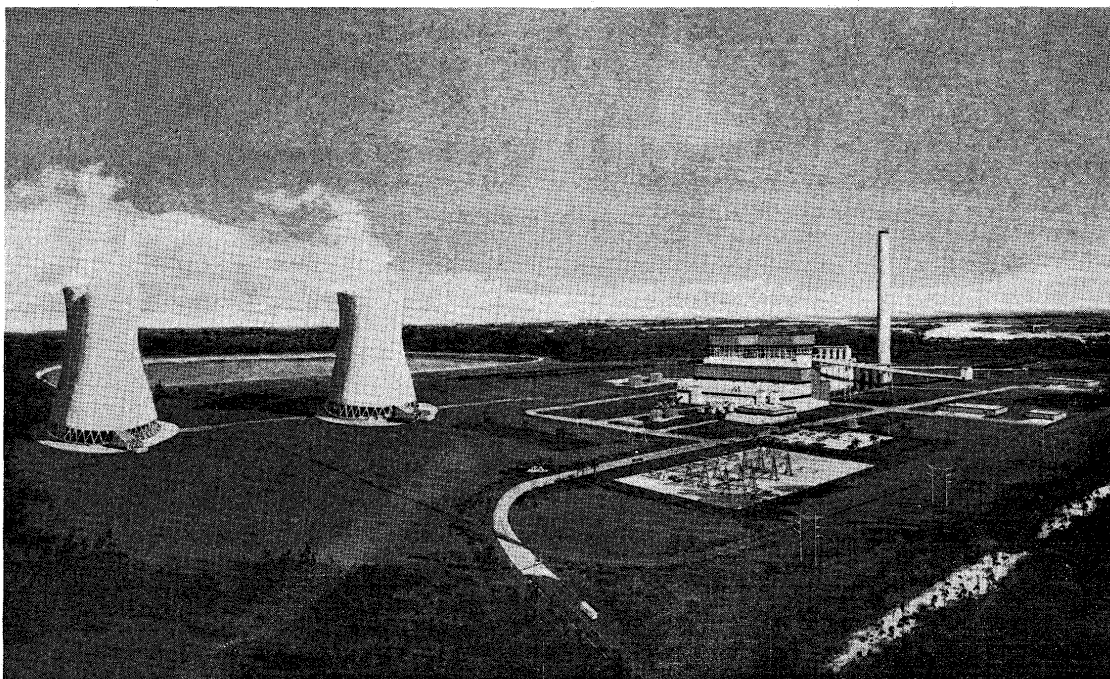




**SITE CERTIFICATION APPLICATION
ENVIRONMENTAL INFORMATION DOCUMENT**

**FOR
JACKSONVILLE ELECTRIC AUTHORITY
ST. JOHNS RIVER POWER PARK
UNITS 1 & 2
1985-1987
VOLUME 2**



envirosphere company

A Division of EBASCO SERVICES INCORPORATED
145 TECHNOLOGY PARK/ATLANTA
NORCROSS, GEORGIA 30092

1981



JACKSONVILLE
ELECTRIC
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POWER PARK

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VOLUME 2



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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:

	<u>Combined Operation (Average Case)</u>	<u>Combined or Proposed Plant Alone Operation (Maximum Case)</u>
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 buoyant 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

<u>Waste Streams and Pollutants</u> ^b	<u>Maximum</u> ^e <u>(mg/l)</u>	<u>Average</u> ^f <u>(mg/l)</u>
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 5b	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 PODe	Maximum Ambient ^d	Case ^c PODe
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 Case ^b		Maximum Case ^c	
		Ambient ^d	POD ^e	Ambient ^d	POD ^e
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)
INFLUENCE OF ST. JOHNS RIVER MIXING ZONES ON CHEMICAL PARAMETERS
ESTIMATED TO EXCEED CLASS III STANDARDS AT POINT OF DISCHARGE

Parameter	Class III Standard	Ambient Conc.d	Average Case ^b			Maximum Case ^c		
			Estimated POD Conc.e	Mixing Zone Concentration at M.Z. Boundary ^f	Area Req'd ^g (Acres)	Estimated POD Conc.e	Mixing Zone Concentration at M.Z. Boundary ^f	Area Req'd ^g (Acres)
Aluminum, mg/l	1.5	0.49	0.5	g	g	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	22,617i	21,011
Chlorine, Total Residual, mg/l	0.01	0.04	1,j	1,j	1	0.2	1,j	1
Copper, mg/l	0.015	0.069	0.073	0.0705 0.0699 0.0699 0.0696h	0.13 0.7 2.9 31	0.275j	0.3j	0.285 0.283 0.282 0.282j
Cyanide, mg/l	0.005	0.01	0.01	0.01h	h	0.09j	0.099j	0.092 0.091 0.091 0.091j
Iron, mg/l	0.30	0.80	0.83	0.808 0.806 0.805 0.801h	0.13 0.7 2.9 31	2.7j	3j	2.76 2.74 2.73 2.73j
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
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	Ambient Conc. ^d	Average Case ^b			Maximum Case ^c		
			Estimated POD Conc. ^e	Mixing Zone Concentration at M.Z. ^f	Influence Area Req'd ^f (Acres)	Estimated POD Conc. ^e	Mixing Zone Concentration at M.Z. ^f	Influence Area Req'd ^f (Acres)
Selenium, mg/l	25	0.5	15	8	8	473	13.5	0.19
				0.173	0.13		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
Silver, ug/l	0.05	0.16	0.21					

- 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 5.1-9
INFLUENCE OF ST. JOHNS RIVER MIXING ZONES ON CHEMICAL PARAMETERS
ESTIMATED TO EXCEED CLASS III STANDARDS AT POINT OF DISCHARGE

Parameter	Class III Standards	Ambient Conc. d	Average Case ^b				Maximum Case ^c			
			Mixing Zone Influence		Percent		Mixing Zone Influence		Percent	
			Estimated POD Conc. e	Above Ambient	Req'd f (Acres)	Ambient Conc. d	Estimated POD Conc. e	Above Ambient	Req'd f (Acres)	
Aluminum, mg/l	1.5	0.49	0.51	(g)	(g)	3.63	4.41 ⁱ	22	0	
								4.1	0.65	
								2.9	3.3	
								2	31	
Chlorides, mg/l	10% increase above background	13,011	13,630	(g)	(g)	20,400	24,776 ⁱ	20	0	
								4.7	0.3	
Copper, mg/l	0.015	0.069	0.073	6	0	0.275	0.344 ^j	25	0	
				1	0.4			4.8	0.65	
								3.4	3.3	
								2	31	
Cyanide, mg/l	0.005	<0.01	0.01	0	(h)	0.09	0.109 ⁱ	21	0	
								4.1	0.65	
								2.9	3.3	
								2	31	
Iron, mg/l	0.30	0.80	0.84	5	0	2.7	6.5 ^j	141	0	
				1	0.4			27	0.65	
								19	3.3	
								11	31	
Mercury, ug/l	0.10	0.24	0.28	17	0	0.6	0.86 ^{i,j}	43	0	
				3.8	0.4			8.3	0.65	
				2.2	6.0			5.9	3.3	
								3.5	31	
Oil and grease, (dissolved), mg/l	5.0	2.0	2.1	(g)	(g)	9.0	10.8 ⁱ	20	0	
								3.8	0.65	
								2.7	3.3	
								1.5	31	
Silver, ug/l	0.05	0.16	0.17	6	0	0.35	0.43 ⁱ	23	0	
				1.5	0.4			4.4	0.65	
								3.1	3.3	
								2	31	

a See Table 2.5-1
b Average case used mode 2 Northside Station flow conditions and zero material handling, storage and disposal area discharge and mean ambient water quality.
c Maximum case used mode 4 Northside Station flow conditions and 1,000 gpm 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 percent levels above ambient.
g At or below Class III Standard at POD; therefore, no mixing zone required.
h At ambient concentrations at POD; therefore, no further decrease possible through mixing with ambient.
i Without material handling, storage and disposal area discharge.
j With material handling, storage and disposal area discharge.

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 of</u>		
		<u>Maximum</u>	<u>Average</u>	<u>Minimum</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, BY MONTH,
DURING COMBINED OPERATION OF THE PROPOSED PLANT WITH NORTHSIDE STATION AND NORTHSIDE STATION ALONE, UNDER AVERAGE CONDITIONS^b

Approximate POD Temperature °F		Average ^c Ambient Temperature °F	Plume Extent (Acres) ^{d,e}		Maximum Plume Width (ft.) at 1 Meter ^{e,f}		
Month	Combined Operation	20° Isotherm Combined Operation	40° Isotherm Combined Operation	Northside Alone	2° Isotherm Combined Operation	4° Isotherm Combined Operation	Northside Alone
January	71.3	59.5	0.00	0.00	70	56	
February	68.5	57.1	0.00	0.00	62.5	51	
March	72.0	61.8	0.00	0.00	50	30	
April	80.8	70.8	0.00	0.00	48	48	
May	87.0	76.5	0.00	0.00	61	61	
June	90.2	79.6	1.29	1.56	229	249	
July	95.5	83.6	2.18	3.10	287	337	
August	96.6	84.0	2.80	3.99	323	379	
September	97.8	82.7	5.86	8.29	454	536	
October	90.8	77.1	0.00	0.10	0.25	114	
November	78.7	70.9	0.00	0.00	0.07	95	
December	76.2	67.0	0.00	0.00	0.00	38	
						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 ^c		Estimated Concentration at Edge of 31 Acre Mixing Zone ^e		Toxicity Levels for Most Sensitive Reported Significant Indigenous Species ^f	
	Avg	Max		Avg ^c	Max ^d	Avg ^c	Max ^d	96 hrLC ₅₀ ^g	Acute ^h Chronic ⁱ
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 Chlone (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 17-4.24(1)(8), 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^a

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-embryo <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 <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-embryo <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 <u>Capitella capitata</u>	0.22 mg/l CdCl ₂ as Cd Reich 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 <u>Capitella capitata</u>	1.2 mg/l Pd(CH ₃ CO ₂) ₂ ·3H ₂ O as Pb Reich 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 5.1-13

DURING COMBINED OPERATION OF THE PROPOSED PLANT WITH NORTHSIDE STATION AND NORTHSIDE STATION ALONE, UNDER AVERAGE CONDITIONS^b

MAXIMUM PREDICTED MIXING ZONE ISOTHERM EXTENTS^a, BY MONTH,

Month	Approximate POD Temperature of	Average ^c Ambient Temperature of	Plume Extent (Acres) ^{d, e}				Maximum Plume Width (ft.) at 1 Meter ^{e, f}			
			20°F Isotherm Combined Operation	Northside Alone	40°F Isotherm Combined Operation	Northside Alone	20°F Isotherm Combined Operation	Northside Alone	40°F Isotherm Combined Operation	Northside Alone
January	74.7	59.5			0.00	0.00			94	56
February	71.5	57.1			0.00	0.00			87	51
March	74.5	61.8			0.00	0.00			68	0.0
April	82.1	70.8			0.00	0.00			64	48
May	88.4	76.5			0.00	0.00			71	61
June	91.6	79.6	2.17	1.56	0.00	0.00	287	249	72	62
July	97.1	83.6	3.42	3.10	0.00	0.00	352	337	88	84
August	98.1	84.0	4.33	3.99	0.01	0.00	393	379	98	95
September	99.5	82.7	9.43	8.29	0.33	0.25	571	536	143	134
October	92.6	77.1			0.12	0.07			116	109
November	80.6	70.9			0.00	0.00			40	0.0
December	78.8	67.0			0.00	0.00			58	0.0

- ^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
COMPARISON OF PREDICTED ALUMINUM, IRON, COPPER, CYANIDE, MERCURY AND SILVER 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 ^c		Estimated Concentration at Edge of 31 Acre Mixing Zone ^e		Toxicity Levels for Significant Indigenous Species ^f	
	Avg	Max		Avg ^c	Max ^d	Avg ^c	Max ^d	96 hrLC ₅₀ &	Acute ^h / Chronic ⁱ
Cyanide (mg/l)	<0.01	0.09	0.005	0.01	0.11	0.01	0.09	0.05-0.07	0.016-0.022 j
Iron (mg/l)	0.80	2.7	0.30	0.84	6.5	0.81	3.0	25	8.5 1.3
Silver (ug/l)	0.16	0.35	0.05	0.17	0.43	0.16	0.36	~5.8k	~1.9 ~0.3
Copper (ug/l)	69	275	15	73	344	69.8	281	80	27 j
Aluminum (mg/l)	0.49	3.63	1.5	j	4.41	j	3.70	8.9-17.8	3.0-5.9 j
Mercury (ug/l)	0.24	0.6	0.1	0.28	0.86	0.24	0.62	~5.6k	~1.9 ~0.28

- 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.

Table 5.1-15
INDICATOR SPECIES AND SENSITIVITIES USED IN COMPUTING ACUTE AND CHRONIC TOXICITY CONCENTRATIONS
FOR CYANIDE, IRON, SILVER, COPPER, ALUMINUM AND MERCURY^a

Parameter	Indicator Species	Reported 96 hrLC ₅₀ Concentration	Reason for Selection
Cyanide	Pinfish <u>Lagodon rhomboides</u>	0.048-0.066 mg/l HCN as CN (Daugherty and Garrett, 1951)	Significant Indigenous Species ^b
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 - trochophored <u>Capitella capitata</u>	80 ug/l CuSO ₄ as Cu (Reish and Martin, 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

- ^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.

