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ATMOSPHERIC DEPOSITION CONTRIBUTIONS TO NITROGEN AND PHOSPHORUS LOADINGS IN TAMPA BAY: INTENSIVE WET AND DRY DEPOSITION DATA COLLECTION AND ANALYSIS AUGUST 1996 - JULY 1998

Interim Data Report

FINAL REPORT

July 1999

ATMOSPHERIC DEPOSITION CONTRIBUTIONS TO NITROGEN AND PHOSPHORUS LOADINGS IN TAMPA BAY: INTENSIVE WET AND DRY DEPOSITION DATA COLLECTION AND ANALYSIS AUGUST 1996 - JULY 1998

Interim Data Report

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1.0 INTRODUCTION

The objectives of the atmospheric deposition data collection and analysis for this project are to determine the proportions of the total nitrogen and phosphorus loadings to the bay resulting from direct deposition to the surface of the bay, and to provide data for use in estimations of watershed loadings to the bay which result from atmospheric deposition. The results of this study will assist the Tampa Bay Estuary Program (TBEP) in apportioning nitrogen load reduction responsibilities among bay-area municipalities and counties, a process delineated in the TBEP Comprehensive Conservation and Management Plan. This report serves as an interim data reporting mechanism, and covers the period August 1996 through July 1998, the first two years of the sampling effort.

Nitrogen and phosphorus loading estimates to Tampa Bay due to atmospheric deposition were determined as part of the total estimated loadings to the bay for 1985-1991 (Zarbock et al., 1994). Wet deposition was estimated utilizing precipitation and nutrient concentration data collected at the National Atmospheric Deposition Program site at Verna Wellfield, and dry deposition estimates were determined by multiplying wetfall estimates by a regionally-derived ratio determined by the Florida Acid Deposition Study. These estimates determined that atmospheric deposition directly to the bay's surface may provide about 29% of the total nitrogen load and about 31% of the total phosphorus load to the bay.

Given the relative importance of these loads in comparison to the total nutrient loads to the bay, it was determined that more accurate estimates of atmospheric deposition of nitrogen and phosphorus to the bay's surface were necessary. The TBEP, Hillsborough, Pinellas, and Manatee counties, and the Florida Department of Environmental Protection asked that the bay be included as an EPA Great Waters Program. The Tampa Bay Atmospheric Deposition Study (TBADS), after approval by the EPA Great Waters Program, was begun in the spring of 1995, and resulted in data collection beginning in August 1996, and continuing through the present, with plans for sampling through 1999. A list of advisors to TBADS is shown in Appendix A. The issues determined to be addressed by the TBADS were

- estimation of the extent of water quality impacts from atmospheric deposition directly to the surface of the bay and that due to stormwater runoff, and

- identification of sources of atmospheric nitrogen and toxic materials deposited to the bay and its watershed.

To determine the estimates of atmospheric nitrogen and phosphorus deposition to the bay, participants in the TBADS recommended a site on the eastern end of the Gandy Bridge, which was approved by the NOAA/Great Waters participants, at which samples are collected. Data collected from this site, in concert with meteorological data collected at a mid-bay site, were analyzed to derive the amount of nitrogen and phosphorus being directly deposited to the bay surface. These

data have also been utilized to estimate contributions of atmospheric deposition to stormwater nutrient loadings to the bay, as part of another study.

2.0 METHODS

Data collection at the Gandy site and the meteorological station (Figure 1) commenced in August 1996, with the first measurements of atmospheric nitrogen species concentrations and meteorological data on August 7, 1996. Collection of wet deposition data began on August 13, 1996.

To determine the wet deposition of nutrient species to the surface of the bay, the concentrations of nitrogen and phosphorus species, as well as sulfate and chlorine, are determined, and the total mass flux to the bay due to wetfall is calculated as the product of the chemical concentration in the rainfall, the rainfall depth, and the surface area of the bay. Determination of dry deposition is not such a straightforward calculation. For dry deposition, concentrations of various nitrogen species in the atmosphere above the bay are determined, and deposition velocities for the various nitrogen components to the bay are determined utilizing a buoy model developed by NOAA. The NOAA model uses as input meteorological data collected near the intensive deposition sampling site.

Wet deposition sampling is done following the protocols developed by the National Atmospheric Deposition Program (NADP) Atmospheric Integrated Research Monitoring Network (NADP/AIRMoN). The primary responsibility of the site operator, the Environmental Protection Commission of Hillsborough County (EPC), is to collect and submit wet deposition samples to the Central Analytical Laboratory (CAL). Clean buckets are shipped by CAL to the site operator. The sample bucket is removed if:

1) precipitation is measured by the rain gauge or
2) the lid of the collector was open for more than one hour, or six or more shorter lid openings occurred regardless of whether any precipitation was measured.

If a sample bucket is removed, it is transported to EPC. There, the bucket with the rain water inside is weighed on a top loading balance. If there is a least 10 ml of rain water volume, the pH is measured and the sample is transferred from the bucket to a sample bottle for shipment to CAL along with any used buckets and lids. CAL provides results for ammonium, chloride, sulfate, potassium, magnesium, specific conductance, orthophosphate, nitrate, sodium, calcium, and pH. Rainfall amount is measured by both a Belfort rain gauge, which documents approximate rainfall and the times that the wet bucket opens, and a National Weather Service rain gauge. The NWS rain gauge provides a more accurate daily rainfall amount.

The dry deposition sampler consists of a special sampling box with a dual flow-through system consisting of a series of annular denuders (to scrub gaseous nitrate and ammonia with denuders internally treated with Na_2CO_3 and citric acid coatings) and a two-stage filter containing a nylon filter. Air flow is maintained by an electric pump. Chemically treated (and sealed) annular denuders

are shipped to the site operator by a contract laboratory, QST Environmental (which acquired Environmental Science and Engineering, Inc., which initially analyzed the samples). The filter pack assembly is also prepared at QST Environmental and shipped sealed to EPC.

The atmospheric concentration sampler is operated for a 24-hour period every sixth day. Following each sampling period, the annular denuders and filter pack are removed from the sampling box and sent to QST Environmental for analysis. The samples are analyzed for gaseous and particulate nitrate, sulfate, and ammonia.

The meteorological site in Tampa Bay provides data for input to a bulk exchange model, the Buoy Model, developed by Dr. Richard Valigura at NOAA's Air Resources Laboratory (Valigura, 1995). Dr. Valigura modified the Buoy Model for Tampa Bay to calculate the air/water transfer rate of hydroscopic compounds (e.g., HNO_3, NH_3, and SO_2) for which transfer can be considered one dimensional (i.e., downwards), and the transfer rate of particulates from 1-2 μm in diameter.

Model output of a heat transfer coefficient enables the calculation of a hydroscopic compound deposition velocity as follows:

$$V_{hd} = (Dh)(U),$$

where: V_{hd} = hydroscopic compound deposition velocity,
Dh = heat transfer coefficient,
and U = windvelocity.

Here, the surface concentration of the hydroscopic compound is assumed to be zero, and the deposition velocity is the inverse of the aerodynamic resistance for the hydroscopic compound. It is also assumed that the aerodynamic resistance for hydroscopic compound exchange across the air-water interface is equivalent to the aerodynamic resistance of air-water exchange of sensible heat.

The model also calculates a particulate deposition velocity as follows:

$$V_{pd} = 1/(1/(VDP*USTARG)+RA),$$

where: V_{pd} = particulate deposition velocity,
VDP = 0.002 if ZLNEW >= 0
= 0.01 if ZLNEW < 0
with ZLNEW= dimensionless stability parameter,
USTARG = friction velocity,
and RA =U2/USTARG^2
with U2=(wind speed) - (friction velocity).

Meteorological data are averaged over 30-minute intervals, from data collected every second. The relevant physical parameters used by the Buoy Model are wind speed, air temperature, water temperature, and relative humidity.

For calculation of the dry deposition of nitrogen to the bay, the measured concentrations taken every six days are allowed to represent the concentrations on the day of sampling, and on the previous 2.5 days and the following 2.5 days. The concentrations of the various nitrogen species in the atmosphere are then multiplied by the appropriate deposition velocity, the surface area of the bay, and the time period over which the deposition velocity is calculated, to determine the total flux of each nutrient species to the bay.

The sum of the wet mass flux and the dry mass flux of the nitrogen species to the bay represents the deposition of nitrogen due only to those nitrogen species converted by the annular denuders to nitrate and ammonium, in addition to the particulate forms of nitrogen collected by the nylon filter pack and the nitrate and ammonium from the wet deposition. Similarly, the phosphorus mass flux to the bay is only represented by the orthophosphate as collected by the wet deposition sampling. Chlorine and sulfate mass fluxes to the bay are also only represented by the wet deposition of these two chemicals.

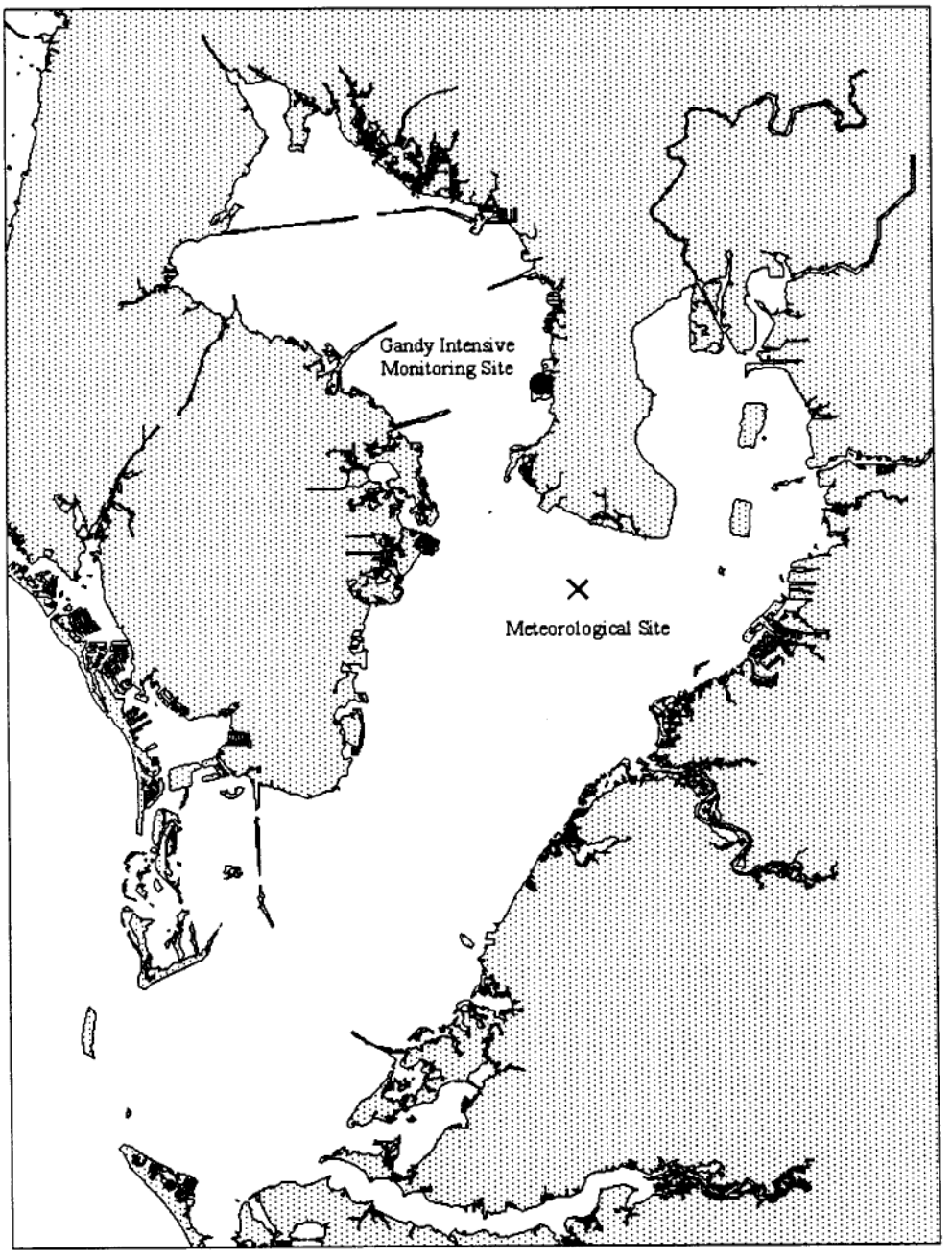

Figure 1. Locations of the Gandy Intensive Monitoring Site and the Meteorological Site.

3.0 RESULTS

Nitrogen, Phosphorus, Sulfate, and Chlorine Wet Deposition

Rainfall data collected at the Gandy site are shown in Figure 2 for August 1996 through July 1998. The associated concentration of nitrogen for each rainfall event is shown in Figure 3, for phosphorus in Figure 4, for sulfate in Figure 5, and for chlorine in Figure 6. The deposition of nitrogen for each rainfall event, calculated from nitrogen concentration in the rainfall samples, is shown in Figure 7, that for phosphorus in Figure 8, that for sulfate in Figure 9, and that for chlorine in Figure 10.

The relationship between rainfall and wet nitrogen deposition is shown graphically in Figure 11. This relationship is linearly fit with a line by the equation

$$\text{N-flux (mg/m}^2) = \text{Rainfall (m)} \times 1.29 + 258.4,$$

with a coefficient of determination (r^2) of 0.45.

The relationship between rainfall and wet phosphorus deposition, as displayed in Figure 12, is not as clearly defined as that between rainfall and nitrogen, with a coefficient of determination of only 0.01. Figures 13 and 14 display the relationships between wet sulfate deposition and precipitation and wet chlorine deposition and precipitation, respectively. The relationship between sulfate deposition and rainfall has a coefficient of determination of 0.54, with a linear fit described by the equation

$$\text{SO,-flux (mg/m}^2) = \text{Rainfall (m)} \times 116.6 + 1590.4.$$

The relationship between chlorine deposition and rainfall has a coefficient of determination of 0.24. Those constituents of rainfall with deposition most closely related to rainfall amounts are nitrogen and sulfate.

The concentration of nitrogen, as determined by summing the nitrate-nitrogen and the ammonium-nitrogen, is related to the amount of rainfall as shown in Figure 15. Here, it is seen that lower rainfall amounts contain greater concentrations of nitrogen than do higher rainfall amounts. This may be due to a “first flush” effect, in which initial rainfall during an event contains greater concentrations of nitrogen than does rainfall later in the event.

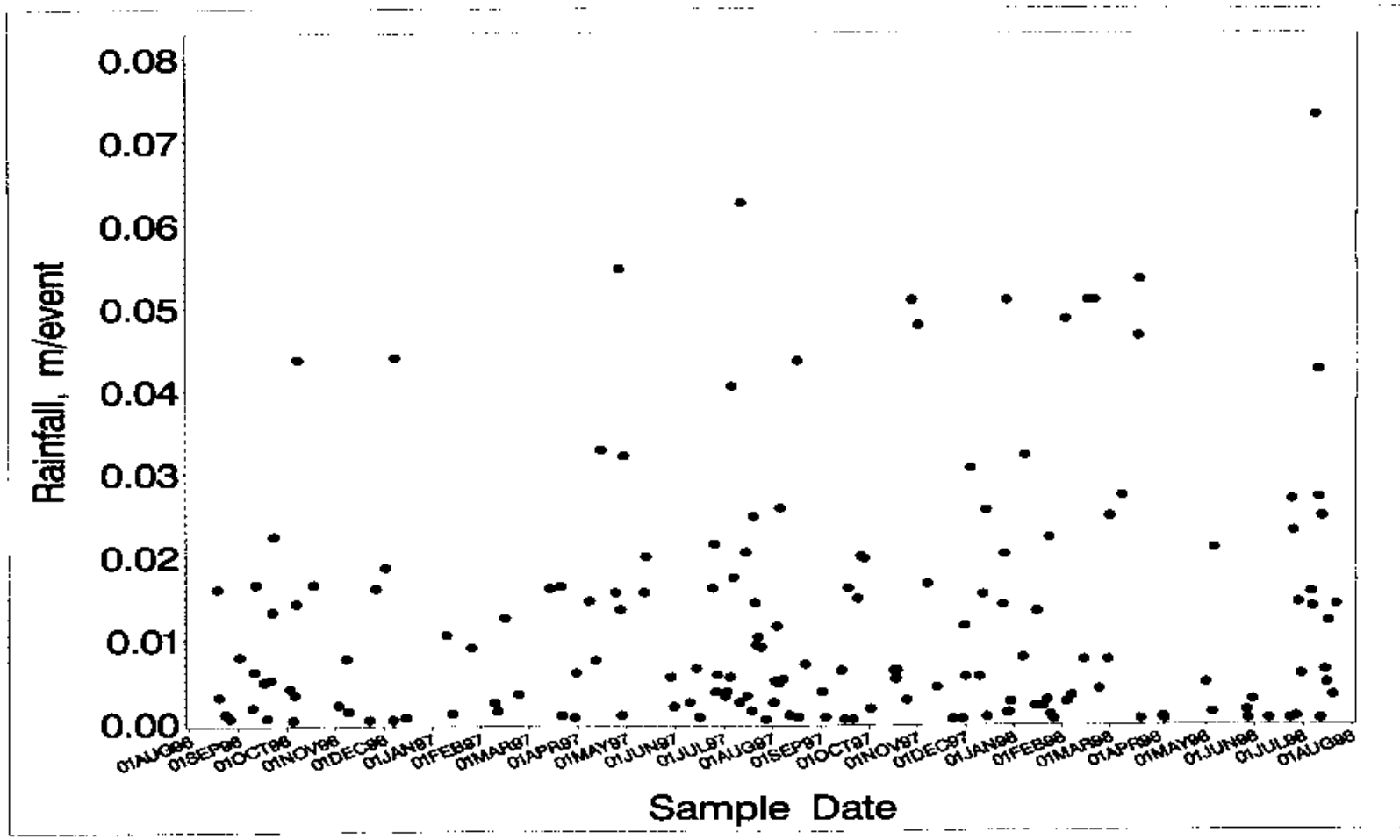

Figure 2. Rainfall (m/event) at Gandy Site from analyzed samples.

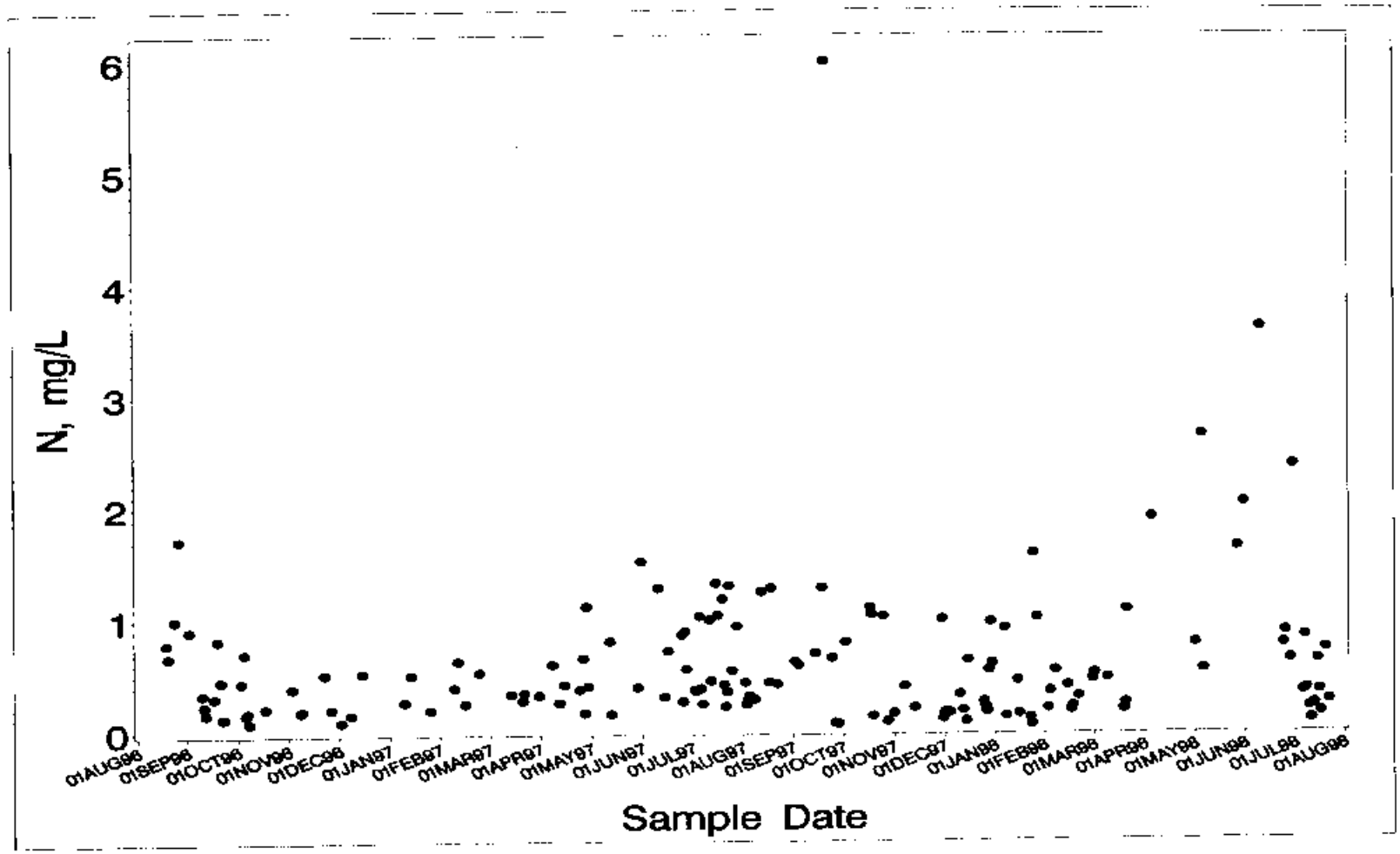

Figure 3. Nitrogen concentration (mg/L) at Gandy Site from analyzed samples.

