FINAL
NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM ANNUAL DATA REPORT APRIL 2003 THROUGH MARCH 2004 *FOR*

CONOCOPHILLIPS ALASKA, INC.

Nuiqsut Ambient Air Quality Monitoring Station

Nuiqsut, Alaska

October 2004

ConocoPhillips

CONOCOPHILLIPS ALASKA, INC.
NUIQSUT AMBIENT AIR QUALITY
MONITORING PROGRAM
ANNUAL DATA REPORT
APRIL 2003 THROUGH MARCH 2004

Prepared for:

CONOCOPHILLIPS ALASKA, INC.
Anchorage, Alaska

Prepared by:

SECOR

SECOR INTERNATIONAL INCORPORATED
Fort Collins, Colorado

October 2004

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October 20, 2004

Mr. Bruce St. Pierre
ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, AK 99510-0360

RE: Nuiqsut Ambient Air Quality Monitoring Program Annual Data Report
April 2003 through March 2004
Nuiqsut, Alaska
SECOR Project No.: 12OT.11481.03.0047

Dear Bruce:

Enclosed for your review and distribution are ten copies of the *Nuiqsut Ambient Air Quality Monitoring Program Annual Data Report: April 2003 through March 2004*. We expect that copies of the report will be distributed as follows:

- six copies to the North Slope Borough (no data diskettes),
- one copy to the village of Nuiqsut (no data diskette),
- one copy to the ADEC (with data diskette), and
- two copies for CPAI's records (with data diskettes).

Please contact me via phone at (970) 226-4040 ext. 721 or via e-mail (tdamiana@secor.com) if you have any questions or comments regarding this report or any other aspect of the project. I appreciate the opportunity to assist you with this project.

Sincerely,
SECOR International Incorporated

Tom Damiana

Tom Damiana
Project Manager

TD\dc

EXECUTIVE SUMMARY

This report summarizes data collected at the Nuiqsut Ambient Air Quality Monitoring Station (Nuiqsut Station) during the monitoring year April 1, 2003 through March 31, 2004. The Nuiqsut Station is operated for ConocoPhillips Alaska, Inc. (CPAI) by SECOR International Incorporated (SECOR). It was established to address air quality concerns raised by the citizens of Nuiqsut and the North Slope Borough and has fulfilled the Alaska Department of Environmental Conservation (ADEC) one-year monitoring requirement in the CPAI Alpine construction permit. Official data collection began April 1999.

Dispersion and ambient air quality data collected at the Nuiqsut Station meet quality assurance and data recovery requirements of the United States Environmental Protection Agency (USEPA) Prevention of Significant Deterioration (PSD) program as administered by ADEC and other specific ADEC ambient monitoring quality assurance requirements (ADEC 1996). Protocols used to collect data at the Nuiqsut Station are fully described in the project Monitoring Plan that consists of:

- the original project monitoring plan (SECOR 2000a), approved by ADEC in April 2000;
- the Partisol Addendum to the original monitoring plan (SECOR 2001a), final ADEC approval pending;
- the draft Expanded Meteorology Addendum to the original monitoring plan (SECOR 2002a), ADEC review pending; and
- the draft Ozone Monitoring Addendum to the original monitoring plan (SECOR 2004c), ADEC review pending.

The Nuiqsut Station is equipped to continuously measure:

- nitrogen oxides (NO, NO_2, and NO_x),
- sulfur dioxide (SO_2),
- inhalable particulate matter less than 10 μm in diameter (PM_{10}),
- 10-meter wind speed, wind direction, and wind direction standard deviation (σ_θ),
- 10-meter vertical wind speed and wind speed standard deviation (σ_w),
- total solar radiation,
- 2- and 10-meter ambient temperature, and
- 10-2 meter ambient temperature difference.

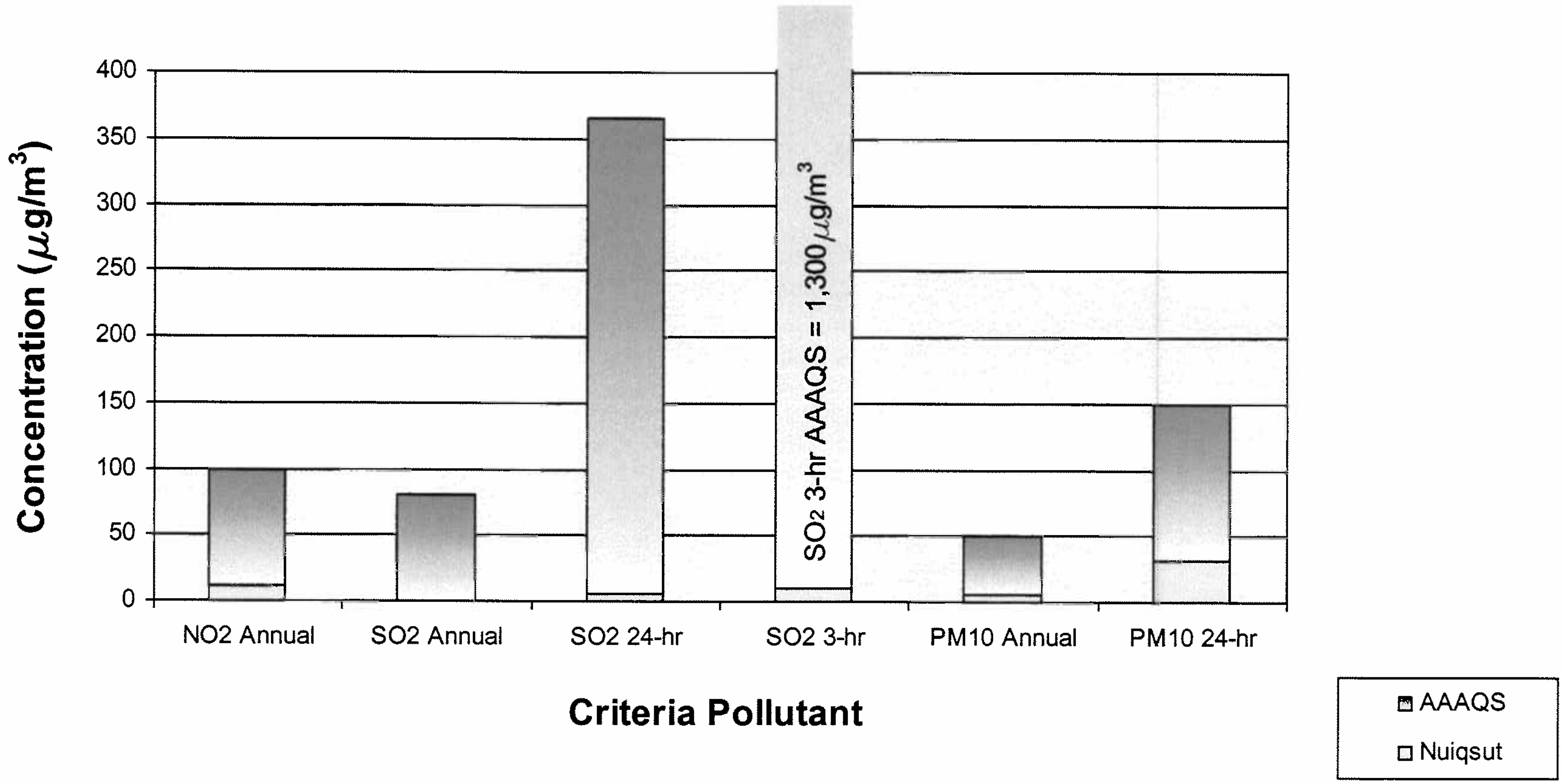
Air quality and meteorological data recovery successfully met project goals for all averaging periods with the exception of vertical wind speed data due to weather-related events (frozen sensors).

During the monitoring year, measured NO_2, SO_2, and PM_{10} concentrations were well below Alaska Ambient Air Quality Standards (AAAQS), which are equivalent to National Ambient Air Quality Standards (NAAQS). Figure 1 and Tables 1 and 2 provide summaries of ambient air quality data collected during the monitoring year compared to previous monitoring years and applicable AAAQS. As shown in these tables and figure, observed concentrations of all monitored pollutants were well below applicable AAAQS.

The annual average of hourly NO_2 concentrations was just above instrument detection, and well below applicable AAAQS. Concentrations measured this monitoring year were only slightly higher than historical data. Opposite to observed historical trends, measured concentrations this monitoring year gradually decreased from summer to winter months.

Measured SO_2 concentrations were at or below instrument detection the entire year. The low concentrations measured are consistent with an airshed containing relatively few and widely dispersed SO_2 sources. This trend has been typical of SO_2 measurements since monitoring began.

The annual average of hourly PM_{10} concentrations were slightly lower compared to previous years and well below the AAAQS. Consistent with historical measurements, slightly elevated particulate levels were a result of naturally occurring wind blown fugitive dust from exposed areas local to the Nuiqsut Station. When fugitive dust from exposed areas is not present (i.e., during winter), hourly concentrations are at or below the instrument detection limit and reflective of global background levels.



Annual Concentrations are the average for the period April 1, 2003 through March 31, 2004.

FIGURE 1: SUMMARY OF AMBIENT AIR QUALITY DATA APRIL 2003 THROUGH MARCH 2004

TABLE 1

NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM MEASURED GASEOUS POLLUTANT CONCENTRATIONS COMPARED TO ALASKA AMBIENT AIR QUALITY STANDARDS APRIL 2003 THROUGH MARCH 2004

Pollutant	Averaging Period	Maximum Period Average Concentration (ppm)					AAAQS (ppm)
		Pre-Alpine	Alpine Operational				
		1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	
NO_2	Annual	0.003	0.003	0.004	0.008	0.006	0.053
SO_2	3-hour	0.010	0.003	0.002	0.003	0.004	0.500
	24-hour	0.002	0.001	0.001	0.002	0.002	0.140
	Annual	0.000	0.000	0.000	0.000	0.000	0.030

TABLE 2

NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM MEASURED PARTICULATE CONCENTRATIONS COMPARED TO ALASKA AMBIENT AIR QUALITY STANDARDS APRIL 2003 THROUGH MARCH 2004

Pollutant	Averaging Period	Maximum Period Average Concentration[1] ($\mu g/m^3$)					AAAQS (ppm)
		Pre-Alpine	Alpine Operational				
		1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	
PM_{10}	24-hour	222.9[2]	113.4	72.1	43.6[3]	31.5	150
	Annual	8.3	8.4	6.6	9.3	5.6	50

1 USEPA Standard Conditions as measured by the TEOM particulate monitor.
2 Second highest 24-hour average concentration was 128.4 $\mu g/m^3$ indicating AAAQS was not exceeded.
3 On-site observations indicated maximum daily concentration was affected by particulate emissions from a tundra fire near Point Lay, Alaska.

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

This report summarizes and documents operation of the Nuiqsut Ambient Air Quality Monitoring Station (Nuiqsut Station) and data collected during the fifth year of monitoring (April 1, 2003 through March 31, 2004). Chapter 2 discusses monitoring network performance, and Chapter 3 summarizes air quality and meteorological data collected. Report appendices contain additional information related to station operation and data reduction. Appendix A contains various statistical formulae used to determine data precision, accuracy, and recovery statistics. Appendix B contains minimum precision, accuracy, and completeness goals for the monitoring network. Appendix C summarizes contents of the diskette containing validated hourly data collected during the monitoring year. Please refer to individual quarterly data reports (SECOR 2003a, SECOR 2004a, SECOR 2004b, SECOR 2004d) for additional details.

1.1 Background/History

ConocoPhillips Alaska, Inc. (CPAI), operates an oil and gas exploration and production complex (Alpine Development Project) approximately 14 kilometers north of Nuiqsut on the North Slope of Alaska. The Alpine Development Project consists of a main facility including production modules, an operating camp, and a temporary drilling operation and satellite drilling site approximately 5 kilometers to the west of the main facility.

Representatives of Nuiqsut expressed an interest in characterizing ambient air quality conditions before and after the Alpine Development Project was operational. In response to citizen concerns, CPAI committed to offer direct assistance by implementing the Nuiqsut Ambient Air Quality Monitoring Program in cooperation with the Alaska Department of Environmental Conservation (ADEC), the North Slope Borough, and Nuiqsut. The spirit of this commitment is to better understand local ambient air quality in Nuiqsut. The spatial relation between major North Slope oil fields and Nuiqsut is shown in Figure 1-1.

The monitoring program is primarily designed to characterize ambient air quality at Nuiqsut, but it also fulfilled Condition IV(C) of the Alpine Development Project Construction Permit (Permit #0073-AC060) issued by ADEC. This permit condition required CPAI to collect at least one year of ambient NO_x, SO_2, PM_{10}, and dispersion meteorology data at Nuiqsut. On March 27, 2001, CPAI informed ADEC by letter (PAI 2001) that the ambient monitoring requirement contained in the construction permit had been met.