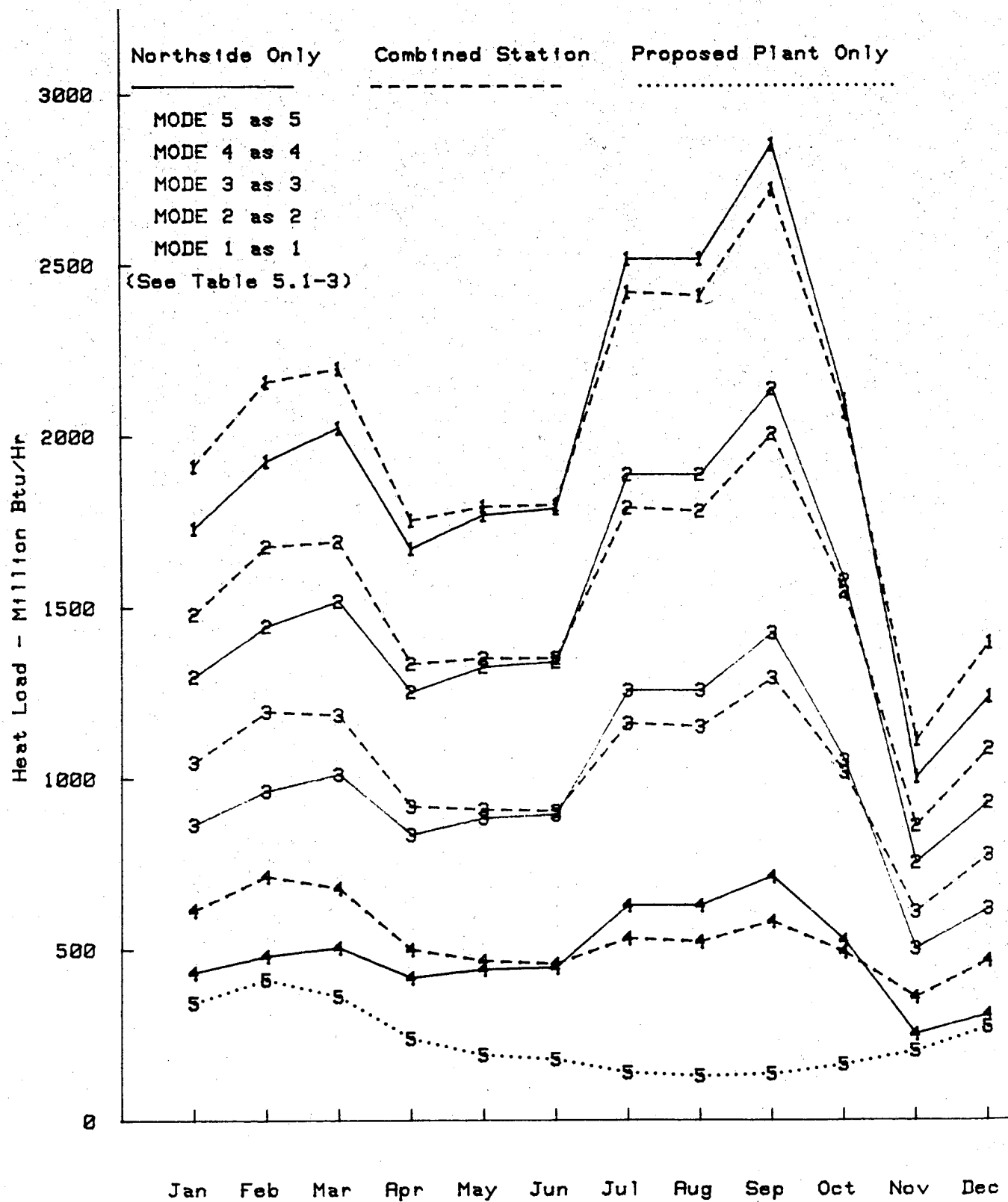


Figure 5.1-1

Heat Rejection Rate - Extreme Conditions

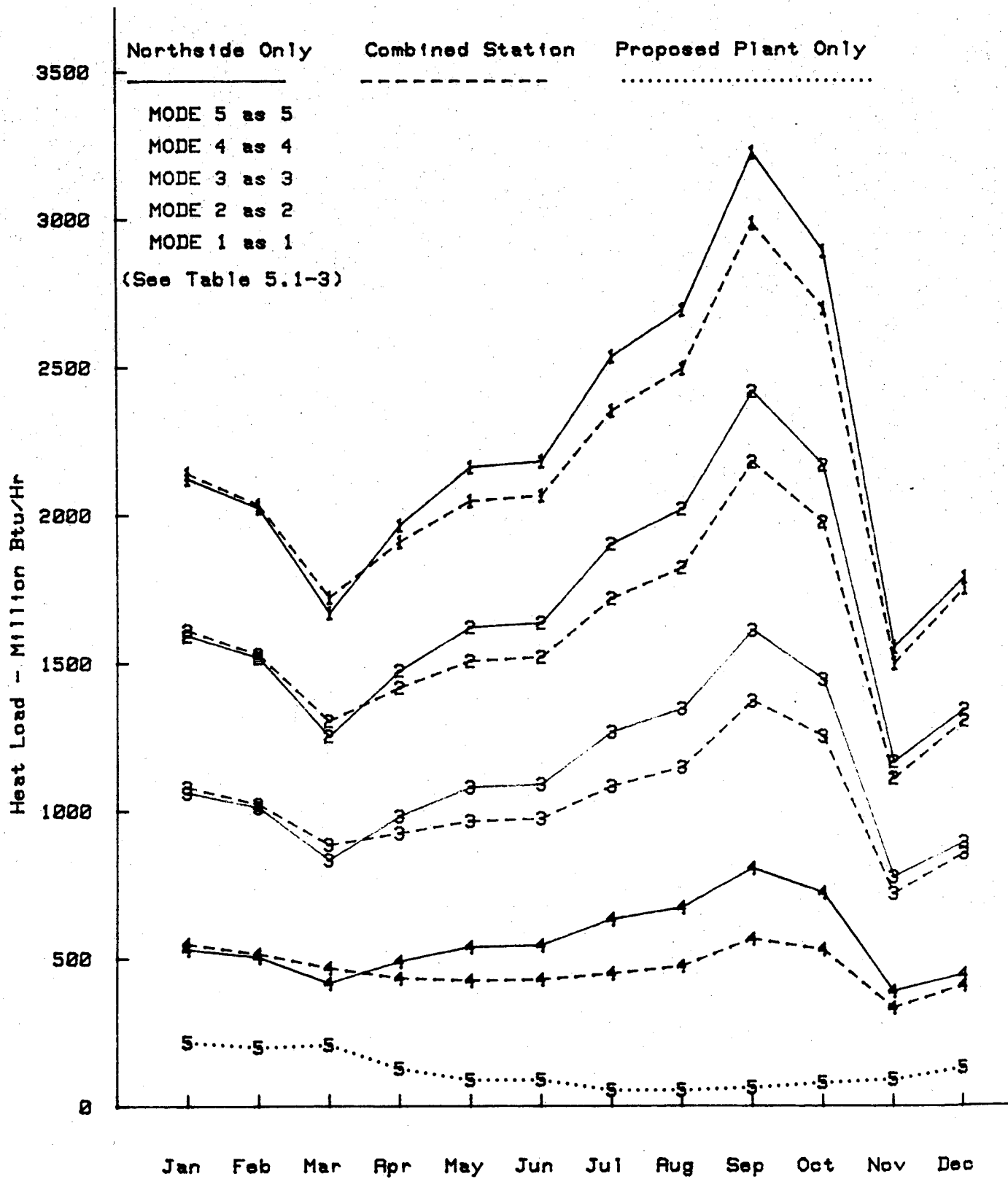
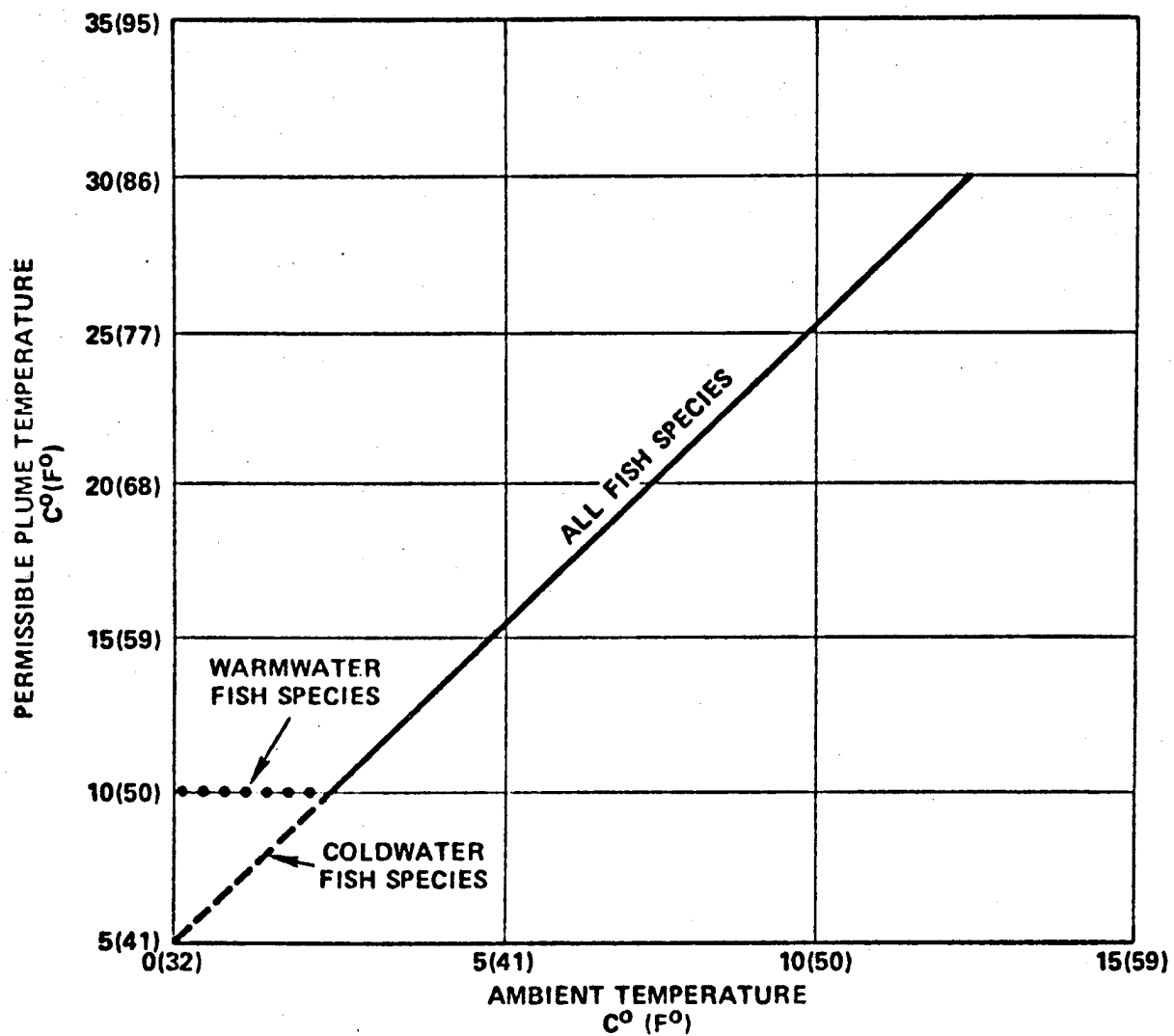


Figure 5.1-2 Heat Rejection Rate - Average Conditions



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 completed 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 Densities ^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%
	Winter		7.2	- 86	7.2	-55
	Spring		69.7	- 86	69.7	-55
	Summer		22.6	- 86	22.6	-55
Proposed Plant Plus Northside	Fall		12.1	0	30% 4.7	30% 11.1
	Winter		53.4	0	21.0	+32
	Spring		514.1	0	203.0	+32
	Summer		167.0	0	65.9	+32
Northside Alone	Fall	96	12.1		30% 3.6	90% 10.9
	Winter	423	53.4		16.0	48.1
	Spring	4071	514.1		154.2	462.7
	Summer	1322	167.0		50.1	150.3

a Entrainment measured at Northside from winter 1979 through summer 1980

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

c 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

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

e Projected seasonal mortality for proposed plant plus Northside at Y% = [(projected seasonal entrainment for proposed plant plus Northside) x (Y/100)] + [(projected seasonal entrainment for the proposed plant alone) x ((100-Y)/100)]

Table 5.2-3

SUMMER ZOOPLANKTON MORTALITIES ASSOCIATED WITH
POWER PLANT ENTRAINMENT

<u>Type</u>	<u>Organism</u> ^a	<u>% Mortality</u> ^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

<u>Mesozooplankton - (x 10⁹ organisms)</u>							
<u>Season</u>	<u>Estimated Number of Organisms Which Pass Through Blount Island Channel^a</u>	<u>Estimated Number of Organisms Lost During Northside Operation Alone^b</u>	<u>Estimated Number of Organisms Lost During Combined Operation^b</u>	<u>Estimated Number of Organisms lost During Proposed Plant Operation Alone^c</u>	<u>Estimated Percent Loss to Seasonal Channel Northside Alone</u>	<u>Combined Operation</u>	<u>Populations Proposed Plant Alone</u>
Fall	232.4	10.9	11.1	1.6	4.7	4.7	0.7
Winter	1,200.8	48.1	48.3	7.2	4.0	4.0	0.6
Spring	10,676.2	462.7	469.7	69.7	4.3	4.4	0.7
Summer	67,917.4	150.3	152.6	22.6	0.2	0.2	0.1
Annual	80,026.8	672.0	681.7	101.1	0.8	0.8	0.1
<u>Ichthyoplankton and Post-Larval Nekton (x 10⁶ organisms)</u>							
Fall	115.6	4.2	4.2	0.6	3.7	3.7	0.5
Winter	150.0	9.7	9.7	1.3	6.5	6.5	0.9
Spring	13,012.3	129.5	129.5	17.5	1.0	1.0	0.1
Summer	19,052.9	603.6	603.6	81.8	3.2	3.2	0.4
Annual	32,330.8	747.0	747.0	101.2	2.3	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 Density ^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
Proposed Plant Alone	Fall		0.6	-86	0.6	-77
	Winter		1.3	-86	1.3	-77
	Spring		17.5	-86	17.5	-77
	Summer		81.8	-86	81.8	-77
Proposed Plant plus Northside	Fall		4.2	0	60% 2.8	60% + 9
	Winter		9.7	0	6.3	+ 9
	Spring		129.5	0	84.7	+ 9
	Summer		603.7	0	394.9	+ 9
Northside Alone	Fall	33.5	4.2		60% 2.5	100% 4.2
	Winter	77.0	9.7		5.8	9.7
	Spring	1025.5	129.5		77.7	129.5
	Summer	4779.9	603.7		362.2	603.7

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 COMMERCIALLY IMPORTANT ICHTHYOPLANKTON DURING PROPOSED PLANT OPERATION

Species	Proposed Plant Alone		Proposed Plant plus Northside		Northside Alone	Percent of Commercial Species Currently Entrained by Northside Station	Percent of Total Ichthyoplankton Currently Entrained by Northside Station
	Annual Total ($\times 10^5$) ^a	Percent Change in Entrainment from Northside Station Projected Current Level	Annual Total ($\times 10^5$) ^a	Percent Change in Entrainment from Northside Station Projected Current Level	Projected Annual Total ($\times 10^5$) ^a		
Blue Crab	2.7	-86	19.7	0	19.7	< 1	0.3
Black Drum	0.7	-86	5.2	0	5.2	< 1	< 0.1
Croaker	62.9	-86	464.0	0	464.0	19	6.1
Menhaden	5.3	-86	38.5	0	38.5	2	0.5
Northern Kingfish	0.1	-86	0.5	0	0.5	< 1	< 0.1
Sciaenidae Species	11.3	-86	83.9	0	83.9	3	1.1
Sheepshead	0.04	-86	0.3	0	0.3	< 1	< 0.1
Shrimp Species	196.8	-86	1452.2	0	1452.2	59	19.2
Silver Perch	3.5	-86	25.9	0	25.9	1	0.3
Southern Kingfish	1.5	-86	11.0	0	11.0	< 1	0.1
Spotted Seatrout	21.4	-86	157.7	0	157.7	6	2.1
Spot	5.6	-86	41.2	0	41.2	2	0.5
Weakfish	22.7	-86	167.8	0	167.8	7	2.2
TOTAL	334.5	-86	2467.9	0	2467.9	100	32.4

^a Projected Annual Entrainment = mean daily entrainment/ 1000m^3 (Appendix B, Table B-12) $\times$ mean volume of cooling water passing through plant(s)/day (Table 5.2-1) $\times$ 365 day/year

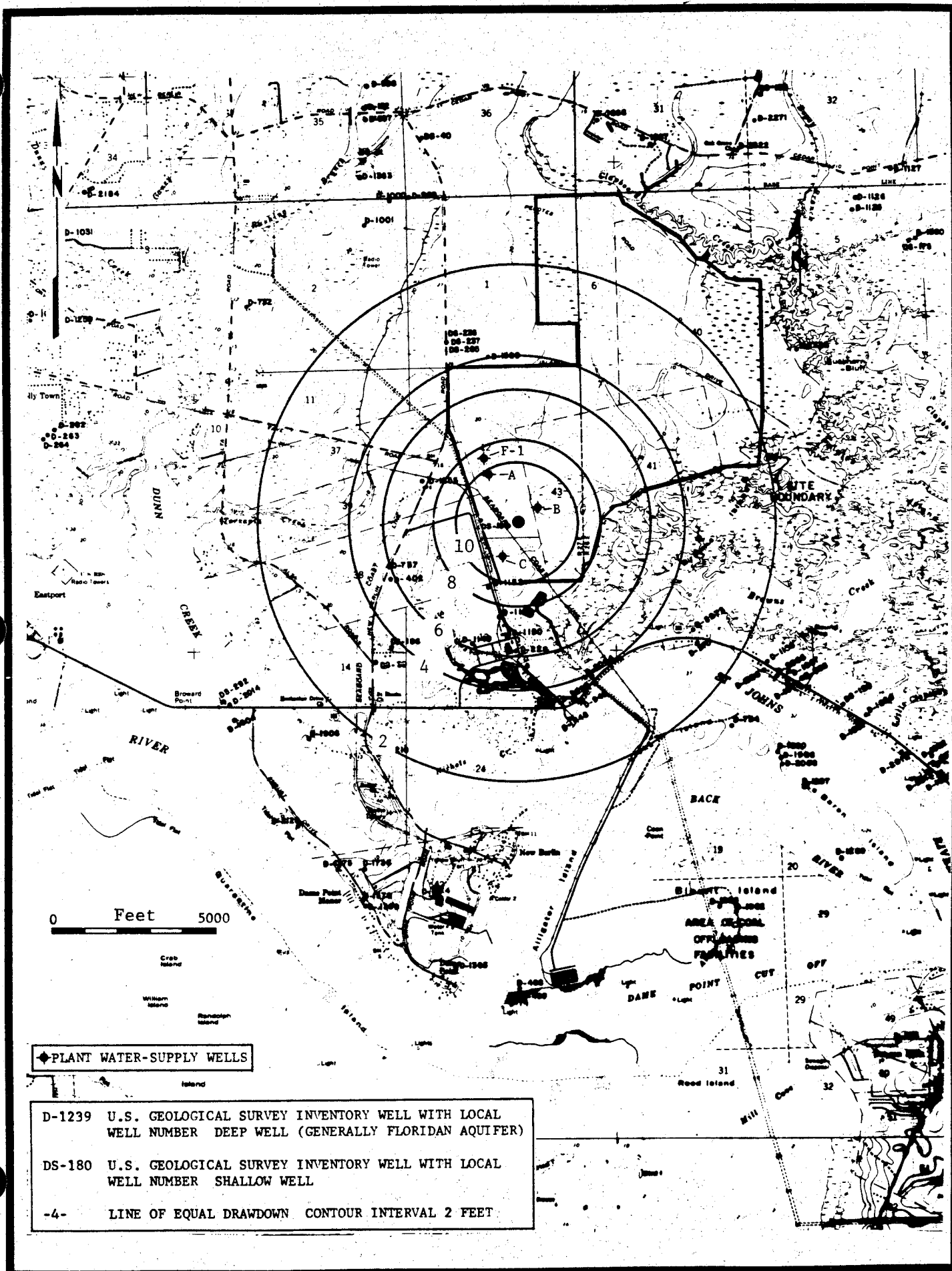


Figure 5.2-1

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

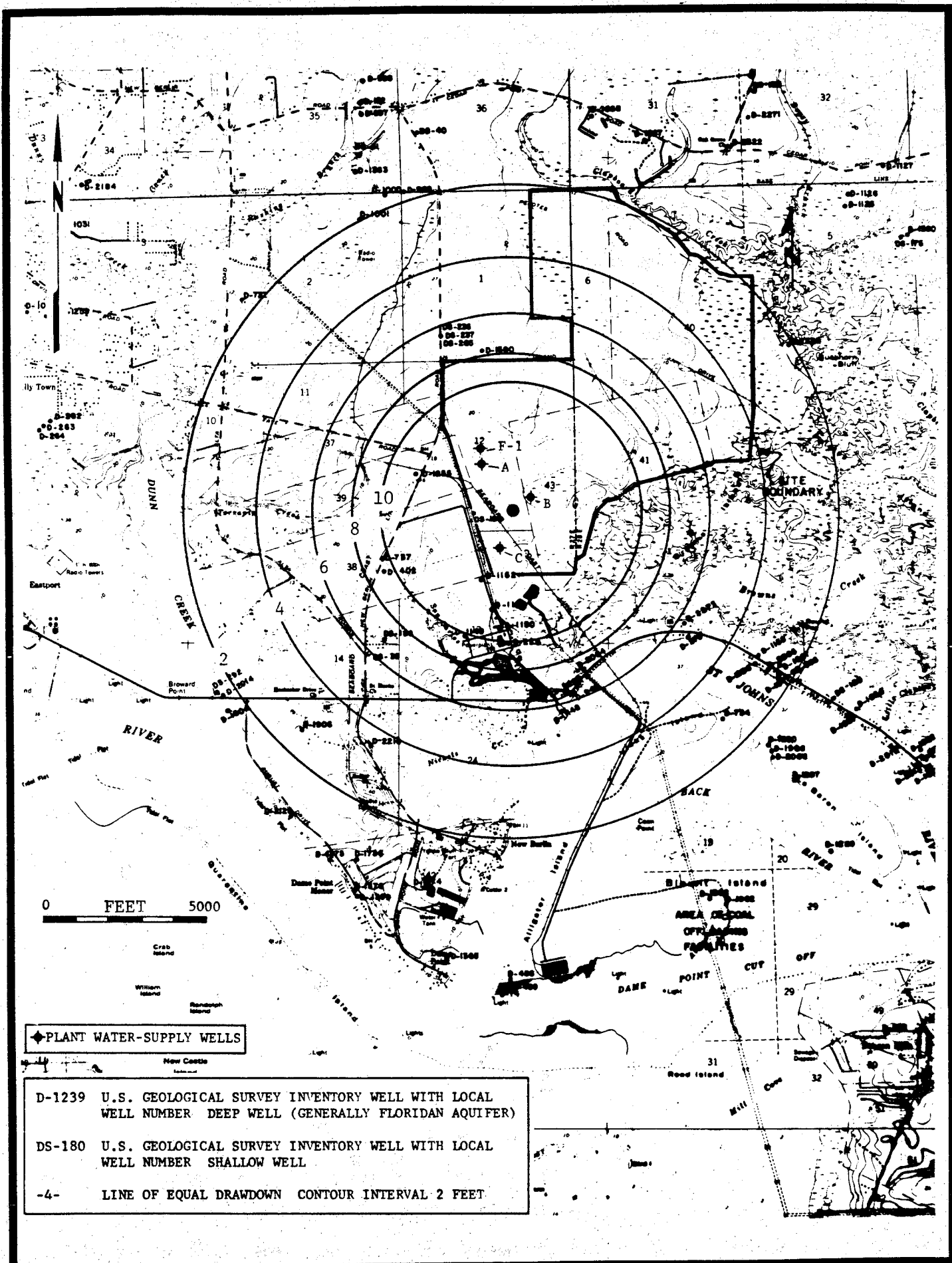


Figure 5.2-2

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 discreet 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 (Tesché, 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 SO₂ (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 SO₂ 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/m³, 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 SO₂ 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 intercoastal 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 $\mu\text{g}/\text{m}^3$ 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 ($294 \mu\text{g}/\text{m}^3$) 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).

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.

