantly pelecypods, some gastropods, greenish gray (5 GY 6/1) very fine sand with trace little (~10%) black phosphonite, shells predominantly pinkish gray (5 YR 8/1)		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-3	SHEET 4 OF 5
SOIL BORING LOG		

PROJECT Indiantown Cogeneration Facility LOCATION Southeast Corner of Site, Indiantown, FL
ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE DTW = 5.93 ft 8/13/90 START 13 00 8/6/90 FINISH 8/8/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6-6-6 (N)	SOIL DESCRIPTION SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
	89-91	S 24	1 6	13 13 18-16 (31)	SHELLY SILTY SAND, (SM) very fine grained, light bluish gray (5 B 7/1) predominantly pinkish gray (5 YR 8/1) to white (N9) pelecypod shells and fragments ~10% very fine black phosphonite		
95	94-96	S 25	1 8	20-22-20-25 (42)	SHELLY SAND (SW), very fine grained, quartz sand, greenish gray (5 GY 6/1), ~40% fine to coarse pelecypod gastropod shell fragments, trace silt		
100	99-101	S 26	1 6	19-20 19-21 (39)	As Above		
105	104-106	S 27	1 2	10 10-10-19 (20)	As Above, more silt (10-20%)		
110	109-111	S-28	2 0	6-7 17 21 (24)	SILTY SAND, (SM) very fine grained greenish gray (5 GY 6/1), quartz CaCO ₃ , and trace black phosphonite grains, angular subrounded, trace-little (10%) pelecypod shells and fragments Trace clay		
115	114-116	S 29	2 0	11-19-21-35 (40)	CLAYEY SHELLY SAND, (SC) very fine grained low plasticity, abundant (30-40%) white (N9) coarse pelecypod shells and fragments		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-3
SHEET 5 OF 5	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Southeast Corner of Site, Indiantown, FL
 ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
 DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
 WATER LEVEL AND DATE DTW = 5.93 ft 8/13/90 START 13 00 8/6/90 FINISH 8/8/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	5'-6" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	119-121	S-30	2 0	11-25-35-30 (60)	SILTY CLAY (CL), low plasticity, greenish gray (5 GY 6/1), trace shell fragments		
125	124-126	S-31	1 8	14-12-16-25 (28)	As Above, more pelecypod shells and fragments (~20%)		
130	129-131	S-32	1 6	18 19-30-39 (49)	CLAYEY SAND AND SANDSTONE, (SC-SS), low plasticity, moderately-highly friable greenish gray (5 GY 6/1), ~10% shell fragments partially cemented Trace-little black phosphonite (very fine grained) in matrix		
135	134-136	S-33	1 8	11-16-36-39 (52)	SILTY CLAYEY SAND, (SC), very fine grained, low plasticity greenish gray (5 GY 6/1), ~10% shell fragments, trace cemented sand		
140	139-141	S-34	1 4	11-10-27-37 (37)	SILTY CLAY, (CL), low plasticity, very fine grained, pale olive (10 Y 6/2) ~10% shell fragments, trace cemented sand		
145	144-146	S-35	1 4	23-21-12-10 (33)	CLAYEY SAND & SANDSTONE, (SC-SS), low plasticity, moderately highly friable, greenish gray (5 GY 6/1), ~10% shell fragments-partially cemented Trace-little black phosphonite (very fine grained) in matrix		
	149-151	S-36	2 0	12-27 50/5" (77)	SILTY SAND, (SM), very fine grained, well sorted low plasticity, light olive (10 Y 5/4) 10% black phosphonite, predominantly quartz, trace clay		Boring abandoned with neat cement from bottom to land surface
					END OF BORING		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-4
SHEET 1 OF 5	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Proposed Power Block Area
 ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
 DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
 WATER LEVEL AND DATE DTW = 6 65 8/13/90 START 1300 7/23/90 FINISH 1400 8/6/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS		
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)						
				6"-6'-6" (N)					
5	0-2	S-1	ND	2-2 3-4 (5)	SAND, (SP), very fine-fine grained, moderately sorted, light gray (N7) dry, organics and roots, quartz	+			
	2-4	S-2	ND	3-3-4-5 (7)	SAND, (SP), very fine-medium, moderately sorted light gray (N7) to light olive gray (5Y 6/1), moist quartz, trace organics, trace black phosphorite				
	4-6	S-3	ND	4-4-6-8 (10)	SAND, (SP) very fine grained moderately to well sorted, dusky brown (5 YR 2/2) heavy organics, some quartz wet slightly silty				
	6-8	S-4	ND	3-6-9-5 (15)	As Above, less organics				
	8-10	S-5	ND	9-21-21-23 (15)	As Above, some hardpan, predominantly quartz				
10	10-12	S-6	ND	4-4-8-9 (12)	SAND (SP-SM), very fine grained moderate-well sorted, somewhat silty, quartz, moderate brown (5 YR 4/4)			+	
	12-14	S-7 S-8	ND	8-9-14-16 (23)	SAND, (SP) fine-medium grained moderate-well sorted, moderate yellowish brown (10 YR 5/4) quartz trace silt			+	
	14-16	S-9	1-6	8-8-8-9 (16)	As Above, yellowish gray (5 Y 7/2)			+	
15					SAND, (SP), fine-medium grained moderately sorted grayish orange (10 YR 7/4) quartz				
20	19-21	S-10	1-6	6-7-8-8 (15)	As Above				
25	24-26	S-11	1-6	7-8-8-9 (16)	SAND, (SP), very fine grained, well sorted, dusky yellow (5 Y 7/4) quartz				



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-4
SHEET 2 OF 5	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Proposed Power Block Area
 ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
 DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
 WATER LEVEL AND DATE DTW = 6.65 ft 8/13/90 START 13 00 7/23/90 FINISH 7/27/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
	29-31	S-12	2.0	3-2-2-2 (4)	SAND, (SP) very fine grained well sorted, grayish olive (10 Y 4/2), quartz slightly silty, subangular grains, very loose		
35	34-36	S-13	1.0	5 3 4 7 (7)	SILTY SAND (SM), very fine-medium grained poorly sorted dark gray (N3) quartz subangular grains loose		Pushed Shelby tube from 31 to 33 feet No recovery
	36-38.6	ST 1		NA			Pushed Shelby tube from 36 to 38.6 feet Very hard at 37 feet
40	39-41	S 14	1.2	5 15-35 50/5" (50)	SAND, (SP) very fine-fine grained, moderate-well sorted light olive gray (5 Y 6/1) to light brownish gray (5 YR 6/1), very clean no silt Quartz subangular grains ~20% very fine black phosphonite, very dense		
45	44-46	S-15	1.0	35-42 50/5" (72)	As Above		
50	49-51	S 16	0.5	36-50/5" (86)	As Above		
55	54-56	S-17	0.5	45 50/5" (95)	As Above		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-4	SHEET 3 OF 5
SOIL BORING LOG		

PROJECT Indiantown Cogeneration Facility LOCATION Proposed Power Block Area
ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE DTW = 6.65 ft 8/13/90 START 13 00 7/23/90 FINISH 7/27/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	59-61	S-18	0 75	45 25-14-11 (39)	As Above		
65	64 66	S 19	1 5	20 26-34-34 (60)	As Above, little-some (15%) pelecypod shell fragments (very brittle) pinkish gray (5 YR 8/1)		
70	69-71	S 20	1 2	31-41 21-20 (62)	As Above		
75	74 76	S 21	1 2	15-30 30-30 (60)	As Above		
80	79 81	S-22	1 6	47-50/5" (97)	As Above less shell (~5%)		
85	84 86	S-23	1 6	25-21-20-16 (41)	As Above, some silt, more shell (25%)		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-4	SHEET 4 OF 5
SOIL BORING LOG		

PROJECT Indiantown Cogeneration Facility LOCATION Proposed Power Block Area
ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE DTW = 6.65 ft 8/13/90 START 13 00 7/23/90 FINISH 7/27/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL	SYMBOL LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-8" (N)			DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	89-91	S 24	1 2	15-17 17-20 (34)	SANDY SHELL HASH, fine grained (~50% shell fragments) Greenish gray (5 GY 6/1) to pinkish gray (5 YR 8/1) Predominantly pelecypod with little gastropod shell fragments Slightly silty quartz		Gradual loss of drilling fluids (slight)
95	94-96	S 25	1 6	11 10-13 17 (23)	SILTY SHELL HASH, very fine grained large worm-like shells (>50% shell) (1/4" dia by 2" long) Greenish gray (5 GY 6/1) to pinkish gray (5 YR 8/1) Some pelecypod shell hash Moderately plastic silty sand Trace cemented sand quartz		Shelby tube sample obtained at 96' bls
	96-98 5	ST 2	2 5	NA			
100	99-101	S-26	2 0	9 20-30-40 (50)	SHELLY SAND, very fine-medium grained, poor-moderately sorted, light olive gray (5 Y 6/1) Slightly silty ~20% pelecypod, gastropod shell and shell fragments Quartz		
105	104-106	S 27	1 8	25 27 30-32 (57)	As Above, slightly more shell (~30%)		
110	109-111	S-28	1 9	20-21 22-22 (43)	As Above less shell (15%) light olive gray (5 Y 6/1) to light bluish gray (5 B 7/1) slightly silty		
115	114-116	S-29	2 0	14-9-12-16 (21)	SILTY SHELLY SAND (marl?) very fine-fine grained light olive gray (5Y 6/1), ~25% shell fragments quartz		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-5	SHEET 1 OF 5
SOIL BORING LOG		

PROJECT Indiantown Cogeneration Facility LOCATION Production Well Site, Indiantown, FL
ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE DTW = 6.2 ft 8/13/90 START 10 15 7/30/90 FINISH 8/7/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6" (N)	SOIL DESCRIPTION SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
5	4-6	S 1	1 2	5-5-7-8 (12)	SAND, (SP) fine-coarse grained, moderately sorted, very light gray (N8), subangular-rounded quartz, thin organic layer at 6 bls medium dense		
		S-2					
10	9 11	S 3	1 2	9 9-10-10 (19)	SAND (SP) fine-medium grained, moderate-well sorted, moderate brown (5 YR 4/4) subangular-rounded quartz, medium dense		
	11-13	S-4	2 0	10-7-8 7 (15)	As Above, yellowish gray (5 Y 7/2)		
	13 15	S 5	1 2	7-10-9 9 (19)	As Above		
15							
20	19-21	S-6	1 0	8-9-12-11 (21)	As Above, dusky yellow (5 Y 6/4)		
25	24-26	S-7	1 8	4-4-3-4 (7)	SAND, (SP), very fine grained well sorted, olive gray (5 Y 4/1), subangular-subrounded, trace of silt, trace-little black phosphonite (very fine grained) Quartz, loose		Obtain Shelby tube from 26 to 29' bls
	26 29	ST-1	3 0	NA			



PROJECT NUMBER

SEF30619 A0

BORING NUMBER

TB-5

SHEET 2 OF 5

SOIL BORING LOG

PROJECT Indiantown Cogeneration Facility

LOCATION Production Well Site, Indiantown, FL

ELEVATION ~32 ft NGVD

DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL

DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning

WATER LEVEL AND DATE DTW = 6.2 ft 8/13/90

START 10 15 7/30/90

FINISH 8/7/90

LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
	29-31	S-8	1 2	WR-WR-10-11 (10)	SAND, (SM) very fine grained, well sorted, light gray (N7) quartz, somewhat silty, some pinkish gray shell fragments (25%), trace-little cemented sand fragments, quartz, loose		
35	34-36	S-9	1 8	16-21-29 28 (50)	SAND, (SP), very fine-medium grained, poor moderately sorted, light olive gray (5 Y 6/1), quartz ~20% gray sandstone fragments, ~20% pelecypod shell fragments ~10% very fine grained black phosphorite, unconsolidated, dense		
40	39-41	S-10	1 2	25 38 50/5" (88)	SAND (SP), very fine grained well sorted, olive gray (5 Y 4/1) quartz, ~25% very fine grained black phosphorite unconsolidated, trace shell fragments angular-subrounded grains, very dense		Refusal Rope breaks at end of hammer Cut and tie new rope
45	44-46	S 11	1 0	25-40-50/5" (90)	As Above		
50	49 51	S 12	1 2	27-36-36-33 (72)	As Above		
55	54 56	S 13	ND	18-16-25-50/5" (41)	As Above dense		



PROJECT NUMBER
SEF30619 A0

BORING NUMBER
TB 5

SHEET 3 OF 5

SOIL BORING LOG

PROJECT Indiantown Cogeneration Facility LOCATION Production Well Site, Indiantown, FL

ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL

DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning

WATER LEVEL AND DATE DTW = 6.2 ft 8/13/90 START 10 15 7/30/90 FINISH 8/7/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
	59-61	S-14	ND	14-17-40-50/5" (57)	SAND (SP), very fine grained, well sorted, olive gray (5 Y 4/1) and SHELL fragments (~30%) pelecypods pinkish gray (5 YR 8/1) Some (10-20%) cemented sand Subangular-subrounded quartz, very fine black phosphonite sand grains very dense		
65	64-66	S-15	0.6	22-35-44-47 (79)	SAND (SP), very fine grained, well sorted olive gray (5 Y 4/1), subangular-subrounded ~25% black phosphonite grains (very fine) quartz very dense		
70	69-71	S-16	2.0	5-3 5 6 (8)	SILTY CLAY, (CL), low-moderate plasticity, dark greenish gray (5 GY 4/1), firm		
	71-74	ST-2	3.0	NA			Obtain Shelby tube sample at 71' bls
75	74-76	S-17	1.8	4-4-3-4 (7)	CLAYEY, SHELLY SILT, (ML) low-moderate plasticity, light olive gray (5 Y 5/2) very fine grained, 30-40% shell fragments (predominantly pelecypods, trace gastropods), firm		
80	79-81	S-18	1.8	22 23-30-31 (53)	SAND, (SP), fine-coarse grained, poorly sorted angular-rounded quartz predominant, ~25% black phosphonite grains ~10% calcium carbonate and pelecypod shell fragments, trace silt very dense		Drill rods chatter at 83' bls
85	84-86	S-19	1.6	10 12-14 20 (26)	SILTY SAND, (SM), very fine grained, well sorted angular-rounded greenish gray (5 GY 6/1) predominantly quartz ~15-20% black phosphonite grains, ~5% calcium carbonate grains, ~5-10% large (1/2" dia) pelecypod shells, medium dense		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-5
SHEET 4 OF 5	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Production Well Site Indiantown FL
 ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
 DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
 WATER LEVEL AND DATE DTW = 6.2 ft 8/13/90 START 10 15 7/30/90 FINISH 8/7/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	89-91	S-20	1.6	11-16-20 (36)	As Above less shell		
95	94-96	S-21	1.6	12-15-23-25 (38)	SHELLY SAND, (SW) fine-medium grained poor-moderately sorted, subangular-subrounded greenish gray (5 GY 6/1) quartz sand grains Shell fragments (pelecypod, trace gastropod) constitute ~30% of sample Trace black phosphonite, very fine grained Medium dense		
100	99-101	S-22	1.4	23-21-21-18 (42)	As Above less shell		
105	104-106	S-23	1.8	14-15-15-14 (30)	SILTY SHELLY SAND (SM), very fine-medium grained poor-mod sorted, subangular-rounded greenish gray (5 GY 6/1) sand grains predominantly quartz composition with 10% very fine black phosphonite Shell (~30% of sample) is predominantly fragments but large (1/2") pelecypod and gastropods also Medium dense		
110	109-111	S-24	1.8	12-12-12-12 (24)	SAND, (SP), very fine-fine grained, moderate-well sorted angular subrounded, light olive gray (5 Y 6/1) quartz grains predominant, ~10-20% fine shell fragments medium dense, trace-little silt		
115	114-116	S-25	0.5	8-11-24-26 (35)	As Above		



PROJECT-NUMBER	BORING-NUMBER
SEF30619 A0	TB-5
SHEET 5 OF 5	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Production Well Site, Indiantown FL
ELEVATION -32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
WATER LEVEL AND DATE DTW = 6.2 ft 8/13/90 START 10 15 7/30/90 FINISH 8/7/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	8"-6"-6" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
	119-121	S-26	2.0	12-32-50/5" (82)	SANDY CLAY, (SC), low plasticity greenish gray (5 GY 6/1) ~15% fine pelecypod shell fragments Hard		
125	124-126	S-27	1.8	17-16-14-12 (30)	CLAYEY SAND, (SC), low plasticity, greenish gray (5 GY 6/1) ~20% fine coarse pelecypod white shells and fragments Trace-little (15%) cemented sand and shell Very stiff		
130	129-131	S-28	2.0	12 15 20-30 (35)	As Above		
135	134-136	S-29	2.0	7-9-26-50/5" (35)	As Above		
140	139-141	S-30	2.0	10-22-45-41 (67)	SANDY CLAY (SC), low plasticity, greenish gray (5 GY 6/1) ~15% fine pelecypod shell fragments, hard, some cemented sand layers (thin)		
145	144-146	S-31	2.0	32-15-12-21 (27)	CLAYEY SAND & SANDSTONE, (SC-SS), low plasticity very light gray (N8) moderate-very friable sandstone ~10% shell fragments in matrix Trace-little (~15%) black phosphonite Very stiff		
	149-151	S 32	2.0	9 17-40 42 (57)	SANDY CLAY (SC), low-mod plasticity, very light gray (N8) ~10% shell fragments END OF BORING		Boring cemented with neat cement to ground surface



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-6
SHEET 1 OF 2	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Pumping Test Location, Indiantown FL
 ELEVATION -32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
 DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
 WATER LEVEL AND DATE DTW = 7 04 ft 8/13/90 START 09 45 8/2/90 FINISH 12 00 8/3/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
				6"-6'-6" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING DRILLING RATE DRILLING FLUID LOSS TESTS AND INSTRUMENTATION
50	49 51	S-1	ND	28-33-46-60 (79)	SAND (SP), very fine grained, well sorted, light olive gray (5 Y 6/1) subangular-subrounded, quartz and ~25% very fine black phosphonite, very dense		Drill with 4-1/2" tncone roller bit from 0 to 49' bls using Van-Flo® biodegradable mud
55	54 56	S-2	ND	19-26-26 33 (52)	As Above trace-little pelecypod shell fragments		
60	59-61	S-3 S-4	1 6	16 30 45-50/4" (75)	SHELLY SAND (SW), very fine-coarse grained poorly sorted quartz w/20% very fine black phosphonite, pelecypod and some gastropod shells SAND (SP), very fine grained, well sorted, light olive gray (5 Y 6/1), very fine black phosphonite (~20%) Trace shell, quartz, very dense		
65	64 66	S 5	1 0	19-20-33-45 (53)	As Above		
70	69-71	S-6	2 0	4 3-4-7 (7)	SILTY CLAY (CL), low plasticity dark greenish gray (5 GY 4/1), firm trace shell fragments		



PROJECT NUMBER SEF30619 A0	BORING NUMBER TB-6
SHEET 2 OF 2	
SOIL BORING LOG	

PROJECT Indiantown Cogeneration Facility LOCATION Pumping Test Location, Indiantown, FL
 ELEVATION ~32 ft NGVD DRILLING CONTRACTOR Ardaman and Associates, West Palm Beach, FL
 DRILLING METHOD AND EQUIPMENT CME 45 Rotary Rig with Split Spooning
 WATER LEVEL AND DATE DTW = 7 04 ft 8/13/90 START 09 45 8/2/90 FINISH 12 00 8/3/90 LOGGER P Kwiatkowski

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	5'-6"-6" (N)	SOIL NAME COLOR MOISTURE CONTENT RELATIVE DENSITY OR CONSISTENCY SOIL STRUCTURE, MINERALOGY USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	74-76	S-1	2 0	4-5-5-7 (10)	CLAYEY SHELLY SILT, (ML), low-moderate plasticity, very fine grained, greenish gray (5 GY 6/1) ~30% shell fragments (pelecypods, trace gastropods), firm		
80	79-81	S-8	ND	9-13-22 35 (35)	SAND, (SP), fine-medium grained moderately sorted, light olive gray (5 Y 6/1), trace silt, trace shell fragments, dense		
86	84-86	S-9	1 8	6-6-7-22 (13)	SILTY SAND (SM) very fine grained, moderate-well sorted, greenish gray (5 GY 6/1), ~20% very fine grained black phosphonite, predominantly quartz, ~10% shell fragments		
90	89-91	S 10	1 6	15-19-23-19 (42)	SHELLY SAND, (SW), very fine grained w/coarse shell fragments (25%), poorly-moderately sorted, greenish gray (5 GY 6/1) sand predominantly quartz with ~15-20% very fine grained black phosphonite		
95	94-96	S-11	ND	11-13-20 18 (33)	As Above, more shell (~40%)		
100	99-101	S-12	1 6	20-22-20-20 (42)	As Above		
					END OF BORING		

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

INDIANTOWN COGENERATION PLANT SOUNDING NO. B-103

PROJECT FILE NO 90-5648

DATE TESTED-7-30-90

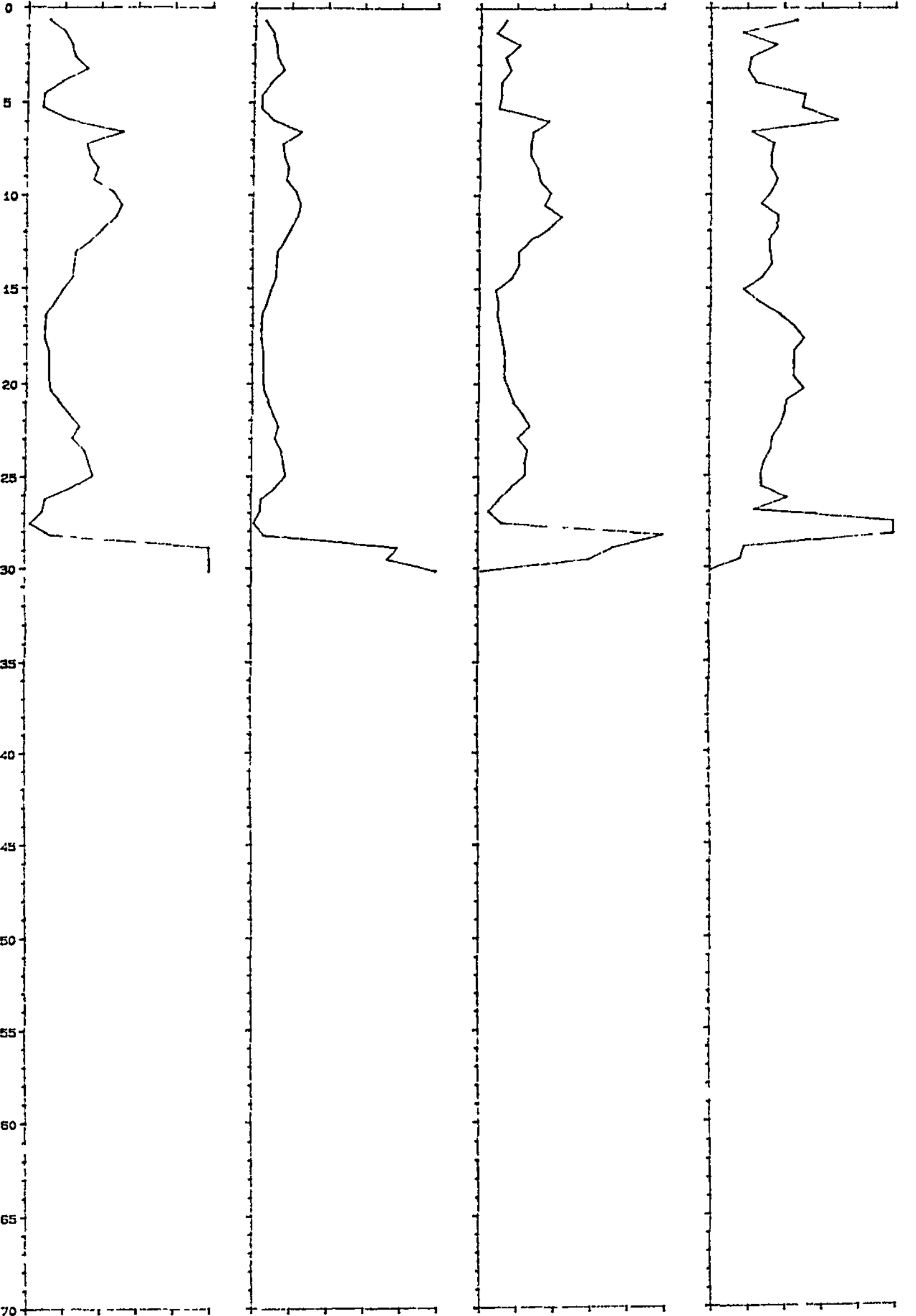
POINT RESISTANCE, KG/CM²

POINT RESISTANCE, KG/CM²

LOCAL FRICTION, KG/CM²

FRICTION RATIO, %

SOUNDING DEPTH, FEET

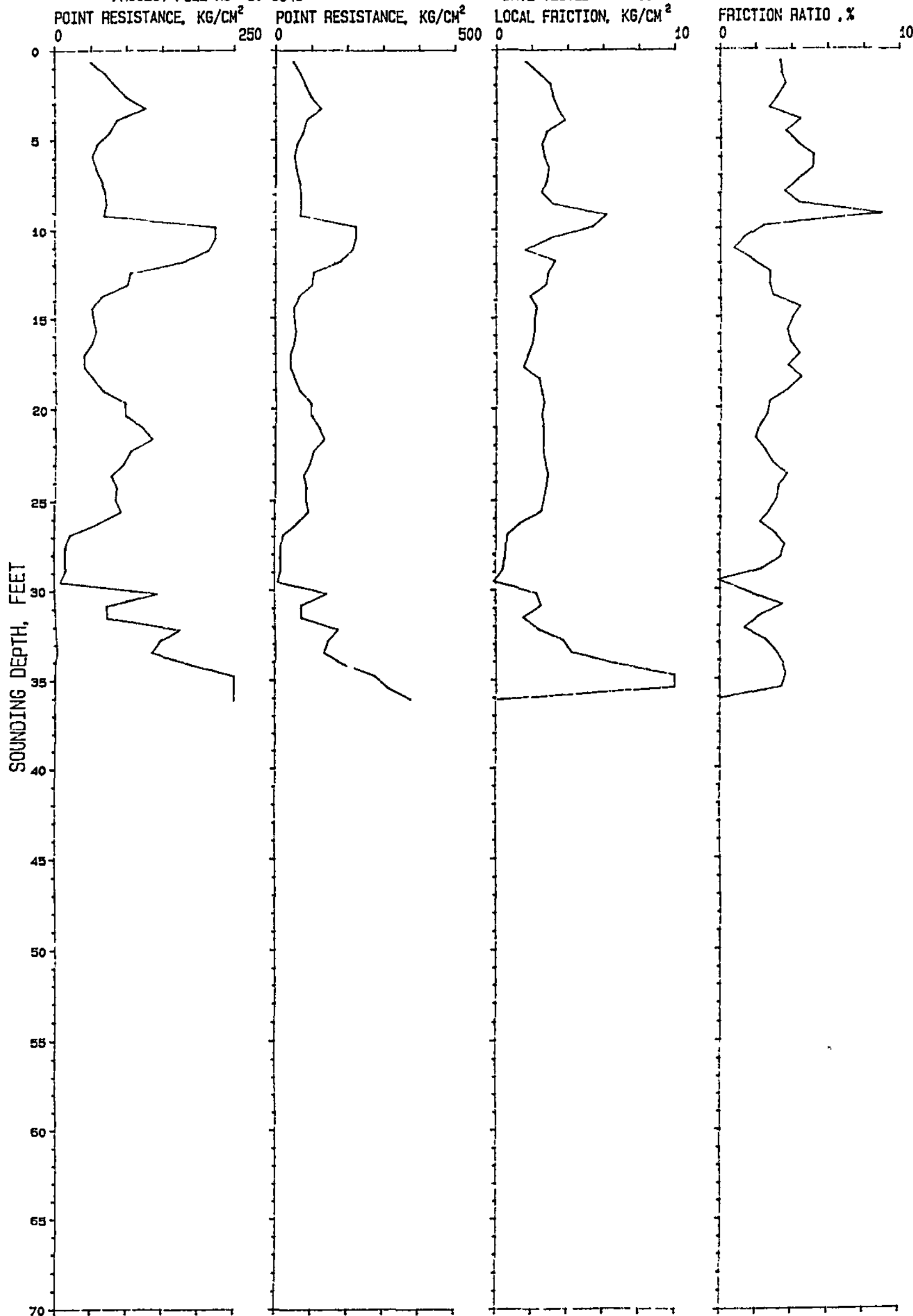


Indiantown Cogeneration Project	
Indiantown Cogeneration, L.P.	
CPT NO B-103	
INDIANTOWN COGENERATION PLANT	
INDIANTOWN, FLORIDA	
DESIGNED BY	CHECKED BY
FILE NO.	DATE
90-5648	

INDIANTOWN COGENERATION PLANT SOUNDING NO B-105

PROJECT FILE NO 90-5648

DATE TESTED=7-30-90

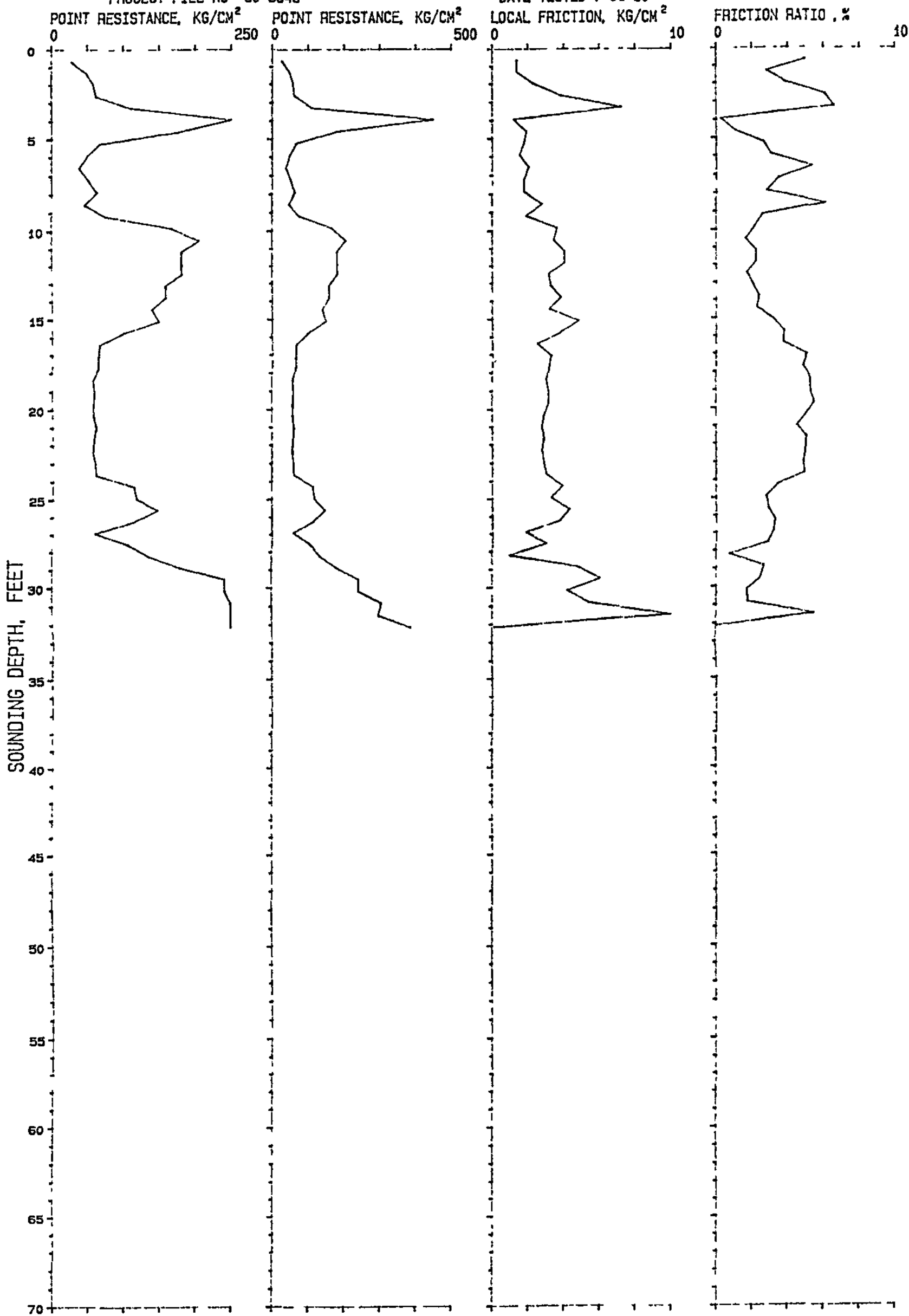


Indiantown Cogeneration Project	
Indiantown Cogeneration, L.P.	
CPT NO B-105	
INDIANTOWN COGENERATION PLANT	
INDIANTOWN, FLORIDA	
DATE	APPROVED BY
90-5648	

INDIANTOWN COGENERATION PLANT SOUNDING NO B-106

PROJECT FILE NO =90-5648

DATE TESTED=7-31-90

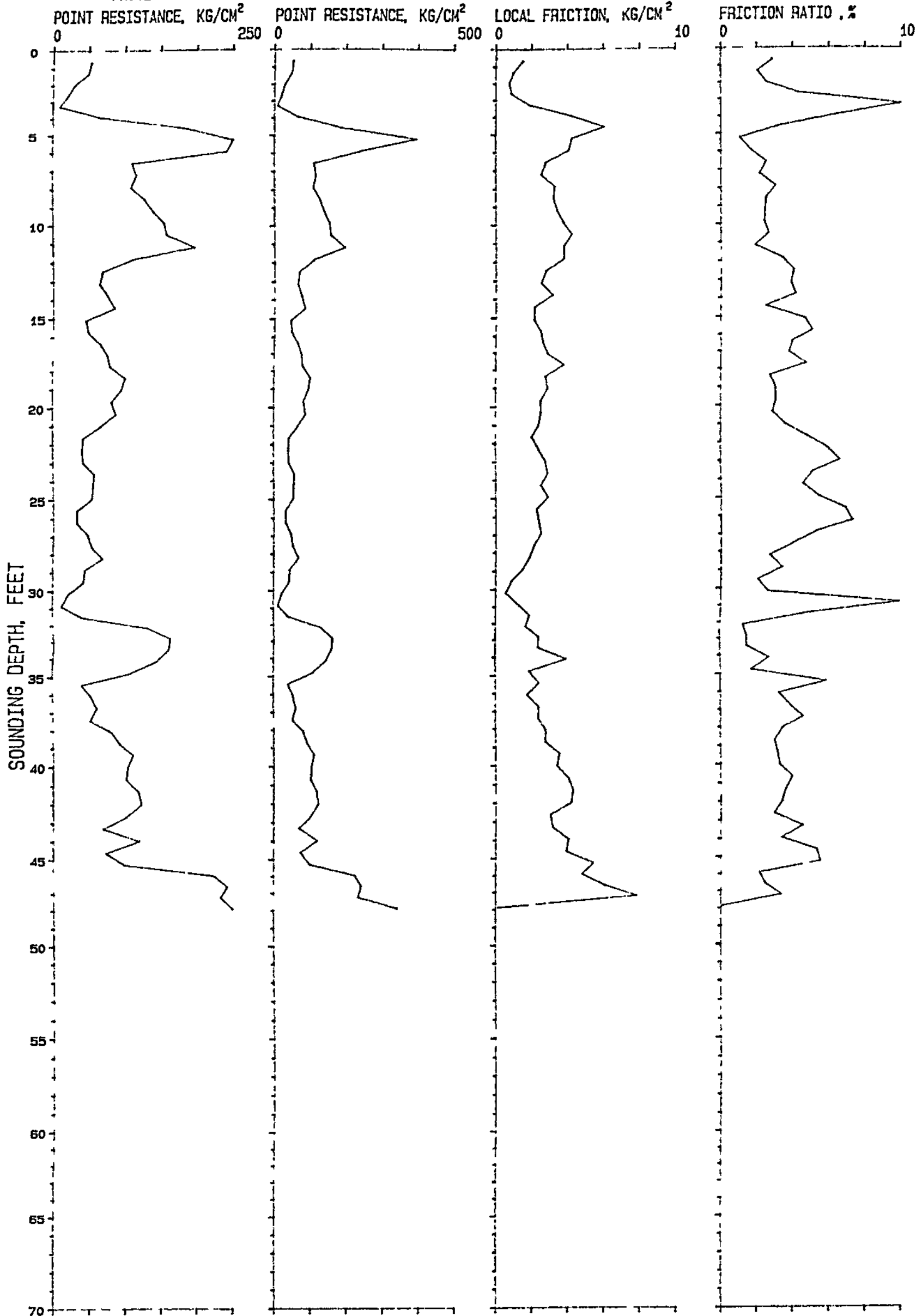


Indiantown Cogeneration Project	
Indiantown Cogeneration, L.P.	
CPT NO B-106	
INDIANTOWN COGENERATION PLANT	
INDIANTOWN, FLORIDA	
DESIGNED BY	CHECKED BY
FILE NO.	DATE
90-5648	

INDIANTOWN COGENERATION PLANT SOUNDING NO. B-109

PROJECT FILE NO 90-5648

DATE TESTED=7-31-90

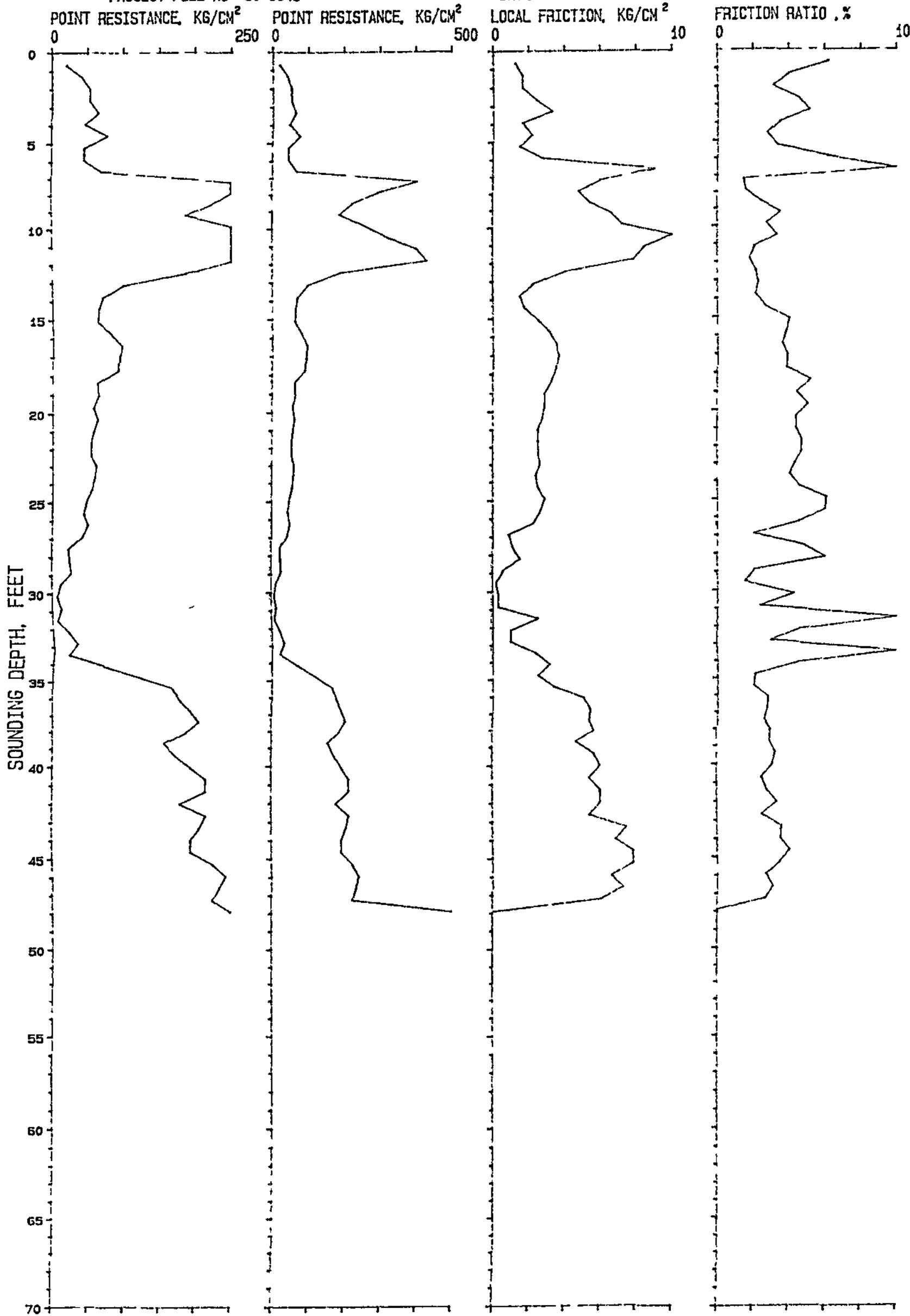


Indiantown Cogeneration Project			
Indiantown Cogeneration, L.P.			
INDIANTOWN COGENERATION PLANT			
INDIANTOWN, FLORIDA			
CPT NO. B-109			
90-5648	CHECKED BY	DATE	

INDIANTOWN COGENERATION PLANT SOUNDING NO B-111

PROJECT FILE NO 90-5648

DATE TESTED=7-31-90



INDIANTOWN Cogeneration Project	
INDIANTOWN Cogeneration, L.P.	
INDIANTOWN, FLORIDA	
CPT NO B-111	
FILE NO.	90-5648
APPROVED BY	
CHECKED BY	
DATE	

INDIANTOWN COGENERATION PLANT SOUNDING NO B-112

PROJECT FILE NO 90-5648

DATE TESTED=7-31-90

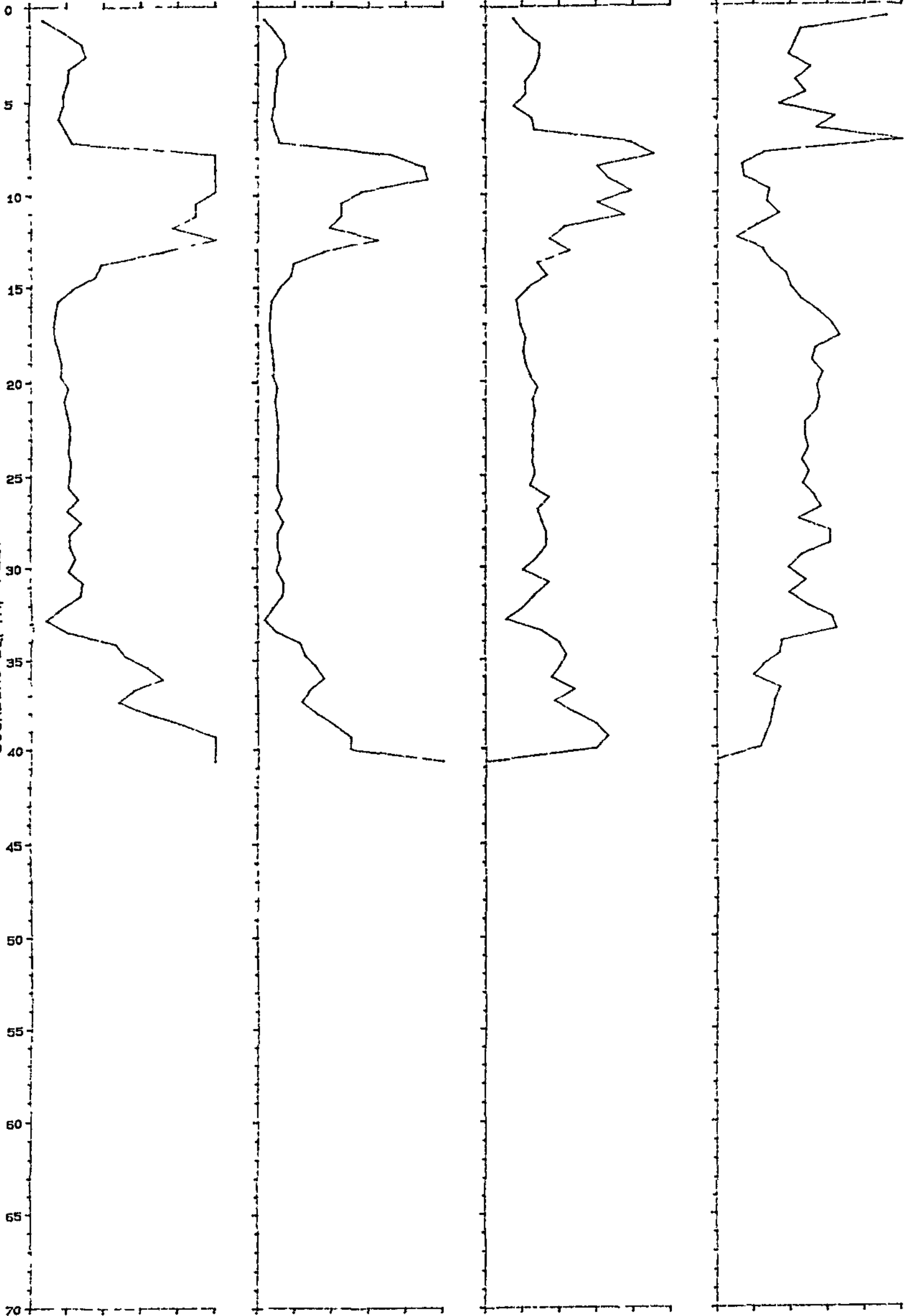
POINT RESISTANCE, KG/CM²

POINT RESISTANCE, KG/CM²

LOCAL FRICTION, KG/CM²

FRICTION RATIO .%

SOUNDING DEPTH, FEET



Indiantown Cogeneration Project			
Indiantown Cogeneration, L.P.			
CPT NO B-112			
INDIANTOWN COGENERATION PLANT			
INDIANTOWN, FLORIDA			
DRAWN BY	CHECKED BY	DATE	
FILE NO.	APPROVED BY		
90-5648			

INDIANTOWN COGENERATION PLANT SOUNDING NO B-113

PROJECT FILE NO 90-5648

DATE TESTED=7-31-90

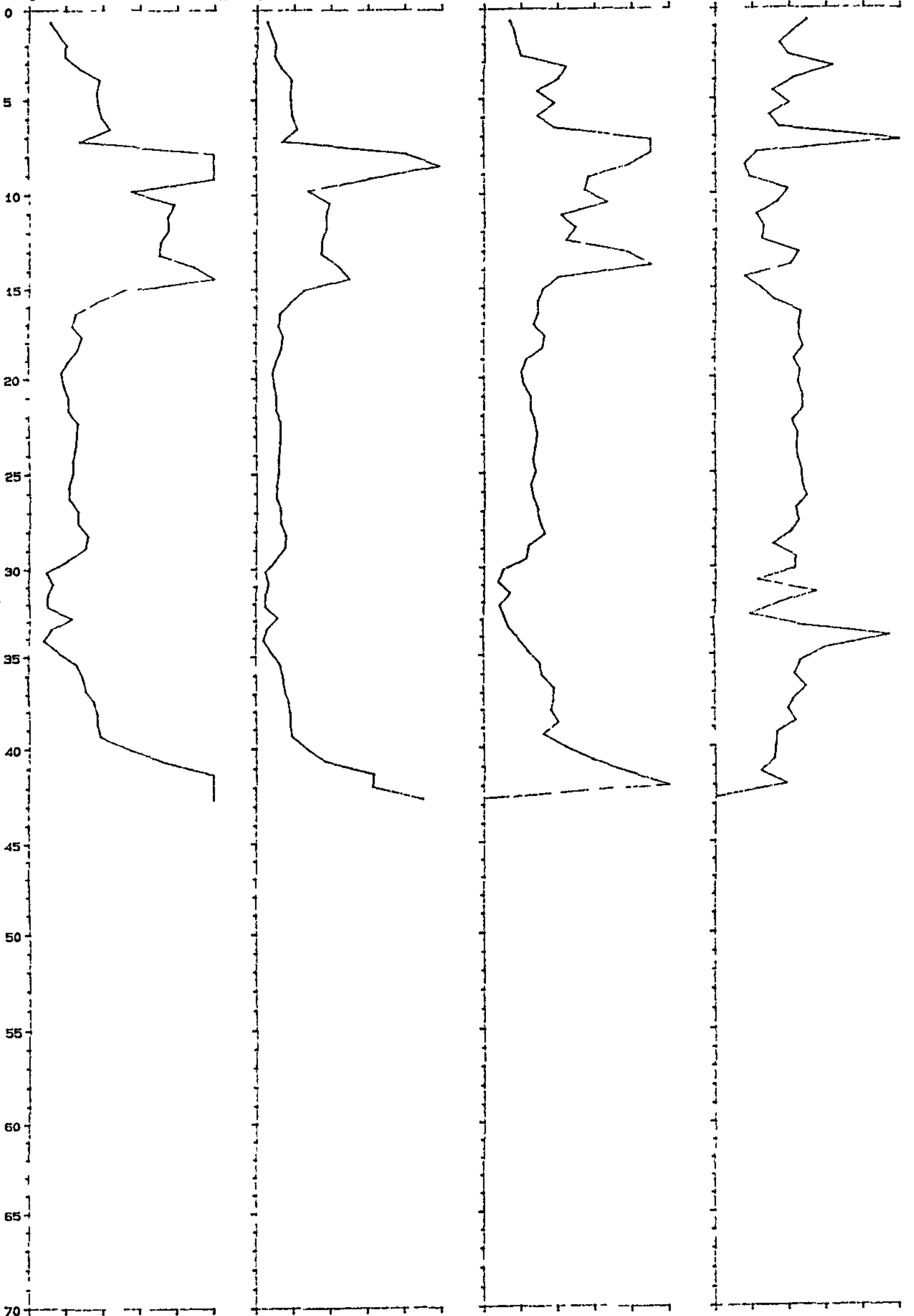
POINT RESISTANCE, KG/CM²

POINT RESISTANCE, KG/CM²

LOCAL FRICTION, KG/CM²

FRICTION RATIO, %

SOUNDING DEPTH, FEET

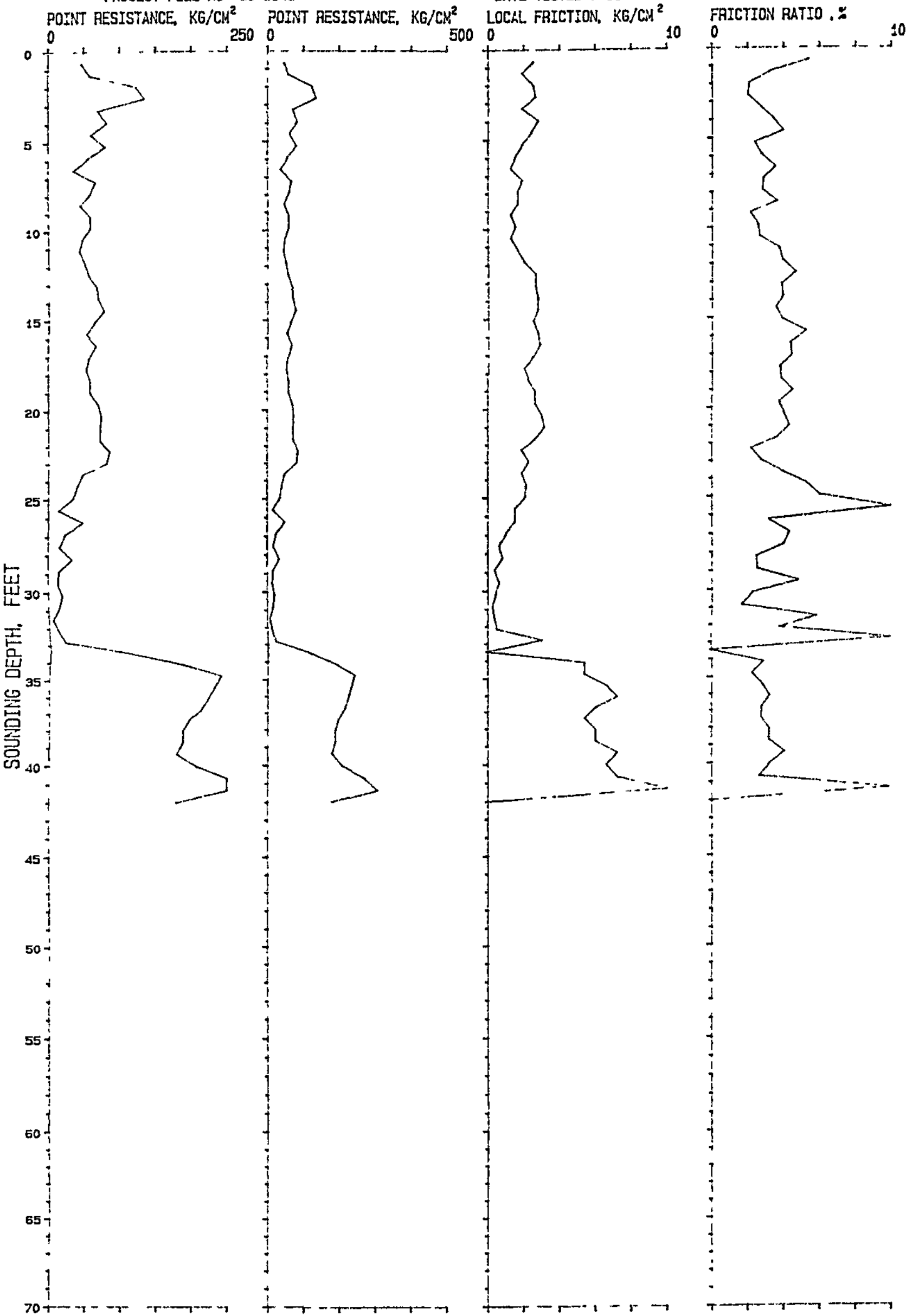


INDIANTOWN Cogeneration Project Indiantown Cogeneration, L.P. INDIANTOWN, FLORIDA	
CPT NO B-113 INDIANTOWN COGENERATION PLANT INDIANTOWN, FLORIDA	DRAWN BY FILE NO. 90-5648
CHECKED BY DATE	APPROVED BY

INDIANTOWN COGENERATION PLANT SOUNDING NO B-114

PROJECT FILE NO 90-5648

DATE TESTED=7-31-90



Indiantown Cogeneration Project Indiantown Cogeneration, L.P.	
CPT NO B-114	
INDIANTOWN COGENERATION PLANT INDIANTOWN, FLORIDA	
DRAWN BY:	CHECKED BY:
FILE NO. 90-5648	DATE:
APPROVED BY:	

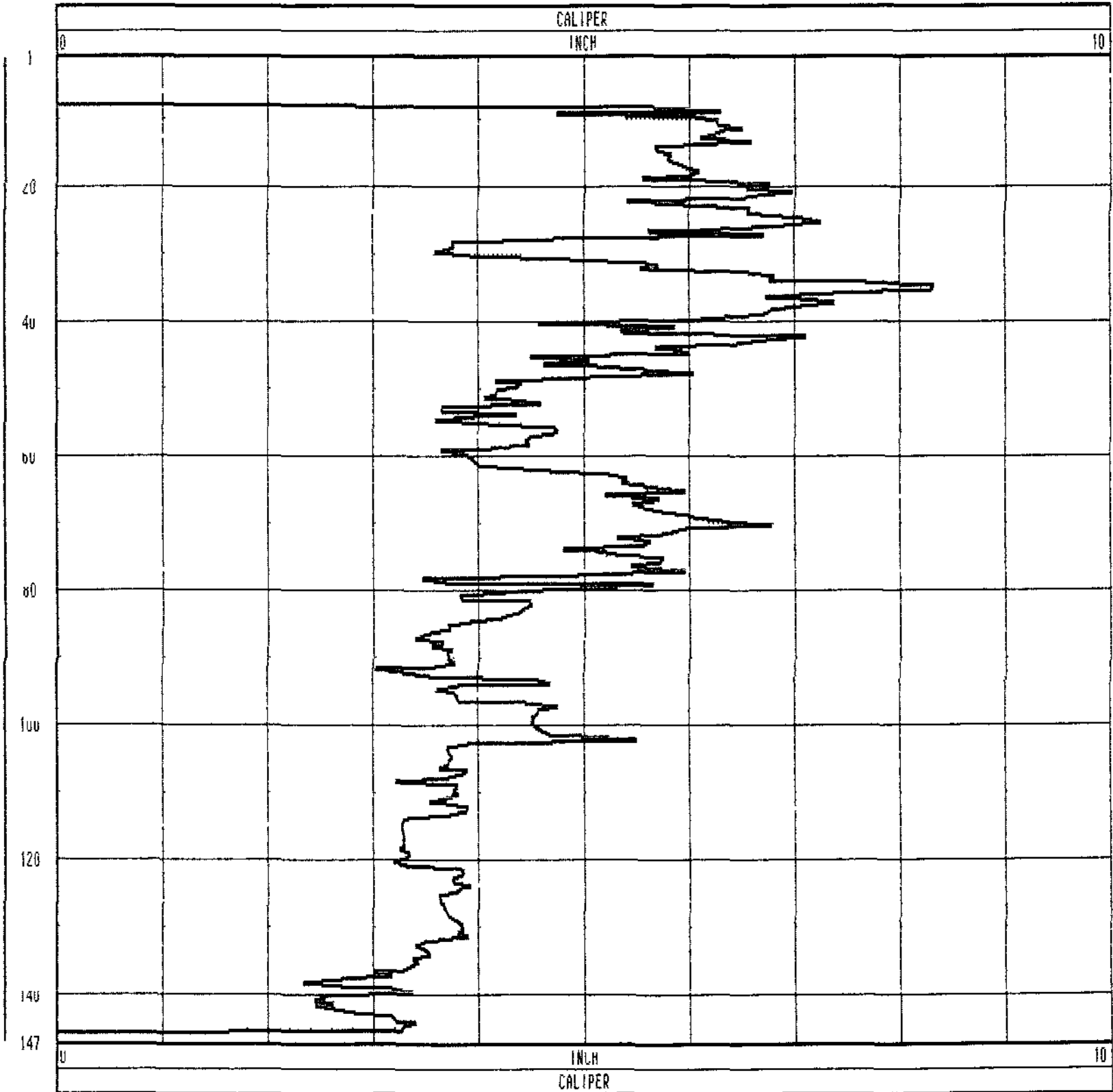
GEOPHYSICAL LOGS

CALIPER



MW-1 0043-0034

COMPANY	BECHTEL	SEF30619 AG	OTHER SERVICES	
WELL	MW-1	0043-0034	GAMMA	
LOCATION/FIELD	INDIANTOWN		SING PT	
COUNTY	MARTIN			
STATE	FL			
SECTION	34	TOWNSHIP	39S	RANGE 38E
DATE	08/15/90	PERMANENT DATUM	GL	ELEVATIONS
DEPTH DRILLER	150	ELEV PERM DATUM	32'	KB
LOG BOTTOM	147 50	LOG MEASURED FROM	GL	DF
LOG TOP	1 50	DRL MEASURED FROM	GL	GL 32'
CASING DRILLER	NA	LOGGING UNIT	1	
CASING TYPE	NA	FIELD OFFICE	DFB	
CASING THICKNESS	NA	RECORDED BY	C DIGIACOMO	
BIT SIZE	3 87	BOREHOLE FLUID	MUD	FILE ORIGINAL
MAGNETIC DECL	NA	RM	NA	TYPE CCAL3
MATRIX DENSITY	NA	RM TEMPERATURE	NA	LOG 4
FLUID DENSITY	NA	MATRIX DELTA T	NA	PLOT REPORT 6
NEUTRON MATRIX	SANDSTONE	FLUID DELTA T	NA	THRESH 30000
REMARKS				
LOG PERFORMED ON A STATIC WELL				
OBSERVER DAVE SYNDER				

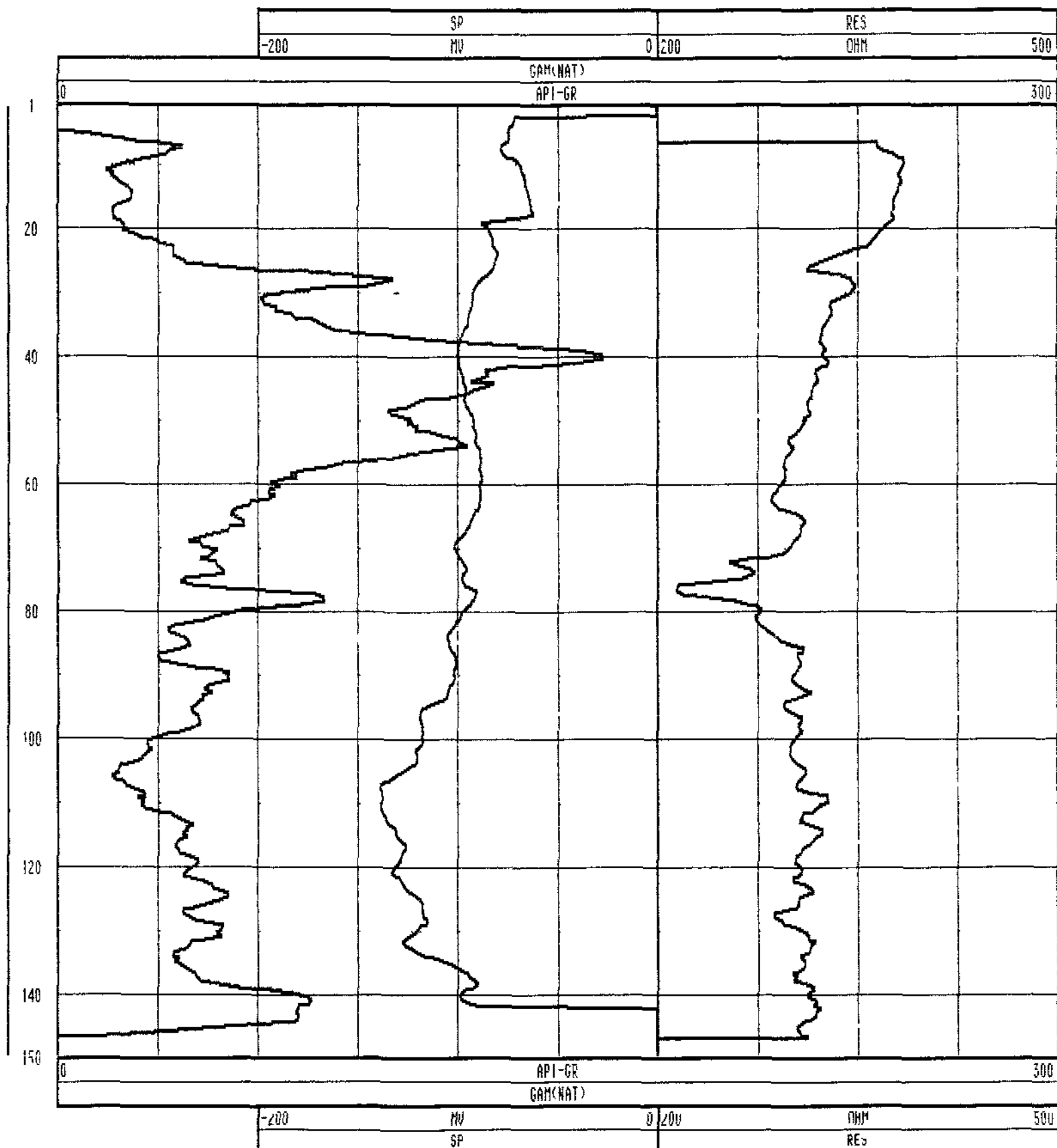




SINGLE POINT
GAMMA

MW-1 0043-0034

COMPANY	BECHTEL SEF30619 AB	OTHER SERVICES	
WELL	MW-1 0043-0034	CALIPER	
LOCATION/FIELD	INDIANTOWN		
COUNTY	MARTIN		
STATE	FL		
SECTION	34	TOWNSHIP	39S
		RANGE	38E
DATE	08/15/90	PERMANENT DATUM	GL
DEPTH DRILLER	150	ELEV PERM DATUM	32'
LOG BOTTOM	150 00	LOG MEASURED FROM	GL
LOG TOP	1 50	DRL MEASURED FROM	GL
			GL 32'
CASING DRILLER	NA	LOGGING UNIT	1
CASING TYPE	NA	FIELD OFFICE	DFB
CASING THICKNESS	NA	RECORDED BY	C DIGIACOMO
BIT SIZE	3 87	BOREHOLE FLUID	MUD
MAGNETIC DECL	NA	RM	NA
MATRIX DENSITY	NA	RM TEMPERATURE	NA
FLUID DENSITY	NA	MATRIX DELTA T	NA
NEUTRON MATRIX	SANDSTONE	FLUID DELTA T	NA
FILE		PROCESSED	
TYPE			9040A
LOG			7
PLOT		REPORT	8
THRESH			30000
REMARKS			
			LOG PERFORMED ON A STATIC WELL
			OBSERVER DAVE SYNDER

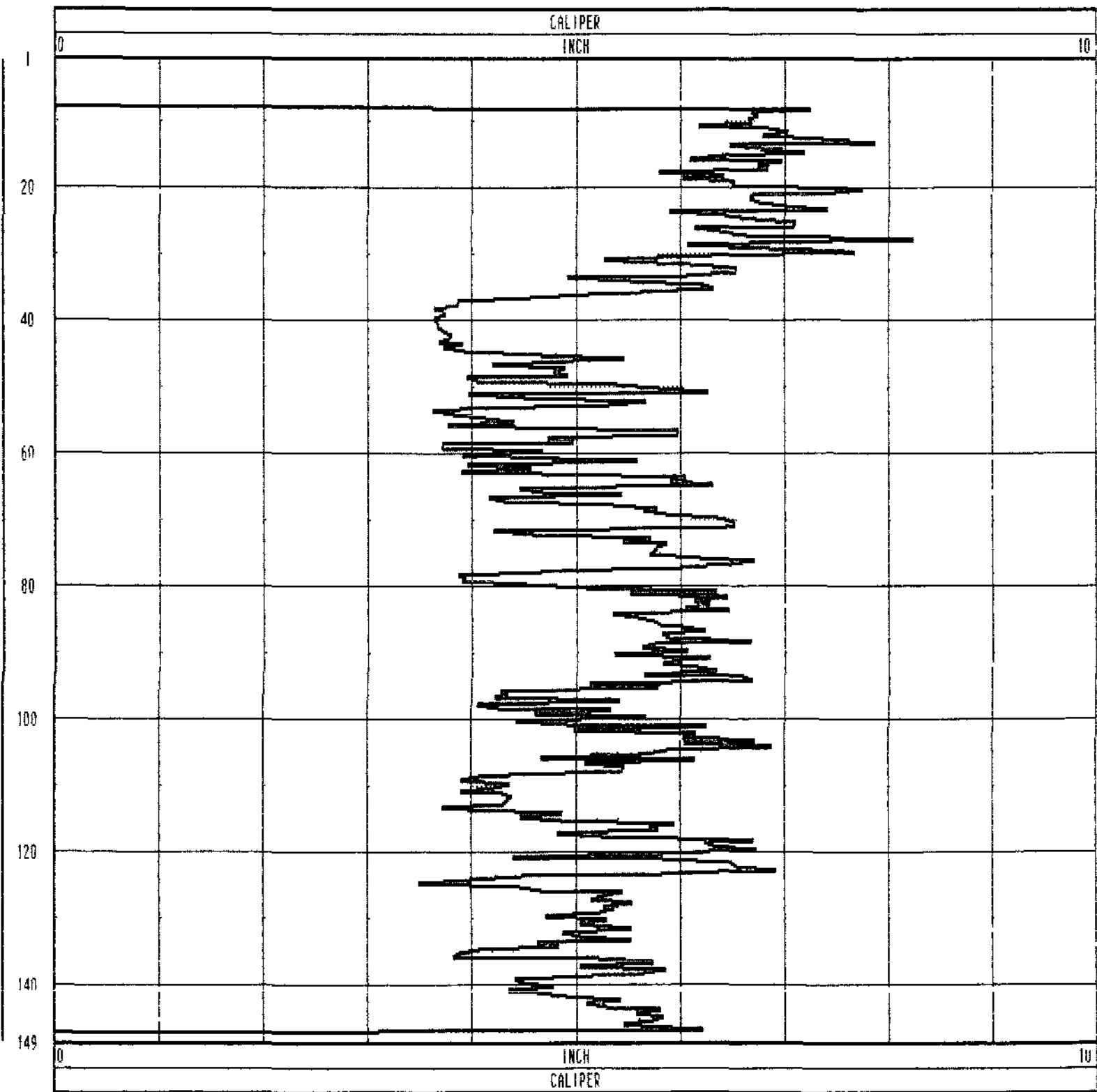


CALIPER



MW-2 0043-0033

COMPANY	BECHTEL	SEF30619 A0	OTHER SERVICES	
WELL	MW-2	0043-0033	GAMMA	
LOCATION/FIELD	INDIANTOWN		SING PT	
COUNTY	MARTIN			
STATE	FL			
SECTION	34	TOWNSHIP	39S	RANGE 38E
DATE	08/10/90	PERMANENT DATUM	GL	ELEVATIONS
DEPTH DRILLER	150	ELEV PERM DATUM	32'	KB
LOG BOTTOM	149 00	LOG MEASURED FROM	GL	DF
LOG TOP	1 50	DRL MEASURED FROM	GL	GL 32
CASING DRILLER	NA	LOGGING UNIT	1	
CASING TYPE	NA	FIELD OFFICE	DFB	
CASING THICKNESS	NA	RECORDED BY	C DIGIACOMO	
BIT SIZE	4 5	BOREHOLE FLUID	MUD	FILE ORIGINAL
MAGNETIC DECL	NA	RM	NA	TYPE CCAL3
MATRIX DENSITY	NA	RM TEMPERATURE	NA	LOG 0
FLUID DENSITY	NA	MATRIX DELTA T	NA	PLOT REPORT 6
NEUTRON MATRIX	SANDSTONE	FLUID DELTA T	NA	THRESH 30000
REMARKS	LOG PERFORMED ON A STATIC WELL			
	OBSERVER PETER KWIATKOWSKI			

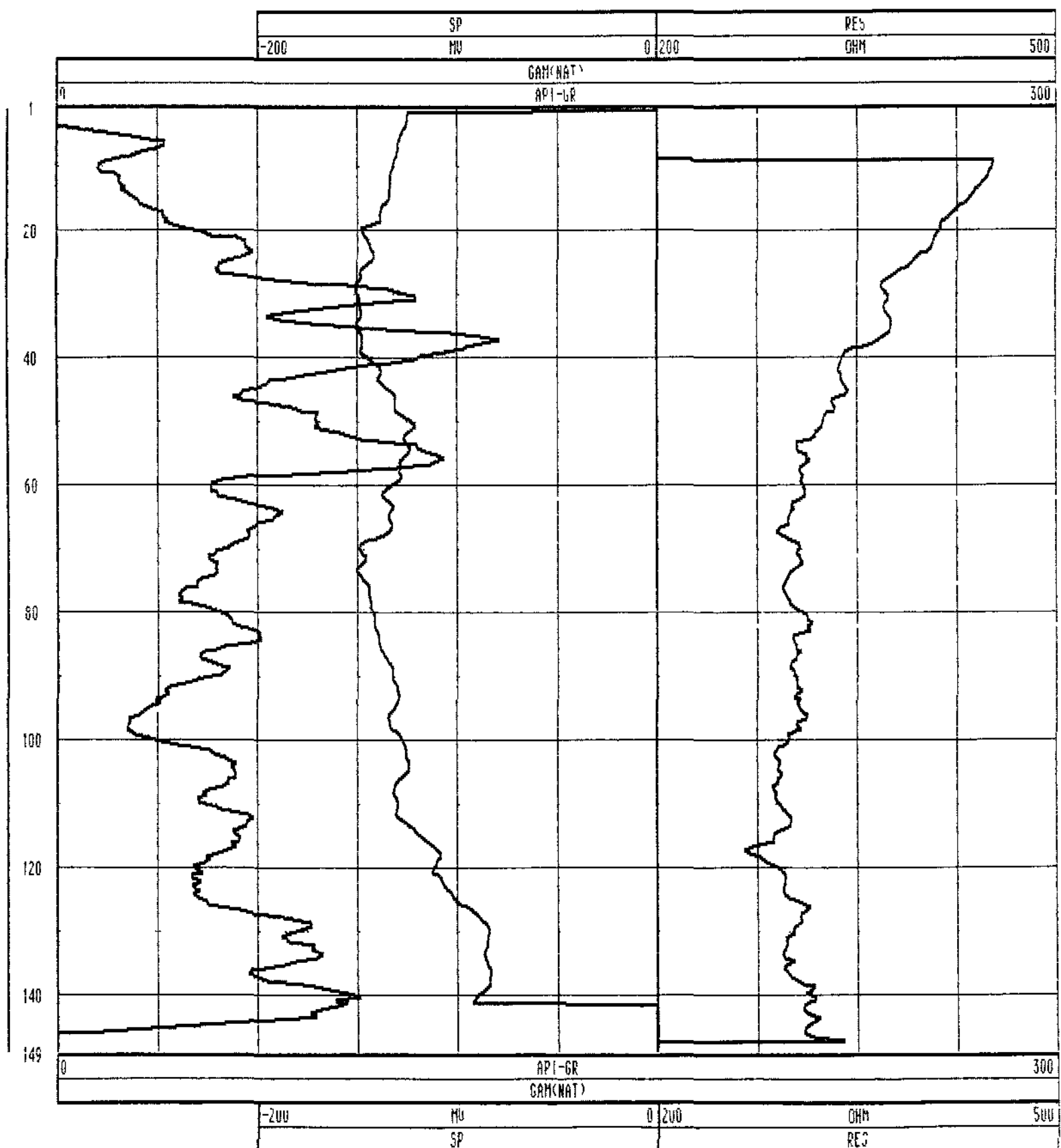




SINGLE POINT
GAMMA

MW-2 0043-0033

COMPANY	BECHTEL SEF30619 AQ	OTHER SERVICES	
WELL	MW-2 0043-0033	CALIPER	
LOCATION/FIELD	INDIANTOWN		
COUNTY	MARTIN		
STATE	FL		
SECTION	34	TOWNSHIP	39S RANGE 38E
DATE	08/10/90	PERMANENT DATUM	GL ELEVATIONS
DEPTH DRILLER	150	ELEV PERM DATUM	32 KB
LOG BOTTOM	149 50	LOG MEASURED FROM	GL DF
LOG TOP	1 50	DRL MEASURED FROM	CL GL 32
CASING DRILLER	NA	LOGGING UNIT	1
CASING TYPE	NA	FIELD OFFICE	DFB
CASING THICKNESS	NA	RECORDED BY	C DIGIACOMO
BIT SIZE	4 5	BOREHOLE FLUID	MUD
MAGNETIC DECL	NA	RM	NA
MATRIX DENSITY	NA	RM TEMPERATURE	NA
FLUID DENSITY	NA	MATRIX DELTA T	NA
NEUTRON MATRIX	SANDSTONE	FLUID DELTA T	NA
REMARKS			
	LOG PERFORMED ON A STATIC WELL		
	OBSERVER PETER KWIATKOWSKI		

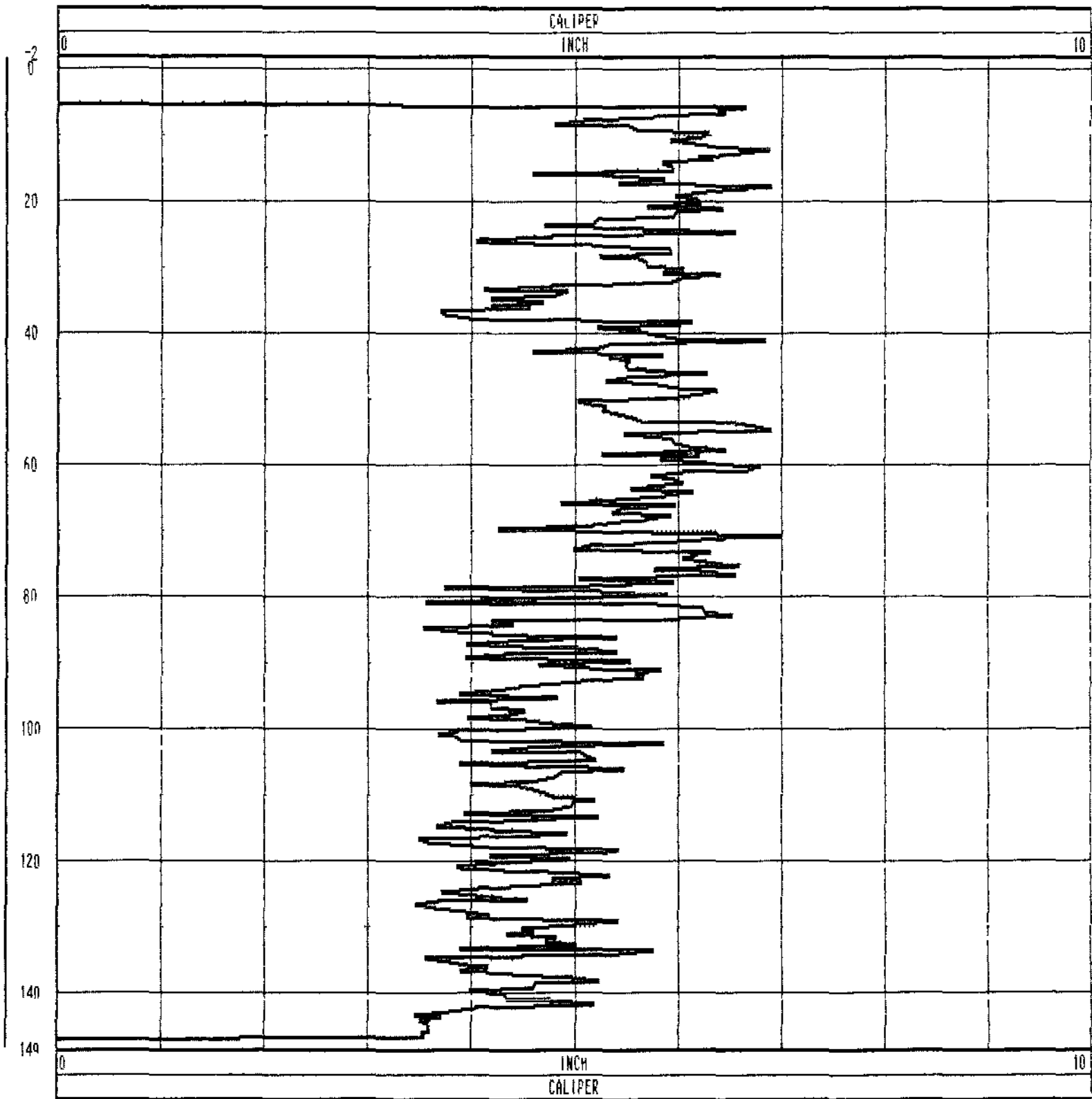


CALIPER



MW-3 0043-0032

COMPANY	BECHTEL	SEF30619 AQ	OTHER SERVICES	
WELL	MW-3	0043-0032	GAMMA	
LOCATION/FIELD	INDIANTOWN		SING PT	
COUNTY	MARTIN			
STATE	FL			
SECTION	35	TOWNSHIP	39S	RANGE 38E
DATE	08/08/90	PERMANENT DATUM	CL	ELEVATIONS
DEPTH DRILLER	150	ELEV PERM DATUM	32'	KB
LOG BOTTOM	149 00	LOG MEASURED FROM	GL	DF
LOG TOP	-1 00	DRL MEASURED FROM	GL	GL 32'
CASING DRILLER	NA	LOGGING UNIT	1	
CASING TYPE	NA	FIELD OFFICE	DFB	
CASING THICKNESS	NA	RECORDED BY	C DIGIACOMO	
BIT SIZE	4 5	BOREHOLE FLUID	MUD	FILE ORIGINAL
MAGNETIC DECL	NA	RM	NA	TYPE CCAL3
MATRIX DENSITY	NA	RM TEMPERATURE	NA	LOG 4
FLUID DENSITY	1	MATRIX DELTA T	NA	PLOT REPORT 6
NEUTRON MATRIX	SANDSTONE	FLUID DELTA T	NA	THRESH 30000
REMARKS	LOG PERFORMED ON A STATIC WELL			
	OBSERVER PETER KWIATKOWSKI			