CPAI retained the services of SECOR International Incorporated (SECOR) to implement the monitoring program. The monitoring program consists of an ambient air quality and dispersion meteorology monitoring station within Nuiqsut, with data analysis and support provided from the SECOR Air Resources Laboratory in Fort Collins, Colorado and aid from locally hired on-site technical support. The Nuiqsut Station was initially brought on-line in two phases. Continuous meteorology, ambient NO_x, and ambient SO_2 collection began on April 9, 1999, and ambient PM_{10} data collection began on April 25, 1999.

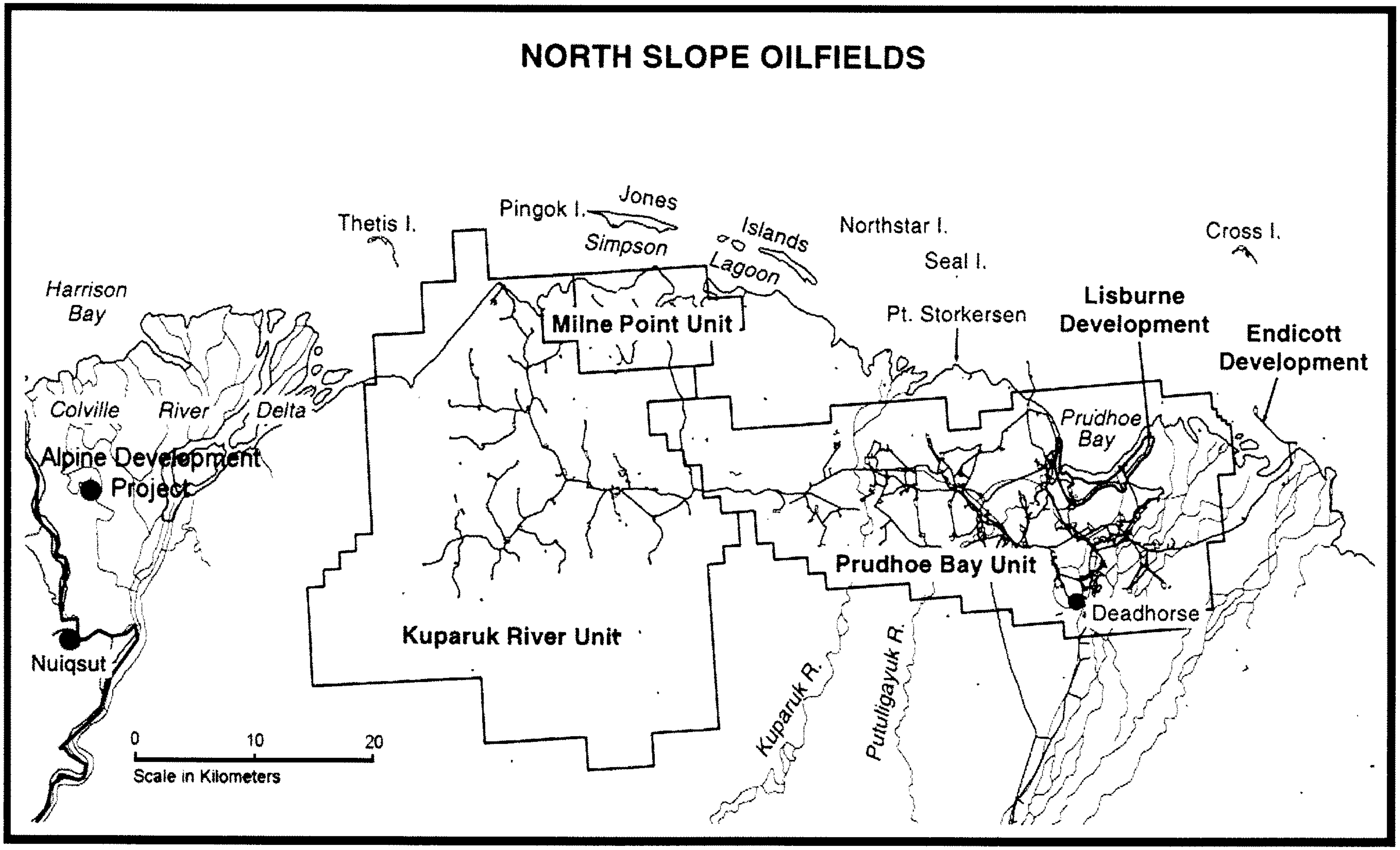


FIGURE 1-1: LOCATION OF REGIONAL NORTH SLOPE OIL FIELDS RELATIVE TO NUIQSUT

The monitoring program has been expanded three times since station commissioning. On July 14, 2000 the monitoring program was expanded to include measurement of PM_{10} using a Partisol PM_{10} sampler. This sampler is a Federal Reference Method for measuring ambient PM_{10} concentrations and was added to provide data for comparison to data collected with the TEOM PM_{10} sampler, which is designated as a Federal Equivalent Method. Partisol PM_{10} monitoring technical objectives were met in the fall of 2002, and the Partisol monitor was taken off-line. A report summarizing the collocated PM_{10} data collected is being prepared for submittal to ADEC later this year. On July 24, 2001 meteorological monitoring was expanded to include additional measurements to better characterize low-level atmospheric dispersion parameters. The enhanced low-level atmospheric dispersion characterization should result in more refined model predicted impacts when used as input into new USEPA dispersion models. In mid-2004, the station will begin monitoring for ambient ozone. The ozone data will be used to produce more refined model predicted NO_2 impacts when using USEPA ozone limiting methodology.

1.2 Project Implementation

Since inception, the specific technical objectives of the program are to:

- document baseline air quality dispersion meteorology conditions in Nuiqsut to support refined modeling of potential impacts in the region,
- document air quality conditions after the Alpine Development Project is operational, and
- meet ambient air quality and meteorological monitoring requirements listed in the Alpine Development Project Permit No. 0073-AC060 (fulfilled).

To meet these objectives, the Nuiqsut Station is instrumented and equipped to continuously measure the parameters listed in Table 1-1. Table 1-1 also details the methods and instruments used for measurement. A complete description of the program including the quality assurance plan is contained in the ADEC approved monitoring plan (SECOR 2000a) and supporting addendums (SECOR 2001a, 2002a, 2004c).

1.2.1 Nuiqsut Station Location

The Nuiqsut Station was sited to take advantage of prevailing wind patterns so that impacts due to oil and gas operations to the north and east could be distinguished from near-field impacts from local Nuiqsut sources located to the south and west. The location of the Nuiqsut Station relative to Nuiqsut and major oil and gas operations is shown in Figure 1-2. A detailed site area map is included in Figure 1-3 to show the site relative to Nuiqsut and near-field sources. This map is augmented by an aerial photo of Nuiqsut taken in August 2000 shown in Figure 1-4.

1.2.2 Project Monitoring Plan

The monitoring plan describes protocols used to collect meteorological and ambient air quality data, which meet the quality assurance and data recovery requirements of the USEPA Prevention of Significant Deterioration program as administered by ADEC and other specific ADEC quality assurance requirements. The original monitoring plan for this project was

TABLE 1-1

NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM MEASUREMENT METHODS

Parameter	Suggested Manufacturer/Model	Sample Frequency	Averaging Period	Measurement Range	Lower Detection Limit	Method
Nitrogen Oxides (NO_x, NO_2, NO)	Thermo Environmental Instruments (TECO) Model 42C	Continuous	1-hour	1-500 ppb	0.5 ppb	Chemiluminescence (EPA reference method RFNA-1289-074)
Sulfur Dioxide (SO_2)	Thermo Environmental Instruments (TECO) Model 43C	Continuous	1-hour	2–500 ppb	2 ppb	Pulsed Fluorescence (EPA equivalent method EQSA-0486-060)
Particulate Matter (PM_{10})	Rupprecht & Patashnick (R&P) Model 1400b TEOM PM_{10}	Continuous	1-hour	<5 µg/m^3 to several g/m^3	<5 µg/m^3	Tapered Element Oscillating Microbalance (EPA equivalent method EQPM-1090-079)
Ozone (O_3)	Thermo Environmental Model 49	Continuous	1-hour	0-1,000 ppb	2 ppb	Pulsed UV Photometric (EPA equivalent method EQOA-0880-047)
Horizontal Wind Speed (10 m)	R.M. Young Wind Monitor AQ – 05305	Continuous	1-hour	0 to 50 m/s	0.2 m/s	Propeller/Magnetically Induced AC
Horizontal Wind Direction (10 m)	R.M. Young Wind Monitor AQ – 05305	Continuous	1-hour	0 to 360°	N.A.	Vane/Potentiometer
Sigma-Theta (σ_θ) (10 m)	Campbell Scientific Model 23X	Continuous	1-hour	0 to 103.9°	N.A.	Single Pass Estimator of Wind Direction Standard Deviation-Yamartino (1984)

TABLE 1-1 (CONTINUED)

NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM MEASUREMENT METHODS

Parameter	Manufacturer/Model	Sample Frequency	Averaging Period	Measurement Range	Lower Detection Limit	Method
Temperature (2 m)	YSI 44020	Continuous	1-hour	-50°C to 50°C	N.A.	Motor Aspirated/Shielded Thermistor (triple-element)
Temperature (10 m)	YSI 44020	Continuous	1-hour	-50°C to 50°C	N.A.	Motor Aspirated/Shielded Thermistor (triple-element)
10m-2m Temperature Difference (ΔT)	Campbell Scientific Model 23X	Continuous	1-hour	-100°C to 100°C	N.A.	Numerical Subtraction
Vertical Wind Speed (10 m)	RM Young Propeller Anemometer Model 27106T	Continuous	1-hour	-35 m/s to 35 m/s	±0.25 m/s	Propeller/Magnetically Induced AC
Sigma-w (σ_w) (10 m)	Campbell Scientific Model 23X	Continuous	1-hour	N.A.	N.A.	Standard Deviation
Total Solar Radiation (2 m)	Eppley 8-48	Continuous	1-hour	0 to 1,400 W/m^2	<1 W/m^2	Differential thermopile

