



SITE CERTIFICATION APPLICATION ENVIRONMENTAL INFORMATION DOCUMENT

**FOR
JACKSONVILLE ELECTRIC AUTHORITY
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Chapter 5

Environmental Effects of Plant Operation

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5. ENVIRONMENTAL EFFECTS OF PLANT OPERATION

5.1 WATER DISCHARGES

5.1.1 Water Quality Standards

Chapter 17-3 of the Florida Administrative Code (FAC), March, 1979, classifies the St. Johns River in the plant vicinity as a predominantly marine, Class III water and describes the minimum water quality criteria to be met in this area. The criteria for Class III waters (those waters designated for use for fish and wildlife propagation and management) are listed in Chapter 2, Table 2.5-1. These criteria specify the concentrations of pollutants which are allowed beyond a designated mixing zone in the river. The chemical mixing zones for the proposed plant will be defined based on present and future river flow conditions and the expected nature and volume of the plant discharge, but will not exceed the established area limit for estuaries of 125,600 square meters [FAC, Section 17-4.244(1)(g)].

In the event that the St. Johns River does not meet the applicable ambient water quality criteria, Section 17-1.57, FAC, authorizes variances and Section 17-3.031, FAC, authorizes relief from Florida water quality criteria. Variances may be granted; (1) because there is no practicable means known or available for the adequate control of the pollution involved, (2) because compliance with the particular requirement or requirements from which a variance is sought will necessitate the taking of measures which, because of their extent or cost, must be spread over a considerable period of time, or (3) to relieve or prevent hardship of a kind other than those provided for in (1) and (2). Relief specifying alternative ambient water quality criteria may be granted based upon relevant factors such as the designated use of the waters, the extent to which biota have adapted to the background, evidence regarding ecological stress, and adverse impacts on adjoining waters.

Section 17-3.05, FAC, describes the thermal surface water criteria, which prohibit the discharge of heated water more than 2 degrees Fahrenheit (F) above the ambient or above 92 degrees F in June, July, August, and September. During the remainder of the year, the limit is 4 degrees F above the ambient temperature or 90 degrees F. However, on a case-by-case basis, zones of mixing for thermal discharges from cooling water systems are established based on the physical and biological characteristics of the receiving body of water.

The proposed plant also will be subject to standards of performance for new sources (40 CFR Part 423, 1974), which are summarized in Table 5.1-1. Revised guidelines have been proposed by the U.S. Environmental Protection Agency (USEPA) and should be promulgated in final form in 1982. At that time, the revised effluent limitations will be applicable to the proposed plant.

5.1.2 Thermal Discharge

5.1.2.1 Temperature Distribution in Receiving Body of Water

The primary factor in determining the impact of the thermal discharge from the proposed plant is the dilution flow available from the existing Northside Generating Station (NGS). As described in Chapter 3, Section 3.4, during operation of the NGS units, the discharge from the proposed plant will be mixed with the NGS discharge water and thus diluted before being discharged through the NGS once-through discharge system. During the infrequent occasions when none of the NGS units are operating (less than 1 day per year), the NGS circulating water pumps may or may not still run. If they are all off, the proposed plant will not discharge to the river because its discharge will be drawn into its makeup system. It is anticipated that this event will not occur for more than 30 minutes at a time and thus will not adversely affect operation of the proposed plant. If the NGS circulating water pumps are on, and following decommissioning of the NGS, a flow of at least 98,000 gpm will be maintained through the

existing fish return system. This will ensure adequate dilution water. (The existing NGS circulating water system is described in Chapter 2, Section 2.5.1.6).

In order to estimate worst case conditions for analysis of the thermal impact of the proposed plant discharge, the five modes of operation of NGS (Chapter 2, Section 2.5.1.6) were examined assuming 70 percent throttling of all NGS pumps (minimum dilution), and full load operation of the proposed plant under extreme conditions (maximum temperature difference between cooling tower blowdown and ambient river water) as described in Chapter 3, Section 3.4.3. The frequency of operation of each NGS mode, by month of the year, is presented in Table 5.1-3.

Figure 5.1-1 shows the projected monthly heat rejection rate to the St. Johns River for both the existing NGS, the proposed plant, and the combined flow of the NGS and the proposed plant, during each of the five operating modes for the NGS under extreme conditions. Tabulated flow rates and temperature rises corresponding to these heat loads are presented in Appendix C, Section C.1. Table 5.1-4 summarizes the results from Figure 5.1-1, tabulating the potential increase in heat load to the River due to the addition of the proposed plant. Because the withdrawal of makeup for the proposed plant will be from the NGS discharge flume, the combined discharge flow will be reduced below the level for NGS only (Appendix C, Tables C-3 through C-12). From July to October, operation of the proposed plant will provide a decrease of up to approximately 18 percent in the total heat presently rejected to the River by the NGS. In the months of November through June, operation of the proposed plant will provide an increase in total heat rejected to the River, up to about 51 percent.

Figure 5.1-2 presents the projected monthly heat rejection rates of both the existing NGS, the proposed plant, and the combined flow of NGS and the proposed plant, under average operating conditions, based on average case blowdown temperatures and associated flows as described in Chapter 3, Section 3.4 and the five operating modes for NGS. Tabulated flow rates and

temperature rises corresponding to these heat loads are presented in Appendix C, Table C-3 through C-12. A summary of Figure 5.1-2, with respect to projected increases in heat load to the river due to the addition of the proposed plant, is presented in Table 5.1-5. During this average case, the net result of the operation of the proposed plant will be to reduce the heat load presently rejected to the river by the NGS by up to approximately 30 percent, except during January, February, and March, when it may increase by up to about 12 percent.

Mathematical modelling (see Appendix C.1 for a description of the model and the reasons for its selection) was performed to predict the average and extreme characteristics of the thermal plumes to the St. Johns River, resulting from operation of the proposed plant with and without the NGS. The maximum length of, and area enclosed by, the 2 degree F isotherm at a depth of 1 meter, were selected to represent the extent of the thermal plume. The 2 degree F isotherm was selected since it represents the most stringent requirement of the NGS National Pollutant Discharge Elimination System (NPDES) Permit (as discussed in Section 5.1.2.2).

Table 5.1-6 presents the predicted monthly maximum centerline distance and area for the 2 degree F isotherm under average operational conditions of the proposed plant with and without the NGS, and the NGS alone. For comparison, the table also presents the predicted monthly plume maximums for the NGS alone under average conditions (see Section 2.5.1.6). Under average conditions, the extent of the thermal plume from the combined discharge is predicted to be greater than that of the NGS alone, during the months of December through April. During the months of May through November, the extent from the combined discharge is less than that from NGS alone. In comparison to NGS operation alone, operation of the proposed plant alone under average conditions will increase the extent of the thermal plume during only five months of the year.

Table 5.1-7 presents the predicted monthly maximum centerline distance and area for the 2 degree F isotherm under extreme operational conditions of the proposed plant with and without the NGS, and of the NGS alone (see

Chapter 2, Section 2.5.1.6). Under extreme conditions, the combined discharge is predicted to increase the extent of the thermal plume, in relation to NGS alone, the greatest during February. The increase during February is predicted to be approximately 840 feet in length and 3.7 acres in area with respect to the 2 degree F isotherm. During August and September, plume extent for the combined discharge is expected to be reduced below that of operation of NGS alone. In comparison to NGS operation alone, operation of the proposed plant alone under extreme conditions will increase the size of the thermal plume during 10 months of the year.

Appendix C, Tables C-21 through C-36, contains figures showing, on a monthly basis, the predicted lengths and areas of the 2 degree F isotherm thermal plumes associated with operation of the proposed plant alone, combined operation during each of the NGS operating modes, and NGS alone under average and extreme conditions.

5.1.2.2 Thermal Compliance

The proposed plant will share a common discharge with the existing NGS. The NPDES permit for the NGS is more stringent with respect to thermal limitations than Chapter 17-3 of the FAC. Thus, if the combined discharge will satisfy the NPDES permit requirements, the proposed plant is expected to be in compliance with present regulatory requirements for thermal discharges from the NGS point of discharge (POD) to the St. Johns River and the same mixing zone should be recognized for the proposed plant.

The major requirements of the NGS NPDES Permit (see Appendix C) with regard to the St. Johns River thermal limitations include the following items:

1. The 2°F above ambient isotherm, at a one meter depth, shall not exceed a width of 825 feet, a length of 5400 feet, and an area of 102.27 acres.

2. The 4°F above ambient isotherm shall not exceed a width of 399 feet or a length of 3900 feet.
3. The temperature at the point of discharge shall not exceed 19°F above ambient, or 105°F, whichever is less.

Table 5.1-5 shows the predicted effect of the proposed plant operation on the combined discharge under average meteorological conditions, 100 percent load on the proposed plant, and the various operating modes of NGS. In most cases, there will be a net reduction in actual heat load to the St. Johns River. The mathematical modelling indicates that under these conditions, the addition of the proposed plant will not increase the maximum extent of the thermal plume (Table 5.1-6) above the NPDES limits. Thus, NPDES requirements 1 and 2 are always met under average conditions.

Table 5.1-4 shows the effect of the proposed plant operation on the combined discharge under extreme meteorological conditions which produce the highest discharge temperature from the proposed plant, the lowest ambient water temperatures, 100 percent load on the proposed plant, and the various operating modes of NGS. The heat rejection rates in Figure 5.1-1 indicate that combined operation results in larger heat rejection rates during the colder months (November through June) and smaller heat rejection rates during the warmer months (July through October). The mathematical modelling indicates that the addition of the proposed plant will not cause the extent of the thermal plume to exceed NPDES requirements 1 and 2 (Table 5.1-7). The modelling also indicates that requirement 3 of the NPDES Permit will be met (Appendix C, Tables C-3 through C-12).

In summary, the operation of the proposed plant will generally decrease the heat load to the St. Johns River, and will not increase the existing thermal impact from operation of the NGS significantly with respect to the NPDES Permit requirements.

5.1.3 Chemical and Other Discharges

5.1.3.1 Wastewater Treatment Discharges

The sources and characteristics of the proposed plant wastewaters are discussed in Chapter 3, Section 3.5. A volumetric flow balance for the proposed plant is presented in Chapter 3, Figure 3.3-1. As seen in this figure, wastewaters from the proposed plant entering the NGS discharge channel will be from two sources: cooling tower blowdown, and discharge from the pump sump. The pump sump discharge will be made up of treated wastewaters from the oily wastewater collection basin, the sanitary wastewater treatment facility, and the chemical wastewater treatment facility. The combined proposed plant wastewater discharges will mix with the circulating water flow of the NGS and be discharged into the St. Johns River through the existing submerged diffuser, which is defined as the point of discharge (POD). As described in Chapter 3, Section 3.5, proposed plant facilities have been designed to ensure that individual and combined waste streams comply with USEPA effluent guidelines and standards of performance for new sources identified in Table 5.1-1. The existing NGS is permitted (see NPDES Permit, Appendix C.3) to discharge only the once-through cooling water with a limited quantity of free available chlorine. All other chemical discharges from the NGS are treated by on-site evaporation-percolation ponds.

Predicted average and maximum chemical characteristics of the combined NGS and proposed plant effluent at the POD are presented in Tables 5.1-8 and 5.1-9. Plant operating conditions and flows used to calculate the average and maximum POD concentrations are:

	Combined Operation (Average Case)	Combined or Proposed Plant Alone Operation (Maximum Case)
NGS Operating Mode	2	4
Proposed Plant Operation	Full Load	Full Load
NGS Circulating Water Discharge	294,000	98,000
Combined Discharge, gpm	287,592	91,033
Proposed Plant Discharge (POD), gpm	27,992	27,433
Cooling Tower Blowdown, gpm	23,881	23,093
Pump Sump Discharge, gpm	4,111	4,340

During combined operation of the proposed plant and the NGS, mode 2 was used as the average operating condition for the NGS since it displays the greatest annual frequency of occurrence, 35.8 percent (Chapter 2, Section 2.5.1.6). For the maximum case, NGS operating mode 4 was used since it will represent the minimum amount of water available for mixing in the discharge channel.

As seen in Chapter 2, Table 2.5-3, nine parameters were found to exceed Class III water quality standards at Transect G, located near center line of POD, under maximum ambient conditions, and five of these same parameters were found to exceed under mean ambient conditions. From results presented in Table 5.1-9, it can be seen that under maximum operating conditions, eight of these nine parameters, plus selenium and chlorides, are predicted to exceed Class III water quality standards at the POD. While under average operating conditions, only copper, total residual chlorine, cyanide, iron, mercury, and silver are predicted to exceed their Class III standards at the POD. Although it is predicted to exceed its Class III standard at the POD, the TRC concentration will be below that allowed by the USEPA, see Table 5.1-1. Total coliform are not included in Table 5.1-9 since they are not a conservative chemical constituent within the various plant processes.

For those parameters predicted to exceed Class III water quality standards, mathematical modelling was performed to predict the influence that mixing zones in the St. Johns River would have on both predicted average and maximum POD concentrations. Table 5.1-9 summarizes the predicted influence of mixing zones on the POD concentrations of the ten parameters and identifies the concentration of each parameter at the edge of the mixing zone in both the average and maximum operating conditions. The basic model used was the thermal model described in Appendix C, Section C.1, with minor changes as discussed in Appendix C, Section C.6.

Under average operating conditions, only cyanide, copper, iron, silver, and mercury are predicted to exceed their respective Class III standards at the edge of a 31 acre mixing zone. Because of difficulties inherent in predicting total residual chlorine (TRC) concentrations, it is possible that the TRC concentration at the edge of a 31 acre mixing zone could also exceed its Class III standard. However, the TRC concentration in the wastewater discharge will be below that allowed by EPA discharge limits, as defined in Table 5.1-1. In all cases, due to rapid mixing within small mixing zones, the impact of these substances on the River water quality are not expected to be adverse.

With regard to maximum case, i.e., minimum dilution, estimated concentrations at the edge of a 31 acre mixing zone, it is predicted that the following substances will exceed their respective Class III water quality standards: aluminum, total residual chlorine, cyanide, oil and grease, copper, iron, mercury and silver (Table 5.1-9). In all cases, the maximum observed ambient concentrations of these parameters in the St. Johns River during the one year monitoring program were significantly above the Class III water quality standards (Table 5.1-9). Again, although it is possible that the TRC concentration at the edge of a 31 acre mixing zone will exceed Class III standard, the maximum POD concentration will be below that allowed by the EPA. For chlorides and selenium, mixing zones of about 0.02 acres will be required to meet Class III standards in the maximum case.

5.1.3.2 Solid Waste Handling and Storage Discharges

Solid Waste Regulations

The solid wastes generated by the combustion of coal (i.e., fly ash, bottom ash and flue gas desulfurization sludge) presently are exempt from the hazardous waste regulations promulgated under Subtitle C of the Resource Conservation and Recovery Act (RCRA) of 1976, and are, therefore, subject to the provisions of Subtitle D of this act. Subtitle D regulations establish guidelines for state solid waste programs developed with federal assistance and set certain criteria for solid waste disposal facilities. These criteria are not applicable to the proposed site, however, as Florida has established its resource recovery and management program without federal assistance. Therefore, the disposal of combustion ash and scrubber sludge is governed by the solid waste regulations outlined in Chapter 17-7 of the FAC, as amended May 25, 1979. Requirements under Chapter 17-7 are modified on a case-by-case basis to account for the differences in the waste material involved.

Based on the classification criteria in the regulations, the proposed plant's ash disposal facility would be considered a Class I sanitary landfill and would be subject to certain provisions pertaining to such landfills. Siting requirements for sanitary landfills which affect the waste disposal area include location, pre-operational hydrogeological and soils characterization, and post-operational monitoring and treatment of surface runoff and leachate to meet the water quality standards at the site boundary (see Table 5.1-10).

Chapter 17-7 of the FAC requires Class I sanitary landfills to have three monitoring wells installed prior to the disposal of waste material. Locations of these wells are designated as upgradient and downgradient of the landfill site, and downgradient of the first section of the site to be filled. In addition, the regulations require that the solid waste may not be disposed of:

1. in an area subject to frequent or periodic flooding, unless drainage provisions are installed;
2. in an area immediately adjacent to or within 500 feet of an existing or approved shallow water supply well;
3. in any natural or artificial body of water including groundwater;
4. within 200 feet of any natural or artificial body of water;
5. in any area open to public view from any major thoroughfare; and,
6. on the right-of-way of any public highway, road, or alley.

Groundwater Impacts

As discussed in Appendix D, there could be a potential for contamination of groundwater by leachate from waste disposal areas containing ponded liquids. Consequently, the oily wastewater collection basin, the flow equalization basin, the coal pile sedimentation ponds, and the metal cleaning waste retention basin (Chapter 3, Figure 3.1-1) will be designed and constructed to preclude or minimize seepage of leachate. As noted in Chapter 3, these impoundment designs will include the use of artificial membrane liners of extremely low permeability. The coal piles will also be lined with similar materials to prevent infiltration of coal pile runoff.

With regard to the fly ash, bottom ash, and gypsum (dry solid waste) disposal areas (Chapter 2, Figure 2.1-5), the potential for groundwater contamination resulting from leachate will depend on the quantity and chemical quality of the leachate produced. As indicated in Chapter 3, Section 3.5.2, the JEA anticipates a market for the fly ash, bottom ash, and gypsum resulting from plant operation. The quantities of leachate generated will, therefore, depend on the sizes of the on-site disposal areas used to store any excess material, and the rate of infiltration of precipitation into these areas. The leachate quality will depend on the

properties of the actual waste materials generated, which in turn will relate to the properties of the actual coal burned, which has not been selected as yet.

The concept of a solid waste disposal test program is proposed in Chapter 3, Section 3.5.2.2. Such a program would include on-site testing of the properties of the actual solid waste generated so that a long term disposal plan, if required, could be developed. Any fly ash, bottom ash, or gypsum not marketed and not utilized in the test program, will be placed into an on-site landfill as discussed in Chapter 3, Section 3.5.2.2. Leachate associated with this storage area could potentially affect the local groundwater regime.

Appendix D presents an analysis of the sensitivity of calculated concentrations of dissolved constituents in groundwater as a function of various hydrologic and engineering parameters. The analysis indicates that the parameters with the greatest influence on groundwater quality are the rate of infiltration of precipitation into the waste and the chemical quality of the leachate. The analysis presented in Appendix D is very conservative, particularly in its assumptions that the waste material will remain saturated and that the rate of leachate generation can be approximated by one-half the rate of natural recharge of precipitation to the shallow aquifer system in Duval County. The proposed solid-waste test program is designed to provide data which will permit more definitive analysis of potential groundwater impacts during long-term storage of solid wastes. During the test program, excess unmarketed solid waste will be physically stabilized and disposed of in a managed landfill on site. If it appears that leachate generated by the landfill might ultimately exceed groundwater standards at the property boundary, the proposed extent of the zone of discharge, appropriate mitigation measures will be instituted. These mitigation measures could include such techniques as the use of top liners to prevent infiltration into the solid waste.

Surface Water Impacts

Wastewater generated from solid waste handling, storage, and disposal operations will be in the form of runoff from the solid waste handling and temporary storage area and from the active and test cell landfill areas.

Runoff from the test cell and active solid waste landfill areas will be conveyed to a sedimentation pond where it will mix with wastewater from the solid waste handling and storage area. Assuming runoff coefficients as discussed in Chapter 3, Section 3.5.1.7, the runoff from the solid waste handling and active disposal areas will be about 29 gpm on a mean monthly basis and about 280 gpm during a once in 10 year, 24 hour storm. After passing through the sedimentation pond, the effluent will be directed to the flow equalization basin where it will combine with other plant wastewaters. This pond effluent will pass through the chemical wastewater treatment facility for pH adjustment and suspended solids removal prior to discharge into the NGS discharge channel. An alternate route of discharge to the pump sump is shown since operating data may demonstrate no additional treatment is needed to meet pH, TSS and other water quality criteria.

Predicted impacts on water quality of the St. Johns River associated with solid waste handling and disposal discharges are presented in Section 5.1.3.1 as they affect overall plant wastewater impacts. The impacts on River water quality associated with runoff from the solid waste areas will depend on the amount and chemical quality of runoff generated. As discussed in the groundwater impacts section, monitoring data will be collected to accurately characterize these wastewaters. In order to estimate point of discharge concentrations to the St. Johns River (Section 5.1.3.1), concentrations of chemical parameters from the coal pile runoff sedimentation pond were conservatively estimated to be similar to coal pile runoff quality (see Appendix C, Section C.6). Concentrations of chemical parameters from the solid waste handling, temporary storage, and landfill

areas reflect an arithmetic volume weighted mean for runoff quality associated with fly ash, bottom ash, and FGD sludge (see Appendix C, Section C.6).

5.1.3.3 Cooling Tower Blowdown

Blowdown from the cooling towers will be pumped into the NGS discharge channel via a common discharge line. As seen in Chapter 3, Figure 3.3-1, the blowdown will be combined with the previously combined effluents from the chemical wastewater treatment facility, the sanitary wastewater treatment facility and the oily wastewater collection basin in a common discharge line. Prior to combining with these three streams, the blowdown will have met the effluent standards of performance for new sources identified in Table 5.1-1. Specifically, the blowdown will be at pH 6.0 to 9.0 with no polychlorinated biphenyl compounds present except those existing in the makeup from the St. Johns River. Water quality impacts on the St. Johns River resulting from the combined discharge are presented in Section 5.1.3.1.

Estimated blowdown rates at full load are presented for average monthly and maximum monthly evaporation rates in Chapter 3, Tables 3.4-1 and 3.4-3, respectively. The cycles of concentration associated with these average and maximum cases are provided in the same tables. As described in Chapter 3, Section 3.5.1.6, the concentrations of conservative chemical and physical constituents in the blowdown will be directly proportional to those in the makeup water. Therefore, individual chemical and physical characteristics of the proposed plant's blowdown have been calculated by multiplying the corresponding parameter in the makeup water by the applicable cycles of concentration estimated for the cooling towers. A description of the blowdown characteristics for average and maximum operating conditions, as defined in Section 5.1.3.1, is presented in Table 5.1-11.

As described in Chapter 2, Section 2.5.1.6, the NGS intake flume withdraws water from (-)9.3 to (-)20.0 feet MSL from the Blount Island Channel. Since the thermal plume at this distance (about 600 feet) from the discharge is predominantly near-surface, no significant chemical recirculation is expected.

As noted in Chapter 3, Section 3.5.1.6, corrosion inhibitors are not expected to be added to the cooling towers. The only expected chemical additions to the towers will be chlorine to control biological fouling, and possibly sulfuric acid to control scale formation. In accordance with the existing effluent standards (Table 5.1-1), concentrations of free available chlorine in the blowdown will not exceed 0.2 mg/l for more than two hours per day per tower prior to combining with the other plant effluents. In fact, tower chlorination will be carefully controlled at minimum levels necessary for efficient operation. The effect of sulfuric acid addition is anticipated to be a slight increase in sulfate levels and a similarly small decrease in bicarbonate levels.

5.1.3.4 Sanitary Discharges

The sanitary wastes generated during operation of the proposed plant will be treated by one of two 15,000 gpd extended aeration package plants. The treated effluent is expected to average approximately 11 gpm, with a daily maximum of about 240 gpm. The extended aeration process will provide secondary treatment of the sanitary waste, with about 90 to 95 percent BOD removal efficiency, in accordance with state domestic waste treatment standards. The process is described in detail in Chapter 3, Section 3.6.2. The primary constituents of the effluent and the anticipated concentrations of each are:

Total Suspended Solids	20 mg/l
Biochemical Oxygen Demand (5 day, 20°C)	20 mg/l
Oil and Grease	10 mg/l
Nitrogen as N	40 mg/l
Phosphorus as P	10 mg/l

The effluent will be directed to the final effluent pump sump where it will mix with effluent from the oily wastewater collection basin and the effluent from the chemical wastewater treatment facility. The discharge from this pump sump will combine with cooling tower blowdown and will be discharged into the existing NGS discharge channel (see Chapter 3, Figure 3.3-1).

The impact of combined plant wastewater discharge is discussed in Section 5.1.3.1. The sanitary effluent will not further impact the concentrations of the chemical parameters expected to exceed Class III water quality standards at the POD (Table 5.1-9); the net change in POD concentrations for the sanitary effluent constituents will be less than one percent with average sanitary flows and chemical characteristics. Accordingly, impacts associated with sanitary effluents on the St. Johns River will not be significant.

5.1.4 Biological Effects of Discharge

5.1.4.1 Thermal

Effects of the thermal discharges of the proposed plant were evaluated in the ultimate receiving water body, the Blount Island Channel at the NGS point of discharge (Chapter 2, Figure 2.5-16). Evaluations of the potential for adverse biological effects in this area were based on the Thermal Surface Water Criteria (Florida Water Quality Standards, Section 17-3.05, FAC). These criteria are summarized below:

1. No discharge of heated water with a temperature at the point of discharge (POD) more than 2°F above the ambient temperature of the receiving body of water (RBW) or in excess of 92°F during the months of June, July, August and September.
2. No discharge of heated water with a temperature at the POD more than 4°F above the ambient temperature of the RBW or in excess of 90°F during the months of October through May.

A zone of mixing beyond the POD may be established to afford a reasonable opportunity for dilution and mixture of heated discharges within the RBW. (The existing NPDES permit already provides for such a zone of mixing.)

Table 5.1-13 lists the projected areas of the thermal mixing zone in Blount Island Channel for the $2^{\circ}\text{F} \Delta T$ and $4^{\circ}\text{F} \Delta T$ isotherms. Configurations of the NGS's thermal plume during September, 1980 are shown in Chapter 2, Figures 2.5-9, 2.5-10 and 2.5-11. Plume configurations of the combined operation of the proposed plant and the NGS are expected to be similar (see Appendix C, Section C.1).

Discharge into Blount Island Channel

Cooling tower blowdown will be injected into the NGS discharge channel and exit into Blount Island Channel via the NGS submerged discharge. The thermal mixing zone for the operation of the proposed plant alone as defined by the $2^{\circ}\text{F} \Delta T$ isotherm will be less than 0.005 acres during the summer (Table 5.1-6). During the remainder of the year, the mixing zone as defined by the $4^{\circ}\text{F} \Delta T$ isotherm also will be less than 0.005 acres during the operation of the proposed plant alone. For comparison, Table 5.1-13 presents the maximum temperatures and corresponding mixing zone sizes for the combined operation of the proposed plant and the NGS.

Fish (Coutant, 1975), manatees and other nekton are capable of avoiding entrainment within the mixing zone and can thereby avoid exposure to adverse temperatures during the summer. During cooler periods, nekton may be attracted to thermal discharges as they seek more preferred conditions for thermo-regulation. Manatees particularly are known to be attracted to thermal plumes, during the winter, however none were observed in the vicinity of the NGS POD during the winter survey although a confirmed siting was made during the summer of 1980 (Chapter 2, Section 2.8.7). The river is deep and relatively fast flowing and there is little or no forage material within this vicinity. This serves to minimize

manatee preference for this area. In cold periods, in the unlikely event that both units of the proposed plant go off line, cessation of thermal discharge into the Blount Island Channel should not subject fish in the plume to "cold shock". Even under worst case conditions, a drop in temperature of 60.8°F to 52.4°F is well within the limit to assure protection of warm water fishes from thermal shock (Figure 5.1-3).

Benthic invertebrates should not be significantly affected by the thermal discharge from the proposed plant. The thermal effluent will be discharged through a diffuser which is inclined 10 degrees toward the mid-channel surface waters. This design, combined with the fact that effluent densities will always be less than the surrounding water in Blount Island Channel, precludes contact of the discharge plume with the river bottom.

Planktonic organisms may be subject to adverse temperatures within the discharge plume during the summer when temperatures are highest (Table 5.1-13). Plankters which travel passively with the currents would be unable to escape contact with the thermal plume. The likelihood of plankton being entrained by the thermal plume and subjected to such conditions is dependent upon the size of the thermal plume. Potentially adverse temperatures, as defined by non-compliance with thermal standards listed above, are projected to occur in a small mixing zone of less than 0.005 acres at a depth of one meter during operation of the proposed plant alone. During combined operation, potentially adverse temperatures are projected to occur in a mixing zone of 5.86 acres or less. For comparison, potentially adverse temperatures are projected to occur in a mixing zone of 8.29 acres or less during operation of Northside alone. The width of the thermal plume during combined operation will be no more than 20 feet wider than the maximum plume width during operation of Northside alone. This represents 1 percent of the river's cross-section. In view of these projections, no substantial damage or harm to the plankton community should result from the proposed plant's thermal discharges.

5.1.4.2 Biocidal

Condenser cooling systems for the proposed plant will use mechanical cleaning to reduce biofouling while the natural draft cooling towers will depend upon chlorination. Operation of the proposed plant will not increase the biocide concentrations at the NGS POD beyond present water quality standards as established in 40 CFR Part 423.

Average ambient levels of chlorine measured in Blount Island Channel (Table 5.1-9) exceed the reported acute toxicity level (one-third of the 96 hr LC_{50}) (Appendix B, Table B-28) for a common member of the second most abundant genus collected in pre-application ichthyoplankton sampling (*Gobiosoma*) (Appendix B, Table B-10). This suggests that total residual chlorine as measured in Blount Island Channel is in less toxic forms.

Projected entrainment rates for the proposed plant (Section 5.2.1.2) assume 100 percent mortality from physical effects associated with the proposed power plant entrainment, therefore no additional plant entrainment mortality will result from the use of chemical biocides. Under present effluent guidelines, concentrations of free available chlorine in the proposed plant's cooling water blowdown is limited to an average of 0.2 mg/l for a period of 2 hours per day per unit.

5.1.4.3 Chemical

Although no evidence of ecological stress was apparent, ambient concentrations of mercury, copper, silver, total coliform, total residual chlorine, aluminum, iron, cyanide, and oil and grease exceeding Class III standards were observed in the Blount Island Channel during the pre-application monitoring program (Chapter 2, Table 2.5-3). During operation of the proposed plant, the concentrations of five of these pollutants (copper, cyanide, iron, mercury and silver) are predicted to be

higher than Class III standards at the point of discharge (POD) to the Blount Island Channel under average conditions. During extreme (maximum) conditions, in addition to these five pollutants, aluminum, chlorides, selenium, and oil and grease are predicted to exceed Class III standards (Table 5.1-9). The concentration of total coliform at the POD is not expected to vary from the concentration present in the ambient river water. The proposed plant will neither add to the coliform levels in the discharge nor concentrate this parameter in the cooling towers.

The discharge of salt as defined by chloride concentration and the discharge of oil and grease are treated only generally in this section. Oil and grease and chlorides were seldom out of compliance under ambient conditions and based upon the projections that oil and grease and chloride will be in compliance with state regulations at the POD during average case operation (Table 5.1-9) emphasis has been placed on the other six pollutants. The estuarine animals that might occur within the small (less than 0.2 acre) area required to attain compliance during an unlikely and short lived maximum case event are euryhaline (USEPA, 1976; Odum, 1967), and may reasonably be expected to tolerate changes in chlorides on the order of 4 g/l. Maximum case discharges of oil and grease are not expected to be highly toxic and will be rapidly diluted to within 2 percent of ambient in a small 0.67 acre mixing zone. The numerous types of possible oil and grease compounds that may occur in coastal waters exhibit a wide range in toxicity (USEPA, 1976). In addition, most of the diesel fuels, gasoline, and residuals which reasonably might represent a significant fraction of the oil and grease measured in the St. Johns River during the pre-operational monitoring program are not toxic to estuarine organisms at levels associated with maximum case discharges for the proposed plant (USEPA, 1976).

For those remaining parameters exceeding Class III standards (seven maximum, five average), three factors have been considered in the assessment of the significance of possible adverse effects on the established community of organisms in Blount Island Channel. These

include: 1) a designation of a significant indigenous species or "substitute species" for assessing toxicities; 2) a determination of acute and chronic toxicities based on reported 96 hr LC₅₀ data for significant indigenous species; and 3) an evaluation of the acute and chronic toxicity levels with respect to the POD, mixing zones, and ambient river concentrations during predicted average and worst case plant operating conditions. Section 17-3.021 of the FAC defines acute and chronic toxicity as the presence of one or more substances or characteristics or components of substances in amounts which are greater than one-third and one-twentieth, respectively, of the amount lethal to 50 percent of the test organisms in 96 hours (96 hr LC₅₀). The 96 hr LC₅₀ is the lowest value which has been determined for a species significant to the indigenous aquatic community or may reasonably be expected, based upon evaluation by generally accepted scientific methods, to produce effects equal to those of the concentration of the substance specified above.

The potential for adverse biological effects in the Blount Island Channel associated with elevated mixing zone concentrations of cyanide, aluminum, copper, iron, mercury, selenium, and silver which are expected to exceed Class III standards will be limited by several factors including: 1) rapid dilution of the pollutants within small, predominately near surface mixing zones; 2) position of the mixing zones (small cross-sectional areas relative to the entire channel); 3) no impingement of the chemical plume on the river bottom and predicted rise of the plume to the surface within approximately 100 feet of the POD; 4) probable presence of a significant portion of the total concentration of the pollutants in less toxic chemical forms; and 5) low potential frequency of occurrence of postulated worst case conditions.

As indicated in Section 5.1.3.1, the mixing zones associated with the chemical parameters expected to exceed Class III standards during proposed plant operation will be relatively small, primarily confined to the near surface water (within top 1-2 meters) of Blount Island Channel, and located

between San Carlos Creek and Browns Creek. The mixing zones will not encroach upon either tidal creek or extend into the Nassau River-St. Johns River Marshes Aquatic Preserve (Chapter 2, Figure 2.8-2).

The reported 96 hr LC_{50} levels for significant indigenous species and the calculated acute and chronic toxicity levels of cyanide, iron, silver, copper, aluminum and mercury are summarized in Table 5.1-14, and compared to ambient conditions, projected average and maximum POD concentrations, and to projected mixing zone concentrations in the Blount Island Channel. Although POD concentrations for most of the chemical parameters are predicted to be reduced to near ambient concentrations within much smaller mixing zone areas (see Table 5.1-9), the maximum 31 acre (125,600 m^2) mixing zone allowed for estuaries (Section 17-4.244(1)(g), FAC) is used in this analysis. Table 5.1-15 identifies the most sensitive reported significant indigenous species used for computation of acute and chronic toxicity levels for the six parameters. No selenium toxicity information was available for an indigenous species. Appendix B, Tables B-22 through B-28 summarize reported toxicity data for other indigenous organisms.

Average and maximum predicted POD, mixing zone, and ambient Blount Island Channel concentrations of iron, silver, aluminum and mercury do not exceed acute toxicity levels calculated based on reported 96 hr LC_{50} data for significant indigenous species (Table 5.1-15). Predicted concentrations for cyanide under average conditions do not exceed the calculated acute toxicity level, although the maximum predicted concentration (0.099 mg/l at the POD) would exceed the calculated acute toxicity level (0.010 mg/l), while copper exceeds the calculated acute toxicity level at all locations under both average and maximum predicted concentrations.

Calculated chronic toxicity levels of iron, silver, and aluminum are greater than average predicted POD and mixing zone concentrations, but copper, cyanide, and mercury exceed the calculated levels. Although the

POD cyanide concentration (0.01 mg/l) under estimated average conditions is shown as exceeding the 0.003 mg/l calculated chronic toxicity level, the POD concentration was conservatively derived by assuming the average ambient concentration to be equal to 0.01 mg/l, the detection limit, when in fact, 48 of the 76 samples analyzed during the one year monitoring program in the Blount Island Channel were below this detection limit. Maximum ambient and consequently, maximum predicted POD and mixing zone concentrations of cyanide, aluminum, copper, iron, mercury and silver exceed the calculated chronic toxicity levels (Table 5.1-14).

In summary, based on calculated acute toxicity levels, potentially adverse conditions due to concentrations of copper in ambient Blount Island Channel water could exist at the POD and within the mixing zone under estimated average conditions. However, the potential for adverse biological effects associated with operation of the proposed plant is considered reduced due to the following factors:

- . It is probable that an appreciable portion of the ambient copper concentration in Blount Island Channel water exists in chemical forms that exhibit relatively low toxicity or availability to organisms. Average and maximum ambient copper concentrations (69 and 275 ug/l) in the Blount Island Channel were found, during the one year monitoring program, to exceed the Class III water quality standard (15 ug/l) and the calculated acute toxicity level, presented in Table 5.1-14 based on the larvae of the polychaete worm, Capitella capitata. However, adult polychaetes including C. capitata are being collected in significant numbers during the on-going NGS NPDES monitoring program (see Chapter 6, Section 6.2.4.2), supporting the possibility that a substantial percentage of the copper in the Blount Island Channel may exist in less toxic chemical forms. Further support for this is provided in a review of copper toxicity to nekton indigenous to Blount Island Channel. Although more copper tolerant than polychaete larvae, nekton show calculated acute and chronic toxicity levels (50 ug/l and 15 ug/l,

respectively, based on 14 d LC₅₀ data presented in Appendix B, Table B-25) which also fell below average and maximum observed ambient copper concentrations.

- . Predicted average copper concentration at the POD (72 ug/l) will be only 4 percent greater than ambient concentrations (Table 5.1-9), and will be due primarily to concentration in blowdown of the cooling tower system.
- . Rapid dilution of the POD copper concentration within a small mixing zone area (predicted concentrations reduced to approximately 1 percent above ambient within a mixing zone of less than a 0.7 acres under average conditions).
- . Bouyancy of the discharge plume which would confine the bulk of the mixing zone to the upper 1-2 meters of water and preclude its contact with the river bottom.

Under predicted worst case conditions (footnote c, Table 5.1-9), potential acute toxicity conditions could exist at the POD and within the mixing zone for cyanide and copper. Potential chronic toxicity conditions could exist for all six parameters, based on concentrations presented in Table 5.1-14. However, the potential for adverse biological effects would be limited by the following factors:

- . The probability for postulated worst case conditions is low. Required events, occurring simultaneously, would include mode 4 NGS operation (only 19 percent of time annually, see Table 5.1-3), full load operation of the proposed plant, and maximum observed ambient chemical concentrations in the Blount Island Channel.
- . The expected limited duration of worst case conditions should they occur.

- . The likelihood that an appreciable portion of the total cyanide, iron, copper, aluminum, mercury and silver in Blount Island Channel exists in a less toxic, or less available chemical form.
- . Except for mercury and selenium, the predicted maximum concentrations at the POD will be primarily of river origin, resulting from concentration in blowdown from the cooling tower system (the proposed plant will not be a significant contributor of cyanide, silver, copper, aluminum or iron).
- . Rapid dilution of the POD concentrations within relatively small mixing zones (Table 5.1-9).
- . Bouyant nature of the mixing zones (within top 1-2 meters of the surface), which precludes contact of the plume with the river bottom.

5.1.4.4 Bioaccumulation Potential

Many trace metals are required in life processes and therefore most organisms have a capability of concentrating them (Waldichuck, 1974). With regard to those parameters expected to exceed Class III standards at the POD to the Blount Island Channel, mercury, copper, iron, aluminum and silver may be bioconcentrated (Waldichuck, 1974; Phillips and Russo, 1978). In comparison, cyanides have not been shown to have this potential (USEPA, 1980). According to Stephan (1980) as cited in USEPA (1980), the concentration factor for cyanide is close to zero, and Hewitt and Nicholas (1963), as summarized in Leduc (1977), also report that cyanide is non-cumulative.

Human consumption of seafoods containing aluminum, iron and silver presents little risk due to the low toxicity of these metals to humans (Phillips and Russo, 1978). They also report that copper is considered low in toxicity to humans even though high concentrations have caused vomiting and liver damage. Human consumption of marine fish containing high levels

of copper presents little risk because copper does not accumulate in the edible fish tissues. In shellfish, such as oysters, copper can be concentrated to levels which could represent a health problem if sufficient amounts were consumed. This is not expected for operation of the proposed plant since the St. Johns River in Duval County is not classified for shellfish harvesting due to low potential. Furthermore, human consumption is deterred by the unpleasant metallic taste which is characteristic of organisms containing high levels of copper.

Mercury can be accumulated in biological systems, but in marine organisms, it is reportedly detoxified after chemically bonding with proteins (Phillips and Russo, 1978). Fish are thus able to tolerate assimilated mercury. Bioaccumulation of mercury by Blount Island Channel organisms should be inconsequential for the following reasons:

- . Under projected average operating conditions, mercury concentrations at the POD will be rapidly diluted to near ambient concentrations within a small mixing zone area (see Table 5.1-9).
- . Direct exposures of benthic organisms should be insignificant due to the bouyant nature of the discharge plume.

5.1.5 References

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Table 5.1-1 (Revision 1)

USEPA STANDARDS OF PERFORMANCE FOR NEW SOURCES
STEAM ELECTRIC POWER GENERATING^a

^b Waste Streams and Pollutants	^e Maximum (mg/l)	^f Average (mg/l)
All waste streams:		
pH (except once-through cooling)	6.0-9.0, (St'd Units)	
Polychlorinated Biphenyls	No Discharge	
Low volume waste streams:		
Total suspended solids	100	30
Oil and grease	20	15
Bottom ash transport water: ^c		
Total suspended solids	100	30
Oil and grease	20	15
Fly ash transport water:		
Total suspended solids	No Discharge	
Oil and grease	No Discharge	
Metal cleaning wastes:		
Total suspended solids	100	30
Oil and grease	20	15
Copper (total)	1	1
Iron (total)	1	1
Boiler blowdown:		
Total suspended solids	100	30
Oil and grease	20	15
Copper (total)	1	1
Iron (total)	1	1
Once-through cooling water:		
Free available chlorined ^d	0.5	0.2
Cooling tower blowdown:		
Free available chlorined ^d	0.5	0.2

Table 5.1-1 (Revision 1) (Continued)
USEPA STANDARDS OF PERFORMANCE FOR NEW SOURCES
STEAM ELECTRIC POWER GENERATING^a

^b Waste Streams and Pollutants	^e Maximum (mg/l)	^f Average (mg/l)
Corrosion inhibitors	No detectable amount	No detectable amount
Area runoff subcategory:		
Total suspended solids	50 mg/l	
pH	6.0-9.0	

^a Source: 40 CFR Part 423, 1974

^b Except where specified otherwise, the allowable discharge equals flow multiplied by the concentration limitation.

^c Allowable discharge equals flow multiplied by concentration divided by 20.0.

^d Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than 2 hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time, unless the utility can demonstrate that the units in a particular location cannot operate at or below this level of chlorination. Values indicated are for maximum and average concentrations of free available chlorine.

^e Maximum for any one day.

^f Average of daily values for 30 consecutive days.

Table 5.1-2 (Revision 1)

WORST CASE OPERATING PARAMETERS FOR THERMAL DISCHARGE

<u>Northside Station Operation^a</u>	<u>Northside Station Flow (gpm)</u>
Mode 1	392,000
Mode 2	294,000
Mode 3	196,000
Mode 4	98,000
Mode 5 ^b	98,000

a See Chapter 2, Section 2.5.1.6 for mode description

b NGS units not operating or decommissioned; two NGS circulating water pumps operated to maintain minimum flow of 98,000 gpm through the NGS circulating water system.

Table 5.1-3

MONTHLY FREQUENCY (%) OF OPERATION OF NORTHSIDE STATION PUMPING MODES

<u>Month</u>	<u>Pumping Mode^a</u>				
	<u>5</u>	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>
November	0	0	7	60	33
December	0	0	4	35	61
January	0	6	0	42	52
February	0	0	11	54	35
March	0	54	46	0	0
April	3	57	40	0	0
May	0	74	26	0	0
June	0	17	50	26	7
July	0	6	6	46	42
August	0	0	16	58	27
September	0	6	27	67	0
October	0	6	52	42	0

^a See Chapter 2, Section 2.5.1.6 for mode descriptions

Note: Due to rounding, monthly totals may not equal 100 percent.

Source: Operating data provided by JEA for 11/78 through 10/79

Table 5.1-4 (Revision 1)

PREDICTED CHANGE IN MAXIMUM HEAT LOAD IN COMBINED DISCHARGE
VERSUS NORTHSIDE DISCHARGE^a

Change in Heat Load - MBtu/hr

<u>Month</u>	<u>Mode 1</u>	<u>Mode 2</u>	<u>Mode 3</u>	<u>Mode 4</u>	<u>Mode 5</u>
Jan	182.0	182.0	182.0	182.0	344.1
Feb	232.2	232.2	232.2	232.2	412.8
Mar	173.3	173.3	173.3	173.3	363.1
Apr	82.4	82.4	82.4	82.4	239.1
May	25.0	25.0	25.0	25.0	190.8
Jun	10.6	10.6	10.6	10.6	178.3
Jul	- 96.7	- 96.7	- 96.7	- 96.7	139.1
Aug	-106.6	-106.6	-106.6	-106.6	129.2
Sep	-131.0	-131.1	-131.1	-131.1	136.1
Oct	- 34.3	- 34.3	- 34.3	- 34.3	162.8
Nov	107.7	107.7	107.7	107.7	201.6
Dec	157.3	157.3	157.3	157.3	273.4

Change in Heat Load - Percent

<u>Month</u>	<u>Mode 1</u>	<u>Mode 2</u>	<u>Mode 3</u>	<u>Mode 4</u>	<u>Mode 5^b</u>
Jan	10.5	14.0	21.0	42.1	
Feb	12.1	16.1	24.1	48.2	
Mar	8.6	11.4	17.1	34.2	
Apr	4.9	6.6	9.9	19.7	
May	10.4	1.9	- 2.8	5.7	
Jun	0.6	0.8	- 1.2	2.4	
Jul	- 3.8	- 5.1	- 7.7	- 15.4	
Aug	- 4.2	- 5.7	- 8.5	- 17.0	
Sep	- 4.6	- 6.1	- 9.2	- 18.4	
Oct	- 1.6	- 2.2	- 3.3	- 6.5	
Nov	10.7	14.3	21.5	43.0	
Dec	12.7	16.9	25.4	50.8	

a Based on values presented in Appendix C, Tables C-3 through C-7 and shown in Figure 5.1-1

b Percent not applicable - Northside Station not operating or decommissioned

Table 5.1-5 (Revision 1)

PREDICTED CHANGE IN AVERAGE HEAT LOAD IN COMBINED DISCHARGE
VERSUS NORTHSIDE DISCHARGE^a

Change in Heat Load - MBtu/hr

<u>Month</u>	<u>Mode 1</u>	<u>Mode 2</u>	<u>Mode 3</u>	<u>Mode 4</u>	<u>Mode 5</u>
Jan	18.4	18.4	18.4	18.4	217.3
Feb	10.9	10.9	10.9	10.9	200.6
Mar	51.6	51.6	51.6	51.6	208.2
Apr	- 57.0	- 57.0	- 57.0	- 57.0	127.3
May	-114.2	-114.2	-114.2	-114.2	88.4
Jun	-115.5	-115.5	-115.5	-115.5	89.0
Jul	-183.5	-183.5	-183.5	-183.5	54.2
Aug	-198.1	-198.1	-198.1	-198.1	54.3
Sep	-239.1	-239.1	-239.1	-239.1	63.1
Oct	-192.0	-192.0	-192.0	-192.0	78.8
Nov	- 56.1	- 56.1	- 56.1	- 56.1	89.4
Dec	- 37.3	- 37.3	- 37.3	- 37.3	130.4

Change in Heat Load - Percent

<u>Month</u>	<u>Mode 1</u>	<u>Mode 2</u>	<u>Mode 3</u>	<u>Mode 4</u>	<u>Mode 5^b</u>
Jan	0.9	1.2	1.7	3.5	
Feb	0.5	0.7	1.1	2.1	
Mar	3.1	4.1	6.2	12.3	
Apr	- 2.9	- 3.9	- 5.8	- 11.6	
May	- 5.3	- 7.0	- 10.6	- 21.1	
Jun	- 5.3	- 7.1	- 10.6	- 21.2	
Jul	- 7.2	- 9.6	- 14.5	- 28.9	
Aug	- 7.4	- 9.8	- 14.7	- 29.4	
Sep	- 7.4	- 9.9	- 14.8	- 29.7	
Oct	- 6.6	- 8.9	- 13.3	- 26.6	
Nov	- 3.6	- 4.8	- 7.2	- 14.5	
Dec	- 2.1	- 2.8	- 4.2	- 8.3	

a Based on values presented in Appendix C, Tables C-8 through C-12 and shown in Figure 5.1-2

b Percent not applicable - Northside Station not operating or decommissioned

Table 5.1-6 (Revision 1)

MAXIMUM PREDICTED 2 DEGREE F PLUME LENGTHS AND AREAS, BY MONTH,
ASSOCIATED WITH PROPOSED PLANT OPERATION UNDER AVERAGE CASES^{a, b}

Month	Northside Only		Northside and Proposed Plant		Proposed Plant Only	
	Centerline Distance (feet)	Area (Acres)	Centerline Distance (Feet)	Area (Acres)	Centerline Distance (feet)	Area (Acres)
January	894	1.21	1126	2.08	0	0
February	821	.97	999	1.58	0	0
March	564	.31	795	0.90	0	0
April	787	.87	800	0.91	0	0
May	974	1.49	898	1.22	0	0
June	995	1.56	917	1.29	0	0
July	1347	3.10	1149	2.18	0	0
August	1515	3.99	1287	2.80	0	0
September	2145	8.29	1876	6.27	0	0
October	1746	5.40	1520	4.02	0	0
November	478	.14	467	0.12	0	0
December	635	.47	670	0.55	0	0

a See Appendix C, Figures C-21 through C-28 for predicted plume lengths and areas under all Northside Station operational modes. Data presented in this table only represent maximums.

b Plume predictions are for conditions within one meter of the Blount Island Channel surface (in accordance with Northside Station NPDES permit requirements).

Table 5.1-7 (Revision 1)

MAXIMUM PREDICTED 2 DEGREE F PLUME LENGTHS AND AREAS, BY MONTH,
ASSOCIATED WITH PROPOSED PLANT OPERATION UNDER EXTREME CASES^{a, b}

Month	Northside Only		Northside and Proposed Plant		Proposed Plant Only	
	Centerline Distance (feet)	Area (Acres)	Centerline Distance (Feet)	Area (Acres)	Centerline Distance (feet)	Area (Acres)
January	618	.43	1204	2.42	375	0.00
February	767	.81	1607	4.53	537	0.26
March	826	.99	1513	3.98	415	0.04
April	554	.29	862	1.10	180	0.00
May	636	.47	794	0.89	0	0.00
June	655	.52	776	0.84	0	0.00
July	1327	3.00	1290	2.82	0	0.00
August	1327	3.00	1274	2.74	0	0.00
September	1695	5.07	1601	4.49	0	0.00
October	919	1.29	975	1.49	0	0.00
November	210	0.00	411	0.03	0	0.00
December	318	0.00	682	0.58	236	0.00

^a See Appendix C, Figures C-29 through C-36 for predicted plume lengths and areas under all Northside Station operational modes. Data presented in this table only represent maximums.

^b Plume predictions are for conditions within one meter of the Blount Island Channel surface (in accordance with Northside Station NPDES permit requirements).

Table 5.1-8 (Revision 1)

ESTIMATED PLANT EFFLUENT QUALITY AT POINT OF DISCHARGE TO THE ST. JOHNS RIVER
FOR CHEMICAL PARAMETERS COMPLYING WITH CLASS III WATER QUALITY CRITERIA

Parameter	Class III Standard ^a	Average Ambient ^d	Case ^b POD ^e	Maximum Ambient ^d	Case ^c POD ^e
Antimony, ug/l	200	<0.2	15.3	0.95	49.4
Arsenic, ug/l	50	0.69	1.08	1	2.28
BOD ₅ , mg/l	Appropriate D.O. must be maintained	2.1	N/A	6.7	N/A
Bromates (as bromides), mg/l	100	37.1	38.2	63	69
Bromine, mg/l	0.1	(f)	-	(f)	-
Cadmium, ug/l	5.0	0.29	0.84	2.2	4.2
Chromium, hexavalent, mg/l:	0.50 (in effluent)	-	<0.001	-	<0.001
total, mg/l:	1.0 (in effluent)	-	0.003	-	0.009
	0.05 (after mixing)	0.002	-	0.005	-
Coliform, fecal, MPN/100 ml	800 (daily max.)	24	N/A	200	N/A
Coliform, total	2400/100 ml (max.)	562	N/A	10,000	N/A
Detergents, mg/l	0.5	(b)	-	(b)	-
Dissolved gases	110% of saturation value at the existing atmospheric and hydrostatic pressures	(b)	-	(b)	-
Dissolved oxygen, mg/l	minimum, 4; 24 hr. avg., 5	6.9	<4	4.1j	<4
Fluorides, mg/l	5.0	0.48	0.57	0.56	0.88
Lead, ug/l	50	0.37	1.4	10	14
Nickel, mg/l	0.1	0.003	0.009	0.017	0.038
Nutrients ^h	nutrient concentrations shall not be altered so as to cause an imbalance in natural populations of aquatic flora and fauna	0.72	0.74	2.1	2.3

Table 5.1-8 (Revision 1) (Continued)

ESTIMATED PLANT EFFLUENT QUALITY AT POINT OF DISCHARGE TO THE ST. JOHNS RIVER
FOR CHEMICAL PARAMETERS COMPLYING WITH CLASS III WATER QUALITY CRITERIA

Parameter	Class III Standard ^a	Average Ambient ^d	Case ^b PODe	Maximum Ambient ^d	Case ^c PODe
Pesticides and Herbicides	(detailed in (a))	(f)	-	(f)	-
pH, st'd units	6.5-8.5	7.8	7.8	7.6/8.2 ^k	7.6/8.2
Phosphorus (elemental), ug/l	0.1	(i)	-	(i)	-
Polychlorinated Biphenyls, ug/l	0.001	0.001	N/A	0.001	N/A
Radioactive substances radium 226 and 228; picocuries/l: gross alpha particle activity (including Ra 226, but excluding radon and uranium); picocuries	5 15	(f) (f)	- -	(f) (f)	- -
Turbidity, JTU	50 above background levels	17	N/A	61	N/A
Zinc, mg/l	1	0.046	0.05	0.15	0.17

a See Table 2.5-1

b Average case uses mode 2 NGS flow conditions and either zero or maximum material handling, storage and disposal area discharge, whichever is more conservative.

c Maximum case uses mode 4 NGS flow conditions and either zero or maximum material handling, storage and disposal area discharge, whichever is more conservative.

d Ambient conditions are mean tide composites from Transect G for average case and maximum tide composites at surface or bottom from Transect G for maximum case (Section 2.5.1.5 and Appendix C, Table C-30).

e POD is point of discharge into St. Johns River through existing submerged diffuser.

f Parameter not analyzed during pre-application water quality monitoring program.

g Both free available chlorine and total residual chlorine will be in compliance with USEPA standards in 40 CFR 423, 1974 (see Table 5.1-1).

h Nitrogen compounds reported as total Kjeldahl nitrogen, mg/l.

i Phosphorus measured as total phosphorus during pre-application water quality monitoring program.

j Dissolved oxygen value reported is minimum observed at Transect G.

k pH values are minimum/maximum observed at Transect G.

Note: N/A - Parameter cannot be treated as conservative constituent within plant systems.

Table 5.1-9 (Revision 1)

Parameter	Class III Standard ^a	Average Case ^b			Mixing Zone Influence			Maximum Case ^c		
		Ambient Conc. ^d	Estimated POD Conc. ^e	Concentration at M.Z. Boundary ^f	Mixing Zone Area Req'd ^f (Acres)	Ambient Conc. ^d	Estimated POD Conc. ^e	Concentration at M.Z. Boundary ^f	Mixing Zone Influence Area Req'd ^f (Acres)	
Aluminum, mg/l	1.5	0.49	0.5	g	g	3.63j	4.41j	3.7 3.68 3.67 3.665j	0.67 4.5 14.9 31	
Chlorides, mg/l	10% increase above background	13,011	13,436	g	g	20,400	22,617j	21,011	0.19	
Chlorine, Total Residual, mg/l	0.01	0.04	1, j	1, j	1	0.2	1, j	1, j	1	
Copper, mg/l	0.015	0.069	0.073	0.0705 0.0699 0.0699 0.0696 ^h	0.13 0.7 2.9 31	0.275j	0.3j	0.285 0.283 0.282 0.282j	0.67 4.5 14.9 31	
Cyanide, mg/l	0.005	0.01	0.01	0.01 ^h	h	0.09j	0.099j	0.092 0.091 0.091 0.091j	0.67 4.5 14.9 31	
Iron, mg/l	0.30	0.80	0.83	0.808 0.806 0.805 0.801 ^h	0.13 0.7 2.9 31	2.7j	3j	2.76 2.74 2.73 2.73j	0.67 4.5 14.9 31	
Mercury, ug/l	0.10	0.24	0.56	0.32 0.30 0.29 0.25j	0.13 0.7 2.9 31	0.6j	1.67i, j	0.82 0.75 0.71 0.7j	0.67 4.5 14.9 31	
Oil and grease, (dissolved), mg/l	5.0	2.0	2.1	g	g	9.0j	9.9j	9.2 9.1 9.1 9.1j	0.67 4.5 14.9 31	

Table 5.1-9 (Revision 1) (Continued)
INFLUENCE OF ST. JOHNS RIVER MIXING ZONES ON CHEMICAL PARAMETERS
ESTIMATED TO EXCEED CLASS III STANDARDS AT POINT OF DISCHARGE

Parameter	Class III Standard ^a	Average Case ^b				Maximum Case ^c			
		Ambient Conc. ^d	Estimated POD Conc. ^e	Mixing Zone Concentration at M.Z. Boundary ^f	Mixing Zone Influence Area Req'd ^g (Acres)	Ambient Conc. ^d	Estimated POD Conc. ^e	Mixing Zone Concentration at M.Z. Boundary ^f	Mixing Zone Influence Area Req'd ^g (Acres)
Selenium, mg/l	25	0.5	15	8	8	0.75	47j	13.5	0.19
Silver, ug/l	0.05	0.16	0.21	0.173	0.13	0.35j	0.54j	0.39	0.67
				0.171	0.7			0.38	4.5
				0.168	2.9			0.37	14.9
				0.161h	31			0.37	31

a See Table 2.5-1

b Average case used mode 2 Northside Station flow conditions and either zero or maximum material handling, storage and disposal area discharge and mean ambient water quality.

c Maximum case used mode 4 Northside Station flow conditions and either zero or maximum material handling, storage and disposal area discharge and maximum ambient water quality unless zero flow yielded highest POD concentrations.

d Ambient conditions are mean tide composites from Transect G for average case and maximum tide composites at surface or bottom from Transect G for maximum case (Section 2.5.1.5 and Appendix C, Table C-30).

e POD is point of discharge into St. Johns River through existing submerged diffuser.

f Approximate mixing zone area required to achieve stated concentration at boundary of respective mixing zone.

g At or below Class III Standard at POD; therefore, no mixing zone required.

h At or below ambient concentration; therefore, no further decrease possible through mixing with ambient.

i Not available, will be below EPA standard (40 CFR Part 423).

j Exceeds Class III water quality criterion.

Table 5.1-10

MAXIMUM PERMISSIBLE CONTAMINANT LEVELS
FOR PARAMETERS AFFECTING GROUNDWATER^a

<u>Contaminant</u>	<u>Level (mg/l)</u> ^b
Arsenic	0.05
Barium	1.0
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate (as N)	10
Selenium	0.01
Silver	0.05
Chlorinated hydrocarbons:	
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
Chlorophenoxys:	
2,4-D	0.1
2,4,5-TP Silvex	0.01
Coliform bacteria	4/100 ml
Radium-226 and Radium-228	5 pCi/l
Fluoride	1.4-2.4
	(temperature dependent)

^a Source: 40 CFR Part 257, 1979

^b unless otherwise noted

Table 5.1-11 (Revision 1)

ESTIMATED CHARACTERISTICS OF COOLING TOWER BLOWDOWN

Parameter	Average ^a	Maximum ^b
Alkalinity (CaCO ₃), mg/l	134	158
Bromide, mg/l	53.4	93.8
Chloride, mg/l	18,742	30,388
Cyanide, mg/l	0.014	0.134
Fluorides, mg/l	0.687	.834
Nitrogen, Kjeldahl-N, mg/l	1.04	3.13
Oil and Grease, mg/l	2.9	13.4
pH, st'd units	7.9	8.2
Phenols, ug/l	11.7	79
Phosphorus, Total, mg/l	0.25	1.34
Silica, Dissolved, mg/l	4.6	11.6
Solids, Total Dissolved, mg/l	33,171	51,243
Sulfate (SO ₄), mg/l	2,501	3,873
Sulfide, ug/l	0.043	0.074
Aluminum, mg/l	0.703	5.4
Antimony, ug/l	0.27	1.4
Arsenic, ug/l	0.99	1.5
Beryllium, ug/l	0.13	0.28
Boron, mg/l	4.5	7.0
Cadmium, ug/l	0.42	3.3
Calcium, mg/l	391	588
Chromium (Total), ug/l	2.3	7.4
Copper, ug/l	100	410
Iron, mg/l	1.2	4.0
Lead, ug/l	0.53	15
Magnesium, mg/l	1,215	1,788
Manganese, ug/l	39.3	134.1
Mercury, ug/l	0.35	0.89
Nickel, ug/l	4.8	25
Potassium, mg/l	385	544
Selenium, ug/l	0.72	1.1
Silver, ug/l	0.23	0.52
Sodium, mg/l	10,301	13,630
Zinc, ug/l	66.6	222

a Average cooling tower evaporation and mean chemical concentrations in St. Johns River (Section 2.5.1.5).

b Maximum cooling tower evaporation and maximum chemical concentrations in St. Johns River (Section 2.5.1.5).

Table 5.1-12

MAXIMUM, MINIMUM AND AVERAGE AMBIENT TEMPERATURES
IN BLOUNT ISLAND CHANNEL^a,
NOVEMBER, 1978 THROUGH OCTOBER, 1979

<u>Month</u>	<u>Year</u>	<u>Intake Temperature °F</u>		<u>Minimum</u>
		<u>Maximum</u>	<u>Average</u>	
November	1978	72.6	70.9	69.0
December	1978	69.8	67.0	64.3
January	1979	63.9	59.5	55.3
February	1979	61.6	57.1	52.4
March	1979	65.4	61.8	56.0
April	1979	72.8	70.8	68.6
May	1979	77.8	76.5	75.2
June	1979	81.6	79.6	77.3
July	1979	85.6	83.6	80.3
August	1979	86.2	84.0	81.7
September	1979	83.9	82.7	81.5
October	1979	78.6	77.1	75.9

a Measured by JEA (1979) at the intake of the Northside Station on an hourly basis.

Table 5.1-13 (Revision 1)

MAXIMUM PREDICTED MIXING ZONE ISOTHERM EXTENTS^a, BY MONTH,
DURING COMBINED OPERATION OF THE PROPOSED PLANT WITH NORTHSIDE STATION AND NORTHSIDE STATION ALONE, UNDER AVERAGE CONDITIONS^b

Month	Approximate POD Temperature °F	Average ^c Ambient Temperature °F	Plume Extent (Acres) ^{d,e}		Maximum Plume Width (ft.) at 1 Meter ^{e,f}	
			20°F Isotherm Combined Operation	40°F Isotherm Combined Operation	2° Isotherm Combined Operation	4° Isotherm Combined Operation
			Northside Alone	Northside Alone	Northside Alone	Northside Alone
January	71.3	59.5		0.00	0.00	70
February	68.5	57.1		0.00	0.00	62.5
March	72.0	61.8		0.00	0.00	50
April	80.8	70.8		0.00	0.00	48
May	87.0	76.5		0.00	0.00	61
June	90.2	79.6	1.29	0.00	229	57
July	95.5	83.6	2.18	0.00	287	72
August	96.6	84.0	2.80	0.00	323	81
September	97.8	82.7	5.86	0.10	454	114
October	90.8	77.1		0.00	0.07	95
November	78.7	70.9		0.00	0.00	38
December	76.2	67.0		0.00	0.00	47

a As defined in Chapter 17-3.05(1)(d), thermal surface water criteria for protection of aquatic life in coastal waters require that temperatures at the edge of a reasonable mixing zone not exceed 20°F above ambient water temperature or 92°F, whichever is less, during the months of June, July, August and September. The limits for the other months are 40°F above ambient water temperature or 90°F, whichever is less. During operation of the proposed plant, the 20°F and 40°F limitations will be applicable, respectively (see Table 5.1-12 and Appendix C, Tables C-3 and C-8).

b Average ambient temperatures and both units at 100 percent load.

c Average ambient temperatures from Table 5.1-12.

d See Table 5.1-6.

e The Northside Station NPDES Permit (see Section 5.1.2.2 and Appendix C) allows mixing zones of 102.27 acres (825 ft. wide x 5400 ft. long) and 35.72 acres (399 ft. wide x 3900 ft. long) for the 20°F above ambient isotherm and 40°F above ambient isotherm, respectively.

f Approximate width of Blount Island Channel at a depth of 1.0 meter is 1,500 feet.

Table 5.1-14 (Revision 1)

COMPARISON OF PREDICTED ALUMINUM, IRON, COPPER, CYANIDE, MERCURY, SILVER, CHLORINE AND SELENIUM CONCENTRATIONS IN THE BLOUNT ISLAND CHANNEL
DURING PROPOSED PLANT OPERATION TO TOXICITY LEVELS REPORTED FOR SIGNIFICANT INDIGENOUS SPECIES
OF THE BLOUNT ISLAND CHANNEL

Parameter	Ambient ^a Concentration		Class III Standard ^b	Estimated POD Concentration ^a		Estimated Concentration at Edge of 31 Acre Mixing Zone ^c		Toxicity Levels for Most Sensitive Reported Significant Indigenous Species ^f		
	Avg	Max		Avg ^c	Max ^d	Avg ^c	Max ^d	96 hrLC50 ^g	Acute ^h	Chronic ^j
Cyanide (mg/l)	0.01	0.09	0.005	0.01	0.099	1	0.091	0.030	0.010	j
Iron (mg/l)	0.80	2.7	0.30	0.83	3.0	1	2.73	25	8.5	1.3
Silver (ug/l)	0.16	0.35	0.05	0.21	0.54	1	0.37	~5.8k	~1.9	~0.3
Copper (mg/l)	0.069	0.275	0.015	0.072	0.3	1	0.282	0.180	0.060	j
Aluminum (mg/l)	0.49	3.63	1.5	j	4	j	3.66	8.9-17.8	3.0-5.9	j
Mercury (ug/l)	0.24	0.6	0.1	0.56	1.67	0.25	0.252	~5.6k	~1.9	~0.28
Total Residual Chlorine (mg/l)	0.04	0.2	0.01	m	m	m	m	0.037	0.012	j
Selenium (ug/l)	0.5	0.75	25	j	47	j	j	n	n	n

^a See Table 5.1-9.

^b See Table 2.5-1.

^c Footnote b, Table 5.1-9.

^d Footnote c, Table 5.1-9.

^e See Appendix C, Section C.6 for estimated concentrations. As discussed in Section 5.1.1, Section 17-4.244(1)(g), FAC, allows maximum chemical mixing zones of 125,600 square meters (31 acres) for estuaries.

^f Significant indigenous species is defined as an important species of the Blount Island Channel as determined through recent studies including the preoperational monitoring program (see Table 5.1-15).

^g The concentration of the pollutant lethal to 50 percent of the test organisms in 96 hours (96 hrLC50) where the 96 hrLC50 is the lowest value which has been determined for a species significant to the indigenous aquatic community, i.e., Blount Island Channel; or may reasonably be expected, based upon evaluation by generally accepted scientific methods, to produce effects equal to those of the concentration of the substance specified above.

^h Defined as one-third of the 96 hrLC50.

ⁱ Defined as one-twentieth of the 96 hrLC50.

^j Concentration below Class III standard.

^k 48 hrLC50.

^l Value less than or essentially equal to observed average ambient concentrations.

^m Not available, will be below EPA standard (40 CFR Part 423).

ⁿ Toxicity data on significant indigenous species not available.

Table 5.1-15 (Revision 1)

INDICATOR SPECIES AND SENSITIVITIES USED IN COMPUTING ACUTE AND CHRONIC TOXICITY CONCENTRATIONS
FOR CYANIDE, IRON, SILVER, COPPER, CHLORINE, CADMIUM, ANTIMONY, LEAD, ALUMINUM AND MERCURY

Parameter	Indicator Species	Reported 96 hrLC ₅₀ Concentration	Reason for Selection
Cyanide	Copepod <u>Acartia clausi</u>	0.030 mg/l HCN as CN (USEPA, 1980b)	Significant Indigenous Species ^f
Iron	Mosquitofish <u>Gambusia affinis</u>	25 mg/l FeCl ₃ as Fe (Wallen et al., 1957)	Substitute for Significant Indigenous Species ^c
Silver	American oyster-embryod <u>Crassostrea virginica</u>	5.8 ug/l AgNO ₃ as Ag ^e (Calabrese et al., 1973)	Significant Indigenous Species ^f
Copper	Polychaete worm - trochophore ^d <u>Capitella capitata</u>	180 ug/l CuSO ₄ as Cu (Reish et al., 1976)	Significant Indigenous Species ^f
Aluminum	White shrimp <u>Penaeus setiferus</u>	8.9-17.8 mg/l AlCl ₃ as Al ^g (Pulley, 1950)	Significant Indigenous Species ^f
Mercury	American oyster-embryod <u>Crassostrea virginica</u>	5.6 ug/l HgCl ₂ as Hg ^e (Calabrese et al., 1973)	Significant Indigenous Species ^f
Total Residual Chlorine	Atlantic silversides <u>Menidia menidia</u>	0.037 mg/l Ca(OCl) ₂ as Cl (Roberts et al., 1975)	Significant Indigenous Species ^f
Cadmium	Polychaete worm-trochophore ^d <u>Capitella capitata</u>	0.22 mg/l CdCl ₂ as Cd Riech et al., 1976	Significant Indigenous Species ^f
Antimony	Sheepshead minnow <u>Cyprinodon variegatus</u>	6200-8300 ug/l SbO ₃ as Sb USEPA, 1978	Substitute for Significant Indigenous Species ^c
Lead	Polychaete worm trochophore ^d <u>Capitella capitata</u>	1.2 mg/l Pd(CH ₃ CO ₂) ₂ ·3H ₂ O as Pb Riech et al., 1976	Significant Indigenous Species

a For a comparative summary of toxicities for other significant indigenous species, refer to Appendix B, Tables B-22 through B-27.

b Only significant indigenous species reported in the available literature.

c There was no report of iron toxicity for a significant indigenous species; therefore, the mosquitofish was used since it occurs in the tidal creeks of the study area and may reasonably be expected to produce effects equal to those of significant indigenous species, i.e., those that commonly occur in Blount Island Channel.

d Planktonic stage.

e Based on the 48 hrLC₅₀ since 96 hrLC₅₀ was not reported; concentration of pollutant for 96 hrLC₅₀ expected to be slightly lower than at the 48 hrLC₅₀.

f Most sensitive of several significant indigenous species reported in the available literature.

g Three other significant indigenous species of nekton within this toxicity range include red drum (Sciaenops ocellata), spotted seatrout (Cynoscion nebulosus), and striped mullet (Mugil cephalus).

Table 5.1-16

Deleted in Revision 1

As a result of the placement of the blowdown into the discharge channel, this table is no longer applicable.

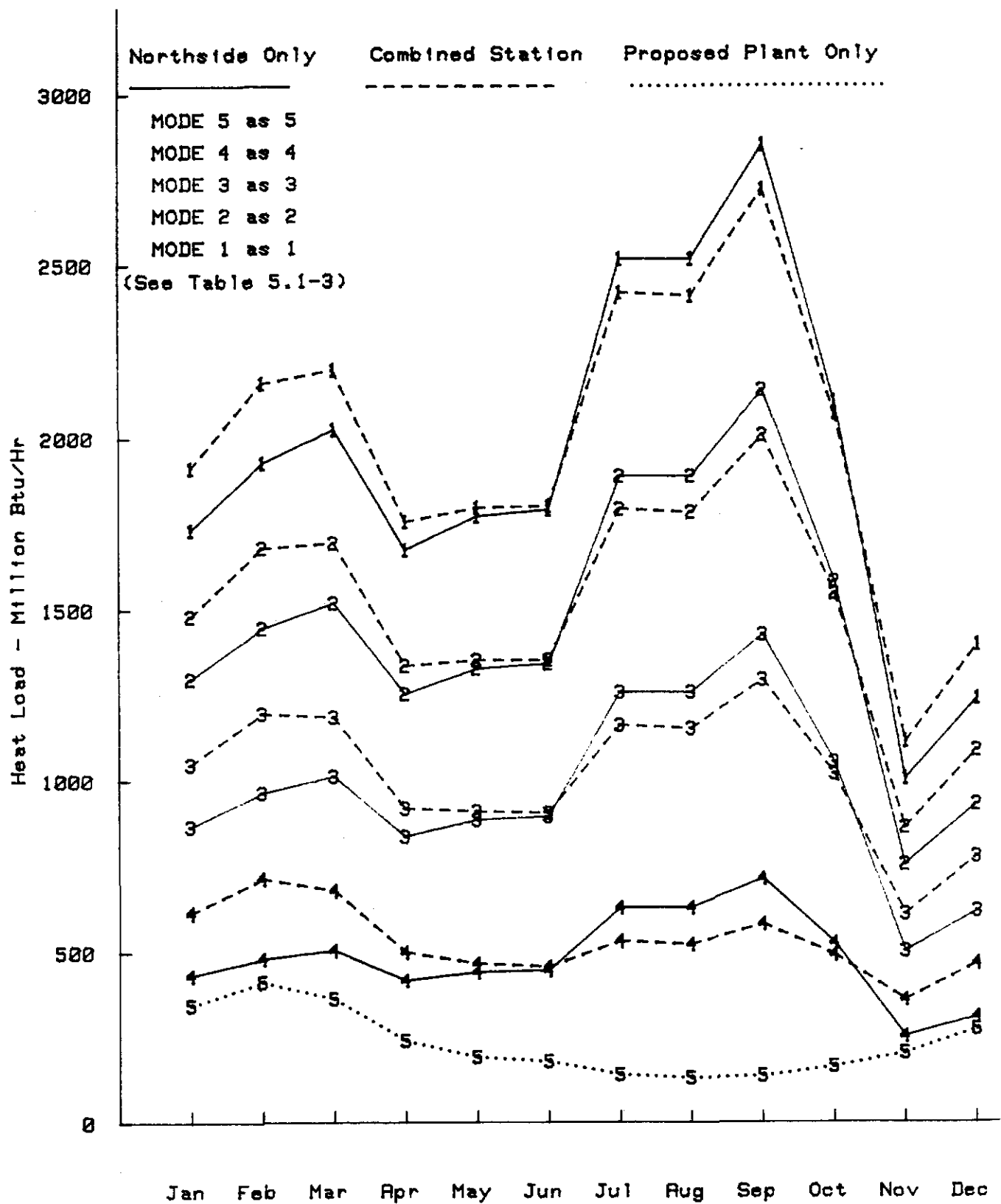


Figure 5.1-1 Heat Rejection Rate - Extreme Conditions

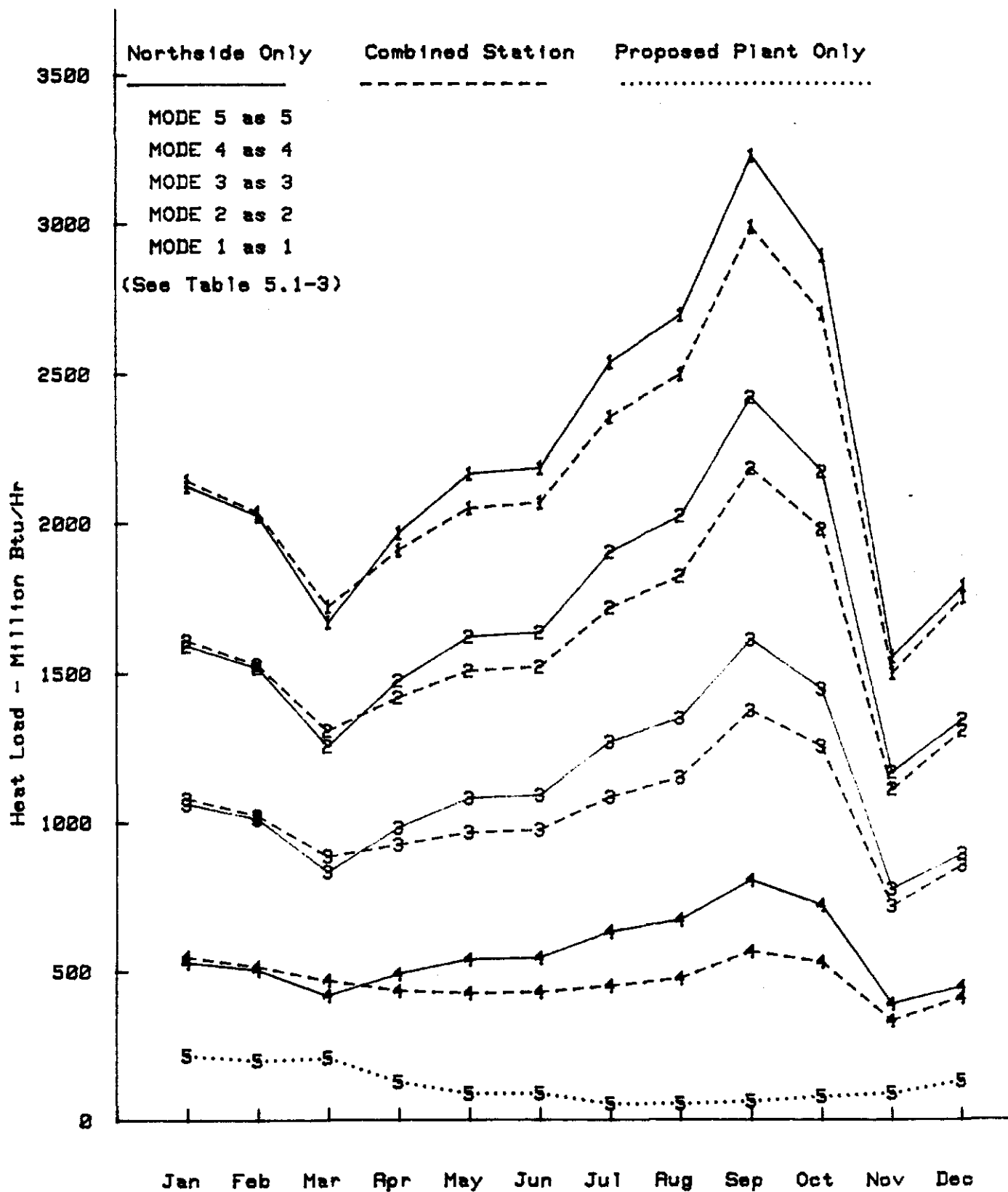
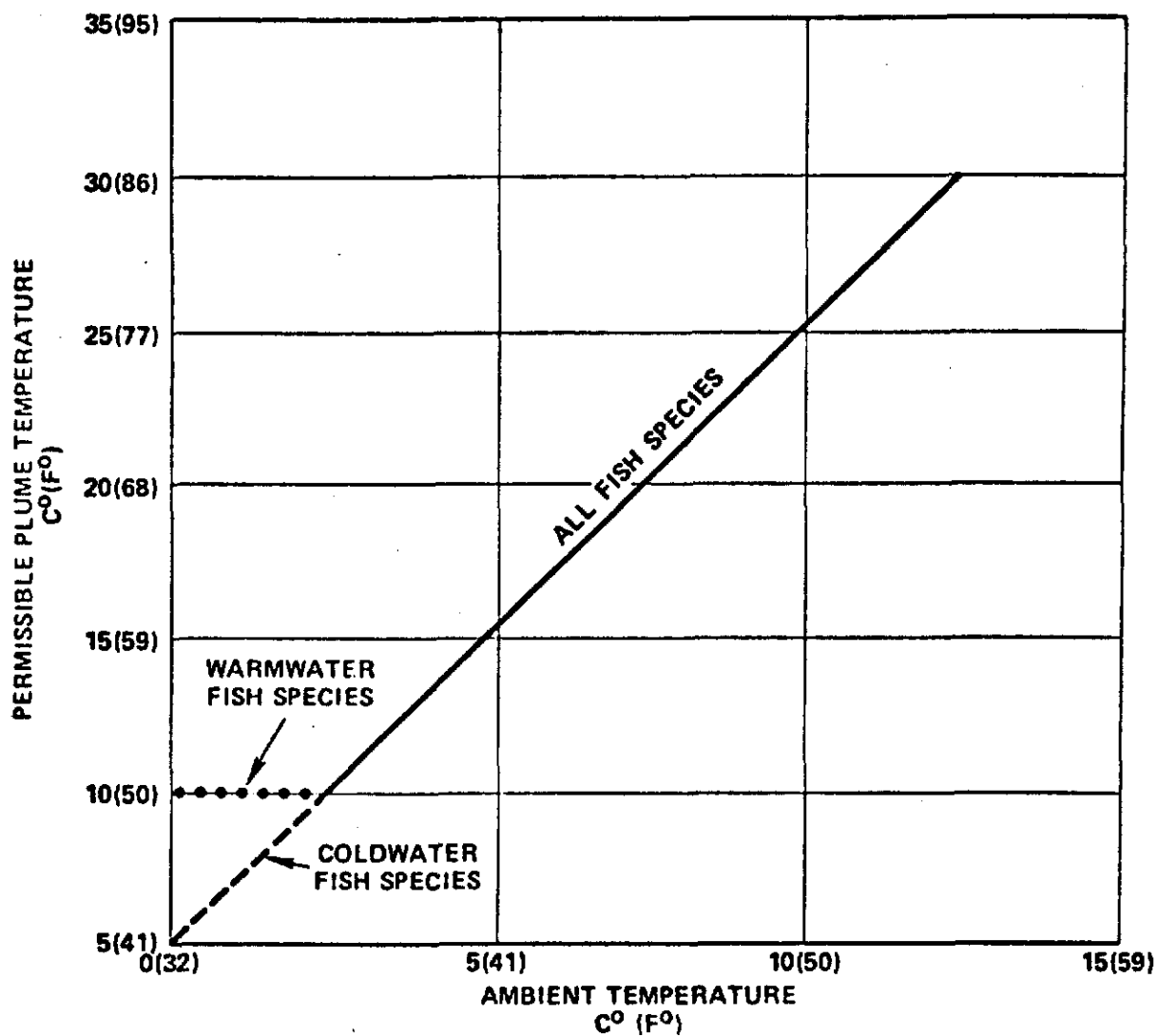


Figure 5.1-2 Heat Rejection Rate - Average Conditions



INFORMATION SOURCE:
(E.P.A. 1976)

Figure 5.1-3 Allowable Thermal Plume Temperatures for the Minimization of Cold Shock in the Event of Plant Shutdown

5.2 PLANT WATER USE

5.2.1 Cooling Water Intake

Blount Island Channel carries 43 percent of the total flow of the St. Johns River; the remaining 57 percent passes through the Fulton-Dame Point Cutoff. Under maximum load conditions, the cooling system of the NGS withdraws approximately 6 percent of the average tidal flow of Blount Island Channel or a maximum of 2.6 percent of the total St. Johns River tidal flow. The proposed plant will remove a maximum of 187,500 m³ (34,400 gpm) of makeup water per day from the NGS discharge or a maximum of 0.3 percent of total river flow for cooling water makeup.

Table 5.2-1 summarizes the cooling water requirements of the NGS in different operational modes. Data are presented for the proposed plant operating alone, for NGS and the proposed plant operating concurrently, and for the NGS operating alone.

Location, design, construction, and capacity of the intake cooling water system are based on best available control technology, and therefore, should satisfy the requirements of Section 316(b) of P.L. 92-500 of the Federal Water Pollution Control Act. These features of the proposed plant are described in Chapter 3, Section 3.4.1 and 3.4.2. Therefore, the intake is designed to have a low potential impact on the aquatic environment.

5.2.1.1 Impingement

No increased impingement of nekton will result from the operation of the proposed plant during combined operation with the NGS. Cooling tower makeup water will be withdrawn from the discharge of the existing once-through cooling water system of the NGS (Chapter 3, Section 3.4.2). Thus, flow rates and velocities at the NGS travelling screens will be equal

to the existing flows and velocities of the NGS. Since makeup water for the proposed plant will have already passed through the NGS's travelling screens, organisms which are subject to impingement will have been removed.

When the proposed plant is operating alone, two circulating water pumps from the NGS will be operated to maintain a minimum flow of 98,000 gpm. NGS impingement associated with this flow is currently estimated to be 125,000 fish, 41,000 commercial shrimp and 17,000 blue crabs per year (Rehm et al., 1975). However, NGS is equipped with a fish return system and most of the impinged nekton should be transferred to San Carlos Creek (JEA, 1976a; JEA, 1979; White and Brehmer, 1976).

5.2.1.2 Entrainment

Aquatic organisms which pass through the 3/8-inch screens of the NGS fish return system will be subject to entrainment by the proposed plant. A small percentage of the NGS discharge and previously entrained organisms will be withdrawn into the proposed plant's cooling system as part of the makeup water. Phytoplankton entrainment losses were not projected based on the premise that in an estuarine system with good tidal exchanges, "losses of phytoplankton by entrainment rarely, if ever, can be documented outside the immediate vicinity of a plant area and are of little consequence" (Schubel and Marcy, 1978). For zooplankton and ichthyoplankton, the projection of entrainment rates and impacts for the proposed plant were based on the direct measurements of entrainment at the NGS during the 1979-1980 monitoring program. As discussed below, operation of the proposed plant will not increase the effects on the entrainment of zooplankton and fish eggs and larvae in relation to existing effects of the NGS operation. Cooling water makeup flows were used in conjunction with the 1979-1980 entrainment data for the NGS and estimated mortality rates to project entrainment impacts for the proposed plant.

Maximum and minimum mortalities used for estimating mortalities at the NGS were projected from tests at NGS (Rehm et al., 1975), and other generating stations located in estuarine systems (Beck and Miller, 1974; Cannon et al., 1977; and Beck et al., 1978). Mortality was reported as ranging from 60-100 percent for ichthyoplankton and 30-90 percent for zooplankton. Maximum impacts of the proposed plant were derived using minimum mortality rates for the NGS and a 100 percent mortality rate for the proposed plant.

Based on the 1979-80 entrainment studies at the NGS, zooplankton entrainment will be unchanged during combined operation (Table 5.2-2). Entrainment during operation of the proposed plant alone is expected to be approximately 15 percent of the NGS rate which is an annual projected range between 12×10^9 and 514×10^9 organisms per season (Table 5.2-2).

The dominant zooplankton entrained by the NGS is the calanoid copepod, Acartia tonsa. In the 1979-80 entrainment studies, this hardy organism accounted for approximately 65 percent of the total zooplankton entrained and is an ideal indicator organism for entrainment effects. Other copepods accounted for 18 percent of the zooplankton community while the remaining 17 percent were meroplankton (Chapter 2, Section 2.8.1). Although projected plant impacts were calculated based on percent mortalities for A. tonsa, Table 5.2-3 lists percent mortalities for other zooplankton species common to the Blount Island Channel.

Studies by Rehm et al. (1975) show 30 to 90 percent lethal entrainment of A. tonsa at the NGS. Entrainment mortalities of 90 percent were found when ambient water temperatures exceeded 77°F and 30 percent entrainment mortalities occurred when ambient water temperatures were below 59°F. NGS entrainment mortalities reported by Rehm et al. were similar to those found by Prager et al. (1970) at the Turkey Point Power Plant in Miami, Florida, as reported in Beck et al. (1978).

Projected zooplankton mortality losses for the proposed plant with and without the influence of the NGS are presented in Table 5.2-2. During periods when ambient water temperatures are less than 59°F, about two months, entrainment losses from combined operation of the proposed plant with NGS may potentially increase by approximately 32 percent relative to current projected NGS losses (Table 5.2-2). However, losses are projected to increase by only 2 percent when ambient temperatures exceed 77°F. When operating alone, entrainment losses at the proposed plant are projected to decrease by 55 to 85 percent when compared to the NGS (Table 5.2-2) which has a projected range of mortality losses between approximately 4×10^9 and 463×10^9 organisms per season.

A comparison of the projected loss of mesozooplankton from entrainment to the number of organisms expected to pass through the Blount Island Channel is presented in Table 5.2-4. Projections for passage of the mesozooplankton through the Blount Island Channel are based on data collected from stations EP1, EP2 and EP3 (Appendix B, Table B-3) while entrainment projections are based on plant passage studies at the NGS.

Operation of the proposed plant is expected to produce the highest percent loss on the mesozooplankton population passing through the Blount Island Channel during the fall and spring. However, these losses are predicted to represent only approximately 0.7 percent of the mesozooplankton travelling through the Blount Island Channel (Table 5.2-4). Annual entrainment losses of the mesozooplankton population passing through the Blount Island Channel are predicted to range between 0.1 and 0.7 percent (Table 5.2-4). These small losses to the total mesozooplankton population coupled with inherently high recruitment rates of the dominant calanoid copepods (e.g., 10 day life cycle for Acartia tonsa; Reeve, 1975) are not expected to produce a measurable impact on the mesozooplankton populations in the Blount Island Channel.

Table 5.2-5 presents the projected 1979-80 daily entrainment rates of ichthyoplankton as determined from water column density (fall) and actual entrainment measurements (winter, spring, summer). Currently, the NGS is

entraining ichthyoplankton at the estimated average rate of 46,000 larvae per day during the fall, 106,300 larvae/day in the winter, 1,419,000/day in the spring and 6,616,000/day during the summer. Combined operation of the proposed plant with the NGS is not expected to change seasonal entrainment (Table 5.2-5). When the proposed plant operates without the NGS, current entrainment rates are expected to decline by 86 percent (Table 5.2-5). This is a result of lower cooling water requirements of the proposed plant.

Commercially important ichthyoplankton which are expected to be entrained by the proposed plant are predominantly penaeid shrimp, Atlantic croaker, and weakfish. These represent 85 percent of the commercially important species and 27.5 percent of all the ichthyoplankton expected to be entrained by the proposed plant (Table 5.2-6). Appendix B, Table B-12 provides a quantitative listing by taxon of all ichthyoplankton entrained by the NGS during the 1979-80 entrainment survey. Projections for entrainment of commercially important ichthyoplankton during combined operation are estimated to be equal to current entrainment rates at the NGS (Table 5.2-6). In comparison, entrainment of commercially important ichthyoplankton by the proposed plant operating alone are projected to be only approximately 14 percent of current entrainment rates at the NGS. The current entrainment rate of commercially important ichthyoplankton is approximately 247×10^6 per year or approximately 33 percent of the total ichthyoplankton entrained by the NGS (Tables 5.2-5 and 5.2-6).

Total seasonal ichthyoplankton mortality losses due to entrainment effects of the proposed plant and the NGS are presented in Table 5.2-5. Assuming 100 percent mortality for passage through NGS, combined operation of the proposed plant with the NGS will not increase losses. Assuming a mortality of 60 percent through the the NGS, entrainment losses during combined operation are projected to be 9 percent greater than current

entrainment losses at the NGS. When operated alone, entrainment losses for the proposed plant are estimated to decline by approximately 76 to 86 percent in relation to current projected NGS losses.

Net losses of ichthyoplankton from operation of the proposed plant alone, in combination with the NGS and the NGS alone are presented in Table 5.2-4. These losses are compared to the estimated number of ichthyoplankton passing through the Blount Island Channel which carries approximately 43 percent of the total flow in the St. Johns River. Operating alone, highest estimated mortalities for the proposed plant are projected for the summer season (87×10^6 individuals, or a loss of 0.5 percent of the total ichthyoplankton in the Blount Island Channel). Greatest losses as a percentage of the ichthyoplankton population present in the Blount Island Channel are projected for the winter when 0.9 percent or 1.4×10^6 ichthyoplankters may be affected. These small losses will have no impact on the nekton population in the Blount Island Channel.

When the proposed plant is operating in conjunction with the NGS, projected ichthyoplankton losses per year are projected to be approximately 747×10^6 organisms or 3.2 percent of the total ichthyoplankton in the Blount Island Channel. These losses are the same as the projected small entrainment mortalities associated with NGS operation (Table 5.2-4).

5.2.2 Potable Water

Plant groundwater requirements are estimated to be approximately 2,600 gallons per minute (gpm) on an average basis, and 5,400 gallons per minute for short-term (24-hour) instantaneous demand. A description of plant water uses is included in Chapter 3, Section 3.3. The average requirement of 2,600 gpm is based on a demand of 2,150 gpm for the FGD system. However, in order to control chloride concentrations, as much as 3,150 gpm may be required continuously for the FGD system. Consequently, impacts of plant groundwater use have been analyzed for conditions of 3,600 gpm average demand and 5,400 gpm maximum demand.

The plant requirements for high quality water will be obtained from the Floridan Aquifer. Based on the results of site investigations, it is anticipated that site groundwater requirements can be satisfied by wells completed in the Ocala or upper water bearing interval within the Upper Permeable Zone (Chapter 2, Section 2.5.2). Although many large capacity Floridan wells in the site vicinity are drilled to penetrate the entire Upper Permeable zone (1,200 to 1,300 feet deep), shallower wells at the plant site should be sufficient to meet the projected demand while minimizing the potential for water quality degradation due to upward migration of mineralized water from deeper sources.

For the purpose of analysis of groundwater impacts resulting from plant water use, the following assumptions have been made, based on the results of site investigations (Chapter 2, Section 2.5.2):

Aquifer Properties

Transmissivity	100,000 gallons per day per foot
Storage coefficient	2.8×10^{-4}
Leakage	$4 \times 10^{-4} \text{ days}^{-1}$ (No storage in confining bed)

Groundwater will be developed from a production well network consisting of four wells, one of which will be essentially a standby well and one of which will be essentially a monitoring well. The four wells have been designated as Test Well F-1 and Deep Wells A, B, and C. Test Well F-1 will serve primarily as a monitoring well to monitor the drawdown effects of operation of the plant production wells. Locations at the wells are shown on Figure 5.2-2.

Test Well F-1 was drilled to a total depth of 752 feet and completed in the uppermost water bearing interval of the Floridan Aquifer, the Ocala Limestone. This well was designed to produce approximately 1,000 gallons per minute (gpm). It is anticipated that Deep Wells A, B, and C will also be drilled to a total depth of approximately 750 feet so as to penetrate

the Ocala Limestone. These wells will probably be completely with 18-inch casing to the top of the Ocala so that they can accommodate pumps capable of producing at least 1,800 gpm.

The drawdown effects of groundwater production from the Floridan Aquifer for plant water supply use have been estimated by assuming that Deep Wells A and C have been producing simultaneously at 1,800 gpm each for a period sufficiently long to establish steady-state drawdown conditions. Utilizing the aquifer properties summarized above, a steady-state cone of depression was simulated (Figure 5.2-1). This cone of depression indicated approximately 15 feet of drawdown at the nearest site boundary, with approximately 9 feet of drawdown at the nearest off-site well (Well D-1255, Figure D-5, Appendix D). Of the approximately 90 inventoried Floridan Aquifer wells shown on Figure D-5, approximately 32 could experience water level declines of 1 foot or greater, and approximately 15 could experience declines greater than 2 feet. The 1-foot drawdown contour is approximately a circle of radius 11,000 feet, and the 2-foot drawdown contour is approximately a circle of radius 8,000 feet, centered at the midpoint between Deep Wells A and C.

In order to estimate the effects of groundwater production of 5,400 gpm for a short period of time, it was assumed that the drawdown resulting from production from Deep Well B at a rate of 1,800 gpm for a period of 24 hours could be superimposed on the steady-state drawdown contours generated previously. The resultant cone of depression (Figure 5.2-2) indicated maximum drawdown at the site boundary of approximately 25 feet, with a drawdown of approximately 15 feet at Well D-1255. Of the inventoried wells shown on Figure D-5, Appendix D, approximately 50 could experience water level drawdown of greater than 1 foot, and approximately 31 could experience drawdown greater than 2 feet. The 1-foot drawdown contour is approximately a circle of radius 14,000 feet and the 2-foot contour is approximately a circle of radius 11,000 feet, centered at the midpoint between Deep Wells A and C. It should be emphasized, however, that this maximum drawdown effect will be a very short-term effect lasting for a period less than 24 hours.

At any given time, any two of the Deep Wells A, B, and C could be in operation. The effects noted above are for the particular case when Wells A and C have been in operation simultaneously in order to meet average plant groundwater demands, with additional production for Deep Wells B to meet short-term maximum groundwater demands. For conditions in which other pairs of deep wells are in operation to meet average groundwater demand, the off-site effects are essentially the same regardless of the scheme of operation of the on-site groundwater production wells.

A long term average groundwater production of 3,600 gpm is the equivalent of about 5 million gallons per day (MGD). This amount of production is relatively small compared with the total Floridan Aquifer production of 162 MGD estimated for the Jacksonville area in 1966 (Appendix D, Table D-4).

5.2.3 Other Water

There are no other plant water uses which are expected to cause changes to surface or groundwater hydrology, quality, or supply.

5.2.4 References

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Table 5.2-1 (Revision 1)

COOLING WATER REQUIREMENTS FROM BLOUNT ISLAND CHANNEL
FOR NORTHSIDE STATION OPERATING ALONE AND
IN COMBINATION WITH THE PROPOSED PLANT

Northside Operational Mode	Northside Generating Units in Operation	Northside Cooling Water Requirements ($10^6\text{m}^3/\text{day}$)	Northside Cooling Water Requirements with the Proposed Plant ($10^6\text{m}^3/\text{day}$)
1	1, 2, 3	2.14	2.14
2	[1 or 2] and 3	1.60	1.60
3	[1 and 2] or 3	1.07	1.07
4	1 or 2	0.53	0.53
Mean Daily Requirement		1.38 ^b	1.38

-
- ^a Cooling makeup water withdrawn from Blount Island Channel by the proposed plant operating alone.
- ^b Based on data collected November, 1978 through October, 1979.

Table 5.2-2 (Revision 1)

PROJECTED SEASONAL ENTRAINMENT AND MORTALITY FOR ZOOPLANKTON
DURING PROPOSED PLANT OPERATION

Generating Station	Season	Measured Mean Entrainment Density ^a (Organisms/m ³)	Projected Seasonal Entrainment ^b (x 10 ⁹ organisms)	Percent Change in Seasonal Entrainment Relative to Northside Alone	Projected Seasonal Mortality ^{c,d} (x 10 ⁹ organisms)	Percent Change in Seasonal Mortality Relative to Northside Alone
Proposed Plant Alone	Fall		1.6	- 86	1.6	30% 90%
	Winter		7.2	- 86	7.2	-55 -85
	Spring		69.7	- 86	69.7	-55 -85
	Summer		22.6	- 86	22.6	-55 -85
Proposed Plant Plus Northside	Fall		12.1	0	30% 4.7	30% 90%
	Winter		53.4	0	21.0	11.1 + 2
	Spring		514.1	0	203.0	48.8 + 2
	Summer		167.0	0	65.9	469.7 + 2
Northside Alone	Fall	96	12.1		30% 3.6	30% 90%
	Winter	423	53.4		16.0	10.9 + 2
	Spring	4071	514.1		154.2	48.1 + 2
	Summer	1322	167.0		50.1	462.7 + 2

a Entrainment measured at Northside from winter 1979 through summer 1980

Fall value determined from an average density of River Zone EP2 (Figure 2.8-4)

b Projected Seasonal Entrainment = Northside measured entrainment density x mean volume of cooling water required by plant(s)/day (1.384 x 10⁶ m³/day) x 91.25 days/season

c Northside Station assumed to have a percent mortality range from 30% to 90% based on site-specific reported mortality for the dominant zooplankter *Acartia tonsa* by Rehm et al., 1975, which closely approximates that reported in Beck et al. (1978). Proposed plant assumed to have 100% mortality

d Projected seasonal mortality for proposed plant plus Northside at $Y\% = \left[\left(\text{projected seasonal entrainment for proposed plant plus Northside} \right) \times \left(\frac{Y}{100} \right) \right] + \left[\left(\text{projected seasonal entrainment for the proposed plant alone} \right) \times \left(\frac{100-Y}{100} \right) \right]$

Table 5.2-3

SUMMER ZOOPLANKTON MORTALITIES ASSOCIATED WITH
POWER PLANT ENTRAINMENT

Type	Organism ^a	% Mortality ^b
Calanoid copepod	<u>Acartia tonsa</u>	42.3 to 92.3
Calanoid copepod	<u>Labidocera neri</u>	30.0 to 55.6
Calanoid copepod	<u>Paracalanus crassirostris</u>	41.7 to 100.0
Calanoid copepod	<u>Tortanus setacaudatus</u>	55.4
Immature copepods	Copepod nauplii	20.0 to 77.4
Cyclopoid copepod	<u>Oithona nana</u>	53.6 to 96.3
Harpacticoid copepods	Harpacticoids	47.9
Meroplankton	"Bivalve" larvae	42.0 to 100.0
Meroplankton	<u>Sagitta</u> sp.	100.0
Meroplankton	Crab Zoea	0.0 to 42.9
Meroplankton	Gastropod larvae	0.0 to 85.0
Meroplankton	Polychaete larvae	66.7 to 100.0

^a Zooplankton common to the Blount Island Channel of St. Johns River, Jacksonville, Florida, and Biscayne Bay, Miami, Florida

^b Beck et al. 1978

Table 5.2-4 (Revision 1)

ESTIMATED SEASONAL LOSSES OF PLANKTON IN THE BLOUNT ISLAND CHANNEL FROM ENTRAINMENT DURING PROPOSED PLANT OPERATION

Season	Mesozooplankton - (x 10 ⁹ organisms)					
	Estimated Number of Organisms Which Pass Through Blount Island Channel ^a	Estimated Number of Organisms Lost During Northside Operation Alone ^b	Estimated Number of Organisms Lost During Combined Operation ^b	Estimated Number of Organisms Lost During Proposed Plant Operation Alone ^c		Estimated Percent Loss to Seasonal Channel Populations Proposed Plant Alone
				Operation Alone ^c	Northside Alone	
Fall	232.4	10.9	11.1	1.6	4.7	0.7
Winter	1,200.8	48.1	48.3	7.2	4.0	0.6
Spring	10,676.2	462.7	469.7	69.7	4.3	0.7
Summer	67,917.4	150.3	152.6	22.6	0.2	0.1
Annual	80,026.8	672.0	681.7	101.1	0.8	0.1
Ichthyoplankton and Post-Larval Nekton (x 10 ⁶ organisms)						
Fall	115.6	4.2	4.2	0.6	3.7	0.5
Winter	150.0	9.7	9.7	1.3	6.5	0.9
Spring	13,012.3	129.5	129.5	17.5	1.0	0.1
Summer	19,052.9	603.6	603.6	81.8	3.2	0.4
Annual	32,330.8	747.0	747.0	101.2	2.3	0.3

a (Number of organisms/m³) x (flow (m³) through Blount Island Channel/season). Densities based on fall 1979 through summer 1980 sampling data.

b Based on 90 percent mortality for the Northside Station for mesozooplankton; 100 percent mortality for ichthyoplankton (see Tables 5.2-2 and 5.2-5)

c Based on 100 percent mortality for the proposed plant.

Table 5.2-5 (Revision 1)

PROJECTED SEASONAL ENTRAINMENT AND MORTALITY FOR ICHTHYOPLANKTON
DURING PROPOSED PLANT OPERATION

Generating Station	Season	Measured Mean Entrainment Densities ^a (larvae/1000 m ³)	Projected Seasonal Entrainment ^b (x 10 ⁶)	Percent Change in Seasonal Entrainment Relative to Northside Alone	Projected Seasonal Mortality ^{c,d} (x 10 ⁶)	Percent Change in Seasonal Losses Relative to Northside Alone
				60%	100%	100%
Proposed Plant Alone	Fall		0.6	-86	0.6	-77
	Winter		1.3	-86	1.3	-86
	Spring		17.5	-86	17.5	-86
	Summer		81.8	-86	81.8	-86
Proposed Plant plus Northside	Fall		4.2	0	60%	60%
	Winter		9.7	0	2.8	+9
	Spring		129.5	0	6.3	+9
	Summer		603.7	0	84.7	+9
Northside Alone	Fall	33.5	4.2		60%	60%
	Winter	77.0	9.7		2.5	+9
	Spring	1025.5	129.5		5.8	+9
	Summer	4779.9	603.7		77.7	+9
					362.2	
					100%	100%

a Entrainment measured at Northside from winter 1979 through summer 1980.

b Fall value determined from mean density of larvae in River Zone EP2 (Figure 2.8-4).

c Projected Seasonal Entrainment = Northside measured mean entrainment density x mean volume of cooling water required by plant(s)/day (1.384 x 10⁶ m³/day) x 91.25 days/season.

d Northside Station assumed to have a percent mortality range from 60% to 100%, based on the findings of Rehm et al., 1975; Beck and Miller, 1974; Cannon et al., 1977.

e Projected seasonal mortality for proposed plant plus Northside at 60% = [(projected seasonal entrainment for proposed plant plus Northside) x (0.6)] + [(projected seasonal entrainment for the proposed plant alone) x (0.4)].

Table 5.2-6 (Revision 1)

PROJECTED ANNUAL ENTRAINMENT OF COMMERCIALY IMPORTANT ICHTHYOPLANKTON DURING PROPOSED PLANT OPERATION

Species	Proposed Plant Alone		Proposed Plant plus Northside		Northside Alone		Percent of Commercially Trained Species Currently Entrainable by Northside Station	Percent of Total Ichthyoplankton Currently Entrained by Northside Station
	Annual Total (x10 ⁵) ^a	Percent Change in Entrainment from Northside Station Projected Current Level	Annual Total (x10 ⁵) ^a	Percent Change in Entrainment from Northside Station Projected Current Level	Projected Annual Total (x10 ⁵) ^a	Projected Annual Total (x10 ⁵) ^a		
Blue Crab	2.7	-86	19.7	0	19.7	19.7	< 1	0.3
Black Drum	0.7	-86	5.2	0	5.2	5.2	< 1	0.1
Croaker	62.9	-86	464.0	0	464.0	464.0	19	6.1
Menhaden	5.3	-86	38.5	0	38.5	38.5	2	0.5
Northern Kingfish	0.1	-86	0.5	0	0.5	0.5	< 1	0.1
Sciaenidae Species	11.3	-86	83.9	0	83.9	83.9	3	1.1
Sheepshead	0.04	-86	0.3	0	0.3	0.3	< 1	0.1
Shrimp Species	196.8	-86	1452.2	0	1452.2	1452.2	59	19.2
Silver Perch	3.5	-86	25.9	0	25.9	25.9	1	0.3
Southern Kingfish	1.5	-86	11.0	0	11.0	11.0	< 1	0.1
Spotted Seatrout	21.4	-86	157.7	0	157.7	157.7	6	2.1
Spot	5.6	-86	41.2	0	41.2	41.2	2	0.5
Weakfish	22.7	-86	167.8	0	167.8	167.8	7	2.2
TOTAL	334.5	-86	2467.9	0	2467.9	2467.9	100	32.4

^a Projected Annual Entrainment = mean daily entrainment/1000m³ (Appendix B, Table B-12) x mean volume of cooling water passing through plant(s)/day (Table 5.2-1) x 365 day/year

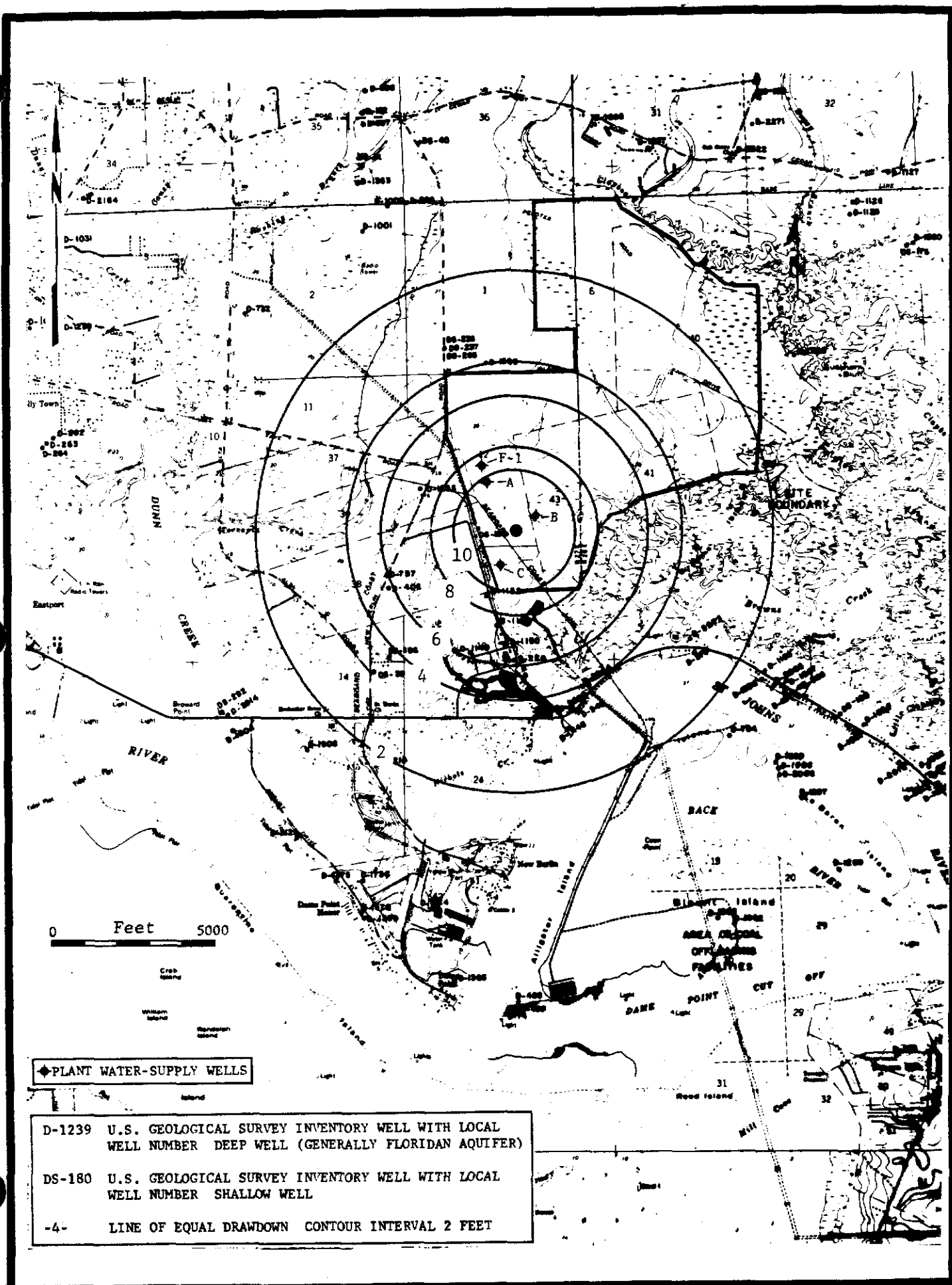


Figure 5.2-1

Approximate Cone of Depression for Groundwater Production of 3600 Gallons Per Minute

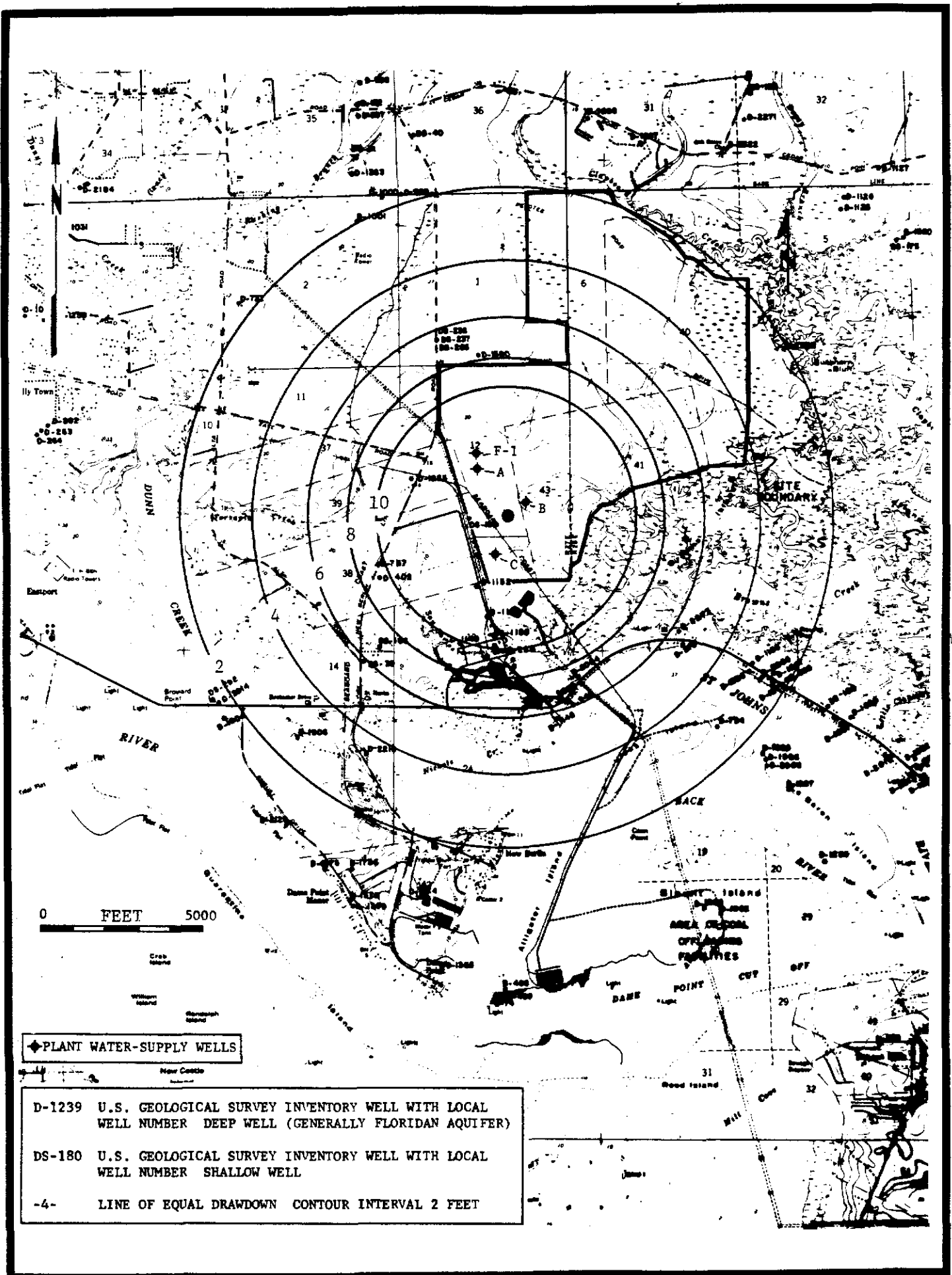


Figure 5.2-2

Approximate Cone of Depression for Groundwater Production of 5400 Gallons Per Minute

5.3 STACK AND FUEL HANDLING EMISSIONS

5.3.1 Modelling Methodology

5.3.1.1 Atmospheric Dispersion Models

The impact of emissions from the proposed plant on ambient air quality was determined using EnviroSphere's versions of several USEPA dispersion models. These models are briefly described in the following paragraphs. The meteorological and emissions input to the models and the receptor grids utilized are described in subsequent sections.