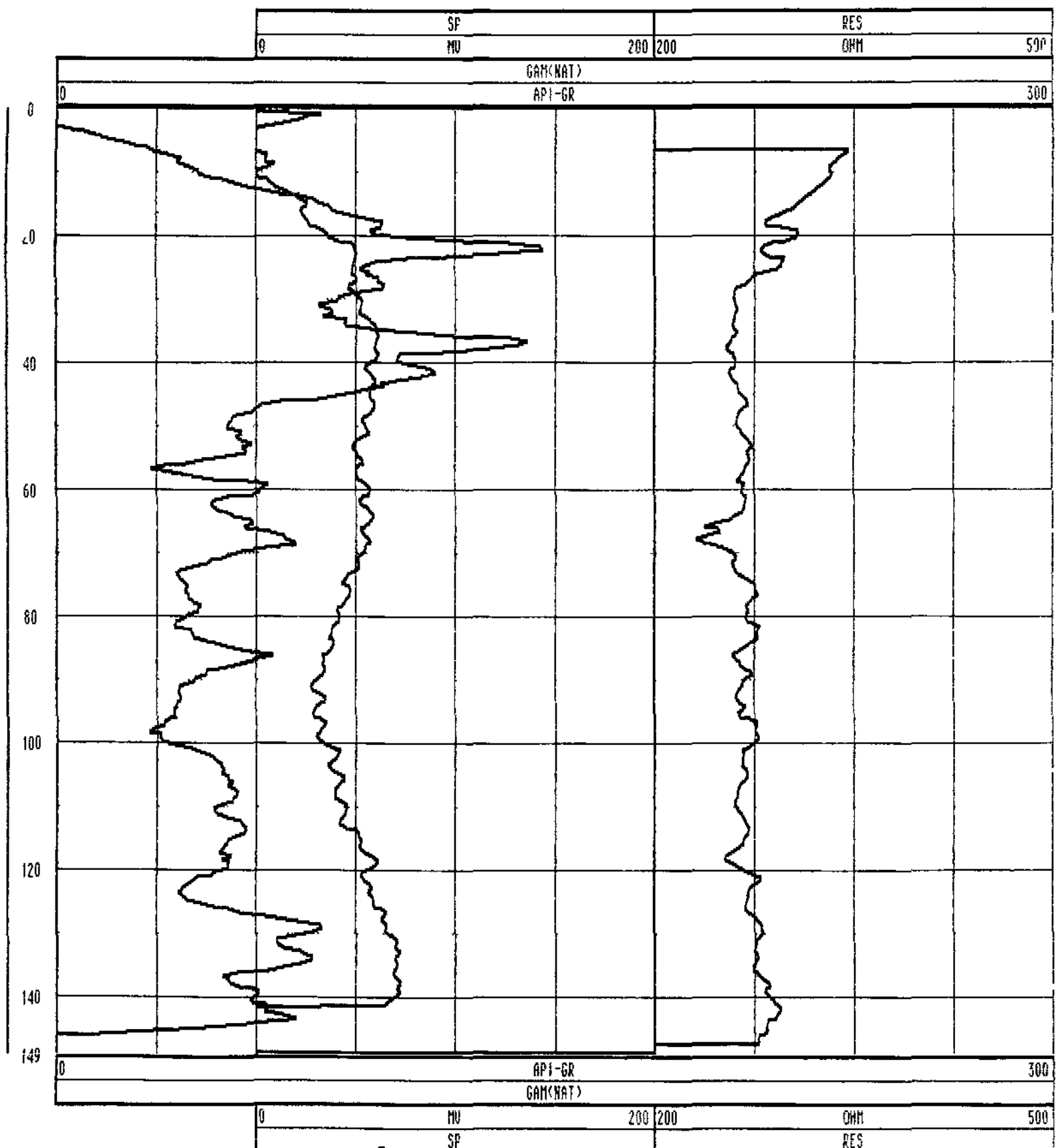




SINGLE POINT
GAMMA

MW-3 0043-0032

COMPANY	BECHTEL	SEF30619	AO	OTHER SERVICES	
WELL	MW-3	0043-0032		CALIPER	
LOCATION/FIELD	INDIANTOWN				
COUNTY	MARTIN				
STATE	FL				
SECTION	35	TOWNSHIP	39S	RANGE	38E
DATE	08/08/90	PERMANENT DATUM	GL	ELEVATIONS	
DEPTH DRILLER	150	ELEV PERM DATUM	32'	KB	
LOG BOTTOM	149 50	LOG MEASURED FROM	GL	DF	
LOG TOP	0 50	DRL MEASURED FROM	GL	GL	32'
CASING DRILLER	NA	LOGGING UNIT	1		
CASING TYPE	NA	FIELD OFFICE	DFB		
CASING THICKNESS	NA	RECORDED BY	C DIGIACOMO		
BIT SIZE	4 5	BOREHOLE FLUID	MUD	FILE	PROCESSED
MAGNETIC DECL	NA	RM	NA	TYPE	90400
MATRIX DENSITY	NA	RM TEMPERATURE	NA	LOG	7
FLUID DENSITY	NA	MATRIX DELTA T	NA	PLOT	REPORT 8
NEUTRON MATRIX	SANDSTONE	FLUID DELTA T	NA	THRESH	30000
REMARKS	LOG PERFORMED ON A STATIC WELL				
	OBSERVER PETER KWIATKOWSKI				

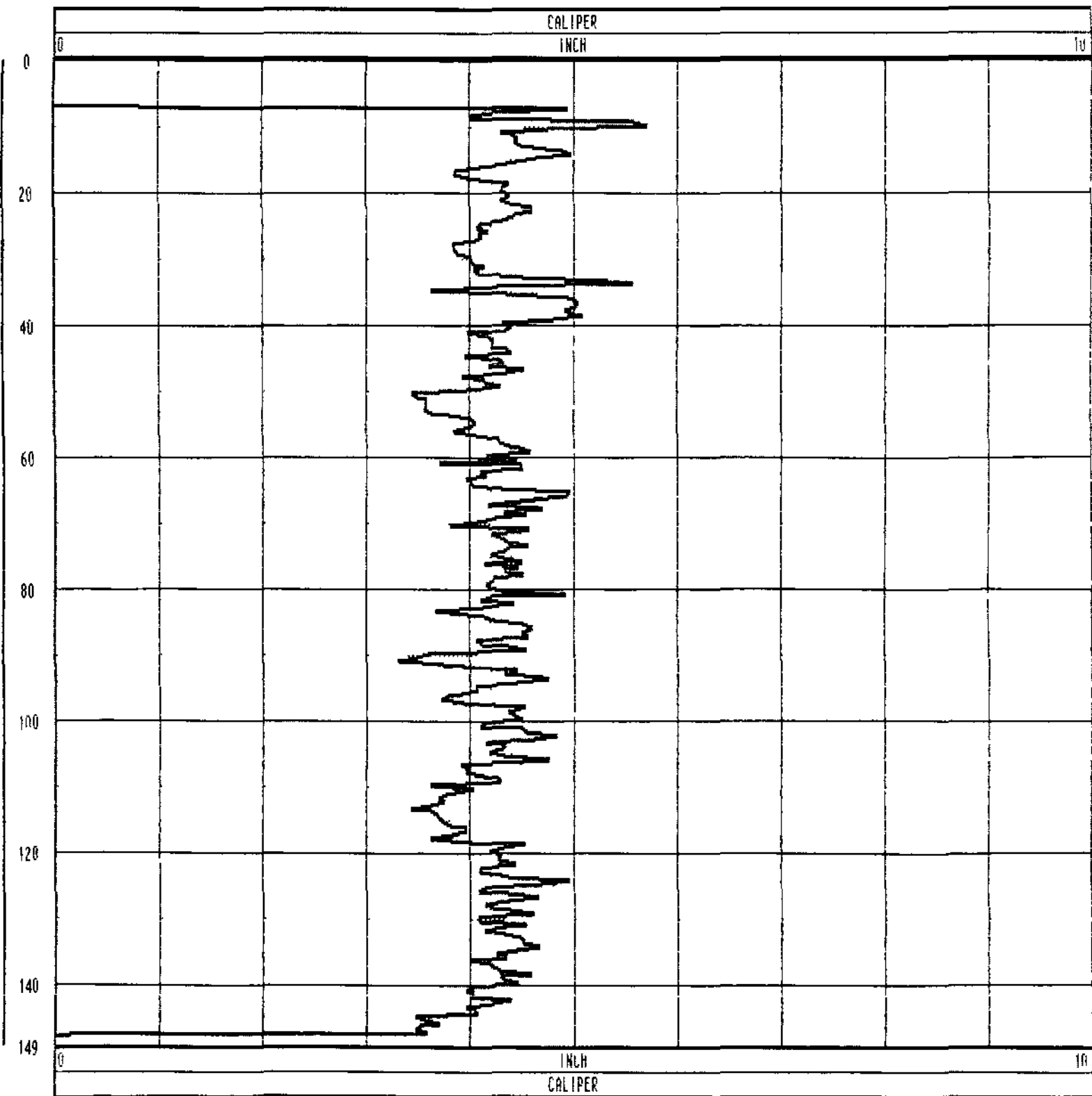


CALIPER



MW-4 0043-0030

COMPANY	BECHTEL	SEF30619	AO	OTHER SERVICES	
WELL	MW-4	0043-0030		GAMMA	
LOCATION/FIELD	INDIANTOWN			LSN ELEC	
COUNTY	MARTIN				
STATE	FL				
SECTION	35	TOWNSHIP	39S	RANGE	38E
DATE	07/27/90	PERMANENT DATUM	GL	ELEVATIONS	
DEPTH DRILLER	150	ELEV PERM DATUM	32'	KB	
LOG BOTTOM	149 50	LOG MEASURED FROM	GL	DF	
LOG TOP	0 50	DRL MEASURED FROM	GL	GL	32'
CASING DRILLER	NA	LOGGING UNIT	1		
CASING IYPF		FIELD OFFICE	DFB		
CASING THICKNESS	NA	RECORDED BY	C DIGIACOMO		
BIT SIZE	4 5	BOREHOLE FLUID	MUD	FILE	ORIGINAL
MAGNETIC DECL	NA	RM	NA	TYPE	CCAL3
MATRIX DENSITY	NA	RM TEMPERATURE	NA	LOG	1
FLUID DENSITY	NA	MATRIX DELTA T	NA	PLOT	REPORT 6
NEUTRON MATRIX	SANDSTONE	FLUID DELTA T	NA	THRESH	30000
REMARKS	LOG PERFORMED ON A STATIC WELL				
	OBSERVER PETER KWIATKOWSKI				

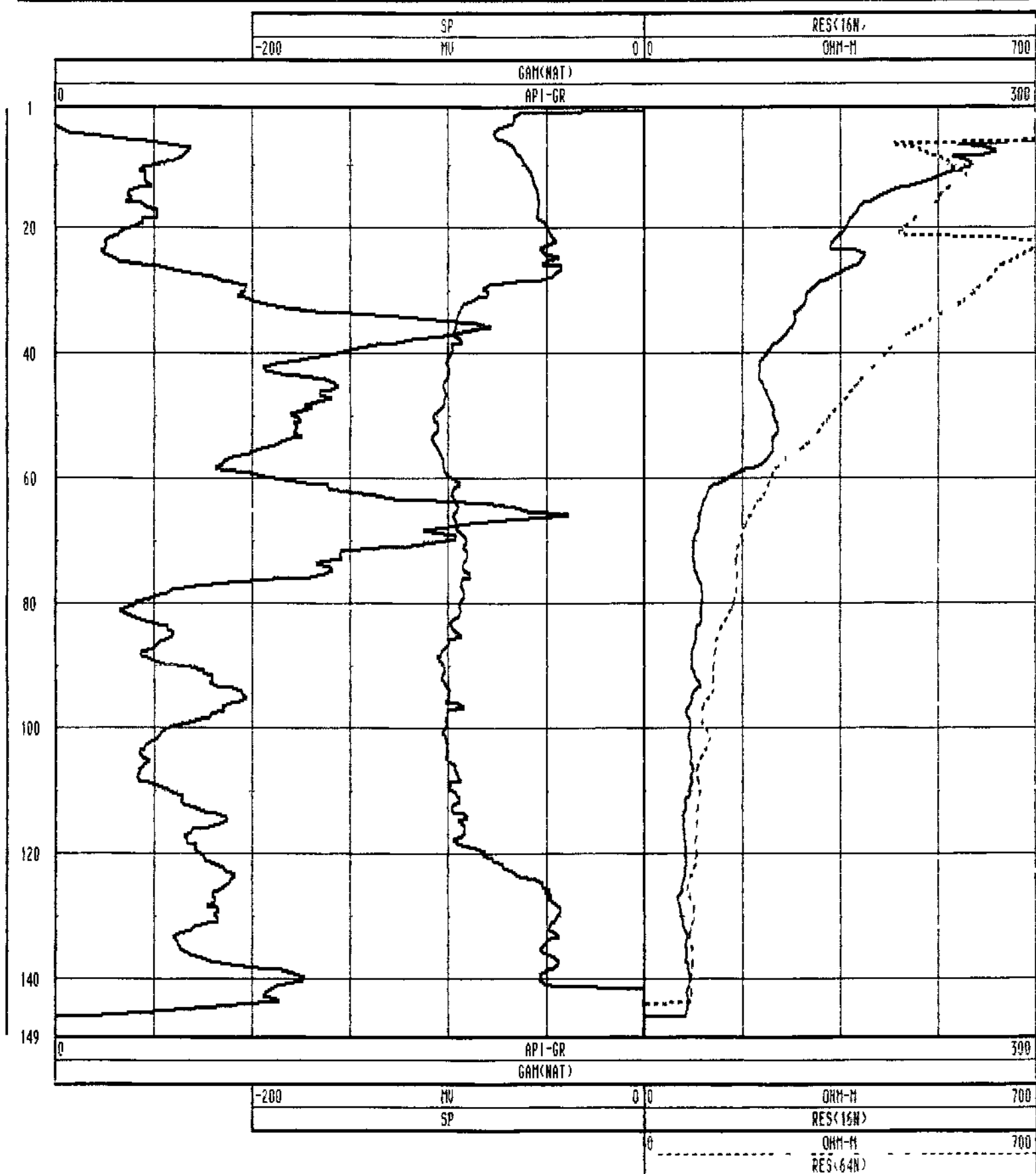




LSN ELECTRIC GAMMA

MW-4 0043-0030

COMPANY	BECHTEL	SEF30619 A0	OTHER SERVICES	
WELL	MW-4	0043-0030	CALIPFR	
LOCATION/FIELD	INDIANTOWN			
COUNTY	MARTIN			
STATE	FL			
SECTION	35	TOWNSHIP	39S	RANGE 38E
DATE	07/27/90	PERMANENT DATUM	GL	ELEVATIONS
DEPTH DRILLER	150 N	ELEV PERM DATUM	32'	KB
LOG BOTTOM	149 50	LOG MEASURED FROM	GL	DF
LOG TOP	1 50	DRL MEASURED FROM	GL	GL 32'
CASING DRILLER	NA	LOGGING UNIT	1	
CASING TYPE		FIELD OFFICE	DFB	
CASING THICKNESS	NA	RECORDED BY	C DIGIACOMO	
BIT SIZE	4 5	BOREHOLE FLUID	MUD	FILE ORIGINAL
MAGNETIC DECL	NA	RM	NA	TYPE 9040A
MATRIX DENSITY	NA	RM TEMPERATURE	NA	LOG 0
FLUID DENSITY	NA	MATRIX DELTA T	NA	PLOT REPORT 7
NEUTRON MATRIX	SANDSTONE	FLUID DELTA T	NA	THRESH 30000
REMARKS	LOG PERFORMED ON A STATIC WELL			
	OBSERVER PETER KWIAIKOWSKI			

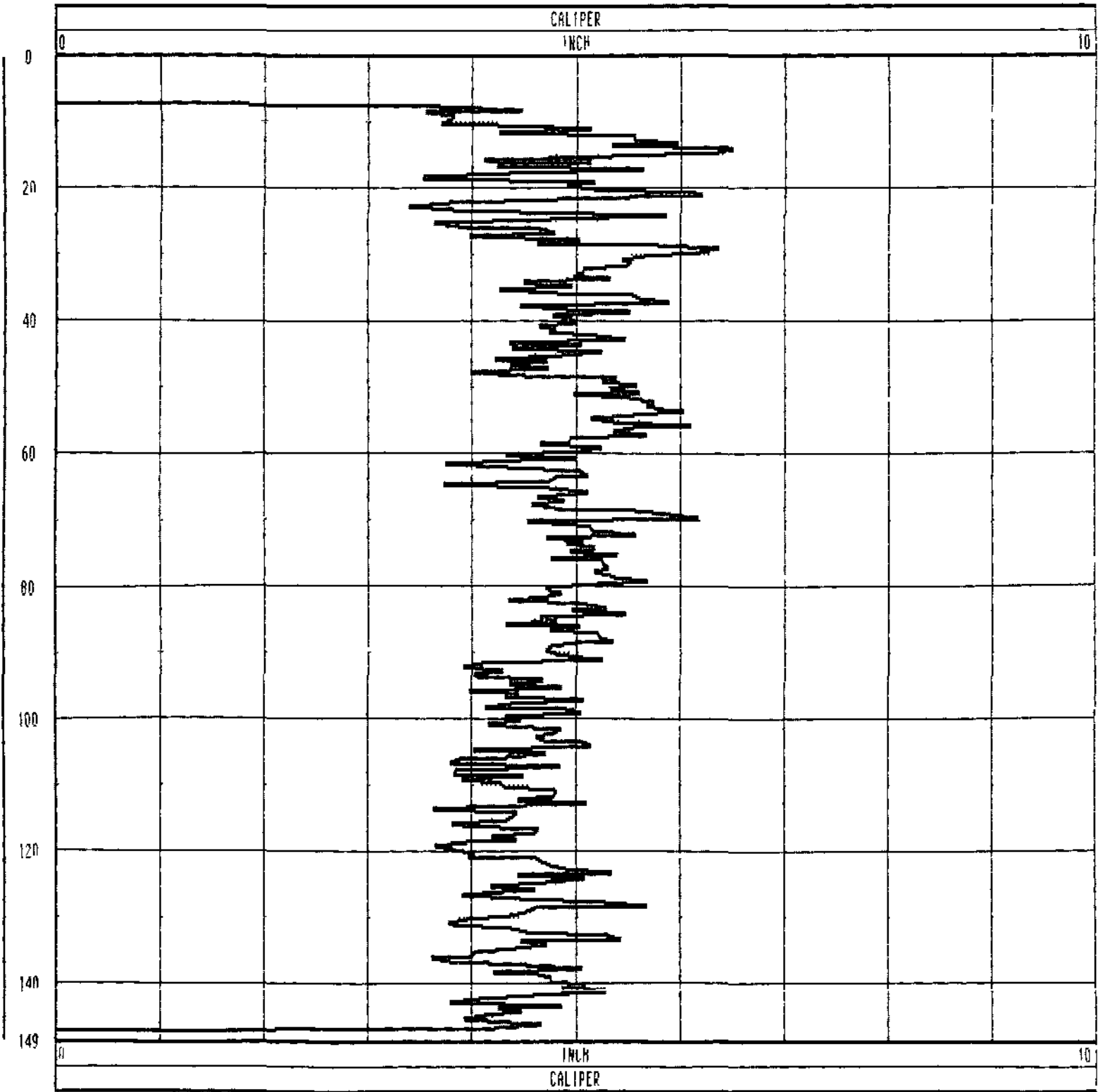


CALIPER



POW-1 0043-0031

COMPANY	BECHTEL SEF30619 PG		OTHER SERVICES	
WELL	POW-1 0043-0031		GAMMA	
LOCATION/FIELD	INDIANTOWN		LSM ELFC	
COUNTY	MARTIN		CALIPER	
STATE	FL			
SECTION	34	TOWNSHIP	39S	RANGE 38E
DATE	07/31/90	PERMANENT DATUM	GL	ELEVATIONS
DEPTH DRILLER	150	ELEV PERM DATUM	32'	KB
LOG BOTTOM	149 00	LOG MEASURED FROM	GL	DF
LOG TOP	1 00	DRL MEASURED FROM	GL	GL 32'
CASING DRILLER	NA	LOGGING UNIT	1	
CASING TYPE		FIELD OFFICE	DFB	
CASING THICKNESS	NA	RECORDED BY	C DIGIACOMO	
BIT SIZE	4 5	BOREHOLE FLUID	MUD	FILE ORIGINAL
MAGNETIC DECL	NA	RM	NA	TYPE CCAL3
MATRIX DENSITY	NA	RM TEMPERATURE	NA	LOG 2
FLUID DENSITY	NA	MATRIX DELTA T	NA	PLOT REPORT 6
NEUTRON MATRIX	SANDSTONE	FLUID DELTA T	NA	THRESH 30000
REMARKS	LOG ON A STATIC WELL			
	OBSERVER PETER KWIATKOWSKI			

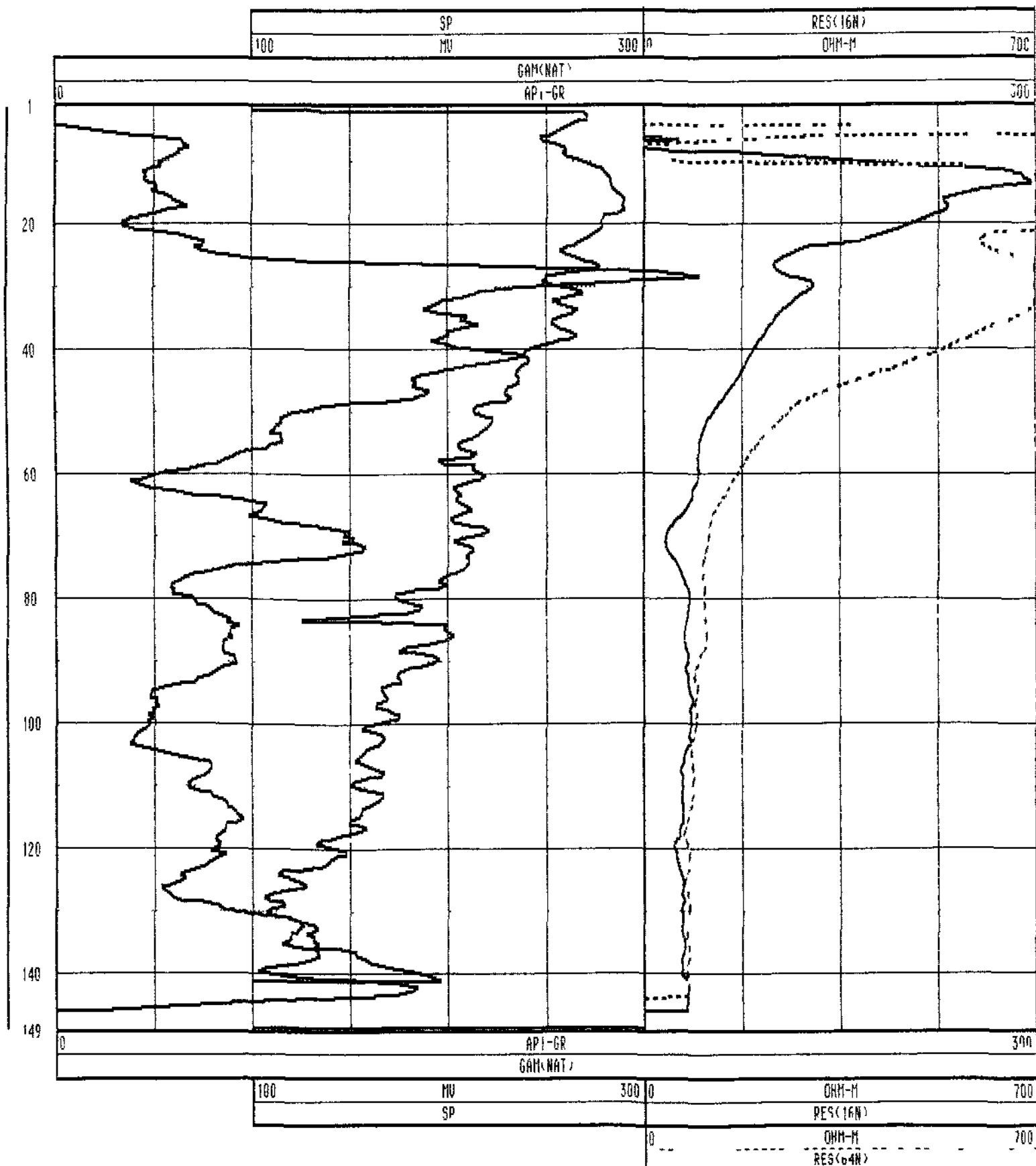




LSN ELECTRIC
GAMMA

POW-1 0043-0031

COMPANY	BECHTEL SEP30619 A0	OTHER SERVICES	
WELL	POW-1 0043-0031	GAMMA	
LOCATION/FIELD	INDIANTOWN	LSN ELEC	
COUNTY	MARTIN	CALIPER	
STATE	FL		
SECTION	34	TOWNSHIP	39S RANGE 38E
DATE	07/31/90	PERMANENT DATUM	GL ELEVATIONS
DEPTH DRILLER	150	ELEV PERM DATUM	32' KB
LOG BOTTOM	149 50	LOG MEASURED FROM	GL DF
LOG TOP	2 00	DRL MEASURED FROM	GL GL 32
CASING DRILLER	NA	LOGGING UNIT	1
CASING TYPE		FIELD OFFICE	DFB
CASING THICKNESS	NA	RECORDED BY	C DIGIACOMO
BIT SIZE	4 5	BOREHOLE FLUID	MUD FILE ORIGINAL
MAGNETIC DECL	NA	RM	NA TYPE 9040A
MATRIX DENSITY	NA	RM TEMPERATURE	NA LOG 3
FLUID DENSITY	NA	MATRIX DELTA T	NA PLOT REPORT 7
NEUTRON MATRIX	SANDSTONE	FLUID DELTA T	NA THRESH 30003
REMARKS	LOG PERFORMED ON A STATIC WELL		
	OBSERVER PETER KWIAKOWSKI		



UNDISTURBED SAMPLE ANALYSIS

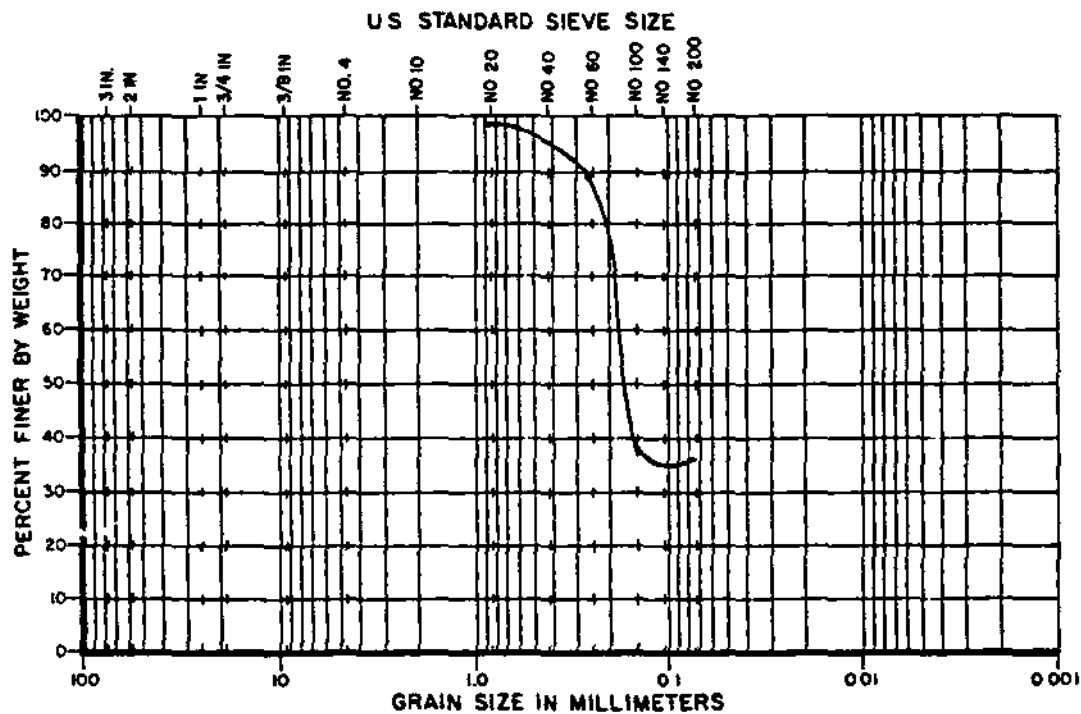
IMAGE QUALITY

**AS YOU REVIEW THE NEXT GROUP OF IMAGES, PLEASE NOTE
THAT THE ORIGINAL DOCUMENTS WERE OF POOR QUALITY.**

SHELBY TUBE TEST RESULTS

Boring No	Depth (ft)	Sample Description	-200 %	M.C %	LL %	PL %	PI	D.D. (pcf)	k (cm/sec)
MW-2	26.0 - 28.0	Dark gray fine sand with silt	12.0	22 3	-	-	-	97.4	1.9×10^{-6}
MW-3	71.0 - 73 5	Gray fine sand with silt and shell	14.4	21 1	-	-	-	101.8	4.5×10^{-6}
MW-4	36 0 - 38.5	Dark gray fine sand	3.0	21.1	-	-	-	105.5	1.0×10^{-3}
MW-4	96.0 - 98 5	Gray fine sand with silt and shell	10.6	23 2	-	-	-	105 9	8.0×10^{-6}
MW-4	134.0 - 136.0	Greenish gray silty fine sand with shell and cemented sand	19 4	28 3	19.7	19 2	1	79 4	9.6×10^{-5}
POW-1	26.0 - 29.0	Dark gray fine sand with traces of clayey fine sand	8 8	24.2	-	-	-	95.2	6.8×10^{-4}
POW-1	71.0 - 74.0	Gray clay with traces of shell	93 7	41.1	74.7	23 3	51	82.1	1.7×10^{-8}

SIEVE ANALYSIS



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

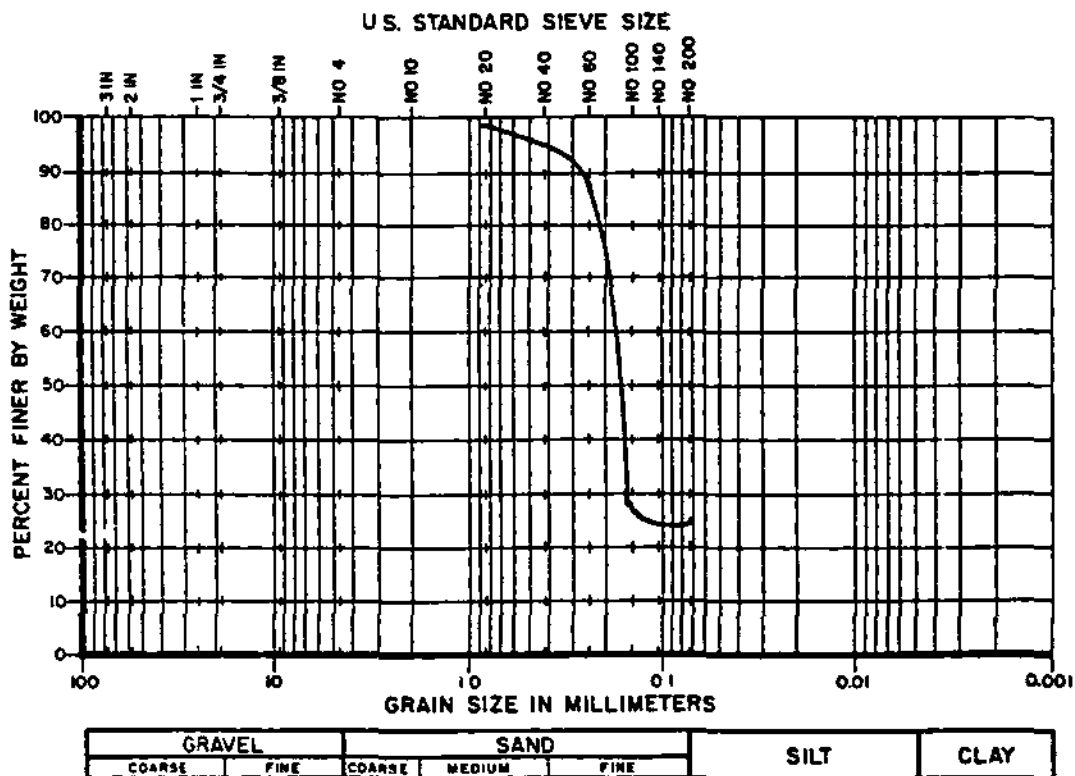
TEST HOLE NO.	SAMPLE NO.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-1	8	10.5-12.0 ft.		Brown fine sand.	SP

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TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-1	11	19.0-20.5 ft.		Brown silty fine sand	SM

GRAIN SIZE DISTRIBUTION

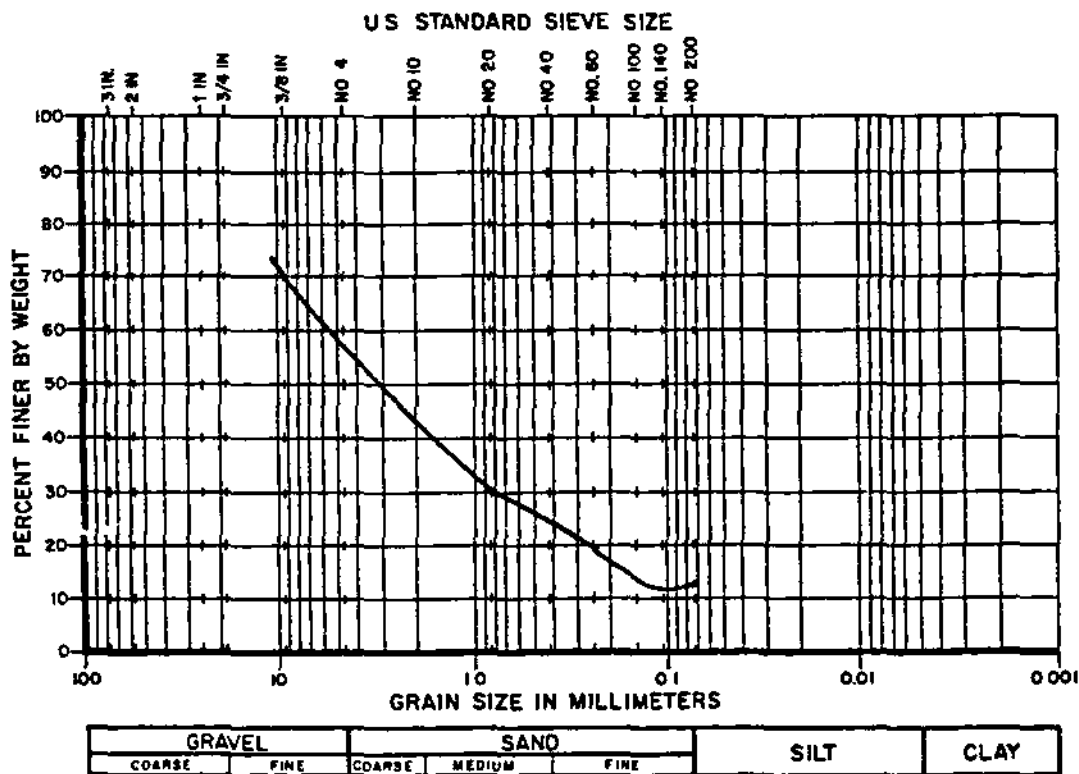
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TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-1	15	39 0-40 5 ft		Gray fine sand with silt, shell, and cemented sand and phosphate	SP-SM

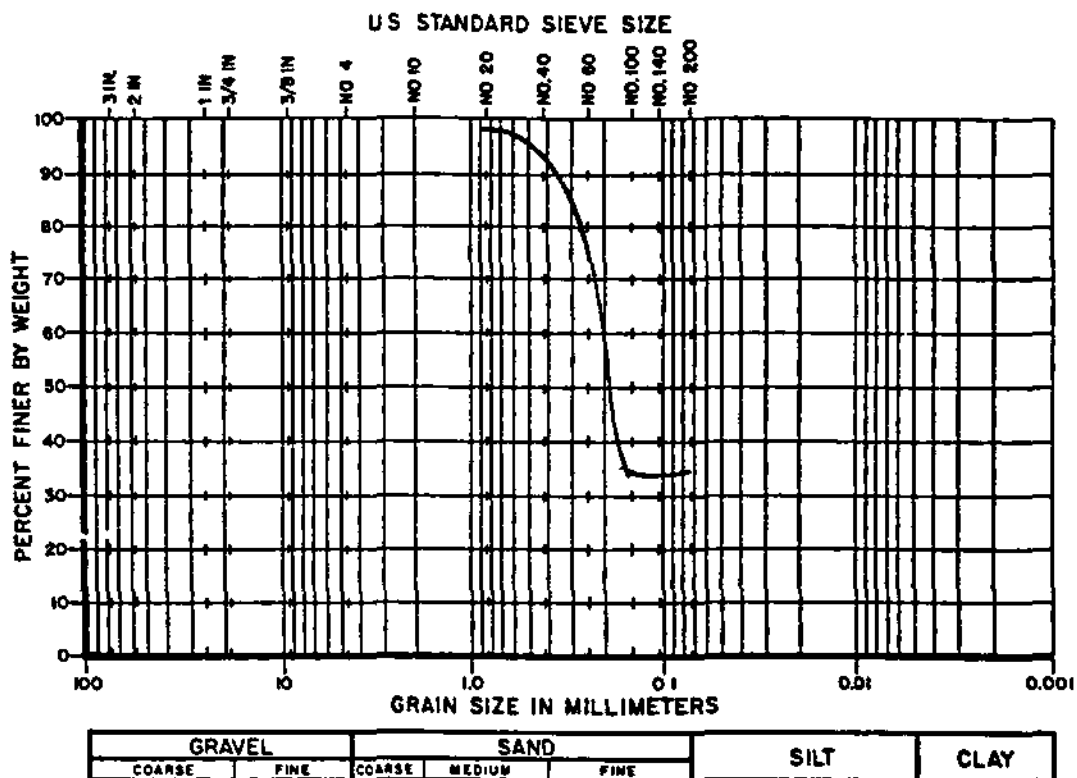
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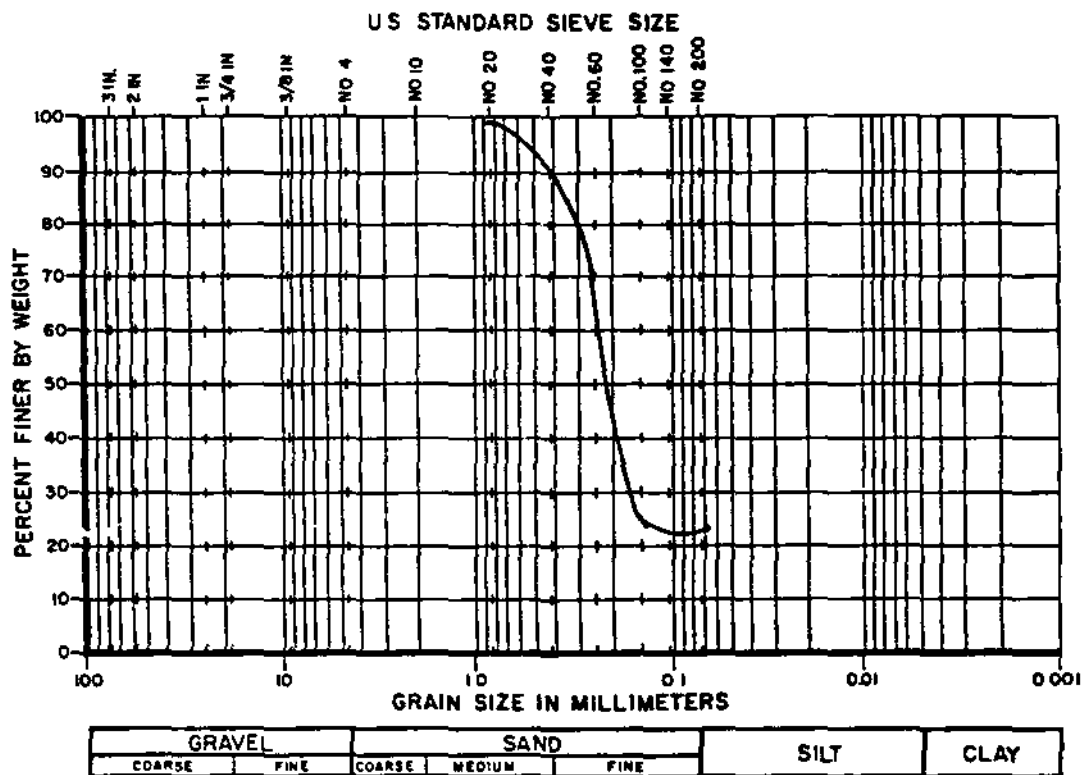
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TEST HOLE NO.	SAMPLE NO.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-1	17	49 0-50 5 ft		Grayishbrown silty fine sand with shell and phosphate	SM

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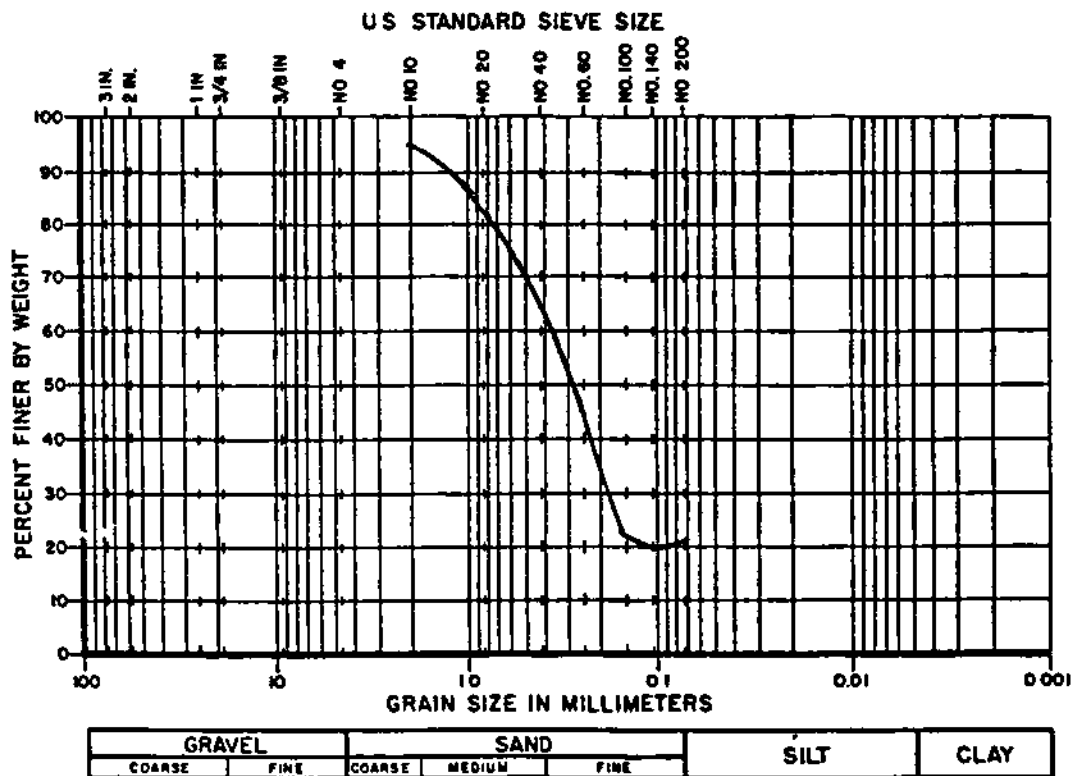
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-1	22	74.0-75.5 ft.		Gray silty fine sand with shell	SM

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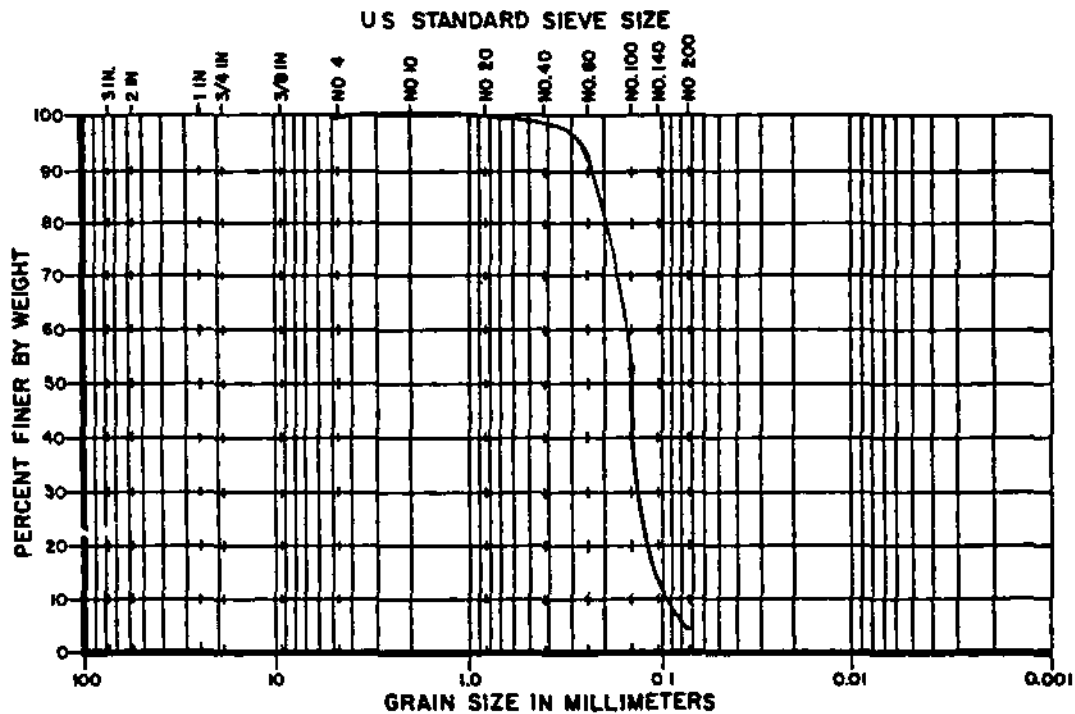
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-1	23	79.0-80.5 ft.		Greenish brown silty fine sand with shell	SM

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TEST HOLE NO.	SAMPLE NO.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-2	8	9.5-10.5 ft.		Dark orangish brown fine sand	SP

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GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST HOLE NO.	SAMPLE NO.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-2	12	19.0-20.5 ft.		Brown fine sand	SP

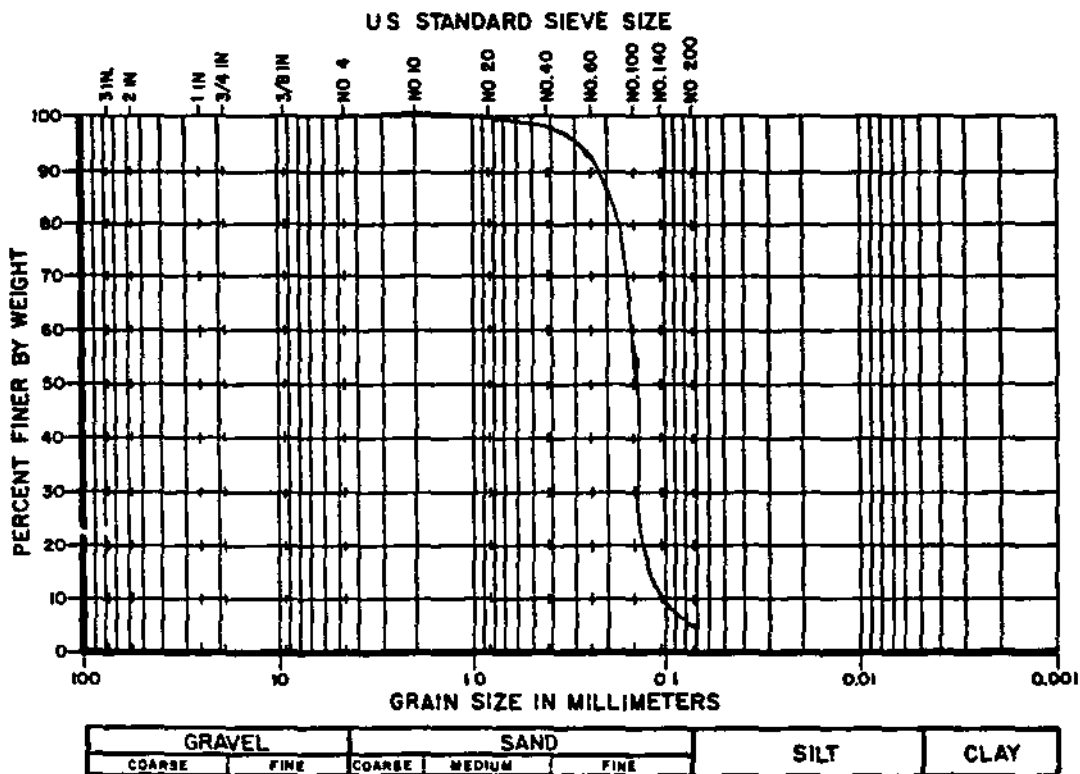
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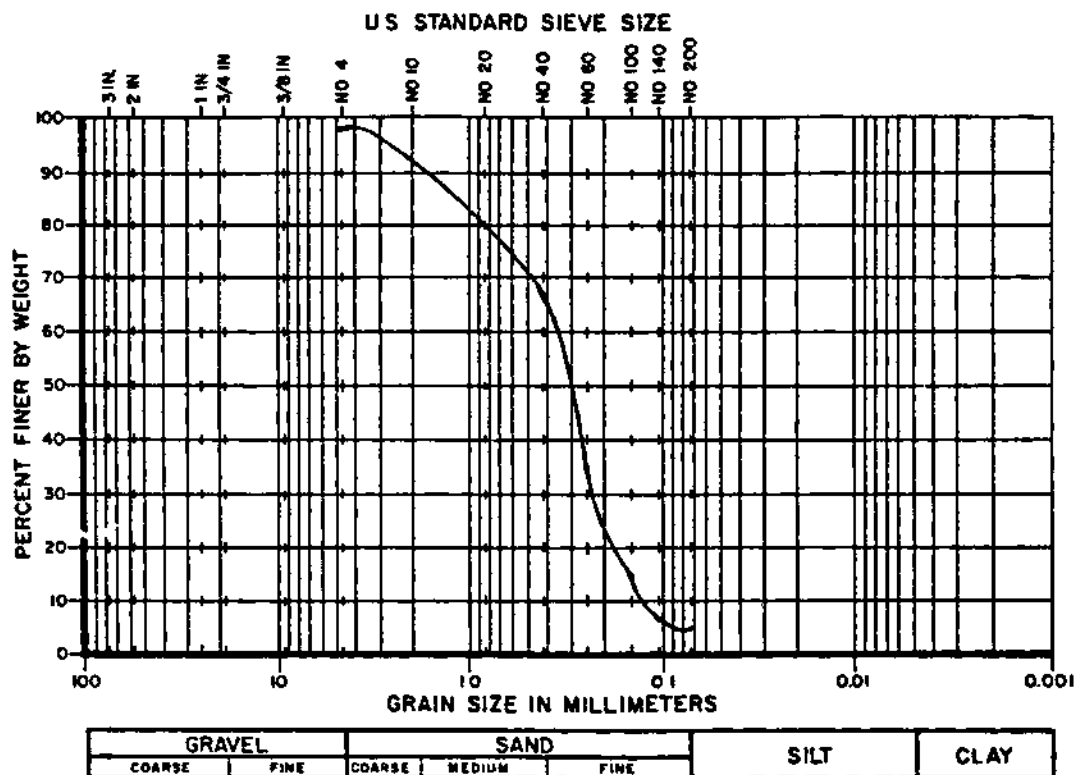
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-2	16	39.0-40.5 ft.		Gray fine sand with phosphate	SP

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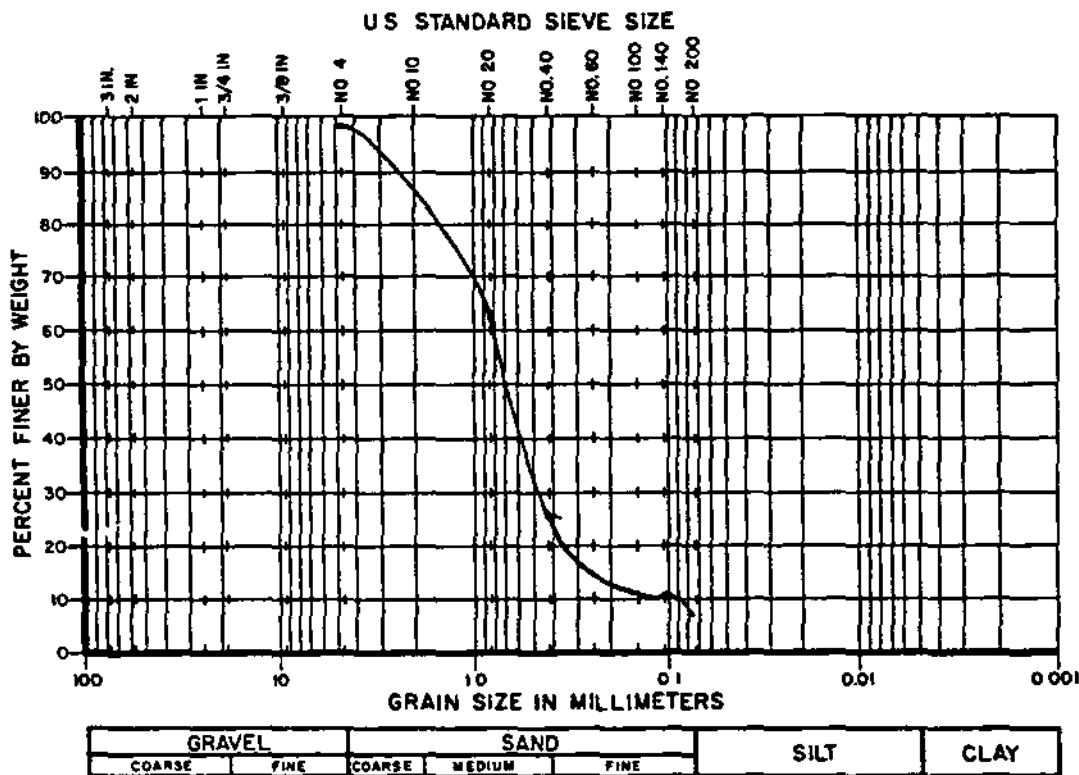
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-2	21	64.0-65.5 fr.		Grayish brown fine sand with silt, shell, and phosphate	SP-SM

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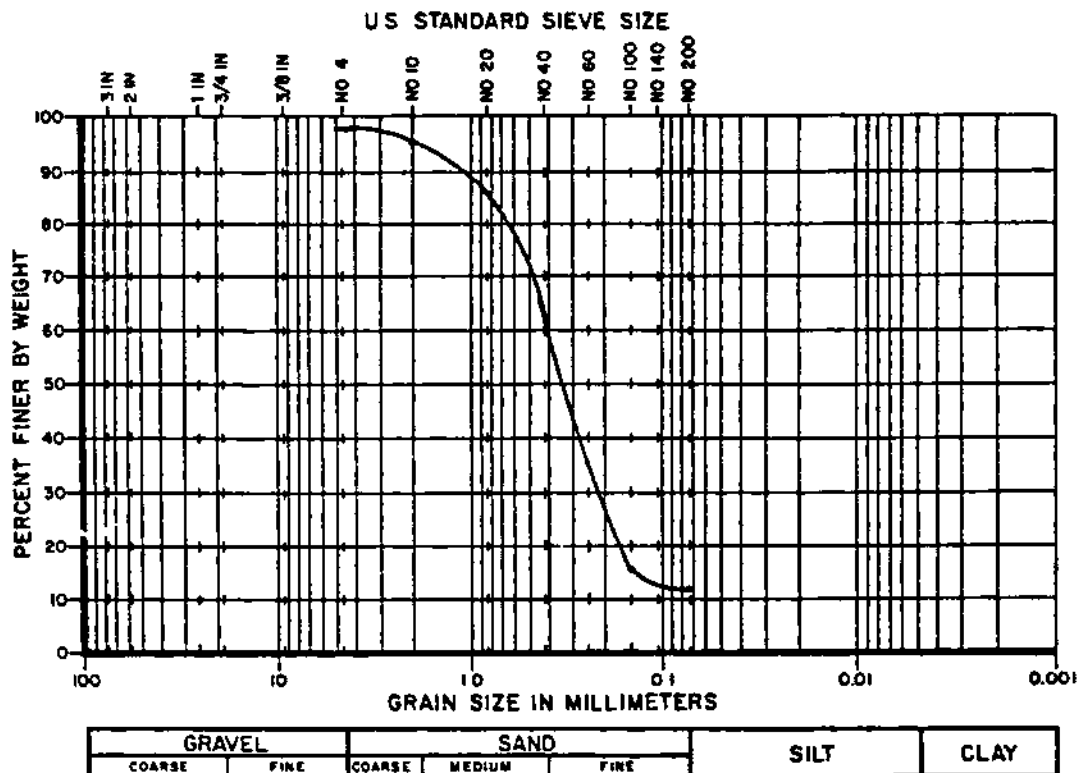
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-2	23	74 0-75 5		Grayish brown fine sand with silt, shell, and phosphate	SP-SM

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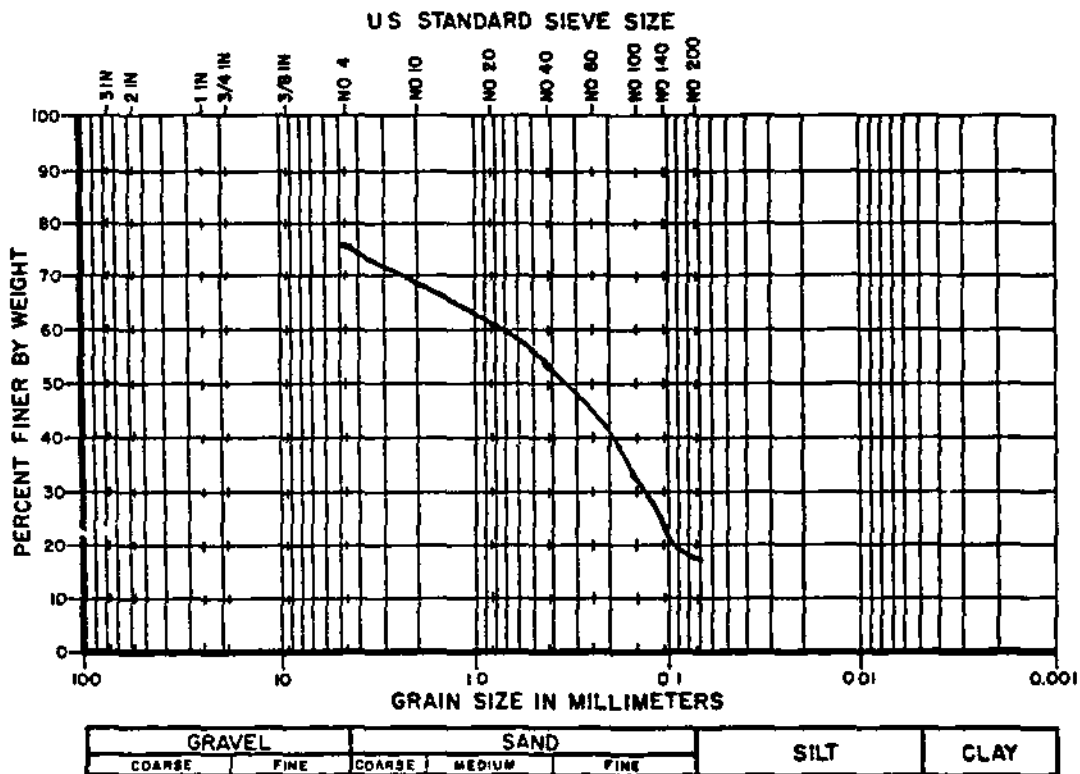
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TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-2	26	89.0-90.5 ft.		Grayish brown fine sand with silt, shell, cemented sand and phosphate	SP-SM

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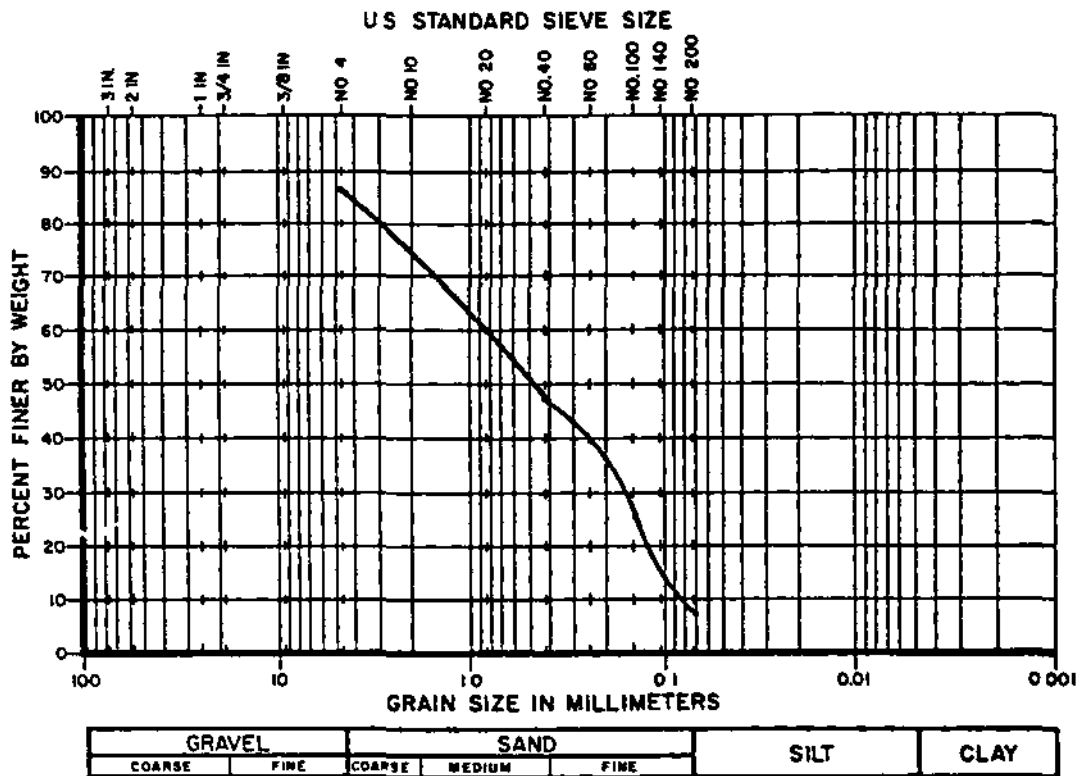
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-2	29	104 0-105 5ft		Gray silty fine sand with shell and phosphate	SP-SM

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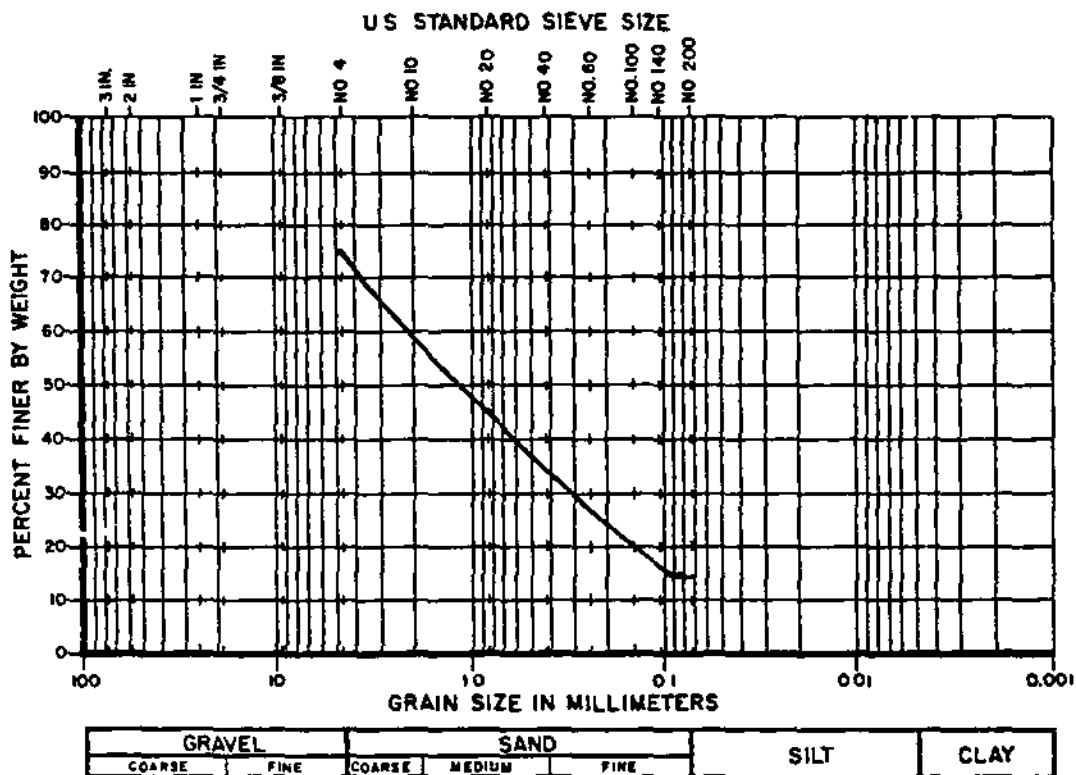
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-2	31	114.0-115.5ft		Greenish gray fine sand with salt, shell, and phosphate	SP-SM

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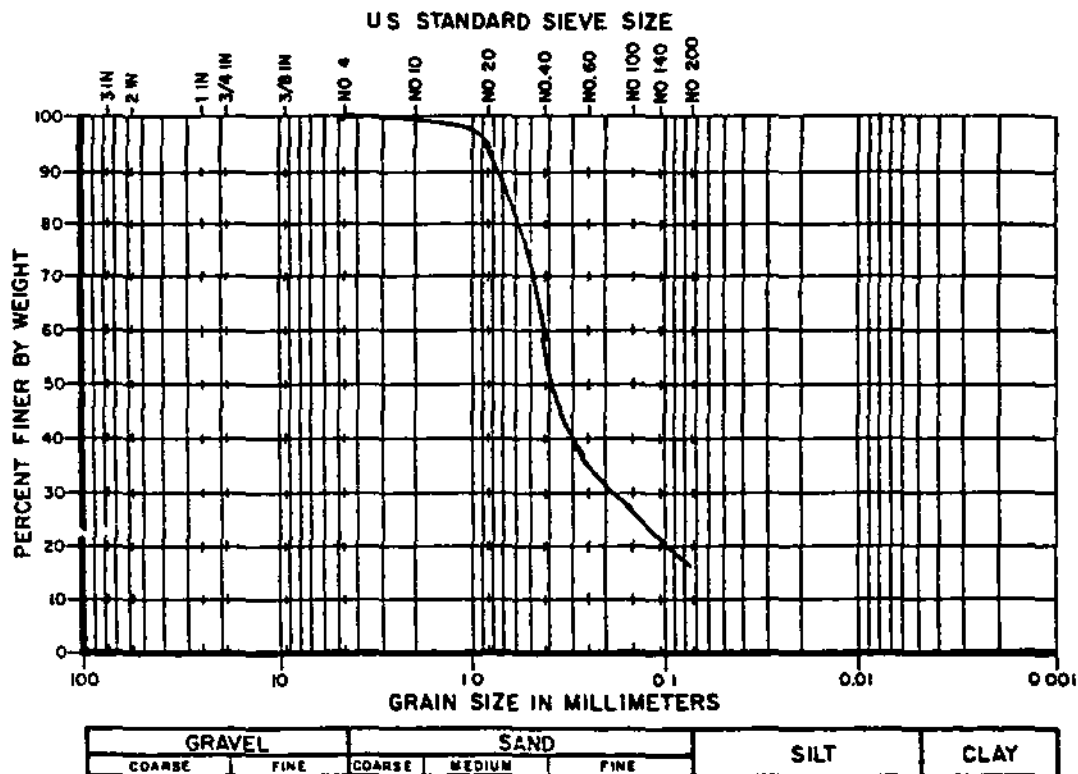
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-2	36	139.0-140.5		Grayish brown silty fine sand with cemented sand, shell and phosphate	SP-SM

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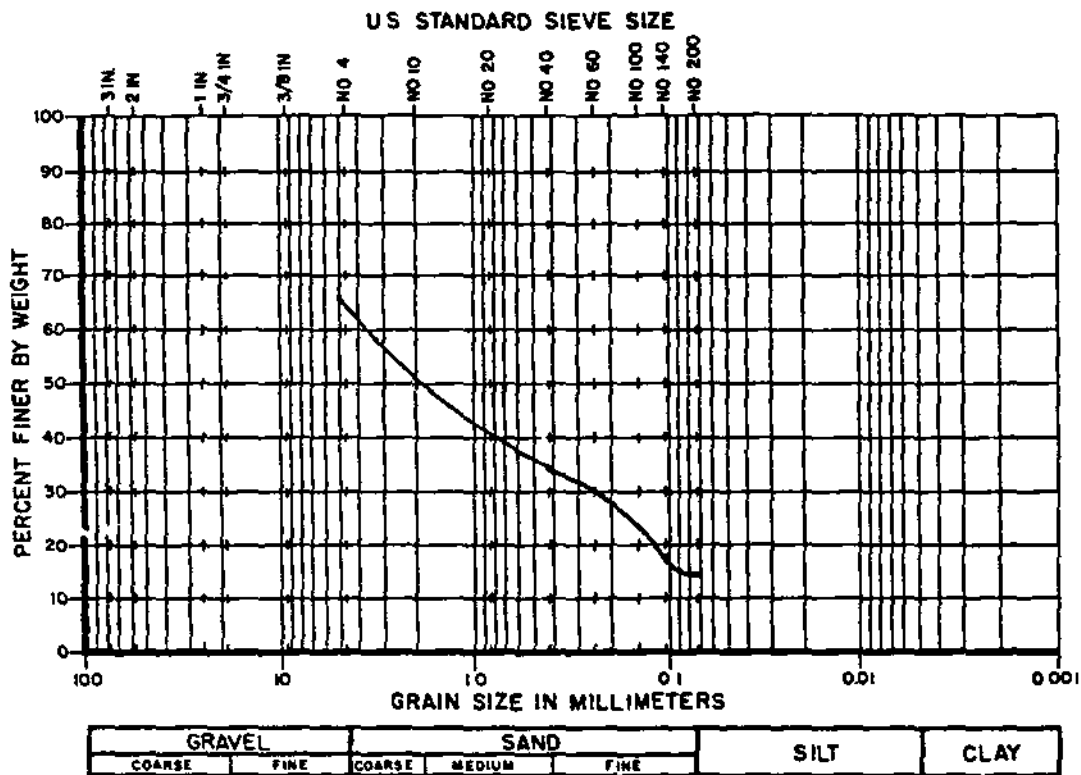
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-3	7	10 0-12 0 ft		Brown silty fine sand	SM

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TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-3	11	24.0-26.0 ft		Graysilty broken shell with cemented sand and shell	SM

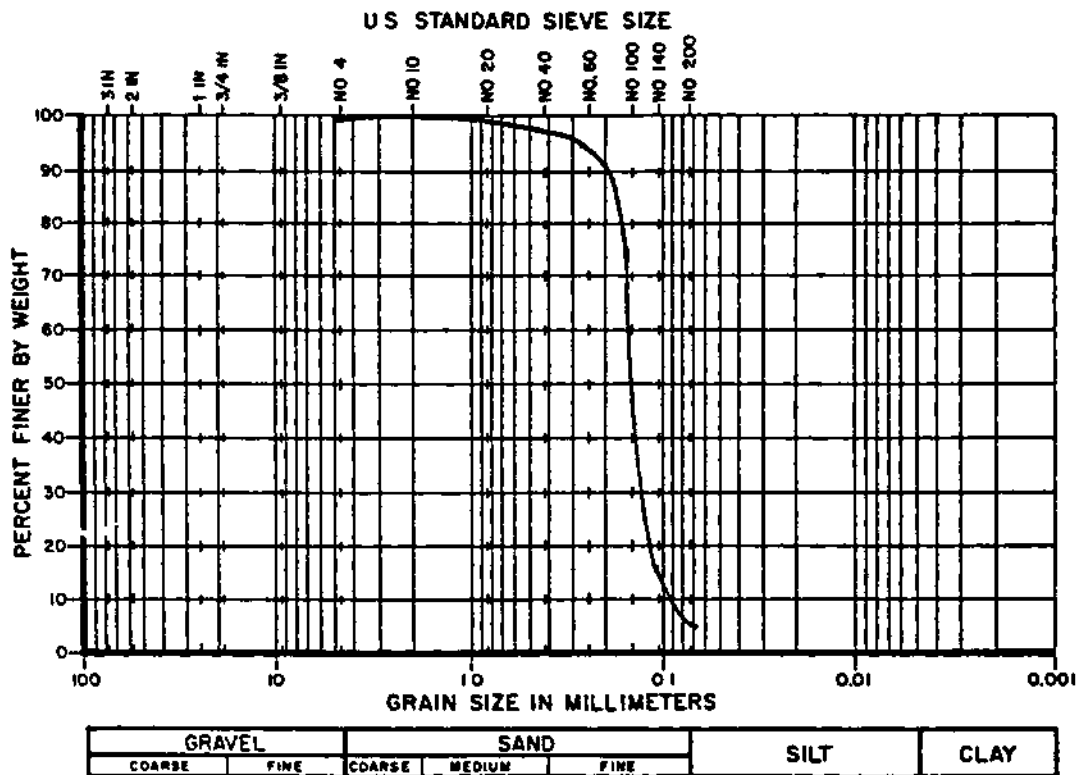
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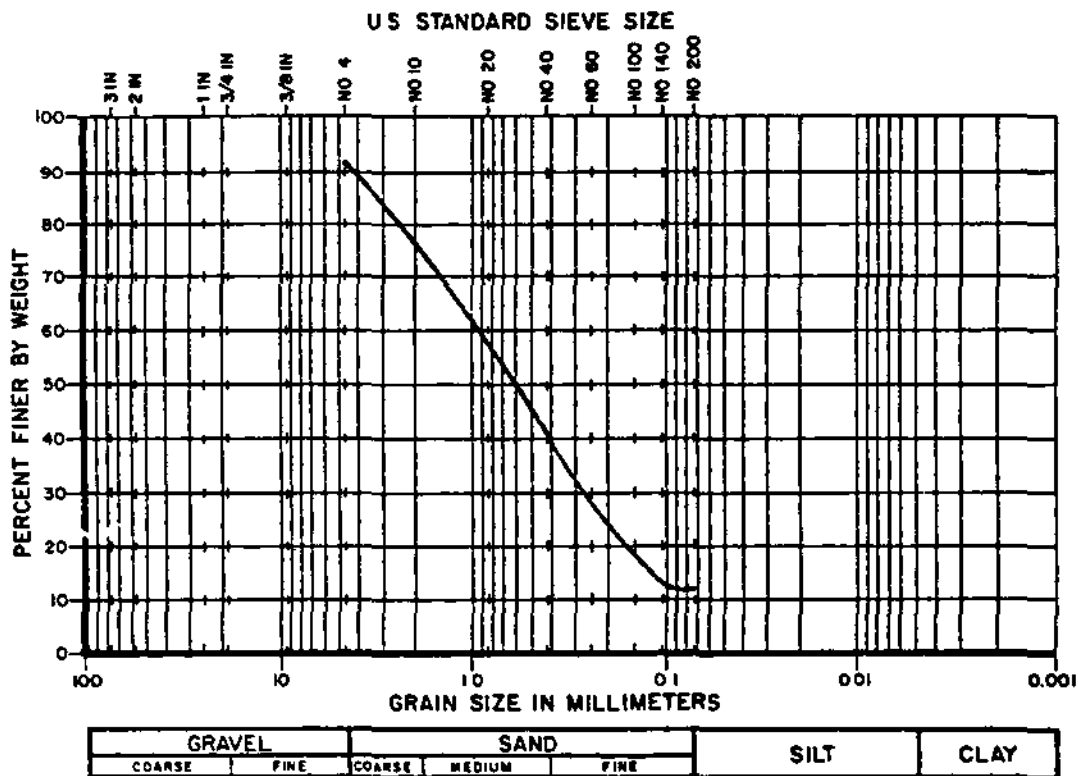
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-3	13	34 0-36 0 ft		Gray fine sand with silt	SP-SM

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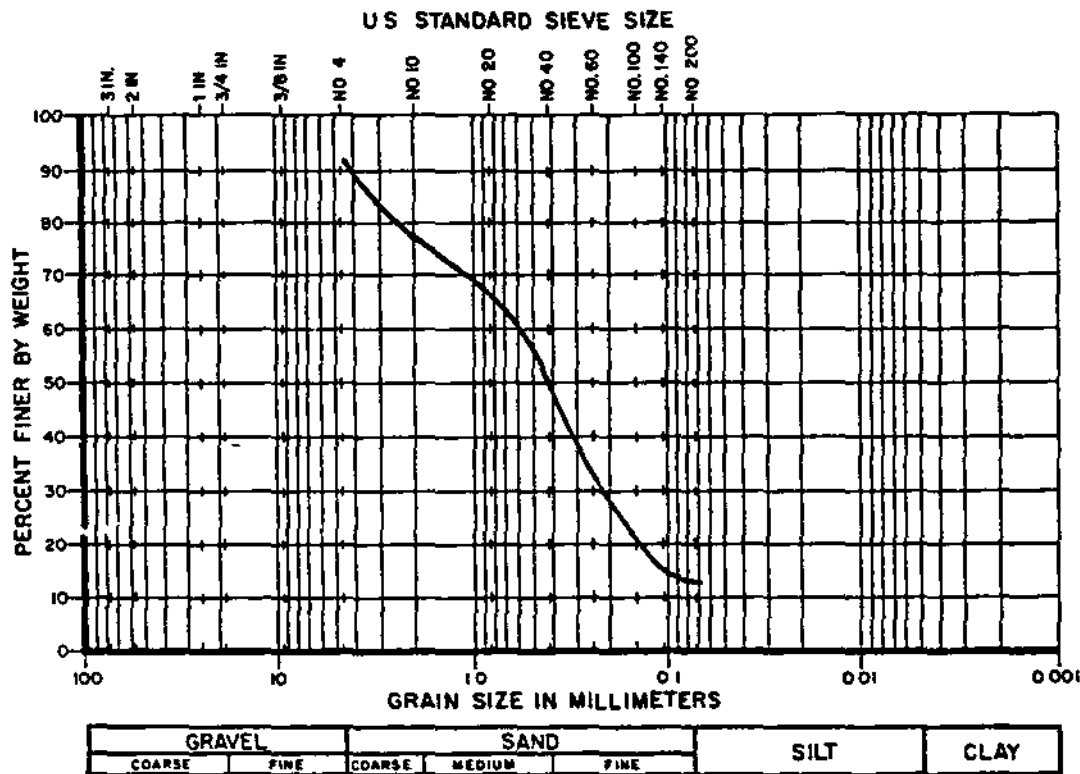
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-3	23	84 0-86 0 ft		Gray fine sand with silt and shell fragments	SP-SM