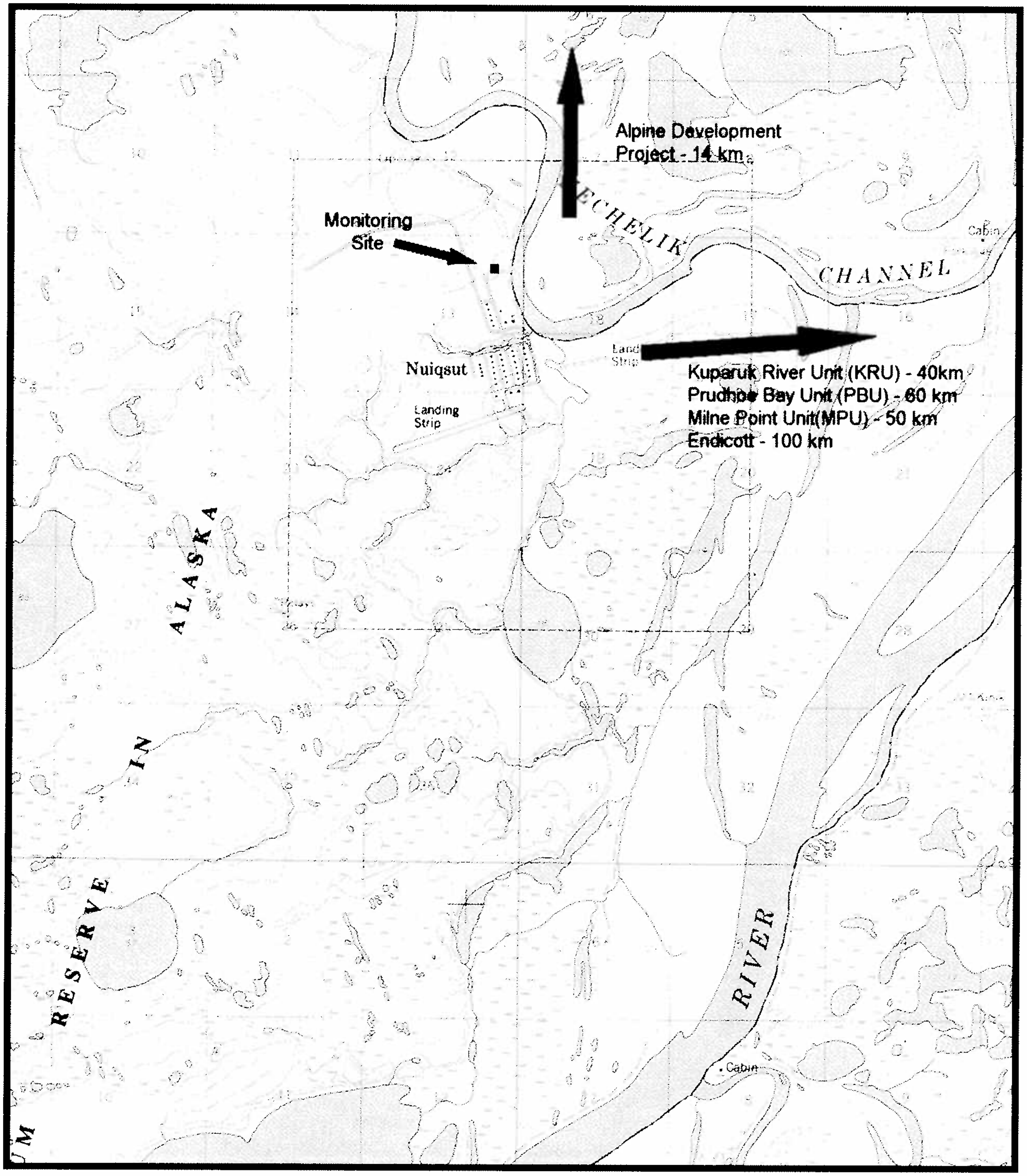


FIGURE 1-2: REGIONAL MAP

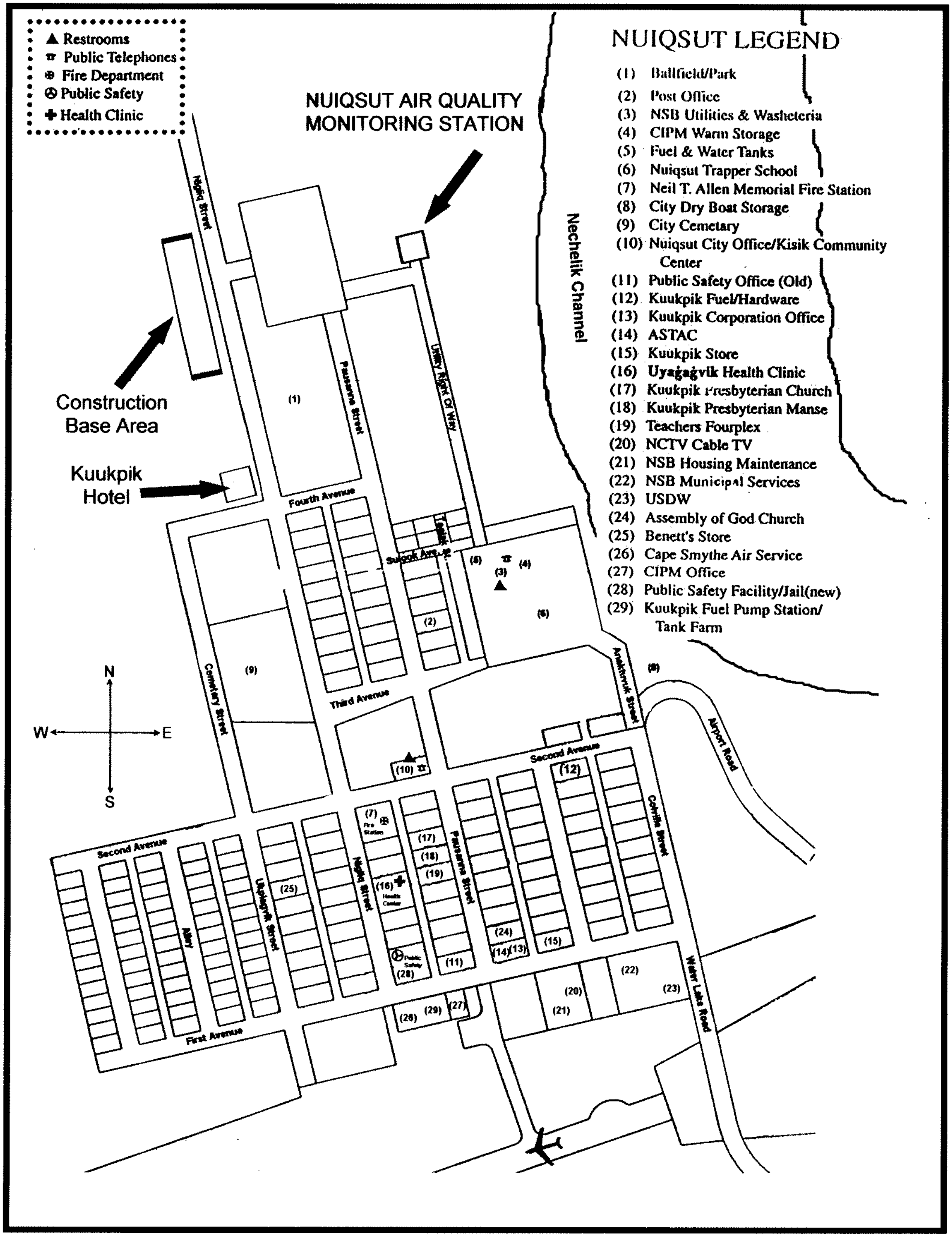


FIGURE 1-3: LOCAL MAP

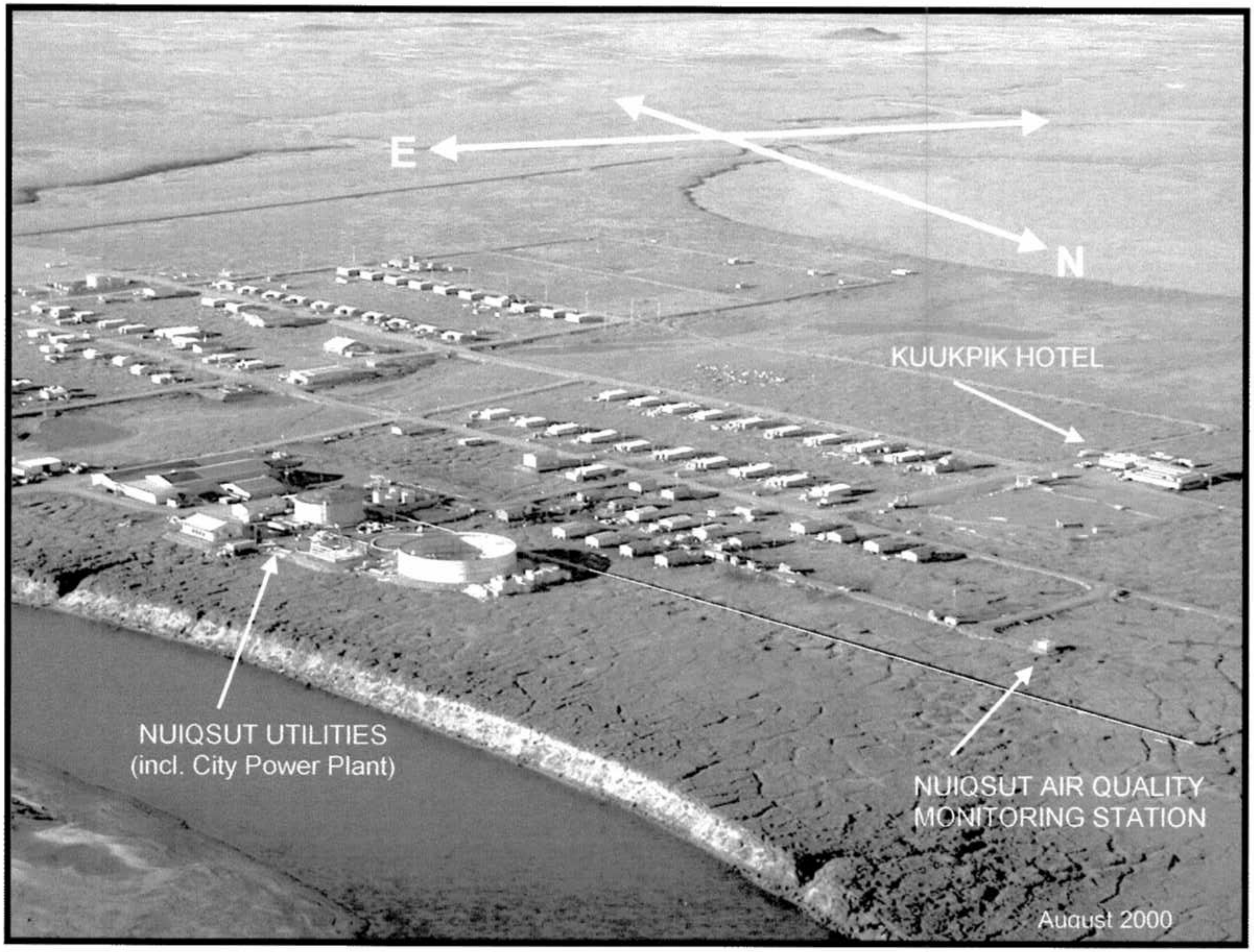


FIGURE 1-4: AERIAL PHOTO OF NUIQSUT

approved by ADEC in April 2000 (SECOR 2000a). Since that time, the monitoring program has been expanded three times requiring the following three addenda to the original monitoring plan:

- Partisol Addendum - The original monitoring plan was amended to include collocated Federal Reference Method particulate monitoring at the Nuiqsut Station. The final Partisol Addendum was submitted to ADEC in January 2001 (SECOR 2001a). ADEC approval of the Partisol Addendum is pending.

- Expanded Meteorology Addendum - The original monitoring plan was amended to expand the meteorological monitoring program. The draft Expanded Meteorology Addendum was submitted to ADEC in March 2002 (SECOR 2002a). ADEC review of the draft Expanded Meteorology Addendum is pending.

- Ozone Addendum – The original monitoring plan was amended to include ozone monitoring at the Nuiqsut Station. The draft Ozone Addendum was submitted to ADEC in April 2004 (SECOR 2004c). ADEC review of the draft Ozone Addendum is pending.

The original monitoring plan combined with the three addenda is referred to as the Monitoring Plan. Guideline documents cited in the Monitoring Plan are:

- *Alaska Quality Assurance Manual for Ambient Air Quality Monitoring (ADEC 1996)*
- *Ambient Monitoring Guidelines for Prevention of Significant Deterioration* (USEPA 1987)
- *Meteorological Monitoring Guidance for Regulatory Modeling Applications* (USEPA 2000)
- *Quality Assurance Handbook for Air Pollution Measurement Systems. Volume II: Ambient Air Specific Methods (Interim Edition) Section 2.10: Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere (Dichotomous Sampler Method)* (USEPA 1990)
- *Quality Assurance Handbook for Air Pollution Measurement Systems. Volume II: Part 1. Ambient Air Program System Development* (USEPA 1998)
- *Quality Assurance Handbook for Air Pollution Measurement Systems. Volume IV: Meteorological Measurements (USEPA 1995a)*
- *Code of Federal Regulations 40 CFR Part 58–Ambient Air Quality Surveillance*:

  Appendix A - *Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS)*

  Appendix B - *Quality Assurance Requirements for Prevention of Significant Deterioration (PSD) Air Monitoring*

  Appendix C - *Ambient Air Quality Monitoring Methodology*

  Appendix E - Probe Siting Criteria for Ambient Air Quality Monitoring

- *Supplemental Interim Guidance for Quality Assurance of Continuous PM_{10} Analyzers. Memorandum from W. Mitchell and F. McElroy, Quality Assurance Branch, Air Measurements Research Division, Research Triangle Park, North Carolina. (USEPA 1995b)*

2.0 STATION PERFORMANCE SUMMARY

This chapter presents a summary of events significant to station performance and contributing to data completeness, precision, and accuracy. Methods for determining data completeness, precision, and accuracy are included in Appendix A. Specific goals for data completeness, precision, and accuracy established in the Monitoring Plan are listed in Appendix B. Data recovery for air quality parameters exceeded project goals for all quarters. Data recovery for all meteorological parameters exceeded project goals for all months during the monitoring year, except for vertical wind speed. Vertical wind speed data recovery was affected by periods throughout the fourth and first quarters when the sensor was frozen. Data accuracy and precision goals for all parameters were exceeded during the monitoring year.

2.1 Significant Project Events

Table 2-1 summarizes significant project events for the monitoring year. Detailed discussions of project events affecting data recovery are presented in Section 2.2.

2.2 Missing, Invalid, and Adjusted Data

All hourly SO_2 and NO_x data have been adjusted according to the procedure outlined in a USEPA Quality Assurance Handbook (USEPA 1998) and described in Appendix A. The adjustment procedure corrects for instrument drift based on daily Level I zero/span results. Without adjustment, zero or span drift of the instrumentation could be misinterpreted as low-level concentrations.

After instrument drift corrections are applied, all hourly SO_2 and NO_x data less than 0.000 ppm have been set to 0.000 ppm to conservatively remove negative biases from the data set. Values less than -0.001 ppm are investigated for correctness before adjusting.

On occasion, reported hourly average PM_{10} values are slightly less than zero (usually between 0 $\mu g/m^3$ and -5 $\mu g/m^3$). Negative PM_{10} concentrations usually occur in conjunction with precipitation events or abrupt changes in weather. As described in Appendix A-1 of this report, and Appendix A-1 of the Monitoring Plan, reported PM_{10} concentrations greater than -10 $\mu g/m^3$ are valid unless a reason exists to invalidate the data. Measured concentrations of -10 $\mu g/m^3$ or less are invalidated.