The primary model utilized in the analysis was a modified version of the CRSTER model. CRSTER is the USEPA model recommended for use on single point sources where there are no significant meteorological or terrain complexities (USEPA, 1978). It calculates ground level concentrations in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) for each receptor point for each hour of the year using hourly values of surface and upper air meteorological variables. The receptor point grid consists of a total of 180 points which occur at the intersection of 36 radial lines (every 10 degrees) and five user-specified distances from the source.

The version of CRSTER used for this analysis differs from the standard USEPA version in three important respects. First, it allows the consideration of multiple point sources at their actual locations rather than at a single common location. Second, in response to a USEPA request (Nagler, 1978), it allows for the calculation of "running" or overlapping three-hour averages. Concentrations for the 24-hour averaging time are still determined on a midnight-to-midnight basis in keeping with USEPA practice. Third, in accordance with discussions with EPA Region IV, it allows for consideration of pollutant transformation when computing concentrations at receptor points greater than 50 kilometers (km) from the source. For this case, a half-life of 12 hours was used for sulfur dioxide (Nagler, 1979).

The computer program produces tables of annual average concentrations predicted for each input receptor point as well as tables of the highest and second-highest concentrations for each receptor point for the 24-hour, three-hour and one-hour averaging times. The second-highest ground level concentrations during a given year of data are of prime importance because the short-term ambient standards and Prevention of Significant Deterioration (PSD) increments are defined by values that are not to be exceeded more than once per year. It should be noted that the "highest, second-highest" concentration, which is used to demonstrate compliance, represents the maximum second-highest value in a spatial sense, [i.e., the concentration at the receptor grid point at which the calculated second-highest value (over a given year) exceeds the second-highest values at all other receptor points].

The second model utilized in the impact analysis was the EPA Industrial Source Complex (ISC) model. It was used in the analysis of sulfate deposition on vegetation and in the analysis of particulate impacts from the project since these impacts result from both point and area sources (area sources cannot be treated in CRSTER). The ISC model was developed to consider complicated air quality impact problems such as complex terrain, fugitive emissions, building wake effects, gravitational settling, deposition, and decay. Most of these problems cannot be adequately treated with the basic EPA models such as CRSTER. The model employs the basic steady-state Gaussian plume algorithm used in the CRSTER model. The receptor points can be specified in a dense grid in areas of expected maximum concentrations in either polar or cartesian coordinates. The ISC program can estimate concentrations of pollutants for either short-term (3-hour, 24-hour) or long-term (annual, seasonal) averaging periods.

5.3.1.2 Meteorological Input Data and Modelling Procedure

The hourly meteorological input data required by the models was derived from two separate data bases (surface and upper-air) through application of a USEPA preprocessor program known as CRSTERPREP. One data

maximum concentrations in either polar or cartesian coordinates. The ISC program can estimate concentrations of pollutants for either short-term (3-hour, 24-hour) or long-term (annual, seasonal) averaging periods.

5.3.1.2 Meteorological Input Data and Modelling Procedure

The hourly meteorological input data required by the models was derived from two separate data bases (surface and upper-air) through application of a USEPA preprocessor program known as CRSTERPREP. One data base consisted of hourly surface observations of wind speed, wind direction (to the nearest 10 degrees), temperature and cloud cover observations recorded at Jacksonville International Airport. The second data base consisted of mixing height data based on rawinsonde upper-air observations taken at the Waycross, Georgia, rawinsonde station and computed according to the method of Holzworth (1972). These surface and upper-air stations are the closest National Weather Service stations to the proposed site and are the most representative of on-site conditions.

Using these data, the preprocessor reformatted the wind and temperature data and determined an atmospheric stability class for each hour based on the STAR method developed by Turner (1964). In addition, the reported wind direction (given to the nearest 10 degrees) was randomized to the nearest degree by addition of a random integer between minus four and plus five. This removed the directional bias created by wind reporting to the nearest 10 degrees. This procedure also provided a means of simulating natural fluctuations in wind direction. Hourly mixing heights were computed by an interpolation technique which utilized the twice daily upper air observations from the rawinsonde station.

Pursuant to recommendations by EPA, the detailed CRSTER analyses were conducted using data from a "worst case" year chosen from a five year data base (1970-1974). The five years of meteorological data were initially modelled using a coarse receptor grid (receptor rings every 0.5 km) with the largest SO₂ sources listed in Chapter 2, Table 2.7-13 consolidated

into six sources: JEA proposed plant, NGS Unit 3, NGS Units 1 and 2, JEA Kennedy, JEA Southside and the St. Regis Paper Company Plant. All of these sources were considered because it was felt that the worst case year should be chosen on the basis of combined impacts rather than based on the proposed plant by itself (since its impact will be relatively small). The total emissions from these sources represent more than 90 percent of the total SO₂ emissions in Duval County. The results of this analysis are presented in Table 5.3-1. As indicated, although the highest annual value occurred in 1970, the more critical highest, second-highest concentrations for both short-term averaging periods occurred in 1973. Therefore, the meteorological data from 1973 were used for the detailed air quality impact analysis.

After the worst case year (1973) was selected, the worst case load for the proposed plant by itself was determined using the CRSTER model and the coarse grid described above. Three plant load levels (100, 75, and 50 percent) were investigated (see Chapter 3, Table 3.8-2). The worst case load was determined to be the full load (100 percent) using this procedure.

For analysis of the plant impacts on Class II PSD areas, the CRSTER model was used along with the meteorological data from the worst case year. A dense receptor grid around the proposed plant was used, consisting of 40 rings of points between one and five kilometers, spaced every 0.1 km along each radial of the 36 radial direction (every 10 degrees) between one and three kilometers and every 0.2 km between three and five kilometers.

The impact of the proposed plant on the nearest Class I PSD area, the Okefenokee Wilderness Area, was determined using the CRSTER model and all five years of meteorological data. Since the worst case year for the other analyses was selected on the basis of multiple sources and a receptor grid emphasizing local impacts, it was possible that a different year of meteorological data might produce higher modelled concentrations at the sensitive Class I area. Therefore, the maximum concentrations were determined by running the model on all five years of data using a four

point receptor grid. The grid was set up along the boundary of the Wilderness Area closest to the proposed plant. The receptor points were located at 61 km in direction 280° , 61 km in direction 290° , 63 km in direction 300° , and 73 km in direction 310° .

The impact of the proposed power plant along with two other major sources of SO_2 and TSP (St. Regis Company, NGS) on ambient air quality standards in the Jacksonville area was determined using the CRSTER model and the worst case year (1973) as determined by the worst case year analysis discussed above. The detailed ambient impact modelling was performed using only the proposed power plant, St. Regis, and NGS rather than every pollutant source because EPA Region IV (Nagler, 1980) recommended procedures to determine background pollutant levels which implicitly account for the other sources of SO_2 and TSP. Modelling runs were made to calculate ambient ground level SO_2 and TSP levels at distances from 1 km to 12 km for 36 directions 10 degrees apart. Ground level concentrations were calculated every 0.2 km between 1.0 and 3.0 km, every 0.5 km between 3.0 and 6.0 km, and every 1.0 km between 6.0 km and 12 km. Background values of SO_2 and TSP as determined by analysis of National Weather Service data and on-site ambient air monitoring data were then added to the results of the ambient computer modelling to predict the future ambient pollutant levels.

A different procedure was used for the analysis of particulate concentrations in the Class II PSD area surrounding the proposed plant and at the downtown Jacksonville TSP nonattainment area. The PAL model was used to analyze the short-term impacts of the plant, including the stack and fugitive dust sources (coal storage areas, coal handling system, cooling towers, etc.). The receptor grid consisted of a circle of points spaced every $22\frac{1}{2}$ degrees with a radius of 1 km centered on the stack in the northwest quadrant, and with a radius of 2 km for the remaining directions. These receptor distances and directions represent the closest off-site locations where ambient standards and PSD increments are

applicable. Five other points were included in this grid representing the closest boundary of the Jacksonville downtown TSP nonattainment area (see Chapter 2, Figure 2.7-1). One additional receptor point was included which represented a point across the St. Johns River south of the proposed coal unloading facility at a distance of approximately 2 km. Meteorological data from 18 worst case days from the worst case year (as determined by CRSTER) were used as input. The CRSTER model was used to analyze the annual TSP impacts including fugitive emissions along with meteorological data for the entire worst case year. The fugitive emissions were consolidated into a small number of low-level point sources for this analysis and the receptor grid consisted of 5 rings of 36 points each, located at distances of 2, 3, 4, 9.4, and 10 km from the proposed plant. The last two rings were used in the particulate nonattainment area analysis. A one kilometer radius ring was not used in this annual analysis because of the extremely conservative nature of treating area sources as point sources; this procedure would make values predicted at such small distances completely unrealistic.

The ISC annual model was used with a polar coordinate receptor grid array consisting of 432 receptor points to analyze pollutant deposition rates in the vicinity of the plant. Meteorological input consisted of the joint frequency distribution of wind direction and speed by stability class for the 1970-1974 period. The polar grid consisted of 16 radials, each separated by 22.5 degrees. Deposition calculations were made at 27 discrete distances along each radial. The receptor points were located every 0.1 km beginning at 0.1 km downwind out to 1.8 km, and every 1 km beginning at 2 km downwind out to a distance of 10 km downwind.

A number of other air quality impact modelling techniques were used as necessary for special impact assessments (i.e., visibility, sulfates, coal trains). Relevant techniques are described in the sections where those impacts are discussed.

5.3.2 Compliance with PSD Increments

Chapter 2, Section 2.7.2 described the PSD regulations and the allowable PSD increments. The following sections present information on which sources contribute to PSD increment consumption and the results of the modelling analysis performed to assess compliance with Class II and Class I PSD increments.

5.3.2.1 PSD Increment Emissions

The emissions which are pertinent to the PSD increment analysis are only those involving changes in the emissions level after a designated baseline date rather than the entire emissions inventory presented in Chapter 2, Tables 2.7-13 and 2.7-14. PSD regulations promulgated by EPA on August 7, 1980, specify the baseline date as the date of filing of the first complete PSD application in the baseline area subsequent to August 7, 1977. However, major sources existing prior to the baseline date must also be considered in the incremental analysis if the source commenced construction on or after January 6, 1975. The applicable baseline date for the project area is November 25, 1977, resulting from a PSD application filed for a facility (Occidental Chemical) in White Springs, Florida. In keeping with EPA practice, all significant increment consuming sources (those constructed after the applicable baseline dates) lying within 50 km of the proposed site were considered for the Class II increment consumption modelling and all significant increment consuming sources lying within 100 km of the Okefenokee Wilderness Area were considered for the Class I increment consumption modelling. The increment consuming source information is presented in Tables 5.3-2 and 5.3-3 for SO₂ and TSP, respectively. The relative strengths and locations of the increment consuming sources are depicted in Figure 5.3-1.

As is obvious from the figure and tables, the emissions from a number of these increment consuming sources would not interact significantly with the emissions from the proposed plant because of the distance between the sources and the very small emission rates for some of them. It was,

therefore, not necessary to consider all increment consuming sources within the 50 or 100 km distances for modelling purposes. Thus, a number of the smaller sources were eliminated from the modelling. Those sources utilized in the Class I and Class II PSD increment analyses are indicated in Tables 5.3-2 and 5.3-3.

Contrary to the federal requirements, the Florida PSD regulations (Section 17-2.04, Rules of the Department of Environmental Regulation) require that any change in ambient concentration resulting from any source or facility issued a construction permit after December 31, 1974 be counted against the PSD increment. This differs from the procedure described above in that minor sources permitted between January 1, 1975 and November 25, 1977 count against the increment for state purposes but not for federal purposes. For this specific requirement, additional modelling was not performed because the total emissions from the additional minor sources were at least two orders of magnitude smaller than the major sources and were, therefore, not expected to significantly interact with the plumes from the major new sources. Thus, Florida PSD increment consumption is assumed to be the same as federal PSD increment consumption.

5.3.2.2 Impact on Class II Areas

Results of the dispersion modelling using the incremental emissions, meteorological input, and computer programs CRSTER and PAL described above for the PSD Class II increment consumption are summarized in Table 5.3-4. The results are based on the worst case plant load (100 percent) and worst case year (1973) resulting from the five year analysis as described in Section 5.3.1.2 and include the impacts from the fugitive TSP emissions.

Predicted annual average SO_2 and TSP concentrations are far below the allowable Class II PSD increments of 20 ug/m^3 for SO_2 and 19 ug/m^2 for TSP. The highest annual levels were calculated to be 2 ug/m^3 for SO_2 occurring 4.0 km northeast of the proposed plant as shown in Figure 5.3-2, and 2 ug/m^3 for TSP occurring 5.0 km south-southeast of the proposed plant as shown in Figure 5.3-3.

increment and as shown in Figure 5.3-4 is predicted to occur 1.2 km northwest of the proposed plant using data from April 30, 1973. The highest, second-highest predicted 3-hour SO_2 concentration is 346 ug/m^3 , which is 68 percent of the PSD Class II increment. This concentration was also calculated at a distance of 1.2 km northwest of the proposed plant as shown in Figure 5.3-5 using data from April 30, 1973. The highest, second-highest 24-hour average TSP concentration is calculated to be 10 ug/m^3 , which represents 26 percent of the increment. As depicted in Figure 5.3-6, this concentration occurs 1.0 km west of the proposed plant using data from March 4, 1973.

5.3.2.3 Impact on Class I Areas

The nearest designated Class I area to the proposed site is the Okefenokee Wilderness Area. Its borders are situated between 61 and 73 km in a northwesterly direction from the site.

As described in Section 5.3.2, the modelling for the plant impacts on the Okefenokee Wilderness Area Class I area included a preliminary five year analysis assuming the proposed plant operating at 100 percent load. Year 1973 was found to produce the highest ground level concentration increase at the Okefenokee Class I area. Because of the relatively large distance between the proposed site and this Class I area, the modelling of ground level concentrations was made using a modified CRSTER model which utilizes a transformation half-life of 12 hours for SO_2 (Nagler, 1979).

Table 5.3-5 summarizes the results of the PSD Class I modelling for the proposed plant and other increment consuming sources. The predicted annual average SO_2 and TSP concentrations of 1 ug/m^3 are below the allowable PSD increments of 2 ug/m^3 for SO_2 and 5 ug/m^3 for TSP.

Because the short term Class I allowable increments are not to be exceeded more than once per year, the highest, second-highest short-term incremental concentrations rather than highest predicted values are

compared with the allowable increments. The highest, second-highest calculated 3-hour SO_2 concentration at the Okefenokee Class I area was 19 ug/m^3 . This represents 76 percent of the allowable increment and occurs using data from May 6, 1973. The highest, second-highest 24-hour SO_2 concentration (4 ug/m^3) was calculated to consume approximately 80 percent of the allowable increment, and occurs using data from September 6, 1973. The highest, second-highest calculated 24-hour TSP concentration was less than 1 ug/m^3 using data from September 6, 1973, which represents only 10 percent of the Class I allowable increment.

5.3.3 Compliance with Ambient Air Quality Standards

The ambient air quality standards established by the state of Florida and the National Ambient Air Quality Standards (NAAQS) were presented in Chapter 2, Table 2.7-1. The Florida standards are more stringent than the NAAQS primary standards for annual and 24-hour SO_2 and TSP levels, and 1-hour ozone values, but are the same for the other pollutants and averaging times.

The federal New Source Review Regulations require that a new source not cause or contribute to a violation of NAAQS in areas where background concentrations are lower than allowed (attainment areas) and also that a new source not have a "significant" impact on any areas where background concentrations are higher than allowed by the NAAQS (nonattainment areas). The following two sections present the results of the dispersion modelling conducted to make the compliance demonstrations for these two areas.

5.3.3.1 Attainment Areas

The analysis for attainment areas consisted of modelling the air quality impacts of the proposed source plus the most significant existing sources using the methodology described in Section 5.3.1, then combining the resulting values with the background values described in Chapter 2, Section 2.7.2, and finally comparing the totals with the AAQS for the various pollutants and averaging times.

The emissions inventory for all sources of SO₂ and TSP are presented in Chapter 2, Tables 2.7-7 and 2.7-8. Because similarly compiled data for NO₂ emissions were not complete, the NO₂ ambient effects were estimated from the results of the SO₂ modelling by assuming that the total point source emissions of NO₂ are proportional to the ratio of the SO₂ emissions to the NO₂ emissions from the main units of the proposed plant. Although this assumption is not necessarily conservative, it is the only logical method available to estimate NO₂ impacts. Since the predicted impacts will be shown to be so far below the NAAQS for NO₂, it is believed that this assumption is adequate for determining compliance with NAAQS.

Chapter 2, Section 2.7.3.2 describes the methodology used to generate the background pollutant levels. The background levels for the various pollutants for the appropriate averaging intervals are summarized below:

	<u>Annual</u>	<u>24-Hour</u>	<u>3-Hour</u>
SO ₂	4	21	90
TSP	27	50	-
NO ₂	10	-	-

These background values were added to the results of the dispersion modelling of all appropriate major point sources to estimate the total ambient air quality concentrations.

The results of the air quality modelling analyses (which explicitly account for the proposed plant, NGS, and St. Regis, and implicitly account for all of the other emission sources listed in Chapter 2, Tables 2.7-7 and 2.7-8) are summarized in Table 5.3-6. Figures 5.3-7 through 5.3-12 are isopleths of the ambient SO₂, TSP, and NO₂ concentrations obtained by modelling the major sources (background concentrations are not included). No results are presented for carbon monoxide, hydrocarbons, ozone or lead since emissions of these pollutants from the proposed plant will be small

(see Chapter 3, Section 3.8), and calculations indicated that impacts on ambient concentrations were insignificant compared to applicable standards. Again, possible impacts due to the infrequent operation of the auxiliary boilers are not included in the figures.

The results indicate that operation of two 600 MW units at the proposed site will not cause the violation of the annual standards for SO_2 or TSP, even after the addition of background values. The highest annual average SO_2 and TSP concentrations (without background) were calculated to be 13 ug/m^3 and 3 ug/m^3 , respectively. These were estimated to occur 4.5 km southwest of the proposed plant and 6.0 km south-southeast of the proposed plant, respectively. Addition of the background values results in maximum annual average estimates of 17 ug/m^3 for SO_2 and 30 ug/m^3 for TSP, which represent 28 and 50 percent of the annual (Florida) standards of 60 ug/m^3 for these pollutants.

The maximum annual average NO_2 level resulting from the operation of these major emission sources (NO_2 emissions for proposed plant, NGS and the St. Regis plant were estimated) was predicted to be only 10 ug/m^3 . Therefore, the NO_2 levels following the start-up of the proposed plant are predicted to remain far below the annual standard of 100 ug/m^3 , even after the addition of 10 ug/m^3 for background levels.

The highest, second-highest concentrations are compared to the short term ambient standards for determining compliance. The highest, second-highest predicted 3-hour and 24-hour SO_2 concentrations (without background) were 987 ug/m^3 and 195 ug/m^3 , respectively and the highest, second-highest predicted 24-hour TSP concentration was 30 ug/m^3 . This 3-hour SO_2 concentration was calculated to occur 1.3 km southwest of the proposed plant using data from May 13, 1973. The highest, second-highest 24-hour SO_2 concentration was predicted to occur 2.6 km east of the proposed plant using May 17, 1973 data. The highest, second-highest 24-hour TSP value was calculated to occur 4.5 km south-southeast of the proposed plant using data from May 2, 1973.

Including the background levels along with the impacts of the major sources results in predicted highest, second-highest SO_2 concentrations of $1,077 \text{ ug/m}^3$ and 216 ug/m^3 for the 3-hour and 24-hour averaging periods, respectively. These values represent 83 percent of the 3-hour and 24-hour standards. The highest, second-highest 24-hour TSP level, including the short-term background level, is estimated to be 80 ug/m^3 , or 53 percent of the standard.

5.3.3.2 Nonattainment Areas

The extent of the contribution of the proposed plant to the formation of ozone and therefore its impact on the Jacksonville ozone nonattainment areas cannot be estimated through modelling. However, because of the plant's low emission levels of oxidants and hydrocarbons (the primary precursors of ozone), it is reasonable to assume that the impacts of the proposed plant on ozone concentrations will not be significant. This is supported by a number of studies (Tesche, et al., 1977; Hegg, et al., 1977; and Ogren, et al., 1976) that have found that power plant plumes generally do not contribute to higher than background ozone concentrations.

The impact of the plant on the Jacksonville TSP nonattainment area was estimated through modelling and compared with the USEPA "significance levels" which are 1 ug/m^3 for an annual average and 5 ug/m^3 for a 24-hour average. The TSP nonattainment area basically covers the central downtown area and is, at its closest point, 9.4 km from the proposed plant (Chapter 2, Figure 2.7-1).

The annual average impact was calculated with the CRSTER model using the total TSP emissions from the operation of the proposed plant (Chapter 3, Table 3.8-3) including fugitive dust emissions from the coal handling facilities, coal unloading facility, FGD reagent handling, waste disposal and cooling towers. The results of the analysis indicate that the annual average TSP impact on the nonattainment area will be less than the 1 ug/m^3 significance value.

The 24-hour average TSP impact was analyzed with the ISC model using the 18 worst case days identified in the annual average CRSTER analysis. Again, all of the TSP sources associated with the proposed plant were included in the modelling. The maximum 24-hour average impact was calculated to be 4.3 ug/m^3 using data from April 30, 1973. Since this value is also below the EPA significance value, it is concluded that the proposed plant will not significantly affect the Jacksonville TSP nonattainment area.

5.3.4 Biological Effects

5.3.4.1 Aquatic Biological Community

Fugitive Coal Dust Emissions

The potential impact from fugitive coal dust reaching the aquatic environment is small. Best available technology (BACT) will be used to minimize the production of coal dust during unloading, transport and pulverizing. Proposed techniques such as dry dust collecting, wet suppression and enclosed conveyor systems will reduce coal dust emissions by greater than 90 percent. That fugitive dust which escapes and settles around the unloading facilities will be collected with the surface water runoff and treated in sedimentation basins to remove suspended solids.

Fugitive Limestone Emissions

The impact of limestone emissions reaching the aquatic environment and altering environmental conditions (i.e., pH would affect the aquatic community) will be undetectable.

Stack Emissions

A review of the potential problems associated with stack emissions via acid rain and the potential impact on biological communities in the aquatic system is presented in Section 5.3.5.6.

5.3.4.2 Vegetation

Stack Emissions

Injury to vegetation from exposure to various levels of air contaminants can be termed acute, physiological, or chronic. Acute injury occurs as the result of a short term exposure to a high contaminant concentration and is typically manifested by visible injury symptoms on the leaves. Symptoms may range from chlorosis (leaf yellowing due to loss of chlorophyll) to necrosis (brown, dead spots or areas on the leaf). A variety of symptoms, each specific to a particular contaminant, have been reported in the literature. Physiological or latent injury occurs as the result of a long term exposure to contaminant concentrations below that which results in acute injury symptoms. Physiological injury is manifest by a change in normal physiological activity of the plant without the concomitant visible injury symptoms. Chronic injury results from repeated exposure to low concentrations over extended periods of time, but differs from physiological injury in that it is manifested by visible symptoms. Chronic injury does not typically involve necrosis. However, as indicated above the distinction between physiological, acute and chronic injury is not always as clearly defined.

The term injury, as opposed to damage, is commonly used to describe all plant responses to air contaminants and will be used in the context of this report. The term damage is used to define those effects which would reduce either the ecological or economic value of the vegetation. For example, in a foliage crop, such as lettuce, where appearance is an important aspect of the crop value, foliar effects could result in damage while some crops, such as soybean and alfalfa, exhibit little or no reduction in yield (damage) due to foliar injury (5 percent maximum) (Barret and Benedict, 1970).

Threshold concentrations of toxic air contaminants are the lowest concentrations which cause deleterious effects on vegetation. Threshold values are best estimates based on one or more data sources. These values

are important since they provide a means by which predictions of effects can be made when actual field or laboratory studies are unavailable. However, it should be noted that it is extremely difficult to assign foolproof threshold concentrations to a particular species for a number of reasons. Species, varieties, cultivars, and even individual plants can respond differently to a given air contaminant level. These responses may be independent of any external environmental factors which may affect the tolerance or sensitivity to a contaminant. The developmental stage of a plant, nutrient supply, and moisture status, as well as the time of exposure largely determine the degree of sensitivity. In general, conditions which stress plants, such as a poor supply of nutrients or lack of moisture, tend to reduce the sensitivity of plants to air contaminants. The overall complexity of vegetation responses to air contaminants, especially when mixtures of air contaminants are involved, also reduces the effectiveness of using threshold concentrations for assessing contaminant effects on vegetation.

In general, threshold concentrations derived from laboratory or greenhouse oriented programs may not be an accurate representation of actual field conditions. The environmental conditions during these laboratory and greenhouse studies are generally more conducive to plant growth and injury than field conditions, which are typically more limiting to plant growth.

In light of the apparent differential between laboratory and field conditions, estimated threshold concentrations as reported in the literature may be conservatively low. Therefore, great care must be employed when extrapolating results from laboratory experiments to actual field conditions.

Sulfur Dioxide

Sensitivity

Sulfur is an essential plant macronutrient which is required in relatively large quantities. Sulfur is obtained by plants primarily through root absorption of soil sulfates. Some plants have been found to receive a portion of their sulfur requirements through direct foliar absorption of SO_2 (Severenson, 1975). However, most plants exhibit toxicity symptoms when exposed to SO_2 . It is thought that acute injury occurs when foliar absorption rates exceed the metabolic capability of foliar tissue to oxidize SO_2 to the less toxic sulfate ion (Taylor, 1973 and Thomas, 1961).

Several factors affect the sensitivity of vegetation to SO_2 . In general, factors which promote high photosynthetic activity such as moderate to high soil moisture, relative humidity (approximately 70 percent), temperature ($70-80^\circ\text{F}$), adequate nutrient supply for normal growth and age of foliar tissue (mature) also promote increased sensitivity.

Acute injury symptoms are typically manifested in broadleaf plants by localized marginal and interveinal necrosis. These necrotic areas initially have a dull, dark green watersoaked appearance which gives way to an ivory-white coloration upon drying and bleaching. Chronic symptoms appear as chlorotic areas, which may also appear as white or reddish-brown. The chlorosis affects margins and interveinal areas. In the case of grain crops, injury symptoms vary from injured leaf tips at low concentrations to necrotic areas at high concentrations. Typically, the markings appear as necrotic streaks between the veins. In coniferous plants, needles develop a watersoaked appearance that rapidly changes to a reddish-brown coloration. Chronic injury of conifers is evidenced by chlorosis of older needles.

Generalized threshold concentration values have been developed for SO_2 (Linzon, 1973; USEPA, 1973; Jones et al., 1974; and Jacobsen, 1977). These values are based on interpretation of results by a number of individuals as reported in the scientific literature. A summary listing of estimated threshold SO_2 concentrations for visible injury to sensitive plant species is presented in Table 5.3-7 and for species of intermediate sensitivity in Table 5.3-8. Typical responses and sensitivity ratings of vegetation found in the vicinity of the proposed plant as reported in the literature, are summarized in Table 5.3-9. The information presented is by no means complete because data related to only a small fraction of the species found in the proposed site vicinity have been studied and reported in the scientific literature.

Assessment

The predicted maximum ground level 1-hour, 3-hour, 24-hour and annual mean concentrations resulting from operation of the proposed plant and existing sources (including highest existing background levels uninfluenced by the major existing sources (see Chapter 2, Section 2.7.3.2) are 2,141, 1,424, 228 and 17 ug/m^3 , respectively. These maximum concentrations are predicted to occur one time per year and are based on the following worst case assumptions: coal with the highest sulfur content, plant operation at maximum output, full load operation of background SO_2 sources (all NGS and St. Regis units in operation), and worst case meteorological conditions. The 1-hour concentration is within the range of the injury threshold concentrations reported in the literature for sensitive plants, while the 3-hour concentration exceeds the reported injury threshold (Table 5.3-7). The 3-hour concentration approaches the low end of the range of values reported to produce foliar injury symptoms on maples, southern pines, sumac, blackberries, sweetgum, and cherry (Table 5.3-9). Under worst case conditions, some injury symptoms could occur in the areas of predicted maximum concentrations. ✓

The concentrations expected under more typical operating conditions of the proposed plant and background sources have not been predicted. However, these concentrations can be estimated knowing the typical concentrations recorded during the field monitoring program and the predicted contribution from the proposed plant. Based on one year of field monitoring data, the highest 24-hour concentration measured was 116 ug/m^3 , and the highest 3-hour concentration was 323 ug/m^3 . The highest predicted increment from operation of the proposed plant is 52 and 410 ug/m^3 for 24-hour and 3-hour averaging periods, respectively. Combining the background with the predicted plant contributions results in concentrations of 168 ug/m^3 and 733 ug/m^3 for 24-hour and 3-hour, respectively. The 3-hour concentration of 733 ug/m^3 is less than the reported threshold concentration of 850 ug/m^3 (Table 5.3-7). It is also less than the threshold values reported for vegetation typical of the proposed plant site (Table 5.3-9). Based on these data, some injury symptoms may appear on vegetation within 1.5 km of the proposed plant but the probability of their occurrence or of a significant impact is considered to be low.

The potential for physiological or chronic injury occurring can not be predicted with certainty. The annual ambient concentration based on one year of data from the field monitoring program was 7 ug/m^3 . The predicted maximum annual increment from operation of the proposed plant is 2 ug/m^3 . Combining the existing background with the plant increment yields an annual ambient concentration of 9 ug/m^3 . Most evidence in the literature suggests that levels around 131 ug/m^3 may be conducive to physiological or chronic injury. Since there is an order of magnitude difference between the predicted ambient concentration and the reported threshold concentration, the probability of physiological or chronic injury is low.

The estimated mean annual SO_2 concentrations resulting from operation of the proposed plant may possibly have a beneficial effect on the local vegetation. Soils in the southeast are typically deficient in

sulfur and require additional sulfur for optimum crop yields. Atmospheric SO_2 at concentrations below the injury threshold level could provide an additional source of sulfur to crops growing on sulfur deficient soils. For example, cotton plants grown in a greenhouse environment were found to absorb 40 percent of their sulfur from an atmosphere containing 26-131 $\mu\text{g}/\text{m}^3$ SO_2 (Olsen, 1957).

Sulfur can also be added to soil through washout of atmospheric SO_2 by precipitation. In Minnesota, annual sulfur additions from atmospheric SO_2 washout range from 100 lbs/acre in urban areas to 5 lbs/acre in rural areas. In southern states, the annual average is about 5 lbs/acre (Kamprath, 1972). In some cases, the amount of sulfur deposition is sufficient to meet crop requirements. However, the amount of sulfur deposition in rural areas is thought to be sufficient only to meet about 20-30 percent of crop needs.

Particulates

Sensitivity

Injury to plants from particulates is frequently associated with the continuous accumulation of dust or fly ash on foliage. There are a few reports in the literature which suggest that an interaction occurs between the leaf surface and the accumulation of metals on the leaf surface (USEPA, 1976). The toxicity to plants from accumulations of metals in the soil due to deposition of particulates has also been identified, with particular emphasis given to arsenic and boron (USEPA, 1976).

The deposition of particulates directly affects vegetation by coating all exposed plant parts. The deposits may accumulate as dry dusts, encrustations (in the presence of moisture), films, or tars. The main effects of encrustations are reduced gas exchange, increased temperatures, reduced photosynthesis, and eventual tissue degradation. A deposition rate of 824 $\mu\text{g}/\text{m}^3$ over a two month period was found to result in a 19 percent

reduction in radial growth of red maple and a 76 percent increase in radial growth of tulip popular. Visible injury effects were observed on beans exposed to cement kiln dusts, applied at a rate of 0.05 to 0.38 mg/cm²/day for 2-3 days (Darley, 1966).

The phytotoxicity of metals deposited on soils in the form of particulate matter has been demonstrated in plants. Plants exposed to a dust containing cadmium, lead, copper and manganese once a week for four weeks exhibited yield reductions of up to 36 percent, as well as injury symptoms on leaves and flowers (Krause and Kaiser, 1977). Concentrations in tissue may be due to direct foliar uptake or from accumulations in the soil. Plants are known to accumulate different elements at different rates. Tissue concentrations of certain elements have been found to be a function of the growing soil concentration.

Assessment

The maximum predicted concentration of total suspended particulates (TSP) is 3 and 33 ug/m³ for an annual and 24-hour average, respectively. The existing background concentration in the vicinity of the proposed plant, based on data from the on-site monitoring program, is 27 and 57 ug/m³ for an annual and 24-hour average, respectively. Combined, the predicted concentrations will be 30 and 90 ug/m³ for annual and 24-hour average. By comparing predicted concentrations with the few injury threshold concentrations reported in the literature, it is anticipated that there will be no measurable impact from particulates.

Nitrogen Dioxide

Sensitivity

Nitrogen dioxide (NO₂) is one (and nitric oxide the other) of the two more potentially toxic gases in the nitrogen oxide group which are produced during high temperature combustion. Nitrogen dioxide can have an

adverse effect on plants either through direct exposure or indirectly through the role of NO_2 in the formation of photochemical oxidants such as ozone. The current thinking is that the indirect effects have a greater influence on vegetation than the direct. However, the studies reported in the literature address effects of NO_2 on vegetation rather than indirect effects which are usually discussed with regard to ozone.

Both internal and external factors can have an effect on the degree of vegetation sensitivity to NO_2 . External factors include soil moisture, nutrient supply, relative humidity, light, and temperature, while internal factors include genetic composition, age, and morphology. The roles of external factors are not as well understood for NO_2 as for SO_2 . Acute injury symptomology is typically manifest as water soaked lesions, which initially appear as irregular shapes in intercostal areas on the upper foliar surface.

Concentrations of NO_2 required to produce visible plant injury are high relative to commonly occurring ambient levels. Thompson *et al.* (1974) suggest that threshold dosages causing visible injury range from 18,800-28,200 ug/m^3 for one hour. The USEPA (1976) suggests a higher threshold concentration of 68,620 ug/m^3 for one hour exposure. Threshold concentrations for other exposure periods are presented in Table 5.3-10. Some typical responses and sensitivity ratings of vegetation common to the proposed site area are summarized in Table 5.3-11.

Assessment

The maximum ground level NO_2 concentration predicted to occur from plant operation (including background) for 1-hour, 3-hour, 24-hour and annual averaging periods are 1,620, 1,083, 200 and 20 ug/m^3 , respectively. These maximum concentrations occur 4.5 km to the southwest of the proposed plant site. These values are well below estimated threshold values with one exception (Table 5.3-10). The one exception is alfalfa which has a reported injury threshold concentration of 940-1316

ug/m³ for 0.75-1.5 hour; however, alfalfa was not observed within the area of predicted maximum NO₂ concentrations. Based on the large differential existing between predicted maximum concentrations and estimated threshold values and the absence of alfalfa in immediate proximity to the proposed plant, it is anticipated that NO₂ concentrations resulting from plant operation will not injure vegetation in the vicinity of the proposed site.

Ozone

Sensitivity

Ozone (O₃) is generally considered to be the most injurious air pollutant to vegetation. Injury attributable to O₃ has been found in both urban and rural areas and is exhibited by a wide range of plant species.

The sensitivity of plants to O₃ is governed by internal as well as external environmental factors. External factors include temperature, humidity, light, soil moisture, soil nutrition and soil texture. The internal factor which has been shown to be the most prevalent in terms of affecting plant sensitivity is genetic variability. Soybeans are one of the many species which exhibit noticeable genetic variability in sensitivity to O₃.

The most common symptoms of ozone injury on many deciduous trees, shrubs and some herbaceous species are small sharply defined dot-like lesions. These lesions may be dark brown, black, purple or red. The injured areas are primarily confined to the upper leaf surface. The common symptom of most herbaceous species and many woody species is small unpigmented necrotic spots or more general upper leaf surface bleaching (Hill et al., 1970).

Threshold O_3 concentrations for most sensitive species are generally considered to be in the range of 98-400 ug/m^3 for 2-4 hours exposures (Hill et al., 1970). Some generalized threshold concentrations for sensitive, intermediate, and tolerant species are presented in Table 5.3-12. Typical responses and sensitivity ratings of plant species typical of northeastern Florida are summarized in Table 5.3-13.

Assessment

Ozone (O_3) will not be a direct by-product from the combustion of coal at the proposed plant, but instead is postulated to result from a complex photochemical reaction involving nitrogen oxides and hydrocarbons. Although considered a major nitrogen dioxide (NO_2) source, the proposed plant will not be a major hydrocarbon source. Furthermore, there are no major hydrocarbon sources known to exist in the vicinity of the proposed plant.

Ozone formation is not well understood, although it is generally believed that it is a phenomenon occurring at long downwind distances from, but not in the immediate vicinity of power plants. This is attributable to the kinetics and time-dependent nature of the necessary photochemical reaction.

The state-of-the-art is such that it is difficult to predict what effect the proposed plant emissions will have on ambient ozone concentrations from either a local or regional scale. It is anticipated that any potential increase in ozone concentration would be more detectable from a regional scale as opposed to a local one. The ambient ozone concentration ($294 ug/m^3$) as reported in the Jacksonville area (BES, 1978) is within the range of threshold concentrations reported to be injurious to vegetation, although it is expected that any effects will be limited to long downwind distances and should not aggravate the existing high concentrations.

Air Contaminant Mixtures

Gaseous air contaminants are rarely found in isolation. Nitrogen oxides, as well as sulfur oxides, are common products of coal combustion. The probability of these two contaminants causing foliar injury has been postulated and is a current topic of research for many investigators. Results from the few studies reported in the literature suggest that mixtures of SO_2 and NO_2 , and SO_2 and O_3 may act synergistically (Tingey et al., 1971; Tingey et al., 1973b). In a synergistic response, concentrations of individual contaminants at levels below that considered to be injurious, may in combination result in visible injury. In general, synergistic responses occur when the SO_2 concentration exceeds that of the other contaminants.

SO_2 - NO_2 Sensitivity

Sensitivity of plants to air contaminants may increase when plants are exposed to a mixture of SO_2 and NO_2 . Plant responses vary widely between species, environmental factors, plant age and dosage. In soybeans, injury symptoms from either SO_2 and NO_2 alone were exhibited as marginal and/or interveinal necrosis on both upper and lower surfaces. Injury symptoms caused by mixtures of SO_2 and NO_2 were found by Tingey et al. (1971) to occur as chlorotic or necrotic flecking on the upper leaf surface. Another injury symptom of SO_2/NO_2 observed by Tingey et al. (1971) was the frequent occurrence of injury on lower leaf surfaces with little or no evidence on upper surfaces.

There does not appear to be a generalized listing of threshold concentrations for mixtures of SO_2 and NO_2 reported in the literature. However, Tingey et al. (1971) were able to demonstrate that in soybeans an SO_2 concentration of 262 ug/m^3 combined with either 188 or 282 ug/m^3 NO_2 (4-hour exposure) results in 35 and 20 percent leaf injury, respectively, while the threshold concentration for SO_2 and NO_2 in isolation is $1,310 \text{ ug/m}^3$. In general, maximum foliar injury was observed

on those species tested using SO_2 and NO_2 ratios of 262:188 or 262:282 ug/m^3 . Foliar injury was found to decrease as the concentrations of the two gases increased to a point below the threshold concentration of each gas in isolation (Tingey et al., 1971).

The responses of soybean, alfalfa, tobacco, and tomato to mixtures of SO_2 and NO_2 are summarized in Table 5.3-14. The summation, as presented, demonstrates that the synergistic effects range from the lack of foliar injury to a many-fold increase in effect over that from exposure to SO_2 in isolation.

SO_2 - NO_2 Assessment

Considered in isolation, the maximum predicted 3-hour concentration of SO_2 (1,424 ug/m^3) exceeds the threshold level for sensitive vegetation, while the maximum predicted 3-hour concentration of NO_2 (1,083 ug/m^3) is lower than the estimated injury threshold. These concentrations are outside of the range of concentrations where SO_2 - NO_2 synergistic effects have been reported to occur (Table 5.3-14). On the basis of information reported in the literature, it is unlikely that vegetation in the immediate vicinity of the proposed plant will exhibit injury symptoms due to SO_2 and NO_2 synergism, because it is possible that effects from the high SO_2 concentration alone will mask any effects due to SO_2 - NO_2 synergism. The possibility exists that synergistic injury symptoms will appear in areas beyond the immediate vicinity of the proposed plant, since the predicted concentrations fall within the range of concentrations where SO_2 - NO_2 effects have been recorded.

There is not sufficient evidence in the literature to either support or deny the possibility that synergistic effects may occur as a result of the predicted annual ambient concentrations. However, the predicted SO_2 and NO_2 concentrations (annual average) appear to be well below that resulting in a synergistic response.

Tingey et al. (1971) report that the concentrations of SO_2 and NO_2 found to cause injury in their studies were similar to those found in urban areas and may result in reduced yields of crops grown under field conditions. However, it should be noted that synergistic effects from SO_2 - NO_2 have been rarely observed in the field. In addition, data on the effects on vegetation due to mixtures of SO_2 and NO_2 are limited and the general consensus of most investigators is that more research is required before SO_2 - NO_2 synergism is completely understood and potential effects predicted for field situations.

SO_2 - O_3 Sensitivity

Sulfur dioxide - ozone is the only other air contaminant mixture which has been studied, which may be applicable to the proposed plant. The few studies conducted to date were designed more to elicit a response than to determine a threshold concentration. Vegetation species include peanuts, tobacco, alfalfa, broccoli, radish, cabbage, tomato, soybeans, and cotton. In most of the studies, the common finding was that mixtures of SO_2 and O_3 at concentrations similar to that found in urban areas have consistently resulted in synergistic or additive effects (Tingey et al., 1973a).

Based on the data obtained from studies of SO_2 and O_3 mixtures on soybeans and other plant species, Tingey et al., (1973b) observed that injury enhancement (from SO_2 - O_3) was dependent on the plant species and concentrations of gases used. Environmental parameters also have an effect on the sensitivity of plants to SO_2 - O_3 . Heagle et al. (1974) found that soil moisture can have an effect on the degree of injury, with higher threshold concentrations expected as soil moisture concentrations increase. Soybean varieties were also found to differ in their sensitivities to mixtures of SO_2 - O_3 (Heagle et al., 1974), typically the case with the sensitivity of vegetation to other air contaminants. In general, all factors, both external and internal, which affect the sensitivity of vegetation to air contaminants in isolation will also have an effect on sensitivity to contaminant mixtures.

Injury symptomology from mixtures of SO_2 and O_3 strongly resemble SO_2 injury symptoms. Barrett and Benedict (1970) have reported the occurrence of silvering on the lower surface of cotton foliage due to SO_2 . This silvering has also been observed on tomato and tobacco leaves when exposed to mixtures of SO_2 and O_3 (Tingey et al., 1973b). The "intensive red pigmentation and undersurface stippling" exhibited by soybean leaves due to SO_2 was also found to occur from exposure to mixtures of SO_2 and O_3 (Tingey et al., 1973b). In another study involving the effects of SO_2 - O_3 mixtures on soybeans, symptoms were found to resemble classic O_3 injury symptomology, a white to tan flecking on the upper leaf surface and general chlorosis of older leaves (Heagle et al., 1974). However, in contrast to O_3 induced injury the chlorosis began at leaf margins and slowly progressed to the mid vein, then, approximately four days after fumigation, the marginal necrotic areas turned a light tan, similar to that caused by SO_2 injury.

There are no generalized threshold concentrations of SO_2 - O_3 (in mixture) listed in the literature which would apply to most species. However, results reported in the literature provide the basis for the prediction of potential effects from low concentrations of these two contaminants. Heagle et al. (1974) have observed that exposure to 262 ug/m^3 SO_2 and 196 ug/m^3 O_3 for six hours resulted in more injury to soybeans than the additive effects of each gas separately at 262 and 196 ug/m^3 , respectively. These differences were considered significant, although investigators speculate that significant synergistic effects are possible when one or both bases are present at concentrations near injury thresholds for each. Tingey et al. (1973b) observed injury to soybeans when exposed to $2,620 \text{ ug/m}^3$ SO_2 and 196 ug/m^3 O_3 for four hours. Tingey et al. (1973b) have concluded from these studies that concentrations of SO_2 and O_3 resulting in plant injury were similar to concentrations found in urban areas. They further speculate that interaction of SO_2 and O_3 may cause foliar injury in many areas of the country. Responses of species found in the vicinity of the proposed plant (cabbage, soybean, cotton, tomato, alfalfa, and tobacco) to mixtures of SO_2 and O_3 are summarized in Table 5.3-15.

SO₂-O₃ Assessment

Under worst case conditions, it is possible that some injury may result from SO₂/O₃ synergism. The probability of this occurring is higher in the summer months than in other months due to the higher O₃ concentrations recorded by the on-site monitoring program during this time period. This potential SO₂/O₃ synergism should be restricted to the area where the maximum SO₂ concentrations are predicted to occur (1.5 km to the southwest of the proposed plant site). The probability that the operating characteristics and meteorological parameters resulting in the maximum predicted concentrations (used in the injury assessment) will actually occur is low. Therefore, the probability that synergistic effects will occur on vegetation in the vicinity of the proposed plant site is also considered to be low. The maximum SO₂ concentrations are predicted to range from 2,141 ug/m³ (1-hour average) to 228 ug/m³ (24-hour average). As a means of comparison to concentrations resulting in a synergistic response as reported in the literature, which are based primarily on 4-hour averages, it is assumed that the typical concentration for a 4-hour average would fall within this range, with an approximate value of 1,300 ug/m³. The maximum ozone concentrations recorded during the on-site monitoring ranged from 60 ug/m³ (6 month average) to 212 ug/m³ (1-hour average). From this range a 4-hour average is estimated to be approximately 200 ug/m³. In a conservative sense, the maximum concentrations of SO₂ and O₃ expected would be 1,300 and 200 ug/m³, respectively, for a 4-hour averaging period. These SO₂ and O₃ concentrations approximate the range of concentrations where synergistic responses have been reported in the literature.

Fuel Handling Emissions

Fugitive dust will be the only emission from fuel handling activities that could have an adverse effect on vegetation. Dusting affects vegetation in a number of ways. A direct effect is the coating of exposed plant parts which results in reduced gas exchange, increased temperatures,

reduced photosynthesis and eventual yellowing. An indirect effect is the absorption of ions from deposited particulate matter through the leaf surface. Certain ions can accumulate to toxic levels in the plant resulting in injury and death. The effects of dust and/or particulate matter on vegetation has not been widely reported in the literature and more research is needed.

Little or no effect on vegetation from fugitive dust is anticipated, due to the dry dust collecting, wet suppression, and enclosed conveyor systems which will reduce coal dust emissions by more than 90 percent (see Chapter 3, Section 3.8). Deposition rates would have to exceed $0.38 \text{ mg/cm}^2/\text{day}$ before any adverse effects are anticipated (see Section 5.3.4.1). Precipitation will also tend to wash off any accumulations, thereby reducing the possibility of injury. In the event that there are any substantial fugitive dust emissions, the effect will be localized and result in an insignificant impact.

5.3.4.3 Wildlife

Coal combustion has many by-products of which SO_2 and NO_x are the two major gaseous pollutants. The effects of these air contaminants may be placed in one of three broad categories: acute, chronic or long-term. Acute effects result from exposures to high concentrations over relatively short periods (1 hour to 1 month). Exposure for several months or even years may result in chronic effects while long term effects (exposure for decades or longer) may bring about abnormal changes in ecosystems, and subtle physiological alternations in organisms (U.S. Fish and Wildlife Service, 1978). The literature contains information on numerous laboratory studies relating dosages and the appearance of acute injury symptoms. Less is known about the pollutant levels associated with chronic injury while virtually no information is available concerning long term effects (U.S. Fish and Wildlife Service, 1978).

Sulfur Dioxide

Respiratory passageways and other mucosal tissues of animals are vulnerable to injury from exposure to sulfur oxides. However, due to the variability in laboratory toxicological studies no clearcut threshold levels for injury or mortality are available. Colucci (1976) has reported that exposures from 65,000 to 3.1 million ug/m^3 for less than 90 hours did not cause significant mortality in laboratory animals (e.g., monkeys, dogs, mice, rats, and hamsters) while acute exposures (2-3 hours) at concentrations as low as 18,000 ug/m^3 had an adverse effect on pulmonary function. Concentrations as low as about 500 ug/m^3 may produce pulmonary problems that are reversible after exposure is terminated (Colucci, 1976).

The SO_2 levels predicted for the proposed plant (Table 5.3-6) are significantly below those reported by Colucci (1976) as causing acute or chronic injury symptoms. The maximum predicted 3-hour concentration is a factor of 10 below the level reported by Colucci (1976) as causing no effects in a variety of animals exposed for periods up to 21 hours/day for 620 days. Because of the limited research addressing the synergistic effect of SO_2 acting in combination with other airborne pollutants, potential impacts from these interactions cannot be predicted at this time.

Sulfur dioxide emissions could potentially affect wildlife populations indirectly through habitat alteration if significant vegetation damage occurred. Such damage is not predicted to occur and, thus, the probability of habitat modifications as a result of SO_2 injury is low.

NO_x

Nitrogen oxides affect primarily the lower respiratory tract with information again based primarily on toxicological studies of laboratory animals. Ziskind and Hausknecht (1976) report that at levels of 1,000 ug/m^3 , possible effects on guinea pigs were observed after exposure for

several days. More pronounced effects were noted when levels exceeded 2,000 ug/m³. Little information is available dealing with the effects of nitrogen oxides on wildlife populations in their natural surroundings.

The levels reported in the literature as causing a physiological response during acute exposure (1-3 hours) (Ziskind and Hausknecht, 1976) are at least an order of magnitude larger than the proposed plant's predicted maximum 3-hour concentration (1110 ug/m³). The maximum annual concentration predicted for the plant vicinity is approximately two orders of magnitude lower than the lowest levels reported by Ziskind and Hausknecht (1976) as having an affect during chronic exposure (Table 5.3-6).

Research to date indicates that there will be no significant impact resulting from the predicted acute or chronic exposure concentrations of NO_x emitted by the proposed plant. Again, the limited amount of available information addressing possible synergistic reactions between NO_x and other atmospheric pollutants makes prediction of impacts in this area impossible at this time.

Coal Storage Impacts

Coal storage will directly affect wildlife through the habitat lost to provide these storage areas (Chapter 4, Section 4.1.1.2). A potential indirect impact is any habitat modification brought about by fugitive dust emissions from the coal piles. A spray system in the storage area along with enclosed conveyors is expected to suppress fugitive dust emissions sufficiently to prevent any significant impact to vegetation.

5.3.4.4 Other Potential Effects on Wildlife

Stack Collisions

Radio and TV towers have long been recognized as hazards to bird migrations, especially under adverse meteorological conditions. In a study at the Davis-Besse Power Plant on Lake Erie, significant bird mortality

associated with the cooling tower was observed only under adverse meteorological conditions with warblers and kinglets the most affected (Jackson et al., 1974). Bird collision impacts are not evenly spread over all species with those birds that migrate at the higher altitudes or during the day being less affected. (Rybak et al., 1973 report that ducks and gulls seem to readily avoid the structures.)

The cooling towers and facility stack are approximately 425 and 640 feet high (AGL), respectively, which is tall enough to obstruct birds migrating along the Atlantic flyway where the proposed plant is located. Mortality will be highest during the fall (August-October) and spring (March-May) migrations especially during periods of inclement weather (i.e., low ceiling, fog, rain). Although collisions will certainly occur, the losses are expected to be insignificant from a population perspective.

5.3.5 Other Air Quality Effects

This section presents the methodologies utilized in and the results of investigations conducted to evaluate potential air quality effects which are not directly regulated by existing state or federal laws. These include impacts of fugitive dust from coal trains, potential impacts of the plant under accidental release conditions, impacts on sulfate concentrations, impacts on visibility, impacts on trace element concentrations, and acid rain.

5.3.5.1 Fugitive Dust Impact from Coal Trains

The movement of coal supply trains to the proposed plant from coal mines outside the state will result in increased fugitive dust levels in areas near the railroad tracks. These increases in fugitive dust levels will be primarily the result of road bed dust emissions and coal dust blowing from the exposed coal contained within each hopper car. The only other quantifiable emissions associated with the coal trains result from the diesel locomotive emissions, which are relatively minor.

For an impact analysis of the coal trains as they move through Jacksonville, it was assumed that trains will travel 500 miles from the mines and that there will be a maximum of three trains per day with 72 cars per train, and a maximum of 106 tons of coal per car. An estimated one percent of coal by weight will be lost as fugitive dust over a journey of about 500 miles (Knife River Coal Mining Company, 1979; Northfolk and Western Railroad, 1973) with an estimated 90 percent of the total losses escaping during the first few hours of train transit (Nimerek and Leflin, 1977). This implies that only 0.1 percent of the original coal weight will be dispersed as fugitive dust during the rest of the trip, and only a small fraction of the 0.1 percent will be dispersed in the Jacksonville area.

The fugitive dust emissions from agitated road bed dust in the Jacksonville area were estimated using USEPA Publication AP-42 (1979), assuming that the road bed dust emissions are conservatively approximated by emissions from motor vehicles travelling on unpaved roads and that each train will travel at an average speed of 10 miles per hour.

The 24-hour average TSP level in the Jacksonville area resulting from the operation of three coal trains per day (a conservative estimate) was calculated to be 22 ug/m^3 at a distance of 100 meters downwind of the railroad tracks under light wind conditions (1 m/s) and neutral (Pasquill Class C) atmospheric stability conditions. When added to the Jacksonville area background level of 50 ug/m^3 , this total is relatively small compared to the National Ambient Air Quality secondary standard and Florida standard of 150 ug/m^3 . It is noteworthy that the amount of the fugitive coal dust which was estimated to blow off the coal cars is about half of the expected emissions resulting from agitation of roadbed dust. This is primarily because of the very conservative method that was employed to estimate roadbed dust emissions.

5.3.5.2 Accidental Releases

This section describes the air quality impacts which would result from the malfunction of the flue gas desulfurization system (FGD) or the electrostatic precipitators (ESP). Because a total shutdown of the FGD system or ESP on both units at the same time is considered an unlikely event, an accidental release condition is described in terms of a shutdown of the FGD system or ESP on one of the two units.

Continued operation of a coal-fired power plant without FGD controls is not normally allowed under current federal regulations (Federal Register, 1979). However, under these regulations there are certain circumstances in which a utility can bypass untreated flue gases around a malfunctioning FGD system if several conditions are met. These conditions are: (1) the FGD system has a spare FGD module, (2) FGD modules are not available in sufficient numbers to treat the entire quantity of flue gas, and (3) all available electric generating capacity is being utilized in the power network. Assuming that the utility meets the requirements for operation under emergency conditions, the USEPA Region IV usually allows a utility a period of time (several hours) to initiate abatement measures to correct the problem.

The worst case scenario for SO_2 emissions would be several hours of operation of one of the proposed units without FGD. Since the SO_2 emissions used in the modelling analyses assume 90 percent control on both units, the instantaneous total SO_2 emissions would increase by a factor of 5.5 in the absence of controls on one unit. Over a 24 hour period, the total SO_2 emissions would increase by a smaller amount since EPA would require corrective action within a few hours and since peak load demand would last for only several hours. Assuming that 3 hours is a conservative estimate for operating both units at full load under emergency FGD system conditions, the 24-hour SO_2 emissions would increase by a factor of about 1.6. These increases are estimated based on the extremely conservative assumption that all four of a unit's FGD modules (three operating modules plus one spare) malfunction at the same time during peak load conditions.

The worst case scenario for malfunction of the ESP system would involve a number of bus sections failing simultaneously on one of the unit's ESP systems. The manufacturing vendor will provide 10 percent redundancy in the ESP systems. Since each ESP unit has approximately 82 bus sections, 8 of these can fail and the New Source Performance Standards will still be met. The proposed ESP system will remove 99.78 percent of particulate matter from the flue gas (leaving 0.22 percent). Even in the highly unlikely scenario of 20 percent of the bus sections failing simultaneously on one unit during peak load conditions, the total instantaneous emissions would increase by a factor of about 24. Allowing for a 3-hour period of 90 percent control on one unit, the total emissions over a 24-hour period would increase by a factor of about 3.8.

5.3.5.3 Sulfates Analysis

Although no national ambient air quality standards have been adopted for aerosol sulfates, much attention has been expressed about this class of atmospheric particulates. Because of this concern and because of the perceived association between sulfur compound emissions from power plants and ambient sulfate levels, a discussion of atmospheric sulfates is provided in this section. Following the discussion are estimates of downwind sulfate levels resulting from the proposed power plant which were modelled using a modified version of the CRSTER model and compared to typical background levels of sulfates.

General Analysis

Sulfates are important because of their reported effect on human health, their potential effects on rainfall acidity, and their relationship to visibility impairment. A major source of sulfate formation ($\text{SO}_4^{=}$, SO_3^-) is the oxidation of sulfur dioxide (SO_2) after the latter is released to the atmosphere from the combustion of sulfur-bearing fuels. If there were no removal mechanisms of SO_2 , it would continue to build up in the atmosphere. However, no such global buildup has been observed. The

removal processes result in eventual oxidation of SO_2 to a higher oxide such as SO_3^- or $\text{SO}_4^{=}$. Additional SO_2 removal results from intake by vegetation, washout, dry deposition, gaseous reaction on solid materials and gaseous absorption by bodies of water. The variables affecting the rate of conversion of SO_2 to sulfates are atmospheric moisture content, the amount of sunlight and the presence of metal oxides, particulates and other pollutants. Basically, two types of reactions can occur. First, during daylight hours, the SO_2 can be converted by photochemical reactions. Secondly, the SO_2 can be converted by catalytic reactions at any time of the day or night.

The trends in ambient concentrations of SO_2 and sulfate throughout the United States have been analyzed by Altschuller (1976). Table 5.3-16 summarizes four years of background data compiled by Altschuller. Substantial decreases in ambient SO_2 concentrations have been noted which correlate well with corresponding reductions in SO_2 emissions. Measurements of ambient SO_2 levels at both urban and nonurban stations have indicated a decline in concentrations over the past 10 years; however, ambient sulfate concentrations have not decreased correspondingly. These differences between trends in SO_2 emissions and ambient sulfate concentrations may be related to a shift toward usage of lower sulfur fuel at low-level emission sources combined with larger quantities of SO_2 emissions from plants using tall stacks which emit at higher levels in the atmosphere. Thus, the urban monitoring stations measure less SO_2 from local low-level sources, whereas the lack of a similar decline in sulfate concentrations can be attributed to an increasing exposure to sulfates formed in the atmosphere and transported from distant elevated sources.

Sulfate particle diameters range between 0.1×10^{-6} and 2.0×10^{-6} meters (Stearn, 1976). Their small size implies that they could well constitute a regional problem extending over many miles, so that sulfate concentrations in a specific area can be due to SO_2 and particulate emissions from sources far removed from the area. Time is an important parameter to consider in the formation and transport of sulfates. If air

mass movement is persistent, but the conversion rate is slow, sulfate exposure will reach a maximum at a point distant from the source. If the air mass is stagnant, SO_2 may remain in the area long enough for the highest sulfate exposure to occur in the region of the SO_2 source.

Sulfates are of additional interest because of their effect on the atmospheric visibility. One of the most effective mechanisms resulting in visibility impairment is that of light scattering by particles and droplets suspended in the atmosphere, known as aerosols. The effectiveness with which aerosols scatter light depends on the size of the aerosol. Visible light is most effectively scattered by aerosols whose sizes are comparable to the wave length of the light (0.4×10^{-6} to 0.7×10^{-6} meters). Furthermore, it has been shown that sulfates tend to dominate the submicron (1.0×10^{-6} meters) aerosol species both in urban and rural areas, and that visibility impairment is directly related to sulfate concentrations (Weiss et al., 1977).

Sulfates Modelling

Estimates of the ground-level concentrations of sulfates (SO_3^- , $\text{SO}_4^{=}$) were made using a modified version of the CRSTER model. This version of the original CRSTER model (discussed in Section 5.3.1) assumes a 12-hour half-life conversion rate of SO_2 to sulfates. This half-life conversion period was recommended by the USEPA (Nagler, 1979) and is comparable to published experimental data (Rodhe, 1977 and Weiss et al., 1977). Because appreciable conversions from SO_2 to sulfates do not occur after short transport times, no effort was made to estimate sulfate concentrations in close to the proposed plant. Modelling was performed for receptor points placed at various distances (40, 50, 60, 63, and 73 km) downwind of the proposed plant in the direction of the Okefenokee Class I area (northwest), and the direction of St. Augustine area (southeast). The St. Augustine area was considered because of the potential sensitivity of its associated historical monuments to the effects of atmospheric sulfur compounds.

Table 5.3-17 summarizes the results of the sulfates modelling. Calculations were performed for two scenarios: the proposed plant by itself, and the proposed plant operating with St. Regis Paper Company Plant and the NGS. The first scenario gives an estimate of the incremental effects of the proposed plant on the Class I area and St. Augustine, and the latter scenario yields an estimate of the future maximum sulfate concentration at these sensitive areas resulting from major sources of SO_2 in Jacksonville.

The maximum calculated sulfate values show that the plant operation itself accounts for approximately one-tenth of the annual sulfates concentrations and one-third or less of the sulfates concentrations for shorter periods at downwind receptor points located at the Okefenokee Class I area and at St. Augustine. The highest calculated sulfate concentrations resulting from the plant operation alone at the Class I area were 0.08 ug/m^3 , 2.2 ug/m^3 , and 14 ug/m^3 for the annual, 24-hour, and 3-hour averaging intervals, respectively. The highest sulfate concentrations at the Class I area resulting from the combined effects of the major SO_2 sources were 0.7 ug/m^3 , 15 ug/m^3 , and 92 ug/m^3 for the annual, 24-hour, and 3-hour averaging intervals, respectively. The sulfate concentrations calculated for the same averaging intervals in the vicinity of St. Augustine were smaller by a factor of about one-half.

These modelling results take on relative meaning when compared to annual average background levels of sulfates measured in Jacksonville (see Chapter 2, Sections 2.7.3.1 and 2.7.3.2) and in various other regions of the U.S. Table 5.3-16 shows that annual average sulfates levels range between 6 ug/m^3 and 17 ug/m^3 , depending on the region. Comparisons of these levels with the modelling results (Table 5.3-17) suggest that the incremental difference of expected sulfate levels resulting from operation of the proposed plant is relatively small on an annual average basis.

5.3.5.4 Impacts on Visibility

Visibility is defined as the greatest distance at which it is just possible to see and identify with the unaided eye a prominent dark object against the sky at the horizon in the daytime, or a known unfocused moderately intense light source at night (Stearn, 1976). Visibility is diminished by four major processes: light scattering by gas molecules, light scattering by particles, light absorption by gases not naturally occurring in the atmosphere, and light absorption by particles.

A majority of visibility reduction results from particles between the sizes of 0.1×10^{-6} and 1.0×10^{-6} m (Stearn, 1976). This fact results from two phenomena: first, particles smaller than 0.1×10^{-6} m, though very abundant, are very inefficient in scattering light; second, particles larger than 1.0×10^{-6} m are both inefficient in scattering light and usually exist in small numbers and thus also contribute very little to visibility reduction.

Coal-fired power plants affect visibility through the three major combustion related pollutants: particulates, sulfur dioxide, and nitrogen dioxide. Visibility is decreased by particulates primarily through light scattering; by nitrogen dioxide through absorption and later by scattering due to conversion of gaseous nitrogen dioxide to particulate nitrates and nitrites; and by sulfur dioxide when it converts to particulate sulfates.

Cost effective, sophisticated models that are capable of accurately predicting the effect of pollutant emissions on atmospheric visibility under all meteorological conditions are not readily available. Simplified models can, however, provide useful estimates of visibility impacts. Ursenbach et al. (1978) has developed one model which computes visible range (L_{vr}) in miles using an extinction coefficient:

$$L_{vr} = \frac{24.2 \text{ miles}}{b_{ext}} \quad (5.3-1)$$

Where: b_{ext} is the extinction coefficient.

The relationship is applicable to a distribution of aerosols along a line of sight. This extinction coefficient is the sum of coefficients for all species in the atmosphere affecting visibility.

The frequency distribution of the visibility observed at Jacksonville Imeson Airport over a five year period (1964-1968) is summarized in Chapter 2, Table 2.6-6. The average quarterly background visibility at Jacksonville Airport is seldom greater than 12 miles or less than two miles. Visibility conditions greater than or equal to those measured at Jacksonville can be expected at St. Augustine (70 km southeast) and the Okefenokee Class I area (60-70 km northwest). Using Eq. 5.3-1, the background b_{ext} may be calculated and the $SO_4^{=}$ and TSP impacts at the Okefenokee Class I and St. Augustine historical areas may be estimated so that the visibility impacts at these areas may also be estimated (Ursenbach et al., 1978). For purposes of this simplified analysis, it was necessary to assume that $SO_4^{=}$ and TSP are the only pollutants contributing to visibility reduction. It was also assumed that the background visibility is 12 miles. Therefore,

$$b_{ext} \text{ (background)} = \frac{24.2}{12} = 2.02$$

Model results for impacts at the Okefenokee Class I area show that the maximum 24-hour TSP impact from the proposed plant is approximately 0.2 ug/m³, and the maximum 24-hour $SO_4^{=}$ impact is 2.2 ug/m³. Ursenbach has developed the following average partial extinction coefficients (b_{ext}):

Type	Observed Typical Particle Size Range (microns)	b_{ext}
Fly Ash TSP	0.4 - 5.0	.005 (+ 30%)
Sulfate	.2 - 1.0	.103 (+ 6%)

The extinction coefficient due to plant impacts [$b_{\text{ext}}(\text{impacts})$] is the sum of the partial extinction coefficient above multiplied by the concentrations of the species. Also, the total extinction coefficient equals $b_{\text{ext}}(\text{background}) + b_{\text{ext}}(\text{impacts})$. Therefore:

$$b_{\text{ext}}(\text{total}) = 2.02 + (0.103)(2.2) + (0.005)(0.2) = 2.25$$

Substituting into Eq. 5.3-1 yields a maximum visual range of:

$$L_{\text{vr}} = \frac{24.2 \text{ miles}}{b_{\text{ext}}(\text{total})} = \frac{24.2}{2.25} = \underline{10.8 \text{ miles}}$$

This corresponds to a reduction of approximately 10 percent in the visual range at the Okefenokee Class I area during worst-case conditions. A similar calculation shows that the visual range at St. Augustine is estimated to be 11.1 miles, or a worst-case reduction of approximately 8 percent. It should be noted that these visibility reductions resulting from the TSP, and $\text{SO}_4^{=}$ transformation from SO_2 are estimated based on Gaussian plume modelling at large distances and empirical extinction coefficients and transformation rates. Therefore, the estimates from such calculations cannot be considered precise.

An analysis was made of 5 years (1964-1968) of Jacksonville surface wind data that is resolved to 22.5 degree sectors to determine the percent of time during which the winds would carry the proposed plant plume in the directions of the Okefenokee Class I area and the St. Augustine area. The Class I area lies in the west-northwest and northwest sectors relative to the proposed plant, and St. Augustine is located in the south-southeast sector relative to the proposed plant. The 5-year average percent occurrence of winds toward the south-southeast sector (St. Augustine) is only 5.6 percent. The 5-year average percent occurrence of winds toward either the west-northwest and northwest sectors (Okefenokee Class I area) is 11.2 percent. The visibility reductions previously discussed do not represent full-time visibility impairment, only the estimated maximum visibility impairment during these periods when the winds blow in the critical directions.

Another facet of plume visibility is plume opacity. As a plume emerges from a stack, the simple visual range formulation is not an appropriate method of evaluating immediate visibility effects. Particulate concentrations are quite high at this point in the plume and particles which escape from electrostatic precipitators are generally very small particles within the size range contributing most to light scattering. Therefore, they will interfere with light transmission while they are concentrated within the near-stack portion of an emitted plume. The degree of interference is regulated by standards which specify the maximum allowable opacity which can be exhibited by stack emissions. The national standard for fossil fuel-fired steam generators prohibits emissions which exceed an opacity of 20 percent for more than six minutes in any hour. The efficiency of the control equipment which will be in operation will ensure that stack opacity standards will be met.

5.3.5.5 Trace Elements

Vegetation

Eighteen trace elements were selected for review on the basis of reported high concentrations in coal, capability for volatilization during combustion, potential for toxicity, and existence of regulatory guidelines. Since a coal source has not been selected, trace element concentrations in coal were obtained from a report on trace elements in coal samples from the eastern United States (Gluskoter et al., 1977). The eastern samples were taken from coal mines in Pennsylvania, Ohio, West Virginia, Kentucky, Tennessee, and Alabama.

The methodology used in estimating stack emissions of trace elements, deposition rates and soil concentration increases is detailed in Appendix A. The predicted deposition rates were determined on the basis of coal consumption, trace element concentration, and SO₂ emission rates. Elements considered to be volatile were assumed to exit the stack in an uncontrolled manner. Those trace elements typically occurring as

particulates or adsorbed on particulates were also assumed to exit in an uncontrolled state. These assumptions were utilized due to the lack of information on the behavior of trace elements passing through an FGD system. In addition, the use of these assumptions introduced a degree of conservatism to the assessment.

Studies of model power plants by Dvorak et al. (1977), Dvorak and Pentecost et al. (1977), and Vaughan et al. (1975) in most cases predicted increases in soil trace element levels of less than 10 percent of the total endogenous concentrations over the life of the model plant. It was concluded that uptake by vegetation could not increase dramatically unless the forms of deposited trace elements were considerably more available than the endogenous forms (U.S. Fish and Wildlife Service, 1978). A summary of the sensitivity of vegetation to the 18 trace elements selected for study is presented in Appendix A.

The estimated annual percent increase in soil concentrations, attributed to the proposed plant, of the 18 trace elements reviewed are presented in Table 5.3-18. The estimated increases ranged from 1.5×10^{-5} to 1.2×10^{-2} percent, using average soil background concentrations obtained from the literature (Horton et al., 1977; U.S. Fish and Wildlife Service; 1978, Environmental Research and Technology, 1978). The estimated increases over the 40 year life of the plant, assuming that the elements remained concentrated in the top 25 cm of soil over this period ranged from 5.9×10^{-4} to 4.7×10^{-1} . The assessment of these estimated increases was based on a number of worst case conditions, which are described in Appendix A. Under these conditions, which are not likely to occur during typical operation of the proposed plant, an increase in the levels of most trace elements in soil should not be perceptible on an annual basis. Over the 40 year plant life, those elements exhibiting a higher percent increase relative to the others studied include: arsenic, boron, cadmium, lead, mercury, and molybdenum.

The estimated soil concentration increase for arsenic would be 1.48×10^{-2} mg per kg of soil over the 40 years plant life. Naturally occurring arsenic levels in soils average about 6 ppm. Soil arsenic concentrations greater than 2 ppm, soluble form, have been shown to produce injury symptoms on alfalfa and barley (Vandecaveye et al., 1936) and as such no effect could be expected under worst case conditions.

The estimated soil concentration increase for boron would be 2.5×10^{-2} mg per kg soil over the 40 year plant life under worst case conditions. Naturally occurring boron concentrations range from 2-100 ppm with the highest levels found in saline and alkaline soils (Bowen, 1966). The average value is considered to be about 10 ppm. Using a toxicity level of 0.5-1.0 ppm for plants sensitive to boron as a means for comparison, no adverse effects to sensitive species such as citrus would be expected under worst case operating conditions.

The estimated soil concentration increase for cadmium would be 1.43×10^{-4} mg per kg of soil over the 40 year plant life. This represents a 2.4×10^{-1} percent increase in soil concentration over the average background level of 0.06 ppm (U.S. Fish and Wildlife Service, 1978), which is high in comparison with the other elements addressed. Toxicity to plants is reported to occur when cadmium concentration in plant tissue reaches about 3 ppm (Allaway, 1968; Bazzay et al., 1974) and it is unlikely that the estimated soil concentration will be high enough for the accumulation of 2 ppm in leaf tissue within the vicinity of the proposed plant.

The estimated soil increase for lead would be 3.49×10^{-2} mg per kg of soil over the 40 year plant life. Naturally occurring lead concentrations in soil averages about 10 ppm. Based on reported threshold concentrations of 10 ppm lead in solution culture (Valkovic, 1975), the addition of 3.49×10^{-2} mg lead per kg of soil to soils containing as much as 5 ppm lead should not result in any adverse effects. It is thought that lead enters the plant primarily through the leaf surface. However,

the effect of such accumulations cannot be predicted due to the lack of information concerning the concentration of lead in plants due to leaf deposition.

The estimated soil increase for mercury would be 1.19×10^{-4} mg per kg of soil. Naturally occurring lead concentrations in soil average 0.1 ppm. Most higher vascular plants are resistant to toxicity from high Hg concentrations even though high concentrations are present in plant tissue. Concentrations of 0.5-50 ppm (HgCl_2) were found to inhibit the growth of califlower, lettuce, potato, and carrots (Bell and Rickard, 1974). The addition of 1.19×10^{-4} mg per kg of soil is not considered to result in an adverse effect.

The estimated soil increase for molybdenum would be 2.73×10^{-3} mg per kg of soil over the 40 year life. Naturally occurring background concentrations average about 2 ppm. Molybdenum (Mo) is considered to be an essential element for plants. Molybdenum toxicity is rarely observed in the field since most plants seem to be able to tolerate high tissue concentration (Allaway, 1968; Johnson, 1966). A Mo concentration of 5 ppm in nutrient solution was found to be toxic to clover and lettuce (Warrington, 1950). It would appear to be unlikely that the contribution of Mo from the proposed plant would result in adverse effects.

Wildlife

Wildlife may be exposed to trace elements from a coal-fired power plant through the emission of vapor and particulates which can be either inhaled directly or taken in through the ingestion of plant material. The effects of trace elements on terrestrial animals are virtually impossible to evaluate on a quantitative base because of a lack of information dealing with (1) concentrations of most trace elements in the diet of wildlife species, and the total amounts of food and water consumed by individual species; (2) food-chain transfers and bioaccumulation of most trace elements; (3) trace element retention times, excretion rates, and

assimilation rates in individual wildlife species; (4) physiological, biochemical, and synergistic effects of individual trace elements in the animal body; and (5) effects of lifetime exposure to very low concentrations (U.S. Fish and Wildlife Service, 1978). Therefore, the impact of trace element emissions associated with the proposed plant on wildlife cannot be predicted at this time.

5.3.5.6 Acid Rain

The subject of acid rain is, at present, a controversial issue. The literature contains a good deal of evidence that supports the contention that the pH of rainfall has decreased. The mechanisms of acid rain formation, the removal processes and rates have been addressed in a number of studies. Effects of acidic precipitation or simulated acid precipitation on terrestrial and aquatic systems have been investigated both in Europe and the U.S. However, a number of the studies that have identified the trend of decreasing precipitation pH were based on incomplete evidence from comparisons made of two different data sets. As a result, conclusions drawn from these studies may be incorrect. At the present, persons on both sides of the issue will agree that rainfall, at least in parts of the U.S., is more acidic than would occur under natural equilibrium with atmospheric CO_2 , that exposures of plants to acidic solutions will result in various types of injury, and that alterations in species composition have occurred in lakes where pH has dropped. The sources and processes involved in the acidification of precipitation are two issues that are yet to be resolved. A literature review on various aspects of the acid rain problem is presented in Appendix L.

The most apparent conclusions from the literature review are, at the current level of knowledge, it is very hard to quantify what effect, if any, a point source emission of SO_2 and NO_2 will have on the acidity of rainfall in the vicinity and in the region of the source; and in turn, what effects, if any, acidic precipitation will have on terrestrial and aquatic systems for both short and long term perspectives. Extensive research

programs have been initiated by the USEPA, Oak Ridge National Laboratories, Electric Power Research Institute, and others (see Appendix L). The results from these studies will have to be carefully analyzed before any conclusive or definitive statements can be made regarding the issue of acid rain.

5.3.6 References

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Table 5.3-1 (Revision 1)
 WORST CASE YEAR ANALYSIS: MAJOR SO₂ SOURCES^{a,c}
 INCLUDING THE PROPOSED PLANT

Averaging Period	Year	Highest Concentration (ug/m ³)	Distance ^b (km)	Direction ^b (degrees)	Highest, Second-Highest Concentration (ug/m ³)	Distance ^b (km)	Direction ^b (degrees)	Standard (ug/m ³)
24-hours	1970	198	4.5	180	147	2.0	90	260
	1971	196	4.0	180	138	2.5	130	
	1972	215	1.0	120	161	3.0	120	
	1973	211	2.0	90	189	2.5	90	
	1974	218	2.5	270	134	3.5	150	
3-hours	1970	1177	1.5	340	863	1.5	149	1300
	1971	1049	2.0	340	837	2.0	220	
	1972	1295	1.0	120	802	1.5	80	
	1973	1089	1.0	120	933	1.0	230	
	1974	1023	2.0	160	688	2.0	120	
Annual	1970	21	4.0	300				60
	1971	15	3.0	120				
	1972	14	3.0	80				
	1973	15	5.0	230				
	1974	15	4.0	180				

^a Includes proposed plant, Northside, Kennedy and Southside Generating Stations, and St. Regis

^b Distance and direction from the stack of proposed plant.

^c Emissions from the proposed plant were based on a unit heat input 5,928 MMBtu/hr rather than the 6,144 MMBtu/hr value currently planned. Thus the emissions utilized for the proposed plant are approximately 3.6 percent too low. Since it was not felt that this change would affect the conclusions of this analysis, the analysis has not been redone.

Table 5.3-2 (Revision 1)
PSD INCREMENT EMISSIONS FOR SO₂

Source Name	Emission Rate (g/s)	Stack Height (m)	Stack Temp (°K)	Exit Velocity (m/s)	Stack Diameter (m)	X-Coord (km)	Y-Coord (km)
JEA Proposed 1&2a,b	1176.6	194.2	327.6	18.29	10.13	447.1	366.3
JEA Proposed Auxiliary Boilersa	25.6	85.4	441.0	12.2	2.08	447.0	366.5
Container Corp, a, b	154.4	103.6	441.5	12.89	4.51	455.1	386.7
Container Corp, a, b	76.0	75.6	485.0	14.4	2.44	455.1	386.7
Container Corp, a, b	119.0	75.6	480.0	16.25	3.35	455.1	386.7
Container Corp, a, b	-78.7	75.6	480.0	19.35	2.44	455.1	386.7
Container Corp, a, b	-62.5	78.9	480.0	12.04	1.52	455.1	386.7
Container Corp, a, b	-10.5	45.1	390.0	13.26	2.74	455.1	386.7
Container Corp, a, b	35.3	88.1	484.0	18.65	1.22	455.1	386.7
NAS Jacksonville	1.4	13.11	505.4	61	1.07	434.3	343.5
NAS Mayport	1.4	18.29	505.4	7.9	1.52	460.4	362.8
Jax Bulk Terminala	4.2	12.2	344.4	9.6	.91	439.3	359.8
Union Campa, b	7.3	15.54	586.0	11.7	1.22	427.6	357.3
Dickersona (Talley Rand Rd)	22.1	13.4	331.0	5.8	1.83	438.5	350.5
ITT Rayonier	-63.0	30.5	453.0	8.02	3.05	453.0	385.0
ITT Rayonier	-63.0	30.5	438.0	9.27	3.05	453.0	385.0
ITT Rayonier	3.5	37.5	307.0	19.57	.91	453.0	385.0
ITT Rayonier	4.4	37.5	303.0	4.24	.91	453.0	385.0
ITT Rayonier	22.1	30.5	308.0	8.05	.61	453.0	385.0
Gainesville Alachua Power Plantb	277.0	106.7	408.0	15.24	5.29	364.0	292.6
Occidental Chemicalb	12.9	15.2	467.0	23.9	1.46	320.9	369.8
Occidental Chemicalb	15.5	30.5	468.0	11.8	2.29	328.9	368.9
Occidental Chemicalb	84.0	61.0	356.0	30.6	1.83	320.9	369.8
Occidental Chemicalb	15.5	15.3	468.0	11.8	2.29	321.1	369.8

a Used for PSD Class II Modelling
b Used for PSD Class I Modelling

Note: Emission sources listed include those within 50 km of the proposed plant or within 100 km of the Okefenokee Wilderness Area.
Negative values indicate emission reductions since the baseline date.

Table 5.3-3 (Revision 1)
PSD INCREMENT EMISSIONS FOR TSP

Source Name	Emission Rate (g/s)	Stack Height (m)	Stack Temp (°K)	Exit Velocity (m/s)	Stack Diameter (m)	X-Coord (km)	Y-Coord (km)
JEA Proposed 1&2a,b	46.4	194.2	327.6	18.29	10.13	447.1	366.3
JEA Proposed a,b (Fugitives)	15.4	Various source heights and locations in plant vicinity					
Container Corp, a,b	13.6	103.6	441.5	12.89	4.51	455.1	386.7
Container Corp, a,b	-2.9	75.6	480.0	19.3	2.44	455.1	386.7
Container Corp, a,b	2.9	76.6	485.0	14.4	2.44	455.1	386.7
Container Corp, a,b	1.5	75.6	480.0	16.25	3.35	455.1	386.7
Container Corp, a,b	-2.3	78.9	480.0	12.04	1.52	455.1	386.7
Container Corp, a,b	-5.2	45.1	390.0	13.26	2.74	455.1	386.7
Container Corp, a,b	10.5	88.1	484.0	18.65	1.22	455.1	386.7
Cargill	1.4	34.75	Amb.+10°F	19.4	1.07	416.0	350.0
NAS Jacksonville	2.6	13.11	505.4	6.1	1.07	434.3	343.5
NAS Mayport	3.5	18.29	505.4	7.9	1.52	460.4	362.8
Dickerson (Somer Rd)	2.0	9.2	339.9	27.0	1.07	438.8	361.1
Anheuser Busch	1.3	21.2	322.1	9.9	1.68	437.9	366.8
Anheuser Busch	1.4	21.3	327.0	10.6	2.06	437.9	366.8
Jax Bulk Term	.4	3.63	Amb.	38.4	1.07	439.3	359.8
Jax Bulk Term	.7	12.2	355.4	9.5	.91	439.3	359.8
Union Camp	.4	15.54	586.0	11.7	1.22	427.6	357.3
Dickerson (Talley Rand Rd)	1.6	13.4	331.0	5.8	1.83	438.5	350.5
Livingston	1.2	11.0	Amb.	23.4	.52	439.5	365.9
ITT Rayonier	-11.3	30.5	453.0	8.02	3.05	453.0	385.0
ITT Rayonier	-11.7	30.5	438.0	9.27	3.05	453.0	385.0
Gainesville Alachua Power Plant ^b	23.0	106.7	408.0	14.25	5.29	364.0	292.6
Occidental Chemical ^b	.5	15.2	467.0	23.9	1.46	320.9	369.8
Occidental Chemical ^b	3.2	61.0	356.0	30.6	1.83	320.9	369.8

a Used for PSD Class II Modelling
b Used for PSD Class I Modelling

Note: Emission sources listed include those within 50 km of the proposed plant or within 100 km of the Okefenokee Wilderness Area.
Negative values indicate emission reductions since the baseline date.

Table 5.3-4 (Revision 1)
MAXIMUM PREDICTED SO₂ AND TSP CLASS II INCREMENT CONSUMPTION

Pollutant	Averaging Time	Highest Concentration (ug/m ³)	Distance ^a (km)	Direction ^a (degrees)	Highest, Second-Highest Concentration (ug/m ³)	Distance ^a (km)	Direction ^a (degrees)	Class II Increment (ug/m ³)	Maximum Increment Consumption (%)
SO ₂	Annual	2	4.0	60	N/A	N/A	N/A	20 ^b	12
	24-Hour	54	1.5	140	44 ^d	1.2	310	91	48
	3-Hour	425	1.4	140	346 ^d	1.2	310	512	68
TSP	Annual	2	5.0	160	N/A	N/A	N/A	19 ^c	11
	24-Hour	14	1.0	280	10	1.0	280	37	27

^a From the stack of the proposed plant

^b Arithmetic Mean

^c Geometric Mean

^d If the auxiliary boilers are assumed to be operating under these worst-case conditions, these highest, second-highest 24-hour and 3-hour averages could increase to approximately 49 and 368, respectively. However, this is extremely unlikely since the auxiliary boilers are expected to be operated 5 percent of the time.

N/A - Not Applicable

Table 5.3-5 (Revision 1)
MAXIMUM PREDICTED SO₂ AND TSP CLASS I INCREMENT CONSUMPTION

Pollutant	Averaging Time	Highest Concentration (ug/m ³)	Distance ^a (km)	Direction ^a (degrees)	Second-Highest Concentration (ug/m ³)	Distance ^a (km)	Direction ^a (degrees)	Class I Increment (ug/m ³)	Maximum Increment Consumption (%)
SO ₂	Annual	< 1	63	300	N/A	N/A	N/A	2b	50
	24-Hour	5	63	300	4	63	300	5	80
	3-Hour	21	63	300	19	63	300	25	76
TSP	Annual	< 1	63	300	N/A	N/A	N/A	5c	20
	24-Hour	< 1	63	300	< 1	63	300	10	10

a From the stack of the proposed plant
b Arithmetic Mean
c Geometric Mean
N/A - Not Applicable

Table 5.3-6 (Revision 1)
MAXIMUM PREDICTED AMBIENT CONCENTRATIONS

Pollutant	Averaging Time	Highest Conc. (ug/m ³)	Distance ^a (km)	Direction ^a (degrees)	Highest, Second-Highest Conc. (ug/m ³)	Distance ^a (km)	Direction ^a (degrees)	Back-ground Conc. (ug/m ³)	Total Conc. (ug/m ³)	Ambient Standard (ug/m ³)	Maximum as Percent of Standard (%)
SO ₂	Annual	13	4.5	230	N/A	N/A	N/A	4	17	60 ^b	28
	24-Hour	207	1.8	100	195 ^d	2.6	90	21	216	260	83
	3-Hour	1298	1.3	230	987	1.3	230	90	1077	1300	83
TSP	Annual	3	6.0	160	N/A	N/A	N/A	27	30	60 ^c	50
	24-Hour	33	1.2	360	30	4.5	160	50	80	150	53
	Annual	10	4.5	230	N/A	N/A	N/A	10	20	100 ^b	20

^a From the stack of the proposed plant

^b Arithmetic Mean

^c Geometric Mean

^d These highest, second-highest SO₂ concentrations are not significantly affected by assumed operation of the auxiliary boilers since the primary contributors to these values are sources other than the proposed plant. Modelling indicates no change in the 3-hour average of 987 and an increase from 195 to 196 in the 24-hour average assuming continuous operation of the auxiliary boilers.

N/A - Not Applicable

Table 5.3-7

THRESHOLD SO₂ CONCENTRATIONS FOR VISIBLE INJURY TO SENSITIVE VEGETATION

Exposure Period (hour)	Threshold Concentration ($\mu\text{g}/\text{m}^3$)			
	Jacobsen (1977)	Jones et al. (1974)	Linzon (1973)	USEPA (1973)
1	2000	1300-2620	1834	1300-7860
2	1050	-	1048	655-5240
3	850	786-1572	785 ^a	400-3750 ^a
4	750	-	681	262-2620
8	500	-	472	131-1310

^a Interpolated value

Table 5.3-8

THRESHOLD SO₂ CONCENTRATIONS FOR VISIBLE INJURY TO VEGETATION
OF INTERMEDIATE SENSITIVITY

Exposure Period (hour)	Threshold Concentration ($\mu\text{g}/\text{m}^3$)	
	USEPA (1973)	Jones et al. (1974)
1	6550-26200	2620-5240
2	3930-19650	-
3	2250-15500	1572-2096
4	1310-13100	-
8	524-6550	-

Table 5.3-9

RESPONSE OR SENSITIVITY RATING OF VEGETATION TYPICAL
OF THE PROPOSED SITE TO SO₂

Vegetation	SO ₂ Concentration (ug/m ³)	Exposure Period	Rating or Response	Reference
<u>Acer sp.</u> (maples)	118 - 2620-5240 1572-2096	Growing season - 1 hr. 3 hr.	No leaf injury Resistant Threshold level Threshold level	Fed. Am. Sec. Exp. Bio. (1973) Sucoff and Bailey (1971) Jones et al. (1974) Jones et al. (1974)
<u>Acer rubra</u>	-	-	Tolerant	USDA (1972)
<u>Cornus sp.</u> (dogwood)	5240 5240 2096	Peak 1 hr. 3 hr.	Resistant Resistant Resistant	Jones et al. (1974) Jones et al. (1974) Jones et al. (1974)
<u>Liquidambar styraciflua</u> (sweetgum)	3930-5240 2620-5240 1572-2096	Peak 1 hr. 3 hr.	Intermediate sensitivity Intermediate sensitivity Intermediate sensitivity	Jones et al. (1974) Jones et al. (1974) Jones et al. (1974)
<u>Nyssa biflora</u> (blackgum)	-	-	Tolerant	USDA (1972)
<u>Pinus sp.</u> (southern pines)	3930-5240 2620-5240 1572-2096	Peak 1 hr. 3 hr.	Sensitive Sensitive Sensitive	Jones et al. (1974) Jones et al. (1974) Jones et al. (1974)
<u>Prunus sp.</u> (cherry)	3930-5240 2620-5240 1572-2096	Peak 1 hr. 3 hr.	Intermediate sensitivity Intermediate sensitivity Intermediate sensitivity	Jones et al. (1974) Jones et al. (1974) Jones et al. (1974)
<u>Pteridium aquilium</u> (bracken fern)	-	-	Sensitive	USEPA (1976)

Table 5.3-9 (Continued)
 RESPONSE OR SENSITIVITY RATING OF VEGETATION TYPICAL
 OF THE PROPOSED SITE TO SO₂

Vegetation	SO ₂ Concentration ($\mu\text{g}/\text{m}^3$)	Exposure Period	Rating or Response	Reference
<u>Quercus marilandica</u> (blackjack oak)	-	-	Sensitive	Loomis and Padgett (1973)
<u>Quercus virginiana</u> (live oak)	-	-	Tolerant	Loomis and Padgett (1973)
<u>Rhus spp.</u> (Sumacs)	2620-3930 1310-2620	Peak 1 hr.	Sensitive Sensitive	Jones et al. (1974) Jones et al. (1974)
<u>Rubus spp.</u>	2620-3930 1310-2620 786-1572	Peak 1 hr. 3 hr.	Sensitive Sensitive Sensitive	Jones et al. (1974) Jones et al. (1974) Jones et al. (1974)
<u>Salix nigra</u>	-	-	Sensitive	Davis and Wilhour (1976)

Table 5.3-10

THRESHOLD NO₂ CONCENTRATIONS FOR VISIBLE INJURY TO PLANT SPECIES

Exposure Period (hour)	Threshold Concentration (ug/m ³) ^a	
	USEPA (1976)	Thompson et al. (1974)
1	68620	1880-28200
2	37600	-
3	22560	-
4	16920	-
8	9024	4324-6580 ^b
24	4324	1880

^a Extrapolated values

^b Values reported for 8-21 hours

Table 5.3-11

RESPONSE OR SENSITIVITY RATING OF VEGETATION TYPICAL
OF THE PROPOSED SITE TO NO₂

Vegetation	NO ₂ Concentration (µg/m ³)	Exposure Period	Rating or Response	Reference
<u>Brassica oleracea</u> (cabbage)	-	-	Relatively insensitive Tolerant	Thompson et al. (1974) USEPA (1976)
<u>Chenopodium sp.</u> (pigweed)	-	-	Resistant	Taylor and MacLean (1970)
<u>Citrus sinensis</u> (orange)	- 18800-470000 470	- 0.2-8 hrs. 8 months	Sensitive Marginal necrosis Reduced yield	Taylor and MacLean (1970) MacLean et al. (1968) Thompson et al. (1970)
<u>Gossypium hirsutum</u> ^a (cotton)	1880 1880 6580 60160	48 hr. 12 hr. 21 hr. 1 hr.	Slight, definite spotting No injury Mild necrotic spots Extensive injury	Heck (1964) Thompson et al. (1974) Thompson et al. (1974) Heck and Tingey (1969)
<u>Glycine sp.</u> ^a (soybeans)	60160	1 hr.	Extensive injury	Heck and Tingey (1969)
<u>Medicago sativa</u> (alfalfa)	940-1316 - 11280	0.75-1.5 hr. - 4, 7, 8 hrs.	Threshold Sensitive Moderate severe necrosis	Hill and Bennett (1970) USEPA (1976) Van Haut & Strattman (1967)
<u>Nicotiana glutinosa</u> (tobacco)	4110 4324	3 days 8.67 hrs.	Leaf injury Severe injury	Taylor and Eaton (1966) Korth et al. (1964)
<u>Nicotiana tabacum</u> (common tobacco)	- -	- -	Medium sensitive Sensitive	Thompson et al. (1974) USEPA (1976)
<u>Solanum tuberosum</u> (potato)	- 56400	- 1 hr.	Medium sensitive Little or no injury	Thompson et al. (1974) Czech and Nothdurft (1952)

Table 5.3-11 (Continued)

RESPONSE OR SENSITIVITY RATING OF VEGETATION TYPICAL
OF THE PROPOSED SITE TO NO₂

Vegetation	NO ₂ Concentration (µg/m ³)	Exposure Period	Rating or Response	Reference
<u>Sorghum vulgare</u> (sorghum)	18800	1 hr.	No leaf injury	Thompson et al. (1974)
<u>Trifolium pratense</u> (red clover)	-	-	Sensitive	Thompson et al. (1974)
<u>Tilia grandifolia</u> (winter lime)	-	-	Medium sensitive	Thompson et al. (1974)
<u>Tilia parvifolia</u> (summer lime)	-	-	Medium sensitive	Thompson et al. (1974)
<u>Zea mays</u> (corn)	940 18800 37600 7520	0.50 hr. 1 hr. 0.5 hr. 7 hr.	Leaf injury (1%) Leaf injury (1%) Leaf injury (1%) Leaf injury (2%)	Thompson et al. (1974) Thompson et al. (1974) Thompson et al. (1974) Thompson et al. (1974)

^a Not specific to northwestern Florida, but typical to region

Table 5.3-12

THRESHOLD O₃ CONCENTRATIONS FOR VISIBLE INJURY
TO PLANT SPECIES ^a

Exposure Period (hour)	Ozone Concentration (ug/m ³)		
	<u>Sensitive</u>	<u>Intermediate</u>	<u>Tolerant</u>
0.5	294-588	490-1176	980
1.0	196-490	392-784	686
2.0	137-392	294-588	490
4.0	98-294	196-490	392
8.0	59-196	157-392	294

^a Source: Heggstad and Heck (1971)

Table 5.3-13

RESPONSE OR SENSITIVITY RATING OF VEGETATION TYPICAL
OF NORTHEASTERN FLORIDA TO O₃

<u>Vegetation</u>	<u>Ozone Concentration ($\mu\text{g}/\text{m}^3$)</u>	<u>Exposure Period</u>	<u>Rating or Response</u>	<u>Reference</u>
<u>Crop Species</u>				
<u>Brassica sp.</u> (cabbage)	-	-	Intermediate sensitivity	USEPA (1976)
<u>Capsicum frutescens</u> (pepper)	1960	8 hr.	No. injury	Ledbetter et al. (1959)
<u>Cucumis sativas</u> (cucumber)	784.0 -	2 hr. -	Leaf injury Intermediate sensitivity	Hill et al. (1961) USEPA (1976)
<u>Gossypium hirsutum</u> (cotton)	784.0	2 hr.	Leaf injury	Hill et al. (1961)
<u>Ipomea batatas</u> (sweet potato)	588-1960	8 hr.	Leaf injury	Ledbetter et al. (1959)
<u>Medicago sativa</u> (alfalfa)	392 196-588	2 hr. 8 hr.	Threshold Leaf injury	Hill et al. (1961) Ledbetter et al. (1959)
<u>Nicotiana tabacum</u> (tobacco)	470.4 980	2 hr. 0.75 hr.	Threshold Leaf injury (3%), 67% reduction in photosynthesis	Hill et al. (1961) Hill and Littlefield (1969)
	196 196-588	8 hr. 8 hr.	Leaf injury Leaf injury	Ledbetter et al. (1959) Ledbetter et al. (1959)
<u>Solanum tuberosum</u> (potato)	1176.0 196	1 hr. 8 hr.	Leaf injury (3%), 50% Leaf injury	Hill and Littlefield (1969) Ledbetter et al. (1959)
<u>Sorghum vulgare</u> (sorghum)	-	-	Intermediate sensitivity	USEPA (1976)

Table 5.3-13 (Continued)

RESPONSE OR SENSITIVITY RATING OF VEGETATION TYPICAL
OF NORTHEASTERN FLORIDA TO O₃

Vegetation	Ozone Concentration (ug/m ³)	Exposure Period	Rating or Response	Reference
<u>Trifolium pratense</u> (red clover)	686	2 hr.	Threshold	Hill et al. (1961)
<u>Zea mays</u> (field corn)	490	2 hr.	Threshold	Hill et al. (1961)
	980	1.5 hr.	Leaf injury 3%, 68% reduction in photosynthesis	Hill and Littlefield (1969)
(sweet corn)	490	2 hr.	Threshold	Hill et al. (1961)
<u>Native Species</u>				
<u>Acer rubrum</u> (red maple)	-	-	Tolerant	USDA (1972)
<u>Albizia julibrissin</u> (mimosa)	-	-	Tolerant	USEPA (1976)
<u>Cornus</u> sp.	-	-	Tolerant	USEPA (1976)
<u>Liquidambar styraciflua</u> (sweetgum)	-	-	Sensitive	USDA (1972)
<u>Nyssa sylvatica</u> (blackgum)	-	-	Tolerant	USEPA (1976)
<u>Parthenocissus</u> <u>quinquefolia</u> (Virginia creeper)	784	4 hrs./day for 14 days	Leaf injury	Treshow (1970)
<u>Pinus elliotii</u> (slash pine)	98	84 days	Reduced photosynthesis in 20 needles	Barnes (1972)
	294	84 days	Reduced photosynthesis	Barnes (1972)
	98	18 weeks	12% reduction in photosynthesis	Barnes (1972)

Table 5.3-13 (Continued)

RESPONSE OR SENSITIVITY RATING OF VEGETATION TYPICAL
OF NORTHEASTERN FLORIDA TO O₃

Vegetation	Ozone Concentration ($\mu\text{g}/\text{m}^3$)	Exposure Period	Rating or Response	Reference
<u>Pinus serotina</u> (pond pine)	98	84 days	Reduced photosynthesis 20 needles	Barnes (1972)
	294	84 days	Reduced photosynthesis	Barnes (1972)

Table 5.3-14

RESPONSE OR SENSITIVITY RATING OF VEGETATION TO MIXTURES OF SO₂ AND NO₂

Vegetation	SO ₂ Concentration ($\mu\text{g}/\text{m}^3$)	NO ₂ Concentration ($\mu\text{g}/\text{m}^3$)	Exposure Period	Rating or Response	Reference
<u>Glycine max</u> (soybean)	131	94	4 hr.	Slight leaf discoloration	Fed. Am. Soc. Exp. Bio. (1973)
	131-655	94-470	4 hr.	Greater than additive effect	USEPA (1976)
	262	188	4 hr.	Leaf injury (35%)	Tingey et al. (1971)
	262	282	4 hr.	Leaf injury (20%)	Tingey et al. (1971)
	524	376	4 hr.	Leaf injury (9%)	Tingey et al. (1971)
<u>Medicago sativa</u> (alfalfa)	262	94	4 hr.	No leaf injury	Tingey et al. (1971)
	655	470	1 hr.	9% inhibition of CO ₂ uptake	White et al. (1974)
	655	470	2 hr.	15% inhibition of CO ₂ uptake	White et al. (1974)
	262	188	4 hr.	Leaf injury (11%)	Tingey et al. (1971)
	262	282	4 hr.	Leaf injury (18%)	Tingey et al. (1971)
<u>Lycopersicon esculentum</u> (tomato)	262	188	4 hr.	Leaf injury (1%)	Tingey et al. (1971)
	262	282	4 hr.	Leaf injury (17%)	Tingey et al. (1971)

Table 5.3-15

RESPONSE OR SENSITIVITY RATING OF VEGETATION TO MIXTURES OF SO₂ AND O₃

Vegetation	SO ₂ Concentration ($\mu\text{g}/\text{m}^3$)	O ₃ Concentration ($\mu\text{g}/\text{m}^3$)	Exposure Period	Rating or Response	Reference
<u>Brassica oleracea</u> <u>capitata</u> (cabbage)	1310 262 655 1310	98 196 196 98	4 hr. 4 hr. 4 hr. 4 hr.	Leaf injury (4%) Leaf injury (22%) Leaf injury (14%) Leaf injury (54%)	Tingey et al. (1973b) Tingey et al. (1973b) Tingey et al. (1973b) Tingey et al. (1973b)
<u>Glycine max</u> (soybean)	2620 131 98 196 655 2620	196 98 98 196 98 196	4 hr. 6 hr. 6 hr. 6 hr. 4 hr. 4 hr.	Additive effect Leaf injury and decreased growth Leaf injury and decreased growth Leaf injury and decreased growth No leaf injury Leaf injury (1%)	USEPA (1976) Tingey et al. (1973b) Heagle et al. (1974) Heagle et al. (1974) Tingey et al. (1973a) Tingey et al. (1973a)
<u>Gossypium</u> sp. (cotton)	734-838	176-216	10 wks.	Leaf injury and chlorosis	Fed. Am. Soc. Exp Bio. (1975)
<u>Lycopersicon esculentum</u> (tomato)	1310 262 655 1310	98 196 196 196	4 hr. 4 hr. 4 hr. 4 hr.	Leaf injury (1%) Leaf injury (50%) Leaf injury (10%) Leaf injury (13%)	Tingey et al. (1973b) Tingey et al. (1973b) Tingey et al. (1973b) Tingey et al. (1973b)
<u>Medicago sativa</u> (alfalfa)	1310 262 655 1310	98 196 196 196	4 hr. 4 hr. 4 hr. 4 hr.	Leaf injury (2%) Leaf injury (24%) Leaf injury (21%) Leaf injury (60%)	Tingey et al. (1973b) Tingey et al. (1973b) Tingey et al. (1973b) Tingey et al. (1973b)
<u>Nicotiana tabacum</u> (tobacco)	1310 262 655 1310	98 196 196 196	4 hr. 4 hr. 4 hr. 4 hr.	Leaf injury (60%) Leaf injury (95%) Leaf injury (88%) Leaf injury (96%)	Tingey et al. (1973b) Tingey et al. (1973b) Tingey et al. (1973b) Tingey et al. (1973b)

Table 5.3-16

ANNUAL SULFUR DIOXIDE AND SULFATE LEVELS ($\mu\text{g}/\text{m}^3$)
 AVERAGED OVER VARIOUS REGIONS IN THE U.S.^a

Region	Pollutant	Year			
		1968	1969	1970	1971
East Coast	SO ₂	119.0	100.0	74.0	66.0
	SO ₄	17.2	16.9	16.6	15.7
Southeast	SO ₂	-	28.0	26.0	-
	SO ₄	10.0	10.4	10.6	10.3
Midwest (East of Mississippi River)	SO ₂	71.0	63.0	54.0	46.0
	SO ₄	14.6	15.2	15.6	15.2
Midwest (West of Mississippi River)	SO ₂	20.0	19.0	18.0	-
	SO ₄	6.2	7.4	7.5	-

^a Source: Altschuller, 1976

Table 5.3-17

ESTIMATES OF MAXIMUM GROUND LEVEL SULFATES CONCENTRATIONS ($\mu\text{g}/\text{m}^3$)^a

<u>At Okeefenokee Class I Area</u>	<u>Annual</u>	<u>24-Hour</u>	<u>3-Hour</u>
Plant by Itself	0.08	2.3	14.4
Proposed Plant and Other Major SO ₂ Sources	0.7	1	92.4
 <u>At St. Augustine</u>			
Plant by Itself	0.04	1.7	9.6
Proposed Plant and Other Major SO ₂ Sources	0.4	4.9	41.3

^a Based on CRSTER model 12-hour half-life conversion rate, using 1973 as worst case year

Table 5.3-18
ESTIMATED TRACE ELEMENT CONCENTRATIONS IN THE SOIL DUE TO EMISSIONS FROM THE PROPOSED PLANT

Elements	Average Background Soil Concentration ^a (ppm)	Estimated Soil Concentration Increased (mg/kg/yr)	Percent Increase Due to Emissions from the Proposed Plant	
			Per Annum	40 Year Plant Life
Arsenic	6	3.71×10^{-4}	6.0×10^{-3}	2.5×10^{-1}
Beryllium	6	1.93×10^{-5}	3.0×10^{-4}	1.3×10^{-2}
Boron	10	6.24×10^{-4}	6.2×10^{-3}	2.5×10^{-1}
Cadmium	0.06	3.57×10^{-6}	5.9×10^{-3}	2.4×10^{-1}
Chromium	100	2.98×10^{-4}	2.9×10^{-4}	1.2×10^{-2}
Cobalt	8	1.46×10^{-4}	1.8×10^{-3}	7.2×10^{-2}
Copper	20	2.67×10^{-4}	1.3×10^{-3}	5.3×10^{-2}
Fluorine	200	1.33×10^{-3}	6.6×10^{-4}	2.6×10^{-2}
Lead	10	8.74×10^{-4}	8.7×10^{-3}	3.5×10^{-1}
Manganese	850	2.67×10^{-4}	3.1×10^{-5}	1.2×10^{-3}
Mercury	0.1 ^b	2.98×10^{-6}	2.9×10^{-3}	1.2×10^{-1}
Molybdenum	2	6.82×10^{-5}	3.4×10^{-3}	1.4×10^{-1}
Nickel	40	4.45×10^{-4}	1.1×10^{-3}	4.4×10^{-2}
Selenium	0.5	5.94×10^{-5}	1.2×10^{-2}	4.7×10^{-1}
Strontium	150 ^b	1.93×10^{-3}	1.3×10^{-3}	5.1×10^{-2}
Tin	200 ^c	2.98×10^{-5}	1.5×10^{-5}	5.9×10^{-4}
Vanadium	100	5.6×10^{-4}	5.6×10^{-4}	2.2×10^{-2}
Zinc	50	3.7×10^{-4}	7.4×10^{-4}	2.9×10^{-2}

^a U.S. Fish and Wildlife Service, 1978

^b Horton *et al.*, 1977

^c Environmental Research and Technology, 1978

^d See Appendix A

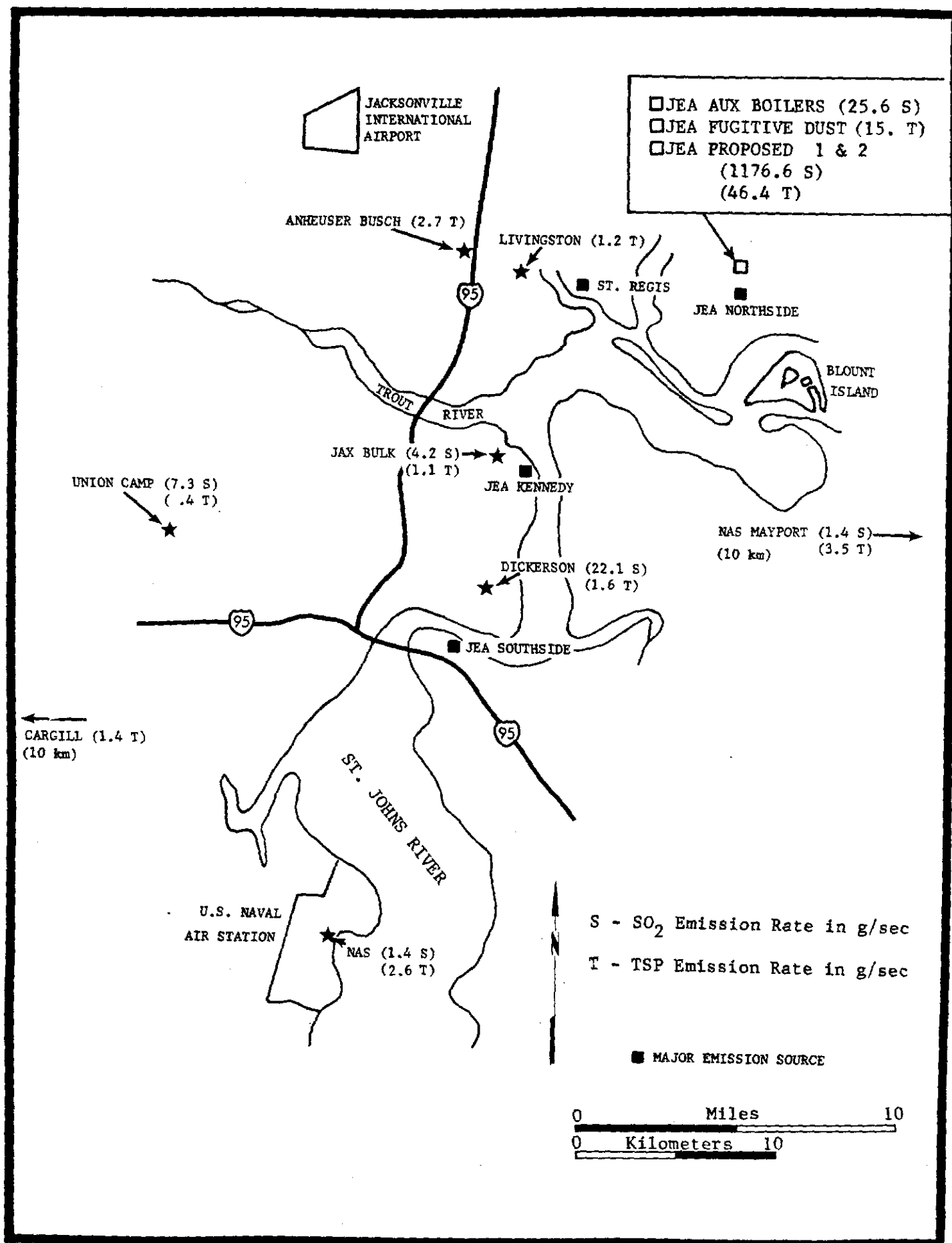


Figure 5.3-1 Jacksonville PSD Emission Source Locations and Strengths

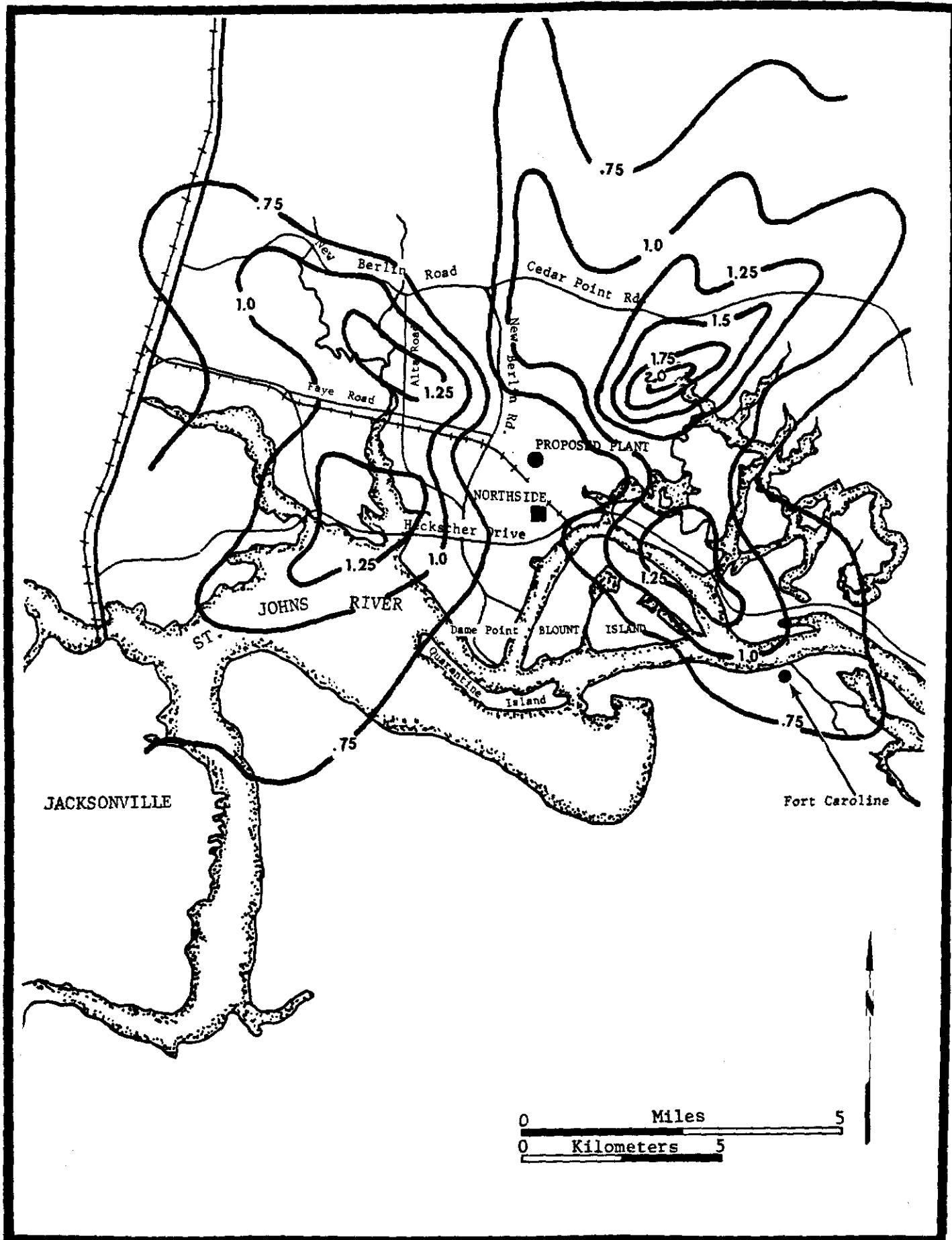


Figure 5.3-2 Predicted Annual Average SO_2 PSD Increment Consumption (in ug/m^3)

