TRC

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SULFUR DIOXIDE AIR QUALITY COMPLIANCE MODELING FOR AREAS SURROUNDING MARTINS CREEK STEAM ELECTRIC STATION USING AERMOD

Prepared for

PP&L, Inc.
Allentown, Pennsylvania

Prepared by

TRC Environmental Corporation
Windsor, Connecticut

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TRC Project No. 25845-0000-00000
June, 1999

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ACKNOWLEDGMENTS

This study was conducted by TRC Environmental Corporation for PP&L, Inc. based on discussions with and recommendations from the Pennsylvania Department of Environmental Protection, New Jersey Department of Environmental Protection, United States EPA Regions II and III, GPU Generation and ENSR Corporation, a consultant to GPU.

EXECUTIVE SUMMARY

This report describes the procedures and results of the dispersion modeling analysis conducted to evaluate predicted sulfur dioxide concentrations in the vicinity of PP&L, Inc.'s Martins Creek Steam Electric Station (MCSES). Modeling of MCSES and other nearby sources was conducted to evaluate compliance with the sulfur dioxide National Ambient Air Quality Standards (NAAQS) in areas surrounding the plant, including the Warren County, New Jersey sulfur dioxide nonattainment area.

Procedures for the modeling study were developed in consultation with the Pennsylvania Department of Environmental Protection (DEP), New Jersey Department of Environmental Protection, EPA Regions II and III and GPU Generation. GPU's Portland Station is one of a few other sources that were included in the study in addition to MCSES. Preliminary compliance modeling had identified areas of concern within the nonattainment area where predicted concentrations needed further evaluation. Therefore, PP&L and GPU worked with the agencies to further refine the accuracy of the modeling studies, which culminated in this study.

The regulatory agencies requested that the modeling evaluation be expanded to include other areas in the vicinity of MCSES and Portland Station as well as the Warren County nonattainment area. As a result of this request, PP&L and GPU identified an expanded area around MCSES and GPU's Portland Station, which includes the Warren County, New Jersey sulfur dioxide nonattainment area, Kittatinny Ridge, which is situated to the north and northwest of the two power plants, and other areas of potential concern. Based on discussions with the regulatory agencies, this expanded modeling domain was divided into a northern domain and a southern domain. MCSES and most of the nonattainment area are located in the southern domain and Portland Station, Kittatinny Ridge and the northern portion of the nonattainment area (Jenny Jump Mountain) are located in the northern domain. This report describes the results of the evaluation of the southern domain. GPU submitted a report of the evaluation of the northern domain.

The EPA's AERMOD dispersion model was used for the evaluation. Due to the recent availability of AERMOD (dated 98314), to be formally proposed by U.S. EPA for guideline status, the involved regulatory agencies suggested the use of AERMOD. Approximately one year of hourly ambient sulfur dioxide measurements, meteorological data and emissions data

collected by PP&L near MCSES comprised one of the data sets that EPA used to evaluate AERMOD during its development.

In addition to MCSES and Portland Station, the Hoffman LaRoche plant and the Warren County Resource Recovery Facility, both located within the Warren County, New Jersey nonattainment area, were modeled and a regional background concentration was added to represent small or distant sources that were not explicitly modeled. The sources were modeled with AERMOD using three years of onsite meteorological data collected near MCSES. Ambient sulfur dioxide concentrations were predicted at a Cartesian receptor grid throughout the modeling domain and at additional discrete receptor locations that had been used in previous evaluations of the nonattainment area. The predicted concentrations were evaluated for compliance with the sulfur dioxide National Ambient Air Quality Standards.

The MCSES sources modeled consist of two 150 MW coal-fired boilers, two 850 MW No. 6 oil and natural gas-fired boilers, a No. 2 oil-fired auxiliary boiler and four No. 2 oil-fired combustion turbines.

The following are the conclusions of this modeling evaluation of the southern modeling domain.

MCSES Combustion Turbines. Initial modeling of the four MCSES combustion turbines at the allowable fuel oil sulfur content of 0.5 percent indicated that predicted concentrations from these units would exceed the NAAQS at locations close to the plant. PP&L decided to reduce the sulfur content to 0.1 percent sulfur. The study was conducted with the turbines at this revised sulfur content. This level of emissions reduction reduced the maximum ambient impact from the combustion turbines to approximately one-half of the NAAQS.

Predicted 3-Hour Concentrations. The controlling (highest second-highest) predicted 3-hour concentration from all sources modeled and the addition of a background concentration is 1298.3 $\mu g/m^3$, which is below the 3-hour NAAQS level of 1300$\mu g/m^3$. This concentration is predicted on the Scotts Mountain portion of the Warren County nonattainment area and is primarily contributed to by MCSES. Initial modeling indicated that the highest second-highest 3-hour concentration would exceed the NAAQS. The Units 1&2 emissions rate of 4.0 lb/MMBtu was reduced to 3.9 lb/MMBtu and the modeling was re-done, which reduced the prediction to 1298.3 $\mu g/m^3$.

Predicted 24-Hour Concentrations. The controlling (highest second-highest) 24-hour predicted concentration from all sources (plus background) is 334.5 $\mu g/m^3$, which is below the 24-hour NAAQS of 365 $\mu g/m^3$.

Predicted Annual Average Concentrations. The highest annual average predicted concentration is 71.0 μg/m3, which is below the annual average NAAQS of 80 $\mu g/m^3$.

The results of this dispersion modeling analysis demonstrate attainment of the NAAQS when the combined sulfur dioxide emissions rate of coal-fired Units 1&2 is reduced from 4.0 lb/MMBtu to 3.9 lb/MMBtu and the sulfur content of the fuel oil for the combustion turbines is reduced to 0.1 percent. The restriction to 0.1 percent sulfur for the combustion turbines is more than sufficient to assure that predictions from those units do not exceed the NAAQS close to the plant. The 3.9 lb/MMBtu emissions rate from the coal units would only be necessary to assure attainment when the other large units (Units 3 and 4) were burning oil.

A companion dispersion modeling evaluation of the northern domain was conducted by GPU using the same dispersion model and general modeling procedures that were used in this modeling evaluation of the southern domain. The results of the northern domain evaluation (ENSR, 1999) indicate compliance with the NAAQS at present, permitted emissions for MCSES, Portland Station and other sources.

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1.0 INTRODUCTION

The Pennsylvania Department of Environmental Protection (DEP), the New Jersey Department of Environmental Protection and the Environmental Protection Agency (EPA) Regions II and III have been working with PP&L, Inc. and GPU Generation, Inc. to evaluate the impacts of sulfur dioxide (SO_2) emissions from PP&L's Martins Creek Steam Electric Station, GPU's Portland Station and other nearby sources in the Warren County, New Jersey nonattainment area. The area is being evaluated for compliance with the SO_2 National Ambient Air Quality Standards (NAAQS). Concern has primarily focused on the high terrain portions of the nonattainment area. Because the preliminary compliance modeling identified areas of concern within the nonattainment area where predicted concentrations needed further evaluation, PP&L and GPU have been working with the agencies to further refine the accuracy of the modeling studies.

The Pennsylvania DEP and the other involved agencies requested that other areas of possible high predicted concentrations from MCSES or Portland Station be included in the evaluation. As a result of this request, PP&L and GPU identified an expanded area around MCSES and Portland Station, which includes the Warren County, New Jersey SO_2 nonattainment area, Kittatinny Ridge, which is situated to the north and northwest of the two power plants, and other areas of potential concern. Based on discussions with the regulatory agencies, this expanded modeling domain was divided into a northern domain and a southern domain. MCSES and most of the nonattainment area are located in the southern domain and Portland Station, Kittatinny Ridge and the northern portion of the nonattainment area (Jenny Jump Mountain) are located in the northern domain.

This study addresses the modeling conducted to evaluate predicted concentrations in the southern domain, based on the protocol for the study (PP&L, 1999) and subsequent comments by the regulatory agencies. GPU conducted a modeling evaluation of the northern domain (ENSR, 1999). Figure 1-1 presents the entire modeling domain and prominent features of the northern and southern domains.

The EPA's AERMOD model was used for the evaluation. AERMOD was recently developed through a collaborative effort of EPA and the American Meteorological Society (Cimorelli et al., 1998). Due to the recent availability of AERMOD (dated 98314), to be formally proposed by U.S. EPA for guideline status, the involved regulatory agencies suggested that compliance modeling be conducted using AERMOD. During the development of AERMOD, PP&L provided approximately one year (May 1, 1992 through May 19, 1993) of meteorological, air quality and hourly emissions data from MCSES to the EPA to be one of several data sets used to evaluate AERMOD.