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

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^- , 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 $\text{SO}_4^=$ 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 $\text{SO}_4^=$ and TSP are the only pollutants contributing to visibility reduction. It was also assumed that the background visibility is 12 miles. Therefore,

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

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/m^3 , and the maximum 24-hour $\text{SO}_4^=$ impact is 2.2 ug/m^3 . 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:

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

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.

mercury

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 (Warington, 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							
Boilers ^a	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 Terminal ^a	4.2	12.2	344.4	9.6	.91	439.3	359.8
Union Camp ^{a,b}	7.3	15.54	586.0	11.7	1.22	427.6	357.3
Dickerson ^a							
(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 Plant ^b	277.0	106.7	408.0	15.24	5.29	364.0	292.6
Occidental Chemical ^b	12.9	15.2	467.0	23.9	1.46	320.9	369.8
Occidental Chemical ^b	15.5	30.5	468.0	11.8	2.29	328.9	368.9
Occidental Chemical ^b	84.0	61.0	356.0	30.6	1.83	320.9	369.8
Occidental Chemical ^b	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 JEA Proposed a,b	46.4	194.2	327.6	18.29	10.13	447.1	366.3
(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 Plantb	23.0	106.7	408.0	14.25	5.29	364.0	292.6
Occidental Chemicalb	.5	15.2	467.0	23.9	1.46	320.9	369.8
Occidental Chemicalb	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)	Highest, Second-Highest Concentration (ug/m ³)	Distance ^a (km)	Direction ^a (degrees)	Class I Increment (ug/m ²)	Maximum Increment Consumption (%)
SO ₂	Annual	< 1	63	300	N/A	N/A	N/A	2 ^b	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	5 ^c	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. ($\mu\text{g}/\text{m}^3$)	Distance ^a (km)	Direction ^a (degrees)	Highest, Second-Highest Conc. ($\mu\text{g}/\text{m}^3$)	Distance ^a (km)	Direction ^a (degrees)	Back-ground Conc. ($\mu\text{g}/\text{m}^3$)	Total Conc. ($\mu\text{g}/\text{m}^3$)	Ambient Standard ($\mu\text{g}/\text{m}^3$)	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
NO ₂	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. Modeling 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 (µg/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	785a	400-3750a
4	750	-	681	262-2620
8	500	-	472	131-1310
a Interpolated value				

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 x 10 ⁻⁴	6.0 x 10 ⁻³	2.5 x 10 ⁻¹
Beryllium	6	1.93 x 10 ⁻⁵	3.0 x 10 ⁻⁴	1.3 x 10 ⁻²
Boron	10	6.24 x 10 ⁻⁴	6.2 x 10 ⁻³	2.5 x 10 ⁻¹
Cadmium	0.06	3.57 x 10 ⁻⁶	5.9 x 10 ⁻³	2.4 x 10 ⁻¹
Chromium	100	2.98 x 10 ⁻⁴	2.9 x 10 ⁻⁴	1.2 x 10 ⁻²
Cobalt	8	1.46 x 10 ⁻⁴	1.8 x 10 ⁻³	7.2 x 10 ⁻²
Copper	20	2.67 x 10 ⁻⁴	1.3 x 10 ⁻³	5.3 x 10 ⁻²
Fluorine	200	1.33 x 10 ⁻³	6.6 x 10 ⁻⁴	2.6 x 10 ⁻²
Lead	10	8.74 x 10 ⁻⁴	8.7 x 10 ⁻³	3.5 x 10 ⁻¹
Manganese	850	2.67 x 10 ⁻⁴	3.1 x 10 ⁻⁵	1.2 x 10 ⁻³
Mercury	0.1 ^b	2.98 x 10 ⁻⁶	2.9 x 10 ⁻³	1.2 x 10 ⁻¹
Molybdenum	2	6.82 x 10 ⁻⁵	3.4 x 10 ⁻³	1.4 x 10 ⁻¹
Nickel	40	4.45 x 10 ⁻⁴	1.1 x 10 ⁻³	4.4 x 10 ⁻²
Selenium	0.5	5.94 x 10 ⁻⁵	1.2 x 10 ⁻²	4.7 x 10 ⁻¹
Strontium	150 ^b	1.93 x 10 ⁻³	1.3 x 10 ⁻³	5.1 x 10 ⁻²
Tin	200 ^c	2.98 x 10 ⁻⁵	1.5 x 10 ⁻⁵	5.9 x 10 ⁻⁴
Vanadium	100	5.6 x 10 ⁻⁴	5.6 x 10 ⁻⁴	2.2 x 10 ⁻²
Zinc	50	3.7 x 10 ⁻⁴	7.4 x 10 ⁻⁴	2.9 x 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

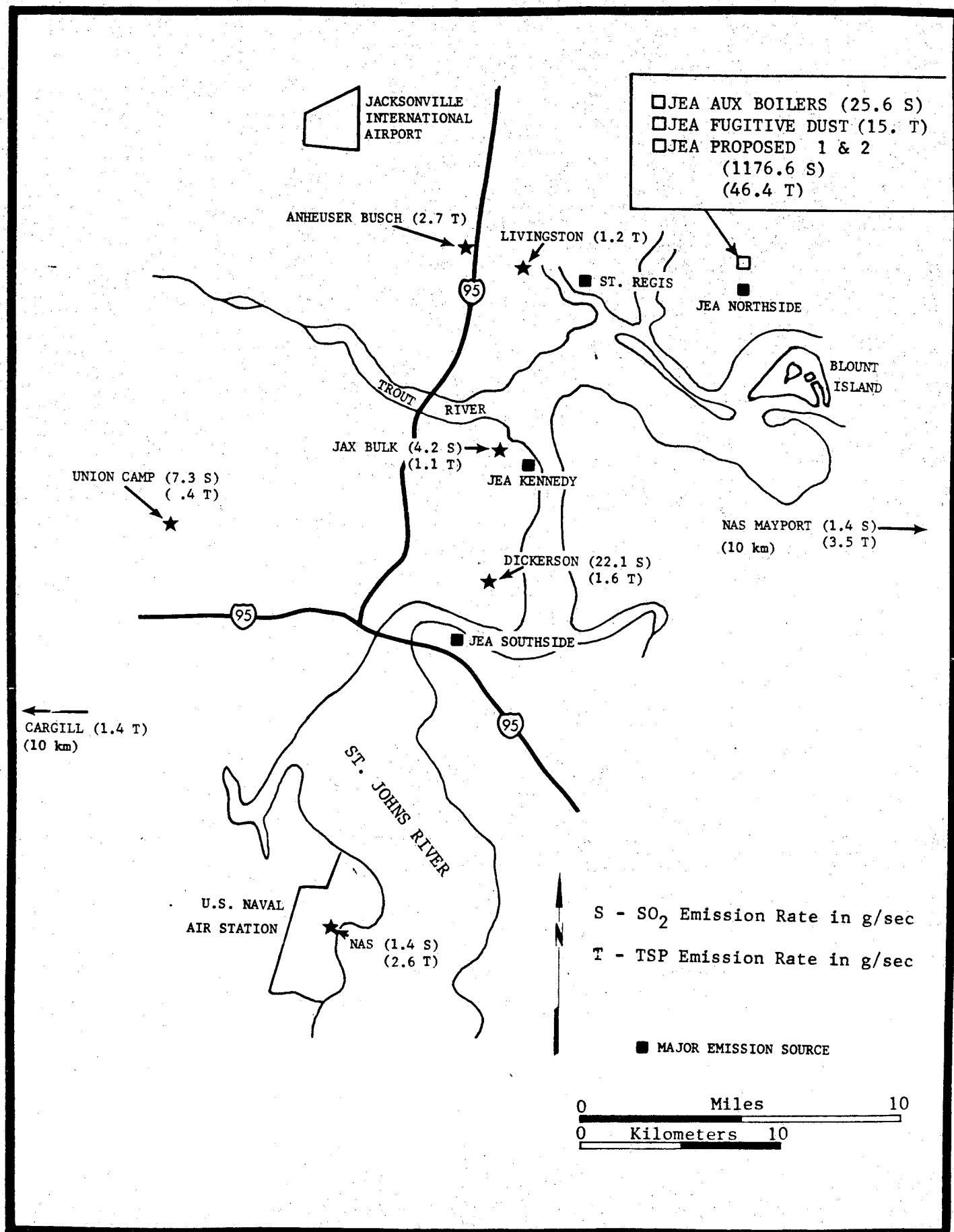


Figure 5.3-1 Jacksonville PSD Emission Source Locations and Strengths

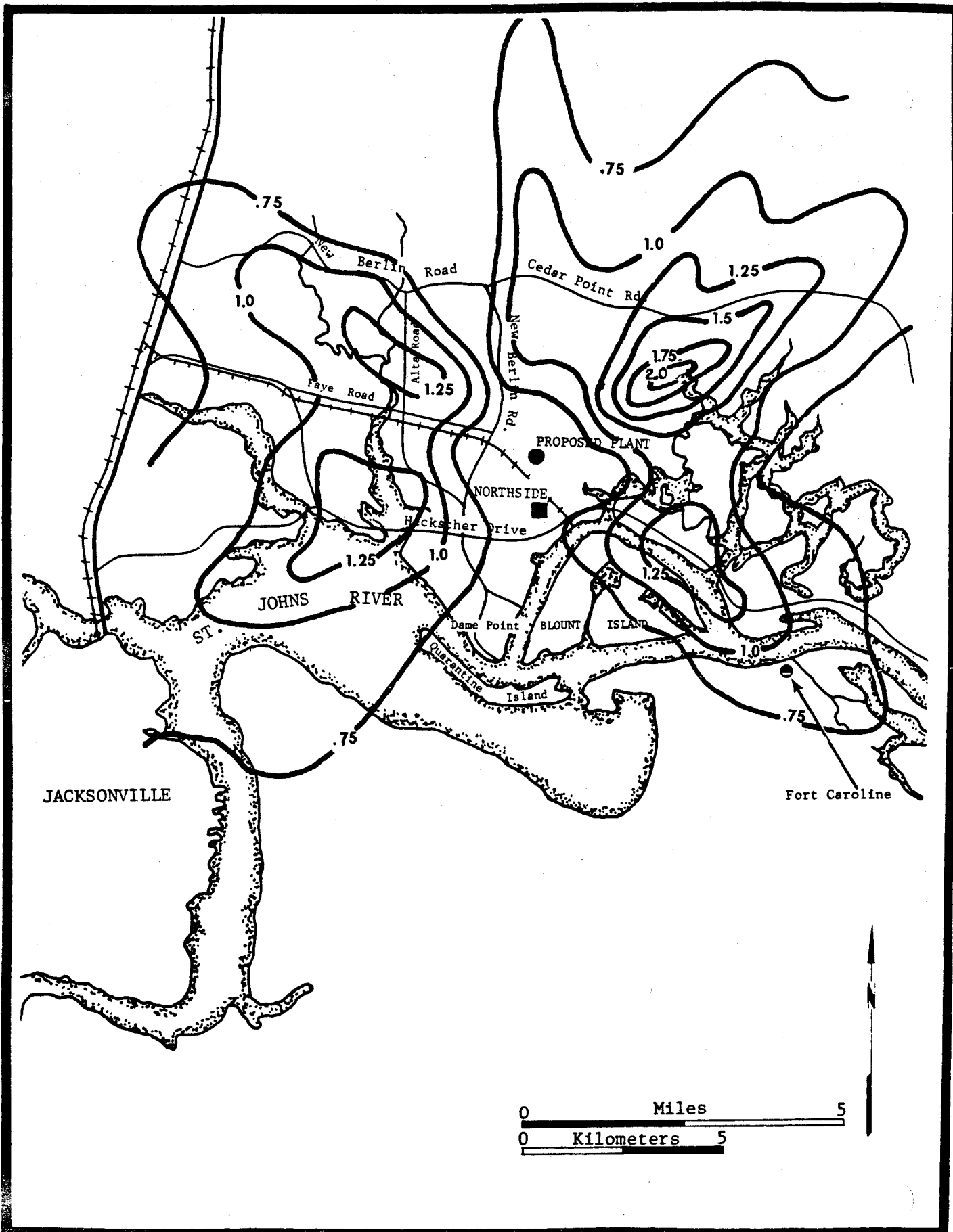


Figure 5.3-2 Predicted Annual Average SO_2 PSD Increment Consumption (in ug/m^3)

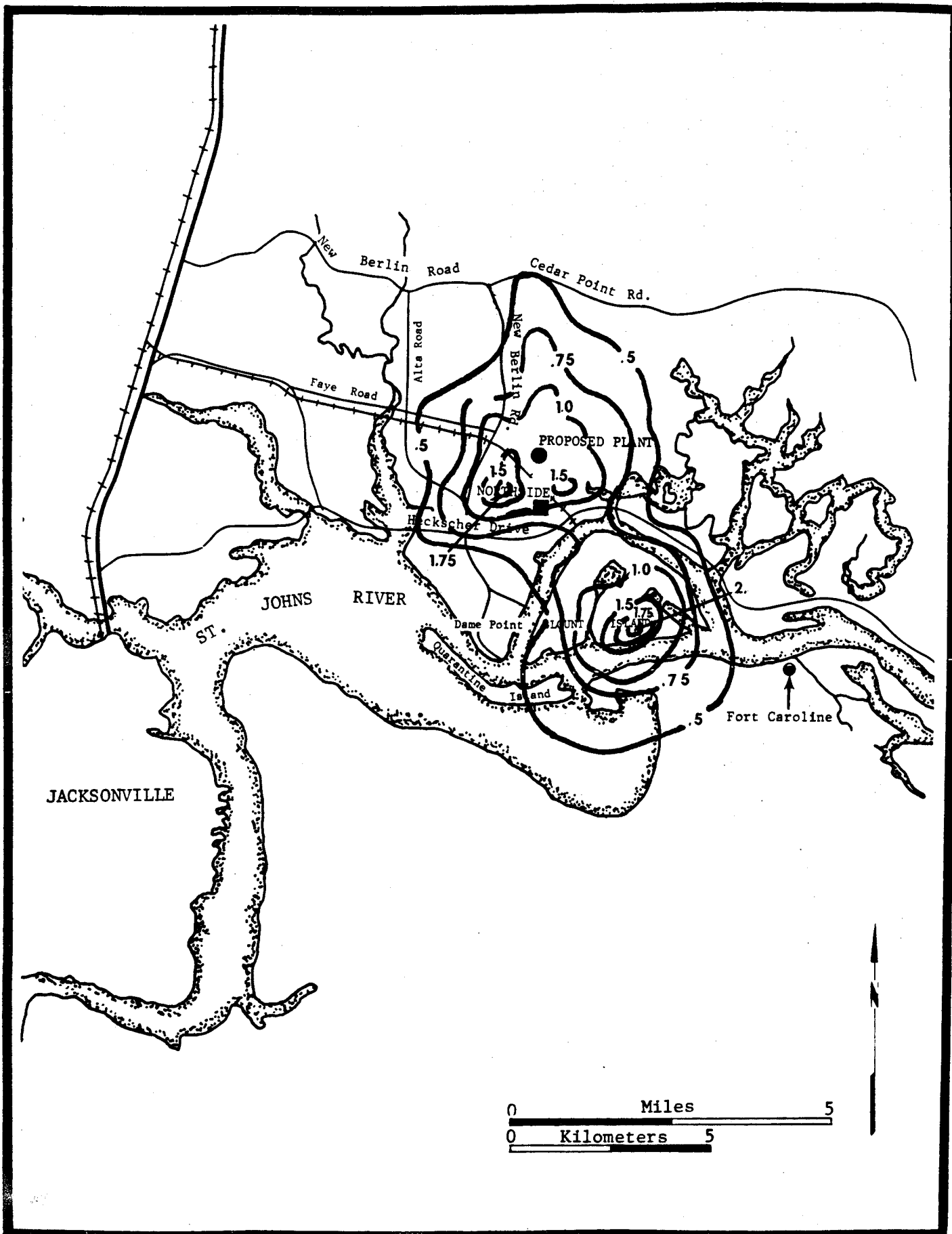


Figure 5.3-3 Predicted Annual Average TSP PSD Increment Consumption (in $\mu\text{g}/\text{m}^3$)

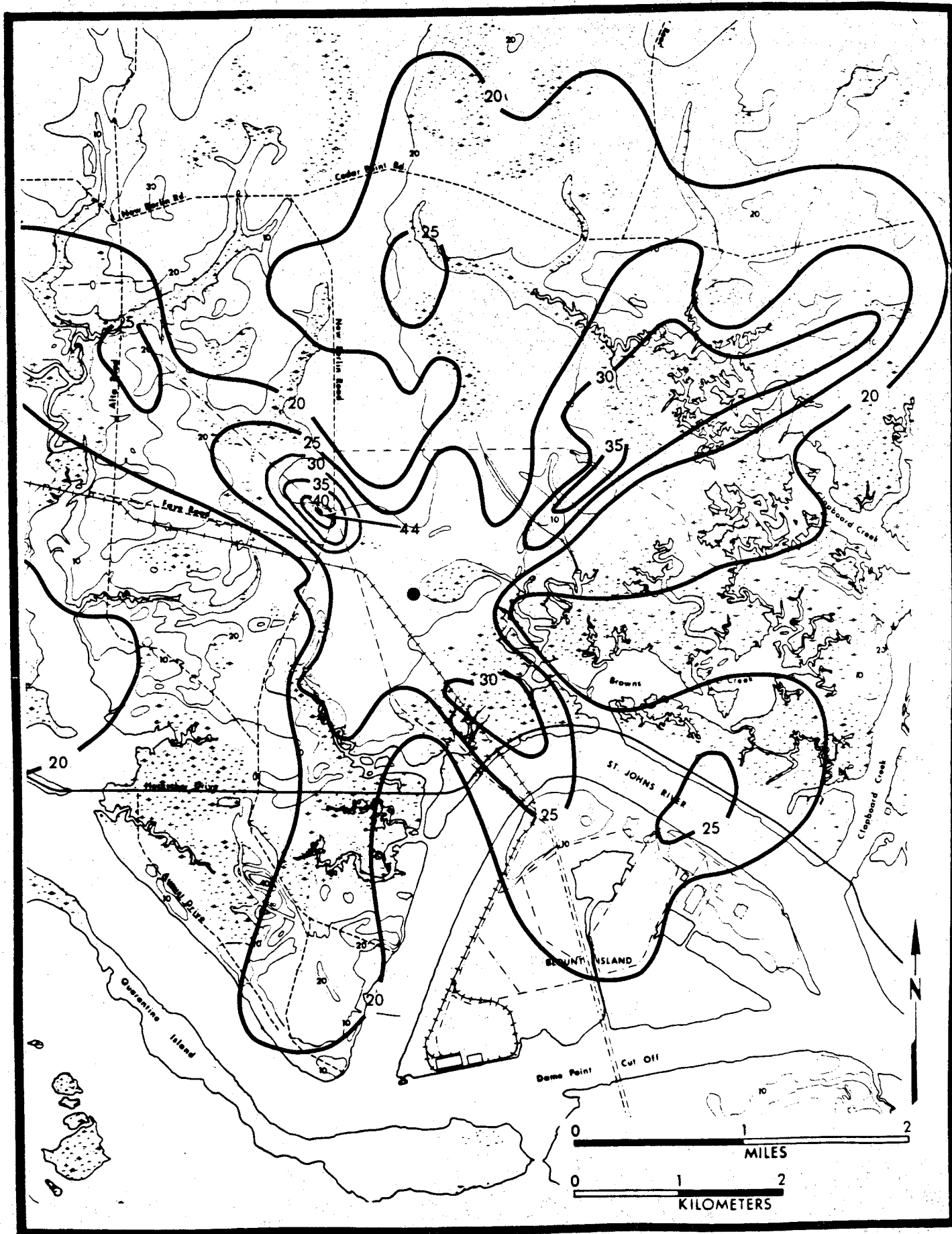


Figure 5.3-4 Predicted Highest, Second-Highest 24-Hour Average SO₂ PSD Increment Consumption (in $\mu\text{g}/\text{m}^3$)