The following sub-sections provide details pertaining to non-routine data losses for each specific portion of the monitoring network. Additional data losses for the year include those due to routine network operation and maintenance, calibrations, audits, and precision checks. Additional details pertaining to each event are included in appropriate quarterly data reports (SECOR 2003a, SECOR 2004a, SECOR 2004b, and SECOR 2004d).

2.2.1 NO_x and SO_2 Data

Losses of NO_x and SO_2 data were limited to the first two days of the second quarter 2003 from problems incurred during the previous quarter. NO_x data was missing because the on-site technician left the instrument in the wrong sample mode. SO_2 data was missing as a result of a

TABLE 2-1

NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM
SIGNIFICANT PROJECT EVENTS
APRIL 1, 2003 THROUGH MARCH 31, 2004

Date	Event/Comment
April 1-3, 2003	SO_2 data invalid due to ruptured sample pump diaphragm.
April 1-3, 2003	NO_x data invalid because the NO_x analyzer had been set in the wrong sampling mode by the on-site technician during the previous quarter.
April 1-4, 2003	PM_{10} data invalid due to a malfunctioning TEOM control unit. The unit was replaced on April 2 but did not stabilize until April 4.
April 1-3, 2003	All vertical wind speed data invalid due to a broken propeller from excessive snow loading during the previous quarter.
April 2-3, 2003[1]	First quarter 2003 independent quality assurance audit of the air quality monitoring system performed by an AMSTech technician. Results of the audit confirmed all instrumentation was operating within acceptable limits.
April 9, 2003[1]	First quarter 2003 calibration of the air quality monitoring system performed by a SECOR technician. The calibration and routine quarterly site service and maintenance visit confirmed all instrumentation was operating within acceptable limits.
June 10, 2003	Second quarter 2003 independent quality assurance audit of the air quality and meteorological monitoring systems performed by an AMSTech technician. The audit confirmed all instrumentation was operating within acceptable limits.
June 25-26, 2003	Second quarter 2003 routine calibration of the air quality and meteorological monitoring systems performed by a SECOR technician. The calibration and routine quarterly site service and maintenance visit confirmed all instrumentation was operating within acceptable limits.
June 25, 2003 through July 2, 2003	TEOM data invalid because the TEOM did not stabilize due to a faulty filter installed during the second quarter calibration. The TEOM stabilized after the filter was replaced by the on-site technician.
August 12-14, 2003	Third quarter 2003 routine calibration of the air quality monitoring system performed by a SECOR technician. The calibration and routine quarterly site service and maintenance visit confirmed all instrumentation was operating within acceptable limits. As a preventative measure, the TEOM sample unit and SO_2 instrument were replaced during this time.

[1] Audit and calibration delayed due to the unexpected closure of the Kuukpik Hotel.

TABLE 2-1 (CONTINUED)

NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM
SIGNIFICANT PROJECT EVENTS
APRIL 1, 2003 THROUGH MARCH 31, 2004

Date	Event/Comment
September 9, 2003	Third quarter 2003 independent quality assurance audit of the air quality monitoring system performed by an AMSTech technician. Results of this audit showed all instrumentation was operating within acceptable limits.
December 9-11, 2003	Fourth quarter 2003 routine calibration of the air quality and meteorological monitoring systems performed by a SECOR technician. Fourth quarter 2003 independent quality assurance audit of the air quality and meteorological monitoring systems performed by an AMSTech technician. The calibration, routine site service and maintenance visit, and audit confirmed all instrumentation was operating within acceptable limits.
March 10-11, 2004	First quarter 2004 independent quality assurance audit of the air quality monitoring system performed by an AMSTech technician. The audit confirmed all instrumentation was operating within acceptable limits.
March 30, 2004	First quarter 2004 routine calibration of the air quality monitoring systems performed by a SECOR technician. The calibration and routine quarterly site service and maintenance visit confirmed all instrumentation operating within acceptable limits.

broken sample pump. These issues were discussed in more detail in the previous annual report (SECOR 2003b).

2.2.2 Continuous PM_{10} Data (TEOM)

TEOM data was not available the first few days of April 2003 because of a TEOM control unit failure. The control unit was replaced on April 3, 2003.

Following the June 25, 2003 calibration and subsequent filter replacement on July 2, the TEOM was operating with an elevated but acceptable level of mass transducer noise. After numerous attempts to identify the noise source, SECOR replaced the TEOM sample unit on August 12 and corrected the problem. At no time was the mass transducer noise considered high enough to warrant data invalidation.

Losses of TEOM data occurred occasionally during the fourth and first quarters due to sampled snow and high winds causing excessive vibration of the instrument.

2.2.3 Meteorological Data

With the exception of routine maintenance and quality assurance activities, the only losses of meteorological data during the monitoring year were for wind speed measurements (horizontal and vertical) resulting from snow loaded and frozen sensors. The largest losses were for vertical wind speed data during the last half of October and the beginning of November as well as the last half of February and the beginning of March.

2.3 Network Data Recovery

Data recovery percentages for each continuous air quality and meteorological parameter have been calculated according to the procedure discussed in Appendix A, Section A-1. Network data recovery for the year achieved project goals for all parameters except vertical wind speed. Table 2-2 provides a detailed summary of monthly and quarterly data recovery for each parameter for the current monitoring year.

2.4 Precision Statistics

Precision statistics have been calculated for the NO_x and SO_2 analyzers based on the method outlined by the USEPA in Quality Assurance Handbook for Air Pollution Systems, Volume II: Part 1, Ambient Air Quality Monitoring Program Quality System Development (USEPA 1998) and summarized in Appendix A, Section A-2 of this report. The NO_2, NO, and SO_2 precision results, shown in Table 2-3, indicate that air quality analyzers operated within tolerances listed in Appendix B, Table B-2. Individual results from each precision check conducted are listed in Appendix A, Table A-1.

2.5 Data Accuracy

The meteorological and ambient air quality monitoring systems are subjected to periodic calibrations and independent quality assurance performance and systems audits to document accuracy and instrument measurements. All calibration and audit equipment is traceable to

TABLE 2-2

NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM
CONTINUOUS AIR QUALITY AND METEOROLOGICAL
DATA RECOVERY STATISTICS
APRIL 1, 2003 THROUGH MARCH 31, 2004

PARAMETER	Monthly (% Recovery)												Quarterly (% Recovery)				Annual 2003 (%)
	APR 2003	MAY 2003	JUN 2003	JUL 2003	AUG 2003	SEP 2003	OCT 2003	NOV 2003	DEC 2003	JAN 2004	FEB 2004	MAR 2004	Q2 2003	Q3 2003	Q4 2003	Q1 2004	
Meteorological																	
10-m Wind Speed	98.3	99.9	98.5	100	97.4	100	100	99.6	95.7	99.1	98.9	96.0	98.9	99.1	98.4	97.9	98.6
10-m Wind Direction	98.3	99.9	98.5	100	97.4	100	100	99.6	95.7	99.1	98.9	96.0	98.9	99.1	98.4	97.9	98.6
10-m Sigma-Theta (σ_θ)	98.3	99.9	98.5	100	97.4	100	100	99.6	95.7	99.1	98.9	96.0	98.9	99.1	98.4	97.9	98.6
10-m Vertical Wind Speed	85.4	99.5	97.2	100	97.4	97.5	47.8	81.5	90.2	92.3	62.6	82.0	94.1	98.3	73.1	79.3	86.2
10-m Sigma-w (σ_w)	85.4	99.5	97.2	100	97.4	97.5	47.8	81.5	90.2	92.3	62.6	82.0	94.1	98.3	73.1	79.3	86.2
10-m Temperature	99.4	99.9	98.5	100	97.4	100	100	99.6	96.2	99.7	99.7	99.9	99.3	99.1	98.6	99.8	99.2
2-m Temperature	99.4	99.9	98.5	100	97.4	100	100	99.6	96.2	99.7	99.7	99.9	99.3	99.1	98.6	99.8	99.2
10-2m Temperature Difference	99.4	99.9	98.5	100	97.4	100	100	99.6	96.2	99.7	99.7	99.9	99.3	99.1	98.6	99.8	99.2
Total Solar Radiation	99.4	99.9	98.5	100	97.4	100	100	99.7	100	100	100	99.9	99.3	99.1	99.9	100	99.6
Total (Meteorological Only)	96.0	99.8	98.2	100	97.4	99.4	88.4	95.6	95.1	97.9	91.2	94.6	98.0	99.0	93.0	94.6	96.2

TABLE 2-2 (CONTINUED)

NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM CONTINUOUS AIR QUALITY AND METEOROLOGICAL DATA RECOVERY STATISTICS APRIL 1, 2003 THROUGH MARCH 31, 2004

PARAMETER	Monthly (% Recovery)												Quarterly (% Recovery)				Annual 2003 (%)
	APR 2003	MAY 2003	JUN 2003	JUL 2003	AUG 2003	SEP 2003	OCT 2003 (%)	NOV 2003 (%)	DEC 2003 (%)	JAN 2004 (%)	FEB 2004 (%)	MAR 2004 (%)	Q2 2004 (%)	Q3 2004 (%)	Q4 2004 (%)	Q1 2004 (%)	
Air Quality																	
Nitrogen Dioxide (NO_2)	92.4	99.2	98.2	99.3	96.0	98.5	99.5	99.0	95.8	99.1	99.0	97.4	96.6	97.9	98.1	98.5	97.8
Nitric Oxide (NO)	92.4	99.2	98.2	99.3	96.0	98.5	99.5	99.0	95.8	99.1	99.0	97.4	96.6	97.9	98.1	98.5	97.8
Sulfur Dioxide (SO_2)	92.4	99.2	98.2	99.3	96.0	98.5	99.5	99.0	95.8	99.1	99.0	96.6	96.6	97.9	98.1	98.2	97.7
Particulate (PM_{10}) (TEOM)	83.8	93.2	81.3	95.0	96.6	98.9	100	99.6	98.1	94.4	92.8	93.0	86.1	96.8	99.2	93.4	93.9
Total (Air Quality Only)	90.2	97.7	94.0	98.3	96.1	98.6	99.6	99.2	96.4	97.9	97.4	96.1	94.0	97.7	98.4	97.1	96.8

TABLE 2-3

NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM
NO_2, NO, AND SO_2 PRECISION STATISTICS
APRIL 1, 2003 THROUGH MARCH 31, 2004

Analyzer	Number of Precision Checks (N)	Average Percent Difference ($\bar{d}_j$)	Standard Deviation (S_j)	Upper 95% Probability Limit (U_{95})	Lower 95% Probability Limit (L_{95})
NO	56	-1.9	3.3	4.6	-8.4
NO_2	54	-1.3	4.7	8.0	-10.6
SO_2	58	0.3	4.1	8.3	-7.8

authoritative standards. The purpose of calibration and performance audit checks is to challenge monitoring systems with known inputs, verifying that each instrument response is accurate to within USEPA-established tolerances listed in Appendix B.

Consistent with project Monitoring Plan goals, four quarterly calibrations of the air quality monitoring system, and two semi-annual calibrations of the meteorological monitoring system, were performed. In addition to calibrations performed by SECOR, four quarterly independent performance audits of the air quality monitoring system, two semi-annual independent performance audits of the meteorological monitoring system, one annual independent field systems audit, and one systems audit of the data handling, validation, processing, and reporting procedures at the SECOR Air Resources Laboratory in Fort Collins, Colorado were performed by AMSTech during the period.

All calibrations and independent quality assurance performance and systems audits showed the station systems were operating within acceptable limits and that procedures described in the project Monitoring Plan were being followed. Specific calibration and independent quality assurance audit details, including data forms, can be found in the respective quarterly data reports (SECOR 2003a, SECOR 2004a, SECOR 2004b, and SECOR 2004d).

3.0 MONITORING NETWORK DATA SUMMARY

This chapter provides a summary and analysis of air quality and meteorology data collected at the Nuiqsut Station during the monitoring year.

It is useful to discuss seasonal trends when analyzing annual data sets. The notion of seasons typically understood at mid-latitudes loses meaning when applied to latitudes as far north as Nuiqsut. Ambiguity in defining seasons is linked to the fact that, at high northern latitudes, days of 24-hour darkness rapidly give way to days of 24-hour daylight, and freezing temperatures can be experienced during any month of the year. Instead of defining four seasons, the Barrow National Weather Service office suggests this area experiences two seasons, winter and summer, separated by a month of rapid transition in May and October. Therefore, for this report, winter is defined as November through April, and summer as June through September.

3.1 Air Quality Data

Criteria pollutants monitored as part of the Nuiqsut Ambient Air Quality Monitoring Program are nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and respirable particulate less than 10 μm in diameter (PM_{10}). Criteria pollutants are those air pollutants for which ADEC has established standards that provide a threshold above which risk to public health and welfare becomes an issue. These standards are referred to as the Alaska Ambient Air Quality Standards (AAAQS) and are the same as the national standards for the pollutants measured. Applicable AAAQS, along with ambient concentrations measured at the Nuiqsut Station, are presented in Table 3-1 and summarized by pollutant below.