AERMOD is designed to optimally use a full vertical profile of meteorological variables consisting of wind speed, wind direction, temperature and turbulence characteristics. However, AERMOD will also accept a more limited meteorological data set. The MCSES meteorological data set used in the AERMOD evaluation by EPA consisted of onsite 10 meter meteorological data and upper level SODAR wind measurements from 90 meters to 420 meters above the surface, but not tower temperature or turbulence data collected above the 10 meter level. On the basis of the performance of AERMOD with that data set, the EPA concluded that AERMOD produced reasonable results for MCSES using 10 meter tower data and SODAR data and asked PP&L to consider using all three years of onsite MCSES data collected from July 1991 through June 1994. The first two years contain 10 meter tower data and SODAR data and the third year contains additional temperature and turbulence data collected on a 100 meter tower. This study was conducted using all three years of data.

This report describes the data and dispersion modeling procedures that were used to evaluate compliance with the NAAQS in the southern domain. The evaluation included the use of the AERMOD model, three years of onsite meteorological data, the same (but updated) emissions inventory as has been used in previous evaluations of the Warren County nonattainment area (e.g., TRC, 1997) and a prediction location (receptor) array that has been expanded beyond the Warren County SO_2 nonattainment area.

Section 2 of this report describes the input data used for the study, Section 3 describes the dispersion modeling procedures, Section 4 presents the results and Section 5 presents the conclusions of the study.

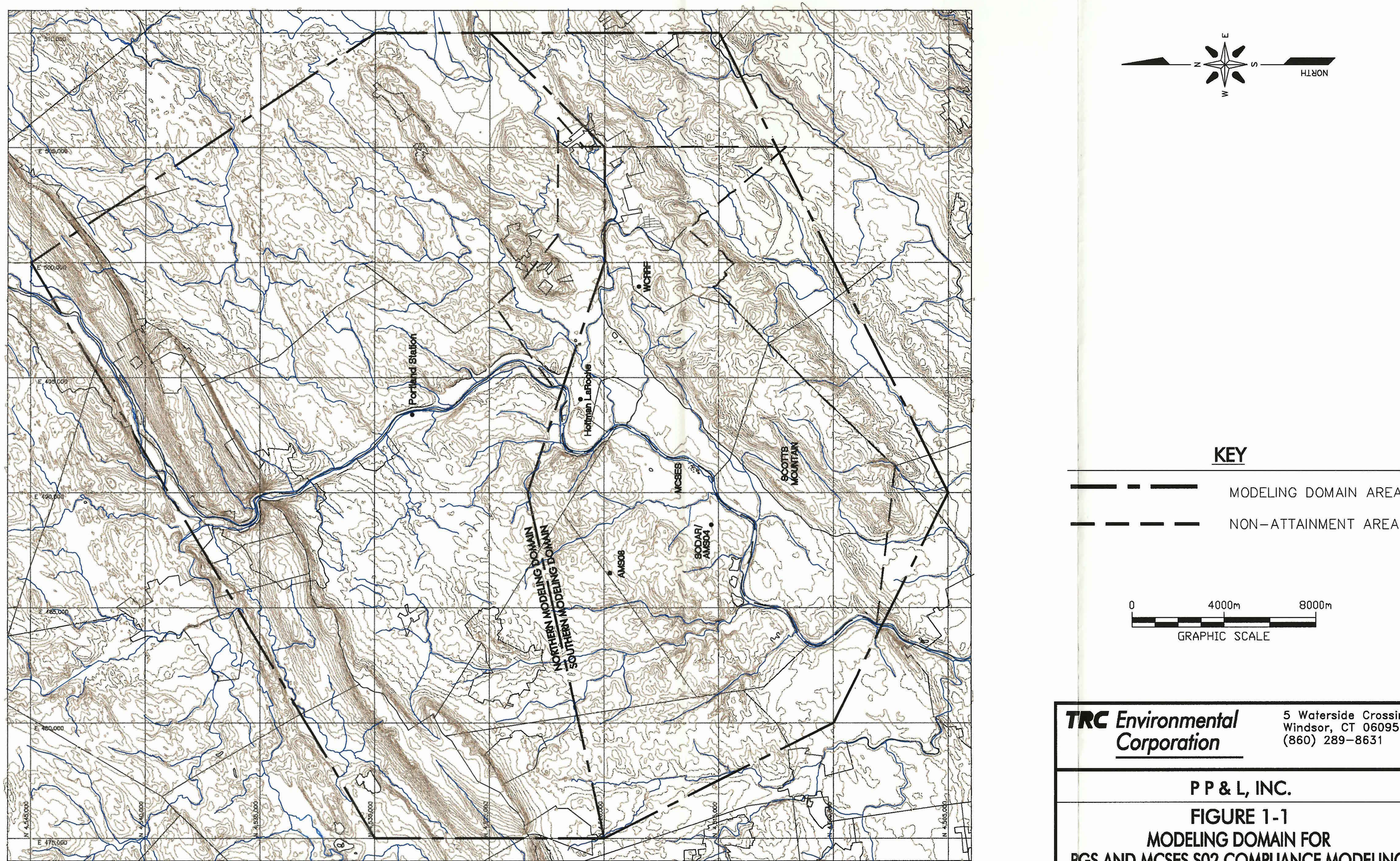

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FIGURE 1-1
MODELING DOMAIN FOR
PGS AND MCSES S02 COMPLIANCE MODELING

Date: 05/31/99 | Project No. 25845-0000-00000

25845\FIG1-1A

2.0 INPUT DATA

2.1 Emissions Inventory

The emissions sources that were modeled are the same sources that have been modeled in previous evaluations of the Warren County, New Jersey SO_2 nonattainment area. These are PP&L's Martins Creek Steam Electric Station (MCSES), GPU's Portland Station, Hoffman LaRoche and the Warren County Resource Recovery Facility.

MCSES Sources

PP&L operates two coal-fired units (Units 1&2) and two large No. 6 oil-fired units (Units 3&4) at MCSES. The coal-fired units are 150.25 megawatts (MW) each, and exhaust to a common 600-foot stack. Units 3 and 4 are 850.5 MW each and exhaust to separate 600-foot stacks. Although Units 3 and 4 are also permitted to burn natural gas, their SO_2 emissions are much greater when burning No. 6 oil, for which their emission rates were based for this study. The coal-fired units were initially modeled at their emission limit of 4 lb/MMBtu; however, as discussed in Section 3, this emissions rate was adjusted to 3.9 lb/MMBtu for the final modeling. The fuel oil sulfur content for Units 3&4 is limited to a maximum of 1 percent. There are also a few smaller sources at MCSES that operate infrequently, but were included in the study. These are auxiliary boiler 4B used to start-up Units 3&4 and four combustion turbines (CTs) used for peaking purposes. These smaller sources burn No. 2 fuel oil. Auxiliary boiler 3A has been converted to natural gas. Therefore, based on discussions with the regulatory agencies, because it has minimal SO_2 emissions it was not included in the modeling analysis. Auxiliary boiler 4B has a relatively tall stack (210 feet), while the CTs have low stacks (53 feet). The auxiliary boiler was modeled at its allowable fuel sulfur content of 0.5 percent. The combustion turbines were initially modeled at an emissions rate corresponding to the allowable fuel oil sulfur content of 0.5 percent; however, as discussed in Section 3, the sulfur content was reduced to 0.1 percent for the final modeling runs.

MCSES Units 1-4 were modeled at both 100 percent and 50 percent load. The four CTs were included in the modeling analysis at 100 percent load for both the 100 percent and 50 percent load condition of Units 1-4. Because auxiliary boiler 4B operates only during low-load, start-up conditions of Units 3&4, it was only included in the modeling analysis of the low load (50 percent) operation of Units 1-4.

An analysis of the geometry of structures and stacks in accordance with EPA's Good Engineering Practice (GEP) stack height guidance shows that all of the MCSES sources may be subject to aerodynamic downwash effects. Emissions from the 600-foot stacks may be subject to downwash from the 416-foot cooling towers at the plant, while the shorter stacks may be affected by the cooling towers as well as other structures at the plant. Therefore, EPA's BPIP software was used to determine the directionally dependent building dimensions used in AERMOD (which has an algorithm parallel to that currently in ISCST3 for downwash).

Neither the GEP formula nor the downwash algorithms in ISCST3 or AERMOD account for the streamlined design of the cooling towers. In consultation with the EPA and the Pennsylvania DEP, the New Jersey DEP has suggested that a rectangular structure with a height of 90 meters, a length of 180 meters, and a width of 90 meters can be used to represent the cooling towers in the BPIP analysis. These dimensions give a formula GEP height of 225 meters, which is consistent with the results of a fluid modeling study conducted for the Units 1&2 stack.

