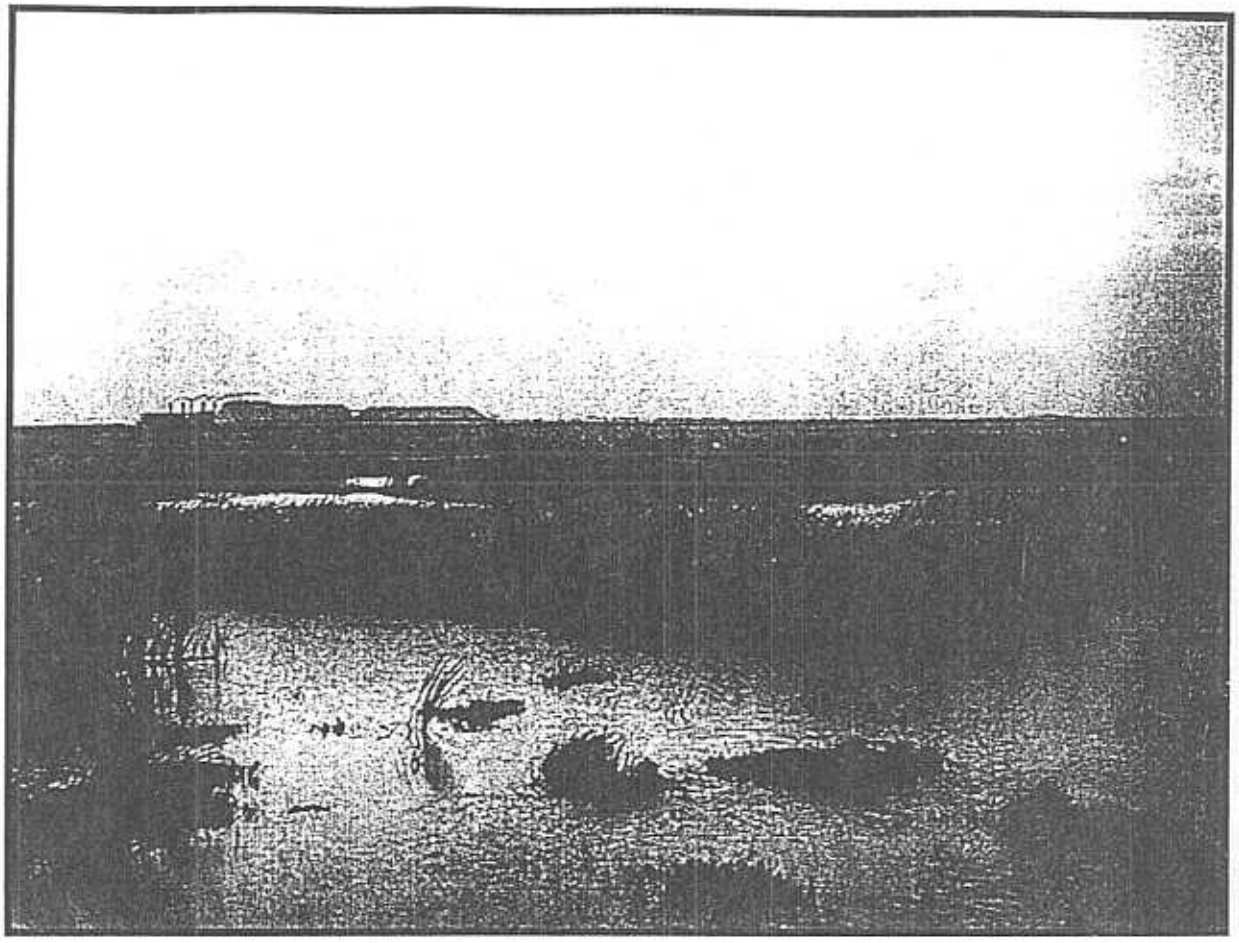
OPERATION PLAN
STORMWATER TREATMENT AREA 1 WEST



JANUARY 2001

Environmental Engineering Section
Everglades Construction Project
South Florida Water Management District

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I. PROJECT DESCRIPTION

Location. STA-1 West, together with its associated canals and the STA-1 Inflow Basin, is a primary component of the Everglades Construction Project mandated by the 1994 Everglades Forever Act (Section 373.4592, Florida Statutes). STA-1W is located within Sections 1, 2, 3, 6, 7, 10, 11, 12, 13, 14, 15, 22, 23, 26, 27, 34, Township 44 South, Range 39 East within Palm Beach County and is positioned immediately west of the Arthur R. Marshall Loxahatchee National Wildlife Refuge, also known as Water Conservation Area 1 (WCA-1) (see Figure 1).

Interim Operations Prior To Construction Of STA-1 East.

Stormwater Runoff. Although STA-1W began operation in 1999, STA-1 East (STA-1E), which is under construction by the U.S. Army Corps of Engineers and will also treat waters flowing to WCA-1, will not be ready for full flow-through operations until 2003. Until STA-1E is operating at full flow-through capacity, it is anticipated that an average of 31,000 acre-feet per year of S-5A basin runoff scheduled to go to STA-1E will continue to go through the S-5A pump station into the STA-1 Inflow Basin. Offsetting this volume is a reduction in the runoff from the C-51W basin, anticipated to be diverted to STA-1W once STA-1E is fully operational. The net is an interim increase of 19,500 acre feet in the average annual flow assumed to go to STA-1W. Prior to completion of STA-1E, these waters may continue to flow to the Refuge, either as treated discharge from STA-1W or as untreated discharge through the STA-1 Inflow Basin.

BMP Replacement Water. Consistent with the Settlement Agreement and the EFA, the District is also required to offset flow reductions in EAA runoff due to BMPs. For the S-5A basin, some of this BMP make-up water is also contemplated to be diverted to STA-1E. Consistent with the intended operations guidelines in the 1994 Conceptual Design, the BMP make-up water will be delivered to the STAs only if available treatment capacity exists. The District's BMP Replacement rule contains the flexibility to reduce delivery to the STAs "when the delivery is likely to cause hydraulic bypass around the STA or otherwise hinder its performance." It is anticipated that minimal BMP replacement water deliveries will be made during the Interim Period.

Southern L-8 Basin Runoff. During the 1979-1988 base period, approximately 50,700 acre feet (with an associated 3.5 metric tons of phosphorus) from the southern L-8 basin was discharged into the Refuge. District planning efforts underway include construction of diversion works that send waters from the southern L-8 basin to Lake Okeechobee and other areas, instead of the Refuge where the runoff goes today. In accordance with the load reduction targets of the proposed modified settlement agreement and conceptual design, the southern L-8 basin water will be diverted, with a current schedule of 2003. Prior to completion of STA-1E and the diversion works, these waters may continue to flow to the Refuge, either as treated discharge from STA-1W or as untreated discharge through the STA-1 Inflow Basin.

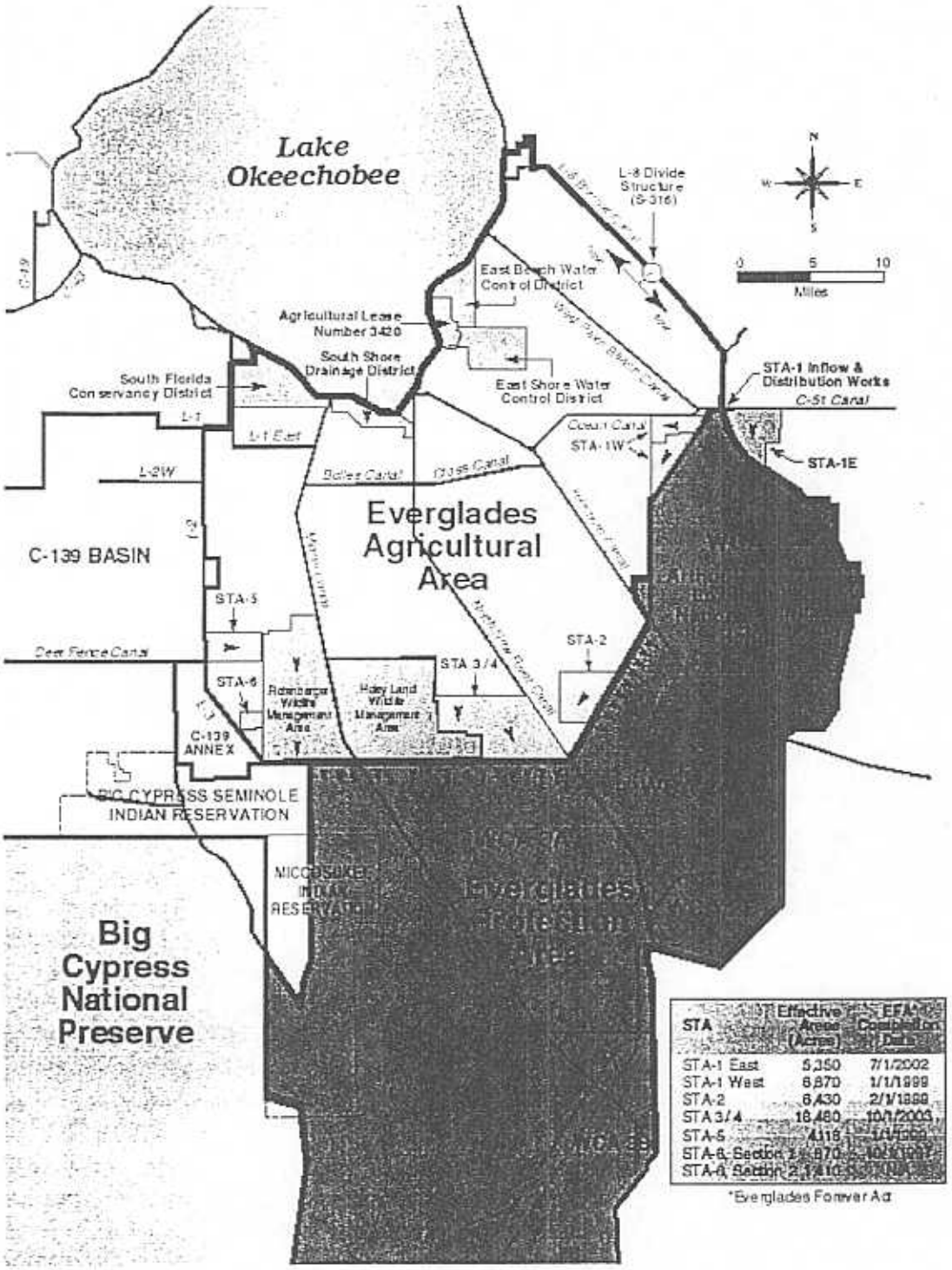


Figure 1. Overview of the Everglades Construction Project.

STA-1 West Flow Patterns. The average annual inflow volume and Total Phosphorus (TP) load to STA-1W was estimated during design as approximately 142,853 acre-feet and 37,701 kilograms, respectively. STA-1W is designed to provide a total effective treatment area of 6,670 acres to treat stormwater runoff and Lake Okeechobee releases. Of the total effective treatment area necessary for STA-1W, 3,815 acres are contained in Cells 1 through 4, formerly known as the Everglades Nutrient Removal Project (ENR). The remaining 2,855 acres of treatment area are contained in the northerly expansion, designated as Treatment Cells 5A and 5B. Specific acreage areas for each cell within STA-1W are provided below:

Cell No.	Effective Treatment Area (ac.)
1	1,490
2	941
3	1,026
4	358
5A	562
5B	2,293

Pump station S-5A is the primary inflow structure for the overall STA-1W project. Stormwater runoff and lake releases pass through S-5A into the STA-1 Inflow Basin, where it can be distributed to three locations: STA-1W treatment area (via structure G-302), STA-1E (when completed, through structure G-311), or WCA-1 under water supply or certain flood conditions (via structures G-300 and G-301).

Treatment Flow-ways. After passing through G-302, the inflow is distributed to three treatment flow-ways by means of the Inflow Canal (see Figure 2): the eastern flow-way consists of Cells 1 and 3; the western flow-way consists of Cells 2 and 4; and the northern flow-way consists of Cells 5A and 5B. During the design flow condition of 3,250 cfs, approximately 29% will flow through the eastern flow-way, 26% will flow through the western flow-way, and 45% will flow through the northern flow-way. Inflow is distributed to the eastern and western flow-ways through structure G-303, and into the northern flow-way through structures G-304A-J. Flows passing through G-303 are distributed either south into the eastern flow-way or west through structure G-255 into the western flow-way.

Eastern Flow-way Operation

The eastern flow-way is composed of Treatment Cells 1 and 3, and contains a total of 2,516 acres of effective treatment area. The majority (67%) of the area is covered by cattail or other emergent vegetation, and the remaining 33% is covered with submerged aquatic vegetation (SAV), floating macrophyte and open water. A portion of Treatment Cell 3 also contains plantings of native Florida species and is referred to as a "mixed marsh" plant community, which has been allowed to develop in a natural manner.

Treatment in the eastern flow-way occurs as the water moves in a southwesterly direction across the marsh for a distance of approximately 5 miles. Treated water is discharged into

WCA-1 via the G-251outflow pump station. Under high flow conditions, some of the eastern flow-way water is conveyed through structures G-259 and G-308 into the Discharge Canal and to WCA-1 via the G-310 outflow pump station. An additional source of water to the eastern flow-way is seepage from the adjacent WCA-1, which is normally maintained at stages that are 2.5 - 5.5 feet higher than Cells 1 and 3.

Western Flow-way Operation

The western flow-way is composed of Treatment Cells 2 and 4, and contains a total of 1,299 acres of effective treatment area. The majority (62%) of the area is covered by submerged aquatic vegetation (SAV), floating macrophyte and open water, and the remaining 38% is covered with cattail or other emergent vegetation.

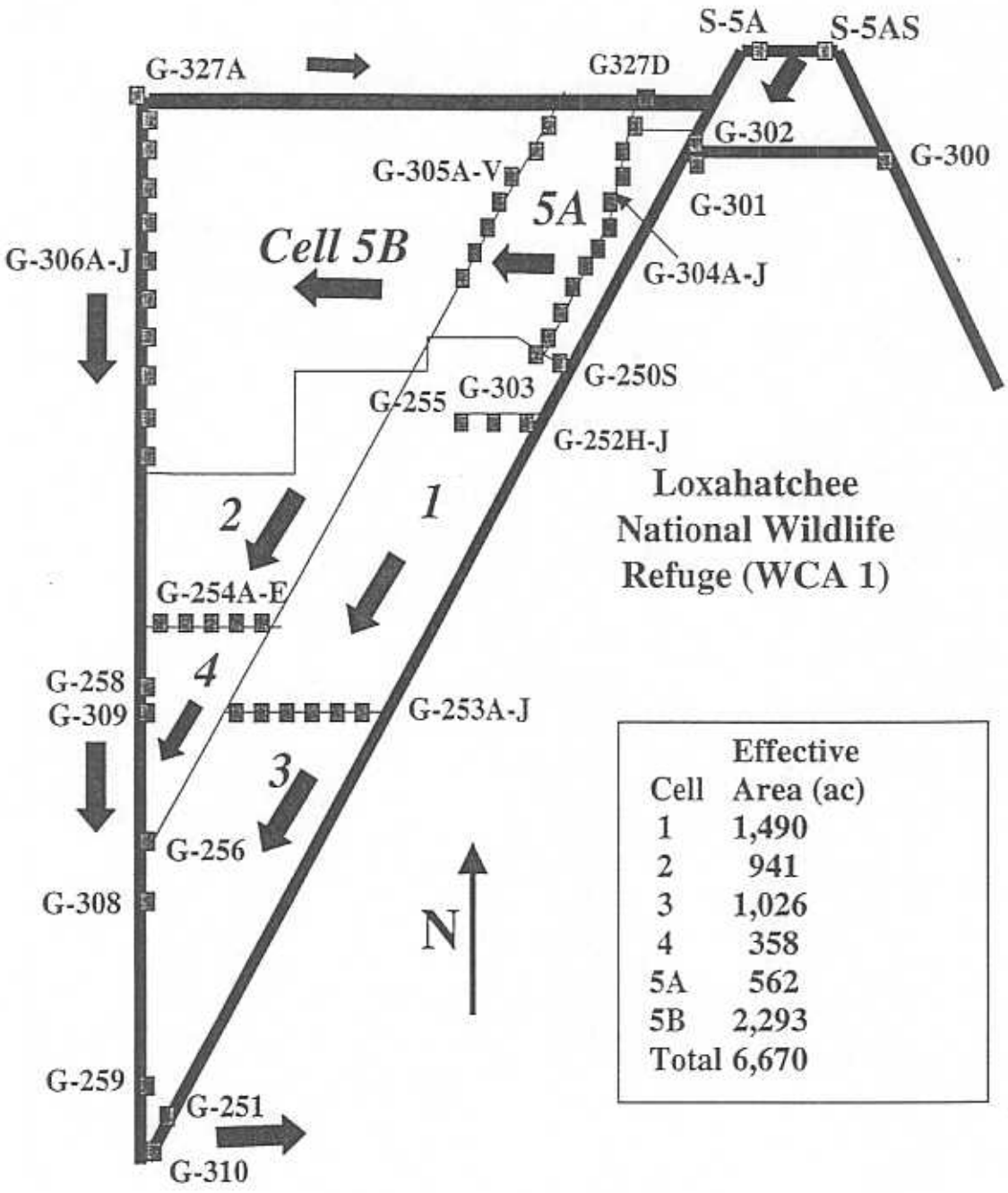
Treatment in the western flow-way occurs as the water moves in a southwest direction across the marsh for a distance of approximately 3.4 miles. Treated water is discharged into WCA-1 via the G-251 outflow pump station. Under high flow conditions, some of the western flow-way water is conveyed through structures G-258 and G-309 into the Discharge Canal and to WCA-1 via the G-310 outflow pump station. Seepage from the western flow-way will be captured by the discharge canal and directed to WCA-1 via the G-310 outflow pump station.

Northern Flow-way Operation

The northern flow-way is composed of Treatment Cells 5A and 5B, and contains a total of 2,855 acres of effective treatment area. The two cells are separated by a levee containing an electric transmission line; twenty-two culverts (G-305 A-V structures) along the levee allow water to flow between the two cells. The present vegetation management objective for this flow-way is to encourage emergent macrophytic vegetation in the approximately 562-acre eastern portion (**Cell 5A**) and encourage submerged aquatic vegetation (SAV) in the approximately 2,293-acre western portion (**Cell 5B**).

Treatment in the northern flow-way occurs as the water moves west across the marsh for a distance of approximately 3.6 miles. Treated water will exit Cell 5 through structures G-306A-J to the discharge canal leading to outflow pump station G-310. Seepage from Cell 5 that is intercepted by the north seepage collection canal will be directed to Cell 1 via the G-250S pump station. Seepage along the western boundary of Cell 5B will be captured by the discharge canal and directed to WCA-1 via the G-310 outflow pump station.

Figure 2 - Schematic of STA-1 West Flows (not to scale)



Cell	Effective Area (ac)
1	1,490
2	941
3	1,026
4	358
5A	562
5B	2,293
Total	6,670

Operations History. Flow-through operation of treatment cells 1 through 4 (the former ENR project) commenced in August 1994. As part of the STA-1W project, modifications to the existing internal levees and water control structures were required to provide additional peak flow capacity through these cells. Operation of the eastern and western flow-ways continued during these construction modifications. Treatment cells 5A and 5B and associated facilities were completed in March 1999. On May 11, 1999, the Florida Department of Environmental Protection (FDEP) issued the Everglades Forever Act permit (FL503074709) and the associated NPDES permit (FL0177692-001) for operation of the expanded STA-1W. Water quality monitoring data at the inlet and outlet locations for Cell 5 demonstrated a net improvement in total phosphorus, total mercury and methylmercury during January 2000, and hence, satisfied the "start-up" requirements in the state operating permits. Operation through the northern flow-way commenced during July 2000. Full operation of STA-1W commenced in October 2000 when the G-310 outflow pump station was completed.

References. This *Operation Plan* for STA-1W was developed based upon the requirements of the FDEP permits mentioned above and the March 1997 Department of the Army Section 404 Permit No. 199404532 for the Everglades Construction Project. Materials utilized extensively in the preparation of this Plan include the February 15, 1994 *Conceptual Design, Everglades Protection Project*; June 5, 1996 Detailed Design Report; April 15, 1996 Hydraulic Analysis Report; October 30, 1996 Supplement to the Detailed Design Report; June 19, 1997 Supplement No.2 to the Detailed Design Report; the March 1999 STA-1W *Pollution Prevention Plan* (presented in Appendix I); and the December 1999 Hutcheon Engineers report *Impacts of Submerged Aquatic Vegetation on STA-1W Design and Operation.*

II. STRUCTURES & CANALS

A. INFLOW CONTROL FACILITIES

Pump station S-5A is the primary inflow structure for the overall STA-1W project. Stormwater runoff and lake releases pass through S-5A into the STA-1 Inflow Basin, where it can be distributed to three locations: STA-1W treatment area (via structure G-302), STA-1E (when completed, through structure G-311), or WCA-1 under water supply or certain flood conditions (via structures G-300 and G-301).

After passing through G-302, the inflow is distributed to three treatment flow-ways by means of the Inflow Canal (see Figure 2): the eastern flow-way consists of cells 1 and 3; the western flow-way consists of cells 2 and 4; and the northern flow-way consists of Cells 5A and 5B. Inflow is further distributed to the eastern and western flow-ways through structure G-303, and into the northern flow-way through structures G-304A-J. Flows passing through G-303 are distributed either south into the eastern flow-way or west through structure G-255 into the western flow-way. The following section describes these inflow control facilities - S-5A, G-302, the Inflow Canal, G-303, G-304, and G-255.