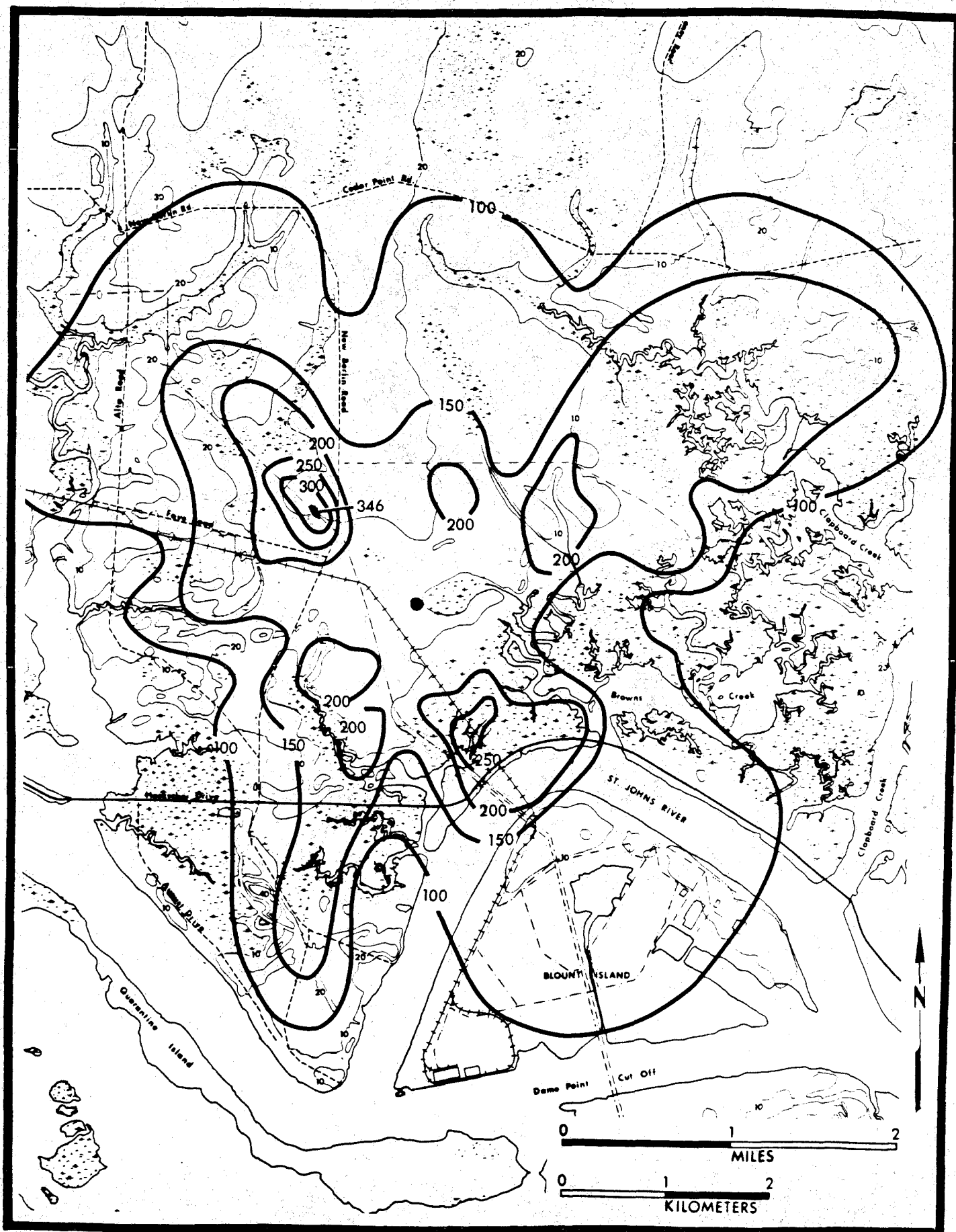


Figure 5.3-5 Predicted Highest, Second-Highest 3-Hour Average SO₂ PSD Increment Consumption (in $\mu\text{g}/\text{m}^3$)

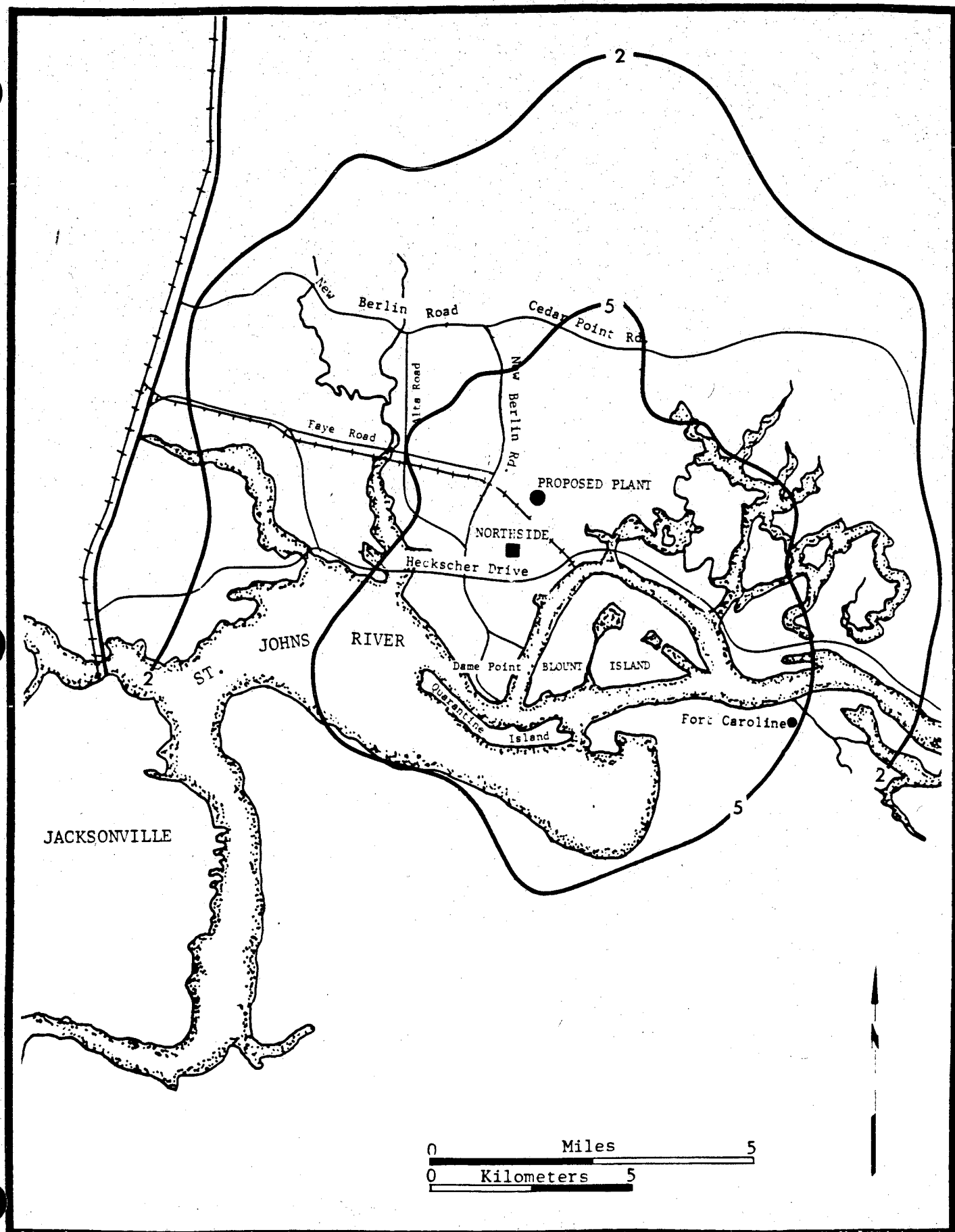


Figure 5.3-6

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

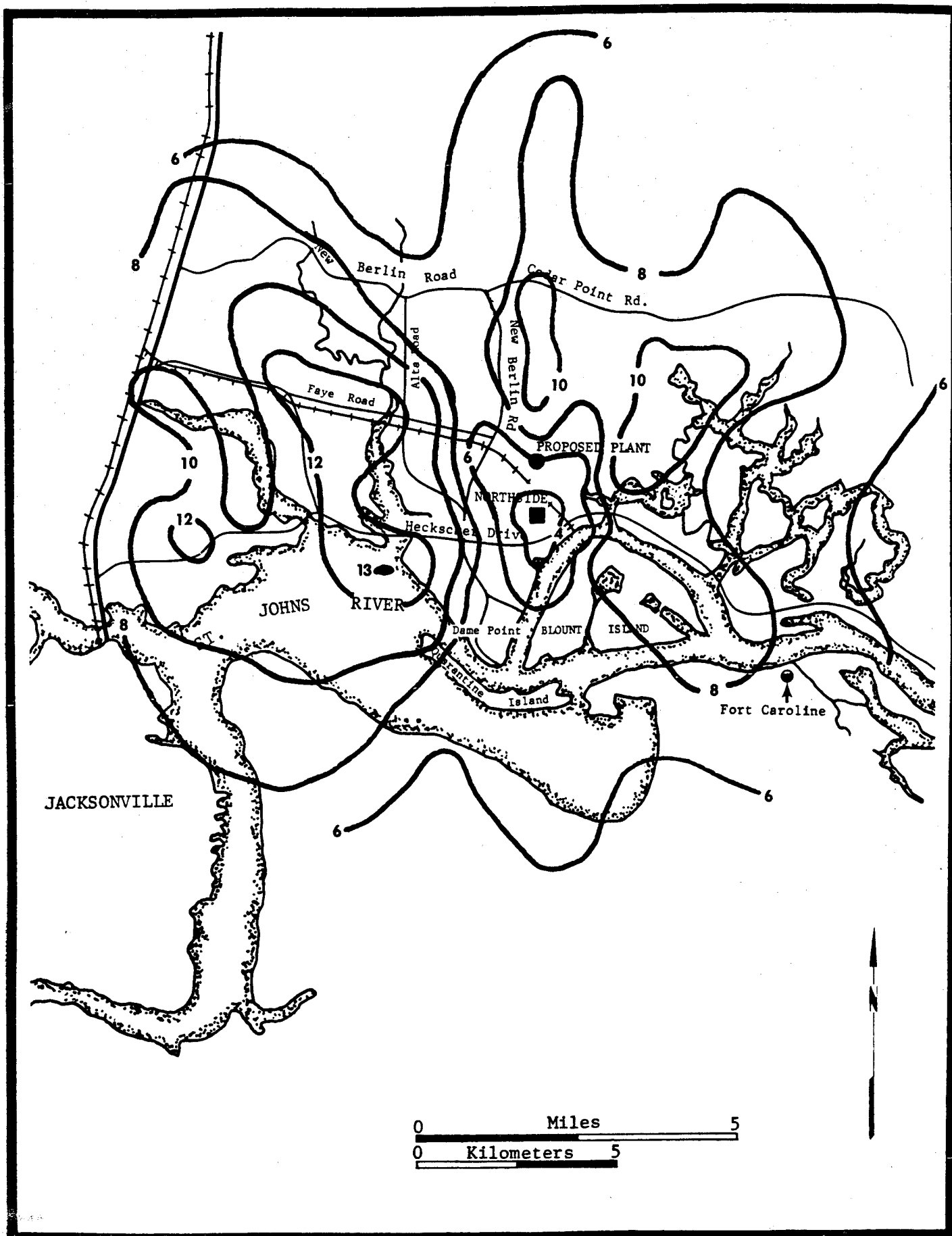


Figure 5.3-7 Predicted Annual Average SO_2 Ambient Impacts (in $\mu\text{g}/\text{m}^3$)

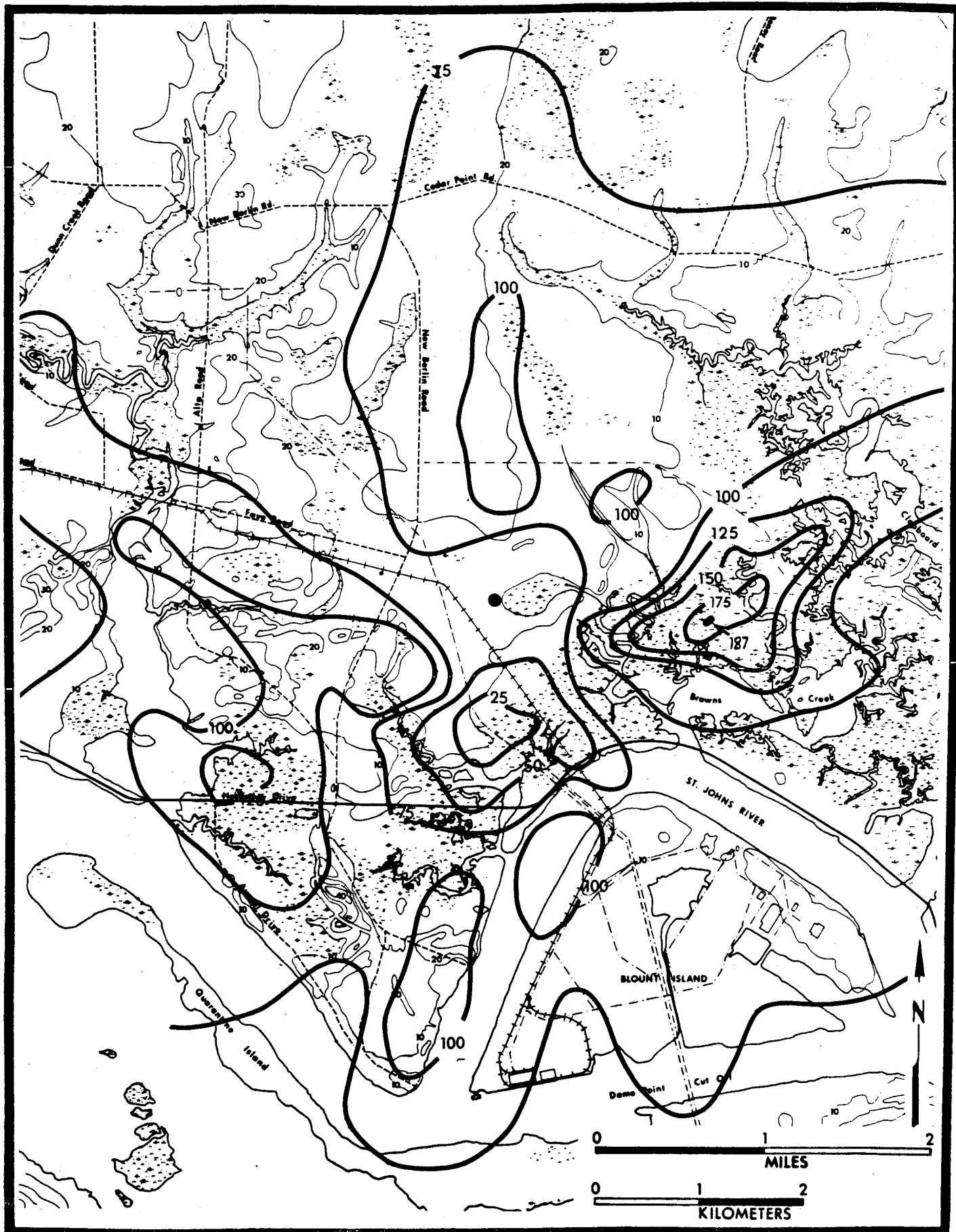


Figure 5.3-8 Predicted Highest, Second-Highest 24-Hour Average SO₂ Ambient Impacts (in $\mu\text{g}/\text{m}^3$)

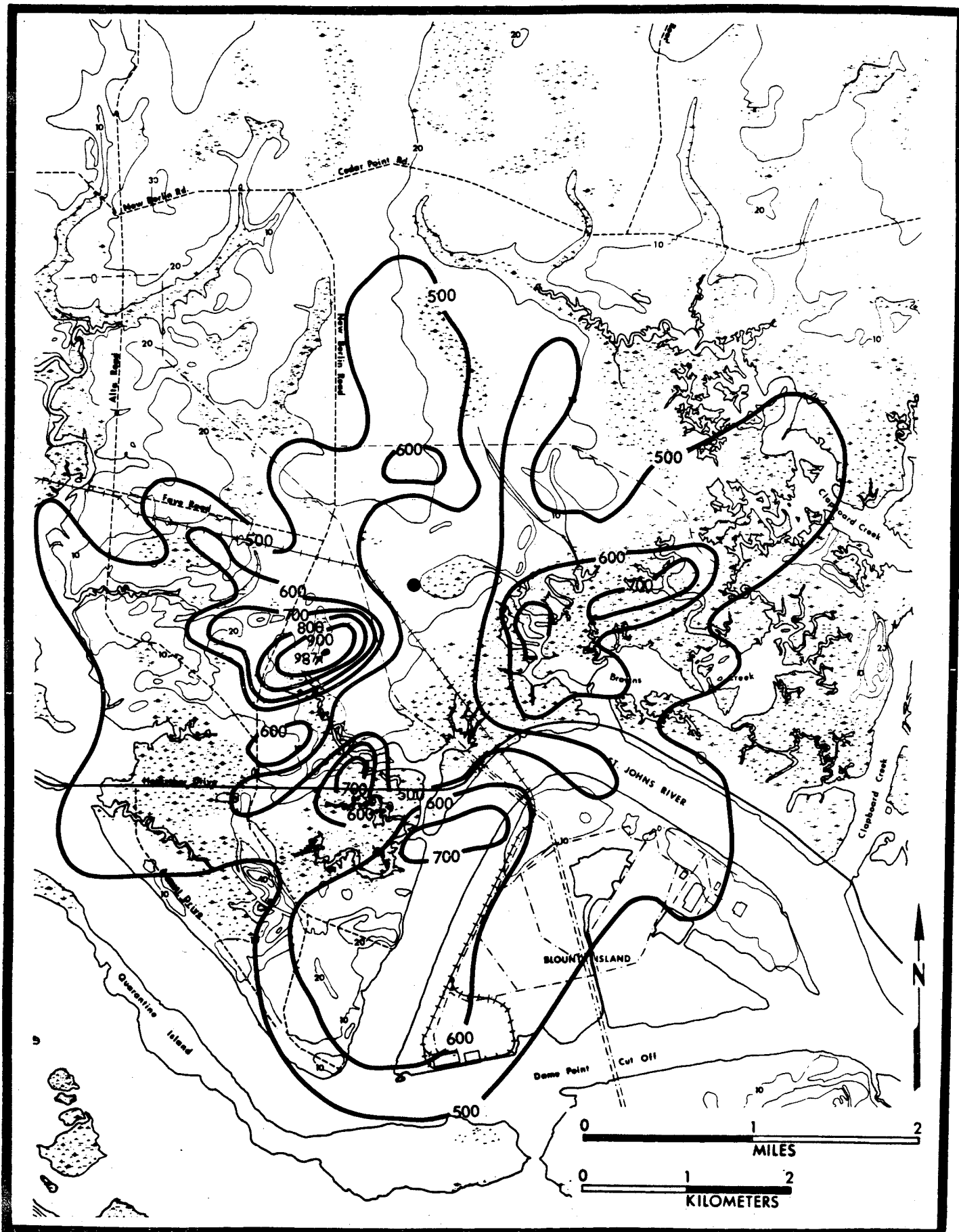


Figure 5.3-9 Predicted Highest, Second-Highest 3-Hour Average SO_2 Ambient Impacts (in ug/m^3)