Portland Station

GPU operates two coal-fired units (Units 1 and 2 with net generation of 158 and 243 MW, respectively), one large simple-cycle combustion turbine (134 MW, Unit 5) and two smaller simple cycle combustion turbines (Units 3 and 4) at Portland Generating Station. The combustion turbines are permitted for either natural gas or No. 2 oil. The coal units will be modeled at an SO_2 emission rate of 4 lb/MMBtu. The SO_2 emissions for the combustion turbine units are based on a fuel oil sulfur content of 0.5 percent for Units 3 and 4 and 0.05 percent for Unit 5. Each of the coal-fired units exhausts to a separate 400-foot stack. The respective stack heights for the three combustion turbines (Units 3, 4 and 5) are 29 feet, 30 feet and 140 feet. Modeling of Units 3 and 4 accounted for aerodynamic downwash based on directional specific building dimensions provided by GPU. The plant base elevation is 294 feet above sea level. The Portland Station coal units were modeled at 100 percent and 50 percent load. The combustion turbines were modeled at 100 percent load under both coal unit load scenarios.

Hoffman LaRoche and the Warren County Resource Recovery Facility

The Hoffman LaRoche and Warren County Resource Recovery Facility (WCRRF) plants, which are located within the nonattainment area, were also included in the modeling inventory. The Hoffman LaRoche SO_2 emissions inventory was revised since earlier compliance modeling analyses of the nonattainment area. The four boilers at the plant now burn 0.05 percent sulfur No. 2 oil rather than No. 6 oil with a sulfur content of 1 percent. The total SO_2 emissions from the plant are now emitted through one 55-foot stack at an allowable emissions rate of 37.6 lb/hr. WCRRF has an SO_2 emissions rate of 0.225 lb/MMBtu and two identical 250-foot stacks.

Table 2-1 presents the maximum operating level, the SO_2 emissions limit and the resulting SO_2 emissions rate for each source that was modeled. Table 2-2 presents the short-term maximum emissions rates and stack parameters for Martins Creek and Table 2-3 presents the same information for Portland Station, Hoffman LaRoche and WCRRF. For the annual average compliance assessment, the initial modeling assumed short-term maximum emissions from all sources.

2.2 Meteorological Data

At the request of the Pennsylvania DEP, New Jersey DEP and EPA, three years of onsite SODAR and tower meteorological data collected near MCSES from July 1991 through June 1994 were used for the modeling analysis. Concurrent twice daily upper air meteorological soundings from the Albany, NY National Weather Service (NWS) station and back-up 10 meter meteorological data from the Allentown, PA NWS station provided the remaining data needed for input into AERMOD. The data were used to create three distinct years of data for the modeling analysis: July 1991 through June 1992, July 1992 through June 1993 and July 1993 through June 1994.

Subsection 2.2.1 describes the meteorological data, Subsection 2.2.2 describes the data processing procedures and Subsection 2.2.3 describes the site-specific surface characteristics that were used.

2.2.1 Data Description

The onsite data consist of tower data collected at PP&L's AMS-4 and AMS-8 towers and SODAR data collected at a site collocated with the AMS-4 tower. The SODAR and AMS-4 site is located 2.5 km to the WSW of MCSES at a base elevation of 320 feet. The SODAR data consist of wind speed, wind direction and standard deviation of vertical wind speed (sigma-w) collected at 30 meter height increments from 90 meters to 420 meters. The AMS-4 data consist of 10 meter wind speed, wind direction, standard deviation of the horizontal wind direction (sigma-theta) and temperature data. The AMS-8 tower is located 6 km to the NW of MCSES at a base elevation of 810 feet. This tower was upgraded in 1993 to collect wind speed, wind direction and standard deviation of the horizontal wind direction (sigma-theta) data at the 10 meter, 60 meter and 100 meter levels; sigma-w and temperature data at the 100 meter level; temperature differences (delta-T) between the 10 meter, 60 meter and 100 meter levels; and total incoming solar radiation at the 2 meter level. Prior to the AMS-8 tower upgrade in 1993, temperature data were collected at the 10 meter level and wind speed, wind direction and sigma-theta data were collected at the 10 meter and 20 meter levels. The data are summarized in Table 2-4.

The only period and sites that PP&L collected meteorological data for intended regulatory application was the period of the model evaluation study (May 1, 1992 through May 19, 1993), for the SODAR and AMS-8 tower data. This is evident from the high data capture rates during this period at these sites, as shown in Table 2-4. The July 1992 through June 1993 modeling year most closely matches the model evaluation period, although tower data for the model evaluation were taken from AMS-8 rather than AMS-4. Data capture for the performance evaluation period and site is over 90 percent. Data capture for the other periods and site is over 85 percent.

All three years of data were used for the compliance modeling evaluation. Due to the complex terrain location, periods for which only 10 meter data are available would provide unreliable predictions and PP&L feels that they could be excluded from the analysis.

2.2.2 Meteorological Data Processing

The meteorological data were processed with the AERMET meteorological model to provide "profile" and "surface" meteorological data files for input into AERMOD. The profile file consists of hourly wind speed, wind direction, temperature, sigma-theta and sigma-w data at available height levels between 10 meters to 420 meters. The surface file consists of hourly wind speed, wind direction and temperature data, surface characteristics (albedo, surface roughness length and Bowen ratio) and calculated boundary layer parameters (heat flux, Monin-Obokhov length, friction velocity, convective velocity scale, convective and mechanically-driven boundary layer heights and vertical potential temperature gradient above the boundary layer). In addition to meteorological data, it is necessary to provide local surface characteristics to calculate several of the boundary layer parameters in the surface file. These site-specific surface characteristics are discussed in Subsection 2.2.3.

AERMOD will make use of an extensive, vertical profile of meteorological variables when such measurements are available, but will also accept a less complete data set if the full set of measurements is not available. For this study, each of the three years of data were processed with AERMET to make use of the most complete data set (when available) and to be consistent with data processed previously for EPA by Pacific Environmental Services, Inc. (PES) when the full set of measurements was not available (PES, 1998). (EPA used the MCSES data, including meteorological data, ambient sulfur dioxide measurements and hourly, actual emissions data from May 1, 1992 through May 19, 1993 for the evaluation of AERMOD, and the meteorological data were processed by PES.)

July 1991 through June 1993 data. The period of the EPA/PES AERMOD model evaluation was May 1, 1992 through May 19, 1993. PP&L's AMS-4 tower data and the SODAR data were used by PES to create the meteorological data files for the evaluation. This meteorological data set was used unaltered for the compliance modeling analysis. The May 1, 1992 through June 30, 1992 portion of the PES data set made up that portion of the July 1991 through June 1992 data year used for this study and the July 1, 1992 through May 19, 1993 portion of the PES data set made up that same portion of the July 1992 through June 1993 data set.

The remainder of the meteorological data for the July 1991 through June 1993 period were processed using the AMS-4 data and SODAR data, to be consistent with the data and procedures used by PES for processing the data for the evaluation period.

July 1993 through June 1994 data. The meteorological data processing for the period July 1993 through June 1994 took advantage of the more complete set of meteorological variables that were collected on the AMS-8 tower during that period. The data used consisted of AMS-8 10 meter wind speed, wind direction and sigma-theta measurements; SODAR wind speed, wind direction and sigma-w values at 30-meter height increments from 90 meters to 420 meters; and AMS-8 temperatures at the 10 meter, 60 meter and 100 meter levels based on the temperatures from the 100 meter tower level and the respective delta-T values. Tower measurements at the 10 meter level were taken from the AMS-8 tower rather than from AMS-4, to assure consistency among the 10 meter tower data and data from the upper levels of the AMS-8 tower. If the SODAR data were missing at all levels, wind speed and wind direction data were substituted into the 60 and 100 meter levels of the profile from the respective tower levels. A minimum sigma-w value of 0.05 m/s was used. If all SODAR sigma-w data were missing, the 100-meter tower sigma-w values from a propeller anemometer were used as backup. If onsite wind speed, wind direction or temperature data were missing at all levels below 100 meters, AERMET automatically substituted the NWS data.

Since the SODAR provides a vertical profile of sigma-w, using the SODAR sigma-w values for this period (July 1993 through June 1994) is consistent with using the full compliment of available meteorological measurements for this modeling year. Recent revisions to EPA's onsite meteorological guidance document (Systems Applications International, 1998) indicate that sigma-w values from SODAR are in reasonable agreement with tower-based values.