1. S-5A Pump Station

S-5A pump station provides flood protection to an upstream agricultural basin of approximately 230 square miles. The removal of stormwater runoff from the upstream basin has been, and will continue to be, the primary function of the S-5A pump station. In addition to flood control for the S-5A tributary basin, the S-5A Pump Station has been used to remove excess flows from the L-8 and C-51 basins as well as to convey excess water from Lake Okeechobee (when it is above its regulation schedule) to WCA-1. In some instances, it has been used to convey water from Lake Okeechobee to WCA-1 for the purpose of water supply for points downstream of the pump station. This structure is a six-unit pumping plant located on the south side of State Road 80 and the West Palm Beach Canal about 20 miles west of West Palm Beach. The pumping station is equipped with six pumps each rated at 800 cfs at a static head of 11.1 feet, with a combined capacity of 4,800 cfs.

Pump station headwater stages of 11.5 ft NGVD and 10.5 ft NGVD are maintained during irrigation and drainage seasons, respectively. The irrigation/drainage phase is a special designation, which indicates if the dominant agricultural activity is irrigation or drainage. The irrigation phase generally occurs in the winter and the drainage phase generally occurs in the summer. Brief periods of very wet or very dry weather at any time of year can initiate a change from one phase to the other. During the irrigation phase, stages in the West Palm Beach canal are held higher; during the drainage phase, the goal is to keep these stages lower.

Pump Station Description:

Number of Pumps:	6
Discharge Capacity (each pump):	800 cfs at 11.1 foot static head
Design headwater elevation:	13.0 ft NGVD
Design tailwater elevation:	24.1 ft NGVD
Pump size:	116-inch impeller
Pump Speed:	125 rpm
Engine Size:	1,600 Hp
Engine Speed:	714 rpm

Structure Operations:

Pump station headwater stages of 11.5 ft NGVD and 10.5 ft NGVD are maintained during irrigation and drainage seasons, respectively.

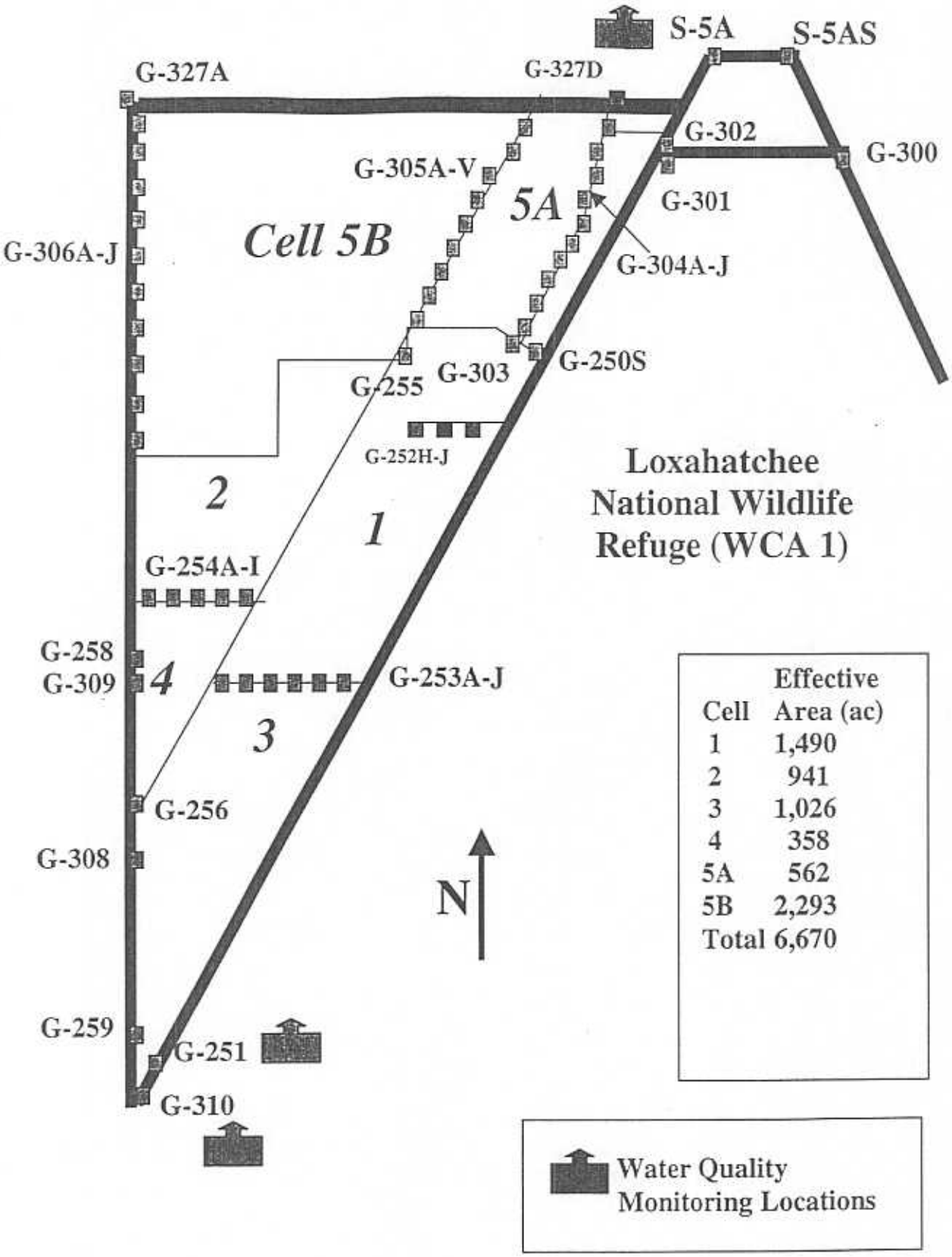
Data Acquisition and Telemetry:

Only local operation of this pump station is possible. Meteorological and hydrologic data are available to the West Palm Beach Control Room, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:

Flow proportional, composite sampling for TP is required by the operating permits, and the necessary automatic sampling equipment is present at this site (see Figure 3).

Figure 3. STA-1W Water Quality Monitoring Locations



2. STA-1 Inflow Basin

The 272-acre STA-1 Inflow Basin provides the capability to convey discharges from Pump Station S-5A to STA-1W, WCA-1 and STA-1E (when completed). The physical facilities of STA-1 Inflow Basin consist of three automated control structures designated as G-300, G-301, and G-302; the L-7 and L-40 borrow canals; and a levee that separates the Inflow Basin from the north end of the WCA-1. Structures G-301, situated on the L-7 Borrow Canal and G-300, situated on the L-40 Borrow Canal are intended to act in parallel with a discharge capacity of 4,800 cfs to provide for full diversion of Pump Station S-5A directly to WCA-1 in the event of a need to divert under emergency or extreme inflow and rainfall conditions. Structures G-300 and G-301 may also be operated to allow for water supply deliveries from WCA-1 to the C-51 and L-8 Canals. The separation levee has a top elevation of 20.0 ft NGVD and a length of 6,100 ft.

3. G-302 (Treatment Area Inflow Control Structure)

Inflow structure G-302 consists of a concrete ogee-shaped spillway with two 20-foot wide vertical lift gates installed on the crest of the spillway at elevation 9.4 ft NGVD. G-302 is located at the head of the Inflow Canal for STA-1W. The design inflow rate for structure G-302 is 3,250 cfs at a headwater elevation of 18.0 ft NGVD and tailwater elevation of 15.8 ft NGVD. Structure G-302 provides the only external inflow source to STA-1W with the exception of direct rainfall. An 84-inch diameter pipe is located below the weir crest to allow uninterrupted conveyance of the north perimeter seepage canal to pump station G-250S. The peak flow rate via the enclosed pipe is approximately 100 cfs.

Structure Operations:
The G-302 structure will be operated in one of the three following modes:

- Manually
- Automatically in response to maintain water surface elevations in the downstream Inflow Canal at or below critical elevation during normal operation conditions.
- Remotely via telemetry from the District's Operations Control Center in West Palm Beach.

G-302 will be typically operated open or partially open. It will be closed when necessary to prevent S-5A flows from entering into STA-1W if interior stages are too high. This structure will be operated to keep tailwater stages below critical levels. When any of the flow-ways are taken off-line, flows through G-302 will need to be reduced or eliminated by partially or fully closing the structure.

Data Acquisition and Telemetry:
Automatic, manual and remote operation of this structure are possible. Telemetry required for remote operation has been provided. Headwater, tailwater and gate position information are available to the remote operators. Headwater and tailwater staff gauges and gate position readings are available for manual operation.

Water Quality Sampling:
No operating permit water quality sampling is required at this site.

4. Inflow Canal

The Inflow Canal begins at structure G-302 and conveys inflows to the treatment flow-ways. The canal initially extends westward then southwest and terminates at structure G-303. The total length of the Inflow Canal is approximately 9,000 ft (1.7 miles). The Inflow Canal has a bottom width of 60 ft at elevation –5.0 ft NGVD and side slopes of 2.5 to 1 (H to V). The top of the perimeter levee adjacent to the east bank canal is at elevation 19.0 ft NGVD with the toe of the levee (berm) at elevation 14.5 ft NGVD.

Based on canal modeling (Interconnected Channel and Pond Routing: ICPR V2.01; Hutcheon Engineers) under design flow conditions (3,250 cfs) the Inflow Canal velocities varied from 0.76 feet-per-second (fps) to 1.37 fps. The largest velocities occur at the upstream end of the canal and correspond to the largest flow rate (3,250 cfs) through the constant canal cross section. The maximum water surface elevation during design flow conditions is 15.70 ft NGVD. Under Standard Project Storm conditions (1,110 cfs) the canal velocities varied from 0 fps to 0.46 fps, with water surface elevations varying from 15.70 max to 15.30 ft NGVD. This drop in stage is attributed to the reduced initial inflow via G-302 (from 3,250 cfs design flow condition to 1,110 cfs for the SPS condition) and fully open G-304 structures. Under Probable Maximum Storm conditions the average water surface elevation is 16.2 ft NGVD.

5. G-303 (Eastern and Western Flow-way Inflow Control Structure)

Structure G-303 consists of a concrete ogee-shaped spillway with two 16-foot-wide vertical lift gates installed on the crest of the spillway at elevation 9.1 ft NGVD. G-303 controls inflows to the eastern and western flow-ways. The design peak flow rate for structure G-303 is 1,780 cfs with a headwater elevation of 15.7 ft NGVD and a tailwater elevation of 14.46 ft NGVD. The maximum tailwater at G-303 should be kept at or below 14.46 ft NGVD.

Structure Operations:
The G-303 structure will be operated in one of the three following modes:

- Manually
- Automatically in response to headwater and tailwater.
- Remotely via telemetry from the District's Operations Control Center in West Palm Beach.

Data Acquisition and Telemetry:
Automatic, manual and remote operation of this structure are possible. Remote operation is from the SFWMD's West Palm Beach Operations Control Center. Telemetry required for remote operation and status of each gate has been provided. Headwater, tailwater

and gate position data are available to the remote operators, while headwater/tailwater staff gauges and gate position information are available for manual operation.

Water Quality Sampling:
No operating permit required water quality sampling is required at this structure.

6. G-255 (Western Flow-way Inflow Control Structure)

Structures G-255 A-G is a series of 7 culverts with risers located on the FPL Access Levee between Treatment Cells 1 and 2. These culverts are 72-inch x 54.5-ft corrugated metal pipes (cmp) with flashboards available for installation in the risers. The design peak flow per structure is 121.4 cfs (850 cfs total) with a headwater elevation of 14.44 ft NGVD and a tailwater elevation of 13.65 ft NGVD.

Operations:
The G-255 structures will normally be open. However, if it is desired to reduce the flow into the western flow-way, flashboards could be installed.

Data Acquisition and Telemetry:
Headwater and Tailwater data are available to the remote operators, while headwater/tailwater staff gauges are available for local observation.

Water Quality Sampling:
No operating permit water quality sampling is required for this site.

7. G-304A-J (Northern Flow-way Inflow Control Structures)

Flow structures G-304 A-J are a series of ten culverts located along the Inflow Canal and serve as inflow control for the northern flow-way. Flow control is achieved through the combination of weir boxes and vertical lift gates. Each structure consists of a 72-inch diameter x 96-ft long corrugated metal pipe fitted with a weir box (crest elevation 11.25 ft NGVD) and a 72-inch x 72-inch slide gate on its upstream end; each culvert flared end section on its downstream end. Maximum design inflow for structures G-304 is 1,470 cfs (147 cfs per structure) with a headwater elevation of 15.7 ft NGVD.

Structure Operations:
Manual operation of these structures is required. The G-304 structures will be operated to provide appropriate flows to the northern flow-way. These structures may be fully or partially closed to restrict flow into the northern flow-way.

Data Acquisition and Telemetry:
Headwater and tailwater data at G-304A and G-304J are available via telemetry to the remote operators, while headwater/tailwater staff gauges and gate position information are available for manual operation at each structure.

Water Quality Sampling:
No operating permit water quality sampling is required at this site.

B. INTERIOR FLOW CONTROL STRUCTURES

1. G-252 (Eastern Flow-way)

Flow structures G-252 H-J are a series of culverts with risers situated on the remaining north interior levee of Treatment Cell 1. These culverts are 72-inch x 54.5-ft cmp structures with flashboards available for installation in the risers.

Structure Operations:
Manual operation of these structures is required. These structures will normally be open.

Data Acquisition and Telemetry:
Headwater/tailwater staff gauges are available for local observation.

Water Quality Sampling:
No operating permit water quality sampling is required at this site.

2. G-253 (Eastern Flow-way)

Structures G-253 A-J are a series of culverts with risers situated on the interior levee between Treatment Cells 1 and 3. These culverts are 72-inch x 58-ft cmp structures with flashboards available for installation in the risers. The design peak flow per structure is 93 cfs (930 cfs total) with a headwater elevation of 13.90 ft NGVD and a tailwater elevation of 13.60 ft NGVD.

Structure Operations:
Manual operation of these structures is required. The G-253 structures will normally be open.

Data Acquisition and Telemetry:
Headwater and tailwater data is available for G-253E to the remote operators, while headwater/tailwater staff gauges are available for local observation.

Water Quality Sampling:
No operating permit water quality sampling is required at this site.

3. G-254 (Western Flow-way)

Structures G-254 A-E are a series of nine culverts with risers located on the interior levee between Treatment Cells 2 and 4. These culverts are 72-inch x 54.5-ft cmp structures with flashboards available for installation in the risers. The design peak flow per structure is 94.4 cfs (850 cfs total) with a headwater elevation of 13.40 ft NGVD and a tailwater elevation of 13.10 ft NGVD.

Structure Operations:
Manual operation of these structures is required. The G-254 structures will normally be open, but may be closed at times to optimize flows entering Cell 4.

Data Acquisition and Telemetry:
Headwater and tailwater data is available for G-254C to the remote operators, while headwater/tailwater staff gauges are available for local observation.

Water Quality Sampling:
No operating permit water quality sampling is required at this site.

4. G-256 (Western Flow-way)

Structures G-256 A-E are a series of 5 culverts with risers located on the southern end of Treatment Cell 4. These culverts are 72-inch x 54.5-ft cmp structures with flashboards available for installation in the risers. The design peak flow per structure is 30 cfs (150 cfs total) with a headwater elevation of 12.5 ft NGVD and tailwater elevation of 12.32 ft NGVD.

Structure Operations:
Manual operation of these structures is required. The G-256 structures will normally be open.

Data Acquisition and Telemetry:
Headwater and tailwater data are available to the remote operators, while headwater/tailwater staff gauges are available for local observation.

Water Quality Sampling:
No operation permit water quality sampling is required at this site.

5. G-257

This is a single, 72-inch x 58-ft cmp with riser structure located in the FPL levee and has the ability to connect Treatment Cell 1 and Treatment Cell 4. This structure will typically remain closed with flashboards installed.

Operations:
Manual operation of these structures is required. The G-257 structure will normally be closed.

Data Acquisition and Telemetry:
No telemetry is present. Headwater/tailwater staff gauges are present for local observation.

Water Quality Sampling:
No operation permit water quality sampling is required at this site.

6. G-305 (Northern Flow-way)

Structures G-305 A-V is a series of 22 uncontrolled culverts situated in the levee between Treatment Cells 5A and 5B. These culverts are 84-inch x 62-ft cmp structures with flared end sections on both ends and an average invert elevation of 3.5 ft. NGVD. The design peak flow per structure is 66.8 cfs (1,470 cfs total) with a tailwater elevation of 12.70 ft NGVD.

Operations:
The G-305 structures will always be open.

Data Acquisition and Telemetry:
A manual reading of headwater and tailwater is available to the remote operators, while headwater/tailwater staff gauges are available for local observation.

Water Quality Sampling:
No operation permit water quality sampling is required at this site.

C. OUTFLOW CONTROL FACILITIES

1. G-251 (Eastern and Western Flow-ways)

Pump station G-251 is the outflow pump station serving the eastern and western flow-ways to discharge treated water into WCA-1. G-251 is equipped with six 36-inch diameter pumps, each with a maximum capacity of 75 cfs, for a total discharge capacity of 450 cfs.

Pump Station Description:

Number of Pumps:	6
Discharge Capacity (each pump):	75 cfs
Design Headwater elevation:	9.5 ft NGVD
Design low water (headwater) elevation:	7.5 ft NGVD
Design Tailwater elevation:	14.0 - 17.5 ft NGVD
Nominal pump operating speed:	373 rpm
Nominal "on" elevation:	as needed to maintain desired stage at G-308 HW.
Nominal "off" elevation:	as needed to maintain desired stage at G-308 HW.
Motor Speed:	373 rpm
Motor Size:	150 Hp
Centerline discharge connection:	14.5 ft NGVD
Pump station floor elevation:	19.75 ft NGVD
Intake floor elevation:	-0.33 ft NGVD

Structure Operations:
The G-251 pump station will be operated in one of the two following modes:

- Locally
- Remotely via telemetry from the District's Operations Control Center in West Palm Beach.

This pump station will operate depending on the On/Off stages described above.

Data Acquisition and Telemetry:
Local and remote operation of these structures is possible. Remote operation is from the SFWMD's West Palm Beach Operations Control Center. Headwater and tailwater data are also available to the remote operators, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
Operating permit required flow proportional, composite sampling equipment for TP is present in the canal immediately upstream of pump station G-251 (see Figure 3).

2. Discharge Canal (All flow-ways)

The Discharge Canal extends along the western boundary of the project, from gated culvert G-327A located in the northwest corner of the STA south to the outflow pump station G-310. The canal conveys discharges from culverts G-306A-J, G-258, G-259, G-309 and G-308, as well as seepage from treatment cells 2, 3, 4 and 5 to the G-310 outflow pump station. At its origin near the G-327 A structure, the Discharge Canal was designed for a trapezoidal cross-section with a bottom width of 50 ft at elevation –5.0 ft NGVD and side slopes 2.5H to 1V. South of G-306J, the Discharge Canal was designed for a bottom width of 30 ft at elevation –5.0 ft NGVD. The Discharge Canal continues south with this design cross-section until it reaches just north of outflow structure G-309 at which point the canal bottom width once again widens to approximately 50 ft. This is to accommodate for G-309 and G-258 flows of up to 700 cfs. Just north of G-308, the design cross-section widens to 80 ft for the G-308 and G-259 inflows of up to 560 cfs and 70 cfs, respectively. The design canal cross-section expands just south of G-259 to a 100-ft wide bottom width, and continues at this cross-section to the outflow pump station. While the as-built cross sections deviate slightly from the design cross section, modeling conducted after construction demonstrated the design conveyance capacity was achieved. The total length of the Discharge Canal is approximately 30,000 ft (5.7 miles).

Using the as-built canal cross sections, normal flow conditions (2,800 cfs) were modeled using HEC-2, and estimated velocities in the Discharge Canal were simulated up to 2.65 feet-per-second (fps) in the south end of the canal (2000, Hutcheon Engineers). The water surface elevation during this flow condition ranged from 8.85 ft NGVD at the north end to 7.0 ft NGVD at the G-310 pump station. Under Standard Project Storm conditions (STA-1W inflow will be limited to 1,100 cfs and project discharges will reach 2,800 cfs), canal velocities varied from 0 fps to 1.2 fps, with water surface elevations ranging from

13.6 ft NGVD in the north to 13.25 ft NGVD at the G-310 pump station. Under Probable Maximum Storm conditions (0 cfs inflow and 2,800 cfs outflow), modeling estimates of the water surface elevations showed a level pool in the discharge canal of 16.1 ft NGVD.

3. G-310 (All flow-ways)

Pump station G-310 serves as the primary outflow pump station for STA-1W. G-310 is located at the extreme southwest corner of STA-1W approximately 400 feet east and 1,500 feet north of the southeast corner of Section 34, Township 44 South, Range 39 East in Palm Beach County. G-310 is equipped with two 100 cfs, two 470 cfs and two 950 cfs pumps with a maximum facility design outflow pumping capacity of 3,040 cfs. Pump station G-310 works in concert with existing pump station G-251.