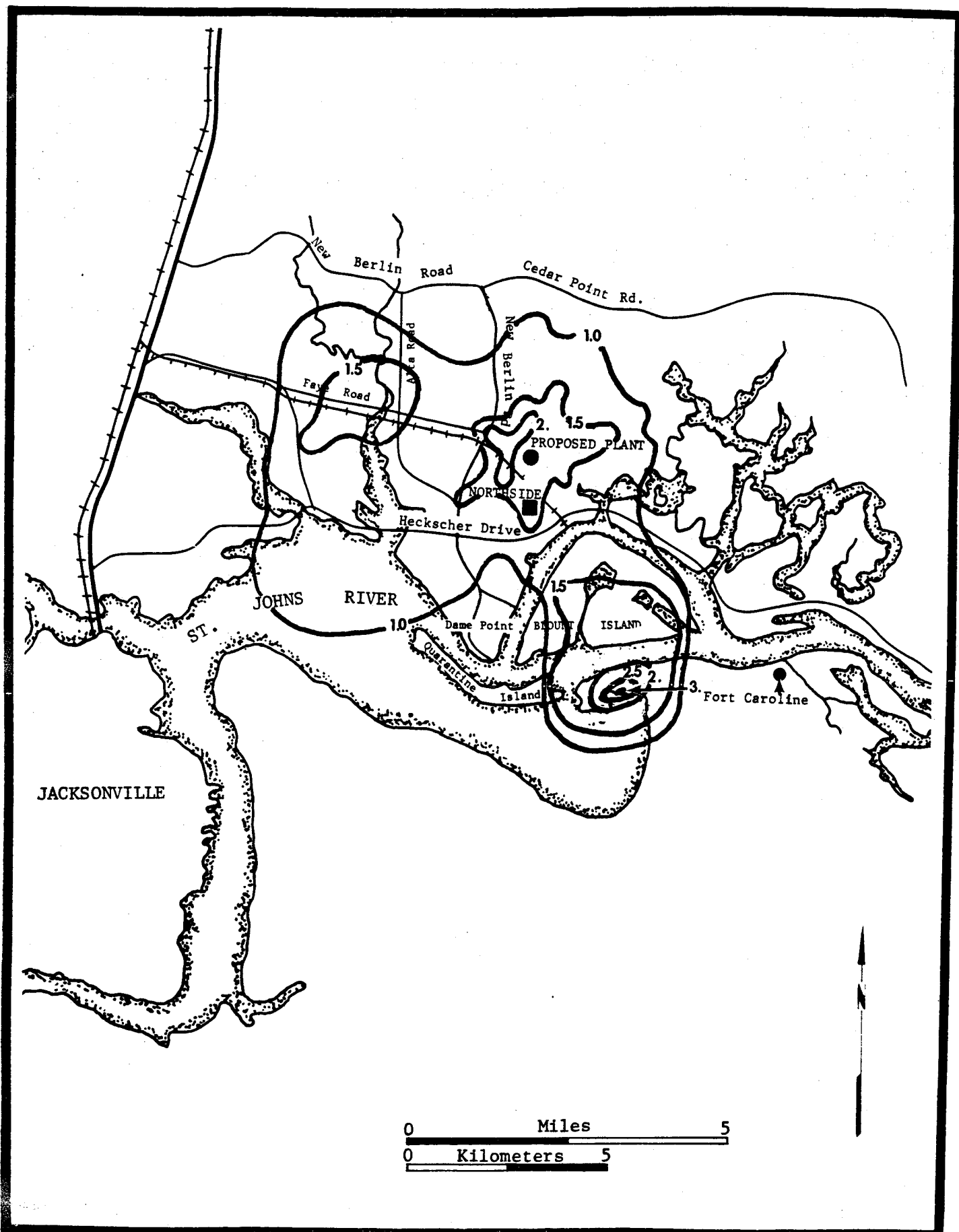
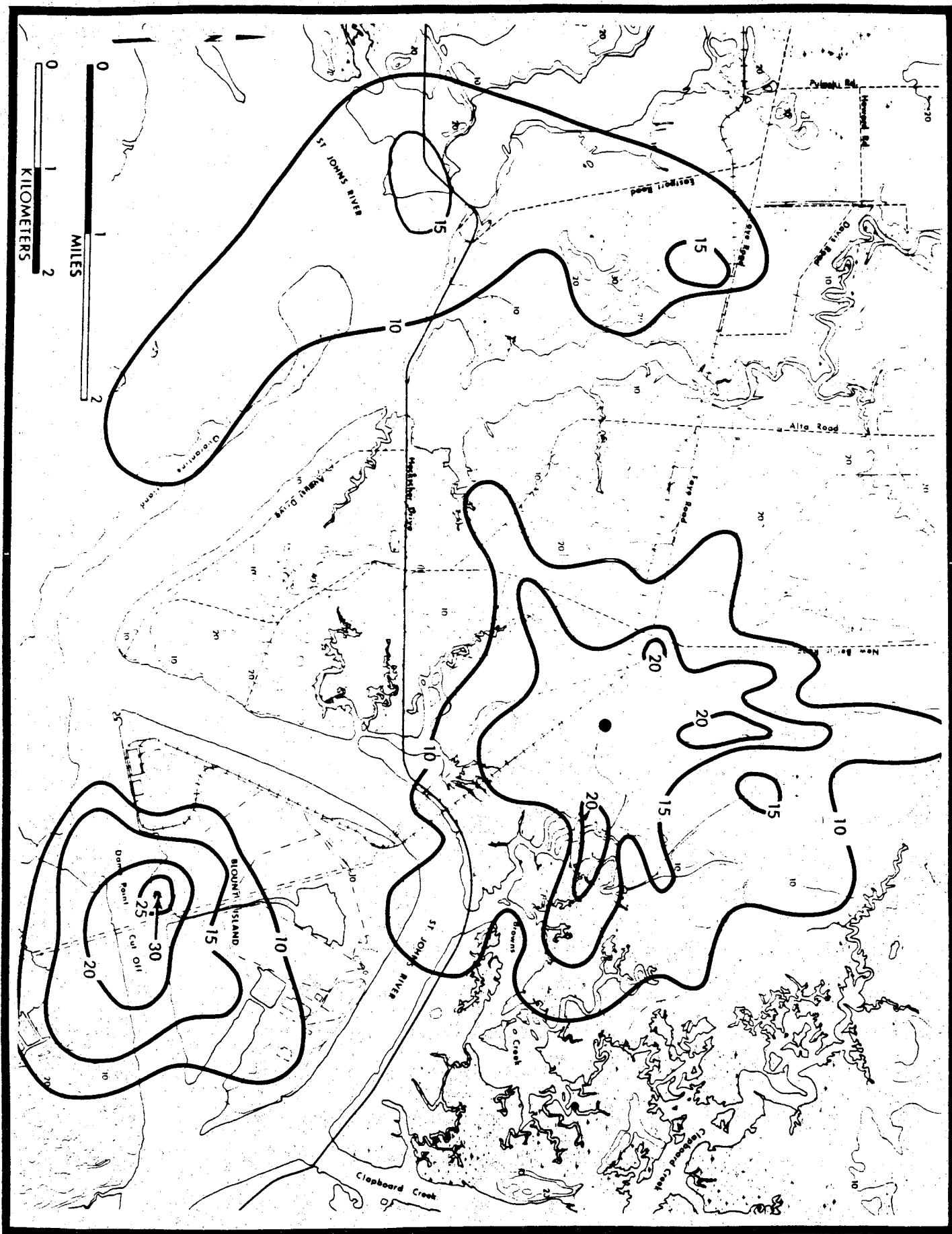


Figure 5.3-10 Predicted Annual Average TSP Ambient Impacts
(in $\mu\text{g}/\text{m}^3$)

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



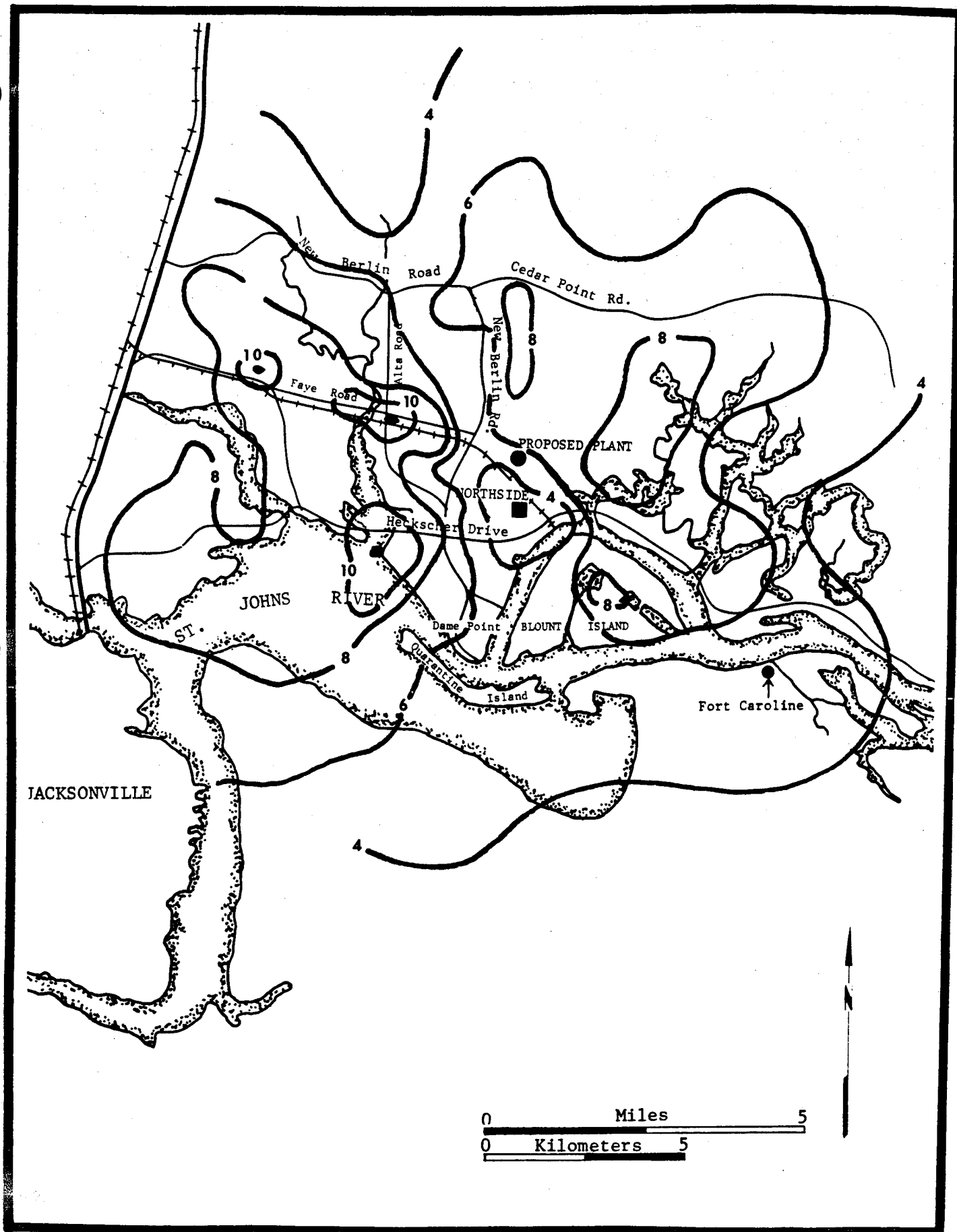


Figure 5.3-12 Predicted Annual Average NO_2 Ambient Impacts
(in ug/m^3)

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 (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 $0.561 \text{ mg Cl}^-/\text{m}^2/\text{hr}$ ($1.02 \text{ mg salt}/\text{m}^2/\text{hr}$) (Curtis et al., 1978) to $16.67 \text{ mg Cl}/\text{m}^2/\text{hr}$ (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 $0.46 \text{ mg Cl}^-/\text{m}^2/\text{hr}$, 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 $0.4 \text{ ug Cl}^-/\text{cm}^2/\text{min}$ ($240 \text{ mg}/\text{m}^2/\text{hr}$) (1-2 hour exposure) for beans. Other threshold values are estimated to be $14.4 \text{ mg Cl}^-/\text{m}^2/\text{hr}$ for corn and $13.5 \text{ mg Cl}^-/\text{m}^2/\text{hr}$ 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 $0.32 \text{ mg}/\text{m}^2/\text{hr}$ ($25 \text{ lbs}/\text{acre}/\text{year}$) 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 $0.13 \text{ mg}/\text{m}^2/\text{hr}$ ($10.1 \text{ lbs}/\text{acre}/\text{year}$) which is well below the reported cautionary limit of $100 \text{ lbs}/\text{acre}/\text{year}$.

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.

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 $0.5 \text{ mg/m}^2/\text{hr}$. 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 $0.2 \text{ mg/m}^2/\text{hr}$. The predicted maximum seasonal average deposition rate at distances beyond approximately 5,000 feet in all directions will be less than the $0.2 \text{ mg/m}^2/\text{hr}$. Assuming that the $0.5 \text{ mg/m}^2/\text{hr}$ 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 ($0.5 \text{ mg/m}^2/\text{hr}$) yields $0.92 \text{ mg/m}^2/\text{hr}$ ($671.6 \text{ mg/m}^2/\text{month}$) 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 ($0.23 \text{ mg Cl}^-/\text{m}^2/\text{hr}$) plus the cooling tower contribution ($0.28 \text{ mg Cl}^-/\text{m}^2/\text{hr}$) yields a seasonal average deposition rate of $0.51 \text{ mg Cl}^-/\text{m}^2/\text{hr}$ or $372.3 \text{ mg Cl}^-/\text{m}^2/\text{month}$.

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 0.51 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 0.5 mg/ m^2/hr (39 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 0.2 mg/ m^2/hr (15.6 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 ($0.035 \text{ mg SO}_4^{=}/\text{m}^2/\text{hr}$) yields a predicted maximum seasonal average deposition rate of $0.455 \text{ mg SO}_4^{=}/\text{m}^2/\text{hr}$ or $332 \text{ mg SO}_4^{=}/\text{m}^2/\text{month}$. 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 ^a	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 0-0.25 2 0.25-0.5 3 0.5-1.0 4 1.0-1.5 5 1.5-2.0 6 2.0-5.0 7 5.0
 Plume lengths (km):