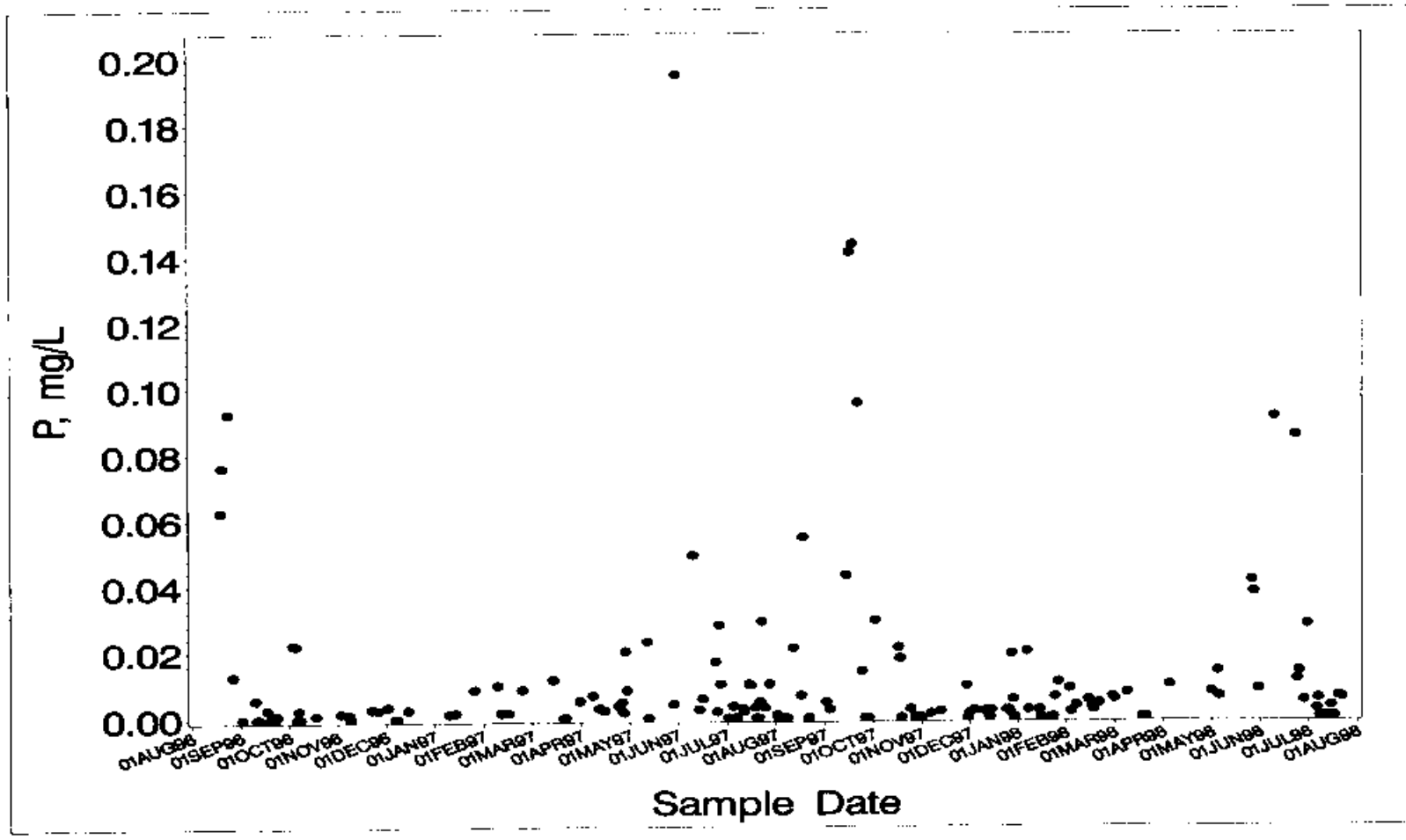

Figure 4. Phosphorus concentration (mg/L) at Gandy Site from analyzed samples.

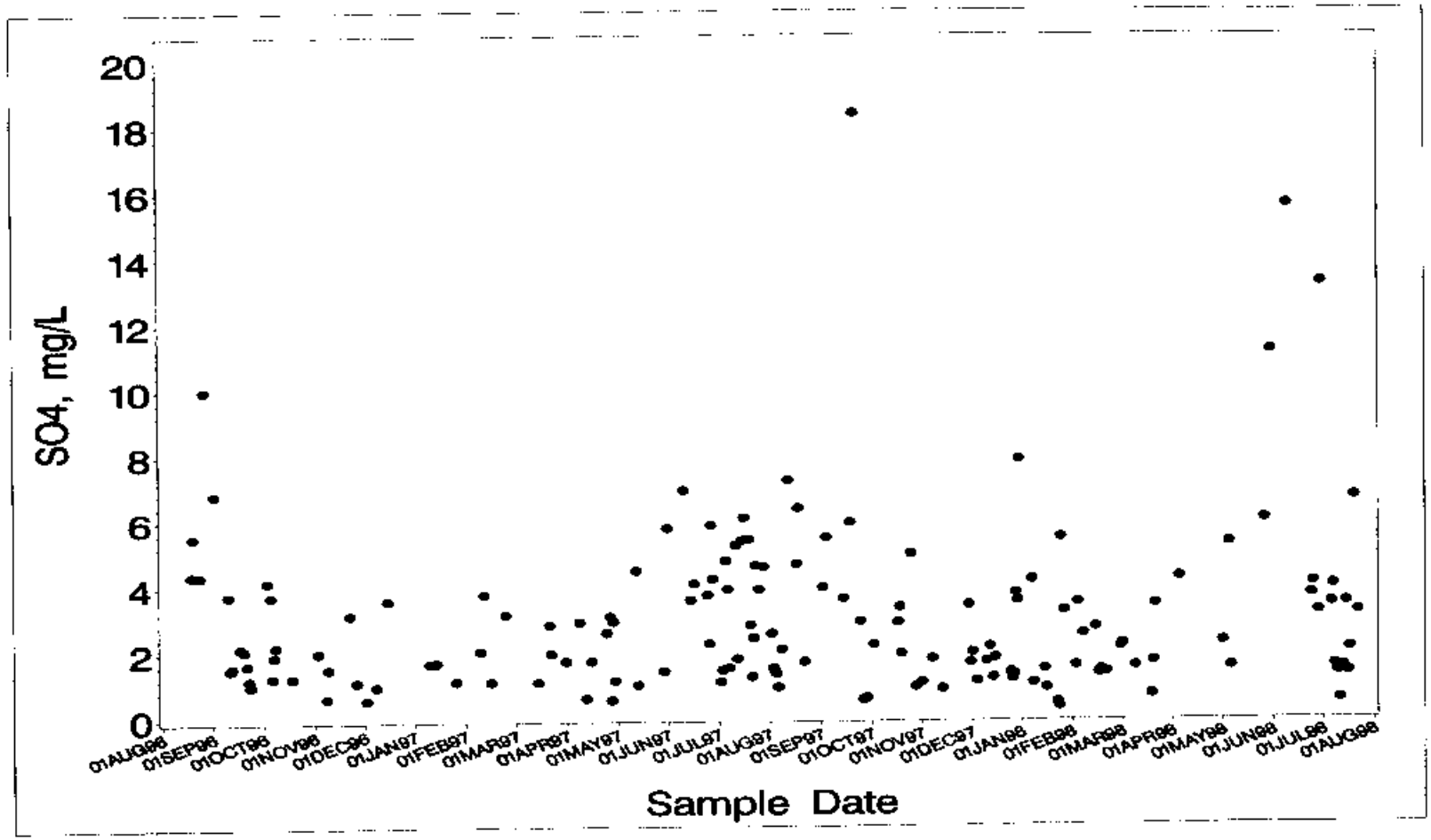

Figure 5. Sulfate concentration (mg/L) at Gandy Site from analyzed samples.

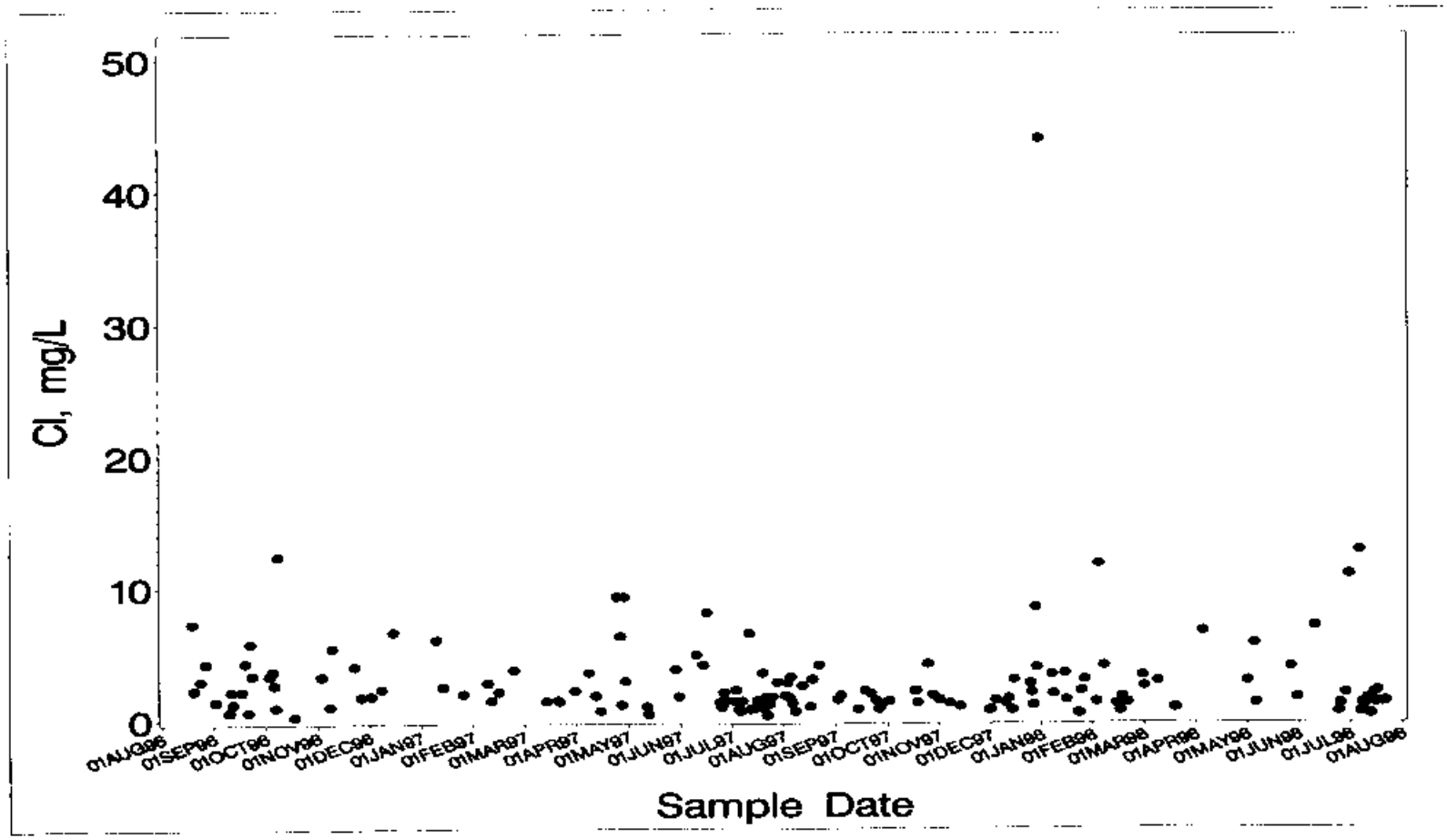

Figure 6. Chlorine concentration (mg/L) at Gandy Site from analyzed samples.

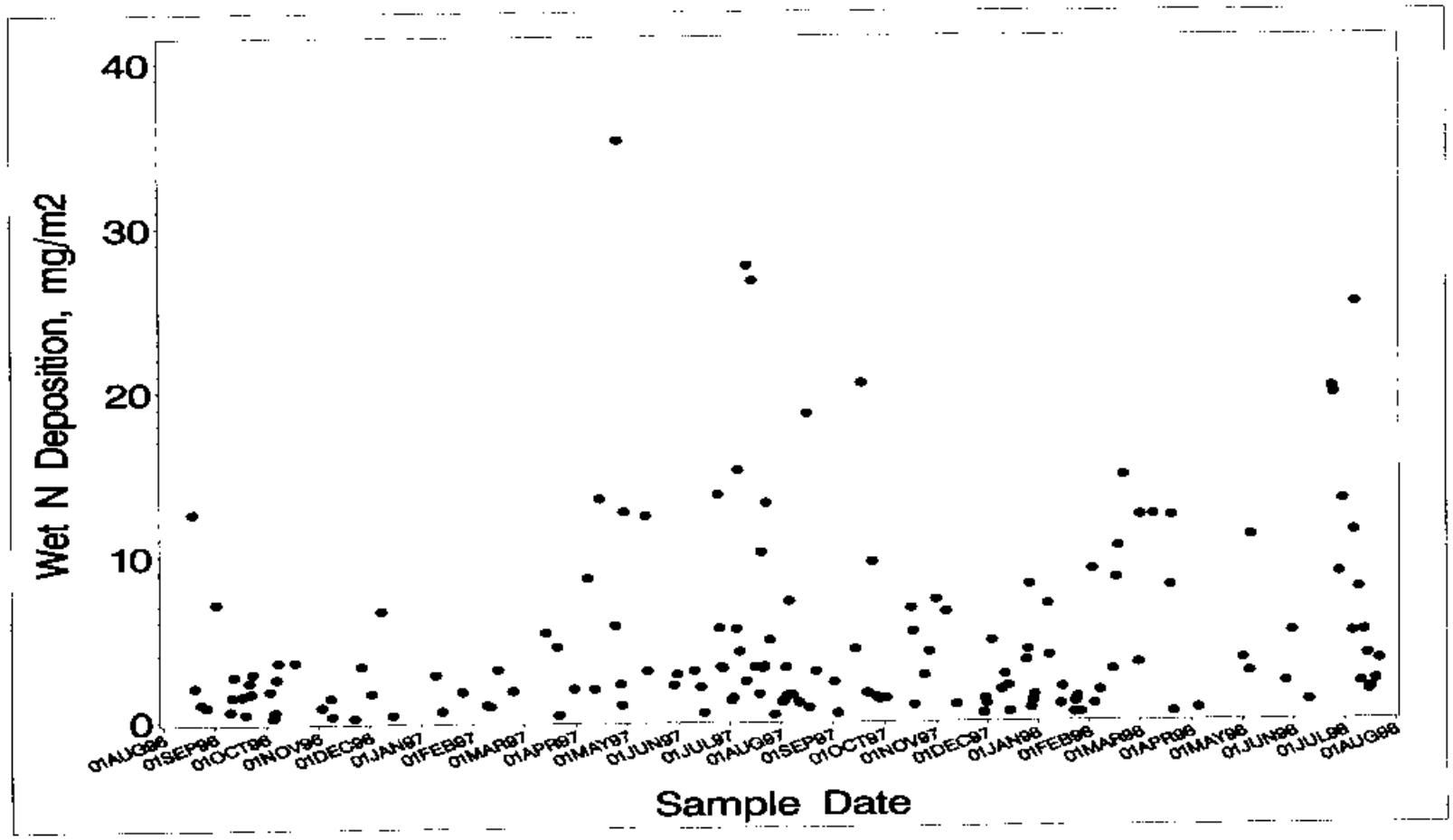

Figure 7. Wet deposition of nitrogen (mg/m^2/event) at Gandy Site.

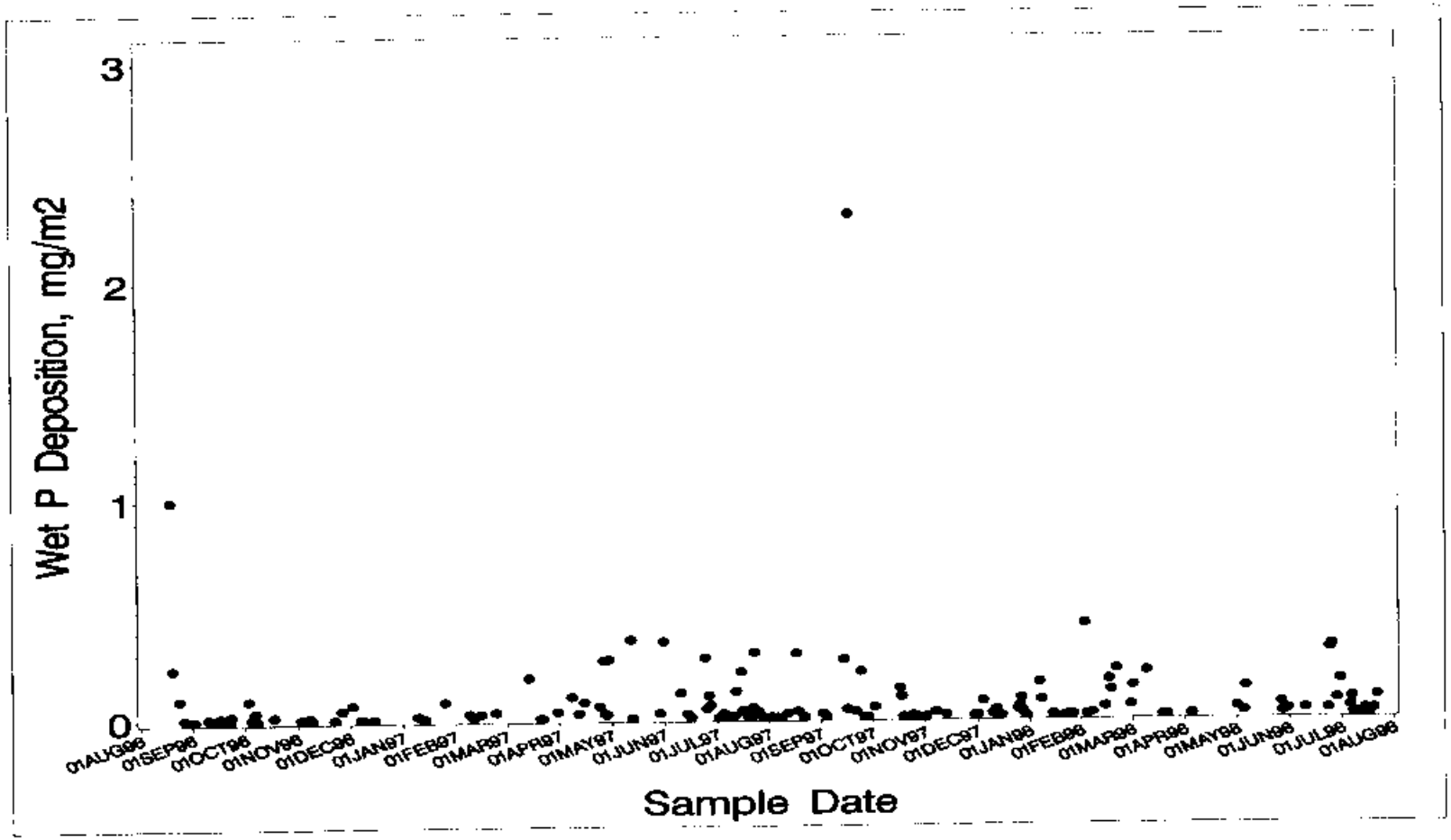

Figure 8. Wet deposition of phosphorus (mg/m^2/event) at Gandy Site.

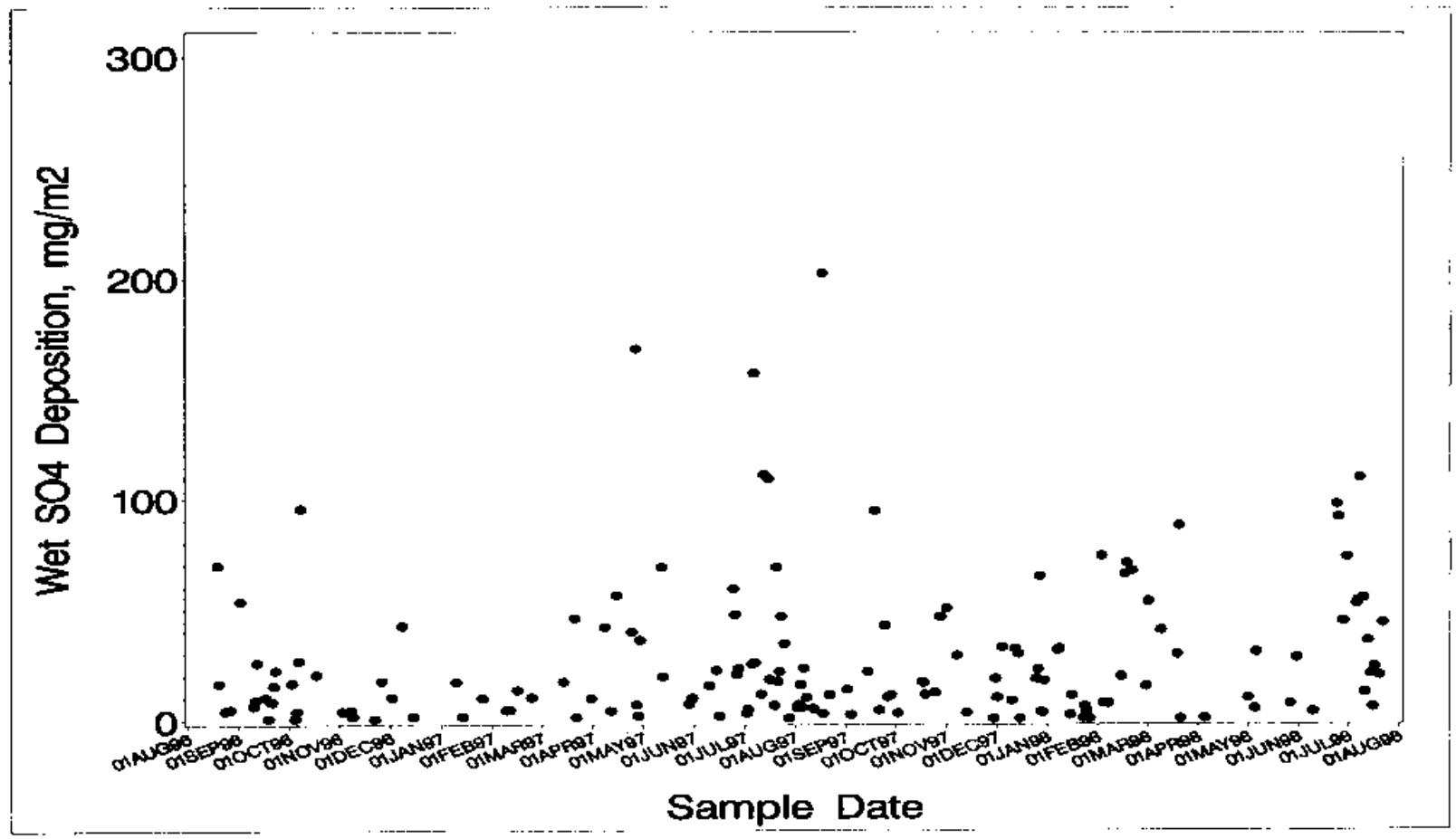

Figure 9. Wet deposition of sulfate (mg/m^2/event) at Gandy Site.

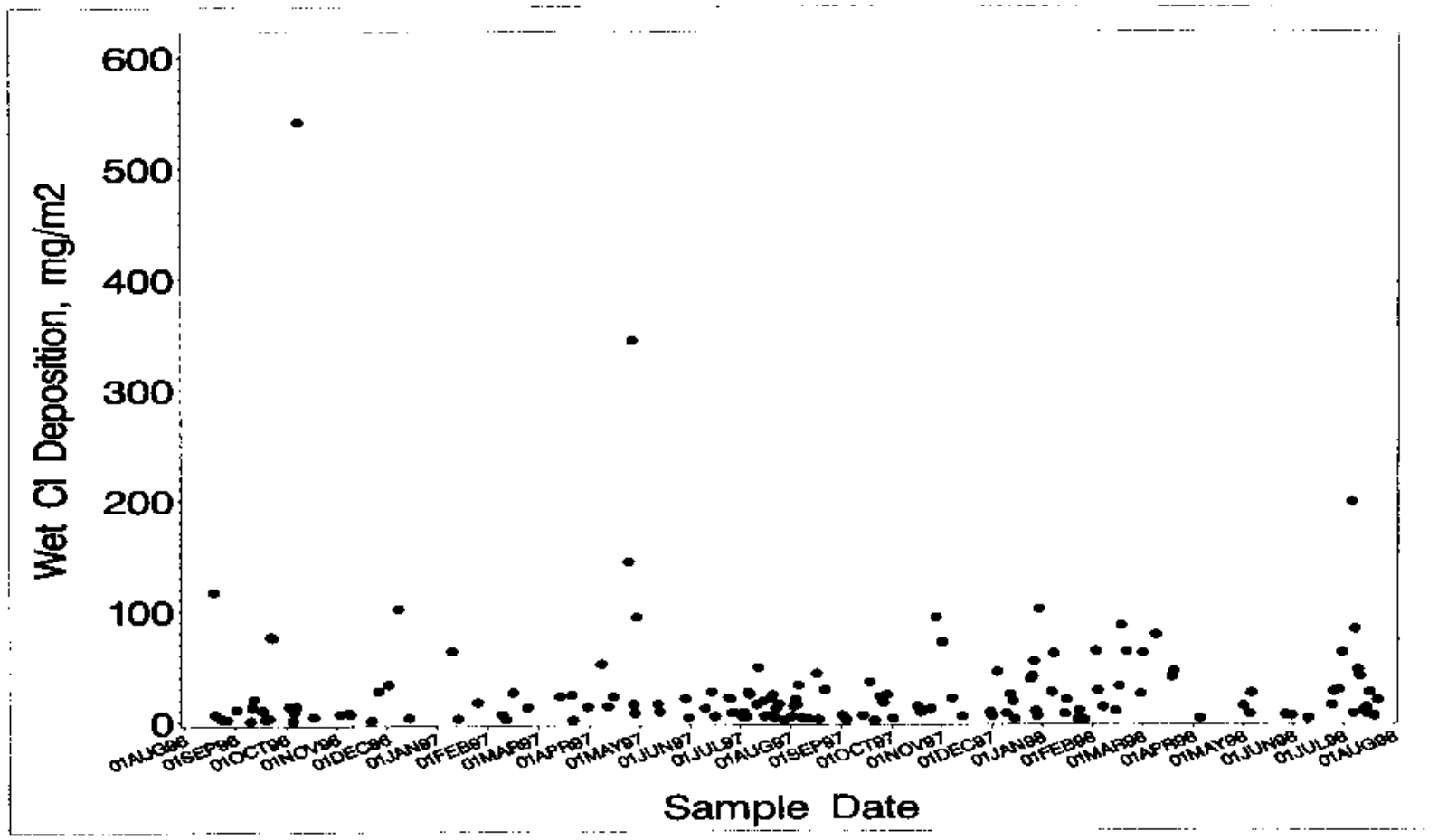

Figure 10. Wet deposition of chlorine (mg/m^2/event) at Gandy Site.