Pump Station Description:

Number of Pumps:	6
Discharge Capacity (combined):	3,040
Design Headwater elevation:	7.0 - 13.5 ft NGVD
Design low water (headwater) elevation:	7.0 ft NGVD
Design Tailwater elevation:	14.0 - 17.5 ft NGVD
Nominal pump operating speed:	
Electric:	440 rpm
Diesel 470-cfs:	177 rpm
Diesel 950-cfs:	125 rpm
Nominal "on" elevation:	refer to Section III B.
Nominal "off" elevation:	refer to Section III B.
Motor Speed:	
Electric:	440 rpm
Diesel:	720 rpm
Motor Size:	
2-100-cfs electric pumps:	200 hp
2- 470-cfs diesel pumps:	1020 hp
2-950-cfs diesel pumps:	1535hp
Centerline discharge connection:	
Electric:	23.25 ft NGVD
Diesel:	25.0 ft NGVD
Pump station floor elevation:	32 ft NGVD
Intake floor elevation:	
Electric:	-6.2 ft NGVD
470cfs diesels:	-4.68 ft NGVD
950cfs diesels:	-8.45 ft NGVD

Structure Operations:

All G-310 pumps have the capability to be operated locally or remotely. However, there are no plans to operate the diesel pumps remotely at this time. While the two G-310 electric pumps have remote operation capability, the four diesel pumps will continue to be operated

locally. In the event the diesel pumps are This pump station will operate depending on the On/Off stages described in Section III B.

Data Acquisition and Telemetry:
Local and remote operation of this pump station is possible. Remote operation is from the SFWMD's West Palm Beach Operations Control Center. Headwater and tailwater data is also available to the remote operators, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
Operating permit required flow proportional, composite sampling equipment for TP is present at this site (see Figure 3). Regular grab samples are also collected at this site.

4. G-259 (Eastern and Western Flow-ways)

Structures G-259 and G-308 work together to allow discharge from the eastern and western flow-ways into the STA-1W Discharge Canal. G-308 is the primary structure used to convey water to the Discharge Canal. Structure G-259 will open as necessary to supplement the conveyance capacity of structure G-308. The operational goal is to maintain G-308 structure headwater stage at or below a maximum elevation of 12.6 ft NGVD.

Structure G-259 is a single culvert extending from Treatment Cell 3 to the Discharge Canal along the western boundary of the ENR. This culvert is a 72-inch x 84-ft cmp flow structure with a sluice gate located at a point 28.5 ft in an east-west direction within the structure. Downstream of the sluice gate there is 50-ft of pipe. The design peak flow is 70 cfs with a headwater elevation 11.5 ft NGVD and a tailwater elevation of 7.1 ft NGVD.

Structure Operations:
The G-259 structure will be operated in one of the two following modes:

- Manually/Locally
- Remotely via telemetry from the District's Operations Control Center in West Palm Beach.

Data Acquisition and Telemetry:
Local and remote operation of these structure are possible. Remote operation is from the SFWMD's West Palm Beach Operations Control Center. Telemetry required for remote operation and status of each gate has been provided. Headwater/tailwater stage and gate position data are also available to the remote operators, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
No operating permit water quality sampling is required at this structure.

5. G-308 (Eastern and Western Flow-ways)

Structures G-259 and G-308 work together to allow discharge from the eastern and western flow-ways into the STA-1W Discharge Canal. G-308 is the primary structure used to convey water to the Discharge Canal. Structure G-259 will open as necessary to supplement the conveyance capacity of structure G-308. The operational goal is to maintain G-308 structure headwater stage at or below a maximum elevation of 12.6 ft NGVD.

G-308 is located along the southwest boundary of Treatment Cell 3 and will control discharges from the eastern and western flow-ways to the Discharge Canal. Structure G-308 consists of a single-bay reinforced concrete spillway with a 14-foot-wide vertical lift gate installed on the crest of an ogee shaped weir. The weir crest elevation is 7.4 ft NGVD. The design peak flow rate for structure G-308 is 560 cfs with a headwater elevation of 11.75 ft NGVD and a tailwater elevation of 7.5 ft NGVD.

Structure Operations:
The G-308 structure will be operated in one of the three following modes:

- Manually/Locally
- Automatically in response to headwater and tailwater.
- Remotely via telemetry from the District's Operations Center in West Palm Beach.

6. G-258 (Western Flow-way)

Structures G-258 and G-309 work together to allow discharge from the western flow-ways into the STA-1W Discharge Canal. G-309 is the primary structure used to convey water to the Discharge Canal. Structure G-258 will open as necessary to supplement the conveyance capacity of structure G-309. The operational goal is to maintain a maximum G-309 structure headwater stage elevation of 12.6 ft NGVD.

Structure G-258 is a single culvert extending from Treatment Cell 4 to the Discharge Canal. This culvert is a 72-inch x 85-ft cmp flow structure with a sluice gate located at a point 26-ft in an east-west direction within the structure. The design peak flow is 140 cfs with a headwater elevation of 12.6-ft NGVD and a tailwater elevation of 7.8 ft NGVD.

Structure Operations:
The G-258 structure will be operated in one of the two following modes:

- Manually/Local
- Remotely via telemetry from the District's Operations Control Center in West Palm Beach.

Data Acquisition and Telemetry:
Manual/Local and remote operation of this structure are possible. Remote operation is from the SFWMD's West Palm Beach Operations Control Center. Telemetry required for remote operation and status of the gate has been provided. Headwater/tailwater stage

and gate position data are also available to the remote operators, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
No operating permit water quality sampling is required at this structure.

7. G-309 (Western Flow-way)

Structures G-258 and G-309 work together to allow discharge from the western flow-ways into the STA-1W Discharge Canal. G-309 is the primary structure used to convey water to the Discharge Canal. Structure G-258 will open as necessary to supplement the conveyance capacity of structure G-309. The operational goal is to maintain a maximum G-309 structure headwater stage elevation of 12.6 ft NGVD.

Structure G-309 consists of a single-bay reinforced concrete spillway with a 14-foot-wide vertical lift gate installed on the crest of an ogee shaped weir. The weir crest elevation is 7.6 ft NGVD.

Structure Operations:
The G-309 structure will be operated in one of the three following modes:

- Manually
- Automatically in response to headwater and tailwater.
- Remotely via telemetry from the District's Operations Control Center in West Palm Beach.

The expected ranges of stages and flows over the expected range of operations are presented in Table 1.

Data Acquisition and Telemetry
Automatic, manual and remote operation of this structure are possible. Remote operation is from the SFWMD's West Palm Beach Operations Control Center. Telemetry required for remote operation and status of this gate has been provided. Headwater and Tailwater data are also available to the remote operators, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
No operating permit water quality sampling is required at this structure.

8. G-306 (Northern Flow-way)

Structures G-306 A-J are a series of 10 weir gated culverts situated on the west perimeter levee of Treatment Cell 5B that convey discharges from Treatment Cell 5B to the Discharge Canal. These culverts are 72" x 130" cmp with 72" x 72" slide gates with electric motors and 11' x 9' weir boxes with crest elevations of 7.8 ft NGVD on the

upstream end. The design peak flow per structure is 147 cfs (1,470 cfs total) with a headwater elevation of 11.5 ft NGVD and tailwater elevation of 9.0 ft NGVD.

Structure Operations:
The G-306 A-J structure will be operated in one of the two following modes:

- Locally/ Manually
- Remotely via telemetry from the District's Operations Center in West Palm Beach.

The G-306 structures will be operated to maintain Treatment Cell 5 stages at desired levels. The structure will be fully closed 1) during the initial "Start-Up" phase of operations, 2) when interior stages fall below prescribed levels during flow through operations, and/or 3) when desired to prevent Treatment Cell 5 discharges for maintenance or performance purposes.

Data Acquisition and Telemetry:
Manual/local and remote operation of these structures are possible. Remote operation is from the SFWMD's West Palm Beach Operations Control Center. Telemetry required for remote operation and status of these gates has been provided. Headwater/tailwater stage and gate position data is also available to the remote operators, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
No operation permit water quality sampling is required at this site.

D. DIVERSION STRUCTURES

1. G-300 and G-301

Structures G-300 and G-301 are reinforced concrete ogee-shaped weir spillways with vertical gates installed on the crest of the spillway. G-300 is located within the existing L-40 Borrow Canal and structure G-301 is located within the existing L-7 Borrow Canal. G-300 is equipped with two 20-ft wide x 8.4-ft high gates while G-301 is equipped with three 22-ft wide x 11.7-ft high gates. Each roller gate is operated by a horizontally-mounted, hydraulically-actuated, piston/cylinder device. Each structure has four wing walls constructed of sheet piling projecting at a 45-degree angle from the corners of each structure. The wing walls have a concrete cap that supports a fence. A 15'-18' wide service bridge is provided for access across the spillway. The bridge is designed for an HS20-44 truckload. Structures G-300 and G-301 are intended to act in parallel and discharge the full 4,800 cfs (maximum capacity of pump station S-5A) directly to WCA-1 in the event of a need to divert this amount under emergency or extreme inflow and rainfall conditions. They may also be operated during water supply conditions to move water into WCA-1 or withdraw water from WCA-1.

The design elevation and length of the separation levee between the Inflow basin and Water Conservation Area 1 is 20.0 ft NGVD and 6,100 ft respectively.

STA-1W inflow and diversion structures, G-302, G-301 and G-300 located within the Inflow basin will be operated to maintain stages below 19.0 ft NGVD within the Inflow basin. Flow diversion to Water Conservation Area 1 via Inflow basin structures G-301 and G-300 will begin at Inflow basin stage elevations of 18.0 ft NGVD. Other operational strategies may be applied to maintain Inflow basin stage elevations below 19.0 ft NGVD for events outside of the SPS and PMS conditions.

Structure Operations:
Remote and automatic operations of G-300 and G-301 are available to maintain headwater stages below 19.0 ft NGVD during Typical Operations (see "Typical Operations" below) and 19.4 ft NGVD for "Standard Project Storm Conditions.

Data Acquisition and Telemetry:
Telemetry for headwater and tailwater data are available to the remote operators, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
No operating permit water quality sampling is required at this site.

E. SEEPAGE CONTROL FACILITIES

Pump stations G-310 and G-250S provide control of STA-1W seepage to ensure adjacent lands are not impacted by the project. The two 100-cfs pumps in G-310 provide this function (discussed above) and G-250S is described below.

1. G-250S

G-250S is a three-unit pumping station located adjacent to inflow structure G-303, and has a maximum total capacity of 201 cfs. However, hydraulic constraints in the north seepage canal limit the estimated maximum conveyance to approximately 120 cfs (see Figure 2). The station is equipped with three 36-inch diameter pumps driven by electric motors. The primary purpose of this station is to control the water stages in the seepage canal north of Treatment Cells 5A and 5B. These pumps have also been used to redirect limited volumes of Cell 5 discharges through structure G-327 A into Treatment Cells 1, 2, 3 and 4 during the Start-up phase.

Pump Station Description:

Number of Pumps:	3
Discharge Capacity (each pump):	67 cfs
Design Headwater elevation:	7.25 ft NGVD
Design Tailwater elevation:	14.8 ft NGVD
Nominal pump operating speed:	383 rpm
Nominal "on" elevation:	8.5 ft NGVD
Nominal "off" elevation:	8.0 ft NGVD

Structure Operations:
The G-250S pump station will be operated in one of the two following modes:

- Locally
- Remotely via telemetry from the District's Operations Control Center in West Palm Beach.

This pump station will operate depending on the On/Off stages described above.

Data Acquisition and Telemetry:
Local and remote operation of these pumps are possible. Remote operation is from the SFWMD's West Palm Beach Operations Control Center. Headwater and tailwater data are also available to the remote operators, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
There is no permit required water quality sampling at this station.

2. G-327A

Structure G-327A is a single gated culvert connecting the Discharge Canal along the western boundary of Treatment Cell 5 to the Seepage Canal along the northern boundary of Treatment Cell 5. This culvert is an 84-inch x 130-ft cmp flow structure with an 84 – inch diameter sluice gate to regulate flow. G-327A redirects STA-1W seepage or discharge from the Discharge Canal to the Seepage Canal, then eventually to the ENR Supply Canal and Treatment Cells 1 through 4 via G-250S when operated during Low-Flow periods. The estimated maximum discharge is approximately 100 cfs with a headwater elevation 9.0 ft NGVD and a tailwater elevation of 8.7 ft NGVD.

Structure Operations:
The G-327A structures will normally be closed and will be open only when necessary to direct seepage or discharge to the north perimeter seepage canal.

Data Acquisition and Telemetry:
Manual and remote operation of this structure are available. Telemetry required for headwater, tailwater and gate position data is available to remote observers. Headwater/tailwater staff gauges and gate position information are available for local operation.

Water Quality Sampling:
No operating permit water quality sampling is required at this site.

3. G-327C

Structure G-327C is a single culvert situated in the north perimeter Seepage Canal. This culvert is an 84-inch x 129-ft cmp uncontrolled equalizing flow structure. G-327C conveys flows across the northern portion of the FPL access levee within the Seepage Canal. The design peak flow is 100 cfs with a headwater elevation 8.4 ft NGVD and a tailwater elevation of 8.2 ft NGVD.

Structure Operations:
No operation required.

Data Acquisition and Telemetry:
No telemetry for headwater and tailwater data are available to the remote operators, while headwater/tailwater staff gauges are available for local observation.

Water Quality Sampling:
No operating permit water quality sampling is required at this site.

4. G-327D

Structure G-327D is a site that was established to accommodate a temporary pump to recirculate STA1-W seepage or discharges into Treatment Cell 5A. This structure, if installed, will connect to and withdraw from the North Perimeter Seepage Canal and discharge to the north end of the Treatment Cell 5A Spreader Canal adjacent to the Cell 5 Inflow Control Levee.

Structure Operations:
TBD

Data Acquisition and Telemetry:
TBD

Water Quality Sampling:
No operating permit water quality sampling is required at this site.

F. RELATED STRUCTURES

1. S-5AS S-5AS is a reinforced concrete gated spillway that has historically been used to facilitate water supply releases from Water Conservation Area 1 to the L-10, L-12, L-8 and C-51 basins for irrigation. The structure is located adjacent to and east of the S-5A pump station, at the confluence of the L-8 and L-40 borrow canals. Two cable-operated vertical lift gates are manually controlled in accordance with operational criteria. Since the construction of the STA-1 Inflow Basin, operation of S-5AS for water supply will require reverse flows through diversion structures G-300 and G-301. This, in turn, will

necessitate the closing of inflow structure G-302, preventing flows from entering STA-1W until irrigation supply demands are met.

In very rare instances, S-5AS gates may also be opened to pass floodwaters into Water Conservation Area 1 when the L-8 headwater stage exceeds the WCA 1 tailwater stage.

III. OPERATIONS

Introduction. This section describes the general operations associated with STA-1W. Operations are classified in the following modes:

1. Start-up operations
2. Normal operations
3. Extreme flow operations
4. Drought operations
5. Operations to take one or more treatment cells out of service, and
6. Future changes to optimize nutrient removal performance

Throughout this operation plan, an operational range of +/- 0.20 ft is applied to all the target stages, unless otherwise stated. For example, if the plan calls for a target stage of 12.0 ft NGVD, then the operational range is 11.8 – 12.2 ft NGVD.

A. START-UP PHASE OPERATIONS

Background. Treatment Cells 1 through 4 were constructed as the Everglades Nutrient Removal Project between 1989 and 1993, and completed Start-up operations in August 1994. Construction was completed on Cell 5 in March 1999, at which time the Cell 5 Start-up phase of operations was initiated. During this Start-up phase of operations, no discharges from the project were authorized by permit until total phosphorus, total mercury and methyl mercury samples demonstrated a net improvement compared to samples taken at the Cell 5 inlet structures. For phosphorus, this net improvement test compared 4-week geometric mean total phosphorus water column concentration from samples collected at pump station S-5A to samples collected at the upstream end of structures G-306 A, D and G. For the mercury species, samples collected at the interior of Cell 5 were compared to samples collected at the S-5A pump station. Cell 5 monitoring data collected during January 2000 documented that a net improvement in total phosphorus, total mercury and methyl mercury was achieved. Treatment Cells 1 through 4 remained fully operational during Treatment Cell 5 Start-up operations. Maximum allowable inflow capacities into the Cells 1 through 4 were limited to the maximum outflow capacity of pump station G-251 (450 cfs). **STA-1W was deemed to be complete with Start-up operations in July 2000 when discharges from Cell 5 began.** From a permit perspective, commencement of discharges from Cell 5 initiates the Stabilization phase of the project.

B. NORMAL OPERATIONS

Normal Operations are defined as the operations of STA-1W for flows up to and including the Design Peak Flow Condition of 3,250 cfs.

1. General. Pump station S-5A provides the stormwater inflow for STA-1W. In general, the operation of S-5A, and subsequent operation of STA-1W, is determined by upstream water conditions (storm or water supply), adjusted for seasonal needs of the tributary basin. When the tributary basin needs are focused on flood control, the stages in the upstream canal systems are held around 10.5 ft NGVD to facilitate this activity. When the tributary basin needs are centered on irrigation practices, the stages in the upstream canal systems are held higher (11.5 ft NGVD) to facilitate this activity. In practice, stages in excess of 12.0 ft NGVD or a rise in S-5A headwater stage of 0.5 feet per hour would be cause to initiate pumping at S-5A.

2. Normal Flow Operations are defined as operations of STA-1W for flows up to and including the Design Peak Flow Condition of 3,250 cfs. Inflow to STA-1W is through the STA-1 Inflow Basin via structure G-302, and outflows are discharged to the Refuge via G-251 and G-310. Downstream of G-302, flows are conveyed via the Inflow Canal to Treatment Cell 5 through structures G-304 A-J and to Cells 1-4 through structure G-303. Discharges from the treatment cells are conveyed to outflow pump station G-310 and G-251 at which point the treated flows are pumped into the Refuge.

Eastern Flow-way Operations (Treatment Cells 1 and 3). Based on the experience gained during the operation of the ENR project, the target water depth for Cell 1 during normal operation is 1.8 ft and for Cell 3 the target water depth is 1.5 ft, with a corresponding stage of approximately 11.9 ft NGVD (+/- 0.20 ft) in each cell. Therefore the initial operating stage range for the G-308 structure during the wet season is 11.7 - 12.1 ft NGVD. During the dry season when water is available, it is desirable to conserve as much water as possible; hence the dry season conservation stage for Cells 1 and 3 is approximately 12.4 ft NGVD (+/- 0.20 ft). Structural operation of this flow-way is discussed in Section II *Structure and Canal Descriptions.*

Western Flow-way Operations (Treatment Cells 2 and 4). The target water depth for Cell 2 during normal operation is 2.2 ft and for Cell 4 the target water depth is 2.0 ft, with a corresponding stage of approximately 11.7 ft NGVD (+/- 0.20 ft) in each cell. Therefore the initial operating range stage for the G-309 structure during the wet season is 11.5 - 11.9 ft NGVD. During the dry season when water is available, it is desirable to conserve as much water as possible; hence the dry season conservation stage for Cells 2 and 4 is approximately 12.2 ft NGVD (+/- 0.20 ft). The structural operation of this flow-way is discussed in Section II *Structure and Canal Descriptions.*

Northern Flow-way Operations (Treatment Cells 5A and 5B). The target water depth for Cell 5 during normal operation is 1.7 ft with a corresponding stage of approximately 11.2 ft NGVD (+/- 0.20 ft). Therefore the initial operating range stage for the G-306 structures is during the wet season is 11.0 - 11.4 ft NGVD. During the dry season when water is available, it is desirable to conserve as much water as possible; hence the dry season conservation stage for Cell 5 is approximately 11.7 ft NGVD (+/- 0.20 ft). The structural operation of this flow-way is discussed in Section II *Structure and Canal Descriptions.*

Table 1. Summary of Target Stages and Depths for STA-1 West

Cell	Wet Season Target Stage / Depth (+/- 0.2 ft)	Dry Season Conservation Stage / Depth When Available (+/- 0.2 ft)	Measured at Structure	Operational Structure
1	11.9 / 1.8	12.4 / 2.3	G-253 HW	N/A
2	11.7 / 2.25	12.2 / 2.75	G-254 HW	N/A
3	11.9 / 1.5	12.4 / 2.0	G-308 HW	Primary: G-251 Secondary: G-308/ G-310
4	11.7 / 2.0	12.2 / 2.5	G-309 HW	Primary: G-308/ G-310 Secondary: G-309/ G-310
5	11.2 / 1.7	11.7 / 2.2	G-306 HW	G-306/G-310

Wet Season: In general, May 15 - October 15, although this may vary based on rainfall conditions.
Dry Season (or other water conservation periods): In general, October 16 - May 14
Structures G-252, G-253, G-254, G-255, G-256, G-303 and G-304 will normally be fully open.
Structures G-258, G-259, G-306, G-308 and G-309 will normally be closed, except when discharging storm flows.