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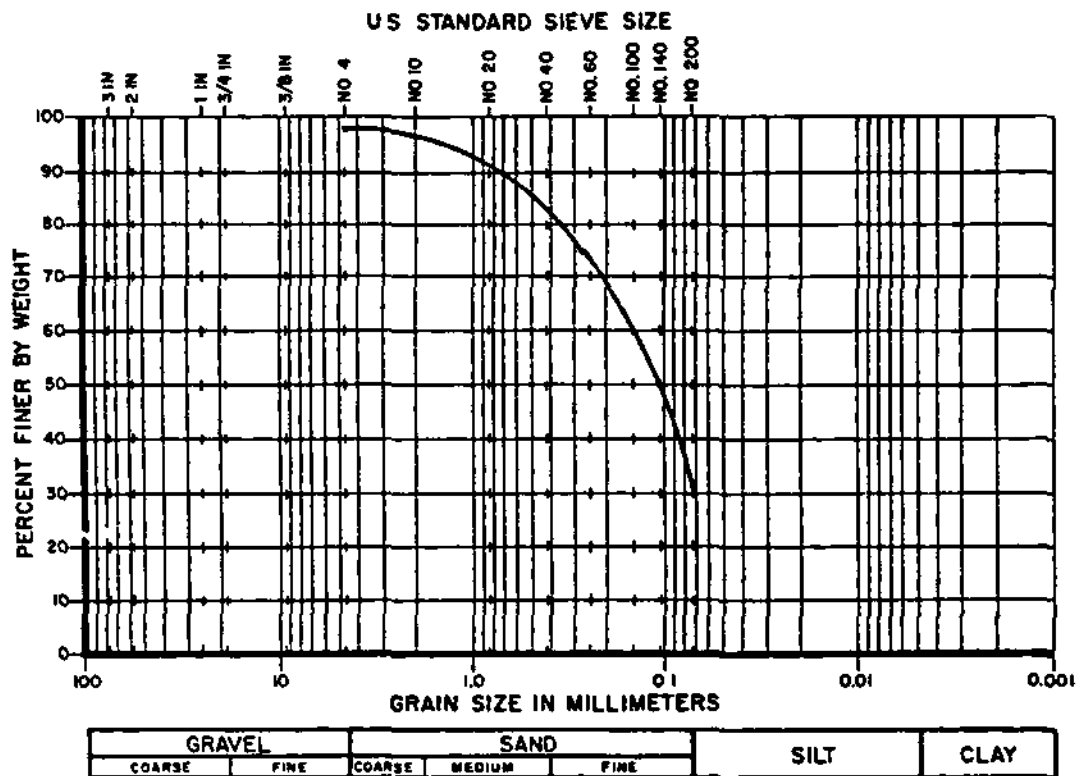
TEST HOLE NO.	SAMPLE NO.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-3	26	99 0-101 0 ft		Gray fine sand with silt and shell fragments	SP-SM

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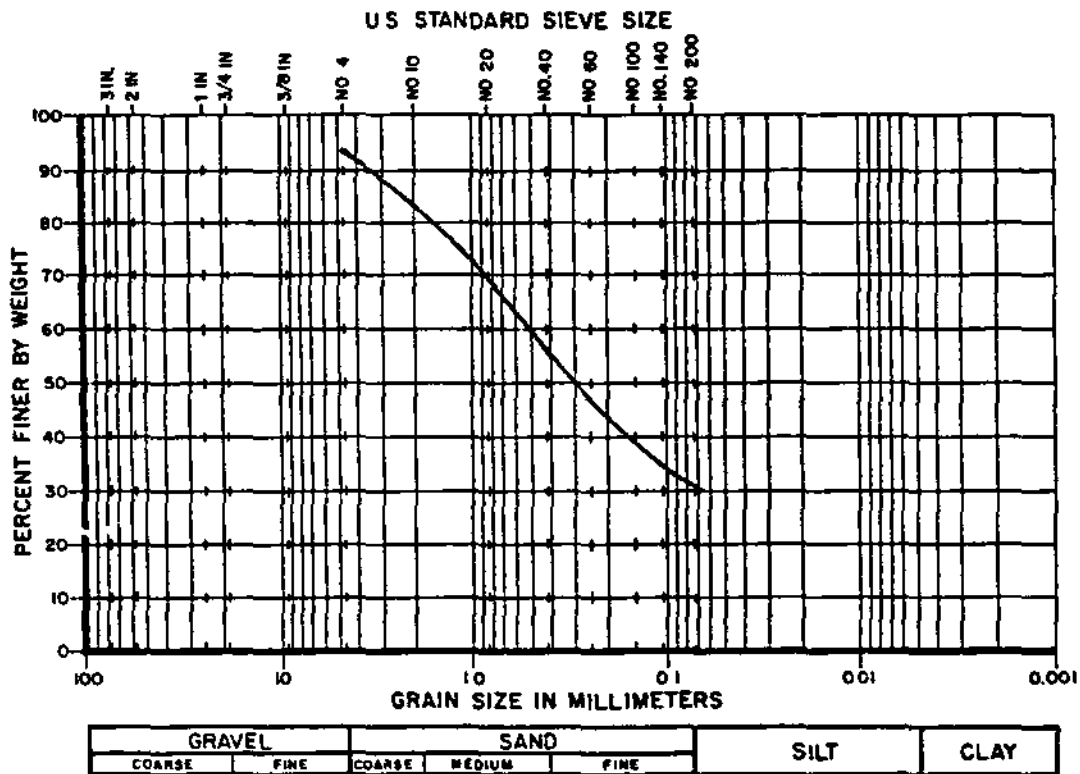
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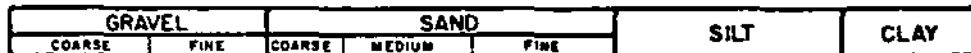
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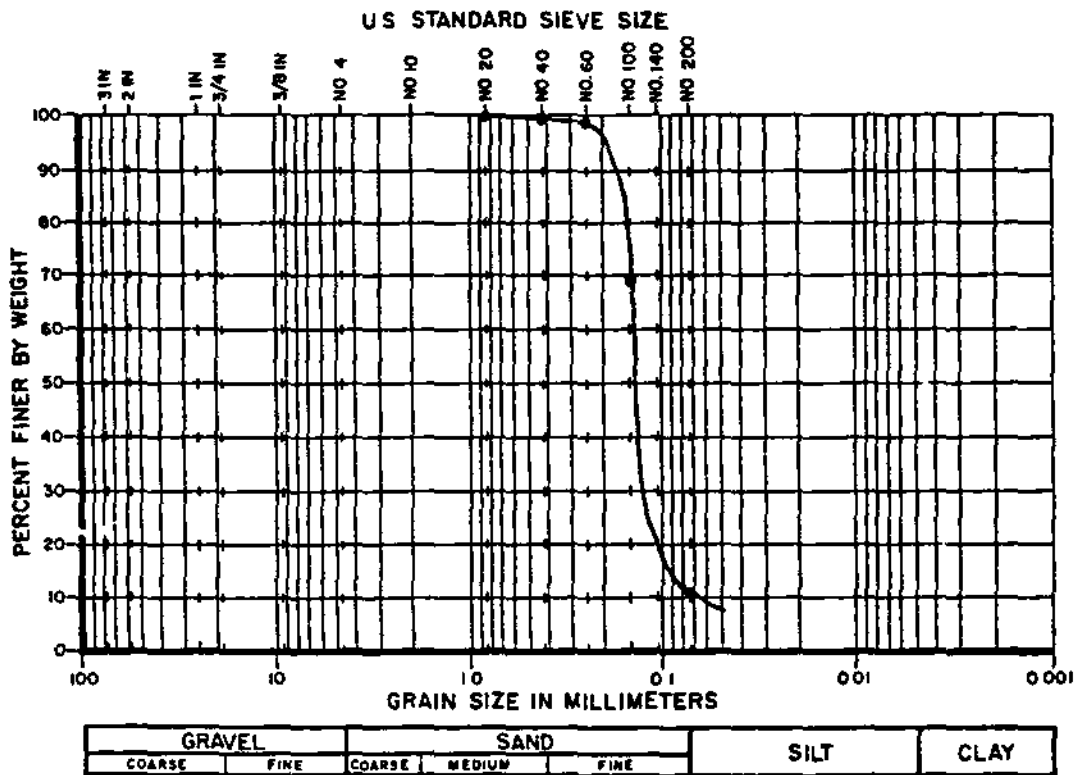
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-3	28	109.0-111.0 ft		Greenish gray silty fine sand with shell	SM

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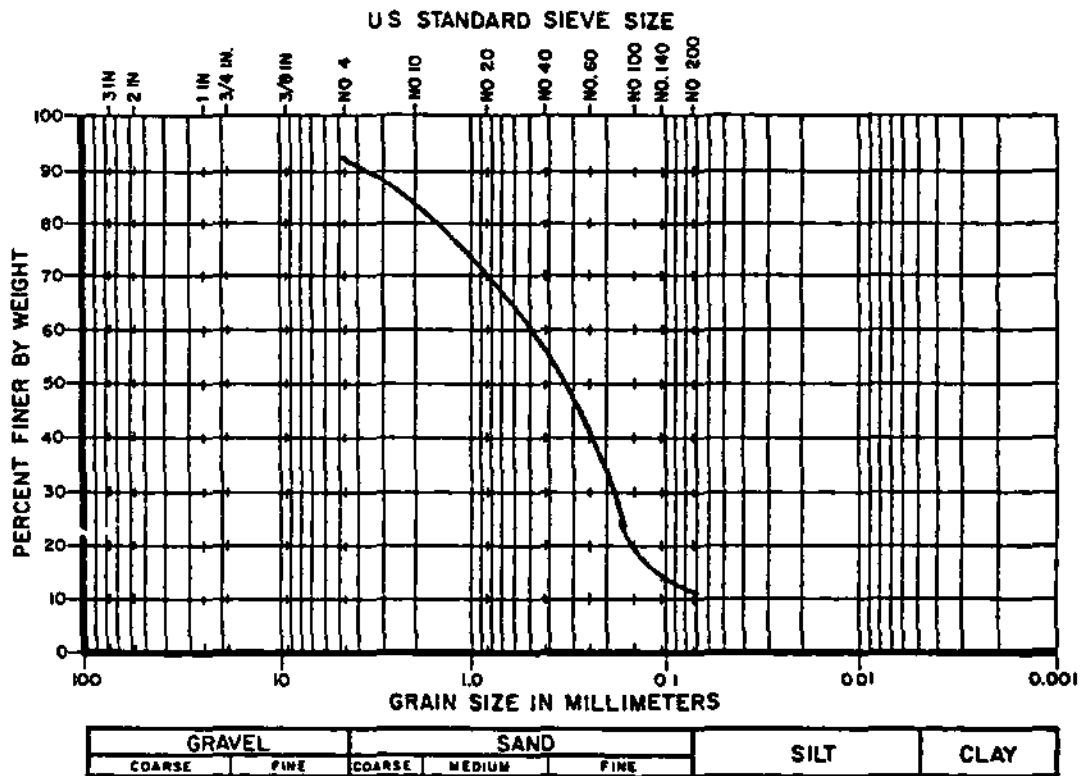
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-4	12	29 0-31 0 ft		Grayish brown fine sand with silt	SP-SM

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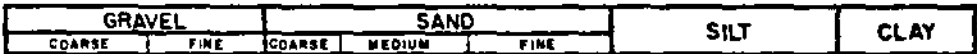
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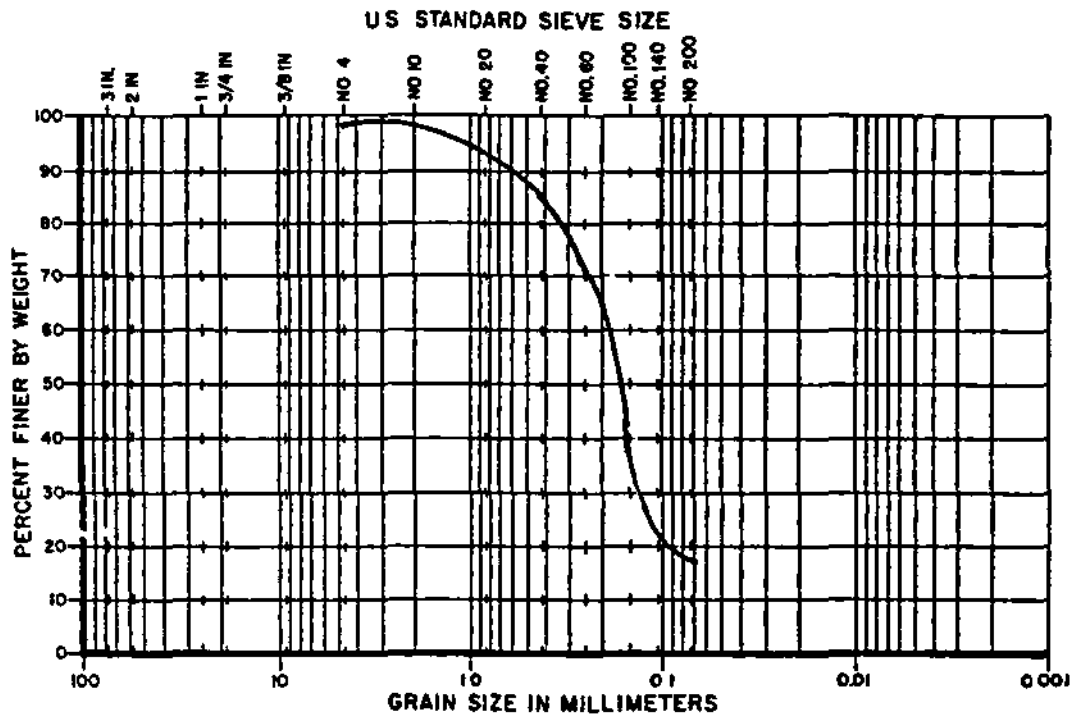
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-4	25	94 0-96 0 ft		Gray fine sand with silt, shell, and cemented sand	SP-SM

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TEST HOLE NO.	SAMPLE NO.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-4	27	104 0-106 0 ft		Gray fine sand with silt, shell, and cemented sand	SP-SM

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DRAWN BY	CHECKED BY	DATE
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90-5648		



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-4	29	114 0-116 0		Gray silty fine sand with shell	SM

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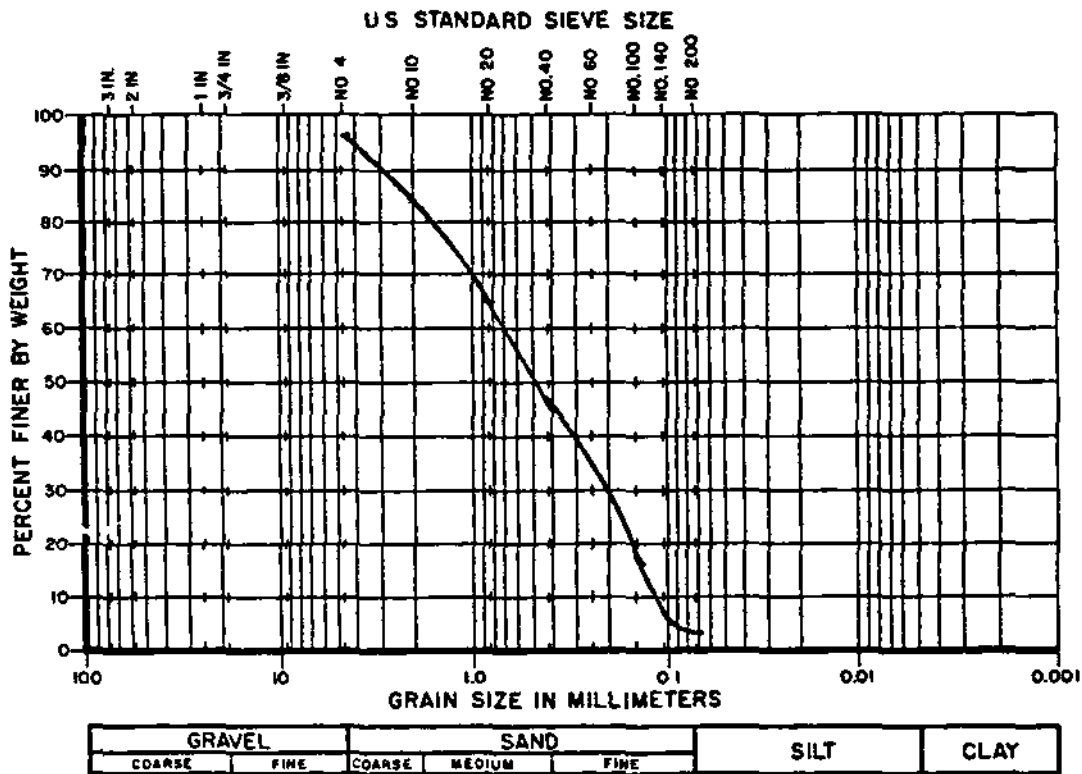
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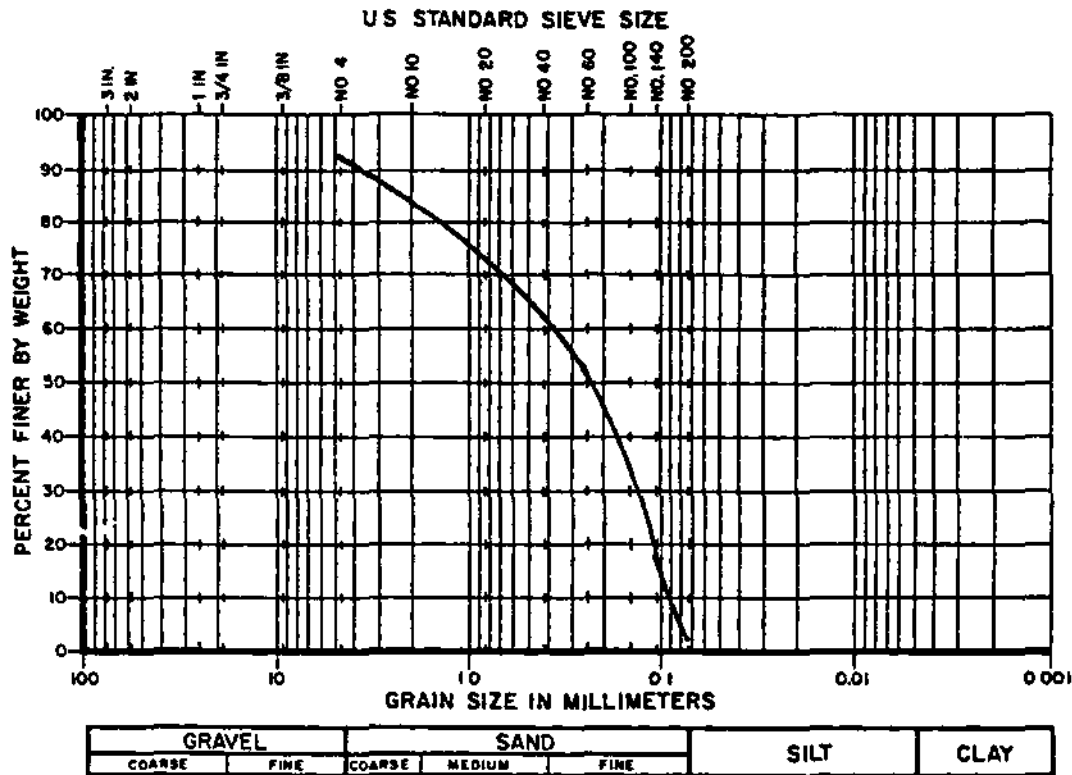
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TEST HOLE NO.	SAMPLE NO.	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-4	32	129 0-131 0 ft		Greenish gray silty fine sand with cemented sand	SM

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TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
MW-4	34	144 0-146 0 ft.		Greenish silty fine sand with cemented sand	SM

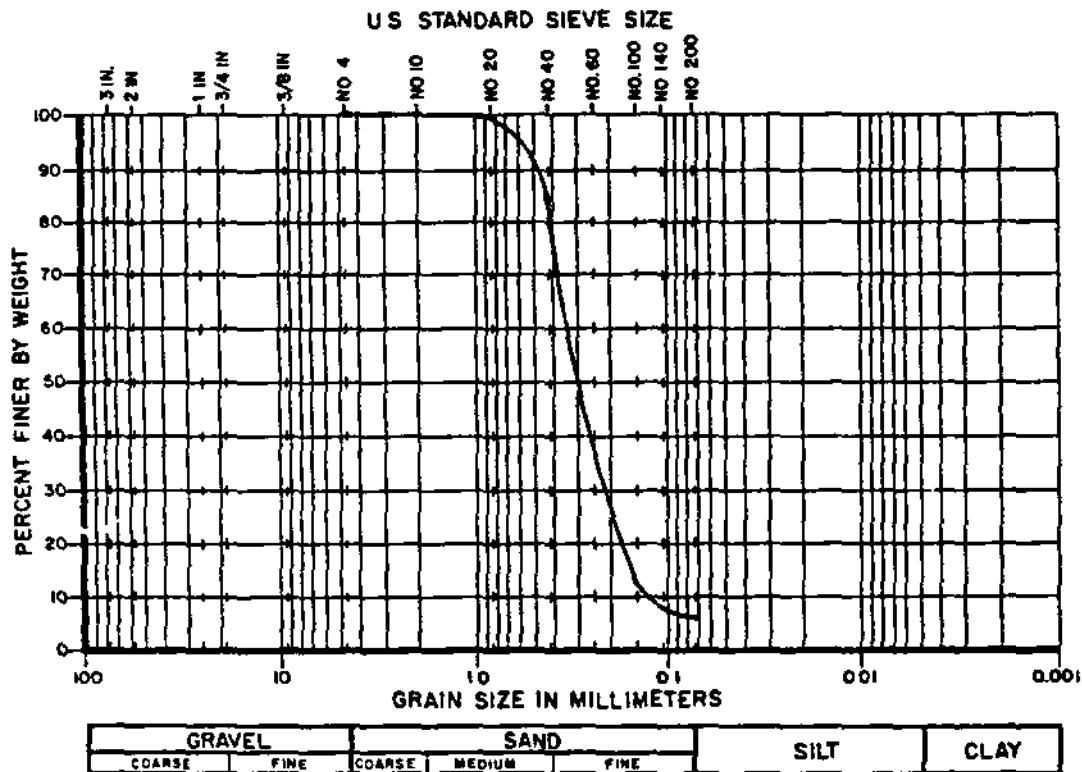
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Foundations and Material Testing

INDIANTOWN COGENERATION PLANT
INDIANTOWN, FLORIDA

DRAWN BY	CHECKED BY	DATE
FILE NO	APPROVED BY	
90-5648		



TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
POW-1	3	9 0-11 0 ft		Dark reddish brown fine sand with silt	SP-SM

GRAIN SIZE DISTRIBUTION

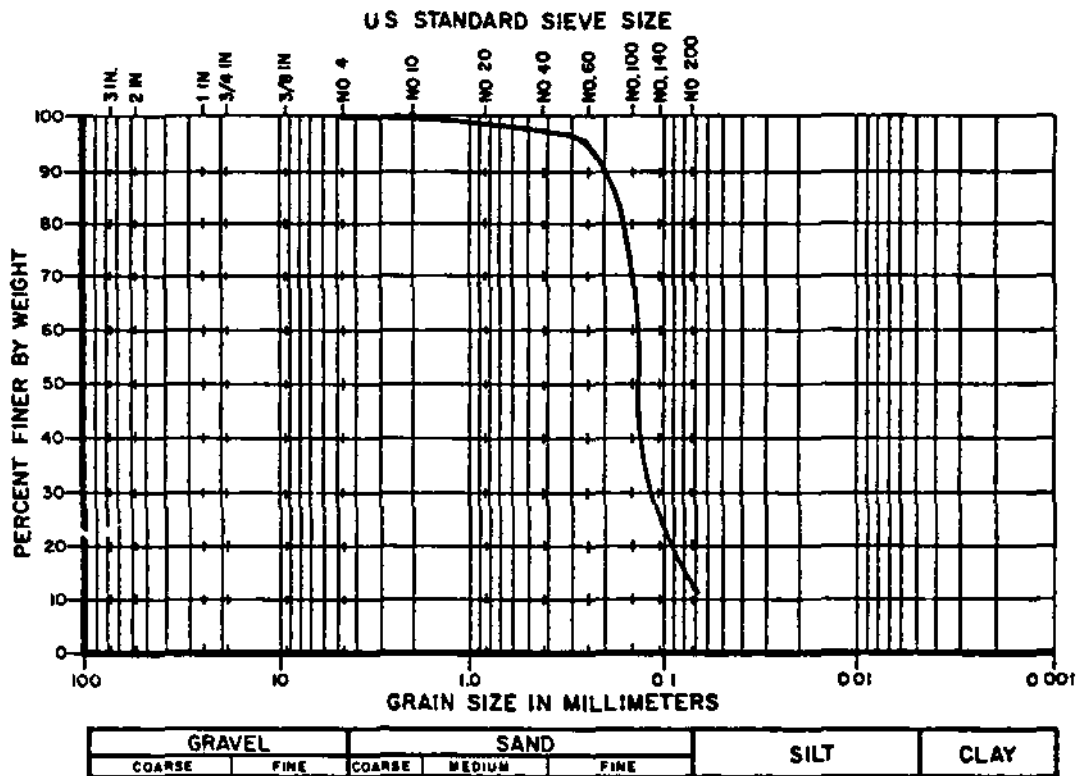


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**INDIANTOWN COGENERATION
PLANT
INDIANTOWN, FLORIDA**

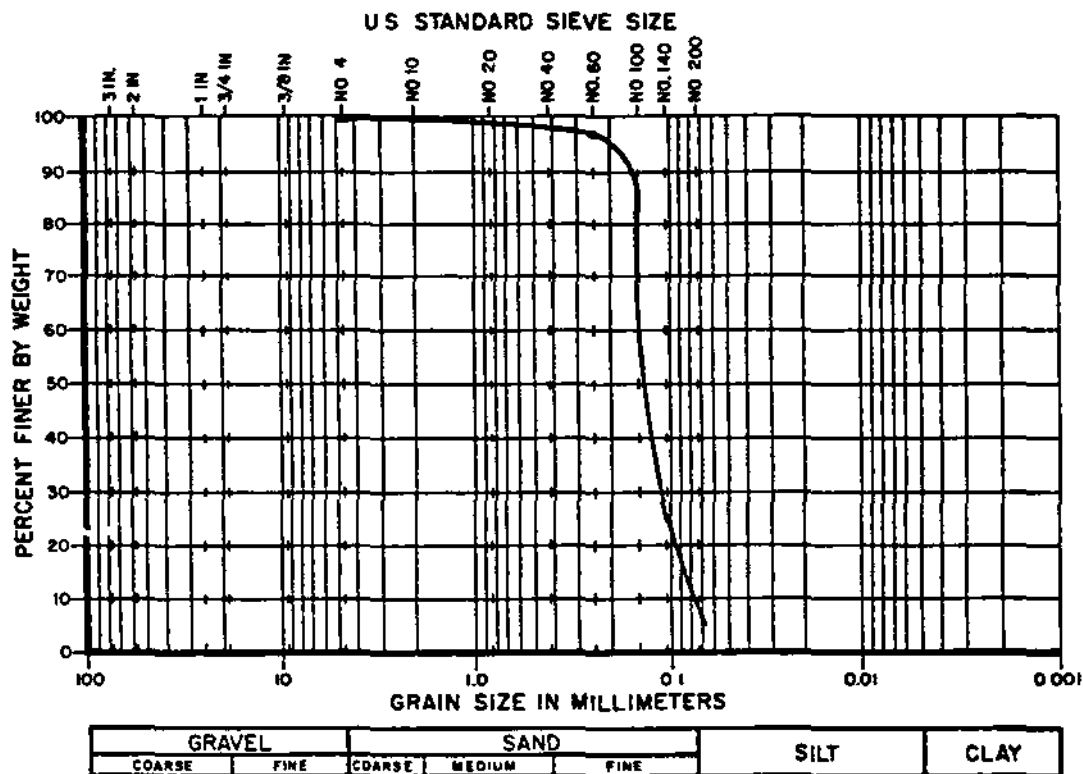
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FILE NO 90-5648 APPROVED BY _____



TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
POW-1	7	24.0-26.0 ft.		Dark gray fine sand with trace of clayey sand	SP-SC

GRAIN SIZE DISTRIBUTION		
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TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
POW-1	10	39 0-41 0 ft		Gray fine sand with silt	SP-SM

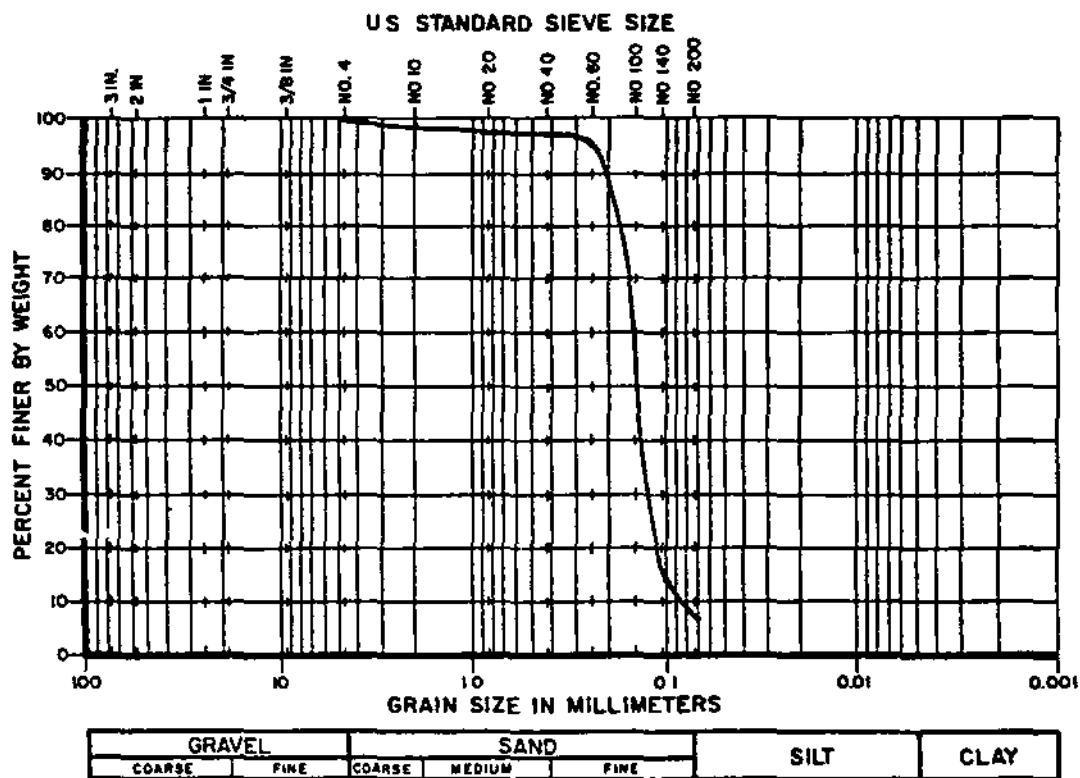
GRAIN SIZE DISTRIBUTION

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PLANT
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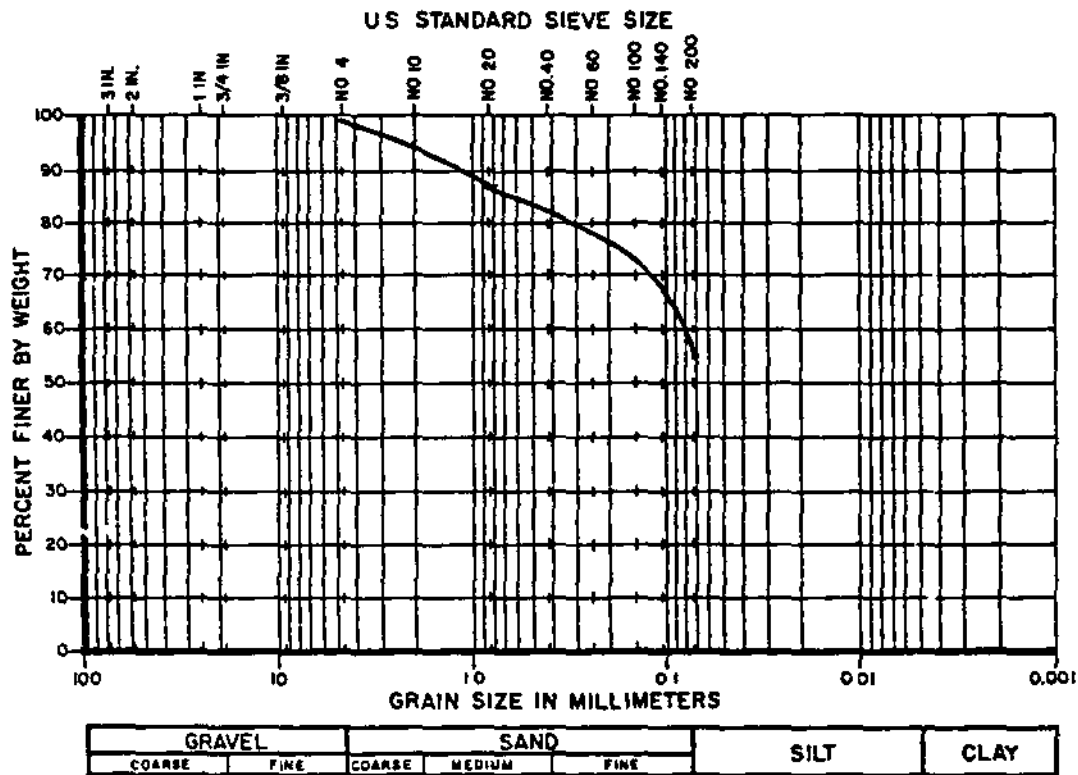
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
POW-1	15	64 0-66 0 ft		Gray sandy silt with shell fragment	ML

GRAIN SIZE DISTRIBUTION

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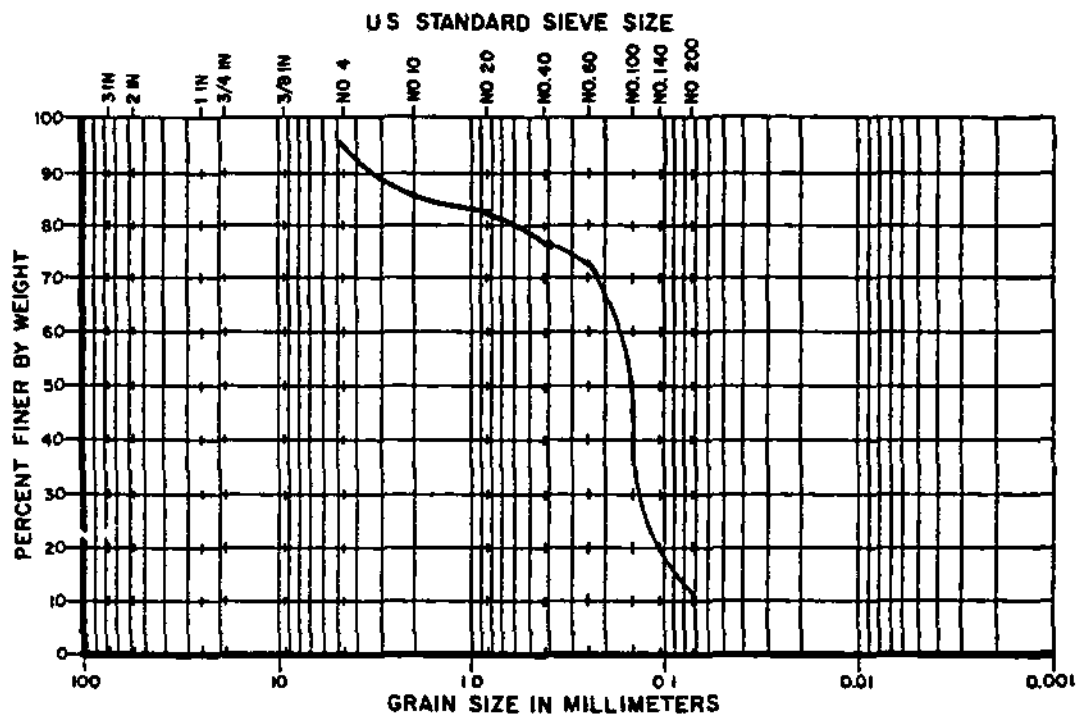
INDIANTOWN COGENERATION
PLANT
INDIANTOWN, FLORIDA

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00-5648		



TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
POW-1	16	69 0-71 0 ft		Gray clay with traces of shell	CH

GRAIN SIZE DISTRIBUTION		
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90-5648		



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

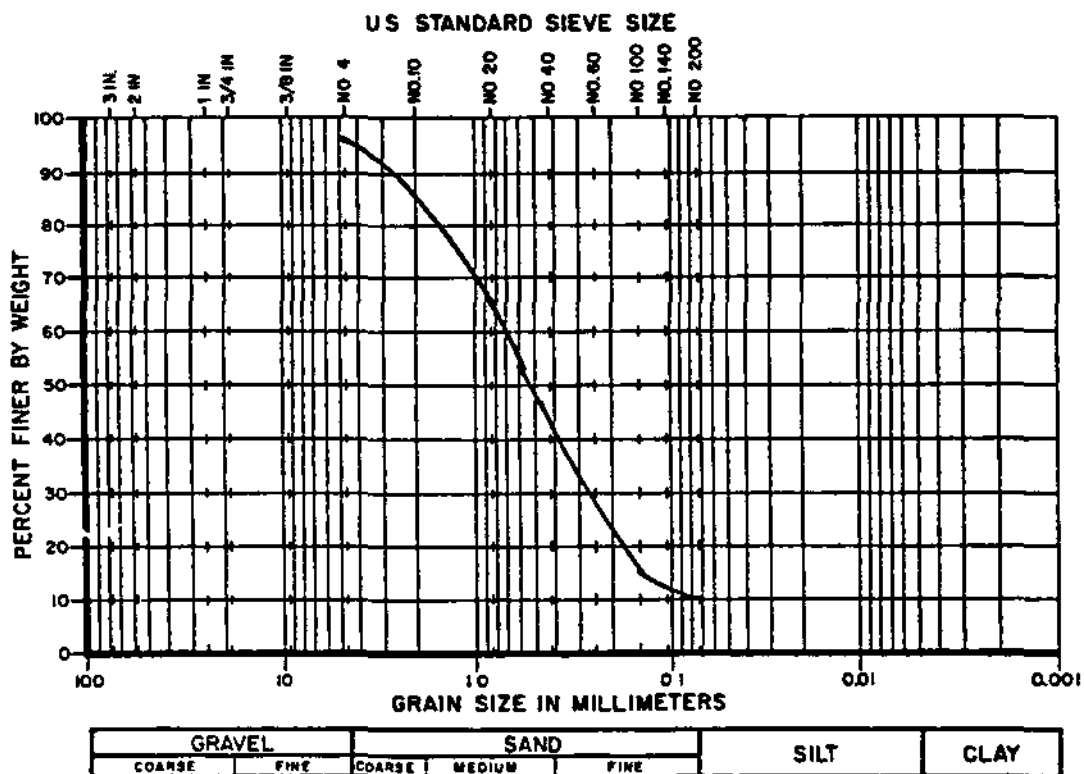
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
POW-1	19	84 0-86 0 ft		Greenish gray fine sand with silt and shell fragments	SP-SM

GRAIN SIZE DISTRIBUTION

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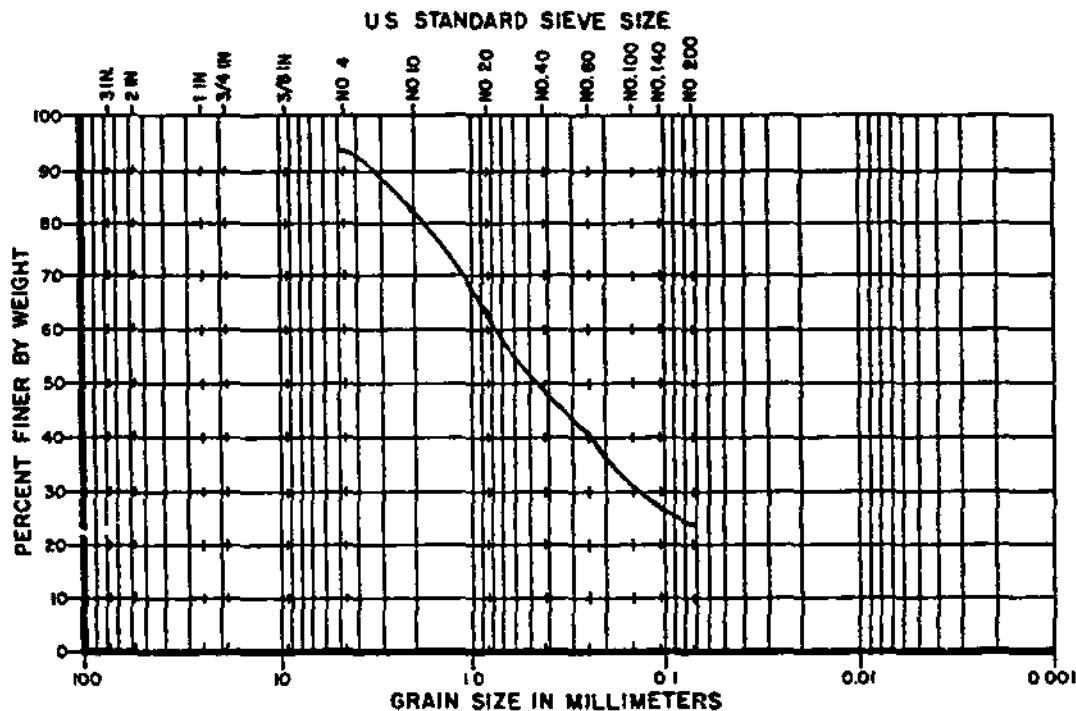
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
PJW-1	21	94 0-96 0 ft		Gray fine sand with silt and shell fragment	SP-SM

GRAIN SIZE DISTRIBUTION

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INDIANTOWN COGENERATION
PLANT
INDIANTOWN, FLORIDA

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FILE NO 90-5648	APPROVED BY	



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

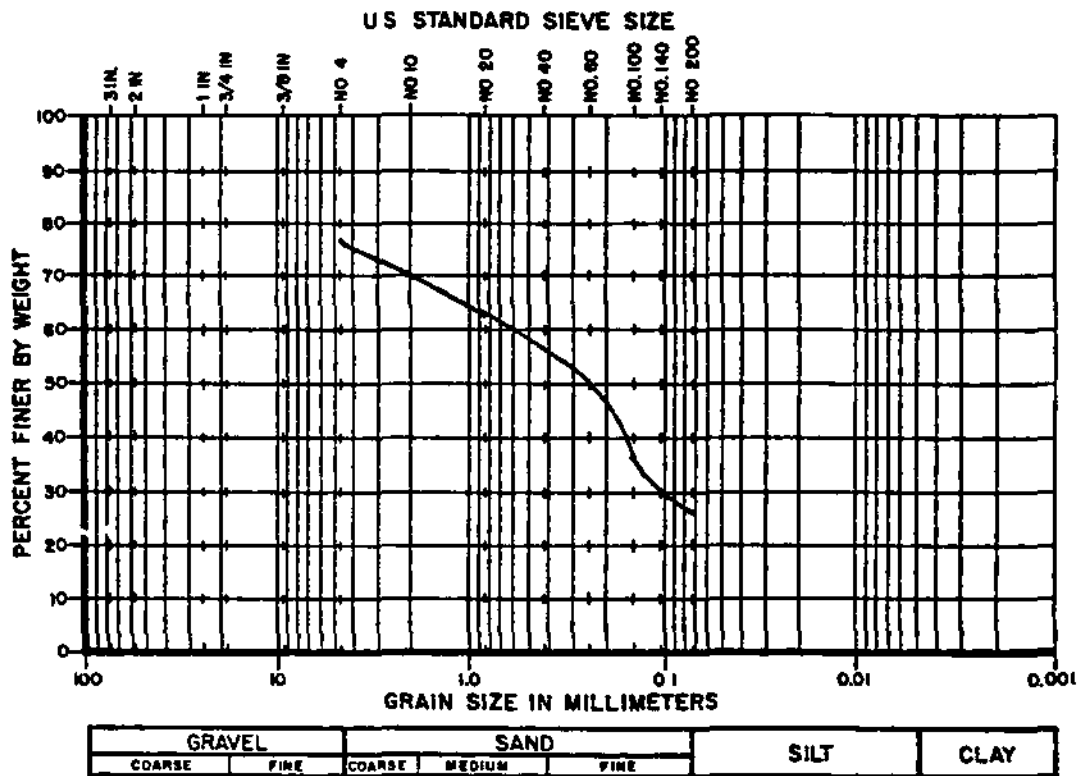
TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
POW-1	27	124 0-126 0 ft		Gray silty fine sand with shell and cemented shell	SM

GRAIN SIZE DISTRIBUTION

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INDIANTOWN COGENERATION
PLANT
INDIANTOWN, FLORIDA

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TEST HOLE NO.	SAMPLE NO	DEPTH	SYMBOL	SAMPLE DESCRIPTION	UNIFIED CLASS
POW-1	32	149 0-151 0 ft		Gray silty sand with shell and cemented sand	SM

GRAIN SIZE DISTRIBUTION

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INDIANTOWN COGENERATION
PLANT
INDIANTOWN, FLORIDA

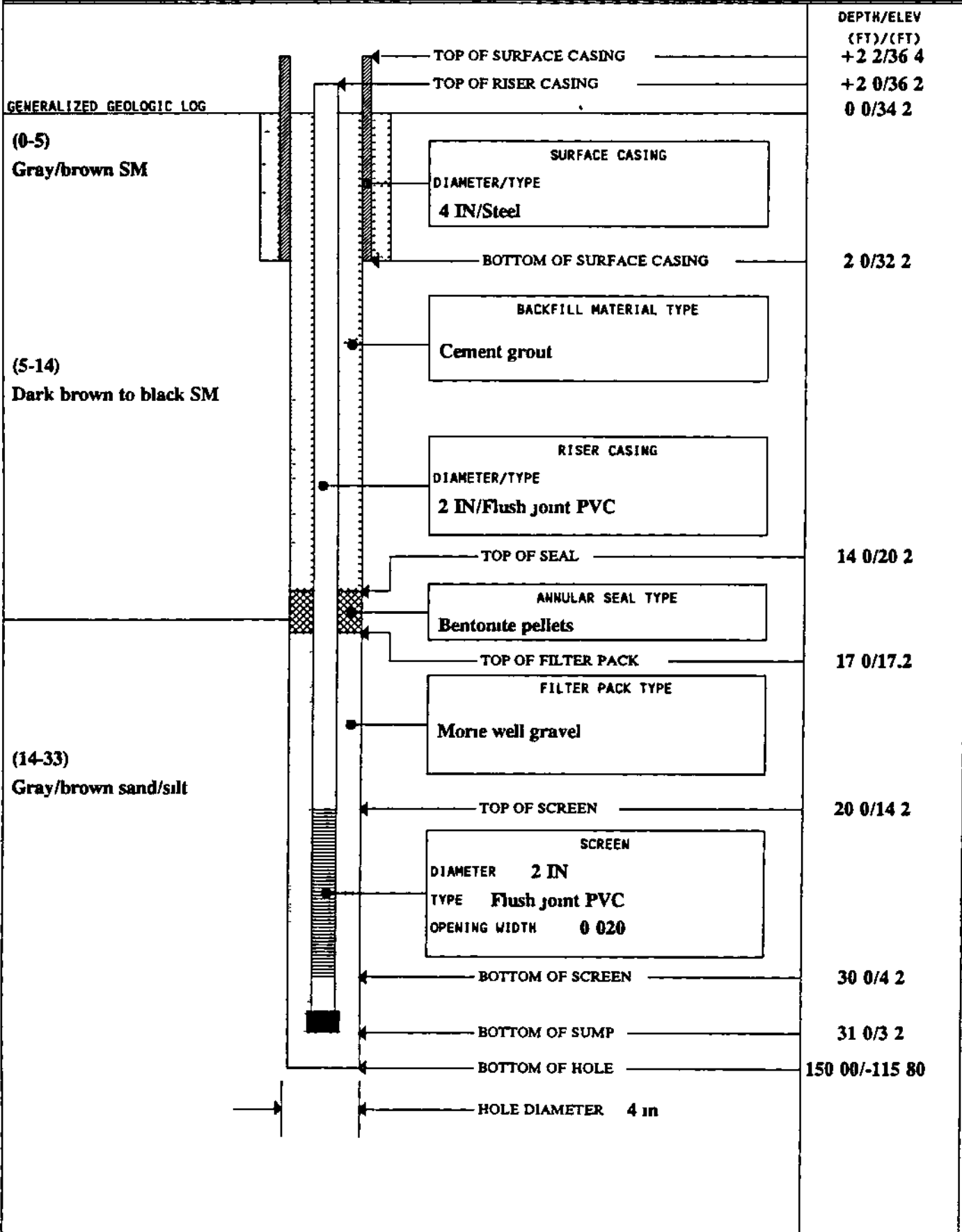
GRAPH BY _____ CHECKED BY _____ DATE _____
FILE NO. 90-5648 APPROVED BY _____

10 5 1 2 Subsurface Hydrologic Data for the Site (2 3 2 1)

- Well Construction Diagrams
- Pump Test Data
- Laboratory Results for Water Quality Sampling

WELL CONSTRUCTION DIAGRAMS

MONITORING WELL		PROJECT	WELL NO
		INDIANTOWN COGENERATION	B-115
JOB NO	SITE	COORDINATES	
20524	Power Block	N 6170, E 10249	
BEGUN	COMPLETE	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
7/27/90	7/27/90	Scott Newhouse	Existing grade





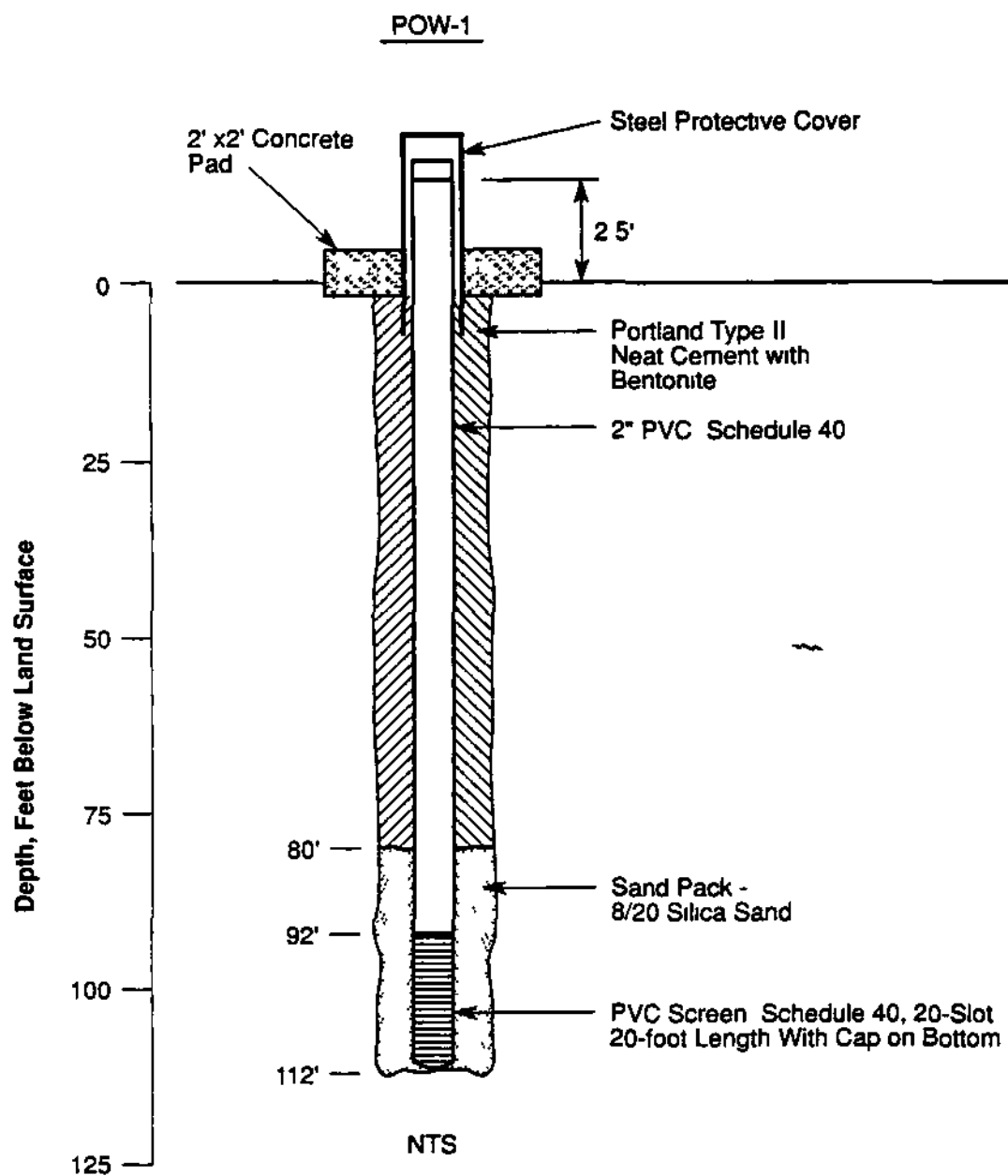


FIGURE 2.3.2-1B.
POW-1 Piezometer Construction Diagram

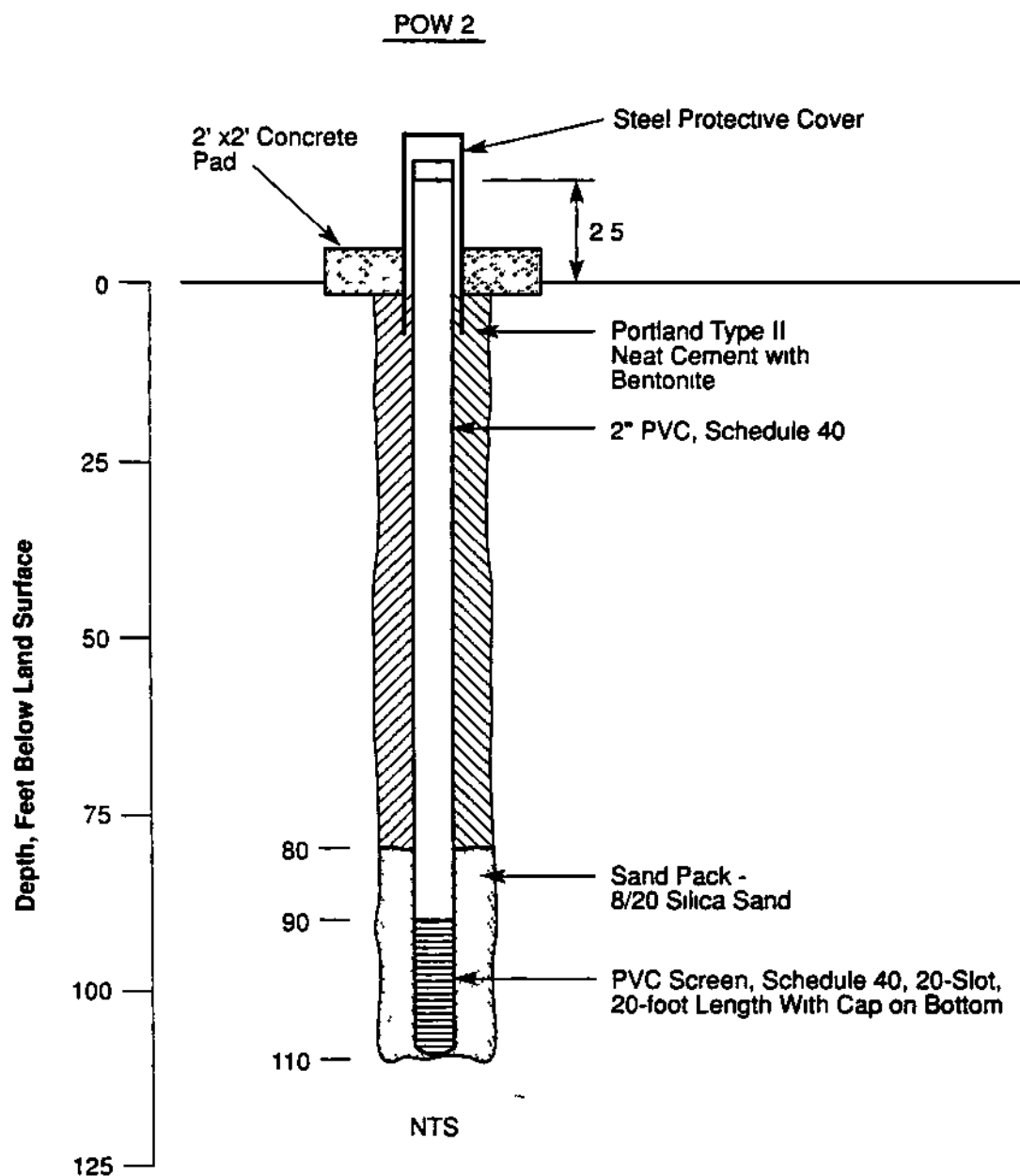


FIGURE 2.3.2-1C.
POW-2 Piezometer Construction Diagram

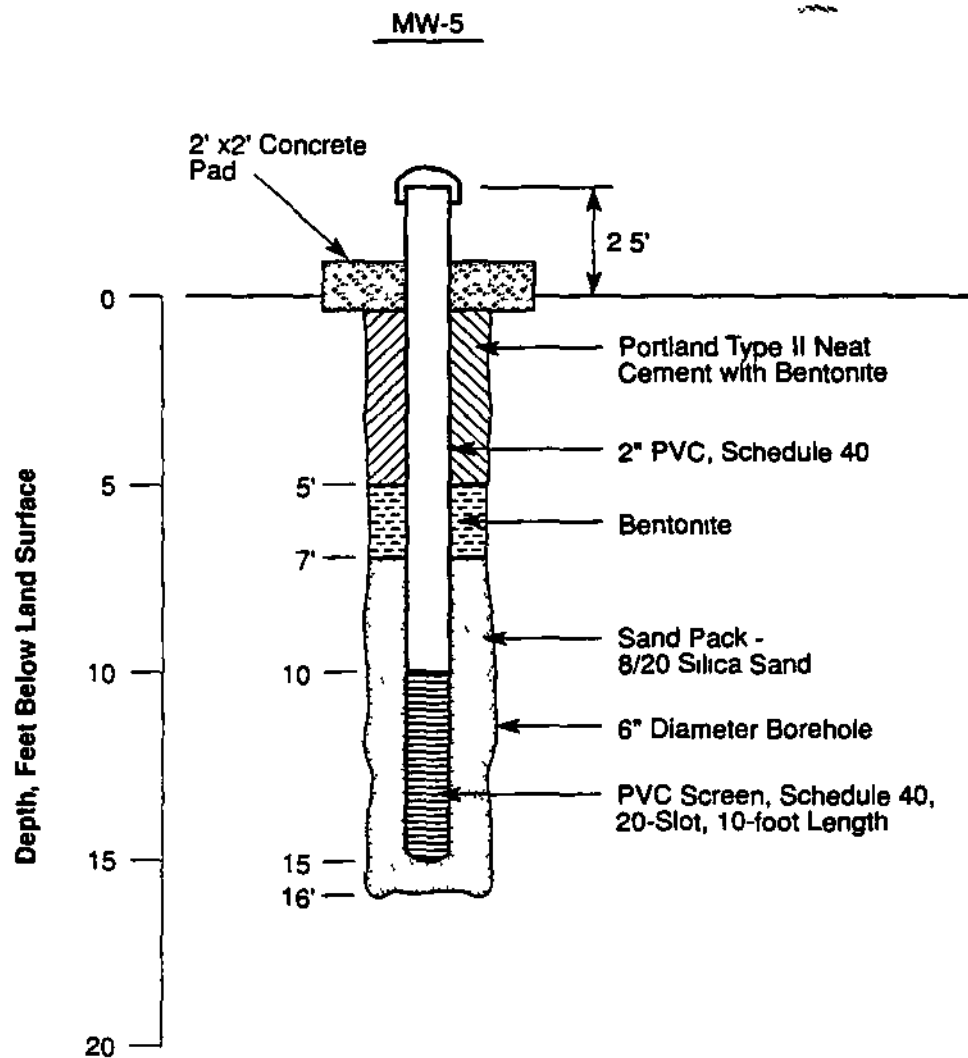


FIGURE 2.3.2-1D.
MW-5 Shallow Piezometer Construction Diagram

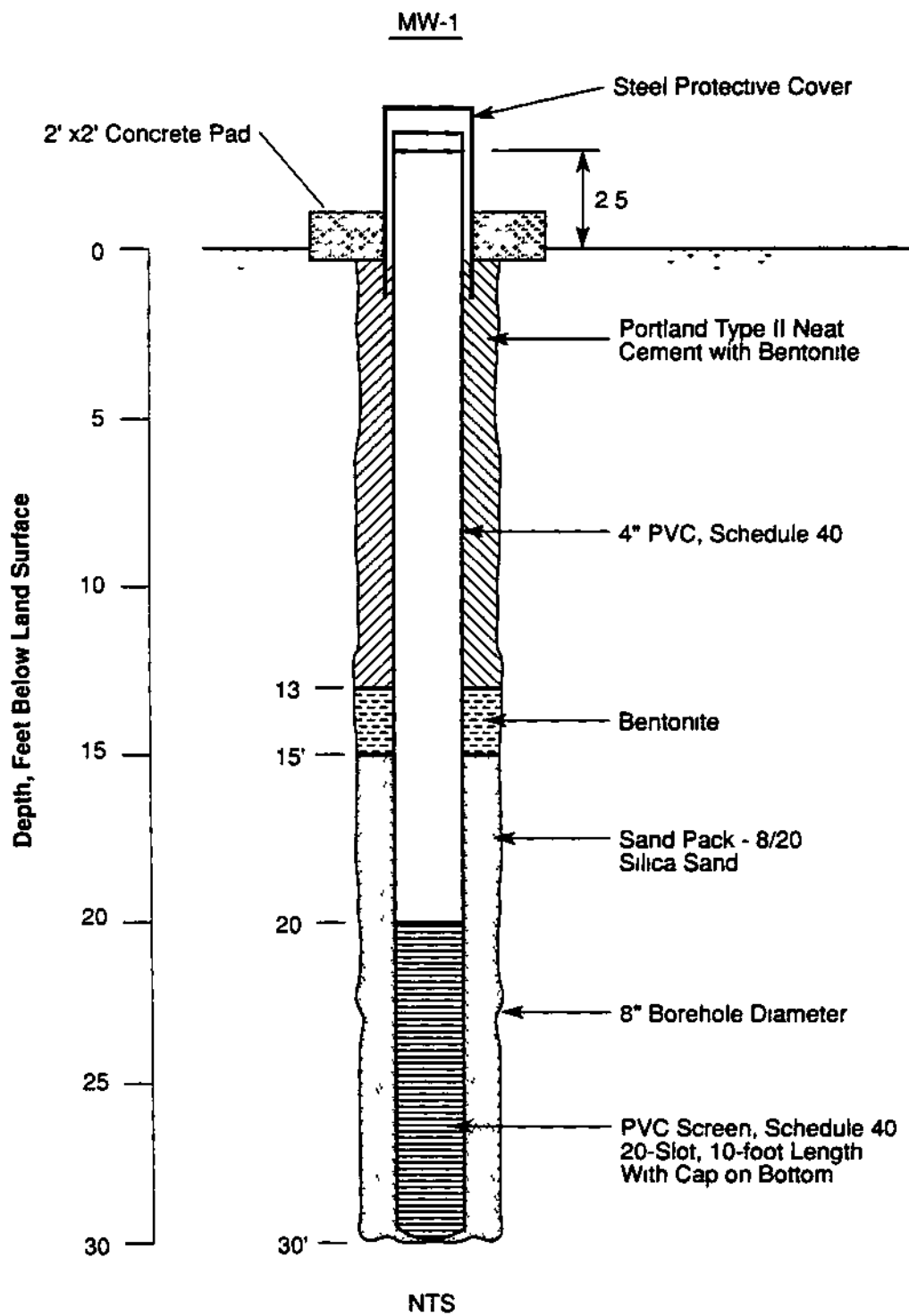


FIGURE 2.3.2-1E.
Monitor Well 1 (MW-1) Construction Diagram

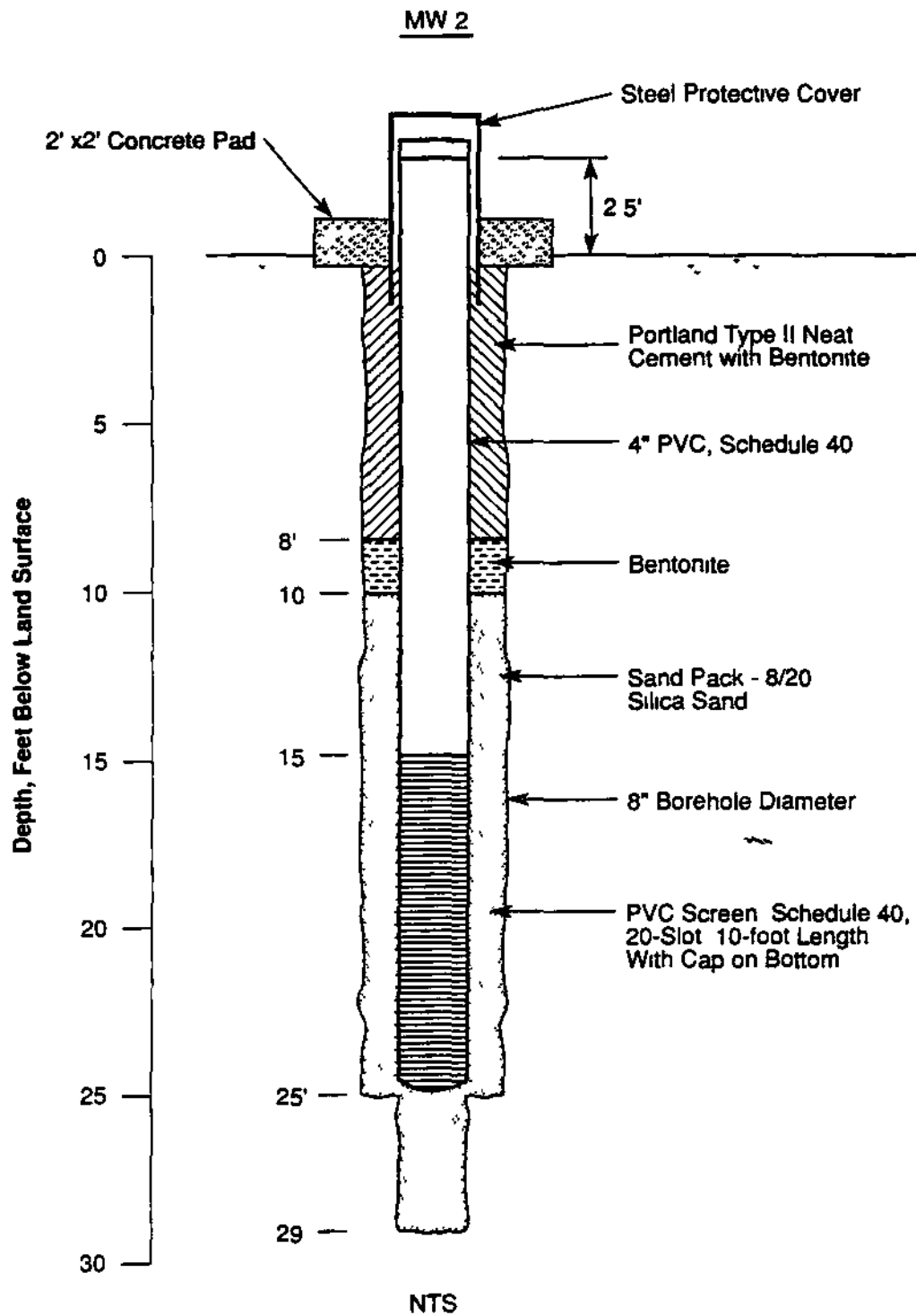


FIGURE 2.3.2-1F.
Monitor Well 2 (MW-2) Construction Diagram



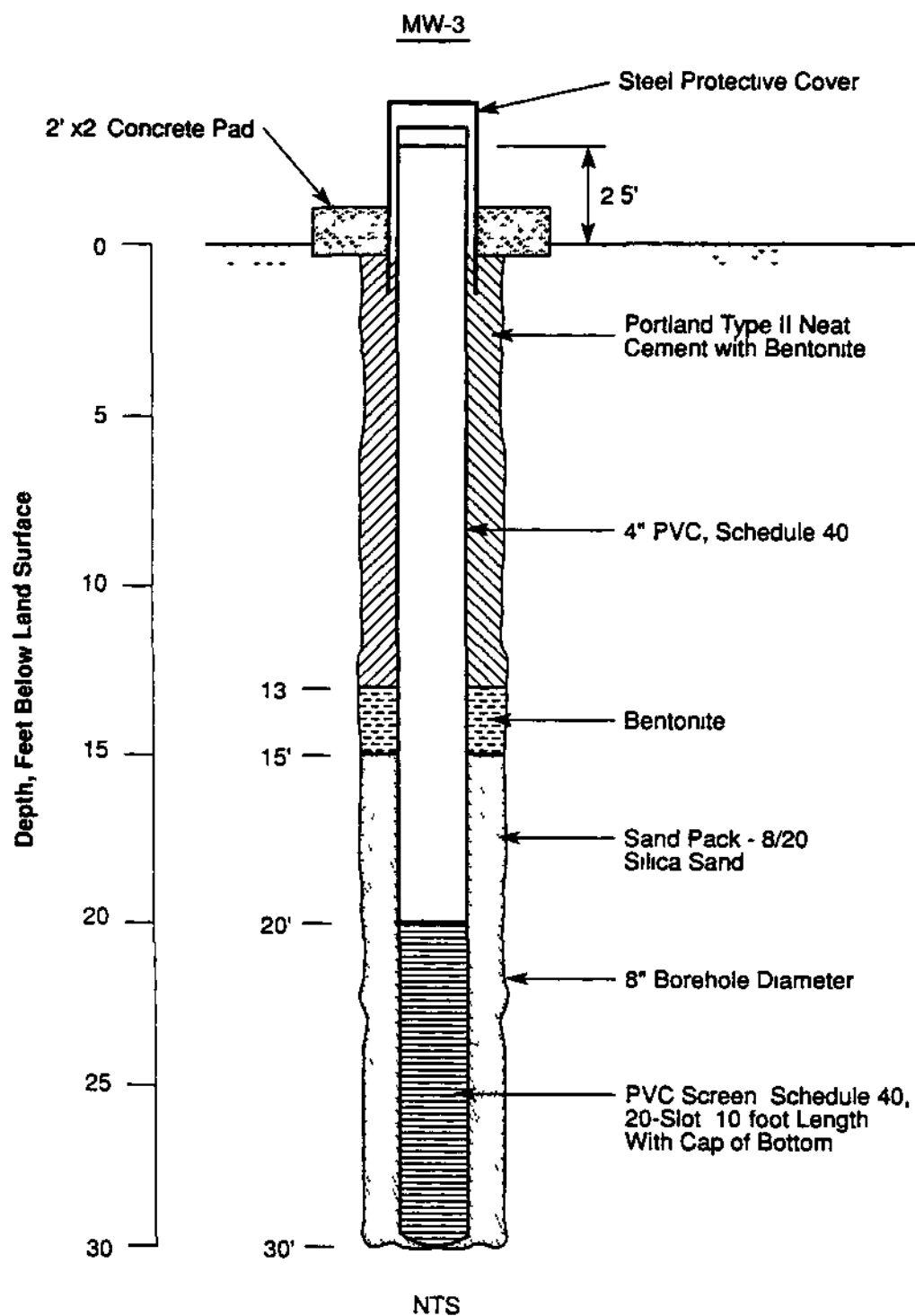


FIGURE 2.3 2-1G.
Monitor Well 3 (MW-3) Construction Diagram



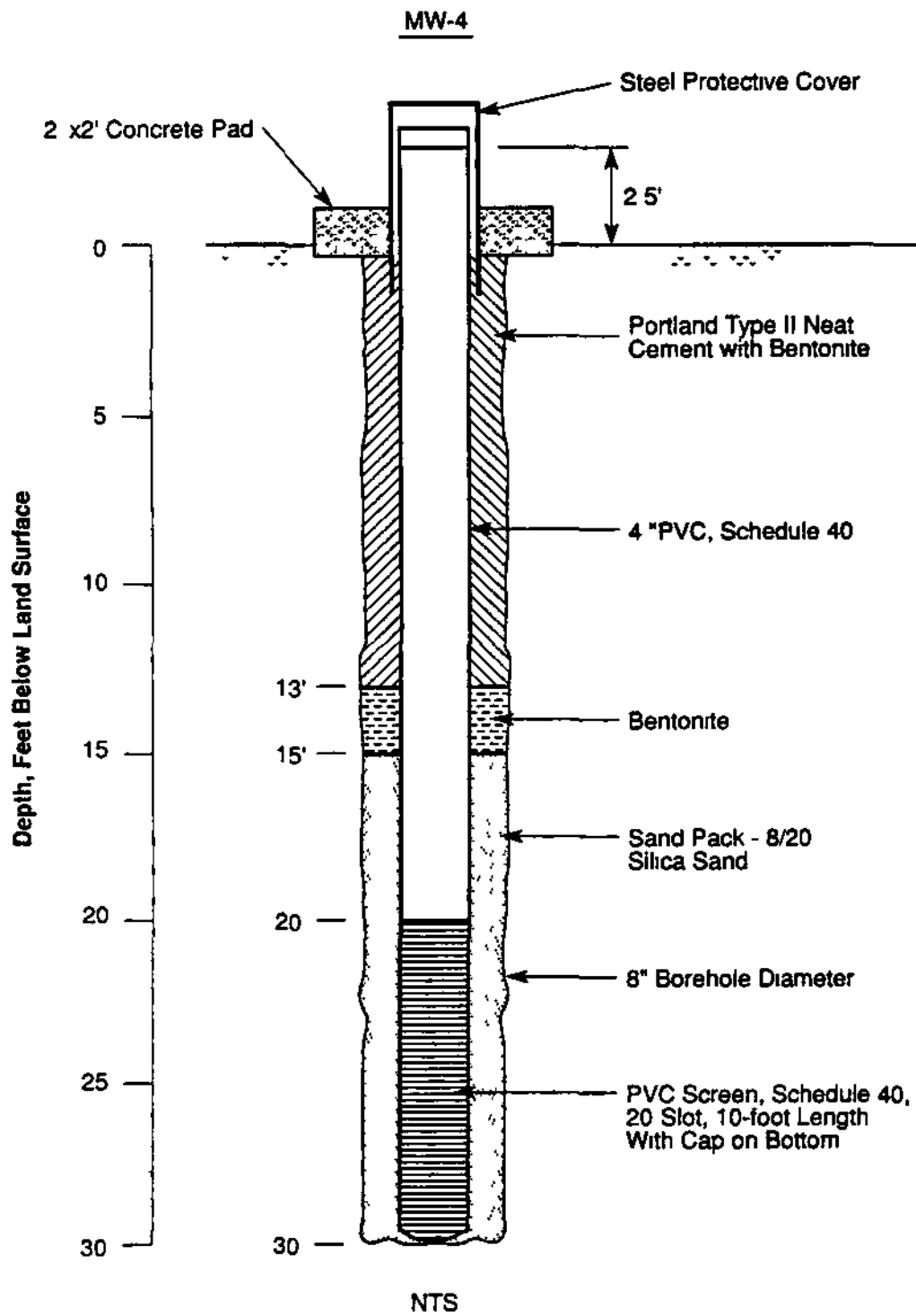


FIGURE 2.3.2-1H
Monitor Well 4 (MW-4) Construction Diagram

PUMP TEST DATA

IMAGE QUALITY

**PLEASE NOTE
THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD
WERE OF POOR QUALITY.**



SUBJECT Aquifer Test Analysis
Bechtel - Indiantown Cogeneration
Project POW-1

BY P Kwiatkowski DATE 8/23/90
SHEET NO 1 OF 2
PROJECT NO SEF 30619. A8

Walton (1962) Method for Leaky Aquifers

Type-Curve Match, $Q = 150$ gpm, $r = 50$ Feet

$$W(u, r/\beta) = 1$$

$$1/u = 1$$

$$s = 3.2 \text{ ft}$$

$$t = 0.18 \text{ min}$$

$$r/\beta = 0.025$$

$$s = \frac{114.6 Q}{T} W(u, r/\beta)$$

$$T = \frac{114.6 Q}{s} (1) = \frac{(114.6)(150 \text{ gpm})}{3.2 \text{ ft}} = \boxed{5372 \text{ gpd/ft}}$$

$$S = \frac{Tt u}{2693 r^2} = \frac{(5372)(0.18)(1)}{2693 (50)^2} = \boxed{1.4 \times 10^{-4}}$$

$$K'/b' = [T (r/\beta)^2] / r^2$$

$$K'/b' = \frac{(5372)(0.025)^2}{(50)^2} = \boxed{1.3 \times 10^{-3} \text{ gpd/ft}^2/\text{ft}}$$

Cooper-Jacob Method

$$\Delta s = 18.02 - 11.02 = 7.0 \text{ ft}$$

$$t_0 = 0.28 \text{ minutes}$$

$$T = \frac{264 Q}{\Delta s} = \frac{(264)(150)}{7.0} = \boxed{5657 \text{ gpd/ft}}$$

$$S = \frac{T t_0}{4790 r^2} = \frac{(5657)(0.28)}{4790 (50)^2} = \boxed{1.32 \times 10^{-4}}$$



SUBJECT Aquifer Test Analysis
Bechtel-Indiantown Cogeneration Project
POW-2

BY P. Kunatkovsk DATE 8/23/90
SHEET NO 2 OF 2
PROJECT NO SEF30619 AØ

Walton (1962) Method for Leaky Aquifers

$$Q = 150 \text{ gpm}$$

$$r = 200 \text{ feet}$$

$$W(u, r/B) = 1$$

$$1/u = 1$$

$$s = 36 \text{ ft}$$

$$t = 3 \text{ min}$$

$$r/B = 0.15$$

$$S = \frac{1146 Q}{T} W(u, r/B)$$

$$T = \frac{1146 Q}{s} W(u, r/B) = \frac{(1146)(150)}{36} (1) = \boxed{4775 \text{ gpd/ft}}$$

$$S = \frac{T+u}{2693 r^2} = \frac{(4775)(3)(1)}{2693 (200)^2} = \boxed{1.33 \times 10^{-4}}$$

$$K'/b' = [T (r/B)^2] / r^2 = \frac{[4775 (0.15)^2]}{(200)^2} = \boxed{269 \times 10^{-3} \text{ gpd/ft}}$$