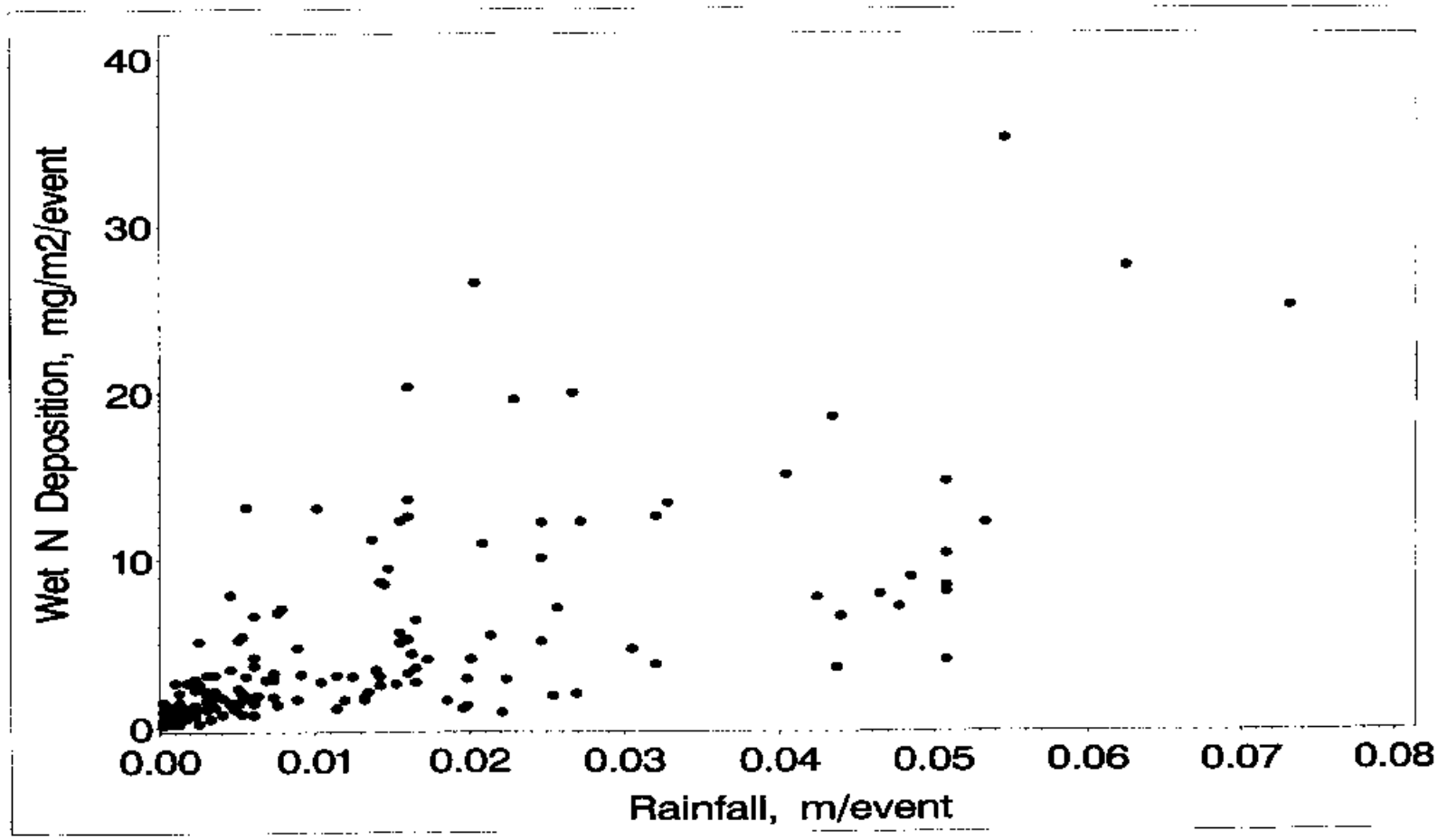

Figure 11. Relationship between wet nitrogen deposition and rainfall at Gandy Site.

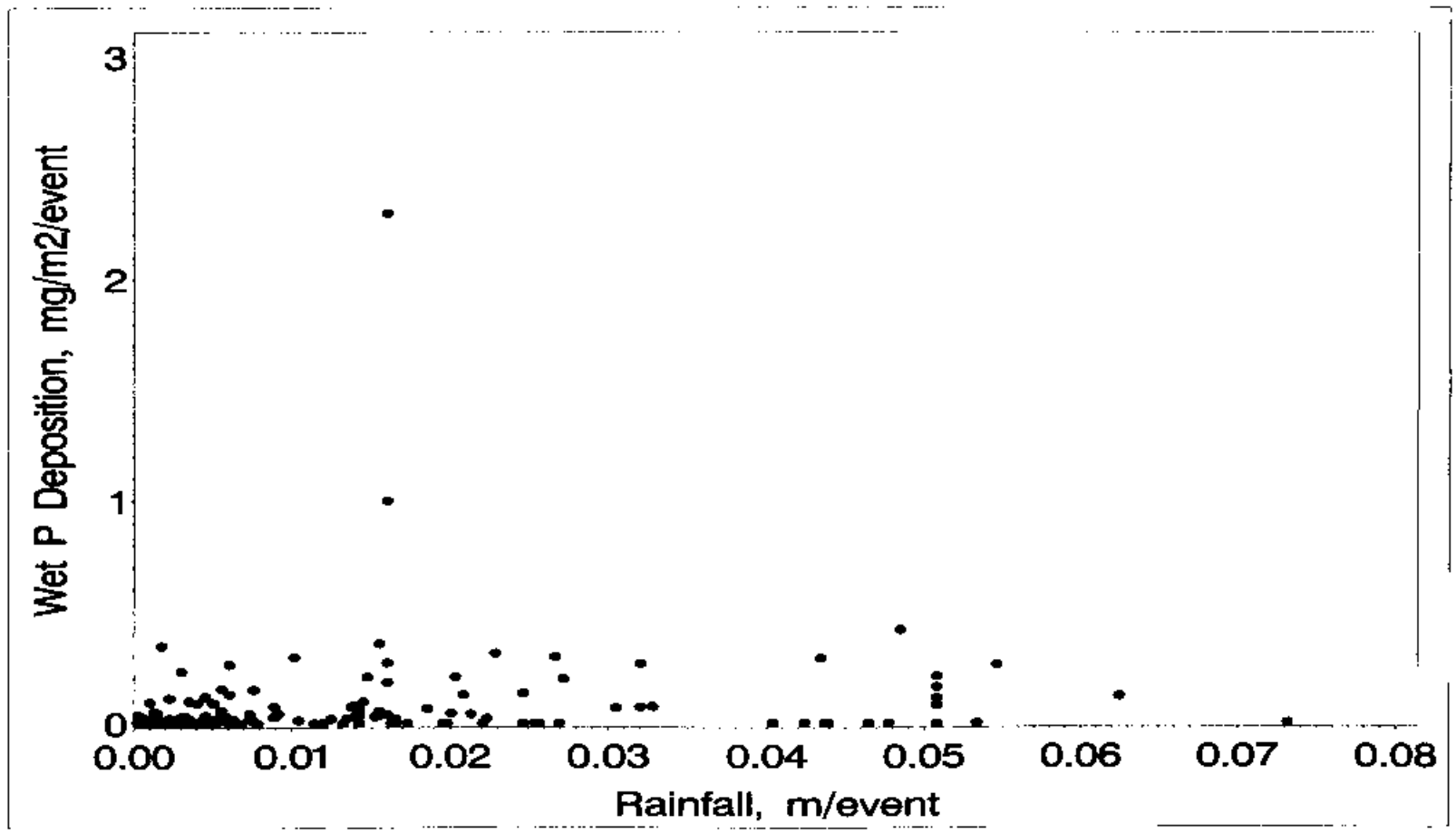

Figure 12. Relationship between wet phosphorus deposition and rainfall at Gandy Site.

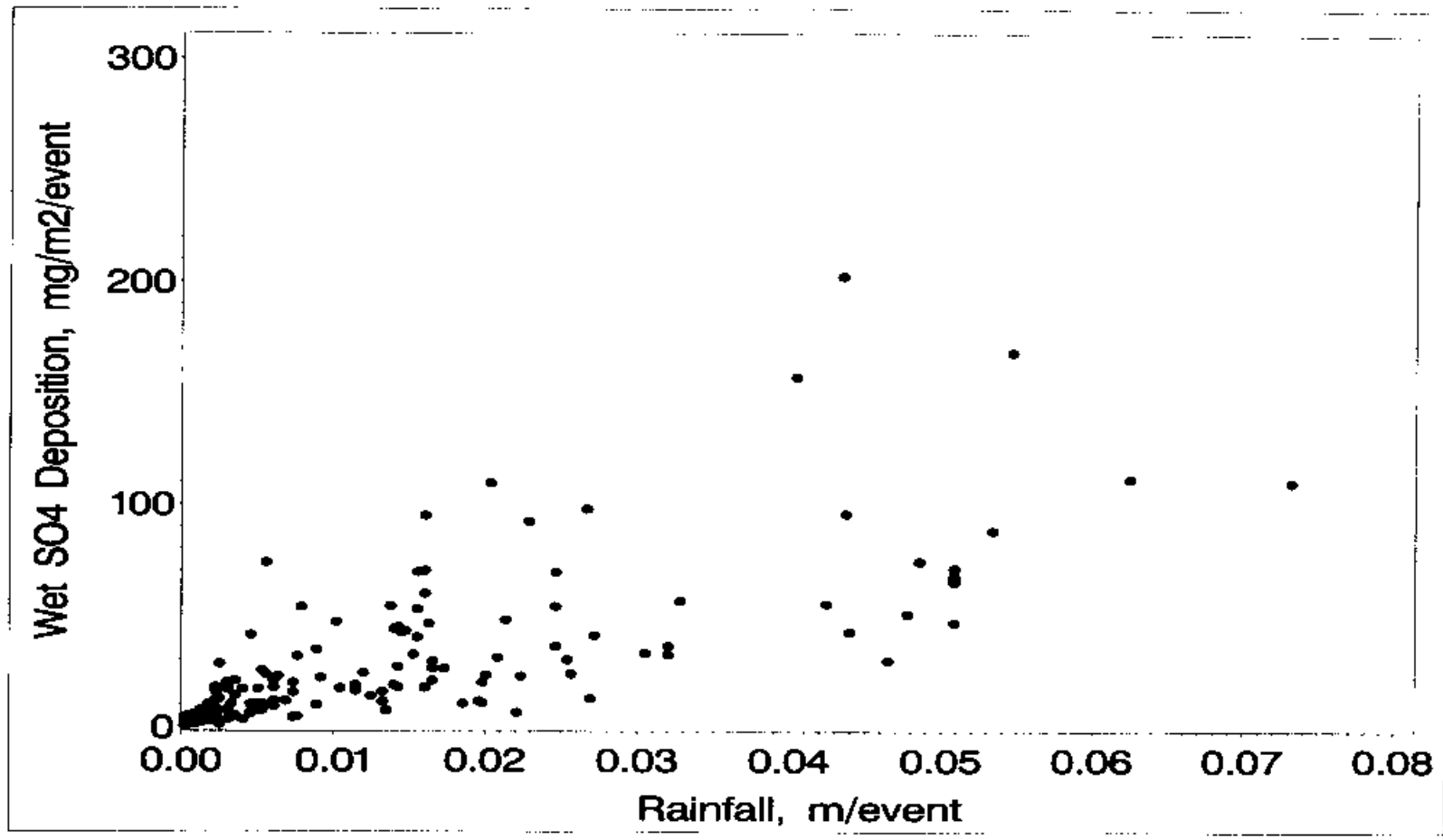

Figure 13. Relationship between wet sulfate deposition and rainfall at Gandy Site.

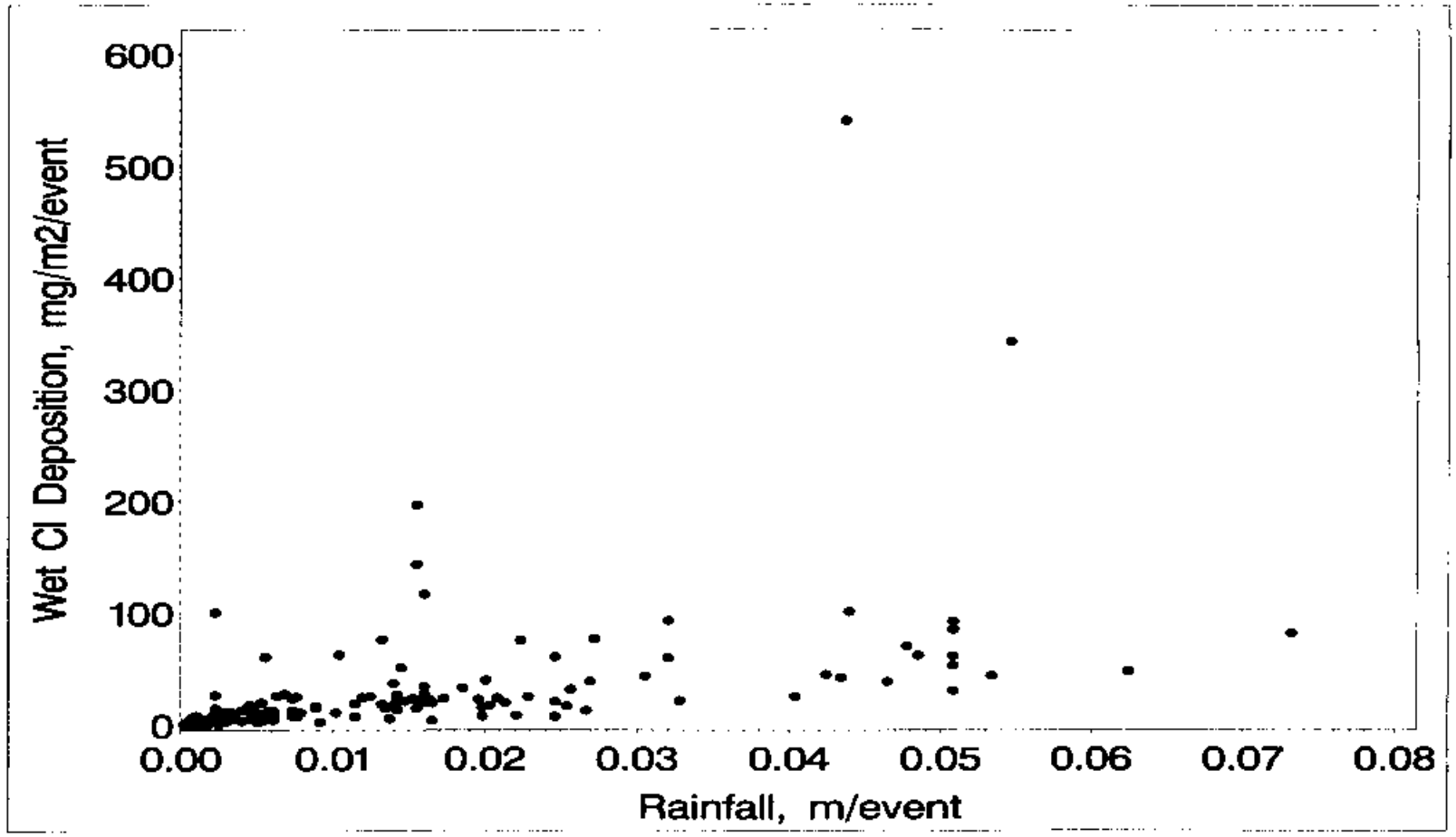

Figure 14. Relationship between wet chlorine deposition and rainfall at Gandy Site.

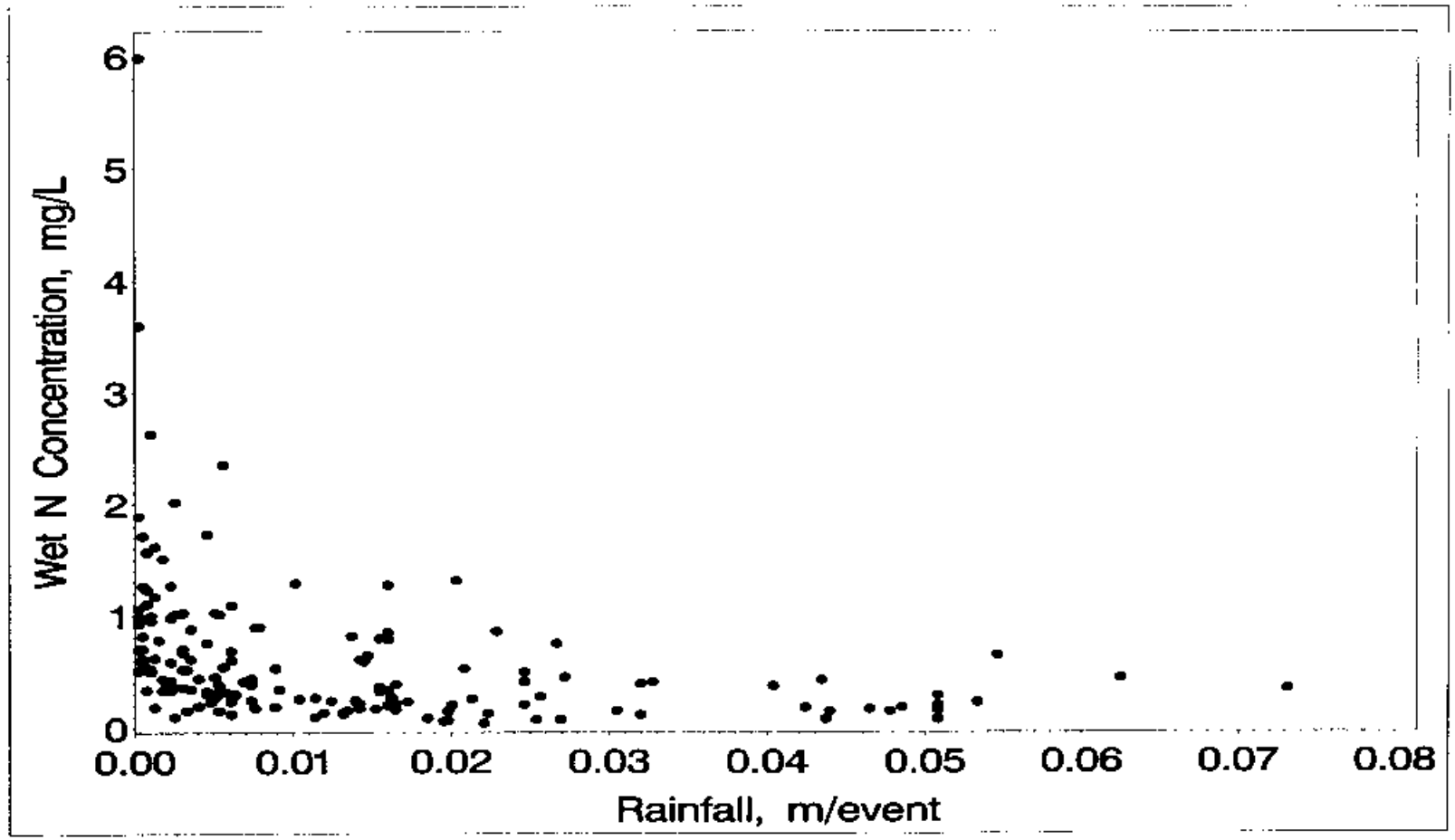

Figure 15. Wet nitrogen concentrations as functions of rainfall at Gandy Site.

Wet deposition totals for each month, from August 1996 through July 1998, are shown in Table 1 for nitrogen, phosphorus, chlorine, and sulfate. For the first year of data, from August 1996 through July 1997, the total wet deposition of nitrogen was 340.2 mg/m^2, total wet deposition of phosphorus was 4.91 mg/m^2, total wet deposition of sulfate was 1,964.7 mg/m^2, and total wet deposition of chlorine was 2,371.6 mg/m^2. For the second year of data, from August 1997 through July 1998, the total wet deposition of nitrogen was 419.3 mg/m^2, total wet deposition of phosphorus was 6.83 mg/m2,total wet deposition of sulfate was 2,453.4 mg/m^2, and total wet deposition of chlorine was 2,142.3 mg/m^2. Over the two-year period, wet deposition of nitrogen averaged 379.8 mg/m^2/yr, wet deposition of phosphorus averaged 5.87 mg/m^2, wet deposition of sulfate averaged 2,209.1 mg/m^2, and wet deposition of chlorine averaged 2,257.0 mg/m^2. As can be seen from the data presented in Table 1, variability within the same month from year to year may be high, as may be expected given the variability in rainfall for the same months. It should be noted that the month of maximum wet nitrogen deposition, July 1997, is not the same as that for maximum wet phosphorus deposition, September 1997. It is also important to note that approximately 59% of the first year's total wet nitrogen deposition occurred in April and July, while approximately 33% of the second year's total wet nitrogen deposition occurred in June and July.

Extrapolation of the total direct wet nitrogen and phosphorus deposition to Tampa Bay, with a surface area of approximately $1x10^9$ m^2, leads to approximately $3.8x10^5$ kg N being deposited directly to the bay surface annually for August 1996 through July 1998, and approximately $5.9x10^3$ kg P annually. An estimate of annual total atmospheric deposition of nitrogen (sum of wet and *dry)* for the period 1985-1991 (Zarbock et al., 1994) was $9.7x10^5$ kg, or approximately 2.6 times the annual average wet deposition of nitrogen calculated for August 1996 through July 1998. As mentioned previously, the estimates for 1985-1991 utilized precipitation and nutrient concentration data collected at the NADP site at Verna Wellfield, and dry deposition estimates were determined by multiplying wetfall estimates by a regionally-derived ratio determined by the Florida Acid Deposition Study.

Table 1. Monthly wet deposition of nitrogen, phosphorus, sulfate, and chlorine.