Maximum Depths. The maximum operational depth for treatment cells 1, 2, 3, and 4 has been established at 4.5 ft above average ground elevation. This depth corresponds to a G-303 tailwater stage of 14.68 ft NGVD. It is considered desirable to limit the duration of this stage to no more than ten consecutive days. If this stage is reached and maintained for ten consecutive days, then the gates at G-303 should be lowered to allow tailwater stages at structure G-303 to recede to 12.68 ft NGVD. For Cell 5, the limiting factor that dictates the maximum depth is the protection of the north perimeter levee. Based on a hydraulic analysis by Hutcheon (1999) on the effects of SAV in Cell 5B, the current maximum water stage is 12.7 ft NGVD measured at the tailwater of G-305A; this corresponds to a depth of approximately 3.2 ft. An additional analysis is underway to update the Hutcheon work based on field estimates of Manning's "n". Additional information is provided in Section III.C. *Extreme Flow Operations.*

Design Peak Flow Condition. The June 1996 *Detailed Design Report* presented results of modeling steady-state Design Peak Flow Condition (3,250 cfs) through STA-1W using a constant Manning's "n" of 0.8 (Hutcheon 1996a). The 1-dimensional hydrodynamic model HEC-2 was used for Cells 1-4, while the 2-dimensional hydrodynamic model FESWMS-2D model was used for Cell 5. The October 1996 *Supplement to the Detailed Design Report* documented the effect of modeling the Design Peak Flow Condition through STA-1W using a depth-dependent Manning's "n" ("n"=1.3 for depths of 1.0 ft or lower; "n"=0.5 for depths of 3 feet or higher; and "n" varied linearly between 1.0 and 3 ft) (Hutcheon 1996b). The headwater at the G-306 structures was assumed to remain

constant at 11.5 ft NGVD during both simulations. A key result was the estimated lowering of the stages throughout the treatment area. For example, the tailwater of the G-304A structure decreased from 13.8 ft NGVD to 13.0 ft NGVD. Without modulation of the G-304 gates during this flow event, there could be too much flow through Cell 5 and reduced flows through Cells 1, 2, 3 and 4; hence Hutcheon recommended adjusting the gates at G-304 as necessary to limit Cell 5 inflow to the design value 1,470 cfs. Prior to inundation of Cell 5 in March 1999, the District decided to encourage the growth of submerged aquatic vegetation (SAV) in Cell 5B in order to improve the phosphorus removal performance of the cell. Cell 5A was managed to encourage emergent vegetation. Studies conducted in Cells 1 and 4 indicated that SAV communities have a different vegetation roughness characteristic than an emergent system such as cattail, as presented in Figure 5. Additional hydraulic analyses were conducted for Cell 5 in order to account for the different vegetation roughness characteristics of SAV from that of cattail. These analyses confirmed the necessity to modulate flows through the G-304 structures in order to balance flows between the northern flow-way and the other two flow-ways. Three options were investigated to modulate flows through the G-304 structures, each of which would achieve the desired hydraulic distribution, including

1. installing weir plates at the box weirs upstream of the structures that would raise the crest elevation by an average of 1.59 ft, from an average of 11.28 ft NGVD to an average of 12.87 ft NGVD,
2. partially closing all ten of the G-304 gates, from 1.4 ft in the north (G-304A) to 1.85 ft in the south (G-304J), and
3. completely closing the gate at G-304A and leaving the remaining 9 open fully.

The resulting water surface elevations for the Design Peak Flow Condition are shown in Figure 5 (Hutcheon Engineers, STA-1West As-built Construction Drawings, September 2000, modified by District January 2001).

Summary of Structure Operations During Design Peak Flow Conditions:

- STA-1W inflow structure G-302 will be opened fully until the tailwater stage at G-303 reaches 14.7 feet, which corresponds to a depth of 4.5 feet (see Figures 6 and 7).

- Structures G-300 and G-301 will initially be closed. If the HW stage exceeds 18.0 ft NGVD, G-300 and G-301 will be opened to allow for diversion of flows to WCA-1.

- STA-1W inflow/interior/outflow control structures will be operated to maintain the target stages shown in the table below.

- Treatment Cell 5 outflow redirection control structure G-327 A will be closed.

- G-310 pump operations: For storm flows less than 1000 cfs (as measured by the combined flows at G-306, G-308, G-309, G-258 and G-259), a pump-on stage of 8.5 ft is recommended, with a pump-off stage of 8.0 ft. For storm flows greater than or

equal to 1000 cfs, a pump-on stage of 7.5 ft is recommended, with a pump-off stage of 7.0 ft.

- Seepage inflow pumping via G-250S and STA outflow pumping via G-251 and G-310 will occur as required.

Simulated Stages and Flows at Design Peak Flow Condition (3,250 cfs)

Structure	Headwater ft NGVD	Tailwater ft NGVD	Flow cfs	Gate opening feet
G-258	12.6	7.8	140	fully open
G-259	11.5	7.1	70	fully open
G-302	18.0	15.8	3,250	fully open
G-303	15.7	14.46	1,760	fully open
G-304A-J	15.7-15.8	12.32-12.81	1,470	G-304A closed; others open
G-306A-J	11.5	8.3-9.0	1,470	fully open
G-308	11.75	7.5	560	open 3.3 feet
G-309	12.61	7.8	560	open 3.1 feet
G-251	varies	varies	450	N/A
G-310	varies	varies	2,800	N/A

Figure 4. Depth-dependency of Manning's "n"

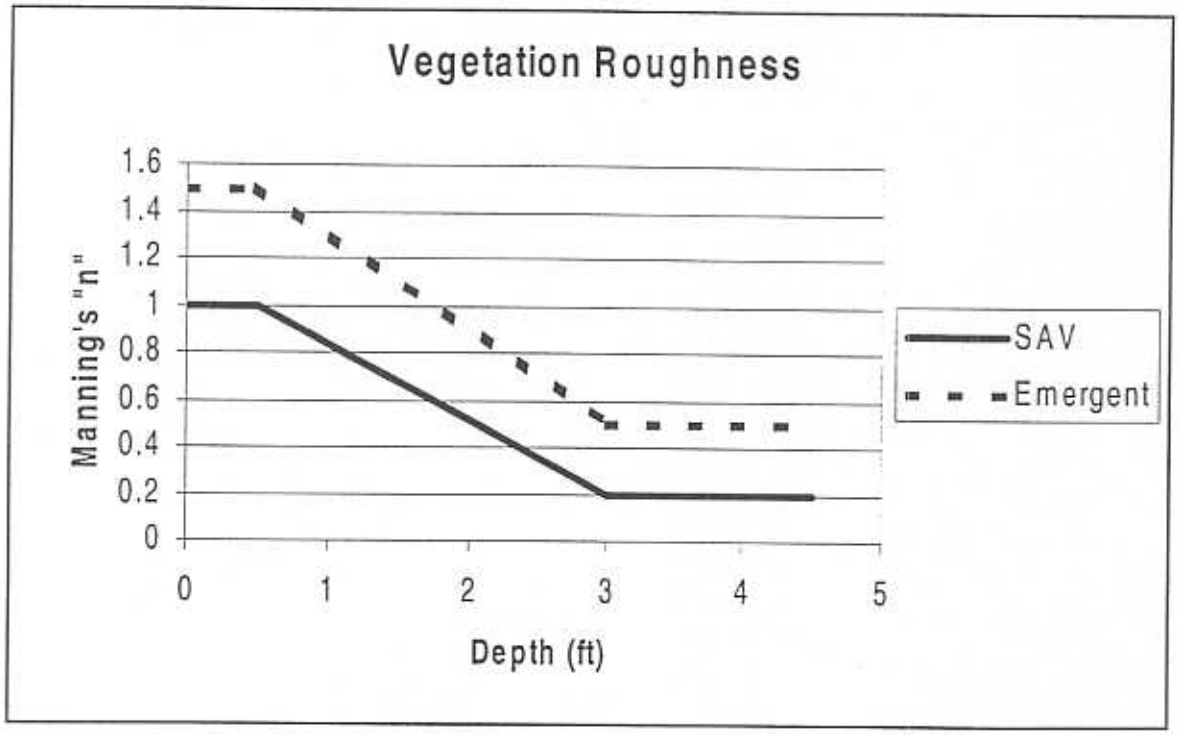
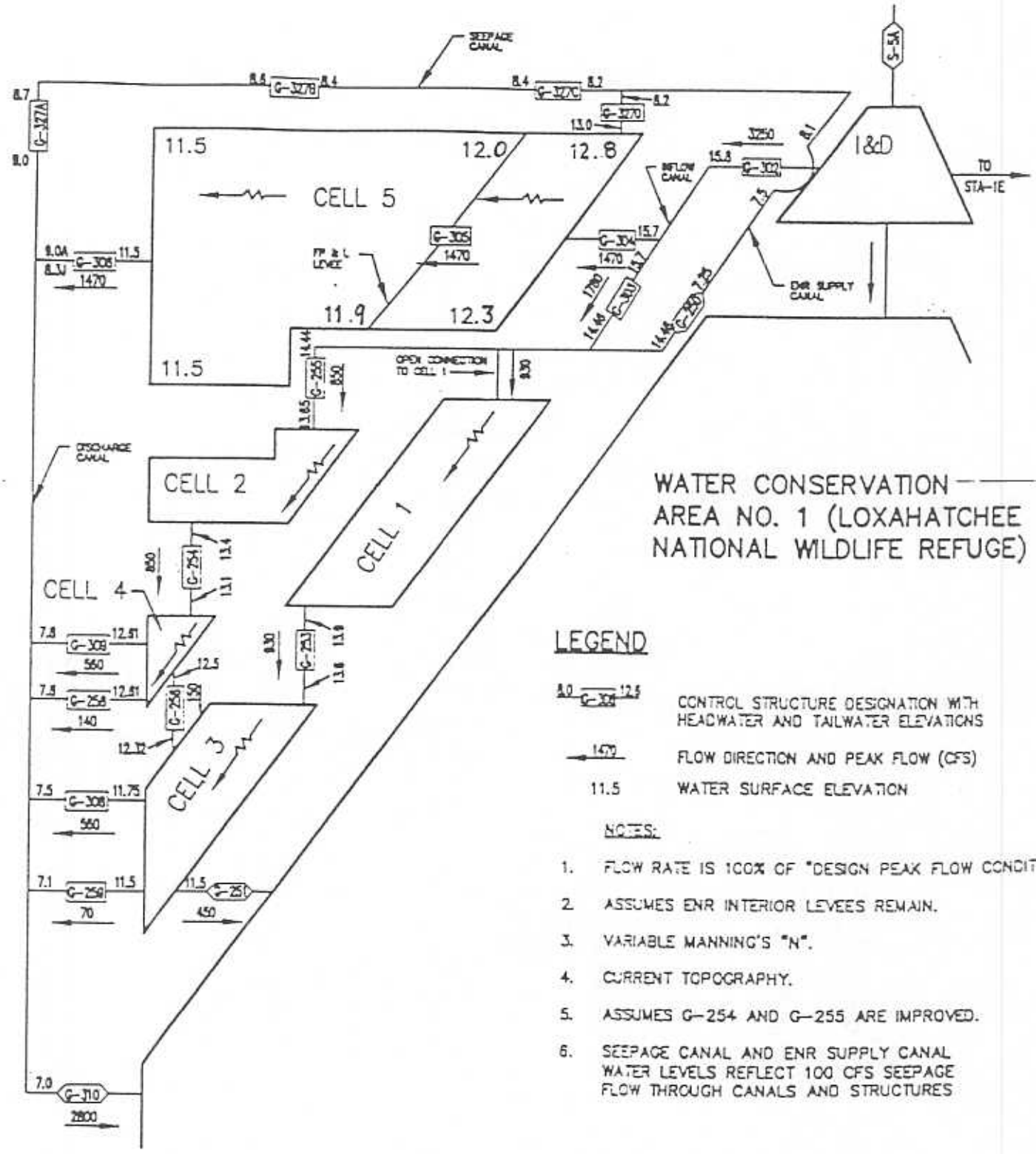


Figure 5

DESIGN PEAK FLOW CONDITION



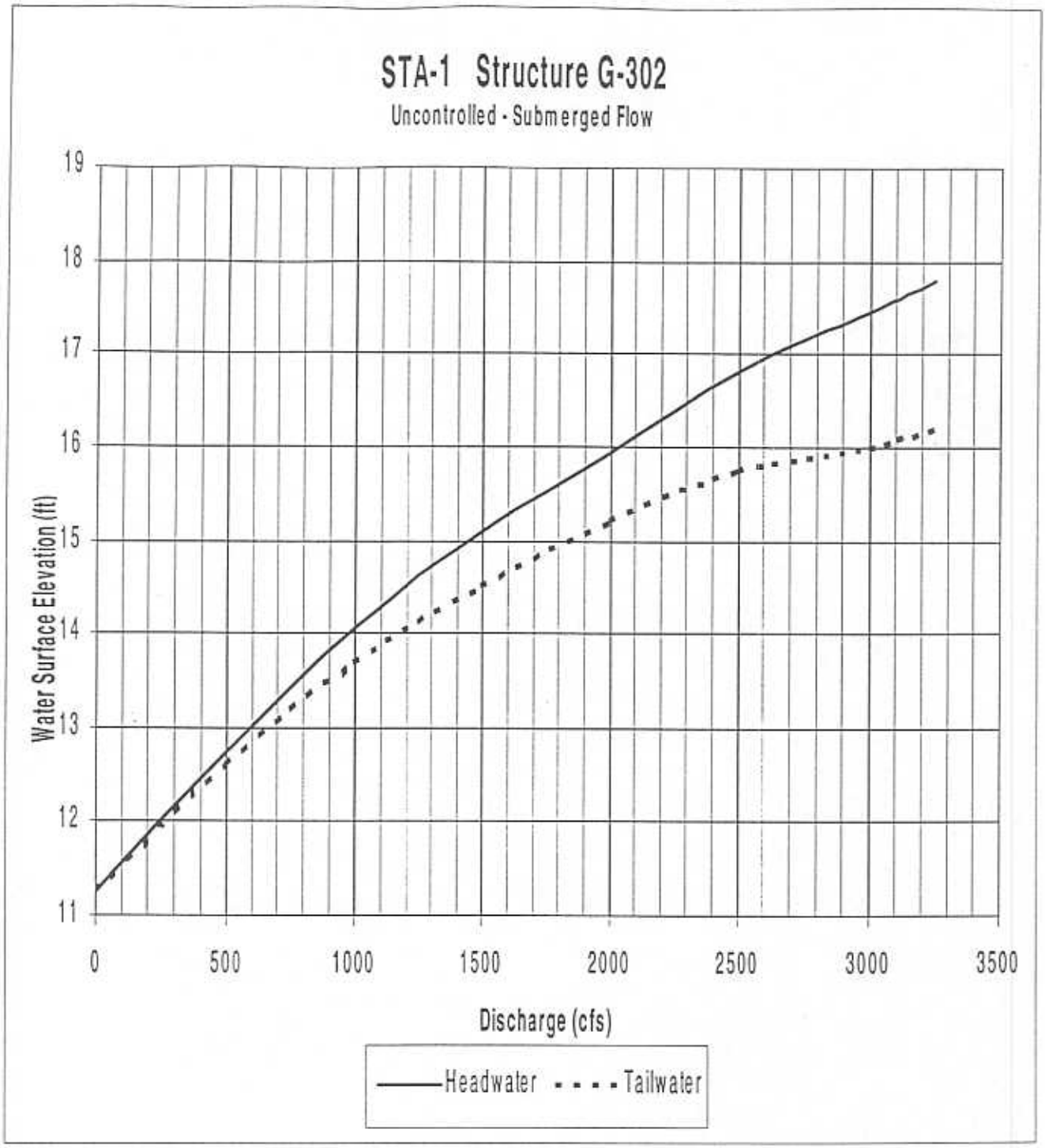
LEGEND

8.0 G-308 12.5	CONTROL STRUCTURE DESIGNATION WITH HEADWATER AND TAILWATER ELEVATIONS
1470	FLOW DIRECTION AND PEAK FLOW (CFS)
11.5	WATER SURFACE ELEVATION

NOTES:

1. FLOW RATE IS 100% OF "DESIGN PEAK FLOW CONDITION".
2. ASSUMES ENR INTERIOR LEVEES REMAIN.
3. VARIABLE MANNING'S "N".
4. CURRENT TOPOGRAPHY.
5. ASSUMES G-254 AND G-255 ARE IMPROVED.
6. SEEPAGE CANAL AND ENR SUPPLY CANAL WATER LEVELS REFLECT 100 CFS SEEPAGE FLOW THROUGH CANALS AND STRUCTURES

Figure 6. Structure G-302 Uncontrolled Submerged Flow



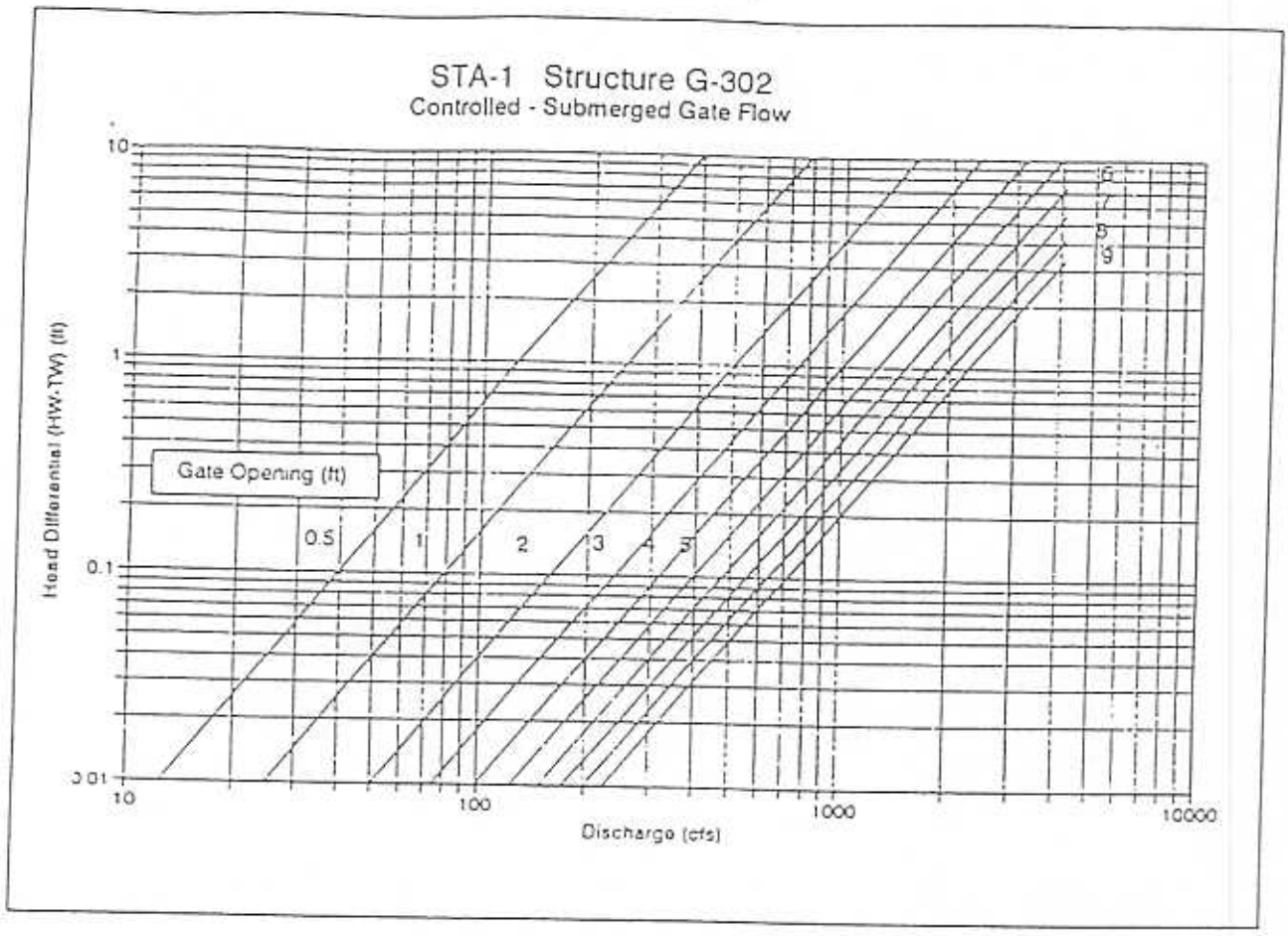


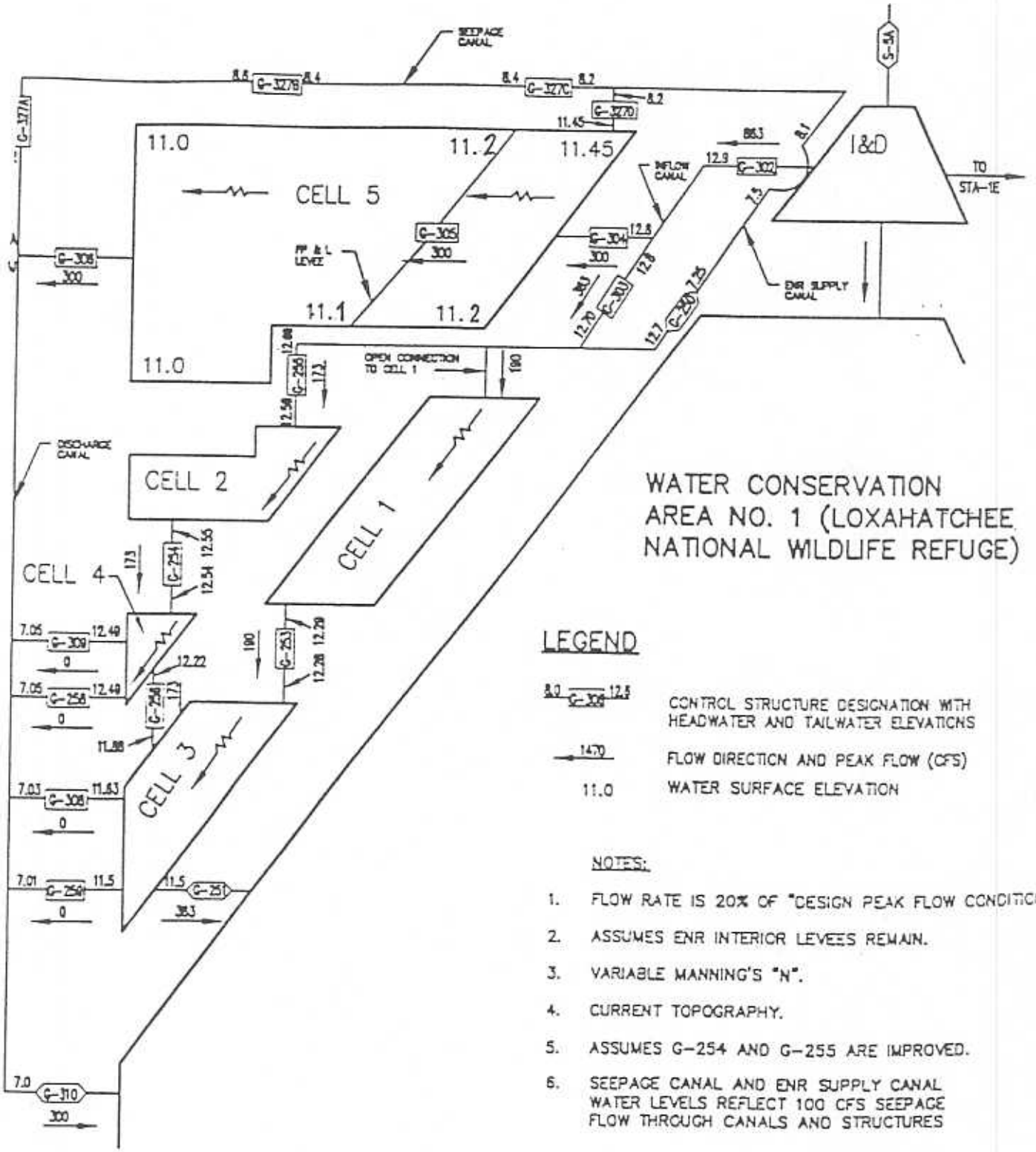
FIGURE 7 : G302 "Controlled-Submerged" Structure Flow Rating Curve.