2.2.3 Surface Characteristics

The AERMET meteorological preprocessor accepts monthly varying surface roughness lengths (z_o), albedos and Bowen ratios in order to characterize the boundary layer. These surface characteristics depend on the surface ground cover, moisture and vegetation and, accordingly, are site specific and vary temporally. The surface roughness lengths that were used for this study are presented in Table 2-5 and the albedo and Bowen ratio values are presented in Table 2-6.

The roughness lengths used for the July 1991 through June 1993 data sets are the values that were used for the MCSES meteorological data set developed by PES for EPA for the testing of AERMOD. For that evaluation, the roughness lengths were partitioned into two sectors around AMS-4. One sector is from 260 degrees to 180 degrees and the other is from 180 degrees to 260 degrees. For the other year of meteorological data (July 1993 through June 1994), the AMS-8 surface meteorological station was used rather than AMS-4. For this site, the sectors based on the AMS-4 site are inappropriate since the land use is relatively homogeneous surrounding the AMS-8 site. The average of the values from the two AMS-4 sectors was judged to be reasonable for AMS-8 and was used.

The Bowen ratio is the ratio of sensible to latent heat flux at the surface and the albedo is a measure of the reflectivity of solar radiation from the surface. Monthly values were determined from the monthly precipitation and snow cover data at the Allentown NWS station during the modeling period and guidance provided in the AERMET user's guide. Months were classified as wet, normal or dry based on comparisons with the normal precipitation amounts reported in the <u>Comparative Climatic Data for the United States</u> (NCDC, 1998).

Table 2-1: Sulfur Dioxide Emissions for the Sources Modeled

Source	Emissions Limit (lb/MMBtu)	Operating Level (MMBtu/hr)	SO2 Emissions At 100% Load[1] (g/s)
MCSES			
Unit 1 (coal)	3.9[2]	1815	891.9
Unit 2 (coal)	3.9	1815	891.9
Unit 3 (#6 oil)	1.14[3]	7721.2	1109.1
Unit 4 (#6 oil)	1.14	7721.2	1109.1
Aux 4B (#2 oil)	0.52[4]	323	21.2
Each CT (#2 oil)	0.104[5]	349.8	4.58
Portland Station			
Unit 1 (coal)	4.0	1464	737.8
Unit 2 (coal)	4.0	2342	1108.4
Unit 3 (CT)	0.51	257	16.51
Unit 4 (CT)	0.51	348	22.36
Unit 5(CT)	0.063	1512	12.0
Hoffman LaRoche			
(all combined)	0.0494	761	4.74
WCRRF			
Unit 1	0.225	88.8	2.5
Unit 2	0.225	88.8	2.5

Notes:

(1) At 50% load, the operating level and SO_2 emissions are 50% of the 100% load values for MCSES and Portland Station.

(2) Units 1&2 were initially modeled at their permitted emission limit of 4.0 lb/MMBtu. The emission limit was reduced to 3.9 lb/MMBtu based on the initial modeling results.

(3) The lb/MMBtu limit for MCSES oil-fired Units 3&4 is based on 1% sulfur limit and No. 6 oil of 151,148 Btu/gal at 8.58 lb/gal.

(4) The lb/MMBtu limit for MCSES oil-fired Aux Boiler 4B is based on 0.5% sulfur limit and No. 2 fuel oil of 139,131 Btu/gal at 7.2 lb/gal.

(5) The lb/MMBtu limit for the MCSES oil-fired combustion turbines is based on 0.1% sulfur limit and No. 2 fuel oil of 139,131 Btu/gal at 7.2 lb/gal. Initially, a sulfur content of 0.5% was used, however, the sulfur content was revised to 0.1% prior to the final modeling runs.

Table 2-2: MCSES Emissions Inventory

	Units 1&2[1]	Unit 3	Unit 4	Aux 4B	CTs[2]
UTM Coordinates					
Easting	491.020	491.123	491.190	491.190	--
Northing	4515.910	4516.030	4516.068	4516.161	--
Base Elevation (feet)	240	240	240	240	240
Stack Height (meters)	183	183	183	64	16.2
Stack Diameter (meters)	5.3	6.9	6.9	3.0	2.73[3]
Exit Velocity (m/s)					
100%	28.4	33.5	33.5	4.1	53.8[3]
50%[4]	14.2	16.8	16.8	--	--
Exit Temperature (Kelvin)					
100%	410	426	421	650	789
50%	399	407	404	--	--
SO_2 Emissions (g/s)					
100%	1783.8	1109.1	1109.1	21.2	4.58
50%	891.9	554.6	554.6	--	--

Notes:

(1) Units 1&2 exhaust to the same stack. The parameters presented are for both units combined.

(2) Stack parameters are presented for one combustion turbine. Each of the four turbines exhausts to separate, identical stacks. The stack UTM coordinates are:

	East	North
CT1	490.875	4515.886
CT2	490.869	4515.882
CT3	490.853	4515.871
CT4	490.848	4515.868

(3) The combustion turbine stacks were rebuilt in 1991, resulting in a decrease to the effective stack diameters and a corresponding increase in the exit velocities.

(4) Auxiliary boiler 4B and the combustion turbines will only be modeled at 100 percent load.

Table 2-3: Portland Station, Hoffman LaRoche and WCRRF Emissions Inventory

	Portland Station					Hoffman	WCRRF	
	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	LaRoche	Unit 1	Unit 2
UTM Coordinates								
Easting	493.349	493.335	493.013	493.019	493.008	494.050	498.950	498.950
Northing	4528.506	4528.554	4528.462	4528.441	4528.897	4521.040	4518.500	4518.500
Base Elevation (feet)	294	294	294	294	294	340	570	570
Stack Height (meters)	122.0	122.0	8.97	9.22	42.7	16.8	76.2	76.2
Stack Diameter (meters)	2.84	3.61	4.53	4.53	6.1	1.7	1.76	1.76
Exit Velocity (m/s)								
100%	43.3	39.9	12.7	19.1	36.6	12.8	16.3	16.3
50%(1)	21.6	20.0	--	--	--	--	--	--
Exit Velocity (Kelvin)								
100%	403.0	406.0	755.4	844.3	821.5	450.0	389.0	389.0
50%	392.0	395.0	--	--	--	--	--	--
SO_2 Emissions (g/s)								
100%	737.8	1180.4	16.51	22.36	12.0	4.74	2.5	2.5
50%	368.9	590.2	--	--	--	--	--	--

Note:

(1) Hoffman LaRoche, WCRRF and the Portland Station combustion turbines are modeled at 100% load.

Table 2-4: Meteorological Data from PP&L's SODAR and AMS-4 and AMS-8 Towers

Parameter	Instrumentation	Measurement Level	Data Capture(1)		
			7/1991 to 6/1992	7/1992 to 6/1993	7/1993 to 6/1994
Radiation	Eppley Pyranometer Model 8-48	2 meters	NC(2)	NC	99%
Wind Speed	Qualimetrics Model 2030	10 meters	88%	86%	99%
		60 meters	NC	NC	98%
		100 meters	NC	NC	96%
Wind Direction	Qualimetrics Model 2020	10 meters	88%	86%	99%
		60 meters	NC	NC	99%
		100 meters	NC	NC	77% (3)
Sigma-Theta	Qualimetrics Model 2020	10 meters	85%	86%	98%
		60 meters	NC	NC	98%
		100 meters	NC	NC	76% (3)
Temperature	Qualimetrics Model 4480-A	10 meters	99%	99%	NC
		100 meters	NC	NC	99%
Delta-T	Qualimetrics Model 1430	60-10 meters	NC	NC	99%
		100-10 meters	NC	NC	99%
		100-60 meters	NC	NC	99%
Sigma-w	R.M. Young Model 08274/27106	100 meters	NC	NC	98%
Sodar WS, WD, & Sigma-W	AeroVironment Model 8000 Doppler Acoustic Sounder	90-420 meters	86%(4)	98%	92%

Notes:

(1) Data capture for the period July 1991 through June 1993 refers to data collected on the AMS-4 tower and the SODAR data. For July 1993 through June 1994, the data capture is for data collected on the AMS-8 tower and the SODAR data.

(2) "NC" means the parameter was not collected.

(3) The wind direction sensor at the 100-meter level was out of service for several weeks during the 1993/1994 winter.

(4) The SODAR data capture is based on obtaining at least three levels of valid data, per EPA on-site data recommendations.