Cooper-Jacob Method

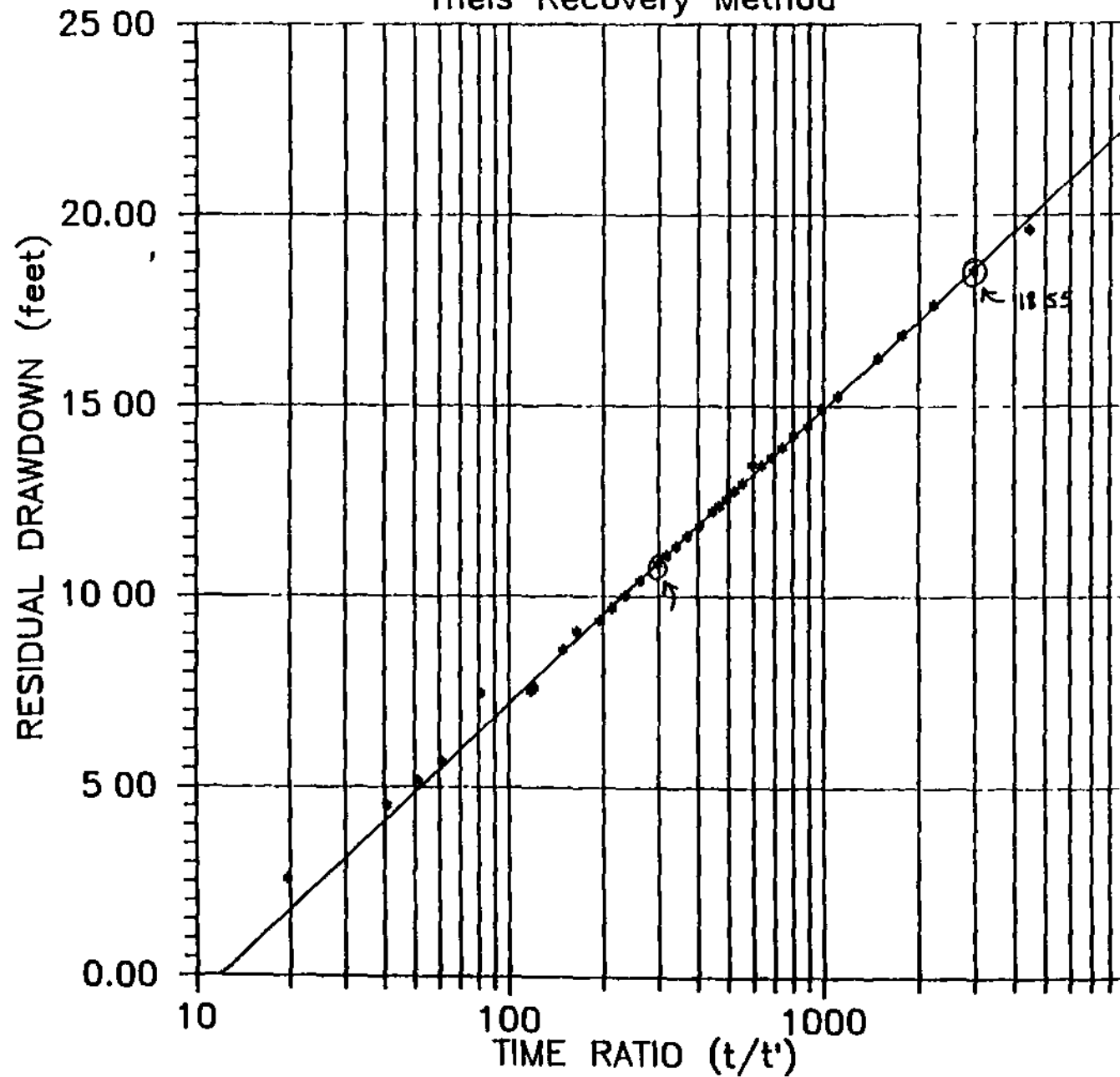
$$\Delta S = 929 - 299 = 63 \text{ ft}$$

$$t_0 = 34 \text{ min}$$

$$T = \frac{264 Q}{\Delta S} = \frac{(264)(150)}{63} = \boxed{6286 \text{ gpd/ft}}$$

$$S = \frac{T t_0}{4790 r^2} = \frac{(6286)(34)}{4790 (200)^2} = \boxed{1.11 \times 10^{-4}}$$

PW-1
Theis Recovery Method



Theis Recovery Method

$$Q = 150 \text{ gpm} = 28,877 \text{ ft}^3/\text{day}$$

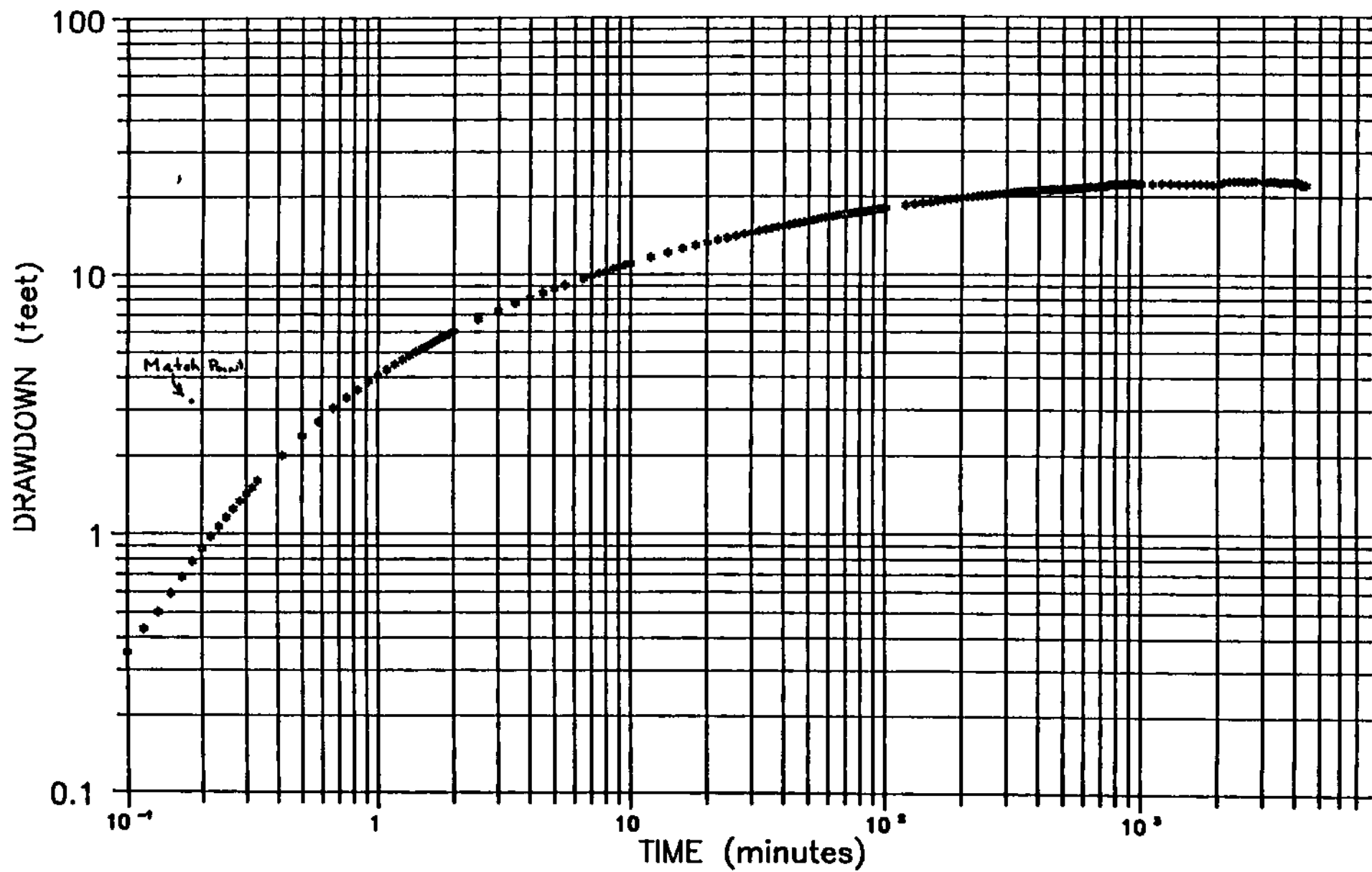
$$S' = 18.55 - 11.0 = 7.55'$$

$$T = \frac{2.3Q}{4\pi s} = \frac{2.3(28,877 \text{ ft}^3/\text{day})}{4\pi(7.55 \text{ ft})}$$

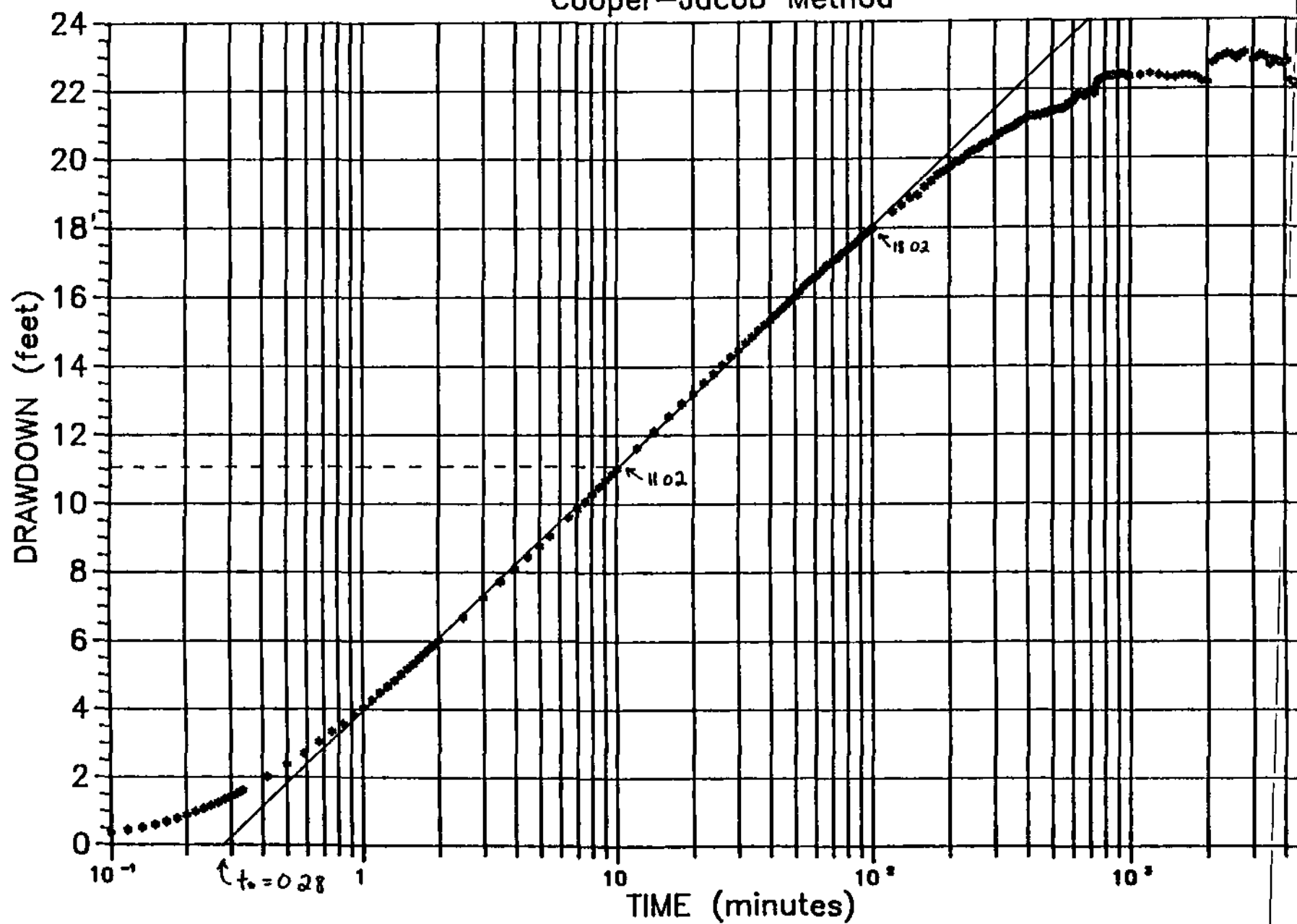
$$T = 700 \text{ ft}^2/\text{day}$$

$$T = 5236 \text{ gpd/ft}$$

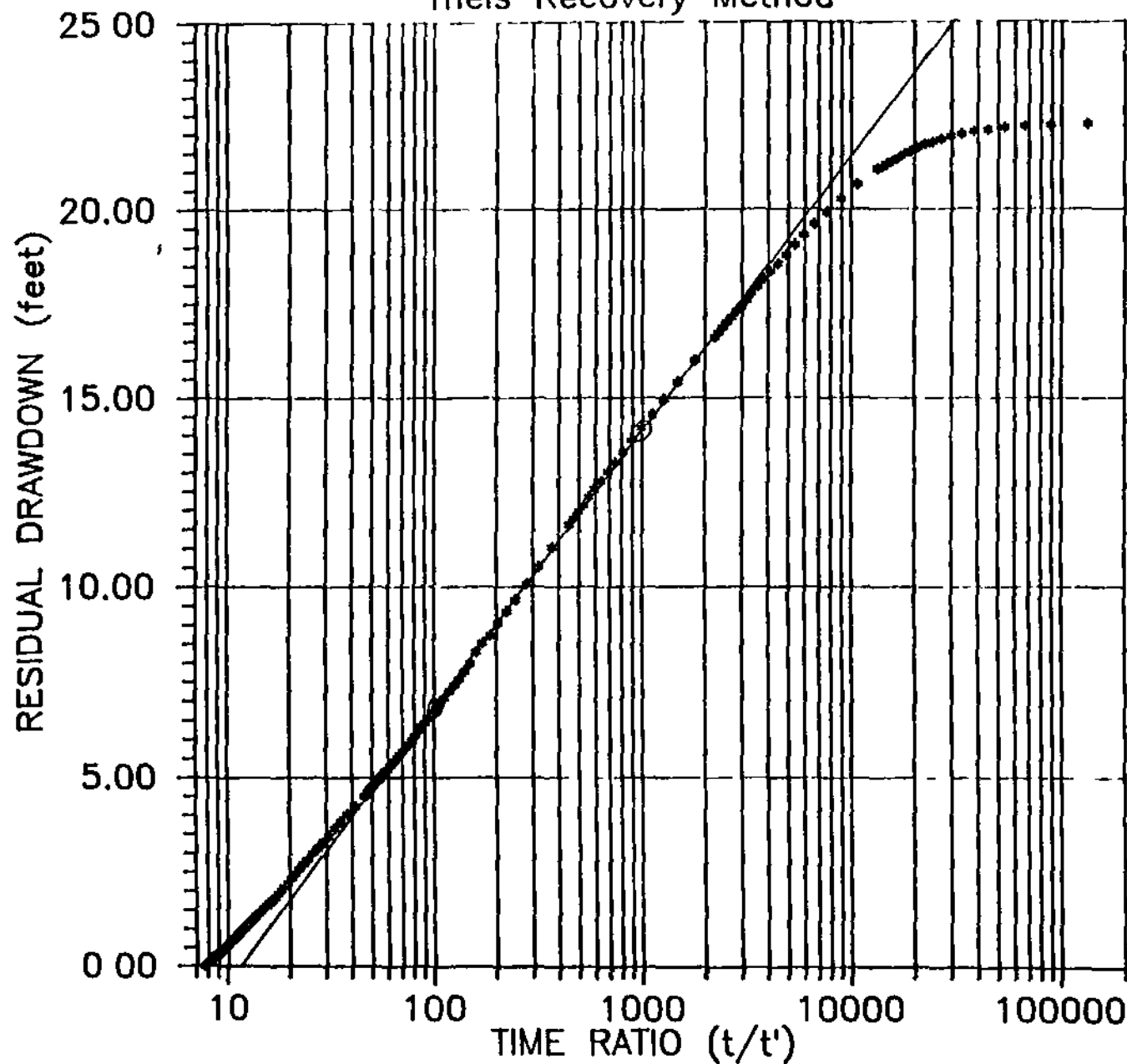
POW-1
Walton Method



POW-1
Cooper-Jacob Method



POW-1
Theis Recovery Method



Theis Recovery Method

$$Q = 150 \text{ gpm} = 28,877 \text{ ft}^3/\text{day}$$

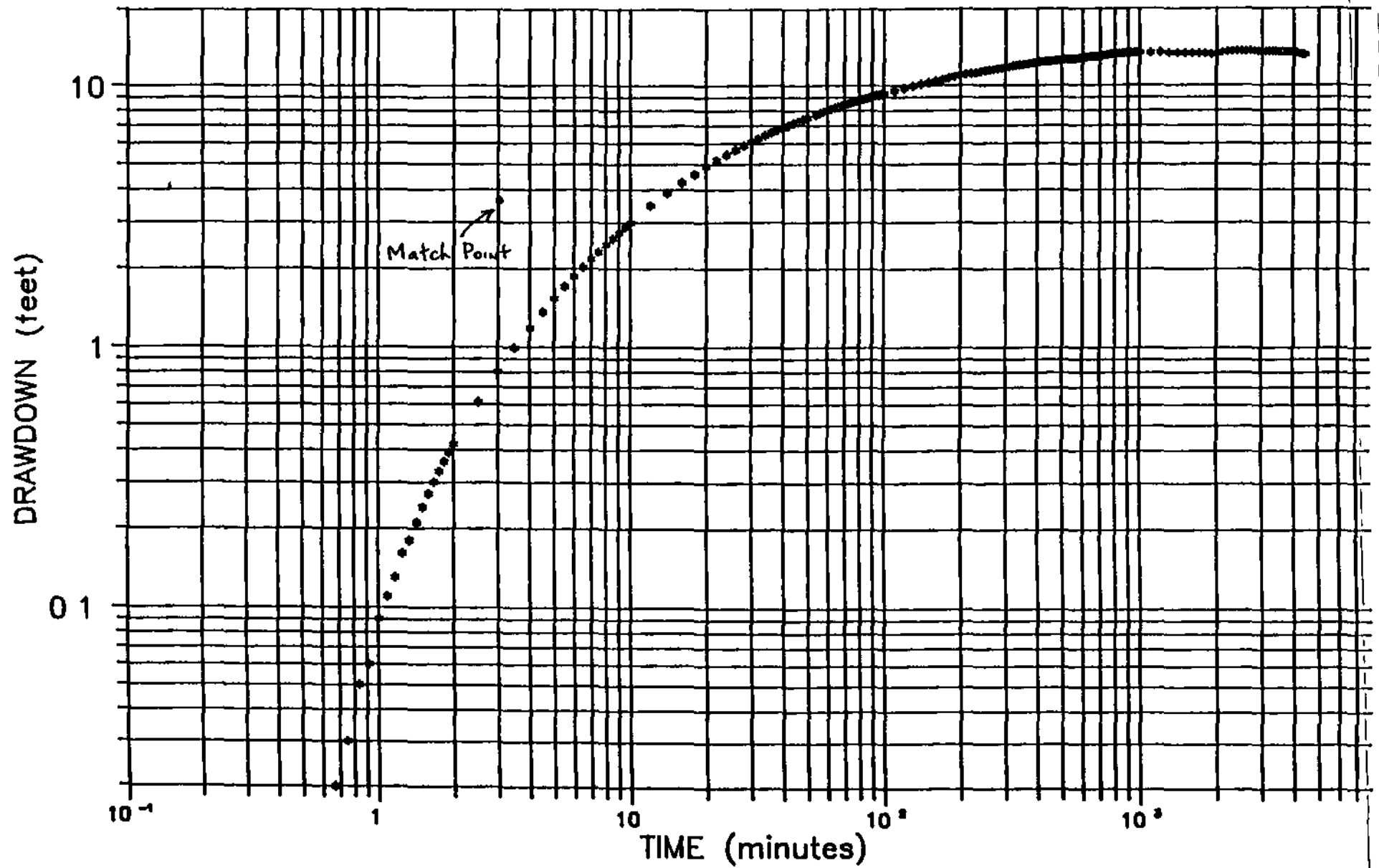
$$S' = 14.20 - 6.75 = 7.45'$$

$$T = \frac{2.3Q}{4\pi S'} = \frac{2.3(28,877 \text{ ft}^3/\text{day})}{4\pi (7.45 \text{ ft})}$$

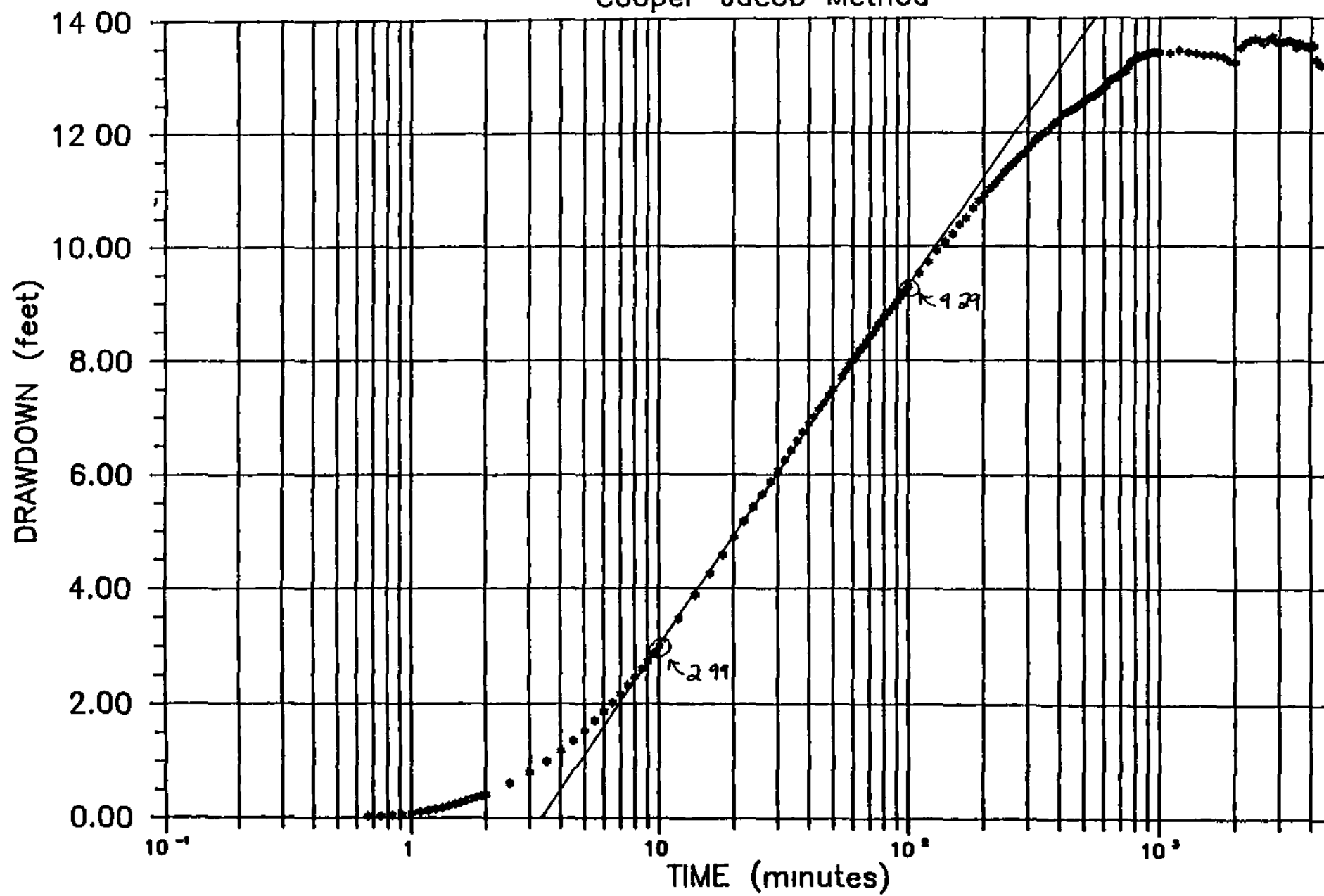
$$T = 709.4 \text{ ft}^2/\text{day}$$

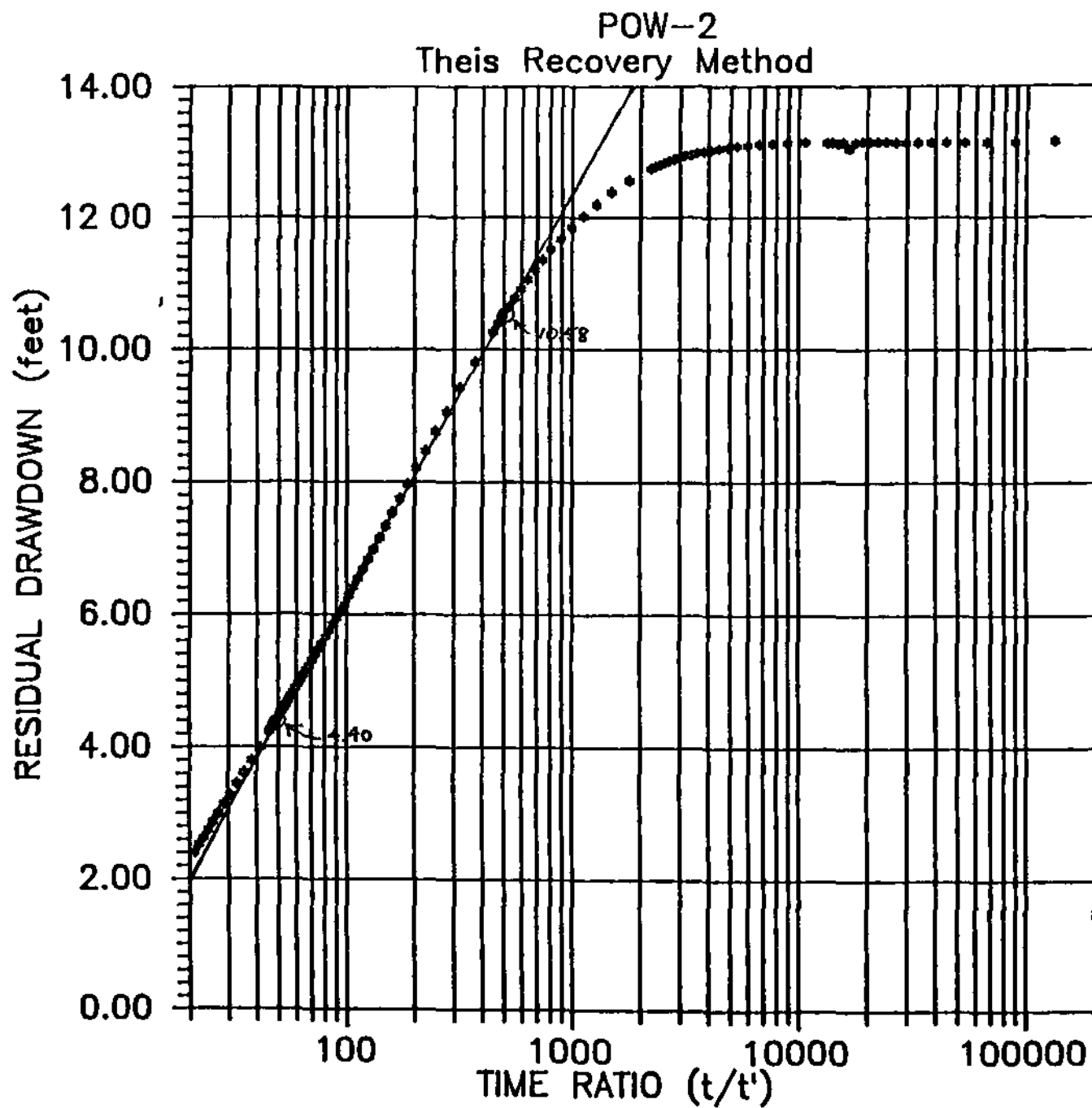
$$T = 5306 \text{ gpd/ft}$$

POW-2
Walton Method



POW-2
Cooper-Jacob Method





Theis Recovery Method

$$Q = 150 \text{ gpm} = 28,877 \text{ Ft}^3/\text{day}$$

$$s' = 10.58 - 4.4 = 6.18$$

$$T = \frac{2.3Q}{4\pi s'} = \frac{2.3(28,877 \text{ Ft}^3/\text{day})}{4\pi(6.18)}$$

$$T = 8552 \text{ Ft}^2/\text{day}$$

$$T = 6397 \text{ gpd/Ft}$$

BECHTEL - INDIANTOWN COGENERATION PROJECT
 WELL PW-1
 THEIS RECOVERY METHOD
 PUMP ON DATE 8/13/90 TIME 1015
 PUMP OFF DATE 8/16/90 TIME 1152
 PUMPING DURATION 4417 MINUTES
 STATIC DEPTH TO WATER 6 09 FEET

t' (minutes)	t (minutes)	t/t'	DTW (feet)	s' (feet)
0 5	4417 5	8835 00	29 1	23 01
1	4418	4418 00	25 7	19 61
1 5	4418 5	2945 67	24 62	18 53
2	4419	2209 50	23 74	17 65
2 5	4419 5	1767 80	22 96	16 87
3	4420	1473 33	22 35	16 26
4	4421	1105 25	21 35	15 26
4 5	4421 5	982 56	21	14 91
5	4422	884 40	20 55	14 46
5 5	4422 5	804 09	20 32	14 23
6	4423	737 17	20	13 91
6 5	4423 5	680 54	19 73	13 64
7	4424	632 00	19 51	13 42
7 5	4424 5	589 93	19 52	13 43
8	4425	553 13	19 04	12 95
8 5	4425 5	520 65	18 84	12 75
9	4426	491 78	18 65	12 56
9 5	4426 5	465 95	18 45	12 36
10	4427	442 70	18 3	12 21
11	4428	402 55	17 91	11 82
12	4429	369 08	17 65	11 56
13	4430	340 77	17 38	11 29
14	4431	316 50	17 14	11 05
15	4432	295 47	16 91	10 82
17	4434	260 82	16 48	10 39
19	4436	233 47	16 1	10 01
21	4438	211 33	15 76	9 67
23	4440	193 04	15 45	9 36
27	4444	164 59	15 16	9 07
30	4447	148 23	14 68	8 59
37	4454	120 38	13 69	7 6
38	4455	117 24	13 6	7 51
55	4472	81 31	13 55	7 46
74	4491	60 69	11 75	5 66
88	4505	51 19	11 25	5 16
112	4529	40 44	10 6	4 51
238	4655	19 56	8 65	2 56

BECHTEL - INDIANTOWN COGENERATION PROJECT
 WELL POW-2
 THEIS RECOVERY METHOD
 PUMP ON DATE 8/13/90 TIME 1015
 PUMP OFF DATE 8/16/90 TIME 1152
 PUMPING DURATION 4417 MINUTES
 STATIC DEPTH TO WATER 7 04 FEET

t (minutes)	t (minutes)	1/t'	s' (feet)
0 0333	4417 0333	132643 64	13 15
0 05	4417 05	88341 00	13 14
0 0666	4417 0666	66322 32	13 14
0 0833	4417 0833	53026 21	13 14
0 1	4417 1	44171 00	13 14
0 1166	4417 1166	37882 65	13 14
0 1333	4417 1333	33136 78	13 14
0 15	4417 15	29447 67	13 14
0 1666	4417 1666	26513 61	13 14
0 1833	4417 1833	24098 11	13 15
0 2	4417 2	22086 00	13 15
0 2166	4417 2166	20393 43	13 15
0 2333	4417 2333	18933 70	13 15
0 25	4417 25	17669 00	13 14
0 2666	4417 2666	16568 89	13 05
0 2833	4417 2833	15592 25	13 15
0 3	4417 3	14724 33	13 13
0 3166	4417 3166	13952 36	13 14
0 3333	4417 3333	13253 33	13 14
0 4167	4417 4167	10600 95	13 15
0 5	4417 5	8835 00	13 14
0 5833	4417 5833	7573 43	13 13
0 6667	4417 6667	6626 17	13 12
0 75	4417 75	5890 33	13 1
0 8333	4417 8333	5301 61	13 09
0 9167	4417 9167	4819 37	13 07
1	4418	4418 00	13 05
1 0833	4418 0833	4078 36	13 03
1 1667	4418 1667	3786 89	13 01
1 25	4418 25	3534 60	12 99
1 3333	4418 3333	3313 83	12 96
1 4166	4418 4166	3119 03	12 95
1 5	4418 5	2945 67	12 92
1 5833	4418 5833	2790 74	12 88
1 6667	4418 6667	2651 15	12 86
1 75	4418 75	2525 00	12 83
1 8333	4418 8333	2410 32	12 8
1 9167	4418 9167	2305 48	12 77

BECHTEL - INDIANTOWN COGENERATION PROJECT
 WELL POW-2
 THEIS RECOVERY METHOD
 PUMP ON DATE 8/13/90 TIME 1015
 PUMP OFF DATE 8/16/90 TIME 1152
 PUMPING DURATION 4417 MINUTES
 STATIC DEPTH TO WATER 7 04 FEET

t' (minutes)	t (minutes)	t/t'	s' (feet)
2	4419	2209 50	12 74
2 5	4419 5	1767 80	12 56
3	4420	1473 33	12 38
3 5	4420 5	1263 00	12 19
4	4421	1105 25	12 01
4 5	4421 5	982 56	11 84
5	4422	884 40	11 66
5 5	4422 5	804 09	11 51
6	4423	737 17	11 35
6 5	4423 5	680 54	11 2
7	4424	632 00	11 05
7 5	4424 5	589 93	10 91
8	4425	553 13	10 77
8 5	4425 5	520 65	10 64
9	4426	491 78	10 51
9 5	4426 5	465 95	10 39
10	4427	442 70	10 26
12	4429	369 08	9 8
14	4431	316 50	9 42
16	4433	277 06	9 05
18	4435	246 39	8 75
20	4437	221 85	8 46
22	4439	201 77	8 2
24	4441	185 04	7 96
26	4443	170 88	7 74
28	4445	158 75	7 53
30	4447	148 23	7 33
32	4449	139 03	7 15
34	4451	130 91	6 98
36	4453	123 69	6 83
38	4455	117 24	6 68
40	4457	111 43	6 54
42	4459	106 17	6 41
44	4461	101 39	6 28
46	4463	97 02	6 14
48	4465	93 02	6 05
50	4467	89 34	5 94
52	4469	85 94	5 84
54	4471	82 80	5 75

BECHTEL - INDIANTOWN COGENERATION PROJECT
 WELL POW-2
 THEIS RECOVERY METHOD
 PUMP ON DATE 8/13/90 TIME 1015
 PUMP OFF DATE 8/16/90 TIME 1152
 PUMPING DURATION 4417 MINUTES
 STATIC DEPTH TO WATER 7 04 FEET

t' (minutes)	t (minutes)	t/t'	s' (feet)
56	4473	79 88	5 65
58	4475	77 16	5 55
60	4477	74 62	5 47
62	4479	72 24	5 38
64	4481	70 02	5 3
66	4483	67 92	5 22
68	4485	65 96	5 15
70	4487	64 10	5 08
72	4489	62 35	5 01
74	4491	60 69	4 94
76	4493	59 12	4 88
78	4495	57 63	4 81
80	4497	56 21	4 75
82	4499	54 87	4 69
84	4501	53 58	4 63
86	4503	52 36	4 58
88	4505	51 19	4 53
90	4507	50 08	4 47
92	4509	49 01	4 42
94	4511	47 99	4 36
96	4513	47 01	4 32
98	4515	46 07	4 27
100	4517	45 17	4 22
110	4527	41 15	3 98
120	4537	37 81	3 79
130	4547	34 98	3 61
140	4557	32 55	3 44
150	4567	30 45	3 27
160	4577	28 61	3 13
170	4587	26 98	2 99
180	4597	25 54	2 86
190	4607	24 25	2 74
200	4617	23 09	2 62
210	4627	22 03	2 52
220	4637	21 08	2 4

BECHTEL - INDIANTOWN COGENERATION PROJECT
WELL. POW-1

THEIS RECOVERY METHOD

PUMP ON DATE 8/13/90 TIME 1015

PUMP OFF DATE 8/16/90 TIME 1152

PUMPING DURATION 4417 MINUTES

STATIC DEPTH TO WATER 62 FEET

t' (minutes)	t (minutes)	t/t'	s' (feet)
0 0333	4417 0333	132643 64	22 22
0 05	4417 05	88341 00	22 2
0 0666	4417 0666	66322 32	22 17
0 0833	4417 0833	53026 21	22 13
0 1	4417 1	44171 00	22 08
0 1166	4417 1166	37882 65	22 03
0 1333	4417 1333	33136 78	21 96
0 15	4417 15	29447 67	21 9
0 1666	4417 1666	26513 61	21 83
0 1833	4417 1833	24098 11	21 75
0 2	4417 2	22086 00	21 68
0 2166	4417 2166	20393 43	21 59
0 2333	4417 2333	18933 70	21 51
0 25	4417 25	17669 00	21 44
0 2666	4417 2666	16568 89	21 33
0 2833	4417 2833	15592 25	21 26
0 3	4417 3	14724 33	21 18
0 3166	4417 3166	13952 36	21 09
0 3333	4417 3333	13253 33	21 04
0 4167	4417 4167	10600 95	20 64
0 5	4417 5	8835 00	20 25
0 5833	4417 5833	7573 43	19 91
0 6667	4417 6667	6626 17	19 59
0 75	4417 75	5890 33	19 3
0 8333	4417 8333	5301 61	19 04
0 9167	4417 9167	4819 37	18 77
1	4418	4418 00	18 54
1 0833	4418 0833	4078 36	18 34
1 1667	4418 1667	3786 89	18 13
1 25	4418 25	3534 60	17 94
1 3333	4418 3333	3313 83	17 76
1 4166	4418 4166	3119 03	17 58
1 5	4418 5	2945 67	17 41

BECHTEL - INDIANTOWN COGENERATION PROJECT
 WELL POW-1
 THEIS RECOVERY METHOD
 PUMP ON DATE 8/13/90 TIME 1015
 PUMP OFF DATE 8/16/90 TIME 1152
 PUMPING DURATION 4417 MINUTES
 STATIC DEPTH TO WATER 62 FEET

t' (minutes)	t (minutes)	u/t'	s' (feet)
1 5833	4418 5833	2790 74	17 29
1 6667	4418 6667	2651 15	17 12
1 75	4418 75	2525 00	16 99
1 8333	4418 8333	2410 32	16 86
1 9167	4418 9167	2305 48	16 72
2	4419	2209 50	16 59
2 5	4419 5	1767 80	15 98
3	4420	1473 33	15 4
3 5	4420 5	1263 00	14 94
4	4421	1105 25	14 53
4 5	4421 5	982 56	14 17
5	4422	884 40	13 85
5 5	4422 5	804 09	13 52
6	4423	737 17	13 25
6 5	4423 5	680 54	13 01
7	4424	632 00	12 76
7 5	4424 5	589 93	12 54
8	4425	553 13	12 33
8 5	4425 5	520 65	12 11
9	4426	491 78	11 96
9 5	4426 5	465 95	11 78
10	4427	442 70	11 61
12	4429	369 08	11 02
14	4431	316 50	10 51
16	4433	277 06	10 06
18	4435	246 39	9 64
20	4437	221 85	9 34
22	4439	201 77	9 04
24	4441	185 04	8 71
26	4443	170 88	8 52
28	4445	158 75	8 28
30	4447	148 23	7 97
32	4449	139 03	7 76
34	4451	130 91	7 56

BECHTEL - INDIANTOWN COGENERATION PROJECT
 WELL POW-1
 THEIS RECOVERY METHOD
 PUMP ON DATE 8/13/90 TIME 1015
 PUMP OFF DATE 8/16/90 TIME 1152
 PUMPING DURATION 4417 MINUTES
 STATIC DEPTH TO WATER 62 FEET

t' (minutes)	t (minutes)	t/t'	s' (feet)
36	4453	123 69	7 4
38	4455	117 24	7 24
40	4457	111 43	7 08
42	4459	106 17	6 93
44	4461	101 39	6 79
46	4463	97 02	6 66
48	4465	93 02	6 53
50	4467	89 34	6 41
52	4469	85 94	6 34
54	4471	82 80	6 21
56	4473	79 88	6 07
58	4475	77 16	5 96
60	4477	74 62	5 86
62	4479	72 24	5 77
64	4481	70 02	5 68
66	4483	67 92	5 6
68	4485	65 96	5 52
70	4487	64 10	5 44
72	4489	62 35	5 36
74	4491	60 69	5 29
76	4493	59 12	5 21
78	4495	57 63	5 14
80	4497	56 21	5 07
82	4499	54 87	5 01
84	4501	53 58	4 95
86	4503	52 36	4 88
88	4505	51 19	4 85
90	4507	50 08	4 76
92	4509	49 01	4 71
94	4511	47 99	4 65
96	4513	47 01	4 59
98	4515	46 07	4 5
100	4517	45 17	4 49
110	4527	41 15	4 21

BECHTEL - INDIANTOWN COGENERATION PROJECT
 WELL POW-1
 THEIS RECOVERY METHOD
 PUMP ON DATE 8/13/90 TIME 1015
 PUMP OFF DATE 8/16/90 TIME 1152
 PUMPING DURATION 4417 MINUTES
 STATIC DEPTH TO WATER 62 FEET

t' (minutes)	t (minutes)	t/t'	s' (feet)
120	4537	37 81	4 01
130	4547	34 98	3 82
140	4557	32 55	3 64
150	4567	30 45	3 43
160	4577	28 61	3 27
170	4587	26 98	3 12
180	4597	25 54	2 98
190	4607	24 25	2 82
200	4617	23 09	2 7
210	4627	22 03	2 57
220	4637	21 08	2 45
230	4647	20 20	2 32
240	4657	19 40	2 2
250	4667	18 67	2 1
260	4677	17 99	2
270	4687	17 36	1 91
280	4697	16 78	1 82
290	4707	16 23	1 74
300	4717	15 72	1 67
310	4727	15 25	1 59
320	4737	14 80	1 52
330	4747	14 38	1 45
340	4757	13 99	1 39
350	4767	13 62	1 33
360	4777	13 27	1 26
370	4787	12 94	1 19
380	4797	12 62	1 14
390	4807	12 33	1 08
400	4817	12 04	1 02
410	4827	11 77	0 98
420	4837	11 52	0 92
430	4847	11 27	0 87
440	4857	11 04	0 82
450	4867	10 82	0 78

BECHTEL - INDIANTOWN COGENERATION PROJECT
 WELL POW-1
 THEIS RECOVERY METHOD
 PUMP ON DATE 8/13/90 TIME 1015
 PUMP OFF DATE 8/16/90 TIME 1152
 PUMPING DURATION 4417 MINUTES
 STATIC DEPTH TO WATER 62 FEET

t' (minutes)	t (minutes)	t/t'	s' (feet)
460	4877	10 60	0 73
470	4887	10 40	0 68
480	4897	10 20	0 65
490	4907	10 01	0 6
500	4917	9 83	0 56
510	4927	9 66	0 51
520	4937	9 49	0 48
530	4947	9 33	0 44
540	4957	9 18	0 4
550	4967	9 03	0 36
560	4977	8 89	0 33
570	4987	8 75	0 3
580	4997	8 62	0 27
590	5007	8 49	0 23
600	5017	8 36	0 19
610	5027	8 24	0 16
620	5037	8 12	0 14
630	5047	8 01	0 11
640	5057	7 90	0 08
650	5067	7 80	0 05
660	5077	7 69	0 01



PUMPING TEST REPORT

PROJECT NO. SEF 30619 A0

WELL PW-1 (PUMPING)/OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO PW-1 RADIUS 4"PUMPING RATES ~150 gpmHOW Q MEASURED Manometer w th 4"x3" or fce plateHOW WL MEASURED M SCOPEDISTANCE FROM PUMPED WELL -MP FOR WL: TOC EL -PUMP ON DATE 8/13/90 TIME 1015amPUMP OFF DATE 8/16/90 TIME 1152amCOMMENTS -

TIME SINCE PUMPING START/ STOPPED (MINUTES)	t/t	WATER LEVEL		Residual DEPTH TO WATER (ft)	DRAW DOWN (ft)	ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS					
		REFERENCE	MEASURE				
0				52.0			shut down Pump @ 1152
0.5				29.1			
1				25.7			
1.5				24.62			
2				23.74			
2.5				22.86			
3				22.35			
4				21.35			
4.5				21.00			
5				20.55			
5.5				20.32			
6				20.00			
6.5				19.73			
7				19.51			
7.5				19.52			
8				19.04			
8.5				18.84			
9				18.65			
9.5				18.45			
10				18.30			
11				17.71			
12				17.65			
13				17.38			



PUMPING TEST REPORT

PAGE 1 OF 2PROJECT NO. SEP30619 A0WELL Pow-1 PUMPING/OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO PW-1 RADIUS 4"PUMPING RATES ~150 gpmHOW Q MEASURED Manometer with 4"x3" orifice plateHOW WL MEASURED Steel tapeDISTANCE FROM PUMPED WELL 50'MP FOR WL: TOC EL PUMP ON DATE TIME PUMP OFF DATE 8-16-90 TIME COMMENTS JML

TIME SINCE PUMPING START/ STOPPED MINUTES	1/4	WATER LEVEL				ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS		DEPTH TO WATER (ft)	DRAW DOWN (ft)		
		REFERENCE	MEASURE				
11 43		30	130	2870			PUMPING @ 150 GPM
11 45		30	137	2863			
11 46		30	130	2870			
11 47		30	124	2876			
11 48		30	120	2880			
0			-	-			STOP PUMP, TIME = 0
.15			234	2766			
1			494	2506			
1.5			607	2393			
2			697	2303			
25		✓	759	2241			
3		25	327	2173			
4		25	393	2107			
5		25	461	2039			
6		25	525	1975			
7		25	572	1928			
8		20	116	1884			
9		20	155	1845			
10		20	190	1810			
11		20	226	1774			
12		20	251	1749			
13		20	272	1728			
14		20	300	1700			



PUMPING TEST REPORT

PAGE 2 OF 2PROJECT NO SEF30619 A0WELL Paw-1 PUMPING OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO Pw-1 RADIUS 4'M.P. FOR WL: TOC EL PUMPING RATES ~150 gpmPUMP ON DATE 8/13/90 TIME 1015HOW Q MEASURED Manometer with 4"x3" orifice platePUMP OFF DATE 8-16-90 TIME 1152HOW WL MEASURED Wetted TapeCOMMENTS NALDISTANCE FROM PUMPED WELL 50 feet

TIME SINCE PUMPING START/ STOPPED (MINUTES)	t/t	WATER LEVEL				ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS		DEPTH TO WATER (ft)	DRAW DOWN (ft)		
		REFERENCE	MEASURE				
15		20	3 24	16 76			
16		20	3 45	16 55			
17		20	3 66	16 34			
18		18	1 86	16 14			
19		18	2 05	15 95			
20		18	2 20	15 80			
22		18	2 50	15 50			
24		18	2 78	15 22			
26		18	3.05	14 95			
28		18	3 28	14 72			
30		18	3 51	14 49			
32		16	1 70	14 30			
34		16	1.92	14 08			
35		16	2 01	13 99			
40		16	2 46	13 54			
45		15	1.84	13 16			
55		15	2 40	12 60			
75		15	3 32	11 68			
90		12	0 80	11 20			
115		12	1 42	10 58			
240		-	-	8 65			IN SCOPE
285		-	-	8 25			
327		-	-	7 85			



PUMPING TEST REPORT

PAGE 1 OF 2

PROJECT NO SEFJD619 A6

WELL POW-2 PUMPING/OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO PW-1 RADIUS 4"MP FOR WL: TOC EL PUMPING RATES ~150 gpmPUMP ON DATE 8/13/90 TIME 10:50 amHOW Q MEASURED Manometer with 4" x 3 orifice platePUMP OFF DATE 8/16/90 TIME 11:52 amHOW WL MEASURED Wetted TapeCOMMENTS DISTANCE FROM PUMPED WELL 200 Ft

TIME SINCE PUMPING START/ STOPPED (MINUTES)	1/4"	WATER LEVEL			ADJUSTED DRAW DOWN (ft)		REMARKS
		READINGS		DEPTH TO WATER (ft)			
		REFERENCE	MEASURE				
0		40	20.17	19.83			Static
05		40	19.82	20.18			
135		40	20.00	20.00			
2		40	20.30	19.70			
3		40	20.65	19.35			
4		40	21.20	19.00			
5		40	21.35	18.65			
6		40	21.67	18.33			
7		40	21.90	17.90			
8		40	22.25	17.75			
9		40	22.51	17.49			
10		40	22.73	17.27			
11		40	22.85	17.15			
12		40	23.17	16.83			
13		40	23.30	16.64			
14		40	23.64	16.36			
15		40	23.78	16.22			
17		40	24.06	15.94			
19		40	24.37	15.63			
21		40	24.84	15.16			
23		40	24.88	15.12			
25		40	25.12	14.88			
27		40	25.33	14.67			

POW-1 RECOVERY
SE1000B
Environmental Logger
08/20 11.16

Unit# 00490 Test# 1

INPUT 1: Level (F)

Reference 0.00
Scale factor 29 92
Offset 0 00

Step# 1 08/16 11 45

Elapsed Time	Value
0 0000	- 22.23
0.0033	- 22.23
0.0066	- 22.23
0 0099	- 22.23
0 0133	- 22.23
0.0166	- 22.23
0.0200	- 22.22
0.0233	- 22.22
0.0266	- 22.22
0.0300	- 22.22
0.0333	- 22.22
0.0500	- 22.20
0.0666	- 22.17
0.0833	- 22.13
0.1000	- 22.08
0 1166	- 22 03
0 1333	- 21 96
0 1500	- 21 90
0 1666	- 21 83
0 1833	- 21 75
0 2000	- 21.68
0.2166	- 21.59
0 2333	- 21.51
0 2500	- 21.44
0 2666	- 21.33
0 2833	- 21 26
0 3000	- 21 18
0.3166	- 21 09
0.3333	- 21.04
0.4167	- 20.64
0.5000	- 20.25
0 5833	- 19.91
0.6667	- 19.59
0 7500	- 19 30
0.8333	- 19 04
0.9167	- 18 77
1.0000	- 18.54

1 0833	- 18 34
1 1667	- 18 13
1 2500	- 17 94
1 3333	- 17.76
1 4166	- 17.58
1.5000	- 17 41
1.5833	- 17 29
1.6667	- 17 12
1.7500	- 16 99
1.8333	- 16.86
1 9167	- 16.72
2 0000	- 16 59
2 5000	- 15 98
3.0000	- 15 40
3.5000	- 14.94
4 0000	- 14.53
4 5000	- 14 17
5 0000	- 13 85
5 5000	- 13 52
6 0000	- 13 25
6 5000	- 13 01
7 0000	- 12 76
7.5000	- 12 54
8 0000	- 12 33
8 5000	- 12.11
9 0000	- 11.96
9 5000	- 11.78
10 0000	- 11.61
12 0000	- 11.02
14.0000	- 10.51
16 0000	- 10.06
18.0000	- 9.64
20.0000	- 9.34
22 0000	- 9 04
24 0000	- 8.71
26 0000	- 8.52
28 0000	- 8.28
30 0000	- 7.97
32 0000	- 7 76
34 0000	- 7 56
36.0000	- 7 40
38.0000	- 7 24
40.0000	- 7 08
42.0000	- 6.93
44 0000	- 6.79
46.0000	- 6.66
48.0000	- 6.53
50.0000	- 6.41
52 0000	- 6 34
54.0000	- 6.21
56.0000	- 6.07
58.0000	- 5 96
60 0000	- 5 86
62 0000	- 5.77

64 0000	-	5.68
66 0000	-	5.60
68 0000	-	5 52
70.0000	-	5.44
72.0000	-	5.36
74.0000	-	5.29
76.0000	-	5 21
78.0000	-	5 14
80.0000	-	5 07
82.0000	-	5 01
84.0000	-	4 95
86.0000	-	4 88
88 0000	-	4 85
90.0000	-	4 76
92 0000	-	4 71
94 0000	-	4.65
96 0000	-	4.59
98.0000	-	4.50
100.000	-	4.49
110.000	-	4.21
120 000	-	4.01
130.000	-	3.82
140.000	-	3 64
150.000	-	3 43
160 000	-	3.27
170.000	-	3 12
180 000	-	2.98
190 000	-	2.82
200 000	-	2 70
210 000	-	2 57
220 000	-	2.45
230 000	-	2 32
240.000	-	2 20
250.000	-	2 10
260.000	-	2.00
270 000	-	1.91
280 000	-	1.82
290.000	-	1.74
300.000	-	1.67
310.000	-	1.59
320.000	-	1.52
330.000	-	1.45
340.000	-	1.39
350.000	-	1.33
360.000	-	1.26
370 000	-	1.19
380.000	-	1.14
390 000	-	1 08
400 000	-	1.02
410 000	-	0.98
420 000	-	0 92
430 000	-	0 87
440 000	-	0 82
450 000	-	0 78

460 000	- 0 73
470 000	- 0.68
480 000	- 0 65
490.000	- 0 60
500.000	- 0.56
510.000	- 0 51
520.000	- 0 48
530.000	- 0 44
540 000	- 0 40
550.000	- 0 36
560.000	- 0 33
570.000	- 0 30
580.000	- 0 27
590.000	- 0 23
600 000	- 0 19
610.000	- 0 16
620 000	- 0 14
630 000	- 0.11
640 000	- 0 08
650.000	- 0 05
660 000	- 0 01
670 000	0 00
680 000	0 02
690 000	0 05
700.000	0 08
710 000	0.11
720 000	0.14
730.000	0 16
740 000	0.18
750 000	0 20
760 000	0 23
770 000	0 25
780 000	0.28
790 000	0 30
800 000	0 32
810 000	0 33
820 000	0.36
830 000	0.38
840 000	0 40
850 000	0 42
860 000	0 44
870 000	0 46
880 000	0 48
890 000	0.50
900 000	0.51
910 000	0.53
920.000	0.55
930 000	0 57
940 000	0 58
950 000	0 60
960 000	0.62
970 000	0.63
980.000	0 65
990.000	0 66

POW-2 RECOVERY
SE1000B
Environmental Logger
08/20 11:20

Unit# 00490 Test# 1

INPUT 2 Level (F)

Reference 0.00
Scale factor 10 01
Offset 0.01

Step# 1 08/16 11:45

Elapsed Time	Value
0 0000	- 13 14
0.0033	- 13.14
0 0066	- 13 14
0 0099	- 13 14
0.0133	- 13.14
0.0166	- 13 15
0 0200	- 13 15
0.0233	- 13.15
0 0266	- 13 15
0 0300	- 13 15
0 0333	- 13.15
0 0500	- 13 14
0 0666	- 13 14
0.0833	- 13 14
0 1000	- 13.14
0.1166	- 13.14
0.1333	- 13 14
0 1500	- 13.14
0 1666	- 13.14
0 1833	- 13 15
0.2000	- 13 15
0 2166	- 13.15
0 2333	- 13.15
0.2500	- 13.14
0 2666	- 13 05
0 2833	- 13 15
0 3000	- 13 13
0 3166	- 13.14
0.3333	- 13.14
0.4167	- 13 15
0 5000	- 13 14
0 5833	- 13.13
0.6667	- 13.12
0 7500	- 13 10
0 8333	- 13 09
0.9167	- 13.07
1 0000	- 13.05

1.0833	- 13.03
1.1667	- 13.01
1 2500	- 12.99
1 3333	- 12.96
1.4166	- 12.95
1.5000	- 12.92
1.5833	- 12.88
1.6667	- 12.86
1.7500	- 12.83
1 8333	- 12.80
1 9167	- 12.77
2.0000	- 12.74
2.5000	- 12.56
3.0000	- 12.38
3.5000	- 12.19
4 0000	- 12.01
4 5000	- 11.84
5.0000	- 11.66
5.5000	- 11.51
6.0000	- 11.35
6 5000	- 11.20
7 0000	- 11.05
7.5000	- 10.91
8 0000	- 10.77
8 5000	- 10.64
9 0000	- 10.51
9 5000	- 10.39
10 0000	- 10.26
12 0000	- 9.80
14 0000	- 9.42
16.0000	- 9.05
18.0000	- 8.75
20.0000	- 8.46
22.0000	- 8.20
24.0000	- 7.96
26.0000	- 7.74
28.0000	- 7.53
30 0000	- 7.33
32.0000	- 7.15
34 0000	- 6.98
36 0000	- 6.83
38.0000	- 6.68
40.0000	- 6.54
42.0000	- 6.41
44.0000	- 6.28
46.0000	- 6.14
48.0000	- 6.05
50.0000	- 5.94
52.0000	- 5.84
54.0000	- 5.75
56.0000	- 5.65
58 0000	- 5.55
60.0000	- 5.47
62.0000	- 5.38

64 0000	-	5.30
66 0000	-	5 22
68.0000	-	5 15
70.0000	-	5 08
72.0000	-	5.01
74 0000	-	4.94
76.0000	-	4.88
78.0000	-	4.81
80 0000	-	4 75
82.0000	-	4.69
84.0000	-	4.63
86.0000	-	4.58
88.0000	-	4.53
90 0000	-	4.47
92.0000	-	4.42
94.0000	-	4.36
96 0000	-	4.32
98 0000	-	4.27
100.000	-	4.22
110.000	-	3.98
120 000	-	3 79
130.000	-	3 61
140 000	-	3.44
150.000	-	3.27
160.000	-	3.13
170 000	-	2 99
180 000	-	2.86
190.000	-	2.74
200.000	-	2.62
210.000	-	2.52
220.000	-	2.40
230 000	-	7 86
240 000	-	7.87
250 000	-	7 91
260 000	-	7 87
270.000	-	7 91
280.000	-	7.91
290.000	-	7 90
300 000	-	7.89
310.000	-	7.91
320 000	-	7.90
330 000	-	7.90
340.000	-	7.90
350 000	-	7 89
360 000	-	7.91
370.000	-	7.90
380.000	-	7.92
390 000	-	7 90
400.000	-	7 90
410.000	-	7 91
420 000	-	7 92
430.000	-	7.91
440.000	-	7.93
450.000	-	7.91

PUMPING TEST REPORT

PAGE 1 OF 1
PROJECT NO SEF30619.A8

WELL MW-5 PUMPING OBSERVATION WELL

TYPE OF DATA DRAWDOWN/RECOVERY

PUMPED WELL NO PW-1 RADIUS 4"

PUMPING RATES ~ 150 gpm

HOW Q MEASURED Manometer with 4" x 3" orifice plate

HOW WL IS MEASURED Wetted Tape

DISTANCE FROM PUMPED WELL 200 Ft

MP FOR WL: TOC EL

PUMP ON DATE 8/13/90 TIME 1015am

PUMP OFF DATE 8/14/90 TIME 1152 am

COMMENTS _____

[illegible]



PUMPING TEST REPORT

PAGE 1 OF 3

PROJECT NO SEF30619.A8

WELL PW-1 PUMPING OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO PW-1 RADIUS 4"MP FOR WL: TOC EL PUMPING RATES 2 = 150 gpmPUMP ON DATE 8/13/90 TIME 1015amHOW Q MEASURED Manometer with 4" X 3" orifice platePUMP OFF DATE 8/16/90 TIME 1152amHOW WL MEASURED M-Scope, Wetted TapeCOMMENTS DISTANCE FROM PUMPED WELL

TIME SINCE PUMPING START STOPPED (MINUTES)	W	WATER LEVEL				ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS		DEPTH TO WATER (ft)	DRAW DOWN (ft)		
		REFERENCE	MEASURE				
0				62.09	0		static
1				31.2	25.11		
1 50g				33.5	27.41		16" manometer
2 135.				34.8	28.71		
2 45				35.9	29.81		
3 10xrc				36.9	30.81		
4 105rc				37.62	31.53		
5 ~ ~				38.05	31.96		
6				38.75	32.66		14.5" manometer
7				39.35	33.16		
8				39.83	33.74		
9				40.40	34.31		
10				40.91	34.82		
12				41.25	35.16		
17				42.25	36.16		14.5" manometer
18				42.50	36.41		
20				42.80	36.71		
32				44.20	38.11		14.5" manometer
36				44.60	38.51		
40				44.65	38.56		
60				46.21	40.12		
70				46.58	40.49		
104				47.69	41.60		



PUMPING TEST REPORT

PAGE 2 OF 3PROJECT NO SEF30619 A0WELL PW-1 PUMPING/OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO PW-1 RADIUS 4"M.P. FOR WL: TOC EL PUMPING RATES ~150 gpmPUMP ON DATE 8/13/90 TIME 10:15 amHOW Q MEASURED Manometer with 4'x3" orifice plate PUMP OFF DATE 8/16/90 TIME 11:52 amHOW WL MEASURED M-Scope, Wetted Tape COMMENTS DISTANCE FROM PUMPED WELL

TIME SINCE PUMPING START/ STOPPED (MINUTES)	W	WATER LEVEL				ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS		DEPTH TO WATER (ft)	DRAW DOWN (ft)		
		REFERENCE	MEASURE				
113				47.85	41.76		
160				49.03	42.94		
202				49.3	43.21		
232				49.7	43.61		
262				49.83	43.74		
322				50.2	44.11		
382				50.60	44.51		
442				50.53	44.44		
539				50.47	44.37		
8 45 pm 630				51.15	45.06		
9 49 pm 694				51.17	45.08		Manometer = 14"
1 43 pm 808				52.03	45.94		
4 00 AM 885				51.98	45.89		MANOMETER = 14.5"
5 00 AM 945				52.00	45.91		
6 00 AM 1005				51.68	45.59		manometer 14.5'
7 00 AM 1065				51.74	45.65		
8 00 AM 1125				51.73	45.64		manometer 14.0"
9 00 AM 1185				52.00	45.91		manometer 14.5"
10 00 AM 1245				52.03	45.94		
11 00 AM 1305				51.79	45.70		manometer 14.0"
12 36 PM 1401		70.00	180.2	51.98	45.89		14'0"
1 10 PM 1470		70.00	184.0	51.60	45.51		14'0"
12 57 PM 1602				51.75	45.66		14'0"



PUMPING TEST REPORT

PAGE 3 OF 3

PROJECT NO SEF30619 A0

WELL PW-1 PUMPING/OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO PW-1 RADIUS 4"M.P. FOR WL: TOC EL PUMPING RATES ~ 150 gpmPUMP ON DATE 8/13/90 TIME 1015 amHOW Q MEASURED Manometer with 4' x 3" or fire platePUMP OFF DATE 8/16/90 TIME 1152 amHOW WL MEASURED M-Scope, Wetted TapeCOMMENTS DISTANCE FROM PUMPED WELL

TIME SINCE PUMPING START/ STOPPED (MINUTES)	WT	WATER LEVEL				ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS		DEPTH TO WATER (ft)	DRAW DOWN (ft)		
		REFERENCE	MEASURE				
2 00pm	1665			51.78	45.69		Getting Ready to Rain very little
3 00pm	1725			51.70	45.66		
3 59pm	1784			51.76	45.67		14"
4 59pm	1844			51.62	45.53		
7 22pm	1987			51.50	45.41		13 inches (DSI adjust)
9:39pm	2124			53.06	46.97		14.5"
11:30pm	2235			53.17	47.08	F	
7 00am	2685			53.58	47.49		15 1/4" Rate up
7 58am	2863			53.21	47.12		15"
12:57pm	3042			53.13	47.04		15'
14 36pm	3141			-			Hard rain 1436 - 1458
555	3220			53.17	47.08		15"
1901	3406			52.92	46.83		15"
2203	3588			52.79	46.70		
11/10 0100am	-			-			No reading
0408	3953			53.14	47.05		15"
0654	4119			53.20	47.11		15"
0952am	4297			51.64	45.55		14" (On-line changed)
	4407			51.80			
	4409			51.90			
	4410			51.99			
	4411			52.00			

POW-1 DRAWDOWN
SE1000B
Environmental Logger
08/20 10.50

Unit# 00490 Test# 1

INPUT 1 Level (F)

Reference 0.00
Scale factor 29.92
Offset 0.00

Step# 0 08/13 10.07

Elapsed Time	Value
0 0000	- 0.00
0 0033	- 0.00
0 0066	- 0.01
0.0099	- 0.02
0 0133	- 0.03
0 0166	- 0.03
0 0200	- 0.04
0 0233	- 0.06
0.0266	- 0.07
0 0300	- 0.09
0 0333	- 0.10
0 0500	- 0.16
0.0666	- 0.22
0 0833	- 0.29
0 1000	- 0.35
0 1166	- 0.43
0 1333	- 0.50
0 1500	- 0.59
0 1666	- 0.68
0 1833	- 0.78
0 2000	- 0.87
0 2166	- 0.97
0 2333	- 1.06
0 2500	- 1.15
0 2666	- 1.24
0 2833	- 1.33
0 3000	- 1.42
0 3166	- 1.50
0.3333	- 1.60
0 4167	- 2.00
0 5000	- 2.37
0 5833	- 2.69
0 6667	- 3.03
0 7500	- 3.33
0 8333	- 3.57
0 9167	- 3.83
1 0000	- 4.04

1.0833	- 4 26
1 1667	- 4 48
1.2500	- 4.66
1 3333	- 4 83
1.4166	- 5 01
1 5000	- 5.17
1 5833	- 5 31
1 6667	- 5 47
1.7500	- 5 62
1.8333	- 5 76
1 9167	- 5.88
2.0000	- 6.02
2.5000	- 6.68
3 0000	- 7.24
3.5000	- 7 72
4 0000	- 8 10
4.5000	- 8 44
5 0000	- 8.76
5 5000	- 9 05
6 0000	- 9.35
6 5000	- 9 60
7 0000	- 9 85
7 5000	- 10 07
8 0000	- 10 28
8 5000	- 10 49
9 0000	- 10.68
9 5000	- 10.85
10 0000	- 11 02
12.0000	- 11.62
14.0000	- 12.11
16 0000	- 12.54
18.0000	- 12.91
20 0000	- 13.21
22 0000	- 13 53
24 0000	- 13.78
26.0000	- 14 04
28 0000	- 14 28
30.0000	- 14 47
32.0000	- 14 68
34 0000	- 14 85
36.0000	- 15 04
38.0000	- 15.20
40 0000	- 15.32
42.0000	- 15 48
44 0000	- 15 62
46 0000	- 15.75
48 0000	- 15 87
50 0000	- 16 00
52 0000	- 16.15
54 0000	- 16.30
56 0000	- 16.42
58.0000	- 16.52
60 0000	- 16.61
62.0000	- 16 70

64 0000	- 16.81
66 0000	- 16 92
68 0000	- 16 96
70.0000	- 17.04
72 0000	- 17.09
74 0000	- 17.18
76 0000	- 17 27
78 0000	- 17 32
80 0000	- 17 38
82 0000	- 17.45
84 0000	- 17 50
86 0000	- 17.57
88.0000	- 17 63
90 0000	- 17 72
92 0000	- 17.78
94 0000	- 17.84
96 0000	- 17 88
98.0000	- 17.94
100 000	- 17 99
110 000	- 18 24
120.000	- 18 46
130 000	- 18 65
140.000	- 18 85
150.000	- 18.93
160 000	- 19 16
170 000	- 19.32
180.000	- 19.50
190 000	- 19 61
200.000	- 19 72
210 000	- 19.84
220 000	- 19 90
230.000	- 20.02
240 000	- 20 15
250 000	- 20 21
260 000	- 20 26
270 000	- 20 38
280 000	- 20.42
290 000	- 20.47
300 000	- 20.57
310 000	- 20 66
320.000	- 20.74
330 000	- 20.79
340 000	- 20 83
350.000	- 20.87
360.000	- 20.92
370 000	- 21 01
380.000	- 21.05
390 000	- 21.11
400 000	- 21.17
410.000	- 21.21
420 000	- 21 21
430.000	- 21 20
440 000	- 21 24
450.000	- 21 20

460 000	- 21.27
470.000	- 21 28
480.000	- 21 26
490 000	- 21.35
500 000	- 21.37
510 000	- 21 39
520.000	- 21.41
530 000	- 21 42
540 000	- 21.43
550.000	- 21.43
560 000	- 21 46
570 000	- 21.51
580.000	- 21 60
590 000	- 21.59
600 000	- 21.60
610.000	- 21 69
620 000	- 21 80
630.000	- 21.81
640 000	- 21 84
650 000	- 21.81
660 000	- 21 80
670.000	- 21.78
680 000	- 21.85
690 000	- 21 90
700 000	- 21.93
710.000	- 21.94
720 000	- 21 92
730 000	- 21 86
740.000	- 22.08
750 000	- 22.21
760.000	- 22.26
770.000	- 22.29
780 000	- 22.30
790 000	- 22 33
800 000	- 22 31
810.000	- 22.35
820 000	- 22 37
830 000	- 22.36
840 000	- 22 36
850.000	- 22 37
860 000	- 22 39
870 000	- 22.37
880 000	- 22.38
890.000	- 22 38
900 000	- 22 36
910 000	- 22 38
920 000	- 22.42
930.000	- 22.42
940.000	- 22.42
950 000	- 22 42
960 000	- 22.38
970.000	- 22.38
980 000	- 22.35
990 000	- 22 37

1000.00	- 22 32
1100.00	- 22.38
1200 00	- 22.44
1300 00	- 22.38
1400.00	- 22.33
1500.00	- 22.32
1600 00	- 22.39
1700.00	- 22.37
1800 00	- 22.34
1900.00	- 22.22
2000 00	- 22 18
2100 00	- 22 75
2200 00	- 22.88
2300 00	- 22.93
2400 00	- 23 00
2500 00	- 22.95
2600 00	- 22 86
2700 00	- 22.97
2800.00	- 23 04
2900 00	- 22.87
3000.00	- 22 82
3100 00	- 22 87
3200.00	- 22 96
3300 00	- 22 94
3400.00	- 22.87
3500.00	- 22.67
3600 00	- 22.81
3700.00	- 22.80
3800.00	- 22.73
3900.00	- 22.73
4000 00	- 22.74
4100 00	- 22 82
4200 00	- 22.22
4300 00	- 22 18
4400 00	- 22 17

END

POW-2 DRAWDOWN
SE1000B
Environmental Logger
08/20 10:59

Unit# 00490 Test# 1

INPUT 2. Level (F)

Reference 0 00
Scale factor 10.01
Offset 0 01

Step# 0 08/13 10:07

Elapsed Time	Value
0 0000	0 00
0 0033	0 00
0.0066	0.00
0 0099	0 00
0 0133	0 00
0.0166	0 00
0 0200	0 00
0 0233	0 00
0.0266	0 00
0.0300	0.00
0 0333	0.00
0 0500	0 00
0 0666	0.00
0.0833	0.00
0 1000	0 00
0 1166	0.00
0 1333	0 00
0 1500	0 00
0.1666	0 00
0 1833	0 00
0 2000	0 00
0 2166	0.00
0 2333	0.00
0.2500	0.00
0 2666	0 00
0 2833	0 00
0 3000	0 00
0 3166	0 00
0 3333	0.00
0.4167	0.00
0 5000	- 0 00
0 5833	- 0 01
0 6667	- 0 02
0.7500	- 0 03
0.8333	- 0 05
0 9167	- 0 06
1 0000	- 0.09

1 0833	-	0.11
1 1667	-	0 13
1 2500	-	0 16
1 3333	-	0.18
1.4166	-	0.21
1.5000	-	0 24
1.5833	-	0 27
1 6667	-	0 30
1 7500	-	0 33
1 8333	-	0.36
1 9167	-	0 39
2.0000	-	0 42
2 5000	-	0 61
3.0000	-	0.80
3 5000	-	0 99
4 0000	-	1.18
4 5000	-	1.36
5.0000	-	1 53
5.5000	-	1 70
6 0000	-	1 86
6.5000	-	2 02
7 0000	-	2.17
7.5000	-	2.32
8 0000	-	2 46
8.5000	-	2 60
9 0000	-	2 73
9 5000	-	2.87
10 0000	-	2.99
12 0000	-	3 47
14 0000	-	3 88
16 0000	-	4.25
18.0000	-	4 58
20.0000	-	4 89
22.0000	-	5 17
24 0000	-	5 42
26 0000	-	5 65
28.0000	-	5 87
30 0000	-	6.07
32.0000	-	6.25
34 0000	-	6.42
36.0000	-	6.58
38 0000	-	6 74
40 0000	-	6 88
42.0000	-	7 01
44 0000	-	7 14
46 0000	-	7 25
48 0000	-	7 38
50 0000	-	7 49
52 0000	-	7 60
54 0000	-	7.70
56.0000	-	7 81
58.0000	-	7 91
60.0000	-	8 00
62.0000	-	8 09

64 0000	- 8 18
66.0000	- 8 25
68.0000	- 8 33
70.0000	- 8 41
72.0000	- 8 47
74.0000	- 8 55
76.0000	- 8 63
78 0000	- 8.68
80 0000	- 8.75
82.0000	- 8 81
84.0000	- 8.86
86.0000	- 8.92
88.0000	- 8.97
90.0000	- 9.03
92.0000	- 9.09
94 0000	- 9.14
96.0000	- 9.20
98.0000	- 9.24
100 000	- 9 29
110 000	- 9 52
120.000	- 9 72
130 000	- 9 91
140 000	- 10 08
150 000	- 10 22
160 000	- 10.38
170 000	- 10.50
180.000	- 10.67
190.000	- 10.80
200.000	- 10.91
210 000	- 11.01
220.000	- 11.09
230 000	- 11.19
240 000	- 11.29
250 000	- 11.37
260 000	- 11.43
270 000	- 11.51
280 000	- 11 58
290 000	- 11 63
300 000	- 11 71
310 000	- 11 78
320.000	- 11 85
330 000	- 11 91
340 000	- 11.96
350 000	- 12.00
360 000	- 12.05
370 000	- 12.11
380 000	- 12 16
390.000	- 12 20
400 000	- 12.26
410 000	- 12 31
420 000	- 12 34
430 000	- 12.36
440 000	- 12 39
450.000	- 12 40

460 000	- 12.43
470 000	- 12.46
480 000	- 12 49
490 000	- 12 51
500.000	- 12 56
510.000	- 12.58
520 000	- 12.60
530.000	- 12.62
540.000	- 12 63
550 000	- 12 65
560 000	- 12 67
570 000	- 12.70
580 000	- 12.74
590.000	- 12.76
600.000	- 12 78
610.000	- 12 81
620 000	- 12.87
630.000	- 12.90
640 000	- 12.93
650 000	- 12 94
660 000	- 12.95
670 000	- 12.95
680 000	- 12 97
690 000	- 13 00
700 000	- 13 03
710.000	- 13 05
720 000	- 13.07
730 000	- 13.06
740 000	- 13.12
750 000	- 13.15
760 000	- 13.21
770 000	- 13 23
780 000	- 13 25
790 000	- 13.28
800 000	- 13 28
810.000	- 13 29
820.000	- 13.34
830.000	- 13.32
840.000	- 13 33
850 000	- 13.33
860.000	- 13.35
870.000	- 13 35
880.000	- 13.36
890.000	- 13.36
900 000	- 13.36
910.000	- 13 37
920.000	- 13.39
930 000	- 13.40
940.000	- 13 40
950 000	- 13 41
960 000	- 13 40
970.000	- 13 40
980.000	- 13 39
990.000	- 13 39

1000.00	- 13.39
1100 00	- 13.38
1200 00	- 13.43
1300 00	- 13.39
1400.00	- 13.37
1500.00	- 13 34
1600.00	- 13 34
1700.00	- 13 33
1800 00	- 13.31
1900.00	- 13.24
2000.00	- 13.21
2100.00	- 13.46
2200 00	- 13 55
2300 00	- 13 59
2400 00	- 13.62
2500 00	- 13.60
2600.00	- 13.54
2700.00	- 13 60
2800 00	- 13 65
2900 00	- 13 57
3000.00	- 13.53
3100 00	- 13.56
3200 00	- 13.57
3300.00	- 13 58
3400 00	- 13 56
3500 00	- 13 47
3600 00	- 13 53
3700 00	- 13.51
3800 00	- 13.48
3900.00	- 13.47
4000.00	- 13.48
4100.00	- 13 50
4200.00	- 13 25
4300.00	- 13 18
4400.00	- 13.16

END



PUMPING TEST REPORT

PAGE 1 OF 3

PROJECT NO SEF30619 AD

WELL POW-2 PUMPING OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO PW-1 RADIUS 4"PUMPING RATES ~ 150 gpmHOW Q MEASURED Manometer with 4"x3" or Fice plateHOW WL MEASURED M-Scope, Wetted TapeDISTANCE FROM PUMPED WELL ~ 200 feetMP FOR WL: TOC EL PUMP ON DATE 8/13/90 TIME 10:15 15PUMP OFF DATE 8/1/90 TIME 11:52 amCOMMENTS

TIME SINCE PUMPING START/ STOPPED MINUTES	H min	WATER LEVEL		DEPTH TO WATER (ft)	DRAW DOWN (ft)	ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS					
		REFERENCE	MEASURE				
0	0			7.04	0		Static
14 00	14			10.95	3.91		
16	16			11.25	4.21		
22	22			12.17	5.13		
24	24			12.43	5.39		
25	25			12.54	5.50		
26	26			12.63	5.59		
27	27			12.77	5.73		
28	28			12.87	5.83		
29	29			12.98	5.94		
30	30			13.07	6.03		
46	46			14.30	7.26		
47	47			14.34	7.30		
50	50			14.51	7.47		
53	53			14.67	7.63		
55	55			14.77	7.73		
57	57			14.87	7.83		
1.13	73			15.54	8.50		
1.16	76			15.65	8.61		
1.41	101			16.35	9.31		
2.34	154			17.6	10.56		
3.27	207			18.2	11.16		
3.57	237			18.47	11.43		



PUMPING TEST REPORT

PAGE 2 OF 3

PROJECT NO

SEF30619 A6

WELL POW-2 PUMPING/OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO PW-1 RADIUS 4"MP FOR WL: TOC EL PUMPING RATES ~150 gpmPUMP ON DATE 2/13/90 TIME 1015amHOW Q MEASURED Manometer with 4"x3" orifice platePUMP OFF DATE 8/16/90 TIME 1152amHOW WL MEASURED M-Scope, Wetted TapeCOMMENTS DISTANCE FROM PUMPED WELL 200 feet

TIME SINCE PUMPING START/ STOPPED (MINUTES)	Hrs (min)	WATER LEVEL			ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS		DEPTH TO WATER (ft)		
		REFERENCE	MEASURE			
4 27	267			1866	11 62	
4 57	297			1889	11 85	
5 27	327			1905	12 01	
5 57	357			1920	12 16	
6 27	387			1937	12 37	
6 57	417			1953	12 49	
7 30	450			1960	12 56	
9 04	544			1972	12 68	
10:47	647			1998	12 94	
11 43	703			2008	13 04	
	819			2036	13 32	
	899			2043	13 39	
	953			2046	13.42	
	1010			20.42	13.38	
	1070			20.43	13 39	
	1130			20.44	13 40	
	1192			20.49	13 45	
	1249			20.49	13 44	
	1309			20.43	13 39	
	1410	40.00	19.62	20 38	13 34	
	1479	40.00	19.61	20.39	13 35	
	1610			20 40	13 36	R.H.M 12.15 - 12.35
	1670			20 37	13 33	STARTED RAINING very little