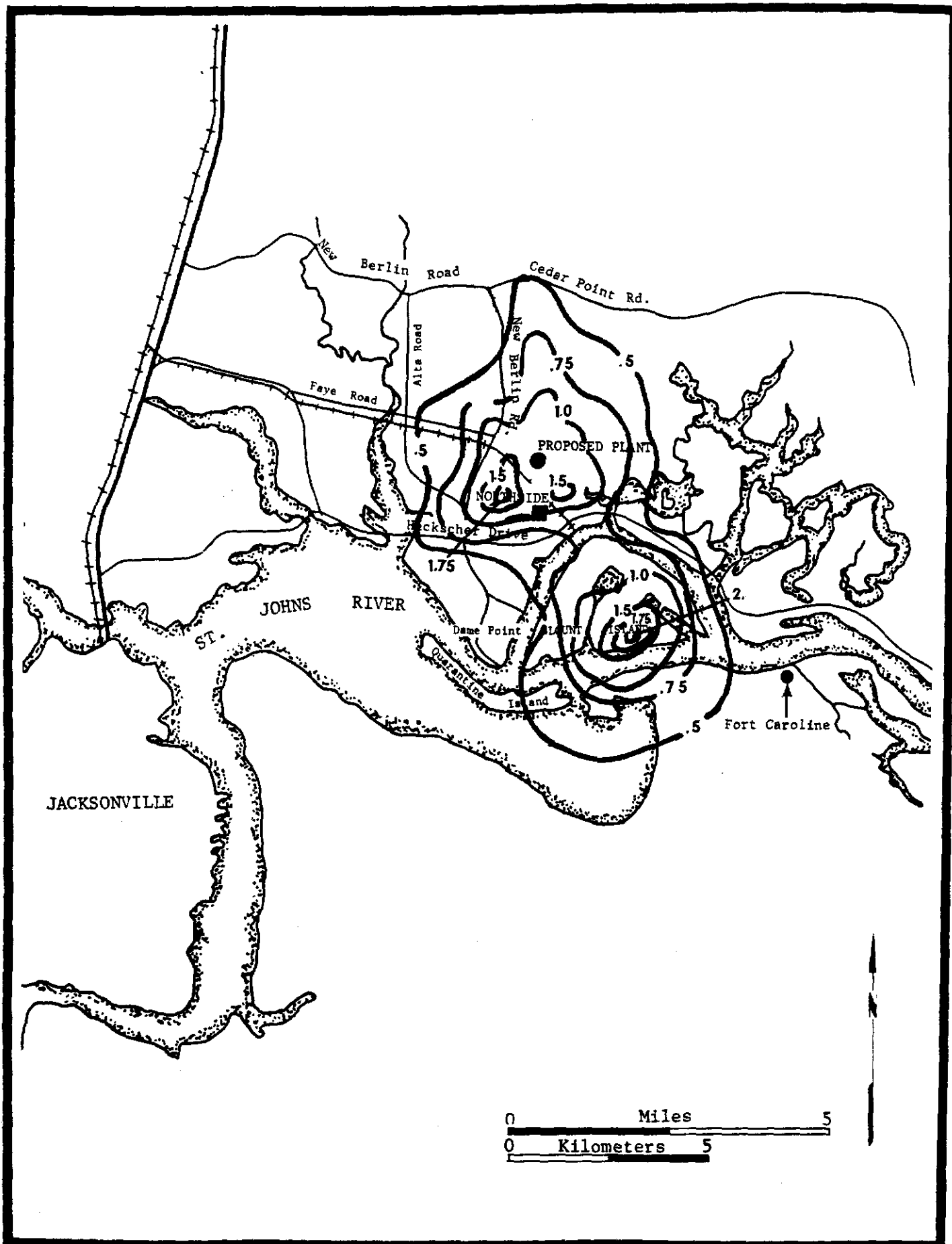


Figure 5.3-3 Predicted Annual Average TSP PSD Increment Consumption (in $\mu\text{g}/\text{m}^3$)

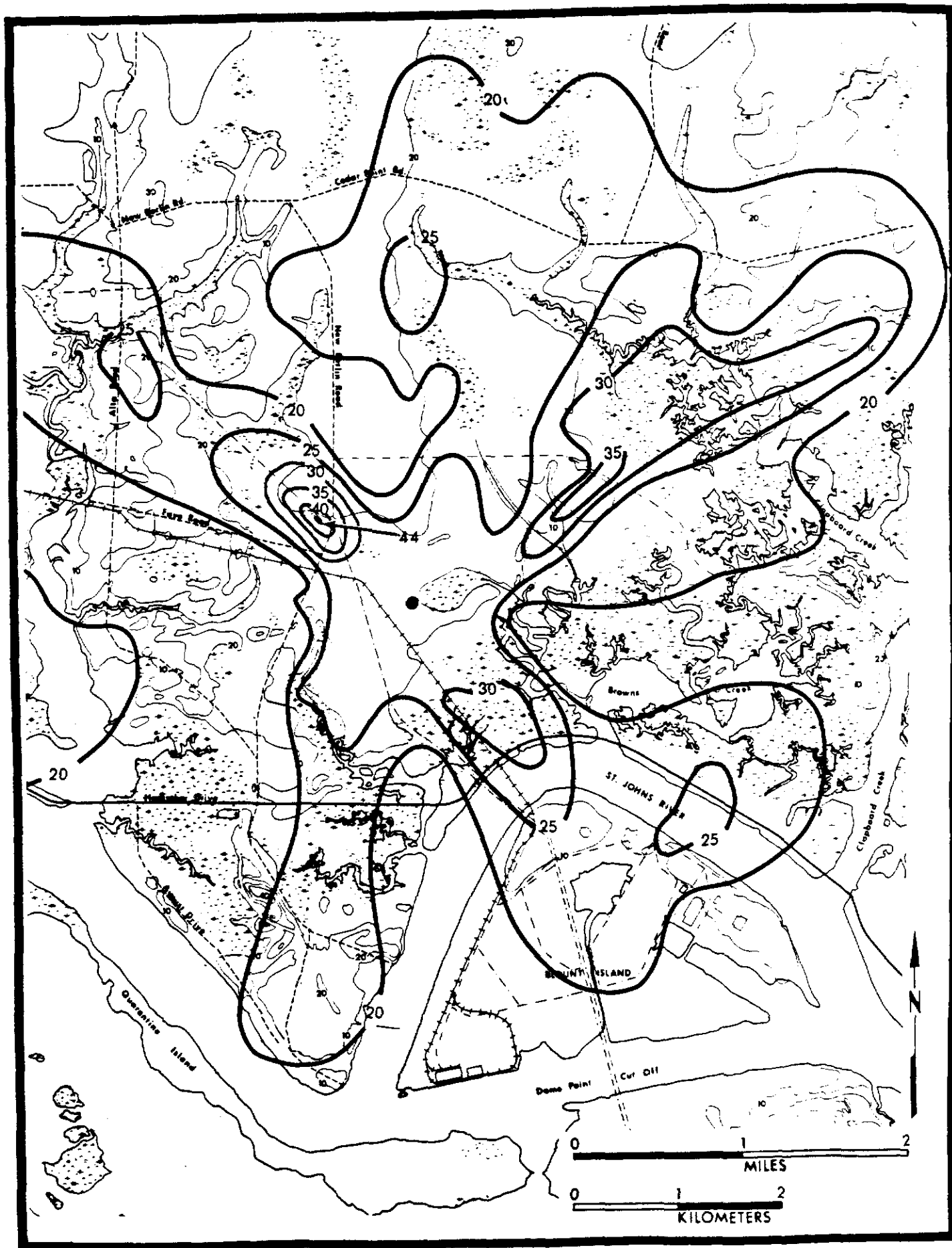


Figure 5.3-4 Predicted Highest, Second-Highest 24-Hour Average SO₂ PSD Increment Consumption (in $\mu\text{g}/\text{m}^3$)

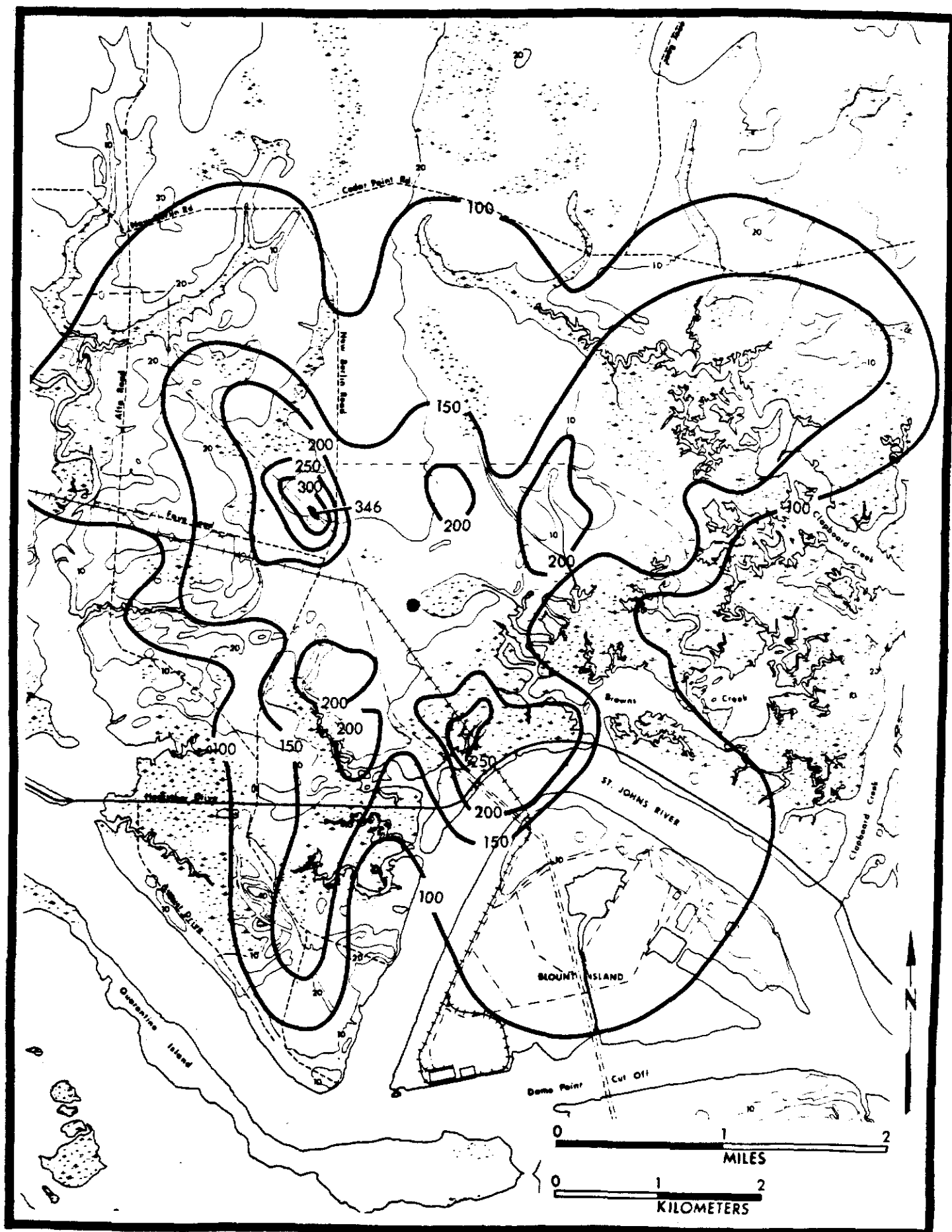


Figure 5.3-5 Predicted Highest, Second-Highest 3-Hour Average SO_2 PSD Increment Consumption (in $\mu\text{g}/\text{m}^3$)

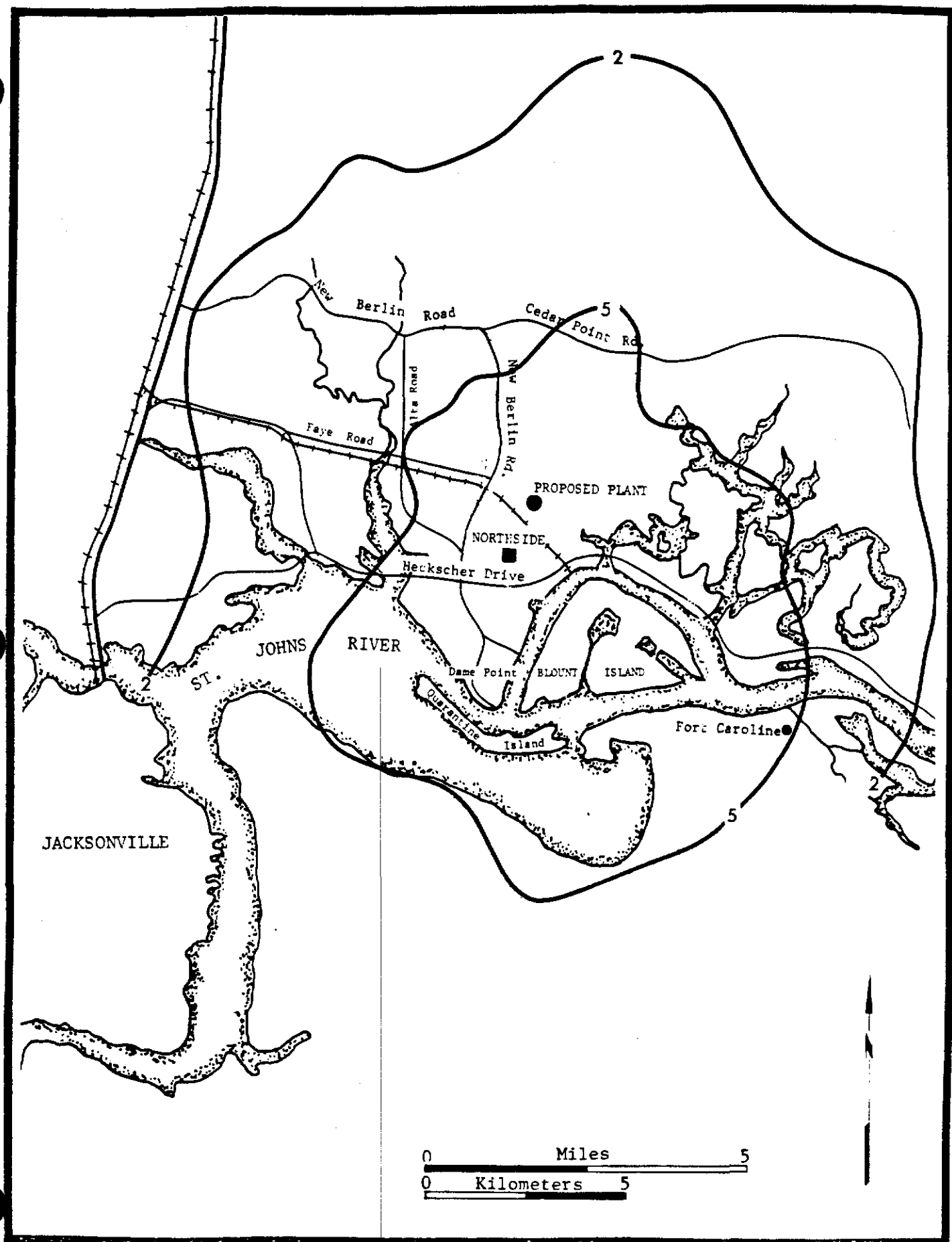


Figure 5.3-6 Predicted Highest, Second-Highest 24-Hour Average TSP PSD Increment Consumption (in $\mu\text{g}/\text{m}^3$)

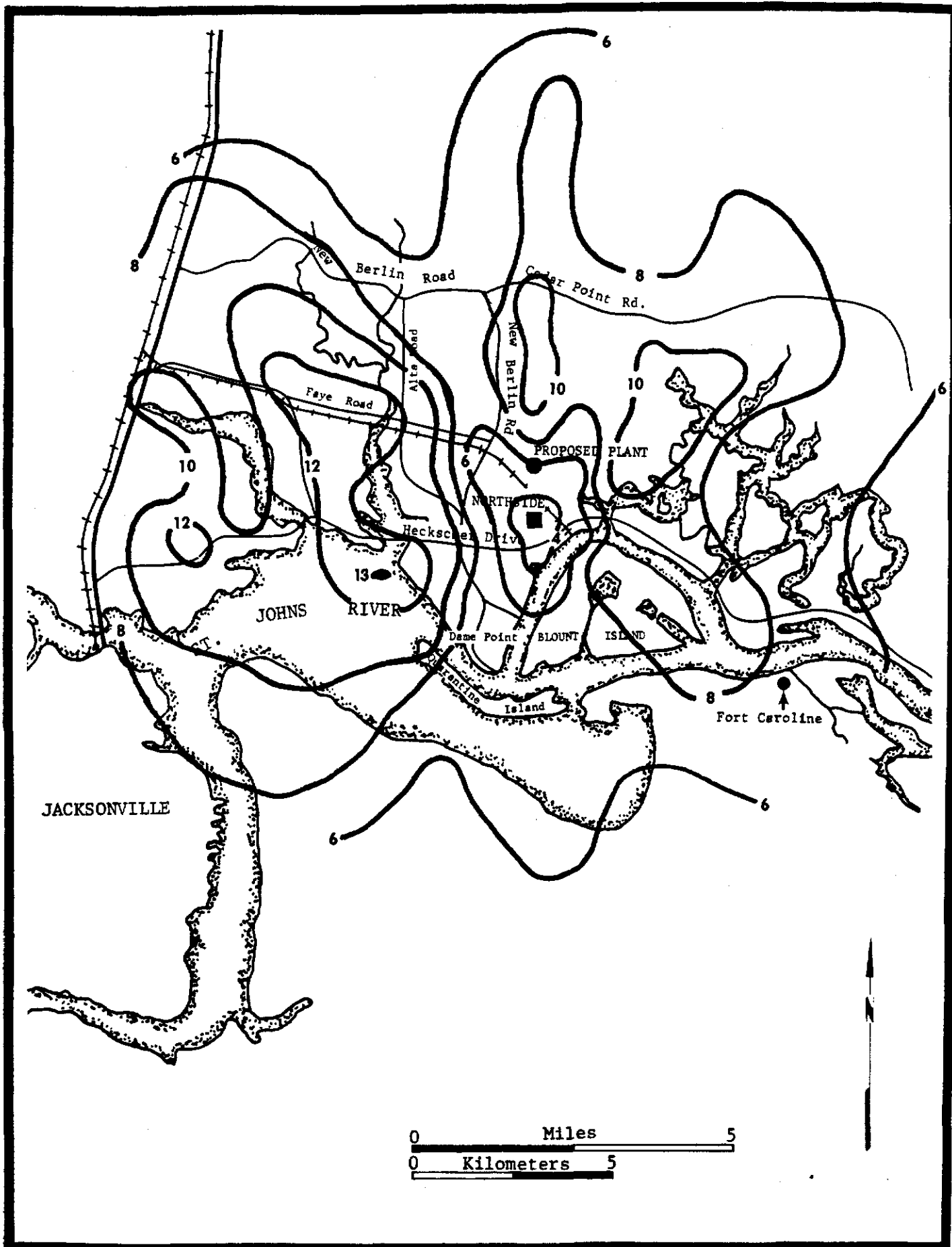


Figure 5.3-7 Predicted Annual Average SO₂ Ambient Impacts (in $\mu\text{g}/\text{m}^3$)

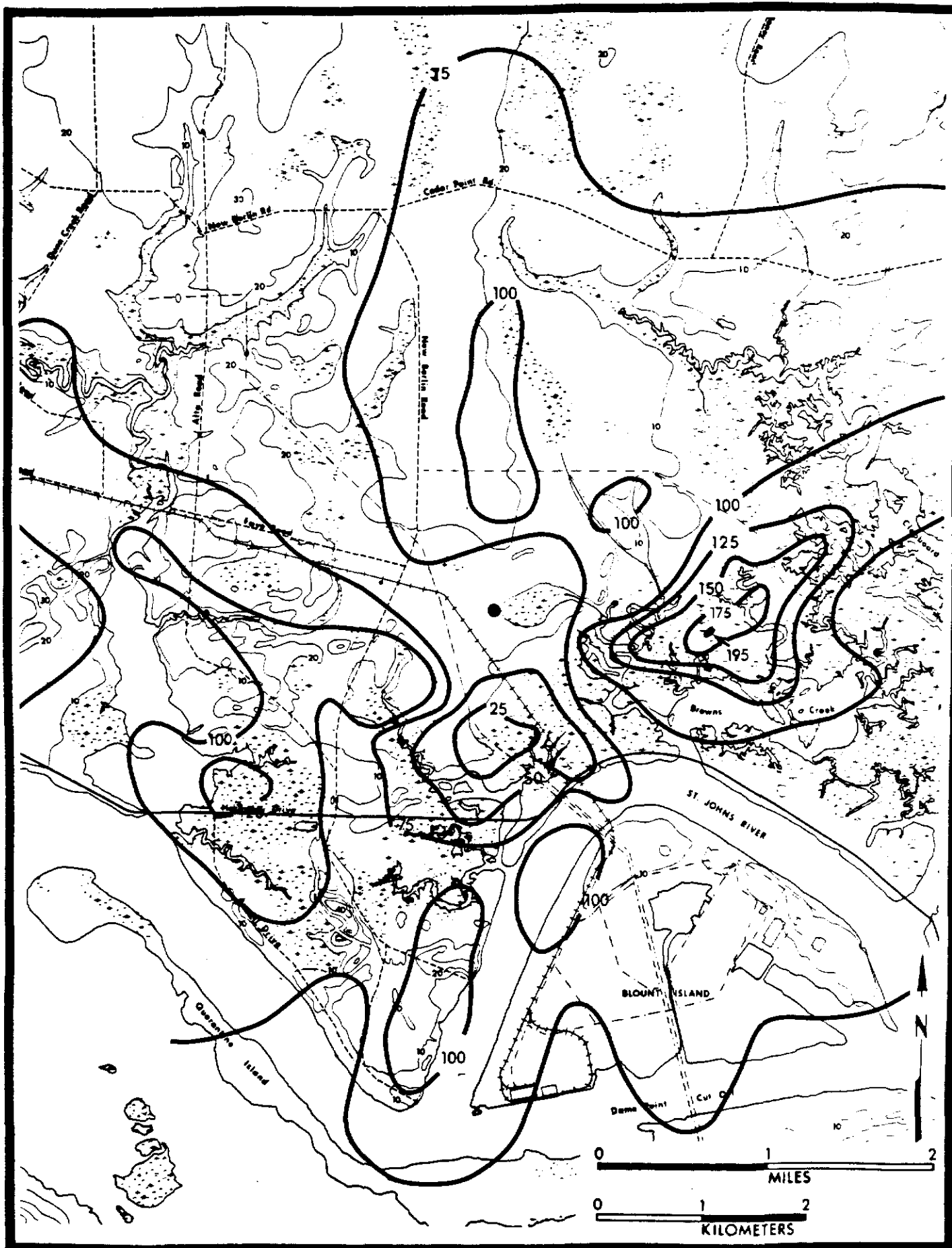


Figure 5.3-8 Predicted Highest, Second-Highest 24-Hour Average SO_2 Ambient Impacts (in $\mu\text{g}/\text{m}^3$)

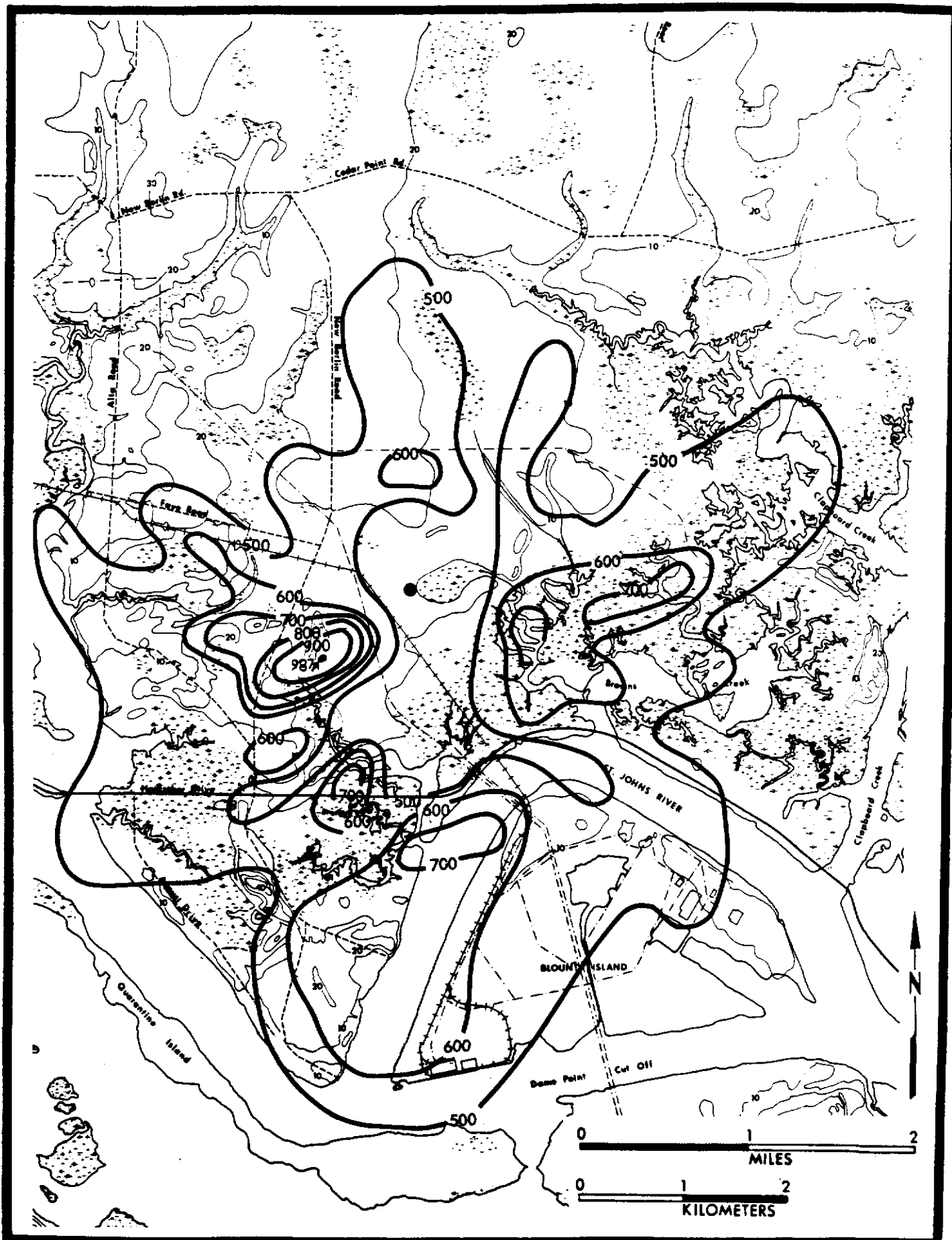


Figure 5.3-9 Predicted Highest, Second-Highest 3-Hour Average SO₂ Ambient Impacts (in ug/m³)

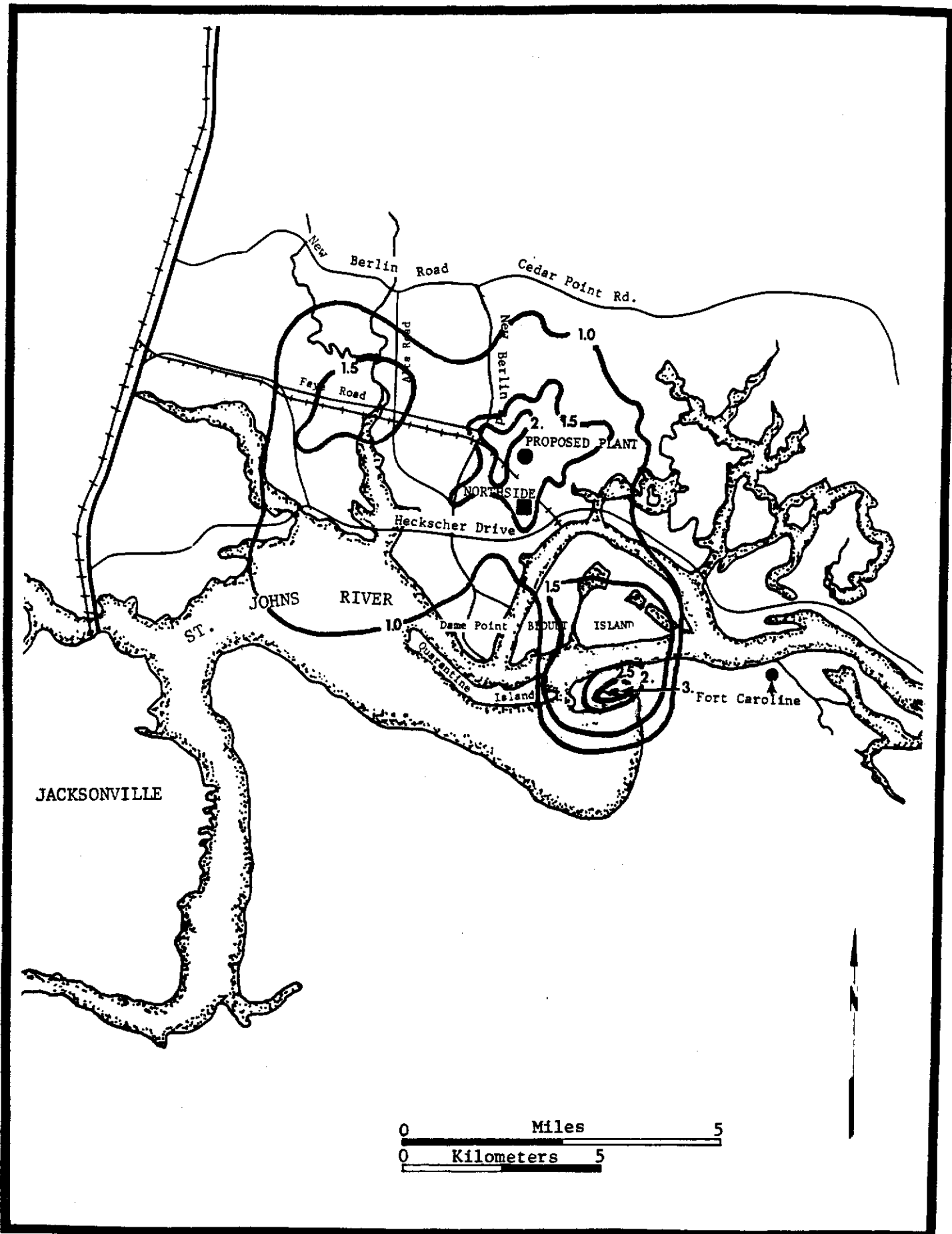


Figure 5.3-10 Predicted Annual Average TSP Ambient Impacts
(in $\mu\text{g}/\text{m}^3$)

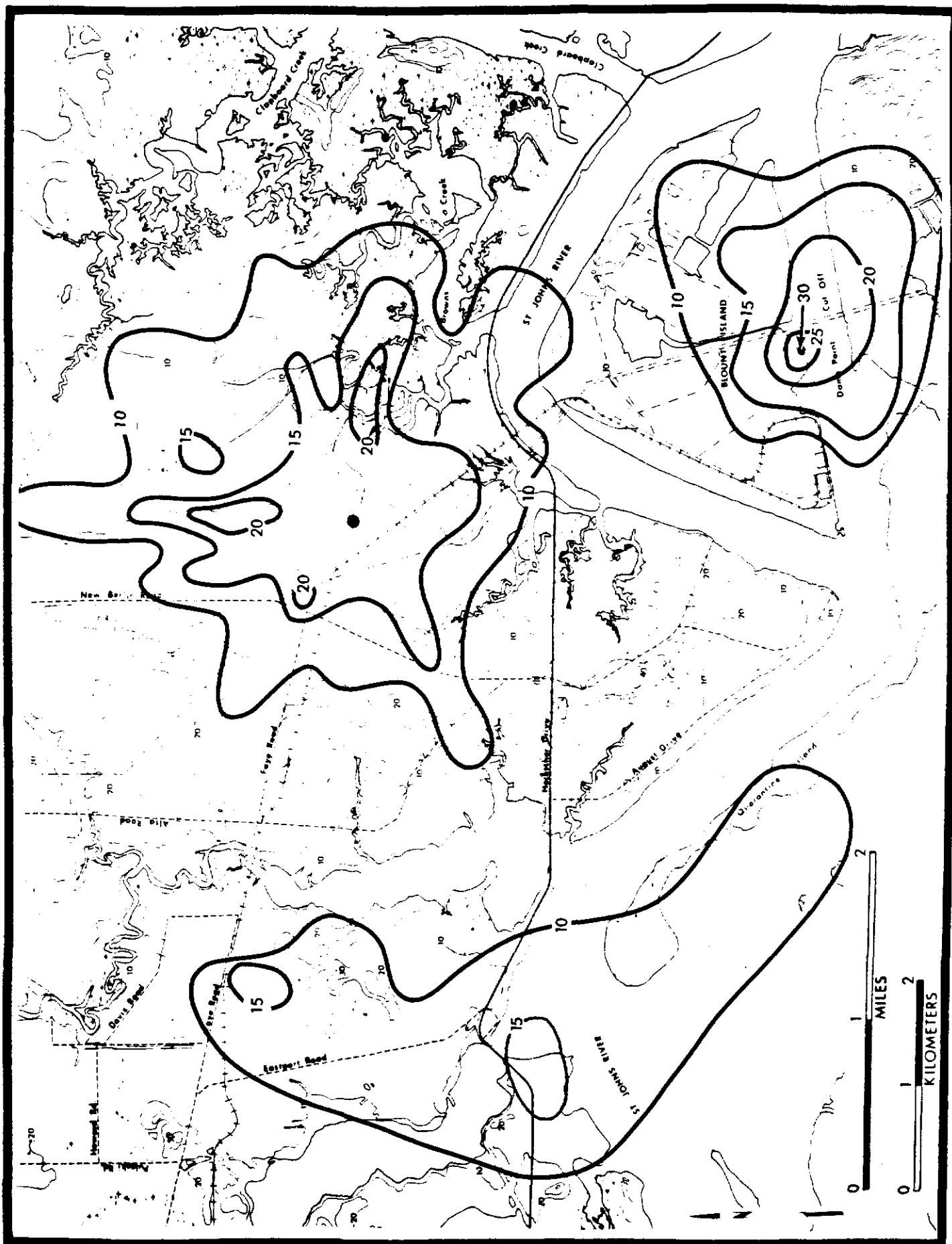


Figure 5.3-11 Predicted Highest, Second-Highest 24-Hour Average TSP Ambient Impacts (in $\mu\text{g}/\text{m}^3$)

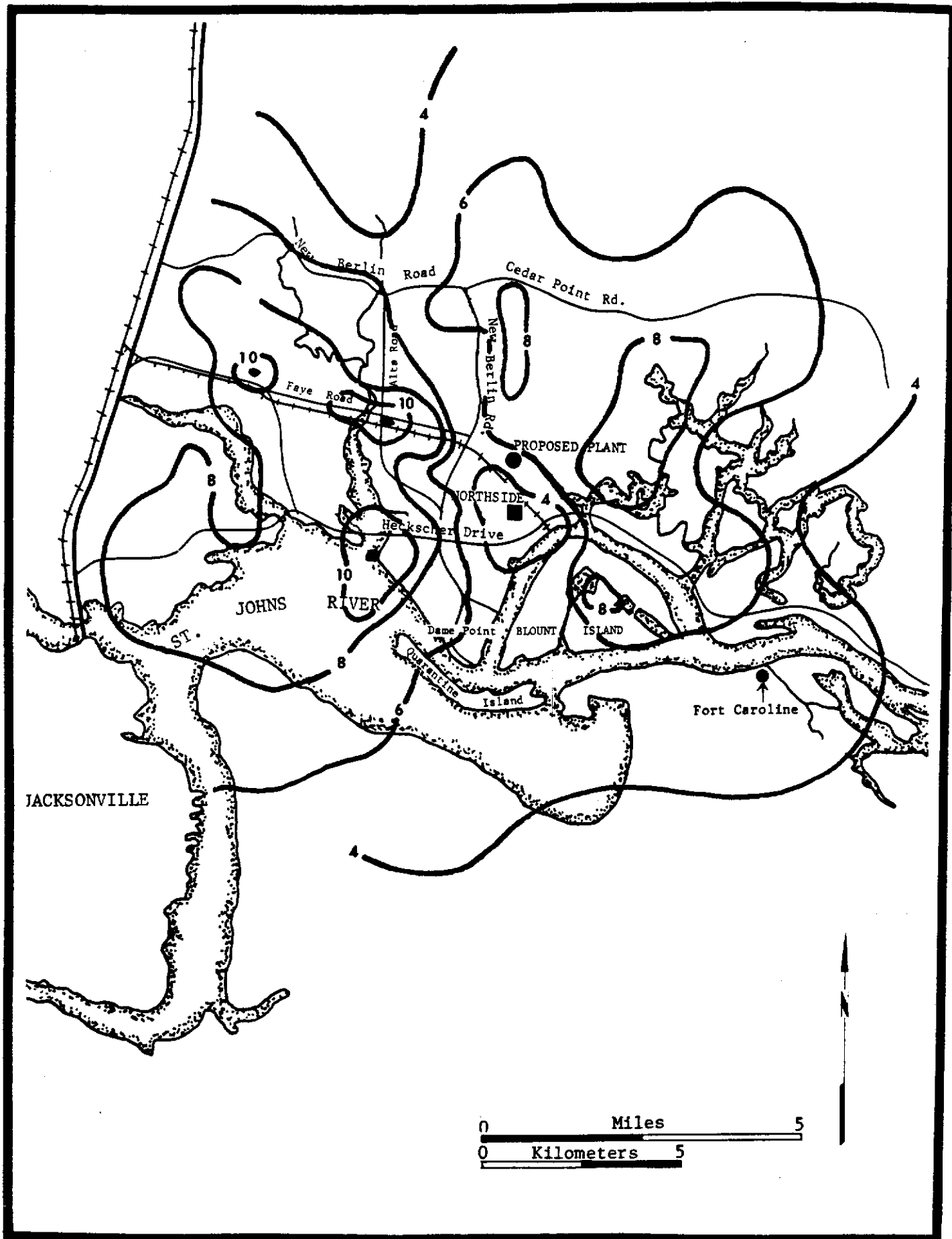


Figure 5.3-12 Predicted Annual Average NO_2 Ambient Impacts
(in $\mu\text{g}/\text{m}^3$)

5.4 COOLING TOWER EMISSIONS

5.4.1 Modelling Methodology

5.4.1.1 Plume Length Modelling

The computer model PLUME, which was employed to estimate plume lengths, is a modified version of a parametric thermodynamic plume model developed by the National Oceanic and Atmospheric Administration's (NOAA) Atmospheric Turbulence and Diffusion Laboratory (ATDL). The model is steady-state and one dimensional, meaning all parameters operate only as a function of height and do not change with time. The model was initially developed for analysis of natural draft cooling tower plumes observed at the John E. Amos Plant in West Virginia, and has since been applied to and tested on plumes from numerous power plants using natural draft cooling. Appendix F contains a detailed discussion of the model and the data processing procedures used to calculate visible plume length.

The ATDL plume length model was selected for two primary reasons. First, this model has been tested and validated on a number of natural draft cooling tower applications including the Rancho Seco steam electric generating station in California, the Paradise Island Electric generating station in Kentucky and the Chalk Point electric generating station in Maryland (Hanna, 1978). The second reason for selection of this model was that the model's original developer was available to assist EnviroSphere in the modifications and application of the model. A detailed theoretical discussion of the model and a summary of a validation studies is presented in a publication by ATDL (Hanna, 1978).

5.4.1.2 Drift Modelling

The computer model employed to estimate the effects of drift from the cooling towers was program DRIFT. This program is a modified version of the model developed by ATDL (Hanna, 1974; Hanna, 1978). Program DRIFT can

be classified as a ballistic type diffusion model since it follows individual droplets from the cooling tower exit upward with the plume, horizontally with the wind, and then downward to the ground. The model simulates a plume trajectory, plume radius, and plume centerline vertical velocity, employing plume formulas developed by Briggs (1975), and modified by Hanna (1976). Appendix F contains a detailed discussion of the model and the data processing used to calculate drift deposition.

The ATDL drift model was selected after review of Argonne National Laboratory's (ANL) Evaluation of Mathematical Models for Salt Drift Deposition from Natural Draft Cooling Towers (ANL, 1979). This evaluation which analyzed and compared ten different drift models emphasized that no model formulation was totally satisfactory. The study reported that although the ATDL model does not explicitly treat vertical atmospheric profiles or atmospheric downwash, it does have the most reasonable evaporation and drift droplet trajectory algorithms of all models tested. Comparison with field data collected at the Chalk Point, Maryland generating station showed that the ATDL drift model was comparable to the other models in terms of both performance and theoretical considerations. An additional reason for which this model was selected was the fact that the model's developer was available to assist in the modifications of the model for this application.

5.4.2 Visible Vapor Plumes

5.4.2.1 Plume Length Frequency Distribution

Table 5.4-1 presents the seasonal and annual frequency of occurrence of plume lengths based on the 572 observations analyzed from the 1964 Jacksonville radiosonde data. These calculations represent only the periods during which naturally occurring meteorological conditions would not have obscured a visible plume (i.e., surface fog, cloud ceilings less than the height of final plume rise, visibilities less than 1/2 mile, or moderate to heavy precipitation).

The plume length data show that longer plumes were generally associated with the winter season and with evenings in particular. During all winter evenings, the frequency of plumes greater than 1 km was 21 percent, and plumes greater than 2 km were estimated to occur 4 percent of the time. On an annual basis, plume lengths between 0 and 0.5 km, 0.5 km and 1 km, and plumes greater than 1 km, were calculated to occur 76, 16 and 9 percent of the time, respectively.

5.4.2.2 Plume Length Frequency Maps

The cumulative plume frequency at a given point is the percent occurrence of plumes in a 22.5 degree sector with lengths equal to or greater than the distance between the point and a cooling tower. This cumulative frequency distribution is superimposed by program CLUSTER to estimate the combined effects for the two cooling towers. There were no significant differences between the morning and evening patterns with the exception that the evening maps exhibited a higher overall plume frequency over the field, which is due to the somewhat higher frequency of long plumes. Because of this similarity, only combined morning and evening cumulative plume frequencies are presented. Figures 5.4-1 through 5.4-4 present the calculated seasonal cumulative plume length frequencies covering a 6 km x 6 km square area surrounding the cooling towers based on one year (1964) of meteorological data.

The spring plume length frequency map (Figure 5.4-1) exhibits the smallest overall plume frequencies. The largest frequency was about 8 percent plume occurrence 0.5 km northwest of the cooling towers. Plume lengths associated with the one percent occurrence level occur as far as 6 km to the southeast and 7 km to the north.

The summer plume length frequency map (Figure 5.4-2) has the shortest plumes. The northeast/southwest orientation of the plume length frequency isopleths reflects the southwesterly wind component that is observed in

this region during the summer. The highest plume frequency was just under 10 percent at a point 1 km northeast of the cooling towers. Plume lengths associated with the 1 percent occurrence level range from 1 km in the easterly and westerly directions to about 4 km to the northeast.

The fall plume length frequency map (Figure 5.4-3) exhibits the highest plume frequency at a point, with a plume occurrence of 12 percent at a point 1 km north-northwest of the cooling towers. There was a distinct north-south orientation of the isopleths reflecting a strong southerly component of the winds aloft during this season. The northward extension of the isopleths indicates a significant occurrence of long plumes during this season. The 1 percent plume occurrence isopleth extended slightly more than 8 km to the north during this season.

The winter frequency occurrence map (Figure 5.4-4) also indicates fairly long plumes. The influence of the prevailing west-northwesterly winds during the winter was quite strong. The highest plume frequency at a point was just under 11 percent about 1/2 km south-southeast of the cooling towers. The eastward extension of the 2 percent isopleths shows the occurrence of significantly long plumes in this direction during the winter season. The 2 percent occurrence isopleth was located more than 8 km to the east of the cooling towers.

The frequency plume length results indicate that the natural draft cooling tower vapor plumes may be relatively long (greater than 1 km) under certain meteorological conditions. However, vapor plumes greater than 1.0 km are expected to occur less than 10 percent of the time. It should be emphasized that all plume length calculations were made assuming 100 percent plant load conditions; therefore, the results are necessarily conservative. There exist no federal, state or local regulations regarding cooling tower vapor plumes. The plumes consist of only water vapor and remain elevated under almost all meteorological conditions; therefore, there are no fogging hazards associated with their occurrence.

5.4.3 Cooling Tower Drift

Figures 5.4-5 through 5.4-12 present the seasonally averaged drift deposition predictions (water and salt), as computed by programs DRIFT and CLUSTER and using 1964-1968 meteorological data. The drift calculations were made assuming 100 percent plant load.

5.4.3.1 Water Deposition

The seasonally averaged water deposition resulting from the cooling towers are depicted in Figures 5.4-5 through 5.4-8. The water deposition is expressed in milligrams of water per square meter per hour ($\text{mg}/\text{m}^2/\text{hr}$). Most of the maximum water deposition ranged between 50 and 80 $\text{mg}/\text{m}^2/\text{hr}$. For comparison purposes, 100 $\text{mg}/\text{m}^2/\text{hr}$ is equivalent to about 0.003 inches of rain per month. Therefore, the water deposition from the cooling towers cannot be expected to be environmentally significant. The maximum water deposition was calculated to occur during the winter months, primarily as a result of the decreased ability of the atmosphere to hold moisture at lower temperatures. The highest seasonally averaged calculated water deposition occurred during the winter and was about 80 $\text{mg}/\text{m}^2/\text{hr}$ which occurred between 0.25 and 1 km south-southeast of the cooling tower. Figures 5.4-5 through 5.4-8 show that well over 90 percent of the drift was calculated to fall within 1 km from the cooling towers.

5.4.3.2 Salt Deposition

The seasonal variation of the basic shape of the salt deposition patterns (Figures 5.4-9 through 5.4-12) was similar to the variation exhibited by the water deposition patterns. The maximum salt deposition occurred between 0.25 and 0.75 km from the cooling towers. The spring and summer salt deposition patterns exhibited relatively low values; the seasonally averaged maxima ranged between 1 and 2.5 $\text{mg}/\text{m}^2/\text{hr}$. The maxima during the spring and summer seasons occurred to the southwest and southeast of the cooling towers. The fall salt deposition pattern revealed

a maxima of about $3 \text{ mg/m}^2/\text{hr}$ about $1/2 \text{ km}$ to the northeast of the cooling towers, with a secondary maxima to the southwest. The winter season salt deposition pattern exhibited the largest area of influence of all the seasons, as well as the highest maximum value, which was calculated to be nearly $4 \text{ mg/m}^2/\text{hr}$ and occurred to the south and southwest of the cooling towers. At distances greater than 1.0 km downwind in any direction, the salt deposition fell below $0.3 \text{ mg/m}^2/\text{hr}$ for any season and wind direction. This rate corresponds roughly to 2 lbs of salt per acre per month.

These deposition results range on the same order of magnitude as sea salt deposition. Ocean salt deposition was reported to be about $5 \text{ mg/m}^2/\text{hr}$ at the coast line and about $0.5 \text{ mg/m}^2/\text{hr}$ 10 miles inland (Rutgers University, 1972).

5.4.4 Stack and Cooling Tower Plume Interactions

5.4.4.1 Potential for Interaction

The potential for stack and cooling tower plume interaction is dependent on the relative positions of these release points in both the horizontal and vertical planes. Figure 5.4-13 depicts the relative orientation of the cooling towers and the main plant stack. Examination of this figure reveals that the cooling tower plume may be superimposed onto the stack plume when the winds blow from the north-northwest, north and north-northeast. Similarly, when the winds blow from the south-southwest, south, and south-southeast, the power plant plume may be superimposed on the cooling tower plume. Analysis of the cooling tower plume heights based on one year of modelling the cooling tower plumes using radiosonde data indicated that the average height of cooling tower plumes is between 300 and 500 meters above ground depending on the season and meteorological conditions. This height range is similar to the plume heights which are expected from the main stack based on modelling the stack exit parameters under a variety of plant loads and meteorological conditions. Since there is little difference between the expected plume heights of the cooling

tower and the main stack plume, it can, therefore, be expected that plume merging will sometimes occur when the winds blow from the wind directions mentioned above.

Table 5.4-2 is a summary of the relative percent occurrence of surface winds based on five years of Jacksonville airport data. The total wind occurrence from the six directions mentioned above averages 39 percent. Although simultaneous plume rise statistics would be required to determine the percentage of this time that the stack and cooling tower plumes level off at the same altitude, it is logical to assume that plume interactions will occur significantly less than 39 percent of the time.

5.4.4.2 Consequences of Interaction

The potential consequences of the plume interactions are twofold: additive effects of total suspended particulates and increased SO_2 oxidation rates. First, the solid particulate matter in the cooling tower drift is added to the particulate matter leaving the main stack, which in turn, adds to the downwind concentrations of total suspended particulates when the wind direction is such that the cooling tower emissions are superimposed on the stack emissions. The impact from cooling tower particulate emissions were taken to account in the air quality impact modelling which was summarized in Sections 5.3.2 and 5.3.3.

The other potential consequence of the cooling tower and stack plume interaction is the creation of a more favorable environment for SO_2 oxidation and the subsequent formation of acid rain. By SO_2 oxidation, we mean the conversion of SO_2 to sulfate ions $\text{SO}_4^{=}$. The subsequent formation of sulfuric acid H_2SO_4 is enhanced by the presence of high atmospheric humidity as well as by the presence of trace element catalysts (Likens, 1976; Enger and Hogstrom, 1978; Freiberg, 1974; Gartrell et al., 1963; and Overton and Durham, 1979). Therefore, when the wind direction alignment allows the smokestack plume to merge with the cooling tower plume, the chemical reactions which govern the conversion of SO_2 to

$\text{SO}_4^=$ and H_2SO_4 are accelerated. The most recent works which address the phenomena of increased SO_2 to sulfate conversion resulting from high relative humidities, do not consider the problem in terms of effects of cooling tower plume and stack plume interactions but rather consider only regional relative humidities. Enger and Hogstrom (1978) determined that more than 70 percent of sulfur dioxide emitted from a power plant was transformed to sulfate within 30 km at relative humidities close to 100 percent and on a much drier (relative humidity 60 percent) day, the conversion was about 10 percent within the same distance. Gartrell et al. (1963), and Stephens and McCaldin (1971) found that high relative humidity promotes the oxidation of SO_2 . Over a time period of 1-2 hours, the extent of oxidation in Gartrell's experiments was 3 percent at 70 percent humidity, 30 percent at 100 percent humidity, and 60 percent under mist conditions. In the experiments of Stephens and McCaldin, no oxidation was observed at relative humidities below 35 percent. At a relative humidity of 40-55 percent, an oxidation rate was noticed of about 15 percent per hour over a time period of 1-3 hours, and at a relative humidity of 79 percent at a rate of about 35 percent over a period of one hour. Smith and Jeffrey (1975) presented curves representing conversion of SO_2 to sulfate as a function of relative humidity. Their results indicate a fourfold increase of oxidation rate from 75 percent relative humidity to 88 percent relative humidity.

In contrast to the above, Li (1977) found from a network of 12 rain gauges covering a 6 km diameter circle around the Chalk Point Power Plant in Maryland that pH levels actually increased from a range of 3.4-4.6 to 4.0-4.8 after two natural draft cooling towers began operation, indicating that conversion of power plant effluents to nitrates and sulfates are not necessarily enhanced due to cooling tower and smoke stack plume interaction. Observations presented by Moore (1975) support the hypothesis that the interaction of the stack and tower plumes is not a significant environmental impact problem. Measurements of natural rainfall under a stack plume showed no significant differences in pH from rainfall measured at stations not under the stack plume. Pell (1975) also questioned whether detectable amounts of acid droplets will reach ground level receptors.

These sometimes contradictory findings illustrate the difficulty in quantitatively or even qualitatively assessing impacts due to the interacting of smoke stack plumes and cooling tower plumes on a site-specific basis.

5.4.5 Biological Effects

Weather conditions, ion toxicity, and plant sensitivity are factors which determine injury thresholds from aerial salt deposition. Salt crystals impacted on leaf blades are washed off during periods of rain (Roffman, 1973). However, investigations of the effects of saltwater cooling towers (Roffman, 1973; Boyce Thompson Inst., 1974; Mulchi and Armbruster, 1975) on vegetation indicate that salts accumulating on leaf surfaces between precipitation events may be rapidly absorbed by foliar tissue when relative humidity is high enough to maintain the salts in the dissolved state.

The chlorine ion (Cl^-) is more important toxicologically than sodium (Na^+) (Boyce, 1954; Homes and Baker, 1966; Walton, 1969; Francis, 1977). It has been the focus of saltwater cooling tower studies because it represents a major component of emitted salts, and because it has been identified as the toxic agent in experiments where foliar damage resulted from applications of sea spray or road salt (Moser and Swain, 1971; Holmes, 1961). Incidences of Cl^- toxicity have been partially attributed to the propensity of some plants to retain and concentrate Cl^- in leaf tissues (Holmes, 1961; Richards, 1954). Injury symptoms to Cl^- are manifest as marginal or tip burn on leaves of woody plants (Smith, 1970; Bernstein, 1975). These symptoms are exhibited when the Cl^- tissue concentration exceeds 0.5 percent (5000 ppm) or when the Na^+ tissue concentration exceeds 0.2 percent (2000 ppm). Woody plants are reported to be more sensitive to Cl^- than are non-woody species (Lauver et al., 1978).

Flowering dogwood (Cornus florida) is considered to be a sensitive species. Lauver et al. (1978) observed leaf damage to dogwood when the foliar Cl^- concentration exceeded 5,000 ug/gm dry weight. Curtis et al.

(1978) found that 7.46 kg/ha/month ($1.02 \text{ mg/m}^2/\text{hr}$) from a cooling tower affected C. florida with the effect manifested as marginal necrosis. Silberman and McCune (1978) exposed northern red oak, flowering dogwood, and Carolina hemlock to a range of simulated salt depositions for a 6 hour period. From the results, these investigators were able to establish an effective dose concentration which was the concentration at which the number of injured leaves equalled the number of uninjured leaves. The effective dose for northern red oak, flowering dogwood, and Carolina hemlock were $40 \text{ ug Cl}^-/\text{cm}^2/6 \text{ hr}$ ($66.67 \text{ mg Cl}^-/\text{m}^2/\text{hr}$), $10 \text{ ug Cl}^-/\text{cm}^2/6 \text{ hr}$ ($16.67 \text{ mg Cl}^-/\text{m}^2/\text{hr}$), and $190 \text{ ug Cl}^-/\text{cm}^2/6 \text{ hr}$ ($316.67 \text{ mg Cl}^-/\text{m}^2/\text{hr}$), respectively. Freudenthal and Beals (1978) report that hemlock, flowering dogwood, and white ash are sensitive to NaCl concentrations exceeding 40 kg/km^2 in the absence of rainfall.

In non-woody agricultural species, Armbruster et al. (1978) observed a significant yield reduction in corn exposed to a simulated salt spray applied at a rate of 7.4 kg/ha/month (5 days per week for 8 weeks). No significant changes in yield of soybeans or tobacco were observed in fields exposed to salt deposition from an operating natural draft cooling tower. These observations were made 1 km from the tower where the salt deposition rate was estimated to be from 1.5-1.6 kg/ha/month ($0.205\text{--}0.219 \text{ mg/m}^2/\text{hr}$). Silberman and McCune (1978) exposed corn and potatoes to a simulated salt spray with the salt concentration ranging from 14.4 to 947 $\text{ug Cl}^-/\text{cm}^2/6 \text{ hr}$ ($24\text{--}1578 \text{ mg Cl}^-/\text{m}^2/\text{hr}$) for corn and from 13.5 to 169 $\text{ug Cl}^-/\text{cm}^2/6 \text{ hr}$ ($22.5\text{--}281.67 \text{ mg Cl}^-/\text{m}^2/\text{hr}$) for potatoes. The concentration at which the number of injured leaves equalled the uninjured leaves was $67.1 \text{ ug Cl}^-/\text{cm}^2/6 \text{ hr}$ ($111.8 \text{ mg Cl}^-/\text{m}^2/\text{hr}$) for corn and $40 \text{ ug Cl}^-/\text{cm}^2/6 \text{ hr}$ ($66.67 \text{ mg Cl}^-/\text{m}^2/\text{hr}$) for potatoes.

The critical factor in assessing salt injury to vegetation appears to be the amount deposited on foliage between periods of precipitation. Research conducted by the Boyce Thompson Institute (1974) on 12 relatively sensitive plant species indicates that, at 85 percent relative humidity, a

deposition rate at or above $0.4 \text{ ug Cl}^-/\text{cm}^2/\text{min}$ ($4 \text{ mg/m}^2/\text{min}$) for an exposure of 4 to 6 hours produces a risk of adverse effects on the most susceptible vegetation.

Isopleths of predicted salt deposition on a seasonal basis from the two proposed natural draft cooling towers are presented in Figures 5.4-9 through 5.4-12. The maximum salt deposition rate on a seasonal average occurring outside the boundaries of the proposed site is predicted to be $0.32 \text{ mg/m}^2/\text{hr}$. This maximum occurs to the west of the site within 1000 feet of New Berlin Road. Approximately 3,500 feet to the northwest of the proposed cooling tower, the maximum seasonal average deposition rate is predicted to be $0.13 \text{ mg/m}^2/\text{hr}$. The predicted maximum seasonal average deposition rate at distances beyond approximately 5,000 feet in all directions will be less than the $0.13 \text{ mg/m}^2/\text{hr}$. Assuming that the $0.32 \text{ mg/m}^2/\text{hr}$ is a conservative seasonally averaged deposition rate, then the following comparisons can be made.

Natural sea salt deposition in New Jersey is reported to be approximately $4.8 \text{ mg/m}^2/\text{hr}$ at the shoreline and $0.42 \text{ mg/m}^2/\text{hr}$ ten miles inland from the ocean (Rutgers University, 1972). The proposed plant site is approximately nine miles from the ocean and it is assumed that the deposition rate will approximate the $0.42 \text{ mg/m}^2/\text{hr}$ reported for ten miles inland. Combining this natural background $0.42 \text{ mg/m}^2/\text{hr}$ with the predicted seasonal average cooling tower contribution ($0.32 \text{ mg/m}^2/\text{hr}$) yields $0.72 \text{ mg/m}^2/\text{hr}$ ($525.6 \text{ mg/m}^2/\text{month}$) total salts.

Chlorides (Cl^-) and sulphates ($\text{SO}_4^{=}$) are two of the components of the salts deposited from cooling towers that are reported to be potentially injurious to vegetation. Assuming that 55 percent of the salts (total dissolved solids) deposited from the cooling towers are chlorides, based on data from the water quality monitoring program, and that 54 percent of the natural sea salts deposited are Cl^- , then the natural background ($0.18 \text{ mg Cl}^-/\text{m}^2/\text{hr}$) plus the cooling tower contribution ($0.28 \text{ mg Cl}^-/\text{m}^2/\text{hr}$) yields a seasonal average deposition rate of $0.46 \text{ mg Cl}^-/\text{m}^2/\text{hr}$ or $335.8 \text{ mg Cl}^-/\text{m}^2/\text{month}$.

It is anticipated that the salt deposited from the cooling towers will have no effect on vegetation or crops within the immediate vicinity or the region of the proposed plant with the possible exception of flowering dogwood. The injury threshold for flowering dogwood is reported to range from 0.561 mg $\text{Cl}^-/\text{m}^2/\text{hr}$ (1.02 mg salt/ m^2/hr) (Curtis et al., 1978) to 16.67 mg $\text{Cl}/\text{m}^2/\text{hr}$ (Silberman and McCune, 1978). Flowering dogwood is the only naturally occurring species found within the immediate vicinity of the proposed plant with a reported Cl^- injury threshold. On the basis of the reported injury threshold and the predicted maximum seasonal average deposition rate of 0.46 mg $\text{Cl}^-/\text{m}^2/\text{hr}$, it is possible that some injury could occur to flowering dogwood if located within the area of maximum off-site deposition (Figure 5.4-14).

Corn and potatoes are the only crops grown in the region of the proposed plant with reported Cl^- injury thresholds. McCune et al. (1974) report an injury threshold value of 0.4 ug $\text{Cl}^-/\text{cm}^2/\text{min}$ (240 mg/ m^2/hr) (1-2 hour exposure) for beans. Other threshold values are estimated to be 14.4 mg $\text{Cl}^-/\text{m}^2/\text{hr}$ for corn and 13.5 mg $\text{Cl}^-/\text{m}^2/\text{hr}$ for potatoes (Silberman and McCune, 1978). The estimated maximum seasonal average deposition rate is an order of magnitude lower than the reported threshold values for these two crops, and as such no adverse effects are anticipated.

In 1973, the Record of the Maryland Power Plant Siting Act reported that up to 500 pounds per acre per year of NaCl can fall on agricultural land without causing acute effects, and recommended a value of 100 pounds per acre per year as a cautionary limit for salt contribution from power plants (Moon, 1973). The proposed cooling towers are estimated to contribute 0.32 mg/ m^2/hr (25 lbs/acre/year) on a seasonal average in the areas just beyond the proposed site boundaries. In the agricultural areas surrounding the proposed site, the salt deposition is predicted to be 0.13 mg/ m^2/hr (10.1 lbs/acre/year) which is well below the reported cautionary limit of 100 lbs/acre/year.

On the basis of the differential between maximum predicted seasonal average concentration and the reported threshold concentration, no adverse effects due to $\text{SO}_4^{=}$ in the cooling tower drift are anticipated. Assuming that 7 percent of the salts (total dissolved solids) deposited from the cooling towers are sulfates ($\text{SO}_4^{=}$), based on data from the water quality monitoring program, and that 100 percent of the natural sea salt deposition is sulfate, a conservative assumption, then the natural background ($0.42 \text{ mg SO}_4^{=}/\text{m}^2/\text{hr}$) plus the cooling tower contribution ($0.02 \text{ mg SO}_4^{=}/\text{m}^2/\text{hr}$) yields a predicted maximum seasonal average deposition rate of $0.44 \text{ mg SO}_4^{=}/\text{m}^2/\text{hr}$ or $321 \text{ mg SO}_4^{=}/\text{m}^2/\text{month}$. In comparison, severe injury to white pine, red oak, and sugar maple was attributable to a $\text{SO}_4^{=}$ deposition injury rate of $2.74 \text{ mg}/\text{m}^2/\text{hr}$ (Rochow, 1978).

The assessment of potential effects due to salt deposition from the two proposed natural draft cooling towers is conservative in that the maximum deposition rate used occurs largely within the proposed site boundaries. Beyond this, the maximum deposition rate would be equal to or less than one-half the rate used in the assessment. In addition, the comparison of maximum deposition rates with reported injury thresholds was based on the assumption that no rain would occur during the period of deposition to wash off any salt accumulation.

5.4.6 References

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Table 5.4-1 (Revision 1)

PREDICTED PERCENT FREQUENCY DISTRIBUTION OF PLUME LENGTHS

Length Class	Morning Radiosonde Data (0700 LST)							Evening Radiosonde Data (1900 LST)							Morning and Evening Combined						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Season																					
Spring	42	41	9	4	2	2	0	16	68	13	2	1	0	0	28	56	11	3	1	1	0
Summer	87	13	0	0	0	0	0	44	52	4	0	0	0	0	63	35	2	0	0	0	0
Fall	28	51	19	0	0	2	0	37	46	15	0	1	0	0	33	48	17	0	1	1	0
Winter	2	35	32	9	8	9	5	5	37	36	13	4	3	1	4	36	34	12	6	6	3
Annual	40	35	15	4	2	3	1	26	51	16	4	2	1	1	32	44	16	4	2	2	1

a Length Class : 1 2 3 4 5 6 7
 Plume Lengths (km): 0-0.25 0.25-0.5 0.5-1.0 1.0-1.5 1.5-2.0 2.0-5.0 5.0

Plume length occurrence percentages may not total 100 percent due to rounding.

Table 5.4-2

PERCENT OCCURRENCE OF WIND DIRECTION AT JACKSONVILLE^a AIRPORT
1964-1968

<u>Direction</u>	<u>Spring</u>	<u>Summer</u>	<u>Fall</u>	<u>Winter</u>	<u>Annual</u>
N	9.2	4.8	3.6	8.8	6.6
NNE	12.4	6.0	5.2	15.2	9.7
NE	7.6	3.6	3.2	8.4	5.6
ENE	7.2	6.0	5.6	10.0	7.1
E	4.4	4.0	4.8	7.2	5.1
ESE	4.0	6.4	6.8	6.8	6.0
SE	2.8	7.2	6.0	4.4	5.2
SSE	3.2	8.4	6.8	3.6	5.5
S	2.8	4.8	6.0	2.0	4.0
SSW	6.4	9.2	10.4	4.8	7.7
SW	3.6	4.4	7.2	2.4	4.4
WSW	4.4	6.8	10.8	4.0	6.5
W	5.2	9.2	8.8	4.0	6.7
WNW	8.8	9.6	8.8	6.8	8.4
NW	8.4	5.2	3.6	5.2	5.7
NNW	9.2	5.2	3.2	6.0	5.6

^a Imeson Field

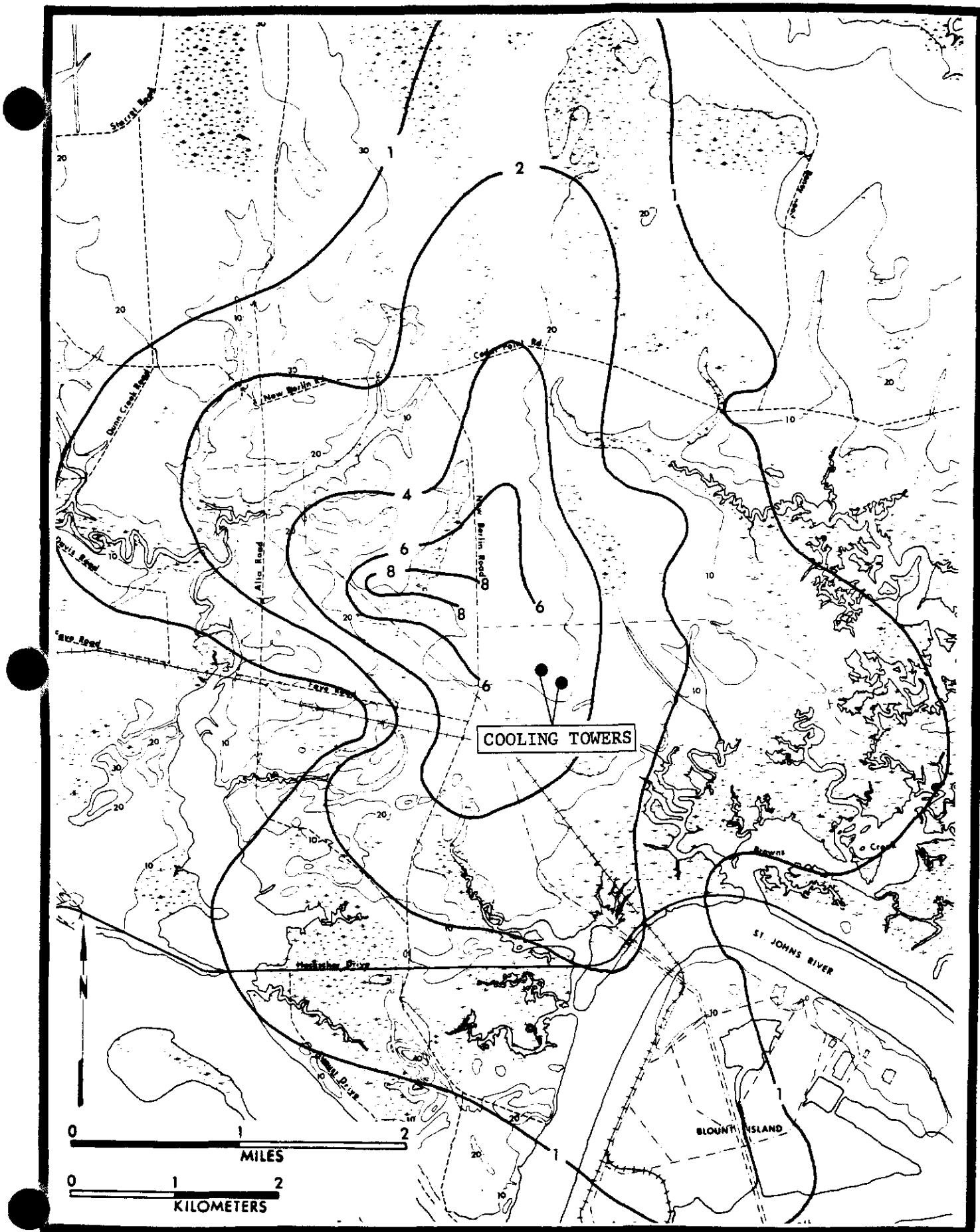


Figure 5.4-1 Percent Vapor Plume Occurrence - Spring

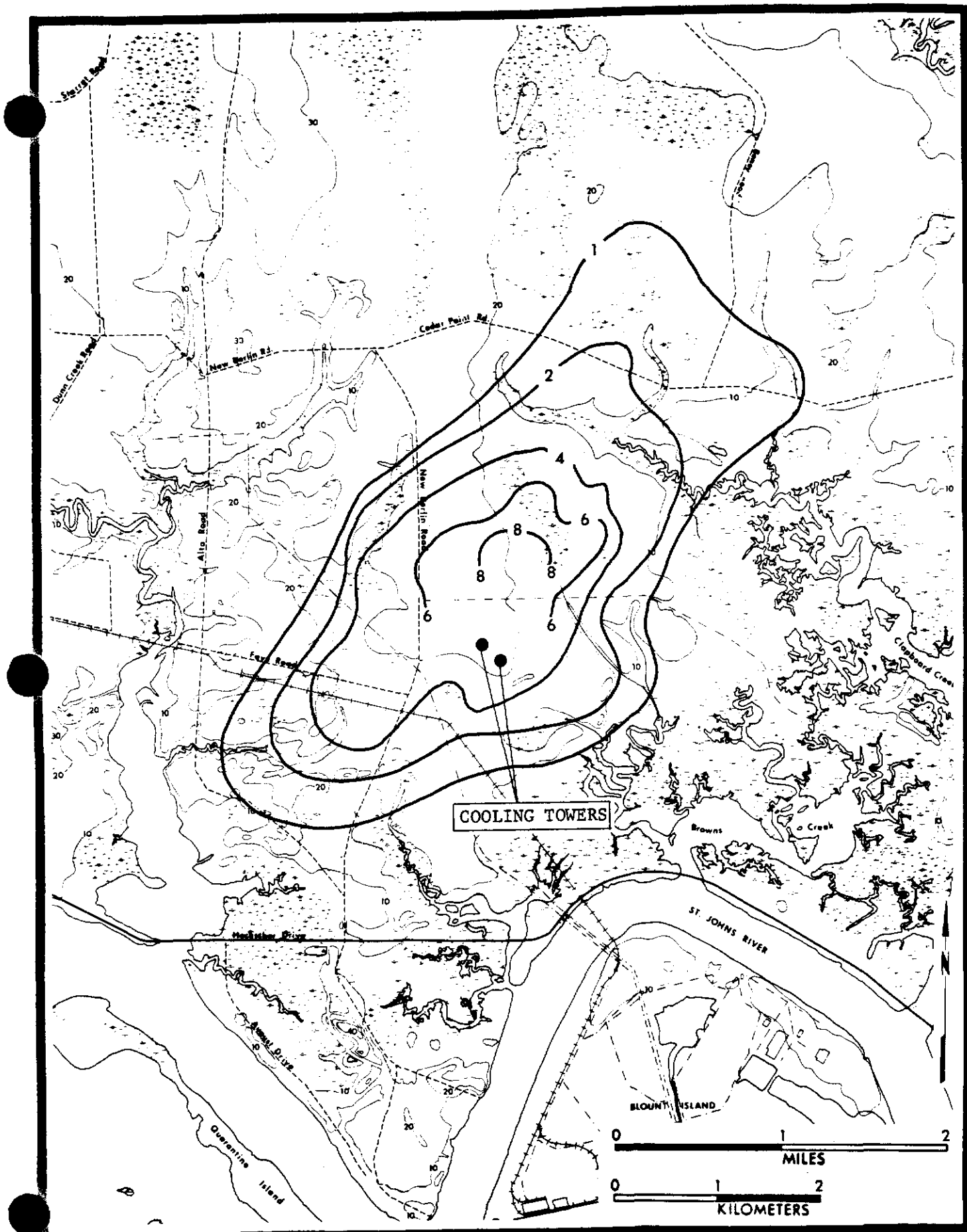


Figure 5.4-2 Percent Vapor Plume Occurrence - Summer

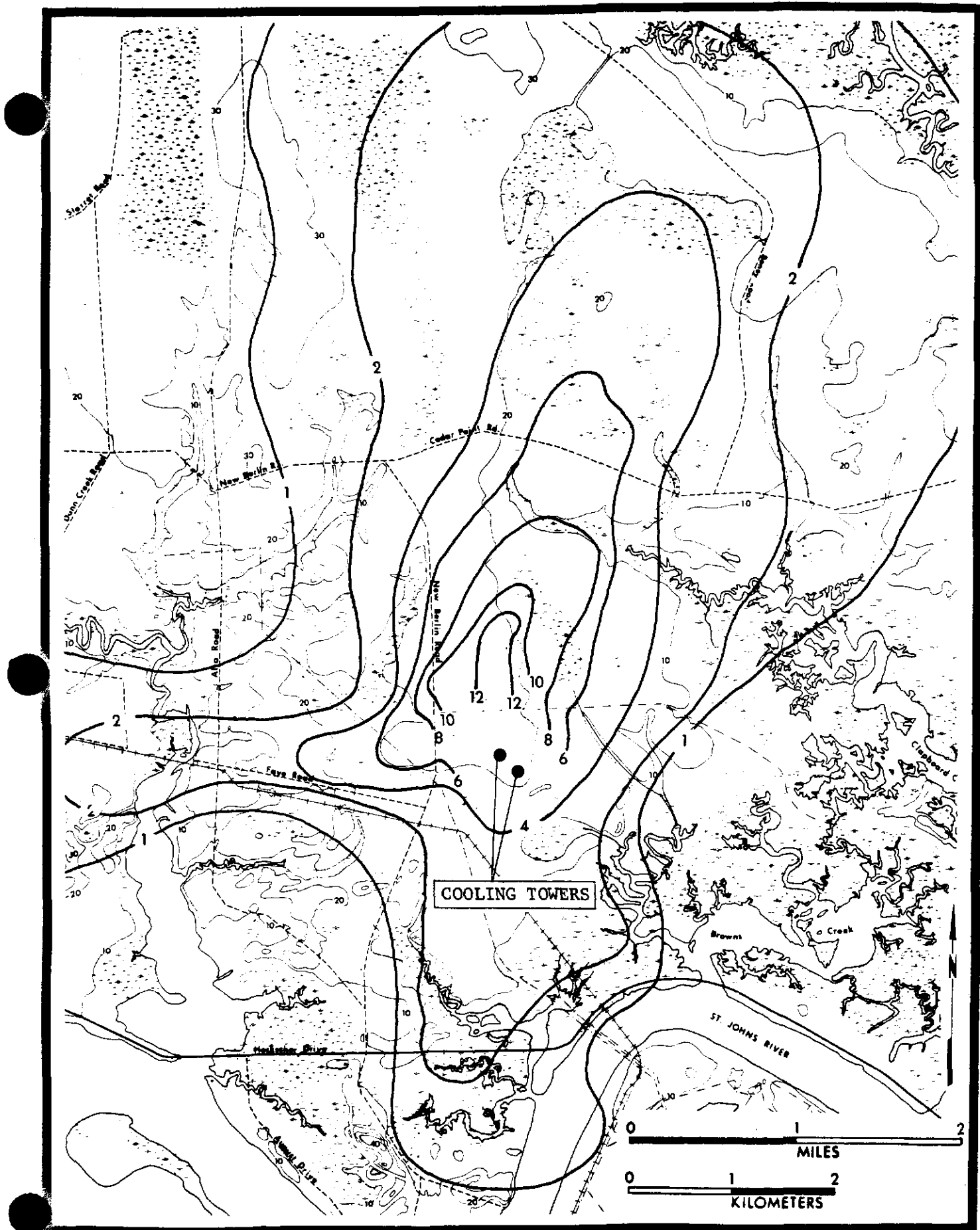


Figure 5.4-3 Percent Vapor Plume Occurrence - Fall

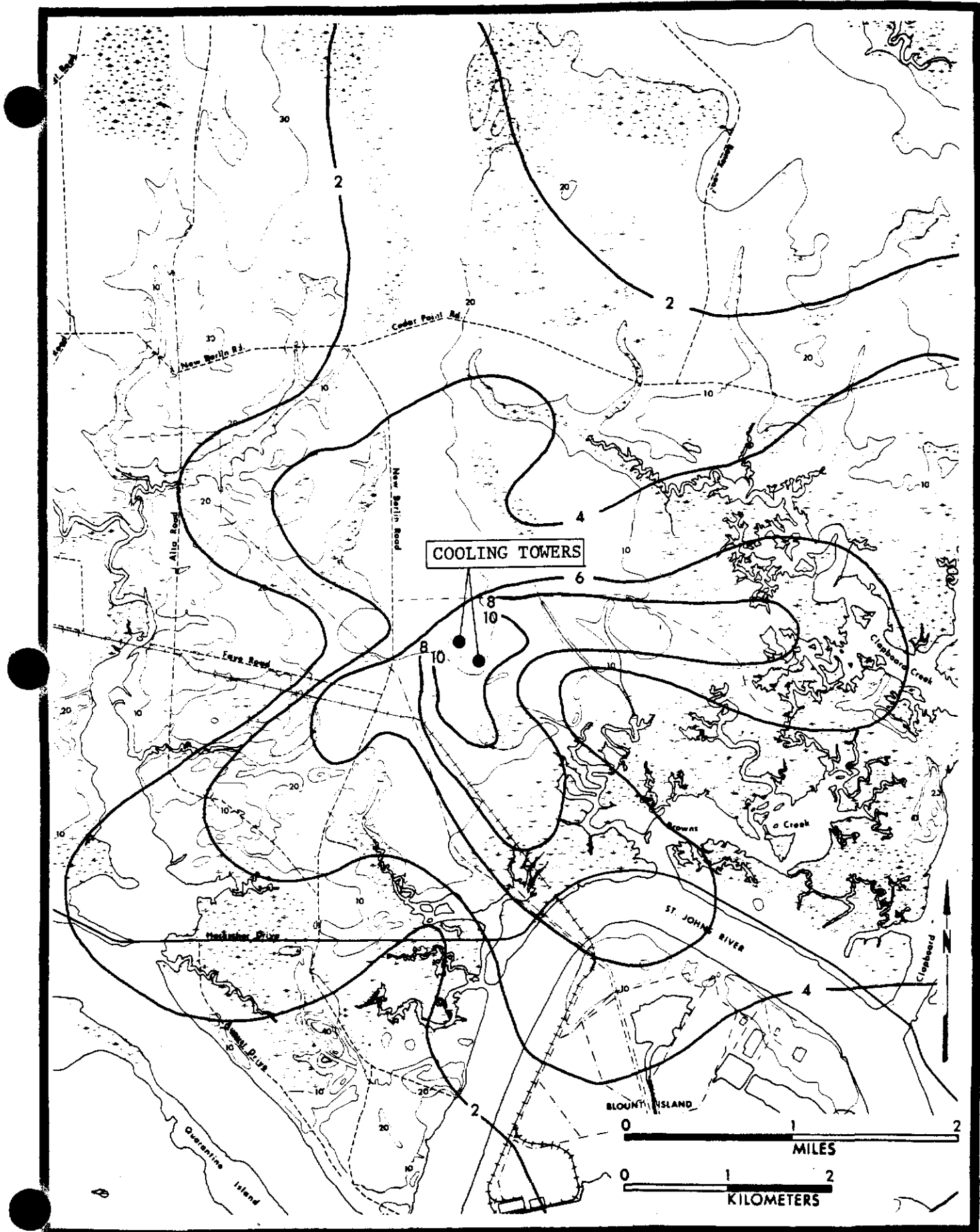


Figure 5.4-4 Percent Vapor Plume Occurrence - Winter

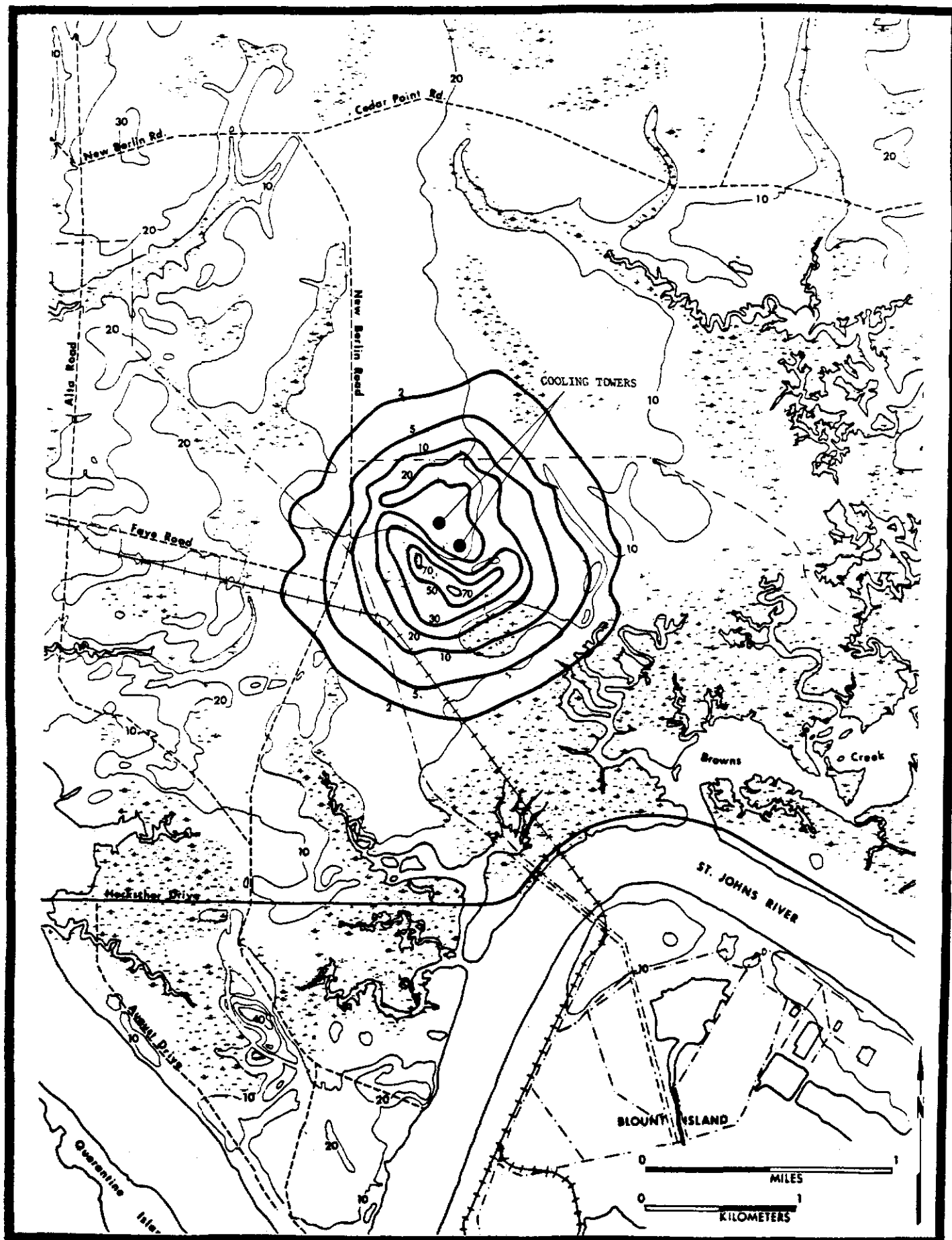


Figure 5.4-5 Seasonally Averaged Water Deposition for Spring
in $\text{mg/m}^2/\text{hr}$

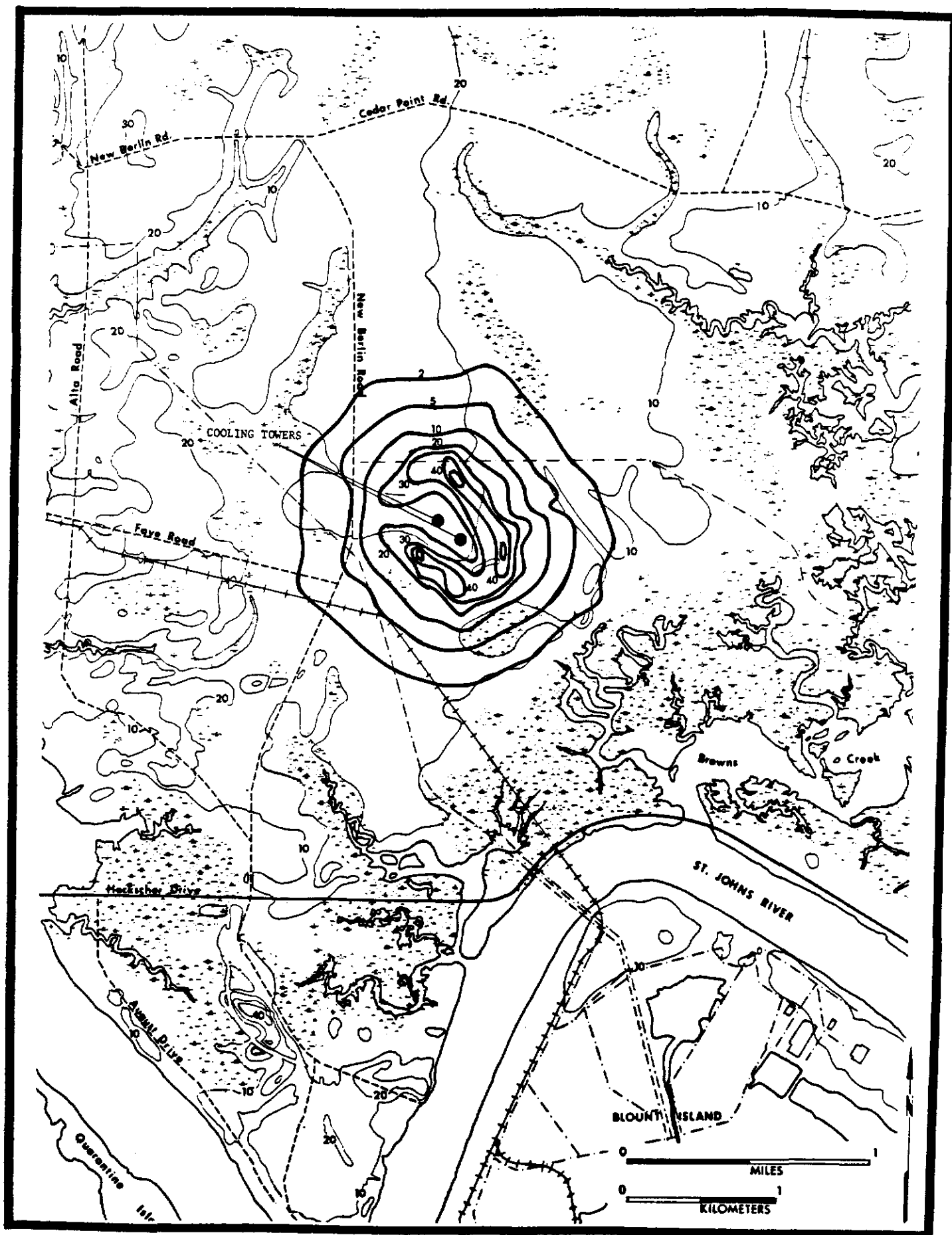


Figure 5.4-6 Seasonally Averaged Water Deposition for Summer in $\text{mg}/\text{m}^2/\text{hr}$

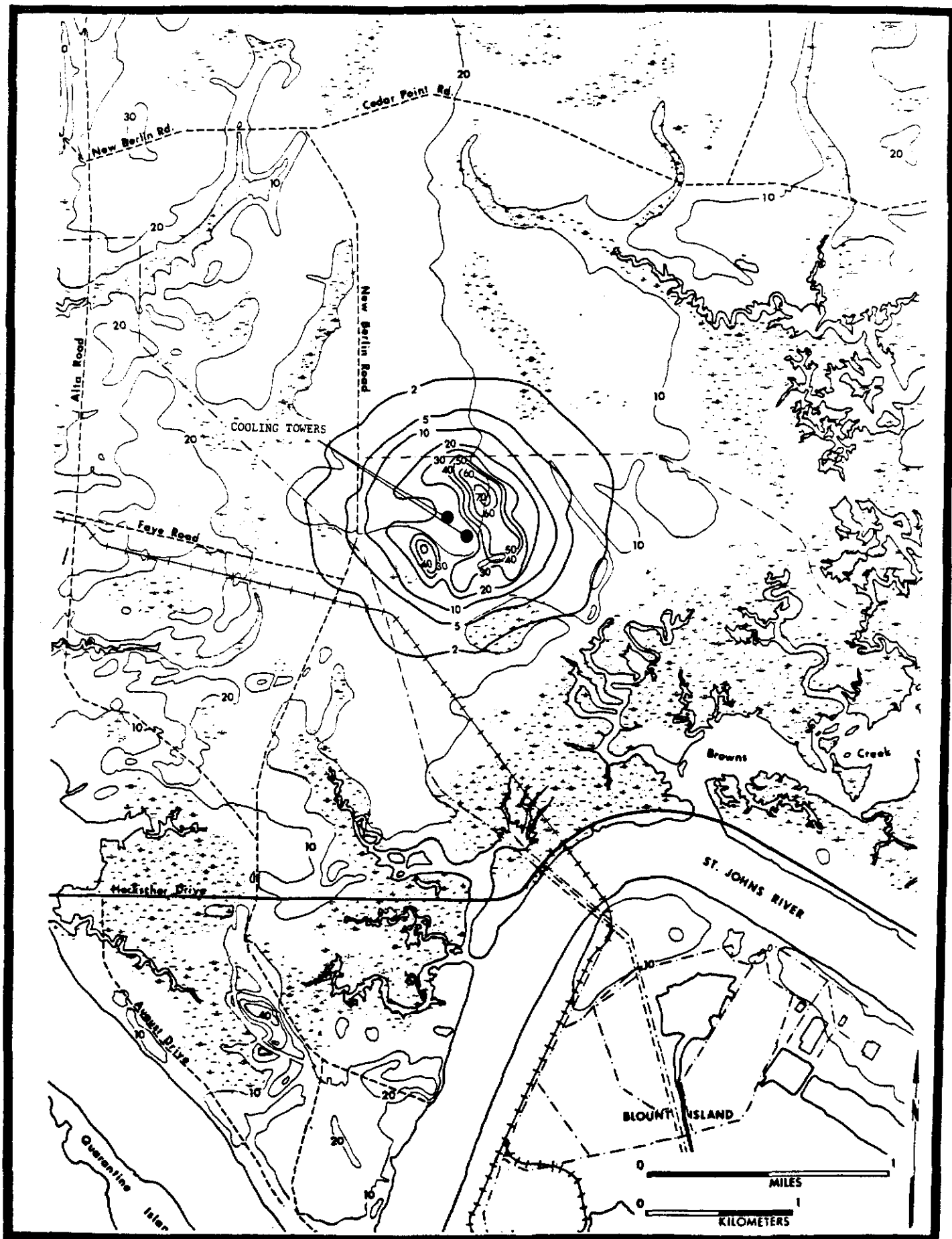


Figure 5.4-7 Seasonally Averaged Water Deposition for Fall
in $\text{mg}/\text{m}^2/\text{hr}$

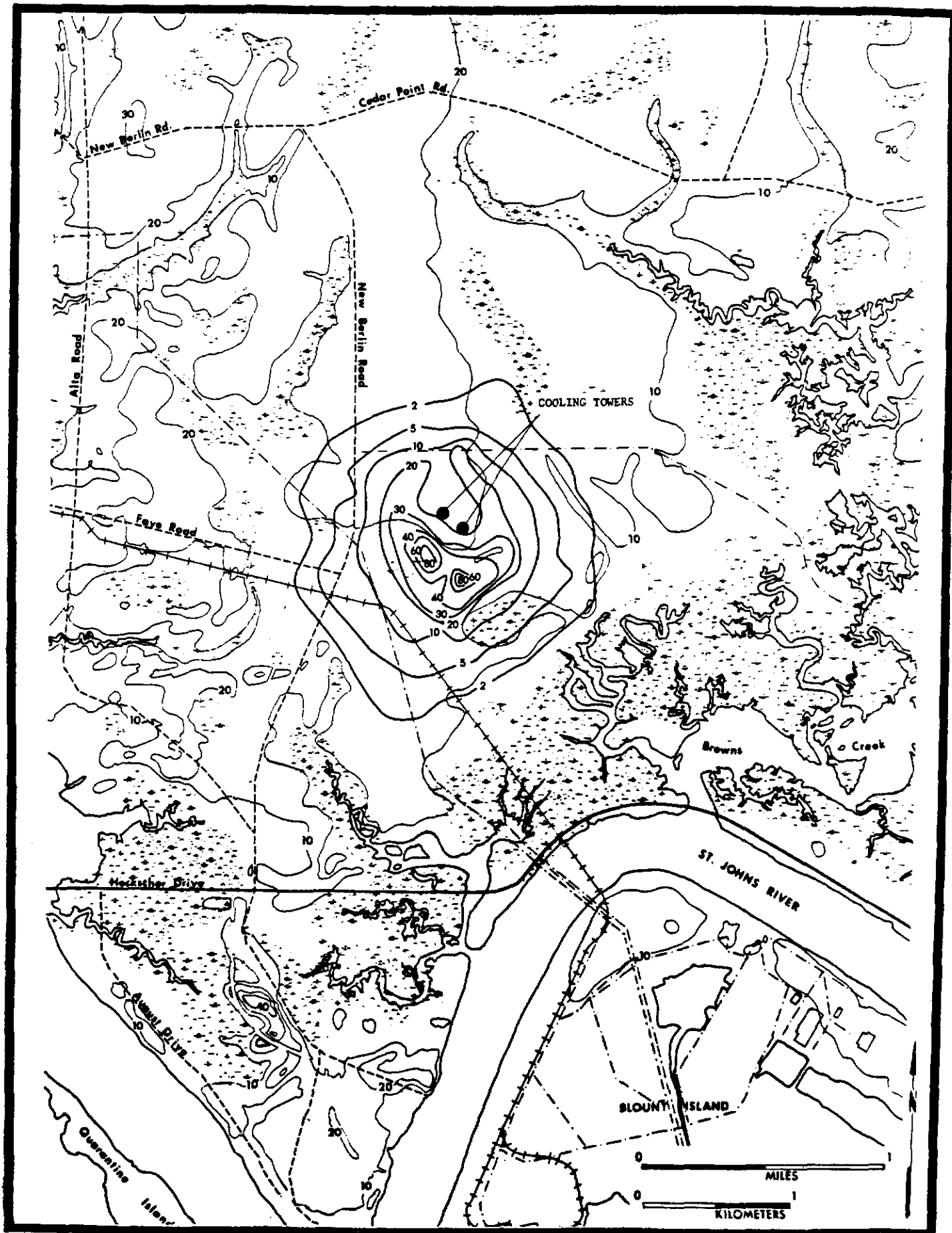


Figure 5.4-8 Seasonally Averaged Water Deposition for Winter
in $\text{mg/m}^2/\text{hr}$

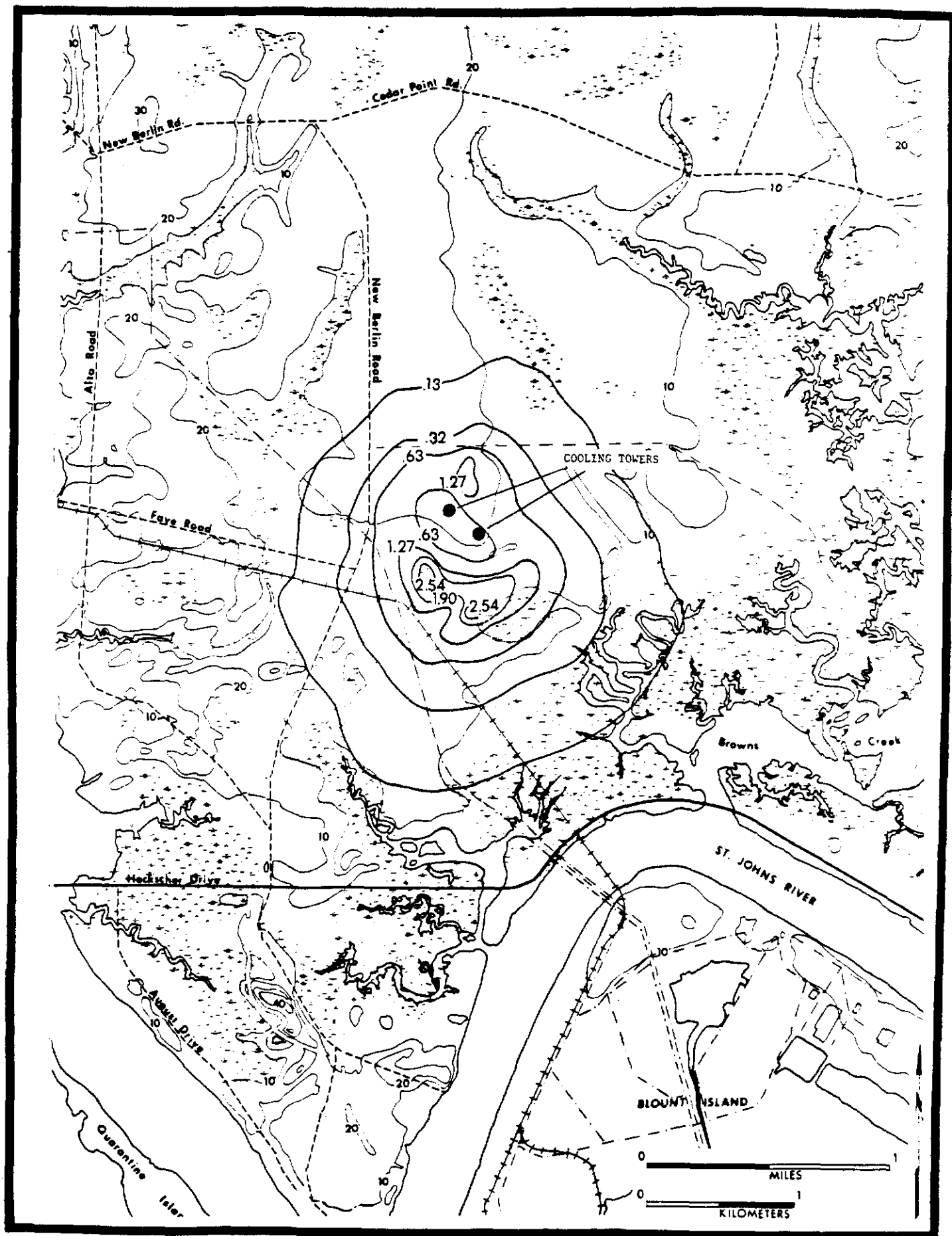


Figure 5.4-9 Seasonally Averaged Salt Deposition for Spring in $\text{mg/m}^2/\text{hr}$

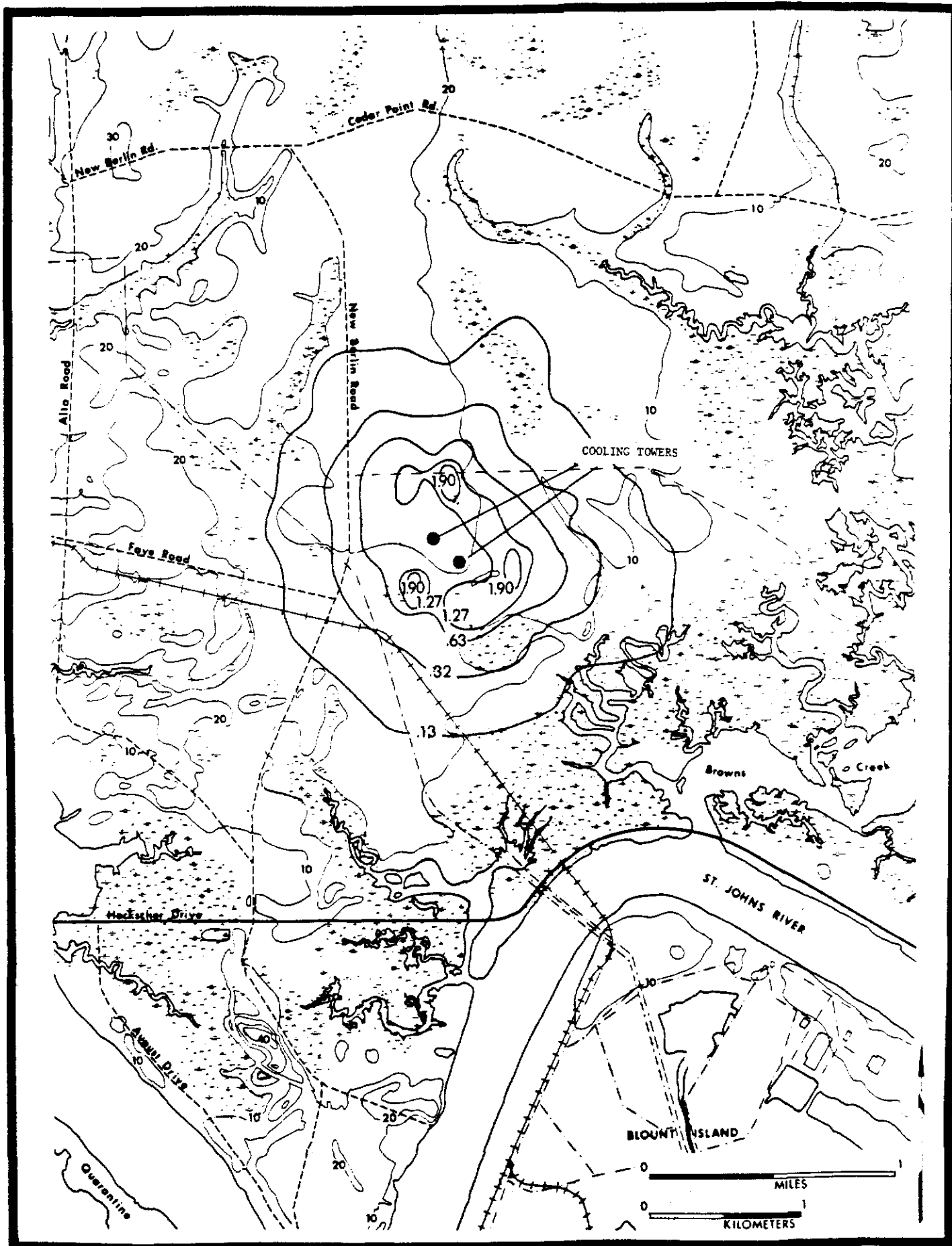


Figure 5.4-10 Seasonally Averaged Salt Deposition for Summer in $\text{mg/m}^2/\text{hr}$

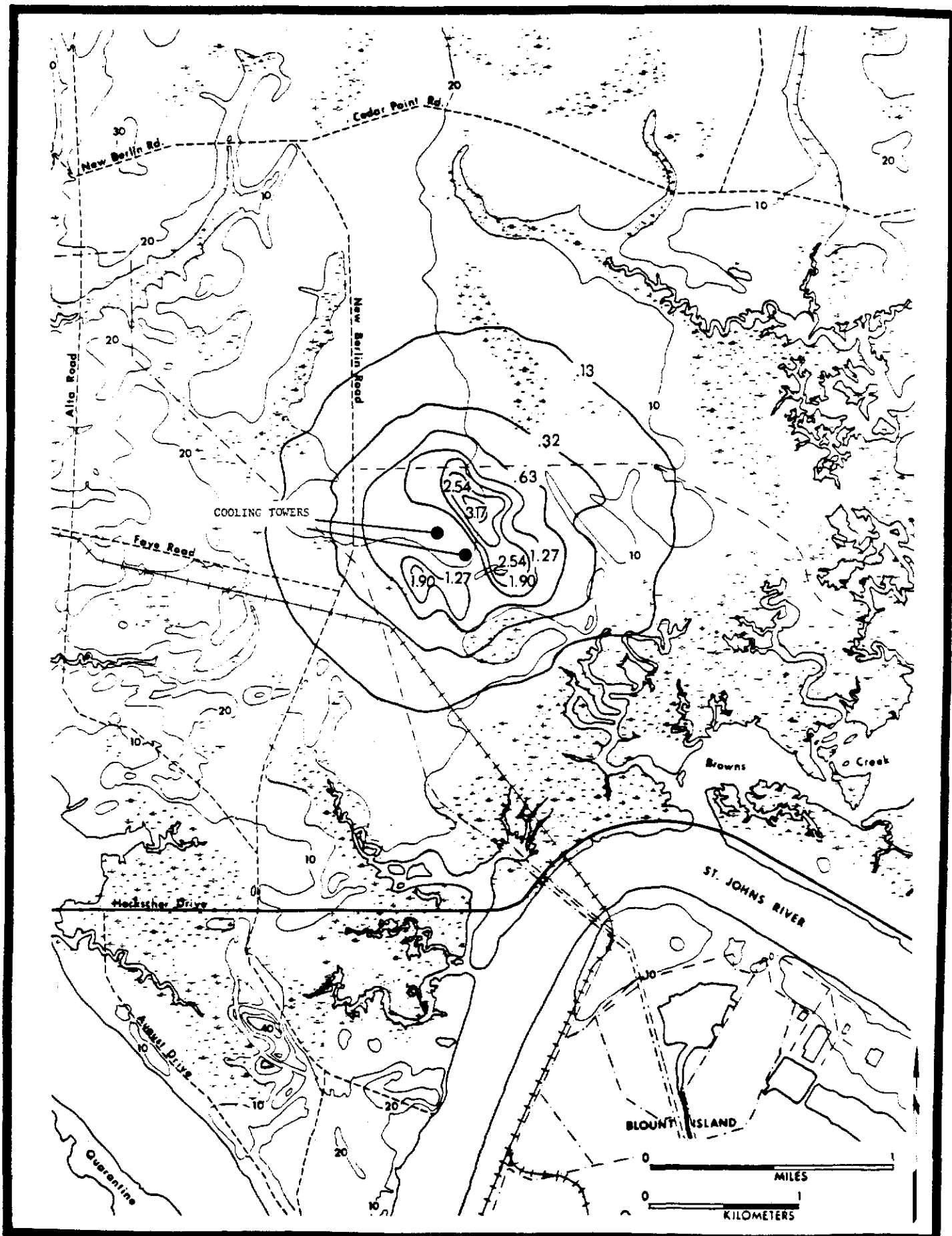


Figure 5.4-11 Seasonally Averaged Salt Deposition for Fall in $\text{mg/m}^2/\text{hr}$

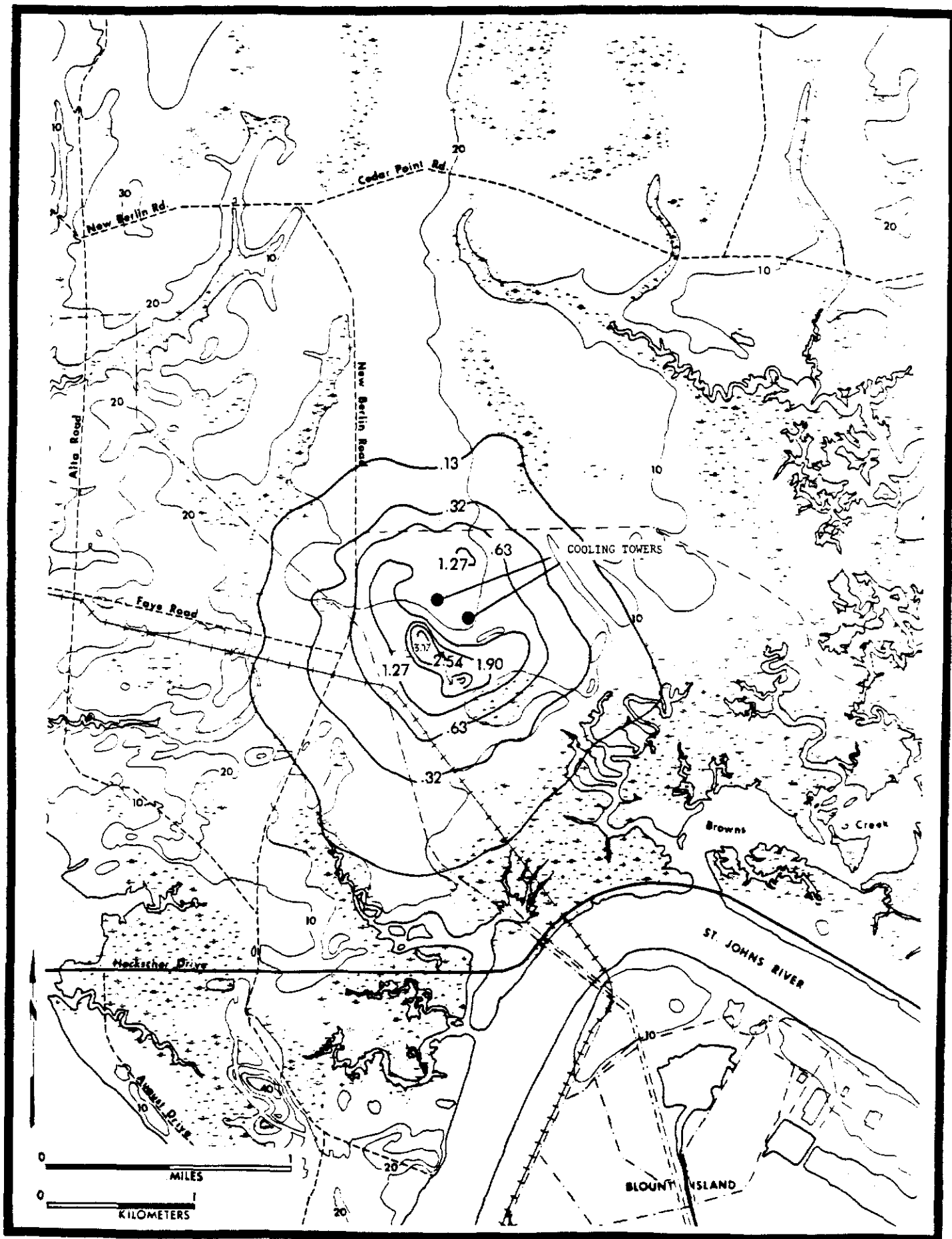


Figure 5.4-12 Seasonally Averaged Salt Deposition for Winter in $\text{mg/m}^2/\text{hr}$

5.5 ASSOCIATED TRANSMISSION SYSTEM

This section presents the evaluation of potential operational impacts associated with transmission lines routed within the preferred corridor. Although a precise right-of-way has not been identified, the occurrence of similar existing transmission lines in the preferred corridor is used as the basis for evaluation of potential impacts.