Table 2-5: Surface Roughness Lengths for Input into AERMET
(Roughness length in meters)

Month	Sector 260 to 180 degrees				Sector 180 to 260 degrees			
	1991	1992	1993	1994	1991	1992	1993	1994
January	---	0.10	0.10	0.20	---	0.30	0.30	0.20
February	---	0.10	0.10	0.20	---	0.30	0.30	0.20
March	---	0.10	0.10	0.20	---	0.30	0.30	0.20
April	---	0.20	0.20	0.35	---	0.50	0.50	0.35
May	---	0.20	0.20	0.35	---	0.50	0.50	0.35
June	---	0.30	0.30	0.45	---	0.60	0.60	0.45
July	0.30	0.30	0.45	---	0.60	0.60	0.45	---
August	0.30	0.30	0.45	---	0.60	0.60	0.45	---
September	0.20	0.20	0.35	---	0.50	0.50	0.35	---
October	0.20	0.20	0.35	---	0.50	0.50	0.35	---
November	0.20	0.20	0.35	---	0.50	0.50	0.35	---
December	0.10	0.10	0.20	---	0.30	0.30	0.20	---

Note: From July 1991 through June 1993 the roughness length values are for AMS-4 and are based on two sectors. For July 1993 through June 1994 the Values are for AMS-8 and only one sector is used (i.e., the values for both sectors are identical).

Table 2-6: Surface Albedos and Bowen Ratios for Input into AERMET

Month	Albedo				Bowen Ratio			
	1991	1992	1993	1994	1991	1992	1993	1994
January	---	0.15	0.15	0.55	---	1.0	1.0	1.5
February	---	0.15	0.40	0.55	---	1.0	1.3	1.5
March	---	0.15	0.40	0.55	---	1.0	0.5	1.5
April	---	0.15	0.15	0.13	---	1.0	0.3	0.5
May	---	0.15	0.15	0.16	---	0.5	0.5	0.4
June	---	0.15	0.15	0.16	---	0.4	0.4	0.4
July	0.15	0.15	0.16	---	0.8	0.3	0.4	---
August	0.15	0.15	0.16	---	0.8	0.4	0.4	---
September	0.15	0.15	0.16	---	0.8	0.8	0.4	---
October	0.15	0.15	0.15	---	0.8	2.0	0.8	---
November	0.15	0.15	0.15	---	0.8	0.4	0.8	---
December	0.15	0.15	0.15	---	1.0	1.0	0.8	---

3.0 DISPERSION MODELING PROCEDURES

Subsection 3.1 describes the modeling domain, Subsection 3.2 describes the location within the domain for which predictions were made (receptors), Subsection 3.3 describes the background air quality levels that were used and Subsection 3.4 describes modeling procedures.

3.1 Modeling Domain

Previous modeling evaluations of SO_2 ambient air quality predictions from MCSES, Portland Station and other nearby sources have focused on the Warren County, New Jersey nonattainment area. Particular emphasis within the nonattainment area has been on Scotts Mountain in the southern portion of the nonattainment area and Jenny Jump Mountain in the northern portion. The involved regulatory agencies asked PP&L and GPU to extend the modeling domain to include other areas of potential concern.

Based on this request, the modeling domain was extended to include the dominant terrain features in the area, including Kittatinny Ridge to the north and northwest of MCSES and Portland Station. Modeling conducted to date indicates that the peak impacts from MCSES and Portland Station are likely to occur on these nearby terrain features, or in other areas within 10 kilometers of either source. In recognition of this and considering the limited representativeness of the meteorological data beyond the major terrain features, GPU and PP&L have designed the modeling domain as shown in Figure 1-1.

The outer perimeter of the area is comprised of a series of connected line segments with vertexes at convenient UTM coordinates for ease of implementation. The area is not "squared off" due to the specific locations and the SW-NE orientation of many of the major terrain features in the area, and the need to include the entirety of the Warren County, New Jersey nonattainment area. The northern perimeter includes the nearby areas of the Kittatinny Ridge, which is expected to be the location of peak impacts from the modeled sources in the northern part of the modeling domain. Areas of lower terrain further to the north would not be expected to see higher concentrations, and the representativeness of the meteorological data beyond the Kittatinny Ridge would be questionable.

The eastern boundary of the modeling domain encompasses all of the nearby major terrain features in New Jersey where peak concentrations would be expected from MCSES or

Portland Station. This boundary is also beyond the extent of the Warren County, New Jersey nonattainment area.

The southern boundary of the modeling domain is at or beyond the extent of the Warren County, New Jersey nonattainment area. Peak concentrations from the modeled facilities are not expected to be found beyond this region, since there are no terrain features immediately to the south to be considered.

The western boundary of the modeling domain encompasses the Kittatinny Ridge area in Pennsylvania west to Pen Argyl. The peak impacts from the sources to be modeled are not expected to be located beyond this region.

The entire domain was divided into a northern and a southern domain. This report addresses the modeling analyses that were conducted to evaluate compliance with the SO_2 NAAQS in the southern domain. MCSES and most of the nonattainment area (except Jenny Jump Mountain) are in the southern domain. Portland Station, Jenny Jump Mountain and Kittatinny Ridge are in the northern domain. A separate report was prepared by GPU (ENSR, 1999) to address the modeling analysis of the northern domain.

The dividing line between the northern and southern domains is designed in the New Jersey portion of the domain to pass close to the Pequest River, as previously proposed by the reviewing agencies. In Pennsylvania, the dividing line is designed to pass about midway between the Portland Station and MCSES facilities and their respective meteorological towers. The Kittatinny Ridge area is in the northern domain.

Although MCSES is in the southern domain and Portland Station is in the northern domain, both of these facilities were included in the modeling analysis of each domain.

3.2 Prediction Locations

Subsection 3.2.1 describes the initial receptor array used for the modeling analysis and Subsection 3.2.2 describes the refined receptor array that was placed at critical prediction locations ("hotspots") based on modeling results at the initial receptor array.

3.2.1 Initial Receptor Array

For this modeling analysis of the southern domain, the initial prediction locations consisted of all of the receptor locations from previous modeling of the Warren County, New

Jersey nonattainment area (e.g., TRC, 1997) that are in the southern domain and at a Cartesian receptor grid throughout the remainder of the southern domain.

Receptor elevations and the associated "height scale", i.e., the controlling hill height required by AERMOD, were selected with the AERMAP model, which extracts the receptor information from USGS topographic Digital Elevation Maps (DEMs). The fine scale, 7 ½ minute topographic maps were used.

The receptor grid within the Warren County nonattainment area consisted of discrete receptors at high terrain points, a Cartesian grid of 300 meter spacing within 3 km of the plant and 1 km spacing within the remainder of the nonattainment area, and refined receptor points at approximate 100 meter spacing at "hotspots" from previous modeling.

Although the receptor locations within the nonattainment area were identical to those used in the previous evaluations, the receptor elevations varied because the receptor elevations for this evaluation were determined by AERMAP, which was run in order to determine the required "height scale" for each receptor.

The Cartesian receptor grid used throughout the remainder of the southern modeling domain consisted of a grid of receptors at 300 meter spacing out to a distance of 3 km from MCSES and a grid of 1 km spacing throughout the remainder of the southern domain. This grid corresponds in terms of the origin, spacing and distance from MCSES with the Cartesian portion of the receptor grid that was used in the nonattainment area. (There are also a series of discrete, high terrain receptors included in the nonattainment area grid.)

Figure 3-1 presents the entire, initial southern domain receptor array, which includes the nonattainment area grid and the grids of 300 meter and 1 km spacing. The figure also identifies the locations of predicted "hotspots" for which refined receptors were added.

3.2.2 Refined Receptor Array

After initial modeling at the initial receptor array described above, receptors at 100 meter spacing were placed at the critical prediction locations ("hotspots"). These consisted of the areas of the predicted highest annual average and highest and highest second-highest predicted 3-hour and 24-hour concentrations for each of the three modeling years at each of the operating load combinations.

These predicted "hotspots" occur at eight areas of one or more initial receptor locations, as shown in Figure 3-2. At each of these locations, receptors were placed at 100 meter spacing out to distances that border the nearest "non-hotspot" receptors.

3.3 Background Air Quality

Background ambient SO_2 concentrations were used to account for ambient concentrations from small and distant sources that were not explicitly modeled. These background concentrations were added to the concentrations predicted by AERMOD to obtain the total concentrations.

A background concentration matrix was developed as a function of 40 meteorological categories to provide meteorologically dependent background concentrations. The matrix was developed from the full set of hourly measurements made at all seven Scotts Mountain monitors and the AMS-8 monitor in Pennsylvania from May 1, 1992 through April 30, 1993, during the model evaluation period. The procedure for representing background concentrations is consistent with EPA's modeling guidelines that recommend using data for the meteorological conditions of concern collected at monitors not impacted by the sources being modeled.