PUMPING TEST REPORT

PROJECT NO SEF30619 A48

WELL POW-2 PUMPING OBSERVATION WELL

TYPE OF DATA DRAWDOWN/RECOVERY

PUMPED WELL NO Pw-1 RADIUS 4"

PUMPING RATES ~150 gpm

HOW Q MEASURED Manometer with 4"x3" orifice plate

HOW WL IS MEASURED M-Scope, Wetted Tape

DISTANCE FROM PUMPED WELL 200 FT

MP FOR WL, TOC

EL _____

PUMP ON DATE 8/13/90 TIME 1015 am

PUMP OFF DATE 8/16/90 TIME 1152am

COMMENTS _____

[illegible]



-PUMPING-TEST-REPORT-

PROJECT NO SEF30619 A0

WELL MW-2 PUMPING ~~OBSERVATION~~ WELL

TYPE OF DATA DRAWDOWN RECOVERY

PUMPED WELL NO PW-1 RADIUS 4"

PUMPING RATES ~150 gpm

HOW Q MEASURED Manometer with 4" x 3" orifice plate

HOW WL : MEASURED M-Scope, Wetted Tape

DISTANCE FROM PUMPED WELL

MP FOR WL: TOC EL

PUMP ON DATE 8/13/90 TIME 10:5 am

PUMP OFF DATE 8/16/90 TIME 1152am

COMMENTS _____

[illegible]



PUMPING TEST REPORT

PAGE 1 OF 2

PROJECT NO SEF30619 A8

WELL MW-3 PUMPING/OBSERVATION WELL

TYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO Pw-1 RADIUS 4"MP FOR WL: TOC EL PUMPING RATES ~150 gpmPUMP ON DATE 8/13/90 TIME 1015amHOW Q MEASURED Manometer with 4"x3" or fire plate PUMP OFF DATE 8/14/90 TIME 1152amHOW WL MEASURED M-Scope, Wetted Tape COMMENTS DISTANCE FROM PUMPED WELL

TIME SINCE PUMPING START/ STOPPED (MINUTES)	MP (m.w.)	WATER LEVEL				ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS		DEPTH TO WATER (ft)	DRAW DOWN (ft)		
		REFERENCE	MEASURE				
0		Hold	Wet	5.93	0		Static
1:57	118			6.00	0.07		
3:38	218			6.03	0.10		
4:35	275			6.04	0.11		
5:34	334			6.04	0.11		
6:04	364			6.05	0.12		
7:04	424			6.09	0.16		
8:23	503			6.07	0.14		
10:57	657			6.13	0.20		
11:50	710			6.14	0.21		Drizzle begins
	829			6.08	0.15		Heavy Rain
	908			5.99	0.06		Rain Subsides
	959			5.96	0.03		
	1016			5.89	-0.04		
	1075			5.84	-0.09		
	1134			5.80	-0.13		
	1196			5.78	-0.15		
	1253			5.76	-0.17		
	1314			5.74	-0.19		
5:51	1420	2400	1826	5.74	-0.19		
	1620			5.68	-0.25		Rain 12:15 - 12:35
	1742			5.71	-0.22		
	1854			5.90	-0.03		

WELL MW-3 PUMPING/OBSERVATION WELL

TYPE OF DATA DRAWDOWN RECOVERY

PUMPED WELL NO PW-1 RADIUS 4"

M.P. FOR WL: TOC EL

PUMPING RATES ~ 150 gpm

PUMP ON DATE 8/13/90 TIME 1015 am

HOW Q MEASURED Manometer with 4" x 3" orifice plate PUMP OFF DATE 8/16/90 TIME

HOW WLs MEASURED M-Scope, Wetted Tape COMMENTS _____

DISTANCE FROM PUMPED WELL[illegible]



PUMPING TEST REPORT

PAGE 1 OF 2PROJECT NO SEF 30619.40WELL MW-4 PUMPING OBSERVATION WELLTYPE OF DATA DRAWDOWN RECOVERYPUMPED WELL NO PW-1 RADIUS 4"MP FOR WL: TOC EL PUMPING RATES ~150 gpmPUMP ON DATE 8/13/90 TIME 1015amHOW Q MEASURED Manometer with 4"x3" or 6cc plate PUMP OFF DATE 8/16/90 TIME 1152amHOW WL MEASURED M-Scope, Wetted Tape COMMENTS DISTANCE FROM PUMPED WELL

TIME SINCE PUMPING START/ STOPPED (MINUTES)	1/4"	WATER LEVEL				ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS		DEPTH TO WATER (ft)	DRAW DOWN (ft)		
		REFERENCE	MEASURE				
9 31 am	0			6 65	0		Static
	125			6 70	0 05		
	186			6 70	0 05		
	281			6 76	0 11		
	371			6 80	0 15		
	431			6 84	0 19		
	511			6 82	0 17		
9 20 pm	665			6 82	0 17		
10 15 pm	720			6.87	0 22		
1 19 p	836			6 72	0.07		RAIN (Heavy)
12 11 am	920			6 59	-0 06		
35 am	965			6 54	-0 11		
- 20 am	1021			6 49	-0 16		
16 am	1080			6 45	-0.20		
4 15 am	1139			6 43	-0 22		
5 14 AM	1201			6.41	-0.24		
6 16 AM	1257			6 39	-0.26		
7 12 AM	1318			6 38	-0 27		
8 13 AM	1425	2900	1756	6.44	-0 21		
10 00 am	1625		-	6 38	-0 27		RAIN 12.15-12 35
1 20	1746			6.37	-0 28		
3 21 pm	1859			6.37	-0.28		
5 14	2008			6.38	-0 27		
7 13 pm							



PUMPING TEST REPORT

PROJECT NO SEF30619. A48

WELL MW-4 PUMPING/OBSERVATION WELL

TYPE OF DATA DRAWDOWN RECOVERY

PUMPED WELL NO Pw-1 RADIUS 4"

PUMPING RATES ~150 gpm

HOW Q MEASURED Manometer with 4" x 3" orifice plate

HOW WL MEASURED M-Scope, Wetted Tape

DISTANCE FROM PUMPED WELL

MP FOR WL: **TOC**

EL _____

PUMP ON DATE 8/13/90 TIME 1015 am

PUMP OFF DATE 8/16/90 TIME 1152 am

COMMENTS _____

[illegible]



PUMPING TEST REPORT

PAGE 1 OF 23

PROJECT NO SEF30617 AB

WELL Mw-5 PUMPING/OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO Pw-1 RADIUS 4"PUMPING RATES ~150 gpmHOW Q MEASURED Manometer with 4"x3" orifice plateHOW WL MEASURED M-Scope, Wetted TapeDISTANCE FROM PUMPED WELL 200 feetMP FOR WL: TOC EL PUMP ON DATE 8/13/90 TIME 1015amPUMP OFF DATE 8/16/90 TIME 1152amCOMMENTS

TIME SINCE PUMPING (START) STOPPED (MINUTES)	WT (m)	WATER LEVEL				ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS		DEPTH TO WATER (ft)	DRAW DOWN (ft)		
		REFERENCE	MEASURE				
0	0			576	0		Static
15 min	15			571	-0.05		
23	23			572	-0.04		
48	48			571	-0.05		
58	58			571	-0.05		
1 14	74			571	-0.05		
1:42	102			571	-0.05		
2 35 ⁽¹⁾	155			576	0		
2 29 ⁽²⁾	209			576	0		
3 59 ⁽²⁾	239			578	0.02		
4 29	269			578	0.02		
4 59	299			574	-0.02		
5 29	329			575	-0.01		
5 59	359			575	-0.01		
6 29	389			577	0.01		
6 59	419			580	0.04		
7 31	451			580	0.04		
9.03	543			579	0.03		
10 49 ^{hours min}	649			581	0.05		
11:45	705			583	0.07		Heavy Rain begins
	821			566	-0.10		
	906			554	-0.22		LIGHT DRIZZLE
	954			548	-0.28		



PROJECT NO

SEF30614 AB

WELL MW-5 PUMPING ~~OBSERVATION~~ WELL

TYPE OF DATA DRAWDOWN RECOVERY

PUMPED WELL NO PW-1 RADIUS 4"

PUMPING RATES ~ 150 gpm

HOW Q MEASURED Manometer with 4" x 3" orifice plate

HOW WL : MEASURED M-Scope, Wetted Tape

DISTANCE FROM PUMPED WELL 200 ft

MP FOR WL: TOC

EL _____

PUMP ON DATE 8/13/90 TIME 1015 am

2 PUMP OFF DATE 8/16/90 TIME 1152am

COMMENTS

[illegible]

PUMPING TEST REPORT

PAGE 3 OF 3

PROJECT NO SEF30679-AQ

WELL MW-5 PUMPING/OBSERVATION WELL

TYPE OF DATA DRAWDOWN/RECOVERY

PUMPED WELL NO PW-1 RADIUS 4"

PUMPING RATES ~ 150 gpm

HOW Q MEASURED Manometer with 4"x3" or 6" plate

HOW WL MEASURED M-Scope, Wetted Tape

DISTANCE FROM PUMPED WELL 200 Feet

MP FOR WL: TOC EL

PUMP ON DATE 8/13/90 TIME 10/5am

PUMP OFF DATE 8/16/90 TIME 1152am

COMMENTS _____

[illegible]



PUMPING TEST REPORT

PAGE 1 OF 2

PROJECT NO SEF30619A0

WELL OW-101 PUMPING OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO PW-1 RADIUS 4"MP FOR WL: TOC EL PUMPING RATES ~150 gpmPUMP ON DATE 8/13/90 TIME 1015amHOW Q MEASURED Manometer with 4'x3" orifice platePUMP OFF DATE 8/16/90 TIME HOW WL MEASURED M-Scope, Wetted TapeCOMMENTS DISTANCE FROM PUMPED WELL

TIME SINCE PUMPING START/ STOPPED (MINUTES)	24 ^{hr} (min.)	WATER LEVEL				ADJUSTED DRAW DOWN (ft)	REMARKS	
		READINGS		DEPTH TO WATER (ft)	DRAW DOWN (ft)			
		REFERENCE	MEASURE					
9:13am	0	0			565	0 00		Static
	^{no min} 2:22	142			571	0 06		
5 09	5:09	309			573	0 08		
	6:09	369			575	0 10		
	8 44	524			573	0 08		Rain begins @ 8 43 ^{hours minutes} into test (bnd)
9:41pm	^{hrs min} 11:26	686			5.77	0 12		
10:27pm	12 22	742			5.78	0 13		Steady Rain (Heavy)
10:27am		852			4.93	-0 72		RAIN SUBSIDED TO DRIZZLE
1 46 am		931			4 80	-0 85		
2 29 am		974			477	-0 88		
225 am		1030			4.76	-0 89		
~ 23 am		1088			476	-0 89		
3 22 am		1147			478	-0 87		
3 24 am		1209			478	-0 87		
~ 21 am		1266			479	-0 86		
2:20 AM		1325			4 82	-0.83		
10 14		1439	2400	1911	4 89	-0 76		
12 48 ^{pm}		1593	2400	19.29	4.71	-0 94		Rain 12:45 - 12 35 ^{pm}
3 34		1759			476	-0 89		
5:31		1876		-	4.65	-1.00		
7 52pm		2017			4.67	-0 98		
								Road inaccessible to car



PUMPING TEST REPORT

PAGE 1 OF 2

PROJECT NO

SEF 30619 A

WELL OW-102 PUMPING/OBSERVATION WELLTYPE OF DATA DRAWDOWN/RECOVERYPUMPED WELL NO PW-1 RADIUS 4"MP FOR WL: TOC EL PUMPING RATES ~150 gpmPUMP ON DATE 8/13/90 TIME 1015 amHOW Q MEASURED Manometer with 4"x3" orifice platePUMP OFF DATE 8/16/90 TIME 1152 amHOW WL MEASURED M-Scope, Wetted TapeCOMMENTS DISTANCE FROM PUMPED WELL

TIME SINCE PUMPING START STOPPED (MINUTES)	1/4"	WATER LEVEL			ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS		DEPTH TO WATER (ft)		
		REFERENCE	MEASURE			
8 59 am	0			6 85		Static
2 13				6.90		
5 41				6 95		
6 33				7.0		
8 53				7 01		
9 31 pm	11.16			7 07		
10 26 pm	12.11			7 08		Steady rain
6 38 am				6.84		
1 54 am				6.71		Rain stopped
2 36 am				6 66		
3 32 am				6 59		
4 30 am				6 55		
5 30 am				6 53		
6 30 am				6 50		
7 27 am				6 49		
8 28 am				6.49		
10 18		24 00	17 48	6 52		
12 39 pm		24 30	17 51	6 49		Rain 12 15 - 12 35
3 46				6.51		
5 41 pm				6.40		
7 58 pm				6.38		
8 07 pm				6.38		
11 55 pm				6.39		



PUMPING TEST REPORT

PAGE 1 OF 2

PROJECT NO. SEF30619.A1

WELL 0W-115 PUMPING OBSERVATION WELLTYPE OF DATA DRAWDOWN RECOVERYPUMPED WELL NO PW-1 RADIUS 4"MP FOR WL: TOC EL PUMPING RATES ~ 150 gpmPUMP ON DATE 8/13/90 TIME 1015amHOW Q MEASURED Manometer with 4"x3" p. c. pipe PUMP OFF DATE 8/16/90 TIME 1152amHOW WL MEASURED M-Scope, Wetted Tape COMMENTS DISTANCE FROM PUMPED WELL

TIME SINCE PUMPING (START) STOPPED (MINUTES)	MP (m ~)	WATER LEVEL		DEPTH TO WATER (ft)	DRAW DOWN (ft)	ADJUSTED DRAW DOWN (ft)	REMARKS
		READINGS	MEASURE				
0				5.63	0		
127				5.63	0		
190				5.64	0.01		
224				5.65	0.02		
374				5.66	0.03		
434				5.7	0.07		
513				5.68	0.05		
668				5.70	0.07		
723				5.71	0.08		
842				5.70	0.07		
924				5.68	0.05		
967				5.64	0.01		
1025				5.52	-0.09		
1082				5.45	-0.18		
1141				5.29	-0.34		
1203				5.22	-0.41		
1260				5.19	-0.44		
1320				5.17	-0.46		
1431		25.00	19.77	5.23	-0.40		
1628				5.19	-0.44		RA = 12.35 PM
1749				5.21	-0.42		
1863				5.13	-0.50		
2011				5.10	-0.53		

LABORATORY RESULTS FOR WATER QUALITY SAMPLING

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**



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August 31, 1990

SEF30619 A0 | AAD241

RE: PG&E/Bechtel laboratory samples

Dear Jeff Lehnert/GW:

On August 17, 1990 the CH2M Hill Gainesville Laboratory received 7 water, grab samples with a request for analysis of selected parameters

The analytical results are enclosed No unusual difficulties were encountered in the analyses
If you should have any questions concerning the results, please call Don Hash or Tom Emenhiser

Sincerely,

Don Hash
Client Services

Enclosure(s).

cc: Pete Kwiatkowski/DF



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REPORT OF ANALYSIS

Florida Certification 82112, E82124

AA0241

08/31/90

Page 1 of 6

Sample Nos 83679 - 83685

PG&E/Bechtel	CH2MHILL
Attention: Jeff Lehen Address: GNV Copies to: Pete Kwiatkowski/DFB	Project No: SEF30619.A0 Received: 08/17/90 Reported: 08/31/90
Collected: 08/16/90 by Pete Kwiatkowski Type: water, grab Location: Indiantown Cogeneration Proj	

SAMPLE NUMBER	83679	83680	83681	83682	83683
	MW-3	MW-4	MW-1	MW-2	PW-1
SAMPLE DESCRIPTIONS	08/17/90 9 50	08/17/90 10 50	08/17/90 11 00	08/17/90 13 30	08/16/90 11 00
GENERAL					
pH (Units)	6 95 08/20/90	5 45 08/20/90	6 40 08/20/90	4 85 08/20/90	7 15 08/20/90
Alkalinity, Total (as CaCO3)	280 08/27/90	< 0 08/27/90	88 0 08/27/90	< 0 08/27/90	280 08/27/90
Color (APHA)	50 08/20/90	50 08/20/90	60 08/20/90	90 08/20/90	10 08/20/90
Conductivity (umhos/cm)	783 08/28/90	141 08/28/90	370 08/28/90	125 08/28/90	567 08/28/90
Hardness, Total (as CaCO3)	336 08/30/90	30 08/30/90	122 08/30/90	38 08/30/90	340 08/30/90
Turbidity (NTU)	12 6 08/20/90	5 7 08/20/90	6 1 08/20/90	16 3 08/20/90	< 2 08/20/90
SOLIDS					
Total Dissolved Solids	562 08/23/90	186 08/23/90	334 08/23/90	168 08/23/90	392 08/23/90
METALS					
Antimony - FL	< 2 08/23/90	< 2 08/23/90	< 2 08/23/90	< 2 08/23/90	< 2 08/23/90
Arsenic - FU	< 005	< 005	< 005	< 005	< 005

NOTE Values are mg/l as substance unless otherwise stated

Respectfully submitted,

Thomas C. Ebenhiser Laboratory Manager

n/r = not requested

NOTE This report contains test data and no interpretation is intended or implied

CH2MHILL

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AA0241

08/31/90

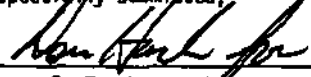
Page 2 of 6

Sample Nos 83679 - 83685

SAMPLE NUMBER	83679	83680	83681	83682	83683
SAMPLE DESCRIPTIONS	MW-3 08/17/90 9 50	MW-4 08/17/90 10 50	MW-1 08/17/90 11 00	MW-2 08/17/90 13 30	PW-1 08/16/90 11 00
Barium - FL	08/23/90 < 2	08/23/90 < 2	08/23/90 < 2	08/23/90 < 2	08/23/90 < 2
Cadmium - FU	08/22/90 < 0002	08/22/90 < 0002	08/22/90 < 0002	08/22/90 < 0002	08/22/90 < 0002
Calcium - FL	08/21/90 124	08/21/90 1 9	08/21/90 35 0	08/21/90 2 3	08/21/90 85 0
Chromium, Tot - FU	08/27/90 < 002	08/27/90 < 002	08/27/90 < 002	08/27/90 < 002	08/27/90 < 002
Copper - FL	08/22/90 0 02	08/22/90 0 03	08/22/90 < 02	08/22/90 < 02	08/22/90 < 02
Iron, Total - FL	08/27/90 2 7	08/27/90 1 6	08/27/90 0 96	08/27/90 2 0	08/27/90 < 02
Lead - FU	08/21/90 < 002	08/21/90 0 003	08/21/90 < 002	08/21/90 < 002	08/21/90 < 002
Magnesium - FL	08/27/90 2 9	08/27/90 2 4	08/27/90 3 7	08/27/90 2 3	08/27/90 3 0
Manganese - FL	08/27/90 0 02	08/27/90 < 01	08/27/90 < 01	08/27/90 < 01	08/27/90 < 01
Mercury - CV	08/22/90 < 0002	08/22/90 0 0004	08/22/90 < 0002	08/22/90 < 0002	08/22/90 < 0002
Molybdenum - FL	08/21/90 < 2	08/21/90 < 2	08/21/90 < 2	08/21/90 < 2	08/21/90 < 2
Potassium	08/29/90 0 79	08/29/90 0 31	08/29/90 1 30	08/29/90 0 49	08/29/90 1 66
Selenium	08/29/90 < 005	08/29/90 < 005	08/29/90 < 005	08/29/90 < 005	08/29/90 < 005
Silica, React	08/29/90 10 6	08/29/90 8 2	08/29/90 8 9	08/29/90 9 1	08/29/90 17 2
Silver - FU	08/27/90 0 0012	08/27/90 0 0008	08/27/90 0 0006	08/27/90 < 0005	08/27/90 0 0014
	08/30/90	08/30/90	08/30/90	08/30/90	08/30/90

NOTE Values are mg/l as substance unless otherwise stated

Respectfully submitted,


Thomas C. Emenhiser, Laboratory Manager

n/r = not requested

NOTE This report contains test data and no interpretation is intended or implied

CH2M HILL

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AA0241

08/31/90

Page 3 of 6

Sample Nos 83679 - 83685

SAMPLE NUMBER	83679	83680	83681	83682	83683
SAMPLE DESCRIPTIONS	MW-3 08/17/90 9 50	MW-4 08/17/90 10 50	MW-1 08/17/90 11 00	MW-2 08/17/90 13 30	PW-1 08/16/90 11 00
Sodium - FL	28 7 08/28/90	16 9 08/28/90	23 4 08/28/90	15 8 08/28/90	11 9 08/28/90
Strontium - FL	0 46 08/30/90	0 09 08/30/90	0 47 08/30/90	0 14 08/30/90	0 55 08/30/90
Vanadium - FL	<0 5 08/30/90	<0 5 08/30/90	<0 5 08/30/90	<0 5 08/30/90	<0 5 08/30/90
Zinc - FL	<0 01 08/27/90	<0 01 08/27/90	<0 01 08/27/90	<0 01 08/27/90	0 01 08/27/90
ANIONS					
Boron	0 039 08/24/90	0 028 08/24/90	0 025 08/24/90	0 029 08/24/90	0 025 08/24/90
Chloride	72 0 08/29/90	32 1 08/29/90	47 1 08/29/90	29 1 08/29/90	18 3 08/29/90
Fluoride	0 34 08/23/90	0 03 08/23/90	0 04 08/23/90	0 05 08/23/90	0 12 08/23/90
Sulfate	1 2 08/29/90	4 4 08/29/90	3 9 08/29/90	5 3 08/29/90	<1 0 08/29/90
NUTRIENTS					
Ammonia (as N)	1 89 08/22/90	0 19 08/22/90	0 86 08/22/90	0 32 08/22/90	0 52 08/22/90
Nitrate & Nitrite (as N)	<0 02 08/23/90	<0 02 08/23/90	<0 02 08/23/90	<0 02 08/23/90	<0 02 08/23/90
Total Phosphorus (as P)	1 18 08/29/90	0 10 08/27/90	0 09 08/27/90	0 18 08/27/90	0 35 08/27/90

NOTE Values are mg/l as substance unless otherwise stated

Respectfully submitted,

Thomas C. Emenhiser
Thomas C. Emenhiser, Laboratory Manager

n/r = not requested

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08/31/90

Page 4 of 6

Sample Nos 83679 - 83685

PG&E/Bechtel	CH2M HILL
Attention: Jeff Lehnen Address: GNV Copies to: Pete Kwiatkowski/DFB	Project No: SEF30619.A0 Received: 08/17/90 Reported: 08/31/90
Collected: 08/16/90 by Pete Kwiatkowski Type: water, grab Location: Indiantown Cogeneration Proj	

SAMPLE NUMBER	83684	83685
SAMPLE DESCRIPTIONS	Travel Blank 08/17/90	Laboratory Method Blank
GENERAL		
pH (Units)	n/r	Not Applicable
	n/r	08/20/90
Alkalinity, Total (as CaCO3)	n/r	< 0
	n/r	08/27/90
Color (APHA)	n/r	0
	n/r	08/20/90
Conductivity (umhos/cm)	n/r	< 0
	n/r	08/28/90
Hardness, Total (as CaCO3)	n/r	< 0
	n/r	08/30/90
Turbidity (NTU)	n/r	< 2
	n/r	08/20/90
SOLIDS		
Total Dissolved Solids	n/r	< 0
	n/r	08/23/90
METALS		
Antimony - FL	< 2	< 2
	08/23/90	08/23/90
Arsenic - FU	< 005	< 005

NOTE Values are mg/l as substance unless otherwise stated

Respectfully submitted,

Thomas C. Emenhiser, Laboratory Manager

n/r = not requested

NOTE This report contains test data and no interpretation is intended or implied

CH2M HILL

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08/31/90

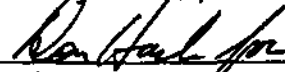
Page 5 of 6

Sample Nos 83679 - 83685

SAMPLE NUMBER	83684	83685
SAMPLE DESCRIPTIONS	Travel Blank 08/17/90	Laboratory Method Blank
Barium - FL	08/23/90 ≤ 2	08/23/90 ≤ 2
Cadmium - FU	08/22/90 ≤ 0002	08/22/90 ≤ 0002
Calcium - FL	08/21/90 ≤ 0	08/21/90 ≤ 0
Chromium, Tot - FU	08/27/90 ≤ 002	08/27/90 ≤ 002
Copper - FL	08/22/90 ≤ 02	08/22/90 ≤ 02
Iron, Total - FL	08/27/90 ≤ 02	08/27/90 ≤ 02
Lead - FU	08/21/90 0 011	08/21/90 ≤ 002
Magnesium - FL	08/27/90 ≤ 25	08/27/90 ≤ 25
Manganese - FL	08/27/90 ≤ 01	08/27/90 ≤ 01
Mercury - CV	08/22/90 ≤ 0002	08/22/90 ≤ 0002
Molybdenum - FL	08/21/90 ≤ 2	08/21/90 ≤ 2
Potassium	08/29/90 ≤ 15	08/29/90 ≤ 15
Selenium	08/29/90 ≤ 005	08/29/90 ≤ 005
Silica, React	08/29/90 n/r	08/29/90 ≤ 01
Silver - FU	n/r 0 0011	08/27/90 ≤ 0005
	08/30/90	08/30/90

NOTE Values are mg/l as substance unless otherwise stated

Respectfully submitted,


Thomas C. Emenhiser, Laboratory Manager

n/r = not requested

NOTE This report contains test data and no interpretation is intended or implied

CH2MHILL

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AAD241

08/31/90

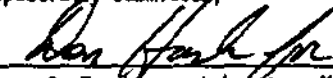
Page 6 of 6

Sample Nos 83679 - 83685

SAMPLE NUMBER	83684	83685
SAMPLE DESCRIPTIONS	Travel Blank 08/17/90	Laboratory Method Blank
Sodium - FL	< 5 08/28/90	< 5 08/28/90
Strontium - FL	< 05 08/30/90	< 05 08/30/90
Vanadium - FL	< 5 08/30/90	< 5 08/30/90
Zinc - FL	< 01 08/27/90	< 01 08/27/90
ANIONS		
Boron	< 015 08/24/90	< 015 08/24/90
Chloride	n/r	< 0 08/29/90
Fluoride	n/r	< 01 08/23/90
Sulfate	n/r	< 0 08/29/90
NUTRIENTS		
Ammonia (as N)	n/r	Not Applicable 08/22/90
Nitrate & Nitrite (as N)	n/r	< 02 08/23/90
Total Phosphorus (as P)	n/r	< 01 08/27/90

NOTE Values are mg/l as substance unless otherwise stated

Respectfully submitted,


Thomas C. Emerhiser, Laboratory Manager

n/r = not requested

NOTE This report contains test data and no interpretation is intended or implied

CH2M HILL

Gainesville
Environmental Laboratory

7201 N.W. 11th Place
Gainesville, Florida 32605

904-331-2442
FAX 904-331-5320



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August 30, 1990

SEF30619 AO

Mr. Don Hash
CH2M HILL/LGN
7201 N W 11th Place
Gainesville, FL 32605

RE Analytical Data for PG & E/Bechtel, Laboratory No 16619

Dear Mr Hash:

On August 21, 1990, the CH2M Hill Montgomery Laboratory received five samples with a request for analysis of selected organic parameters

The analytical results and associated quality control data are enclosed
No unusual difficulties were encountered during the analysis of these samples

If you should have any questions concerning the data, please inquire

Sincerely,

Ward Dickens
Organics Division Manager

Enclosures

cc Mr Craig Vinson

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ANALYTICAL METHODOLOGY

Organic Analysis

Priority Pollutants: Water, soil and waste samples are analyzed in accordance with procedures described in Methods 608, 624, and 625, EPA-600/4-82-057 (1982), Methods 8080, 8240, and 8270, Test Methods for Evaluating Solid Waste, 1986, SW-846, Third Edition; and methods outlined in the USEPA Contract Laboratory Program Statement of Work for Organics Analysis, February, 1988

Volatile Analysis (Safe Drinking Water Act): Water samples are analyzed in accordance with procedures described in Method 524.2, Federal Register (50 FR 46902), November 13, 1985.

Chlorinated Phenoxyacid Herbicides Samples are analyzed with procedures described in Method 8150, Test Methods for Evaluating Solid Waste, 1986, SW-846, Third Edition

Organophosphate Pesticides: Samples are analyzed in accordance with procedures described in Methods 614 and 622, EPA-600/4-79-019 (1979) and in Method 8140, Test Methods for Evaluating Solid Waste, 1986, SW-846, Third Edition.

Phenol Analysis by GC Samples are analyzed in accordance with procedures outlined in Method 604, Federal Register, 40 CFR, Part 136 (July 1, 1987) and in Method 8040, Test Methods for Evaluating Solid Waste, 1986, SW-846, Third Edition.

Polynuclear Aromatic Hydrocarbons (GC analysis) Samples are analyzed with procedures described in Method 610, Federal Register, 40 CFR, Part 136 (July 1, 1987) and in Method 8100, Test Methods for Evaluating Solid Waste, 1986, SW-846, Third Edition

Ethylene Dibromide : Water samples are analyzed in accordance with procedures outlined in Method 504, Federal Register (50 FR 46902), November 13, 1985

Trihalomethanes: Water samples are analyzed with procedures described in Method 501.2, Federal Register, Vol. 44, No. 231, Part II, November 29, 1979



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EPA - DEFINED QUALIFIERS

ORGANICS

Definitions for the EPA-defined qualifiers:

- U -- Indicates the compound was analyzed for but not detected. The number adjacent to the "U" qualifier indicates the quantitation limit for that compound. The detection limit can vary from sample to sample depending on dilution factors or percent moisture adjustment when indicated.
- J -- Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound below the stated quantitation limit. The "J" qualifier is not used with pesticide results.
- C -- This flag applies to pesticide results only. The "C" flag indicates the presence of this compound has been confirmed by GC/MS analysis.
- B -- This flag is used when the analyte is found in the associated blank as well as the sample. This notation indicates possible blank contamination and suggests the data user evaluate these compounds and their amounts carefully.
- E -- This flag applies to GC/MS only. The "E" qualifier indicates a compound may be above or below the linear range of the instrument. If the particular compound level is deemed above the linear calibration range, then the sample should be reanalyzed at an appropriate dilution. Therefore, the "E" qualified amount is an estimated concentration. The results for the dilution will be reported on a separate Form I and will be flagged with a "D" if the dilution brings the concentration within proper calibration.
- D -- This flag identifies compounds which have been run at a dilution to bring the concentration of that compound within the linear range of the instrument. "D" qualifiers are only used for samples that have been run initially with results above acceptable ranges. For secondary dilutions the "DL" suffix is appended to the sample number on the Form I.
- A -- Indicates the Tentatively Identified Compound (TIC) is a suspected aldol-condensation product.
- X -- Indicates the compound concentration has been manually modified or the EPA qualifier has been manually modified or added.
- JX -- The compound was detected and quantitated below the Contract Required Quantitation Limit.

CLIENT SAMPLE ID QUALIFIERS

LEVEL 1

The qualifiers that GC/MS uses with the client sample ID are defined below:

- DL -- Dilution Run
- R -- Rerun (may be followed by a digit to indicate multiple reruns)
- RD -- Diluted Rerun
- RX -- Re-extraction Analysis
- MS -- Matrix Spike (may be followed by a digit to indicate multiple matrix spikes within a sample set)
- MSD -- Matrix Spike Duplicate (may be followed by a digit to indicate multiple matrix spike duplicates within a sample set)
- QC_BLANK -- Method Blank (may be followed by an S for soils run at a low level, W for waters, or SM for soils run at a medium level) (letters may be followed by a digit to indicate multiple blanks of that type, if there are no letters the digit indicates multiple blanks).

These qualifiers allow GC/MS to have unique client sample ID's so that the client can get more accurate information from the data reported



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TABLE 1

SAMPLE CROSS-REFERENCE SUMMARY

CH2M HILL Laboratory No. 16619

<u>IMG</u> <u>Sample No.</u>	<u>LGN</u> <u>Sample No.</u>	<u>Sample Description</u>			
16619001	83679	SAMPLE MW-3	08/17/90	0950	GRAB
16619002	83680	SAMPLE MW-4	08/17/90	1050	GRAB
16619003	83681	SAMPLE MW-1	08/17/90	1100	GRAB
16619004	83682	SAMPLE MW-2	08/17/90	1330	GRAB
16619005	83683	SAMPLE PW-1	08/16/90	1100	GRAB

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: CH2M HILL/MGM
 Lab Sample ID: 16619001
 Client Sample ID: MW-3

Concentration: LOW
 Sample Matrix: WATER
 Percent Moisture:

Date Extracted: 08/21/90
 Date Analyzed: 08/28/90
 Dilution Factor: 1.0

SDWA PESTICIDE COMPOUNDS

CAS Number		ug/L		CAS Number		ug/L
58-89-9	gamma-BHC (Lindane)	0.01	U			
72-20-8	Endrin	0.02	U			
72-43-5	Methoxychlor	0.04	U			
8001-35-2	Toxaphene	0.5	U			
	Dibutylchloroendate - SS	106				

U - Analyzed for but not detected
 B - Detected in QC blank
 JX - Detected, concentration estimated.
 SS - Surrogate Standard reported as percent recovery

Form I

Handwritten signature

ORGANICS ANALYSIS DATA SHEET

Laboratory Name CH2M HILL/MGM Concentration: LOW Date Extracted: 08/21/90
 Lab Sample ID 16619002 Sample Matrix: WATER Date Analyzed 08/28/90
 Client Sample ID MW-4 Percent Moisture: Dilution Factor. 1.0

SDWA PESTICIDE COMPOUNDS

CAS Number		ug/L		CAS Number		ug/L
58-89-9	gamma-BHC (Lindane) . .	0 01	U			
72-20-8	Endrin .	0 02	U			
72-43-5	Methoxychlor .	0 04	U			
8001-35-2	Toxaphene	0.5	U			

	Dibutylchloredate - SS	105				

U - Analyzed for but not detected
 B - Detected in QC blank
 JX - Detected, concentration estimated
 SS - Surrogate Standard reported as percent recovery

Form I

JWS

000002

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: CH2M HILL/MGM Concentration: LOW Date Extracted: 08/21/90
 Lab Sample ID: 16619003 Sample Matrix: WATER Date Analyzed: 08/28/90
 Client Sample ID: MW-1 Percent Moisture: Dilution Factor: 10

SDWA PESTICIDE COMPOUNDS

CAS Number		ug/L		CAS Number		ug/L	
58-89-9	gamma-BHC (Lindane)	0 01	U				
72-20-8	Endrin	0 02	U				
72-43-5	Methoxychlor	0 04	U				
8001-35-2	Toxaphene	0.5	U				
	Dibutylchloroendate - SS	110					

U - Analyzed for but not detected
 B - Detected in QC blank
 JX - Detected, concentration estimated
 SS - Surrogate Standard reported as percent recovery

Form I



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ORGANICS ANALYSIS DATA SHEET

Laboratory Name: CH2M HILL/MGM Concentration LOW Date Extracted. 08/21/90
Lab Sample ID: 16619004 Sample Matrix WATER Date Analyzed 08/28/90
Client Sample ID: MW-2 Percent Moisture Dilution Factor: 1.0

SDWA PESTICIDE COMPOUNDS

CAS Number		ug/L		CAS Number		ug/L
58-89-9	gamma-BHC (Lindane)	. . 0.01	U			
72-20-8	Endrin	. . 0.02	U			
72-43-5	Methoxychlor . . .	0 04	U			
8001-35-2	Toxaphene	0 5	U			
Dibutylchloroendate - SS		82				

U - Analyzed for but not detected.
B - Detected in QC blank
JX - Detected, concentration estimated.
SS - Surrogate Standard reported as percent recovery.

Form I

CH2M HILL

Montgomery
Environmental Laboratory

2567 Fairlane Drive P O Box 230548
Montgomery Alabama 36116

000004
205 271 1444

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: CH2M HILL/MGM Concentration: LOW Date Extracted: 08/21/90
 Lab Sample ID: 16619005 Sample Matrix: WATER Date Analyzed: 08/28/90
 Client Sample ID: PW-1 Percent Moisture: Dilution Factor: 1.0

SDWA PESTICIDE COMPOUNDS

CAS Number		ug/L		CAS Number		ug/L
58-89-9	gamma-BHC (Lindane)	0.01	U			
72-20-8	Endrin	0.02	U			
72-43-5	Methoxychlor	0.04	U			
8001-35-2	Toxaphene .	0.5	U			

	Dibutylchlorodate - SS	94				

U - Analyzed for but not detected
 B - Detected in QC blank
 JX - Detected, concentration estimated.
 SS - Surrogate Standard reported as percent recovery.

Form I

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: CH2M HILL/MGM Concentration LOW Date Extracted: 08/21/90
 Lab Sample ID: W08210B1 Sample Matrix WATER Date Analyzed 08/28/90
 Client Sample ID QC BLANK Percent Moisture: Dilution Factor: 1.0

SDWA PESTICIDE COMPOUNDS

CAS Number		ug/L		CAS Number		ug/L	
58-89-9	gamma-BHC (Lindane)	0.01	U				
72-20-8	Endrin	0.02	U				
72-43-5	Methoxychlor	0.04	U				
8001-35-2	Toxaphene	0.5	U				
Dibutylchloroendate - SS		114					

U - Analyzed for but not detected
 B - Detected in QC blank.
 JX - Detected, concentration estimated
 SS - Surrogate Standard reported as percent recovery

Form I

JH

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: CH2M HILL/MGM Concentration: LOW Date Extracted 08/21/90
 Lab Sample ID: 16619001 Sample Matrix: WATER Date Analyzed 08/29/90
 Client Sample ID: MW-3 Percent Moisture: Dilution Factor: 1 0

SDWA HERBICIDE COMPOUNDS

CAS Number	ug/L	CAS Number	ug/L
94-75-7 2,4-D	2 5 U		
93-72-1 Silvex	0 5 U		

3,5-Dichlorobenzoic acid - SS	93		

U - Analyzed for but not detected.
 B - Detected in QC blank
 JX - Detected, concentration estimated.
 SS - Surrogate Standard reported as percent recovery

Form I

Handwritten signature

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: CH2M HILL/MGM Concentration: LOW Date Extracted: 08/21/90
 Lab Sample ID: 16619002 Sample Matrix: WATER Date Analyzed: 08/29/90
 Client Sample ID: MW-4 Percent Moisture: _____ Dilution Factor: 1.0

SDWA HERBICIDE COMPOUNDS

CAS Number		ug/L	CAS Number	ug/L
94-75-7	2,4-D	2 5 U		
93-72-1	Silvex	0 5 U		

	3,5-Dichlorobenzoic acid - SS	96		

U - Analyzed for but not detected
 B - Detected in QC blank
 JX - Detected, concentration estimated
 SS - Surrogate Standard reported as percent recovery

Form I

Jms

ORGANICS ANALYSIS DATA SHEET

Laboratory Name	<u>CH2M HILL/MGM</u>	Concentration:	<u>LOW</u>	Date Extracted:	<u>08/21/90</u>
Lab Sample ID	<u>16619003</u>	Sample Matrix	<u>WATER</u>	Date Analyzed	<u>08/29/90</u>
Client Sample ID	<u>MW-1</u>	Percent Moisture:	<u> </u>	Dilution Factor	<u>10</u>

SDWA HERBICIDE COMPOUNDS

CAS Number		ug/L	CAS Number	ug/L
94-75-7	2,4-D	25 U		
93-72-1	Silvex	05 U		

	3,5-Dichlorobenzoic acid - SS	86		

- U - Analyzed for but not detected
- B - Detected in QC blank
- JX - Detected, concentration estimated.
- SS - Surrogate Standard reported as percent recovery

Form I

ORGANICS ANALYSIS DATA SHEET

Laboratory Name CH2M HILL/MGM Concentration. LOW Date Extracted: 08/21/90
 Lab Sample ID 16619004 Sample Matrix WATER Date Analyzed 08/29/90
 Client Sample ID: MW-2 Percent Moisture: Dilution Factor 1.0

SDWA HERBICIDE COMPOUNDS

CAS Number		ug/L		CAS Number	ug/L
94-75-7	2,4-D	2.5	U		
93-72-1	Silvex	0.5	U		

	3,5-Dichlorobenzoic acid - SS	93			

U - Analyzed for but not detected
 B - Detected in QC blank.
 JX - Detected, concentration estimated
 SS - Surrogate Standard reported as percent recovery

Form I

JMS

ORGANICS ANALYSIS DATA SHEET

Laboratory Name: CH2M HILL/MGM Concentration: LOW Date Extracted: 08/21/90
 Lab Sample ID: 16619005 Sample Matrix: WATER Date Analyzed: 08/29/90
 Client Sample ID: PW-1 Percent Moisture: Dilution Factor: 1.0

SDWA HERBICIDE COMPOUNDS

CAS Number		ug/L	CAS Number	ug/L
94-75-7	2,4-D	2.5 U		
93-72-1	Silvex	0.5 U		

	3,5-Dichlorobenzoic acid - SS	94		

U - Analyzed for but not detected
 B - Detected in QC blank
 JK - Detected, concentration estimated
 SS - Surrogate Standard reported as percent recovery

Form I



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ORGANICS ANALYSIS DATA SHEET

Laboratory Name: CH2M HILL/MGM Concentration: LOW Date Extracted: 08/21/90
Lab Sample ID: W08210B1 Sample Matrix: WATER Date Analyzed: 08/29/90
Client Sample ID: QC BLANK Percent Moisture: Dilution Factor: 1.0

SDWA HERBICIDE COMPOUNDS

CAS Number		ug/L	CAS Number	ug/L
94-75-7	2,4-D	2 5 U		
93-72-1	Silvex	0 5 U		

	3,5-Dichlorobenzoic acid - SS	92		

U - Analyzed for but not detected
B - Detected in QC blank
JX - Detected, concentration estimated
SS - Surrogate Standard reported as percent recovery

Form I

JMS

CH2M HILL

Montgomery
Environmental Laboratory

2567 Fairlane Drive P.O. Box 230548
Montgomery Alabama 36116

000012
205 271 1444



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Client: PG & E/BECHTEL/INDIANTOWN COGENERATION PROJ
Attention: JEFF LEHNEN
Address: CH2M HILL GAINESVILLE OFFICE

Sample Number 83679-84
Date Received 08/17/90

Dear Client

The Gainesville Organics Laboratory received your samples with a request for analysis of selected parameters

The analytical results are enclosed No unusual difficulties were encountered in the analyses

If you should have any questions concerning the results please contact us Thank you

Sincerely,

A handwritten signature in cursive script, appearing to read "Don Hash".

Don Hash
Client Services



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CH2M Hill Organics Laboratory
Analytical Report

Report Contents

Sample Information

Definitions of Reporting Qualifiers

Description of Analytical Methods

Sample Quantitation Reports including Surrogate Recoveries

QA/QC Package Including

Initial Calibration (*)

Continuing Calibration (Daily Standard) (*)

Quantitation Reports for Organic-Free Water Blanks

Matrix Spike/Matrix Spike Duplicate (*)

Surrogate Control Charts (*)

Chromatograms (*)

Copy of Chain-of-Custody

(*) Information provided where applicable or when requested



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SAMPLE INFORMATION

Client: PG & E/BECHTEL/INDIANTOWN COGENERATION PROJ
Attention: JEFF LEHNEN
Address CH2M HILL GAINESVILLE OFFICE

Description: WATER SAMPLES
INDIANTOWN COGENERATION PROJ
601/602 ANALYSIS

Sample Number: 83679-84
Quantity 6
Date Received 08/17/90
Date Completed: 08/23/90
Date Reported 08/31/90
Project Number: SEF 30619 A0
Number of Pages 15

The information shown in this report is test data only
and no interpretation of this data is intended or implied.

State of Alabama Certification No 40080

State of Florida Certification No 82112, E82124

Respectfully submitted,


Tom Emenhiser
Laboratory Manager



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Definitions of Reporting Qualifiers

- (U) Indicates the compound was analyzed for but not detected. The number adjacent to the "U" qualifier indicates the Detection Limit for that compound. The detection limit can vary from sample to sample depending on dilution factors or percent moisture adjustment when indicated.
- (M) Matrix interference precludes achieving lower detection limit. The detection limit is determined by the largest peak in the sample, and the dilution is adjusted so that neither chemical nor electronic overload of the gas chromatography system takes place. Either condition could affect the reliability of peak identification and quantitation.
- (F) Presence indicated but less than stated detection limit. In a diluted sample, a clearly defined peak was present at less than the stated detection limit.
- (N) Sample contains non-target compounds. Many samples, especially "fuel" samples, often contain non-target compounds. This qualifier is used to alert the client to the presence of non-target compounds in samples that may not contain any of the listed "target" compounds.

Detection Limit = 1.0 ug/l for water samples and 1.0 ug/kg for soil and sediment samples unless noted otherwise.

Note: the minimum detection limit for methanol extracts of high-level soil and sediment samples is 50 ug/kg due to the effect of methanol on "purging efficiency."



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Analytical Methods

Purgeable Halocarbons in Water EPA Method 601 as described in the Title 40 Code of Federal Regulations, Part 136, Appendix A, July, 1988, and CH2M Hill GC Volatiles SOP, October, 1988

Purgeable Aromatics in Water EPA Method 602 as described in the Title 40 Code of Federal Regulations, Part 136, Appendix A, July, 1988, and CH2M Hill GC Volatiles SOP, October, 1988

Purgeable Halocarbons in Soil and Sediment EPA Method 8010 as described in Test Methods for Evaluating Solid Waste (SW-846) and CH2M Hill GC Volatiles SOP, October, 1988

Purgeable Aromatics in Soil EPA Method 8020 as described in Test Methods for Evaluating Solid Waste (SW-846) and CH2M Hill GC Volatiles SOP, October, 1988

Trihalomethanes in Water EPA Method 501.1 as described in the Federal Register, Vol 44, No 231, Appendix C, and CH2M Hill Volatiles SOP, October, 1988

Ethylene Dibromide in Water EPA Method 504 (1,2-dibromomethane and 1,2-dibromo-3-chloropropane in water by microextraction and gas chromatography).

Fuel Screening Procedure for estimation of concentration and identification of "fuel" samples, used to assist in determination of required EPA methods for subsequent analysis This methodology is not an established EPA procedure

State of Alabama Certification Number: 40080

State of Florida Certification Numbers 82112 and E82124

Report of Analytical Data - Purgeable Halocarbons/Aromatics

Client	PG&E / BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/17/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	83679	Date Received	8/17/90
Proj No	SEF 30619 A0	% Moisture	0 0	Date Extracted	N/A
Method	601/602	Dilution Factor	1 0	Date Analyzed	8/22/90
Matrix	WATER	Instrument ID	GC#2	Analyst	SS
Sampler	PK	Column	J & W DB-1	Date Reported	8/24/90

Client Sample ID/Description MW 3

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
74-87-3	Chloromethane	1 0	U	ug/L
75-01-4	Vinyl Chloride	1 0	U	ug/L
74-83-9	Bromomethane	1 0	U	ug/L
75 00 3	Chloroethane	1 0	U	ug/L
75-69 4	Trichlorofluoromethane	1 0	U	ug/L
75 35 4	1 1-Dichloroethene	1 0	U	ug/L
75 09-2	Dichloromethane	1 0	U	ug/L
156-60 5	trans 1,2 Dichloroethene	1 0	U	ug/L
75 34-3	1,1 Dichloroethane	1 0	U	ug/L
67-66 3	Chloroform	1 0	U	ug/L
107 06 2	1 2 Dichloroethane	1 0	U	ug/L
71-55-6	1 1 1 Trichloroethane	1 0	U	ug/L
56 23 5	Carbon Tetrachloride	1 0	U	ug/L
78 87 5	1,2 Dichloropropane	1 0	U	ug/L
79 01-6	Trichloroethene			
75 27 4	and Bromodichloromethane	1 0	U	ug/L
10061 01 5	cis-1,3 Dichloropropene	1 0	U	ug/L
10061 02 6	trans 1 3 Dichloropropene	1 0	U	ug/L
79 00 5	1 1 2 Trichloroethane	1 0	U	ug/L
124-48 1	Dibromochloromethane	1 0	U	ug/L
127 18 4	Tetrachloroethene	1 0	U	ug/L
108 90 7	Chlorobenzene	1 0	U	ug/L
75-25 2	Bromoform	1 0	U	ug/L
79 34-5	1 1 2,2-Tetrachloroethane	1 0	U	ug/L
541 73-1	1,3 Dichlorobenzene	1 0	U	ug/L
106-46 7	1 4 Dichlorobenzene	1 0	U	ug/L
95 50 1	1,2 Dichlorobenzene	1 0	U	ug/L
1634 04 4	tert Butyl methyl ether	1 0	U	ug/L
71 43 2	Benzene	1 0	U	ug/L
108 88 3	Toluene	1 0	U	ug/L
100 41-4	Ethylbenzene	1 0	U	ug/L
N/A	Xylenes (Total)	1 0	U	ug/L

74 97 5	Bromochloromethane-SS	104	%rec
98 08 8	a,a,a Trifluorotoluene SS	96	%rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by Charlie Jarman 8/31/90

Report of Analytical Data - Purgeable Halocarbons/Aromatics

Client	PG&E / BECTEL	Laboratory	GAINESVILLE	Date Sampled	8/17/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	83680	Date Received	8/17/90
Proj No	SEF 30619 A0	% Moisture	0 0	Date Extracted	N/A
Method	601/602	Dilution Factor	1 0	Date Analyzed	8/22/90
Matrix	WATER	Instrument ID	GC#2	Analyst	SS
Sampler	PK	Column	J & W DB-1	Date Reported	8/24/90

Client Sample ID/Description MW-4

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
74 87 3	Chloromethane	1 0	U	ug/L
75 01 4	Vinyl Chloride	1 0	U	ug/L
74 83 9	Bromomethane	1 0	U	ug/L
75 00 3	Chloroethane	1 0	U	ug/L
75 69 4	Trichlorofluoromethane	1 0	U	ug/L
75 35 4	1,1 Dichloroethene	1 0	U	ug/L
75 09 2	Dichloromethane	1 0	U	ug/L
156 60 5	trans 1,2 Dichloroethene	1 0	U	ug/L
75 34 3	1,1 Dichloroethane	1 0	U	ug/L
67 66 3	Chloroform	1 0	U	ug/L
107 06 2	1,2 Dichloroethane	1 0	U	ug/L
71 55 6	1,1,1-Trichloroethane	1 0	U	ug/L
56 23-5	Carbon Tetrachloride	1 0	U	ug/L
78 87 5	1,2 Dichloropropane	1 0	U	ug/L
79 01-6	Trichloroethene			
75 27 4	and Bromodichloromethane	1 0	U	ug/L
10061-01 5	cis 1,3 Dichloropropene	1 0	U	ug/L
10061-02 6	trans-1,3 Dichloropropene	1 0	U	ug/L
79 00 5	1,1,2 Trichloroethane	1 0	U	ug/L
124 48 1	Dibromochloromethane	1 0	U	ug/L
127 18 4	Tetrachloroethene	1 0	U	ug/L
108 90 7	Chlorobenzene	1 0	U	ug/L
75 25 2	Bromoform	1 0	U	ug/L
79 34-5	1,1,2,2 Tetrachloroethane	1 0	U	ug/L
541 73 1	1 3 Dichlorobenzene	1 0	U	ug/L
106 46 7	1,4 Dichlorobenzene	1 0	U	ug/L
95 50 1	1,2 Dichlorobenzene	1 0	U	ug/L
1634-04 4	tert Butyl methyl ether	1 0	U	ug/L
71 43 2	Benzene	1 0	U	ug/L
108 88 3	Toluene	1 0	U	ug/L
100 41-4	Ethylbenzene	1 0	U	ug/L
N/A	Xylenes (Total)	1 0	U	ug/L

74 97 5	Bromochloromethane-SS	90	%rec
98 08-8	a,a,a Trifluorotoluene-SS	100	%rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by Charlie Jarman 8/31/90

Report of Analytical Data Purgeable Halocarbons/Aromatics

Client	PG&E / BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/17/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	83681	Date Received	8/17/90
Proj No	SEF 30619 AD	% Moisture	0.0	Date Extracted	N/A
Method	601/602	Dilution Factor	1.0	Date Analyzed	8/22/90
Matrix	WATER	Instrument ID	GC#2	Analyst	SS
Sampler	PK	Column	J & W DB-1	Date Reported	8/24/90

Client Sample ID/Description MW-1 (N)

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
74-87-3	Chloromethane	1.0	U	ug/L
75-01-4	Vinyl Chloride	1.0	U	ug/L
74-83-9	Bromomethane	1.0	U	ug/L
75-00-3	Chloroethane	1.0	U	ug/L
75-69-4	Trichlorofluoromethane	1.0	U	ug/L
75-35-4	1,1-Dichloroethene	1.0	U	ug/L
75-09-2	Dichloromethane	1.0	U	ug/L
156-60-5	trans-1,2-Dichloroethene	1.0	U	ug/L
75-34-3	1,1-Dichloroethane	1.0	U	ug/L
67-66-3	Chloroform	1.0	U	ug/L
107-06-2	1,2-Dichloroethane	1.0	U	ug/L
71-55-6	1,1,1-Trichloroethane	1.0	U	ug/L
56-23-5	Carbon Tetrachloride	1.0	U	ug/L
78-87-5	1,2-Dichloropropane	1.0	U	ug/L
79-01-6	Trichloroethene			
75-27-4	and Bromodichloromethane	1.0	U	ug/L
10061-01-5	cis-1,3-Dichloropropene	1.0	U	ug/L
10061-02-6	trans-1,3-Dichloropropene	1.0	U	ug/L
79-00-5	1,1,2-Trichloroethane	1.0	U	ug/L
124-48-1	Dibromochloromethane	1.0	U	ug/L
127-18-4	Tetrachloroethene	1.0	U	ug/L
108-90-7	Chlorobenzene	1.0	U	ug/L
75-25-2	Bromoform	1.0	U	ug/L
79-34-5	1,1,2,2-Tetrachloroethane	1.0	U	ug/L
541-73-1	1,3-Dichlorobenzene	1.0	U	ug/L
106-46-7	1,4-Dichlorobenzene	1.0	U	ug/L
95-50-1	1,2-Dichlorobenzene	1.0	U	ug/L
1634-04-4	tert-Butyl methyl ether	1.0	U	ug/L
71-43-2	Benzene	1.0	U	ug/L
108-88-3	Toluene	1.0	U	ug/L
100-41-4	Ethylbenzene	1.0	U	ug/L
N/A	Xylenes (Total)	1.0	U	ug/L

74-97-5	Bromochloromethane	SS	108	%rec
98-08-8	o,p,p'-Trifluorotoluene	SS	90	%rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by Charles Jarman 8/31/90

Report of Analytical Data - Purgeable Halocarbons/Aromatics

Client	PG&E / BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/17/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	83682	Date Received	8/17/90
Proj No	SEF 30619 AD	% Moisture	0.0	Date Extracted	N/A
Method	601/602	Dilution Factor	1.0	Date Analyzed	8/22/90
Matrix	WATER	Instrument ID	GC#2	Analyst	SS
Sampler	PK	Column	J & W DB-1	Date Reported	8/24/90

Client Sample ID/Description MW 2

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
74 87 3	Chloromethane	1.0	U	ug/L
75 01 4	Vinyl Chloride	1.0	U	ug/L
74 83 9	Bromomethane	1.0	U	ug/L
75 00 3	Chloroethane	1.0	U	ug/L
75 69 4	Trichlorofluoromethane	1.0	U	ug/L
75 35 4	1,1 Dichloroethene	1.0	U	ug/L
75 09 2	Dichloromethane	1.0	U	ug/L
156 60 5	trans 1,2-Dichloroethene	1.0	U	ug/L
75-34-3	1,1-Dichloroethane	1.0	U	ug/L
67 66 3	Chloroform	1.0	U	ug/L
107 06 2	1,2 Dichloroethane	1.0	U	ug/L
71 55 6	1,1,1-Trichloroethane	1.0	U	ug/L
56 23 5	Carbon Tetrachloride	1.0	U	ug/L
78 87 5	1,2 Dichloropropane	1.0	U	ug/L
79 01-6	Trichloroethene			
75 27 4	and Bromodichloromethane	1.0	U	ug/L
10061 01 5	cis 1,3 Dichloropropene	1.0	U	ug/L
10061 02 6	trans 1,3 Dichloropropene	1.0	U	ug/L
79 00 5	1,1,2 Trichloroethane	1.0	U	ug/L
124 48 1	Dibromochloromethane	1.0	U	ug/L
127 18 4	Tetrachloroethene	1.0	U	ug/L
108 90 7	Chlorobenzene	1.0	U	ug/L
75-25 2	Bromoform	1.0	U	ug/L
79 34 5	1,1,1,2,2 Tetrachloroethane	1.0	U	ug/L
541 73-1	1,3 Dichlorobenzene	1.0	U	ug/L
106 46 7	1,4 Dichlorobenzene	1.0	U	ug/L
95-50 1	1,2 Dichlorobenzene	1.0	U	ug/L
1634 04 4	tert-Butyl methyl ether	1.0	U	ug/L
71 43 2	Benzene	1.0	U	ug/L
108-88-3	Toluene	1.0	U	ug/L
100 41 4	Ethylbenzene	1.0	U	ug/L
N/A	Xylenes (Total)	1.0	U	ug/L

74 97 5	Bromochloromethane SS	98	%rec
98 08 8	a,s,a Trifluorotoluene-SS	92	%rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by Charlie Jarman 8/31/90

Report of Analytical Data - Purgeable Halocarbons/Aromatics

Client	PG&E / BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/16/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	83683	Date Received	8/17/90
Proj No	SEF 30619 A0	% Moisture	0 0	Date Extracted	N/A
Method	601/602	Dilution Factor	1 0	Date Analyzed	8/22/90
Matrix	WATER	Instrument ID	GC#1	Analyst	SS
Sampler	PK	Column	J & W DB 624	Date Reported	8/24/90

Client Sample ID/Description PW-1

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
74-87-3	Chloromethane	1 0	U	ug/L
75 01-4	Vinyl Chloride	1 0	U	ug/L
74 83 9	Bromomethane	1 0	U	ug/L
75-00 3	Chloroethane	1 0	U	ug/L
75 69-4	Trichlorofluoromethane	1 0	U	ug/L
75 35-4	1,1-Dichloroethene	1 0	U	ug/L
75 09 2	Dichloromethane	1 0	U	ug/L
156-60-5	trans 1 2 Dichloroethene	1 0	U	ug/L
75 34 3	1,1-Dichloroethane	1 0	U	ug/L
67-66-3	Chloroform	1 0	U	ug/L
71-55 6	1,1 1 Trichloroethane	1 0	U	ug/L
56 23-5	Carbon Tetrachloride	1 0	U	ug/L
107 06 2	1,2-Dichloroethane	1 0	U	ug/L
79-01-6	Trichloroethene	1 0	U	ug/L
78-87 5	1,2-Dichloropropane	1 0	U	ug/L
75 27-4	Bromodichloromethane	1 0	U	ug/L
10061-01 5	cis 1,3 Dichloropropene	1 0	U	ug/L
10061 02 6	trans-1,3 Dichloropropene	1 0	U	ug/L
79-00 5	1,1 2 Trichloroethane	1 0	U	ug/L
127 18 4	Tetrachloroethene	1 0	U	ug/L
124 48 1	Dibromochloromethane	1 0	U	ug/L
108 90 7	Chlorobenzene	1 0	U	ug/L
75 25 2	Bromoform	1 0	U	ug/L
79-34 5	1,1 2,2-Tetrachloroethane	1 0	U	ug/L
541 73 1	1,3 Dichlorobenzene	1 0	U	ug/L
106 46-7	1,4 Dichlorobenzene	1 0	U	ug/L
95 50 1	1,2 Dichlorobenzene	1 0	U	ug/L
1634 04 4	tert-Butyl methyl ether	1 0	U	ug/L
71-43 2	Benzene	1 0	U	ug/L
108 88 3	Toluene	1 0	U	ug/L
100 41 4	Ethylbenzene	1 0	U	ug/L
N/A	Xylenes (Total)	1 0	U	ug/L

74 97 5	Bromochloromethane SS	100	%rec
98 08 8	a,a,a Trifluorotoluene-SS	94	%rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by

Charlie Garman 8/31/90

Report of Analytical Data Purgeable Halocarbons/Aromatics

Client	PG & E/BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/17/90
Project	INDIANTOWN COGENERATION PROJ	Lab Sample Id	83684	Date Received	8/17/90
Proj No	SEF 30619 A0	% Moisture	0.0	Date Extracted	N/A
Method	601/602	Dilution Factor	1.0	Date Analyzed	8/23/90
Matrix	WATER	Instrument ID	GC#2	Analyst	CJ
Sampler	PW	Column	J & W DB 1	Date Reported	8/31/90

Client Sample ID/Description TRAVEL BLANK

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
74-87-3	Chloromethane	1.0	U	ug/L
75-01-4	Vinyl Chloride	1.0	U	ug/L
74-83-9	Bromomethane	1.0	U	ug/L
75-00-3	Chloroethane	1.0	U	ug/L
75-69-4	Trichlorofluoromethane	1.0	U	ug/L
75-35-4	1,1-Dichloroethene	1.0	U	ug/L
75-09-2	Dichloromethane	1.0	U	ug/L
156-60-5	trans-1,2-Dichloroethene	1.0	U	ug/L
75-34-3	1,1-Dichloroethane	1.0	U	ug/L
67-66-3	Chloroform	1.0	U	ug/L
107-06-2	1,2-Dichloroethane	1.0	U	ug/L
71-55-6	1,1,1-Trichloroethane	1.0	U	ug/L
56-23-5	Carbon Tetrachloride	1.0	U	ug/L
78-87-5	1,2-Dichloropropane	1.0	U	ug/L
79-01-6	Trichloroethene			
75-27-4	and Bromodichloromethane	1.0	U	ug/L
10061-01-5	cis-1,3-Dichloropropene	1.0	U	ug/L
10061-02-6	trans-1,3-Dichloropropene	1.0	U	ug/L
79-00-5	1,1,2-Trichloroethane	1.0	U	ug/L
124-48-1	Dibromochloromethane	1.0	U	ug/L
127-18-4	Tetrachloroethene	1.0	U	ug/L
108-90-7	Chlorobenzene	1.0	U	ug/L
75-25-2	Bromoform	1.0	U	ug/L
79-34-5	1,1,2,2-Tetrachloroethane	1.0	U	ug/L
541-73-1	1,3-Dichlorobenzene	1.0	U	ug/L
106-46-7	1,4-Dichlorobenzene	1.0	U	ug/L
95-50-1	1,2-Dichlorobenzene	1.0	U	ug/L
1634-04-4	tert-Butyl methyl ether	1.0	U	ug/L
71-43-2	Benzene	1.0	U	ug/L
108-88-3	Toluene	1.0	U	ug/L
100-41-4	Ethylbenzene	1.0	U	ug/L
N/A	Xylenes (Total)	1.0	U	ug/L

74-97-5	Bromochloromethane-SS	108	%rec
98-08-8	a,a,a-Trifluorotoluene SS	93	%rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by

Charles Jarman 8/31/90

Report of Analytical Data - Purgeable Halocarbons/Aromatics

Client	PG & E/BECNTEL	Laboratory	GAINESVILLE	Date Sampled	8/21/90
Project	INDIANTOWN COGENERATION PROJ	Lab Sample Id	2VB08218H	Date Received	N/A
Proj No	SEF 30619 AD	% Moisture	0 0	Date Extracted	N/A
Method	601/602	Dilution Factor	1 0	Date Analyzed	8/21/90
Matrix	WATER	Instrument ID	GC#2	Analyst	CJ
Sampler	N/A	Column	J & W DB 1	Date Reported	8/31/90

Client Sample ID/Description OFW BLANK

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
74-87 3	Chloromethane	1 0	U	ug/L
75 01-4	Vinyl Chloride	1 0	U	ug/L
74 83 9	Bromomethane	1 0	U	ug/L
75 00 3	Chloroethane	1 0	U	ug/L
75 69 4	Trichlorofluoromethane	1 0	U	ug/L
75 35-4	1,1-Dichloroethene	1 0	U	ug/L
75 09 2	Dichloromethane	1 0	U	ug/L
156-60 5	trans 1,2 Dichloroethene	1 0	U	ug/L
75 34-3	1,1 Dichloroethane	1 0	U	ug/L
67 66-3	Chloroform	1 0	U	ug/L
107 06 2	1,2-Dichloroethane	1 0	U	ug/L
71 55 6	1,1,1 Trichloroethane	1 0	U	ug/L
56 23 5	Carbon Tetrachloride	1 0	U	ug/L
78 87 5	1,2 Dichloropropane	1 0	U	ug/L
79 01-6	Trichloroethene			
75 27 4	and Bromodichloromethane	1 0	U	ug/L
10061-01 5	cis 1,3-Dichloropropene	1 0	U	ug/L
10061 02-6	trans 1 3 Dichloropropene	1 0	U	ug/L
79 00-5	1,1,2 Trichloroethane	1 0	U	ug/L
124 48 1	Dibromochloromethane	1 0	U	ug/L
127 18 4	Tetrachloroethene	1 0	U	ug/L
108 90 7	Chlorobenzene	1 0	U	ug/L
75 25 2	Bromoform	1 0	U	ug/L
79 34-5	1 1,2,2-Tetrachloroethane	1 0	U	ug/L
541 73-1	1,3-Dichlorobenzene	1 0	U	ug/L
106 46-7	1,4-Dichlorobenzene	1 0	U	ug/L
95 50-1	1,2 Dichlorobenzene	1 0	U	ug/L
1634 04 4	tert-Butyl methyl ether	1 0	U	ug/L
71 43 2	Benzene	1 0	U	ug/L
108 88-3	Toluene	1 0	U	ug/L
100-41-4	Ethylbenzene	1 0	U	ug/L
N/A	Xylenes (Total)	1 0	U	ug/L

74 97 5	Bromochloromethane SS	110	%rec
98 08 8	a a,a Trifluorotoluene SS	96	%rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by Charles Jarman 8/31/90

Report of Analytical Data - Purgeable Halocarbons/Aromatics

Client	PG&E / BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/22/90
Project	INDIAN TOWN COGENERATION PROJECT	Lab Sample Id	1VB0822A	Date Received	N/A
Proj No	SEF 30619 AD	% Moisture	0.0	Date Extracted	N/A
Method	601/602	Dilution Factor	1.0	Date Analyzed	8/22/90
Matrix	WATER	Instrument ID	GC#1	Analyst	SS
Sampler	N/A	Column	J & W DB-624	Date Reported	8/24/90

Client Sample ID/Description OFW BLANK

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
74-87-3	Chloromethane	1.0	U	ug/L
75-01-4	Vinyl Chloride	1.0	U	ug/L
74-83-9	Bromomethane	1.0	U	ug/L
75-00-3	Chloroethane	1.0	U	ug/L
75-69-4	Trichlorofluoromethane	1.0	U	ug/L
75-35-4	1,1-Dichloroethene	1.0	U	ug/L
75-09-2	Dichloromethane	1.0	U	ug/L
156-60-5	trans 1,2 Dichloroethene	1.0	U	ug/L
75-34-3	1,1 Dichloroethane	1.0	U	ug/L
67-66-3	Chloroform	1.0	U	ug/L
71-55-6	1,1,1 Trichloroethane	1.0	U	ug/L
56-23-5	Carbon Tetrachloride	1.0	U	ug/L
107-06-2	1,2 Dichloroethane	1.0	U	ug/L
79-01-6	Trichloroethene	1.0	U	ug/L
78-87-5	1,2-Dichloropropane	1.0	U	ug/L
75-27-4	Bromodichloromethane	1.0	U	ug/L
10061-01-5	cis 1,3 Dichloropropene	1.0	U	ug/L
10061-02-6	trans 1,3 Dichloropropene	1.0	U	ug/L
79-00-5	1,1,2 Trichloroethane	1.0	U	ug/L
127-18-4	Tetrachloroethene	1.0	U	ug/L
124-48-1	Dibromochloromethane	1.0	U	ug/L
108-90-7	Chlorobenzene	1.0	U	ug/L
75-25-2	Bromoform	1.0	U	ug/L
79-34-5	1,1,2,2 Tetrachloroethane	1.0	U	ug/L
541-73-1	1,3 Dichlorobenzene	1.0	U	ug/L
106-46-7	1,4-Dichlorobenzene	1.0	U	ug/L
95-50-1	1,2 Dichlorobenzene	1.0	U	ug/L
1634-04-4	tert-Butyl methyl ether	1.0	U	ug/L
71-43-2	Benzene	1.0	U	ug/L
108-88-3	Toluene	1.0	U	ug/L
100-41-4	Ethylbenzene	1.0	U	ug/L
N/A	Xylenes (Total)	1.0	U	ug/L

74-97-5	Bromochloromethane SS		103	%rec
98-08-8	a,a,a Trifluorotoluene SS		99	%rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by Charlie Jarman 8/31/90

Report of Analytical Data Purgeable Halocarbons/Aromatics

Client	PG&E / BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/22/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	2VB0822AH	Date Received	N/A
Proj No	SEF 30619 A0	% Moisture	0 0	Date Extracted	N/A
Method	601/602	Dilution Factor	1 0	Date Analyzed	8/22/90
Matrix	WATER	Instrument ID	GC#2	Analyst	SS
Sampler	N/A	Column	J & W DB 1	Date Reported	8/24/90

Client Sample ID/Description OFW BLANK

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
74-87 3	Chloromethane	1 0	U	ug/L
75 01-4	Vinyl Chloride	1 0	U	ug/L
74 83 9	Bromomethane	1 0	U	ug/L
75-00-3	Chloroethane	1 0	U	ug/L
75 69 4	Trichlorofluoromethane	1 0	U	ug/L
75 35-4	1 1 Dichloroethene	1 0	U	ug/L
75-09 2	Dichloromethane	1 0	U	ug/L
156 60 5	trans 1 2 Dichloroethene	1 0	U	ug/L
75 34 3	1,1 Dichloroethane	1 0	U	ug/L
67-66 3	Chloroform	1 0	U	ug/L
107 06 2	1 2 Dichloroethane	1 0	U	ug/L
71 55 6	1 1,1-Trichloroethane	1 0	U	ug/L
56 23 5	Carbon Tetrachloride	1 0	U	ug/L
78 87 5	1,2-Dichloropropane	1 0	U	ug/L
79 01-6	Trichloroethene			
75 27 4	and Bromodichloromethane	1 0	U	ug/L
10061 01 5	cis 1,3 Dichloropropene	1 0	U	ug/L
10061 02 6	trans 1 3 Dichloropropene	1 0	U	ug/L
79 00 5	1 1,2 Trichloroethane	1 0	U	ug/L
124 48 1	Dibromochloromethane	1 0	U	ug/L
127 18-4	Tetrachloroethene	1 0	U	ug/L
108 90 7	Chlorobenzene	1 0	U	ug/L
75 25 2	Bromoform	1 0	U	ug/L
79-34 5	1,1,2 2-Tetrachloroethane	1 0	U	ug/L
541 73 1	1 3 Dichlorobenzene	1 0	U	ug/L
106 46 7	1,4 Dichlorobenzene	1 0	U	ug/L
95 50-1	1 2 Dichlorobenzene	1 0	U	ug/L
1634 04 4	tert Butyl methyl ether	1 0	U	ug/L
71 43 2	Benzene	1 0	U	ug/L
108 88 3	Toluene	1 0	U	ug/L
100-41 4	Ethylbenzene	1 0	U	ug/L
N/A	Xylenes (Total)	1 0	U	ug/L

74 97-5	Bromochloromethane SS		92	%rec
98 08 8	a a,a-Trifluorotoluene SS		94	%rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by Charlie Jarman 8/31/90



Engineers
Planners
Economists
Scientists

Client PG & E/BECHTEL/INDIANTOWN COGENERATION PROJ
Attention JEFF LEHNEN
Address. CH2M HILL GAINESVILLE OFFICE

Sample Number 83679-84
Date Received 08/17/90

Dear Client

The Gainesville Organics Laboratory received your samples with a request for analysis of selected parameters

The analytical results are enclosed No unusual difficulties were encountered in the analyses

If you should have any questions concerning the results please contact us Thank you

Sincerely,

Don Hash
Client Services



Engineers
Planners
Economists
Scientists

CH2M Hill Organics Laboratory
Analytical Report

Report Contents

Sample Information

Definitions of Reporting Qualifiers

Description of Analytical Methods

Sample Quantitation Reports including Surrogate Recoveries

QA/QC Package Including

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Continuing Calibration (Daily Standard) (*)

Quantitation Reports for Organic-Free Water Blanks

Matrix Spike/Matrix Spike Duplicate (*)

Surrogate Control Charts (*)

Chromatograms (*)

Copy of Chain-of-Custody

(*) Information provided where applicable or when requested

SAMPLE INFORMATION

Client: PG & E/BECHTEL/INDIANTOWN COGENERATION PROJ
Attention: JEFF LEHNEN
Address: CH2M HILL GAINESVILLE OFFICE

Description: WATER SAMPLES
INDIANTOWN COGENERATION PROJ
504 (EDB) ANALYSIS

Sample Number 83679-84
Quantity 6
Date Received 08/17/90
Date Completed 08/21/90
Date Reported 09/07/90
Project Number SEF 30619 A0
Number of Pages 12

The information shown in this report is test data only
and no interpretation of this data is intended or implied.

State of Alabama Certification No. 40080

State of Florida Certification No 82112, E82124

Respectfully submitted,


Tom Emenhiser
Laboratory Manager



Engineers
Planners
Economists
Scientists

Definitions of Reporting Qualifiers

- (U) Indicates the compound was analyzed for but not detected. The number adjacent to the "U" qualifier indicates the Detection Limit for that compound. The detection limit can vary from sample to sample depending on dilution factors or percent moisture adjustment when indicated.
- (M) Matrix interference precludes achieving lower detection limit. The detection limit is determined by the largest peak in the sample, and the dilution is adjusted so that neither chemical nor electronic overload of the gas chromatography system takes place. Either condition could affect the reliability of peak identification and quantitation.
- (F) Presence indicated but less than stated detection limit. In a diluted sample, a clearly defined peak was present at less than the stated detection limit.
- (N) Sample contains non-target compounds. Many samples, especially "fuel" samples, often contain non-target compounds. This qualifier is used to alert the client to the presence of non-target compounds in samples that may not contain any of the listed "target" compounds.

Detection Limit = 10 ug/l for water samples and 10 ug/kg for soil and sediment samples unless noted otherwise

Note the minimum detection limit for methanol extracts of high-level soil and sediment samples is 50 ug/kg due to the effect of methanol on "purging efficiency"

Analytical Methods

Purgeable Halocarbons in Water: EPA Method 601 as described in the Title 40 Code of Federal Regulations, Part 136, Appendix A, July, 1988, and CH2M Hill GC Volatiles SOP, October, 1988.

Purgeable Aromatics in Water EPA Method 602 as described in the Title 40 Code of Federal Regulations, Part 136, Appendix A, July, 1988, and CH2M Hill GC Volatiles SOP, October, 1988

Purgeable Halocarbons in Soil and Sediment: EPA Method 8010 as described in Test Methods for Evaluating Solid Waste (SW-846) and CH2M Hill GC Volatiles SOP, October, 1988

Purgeable Aromatics in Soil EPA Method 8020 as described in Test Methods for Evaluating Solid Waste (SW-846) and CH2M Hill GC Volatiles SOP, October, 1988

Trihalomethanes in Water: EPA Method 501.1 as described in the Federal Register, Vol 44, No 231, Appendix C, and CH2M Hill Volatiles SOP, October, 1988

Ethylene Dibromide in Water EPA Method 504 (1,2-dibromomethane and 1,2-dibromo-3-chloropropane in water by microextraction and gas chromatography).

Fuel Screening Procedure for estimation of concentration and identification of "fuel" samples; used to assist in determination of required EPA methods for subsequent analysis. This methodology is not an established EPA procedure.