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

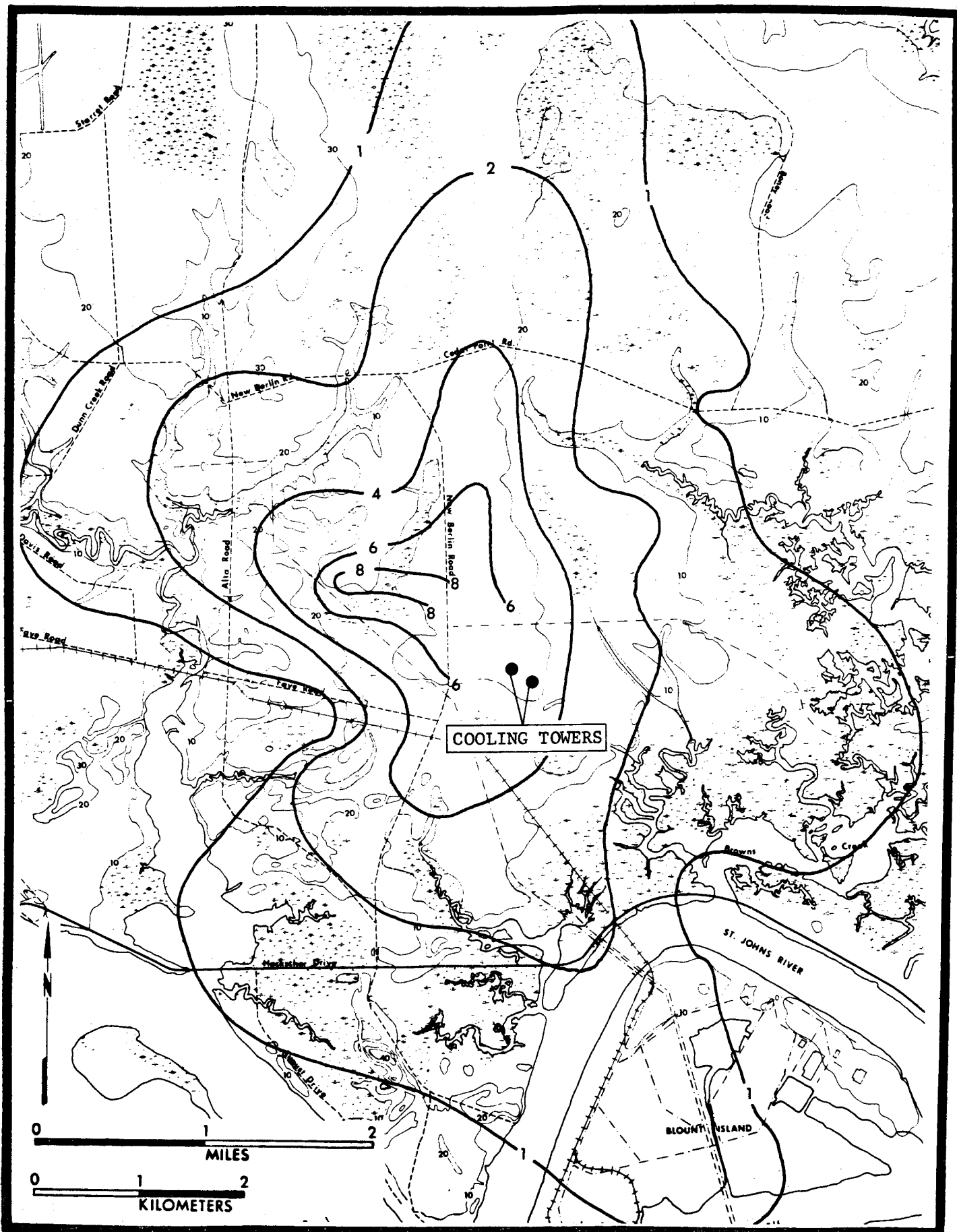


Figure 5.4-1 Percent Vapor Plume Occurrence - Spring

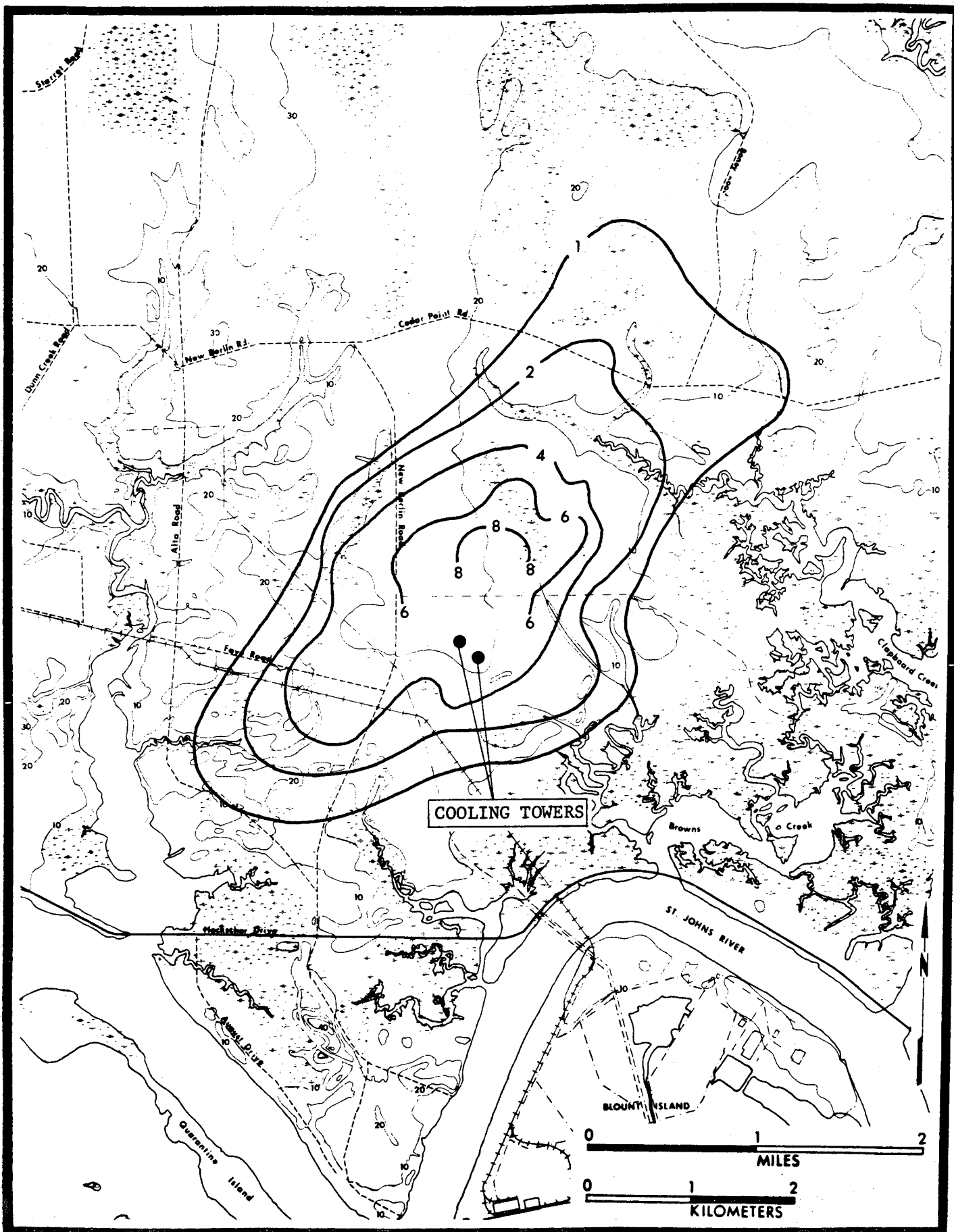


Figure 5.4-2 Percent Vapor Plume Occurrence - Summer

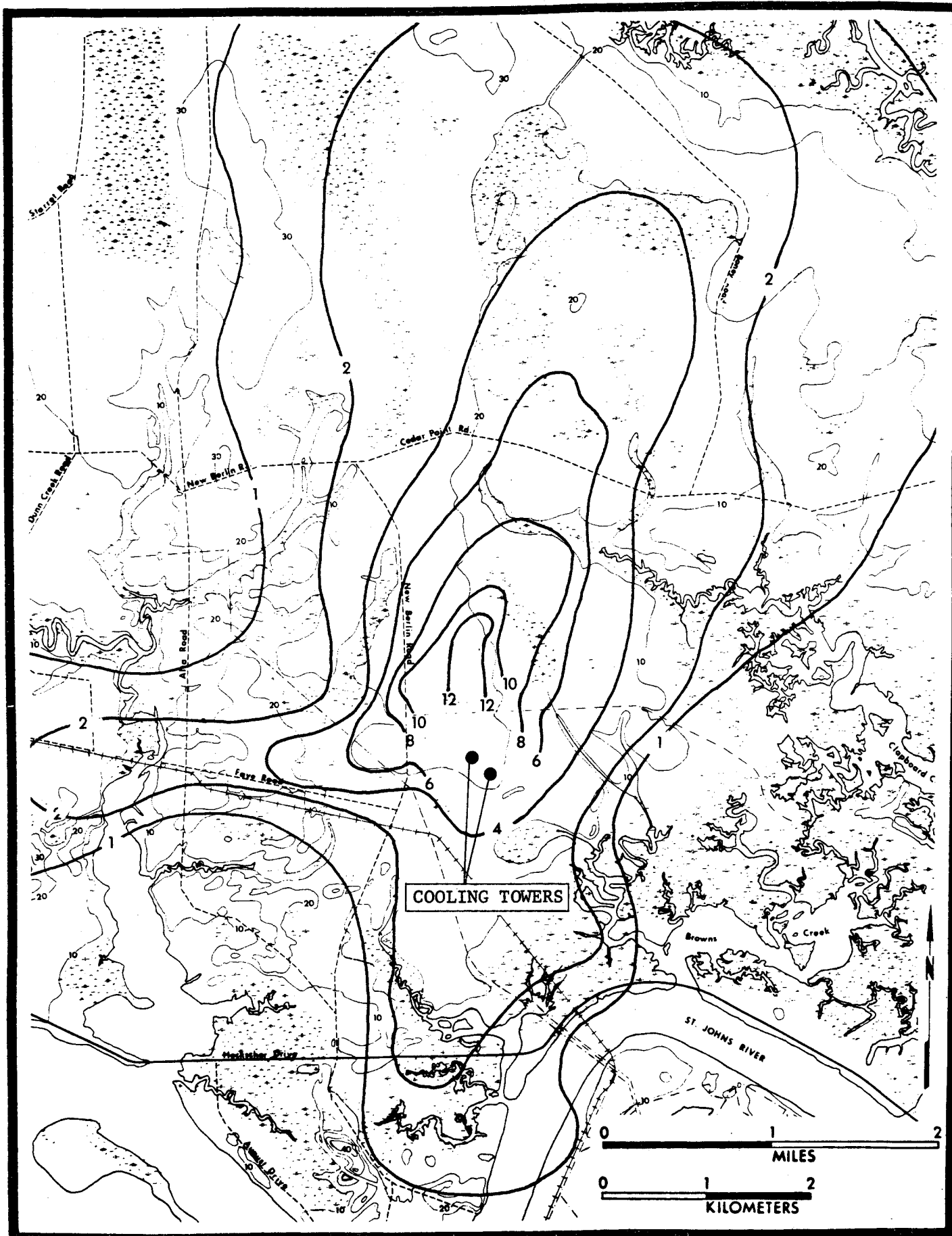


Figure 5.4-3 Percent Vapor Plume Occurrence - Fall

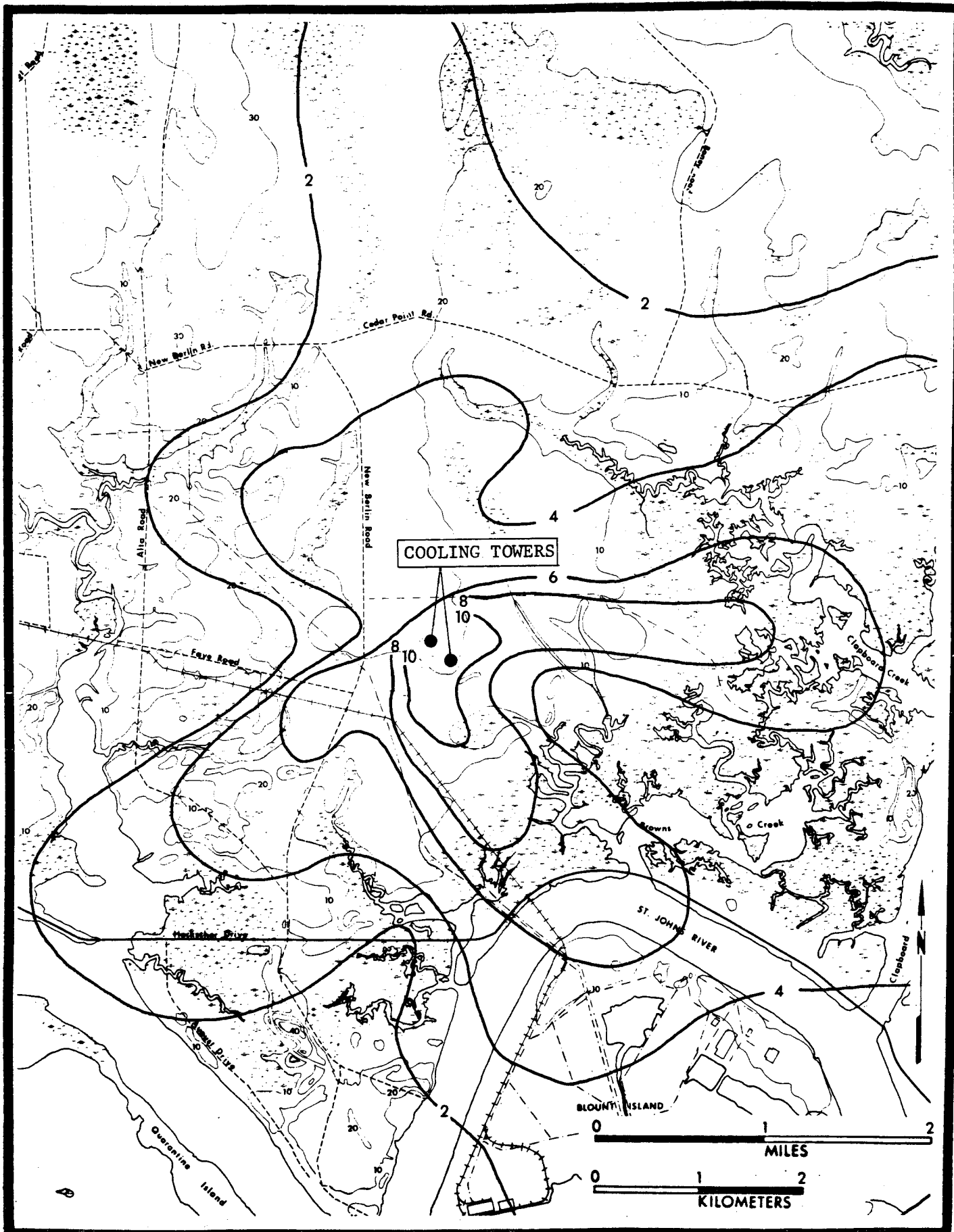


Figure 5.4-4 Percent Vapor Plume Occurrence - Winter

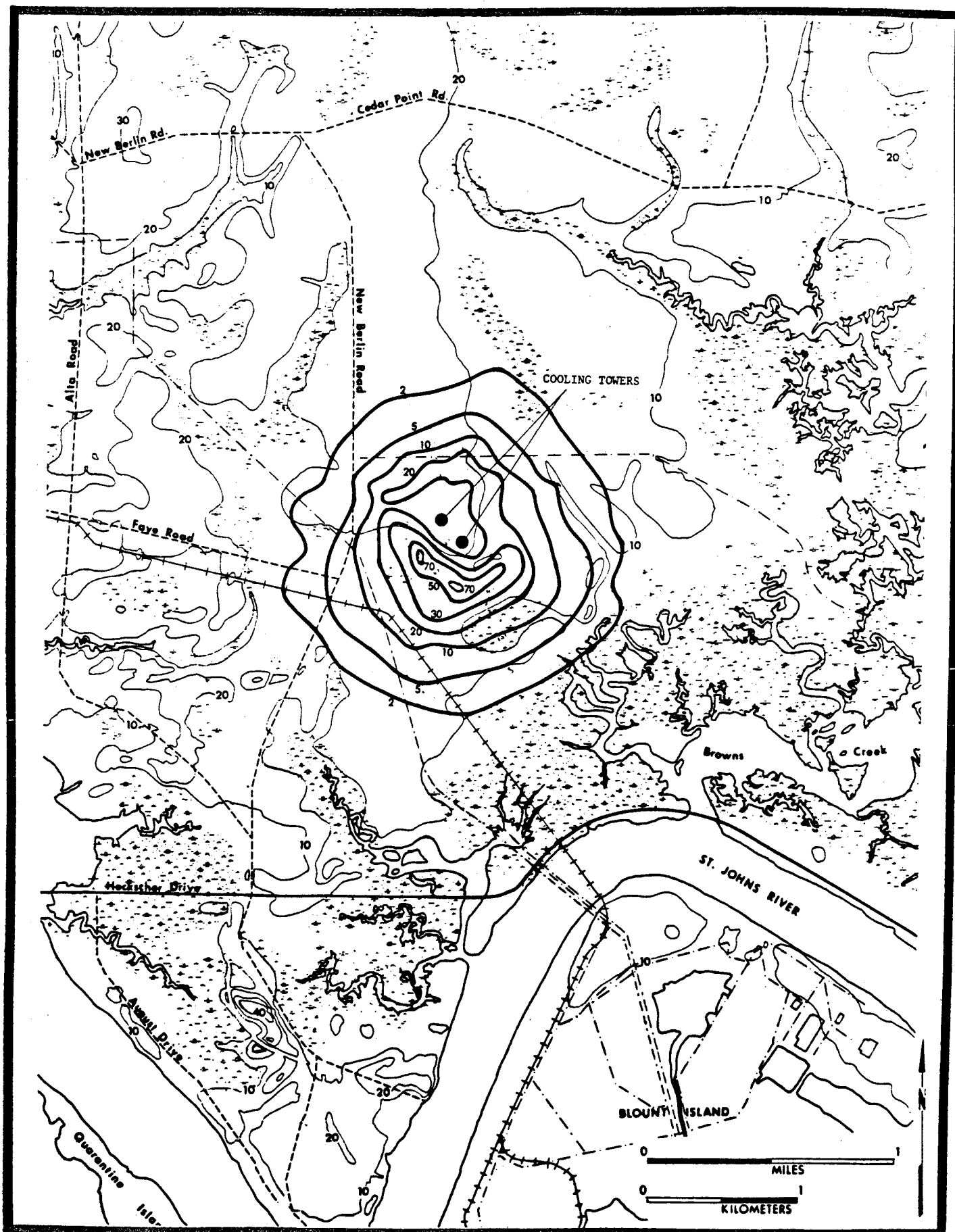


Figure 5.4-5 Seasonally Averaged Water Deposition for Spring
in $\text{mg}/\text{m}^2/\text{hr}$

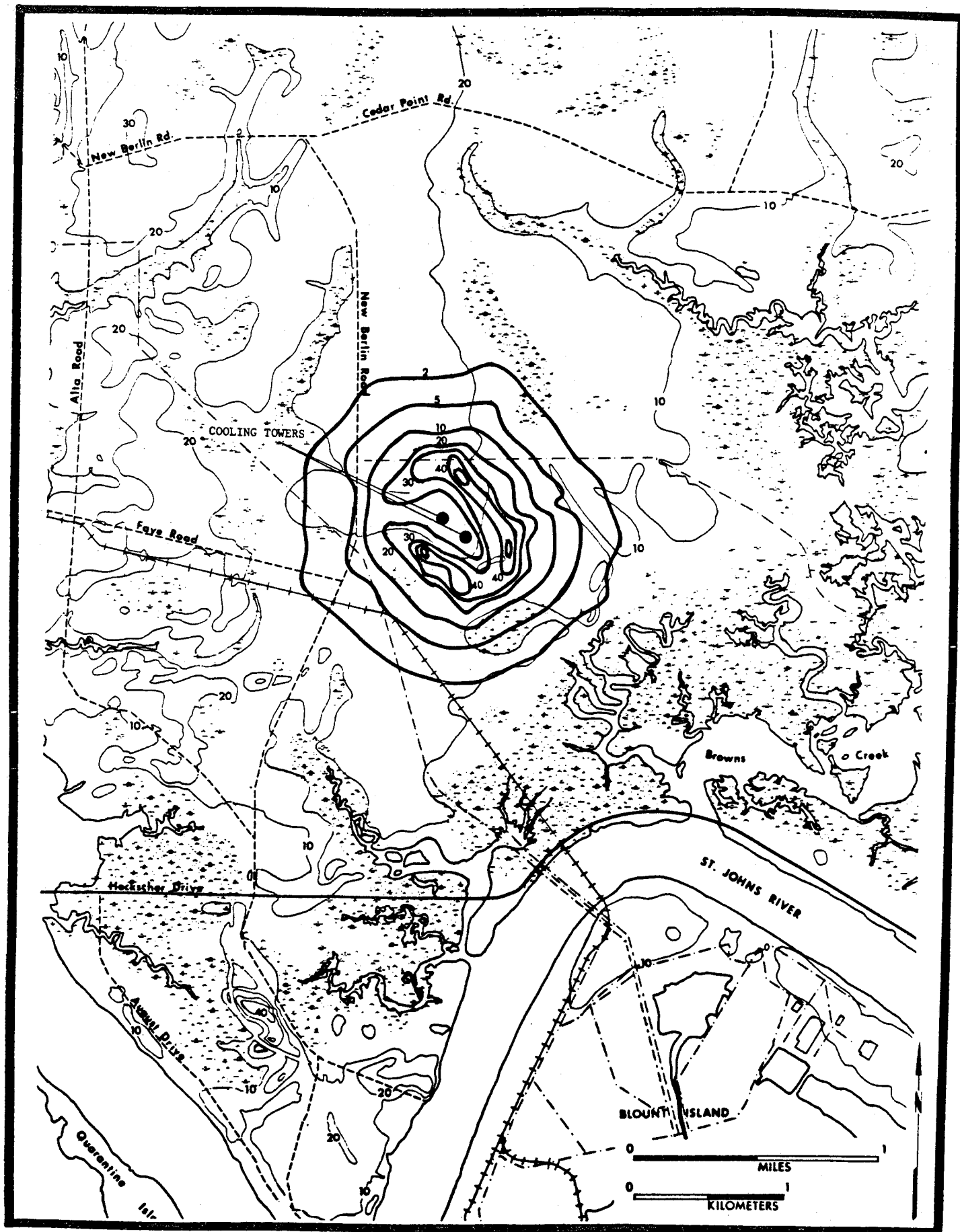


Figure 5.4-6 Seasonally Averaged Water Deposition for Summer
in $\text{mg}/\text{m}^2/\text{hr}$