The hourly background value for each meteorological category was determined by averaging the measurements from all monitors upwind of MCSES for each hour and then taking the median value over all hours in each respective category. A monitor was considered upwind if it did not fall within a 90 degree sector centered on the hourly wind flow vector relative to MCSES. Only monitors upwind of MCSES for each hour were used for each hour to minimize the effects of MCSES on the background concentration. This may "double count" the contributions from the other nearby sources that were explicitly modeled.

The meteorological categories used in the background concentration determination represent 40 categories of wind speed, wind direction and atmospheric stability class. Although AERMOD does not utilize stability classification, the matrix was developed based on the Pasquill/Turner stability classification developed for the performance evaluation study that was conducted using the same data set. For the AERMOD dispersion modeling analysis, each hour of the three year period was classified into Pasquill/Turner stability for the purpose of selecting the hourly background concentration from the matrix. Stability classification was based on sigma-theta measurements at the 10 meter level of the AMS-8 meteorological tower, which is the same site used to develop the background concentration matrix. Stability classification based on Allentown NWS data was used as backup.

The background concentration matrix from which hourly background concentrations were determined is presented in Table 3-1. The meteorological categories are divided into four flow vector quadrants relative to MCSES based on the flow vector from the 420 meter SODAR level, six Pasquill/Turner stability classes based on sigma-theta from the AMS-8 10 meter level, four wind speed categories for stability class D and three wind speed categories for the other stability classes.

3.4 Modeling Procedures

Sulfur dioxide emissions from MCSES, Portland Station, Hoffman LaRoche and the Warren County Resource Recovery Facility were modeled with AERMOD with each of the three years of meteorological data described in Subsection 2.2 to determine predicted concentrations at the receptor grids identified in Subsection 3.2. The background concentrations presented in Table 3-1 were added to the predicted concentrations to determine total combined concentrations for each hour. The predicted highest annual average and highest second-highest 3-hour and 24-hour concentrations (per year) were evaluated for compliance with the SO_2 National Ambient Air Quality Standards.

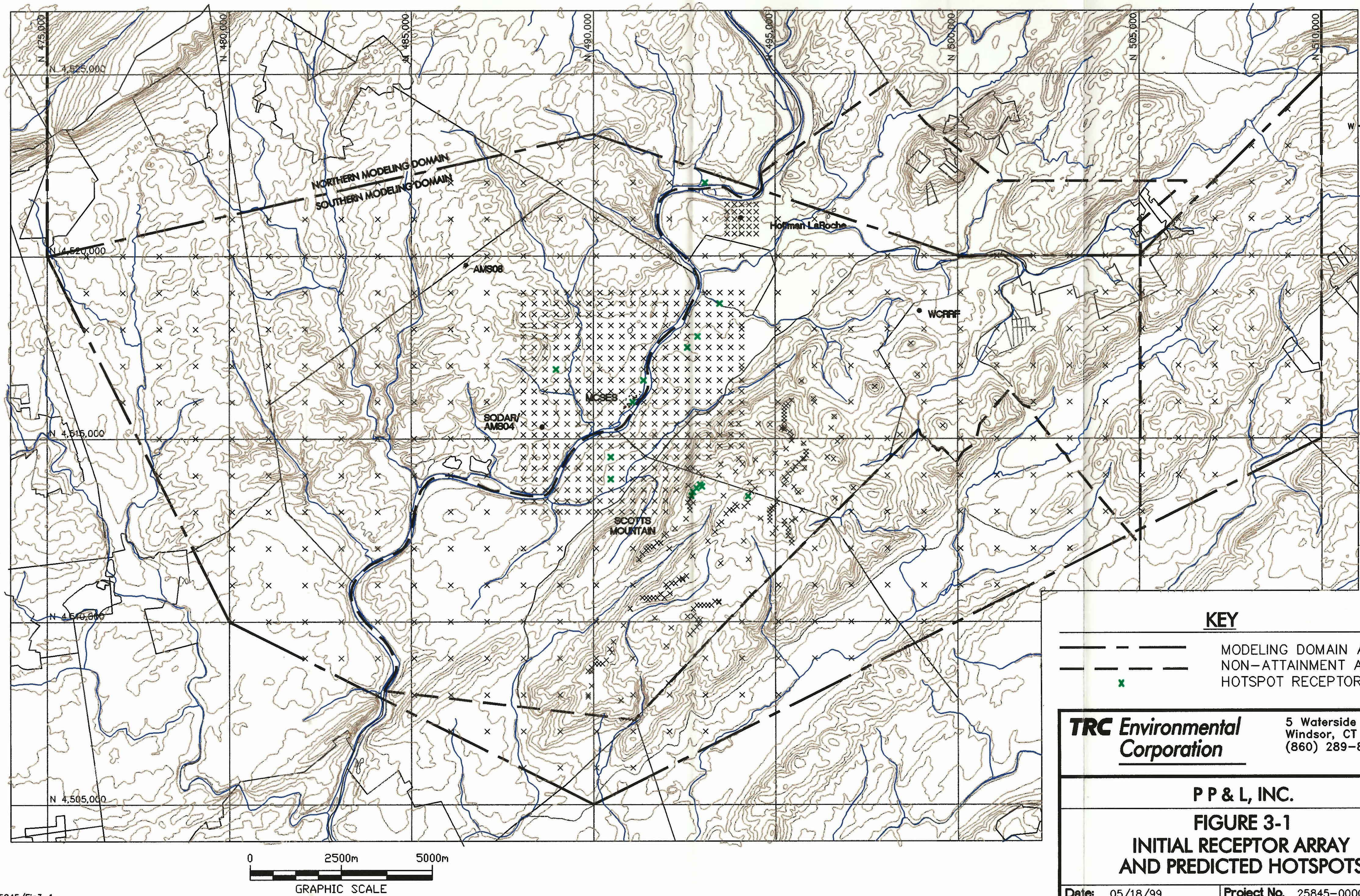
MCSES and Portland Station were modeled at 100 percent and 50 percent operating loads, as described in Section 2, and Hoffman LaRoche and the Warren County Resource Recovery Facility were modeled at 100 percent load. Based on past modeling, the 100 percent and 50 percent load conditions for MCSES are believed to be associated with higher predicted concentrations than the 75 percent load condition. MCSES and Portland Station were modeled at both 100 percent and 50 percent load for each of the other's load scenarios.

Initial screening indicated that predictions from the MCSES combustion turbines would exceed the NAAQS close to the plant. Therefore, the sulfur content of the No. 2 fuel oil burned in the turbines was reduced to 0.1 percent for the final modeling analyses. Also, the emissions limit for the coal-fired units was reduced to 3.9 lb/MMBtu because initial modeling indicated that the predicted concentrations would slightly exceed the NAAQS at an emission rate of 4.0 lb/MMBtu.

As described in Subsection 3.2.2, a refined receptor grid of 100 meter spacing was placed at the locations of the highest annual average, 24-hour and 3-hour predictions and the highest second-highest 3-hour and 24-hour predictions for each modeling year and each operating load scenario in order to refine the modeling results.