3. Low Flow Condition. The October 1996 *Supplement to the Detailed Design Report* documented the effect of modeling steady-state low flow condition (633 cfs) through STA-1W using a depth-dependent Manning's "n". This low flow condition approximates 20 percent of the design flow condition. The 1-dimensional hydrodynamic model HEC-2 was used for Cells 1-4, while the 2-dimensional hydrodynamic model FESWMS-2D model was used for Cell 5. Additional analyses were performed by District staff to account for the change in vegetation community in Cell 5, and all of the three options to modulate the G-304 gates were adequate to pass the low flows. The resulting water surface elevations for the low flow condition are shown in Figure 8 (Hutcheon Engineers, STA-1West As-built Construction Drawings, September 2000, modified by District January 2001). Please note that during low flow conditions, instead of maintaining a headwater of 7.0 ft at G-310 as shown in Figure 8, a pump-on stage of 8.5 ft is recommended for a flow of 300 cfs, with a pump-off stage of 8.0 ft.

During certain low flow conditions, redirection of seepage and treated flows from the Discharge Canal to G-250S is possible via gated culvert G-327A. Total seepage flows to G-250S are estimated to range from 44 to 74 cfs. STA design flow redirection capacity is approximately 75-100 cfs. Flow redirection is accomplished by first allowing the water stage in the Discharge Canal to rise to elevation 8.0-9.0 ft NGVD, at which point gated culvert G-327A is opened, allowing discharges from the Discharge Canal to flow into the Seepage Canal along the northern boundary of the STA. Flows are conveyed east and then south in the Seepage Canal to seepage pump station G-250S where subsequent discharges occur into Cell 1. Flow redirection into Treatment Cell 5 may also be possible with the installation of temporary pumping facilities at site G-327D, located along the north boundary of Cell 5A.

Figure 8

LOW FLOW CONDITION



C. EXTREME FLOW OPERATIONS

STA-1W has been designed to accommodate estimated inflows resulting from extreme precipitation events, the Standard Project Storm (SPS) and the Probable Maximum Storm (PMS) as described below. Inflows resulting from precipitation events smaller than the SPS and PMS events should fall under "Normal Operating Conditions" for the STA.

Discretion in the operation of STA-1W structures is reserved by the District Operations staff to account for flood protection, excess precipitation and upstream and downstream conditions. The following discussion is offered only as general guidance.

Stages within STA-1W will rise and fall with the passing of the extreme storm event, and will be influenced by the rainfall amount, the stage at the initiation of rainfall, the operations during the event, and the volume of pumping before and during the event.

2. Standard Project Storm

The Standard Project Storm (SPS; 120% of the 100 year/24-hour storm) rainfall depth is estimated as 23.6 inches for a 24-hour duration over a 10-square mile basin area. During an SPS event, it is recommended to restrict inflow through structure G-302 to 1,110 cfs. For an SPS event, the estimated STA-1 Inflow Basin maximum stage elevation was estimated as 19.4 ft NGVD. Flows will be conveyed to Treatment Cell 5 through structures G-304 A-J (maximum rate for SPS event: 1,110 cfs). No inflows will be conveyed to the existing ENR project through structure G-303 (maximum rate for SPS event: 0 cfs). Pumped inflows and SPS rainfall flows will travel in a westerly direction within Treatment Cell 5 and in a southwesterly direction within Cells 1 - 4, subsequently being discharged to the Discharge Canal via outflow structures G-306 A-J, G-309, G-258, G-308, and G-259 (nominal capacities: 1,470 cfs, 560 cfs, 140 cfs, 560 cfs, 70 cfs, respectively).

Effects of SAV on Cell 5 Operations. The exterior levees were designed to protect against overtopping during extreme storm events due to wind setup and wave run up. In general, the top of the levee was established as the greater of two criteria – either 3.0 ft freeboard on top of a 4.5 ft water depth, or the height necessary to contain the wind and wave effects during the SPS and PMS events. The interior vegetation of an STA indirectly affects operation guidelines as a result of hydraulic energy losses associated with resistance to flow. In hydraulic modeling, this resistance to flow is often expressed as the Manning's "n" roughness factor. This resistance to flow influences the hydraulic conveyance capacity of the treatment area with associated influence on operating levels and levee design. In addition, the height and type of vegetation influences the wave runup and wind setup, both of which influence the maximum allowable operating depths of treatment cells.

Cell 5 of STA-1W was originally designed under the assumption that cattails or other emergent vegetation would dominate the treatment cell. Hutcheon Engineers originally modeled Cell 5 hydraulics with a constant Manning's "n" (Hutcheon 1996). Subsequently,

they performed revised hydrodynamic modeling with a depth-dependent Manning's "n" (n=1.5 for depths of 0.5 ft or lower; n=1.5 for depths of 3 feet or higher; and n varies linearly between 0.5 and 3 ft). The levees and control structures were subsequently designed with this roughness function. The maximum stage simulated in Cell 5B was approximately 14.2 ft NGVD for the Standard Project Storm and approximately 15.9 ft for the Probable Maximum Storm (Hutcheon Engineers June 19, 1999). The combined wave runup and wind setup for the SPS (119 mph wind speed) was 2.1 ft and 1.0 foot for the PMS (71 mph wind speed) (Hutcheon Engineers June 19, 1999).

Based on superior phosphorus removal performance of Cell 4 in the ENR project, in March 1999 the District decided to start up Cell 5B with submerged aquatic vegetation (SAV) instead of cattails or other emergent vegetation. Cell 5A was managed to encourage emergent vegetation.

The District asked Hutcheon to determine the effects of SAV on the operation guidelines for Cell 5B. In December 1999 Hutcheon produced the report "Impacts of Submerged Aquatic Vegetation on STA-1W Design and Operation." In that report, Hutcheon used a Manning's "n" of 0.06 based on guidance contained within USGS Water Supply Paper 2339. Unknown to Hutcheon at the time of their analysis, Manning's "n" estimates had been obtained for an SAV cell, Cell 4, of the ENR project by the District and other consultants during the STA design. These estimates ranged from an n of 0.2 to 1.3 (Brown & Caldwell 1996, Kadlec 1999, and Guardo 1996), representing significantly higher resistance to flow than used in 1999 Hutcheon analysis. Hence, for a mature SAV community, a Manning's "n" of 0.06 does not appear to be appropriate. However, during the start-up period of Cell 5B, and other similar treatment areas with little or no rooted vegetation, the use of a Manning's "n" of 0.06 may be appropriate. Using this low value, which may be appropriate with little or no rooted growth in the treatment area, Hutcheon made the following estimates and operational recommendations for peak flow events (3,250 cfs) through STA-1W:

1. The combined wind and wave effects increased by 2.6 ft for the SPS and 2.3 ft for the PMS.
2. With the decrease in Manning's "n", the design flow can be accommodated at a lower flow depth with Cell 5.
3. With the lower depths in Cell 5A and Cell 5B, in order to balance the STA-1W flow between Cell 5 and the remainder of STA-1W, the G-304 inlet structures will need to be modulated. The 1999 Hutcheon report recommends that the top 2.2 ft of culvert cross section be blocked (i.e., open 3.8 ft) and the G-306 outlet structures should be adjusted such that the top 1 ft of the culvert is blocked (i.e., open 5 ft). In preparation for a large storm, these gates should be opened fully to provide maximum flow capacity.
4. Cell 5 should be operated such that the G-305 tailwater stage does not exceed 12.7 ft during the SPS (23.6 inches in 24 hours with 119 mph winds) and that the G-305 tailwater stage does not exceed 14.0 ft during the PMS (47.6 inches in 24 hours with 71 mph winds). Given the uncertainties with extreme storm forecasting, the report recommends that Cell 5 should be operated such that the G-305 tailwater stage does not exceed 12.7 ft during any extreme event.

5. As is the standard District practice, STA-1W will be drawn down in anticipation of a pending large storm such as a hurricane. The Hutcheon report recommended 30 hours of pumping to maintain stages in Cell 5B at less than 12.7 ft during SPS conditions with 1,100 cfs through G-302. A shortened pre-pumping period can be achieved by keeping G-302 closed during the storm.

As of January 2001, submerged aquatic vegetation continues to expand in Cell 5B; in addition a large area of emergent vegetation persists in the southwest portion of the cell. As the SAV continues to grow in within Cell 5B, the resistance to flow should increase considerably, possibly attaining Manning's "n" similar to that observed in Cell 4 (ranging from 0.2 to 1.3). It is projected that by July-August 2001 timeframe, the SAV community in Cell 5B should be of similar in density to that in Cell 4. Using the Cell 4 Manning's "n" values (see Figure 4), District staff analyzed flow conditions up to the design peak flow of 1,470 cfs through Cell 5. Recommendations include:

1. Design flows can be achieved at lower depths than originally anticipated. A stage of 12.81 ft at G-304A was simulated for the 1,470 cfs scenario.
2. To balance flows between Cell 5 and the other flow-ways, the flow through the G-304 structure will need to be modulated. This can be accomplished in any of 3 ways:
   a. installing weir plates at the box weirs upstream of the structures that would raise the crest elevation by an average of 1.59 ft, from an average of 11.28 ft NGVD to an average of 12.87 ft NGVD,
   b. partially closing all ten of the G-304 gates from 1.4 ft in the north (G-304A) to 1.85 ft in the south (G-304J), and
   c. completely closing the gate at G-304A and leaving the remaining 9 open fully.
3. No modulation of G-306 structures will be necessary as a result of the SAV community. However, to balance flows through the G-306 structures from north to south (as the tailwater is assumed to decrease from 9.0 ft to 8.3 ft in the discharge canal), the gates could be modulated, e.g., the G-306J gate could be closed approximately 2.4 ft (i.e., open 3.6 ft) and still pass the design capacity of 147 cfs at a headwater of 11.5 ft. **Because the G-306 structures have not been calibrated with respect to flow, it is recommended to start with the gates open fully, and Operations staff can make appropriate adjustments as conditions are monitored.**
4. While the Hutcheon recommendation to keep stages in Cell 5 at or below 12.7 ft was appropriate while there was very little rooted vegetation with Cell 5, as Cell 5 becomes established with more rooted vegetation, the maximum stage can increase above 12.7 ft. Analyses are presently underway to determine the maximum allowable depth of a "fully mature" SAV community (such as that observed in Cell 4) in Cell 5B. In the interim, the 12.7 ft is a conservative estimate of the maximum allowable stage in Cell 5B. It is recommended that periodic estimates of Manning's "n" be obtained in Cell 5A and 5B during the first 2-5 years of vegetation establishment to update the estimate of maximum allowable depth.

Summary of STA Structure Operations During SPS Event:

- STA-1W inflow structure G-302 will be partially opened, allowing up to maximum inflow of 1,110 cfs. This will be achieved through modulation of the G-302 gates, thus creating a "Submerged Controlled Flow" condition across G-302 (see Figure 6).

- If the STA-1 Inflow Basin stage exceeds 18.0 ft, structures G-300 and G-301 will be fully opened (Uncontrolled Submerged Flow). Stages/operations within the Inflow Basin will be monitored so as to not exceed maximum stage of 19.4 ft NGVD (see Figures 9 through 12).

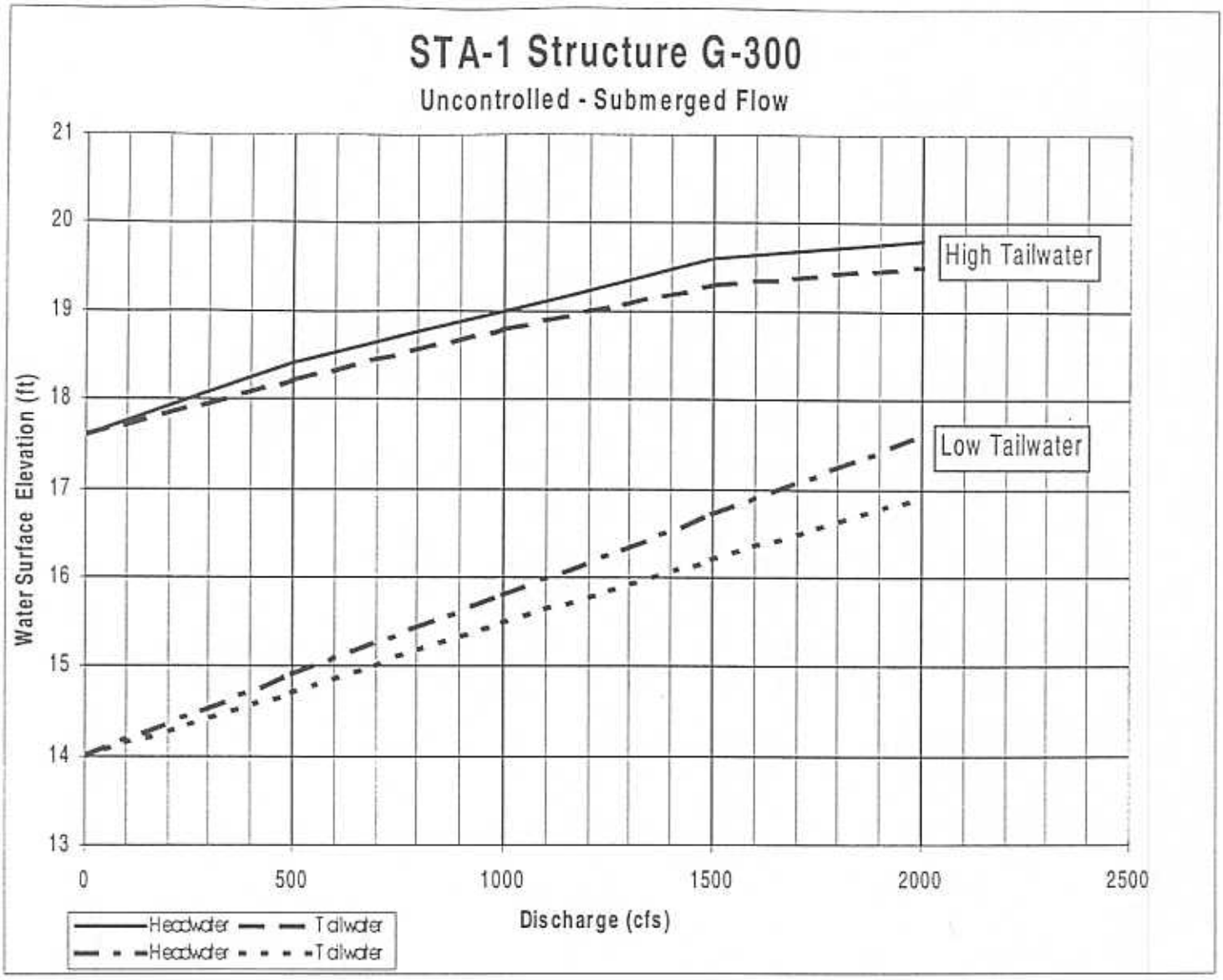
- The gates at G-303 and G-327A will be closed. All other inflow/interior/outflow flow control structures will be fully opened.

- Seepage return via pump station G-250S and STA outflow via pump stations G-251 and G-310 will occur simultaneously.

- Operational discretion for structure operations is reserved by the District Operations staff, to account for flood protection, excess precipitation and upstream and downstream conditions. Treatment Cell depths are predicted to exceed the "Design Flow Operations" range of 0.50 ft NGVD to 4.50 ft NGVD above average Treatment Cell ground elevation.

- In Cell 5B, due to the combination of long fetch and submerged aquatic vegetation, the G-305 tailwater stage (in Cell 5B) should be maintained below 12.7 ft.