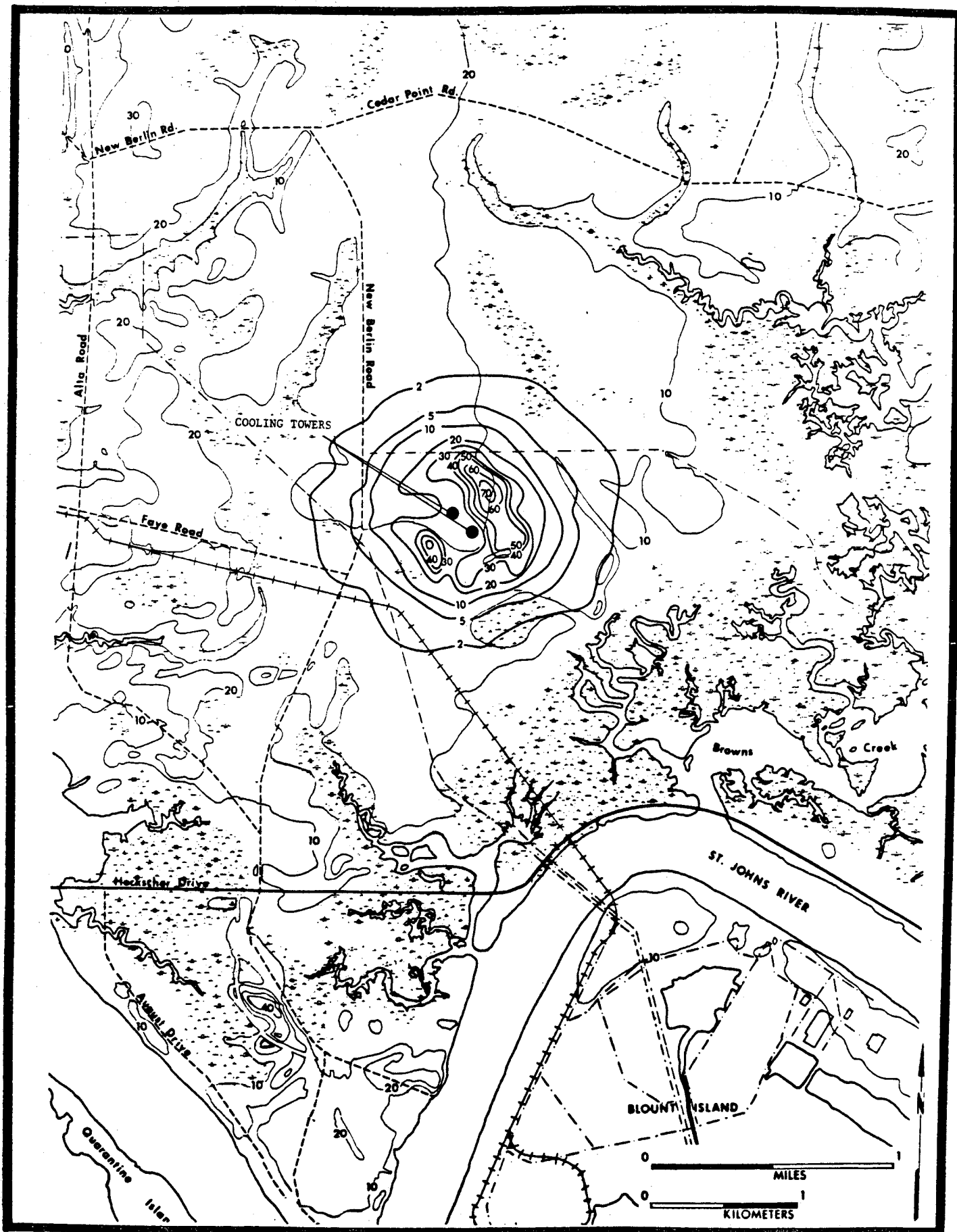


Figure 5.4-7 Seasonally Averaged Water Deposition for Fall
in $\text{mg/m}^2/\text{hr}$

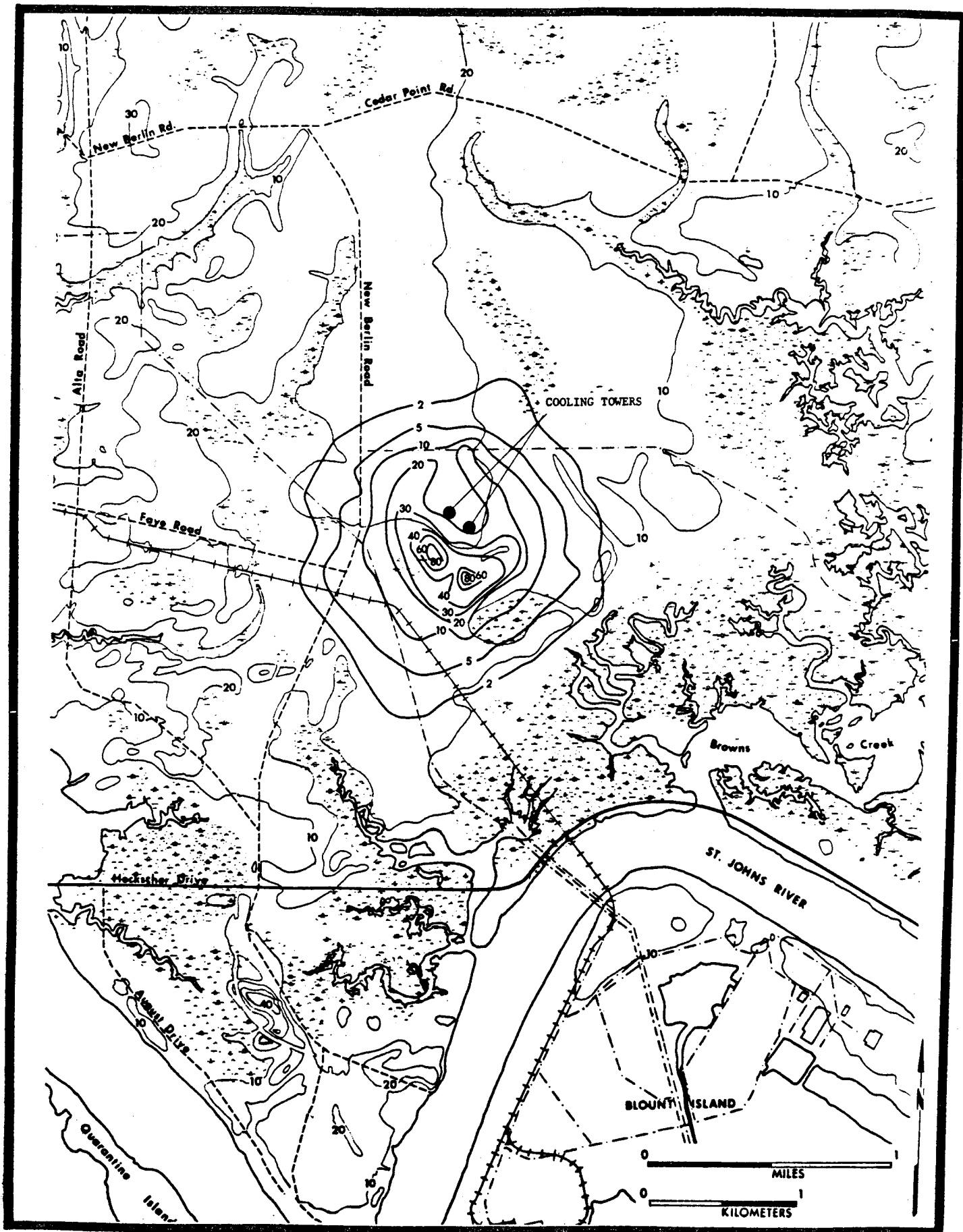


Figure 5.4-8 Seasonally Averaged Water Deposition for Winter in $\text{mg/m}^2/\text{hr}$

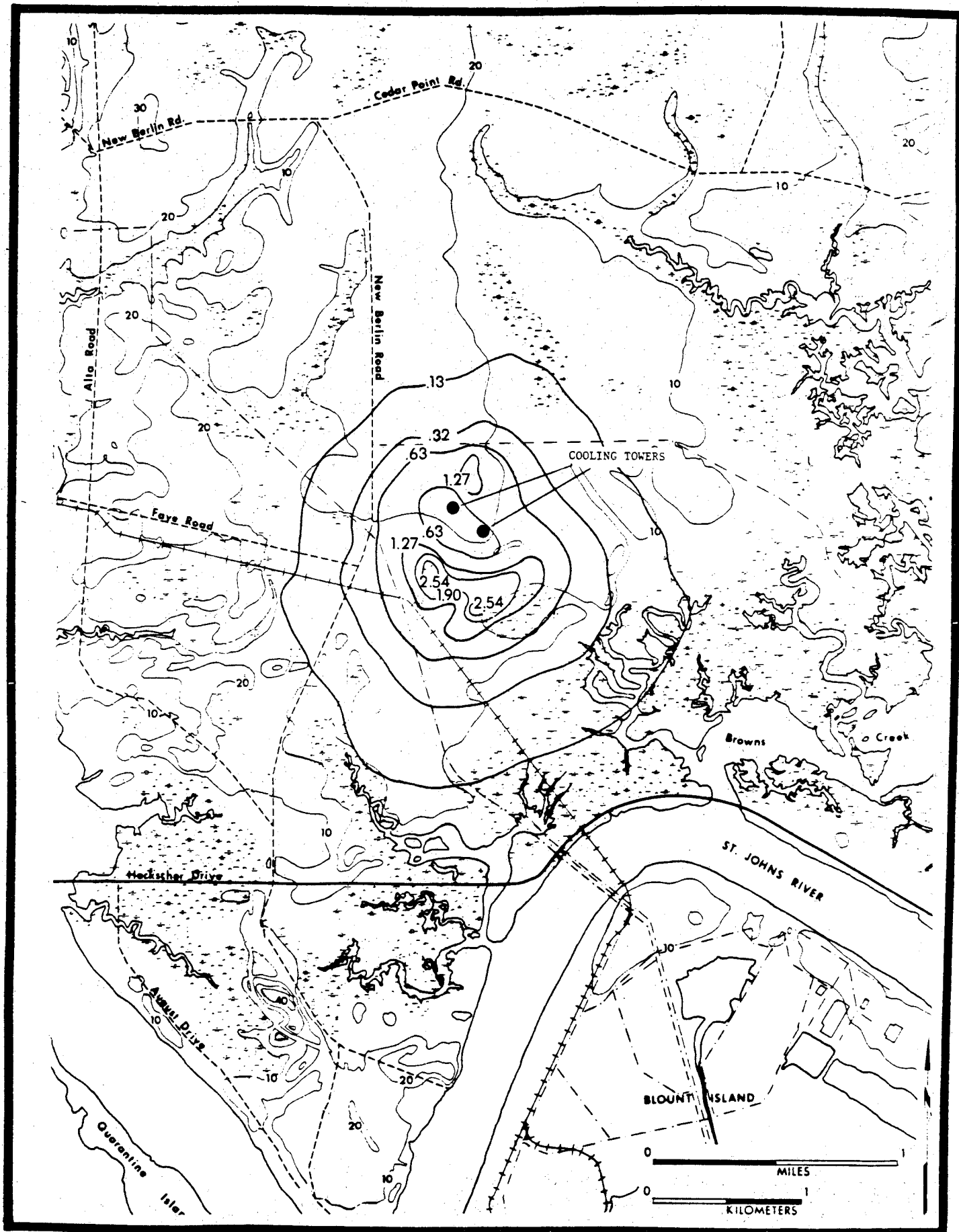


Figure 5.4-9 Seasonally Averaged Salt Deposition for Spring in $\text{mg/m}^2/\text{hr}$

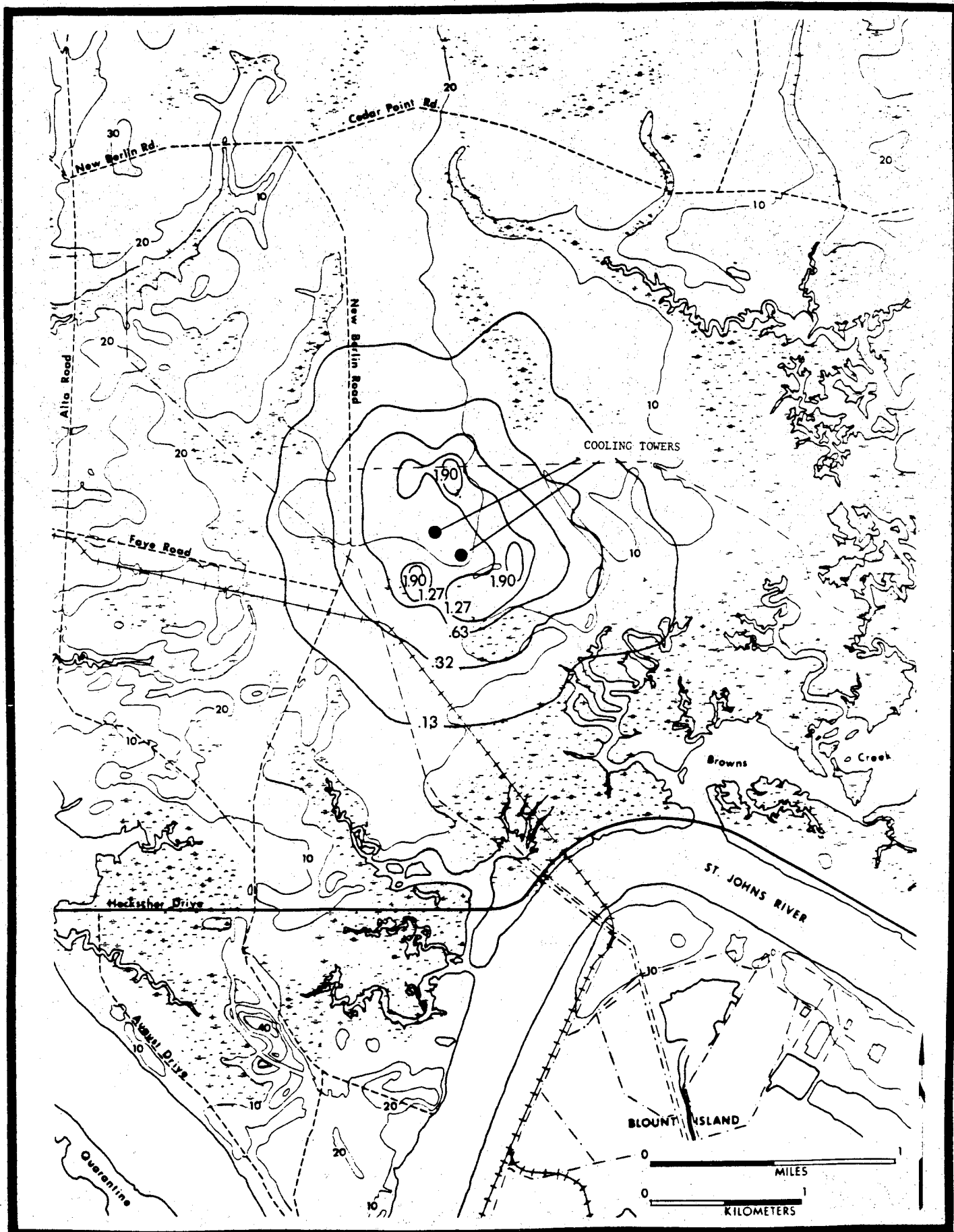


Figure 5.4-10 Seasonally Averaged Salt Deposition for Summer
in $\text{mg/m}^2/\text{hr}$

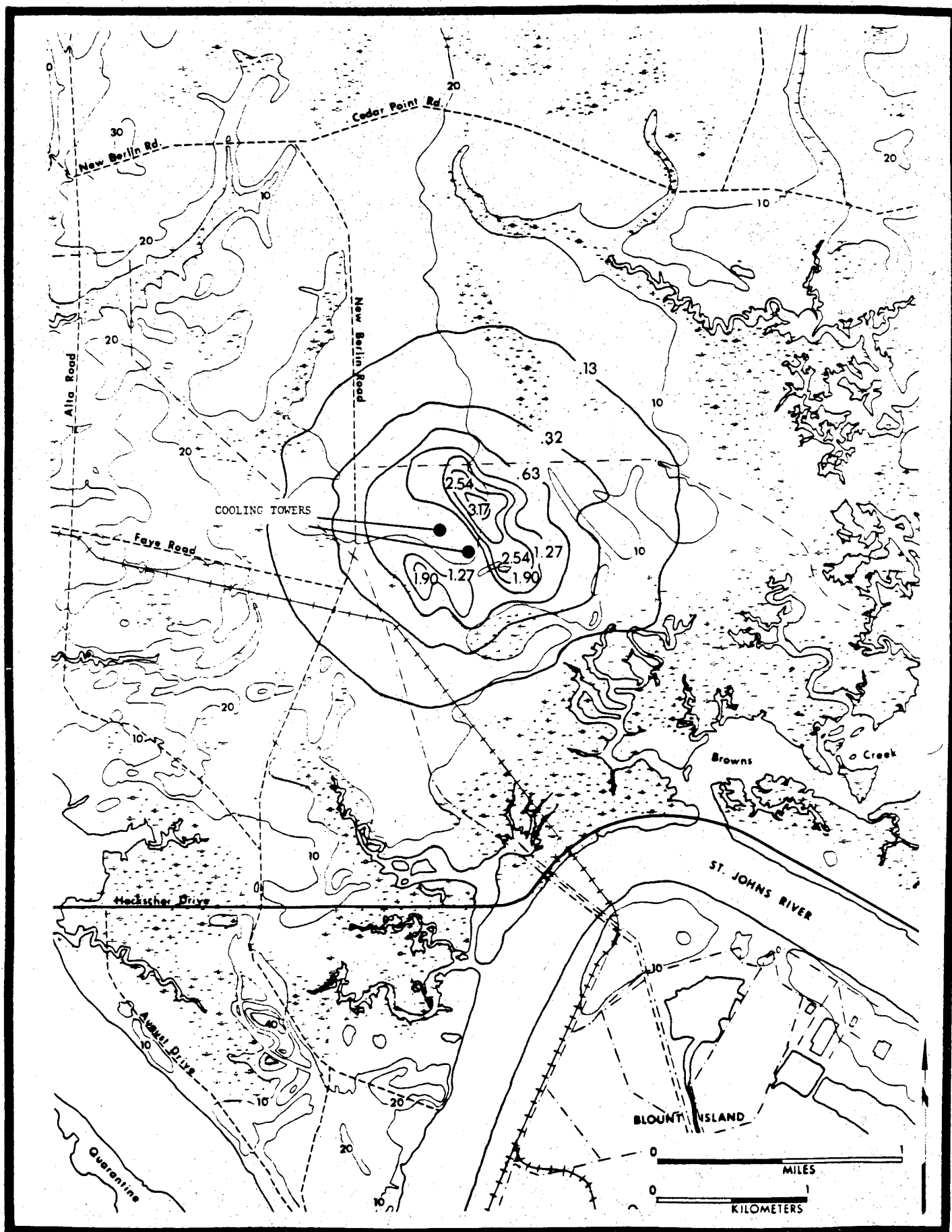


Figure 5.4-11 Seasonally Averaged Salt Deposition for Fall in $\text{mg/m}^2/\text{hr}$