Year	Month	Wet N Deposition ($mg/m^2/month$)	Wet P Deposition ($mg/m^2/month$)	Wet SO_4 Deposition ($mg/m^2/month$)	Wet Cl Deposition ($mg/m^2/month$)
1996	8	23.6	1.33	149.9	140.4
1996	9	13.5	0.05	100.2	202.6
1996	10	12.0	0.15	165.2	582.9
1996	11	7.3	0.12	39.7	83.2
1996	12	6.9	0.00	44.4	104.9
1997	1	4.9	0.09	29.0	82.5
1997	2	6.4	0.07	33.5	46.3
1997	3	11.7	0.21	75.0	59.7
1997	4	80.2	0.81	356.7	689.3
1997	5	20.0	0.72	106.8	46.9
1997	6	31.5	0.60	195.4	102.3
1997	7	122.2	0.76	668.9	230.6
1997	8	39.2	0.35	300.3	161.6
1997	9	39.5	2.87	192.6	104.2
1997	10	26.4	0.23	156.2	205.9
1997	11	9.4	0.04	62.7	35.8
1997	12	29.5	0.29	237.1	336.9
1998	1	24.7	0.65	164.5	185.6
1998	2	54.2	0.72	309.2	310.6
1998	3	32.7	0.20	159.4	160.2
1998	4	4.0	0.04	11.3	14.7
1998	5	20.8	0.22	72.0	39.3
1998	6	67.4	0.91	364.4	325.4
1998	7	71.5	0.31	423.7	262.1
Annual Average		**379.8**	**5.87**	**2,209.1**	**2,257.0**

Nitrogen Dry Deposition

Atmospheric concentrations of nitrogen species were determined from data collected every six days at the Gandy site from August 1996 through July 1998. Meteorologic data were collected for the same time period, with missing meteorological data for periods during October 11-25, 1996, July 16 through August 11, 1997, August 24-25, 1997, September 24, 1997, November 20, 1997, and December 24, 1997. The meteorological data, when input to the NOAA buoy model, determine gaseous and particulate nitrogen deposition velocities, which are multiplied with particulate and gaseous nitrogen concentrations to yield *dry* nitrogen deposition fluxes to the surface of the bay. Nitrogen concentrations are shown in Figure 16 for the period from August 1996 to July 1998.

Dry deposition velocities are calculated for every 30 minutes for which meteorological data exist, and multiplication of the deposition velocities with the atmospheric nitrogen concentrations over the 6-day periods results in the daily total *dry* nitrogen deposition fluxes as shown in Figure 17, and the monthly total dry nitrogen fluxes displayed in Figure 18.

Table 2 contains the monthly total dry nitrogen deposition for the August 1996 through July 1998 period. For the first year of data, collected from August 1996 through July 1997, the total dry deposition of nitrogen was 342 mg/m^2, and for the second year, from August 1997 through July 1998, the total dry deposition of nitrogen was 419 mg/m^2. It should be noted that the month of maximum *dry* nitrogen deposition, October 1997, accounted for approximately 22% of the total *dry* nitrogen deposition for August 1997-July 1998, and the next highest deposition of approximately 16% of the total for the same period occurred in September 1997. The average annual dry deposition of nitrogen for the two-year period was 381 mg/m^2.

Extrapolation of the total direct dry nitrogen deposition to the surface of Tampa Bay, containing approximately $1x10^9$ m^2, leads to approximately $3.8x10^5$ kg N/year. An estimate of annual total atmospheric deposition of nitrogen (sum of wet and dry) for the period 1985-1991 (Zarbock et al., 1994) was $9.7x10^5$ kg, or approximately 2.6 times the annual *dry* deposition calculated for the August 1996-July 1998 period. As mentioned previously, the estimates for 1985-1991 utilized precipitation and nutrient concentration data collected at the National Atmospheric Deposition Program site at Verna Wellfield, and dry deposition estimates were determined by multiplying wetfall estimates by a regionally-derived ratio determined by the Florida Acid Deposition Study.

To preliminarily determine if any relationship existed between atmospheric concentrations of nitrogen species and possible sources of atmospheric nitrogen, the meteorological data over the period of sampling were examined to determine wind directions over the sampling period. Wind direction is one of the variables collected at the meteorological station. For this analysis, wind directions were constrained to fall into one of four quadrants, with each quadrant containing 90° of the compass, and atmospheric nitrogen concentrations as determined by the denuder were assigned to quadrants based on wind direction over the period of time for which the concentrations were applied. The results of this rough analysis are given below in Table 3. For particulate nitrogen as collected on the nylon filter, the greatest atmospheric concentrations were found when the wind

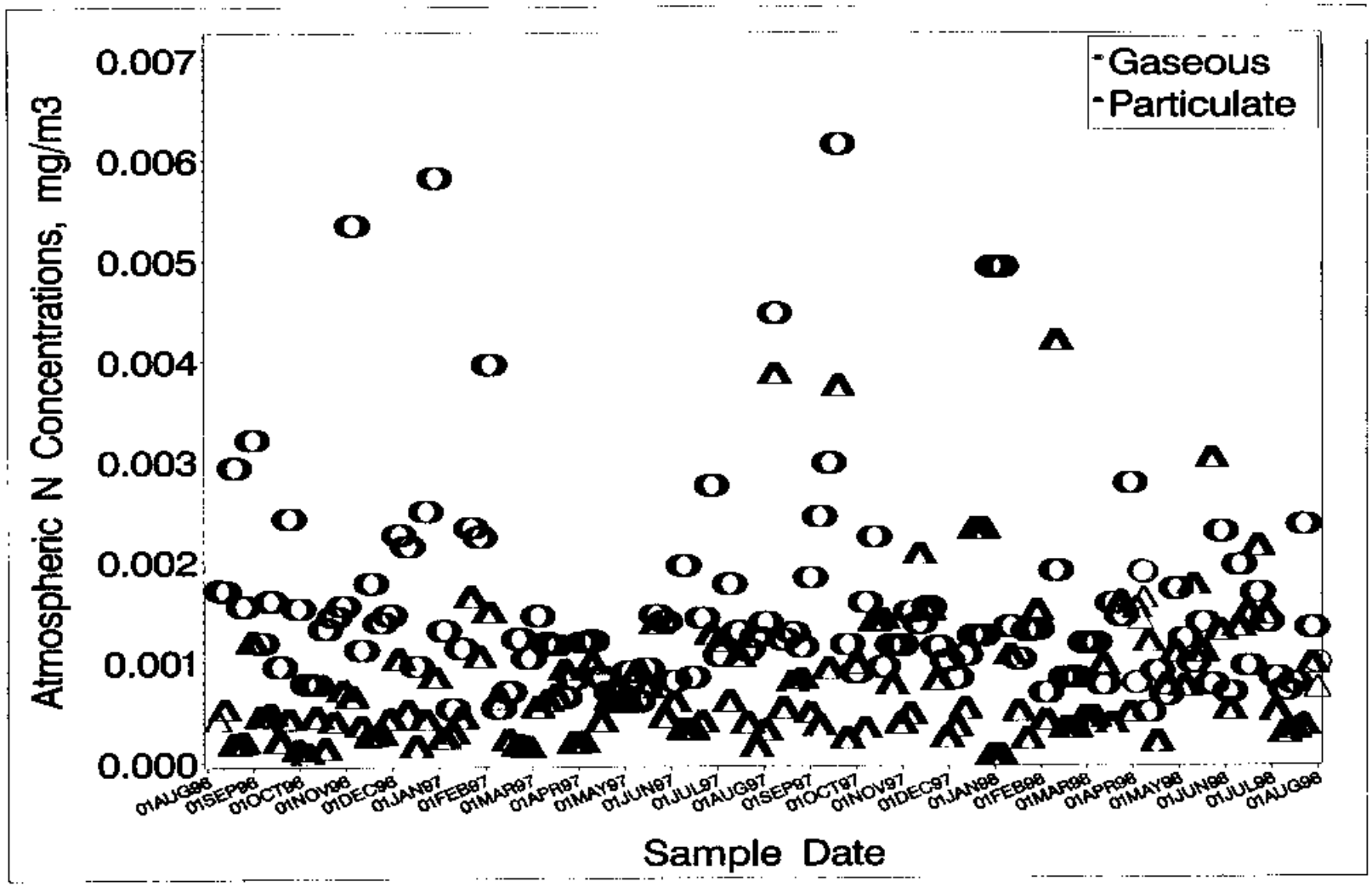

Figure 16. Gaseous and particulate nitrogen concentrations (mg/m^3) at Gandy Site.

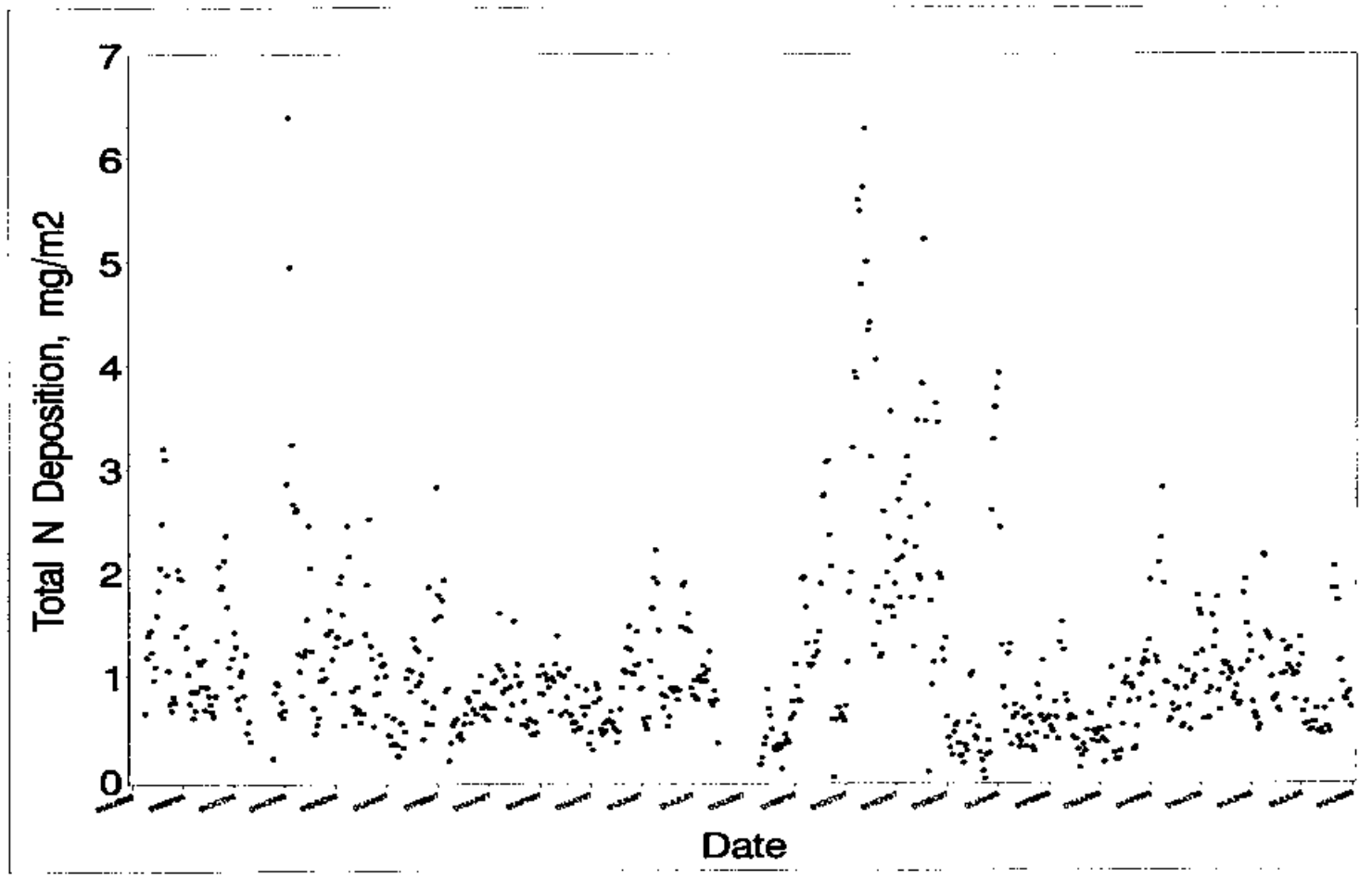

Figure 17. Daily total dry nitrogen deposition fluxes (mg/m^2) from data collected at Gandy Site and Meteorological Site.

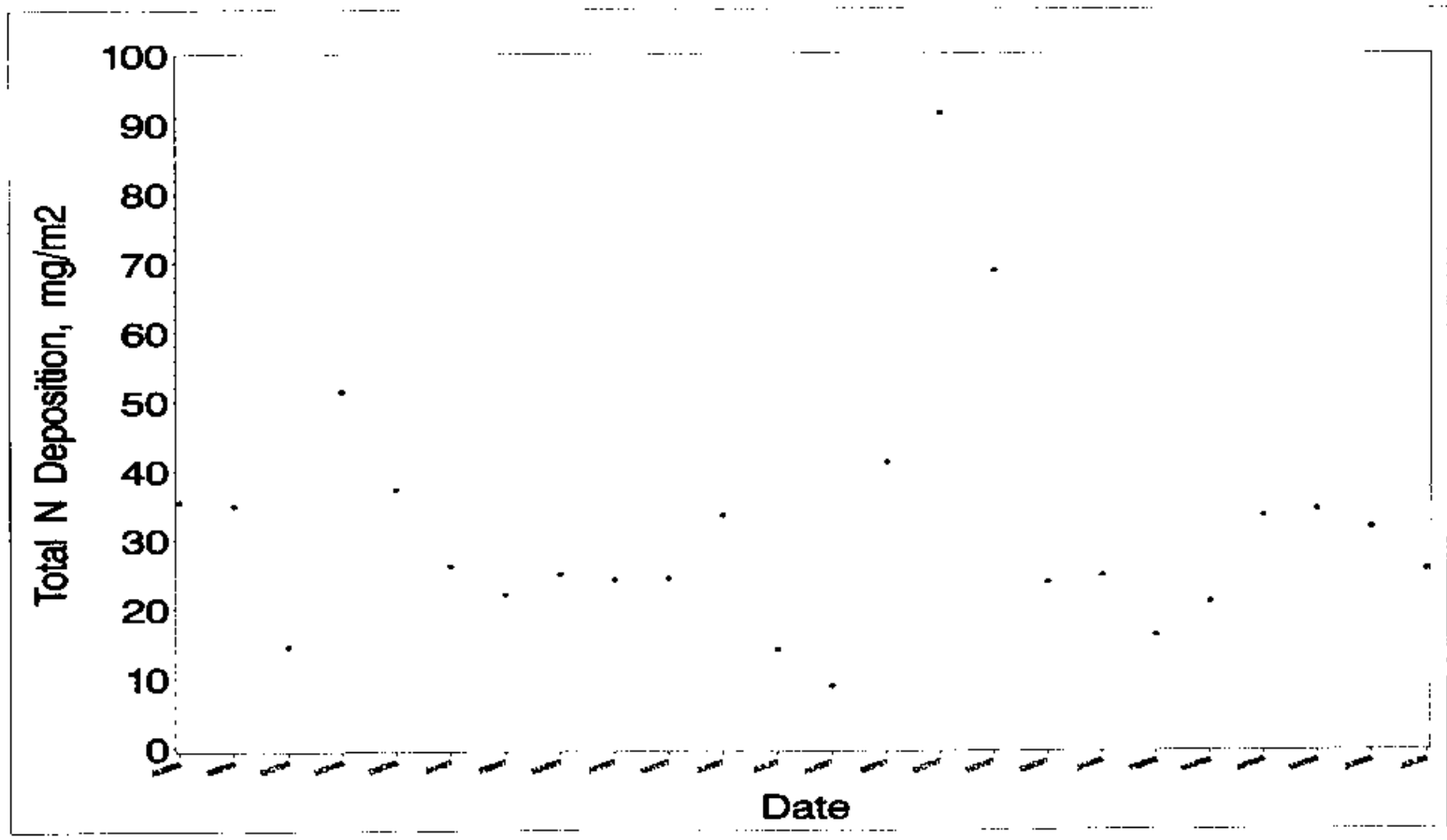

Figure 18. Monthly total dry nitrogen deposition fluxes (mg/m^2) from data collected at Gandy Site and Meteorological Site.

Table 2. Monthly dry deposition of nitrogen.

Year	Month	Dry Gaseous N Deposition ($mg/m^2/month$)	Dry Particulate N Deposition ($mg/m^2/month$)	Total Dry N Deposition ($mg/m^2/month$)
1996	8	34.5	0.96	35.4[a]
1996	9	33.6	1.25	34.8
1996	10	13.9	0.50	14.5[b]
1996	11	50.0	1.35	51.4
1996	12	36.0	1.23	37.2
1997	1	24.5	1.51	26.1
1997	2	21.0	1.01	22.0
1997	3	22.9	2.05	24.9
1997	4	22.1	2.02	24.1
1997	5	21.6	2.63	24.2
1997	6	31.6	1.79	33.4
1997	7	12.6	1.37	14.0[c]
1997	8	8.3	0.47	8.8[d]
1997	9	38.9	2.07	41.0[e]
1997	10	82.1	9.28	91.3
1997	11	61.4	7.27	68.7[f]
1997	12	22.5	1.16	23.7[g]
1998	1	23.6	0.99	24.6
1998	2	14.0	1.94	16.0
1998	3	19.8	1.03	20.8
1998	4	28.8	4.36	33.2
1998	5	28.5	5.66	34.2
1998	6	27.2	4.39	31.5
1998	7	23.9	1.60	25.5

a - Missing August 1 0:00 - August 9 10:30, 1996
b - Missing October 11 15:00 - October 25 10:00, 1996
c - Missing July 16 12:30 - July 31 23:30, 1997
d - Missing August 1 0:00 - August 11 14:00, August 24 8:30 - August 25 3:00, 1997
e - Missing September 24 0:00 - 23:30, 1997
f - Missing November 20 0:00 - 23:30, 1997
g - Missing December 24 0:00 - 23:30, 1997

direction was from the northwest. In contrast, for gaseous nitrate-nitrogen as collected on the carbonate denuder, highest concentrations were found when winds were from the southeast quadrant, and highest concentrations of ammonium-nitrogen as collected on the citric acid denuder were found when winds were from the northeast quadrant. The differences between the highest concentrations and the lowest for each form of nitrogen, by quadrant, were not large, with maximum differences of 38% for gaseous ammonium-nitrogen, 35% for particulate ammonium-nitrogen, 25% for gaseous nitrate-nitrogen, and only 11% for the particulate nitrate-nitrogen.

The location of the Gandy site for data collection was determined as the site most likely to be unimpacted by any plumes associated with the urban area to the east of the site, including areas involved in fertilizer handling associated with shipping. The small variability in nitrogen species concentrations associated with wind direction supports the idea that the intensive site is not in an area impacted by atmospheric plumes of pollutants preferentially from any one direction. The greatest concentrations of gaseous nitrate-nitrogen are found in association with winds from the southeast and northwest quadrants, and highest gaseous ammonium-nitrogen concentrations are associated with winds from the northeast quadrant, but greatest particulate nitrate-nitrogen and ammonium-nitrogen concentrations are found when the winds are from the northwest. These data seem to support the hypothesis that the Gandy intensive site is relatively unaffected by atmospheric pollutant plumes preferentially from any one direction.

Table 3. Mean atmospheric concentrations of nitrogen species in relation to wind direction.

Quadrant	NO,-N, $\mu g/m^3$ (Particulate)	NH_4-N, $\mu g/m^3$ (Particulate)	NO_3-N, $\mu g/m^3$ (Gaseous)	NH_4-N, $\mu g/m^3$ (Gaseous)
North-East	0.19	0.56	0.25	1 .50
South-East	0.17	0.59	0.27	1.38
South-West	0.17	0.57	0.22	1.09
North-West	0.19	0.74	0.27	1.15

Total Nitrogen Deposition

The total nitrogen reaching the surface of Tampa Bay due to atmospheric deposition is the sum of the wet and *dry* nitrogen fluxes. Table 4 shows the wet, *dry*, and total nitrogen deposition for each month from August 1996 through July 1998, as well as the ratio of *dry* to wet deposition. For August 1996 through July 1997, total nitrogen deposition to the surface of the bay was approximately 682 mg/m^2, with some of the *dry* deposition missing as noted before. For the second full year of data, August 1997 through July 1998, total nitrogen deposition to the bay's surface was approximately 839 mg/m^2. Given the average annual total nitrogen deposition of approximately 760

mg/m^2, approximately 7.6x10^5 kg N was deposited directly to the bay surface, or approximately 78% of the previous estimate for 1985-1991 (Zarbock et al., 1994).

The ratio of dry to wet deposition used for estimating total atmospheric deposition of nitrogen to the surface of the bay for the 1985-1991 time period (Zarbock et al., 1994) was 2.04:l. From the results of this study after the first two years, this ratio is approximately 1:1. However, given the missing dry deposition data as previously described, this estimate may be low. Still, the proportions of nitrogen deposition due to dry and wet fluxes for the August 1996 - July 1998 time period appear to be more nearly equal than previously estimated (Zarbock et al., 1994).

A comparison of nitrate and ammonium concentrations and wet deposition fluxes at the Gandy Site for the sampling period to concentrations and wet deposition fluxes measured at NADP sites in Florida over 1990-1996 is shown in Tables 5 and 6 below, compiled from information obtained from NADP electronically. The Bradford Forest site is in northeastern Florida, the Quincy site is in northwestern Florida, the Verna Wellfield site is in west-central Florida, the Kennedy site is at the Kennedy Space Center in the east-central part of the state, and the Everglades site is in south Florida.

Concentrations of ammonium in rainfall at the Tampa Bay site from the August 1996 through July 1998 sampling period (Table 5) are in the middle to high range of values found at other NADP sites in Florida during the dry season (November-May), but are at the high portion of the statewide measurements during the remainder of the year. The precipitation-weighted mean annual ammonium concentration at the Tampa Bay site of 0.20 mg/L is one-third greater than the maximum annual precipitation-weighted mean ammonium concentration at the other NADP sites in Florida, which range from 0.12 to 0.15 mg/L. A similar pattern is seen in nitrate concentrations, with the precipitation-weighted mean annual concentration at the Tampa Bay site of 0.88 mg/L being 1.06 times greater than the maximum annual precipitation-weighted mean nitrate concentration at the other NADP sites in Florida, which range from 0.60 to 0.83 mg/L.

Wet deposition of ammonium and nitrate (Table 6) in Tampa Bay has a variable relationship with deposition at the other Florida sites, with about twice as much ammonium and nitrate deposited in February than for the 1990-1996 February average for any other site. Annual average ammonium deposition at the Gandy site is 1.05 times that at the Vernal Well Field site, whereas annual average nitrate deposition at the Gandy site is approximately three-fourths that at the Vernal Well Field site. The comparison between the Florida NADP sites for 1990-1996 and the Tampa Bay site for August 1996-July 1998 is preliminary at best, with the relatively short time period of the Gandy Site measurements making relationships only tentative. As more data become available from NADP, additional comparisons will be made between the wet nutrient fluxes at the Gandy site and those at the Verna Wellfield NADP site.

Table 4. Monthly wet, dry, and total deposition of nitrogen.

Year	Month	Wet N Deposition ($mg/m^2/month$)	Dry N Deposition ($mg/m^2/month$)[a]	Dry/Wet Ratio	Total N Deposition ($mg/m^2/month$)
1996	8	23.6	35.4	1.50	59.0
1996	9	13.5	34.8	2.56	48.3
1996	10	12.0	14.5	1.21	26.5
1996	11	7.3	51.4	7.04	58.7
1996	12	6.9	37.2	5.39	44.1
1997	1	4.9	26.1	5.33	31.0
1997	2	6.4	22.0	3.44	28.4
1997	3	11.7	24.9	2.13	36.6
1997	4	80.2	24.1	0.30	104.3
1997	5	20.0	24.2	1.21	44.2
1997	6	31.5	33.4	1.06	64.9
1997	7	122.2	14.0	0.11	136.2
1997	8	39.2	8.8	0.22	48.0
1997	9	39.5	41.0	1.04	80.5
1997	10	26.4	91.3	3.46	117.7
1997	11	9.4	68.7	7.3 1	78.1
1997	12	29.5	23.7	0.80	53.2
1998	1	24.7	24.6	1.00	49.3
1998	2	54.2	16.0	0.30	70.2
1998	3	32.7	20.8	0.63	53.5
1998	4	4.0	33.2	8.3	37.2
1998	5	20.8	34.2	1.64	55.0
1998	6	67.4	31.5	0.47	98.9
1998	7	71.5	25.5	0.36	97.0

a - Missing data listed for Table 2 previously.