Table 3-1: Background SO2 Concentrations as a Function on Meteorology

Bin Number	Flow Vector Quadrant	P-G Stability	Wind Speed (m/s)	Median (μg/m3)	Number of Monitor – Hours	Number of Minimum-Hours	Number of Hours in Bin
1	Northeast	Stable	<1.55	19.163	458	0	66
2	Northeast	Stable	1.55 – 3.0	22.700	1372	0	215
3	Northeast	Stable	>3.0	20.963	6061	0	906
4	Northeast	Neutral	<1.55	27.344	432	0	64
5	Northeast	Neutral	1.55 – 3.0	24.575	1327	0	197
6	Northeast	Neutral	>3 8.0	18.000	5258	0	796
7	Northeast	Neutral	> 8.0	16.363	1249	0	192
8	Northeast	Unstable	<1.55	27.950	357	0	55
9	Northeast	Unstable	1.55 – 3.0	23.150	895	0	127
10	Northeast	Unstable	>3.0	16.688	401	0	59
11	Southeast	Stable	<1.55	19.395	267	0	92
12	Southeast	Stable	1.55 – 3.0	22.370	474	0	174
13	Southeast	Stable	>3.0	15.180	1494	1	573
14	Southeast	Neutral	<1.55	15.700	181	0	54
15	Southeast	Neutral	1.55 – 3.0	17.373	274	2	116
16	Southeast	Neutral	>3.0 – 8.0	10.500	2316	7	976
17	Southeast	Neutral	> 8.0	8.767	1135	6	498
18	Southeast	Unstable	<1.55	17.840	147	0	51
19	Southeast	Unstable	1.55 – 3.0	19.370	192	1	72
20	Southeast	Unstable	>3.0	10.467	141	0	47
21	Southwest	Stable	<1.55	23.375	215	0	30
22	Southwest	Stable	1.55 – 3.0	14.862	1000	0	136
23	Southwest	Stable	>3.0	11.794	4088	0	558
24	Southwest	Neutral	<1.55	13.550	229	0	31
25	Southwest	Neutral	1.55 – 3.0	10.857	550	0	77
26	Southwest	Neutral	>3.0 – 8.0	11.488	4360	0	602
27	Southwest	Neutral	> 8.0	9.357	2537	0	347
28	Southwest	Unstable	<1.55	22.600	351	0	51
29	Southwest	Unstable	1.55 – 3.0	15.707	520	0	74
30	Southwest	Unstable	>3.0	10.663	450	0	64
31	Northwest	Stable	<1.55	10.129	431	0	60
32	Northwest	Stable	1.55 – 3.0	8.979	1266	0	180
33	Northwest	Stable	>3.0	9.357	2522	0	357
34	Northwest	Neutral	<1.55	10.825	465	0	67
35	Northwest	Neutral	1.55 – 3.0	8.986	1111	0	160
36	Northwest	Neutral	>3.0 – 8.0	8.629	2929	0	421
37	Northwest	Neutral	> 8.0	5.233	546	0	79
38	Northwest	Unstable	<1.55	12.736	358	0	52
39	Northwest	Unstable	1.55 – 3.0	11.150	351	0	51
40	Northwest	Unstable	>3.0	11.614	226	0	33



TRC Environmental Corporation

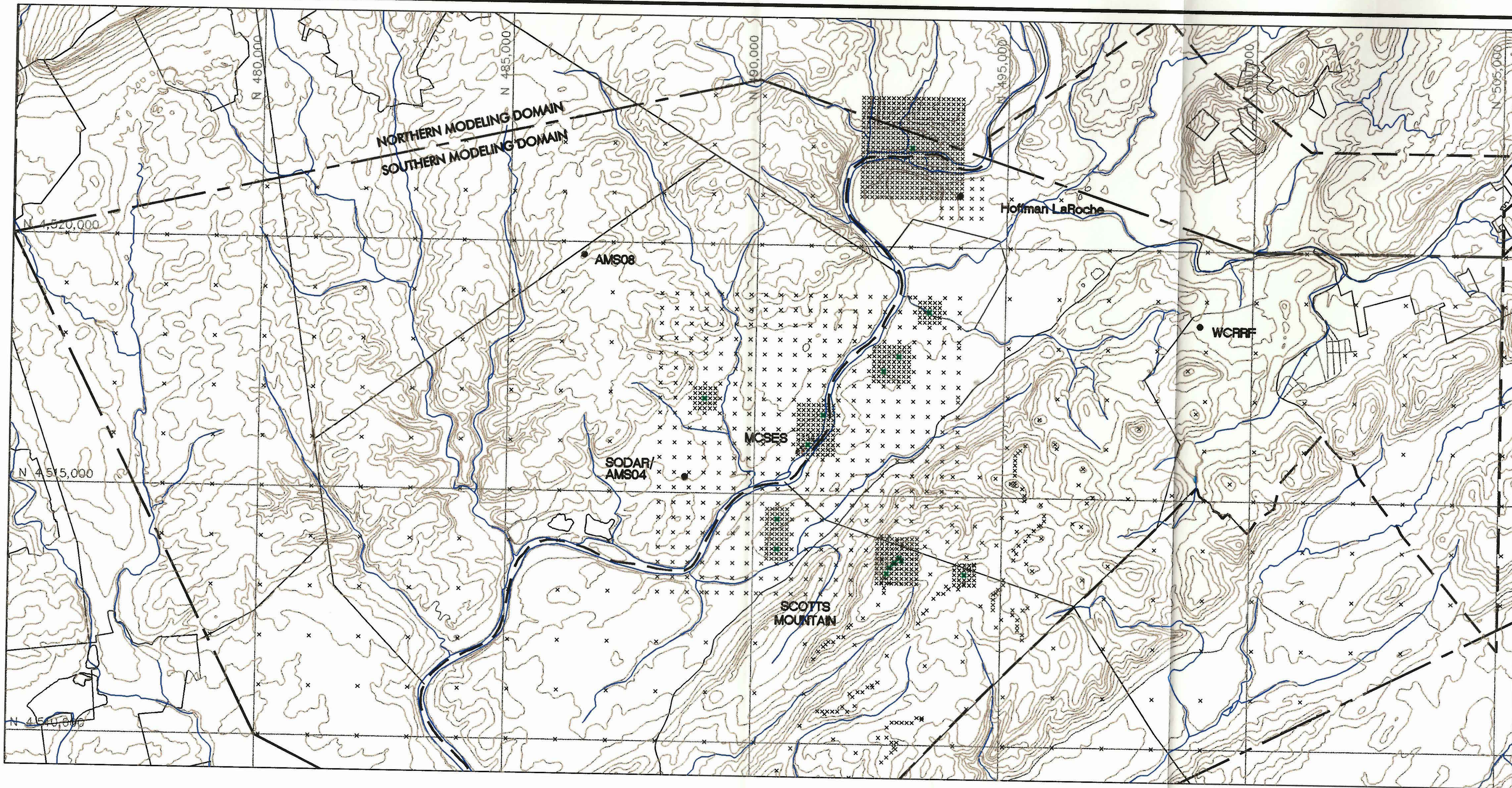
5 Waterside Crossing
Windsor, CT 06095
(860) 289-8631

P P & L, INC.

FIGURE 3-1
INITIAL RECEPTOR ARRAY AND PREDICTED HOTSPOTS

Date: 05/18/99 | Project No. 25845-0000-00000

25845/Fig3-1



KEY

MODELING DOMAIN AREA

NON-ATTAINMENT AREA

0 2000m 4000m

GRAPHIC SCALE

N W E S

NORTH

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FIGURE 3-2
INITIAL RECEPTOR ARRAY AND REFINED RECEPTOR ARRAY

Date: 05/18/99	Project No. 25845-0000-00000

25845/Fig3-2

4.0 RESULTS

The modeling results for each modeling year and each operating load scenario evaluated are presented in Tables 4-1 (July 1991-June 1992), 4-2 (July 1992-June 1993) and 4-3 (July 1993-June 1994). The results are based on the emissions rates presented in Tables 2-2 and 2-3. For the MCSES combustion turbines and coal-fired units, the results are based on the emissions rates that were revised during the study based on initial modeling results. For the combustion turbines, the revised emission rate is based on a fuel oil sulfur content of 0.1 percent, rather than 0.5 percent. The emission rate for the coal units was reduced from 4.0 lb/MMBtu to 3.9 lb/MMBtu. Each table presents the different load scenarios for MCSES and Portland Station, the maximum modeled annual concentrations on the refined grid, the receptor locations (UTM Easting and Northing, elevation in meters), the high-second-high (H2H) 3-hour average concentrations, receptor locations and time periods for the prediction (year, Julian day, model hour ending), the H2H 24-hour average concentrations, locations and time periods.

Predicted concentrations closest to the NAAQS among the four operating load scenarios for each averaging period (controlling concentrations) appear on Table 4-1, the July 1991-June 1992 meteorological data year. The annual controlling value (71 $\mu g/m^3$) occurs with MCSES at 50 percent load and Portland Station at 100 percent load. The controlling H2H 3-hour average (1298.3 $\mu g/m^3$) occurs with MCSES at 50 percent load. The controlling H2H 24-hour average (334.5 $\mu g/m^3$) concentration occurs with MCSES at 100 percent load and Portland Station at 100 percent load.

Table 4-4 presents source attributions for the predicted controlling events in each averaging period for the three years of meteorology and the four combinations of load conditions. The table lists the predicted controlling concentrations (including background), the receptor locations, elevations and time periods (year, Julian day, hour ending). All controlling predicted concentrations occurred during the July 1991 to June 1992 modeling year. Listed below on Table 4-4 are the contributions from each source to the predicted controlling concentrations. The annual predicted controlling concentration occurs at low elevation close to the MCSES sources. The main contributor is Auxiliary Boiler 4, contributing 45.0 $\mu g/m^3$ of a 71.03 $\mu g/m^3$ total. This is unlikely for the annual average, since this boiler only operates during start-up conditions and will not operate a significant number of hours over an entire year. Both the 3-hour and 24-hour H2H events are predicted to occur on elevated terrain to the east of the facility on Scotts Mountain. Both of these events are dominated by contributions from MCSES Units 1 and 2. The controlling 3-hour concentration occurs during a period for which vertical profile data from the SODAR are not available.