3.1.1 Nitrogen Dioxide

Table 3-1 shows the annual average NO_2 concentration was 0.006 ppm, compared to the annual NO_2 AAAQS of 0.053 ppm. The annual average NO_2 concentration is just above instrument detection level and only 11 percent of the NO_2 AAAQS. The annual average measured this year is higher than the historical Nuiqsut Station average of 0.004 ppm but slightly lower than the annual average measured the previous year (0.008 ppm).

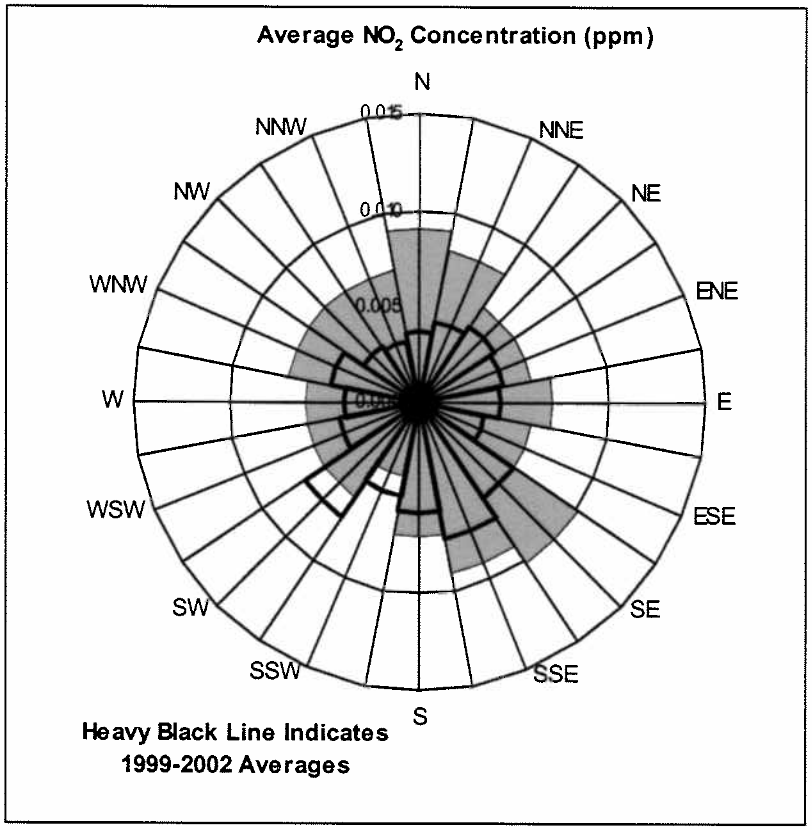
The variation of average hourly NO_2 concentration by wind direction this year was typical of past years with an approximate positive 0.002 ppm average offset. This offset is consistent with the difference between the historical and current years annual averaged hourly concentrations. As shown in Figure 3-1, the historical trend shows the lowest concentrations are measured when winds transport background air to the Nuiqsut Station (west-northwest through east-southeast). Slightly higher concentrations occur for hourly concentrations associated with sources located in Nuiqsut (southeast through west of Nuiqsut Station). Except for the overall increase of approximately 0.002 ppm, the difference in trends were minor (i.e. on the scale of the measurement accuracy) and not significant. In general, measured NO_2 concentrations at Nuiqsut are extremely low.

TABLE 3-1

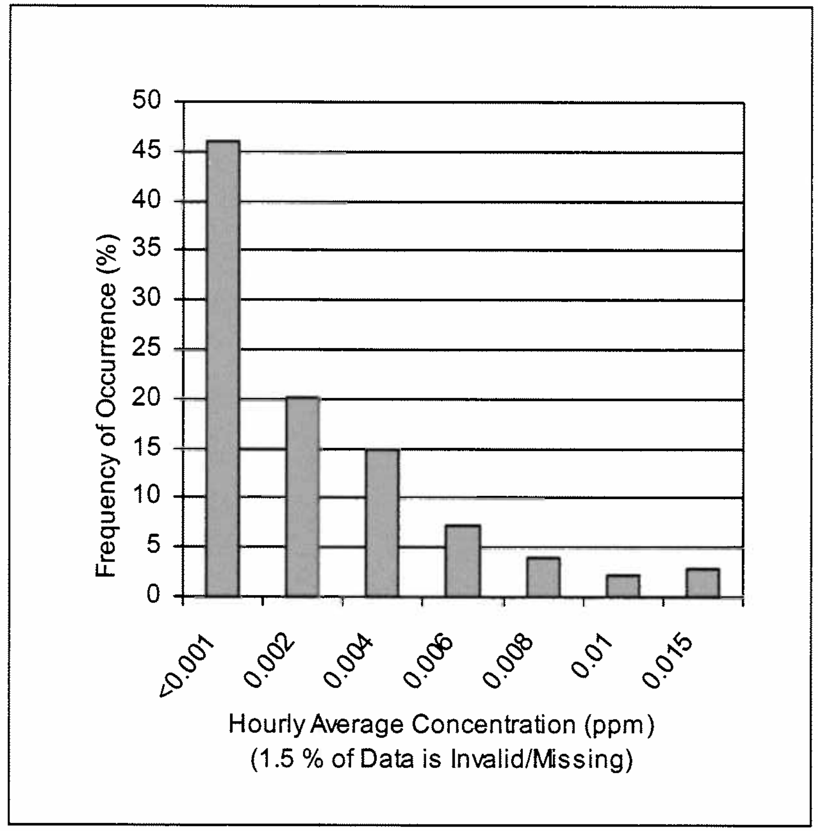
NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM
MEASURED NO_2, SO_2, AND PM_{10} CONCENTRATIONS BY MONTH
(APRIL 1, 2003 THROUGH MARCH 31, 2004)

Monitoring Period	Period Average NO_2 Concentration (ppm)	Maximum 3-hour SO_2 Concentration[1] (ppm)	Maximum 24-hour SO_2 Concentration[2] (ppm)	Period Average SO_2 Concentration (ppm)	Maximum 24-hour PM_{10} Concentration[2,3] (µg/m³)		Period Average PM_{10} Concentration[3] (µg/m³)	
					Standard[4]	Actual	Standard[4]	Actual
April 2003	0.011	0.002	0.000	0.000	11.0	12.2	5.3	6.0
May 2003	0.012	0.001	0.001	0.000	31.5	34.5	9.1	10.0
June 2003	0.014	0.001	0.001	0.000	19.3	20.2	6.3	6.7
July 2003	0.010	0.001	0.001	0.000	25.4	25.8	8.3	8.6
August 2003	0.008	0.002	0.001	0.000	18.8	19.5	5.7	6.1
September 2003	0.005	0.003	0.001	0.000	14.5	15.8	5.0	5.5
October 2003	0.004	0.002	0.001	0.000	13.1	14.2	4.8	5.3
November 2003	0.002	0.001	0.000	0.000	12.4	14.1	5.3	6.2
December 2003	0.002	0.004	0.002	0.001	11.6	14.3	6.0	7.1
January 2004	0.003	0.002	0.001	0.001	6.9	8.4	3.6	4.4
February 2004	0.003	0.002	0.001	0.000	5.5	6.7	3.3	4.1
March 2004	0.003	0.004	0.002	0.000	8.1	10.3	4.7	5.8
Reporting Period	0.006[5]	0.004	0.002	0.000[5]	31.5	34.5	5.6[5]	6.3[5]
AAAQS	0.053[5]	0.5	0.14	0.03[5]	150	N.A.	50[5]	N.A.

1 Running 3-hour average
2 24-hour average from midnight to midnight.
3 Based on continuous particulate (TEOM) data.
4 Standard refers to measured concentrations based on a flow rate corrected from actual conditions to USEPA designated standard conditions by using a pressure of 1 Atmosphere and a temperature of 25°C.
5 Annual average



Statistics Based on Data Collected from April 1, 2003 through March 31, 2004.



Statistics Based on Data Collected from April 1, 2003 through March 31, 2004.

FIGURE 3-1: NO_2 FREQUENCY ANALYSIS AND AVERAGE CONCENTRATION BY WIND DIRECTION

Monthly average NO_2 concentrations are presented in Figure 3-2. For this monitoring year, concentrations followed a trend opposite of the historical trend. This year observed concentrations were higher in summer and lower in winter. Historically, it is typical to observe increases in monthly averaged hourly NO_2 concentrations during the winter. The pattern of higher measured impacts in winter has been attributed to differences in atmospheric dispersion characteristics between winter and summer, and potential changes in local emissions. Seasonal differences in atmospheric dispersion characteristics arise because in winter, there is an increase in stable and neutral atmospheric conditions. With the sun up in summer, solar radiation and heating of the surface induces more vertical mixing of the lower atmosphere than in winter, thereby increasing diffusion of air pollution. In winter, without the benefit of solar energy, the atmosphere remains relatively stable and vertical dispersion of pollution is reduced. In addition, the increased local use of heating systems and idling vehicles in winter contribute to the NO_2 load. In general, however, measured concentrations are too low to speculate on any trend reversal that was observed this year.

3.1.2 Sulfur Dioxide

Table 3-1 lists measured maximum 3-hour (running) and 24-hour (midnight-to-midnight) average hourly SO_2 concentrations for each month, as well as the annual average hourly SO_2 concentration. Concentrations for all averaging periods were near or below instrument detection limit and well below applicable AAAQS. Measured SO_2 concentrations were typical of historical (1999-2002) values.

Measured hourly SO_2 concentrations were less than or equal to 0.002 ppm for 99.6 percent of the monitoring year. No hourly concentrations were greater than 0.005 ppm. The majority of measured SO_2 concentrations were just above the instrument detection limit making it difficult to discuss significant trends. Simply, there was no single near-field or far-field measurable SO_2 source observed in the data collected this year. Without identifiable sources, measured concentrations are representative of a regional or global background signature. The low average concentrations measured are consistent with an airshed containing relatively few and widely distributed sources. This trend has been typical of SO_2 measurements since monitoring began.

3.1.3 Respirable Particulate Matter (PM_{10}) - TEOM Data

Throughout the monitoring project history, the majority of elevated measured particulate concentrations result from naturally occurring wind blown fugitive dust from exposed or disturbed areas local to the Nuiqsut Station. Exposed areas identified in the program are:

- the exposed bank of the Nechelik channel east-northeast through east-southeast of the station,
- the exposed gravel mining area southeast of the station,
- disturbed ground due to residential construction along the utility right-of-way and road southeast through south-southeast of the station, and
- to a much lesser degree, disturbed ground associated with dirt roads within Nuiqsut south through west-southwest of the station.

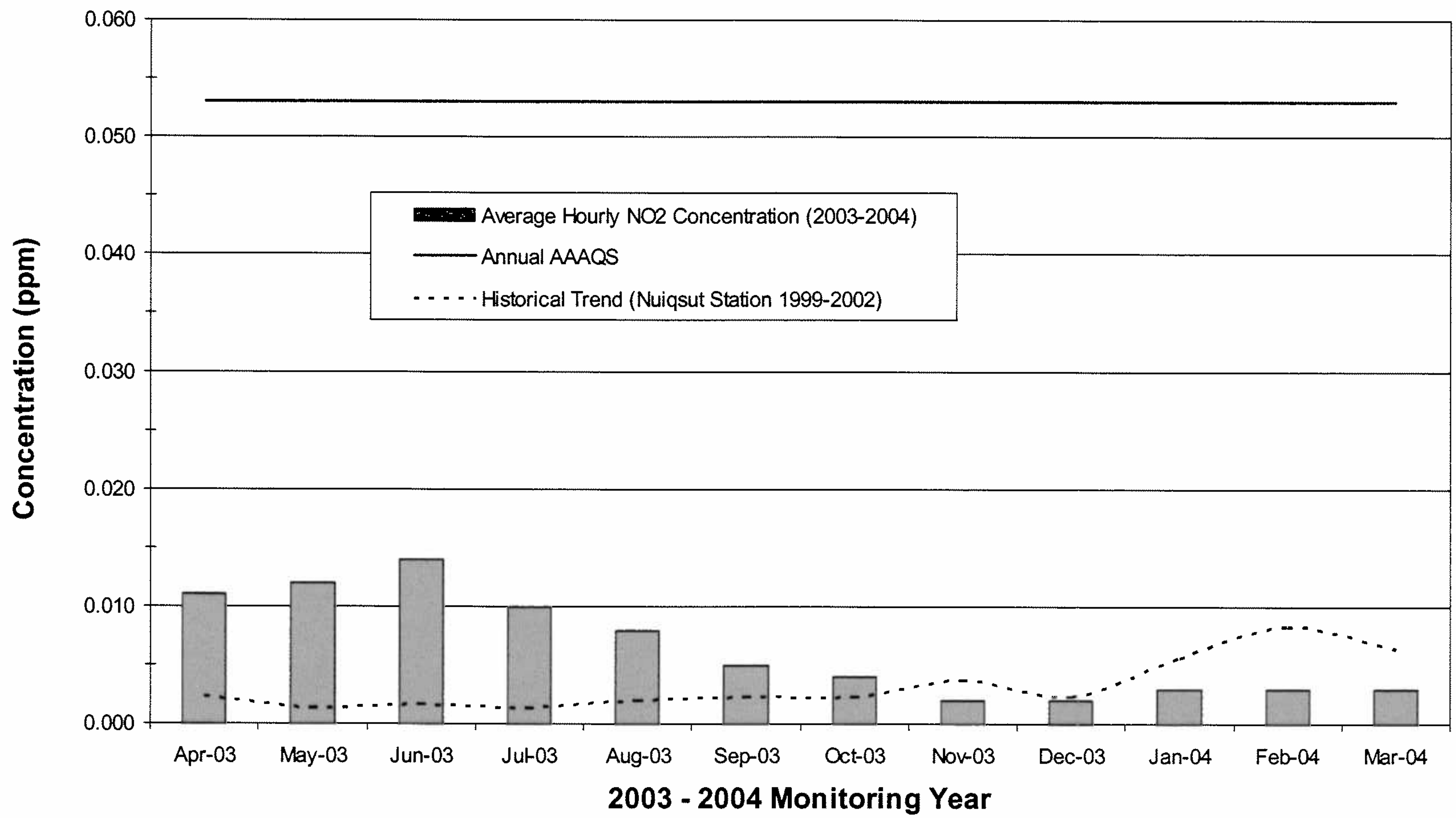


FIGURE 3-2: AVERAGE NO_2 CONCENTRATION BY MONTH

In addition to these local fugitive sources, elevated particulate has also been measured from remote tundra fires. When particulate from these sources is not present (i.e., during winter), hourly concentrations are at or below the instrument detection limit.