Table 5. Concentrations (mg/L) of nitrate and ammonium in wet deposition at Gandy site and Florida NADP sites*

Concentration (mg/L)	Bradford Forest		Kennedy		Everglades		Quincy		Verna Well Field		Tampa Bay	
Month	NH_4	NO_3	NH_4	NO_3	NH_4	NO_3	NH_4	NO_3	NH_4	NO_3	NH_4	NO_3
1	0	0.42	0.07	0.60	0.23	0.41	0.07	0.44	0.12	0.46	0.12	0.46
2	0.11	0.53	0.12	0.61	0.15	0.62	0.09	0.43	0.10	0.48	0.18	0.60
3	0.14	0.71	0.20	0.79	0.27	0.59	0.13	0.49	0.16	0.64	0.18	0.57
4	0.19	0.89	0.14	0.81	0.25	0.81	0.20	0.74	0.20	0.84	0.37	0.85
5	0.29	1.18	0.37	1.27	0.14	0.44	0.19	0.90	0.42	2.08	0.39	1.32
6	0.11	1.01	0.10	0.89	0.09	0.62	0.14	0.92	0.16	0.91	0.38	1.73
7	0.08	1.04	0.09	1.29	0.06	0.80	0.13	0.96	0.09	1.06	0.18	1.29
8	0.09	0.88	0.11	1.22	0.09	0.73	0.11	0.84	0.12	1.08	0.20	1.35
9	0.15	0.96	0.08	0.74	0.07	0.49	0.08	0.62	0.09	0.70	0.18	0.95
10	0.03	0.38	0.04	0.33	0.07	0.44	0.06	0.37	0.07	0.51	0.13	0.40
11	0.09	0.88	0.36	0.88	0.16	0.84	0.08	0.35	0.15	0.80	0.11	0.50
12	0.11	0.70	0.07	0.41	0.09	0.42	0.14	0.76	0.08	0.44	0.11	0.39
Annual Mean	0.12	0.80	0.15	0.82	0.14	0.60	0.12	0.65	0.15	0.83	0.20	0.88

* - From NADP electronic database, for 1990-1996 precipitation-weighted monthly means

Table 6. Wet deposition fluxes (kg/ha) of nitrate and ammonium at Gandy site and Florida NADP sites*

Deposition (kg/ha)	Bradford Forest		Kennedy		Everglades		Quincy		Verna Well Field		Tampa Bay	
Month	NH_4	NO_3	NH_4	NO_3	NH_4	NO_3	NH_4	NO_3	NH_4	NO_3	NH_4	NO_3
1	0.08	0.43	0.05	0.39	0.12	0.21	0.13	0.77	0.07	0.28	0.09	0.35
2	0.07	0.33	0.07	0.39	0.07	0.29	0.09	0.41	0.06	0.28	0.20	0.66
3	0.19	0.91	0.28	1.10	0.15	0.34	0.23	0.87	0.15	0.61	0.15	0.48
4	0.19	0.89	0.09	0.51	0.14	0.45	0.17	0.65	0.21	0.86	0.32	0.74
5	0.18	0.72	0.25	0.83	0.20	0.63	0.21	1.00	0.46	2.28	0.13	0.45
6	0.21	1.97	0.20	1.69	0.26	1.86	0.21	1.42	0.36	2.05	0.28	1.25
7	0.12	1.53	0.12	1.73	0.10	1.26	0.22	1.57	0.17	1.95	0.40	2.92
8	0.14	1.37	0.16	1.85	0.18	1.45	0.19	1.44	0.27	2.47	0.14	0.92
9	0.17	1.10	0.14	1.28	0.13	0.91	0.11	0.80	0.13	1.09	0.14	0.71
10	0.04	0.51	0.07	0.53	0.11	0.73	0.05	0.34	0.06	0.44	0.13	0.40
11	0.04	0.39	0.34	0.83	0.12	0.62	0.05	0.25	0.06	0.30	0.05	0.21
12	0.07	0.44	0.04	0.22	0.02	0.11	0.12	0.65	0.03	0.17	0.12	0.41
Annual Total	**1.5**	**10.59**	**1.81**	**11.35**	**1.6**	**8.86**	**1.78**	**10.17**	**2.03**	**12.78**	**2.13**	**9.48**

* - From NADP electronic database, for 1990-1996 precipitation-weighted monthly means

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APPENDIX A

TBADS ADVISORS

TAMPA BAY ATMOSPHERIC DEPOSITION STUDY
Steering Committee
January 1999

John Ackermann	EPA Region IV Air Quality
Eric Ginsberg	EPA Great Waters Program
Holly Greening	Tampa Bay Estuary Program
Tom Rogers	Florida Department of Environmental Protection
Rich Batiuk	EPA/Chesapeake Bay Program
Joel Baker	University of Maryland, Chesapeake Biological Laboratory
Rick Artz	NOAA Air Resources Laboratory
Richard Valigura	NOAA Air Resources Laboratory
Brenda Johnson	EPA Region IVAir Quality Division
Ellen Porter	US Fish and Wildlife Service Air Quality Division
Tony D'Aquila	Hillsborough County Environmental Protection Commission
Tom Taminini	Hillsborough County Environmental Protection Commission
Don Moores	Pinellas County Dept. of Environmental Management
Andy Squires	Pinellas County Dept. of Environmental Management
Rob Brown	Manatee County Department of Environmental Management
Jeff Chanton	Department of Oceanography, Florida State University
Tom Atkeson	Florida Department of Environmental Protection Air Division
Bob Stevens	USEPA/ FDEP
Noreen Poor (4/99)	University of South Florida Department of Public Health

APPENDIX B

WET DEPOSITION DATA

BEGIND	- Sample start date
ENDD	- Sample recovery date
TIMEON	- Sample start time
TIMEOFF	- Sample end time
NWS PRECIP	- NWS gauge precipitation, inches
SO4	- SO_4 concentration in rain, mg/L
NO3	- NO_3 concentration in rain, mg/L
Cl	- Cl concentration in rain, mg/L
NH4	- NH_4 concentration in rain, mg/L
PO4	- PO_4 concentration in rain, mg/L

TBNEP Wet Deposition

BEGIND	ENDD	TIMEON	TIMEOFF	NWS precip. (in)	SO4 (mg/L)	NO3 (mg/L)	Cl (mg/L)	NH4 (mg/L)	PO4 (mg/L)
13AUG96	19AUG96	1300	1300	0.63	4.3700	1.9700	7.3100	0.4400	0.1960
19AUG96	20AUG96	1300	1300	0.12	5.5200	1.6200	2.2800	0.3900	0.2390
20AUG96	24AUG96	1300	1300	0.04	4.3400	2.8400	2.9600	0.4600	0.2900
24AUG96	27AUG96	1300	1300	0.02	10.0000	6.5600	4.2800	0.3000	0.0400
27AUG96	02SEP96	1300	1300	0.31	6.8200	3.3000	1.4300	0.2000	0.0000
09SEP96	10SEP96	1300	1300	0.07	3.7500	0.9400	0.6300	0.1600	0.0180
10SEP96	11SEP96	1300	1300	0.24	1.5200	0.7700	2.1600	0.0800	0.0000
11SEP96	12SEP96	1300	1300	0.65	1.5800	0.5500	1.2400	0.0500	0.0000
12SEP96	17SEP96	1300	1300	0.19	2.1600	0.7500	2.1800	0.1800	0.0090
17SEP96	19SEP96	1300	1300	0.02	2.0800	1.7000	4.3200	0.5600	0.0000
19SEP96	21SEP96	1300	1300	0.20	1.6500	1.2900	0.6400	0.2100	0.0000
21SEP96	22SEP96	1300	1300	0.52	1.1900	0.2800	5.7800	0.0800	0.0000
22SEP96	23SEP96	1300	1300	0.88	1.0100	0.3600	3.3800	0.0600	0.0030
01OCT96	03OCT96	1300	1300	0.16	4.1600	1.0600	3.3700	0.2600	0.0700
03OCT96	05OCT96	1300	1300	0.01	3.7100	1.3700	3.7100	0.5000	0.0690
05OCT96	06OCT96	1300	1300	0.13	1.2600	0.2800	2.6700	0.1200	0.0000
06OCT96	07OCT96	1300	1300	0.56	1.8900	0.2300	0.9800	0.1600	0.0080
07OCT96	08OCT96	1300	1300	1.72	2.1900	0.1500	12.3800	0.0600	0.0000
15OCT96	18OCT96	1300	1300	0.65	1.2500	0.4300	0.2800	0.1500	0.0030
02NOV96	03NOV96	1400	1400	0.08	2.0000	1.0300	3.2800	0.2000	0.0050
03NOV96	08NOV96	1400	1400	0.30	0.6300	0.3700	1.0200	0.1200	0.0040
08NOV96	09NOV96	1400	1400	0.05	1.5100	0.3400	5.4200	0.1400	0.0000
15NOV96	22NOV96	1400	1400	0.01	3.1400	1.6400	4.0300	0.1800	0.0090
22NOV96	26NOV96	1400	1400	0.63	1.1100	0.3100	1.7200	0.1700	0.0080
26NOV96	02DEC96	1400	1400	0.73	0.5600	0.2100	1.8000	0.0500	0.0110
02DEC96	07DEC96	1400	1400	0.01	.	.	.	0.0800	0.0000
07DEC96	08DEC96	1400	1400	1.73	0.9700	0.3200	2.3100	0.1000	0.0000
08DEC96	15DEC96	1400	1400	0.02	3.5700	1.5000	6.6100	0.2300	0.0080
05JAN97	10JAN97	1400	1400	0.41	1.6600	0.5300	6.0400	0.1800	0.0040
10JAN97	14JAN97	1400	1400	0.04	1.6800	1.5900	2.4400	0.1800	0.0050
21JAN97	26JAN97	1400	1400	0.35	1.1200	0.3900	1.9300	0.1300	0.0270
04FEB97	09FEB97	1400	1400	0.09	2.0300	0.6100	2.7600	0.2600	0.0310
09FEB97	11FEB97	1400	1415	0.06	3.7500	1.2400	1.4400	0.4400	0.0050
11FEB97	15FEB97	1415	1400	0.49	1.1000	0.4200	2.0800	0.1900	0.0050
16FEB97	23FEB97	1400	1400	0.13	3.1400	0.9600	3.7200	0.3900	0.0270
10MAR97	14MAR97	1400	1400	0.63	1.0900	0.6600	1.3950	0.2300	0.0360
20MAR97	21MAR97	1400	1400	0.64	2.8300	0.6400	1.4500	0.1600	0.0000
21MAR97	22MAR97	1400	1400	0.03	1.9500	1.2200	1.3700	0.0800	0.0000
28MAR97	30MAR97	1400	1400	0.02	.	.	.	.	.
30MAR97	31MAR97	1400	1400	0.23	1.7200	0.5700	2.1900	0.2400	0.0160
04APR97	08APR97	1400	1300	0.57	2.9100	1.1300	3.5400	0.4300	0.0210
08APR97	12APR97	1300	1300	0.29	0.6000	0.6500	1.8000	0.1300	0.0090
12APR97	15APR97	1300	1300	1.29	1.7200	0.8800	0.6700	0.2700	0.0070
21APR97	24APR97	1300	1300	0.61	2.5800	0.7900	9.2700	0.2400	0.0110
24APR97	26APR97	1300	1300	2.15	3.0800	1.0300	6.2900	0.5300	0.0150
26APR97	27APR97	1300	1300	0.53	0.5400	0.2800	1.1300	0.1200	0.0050

TBNEP Wet Deposition

BEGIND	ENDD	TIMEON	TIMEOFF	NWS precip. (in)	SO4 (mg/L)	NO3 (mg/L)	Cl (mg/L)	NH4 (mg/L)	PO4 (mg/L)
27APR97	28APR97	1300	1300	0.03	2.9200	2.6200	9.2700	0.6600	0.0630
28APR97	29APR97	1300	1300	1.26	1.1300	0.5700	2.9200	0.3400	0.0260
06MAY97	12MAY97	1300	1300	0.61	4.4700	1.6300	0.9900	0.5500	0.0720
12MAY97	13MAY97	1300	1300	0.78	1.0000	0.3400	0.4200	0.0900	0.0000
24MAY97	29MAY97	1300	1300	0.21	1.4100	0.8700	3.7800	0.2400	0.0130
29MAY97	31MAY97	1300	1300	0.07	5.7600	2.4100	1.7500	1.2400	0.6110
08JUN97	10JUN97	1300	1300	0.09	6.9100	1.7300	4.8800	1.1300	0.1540
10JUN97	14JUN97	1300	1300	0.25	3.5700	1.0200	4.1200	0.0900	0.0080
14JUN97	16JUN97	1300	1318	0.02	4.0600	1.8600	8.0900	0.3700	0.0180
22JUN97	24JUN97	1300	1300	0.63	3.7200	2.5600	1.3200	0.3500	0.0530
24JUN97	25JUN97	1300	1300	0.84	2.2400	0.6900	0.9500	0.1300	0.0060
25JUN97	26JUN97	1300	1300	0.14	5.8400	3.0100	2.0400	0.2600	0.0880
26JUN97	27JUN97	1300	1300	0.22	4.2000	1.6600	1.4400	0.2200	0.0320
27JUN97	02JUL97	1300	1300	0.12	1.0900	1.1200	1.3800	0.1400	0.0000
02JUL97	03JUL97	1300	1300	0.14	1.4400	1.2600	2.2300	0.0800	0.0000
04JUL97	05JUL97	1300	1300	0.21	4.7600	3.0500	0.7400	0.4200	0.0110
05JUL97	06JUL97	1300	1300	1.59	3.8900	1.0000	0.6400	0.1900	0.0000
06JUL97	07JUL97	1300	1300	0.68	1.5100	0.6600	1.3900	0.1100	0.0000
07JUL97	11JUL97	1300	1300	0.09	5.2300	3.2900	6.5000	0.3100	0.0090
11JUL97	12JUL97	1300	1300	2.46	1.7800	1.3000	0.7700	0.1900	0.0060
12JUL97	15JUL97	1300	1300	0.80	5.3800	4.4600	0.8800	0.3900	0.0320
15JUL97	16JUL97	1300	1300	0.12	6.0700	3.6500	1.4100	0.2600	0.0310
16JUL97	19JUL97	1300	1300	0.05	5.4100	4.2200	3.5000	0.2800	0.0100
19JUL97	20JUL97	1300	1300	0.97	2.8100	1.0200	0.8600	0.2300	0.0000
20JUL97	21JUL97	1300	1300	0.56	1.2400	0.6400	1.6700	0.0900	0.0000
21JUL97	22JUL97	1300	1300	0.36	2.4100	1.2200	0.3100	0.0900	0.0150
22JUL97	23JUL97	1300	1300	0.40	4.6100	4.1600	1.1200	0.4500	0.0910
23JUL97	25JUL97	1300	1300	0.35	3.8900	1.5000	1.7200	0.2500	0.0100
25JUL97	28JUL97	1300	1300	0.01	4.5700	3.0100	2.8000	0.3200	0.0320
31JUL97	02AUG97	1300	1300	0.09	2.5500	1.5100	1.8000	0.1100	0.0030
02AUG97	03AUG97	1300	1300	0.19	1.5000	0.8900	2.7500	0.0400	0.0000
03AUG97	04AUG97	1300	1300	0.45	1.4100	0.8500	1.6700	0.1000	0.0000
04AUG97	05AUG97	1300	1300	0.18	1.3300	1.0200	3.2200	0.1000	0.0000
05AUG97	06AUG97	1300	1300	1.01	0.9200	0.7100	1.2500	0.1500	0.0000
06AUG97	08AUG97	1300	1300	0.20	2.0700	0.9100	0.6100	0.0900	0.0000
08AUG97	12AUG97	1300	1300	0.03	7.2100	3.9500	2.5600	0.4400	0.0660
12AUG97	17AUG97	1300	1300	1.71	4.6600	1.2000	0.9800	0.2000	0.0210
17AUG97	18AUG97	1300	1300	0.02	6.3600	4.6800	3.0400	0.2700	0.1710
18AUG97	22AUG97	1300	1300	0.27	1.6900	1.4900	4.0800	0.1000	0.0000
29AUG97	02SEP97	1300	1300	0.14	3.9400	1.4400	1.5000	0.3700	0.0150
02SEP97	04SEP97	1300	1300	0.02	5.4600	1.5100	1.8300	0.3100	0.0080
10SEP97	14SEP97	1300	1300	0.24	3.6100	1.8000	0.8000	0.3600	0.1350
14SEP97	16SEP97	1300	1300	0.01	.	.	.	0.9700	0.4420
16SEP97	18SEP97	1300	1300	0.63	5.9200	3.5700	2.1600	0.6000	0.4500
18SEP97	21SEP97	1300	1300	0.01	18.3600	18.0000	1.9900	2.4700	0.2990
21SEP97	24SEP97	1300	1300	0.58	2.9100	1.3700	1.4600	0.4300	0.0440
24SEP97	26SEP97	1300	1300	0.78	0.5400	0.1900	0.8200	0.0300	0.0000

TBNEP Wet Deposition

BEGIND	ENDD	TIMEON	TIMEOFF	NWS precip. (in)	SO4 (mg/L)	NO3 (mg/L)	Cl (mg/L)	NH4 (mg/L)	PO4 (mg/L)
27SEP97	28SEP97	1300	1300	0.77	0.5900	0.1200	1.2000	0.0400	0.0000
28SEP97	02OCT97	1300	1300	0.06	2.2000	2.5700	1.4000	0.2600	0.0920
14OCT97	17OCT97	1300	1300	0.24	2.8700	2.7000	2.1250	0.6200	0.0665
17OCT97	18OCT97	1300	1300	0.20	3.3400	1.1100	2.1600	1.0000	0.0560
18OCT97	19OCT97	1300	1300	0.24	1.9300	0.3500	1.2700	0.0600	0.0000
19OCT97	25OCT97	1300	1300	0.10	4.9600	2.7000	4.1700	0.5200	0.0080
25OCT97	28OCT97	1300	1400	2.00	0.9200	0.2100	1.8300	0.0400	0.0000
28OCT97	01NOV97	1400	1400	1.88	1.0600	0.3200	1.4800	0.1000	0.0000
01NOV97	07NOV97	1400	1400	0.65	1.7700	1.2400	1.2100	0.1400	0.0040
07NOV97	13NOV97	1400	1400	0.16	0.8500	0.4900	0.9700	0.1100	0.0060
22NOV97	23NOV97	1400	1400	0.01	.	.	.	.	.
23NOV97	29NOV97	1400	1400	0.01	3.3900	3.1500	.	0.3500	0.0300
29NOV97	30NOV97	1400	1400	0.45	1.6400	0.2300	0.6900	0.0600	0.0000
30NOV97	01DEC97	1400	1400	0.21	1.9500	0.3000	0.7400	0.1100	0.0040
01DEC97	04DEC97	1400	1400	1.20	1.0800	0.4000	1.4400	0.0600	0.0070
09DEC97	10DEC97	1630	1400	0.21	1.6800	0.7300	1.2400	0.1900	0.0060
11DEC97	12DEC97	1400	1400	0.60	2.1200	0.4100	1.5600	0.1000	0.0060
13DEC97	14DEC97	1400	1400	1.00	1.1800	0.1900	0.6800	0.0400	0.0000
14DEC97	15DEC97	1400	1400	0.02	1.7800	2.3200	2.9600	0.1200	0.0070
22DEC97	25DEC97	1400	1400	0.55	1.3400	0.6400	2.6800	0.1300	0.0070
25DEC97	26DEC97	1400	1400	0.79	1.1500	0.5200	2.0000	0.1100	0.0070
26DEC97	27DEC97	1400	1400	2.00	1.2800	0.2200	1.0500	0.1400	0.0050
27DEC97	28DEC97	1400	1400	0.04	3.7500	1.0900	8.4300	0.3600	0.0600
28DEC97	29DEC97	1400	1400	0.04	3.5100	3.2000	3.8800	0.3000	0.0170
29DEC97	30DEC97	1400	1400	0.09	7.8200	1.6700	43.9500	0.2700	0.0000
06JAN98	07JAN98	1400	1400	0.30	4.1500	2.7100	3.3500	0.3700	0.0620
07JAN98	08JAN98	1400	1400	1.26	1.0100	0.2400	1.8800	0.0800	0.0070
13JAN98	15JAN98	1400	1400	0.07	1.4400	1.0600	3.4300	0.2500	0.0070
15JAN98	16JAN98	1400	1400	0.52	0.8550	0.3300	1.4300	0.0800	0.0000
16JAN98	20JAN98	1400	1400	0.07	.	.	.	.	.
20JAN98	23JAN98	2015	1400	0.10	0.4200	0.2400	0.4400	0.0600	0.0000
23JAN98	24JAN98	1400	1400	0.87	0.2900	0.1100	0.4000	0.0200	0.0000
24JAN98	25JAN98	1400	1400	0.03	5.4400	3.4700	2.1100	1.0100	0.0190
25JAN98	27JAN98	1400	1400	0.01	3.2000	2.6800	2.9600	0.5000	0.0330
27JAN98	03FEB98	1400	1400	1.91	1.5300	0.3700	1.2900	0.1300	0.0270
03FEB98	04FEB98	1400	1400	0.09	3.4500	1.2500	11.7300	0.0700	0.0050
04FEB98	07FEB98	1400	1400	0.12	2.5000	1.9000	4.0100	0.1200	0.0110
12FEB98	14FEB98	1400	1400	0.29	2.6900	0.8500	1.1400	0.2500	0.0160
14FEB98	16FEB98	1400	1400	2.00	1.3000	0.3900	0.6100	0.1000	0.0100
16FEB98	17FEB98	1400	1400	2.00	1.4000	0.4200	1.6800	0.1400	0.0070
17FEB98	20FEB98	1400	1400	2.00	1.3300	0.6600	1.2200	0.1800	0.0130
20FEB98	23FEB98	1400	1400	0.15	.	.	.	.	.
23FEB98	28FEB98	1400	1400	0.29	2.1000	0.9200	3.2600	0.3000	0.0190
28FEB98	01MAR98	1400	1400	0.97	2.1800	0.9600	2.4700	0.3600	0.0170
08MAR98	09MAR98	1400	1400	1.07	1.5000	0.6900	2.8300	0.3800	0.0230
17MAR98	19MAR98	1400	1400	1.83	0.6400	0.4800	0.8400	0.0800	0.0000
19MAR98	20MAR98	1400	1400	2.10	1.6500	0.5300	0.8300	0.1400	0.0000