Figure 9. Structure G-300 Uncontrolled Submerged Flow



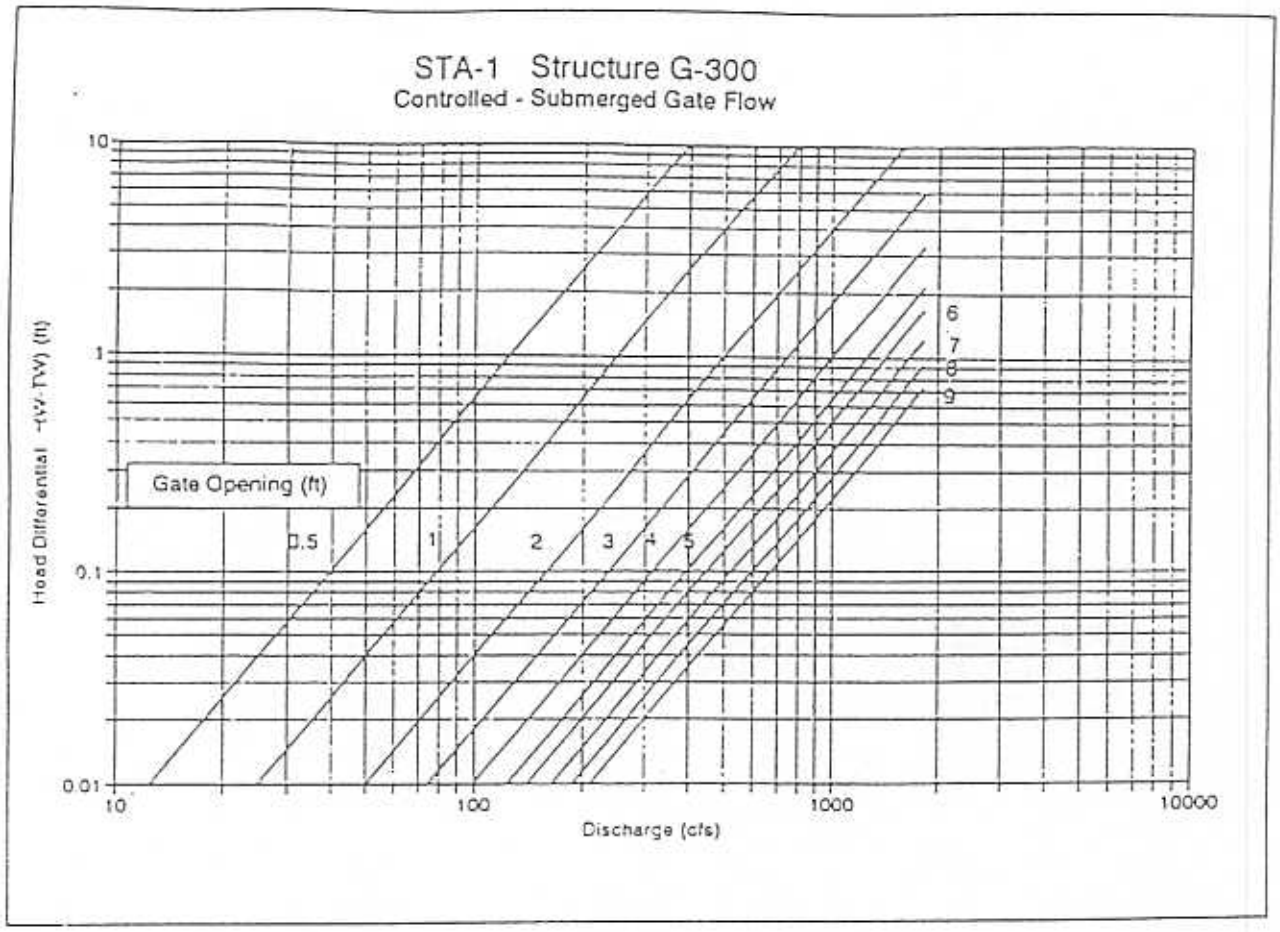
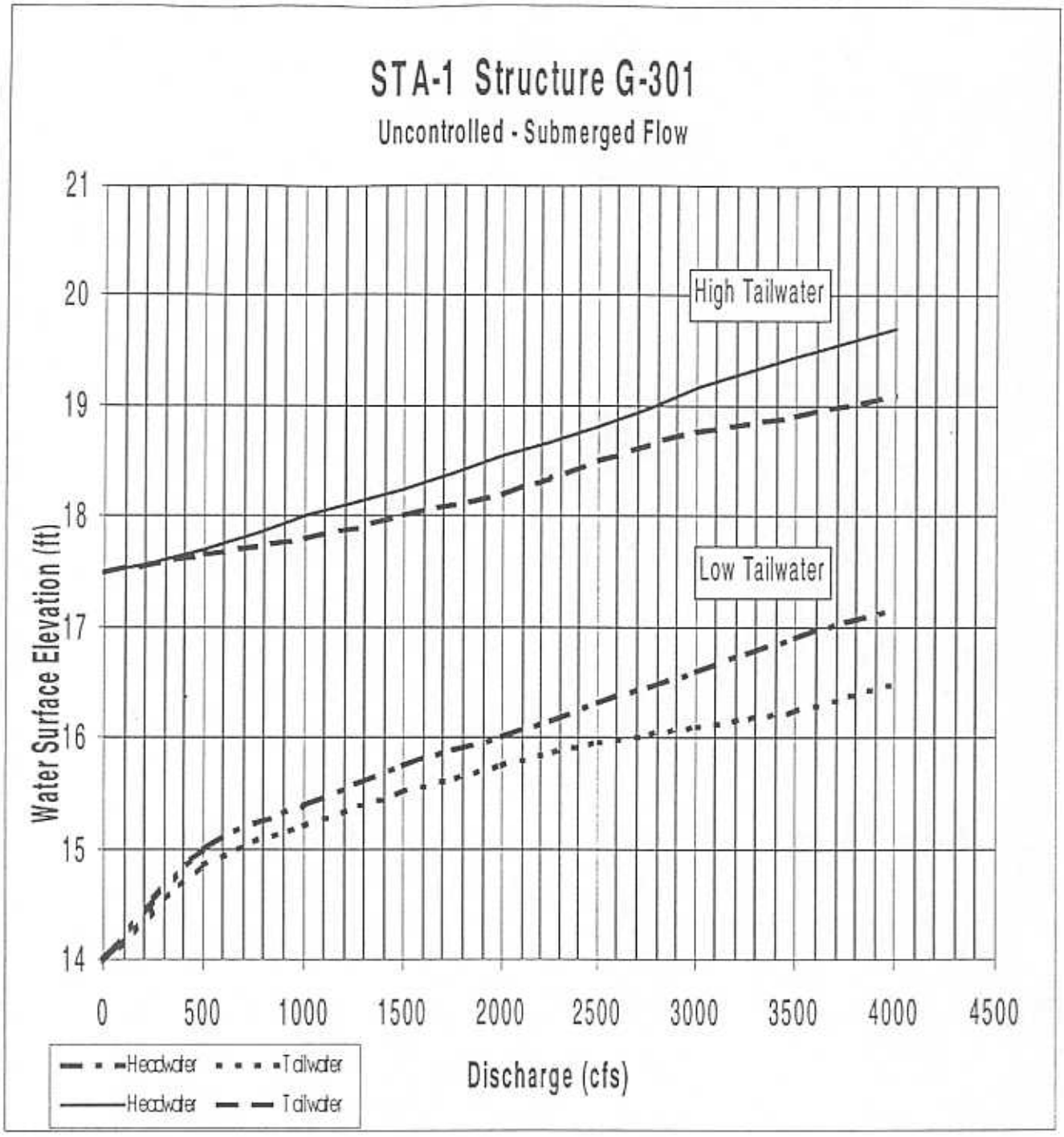


FIGURE 10: G300 "Controlled-Submerged" Structure Flow Rating Curve.

Figure 11. Structure G-301 Uncontrolled Submerged Flow



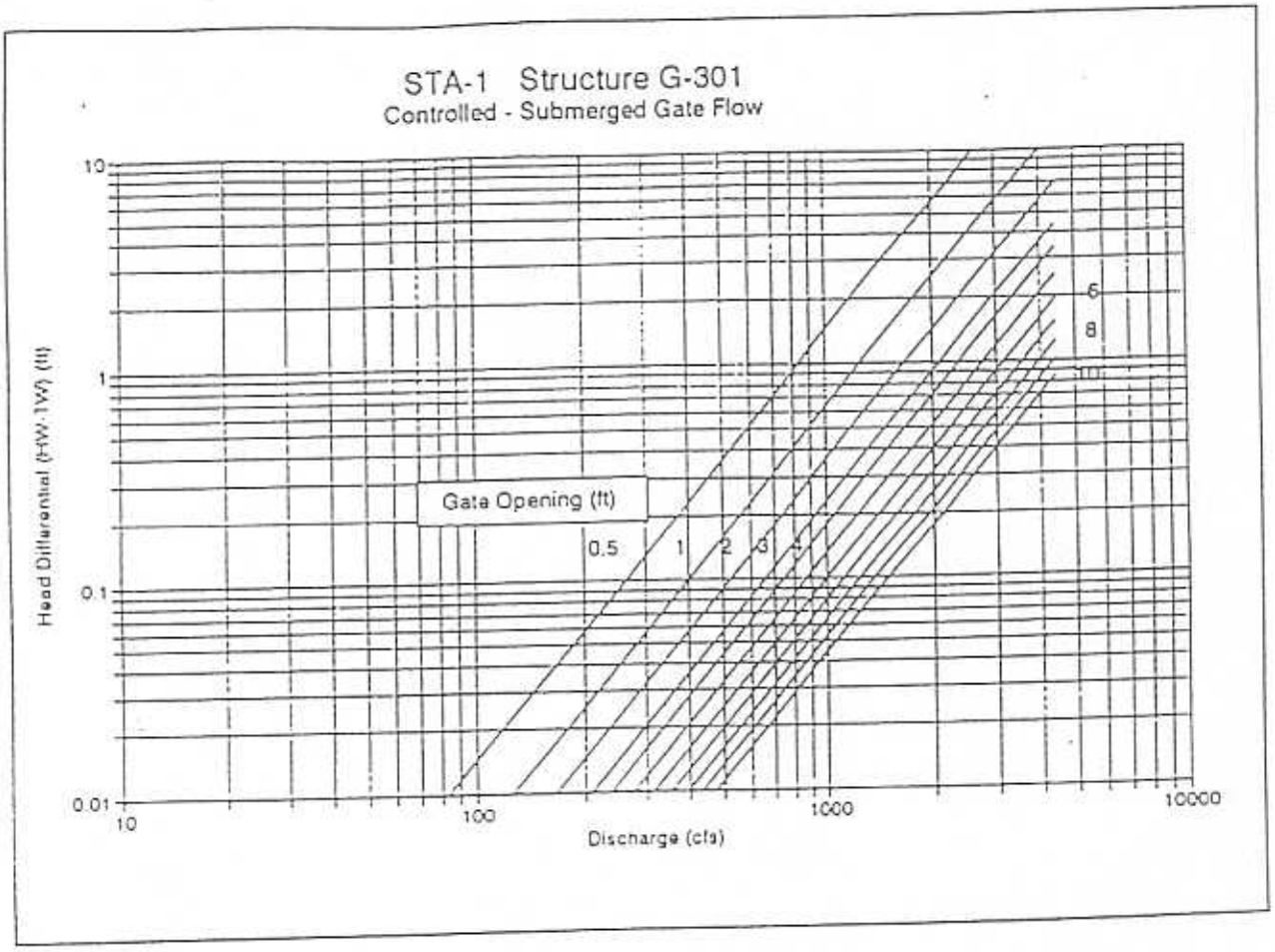


FIGURE 12: G301 "Controlled-Submerged" Structure Flow Rating Curve.

2. Probable Maximum Storm Event

The Probable Maximum Storm (PMS) rainfall depth is estimated as 47.2 inches for a 24-hour duration over a 10 square mile basin area. The PMS precipitation is defined as theoretically the greatest depth of precipitation for a given duration that is physically possible over a given area at a particular geographical location at a certain time of the year. The estimated return frequency for a storm of this magnitude is somewhere between 500 and 1000 years. During a PMS event there should be no inflow into the STA via G-302 (maximum rate for PMS event: 0 cfs) and outflows generated from direct rainfall on the project will be discharged simultaneously via G-251 and G-310. PMS rainfall flows will travel in a westerly direction within Treatment Cell 5 and in a southwesterly direction within Cells 1 - 4, subsequently being discharged to the Discharge Canal via outflow structures G-306 A-J, G-309, G-258, G-308, and G-259 (maximum capacities; 1,470 cfs, 560 cfs, 140 cfs, 560 cfs, 70 cfs respectively).

For a PMS event, the design allows for water to flow over the top of the levee separating the STA-1 Inflow Basin from the Refuge. For a PMS event, the estimated STA-1 Inflow Basin maximum stage elevation is 20.5 ft NGVD.

STA Physical Structure Operations During PMS Event:

- If a storm of a PMS magnitude is expected, pumping stations G-310 and G-251 should be operated as much as 30 hours in advance of the storm to lower stages in the treatment area.

- STA-1W inflow structure G-302 will be fully closed. No inflows will be allowed into STA-1W via G-302 during this event.

- Inflow basin Diversion Structure G-300 and G-301 will be fully opened. For this event condition, flows will overtop the Inflow basin Separation Levee (top elevation 20.0 ft NGVD, length is 6,100 ft). Levee overflow rate is estimated at 5,300 cfs.

- Recirculation control structure G-327 A will be closed. All other inflow/interior/outflow flow control structures will be fully opened.

- Seepage inflow pumping via G-250S and STA outflow pumping via G-251 and G-310 will occur simultaneously.

- Operational discretion for physical structure manipulations are reserved by SFWMD Operations Division to account for flood protection, excess precipitation and upstream and downstream conditions. Treatment Cell depths will exceed the "Design Flow Operations" range of 0.50 ft NGVD to 4.50 ft NGVD above average Treatment Cell ground elevation.

- To protect against overtopping of the northern perimeter levee due to wind and wave effects, the G-305 tailwater stage (in Cell 5B) should be maintained below 12.7 ft.

D. DROUGHT OPERATIONS

In accordance with the operating permit, to the greatest extent practicable, operations of STA-1W will maintain stages at or above 0.5 feet above the average ground elevation in the treatment cells to minimize potential negative effects of drought on subsequent project performance. Operating the STA at the recommended target depths in Table 1 will help achieve this goal. The ability to maintain this minimum water elevation is determined primarily by the availability of water from the upstream watershed and on rainfall. In the extreme case that there is no water available from the upstream watershed and/or from rain, the treatment cells may dry out. After an extended dryout, there is a potential that the water quality improvement performance of subsequent discharges of water from treatment cells may be adversely affected. The severity and duration of the dry conditions that may lead to reduced project performance is currently unknown, as is the magnitude and duration of the potential depression of project performance. Analysis of the monthly compliance monitoring data collected at the project outflow monitoring station will be useful in making these determinations.

If the 12-month flow-weighted average Total Phosphorus concentration exceeds FDEP permit compliance requirements and this exceedance can be related to dryout, then the Annual Report will identify the causes and specify remediation measures.

Summary of Operations During Drought Events:

- Inflow structures G-302, G-303 and G-304 A-J will be open to allow for available inflows to enter the treatment cells.
- Outflow structures G-306 A-J, G-309, G-308, G-259 and G-258 will be closed to detain available water within the treatment cells.
- All interior structures will remain open.
- Culvert structure G-327 A will be opened to direct available discharge canal flows back into the treatment cells.
- Outflow pump station G-310 and G-251 will not discharge until desirable water levels and vegetative conditions within treatment cells have improved allowing for discharge and the closing of structure G-327 A.

E. TREATMENT CELLS OUT OF SERVICE

Treatment cells and/or flow-ways may be isolated, or "taken off-line", when deemed necessary or desirable. Treatment Cells 5A and 5B can be taken off-line by closing structures G-304 A-J and G-306 A-J. Treatment Cells 1 through 4 can be taken off-line by closing G-303. Treatment flow-ways 1/3 and 2/4 also have the capability of being taken off-line independently through manipulation of their various inflow and outflow structures.

F. PERFORMANCE OPTIMIZATION

The performance objective of STA-1W is to reduce the long-term flow weighted mean total phosphorus concentrations to 50 parts per billion (ppb) prior to discharge to the Everglades Protection Area (EPA). It is recognized that further reductions in Total Phosphorus concentrations are beneficial to the EPA. In addition, the Everglades Forever Act (*F.S. Section 373.4592 4.d.3*) directs the District to "include research seeking to optimize the design and operation of the STAs" in its research and monitoring program. To fulfill these obligations, the District has initiated a research program to elucidate operational strategies and design features that will lead to further reductions in Total Phosphorus reaching the EPA. As additional knowledge becomes available, this operational plan will be modified to reflect those changes.

Potential operational changes to increase treatment efficacy include operations to increase hydraulic retention time and/or altering the average depth of the Treatment Cells. By partially closing the outflow structures, the hydraulic retention time could be increased accompanied by an increase in the average operating depth of the system. In practice, the Treatment Cell outflow structures could be partially closed to increase hydraulic retention time during periods of less than full capacity flow, then opened fully in response to full flow events. During low flow periods, Flow Redirection Operations via G-327 A can be initiated to aid treatment efficacy.

IV. HYDROPATTERN RESTORATION

Discharges from STA-1W will be conveyed to the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1) via outflow pump stations G-251 and G-310. There are no hydropattern changes expected as a result of the operation of STA-1W.

V. ADDITIONAL FLOWS AND BMP MAKE-UP WATER

1. STA-1W Design Inflow Volumes and Loads

STA-1W acting in combination with other elements of the Everglades Construction Project is intended to reduce the long-term flow-weighted average concentration of Total Phosphorus (TP) in runoff to the interim goal of 50 parts-per-billion (ppb) prior to their discharge to WCA-1. The S-5A and C-51 West drainage basins both will be served by STA-1W, with an average annual inflow volume of 124,742 acre-feet and average annual TP load of 32,431 kilograms contributed from the S-5A drainage basin and an average annual inflow volume of 11,500 acre-feet and average annual load of 2,600 kilograms contributed from the C-51 West drainage basin. STA-1W will also serve to treat historic Lake Okeechobee releases and diverted runoff from the East Beach Water Control District (EBWCD) at an average annual inflow volume of 4,300 acre-feet and average annual load of 2,100 kilograms from the EBWCD and average annual inflow volume of 2,311 acre-feet and average annual load of 570 kilograms from the Lake. The total average annual design inflow volume and TP load to STA-1W is determined as 142,853 acre-feet and 37,701 kilograms. Accounting for Rainfall (at 26,960 ac-ft average annual volume and 998 kg average annual load) into the STA minus Evapotranspiration (at 25,180 ac-ft average annual volume and 0 kg average annual load) out of the STA, total average annual inflow volume and load is adjusted to *144,633 ac-ft* and *38,699 kilograms* respectively.

2. STA-1W Potential BMP Make-Up Water Volumes

When sufficient capacity exists, STA-1W may be utilized to treat additional Lake Okeechobee regulatory releases and to replace the estimated volume of water held within the EAA due to the BMP program (referred to as BMP Make-Up Water). EAA-BMP Make-Up Water could redirect up to an additional annual average inflow of 34,308 acre-feet and 2,963 kilograms TP load into STA-1W. The total average annual volume and TP load, accounting for this additional BMP Make-Up Water into STA-1W would increase to 177,162 acre-feet and 40,665 kilograms respectively. Accounting for Rainfall into the STA and Evapotranspiration from the STA (at above described respective volumes and loads), total STA-1W inflow volume and load including maximum BMP Make-Up Water volumes and loads is determined at *178, 941 acre-feet* and *41,663*

kilograms TP. Due to the variability and discretion of BMP Make-Up Water volumes as they apply to STA-1W, and the historic period of record variability of the S-5A Basin runoff volume (see "Stormwater Treatment Area 1 West Pollution Prevention Plan") to the EPA (Everglades Protection Area), it is expected that the range in annual average inflow volumes and loads will fluctuate (see Figure 13).

3. STA-1W Potential Volumes/Loads Prior to STA-1E and STA-2 Operation

STA-1W design inflow volumes and loads as described above (including average annual rainfall minus average annual evapotranspiration) are determined to be 144,633 ac-ft and 38,699 kilograms respectively without the potential directed inflow of maximum BMP Make-Up Water and 178,941 ac-ft and 41,663 kilograms respectively with the inclusion of maximum BMP Make-Up Water. The S-5A basin is the primary inflow volume and load source for STA-1W contributing an average annual inflow volume of 124,742 acre-feet and average annual load TP of 32,431 kilograms. This computed average annual runoff volume and load from the S-5A basin directed to STA-1W assumes that 31,000 ac-ft runoff volume and 8,000 kilograms load is directed from the S-5A basin to STA-1E and 39,600 ac-ft runoff volume and 10,200 kilograms is directed from the S-5A basin to STA-2 and Lake Okeechobee via the Hillsboro Canal. Until the development of STA-1E and STA-2 flow through operations, it is anticipated that this combined additional volume and load (70,600 ac-ft and 18,200 kilograms) could be directed to STA-1W or to WCA-1 (see Appendix I - Pollution Prevention Plan).

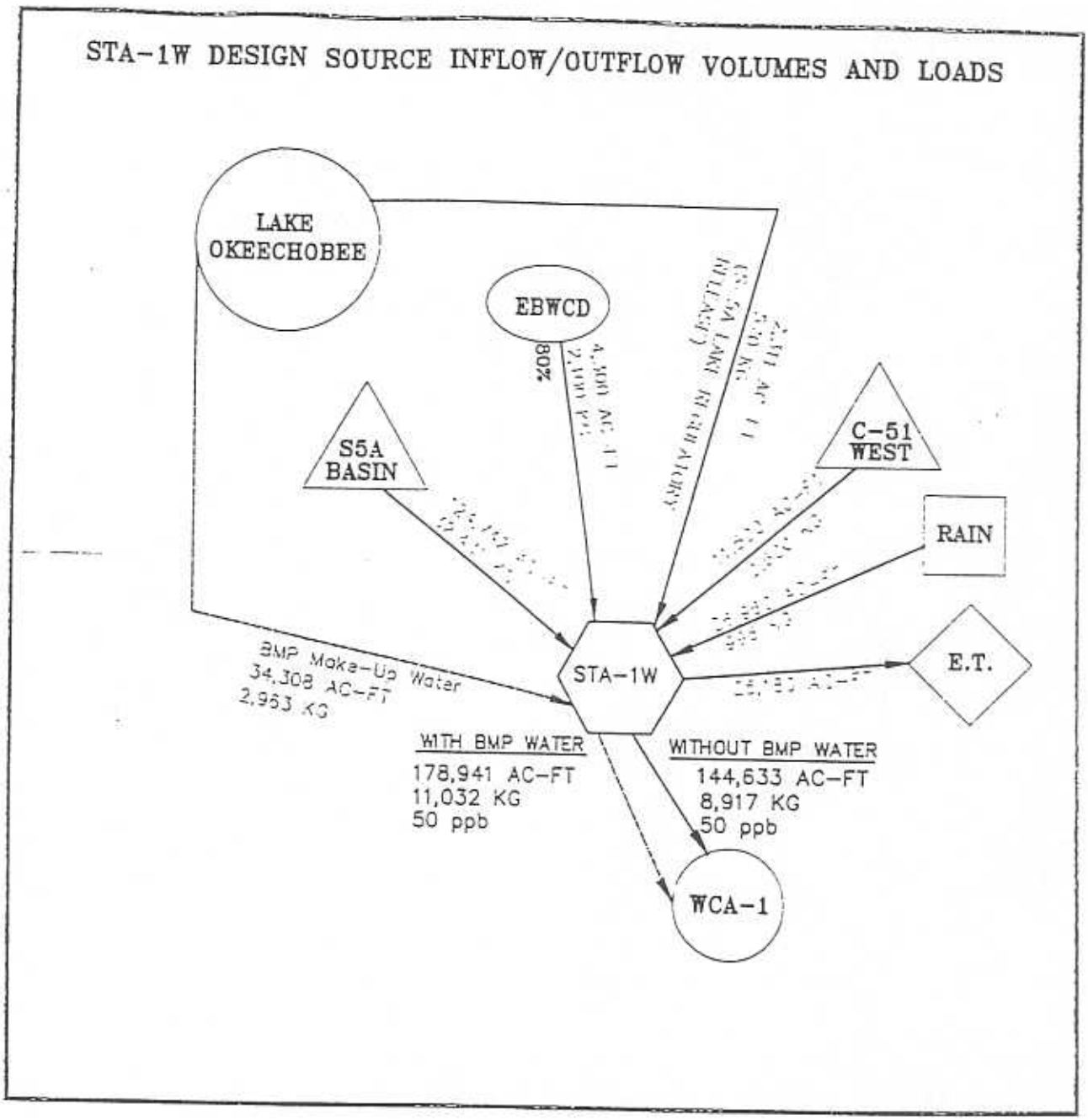


FIGURE 13 STA-1W Design Source Inflow/Outflow Volumes and Loads.