State of Alabama Certification Number: 40080

State of Florida Certification Numbers 82112 and E82124

Report of Analytical Data - EDB and DBCP

Client	PG & E/BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/17/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	83679E	Date Received	8/17/90
Proj No	SEF 30619 A0	% Moisture	0 00	Date Extracted	8/20/90
Method	504	Dilution Factor	1 00	Date Analyzed	8/21/90
Matrix	WATER	Instrument ID	GC#3	Analyst	JEH
Sampler	N/A	Column	J & W DB 624	Date Reported	8/28/90

Client Sample ID/Description MW-3

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
106 93 4	1,2 Dibromoethane	0 02	U	ug/L
96 12-8	1,2-Dibromo-3 chloropropane	0 02	U	ug/L

79 34 5 1,1,2,2 Tetrachloroethane SS

112 %rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by Charles Farman 9/7/90

Report of Analytical Data - EDB and DBCP

Client	PG & E/BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/17/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	83680E	Date Received	8/17/90
Proj No	SEF 30619 A0	% Moisture	0 00	Date Extracted	8/20/90
Method	504	Dilution Factor	1 00	Date Analyzed	8/21/90
Matrix	WATER	Instrument ID	GC#3	Analyst	JEN
Sampler	N/A	Column	J & W DB-624	Date Reported	8/28/90

Client Sample ID/Description MW 4

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
106-93 4	1,2-Dibromoethane	0 02	U	ug/L
96 12 8	1,2 Dibromo 3 chloropropane	0 02	U	ug/L

79 34 5	1,1,2,2 Tetrachloroethane-SS	109	%rec
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U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by Charlie Garman 9/7/90

Report of Analytical Data EDB and DBCP

Client	PG & E/BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/17/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	83681E	Date Received	8/17/90
Proj No	SEF 30619 A0	% Moisture	0 00	Date Extracted	8/20/90
Method	504	Dilution Factor	1 00	Date Analyzed	8/21/90
Matrix	WATER	Instrument ID	GC#3	Analyst	JEH
Sampler	N/A	Column	J & W DB 624	Date Reported	8/28/90

Client Sample ID/Description MW 1

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
106 93 4	1 2 Dibromoethane	0 02	U	ug/L
96 12 8	1,2 Dibromo 3-chloropropane	0 02	U	ug/L

79 34 5	1,1,2,2 Tetrachloroethane SS	110	%rec
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U = Compound analyzed for but not detected
 SS = Surrogate Standard reported as percent recovery

Reviewed by Charles Jarman 9/7/90

Report of Analytical Data EDB and DBCP

Client	PG & E/BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/17/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	83682E	Date Received	8/17/90
Proj No	SEF 30619 A0	% Moisture	0 00	Date Extracted	8/20/90
Method	504	Dilution Factor	1 00	Date Analyzed	8/21/90
Matrix	WATER	Instrument ID	GC#3	Analyst	JEN
Sampler	N/A	Column	J & W DB 624	Date Reported	8/28/90

Client Sample ID/Description MW-2

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
106 93 4	1,2 Dibromoethane	0 02	U	ug/L
96 12 8	1,2 Dibromo-3 chloropropane	0 02	U	ug/L

79 34 5	1,1,2,2 Tetrachloroethane-SS	113	%rec
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U = Compound analyzed for but not detected
 SS = Surrogate Standard reported as percent recovery

Reviewed by Charles Jarman 9/7/90

Report of Analytical Data EDB and DBCP

Client	PG & E/BECHTEL	Laboratory	GAINESVILLE	Date Sampled	8/16/90
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	83683E	Date Received	8/17/90
Proj No	SEF 30619 A0	% Moisture	0 00	Date Extracted	8/20/90
Method	504	Dilution Factor	1 00	Date Analyzed	8/21/90
Matrix	WATER	Instrument ID	GC#3	Analyst	JEN
Sampler	N/A	Column	J & W DB 624	Date Reported	8/28/90

Client Sample ID/Description PW 1

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
106 93-4	1,2-Dibromoethane	0 02	U	ug/L
96-12 8	1,2 Dibromo 3 chloropropane	0 02	U	ug/L

79 34-5	1,1,2,2 Tetrachloroethane SS	103	%rec
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U = Compound analyzed for but not detected
 SS = Surrogate Standard reported as percent recovery

Reviewed by Charlie Jarman 9/7/90

Report of Analytical Data - EDB and DBCP

Client	PG & E/BECHTEL	Laboratory	GAINESVILLE	Date Sampled	N/A
Project	INDIANTOWN COGENERATION PROJECT	Lab Sample Id	3V80821E	Date Received	N/A
Proj No	SEF 30619 A0	% Moisture	0 00	Date Extracted	8/21/90
Method	504	Dilution Factor	1 00	Date Analyzed	8/21/90
Matrix	WATER	Instrument ID	GC#3	Analyst	JEH
Sampler	N/A	Column	J & W DB-624	Date Reported	8/28/90

Client Sample ID/Description OFW BLANK

CAS Number	Compound	Reporting Limit	Sample Result	Reporting Units
106 93-4	1,2 Dibromoethane	0 02	U	ug/L
96 12-8	1,2 Dibromo 3-chloropropene	0 02	U	ug/L

79 34 5 1,1,2,2-Tetrachloroethane SS

114 %rec

U = Compound analyzed for but not detected

SS = Surrogate Standard reported as percent recovery

Reviewed by Charles Jannan 9/7/90

CHM HILL QUALITY ANALYTICS

CHAIN OF CUSTODY RECORD

70 LMC

PROJECT NUMBER SEF 30619 A		PROJECT NAME Indiantown Cogenertor Pw		CLIENT ADDRESS AND PHONE NUMBER		FOR LAB USE ONLY	
CLIENT NAME PG & E/Bechtel				ANALYSES REQUESTED EDB 504 Metals S = Attached List 608 615 SWW HAST per NEES REF		LAB# 16619	
PROJECT MANAGER Jeff Lehnen/GNV		COPY TO Pete Kwiatkowski/DFB				LAB#	
REQUESTED COMP DATE 8/27/90		SAMPLING REQUIREMENTS SDWA ☐ NPDES ☐ RCRA ☐ OTHER ☐		LAB ID		PROJECT NO	
STA NO		DATE				ACK	
TIME		C O M A B I L		NO OF SAMP		PG	
SAMPLE DESCRIPTIONS (12 CHARACTERS)		REMARKS		QUOTE#		BS	
MW-3 8/17/90 0950 X MW-3		9		83679 001		See attached list for anal	
MW-4 " 1050 X MW-4		9		80 002			
MW-1 " 1100 X MW-1		9		81 003			
MW-2 " 1330 X MW-2		9		82 004			
PW-1 8/16/90 1100 X PW-1		9		83 005		Dues...	
				84			
				83685		10 Day TAT No multiplier	
						Results to be fresh Due 8-27-90 QC level 1 830 90 per Sine	
						Felix Report to Don/mkt	
HAZWRAP/NEESA Y N		QC LEVEL 1 2 3		COC		ICE	
GC EV 102 3		ANA REQ		CUST SEAL		PH	
SAMPLE COND WATER							
SAMPLED BY AND TITLE Jeff Lehnen Hydrologist		DATE/TIME 8/17/90		RELINQUISHED BY JEFF LEHNEN / PIM		DATE/TIME 8-17-90 / 8 45 PM	
RECEIVED BY Jeff Lehnen		DATE/TIME 8/20/90 0900		RELINQUISHED BY M. Morgan		DATE/TIME 8-20-90 1440	
RECEIVED BY Jeff Lehnen		DATE/TIME 8-17-90 8 47		RELINQUISHED BY		DATE/TIME	
RECEIVED BY LAB Lehnen		DATE/TIME		SAMPLE SHIPPED VIA UPS ☒ FED-EX ☐ HAND ☐ OTHER		AIR BILL#	
REMARKS 10-Day TAT per Tom Erenhuver		033 413 236 0 501		ENTERED INTO LIMS		COC REVIEWED	

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CH2HILL QUALITY ANALYTICS
CHAIN OF CUSTODY RECORD

PROJECT NUMBER SEF 30619 A		PROJECT NAME Indian town Cogeneration Plant		CLIENT ADDRESS AND PHONE NUMBER								FOR LAB USE ONLY							
CLIENT NAME PG & E / Bechtel												LAB# AAD 241							
PROJECT MANAGER Jeff Lehnen / GNV				COPY TO Pete Kuriakowski / DFB								LAB#							
REQUESTED COMP DATE 8/27/90				SAMPLING REQUIREMENTS SDWA NPDES RCRA OTHER ☐ ☐ ☐								PROJECT NO.							
STA NO	DATE	TIME	CMP	GRAIL	SAMPLE DESCRIPTIONS (12 CHARACTERS)	# OF CONTAINERS	EDB	Metals	SEE ATTACHED LIST	LOW	MID	HIGH						ACK	VERIFIED
MW-3	8/17/90	0950	X		MW-3	9				X	X		836	79				QUOTE#	BS
MW-4	"	1050	X		MW-4	9				X	X			80			NO OF SAMP	PG	OF
MW-1	"	1100	X		MW-1	9				X	X			81			REMARKS See attached list for analyses Bore sent to ARJ		
MW-2	"	1330	X		MW-2	9				X	X			82					
PW-1	8/16/90	1100	X		PW-1	9				X	X			83					
					mud 7 ft method blank	3								84					
SAMPLED BY AND TITLE Peter J. Kuriakowski Hydrologist				DATE/TIME 8/17/90				RELINQUISHED BY JEFF LEHNEN / PIN				DATE/TIME 8-17-90 / 8:45 PM				HAZWRAP/NEESA Y N			
RECEIVED BY				DATE/TIME				RELINQUISHED BY				DATE/TIME				QC LEVEL 1 2 3			
RECEIVED BY				DATE/TIME				RELINQUISHED BY				DATE/TIME				COC y ICE			
RECEIVED BY				DATE/TIME				RELINQUISHED BY				DATE/TIME				ANA REQ y TEMP			
RECEIVED BY LAB Levens Synch				DATE/TIME 8-17-90 8:47				SAMPLE SHIPPED VIA UPS BUS FED-EX HAND OTHER				AIR BILL#				CUST SEAL y Ph			
REMARKS 10-Day TAT per Tom Ehrenhu...												ENTERED INTO LIMS				COC REVIEW			

10 5 1 3 Groundwater Impacts (4 3)

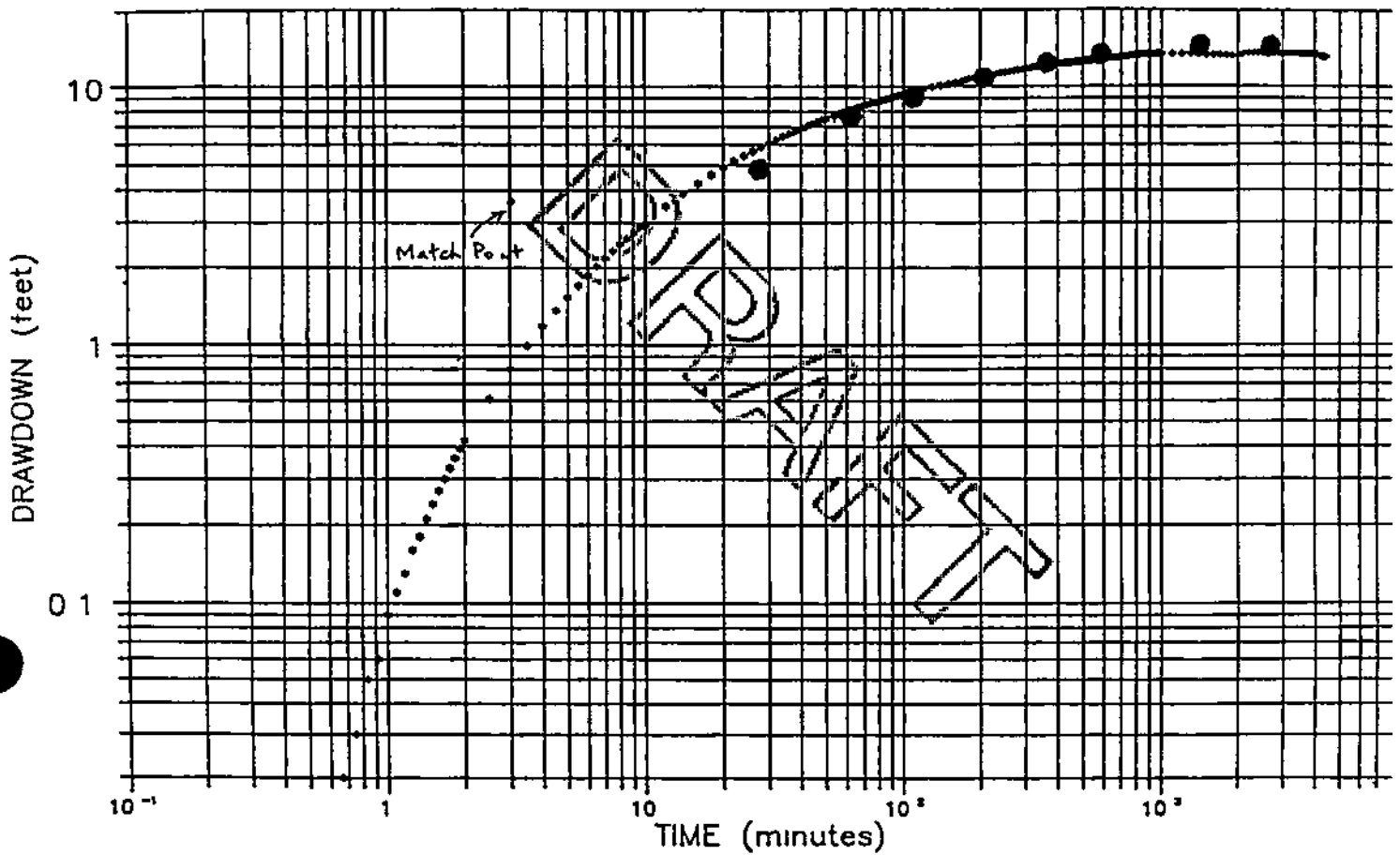
- Calibration of PLASM Groundwater Flow Simulations with the Onsite Aquifer Performance Test
- Dewatering at the Coal Unloading Excavation Site Scenario 1
Dewatering for 180 Days During the Wet Season
- Dewatering at the Coal Unloading Excavation Site Scenario 2
Dewatering for 180 Days During the Dry Season
- Dewatering at the Coal Unloading Excavation Site Scenario 3
Dewatering for 90 Days Under Drought Conditions
- Theis Analytical Model of Dewatering the Circulation Line Excavation for 45 Days

**CALIBRATION OF PLASM GROUNDWATER FLOW SIMULATIONS
WITH THE ONSITE AQUIFER PERFORMANCE TEST (With Computer
Printout for t = 02 Days as example)**

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

POW-2
Walton Method



Comparison of drawdowns observed in Layer 3 during the onsite
aquifer performance test and simulated drawdowns using PLASM

● Drawdown predicted by model simulation

MULTILAYER AQUIFER, VARIABLE PROPERTIES, MULTIPLE WELLS

NO OF ROWS= 21
 NO OF LAYERS= 3
 NO. OF TIME STEPS= 5
 INITIAL TIME STEP (DAY)= 2.0E-02
 ERROR TOLERANCE (FT)= 5
 WATER BALANCE TOLERANCE (PERCENT)= 5
 DELTA FACTOR= 2

LAYER: 1
 TT= 3300
 S1= 1
 HH= 0
 QQ= 0
 RR= 3.0E-02

LAYER. 2
 TT= 1500
 S1= 4 0E-04
 HH= 0
 QQ= 0
 RR= .002

LAYER: 3
 TT= 5600
 S1= 1.0E-04
 HH= 0
 QQ= 0
 RR= .002
 UNIFORM GRID SPACING= 200 FT.
 NODE DATA

			T1,T2=	S1,Q=	LEAKAGE=
1	1	1	3300 3300	29920 0	1200
1	2	1	3300 3300	29920 0	1200
1	3	1	3300 3300	29920 0	1200
1	4	1	3300 3300	29920 0	1200
1	5	1	3300 3300	29920 0	1200
1	6	1	3300 3300	29920 0	1200
1	7	1	3300 3300	29920 0	1200
1	8	1	3300 3300	29920 0	1200
1	9	1	3300 3300	29920 0	1200
1	10	1	3300 3300	29920 0	1200
1	11	1	3300 3300	29920 0	1200
1	12	1	3300 3300	29920 0	1200
1	13	1	3300 3300	29920 0	1200
1	14	1	3300 3300	29920 0	1200
1	15	1	3300 3300	29920 0	1200
1	16	1	3300 3300	29920 0	1200
1	17	1	3300 3300	29920 0	1200
1	18	1	3300 3300	29920 0	1200
1	19	1	3300 3300	29920 0	1200
1	20	1	3300 3300	29920 0	1200
1	21	1	0 3300	29920 0	1200
2	1	1	3300 3300	29920 0	1200
2	2	1	3300 3300	29920 0	1200

2	3	1	3300	3300	29920	0	1200
2	4	1	3300	3300	29920	0	1200
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2	6	1	3300	3300	29920	0	1200
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2	8	1	3300	3300	29920	0	1200
2	9	1	3300	3300	29920	0	1200
2	10	1	3300	3300	29920	0	1200
2	11	1	3300	3300	29920	0	1200
2	12	1	3300	3300	29920	0	1200
2	13	1	3300	3300	29920	0	1200
2	14	1	3300	3300	29920	0	1200
2	15	1	3300	3300	29920	0	1200
2	16	1	3300	3300	29920	0	1200
2	17	1	3300	3300	29920	0	1200
2	18	1	3300	3300	29920	0	1200
2	19	1	3300	3300	29920	0	1200
2	20	1	3300	3300	29920	0	1200
2	21	1	0	3300	29920	0	1200
3	1	1	3300	3300	29920	0	1200
3	2	1	3300	3300	29920	0	1200
3	3	1	3300	3300	29920	0	1200
3	4	1	3300	3300	29920	0	1200
3	5	1	3300	3300	29920	0	1200
3	6	1	3300	3300	29920	0	1200
3	7	1	3300	3300	29920	0	1200
3	8	1	3300	3300	29920	0	1200
3	9	1	3300	3300	29920	0	1200
3	10	1	3300	3300	29920	0	1200
3	11	1	3300	3300	29920	0	1200
3	12	1	3300	3300	29920	0	1200
3	13	1	3300	3300	29920	0	1200
3	14	1	3300	3300	29920	0	1200
3	15	1	3300	3300	29920	0	1200
3	16	1	3300	3300	29920	0	1200
3	17	1	3300	3300	29920	0	1200
3	18	1	3300	3300	29920	0	1200
3	19	1	3300	3300	29920	0	1200
3	20	1	3300	3300	29920	0	1200
3	21	1	0	3300	29920	0	1200
4	1	1	3300	3300	29920	0	1200
4	2	1	3300	3300	29920	0	1200
4	3	1	3300	3300	29920	0	1200
4	4	1	3300	3300	29920	0	1200
4	5	1	3300	3300	29920	0	1200
4	6	1	3300	3300	29920	0	1200
4	7	1	3300	3300	29920	0	1200
4	8	1	3300	3300	29920	0	1200
4	9	1	3300	3300	29920	0	1200
4	10	1	3300	3300	29920	0	1200
4	11	1	3300	3300	29920	0	1200
4	12	1	3300	3300	29920	0	1200
4	13	1	3300	3300	29920	0	1200
4	14	1	3300	3300	29920	0	1200
4	15	1	3300	3300	29920	0	1200
4	16	1	3300	3300	29920	0	1200
4	17	1	3300	3300	29920	0	1200
4	18	1	3300	3300	29920	0	1200
4	19	1	3300	3300	29920	0	1200
4	20	1	3300	3300	29920	0	1200

4	21	1	0	3300	29920	0	1200
5	1	1	3300	3300	29920	0	1200
5	2	1	3300	3300	29920	0	1200
5	3	1	3300	3300	29920	0	1200
5	4	1	3300	3300	29920	0	1200
5	5	1	3300	3300	29920	0	1200
5	6	1	3300	3300	29920	0	1200
5	7	1	3300	3300	29920	0	1200
5	8	1	3300	3300	29920	0	1200
5	9	1	3300	3300	29920	0	1200
5	10	1	3300	3300	29920	0	1200
5	11	1	3300	3300	29920	0	1200
5	12	1	3300	3300	29920	0	1200
5	13	1	3300	3300	29920	0	1200
5	14	1	3300	3300	29920	0	1200
5	15	1	3300	3300	29920	0	1200
5	16	1	3300	3300	29920	0	1200
5	17	1	3300	3300	29920	0	1200
5	18	1	3300	3300	29920	0	1200
5	19	1	3300	3300	29920	0	1200
5	20	1	3300	3300	29920	0	1200
5	21	1	0	3300	29920	0	1200
6	1	1	3300	3300	29920	0	1200
6	2	1	3300	3300	29920	0	1200
6	3	1	3300	3300	29920	0	1200
6	4	1	3300	3300	29920	0	1200
6	5	1	3300	3300	29920	0	1200
6	6	1	3300	3300	29920	0	1200
6	7	1	3300	3300	29920	0	1200
6	8	1	3300	3300	29920	0	1200
6	9	1	3300	3300	29920	0	1200
6	10	1	3300	3300	29920	0	1200
6	11	1	3300	3300	29920	0	1200
6	12	1	3300	3300	29920	0	1200
6	13	1	3300	3300	29920	0	1200
6	14	1	3300	3300	29920	0	1200
6	15	1	3300	3300	29920	0	1200
6	16	1	3300	3300	29920	0	1200
6	17	1	3300	3300	29920	0	1200
6	18	1	3300	3300	29920	0	1200
6	19	1	3300	3300	29920	0	1200
6	20	1	3300	3300	29920	0	1200
6	21	1	0	3300	29920	0	1200
7	1	1	3300	3300	29920	0	1200
7	2	1	3300	3300	29920	0	1200
7	3	1	3300	3300	29920	0	1200
7	4	1	3300	3300	29920	0	1200
7	5	1	3300	3300	29920	0	1200
7	6	1	3300	3300	29920	0	1200
7	7	1	3300	3300	29920	0	1200
7	8	1	3300	3300	29920	0	1200
7	9	1	3300	3300	29920	0	1200
7	10	1	3300	3300	29920	0	1200
7	11	1	3300	3300	29920	0	1200
7	12	1	3300	3300	29920	0	1200
7	13	1	3300	3300	29920	0	1200
7	14	1	3300	3300	29920	0	1200
7	15	1	3300	3300	29920	0	1200
7	16	1	3300	3300	29920	0	1200
7	17	1	3300	3300	29920	0	1200

7	18	1	3300	3300	29920	0	1200
7	19	1	3300	3300	29920	0	1200
7	20	1	3300	3300	29920	0	1200
7	21	1	0	3300	29920	0	1200
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8	2	1	3300	3300	29920	0	1200
8	3	1	3300	3300	29920	0	1200
8	4	1	3300	3300	29920	0	1200
8	5	1	3300	3300	29920	0	1200
8	6	1	3300	3300	29920	0	1200
8	7	1	3300	3300	29920	0	1200
8	8	1	3300	3300	29920	0	1200
8	9	1	3300	3300	29920	0	1200
8	10	1	3300	3300	29920	0	1200
8	11	1	3300	3300	29920	0	1200
8	12	1	3300	3300	29920	0	1200
8	13	1	3300	3300	29920	0	1200
8	14	1	3300	3300	29920	0	1200
8	15	1	3300	3300	29920	0	1200
8	16	1	3300	3300	29920	0	1200
8	17	1	3300	3300	29920	0	1200
8	18	1	3300	3300	29920	0	1200
8	19	1	3300	3300	29920	0	1200
8	20	1	3300	3300	29920	0	1200
8	21	1	0	3300	29920	0	1200
9	1	1	3300	3300	29920	0	1200
9	2	1	3300	3300	29920	0	1200
9	3	1	3300	3300	29920	0	1200
9	4	1	3300	3300	29920	0	1200
9	5	1	3300	3300	29920	0	1200
9	6	1	3300	3300	29920	0	1200
9	7	1	3300	3300	29920	0	1200
9	8	1	3300	3300	29920	0	1200
9	9	1	3300	3300	29920	0	1200
9	10	1	3300	3300	29920	0	1200
9	11	1	3300	3300	29920	0	1200
9	12	1	3300	3300	29920	0	1200
9	13	1	3300	3300	29920	0	1200
9	14	1	3300	3300	29920	0	1200
9	15	1	3300	3300	29920	0	1200
9	16	1	3300	3300	29920	0	1200
9	17	1	3300	3300	29920	0	1200
9	18	1	3300	3300	29920	0	1200
9	19	1	3300	3300	29920	0	1200
9	20	1	3300	3300	29920	0	1200
9	21	1	0	3300	29920	0	1200
10	1	1	3300	3300	29920	0	1200
10	2	1	3300	3300	29920	0	1200
10	3	1	3300	3300	29920	0	1200
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12	21	3	0	5600	29 92	0	80
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13	19	3	5600	5600	29 92	0	80
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14	2	3	5600	5600	29.92	0	80
14	3	3	5600	5600	29.92	0	80
14	4	3	5600	5600	29 92	0	80
14	5	3	5600	5600	29.92	0	80
14	6	3	5600	5600	29.92	0	80
14	7	3	5600	5600	29.92	0	80
14	8	3	5600	5600	29 92	0	80

14	9	3	5600	5600	29	92	0	80
14	10	3	5600	5600	29.92	0	80	
14	11	3	5600	5600	29.92	0	80	
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14	18	3	5600	5600	29.92	0	80	
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15	18	3	5600	5600	29	92	0	80
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16	9	3	5600	5600	29.92	0	80	
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16	12	3	5600	5600	29.92	0	80	
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16	19	3	5600	5600	29.92	0	80	
16	20	3	5600	5600	29	92	0	80
16	21	3	0	5600	29	92	0	80
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17	2	3	5600	5600	29.92	0	80	
17	3	3	5600	5600	29.92	0	80	
17	4	3	5600	5600	29	92	0	80
17	5	3	5600	5600	29	92	0	80

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20	16	3	5600	5600	29.92	0	80	
20	17	3	5600	5600	29.92	0	80	
20	18	3	5600	5600	29	92	0	80
20	19	3	5600	5600	29.92	0	80	
20	20	3	5600	5600	29.92	0	80	
20	21	3	0	5600	29	92	0	80
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21	3	3	5600	0	29.92	0	80	
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21	8	3	5600	0	29	92	0	80
21	9	3	5600	0	29	92	0	80
21	10	3	5600	0	29.92	0	80	
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21	12	3	5600	0	29.92	0	80	
21	13	3	5600	0	29	92	0	80
21	14	3	5600	0	29	92	0	80
21	15	3	5600	0	29.92	0	80	
21	16	3	5600	0	29	92	0	80
21	17	3	5600	0	29	92	0	80
21	18	3	5600	0	29	92	0	80
21	19	3	5600	0	29.92	0	80	
21	20	3	5600	0	29	92	0	80
21	21	3	0	0	29.92	0	80	

NO. OF ITERATIONS= 4

TIME= 1.0E-02 DAY

WATER BALANCE RESULTS FOR LAYER. 1

CONVERGENCE ERROR= 0 PERCENT

TOTAL TEST ERROR= 3 007139 FT

PUMPAGE FROM THIS LAYER= 0 GPD

CHANGE IN AQUIFER STORAGE=-34.2066 GPD

NET UPWARD LEAKAGE= 0 GPD

NET DOWNWARD LEAKAGE= 35 24517 GPD

WATER BALANCE RESULTS FOR LAYER. 2

CONVERGENCE ERROR= 0 PERCENT

TOTAL TEST ERROR= 3 007139 FT

PUMPAGE FROM THIS LAYER= 0 GPD

CHANGE IN AQUIFER STORAGE=-5272 814 GPD

NET UPWARD LEAKAGE=-35.24517 GPD

NET DOWNWARD LEAKAGE= 5420 6 GPD

WATER BALANCE RESULTS FOR LAYER 3

CONVERGENCE ERROR= 3.117764 PERCENT
TOTAL TEST ERROR= 3 007139 FT
PUMPAGE FROM THIS LAYER= 216000 GPD
CHANGE IN AQUIFER STORAGE=-204048.6 GPD
NET UPWARD LEAKAGE=-5420 6 GPD
NET DOWNWARD LEAKAGE= 0 GPD

24

HEADS FOR LAYER: 1

-	0.00-	0 00-	0 00-	0.00-	0.00-	0.00-	0 00-	0 00-	0.00-	0.00-	0.00
-	0 00-	0.00-	0 00-	0.00-	0.00-	0 00-	0.00-	0 00-	0 00-	0.00-	0.00
-	0.00-	0.00-	0 00-	0.00-	0.00-	0 00-	0 00-	0.00-	0.00-	0.00-	0.00
-	0.00-	0.00-	0.00-	0 00-	0 00-	0.00-	0 00-	0.00-	0 00-	0.00-	0.00
-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0.00-	0.00-	0.00-	0.00-	0 00
-	0 00-	0.00-	0.00-	0.00-	0 00-	0.00-	0 00-	0.00-	0.00-	0.00-	0 00
-	0 00-	0 00-	0.00-	0 00-	0.00-	0 00-	0.00-	0 00-	0.00-	0 00-	0 00
-	0 00-	0 00-	0.00-	0 00-	0.00-	0 00-	0.00-	0.00-	0.00-	0.00-	0 00
-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00-	0.00-	0.00-	0 00
-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00-	0.00-	0.00-	0 00-	0 00	0 00
-	0.00-	0 00-	0.00-	0.00-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00
-	0.00-	0 00-	0.00-	0.00-	0.00-	0.00-	0 00-	0.00-	0 00-	0.00	0 00
-	0.00-	0.00-	0.00-	0 00-	0.00-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00
-	0 00-	0 00-	0 00-	0.00-	0.00-	0.00-	0 00-	0.00-	0 00-	0 00	0 00
-	0.00-	0 00-	0.00-	0 00-	0 00-	0.00-	0 00-	0.00-	0 00-	0 00-	0 00
-	0 00-	0 00-	0.00-	0 00-	0 00-	0.00-	0 00-	0.00-	0 00-	0 00	0 00

-	0.00-	0 00-	0.00-	0 00-	0 00-	0.00-	0 00-	0.00-	0.00-	0.00-	0 00
-	0.00-	0.00-	0.00-	0.00-	0.00-	0.00-	0.00-	0 00-	0 00-	0 00	
-	0.00-	0.00-	0 00-	0 00-	0 00-	0.00-	0.00-	0 00-	0 00-	0.00-	0.00
-	0.00-	0.00-	0 00-	0.00-	0.00-	0.00-	0 00-	0 00-	0.00-	0 00	
-	0 00-	0 00-	0.00-	0.00-	0.00-	0.00-	0 00-	0 00-	0.00-	0.00-	0.00
-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00-	0.00-	0.00-	0 00-	0 00	
-	0 00-	0 00-	0.00-	0.00-	0.00-	0.00-	0.00-	0 00-	0 00-	0 00-	0.00
-	0 00-	0.00-	0.00-	0 00-	0 00-	0 00-	0 00-	0.00-	0.00-	0.00	
-	0 00-	0.00-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00
-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00	
-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00-	0 00-	0.00-	0.00-	0 00-	0 00
-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00-	0 00-	0.00-	0 00	
-	0 00-	0 00-	0.00-	0 00-	0.00-	0.00-	0.00-	0.00-	0 00-	0.00-	0 00
-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00-	0.00-	0 00-	0 00-	0.00	
-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00
-	0 00-	0 00-	0 00-	0 00-	0.00-	0.00-	0.00-	0 00-	0 00-	0 00	
-	0 00-	0.00-	0 00-	0 00-	0.00-	0.00-	0.00-	0.00-	0 00-	0 01-	0 03
-	0 01-	0.00-	0.00-	0 00-	0 00-	0.00-	0.00-	0.00-	0 00-	0.00	
-	0.00-	0 00-	0.00-	0 00-	0 00-	0.00-	0 00-	0.00-	0.00-	0.03-	0 06
-	0.03-	0 00-	0.00-	0 00-	0 00-	0.00-	0.00-	0.00-	0 00-	0 00	
-	0 00-	0.00-	0.00-	0 00-	0 00-	0.00-	0 00-	0 00-	0 00-	0 01-	0.02
-	0 01-	0 00-	0 00-	0.00-	0 00-	0 00-	0.00-	0.00-	0 00-	0 00	
-	0 00-	0 00-	0.00-	0.00-	0 00-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00
-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00-	0.00-	0.00	

-	0 00-	0.00-	0.00-	0.00-	0.00-	0 00-	0.01-	0 02-	0 03-	0.04-	0 04
-	0.04-	0.03-	0.02-	0.01-	0 00-	0.00-	0 00-	0.00-	0 00-	0.00	

-	0.00-	0.00-	0.00-	0.00-	0.00-	0.01-	0 02-	0.04-	0.06-	0.08-	0 09
-	0.08-	0 06-	0 04-	0.02-	0.01-	0.00-	0.00-	0.00-	0.00-	0.00	

-	0 00-	0.00-	0.00-	0.00-	0.01-	0.02-	0.05-	0.08-	0.13-	0 19-	0 22
-	0.19-	0.13-	0.08-	0 05-	0.02-	0.01-	0.00-	0.00-	0.00-	0.00	

-	0.00-	0.00-	0 00-	0 00-	0.02-	0.04-	0.08-	0.16-	0 28-	0.44-	0 54
-	0 44-	0 28-	0 16-	0.08-	0.04-	0 02-	0.00-	0.00-	0 00-	0.00	

-	0 00-	0 00-	0 00-	0 01-	0.03-	0.06-	0.13-	0.28-	0 55-	0.99-	1.39
-	0 99-	0 55-	0.28-	0 13-	0.06-	0.03-	0 01-	0 00-	0.00-	0 00	

-	0.00-	0 00-	0.00-	0.02-	0 04-	0 08-	0 19-	0.44-	0 99-	2.12-	3 84
-	2.12-	0.99-	0 44-	0 19-	0 08-	0 04-	0.02-	0 00-	0.00-	0 00	

-	0 00-	0 00-	0.00-	0.02-	0 04-	0 09-	0 22-	0.54-	1 39-	3.84-	11 85
-	3.84-	1.39-	0.54-	0 22-	0 09-	0.04-	0 02-	0 00-	0.00-	0 00	

-	0 00-	0 00-	0.00-	0.02-	0 04-	0.08-	0.19-	0 44-	0 99-	2 12-	3 84
-	2.12-	0.99-	0 44-	0 19-	0 08-	0 04-	0 02-	0 00-	0 00-	0.00	

-	0.00-	0 00-	0.00-	0.01-	0.03-	0 06-	0 13-	0.28-	0.55-	0 99-	1 39
-	0.99-	0.55-	0 28-	0.13-	0.06-	0.03-	0 01-	0.00-	0.00-	0 00	

-	0.00-	0 00-	0.00-	0 00-	0.02-	0 04-	0.08-	0 16-	0 28-	0.44-	0.54
-	0.44-	0.28-	0 16-	0 08-	0.04-	0 02-	0.00-	0.00-	0.00-	0.00	

-	0 00-	0 00-	0 00-	0 00-	0 01-	0 02-	0 05-	0.08-	0.13-	0 19-	0.22
-	0.19-	0.13-	0.08-	0.05-	0.02-	0 01-	0.00-	0 00-	0 00-	0 00	

-	0.00-	0 00-	0 00-	0 00-	0 00-	0.01-	0 02-	0.04-	0.06-	0.08-	0 09
-	0.08-	0 06-	0 04-	0 02-	0.01-	0.00-	0.00-	0.00-	0.00-	0 00	

-	0 00-	0.00-	0.00-	0.00-	0 00-	0 00-	0 01-	0 02-	0.03-	0.04-	0.04
-	0 04-	0 03-	0 02-	0 01-	0 00-	0.00-	0 00-	0 00-	0 00-	0.00	

-	0.00-	0 00-	0 00-	0.00-	0.00-	0.00-	0.00-	0.00-	0.01-	0.02-	0 02
-	0 02-	0 01-	0 00-	0.00-	0 00-	0 00-	0 00-	0.00-	0.00-	0.00	

-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00-	0.00-	0.00-	0 00-	0.00-	0.00
-	0.00-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0.00-	0.00-	0.00	

-	0.00-	0 00-	0.00-	0.00-	0 00-	0.00-	0.00-	0.00-	0.00-	0.00-	0 00
-	0 00-	0.00-	0.00-	0.00-	0.00-	0.00-	0.00-	0 00-	0.00-	0 00	

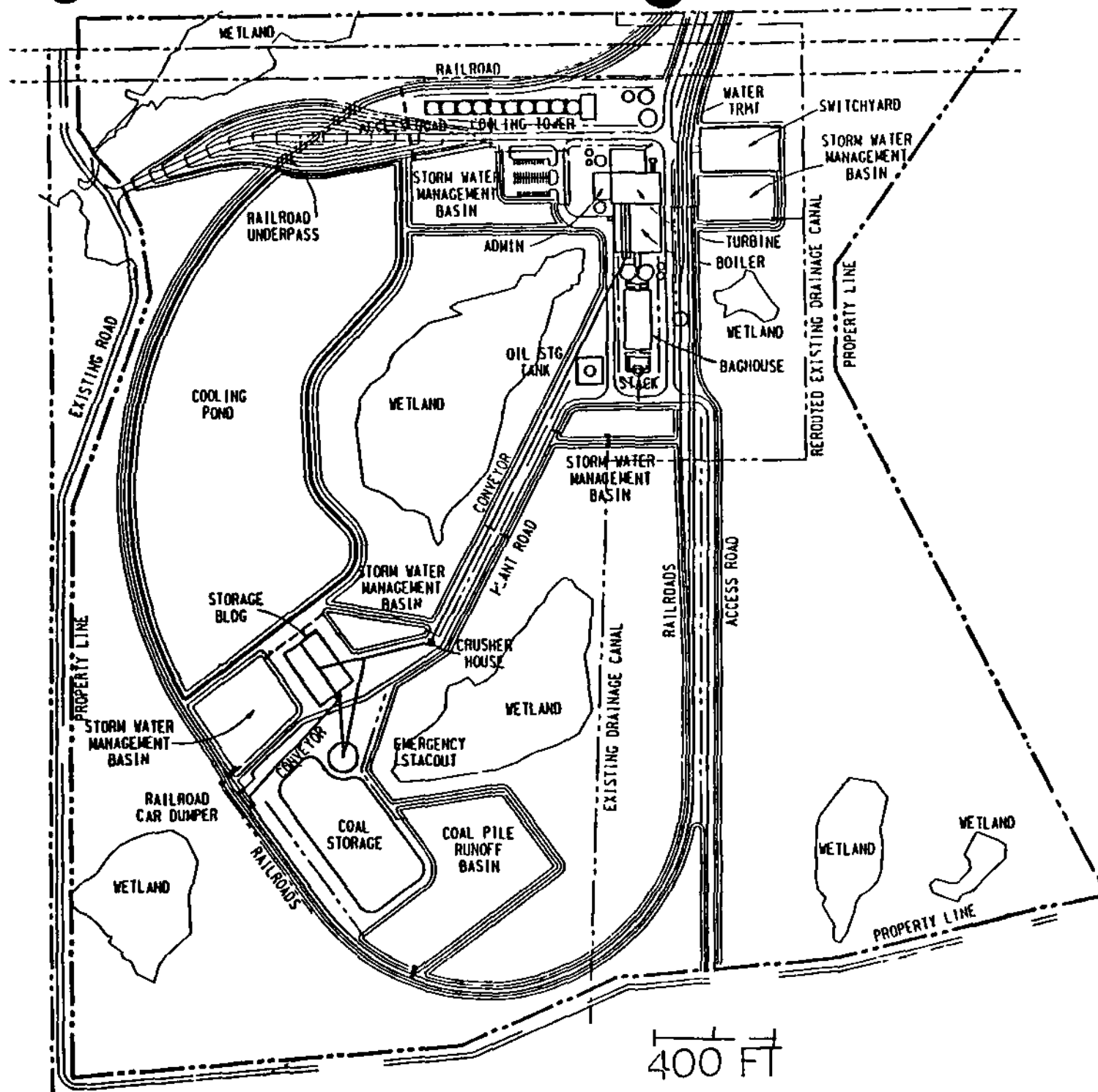
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DEWATERING AT THE COAL UNLOADING EXCAVATION SITE

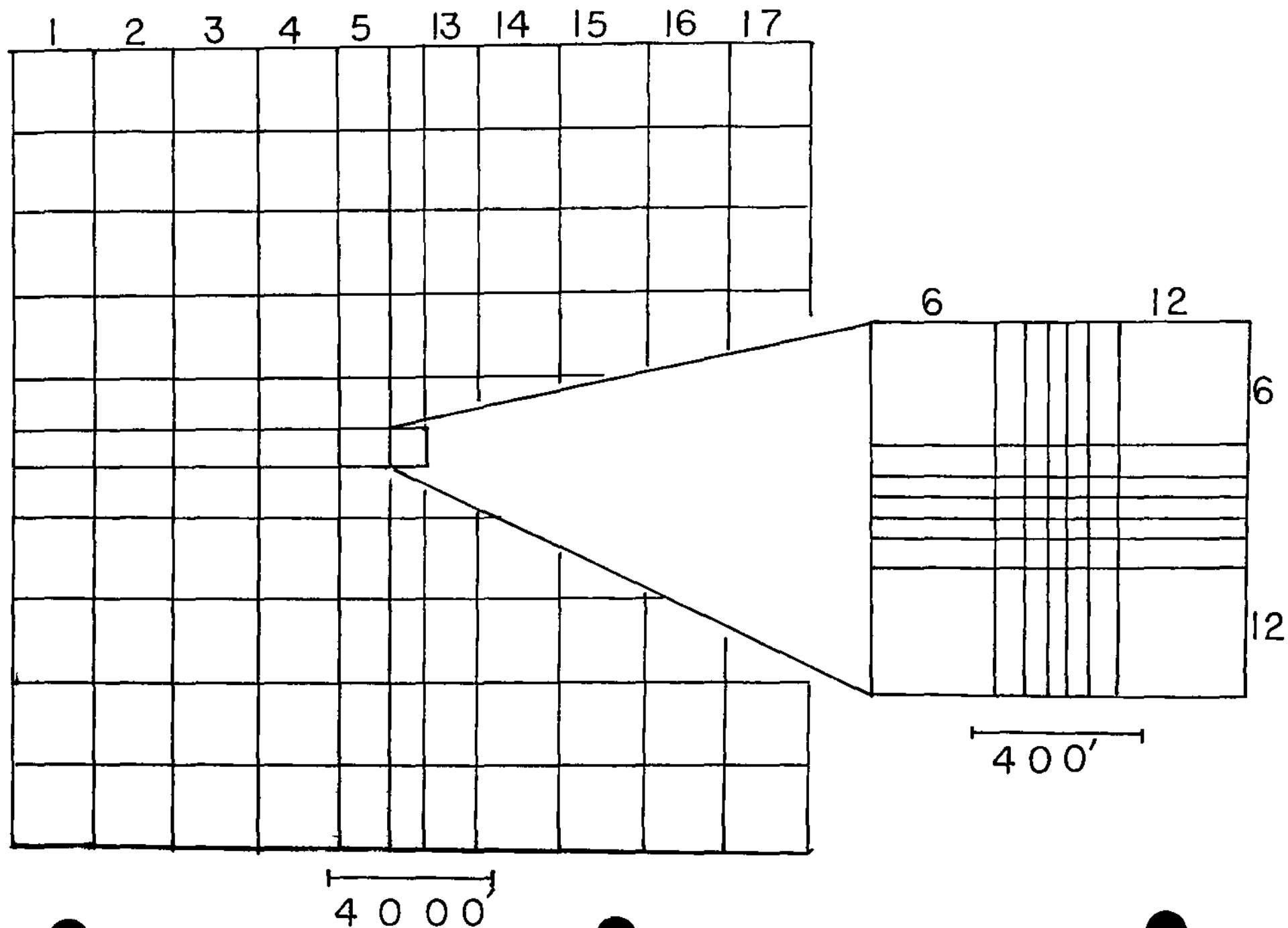
Scenario 1 Dewatering for 180 days during the wet season

DEWATERING AT THE COAL UNLOADING EXCAVATION SITE

Site location and model grid



Model grid used to simulate dewatering at 1 coal unloading excavation site



MULTILAYER AQUIFER, VARIABLE PROPERTIES, MULTIPLE WELLS

NO OF ROWS= 17
 NO OF LAYERS= 2
 NO. OF TIME STEPS= 20
 INITIAL TIME STEP (DAY)= 38 33764
 ERROR TOLERANCE (FT)= 5
 WATER BALANCE TOLERANCE (PERCENT)= 5
 DELTA FACTOR= 1.2

LAYER: 1
 TT= 3300
 S1= .15
 HH= 0
 QQ= 0
 RR= .05

LAYER: 2
 TT= 1500
 S1= 4.0E-04
 HH= 0
 QQ= 0
 RR= .002
 VARIABLE GRID SPACINGS
 NODE DATA

			T1,T2=		S1,Q=		LEAKAGE=
1	1	1	3300	3300	4488000	0	200000
1	2	1	3300	3300	4488000	0	200000
1	3	1	3300	3300	4488000	0	200000
1	4	1	3300	3300	4488000	0	200000
1	5	1	13200	2062 5	2805000	0	125000
1	6	1	66000	495	673200	0	30000
1	7	1	132000	123 75	168300	0	7500
1	8	1	132000	82 5	112200	0	5000
1	9	1	132000	82 5	112200	0	5000
1	10	1	132000	82 5	112200	0	5000
1	11	1	66000	123 75	168300	0	7500
1	12	1	13200	495	673200	0	30000
1	13	1	3300	2062 5	2805000	0	125000
1	14	1	3300	3300	4488000	0	200000
1	15	1	3300	3300	4488000	0	200000
1	16	1	3300	3300	4488000	0	200000
1	17	1	0	3300	4488000	0	200000
2	1	1	3300	3300	4488000	0	200000
2	2	1	3300	3300	4488000	0	200000
2	3	1	3300	3300	4488000	0	200000
2	4	1	3300	3300	4488000	0	200000
2	5	1	13200	2062 5	2805000	0	125000
2	6	1	66000	495	673200	0	30000
2	7	1	132000	123 75	168300	0	7500
2	8	1	132000	82 5	112200	0	5000
2	9	1	132000	82.5	112200	0	5000
2	10	1	132000	82 5	112200	0	5000
2	11	1	66000	123 75	168300	0	7500
2	12	1	13200	495	673200	0	30000
2	13	1	3300	2062 5	2805000	0	125000

2	14	1	3300	3300	4488000	0	200000
2	15	1	3300	3300	4488000	0	200000
2	16	1	3300	3300	4488000	0	200000
2	17	1	0	3300	4488000	0	200000
3	1	1	3300	3300	4488000	0	200000
3	2	1	3300	3300	4488000	0	200000
3	3	1	3300	3300	4488000	0	200000
3	4	1	3300	3300	4488000	0	200000
3	5	1	13200	2062 5	2805000	0	125000
3	6	1	66000	495	673200	0	30000
3	7	1	132000	123.75	168300	0	7500
3	8	1	132000	82 5	112200	0	5000
3	9	1	132000	82 5	112200	0	5000
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6	7	1	19800	2475	25245	0	1125
6	8	1	19800	1650	16830	0	750
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7	7	1	4950	4950	6311.25	0	281.25
7	8	1	4950	3300	4207.5	0	187.5
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13	13	1	2062 5	2062.5	1753125	0	78125
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8	11	2	750	2250	11.22	0	7.5
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8	13	2	37.5	37500	187	0	125
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9	7	2	1500	2250	11.22	0	7.5
9	8	2	1500	1500	7.48	0	5
9	9	2	1500	1500	7.48	93600	0
9	10	2	1500	1500	7.48	0	5
9	11	2	750	2250	11.22	0	7.5
9	12	2	150	9000	44.88	0	30
9	13	2	37.5	37500	187	0	125
9	14	2	37.5	60000	299.2	0	200
9	15	2	37.5	60000	299.2	0	200
9	16	2	37.5	60000	299.2	0	200
9	17	2	0	60000	299.2	0	200
10	1	2	37.5	60000	299.2	0	200
10	2	2	37.5	60000	299.2	0	200
10	3	2	37.5	60000	299.2	0	200
10	4	2	37.5	60000	299.2	0	200
10	5	2	150	37500	187	0	125
10	6	2	750	9000	44.88	0	30
10	7	2	1500	2250	11.22	0	7.5
10	8	2	1500	1500	7.48	0	5

10	9	2	1500	1500	7.48	0	5
10	10	2	1500	1500	7.48	0	5
10	11	2	750	2250	11.22	0	7.5
10	12	2	150	9000	44.88	0	30
10	13	2	37.5	37500	187	0	125
10	14	2	37.5	60000	299.2	0	200
10	15	2	37.5	60000	299.2	0	200
10	16	2	37.5	60000	299.2	0	200
10	17	2	0	60000	299.2	0	200
11	1	2	56.25	30000	448.8	0	300
11	2	2	56.25	30000	448.8	0	300
11	3	2	56.25	30000	448.8	0	300
11	4	2	56.25	30000	448.8	0	300
11	5	2	225	18750	280.5	0	187.5
11	6	2	1125	4500	67.32	0	45
11	7	2	2250	1125	16.83	0	11.25
11	8	2	2250	750	11.22	0	7.5
11	9	2	2250	750	11.22	0	7.5
11	10	2	2250	750	11.22	0	7.5
11	11	2	1125	1125	16.83	0	11.25
11	12	2	225	4500	67.32	0	45
11	13	2	56.25	18750	280.5	0	187.5
11	14	2	56.25	30000	448.8	0	300
11	15	2	56.25	30000	448.8	0	300
11	16	2	56.25	30000	448.8	0	300
11	17	2	0	30000	448.8	0	300
12	1	2	225	6000	1795.2	0	1200
12	2	2	225	6000	1795.2	0	1200
12	3	2	225	6000	1795.2	0	1200
12	4	2	225	6000	1795.2	0	1200
12	5	2	900	3750	1122	0	750
12	6	2	4500	900	269.28	0	180
12	7	2	9000	225	67.32	0	45
12	8	2	9000	150	44.88	0	30
12	9	2	9000	150	44.88	0	30
12	10	2	9000	150	44.88	0	30
12	11	2	4500	225	67.32	0	45
12	12	2	900	900	269.28	0	180
12	13	2	225	3750	1122	0	750
12	14	2	225	6000	1795.2	0	1200
12	15	2	225	6000	1795.2	0	1200
12	16	2	225	6000	1795.2	0	1200
12	17	2	0	6000	1795.2	0	1200
13	1	2	937.5	1500	7480	0	5000
13	2	2	937.5	1500	7480	0	5000
13	3	2	937.5	1500	7480	0	5000
13	4	2	937.5	1500	7480	0	5000
13	5	2	3750	937.5	4675	0	3125
13	6	2	18750	225	1122	0	750
13	7	2	37500	56.25	280.5	0	187.5
13	8	2	37500	37.5	187	0	125
13	9	2	37500	37.5	187	0	125
13	10	2	37500	37.5	187	0	125
13	11	2	18750	56.25	280.5	0	187.5
13	12	2	3750	225	1122	0	750
13	13	2	937.5	937.5	4675	0	3125
13	14	2	937.5	1500	7480	0	5000
13	15	2	937.5	1500	7480	0	5000
13	16	2	937.5	1500	7480	0	5000
13	17	2	0	1500	7480	0	5000

14	1	2	1500	1500	11968	0	8000
14	2	2	1500	1500	11968	0	8000
14	3	2	1500	1500	11968	0	8000
14	4	2	1500	1500	11968	0	8000
14	5	2	6000	937.5	7480	0	5000
14	6	2	30000	225	1795.2	0	1200
14	7	2	60000	56.25	448.8	0	300
14	8	2	60000	37.5	299.2	0	200
14	9	2	60000	37.5	299.2	0	200
14	10	2	60000	37.5	299.2	0	200
14	11	2	30000	56.25	448.8	0	300
14	12	2	6000	225	1795.2	0	1200
14	13	2	1500	937.5	7480	0	5000
14	14	2	1500	1500	11968	0	8000
14	15	2	1500	1500	11968	0	8000
14	16	2	1500	1500	11968	0	8000
14	17	2	0	1500	11968	0	8000
15	1	2	1500	1500	11968	0	8000
15	2	2	1500	1500	11968	0	8000
15	3	2	1500	1500	11968	0	8000
15	4	2	1500	1500	11968	0	8000
15	5	2	6000	937.5	7480	0	5000
15	6	2	30000	225	1795.2	0	1200
15	7	2	60000	56.25	448.8	0	300
15	8	2	60000	37.5	299.2	0	200
15	9	2	60000	37.5	299.2	0	200
15	10	2	60000	37.5	299.2	0	200
15	11	2	30000	56.25	448.8	0	300
15	12	2	6000	225	1795.2	0	1200
15	13	2	1500	937.5	7480	0	5000
15	14	2	1500	1500	11968	0	8000
15	15	2	1500	1500	11968	0	8000
15	16	2	1500	1500	11968	0	8000
15	17	2	0	1500	11968	0	8000
16	1	2	1500	1500	11968	0	8000
16	2	2	1500	1500	11968	0	8000
16	3	2	1500	1500	11968	0	8000
16	4	2	1500	1500	11968	0	8000
16	5	2	6000	937.5	7480	0	5000
16	6	2	30000	225	1795.2	0	1200
16	7	2	60000	56.25	448.8	0	300
16	8	2	60000	37.5	299.2	0	200
16	9	2	60000	37.5	299.2	0	200
16	10	2	60000	37.5	299.2	0	200
16	11	2	30000	56.25	448.8	0	300
16	12	2	6000	225	1795.2	0	1200
16	13	2	1500	937.5	7480	0	5000
16	14	2	1500	1500	11968	0	8000
16	15	2	1500	1500	11968	0	8000
16	16	2	1500	1500	11968	0	8000
16	17	2	0	1500	11968	0	8000
17	1	2	1500	0	11968	0	8000
17	2	2	1500	0	11968	0	8000
17	3	2	1500	0	11968	0	8000
17	4	2	1500	0	11968	0	8000
17	5	2	6000	0	7480	0	5000
17	6	2	30000	0	1795.2	0	1200
17	7	2	60000	0	448.8	0	300
17	8	2	60000	0	299.2	0	200
17	9	2	60000	0	299.2	0	200

17	10	2	60000	0	299.2	0	200
17	11	2	30000	0	448.8	0	300
17	12	2	6000	0	1795.2	0	1200
17	13	2	1500	0	7480	0	5000
17	14	2	1500	0	11968	0	8000
17	15	2	1500	0	11968	0	8000
17	16	2	1500	0	11968	0	8000
17	17	2	0	0	11968	0	8000

NO OF ITERATIONS= 2

TIME= 186.6881 DAY

WATER BALANCE RESULTS FOR LAYER. 1

CONVERGENCE ERROR= 0 PERCENT

TOTAL TEST ERROR= .1010838 FT

PUMPAGE FROM THIS LAYER= 0 GPD

CHANGE IN AQUIFER STORAGE=-219 9946 GPD

NET UPWARD LEAKAGE= 0 GPD

NET DOWNWARD LEAKAGE= 93672 47 GPD

WATER BALANCE RESULTS FOR LAYER: 2

CONVERGENCE ERROR= 7.992983E-02 PERCENT

TOTAL TEST ERROR= .1010838 FT

PUMPAGE FROM THIS LAYER= 93600 GPD

CHANGE IN AQUIFER STORAGE=-2 404079 GPD

NET UPWARD LEAKAGE=-93672.47 GPD

NET DOWNWARD LEAKAGE= 0 GPD

HEADS FOR LAYER. 1

-	0 00-	0.00-	0 00-	0.00-	0.00-	0 00-	0 00-	0.00-	0 00-	0.00-	0 00
-	0.00-	0 00-	0.00-	0 00-	0 00-	0.00					
-	0 00-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0.00-	0 00
-	0.00-	0 00-	0.00-	0.00-	0.00-	0.00					
-	0.00-	0.00-	0.00-	0 00-	0.00-	0.00-	0.00-	0 00-	0.00-	0.00-	0 00
-	0.00-	0 00-	0.00-	0.00-	0 00-	0.00					
-	0 00-	0 00-	0 00-	0.00-	0.01-	0.01-	0.01-	0 01-	0 01-	0.01-	0 01
-	0.01-	0.01-	0.00-	0 00-	0.00-	0 00					
-	0.00-	0.00-	0.00-	0 01-	0 09-	0.13-	0.14-	0 14-	0.14-	0.14-	0.14
-	0 13-	0 09-	0 01-	0.00-	0.00-	0 00					
-	0 00-	0 00-	0.00-	0 01-	0 13-	0 32-	0 34-	0 34-	0.35-	0 34-	0 34
-	0 32-	0.13-	0.01-	0 00-	0 00-	0 00					
-	0 00-	0.00-	0.00-	0.01-	0 14-	0.34-	0 37-	0 38-	0.39-	0 38-	0 37
-	0.34-	0.14-	0 01-	0 00-	0 00-	0 00					
-	0 00-	0.00-	0 00-	0 01-	0 14-	0 34-	0.38-	0 40-	0.40-	0 40-	0.38
-	0 34-	0 14-	0 01-	0.00-	0.00-	0.00					

-	0 00-	0 00-	0 00-	0 01-	0 14-	0.35-	0.39-	0.40-	0.40-	0.40-	0 39
-	0.35-	0.14-	0 01-	0.00-	0 00-	0.00					

-	0 00-	0 00-	0.00-	0 01-	0 14-	0.34-	0.38-	0 40-	0 40-	0 40-	0 38
-	0 34-	0 14-	0.01-	0 00-	0.00-	0 00					

-	0 00-	0 00-	0.00-	0.01-	0.14-	0 34-	0 37-	0 38-	0.39-	0 38-	0 37
-	0 34-	0 14-	0.01-	0.00-	0.00-	0.00					

-	0.00-	0.00-	0 00-	0.01-	0 13-	0 32-	0 34-	0.34-	0.35-	0 34-	0.34
-	0.32-	0.13-	0 01-	0.00-	0 00-	0 00					

-	0 00-	0 00-	0 00-	0 01-	0.09-	0.13-	0 14-	0.14-	0.14-	0 14-	0 14
-	0 13-	0.09-	0 01-	0 00-	0 00-	0 00					

-	0 00-	0 00-	0 00-	0 00-	0 01-	0.01-	0.01-	0 01-	0 01-	0 01-	0 01
-	0 01-	0.01-	0 00-	0 00-	0 00-	0 00					

-	0 00-	0.00-	0.00-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00
-	0 00-	0.00-	0.00-	0.00-	0.00-	0.00					

-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00-	0.00-	0.00-	0 00-	0 00
-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00					

-	0 00-	0 00-	0 00-	0.00-	0 00-	0.00-	0.00-	0 00-	0 00-	0 00-	0 00
-	0.00-	0 00-	0 00-	0.00-	0 00-	0.00					

HEADS FOR LAYER: 2

-	0 00-	0 00-	0.00-	0 00-	0 00-	0.00-	0.00-	0 00-	0 00-	0 00-	0 00
-	0.00-	0 00-	0.00-	0 00-	0 00-	0.00					

-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00
-	0 00-	0.00-	0 00-	0.00-	0.00-	0 00					

-	0 00-	0 00-	0 00-	0 01-	0 04-	0 04-	0.04-	0 04-	0.04-	0 04-	0.04
-	0.04-	0 04-	0.01-	0 00-	0.00-	0 00					

-	0.00-	0 00-	0 01-	0 07-	0.29-	0.35-	0 35-	0 35-	0.35-	0.35-	0 35
-	0 35-	0 29-	0 07-	0 01-	0.00-	0.00					

-	0 00-	0.00-	0.04-	0 29-	2 07-	3 34-	3.45-	3.48-	3 49-	3 48-	3.45
-	3 34-	2.07-	0.29-	0 04-	0 00-	0 00					

-	0 00-	0 00-	0 04-	0 35-	3 34-	9.80-	11.28-	11.76-	11 95-	11 76-	11 28
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- 9 80- 3-34--0-35- 0 04- 0.00- 0.00

- 0.00- 0 00- 0.04- 0.35- 3 45- 11.28- 15.34- 17 41- 18.64- 17 41- 15 34
- 11 28- 3 45- 0.35- 0 04- 0.00- 0.00

- 0 00- 0 00- 0 04- 0.35- 3 48- 11 76- 17 41- 21.57- 25 76- 21 57- 17.41
- 11.76- 3 48- 0.35- 0.04- 0 00- 0.00

- 0.00- 0 00- 0 04- 0 35- 3.49- 11.95- 18.64- 25 76- 41.36- 25.76- 18.64
- 11 95- 3 49- 0.35- 0.04- 0 00- 0.00

- 0.00- 0.00- 0 04- 0.35- 3 48- 11.76- 17.41- 21 57- 25 76- 21 57- 17.41
- 11 76- 3 48- 0.35- 0.04- 0.00- 0.00

- 0 00- 0.00- 0 04- 0 35- 3.45- 11.28- 15 34- 17 41- 18.64- 17.41- 15 34
- 11 28- 3 45- 0 35- 0.04- 0 00- 0.00

- 0 00- 0 00- 0 04- 0 35- 3 34- 9 80- 11 28- 11 76- 11.95- 11 76- 11 28
- 9 80- 3.34- 0.35- 0.04- 0.00- 0 00

- 0 00- 0 00- 0 04- 0 29- 2.07- 3.34- 3.45- 3 48- 3 49- 3 48- 3 45
- 3 34- 2 07- 0.29- 0.04- 0.00- 0 00

- 0.00- 0.00- 0 01- 0 07- 0 29- 0.35- 0 35- 0 35- 0 35- 0 35- 0 35
- 0.35- 0.29- 0.07- 0 01- 0 00- 0.00

- 0 00- 0.00- 0 00- 0 01- 0 04- 0.04- 0 04- 0 04- 0.04- 0.04- 0.04
- 0 04- 0.04- 0.01- 0 00- 0 00- 0.00

- 0.00- 0 00- 0 00- 0.00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0.00
- 0.00- 0 00- 0 00- 0.00- 0.00- 0 00

- 0 00- 0.00- 0.00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00
- 0 00- 0.00- 0.00- 0 00- 0.00- 0 00

DEWATERING AT THE COAL UNLOADING EXCAVATION SITE

Scenario 2 Dewatering for 180 days during the dry season

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

MULTILAYER AQUIFER, VARIABLE PROPERTIES, MULTIPLE WELLS

NO. OF ROWS= 17
 NO. OF LAYERS= 2
 NO OF TIME STEPS= 20
 INITIAL TIME STEP (DAY)= 38.33764
 ERROR TOLERANCE (FT)= 5
 WATER BALANCE TOLERANCE (PERCENT)= 5
 DELTA FACTOR= 1.2

LAYER: 1
 TT= 3300
 S1= 15
 HH= 0
 QQ= 0
 RR= 3.0E-02

LAYER: 2
 TT= 1500
 S1= 4.0E-04
 HH= 0
 QQ= 0
 RR= 002
 VARIABLE GRID SPACINGS
 NODE DATA

			T1, T2=	S1, Q=	LEAKAGE=
1	1	1	3300 3300	4488000 0	120000
1	2	1	3300 3300	4488000 0	120000
1	3	1	3300 3300	4488000 0	120000
1	4	1	3300 3300	4488000 0	120000
1	5	1	13200 2062 5	2805000 0	75000
1	6	1	66000 495	673200 0	18000
1	7	1	132000 123 75	168300 0	4500
1	8	1	132000 82.5	112200 0	3000
1	9	1	132000 82.5	112200 0	3000
1	10	1	132000 82.5	112200 0	3000
1	11	1	66000 123 75	168300 0	4500
1	12	1	13200 495	673200 0	18000
1	13	1	3300 2062 5	2805000 0	75000
1	14	1	3300 3300	4488000 0	120000
1	15	1	3300 3300	4488000 0	120000
1	16	1	3300 3300	4488000 0	120000
1	17	1	0 3300	4488000 0	120000
2	1	1	3300 3300	4488000 0	120000
2	2	1	3300 3300	4488000 0	120000
2	3	1	3300 3300	4488000 0	120000
2	4	1	3300 3300	4488000 0	120000
2	5	1	13200 2062.5	2805000 0	75000
2	6	1	66000 495	673200 0	18000
2	7	1	132000 123.75	168300 0	4500
2	8	1	132000 82 5	112200 0	3000
2	9	1	132000 82 5	112200 0	3000
2	10	1	132000 82 5	112200 0	3000
2	11	1	66000 123 75	168300 0	4500
2	12	1	13200 495	673200 0	18000
2	13	1	3300 2062 5	2805000 0	75000

2	14	1	3300	3300	4488000	0	120000
2	15	1	3300	3300	4488000	0	120000
2	16	1	3300	3300	4488000	0	120000
2	17	1	0	3300	4488000	0	120000
3	1	1	3300	3300	4488000	0	120000
3	2	1	3300	3300	4488000	0	120000
3	3	1	3300	3300	4488000	0	120000
3	4	1	3300	3300	4488000	0	120000
3	5	1	13200	2062.5	2805000	0	75000
3	6	1	66000	495	673200	0	18000
3	7	1	132000	123.75	168300	0	4500
3	8	1	132000	82.5	112200	0	3000
3	9	1	132000	82.5	112200	0	3000
3	10	1	132000	82.5	112200	0	3000
3	11	1	66000	123.75	168300	0	4500
3	12	1	13200	495	673200	0	18000
3	13	1	3300	2062.5	2805000	0	75000
3	14	1	3300	3300	4488000	0	120000
3	15	1	3300	3300	4488000	0	120000
3	16	1	3300	3300	4488000	0	120000
3	17	1	0	3300	4488000	0	120000
4	1	1	3300	3300	4488000	0	120000
4	2	1	3300	3300	4488000	0	120000
4	3	1	3300	3300	4488000	0	120000
4	4	1	3300	3300	4488000	0	120000
4	5	1	13200	2062.5	2805000	0	75000
4	6	1	66000	495	673200	0	18000
4	7	1	132000	123.75	168300	0	4500
4	8	1	132000	82.5	112200	0	3000
4	9	1	132000	82.5	112200	0	3000
4	10	1	132000	82.5	112200	0	3000
4	11	1	66000	123.75	168300	0	4500
4	12	1	13200	495	673200	0	18000
4	13	1	3300	2062.5	2805000	0	75000
4	14	1	3300	3300	4488000	0	120000
4	15	1	3300	3300	4488000	0	120000
4	16	1	3300	3300	4488000	0	120000
4	17	1	0	3300	4488000	0	120000
5	1	1	2062.5	13200	2805000	0	75000
5	2	1	2062.5	13200	2805000	0	75000
5	3	1	2062.5	13200	2805000	0	75000
5	4	1	2062.5	13200	2805000	0	75000
5	5	1	8250	8250	1753125	0	46875
5	6	1	41250	1980	420750	0	11250
5	7	1	82500	495	105187.5	0	2812.5
5	8	1	82500	330	70125	0	1875
5	9	1	82500	330	70125	0	1875
5	10	1	82500	330	70125	0	1875
5	11	1	41250	495	105187.5	0	2812.5
5	12	1	8250	1980	420750	0	11250
5	13	1	2062.5	8250	1753125	0	46875
5	14	1	2062.5	13200	2805000	0	75000
5	15	1	2062.5	13200	2805000	0	75000
5	16	1	2062.5	13200	2805000	0	75000
5	17	1	0	13200	2805000	0	75000
6	1	1	495	66000	673200	0	18000
6	2	1	495	66000	673200	0	18000
6	3	1	495	66000	673200	0	18000
6	4	1	495	66000	673200	0	18000
6	5	1	1980	41250	420750	0	11250

6	6	1	9900	9900	100980	-0	2700
6	7	1	19800	2475	25245	0	675
6	8	1	19800	1650	16830	0	450
6	9	1	19800	1650	16830	0	450
6	10	1	19800	1650	16830	0	450
6	11	1	9900	2475	25245	0	675
6	12	1	1980	9900	100980	0	2700
6	13	1	495	41250	420750	0	11250
6	14	1	495	66000	673200	0	18000
6	15	1	495	66000	673200	0	18000
6	16	1	495	66000	673200	0	18000
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7	2	1	123.75	132000	168300	0	4500
7	3	1	123.75	132000	168300	0	4500
7	4	1	123.75	132000	168300	0	4500
7	5	1	495	82500	105187.5	0	2812.5
7	6	1	2475	19800	25245	0	675
7	7	1	4950	4950	6311.25	0	168.75
7	8	1	4950	3300	4207.5	0	112.5
7	9	1	4950	3300	4207.5	0	112.5
7	10	1	4950	3300	4207.5	0	112.5
7	11	1	2475	4950	6311.25	0	168.75
7	12	1	495	19800	25245	0	675
7	13	1	123.75	82500	105187.5	0	2812.5
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7	15	1	123.75	132000	168300	0	4500
7	16	1	123.75	132000	168300	0	4500
7	17	1	0	132000	168300	0	4500
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8	5	1	330	82500	70125	0	1875
8	6	1	1650	19800	16830	0	450
8	7	1	3300	4950	4207.5	0	112.5
8	8	1	3300	3300	2805	0	75
8	9	1	3300	3300	2805	0	75
8	10	1	3300	3300	2805	0	75
8	11	1	1650	4950	4207.5	0	112.5
8	12	1	330	19800	16830	0	450
8	13	1	82.5	82500	70125	0	1875
8	14	1	82.5	132000	112200	0	3000
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9	8	1	3300	3300	2805	0	75
9	9	1	1	1	1.87E-02	0	0
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9	13	1	82.5	82500	70125	0	1875
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11	4	1	123	75 66000	168300	0	4500
11	5	1	495	41250	105187.5	5 0	2812.5
11	6	1	2475	9900	25245	0	675
11	7	1	4950	2475	6311.25	0	168.75
11	8	1	4950	1650	4207.5	0	112.5
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11	10	1	4950	1650	4207.5	0	112.5
11	11	1	2475	2475	6311.25	0	168.75
11	12	1	495	9900	25245	0	675
11	13	1	123	75 41250	105187.5	5 0	2812.5
11	14	1	123	75 66000	168300	0	4500
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12	4	1	495	13200	673200	0	18000
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13	4	1	2062.5	3300	2805000	0	75000
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13	10	1	82500	82.5	70125	0	1875
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13	13	1	2062 5	2062.5	1753125	0	46875
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1	2	2	1500	1500	11968	0	8000
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1	7	2	60000	56 25	448 8	0	300
1	8	2	60000	37 5	299 2	0	200
1	9	2	60000	37 5	299 2	0	200
1	10	2	60000	37 5	299.2	0	200
1	11	2	30000	56 25	448.8	0	300
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2	7	2	60000	56.25	448.8	0	300
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3	2	2	1500	1500	11968	0	8000
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3	6	2	30000	225	1795.2	0	1200
3	7	2	60000	56.25	448.8	0	300

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3	10	2	60000	37.5	299.2	0	200
3	11	2	30000	56.25	448.8	0	300
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3	13	2	1500	937.5	7480	0	5000
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3	16	2	1500	1500	11968	0	8000
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4	2	2	1500	1500	11968	0	8000
4	3	2	1500	1500	11968	0	8000
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4	13	2	1500	937.5	7480	0	5000
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6	4	2	225	30000	1795.2	0	1200
6	5	2	900	18750	1122	0	750
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6	7	2	9000	1125	67.32	0	45
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6	9	2	9000	750	44.88	0	30
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6	13	2	225	18750	1122	0	750
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6	15	2	225	30000	1795.2	0	1200
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7	2	2	56	25 60000	448.8	0	300
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7	4	2	56	25 60000	448.8	0	300
7	5	2	225	37500	280.5	0	187.5
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7	7	2	2250	2250	16.83	0	11.25
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7	11	2	1125	2250	16.83	0	11.25
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8	4	2	37.5	60000	299.2	0	200
8	5	2	150	37500	187	0	125
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9	5	2	150	37500	187	0	125
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9	7	2	1500	2250	11.22	0	7.5
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9	11	2	750	2250	11.22	0	7.5
9	12	2	150	9000	44.88	0	30
9	13	2	37.5	37500	187	0	125
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11	4	2	56.25	30000	448.8	0	300
11	5	2	225	18750	280.5	0	187.5
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11	7	2	2250	1125	16.83	0	11.25
11	8	2	2250	750	11.22	0	7.5
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11	15	2	56.25	30000	448.8	0	300
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12	7	2	9000	225	67.32	0	45
12	8	2	9000	150	44.88	0	30
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12	11	2	4500	225	67.32	0	45
12	12	2	900	900	269.28	0	180
12	13	2	225	3750	1122	0	750
12	14	2	225	6000	1795.2	0	1200
12	15	2	225	6000	1795.2	0	1200
12	16	2	225	6000	1795.2	0	1200
12	17	2	0	6000	1795.2	0	1200
13	1	2	937.5	1500	7480	0	5000
13	2	2	937.5	1500	7480	0	5000
13	3	2	937.5	1500	7480	0	5000
13	4	2	937.5	1500	7480	0	5000
13	5	2	3750	937.5	4675	0	3125
13	6	2	18750	225	1122	0	750
13	7	2	37500	56.25	280.5	0	187.5
13	8	2	37500	37.5	187	0	125
13	9	2	37500	37.5	187	0	125
13	10	2	37500	37.5	187	0	125
13	11	2	18750	56.25	280.5	0	187.5
13	12	2	3750	225	1122	0	750
13	13	2	937.5	937.5	4675	0	3125
13	14	2	937.5	1500	7480	0	5000
13	15	2	937.5	1500	7480	0	5000
13	16	2	937.5	1500	7480	0	5000
13	17	2	0	1500	7480	0	5000

14	1	2	1500	1500	11968	0	8000
14	2	2	1500	1500	11968	0	8000
14	3	2	1500	1500	11968	0	8000
14	4	2	1500	1500	11968	0	8000
14	5	2	6000	937.5	7480	0	5000
14	6	2	30000	225	1795.2	0	1200
14	7	2	60000	56.25	448.8	0	300
14	8	2	60000	37.5	299.2	0	200
14	9	2	60000	37.5	299.2	0	200
14	10	2	60000	37.5	299.2	0	200
14	11	2	30000	56.25	448.8	0	300
14	12	2	6000	225	1795.2	0	1200
14	13	2	1500	937.5	7480	0	5000
14	14	2	1500	1500	11968	0	8000
14	15	2	1500	1500	11968	0	8000
14	16	2	1500	1500	11968	0	8000
14	17	2	0	1500	11968	0	8000
15	1	2	1500	1500	11968	0	8000
15	2	2	1500	1500	11968	0	8000
15	3	2	1500	1500	11968	0	8000
15	4	2	1500	1500	11968	0	8000
15	5	2	6000	937.5	7480	0	5000
15	6	2	30000	225	1795.2	0	1200
15	7	2	60000	56.25	448.8	0	300
15	8	2	60000	37.5	299.2	0	200
15	9	2	60000	37.5	299.2	0	200
15	10	2	60000	37.5	299.2	0	200
15	11	2	30000	56.25	448.8	0	300
15	12	2	6000	225	1795.2	0	1200
15	13	2	1500	937.5	7480	0	5000
15	14	2	1500	1500	11968	0	8000
15	15	2	1500	1500	11968	0	8000
15	16	2	1500	1500	11968	0	8000
15	17	2	0	1500	11968	0	8000
16	1	2	1500	1500	11968	0	8000
16	2	2	1500	1500	11968	0	8000
16	3	2	1500	1500	11968	0	8000
16	4	2	1500	1500	11968	0	8000
16	5	2	6000	937.5	7480	0	5000
16	6	2	30000	225	1795.2	0	1200
16	7	2	60000	56.25	448.8	0	300
16	8	2	60000	37.5	299.2	0	200
16	9	2	60000	37.5	299.2	0	200
16	10	2	60000	37.5	299.2	0	200
16	11	2	30000	56.25	448.8	0	300
16	12	2	6000	225	1795.2	0	1200
16	13	2	1500	937.5	7480	0	5000
16	14	2	1500	1500	11968	0	8000
16	15	2	1500	1500	11968	0	8000
16	16	2	1500	1500	11968	0	8000
16	17	2	0	1500	11968	0	8000
17	1	2	1500	0	11968	0	8000
17	2	2	1500	0	11968	0	8000
17	3	2	1500	0	11968	0	8000
17	4	2	1500	0	11968	0	8000
17	5	2	6000	0	7480	0	5000
17	6	2	30000	0	1795.2	0	1200
17	7	2	60000	0	448.8	0	300
17	8	2	60000	0	299.2	0	200
17	9	2	60000	0	299.2	0	200

17	10	2	60000	0	299.2	0	200
17	11	2	30000	0	448.8	0	300
17	12	2	6000	0	1795.2	0	1200
17	13	2	1500	0	7480	0	5000
17	14	2	1500	0	11968	0	8000
17	15	2	1500	0	11968	0	8000
17	16	2	1500	0	11968	0	8000
17	17	2	0	0	11968	0	8000

NO. OF ITERATIONS= 2
TIME= 186 6881 DAY

WATER BALANCE RESULTS FOR LAYER 1
CONVERGENCE ERROR= 0 PERCENT
TOTAL TEST ERROR= 1.707327 FT
PUMPAGE FROM THIS LAYER= 0 GPD
CHANGE IN AQUIFER STORAGE=-1994.369 GPD
NET UPWARD LEAKAGE= 0 GPD
NET DOWNWARD LEAKAGE= 94798 63 GPD

WATER BALANCE RESULTS FOR LAYER 2
CONVERGENCE ERROR= 1 27533 PERCENT
TOTAL TEST ERROR= 1 707327 FT
PUMPAGE FROM THIS LAYER= 93600 GPD
CHANGE IN AQUIFER STORAGE=-10.50781 GPD
NET UPWARD LEAKAGE=-94798 63 GPD
NET DOWNWARD LEAKAGE= 0 GPD

HEADS FOR LAYER 1

-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00
-	0.00-	0.00-	0.00-	0 00-	0.00-	0 00					
-	0.00-	0.00-	0 00-	0 00-	0 00-	0.00-	0.00-	0.00-	0.00-	0 00-	0.00
-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00					
-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00
-	0 00-	0 00-	0.00-	0 00-	0 00-	0.00					
-	0 00-	0.00-	0.00-	0 00-	0.02-	0.03-	0.03-	0.03-	0.03-	0.03-	0 03
-	0.03-	0.02-	0.00-	0 00-	0 00-	0.00					
-	0 00-	0.00-	0.00-	0 02-	0.14-	0 22-	0 22-	0 22-	0 22-	0 22-	0 22
-	0.22-	0.14-	0.02-	0 00-	0 00-	0.00					
-	0.00-	0.00-	0.00-	0.03-	0.22-	0.47-	0 49-	0 50-	0 51-	0 50-	0 49
-	0 47-	0.22-	0 03-	0 00-	0 00-	0 00					
-	0 00-	0 00-	0.00-	0 03-	0 22-	0 49-	0 54-	0 55-	0 55-	0 55-	0 54
-	0.49-	0 22-	0 03-	0 00-	0 00-	0.00					
-	0.00-	0 00-	0 00-	0.03-	0 22-	0.50-	0 55-	0 56-	0.57-	0.56-	0.55
-	0 50-	0 22-	0 03-	0.00-	0 00-	0.00					

-	0 00-	0 00-	0 00-	0 03-	0 22-	0 51-	0 55-	0.57-	0 57-	0 57-	0 55
-	0 51-	0 22-	0 03-	0 00-	0 00-	0.00					

-	0 00-	0 00-	0 00-	0.03-	0.22-	0.50-	0.55-	0 56-	0.57-	0.56-	0.55
-	0 50-	0 22-	0 03-	0 00-	0.00-	0 00					

-	0 00-	0 00-	0 00-	0 03-	0.22-	0 49-	0.54-	0.55-	0 55-	0 55-	0 54
-	0 49-	0.22-	0.03-	0 00-	0.00-	0 00					

-	0 00-	0.00-	0.00-	0 03-	0.22-	0.47-	0.49-	0.50-	0 51-	0.50-	0 49
-	0 47-	0 22-	0.03-	0 00-	0 00-	0 00					

-	0.00-	0.00-	0 00-	0 02-	0 14-	0 22-	0 22-	0.22-	0 22-	0 22-	0 22
-	0 22-	0 14-	0 02-	0 00-	0 00-	0.00					

-	0 00-	0 00-	0 00-	0.00-	0 02-	0 02-	0.03-	0.03-	0.03-	0 03-	0 03
-	0.02-	0.02-	0 00-	0.00-	0 00-	0 00					

-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00
-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00					

-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00-	0 00-	0.00-	0.00
-	0.00-	0 00-	0 00-	0 00-	0 00-	0.00					

-	0 00-	0 00-	0.00-	0.00-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00
-	0 00-	0 00-	0.00-	0 00-	0 00-	0.00					

HEADS FOR LAYER- 2

-	0.00-	0.00-	0 00-	0 00-	0 00-	0.00-	0.00-	0.00-	0 00-	0 00-	0 00
-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00					

-	0 00-	0 00-	0.00-	0.00-	0 00-	0.00-	0 00-	0.00-	0 00-	0 00-	0 00
-	0 00-	0 00-	0.00-	0.00-	0 00-	0.00					

-	0 00-	0 00-	0 00-	0.01-	0.04-	0.05-	0.05-	0.05-	0.05-	0 05-	0 05
-	0 05-	0 04-	0 01-	0 00-	0 00-	0.00					

-	0 00-	0 00-	0 01-	0.07-	0 31-	0.36-	0.37-	0 37-	0.37-	0 37-	0 37
-	0 36-	0 31-	0 07-	0.01-	0.00-	0.00					

-	0 00-	0 00-	0.04-	0 31-	2 15-	3.44-	3.55-	3 58-	3.59-	3.58-	3 55
-	3 44-	2 15-	0.31-	0 04-	0.00-	0 00					

-	0 00-	0 00-	0.05-	0 37-	3.44-	9.98-	11 47-	11 96-	12 15-	11 96-	11 47
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- 9.98- 3.45- 0.37- 0.05- 0.00- 0.00

- 0.00- 0 00- 0 05- 0.37- 3.55- 11.48- 15 57- 17.64- 18.88- 17.64- 15.57
- 11.48- 3 56- 0.37- 0.05- 0.00- 0 00

- 0.00- 0 00- 0.05- 0 37- 3.58- 11.97- 17.65- 21.82- 26.02- 21 82- 17.65
- 11.97- 3.59- 0.37- 0.05- 0.00- 0.00

- 0.00- 0 00- 0.05- 0.37- 3.59- 12.16- 18.88- 26.01- 41.62- 26.01- 18.88
- 12.16- 3 60- 0.37- 0 05- 0.00- 0 00