TBNEP Wet Deposition

BEGIND	ENDD	TIMEON	TIMEOFF	NWS precip. (in)	SO4 (mg/L)	NO3 (mg/L)	Cl (mg/L)	NH4 (mg/L)	PO4 (mg/L)
20MAR98	21MAR98	1400	1400	0.01	3.3900	1.8400	.	0.8300	0.0000
31MAR98	04APR98	1400	1400	0.02	.	.	.	.	.
04APR98	05APR98	1400	1300	0.01	4.2100	3.5800	6.6000	1.3900	0.0300
27APR98	01MAY98	1300	1300	0.18	2.2400	1.1400	2.8400	0.6450	0.0235
01MAY98	05MAY98	1300	1300	0.04	5.2500	6.8800	5.6400	1.3800	0.0430
05MAY98	06MAY98	1300	1300	0.82	1.4800	0.9200	1.1800	0.4100	0.0190
20MAY98	27MAY98	1300	1300	0.05	5.9700	3.5200	3.8900	1.0600	0.1290
27MAY98	28MAY98	1300	1300	0.01	.	.	.	1.0900	0.1180
29MAY98	31MAY98	1300	1300	0.10	11.1200	7.2800	1.5800	0.4800	0.0260
09JUN98	10JUN98	1300	1300	0.01	15.5700	9.5200	6.9700	1.8600	0.2850
17JUN98	23JUN98	1300	1300	0.01	.	.	.	1.1700	0.2670
23JUN98	24JUN98	1300	1300	1.05	3.6600	1.6000	0.5000	0.5000	0.0350
24JUN98	25JUN98	1300	1300	0.90	4.0200	1.9400	1.1200	0.5400	0.0430
25JUN98	27JUN98	1300	1300	0.02	.	.	.	.	.
27JUN98	28JUN98	1300	1300	0.56	3.1400	1.6000	1.9100	0.3200	0.0150
28JUN98	30JUN98	1300	1300	0.22	13.1900	6.1100	10.8800	1.2500	0.0870
30JUN98	06JUL98	1300	1300	0.61	3.3900	0.8200	12.7000	0.1800	0.0070
06JUL98	07JUL98	1300	1300	0.54	3.9400	2.2100	0.4400	0.4100	0.0170
07JUL98	08JUL98	1300	1300	2.88	1.5000	0.8700	1.1200	0.1900	0.0000
08JUL98	10JUL98	1300	1300	1.67	1.3000	0.6000	1.0700	0.0600	0.0000
10JUL98	11JUL98	1300	1300	1.06	0.4700	0.2600	1.4600	0.0200	0.0000
11JUL98	12JUL98	1300	1300	0.01	.	.	.	.	.
12JUL98	13JUL98	1300	1300	0.97	1.4600	0.6100	0.3200	0.0900	0.0000
13JUL98	15JUL98	1300	1300	0.24	3.4200	2.1600	1.9000	0.1500	0.0100
15JUL98	16JUL98	1300	1300	0.18	1.2900	1.1200	1.1700	0.1000	0.0000
16JUL98	17JUL98	1300	1300	0.47	2.0200	0.4000	2.0800	0.0600	0.0000
17JUL98	20JUL98	1300	1300	0.12	6.6400	2.3600	1.2000	0.2200	0.0190
20JUL98	22JUL98	1300	1300	0.55	3.1400	0.6900	1.2800	0.1100	0.0180
28JUL98	02AUG98	1300	1300	0.18	9.0200	6.1500	3.9900	0.4400	0.0820

APPENDIX C

DRY CONCENTRATION DATA FROM SAMPLERS

SITE	- Two samplers, A and B, side by side
SO4NYL	- Total μg of SO4 from 24-hour measurement, Nylon filter
NO3NNYL	- Total μg of Nitrogen in NO3 from 24-hour measurement, Nylon filter
NH4NNYL	- Total μg of Nitrogen in NH4 from 24-hour measurement, Nylon filter
SO4CARB	- Total μg of SO4 from 24-hour measurement, Carbonate denuder
NO3NCARB	- Total μg of Nitrogen in NO3 from 24-hour measurement, Carbonate denuder
NH4NCITR	- Total μg of Nitrogen in NH4 from 24-hour measurement, Citric Acid denuder

(From pumping rate of 10 L/min over 24-hour period)

DATE	SITE	SO4NYL	NO3NNYL	NH4NNYL	SO4CARB	NO3NCARB	NH4NCITR
07AUG96	A	52.800	3.303	3.031	341.900	4.851	19.510
12AUG96	A	86.930	4.354	3.349	580.900	2.905	20.620
19AUG96	A	23.710	1.493	1.196	359.300	2.682	22.500
25AUG96	A	37.640	1.745	1.314	234.000	5.851	16.120
31AUG96	A	93.000	5.307	12.100	458.100	6.769	39.980
06SEP96	A	84.480	0.664	6.010	151.800	4.970	12.340
12SEP96	A	78.230	1.243	5.591	197.500	7.205	15.550
18SEP96	A	40.300	1.619	1.670	31.170	2.219	12.230
24SEP96	A	47.020	2.052	4.064	384.000	4.806	30.720
30SEP96	A	27.770	1.770	1.247	556.000	1.714	37.640
06OCT96	A	10.620	0.860	0.500	325.800	1.437	9.354
12OCT96	A	60.740	1.919	4.438	68.420	3.972	7.975
18OCT96	A	1.000	0.200	0.500	113.000	1.776	16.830
24OCT96	A	49.420	2.261	3.370	68.810	4.236	15.290
30OCT96	A	93.110	3.241	6.910	244.700	6.101	13.750
05NOV96	A	54.910	3.890	4.987	496.900	3.036	76.240
11NOV96	A	19.130	1.864	3.290	87.240	3.013	13.400
17NOV96	A	9.076	1.087	0.500	331.900	1.858	14.230
23NOV96	A	42.540	2.486	4.449	365.500	2.549	17.770
29NOV96	A	38.990	2.282	3.775	272.700	2.351	17.200
05DEC96	A	40.010	4.452	9.582	216.900	2.489	25.400
11DEC96	A	24.870	5.043	1.652	107.900	2.612	21.180
17DEC96	A	22.390	1.894	0.500	37.090	2.082	11.870
23DEC96	A	25.810	3.254	2.746	330.800	1.720	33.060
29DEC96	A	36.420	6.082	5.520	225.400	1.935	80.750
04JAN97	A	28.570	2.692	0.863	61.960	1.769	17.460
10JAN97	A	27.130	1.802	2.316	39.620	1.515	6.409
16JAN97	A	24.820	2.478	3.986	73.190	1.059	14.660
22JAN97	A	52.650	7.378	15.570	182.000	2.395	30.860
28JAN97	A	39.300	7.238	7.291	248.100	1.658	41.220
03FEB97	A	51.530	8.734	12.670	452.400	4.784	40.010
09FEB97	A	1.000	0.200	0.500	2.752	0.160	5.068
15FEB97	A	18.950	0.943	2.261	32.090	0.969	9.572
21FEB97	A	14.160	2.072	0.500	208.400	1.493	15.900
27FEB97	A	8.128	1.748	0.500	17.260	0.807	14.080
05MAR97	A	48.700	4.130	3.586	179.000	2.597	18.680
11MAR97	A	53.870	3.447	5.059	81.590	4.082	11.560
17MAR97	A	54.910	3.113	6.308	245.600	2.475	13.200
23MAR97	A	98.770	2.816	9.495	52.630	3.009	5.229
29MAR97	A	41.950	1.592	1.105	49.490	1.606	10.680
04APR97	A	20.980	2.087	0.782	182.600	2.566	14.420
10APR97	A	56.580	2.173	11.460	378.500	6.789	10.500
16APR97	A	42.450	2.953	2.778	60.780	2.123	9.253
22APR97	A	54.090	1.913	6.669	234.000	1.407	7.674
28APR97	A	51.100	1.830	6.543	95.570	0.954	8.722
04MAY97	A	41.640	1.152	7.674	59.470	2.606	14.010
10MAY97	A	72.210	1.738	11.120	142.400	2.817	5.214
16MAY97	A	88.610	2.641	18.170	304.400	5.012	12.310
22MAY97	A	96.930	2.363	17.400	296.400	3.900	14.590
28MAY97	A	40.500	2.556	4.851	170.900	3.487	16.910

DATE	SITE	SO4NYL	NO3NNYL	NH4NNYL	SO4CARB	NO3NCARB	NH4NCITR
03JUN97	A	66.420	0.467	4.516	15.40	3.420	7.474
09JUN97	A	20.340	1.667	2.915	610.70	2.409	27.120
15JUN97	A	38.350	1.797	2.821	121.60	1.474	9.894
21JUN97	A	26.550	2.876	2.766	92.86	3.983	18.620
27JUN97	A	85.340	4.786	13.530	745.80	8.042	31.290
03JUL97	A	119.500	2.390	14.650	354.60	4.714	10.530
09JUL97	A	49.230	1.882	6.912	285.60	5.782	16.320
15JUL97	A	96.140	1.171	13.640	427.60	6.678	13.550
21JUL97	A	36.000	1.167	4.667	81.71	2.528	13.530
27JUL97	A	23.310	1.323	0.798	304.10	1.330	16.460
02AUG97	A	33.180	1.276	3.394	357.00	1.997	18.680
08AUG97	A	192.500	7.462	47.690	902.10	7.601	51.970
14AUG97	A	1.000	0.200	1.124	0.80	0.914	6.597
20AUG97	A	91.590	1.003	10.460	43.98	6.686	12.070
26AUG97	A	62.580	1.366	10.380	34.75	3.623	11.170
01SEP97	A	41.880	1.318	5.834	225.60	2.384	26.040
07SEP97	A	33.740	1.526	3.833	887.20	2.817	34.300
13SEP97	A	74.020	1.933	11.480	803.60	10.420	30.920
19SEP97	A	78.690	2.597	18.370	590.10	9.699	77.750
25SEP97	A	19.700	1.243	1.628	57.50	2.101	16.010
01OCT97	A	1.000	0.200	0.500	0.80	0.221	5.631
07OCT97	A	29.140	1.216	3.623	540.90	4.899	17.320
13OCT97	A	90.640	1.875	18.120	780.30	4.810	26.130
19OCT97	A	131.300	0.905	18.980	108.40	4.430	9.357
25OCT97	A	64.070	1.902	9.028	105.70	2.239	14.500
31OCT97	A	44.990	1.608	6.769	259.30	1.770	17.920
06NOV97	A	48.360	1.633	7.309	303.80	5.860	14.660
12NOV97	A	127.500	4.020	25.770	159.10	4.316	16.930
18NOV97	A	69.120	5.364	16.150	322.30	4.866	16.930
24NOV97	A	47.280	1.521	10.030	75.87	3.778	11.250
30NOV97	A	24.540	1.053	2.309	124.10	1.416	12.630
06DEC97	A	21.190	1.111	3.901	98.63	2.543	10.190
12DEC97	A	46.740	1.449	13.080	181.00	0.494	14.090
18DEC97	A	72.090	12.220	21.850	110.30	6.915	12.380
05JAN98	A	2.215	0.200	0.756	327.70	2.581	68.410
11JAN98	A	37.290	4.384	10.850	296.20	5.501	13.740
17JAN98	A	30.400	1.416	5.833	35.26	3.065	11.520
23JAN98	A	20.250	1.257	2.079	27.36	1.685	16.900
29JAN98	A	73.120	3.340	17.870	225.50	5.013	13.540
04FEB98	A	28.870	2.292	3.751	16.52	1.171	10.130
10FEB98	A	134.500	15.810	43.830	862.10	5.193	22.110
16FEB98	A	40.620	1.480	6.407	175.60	2.105	16.350
06MAR98	A	1.000	0.200	0.500	0.80	0.160	8.640
12MAR98	A	42.660	2.325	11.160	181.30	4.296	5.128
18MAR98	A	31.250	3.034	2.354	373.70	3.454	20.980
24MAR98	A	70.280	4.124	18.420	299.30	8.828	9.957
30MAR98	A	24.580	2.551	4.581	411.20	2.566	38.620
05APR98	A	109.500	0.922	20.640	114.90	3.378	8.322
06APR98	A	156.800	2.655	1.910	581.20	8.130	19.030
07APR98	A	117.600	2.992	20.180	76.23	2.441	24.570

DATE	SITE	SO4NYL	NO3NNYL	NH4NNYL	SO4CARB	NO3NCARB	NH4NCITR
11APR98	A	84.470	0.90800	16.010	92.230	2.780	3.192
17APR98	A	1.000	0.20000	0.612	1.222	0.160	5.184
23APR98	A	43.250	1.10500	9.610	14.430	1.403	7.576
29APR98	A	65.687	2.50756	13.080	348.900	3.747	20.870
05MAY98	A	53.231	2.79895	7.989	196.300	2.199	15.250
11MAY98	A	167.220	2.12543	23.160	38.200	2.367	11.650
17MAY98	A	66.412	1.96604	13.660	159.800	6.600	13.180
23MAY98	A	234.165	0.83665	42.700	21.600	4.271	6.663
29MAY98	A	79.328	3.65495	15.040	420.900	9.262	23.580
04JUN98	A	47.801	1.24890	6.181	80.180	1.767	8.048
10JUN98	A	96.493	2.98719	16.220	291.300	6.750	21.310
16JUN98	A	119.276	1.35718	19.970	116.200	3.547	10.010
22JUN98	A	159.862	1.38885	29.530	521.000	11.790	12.280
28JUN98	A	102.769	2.94816	18.140	155.700	8.249	11.600
04JUL98	A	47.429	2.31855	4.954	108.300	2.531	9.429
10JUL98	A	33.222	1.37763	2.738	59.550	1.422	8.680
16JUL98	A	32.146	1.83201	2.792	329.200	2.343	8.773
22JUL98	A	29.882	1.95691	3.244	457.900	4.419	29.480
28JUL98	A	96.429	2.80161	11.240	254.700	7.741	11.310
03AUG98	A	56.331	2.39754	8.152	447.000	5.813	8.227
09AUG98	A	85.663	2.80462	20.700	644.100	20.890	51.540
15AUG98	A	13.368	0.21815	1.234	257.800	3.324	8.469
21AUG98	A	11.576	1.01780	1.082	370.500	1.773	34.490
27AUG98	A	87.538	1.51042	14.560	128.900	7.075	13.700
02SEP98	A	54.975	1.48519	5.439	407.200	1.015	24.850
08SEP98	A	17.587	1.15836	1.285	158.000	1.550	9.168
14SEP98	A	7.785	0.31178	0.500	889.700	4.775	51.840
02OCT98	A	38.327	1.14139	4.044	177.400	3.746	12.530
08OCT98	A	30.205	1.24524	2.733	301.900	4.791	21.800
14OCT98	A	44.716	1.49499	6.540	456.200	3.279	19.290
20OCT98	A	14.724	1.25049	0.967	173.700	3.205	13.250
26OCT98	A	15.675	1.02157	1.608	111.400	2.734	12.560
07AUG96	B	52.190	2.98500	2.925	350.300	4.191	20.780
12AUG96	B	84.460	4.30600	3.389	559.100	3.694	21.800
19AUG96	B	23.650	1.50100	1.222	350.100	2.830	56.480
25AUG96	B	37.120	1.66700	1.196	236.100	6.841	15.850
31AUG96	B	93.490	5.39800	11.760	458.400	7.665	38.070
06SEP96	B	86.180	0.67900	5.984	151.900	5.463	11.350
12SEP96	B	77.920	1.25700	5.927	194.900	7.237	16.130
18SEP96	B	40.920	1.70300	1.181	29.600	2.078	10.810
24SEP96	B	48.340	2.09600	4.305	397.300	4.989	29.330
30SEP96	B	1.000	0.20000	0.500	0.800	0.160	4.472
06OCT96	B	10.790	0.89800	0.500	337.500	1.938	9.748
12OCT96	B	57.280	2.00600	4.693	57.160	3.042	7.193
18OCT96	B	34.650	1.91400	1.392	116.600	2.043	17.470
24OCT96	B	51.380	2.24600	3.810	71.800	4.297	17.810
30OCT96	B	95.980	3.25400	7.234	259.300	7.221	17.520
05NOV96	B	57.280	3.88000	6.075	527.800	2.735	72.030
11NOV96	B	19.800	1.92800	3.397	91.920	3.570	12.090
17NOV96	B	25.530	4.84300	1.284	714.300	4.319	30.790

DATE	SITE	SO4NYL	NO3NNYL	NH4NNYL	SO4CARB	NO3NCARB	NH4NCITR
23NOV96	B	12.320	0.833	0.500	380.80	2.844	16.760
29NOV96	B	40.710	2.379	4.052	288.20	1.966	20.490
05DEC96	B	43.260	4.687	10.890	232.20	2.635	34.590
11DEC96	B	26.500	5.301	3.062	111.00	2.999	35.030
17DEC96	B	22.920	1.785	0.547	37.76	1.811	11.640
23DEC96	B	26.610	3.356	2.970	353.30	1.702	35.350
29DEC96	B	37.930	6.443	6.341	243.80	1.900	83.050
04JAN97	B	30.660	2.653	0.902	69.54	2.083	16.310
10JAN97	B	28.690	1.819	2.521	40.16	1.293	5.960
16JAN97	B	26.150	2.327	4.164	81.47	1.119	15.590
22JAN97	B	56.800	7.888	16.550	197.30	2.928	30.900
28JAN97	B	40.990	7.578	8.088	270.60	1.651	19.950
03FEB97	B	55.650	9.156	12.480	470.50	5.128	64.110
09FEB97	B	62.820	2.506	15.100	98.32	3.277	6.970
15FEB97	B	16.930	0.944	2.316	32.64	0.873	8.621
21FEB97	B	14.510	1.990	0.500	217.10	1.865	15.950
27FEB97	B	8.426	1.681	0.500	18.23	0.937	13.760
05MAR97	B	51.380	4.144	3.997	189.60	2.936	17.520
11MAR97	B	57.710	3.515	5.563	85.81	3.673	14.590
17MAR97	B	57.920	3.086	6.640	266.50	2.631	15.010
23MAR97	B	108.100	2.977	11.170	58.81	4.182	6.059
29MAR97	B	45.990	1.447	1.453	54.14	2.233	9.294
04APR97	B	22.380	2.124	0.869	190.30	2.511	14.660
10APR97	B	59.370	2.187	12.480	410.90	6.982	10.310
16APR97	B	46.450	2.891	3.092	75.72	2.315	10.550
22APR97	B	57.120	1.894	7.478	256.10	1.487	9.471
28APR97	B	54.590	1.692	6.920	98.71	0.962	8.581
04MAY97	B	42.020	1.146	7.590	58.96	2.839	6.292
10MAY97	B	75.700	1.828	11.700	143.30	2.666	6.597
16MAY97	B	1.000	0.200	0.500	0.80	0.424	8.851
22MAY97	B	98.870	2.589	17.300	298.50	3.809	19.670
28MAY97	B	34.040	1.903	3.568	138.10	3.494	16.180
03JUN97	B	67.780	0.512	11.800	17.00	3.809	8.420
09JUN97	B	20.720	1.693	3.241	620.10	1.790	24.840
15JUN97	B	39.080	1.835	2.942	120.90	1.641	11.140
21JUN97	B	27.090	2.755	3.241	93.06	4.315	14.220
27JUN97	B	86.940	4.826	13.560	750.30	7.939	31.930
03JUL97	B	120.600	2.238	15.120	360.10	5.871	9.040
09JUL97	B	49.620	1.840	6.809	286.40	5.559	23.170
15JUL97	B	96.420	1.062	14.270	440.00	7.361	9.623
21JUL97	B	36.140	1.209	4.238	83.53	2.823	13.000
27JUL97	B	23.710	1.340	0.946	302.60	1.298	16.410
02AUG97	B	33.830	1.245	3.305	369.40	2.736	16.410
08AUG97	B	195.400	7.557	48.870	916.30	8.513	60.710
14AUG97	B	80.850	2.147	11.960	470.70	9.633	17.730
20AUG97	B	92.940	0.997	10.500	43.92	5.343	12.660
26AUG97	B	63.580	1.379	10.710	34.01	4.167	13.800
01SEP97	B	42.510	1.346	5.606	235.60	3.143	21.090
07SEP97	B	34.090	1.490	3.605	885.10	3.919	29.140
13SEP97	B	75.210	1.997	11.300	796.60	12.610	31.720

DATE	SITE	SO4NYL	NO3NNYL	NH4NNYL	SO4CARB	NO3NCARB	NH4NCITR
19SEP97	B	225.700	7.084	79.960	606.400	11.330	78.420
25SEP97	B	19.290	1.237	2.718	57.750	1.691	13.620
01OCT97	B	150.400	0.862	26.590	77.460	6.536	12.930
07OCT97	B	28.730	1.166	3.637	540.900	4.835	18.430
13OCT97	B	91.410	1.924	18.340	809.700	5.991	27.370
19OCT97	B	131.100	0.964	19.880	110.000	4.367	8.791
25OCT97	B	64.690	1.885	9.250	104.100	1.988	14.480
31OCT97	B	22.660	0.633	1.997	124.600	0.737	12.700
06NOV97	B	29.820	1.247	3.607	332.500	6.554	15.660
12NOV97	B	128.000	4.010	25.710	169.400	4.124	14.070
18NOV97	B	70.610	5.371	16.510	328.300	4.729	17.530
24NOV97	B	46.790	1.536	10.340	77.970	3.564	14.120
30NOV97	B	24.170	1.066	2.583	125.900	1.436	13.180
06DEC97	B	21.530	1.122	4.058	100.900	2.772	8.297
12DEC97	B	1.677	0.200	0.500	232.000	0.580	15.070
18DEC97	B	70.000	12.010	20.700	102.300	5.842	10.730
29JAN98	B	73.620	3.449	18.530	237.900	4.764	14.280
04FEB98	B	28.190	2.148	3.700	18.440	1.240	7.003
10FEB98	B	136.900	16.250	45.060	889.800	2.945	24.230
16FEB98	B	1.317	0.200	1.524	0.897	0.185	5.118
06MAR98	B	43.570	3.975	8.167	233.400	3.298	21.640
12MAR98	B	43.570	2.416	11.580	186.400	4.544	7.846
18MAR98	B	30.830	2.820	2.711	372.800	2.929	17.700
24MAR98	B	71.880	4.132	19.040	291.000	9.359	13.350
30MAR98	B	25.230	2.543	4.395	431.200	2.883	35.660
05APR98	B	113.800	1.002	21.360	115.600	3.302	7.245
06APR98	B	164.300	2.605	33.400	594.600	8.280	18.840
07APR98	B	123.400	3.212	20.340	76.840	2.286	24.620
11APR98	B	88.360	0.946	16.350	109.200	3.876	4.044
17APR98	B	31.080	2.335	2.632	33.280	1.805	18.480
23APR98	B	45.140	1.102	10.200	15.860	1.576	8.268

APPENDIX D

DAILY MEANS OF METEOROLOGICAL STATION DATA

WS	- Wind speed, m/s
WD	- Wind direction, compass degrees
Atemp	- Air temperature, degrees Celsius
Wtemp	- Water temperature, degrees Celsius
Rh	- Relative humidity, %.