VI. COORDINATION WITH OTHER PLANS

As modifications to the Central and Southern Florida Project are analyzed through the Lower East Coast Regional Water Supply Plan (LECRWSP), Lake Okeechobee Regulation Schedule Study (LORSS), and Comprehensive Everglades Restoration Program (CERP), the hydraulic and treatment capacities of the current STA designs will be evaluated. If it is deemed necessary, these studies will recommend additional treatment facilities. The operational plans for the STAs will be reviewed by SFWMD staff involved with the aforementioned studies, and modified for consistency with said studies accordingly.

VII. PERMITS FOR OPERATION OF STA-1 WEST

A. EVERGLADES FOREVER ACT PERMIT NO. 50-3074709

On May 12, 1999, the Florida Department of Environmental Protection (FDEP) issued an Everglades Forever Act (EFA) permit to the District for construction, operation and maintenance of STA-1W. Accordingly, the STA-1W Operation Plan must be consistent with the following requirements of the EFA permit.

Project Operation and Maintenance. By operating in accordance with the following items, the objectives of the ECP will be achieved, as outlined in the EFA, §373.4592(9)(e) and §373.4592 (9)(h), F.S.

(a) the Conceptual Design Document for the Everglades Protection Project, dated February 15, 1994,
(b) the General, Detailed and Supplements to the Detailed Design documents for STA-1W, dated August 1995, June 5, 1996, October 30, 1996 and June 19, 1997, respectively,
(c) the Detailed Design Report for the Inflow and Distribution Works, September 29, 1996,
(d) the Detailed Design Report for Pump Stations G-310 and G-335, January 1997,
(e) the Pollution Prevention Plan (PPP) dated March 12, 1999,
(f) Rule 40E-63 of the Florida Administrative Code,
(g) the STA optimization research plan, (RAM 5),
(h) the requirements of specific condition 9 of the EFA permit, and
(i) the operational experience from the Everglades Nutrient Removal Project (ENR) and STA 6, Section 1, as appropriate.

To the extent that there is a conflict with the above items, the permit conditions shall control. If the permitted facilities are demonstrated to be not achieving compliance with the requirements of the EFA permit, the District will modify the Operation Plan as appropriate. STA-1 West operation activities may be further modified for standard engineering practices pursuant to §373.4592(9)(j)(3), F.S., or for technological advances pursuant to §373.4592(9)(j)(2), F.S.

Pump Stations Testing and Maintenance. In order to ensure operational readiness, initial testing is required by the construction contractor for the G-310 discharge pump station prior to turnover of the pump stations to the District for operation. Maintenance requirements for the pump stations include operation of the pumps for approximately 2 to 4 hours per month, as necessary, to maintain their mechanical integrity. Therefore, temporary operation of the pump stations for testing and maintenance purposes is authorized by the EFA permit.

Operations Plan. In compliance with specific condition 9 of the EFA permit, the operation plan for STA-1W was submitted to FDEP in June 1999. The current changes in the operating plan reflect updated information and refined operational objectives gained since the completion of the plan in June 1999. This operation plan contains specific provisions for operation of the STA-1W project components, and includes the information required in specific condition 9 (A-D) and described below.

A. **Minimum Water Level Targets to Avoid Dryout.** In accordance with the relevant project design documents, the District is required to maintain a minimum of six (6) inches of water within STA-1W to prevent dryout of the treatment cells, subject to available water from the upstream watershed. Analyses conducted during the preliminary design of the STAs indicated that a depth of 15" above the average ground surface in the STAs would be adequate to maintain a minimum of six inches of water within the STAs. Topographic data were utilized to establish the static water level in STA-1 West. This corresponded to static water elevations to prevent dryout of 10.75 feet NGVD for cells 5a and 5b (based on a prevailing ground elevation of 9.5 feet NGVD).

B. **Responding to Dryout Conditions.** The operations plan is required to contain provisions to evaluate and correct potential dryout effects on the water quality performance of STA-1W. If the compliance requirements in the EFA permit are not met due to dryout conditions, then the District shall propose modifications to the operations plan as appropriate and as approved by the FDEP.

C. **Maximum Water Level Targets.** The operations plan is required to include provisions to ensure that maximum water depths of 4.5 feet are not exceeded for more than 10 consecutive days during storm events.

D. **Phosphorus uptake optimization.** The STA-1W operations plan is required to also contain provisions for the distribution of flows and water levels within STA-1 West to optimize the phosphorus reduction performance and shall be updated as needed to include the results of the District's STA optimization research conducted pursuant to Subsection 373.4592(4)(d)(7) of the EFA.

Interim Operations. Although STA-1W began operation in 1999, STA-1 East (STA-1E), which is to be constructed by the U.S. Army Corps of Engineers, and which will also treat waters flowing to the A. R. Marshall Loxahatchee National Wildlife Refuge (Refuge), will not begin Start-up operations until 2002 and will not be ready for full flow-through operations until 2003, with completely stabilized discharge expected about one year later. Until STA-1E is operating at full

flow-through capacity, it is anticipated that an average of 31,000 acre feet per year of S-5A basin runoff scheduled to go to STA-1E will continue to go through the S-5A pump station. Offsetting this volume is a reduction in the runoff from the C-51W basin contemplated to be diverted to STA-1W once STA 1E is fully operational. The net is an interim increase of 19,500 acre feet in the average annual flow assumed to go to STA-1W. Prior to completion of STA-1E, these waters will continue to flow to the Refuge, either as treated discharge from STA-1W or as untreated discharge through the STA-1 Inflow and Distribution Works.

Consistent with the Settlement Agreement and the EFA, the District is also required to offset flow reductions in EAA runoff due to BMPs. For the S-5A basin, some of this BMP make-up water is also contemplated to be diverted to STA-1E. Consistent with the intended operations guidelines in the 1994 Conceptual Design, the BMP make-up water will be delivered to the STAs only if available treatment capacity exists. The District's BMP Replacement rule contains the flexibility to reduce delivery to the STAs "when the delivery is likely to cause hydraulic bypass around the STA or otherwise hinder its performance." It is anticipated that minimal BMP replacement water deliveries will be made during the Interim Period.

During the 1979-1988 base period, approximately 50,700 acre feet (with an associated 3.5 metric tons of phosphorus) from the southern L-8 basin was discharged into the Refuge. District planning efforts underway include construction of diversion works that send waters from the southern L-8 basin to Lake Okeechobee and other areas, instead of the Refuge where the runoff goes today. In accordance with the load reduction targets of the proposed modified settlement agreement and conceptual design, the southern L-8 basin water will be diverted, with a current schedule of 2003. Prior to completion of STA-1E and the diversion works, these waters may continue to flow to the Refuge, either as treated discharge from STA-1W or as untreated discharge through the STA-1 Inflow and Distribution Works.

It is important to note that all of these waters historically flowed to the Refuge. STA-1E will treat waters from the S-5A Basin and the C-51 Basin, which historically flowed to the Refuge. BMP make up waters come from Lake Okeechobee to compensate for the reduction in volume of waters reaching the Refuge because of the implementation of Best Management Practices. Finally, waters which will eventually be diverted to Lake Okeechobee or other points through the L-8 Diversion Projects have historically reached the Refuge. Thus, no new discharges of waters are flowing to the Everglades or the Refuge. A summary of historic, interim and ultimate operations is presented in Exhibit 1.

Emergency Conditions. The EFA permit allows discharges from STA-1W or diversion of waters from the STA-1W inflow structures through the G-301 structure in accordance with Section 373.439, F.S., or when water conditions within STA-1W may damage existing marsh vegetation. The District is required to notify the FDEP within 48 hours of such an occurrence. The permit requires that such notification to contain information regarding the circumstances related to the discharge, as well as a projection regarding the anticipated duration of the discharge. In the event any such discharge extends beyond the period specified in the original notification, the District is required to notify the FDEP within 48 hours of the continuation of the discharge, and such notice shall contain additional information regarding the circumstances causing the need for the discharge.

B. NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (FDEP PERMIT NO. FL0177962)

On May 11, 1999, the FDEP issued a draft National Pollutant Discharge Elimination System (NPDES) permit for STA-1W and associated works. The STA-1W Operations Plan is consistent with the following requirements of the NPDES permit.

Section V. Operation and Maintenance Requirements

A. Operation of Treatment and Disposal Facilities

1. The operation of STA-1W and associated works is consistent with the permit application and supporting documents (see Section III for details.)
2. The operation of STA-1W is under the supervision of a person who is qualified by formal training and/or practical experience in the field of water pollution control. The operation of STA-1W is under the supervision of Gary F. Goforth, P.E., Ph.D., who is qualified by both formal training and practical experience in the field of water pollution control.

Section VII. Other Specific Conditions

D. Specific Conditions related to the Pollution Prevention Plan

1. The STA-1W Pollution Prevention Plan (PPP) is incorporated and made part of the NPDES permit (see Appendix III for the STA-1W PPP).
2. The STA-1W Project shall be operated in accordance with the PPP. To the extent that there is a conflict with the PPP itself or the application of the PPP and this permit, the permit conditions shall control.

   If the permitted facilities are demonstrated to be not achieving compliance with the requirements of the NPDES permit, the District will modify the PPP or the operation plan as appropriate.

Section VIII. General Conditions

G. Operation and Maintenance Responsibilities. The District shall at all times properly operate and maintain the facility and systems of treatment and control, and related appurtenances, that are installed and used to achieve compliance with the conditions of the NPDES permit. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to maintain or achieve compliance with the conditions of the permit.

V. Bypass Provisions. Bypass is prohibited, unless the District demonstrates it was unavoidable to prevent loss of life, personal injury, or severe property damage and there were no feasible alternatives to bypass (see NPDES permit for more details). Bypass may occur which does not cause effluent limitations to be exceeded if it is essential maintenance to assure efficient operation (see NPDES permit for more details). "Bypass" shall mean the intentional diversion of waste streams from any portion of the treatment

works. The term "bypass" does not include waters diverted around the entire STA-1W project, e.g., through structure G-301. For STA-1W, it is physically impossible to bypass with the current project components.

REFERENCES

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Hutcheon Engineers. April 1996. Hydraulic Analysis Report, Stormwater Treatment Area 1 West. South Florida Water Management District (SFWMD).

Hutcheon Engineers. June 1996. Everglades Construction Project, Detail Design Report, Stormwater Treatment Area No. 1 West (STA-1W). South Florida Water Management District (SFWMD).

Hutcheon Engineers. October 1996. Supplement to the Detailed Design Report, Stormwater Treatment Area No. 1 West (STA-1W). South Florida Water Management District (SFWMD).

Hutcheon Engineers. June 1997. Supplement No. 2 to the Detailed Design Report, Stormwater Treatment Area 1 West (STA-1W). South Florida Water Management District (SFWMD).

Department of the Army Regulatory Division. March 1997. Everglades Construction Project Permit # 199404532 .

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Stormwater Treatment Area 1 West Works Pollution Prevention Plan. March 12, 1999. South Florida Water Management District (SFWMD).

Hutcheon Engineers. December 1999. Impacts of Submerged Aquatic Vegetation on STA-1W Design and Operation. South Florida Water Management District (SFWMD).

Hutcheon Engineers. September 2000. Stormwater Treatment Area 1 West, As-built Construction Drawings. South Florida Water Management District (SFWMD).

APPENDIX I. POLLUTION PREVENTION PLAN

South Florida Water Management District

STORMWATER TREATMENT AREA 1W

Pollution Prevention Plan

March 12, 1999

Submitted in accordance with the Everglades Forever Act, §373.4592, Fla. Stat., and the State of Florida's National Pollutant Discharge Elimination System Program, §403.0885, Fla. Stat.

I. BACKGROUND

The South Florida Water Management District (District), in accordance with the Everglades Forever Act (EFA), §373.4592, Fla. Stat., and an agreement with the federal government, is implementing the Everglades Construction Project (ECP) in an effort to restore the quality of the water entering the Everglades Protection Area (EPA). The ECP consists of the construction of a series of filter marshes, which will use natural physical, chemical, and biological processes to remove excess nutrients, including total phosphorus (TP), from stormwater runoff and other sources prior to discharge into the EPA. Stormwater Treatment Area 1 West (STA-1W), located adjacent to the northwest corner of the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge), is one of six marshes being constructed as part of the ECP, and is the subject of this Pollution Prevention Plan (PPP).

II. MISSION STATEMENT

Recognizing that stormwater runoff from the Everglades Agricultural Area (EAA) and other sources contains excessive levels of phosphorus, the District is dedicated to implement the STA-1W Project in order to reduce levels of phosphorus and otherwise improve water quality in the EPA to the maximum extent practicable.

III. PURPOSE

This PPP provides a summary of normal operations for STA-1W, and describes factors, which may impact those operations. STA-1W shall be operated in accordance with this document to achieve the design objectives of the ECP for phosphorus and reduce adverse impacts to downstream water quality conditions in the EPA.

This PPP is based upon information from (a) the Conceptual Design Document for the Everglades Protection Project, dated February 15, 1994, (b) the General, Detailed and Supplement to the Detailed Design documents for STA-1W, dated August 1995, June 5, 1996 and June 19, 1997, respectively, (c) Rule 40E-63 of the Florida Administrative Code, (d) the STA optimization research plan, (RAM 5), and (e) operational experience from the Everglades Nutrient Removal Project (ENR). By operating in accordance with these documents, the objectives of the ECP for phosphorus will be achieved, in accordance with the EFA, §373.4592(9)(e) and (9)(h), Fla. Stat.

STA-1W is a dynamic system, subject to variation in rainfall, hydraulic and nutrient loading, inflow water quality and interior vegetative conditions. As a result, this PPP is only intended to provide an understanding of the range of conditions under which the STA-1W system has been designed and will be operated. This document is NOT intended to reflect absolute limitations upon operation of STA-1W; instead, system operation will at all times require District operating personnel to exercise their best

professional judgment based upon existing regional and on-site conditions and data available at the time.

While this document characterizes the operational expectations for STA-1W, it also recognizes that operation may fluctuate outside of these predefined ranges. For example, extreme storm events could result in inflows to the STA which exceed the system's hydraulic and treatment capacity. As a result, the PPP describes measures that will be taken by operators in order to minimize any adverse impacts that could occur within and downstream of the STA under those circumstances.

IV. OBJECTIVES

In accordance with the Conceptual Design Document for the Everglades Protection Project, dated February 15, 1994, the primary objectives of the ECP include the following:

A. ACHIEVE A LONG-TERM ANNUAL FLOW-WEIGHTED INTERIM TP DISCHARGE CONCENTRATION OF 50 PPB

In combination with the implementation of the EAA Best Management Practice (BMPs) Program, STA-1W is designed to reduce the long-term, annual flow weighted average concentration of TP in discharges from the EAA to an interim goal of 50 parts per billion (ppb).

B. SUPPLY BMP MAKE-UP WATER

STA-1W will be operated to the maximum extent practical to offset reductions in volumetric discharges to the EPA resulting from the implementation of the EAA BMP Program. Replacement water will be provided from Lake Okeechobee and distributed to the STAs. However, actual volumes sent to each STA cannot be quantified in advance since the quantities depend on temporal and spatial variables: the annual reduction in discharge due to BMP implementation, available treatment capacity in each STA, and water conditions in the downstream water conservation areas.

C. IMPROVE WATER QUANTITY ENTERING THE EPA

STA-1W will be operated, to the maximum extent practical to increase quantity of water delivered to the EPA through redirection of runoff from the Western C-51 and L-8 Basins. Specifically, upon completion of two future projects, STA 1 East (in 2003) and the Northern L-8 Basin Improvements (in 2007), facilities should be in place to capture an annual average of 11,500 acre-feet from the Western C-51 Basin, and up to 20,000 acre-feet from the L-8 Basin.

D. REDUCE DISCHARGES OF FRESH WATER AND ASSOCIATED POLLUTANTS TO LAKE WORTH ESTUARY

STA-1W will be operated, to the maximum extent practical, to reduce the amount of freshwater discharged eastward to the Lake Worth estuary by an estimated annual average of 11,500 acre-feet, when the STA-1 East project is operational (in 2003).

E. PROVIDE ADDITIONAL FLOOD PROTECTION FOR THE C-51 WEST BASIN

STA-1W will be operated, to the maximum extent practical, to improve the level of flood protection in the Western C-51 Basin, specifically the capture and treatment of an estimated annual average of 11,500 acre-feet when the STA-1 East project is operational.

F. IMPROVE WATER QUALITY OF DISCHARGES FROM EAST BEACH DRAINAGE DISTRICT

STA-1W will be operated, to the maximum extent practical, to provide water quality treatment for diversions estimated at approximately 1,000 acre-feet per year from East Beach Drainage District.

V. ACTION PLAN

The District intends to meet the design objectives of the STA-1W project to comply with the EFA, §373.4592(9)(e)(h)1, Fla. Stat., by operating within the normal operational guidelines established in subsection (A), below. However, the STA-1W Project and the ECP were not designed to operate under all possible conditions. For example, extreme storm events could create conditions that would necessitate the District to partially divert flows from the STA-1W treatment system in order to prevent damage to the structural and vegetative integrity and prevent upstream flooding. *See*, Miccosukee Tribe of Indians v. South Florida Water Management District, Fla. DEP Case No. 96-1851, Final Order, Finding of Fact Number 23, (April 21, 1998). Accordingly, subsection (B) describes circumstances requiring deviation from those normal operational guidelines. Finally, subsection (C) provides information on the District's research program directed at improving the treatment efficiency of the STAs.

A. STA-1W NORMAL OPERATIONAL GUIDELINES

As stated in section (IV) above, the STA-1W project, together with the EAA, BMPs, was designed to achieve a long-term annual average TP interim outflow concentration of 50 ppb. That objective is expected to be reached by operating the system in accordance with the following guidelines:

1. *Anticipated Rainfall Ranges (upper and lower limits)*

The project shall operate in a normal operating mode when the EAA adjusted annual rainfall values, as defined in Rule 40E-63, F.A.C., are within the range of 35.1 inches to 63.8 inches.

2. *STA Source Inflow Variations*

The average annual inflow volume (hydraulic design inflow volume) is 142,853 acre-feet. However, during normal operations annual inflow volumes and associated TP loads into STA-1W are expected to fluctuate in response to variations in upstream rainfall and runoff.

The total discharge volume for the S-5A basin to the EPA for the period of record 1979-1988 was 2,568,016 ac-ft. The average annual discharge volume from S-5A for this period of record is 256,802 ac-ft. The minimum and maximum annual average flows for this period of record were 130,441 ac-ft and 339,989 ac-ft respectively. It is expected that the range in annual average inflow volumes, during which normal project operations occur, will fluctuate accordingly.

3. *Phosphorus Load Variations*

The anticipated average annual inflow TP load (design inflow load) is 37,701 kg. During normal project operations this load value is expected to fluctuate with variations in inflow volumes.

The minimum and maximum annual inflow TP load values, based on variations in the historic S-5A basin discharges to the EPA for the period of record 1979-1988, were 34,418 kg and 89,710 kg respectively. It is expected that the range in annual average TP inflow load, during which normal project operations occur, will fluctuate accordingly.

4. *Inflow Capacity*

Gated spillway G-302 is the inflow control structure for STA-1W. During normal project operations, this structure will be operated to allow for inflow up to the inflow design capacity of 3,250 cfs.

5. *Outflow Capacity*

The G-251 and G-310 pump stations are the outflow structures for the project. During normal project operations, these structures will be operated to provide up to a combined maximum outflow capacity for STA-1W of up to 3,490 cfs.

6. Anticipated BMP Performance

The EAA BMP regulatory program requires a minimum 25% TP load reduction from baseline historical EAA discharge loads, adjusted for hydrologic variability. This regulatory program, along with STA-1W when operating in a normal operational mode, is expected to result in a reduction of the long-term, flow-weighted, annual average TP interim concentration in STA-1W discharges to 50 ppb.

7. Anticipated Vegetative Conditions

After the start-up and stabilization phases of operation, otherwise known as normal project operation, the District shall manage interior water levels to maintain marsh vegetation within the treatment system in a mature and productive condition. It is expected that cattail will be the dominant emergent macrophyte species found within the project. The percentages of cattail and other vegetative coverage will fluctuate in response to variations in climatic, biological and inflow water quality and quantity conditions.

8. Operating Levels

Subject to water availability, during normal project operation the minimum target operating level for STA-1W is 0.5 feet above average ground elevation. The maximum target operating level for STA-1W during normal project operations is 4.5 feet above average ground elevation. The optimal long-term target operating range for STA-1W during normal project operations is between 1.5 and 2.0 feet above average ground elevation.