- 0 00- 0 00- 0.05- 0.37- 3.58- 11.96- 17.64- 21.81- 26.01- 21 81- 17 64
- 11.97- 3 59- 0 37- 0.05- 0.00- 0.00

- 0.00- 0.00- 0.05- 0 37- 3.55- 11 48- 15.56- 17 64- 18 87- 17 64- 15.57
- 11 48- 3 56- 0 37- 0 05- 0 00- 0 00

- 0 00- 0.00- 0.05- 0 37- 3.44- 9.98- 11.47- 11.96- 12.15- 11 96- 11 47
- 9.98- 3 44- 0 37- 0 05- 0.00- 0 00

- 0 00- 0.00- 0.04- 0 31- 2 15- 3.44- 3 55- 3 58- 3.59- 3 58- 3 55
- 3.44- 2 15- 0 31- 0 04- 0 00- 0.00

- 0.00- 0.00- 0.01- 0 07- 0.31- 0 37- 0.37- 0.37- 0.37- 0 37- 0 37
- 0 37- 0.31- 0 07- 0 01- 0.00- 0 00

- 0.00- 0 00- 0.00- 0.01- 0 04- 0 05- 0 05- 0.05- 0 05- 0 05- 0 05
- 0.05- 0 04- 0.01- 0 00- 0 00- 0 00

- 0.00- 0.00- 0 00- 0.00- 0 00- 0 00- 0 00- 0 00- 0.00- 0 00- 0 00
- 0.00- 0 00- 0.00- 0.00- 0.00- 0 00

- 0 00- 0 00- 0.00- 0.00- 0.00- 0.00- 0 00- 0 00- 0.00- 0 00- 0 00
- 0 00- 0.00- 0.00- 0 00- 0 00- 0.00

DEWATERING AT THE COAL UNLOADING EXCAVATION SITE

Scenario 3 Dewatering for 90 days under drought conditions

MULTILAYER AQUIFER, VARIABLE PROPERTIES, MULTIPLE WELLS

NO. OF ROWS= 17
 NO. OF LAYERS= 2
 NO. OF TIME STEPS= 18
 INITIAL TIME STEP (DAY)= 18 48844
 ERROR TOLERANCE (FT)= 5
 WATER BALANCE TOLERANCE (PERCENT)= 5
 DELTA FACTOR= 1 2

LAYER: 1

TT= 3300

S1= .15

HH= 0

QQ= 0

RR= 0

LAYER 2

TT= 1500

S1= 4.0E-04

HH= 0

QQ= 0

RR= 002

VARIABLE GRID SPACINGS

NODE DATA

			T1,T2=	S1,Q=	LEAKAGE=
1	1	1	3300 3300	4488000 0	0
1	2	1	3300 3300	4488000 0	0
1	3	1	3300 3300	4488000 0	0
1	4	1	3300 3300	4488000 0	0
1	5	1	13200 2062 5	2805000 0	0
1	6	1	66000 495	673200 0	0
1	7	1	132000 123.75	168300 0	0
1	8	1	132000 82.5	112200 0	0
1	9	1	132000 82 5	112200 0	0
1	10	1	132000 82 5	112200 0	0
1	11	1	66000 123.75	168300 0	0
1	12	1	13200 495	673200 0	0
1	13	1	3300 2062.5	2805000 0	0
1	14	1	3300 3300	4488000 0	0
1	15	1	3300 3300	4488000 0	0
1	16	1	3300 3300	4488000 0	0
1	17	1	0 3300	4488000 0	0
2	1	1	3300 3300	4488000 0	0
2	2	1	3300 3300	4488000 0	0
2	3	1	3300 3300	4488000 0	0
2	4	1	3300 3300	4488000 0	0
2	5	1	13200 2062 5	2805000 0	0
2	6	1	66000 495	673200 0	0
2	7	1	132000 123.75	168300 0	0
2	8	1	132000 82 5	112200 0	0
2	9	1	132000 82 5	112200 0	0
2	10	1	132000 82.5	112200 0	0
2	11	1	66000 123 75	168300 0	0
2	12	1	13200 495	673200 0	0
2	13	1	3300 2062.5	2805000 0	0

2	14	1	3300	3300	4488000	0	0
2	15	1	3300	3300	4488000	0	0
2	16	1	3300	3300	4488000	0	0
2	17	1	0	3300	4488000	0	0
3	1	1	3300	3300	4488000	0	0
3	2	1	3300	3300	4488000	0	0
3	3	1	3300	3300	4488000	0	0
3	4	1	3300	3300	4488000	0	0
3	5	1	13200	2062.5	2805000	0	0
3	6	1	66000	495	673200	0	0
3	7	1	132000	123.75	168300	0	0
3	8	1	132000	82 5	112200	0	0
3	9	1	132000	82 5	112200	0	0
3	10	1	132000	82.5	112200	0	0
3	11	1	66000	123 75	168300	0	0
3	12	1	13200	495	673200	0	0
3	13	1	3300	2062.5	2805000	0	0
3	14	1	3300	3300	4488000	0	0
3	15	1	3300	3300	4488000	0	0
3	16	1	3300	3300	4488000	0	0
3	17	1	0	3300	4488000	0	0
4	1	1	3300	3300	4488000	0	0
4	2	1	3300	3300	4488000	0	0
4	3	1	3300	3300	4488000	0	0
4	4	1	3300	3300	4488000	0	0
4	5	1	13200	2062 5	2805000	0	0
4	6	1	66000	495	673200	0	0
4	7	1	132000	123 75	168300	0	0
4	8	1	132000	82 5	112200	0	0
4	9	1	132000	82 5	112200	0	0
4	10	1	132000	82 5	112200	0	0
4	11	1	66000	123.75	168300	0	0
4	12	1	13200	495	673200	0	0
4	13	1	3300	2062 5	2805000	0	0
4	14	1	3300	3300	4488000	0	0
4	15	1	3300	3300	4488000	0	0
4	16	1	3300	3300	4488000	0	0
4	17	1	0	3300	4488000	0	0
5	1	1	2062.5	13200	2805000	0	0
5	2	1	2062.5	13200	2805000	0	0
5	3	1	2062 5	13200	2805000	0	0
5	4	1	2062.5	13200	2805000	0	0
5	5	1	8250	8250	1753125	0	0
5	6	1	41250	1980	420750	0	0
5	7	1	82500	495	105187.5	0	0
5	8	1	82500	330	70125	0	0
5	9	1	82500	330	70125	0	0
5	10	1	82500	330	70125	0	0
5	11	1	41250	495	105187.5	0	0
5	12	1	8250	1980	420750	0	0
5	13	1	2062.5	8250	1753125	0	0
5	14	1	2062 5	13200	2805000	0	0
5	15	1	2062 5	13200	2805000	0	0
5	16	1	2062 5	13200	2805000	0	0
5	17	1	0	13200	2805000	0	0
6	1	1	495	66000	673200	0	0
6	2	1	495	66000	673200	0	0
6	3	1	495	66000	673200	0	0
6	4	1	495	66000	673200	0	0
6	5	1	1980	41250	420750	0	0

6	6	1	9900	9900	100980	0	0
6	7	1	19800	2475	25245	0	0
6	8	1	19800	1650	16830	0	0
6	9	1	19800	1650	16830	0	0
6	10	1	19800	1650	16830	0	0
6	11	1	9900	2475	25245	0	0
6	12	1	1980	9900	100980	0	0
6	13	1	495	41250	420750	0	0
6	14	1	495	66000	673200	0	0
6	15	1	495	66000	673200	0	0
6	16	1	495	66000	673200	0	0
6	17	1	0	66000	673200	0	0
7	1	1	123	75 132000	168300	0	0
7	2	1	123.75	132000	168300	0	0
7	3	1	123.75	132000	168300	0	0
7	4	1	123.75	132000	168300	0	0
7	5	1	495	82500	105187.5	0	0
7	6	1	2475	19800	25245	0	0
7	7	1	4950	4950	6311	25 0	0
7	8	1	4950	3300	4207.5	0	0
7	9	1	4950	3300	4207.5	0	0
7	10	1	4950	3300	4207.5	0	0
7	11	1	2475	4950	6311	25 0	0
7	12	1	495	19800	25245	0	0
7	13	1	123	75 82500	105187.5	0	0
7	14	1	123	75 132000	168300	0	0
7	15	1	123.75	132000	168300	0	0
7	16	1	123.75	132000	168300	0	0
7	17	1	0	132000	168300	0	0
8	1	1	82.5	132000	112200	0	0
8	2	1	82.5	132000	112200	0	0
8	3	1	82	5 132000	112200	0	0
8	4	1	82.5	132000	112200	0	0
8	5	1	330	82500	70125	0	0
8	6	1	1650	19800	16830	0	0
8	7	1	3300	4950	4207	5 0	0
8	8	1	3300	3300	2805	0	0
8	9	1	3300	3300	2805	0	0
8	10	1	3300	3300	2805	0	0
8	11	1	1650	4950	4207.5	0	0
8	12	1	330	19800	16830	0	0
8	13	1	82.5	82500	70125	0	0
8	14	1	82.5	132000	112200	0	0
8	15	1	82	5 132000	112200	0	0
8	16	1	82.5	132000	112200	0	0
8	17	1	0	132000	112200	0	0
9	1	1	82.5	132000	112200	0	0
9	2	1	82.5	132000	112200	0	0
9	3	1	82.5	132000	112200	0	0
9	4	1	82.5	132000	112200	0	0
9	5	1	330	82500	70125	0	0
9	6	1	1650	19800	16830	0	0
9	7	1	50000	75000	27769	5 0	3750
9	8	1	3300	3300	2805	0	0
9	9	1	1	1	1.87E-02	0	0
9	10	1	3300	3300	2805	0	0
9	11	1	1650	4950	4207.5	0	0
9	12	1	330	19800	16830	0	0
9	13	1	82.5	82500	70125	0	0
9	14	1	82.5	132000	112200	0	0

9	15	1	82	5	132000	112200	0	0
9	16	1	82	5	132000	112200	0	0
9	17	1	0	132000	112200	0	0	0
10	1	1	82.5	132000	112200	0	0	0
10	2	1	82.5	132000	112200	0	0	0
10	3	1	82.5	132000	112200	0	0	0
10	4	1	82.5	132000	112200	0	0	0
10	5	1	330	82500	70125	0	0	0
10	6	1	1650	19800	16830	0	0	0
10	7	1	3300	4950	4207.5	0	0	0
10	8	1	3300	3300	2805	0	0	0
10	9	1	3300	3300	2805	0	0	0
10	10	1	3300	3300	2805	0	0	0
10	11	1	1650	4950	4207.5	0	0	0
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10	13	1	82	5	82500	70125	0	0
10	14	1	82.5	132000	112200	0	0	0
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10	16	1	82.5	132000	112200	0	0	0
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11	4	1	123	75	66000	168300	0	0
11	5	1	495	41250	105187	5	0	0
11	6	1	2475	9900	25245	0	0	0
11	7	1	4950	2475	6311	25	0	0
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11	9	1	4950	1650	4207	5	0	0
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11	11	1	2475	2475	6311.25	0	0	0
11	12	1	495	9900	25245	0	0	0
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11	14	1	123.75	66000	168300	0	0	0
11	15	1	123.75	66000	168300	0	0	0
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11	17	1	0	66000	168300	0	0	0
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12	2	1	495	13200	673200	0	0	0
12	3	1	495	13200	673200	0	0	0
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12	6	1	9900	1980	100980	0	0	0
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12	8	1	19800	330	16830	0	0	0
12	9	1	19800	330	16830	0	0	0
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12	14	1	495	13200	673200	0	0	0
12	15	1	495	13200	673200	0	0	0
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13	4	1	2062	5	3300	2805000	0	0
13	5	1	8250	2062	5	1753125	0	0
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13	7	1	82500	123	75	105187.5	-0-	-0
13	8	1	82500	82	5	70125	0	0
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13	11	1	41250	123	75	105187	5	0
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1	5	2	6000	937 5	7480	0	5000
1	6	2	30000	225	1795.2	0	1200
1	7	2	60000	56 25	448.8	0	300
1	8	2	60000	37.5	299.2	0	200
1	9	2	60000	37.5	299.2	0	200
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1	11	2	30000	56.25	448 8	0	300
1	12	2	6000	225	1795.2	0	1200
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3	6	2	30000	225	1795.2	0	1200
3	7	2	60000	56.25	448.8	0	300

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3	10	2	60000	37 5	299.2	0	200
3	11	2	30000	56.25	448 8	0	300
3	12	2	6000	225	1795 2	0	1200
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4	7	2	60000	56 25	448.8	0	300
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5	5	2	3750	3750	4675	0	3125
5	6	2	18750	900	1122	0	750
5	7	2	37500	225	280.5	0	187 5
5	8	2	37500	150	187	0	125
5	9	2	37500	150	187	0	125
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5	16	2	937 5	6000	7480	0	5000
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6	1	2	225	30000	1795.2	0	1200
6	2	2	225	30000	1795 2	0	1200
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6	6	2	4500	4500	269 28	0	180
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6	8	2	9000	750	44.88	0	30
6	9	2	9000	750	44.88	0	30
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6	11	2	4500	1125	67 32	0	45
6	12	2	900	4500	269 28	0	180
6	13	2	225	18750	1122	0	750
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7	1	2	56	25 60000	448.8	0	300
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7	7	2	2250	2250	16.83	0	11.25
7	8	2	2250	1500	11.22	0	7.5
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7	12	2	225	9000	67.32	0	45
7	13	2	56	25 37500	280.5	0	187.5
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7	16	2	56.25	60000	448.8	0	300
7	17	2	0	60000	448.8	0	300
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8	2	2	37	5 60000	299.2	0	200
8	3	2	37.5	60000	299.2	0	200
8	4	2	37.5	60000	299.2	0	200
8	5	2	150	37500	187	0	125
8	6	2	750	9000	44.88	0	30
8	7	2	1500	2250	11.22	0	7.5
8	8	2	1500	1500	7.48	0	5
8	9	2	1500	1500	7.48	0	5
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8	11	2	750	2250	11.22	0	7.5
8	12	2	150	9000	44.88	0	30
8	13	2	37.5	37500	187	0	125
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8	15	2	37.5	60000	299.2	0	200
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9	2	2	37	5 60000	299.2	0	200
9	3	2	37.5	60000	299.2	0	200
9	4	2	37.5	60000	299.2	0	200
9	5	2	150	37500	187	0	125
9	6	2	750	9000	44.88	0	30
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9	11	2	750	2250	11.22	0	7.5
9	12	2	150	9000	44.88	0	30
9	13	2	37.5	37500	187	0	125
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10	12	2	150	9000	44.88	0	30	
10	13	2	37.5	37500	187	0	125	
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11	2	2	56.25	30000	448.8	0	300	
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11	4	2	56.25	30000	448.8	0	300	
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11	15	2	56.25	30000	448.8	0	300	
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12	3	2	225	6000	1795.2	0	1200	
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12	9	2	9000	150	44.88	0	30	
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13	4	2	937.5	1500	7480	0	5000	
13	5	2	3750	937.5	4675	0	3125	
13	6	2	18750	225	1122	0	750	
13	7	2	37500	56.25	280.5	0	187.5	
13	8	2	37500	37.5	187	0	125	
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14	7	2	60000	56 25	448.8	0	300
14	8	2	60000	37.5	299.2	0	200
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15	2	2	1500	1500	11968	0	8000
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15	9	2	60000	37.5	299.2	0	200
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16	2	2	1500	1500	11968	0	8000
16	3	2	1500	1500	11968	0	8000
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16	6	2	30000	225	1795.2	0	1200
16	7	2	60000	56.25	448.8	0	300
16	8	2	60000	37 5	299.2	0	200
16	9	2	60000	37 5	299 2	0	200
16	10	2	60000	37.5	299 2	0	200
16	11	2	30000	56 25	448.8	0	300
16	12	2	6000	225	1795.2	0	1200
16	13	2	1500	937 5	7480	0	5000
16	14	2	1500	1500	11968	0	8000
16	15	2	1500	1500	11968	0	8000
16	16	2	1500	1500	11968	0	8000
16	17	2	0	1500	11968	0	8000
17	1	2	1500	0	11968	0	8000
17	2	2	1500	0	11968	0	8000
17	3	2	1500	0	11968	0	8000
17	4	2	1500	0	11968	0	8000
17	5	2	6000	0	7480	0	5000
17	6	2	30000	0	1795.2	0	1200
17	7	2	60000	0	448 8	0	300
17	8	2	60000	0	299.2	0	200
17	9	2	60000	0	299.2	0	200

17	10	2	60000	0	299	2	0	200
17	11	2	30000	0	448.8	0	300	
17	12	2	6000	0	1795	2	0	1200
17	13	2	1500	0	7480	0	5000	
17	14	2	1500	0	11968	0	8000	
17	15	2	1500	0	11968	0	8000	
17	16	2	1500	0	11968	0	8000	
17	17	2	0	0	11968	0	8000	

NO. OF ITERATIONS= 2

TIME= 87 44217 DAY

WATER BALANCE RESULTS FOR LAYER: 1

CONVERGENCE ERROR= 0 PERCENT

TOTAL TEST ERROR= .6206737 FT

PUMPAGE FROM THIS LAYER= 0 GPD

CHANGE IN AQUIFER STORAGE=-90939 2 GPD

NET UPWARD LEAKAGE= 0 GPD

NET DOWNWARD LEAKAGE= 93699 58 GPD

WATER BALANCE RESULTS FOR LAYER 2

CONVERGENCE ERROR= .4238188 PERCENT

TOTAL TEST ERROR= 6206737 FT

PUMPAGE FROM THIS LAYER= 93600 GPD

CHANGE IN AQUIFER STORAGE=-298 8073 GPD

NET UPWARD LEAKAGE=-93699 58 GPD

NET DOWNWARD LEAKAGE= 0 GPD

HEADS FOR LAYER: 1

-	0.00-	0.00-	0 00-	0 00-	0 00-	0 00-	0.00-	0.00-	0 00-	0 00-	0 00
-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00					
-	0.00-	0.00-	0 00-	0.00-	0 00-	0 00-	0 00-	0.00-	0 00-	0.00-	0 00
-	0 00-	0.00-	0 00-	0 00-	0 00-	0.00					
-	0 00-	0.00-	0 00-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00-	0 00-	0 00
-	0 00-	0 00-	0 00-	0 00-	0 00-	0.00					
-	0.00-	0 00-	0 00-	0 01-	0 05-	0.06-	0.06-	0.06-	0 06-	0.06-	0.06
-	0.06-	0 05-	0.01-	0 00-	0 00-	0 00					
-	0 00-	0.00-	0 00-	0 05-	0 34-	0 48-	0 49-	0 49-	0 49-	0 49-	0 49
-	0 48-	0 34-	0.05-	0 00-	0 00-	0.00					
-	0 00-	0.00-	0.00-	0 06-	0 48-	0.85-	0.86-	0.85-	0.85-	0.85-	0.85
-	0.84-	0 48-	0 06-	0 00-	0 00-	0.00					
-	0.00-	0 00-	0 00-	0 06-	0 49-	0.88-	0 87-	0 81-	0.72-	0 73-	0 83
-	0.87-	0 49-	0 06-	0 00-	0 00-	0.00					
-	0 00-	0 00-	0 00-	0.06-	0 49-	0.90-	0.88-	0.83-	0.73-	0.81-	0.86
-	0.89-	0.49-	0.06-	0.00-	0.00-	0 00					

- 0 00- 0.00- 0.00- 0.06- 0.50- 0.91- 0.91- 0.88- 0 81- 0.90- 0 90
- 0 90- 0 49- 0.06- 0 00- 0.00- 0 00

- 0 00- 0 00- 0 00- 0 06- 0 50- 0 91- 0 93- 0 94- 0 95- 0 94- 0 93
- 0 90- 0.49- 0.06- 0.00- 0 00- 0.00

- 0.00- 0 00- 0.00- 0 06- 0.49- 0.91- 0 94- 0 95- 0.96- 0 95- 0 94
- 0 90- 0 49- 0 06- 0 00- 0 00- 0.00

- 0 00- 0 00- 0 00- 0 06- 0 48- 0 88- 0 92- 0 93- 0 93- 0 93- 0 92
- 0.88- 0 48- 0.06- 0.00- 0 00- 0 00

- 0.00- 0 00- 0 00- 0.05- 0 34- 0 48- 0.49- 0 50- 0 50- 0.50- 0.49
- 0 48- 0 34- 0.05- 0 00- 0 00- 0 00

- 0 00- 0 00- 0 00- 0 01- 0 05- 0 06- 0 06- 0 06- 0 06- 0.06- 0 06
- 0 06- 0 05- 0 01- 0 00- 0.00- 0.00

- 0 00- 0 00- 0 00- 0.00- 0 00- 0.00- 0 00- 0.00- 0 00- 0.00- 0 00
- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00

- 0.00- 0.00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00
- 0.00- 0 00- 0 00- 0.00- 0.00- 0.00

- 0.00- 0.00- 0 00- 0 00- 0 00- 0 00- 0 00- 0.00- 0.00- 0.00- 0 00
- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00

HEADS FOR LAYER: 2

- 0 00- 0 00- 0.00- 0.00- 0.00- 0.00- 0 00- 0.00- 0 00- 0 00- 0.00
- 0.00- 0 00- 0 00- 0 00- 0 00- 0 00

- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00- 0 00
- 0 00- 0 00- 0.00- 0 00- 0 00- 0.00

- 0 00- 0 00- 0.00- 0.02- 0 05- 0 05- 0 05- 0 05- 0.05- 0.05- 0 05
- 0 05- 0 05- 0 02- 0 00- 0 00- 0 00

- 0 00- 0 00- 0.02- 0 08- 0 35- 0 41- 0.41- 0 41- 0 41- 0 41- 0 41
- 0 41- 0.35- 0 08- 0 02- 0.00- 0 00

- 0 00- 0 00- 0.05- 0.35- 2.29- 3.60- 3 71- 3 74- 3.75- 3.74- 3 71
- 3 60- 2.29- 0 35- 0 05- 0 00- 0 00

- 0 00- 0 00- 0 05- 0 41- 3 60- 10 11- 11 60- 12 08- 12 27- 12 08- 11 60

- - 10-11- 3.60- 0-41- 0 05- 0.00- 0 00

- 0 00- 0 00- 0.05- 0.41- 3 71- 11 60- 15.68- 17 75- 18 98- 17 75- 15 68
- 11.60- 3.71- 0.41- 0.05- 0 00- 0.00

- 0.00- 0.00- 0.05- 0.41- 3 74- 12.09- 17.75- 21 92- 26.12- 21 92- 17.75
- 12.09- 3.74- 0.41- 0.05- 0 00- 0.00

- 0.00- 0.00- 0.05- 0.41- 3.75- 12.28- 18.98- 26.12- 41.72- 26 12- 18 98
- 12 28- 3 75- 0.41- 0.05- 0 00- 0.00

- 0 00- 0.00- 0 05- 0.41- 3 74- 12.09- 17.75- 21 92- 26 12- 21.92- 17 75
- 12.09- 3 74- 0.41- 0.05- 0.00- 0.00

- 0.00- 0.00- 0 05- 0 41- 3.71- 11.60- 15.68- 17 75- 18 98- 17.75- 15 68
- 11.60- 3.71- 0 41- 0 05- 0 00- 0.00

- 0 00- 0 00- 0.05- 0 41- 3 60- 10.11- 11.60- 12 09- 12 28- 12 09- 11.60
- 10.12- 3.60- 0 41- 0 05- 0 00- 0.00

- 0.00- 0 00- 0 05- 0 35- 2 30- 3 60- 3.71- 3.74- 3.75- 3.74- 3.71
- 3.60- 2.29- 0 35- 0 05- 0 00- 0 00

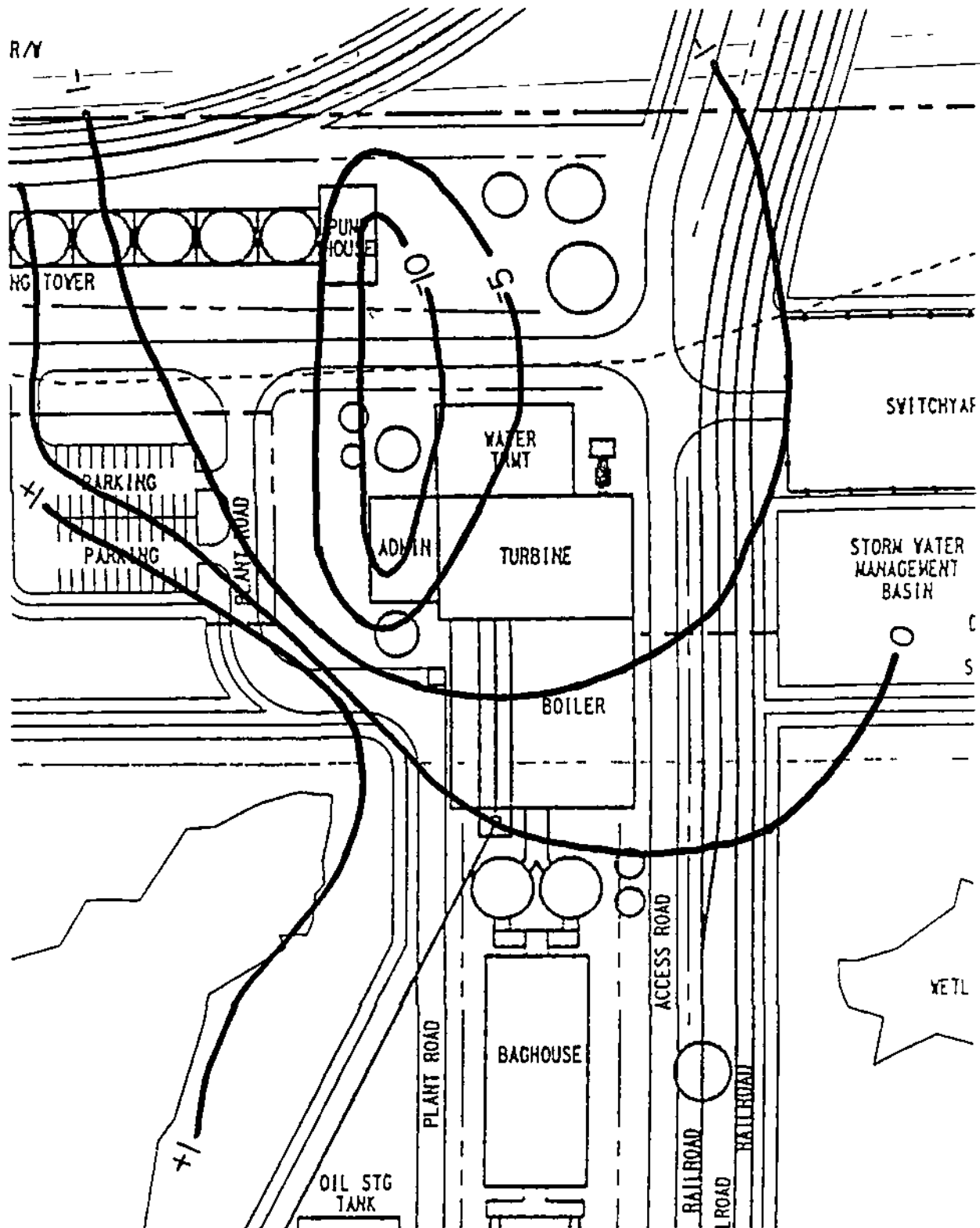
- 0 00- 0 00- 0 02- 0 08- 0 35- 0.41- 0 41- 0 41- 0 41- 0 41- 0 41
- 0 41- 0 35- 0 08- 0 02- 0.00- 0 00

- 0.00- 0 00- 0.00- 0 02- 0 05- 0 05- 0 05- 0 05- 0.05- 0 05- 0 05
- 0.05- 0 05- 0.02- 0 00- 0 00- 0 00

- 0 00- 0.00- 0 00- 0 00- 0 00- 0.00- 0.00- 0.00- 0 00- 0 00- 0 00
- 0.00- 0 00- 0 00- 0.00- 0.00- 0.00

- 0 00- 0 00- 0 00- 0.00- 0 00- 0 00- 0.00- 0.00- 0.00- 0 00- 0 00
- 0.00- 0.00- 0.00- 0.00- 0.00- 0.00

**THEIS ANALYTICAL MODEL OF DEWATERING THE
CIRCULATION LINE EXCAVATION FOR 45 DAYS**



Predicted change in water table elevations after 45
 days of dewatering the circulation lines excavation
 (Theis Analytical Model)

1-LAYER AQUIFER- UNIFORM PROPERTIES-THEIS ANALYTICAL MODEL

AQUIFER TRANSMISSIVITY (GPD/FT)= 3300

AQUIFER STORATIVITY (DIM)= 1

NO OF COLUMNS= 9

NO OF ROWS= 10

GRID SPACING (FT)= 100

NO OF WELLS= 9

XWELL (FT)= 500

YWELL (FT)= 200

WELL DISCHARGE (GPM)= 15

TIME(DAY)= 45

XWELL (FT)= 500

YWELL (FT)= 300

WELL DISCHARGE (GPM)= 15

TIME(DAY)= 45

XWELL (FT)= 500

YWELL (FT)= 400

WELL DISCHARGE (GPM)= 15

TIME(DAY)= 45

XWELL (FT)= 500

YWELL (FT)= 500

WELL DISCHARGE (GPM)= 20

TIME(DAY)= 45

XWELL (FT)= 400

YWELL (FT)= 600

WELL DISCHARGE (GPM)=-10

TIME(DAY)= 45

XWELL (FT)= 300

YWELL (FT)= 600

WELL DISCHARGE (GPM)=-10

TIME(DAY)= 45

XWELL (FT)= 200

YWELL (FT)= 600

WELL DISCHARGE (GPM)=-10

TIME(DAY)= 45

XWELL (FT)= 200

YWELL (FT)= 500

WELL DISCHARGE (GPM)=-5

TIME(DAY)= 45

XWELL (FT)= 200

YWELL (FT)= 400

WELL DISCHARGE (GPM)=-5

TIME(DAY)= 45

DRAWDOWNS AT-OB WELLS (FT)

	0 82	1.39	2 19	3 17	3 87	3 50	2 79	2 15	1.62
	0 65	1 32	2 46	4.16	9.73	4.67	3 39	2 48	1 82
	0 20	0 81	2 24	4 46	10 50	5 25	3 69	2 64	1 91
-	0 51-	1 61	1 34	3 88	10 22	5 07	3 56	2 55	1 85
-	1 19-	2 77-	0 15	2.28	10 18	4.13	2.99	2.22	1 65
-	1 54-	4 90-	4 32-	2 61	2 16	2 54	2 18	1 74	1 35
-	1 28-	1 57-	1.24-	0 30	0 82	1 37	1 42	1 26	1.04
-	0 92-	0.95-	0.71-	0 20	0.36	0 74	0.88	0 85	0.75
-	0.65-	0 62-	0.45-	0 16	0 15	0 40	0 53	0 56	0 52
-	0 46-	0 42-	0 31-	0 14	0 05	0 21	0 31	0 35	0 35

10 5 1 4 Impacts on Water Supplies - Groundwater (5 3 2)

- Uppermost Floridan - One 300 gpm Well for 90 Days
- Lower Horizon, Floridan Aquifer - Four 1000 gpm Wells for 90 Days

UPPERMOST FLORIDAN - ONE 300 GPM WELL FOR 90 DAYS

TWO MUTUALLY-LEAKY-AQUIFERS--MULTIPLE WELLS

T1(GPD/FT)=. 3000000
 T2(GPD/FT)=. 100000
 P1(GPD/SQFT)=. 7 93
 M'(FT)=. 400
 S1(DIM.)=.00075
 S2(DIM.)=.00075
 NO OF COLUMNS=. 9
 NO.OF ROWS=. 9
 GRID SPACING(FT)=. 250
 NWELLS=. 1

XWELL(FT)=. 1250
 YWELL(FT)=. 1250
 Q(GPM)=. 300
 TIME(DAY)=. 90

DRAWDOWNS AT OB WELLS IN UPPER AQUIFER (FT):

0.07	0 07	0 08	0 08	0.08	0 08	0 08	0.07	0 07
0 07	0.08	0 08	0 08	0.08	0 08	0 08	0.08	0.07
0 08	0.08	0 08	0 08	0.08	0 08	0 08	0.08	0.08
0.08	0 08	0 08	0 08	0.08	0 08	0.08	0.08	0.08
0 08	0.08	0 08	0 08	0 08	0 08	0.08	0.08	0.08
0 08	0.08	0 08	0 08	0 08	0 08	0.08	0.08	0.08
0 08	0.08	0.08	0 08	0 08	0 08	0.08	0 08	0.08
0 07	0 08	0.08	0.08	0 08	0 08	0.08	0 08	0.07
0.07	0 07	0.08	0.08	0 08	0.08	0.08	0 07	0.07

DRAWDOWNS AT OB. WELLS IN LOWER AQUIFER (FT)

0 57	0 64	0 70	0.75	0 77	0 75	0 70	0.64	0 57
0 64	0 73	0 83	0.91	0 94	0 91	0 83	0 73	0 64
0 70	0 83	0.98	1 13	1 20	1 13	0 98	0 83	0 70
0 75	0 91	1.13	1 43	1.66	1.43	1.13	0.91	0.75
0 77	0 94	1 20	1 66	5.45	1.66	1.20	0 94	0.77
0 75	0 91	1 13	1 43	1.66	1.43	1.13	0 91	0 75
0 70	0 83	0 98	1.13	1.20	1.13	0.98	0 83	0 70
0 64	0 73	0 83	0 91	0.94	0.91	0.83	0.73	0 64
0.57	0 64	0.70	0 75	0.77	0.75	0.70	0.64	0 57

TWO MUTUALLY LEAKY AQUIFERS- MULTIPLE WELLS

T1 (GPD/FT)= 3000000
 T2 (GPD/FT)= 100000
 P' (GPD/SQFT)= 7 93
 M' (FT)= 400
 S1 (DIM)=00075
 S2 (DIM)= 00075
 NO OF COLUMNS= . 9
 NO.OF ROWS= . 9
 GRID SPACING(FT)= 500
 NWELLS= 1

XWELL(FT)= 2500
 YWELL(FT)= 2500
 Q (GPM)= 300
 TIME(DAY)= 90

DRAWDOWNS AT OB. WELLS IN UPPER AQUIFER (FT):

0 07	0 07	0 07	0.07	0 07	0 07	0.07	0 07	0 07
0.07	0 07	0 07	0 07	0 07	0 07	0 07	0 07	0 07
0 07	0 07	0 07	0 08	0.08	0 08	0 07	0 07	0 07
0 07	0 07	0 08	0 08	0 08	0 08	0 08	0 07	0 07
0.07	0 07	0 08	0.08	0 08	0.08	0 08	0 07	0 07
0.07	0 07	0 08	0 08	0 08	0.08	0 08	0 07	0 07
0 07	0 07	0 07	0 08	0 08	0.08	0 07	0 07	0 07
0 07	0 07	0 07	0.07	0 07	0 07	0.07	0.07	0 07
0 07	0.07	0 07	0 07	0.07	0 07	0.07	0.07	0 07

DRAWDOWNS AT OB WELLS IN LOWER AQUIFER (FT):

0.27	0.31	0 36	0 39	0 40	0 39	0 36	0.31	0 27
0 31	0 38	0 45	0 52	0.54	0 52	0 45	0.38	0 31
0 36	0 45	0 57	0 70	0 77	0 70	0 57	0.45	0 36
0 39	0 52	0 70	0 98	1 20	0 98	0 70	0 52	0 39
0 40	0 54	0 77	1 20	5 45	1 20	0 77	0 54	0 40
0 39	0 52	0 70	0 98	1 20	0 98	0 70	0 52	0 39
0.36	0 45	0 57	0.70	0 77	0 70	0.57	0 45	0 36
0 31	0.38	0 45	0.52	0 54	0.52	0 45	0.38	0 31
0.27	0 31	0.36	0 39	0 40	0.39	0 36	0 31	0 27

TWO MUTUALLY LEAKY AQUIFERS- MULTIPLE WELLS

T1(GPD/FT)= . 3000000
 T2(GPD/FT)= . 100000
 P1(GPD/SQFT)=... 7.93
 M1(FT)=. . . 400
 S1(DIM)= . . . 00075
 S2(DIM.)=. . 00075
 NO.OF COLUMNS= . 9
 NO OF ROWS= . 9
 GRID SPACING(FT)= 1000
 NWELLS=. . . . 1

XWELL(FT)= . . . 5000
 YWELL(FT)= . . 5000
 Q(GPM)=. . . 300
 TIME(DAY)= . 90

DRAWDOWNS AT OB WELLS IN UPPER AQUIFER (FT)

0 06	0 06	0 06	0 06	0 06	0.06	0 06	0.06	0 06
0 06	0 06	0.07	0 07	0.07	0 07	0 07	0 06	0 06
0.06	0 07	0 07	0 07	0 07	0 07	0 07	0 07	0.06
0 06	0 07	0 07	0 07	0 08	0 07	0 07	0.07	0 06
0 06	0 07	0 07	0 08	0.08	0.08	0 07	0 07	0.06
0 06	0 07	0.07	0 07	0 08	0 07	0 07	0.07	0 06
0.06	0 07	0 07	0 07	0 07	0 07	0 07	0.07	0 06
0.06	0 06	0 07	0.07	0 07	0.07	0.07	0 06	0.06
0.06	0 06	0 06	0 06	0.06	0 06	0 06	0.06	0 06

DRAWDOWNS AT OB WELLS IN LOWER AQUIFER (FT)

0 10	0 12	0.14	0.16	0 16	0 16	0 14	0.12	0 10
0 12	0 15	0 19	0 23	0 25	0 23	0 19	0.15	0 12
0 14	0 19	0 27	0 36	0 40	0.36	0.27	0 19	0 14
0 16	0 23	0.36	0.57	0.77	0 57	0 36	0 23	0 16
0 16	0.25	0 40	0 77	5 45	0 77	0 40	0 25	0 16
0 16	0 23	0 36	0 57	0 77	0 57	0.36	0.23	0.16
0 14	0 19	0 27	0.36	0.40	0.36	0 27	0 19	0 14
0.12	0.15	0 19	0 23	0 25	0 23	0 19	0 15	0 12
0 10	0 12	0 14	0 16	0 16	0 16	0.14	0 12	0 10

TWO MUTUALLY LEAKY AQUIFERS- MULTIPLE WELLS

T1(GPD/FT)= . 3000000
 T2(GPD/FT)= 100000
 P1(GPD/SQFT)= . 7.93
 M1(FT)= .. . 400
 S1(DIM)=.. . . 00075
 S2(DIM)= 00075
 NO OF COLUMNS= . . 9
 NO OF ROWS= . 9
 GRID SPACING(FT)=. 2000
 NWELLS= . 1

XWELL(FT)=.. . . 10000
 YWELL(FT)= . . . 10000
 Q(GPM)= . . . 300
 TIME(DAY)=. . . . 90

DRAWDOWNS AT OB WELLS IN UPPER AQUIFER (FT)

0 04	0 05	0 05	0 05	0 05	0 05	0 05	0 05	0 04
0 05	0 05	0 05	0.06	0.06	0 06	0 05	0 05	0 05
0 05	0 05	0 06	0 06	0 06	0 06	0 06	0 05	0 05
0 05	0.06	0.06	0.07	0 07	0 07	0.06	0.06	0 05
0 05	0 06	0 06	0.07	0 08	0 07	0 06	0 06	0 05
0 05	0 06	0 06	0.07	0.07	0 07	0 06	0 06	0 05
0 05	0 05	0.06	0 06	0 06	0 06	0.06	0 05	0 05
0 05	0 05	0 05	0.06	0 06	0 06	0 05	0.05	0 05
0 04	0 05	0 05	0 05	0 05	0 05	0.05	0 05	0 04

DRAWDOWNS AT OB WELLS IN LOWER AQUIFER (FT)

0 05	0 05	0 06	0 06	0 06	0 06	0 06	0 05	0.05
0 05	0 06	0 07	0 08	0 09	0 08	0 07	0 06	0 05
0 06	0.07	0 10	0 14	0 16	0 14	0 10	0 07	0.06
0 06	0 08	0 14	0 27	0.40	0 27	0 14	0 08	0 06
0 06	0 09	0 16	0 40	5 45	0.40	0 16	0 09	0 06
0 06	0 08	0 14	0 27	0 40	0 27	0 14	0 08	0 06
0 06	0 07	0.10	0 14	0 16	0 14	0 10	0.07	0 06
0 05	0 06	0 07	0 08	0.09	0.08	0.07	0 06	0 05
0 05	0.05	0 06	0.06	0 06	0.06	0.06	0.05	0 05

**LOWER HORIZON, FLORIDAN AQUIFER - FOUR
1000 GPM WELLS FOR 90 DAYS**

TWO-MUTUALLY-LEAKY-AQUIFERS- MULTIPLE WELLS

T1 (GPD/FT)= .. . 100000
T2 (GPD/FT)=. 3000000
P! (GPD/SQFT)=... 7 93
M' (FT)= 400
S1 (DIM)=.00075
S2 (DIM)=.00075
NO.OF COLUMNS=. .. 10
NO OF ROWS= 20
GRID SPACING(FT)=. 1000
NWELLS=. 4

XWELL(FT)=. . . 4000
YWELL(FT)= . . . 8000
Q (GPM)=.. .. 1000
TIME(DAY)= .. . 90
XWELL(FT)=. 4000
YWELL(FT)= 11000
Q (GPM)= 1000
TIME(DAY)=. .. . 90
XWELL(FT)= . . . 7000
YWELL(FT)= . . . 8000
Q (GPM)= . . . 1000
TIME(DAY)=. . . 90
XWELL(FT)=. .. . 7000
YWELL(FT)= . . . 11000
Q (GPM)=. . . 1000
TIME(DAY)= . . . 90

DRAWDOWNS AT OB WELLS IN UPPER AQUIFER (FT)

0 64	0 65	0 66	0 67	0 67	0 67	0 67	0 66	0 65	0 64
0 66	0 68	0 69	0 70	0 70	0.70	0 70	0 69	0 68	0 66
0 69	0.71	0 72	0 74	0 74	0 74	0.74	0.72	0 71	0 69
0 72	0 74	0 76	0 77	0 78	0 78	0 77	0 76	0 74	0 72
0.75	0 77	0.80	0.81	0.82	0.82	0 81	0 80	0 77	0 75
0 77	0 81	0 83	0 85	0 87	0 87	0 85	0 83	0 81	0 77
0.80	0 83	0 87	0.89	0 91	0.91	0 89	0 87	0 83	0 80
0 81	0 85	0.89	0.92	0 94	0.94	0.92	0 89	0.85	0 81
0 82	0 87	0 91	0 94	0.95	0 95	0 94	0 91	0.87	0 82
0.82	0 87	0.91	0 94	0.95	0.95	0 94	0 91	0 87	0 82
0.81	0 85	0 89	0 92	0.94	0.94	0 92	0.89	0 85	0 81
0 80	0 83	0 87	0 89	0 91	0.91	0 89	0.87	0 83	0 80
0 77	0 81	0 83	0 85	0.87	0.87	0.85	0.83	0 81	0 77
0.75	0 77	0 80	0 81	0 82	0 82	0.81	0 80	0 77	0 75
0.72	0.74	0.76	0 77	0.78	0.78	0.77	0.76	0 74	0 72
0 69	0 71	0 72	0.74	0.74	0 74	0.74	0 72	0 71	0.69
0.66	0.68	0 69	0 70	0 70	0.70	0 70	0.69	0 68	0 66
0 64	0.65	0 66	0 67	0.67	0 67	0.67	0.66	0 65	0 64
0.61	0 62	0 63	0 64	0 64	0.64	0.64	0 63	0 62	0 61
0.59	0.60	0 60	0 61	0.61	0 61	0.61	0 60	0 60	0 59

DRAWDOWNS AT OB WELLS IN LOWER AQUIFER (FT) -

0 64	0 65	0 66	0 67	0 68	0.68	0 67	0 66	0 65	0 64
0 67	0.68	0.70	0 71	0.71	0 71	0.71	0 70	0 68	0 67

0 70	0.72	0 74	0 75	0.75	0.75	0.75	0.74	0.72	0 70
0 73	0 76	0 78	0 79	0.80	0.80	0 79	0.78	0 76	0 73
0 76	0 80	0 83	0.85	0 86	0 86	0 85	0 83	0 80	0 76
0.80	0.84	0.88	0 92	0.93	0 93	0 92	0 88	0 84	0 80
0 83	0 88	0 95	1.01	1.01	1 01	1.01	0 95	0 88	0.83
0 85	0 92	1.01	1.57	1.08	1 08	1.57	1 01	0.92	0.85
0 86	0 93	1 01	1.08	1 09	1 09	1.08	1 01	0.93	0 86
0 86	0 93	1 01	1 08	1.09	1.09	1 08	1.01	0 93	0 86
0 85	0 92	1 01	1 57	1.08	1.08	1.57	1 01	0 92	0 85
0 83	0 88	0 95	1 01	1.01	1.01	1 01	0 95	0 88	0 83
0 80	0 84	0 88	0 92	0.93	0.93	0 92	0 88	0 84	0 80
0 76	0 80	0 83	0 85	0.86	0 86	0 85	0 83	0 80	0 76
0 73	0 76	0 78	0 79	0 80	0 80	0.79	0 78	0 76	0 73
0 70	0.72	0 74	0.75	0 75	0 75	0 75	0 74	0 72	0 70
0 67	0 68	0 70	0.71	0 71	0 71	0 71	0 70	0 68	0 67
0 64	0 65	0.66	0 67	0 68	0.68	0 67	0 66	0.65	0 64
0 61	0 63	0 63	0.64	0 64	0.64	0 64	0 63	0 63	0 61
0 59	0 60	0 61	0 61	0 61	0 61	0 61	0.61	0 60	0 59

TWO-MUTUALLY-LEAKY-AQUIFERS- MULTIPLE WELLS

T1(GPD/FT)=..... 100000
T2(GPD/FT)= 3000000
P1(GPD/SQFT)=. . . 7 93
M1(FT)=..... 400
S1(DIM)=00075
S2(DIM.)=00075
NO OF COLUMNS=. . 10
NO.OF ROWS=..... 20
GRID SPACING(FT)=. 3000
NWELLS=. 4

XWELL(FT)=..... 15000
YWELL(FT)=.. . . 27000
Q(GPM)=..... 1000
TIME(DAY)= 90
XWELL(FT)=..... 15000
YWELL(FT)=. . . 30000
Q(GPM)= 1000
TIME(DAY)=.. . . 90
XWELL(FT)= 18000
YWELL(FT)=. . . . 27000
Q(GPM)= 1000
TIME(DAY)= 90
XWELL(FT)=..... 18000
YWELL(FT)=..... 30000
Q(GPM)=. 1000
TIME(DAY)=. . . 90

DRAWDOWNS AT OB. WELLS IN UPPER AQUIFER (FT)

0.32	0.34	0.35	0.35	0.36	0.36	0.35	0.35	0.34	0.32
0.35	0.37	0.38	0.39	0.39	0.39	0.39	0.38	0.37	0.35
0.38	0.40	0.41	0.43	0.43	0.43	0.43	0.41	0.40	0.38
0.41	0.43	0.46	0.47	0.48	0.48	0.47	0.46	0.43	0.41
0.44	0.47	0.50	0.53	0.54	0.54	0.53	0.50	0.47	0.44
0.47	0.51	0.55	0.59	0.61	0.61	0.59	0.55	0.51	0.47
0.50	0.55	0.61	0.66	0.70	0.70	0.66	0.61	0.55	0.50
0.53	0.59	0.66	0.75	0.81	0.81	0.75	0.66	0.59	0.53
0.54	0.61	0.70	0.81	0.92	0.92	0.81	0.70	0.61	0.54
0.54	0.61	0.70	0.81	0.92	0.92	0.81	0.70	0.61	0.54
0.53	0.59	0.66	0.75	0.81	0.81	0.75	0.66	0.59	0.53
0.50	0.55	0.61	0.66	0.70	0.70	0.66	0.61	0.55	0.50
0.47	0.51	0.55	0.59	0.61	0.61	0.59	0.55	0.51	0.47
0.44	0.47	0.50	0.53	0.54	0.54	0.53	0.50	0.47	0.44
0.41	0.43	0.46	0.47	0.48	0.48	0.47	0.46	0.43	0.41
0.38	0.40	0.41	0.43	0.43	0.43	0.43	0.41	0.40	0.38
0.35	0.37	0.38	0.39	0.39	0.39	0.39	0.38	0.37	0.35
0.32	0.34	0.35	0.35	0.36	0.36	0.35	0.35	0.34	0.32
0.30	0.31	0.32	0.32	0.33	0.33	0.32	0.32	0.31	0.30
0.28	0.29	0.29	0.30	0.30	0.30	0.30	0.29	0.29	0.28

DRAWDOWNS AT OB. WELLS IN LOWER AQUIFER (FT).

0.32	0.34	0.35	0.35	0.36	0.36	0.35	0.35	0.34	0.32
0.35	0.37	0.38	0.39	0.39	0.39	0.39	0.38	0.37	0.35

0 38	0.40	0 41	0 43	0 43	0 43	0 43	0 41	0 40	0 38
0.41	0 43	0 46	0 47	0 48	0 48	0 47	0 46	0 43	0.41
0 44	0.47	0 50	0 53	0.54	0 54	0 53	0 50	0 47	0 44
0.47	0 51	0.55	0 59	0.61	0.61	0.59	0.55	0 51	0.47
0 50	0 55	0 61	0 67	0.71	0 71	0 67	0.61	0 55	0 50
0.53	0.59	0 67	0 76	0.85	0.85	0.76	0.67	0 59	0 53
0.54	0.61	0.71	0 85	1.57	1.57	0.85	0.71	0 61	0 54
0 54	0.61	0 71	0 85	1.57	1.57	0.85	0.71	0.61	0 54
0 53	0.59	0 67	0 76	0.85	0.85	0 76	0 67	0 59	0 53
0 50	0 55	0.61	0.67	0 71	0 71	0 67	0 61	0 55	0 50
0 47	0 51	0.55	0 59	0 61	0 61	0 59	0 55	0.51	0 47
0.44	0 47	0.50	0 53	0 54	0 54	0.53	0 50	0 47	0 44
0 41	0 43	0.46	0.47	0 48	0 48	0.47	0 46	0.43	0 41
0 38	0 40	0 41	0 43	0 43	0 43	0 43	0 41	0 40	0 38
0 35	0 37	0.38	0 39	0 39	0 39	0.39	0.38	0 37	0 35
0 32	0 34	0 35	0.35	0.36	0 36	0 35	0 35	0 34	0 32
0 30	0 31	0.32	0.32	0.33	0.33	0.32	0.32	0 31	0.30
0 28	0 29	0.29	0 30	0 30	0 30	0 30	0.29	0 29	0 28

10 5 1 5 - Bathymetric Studies

**BATHYMETRIC AND WATER QUALITY
SURVEY OF TAYLOR CREEK/NUBBIN SLOUGH**

Submitted to:

**INDIANTOWN COGENERATION LIMITED PARTNERSHIP
Indiantown, Florida**

Submitted by:

ECT

Environmental Consulting & Technology, Inc.

Gainesville, Florida

October 1990

IMAGE QUALITY

**PLEASE NOTE THE ORIGINAL DOCUMENTS
SCANNED FOR THIS RECORD WERE OF POOR
QUALITY.**

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1.0 INTRODUCTION

Indiantown Cogeneration Limited Partnership (ICL) is currently preparing a site certification application (SCA) for its 300-megawatt (MW) Indiantown cogeneration project (ICP) located approximately 3 miles northwest of Indiantown, Florida. The project will withdraw water from Taylor Creek/Nubbin Slough (TC/NS) for process water and cooling water makeup, which requires that an intake structure be designed and constructed on TC/NS. To aid in the engineering design and subsequent impact analysis, Environmental Consulting & Technology, Inc. (ECT) was contracted to complete a bathymetric survey and water quality and velocity measurements in the vicinity of the proposed intake structure. ECT was assisted by Lindahl, Browning, Ferrari & Hellstrom, Inc. (LBF&H) for the land surveying portion of the project.

2.0 METHODS AND MATERIALS

2 1 LAND SURVEYING

Fourteen transects were established at approximately 100-foot (ft) intervals along TC/NS as shown in Figure 1. The positions (in state plan coordinates) and land elevations at the end of each transect were surveyed by LBF&H using standard surveying techniques. Concrete monuments located along the railroad were used for reference points and elevations were established in national geodetic vertical datum (NGVD) 1929. LBF&H also surveyed 11 bank profiles along the end of the transects located on the intake-side of the canal. An additional seven bank profiles were measured on the opposite side of the canal. Two concrete monuments were also established on the site to aid in subsequent surveying that might be required.

2 2 BATHYMETRY SURVEY

Bathymetric surveys were conducted along the established 14 transects on October 3, 1990. A Raytheon Model DE-719 acoustic fathometer was used to measure water depth along each transect. This instrument operates at 200 kilohertz (KHz) and can record 534 soundings per minute on chart paper. The fathometer is accurate to 0.5 percent ± 1 inch of the measured depth and can be resolved reliably to the nearest 0.2 foot (ft). The fathometer was calibrated three times during the survey with a target on a graduated line lowered beneath the transducer.

Navigation during the survey was accomplished by stringing a taut, graduated line between the end markers on each transect. As the survey vessel traversed each transect, a fix mark was recorded on the fathometer chart paper at 20-ft intervals by using markings on the taut line as a guide. The navigation fixes were then noted as distance from the end marker on each transect. The transect marker on the east side of the canal was assigned a distance of 0 ft for all transects.

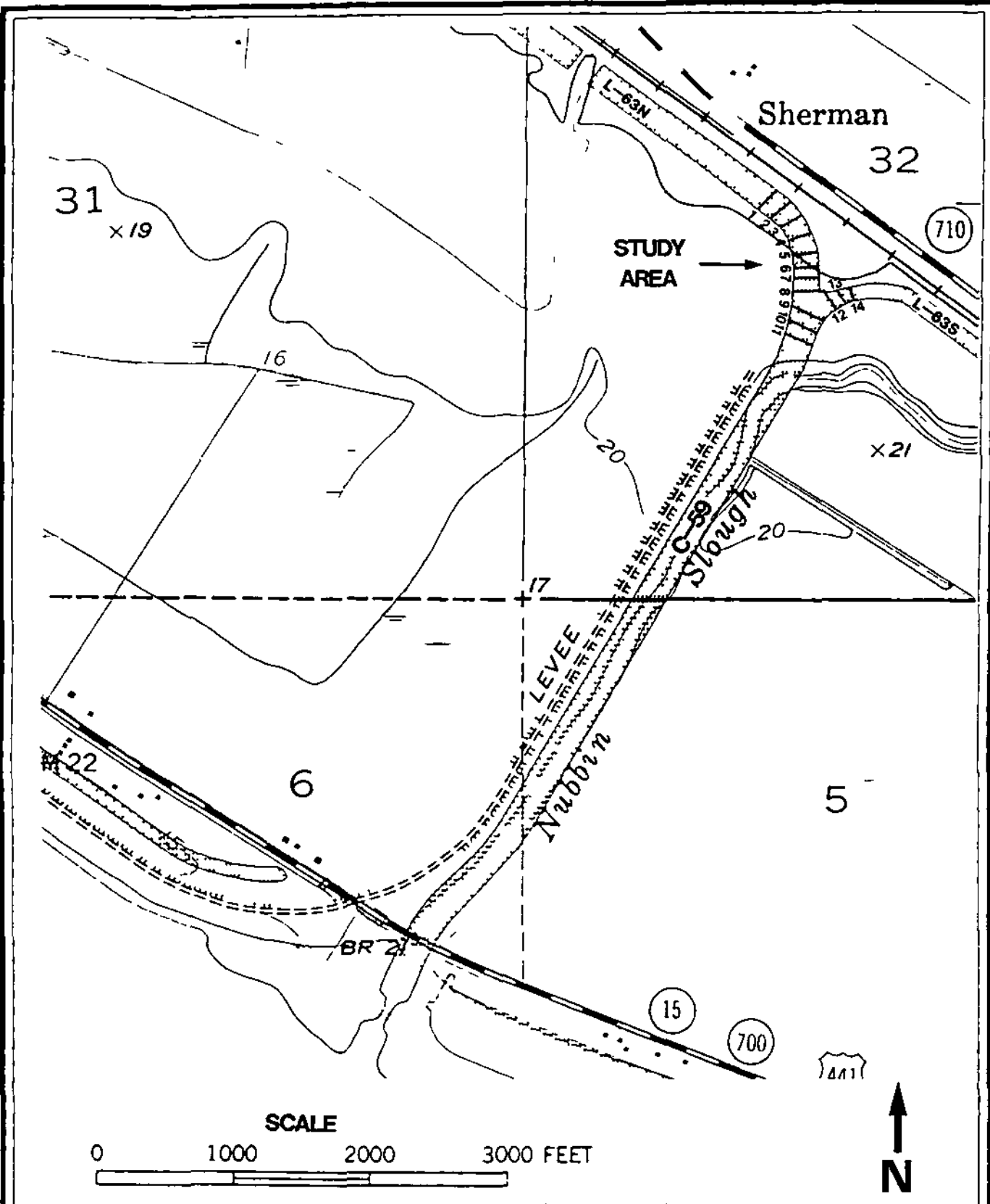


FIGURE 1

STUDY AREA SHOWING TRANSECT LOCATIONS

Source ECT 1990

ECT
Environmental Consulting & Technology Inc

A water level staff was installed at the site to monitor water level variations during the survey. The staff was surveyed relative to the benchmarks at the site and its elevation was established in NGVD. The water level at the site was read from the staff during each bathymetry transect to assure the measured water depths could be properly adjusted to elevations in NGVD.

The strip charts from the fathometer were read and digitized by two individuals and compared to minimize errors. The digitized depths for each transect were then corrected for water level variations (from the staff readings) and adjusted to elevations in NGVD. The final bathymetry database consisted of data points expressed as distance along the transect and elevation in NGVD.

The bathymetry database was then merged with the bank profile database obtained during the land surveying. Since the bank profile surveys extended from each transect end marker to a water depth of approximately 3 ft, there was occasionally some overlap with the bathymetry survey. In cases where there was overlap, the land survey was given precedent because it was more accurate near the bank, and the bathymetry survey points near the edge of the bank were deleted. The final database for each transect consisted of both land survey points and bathymetry survey points expressed as distance from the transect marker and elevations in NGVD.

2.3 WATER QUALITY

Water quality measurements were made along transects 1, 6, 11, and 14 on October 4, 1990. Stations along each transect were occupied at 30-ft intervals (beginning at the water's edge). Measurements at each station were made at depths of 1 ft and subsequently at 2-ft intervals to the bottom. A taut, graduated line stretched between the transect markers was used to locate the stations. The bow of the survey vessel was tied to the taut line and the stern was anchored to minimize vessel movement during the survey.

The water quality data measured during the surface water sampling consisted of pH, conductivity, dissolved oxygen (DO), oxidation/reduction potential, and temperature. All field measurements were made using a Hydrolab 4041 analytical instrument.

The Hydrolab 4041 instrument is an integrated analytical unit containing six analytical electrodes, pressure transducers, and associated electronics.

Instrument calibration was performed and recorded prior to and after the survey. The pH calibration consisted of testing three pH buffer standards (4, 7, and 10) and adjustment to the Hydrolab function to read the specified pH units. Three saline (potassium chloride) solutions of known conductivity (laboratory prepared) were measured using the conductivity function and adjusted to read the specified conductivity. Temperature values were calibrated (checked) against laboratory thermometers. DO functions were checked using temperature/DO tables.

In addition to water quality data, support meteorological data were collected during the survey. Wet and dry bulb air temperatures were obtained with a Taylor sling psychrometer and windspeed was measured with a Davis Instruments digital turbometer. Wind direction was estimated visually.

2.4 WATER VELOCITY

Water velocity was measured on October 4, 1990, at the same stations as the water quality measurements, described previously. Measurements were taken at 2-ft intervals to a maximum depth of 8 ft using a Gurley No. 625 Pygmy current meter. The current meter contained six 0.75-inch rotor cups capable of measuring currents in the range of 0.05 to 3.0 ft per second (ft/sec). The rotor counts at each depth were monitored for approximately 30 seconds. The rotor counts were then converted to water velocity in ft/sec for final presentation.

3.0 RESULTS AND DISCUSSION

3.1 LAND SURVEYING

Figure 2 (an attached oversized figure, 34 inches by 44 inches) presents the results of the land surveying completed by LBF&H. The figure is provided at a scale of 1 inch equals 50 ft and contains all the transect marker locations and monument locations on the site. Figure 2 also shows all state plane coordinates of the transect markers and monuments, as well as the bank profile data.

3.2 BATHYMETRY SURVEY

Appendix A provides the final elevation profile database prepared from the land survey and the bathymetry survey. Appendix B provides 14 channel profiles plotted from the database. Appendix C provides copies of the original fathometer strip charts used to measure the water depth. Table 1 provides the water level staff readings and the support meteorological data collected during the survey.

The water level during the study varied from a high of 19.44 ft NGVD to a low of 18.23 ft NGVD for a range of 1.21 ft. The water level in the canal is controlled by structure S-191 located approximately one mile downstream of the site. Personnel at South Florida Water Management District stated that when the water reaches a certain level, the gates at S-191 are opened. When the water recedes to a certain level, the gates are closed, which produced the large variations in the water level observed at the site. The recorded water levels in Table 1 were used to adjust the bathymetry values.

The final transect elevations were plotted on a land surveying base map (Figure 2) and the elevations were hand contoured in 1-ft intervals to provide a topographic map of the site. Figure 3 presents the results.

Table 1 Water Level and Meteorological Data

Date	Time	Water Level (ft NGVD)	Dry Bulb (°F)	Wet Bulb (°F)	Windspeed (mph)	Wind Direction
10/02/90	1520	18 59	90 0	78 8	6 0	NE
10/02/90	1630	18 23	-	-	-	-
10/02/90	1730	18 48	-	-	-	-
10/02/90	1800	18 62	85 0	76 0	8 2	E
10/03/90	0800	19 07	76 2	74 0	1 5	SE
10/03/90	0845	19 14	-	-	-	-
10/03/90	1100	19 30	90 5	79 5	6 5	SE
10/03/90	1130	19 36	-	-	-	-
10/03/90	1242	19 43	-	-	-	-
10/03/90	1250	19 44	-	-	-	-
10/03/90	1401	19 07	89 2	79 0	7 2	SE
10/03/90	1410	19 07	-	-	-	-
10/03/90	1445	18 86	-	-	-	-
10/03/90	1457	18 66	-	-	-	-
10/03/90	1517	18 49	-	-	-	-
10/03/90	1532	18 34	-	-	-	-
10/03/90	1620	18 33	-	-	-	-
10/03/90	1700	18 26	88 8	72 4	7 6	SE
10/03/90	1720	18 24	-	-	-	-
10/03/90	1733	18 33	-	-	-	-
10/03/90	1750	18 23	-	-	-	-
10/03/90	1810	18 41	-	-	-	-
10/04/90	0800	18 73	79 2	77 0	1 0	NNE
10/04/90	1100	18 73	-	-	-	-
10/04/90	1200	18 72	-	-	-	-
10/04/90	1209	18 72	90 8	82 2	4 8	E
10/04/90	1420	18 70	-	-	-	-
10/04/90	1600	18 67	84 1	78 0	7 4	S
10/04/90	1633	18 72	-	-	-	-
10/04/90	1800	18 73	74 2	73 8	5 8	NE
10/04/90	1835	18 75	-	-	-	-
10/04/90	1901	18 75	-	-	-	-
10/04/90	1925	18 79	-	-	-	-

Source ECT, 1990

The deepest points in L-63N occurred approximately mid-channel and averaged approximately 1.0 ft-NGVD, the deepest point was 0.5 ft-NGVD. Canal L-63S was not as deep with the midpoint depths averaging approximately 4.0 ft-NGVD. Canal C-59 was the deepest with values below sea level (deepest value -0.7 ft-NGVD). The depth contours are typical of a canal with the lines parallel to the banks. The steepest gradients are near the banks with relatively flat areas near the center of the channel.

3.3 WATER QUALITY

Table 2 presents the results of the water quality survey for the four transects measured. The temperature varied from a high of 30.21 degrees Fahrenheit (°F) to a low of 26.78°F. The coolest water was found along transect 14 in Canal L-63S. The temperature at all stations decreased with depth and there was typically a 1- to 2°F change in temperature from the surface to the bottom.

The pH measured was relatively constant and only varied between 6.98 and 5.62. The conductance was also relatively constant and averaged approximately 170 µmhos/cm. The oxidation/reduction potential varied between 68 and 147 millivolts (mV) with the highest values near the bottom. The DO in most cases was below the Class III water quality standard of 5.0 parts per million (ppm). As expected, the DO decreased from the surface to the bottom with the lowest observed value being 2.60 ppm.

3.4 WATER VELOCITY

Table 2 presents the water velocity measurements with the water quality. Unlike the previous day (as observed during the bathymetry surveys), there was little change in the water level during the survey. Apparently, the gates at S-191 must have been closed which resulted in slow water velocities. At most points, the measured water velocity was less than 0.3 ft/sec. The highest value observed was 0.61 ft/sec. Because of the relatively stable water level on the day of the survey, it is probable

Table 2 Water Quality and Water Velocity from TC/NS on October 4, 1990

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
TRANSECT 1-1A								
Water level at beginning of transect (12 20) = 18 72 ft NGVD						NGVD		
Water level at completion of transect (14 20) = 18 70 ft NGVD						NGVD		
10'	5 5	1 0	29 90	6 04	170	090	4 84	0 08
		3 0	29 31	6 01	170	109	4 42	0 09
		5 0	28 53	5 97	169	115	3 61	-
30'	9 0	1 0	30 21	6 34	168	088	4 45	0 29
		3 0	29 35	6 01	168	110	4 16	0 29
		5 0	28 33	6 02	169	114	4 01	0 24
		7 0	27 39	5 99	169	119	3 62	0 21
		9 0	27 43	6 38	170	106	3 50	-
60'	15 0	1 0	30 03	6 34	168	087	4 44	0 24
		3 0	28 47	6 05	169	106	4 42	0 22
		5 0	28 24	6 02	170	109	4 40	0 22
		7 0	27 44	6 00	170	113	4 05	0 06
		9 0	27 36	5 96	170	118	4 01	-
		11 0	27 28	5 94	171	120	3 60	-
		13 0	27 28	5 89	170	124	3 60	-
		15 0	27 31	5 89	170	129	3 51	-
90'	15 5	1 0	29 00	6 33	169	090	5 72	0 26
		3 0	28 47	5 95	169	119	5 24	0 33
		5 0	28 63	5 96	169	120	5 10	0 30
		7 0	27 72	5 94	169	125	4 06	0 34
		9 0	27 51	5 92	170	129	3 61	-
		11 0	27 30	5 91	170	134	3 55	-
		13 0	27 30	5 88	170	140	3 52	-
		15 0	27 31	5 88	170	143	3 13	-

Table 2 Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 2 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
<u>TRANSECT 1-1A (contd.)</u>								
3-5 120'	15 0	1 0	28 98	6 34	168	086	6 11	0 28
		3 0	28 67	5 91	168	114	5 69	0 22
		5 0	28 32	5 93	170	115	5 68	0 33
		7 0	27 59	5 95	170	117	4 17	0 28
		9 0	27 39	5 96	170	116	4 45	-
		11 0	27 33	5 93	170	119	3 71	-
		13 0	27 30	5 91	170	120	4 12	-
		15 0	27 30	5 85	170	126	3 60	-
150'	14 0	1 0	28 31	6 27	169	095	6 03	0 52
		3 0	27 96	6 26	169	098	5 62	0 22
		5 0	28 84	5 88	169	129	4 51	0 22
		7 0	27 61	5 85	168	129	4 43	0 22
		9 0	27 36	5 87	169	132	3 78	-
		11 0	27 36	5 83	170	139	3 10	-
		14 0	27 28	5 74	169	147	3 07	-
180'	12 0	1 0	29 00	6 02	168	119	7 22	0 09
		3 0	28 60	6 01	168	119	6 19	0 11
		5 0	28 20	6 30	167	108	6 17	0 06
		7 0	27 49	6 54	169	094	4 56	0 06
		9 0	27 50	6 48	169	099	4 17	-
		12 0	27 50	6 40	170	109	3 64	-
210'	6 0	1 0	29 40	6 98	168	072	4 17	0 29
		3 0	28 65	6 86	168	073	3 54	0 22
		5 5	28 40	6 74	167	070	3 64	0 29

Table 2 Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 3 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
<u>TRANSECT 6-6A</u>								
Water level at beginning of transect (15 00) = 18 69 ft NGVD								
Water level at completion of transect (17 20) = 18 71 ft NGVD								
3-6	10'	6 5	1 0	29 75	6 15	169	091	4 53
			3 0	29 10	6 01	169	100	4 14
			5 0	28 51	5 93	171	108	3 67
			6 5	28 25	5 89	171	116	3 10
	30'	12 0	1 0	29 15	6 31	169	084	5 61
			3 0	28 76	6 01	169	106	5 03
			5 0	28 30	6 01	170	111	5 15
			7 0	27 59	5 96	170	114	4 14
			9 0	27 56	5 95	169	120	3 49
			11 0	27 45	5 89	170	126	4 52
			12 0	27 43	5 91	170	129	3 13
	60'	15 0	1 0	29 41	6 48	168	089	4 98
			3 0	28 61	6 06	168	101	4 91
			5 0	28 18	6 01	169	104	4 02
			7 0	27 40	6 00	170	110	4 17
			9 0	27 36	5 96	170	118	4 11
			11 0	27 32	5 94	170	119	3 96
			13 0	27 30	5 92	170	123	3 32
			15 0	27 30	5 91	171	126	3 15
	90'	18 0	1 0	29 04	6 27	168	092	5 87
			3 0	28 82	6 11	170	101	6 08
			5 0	28 71	6 05	169	103	5 12
			7 0	28 14	6 00	170	104	4 91
			9 0	27 52	6 01	170	109	4 17

Table 2 Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 4 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
<u>TRANSECT 6-6A (continued)</u>								
3-7		11 0	27 36	5 93	170	109	5 01	-
		13 0	27 30	5 89	171	117	4 23	-
		15 0	27 30	5 91	171	119	3 36	-
		18 0	27 28	5 85	171	126	3 70	-
	120'	19 0						
		1 0	28 97	6 19	169	076	6 12	0 42
		3 0	28 70	5 94	170	100	5 81	0 35
		5 0	28 52	5 93	169	101	5 53	0 22
		7 0	28 11	5 91	170	105	4 90	0 22
		9 0	27 56	5 92	170	108	4 56	-
		11 0	27 34	5 91	170	109	4 36	-
		13 0	27 31	5 89	170	111	3 81	-
		15 0	27 30	5 89	170	115	4 06	-
		17 0	27 29	5 89	171	117	4 15	-
		19 0	27 29	5 88	171	121	3 32	-
	150'	17 0						
		1 0	28 70	6 02	169	081	5 90	0 42
		3 0	28 51	6 00	169	106	4 89	0 26
		5 0	28 36	5 99	168	110	4 57	0 27
		7 0	28 24	5 96	169	110	4 15	0 19
		9 0	27 81	5 94	169	114	3 98	-
		11 0	27 36	5 95	170	120	4 09	-
		13 0	27 29	5 92	170	125	3 72	-
		15 0	27 29	5 90	170	126	3 51	-
		17 0	27 28	5 91	170	131	3 31	-
	180'	13 0						
		1 0	28 77	6 10	168	089	5 20	0 16
		3 0	28 65	5 96	169	110	4 55	0 26
		5 0	28 35	5 97	169	118	3 35	0 21

Table 2 Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 5 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
<u>TRANSECT 6-6A (continued)</u>								
		7 0	28 27	5 95	169	120	4 17	0 16
		9 0	27 88	5 94	170	123	3 96	-
		11 0	27 33	5 92	170	126	4 70	-
		13 0	27 30	5 89	171	131	3 09	-
210'	7 5	1 0	29 30	6 37	170	073	4 75	0 21
		3 0	28 37	6 10	170	101	4 20	0 24
		5 0	28 01	6 08	170	107	3 57	0 06
		7 0	27 67	6 02	171	115	3 55	-
<u>TRANSECT 11-11A</u>								
Water level at beginning of transect (18 00) = 18 73 ft NGVD								
Water level at completion of transect (19 25) = 18 79 ft NGVD								
10'	8 0	1 0	29 30	6 43	168	083	4 08	0 11
		3 0	29 05	6 02	168	099	4 11	0 09
		5 0	28 51	5 94	170	112	3 82	-
		7 0	28 05	5 91	171	117	3 61	-
30'	11 0	1 0	29 33	6 55	168	075	5 01	0 17
		3 0	29 25	6 16	168	100	4 84	0 27
		5 0	28 80	6 09	170	106	4 06	0 19
		7 0	28 17	6 11	169	108	4 10	0 03
		9 0	27 55	6 06	171	114	3 55	-
		11 0	27 58	6 02	171	091	3 21	-
60'	18 0	1 0	29 33	6 58	168	069	6 12	0 35
		3 0	29 18	6 12	169	098	5 61	0 35
		5 0	28 70	6 07	170	103	5 01	0 27

Table 2 Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 6 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
<u>TRANSECT 11-11A (continued)</u>								
3-9	90'	7 0	27 84	6 07	170	107	4 44	0 35
		9 0	27 62	6 06	170	110	4 57	-
		11 0	27 41	6 06	171	114	3 40	-
		13 0	27 29	6 05	172	118	3 18	-
		15 0	27 25	6 04	172	122	3 17	-
		18 0	27 25	6 06	172	125	3 06	-
		1 0	28 99	6 24	168	074	6 10	0 32
		3 0	28 83	6 01	168	099	5 50	0 33
		5 0	28 70	6 00	169	099	4 76	0 30
		7 0	28 13	6 09	169	100	5 01	0 30
		9 0	27 55	6 06	171	101	4 15	-
		11 0	27 36	6 06	171	105	4 11	-
		13 0	27 27	6 07	172	106	3 57	-
		15 0	27 26	6 06	172	108	3 71	-
		17 0	27 28	6 01	172	112	3 16	-
		20 0	27 28	6 00	172	114	3 06	-
	120'	1 0	29 04	6 52	169	068	6 15	0 22
		3 0	28 96	6 00	172	098	6 00	0 31
		5 0	28 75	6 01	172	098	5 14	0 61
		7 0	28 03	6 09	170	099	4 76	0 52
		9 0	27 66	6 07	169	102	4 11	-
		11 0	27 37	6 06	171	104	3 89	-
		13 0	27 27	6 06	172	105	3 21	-
		15 0	27 26	6 02	172	109	3 17	-
		17 0	27 28	6 01	172	111	5 10	-
		19 0	27 28	6 01	172	113	3 00	-

Table 2 Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 7 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
TRANSECT 11-11A (continued)								
150'	19 0	1 0	28 94	5 98	175	072	5 01	0 35
		3 0	28 82	5 98	175	100	4 72	0 52
		5 0	28 59	6 01	171	100	4 81	0 35
		7 0	28 33	6 06	169	101	4 71	0 35
		9 0	27 46	6 06	170	103	4 54	-
		11 0	27 33	6 04	170	104	4 01	-
		13 0	27 28	6 02	171	106	3 79	-
		15 0	27 28	5 98	171	110	3 56	-
		17 0	27 28	5 97	172	112	4 16	-
		19 0	27 28	5 96	171	114	3 16	-
180'	17 5	1 0	28 77	5 90	175	079	4 97	0 32
		3 0	28 66	5 88	176	106	5 09	0 29
		5 0	28 46	5 93	172	106	4 71	0 19
		7 0	28 31	5 98	170	106	4 33	0 22
		9 0	27 83	5 94	169	108	4 01	-
		11 0	27 41	5 99	170	110	3 96	-
		13 0	27 30	6 01	170	111	3 90	-
		15 0	27 30	5 95	170	114	3 52	-
		17 0	27 27	5 93	170	118	3 46	-
		210'	9 0	1 0	28 69	6 30	175	088
3 0	28 56			5 82	175	118	3 19	0 22
5 0	28 36			5 84	175	124	3 19	0 27
7 0	28 05			5 83	173	128	3 17	0 25
9 0	28 06			5 79	173	134	3 15	-

Table 2 Water Quality and Water Velocity from TC/NS on October 4, 1990 (Continued, Page 8 of 8)

Distance from East Bank	Water Depth (ft)	Sample Depth (ft)	Temperature (°F)	pH (units)	Conductance (µmhos/cm)	Oxidation/ Reduction (mV)	Dissolved Oxygen (ppm)	Water Velocity* (ft/sec)
TRANSECT 14-14A								
Water level at beginning of transect (11 00) = 18 73 ft NGVD								
Water level at completion of transect (12 00) = 18 72 ft NGVD								
10'	6 0	3 0	27 01	5 80	169	088	2 60	0 09
		5 0	26 97	6 15	170	109	2 94	0 16
30'	9 0	3 0	26 99	5 80	171	092	4 67	0 21
		5 0	26 93	5 80	170	088	5 16	0 16
		7 0	26 86	5 79	170	083	3 36	0 06
		9 0	26 87	5 77	170	078	3 11	-
60'	12 5	1 0	27 80	5 88	171	099	5 28	0 44
		3 0	27 01	5 70	171	113	5 19	0 16
		5 0	26 95	5 79	171	115	4 61	0 19
		7 0	26 92	5 74	170	117	4 47	0 16
		9 0	26 90	5 81	170	119	4 13	-
		11 0	26 89	5 62	171	124	5 02	-
		12 5	26 78	5 65	172	126	3 51	-
90'	5 5	1 0	27 57	6 00	172	103	4 12	0 21
		3 0	27 15	5 93	171	119	4 00	0 09
		5 0	27 02	5 88	171	124	3 52	-
110'	3 0	1 0	27 66	6 01	171	100	3 20	0 09
		3 0	27 10	5 95	171	113	3 11	-

*Sample depths for water velocities are 1 ft greater than shown (e g , for a sample depth shows as 1 ft, the water velocity was actually measured at 2 ft)

Source ECT, 1990

that the water velocities were much higher on the previous day when the water level dropped more than 1 ft in less than three hours

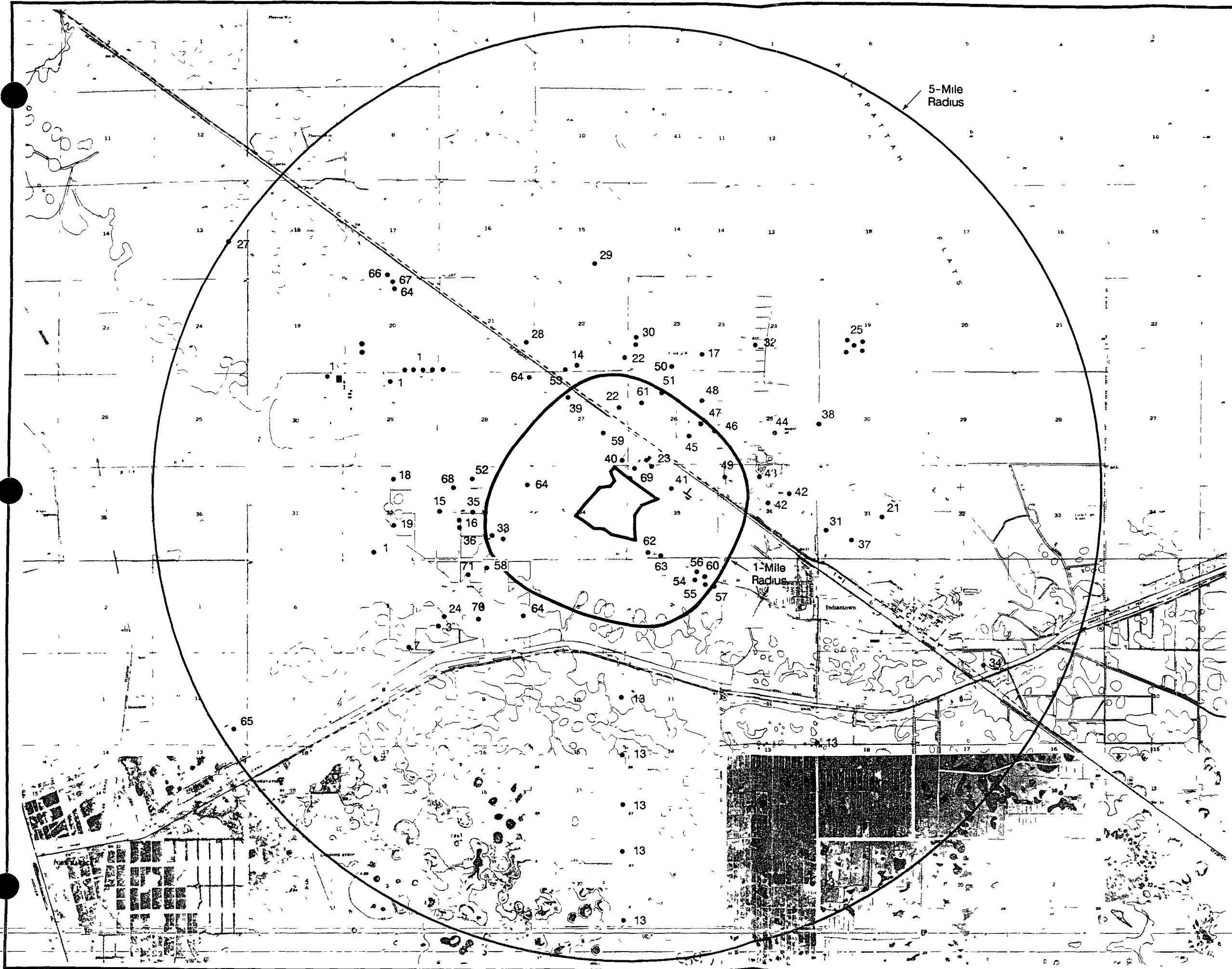


Figure 2 3.3-1
WATER USERS WITHIN FIVE
MILE RADIUS OF INDIAN-
TOWN SITE



Poor Original

Scale 1 Inch = 1-Mile

LEGEND

- Site Boundary
- 1 Water User Location Number Corresponds to the Water User Identification Number Shown in Tables 2 3 3-4 and 2 3 3-6

Sources SFWMD
USGS
FPL

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L P

- (2) A tabulation of data on all wells within the area of review which penetrate into the proposed injection zone, confining zone, or proposed monitoring zone. Such data shall include a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion, and any additional information the Department may require.