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
09AUG96	4.54615	230.769	29.0385	29.9500	74.0000
10AUG96	4.21667	201.229	27.7500	30.0812	79.8333
11AUG96	4.97708	191.146	26.2917	29.8292	87.1667
12AUG96	5.15208	217.479	25.1250	29.1458	89.1250
13AUG96	4.94583	230.188	27.9167	28.6438	77.2917
14AUG96	3.41250	194.479	27.6667	29.1396	76.6250
15AUG96	4.13333	184.917	28.1667	29.5542	76.0000
16AUG96	3.22083	162.708	27.3750	29.8021	76.4167
17AUG96	3.84583	134.750	27.4167	29.9771	76.9167
18AUG96	4.48958	82.458	27.5417	29.9292	76.5417
19AUG96	5.75208	59.667	27.7083	29.7500	78.7500
20AUG96	7.63542	45.521	27.9583	29.6333	78.6667
21AUG96	7.50417	49.083	28.3333	29.1854	70.9583
22AUG96	6.20833	54.146	28.0833	28.8375	70.0000
23AUG96	4.25417	88.167	25.7500	28.8521	80.7500
24AUG96	2.50833	144.500	25.2292	28.7583	83.2917
25AUG96	2.34792	169.875	26.0417	28.8083	77.7917
26AUG96	2.88333	167.542	25.6458	29.1542	81.5208
27AUG96	2.62292	190.521	26.4167	29.2375	78.4167
28AUG96	3.17083	162.417	27.0833	29.4437	79.1667
29AUG96	3.73542	179.438	27.9167	29.6229	75.8750
30AUG96	3.38542	118.604	27.1875	29.7875	79.1458
31AUG96	3.38542	138.938	27.3333	29.8563	79.5417
01SEP96	2.34375	165.625	27.5208	30.5479	77.7708
02SEP96	2.54167	175.063	28.0833	30.8396	75.8333
03SEP96	3.63958	224.458	28.5417	30.9438	75.2500
04SEP96	5.27917	241.979	28.5833	30.9625	73.4167
05SEP96	3.55625	283.458	28.5208	30.8938	73.9167
06SEP96	4.23958	233.667	28.4167	30.8042	72.6250
07SEP96	2.50417	228.938	26.0833	30.8750	83.5833
08SEP96	2.99583	122.042	27.7500	31.0667	75.5833
09SEP96	3.16667	88.146	26.1250	31.0625	83.8333
10SEP96	3.93958	111.563	25.3333	30.7583	88.3333
11SEP96	3.83750	149.000	25.0833	30.3437	89.8750
12SEP96	3.15208	203.479	26.5000	30.1000	57.2500
13SEP96	4.36042	305.750	27.3333	30.0646	73.0417
14SEP96	2.01667	234.563	26.6667	30.0021	75.0417
15SEP96	4.13333	151.521	27.9583	29.9729	76.5000
16SEP96	5.72917	153.083	28.2500	29.6979	77.0417
17SEP96	5.18958	205.750	28.7917	29.9125	80.4167
18SEP96	4.48333	259.021	28.3333	29.9750	80.2917
19SEP96	3.74792	194.979	27.4583	29.9833	75.1250
20SEP96	5.26875	54.229	26.5000	29.9958	76.5000
21SEP96	5.44167	151.000	26.2500	29.9521	82.3750
22SEP96	5.22917	210.146	24.9792	29.6125	85.5417
23SEP96	4.46667	169.771	25.3750	29.2521	60.9583
24SEP96	4.67292	53.813	24.9167	28.8021	67.5417
25SEP96	5.50000	82.438	25.0000	28.4250	68.9583
26SEP96	6.83542	90.583	26.8333	28.0021	70.4167

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
27SEP96	5.78750	81.896	27.0833	27.8771	74.0000
28SEP96	4.9667	158.854	26.5833	27.8875	79.000
29SEP96	4.0667	133.479	26.5000	28.0562	82.500
30SEP96	5.2149	76.979	26.3830	28.1830	84.617
01OCT96	6.6604	70.208	27.1667	28.1792	82.667
02OCT96	5.7542	78.208	26.3750	28.2708	86.125
03OCT96	4.1313	71.063	25.2917	28.1958	87.000
04OCT96	5.8521	28.188	24.9167	27.8000	84.542
05OCT96	8.8438	36.646	24.4167	27.4083	87.167
06OCT96	9.2229	47.500	23.6667	26.9375	93.833
07OCT96	7.3792	83.792	24.9167	26.4458	93.000
08OCT96	10.3792	202.542	23.6667	26.3333	86.000
09OCT96	3.3250	229.125	23.3750	26.2125	77.750
10OCT96	3.9813	259.583	22.0833	26.1792	63.333
11OCT96	4.2267	275.400	21.6000	25.9067	62.667
25OCT96	2.5667	153.556	28.6000	24.5333	69.519
26OCT96	4.6146	75.250	25.7208	24.6708	86.479
27OCT96	5.1875	55.646	26.6021	24.8917	84.417
28OCT96	4.2667	144.688	25.1083	25.0917	90.583
29OCT96	2.8688	189.083	25.3604	25.3771	90.896
30OCT96	3.2229	195.167	25.0833	25.4604	92.417
31OCT96	2.4521	233.771	25.4667	25.8604	91.229
01NOV96	2.6729	149.604	25.3688	26.1479	93.271
02NOV96	4.8042	237.854	24.9729	25.9312	96.229
03NOV96	7.8083	156.104	17.5313	23.1583	62.458
04NOV96	6.7542	44.854	21.9688	23.1833	74.188
05NOV96	5.0792	55.792	24.8875	23.6188	85.917
06NOV96	4.0646	113.396	24.6521	24.1792	92.917
07NOV96	4.0063	138.646	25.0292	24.3438	95.083
08NOV96	7.2729	208.292	22.9229	24.1438	91.188
09NOV96	6.7292	211.521	16.4563	21.6667	55.250
10NOV96	5.5646	172.271	15.2854	20.5875	49.854
11NOV96	4.4938	106.917	17.5729	20.2625	59.604
12NOV96	7.1542	36.313	16.6167	19.1146	61.542
13NOV96	7.9938	16.229	18.1938	18.9729	84.000
14NOV96	7.8521	28.979	19.3375	19.0792	83.688
15NOV96	10.0542	26.438	20.1875	19.1979	88.729
16NOV96	8.5083	40.042	19.9354	19.0583	81.063
17NOV96	5.7104	46.146	20.4271	19.1729	89.729
18NOV96	3.2792	157.021	20.4250	19.5188	87.604
19NOV96	2.0875	166.583	20.4521	19.7771	92.979
20NOV96	3.1000	191.250	20.7354	20.2104	100.375
21NOV96	3.6792	188.271	21.2375	20.7042	100.000
22NOV96	5.3729	141.146	21.1979	20.9583	85.125
23NOV96	5.2250	55.167	17.7646	20.1063	79.375
24NOV96	5.2854	91.792	20.4375	20.2750	77.958
25NOV96	5.6958	132.021	21.5729	20.3688	84.521
26NOV96	7.1208	264.979	19.5979	20.3813	94.313
27NOV96	7.3292	119.688	15.1563	19.0583	84.688

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
28NOV96	6.9708	31.104	17.3750	18.8250	85.792
29NOV96	5.9188	51.583	18.7458	19.0604	88.667
30NOV96	4.83750	109.208	20.5063	19.2833	92.438
01DEC96	7.02500	145.313	21.0146	19.4771	98.583
02DEC96	4.96458	271.542	18.2271	19.6979	90.750
03DEC96	5.13333	180.438	15.9625	19.0146	89.083
04DEC96	5.55833	111.375	16.1250	18.4708	70.792
05DEC96	5.26250	126.438	18.2229	18.6042	93.208
06DEC96	2.36250	173.313	19.9375	18.9833	97.354
07DEC96	4.77500	183.167	20.0000	19.1688	99.854
08DEC96	7.72083	300.104	17.4813	18.6667	69.458
09DEC96	6.68333	321.521	15.6417	17.5354	51.021
10DEC96	3.73750	150.167	15.0417	17.0646	54.625
11DEC96	3.05833	149.521	17.1583	17.5083	84.625
12DEC96	3.17292	139.979	18.8750	17.6417	94.167
13DEC96	2.79375	199.958	19.5292	18.0875	96.667
14DEC96	3.75417	217.417	17.1979	17.9917	81.125
15DEC96	5.28542	30.333	17.2208	17.9313	79.208
16DEC96	4.20000	107.771	16.7167	17.8979	89.583
17DEC96	5.37917	148.750	18.6813	17.8979	85.833
18DEC96	5.47500	143.104	19.3688	18.2167	84.625
19DEC96	9.80833	310.396	11.3125	16.8979	90.771
20DEC96	6.80625	294.125	4.3021	12.6042	56.125
21DEC96	6.63750	106.167	9.4479	13.5500	69.542
22DEC96	4.42500	31.271	14.6250	13.9604	84.542
23DEC96	4.26250	49.917	15.8271	14.4437	92.104
24DEC96	2.55000	129.417	16.6917	14.9000	98.479
25DEC96	3.16250	91.646	16.0813	15.2583	99.625
26DEC96	3.19792	150.896	17.3479	15.4729	97.021
27DEC96	2.43542	77.167	18.5083	16.2688	100.000
28DEC96	2.57500	145.542	18.7479	17.1375	100.000
29DEC96	2.87917	107.479	20.0833	17.4000	95.646
30DEC96	2.50625	161.208	20.2438	18.1083	99.979
31DEC96	2.17292	188.542	20.3229	18.7167	97.125
01JAN97	1.87708	187.854	19.9313	18.8854	100.000
02JAN97	2.52917	275.354	19.0813	19.0750	99.208
03JAN97	2.01458	237.729	17.0771	18.6833	100.000
04JAN97	2.13125	163.958	18.8354	19.0604	99.688
05JAN97	3.99167	173.667	20.0583	19.3771	100.000
06JAN97	2.26250	182.313	20.1354	19.8250	100.000
07JAN97	2.77083	170.583	20.2292	19.9792	100.000
08JAN97	3.40208	124.229	20.5271	20.1729	99.750
09JAN97	7.26250	215.563	19.5625	20.2125	100.000
10JAN97	6.13333	298.521	14.6813	19.0167	78.625
11JAN97	3.17292	206.917	15.6188	18.9771	73.563
12JAN97	5.61042	18.458	16.2167	18.5104	79.667
13JAN97	8.21250	23.396	14.7688	17.2292	82.792
14JAN97	6.51042	34.021	15.6333	17.4229	96.292
15JAN97	5.60208	57.563	16.9333	17.5604	99.250

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
16JAN97	6.72500	230.542	17.2500	17.6708	94.604
17JAN97	7.27917	331.688	8.5500	15.2250	60.729
18JAN97	6.65833	338.188	6.0208	13.7458	48.688
19JAN97	2.67917	123.729	9.2813	13.9375	59.958
20JAN97	3.12083	210.167	13.9063	14.6667	79.271
21JAN97	2.63750	52.979	14.7354	14.8917	64.688
22JAN97	3.66042	133.271	16.2813	15.0854	83.563
23JAN97	1.82708	187.417	17.5938	15.6771	87.042
24JAN97	3.46667	150.750	18.1792	15.9667	95.771
25JAN97	2.61458	199.042	17.7125	16.3771	100.000
26JAN97	6.20000	36.479	16.6188	16.1146	75.813
27JAN97	4.44792	43.521	18.0167	16.6688	87.208
28JAN97	2.78333	187.750	19.2771	17.4479	93.146
29JAN97	3.24167	120.979	19.4146	17.6979	93.813
30JAN97	4.55417	295.917	16.2104	17.9792	100.000
31JAN97	5.93542	308.104	14.4521	17.1437	83.458
01FEB97	2.58542	232.167	15.7021	17.3521	89.000
02FEB97	2.43542	173.458	16.9792	17.7583	82.042
03FEB97	3.34792	117.479	18.7542	18.1208	69.958
04FEB97	4.18333	143.375	19.8188	18.2271	76.979
05FEB97	2.52500	194.083	20.7979	18.9521	91.979
06FEB97	2.86458	285.521	20.1396	19.3792	86.667
07FEB97	2.41250	162.104	19.8917	19.5938	94.208
08FEB97	4.75625	205.125	19.9875	19.7979	97.208
09FEB97	5.31042	286.083	16.1271	19.3792	80.125
10FEB97	5.70833	257.125	15.2625	19.0271	83.563
11FEB97	5.78750	300.188	13.3250	18.0542	66.979
12FEB97	3.85625	157.542	14.7042	18.1229	73.521
13FEB97	5.08958	130.958	19.5813	18.5792	87.271
14FEB97	5.18542	160.917	21.2729	18.9687	92.771
15FEB97	5.78333	217.771	19.1813	19.5771	92.375
16FEB97	5.95625	131.563	16.2521	18.1667	73.667
17FEB97	7.90417	26.063	17.0292	17.4229	58.188
18FEB97	6.29375	49.729	18.3438	17.9208	76.417
19FEB97	4.37083	62.521	20.7583	18.8208	89.167
20FEB97	5.06250	82.333	21.8125	19.3625	79.771
21FEB97	5.91875	139.396	21.7250	19.7583	85.208
22FEB97	4.05417	167.375	20.6104	20.3813	98.083
23FEB97	5.11458	147.250	20.4437	20.6125	85.813
24FEB97	6.53542	39.438	19.8063	20.2521	80.563
25FEB97	5.04792	90.354	20.6479	20.8646	84.625
26FEB97	4.70208	124.938	21.7375	21.1583	86.000
27FEB97	5.63750	154.979	22.6063	21.5979	85.250
28FEB97	4.53542	132.104	23.1729	22.0604	85.250
01MAR97	5.16458	128.813	23.0687	22.4646	83.188
02MAR97	4.31250	155.188	22.9000	22.8875	89.375
03MAR97	4.61458	173.167	22.9938	23.2896	93.667
04MAR97	3.00417	224.625	23.4688	24.0646	92.667
05MAR97	4.24167	161.125	23.1708	24.0250	81.979

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
06MAR97	4.96875	299.667	22.9917	23.9771	82.688
07MAR97	7.17083	51.583	19.9896	22.0521	50.146
08MAR97	5.17083	124.521	22.2521	22.8917	64.625
09MAR97	4.85833	64.021	22.5292	22.8771	71.729
10MAR97	5.45208	179.875	22.3125	23.2042	75.2500
11MAR97	4.76875	272.229	22.7542	23.4708	75.6042
12MAR97	3.13542	199.125	23.6188	23.7771	73.6042
13MAR97	3.15000	117.646	23.7979	23.8396	79.0625
14MAR97	4.50625	191.417	22.2146	23.8917	54.4583
15MAR97	3.42083	257.542	21.8958	23.6833	34.7708
16MAR97	8.21042	126.896	20.4875	22.7646	29.7083
17MAR97	5.35833	52.583	20.8771	22.2083	53.0833
18MAR97	6.39375	122.792	22.6438	23.0687	67.5625
19MAR97	4.71667	172.646	22.0396	23.2146	45.7917
20MAR97	6.31042	194.417	22.1000	23.4271	51.0833
21MAR97	4.28333	246.979	20.8313	23.2667	59.9792
22MAR97	6.65625	273.708	21.5438	23.1021	76.2500
23MAR97	4.38750	261.917	21.5250	23.2104	85.7292
24MAR97	5.05625	61.458	22.6896	23.2958	89.8333
25MAR97	5.45208	101.354	23.0938	23.5917	79.3542
26MAR97	4.76875	173.688	22.5958	23.8063	78.0417
27MAR97	3.13542	253.438	23.1896	24.2063	77.7083
28MAR97	3.15000	181.542	23.1875	24.4479	86.6667
29MAR97	4.50625	227.688	23.7521	24.5979	87.7292
30MAR97	3.42083	180.063	24.0271	24.8854	80.3750
31MAR97	8.21042	292.438	22.6729	24.5604	77.3958
01APR97	5.35833	178.771	18.4292	22.3104	76.1250
02APR97	6.39375	54.292	20.4979	22.1438	77.1667
03APR97	4.71667	86.688	21.4667	22.5000	76.6250
04APR97	6.27292	86.000	22.0667	22.5292	75.3750
05APR97	5.83958	143.583	22.2896	22.7125	76.7292
06APR97	5.40208	157.417	22.8042	23.0583	81.2500
07APR97	3.38333	191.979	22.8813	23.3771	73.8333
08APR97	5.05625	207.271	22.3625	22.9833	70.2917
09APR97	5.08958	75.167	22.2417	22.8375	73.8542
10APR97	6.32708	50.354	22.6167	22.7750	85.0000
11APR97	7.36250	90.104	21.6521	22.6062	79.8542
12APR97	5.41667	180.229	21.9979	22.7208	80.9792
13APR97	3.92083	222.083	22.9146	23.1854	78.9583
14APR97	7.48958	137.604	18.1917	21.8896	78.9167
15APR97	7.60417	49.833	18.4604	20.9875	76.2917
16APR97	5.19792	35.542	20.1396	21.1042	79.3333
17APR97	5.96667	245.917	20.6000	21.3708	61.2500
18APR97	7.88542	309.604	17.1896	20.4271	43.4167
19APR97	4.73958	277.875	18.6167	20.6479	52.9583
20APR97	4.73958	269.250	20.4521	21.1271	64.1042
21APR97	4.24375	196.188	21.3417	21.5042	81.9583
22APR97	5.95625	194.021	22.8563	22.1000	89.4583
23APR97	8.60208	214.271	22.2583	22.3312	85.1042

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
24APR97	4.08542	277.146	21.1563	22.1167	71.8333
25APR97	4.82292	67.708	22.6083	22.4250	57.3750
26APR97	6.57917	94.458	22.6062	22.9000	46.0625
27APR97	6.58125	141.708	25.1479	23.2437	55.9792
28APR97	8.43958	174.958	24.2125	23.7250	67.6250
29APR97	6.49167	258.875	22.8979	23.5313	82.6042
30APR97	2.80208	239.729	22.3396	23.6708	92.6875
01MAY97	3.58542	262.292	23.8979	24.1563	78.1458
02MAY97	2.23542	152.458	25.6625	25.0708	83.0000
03MAY97	5.51042	172.667	25.6896	25.5938	80.0000
04MAY97	6.42083	275.083	24.0583	25.3854	71.9792
05MAY97	6.08750	44.458	22.0000	24.2833	73.4583
06MAY97	5.19167	171.021	22.6896	24.6479	67.9583
07MAY97	3.53125	163.854	23.5167	24.9083	72.0417
08MAY97	3.83542	190.188	23.9917	25.1833	73.4583
09MAY97	5.01875	194.896	24.2104	25.4479	78.2500
10MAY97	4.39583	299.250	25.0250	25.8021	83.0000
11MAY97	5.31458	75.563	23.9688	25.2646	80.0625
12MAY97	4.94375	132.729	22.6708	25.3771	72.0833
13MAY97	4.83333	287.000	23.6688	25.4563	73.4583
14MAY97	3.19792	270.167	24.4375	25.7167	68.2083
15MAY97	2.80833	262.021	24.6354	25.8167	71.9375
16MAY97	2.62708	187.229	24.5688	25.8396	73.3542
17MAY97	1.82292	115.375	24.8458	25.9083	78.1875
18MAY97	2.86458	99.958	25.5542	26.1562	80.1875
19MAY97	3.43542	153.354	25.9271	26.5396	80.3958
20MAY97	3.50000	196.188	26.0521	26.9979	82.6667
21MAY97	4.43333	295.229	26.6875	27.2021	81.9792
22MAY97	4.00625	224.938	26.6979	27.5792	73.2708
23MAY97	5.17917	69.188	26.4354	27.8375	75.3958
24MAY97	6.01875	112.792	26.3125	27.9208	71.6458
25MAY97	5.17292	169.104	25.9646	28.0250	74.8542
26MAY97	4.68750	213.021	26.9875	28.4687	77.2708
27MAY97	4.57917	287.729	27.4938	28.8500	77.0208
28MAY97	4.72708	67.333	25.4229	28.4563	75.3542
29MAY97	6.82500	51.583	25.5521	27.6396	78.1458
30MAY97	4.90833	138.688	25.6083	27.8938	72.9792
31MAY97	4.86875	154.229	25.9958	27.9292	71.1042
01JUN97	6.68958	190.875	25.8854	27.8875	73.1667
02JUN97	4.05208	233.958	25.4604	27.6771	67.9792
03JUN97	3.63333	274.271	25.8583	27.5938	71.7292
04JUN97	3.22083	283.354	25.7229	27.6667	74.8542
05JUN97	4.29375	181.313	25.3083	27.7083	79.3750
06JUN97	4.63958	274.875	24.7958	27.7375	82.2292
07JUN97	5.38333	144.854	23.9313	27.3938	79.8958
08JUN97	6.63750	62.875	24.3729	27.0229	71.1875
09JUN97	7.72708	55.438	25.0208	27.1688	73.1042
10JUN97	6.60208	39.417	25.5479	27.0500	67.8750
11JUN97	4.77292	96.938	26.0396	27.4333	71.9375

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
12JUN97	4.78958	154.917	26.1479	27.6708	74.0625
13JUN97	6.48750	207.458	26.8417	27.8646	79.2500
14JUN97	5.48750	201.375	27.5563	28.0917	79.6250
15JUN97	6.51042	238.083	28.1292	28.5062	80.2708
16JUN97	4.02083	245.729	28.3000	28.8396	83.1667
17JUN97	4.69375	211.854	28.6646	29.3458	81.2708
18JUN97	4.90000	195.688	28.6042	29.7250	72.3125
19JUN97	3.74792	252.250	29.2563	29.9896	75.3333
20JUN97	3.66875	262.521	28.9375	29.9417	71.9167
21JUN97	3.73333	151.646	28.7854	30.0229	76.5000
22JUN97	3.10208	127.667	28.3250	30.0958	77.1458
23JUN97	3.28542	142.167	26.6771	30.0271	76.8542
24JUN97	4.41042	134.208	26.2688	29.4875	78.5000
25JUN97	3.90417	104.875	26.8375	29.5333	83.0208
26JUN97	3.95625	120.875	27.1917	29.7583	80.1042
27JUN97	2.83750	158.750	27.7937	30.0208	72.4375
28JUN97	3.07708	136.813	27.5396	30.2646	73.3542
29JUN97	2.72500	181.833	28.3771	30.3833	68.6667
30JUN97	2.56250	203.417	28.7833	30.4708	71.8333
01JUL97	4.22500	288.083	28.7938	30.1729	73.1250
02JUL97	5.25208	279.167	29.2063	30.2979	77.8333
03JUL97	4.35208	272.083	29.9771	30.4229	80.5000
04JUL97	4.07917	214.563	29.4542	30.5875	80.2083
05JUL97	5.12292	136.729	26.8271	30.1875	82.5000
06JUL97	4.00833	157.500	26.9146	29.8104	82.5208
07JUL97	3.68125	187.354	28.7729	30.0771	73.4375
08JUL97	3.26667	159.583	28.5563	30.1729	75.4375
09JUL97	2.96250	195.500	28.3937	30.2062	71.2917
10JUL97	3.34375	193.271	28.0604	30.2417	74.9375
11JUL97	4.09167	191.833	27.5583	30.0042	76.9167
12JUL97	2.46667	169.063	27.3208	29.7771	77.3125
13JUL97	2.71042	130.646	28.0521	30.1250	75.4792
14JUL97	3.51875	102.208	27.1396	29.9021	78.0000
15JUL97	2.97500	161.167	27.5208	29.9938	73.0000
16JUL97	2.34400	118.880	25.9320	29.7320	78.8800
11AUG97	3.46316	174.842	30.9211	28.8105	91.8947
12AUG97	1.42292	168.313	31.4917	29.9312	79.3333
13AUG97	2.35000	159.458	31.4312	29.8833	79.5833
14AUG97	2.70638	206.532	31.4638	29.9255	75.0638
15AUG97	5.28750	207.021	31.5396	30.1146	68.8958
16AUG97	4.36222	89.911	31.2000	29.4000	66.7778
17AUG97	3.74773	139.591	31.0932	29.8568	71.6364
18AUG97	2.51250	196.250	31.4125	30.1813	62.0625
19AUG97	2.14583	202.750	31.3479	28.9250	65.4792
20AUG97	1.74255	218.532	31.4447	29.8340	71.5745
21AUG97	1.54681	246.277	31.3404	29.9362	72.7660
22AUG97	2.07917	271.167	30.8938	29.9167	75.1875
23AUG97	1.93556	146.511	30.5578	29.5578	77.1111
24AUG97	1.51176	147.412	30.0118	30.0176	90.5294