5.5.1 Operation and Maintenance

5.5.1.1 Use of Herbicides and Pesticides

The right-of-way (ROW) will be maintained in an early ecological stage of succession. Immature tree species will be preserved along the peripheries of the right-of-way. The area between structures ten feet to either side of the outside conductor will be cleared of all tree growth. Only trees in excess of ten feet in height will be removed from the outer portion of the ROW, except where location of new access roads necessitates complete clearing. Pesticides or herbicides will not be used for vegetation or pest control along the transmission line or at substations without prior approval of the FDER.

5.5.1.2 Visual Impact

Placement of a transmission line ROW within the preferred corridor is not expected to result in a major disturbance to the viewshed. Towers will normally be limited in height to 100 feet maximum with trees providing an adequate buffer between the tower and viewshed. The trees along with the level topography of the region will preclude views of the towers from great distances, except from elevated structures such as bridges. In addition, the rural land use pattern of most of the corridor areas will minimize the number of viewers as well as access to such viewing opportunities.

Areas that will be most subjected to aesthetic impacts include road crossings and areas of medium density development. The major road crossings to the south of the proposed site will be Fort Caroline Road and Atlantic Boulevard. West of the proposed site, the transmission line ROW will cross U.S. 17 and Interstate 95. Residents and local commuters will be familiar with the local environment and busy with routine activities; therefore, they are not as likely to notice the new ROW. Although tourists are much more likely to notice any deviation from the natural visual environment, their viewing opportunity will be limited since they will be travelling at speeds of 40 to 55 mph. The ROW will be routed in the vicinity of medium density development to the south of the proposed site in the area of Anniston Road and near the intersection of Fort Caroline Road and Merrill Road. The crossing point on the St. Johns River will also present a greater aesthetic impact as tower heights at this point will increase to approximately 350 feet to avoid obstructing channel navigation. In all cases, the visual impact of the transmission line ROW will be reduced where the new transmission facilities are in close proximity to an existing ROW. This will have less of an impact than establishing the new ROW on a previously undisturbed visual environment.

The visual impacts of the transmission lines will be minimized by the following guidelines (U.S. Department of the Interior):

- . Clearing of natural vegetation will be limited to that material which poses a hazard to the transmission line.
- . Long tunnel views of transmission lines crossing highways in wooded areas will be avoided by occasionally deflecting the ROW.
- . In scenic areas visible to the public, ROW strips through timber stands will be deflected occasionally and will follow irregular patterns or be suitably screened to prevent the ROW from appearing as a tunnel.
- . Crossings at the crest of a highway will be avoided where possible.

- . Open expanses of water and marsh land, particularly those areas heavily used by migratory birds and waterfowl will be avoided when practical.
- . Long views of ROW parallel to a highway will be avoided.
- . Transmission lines will not be located or cross at road intersections.
- . The size of transmission towers will be kept to the minimum practical.
- . Access roads will be located to minimize erosion and preserve natural beauty.
- . Designs of towers and poles similar to existing structures will be used where practical.
- . When lines cross roads, the ROW will be left in its natural state as far back from the road as possible.

5.5.1.3 Other Effects

The proposed 230 kV lines will not be of sufficient magnitude or close enough to the ground to create noise or induced current problems. Towers and lines will also be designed to minimize induced current potential. Chartier (1980) states that corona-produced noise from lines between 110 and 230 kV is quite low. Ground surveys conducted beneath existing 230 kV lines detected no appreciable noise emanating from the lines.

Electromagnetic radiation research to date indicates that observable effects only occur at field levels (i.e., 20-25 kV/m), well above those encountered beneath present day transmission lines (i.e., 13 kV/m) (Baldwin, 1980). Thus, no significant environmental impact is expected. At present, most available evidence indicates that transmission lines do not constitute a significant biological hazard (Lee and Griffith, 1978).

Maintenance of towers and lines will involve very few workers and at infrequent intervals. Consequently, maintenance activities should not significantly interfere with recreational, residential, institutional and agricultural land uses which may be located adjacent to the ROW.

5.5.2 Public Access

The anticipated close proximity of the new ROW to the existing ROW will result in little additional need for access roads servicing the line. Consequently, resident wildlife will not be exposed to human activity significantly more than under current conditions.

5.5.3 References

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- Chartier, V.L., 1980. Designing Overhead Power Lines to be Compatible with the Electromagnetic Environment. Presented in the Westinghouse Electric Corporation Transmission and Distribution Technology Forum. Pittsburgh, Pennsylvania.
- Lee, J.M. and D.B. Griffith, 1978. Transmission Line Audible Noise and Wildlife. In: Effects of Noise on Wildlife Academic Press, New York. p. 105-168.
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5.6 ASSOCIATED FACILITIES AND OTHER EFFECTS

5.6.1 Associated Facilities

5.6.1.1 Transportation System

Although plant operation will increase local traffic volumes, this increase will be greatly reduced from the construction phase. Chapter 4, Section 4.1.3.2 details the potential ability of local roads to accommodate the greatly increased traffic during construction. Plant operation will require approximately 375 employees, 90 percent of whom are expected to be assigned to the day shift. Based upon 1.2 persons per car, JAPB reported local passenger averages, approximately 280 automobiles will be added to the current traffic volume during the morning shift change. The traffic analysis in Chapter 4, Section 4.1.3.2 illustrates that local roads are capable of accommodating this small increased volume.

The effects of coal trains entering and leaving the plant site will be the most significant traffic impact during plant operation. Assuming coal trains operated during peak traffic hours, "worst case" delay times created by plant related coal train traffic along Heckscher Drive, Main Street, and Eastport Road were calculated based on formulas presented in Matson (1955). Tables 5.6-1, 5.6-2, and 5.6-3 present the delay per day and total annual social cost calculated for crossing each of these roadways. Social costs are defined as the delay time per individual passenger multiplied by minimum wage rates.

Table 5.6-1 is for the Heckscher Drive crossing east of the intersection of New Berlin Road and Heckscher Drive. The single coal train operating between the Blount Island coal unloading facility and the proposed plant was assumed to travel during peak traffic hours in order to evaluate the maximum delay to vehicles on the roadway. The trip from the plant to the unloading area was therefore assumed to occur between 8:00 and

9:00 a.m., returning between 4:00 and 5:00 p.m. As shown in Table 5.6-1, the delay to be expected in 1985 at this crossing would be approximately 31,000 seconds per day, with a longest anticipated single delay of 4.8 minutes. This would equate to a total annual social cost of about \$29,600 in 1980 dollars.

Table 5.6-2 is for the crossing of Main Street at Eastport Road by coal trains supplying the proposed plant. Again, the most traffic intensive time periods were used in order to create the maximum delay that could be expected. It was also assumed trains crossing at this location would be in a switching type operation and therefore, a speed of 10 mph was used. The delay shown along Main Street is projected to be approximately 72,200 seconds per day in 1985, with a longest anticipated single delay of 5 minutes. This would equate to a total annual social cost of about \$61,200 in 1980 dollars.

Table 5.6-3 is for the crossing along Eastport Road by coal trains supplying the proposed plant. There are two crossings along Eastport Road, one near Main Street and one where Eastport Road turns south towards Heckscher Drive. The same basic information was input for both crossings into the computer program with the trains projected to cross the roadway during peak hours to obtain the maximum delay. As shown in Table 5.6-3, the daily delay is projected to be 32,424 seconds, with a longest anticipated single delay of 5 minutes. This would equate to a total annual social cost of \$31,040 in 1980 dollars.

Under actual operating conditions, the "worst case" situations discussed above will not likely occur since hopefully coal trains will be scheduled mostly during non-peak traffic hours. Therefore, delay times caused by coal trains will be less than those indicated by the model.

5.6.1.2 Materials Handling Systems

Air Quality

The only air pollutant of concern that will be generated by the materials handling systems is fugitive dust. The emission sources are listed in Chapter 3, Table 3.8-3 along with the control technologies which will be employed and estimates for average particulate emission rates.

The impacts of the fugitive dust emissions on ambient total suspended particulate (TSP) concentrations in the vicinity of the sources and at the downtown Jacksonville TSP nonattainment area are addressed in Sections 5.3.2 and 5.3.3, along with the impacts of other project emissions. As indicated in those sections, the project emissions, including fugitive dust emissions due to materials handling, will not result in the violation of ambient air quality standards or PSD increments nor will they have a significant impact on the Jacksonville TSP nonattainment area.

Water Quality

Potential impacts to groundwater quality on the plant site for both solid and liquid wastes are discussed in Section 5.1.3.2 and Appendix D. Storage of liquid wastes in lined ponds on the plant site will effectively eliminate infiltration of these wastes to the groundwater regime, and no impacts to groundwater quality are predicted on the plant site.

Coal storage areas at the plant site (Section 3.2.2) and the coal off-loading facility (Section 3.10.2) will be lined to protect underlying groundwater. Runoff from the coal storage area at the plant site will be collected and routed to the central wastewater treatment facility (Ebasco Services Incorporated, 1981).

On Blount Island, potential impacts to groundwater quality will be limited to fluid losses through the bottom and sides of the percolation pond, which will enter the existing near surface soils on the island.

Infiltrating water will travel short distances in the subsurface before discharging to the St. Johns River. Minimal renovation of this water, e.g. by adsorption of metals, is expected because of the short travel distance. Groundwater underflow beneath the percolation pond will probably result in some dilution of infiltrating fluids. Flow paths are expected to be lateral toward the river, with no significant vertical flow components. Accordingly, no impacts to the deeper aquifers (shallow rock aquifer, Floridan aquifer) are anticipated.

The quality of the groundwater beneath the percolation pond is expected to be much the same as the average river water quality, as a result of encroachment of river water due to tidal fluctuations in river stage. That is, although a net discharge of groundwater to the river is expected, at high river stage river water is likely to encroach into the groundwater aquifer, resulting in degradation of groundwater quality, particularly along the margin of the island.

In April, 1981, five piezometers were installed at depths of 10 to 12.5 feet below land surface at the proposed coal offloading facility. Water samples taken from two of these piezometers had total dissolved solids (TDSS) concentrations of 1,814 and 7,535 mg/l, and met the Florida Class I-B water quality standards, although concentrations of arsenic, lead, and fluoride in one sample approached the Class I-B standards. Because of the high TDS concentrations observed at the top of the water table, at very shallow depths, it is expected that TDS concentrations at greater depths, and along the margin of the island, will exceed 10,000 mg/l. In this instance, the groundwater would be classified as V-B water. Furthermore, since shallow groundwater on the island is not now used for potable water supply, and is not expected to be so used in the future, the only standards which would apply are the general standards of FAC 17-3.051(1), rather than the explicit numerical standards of FAC 17-3.101. The applicable general standards are expected to be met by infiltration from the percolation pond, which will consist of effluent from the treatment facility on Blount Island.

5.6.2 Other Plant Operations

5.6.2.1 Land Use

The proposed plant will affect land use patterns within a five mile radius of the proposed facilities by reinforcing current land use plans and trends. However, the proposed plant is not expected to significantly affect regional land use outside of the five mile radius. The five mile land use analysis was based on information from the Jacksonville Area Planning Board, aerial photos from January, 1980, United States Geological Survey, and field inspection.

Land use in the proposed plant vicinity is and will be highly related to use of the St. Johns River. Heavy demands are made for that land which is in easy access of the river. These demands are made mostly by four types of land use including: industry, residential, commercial and recreational. The proposed site is presently zoned for heavy industry which, by exception, can include a power plant (Jacksonville Area Planning Board, 1979b). The site and land contiguous to the north, west and south of the site is all zoned industrial and is designated industrial in the 2005 Comprehensive Plan prepared by the Jacksonville Area Planning Board (1979). Marsh land to the east of the proposed site will be protected as such according to the Comprehensive Plan. It is important that these marshes be protected because they serve as hurricane buffers, wildlife refuges, retention areas for runoff, propagation grounds for marine life, scenic resources and recreational areas.

The industrial areas to the north, west, and south of the site should continue to experience growth as this area is highly suitable for industrial uses. The variety of transportation modes available gives a firm basis for industrial use in this area. This is true not only for the five mile area but the region as well. Current and planned land use within five miles of the proposed site is discussed in Chapter 2, Section 2.2.1. Land use for the region is discussed in Appendix G. As shown in Chapter 2,

Figure 2.2-4, surrounding land uses are now primarily industrial and are planned for industrial use in the future. This makes operation of a power plant compatible with land use plans.

An analysis of the land uses within the five mile radius is shown in Table 5.6-4. The table shows that the largest land use category is a combination of woodlands and wet woodlands with 16,686 acres. The 13,582 acres of woodlands are mostly suitable as commercial forest while the 3,104 acres of wet woodlands are considered natural woodlands. Open water constitutes the second largest land use category with 10,570 acres. St. Johns River and Mill Cove make up the majority of this classification. Coastal lands make up the third largest land use category with 6,780 acres. Marshes comprise the majority of this category. Residential comprises 5,652 acres in the five mile area while industry comprises 1,875 acres.

The effects that power plant operation will have on surrounding land uses are expected to reinforce the future industrial development of these areas, as designated in the 2005 Comprehensive Plan. The construction of the proposed plant along with the existing industries in the area will serve to strengthen the designation of port related industry for this area as well as preserve other areas in the city and the region for their designated land uses.

The site area is currently industrial in nature, there will be no significant changes in land values expected due to the proposed plant other than enhancement of industrial property value resulting from a more reliable power supply available to prospective industries in the service area.

5.6.2.2 Noise

The sound levels of major sources of noise that may have an impact on the area around the proposed plant site have been developed from actual field measurements of similar coal-fired plants, analytical calculations

and data supplied by various equipment manufacturers. Equipment located indoors, such as the turbine-generators, will have less effect on the outside noise environment than manufacturers' data suggest because the plant's siding walls will provide significant noise insulation.

All noise projections were made to the nearest residence which is located approximately one mile north-northwest of the plant center on New Berlin Road across from the city landfill. Rather than using a single acoustic center for the site, the approximate distance from each major component to the residence was determined and used in the noise projections. The attenuated levels, at the residence, of each component were then combined to produce the projected site noise level as perceived from that point.

Table 5.6-5 lists the major noise producing components of the proposed plant. Corresponding noise levels are based on full power operation with shielding where specified. All of the fans and transformers will be designed with sound absorbing materials or shielding to meet the indicated noise levels. The cooling towers, turbine-generators and stacker-reclaimer will have no special noise reducing features. However, the turbine-generators will be inside the building which will provide significant sound insulation to the outside environment. The rotary coal car dumper will also be located inside a building, designed primarily to control fugitive dust emissions, but which will also reduce the level of noise transmitted to the outside. A maximum of two coal trains per day going to and from the site will produce a temporary increase in site noise levels. However, because of the temporary nature of the noise, it is not expected to be significant.

The individual attenuated levels shown in Table 5.6-5 do not take into consideration shielding provided by the building walls nor atmospheric attenuation. The 44 dB(A) level projected at the nearest residence is, therefore, the maximum value expected from the plant.

Because the projected noise level at the nearest residence is more than 10 decibels below the existing noise level at the residence [$L_{eq}(24) = 55$ dB(A), Chapter 2, Table 2.10-1], normally there should be no impact on the noise environment due to operation of the proposed plant. Furthermore, the land use plan through the year 2005 (Jacksonville Area Planning Board, 1979) indicates that all land adjacent to the proposed plant will be reserved for industrial use or protected open marsh; thus precluding residential development in closer proximity to the plant.

Primary sources of noise at the proposed Blount Island coal handling facility are listed in Table 5.6-6 along with the respective noise level of each. The loudest source of noise will be the two diesel powered dozers and one front end loader which will be used approximately 8 hours per week during the normal day shift for maintenance of the coal pile at Blount Island.

Actual noise measurements were taken at a similar coal handling facility of a stacker-reclaimer, a ship unloader and the conveyors. The loudest operation at that facility was the ship unloader dropping a 15 ton bucket of coal into an unshielded hopper. A peak impulse of 98 dB(A) was produced. Because of this high noise level, the hopper at the proposed coal unloading site will utilize an enclosure of sound-deadening material.

The ship unloader, stacker-reclaimer, and all conveyors will be powered by electric motors which are inherently quieter than diesel engines. The ship unloader is expected to produce 71 dB(A) and the stacker-reclaimer, 68 dB(A) at 100 feet. The rubber belt conveyors and the railcar loader, enclosed in a building, will be quiet in comparison to other machinery and will, therefore, not add significantly to noise level projections off-site.

Projected maximum noise levels at the nearest residences (Beacon Hills), located approximately 7000 feet southeast of the proposed Blount Island coal handling facilities, will be approximately 43 dB(A) during

operation assuming all equipment is operating simultaneously and at their maximum noise output levels. This level is below the existing $L_{eq}(24)$ of 52 dB(A) (Chapter 2, Table 2.10-1). Therefore, due to the intermittent nature of the operation and the low noise levels, the noise impact from the proposed facility at these residences is not expected to be significant.

The transmission lines leading from the plant will at times produce an audible low level, low frequency hum. This hum is generally noticeable only where ambient noise levels are much lower than those measured around the site area (Section 2.10.1). Because of the low levels and the fact that the transmission lines will parallel existing transmission lines, the impact of the noise is expected to be minimal.

5.6.2.3 Aesthetics

Proposed Plant

An artist's rendering of the proposed plant appears on the cover of this report. The proposed plant will be an addition to the visual environment or viewshed and as such will have an aesthetic impact on the viewer. It is difficult to analyze such an impact precisely because it is of a highly subjective nature. A number of factors, however, can be measured. Among these factors are the number of people to be visually impacted, the duration of the average visual impact, and the visual quality of the surrounding area and its relationship to the proposed plant.

The most prominent features of the proposed plant that will affect the visual environment are the stack (640 feet above ground level), the cooling towers (425 feet above ground level), and the boiler building (256 feet above ground level). As mentioned in Chapter 2, Section 2.10.2, the visual impact will be influenced by two factors. First, the proposed plant is near the boundary of industrial land use areas and tidal marshes. This is significant because the openness of these areas will allow an unobstructed view of plant facilities from the east. The second factor is the three

existing stacks of the oil-fired NGS as well as other existing structures. The grouping of all these structures in one general area, contiguous to an existing generating station and industrial area, has a lessened impact than building on a previously undisturbed visual environment.

As shown in Figure 5.6-1, the proposed plant facilities will be visible from various points in a 5-mile radius. A summary of the visual impact in the 5-mile area is given in Table 5.6-7. Of the ten major viewpoints listed in the table, five are discussed below based on direction of view and a sixth from the Kingsley Plantation since it is a recreation area. Four viewpoints were used to show a computer simulation of the various views of proposed plant (Figure 5.6-2).

East

Heckscher Drive will provide the only view of the proposed plant facilities from the east because it is the only publicly accessible route through the marshes. Heckscher Drive approaches the proposed site from the east with the St. Johns River to the left side (south) of the road and the marshes to the right (north). The view from this road will extend from the entrance of the NGS out to a distance of up to five miles from the proposed plant. However, the view will occasionally be broken by stands of tall trees or shrubs and an occasional structure. As shown in Table 5.6-7, the potential number of viewers along Heckscher Drive is 16,136. It should be noted that from five miles, the existing stacks at the NGS just barely show up on the horizon, appearing blue to purple in color as do the trees in the distant background on the horizon. At 2 to 3 miles from the NGS, the stacks become more evident, but are seen as middle background with other more noticeable features present in the foreground. These features include signs (usually billboards), restaurants, tackle shops, trees and the telephone lines and utility poles running parallel to Heckscher Drive. Appearing in the middle background with the stacks are the transmission towers crossing the St. Johns River. In addition, the Offshore Power Systems crane on Blount Island has a dominant visual impact when driving

along Heckscher Drive because of its size and height as well as closer proximity to the road. With these existing features cluttering the horizon, the plant impact will be decreased.

Figure 5.6.2 includes a computer simulation demonstrating how the proposed power plant will appear on a clear day, from Kingsley Plantation, located 6.5 miles east of the plant. Any haze or discoloration, however, would tend to screen the plant from view due to the distance involved. Considering this distance and the typical view from this point, the aesthetic impact is not expected to be significant.

Southeast

Four and a half miles to the southeast there will be a view from Fort Caroline National Memorial which is located on the southside of the river. The park has 400,000 visitors each year according to the Jacksonville Area Planning Board (1979a). These visitors will receive a partially screened view unless they take the quarter mile trail down to the fort. The fort itself is in the open on the shore of the St. Johns River and therefore has a view north. However, immediately across the river is the Offshore Power Systems crane. With this structure, the existing NGS and the St. Regis Paper Company plant in the foreground, the impact of the proposed plant's facilities will be decreased (Figure 5.6-2). Figure 5.6-2 also includes a simulated view from the residential area just west of the park. The views are about the same from both locations.

Southwest

Four miles to the southwest there will be the possibility of a view from those residences located on the shores of Mill Cove. Most of these will have broken views due to trees and shrubs in their backyards. Even without screening at this point, the distance of four miles, along with the trees between the river and the opposite shore of Mill Cove, will limit the aesthetic impact. Furthermore, the St. Regis Paper Company plant is expected to make a greater visual impact than the proposed facilities.

West

Two miles to the west, the only major view will come from Heckscher Drive just before and as it crosses Dunn Creek. The number of potential viewers at this point is 16,136, consisting primarily of local commuters in transit. With the shrubs in foreground and trees in the background near the proposed plant plus the distance of just over 2 miles, the impact will be minimal.

North

The only major view from the north will be where Boney Road intersects Cedar Point Road. At this point, the view toward the proposed plant is across a large pasture, as can be seen in Figure 5.6-2. The stacks will appear just over the tree tops in the middle background at a distance of about 2.5 miles. From this viewpoint, considering the changing scenery of the pasture and the intermittent nature of the view, the visual impact is expected to be only slightly significant.

Proposed Coal Unloading Facilities

The coal unloading facilities proposed for Blount Island will not have a significant impact on the viewshed. The most significant structures will be the coal unloader (180 feet high) and the coal pile (40 feet high). A summary of the aesthetic impact in a 5-mile area is presented in Table 5.6-8. Figure 5.6-1 shows the viewpoints from which the proposed unloading facilities will be visible.

Fort Caroline is located across the St. Johns River to the southeast of the proposed facilities at a distance of about 2 miles. The view from Fort Caroline will be screened due to the slight bend in the river. In addition, the large gantry crane maintained at the Offshore Power Systems site would be an imposing feature located directly between the fort and the proposed coal unloading facilities. Due to the crane, existing

transmission towers and other industrial structures in the view from the fort, the coal facilities should have little impact on viewers from that point.

Directly south of the proposed coal facilities, on the opposite shore of the Dame Point Cutoff, is some open and forest land and beyond that is Mill Cove. The only residential areas to the southwest that may be affected are two miles away on the opposite shore of Mill Cove. From these residential areas, the coal unloading facilities will be screened for the most part by trees on the northern side of Mill Cove. The 40 foot coal pile will appear below the existing tree line. The coal unloader will be visible, but lower than the existing cranes on Blount Island. Considering the viewing distance of over two miles and the partial screening of the trees, the visual impact of the coal unloading facilities to these residential areas will be limited.

To the north, the coal unloader is likely to be visible from the bridge on Heckscher Drive at Browns Creek. The viewer will either be driving at highway speeds of 40-45 mph or standing on the bridge, so duration of the view will depend on the activity. The view will comprise all of the industrial structures on Blount Island such as the Offshore Power Systems crane, the transmission towers and other structures. The impact will, therefore, be insignificant from this viewpoint.

The marshes which are 1.5 miles to the east are considered sensitive because of their use as a recreational area. At this distance, the coal unloader will appear relatively low over the tree tops and will not make much of an impression on the viewer. It should be noted that the view in this direction from the marshes can not be considered sensitive since the entire industrial section will be in view. As mentioned before, this will include the Offshore Power Systems crane, the transmission towers across the St. Johns River, the NGS and the proposed plant as well as all of the other shipping and industrial features in the area.

5.6.2.4 Work Force and Settlement Patterns

Start-up, testing, and commercial operation of Unit 1 will overlap with the final three years of the Unit 2 construction phase (1984-1987). Based upon previous experience, it is estimated that as a worst case 15 percent of the total operational work force of 375 workers will be immigrants to the region. The entire operational work force is expected to reside in Duval County. Table 5.6-9 presents the estimated immigrant operational work force and the total population effects that will be created by these workers.

During the Unit 1 start-up and testing period of 1984, it is estimated that 10 of the 68 operational workers will be immigrants, creating a total addition of approximately 30 persons to the Duval County population. The total estimated operational work force of 375 would be fully assembled by 1987. Of this total, 56 workers are expected to be immigrants, adding about 160 additional persons to the population. The immigrant worker and population levels would remain constant through the year 2025.

5.6.3 References

Ebasco Services Incorporated, August, 1981. Jacksonville Electric Authority St. Johns River Power Park Units 1 and 2, Water and Waste Management Study. 145 Technology Park/Atlanta, Norcross, Georgia.

Fairchild, R.W., 1972. The Shallow-Aquifer System in Duval County, Florida: Florida Department of Natural Resources, Bureau on Geology Report of Investigations No. 59, 50 p.

Harland Bartholomew and Associates, Inc., 1980. Report Prepared for Envirosphere Company.

Jacksonville Area Planning Board, June, 1979. Land Use Element - 2005 Comprehensive Plan. 330 E. Bay Street, Room 401, Courthouse, Jacksonville, Florida 32202.

Jacksonville Area Planning Board, June, 1979a (Draft Copy). Regional Recreation and Open Space Plan. Northeast Florida Regional Planning Council, Jacksonville, Florida 32202.

Jacksonville Area Planning Board, 1979b. Land Use - Zoning Code - City of Jacksonville. Jacksonville, Florida.

Maston, T.M., 1955. Traffic Engineering. McGraw Hill Book Company. New York, NY.

U.S. Environmental Protection Agency, December, 1971. Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances. NTID 300.1, Washington, D.C. 20460.

percent of the total operational work force of 375 workers will be immigrants to the region. The entire operational work force is expected to reside in Duval County. Table 5.6-9 presents the estimated immigrant operational work force and the total population effects that will be created by these workers.

During the Unit 1 start-up and testing period of 1984, it is estimated that 10 of the 68 operational workers will be immigrants, creating a total addition of approximately 30 persons to the Duval County population. The total estimated operational work force of 375 would be fully assembled by 1987. Of this total, 56 workers are expected to be immigrants, adding about 160 additional persons to the population. The immigrant worker and population levels would remain constant through the year 2025.

5.6.3 References

- Fairchild, R.W., 1972. The Shallow-Aquifer System in Duval County, Florida: Florida Department of Natural Resources, Bureau on Geology Report of Investigations No. 59, 50 p.
- Harland Bartholomew and Associates, Inc., 1980. Report Prepared for Envirosphere Company.
- Jacksonville Area Planning Board, June, 1979. Land Use Element - 2005 Comprehensive Plan. 330 E. Bay Street, Room 401, Courthouse, Jacksonville, Florida 32202.
- Jacksonville Area Planning Board, June, 1979a (Draft Copy). Regional Recreation and Open Space Plan. Northeast Florida Regional Planning Council, Jacksonville, Florida 32202.
- Jacksonville Area Planning Board, 1979b. Land Use - Zoning Code - City of Jacksonville. Jacksonville, Florida.
- Maston, T.M., 1955. Traffic Engineering. McGraw Hill Book Company. New York, NY.
- U.S. Environmental Protection Agency, December, 1971. Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances. NTID 300.1, Washington, D.C. 20460.

Table 5.6-1 (Revision 1)

DELAY CALCULATIONS - HECKSCHER DRIVE

	<u>Existing Traffic^a</u>	<u>Projected 1985 Traffic</u>
Auto (% of total)	86%	83%
Single Unit Trucks (% of total)	8%	8%
Tractor Trailer (% of total)	6%	9%
Average Daily Traffic	8265	9918

1985 Hourly Traffic Distribution^a

6-7 a.m.	1.7%	6-7	7.6%
7-8	3.8%	7-8	1.4%
8-9	8.0%	8-9	1.2%
9-10	8.4%	9-10	.9%
10-11	8.5%	10-11	1.0%
11-12	8.6%	11-12	.6%
12-1 p.m.	8.7%	12-1 a.m.	.5%
1-2	8.2%	1-2	.6%
2-3	2.9%	2-3	.3%
3-4	8.8%	3-4	.2%
4-5	9.0%	4-5	.5%
5-6	8.3%	5-6	.4%

Longest Single Delay - 4.8 minutes

Total Delay per Day (1985 Traffic Volumes) - 31,062 seconds

Total Annual Social Cost^b (1980 Dollars) - \$29,575

Assumptions:	No. of Lanes	2 lanes
	Vehicle Speed	20 mph
	Time of Day each Train (1/day)	8-9 a.m. - 4-5 p.m.
	Length of Train	70 Cars (106 tn) 1 Engine
	Speed of Train	10 mph

^a Traffic survey, Harland Bartholomew and Associates, Inc., 1980^b Derived as total annual delay x minimum wage

Table 5.6-2 (Revision 1)

DELAY CALCULATIONS - MAIN STREET

	<u>Existing Traffic^a</u>	<u>Projected 1985 Traffic</u>
Auto (% of total)	86%	86%
Single Unit Trucks (% of total)	8%	8%
Tractor Trailer (% of total)	6%	6%
Average Daily Traffic	16,446	20,950

1985 Hourly Traffic Distribution^a

6-7 a.m.	6.3%	6-7	5.3%
7-8	8.4%	7-8	4.2%
8-9	5.1%	8-9	3.3%
9-10	4.9%	9-10	3.2%
10-11	5.2%	10-11	1.5%
11-12	5.0%	11-12	2.0%
12-1 p.m.	5.5%	12-1 a.m.	1.4%
1-2	5.8%	1-2	.6%
2-3	6.4%	2-3	.6%
3-4	7.7%	3-4	.4%
4-5	7.9%	4-5	.5%
5-6	7.5%	5-6	1.4%

Longest Single Delay - 5 minutes

Total Delay per Day (1985 Traffic Volumes) - 72,189 seconds

Total Annual Social Cost^b (1980 Dollars) - \$61,240

Assumptions:	No. of Lanes	4 (two lanes each direction)
	Vehicle Speed	20 mph
	Time of Day each Train (1/day)	7-8 a.m. - 4-5 p.m.
	Length of Train	72 Cars (106 tn) 4 Engines
	Speed of Train	10 mph

^a Traffic survey, Harland Bartholomew and Associates, Inc., 1980^b Derived as total annual delay x minimum wage

Table 5.6-3 (Revision 1)

DELAY CALCULATIONS - EASTPORT ROAD

	<u>Existing Traffic^a</u>	<u>Projected 1985 Traffic</u>
Auto (% of total)	87%	85%
Single Unit Trucks (% of total)	4%	3.5%
Tractor Trailer (% of total)	9%	11.5%
Average Daily Traffic	7306	10,030

1985 Hourly Traffic Distribution^a

6-7 a.m.	6.4%	6-7	5.4%
7-8	8.0%	7-8	4.3%
8-9	5.5%	8-9	3.4%
9-10	5.3%	9-10	3.0%
10-11	5.0%	10-11	3.0%
11-12	5.7%	11-12	2.0%
12-1 p.m.	5.6%	12-1 a.m.	1.5%
1-2	5.8%	1-2	.8%
2-3	6.5%	2-3	.5%
3-4	8.2%	3-4	.6%
4-5	8.1%	4-5	.6%
5-6	7.0%	5-6	.9%

Longest Single Delay - 5 minutes

Total Delay per Day (1985 Traffic Volumes) - 32,424 seconds

Total Annual Social Cost^b (1980 Dollars) - \$31,040

Assumptions: No. of Lanes

2 lanes (one each
direction)

Vehicle Speed

20 mph

Time of Day each Train (1/day)

7-8 a.m. - 4-5 p.m.

Length of Train

72 Cars (106 tn) 4 Engines

Speed of Train

10 mph

^a Traffic survey, Harland Bartholomew and Associates, Inc., 1980^b Derived as total annual delay x minimum wage

Table 5.6-4

PRESENT LAND USE ACREAGE WITHIN 5-MILE RADIUS
OF PROPOSED SITE

<u>Land Usage</u>	<u>Approximate Number of Acres</u>	<u>Percentage of Total Land Area</u>
Cropland	167	0.3
Pasture	1271	2.5
Agriculture Sub Total	1438	2.8
Woodlands	13582	26.9
Commercial	69	0.1
Industry	1875	3.7
Institutional	35	0.1
Residential		
Single Family	5534	11.0
Multi-Family	118	0.2
Residential Subtotal	5652	11.2
Utility	208	0.4
Transportation	132	0.3
Wetlands	2861	5.6
Open Water	10570	21.0
Coastal	6784	13.4
Marine	611	1.2
Recreation	264	0.5
Historical Sites	120	0.2
Wet Woodlands	3104	6.1
Other	2961	6.9
Total	50,265	100

NOTE: Due to rounding error, percentages do not total to 100 percent

Source: Envirosphere Company surveys

Table 5.6-5

PROJECTED OPERATIONAL NOISE LEVELS DUE TO MAJOR COMPONENTS
OF 2-600 MW COAL-FIRED UNITS

<u>Component</u>	<u>Level dB(A)^a</u>	<u>@ Feet</u>	<u>Total Number of Units</u>	<u>Distance to Nearest Residence^b (feet)</u>	<u>Attenuated Level at Nearest Residence (dBA)</u>
Cooling Tower	76	50	2	3700	38
Forced Draft Fan	85	5	4	5200	31
Induced Draft Fan	85	5	8	5400	34
Primary Air Fan	85	5	4	5200	31
Turbine-Generator	95	5	2	5200	38
Main Transformer	85	5	4	4300	31
Aux. Transformer	85	5	4	4300	31
Rotary Coal Car Dumper	73	50	1	5700	32
Stacker-Reclaimer	75	50	1	6000	33

Total plant noise level projected to nearest residence = 44 dB(A)

^a Per Ebasco specifications and vendor information

^b See Figure 2.10-1

Table 5.6-6

PROJECTED OPERATIONAL NOISE LEVELS OF MAJOR COMPONENTS
OF BLOUNT ISLAND COAL HANDLING FACILITIES

<u>Component</u>	<u>Noise Level (dBA)</u>	<u>@ Feet</u>	<u>Total Number of Units</u>	<u>Combined Level at Near Field (dBA)</u>	<u>Attenuated Level at Nearest Residence^c (dBA)</u>
Ship Unloader	71 ^a	100	1	71	29
Stacker-Reclaimer	68 ^a	100	1	68	26
Bulldozer	80 ^b	50	2	83	41
Front End Loader	79 ^b	50	1	79	37

Total coal handling facility noise level projected to nearest residence = 43 dB(A)

a Actual measurements of units manufactured by Dravo

b USEPA, 1971

c Beacon Hills located 1.35 miles south (See Figure 2.10-1)

Table 5.6-7

PROJECTED IMPACTS ON THE VIEWSHEDS OF THE PROPOSED PLANT VICINITY

Direction	Key ^b	Area	Daily Average No. Viewers	Impact
East	A	Heckscher Drive at Browns Creek	16,136 ^c	The plant will be partially screened at various points, but due to the elevation and direction of the road as well as a distance of only 1.5 miles, the visual impact will be significant.
	B	Heckscher Drive at Cedar Point Creek	16,136	The plant will be in the distant background on the horizon at a viewing distance of about 4.5 miles. The visual impact will be minimal.
	C	Kingsley Plantation	100 ^d	The plant will be mostly screened at a viewing distance of 6.5 miles. The visual impact will be insignificant.
South	D	St. Johns River	e	The plant will be partially screened and views will be intermittent. Distance will be 1 to 2 miles. Other structures will be present in viewing area. Visual impact will be moderate.
	D	Residences along southern shores of Mills Cove and St. Johns River	e	The plant will be mostly screened at a viewing distance of about 4 miles. St. Regis plant to the west will have more of a visual impact on residences. Visual impact will be slight.
	F	Fort Caroline Road	e	The plant will only be visible for one interval at typical highway speeds and from a distance of 5 miles. Visual impact will be very minimal.
G		Fort Caroline Memorial	1,100 ^d	The plant will be visible in the background, but in the middle- and foreground will be transmission towers, water towers, and the Offshore Power Systems crane. Distance is about 5 miles. Visual impact will be minimal.
H		Residences on southern shores of St. Johns River and Dames Point Outoff	e	The view will be almost identical to the view from Fort Caroline Memorial
I		Heckscher Drive at Nichols Creek	16,136 ^c	The plant will be visible for one interval at a distance of 1 mile. The existing Northside Station will be in the foreground. Visual impact will be moderate.

Table 5.6-7 (Continued)

PROJECTED IMPACTS ON THE VIEWSHEDS OF THE PROPOSED PLANT VICINITY

Direction	^b Key	Area	Daily Average No. Viewers	Impact
West	J	Heckscher Drive at Dunn Creek	16,136 ^c	The plant will be intermittently visible at a viewing distance of 2.5 miles. Visual impact will be moderate.
North	K	Boney Road at Cedar Creek Road	e	The plant will be partially visible due to some screening by trees. The viewing distance is 2.5 miles. The area is basically open. Visual impact will be slight.

^a See Table 2.2-2 for description of viewshed.

^b See Figure 5.6-1 for locations.

^c Number of viewers based on projected 1985 average daily traffic.

^d Based on peak visitation according to the Jacksonville Area Planning Board (1979a).

^e No information available on these points.

Note: The clustering of the proposed plant with the existing Northside Station and a number of other industrial structures in the area will lessen the visual impact on the area.

Table 5.6-8

VIEWSHED AND PROJECTED IMPACTS - PROPOSED COAL UNLOADING FACILITIES

Direction	Key ^a	Area	Impact
East	1	Marshes and Heckscher Drive	The coal unloading facilities will be partially screened. The unloader will be in view, but the other industrial structures including the Offshore Power Systems crane, Northside Station, and transmission towers will be visible in the same view.
Southeast	2	Residences on southern shores at St. Johns River and Dames Point Cutoff	The coal unloading facilities will be partially screened. The other industrial structures such as the OPS crane, water towers and transmission towers will be more visible from this viewpoint.
South	3	St. Johns River (Dame Point Cutoff)	The coal unloading facilities will be in full view of anyone using the Dame Point Cutoff. The aesthetic impact will be moderate, however, due to the other industrial structures in the vicinity and the viewing distance which will be 2 or more miles.
	4	Fort Caroline Road	The coal unloading facilities will only be visible for one interval at typical highway speeds and from a viewing distance of over 2 miles. Thus, visual impact will be minimal.
	-	Fort Caroline Memorial	The coal unloading facilities will be 2 miles from this point and will be screened due to the terrain and slight bend in the river. Visual impact will be negligible.
Southwest	5	Residences along southern shores of Mills Cove and St. Johns River	The coal unloading facilities will be mostly screened from this point by trees on the north shore of Mill Cove. Only the unloader may be seen and its affect will be lessened by the other industrial structures. Viewing distance will be 2 miles.

Table 5.6-8 (Continued)

VIEWED AND PROJECTED IMPACTS - PROPOSED COAL UNLOADING FACILITIES

Direction	Key ^a	Area	Impact
North	-	Heckscher Drive at Browns Creek Bridge	The coal unloader may possibly be visible from this point which is 2 miles away. The industrial structures of the area will also be visible. The visual impact will be minimal.
West	-	Dames Point	The coal unloader will be visible at a viewing distance of 1.5 miles. However industrial structures of the area will be visible. The visual impact will be moderate.

^a See Figure 5.6-1

Table 5.6-9

PROJECTED IMMIGRANT OPERATIONAL WORK FORCE LEVELS FOR DUVAL COUNTY

<u>Year</u>	<u>Immigrant Workers</u>	<u>Total Population Effect^a</u>
1984	10	30
1985	42	120
1986	42	120
1987	56	160
1988	56	160
1989	56	160
1990	56	160

^a Includes immigrant workers and their families.

Source: Ebasco/Envirosphere Company (for further explanation, see Appendix H)

Table 5.6-10

Deleted in Revision 1

As a result of the addition of a treatment facility for coal pile runoff on Blount Island, this table is no longer applicable.

Table 5.6-11

Deleted in Revision 1

As a result of the addition of a treatment facility for coal pile runoff on Blount Island, this table is no longer applicable.

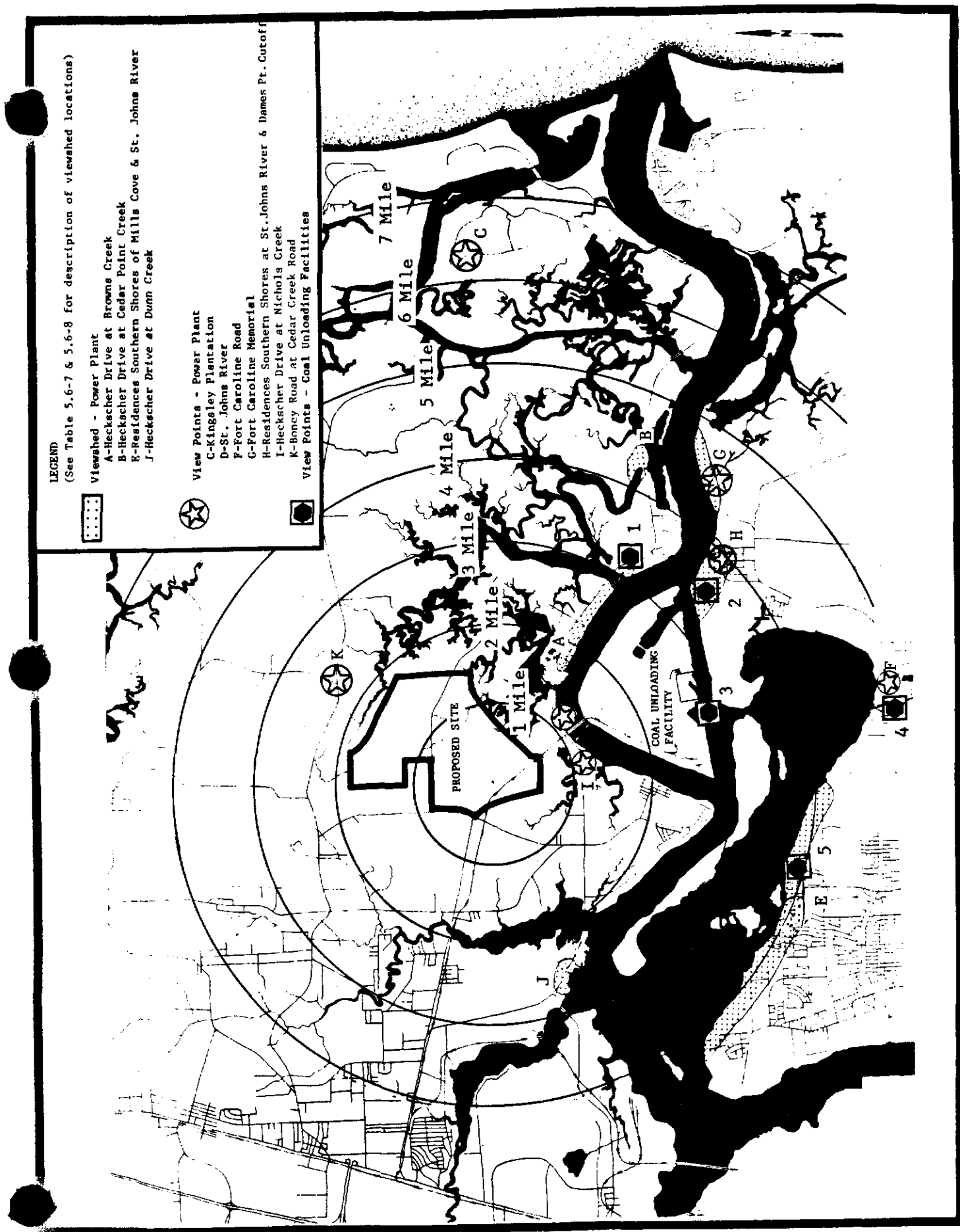
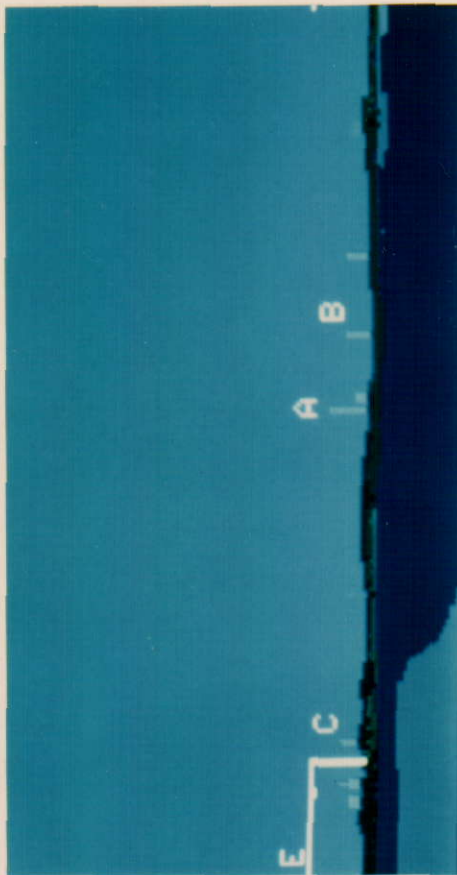


Figure 5.6-1 Viewshed and Point Locations

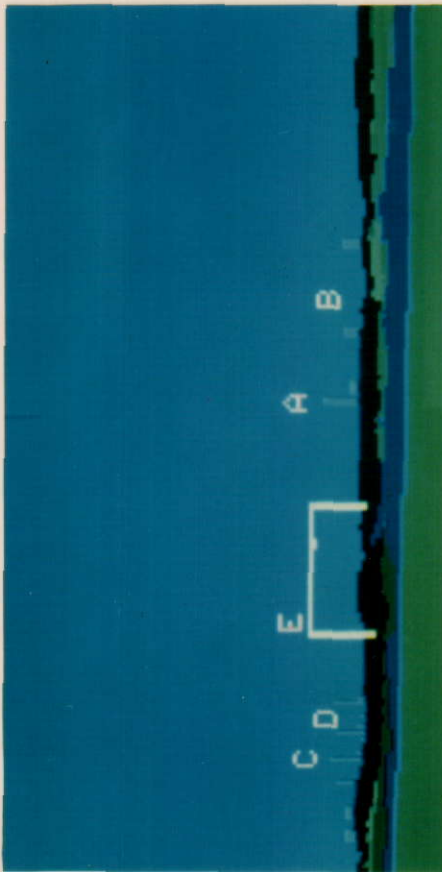
c - VIEW FROM KINGSLEY PLANTATION



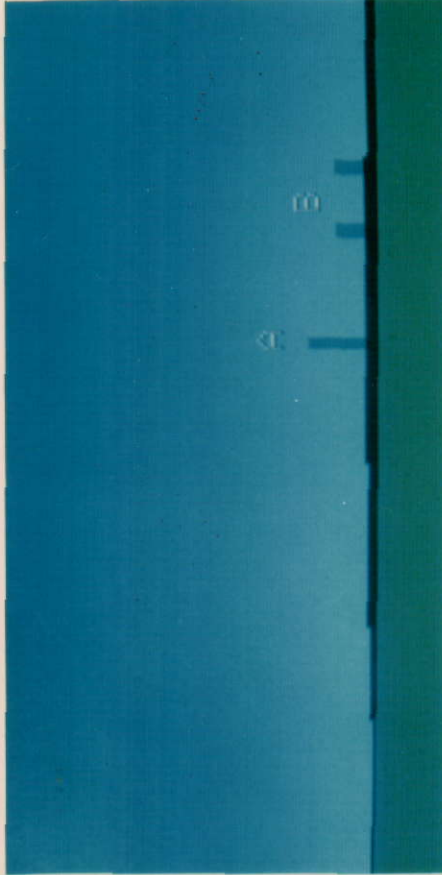
g - VIEW FROM FORT CAROLINE MEMORIAL



h - VIEW FROM RESIDENCES ON SHORES OF ST. JOHNS RIVER



k - VIEW FROM BONEY ROAD AT CEDAR CREEK ROAD



KEY:

- A = 640' PROPOSED PLANT STACK
- B = PROPOSED COOLING TOWERS
- C = 300' TRANSMISSION TOWERS
- D = 100' TRANSMISSION TOWERS
- E = OFFSHORE POWER SYSTEMS CRANE

NOTE: FOR DESCRIPTION OF LOCATIONS SEE TABLE 5.6-7
FOR LOCATIONS SEE FIGURE 5.6-1

5.7 RESOURCES COMMITTED

5.7.1 Lost Resources

Major commitments of resources resulting from operation of the proposed plant will include commitments of coal, oil, limestone and water. Based on estimated average annual coal consumption, the proposed plant is expected to consume 95.7 million tons of coal over its projected 40 year life. Consumption of fuel oil for initial light-off and low-load flame stabilization is expected to be 7.1 million gallons (approximately 169,000 barrels) over the life of the plant. Limestone consumption over the life of the plant will be approximately 8.6 million tons.

Consumptive uses of water will include condenser cooling, ash handling and FGD sludge handling evaporation. The St. Johns River will be the source of all but a small percent of this water which when evaporated will enter the hydrosphere system as vapor, ultimately returning to the surface and groundwater systems as precipitation. Consumptive water use is expected to average approximately 12,400 gpm or approximately 17.9 MGD over the life of the plant. This will represent only 0.6 percent of the 2909 MGD of surface water reported used in 1975 for power generation in the St. Johns River Water Management District (1977).

5.7.2 Changes in Species Population

5.7.2.1 Aquatic

Aquatic communities in the vicinity of the proposed plant will not incur significant adverse effects from thermal additions to the St. Johns River nor by entrainment or impingement effects. Although certain chemical substances will be discharged to the St. Johns River at levels greater than existing ambient concentrations, these levels will be rapidly diluted and are not anticipated to cause any significant losses to aquatic communities.

Maximum thermal loadings will occur in February (Section 5.1.2.1) when planktonic populations are low, thus, any potential adverse impacts would be minimized. Upon retirement of the NGS, thermal loading from the proposed plant alone will decrease from that associated with combined operation.

There should be no increased impingement associated with operation of the proposed plant in comparison to existing NGS impingement (Section 5.2.1.1). During combined operation, flow rates and velocities at the NGS travelling screens will be equal to the existing flow and velocities at the NGS. When operating alone, impingement by the proposed plant is expected to be 125,000 fish per year, the level predicted for the NGS operating in mode 4 (98,000 gpm). In all cases, however, mortalities should be minimized by the NGS fish return system.

Entrainment effects of the proposed plant, either operating alone or in conjunction with the NGS, will be negligible. Entrainment will be related directly to the volume of cooling water withdrawn from Blount Island Channel. Combined operation is expected to increase yearly ichthyoplankton entrainment mortality by approximately 0 to 9 percent in comparison to NGS operation alone (Section 5.2.1.2). When the NGS is not operating or decommissioned, entrainment mortality by the proposed plant is projected to be only 14 to 24 percent of the NGS present yearly entrainment mortality, representing only approximately 0.3 percent of the annual ichthyoplankton passing through the Blount Island Channel.

5.7.2.2 Terrestrial

The stack and cooling tower emissions associated with operation of the proposed plant are not expected to have a significant effect on flora and fauna either in the immediate vicinity or within the region of the proposed plant. Bird mortalities resulting from collisions with plant facilities will occasionally occur, but these will not have an effect on bird populations (Section 5.3.4.4).

plant. Bird mortalities resulting from collisions with plant facilities will occasionally occur, but these will not have an effect on bird populations (Section 5.3.4.4).

5.7.3 References

St. Johns River Water Management District, November, 1977. Water Resource Management Plan, Phase I. Palatka, Florida.

5.8 VARIANCES AND OTHER RELIEF

The proposed site will be in compliance with municipal, state and federal ordinances, standards and guidelines given certain variances for wastewater discharge.

5.8.1 Wastewater Discharge

Surface water quality data collected from November, 1979 to October, 1980 indicate that certain substances are present in the St. Johns River in concentrations higher than the allowable water quality criteria established in the FAC (Chapter 17, Sections 3.051, 3.061, and 3.121). These substances include aluminum, copper, cyanide, iron, mercury, oil and grease, silver, total coliform, and total residual chlorine. The concentrations measured in some cases, such as total residual chlorine, actually may be within the allowable water quality standards, but have been reported in excess because of the limitations of the analytical methodologies utilized.

Operation of the proposed plant may add small quantities of some of these parameters plus selenium to the river water. The evaporative process in the cooling towers will further increase the existing levels of these parameters prior to discharge into the river. Variances from Class III water quality standards will be necessary, therefore, for the following parameters: aluminum, copper, iron, mercury, cyanide, oil and grease, silver, and total residual chlorine. Maximum observed concentrations of these eight substances exceeded their respective Class III water quality criteria. Although observed ambient levels of total coliform bacteria exceeded the Class III water quality standards, operation of the proposed plant is expected to neither add to the ambient coliform levels nor concentrate these levels in the cooling towers.

Since the processes that will contribute to violations of water quality standards are integral parts of the total operation of the plant, the variances or other relief will be required for the life of the plant.

Additional variances from water quality standards will be required as allowed under FAC Chapter 17-4.244 for the dredging activity necessary to construct the proposed coal unloading facility associated with the proposed plant. Data obtained during the year long monitoring program and during an elutriate test on sediments obtained in the proposed dredging area, indicate that ambient concentrations of aluminum, cadmium, copper, cyanide, iron, mercury, lead, and silver in the waters at the proposed dredging site have exceeded their respective water quality standards (see Appendix C, Tables C-30 through C-35). Water discharging from the dredged material disposal site may exceed water quality standards for these substances and for antimony and oil and grease as well, due to the concentrations of these substance in the river sediments. Variances requested for these constituents in the dredging and disposal areas will be required for the duration of the dredging activity, estimated to be twelve months. Subsequent variances to allow for maintenance dredging activities may also be required.

In addition to variances to Class III water quality criteria, variances to the discharge and resuspension of copper, cyanide and silver in concentrations exceeding their acute toxicity and 96 hr LC_{50} levels will also be required. These discharge limitations are contained in Sections 17-3.051(d) and 17-4.244(4), F.A.C. Acute toxicity and 96 hr LC_{50} levels relating to significant indigenous species are listed in Tables 5.1-14 and 5.1-15.

Chapter 6

Environmental Measurements and Monitoring Programs

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6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1 GENERAL

This chapter outlines the environmental programs which were implemented to gather background baseline information for use in the assessment of environmental impacts resulting from the site preparation, construction, and operation of the proposed facility. These programs have been previously submitted (draft, October, 1979; final, April, 1980) to the Florida Department of Environmental Regulation (FDER) and the United States Environmental Protection Agency (USEPA) and other appropriate agencies for review, comment, and approval through the Site Certification Application and Environmental Information Document (SCA/EID) Plan of Study (Envirosphere, 1980).

The environmental program related to the transmission corridor evaluation and selection has also received regulatory approval. This is presented in Chapter 9, Section 9.6.

The Jacksonville Electric Authority (JEA) also plans to monitor environmental effects after start of construction, and these plans are outlined in Section 6.3.

The presentation of the baseline and site preparation/construction environmental programs is organized in this chapter according to specific environmental factors.

A description of the operational monitoring program will be submitted to FDER, USEPA and other appropriate agencies between six months and one year prior to the plant start-up target date.

6.2 PRE-APPLICATION MONITORING

6.2.1 Sampling Techniques

In describing pre-application monitoring methods, it is important to include a description of the sampling techniques employed. Subsections 6.2.4 through 6.2.10 present these techniques according to specific environmental factors for which a monitoring program was initiated. Each program presented includes, where applicable, information concerning:

1. Program Design
2. Sampling Methodology
3. Laboratory Analyses
4. Quality Assurance

Through the SCA/EID Plan of Study, all techniques have been reviewed by the FDER and the USEPA - Region IV, and are consistent with their respective guidelines and/or regulations, and have been approved.

6.2.2 Use of Published Data

In addition to obtaining site specific information for use in the environmental assessment and in evaluating plant design alternatives, another source of information is published data. Subsections 6.2.4 through 6.2.10 include references to the published data consulted in the design of the pre-application monitoring programs.

6.2.3 Use of Reports Developed by the Applicant

Reports developed by the Applicant are additional sources of information for use in the environmental assessments. Subsections 6.2.4 through 6.2.10 indicate, as appropriate, where such reports have been utilized.

6.2.4 Surface Waters

6.2.4.1 Physical and Chemical Parameters

Program Design

One aspect of the surface water quality monitoring program was to provide hydrologic, hydrographic and water quality information for the St. Johns River and other significant water bodies located on, and in the vicinity of both the proposed plant and coal unloading facility sites. The data obtained from the field investigations were used to define the baseline conditions of the surface waters and to provide information required for the following:

1. design of plant water and wastewater systems,
2. analytical modelling of the proposed plant's aqueous discharge,
3. assessing plant compliance with applicable water quality standards, and
4. assessing plant impacts on the chemical, physical and biological components of affected surface waters.

Existing literature and historical data concerning surface water quality in the general site area were reviewed prior to implementing the site specific monitoring program. This information provided a general basis for design of the on-site program. Results of the on-site program are presented and compared with historical data in Chapter 2, Section 2.5. Methodologies and results of the analytical modelling of aqueous discharges from the proposed plant are discussed in Chapter 5, Section 5.1. The model used is discussed in Appendix C, Sections C.1 and C.6.

The hydrologic and hydrographic parameters measured relating to surface waters of the proposed site area were: current speed and direction, temperature, water levels, bathymetry, and thermal plume mapping. The data collection points are indicated in Figure 6.2-1.

Between November, 1979 and October, 1980, in situ measurements of current speed and direction, and water temperature were made at the indicated locations in the St. Johns River. Water level measurements were taken at the mouth of San Carlos Creek, and on two freshwater streams on the proposed site. In addition to the in situ measurements, two mapping surveys were conducted; one a bathymetry survey of the St. Johns River in the vicinity of the Northside Generating Station (NGS) intake/discharge and coal unloading facilities made in July, 1980, and the second, a thermal plume mapping of the heated discharge from the NGS made in September, 1980, from point of discharge to the point where the plume temperature became equivalent to the ambient temperature.

Over a 12 month period beginning in November, 1979, water samples from the St. Johns River and the discharge bay of the NGS were collected and analyzed on both monthly and quarterly bases for various water quality parameters, 47 for monthly and 50 for quarterly (see Tables 6.2-1 and 6.2-2). Sampling transects in the St. Johns River were located near the proposed plant intake as well as upstream and downstream of this intake (Figure 6.2-2). A total of 18 discrete sampling points were located on these transects. Sampling stations at all three transects were at 1/4, 1/2, and 3/4 distances from shore, and readings were taken at 1/4 and 3/4 of the river water column depth at each station (see Figure 6.2-3). In situ measurements (e.g., conductivity, pH) were taken at all points and chemical analyses were performed on samples collected at the ten designated points shown in Figure 6.2-2 (two depths at Stations F2, G1, G2, G3 and H2). These ten points were selected to provide an "envelope" of water quality information around the proposed intake and discharge.

In addition to the 12 month water quality sampling program, three supplemental water quality programs were conducted. One supplemental sampling program consisted of analyzing six water samples from wetlands and streams on and adjacent to the proposed site (Figure 6.2-4). Measurements were made in February, 1980 for cobalt, molybdenum, and ortho-phosphates, in addition to the 50 parameters indicated in Table 6.2-2.

In a second program, water, soil and sediment samples were collected at the locations shown in Figure 6.2-4, and analyzed for polychlorinated biphenyls (PCBs). These samples were collected in August and November, 1980.

The third supplemental sampling program was established to provide baseline data necessary to determine the impacts associated with dredging for the proposed coal unloading facility. This program consisted of elutriate testing in the proposed coal unloading facility area. Figure 6.2-5 indicates the locations of the samples collected in November, 1980. The supernatant from the elutriate tests and the associated dilution water were analyzed for the parameters listed in Table 6.2-3.

Sampling Methodology

Currents

In situ measurements of current speed and direction using Endeco Type 105 recording current meters were made at stations NB, PK, SCC, INT and BIS in the St. Johns River (Figure 6.2-1). Each meter had a half-hourly sampling frequency. Although with capabilities of up to 3 months continuous data collection, the meters were left in the water for only approximately 6 weeks at a time. Standard procedures used for deployment/retrieval and instrumentation checkout are discussed in Appendix C. Data reduction was performed by Environmental Devices Corp. with two printed copies and one magnetic tape as final output. Instrument accuracy is specified as ± 0.1 knots with 0.05 knot threshold for velocity and ± 7 degrees for direction. Each meter was moored to the river bottom as shown in Figure 6.2-6. The Endeco 105 tether design allowed free movement of the meter in both vertical and horizontal directions.

Temperature

In situ measurements were made with Endeco Type 109 Recording Thermographs at Stations NB, PK, BIS, BCB, DIS, SCC, and INT, as shown on Figure 6.2-1. At stations NB, PK and BIS, the thermographs were moored with the current meters as shown in Figure 6.2-6. Stations BCB, DIS, SCT and INT thermograph mooring configurations are shown in Figure 6.2-7. Data were collected on an hourly basis with deployment periods lasting approximately six weeks. Standard procedures used in deployment/retrieval and instrumentation checkout are discussed in Appendix C. Data reduction is performed in the same manner as described for the recording current meters. Instrument accuracy is specified as ± 0.2 degrees C.

Water Levels

Water level measurements were made at three locations (SCC, BB and CC, Figure 6.2-1) in the vicinity of the proposed site.

Water levels in the St. Johns River (location SCC) were measured with a Leupold & Stevens Digital Tide Gauge installed over a stilling well located near the mouth of San Carlos Creek. Half-hourly measurements were recorded on foil backed punch tape with instrument accuracy specified as ± 0.01 feet. Timing was controlled by a solid state clock. The data were retrieved twice, at six month intervals. The punched tape data were reduced through the use of a Leupold Stevens optical reading assembly which translated the punched tape into a LED display which was then keypunched onto cards for computer storage. The data were then stored on magnetic tape and a hard copy printed. From these data, tidal heights and ranges were determined.

Water level measurements were made for two freshwater streams on the proposed site during the period February through September, 1980. At Station BB (Figure 6.2-1), a standard V-notched weir was used in conjunction with the Leupold & Stevens Digital Tide Gauge and stilling

well. At Station CC, a 6-inch high sill was employed in conjunction with the water level recorder and stilling well. In both cases, flow determinations were calculated utilizing the change in height of the water and standard weir calculation figures.

Bathymetry

Bathymetric contour maps of the St. Johns River near the proposed site were created from over water measurements made during July, 1980. A Raytheon DE-719B Fathometer^R was used for depth measurements. A Motorola Mini-Ranger III System was used to provide positioning for the depth measurements, coupled with an on-board data acquisition system; consisting of a 9835B Hewlett Packard (HP) Computer, Analog to Digital Converter, Multiprogrammer and the Motorola MRS III. In addition, an HP flatbed plotter was used to track plot lines and facilitate positioning. Cross river track lines were run with longitudinal tie lines. Depth measurements were digitized to the nearest 0.5 feet.

Thermal Plume Mapping

Seven mapping surveys of the existing thermal plume at the NGS were performed. Two surveys were conducted at maximum flood tide, two at maximum ebb tide, and three at approximate slack tide. An on-board data acquisition system was used in conjunction with quick response thermistor probes towed through the water on a common line at 1, 2 and 3 meter levels. Temperature data, coupled with positioning provided by the Motorola Mini-Ranger III, were recorded on magnetic tape with a hard paper copy, and fix information was plotted during the survey on a flatbed plotter. Contour maps of the temperature distribution were created from the mapping survey. In situ temperature recorders were used as references. Accuracy of the positioning system is specified as ± 3 meters. Accuracy of the thermistors is specified as ± 0.25 degrees F.

Twelve Month Water Quality Program

Samples were collected in the St. Johns River (Figures 6.2-2 and 6.2-3) at monthly and quarterly intervals, with the quarterly analyses being the most comprehensive. A total of 50 parameters were measured quarterly and a subset of 47 parameters were measured monthly. Tables 6.2-1 and 6.2-2 list these parameters according to the following definitions for location and sample type:

Sample Set A - Discrete samples collected around high and low tides at 1/4 and 3/4 of total depth at mid-station on the upstream and downstream transects, and at all three stations for the center transect, totaling 10 samples for each tide phase.

Sample Set B - Samples collected as tide phase composites at the stations designated in the Sample Set A definition above, totaling 5 samples for each tide phase.

Sample Set C - Discrete field measurements taken at all sample points, totaling 18 samples for each tide phase.

The Sample Set B composite samples were prepared by combining water collected from the 1/4 and 3/4 depth points at the designated stations during each tide phase.

The Sample Set C parameters were measured in situ at all sampling stations using the following instruments:

pH - Orion Research portable specific ion meter, Model 407A/F.

Turbidity - HF Instruments, Limited, DRT-15 portable turbidimeter.

Dissolved oxygen - Yellow Springs Instruments, Inc. (YSI) D.O. meter, Model 57; D.O. probe, YSI Model 5740, 50 foot length.

Salinity, conductivity, temperature (S-C-T) - YSI S-C-T meter, Model 33 and YSI S-C-T probe, Model 331, 50 foot length.

Each meter was calibrated in the field at the beginning of each sampling session (before high and low tides), in accordance with their respective procedures manuals. Care was taken to air calibrate the dissolved oxygen (D.O.) meter with fresh water, rather than saline water, to avoid a significant error in measurement.

Water samples were collected and in situ field measurements were made each month by a team of three: an investigator, a sampler, and a recorder. The principal investigator calibrated the field equipment and performed the in situ measurements which the recorder registered on a standard data form, of which a copy is included in Appendix C. The principal sampler was responsible for collecting the water samples for chemical analysis.

In situ measurements were obtained with D.O. and S-C-T probes connected to the sample intake line lowered to the selected sampling depth. Sample water was pumped to the surface and discharged into the sample bottles. The intake and discharge lines were flushed before water samples were collected to remove all traces of water from the previous sampling location.

The sampler collected varying quantities of water, depending on which chemical analyses were to be done that month and whether the samples were discrete or composite. The bottles filled for these analyses were prepared in advance by the laboratory with the appropriate preservatives and were prelabeled with the date, sampling location, and tide stage. The water collected by the investigator was used to thoroughly rinse the pH electrode and to triple rinse and fill the pH beaker and turbidimeter cuvet. The results of these tests were recorded on the standard data sheet.

The activities described above were repeated by the sampler at all sampling points along the center transect and at the mid-point stations of the upstream and downstream transects. The investigator repeated his activities at every sampling location. The sampling sessions were completed during a period of approximately an hour and half before and after high and low tides. When all samples had been collected, they were promptly delivered to the laboratory, where an inventory record was completed and signed by both delivering and receiving parties.

Supplemental Water Quality Programs

Water, soil and sediment samples for Aroclor 1016 polychlorinated biphenyls (PCB) analysis were collected in August and November, 1980, during the pre-application monitoring period (Figure 6.2-4). The river water samples were collected from stations F2, H2 and G1 in the same manner as that used for grab composite samples in the 12-month program. At each station, 200 milliliters of water were collected at high tide, at both surface and bottom depths, and combined in bottles supplied by the analytical laboratory with an equal volume of water collected at low tide. The samples were refrigerated prior to delivery to the laboratory for PCB analysis (within 24 hours). These samples were taken in addition to the regular program and measurements of pH, conductivity, salinity and temperature were also made.

On-site stream water sampling (Figure 6.2-4) for PCB analysis consisted of grab samples collected in a beaker pre-rinsed with Freon 113 to remove residual oils, then triple rinsed with sample water. While each sample for chemical analysis was collected, the temperature and conductivity of the water were obtained and recorded. Also collected at this time were grab samples of stream bed sediments, which were placed in wide mouth glass jars with foil lined lids. These samples were analyzed in the laboratory for PCB concentrations and pH.

Soil samples were collected in the area of the proposed plant facilities (Figure 6.2-4) at the request of the Jacksonville Bio-Environmental Services Division (BESD). Six sampling locations on the site were selected by using a random sampling procedure. From the central point of each sampling location, four additional points were marked to the north, south, east and west in a 25 foot radius. Volume composite samples representative of the area were made by combining grab core samples from each of these five points. Prior to use at each location, the core sampler was cleaned and rinsed with Freon 113 to remove residual soil and oils. The sampler used was an 18-inch case hardened steel tube, plated with cadmium (Model 22-H, manufactured by Oakfield Appartus, Inc.). Similar to the sediment samples, the soils samples were analyzed for PCBs and pH by the laboratory.

Additional sediment samples were collected at two stations in the area of the proposed coal unloading facility (Figure 6.2-5), for the purpose of elutriate testing. These samples were collected in conjunction with a subsurface study performed in November, 1980. Sediment samples were collected in standard 2.5-inch outside diameter thin-wall Shelby Tubes, brought to the surface and transferred into a properly labeled polypropylene container. At both boreholes BI-4 and BI-6 (Figure 6.2-5), sediment was collected from approximately 3 feet below the mud-water interface.

The water samples necessary for the elutriate tests were taken above each sediment sampling location. Water samples were a composite of high and low tide (stage) at 1/4 and 3/4 depth of the water column. Collection, preservation and recording methodologies were the same as those described for the 12 month water quality monitoring program. The elutriate tests and the necessary water analyses were performed within one week after the

laboratory received the samples. Both the supernatant in the elutriate test and the composite river water were analyzed for the parameters listed in Table 6.2-3.

Laboratory Analyses

Two Jacksonville laboratories were contracted to perform the water quality and sediment analyses, PCB analyses and elutriate testing required during the surface water quality monitoring program. Branchemco, Inc. was responsible for the water chemistry analyses while Technical Services, Inc. was responsible for PCB analyses, sediment analyses and elutriate testing.

The water chemistry analyses were performed in accordance with USEPA approved laboratory techniques. Table 6.2-4 indicates the techniques employed and references the specific methods utilized for each parameter analyzed. Elutriate testing on the sediment samples was performed in accordance with a standard U.S. Corps of Engineers (COE) methodology (U.S. Corps of Engineers, 1976).

As indicated, samples were appropriately preserved and labelled in the field prior to shipment to the laboratories. A list of preservatives used and a detailed discussion of laboratory procedures from sample receipt to disposition is included in Appendix C, Section C.2. After completing each set of chemical analyses associated with the monthly, quarterly and supplemental sampling programs, the respective laboratories transmitted the results to EnviroSphere for data interpretation and analysis.

Quality Assurance

During all phases of the pre-operational surface water monitoring program, standard EnviroSphere procedures were followed for sampling methodology, instrument/equipment calibration, sample preparation and analysis, and data recording and tracking. Field activities were recorded on the appropriate field data sheets, as were equipment failures and

instrument calibrations. Forms used during data collection are included in Appendix C, Section C.2. Copies of the original data sheets were made as soon as practicable, then both were filed as appropriate.

The laboratories selected to perform the water quality chemical analyses were required to demonstrate certification by the State of Florida and use of analytical methods approved by USEPA. Although each laboratory follows internal quality assurance procedures, system reliability checks were made periodically through submission of replicate samples. In addition, a quality assurance check was made to measure the technique and performance of the water quality laboratory using control samples obtained from USEPA. Details of the quality assurance procedure used and its results are included in Appendix C, Section C.2.

6.2.4.2 Ecological Parameters

Program Design

The aquatic ecology pre-application monitoring program involved quantitative surveys of zooplankton, ichthyoplankton, nekton, and benthic macroinvertebrates in the vicinity of the proposed plant site from October, 1979 to September, 1980. These surveys were designed to document gross seasonal changes in species composition, abundance and spatial distribution within the study area. Qualitative surveys (habitat mapping, sediment characterizations and manatee watches) were conducted during this same time period to supplement the quantitative surveys.

In the spring and summer of 1980, surveys of nekton, ichthyoplankton and benthic macroinvertebrates were performed in the vicinity of the proposed coal unloading facility to establish baseline conditions for the associated dredge and fill operation. Objectives were to document species composition and abundance.

The aquatic ecology pre-application monitoring program was approved by the USEPA and FDER to meet most of the first year environmental surveillance requirements for the required two-year NPDES biomonitoring program at the NGS. The second year of the NPDES biomonitoring program will include a continuation of the quantitative surveys through the summer of 1981. In addition, the NPDES biomonitoring program includes Nichols Creek as part of the study area, but not the Fulton-Dame Point Cutoff. Other NPDES biomonitoring programs which are supplemental to pre-application monitoring involve a two-season study of phytoplankton primary productivity and a four season study of periphyton biomass and species composition.

Listed below are the aquatic areas (Figure 6.2-8) that were studied during pre-application monitoring and a brief explanation of their importance:

1. Three river zones in the Blount Island Channel of the St. Johns River; the ultimate cooling water source and receiving water body for the proposed plant.
2. Tidal creek zones in San Carlos and Browns Creeks; spawning, feeding and nursery areas for fish adjacent to the Blount Island Channel river zones.
3. Nontidal creek zones including the contiguous freshwater wetlands located on the proposed plant site and excluding Clapboard Creek.
4. Discharge basin of NGS; the immediate source of cooling water for the proposed plant.
5. One river zone in the Fulton-Dame Point Cutoff of the St. Johns River; the site for the proposed coal unloading facility.

6. The drainage ditch on Blount Island; a possible feeding, spawning and nursery area for fish, adjacent to the proposed coal unloading facility.
7. A brackish water pond on Blount Island adjacent to the proposed coal unloading facility.
8. Dunn Creek and Mill Cove; far field sites for comparison of benthic macroinvertebrates to the Blount Island Channel and tidal creek stations.

Figure 6.2-8 illustrates the grid-sampling scheme used for Blount Island Channel, San Carlos Creek, and Browns Creek. Each river zone (EP1, EP2 and EP3) was approximately one mile long and the width of the river. Zones were then subdivided into 12 grids and assigned a number from 1 through 12. Prior to each sampling date for benthic invertebrates, ichthyoplankton, fish trawling and zooplankton, a single grid was selected for sampling from each river zone. Grid selections were determined by selecting a random number (1 through 12) for each zone from a table of random numbers. San Carlos and Browns Creeks were subdivided into four quadrants. Grid numbering and selection methods were similar to those for the river zones. Creek grids were used for the benthic invertebrate program. Ichthyoplankton and zooplankton programs sampled areas equivalent to grids 1 through 3, and the nekton program used beach seines and gill nets to sample the fish population.

Sampling design and program intensity were selected on the basis of: (1) literature references on the design of biological surveys; (2) data available from the literature; and (3) perceived impacts from construction and operation of the proposed plant and coal unloading facility. Table 6.2-5 lists the frequency and duration of each sampling program.

Qualitative surveys (i.e., rare and endangered species, aquatic habitat mapping, sediment characterization) were conducted where descriptions in the available literature were ample and impact was

perceived to be minimal. These surveys were conducted during the season when the possibility of impact would be maximum; winter for the manatee and summer for the emergent and intertidal habitats. In areas of potentially greater impacts, intensive sampling programs were pursued. Zooplankton, benthic macroinvertebrates, and nekton exhibit seasonal variability in density and faunal composition and, therefore, were sampled quarterly. Ichthyoplankton were sampled frequently because spawning and utilization of estuarine nurseries is highly variable in both duration and seasonality among fishes. The greater frequency of ichthyoplankton sampling, particularly during winter and spring, reflects the protracted spawning periods and the temporal and spatial utilization of the estuary by different species of fish. Selected methods for the collection and processing of zooplankton, benthic macroinvertebrates and juvenile and adult fish are supported by Slack et al., 1973; Weber, 1973; Jacobs and Grant, 1978; and A.P.H.A., 1976. Ichthyoplankton methods were selected from Bowles, et al., 1978, 1978a and Bowles and Merriner, 1977.

Ichthyoplankton and Macrozooplankton

Sampling Methodology

Gear and sampling methodology were based on current scientifically accepted practices (Bowles and Merriner, 1977; Copeland, et al., 1976) and preliminary site-specific evaluations of alternative sampling techniques. Prior to sampling, a station in each of the three channel zones (Figure 6.2-8) was selected randomly. Because of the short length available for sampling, creeks were considered to consist of a single station. Entrainment samples were taken at single stations in the discharge basin of the NGS and the drainage easement adjacent to the proposed coal unloading facility on Blount Island.

Samples were taken at night using 360 micron mesh plankton nets mounted on 0.5 meter rings with center-mounted flowmeters. Replicate ten minute surface and bottom tows were made simultaneously in the direction of

the prevailing surface current in the channel and creeks. Incoming and outgoing tidal samples were collected. Ten minute tows allowed the filtering of approximately 100 m³ of water. Entrainment and Blount Island ditch samples were taken by positioning one pair of stationary nets at median depth and perpendicular to flow. Differential flow and low current velocities through culverts at the Blount Island ditch station precluded replicate samples. All samples were preserved in the field in 10 percent formalin and returned to the laboratory for processing.

Laboratory Analyses

Laboratory processing was performed in two phases, a Phase I analysis of larval fish, penaeid shrimp and portunid crabs (ichthyoplankton) and a Phase II analysis of crab zoea and megalops, non-penaeid shrimp and fish eggs (macrozooplankton). In Phase I, samples containing large numbers of fish larvae were subsampled using a Folsom plankton splitter. Split samples were initially passed through a U.S. Standard No. 10 seive to remove large organisms. The remainder was split into eighths, sixteenths, thirty-seconds, sixty-fourths, or one hundred and twenty-eighths. Randomly selected subsamples were picked. Samples containing much detritus received 2 mg/l of rose bengal to facilitate picking. Larval and post-larval fish, penaeid shrimp and portunid crabs were picked from each replicate, identified, enumerated and standard lengths determined for a maximum of 100 individuals of a single species per replicate. Lengths and total number of each species were recorded on data processing sheets. Following quality assurance processing, replicates, recombined replicates if split, were retained for Phase II (macrozooplankton analysis).

In Phase II, samples were rinsed in a U.S. Standard No. 200 seive and diluted to a known volume, e.g., 1,500 ml. The diluted sample was stirred in a figure 8 motion and a 10 ml aliquot removed with a Stempel pipette. The numbers of crab zoea and megalops, non-penaeid shrimp and fish eggs were recorded and the aliquot recombined with the diluted sample. A total

of four aliquots were taken in this manner. The fourth aliquot was retained for quality assurance. Macrozooplankton analysis was performed quarterly.

References used in identification of ichthyoplankton and macrozooplankton included Dahlberg, 1975; Walls, 1975; Hoese and Moore, 1977; U.S. Department of the Interior, 1978; Lippson and Moran, 1974; Miller and Jorgenson, 1973; Houde et al., 1970; Houde and Swinson, 1975; Gosner, 1971 and 1978; Williams, 1965; and Fable et al., 1978.

Quality Assurance

Data sheets and sample bottles were prepared for each station before each sampling episode. Data sheets included sample number, site, zone, subzone and station. Sample bottles were indelibly labeled externally and also carried an internal identifying label. Temperature, salinity, relevant field conditions and observations, and meter revolutions were recorded in the field. Following each tow, replicate surface meter readings were compared, as were bottom meter readings, and the sampling repeated if replicate readings differed by more than 20 percent. Samples from the site of the proposed coal unloading facility were not considered as replicates due to the varying amounts of water flowing through each culvert and net-mounted meters differing by more than 20 percent. Flowmeters were calibrated quarterly in a known flow.

As samples were processed, organisms were placed into externally and internally labeled vials. Additionally, a laboratory record was maintained of the replicate number, subsample number, and numbers of fish larvae, penaeid shrimp, and crabs. This record was retained in the data log book.

Ten percent, by volume, of every sample was repicked for quality assurance. If the number of larvae/post-larvae and shrimp exceeded 1 percent of the number already picked, the entire sample was submitted for

repicking. A reference collection was compiled from these samples and will be maintained in the Envirosphere laboratories through the licensing process.

Identification and enumeration of larval fish and shrimp was verified by randomly selecting one sample in ten and having a second taxonomist reidentify and enumerate the contents. Quality assurance relative to proper species identification was accomplished by Envirosphere Company taxonomists using the identification references cited above under the discussion of laboratory analyses.

The fourth aliquot retained from macrozooplankton determinations had the contents identified and enumerated by a taxonomist that originally did not perform the assay.

A log book was kept of the disposition and physical location of each sample. The log also listed the individual who performed identification and quality assurance procedures. A key to sample coding (labeling) was included in the log as well as within cabinets where samples were stored. Each cabinet contained a list of the samples stored.

Nekton

Sampling Methodology

The Blount Island Channel and its contiguous tidal creeks (excluding Clapboard Creek) were sampled with experimental gill nets. These nets were 125 feet long by 6 feet tall with five panels of consecutive stretched mesh sizes of one, two, three, four and five inches. Nets were set perpendicular to the shore within each zone and fished twice from dusk to dawn during each seasonal sampling period.

Trawling was conducted in the Blount Island Channel and the Fulton-Dame Point Outoff. The trawl was a 16-foot semi-balloon otter trawl with a 1-inch stretched mesh body and a 1/4-inch mesh cod end liner. This

was towed twice in each zone during each seasonal sampling period. Twenty-five minute tows were made with and against the prevailing surface current.

Seine samples were made in San Carlos Creek and Browns Creek and adjacent to the proposed Blount Island coal unloading site in the dredge spoil pond, freshwater pond and the spoil pond drainage ditch. All seine hauls were made at low tide. Sampling points are indicated on Figure 6.2-8. Exact sampling locations were dictated by site characteristics, i.e., depth and availability of suitable landing areas. Seine hauls covered a specified distance parallel to the beach or in a sweeping arc.

Figure 6.2-8 shows the two freshwater creeks on the proposed plant site. Fish populations of representative sections of each of the two creeks were sampled with the following fishing gear:

1. Electrofishing - Measured sections of each creek were blocked with 1/4-inch mesh nylon nets. Selected sections were electrofished with a direct current (Smith-Root Type III) backpack shocker, and the stunned aquatic life (fish and macroinvertebrates) were collected with dip nets.
2. On-site wetlands were sampled with trap nets. Trap nets were constructed of 1/4-inch mesh metal wire screen and consisted of a single 10-foot wing leading to a 4-foot square heart shaped pound with a 2-inch throat. Traps were set for two 24-hour periods during the spring and summer sampling periods.

Data sheets for each sample were prepared in the field, recording information relevant to field conditions and observations (e.g., conductivity, salinity, water temperature, time, location).

Laboratory Analyses

All fish collected during field sampling were tagged and preserved with ice or 10 percent formalin in the field and returned to the field laboratory for identification, enumeration, and length-weight determinations. Identifications were made by EnviroSphere fishery biologists. Adult and juvenile fish were identified to the lowest possible taxonomic level (species in most cases). Standard length and weight measurements were made of each individual fish collected, except when more than 100 individuals of a species were represented in a single sample. When this threshold was exceeded, a subsample (10 percent) was used for individual length and weight determinations.

References used in identification of nekton included Carr and Goin, 1959; Dahlberg, 1975; Eddy, 1969; Walls, 1975; Hoese and Moore, 1977; U.S. Department of the Interior, 1978; and Williams, 1965.

Quality Assurance

All samples were taken in a systematic, standardized and repeatable manner. Immediately after collection, all samples were placed in suitable containers and preserved. All containers were labeled internally and externally in the field with indelible markers. Data sheets were completed and maintained in data acquisition notebooks. After collection, all samples were taken to the laboratory for immediate processing or preserving in 10 percent buffered formalin for subsequent analyses. Species identification was made through the use of standard texts or from verified voucher specimens. Independent identifications by another EnviroSphere fishery biologist were made in the case of new and unfamiliar specimens. Representative specimens from field samples were retained in a reference collection, which will be maintained at the EnviroSphere laboratories throughout the licensing process.

Benthic Macroinvertebrates

Sampling Methodology

A station in each channel and tidal creek zone (Figure 6.2-8) was selected randomly before each sampling episode. Additional sampling sites in Dunn Creek and Mill Cove, as required by FDER, consisted of a single station at each location. The proposed coal unloading facility at Blount Island had a single station in the drainage ditch and single stations at 5 feet and 10 feet below mean low water in Fulton-Dame Point Cutoff. Only the dominant substrate of the study area, an organic mud, was sampled at each station. Sampling consisted of collecting three replicate sediment samples at each station using a Ponar grab sampler. The size of each replicate consisted of 20 grabs or 1.05 m². This sample size was necessary in order to assure that a sufficient number of large organisms, e.g., generally 100 or more organisms per sample, were collected to develop a representative data base. After collection, the sediment samples were washed on a U.S. Standard No. 30 sieve. Material retained by the sieve after washing was placed in labeled containers and narcotized for 8 to 14 hours with 5 percent magnesium sulfate (Gosner, 1971). After this treatment, the samples were preserved with 10 percent formalin.

Laboratory Analyses

Preserved samples were washed in a U.S. Standard No. 30 sieve, rehydrated, and benthic macroinvertebrates removed by hand picking. All organisms were placed in labeled sample vials with 90 percent ethanol. The remainder of the picked sample was returned to its original container and 10 percent formalin added. All organisms were identified to the lowest possible taxon and their numbers recorded on data processing sheets.

Quality Assurance

Samples were labeled with an indelible marker on the outside of the container. Data acquisition sheets were completed in standard format and maintained in a log. The hand picked samples were preserved and stained in 10 percent formalin containing 2 mg/l of rose bengal. Ten percent of a well mixed (picked) sample was removed and examined for organisms. If the number of organisms found was greater than 1 percent of the total number already picked, the sample was submitted for repicking. One randomly selected sample in ten had identification verified by outside experts. A reference collection containing each species of benthic macroinvertebrates was retained and will be maintained in the Envirosphere laboratories throughout the licensing process.

Zooplankton

Sampling Methodology

Gear selection and sampling methodology were based on current scientifically accepted practices presented in Jacobs and Grant (1978). A station in each of the three channel zones (Figure 6.2-8) was selected randomly before each sampling episode. Creeks were considered single stations because of their short lengths. All zooplankton collections were made in replicate using metered Wisconsin-style plankton nets constructed of 202 micron mesh netting, mounted on 0.5 meter rings. Nets were towed horizontally near the surface during daylight hours on incoming tides. Tows lasted 300 seconds (5 minutes) at speeds in excess of 0.5 feet per second.

At the end of each tow, the nets were retrieved, flowmeter readings recorded, and net sides washed to concentrate the collected material into the strainer buckets. All samples were preserved in the field with 5 percent buffered formalin.

Direction of tow, tidal stage, date, salinity, conductivity and temperature were field measurements made for each station.

Laboratory Analyses

Zooplankton samples were returned to the field laboratory for processing and identification. Each sample was placed in a large white pan and all macrozooplankton (i.e., shrimp, large amphipods and isopods, polychaetes) were removed, counted and placed in labeled vials with 4 percent buffered formalin. Large debris (i.e., plant material, paper, etc.) were discarded after carefully rinsing off any adhering zooplankton. Zooplankton samples were then concentrated through 202 micron mesh netting and split with a Folsom plankton splitter. All organisms were identified to the lowest practical taxon (i.e., genus and species, if possible), counted and recorded on laboratory bench sheets. Date, sample type, sample location, number of Folsom splits, and flowmeter revolutions were also recorded on these laboratory data sheets.

References and taxonomic keys used for the identification of zooplankton were Bowman, 1971; Hopkins, 1977; Newell and Newell, 1967; Owre and Foys, 1967; Wilson, 1932; and Grice, 1960.

Quality Assurance

At the end of each zooplankton tow, flowmeters were checked to see that their logged data were similar and above 3000 revolutions. Nets were visually examined for clogging (large numbers of ctenophores). Samples were retaken if clogging was suspected. Instruments required for in situ physical measurements were calibrated according to the manufacturer's instructions. Flowmeters were calibrated quarterly.

Reference collections of each sample and individual species will be retained by EnviroSphere during the licensing process. The following reference collection log was maintained:

1. Reproduced illustrations for each species identified.
2. Representative length of each species.
3. Taxonomic key, page number, and individual who described the organism's characteristics.

Organisms for the reference collection were submitted to a qualified taxonomist for confirmation of identification. Data from the laboratory bench sheets were transferred to computer coding sheets and checked against bench sheets. Data cards were then read into the computer and cards stored for later reference.

Rare and Endangered Species

Rare and endangered aquatic organisms observed on the site or in the site vicinity were noted. Observations were relayed to the field coordinator who kept a record of the date of the observation, number of organisms seen, type of organisms, time of day and location.

In addition to these general efforts, a specific program was developed for observing manatees. The manatee watch was conducted in the vicinity of major thermal discharges in the proposed site area (Figure 6.2-9). Thermal discharges at the NGS, Alton Box Company, Kennedy Generation Station, and Southside Generating Station were monitored. One-hour observations were made at each location once a week during the cold months (February through April) when manatees seek refuge in warmer water. During each watch, field observations were recorded noting physical water measurements, time of day, location, number of manatees and their size.

Aquatic Habitat Mapping and Characterization

Sampling Methodology

The aquatic habitat of the study area was mapped and characterized by zones. Sampling was performed to define the dominant sediment types within the proposed site area. Sediment samples were taken at evenly spaced locations (Figure 6.2-8) in each station of each zone using a Ponar grab sampler. Vegetation associations were characterized using aerial photography and ground truthed by field sampling. The type and boundaries of unique and transition zone areas between the aquatic and wetland communities were delineated using indicator species. Ground truthing involved field observations of species composition and relative abundance of dominant aquatic macrophytes in the on-site wetlands during the wet growing season. A data log was maintained on the floral species observed and collected, and the location(s) of their occurrence. Whole plants or cuttings of each species of aquatic vegetation were collected and returned to the laboratory.

Laboratory Analyses

Field collected sediment samples and aquatic vegetation cuttings were processed in the laboratory. Sediment samples were analyzed for percent (by volume) of shell, sand and fines by wet sieving. Sample location coordinates and the dominant substrate type were entered on a map of the study area as described in Folk, 1968. Aquatic vegetation were identified in the laboratory when field identifications were not possible. Results were integrated with data from wetland ecology, water quality and hydrographic monitoring programs.

Quality Assurance

Vegetation samples were dry pressed and will be retained in a reference collection at the Envirosphere laboratory throughout the licensing process. Species identification was performed using the quality assurance methods described in Section 6.2.10.2.

6.2.5 Groundwater

6.2.5.1 Program Design

The objective of the groundwater investigation was to describe the hydrogeologic framework of the proposed plant site as a basis for (1) plant design and (2) predicting potential impacts to the prevailing groundwater system likely to occur as the result of plant construction and operation. The investigation involved the collection of basic data and the conduct of controlled testing for the purpose of characterizing the existing hydrologic regime.

Where appropriate, selected analytical tools, including models, were used to describe existing groundwater conditions and to predict groundwater impacts. A description of the analytical methods, including use of models, is provided in Appendix D. Results of the groundwater investigation are presented in Chapter 2, Section 2.5.

Background Investigations

A review of published, open-file, and unpublished reports and maps provided the basic framework for the groundwater study. Field and office interviews were conducted with representatives of the U.S. Geological Survey (USGS), FDER, St. Johns River Water Management District (SJRWMD), Duval County Department of Health, BESD, and local drilling contractors for additional information on the regional and local hydrogeologic conditions. Records of wells and groundwater quality data contained in the USGS

WATSTORE system were accessed through the USGS district office in Jacksonville and through the western region office in Denver, Colorado. This information, along with information compiled in field interviews with the USGS and private well owners, formed the basis for a detailed well and groundwater quality inventory for the proposed site and vicinity (see Appendix D).

Preliminary Subsurface Investigations

Preliminary subsurface investigations were completed in January, 1980, and provided information on the physical, stratigraphic, and hydrologic conditions at the site (see Section 6.2.7). Eighty-three soil borings were made, to depths up to 150 feet. The subsurface investigations included collection of pertinent lithologic data, hydrologic data, information on rock and soil engineering properties, acquisition of disturbed and undisturbed samples, and conduct of constant-head, variable-discharge permeability tests in selected boreholes. Nine of the boreholes were completed as piezometers by installing two inch slotted pipe, or screen, and a gravel envelope adjacent to water-bearing intervals. Short-duration, constant discharge aquifer tests were conducted using these piezometers. Further information regarding the preliminary subsurface investigations can be found in Appendix D.

In July, 1980, 14 soils borings were completed in the vicinity of the proposed fly ash and flue gas desulfurization (FGD) waste disposal area north of Island Drive. These borings were all 25 feet deep. Piezometers were installed in seven of the borings, at the locations indicated on Figure 6.2-10. Two additional piezometers were also installed in the area south of Island Drive at this time (Figure 6.2-10). In November, 1980, nine additional piezometers were installed in the main power block area (Figure 6.2-10).

Groundwater Field Investigations

Based on the results of the background investigations and preliminary subsurface investigations, seven test wells, including one well completed in the Floridan aquifer, were drilled and tested for detailed assessment of site hydrogeologic conditions.

A single deep well (Well F-1) was drilled to a depth of 752 feet and completed in the uppermost water-bearing interval of the Floridan aquifer, since this is the interval most likely to be developed for the groundwater supply requirements of the proposed plant. The well was designed to accommodate a test pump large enough to produce 1000-1200 gallons per minute from the Floridan aquifer during hydrologic testing. The well was permitted and completed for use as a public water supply well. The location of the well is shown on Figure 6.2-10. A geologic log was kept during drilling, and geophysical logs (gamma, resistivity, and caliper) were obtained on the completed well. The geologic logs, geophysical logs and details of well construction are provided in Appendix D.

Six test wells were drilled to depths ranging from 21' to 90' at the northern edge of the proposed bottom ash disposal area, at locations shown in Figure 6.2-10. The wells were drilled by conventional, forward rotary methods using bentonite mud or water as a drilling fluid. Two wells (GW-1 and GW-6) were completed as open-hole in the limestone/shell/cemented sand aquifer (shallow-rock aquifer). Wells GW-3 and GW-4 were screened and gravel-packed in water-bearing sand between 11 and 21 feet, locally referred to as the "water-table" aquifer. Wells GW-2 and GW-5 were screened and gravel-packed in water-bearing sands occurring between the water table sands and the shallow-rock aquifer. For each pair of wells, one was completed as a pumping well, and one as an observation well. All wells were developed using compressed air until the produced water was essentially free of turbidity.

Geologic logs and well construction logs for wells GW-1 through GW-6 are reproduced in Appendix D. A gamma log and caliper log was obtained in well GW-6 and are also reproduced in Appendix D.

Constant rate aquifer tests were performed on shallow wells GW-1, GW-2 and GW-3 and Well F-1. A line-shaft turbine pump was installed and operated for a period of 22 hours in Well F-1. A three inch centrifugal pump was used for testing the shallow wells for periods ranging from one to six hours. Discharge was measured by means of an appropriately sized circular orifice, and was regulated and maintained with a gate valve located on the pump discharge. Water levels were measured with electric water level probes, a pressure recording instrument and/or water level (float) recorders for the duration of each test. More detailed information regarding the aquifer tests is given in Appendix D.

6.2.5.2 Sampling Methodology

Well Drilling

All test wells and piezometers were drilled by auger and/or rotary methods using forward circulation. Where possible, air and/or clear water was used as a drilling fluid to minimize formation damage. Unstable hole conditions occasionally required the use of a bentonite based drilling fluid. Well F-1 was drilled by forward rotary methods using bentonite mud to the top of the Ocala Formation. Drilling through the Ocala (Floridan aquifer) was accomplished with reverse-air circulation to minimize formation damage, insure complete development of the aquifer, and provide indication of well production with increasing penetration into the aquifer.

Formation samples were collected during the drilling process. Sampling during preliminary subsurface investigations included recovery of undisturbed samples. These samples were placed in appropriate containers and delivered to the soil laboratories of Law Engineering and Testing Company, Jacksonville, Florida for further analysis. Formation samples

were collected from the drilling fluid returns during drilling of well F-1 and test wells GW-1 through GW-6. These samples were placed in appropriate containers and shipped to the Bureau of Geology, in Tallahassee, for cataloging and storage.

Pertinent drilling and well performance data were recorded during construction of all wells. Drilling performance data included penetration rate, fluid circulation rate (qualitative), and water production (quantitative), where the wells were drilled by air rotary methods. Where possible, static water levels were measured at the start of each drilling period.

Water Level Measurements

Instrumentation for water level measurement included electric probes, wetted tapes, float recorders, pressure recorders, and piezometer tubes.

Monitoring of shallow groundwater levels in the nine piezometers south of Island Drive (Figure 6.2-10) drilled during preliminary site investigations has been conducted on an approximate monthly basis since January 1980. Monitoring of shallow groundwater levels in the seven piezometers north of Island Drive, the two additional piezometers south of Island Drive and three test wells (GW-2, GW-3 and GW-6) commenced with their construction in August 1980, and is continuing on a monthly basis. Monitoring of shallow groundwater levels in the nine additional piezometers constructed within the proposed rail loop in November, 1980 will also be conducted on an approximate monthly basis. Monitoring of static pressures of the Floridan well, F-1, commenced with the completion of the well in August 1980, and will continue on a quarterly basis. Summary descriptions of field investigations are included in Section 2.5.2. Detailed results of these investigations may be found in Appendix D.

Water Quality Sampling and Analysis

Selected piezometers and wells were sampled for analysis of background groundwater quality. Groundwater samples were obtained by pumping the equivalent of two casing volumes of water from the well/piezometer before sample collection.

Water samples were collected in bottles furnished by the testing laboratory, to which appropriate preservatives had been added, according to standard procedures, and delivered to the laboratory for analysis as soon as practicable after collection. Table 6.2-6 lists the physical and chemical parameters constituting the groundwater quality analysis. A second sample was collected at each sampling location for field water quality measurements. Field temperature, pH and conductivity were measured at the time of sample collection. Table D-2, Appendix D lists sample handling and preservation methods used in the investigation. All methods were in accordance with procedures specified by Standard Methods (1975) or the USEPA (1974).

Groundwater quality data obtained during the course of field investigations were supplemented by water quality records maintained by the North Landfill of the City of Jacksonville, and by the NGS. Summary descriptions of the results of water quality sampling and analysis are included in Section 2.5.2. Detailed results of these investigations may be found in Appendix D.

Other Field Information

Other information obtained during aquifer testing included data on tidal stages in the St. Johns River and barometric records obtained from Jacksonville International Airport Weather Service.

6.2.5.3 Laboratory Analyses

Groundwater quality analyses were performed by Technical Services, Inc., located in Jacksonville, Florida. Sample containers were furnished by the lab with preservatives added. Sampling instructions were also furnished for those parameters requiring special handling (e.g. Hydrogen Sulfide). Methods for handling of samples are described in Table D-2, Appendix D, as specified by Standard Methods (1975) or the U.S. Environmental Protection Agency (1974). Water was extracted from the well/piezometer with a centrifugal pump. Samples were collected after the equivalent of two casing volumes had been extracted, and all samples were transported to the lab within 24 hours of the time of collection.

A field log was maintained for all samples collected, including date, time, and location of sample collected and all field measurements.

6.2.5.4 Quality Assurance

Daily work summaries were completed at the conclusion of each working day. These included an account of all work performed, equipment failures (including duration of down time) and identification of anticipated problems in achieving project objectives. All field activities were documented on appropriate field data sheets as soon as practicable after the time of collection. Standardized procedures (Envirosphere, internal procedures documents) were followed for the conduct of aquifer tests and the acquisition of water level and water quality data.

A performance audit was conducted on the laboratory (Technical Services, Inc.) performing analytical services, in which the laboratory demonstrated as a minimum:

1. A working quality assurance plan,
2. Analytical methods and equipment consistent with standard methods, prescribed by the USEPA and other organizations,

3. State certification, if applicable, and
4. Systematic instrument calibration traceable to the National Bureau of Standards.

Reliability checks were made on laboratory analyses, including submission of replicate samples. Laboratory results were assessed by calculation of ion balances, and comparison of reported dissolved solids by sum of constituents with dissolved solids by evaporation.

Performance and equipment audits were conducted for the contractors selected for drilling and testing services (Layne-Atlantic Company, Savannah, Georgia, and Partridge Well Drilling Company, Orange Park, Florida). The contractors successfully demonstrated as a minimum:

1. Licensing within the state of Florida,
2. Technical knowledge of local conditions,
3. Successful execution of similar work,
4. Equipment having rated capability to perform the work, and
5. Backup and support equipment.

6.2.6 Air Quality/Meteorology

6.2.6.1 Program Design

The purpose of the preoperational air quality/meteorology monitoring program was to obtain sufficient background data such that, together with the data available from regional sources, a complete description of the baseline conditions could be developed. The baseline climatological parameters are used (1) in the design of the facility; (2) as input to the air quality dispersion modelling and; (3) in cases such as visibility and natural fogging, as a base against which project impacts can be measured. The baseline air quality parameters of interest include those regulated (pollutants for which standards exist) and unregulated (e.g., sulfates) pollutants that will be emitted by the plant or formed in the atmosphere as

a result of plant emissions. The baseline concentrations of these parameters are important in determining project compliance with air quality standards and in assessing overall project impacts. The description of baseline conditions that resulted from the baseline monitoring program is presented in Chapter 2, Sections 2.6 and 2.7 for meteorology and air quality, respectively.

Dispersion models were not used in the estimation of background air quality or meteorological conditions. However, a number of dispersion models were utilized in the estimation of project impacts. These models and their input data are described in Chapter 5, Sections 5.3.1 and 5.4.1 for the stack/fuel handling and cooling tower emissions, respectively, and in Appendix F. The methods used to determine project emissions are described in Chapter 3, Section 3.8.

Regional Data Sources

The regional climatological data presented in Section 2.6 were obtained primarily from a publication entitled "Local Climatological Data Annual Summary with Comparative Data, Jacksonville, Florida" (USDC, 1978). This publication contains summaries of hourly meteorological data collected by the National Weather Service at Jacksonville International Airport, which is located about 14 km west-northwest of the proposed plant at latitude 30° 30' north, longitude 81° 42' west. The ground elevation at the airport is 26 feet (MSL). The airport meteorological data are reasonably representative of on-site conditions; a comparison of airport and on-site data is contained in Chapter 2, Section 2.6.4.

Other meteorological data sources included a magnetic tape containing five years (1970-1974) of hourly surface observations from the Jacksonville International Airport and the same five years of twice daily radiosonde observations (upper air data) from Waycross, Georgia. Waycross, located approximately 120 km northwest of Jacksonville at an approximate elevation of 120 feet (MSL), is the nearest National Weather Service station where

radiosonde observations are currently obtained. This magnetic tape of meteorological data was supplied by the FDER and was used in the air quality dispersion modelling.

A different period of meteorological data was used in the cooling tower modelling because of the advantages in having the surface and radiosonde observations from the same location in this case. Therefore, a magnetic tape containing 1964-1968 surface data and 1964 upper air data for Jacksonville Imeson Airport was obtained from the National Climatic Center in Asheville, North Carolina. Jacksonville Imeson Airport is located 7.5 km west of the proposed plant at latitude $30^{\circ} 25'$ north, longitude $81^{\circ} 39'$ west. Its elevation is 25 feet (MSL). The weather station at Imeson Field was closed in 1971 and moved to the International Airport site.

The regional air quality data presented in Chapter 2, Section 2.7 was obtained from the FDER and BESD. The data were available for a variety of monitoring periods from a large number of locations in the Jacksonville area. The locations of the monitoring sites and parameters measured are depicted in Figure 6.2-11 in relation to the proposed plant and existing major emission sources.

Monitoring Site Selection

The determination of the location of a new monitoring station is generally based on such factors as existing emission sources, climatology, population areas, land use, and topography (USEPA, 1978). These criteria are used to ensure that the monitoring station is properly located in an area representative of the proposed plant site and/or the area of maximum predicted air quality impact due to the proposed source combined with other sources in the vicinity.

The results of dispersion analyses conducted in support of a Prevention of Significant Deterioration (PSD) application for the proposed plant (JEA, 1978), as well as dispersion modelling based on historical

SO₂ monitoring data conducted as part of the Florida Sulfur Oxides Study (Dames and Moore, 1978) were utilized to determine the general locations where the maximum plant related air quality impacts are expected to occur. The annual wind rose (Figure 6.2-12) was used to determine the expected frequency distribution of pollutant concentrations with respect to direction from the proposed plant. The locations of the existing official monitoring stations operated by the BESD (1978) were also considered in determining the areas for which additional monitoring was needed.

Based on this analysis and upon discussions with USEPA, FDER, and BESD, a site was selected for the on-site meteorology/air quality monitoring station. A detailed discussion of the site selection procedure as well as a description of the equipment and procedures utilized is presented in the monitoring plan (Envirosphere, 1979).

Monitoring Site Description

The air monitoring site was located 250 meters south of Cedar Point Road near the intersection of Boney Road in Section 31 of Range 28 east, Township 1 north at an elevation of approximately 10 feet (MSL). The UTM coordinates are 448.7 easting and 3369.4 northing. The monitoring site was 0.5 km north of the northern edge of the proposed plant site. Figure 6.2-13 shows the location of the monitoring station with respect to the proposed plant site and topographic features. There were no pollutant sources in the immediate site area (within 3 km). Figure 6.2-14 depicts the location of the trailer and meteorological tower with respect to the immediate surroundings. The locations are such that the monitoring probe siting criteria and meteorological monitoring guidelines (USEPA, 1978) were met.

Parameters/Sampling Duration and Frequency

Ambient air quality and meteorological monitoring began on December 10, 1979, and continued for one full year at the location described above. Table 6.2-7 presents a listing of the parameters monitored as well as the

sampling duration and frequency. Continuous monitoring for ozone was conducted for the period from April 1, 1980, to October 31, 1980, since ozone monitoring is required during the warm season only. Sampling for total suspended particulates was performed on a once every third day basis in coordination with the sampling schedule of the official (BESD) monitoring network. The schedule for analysis of the particulate filters for lead (which consisted of one month of data during the winter and then monthly from May through November) was agreed upon with BESD, who conducted the analyses.

6.2.6.2 Sampling Methodology

Monitoring methods and instrumentation utilized met USEPA reference or equivalent method requirements where applicable. The continuous monitoring equipment was housed in a heated/air-conditioned trailer. A data logger was used to record the output from the continuous monitors; strip chart recorders were used as back-up and for quality assurance purposes. Daily zero and span calibration cycles were automatically activated on continuous monitors with the use of a calibration controller. Wind speed and direction were measured from a 10-meter tower located near the trailer. Temperature, dewpoint and precipitation were also recorded.

Instrumentation

Table 6.2-8 presents a list of the equipment, the monitoring method, the reference or equivalence designation, and the age of the instruments. The calibration equipment, as well as the data acquisition/recording equipment are listed in Table 6.2-9. All equipment is state-of-the-art and meets the accuracy requirements of the PSD monitoring guidelines (USEPA, 1978). All air quality analyzers are designated reference or equivalent methods.

The hi-vol samplers were mounted on construction scaffolds, providing an inlet height of approximately 3 meters. Wind measurements were made at the 10-meter level. The glass air quality sampling manifold had an inlet at a height of 4 meters above ground level.

Operating Procedures

The monitoring station was operated by a trained technician stationed in the Jacksonville area. This technician visited the station a minimum of five days per week to perform system status checks, record the daily zero and span values to determine instrument control status, perform scheduled and unscheduled equipment maintenance and servicing, perform monthly calibrations and change hi-vol filters. The station was operated in accordance with a generic standard operating procedures and quality assurance manual (Envirosphere, 1979a), as well as a specific station operating and quality assurance procedures manual (Envirosphere, 1980a).

Data Handling and Reporting

Data from the continuous monitors at each location were collected by the data logger which converted the voltage signals to engineering units, produced hourly averages, and printed the results on paper tape and on a cassette tape. The data from the continuous monitors were also recorded on strip charts. These served as back-up for the data loggers and were used for quality assurance purposes.

Upon receipt of a cassette tape at the Envirosphere office, it was loaded onto Envirosphere's Burroughs 7700 computer system via a cassette tape reader. The data were then reblocked and reformatted and then printed for inspection. After manual data review, checking against the station's invalid data log, and computer checking of the data's continuity and reasonableness, the data were edited directly on a computer disk file. Once an edited disk file was developed, several data analysis and reporting programs were run to produce appropriate summaries of the data. The

general flow of the data processing and analysis programs is depicted in Figure 6.2-15. A discussion of these programs as well as the data handling and analysis procedures is contained in the specific station operating and quality assurance procedures manual (Envirosphere, 1980a).

Data have been submitted on a quarterly basis to the FDER and USEPA in the form of quarterly reports. These reports present the hourly and/or daily data as well as appropriate statistical summaries. The data collected and analyzed as described above are summarized in Chapter 2, Sections 2.6 and 2.7 of this document.

6.2.6.3 Laboratory Analyses

The majority of the monitoring program was conducted with continuous meteorological and air quality analyzers; hence, very little laboratory analysis was performed. However, the hi-vol filters were analyzed gravimetrically in Envirosphere's field laboratory using standard procedures described in the specific station operating and quality assurance procedures manual (Envirosphere, 1980a). Also, selected filters were analyzed for lead by the Jacksonville BESD using EPA approved procedures (Federal Register, 1978), and some filters were analyzed for trace elements by an independent laboratory, (Technical Services, Inc.), using standard procedures.

6.2.6.4 Quality Assurance

The operating status of all equipment was tracked with the use of station logs and control charts which were completed by the station operator and reviewed by the monitoring coordinator. Automatic calibration systems provided for daily zero and span checks for the continuous air quality equipment. The system operator verified that the automatic calibration systems were operating correctly and periodically conducted manual zero and span checks. Calibration of the hi-vol samplers and multipoint calibrations of the continuous air quality analyzers were

conducted once per month or more frequently, when (1) zero and span values indicated a significant change in instrument response, (2) after instrument repair, and (3) after replacement of major instrument components. The meteorological monitoring equipment was calibrated quarterly.

Quality assurance was performed in accordance with the generic standard operating procedures and quality assurance manual (Envirosphere, 1979a) and the specific station operating and quality assurance procedures for this monitoring program (Envirosphere, 1980a). These documents describe internal quality control procedures as well as data precision and accuracy calibration procedures. The quality assurance plan was specifically designed to meet the requirements of Appendix B of Part 58, Title 40 of the Code of Federal Regulations (USEPA, 1979). Quarterly quality assurance audits were performed by the Jacksonville Bio-Environmental Services Division, and their results reported to the USEPA (BESD; 1980, 1980a, 1980b, 1980c).

As part of the quality assurance program, a data assessment report was completed during each quarter of monitoring operation. This report, which formed a portion of the quarterly data report submitted to the USEPA and to DER, summarized the result of the air quality audits used to determine the accuracy of the air quality data and the results of the zero and span checks used to determine the precision of the air quality data.

6.2.7 Geology

6.2.7.1 Program Design

A two-phase geologic boring program was conducted to obtain information on the subsurface conditions of the proposed site, especially in the areas of the proposed plant structures. The geologic information derived from the field investigations will be used in (1) developing subsurface profiles of the proposed site; (2) verifying that foundation conditions for major plant structures are acceptable; and (3) preliminary engineering of the proposed plant.