Respirable particulate matter less than 10 μm in diameter (PM_{10}) measured at USEPA standard temperature and pressure, has a 24-hour and annual AAAQS of 150 $\mu g/m^3$ and 50 $\mu g/m^3$, respectively. As listed in Table 3-1, the maximum 24-hour PM_{10} concentration measured during the monitoring year was 31.5 $\mu g/m^3$, which is below the 24-hour AAAQS, and is lower than the maximum 24-hour concentration of 43.5 $\mu g/m^3$ measured during the previous monitoring year. The yearly average PM_{10} concentration was 5.6 $\mu g/m^3$, which is well below the annual AAAQS of 50 $\mu g/m^3$ and lower than the average of 9.3 $\mu g/m^3$ obtained last year.

The low concentrations measured at Nuiqsut is demonstrated with the frequency distribution of hourly measurements presented in Figure 3-3. This distribution shows that over 75 percent of hourly measurements were below 7.5 $\mu g/m^3$. The high percentage of low measurements reflects the rural site setting combined with frozen and or snow covered ground for a majority of the year.

Figure 3-3 shows annual average hourly PM_{10} concentrations by wind direction measured this year. Concentrations for all wind directions were below historical annual averages and approximately equal to the overall annual average. The lack of directional dependence indicates measurements are representative of a regional background signature.

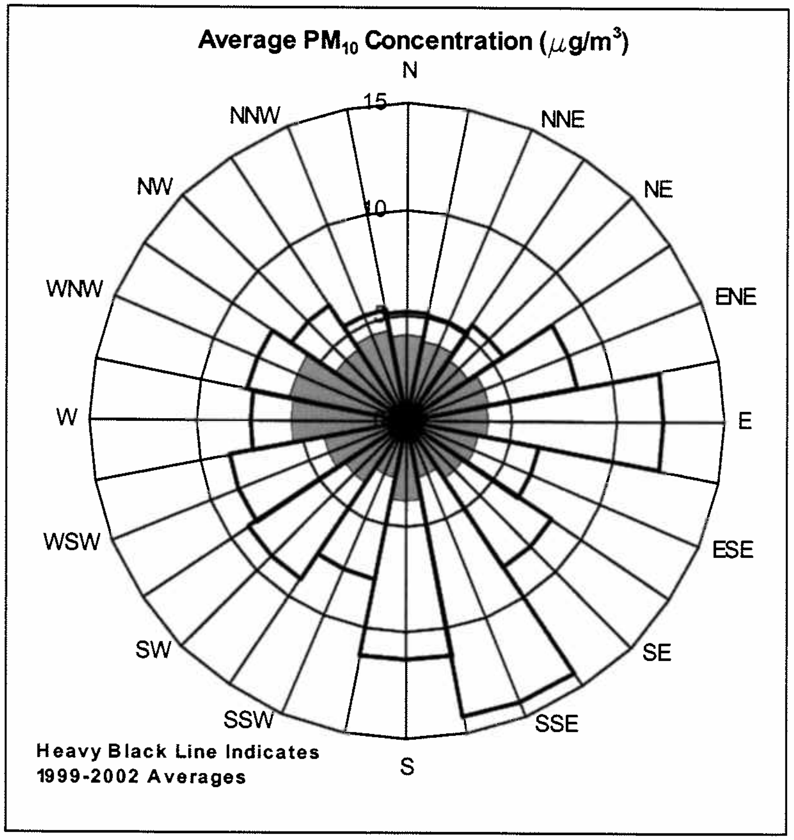
Figure 3-4 compares the monthly average hourly PM_{10} concentrations measured this year to average monthly PM_{10} concentrations obtained over the past four years at Nuiqsut. Historical trends show that the first and fourth calendar quarters (October through March) typically experience lower average hourly PM_{10} concentrations reflecting snow covered conditions that suppress fugitive dust. In contrast, the second and third quarters (April through September) record higher average hourly concentrations by month as fugitive dust sources thaw and become exposed. Average hourly concentrations reported by month this year generally followed this trend but with much less monthly variability. The variability seen throughout the year and compared to previous years is expected considering PM_{10} concentrations are highly dependent on the interplay of many meteorological characteristics such as wind speed and frequency, precipitation, and temperature.

3.2 Meteorological Data

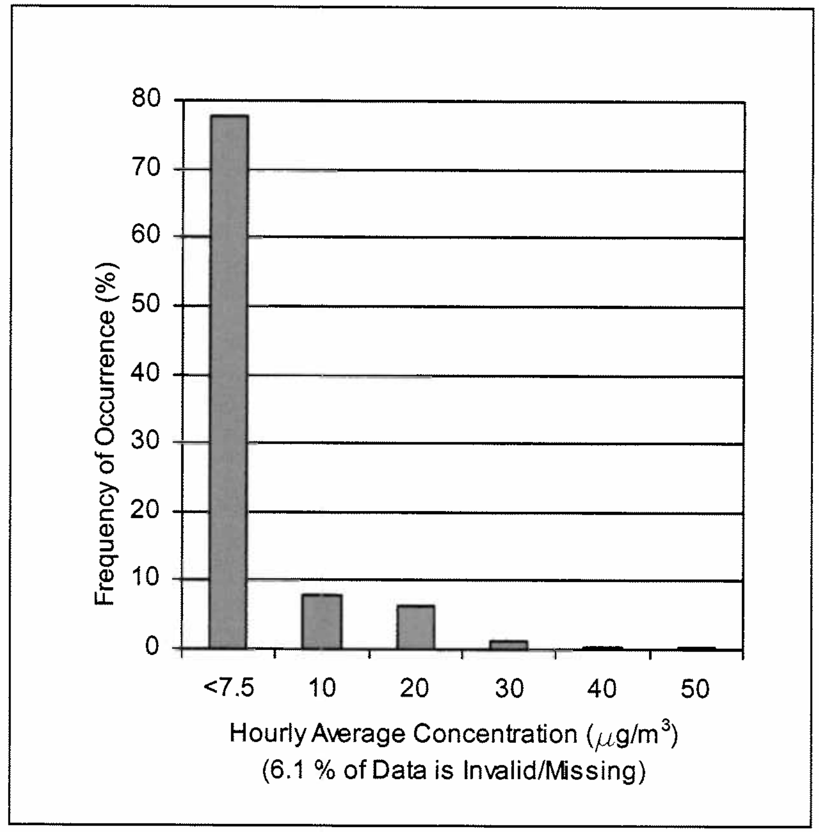
Wind speed, wind direction and temperature data collected at the Nuiqsut Station during the monitoring year are summarized in the following subsections. Vertical wind speed and solar radiation data are also collected at the Nuiqsut Station but are not discussed separately. However, they are used in the atmospheric stability presentation.

3.2.1 Wind Speed and Direction Climatology

The annual Nuiqsut bivariate wind frequency distribution (wind rose) is presented in Figure 3-5. Data presented in this figure is consistent with the North Slope wind climatology and typical of the Nuiqsut bimodal wind direction distribution demonstrated every year since monitoring began. This figure shows winds during the monitoring year were dominated by northeast through easterly (NE-E) for one sector and south-southwest through westerly (SSW-W)

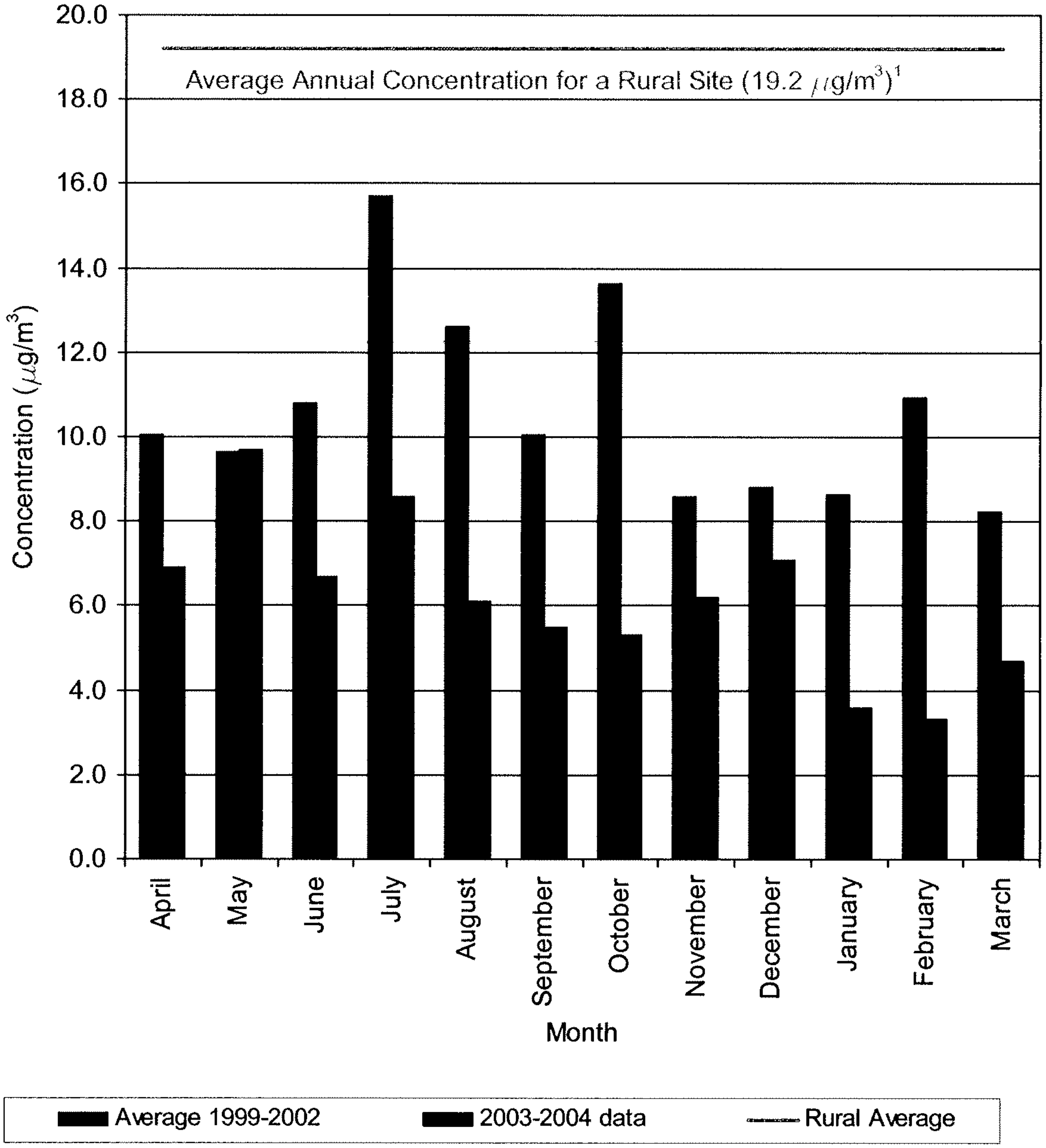


Statistics Based on Data Collected from April 2003 through March 2004.



Statistics based on data collected from April 2003 through March 2004

FIGURE 3-3: PM_{10} FREQUENCY ANALYSIS AND AVERAGE CONCENTRATION BY WIND DIRECTION



[1] Average annual concentration obtained from 153 rural sites as summarized in the National Air Quality and Emissions Trends Report, 1999 (USEPA 2001).