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
25AUG97	2.39512	89.878	30.3000	28.9415	69.7805
26AUG97	2.13958	25.625	29.8354	30.0792	76.4583
27AUG97	2.04792	48.396	29.7021	29.6625	77.5833
28AUG97	1.79583	182.125	29.6646	29.9042	75.3333
29AUG97	2.31458	179.438	29.7646	29.9771	66.6042
30AUG97	2.37083	135.333	29.8250	29.9250	66.1250
31AUG97	2.00208	99.292	29.9438	29.9750	66.4583
01SEP97	3.2771	84.958	27.3750	31.0000	83.7083
02SEP97	2.4708	141.583	27.8125	31.0000	82.0833
03SEP97	2.0500	247.479	28.6458	31.0000	78.2083
04SEP97	1.7021	171.333	29.2917	31.0000	76.0208
05SEP97	4.9250	84.417	27.5625	31.0000	74.0208
06SEP97	4.7979	83.979	26.7708	31.0000	65.2917
07SEP97	3.9500	79.979	27.3958	31.0000	75.1458
08SEP97	2.6896	101.521	27.1667	31.0000	62.1667
09SEP97	2.2000	143.000	27.3542	31.0000	64.8125
10SEP97	1.8313	187.313	27.8125	31.0000	70.2292
11SEP97	1.5875	231.458	28.1458	31.0000	72.3750
12SEP97	1.8042	166.083	28.3542	31.0000	74.7708
13SEP97	2.1271	130.271	27.0417	31.0000	76.0625
14SEP97	1.9375	83.729	28.6458	31.0000	76.5000
15SEP97	2.3396	117.854	28.0625	31.0000	75.1250
16SEP97	1.9438	175.146	27.8750	31.0000	78.4167
17SEP97	2.0354	134.938	29.0417	31.0000	70.9583
18SEP97	2.0229	82.271	28.0208	31.0000	73.7708
19SEP97	2.3437	108.500	28.2708	31.0000	65.6875
20SEP97	2.3375	115.063	28.2917	31.0000	66.1875
21SEP97	1.7125	159.188	28.2500	31.0000	66.0833
22SEP97	2.6292	134.104	28.4167	31.0000	68.4167
23SEP97	2.5646	130.667	27.5625	31.0000	77.3958
25SEP97	2.4708	164.771	27.6458	31.0000	80.2500
26SEP97	3.3229	193.333	27.9375	31.0000	79.9375
27SEP97	3.3500	215.042	27.7292	31.0000	89.2083
28SEP97	3.1292	201.917	26.0833	31.0000	92.7500
29SEP97	3.4208	245.896	27.8750	31.0000	78.1042
30SEP97	3.0938	289.479	28.6458	31.0000	70.9583
01OCT97	4.3917	250.583	28.1146	29.7917	74.5521
02OCT97	7.5313	227.208	27.8542	28.5625	75.2083
03OCT97	11.4521	52.167	26.1875	28.3542	66.6875
04OCT97	10.7000	71.604	26.6667	28.0625	69.8333
05OCT97	13.4583	85.917	27.0000	28.0000	74.3750
06OCT97	16.1750	89.417	26.5625	28.0000	73.1667
07OCT97	15.9625	91.667	26.5625	27.5417	67.9792
08OCT97	18.9854	94.563	26.3958	27.1250	76.3333
09OCT97	19.0021	92.188	26.6667	27.1458	73.2500
10OCT97	15.5875	83.188	26.3333	27.0000	70.9583
11OCT97	15.4688	81.854	25.5417	26.8125	67.8958
12OCT97	17.0250	100.417	25.5625	26.4792	72.0208
13OCT97	14.0958	104.458	26.3958	26.2500	70.2500

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
14OCT97	12.2896	74.917	26.3750	26.3958	72.5208
15OCT97	12.4167	71.313	25.6458	26.3750	66.8958
16OCT97	10.9667	102.979	25.0833	26.3958	73.4583
17OCT97	9.6688	124.771	24.0833	26.2708	82.6042
18OCT97	7.2958	133.417	23.2083	26.1042	90.0625
19OCT97	18.1208	321.208	22.6250	25.4375	67.9792
20OCT97	10.5375	102.292	21.5208	24.5625	68.0208
21OCT97	8.6083	118.396	21.6875	24.3958	66.8125
22OCT97	6.5333	171.667	22.4167	24.0417	72.042
23OCT97	6.2375	124.417	22.5625	24.0000	74.750
24OCT97	13.9646	148.979	22.6250	24.0625	70.750
25OCT97	9.9062	185.771	25.2083	24.1458	84.729
26OCT97	11.6104	176.750	25.5625	24.3333	89.000
27OCT97	13.1915	231.213	24.8936	25.0000	93.532
28OCT97	14.9438	118.688	17.1875	24.1458	70.667
29OCT97	9.3638	54.532	18.8723	23.1702	77.851
30OCT97	9.1229	54.833	21.1458	22.9792	76.979
31OCT97	11.1083	153.458	23.2917	23.0000	86.917
01NOV97	12.8271	244.313	25.3369	23.0723	84.417
02NOV97	15.4354	279.979	24.6648	23.6556	72.688
03NOV97	8.4687	197.354	21.4350	23.2346	64.208
04NOV97	9.3417	188.458	20.8569	22.8244	60.896
05NOV97	12.5229	64.396	19.7333	22.3815	67.208
06NOV97	10.3979	116.167	21.5979	22.3194	76.292
07NOV97	13.0500	259.104	20.8692	22.5254	76.771
08NOV97	12.4604	225.583	16.8638	21.6217	68.771
09NOV97	10.4021	184.188	16.5975	20.6700	71.854
10NOV97	7.2375	238.458	19.3519	20.5365	73.458
11NOV97	5.1708	83.563	20.9044	20.8015	72.354
12NOV97	9.9396	139.229	22.1527	21.1467	71.104
13NOV97	15.8417	192.104	23.4367	21.4850	92.854
14NOV97	9.8125	260.917	23.1710	21.7854	91.000
15NOV97	7.6792	194.729	20.6144	21.9663	81.625
16NOV97	14.0750	77.750	17.6042	21.5400	72.896
17NOV97	18.3167	64.146	14.0515	20.3548	53.813
18NOV97	12.8729	75.313	16.3304	19.5279	78.500
19NOV97	10.7260	59.021	19.3397	19.6042	73.875
21NOV97	8.8208	153.604	22.1988	20.0560	79.000
22NOV97	6.3167	124.813	22.5075	20.8000	91.167
23NOV97	7.1729	43.521	22.0148	21.0356	89.125
24NOV97	18.2188	60.063	18.1479	20.7079	66.313
25NOV97	17.5750	58.146	17.5133	19.4260	65.000
26NOV97	11.3437	82.792	19.2825	18.9669	74.896
27NOV97	11.8354	48.854	19.5598	19.2198	69.833
28NOV97	9.4191	134.468	20.9689	19.4526	73.915
29NOV97	8.9208	132.583	22.3733	19.9058	90.875
30NOV97	9.7719	202.042	21.2628	20.1796	98.802
01DEC97	4.0581	320.708	19.3750	19.9563	72.000
02DEC97	2.0040	131.354	17.3875	19.6563	80.583

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
03DEC97	2.3129	134.542	20.2000	19.7396	81.417
04DEC97	2.9408	147.646	21.2750	19.9292	92.458
05DEC97	3.1519	219.542	17.5021	19.8167	78.458
06DEC97	3.1831	147.063	13.7354	18.9438	63.979
07DEC97	3.3227	139.354	12.1396	18.0396	56.500
08DEC97	2.3185	134.521	14.3917	17.3333	68.229
09DEC97	3.3981	192.375	20.5188	17.3250	87.896
10DEC97	3.8752	211.833	22.5958	17.9792	99.875
11DEC97	2.9035	169.938	22.7563	18.5417	100.000
12DEC97	3.930	112.583	22.7292	18.8938	100.000
13DEC97	2.551	49.729	19.2813	18.9437	99.833
14DEC97	-104.009	12.125	-8.0729	18.8000	92.625
15DEC97	4.275	189.167	12.6938	17.9625	84.833
16DEC97	4.576	338.417	15.3875	16.5917	62.750
17DEC97	2.277	271.813	15.6708	16.5438	76.625
18DEC97	1.356	198.250	15.8729	16.6521	79.396
19DEC97	1.541	161.125	16.8000	16.6708	83.750
20DEC97	2.372	66.708	17.8500	16.8937	74.729
21DEC97	2.118	112.792	19.6208	17.2667	86.375
22DEC97	3.194	161.708	22.2917	17.5042	90.854
23DEC97	1.377	173.438	22.0313	17.6521	94.979
25DEC97	3.526	170.188	23.2667	17.9083	91.958
26DEC97	4.315	204.313	23.0813	18.3771	97.583
27DEC97	1.739	151.354	21.1438	18.9021	97.208
28DEC97	4.901	243.188	20.8500	19.3354	91.979
29DEC97	3.699	144.542	11.2646	18.5333	69.958
30DEC97	4.730	231.938	13.9896	17.6750	77.979
31DEC97	5.240	297.479	14.3083	16.3063	71.750
01JAN98	5.256	56.083	11.7958	15.1771	56.021
02JAN98	4.127	73.604	15.5604	14.8292	74.583
03JAN98	3.406	75.417	18.7333	15.1875	74.313
04JAN98	3.592	74.583	21.0979	16.0229	79.813
05JAN98	3.502	105.958	23.1125	17.0229	83.458
06JAN98	2.444	131.854	22.5854	17.5979	97.604
07JAN98	4.142	157.354	23.9042	17.8854	87.250
08JAN98	4.473	221.688	22.5583	18.4625	88.354
09JAN98	1.960	233.396	19.7479	18.7208	80.688
10JAN98	2.106	101.917	17.4458	19.0250	76.667
11JAN98	2.704	61.521	16.6542	18.9437	75.208
12JAN98	3.200	102.854	18.6396	18.6708	72.854
13JAN98	2.271	116.708	19.7542	18.7688	82.563
14JAN98	2.473	117.667	20.3521	18.9708	84.354
15JAN98	3.656	143.583	20.6458	19.0396	92.771
16JAN98	5.073	260.479	19.3417	19.1146	78.771
17JAN98	3.240	312.125	16.5375	18.7104	71.896
18JAN98	1.450	257.375	17.8792	18.6771	81.667
19JAN98	2.852	218.604	18.7979	18.8604	84.396
20JAN98	2.869	129.917	15.1500	18.5667	76.708
21JAN98	2.781	65.021	17.4625	18.1771	83.938

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
22JAN98	3.088	147.167	20.9771	18.3479	88.625
23JAN98	2.925	177.188	21.0104	18.7687	93.771
24JAN98	2.563	303.479	19.9583	18.9667	88.771
25JAN98	3.975	75.604	14.0104	18.3833	55.500
26JAN98	3.981	78.458	15.8125	17.5812	78.625
27JAN98	4.004	221.000	18.7521	17.4333	83.958
28JAN98	5.048	327.104	15.6188	17.1479	65.604
29JAN98	1.940	183.667	15.2125	16.7813	72.000
30JAN98	1.594	289.063	16.4125	16.7188	78.313
31JAN98	2.181	196.417	15.9000	16.8333	69.229
01FEB98	3.53542	96.250	15.6979	16.6688	67.2500
02FEB98	6.49583	120.604	20.4021	16.8688	79.0833
03FEB98	6.13958	171.375	20.5458	17.3604	86.3542
04FEB98	7.34681	296.085	16.6702	17.6170	69.9149
05FEB98	5.44792	317.688	15.0938	16.7542	66.4583
06FEB98	3.06667	172.750	14.0521	16.3146	84.6042
07FEB98	4.73958	315.958	12.7104	15.7042	72.5000
08FEB98	3.91458	257.292	13.1750	15.1792	64.6042
09FEB98	3.08958	256.125	13.6417	14.9938	68.3125
10FEB98	2.04792	108.750	14.4979	15.1917	75.5417
11FEB98	3.47083	146.292	18.3854	15.6958	81.2292
12FEB98	2.62708	124.396	17.6958	16.3208	84.4167
13FEB98	2.37021	105.723	15.1745	16.6043	80.0213
14FEB98	2.51667	52.333	13.4688	16.3042	81.1875
15FEB98	5.28750	98.375	17.0750	16.3208	71.8542
16FEB98	5.01250	146.667	20.3667	16.6271	94.4167
17FEB98	4.39792	227.396	22.2417	17.4354	86.2917
18FEB98	1.94375	208.188	20.0896	18.2875	79.8542
19FEB98	1.85208	133.125	19.3771	18.4542	78.1667
20FEB98	3.48333	219.896	19.7188	18.4500	82.8125
21FEB98	1.76875	199.479	17.8896	18.7063	75.4375
22FEB98	4.80000	139.292	21.4979	19.2167	76.4375
23FEB98	5.83125	267.083	20.5479	19.8500	80.7708
24FEB98	4.57708	332.063	16.7188	19.0000	61.5833
25FEB98	2.20000	176.208	17.9542	18.7813	72.1458
26FEB98	3.00000	152.104	19.9104	19.1313	67.2917
27FEB98	3.74255	182.298	21.5489	19.5426	83.4894
28FEB98	2.85208	184.333	21.0604	19.7667	87.8750
01MAR98	3.52447	159.234	20.2245	19.2532	89.2340
02MAR98	3.83511	190.372	22.2511	19.6021	56.3936
03MAR98	2.42766	207.660	19.8426	19.0447	52.7021
04MAR98	2.61915	158.170	18.3638	14.3170	57.1915
05MAR98	2.73936	180.511	18.2819	16.9489	59.9894
06MAR98	2.37500	197.283	18.5848	21.2772	76.0652
07MAR98	3.55109	173.543	19.1663	21.8641	76.3152
08MAR98	5.72872	172.181	19.8213	23.5085	77.3936
09MAR98	5.46277	242.351	20.5021	20.7957	76.6809
10MAR98	5.45638	28.330	19.9106	10.7447	66.6809
11MAR98	4.39149	114.904	18.5968	11.3340	62.5426

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
12MAR98	4.06809	78.372	17.2032	10.7979	56.6170
13MAR98	3.75745	67.947	16.4096	11.4362	54.5426
14MAR98	3.17447	90.638	16.1340	14.6394	60.9043
15MAR98	3.09255	41.223	16.4340	16.8351	62.8085
16MAR98	3.62766	113.840	17.1043	19.6660	60.7660
17MAR98	3.76809	121.957	17.9755	21.0085	67.7979
18MAR98	4.31596	144.447	18.6234	22.6574	80.6170
19MAR98	3.27979	150.447	19.0819	20.0638	97.6489
20MAR98	3.88043	180.370	19.0087	19.8891	96.3696
21MAR98	5.04574	311.553	18.8819	16.9723	74.6915
22MAR98	3.10426	266.500	18.4723	14.1947	74.2979
23MAR98	2.76489	153.830	17.9383	15.0234	84.6809
24MAR98	3.02128	110.681	18.0989	17.0351	72.3298
25MAR98	2.94468	83.936	18.5202	20.1447	67.4468
26MAR98	4.03511	88.277	19.2074	21.2894	73.5319
27MAR98	3.28404	100.277	19.8904	21.6085	74.2128
28MAR98	2.81489	134.096	20.5894	21.9266	80.9043
29MAR98	2.48404	115.819	21.3319	23.4787	82.7553
30MAR98	2.82872	99.202	22.1447	23.1617	81.3085
31MAR98	3.24787	158.638	22.8074	23.8936	83.5106
01APR98	5.04375	184.250	23.9729	23.3771	76.1458
02APR98	3.17500	202.313	23.0979	23.7562	73.4792
03APR98	5.03125	205.688	24.0333	24.3271	77.8750
04APR98	8.17660	258.277	24.0723	24.5511	73.1702
05APR98	7.19583	196.250	20.0417	24.0563	76.5000
06APR98	6.53958	143.375	19.8979	23.6375	67.7917
07APR98	7.63750	150.479	22.9688	23.5708	36.6667
08APR98	9.10417	182.063	24.3958	23.8479	23.0000
09APR98	9.77500	219.563	24.7146	24.2438	54.3125
10APR98	9.15833	302.500	20.9854	23.7854	58.9375
11APR98	8.80625	189.375	17.9125	22.7563	55.3542
12APR98	5.20208	134.938	18.8438	22.0792	47.6250
13APR98	5.88125	157.125	20.3958	22.1875	57.6667
14APR98	6.17917	184.125	20.8333	22.2604	69.8333
15APR98	5.40833	188.708	22.3438	22.4979	83.0833
16APR98	7.31667	181.542	23.3271	23.0313	92.7083
17APR98	7.12292	184.833	23.9021	23.3667	80.5000
18APR98	5.61458	172.646	24.2833	23.8479	80.4167
19APR98	8.49583	179.729	24.5229	24.2854	77.3750
20APR98	3.83542	257.208	24.5958	24.5500	83.1250
21APR98	4.35417	275.563	22.6708	24.5000	84.4583
22APR98	7.66667	322.833	21.5354	24.4521	89.5000
23APR98	8.95625	320.417	19.9521	23.8125	76.7500
24APR98	5.94792	270.375	19.3083	22.9563	67.9792
25APR98	3.63542	183.292	20.2333	22.9229	57.3750
26APR98	4.82292	188.063	22.1333	23.2104	46.0625
27APR98	3.51667	182.271	23.7188	23.6938	55.9792
28APR98	4.65000	185.583	24.0313	24.2625	67.6250
29APR98	7.23125	129.438	24.6083	24.6042	82.6042

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
30APR98	6.25833	172.104	23.4771	24.6958	92.6875
01MAY98	5.79375	275.021	23.2146	24.3729	80.9583
02MAY98	5.53542	299.333	23.6729	24.4292	80.5833
03MAY98	3.05000	227.583	22.9500	24.5667	80.0000
04MAY98	5.53958	215.375	23.9479	24.7167	71.9792
05MAY98	4.25745	239.553	24.0085	24.5574	73.3404
06MAY98	3.09583	216.229	23.1250	24.8563	79.1458
07MAY98	4.71458	198.604	24.8729	25.5292	76.8750
08MAY98	8.58125	232.917	25.8021	26.0812	69.9792
09MAY98	6.92917	275.313	25.5688	26.4208	72.7292
10MAY98	7.76875	236.042	26.0979	26.7479	69.8125
11MAY98	9.45833	295.083	25.0646	26.7000	70.8333
12MAY98	4.34583	255.333	24.2854	26.6896	72.0833
13MAY98	3.30625	173.646	25.7625	26.9604	73.4583
14MAY98	5.17917	185.542	27.7208	27.4771	68.2083
15MAY98	4.81042	154.458	26.2396	27.5792	71.9375
16MAY98	4.59583	179.063	25.0563	27.6083	73.3542
17MAY98	4.68542	196.313	25.3667	27.5979	78.1875
18MAY98	3.97292	262.417	26.0750	27.6313	80.1875
19MAY98	4.47917	281.854	26.4729	27.9188	80.3958
20MAY98	4.80833	231.792	26.5771	28.2479	82.6667
21MAY98	3.97083	255.542	27.1354	28.4146	81.9792
22MAY98	4.19792	303.042	26.9563	28.5917	73.2708
23MAY98	4.67708	295.083	26.8042	28.7479	75.3958
24MAY98	3.58125	303.125	27.2229	28.9271	71.6458
25MAY98	3.71667	193.729	26.6563	29.0458	74.8542
26MAY98	3.35625	177.875	26.5833	29.2688	77.2708
27MAY98	4.71250	129.375	27.3271	29.1375	77.0208
28MAY98	5.02708	146.208	26.1063	28.4812	75.3542
29MAY98	3.75417	166.917	25.9667	28.0333	78.1458
30MAY98	2.67083	203.500	25.6021	28.5271	72.9792
31MAY98	3.49583	193.521	26.0292	28.3688	71.1042
01JUN98	5.66250	292.333	28.1063	28.7146	73.1667
02JUN98	6.83542	287.000	28.3292	28.9604	67.9792
03JUN98	5.71042	291.667	28.4792	29.2833	71.7292
04JUN98	5.23750	275.479	28.5792	29.6042	74.8542
05JUN98	4.16667	253.917	29.2708	30.0917	79.3750
06JUN98	4.66875	275.125	29.7896	30.5896	82.2292
07JUN98	5.14583	323.625	29.4125	30.6833	79.8958
08JUN98	6.99792	108.833	28.4708	30.4354	71.1875
09JUN98	6.76250	160.500	27.6188	29.9000	73.1042
10JUN98	4.06042	191.354	27.6563	30.0667	67.8750
11JUN98	4.16458	230.688	28.9542	30.5083	71.9375
12JUN98	4.07083	263.021	28.0042	30.9021	74.0625
13JUN98	3.53750	206.500	28.1292	30.2083	79.2500
14JUN98	4.24375	230.333	28.8958	30.4854	79.6250
15JUN98	4.45417	239.271	28.4750	30.7708	80.2708
16JUN98	4.65208	227.938	29.5458	30.6542	83.1667
17JUN98	3.66875	233.208	29.9604	31.0917	81.2708

TBNEP Meteorologic Data

DATE	WS	WD	ATEMP	WTEMP	RH
18JUN98	3.43125	299.354	28.1313	31.5354	72.3125
19JUN98	3.95833	243.500	30.0771	31.5458	75.3333
20JUN98	4.11875	269.646	29.9708	31.5083	71.9167
21JUN98	3.21042	298.688	30.4333	31.6729	76.5000
22JUN98	3.98750	162.604	30.2396	31.7563	77.1458
23JUN98	3.46875	189.167	29.2646	31.7563	76.8542
24JUN98	3.81250	205.021	28.2979	31.7271	74.1875
25JUN98	3.70833	184.167	27.4083	31.5771	73.1250
26JUN98	3.89167	203.479	29.6417	31.1250	69.2917
27JUN98	2.70208	214.396	29.5333	31.0875	71.7500
28JUN98	4.01042	201.000	27.2500	31.6125	73.3542
29JUN98	4.42917	159.813	30.4292	31.1917	68.6667
30JUN98	5.78125	267.063	29.9125	31.1167	71.8333
01JUL98	6.20208	272.500	29.7250	31.1208	81.0208
02JUL98	4.98125	268.104	30.6542	31.3688	82.0833
03JUL98	3.92500	231.458	31.2875	31.4208	78.2083
04JUL98	5.68750	246.979	30.9917	31.3604	76.0208
05JUL98	3.89583	277.688	29.8479	31.2208	85.5625
06JUL98	3.25417	217.792	30.4125	31.0917	77.3333
07JUL98	3.49792	208.604	29.4500	31.1917	74.5000
08JUL98	4.64167	230.000	28.1667	30.7458	62.1667
09JUL98	4.85625	259.104	29.4563	30.6042	64.8125
10JUL98	6.21042	268.313	28.8833	30.1750	70.2292
11JUL98	3.91667	207.771	28.5750	29.4875	76.1458
12JUL98	4.00833	241.958	29.4125	29.7979	59.8542
13JUL98	3.69167	200.729	24.4667	30.3667	76.0625
14JUL98	3.12917	178.229	24.8063	30.5333	76.5000
15JUL98	5.46042	232.771	27.9833	30.1917	75.1250
16JUL98	3.91875	227.292	27.1188	29.5938	78.4167
17JUL98	3.87917	206.771	28.5458	29.4833	70.9583
18JUL98	3.60625	237.292	29.4313	29.8042	73.7708
19JUL98	2.45625	197.354	27.1729	30.3021	65.6875
20JUL98	4.86042	145.833	27.3688	30.1333	66.1875
21JUL98	5.52500	123.313	27.4750	30.0938	66.0833
22JUL98	4.87083	140.792	27.2750	29.9938	68.4167
23JUL98	4.70000	167.458	28.0021	30.1333	77.3958
24JUL98	2.85833	183.396	28.5646	30.5292	80.2500
25JUL98	3.84167	149.313	30.6688	30.9417	79.9375
26JUL98	4.31875	147.479	30.0354	31.1542	89.2083
27JUL98	3.42292	194.771	29.1021	31.4208	92.7500
28JUL98	3.15208	216.063	28.5375	31.7396	78.1042
29JUL98	3.46458	260.667	29.0167	31.8313	70.9583
30JUL98	3.44375	197.417	29.7542	31.7729	73.1667
31JUL98	3.18750	202.833	29.9646	32.0125	78.2917