The field investigation was developed by Ebasco Services Incorporated and was conducted in accordance with Ebasco Specification JEA 1165-C-001, "Subsurface Investigation - Drilling". Drilling and field testing was performed by Law Engineering Testing Company, Jacksonville, Florida, under the supervision and direction of Ebasco geotechnical personnel. The program consisted of:

1. recording of boring logs of drilling
2. field classification of materials
3. installation and monitoring of piezometers
4. selection of soil sampling locations and techniques
5. field classification of geologic strata
6. field testing to determine soil permeabilities
7. collecting samples for laboratory tests

Phase I of the boring program started on September 20, 1979, and was completed on October 19, 1979. Phase I consisted of 11 borings, DP-1 through DP-10 and DP-12 (DP-11 was not drilled due to access problems) (Figure 6.2-16). The borings were drilled to a depth of 150 feet on an approximate 2,000 foot grid across the site.

The information obtained from the Phase I boring program was used for an initial evaluation of the site subsurface conditions. Subsurface profiles were developed and zones of potentially compressible material were identified as well as the bearing stratum for deep foundations.

Phase II of the boring program was established following the development of the proposed plant layout. The program started on October 23, 1979 and was completed on January 29, 1980. Phase II was a more detailed program consisting of 43 borings (DP-100 through DP-142) drilled in the plant area and 44 borings (DA-1 through DA-44) drilled across the remainder of the proposed site (Figure 6.2-16). The plant layout was used to locate borings in the area of the proposed structures. The depths of the borings ranged from 50 to 150 feet depending on the anticipated loading of the proposed structures.

6.2.7.2 Sampling Methodology

Prior to any drilling, each boring was located and staked in the field by survey crews that provided the coordinates and ground elevations. The drilling equipment included three truck mounted drill rigs and one drill mounted on an all-terrain vehicle. The drill rigs used were CME55's and a Failing 1500. A dozer was required to provide access for the drilling rigs to the boring locations in the heavily wooded and wet areas.

All borings were made in accordance with ASTM Specification D1586. The test borings were advanced by drilling and washing to the top of the sample interval, driving the 18-inch standard split spoon sampler and again drilling and washing to the top of the next sample interval.

The standard penetration test (SPT) involves the use of a 2-inch O.D. split spoon sampler which is driven into the soil by a 140 pound weight free falling 30 inches. The split spoon sampler obtains a representative sample of soil for field identification and laboratory classification tests. It also provides a measure of the shear resistance of the soil to penetration by the sampler. Measurements were made to assure the proper hammer drop and to accurately monitor the movement of the split spoon sampler. In addition, the depth of the hole during drilling was cross-checked with the depth where the spoon would come to rest before performing the standard penetration test. Thus, it could be determined if material from the sides of the hole had caved in to the bottom which would give unreliable results. Standard penetration tests were performed at 2 foot 6-inch intervals for the first 10 feet of each boring and at 5 foot intervals for the remainder of the hole.

A thick bentonite slurry was used as the drilling fluid. The purpose of a drilling fluid is (1) to balance the differential hydrostatic head on the side and bottom of the bore hole due to groundwater (a condition which could cause collapse of the hole and damage to soils at the points of

sampling) and (2) to flush soil particles to the surface in suspension after they are loosened by the action of the bit. The drilling fluid was sufficiently thick to prevent its penetration into the soil during drilling.

Material removed from the split spoon sampler was logged and placed in jars. Jar samples were carefully sealed and labeled indicating the date, soil description, boring number, sample depth and blow count. The jars were then transported to the Law Engineering Laboratory for storage. Soil classification tests were performed on selected jar samples. A total of 1556 standard penetration tests were performed during the investigation.

Undisturbed samples of cohesive soil and loose cohesionless soil were obtained using a 3-inch thin walled tube sampler (shelby tube) in general accordance with ASTM Specification D1587. This sampling method is normally used exclusively for cohesive soils. However, by using care and special sampling techniques, good quality cohesionless samples were recovered. Every effort was made during transportation and storage of the sample to minimize disturbance prior to laboratory testing.

Piezometers were installed in selected borings to monitor the groundwater levels and measure soil permeabilities at the proposed site. The borings in which piezometers were installed were drilled with a special drilling fluid designed to lose its low permeability properties with time. The piezometers consisted of 2-inch diameter polyvinyl chloride (PVC) casings installed in the drilled bore hole. The lower 5 feet of each casing was slotted to allow groundwater to flow into the piezometer.

Clean water was used to flush the drilling fluid from the holes prior to the piezometer installation. With the PVC casing in place, a clean sand filter was placed around each PVC casing to a depth approximately 5 feet above the slotted section of casing. The remainder of each hole was grouted above the sand filter using a cement-bentonite grout. After completion of the installation, the piezometers were developed by pumping water from and into the PVC casings.

With the exception of the borings with piezometer installations, each boring hole was grouted for its full length using a cement-bentonite grout.

The following is the summary of the drilling and testing quantities performed during the site investigation:

Number of borings	83
Range of boring depth	50 to 150 feet
Total linear feet drilled	6967
Number of standard penetration tests	1556
Number of shelby tube samples	35
Number of piezometers installed	9

6.2.7.3 Laboratory Analyses

All laboratory tests were performed in accordance with the latest ASTM specifications. The testing was conducted on disturbed, undisturbed, and recompacted samples to determine the physical properties of the soils for strength evaluation. Grain size and Atterberg limits were performed to determine soil classification. Standard Proctor and Modified Proctor moisture-density tests were performed to develop physical compaction characteristics and for correlation with soil strength parameters. Laboratory permeability tests were performed to determine the permeability coefficient for the in situ sand and for comparison with field permeability measurements.

The laboratory tests were performed by Law Engineering Testing Company, Jacksonville, Florida, under the technical direction of Ebasco geotechnical personnel.

Classification Testing

Grain size distribution and Atterburg limit tests were performed on selected disturbed and undisturbed samples in accordance with ASTM Specification D422, D423, and D424. Various split spoon samples were

tested to verify the field classification and descriptions. Laboratory classification testing was also performed on undisturbed and remolded samples that were tested for strength and permeability.

Compaction tests were performed in accordance with the standard and modified Proctor compaction procedures. These tests were performed on the site sands in order to develop a moisture-density relationship for potential load bearing fill as well as general plant area fill.

Strength Testing

Two types of shear strength parameters (drained and undrained) were investigated for the materials. Drained shear strength is characteristic of the material under long-term static loading, wherein porewater pressure build-up during construction is dissipated. Undrained shear strength is exhibited by the material prior to complete porewater pressure dissipation from static construction loads during rapid watertable drawdown or during earthquake loading where porewater pressure is built up rapidly due to the frequent recurrence of seismic shocks.

Triaxial CIU (Isotropically Consolidated Undrained with pore pressure measurements) test specimens were trimmed from undisturbed shelly tube samples. Each test specimen was placed in the triaxial test apparatus and back pressured to insure saturation. After saturation, the specimen was isotropically consolidated to a constant confining pressure and then axially loaded to a shear failure. Typical confining pressures ranged from 1 KSF to 6 KSF. No drainage was permitted during loading; however, porewater pressure measurements were taken. The drained effective shear strength was then obtained by subtracting the imposed stresses carried by porewater for the total imposed stress. The effective stress is the stress carried directly by the soil matrix.

Triaxial CD (Consolidated Drained) test specimens were prepared, consolidated, and axially loaded in the same manner as the CIU specimen. With the CD test, however, the porewater was allowed to drain. The measured shear strength is, therefore, the effective stress for the long-term static condition. CD tests were performed on selected fine sand specimens with low silt or clay content.

For all triaxial shear tests, the magnitude of the confining pressure was chosen to simulate the anticipated field conditions. All soil samples were loaded by a constant rate of axial strain and the resulting stresses were recorded.

Plots of major and principal stress versus strain and pore pressure versus strain were made and the principal stresses for each specimen were plotted as Mohr's circles. The cohesion and angle of internal friction of each triaxial test were determined from the Mohr's envelopes.

Consolidation Test

Relatively undisturbed samples of sand and clayey soils were tested to determine their consolidation characteristics. A section of each sample was trimmed into a disc. The soil disc was confined in a stainless steel ring and subjected to incrementally increasing vertical loads and the resulting deformations were measured. The specimens were typically loaded up to 8 tons per square foot, incrementally unloaded, and then reloaded, incrementally, to 16 tons per square foot.

6.2.7.4 Quality Assurance

Quality assurance during all phases of the field investigation was maintained by (1) surveying all boring locations; (2) supervision of testing crews by qualified Ebasco geotechnical personnel; (3) performance of the testing in accordance with a detailed project specification

developed prior to testing; and (4) keeping detailed records of all field activities in boring logs of drilling. All field and laboratory testing was conducted in accordance with standard testing procedures.

6.2.8 Archeology

An initial evaluation of the archeological sensitivity of the project site was made by project archeologists in consultation with the archeological staff of the Florida State Historic Preservation Officer. This evaluation resulted in the definition of specific portions of the project area as sensitive or having a high probability of containing archeological resources. Sensitive areas included those where archeological sites had been previously reported. High probability areas included stream confluences, wetland margins, and elevated areas. These types of areas, in the St. John's River region, have been shown to have the greatest likelihood of containing prehistoric and historic archeological remains.

An archeological field survey of the site, implementing a research strategy based on the sensitivity analysis, was conducted. All sensitive and high probability areas were surveyed by placing systematic shovel tests at 50 meter intervals along the perimeters and ridges above creeks and wetlands. This work was supplemented by an inspection of all roads and trails on the site and the excavation of shovel tests at 50 meter intervals along four transects located parallel to Island Drive. A total of twelve archeological sites were identified and their boundaries defined by excavating additional shovel tests. A supplemental survey to evaluate the significance of each of these sites was conducted. Appendix J contains a detailed discussion of the archeological program and identification of the sites investigated for archeological significance.

A project archeologist also conducted a helicopter flyover of the proposed transmission line corridor and coal unloading facility site on Blount Island. The results of this flyover and an analysis of topographic

maps were then discussed with the staff of the State Historic Preservation Officer. Three small areas within the transmission line corridor were defined as archeologically sensitive on the basis of physiographic characteristics. A field survey will be made within these areas if included in the final right-of-way. The proposed coal unloading facility site on Blount Island was determined by the staff to be unlikely to contain any archeological remains and was not to be investigated further.

6.2.9 Noise

6.2.9.1 Program Design

Noise surveys were conducted on and around the proposed site in order to determine the existing baseline noise levels. This information was used (1) to describe the area's present noise environment, based on existing noise standards or accepted guidelines; and (2) as the base upon which predicted noise levels from the proposed plant were superimposed to evaluate the effects of plant construction and operation.

The monitoring program was designed to include all nearby noise sensitive areas which may be affected by plant construction and operational activities, as well as all major sources of noise in the area. Monitoring at noise sensitive locations documents existing conditions and provides a base from which to determine the degree of impact at these locations. Monitoring at major sources of noise aids in understanding and describing the existing noise conditions in the entire area, including the noise sensitive areas.

All noise measurements were made on the dB(A) scale, which most closely duplicates the response of the human ear to sound levels. Statistical levels obtained were hourly L_{eq} , L_{10} , L_{50} and L_{90} levels and 24 hour L_{eq} and L_{DN} levels. These levels are defined as follows:

L_{eq} - Equivalent A-weighted sound level over a given time interval.

L_x - X-percent sound level, the A-weighted sound level equalled or exceeded X percentage of the time. Here X equals either 10, 50 or 90 percent.

L_{DN} - Day-night equivalent sound level, the 24 hour A-weighted equivalent sound level, with a 10 decibel penalty applied to nighttime levels.

The USEPA guideline document entitled "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety" (USEPA, 1974a), was the principle document used in designing the program and determining the acceptability of existing and predicted noise levels.

Two noise surveys were conducted in the vicinity of the proposed plant to establish the existing noise environment. The first was conducted in February, 1978, during the winter when insect activity is at a minimum, and the second in July and August, 1980, when such activity is at a maximum. It has been observed that insects cause the greatest seasonal variation in noise levels in sparsely populated, wooded areas similar to that which exists in and around much of the proposed site area.

The first survey was conducted at six different locations which represent the following types of land use or noise sensitive areas: (1) Station 1 - nearest community south of the proposed site; (2) Station 2 - in the woods on the north boundary of the proposed site; (3) Station 3 - nearest residence northwest of the proposed site; (4) Station 4 - nearest residence northeast of the proposed site; (5) Station 5 - nearest community east of the proposed site; and (6) Station 6 - at the NGS which is the largest stationary source of noise adjacent to the proposed site. Figure 6.2-17 depicts the locations of these monitoring stations.

During the second survey, three additional monitoring locations were added to describe the noise environment existing in the area which could be affected by the proposed coal unloading facility on Blount Island. These additional locations (Figure 6.2-17) include (1) Station 7 - on Blount Island at the location of the proposed facility; (2) Station 8 - west of the island at Dame Point which is the nearest community to the west; and (3) Station 9 - at Beacon Hills which is the nearest residential area to the southeast.

No noise sensitive land use, other than residential, exists on or near the proposed site. All individual residences and communities adjacent to the proposed site were taken into consideration in the nine monitoring locations described. Sources of noise in the area, other than the NGS, are diesel truck traffic on New Berlin Road and Heckscher Drive, and ship and other equipment servicing the port facility on Blount Island. These noise sources were monitored at Stations 2, 4, 7 and 8, respectively. The results of the survey are presented in Chapter 2, Section 2.10.1.

6.2.9.2 Sampling Methodology

Noise monitoring was conducted using a Metrosonics dB-602 Sound Level Analyzer and a General Radio 1945 Community Noise Analyzer. Both the Metrosonics dB-602 and the General Radio 1945 analyzers meet ANSI S1.4-1971 Type I precision sound level meter specifications. Both analyzers were calibrated before and after each 24-hour monitoring period using a Metrosonics Cl-301 or a General Radio 1562-A acoustical calibrator.

Monitoring was restricted to days when high winds and/or rain were not expected. High winds generate a loud popping sound in the microphone which is not representative of the noise environment and rain usually causes damage to the microphone or analyzer. Windspeed data was monitored continuously at the on-site meteorological/air quality station on Cedar Point Road and this record was used to invalidate data when windspeeds were greater than 12 mph during the noise monitoring program. At each

monitoring station, the microphone was mounted in a location at which the noise level was representative of the general area. That is, it was not located near obstructions, large reflecting surfaces, or near sources of noise not indicative of the total noise environment at the station.

The noise levels at monitoring stations 1 through 7 were monitored continuously for at least one 24-hour period during each survey using the Metrosonics dB-602 Analyzer. This analyzer, which monitors on the dB(A) scale in decibels, contains a microprocessor computer which automatically calculates and stores in memory hourly values of L_{eq} , L_{10} , L_{50} and L_{90} for each of the 24 hours.

Monitoring at stations 8 and 9 was conducted using the General Radio 1945 Community Noise Analyzer. It also was set to measure on the dB(A) scale and to produce L_{eq} , L_{10} , L_{50} and L_{90} levels. The only significant difference was in the computational period. Rather than computing hourly levels over a 24-hour period, three 8-hour levels were computed. The three 8-hour periods were 10 p.m. to 6 a.m. (nighttime), 6 a.m. to 2 p.m. (daytime), and 2 p.m. to 10 p.m. (afternoon and evening).

Neither analyzer provides a written record of data, but only outputs data via an LED readout. At the end of each 24-hour monitoring period, the operator read the display and recorded the values on standardized log forms which are presented in Appendix N.

6.2.9.3 Quality Assurance

Calibration of the noise monitors was conducted before and after each 24-hour monitoring period. The instrument response to the calibration tone was recorded on the data sheets. It should be noted that after a minor initial adjustment of each analyzer, no further adjustments were required during the program. That is, the calibration level never varied from the setpoint.

Quality assurance was performed on the entire data block. This operation consisted of scanning the data for (1) unusually high or low readings; (2) readings taken when windspeeds exceeded 12 mph; and (3) readings which were out of order statistically. Readings taken when windspeeds exceeded 12 mph were automatically voided. In addition, if a suspect reading deviated more than 5 dB from the prevailing trend for no apparent reason, it was voided. By definition, L_{90} is lower than L_{50} and L_{50} is lower than L_{10} , and statistically, L_{eq} is most always between L_{10} and L_{50} . Any time these conditions were not met, instrument malfunction was indicated and the data were voided. All field data is presented in Appendix N, and evaluated data in Chapter 2, Section 2.10.1.

6.2.10 Terrestrial Biota

6.2.10.1 Program Design

The terrestrial biota baseline environmental program was conducted to (1) characterize the terrestrial biota on and in the general vicinity of the proposed plant site, directly associated transmission line corridors, and coal unloading facility, and (2) provide a basis for the assessment of potential effects resulting from the construction and operation of these proposed facilities. The program consisted of a search of existing literature and field sampling. The objective of the literature search was to obtain varied types of ecological information characterizing the general region surrounding the proposed facilities. The objective of the field sampling program was to investigate the predominant floral and faunal communities of the proposed site, and coal unloading facility; and to document important botanical and zoological features, such as the presence of rare, threatened, or endangered biota. The transmission line corridor selection and evaluation involved specialized procedures, the specifics of which are detailed in Chapter 9, Section 9.6.

The ecological components investigated in the field sampling program included woody and herbaceous vegetation, small mammals, medium and large mammals, riparian species, waterfowl, other birds, reptiles, amphibians, and important species such as game, and rare or endangered species. The field sampling program focused upon the area encompassed by the proposed plant site boundaries, since disturbances from the proposed facility development would be concentrated within this area. The field studies conducted at the proposed site of the coal unloading facility were qualitative due to the high degree of disturbance, the low complexity of the existing floral communities, and the small area comprising the proposed site.

The sampling design employed in the field sampling program was based upon vegetation community or wildlife habitat as the sampling unit, and upon seasonal sampling (Table 6.2-10). The techniques employed are consistent with EPA and DER guidelines and have been approved by each agency as suitable for satisfying the objectives of the program (Envirosphere, 1980).

6.2.10.2 Flora

Sampling Methodology

The flora sampling methodology involved a number of sequentially conducted tasks. The initial task was the preparation of a vegetation community map followed by the establishment of sampling transects and the actual sampling technique. The final task is the preparation of species lists for the proposed plant site and coal unloading facility. Each of these tasks are discussed in detail in the following sections.

Vegetation Community Map

Color aerial photography (1:12,000 and 1:24,000 scale) was used to prepare a map of the vegetation types observed on the proposed plant site and the proposed coal unloading facility on Blount Island. Preliminary

boundaries were delineated from interpretation of the aerial photos. These boundaries were then ground truthed and finalized. It should be noted that vegetation communities have the tendency to blend or integrate with each other and often do not exhibit sharply defined borders. Therefore, some of the boundaries depicted may be arbitrary within areas of community overlap. The vegetation community maps for the proposed plant site and for Blount Island are presented in Chapter 2 of this document (Figures 2.9-1 and 2.9-2, respectively).

Establishment of Sampling Transects

On the basis of the aerial photography interpretation, nine vegetation community types were identified on the proposed plant site, including: pine flatwoods, grassy scrub, grassy scrub/pine flatwoods, hardwood swamp, hardwood hammock, bottomland hardwood, bayhead, cypress swamp, and salt marsh. Sampling transects were located in each community with the exception of the salt marsh, which was not considered to be a significant portion of the proposed site. Some of the transects cross the boundary between adjacent community types, sampling the vegetation of both.

Sampling transects were located within each of the communities selected for sampling in the following manner. The transect starting point was selected on the basis of accessibility, homogeneity of vegetation, protection from vandalism, and ease of relocating the point during subsequent sampling periods. Utilizing the appropriate aerial photo, the compass bearing of a line from the transect starting point through the main portion of the community being sampled was determined. This compass bearing was then used in delineating the transect in the field. The length of each transect was determined on the basis of the size of the community being sampled. The compass bearing, transect length, and other pertinent information are summarized by community type in Table 6.2-11. The location of each transect is depicted in Figure 6.2-18.

Quadrats were spaced along each transect line at specific sampling points. The distance between each sampling point (quadrat) was determined on the basis of the approximate size (as estimated from the aerial photographs) of the community being sampled. The first quadrat on each transect line was located approximately 25-50 meters from the transect starting point. The distance each quadrat was located from the starting point of the transect, as well as the spacing between quadrats, is summarized by community types in Table 6.2-11.

Quadrats were oriented on opposite sides of the transect with the first quadrat always placed to the right of the line, the second to the left, etc. Quadrat delineation was conducted once the sampling points were selected along the transect line. Using the sampling points as a reference, one 10-meter (m) x 10m quadrat and two 4m x 4m quadrats were delineated at each point. The 10m x 10m quadrat was oriented 90° to the compass bearing of the transect line with one side of the quadrat formed by the transect line. The two 4m x 4m quadrats were nested within the corners of the 10m x 10m quadrat using the corner formed by the sampling point (on the main transect line) and the corner directly opposite (Figure 6.2-19). The 10m x 10m and 4m x 4m quadrats were permanently located. Red flags were used to mark the corners of the 10m x 10m and blue flags to mark the corners of the 4m x 4m quadrats. One 0.5m x 1m quadrat was nested within each of the two 4m x 4m quadrats. The 0.5m x 1m quadrats were oriented such that their 1m dimension was parallel to and continuous with the main transect line. The number of 10m x 10m quadrats established along each transect varied for each community type sampled, and was based on the size of the community being sampled as well as the number of new species recorded with the addition of successive quadrats. The minimum number of quadrats utilized in any community type was two.

Five vegetation community types, salt marsh, Myrica shrub, Baccharis shrub, grassy scrub, and mixed hardwood were identified on Blount Island. No quantitative sampling were used on Blount Island due to the high degree

of disturbance and the low species diversity exhibited by these communities. A systematic search of these communities was substituted in lieu of quantitative sampling.

Vegetation Sampling Technique

Canopy level vegetation, designated as all species greater than 5 cm diameter breast height (dbh) and 2m in height, was recorded within each 10m x 10m quadrat. Shrub level vegetation, that equal to or greater than 1 cm dbh with a height of more than 50 cm but less than or equal to 2m, was recorded in the 4m x 4m quadrats. Herbaceous level vegetation, defined as that less than or equal to 50 cm in height, was sampled in the two 0.5m x 1m quadrats.

The species and dbh of each tree meeting the sampling criteria (greater than 5 cm dbh and 2m in height) was recorded. The overall height of the canopy was estimated by two field investigators and the average of the two estimates recorded. The species and percent cover of each plant meeting the criteria for a shrub level species was recorded from the 4m x 4m quadrats. Percent cover was estimated for each species encountered using cover class values based on the Braun-Blanquet scale (Mueller-Dombois and Ellenberg, 1974). The species and percent cover of each plant meeting the criteria of a herbaceous level species were recorded from the two 0.5m x 1m quadrats. Percent cover was estimated for each species using the cover class values based on the Braun-Blanquet scale.

Canopy level vegetation in the bayhead/hardwood swamp, hardwood hammock, cypress swamp/bayhead, and grassy scrub/pine flatwoods were sampled in December, 1979. Due to an adjustment in site boundaries, additional canopy level sampling was conducted in the hardwood swamp and cypress swamps in the northern portion of the site during April, 1980.

Shrub and herbaceous level vegetation were sampled in the bayhead/hardwood swamp, hardwood hammock, cypress swamp/bayhead, and grassy scrub/pine flatwoods in December, 1979; April, 1980; and June, 1980. The

shrub and herbaceous species in the hardwood swamp and cypress swamp in the northern portion of the site were not sampled in December, 1979, since they were not part of the site at that time. However, they were sampled in April and June, 1980. Each 10m x 10m quadrat was systematically searched for evidence of perturbation (air contaminants, insects, disease, fire, overgrazing and storm damage). Such evidence, if readily apparent, was noted.

Species List Preparation

A species list for the proposed site was compiled from the data collected from the sampling program and observations made during systematic searches conducted periodically. These searches consisted of driving all the roads and access routes to and through the proposed site with the intent of identifying species not recorded in the sampling quadrats. Species were recorded when observed with particular attention given to flowering specimens. Searches were conducted in December, 1979; April, 1980; June, 1980; and July, 1980.

The species list for Blount Island was compiled from observations made during the systematic searches conducted periodically. The systematic searches consisted of walking through each community type identified on the aerial photos and noting the species encountered. Searches were conducted in June and August, 1980.

Quality Assurance

Identification of unknown specimens was accomplished in three ways: (1) specimens were identified by the investigator prior to pressing; (2) specimens were identified by the investigator after pressing; and (3) specimens were sent to Dr. K. Miller (Jacksonville University) for identification. Identifications were verified by consulting the following references: Radford et al. (1968), Kurz and Godfrey (1962), Duncan (1975), U.S. Department of Agriculture (1971), Duncan and Foote (1975), and Cobb

(1963). The aid of a local taxonomic expert was also employed in verification of identifications in a number of ways. Two specimens of the same unknown were identified simultaneously by the Envirosphere principal investigator and the local expert, and the results compared. Unknown specimens, previously identified, were sent unlabeled to the local expert for an independent identification. Identified and labeled specimens were chosen at random from the voucher collection prepared by the principal investigator and sent to the local expert for review. The voucher collection will be kept in the Atlanta office of Envirosphere through the site certification process.

6.2.10.3 Fauna

Sampling Methodology

A qualitative approach was taken with all wildlife surveys with no attempt being made to estimate the size of animal populations. The literature on Florida wildlife provided information on relative abundances and was used to weigh the significance of the species present on the proposed plant and coal unloading sites. No trapping effort was conducted on Blount Island, the proposed coal unloading area. However, the island was visited numerous times to record the more conspicuous animals and search for biologically sensitive areas.

All information gathered during the course of the study was used to characterize the fauna of both proposed sites (see Section 2.9). The location of all sampling stations is shown in Figure 6.2-20.

Mammals

Due to the nocturnal and secretive nature of most mammalian species, sign (tracks, scat, etc.) was often used to indicate the presence of a species on the site. Small mammal traps were placed in a linear configuration of 40 traps spaced at 5 meter intervals. The trap lines were

operated for three consecutive nights giving a total of 120 trap nights (no. traps x no. of nights trapped) per habitat type per season trapped. Trapping during the fall sampling trip was conducted in four vegetative communities, while during the spring trip two additional lines (20 traps each) were monitored in the area of the site north of Island Drive.

Traps were checked each morning with appropriate measurements recorded for each animal before release. Several different guides were used to assist in identifying individuals and interpreting animal sign (Burt and Grossenheider, 1976; Blair, et al., 1968; Stevenson, 1976; Murie, 1974).

In an effort to discover nocturnal species not previously observed on the proposed plant site, two night surveys were conducted. Sportsmen in the area were also questioned for additional information.

Avifauna

Transects 200 meters long and ranging in width from 50 to 100 meters were used to survey the bird community. The center of the survey line coincided with the small mammal trap line in three communities and ran at right angles in a fourth. Bird transects were walked for three consecutive mornings during each of the four quarterly sampling trips. Sampling commenced at approximately sunrise each day and all birds observed or heard singing within the strip were recorded. The transects were walked at approximately the same rate and the order of sampling was rotated in an effort to avoid introducing a bias into the data. Birds flying through transects and birds not positively identified were not included in the counts.

During one sampling trip, a mist net was set up in the pine flatwoods community in an effort to identify some of the more secretive species using this habitat. The net was monitored for three days with captured birds being identified and banded. The salt marsh and the borrow pit (Figure

6.2-20) were visited regularly to determine their importance to local bird populations. During the normal course of driving on the site, species were recorded as encountered.

Aerial surveys were conducted in January and August of 1980. The winter flight was part of the Florida Game and Fresh Water Fish Commission's annual survey for nesting bald eagles (Haliaeetus leucocephalus). In conjunction with this effort, the proposed site and surrounding marsh were surveyed for active nests.

On the August aerial survey, several rookeries in the vicinity of the site were examined and the site was surveyed for additional nesting areas. An active rookery (Figure 6.2-20) was found just east of the northeast boundary of the proposed plant site and baseline data was gathered during June, July, and August of 1980. The rookery was divided into 16 equal pie shaped sections with alternating sections being surveyed for young birds and nests with eggs. Individuals and eggs were identified to species where possible and the information was used to estimate the total number of nesting birds and the relative abundance of the various species. Appropriate field guides (Bull and Farrano, 1977; Harrison, 1978; Peterson, 1947; Robbins, et al., 1966) were used as needed in identifying species.

Amphibians and Reptiles

Amphibians and reptiles were surveyed during each of the fall, winter, spring and summer sampling trips. Rocks, logs and various other kinds of debris were searched in all habitat types for herptiles. During the warmer spring and summer seasons, an effort was made to sample during the cooler late afternoon and early evening hours when the animals were more active.

Drift fences were used during the spring and summer sampling periods as well as during an additional trip to the site in June. Each fence was constructed with a 20-foot section of 10-inch, solid lawn edging material with a pitfall (2-5 gallon bucket) at each end. The fences were placed in

appropriate habitats across suspected natural corridors of movement. Logs and other materials were strategically placed around each bucket to provide additional avenues of approach. Herptiles were also sampled during the two night surveys. Individuals were identified using several field guides (Behler and King, 1979; Conant, 1975) and then released.

Quality Assurance

The sampling methodology conforms with that generally accepted as appropriate for accomplishing the stated objectives of the field program. Appropriate state and federal agencies were consulted to assure that they concurred with the sampling methods chosen. On two occasions, independent observers accompanied field personnel on sampling trips to assure compliance with the approved methodologies.

Standard field guides were used to identify all species encountered during the field effort. Each animal was independently identified by at least two biologists and when a consensus could not be reached, the species was not included in the data base. This did not ultimately result in the exclusion of any additional species from the site species list.

6.2.11 References

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Table 6.2-1

SURFACE WATER QUALITY MONTHLY MONITORING PROGRAM
PHYSICAL AND CHEMICAL PARAMETERS ANALYZED

Parameter	Sample Set		
	<u>A^a</u>	<u>B^b</u>	<u>C^c</u>
Alkalinity		X	
Ammonia		X	
Bicarbonate		X	
BOD-5		X	
Bromide			
Carbonate		X	
Chloride		X	
Chlorine, Total Residual		X	
Coliform, Fecal		X	
Coliform, Total		X	
Conductivity			X
Hardness, Total		X	
Nitrate		X	
Nitrite		X	
Nitrogen, Kjeldahl		X	
Oil and Grease		X	
Oxygen, Dissolved			X
pH			X
Phosphorus, Total		X	
Salinity			X
Silica, Dissolved		X	
Solids, Total Dissolved		X	
Solids, Total Suspended		X	
Sulfate		X	
Sulfide		X	
Temperature			X
Turbidity			X
Aluminum		X	
Antimony		X	
Arsenic		X	
Beryllium		X	
Boron		X	
Cadmium		X	
Calcium		X	
Chromium		X	
Copper		X	
Iron		X	
Lead		X	

Table 6.2-1 (Continued)

SURFACE WATER QUALITY MONTHLY MONITORING PROGRAM
PHYSICAL AND CHEMICAL PARAMETERS ANALYZED

Parameter	Sample Set		
	<u>A</u> ^a	<u>B</u> ^b	<u>C</u> ^c
Magnesium		X	
Manganese		X	
Mercury		X	
Nickel		X	
Potassium		X	
Selenium		X	
Silver		X	
Sodium		X	
Zinc		X	

- a Sample Set A. Discrete samples collected around high and low tides at 1/4 and 3/4 of total depth at mid-station on the upstream and downstream transects, and at all three stations for the center transect.
- b Sample Set B. Samples collected as tide phase composites at the stations designated in the Sample Set A definition above.
- c Sample Set C. Discrete field measurements taken at all sample points.

Table 6.2-2

SURFACE WATER QUALITY QUARTERLY MONITORING PROGRAM
PHYSICAL AND CHEMICAL PARAMETERS ANALYZED

Parameter	Sample Set		
	<u>A</u> ^a	<u>B</u> ^b	<u>C</u> ^c
Alkalinity	X	X	
Ammonia	X	X	
Bicarbonate	X	X	
BOD-5	X		
Bromide	X	X	
Carbonate	X	X	
Chloride	X	X	
Chlorine, Total Residual	X	X	
Coliform, Fecal	X	X	
Coliform, Total	X	X	
Conductivity	X		X
Cyanide	X		
Fluorides	X		
Hardness, Total	X	X	
Nitrate	X	X	
Nitrite	X	X	
Nitrogen, Kjeldahl	X	X	
Oil and Grease	X	X	
Oxygen, Dissolved	X		X
pH	X		X
Phenols	X		
Phosphorus, Total	X	X	
Salinity	X		X
Silica, Dissolved	X	X	
Solids, Total Dissolved	X	X	
Solids, Total Suspended	X	X	
Sulfate	X	X	
Sulfide	X	X	
Temperature	X		X
Turbidity	X		X
Aluminum	X		
Antimony	X		
Arsenic	X		
Beryllium	X		
Boron	X		
Cadmium	X		
Calcium	X	X	
Chromium	X		
Copper	X	X	
Iron	X	X	
Lead	X		

Table 6.2-2 (Continued)

SURFACE WATER QUALITY QUARTERLY MONITORING PROGRAM
PHYSICAL AND CHEMICAL PARAMETERS ANALYZED

Parameter	Sample Set		
	<u>A</u> ^a	<u>B</u> ^b	<u>C</u> ^c
Magnesium	X	X	
Manganese	X		
Mercury	X		
Nickel	X		
Potassium	X	X	
Selenium	X		
Silver	X		
Sodium	X	X	
Zinc	X		

- a Sample Set A. Discrete samples collected around high and low tides at 1/4 and 3/4 of total depth at mid-station on the upstream and downstream transects, and at all three stations for the center transect.
- b Sample Set B. Samples collected as tide phase composites at the stations designated in the Sample Set A definition above.
- c Sample Set C. Discrete field measurements taken at all sample points.

Table 6.2-3

PROPOSED COAL UNLOADING FACILITY DREDGE AREA
PHYSICAL AND CHEMICAL PARAMETERS ANALYZED

Background Water
and Elutriate Samples

Aluminum
Ammonia Nitrogen
Antimony
Arsenic
Beryllium
Cadmium
Chlorine, Total Residual
Chromium, Hexavalent
Chromium, Total
Coliform, Fecal
Coliform, Total
Conductivity
Copper
Cyanide
Fluorides
Iron
Lead
Manganese
Mercury
Nickel
Oil and Grease
Oxygen, Dissolved
pH
Phosphorus, Elemental
Polychlorinated Biphenyls
Salinity
Silver
Solids, Total Suspended
Turbidity
Zinc

Table 6.2-4 (Revision 1)

TECHNIQUES FOR CHEMICAL ANALYSIS OF WATER

Parameter	Technique	Reference
Bromide	Titrimetric (Phenylarsine oxide)	EPA Methods for Chemical Analysis of Water and Wastes (1979) #320.1
Fluoride	Ion selective electrode	Ibid., #340.2
Phenols	MBTH Spectrophotometric	Ibid., #420.3
Cyanide	Spectrophotometric	Ibid., #335.2
Antimony, total	AA, hydride	Ibid., #204.1; Analytical Methods for Atomic Absorptoin Spectrophotometry Perkin-Elmer, P.GN-4R
Arsenic, total	AA, hydride	Ibid., #206.3
Beryllium, total	AA, oxine/MIBK extraction	Ibid., #210.1; Std. Methods, #301 V
Cadmium, total	AA, APDC/MIBK extraction	Ibid., #213.1; Std. Methods, #301 III
Chromium, total	AA, oxidation-APDC/MIBK ex.	Ibid., #218.3
Chromium VI, total	AA, APDC/MIBK extraction	Ibid., #218.4
Lead, total	AA, APDC/MIBK extraction	Ibid., #239.1; Std. Methods, #301 III
Mercury, total	AA, cold vapor	Ibid., #245.1
Nickel	AA, APDC/MIBK extraction	Ibid., #249.1, Std. Methods, #301 III
Potassium	Atomic Emission	Std. Methods, 14th ed. #317A
Selenium	AA, hydride	Op. Cit, EPA, #270.3

Table 6.2-4 (Revision 1) (Continued)

TECHNIQUES FOR CHEMICAL ANALYSIS OF WATER

Parameter	Technique	Reference
Silver	AA, APDC/MIBK extraction	Op. Cit., EPA, #272.1; Std. Methods, #301 III
Sodium	Atomic Emission	Std. Methods, 14th ed. #320A
Zinc	AA, APDC/MIBK extraction	Op. Cit., EPA, #289.1
Total Dissolved Solids	Gravimetric	Methods for EPA, Chemical Analysis of Water and Wastes, #160.1 (1979)
Total Suspended Solids	Gravimetric	Ibid., #160.2
Total Hardness	EDTA titrimetric	Ibid., #130.2
Alkalinity	Titrimetric	Ibid., #310.1
Oil and Grease	Gravimetric, Sep. Funnel Extraction	Ibid., #413.1
BOD - 5	Dilution, Probe Measurement	Ibid., #405.1
Fecal Coliform	MP or MPN	EPA, Microbiological Methods for the Examination of Water and Wastes, pp. 124-134 (1978)
Total Coliform	MP or MPN	Ibid., pp. 108-123
Chlorine, Total Residual	DPD Spectrophotometric	EPA, Methods for Chemical Analysis of Water and Wastes, #330.5 (1979)
Total Phosphorus	Spectrophotometric, Ascorbic Acid Reduction	Ibid., #365.3
Kjeldahl, Nitrogen	Potentiometric, Ion Selective Electrode	Ibid., #351.4
Ammonia Nitrogen	Potentiometric, Ion Selective Electrode	Ibid., #350.3

Table 6.2-4 (Revision 1) (Continued)

TECHNIQUES FOR CHEMICAL ANALYSIS OF WATER

Parameter	Technique	Reference
Nitrate Nitrogen	Spectrophotometric, Cadmium Reduction	<u>Ibid.</u> , #353.3
Nitrite Nitrogen	Spectrophotometric	<u>Ibid.</u> , #354.1
Sulfate	Turbidimetric	<u>Ibid.</u> , #375.4
Chloride	Titrimetric, Mercuric Nitrite	<u>Ibid.</u> , #325.3
Carbonate	Nomographic Calculation	Standard Methods for the Examination of Water and Wastes Water, 14th ed. pp. 293-298 (1975)
Bicarbonate	Nomographic Calculation	<u>Ibid.</u> , pp. 293-298
Silica (dissolved)	Spectrophotometric	EPA, Methods for Chemical Analysis of Water and Wastes, #370.1 (1979)
Calcium	AA	<u>Ibid.</u> , #215.1
Magnesium	AA	<u>Ibid.</u> , #242.1
Copper, total	AA	<u>Ibid.</u> , #220.1
Iron, total	AA	<u>Ibid.</u> , #236.1

Notes:

- MF - Membrane Filter
- MPN - Most Probable Number
- AA - Atomic Absorption
- APDC - Ammonium pyrrolidine dithiocarbamate
- MIBK - Methyl isobutyl ketone
- MBTH - 3-Methyl-2-benzothiazolinone hydrazone
- EDTA - Ethylenediamine tetraacetate
- DPD - N,N-Diethyl-p-phenylenediamine

Table 6.2-5

PRE-APPLICATION BIOMONITORING PROGRAM AND NORTHSIDE NPDES BIOMONITORING PROGRAM

Community/Parameter	Method	No. Stations ^a	Replicates	Frequency	No. Episodes	Begin/End ^b
Phytoplankton Primary Productivity ^c	D.O. LB-DB	32	2	Every 3 mos.	2	May, 1980- Oct., 1980
Periphyton-Identification, Enumeration, Biomass ^c	Glass Slide	6	3	Every 3 mos.	4	Nov., 1979- Oct., 1980
Zooplankton-Identification and Enumeration ^d	0.5 Meter Wisconsin Net w/ 202 Micron Mesh	7	2	Every 3 mos.	8	Nov., 1979- Oct., 1981
Ichthyoplankton-Identification and Enumeration ^e	0.5 Meter Wisconsin Net w/ 363 Micron Mesh	7	2	Bimonthly-Winter Bimonthly-Spring Monthly-Summer Once-Fall	32	Nov., 1979- Oct., 1981
Benthic Macroinvertebrates-Identification and Enumeration ^f	Standard Ponar and No. 30 Mesh Sieve	8	3	Every 3 mos.	8	Nov., 1979- Oct., 1981
Fish/Nekton ^g	Otter Trawl - 16' Semi-Balloon	3	2	Every 3 mos.	8	Nov., 1979- Oct., 1981
	Gill Net - 5 Panel/25' x 6' each	6	2	Every 3 mos.	8	Nov., 1979- Oct., 1981
	Beach Seine - 1/4" Mesh	3	2	Every 3 mos.	8	Nov., 1979- Oct., 1981

^a Refer to Figure 6.2-8 for site locations.

^b Nichols Creek included as a sampling area beginning April, 1980 to satisfy the requirements of the Northside NPDES permit; second year required by the Northside NPDES. Northside discharge included as an ichthyoplankton and zooplankton sampling station beginning February, 1980 after selection of proposed site.

^c Phytoplankton primary productivity and periphyton surveys are requirements of the Northside NPDES permit and were not required for certification of the proposed plant.

^d Zooplankton - sampled in surface water on incoming tide during daylight hours.

^e Ichthyoplankton - sampled in surface water and bottom water on incoming and outgoing tide during night. Samples were also taken in man-made canal adjacent to proposed coal unloading site during May and August, 1980.

^f Benthos also sampled in the man-made canal adjacent to proposed coal unloading site and at 5 and 10 foot depths in the Fulton-Dame Point Outfall on May and August, 1980; in addition a qualitative inventory was performed in the canal.

^g Fish/nekton also sampled in the man-made canal adjacent to the coal unloading site using a beach seine and at 15, 15-30 and 30-45 foot depths in the Fulton-Dame Point Outfall using an otter trawl during May and August, 1980.

Table 6.2-6

LIST OF PHYSICAL AND CHEMICAL PARAMETERS
FOR GROUNDWATER QUALITY ANALYSIS

Inorganic Constituents

Ammonia (as NH_4)
 Calcium
 Chloride
 Fluoride
 Hardness (as CaCO_3)
 Hydrogen Sulfide
 Magnesium
 Nitrate (NO_3^-)
 Nitrite (NO_2^-)
 Phosphate
 Potassium
 Silica (colloidal and dissolved)
 Sodium
 Strontium
 Sulfate

Miscellaneous

Alkalinity (as CaCO_3)^a
 Alkalinity (as HCO_3)^a
 Color
 Conductivity^a
 Gross Alpha
 pH^a
 Temperature^a
 Total Dissolved Solids
 Total Suspended Solids
 Turbidity

^a Field and laboratory
 measurements

Organic Constituents

PCB
 Phenols
 Total Organic Carbon

Metals (total)

Aluminum
 Arsenic
 Barium
 Boron
 Cadmium
 Chromium (Hexavalent)
 Copper
 Iron
 Lead
 Manganese
 Mercury
 Molybdenum
 Nickel
 Selenium
 Silver
 Vanadium
 Zinc

Table 6.2-7

METEOROLOGICAL/AIR QUALITY PARAMETERS MONITORED

<u>Parameter</u>	<u>Duration</u>	<u>Sampling</u> <u>Frequency</u>
Wind Speed	1 year	Continuous
Wind Direction	1 year	Continuous
Temperature	1 year	Continuous
Dewpoint	1 year	Continuous
Precipitation	1 year	Daily/Weekend
Sulfur Dioxide	1 year	Continuous
Nitrogen Dioxide	1 year	Continuous
Carbon Monoxide	1 year	Continuous
Ozone	April-October	Continuous
Particulates	1 year	24 hours every 3rd day
Lead	January, May-Nov.	24 hours every 6th day
Trace Elements	1 year	24 hours once per month
Arsenic		
Asbestos		
Beryllium		
Cadmium		
Chloride		
Flouride		
Mercury		
Nitrate		
Selenium		
Sulfate		

Table 6.2-8

MAJOR MONITORING EQUIPMENT ITEMS

<u>Parameter</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Method</u>	<u>Ref. or Equiv. Desig.</u>	<u>Age</u>
Sulfur Dioxide	Monitor Labs	8850	Fluorescent	EQSA-0779-039	new
Nitrogen Oxides	Monitor Labs	8440	Chemiluminescent	RFNA-0677-021	new
Carbon Monoxide	Monitor Labs	8310	NDIR	RFCA-0979-041	new
Ozone	Dasibi	1003AH	UV Photometry	EQOA-0577-019	new
Suspended Particulates	General Metals	Hi-Vol	Gravimetric	N.A.	new
Wind Direction	Climet	012-10	Potentiometer	N.A.	5 yearsa
Wind Speed	Climet	011-1	Light Chopper	N.A.	5 yearsa
Temperature	Endevco	4473.2RTD	Platinum Resistance	N.A.	5 yearsa
Dewpoint	EG & G	110S-M	Chilled Mirror	N.A.	5 yearsa
Precipitation	Taylor	2701	Volumetric	N.A.	new
Wind Sigma	Climet	05-8016-2	Electronic	N.A.	5 yearsa

^a Never used.

Table 6.2-9
METEOROLOGICAL/AIR QUALITY CALIBRATION AND DATA ACQUISITION EQUIPMENT

Function	Manufacturer	Model	Method	Age
SO ₂ & NO _x Calibrator	Monitor Labs	8500	Permeation Devices for SO ₂ , NO ₂ No Dilution, Gas Phase Titration	new
CO Calibration	Monitor Labs	8310 w/ Calibrator	Dilution of CO Cylinder Gas	new
Ozone Calibration	Dasibi	1008PC	UV Ozone Generation	new
Data Logger	Monitor Labs	9300	A/D Conversion, cassette storage	new
Strip Charts	Esterline Angus	E1102R	Galvanometer	5 years ^a
	Esterline Angus	E1124E	Potentiometric	5 years ^a
	Leeds & Northrup	Speedomax M	Servo	new

^a Never used

SUMMARY OF TERRESTRIAL ECOLOGY SAMPLING PROGRAM

* - denotes quantitative samples
X - denotes qualitative samples
0 - denotes trapping or bird transect effort

* - denotes quantitative samples

X - denotes qualitative samples

0 - denotes trapping or bird transect effort

Table 6.2-11

SUMMARY OF SAMPLING TRANSECT CHARACTERISTICS

Transect Designation	Vegetation Community Type	Transect Compass Bearing (°)	Transect Length (m)	Number of Quadrats	Distance of First Quadrat From Transect Start (m)	Spacing Between Quadrats (m)
E1	Hardwood Swamp/Bayhead	110	350	4	50	100
E2	Grassy Scrub/Pine Flatwoods	90	475	4	25	150 ^a
E3	Hardwood Hammock/Bottomland Hardwood	90	250	5	50	50 ^a
E4	Cypress Swamp/Bayhead	300	100	2	50	50
E5	Hardwood Swamp	340	150	2	50	100
E6	Hardwood Swamp	0	250	3	50	100
E7	Cypress Swamp	70	150	3	50	50

^a Spacing not uniform due to use of substitute plots.

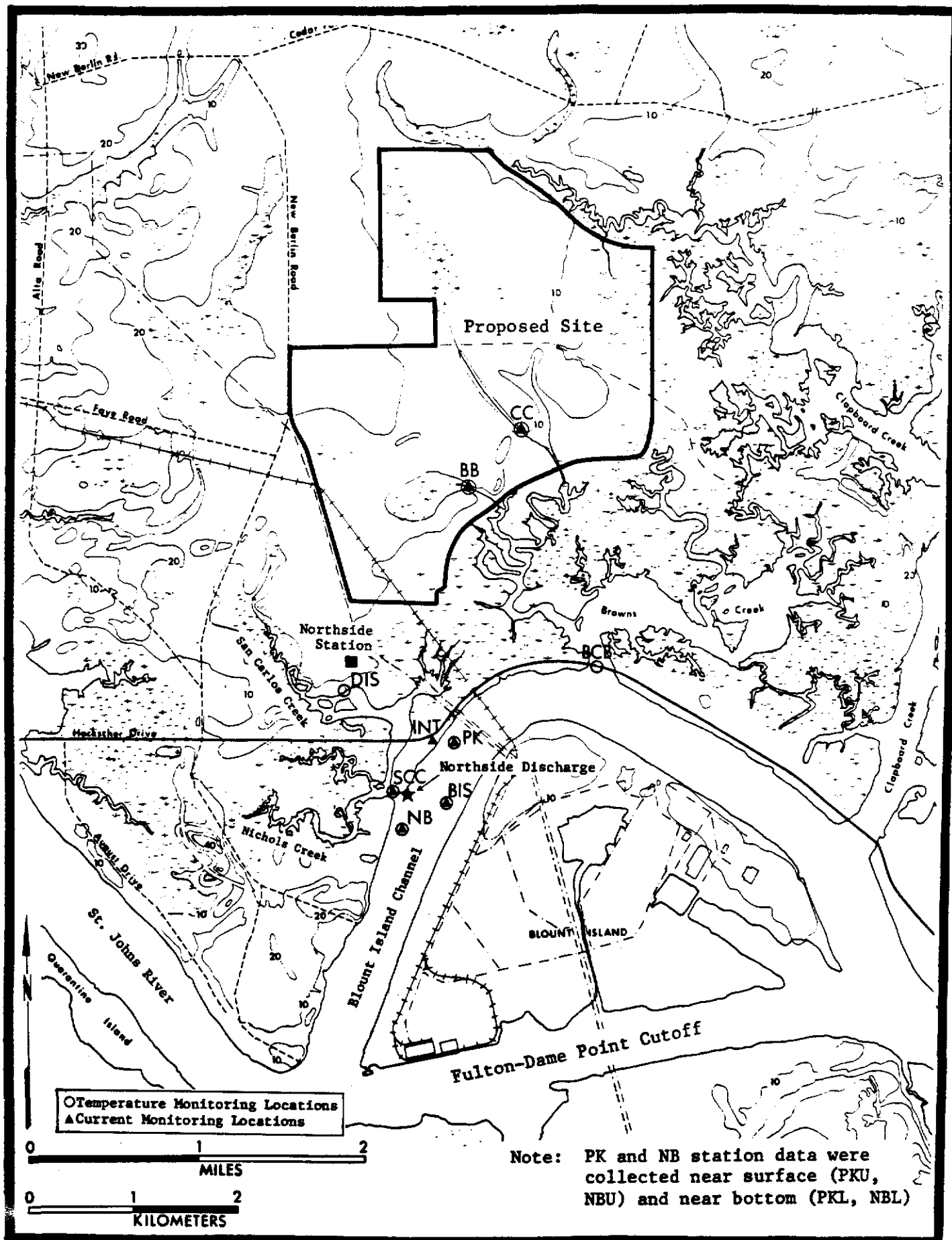


Figure 6.2-1 Hydrological Monitoring Sites in the St. Johns River

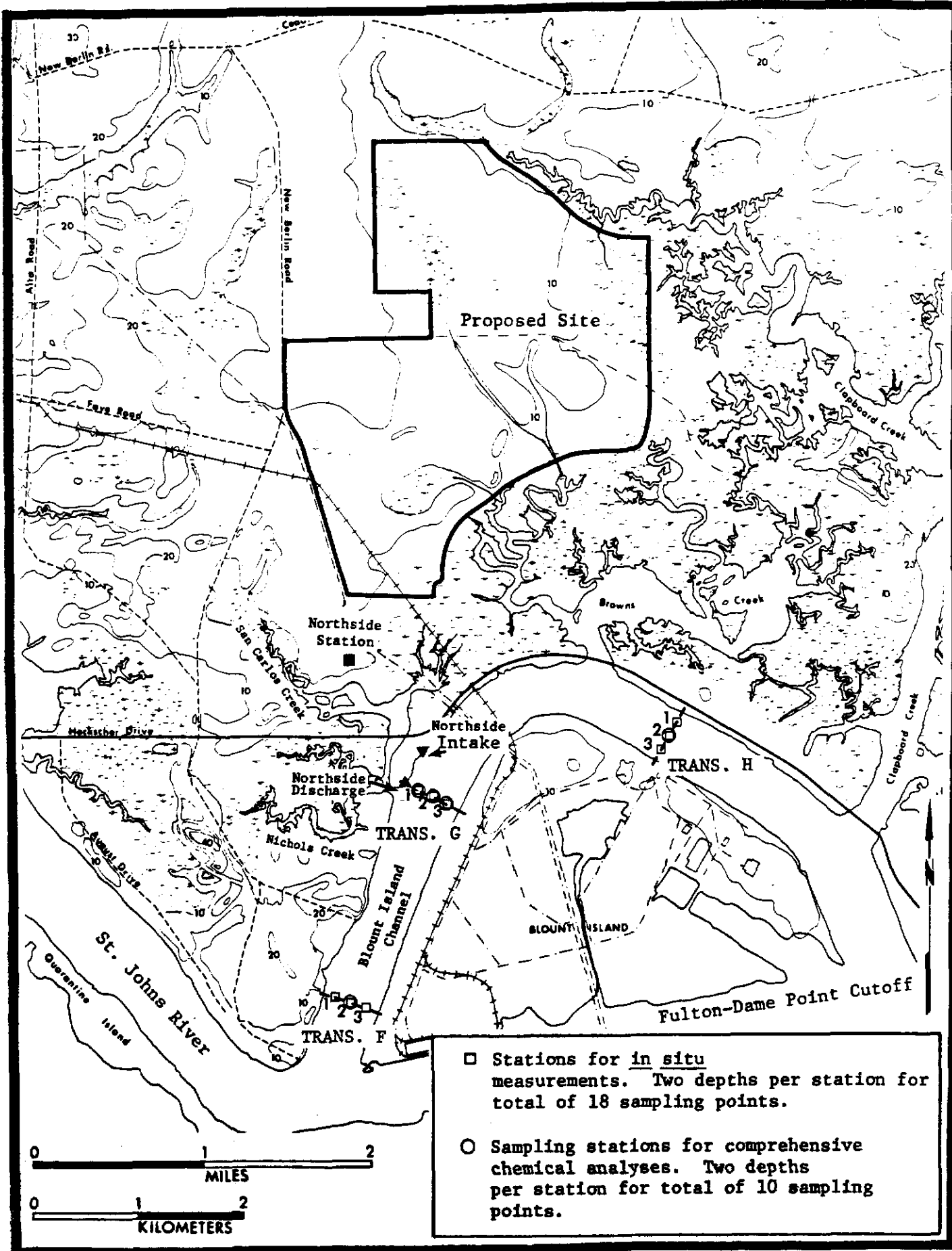


Figure 6.2-2

St. Johns River Water Quality Monitoring Locations

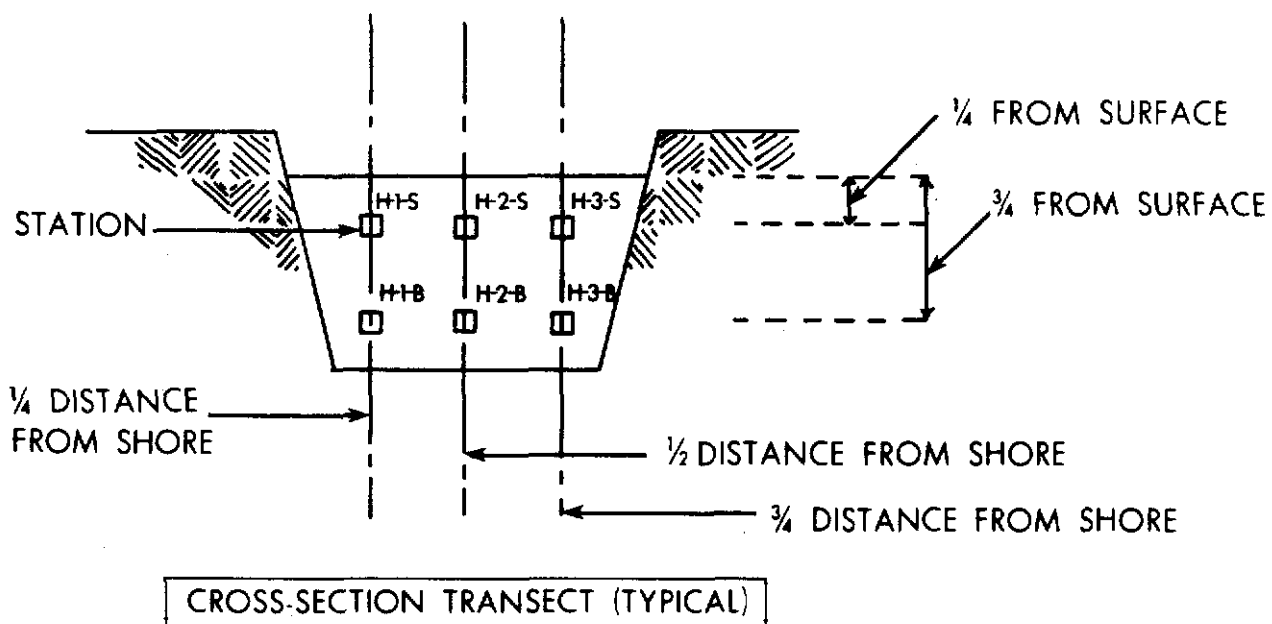
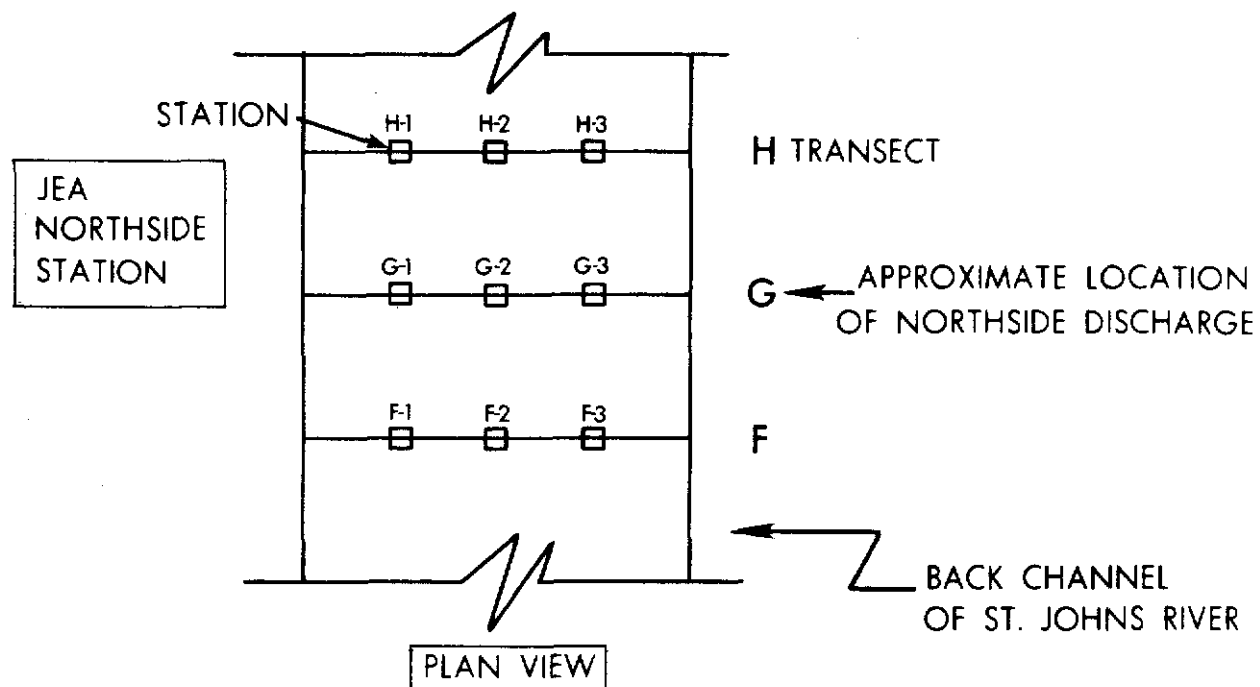


Figure 6.2-3 Plan View and Cross-Section of Water Quality Sampling Stations

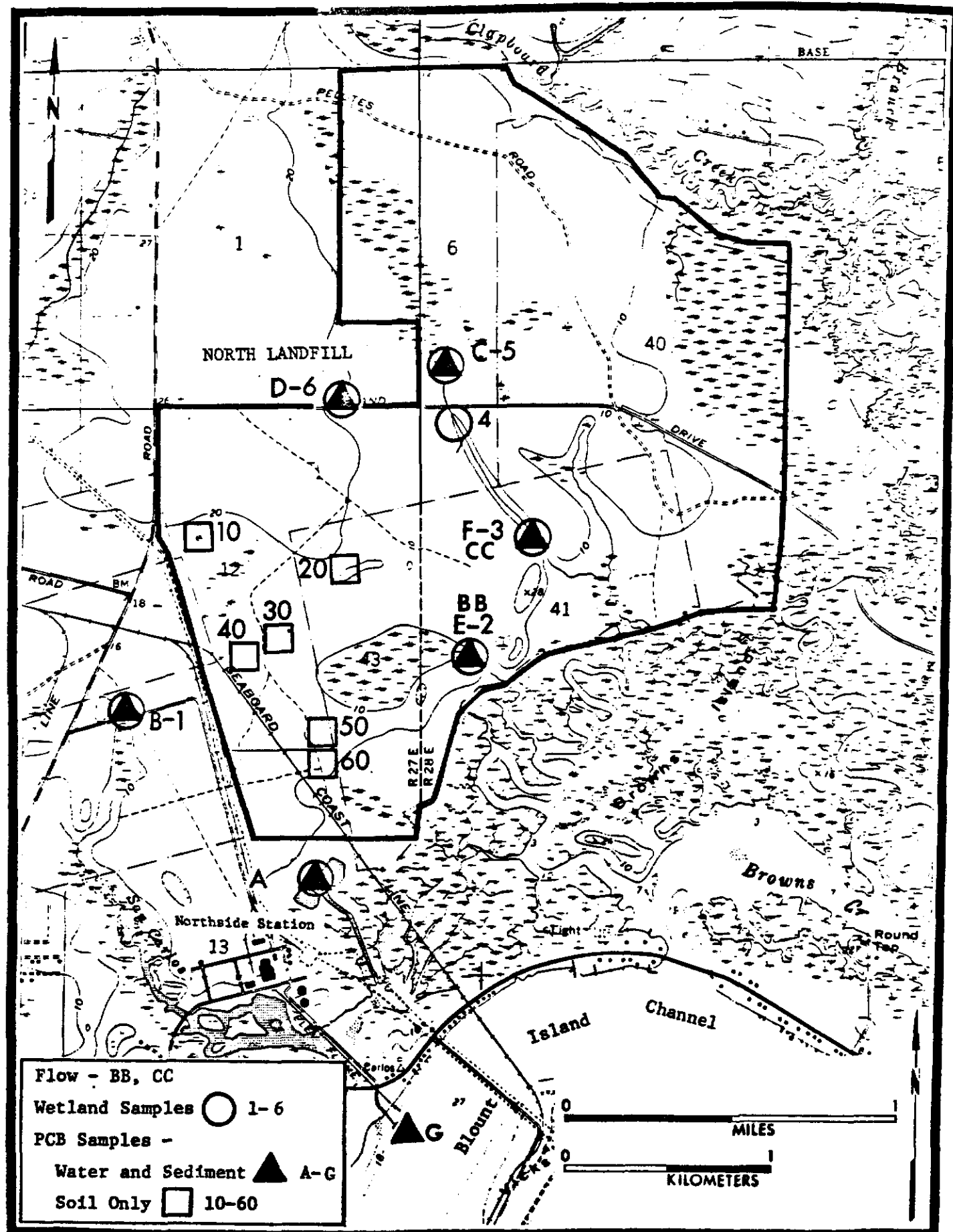


Figure 6.2-4

Locations of Wetland Water Quality Samples
and Samples for PCB Analysis

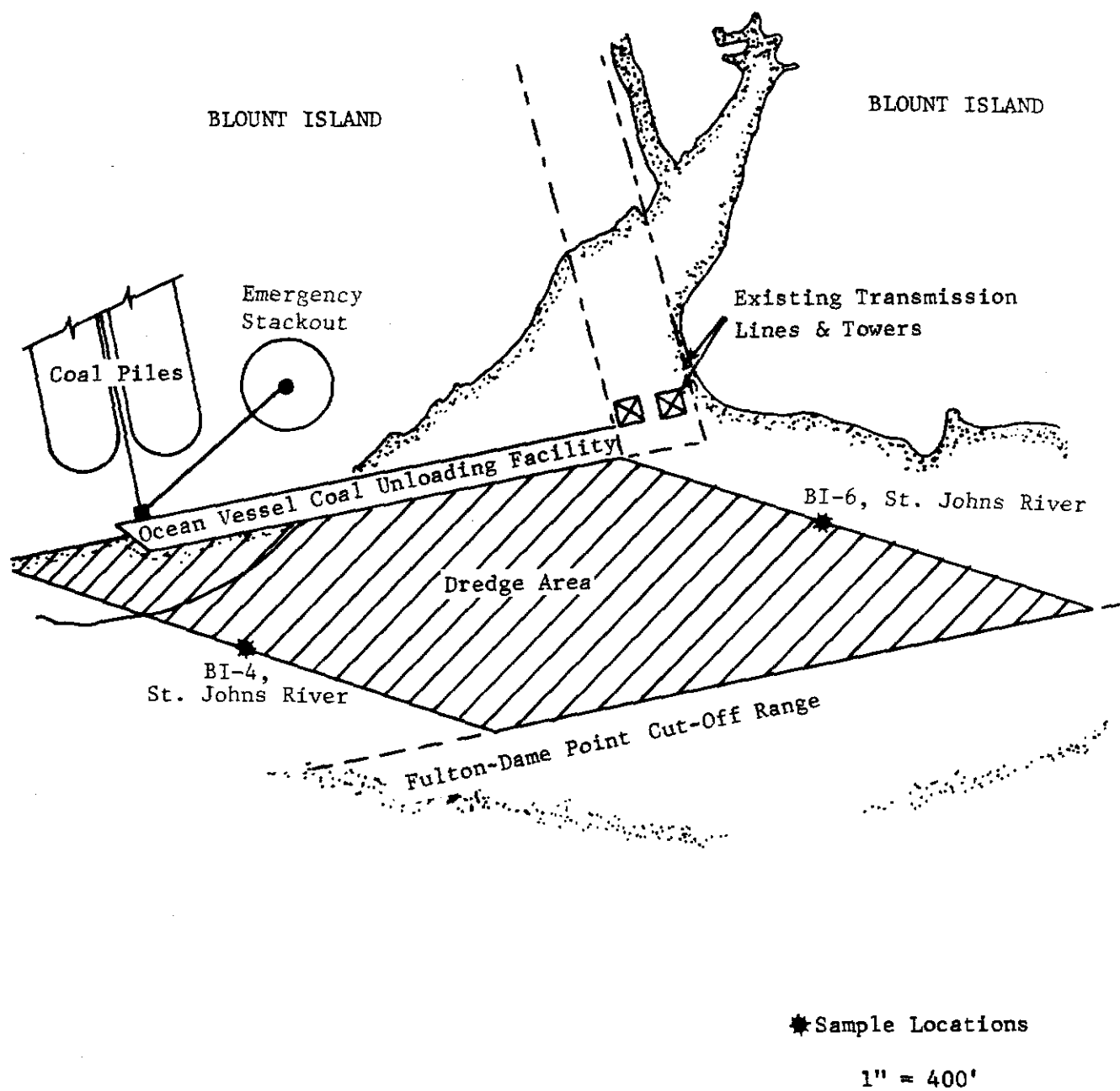


Figure 6.2-5 Sampling Locations in Dredge Area of Proposed Coal Unloading Facility

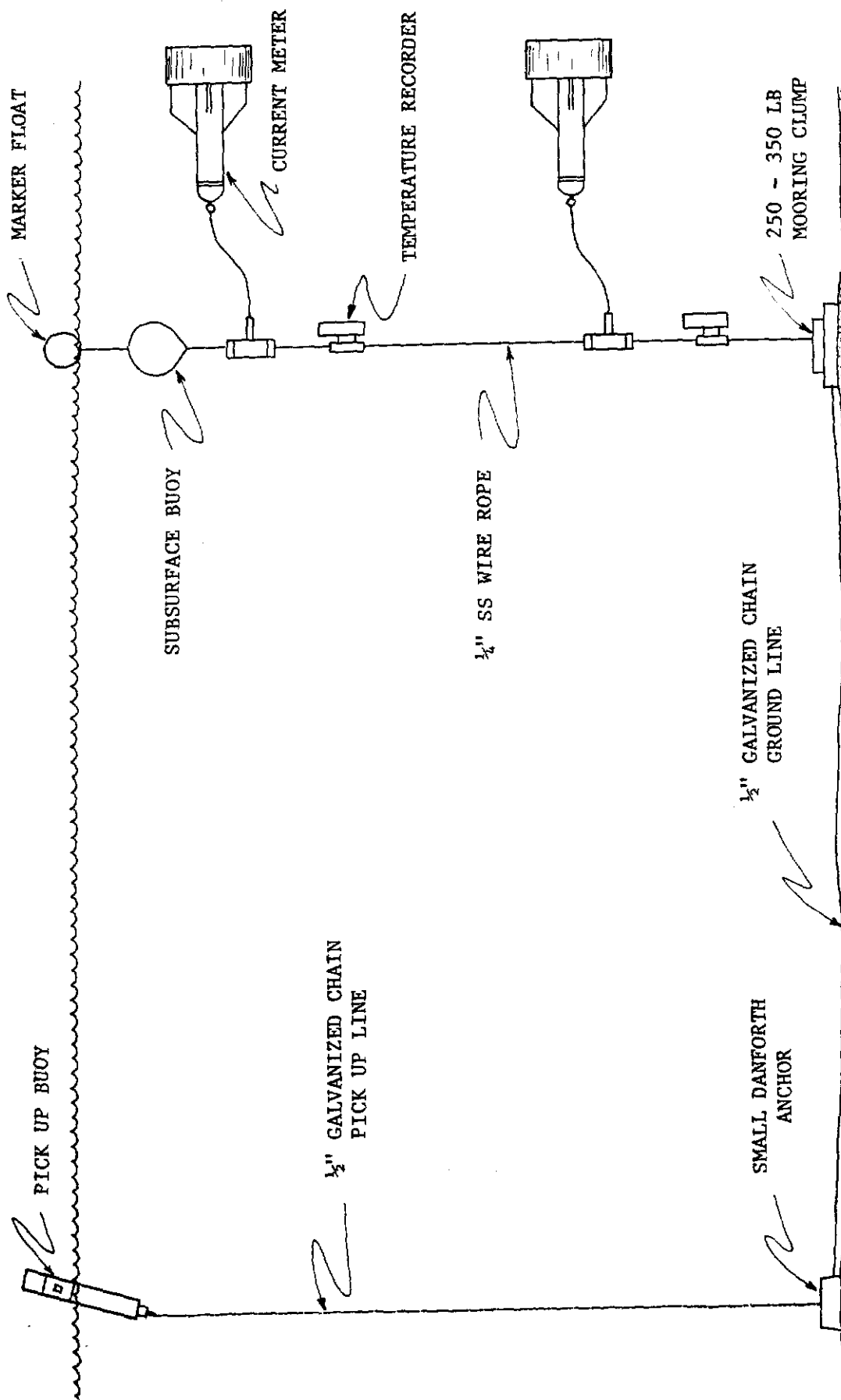


Figure 6.2-6 Current Meter Mooring

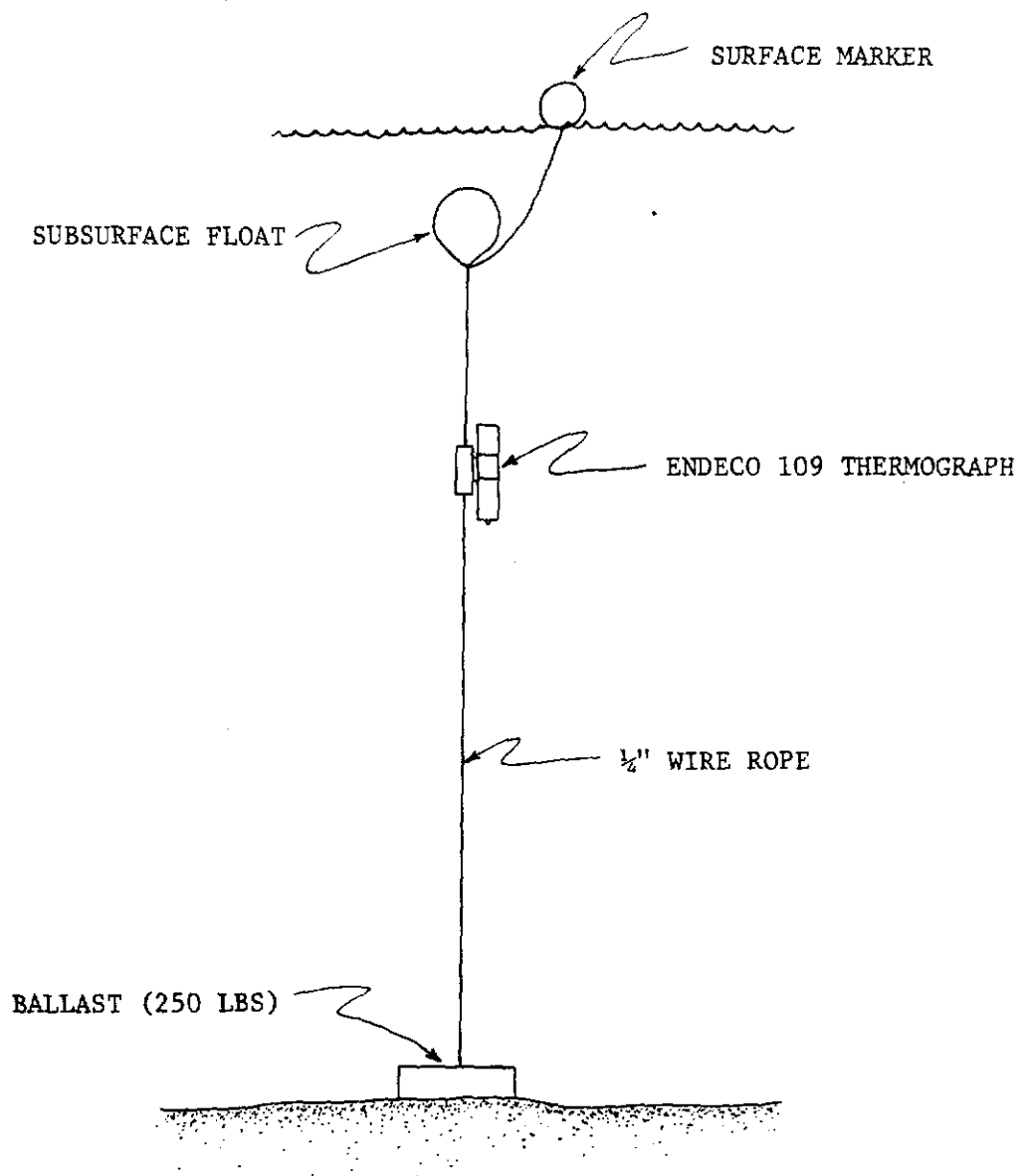


Figure 6.2-7 Typical Thermograph Mooring

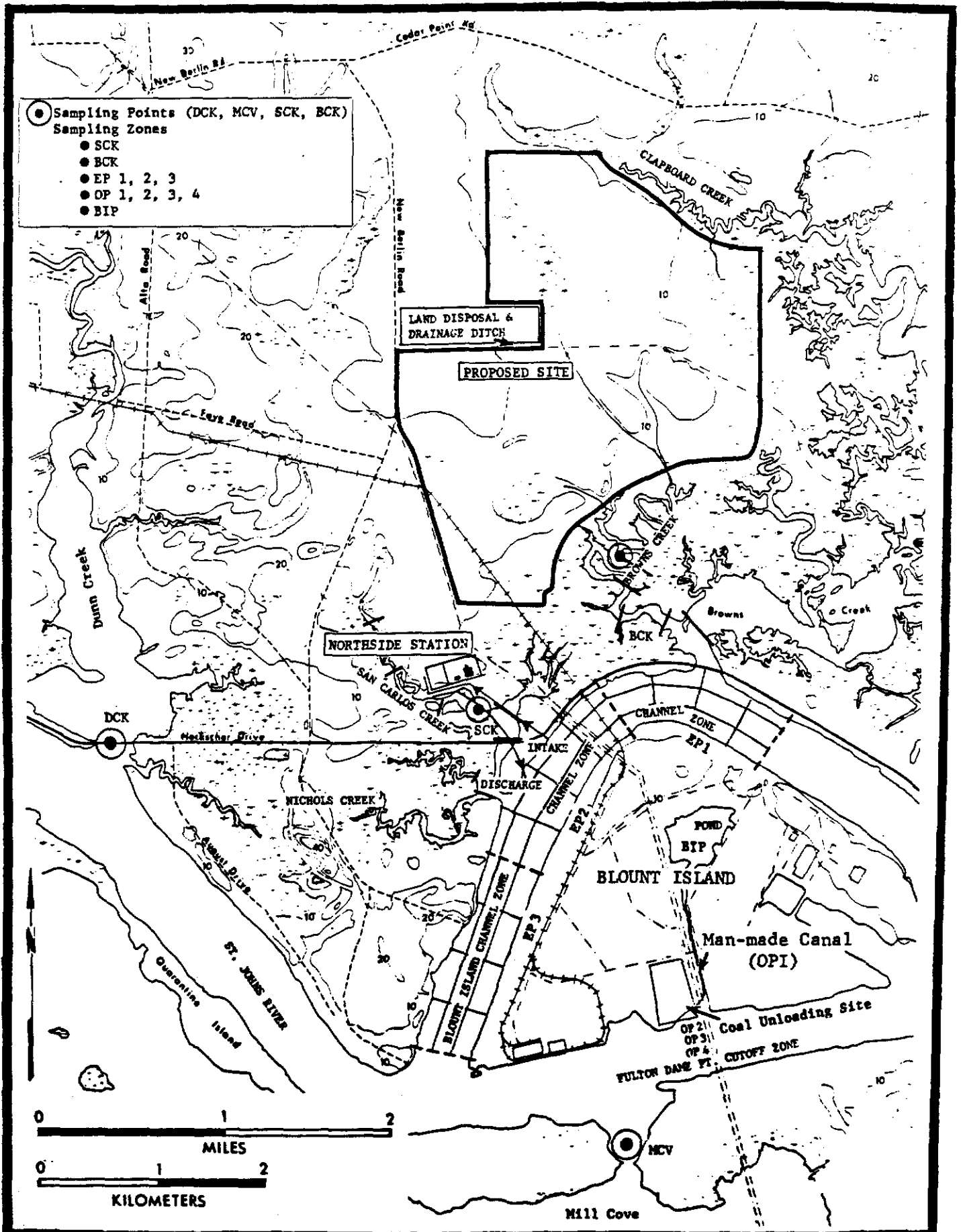


Figure 6.2-8 Aquatic Ecology Study Area

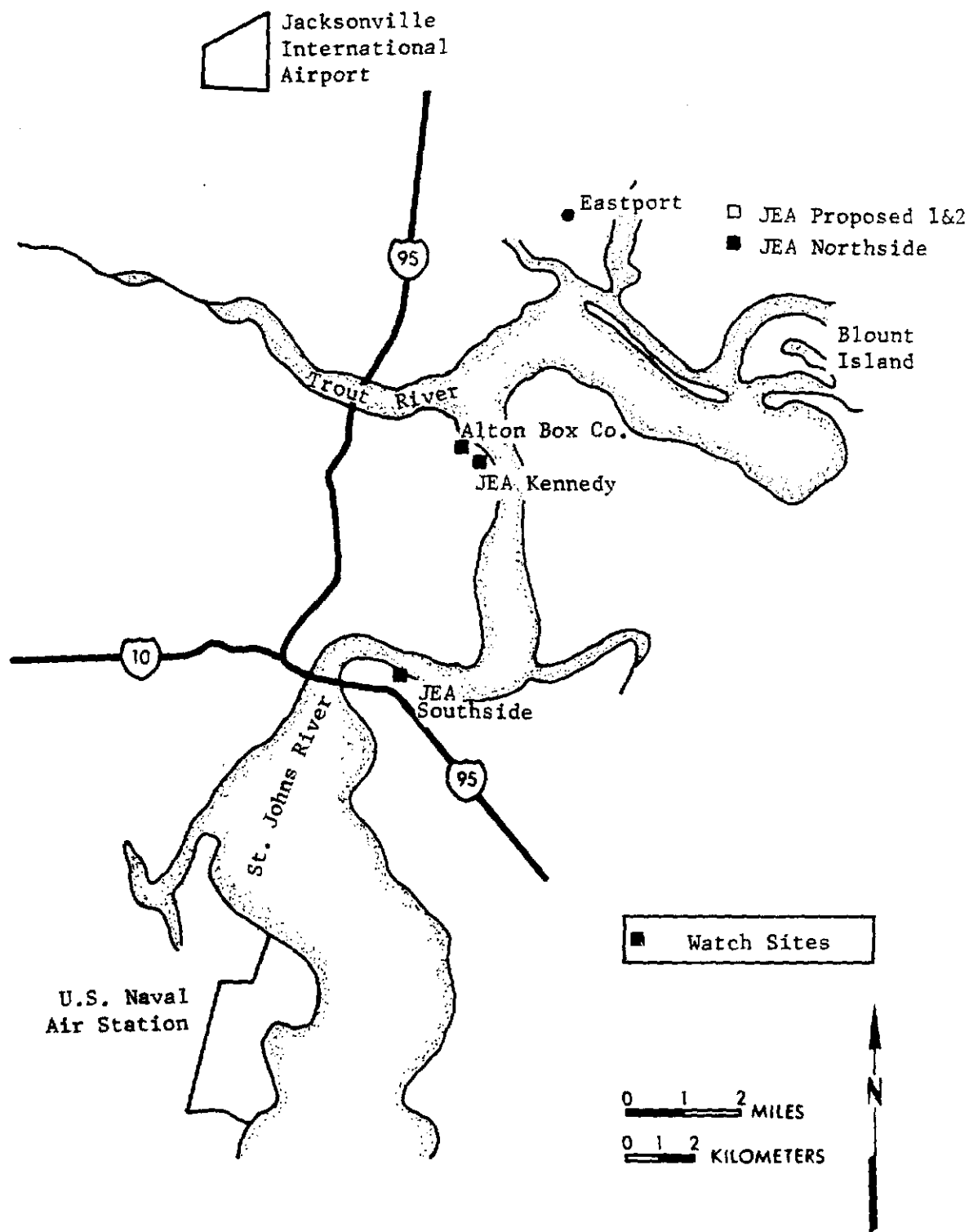


Figure 6.2-9 Manatee Watch Sites

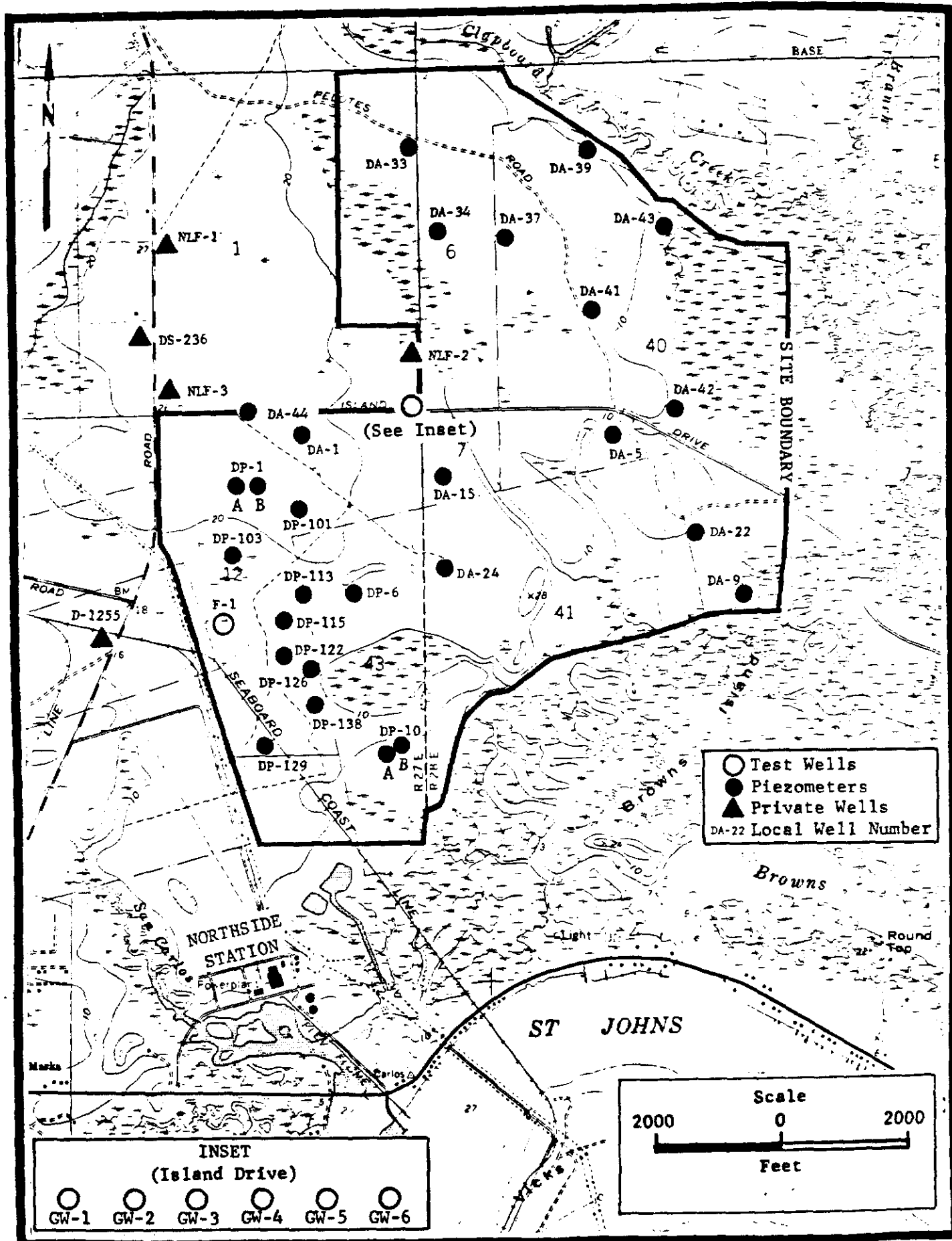


Figure 6.2-10 Locations of Pre-Application Groundwater Monitoring Points

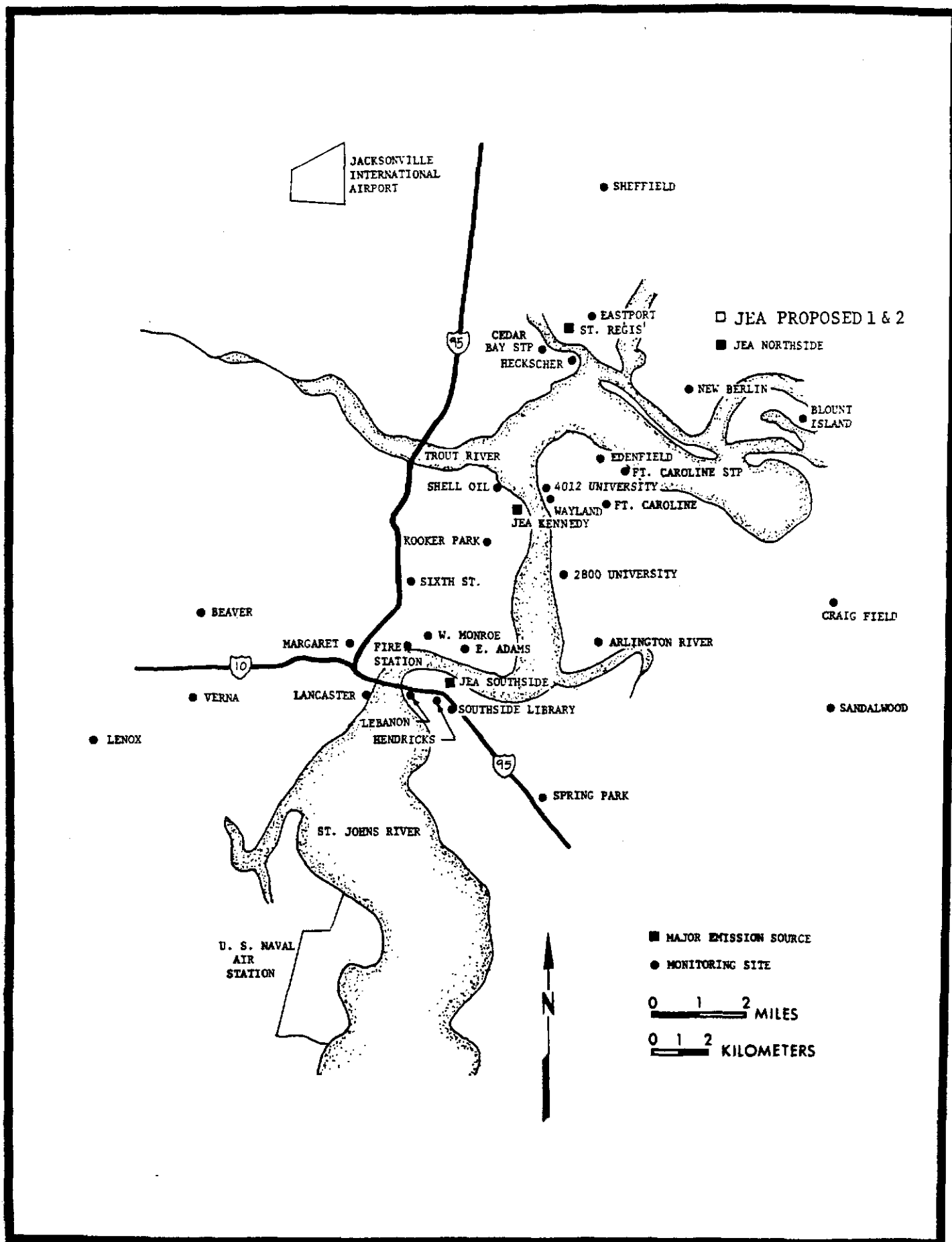
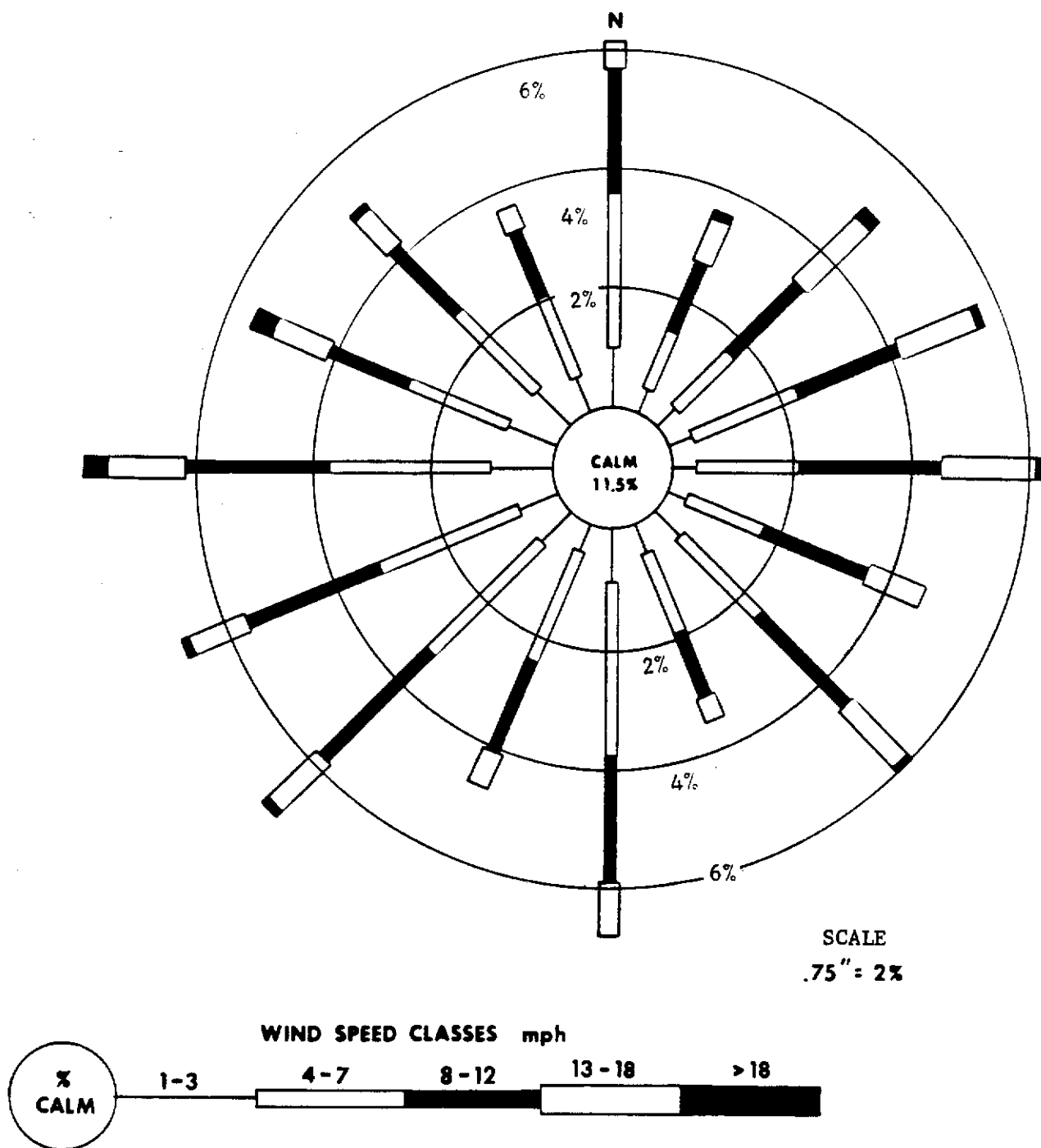


Figure 6.2-11 Locations of Major Emission Sources and Monitoring Sites



Source: USDC, 1974

Figure 6.2-12 Jacksonville, Florida Annual Wind Rose (1970-1974)

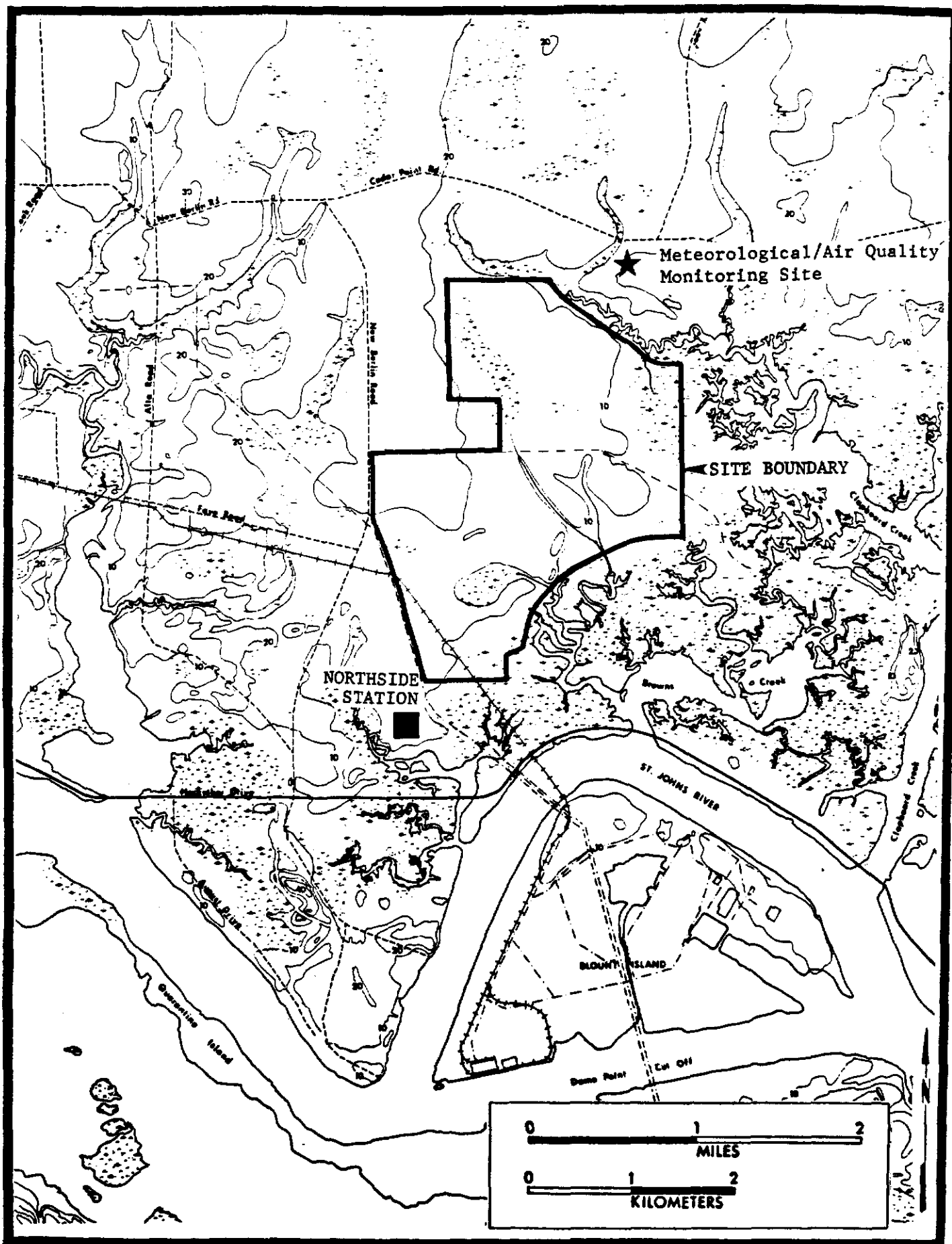


Figure 6.2-13 Meteorological/Air Quality Monitoring Site Location Map

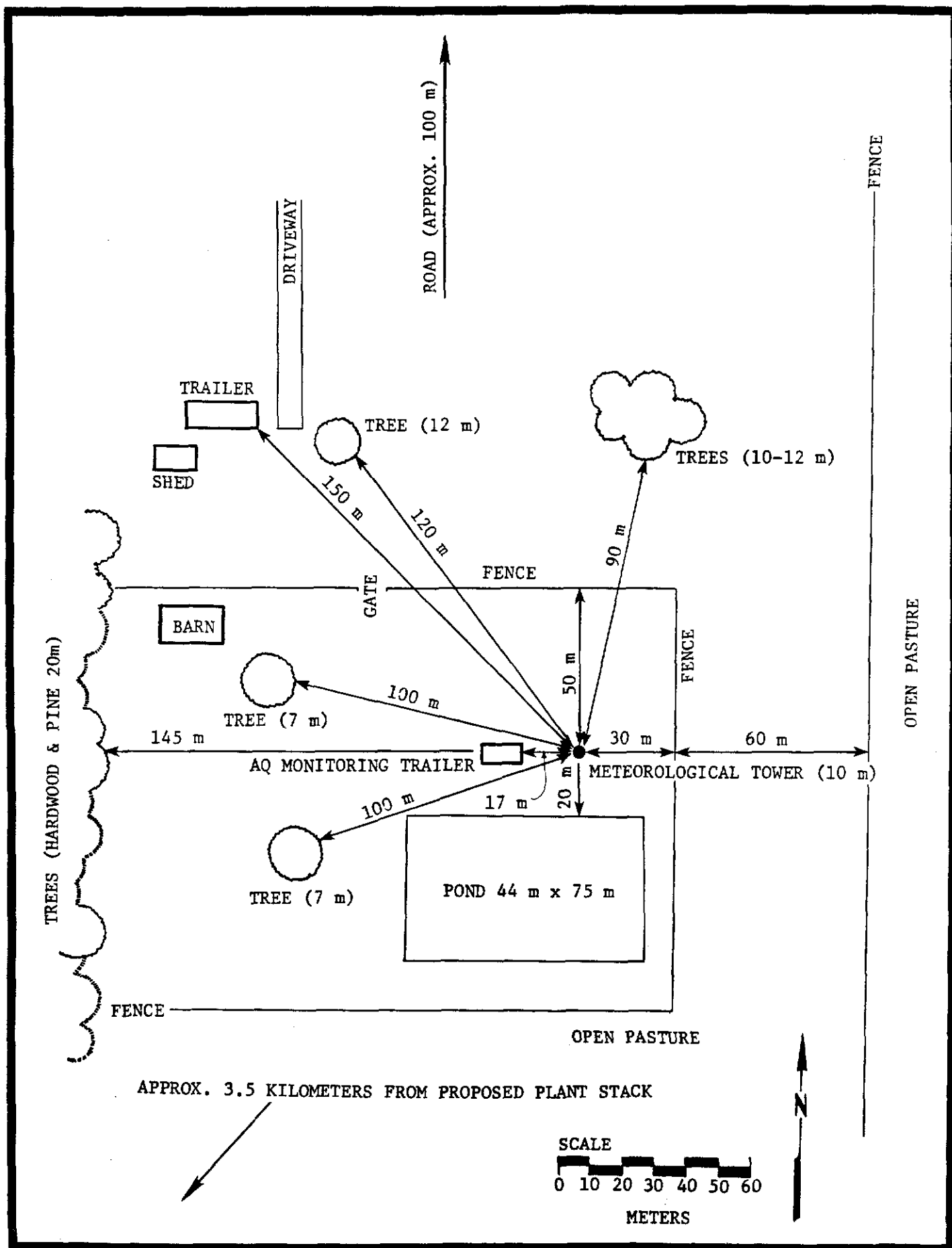


Figure 6.2-14 Monitoring Site Vicinity

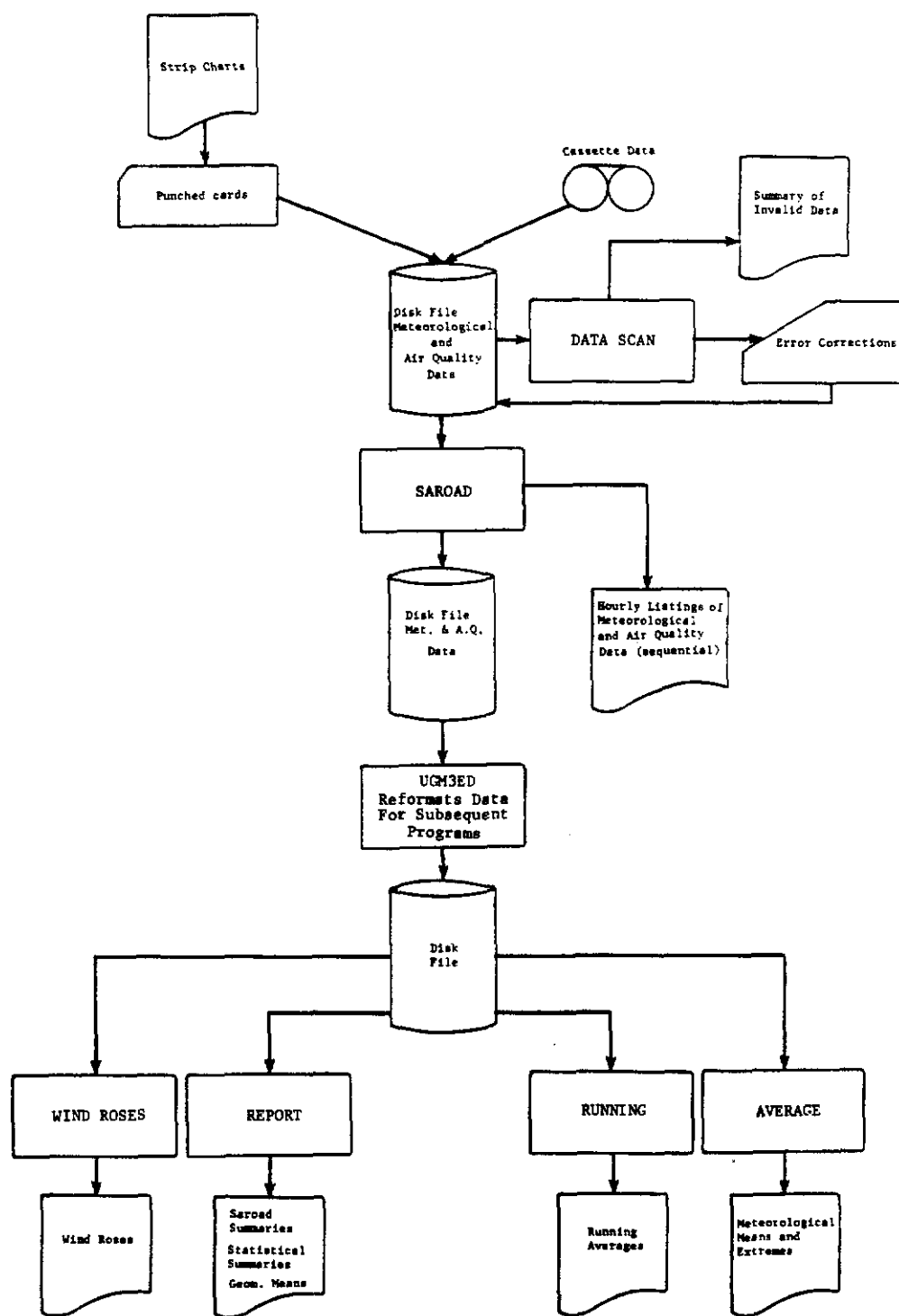


Figure 6.2-15 Air Quality Data Analysis Programs

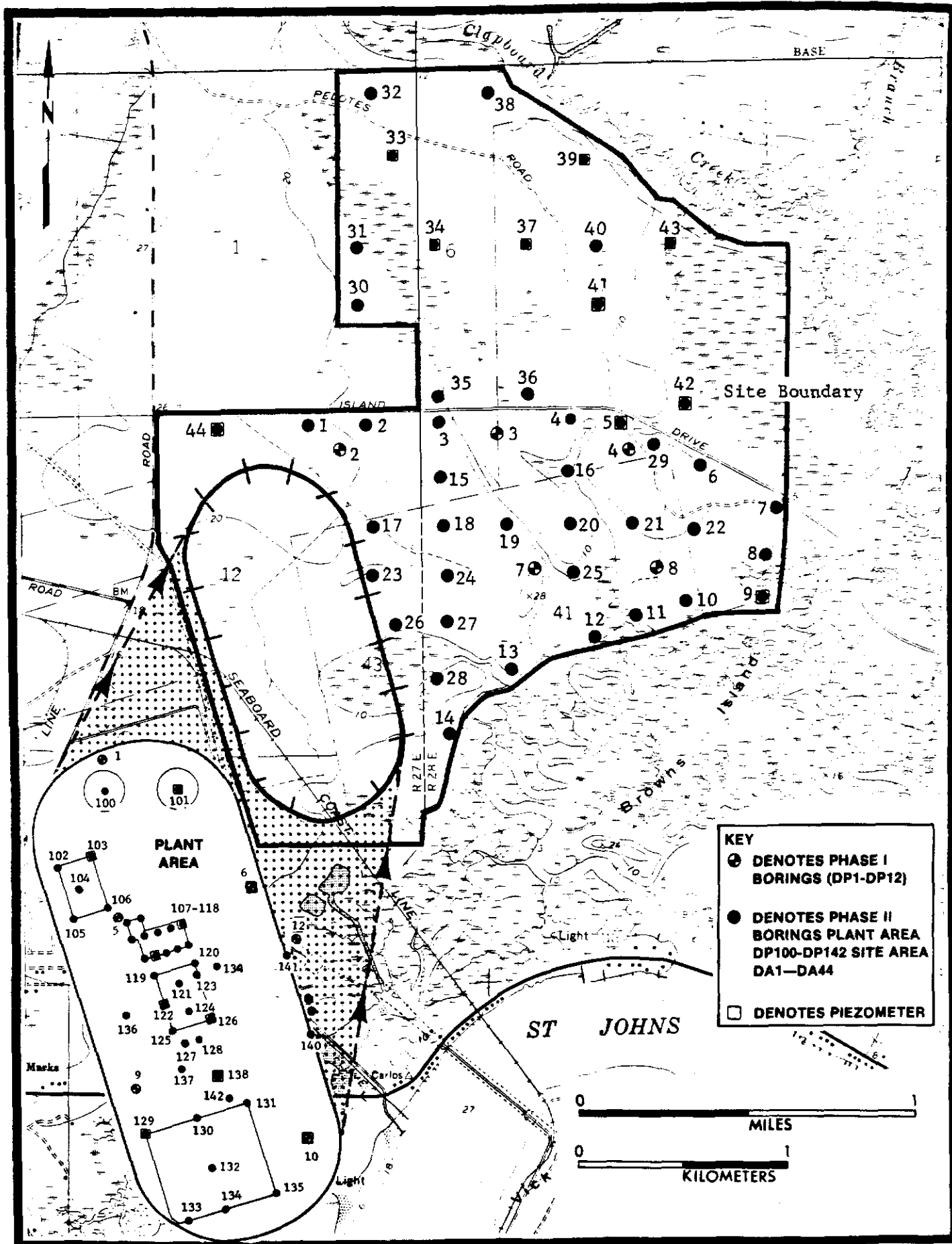


Figure 6.2-16 Boring Locations Plan

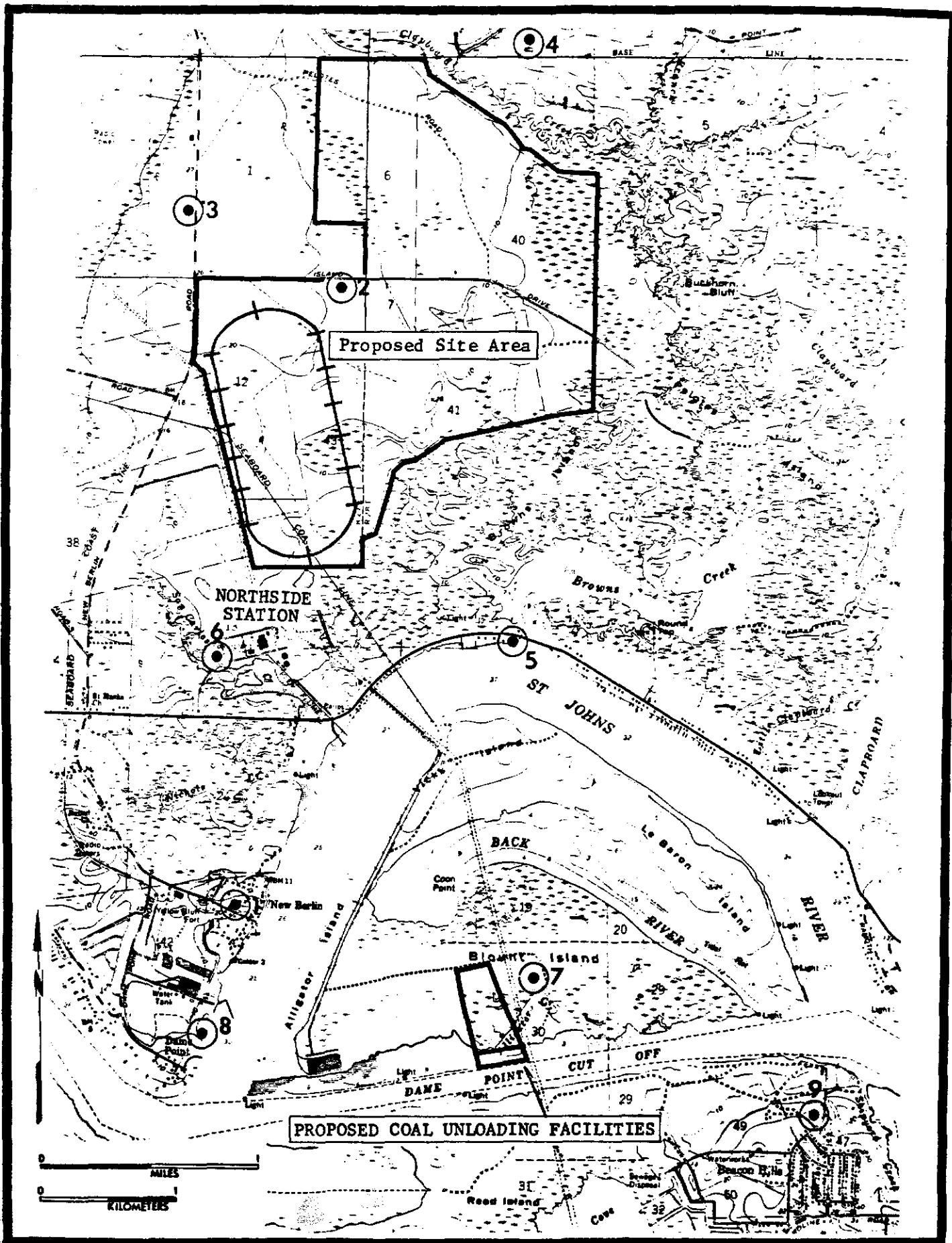


Figure 6.2-17 Noise Survey Monitoring Locations

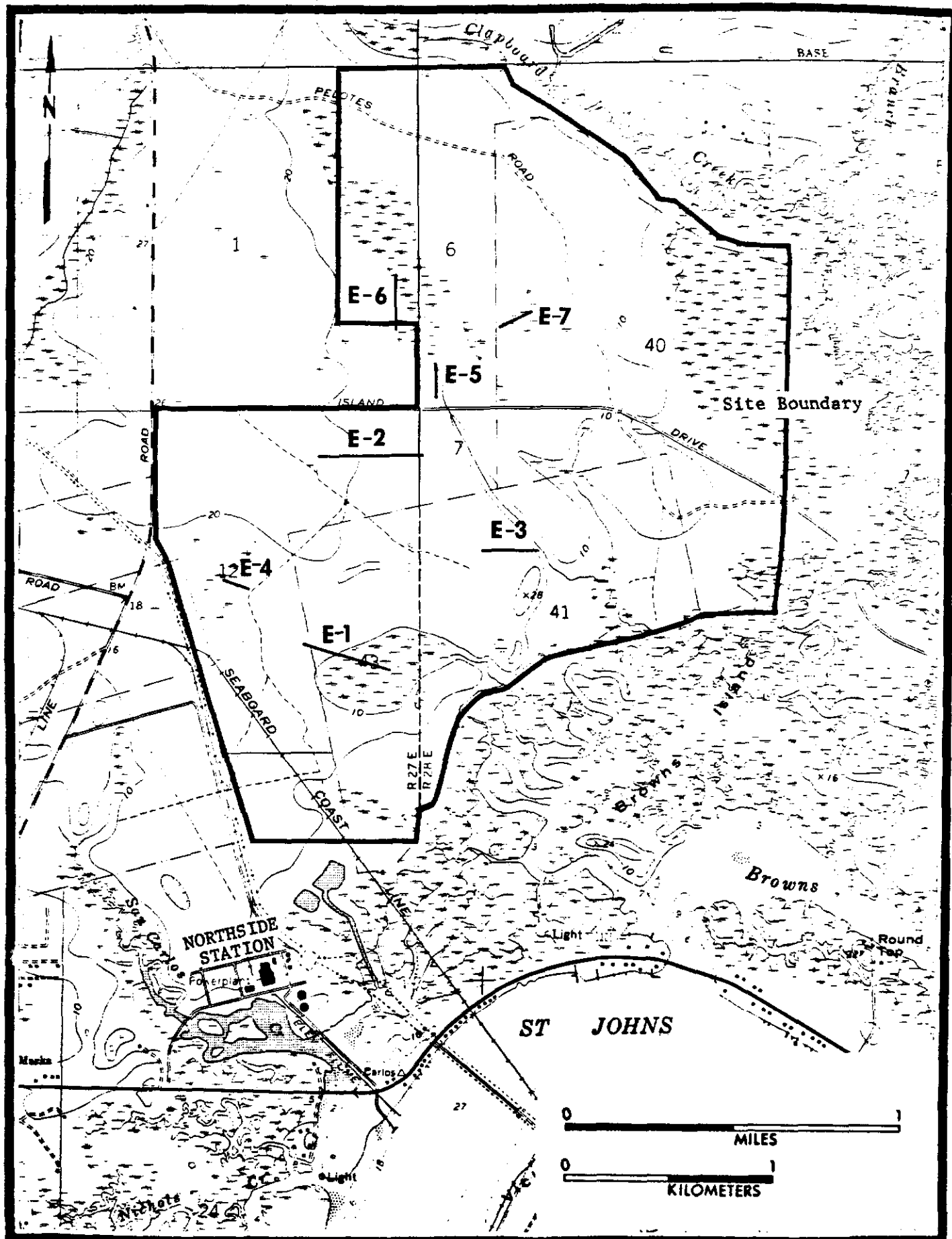


Figure 6.2-18 Location of Vegetation Sampling Transects

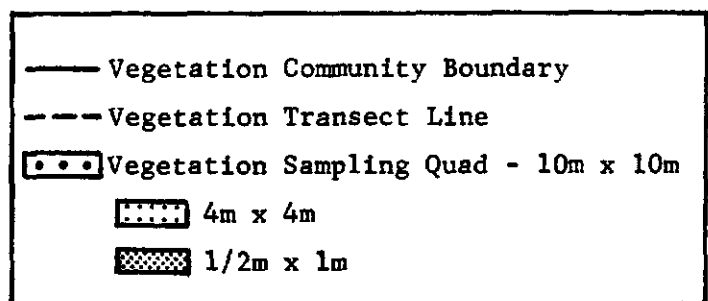
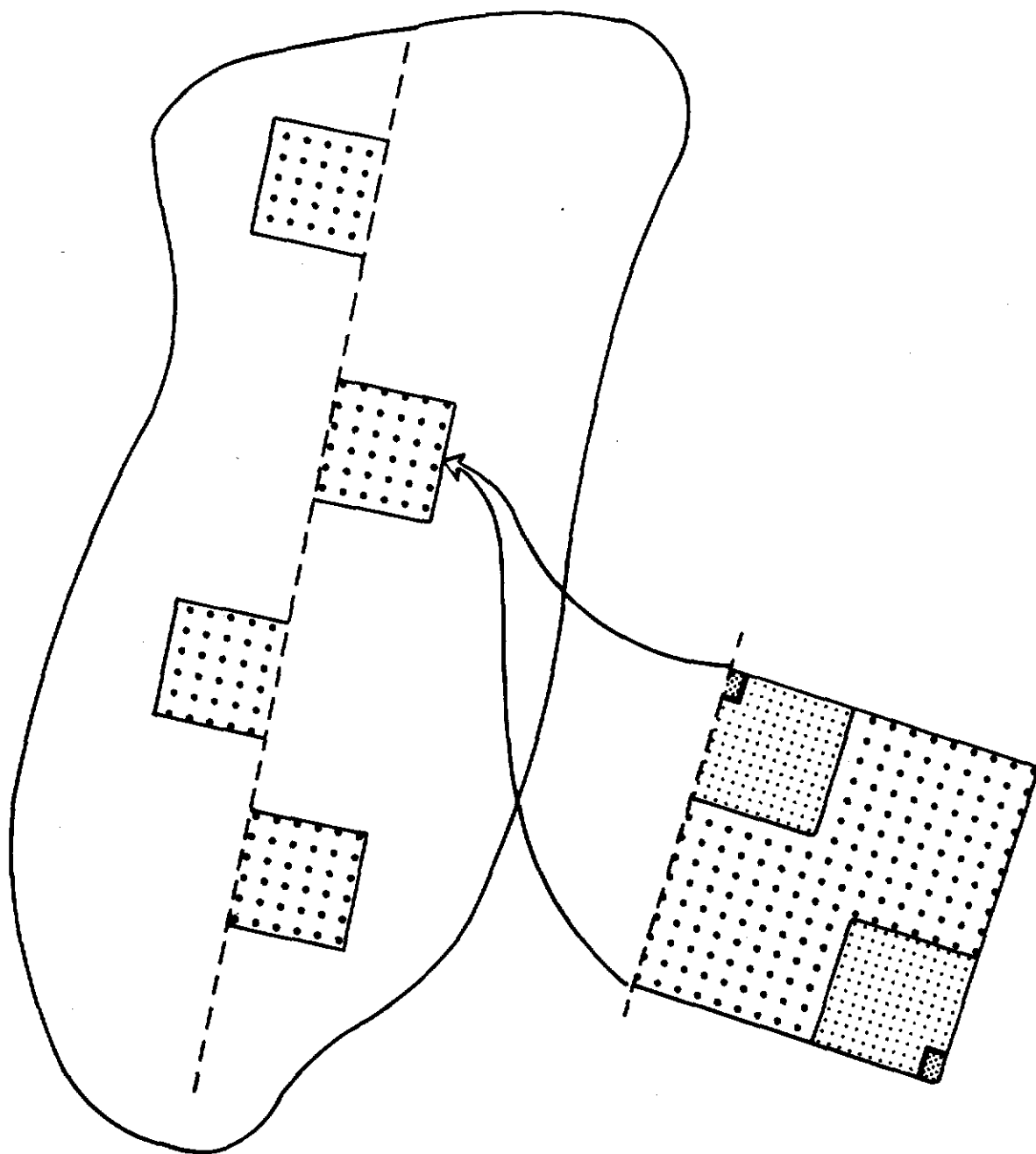


Figure 6.2- 19

Typical Terrestrial Ecology Sampling Quadrat Arrangement

6.3 CONSTRUCTION AND OPERATIONAL MONITORING

6.3.1 Sampling Techniques

Construction and operational monitoring is an important follow-through to environmental investigations. The subsequent sections discuss the proposed techniques to be used in conjunction with each environmental parameter for which a construction monitoring program may be initiated. A description of the operational monitoring program will be submitted to the FDER and the USEPA for review and approval between six months and one year prior to the plant start-up target date.