The controlling annual average (71.0 $\mu g/m^3$), H2H 24-hour average (334.5 $\mu g/m^3$) and H2H 3-hour average (1298.3 $\mu g/m^3$) concentrations (which account for a reduction from 4.0 lb/MMBtu to 3.9 lb/MMBtu for MCSES Units 1 and 2) are less than the respective NAAQS of 80 $\mu g/m^3$, 365 $\mu g/m^3$, and 1300 $\mu g/m^3$.

Table 4-1

PP&L Air Quality Compliance Modeling Results

Including background

Refined Grid

Modeling Period: July 1991 - June 1992

Load Description	Annual		H2H 3-Hour			H2H 24-Hour		
	Concentration ($\mu g/m^3$)	Location (UTM) Elevation (m)	Concentration ($\mu g/m^3$)	Location (UTM) Elevation (m)	Period *	Concentration ($\mu g/m^3$)	Location (UTM) Elevation (m)	Period *
50% MCSES 50% PGS	69.9	491380 4516400 70.71	1298.3 §	492750 4513550 365.46	1992, 89, 21	333.5	491380 4516400 70.71	1991, 345, 24
100% MCSES 50% PGS	41.5	494260 4513430 389.53	1071.2	493000 4513740 367.79	1991, 355, 24	326.6	494160 4513330 382.32	1992, 80, 24
50% MCSES 100% PGS	71.0 §	491380 4516400 70.71	1298.3 §	492750 4513550 365.46	1992, 89, 21	333.5	491380 4516400 70.71	1991, 345, 24
100% MCSES 100% PGS	44.2	494260 4513430 389.53	1071.2	493000 4513740 367.79	1991, 355, 24	334.5 §	494160 4513330 382.32	1992, 80, 24

* - Year, Julian day, hour ending. § - Controlling predicted concentration.

Table 4-2

PP&L Air Quality Compliance Modeling Results

Including background

Refined Grid

Modeling Period: July 1992 - June 1993

Load Description	Annual		H2H 3-Hour			H2H 24-Hour		
	Concentration ($\mu g/m^3$)	Location (UTM) Elevation (m)	Concentration ($\mu g/m^3$)	Location (UTM) Elevation (m)	Period *	Concentration ($\mu g/m^3$)	Location (UTM) Elevation (m)	Period *
50% MCSES 50% PGS	64.0	491380 4516400 70.71	1196.7	493000 4513740 367.79	1992, 361, 24	328.3	491080 4516000 73.36	1992, 229, 24
100% MCSES 50% PGS	43.0	492850 4513650 367.18	1195.8	494360 4513430 387.06	1993, 55, 24	301.1	492850 4513650 367.18	1992, 361, 24
50% MCSES 100% PGS	65.1	491380 4516400 70.71	1196.7	493000 4513740 367.79	1992, 361, 24	328.3	491080 4516000 73.36	1992, 229, 24
100% MCSES 100% PGS	45.6	492850 4513650 367.18	1195.8	494360 4513430 387.06	1993, 55, 24	301.1	492850 4513650 367.18	1992, 361, 24

* - Year, Julian day, hour ending.

Table 4-3

PP&L Air Quality Compliance Modeling Results

Including background

Refined Grid

Modeling Period: July 1993 - June 1994

Load Description	Annual Concentration ($\mu g/m^3$)	Annual Location (UTM) Elevation (m)	H2H 3-Hour Concentration ($\mu g/m^3$)	H2H 3-Hour Location (UTM) Elevation (m)	H2H 3-Hour Period *	H2H 24-Hour Concentration ($\mu g/m^3$)	H2H 24-Hour Location (UTM) Elevation (m)	H2H 24-Hour Period *
50% MCSES 50% PGS	60.5	490980 4516000 74.47	589.7	492580 4517500 97.94	1993, 352, 15	223.9	491280 4516500 74.68	1993, 257, 24
100% MCSES 50% PGS	37.1	492850 4513650 367.18	828.9	492780 4517700 98.45	1993, 352, 15	208.3	490980 4516000 74.47	1994, 114, 24
50% MCSES 100% PGS	61.8	490980 4516000 74.47	589.7	492580 4517500 97.94	1993, 352, 15	223.9	491280 4516500 74.68	1993, 257, 24
100% MCSES 100% PGS	38.9	492850 4513650 367.18	828.9	492780 4517700 98.45	1993, 352, 15	208.3	490980 4516000 74.47	1994, 114, 24

* - Year, Julian day, hour ending.

Table 4-4

PP&L Air Quality Compliance Modeling Results

Source Attributions for Modeled Controlling Events
Refined Grid
Modeling Period: July 1991 - June 1994

	Annual		H2H 3-Hour		H2H 24-Hour	
Source Description	Concentration ($\mu g/m^3$)	Location (UTM) Elevation (m) Period	Concentration ($\mu g/m^3$)	Location (UTM) Elevation (m) Period *	Concentration ($\mu g/m^3$)	Location (UTM) Elevation (m) Period *
ALL Period	71.0	491380 4516400 70.71 7/91 - 6/92	1298.3	492750 4513550 365.46 1992, 89, 21	334.5	494160 4513330 382.32 1992, 80, 24
MCSES:						
Units 1, 2	6.1		865.0		204.7	
Unit 3	1.1		220.0		53.1	
Unit 4	0.7		201.0		53.1	
CTs	1.5		0.007		1.1	
Auxiliary 4	45.0		1.8		N/A	
PGS	3.7		0.0		8.2	
WC	0.04		0.0		0.0	
HL	0.2		0.0		0.04	
Background	12.7		10.5		14.3	

* - Year, Julian day, hour ending.

5.0 CONCLUSIONS

The following are the conclusions of the modeling evaluation of the southern modeling domain:

MCSES Combustion Turbines. Initial modeling of the four MCSES combustion turbines at the allowable fuel oil sulfur content of 0.5 percent indicated that predicted concentrations from these units would exceed the NAAQS at locations close to the plant. PP&L decided to reduce the sulfur content to 0.1 percent sulfur. The study was conducted with the turbines at this revised sulfur content. This level of emissions reduced the maximum ambient impact from the combustion turbines to approximately one-half of the NAAQS.

Predicted 3-Hour Concentrations. The controlling (highest second-highest) predicted 3-hour concentration from all sources modeled and the addition of a background concentration is 1298.3 $\mu g/m^3$, which is below the 3-hour NAAQS level of 1300 $\mu g/m^3$. This concentration is predicted on the Scotts Mountain portion of the Warren County nonattainment area and is primarily contributed to by MCSES. Initial modeling indicated that the highest second-highest 3-hour concentration would exceed the NAAQS. The Units 1&2 emissions rate of 4.0 lb/MMBtu was reduced to 3.9 lb/MMBtu and the modeling was re-done, which reduced the prediction to 1298.3 $\mu g/m^3$.

Predicted 24-Hour Concentrations. The controlling (highest second-highest) 24-hour predicted concentration from all sources (plus background) is 334.5 $\mu g/m^3$, which is below the 24-hour NAAQS of 365 $\mu g/m^3$.

Predicted Annual Average Concentrations. The highest annual average predicted concentration is 71.0 $\mu g/m3$, which is below the annual average NAAQS of 80 $\mu g/m^3$.

The results of this dispersion modeling analysis of the southern domain demonstrate attainment of the NAAQS when the combined sulfur dioxide emissions rate of coal-fired Units 1&2 is reduced from 4.0 lb/MMBtu to 3.9 lb/MMBtu and the sulfur content of the fuel oil for the combustion turbines is reduced to 0.1 percent. The restriction to 0.1 percent sulfur for the combustion turbines is more than sufficient to assure that predictions from those units do not exceed the NAAQS close to the plant. The 3.9 lb/MMBtu emissions rate from the coal units would only be necessary to assure attainment when the other large units (Units 3 & 4) were burning oil.

A companion dispersion modeling evaluation of the northern domain was conducted by GPU using the same dispersion model and general modeling procedures that were used in this modeling evaluation of the southern domain. The results of the northern domain evaluation (ENSR, 1999) indicate compliance with the NAAQS at present, permitted emissions for MCSES, Portland Station and other sources.

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