FIGURE 3-4: NUIQSUT PARTICULATE CLIMATOLOGY

Nuiqsut Air Quality Monitoring Program - Nuiqsut, AK
WIND ROSE ANALYSIS (PERCENT)
4/ 1/03 through 3/31/04
All Hours

WIND DIRECTION	WIND SPEED (M/S) <= 1.5	<= 3.1	<= 5.1	<= 8.2	<=10.8	>10.8	TOTAL	AVG SPEED
N	0.38	1.12	0.92	0.23	0.00	0.00	2.66	2.97
NNE	0.46	1.56	1.41	0.33	0.00	0.00	3.76	3.10
NE	0.67	2.49	4.18	3.46	0.84	0.43	12.08	4.88
ENE	0.76	2.36	4.49	6.08	3.08	2.63	19.43	6.52
E	0.38	1.81	3.08	3.63	1.49	1.62	12.01	6.45
ESE	0.42	1.03	0.87	0.42	0.05	0.08	2.85	3.61
SE	0.29	0.61	0.37	0.05	0.00	0.00	1.32	2.64
SSE	0.50	0.80	0.31	0.05	0.00	0.00	1.65	2.35
S	0.37	1.35	1.71	0.55	0.00	0.00	3.98	3.44
SSW	0.42	2.30	3.97	1.52	0.00	0.00	8.21	3.79
SW	0.40	1.62	2.76	1.44	0.42	0.06	6.70	4.36
WSW	0.33	1.58	2.12	3.09	0.89	0.43	8.45	5.56
W	0.28	1.18	2.10	2.01	0.74	0.37	6.67	5.36
WNW	0.48	1.24	1.52	1.11	0.29	0.03	4.68	4.23
NW	0.39	1.33	0.80	0.33	0.00	0.00	2.85	3.06
NNW	0.39	0.99	0.77	0.22	0.03	0.00	2.41	3.04
CALM	0.29						0.29	
TOTAL	7.22	23.38	31.39	24.54	7.83	5.65	100.00	

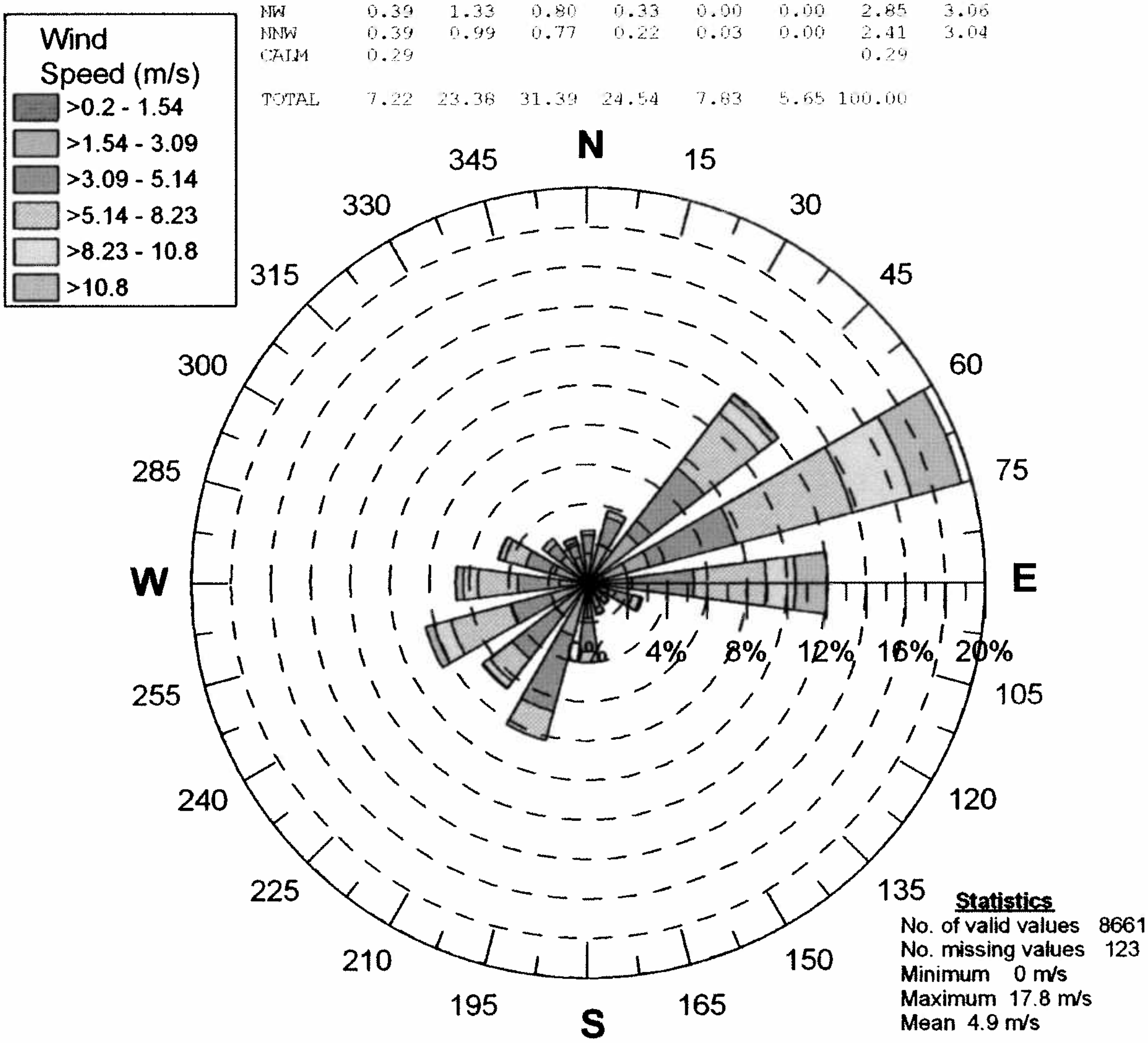


FIGURE 3-5: ANNUAL WIND ROSE ANALYSIS

directions for the other sector. Winds from these two sectors occurred nearly 74 percent of the time this year and are based on persistent regional weather patterns. Data summarized from Figure 3-5 is tabulated below. The tabulated summary shows NE-E winds average slightly higher speeds than SSW-W winds and occur with a higher frequency. Without respect to direction, the mean 10-meter wind speed for the monitoring year was 4.9 m/s and the maximum was 17.8 m/s.

Wind Speed/ Wind Direction Parameter	April 2003 through March 2004	April 2002 through March 2003	April 2001 through March 2002	April 2000 through March 2001	April 1999 through March 2000
Frequency of NE-E Winds (%)	43.5	39.4	43.8	50.7	53.8
Frequency of SSW-W Winds (%)	30.0	32.5	29.2	22.7	22.9
Mean Wind Speed over NE-E Winds (m/s)	6.0	6.0	5.3	6.0	6.6
Mean Wind Speed over SSW-W Winds (m/s)	4.8	4.8	4.1	4.6	4.6
Mean Hourly Wind Speed (m/s)	4.9	4.9	4.3	5.0	5.3
Maximum Hourly Wind Speed (m/s)	17.8	21.7	20.2	23.7	20.1

The wind speed/wind direction summary also provides a comparison of the wind climatology for the current monitoring year compared to those measured in previous years. It is very clear from these statistics that though the maximum hourly wind speed this year was low, there has been very little change in the wind speed and direction climatology over the past five monitoring years. This climatology demonstrates the persistence of weather patterns as they move across the well-exposed, relatively flat Alaska North Slope Coastal Plain.

The persistence of weather patterns season to season can be derived from Figure 3-6. Figure 3-6 presents both a winter and summer wind rose based on data from the current year. As was observed during the last four monitoring years, the seasonal wind roses collected this year indicate there is a persistence of NE-E and SSW-W winds all year long. In the winter, this pattern is more defined and is associated with higher wind speeds than the summer.

3.2.2 Stability Frequencies

Turbulence, which drives air pollution dispersion in the mixed (near-surface) layer of the atmosphere, is a result of thermal and mechanical processes. This turbulence can be estimated by examining the atmospheric stability, which has been divided into various stability classifications by Pasquill-Gifford (USEPA 1995a). The stability classifications can be calculated using various methodologies including solar radiation/delta-T (SRDT) and sigma-theta (σ_θ) methods. A more detailed discussion of stability and these two calculation methods are included in Appendix A of this report.

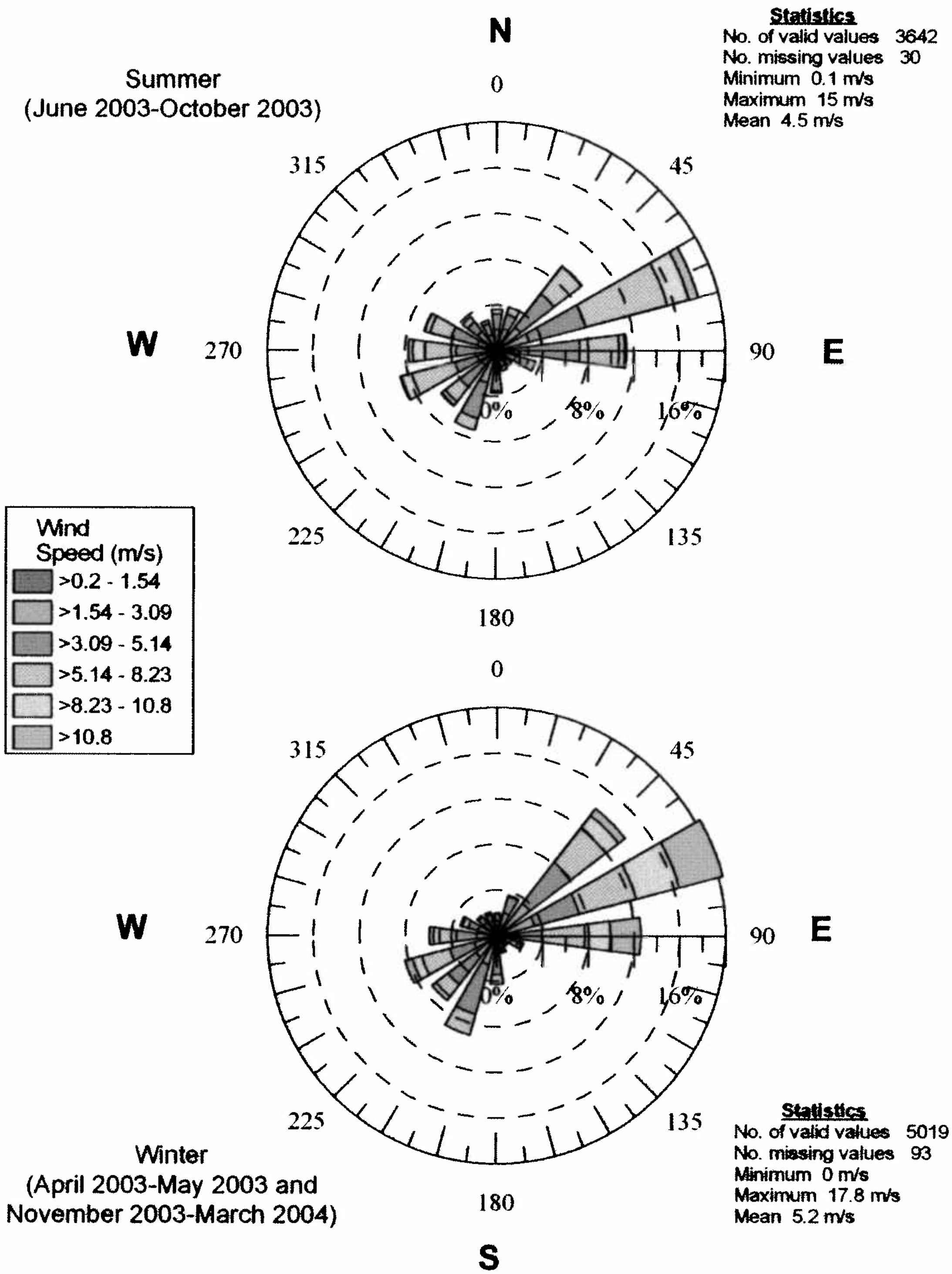


FIGURE 3-6: SEASONAL WIND ROSE ANALYSIS

Figure 3-7 presents a comparative analysis of the distribution of the P-G stability classes calculated using SRDT and σ_θ methods for the year. The SRDT method estimates neutral conditions occurred 80 percent of the time, while stable conditions (slightly stable and stable) occurred 9.2 percent of the time, and unstable conditions (unstable and slightly unstable) occurred 10.7 percent of the time. Extremely unstable conditions were not estimated to occur using the SRDT method.

A comparison of the σ_θ method with the SRDT method shows a relative shift in category distribution from neutral to stable using the σ_θ method. Estimated frequencies of stable conditions are higher using the σ_θ method (12.1 percent for σ_θ and 9.2 percent for SRDT), while the frequency of neutral conditions is slightly lower for the σ_θ method (66.8 percent compared to 80.0 percent). Note that because of the way the SRDT method determines stability, extremely unstable, unstable, and slightly unstable conditions will not occur during nighttime hours near the winter solstice for the North Slope using this method.