6.3.2 Modifications

Site preparation and/or facility construction may alter a previously measured or observed environmental condition. Therefore, if such is the case among the environmental parameters subsequently discussed, the program for monitoring the modified condition will be conducted as indicated in the following sections. All programs will be consistent with FDER and USEPA guidance.

6.3.3 Surface Waters

6.3.3.1 Physical and Chemical Parameters

Chemical Parameters

Monitoring of surface waters which may be affected during site preparation and power plant construction will continue to the extent required by FDER and USEPA. In accordance with anticipated NPDES permit requirements, the construction monitoring program will include periodic analysis of total suspended solids and pH of the sedimentation pond to be

constructed for retention of surface runoff from within the railroad loop. Monitoring will be by grab sample collected at the overflow weir when discharging during severe rainfall events or once per month should a continuous discharge occur.

6.3.3.2 Ecological Parameters

Monitoring of ecological parameters which may be affected during dredge and fill operations, and during plant construction will be in accordance with requirements established in the conditions of certification and in the NPDES permit.

6.3.4 Groundwater

Construction groundwater monitoring will consist of a program of monitoring groundwater conditions in the general site vicinity. Monitoring will be oriented toward ascertaining variations in shallow aquifer water levels and piezometric pressure in the Floridan aquifer resulting from construction activities, including construction dewatering (Section 4.1.7). Groundwater monitoring points will include the Floridan water supply well, F-1, plus an appropriate selection of shallow wells drawn from the preapplication monitoring wells and piezometers shown on Figure 6.2-10. Piezometric pressure at well F-1 will be measured on a quarterly basis. Water levels in shallow monitoring wells will be measured on a monthly basis. Samples for water quality analyses will be collected from the shallow monitoring locations on a quarterly basis. The samples will be analyzed for an appropriate set of parameters selected from the list on Table 6.2-6.

6.3.5 Air Quality

The pre-application on-site meteorological and air quality monitoring program described in Section 6.2.6 was discontinued after a full year of data collection. No construction or operation phase meteorological monitoring is proposed because of the proximity of the site to the National Weather Service first order monitoring station at the Jacksonville

International Airport. This station, which is located approximately 15 km west-northwest of the proposed site in essentially flat terrain, includes equipment for monitoring wind direction and speed, temperature, humidity, and precipitation. Data from this equipment is collected at least hourly along with visual observations of visibility, sky cover, cloud heights and types, and other weather conditions. Data are available from the National Weather Service office at the airport or from the National Climatic Center in Asheville, North Carolina.

Appropriate ambient air quality monitoring programs will be developed and implemented to comply with any monitoring requirements set forth in the FDER's conditions of certification and USEPA's PSD permit.

6.3.6 Geology

There are no conditions of a geological nature which will require environmental measurements, or monitoring, either during plant construction or operation.

6.3.7 Archeological Monitoring During Construction

There are presently no archeological resources on, nominated to, or declared eligible for the National Register of Historic Places within the project area. Therefore, 36 CFR 800.7 which deals with previously identified cultural resources being found during construction will not apply.

Surveys intended to locate and evaluate all previously unidentified and/or unevaluated archeological sites within the project area were conducted. Reports describing this work have been submitted to the Director of the Division of Archives, History, and Records Management for review. Because the survey methodologies were intended to locate all archeological resources which may be present, the possibility that unidentified resources will be found during construction is small. However, in the event that such resources are discovered, the project

manager will be notified immediately and all construction activities in the vicinity of the find will be halted. The project manager will arrange for a professional archeologist to confirm the presence of an archeological site. If the presence is confirmed, the Florida Division of Archives, History, and Records Management will be consulted to determine the necessity for and scope of any mitigative measures.

6.3.8 Noise

The pre-application noise monitoring surveys revealed that two residences located in immediate proximity to the proposed site may be affected by increased noise levels due to construction activities. Noise monitoring will be performed to assess noise levels at these residences. Monitoring will be with an analyzer capable of continuously monitoring and computing statistical values of L_{eq} , L_{10} , L_{50} and L_{90} , over a period of at least two days. The monitor used will meet ANSI S1.4-1971 Type 1 precision sound level meter specifications. The results of the survey will be evaluated relative to the USEPA's noise guidelines.

If the noise level exceeds guidelines, the source will be identified and appropriate mitigative measures taken.

6.3.9 Terrestrial Biota

The pre-application monitoring program identified two potentially sensitive bird habitats: a rookery, located to the east of the proposed site, and a Least Tern nesting area, located in the vicinity of the proposed coal unloading facility. These two habitats will be surveyed each nesting season for the duration of construction by the methods presented in Section 6.2.10.3.

In addition, the two rookeries located adjacent to Cedar Point Pond will be censused (depending on accessibility) in an effort to determine if birds are relocating during plant construction.

Chapter 7

Economic and Social Effects of Plant Construction and Operation

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7. ECONOMIC AND SOCIAL EFFECTS OF PLANT CONSTRUCTION AND OPERATION

7.1 SOCIOECONOMIC BENEFITS

Construction and operation of the proposed plant will have a variety of effects on the residents and economy of Jacksonville/Duval County, as well as the Florida Power and Light (FPL) service area. The purpose of this section is to identify to the extent possible the ramifications of these effects.

Socioeconomic effects are most often classified as "direct" or "indirect" effects. Synonymous descriptors are "internal" or "external" effects. Direct or internal effects are those affecting primarily the owners, operators, and users of the proposed plant. Indirect or external effects are those affecting people and/or interests in the vicinity of the proposed plant who, because of their proximity to the project and its activities, experience changes in their situations.

This section is divided into two parts. Section 7.1.1 deals with direct or internal benefits associated with the construction and operation of the proposed plant, while 7.1.2 deals with the indirect or external benefits associated with these activities.

7.1.1 Direct Benefits

The principal direct benefits of the proposed plant will be those inherent in the uses of the electrical energy generated. With both units in operation, the proposed plant will have approximately 1,200 megawatts of generating capacity. Unit 1 is projected to be on line in late 1985 and Unit 2 is projected to be on line in mid 1987. At these times, the consumers of the electricity produced at the proposed plant will begin to receive the primary direct benefit of the proposed investment. Although the generation of this electrical energy is taken to be the primary direct benefit of the proposed plant, it is difficult to measure exactly what this

electrical power is worth to the customers of both utilities and to the Jacksonville area. One obvious plus for the consumer will be the presence of a reliable supply of electricity. This is a direct benefit to the consumer in that a reliable source of electrical energy reduces the chances of inconvenient, and sometimes costly, power outages. A reliable and plentiful source of electricity also provides positive incentive for industrial location. As pointed out in a recent study by the Battelle Institute (Battelle - Columbus Division and Plantec Corp., 1980), the Jacksonville area has had problems in recent years attracting major industry because of a questionable and costly electrical energy supply. In the face of increasing siting problems and the rapidly expanding demand for electricity by residential and industrial consumers, a reliable and competitive cost source of electrical energy is essential to the social and economic welfare of the Jacksonville area (this subject is discussed in detail in Chapter 1).

7.1.2 Indirect Benefits

Major indirect or external benefits of the proposed plant will be increased employment, personal income and public revenues in the Jacksonville area. The community will also benefit in the long run from the various road improvements (Section 7.2.2.1) necessitated by plant construction.

Employment and Personal Income

The model used to estimate the magnitude of the changes in employment and income are discussed in Appendix H, Section H.3. The term "income" is defined as wage and salary payments, other labor income (e.g., pension funds) and proprietor's income (e.g., retail trade). Income is measured in 1980 constant dollars.

New levels of direct basic employment that would occur during the construction phase (1982-1987) are presented in Table 7.1-1. During the first year of construction (1982), the proposed plant is expected to create

254 new jobs. By the second year of this phase (1983), the proposed plant is projected to produce an additional 1,112 new basic jobs, for a total employment level of 1,366 jobs. In the peak construction year of 1984, which begins the overlap period of both operation and construction employment, basic employment would increase by 1,018 new jobs (950 construction and 68 operational) and reach a total of 2,384 jobs. In 1985, the basic construction jobs would decline to 2,294, but basic operational jobs would increase to 281, for a total of 2,575 basic jobs or an overall increase of 191 basic jobs from the previous year. During 1986, basic operational employment will remain at 281, but basic construction employment will continue to decline to 1,089 jobs for a total basic job level of 1,370 for that year. The final year of the construction phase (1987) will result in a further reduction of basic construction employment, but basic operational employment will reach its peak of 375 workers during that year. Basic construction employment for 1987 will be 615 jobs for a total basic employment level of 989 during that year.

During the first year of construction (1982), the 254 basic jobs would generate an additional 321 non-basic jobs (indirect and income-induced) equaling a total employment impact of 575 new jobs within the region. In the peak construction year (1984), the 2,384 basic jobs (construction and operation) are projected to generate 3,521 non-basic/indirect jobs, resulting in a total employment of 5,905. The total employment impact will start to decline in 1986 when the 1,370 basic jobs will generate 2,942 non-basic jobs resulting in a total employment level of 4,312 which is a decrease of 2,524 jobs from the 1985 peak level of 6,836. In the final construction year (1987), the 989 basic jobs are expected to generate 2,107 non-basic jobs for total employment level of 3,096. The total (basic and non-basic/indirect) employment impacts for the construction phase are illustrated in Table 7.1-2 (see Appendix H, Section H.2 for methodology).

The impacts the proposed plant would have on income in the region during the construction phase are illustrated in Table 7.1-3 (see Appendix H, Section H.2 for methodology). During the first two years of

construction (1982 and 1983), the income effects will be the result of new construction employment and the non-basic/indirect jobs created by this construction employment. In 1982, the 575 new jobs created by the proposed plant would generate approximately \$7.4 million in additional income in the region. During 1983, additional regional income attributable to the proposed plant would amount to about \$41 million. The increase in direct construction employment during this year to the level of 1,366 workers will generate additional basic income of about \$25.3 million while the non-basic/indirect induced income will amount to approximately \$15.4 million. During the construction and operation overlap years of 1984-1987, the region would realize additional income of over \$240 million. The total increase in additional regional income that would result from the construction phase (1982-1987) of the proposed plant is projected to be in excess of \$287 million.

In the first full operational year (1985) of Unit 1 of the proposed plant, basic employment is expected to increase by 191 jobs to a level of 2,575. This increase is due to the overlap of the construction and operation phase during this year. Not until the beginning of 1988 will the entire construction phase be complete, resulting in an operational employment level of 375 basic jobs. The basic operational employment level is expected to remain constant at this level through the year 2025. However, the non-basic/indirect employment created by this basic operational employment will not stabilize until 1992, as illustrated in Table 7.1-2. This is due to the "lag" effect associated with the employment multiplier process which is discussed in Appendix H, Section H.2. From the first full year of operation of both units of the proposed plant (1988), non-basic/indirect employment will decline from 1,096 jobs to the stabilizing level of 704 in 1992. This will result in a total employment effect of 1,079 jobs through the year 2025.

The additional income that would be generated within the region during the operational phase is presented in Table 7.1-3. During 1984, the first year of construction/operational personnel overlap, the proposed plant is expected to generate additional regional income of approximately \$74

million. Since 1984-1987 is an overlap period, income effects attributable to both the construction and operational phases are reflected in the overall annual income effects during these years. In the first year of operation for both units (1988), the region is expected to realize additional income due to plant operation of over \$14.3 million. Additional income created in the region due totally to plant operation will begin to decline in 1988 as the indirect employment associated with construction declines, stabilizing at approximately \$11 million in 1992. This level of income attributable to plant operation will remain constant through the year 2025. During the final two years of operation (2026 and 2027), income due to plant operation will decline to approximately \$8 million as plant employment is reduced in anticipation of plant shutdown. The cumulative effect of the proposed plant on regional income during its complete operational phase (1984-2027) is expected to be approximately \$680 million.

A secondary indirect benefit will be realized by the community in the long run due to various road improvements necessitated by plant construction. Although these improvements are necessary to accommodate the increased traffic volumes during the construction phase of the plant, the community will benefit from these road improvements long after the construction phase is over. A detailed discussion of the recommended road improvements is presented in Section 7.2.2.1.

Public Revenues

Electric generation also involves substantial public revenues, primarily through taxes. However, because the proposed plant is to be jointly owned by the Jacksonville Electric Authority (JEA), which is a municipally owned entity, and FPL, the revenue impacts of the proposed plant take on a different perspective. The JEA, being a municipally owned power company, is not subject to property taxes. However, JEA does make an annual "payment in lieu of taxes" to the city of Jacksonville. Table 7.1-4 presents a projected yearly breakout of these payments. These payments are based on total taxable sales of electrical energy, times the applicable

millage rate, which is currently (1980) 4.5 mills (City of Jacksonville/Duval County, 1980a). Total taxable sales refer to all sales of electrical power to residential, commercial and industrial customers, minus any sales of electricity to other utility companies. As illustrated in Table 7.1-4, the proposed plant would generate additional revenues in the form of "payments in lieu of taxes" of approximately \$514,000 in its first year of operation (1985). These additional revenues would reach a projected \$16.4 million during 1988, which is the first complete year in which both units of the plant will be in full operation. These revenues will begin to decline in 2000 due to the reduction in the estimated production capacities of the plant over its 40 year life. During the estimated 40 year life of the proposed plant, it is projected these "payments in lieu of taxes" will generate over \$567 million in additional revenue for Jacksonville/Duval County.

Additional public revenues will also be realized from the property taxes imposed on the percentage of the proposed plant owned by FPL (Table 7.1-4). FPL is to be a 20 percent owner in the proposed plant, thereby being subject to property taxes on 20 percent of the assessed value of the plant. At present, the basis for assessment of ad valorem property taxes on the proposed plant has not been determined. The following is, therefore, an estimate of additional revenues the City of Jacksonville will receive from this source.

It is uncertain how much of the estimated capital cost (or other basis) of the proposed plant will be assessed for property taxes and how much will be exempt. However, it is assumed the proposed plant will be exempt from property taxes until 1985, when Unit 1 becomes operational. If it is assumed that 100 percent of estimated capital investment cost of the proposed plant (\$1.6 billion) is the assessed valuation of the facility, property tax revenues from the plant would reach a maximum of approximately \$5.4 million (1980 dollars) in 1987. Thereafter, they would decline because of plant depreciation factors. For purposes of this study, the total capital cost of \$1.6 billion was depreciated (straight line) over the

40 year life of the plant to arrive at a reasonable projection of property tax liability (Tabel 7.1-4). These projections assume investment and fuel costs, assessment ratios and millage rates will remain constant. In actuality these parameters are likely to vary significantly over time, whereby additional revenues from plant property taxes will also vary.

The City of Jacksonville would also receive additional property tax revenues derived from the value of immigrant worker owned housing within its boundaries. Immigrant workers are defined as those skilled and/or semi-skilled workers who will migrate to the Jacksonville area to work at the proposed plant and will remain in the area only as long as project work is available. Based on the projected immigrant worker levels for Duval County, which are presented in Chapter 4, Table 4.1-5 and Chapter 5, Table 5.6-9 the city/county can expect additional property tax revenues as illustrated in Table 7.1-5. These revenues are based on the average value of single family homes and mobile homes, minus a homestead exemption, times the current (1980) effective property tax millage rate of 16.934 (City of Jacksonville/Duval County, 1980b). During the first year of construction (1982), Jacksonville/Duval County can expect additional property tax revenues of approximately \$5,200 because of home purchases by immigrant workers. This amount will reach a peak of about \$50,000 in 1985 and then stabilize at approximately \$20,100 per year through the year 2025. The cumulative revenue the city will receive due to immigrant owned housing over the complete construction and operational phases of the proposed plant is projected to be approximately \$982,000.

State Aid to Schools

Another form of additional revenue attributable to the proposed plant will benefit the Duval County school system. These revenues will be in the form of state aid to local education and are based on student enrollment (State of Florida, 1980). Table 7.1-6 presents the number of immigrant school age children expected to locate in Jacksonville/Duval County due to plant construction and operation, and the additional revenues associated

with the increased school enrollment caused by these children. During the first year of construction (1982), the Duval County school system will receive approximately \$19,800 in additional state aid due to the increase of 22 immigrant school age children in the system. By 1985, the number of immigrant school age children is expected to reach 179, accounting for \$161,660 in additional state educational aid. By 1988, the number of immigrant school age children is expected to stabilize at approximately 36 through the year 2025. During these years (1988-2025), the school system will receive about \$33,120 annually (1980 dollars) in additional state aid attributable to the immigrant school age children.

Other Taxes

Although there are other state levied taxes such as the gross receipts tax and sales tax, the focus of the fiscal analysis is local (Jacksonville/Duval County). Therefore, these state taxing mechanisms, which can benefit local jurisdictions indirectly, were not considered in this study.

Cost of Electricity

All families serviced by JEA will benefit from the proposed plant, particularly low and moderate income families, through lower electrical costs than would otherwise occur. The current generating cost of electricity per kilowatt by coal is about one-half the cost of oil-based electric generation (Power Engineering, 1980 and Wall Street Journal, 1980). This cost differential is expected to continue. Therefore, the addition of the proposed coal-fired plant will be reflected in lower electric rates compared to generation by oil. Low income areas will also benefit from the new jobs generated by construction and operation of the plant. Construction, operation, and non-basic/secondary employment will cumulatively create 6,836 jobs by 1985. Of these 6,836 jobs, approximately 150 are unskilled construction positions and 4,261 are non-basic, primarily service oriented jobs requiring minimal skills. The additional revenues

(property taxes and payments in lieu of taxes) generated by the proposed plant would also benefit low income areas. These additional funds could provide some relief for low-cost housing construction and/or restoration of lower income neighborhoods.

Secondary Commercial and Industrial Development

The proposed plant will also play an instrumental role in secondary commercial and industrial development in the Jacksonville area. The assurance of an adequate energy supply and competitive electric rates are prime locational criteria for many industries, especially energy intensive operations.

7.1.3 References

Battelle - Columbus Division and Plantec Corporation, 1980. A Targeted Industry Identification Program for the Jacksonville Area.

City of Jacksonville/Duval County, 1980a. Department of Finance, Budget Division.

City of Jacksonville/Duval County, 1980b. Property Appraiser's Office.

Power Engineering Magazine, December, 1980.

State of Florida, 1980. State Board of Education.

Wall Street Journal, 1980.

Table 7.1-1

BASIC CONSTRUCTION AND OPERATIONAL EMPLOYMENT

<u>Year</u>	<u>Construction Phase</u>	<u>Operational Phase</u>	<u>Total Basic Employment</u>
1982	254	-	254
1983	1,366	-	1,366
1984	2,316	68	2,384
1985	2,294	281	2,575
1986	1,089	281	1,370
1987	614	375	989
1988	-	375	375
1989	-	375	375
1990	-	375	375

Source: Ebasco/Envirosphere Company

Table 7.1-2

TOTAL EMPLOYMENT IMPACTS
(Construction and Operational Phases)

<u>Year</u>	<u>Basic Employment</u>		<u>Non-Basic/Indirect</u>	<u>Total</u>
	<u>Construction</u>	<u>Operational</u>	<u>Employment</u>	<u>Employment</u>
1982	254	-	310	575
1983	1,366	-	1,814	3,180
1984	2,316	68	3,521	5,905
1985	2,294	281	4,261	6,836
1986	1,089	281	2,942	4,312
1987	614	375	2,107	3,096
1988		375	1,096	1,471
1989		375	826	1,201
1990		375	733	1,108
1991		375	715	1,090
1992		375	704	1,079
1993		375	704	1,079
1994		375	704	1,079

Source: Ebasco/Envirosphere Company

Table 7.1-3

DIRECT AND INDIRECT INCOME EFFECTS
(Construction and Operational Phases)
(1980 Dollars)

<u>Year</u>	<u>Basic Income</u>		<u>Non-Basic/Indirect Income</u>	<u>Total Income</u>
	<u>Construction</u>	<u>Operational</u>		
1982	\$ 4,708,027	-	\$ 2,729,827	\$ 7,437,854
1983	25,319,545		15,426,496	40,746,041
1984	42,928,306	\$ 916,200	29,943,051	73,787,557
1985	42,520,524	3,786,061	36,236,109	82,542,694
1986	20,185,201	3,786,061	25,019,158	48,990,420
1987	11,380,820	5,052,573	17,918,207	34,351,600
1988		5,052,573	9,320,529	14,373,102
1989		5,052,573	7,024,413	12,076,986
1990		5,052,573	6,233,529	11,286,102
1991		5,052,573	6,080,455	11,133,028
1992		5,052,573	5,986,909	11,039,482
-				
-				
-				
2025		5,052,573	5,986,909	11,039,482
2026		3,786,061	4,192,537	7,978,598
2027		3,786,061	4,192,537	7,978,598
Total	147,02,4237	213,110,791	367,871,754	728,024,968

Source: Ebasco/Envirosphere Company

Table 7.1-4

JEA PAYMENTS IN LIEU OF TAXES AND
FPL PROPERTY TAXES
(1980 Dollars)

<u>Operational Year</u>	<u>JEA Annual Level</u>	<u>FPL Annual Level</u>
1985	\$ 514,190	\$ 4,741,500
1986	\$ 8,159,940	\$ 5,080,200
1987	\$12,765,280	\$ 5,418,900
1988	\$16,438,140	\$ 5,283,400
-		
1992	\$16,556,400	\$ 4,741,500
-		
1997	\$16,556,400	\$ 4,064,200
-		
2002	\$14,191,200	\$ 3,386,800
-		
2012	\$14,191,200	\$ 2,032,100
-		
2017	\$14,191,200	\$ 1,354,700
-		
2022	\$ 9,460,800	\$ 677,400
-		
2025	\$ 9,175,680	\$ 270,900
2026	\$ 4,730,400	\$ 135,500
2027	\$ 2,060,640	\$ 67,700

Source: Ebasco/Envirosphere Company

Table 7.1-5

ADDITIONAL PROPERTY TAX REVENUE FROM
IMMIGRANT CONSTRUCTION AND OPERATIONAL WORKERS

<u>Year</u>	<u>Construction</u>		<u>Operational</u>	<u>Total</u>	<u>Cumulative</u>
	<u>SFH</u>	<u>MH</u>	<u>SFH</u>	<u>Tax</u>	<u>Effect</u>
1982	7	15		\$ 5,295	\$ 5,295
1983	32	72		24,406	29,701
1984	46	102	6	38,833	68,534
1985	46	103	24	50,113	118,647
1986	26	59	24	34,978	153,625
1987	16	35	32	32,302	185,927
1988			32	20,158	206,085
-					
1992			32	20,158	286,717
-					
1997			32	20,158	387,507
-					
2002			32	20,158	488,297
-					
2007			32	20,158	589,087
-					
2012			32	20,158	689,877
-					
2017			32	20,158	790,667
-					
2022			32	20,158	891,457
-					
2025			32	20,158	951,931
2026			32	15,118	967,049
2027			32	15,118	982,167

SFH - Single Family Home

MH - Mobile Home

Source: Ebasco/Envirosphere Company

Table 7.1-6

ADDITIONAL STATE EDUCATIONAL AID

<u>Year</u>	<u>Number of Immigrant School Age Children</u>		<u>Total Revenue</u>	<u>Cumulative Revenue</u>
	<u>Construction</u>	<u>Operation</u>		
1982	22		\$ 19,800	\$ 19,800
1983	105		94,500	114,300
1984	151	7	142,340	256,640
1985	151	28	161,660	418,300
1986	87	28	104,060	522,360
1987	52	36	79,920	602,280
1988		36	33,120	635,400
-				
1992		36	33,120	767,880
-				
1997		36	33,120	933,480
-				
2002		36	33,120	1,099,080
2007		36	33,120	1,264,680
-				
2012		36	33,120	1,430,280
-				
2017		36	33,120	1,595,880
-				
2022		36	33,120	1,761,480
-				
2025		36	33,120	1,860,840
2026		28	25,760	1,886,600
2027		28	25,760	1,912,360

Source: State of Florida, 1980 and Ebasco/Envirosphere Company

7.2 SOCIOECONOMIC COSTS

In order to attain the benefits discussed in Section 7.1, certain costs will have to be incurred. In this section direct, or internal, and indirect, or external costs of construction and operation of the proposed plant are discussed.

7.2.1 Plant Costs

The direct costs of relevance are the costs of constructing and operating the proposed plant. Construction of Units 1 and 2 will involve an expenditure of approximately \$1.6 billion in capital investment. Table 7.2-1 presents the annual "payback schedule" of this investment through the year 2015. These figures represent actual investment costs plus interest and are based on current (1980) estimates. The capital cost of the completed plant will be \$1,333 per kW of generating capacity. These capital costs are based on current (1980) costs of construction and equipment and a nominal power rating of 600,000 kilowatts (kW) per unit.

Operating and maintenance (O&M) costs are also direct costs of relevance (Table 7.2-2). Labor and materials costs to operate the proposed plant are projected to be approximately \$1.14 million in 1985, when Unit 1 is in full operation (Unit 1 will operate only one month, December, in 1985) and will rise to \$19.55 million in 1987 when both units are in operation (Table 7.2-3). The plant's regular payroll is estimated to number 281 employees when only Unit 1 is in operation with a total annual wage and salary cost averaging \$4.84 million (Table 7.2-2). Unit 2 will require an additional 94 employees commencing in 1987, raising the annual labor costs to about \$6.32 million for 375 employees (Table 7.2-2).

There is also a peak maintenance labor force that must be considered in annual O&M costs. This peak labor force is required six weeks out of every year for routine maintenance and repair. During 1985 and 1986, the average annual wage and salary cost for these additional workers is

projected to be \$615,000. After Unit 2 comes on line in 1987, this figure will rise to an annual average of approximately \$1.2 million. A complete breakdown of annual wage and salary costs is presented in Table 7.2-2. These wage and salary rates are based on current (1980) levels and trends in generating station personnel costs. Additional labor costs, as well as the projected material and supplies costs, are also presented in Table 7.2-2. The fringe benefits and employer's contributions for the proposed plant will average about \$1.43 million annually (1980 dollars) when only Unit 1 is operating (1985 and 1986) and increase to approximately \$1.94 million annually after Unit 2 comes on line in 1987. An average annual cost of about \$2.18 million (1980 dollars) will be incurred for materials and supplies during the years when only Unit 1 is operating. This figure will almost double to a level of \$4.35 million after Unit 2 begins operation. A complete yearly breakdown of annual costs for the proposed plant is presented in Table 7.2-3.

7.2.2 External Costs

External or indirect costs are those which affect people and/or interests in the vicinity of the proposed plant who, because of their proximity to the project and its activities, experience changes in their local environment. The most significant anticipated indirect costs associated with the proposed plant are various highway improvements and repairs and public service function costs induced by the immigrant populations.

7.2.2.1 Temporary External Costs

For the purposes of this assessment, "temporary" is defined as the period during which the proposed plant is being constructed (1982-1987). The projected construction work force and its impact on the human population is discussed in Chapter 4, Section 4.1.4.

Traffic and Road Wear

The most significant temporary external cost during construction will be traffic and road wear. Due to increased traffic, especially by heavy trucks, during construction, roads in the vicinity of the proposed plant will experience increased wear and congestion. In order to properly and adequately assess the possible impacts the proposed plant might have on traffic and road conditions in the proposed plant area, Envirosphere retained the services of Harland Bartholomew and Associates Inc. of Jacksonville to conduct a study of current traffic and road conditions in the plant vicinity and any projected impacts the construction and operation of the proposed plant might have on these conditions. Based on the results of this study, which are discussed in Chapter 2, Section 2.3, construction and operational activities of the proposed plant would likely require the following road improvements (see Figure 7.2-1 for locations):

- . Main Street at New Berlin Road - extension of the northern approach left turn lane on Main Street by 150-200 feet, flaring of New Berlin Road at the intersection to accommodate a wider turning radius. Cost - \$20,000.
- . Heckscher Drive at Main Street - extension of the northern approach left turn lane and the southern approach right turn lane of Main Street by 150-200 feet. Cost - \$20,000.
- . Main Street at Eastport Road - extension of the northern approach left turn lane of Main Street by 150-200 feet, flaring of Eastport Road at the intersection to accommodate a wider turning radius. Cost - \$20,000.
- . Heckscher Drive at I-95 spur - complete signalization of intersection. This includes a 4-phase controller, 7 ring-around heads, and all accessory equipment and installation. Cost - \$30,000.

- . New Berlin Road at Heckscher Drive - widen Heckscher Drive for a distance of approximately 500 feet at the intersection (250 feet on each side of New Berlin Road). This would provide room for a western approach left turn lane. Widen New Berlin Road on the northern approach to the intersection for a distance of approximately 300 feet. This would allow room for a "right turn on red" lane. Re-signalization of the intersection including a 4-phase controller, 10 ring-around heads and all accessory equipment and installation. Cost - \$50,000.
- . Eastport Road at Heckscher Drive - realignment of intersection resulting in a T-type intersection. This would entail rebuilding Eastport Road for a distance of 500-600 feet and widening Heckscher Drive through the intersection for a distance of approximately 500 feet (250 feet on each side of Eastport Road). Complete signalization of intersection including a 4-phase controller, 7 or 8 ring-around heads and all accessory equipment and installation. Cost - \$80,000.

These improvements would have a total cost of \$220,000 (1980 dollars). Because of the projected heavy truck traffic on New Berlin Road during construction and operation of the plant, the Jacksonville Highway Department predicts New Berlin Road will need resurfacing about every 10 years beginning in 1987. This required maintenance would amount to approximately \$32,884 per resurfacing and will be discussed in Section 7.2.2.2. Annual signal and road maintenance costs of these improvements must also be considered (City of Jacksonville/Duval County, 1980a).

The annual operating and maintenance costs for the newly signalized intersections (Heckscher Drive at I-95 spur, New Berlin Road at Heckscher Drive and Eastport Road at Heckscher Drive) are projected to be approximately \$4,725 (1980 dollars). The annual maintenance cost for New Berlin Road is projected to be approximately \$4,384 (1980 dollars). These figures amount to a total annual highway O&M cost attributable to plant

construction and operation of about \$9,109 (1980 dollars). Table 7.2-4 presents a detailed breakdown of these highway costs. As mentioned previously in this section, the resurfacing of New Berlin will not take place until 1987. Therefore, any costs associated with these improvements after 1987 are considered "long term" and will be discussed in Section 7.2.2.2 (City Jacksonville/Duval County, 1980a).

Services

The levels and capacities of specific services within Jacksonville/Duval County and the impacts of construction and operation of the proposed plant might have on these services must also be considered in cost analysis. Based on the results of an analysis of the Ebasco/Envirosphere Construction Worker Model (Appendix H, Section H.4), it was determined any major population increase generated by the construction and operation of the proposed plant would be in Jacksonville/Duval County. Therefore, information involving counties of the secondary impact area will be presented only in cases deserving special attention.

Public service impacts are classified as residential and nonresidential, with residential impacts focusing on the impact the immigrant population will have upon public and non-public services and non-residential impacts focusing on the operating impacts the proposed plant will have on public and non-public services. Since a majority of the immigrant work force during construction of the proposed plant is expected to reside in Jacksonville/Duval County, and since Jacksonville/Duval County is a consolidated government, all public service impacts will be on city/county administered public services.

The Fiscal Impact Model, discussed in Appendix H, Section H.5, used to determine the impact of the immigrant (residential) population on public services assesses the current excess or deficient capacities of identified public services, incorporating desired local service standards, if available, for each of the public services. The model computes the service demand induced by the immigrant populations for each of the identified

public services. By a simple comparison of the current (excess or deficient) capacities and the induced demand for a specific public service, it can be determined if the immigrant induced demand will generate any additional public service costs. Chapter 2, Table 2.3-9 illustrates the service functions examined, the governmental jurisdiction of each service function and the desired service standard.

Nonresidential impacts focus on the impacts the proposed plant might have on Jacksonville/Duval County public services. The public service operational model utilized in this analysis identifies any specific public responses (e.g., police patrolling) that might be attributed to a nonresidential use. If an identification of this type is made, the model determines the service units (number of times a service is rendered), time required (time needed to complete one service unit), operational personnel (personnel required to perform the service) and an operational cost (cost required to perform one hour of the operational task). The model then incorporates these inputs to determine the public service operational costs attributed to a nonresidential use.

Along with the examination of the residential and nonresidential impacts on public services, this section also investigates impacts the immigrant population would have on two non-public services, hospitals and housing. The examination focuses on the ability of the various hospitals in Jacksonville/Duval County to absorb the immigrant population demand for hospitalization and determines if there will be additional housing construction required above the level projected without the presence of the proposed plant.

Residential Public Service Impacts

Tables 7.2-5 through 7.2-14 illustrate current (1980) and projected service levels of the identified public services. These tables also presents the immigrant induced demand for these services, the excess or deficient capacities these services will have during a given year and any public cost attributable to the immigrant induced demand.

As discussed in previous sections, there is an overlap of the construction and operation phases from 1984-1987. Therefore, any additional public cost figures presented in Tables 7.2-5 through 7.2-14 for these years reflect the induced demand for the specific public service by both construction and operational immigrant populations.

The city's general administration service function with its two components, financial administration and general control, is currently (1980) operating with a deficiency of 122 personnel. Although a deficiency in personnel could continue throughout the entire construction period (1982-1987), only one additional staff member would be attributable to the immigrant construction population. As Table 7.2-5 illustrates, the immigrant population would not necessitate the addition of personnel in this department during the first year of construction (1982), but one additional person would be needed to meet the immigrant induced demand for this service during the period 1983-1987 at a public cost of \$37,803 per year (1980 dollars). From 1988-2027, there would be no additional public service costs in the city's general administration service function attributable to the immigrant populations.

The police component of the public safety service function has a current (1980) excess of 161 full time personnel (Table 7.2-6). As illustrated in Table 7.2-6, there will be an immigrant induced demand for one additional full time police employee during each of the years 1983-1987. However, the projected excess of police department employees during these years will be able to absorb this demand without additional public cost. The remaining operational years (1988-2027) will have no additional public costs for police services attributable to the immigrant population. Fire service function standards are based on first due response time and pumping capacity, rather than number of personnel. The Jacksonville/Duval County Fire Department is structured such that engine companies have a service radius of two miles or less and a ladder company has a service radius of three miles or less, each having a first due pumping capacity of 500 to 1,500 gallons per minute. The fire component is

currently (1980) operating well within the standards presented in Chapter 2, Table 2.3-9 and is projected to be able to absorb the immigrant demand throughout the life of the proposed plant.

The Jacksonville/Duval County Public Works function is comprised of three components--sewage, water and sanitation. At present (1980), all three components are operating with excess capacity. The sewer component has a 3-stage (1984, 1988, 1990) expansion project planned which will adequately meet immigrant demand throughout the construction and operational phases of the proposed plant. These proposed expansions and the corresponding excess capacity levels are presented in Table 7.2-7. The water system has a current (1980) capacity of approximately 178 million gallons per day. The city has a planned expansion of the Arlington and Marietta facilities for 1984, which will increase the systems capacity by 20 million gallons per day. Based on future population projections and water demand, the city's water system will have enough excess capacity to absorb the induced demand of the immigrant populations during the construction and operational phases of the proposed plant (Table 7.2-8). The sanitation component, based on projected populations and planned increases of the system's capacity, would also have enough excess capacity to absorb the induced demand of the immigrant populations during the construction and operational phases of the proposed plant. Sanitation service levels are based on capacity of packers and mode of disposal, and as illustrated in Table 7.2-9, projected capacity levels are more than adequate to accommodate the increased immigrant demand for this service function. Existing landfill sites will also experience minimal impacts due to immigrant population. Based on projections by the city of Jacksonville Sanitation Department (City of Jacksonville/Duval County, 1980b), the Northside landfill, which is the largest in the county, has a remaining life of 17 years. The total solid waste attributable to the immigrant population during those 17 years (1980-1997) is projected to require approximately 8000 cubic yards of landfill capacity. This equates to about 42 cubic yards per month (Envirosphere, from City of Jacksonville/Duval

County, 1980b). If these data are applied to the expected life calculations of the Northside landfill alone, the projected life of the landfill would be shortened by less than one week.

At present (1980), the public health component of the health and welfare service function is operating with a large deficiency in personnel. One explanation for this could be the abundance of non-public health facilities in Jacksonville/Duval County. However, not until the second year of the construction phase (1983), would the induced immigrant demand for this service warrant the addition of full time public health personnel. As depicted in Table 7.2-10, there would be the need for one additional full time public health staff member during the years 1983-1986 at an annual public cost of \$40,855. There would be no need for additional public health personnel attributable to the immigrant populations throughout the remaining operational life of the proposed plant (1987-2027).

The recreation service function pertains primarily to city and community parks. Due to the great variation in desired service standards, attempts to use the same recreation standards for a variety of locations, each with different site situations and participant circumstances, are usually unsatisfactory. The determination of recreational needs of a community is for the most part a value judgement on the part of administrators and planners and does not, therefore, sufficiently lend itself to the quantitative approach taken in this analysis. Even with the planned expansion of existing parks and the creation of new ones in Jacksonville/Duval County, there will be a constant deficit in this service function due to growing populations and limited land resources. Therefore, no public service cost will be assigned to this service function.

The library service function of Jacksonville/Duval County is currently (1980) operating at a deficit as far as total book holdings are concerned (see Chapter 2, Table 2.3-9 for state library standards). The Jacksonville/Duval County library system also serves Nassau County. Therefore, the resident population of Nassau County, and any immigrant

population attributable to the proposed plant that might settle in Nassau County, must be included in the analysis of the library service function. Table 7.2-11 illustrates the current deficit in total book holdings and the continued deficit through the year 1994. Not until the year 1995 will the library service function be able to meet the total demand, both resident and immigrant, for its services.

The service levels of the Jacksonville/Duval County school district are presented in Tables 7.2-12 through 7.2-14. Although the physical capacity of the school system would be able to absorb the additional school children of the immigrant workers, it is assumed the staffing of the school system would be based on projected enrollment figures. That is to say, a particular school may have the physical capacity to accommodate 500 students, but if the school's enrollment is only 350, the teaching staff will be based on the enrollment of 350 students in accordance with the specific standards set forth in Chapter 2, Table 2.3-9. The school system of Jacksonville/Duval County is segmented in three levels: elementary (grades K-6); junior high or middle school (grades 7-9); and high school (grades 10-12). As previously mentioned, this analysis assumes each level of the school system to be presently operating at full capacity. Table 7.2-12 presents projected levels for the elementary level (grades K-6). As illustrated in this table, the immigrant population will necessitate additions to the teaching staff at this grade level throughout the construction and operational phases of the proposed plant. During the first year of construction (1982), the immigrant induced demand will create the need for one additional classroom teacher at a public cost of \$28,920. The immigrant induced demand for additional teachers at the elementary grade level will peak in 1985, with a need for five additional teachers at an annual cost of \$144,600. The immigrant induced demand for elementary grade level teachers will decrease from this point, reaching a stabilizing level in 1988 of one additional teacher over the present (1980) level. The need for one additional (over the 1980 level) teacher at this grade level will remain constant throughout the remaining life (1988-2027) of the proposed plant at an annual public cost of \$28,920 (1980 dollars).

The projected capacities for the junior high or middle school level (grades 7-9) are illustrated in Table 7.2-13. The immigrant population will generate no need for additional teachers during 1982, but the immigrant induced demand will create the need for one additional classroom teacher in 1983 at an annual public cost of \$30,205. A need for two additional teachers (over the 1980 level) at this grade level will be generated by the immigrant school age children during 1984 and 1985 at an annual cost of \$60,410. The immigrant induced demand for teachers at this grade level will decline in 1986 and 1987 to one additional teacher (over the 1980 level) at an annual public cost of \$30,205 (1980 dollars). There will be no need for additional teachers at this level created by the immigrant population for the remaining life of the plant (1987-2027). The immigrant population will generate a need for additional teachers at the high school level (grades 10-12) in the years 1983-1987 (Table 7.2-14). The immigrant induced demand for teachers at this level will require one additional classroom teacher (over the 1980 level) in each of these years at an annual public cost of \$31,975. The school system will be able to absorb the high school age children of the immigrant workers throughout the remaining life of the proposed plant (1988-2027) without additional classroom teachers.

Residential Impacts on Nonpublic Services

As pointed out in Chapter 2, Section 2.3.2, and earlier in this section, two nonpublic services (hospitals and housing) are examined to ascertain their ability to absorb the impact of construction and operational phase immigrant populations.

The various hospitals in Jacksonville/Duval County are currently (1980) maintaining a service level of approximately 1,065,000 patient days, which allows for an excess capacity of about 286,000 patient days. The capacity benchmark utilized by a majority of the hospitals in the area is 80 percent. When resident demand (utilization) reaches the 80 percent benchmark, enough beds are added to reduce the utilization percentage to 70

percent. As illustrated in Table 7.2-15, the 80 percent benchmark is reached in the years 1985, 1994, 2006 and 2020. Additional beds will be needed in each of the years following these to reduce the utilization factor to 70 percent. Based on these projections and policies, the hospitals in Jacksonville/Duval County would be able to absorb the induced patient days created by the immigrant populations during the construction and operational phases of the proposed plant.

The Jacksonville/Duval County projected housing supply and its ability to absorb immigrant demand is displayed in Table 7.2-16. At present (1980), there are approximately 223,000 total available housing units in Jacksonville/Duval County, which is a surplus of about 11,000 units (Chapter 2, Section 2.3). The type units included in this analysis were single family homes (owned or rented), apartments, and mobile homes - motel rooms were not included. Based on current projections of future total and occupied housing units, the city would be able to absorb the immigrant demand for housing during the construction and operational phases of the proposed plant without having to add units beyond the projected levels. During the construction phase (1982-1987), the excess capacity or vacancies in housing would range from about 11,600 to 12,400. As discussed in Chapter 2, Section 2.3, the Jacksonville area experienced an apartment boom during the seventies and construction of single family units also showed steady increases. This resulted in a surplus of housing units in the area and high vacancy rates, especially for apartments. Due to the transient nature of construction workers, it is assumed a majority of the immigrant construction workers at the proposed plant will choose to reside in rental units (primarily apartments), thereby reducing the vacancy rate for these units. The projected available housing levels and demand for housing indicate there will be more than adequate housing throughout the life of the proposed plant.

Non-Residential Impacts

The non-residential impacts of plant construction and operation which could possibly affect the public are confined to such factors as noise, air quality, water quality, and aesthetic disturbances. Discussion of these factors with relation to plant construction and operation are presented in Chapters 4 and 5, respectively.

7.2.2.2 Long Term External Costs

For the purpose of this assessment, "long term" is defined as the period during which both proposed units are in full operation (1988-2027). The projected operational work force and its impact on the human population is discussed in Chapter 5, Section 5.6.2.4.

There will be the continued non-residential or plant induced costs related to annual road and signal maintenance and the expense of resurfacing New Berlin Road every 10 years. Table 7.2-17 presents the projected annual costs for these items. Jacksonville/Duval County will incur an annual expense of approximately \$9,100 in routine highway maintenance through the operational years of 1988-2027. The only exception to these annual highway costs will be in the years 1997, 2007, 2017, and 2027, when the city/county will incur an expense of approximately \$37,600 (1980 dollars) for the resurfacing of New Berlin Road.

The only other external costs that will extend beyond 1987 are the residentially induced costs to the public library system and public school system. As discussed in Section 7.2.2.1, the library will not be able to totally absorb the additional immigrant induced demand for its services until 1995. During the years 1988-1994, there will be an annual public cost in this service function of a little over \$7,600 which will be attributable to the immigrant population. The public school system will incur an annual cost of \$28,920 (1980 dollars) during the years 1988-2027.

This is due to the one additional teacher (over the 1980 level) needed to meet immigrant induced demand at the elementary (grades K-6) grade level during these years.

7.2.2.3 Overall Fiscal Impact

Yearly breakdowns of public costs and revenues attributable to construction and operation of the proposed plant are presented in Tables 7.2-17 and 7.2-18, respectively. The overall fiscal impact of the proposed plant on Jacksonville/Duval County is presented in Table 7.2-19. As these figures illustrate, there will be a negative overall impact during the first three years of construction. These three years (1982, 1983, 1984) coincide with the years of greatest immigrant population influx which will induce a greater demand for various public services. Also incurred during this period will be the highway capital improvement costs of \$220,000. Since the plant will not be in operation during these years, the only additional public revenues attributable to the proposed plant to compensate for these public costs will be those generated through the additional property taxes levied on immigrant purchased housing and the additional state education funds induced by immigrant school enrollment. During these first three years, the proposed plant will have a cumulative negative overall impact of approximately \$518,500. Once Unit 1 comes on line in 1985, public revenues (Table 7.2-18), primarily through "payments in lieu of taxes" and property taxes paid by FPL, generated by the proposed plant will outweigh public costs (Table 7.2-17) induced by the plant by about \$5 million, creating an overall positive fiscal impact of approximately \$4.6 million. Over the estimated 40 year life of the plant, it is projected the plant will demonstrate a cumulative overall positive fiscal impact on Jacksonville/Duval County of over \$687 million. This figure is in excess of the direct benefits attributable to additional power.

7.2.3 References

City of Jacksonville/Duval County, 1980a. Personal Communication with
Bob Hill, Department of Public Works, Streets and Highways Division.

City of Jacksonville/Duval County, 1980b. Preliminary Draft: Solid Waste
Management and Resource Recovery Plant

Harland Bartholomew and Associates, Inc., 1980. Contract Traffic Study.

Table 7.2-1
CAPITAL INVESTMENT COSTS
(Payback Schedule)
(\$1,000)

<u>Year</u>	<u>JEA</u> ^a	<u>FPL</u> ^b	<u>Total</u>
1986	0	47	47
1987	0	67	67
1988	102	149	251
1989	93	145	238
1990	91	142	233
1991	89	139	228
1992	87	136	223
1993	86	133	219
1994	86	130	216
1995	86	127	213
1996	86	125	211
1997	86	122	208
1998	86	126	206
1999	86	117	203
2000	86	115	201
2001	86	113	199
2002	86	111	197
2003	86	108	194
2004	86	106	192
2005	86	104	190
2006	86	101	187
2007	86	99	185
2008	86	97	183
2009	86	94	180
2010	86	93	179
2011	86	91	177
2012	86	90	176
2013	86	88	174
2014	86	87	173
2015	86	85	171

^a From Table 1.2-9.

^b From Table 1.2-10.

Source: Jacksonville Electric Authority and Florida Power & Light

Table 7.2-2
ANNUAL OPERATING AND MAINTENANCE COSTS
(1980 Dollars)

Normal Plant Labor and Supervision Wages and Salaries

<u>Description of Position</u>	<u>No. Two Units/One Unit</u>	<u>Rate (\$1980)</u>	<u>Annual Cost Two Units/One Unit</u>
Plant Manager	1	45,000	45,000
Assistant Plant Manager	1	38,000	38,000
Superintendents	5	34,000	170,000
Assistant Superintendents	4	32,000	128,000
Supervisor of Plant Operations	1	32,000	32,000
Shift Engineers	5	30,000	150,000
Supervisors	4	30,000	120,000
Assistant Shift Engineers	10/5	28,000	280,000/ 140,000
Engineers	9	28,000	252,000
Public Relations	1	26,000	26,000
Training	1	24,000	24,000
Unit Operator	10/5	18,000	180,000/ 90,000
Assistant Unit Operator	35/20	14,000	490,000/ 280,000
Auxiliary Unit Operator	25/15	12,000	300,000/ 180,000
Foremen	21	20,000	420,000
Mechanics and Welders	109/80	18,000	1,962,000/1,440,000
Equipment Operators and Drivers	17/10	18,000	306,000/ 180,000
Lab Analysts and Testers	20/15	18,000	360,000/ 270,000
Apprentices	13	13,000	169,000
Switchboard Operators	10	12,000	120,000
Trainees	5	12,000	60,000
Guards	6	11,000	66,000
Clerk Steno	1	11,000	11,000
Engineering Aides	5	10,000	50,000
Clerks	12	10,000	120,000
Labor and Janitors	<u>44/26</u>	10,000	<u>440,000/ 260,000</u>
Subtotal	375/281		6,319,000/4,841,000

Table 7.2-2 (Continued)
ANNUAL OPERATING AND MAINTENANCE COSTS
(1980 Dollars)

Peak Maintenance Labor Wages

<u>Description of Position</u>	<u>Weeks/Year</u>	<u>No. Two Units/One Unit</u>	<u>Rate (\$1980)</u>	<u>Annual Cost Two Units/One Unit</u>
Mechanics	6	500/250	18,000	1,038,000/519,000
Apprentices	6	50/ 25	13,000	75,000/ 38,000
Foremen	6	50/ 25	20,000	115,000/ 58,000
Subtotal		600/300		1,228,000/615,000

Fringe Benefits and Taxes

<u>Description</u>	<u>Annual Cost Two Units/One Unit</u>
Fringes on Normal Labor	1,259,000/ 998,000
Fringes on Peak Labor	242,000/ 121,000
FICA on Normal Labor	363,000/ 278,000
FICA on Peak Labor	74,000/ 37,000
Subtotal	1,938,000/1,434,000

Total Labor Costs

<u>Description</u>	<u>Annual Cost Two Units/One Unit</u>
Normal Labor	6,319,000/4,841,000
Peak Labor	1,228,000/ 615,000
Fringe Benefits and Taxes	1,938,000/1,434,000
Total	9,485,000/6,890,000

<u>Material and Supplies</u>	<u>Annual Cost Two Units/One Unit</u>
Based on 82% of Maintenance Labor	4,350,000/2,175,00

Table 7.2-2 (Continued)
ANNUAL OPERATING AND MAINTENANCE COSTS
(1980 Dollars)

Start-up and Shutdown Fuel Oil

<u>Description</u>	<u>Events/Yr</u>	<u>Gals Ea.</u>	<u>Total</u>
Hot Start Ignition Oil	5	4,860	24,300
Cold Start Ignition Oil	2	14,580	29,160
Aux. Boiler (Cold Start)	2	1,950	3,900
Shutdown Ignition Oil	7	3,888	27,216
			84,576 (One Unit)
Total Annual Cost (One Unit)			\$81,300
(Two Units)			\$162,600

Fuel and Reagent Cost

<u>Coal Cost</u>	<u>\$/Ton</u>	<u>\$/MMBtu</u>
Coal (avg.) @ 12,000 Btu/lb	26.50	
Transportation, etc.	12.00	
Total	38.50	1.5524
<u>Reagent Cost</u>		
Limestone (hardrock)	3.00	
Transportation, etc.	10.68	
Total*	13.68	0.0037

* Based on: 20 TPH; 554,002 kW; and 9,695 Btu/kWh at 100% load.

Table 7.2-3

TOTAL ANNUAL OPERATING COSTS

(Escalated to Actual Year of Operation)

Year	Fixed Charges (\$10 ³)	O&M Labor (\$10 ³)	Maint. Mat'l (\$10 ³)	Ign. Oil (\$10 ³)	Fuel and Reagent Unit (\$/MMBtu)	Annual	Total Cost (10 ³)	Annual Output (10 ⁶ kWh)	Cost/ kWh (¢/kWh)
1985	0	863	275	11	2.64	6,545	7,694	248	3.1
1986	47,000	11,184	3,563	152	2.91	96,396	158,295	3,324	4.76
1987	67,000	14,743	4,810	265	3.18	168,768	255,586	5,274	4.85
1988	251,000	17,974	8,313	370	3.48	234,395	512,052	6,697	7.65
1989	238,000	19,417	8,798	409	3.81	258,134	524,758	6,793	7.72
1990	233,000	20,965	9,696	443	4.17	283,290	547,394	6,745	8.12
1991	228,000	22,646	10,472	490	4.56	310,270	571,878	6,745	8.48
1992	223,000	24,450	11,300	531	4.99	337,250	596,531	6,745	8.84
1993	219,000	26,415	12,214	576	5.46	370,975	629,180	6,745	9.33
1994	216,000	28,532	13,191	625	5.97	404,700	663,048	6,745	9.83
1995	213,000	30,811	14,246	678	6.53	445,170	703,905	6,745	10.44
1996	211,000	33,270	15,386	735	7.15	485,640	746,031	6,745	11.06
1997	208,000	35,929	16,617	797	7.82	532,855	794,198	6,745	11.77
1998	206,000	38,816	17,946	864	8.55	580,070	843,696	6,745	12.51
1999	203,000	41,920	19,382	937	9.36	640,775	906,014	6,745	13.43
2000	201,000	45,272	20,933	1,016	10.24	694,735	962,956	6,745	14.28
2001	199,000	48,889	22,607	1,102	11.20	653,366	924,964	5,782	16.00
2002	197,000	52,802	24,416	1,195	12.25	716,968	992,381	5,782	17.16
2003	194,000	57,026	26,369	1,296	13.40	780,570	1,059,261	5,782	18.32
2004	192,000	61,585	28,479	1,406	14.66	826,826	1,110,296	5,782	19.20
2005	190,000	66,511	30,757	1,525	16.04	936,684	1,225,477	5,782	21.19
2006	187,000	71,832	33,217	1,654	17.55	1,023,414	1,317,117	5,782	22.78
2007	185,000	77,579	35,874	1,793	19.20	1,121,708	1,421,954	5,782	24.59
2008	183,000	83,785	38,745	1,945	21.00	1,225,784	1,533,259	5,782	26.52
2009	180,000	90,488	41,844	2,109	22.18	1,341,424	1,655,865	5,782	28.64
2010	179,000	97,727	45,192	2,288	35.14	1,468,628	1,792,835	5,782	31.01
2011	177,000	105,545	48,807	2,481	27.50	1,607,396	1,941,229	5,782	33.57
2012	176,000	113,989	52,712	2,690	30.08	1,757,728	2,103,119	5,782	36.37
2013	174,000	123,108	56,929	2,918	32.91	1,919,624	2,276,579	5,782	39.37
2014	173,000	132,956	61,483	3,164	36.01	2,104,648	2,475,251	5,782	42.81
2015	171,000	143,593	66,402	3,432	39.39	2,301,236	2,685,663	5,782	46.45

Table 7.2-4

PLANT INDUCED HIGHWAY COSTS
(1980 Dollars)

Capital Improvements

1982 - Main Street at New Berlin Road	\$ 20,000
1982 - Heckscher Drive at Main Street	20,000
1982 - Main Street at Eastport Road	20,000
*1982 - Heckscher Drive at I-95 spur	30,000
*1982 - New Berlin Road at Heckscher Drive	50,000
*1982 - Eastport Road at Heckscher Drive	<u>80,000</u>
Total	\$ 220,000
1987 - Resurface New Berlin Road	\$ 32,884
1997 - Resurface New Berlin Road	\$ 32,884
2007 - Resurface New Berlin Road	\$ 32,884
2017 - Resurface New Berlin Road	<u>\$ 32,884</u>
Total	\$ 131,536

Annual O&M Costs

Signal Maintenance of *Intersections - \$500/year/intersection	\$ 1,500
Operating Costs of *Intersections - \$1075/year/intersection	3,225
Maintenance of New Berlin Road - Regular Maintenance	4,177
- Supervisory Cost	<u>207</u>
Total	\$ 9,109

Source: Harland Bartholomew and Associates
City of Jacksonville Highway Department

Table 7.2-5

IMMIGRANT EFFECT ON FINANCIAL ADMINISTRATION/GENERAL CONTROL
(Construction and Operational Phases)
(1980 Dollars)

<u>Year</u>	<u>Resident Demand</u>	<u>(Full Time Personnel)</u>		<u>Immigrant Demand</u>	<u>Ability to Absorb/Cost</u>
		<u>Service Level</u>	<u>Excess/ Deficiency</u>		
1980	1135	1013	- 122	-	-
1982	1170	1047	- 123	0	yes/no cost
1983	1188	1063	- 125	1	no/\$37,803
1984	1206	1079	- 127	1	no/\$37,803
1985	1224	1095	- 129	1	no/\$37,803
1986	1241	1110	- 131	1	no/\$37,803
1987	1257	1124	- 133	1	no/\$37,803
1988	1274	1139	- 135	0	yes/no cost
1992	1340	1199	- 141	0	yes/no cost
1997	1423	1272	- 151	0	yes/no cost
2002	1500	1341	- 159	0	yes/no cost
2007	1572	1406	- 166	0	yes/no cost
2012	1645	1471	- 174	0	yes/no cost
2017	1717	1536	- 181	0	yes/no cost
2022	1790	1601	- 189	0	yes/no cost
2025	1833	1640	- 193	0	yes/no cost
2026	1848	1653	- 195	0	yes/no cost
2027	1864	1666	- 198	0	yes/no cost

Source: U.S. Department of Commerce and Ebasco/Envirosphere Company

Table 7.2-6

IMMIGRANT EFFECT ON POLICE SERVICES
(Construction and Operational Phases)
(1980 Dollars)

<u>Year</u>	<u>Resident Demand</u>	<u>(Full Time Police Personnel)</u>		<u>Immigrant Demand</u>	<u>Ability to Absorb/Cost</u>
		<u>Service Level</u>	<u>Excess/ Deficiency</u>		
1980	1324	1485	+ 161		
1982	1365	1495	+ 130	0	yes/no cost
1983	1387	1518	+ 131	1	yes/no cost
1984	1407	1541	+ 134	1	yes/no cost
1985	1428	1564	+ 136	1	yes/no cost
1986	1447	1585	+ 138	1	yes/no cost
1987	1468	1606	+ 138	1	yes/no cost
1988	1486	1627	+ 141	0	yes/no cost
1992	1563	1712	+ 149	0	yes/no cost
1997	1660	1818	+ 158	0	yes/no cost
2002	1750	1916	+ 166	0	yes/no cost
2007	1834	2009	+ 175	0	yes/no cost
2012	1919	2101	+ 182	0	yes/no cost
2017	2002	2194	+ 192	0	yes/no cost
2022	2088	2288	+ 200	0	yes/no cost
2025	2140	2343	+ 203	0	yes/no cost
2026	2157	2362	+ 205	0	yes/no cost
2027	2174	2381	+ 207	0	yes/no cost

Source: U.S. Department of Commerce and Ebasco/Envirosphere Company

Table 7.2-7

**IMMIGRANT EFFECT ON PUBLIC SEWER SYSTEM
(Construction and Operational Phases)
(1980 Dollars)**

<u>Year</u>	<u>Resident Demand</u>	<u>(Million Gallons Per Day)</u>		<u>Immigrant Demand</u>	<u>Ability to Absorb/Cost</u>
		<u>Service Level</u>	<u>Excess/ Deficiency</u>		
1980	50.73	71.655	+20.925		
1982	52.31	71.655	+19.345	.002	yes/no cost
1983	53.11	71.655	+18.545	.011	yes/no cost
1984	53.90	114.805	+60.905	.017	yes/no cost
1985	54.70	114.805	+60.105	.017	yes/no cost
1986	55.44	114.805	+59.365	.012	yes/no cost
1987	58.18	114.805	+56.625	.009	yes/no cost
1988	56.92	122.305	+65.385	.004	yes/no cost
1992	59.90	144.805	+84.905	.004	yes/no cost
1997	63.58	144.805	+81.225	.004	yes/no cost
2002	67.01	144.805	+77.795	.004	yes/no cost
2007	70.25	144.805	+74.555	.004	yes/no cost
2012	73.49	144.805	+71.315	.004	yes/no cost
2017	76.72	144.805	+68.085	.004	yes/no cost
2022	80.00	144.805	+64.805	.004	yes/no cost
2025	81.96	144.805	+62.845	.004	yes/no cost
2026	82.61	144.805	+62.195	.003	yes/no cost
2027	83.26	144.805	+61.545	.003	yes/no cost

Source: City of Jacksonville/Duval County Department of Public Works, Water Resources Council and Ebasco/Envirosphere Company

Table 7.2-8

**IMMIGRANT EFFECT ON PUBLIC WATER SYSTEM
(Construction and Operational Phases)
(1980 Dollars)**

<u>Year</u>	<u>(Million Gallons Per Day)</u>				<u>Ability to Absorb/Cost</u>
	<u>Resident Demand</u>	<u>Service Level</u>	<u>Excess/ Deficiency</u>	<u>Immigrant Demand</u>	
1980	57.14	178.263	+121.123		
1982	58.94	178.263	+119.323	.003	yes/no cost
1983	59.83	178.263	+118.433	.015	yes/no cost
1984	60.73	198.263	+137.653	.023	yes/no cost
1985	61.62	198.263	+136.643	.024	yes/no cost
1986	62.46	198.263	+135.803	.016	yes/no cost
1987	63.29	198.263	+134.973	.013	yes/no cost
1988	64.12	198.263	+134.143	.005	yes/no cost
1992	67.48	198.263	+130.783	.005	yes/no cost
1997	71.63	198.263	+126.633	.005	yes/no cost
2002	75.50	198.263	+122.763	.005	yes/no cost
2007	79.14	198.263	+119.123	.005	yes/no cost
2012	82.79	198.263	+115.473	.005	yes/no cost
2017	86.43	198.263	+111.833	.005	yes/no cost
2022	90.13	198.263	+108.133	.005	yes/no cost
2025	92.33	198.263	+105.935	.005	yes/no cost
2026	93.06	198.263	+105.203	.004	yes/no cost
2027	93.79	198.263	+104.473	.004	yes/no cost

Source: City of Jacksonville/Duval County Department of Public Works, Water Resources Council and Ebasco/Envirosphere Company

Table 7.2-9

IMMIGRANT EFFECT ON PUBLIC SANITATION SERVICES
(Construction and Operational Phases)

<u>Year</u>	<u>Resident Demand</u>	<u>(Total Pounds per Day)</u>		<u>Immigrant Demand</u>	<u>Ability to Absorb/Cost</u>
		<u>Service Level</u>	<u>Excess/ Deficiency</u>		
1980	863,922	1,112,800	+248,878		
1982	890,993	1,112,800	+221,807	239.12	yes/no cost
1983	904,529	1,112,800	+208,271	1129.72	yes/no cost
1984	918,064	1,112,800	+194,736	1688.48	yes/no cost
1985	931,600	1,112,800	+181,200	1708.00	yes/no cost
1986	944,204	1,240,000	+295,796	1220.00	yes/no cost
1987	956,808	1,240,000	+283,192	941.84	yes/no cost
1988	969,412	1,240,000	+270,588	392.84	yes/no cost
1992	1,020,158	1,240,000	+219,842	392.84	yes/no cost
1997	1,082,848	1,240,000	+157,152	392.84	yes/no cost
2002	1,141,347	1,240,000	+ 98,653	392.84	yes/no cost
2007	1,196,489	1,240,000	+ 43,511	392.84	yes/no cost
2012	1,251,632	1,440,000	+188,368	392.84	yes/no cost
2017	1,306,706	1,440,000	+133,294	392.84	yes/no cost
2022	1,362,574	1,440,000	+ 77,426	392.84	yes/no cost
2025	1,395,825	1,440,000	+ 44,175	392.84	yes/no cost
2026	1,406,908	1,440,000	+ 33,092	295.24	yes/no cost
2027	1,417,991	1,440,000	+ 22,009	295.24	yes/no cost

Source: City of Jacksonville/Duval County Department of Public Works, Water Resources Council and Ebasco/Envirosphere Company

Table 7.2-10

IMMIGRANT EFFECT ON PUBLIC HEALTH SERVICES
(Construction and Operational Phases)
(1980 Dollars)

<u>Year</u>	<u>Resident Demand</u>	<u>(Full Time Public Health Personnel)</u>			<u>Ability to Absorb/Cost</u>
		<u>Service Level</u>	<u>Excess/ Deficiency</u>	<u>Immigrant Demand</u>	
1980	757	165	- 592		
1982	780	195	- 585	0	yes/no cost
1983	792	198	- 594	1	no/\$40,855
1984	804	201	- 603	1	no/\$40,855
1985	816	204	- 612	1	no/\$40,855
1986	827	207	- 620	1	no/\$40,855
1987	838	210	- 628	0	yes/no cost
1988	849	212	- 637	0	yes/no cost
1992	894	223	- 671	0	yes/no cost
1997	948	237	- 711	0	yes/no cost
2002	1000	250	- 750	0	yes/no cost
2007	1048	262	- 786	0	yes/no cost
2012	1096	274	- 822	0	yes/no cost
2017	1145	286	- 859	0	yes/no cost
2022	1193	298	- 895	0	yes/no cost
2025	1223	306	- 917	0	yes/no cost
2026	1232	308	- 924	0	yes/no cost
2027	1242	310	- 932	0	yes/no cost

Source: U.S. Department of Commerce and Ebasco/Envirosphere Company

Table 7.2-11

IMMIGRANT EFFECT ON PUBLIC LIBRARY SERVICES
(Construction and Operational Phases)
(1980 Dollars)

Year	Resident Demand	(Total Book Holdings)		Immigrant Demand	Ability to Absorb/Cost
		Service Level	Excess/ Deficiency		
1980	1,664,000	1,179,745	- 484,255		
1982	1,721,100	1,300,145	- 420,955	268	no/\$ 5,079
1983	1,749,650	1,360,345	- 389,305	1355	no/\$25,677
1984	1,778,200	1,420,545	- 357,655	2123	no/\$40,231
1985	1,806,750	1,480,745	- 326,005	2135	no/\$40,458
1986	1,832,650	1,540,945	- 291,705	1398	no/\$26,492
1987	1,858,550	1,601,145	- 257,405	1033	no/\$19,575
1988	1,884,450	1,661,345	- 223,105	403	no/\$ 7,637
1992	1,988,050	1,902,145	- 85,905	403	no/\$ 7,637
1994	2,038,650	2,022,545	- 16,105	403	no/\$ 7,637
1995	2,064,250	2,082,745	+ 18,495	403	yes/no cost
1997	2,114,550	2,203,145	+ 88,595	403	yes/no cost
2002	2,233,500	2,504,145	+ 270,645	403	yes/no cost
2007	2,348,500	2,805,145	+ 456,645	403	yes/no cost
2012	2,463,500	3,106,145	+ 642,645	403	yes/no cost
2017	2,578,375	3,407,145	+ 828,770	403	yes/no cost
2022	2,694,700	3,708,145	+1,013,445	403	yes/no cost
2025	2,764,000	3,888,745	+1,124,745	403	yes/no cost
2026	2,787,100	3,948,945	+1,161,845	303	yes/no cost
2027	2,810,200	4,009,145	+1,198,945	303	yes/no cost

Source: Florida Library Association and Ebasco/Envirosphere Company

Table 7.2-12

IMMIGRANT EFFECT ON PUBLIC SCHOOLS - ELEMENTARY
(Construction and Operational Phases)
(1980 Dollars)

<u>Year</u>	<u>Resident Demand</u>	<u>(Classroom Teachers)</u>		<u>Immigrant Demand</u>	<u>Ability to Absorb/Cost</u>
		<u>Service Level</u>	<u>Excess/ Deficiency</u>		
1980	2541	2541	0		
1982	2481	2481	0	1	no/\$ 28,920
1983	2437	2437	0	3	no/\$ 86,760
1984	2417	2417	0	4	no/\$115,680
1985	2432	2432	0	5	no/\$144,600
1986	2465	2465	0	3	no/\$ 86,760
1987	2488	2488	0	3	no/\$ 86,760
1988	2512	2512	0	1	no/\$ 28,920
1992	2609	2609	0	1	no/\$ 28,920
1997	2710	2710	0	1	no/\$ 28,920
2002	2755	2755	0	1	no/\$ 28,920
2007	2700	2700	0	1	no/\$ 28,920
2012	2647	2647	0	1	no/\$ 28,920
2017	2634	2634	0	1	no/\$ 28,920
2022	2613	2613	0	1	no/\$ 28,920
2025	2613	2613	0	1	no/\$ 28,920
2026	2610	2610	0	1	no/\$ 28,920
2027	2608	2608	0	1	no/\$ 28,920

Source: City of Jacksonville/Duval County School Board and
 Ebasco/Envirosphere Company

Table 7.2-13

IMMIGRANT EFFECT ON PUBLIC SCHOOLS - JUNIOR HIGH OR MIDDLE SCHOOL
(Construction and Operational Phases)
(1980 Dollars)

<u>Year</u>	<u>Resident Demand</u>	<u>(Classroom Teachers)</u>		<u>Immigrant Demand</u>	<u>Ability to Absorb/Cost</u>
		<u>Service Level</u>	<u>Excess/ Deficiency</u>		
1980	1040	1040	0		
1982	1012	1012	0	0	yes/no cost
1983	1047	1047	0	1	no/\$30,205
1984	1065	1065	0	2	no/\$60,410
1985	1031	1031	0	2	no/\$60,410
1986	1102	1102	0	1	no/\$30,205
1987	1118	1118	0	1	no/\$30,205
1988	1134	1134	0	0	yes/no cost
1992	1188	1188	0	0	yes/no cost
1997	1245	1245	0	0	yes/no cost
2002	1267	1267	0	0	yes/no cost
2007	1230	1230	0	0	yes/no cost
2012	1206	1206	0	0	yes/no cost
2017	1201	1201	0	0	yes/no cost
2022	1194	1194	0	0	yes/no cost
2025	1190	1190	0	0	yes/no cost
2026	1189	1189	0	0	yes/no cost
2027	1188	1188	0	0	yes/no cost

Source: City of Jacksonville/Duval County School Board and
Ebasco/Envirosphere Company

Table 7.2-14

IMMIGRANT EFFECT ON PUBLIC SCHOOLS - HIGH SCHOOL
(Construction and Operational Phases)
(1980 Dollars)

<u>Year</u>	<u>Resident Demand</u>	<u>(Classroom Teachers)</u>		<u>Immigrant Demand</u>	<u>Ability to Absorb/Cost</u>
		<u>Service Level</u>	<u>Excess/ Deficiency</u>		
1980	1121	1121	0		
1982	1104	1104	0	0	yes/no cost
1983	1098	1098	0	1	no/\$31,975
1984	1097	1097	0	1	no/\$31,975
1985	1075	1075	0	1	no/\$31,975
1986	1012	1012	0	1	no/\$31,975
1987	1030	1030	0	1	no/\$31,975
1988	1048	1048	0	0	yes/no cost
1992	1114	1114	0	0	yes/no cost
1997	1184	1184	0	0	yes/no cost
2002	1204	1204	0	0	yes/no cost
2007	1186	1186	0	0	yes/no cost
2012	1172	1172	0	0	yes/no cost
2017	1171	1171	0	0	yes/no cost
2022	1170	1170	0	0	yes/no cost
2025	1169	1169	0	0	yes/no cost
2026	1168	1168	0	0	yes/no cost
2027	1168	1168	0	0	yes/no cost

Source: City of Jacksonville/Duval County School Board and
Ebasco/Envirosphere Company

Table 7.2-15

IMMIGRANT EFFECT ON HOSPITALS
(Construction and Operational Phases)
(1980 Dollars)

<u>Year</u>	<u>Resident Demand</u>	<u>(Total Patient Days)</u>		<u>Immigrant Demand</u>	<u>Ability to Absorb/Cost</u>
		<u>Service Level</u>	<u>Excess/ Deficiency</u>		
1980	779,212	1,065,070	+285,858		
1982	812,013	1,065,070	+253,057	120	yes/no cost
1983	828,414	1,065,070	+236,656	644	yes/no cost
1984	844,814	1,065,070	+220,256	1121	yes/no cost
1985	861,214	1,065,070	+203,856	1124	yes/no cost
1986	875,526	1,250,751	+375,225	633	yes/no cost
1987	889,837	1,250,751	+360,914	447	yes/no cost
1988	904,148	1,250,751	+346,603	157	yes/no cost
1992	960,261	1,250,751	+290,490	157	yes/no cost
1997	1,028,205	1,430,709	+402,504	157	yes/no cost
2002	1,094,695	1,430,709	+336,014	157	yes/no cost
2007	1,160,760	1,658,229	+497,469	157	yes/no cost
2012	1,226,903	1,658,229	+431,326	157	yes/no cost
2017	1,293,164	1,658,229	+365,065	157	yes/no cost
2022	1,359,424	1,923,103	+563,679	157	yes/no cost
2025	1,390,180	1,923,103	+523,923	157	yes/no cost
2026	1,412,432	1,923,103	+510,671	118	yes/no cost
2027	1,425,684	1,923,103	+497,419	118	yes/no cost

Source: Health Systems Agency of Northeast Florida and Ebasco/Envirosphere Company

Table 7.2-16

IMMIGRANT EFFECT ON HOUSING
(Construction and Operational Phases)
(1980 Dollars)

<u>Year</u>	<u>Resident Demand</u>	<u>(Total Housing Units)</u>		<u>Immigrant Demand</u>	<u>Ability to Absorb/Cost</u>
		<u>Service Level</u>	<u>Excess/ Deficiency</u>		
1980	211,852	223,002	+ 11,150		
1982	220,626	232,238	+ 11,612	40	yes/no cost
1983	224,717	236,545	+ 11,828	188	yes/no cost
1984	228,030	240,032	+ 12,002	279	yes/no cost
1985	231,197	243,365	+ 12,168	309	yes/no cost
1986	234,376	246,722	+ 12,346	196	yes/no cost
1987	237,575	250,014	+ 12,439	147	yes/no cost
1988	240,765	253,371	+ 12,606	56	yes/no cost
1992	253,593	266,871	+ 13,278	56	yes/no cost
1997	269,420	283,526	+ 14,106	56	yes/no cost
2002	285,243	300,178	+ 14,935	56	yes/no cost
2007	299,748	315,442	+ 15,694	56	yes/no cost
2012	312,333	328,687	+ 16,354	56	yes/no cost
2017	326,360	343,448	+ 17,088	56	yes/no cost
2022	340,339	358,159	+ 17,820	56	yes/no cost
2025	348,856	367,122	+ 18,266	56	yes/no cost
2026	351,695	370,205	+ 18,510	42	yes/no cost
2027	354,397	373,049	+ 18,652	42	yes/no cost

Source: Jacksonville Area Planning Board and Ebasco/Envirosphere Company

Table 7.2-17
TOTAL PUBLIC COSTS
(1980 Dollars)

Year	Residential				Non-Residential	Total Costs	Cumulative Costs
	Gen. Control/ Finan. Adm.	Education	Health	Library	Highway		
1982	\$	\$ 28,920	\$	\$ 5,079	\$220,000	\$253,999	\$ 253,999
1983	37,803	148,940	40,855	25,677	4,725	258,000	511,999
1984	37,803	208,065	40,855	40,231	4,725	331,679	843,678
1985	37,803	236,985	40,855	40,458	4,725	360,826	1,204,504
1986	37,803	148,940	40,855	26,492	4,725	258,815	1,463,319
1987	37,803	148,940		19,575	37,609	243,927	1,707,246
1988		28,920		7,637	9,109	45,666	1,752,912
1989		28,920		7,637	9,109	45,666	1,798,578
1990		28,920		7,637	9,109	45,666	1,844,244
1991		28,920		7,637	9,109	45,666	1,889,910
1992		28,920		7,637	9,109	45,666	1,935,576
1993		28,920		7,637	9,109	45,666	1,981,242
1994		28,920		7,637	9,109	45,666	2,026,908
1995		28,920			9,109	38,029	2,064,937
1997		28,920			37,609	66,529	2,169,495
2002		28,920			9,109	38,029	2,359,640
2007		28,920			37,609	66,529	2,578,285
2012		28,920			9,109	38,029	2,768,430
2017		28,920			37,609	66,529	2,987,075
2022		28,920			9,109	38,029	3,177,220
2025		28,920			9,109	38,029	3,291,307
2026		28,920			9,109	38,029	3,329,336
2027		28,920			37,609	66,529	3,395,865

Source: Ebasco/Envirosphere Company

Table 7.2-18

TOTAL PUBLIC REVENUES
(1980 Dollars)

<u>Year</u>	<u>Residential Property Taxes</u>	<u>FPL Property Taxes</u>	<u>JEA Payments In Lieu of Taxes</u>	<u>State Aid to Local Education</u>	<u>Total Revenues</u>	<u>Cumulative Revenue</u>
1982	\$ 5,295			\$ 19,800	\$ 25,095	\$ 25,095
1983	24,406			94,500	118,906	114,001
1984	38,833			42,340	181,173	325,174
1985	50,113	\$4,741,500	\$ 514,190	161,660	5,467,463	5,792,637
1986	34,978	5,080,200	8,159,940	104,060	13,379,178	19,171,815
1987	32,302	5,418,900	12,765,280	79,920	18,296,402	37,468,217
1988	20,158	5,283,400	16,438,140	33,120	21,774,818	59,243,035
-						
1992	20,158	4,741,500	16,556,400	33,120	21,351,178	145,578,907
-						
1997	20,158	4,064,200	16,556,400	33,120	20,673,878	250,302,797
-						
2002	20,158	3,386,800	14,191,200	33,120	17,631,278	344,544,287
-						
2007	20,158	2,709,400	14,191,200	33,120	16,953,878	430,668,577
-						
2012	20,158	2,032,100	14,191,200	33,120	16,276,578	513,406,167
-						
2017	20,158	1,354,700	14,191,200	33,120	15,599,178	592,756,857
-						
2022	20,158	677,400	9,460,800	33,120	10,191,478	654,529,547
-						
2025	20,158	270,900	9,175,680	33,120	10,191,478	684,005,861
2026	15,118	135,500	4,730,400	25,760	4,906,778	688,912,639
2027	15,118	67,700	2,060,640	25,760	2,169,218	691,081,857

Source: Ebasco/Envirosphere Company

Table 7.2-19

OVERALL FISCAL IMPACT
(1980 Dollars)

<u>Year</u>	<u>Total Public Cost</u>	<u>Total Public Revenue</u>	<u>Annual Fiscal Impact</u>	<u>Cumulative Fiscal Impact</u>
1982	\$ 253,999	\$ 25,095	\$ -228,904	\$ -228,904
1983	258,000	118,906	-139,094	-367,998
1984	331,679	181,173	-150,506	-518,504
1985	360,826	5,467,463	+5,196,637	+4,588,133
1986	258,815	13,379,178	+13,120,363	+17,708,496
1987	243,927	18,296,402	+18,052,475	+35,760,971
1988	45,666	21,774,818	+21,729,152	+57,490,123
-				
1992	45,666	21,351,178	+21,305,512	+143,643,331
-				
1997	66,529	20,673,878	+20,607,349	+248,133,302
-				
2002	38,029	17,631,278	+17,593,249	+342,184,647
-				
2007	66,529	16,953,878	+16,887,349	+428,090,292
-				
2012	38,029	16,276,578	+16,238,549	+410,637,737
-				
2017	66,529	15,599,178	+15,532,649	+589,769,782
-				
2022	38,029	10,191,478	+10,153,449	+651,352,327
-				
2025	38,029	9,499,858	+9,461,829	+680,714,554
2026	38,029	4,906,778	+4,868,749	+685,583,303
2027	66,529	2,169,218	+2,103,689	+687,685,992

Source: Ebasco/Envirosphere Company

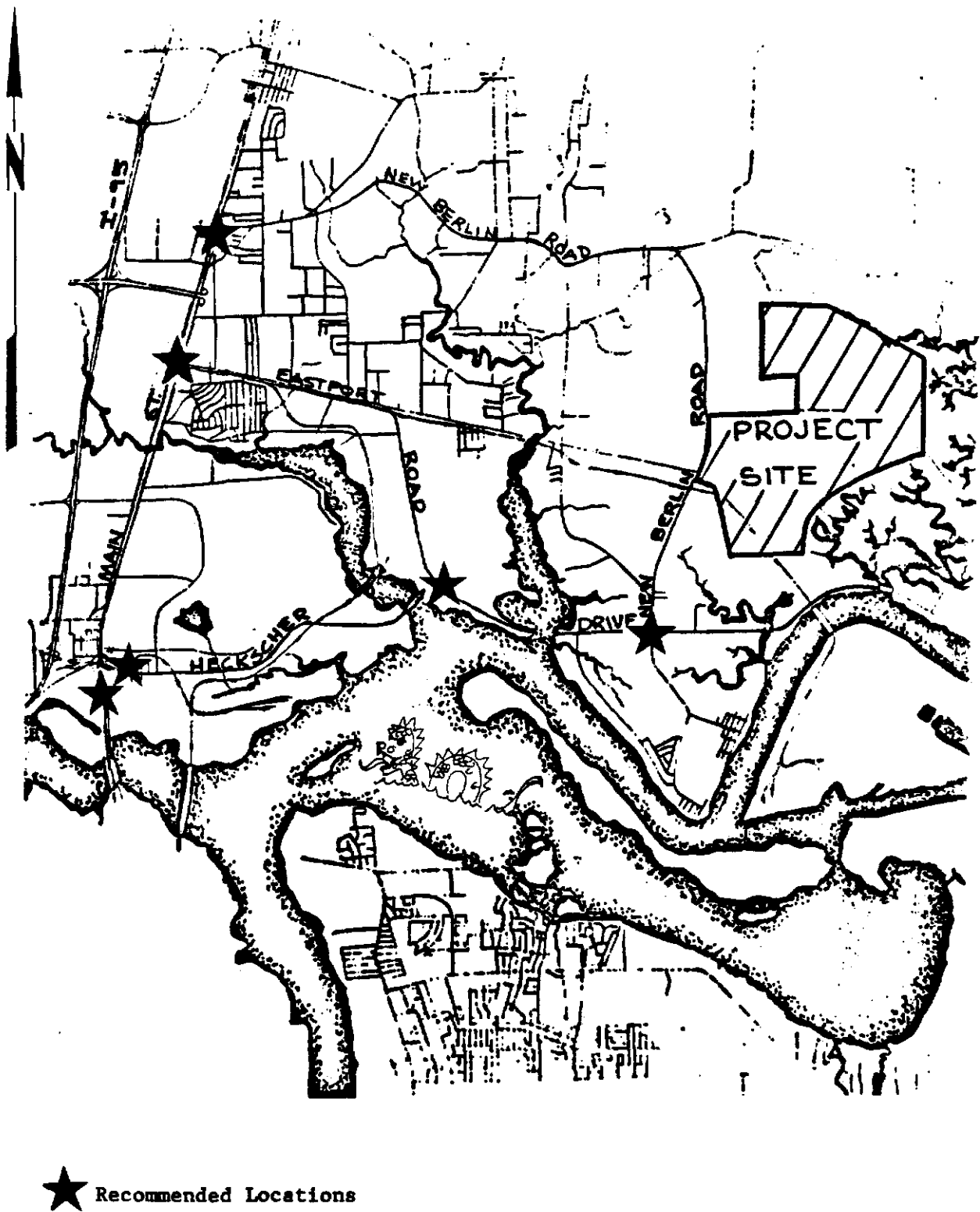


Figure 7.2-1 Recommended Highway Improvements Locations

Chapter 8

Alternative Energy Sources and Sites

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8.0 ALTERNATIVE ENERGY SOURCES AND SITES

This chapter presents an overview of the factors which led to the decision to build the proposed two 600 MW class unit coal-fired plant at the Eastport site.

Section 8.1, Management Alternatives, presents a discussion of possible alternatives to building a generating facility; these include: purchase of required energy, expansion/conversion of existing units, and conservation. These options were not considered viable alternatives to the proposed project due to either technological considerations, economic risk, or capacity need.

Section 8.2, Alternative Energy Sources, presents a discussion of alternative generating technologies examined once the decision to build a generating facility was made. These alternatives ranged from the more conventional to those that are renewable or exotic. For the reasons stated above, and/or the benefits of oil displacement associated with the construction of the proposed plant, all alternatives except for coal were eliminated as viable options.

Section 8.3, Alternative Sites, discusses general siting criteria, identification of candidate areas and sites, and the selection process for the preferred site. The rationale for the final site selection is presented in Section 8.4.

Section 8.4 also discusses the final step in the decision to construct a coal-fired generating facility; a review of the quantities of coal needed, supply, and transportation modes for this selected fuel. To assure an uninterrupted supply and fuel flexibility, an unloading facility will be constructed on Blount Island to handle coal unloading from ocean vessels for transport to the plant located at the Eastport site.

8.1 MANAGEMENT ALTERNATIVES

The information in this section is organized and presented to reflect the joint participation between Jacksonville Electric Authority (JEA) and Florida Power & Light Company (FPL) in the construction and future operation of the proposed plant. The information in each subsection is presented as a common write-up with specific areas of special interest to each utility emphasized.

8.1.1 Constraints Identification

As discussed in Chapter 1, the decision to construct a new generating facility is governed and influenced by many factors. Under current JEA and FPL load and energy forecasts, both utilities will develop a capacity need for the facility in the late 1980's to early 1990's to maintain an acceptable system reliability. The supply of power required to meet the amount of increased load projected in both JEA's and FPL's forecasts, combined with the time requirement associated with construction lead times dictates that the selection of bulk power supply alternatives be confined to current commercially available technologies.

Another factor affecting the decision making process is the selection of a fuel or fuels to be used for the production of electricity. Fuel selection is subject to the constraints of price, availability and transportation. Both JEA and FPL are committed to supplying electrical power to their customers at the lowest possible cost. Therefore, the choice of fuel is dependent on its anticipated price and availability over the generating plant's expected life. As current world market conditions illustrate, it is prudent to select a fuel which will be available from a number of sources. Such a selection will assure a continuous supply of fuel if one source is eliminated or curtailed. The availability of alternate transportation modes is also of great advantage to the operation of the generating plant. Alternative modes of transportation assure competitive transportation prices and an uninterrupted supply, thus helping

to provide the lowest possible cost to the customer. The following sections review the options which were considered as possible alternatives to constructing the proposed plant.

8.1.2 Omission of Proposed Project

As shown in Section 1.2 and 1.3 of Chapter 1, omission of the proposed plant would have detrimental effects on levels of oil consumption and system reliability for both JEA and FPL. These two factors are part of the system supply considerations which govern the need to construct a generating facility. Consideration of these parameters in the process of evaluating alternatives was a major factor in the selection of the proposed jointly owned coal-fired plant as the desirable choice from an economic, reliability, and oil displacement standpoint.

Omission of the plant would result in a degradation of system reliability to levels below those considered acceptable by both utilities for an economic and reliable system to insure against uncertainties in load growth, construction lead times, and maintenance requirements.

In addition, the omission of a generating facility which would reduce the levels of oil consumption for both utilities would cause the customers of JEA and FPL to face increased exposure to interruptions in fuel supplies, susceptibility to price fluctuations, the unfavorable economics of oil consumption, and forego furtherance of state and national energy policies.

8.1.3 Purchase of Required Energy

It is the policy of both utilities to pursue firm purchases of blocks of power whenever the potential for a mutually beneficial transaction between two utilities exists.

JEA began purchasing up to 100 MW of non-firm power (Schedule E) from the Southern Company in February of 1980. These non-firm purchases will increase to a total of 300 MW upon completion of the JEA/FPL-Southern 500 kV interconnection in August of 1982. While this is not a firm purchase, it has been available and utilized a significant amount of the time, supplying up to 10 percent of JEA's energy requirements during 1980. However, this contract will end during 1985.

JEA, in February, 1981, signed an agreement with the Southern Company to purchase from 300 MW to 500 MW of firm power through 1992. This power will be available following the construction of several currently licensed coal plants in Georgia and completion of the joint JEA/FPL 500-Southern kV interconnection in August, 1982. The firm power purchase provides for coal-by-wire as follows:

<u>From</u>	<u>Through</u>	<u>Capacity</u>
January 1, 1983	December 31, 1986	300 MW
January 1, 1987	December 31, 1987	500 MW
January 1, 1988	December 31, 1992	400 MW

Because firm power is available for purchase only through 1992, power purchases do not satisfy JEA's long-term need for additional capacity. Prior to contracting with the Southern Company, JEA performed an analysis which varied both the timing of SJRPP and the size of power purchases to determine the most cost-effective combination of these two resources. That analysis showed that construction of SJRPP Units 1 and 2 in 1985 and 1987, coupled with purchases from the Southern Company in amounts shown above, was the combination which provided the greatest savings to JEA's customers.

Further JEA also engaged in negotiations with Seminole Electric Cooperative for purchase of capacity from their facility currently under construction. This power would have been available concurrent with on-line operation of Units 1 and 2 of the proposed plant in 1985 and 1987, and

would have continued for approximately 10 years thereafter. The purchase of additional power from Seminole was not considered an economic alternative to SJRPP because it was not as economical as the competing alternative of purchase power from the Southern Company.

JEA has also evaluated the possibility of purchasing a share of Georgia Power Company's nuclear Plant Vogtle. In making this evaluation, JEA management considered a number of factors, including the regulatory risks associated with the construction and operation of nuclear units, uncertainty as to cost, uncertainty as to in-service dates, uncertainty as to decommissioning methods and costs, lack of a firm national policy on nuclear waste management, higher financing costs, higher initial capital costs, and the lack of operational control by JEA or regulatory control by the State of Florida. Based on these factors, JEA concluded that purchase of a large share of Plant Vogtle involved too many risks and uncertainties to be a viable alternative to SJRPP.

Nevertheless, JEA has not precluded the potential of purchasing a small share from Vogtle for future load growth and fuel diversity if the uncertainties associated with nuclear projects can be satisfactorily resolved.

Power purchases for FPL are potentially available from several sources. These are:

- . Florida units currently planned
 - Tampa Electric Company (TECO) Big Bend No. 4
 - Seminole Electric Cooperative
- . Southern Company
 - Power from a block of coal units planned and under construction
- . Bahamas
 - Several entities have proposed projects which will generate electrical power for sale on the Florida mainland.

While these options are potentially available to FPL, it should be noted that power purchase arrangements are frequently limited in duration because the power producer desires to withdraw the power from sale and redirect it to his own use as his need develops. This means that at some future time the power will have to be replaced by the purchaser, most certainly at a higher cost.

Of these four options, only the TECO Big Bend Unit No. 4 and the Southern Company purchase are viable for FPL at this time. FPL has entered into an agreement with TECO for the purchase of firm power from its Big Bend Unit No. 4 through December, 1987. FPL is also currently purchasing 100 MW of "coal-by-wire" on an interruptible basis (Schedule E) from the Southern Company. This power is priced at Southern's average system-wide capacity cost and incremental energy cost and is thus quite competitive with the incremental cost of oil generation. Upon completion of the planned FPL/JEA-Southern 500 kV interconnection, FPL plans to increase these purchases. To this end, FPL has recently executed an agreement with Southern for the purchase of up to 300 MW of Schedule E non-firm power through 1986.

In addition, FPL contracted, in February, 1981, for the purchase of up to 1000 MW of firm power through 1992. Under terms of this contract, FPL will receive the following amounts of firm coal power:

<u>From</u>	<u>Through</u>	<u>Capacity</u>
January 1, 1983	Decmeber 31, 1986	350 MW
January 1, 1987	December 31, 1987	650 MW
January 1, 1988	December 31, 1992	1000 MW

The other two options, purchase of power from Seminole Electric Cooperative and the Bahamas, have not progressed to a point where they appear viable. Negotiations have been pursued with Seminole, but at this time a final price for purchase power from their units has not been

established. FPL is also closely following the Bahamas developments involving electric power sales to mainland Florida. Should these developments materialize and be cost-effective, FPL would undertake negotiations for purchase of power.

8.1.4 Cogeneration

It is the policy of JEA and FPL to actively pursue all opportunities for cogeneration with their customers which can be shown to be cost-effective.

Existing Cogeneration Facilities

The JEA currently has one 13 MW cogeneration customer, Regency Square, and is continuing to evaluate opportunities on a case-by-case basis as they are identified. JEA has entered into contractual arrangements with Regency Square where the cogenerator will go off-line at night with JEA supplying the needs of that system. During the daytime hours, the energy delivered by JEA at night will be returned to JEA by this cogenerator. Additionally, JEA may call upon the cogenerator for up to 5 MW of peak-time capacity during JEA's peak hours. The additional nighttime JEA load, with concomitant reduction in daytime kWh production by JEA, will increase JEA's system load factor, thus making more efficient use of installed and planned capacity.

FPL is currently purchasing approximately 12 MW of power from United States Sugar Corporation (USSC) in Clewiston. This power is normally purchased on a round the clock basis from mid-November through mid-March and is generated with bagasse. FPL began purchasing power from USSC in February of 1980.

FPL will also purchase power from the Dade County Resource Recovery Project. Approximately 60 MW of power will be available from this facility beginning in 1981.

Future Cogeneration Potential

In addition to Regency Square, the JEA has had meetings with five other industrial customers in an effort to develop cogeneration arrangements, pending customer plant expansion. These customers are Celotex Corporation, Jim Walter Corporation, U.S. Gypsum, Ring Power and Alton Packaging.

The JEA maintains a list of 70 customers known to have auxiliary generation capability. When it can be determined that cogeneration with these customers is feasible for both parties, JEA will pursue this option. Table 8.1-1 outlines known potential cogeneration and small power producers within the JEA service area.

FPL expects that future cogeneration potential will develop under the encouragement of Section 210 of the Public Utilities Regulatory Policy Act of 1978 (PURPA) and the Florida Public Service Commission rules which will implement FERC regulations adopted under PURPA.

As part of its "Energy Management Plan for the 80's", submitted to the FPSC, FPL has outlined a program for the promotion of cogeneration facilities. FPL will do so by assisting customers in overcoming technological limitations and by offering to purchase power at rates that will encourage the development of customer-generated power. Because of options available to cogenerators under FERC rules regarding the use of their power, FPL cannot determine at this time whether these sources will affect FPL's forecast. In addition, it must be recognized that cogeneration will not deter the development of generating capacity unless the cogenerator can be depended upon for firm power sales at times of system need. This could occur as a result of contracts between individual cogenerators and utilities or when sufficient cogeneration capacity becomes available so that, through diversity, a percentage of that total capacity can be relied upon. FPL cannot currently predict when cogeneration facilities will develop to the point where their generation may deter the

development of additional capacity. Until such an estimate can be made, however, those cogeneration facilities that can demonstrate a greater efficiency than the utility's own generation can make a significant contribution to oil reduction efforts and should be encouraged. For these reasons, FPL's program also calls for additional studies and surveys of the potential for cogeneration in its service area. As more experience is gathered in this field, adjustments to FPL's load forecast and generation expansion plans may be made. However, these adjustments would not affect the need or timing of the proposed plant but may result in the deferral of subsequent units. Table 8.1-2 outlines known potential cogeneration and small power producers within the FPL service area.

8.1.5 Expansion/Conversion of Existing Units

Both JEA and FPL believe that all areas should be investigated to reduce their dependence on oil. To accomplish this reduction, several programs have been instituted and are discussed below:

JEA, with 100 percent of its installed generation oil-fired, has placed a high priority on measures designed to utilize existing generation in ways which will reduce future costs to the customer. Management has pursued a two-pronged approach. A Generation Capacity and Availability Program was instituted to assure maximum generation output. Conversion of generators to alternative fuels is being thoroughly examined to determine applicability to JEA's oil-fired generators.

In 1977, JEA put into action a five-year program to increase generation availability and efficiency by overhauling, and upgrading where possible, all units within the JEA generating system to achieve nameplate capacity or better and to improve unit heat rates. Completion of the maintenance and upgrade program will be accomplished according to the indicated schedule, and will result in the capacity ratings of JEA's oil-fired units being increased to those shown below. This program will produce an upgrade in total net capacity from 1350.9 MW to 1990.3 MW in the summer and from 1417.7 MW to 2086 MW in the winter.

	Capacity Rating		<u>Completion Date</u>
	<u>Summer Maximum (MW)</u>	<u>Winter Maximum (MW)</u>	
Northside 1	262.4	262.4	1/81
Northside 2	262.4	262.4	3/82
Northside 3	499.4	499.4	5/81
Northside CT 3	52.0	61.5	2/79
Northside CT 4	52.0	61.5	2/79
Northside CT 5	52.0	61.5	3/79
Northside CT 6	52.0	61.5	3/79
Southside 1	26.4	27.4	12/80
Southside 2	28.6	31.6	4/82
Southside 3	46.3	48.3	12/78
Southside 4	70.1	71.1	5/79
Southside 5	142.9	143.9	5/80
Kennedy 8	43.1	46.1	6/82
Kennedy 9	42.8	45.8	2/81
Kennedy 10	130.2	136.2	9/79
Kennedy CT 1	12.9	15.4	6/82
Kennedy CT 3	53.7	62.5	6/82
Kennedy CT 4	53.7	62.5	6/82
Kennedy CT 5	53.7	62.5	4/82
Kennedy CT 6	53.7	62.5	7/82

In addition to the upgrade program, JEA has recently obtained consulting services for an Operations and Maintenance Management Program. The consultant will provide JEA with the services and assistance necessary to plan, organize, develop and implement an Operations and Maintenance Management Program within the Power Production group and related support divisions. This program will be developed and implemented to increase and maintain the availability of the JEA's existing power generation equipment through improvements to the operations and maintenance organization and systems.

JEA is carefully investigating several alternatives to oil for use as fuel in existing boilers. When these technologies can be demonstrated effective for use in JEA generating units, full scale application will be pursued.

Currently, the JEA is examining four options: coal-oil mixtures, conversion to direct coal firing, synthetic gas, and conversion to natural gas firing.

- . Coal-Oil Mixture (COM) - JEA submitted to the Department of Energy (DOE) a cost sharing proposal to convert Unit No. 10 at Kennedy Generating Station to burn a 50-50 mixture of coal and oil. Kennedy 10 is a 134 MW Babcock and Wilcox unit designed for, and presently firing, No. 6 oil. The proposed venture was a demonstration project to assess the feasibility of burning COM in a large utility boiler originally designed for oil burning. Although the award was made by DOE in November, 1980 to JEA, funding was never approved.
- . Conversion to Direct Coal Firing - Burns & Roe Consulting Company is performing a study under DOE contract in which they will study three units on the JEA system as to feasibility for conversion to direct coal firing. They will also do a conceptual design for the unit which appears to have the best possibility for conversion. This conceptual design is scheduled for submittal to JEA in the last quarter of 1981.
- . Synthetic Gas - JEA is presently requesting funds from DOE in response to the solicitation for "Feasibility Studies for Alternative Fuels Production". JEA is proposing a feasibility study for the utilization of synthetic medium Btu gas in several existing units. The synthetic fuel could be generated from high sulfur coal, low sulfur coal, peat, petroleum coke, and possibly refuse waste. Stone and Webster Architects & Engineering

Corporation, acting as primary contractors to JEA in the study, will evaluate the feasibility of burning synthetic gas in Northside Units 1 and 2 and combustion turbines.

- . Conversion to Natural Gas Firing - JEA has received an exemption from FERC to burn natural gas in existing units at the Northside Generating Station. JEA is now pursuing means to secure transportation of the gas from the gas fields. If these problems can be successfully resolved, JEA will convert one or more units at the Northside Station to natural gas firing.

For FPL, several potential conversion options exist which offer potential for future oil reduction:

- . Coal-Oil Mixture - COM was tested on one type of unit by FPL but several uncertainties remain. It is not known what the long-term operating characteristics will be which will enable the assessment of operating reliability and cost. COM cannot be applied at all plants due to site limitations and/or equipment design limitations. At this time it is not known what environmental requirements will be imposed or recommended on commercial installations burning COM as opposed to test installations. These requirements will affect the initial capital and operating costs. Consequently the comparative cost effectiveness of this option cannot be determined at this time.
- . Coal-Water Mixtures - These are in an early stage of development and have not yet been demonstrated in full-sized utility boilers on a commercial scale. FPL is planning a coal-water mixture research test for 1981.

- . Direct-Fired Coal - FPL's Board of Directors has recently authorized funding for a detailed engineering review and bid solicitation for conversion of Sanford Unit 5 to direct coal firing. A final determination on the feasibility of such a conversion will be made upon completion of these efforts.
- . Synthetic Liquid or Gas - The final option is the conversion of coal into a synthetic liquid or gas for use in existing boilers. While there are many test facilities underway to demonstrate the feasibility of the various conversion processes, the costs associated with each appear to be prohibitive for use as a means of reducing oil dependence at this time.

Demonstration and development work are proceeding on coal conversion options. Until such work has reached the state where prudent judgments can be made, comparative determinations of cost-effectiveness cannot be made with the level of certainty required for irrevocable commitments to their commercial implementation in a utility system. Moreover, conversion options do not provide new capacity, in fact, these options may reduce the output of a unit. From a capacity and reliability standpoint, unit conversions are not alternatives to satisfy additional capacity requirements. The evaluation of conversion is, therefore, being pursued independently of SJRPP as a possible method of supplementing SJRPP's oil reduction benefits.

8.1.6 Conservation

JEA strongly supports the concept of conservation of electrical energy in the state of Florida. Since the effect of increasing oil prices has severely impacted its customers, the JEA is vigorously pursuing all efforts to decrease the cost of power. Where cost-effective, the JEA will implement conservation programs as directed by rules under the Florida Energy Efficiency and Conservation Act (FEECA).

However, even with the power purchases from Southern Company, over 90 percent of the JEA's power is currently generated by oil-fired units. Thus, even the most effective conservation programs will not displace the amount of oil necessary to insulate the JEA customers from the threat of interruption of oil supply or the ever-upward spiraling cost of oil.

In an attempt to assess the impact of decreased system load resulting from implementation of programs under FEECA, the JEA has conducted planning studies which estimate impacts on reserve margins and operating costs. These studies were conducted assuming that programs implemented will achieve the full reduction required by the FEECA conservation goals.

If the goals are fully realized, system reliability will not fall to a level which dictates addition of generation until the early 1990's. However, cost studies indicate that even if energy requirements are substantially decreased by conservation, the displacement of oil as a generating fuel will result in a substantial savings to JEA.

FPL has long been aware of the benefits of energy conservation and efficiency in the supply and use of electricity. The company has been innovative in its approaches to energy management and is recognized as a leader in the development of new techniques to further the purposes of conservation and alternative energy generation. The Energy Management Plan for the 80's (submitted to FPSC on November 2, 1980), represents a continued intensive commitment by FPL to energy conservation and the efficient supply and use of electricity, and it responds to the goals established by the FPSC as a result of FEECA.

The projected results of the plan rely upon a positive customer response along with aggressive action on the part of FPL to implement the programs. In addition, the projected results depend upon the realization of certain conditions which are critical to the success of the programs. If these conditions are realized by 1990, the plan is estimated to have the potential to reduce FPL summer peak demand by about 2.1 million kilowatts

and annual energy generation by approximately 5.7 billion kilowatt-hours. In addition, if the results of the plan are realized, the annual amount of oil that would otherwise be required to be burned without the plan could potentially be reduced by approximately 9.1 million barrels by 1990. The oil reduction eventually obtained will depend upon the actual results of all programs, the effects of generation alternatives implemented to achieve oil reduction and the relationship between implementation of the programs and schedule of future generation additions.

FPL's forecast of peak load and net energy presented in Chapter 1 includes the impact of the conservation which is expected to be achieved in the proposed time frame. Due to the uncertainties associated with customer acceptance and response to new programs, FPL believes that the need for these units from a capacity standpoint will not be affected.

8.1.7 Construction of Facilities as Proposed

Electric utilities in Florida have an obligation to provide electric service to satisfy customer needs. It is also important to assess the risks which accompany a commitment to any energy source. In today's environment, there are great uncertainties inherent in the planning and construction of a generating facility. JEA and FPL believe that the joint construction of a generating facility would distribute these risks. Joint participation with other utilities allows the participants to exploit several attractive features unique to joint ventures:

- . Combination of the resources and needs of two utilities allows both partners to benefit from economies of scale inherent in operation of large generating facilities.
- . Participation with other utilities allows each partner to spread risk associated with bulk power supply generation.

- . Since joint projects utilize fewer sites than separate independent facilities, impact on the environment is lessened. As power plant sites and transmission corridors become more difficult to develop, this feature becomes more and more critical.

Another consideration in the commitment to a generating source is the size of the unit. Sizing of the unit must take into account a number of factors including: economies of scale, plant efficiency, reliability, operating and load characteristics and environmental considerations. Advantages and disadvantages for each factor must be carefully balanced in the selection of the optimum sized unit for the utility.

- . Economies of Scale/Plant Efficiency - Larger unit sizes (600 MW class units and above) enjoy distinct advantages over smaller units in terms of per unit capital investment and net heat rates. These economic and efficiency factors tend to cause unit size to be forced upward.
- . Reliability - Given a known incremental future demand, several smaller units tend to be inherently more reliable than a single large unit. This is mainly a function of slightly lower outage rates and the reduced impact of individual outages from smaller units. This reliability factor works to moderate the push for larger, more economical units when sizing is examined.
- . Operating Characteristics - When sizing the unit to be added to a particular system, unit sizes of current generators in the system must be taken into account. Backup generation must be available in the event of forced outage on the new generator. This factor will preclude the addition of a generator grossly larger than current generators on the system.

- Environmental Considerations - Addition of many smaller units (potentially on different sites) would have a significantly larger impact on the environment than one or two larger units at a single site.

During JEA's selection of unit size for the proposed facility, each of the above factors was used to assess: (1) a single 233 MW combined cycle unit, (2) a single 500 MW coal unit, and (3) 300 MW shares of two jointly-owned 600 MW class coal units. Alternative 3 was selected as the most effective means of allowing both JEA and FPL to realize the benefit of economies of scale inherent to large units.