See the attached Table 1 for the required information on those wells within the area of review that penetrate the Upper Floridan aquifer monitoring zone. No wells penetrate the confining or injection zones within the area of review.

**Table 1
1-MILE RADIUS WELL INVENTORY**

Well No ⁽¹⁾	Location	Permit/ Ref No	Owner	Use	Casing Diameter	Casing Depth	Well Depth	Casing Material	Production Rate	Active	Comments
49	NW 1/4 NW 1/4 Sec 36 T39S R38E	USGS M-34*	Norman Hales	Agricultural	6"	--	1,100'	--	400 gpm	--	No Access, property being sold to Indian Wood Residential & Golf Course Development
46	NE 1/4 SE 1/4 Sec 36 T39S R38E	USGS M-31*	Norman Hales	Agricultural	6"	--	1,100'	--	200 gpm	--	No Access, property being sold to Indian Wood Residential & Golf Course Development
47	NE 1/4 SE 1/4 Sec 26 T39S R38E	USGS M-32*	Norman Hales	Agricultural	4"	--	1,100'	--	70 gpm	--	No Access, property being sold to Indian Wood Residential & Golf Course Development
45	NW 1/4 SE 1/4 Sec 26 T39S R38E	USGS M-30*	Norman Hales	Agricultural	6"	450'	1,100'	--	75 gpm	--	No Access, property being sold to Indian Wood Residential & Golf Course Development
51	NE 1/4 NW 1/4 Sec 26 T39S R38E	USGS M-915*	Mr Quinn	Agricultural	8"	--	1,120'	--	160 gpm	Yes	
23	SW 1/4 SW 1/4 Sec 26 T39S R38E	43-00362	Caulkins Citrus	Industrial	10"	400'	1,000'	--	300 gpm	Yes	Caulkins Plant
69	SW 1/4, NW 1/4, NW 1/4, Sec 35 T39S, R38W	MF-37 **	Caulkins Citrus	Monitoring Well	10"	391'	1,260'	Steel	--	No	SFWMD Monitoring Well

⁽¹⁾See Figure 2 3 3-1 for location of corresponding number

*US Geological Survey Well Number

** SFWMD Well Number

Note Information not available where not indicated

Source CH2M Hill, 1990

- (3) Maps and cross sections indicating the general vertical and lateral limits within the area of review of all underground sources of drinking water, their position relative to the injection formation and the direction of water movement, where known, in each underground source of drinking water which may be affected by the proposed injection.

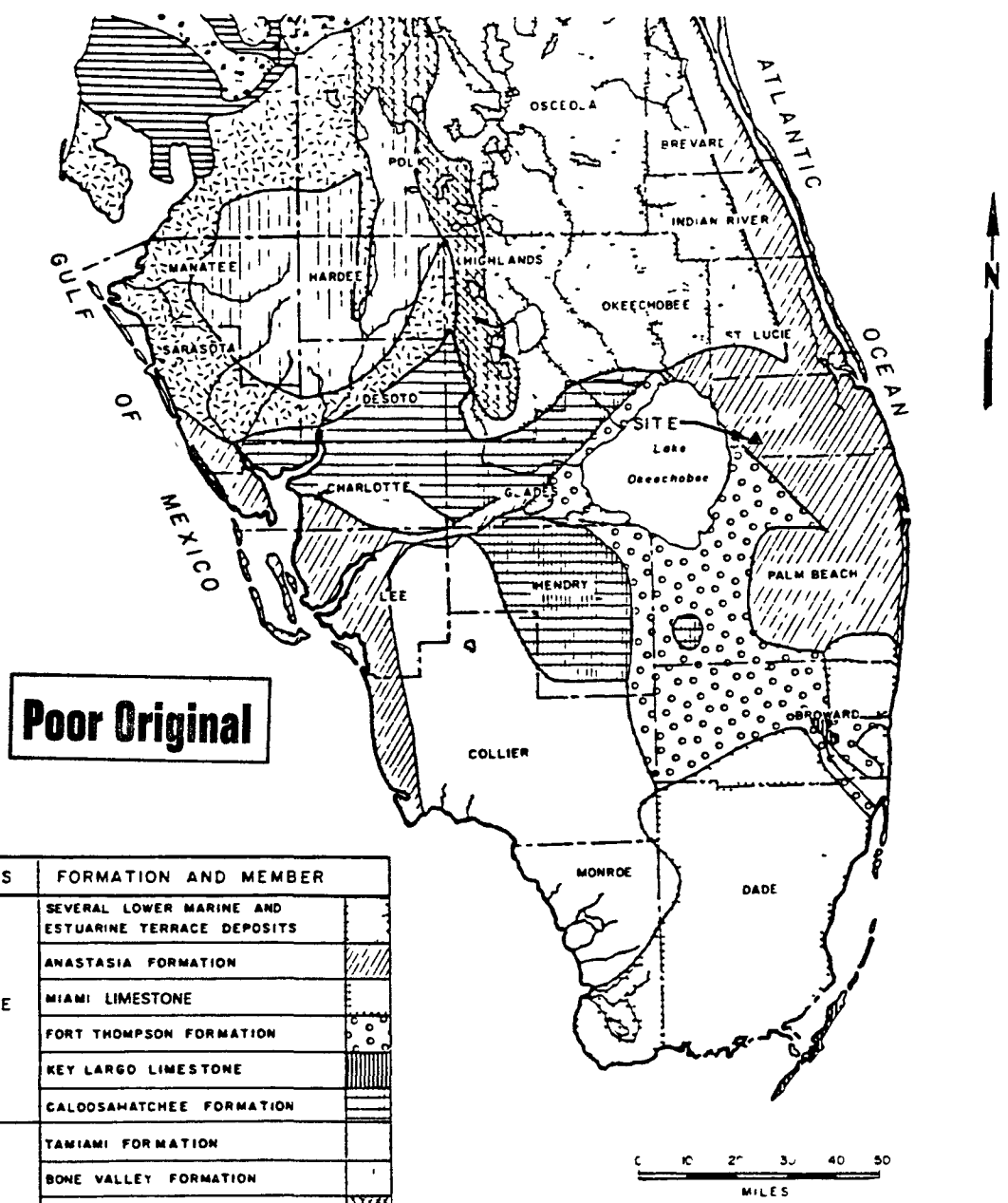
Regionally, the depth to the base of the underground sources of drinking water occurs in the interval between 1,600 and 1,850 feet based on data from injection wells constructed for the City of Stuart, North Port St. Lucie, Pratt & Whitney, and QO Chemicals (see discussion on Depth to Base of USDWs in the attached SCA Section 3.5.1.5). The base of the underground sources of drinking water beneath the Indiantown site is expected to be about 900 to 1,000 feet above the estimated top of the proposed injection zone. Hydrogeologic information on the Surficial and Upper Floridan aquifers is presented in SCA Section 2.3.2.1.

- (4) **Maps and cross sections detailing the hydrology and geologic structures of the local area.**

For a discussion of the geology and hydrogeology of the site area, including appropriate maps and cross sections, see the discussion presented in SCA Section 2.3.2.1.

- (5) **Generalized maps and cross sections illustrating the regional geologic setting.**

For a discussion of the regional geology, see SCA Section 2.3.1.1 and the attached Figure 2.3.1-16. Also see Figures 3.5.1-3 and 3.5.1-4 in the attached Section 3.5.1.5.



SERIES	FORMATION AND MEMBER
POST MIOCENE	SEVERAL LOWER MARINE AND ESTUARINE TERRACE DEPOSITS
	ANASTASIA FORMATION
	MIAMI LIMESTONE
	FORT THOMPSON FORMATION
	KEY LARGO LIMESTONE
	CALOOSAHATCHEE FORMATION
MIOCENE	TAMIAMI FORMATION
	BONE VALLEY FORMATION
	FT PRESTON FORMATION
	HAWTHORN FORMATION
	ST MARKS FORMATION
OLIGOCENE	SUWANNEE LIMESTONE

MODIFIED AFTER VERNON AND PURI, 1964

Figure 2.3.1-16
REGIONAL GEOLOGIC MAP

INDIANTOWN
COGENERATION
PROJECT

Indiantown Cogeneration, L P

(6) Proposed operating data.

- a. Average and maximum daily rate and volume of the fluid to be injected;
- b. Average and maximum injection pressure; and,
- c. Source and an analysis of the chemical, physical, radiological and biological characteristics of injection fluids.

The following preliminary operating data have been determined for design of the proposed injection well system:

- a. For Taylor Creek/Nubbin Slough as the primary plant cooling water supply source these values are:

Average daily injection rate = 0.375 mgd
Maximum daily injection rate = 0.426 mgd
Average daily volume of injected fluid = 0.375
million gallons (50,130 cu. ft.)
Maximum daily volume of injected fluid = 0.426
million gallons (56,950 cu. ft.)

For the Floridan aquifer as the alternate plant cooling water supply source these values are:

Average daily injection rate = 1.65 mgd
Maximum daily injection rate = 1.84 mgd
Average daily volume of injected fluid = 1.65
million gallons (220,570 cu. ft.)
Maximum daily volume of injected fluid = 1.84
million gallons (245,970 cu. ft.)

- b. The preliminary average and maximum injection pressures have been determined to be 25 and 50 psi, respectively.
- c. A brief description of the source and estimated quality of the injected wastewater is presented in the attached SCA Section 3.5.1.5. A more complete discussion of the source and analysis of the injection fluid characteristics is presented in Section 3.6 of the SCA.

Final design data will be provided with the injection well engineering design documents to be completed during the SCA review period.

- (7) **Proposed formation testing program to obtain an analysis of the chemical, physical and radiological characteristics of and other information on the injection zone.**

Tests will be performed in both the injection and monitor wells to determine the depth to the 10,000 mg/l TDS interface, the permeability and thickness of the confining sequence, and the transmissivity of the injection zone. Testing will include the collection of drill cuttings, samples for water quality testing, and rock cores, and the performance of geophysical logging, packer tests, and injection tests. Background water quality samples will be sent to a certified laboratory for analysis and will be analyzed for parameters specified by the FDER. See the attached SCA Section 3.5.1.5 for a more complete description of the proposed testing program.

(8) Proposed stimulation program.

No stimulation program is anticipated because the injection zone is expected to have a transmissivity sufficient to achieve reasonable well head pressures at the anticipated flows.

(9) Proposed injection procedure.

The proposed injection system will include a main injection well, standby injection well, a two-zone monitoring well, pumps, surge tank, and instrumentation and controls. The wastewater will be collected in a tank and level switches in the tank will control the injection pumps. The wastewater will normally be pumped to the main injection well. If the main injection well is out of service, the standby injection well will be used. The injection piping will be connected to the hydraulic surge control system.

The hydraulic surge control system will be designed to dissipate hydraulic surges caused by an increase or decrease in the flow velocity within the piping system. The surge control system will consist of a surge tank, air source, and a level control system. The system components will be sized based on actual flows and pressures. Figure 3.5.1-7 in the attached SCA Section 3.5.1.5 contains a conceptual diagram of the injection system.

- (10) Engineering drawings of the surface and subsurface construction details of the system.**

See the attached SCA Section 3.5.1.5 for conceptual design drawings. Detailed construction drawings of the system will be made available during the SCA review period.

- (11) Contingency plans to cope with all shut-ins or well failures, so as to protect the quality of the waters of the State as defined in Florida Administrative Code Rule 17-3, including alternate or emergency discharge provisions.

The injection system will have a standby injection well that will be used during shut-ins of the main well due to maintenance, testing, or emergency situations. Both the main and standby wells will be of sufficient size to accept the maximum wastewater flow. The standby well will, therefore, provide 100 percent redundancy to the injection well system.

- (12) Plans (including maps) and proposed monitoring data to be reported for meeting the monitoring requirements in Florida Administrative Code Rule 17-28.25.

The injection well system includes a two-zone monitor well to permit monitoring of the first permeable zone above the injection zone and the base of the USDW. Monitoring of the first permeable zone above the injection zone will provide an early warning of injected fluid migration in the direction of the USDW. Injection system monitoring data will be collected to provide a record of system performance and to detect any movement of injected fluid into the USDW. The injection system monitoring plan consists of monitoring the injection well capacity and the injection flow rate and pressure, the annular fluid tank levels, the water elevation in the upper and lower monitoring zones, and the water quality of the two zones. Water quality and water level data will be reported to the FDER on a monthly basis. For a more complete description of the proposed monitoring plan, see the attached SCA Section 3.5.1.5, especially Figure 3.5.1-6 and Table 3.5.1-8.

- (13) For wells within the area of review which penetrate the injection zone but are not properly completed or plugged, the corrective action proposed to be taken under Florida Administrative Code Rule 17-28.13(5).

No wells currently penetrate the injection zone within the area of review. Therefore, no plugging or other corrective action is required. The existing Pratt & Whitney injection well, approximately 14 miles from the Indiantown site, is the nearest known well which penetrates the proposed injection zone.

- (14) Construction procedures including a cementing and casing program, logging procedures, deviation checks, proposed blowout protection (if necessary), and a drilling, testing and coring program.

The injection and monitor wells will be constructed by drilling a pilot hole, reaming the pilot hole, installing casing, and progressing with the pilot hole to install the next smaller-sized casing. Testing will occur throughout the drilling process. For a complete description of the proposed well drilling, geophysical logging, testing, and construction procedures, see the attached SCA Section 3.5.1.5. Additional description of these procedures will be provided in the injection well design and bid specifications to be prepared during the SCA review period.

- (15) A certification that the applicant has ensured, through a performance bond or other appropriate means, the resources necessary to close, plug or abandon the well as required by Florida Administrative Code Rule 17-28.27(9).

To be provided as part of the SCA review process and established as a condition of certification.

INDIANTOWN UIC PERMIT ATTACHMENT: Section 3.5.1.5 of the Indiantown Cogeneration Projects Site Certification Application, December 1990.

3.5.1.5 Injection Wells

Injection wells are proposed for the disposal of cooling system and process wastewaters produced at the ICL plant. This section addresses the feasibility of injection of such industrial wastewater at the ICL site based on the known and expected hydrogeology. Conceptual designs for the injection and monitor wells are presented. The construction and testing program is outlined and the injected fluid is characterized. An injection system monitoring plan is presented.

The injection wells will be designed to comply with the requirements for underground injection control (FAC 17-28). As part of this regulation, a Technical Advisory Committee (TAC) is established for each application to ensure the system is designed properly and will operate according to the design. The ICL TAC will consist of agency personnel from the DER's regional and main offices, the SFWMD, EPA Region IV, and the Fish and Wildlife.

Background

The wastewater from the ICL facility is proposed to be injected into Class I injection wells. Class I wells inject wastewater beneath the lowermost formation containing an underground source of drinking water (USDW), defined as 10,000 mg/l TDS or less.

The wastewater from various sources will be collected in a wastewater collection tank. A portion of this wastewater will be recycled and used in the spray dryer dilution system. The remainder will be disposed of in the injection well. As discussed in Section 3.6, the wastewater from this facility is expected to be non-hazardous.

Maximum daily flow (MDF) to the injection wells at the ICL facility is anticipated to be 1,280 gallons per minute (gpm). The proposed location of the injection wells onsite is shown on Figure 3.1.1-1.

Feasibility of Injection Well Disposal

The feasibility of injection well disposal at the ICL site can be assessed from the performance of injection wells in St. Lucie, Martin, and Palm Beach Counties. Data were reviewed on the existing injection wells in those counties to evaluate the regional hydrogeology and to extrapolate the findings to the Indiantown area.

Within a 25-mile radius of the site, several injection wells have been operational for up to 13 years (North Port St. Lucie, 1988; South Port St. Lucie, 1983; City of Stuart, 1982; Pratt and Whitney, 1985; QO Chemicals, Inc., 1977; Seacoast Utilities, 1989). All of these wells inject into the lower Oldsmar Formation (Boulder Zone) at depths of 2,900 to 3,300 feet below land surface (bls).

In south Florida, sedimentary rock types such as dolomite and fractured limestone are potentially good injection zones. Injection zones must be adequate in thickness and areal extent to receive the proposed volume of injected fluid. Overlying formations should be essentially horizontal and without faults or fractures. The proposed injection zone also should have sufficient porosity and permeability to accommodate the proposed flow without undue pressure buildup.

Typical confining strata in Florida include clays and unfractured limestones. Because of the potential for fractures or solution channels in the limestones and dolomites, site-specific demonstration of the adequacy of the proposed confining strata is required by state underground injection control regulations. Factors considered in demonstrating this adequacy include lithology, thickness, areal extent, structure, porosity, and permeability. The overlying rock unit proposed to provide confinement must be sufficiently thick and areally extensive, free of fractures or faults, and of sufficiently low porosity and permeability to retard the upward migration of injected fluids.

Regional Geology

Data were obtained on the existing injection and test wells in Martin and neighboring counties to evaluate the regional geology and extrapolate the findings to the Indiantown area. Table 3.5.1-3 is a summary of the well locations used. Figure 3.5.1-3 is a location map of the referenced wells, and Figure 3.5.1-4 is a cross section from A-A'. A lithologic log of the Amerada Cowles Magazines Inc. No. 1 well was obtained from the Florida Geological Survey files (Reference No. W-4086). This well is approximately 12 miles north-northeast from the site, and was drilled to over 5,000 feet in depth. Based on the data obtained from these wells, the Cedar Keys Formation is the oldest formation expected to be encountered during drilling of the injection wells, at an approximate depth of 3,200 feet.

Regional Hydrogeology

Injection Zone

The stratum most commonly used for injection in southeast Florida is the lower portion (Boulder Zone) of the Oldsmar Formation. Water quality in this zone typically exceeds 30,000 mg/l TDS. The principal overlying confining units are the upper Oldsmar Formation and the lower part of the Avon Park Limestone.

The dolomitic portions of the lower Oldsmar Formation are finely crystalline and sucrosic, with areas that are highly fractured and cavernous. Cavities in the lower Oldsmar Formation range in size from small vugs to large caverns. The caverns persist to the base of the formation, where interbedded dolomite and anhydrite of the Paleocene age Cedar Keys Formation are encountered. The existence of these formation characteristics in south Florida accounts for the success of injection wells there.

The areal extent of the lower Oldsmar Formation is well documented in the literature and well data. Chen (1965) postulates that during the early Tertiary age, Florida existed as a broad carbonate platform, with warm and shallow marine conditions similar to the present-day Bahamas and Compeche

**Table 3.5.1-3
INJECTION AND TEST WELL LOCATIONS**

<u>Well</u>	<u>County</u>	<u>Section/ Township/Range</u>	<u>Depth (feet)</u>
Amerada Cowles Magazine No 1	St Lucie	Sec 19 T36S, R40E	5,159
Indiantown Cogeneration Facility (proposed)	Martin	Sec 35 T39S, R37E	3,300 (est)
North Port St Lucie	St Lucie	Sec 20 T36S, R40E	3 324
South Port St Lucie	St Lucie	Sec 13 T37S, R40E	3,418
Pratt & Whitney	Palm Beach	Sec 14 T41S, R40E	3,320
Florida Power and Light	Martin	Sec 25 T39S, R37E	1,056*
QO Chemicals	Palm Beach	Sec 28 T43S, R37E	3,156
Alligator Alley Test Well	Broward	Sec (N/A) T50S, R35E	2,811
Stuart	Martin	Sec 1	3,305
Seacoast	Palm Beach	Sec 4 T42S, R42E	3,320

*Test Well

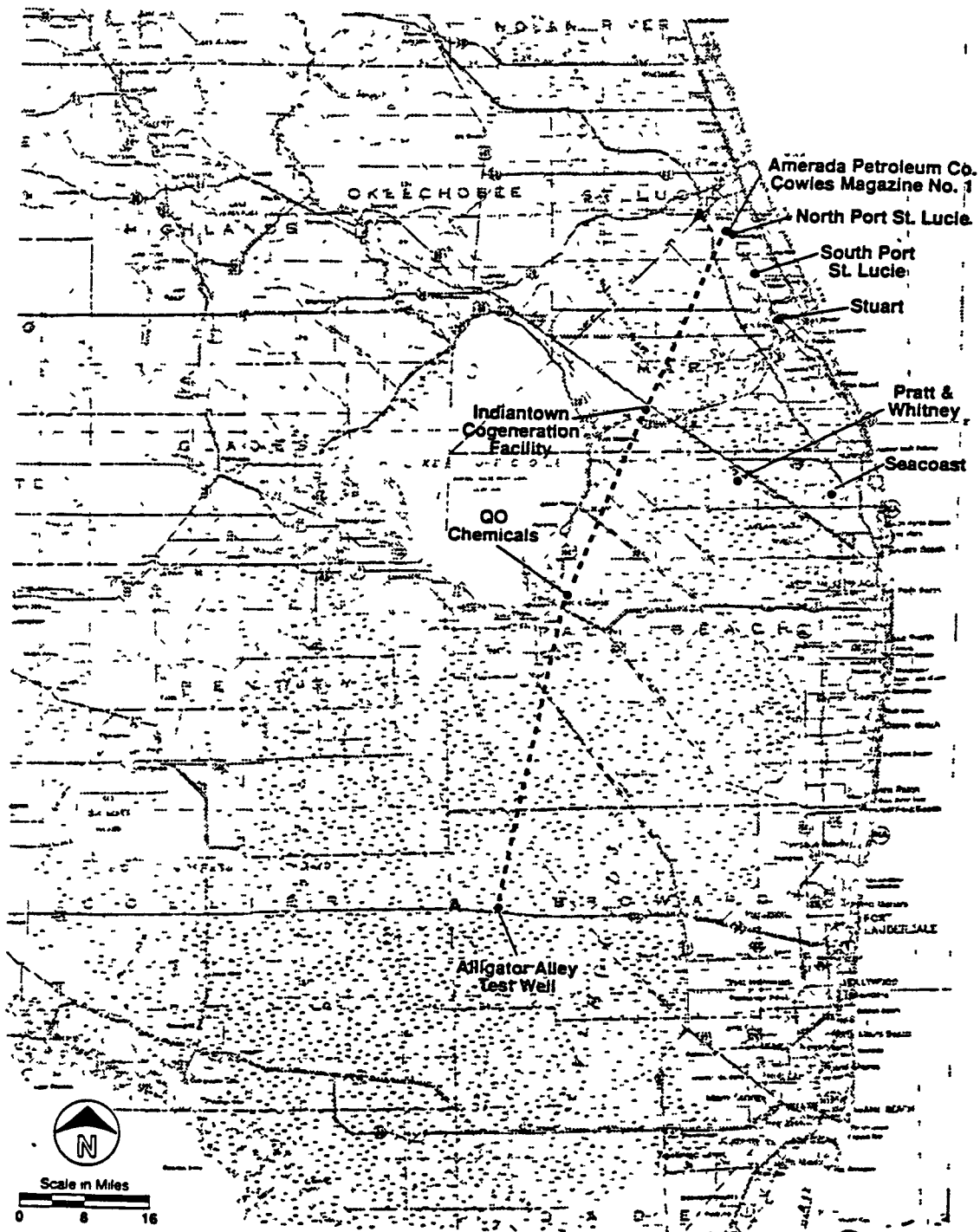


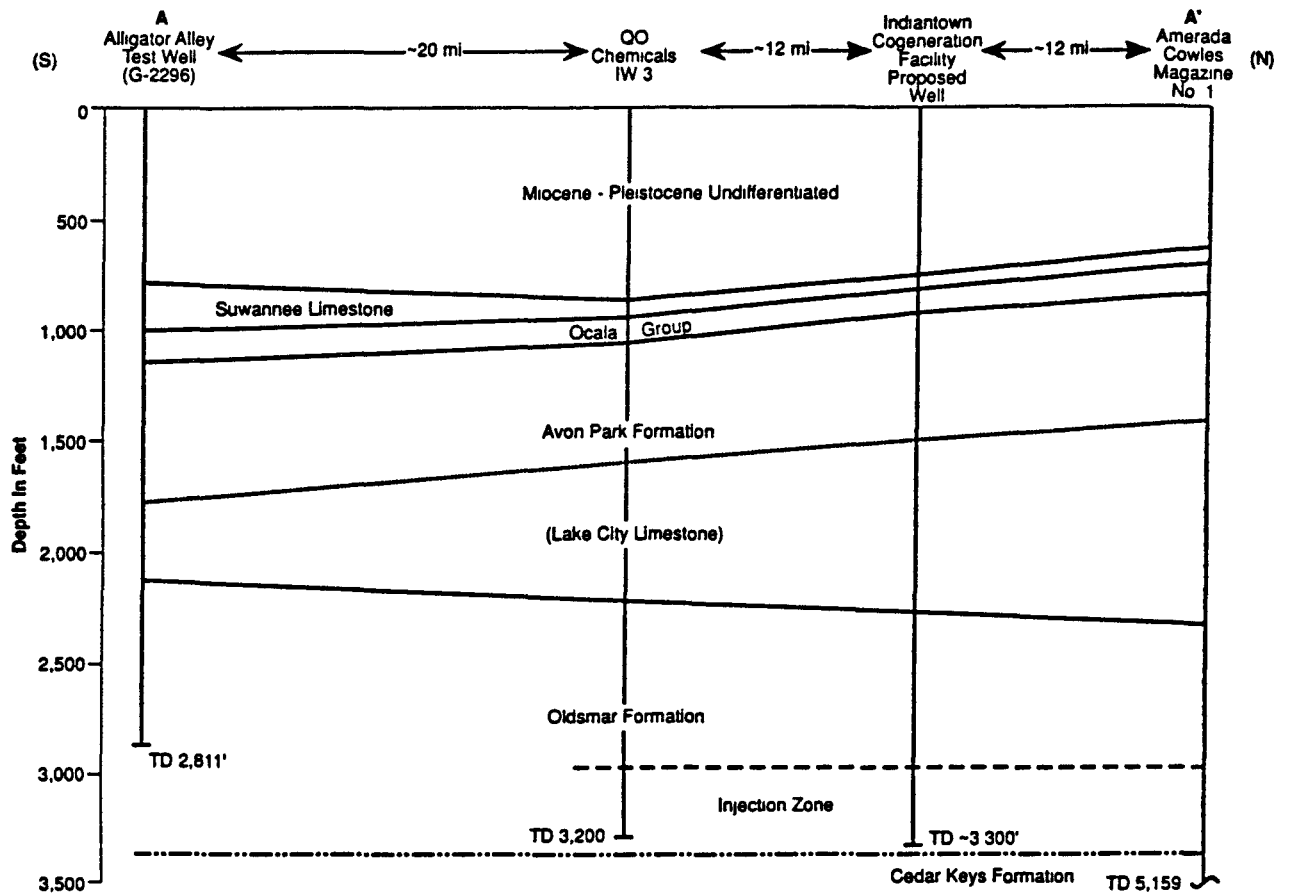
Figure 3.5.1-3
LOCATION OF GENERALIZED NORTH-SOUTH
GEOLOGIC CROSS SECTION AND ADJACENT
INJECTION WELLS

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Source: Chen, 1965; Pun and Winston, 1974; Meyer, 1988.

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Figure 3.5.1-4
GENERALIZED NORTH-SOUTH GEOLOGIC
CROSS SECTION

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Bank. Carbonates were deposited throughout the Florida platform. The Oldsmar Formation is present in all of peninsular Florida and exhibits the greatest degree of dolomitization along the structural high of the Peninsular arch. The thickness of the Oldsmar Formation varies from approximately 400 feet along the crest of the Peninsular arch to as much as 1,200 feet in south Florida.

Puri and Winston (1974) identified areas suitable for injection in south Florida in their regional study. The Amerada Cowles Magazine Inc. No. 2 well adjacent to No. 1 (referenced by Chen, 1965) in St. Lucie County has zones of high transmissivity in the middle to lower Oldsmar Formation that are approximately 2,300 to 3,200 feet in depth. The North Port St. Lucie well has injected successfully in the interval between 2,900 and 3,200 feet since 1988, while the QO Chemicals wells have successfully used that same interval since 1977.

Depth to Base of USDWs

The relationship of the location of the interface between fresh water and water containing greater than 10,000 mg/l of TDS to the injection and confining zones is one factor determining the feasibility of injection at a particular site. Ideally, the base of fresh water should occur near the top of the confining sequence.

Regionally, the 10,000 mg/l TDS interface occurs in the interval between 1,600 and 1,850 feet in depth. At the City of Stuart's injection well, the depth to the interface occurs in the 1,600- to 1,700-foot interval, while at the North Port St. Lucie well the interface occurs at approximately 1,700 feet in depth. At both the Pratt & Whitney and the QO Chemicals wells, the interface occurs at approximately 1,800 feet in depth.

Confining Zone

Eocene carbonates are the principal stratigraphic units providing confinement and have been found in every injection well drilled in southeast Florida. The structure contour maps and isopach-lithofacies maps Chen (1965) developed attest to the regional areal extent of the formations that provide confinement to the injection zone. An approximately 1,100-foot-thick confining sequence

found at the North Port St. Lucie site increases to a thickness exceeding 1,300 feet at the City of Stuart.

Results of core analyses from the North Port St. Lucie well are shown in Table 3.5.1-4. The average permeability was found to be about 1.0×10^{-5} cm per second. This is consistent with permeability values found in other wells in the area.

These data indicate that the confining beds above the injection zone are of sufficient thickness and areal extent to retard the upward migration of fluids and should be present at the ICL site.

Expected Hydrogeology at the Site

The hydrogeology in the vicinity of Indiantown is reasonably well documented from injection wells that have been drilled within a 25-mile radius, test oil wells that have been drilled in the vicinity, and from published regional studies. The data strongly suggest that the formations used in south Florida for injection and confinement will be encountered at the proposed ICL facility. Rock formations that are important to the injection process are found throughout the region. They dip gently seaward (Miller, 1986) and lack structural features that could affect their suitability for injection. It is expected that the hydrogeology and formation boundaries beneath the proposed site are similar to those beneath the Amerada Cowles and QO Chemicals sites.

In the cross section shown on Figure 3.5.1-4, the injection zone occurs at about the same depths from north to south, at approximately 2,900 feet. The injection zone at the Pratt & Whitney well also occurs at that depth.

Figure 3.5.1-5 shows the anticipated hydrogeology at the ICL site. The top of the injection zone is expected to occur at a depth of approximately 2,900 feet and extend to a depth of 3,200 feet. The confining sequence is expected to extend from a depth of about 1,850 feet to the top of the injection zone. It is anticipated, based on the location of the 10,000 mg/l TDS interface at the Pratt & Whitney, QO Chemicals, Stuart, and Port St. Lucie wells, that the

Table 3.5.1-4
CORE ANALYSIS SUMMARY
NORTH PORT ST. LUCIE INJECTION WELL

Depth (feet)	Orientation (Horizontal or Vertical)	Coefficient of Permeability (cm/sec)	Porosity (%)
2101.0-2101.8	V	4.5×10^{-5}	35
2101.0-2101.8	H	5.4×10^{-5}	35
2108.2-2109.0	V	4.4×10^{-5}	32
2108.2-2109.0	H	3.3×10^{-5}	31
2249.0-2250.0	V	3.5×10^{-7}	13
2249.0-2250.0	H	1.4×10^{-7}	9
2253.5-2254.0	V	2.8×10^{-3}	37
2253.5-2254.0	H	1.2×10^{-3}	32
2425.0-2426.2	V	6.7×10^{-4}	35
2425.0-2426.2	H	5.7×10^{-4}	35
2430.0-2431.0	V	1.6×10^{-5}	34
2430.0-2431.0	H	3.4×10^{-4}	36
2449.0-2450.0	V	3.5×10^{-6}	35
2449.0-2450.0	H	8.9×10^{-5}	38
2451.0-2451.8	V	2.3×10^{-5}	31
2451.0-2451.8	H	1.1×10^{-5}	30
2628.0-2629.0	V	4.1×10^{-5}	25
2628.0-2629.0	H	1.9×10^{-4}	30
2632.5-2633.0	V	5.0×10^{-4}	31
2632.5-2633.0	H	1.5×10^{-4}	32

Note: Core analyses performed by Ardaman and Associates, Orlando, Florida.

10,000 mg/l TDS interface at the ICL site will occur between 1,750 and 1,850 feet bls.

Conceptual Design

Injection System Plan

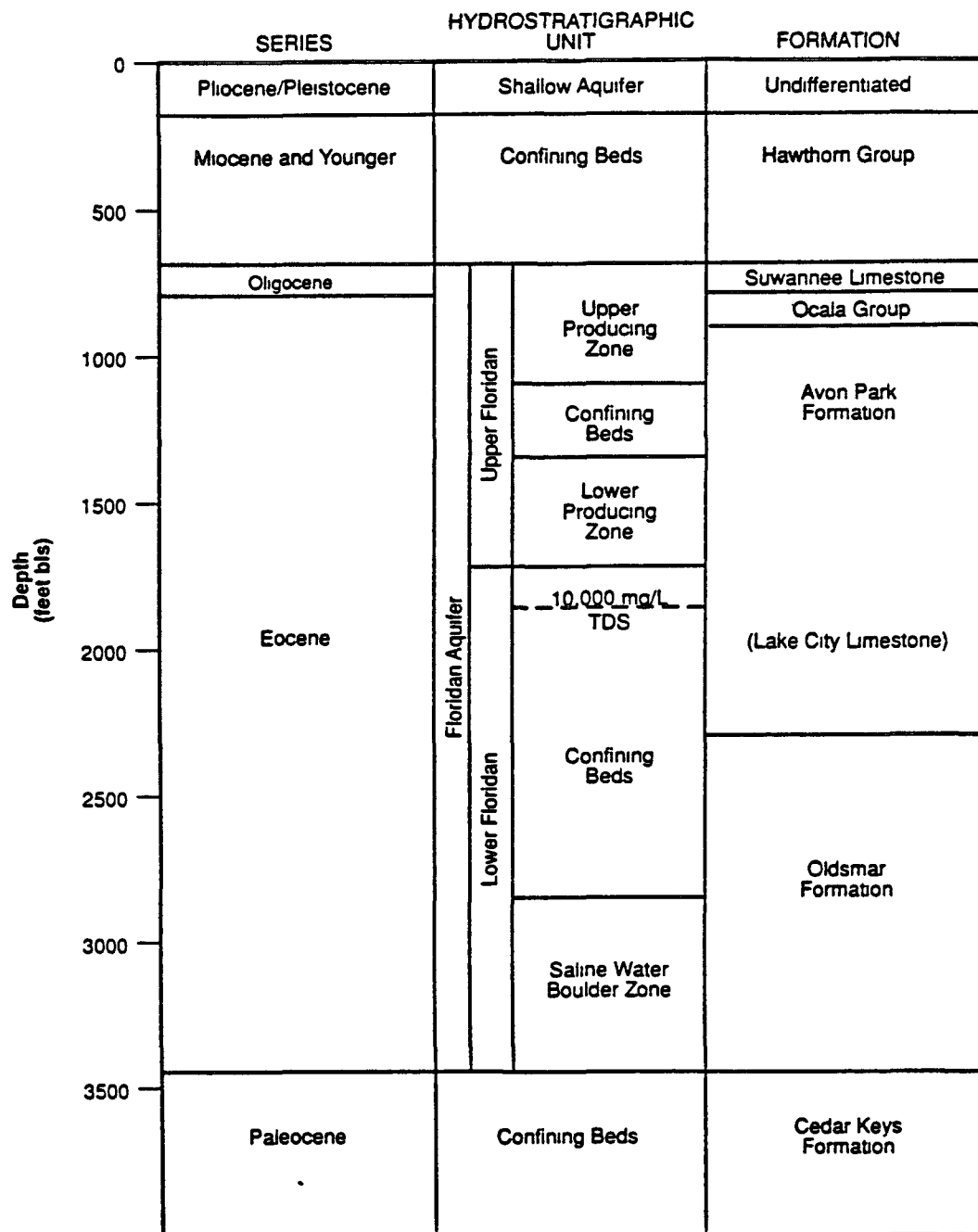
The injection and monitor wells will be located on a reinforced concrete pad, typically 8 to 12 inches thick and approximately 80 x 180 feet in size. The pad will protect the Surficial aquifer from spills and supports drilling loads during construction and workovers. The proposed location for the injection and monitor wells is shown on Figure 3.5.1-6.

The injection system will include a main injection well, standby injection well, a two-zone monitoring well, pumps, surge tank, and instrumentation and controls. The wastewater will be collected in a tank and level switches in the tank will control the injection pumps. The wastewater will normally be pumped to the main injection well. If the main injection well is out of service, the standby injection well will be used. The injection piping will be connected to the hydraulic surge control system.

The hydraulic surge control system will be designed to dissipate hydraulic surges caused by an increase or decrease in the flow velocity within the piping system. The surge control system will consist of a surge tank, air source, and a level control system. The system components will be sized based on actual flows and pressures. Figure 3.5.1-7 is a conceptual diagram of the injection system.

Water Supply

The primary water supply for cooling tower makeup will be Taylor Creek/Nubbin Slough, located approximately 19 miles northwest of the site. Occasionally, makeup water will be required to be withdrawn from the Floridan aquifer. Taylor Creek/Nubbin Slough will be used as long as specific hydraulic conditions are met in the canal system. During periods of extended drought, water will be required to be withdrawn from Floridan aquifer wells constructed at the facility.



Source: Chen, 1965; Lichter, 1960; CH2M HILL files

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Figure 3.5.1-5
GENERALIZED HYDROGEOLOGIC COLUMN AT
THE INDIANTOWN COGENERATION FACILITY

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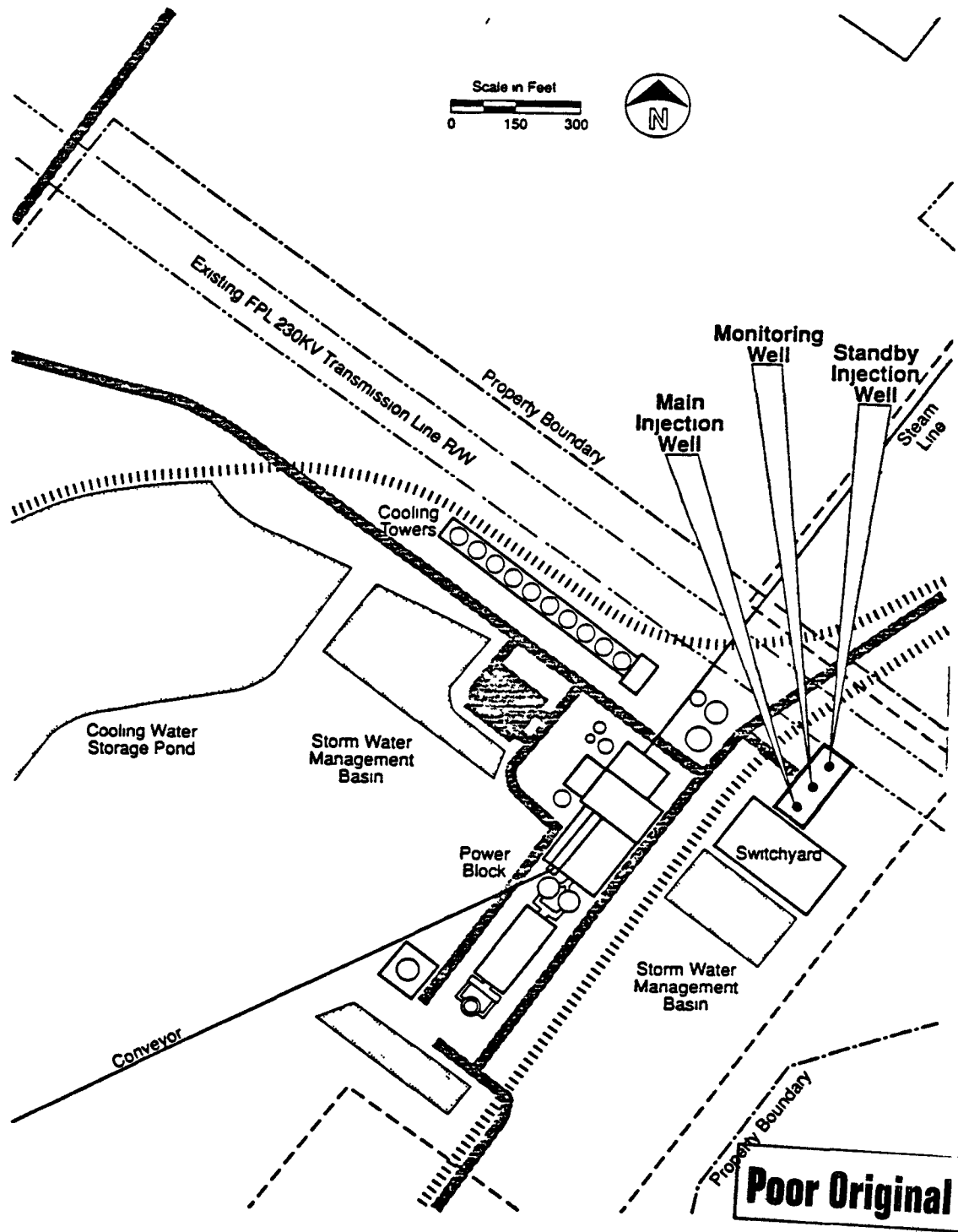
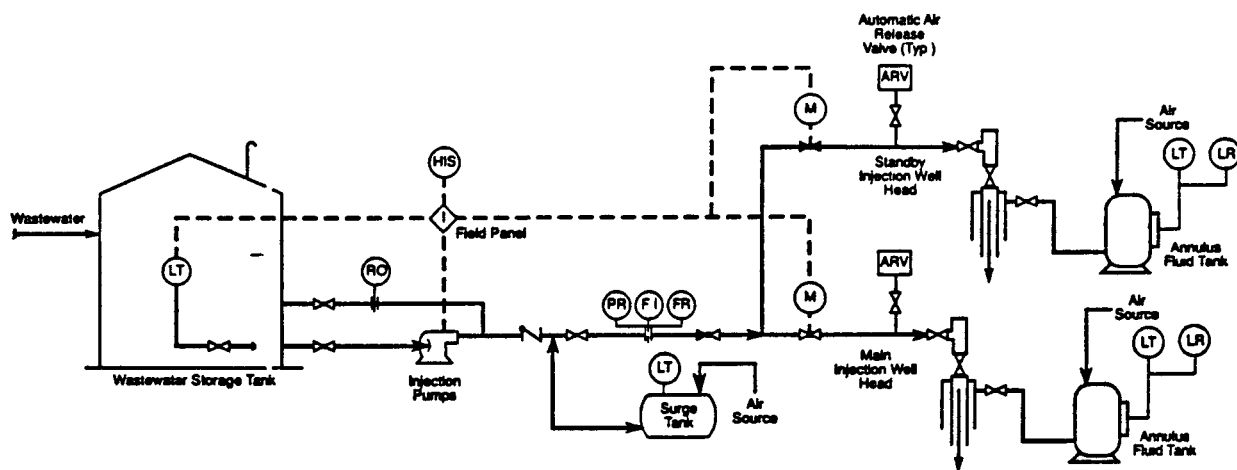


Figure 3.5.1-6
DETAILED SITE PLAN OF THE INDIANTOWN
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LEGEND

(LT)	Level Transmitter	⋈	Gate Valve
(FI)	Flow Indicator	⋈	Globe Valve
(RO)	Restriction Orifice	⌋	Check Valve
(HIS)	Hand Indicating Switch	⋈	Throttle Valve
(M)	Motor		
(PR)	Pressure Recorder		
(FR)	Flow Recorder		
(LR)	Level Recorder		

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Figure 3.5.1-7
CONCEPTUAL INJECTION SYSTEM DIAGRAM,
INDIANTOWN COGENERATION FACILITY

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The raw water quality of the two sources will result in different concentration cycles in the cooling tower. The resulting wastewater quality and quantity will be different depending on the raw water source. The estimated peak flow to the injection well when utilizing the canal source is 250 gallons per minute (gpm). The estimated peak flow to the well when utilizing the Floridan aquifer is 1,280 gpm.

Injection Tubing Size

The Florida Department of Environmental Regulation (FDER) has developed a limitation on the flow velocity of injected fluids in the injection casing or tubing. The maximum flow velocity allowed is 8 feet per second (fps). This criterion is typically the limiting factor in determining the capacity of an injection well.

The injected flow will reach rates up to 1,280 gpm when the Floridan aquifer is utilized for water supply. A 10-inch diameter injection tubing will be required to accommodate this flow. At 8 fps fluid velocity, the allowable flow in the 10-inch tubing will be about 1,714 gpm. Each injection well will be designed to accept the maximum wastewater flow, thereby providing 100 percent redundancy for the injection well system.

Material Selection Criteria

The intermediate casings of the injection wells will be carbon steel as is typically used on Class I injection wells. The injection tubing material will be selected to provide a reliable mechanical system for injection. The injected fluid will be slightly brackish when utilizing Taylor Creek/Nubbin Slough, and will be moderately brackish when the Floridan aquifer is used for supply. The tubing material will be selected to be compatible with the brackish nature of the wastewater. Possible tubing materials include carbon steel, internally coated carbon steel, fiberglass reinforced plastic, and other specialty metals.

Final material selection will be based on suitable mechanical properties, capital costs, operation and maintenance costs, and corrosion resistance.

Preliminary Design

The conceptual design of the injection wells is based on providing capacity for maximum daily flow without any storage and on the regulatory limitation on flow velocity of 8 fps. The preliminary design of the injection wells is presented on Figure 3.5.1-8. This design is based on the assumption that fiberglass reinforced plastic (FRP) tubing will be used for the injection tubing. The FRP couplings in this size have an outside diameter of 12.625 inches. If coated steel or alloy steel is used, the casing sizes may be reduced because the coupling dimensions are smaller than for a similar size FRP tubing.

A 10-inch-diameter tubing set with a packer will be required to accommodate the maximum 1,280 gpm flow. A 16-inch-diameter final casing, set to the top of the injection zone, will be required to provide adequate clearance for the packer and tubing couplings. The remaining casing sizes are proposed to be 26, 34, and 42 inches in diameter. Intermediate casings are included in injection well designs to facilitate construction and to protect overlying aquifers.

Construction and Testing Plan

Drilling Program for Injection Wells

The injection wells will be constructed by advancing the hole with a pilot hole, reaming the pilot hole, installing casing, and progressing with the pilot hole to install the next smaller-sized casing. Testing will occur throughout the drilling process. The proposed drilling and testing program for each injection well is described below.

1. Install by driving or drilling a minimum 42-inch-diameter surface casing to about 25 to 40 feet in depth; cement the annulus back to surface if drilled. Drill a 12-inch-diameter pilot hole through the Surficial aquifer and underlying clay into the consolidated limestone at an approximate depth of 500 feet. Run geophysical logs.
2. Ream the 500-foot pilot hole to about 42 inches in diameter; install approximately 500 feet of 34-inch-diameter casing and

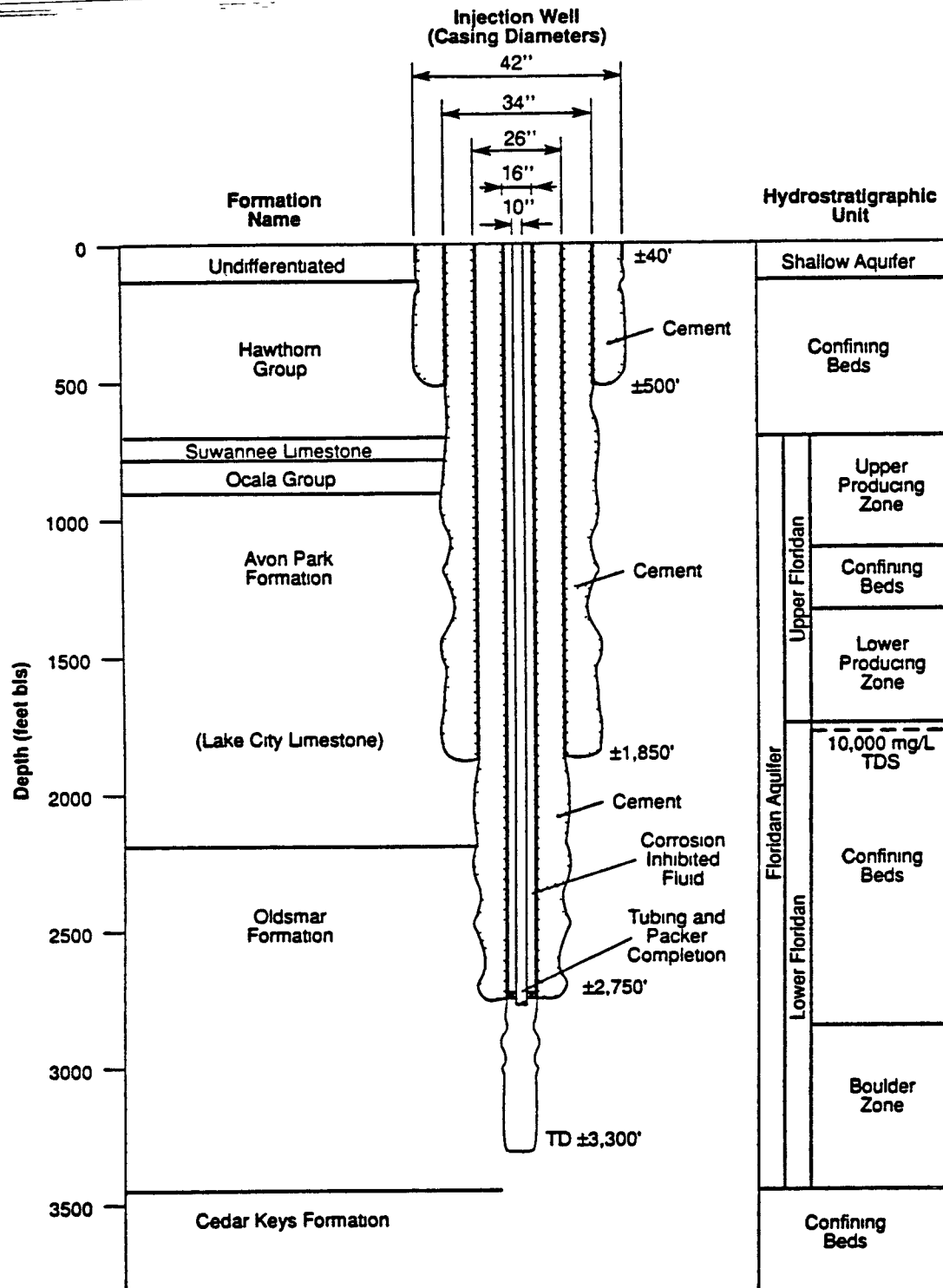


Figure 3.5.1-8.

PRELIMINARY DESIGN OF THE INDIANTOWN COGENERATION FACILITY INJECTION WELL

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cement the annulus to ground surface. Advance the 12-inch-diameter pilot hole to approximately 1,850 feet. Run packer tests to identify the base of the USDW. Run a suite of geophysical logs.

3. Ream the pilot hole to total depth; install a 26-inch-diameter casing to about 1,850 feet and cement the annulus to surface. Drill the pilot hole to a depth of 3,300 feet. During pilot hole drilling for one of the injection wells, obtain five 10-foot rock cores from the 2,000- to 2,700-foot depth interval, run four packer tests in the same interval, and perform a suite of geophysical logs. Packer tests will be run to evaluate the confining beds and to select the lower monitoring zone.
4. Set a bridge plug in the final pilot hole to permit installation of the final 16-inch-diameter casing. The bridge plug will be set immediately below the intended casing installation depth of 2,750 feet. Ream the pilot hole to a depth of about 2,760 feet and install the 16-inch-diameter casing to an approximate depth of 2,750 feet. Cement the annulus to the surface in stages.
5. Run temperature and gamma logs inside the 16-inch-diameter casing after the first stage of cement to pick the top of that stage. Run a 1-hour pressure test and a cement bond log on the final casing.
6. Drill out the bridge plug and clean out the hole to a total depth of approximately 3,300 feet. Run geophysical logs to total depth.
7. Install the 10-inch-diameter tubing with a packer assembly set just above the bottom of the final casing.
8. Run a suite of geophysical logs, TV survey, and a radioactive tracer survey.

Drilling Program for Monitor Well

The current regulatory requirements for monitoring the aquifers above the injection zone are to monitor the first permeable zone above the injection zone and the base of the USDW. The first permeable zone above the injection zone typically occurs at a depth of about 2,000 to 2,100 feet and the water in this interval is salty. Because it is not a USDW, monitoring in this zone provides an early warning of injected fluid migration in the direction of the USDW. The 10,000 mg/l TDS isochlor is expected to occur between approximately 1,750 and 1,850 feet in depth at the ICL facility.

The monitor well is designed to monitor the two zones required by regulations. An open annulus between the 6- and 14-inch- diameter casings will be provided near the base of the USDW to monitor the interval from about 1,600 to 1,650 feet. The 6-inch diameter casing will be set to a depth of approximately 2,000 feet and the hole extended to monitor the interval from about 2,000 to 2,100 feet. Figure 3.5.1-9 shows the proposed monitor well design.

Drilling of the pilot hole, geophysical logging, and reaming and casing installation will be performed as follows.

1. Install an approximately 30-inch-diameter surface casing by driving or drilling to about 40 feet in depth; cement the annulus back to surface if drilled. Drill a 12-inch-diameter pilot hole through the Surficial aquifer and underlying clay into competent rock at an approximate depth of 500 feet. Run geophysical logs.
2. Ream the pilot hole to 500 feet in depth; install about 500 feet of 20-inch-diameter casing and cement the annulus back to surface. Continue pilot hole drilling to about 1,200 feet in depth. Run geophysical logs. Install a test pump and pump the well for the injection tests on the injection wells.
3. Resume drilling the 12-inch-diameter pilot hole to a depth of 1,600 feet. Run geophysical logs.

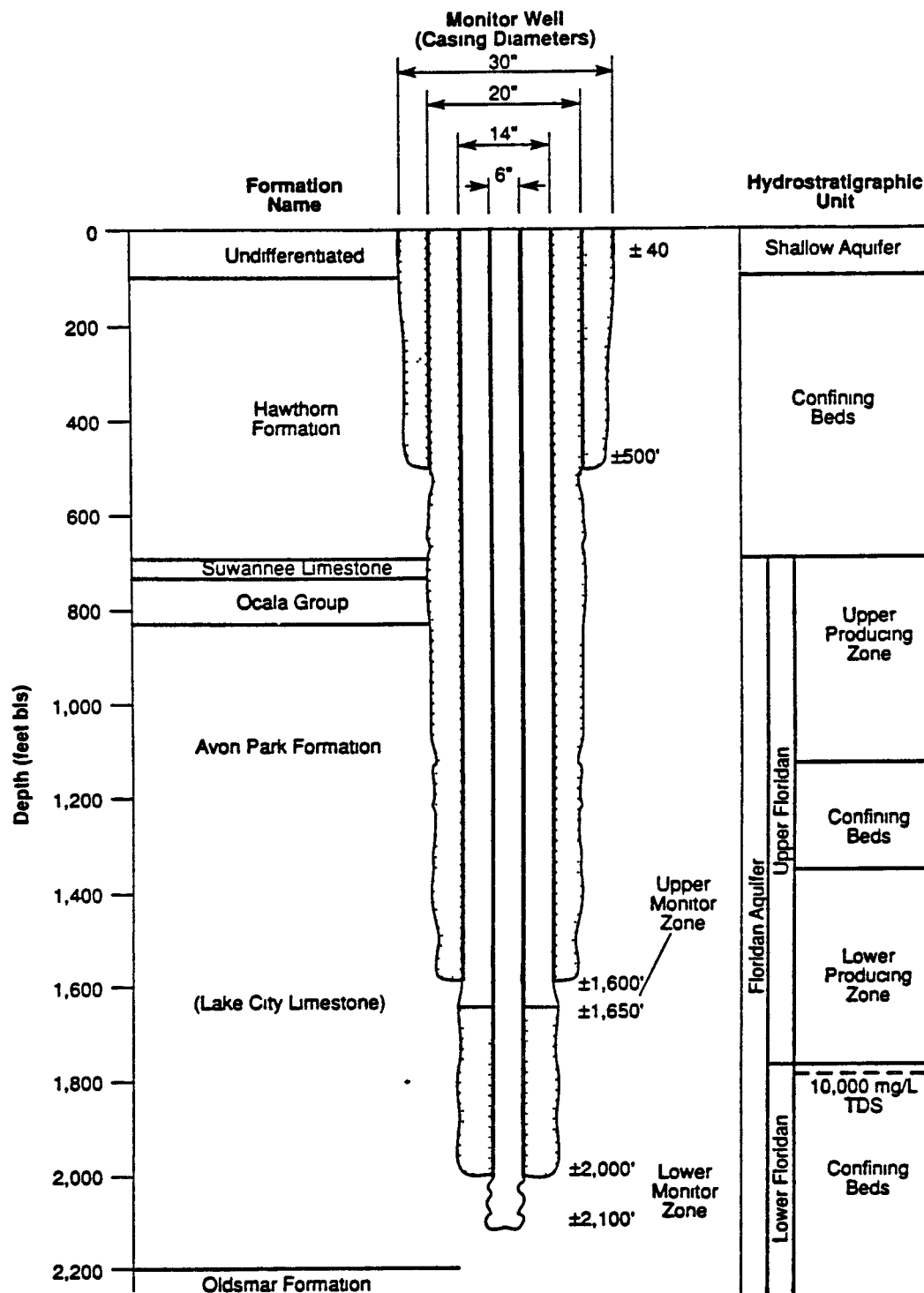


Figure 3.5.1-9.

PRELIMINARY DESIGN OF THE INDIANTOWN COGENERATION FACILITY MONITOR WELL

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4. Ream the 1,600-foot pilot hole to about 20 inches in diameter; install approximately 1,600 feet of 14-inch-diameter casing and cement the annulus back to surface. Run geophysical logs. Advance the 12-inch-diameter pilot hole to approximately 2,000 feet and run a suite of geophysical logs.
5. Install a 6-inch-diameter casing to about 2,000 feet and cement the annulus up to about the 1,650-foot depth. Run a pressure test on the 6-inch diameter casing for 1 hour. Run geophysical logs.
6. Drill out the hole to a depth of 2,100 feet and run geophysical logs. Develop the lower zone by airlifting and allow the upper zone to flow until background conditions return and background water quality samples are taken.

Casing Grout Program

After each casing is set, it will be cemented in place by a multi-staged process using ASTM Type II neat cement mixed with 2 to 12 percent bentonite. A specific cementing program will be developed for each casing and modified as necessary in the field based on data obtained during drilling. The cement formulations are typically based on the fluid loss properties of the formations being cemented. Lighter formulations are used when highly permeable formations are encountered.

After each casing is positioned at the setting depth, a grout pipe is lowered inside the casing to within approximately 25 feet of the casing bottom and a header is installed on the casing to seal the grout pipe and casing. The first stage of cement is pumped through the grout pipe, out the bottom of the casing, and upward into the annulus.

After the first-stage cement has set, the depth to the top of the cement will be determined by geophysical logging and tagging. Subsequent cement stages containing blends of from 2 to 12 percent bentonite will then be pumped through two grout pipes installed in the annulus. The cement will be pumped to the ground surface for all injection well casings and intermediate monitor well casings. The 6-inch-diameter casing for the monitor well will be

cemented only up to a depth of about 1,650 feet to provide for the open annulus monitoring zone described previously.

Geophysical Logging Program

Geophysical logs will be run in each pilot hole before it is reamed. These logs will be used to evaluate the hydrogeology of the strata penetrated by the exploratory hole. The casing setting depths will be determined and cement calculations prepared based on these logs. The proposed logging program for both the injection and monitor wells is shown in Table 3.5.1-5.

Hydrogeologic Testing

Tests will be performed in both the injection and monitor wells to determine the depth to the 10,000 mg/l TDS interface, the permeability and thickness of the confining sequence, and the transmissivity of the injection zone. Testing will include taking drill cuttings, water quality samples, and rock cores, and performing geophysical logging, packer tests, and injection tests. Background water quality samples will be sent to a certified laboratory for analysis and will be analyzed for parameters specified by FDER.

Drill Cuttings - A sample of the drill cuttings will be taken every 10 feet, or at a formation change, during drilling and a lithologic description prepared from them. The drill cuttings will be used in conjunction with the geophysical logs to determine the depths at which each formation is encountered and to characterize the formations.

Rock Cores - The confining beds above the injection zone will be cored to characterize their lithology and hydraulic properties. Five cores will be obtained during drilling of the 12-inch-diameter pilot hole for the injection well. The cores will be obtained using a 10-foot-long core barrel.

Representative portions of the cores will be sent to a geotechnical lab for determination of the vertical and horizontal coefficients of permeability and porosity. Laboratory results and the lithologic descriptions will be compared to the geophysical logs for confirmation of the confining nature of the beds overlying the injection zone.

**Table 3.5.1-5
GEOPHYSICAL LOGGING PROGRAM**

<u>Injection Wells</u>	<u>Interval (feet)</u>	<u>Geophysical Logs</u>
12-inch Pilot Hole	± 0 to 500	LSN, GR, CAL
12-inch Pilot Hole	± 500 to 1,850	CAL, GR, IL, FM-p, TEMP-s, FLRES-s, SON
12-inch Pilot Hole	$\pm 1,850$ to 3,300	CAL, GR, IL, FM-p, TEMP-s, FLRES-s, SON
26-inch Reamed Hole	$\pm 1,850$ to 2,750	CAL
16-inch Cemented Casing	± 0 to 2,750	TEMP, CBL, GR
16-inch Casing and Open Hole	± 0 to 3,300	TV, TEMP, CAL, RTS
10-inch Tubing	± 0 to 2,750	TV, CAL
<u>Monitor Well</u>	<u>Interval (feet)</u>	<u>Geophysical Logs</u>
12-inch Pilot Hole	± 0 to 500	LSN, GR, CAL
12-inch Pilot Hole	± 500 to 1,200	LSN, GR, CAL
12-inch Pilot Hole	± 500 to 1,600	LSN, GR, CAL, TEMP, FLRES
14-inch Casing	± 0 to 1,600	CBL
12-inch Pilot Hole	$\pm 1,600$ to 2,000	LSN, GR, CAL, TEMP, FLRES
6-inch Cemented Casing	± 0 to 2,000	TEMP, CBL
6-inch Casing and Open Hole	$\pm 2,000$ to 2,100	CAL, GR, ELEC

Key	ELEC	Single-Point Electric and Spontaneous Potential
	CAL	Caliper
	GR	Gamma Ray
	LSN	Long and Short Normal Electric and Spontaneous Potential
	TEMP	Temperature
	FM	Flowmeter
	FLRES	Fluid Resistivity
	IL	Induction Log
	SON	Acoustic Velocity Log
	TV	Color Video Survey
	p	Pumping
	s	Static
	RTS	Radioactive Tracer Survey
	CBL	Cement Bond Log

Source CH2M Hill, 1990

Packer Testing - Straddle packer testing is proposed in the lowermost confining sequence to isolate a discrete interval in the confining zone and to test its hydraulic characteristics. Packer testing intervals will be selected after reviewing the cores and cuttings, the geophysical logs of the pilot hole, and the drilling rate. Dual inflatable packers will be set across the selected interval to be tested and the interval pumped while water levels are recorded. Time-drawdown curves will be prepared and the transmissivity of the tested interval will be calculated. Packer tests will also be run in the injection well to identify the base of the USDW and to help select the lower monitoring zone.

Injection Test - After installing the 16-inch-diameter casing, an injection test will be run to evaluate the hydraulic characteristics of the injection well. Brackish water from the monitor well will be used for the injection test. The injection rate in the 16-inch-diameter casing will be increased incrementally from 1,000 gpm to approximately 3,000 gpm, the duration of the test being approximately 8 to 12 hours. The maximum injection pressure and static head will be measured and the injection pressure caused by the formation will be calculated.

After installing the tubing and packer, a second injection test will be performed. The injection rate will be incrementally increased from 250 to 1,725 gpm.

Mechanical Integrity Testing

Tests to demonstrate the initial mechanical integrity of the injection wells will be run before the wells are placed in operation. The demonstration will be in two parts, the first requiring a showing that the casing has no leaks, and the second that no injected fluid can leak up around the outside of the casing into a USDW.

The integrity of the 16-inch-diameter casings will be demonstrated with a casing pressure test, which requires that 1.5 times the injection pressure be maintained for 1 hour with less than a 5-percent pressure drop. The absence of fluid movement behind the casings will be demonstrated with a radioactive tracer survey to satisfy the second part of the mechanical integrity

demonstration. The 8-inch-diameter tubings will be pressure tested after installation by an annular pressure test.

Water Quality Testing

The water quality profile at the site will be developed through several means of data collection. Two primary purposes of water quality testing are to determine the depth to the 10,000 mg/l TDS interface and the background water quality of the injection and monitoring zones.

Reverse-air water samples will be collected every 30 feet while drilling the pilot hole in the injection and monitor wells. These samples will be analyzed in the field for temperature, specific conductance, and chloride concentration, and the results will be used to help define the 10,000 mg/l TDS interface. Water quality samples from the pilot hole packer tests also will be used to identify the base of the USDW and the water quality in the confining zone.

Background water quality samples of the injection and monitor zones will be taken. Water quality samples will be taken after the final casing is set and the well is developed to determine the background quality of the injection zone.

The monitoring zone will be allowed to flow for several days upon completion of construction to flush out all non-native water. To establish the background water quality in the monitoring zones, samples will be collected from the zones before injection begins and will be analyzed for the parameters shown in Table 3.5.1-6. The pre-injection monitoring zone water levels will also be measured to establish natural background water levels and fluctuation in the monitoring zones.

Characterization of the Injected Fluid

Volume

The volume of fluid to be injected will vary with the source of water used to supply the plant. When the Taylor Creek/Nubbin Slough source is used, a maximum injection volume of approximately 250 gpm will be generated. When the

Table 3.5.1-6
PARAMETER LIST FOR ESTABLISHING BACKGROUND WATER QUALITY

<u>Primary Drinking Water Standards</u>	<u>Secondary Drinking Water Standards</u>
Arsenic	Chloride
Barium	Color
Cadmium	Copper
Chromium	Corrosivity
Fluoride	Fluoride
Lead	Foaming agents
Mercury	Iron
Nitrate (as N)	Manganese
Selenium	Odor
Silver	pH
Sodium	Sulfate
Endrin	Total dissolved solids
Lindane	Zinc
Methoxychlor	
Toxaphene	<u>Others</u>
2,4-D	Calcium
2,4,5-TP, Silvex	Magnesium
Total trihalomethanes	Potassium
Trichloroethene	Ortho phosphate as P
Tetrachloroethene	Total phosphorus as P
Carbon tetrachloride	Hardness, total
Vinyl chloride	Specific conductivity field
1,1,1-trichloroethane	Total organic carbon
1,2-dichloroethane	Specific gravity
Benzene	Bicarbonate
Ethylene dibromide	Carbonate
p-dichlorobenzene	Nitrite nitrogen as N
1,1-dichloroethene	Ammonia nitrogen as N
Turbidity	Total kjeldahl, nitrogen as
Coliform bacteria	
N	
Radionuclides	

EPA Methods 608, 624, 625

Source: CH2M Hill, 1990

Floridan aquifer source is used, a maximum volume of approximately 1,280 gpm will be generated.

Chemistry

When using the primary source of water makeup for the plant, the wastewater disposed of via the injection well is only cooling tower blowdown. All process wastewater from the plant is reused as lime slurry dilution water for the spray dryer. When using the backup sources of water for the plant, the wastewater disposed of via the injection well is a mixture of cooling tower blowdown and excess process wastewater that cannot be reused. As discussed in Section 3.6, the wastewater from this facility is expected to be non-hazardous. Table 3.5.1-7 is a summary of the estimated wastewater quality from the raw water sources. The cooling tower blowdown will also contain some sulfuric acid and chlorine because these compounds are injected in the tower basin to control scaling, pH, slime, and algae growth. The pH of the wastewater will be maintained by adjustment during the treatment process.

Compatibility

The proposed fluids to be injected must be compatible with the injection zone rock material and the formation fluids contained within the pores of that rock material. Injected fluids incompatible with the formation fluids can cause plugging or may chemically react with the formation material, causing detrimental effects to the injection or confining strata. A fractured and cavernous injection zone precludes the need to remove suspended solids to within the range of 1 to 5 mg/l. Based on other high TDS wastewaters injected in south Florida and the fractured and cavernous nature of the injection zone, wastewater from the ICL facility is expected to be compatible with the formation and formation fluids.

Injection System Operation and Monitoring Plan

Injection system monitoring data will be collected to provide a record of system performance and to detect any movement of injected fluid into the USDW. The injection system monitoring plan will consist of monitoring the injection well capacity and the injection flow rate and pressure, the annular fluid tank

Table 3.5.1-7
ESTIMATED WASTEWATER EFFLUENT QUALITY

<u>Parameter</u>	<u>Cooling Water Source</u>	
	<u>Taylor Creek/ Nubbin Slough (mg/l)</u>	<u>Floridan Aquifer (mg/l)</u>
pH	6 - 9	6 - 9
Alkalinity (as CaCO ₃)	153	118
Total Dissolved Solids	3240	14800
Silica	25	17
Calcium	103	285
Magnesium	26	207
Sodium	994	4820
Potassium	61	96
Iron	0.73	<0.06
Sulfate	1095	1480
Chloride	832	7700
Fluoride	-	3.2
Nitrate	3.4	-
Phosphate	1.9	<2.3

Note: Concentrations are in mg/l of the ion.

Source: Bechtel, 1990

levels, the water elevation in the upper and lower monitor zone, and the water quality of the two monitoring zones (Table 3.5.1-8).

Contingency Plan

Each of the two injection wells will have the capacity to accept the maximum anticipated wastewater flow. If one of the wells is out of service, the second well will be used for injection. This will provide 100 percent redundancy in the injection well system for reliability, maintenance, and testing.

Injection Well Operational Monitoring

Injection well operational monitoring will consist of continuous recording, indicating, and totalizing the injection flow rate, and reporting the total daily flow, monthly average flow, monthly maximum flow, and monthly minimum flow. The injection pressure will be recorded, indicated, and totalized, and daily minimum and maximum and average pressure (psig) will be reported (Table 3.5.1-8).

Continuous water level monitoring of the annular fluid between the tubings and the final casings will be provided, with an alarm for low level warning. Detection of leaks from the tubing, packer, or casing will be provided with this monitoring system.

On a quarterly basis, a specific injectivity test will be run on the active injection well. This test will evaluate the injection capacity of the well to detect any changes over time caused by plugging or other flow-restricting conditions. This test will typically require the well to be out of service for less than 15 minutes.

Monitoring Well Operational Monitoring

Every month, water quality samples will be collected from the two monitoring zones in the monitoring well and tested for comparison with the pre-injection water quality to detect changes caused by possible migration of the injected effluent. The samples will be collected after flowing a minimum of two casing volumes from both zones. The fluid produced from the monitor well will be pumped to the wastewater collection tank, from where it will be pumped into

Table 3.5.1-8
MONITORING PARAMETERS
ICL FACILITY

<u>Monitoring Station</u>	<u>Parameter</u>	<u>Frequency</u>
Injection Well	Flow Pressure	Continuous Continuous
Monitoring Well	Pressure/water level Conductance Chloride Standard complete chemical	Continuous Monthly Monthly Annual
Wastewater	pH TDS	Weekly average Weekly average

Source: CH2M Hill, 1990

the injection well. The expected parameters to be analyzed for on a monthly basis are presented in Table 3.5.1-8.

In addition, continuous water level monitoring of the two monitoring intervals will be provided by recorders. Daily minimum and maximum levels and monthly minimum and maximum levels will be reported, along with the water quality data, on a monthly basis to the FDER.

Conclusions

Based on the literature and data from several operating injection wells in the vicinity of the proposed ICL facility, Class I well injection is feasible at this site. The injection zone used throughout south Florida for similar systems is expected to be encountered at a depth of approximately 2,900 feet. Adequate confinement is also expected to be demonstrated.

The conceptual design of the injection wells is dependent upon the type of material used for the tubing, as tubing material dictates tubing and subsequent casing sizes. Two injection wells with 10-inch-diameter FRP tubings and 16-inch-diameter final casings are anticipated at the ICL facility.

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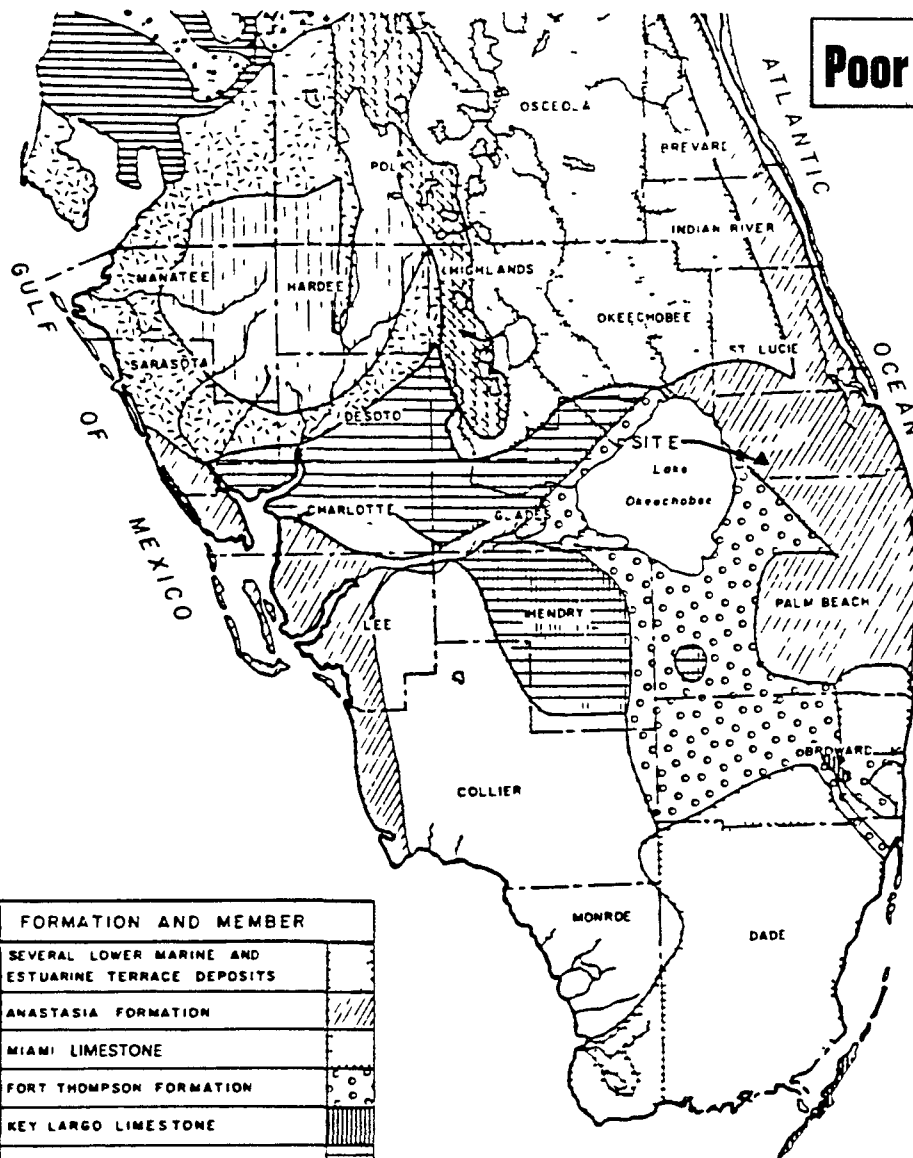
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Poor Original

SERIES	FORMATION AND MEMBER
POST MIOCENE	SEVERAL LOWER MARINE AND ESTUARINE TERRACE DEPOSITS
	ANASTASIA FORMATION
	MIAMI LIMESTONE
	FORT THOMPSON FORMATION
	KEY LARGO LIMESTONE
	CALOOSAHATCHEE FORMATION
MIOCENE	TAMIAMI FORMATION
	BONE VALLEY FORMATION
	FT PRESTON FORMATION
	HAWTHORN FORMATION
	ST MARKS FORMATION
OLIGOCENE	SUWANNEE LIMESTONE

MODIFIED AFTER VERNON AND PURI, 1964

Figure 2.3.1-16.

REGIONAL GEOLOGIC MAP

INDIANTOWN COGENERATION PROJECT

Indiantown Cogeneration, L P

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