Both methods demonstrate that neutral stability conditions dominate, with unstable and stable conditions rarely occurring. Combining this information with statistics gathered during previous monitoring years yields the following comparison which shows that stability characteristics tend to remain fairly constant:

Stability Parameter	April 2003 through March 2004	April 2002 through March 2003	April 2001 through March 2002	April 2000 through March 2001	April 1999 through March 2000
Frequency of Neutral Conditions (σ_θ Method) (%)	66.8	65.2	63.9	66.9	70.0
Frequency of Neutral Conditions (SRDT Method) (%)	80.0	77.2	76.5[1]	N.A.	N.A.

[1] Monitoring of parameters necessary to make this assessment (solar radiation and temperature difference) began July 24, 2001. Percentage is based on 5,791 valid hours.

3.2.3 Temperature Climatology

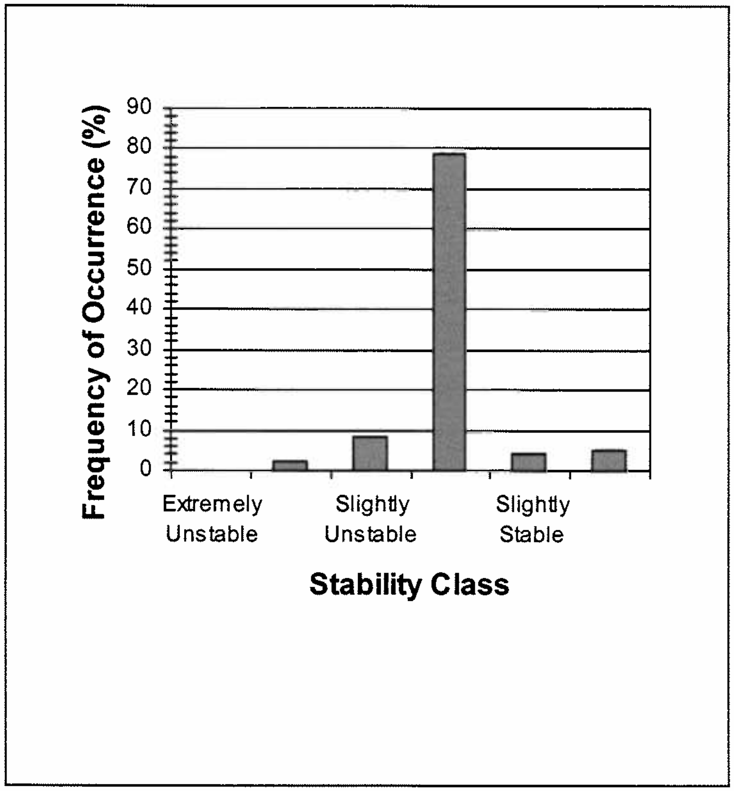
During the monitoring year, the hourly averaged 2-meter ambient temperature reached a maximum of 27.3°C (81.1°F) on the afternoon of June 29, 2003 and a minimum of -45.9°C (–50.6°F) in the evening of February 19, 2004. Combining this information with data gathered during the last four monitoring years yields the following comparison which shows extremes measured this year are typical of those measured during the last four monitoring years.

Temperature	April 2003 through March 2004	April 2002 through March 2003	April 2001 through March 2002	April 2000 through March 2001	April 1999 through March 2000
Maximum Hourly Temperature (°C)	27.3	27.0	28.0	27.1	27.8
Minimum Hourly Temperature (°C)	-45.9	-40.4	-43.1	-43.0	-41.5

NUIQSUT AIR QUALITY MONITORING SITE
APRIL 1, 2003 THROUGH MARCH 31, 2004

Calculated using the SRDT Method

Stability Class	Frequency (%)
Extremely Unstable	0.0
Unstable	2.2
Slightly Unstable	8.5
Neutral	80.0
Slightly Stable	4.2
Stable	5.0



Calculated using the Sigma-Theta Method

Stability Class	Frequency (%)
Extremely Unstable	4.7
Unstable	4.0
Slightly Unstable	12.4
Neutral	66.8
Slightly Stable	8.6
Stable	3.5

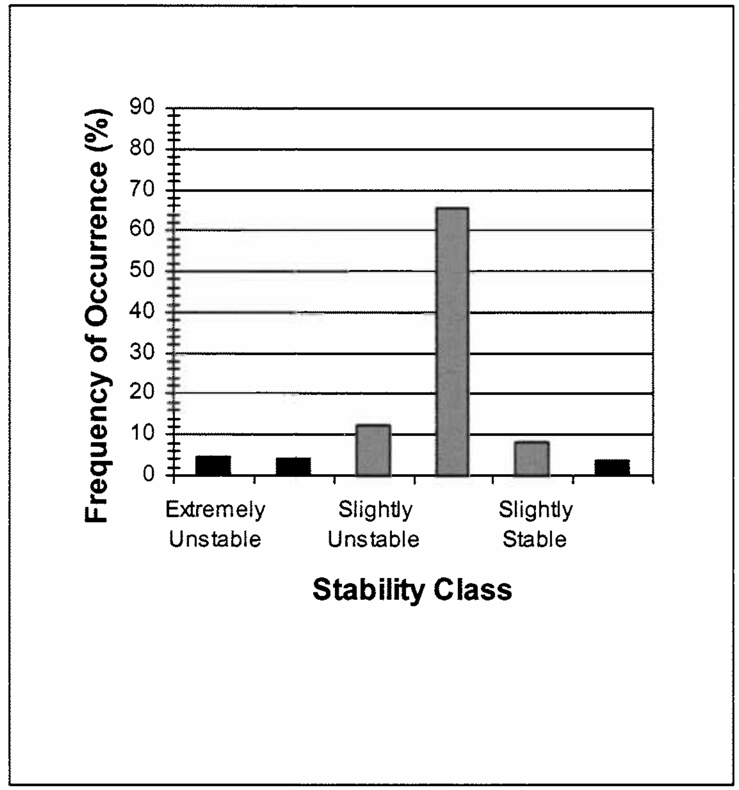


FIGURE 3-7: NUIQSUT STABILITY CLASS FREQUENCY DISTRIBUTIONS

Figure 3-8 compares average hourly temperatures by month measured at Nuiqsut during the current monitoring year to historical data collected at Barrow and the Nuiqsut Station. Comparisons are made to Barrow data because that data, collected over a 49-year period, is less likely influenced by interannual variability. Consistent with past comparisons made between Nuiqsut Station and Barrow temperatures, Nuiqsut Station temperatures were consistently higher than those collected at Barrow from June through September and lower than those at Barrow from January through March. This difference has been relatively constant since monitoring began and is in part related to the fact that the Nuiqsut Station is located further inland than Barrow and away from moderating effects of the ocean.

With some exceptions, temperatures measured at Nuiqsut during the first part of the monitoring year (April through October) were slightly higher those measured historically at Nuiqsut. This trend rapidly gave way to abnormally cool temperatures in February and March 2004. The February hourly average temperature was almost 8°C cooler than historical normals. Abnormally cool winter measurements and slightly elevated summer measurements are also reflected in the developing temperature climatology presented in Table 3-3, which shows the yearly hourly minimum for the period of record was broken in February and two monthly hourly maximums were broken during the summer.

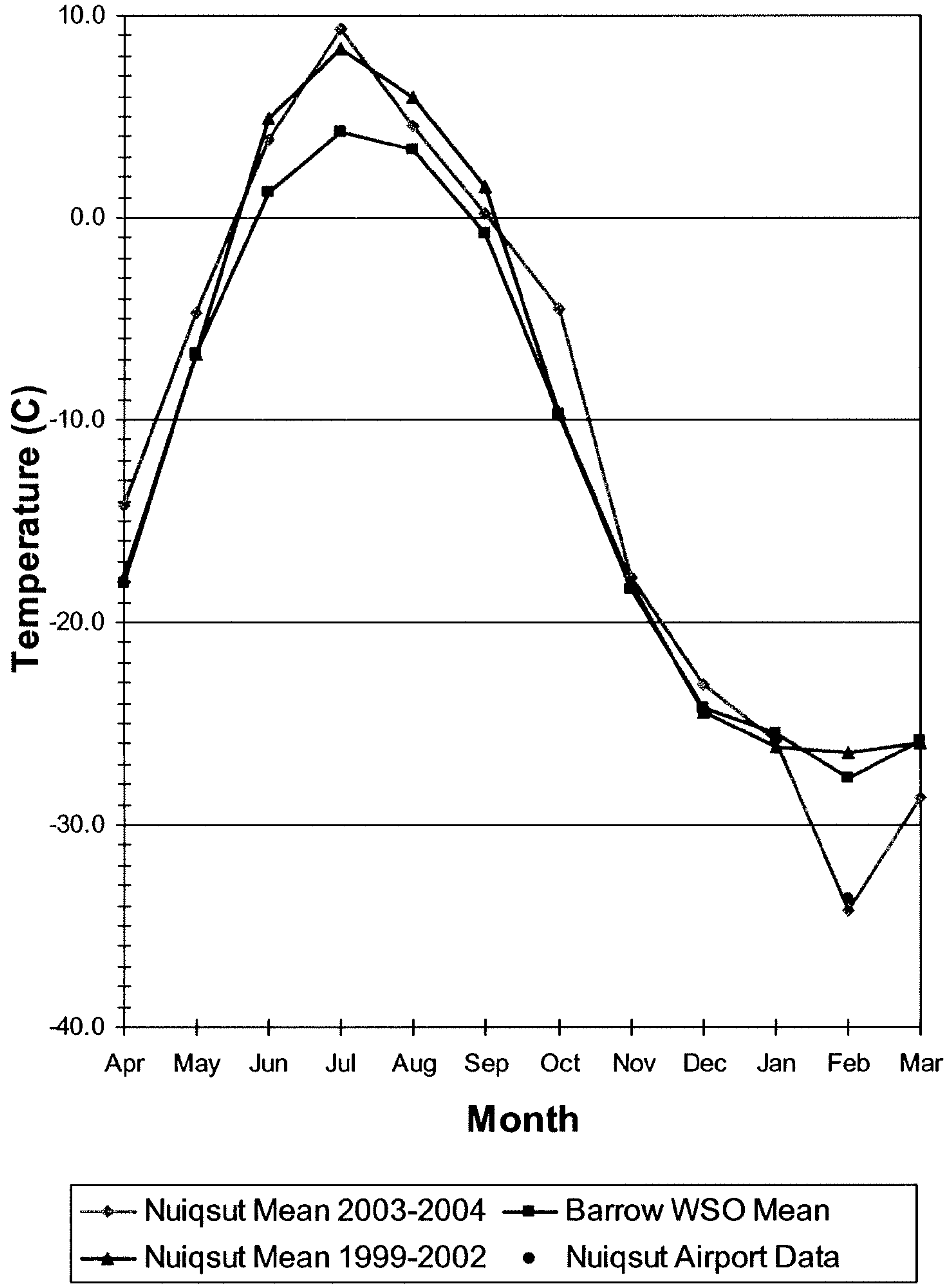


FIGURE 3-8: NUIQSUT TEMPERATURE CLIMATOLOGY

TABLE 3-2

NUIQSUT AMBIENT AIR QUALITY MONITORING PROGRAM
TEMPERATURE CLIMATE SUMMARY
PERIOD OF RECORD APRIL 9, 1999 THROUGH MARCH 31, 2004

2-Meter Temperature (°C)									
Month	Mean			Extreme					
	Maximum Daily (Monthly Average)	Minimum Daily (Monthly Average)	Monthly	Record Highest (Hourly Average)	Year	Day	Record Lowest (Hourly Average)	Year	Day
April 2003	-11.0	-17.8	-14.2	2.5	2002	26	-34.0	2000	4
May 2003	-2.5	-7.3	-4.7	18.5	2002	24	-28.7	2001	1
June 2003	7.6	0.2	3.8	27.3	2003	29	-5.0	2000	5
July 2003	13.3	5.5	9.3	28.0	2001	16	-1.6	2002	26
August 2003	7.5	1.7	4.5	27.8	1999	5	-3.3	2000	27
September 2003	2.4	-1.9	0.2	18.8	2002	5	-13.6	1999	30
October 2003	-2.5	-8.0	-4.5	7.4	2003	2	-27.2	1999	31
November 2003	-14.4	-21.4	-17.8	0.7	2003	6	-35.5	1999	5
December 2003	-20.7	-25.9	-23.2	-2.5	2001	28	-42.1	1999	18
January 2004	-21.9	-25.4	-26.0	-11.7	2003	22	-43.1	2002	23
February 2004	-31.6	-36.9	-34.2	-14.9	2003	8	-45.9	2004	19
March 2004	-25.2	-32.7	-28.7	-3.1	2004	21	-40.0	2003	26
Monitoring Year	-8.2	-14.1	-11.2	28.0	2001		-45.9	2004	

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