As a result of the above considerations, the reliability needs of both JEA and FPL, and the ability to displace oil-fired generation as discussed in Section 1.1.3, 1.2 and 1.3, JEA and FPL will construct two jointly owned 600 MW class coal-fired generating units.

Table 8.1-1

JACKSONVILLE ELECTRIC AUTHORITY

POTENTIAL COGENERATION AND SMALL POWER PRODUCERS

Name/Location	Project Description	Maximum Capacity MW	Other Output	Fuel Type	Projected Date of Operation	Comments/Status of Project Development
Regency Square	Complex Self-Generated	13	Steam	Natural Gas & #2 Oil	In Service	Net Energy Available - 5 MW
U.S. Gypsum	Plant Expansion	Unknown	Steam	Unknown	Unknown	In House Engineering Study
Celotex Corp.	Gas Turbine	1.6	Hot Air	Propane & #2 Oil	1982	In House Engineering Study
Jim Walter Paper	Paper Mill	2	Steam	Bark & #2 Oil	1982	In House Engineering Study
Alton Packaging	Paper Mill	17	Steam	Wood/Bark	1984	In Negotiation for Interconnection
Ring Power	Heavy Equipment Service	1	None	Natural Gas	1982	In Negotiation for Inter-connection; Net Energy Available - 0.5 MW
		34.6				

TABLE - R.1-2

FLORIDA POWER & LIGHT COMPANY
POTENTIAL COGENERATION (COG) AND SMALL POWER PRODUCERS (SPP)

COMPANY	LOCATION	COG/ SPP	SYSTEM TYPE	FUEL	EXISTING ENERGY USE kW (000)	POTENTIAL MW UNDER PRESENT OPERATION	NET ENERGY	% ANNUAL ENERGY GENERATION	STATE OF NEGOTIATIONS
U. S. Sugar Corp.	Clewiston	SPP	Steam Electric Net Billing	Bagasse	10,000	5,000	12	-	Completed- in operation
U. S. Sugar Corp.	Clewiston	SPP	"	Bagasse	-	-	(12)	-	City System - Not FPL.
Atlantic Sugar	Belle Glade	SPP	Steam	Bagasse	1,800	1,000	3	-	Provides own capacity.
Talisman Sugar	5 mi. south of South Bay	SPP	Steam	Bagasse	1,900	1,000	4	-	Provides own seasonal burning.
Everglades Sugar	Clewiston	No	Steam	Oil	8,400	1,500	-	-	Refining only.
Gulf/Western	South Bay	SPP	Steam Electric	Bagasse	3,000	1,800	12	-	Discussing interconnection and design.
Sugar Cane Growers	Belle Glade	SPP	Steam	Bagasse	17,000	5,000	6	-	-
Osceola	Pahokee	SPP	Steam	Bagasse	800	500	3	-	-
Dade County Resource Recovery	Dade County	SPP	Steam Electric	Waste	Not Applicable	40	40	90%	Under contract - start 1981
Waste Management, Inc. - ERDA	Pompano Beach	SPP	Permentation Methane	Sewage, Garbage	Not Applicable	4	4	-	Test facility, ERDA.
Waste Management, Inc.	Pompano Beach	SPP	Steam Gen.	Solid Waste - Hospital	Not Applicable	0.9	0.9	-	In negotiation.
Broward County Waste Division	ALL	SPP	Steam Gen.	Solid Waste	Not Applicable	44	44	-	In negotiation. (pursuing two methods. Will make presentation to Commission.)
National Resource Recovery		SPP	Pyrolysis/ Pellets	Solid Waste	Not Applicable	See Above		-	In negotiation.
Palm Beach Waste Authority	Palm Beach County	SPP	Unknown	Solid Waste	Not Applicable	22	22	-	Preliminary negotiation.
Sarasota/Manatee	Sarasota/ Manatee	SPP	Unknown	Solid Waste	Not Applicable	6	6	-	Estimate only from population. No negotiations.
Daytona	Volusia	SPP	Unknown	Solid Waste	Not Applicable	3	3	-	Estimate only from population. No negotiations.
Dade County Waste Water	Dade County	SPP	Fermentation	Sewage	2,000	4,500	3.5	70%	In negotiation
Georgia Pacific Hudson Pulp	Palatka	COG	Steam Electric	Wood	5,804	3,500	-	-	Customer generates for own use (323,000 tons).
Pratt Whitney	West Palm Beach	-	Direct Drive	Oil	72,000	16,000	-	-	Boiler used for small internal process heat.
Small Package Negotiations (under 20kw)	Various	SPP	Wind, Solar, Water	-	Not Applicable	18 (kw) max.	18	-	6 windmill inquiries. 3 water.
I.B.N.	West Palm Beach	No	Direct Drive	Oil	Not Applicable	2.5	2.5	-	Standby study for parallel operation. Not "qf".
NASA	Titusville	No	Direct Drive	Oil	Not Applicable	4.5	4.5	-	Negotiations on parallel operation. Not "qf".
On Peak Gen- eration (over 1,000 kw)	Various	No	Direct Drive	Various	Not Applicable	18	18	-	To be negotiated thru interruptible/ curtailable Rates

8.2 ALTERNATIVE ENERGY SOURCES

In assessing alternative technologies and/or fuels for the generation of electric power to satisfy the projected needs of its service area in the mid to late 1980's, both JEA and FPL have considered a wide spectrum of alternatives ranging from traditional to unconventional. Further, these technologies can be grouped as being steam turbine driven (with the differences lying primarily in the fuel or technology utilized to generate steam), direct driven by a gas turbine or engine, or involve direct conversion from some energy source to electricity, as in photovoltaic cells.

To satisfy the need for additional capacity and oil displacement discussed in Chapter 1, the selection of technology must concurrently satisfy certain basic criteria which, when applied, tend to eliminate some options. The criteria applied to the selection process plant included:

1. The ability to be operational on a commercial scale in the mid to late 1980's.
2. Minimal technical and economic risk, i.e., technology commercially demonstrated elsewhere on similar size units.
3. Consistency with known national energy objectives which dictate conservation of natural gas and a reduction in reliance on imported petroleum.

The final selection of technology must reflect careful consideration of these criteria and will not necessarily result in one single alternative clearly superior with respect to each of the criteria.

Several innovative and futuristic alternatives currently exist which, on the basis of scientific principles, appear very promising as a future source of electric power. The promise demonstrated by these technologies lies in their ultimate reliance on either very abundant, or renewable

energy resources. To make available to their respective service territories the benefits which accrue from innovations and developments in new technologies, JEA and FPL are engaged in research activities which evaluate various energy sources. JEA, for example, has applied to the DOE for a grant to study gasification of municipal wastes. FPL is simultaneously monitoring and supporting the evaluation of various energy sources through several avenues, such as providing technical input, funding, and more detailed engineering analyses involving FPL host sites in such areas as utilization of coal-oil mixtures. For purposes of providing the kind and quantity of capacity additions needed for the mid-1980's and immediately beyond, most of these technologies (described in Subsection 8.2.2) are considered commercially unavailable based on one or more of the aforementioned criteria.

Subsection 8.2.1 addresses the more conventional forms of power generating technologies based on nuclear, coal, gas and liquid fuels and in large part relying on the thermodynamic steam cycle. This part of the analysis narrows the most feasible and economical choices down to pulverized coal firing and nuclear based steam generation, eliminating the latter on licensing/scheduling considerations. With respect to flexibility, the analysis concludes that the coal-fired steam generator design will have provisions to allow for possible conversion to oil, gas or refuse firing.

8.2.1 Major Generating Technologies

Nuclear

The vast majority of nuclear reactors currently in service or under construction are thermal reactors, so named because they employ thermal neutrons to induce the fission reactions. Materials such as light (ordinary) water (in predominant use), heavy water (in Canada), beryllium oxide, or graphite (in Britain) are used to "thermalize" or slow down the

neutrons. The importance of fission lies in the extremely large quantities of heat released in the reaction and the fact that a chain reaction can be sustained by the production of excess neutrons.

Fast Breeder Reactors

There are two broad categories of nuclear fuels, namely fissile and fissionable nuclides. Light water reactors use fissile nuclides as a fuel while fast breeder reactors utilize fissionable materials - the latter not only generate heat for steam production but also produce new fuel. This phenomenon coupled with the fact that natural reserves of fissionable materials are more than 100 times greater than the reserves of fissile fuels, makes breeder reactor technology desirable in an energy constrained period. Breeder technology, however, is currently not commercially available in the U.S. and further demonstration of it is precluded in the time frame of concern by political and institutional controversy.

Light Water Reactors

Light water reactors are of two principal designs, either pressurized water reactors (PWR) or boiling water reactors (BWR). Both types of reactors have found widespread commercial application in the United States. From a fuel utilization standpoint, the designs are essentially equivalent. The primary difference between designs is that in the BWR steam is generated in the reactor itself, while in the PWR the reactor produces high temperature water under pressure which is then used to generate steam in a separate heat exchanger.

Economics and Feasibility

Nuclear reactors utilize a very small quantity of fuel, compared to practical fossil plants (requiring 35 tons of uranium dioxide compared to approximately 3 million tons of coal, annually, for a 1000 MW plant of each type). This, and the related fact that only one nuclear fuel shipment is required annually, means that:

1. The economics of fuel purchasing are relatively insensitive to transportation distances (particularly important for a Florida site since it is more remote from domestic coal reserves than is almost any other part of the continental U.S.).
2. The economics of fuel purchasing are relatively insensitive to inflation. Since nuclear generation is more capital intensive, fuel purchases represent a small annual expense; whereas with coal generation fuel is a large portion of the total expense.
3. The uncertainties of transportation and of long-term continuity and reliability of fuel supply are of relatively minor concern.

Data Resources Inc. (DRI) has conducted extensive economic modelling of nuclear and coal-fired power generation for the period 1980 to 2000 and concludes that on the balance, nuclear generation is approximately 20 percent less costly than coal after accounting for capital and operating and fuel costs. For the South Atlantic region, this difference widens considerably, and it would be reasonable to infer, as indicated above, that for Florida the difference would be even greater than for the region. Despite projections that for most regions of the country nuclear is the economic choice, DRI assigns a significantly larger percentage of new plants in its forecasts to coal than the relative economics above would dictate. This relative allocation of new plants is predicated on the assessment of the implications of the Three Mile Island accident and the subsequent recommendations of the Kemeny Commission. DRI indicates that these factors justify a conservative position for nuclear.

Regardless of pros and cons, the critical factor in the specific selection of technologies for the site is the influence of timing and scheduling - the timing of the occurrence of the need for the plant (the time available) compared to the time period required for the licensing and subsequent construction of nuclear units. In the absence of mandated time periods for regulatory review and approval, licensing of nuclear plants has

been subjected to increasing delays, and it is anticipated that further delays will continue to compound, such that a new unit would now take at least 12 years for licensing and construction. Consequently, nuclear capacity is not an acceptable alternative to the needs which would be met by the proposed units.

Coal

There is little variation among conventional boilers utilizing coal for the generation of high temperature, high pressure steam, except for the manner in which coal is fired. Modern boilers utilize water - tube walls to enclose the space constituting the furnace into which coal is fed continuously for sustained combustion, in various ways. The traveling, or chain grate type of boiler for example, employs a continuous belt made up of links that pass over sprockets; coal fed at one end provides a moving, burning bed which discharges ash at the far end. A very wide range of fuels can be burned in this type of boiler, but it is viable only in the lower ranges of steam capacities, thus making it an impractical choice for commercial utility sized applications. The following alternatives of firing coal in conventional boilers were evaluated in terms of economic risk, energy efficiency, and commercial availability.

Cyclone Fired Boiler

The cyclone fired boiler employs a water cooled horizontal cylinder in which crushed coal is fired, heat released at extremely high rates and combustion completed with the aid of considerable turbulence. Given the good combustion possible with cyclone burners, it is not necessary to grind coal very finely, thereby eliminating an energy penalty. Effective combustion, occurring at high temperatures (>3000 F), is conducive to the formation of elevated nitrogen oxide (NO_x) emissions in the flue gas. These emissions, which are inherent to the design of the furnace and cannot be reduced significantly by boiler modifications, have essentially rendered cyclone boilers obsolete. Cyclone boilers, therefore, cannot be considered a viable technology for the proposed plant.

Fluidized Bed Combustion (FBC)

In FBC boilers, the heat of combustion is not only transferred from combustion gases in conventionally located water walls, but also from additional water tubes submerged directly in a bed of burning coal which is agitated by the motion of combustion air flowing upward through it. Hot solids and gases, intimately surrounding the tubes exhibit superior heat transfer characteristics and thereby allow combustion temperatures to be maintained low enough to minimize formation of NO_x and to eliminate slagging problems conventionally encountered with molten ash.

The fluidized bed is composed of a mixture of coal and limestone. The limestone reacts with sulfur in the coal, thereby serving to minimize the formation of sulfur dioxide by forming, instead, solid calcium sulfate. By suppressing the formation of sulfur dioxide during the combustion process, the need for expensive and complex flue gas desulfurization equipment is eliminated.

Since combustion of the coal is essentially complete, emissions of carbon monoxide and hydrocarbons are also suppressed.

FBC boilers represent a potentially desirable means of generating steam from coal in terms of engineering, environmental and economic considerations. However, FBC has been in research and development for the last several years, and remains to be demonstrated on a commercial size unit. Given its great future potential, however, FPL and JEA continue to actively monitor the development of FBC. Based on the time frame in which both utilities need generating capacity additions (late 1980's), and the quantity of generation need, FBC cannot be considered as a commercially demonstrated technology, or as representing an acceptable economic and technological risk.

Pulverized Coal (PC) Firing

Modern coal-fired power plant designs rely primarily on grinding coal to the consistency of talcum powder to obtain efficient combustion. The finely ground coal, transported by preheated air from pulverizers, is introduced into the furnace by burners specially designed and sized for a given installation and fuel type. For good combustion, reaction time is provided for by allowing enough furnace volume and sufficient turbulence through burner design and configuration (placement). Temperature control is important since it must be adequate to achieve complete combustion, but not so high as to promote formation of NO_x emissions. This is accomplished by providing preheated air, to expedite burning, and by sufficient cooling surface in the furnace to extract heat from the flue gases as they are produced. PC firing allows good control of temperature, and therefore of NO_x , while minimizing emissions of carbon monoxide or hydrocarbons, both largely through completeness of combustion. Two remaining air contaminants of significance - particulates and sulfur dioxide - are controlled separately in post-combustion auxiliaries discussed in Chapter 3, Section 3.8.

Given the strengths, weaknesses and flexibilities of the range of alternatives available for burning coal to generate steam/electric power, a PC furnace represents state-of-the-art technology and was selected as the most cost effective, energy efficient and commercially established alternative.

Economics and Feasibility

Coal characteristics vary considerably from one geographical location to another and are primarily a function of geological aging of plant material, going through a progression of ranks from peat (containing as much as 75 percent moisture) to brown coal or lignite, black lignite or subbituminous coal, bituminous or soft coal, to semianthracite and anthracite.

Lignite is eliminated as a potential fuel for the site based largely on its low calorific and high moisture content. Considering the long transportation distances to potential sources of reserves, and the fact that transportation is a very significant component of delivered cost, particularly for Florida sites, lignite represents an economically unattractive fuel. Anthracite is unattractive from the standpoint of hardness and therefore grindability - it is known as "hard coal" and "stone coal". The equipment necessary for grinding/pulverizing anthracite would need to be specially designed for this hardness, and the energy costs would be high. Also anthracite has undesirable ignition and burning characteristics due to its high fixed carbon to volatile matter ratio. Furthermore, reserves of anthracite are in short supply thus making it expensive. Consequently, consideration of coal as a fuel is limited to bituminous and subbituminous coals.

Published estimates of coal reserves in the U.S. vary considerably according to sources and to bases which are often undefined. Widely quoted recent estimates by the U.S. Geological Survey indicate a resource base of 3.2 trillion tons, about half of which is considered recoverable, the other half being left in the ground for support (in underground mining) or otherwise being lost because of location below cities, towns or lakes. Of the 1.6 trillion tons of recoverable coal, about half was determined by actual mapping and by exploration to depths of 3000 feet; the other half was considered as occurring in unmapped areas or at unexplored depths to 6000 feet. Of these quantities, approximately 200 billion recoverable tons occur in thickness of sufficient magnitude to support large scale mining operations with current technology and prices. Ignoring future advances in mining technology which would render thinner seams economically minable, the quantities recoverable by current technology represent an abundant reserve. Of that reserve, approximately 60 percent is concentrated in Montana, Illinois, Wyoming, Alaska and North Dakota. An additional 23 percent is located in Colorado, West Virginia, Pennsylvania and Kentucky. By rank and tonnage 1 percent is anthracite, 48 percent bituminous, 34 percent subbituminous, and 17 percent lignite - the vast majority of the

last two ranks occur in the western states. Consequently, by eliminating lignite and anthracite as design basis fuels, both utilities will still have a broad spectrum of coals to select from and assure themselves of the most economical, reliable supply of fuel at any given time during the useful life of the proposed plant.

Just as in its selection of fuels within a wide range, JEA and FPL are also retaining flexibility with respect to transportation mode. Although it is expected that coal will be delivered by rail from the mine to the site, options for delivery by barge, collier or combination of these are currently contemplated to provide reliability and diversity of fuel supply.

Gas

For commercial power generation, natural gas is a desirable fossil fuel since it can be conveyed by pipeline without intermediate storage and is virtually free of contaminants. Possibly the only inherent disadvantage, relative to other fuels, is the high content of hydrogen (bound mainly as methane and ethane) which results in higher water vapor upon combustion, and a correspondingly lower efficiency for steam generating equipment.

Natural Gas

The technical, economic and environmental desirability of natural gas as a fuel is limited due to its relative unavailability. In recognition of this unavailability, the Power Plant and Industrial Fuel Use Act of 1978 essentially preempts the use of gas in new, baseload steam/electric generating plants which have coal as a viable option.

Liquid Natural Gas (LNG)

The long range supply and price outlooks for LNG are quite uncertain due primarily to dependence on foreign sources. There are currently no known existing or planned cryogenic receiving and unloading terminals for

LNG in Florida. Additionally, vessels involved in shipping LNG are already dedicated and obtaining additional vessels that would be required for the size of generating units planned would be prohibitive.

Synthesis or Substitute Natural Gas (SNG)

High or moderate Btu pipeline quality gas can and has been produced using either coal or petroleum fractions (such as naptha), with coal being the more abundant and economical. The most advanced of current technologies are just reaching the demonstration stage, and it is not anticipated that they will be available on a commercial scale of the size of interest for the proposed plant in the time frame that this additional energy is needed. For these reasons, and due to the various competing uses, such as for space heating, pipeline quality SNG is not considered a feasible fuel.

Coal Gasification

Coal gasification is distinguished from SNG in that it produces a low (100 to 180) Btu/cubic foot or intermediate (350 to 450) Btu/cubic foot gas, eliminating some of the more technically complex and expensive process steps required in the production of SNG. Although technology to produce low Btu gas has been established, the economics remain in question. An economic and technical justification would need to be based on substitution of a flue gas treatment system with a gasification facility. The basis for the attractiveness of gasification is that contaminants in the fuel gas occur at a higher concentration and in a form that is more easily cleaned, than in the products of combustion from direct coal firing (flue gas). Both utilities believe that the flue gas treatment system described as Best Available Control Technology in Chapter 3, Section 3.8 is relatively more developed at this time and poses a smaller technological and economic risk than a low Btu gasification facility. The latter shows potential for future applications, and both utilities are supportive of demonstration

projects underway which will define and improve such vital parameters as reliability and economics, and promote the utilization of coal in other environmentally acceptable manners.

At this time, low Btu gas from coal is considered unavailable for the proposed plant in its time frame.

However, to assure diversity, the units will also have the capability of future conversion to burn gaseous fuels. This diversity is essential to the reliability and integrity of both utility systems, and will not only assure a fallback capability in the event of an emergency, such as a prolonged disruption in the supply of coal, but will also provide the flexibility for taking advantage of emerging technologies which are expected to be capable of producing cost competitive (with coal) gaseous fuels sometime in the future.

Liquid Fuels

Liquid fuels for generation of electric power on a commercial scale may be categorized as being derived from either crude petroleum or coal. Liquid fuels can be burned in a conventional configuration of boiler-steam turbine-electric generator, or burned directly in the combustion section of a turbine with the gaseous combustion products serving as the working medium for rotating the gas turbine. In more advanced form, the gases exiting from the gas turbine, still containing large quantities of thermal energy, can be used to generate steam (in a waste heat boiler) for use in a steam turbine. A unit utilizing both the gas and steam thermodynamic cycles is referred to as a combined cycle unit. A discussion of the engineering and economic considerations given to gas turbines and combined cycle units is not included here since these technologies, although well understood and considered available in the time frame needed, are characterized by high operating cost and maintenance and a relatively short useful life, making them more appropriate for peaking and intermediate capacity than for the baseload capability required.

Liquid fuels can also be utilized in internal combustion cylinders to drive pistons in a reciprocating manner. The reciprocating motion is converted to rotational work by means of a crankshaft - much as in automotive applications - which then rotates an electric generator. The internal combustion engine is quite inefficient, however, and therefore too costly to operate for power production except in some cases for peaking power.

Fuel Oil

The term fuel oil is used to distinguish liquid fuels derived from petroleum or crude oil by the process of refining from those derived from coal by liquefaction. The latter are discussed in this subsection later.

In conventional refining it is common practice to produce fuels complying with various sets of specifications compiled by the American Society of Testing and Materials and adopted by the National Bureau of Standards as a commercial standards. Fuel oils produced as discrete fractions are graded according to density and viscosity, the lightest being No. 1 and the heaviest No. 6 which is a by-product of the refining process and has the highest ash content, ranging from 0.01 to 0.5 percent but seldom exceeding 0.2 percent. The predominant commercial fuel oils are No. 2, or distillate, and No. 6, or residual.

Distillate

Distillate fuel oil in electric utility applications is generally restricted to gas turbines, internal combustion engines and as an auxiliary fuel during start-up of coal-fired boilers - situations in which fuel quality is important and justifies the higher cost when compared to residual fuel oil. In the JEA and FPL's generating systems, distillate fuel oil is used as a peaking fuel in gas turbines which are typically not suited to extended operations, but fulfill an important function in allowing response to unexpected short-term variations in load. As

discussed in Chapter 1, the need for power justifying the proposed new units for oil displacement and reliability requires that they be of the baseload type rather than the peaking type required by short-term perturbations in demand. The nature of the capacity required, then, militates against the use of gas turbines or internal combustion engines and, thus, distillate fuel oil.

Residual

The technology and practice of burning No. 6, or residual fuel oil, for the production of steam and generation of power is quite familiar to both utilities, currently comprising 100 percent of JEA's and 82 percent of FPL's total installed generating capacity. JEA and FPL are not unique in the utility industry in their reliance on residual fuel oil for base and intermediate load capacity. Many utilities have built such capacity in the past for some or all of the following considerations:

1. To gain diversification of fuels.
2. To take advantage of favorable economics (of transportation and costs from foreign sources to the east and west coasts).
3. To achieve compliance with the mandates of the Clean Air Act of 1970, the choice being dictated by the relative economics of retrofitting electrostatic precipitators on coal plants, often with severe space constraints, as compared with that of converting to oil.

Factors governing the selection of fuels have changed radically over the past decade so that residual is currently neither economical nor abundant as a primary fuel for the design life of the proposed units. At the early 1980's price differentials of oil over coal, the incremental fuel cost for oil over the design life of the units would pose a substantial and

unreasonable burden to the customers of both utilities. The Power Plant and Industrial Fuel Use Act of 1978, addressing domestic scarcity of petroleum, provides Congressional guidance away from reliance on oil.

Coal Liquefaction

Synthetic organic fuels, or synfuels, can be produced from coal, oil shale, tar sands and various types of biomass (discussed later in this subsection) such as wood, grain, and garbage. Oil shale deposits - primarily in the Green River formation of northern Colorado and Utah and in southern Wyoming - are in areas geographically remote from the site. In addition, technologically, oil shale resource recovery has yet to emerge from the research stage.

Somewhat more developed than shale oil are liquid fuels obtainable from coal by some eight distinct processes at various stages of development. These development projects are being pioneered by private companies with a strong interest in oil and/or coal, under the sponsorship and funding of the federal government and the electric utility industry.

The synfuels program, which includes development of a broad range of liquid and gaseous fuels has been spurred by passage of the Power Plant and Industrial Fuel Use Act of 1978, by international events highlighting the scarcity of domestic oil and gas, and by the sharp increases in energy prices which make alternative sources increasingly attractive. Projections based on analyses by EPRI indicate that by 1995 there will be sufficient synfuel production capacity in the U.S. to make a significant contribution (in excess of 2 million barrels per day) to the domestic energy supply. If coal derived liquid fuels become available as a cost competitive power plant fuel, the dual-fuel capability of the proposed units will allow the utilization of such fuels. Given the remoteness of the site from viable coal fields and the technological and economic risk inherent in any demonstration project it is prudent to not consider either of the proposed units as a liquefaction/utilization facility. The time frame in which the

proposed capacity is needed also does not allow consideration of reliance on externally produced synfuel as an energy source during the initial years of operation. During later years of the plants' life, as the supply and relative costs improve, use of such liquid fuels may warrant reconsideration and will not have been precluded by design.

As described in Subsection 8.2.1, the proposed units are scheduled to be coal-fired units and will incorporate all of the appropriate pollution control equipment. However, to assure diversity, the units will also have the capability of future conversion to burn liquid fuels. This diversity is essential to the reliability and integrity of both utility systems, and will not only assure a fallback capability in the event of an emergency, such as prolonged disruption in the supply of coal, but will also provide the flexibility for taking advantage of emerging technologies which are expected to be capable of producing cost competitive (with coal) liquid fuels sometime in the future.

8.2.2 Other Generating Technologies

Consideration of alternative means of power production is no longer restricted to nuclear and conventional fossil fuels, or to the steam-electric power generating cycle. Currently a number of a new "renewable" or "exotic" power generation technologies are being seriously investigated for use in the U.S. Some of these utilize the energy contained in the wind or the ocean, or radiated by the sun; others utilize the energy captured from the sun in biomass. While several of these alternative approaches to power production will undoubtedly ultimately achieve some degree of commercial success, none of these has the present capability to satisfy the need for power to be furnished by the proposed project. Brief descriptions of these alternatives and their distinguishing characteristics follow.

Renewable

Municipal Waste

Municipal waste is fundamentally a variant of biomass, since most of the combustibles in municipal waste consist of varying forms of biomass. However, it differs from biomass in that it must be collected and disposed of somehow, whether beneficially or not. Being already concentrated and collected, it constitutes, in most U.S. metropolitan areas, an available and most often unused energy resource.

The typical moisture content and percentage of noncombustibles in municipal solid wastes limit their average heating value to 4000 to 6000 Btu/lb (Ballantyne, 1978). However, this is sufficiently large to produce useful heat and several U.S. cities are producing steam or power, primarily the former. Typical units burn from 300 to 400 tons/day, and a plant may contain from two to four generating units.

The Union Electrical Company of St. Louis, Missouri, conducted an extensive test on two 125 MW coal-fired boilers in the early 1970's in which municipal refuse, shredded and with large bulky items and ferrous metal removed, was utilized to save 10 percent of the coal. The test was regarded as successful enough to warrant an expansion of the project to handle essentially all of the refuse generated in the St. Louis metropolitan region (2.5 to 3 million tons/year) (Ballantyne, 1978). However, this project had to be abandoned because of local opposition to the proposed site (Gallese, 1977).

Columbus, Ohio is beginning the construction of a 90 MW generating plant (3 to 30 MW water-wall units) to be fired by a mixture of up to 80 percent solid waste and 20 percent coal. Generation of 90 MW will require about 2,000 tons/day of refuse; maximum design throughput is 2,700 tons/day (Bell, 1979). The 550,000 residents of Columbus are expected to generate about 1,000 tons/day in 1980. In Dade County, Florida, a solid waste

recovery facility, which would consume up to 4,000 tons of refuse per day in a 60 MW plant, is under construction and is expected to be completed during 1981.

The maximum generating capability of a facility, when utilizing municipal refuse as a fuel, is limited by the amount of refuse that is collected. The refuse from a municipality with a population of approximately one-half million, such as all of Duval County, is required to support a generating station that would produce approximately 50 MW. Municipal waste, therefore, can be considered no more than a supplementary fuel source for a large scale coal burning facility. The Jacksonville Electric Authority is evaluating refuse co-firing for its proposed 600 MW generating units. At this time, there appear to be no insurmountable barriers to the incorporation of refuse co-firing. Therefore, the Jacksonville Electric Authority is planning to retain the capability to co-fire refuse with the anticipation that all technical, economic and environmental issues will be satisfactorily resolved.

Solar Power

Solar power can take many forms. Solar radiation can be utilized directly, as in thermal or photovoltaic conversion. Thermal differences between the top layer of the ocean and its depths, which result from heating by the sun, can be tapped to provide useful energy. Winds, created by uneven heating of the earth's surface by sunlight can drive power generating units. The energy in biomass is the result of photosynthesis fueled by sunlight.

Thermal Conversion

Thermal conversion would use a thermodynamic cycle as is used in present steam-electric generating plants, except that concentrated solar energy would be the heat source, using a steerable array of light collectors focused on a stationary heat collection unit. Solar thermal

generation units are in the development stage, and a small (10 MW) experimental generator is expected to be tested in the near future (1982) by the DOE at Barstow, California (U.S. Department of Energy, 1978). Operation of a full size (50 to 300 MW) solar thermal demonstration plant is tentatively scheduled for 1986 (U.S. Department of Energy, 1979). In a conceptual design for a 100 MW plant, 22,900 heliostats, each containing 400 square feet of mirrors, are focused on an elevated boiler mounted on a 1,000 foot tower. The mirror array occupies a circle a little over a mile in diameter (U.S. Department of Energy, 1979). A solar thermal plant with a capacity of the proposed plant (1200 MW) would require a land area of approximately 9 square miles (approximately 6000 acres).

A thermal conversion system has power generation capability, but cannot meet base load demand requirements; power is not generated during nighttime or other sunless periods so that the systems would require a method of storing electricity until it is needed or a backup generator. For economic power generation in comparison to conventional plants, the cost of solar collectors must not exceed about \$1/ft² of mirror surface. However, concentrating solar collectors which can be steered to follow the sun would cost more than \$4/ft². There are no systems commercially available of sufficient capacity for power plant use, and none is anticipated in the foreseeable future. Thus, at this time, direct thermal conversion is not an economically viable option for the proposed plants.

Photovoltaic Conversion

A photovoltaic cell converts sunlight directly to low voltage dc electricity. Photovoltaic conversion has been well developed technically through the space program for spacecraft use. Some small photovoltaic conversion systems are used on earth for remote weather stations and signal buoys. For central power station use, the low voltage dc would have to be inverted to higher voltage ac. A conceptual 100 MW central station was calculated to require 234 acres of flat plate stationary silicon cells. Approximately 2,800 acres of silicon flat-plate collector area would be

required for a plant the size of the proposed units (1200 MW). The key element in the commercial success of photovoltaic conversion is increased cell efficiency and reduced costs of photovoltaic cell production.

Present cell costs are \$10 per watt for the most economic system. Research is underway to reduce photovoltaic conversion costs to 30 to 40 cents per watt (McKelvey, 1979). Attention is being focused on increasing the efficiency of photovoltaic conversion by use of gallium arsenide with the goal of maximum practicable 30 percent conversion (McKelvey, 1979). Single crystal silicon cells presently have a maximum practical conversion efficiency of about 10 percent. Both single crystal silicon and gallium arsenide cells are expensive and difficult to manufacture. Costs would be cut by mass production of relatively impure polycrystalline or amorphous cells by automation instead of the time consuming manual method which can produce high purity single crystals.

There are no commercially available systems of sufficient capacity for power plant use, and in the present state-of-the-art, capital costs would be prohibitive for a central power station application. As in solar thermal conversion, photovoltaic cells do not operate during night or on sunless days. Therefore, a costly electricity storage system of batteries or a backup generator would be required. Aesthetics may also be a problem, although the electricity produced will be clean and renewable.

Ocean Thermal Energy Conversion

The solar energy stored in the surface waters of the oceans may provide a clean source of power. In the "closed cycle" concept, warm ocean surface waters are used to evaporate a low boiling working fluid such as ammonia or freon whose vapor expansion drives a turbo-electric generator. After passing through the turbine, the vapor is condensed in a heat exchanger that is cooled by cold water pumped from deep waters below.

The DOE is currently investigating and developing the technology to produce electricity via the Ocean Thermal Energy Conversion (OTEC) program. Efficient heat exchangers are critical to OTEC, and much attention is being devoted to this problem. Field tests of prototypes were scheduled to begin near Hawaii in 1980. The DOE's current OTEC development program consist of gradual scale-up of tube-shell heat exchanger hardware from bench-test sized units with capacity of 25 kW - 1 MW range to power packages of 5 to 25 MW range, which may be put together in 1984 to form a 100 MW commercial demonstration plant. "Mini-Otec", a 10 kilowatt, barge mounted power system off the coast of Hawaii, has recently started generating electricity.

Other major technical problems in addition to efficient condensers are the very long lengths of large suspended pipe, the method of transporting the electricity generated to shore, biofouling, cleaning of pipes and equipment underwater, and corrosion.

The local thermal structure could be influenced by OTEC plant operation. Substantial flow of hot water through the evaporators and cold water through the condensers creates a continuous redistribution of energy in the surrounding water column. An OTEC plant could affect the climate of nearby land masses or endanger living organisms in the ocean by altering the natural thermal layering of the ocean where it is located.

South Florida has the required temperature difference of 18°C between the warmer surface strata and the colder waters at the bottom for electrical generation in the relative shallow waters along its western coast. An OTEC plant can be independent of diurnal variation in temperatures so that it can serve effectively as a base load system. Still, an OTEC system, like any other solar energy system, must be designed to cope with seasonal variations in the energy source.

An OTEC plant of the magnitude of the proposed coal units could be considered only when issues such as the type of heat exchangers to be used and their performance, bio-fouling, cleaning of pipes and equipment underwater, corrosion and, most importantly, economics are properly answered. Such answers are unlikely to be obtained before 1990 and as such, the power to meet system needs cannot be derived from OTEC technology.

Wind Power

Wind power is and has been used for many years to satisfy many small energy needs around the world, primarily where mechanical power is sought. A familiar historical use in this country has been for pumping water from farm wells. The potential amount of wind energy is large, although it is an unreliable source where energy needs are continuous.

No large scale systems for the generation of electricity by wind power presently exist. In the 1940's, a 1.25 MW wind-powered generating unit operated atop Grandpa's Knob in Vermont, until structural failure occurred. National Aeronautics and Space Administration (NASA) recently built and operated a 100 kW machine at the Plum Brook Research Center near Sandusky, Ohio. The DOE is constructing a MOD-2, 2.5 MW wind powered generator with a blade span of 300 feet at Goodnoe Hills, Washington (U.S. Department of Energy, 1980). This unit is expected to generate electricity for commercial purposes by February, 1981. Between 1981 and 1982, it is anticipated that four other turbines in the advanced intermediate (200 kW) and advanced large (3 MW) size ranges will be developed and tested (U.S. Department of Energy, 1979). However, since the wind is variable and unpredictable, so also is the power generated. In addition, the power generated is approximately proportional to the cube of the speed, and until wind speed reach substantial levels (10 miles per hour) power output is but a small fraction of rated output. For example, a drop in wind speed from 30 mph to 15 mph reduces the power output from a 200 foot diameter windmill from 1,600 kW to 200 kW. The stall speed of most wind generators is between 5 and 10 miles/hour (Sutherland, 1978).

Florida is a region of low wind activity so that it would be difficult to extract power economically. Ways to surmount this difficulty (including use of extremely large diameter fans and very high towers) are being studied. A result of such studies will be assessment of the technological and economic feasibility of wind power in areas similar to Florida.

Windspeed is variable and the possibility of windless days requires installation of either a backup generator or battery storage; at least 6 hours of storage are needed to meet reliability requirements, and such a storage technology is not estimated to be available until 1990. The desired goal of current research is to reduce the cost of wind-generated electricity to 1.7 - 2.5 ¢/kW in order to be competitive with other conventional sources of energy. At best, wind power can supplement power in remote areas (for water pumping, grain-milling, timber milling, communications, etc.) but cannot supply power to meet urban area baseload demands on a continuous basis.

Enormous amounts of land area would be used to site windmills, 50 times more than would be required by a conventional nuclear plant (Rudmann, 1978). In addition, environmental issues have been raised concerning radio and television transmission. Based on the above discussion, wind-driven turbines are not considered suitable in lieu of the proposed plant, for providing the power to meet systems needs.

Hydroelectric Power

Hydroelectric plants utilize the energy of falling water to generate electricity. The amount of generation capability is a function of the mass flow and the available head. Florida is not well suited for hydroelectric power generation because of its relatively level topography. The only potential for developed and undeveloped hydro resources is on the Apalachicola, Blue Springs and Yellow Rivers and on the St. Mary's River in northeastern Florida. The St. Mary's River is considered viable for installed capacity of only 36.5 MW. Therefore, hydroelectric energy is not considered a viable alternative for this generating station.

Exotic

Biomass

The establishment of energy plantations has been suggested to produce fuel for baseload power plants from sunlight by the process of photosynthesis. A biomass-fueled power plant operates similarly to a coal-fired steam electric facility. As a fuel, one ton of dry biomass is equivalent to 0.4 ton of coal, 1.25 barrels of oil, 1,200 cubic feet of medium Btu gas or 750 lb of solid combustible residue (e.g., municipal refuse or crop wastes). Because of the low heat content of such materials and the bulk necessary to fuel a power plant, transportation costs can be a very significant economic factor. Materials that have been suggested for biomass facilities include land-based crops of sorghum, sugarcane residue, sycamore and eucalyptus trees, etc., and watercrops of algae and water hyacinth. Typical land requirements are 285 square miles and 50 square miles for a 100 MW continuously-operated power plant using sycamore and sugar/sorghum, respectively. These acres would compete with agriculture for available land, water and fertilizer. Dried biomass fuel cost would be high when compared with return from investments on food crops. Wood is more valuable as lumber or feed for paper production than simply as a heat source. Harvesting and collection of biomass presents logistical problems with the attendant processing, dewatering, and drying operations.

The moisture content of wood is typically 40 to 50 percent, and heating values are between 4300 to 5300 Btu/lb, including all tree parts (Schwieger, 1980). Wood and wood wastes are currently the most commonly used biomass fuels; bagasse is used as an energy source in the extraction of sugar from sugarcane. Biomass can be converted to gaseous e.g., methane or liquid e.g., alcohol fuels but direct conversion to steam and/or electricity by combustion is the most common practice.

Research on rapidly growing nutrient-rich water hyacinths has demonstrated a yield in excess of 16 tons of dry matter per year per acre. Economic and technical feasibility studies underway will yield additional

data by mid-to-late 1980's. Optimistically, it may be possible by the end of this century to obtain up to 20 trillion cubic feet/year methane gas from ocean biomass and 7 to 11 trillion cubic feet/year methane gas from land biomass. As discussed earlier, land biomass plantations can be built at the expense of agricultural land or on marginal land. Electrical power generation using biomass is currently not viable to meet system needs in lieu of the proposed plant.

Geothermal Power

Geothermal energy is a natural thermal energy source in the earth's crust that produces steam or hot brines which can be used to generate power. This energy source has been put to practical use since 1904 when the first geothermal power station in the world, the Larderello Plant, went on-line in Italy. In the United States, the first plant, rated at 12 MW, went on-line in 1960 in northern California in a field called the Geysers. In both of these cases, the underground reservoirs are made up of hot water, with and without steam, which have been employed commercially in the U.S. only for heating purposes.

Plans are underway to construct the first commercial-scale plant to generate electricity using underground reservoirs in north central New Mexico. Water under pressure and at approximately 550 degrees F will be converted to steam to generate up to 50 MW of electricity (U.S. Department of Energy, 1978). A measure of life-time costs of a generating facility is the levelized annual busbar costs. For a geothermal plant using a liquid dominated, moderate temperature, low salinity source and beginning operation in 1985, electricity would cost 90 to 110 mills per kWh which is 50 to 100 percent greater than for nuclear or coal-fired plants.

Investigation of the possibilities of geothermal resources on the east coast has just begun by the DOE. Eastcoast geothermal resources are believed to consist of hot water trapped within the rock formations at depths of one mile or more. Exploratory wells are planned for New Jersey,

Delaware, Maryland, North and South Carolina, Georgia, and Florida (U.S. Department of Energy, 1978). According to the State Bureau of Geology of Florida, there are no outstanding geothermal resources in Florida. However, even if a new geothermal resource was located, it is not likely that it could be developed within the time frame required. Therefore, geothermal energy is not considered to be a viable alternative to the proposed project.

Magnetohydrodynamics (MHD)

MHD generation is based on the principle that an electric charge moving through a magnetic field produces an electromotive force. In an MHD generator ionized gases are passed through a magnetic field to produce an electric current. Future MHD plants in the U.S. will use coal and are expected to generate electricity up to 50 percent more efficiently than today's steam-turbine power plants. A MHD plant would direct hot combustion gases from burning coal through a channel surrounded by a powerful magnetic field. Electricity, produced directly from the hot gases, is withdrawn through electrodes in the channel walls. MHD power has been generated experimentally, but severe technical and material problems have so far prevented its reduction to commercial practice. One critical problem is recovering the potassium seed material added to improve the conductivity of the gas. Recovery of this material for reuse is necessary for MHD systems to operate economically and efficiently. A \$20 million development program, not scheduled to be completed until 1983, has just been initiated (U.S. Department of Energy, 1979).

Based on the present state of its development, large scale commercial application is likely much more than a decade away, and the generation of electricity by MHD is not a viable alternative to the proposed project.

Fuel Cells

Fuel cells generate electricity by the direct conversion of chemical energy. Hydrogen is combined with oxygen in the fuel cell to produce water, heat, and electricity with few environmental problems. Emissions from experimental fuel cells operating on natural gas, e.g., NO_x , SO_2 , smoke and particulates, are 1/10 to 1/50000 of conventional plants. No process water supply is needed since fuel cell by-product water is used in fuel conditioner. Cooling water is not needed because heat is rejected to air circulated by quiet, low speed fans. This provides an advantage in locating fuel cells close to load centers where utilization of the waste heat becomes practical and transmission distances are reduced. Fuel cells for a 4.5 MW demonstration unit are now being manufactured by the United Technologies Corporation to be installed on the Consolidated Edison Company system in New York City, a densely populated area.

An obstacle to the adoption of large scale utilization of fuel cells is the production of hydrogen. Fuel cell technology to date has been based on hydrogen derived from natural gas or naphtha, neither of which is now an acceptable base for new large scale power production plants. Technology for the commercial production of hydrogen, using coal as a fuel, has yet to be demonstrated. A major 4-year program of the DOE and the Gas Research Institute pilot plant has recently been terminated.

Fuel cells are still untried for large scale power generation, and are not considered a viable alternative to the proposed project.

Tidal Power

Where tidal variations are large and a suitable topography exists, the energy contained in tidal action can be harnessed for the generation of electricity. There are few suitable locations in the world, and only one large scale tidal power plant is in operation in the free world. This is the development on the Rance River in France, which has been in operation

since 1966. Total installed capacity, supplied by 24 turbines, is 240 MW, but the average plant capacity factor is only about 26 percent (Iceman, 1975). Mean tidal range is 28 feet.

There are two locations in North America with tides of a magnitude suitable for a tidal power plant - The Bay of Fundy located on the Atlantic Coast and Passamaguoddy Bay in Maine. However, Atlantic Ocean tides in Florida are but a few feet, far below the practical level. A suitable estuary or coastal inlet must be available for closure damming, substantially reducing the tidal range. Under these circumstances, tidal power is not a viable option for the proposed project.

Ocean Currents

The feasibility of tapping energy from the Gulf Stream using giant turbines moored beneath the ocean's surface is a concept undergoing preliminary investigation by the DOE; however, prototype units have yet to be built and tested. The concept envisions as many as 242 turbines, each 560 feet in diameter, positioned in a single array roughly 15 to 20 miles offshore in the Gulf Stream. The steady 5 to 6 knots undersea current would turn the turbines, each of which could develop up to 75 MW.

It is claimed by proponents that studies have shown that even 242 turbines would have almost no impact on marine life, the Gulf Stream, the tides, commercial shipping or global weather patterns (Reaves, 1979).

Florida is geographically situated to utilize the Gulf Stream as an energy source, but development of a commercial technology, if achievable, is too far in the future to provide a satisfactory alternative to the proposed project.

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8.3 ALTERNATIVE SITES

On February 5, 1980, the JEA selected the Eastport site as its preferred site for the proposed two 600 MW unit coal-fired power plant. This selection culminated three years of site identification and evaluation whereby specific environmental, engineering, and cost factors were used to select the preferred site. The siting process began in May, 1977, when JEA retained United Engineers and Constructors (UE&C) to conduct preliminary studies. From 1977 to 1980, UE&C conducted numerous studies and prepared four reports. The initial report, Site Selection Study, Final Report, was issued in December, 1977 (UE&C, 1977), followed by Site Selection Study - Supplement, issued in February, 1978 (UE&C, 1978), Site Selection Study, Final Report and Supplement Review issued in August, 1979 (UE&C, 1979), and Site Selection Study - Four Air Quality Studies in Addition to Final Report and Supplement Review issued in January, 1980 (UE&C, 1980).

The site selection process consisted of four distinct stages: (1) Identification of Candidate Areas, (2) Identification of Candidate Sites, and (3) Identification of Recommended Sites, and (4) Selection of the Preferred Site. The general trend of the process was to successively reduce the areas and number of sites under consideration while increasing the investigative detail.

The study area included Duval, Baker, Clay, Nassau, and St. Johns Counties and the northeast portion of Bradford County. Within this area, 32 candidate sites were evaluated and six sites were recommended. From these six sites, three were investigated in greater detail by UE&C, JEA, Ebasco and others (JEA, 1980).

The results of studies conducted from May, 1977 through January, 1980 was the selection of the 1,656 acre Eastport Site, located approximately 9 miles north-northeast of downtown Jacksonville and adjacent to the existing Northside Generating Station, as the preferred site.

8.3.1 General Siting Criteria

The ultimate purpose of the site selection studies was to identify a preferred site for the proposed plant using specific environmental, societal, engineering, and economic criteria.

Throughout all stages of the studies, appropriate laws, rules, regulations, guidelines, objectives and policies of the federal, state and local governments were continually analyzed to ensure that the site ultimately selected would be environmentally acceptable.

The initial step in the process was to establish some baseline assumptions providing a common ground for the development of siting criteria and the identification and comparison of candidate areas and sites. The following were the primary baseline assumptions used:

1. The region of interest encompassed the Duval County area, its four contiguous counties (Baker, Clay, Nassau, St. Johns) and the northeast portion of Bradford County (Figure 8.3-1). This area corresponded to that for available site locations described in the "Jacksonville Electric Authority Ten Year Site Plan (1977-1986) for Electric Generating Facilities and Associated Transmission Lines", April 1, 1977. The Duval County area and its four contiguous counties represented the service area prescribed for JEA by its special creating act, Charter 67-1569.
2. Based on preliminary load projections, a developing national energy policy and a need for JEA to diversify its fuel mix, the proposed plant was preliminarily identified as a coal-fired facility (Section 8.2) consisting of two units, generating approximately 600 MW each.
3. Sites were to be of sufficient size to support the proposed plant (> 1000 acres).

4. Sites were to be, at a minimum, capable of supporting a closed-cycle condenser cooling system.
5. During periods of low flow, it was possible that certain streams and rivers, and portions thereof, would be incapable of supplying plant makeup water requirements. In these instances, an impoundment would be required. Because the development of large impoundments may result in significant additional costs and some adverse environmental impacts, sites were to have sufficient water supply without impoundment.
6. It was desirable for a site to have water and railroad access. Dual access was considered to be very important in terms of increased reliability of fuel supply and lower costs of fuel and delivery.

8.3.2 Identification of Candidate Areas

The second step in the process was the establishment and evaluation of environmental and engineering factors from which candidate areas could be identified.

These factors included air quality, civil-structural limitations, fuel delivery and site access, hydrology, and land use. The result of each factor evaluation was a study area map indicating favorable, fair and unfavorable areas. The integration of all of the factor maps into a Composite Factors Map allowed the identification of candidate areas. A brief discussion of the evaluation process for each factor is presented below.

Factor Evaluation

Air Quality

Available ambient air quality and modelling data for the region of interest were analyzed to identify areas where present or future projected air quality may preclude or severely restrict the siting of 1200 MW of coal-fired generation capacity. Ambient data were examined for the following pollutants to identify areas with poor air quality: sulfur dioxide (SO_2), total suspended particulates (TSP), nitrogen dioxide (NO_2), carbon monoxide (CO) and photochemical oxidants (O_3).

Specific areas with poor air quality were identified. Unfavorable areas were identified as those in which it would not be possible to operate a 1200 MW plant in compliance with air quality standards and regulations. These would include areas subject to the EPA Class I designation under the Prevention of Significant Deterioration (PSD) regulations of the 1977 Clean Air Act Amendments, since these areas and areas adjacent to them would likely be subject to siting restrictions. Areas of marginal suitability and those with no apparent conflicts were also identified, and designated fair or favorable as appropriate.

Civil-Structural Limitations

The soils capability to support plant foundations was evaluated according to relative suitability. Unfavorable areas included salt water marsh association, freshwater swamp association, and dredge spoil. Areas which are subject to significant seismic risks and areas in which competent foundation strata are in excess of 100 feet below existing grade were also considered unfavorable.

Areas in which soil conditions and water level variations were somewhat more suitable but still presented moderate civil-structural construction limitations were considered fair. Areas not designated unfavorable or fair were deemed to be favorable.

Fuel Delivery and Site Access

The region of interest was examined to identify the location of railroads and the availability of water transport. Areas were rated according to their accessibility.

Railroad access was considered an essential requirement for all sites. All areas within the region were considered accessible by rail. Because rail access was available all areas were considered at least fair. Areas with both rail and water access were rated favorable.

Hydrology

Data obtained from United States Geological Survey (USGS) gauging station records and statistical analyses of these data were utilized to determine water source suitability/availability.

All non-tidal streams and rivers which had an available flow less than that required for plant operation were considered unfavorable. All lakes with small retention volumes and flows less than that required for plant operation were also considered unfavorable.

Geographic areas which were greater than 10 miles from water sources that could provide sufficient volume and flow for plant operation were evaluated as fair because of potential adverse environmental and economic impacts associated with constructing and operating a system with a long intake pipe. Favorable geographic areas included all those within 10 miles of an adequate water supply.

Land Use

Available published information was used to identify large dedicated land uses such as parks, wildlife refuges, aquatic preserves, forests of federal and state importance, and active military reservations. These land

uses are considered incompatible with power plant development and were classified as an incompatible land use or unfavorable. Densely populated land areas were also identified as unfavorable.

Other areas considered potentially unfavorable for power plant use were land resources of state or regional significance. Such land areas included mineral resources, wetlands, beaches, shores, dunes, densely populated places, and prime agricultural lands. These land uses were considered to be less important than federal or state-designated lands, since it may be possible to incorporate small portions of them within the site boundaries without significant adverse impacts. Nevertheless, such areas should be avoided if possible and were classified as sensitive or fair. All other areas were considered to be favorable.

Results

The results of the Identification of Candidate Areas stage are summarized in the Composite Factors Map (Figure 8.3-2).

8.3.3 Identification of Candidate Sites

Each candidate area was investigated in greater detail to allow the identification of candidate sites. Local land uses and site size criteria were the predominant factors considered.

Factor Evaluation

Site Size

A minimum site size of 1,000 acres was used in identifying candidate sites. This was considered sufficient to accommodate the necessary structures and storage areas for the proposed plant. A template indicating this minimum size requirement was prepared and used as an overlay on USGS

7.5 Minute Series (topographic) maps to find tracts of land of the requisite size. The maps were analyzed in detail to develop potential site boundaries.

Land Use

Land uses that could conflict with plant siting were identified so that they could be screened from further consideration. In the identification of candidate areas, large scale (federal and state) dedicated land areas were eliminated. Dedicated land uses on a more local level were also identified and avoided.

Environmentally sensitive areas such as river banks, barrier islands and marshes, and areas adjacent to beaches were eliminated from further consideration.

Historical and archaeological locations and areas of intense land use were also avoided. Sites in proximity or adjacent to public amenity areas; churches, hospitals, schools, convalescent houses and other institutions, were not selected.

Other Criteria

Although most of the candidate sites were selected by the above methodology so as to be located in "favorable" areas, some sites located in "fair" areas were included based on the following considerations:

1. Sites which were particularly suited to accommodate unique needs of a power plant, such as the potential for once-through cooling offered by coastal locations, were included if they did not appear to present significant adverse impacts.

2. In order to maximize the probability of finding an acceptable site, sites were dispersed geographically throughout the region of interest. This placed some sites in "fair" areas.
3. Previous JEA site selection studies had identified a number of suitable sites. Some of these were added to the analysis to insure completeness in the identification of candidate sites, despite their location in "fair" areas.

Results

The UE&C final report and final report supplement identified 32 candidate sites (Figure 8.3-3). Of these 32 sites, 30 were of sufficient size (>1000 acres) to accommodate the proposed plant (>1000 acres). As shown in Figure 8.3-3, the sites are located throughout four counties of the study area (Nassau, Duval, Clay, and St. Johns). No sites were located in Baker or Bradford counties because of the significantly greater distance to adequate water sources from each of the candidate areas in these counties.

8.3.4 Identification of Recommended Sites

The Identification of Recommended Sites stage continued the approach of applying increasingly more detailed data and evaluations to the site selection process. The methods used in this stage differ from those in the Identification of Candidate Sites in that they rely upon more site-specific data. Six recommended sites were selected from the 32 candidate sites based upon the most favorable balance of environmental/societal compatibility and costs. By eliminating sites with even a slightly less favorable balance and thus reducing the number under investigation, it was possible to undertake more detailed examinations.

Factors evaluated in the Identification of Recommended Sites included engineering/economic and environmental/societal factors. A brief discussion of the evaluation process for each of these factors is presented below.

Factor Evaluation

Engineering/Economics

Each of the engineering/economic factors below was evaluated and cost estimates were developed for each site. These estimates were then expressed as a differential cost between sites with the lowest cost situation indicated as base.

Factors considered in the engineering/economic evaluation included the following:

1. Fuel Transport and Site Access
2. Geology/Foundations
3. Circulating Water System: Piping Installation and Pumping Costs
4. Land Rights and Costs
5. Transmission System Construction and Operating Costs

The total evaluation cost of a coal plant at a given site was defined as the sum of the capital cost and the capitalized operating cost. The capital cost consisted of the base plant construction cost and the site-related costs. The operating costs include the cost of fuel, operation and maintenance, and pumping, capitalized over the life of the plant.

To make a meaningful comparison of the cost of the coal plant for the candidate sites, an order-of-magnitude estimate of the base plant was first developed. The base plant assumed the following:

1. The units were of the duplicate "slide" along concept with no major shared facilities.
2. The units were equipped with flue gas desulfurization (FGD) equipment.
3. Roads, rail, etc., abutted the plant property.
4. The plant abutted the cooling water makeup source.
5. Solid rock of adequate quality for support of all structures was at or near plant surface grade. No provisions were made for any piles or caissons for structural support.
6. Makeup intake and discharge structures were located at the shore of the cooling water makeup source with surface intake and discharge.
7. All licensing activities were assumed to proceed in support of the site construction schedule.
8. A construction management (segregated construction contracts) approach was assumed.

The site-related costs for each site were made up of the cost to construct railroad spurs, roads, pipelines, makeup pumping equipment and energy costs, land costs, additional excavation and foundation costs, and transmission construction costs to the existing 230 kV grid. The site-related costs were used as a basis of comparing the candidate sites.

The plant construction costs, and the capitalized fuel, operation and maintenance costs were used in developing the capitalized cost of the site related auxiliaries.

Environmental/Societal

In contrast to the engineering/economic factors, the environmental/societal factors cannot readily be expressed in terms of a common denominator, such as dollars. Because of the larger number of sites to be compared, a means to express judgments regarding the relative degree of environmental/societal compatibility in a common form was developed. This permitted the uniform comparison of all candidate sites and provided a consistent means of making judgments. The mechanism used to accomplish this comparison was termed the environmental evaluation matrix (EEM).

The EEM involved the consideration of both the magnitude and relative significance of the potential environmental/societal impact. The environmental factors considered were air quality, meteorology, aquatic ecology, land use, aesthetics, off-site transmission line routings, socioeconomics and terrestrial ecology. The magnitude of the potential impact was indicated by an environmental rating which was assigned to each factor relative to other factors being considered. The relative importance of each factor was expressed by a weighting factor. The environmental rating and the weighting factor were combined to produce a total site rating.

Results

The results of the combined environmental/societal and engineering/economics evaluation of the candidate sites produced the following six recommended sites:

Clay County

Flemming Island
Walkill
Willis Point

Duval County

Bayard
Eastport

St. Johns County

Switzerland

These sites are shown in Figure 8.3-3.

8.3.5 Selection of the Preferred Site

In October, 1979, the JEA selected three of the six recommended sites for further detailed investigation. Preliminary engineering and environmental field studies were initiated simultaneously on the Eastport, Walkill, and Willis Point sites. These studies were initiated to obtain site-specific data for the eventual licensing of the preferred site and to assist in the selection of the preferred site.

The JEA based its selection of the two recommended sites in Clay County (Walkill and Willis Point) on the UE&C studies which concluded that those two sites would be the best of the recommended sites. It was considered not necessary to consider a third less desirable site in Clay County, therefore, the Flemming Island site was eliminated from further consideration. The St. Johns County recommended site (Switzerland) was eliminated due to political opposition to the proposed plant in that county, thereby substantially increasing the potential for delay. Of the two remaining recommended sites, both were in Duval County (Bayard and Eastport). The Eastport site was selected for further consideration primarily because of its proximity to the St. Johns River for use as a water source and as a deep water fuel delivery port for oceangoing coal supply vessels.

To select a preferred site from the three recommended sites, the JEA again evaluated each site on the basis of engineering, environmental, and cost factors. The selection process was similar to that used in the identification of candidate areas, candidate sites and recommended sites. The process differed, however, in that the site evaluations were presented to the JEA in seven separate public meetings, and based upon these detailed evaluations, a preferred site was selected. A summary of the selection process and a listing of the factors considered is provided on the following pages.

Prior to the first public meeting, a schedule was developed and factors to be considered were determined (Table 8.3-1). The format for each of the public meetings was also established.

Each meeting was to consist of presentations to the JEA Site Selection Committee of data related to specific evaluation factors. The data presented by JEA staff, consultants and others were to be an update of previous studies using the best information available at the time, including site-specific information where available. Additional supplemental data, where no previous data had been provided, were also presented. After each presentation, members of the public were invited to ask questions or comment. At the beginning of the following meeting, the Committee rated the sites either 1, 2, or 3, for the topics reviewed at the preceeding meeting, or where appropriate, a differential cost was developed for each site. A 3 indicated that a site was most suitable for power plant development; 2 was fairly suitable; and 1 was least suitable. It was recognized that all three sites were recommended sites and that all three were considered to be acceptable from environmental, engineering, and cost standpoints. This process was implemented to obtain additional data in a public forum and to select the preferred site from the three recommended sites.

All seven site selection meetings were noticed in the local newspapers and were open to the public. Each meeting was held at the JEA Central Office Building in downtown Jacksonville. The meetings were well attended by citizen groups, private citizens, industry representatives and local officials interested in the siting of the proposed plant. Also, every meeting was attended by local television, radio, or newspaper reporters who published reports in their respective media.

The citizen groups attending the meetings included the Clay County Coalition (a group specifically organized to oppose the JEA coal plant siting in Clay County), the Clay County League of Women Voters, and St.

Johns River Citizens for Clean Air. Each of these groups had representatives in attendance at most committee meetings. Other citizens not affiliated with any citizen group were in attendance.

Factor Evaluation

To summarize the site selection factors and to provide a tool to more clearly assess the relative merits of each site, the JEA developed a "Site Selection Criteria Assessment" sheet (Table 8.3-2) to record site rankings and differential costs. As the information was received, developed and evaluated at each public meeting, a site ranking or differential cost was logged on the criteria sheet. The factors considered in the selection of the preferred site included fuel transportation costs, land costs, transmission line construction costs, transmission line loss costs, circulating water system costs, foundations costs, air quality control system costs, taxes and payments in lieu of taxes, system stability, site size/configuration, air quality, compatibility with existing land use, environmental regulatory agency opinion, terrestrial ecology, aquatic ecology, and avoidance of delay. The following discussion reviews the evaluation of each of these factors.

Differential Costs

Fuel Transportation

It was assumed that JEA would purchase its coal from three suppliers, with some coal purchased on the spot market and some from foreign suppliers. Transportation of coal to each site was available by rail. At the Eastport site ocean vessel delivery was feasible, and at the Willis Point and Walkill sites shallow draft barges could deliver coal.

The feasibility of coal transportation by ocean vessels was a significant advantage to the Eastport site. Not only would it provide an alternate means of transportation of coal and improve reliability of supplies, but it would also potentially provide a significant economic savings through purchase of spot market coal.

Based on this scenario, it was estimated that the coal transportation cost to the Eastport site would be about 60 million dollars less than at the Willis Point or Walkill site over the life of the plant. Transportation costs to the Willis Point or Walkill site were about equal because of the close proximity of these sites to each other and their similar distances to the river for barge unloading and conveyance of coal to the site.

Land Costs

A cost estimate was determined by two independent professional appraisals at both the Eastport and Willis Point sites. The appraisals determined a differential cost of 2.0 million dollars greater at Eastport than at Willis Point. An appraisal of the Walkill property was not available because the land owner restricted permission for access before a survey or appraisal could be made.

Transmission Line Construction and Transmission Line Losses

The preliminary studies conducted by JEA and FPL indicated that the associated transmission lines from the Eastport site would probably parallel the existing transmission lines from the Northside Generating Station. However, the existing right-of-way would not be wide enough to accommodate any additional transmission lines so additional right-of-way would have to be purchased. These preliminary studies also indicated that a new transmission line river crossing would be required across the St. Johns River in southern Duval County. The crossing would complete a 230 kV transmission loop around the JEA service area.

Further detailed transmission studies, conducted after the selection of the preferred site, concluded that a southern river crossing was not necessary. A description of the directly associated transmission system is presented in Chapter 3, Section 3.4.

Because of the proximity of the sites in Clay County, the transmission lines from the Willis Point or Walkill site were anticipated to be routed along the same corridors. These sites would also have two transmission lines from the plant. One line could be routed north along an existing FPL right-of-way to the west of Orange Park; the other line would also be routed north, but would cross the St. Johns River to the east.

The estimated differential construction costs were: Walkill 0 or base, Willis Point 9.2 million dollars, and Eastport 26.5 million dollars.

The transmission losses and costs for each site were also determined. The Eastport site was expected to have losses over the length of its transmission lines 16 megawatts greater than either Willis Point or Walkill, which both had equal losses. The present value cost associated with the transmission losses over the life of the plant was evaluated to be 86.8 million dollars greater at the Eastport site than the Walkill or Willis Point site.

Circulating Water System

The relative economics of closed cycle cooling systems at the three sites were evaluated. The major cost differential was determined to be the cost of the intake and discharge pipelines. The distances to the St. Johns River from the Willis Point or Walkill site is approximately equal,

consequently the costs are approximately equal. To minimize potential environmental impact at the Eastport site, it was assumed that makeup water for the cooling towers would be taken from the Northside Generating Station circulating water system. The distance from the plant at Eastport to the Northside Generating Station would also be approximately the same as for the Clay County sites. Therefore, there was no apparent cost advantage at any of the sites.

Foundations

As a result of the core boring program conducted at Eastport and Willis Point, it was estimated that the foundation at Willis Point would cost 2 million dollars more than at Eastport. Access to the Walkill site was restricted by the owner and a boring program could not be completed.

Air Quality Control Systems

To determine if additional costs would be incurred for an air quality control system at any one site versus the others, JEA authorized UE&C to perform a more detailed study on the potential air quality impact at the Eastport site. The report was entitled, "Site Selection Study, Four Air Quality Studies in Addition to Final Report and Supplement Review, January, 1980" (UE&C, 1980). The four studies were on the following:

1. SO₂ impacts - Eastport site on the Okefenokee Class I Wilderness Area.
2. Revised multi-source dispersion modelling for SO₂ - Eastport Site.
3. Particulate impacts - Eastport site on Jacksonville nonattainment area.
4. SO₂ impacts - Walkill and Willis Point site on the St. Augustine Historical Area.

Studies 1 through 3 were initiated to determine if the proposed plant could be located at the Eastport site and comply with the existing regulations without utilizing any additional pollution control equipment beyond that required at the two Clay County sites. Study number 4 was conducted at the request of a St. Augustine citizen. UE&C used EPA approved modelling techniques in their evaluations.

The results of the report concluded that the proposed plant located at the Eastport site would meet all applicable air quality standards without additional pollution control equipment beyond those required at the other two sites. Therefore, the air quality control system costs at each site would be the same.

Insignificant impacts within the St. Augustine Historical District were predicted for the proposed plant if located at any of the three sites.

Payments in Lieu of Taxes

The Clay County Property Assessors Office prepared a written statement estimating the annual taxes or payment in lieu of taxes JEA and FP&L as owners would pay to Clay County (export cost) if the plant were located at the Willis Point or Walkill sites. The estimated payment ranged between 6.2 and 10.1 million dollars per year. The present value of a 10.1 million dollar annual payment over the 40 year plant life was determined to be 113.7 million dollars. This export cost was applicable to the Clay County sites but not to the Eastport site. Since the Eastport site is located in the consolidated City of Jacksonville, any revenues generated by the plant which are paid as taxes or in lieu of taxes by JEA and FPL would remain in Jacksonville rather than being exported to Clay County.

Technical

System Stability

To provide for uniform reliable service, utilities have formed the Southeast Electric Reliability Council (SEEC). The Council has adopted guidelines to accomplish this goal of reliable service. A portion of Guideline 3 states "The objective of the regional criteria is to assure that the SEEC bulk power systems are planned so that cascading outages will not result from any foreseeable contingencies". Each SEEC member's system, including JEA's, is planned to avoid cascading outages upon the occurrence of certain contingencies. One contingency would be the loss of all lines on a common right-of-way. If the transmission lines on one of the right-of-ways from either Clay County site were lost, no significant problem would occur to the system. However, if the transmission line from the Eastport site to the Normandy substation were lost in combination with a simultaneous loss of the line from Northside Station to the Normandy Substation, this could possibly cause a cascading blackout which would effect the entire system. The possibility of this dual failure was, however, considered unlikely.

From a system stability/reliability perspective, the sites were rated Willis Point and Walkill 3, Eastport 2.

Site Size/Configuration

The plant island would require between 400 to 500 acres. The ash and flue gas desulfurization waste products, if not sold commercially, were conservatively estimated to require an on-site disposal area of approximately 500 acres. This area was determined by assuming a conservative coal characteristics and waste handling process and estimating the total number of hours of plant operation generating these wastes over its life. An additional 600 acres would also be required for use as a possible buffer zone or as reserve for solid waste disposal.

The resulting 1,500 acre estimate was larger than that used by United Engineers and Constructors in the Site Selection Studies. Consequently, it became necessary to review the site boundaries and modify them to increase each site's size to approximately 1,500 acres.

At Willis Point, the boundaries could be modified to add the necessary acres without difficulty. However, at Walkill the owner was not willing to sell a significant portion of the original site identified by UE&C or the additional acreage proposed. At Eastport, there was additional acreage to the north which could be purchased.

From a site size/configuration perspective, the sites were rated Willis Point 3, Eastport 2 and Walkill 1.

Air Quality Impact

The impact of the proposed coal plant on air quality at the Willis Point and Walkill site was estimated by computer modelling to be within that allowed by federal and state air quality regulations.

At the Eastport site, however, there was concern that the proposed plant might exceed some air quality standards because of the proximity of a federal Class I area, a nonattainment area for particulates and other SO₂ emitting sources, without the addition of pollution control equipment beyond that required at the two Clay County sites. For this reason, JEA authorized UE&C to conduct detailed site-specific modelling to estimate the air quality impact.

The conclusion of the report (UE&C, 1980) was that the proposed plant at the Eastport site would meet air quality standards without the addition of extra pollution control equipment.

From an air quality perspective, the sites were rated Willis Point 3, Walkill 3, and Eastport 2.

Compatibility with Existing Land Use

The Jacksonville Area Planning Board in its "Long Range Plan for the Port of Jacksonville" had identified the Eastport site as appropriate for port related industry. The proposed plant would conform with this plan because of the directly associated ocean vessel coal unloading potential. In addition, the site is adjacent to the Northside Generating Station which is a similar land use. The existing zoning for the Eastport site is for heavy industrial development.

Both Clay County sites are zoned for agricultural use. Siting a power plant at either Willis Point or Walkill would require rezoning to heavy industrial development and approval of a special land use permit by the Clay County Board of County Commissioners.

From a compatibility with existing land use perspective, the sites were rated Eastport 3, Willis Point 3, and Walkill 2.

Regulatory Agency Opinion

Based on comments received from the Department of Environmental Regulation all of the sites were considered licensable. However, primarily for air quality reasons, the sites were ranked Willis Point 3, Walkill 2, and Eastport 1. This ranking occurred before the fourth UE&C study was completed indicating that there would be no difference in the requirements for air pollution control equipment at any of the sites.

Terrestrial Ecology

The terrestrial habitat at the Eastport site consists of grassy scrub/pine flatwoods, hardwood hammocks, and some wetlands. The species diversity is moderate. The habitat of the Walkill site consists of meadow,

mature pine stand, and a hardwood swamp. The species diversity is high at this site. At Willis Point, the habitat is mostly pine plantation with some isolated wetlands, and the species diversity is low.

From on-site observation and data, it was also determined that the habitat value of Walkill was high, Eastport moderate, and Willis Point low. Therefore, the impact upon the habitat at Walkill would be greatest, moderate at Eastport and lowest at Willis Point.

Certain wetlands are considered environmentally sensitive. At Walkill, there is an extensive hardwood swamp south of the site. There are also approximately 40 acres of wetlands that bisect the site. At Willis Point, there are approximately 30 acres of isolated wetlands on the site, and extensive wetlands between the site and the river. At Eastport, there are approximately 100 acres of isolated wetlands on site. Also there are approximately 175 acres of wetlands on the site which are connected to the salt water marsh by streams with intermittent flow.

Certain rare and endangered species are indigenous to northeast Florida. Active eagles' nests were reported at the Walkill site and a potential nest area was reported to be near Willis Point adjacent to the river. This area was a distance of 1 to 1-1/2 miles from the plant structures and 1/4 mile from the proposed coal conveyor and makeup water pipeline corridor to the river. There was also a plant species on the rare and endangered list that is indigenous to Clay County, however, no sightings on either site were made. No rare or endangered species had been sighted on or near the Eastport site. In general, this site was believed to have fewer rare and endangered species than either Willis Point or Walkill.

From a terrestrial ecology perspective, the sites were rated Willis Point 3, Eastport 2 and Walkill 1.

Aquatic Ecology

Adjacent to the Eastport site is a large salt water marsh. This salt water marsh is extensive throughout this area and is considered to be important to the coastal ecosystem. By using the Northside Generating Station discharge for makeup water for the proposed plant and discharging to the Northside Generating Station intake flume, thermal impacts to the marsh due to the proposed plant located at the Eastport site are eliminated.

Near the Willis Point and Walkill sites, the aquatic environment consists of shoreline wetlands and submerged grassbeds along the St. Johns River. These were considered to be important to the aquatic environment of the St. Johns River. Some potential impact to the aquatic environment would be expected because an intake and discharge structure for makeup water and discharge would need to be built out into the river. This impact was, however, considered to be small.

The impact upon rare and endangered species, particularly the manatee, was considered. At the Eastport site, no impact to manatees was expected because of utilization of the existing Northside Generating Station circulating water system for cooling tower makeup water and blowdown discharge. At the Willis Point or Walkill sites, little or no impact upon the manatee was expected with the use of a closed cycle cooling system and proper intake and discharge structure design.

From an aquatic ecology perspective, the sites were rated Eastport 3, Willis Point and Walkill 2.

Avoidance of Delays

Public and political opposition to the Willis Point and Walkill sites was openly expressed. The Clay County Board of County Commissioners passed a resolution stating their opposition to the construction of the plants at either Clay County sites. Also, a petition had been signed by over 10,000 Clay County citizens in opposition to the JEA siting a plant in Clay County.

Because of this opposition, it was believed that obtaining the required change in the zoning classification of the Clay County sites and obtaining the required special use permit from the County Commissioners would be very difficult. This situation had the potential of causing substantial delay to the project if either Clay County site was selected.

From an avoidance of delay perspective, the sites were initially rated Eastport 3, Willis Point 1, and Walkill 1. However, notification of official opposition by the Clay County Board of County Commissioners resulted in re-evaluation of the initial ranking taking into consideration the significant potential for licensing delay. The final rating was Eastport 3, Willis Point and Walkill 0.

Results

The JEA, at its final public meeting, reviewed the results of the analyses that were summarized on the Site Selection Criteria Assessment sheet (Table 8.3-2). The total differential costs for the three sites indicated that Eastport was the lowest cost site, being 68.5 million dollars less than Willis Point and 57.3 million dollars less than Walkill. However, the cost data was not complete for Walkill since a cost could not be determined for land cost and foundations due to restrictions instituted by the property owner. Totaling the site rankings based on factors other than costs, resulted in Willis Point being the most favorable site by 2 points over Eastport, and 6 points over Walkill.

In summary the following were the key issues considered in the selection of Eastport as the preferred site:

1. The construction and operation of the proposed plant at the Eastport site was less costly than at Willis Point or Walkill over the life of the plant.

2. The existing and projected air quality associated with the proposed plant located at the Eastport site was determined to be acceptable.
3. The feasibility of deep water barge unloading at Eastport was considered a significant advantage especially in terms of fuel delivery diversification and costs.
4. The Clay County Board of County Commissioners had formally opposed the plant, and thus the potential for delay in obtaining the required local zoning actions was assessed to be significant.
5. The Eastport site is compatible with present and planned land use in the area.

Based upon all of the studies conducted since 1977, data presented by the public and various agencies, and additional information provided by the JEA and its consultants, the Eastport site was selected as the preferred site on February 5, 1980.

8.3.6 References

Jacksonville Electric Authority, Site Selection Committee Meeting Minutes: November 2, 1979; November 30, 1979; December 31, 1979; December 20, 1979; January 3, 1980; January 17, 1980; January 29, 1980.

United Engineers and Constructors, Inc., January, 1980. Site Selection Study - Four Air Quality Studies in Addition to Final Report and Supplement Review. Boston, Mass.

United Engineers and Constructors, Inc., February, 1978. Site Selection Study - Final Report Supplement. Boston, Mass.

United Engineers and Constructors, Inc., December, 1977. Site Selection Study - Final Report. Boston, Mass.

United Engineers and Constructors, Inc., August, 1977. Site Selection Study - Final Report and Supplement Review. Boston, Mass.

Table 8.3-1
SCHEDULE FOR SITE SELECTION MEETING

<u>Date</u>	<u>Topic</u>
November 2, 1979	Site Certification Procedure Regulatory Agency Comments Land Use/Regional Development
November 30, 1979	Air Quality Impacts
December 13, 1979	Cooling System Alternatives Natural Gas Impact on Licensing Site Size
December 20, 1979	Class One Waiver Zoning: Clay County Zoning: Duval County
January 3, 1980	Transmission Related Reliability, Stability and Losses Transmission Related Cost Estimates Estimated Cost of Delay
January 17, 1980	Air Quality/Air Quality Control System Costs Foundations Aquatic and Terrestrial Ecology Land Cost Fuel Sources and Transportation Costs Analyses of Differential Costs
January 29, 1980	Site Data Evaluation Summary Site Ranking

Table 8.3-2

SITE SELECTION CRITERIA ASSESSMENT

Siting Factor	Site		
	Eastport	Walkill	Willis Point
Differential Cost (millions of \$)			
Fuel Transportation	0	60	60
Land Costs	2.0	*	0
Transmission Line Const.	26.5	0	9.2
Transmission Line Losses	86.8	0	0
Circulating Water System	0	0	0
Foundations	0	*	2
Air Quality Control Systems	0	0	0
Payment in Lieu of Taxes	0	113.7	113.7
Total Differential Costs	0	58.4	67.6
Technical			
System Stability	2	3	3
Site Size/Configuration	2	1	3
Environmental Concerns			
Air Quality	2	3	3
Compatibility with Existing Land Use	3	2	3
Regulatory Agency Opinion	1	2	3
Terrestrial Ecology	2	1	3
Aquatic Ecology	3	2	2
Legal Concerns			
Avoidance of Delays (Zoning, Class 1 Wavier, legal obstacles)	3	0	0
Total Subjective Evaluation	18	14	20

Ranking: 3 - Good; 2 - Average; 1 - Poor; 0 - Potential for Delay Significant

* Cost estimate is not available

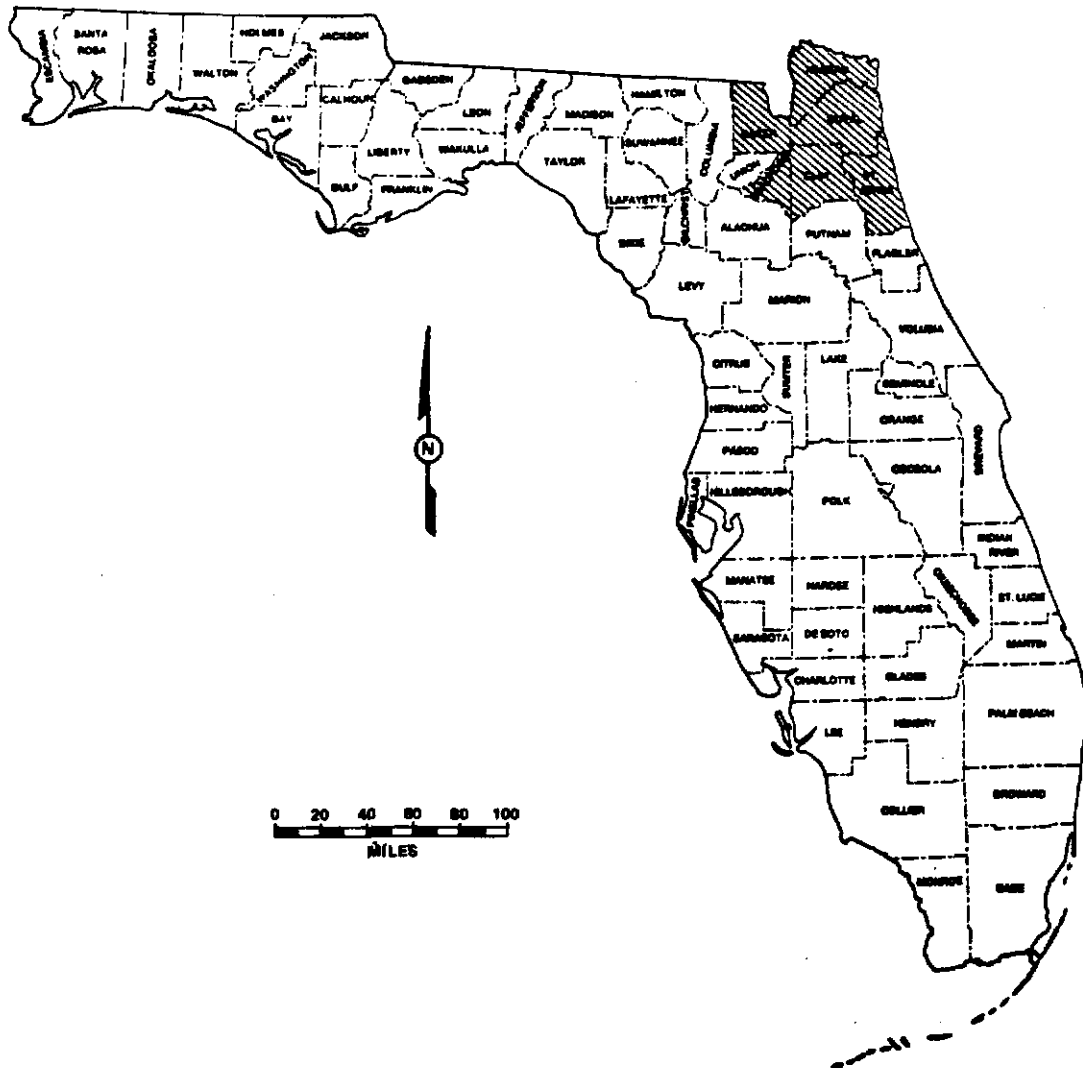
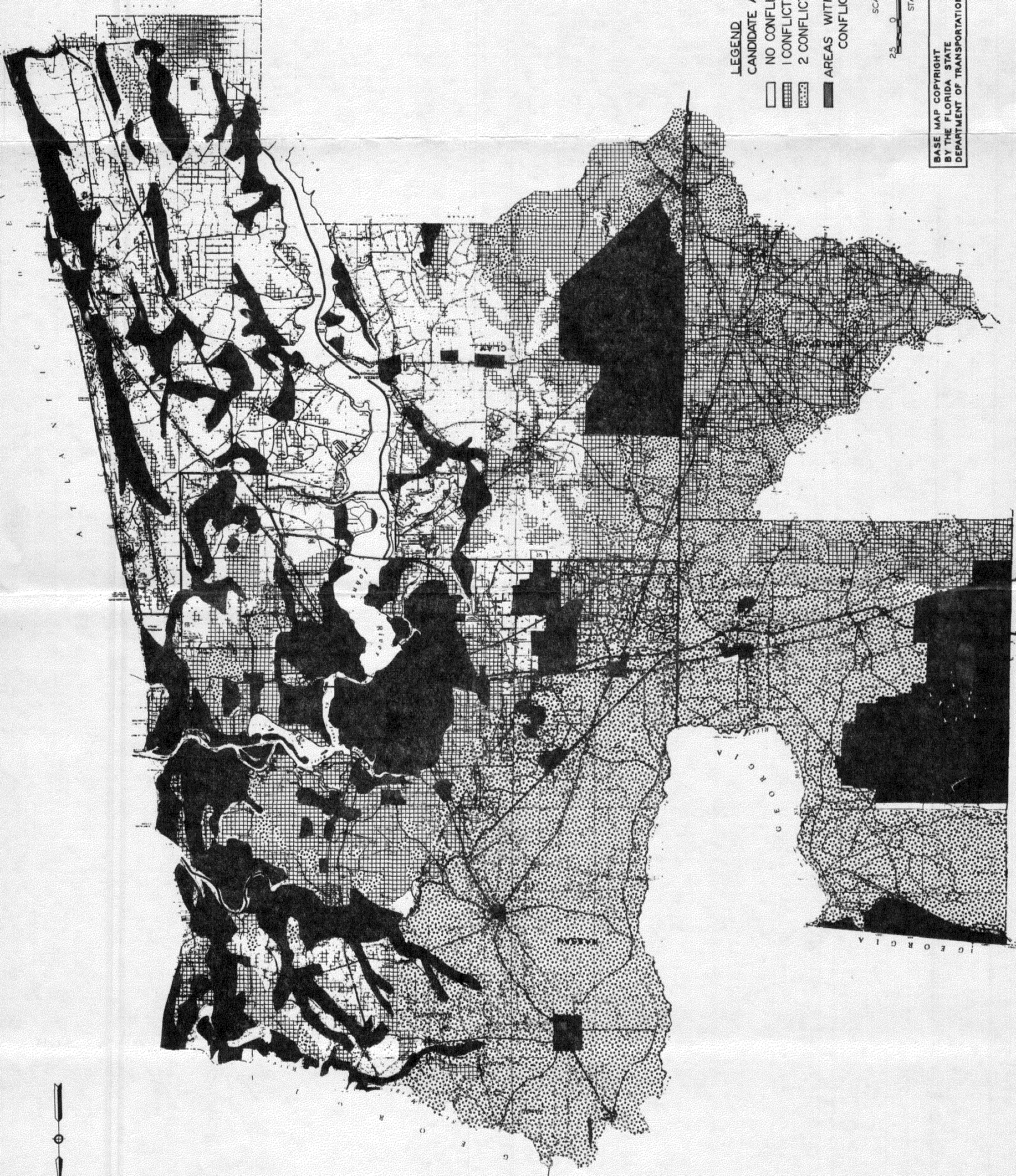


Figure 8.3-1 Region of Interest

N



- LEGEND**
- CANDIDATE AREAS**
- NO CONFLICT
 - 1 CONFLICT
 - 2 CONFLICTS OR MORE
 - AREAS WITH SIGNIFICANT CONFLICTS

SCALE 1:158,400

25 0 25 50 75 100

STATUTE MILES

BASE MAP COPYRIGHT
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DEPARTMENT OF TRANSPORTATION

8.4 RATIONALE FOR PROPOSED FINAL SITE AND ENERGY SOURCE

The details for the selection of the Eastport site and the installation of the proposed coal-fired power plant on that site are presented in Section 8.2 and 8.3.

A summary of the site identification and selection process is provided in Section 8.4.1, and additional information relating to the source of coal and the methods of transportation are provided in Section 8.4.2.

8.4.1 Rationale for Site Selection

As discussed in Section 8.3, JEA has been in the process of identifying and evaluating potential power plant sites since 1977. On February 5, 1980, these efforts resulted in the selection of the Eastport site for the installation of a two 600 MW unit coal-fired power plant.

The site selection process proceeded in a logical manner, whereby candidate areas were first selected, followed by the identification of 32 candidate sites. These 32 sites were narrowed to 6 recommended sites, 3 of which were evaluated in great detail. Of these 3 sites, the Eastport site was selected as the preferred site. Therefore, within the entire study area, considering all appropriate environmental, engineering, and cost factors, the Eastport site is the preferred site.

8.4.2 Rationale For Fuel Selection

As discussed in Section 8.2, a coal-fired plant represents the most cost effective and commercially viable alternative for base load generation today. One of the major decisions in the construction of a coal plant is development of the source of supply for the coal to be used as a fuel to fire the boilers.

The procurement of coal for a power plant involves consideration of a number of elements, some of which can be objectively evaluated and others which must be approached on a judgemental basis. These elements include estimated prices of mined coal, its estimated transportation cost to the site or sites, adjustments for the effect of coal quality on the power plant, and the cost of site facilities required for alternative methods of transportation. The estimated mined coal prices for the proposed units were obtained from potential suppliers. However, the validation of information received was limited to a review of the estimate documents, along with discussions with some of the potential suppliers. Transportation costs were projected based on prevailing rates for similar hauls and discussions with rail and barge company representatives. The exact costs will be known after responses to JEA's solicitation for tentative proposals are received and transportation rates are established and/or negotiated.

The coal requirements for a power plant cover a period from 30 to 40 years. Hence inflation will have a major effect on pricing. Inflation will not impact all elements of the process alike. The escalation rate of mine mouth coal prices will differ from the escalation rate of the transportation component, which will also have different rates for rail and barge movements. It is the general practice of utilities to monitor the inflation of coal pricing by tying such prices into government indices published by the Bureau of Labor Statistics on a monthly basis and the labor component is tied into the United Mine Workers Association (UMWA) contract rates. It is the intent of JEA to follow this practice by requiring future coal suppliers to base their costing on such UMWA contract price plus other governmental indices covering other components of coal costs. By using these government indices, it is hoped that should one of the indices experience excessive inflation, the presence of the remaining ones will help to control the cost of the coal being supplied.

The coal requirements of a plant will typically be reduced with time as new units are added to the system. The estimated capacity factors and associated coal consumption for the life of the plant are tabulated below:

<u>Year</u>	<u>Capacity Factor</u>		<u>Annual Tonnage⁽¹⁾</u>	
	<u>Unit 1</u>	<u>Unit 2</u>	<u>1000 Tons</u>	
	<u>%</u>	<u>%</u>	<u>Unit 1</u>	<u>Unit 2</u>
1985	69	0	99	0
1986	69	0	1387	0
1987	69	69	1387	821
1988	70	69	1407	1387
1989	71	70	1427	1407
1990-2000	70	70	1407	1407
2001-2020	60	60	1206	1206
2021-2025	40	40	804	804
2026-2027	0	40	0	804

(1) Based on a heating value of 12,000 Btu/lb
Estimated heat rate of 10,015 Btu/kWh

The above annual tonnages result in a total coal requirement over the period of 98,164,000 tons.

Coal for utility power plant use may be obtained by three methods:

- . Purchase of mined coal from a company with mining experience and ownership of coal reserves.
- . Purchase or lease of coal reserves with the utilities assuming the responsibility for mining the coal.
- . A joint venture with a mining company. This would most likely require the utilities to assume 50 percent of the costs of the reserve acquisition plus half the costs of the mine development. The actual mining would be accomplished by the joint venture partner.

The purchase of mined coal is the most common method of coal procurement by utilities. This method relieves the utility of the responsibility for the mining of coal, labor relations in the mines, the meeting of environmental and safety regulations and all the myriad problems associated with coal mining.

The proposed plant would require a relatively small staff to monitor the activities of a coal producer. However, if responsibility for coal mining is assumed, then a large staff would be required located far from the utility service area. In addition, a staff skilled in activities alien to their normal activity of producing and distributing electricity would have to be developed.

Another advantage of purchasing mined coal is that the selling price is reasonably well defined. While the price is subject to escalation, the basis for the escalation is detailed in the contract. The efficiency of operation would be the responsibility of the mining company and not the utility if mined coal were purchased.

The advantages to a utility in purchasing or leasing coal reserves are the assurance of coal supply and the possibility of lower coal cost. The ownership of coal reserves provides somewhat greater assurance of coal supply than the dedication of reserves in a mined coal purchase. This is due to the possibility that disagreements may occur between parties resulting in dissolution of the contract for mined coal.

The lower cost potential in reserve ownership results from the profit margin involved in the purchase price of coal accruing to the utility if it mined its own coal. This assumes that the utility mining operation would be as efficient as that of a coal company. This increment would be reduced if the utility had the coal mined on a contract basis.

Reserve ownership would require assumption of responsibility for opening the mine to meet the scheduled operating date of the power plant. This would involve obtaining all licenses and permits including

environmental studies. Assuming responsibility for this effort would add another factor to the risk of not achieving reliable plant operation on the scheduled date. Risks here are not considered commensurate with potential savings.

A number of utilities have acquired coal reserves and mined or arranged for mining of the reserves. This experience has been mixed. Recently published data have indicated that captive coal operation has, in the majority of cases, resulted in higher cost coal than could be purchased on the open market.

A joint venture partnership has advantages and disadvantages which lie between those of purchased coal and purchased reserves. The purchaser has some control of the reserves but not as much as with ownership of reserves; a considerable initial investment is required but not as much as with reserve ownership; the purchaser has more responsibility for mine operation than with the purchase of mined coal but not to the extent required with the purchase of reserves. In general, the majority of the better coal reserves are owned by strong suppliers who have more interest in the sale of mined coal or partnership in a joint venture than in the sale of reserves.

Comparing the purchase of mined coal with a joint venture resulted in relatively modest cost saving for the joint venture. Compared to the risks involved, the savings offer an insufficient incentive to assume more responsibilities than those associated with the purchase of mined coal.

Domestic Supplies

There are four regions which offer the potential for supplying coal to this project: The Illinois Basin, Eastern Kentucky and Tennessee, Virginia-West Virginia, and Ohio-Pennsylvania.

The Illinois Basin can supply Southern Illinois, Indiana and Western Kentucky coal from large mines which now exist or can be developed in this area. In general, an economic new mine would have a capacity of about 2 million tons per year. Most suppliers would consider opening a new mine on the basis of a long-term contract for one million tons per year. They would then sell the remainder of the production to others. Coals from this area generally are high sulfur with slagging and fouling tendencies. Most of the coals would be subject to some treatment at the mine to reduce ash and sulfur levels. The natural markets for these coals are utilities located on the Ohio and Mississippi Rivers, as well as certain TVA plants. Coals from this area are penalized by the long transportation distance to Jacksonville, whether by rail or barge.

Eastern Kentucky and Tennessee coals have a low sulfur content and are low slagging, low fouling. Mines in these areas tend to be of smaller capacity than in the Illinois Basin, however, many have sophisticated facilities capable of loading unit trains. Supplier offerings have been in the 600,000 to 1,000,000 ton per year range. Transportation distance is favorable, and coal that might be secured from mines on the Seaboard Coast Line Railroad system results in the advantage of a single line rail haul.

Virginia and West Virginia coal characteristics are variable but generally have a moderate sulfur content with little slagging and fouling tendencies. Mines are of moderate size. Transportation can be by rail or combination rail and barge through East Coast ports. Northern West Virginia mines are particularly suited to this latter type movement since at present the most favorable transportation cost would be realized via this mode of transport.

The Ohio-Pennsylvania coals are high sulfur and are generally treated at the mine. Transportation can be by rail, or rail to the East Coast and barge to Blount Island, or all barge via the Ohio, Mississippi, Gulf of Mexico and around the Florida peninsula to Blount Island.

Foreign Supplies

The supply of coal from a foreign source entails some risk of loss of supply. Political unrest in the country of origin or interruption of ocean traffic are distinct possibilities. Further, possible new U.S. foreign policy may discourage the spending of U.S. dollars abroad. For these reasons, supply of coal from foreign sources should be limited to some percentage of the annual requirements in any one year.

Argentina and Colombia are not currently exporters. However, efforts are underway to develop facilities so that these countries could become a factor in the world coal market. Information is available on Argentina's reserves, mining conditions, quality and internal and external transportation conditions. Colombian coal supply would be a joint venture between Exxon and the Colombian government. The feasibility study has been completed and engineering decisions made on the mine design, rail transportation and port facility. However, the project has not received the approval of the Colombian government or the Exxon Board of Directors.

The current schedule requires an Exxon decision by December 1980 with final Colombian government approval by July 1981. A potential problem is the ability of the government to finance its portion of the estimated \$1.5 billion project costs. The project schedule anticipates shipping coal in time to meet the plant requirements.

Australia and Canada have a history of exporting coal. They should be regarded as the most reliable foreign suppliers due to this experience and the political stability in these countries.

South Africa is presently serving the export market including some deliveries to the United States. All export coal is low sulfur with low to moderate ash content and appear to have low slagging and fouling characteristics.

No interest was shown by Poland in supplying coal for the project. Indications are that Poland is reserving their coal for the eastern European market.

Coal Transportation

In the past few years, the importance of coal transportation has increased dramatically. Both suppliers and consumers have gained a new appreciation of the importance of transportation as both have encountered and contended with transportation and delivery problems.

Several alternative modes of coal transportation were investigated and included coal deliveries by railroads, river barges, ocean barges, ocean colliers and various combinations of each.

Slurry pipeline delivery of coal was not considered viable as a transportation mode in the time frame required for this plant since a pipeline to Florida is in initial study stages with many licensing, design, and construction problems to be resolved before it develops into a project. Thus its completion date is also indeterminate.

Of the various modes of transportation, deliveries by both railroad and water-borne carries were evaluated as being cost-effective. Based on results of studies performed and current transportation scenarios, the plant will be served by both all-rail and water borne coal delivery systems. Coal deliveries by water would use Blount Island as an associated facility to the project with a shuttle train providing transportation to the plant itself. By providing for the Blount Island facility, JEA and FPL will insure their customers of a diversity of coal supply and transportation modes.

Rail Transportation

Railroads vary somewhat in transportation cost, but generally establish rates according to four broad categories:

- . Single-Car Rate
- . Volume Rate
- . Trainload Rate
- . Unit Train Rate

A single-car rate is the highest and is available from one rail point.

A volume rate is conditioned upon the delivery of a specific minimum tonnage to a single consignee during a designated time period (generally one year). If total tonnage delivered during the designated time period is less than the minimum tonnage specified, then the volume rate is not applicable and the existing single-car rate in effect on the date of shipments is levied on any and all tonnage delivered.

A trainload rate is applicable on specific minimum tonnage lots (usually of 4,500 to 10,000 tons) tendered to the carrier in solid blocks in carrier equipment at one or more designated origins on a prescheduled day and consigned to a specific receiver or receivers. Loading and unloading time is usually restricted to one or two days each with assessment of detention charges according to contract or rate terms when cars are held beyond the allocated time.

A unit train rate is a rate applicable on specific minimum tonnage in a solid block or train of dedicated cars operated and managed as a single unit from one specified loading point to one specified receiver at one specified destination. Loaded and empty cars are tendered to the carrier in a single lot. Loading and unloading time is generally restricted to a period of hours with penalties assessed for any delay beyond the time provided. The dedicated cars may be furnished by the shipper, the receiver, or the railroad.

Summary

JEA's solicitation will consider all coals found east of the Mississippi River including foreign supply, if feasible. The responses from coal producers will be evaluated on the basis of the effect of the coal upon boiler efficiency, the delivered million Btu's cost, the effect of price adjustments under the escalation provisions, the anticipated effects of transportation modes and costs, the suitability of the coal for the intended use, the extent of the proven reserves, the financial dependability of the producer and his ability to produce the coal required. Construction of water unloading facilities on Blount Island will proceed simultaneously with the power plant to ensure that coal can be received by water transport whether by ocean colliers, ocean-going barges, or regular barges. Also being considered is a decision relating to the private ownership of railroad cars. If a decision is made to own such cars, the type of cars will be determined by the selection of design for the rail unloading facilities.

Events in recent years such as mine strikes, rail transportation problems including car shortages and poor track conditions, and embargos placed on certain countries have focused attention on the problem of providing a secure coal supply to a power plant. Diversity of coal sources and means of transportation reduces the risk associated with these events. JEA and FPL believe that a coal-fired base load plant, with a diversity of transportation modes, offers the best alternative to supply the needs of their customers and also meet the criteria listed in Section 8.2.

Chapter 9

Plant Design Alternatives

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9. PLANT DESIGN ALTERNATIVES

This chapter summarizes the many investigations conducted and the evaluation processes utilized to select the most favorable design alternatives for the proposed power generating plant systems. The guiding principle of these studies has been that design features should minimize all categories of environmental impact subject to reasonable constraints upon cost, energy consumption and technical feasibility. The proposed power generating plant must meet quantitative standards established by state and federal agencies for air and water impacts, and also must be consistent with public policies, objectives, and guidelines pertaining to a wide variety of ecological and social values. These design objectives and regulatory requirements are summarized for each system for which alternatives are discussed in this chapter.

Alternatives have been developed and evaluated critically for every major aspect of plant design for which some flexibility existed within the framework of the standard/reference plant concept (Ebasco, 1978). However, the present discussion is limited to those aspects which related directly or indirectly to environmental impact. The level of detail in which these alternatives have been evaluated has depended upon the magnitude of the issues involved, the information available, and the degree of difficulty encountered in establishing relative favorability. For each system, an attempt has been made to describe each alternative given serious consideration, to discuss the advantages and disadvantages of each (economic, technical, energy and environmental impact), and finally to identify the preferred alternative and reiterate the reasons for its selection.

9.1 CONDENSER COOLING SYSTEM

9.1.1 Design Objectives and Regulatory Requirements

The design objectives of the condenser cooling system include reliability, economic optimization and environmental acceptability. The design process involves optimizing the system configuration within the constraints of turbine back pressure, expected ambient meteorology and regulatory requirements.

The main regulatory requirements to be met by this system are those of Chapter 17-3 of the Florida Administrative Code (FAC). Under these rules, the portion of the St. Johns River near the site is defined as coastal waters. While the detailed requirements are presented in Chapter 5, Section 5.1.1, the essential factor is that the size of the allowable mixing zone and temperature requirements in the Receiving Body of Water (RBW) are to be determined on a case-by-case basis. The federal requirements will be met through compliance with the existing National Pollutant Discharge Elimination System (NPDES) Permit requirements for the Northside Generating Station (NGS).

9.1.2 Heat Dissipation System Alternatives

9.1.2.1 Feasible Alternatives

The purpose of the heat dissipation system is to remove the waste heat produced as a by-product of the generation of electricity. Heat removal is accomplished by circulating water inside the tubes of a condenser where the circulating water absorbs the waste heat in the process of condensing the steam from the turbine-generator.

This station will consist of two units, each with a gross nameplate rating of 612 megawatts (MW) at 100 percent load, corresponding to a per unit heat load of 2.33×10^9 British thermal units per hour (Btu/hour) to be rejected to the condenser.

The first step in the alternatives study involved a comparison between once-through cooling and closed cycle cooling utilizing evaporative cooling towers. In order that the existing NGS NPDES Permit requirements not be violated, the once-through system considered included intake and discharge lines of 10,500 feet and 19,500 feet, respectively. Conceptual estimates based on preliminary design demonstrated that the costs of installing these conduits and pumping water through them would be between \$25 million and \$40 million more, in capital and operating costs over the life of the plant, than comparable closed cycle evaporative cooling tower systems. Since once-through cooling has a larger thermal impact on the RBW as well, the once-through alternative was eliminated from further consideration.

Several potential types of closed cycle cooling systems were not included in the alternatives study. These include dry cooling towers, wet-dry combination cooling towers, cooling ponds, and spray ponds. Dry cooling towers have been found to be approximately an order of magnitude more expensive than wet towers, and have been utilized only where an insufficient supply of water is available. Wet-dry towers would be more expensive than wet towers and would offer little advantage with respect to ground fogging or water use in comparison to wet natural draft towers. Cooling ponds and/or spray ponds would require larger land areas than the cooling tower alternatives evaluated; these larger areas are not available at this site.

9.1.2.2 Economic Comparison

Three types of closed cycle evaporative cooling systems were evaluated. They were natural draft cooling towers, rectangular mechanical draft cooling towers, and round mechanical draft cooling towers, all of counterflow design. A detailed economic analysis of these three systems was performed, optimizing each system economically with respect to range, flow, approach and pumping head. The results of this conceptual study are shown in Table 9.1-1.

Although the initial investment cost of the natural draft cooling tower is higher than that of either of the mechanical draft towers, the high capability penalty and net generation penalty associated with operation of fan motors made both types of mechanical draft towers less attractive.

9.1.2.3 Energy Consumption

The natural draft towers require more energy consumption than either mechanical draft alternative with respect to circulating water pumps because they have a higher head on the towers to pump against. This consumption is more than offset by the energy consumption of the mechanical draft towers' fan motors and the reduced net plant generation capability due to increased back pressure on the turbines. The latter is caused by the fact that, at the same design point, the natural draft towers will average a closer approach to the wet bulb. The energy consumption savings of each natural draft tower is estimated at 12,145 MW-hours/year and 14,035 MW-hours/year over rectangular and round mechanical draft towers, respectively, based on preliminary design estimates.

9.1.2.4 Environmental Comparison

The two major environmental impacts of evaporative cooling towers are the production of visible plumes and the deposition of drift (droplets of the circulating water carried out of the tower). Natural draft towers, because of the height at which vapor is released (generally between 360 and 550 feet), rarely produce visible plumes that reach the ground. Mechanical draft towers discharge the waste heat and moisture much closer to the ground (60 to 100 feet). Thus, their visible plumes are subject to downwash and other surface mechanical turbulence, which can bring the moisture plume to the ground level, resulting in fogging.

Natural draft cooling towers, because of their greater height compared to mechanical draft towers, would be less desirable from an aesthetic standpoint. However, this consideration is more than offset by the two environmental advantages discussed in the preceding paragraph.

Although drift deposition from natural draft towers would be expected to cover a larger area than that from mechanical draft towers, it is subject to increased dilution by transport. The differences between the three alternatives with respect to drift deposition are not expected to be environmentally significant.

Overall, the natural draft towers are more desirable from an environmental impact standpoint than the mechanical draft towers, because of the reduced potential for fogging associated with natural draft towers. This is particularly important in the humid climate of northeastern Florida.

9.1.2.5 Results

Because of economic advantage and environmental desirability, the preferred cooling system utilizes one natural draft cooling tower per unit. The details of this preferred system are presented in Chapter 3, Section 3.4.

9.1.3 Water Source Alternatives

The maximum makeup flow rate required by the station condenser cooling system utilizing natural draft towers is estimated to be approximately 34,400 gallons per minute (gpm). Possible sources included both groundwater and surface water. These possible sources are all listed and described in Chapter 2, Section 2.5. Groundwater was eliminated as a source because a withdrawal of this magnitude could increase the possibility of local salt water intrusion in the Floridan aquifer.

All surface water sources capable of yielding the required flow rate are ultimately portions of the St. Johns River. In order to minimize the construction impact of the installation of the intake, it was determined that the existing NGS circulating water system should be utilized as much as possible. Thus, the source of makeup water will be the Blount Island Channel, via the existing NGS once-through circulating water (CW) system.

9.1.4 Water Use Requirements

The cooling system water use requirements are described in detail in Chapter 3, Section 3.3.3. The quantity of water required for the various plant operating modes is described in Chapter 3, Section 3.4, while the quality of water required is described in Chapter 2, Section 2.5.1. The water use requirements for plant systems other than the cooling system are described in Chapter 3, Section 3.3.

9.1.5 Intake System Alternatives

Two alternative intake locations for tower makeup water were considered: a structure withdrawing from the Blount Island Channel of the St. Johns River, and a structure withdrawing from the NGS CW system, at various points. The withdrawal from the NGS CW system has several advantages as stated below.

1. Dredging for intake construction and operation would be eliminated.
2. New pipeline installation to the river would be eliminated.
3. Impingement and entrainment effects would be reduced or eliminated by withdrawing from NGS discharge canal.

For these reasons, withdrawal from the NGS CW system and specifically from the discharge canal was selected as the preferred intake location. In order to allow cleaning after biofouling, the withdrawal point is located

within the open channel portion of the NGS discharge channel (Figure 9.1-1). The inlet from the NGS discharge channel is located west of the Unit 3 discharge flume.

A description of the makeup intake system is presented in Chapter 3, Section 3.4.2. The most significant design features of the selected system are the reduced flow rate because of the closed cycle system, and the location of the withdrawal points within the existing NGS CW system. The design of the actual inlet points is important in that it determines the entrance velocity into the makeup system. In order to attempt to minimize the impingement of aquatic organisms which might reach the makeup intake location, a design entrance velocity of 0.25 feet per second was selected. To provide screening for makeup system protection, the inlet will consist of sections of perforated pipe or an open channel with fixed screens. As designed, the intake pipe will be located in the NGS discharge canal (Figure 9.1-1). This will have the following advantages over placement in the Blount Island Channel:

1. The potential for biofouling will be reduced due to the entrainment effects and biocide treatments from the NGS operation.
2. Most of the organisms which would otherwise be susceptible to impingement will already have been removed by the NGS traveling screens before the water reaches the proposed plant's intake.

Entrainment effects are discussed in Chapter 5, Section 5.2.1.2. Essentially, the potential environmental impacts from entrainment of organisms are a function of the quantity of cooling water used and the density of viable organisms in that cooling water. Utilization of closed cycle cooling minimizes the quantity of cooling water required. In addition, placement of the proposed plant's intake in the NGS discharge has an advantage over an intake in the Blount Island Channel or NGS intake flume as relates to the number of entrained viable organisms. The total number of organisms entrained by the NGS will not be changed due to the

operation of the proposed plant. By withdrawing cooling water from the NGS discharge, rather than Blount Island Channel or NGS intake, organisms entrained by the proposed plant will be previously stressed or dead from their passage through NGS. A discussion of the proposed plant's intake and discharge systems is discussed in Chapter 5, Section 5.1.2.

The environmental advantages and disadvantages of cooling water intake alternatives are presented in Table 9.1-2. Of the alternatives presented, placement of the intake for the proposed plant in the discharge canal for NGS will subject the least number of organisms to impingement or entrainment.

9.1.6 Discharge System Alternatives

Various combinations of location and configuration for the cooling water system discharge are possible. The maximum design flow rate for alternatives evaluation is estimated to include about 34,400 gpm of cooling tower blowdown, which is equal to the makeup when no heat is being rejected from the plant. This flow will be combined with a maximum 4,340 gpm of effluent from the other plant discharges (see Chapter 3, Section 3.3). Thus, a maximum of 38,740 gpm of water is the design discharge flow.

The only receiving body of water (RBW) of sufficient size and flow volume to receive this flow rate, in the vicinity of the station, is the Blount Island Channel of the St. Johns River. The discharge could be routed there by either a new pipeline and discharge structure, or by utilizing the existing NGS discharge pipe and Y-nozzle diffuser.

Table 9.1-3 summarizes the various effects of thermal entrainment and construction impact with respect to these alternatives for placement of the proposed plant's discharge. Placement of the proposed plant's discharge in the NGS discharge channel (Figure 9.1-1) will have the following advantages over direct discharge into the Blount Island Channel:

1. No construction of a new pipeline to the river.
2. No new discharge structure in the river.
3. Dilution effects from mixing with the NGS discharge will reduce the 1.5 concentration factor from the cooling towers to a maximum of 1.14 and a minimum of 1.03.

These advantages will minimize potential environmental impacts of thermal plume entrainment and attraction, cold shock, salinity and biocidal effects, and chemical effects.

Because of these advantages, discharge through the existing NGS discharge system is the preferred alternative. A description of the configuration and operation of this system is presented in Chapter 3, Section 3.4.3.

9.1.7 Reference

Ebasco Services Incorporated, 1978. Ebasco 600 MW Coal-Fired Standard Plant, Project Description, 1263 pp.

Table 9.1-1

ECONOMIC OPTIMIZATION OF CLOSED CYCLE COOLING SYSTEM ALTERNATIVES

<u>System</u>	<u>Natural Draft</u>	<u>Rectangular Mech. Draft</u>	<u>Round Mech. Draft</u>
Design Approach	10°F	8°F	8°F
Initial Investment Cost (Millions of \$)	46.178	36.703	37.155
Total Annualized Cost (Millions of \$)	10.660	12.163	11.857
Total Annualized Cost Differential (Millions of \$)	Base	1.503	1.197

Table 9.1-2

ENVIRONMENTAL ASSESSMENT OF COOLING WATER INTAKE ALTERNATIVES FOR THE PROPOSED PLANT

Options	Advantages	Disadvantages
O-A Closed Cycle Cooling -- Intake from NGS (Northside Generating Station) cooling water discharge canal during NGS operation	A-1 Eliminates impingement at the proposed plant's intake A-2 Of those organisms entrained 30 to 100% will be already stressed beyond recovery from passage through NGS A-3 Construction impact on the aquatic environment limited to NGS discharge canal	D-1 Construction impact on the aquatic environment moved to Blount Island Channel D-2 Chance for impingement of aquatic organisms D-3 More viable organisms would be entrained
O-B Closed Cycle Cooling -- Intake from St. Johns River		

Table 9.1-3 (Revision 1)

ENVIRONMENTAL ASSESSMENT OF COOLING WATER DISCHARGE ALTERNATIVES FOR THE PROPOSED PLANT

Options	Advantages	Disadvantages
O-A Closed Cycle Cooling -- Discharge to NGS (Northside Generating Station) cooling water discharge channel	A-1 Increased temperature, salinity and chemical discharge above ambient will be mixed with the NGS discharge, thereby reducing potential impacts in Blount Island Channel A-2 Construction impact on the aquatic ecosystem limited to NGS discharge channel	D-1 Small increase in thermal attraction at Northside's discharge in Blount Island Channel
O-B Closed Cycle Cooling -- Discharge to Blount Island Channel		D-1 Construction impact on aquatic ecosystem moved to Blount Island Channel D-2 Increased temperature, salinity and chemical concentrations from blowdown will be discharged directly into the Blount Island Channel resulting in a potential impact on the aquatic ecosystem D-3 Greater potential for thermal attraction by placing an additional point of discharge in Blount Island Channel

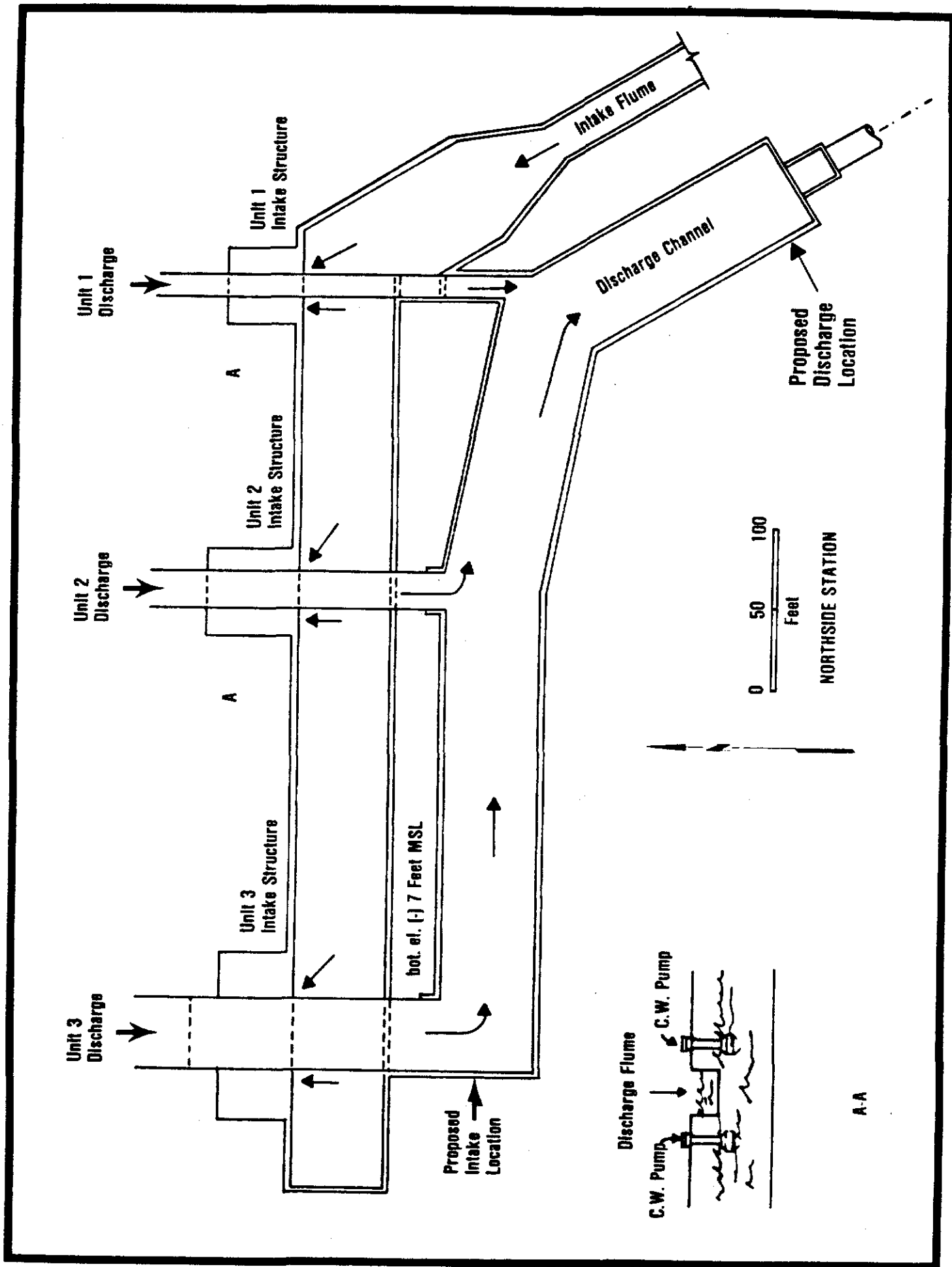


Figure 9.1-1 Northside Generating Station Intake and Discharge Configuration

9.2 PLANT WATER SYSTEMS

9.2.1 Design Objectives and Regulatory Requirements

A Water and Waste Management Study (Appendix O) was conducted in an effort to minimize overall station water use. One of the objectives of this study was to reuse water to the extent possible within the constraints of efficient plant operation. No specific regulations limiting water use were identified.