9. Preventive Maintenance

Preventive maintenance of STA-1W project features may be required on a routine basis to avert severe property damage, maintain upstream flood protection and ensure continued functionality and efficiency of the conveyance and treatment systems. During preventive maintenance, individual treatment cells may be temporarily taken off-line and/or water levels within treatment cells may be adjusted through operations of various project structures. To minimize the impacts to operation during times of preventive maintenance, the District shall lower stages to minimal levels and/or take treatment cells off-line independently, for as short a period of time necessary to complete maintenance activities. Specific maintenance activities will include:

a. Water Control Structure Maintenance

In order to ensure operational readiness, the pump manufacturer requires operational testing of the STA-1W outflow pump station G-310 prior to turnover to the District for project operation. Thereafter, the STA 1W discharge pumps G-310 and G-251 will

require limited maintenance operation, because failure to operate these pumps could lead to premature breakdown and loss of manufacture's warranty. Based on these mechanical requirements, the District will periodically operate the STA 1W pump stations for approximately 2 to 4 hours per month, as necessary, to fulfill manufactures requirements and maintain their mechanical integrity. The District shall operate the STA-1W outflow pump stations accordingly for startup and maintenance purposes unless the Department takes agency action to prohibit such discharges. All temporary discharges will be reported in accordance with the monitoring requirements of the STA 1W permit.

The District shall also maintain other project water control structures to ensure that culverts and risers are conveying prescribed volumes and that gated weirs are functioning properly. Similarly, the District shall service pump stations routinely to ensure that pumps are functioning properly and not leaking contaminants into upstream or downstream waters.

b. Levee and Canal Maintenance

The District shall maintain all levees to best ensure continued structural integrity. Activities shall include maintenance of cover vegetation through regular mowing and/or appropriate use of herbicides. Levees will also be inspected regularly in response to factors such as rapid changes in flow rates, high water stages, normal wear and tear, or any other factor which could cause levee destabilization. Project canals will be maintained via periodic dredging, as needed to restore water conveyance and depths to design criteria.

c. Vegetative Maintenance

The District shall control invasive and/or exotic plant species through periodic use of approved herbicides both inside the treatment system and along the project perimeter. Vegetative maintenance shall also include physical removal of excess vegetation at inflow, outflow and interior locations to ensure adequate conveyance.

B. DEVIATION FROM NORMAL OPERATIONAL GUIDELINES

Under some circumstances beyond the control of the District, operation of STA-1W may deviate from normal operation guidelines. Under those circumstances, including those defined below, the District shall take measures to minimize any adverse downstream impacts, and to avoid continued deviations from the normal operation of the STA-1W project. During these deviations from normal operation guidelines, every consideration shall be given to minimizing impacts within and downstream of the treatment area.

1. Excessive Rainfall or Flooding Conditions.

When waters at the interior of the treatment cells reach a critical depths identified below, or when an oncoming storm event is expected to cause interior waters to approach or exceed these depths, the District shall divert some additional inflows to the project through the STA-1 Inflow and Distribution Works to the Refuge via the G-300 and G-301 water control structures. Accordingly, the District may divert water from inflowing into the STA-1W treatment cells when any of the four factors listed below occur, creating unavoidable conditions that could cause loss of life, personal injury, or severe property damage.

Since the STA-1W Inflow and Distribution Works are not part of the treatment system, the inflow diversions described above will not constitute bypass as defined in the general condition of STA 1W permit. However, the District shall keep records of all diversions, including the date, flow, duration, and conditions warranting the diversion. Those records will be included in the annual report submitted to the Department

a. Maximum Stage Elevations.

When waters at interior structures within the STA-1W Project reach stage elevations at a depth of 4.5 feet.

b. Threats to Structural Integrity

When stage elevations of waters, or the rates of inflows threaten the structural integrity of the interior and exterior project levees; or

c. Threats to Vegetative Survival and Treatment Efficiency

When stage elevations of waters, rates of inflows, or the duration of sustained inundation creates conditions threatening the survival of marsh vegetation and the treatment efficiency of the project.

d. Exceeding Inflow Capacity

When the rate of inflows at the G-302 structure reach the structures capacity of 3250 cfs, and discharges through the S-5A pump station exceed 3250cfs;

Example: Operation of STA 1W When Experiencing Excessive Rainfall or Flooding Conditions

1. Operation of the G-302 inflow spillway would be manipulated to decrease inflows into the project in order to maintain project Treatment Cell water levels below maximum design limitation of 4.5 ft deep. By decreasing inflows rather than immediately closing G-302 inflow structure in response to above conditions, the District shall be minimizing adverse interior conditions while also considering downstream impacts.
2. Alternatively, when flooding conditions prevail and water levels at the interior of the treatment cells approached the critical level of 4.5 feet deep, the G-302 inflow spillway would be completely closed and water diverted to the Refuge via the G-300 and G-301 structures. At this time all interior flow control structures will be opened to convey flows originating solely from precipitation.

2. *Emergency Discharges.*

The District shall discharge water from STA-1 West in accordance with Section 373.439, F.S., including when water conditions within STA-1 West may damage existing marsh vegetation. The District shall notify the Department within 48 hours of such an occurrence. Such notification shall contain information regarding the circumstances related to the discharge, as well as a projection regarding the anticipated duration of the discharge. In the event any such discharge extends beyond the period specified in the original notification, the District shall notify the Department within 48 hours of the continuation of the discharge, and such notice shall contain additional information regarding the circumstances causing the need for the discharge.

3. *Drought Conditions.*

In order to preserve the continued viability of the marsh vegetation within STA-1W treatment cells, to the maximum extent practicable, the District shall maintain a minimal static water level of 0.5 feet above average interior ground elevation. The District's ability to maintain this minimum water elevation is determined primarily by the availability of water from rainfall within the project and the upstream watershed.

Example: Operation of STA 1W During Low Flow or Drought Conditions

To maintain minimum static water levels to the maximum extent practicable, inflow structure G-302 will be maintained open to allow for any available inflows to enter the project. Treatment cell interior structures G-305 A-V, G-253 A-J, and G-254 A-I, will be manipulated to detain available water. Outflow pump station G-310 and G-251 will not discharge until desirable water levels and vegetation conditions within the treatment cells have improved. In the extreme case that there is no water available from the upstream watershed and/or from rain for extended periods of time, the treatment cells may dry out.

4. *BMP Performance Below Expectations.*

If the EAA BMPs fail to achieve the 25% TP load reduction required under the EAA BMP regulatory program, then the District shall require corrective actions for permittees out of compliance, pursuant to Florida law, and consistent with Rule 40E-63, F.A.C., and Section 373.4592(4)(f) of the EFA.

5. *Vegetative Conditions.*

Deviation from normal operation may be caused or necessitated by vegetative conditions as follows:

a. Failure to Achieve Design Performance Criteria

Within 6 months of start-up operation of the STA-1W project, the District shall propose a baseline vegetation coverage evaluation program consistent with those methods identified in the vegetation coverage maps for the ENR project. Vegetation is expected to consist of predominantly cattail and open waters with associated submerged aquatic vegetation and periphyton.

In the event that the STA-1W project fails to achieve specified performance criteria, and vegetative composition is suspected to be a potential factor, a second vegetative coverage map shall be prepared for comparison with baseline vegetative conditions. If necessary, the District shall modify STA-1W operations in order to respond to undesirable vegetative conditions.

b. Vegetative Management

During the start-up period, water levels will be kept low to encourage growth of desirable vegetation until the system is capable of achieving its design performance objectives. Thereafter, operational changes may not be made based upon perceived stress to the vegetation unless there is also a drop in system performance or new information is obtained as a result of the District's STA optimization research program.

C. STA-1W INTERIM OPERATIONS

1. Background.

Stormwater Treatment Area 1 West (STA-1W) is one of six wetland treatment systems being constructed to treat waters flowing into the Loxahatchee National Wildlife Refuge (Refuge) and the Everglades Protection Area (EPA). The effort is required by the Everglades Forever Act (EFA), §373.4592, Fla. Stat., which was passed by the Florida Legislature in 1994. The EFA expanded the number and effective acreage of the treatment areas contained in the 1991

Settlement Agreement with the United States of America. Based upon the timelines in the 1994 EFA and the 1995 Proposed Modified Settlement Agreement, the STAs will be constructed and begin operation in accordance with a phased schedule. STA 1 East, to be constructed by the U.S. Army Corps of Engineers, is presently projected to begin start-up operation by August 1, 2002; STA 1West and STA 2 are anticipated to begin initial flow-through operations between May and October 1999 and begin full flow-through operations simultaneously on July 23, 2000; the last STA, STA 3/4, is presently projected to begin start-up operation by October 1, 2003. Neither the 1994 Conceptual Design for the STAs, the 1994 EFA nor the 1995 Proposed Modified Settlement Agreement specified what operational steps the District should take during the interim period when some, but not all, of the STAs were functional. However, both the EFA and the 1991 Settlement Agreement provide a framework for these interim operations based on overall load reductions. This document describes the District's proposed operations during that period.

2. ANNUAL VARIABILITY IN FLOW

The average annual inflow volume envisioned in the design assumptions for STA-1W operation contained in the February 15, 1994, *Conceptual Design* for the Everglades Construction Project and the STA-1W Design Reports dated June 5, 1996, October 30, 1996, and January 1997 is 142,853 acre-feet (ac-ft). During normal operations, annual inflow volumes and associated TP loads into STA-1W are expected to fluctuate in response to variations in upstream rainfall and runoff. For example, during the Base Period of record, 1979-1988, the annual average discharge to the Refuge via the S-5A structures was 314,749 ac-ft, while the minimum and maximum annual discharge volumes for this period of record were 141,191 ac-ft and 388,419 ac-ft, respectively. These minimum and maximum values represent a deviation of -55% to +23% from the average value. Base Period discharges to the Refuge via the S-5A structures included certain flows from the S-5A basin, Lake Okeechobee regulatory releases, East Beach Water Control District, the C-51 West basin and the L-8 basin. A summary of the variability observed in these flows during the Base Period is attached as Exhibit 1 to this document.

3. Treatment Objectives of Everglades Restoration.

The EFA and Proposed Modified Settlement Agreement both have a common objective: to reduce discharges of phosphorus into the Everglades Protection Area. Based upon scientific calculations developed by federal experts William Walker and Bob Kadlec, operation of all six STAs will reduce phosphorus concentrations and total phosphorus loads reaching the Everglades, when compared with a historic baseline period of 1979-1988. The STAs are expected to remove approximately 70 percent of the influent phosphorus loads (Settlement Agreement, C-2), and discharges from the STAs are expected to reduce long-term average annual phosphorus concentrations to levels at or below 50 parts per billion (ppb) (February 15, 1994 Conceptual Design, IV-2, Settlement Agreement, C-3). Further, the BMP regulatory component of the control program is expected to reduce long-term average phosphorus loads to the EPA from EAA runoff by at least 25%. After construction is completed and phosphorus stabilization is achieved at all the STAs, implementation of these two components of the control program

together – BMPs and STAs – is expected to reduce the overall long-term average phosphorus loading from the EAA to the EPA and the Refuge by approximately 80% and 85%, respectively.

4. Operations and Source of Waters During the Interim Period.

Achieving those objectives, however, depends upon completion of all the components of the ECP.

Although STA-1W will begin operation in 1999, STA-1 East (STA-1E), which is to be constructed by the U.S. Army Corps of Engineers, and which will also treat waters flowing to the A. R. Marshall Loxahatchee National Wildlife Refuge (Refuge), will not begin Start-up operations until 2002 and will not be ready for full flow-through operations until 2003, with completely stabilized discharge expected about one year later. Until STA 1E is operating at full flow-through capacity, it is anticipated that an average of 31,000 acre feet per year of S-5A basin runoff scheduled to go to STA 1E will continue to go through the S-5A pump station. Offsetting this volume is a reduction in the runoff from the C-51W basin contemplated to be diverted to STA 1W once STA 1E is fully operational. The net is an interim increase of 19,500 acre feet in the average annual flow assumed to go to STA 1W. Prior to completion of STA-1E, these waters may continue to flow to the Refuge, either as treated discharge from STA 1W or as untreated discharge through the STA 1 Inflow and Distribution Works.

Consistent with the Settlement Agreement and the EFA, the District is also required to offset flow reductions in EAA runoff due to BMPs. For the S-5A basin, some of this BMP make-up water is also contemplated to be diverted to STA 1E. Consistent with the intended operations guidelines in the 1994 Conceptual Design, the BMP make-up water will be delivered to the STAs only if available treatment capacity exists. The District's BMP Replacement rule contains the flexibility to reduce delivery to the STAs "when the delivery is likely to cause hydraulic bypass around the STA or otherwise hinder its performance." It is anticipated that minimal BMP replacement water deliveries will be made during the Interim Period.

During the 1979-1988 base period, approximately 50,700 acre feet (with an associated 3.5 metric tons of phosphorus) from the southern L-8 basin was discharged into the Refuge. District planning efforts underway include construction of diversion works that send waters from the southern L-8 basin to Lake Okeechobee and other areas, instead of the Refuge where the runoff goes today. In accordance with the load reduction targets of the proposed modified settlement agreement and conceptual design, the southern L-8 basin water will be diverted, with a current schedule of 2003. Prior to completion of STA-1E and the diversion works, these waters may continue to flow to the Refuge, either as treated discharge from STA 1W or as untreated discharge through the STA 1 Inflow and Distribution Works.

5. Comparison of Interim Operation to Historic Flows

It is important to note that all of these waters historically flowed to the Refuge. STA-1E will treat waters from the S-5A Basin and the C-51Basin, which historically flowed to the Refuge. BMP

make up waters come from Lake Okeechobee to compensate for the reduction in volume of waters reaching the Refuge because of the implementation of Best Management Practices. Finally, waters which will eventually be diverted to Lake Okeechobee or other points through the L-8 Diversion Projects have historically reached the Refuge. Thus, no new discharges of waters are flowing to the Everglades or the Refuge. A summary of historic, interim and ultimate operations is presented in Exhibit 1.

6. Mitigating Increases in Phosphorus Loads or Concentrations During the Interim Period.

In order to maximize reductions in phosphorus to the Refuge and the EPA during the interim period prior to the complete implementation and stabilization of the control program – when some but not all of the STAs and diversion works are operating at their design conditions – the District shall, to the extent consistent with its responsibilities as the local sponsor of the C&SF Project:

(1) reduce phosphorus loading to the Refuge and the EPA compared to 1979-1988 base period;

(2) consistent with the provisions of this permit, optimize the quantity of waters sent through the STAs, subject to their hydraulic, structural and biologic design limitations (with respect to STA-1W, waters flowing into STA-1W cannot exceed the inflow capacity of 3,250 cfs and water depths cannot exceed 4.5 feet unless during extreme rainfall events).

7. Conclusions.

It is essential to understand that this proposal does not increase the total volume of waters flowing to the Refuge, and since those waters will be treated, the total phosphorus loads are decreasing compared to the historic data. The District is committed to achieving the load reductions of the Settlement Agreement and the design objectives of the ECP, and ultimately, the restoration of the Everglades. During the interim period prior to completion of all components of the ECP, including the STAs, the District is further committed to maximizing the treatment of phosphorus in the watershed. The above proposal reflects the District's best efforts to achieve those interim objectives.

D. STA Optimization

The EFA, Sections 373.4592(4)(d)3. and 373.4592(4)(d)7., Fla. Stat., require the District to conduct research on optimizing the treatment performance of the STAs, recognizing that additional reductions in TP outflow concentrations, beyond the interim goal of 50 ppb, may be beneficial to the EPA. In accordance with this requirement, current optimization research activities include the development of the "Wetlands Water Quality Model" and research required by FDEP Permit No.502232569 (ENR Operational Permit). Based upon the results of these and other research efforts, the operation of STA-1W will be periodically adjusted to optimize treatment efficiency of the project, in accordance with the EFA, §373.4592(9)(j)3., Fla. Stat.

VI. COMMITMENT TO WATER QUALITY IMPROVEMENT

A. COMPLIANCE WITH WATER QUALITY STANDARDS

The District is committed to the implementation of its responsibilities pursuant to the EFA, §373.4592, Fla. Stat., and its agreements with the federal government. Water quality conditions both upstream and downstream of the STA-1W project will be monitored through a series of programs, including the Best Management Practices permit programs required by Rule 40E-63, F.A.C., the Everglades Stormwater Program required by Florida DEP permit no. 06, 502590709, and the permits for this project. While this project is directed toward compliance with interim water quality goals, the District is supporting an effort to evaluate long-term water quality standards in the EPA, and will be required to achieve compliance with all water quality standards by December 31, 2006, which may require the implementation of additional water quality improvement measures.

B. EMERGENCY SUSPENSION AND RESCHEDULING OF SAMPLING

Under hurricane, tropical storm warnings, or other extreme weather conditions, the District's normal water quality sampling schedule may be suspended and rescheduled, as necessary. The District shall notify the Department's Southeast District and Everglades Technical Support Section at the addresses and telephone numbers listed in the STA 1 W permit, of any anticipated sampling suspension or rescheduling associated with hurricanes, tropical storms, or other extreme weather events that may require deviation from the normal sampling schedule. The District shall resume the normal sampling schedule as soon as possible. Within 14 days following the cessation of emergency conditions, the District shall notify the Department of when normal sampling is expected to resume.

VII. POLLUTION PREVENTION TEAM

Numerous District personnel will be responsible for the management of this project from the construction phase through the operational phase of the project including, Joe Schweigart, Jennifer Jorge, Victor Powell, Raul Pellegrino, Gary Goforth, Jim Kunard, Tom Kosier, Michael Chimney and Andre Cadogan, of the Ecosystem Restoration Department, Maxine Cheesman, Sherry Scott, Linda Lindstrom, Larry Fink and Tim Bechtel of the Water Resources Evaluation Department, Ron Mierau, George Hwa, Tommy Strowd and Arlin Pankow of the Operation & Maintenance Department and Keith Rizzardi of the Office of Counsel. The permit administrator for this project is Ron Bearzotti of the Ecosystem Restoration Department and can be reached at (561) 682-6291.

VIII. BASELINE CONDITIONS

Documents evaluating baseline water quality conditions for the EAA, ENR and the Refuge have been previously completed and submitted to the Department, including: *Water Quality Criteria in the Everglades Protection Area*, SFWMD (Bechtel, Krupa, Hill, Xue), May 1996 and *the Everglades Nutrient Removal Project Annual Monitoring Report*, SFWMD, 1995, 1996 and 1997.

Summary of Estimated Flows to the Refuge via S-5A/STA 1 West Under Different Operational Scenarios

Source of Water to Refuge via S-5A / STA 1W	Base Period (1979-1988) Data used as basis for 1994 Conceptual Design			Ultimate operations (After STA 1E and the L-8 diversion projects are fully operational) Assumes similar hydrologic % variability as Base Period. Actual flows will differ based on actual conditions.			Interim Period (Before STA 1E and the L-8 diversion projects are fully operational) Assumes similar hydrologic % variability as Base Period. Actual flows will differ based on actual conditions.		
	Average acre-feet/yr	Minimum acre-feet/yr	Maximum acre-feet/yr	Average acre-feet/yr	Minimum acre-feet/yr	Maximum acre-feet/yr	Average acre-feet/yr	Minimum acre-feet/yr	Maximum acre-feet/yr
S-5A basin runoff	256,802	130,441	339,989	256,802	130,441	339,989	256,802	130,441	339,989
BMP reduction in runoff	0	0	0	(50,509)	(25,656)	(66,870)	(50,509)	(25,656)	(66,870)
Reduction by conv. to STA	0	0	0	(10,951)	(5,563)	(14,498)	(10,951)	(5,563)	(14,498)
Divert to STA 1 East	0	0	0	(31,000)	(15,746)	(41,042)	0	0	0
Divert to S-6 basin (See Note 1)	0	0	0	(39,600)	(20,115)	(52,428)	(39,600)	(20,115)	(52,428)
Net runoff to S-5A/STA 1 W	0	0	0	124,742	63,362	165,151	155,742	99,223	258,620
Lake Okee. regulatory rel.	2,311	127	11,923	2,311	127	11,923	2,311	127	11,923
Additional East Beach WCD runoff	See Note 2	See Note 2	See Note 2	4,306	957	9,719	4,306	957	9,719
C-51 West basin runoff	4,897	0	23,375	11,500	0	54,897	4,897	0	23,375
BMP make up water (See Note 3)	0	0	0	50,509	0	0	0	0	0
Divert to STA 1 East	0	0	0	(8,233)	(4,182)	(10,900)	0	0	0
Divert to S-6 basin	0	0	0	(7,960)	(4,054)	(10,565)	0	0	0
Net BMP water to S-5A/STA 1 W	0	0	0	34,296	(8,235)	(21,465)	0	0	0
L-8 basin runoff	50,740	4,907	125,199	0	0	0	50,740	4,907	125,199
Total to Refuge via S-5A/STA 1W	314,749	141,191	388,419	177,155	79,469	218,620	217,996	97,789	269,020
Deviation from Average Flow	0%	-55%	23%	0%	-55%	23%	0%	-55%	23%

Notes:

1. STA 1 W and STA 2 are anticipated to begin full flow-through operations at the same time, July 23, 2000.

2. A portion of the East Beach Water Control District runoff is presently directed to the S-5A basin, and is included in the flows for that source. Flow values reported for the interim period and ultimate operations represent additional stormwater diverted away from Lake Okeechobee.

3. Consistent with the intended operations guidelines documented in the Conceptual Design, BMP make-up water will be delivered to the STAs if available treatment capacity exists. Assumes that BMP make-up water is returned to the same basin/STA that the runoff reduction occurs. The District's BMP Replacement Water rule contains the flexibility to reduce delivery to the STAs "when the delivery is likely to cause hydraulic bypass around the STA or otherwise hinder its performance." It is anticipated that minimal BMP replacement water deliveries will be made during the Interim Period.

EXHIBIT 1 TO POLLUTION PREVENTION PLAN