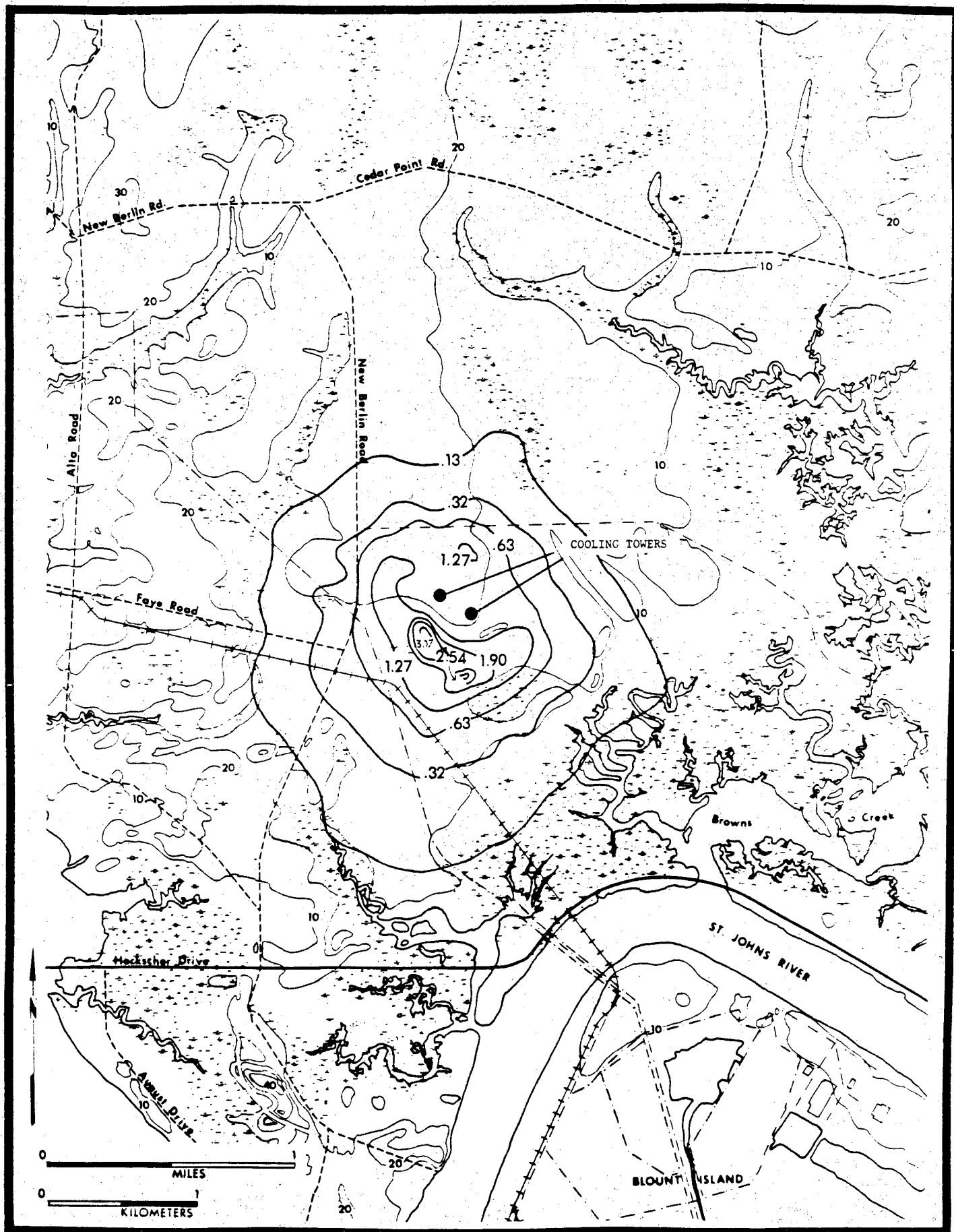


Figure 5.4-12 Seasonally Averaged Salt Deposition for Winter in $\text{mg}/\text{m}^2/\text{hr}$

Image Quality

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

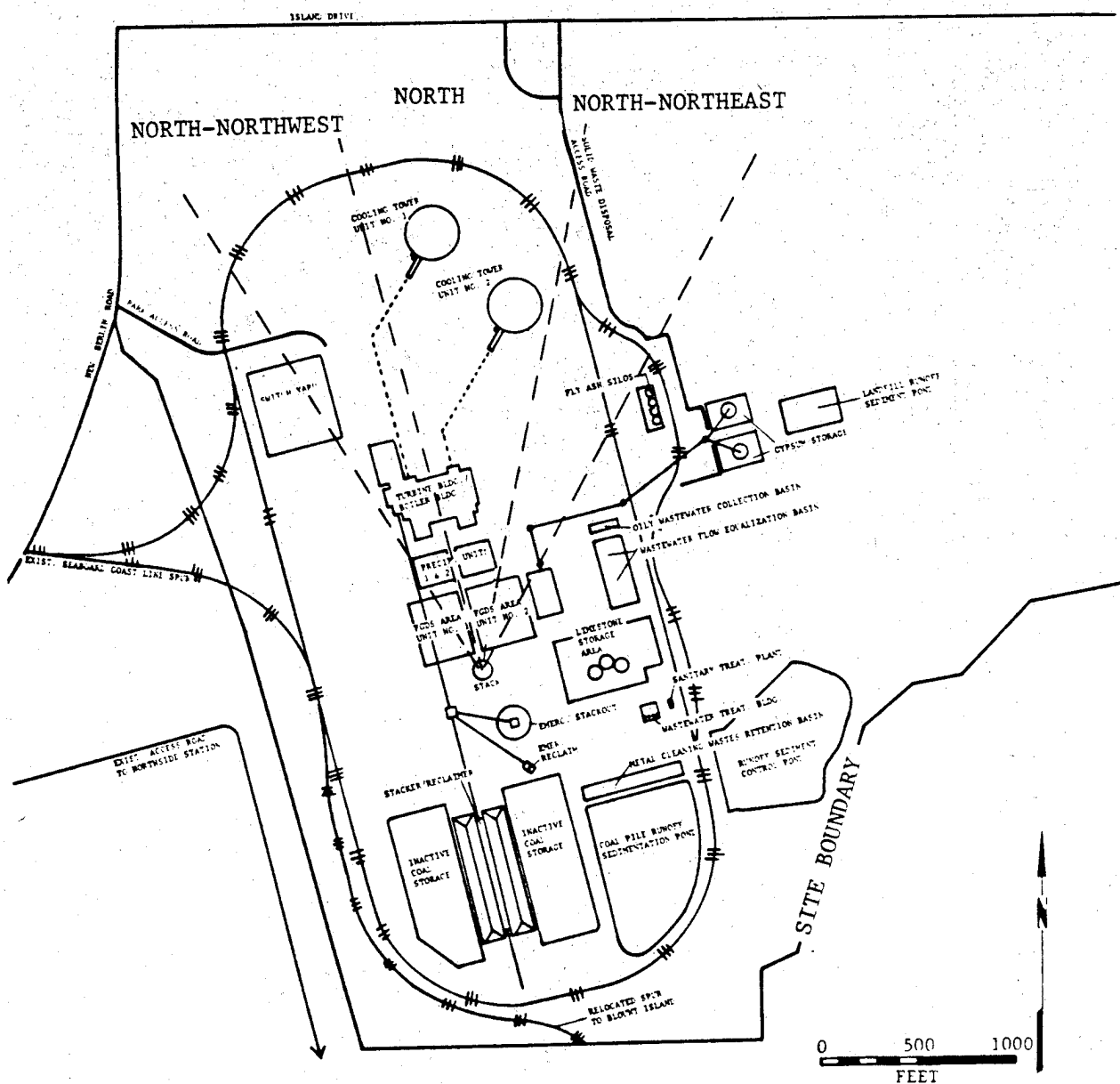


Figure 5.4-13 Relative Orientation of Cooling Towers & Main Plant Stack

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

- Baldwin, C.J., 1980. Environmental Impact of Transmission Systems. Presented in the Westinghouse Electric Corporation Transmission and Distribution Technology Forum. Pittsburgh, Pennsylvania.
- 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.
- U.S. Department of the Interior and U.S. Department of Agriculture. Environmental Criteria for Electric Transmission Systems. U.S. Government Printing Office. Washington, DC.

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.

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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	<u>1271</u>	<u>2.5</u>
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	<u>118</u>	<u>0.2</u>
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.
South	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.
	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 Cutoff	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	Key ^b	Area	Daily Average No. Viewers	Impact
West	J	Heckeher Drive at Dunn Creek	16,136c	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

<u>Direction</u>	<u>Key</u> ^a	<u>Area</u>	<u>Impact</u>
East	1	Marshes and Hecksher 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)
VIEWSHED AND PROJECTED IMPACTS - PROPOSED COAL UNLOADING FACILITIES

<u>Direction</u>	<u>Key</u> ^a	<u>Area</u>	<u>Impact</u>
North	-	Heckacher 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

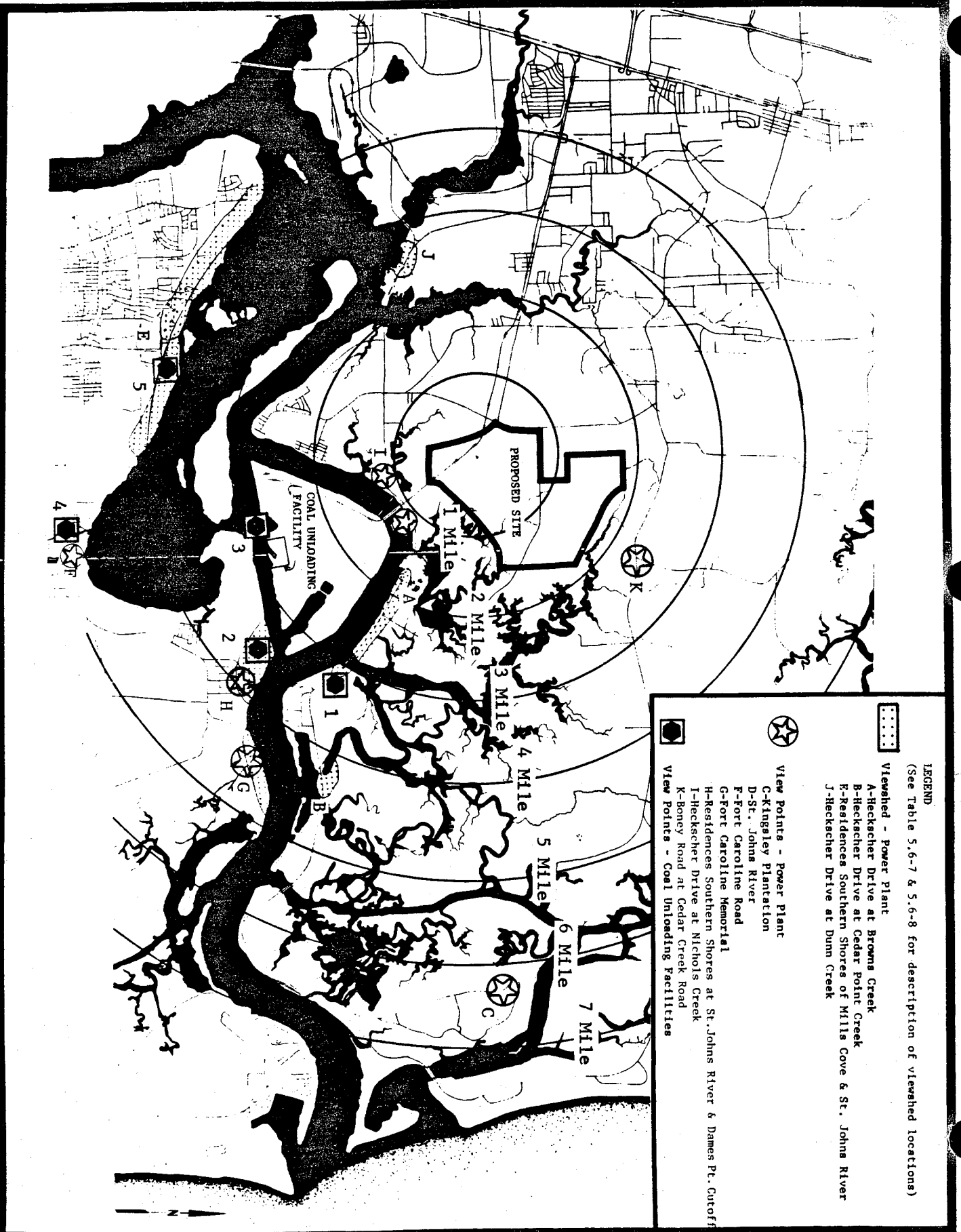
As a result of the addition of a treatment facility for coal pile runoff on Blount Island, this table is no longer applicable.

Table 5.6-11

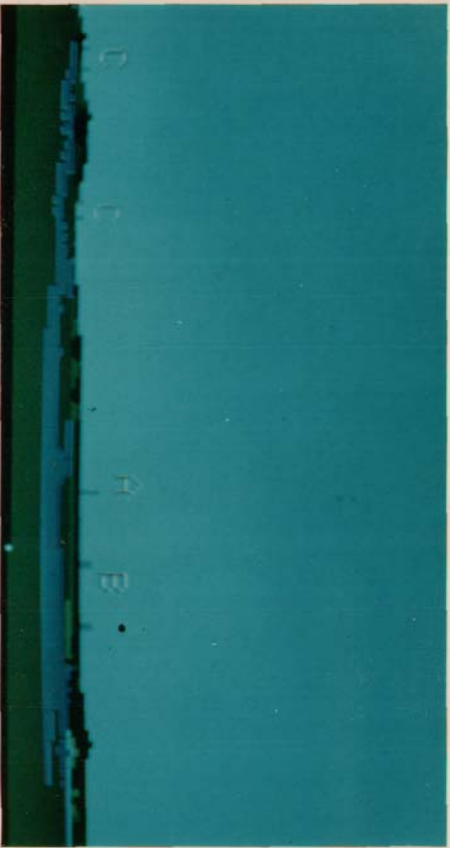
Deleted in Revision 1

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

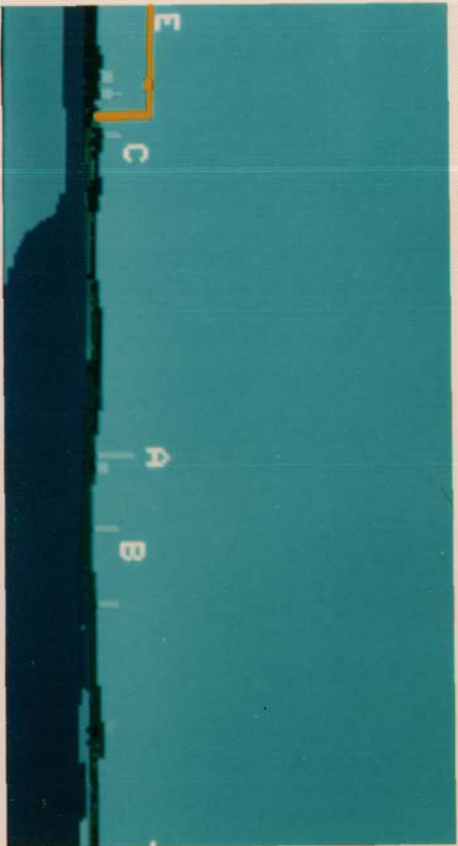
Figure 5.6-1 Viewshed and Point Locations



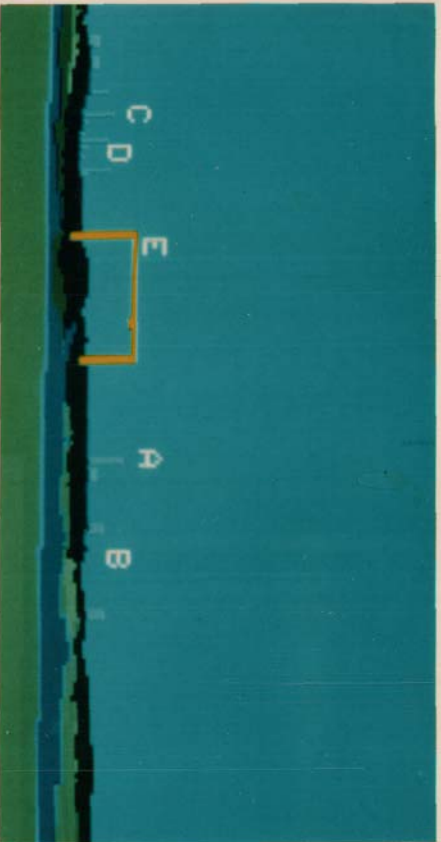
c - VIEW FROM KINGSLEY PLANTATION



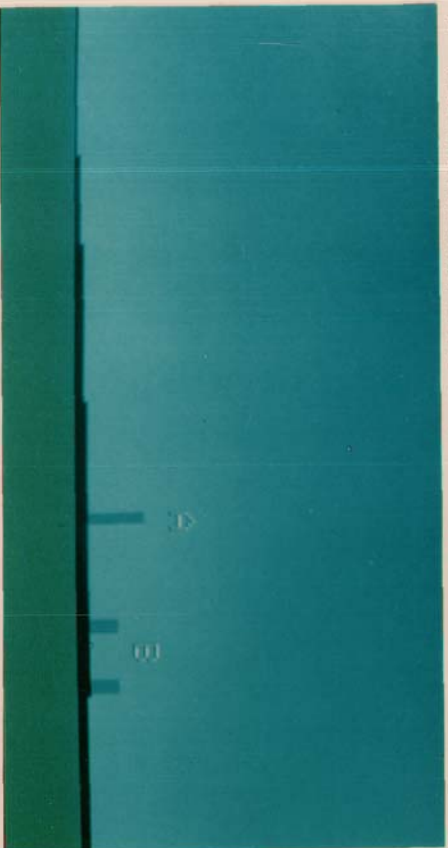
g - VIEW FROM FORT CAROLINE MEMORIAL



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



k - VIEW FROM BONEY ROAD AT CEDAR CREEK ROAD



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

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

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).

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. When operating concurrently with NGS, approximately 130,000 m³/day (23,850 gpm) of cooling water will be recirculated from the proposed plant to NGS intake, thus reducing cooling water requirements and associated entrainment from Blount Island Channel. Combined operation is expected to reduce yearly ichthyoplankton entrainment 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).

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.