9.2.2 Water Use Requirements

Plant water use requirements have been discussed in detail in Chapter 3, Section 3.3. Annual average and maximum water requirements for the various plant systems are approximately as follows:

<u>Plant System</u>	<u>Water Requirement, gpm</u>	
	<u>Average</u>	<u>Maximum</u>
Recirculating Cooling System	34,400	34,400
Flue Gas Desulfurization (FGD)	2,150	3,150
Makeup Demineralizer	170	680
Service Water	113	1015
Bottom Ash Handling Makeup	200	200
Potable Water	11	240
Fire Protection	Will range from 0 to 625	

Water for demineralization and plant service water must be low in suspended solids. Potable water must meet drinking water quality standards, and fire protection water must not have any scale forming or corrosive tendencies.

9.2.3 Water Source Alternatives

There are three sources of water available for use by the various plant water systems. These sources are groundwater, surface water and reclaimed water. In an effort to conserve valuable groundwater resources, the use of groundwater from the Floridan Aquifer is limited. Plant effluents will be reclaimed where feasible and when necessary, treated prior to reuse. Surface water from the St. Johns River is used for the remainder of the plant systems which can use water of a lower quality. The surface water contains a high level of dissolved solid and thus is not suitable for certain uses. Plant systems with major water requirements are further discussed in this section.

9.2.3.1 Cooling Water System

The recirculating cooling water system is discussed in Section 9.1.

9.2.3.2 Flue Gas Desulfurization

An average of approximately 2,150 gpm (3,150 gpm maximum) of water will be required as makeup to the FGD system. This requirement is based on the production of commercial grade gypsum as a by-product of the FGD system. The makeup water has to be of high purity in order to produce a by-product gypsum. Exclusive use of surface water or reclaimed water would require extensive pretreatment at correspondingly great expense. Therefore, groundwater must be available as makeup to the FGDS since commercial grade gypsum cannot be produced by using the available surface water or reclaimed water as the source of makeup because of the high dissolved solids content.

9.2.3.3 Makeup Demineralizer System

On an average, approximately 170 gpm of water is expected to be required by the demineralizer system for plant operation. Feedwater for the demineralizer system is groundwater. Should surface water or reclaimed

water be used as feedwater, extensive pretreatment would be necessary, at correspondingly great expense. Considering the relatively small water requirement, groundwater is the preferred source.

9.2.3.4 Service and Potable Water

Total plant requirements for service and potable water are expected to average 124 gpm, a relatively small amount. Use of surface water or reclaimed water would have required extensive treatment. Thus, groundwater is the preferred source.

9.2.3.5 Fire Protection

Fire protection water does not have a normal use requirement, except for nominal test requirements. Approximately 600,000 gallons of water will be stored on-site for fire protection. The stored water must be non-scaling and non-corrosive. Surface water or reclaimed water is not used because of the extensive treatment requirements considered necessary for long term storage. Thus, groundwater is the preferred source.

9.2.3.6 Ash Handling System

The bottom ash handling system requires an average of approximately 2,250 gpm of recirculating water. The system will require approximately 200 gpm of makeup. The makeup water should not be high in dissolved solids and thus surface water from the St. Johns River is not considered to be a suitable source. Use of reclaimed wastewater from other plant systems is not suitable because of high dissolved solids levels which would be further concentrated in the recirculating system. Thus, groundwater is the preferred alternative for a portion of the makeup water requirement.

9.2.3.7 Coal Handling System

An average of approximately 18 gpm is expected to be required for dust suppression at the coal handling facilities. There are requirements for this water to be a quality which precludes scaling. Plant wastewater collected from the FGD blowdown, with its high calcium hardness, could not be reclaimed for this use because of scaling potential. Further, plant wastewaters which could contain oil are not suitable since no discharge of oil from coal pile runoff is permissible. The use of surface water would result in scaling of nozzles and an increase in the total plant water use. Thus, groundwater is the preferred alternative.

9.2.4 Reference

Ebasco Services Incorporated, 1981. Water and Waste Management Study.

Prepared for the Jacksonville Electric Authority. Norcross, Georgia.

9.3 WASTEWATER TREATMENT SYSTEM

9.3.1 Design Objectives and Regulatory Requirements

The station will be subject to the USEPA Effluent Guidelines and Standards for Steam Electric Power Generating, Standards of Performance for New Sources (40 CFR, Part 423.15, October 8, 1974, as amended). The standards are summarized in Table 9.3-1. The design objectives of the station wastewater treatment system are to comply with these effluent guidelines and standards, to optimize the use of the plants water resources by minimizing plant water makeup and discharges and maximizing water reuse, and to minimize costs.

In addition, water quality standards set forth in the Chapter 17-3 FAC are applicable as discussed in Chapter 5.

9.3.2 Sources of Plant Wastewater

Sources and characteristics of various plant wastewater streams are discussed in detail in Chapter 3, Section 3.5.1. Figure 9.3-1 presents the selected water management plan for the plant and indicates the various wastewater sources and treatment schemes. The selected treatment system and alternatives are discussed in the following sections.

9.3.3 Chemical Wastewater Treatment Alternatives

Basically, three alternatives are available for chemical wastewater treatment systems: an integrated treatment approach, a segregated treatment approach, and a complete wastewater reuse approach.

The integrated water management plan incorporates water requirements and effluents for the various systems to minimize total plant makeup and discharge while providing the necessary wastewater treatment. The final effluent complies with the applicable regulations.

For the segregated treatment approach, each wastewater stream is segregated and treated in separate facilities to meet effluent limitations. This approach involves the construction and operation of several wastewater treatment facilities instead of a centralized facility. However, since the regulated parameters total suspended solids (TSS), oil and grease, and pH are common to all the wastewater streams with the exception of cooling tower blowdown (discussed in Section 9.3.4), the centralized chemical wastewater treatment facility is considered to be advantageous because of lower capital and operating costs and ease of operation.

The third alternative is the reuse of all wastewater flows except for cooling tower blowdown. For this alternative, the central chemical wastewater treatment facility is designed to soften, that is to reduce calcium, magnesium, and silica concentrations in the entire wastewater flow in addition to the treatment described above. The effluent from the treatment facility is then reused as makeup to the bottom ash system and the cooling towers. A reduction of both makeup and effluent would be accomplished for the station. However, the construction and operation of the wastewater treatment plant for this alternative would result in significant increased capital and operational costs.

Of the alternatives considered, the integrated approach is preferred since it minimizes water makeup and discharge and meets all applicable environmental regulations. Additional advantages of the integrated system are ease of operation and maintenance, and reduced land requirements.

9.3.4 Biocide Treatment Alternatives

A mechanical condenser cleaning system is provided for the condenser tubes. The tube inner walls are cleaned and kept free of bio-fouling without the use of biocides. However, biocide treatment of the recirculating cooling water is still necessary to control biological fouling of the cooling towers and the associated piping and structures. Available biocide treatments (chlorination, bromochlorination, and ozonation) are discussed in this section.

9.3.4.1 Chlorination

The biocide most widely used in the electric utility industry is chlorine. Although other biocides are available, utilities generally use chlorination because of economics and effectiveness. When dissolved in water, chlorine hydrolyzes to form hydrochloric and hypochlorous acids. Hypochlorous acid (HOCl) and hypochlorite ion (ClO_3^-) are the effective biocides. Because of this, gaseous, liquid, or solid chemicals may be used for treatment - chlorine as a compressed gas, sodium hypochlorite solution, or solid calcium hypochlorite.

Biological control is achieved by adding sufficient chlorine to obtain a killing residual. Total residual chlorine (free plus combined) must be maintained long enough to destroy microorganisms. Chlorine, hypochlorous acid, and hypochlorite remaining in the system after disinfection are known as free chlorine residual. Combined chlorine residual is the portion of the total chlorine existing in the form of chloramine, or organic chloramines which are biocides requiring large concentrations or long contact times to produce the same kill as low concentrations of free residual chlorine.

The use of chlorine in power plant operation has demonstrated effectiveness through vast operating experience.

9.3.4.2 Bromochlorination

Bromochlorination is a relative new approach to biocide treatment of cooling waters and is presently under development and study across the nation. Upon dissolution, bromine chloride (BrCl) hydrolyzes to hypobromous acid (HOBr), the effective biocide, and hydrochloric acid (HCl). Some oxidation of hydrochloric acid by the hypobromous acid can occur. However, due to the way in which bromine chloride hydrolyzes, there is a substantial reduction in the amount of free chlorine and chloramines formed.

While exhibiting significant biocidal activity, bromine chloride is often reported to be less toxic than chlorine to fish. Also, as a biocide, bromine chloride may be more effective than chlorine when compared on an equal molar basis. However, on an equal weight basis, bromine chloride and chlorine exhibit comparable biocidal effects.

Although bromochlorination has a potential as a biocide treatment, the technology has yet to be demonstrated as effective for large cooling water systems and as such is not considered feasible for the proposed plant.

9.3.4.3 Ozonation

Ozone, the reactive triatomic allotrope of oxygen (O_3), is one of the most powerful biocidal agents known. Ozone is produced by passing clean, dry air or oxygen through a zone of high voltage, high frequency electrical discharge. Under optimum conditions, only a small fraction of the oxygen gas is converted to ozone.

Ozone does have a biocidal activity from several to hundreds of times that of chlorine depending on the particular application. Since ozone cannot be stored practicably, continuous generating systems must be used. Quantities of ozone must be produced to provide a contact time of several minutes at levels of about 0.1 to 5 parts per million (ppm); since ozone decomposes very rapidly in water, very large instantaneous production capacities are required to maintain such level.

Furthermore, even at comparable concentrations, chlorine is still a slightly better biocide than ozone for control of bacterial slimes which are a significant cause of biofouling in condenser cooling water systems. Ozone may also accelerate the corrosion of iron alloys; there is some evidence of this corrosive action from existing tertiary wastewater treatment plants.

From an environmental viewpoint, ozonation is probably the ideal biocide treatment approach. Residual ozone is reduced in minutes to molecular oxygen which is either released to the atmosphere or remains in solution, enhancing water quality. Unfortunately, no operating experience exists on the scale required for condenser cooling water systems, and costs, both capital and operating, are approximately twice those for equivalent chlorination systems. This approach will not be feasible until favorable operating and economic data become available.

9.3.4.4 Preferred Alternative

Chlorination is the preferred biocide for the recirculating cooling water system because of its proven effectiveness and extensive operating experience with similar cooling systems.

9.3.5 Sanitary Waste System Alternatives

The preferred sanitary waste treatment system is described in Chapter 3, Section 3.6.2. Under this system, plant sanitary wastes will be treated in an extended aeration package plant. The extended aeration process has been demonstrated to be a relatively simple process which is easy to operate and maintain. Characteristics of the discharge from the extended aeration plant are presented in Chapter 5, Section 5.1.3.4. No adverse effects on water quality or biota are expected from the discharge of treated sanitary wastes. For relatively small waste quantities, subject to considerable fluctuations in flow, as is the case with sanitary wastes from the proposed plant, the extended aeration process is ideally suited.

As an alternative to in-plant treatment of sanitary wastes, a connection with the City of Jacksonville wastewater treatment system was considered. However, the nearest manhole of the Jacksonville system is approximately five miles from the site and conveying the plant sanitary wastes to this manhole would not be cost effective. Another alternative

would be temporary storage on-site with off-site disposal by tank trucks to an approved treatment plant. This alternative does not offer any economic or environmental advantage and was therefore not further considered.

On-site treatment of the sanitary wastes in an extended aeration package plant is the preferred alternative.

9.3.6 Reference

USEPA. Effluent Guidelines and Standards for Steam Electric Power Generating, Standards of Performance for New Sources (40 CFR Part 423-15, October 8, 1976, as amended).

Table 9.3-1 (Revision 1)
USEPA STANDARDS OF PERFORMANCE FOR NEW SOURCES
STEAM ELECTRIC POWER GENERATING

Waste Streams and Pollutants	(a) (d) Maximum mg/l	Average mg/l
All waste streams:		
pH (except once-through cooling)	6.0-9.0 (St'd Units)	
PCB's	No Discharge	
Low volume waste streams:		
TSS (Total suspended solids)	100	30
Oil and grease	20	15
Bottom ash transport water:(b)		
TSS	100	30
Oil and grease	20	15
Fly ash transport water:		
TSS	No Discharge	
Oil and grease	No Discharge	
Metal cleaning wastes:		
TSS	100	30
Oil and grease	20	15
Copper (total)	1	1
Iron (total)	1	1
Boiler blowdown:		
TSS	100	30
Oil and grease	20	15
Copper (total)	1	1
Iron (total)	1	1
Once-through cooling water:		
Free available chlorine(c)	0.5	0.2
Cooling tower blowdown:		
Free available chlorine(c)	0.5	0.2
Corrosion inhibitors	No Detectable Amount	
Area runoff subcategory:		
TSS	50	
pH	6.0-9.0	

Source: 40 CFR 423, 1974.

- a Except where specified otherwise, the allowable discharge equals flow multiplied by the concentration limitation.
- b Allowable discharge equals flow multiplied by concentration divided by 20.0.
- c Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than 2 hours in any one day; and not more than one unit in any plant may discharge free available or total residual chlorine at any one time, unless the utility can demonstrate that the units in a particular location cannot operate at or below this level of chlorination.
- d When waste streams with dissimilar effluent limitations are combined, the appropriate effluent limitations for the individual waste streams must be met prior to combination.

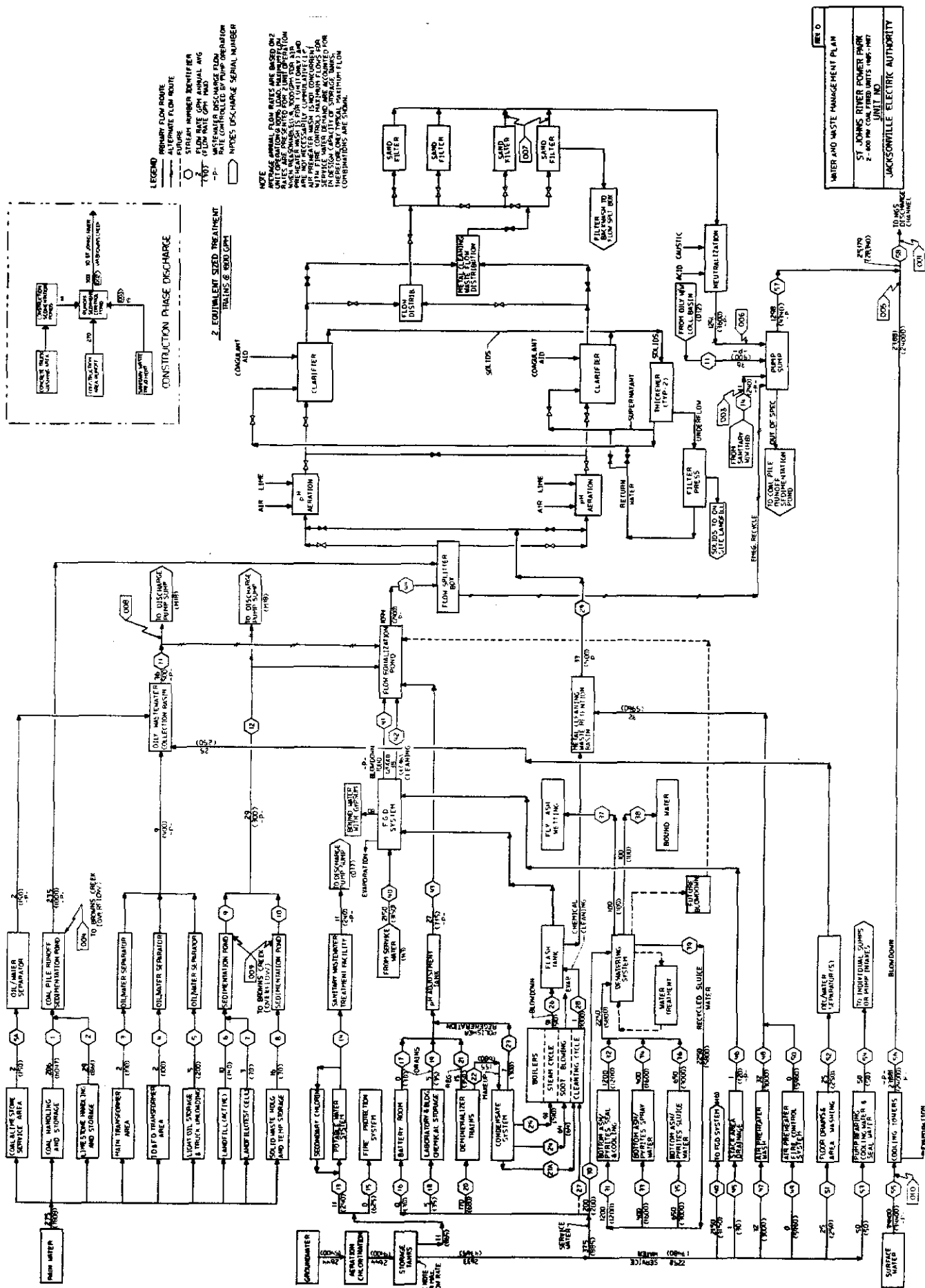


Figure 9.3-1 Water Management Plan

9.4 AIR POLLUTION CONTROL SYSTEM

9.4.1 Design Objectives and Regulatory Requirements

The air quality control systems (AQCS) are designed to minimize air pollution emissions from the project while minimizing energy requirements, capital costs, and the generation of water pollutants and solid wastes. The evaluation of AQCS alternatives with regard to energy, environmental, engineering and economic objectives is a requirement of the Best Available Control Technology (BACT) portions of the applicable federal Prevention of Significant Deterioration (PSD) Regulations [43 FR (118) 26379-26410, June 19, 1978], and their counterparts in the rules of the Florida Department of Environmental Regulation (FDER), Chapter 17-2, Florida Administrative Code. The revised federal PSD regulations [45 FR (154) 52675-52748, August 7, 1980] are not entirely applicable to this project since a complete PSD application (Envirosphere, 1980) was filed with EPA before the new rules were promulgated.

This section presents an evaluation of alternative air quality control systems and describes the selected BACT (preferred alternative) for particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, hydrocarbons and fugitive dust. BACT is described in the PSD regulations as follows:

"Best available control technology means an emission limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Act which would be emitted from any proposed major stationary source or major modification, which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques, for control of such pollutant.

In no event shall application of best available control technology result in emissions of any pollutants which would exceed the emissions allowed by any applicable standard under 40 CFR Part 60 and Part 61..."

The aforesaid pollutants were evaluated because the proposed facility will be a "major" source of these pollutants (except hydrocarbons), as defined in the PSD regulations which were applicable at the time the PSD application was filed. The proposed facility was considered a "major" source since it will have the potential to emit these pollutants in excess of 100 tons per year and because it will not be exempt as provided in Paragraph k of those regulations.

The revised PSD regulations [45 FR (154) 52675-52748, August 7, 1980] require BACT demonstrations not only for the pollutants for which the source is "major", but also for all other pollutants regulated under the Clean Air Act that would be emitted in greater than de minimis amounts, other than pollutants for which the area is nonattainment. Although there is some uncertainty at this point because the specific project coal(s) has not been selected, it is believed based on generic eastern coal analyses that no additional pollutants would fall into this category. However, since the Jacksonville area is nonattainment for ozone, a section on hydrocarbons is presented, even though projected hydrocarbon emissions will be too small to trigger any nonattainment requirements existing in the regulations applicable to this project.

An evaluation of alternative air quality control methods taken from the PSD report already filed with the U.S. Environmental Protection Agency (Envirosphere, 1980) and based on an Air Quality Control System Study (Ebasco, 1980) is presented in the following portions of this section. This evaluation includes an assessment of available technology, removal efficiencies, auxiliary power requirements, environmental considerations and economics for applicable control methods for the proposed facility. Based upon this evaluation and the level of control required to meet

applicable state and federal emission standards (discussed in Chapter 3, Section 3.8.2.1), PSD increments, and ambient air quality standards, the BACTs were selected. The BACTs thus selected will provide emission levels offering the maximum level of environmental protection consistent with the efficient use of energy and capital.

9.4.2 Particulate Matter Control Alternatives

9.4.2.1 Identification of Applicable Technology and Emission Levels

The control of particulate matter emissions from large coal-fired steam electric generators has traditionally been accomplished with electrostatic precipitators. Recently, fabric filters have been used primarily on a number of western low sulfur coal applications in the electric utility industry. Both electrostatic precipitators and fabric filters have been accepted by the EPA Administrator in the promulgation of the revised New Source Performance Standards (NSPS), as having demonstrated the ability to limit particulate matter emissions to 0.03 pounds per million British thermal units (lb/MMBtu).

High energy wet scrubbers for particulate matter emission control were addressed by the administrator in the revision to NSPS [44 FR (113) 33579-33624, June 11, 1979] by stating:

"Scrubber pressure drop can be increased to improve scrubber particulate matter removal efficiencies; however, because of cost and energy considerations, the administrator believes that wet particulate matter scrubbers will only be used in special situations and generally will not be selected to comply with the standards."

The applicant believes that a particulate matter wet scrubber would not be suitable for the proposed project because:

- . The wet scrubber would be integral with the FGD system, thus preventing emergency bypassing of the FGD system while maintaining particulate matter emission limits.
- . The wet scrubber approach requires the use of wet and semi-wet induced draft fans. Wet and semi-wet fans have traditionally experienced corrosion and imbalance problems.
- . The flue gas pressure loss across the scrubber is very high, on the order of 25 inches of water. This requires the application of extra energy to maintain the required gas flow through the system.
- . Fly ash would have to be handled in a wet mode, thus limiting its marketability as a valuable resource.
- . Since the fly ash would enter into the FGD liquid circuitry, contamination of the FGD system by-product would occur thus making it unsuitable for the manufacture of wallboard.

Based upon the foregoing, only the electrostatic precipitator and fabric filter could be considered as offering the required level of control.

Electrostatic precipitators have been designed for and operated over broad ranges of fuel characteristics as would be the case for the proposed project. As indicated in Chapter 3, Section 3.2.1, the design range in fuel includes sulfur contents ranging from 0.5 to 4.0 percent. It must be noted that electrostatic precipitators are sensitive to the electro-chemical properties and the particle size distribution of the particulate matter, thus requiring care and attention in establishing minimum sizing criteria. Based upon past operating experience and performance testing, it is concluded that electrostatic precipitators are viable control equipment for the proposed project.

Fabric filters, having been extensively used in industrial applications for many years, are now being applied to coal-fired electric utility steam generators. To date, fabric filters are operating on approximately 3,480 MW's of coal-fired capacity in the electric utility industry. Approximately 89 percent of these installations are designed to operate on low sulfur (less than 2 percent) coal, with the remaining installation designed to operate on coal with sulfur contents up to 3 percent. It should be noted that none of these installations are designed to fire substantial quantities of fuel oil with the resultant particulate matter collected by the fabric filter. This is important for this project since it is desired that the units maintain the flexibility for oil firing. In terms of unit size, these installations range from 10 to 500 MW class units. To date, fabric filter performance (pressure drop and fabric life) has varied from excellent to poor. The causes for the variations in performance have neither been well defined nor documented in open literature. In reviewing the available data, it is apparent that at least the following factors will affect fabric filter performance:

- . Particulate matter size distribution
- . Particulate matter chemical composition
- . Fabric composition and coatings
- . Fabric cleaning method
- . Flue gas composition and temperature
- . Flue gas flow to fabric area ratio

Therefore, as in the case of the electrostatic precipitator, a great deal of care and attention must be used when evaluating fabric filters. Further, one must be cognizant of the generally limited fabric filter experience in the electric utility industry and factor that into the BACT selection process.

The following sections consider particulate emission levels of 0.03 lb/MMBtu (the applicable NSPS) and an arbitrary lower alternative of 0.02 lbs/MMBtu. Energy, economic and environmental comparisons are made and a BACT system selected.

9.4.2.2 Energy Impacts

The average annual energy consumed for the two unit proposed project by electrostatic precipitators and fabric filters for specific emission levels are:

	<u>Electrostatic Precipitator</u>	<u>Electrostatic Precipitator</u>	<u>Fabric Filter</u>
Emission, lb/MMBtu	0.03	0.02	0.02
Electric Power Consumption kW-yr	5462	5707	5679
Excess Fuel to Maintain Flue Gas at 300°F for the Fabric Filter as Equivalent kW-yr	—	—	<u>4119</u>
Total Equivalent kW-yr	5462	5707	9798
Differential Equivalent kW-yr	Base	245	4336

9.4.2.3 Economic Impacts

Investment and annual operating cost estimates have been prepared for two particulate emission levels (0.03 and 0.02 lb/MMBtu) utilizing electrostatic precipitators as the control equipment. Estimates have also been prepared for fabric filters with a single particulate emission level of 0.02 lb/MMBtu. This fabric filter emission level is a function of the filtration mechanism which tends to produce a constant emission rather than a specific collection efficiency. Thus, more than one collection efficiency cannot be evaluated for fabric filters.

The electrostatic precipitator sizing is based upon the entire range of fuel characteristics listed herein and designed under a worst case basis (maximum coal ash, minimum coal sulfur, maximum gas flow, operates with 10 percent of electrical bus sections out of service) for collection efficiencies of 99.78 and 99.85 percent (0.03 and 0.02 lbs/MMBtu, respectively).

The fabric filter sizing was based upon the entire range of fuel characteristics listed herein and designed under a worst case basis (maximum coal ash, maximum coal sulfur, maximum gas flow) to operate with two compartments (out of 28) out of service, for an emission level of 0.02 lbs/MMBtu.

Investment and annual operating cost estimates for both are summarized in Table 9.4-1. They indicate that the higher efficiency precipitator is \$11,998,000 more expensive than the 99.78 percent removal system and the fabric filter system is \$38,686,000 more expensive on a capitalized annual cost basis.

9.4.2.4 Environmental Impacts

A reduction from 0.03 to 0.02 lbs/MMBtu would mean a reduction by one-third of the stack contribution to ground level particulate concentrations. However, as indicated in Chapter 5, Section 5.3, the particulate emissions from the stack are not expected to be significant, even at the 0.03 lbs/MMBtu emission level. Ambient air quality standards will not be exceeded, PSD increments will not be violated, and there will not be a significant impact (less than 5 ug/m³) on the Jacksonville TSP nonattainment area. Hence, although there would be some air quality benefit from the lower emission rate, the decrease in ground level concentrations would not be significant.

9.4.2.5 Selected BACT

Based upon the foregoing discussion which is summarized in Table 9.4-2, the proposed BACT for the control of particulate matter emissions for the proposed project is an electrostatic precipitator rather than a fabric filter. This selection is based upon a combination of extensive operating experience over wide ranges of fuels and the economic advantage enjoyed by the electrostatic precipitator over the fabric filter. Also,

the fabric filter may not allow the flexibility of oil firing. As discussed in Section 9.4.2.1, the performance of fabric filter control systems as applied to large oil burning systems is not well defined, nor is design experience extensive. Further, an emission level of 0.03 lb/MMBtu is the appropriate control level considering the energy, economic, and environmental factors discussed above.

9.4.3 Sulfur Dioxide Control Alternatives

9.4.3.1 Identification of Applicable Technology and Emission Levels

In the past, when the control of sulfur dioxide emissions was required from large coal-fired steam electric generators, low sulfur coal was the primary control method. However, with the enactment of the Clean Air Act Amendments of 1977, flue gas desulfurization systems (FGDS) have generally been required on coal-fired steam electric generators to control sulfur dioxide emissions. Extensive research and development efforts have been applied to various FGD processes during the past ten years.

There are a large number of FGD processes which are currently at various stages of development ranging from laboratory bench scale apparatus through pilot and full size commercial installations. FGD processes whose development range from the pilot stage to full size commercial installations are summarized in Figure 9.4-1.

These processes can be broken down into a number of logical categories in order to facilitate the discussion. The first distinction of FGD processes is one of end product disposition; throwaway and recovery. Throwaway processes generate mixed sulfite/sulfate salts of calcium or sodium which presently have little commercial value without additional processing. Processes generating relatively pure calcium sulfate (gypsum) are included in this type because of the basic similarity of the technology even though gypsum can be a recovered product. Recovery processes generate a saleable by-product such as sulfur dioxide, sulfuric acid, sulfur, or ammonium sulfate.

The second level of categorization of FGD processes is based on whether the process operates wet, dry or semi-dry. This distinction provides some indication of the characteristics of the technology employed. Wet technology usually implies pumping the major materials to be handled, and low temperature operation. Corrosion and materials of construction are the major problem areas, and solids/liquids separations are the important unit operations. Dry technology usually implies conveying of major materials by mechanical or pneumatic means and high temperature operation. Abrasion is a major problem area (of more concern than corrosion), and solids/gases separations are the important unit operations. The semi-dry technology, consisting of liquids in spray dryers followed by dry fabric filters for collection, occupies an intermediate position, although closer to the dry technology.

The third level of distinction of FGD processes applies only to wet technology. This distinction is whether the absorbent liquid contacting the flue gas is a slurry or a clear liquor. The use of slurries generally implies abrasion, deposition, and scaling as additional operating problems.

With this philosophy of classification, 25 alternative FGD processes have been listed. Although the status is not indicated, essentially all have progressed to the 1 MW pilot plant size and have been reported in the open literature. Although most of the processes listed are unique, several are meant to represent generic groups of processes.

In order to reasonably address the large number of possible technology alternatives, it is necessary to establish logical selection criteria. These criteria are applied as a screening procedure to identify those control alternatives which have been sufficiently demonstrated to be considered for the proposed project. The selection criteria and sequence of application are as follows:

Process Development Status

- . Commitment (in operation, on order or both) with a 100 MW unit in operation prior to the end of 1980, of more than 2,500 MW's to a particular process technology.
- . Existence of three or more qualified suppliers.
- . Suppliers offer extended performance guarantees and material warranties with liabilities up to the value of the contract.

Process Capabilities and Requirements

- . Emission level performance capability.
- . Environmental acceptability of process waste products.
- . Market acceptability of saleable by-products.
- . Dependence on readily available fuels and reagents.

Technical and Economic Feasibility

- . Technical feasibility.
- . Economics of investment and operation.
- . Energy requirements.

The application of the Process Development Status criteria includes examination of the success of each process in previous applications and is designed to screen out those processes which have been abandoned by the developer as non-feasible or superceded by more advanced technology. A rigorous application of a success criterion, such as demonstrated reliable low cost operation, would eliminate all processes; therefore, discretion must be used. A liberal criterion is used here in that a process is considered successful if it is still proceeding along an orderly development path and has not been terminated.

The requirement for the commitment of at least 2,500 MW's to a particular process type along with the requirement of a 100 MW unit in operation by the end of 1980, permits the consideration of those processes

which have demonstrated the capability to be engineered, designed, fabricated and operated. Further, this criterion permits the consideration of emerging technology while also reflecting the degree of confidence expressed in a particular process by the entire electric utility industry. Although duration of operations, ease of operation, design parameters and economic considerations are important for the ultimate selection, they are omitted as criteria for initial screening. The existence of three or more qualified domestic suppliers of a particular process technology assures competition among designs, operating philosophies and experiences, and of course, the cost of the equipment. In addition, these suppliers should be financially sound and responsible so that significant liabilities can be assumed in terms of extended (two year minimum) performance guarantees and material warranties. These requirements are included because of the fact that the FGDS for the proposed project will not be a prototype or demonstration installation, although it is recognized that the technology is still developing.

The application of the Process Capability and Requirements criteria examines the inherent capabilities of the technology to meet the emission levels required for the application, the feasibility of acceptable methods of waste and by-product disposition, and the possible system requirements for special fuels and reagents which may not be reliably available over the life of the plant. For example, processes which require significant quantities of fuel oil, natural gas, clean liquid fuels (naphtha) for reducing gas production are no longer viable alternates in today's market. Meeting these requirements with yet to be demonstrated simplified coal gasification technology is a possibility, but cannot be considered a feasible alternate at this point in time.

The third criteria of Technical and Economic Feasibility requires a detailed examination of these features of the surviving processes: extrapolation of size and process conditions, area requirements, schedule and interface constraints, system operability, reliability,

maintainability, constructibility, safety and environmental acceptability, and the owning and operating costs of the process. Energy requirements are developed in conjunction with the technical and economic evaluations.

The application of the aforementioned criteria to the processes listed in Figure 9.4-1 can be summarized as shown by Table 9.4-3. The result of this screening process is that the lime/limestone and lime spray drying processes are considered applicable for the proposed project.

The following sections consider a design sulfur dioxide removal efficiency of 90 percent with an emission rate of 0.76 lb/MMBtu (the applicable NSPS) based upon the "worst case" coal (4 percent sulfur, 10,500 Btu/lb heating value) for both the lime/limestone and lime spray drying processes. In addition, the lime/limestone process is examined at an arbitrary removal efficiency of 95 percent with an emission rate of 0.4 lb/MMBtu under the "worst case" coal condition. The lime spray dry process is not considered to be viable at 95 percent removal efficiency and so has not been evaluated at that level.

9.4.3.2 Energy Impacts

The average annual energy consumed for the two unit proposed project by lime/limestone and lime spray drying FGD systems for specific removal efficiencies and emission levels are:

	<u>Lime/ Limestone</u>	<u>Lime/ Limestone</u>	<u>Lime Spray Dryer</u>
Removal Efficiency, Percent	90	95	90
Emission, lb/MMBtu	0.76	0.4	0.76
Electric Power Consumption kW-yr	21,296	22,361	15,016
Excess Fuel Due to Steam Reheating of Flue Gases as Equivalent kW-yr	<u>3,686</u>	<u>3,686</u>	<u>-0-</u>

	<u>Lime/ Limestone</u>	<u>Lime/ Limestone</u>	<u>Lime Spray Dryer</u>
Total Equivalent kW-yr	24,982	26,047	15,106
Differential Equivalent kW-yr	9,966	11,031	Base

9.4.3.3 Economic Impacts

Investment and annual operating cost estimates have been prepared for two sulfur dioxide emission levels (0.76 and 0.4 lb/MMBtu) utilizing a lime/limestone FGD system as the control equipment. Estimates have also been prepared for a lime spray drying FGD system with a single sulfur dioxide emission level of 0.76 lb/MMBtu.

Both types of FGD systems are sized to operate the entire range of fuel characteristics listed herein and designed under a worst case basis (maximum sulfur, minimum heating value, maximum gas flow, and one spare vessel per unit). Design sulfur dioxide removal efficiencies for the lime/limestone system are 90 and 95 percent (0.76 and 0.4 lb/MMBtu, respectively). It must be noted that although the 90 percent removal level can be and will be guaranteed by various system suppliers, the 95 percent removal level guarantee may not be available from all suppliers. The design sulfur dioxide removal efficiency for the lime spray drying system is 90 percent (0.76 lb/MMBtu).

In terms of system by-product disposal, both systems can produce a stable material which can be stored on-site in a landfill. It must be noted that the lime/limestone FGD system is capable of producing gypsum (calcium sulfate) which may be of sufficient quality to permit its use in the manufacture of wallboard while the lime spray dryer system is not. At this point in time, a limestone FGD system is being designed to accommodate the wallboard concept. However, addition work and investigation must be performed to establish wallboard market requirements, impact of changes in material quality on existing manufacturing facilities, gypsum quality control procedures and contingency plans along with a study of the

economics involved in the process. In addition, as the wallboard concept is being investigated, the marketing of fly ash must be addressed. Should the marketing of both the gypsum and fly ash be accomplished waste disposal impacts would be minimal.

Investment and annual operating cost estimates for both FGD systems are summarized in Table 9.4-4. They indicate that the 95 percent removal lime/limestone FGD system is \$26,616,000 more expensive than the 90 percent removal lime/limestone FGD system and that the 90 percent removal lime spray dryer FGD is \$240,450,000 more expensive on a capitalized annual cost basis.

9.4.3.4 Environmental Impacts

An increase in FGD system efficiency from 90 percent to 95 percent would reduce stack emissions of sulfur dioxide from 0.76 lbs/MMBtu to 0.4 lbs/MMBtu. This reduction in emission would decrease PSD increment consumption by nearly 50 percent, although the allowable PSD increments would not be exceeded in either case. However, since the proposed project would not be the only contributor to ambient concentrations in the Jacksonville area, this reduction would not normally occur in ambient concentrations. Although for maximum short-term concentrations in the immediate plant vicinity, about a 20 percent reduction is possible, on an annual average basis, maximum concentrations would likely be reduced by only about 5 percent. Again, in either case, the ambient air quality standards for sulfur dioxide will not be exceeded, as discussed in Chapter 5, Section 5.3.3.

9.4.3.5 Selected BACT

Based upon the foregoing discussion, which is summarized in Table 9.4-5, the applicant believes that BACT for the control of sulfur dioxide emissions from the proposed project is a limestone wet scrubbing system rather than a spray drying system. This selection is based upon a

combination of extensive operating experience over wide ranges of fuels and the economic advantage enjoyed by the limestone system over the spray dryer. Limestone has been selected as the reactant rather than lime based on cost considerations. Further, an emission level of 0.76 lb/MMBtu is the appropriate emissions level considering the energy, economic, and environmental factors discussed above.

9.4.4 Nitrogen Oxides Control Alternatives

As indicated in Chapter 3, Section 3.8.2.5, the control technology for nitrogen oxides (NO_x) consists of design parameters and operating practices for the steam generator rather than a distinct process or system. Nitrogen oxides emissions for large coal-fired units are a function of furnace size, burner spacing, burner design, fuel nitrogen and moisture contents, excess air, off stoichiometric firing with overfire air and flame temperature.

When considering a maximum NO_x emission rate of 0.6 lb/MMBtu as required by NSPS and arbitrary lower alternatives, it was determined that steam generator manufacturers will guarantee an emission of 0.6 lb/MMBtu for eastern bituminous coal. However, although some western coal units have been designed and guaranteed for lower NO_x emission rates, steam generator manufacturers will not guarantee lower emission levels for this project when firing the design range of eastern bituminous coal. Hence, it has been determined that better control technology than that required to achieve an emission rate of 0.6 lb/MMBtu is not available for this project. Therefore, in accordance with the Guidelines for Determining Best Available Control Technology (USEPA, 1978), an analysis of the energy, economic, and environmental impacts associated with alternative emission control levels is not required, and the BACT emission level is 0.6 lb/MMBtu.

9.4.5 Other Air Emission Control Alternatives

9.4.5.1 Carbon Monoxide Control Alternatives

As indicated in Chapter 3, Section 3.8.2.6, carbon monoxide is a minor by-product of the combustion of coal in large utility steam generators. The generation of carbon monoxide is a function of excess air, off stoichiometric firing with overfire air, and low flame temperatures, and varies inversely as a function of the production of nitrogen oxides. In practice, the steam generator manufacturers optimize their designs in order to minimize and balance the emissions of both air pollutants. Therefore, there are no specific control technologies available at this point in time and thus no alternatives to be evaluated. Based upon the BACT NO_x emission rates in Section 9.4.4, the boiler vendor has indicated that the carbon monoxide emission rate would be on the order of 0.05 lb/MMBtu, although this emission rate cannot be guaranteed.

9.4.5.2 Hydrocarbon Control Alternatives

It is not expected that non-methane hydrocarbons will be a "major" pollutant from the proposed plant (i.e., emitted in quantities greater than 100 tons/year). However, since the Jacksonville area is nonattainment for ozone, a discussion of hydrocarbon emissions has been included.

Non-methane hydrocarbon emissions from steam electric generators have not been well defined to date. However, the limited information available (Neligan, 1978), indicates that uncontrolled non-methane hydrocarbon emissions would be on the order of 0.0005 lbs/MMBtu. Since there is no known specific control technology for these emissions and based upon the extremely low emission levels, it is the applicant's position that no specific measures can be taken to control or limit non-methane hydrocarbon emissions for the proposed project. No alternatives have been considered, and no specific emission rate can be guaranteed.

9.4.5.3 Fugitive Dust Control Alternatives

Fugitive dust is produced by a number of sources associated with the project. These include the coal handling system, limestone handling system, fly ash handling system, and FGD waste handling and disposal systems. Also since salt water cooling towers will be used, EPA has indicated (Nagler, 1980) that dissolved and suspended solids in the small droplets fraction (less than 50 microns diameter) of cooling tower drift would be considered as contributing to particulate concentrations in the impact assessment. The control systems and/or methods proposed as BACT for these fugitive dust sources were described in Chapter 3, Sections 3.8.2 and 3.8.3. Prewashing of coal was not considered as a BACT alternative for coal handling since it would not prevent the subsequent generation of fugitive coal dust by the follow-on coal handling system operations. The alternative measures available for fugitive dust control systems generally produce about the same levels of control efficiency, and the selection of the preferred control systems is dictated by engineering feasibility rather than the combination of factors usually considered. Therefore, an analysis of alternative dust control systems per se was not conducted nor justified and is not presented here.

9.4.5.4 Auxiliary Boiler Control Alternatives

As indicated in the project description, the auxiliary boilers will burn No. 2 fuel oil and have emissions which are much smaller than those from the main units. Also, it is expected that the auxiliary boilers will have an annual capacity factor of only 0.05 compared to 0.74 for the main units during the first years of operation. Annual emissions are projected to be less than the levels which require the consideration of control systems. Thus, it would not be cost-effective to install any pollution control systems on the auxiliary boilers nor would the environmental benefits of doing so be significant. As a result, no alternative control systems have been considered.

9.4.6 References

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- Federal Register, June 19, 1978. 1977 Clean Air Act; Prevention of Significant Air Quality Deterioration. State Implementation Plans; Requirements. Vol. 43, No. 118, p. 26379-26410.
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- Federal Register, August 7, 1980. Requirements for Preparation, Adoption and Submittal of Implementation Plans; Approval and Promulgation of Implementation Plans. Vol. 45, No. 154, p. 52675-52748.
- Ebasco Services Incorporated, 1980. Air Quality Control System Study, prepared for the Jacksonville Electric Authority. Norcross, Georgia.
- U.S. Environmental Protection Agency, 1978b. Guidelines for Determining Best Available Control Technology (BACT). Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.
- Nagler, L., January 28, 1980. Meeting with Ebasco/Envirosphere and Jacksonville Electric Authority Personnel. U.S. Environmental Protection Agency, Region IV. Atlanta, Georgia.
- Neligan, R.E., January 23, 1978. Memorandum to D. Wagoner on Reactive VOC from Coal-Fired Power Plants. U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

Table 9.4-1
INVESTMENT AND ANNUAL OPERATION COST ESTIMATES,
PARTICULATE REMOVAL SYSTEMS
(In Thousands of Dollars)

	Electrostatic Precipitator 0.03 lb/MMBtu	Electrostatic Precipitator 0.02 lb/MMBtu ^a	Fabric Filter 0.02 lb/MMBtu ^a
Total Plate or Fabric Area Per Unit (ft ²)	2.041 x 10 ⁶	2.236 x 10 ⁶	1.814 x 10 ⁶
Gross Size Factor (Plate-ft ² /1000 ACFM, Fabric-ACFM/ft ²)	767	840	1.5
Capital Investment	77,154	81,545	63,745
Including collection equipment, ductwork, support steel, ash handling, foundations, piling, electrical power supply and wiring, insulation and lagging			
Miscellaneous Costs	96,967	102,486	80,114
Including indirect construction, engineering, interest during construction and contingencies			
TOTAL INVESTMENT	174,121	184,031	143,859
Annual Operating Cost			
Fixed Charges @ 11.11% on investment	19,345	20,446	15,983
on capability @ 890 \$/kW	885	925	920
Levelized power consumption @ 692.25 \$/kW-Yr	3,781	3,951	3,931
Levelized operating labor @ 117,000 \$/Man-Yr	234	234	234
Levelized general maintenance @ 0.5% of direct investment	386	408	319
Levelized fabric replacement @ 276 \$/Bag x 17.472 Bags/Yr	-0-	-0-	4,822
Levelized excess fuel to maintain higher A-H exit temperature for fabric filter @ 356,500 MBtu/Yr @ 7.63 \$/MBtu	-0-	-0-	2,720
TOTAL ANNUAL COST	24,631	25,964	28,929
CAPITALIZED ANNUAL COST	221,701	233,699	260,387
DIFFERENTIAL CAPITALIZED ANNUAL COST	BASE	11,998	38,686

^a A 0.03 lb/MMBtu fabric filter would have the same economics since it would in fact be identical to the equipment for the 0.02 lb/MMBtu system.

Table 9.4-2

ADVANTAGES AND DISADVANTAGES OF PARTICULATE CONTROL ALTERNATIVES

System/Control Level	Advantages	Disadvantages
1. Electrostatic Precipitator (0.03 lb/MMBtu)	- Lowest cost - Energy consumption lower than for System 2 or 3	Higher emission levels, but ground level concentrations not significantly higher
2. Electrostatic Precipitator (0.02 lb/MMBtu)	- Low emission rate - Energy consumption lower than for System 3 - Cost lower than System 3 by \$26,688,000	- Cost higher than System 1 by \$11,998,000 - Energy consumption higher than for System 1
3. Fabric Filter (0.02 lb/MMBtu)	Low emission rate	- Cost higher than System 1 by \$38,086,000 and System 2 by \$26,688,000 - Energy consumption higher than for System 1 or 2 - Might not allow oil-firing. - Less extensive operating experience than for electrostatic precipitators.

Note: Cost differentials are capitalized annual costs

Table 9.4-3

FLUE GAS DESULFURIZATION TECHNOLOGY APPLICATION
OF SCREENING CRITERIA

Process	2500 MWs in Operation and/or on Order	Existence of Qualified Domestic Suppliers	Inherent Performance Capability	Waste Disposal/ By-Product Acceptability	Special Fuels/ Reagents/ Reprocessing Facilities
Lime/Limestone					
Alkaline Fly Ash					X
Limestone Boiler Injection	X	X	X		
Sea Water	X	X		X	
Sodium Carbonate	X			X	
Dual Alkali	X				
Lime/Chloride	X	X			
Dilute Acid	X	X			
Semi-Dry Spray Dryer - Lime					
- Sodium	X			X	
Dry Nahcolite	X	X(?)	X	X	X
Furnace Injection - Calcium	X	X	X		
- Sodium	X	X		X	
Magnesia	X	X			X
Steam Stripping	X	X			X(?)
Wellman Lord Sodium Sulfite	X	X			
Ammonia	X	X			
Buffer Solution (Citrate and Phosphate)	X	X			X
Semi-Dry Ammonia	X	X			
Semi-Dry Sodium Carbonate	X	X			X
Dry Carbon Sorption	X	X			
Copper Oxide	X	X			X
Catalytic Oxidation	X	X			X
Molten Carbonate	X	X			

NOTE: X - Denotes unacceptability

Table 9.4-4
INVESTMENT AND ANNUAL OPERATION COST ESTIMATES,
SULFUR DIOXIDE REMOVAL SYSTEMS
(In Thousands of Dollars)

	Lime/ Limestone <u>0.76 lb/MBtu</u>	Lime/ Limestone <u>0.4 lb/MBtu</u>	Lime Spray Dryer <u>0.76 lb/MBtu</u>
Sulfur Dioxide Removal Efficiency, Percent	90	95	90
Capital Investment	110,672	111,743	162,184
Absorbers, ductwork and support steel, foundations, piling, reagent unloading, storage and preparation, waste processing, by fixation, electrical power supply, wiring, instrumentation and controls, insulation and lagging, and fabric filters for the spray dryer			
Miscellaneous Costs	172,851	174,524	253,303
Including indirect construction costs, engineering, interest during construction and contingencies			
TOTAL INVESTMENT	283,523	286,267	415,487
Annual Operating Cost			
Fixed Charges @ 11.11% on investment	31,499	31,804	46,161
on capability @ 890 \$/kW	3,452	3,625	2,434
Levelized power consumption @ 890 \$/kW-Yr	14,742	15,479	10,395
Levelized reagent cost			
Limestone @ 39.53 \$/ton	16,493	17,358	-0-
Lime @ 197.65 \$/ton	3,994	4,204	64,854
General maintenance @ 0.4% of direct investment			
for limestone	4,427	4,427	-0-
1.5% of direct investment for spray dryer	-0-	-0-	2,433
Levelized fabric replacement @ 276 \$/Bag x 15,570 Bags/Yr	-0-	-0-	4,297
Levelized Operating Labor @ 117,000 \$/Man-Yr	4,680	4,680	3,510
Levelized flue gas reheating up to 319,000 MBtu/Yr @ 7.63 \$/MBtu	2,434	2,434	-0-
Levelized Waste Disposal with Trucking to Landfill Site 14.47 \$/ton	<u>18,276</u>	<u>18,900</u>	<u>17,258</u>
TOTAL ANNUAL COST	99,997	102,954	151,342
CAPITALIZED ANNUAL COST	900,063	926,679	1,362,214
DIFFERENTIAL CAPITALIZED ANNUAL COST OF PARTICULATE MATTER CONTROL FOR EQUIVALENCY WITH SPRAY DRYER	<u>221,701</u>	<u>221,701</u>	<u>-0-</u>
EQUIVALENT SYSTEM CAPITALIZED ANNUAL COST	1,121,764	1,148,380	1,362,214
DIFFERENTIAL EQUIVALENT SYSTEM CAPITALIZED ANNUAL COST	BASE	26,616	240,450

Table 9.4-5
ADVANTAGES AND DISADVANTAGES OF SULFUR DIOXIDE CONTROL ALTERNATIVES

System/Control Level	Advantages	Disadvantages
1. Lime/Limestone Scrubber (0.76 lb/MMBtu)	1. Energy consumption lower than System 2 2. Lowest cost	1. Energy consumption higher than System 3
2. Lime/Limestone Scrubber (0.4 lb/MMBtu)	1. Lowest emission rate 2. Cost lower than System 3 by \$213,834,000	1. Highest energy consumption 2. Sludge generation higher 3. Cost higher than System 1 by \$26,616,000
3. Lime Spray Dryer (0.76 lb/MMBtu)	1. Low energy consumption	1. Cost higher than System 1 by \$240,450,000 and System 2 by \$213,834,000 2. Not as much operating experience as for lime/limestone scrubber 3. Will not allow production of a usable by-product (gypsum).

Note: Cost differentials presented are capitalized annual costs.

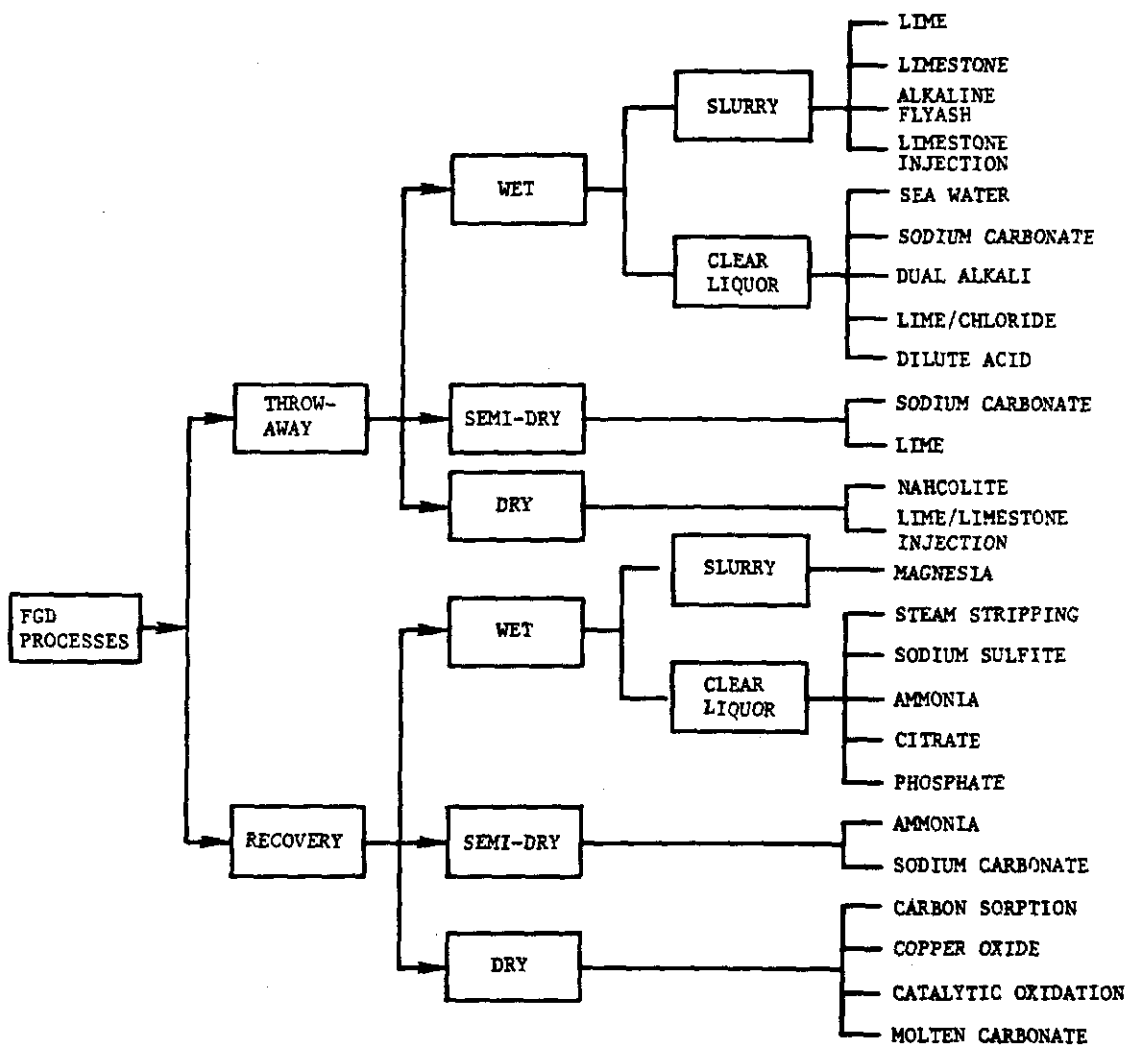


Figure 9.4-1 Flue Gas Desulfurization Process Alternatives

9.5 SOLID WASTE DISPOSAL

9.5.1 Design Objectives and Regulatory Requirements

Specific regulatory requirements for the disposal of the high volume solid waste generated by the operation of the proposed plant are discussed in Chapter 5, Section 5.1.3.2. Design objectives for the disposal of high volume solid wastes at the proposed plant are to minimize leachates into groundwater and surface waters. In general, best engineering practices govern the design and operation of the high volume solid waste disposal areas.

9.5.2 Bottom Ash Disposal Alternatives

Three bottom ash disposal alternatives are available: wet sluicing to ash pond for disposal, wet sluicing to dewatering bins and disposal in landfill; and mechanical ash removal with landfill disposal.

In the first alternative, bottom ash from the ash hoppers is sluiced with water to a bottom ash pond for disposal. In the pond, the ash settles down and the supernatant water is recirculated. The bottom ash pond is lined to prevent leachates into the groundwater. A small amount of blowdown and makeup is usually required. This system is widely used by the electric utility industry in the United States and has been demonstrated to be reliable.

The second alternative utilizes wet sluicing of the bottom ash to dewatering bins and recycling of the clarified water. The dewatered ash is then trucked to landfills for disposal. This alternative is usually selected where land for on-site disposal is not available. Water requirements are essentially the same as for the first alternative.

As a third alternative, a mechanical conveyor system is employed to remove ash from the bottom ash system. The ash moves up an inclined conveyor which accomplishes dewatering. The dewatered ash is then disposed of in a landfill. There is operating experience with this system in Europe, and it is currently proposed for use by several utilities in the United States. The advantages include lower water and power requirements.

The preferred alternative for the proposed plant is the wet sluicing to dewatering bins and disposal in a landfill. This alternative was selected because of its demonstrated reliability in the United States and the availability of on-site land, and because no significant environmental advantage is gained through the other available alternatives.

9.5.3 Fly Ash Disposal Alternatives

Basically, three fly ash disposal alternatives are available: wet sluicing with ponded disposal, pneumatic conveyance with on-site disposal, and pneumatic conveyance with off-site disposal.

In the first alternative, the system utilizes wet sluicing and disposal of the fly ash in a pond. However, EPA effluent limitations do not permit any discharge of TSS and oil and grease in the fly ash transport water. This regulation implies either a pneumatic transport system or a totally recirculating hydraulic system. A totally recirculating hydraulic system has the potential for excessive scaling of the system due to the buildup of dissolved solids in the recirculating water.

In the second alternative, fly ash collected in the electrostatic precipitators is conveyed pneumatically to temporary storage silos. Fly ash is then conveyed to on-site landfills for disposal.

The third alternative also utilizes pneumatic conveyance to temporary storage of the fly ash in silos. The fly ash is then trucked off-site for disposal or possible sale as a resource.

The preferred alternative is pneumatic conveyance to temporary storage silos. If sale of the fly ash as a resource is not possible disposal will be made in an on-site landfill. Considerations in the selection of the on-site disposal process are discussed in the following section.

9.5.4 Scrubber Waste Disposal Alternatives

Basic alternatives available for the disposal of the FGDS scrubber wastes are on-site disposal in ponds, on-site landfill disposal, and use as a recoverable resource.

The FGDS system at the proposed plant will be designed to produce a commercial grade by-product gypsum. This alternative was selected because of the existence of nearby wallboard manufacturing facilities and the obvious potential market for the by-product gypsum. Although this alternative involves the expenditure of large sums of money for equipment and quality control activities, the advantages of a recoverable resource over a throwaway waste product justify the selection of this alternative.

In the event markets for fly ash and gypsum do not materialize, or during temporary market interruptions, on-site storage will be necessary. Because of the absence of a specific plant coal and leachate characteristics, a storage program having two elements will be implemented. The elements include an on-site solid waste disposal test program and an on-site landfiling operation for material not directly associated with the test program.

The test program will be designed to characterize the handleability, structural stability, and other physical and chemical properties of fly ash and gypsum mixtures, and to develop criteria for establishing an environmentally acceptable and cost effective long term disposal plan.

During the testing period (approximately five years), the material not directly associated with the test program will be placed into a secure, on-site, monitored landfill. This landfill is described in Chapter 3, Section 3.5.2.2.

9.6 TRANSMISSION FACILITIES

9.6.1 Design Objectives and Regulatory Requirements

The purpose of the transmission facilities study was to define corridor route which represented a minimum cost and potential risk to the environment and land use practices. A corridor has been defined below, in which it is felt a transmission line can be routed that will not significantly impact the following resources:

- . Wetlands,
- . Rare and endangered species,
- . Important wildlife and botanical areas,
- . Floodplains,
- . Historical and archeological sites,
- . Land uses,
- . Important aesthetic areas, and
- . Public lands.

The above resources are regulated by several federal and state laws and administrative actions. The state level guidelines considered included the Department of Environmental Regulation Guidelines for Application for Certification of Proposed Electric Power Generating Plant Site [DER Form 17-1.122 (72) January, 1979]. These guidelines represent a comprehensive input from several state agencies charged with protecting various land uses and environmental resources.

At the federal level, compliance with the acts and executive orders cited below was maintained. These federal actions include:

- . Environmental Protection Agency proposed regulations on the implementation of procedures of the National Environmental Policy Act,

- . Endangered Species Act,
- . Army Corps of Engineers, Section 10, Part 404, Dredge and Fill Permitting,
- . National Historic Preservation Act,
- . Secretary of Agriculture's memorandum, Prime Farmland, Range and Forest Land No. 1827,
- . Executive Order 11593 concerning cultural resources,
- . Executive Order 11988 concerning floodplain management, and
- . Executive Order 11990 concerning wetlands protection.

Collectively, compliance with such regulatory requirements will assure an acceptable level of environmental impact. Section 9.6.4 presents the mechanism by which protection of the above resources was factored into the corridor selection process.

9.6.2 Existing Facilities

Figure 9.6-1 presents the existing JEA transmission system for lines in excess of 115 kV. Most system transmission exits from the Northside Station.

Major substations are also included on this map. Interconnections to other utilities include two 138 kV ties to Florida Public Utilities at the Yulee Substation in Nassau County and the following Florida Power and Light Company (FP&L) ties: the Normandy Substation has transmission interconnection to FP&L Baldwin (115 kV) and Lawtey (240kV) substations to the west of Jacksonville; the Greenland Substation transmits power to the FP&L Orangedale Substation south of Jacksonville via a 240 kV line.

In order to integrate the proposed plant into the existing transmission system, several 230 kV lines will exit the plant. Four lines are needed for adequate power distribution. It was determined that the new lines should terminate at a combination of the following substations (as described in Chapter 1, Section 1.4):

- . Robinwood Substation (3 miles SSE of Craig Field),
- . Fort Caroline Substation (2 miles NW of Craig Field),
- . Yulee Substation (12 miles NNW of the plant in Nassau County),
- . Normandy Substation (4 miles SE of Cecil Naval Air Station), and
- . Interconnection to Northside Switchyard.

An alternative arrangement was developed which satisfied system stability criteria. A description of the selected tie in points and lines associated with them are found in Section 9.6.3.

9.6.3 Future Requirements

In-house transmission system stability studies resulted in the following combination of lines, voltages and tie-in points.

- . Two 230 kV lines to the Normandy Substation,
- . One 230 kV line to the Robinwood Substation, and
- . One 230 kV line to the Fort Caroline Substation.

These tie-in points are shown on Figure 9.6-1.

9.6.4 Transmission System Alternatives

Section 9.6.3 identified several tie-in points for consideration in the corridor selection process. The objective of the transmission line portion of this Site Certification Application/Environmental Information Document is the licensing of a corridor rather than a specific right-of-way (ROW). Following Site Certification Application/Environmental Information

Document approval, the Applicant's right-of-way staff will select a precise ROW within the approved corridor with known widths and probable tower locations, as guided by specific conditions of certification and state agency overview.

Emphasis has been placed on selecting and examining alternative corridors within a study area. The initial study area was defined by system stability studies and general cost and engineering feasibility analyses. Within the study area, an environmental review took place which resulted in delineation of alternative corridors. Engineering and environmental comparisons were then made of each alternative to arrive at a preferred corridor. The preferred corridor was then examined to further assure its acceptability. Details of this methodology follow.

9.6.4.1 Corridor Selection Methodology

The corridor definition process began with determination of licensing issues. These issues included:

- . Wetlands avoidance (particularly wooded wetlands),
- . Floodplain avoidance,
- . Avoidance of important habitats,
- . Avoidance of historical and archeological sites,
- . Avoidance of land use sensitivities (airports, property ownership, public lands),
- . Avoidance of endangered species, and
- . Avoidance of important aesthetic areas.

The above avoidance criteria and their relative importance were developed from contacts with agencies including:

- . U.S. Department Transportation,
- . U.S. Fish and Wildlife Service,
- . U.S. Corps of Engineers,

- . Federal Aviation Administration,
- . Florida Department of Environmental Regulation,
- . Florida Game and Freshwater Fish Commission,
- . Florida State Division of Forestry,
- . Florida State Historical Preservation Office,
- . Florida State Highway Department,
- . Northeast Florida Regional Planning Council,
- . St. Johns River Water Management District,
- . Jacksonville Area Planning Board, and
- . Bio-Environmental Services Division of the City of Jacksonville.

From these agencies and regional literature, sensitive portions of the study area were mapped (Figure 9.6-2). Sensitive study area components were classified in the following manner:

Highly sensitive zones including:

- . Existing high and medium population density (Jacksonville Area Planning Board, 1975),
- . Proposed high and medium population density (Jacksonville Area Planning Board, 1979),
- . Historical and archeological sites,
- . Public lands,
- . Wooded wetlands, and
- . Airports.

Moderately sensitive zones including:

- . Existing low population density (Jacksonville Area Planning Board, 1975),
- . Salt marshes and nonwooded wetlands (Jacksonville Area Planning Board, 1979),

- . Open aquatic habitats such as major river crossings, and
- . Zoned open space and recreation lands.

Zones of low sensitivity included other land use and land cover types. These areas represent no major licensing difficulties and consequently were not mapped.

Highly sensitive zones represent areas which should be avoided entirely or traversed by a transmission line only with utmost care. If these areas must be crossed, additional mitigation, engineering design, and land acquisition costs should be expected. Moderately sensitive zones represent areas which should be avoided if practical alternatives are available. Zones of low sensitivity do not warrant special avoidance procedures. The latter areas may include small sensitive components such as stream crossings, but it is assumed these areas can be spanned without measurable impact during the identification of a specific ROW.

Implementation of criteria used to screen out portions of the study area is described below. In terms of population density and land use, existing high and medium level densities and presence of significant public and historical lands (including airports) were considered of greatest importance and should be avoided. For sensitivity mapping purposes, large areas of these categories were considered impenetrable, though in reality it may be possible to find a small but "licensable" route through these areas. It is felt that corridors identified in this study represent less potential impact and lower cost than routes passing through and near large areas of high or medium population density.

Areas proposed for medium to high population density development but which are largely undeveloped at this date are considered less significant than existing higher density areas. Low density areas must be reviewed on a case-by-case basis but it is assumed spacing between housing in these areas would allow passage of a ROW with minimal land use impact. For purposes of analysis, aesthetic impacts are considered directly

proportional to population density levels, to the presence of public lands and historical sites and open waters. Protection against aesthetic impacts are therefore implied in subsequent discussions of these issues.

Ecological significance is based on habitat importance in the corridor areas. Known rare and endangered species habitat and wooded wetlands are considered of greatest importance. Because the clearing of wooded wetlands represents the loss of a habitat which took a significant time period to develop, loss of this habitat type is more important than loss of small areas for tower placement in a marsh habitat where clearing is not needed. It is assumed that construction in a marsh is performed under controlled conditions (use and removal of mats, etc.). Tower construction in open water or mud flat habitats is of similar importance to construction in marshes. Both should be done under controlled conditions.

Wetland and open water ROW crossings also result in more costly construction procedures, tower equipment and foundations. Depending on foundation conditions, it may cost up to two times as much to construct the same towers in wetlands as in an upland environment.

Variable width corridors were established from the proposed plant area to the Normandy and Robinwood Substations. Corridor widths are generally 0.5 mile to 1.0 mile. Wider corridors were assigned to relatively homogenous areas. A network of corridors was used to allow use of the best components of each alternative routing segment. The corridor area between Cedar Creek and Little Trout River is made up of a single mile wide corridor (Figure 9.6-2, Section H). However, for analyses, the northern half and southern half were considered separately. Because less easement would be needed adjacent to an existing ROW, special attention was paid to acceptability of this portion of the corridor. A qualitative assessment of engineering requirements of the corridors was undertaken using Soil Survey materials (Stem, et al., 1978), and inspection of the line from aircraft and ground in the vicinity of the existing ROW.

The evaluation of each alternative corridor segment was based on criteria defined in this section and a conceptual engineering analysis of probable foundation requirements and tower types and costs attendant to these situations. Because tower positions and route alignment will not be determined until the preferred corridor is licensed, analyses are based on soil conditions, habitat types, and land use features characteristic of an entire corridor segment alternative. The position of the proposed plant relative to the existing ROW dictates that the new ROW should be on the same side of the existing line, except in unusual circumstances where line relocation may be required to avoid critically sensitive areas.

The preferred corridor was selected as the alternate representing the minimal opportunity for impact. The preferred corridor was reviewed in terms of its ability to accept a two-line 200 foot ROW and/or double circuit line.

All corridors were inspected by fixed wing aircraft in July, 1980. During these flights, potential land use and ecological problems were evaluated. In August, 1980, the preferred corridor was flown by helicopter to further evaluate corridor land use, ecological and engineering conditions. Potentially sensitive areas in the preferred corridor (Figure 9.6-2) were then visited on foot and by vehicle.

9.6.4.2 Corridor Selection Results

Introduction

Alternate corridors from the proposed plant to the Normandy Substation and to the Robinwood Substation are compared in Table 9.6-1. Because of the network arrangements of corridors, analyses were performed by each route segment (e.g., A versus A', Figure 9.6-2). Salient and distinguishing advantages and disadvantages of each alternate are presented. The preferred corridor is underscored in Table 9.6-1, and

9.6-1, and includes an existing transmission ROW (Figure 9.6-1). Below is a discussion of corridor selection results and a review of four sensitive areas within this corridor.

Alternate Corridor Analysis

In general, in locating a corridor, it is desirable to closely parallel an existing transmission ROW because new ROW width requirements will be less, the need for new access roads will be minimized, and environmental and aesthetic impacts will be less than if the corridor were located elsewhere since these impacts have already occurred with the construction of the existing transmission line ROW. The new ROW will follow the existing ROW for approximately 90 percent of its length.

Land use constraints south of the St. Johns River (Figure 9.6-2) limit available river crossing alternatives toward the Robinwood Substation area. Segment A' which includes the existing ROW is clearly the preferred choice based on cost, engineering and environmental factors. The presence of sensitive corridor portions in A' (golf and tennis recreation areas) represents much less potential impact than the wetlands and cost impacts associated with Segment A. The presence of nesting habitat (sand flat) for Least Terns (Sterna albifrons) on Blount Island is not considered critical because much suitable habitat is present in the area.

Segment B' is preferred over B because it includes the existing ROW, and has less moderately sensitive acreage on an actual and percentage basis. Large drainage ditches in this area have reduced the value and persistence of wetlands locally. These ditches are approximately 15-20 feet in depth, up to about 40 feet in width, and bracket the preferred corridor area. Corridor segment B also has areas of greater population density.

Segment D is combined with each C and C' because it is a small area common to both alternatives. C'D is preferred over corridor segment CD because it includes the existing ROW and the Ft. Caroline Substation and has relatively less wetland acreage percentage. The area adjacent to the existing ROW on its eastern side includes few wetland areas.

Alternatives E and E' include the Robinwood Substation. Corridor alternative E is preferred because fewer wooded wetlands would be cleared compared with alternative E'.

Alternative corridor G is preferred over G' as the first segment of the Normandy Substation route. Corridor G includes the existing ROW and crosses estuarine and marsh habitats at much smaller areas than with G'. River, marsh and estuarine crossing represent significant additional costs over transmission in average upland conditions because of more extensive foundation requirements, construction costs and possibly more sophisticated tower structures. Mitigation at the population sensitive area near Pulaski Road is more easily managed than at the wetland estuarine crossing areas associated with corridor segment G'. Because of these aquatic crossings, G' should be a much more costly alternative. Segment G' also has potential land use and population sensitive areas (Jacksonville Area Planning Board, 1975).

The southern half of corridor segment H is preferred over its northern half because it includes the existing ROW (less easement needed) and includes less wetland acreage. A potentially sensitive area at an interstate crossing exists. This area is proposed for medium to high density population in the Comprehensive Master Plan prepared by the Jacksonville Area Planning Board for the year 2005. It is currently of low population status. Routing a line through this area and across Interstate 295 is feasible.

From an engineering and environmental standpoint, there is very little to distinguish between alternative corridor segments I and I'. Segment I is approximately one mile shorter than Segment I'. However I' includes the existing ROW and therefore less easement will be required thus tending to cancel out the land acquisition advantage of the shorter segment. Because the aesthetic and habitat impacts are already present in the area of I', it is preferred over alternative Segment I.

Alternative segments J and J' include the Normandy Substation. Segment J is preferred over J' for essentially the same reasons as the selection of segment I' above. Segment J' also has a somewhat greater percentage of wetlands and population sensitive areas (high density, Jacksonville Area Planning Board, 1975) than alternative Segment J.

Summary of Sensitive Areas

A description of the preferred corridor is found in Chapter 3, Section 3.9. The preferred corridor includes the existing ROW and alternate Segments A', B', C', D and E from the site to Robinwood Substation and Segments G, H (southern half), I' and J to the Normandy Substation.

Four relatively sensitive areas exist within the preferred corridor. The area near Pulaski Road in the corridor (5 mile WNW of the proposed plant) has a medium to high population density. By paralleling the existing ROW in this area and tower modification, the impact can be minimized. A medium high density population zoning is found in the vicinity of I-295 and the existing ROW. Currently, few families inhabit this area and routing a line through much of the area would cause minimal impact, particularly if close proximity to the interstate highway is maintained.

Two recreation areas (golf courses) are found in the preferred corridor north of Craig Field (Section A'). Tower modifications and paralleling the existing ROW can minimize impacts to this area. The final

remaining area of sensitivity is in the preferred corridor at the Sandalwood High School area near the Robinwood Substation. Tower modification and paralleling the existing ROW can minimize project impacts. It is also possible to use currently available tower space to route a line in this area.

With the exception of the crossing of Interstate 295 at its northwest side, road crossings near the Normandy Substation, crossing of the St. Johns River, and the Beachwood and Blount Island area relatively few people will see much of the proposed lines. Vegetation will provide an important screening effect in most of the proposed corridors.

No rare and endangered species habitats are known for the study area, although due to the open habitat created by ROW construction and the dry, friable soil, potential exists for the gopher tortoise (Gopherus polyphemus) and the Florida gopher frog (Rana areolata aesopus) to occur along the ROW. No burrows were found during ROW searches. The indigo snake (Drymarchon corais couperi) does not commonly utilize gopher tortoise burrows in this area (Moler, personal communication), although it has been observed doing so elsewhere in its range. The potential of its occurring along the ROW is slight. Because tower construction will result in minimal aquatic habitat loss, Manatee (Trichechus manatus) habitat impact is not considered significant.

9.6.5 References

Jacksonville Area Planning Board. 1979. 2005 Comprehensive Plan (Map). Jacksonville Florida.

Jacksonville Area Planning Board. 1975. Duval County Florida Land Cover and Selected Characteristics (Map). Jacksonville, Florida.

Moler, P., 1980. Personal Communication. Florida Game and Freshwater Fish Commission. Gainesville, Florida.

Stem, L.T., H.D. Dollar, D.A. Howell, D.L. Lewis, C.A. Wettstein, and H. Yamatak. 1978. Soil Survey of City of Jacksonville - Duval County, Florida. U.S. Department of Agriculture Soil Conservation Service and University of Florida Soil Science Department.

Table 9.6-1
ENVIRONMENTAL ASSESSMENT OF ALTERNATIVE
TRANSMISSION LINE CORRIDORS - TERRESTRIAL ECOLOGY a
(Figure 9.6-2)b

I. Robinwood Substation from Plant

Corridor Segment ^c	Advantages	Disadvantages
<u>A'</u>	1. Crosses large amount of disturbed (low sensitivity) land. 2. Includes existing right-of-way (ROW).	1. Spoil areas are nesting areas for least terns, which may be temporarily disturbed during construction phase (moderate sensitivity).
<u>A</u>		1. Over 90% wetland, including large expanses of salt marshes, and estuarine biological communities. (moderate sensitivity) 2. Long river crossing 3. Much more costly due to tower and foundation conditions and corridor length. 4. Aesthetic impacts to Ft. Caroline National Monument.
<u>B'</u>	1. Large amount of pine flatwoods (low sensitivity area) 2. Existing ROW present	1. Relatively large hardwood swamp component (high sensitivity)
<u>B</u>	1. Large amount of pine flatwoods.	1. Large amount of salt marsh (moderate sensitivity), higher cost. 2. Large amount of residential area (moderate sensitivity)
<u>C'D</u>	1. Contains large amounts of pine flatwoods 2. ROW present	1. Contains large amount of hardwood swamp
<u>CD</u>	1. Large amounts of pine flatwoods and sandhill communities (low sensitivity) 2. ROW present	1. Large amounts of hardwood swamp and salt marshes. 2. Higher cost

Table 9.6-1 (Continued)
ENVIRONMENTAL ASSESSMENT OF ALTERNATIVE
TRANSMISSION LINE CORRIDORS - TERRESTRIAL ECOLOGY a
(Figure 9.6-2)b

I. Robinwood Substation from Plant

<u>Corridor Segment^c</u>	<u>Advantages</u>	<u>Disadvantages</u>
<u>E'</u>	1. Large amount of pine flatwoods	1. Over 75% hardwood swamp. 2. Higher cost
<u>E</u>	1. Large amount of pine flatwoods 2. ROW present	1. Approximately 55% hardwood swamp; some fresh water marsh and hammock (moderate sensitivity)
<u>G</u>	1. Large amounts of agricultural and upland biological communities 2. Small overall amount of wetlands and estuaries 3. ROW present	1. Area is approximately 10% hardwood swamp. 2. Higher population density.
<u>G'</u>	1. Larger acreages of upland biological communities	1. Wetlands total 20% of area, including areas of hardwood swamp, swamp hammock, cypress pond, fresh water marsh, rivers, streams and salt marshes. 2. Wetland areas include more estuary crossings. 3. Higher cost
<u>H</u> (Northern Half)		1. More wooded wetland crossings.
<u>H</u> (Southern Half)	1. ROW present	1. Small area zoned medium population density (very low current density)

Table 9.6-1 (Continued)
ENVIRONMENTAL ASSESSMENT OF ALTERNATIVE
TRANSMISSION LINE CORRIDORS - TERRESTRIAL ECOLOGY a
(Figure 9.6-2)b

I. Robinwood Substation from Plant

<u>Corridor Segment</u> c	<u>Advantages</u>	<u>Disadvantages</u>
I	1. Large areas of low sensitivity agricultural and upland habitats 2. Shorter	
I'	1. ROW and aesthetic impacts present 2. Large areas of low sensitivity upland and agricultural lands	
J	1. ROW present 2. Large area of low sensitivity upland acreage (pine flatwoods)	
J'		1. More wetlands in corridor. 2. Local high population densities.

- a Ft. Caroline Substation is in the preferred corridor to Robinwood and therefore not considered separately.
b Reference figure
c The preferred corridor segment is underscored.

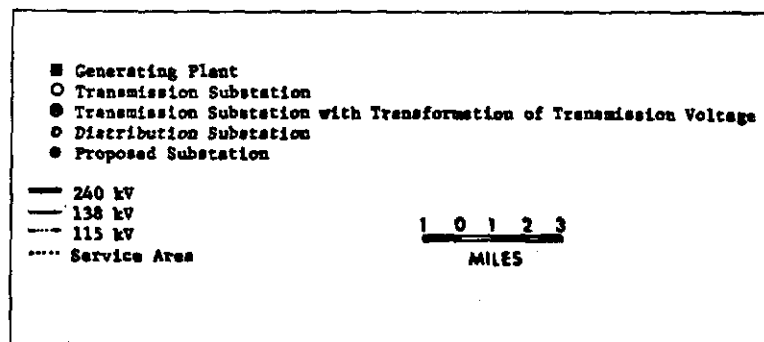
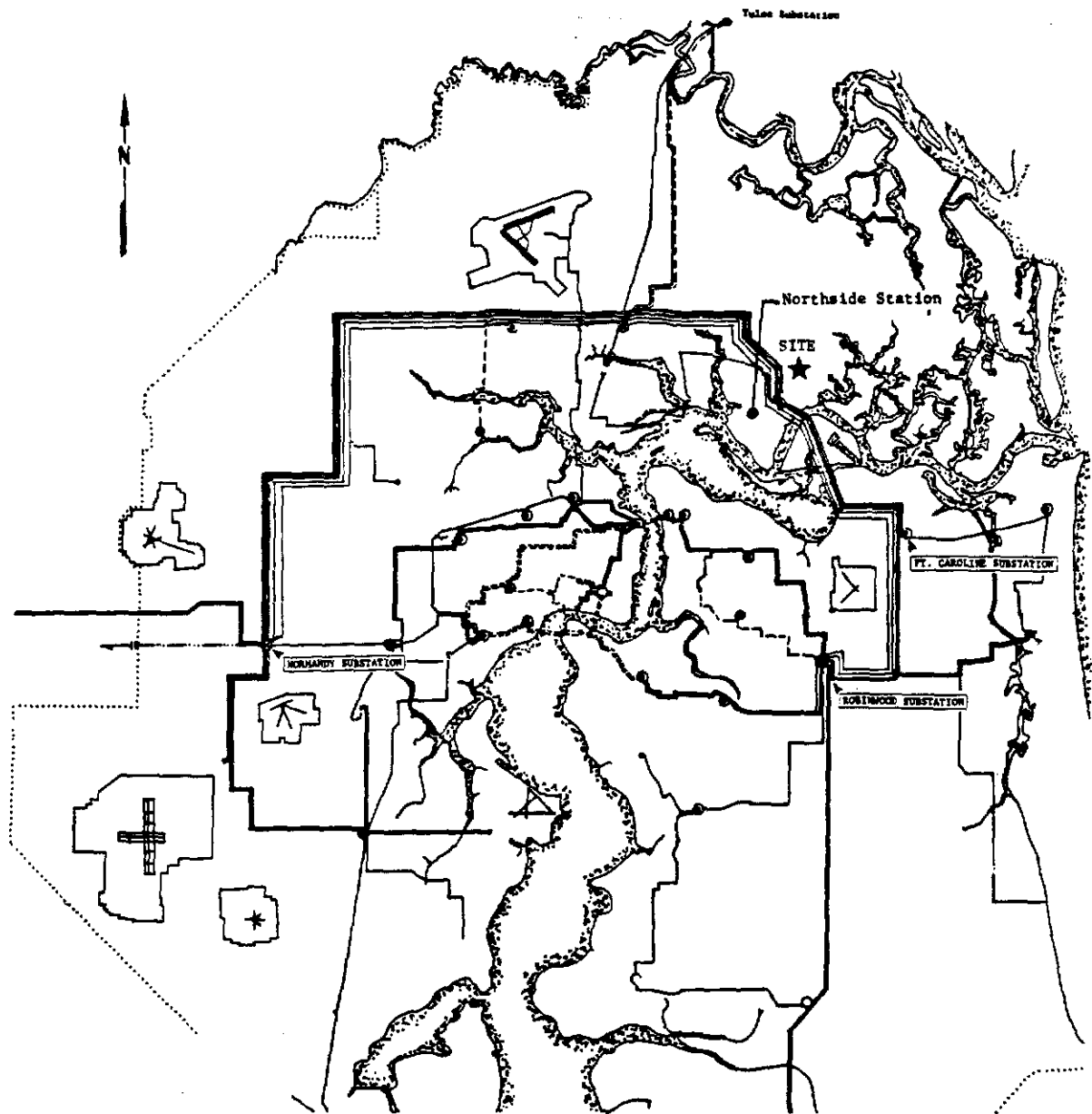


Figure 9.6-1 Existing Transmission System

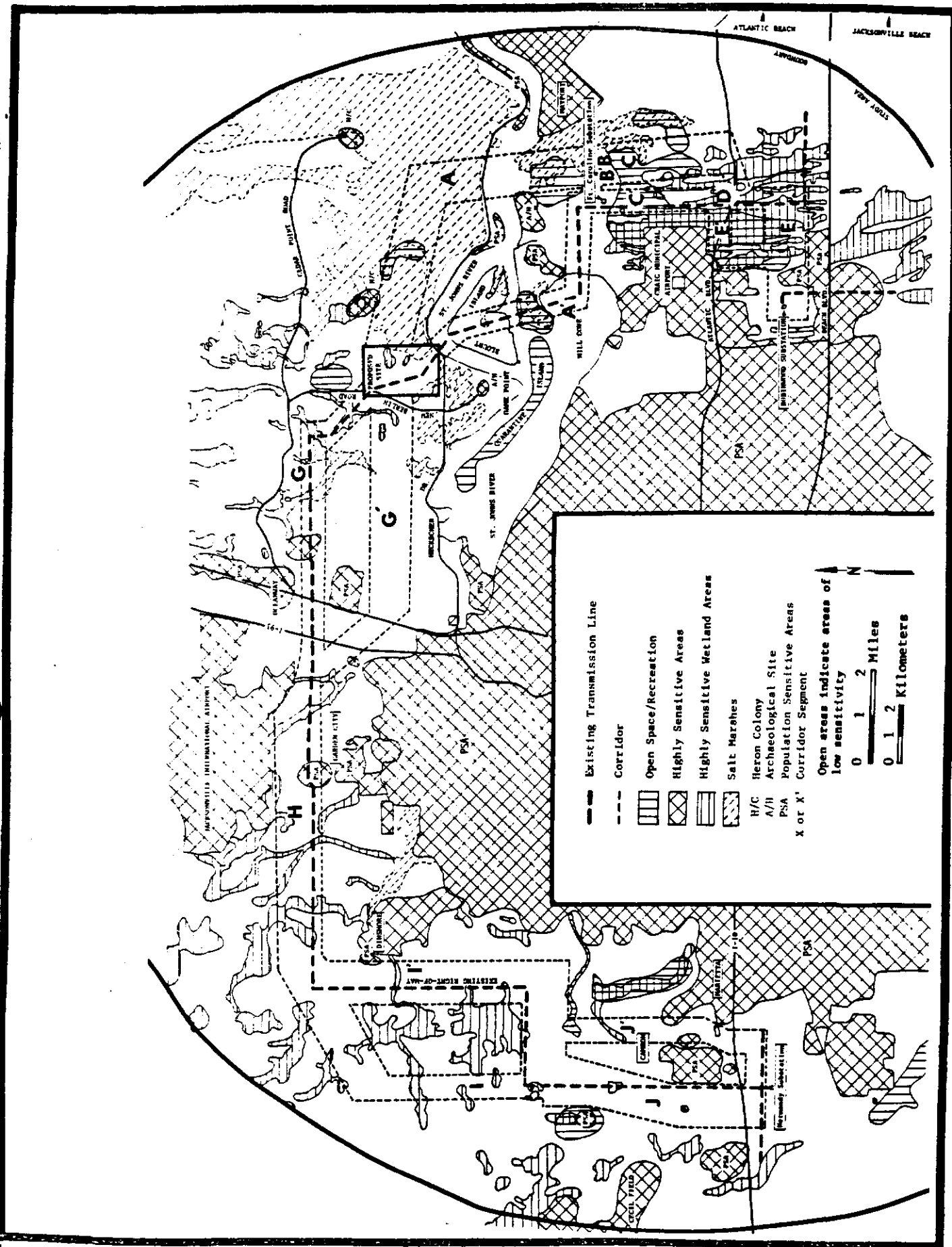


Figure 9.6-2 Sensitive Areas in Study Area

9.7 PLANT LOCATION AND LAYOUT AT THE PROPOSED SITE

9.7.1 Design Objectives and Regulatory Requirements

The design objectives with regard to plant location and layout at the site include making maximum use of existing facilities at the adjacent Northside units, minimizing necessary earthwork, and considering such environmental factors as interaction of cooling tower and stack plumes, cooling tower drift deposition on critical project components and sensitive vegetation areas, avoidance of wetlands, existing land use, aesthetics, noise, and groundwater and surface water contamination potential. Federal regulatory requirements directly applicable to plant location and layout considerations within the proposed site are: the Rivers and Harbors Act of 1899; Section 404 of the Federal Water Pollution Control Act Amendments of 1972, which requires that permits be obtained from the U.S. Army Corps of Engineers for filling of wetlands; the Marine Protection, Research and Sanctuaries Act of 1972; and Executive Orders 11988 and 11990, which concern floodplain management and which direct federal agencies to minimize the destruction, loss or degradation of wetlands, respectively. In addition, the Florida Departments of Natural Resources and Environmental Regulation regulate certain activities in wetlands and submerged lands through rules contained in Chapters 161, 253, 258 and 403 of the Florida Statutes. The Section 404 Clean Water Act permitting process is carried out jointly by the Florida Department of Environmental Regulation and the U.S. Army Corps of Engineers.

9.7.2 Plant Location Alternatives

9.7.2.1 Plant Island

Several alternative locations were considered for the plant at the proposed site. The two primary alternatives for the plant area are depicted in Figures 9.7-1 and 9.7-2. These alternatives were evaluated

on the basis of the factors identified in the previous section. These evaluations led to the conclusion that scheme A (Figure 9.7-1) was the preferred alternative. The primary reasons for this selection were the greater impact on wetlands associated with scheme B (Figure 9.7-2), particularly the disruption of the stream that would be associated with this plan.

9.7.2.2 Ship Coal Unloading Facility

Alternate locations were also considered for the ship coal unloading facility at the proposed site. These include Dunn's Terminal, Dame Point and Blount Island and are depicted in Figure 9.7-3. The environmental advantages and disadvantages of these alternatives are summarized in Table 9.7-1. Based on this information and cost considerations (including estimates for land acquisition, construction, cost of railroad or conveyor, operation and maintenance), the Blount Island unloading option is the preferred alternative.

9.7.3 Plant Layout Alternatives

The proposed plant layout is depicted in Figure 9.7-4. This plant layout is associated with the standard/reference plant concept on which the project is based; therefore, limited consideration was available to major alternative layouts. Continuing economic and environmental optimization of this proposed layout will likely require only minor revisions.

Table 9.7-1

ENVIRONMENTAL ASSESSMENT OF ALTERNATIVE COAL UNLOADING FACILITY LOCATIONS

<u>Site</u>	<u>Advantages</u>	<u>Disadvantages</u>
Dames Point		1. Destruction of 1300 foot linear of tidal flat. 2. Extensive dredging and spoiling would be required. 3. Possible damage to wetlands from construction of a railroad spur.
Dunn's Terminal	1. Presently bulkhead - eliminate some construction impact	1. Densities and type of benthic fauna are less depressed than the other sites under consideration. 2. Dunn Creek may be expected to have spawning/nursery ground characteristics as other tidal creeks studied in the immediate area, i.e., Brown's and San Carlos Creeks. 3. Extensive dredging and spoiling would be required.
Blount Island	1. No important spawning or nursery grounds habitat for commercially important species 2. Depressed benthic macro-invertebrate fauna 3. Blount Island previously has been designated as spoil site	1. Extensive dredging and spoiling would be required.

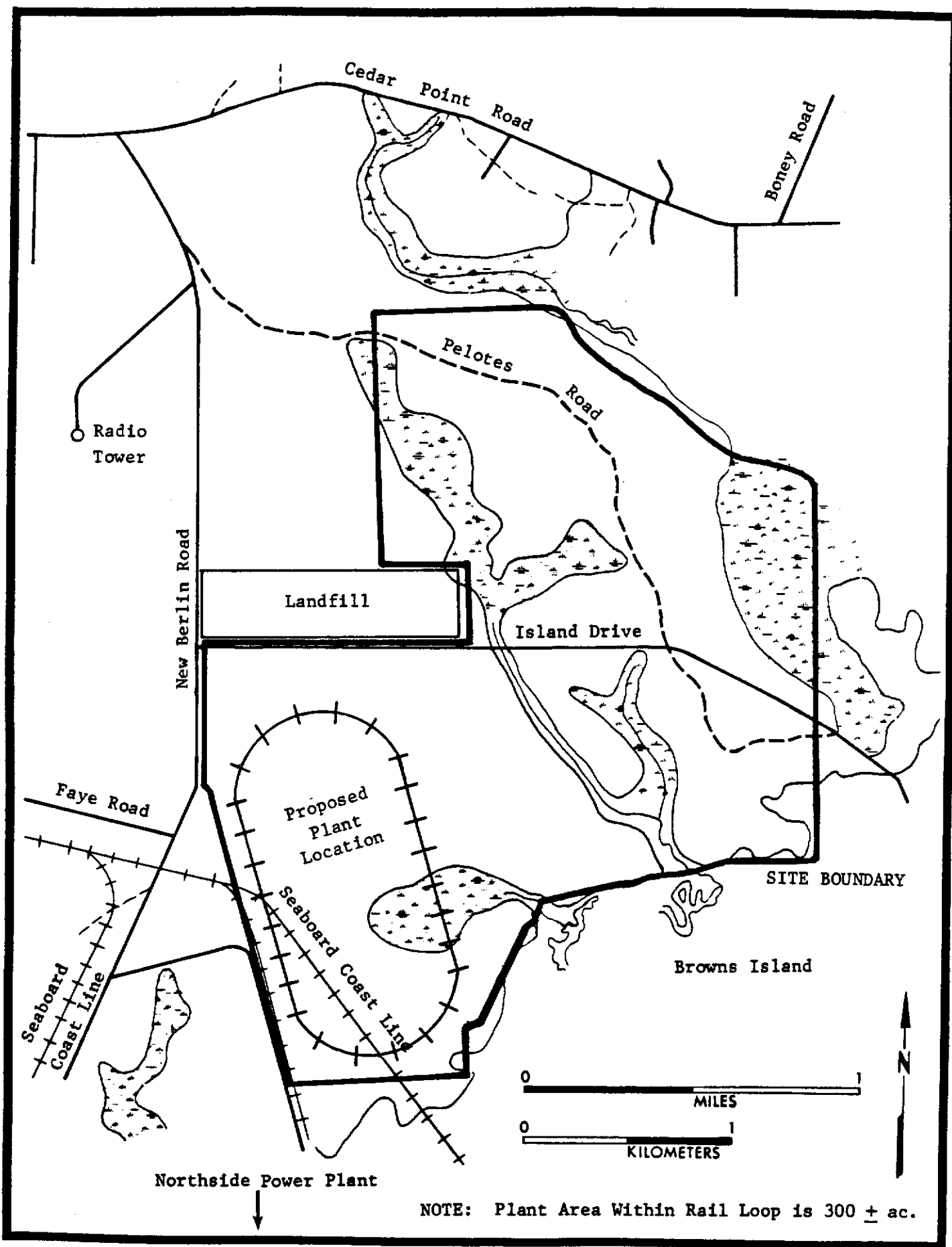


Figure 9.7-1

Plant Location - Scheme A

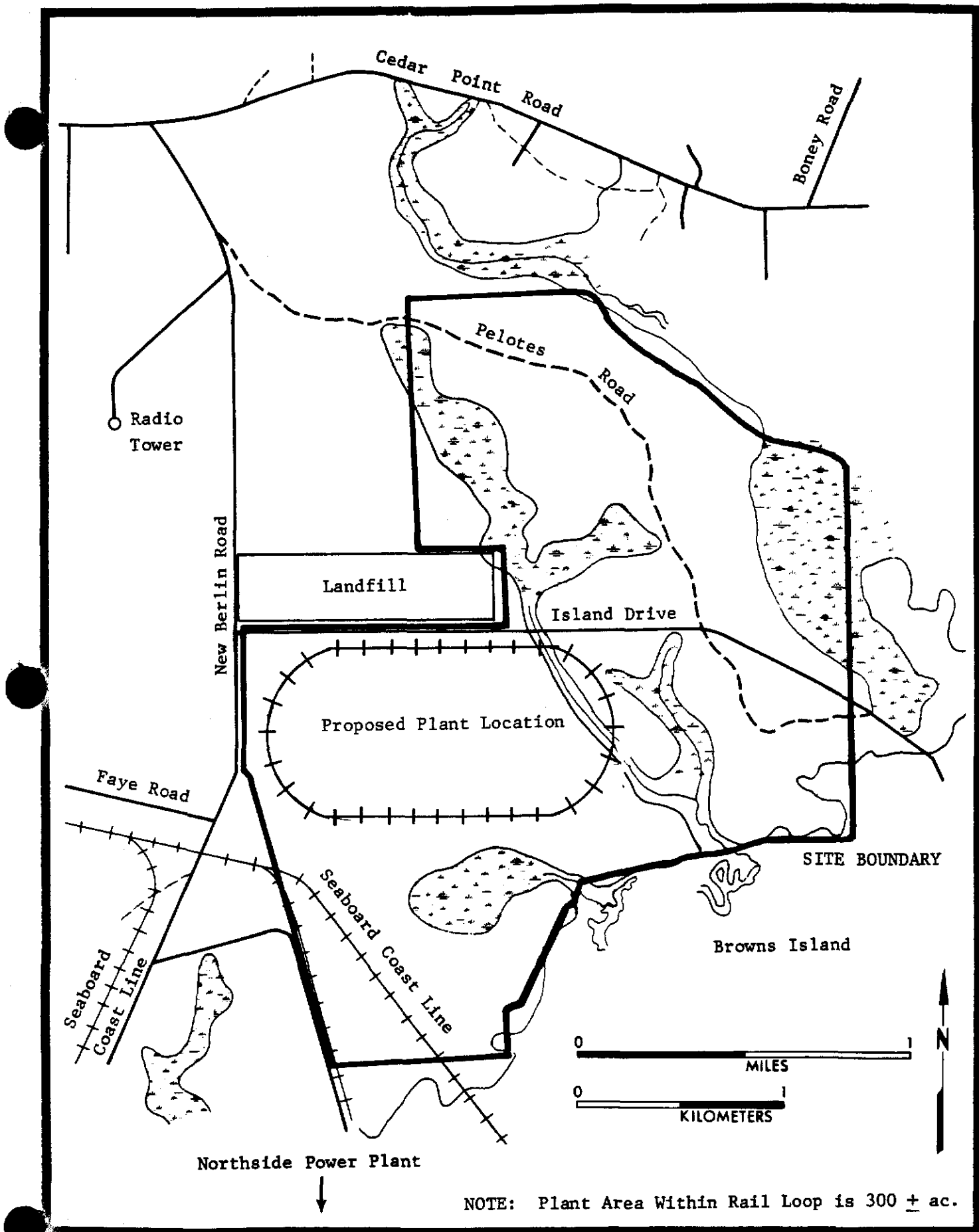


Figure 9.7-2 Plant Location - Scheme B

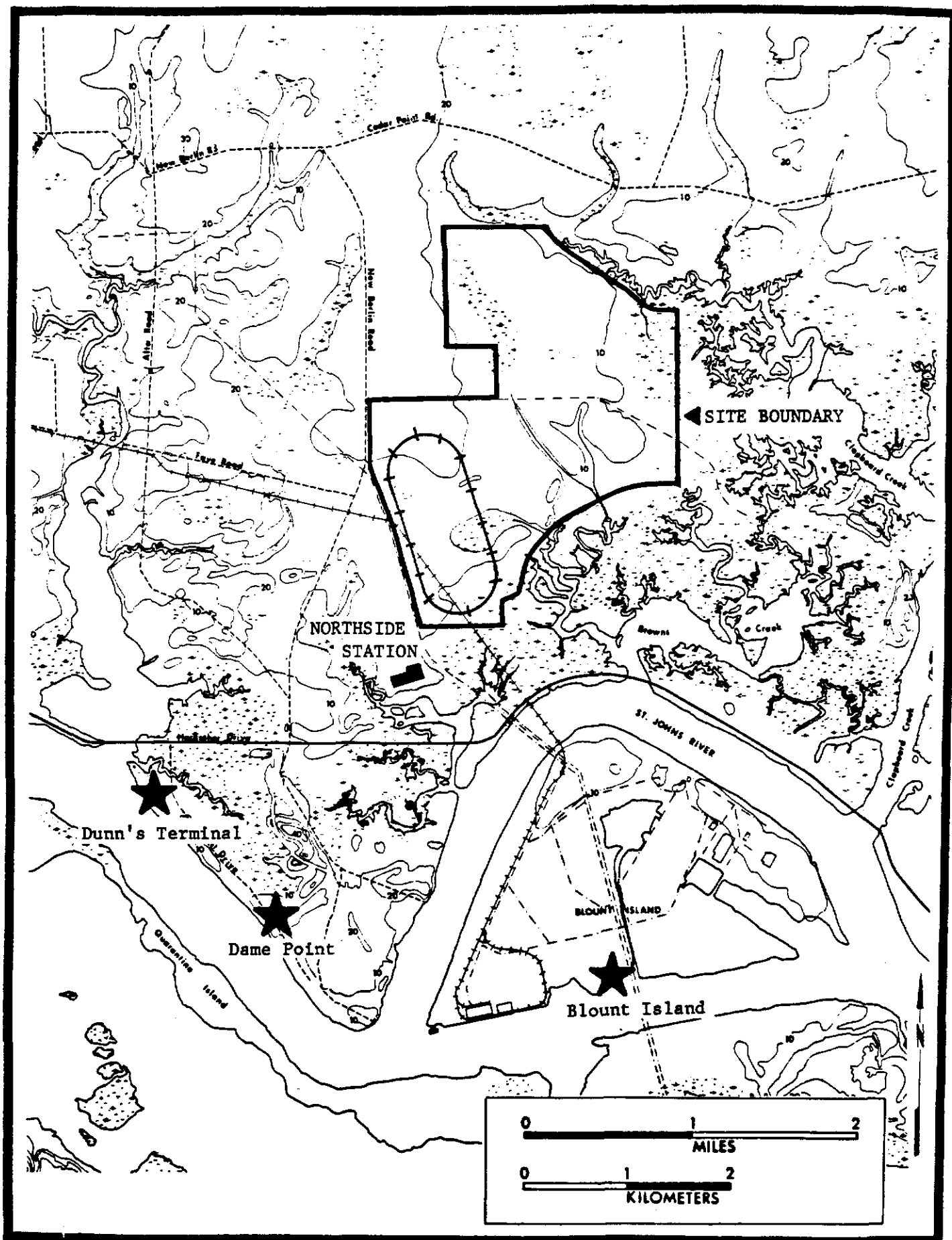


Figure 9.7-3 Alternate Coal Unloading Facility Locations

9.8 COAL HANDLING SYSTEMS

9.8.1 Design Objectives and Regulatory Requirements

The coal handling systems are designed to remove the coal from the rail and ship/barge coal delivery systems, convey it either directly to the units or active or inactive storage, reclaim it from active or inactive storage, and convey it to the in-plant silos. Design considerations include consideration of both rail and barge delivery, unloading time, reclaim time, fugitive dust control, fire protection, sampling technique, storage quantities, size and shape of storage piles, use of different types and grades of coals, and regulatory constraints. The applicable regulatory requirements which enter into the consideration of the coal handling system alternatives are the BACT requirements of both federal and state PSD regulations with respect to fugitive dust, control of coal pile runoff under the NPDES regulations, and the dredge and fill requirements with respect to the ship/barge unloading facility.

9.8.2 Existing and Committed Facilities

There are no coal delivery or coal handling facilities associated with the proposed project which are in existence or which have been committed to at this time. However, an existing line of the Jacksonville Port Authority Municipal Docks Railway (which connects with the Seaboard Coastline Railroad) runs through the southwestern portion of the site and could be used to transport coal to the site. The Southern Railroad would be unable to serve the site as a single-line carrier, but could serve it through negotiation of a joint tariff with the Seaboard Coastline. Barge and ocean collier delivery of coal to the site is possible due to the presence of the St. Johns River with its 38-foot draft channel in the vicinity of Blount Island.

9.8.3 Requirements for New Facilities

New coal delivery and coal handling facilities will be required to transport approximately 3,500,000 tons per year during peak years of generation. The on-site reserve storage capacity should equal about 120-day supply. This capacity is conservatively estimated at 1,150,000 tons, which would cover about 30 acres assuming an average pile depth of 40 feet. The volume of active storage should equal a three-day supply of coal. This is approximately 39,000 tons, which would cover about 8 acres to a depth of 40 feet.

Various alternative coal handling facilities were evaluated with respect to providing these quantities of coal and meeting the coal storage requirements in a cost-effective and environmentally acceptable fashion in a coal handling system study (Ebasco, 1980). These alternatives and the preferred systems are described in the following section.

9.8.4 Coal Handling System Alternatives

In accomplishing the study, six primary coal handling systems approaches were investigated. Each of these primary systems is based on rail-borne coal transport, which is the primary means of coal delivery. Three rail car unloading systems were investigated:

- . Trestle unloading (using rapid discharge bottom dump cars)
- . Bottom dump pit unloading (using rapid discharge bottom dump cars)
- . Rotary dumper unloading (using flat bottom "bathtub" gondola cars designed for rotary dumping)

Two active storage systems were investigated:

- . Reclaim by rotary plow feeder with stackout by trestle or twin boom stacker.
- . Reclaim by bucket wheel stacker-reclaimer with stackout by trestle or stacker-reclaimer.

The six optional primary systems are as listed below:

<u>Option Number</u>	<u>Unloading Method</u>	<u>Stackout Method</u>	<u>Reclaim Method</u>
I	Rotary Dumper	Stacker-Reclaimer	Stacker-Reclaimer
II	Dump Pit	Stacker-Reclaimer	Stacker-Reclaimer
III	Rotary Dumper	Boom Stacker	Rotary Plow
IV	Dump Pit	Boom Stacker	Rotary Plow
V	Trestle	Trestle	Rotary Plow
VI	Trestle	Trestle	Stacker-Reclaimer

In addition to the six primary systems, three secondary systems for unloading water borne coal were investigated.

These secondary systems are listed below:

<u>Option Number</u>	<u>Description of System</u>
VII	Continuous bucket ladder barge unloader/overland conveyor to plant
VIII	Receiving bin for self-unloading barge or ship/overland conveyor to plant
IX	Barge/ship unloader/overland conveyor to plant

All three of these secondary system options would be sited on Blount Island, with overland conveyor delivery to the plant site. A fourth approach involving a separate terminal for water-borne coal transport to rail-borne coal transit transfer was also explored.

As indicated above, these options were evaluated on the basis of engineering feasibility, cost and environmental acceptability. However, all systems appear to be feasible from an engineering standpoint, and the dust control systems discussed in Chapter 3, Section 3.8.2 of this report would make each alternative essentially equivalent from an environmental standpoint, with a few exceptions. Hence, the primary consideration in evaluating the alternatives is cost, with energy consumption included as a cost.

The order of magnitude estimates of capital and operating costs for each of the options investigated are summarized in Table 9.8-1. Two unit train coal delivery rates were considered. Plan A provides for 900,000 tons per year by unit train. Plan B provides for 1,800,000 tons per year by unit train. Both plans call for 650,000 tons per year of spot coal delivered in trainload lots of random, railroad owned cars.

Option II, (which utilizes bottom dump pit unloading of rapid-discharge coal cars and stacker-reclaimer active storage of coal) is estimated to be the least expensive of the primary system options studied, based on coal handling system costs alone. If rail cars are purchased for unit trains, as this is the most economic approach, then the cost of using the more expensive rapid discharge coal cars which are required with Option II would tend to offset the estimated systems cost differential between Option II and the next most expensive alternative, Option I (which utilizes rotary dumper unloading of the less expensive "bathtub" type cars, and stacker-reclaimer active coal storage).

It is planned to purchase about 650,000 tons of coal per year on the spot market with shipment in trainload lots of random cars. Based on past experience, some gondola cars and some hopper cars with inoperative doors will occasionally be delivered, under these circumstances. A rotary dumper would be required to unload these cars in a timely manner. Therefore, to minimize cost yet retaining a flexible system, Option I is preferred.

The capital and annual costs associated with Options VII, VIII and IX (the secondary systems) are summarized in Table 9.8-2. Option VII is the least expensive of the three. However, as indicated earlier, consideration has been given to the construction of a terminal to permit transfer of coal from ships or barges to rail transit. The terminal would be located on Jacksonville Port Authority (JPA) property on Blount Island. From the terminal, the coal could be transported by rail, using the Port Authority rail spur to the plant site. Because of the high costs and attendant potential right-of-way and environmental problems which are associated with the long, overland conveyor in Options VII, VIII and IX, the fourth alternative (ship/barge unloading on Blount Island with shuttle train transport to the plant site) is the preferred alternative.

9.8.5 Preferred Alternatives

Option I (rotary dumper with stacker-reclaimer) is preferred as the primary coal handling system for unloading (from rail cars), storing, reclaiming, processing, and delivering coal to the coal silos in the new JEA power plants. Further, it is preferred that the barge/ship unloader be utilized as the secondary coal handling system for unloading from ships and barges, combined with shuttle train rail delivery to the plant.

9.8.6 Reference

Ebasco Services Incorporated, 1980. Coal Handling System Study, Prepared for the Jacksonville Electric Authority. Norcross, Georgia.

Table 9.8-1

COAL HANDLING SYSTEM STUDIES
PRIMARY SYSTEMS COST COMPARISON
(\$1000)

Option Number	I	II	III	IV	V	VI
1) Unloading Method	Rotary Dumper	Dump Pit	Rotary Dumper	Dump Pit	Trestle	Trestle
2) Stackout Method	Stacker-Reclaimer	Stacker-Reclaimer	Boom Stacker	Room Stacker	Trestle	Trestle
3) Reclaim Method	Stacker-Reclaimer	Stacker-Reclaimer	Rotary Plow	Rotary Plow	Rotary Plow	Stacker-Reclaimer
4) Total Initial Capital Charges (a)	88,061	83,431	94,431	89,245	102,982	93,692
5) Fixed Charges	9,784	9,269	10,519	9,915	11,441	10,409
6) Annual Plant Operating Cost (b)	4,932	4,431	5,047	4,717	4,167	4,268
7) Annualized Plant Cost (c)	14,716	13,700	15,566	14,632	15,608	14,677
8) Rail Adjustment (Plan A/Plan B) (d)	4,132/ 7,457	4,601/ 8,336	4,132/ 7,457	4,601/ 8,336	4,601/ 8,336	4,601/ 8,336
9) Total Annual Cost (e)	18,848/22,173	18,301/22,036	19,698/23,023	19,233/22,968	20,209/23,944	19,278/23,013
10) Differentials (Plan A/Plan B)	547/Base	Base/Base	1,397/ 987	932/ 932	1,908/1,908	977/ 977

(a) Includes material, installation, indirects, services, escalation, interest during construction, contingency and capacity charges.

(b) Includes operating labor cost, maintenance cost, and energy cost on average operating horsepower.

(c) Includes both the fixed charges and the annual operating cost (Items 6 and 7)

(d) Annual costs associated with unit train ownership. Plan A ships 27% of coal by unit train; Plan B ships 54% by unit train

(e) Plant cost and unit train costs for both Plan A and Plan B.

Table 9.8-2

COAL HANDLING SYSTEM STUDIES
SECONDARY SYSTEMS COST COMPARISON
(\$1000)

1) Option Number	VII		VIII		IX	
	Unloading Method		Self Unload Ship		Ship/Barge Unloader	
2) Unloading Method	Barge Unloader		Self Unload Ship		Ship/Barge Unloader	
3) Total Initial Capital Charges (a)	44,792		62,758		71,912	
4) Fixed Charges	4,977		6,972		7,912	
5) Incremental Annual Plant Operating Cost (b)	2,163		3,359		3,409	
8) Annualized Plant Cost (c)	7,140		10,331		11,321	
9) Differentials	Base		3,191		4,181	

- (a) Includes material, installation, indirects, services, escalation, interest during construction, contingency and capacity charges.
 (b) Includes operating labor cost, maintenance cost, and energy cost on average operating horsepower.
 (c) Sum of Items 4 and 5.