HYDROGEN SULFIDE
EMISSIONS CHARACTERIZATION

IN SUPPORT OF

26th WARD WPCP
PRELIMINARY TREATMENT & SOLIDS HANDLING
FACILITY UPGRADE
CONSTRUCTION CONTRACT 26W-20

SUBMITTED TO:

THE NEW YORK CITY
DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF ENGINEERING DESIGN
& CONSTRUCTION
AND
BUREAU OF ENVIRONMENTAL PLANNING
AND ANALYSIS

JULY 2009

PREPARED FOR AND SUBMITTED BY:
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SELECTED ACRONYMS AND ABBREVIATIONS

Acronym	Meaning
AERMET	AERMOD meteorological pre-processor
AERMOD	***A***merican Meteorological Society / ***E***PA ***R***egulatory ***Mod***el
BEDC	Bureau of Engineering Design & Construction
BEPA	Bureau of Environmental Planning and Assessment
CERCLA	Comprehensive Environmental Restoration, Compensation and Liability Act
CEQR	City Environmental Quality Review
CF_4	carbon tetrafluoride
CLS	classical least squares
CSO	combined sewage overflow
ΔT	change in temperature with height (delta-T)
DDWF	design dry-weather flow
DEP	New York City Department of Environmental Protection
DQO	data quality objective
EDT	Eastern Daylight Time
F	Fahrenheit
FTIR	Fourier-transform infrared
g	gram
H_2S	hydrogen sulfide
IR	infrared
ISCST3	Industrial Source Complex Short-Term Model, Version 3
K	Kelvin
m	meter
mg	milligram
mgd	million gallons per day
mph	miles per hour
MQO	measurement quality objective
NIST	National Institute of Standards and Technology
NWS	National Weather Service
OAQPS	USEPA Office of Air Quality Planning and Standards
PARCC	precision, accuracy, representativeness, completeness, and comparability
P-G	Pasquill-Gifford
ppb	parts per billion
ppm	parts per million
PQL	practical quantitation limit
QAPjP	quality assurance project plan

SELECTED ACRONYMS AND ABBREVIATIONS (Cont'd)

Acronym	Meaning
PST	preliminary settling tank
RAS	return activated sludge
σ_θ	standard deviation of the horizontal wind direction (sigma-theta)
σ_z	vertical dispersion coefficient (sigma-z)
s	second
SAP	sampling and analysis plan
SF_6	sulfur hexafluoride
T	temperature
ug	microgram
USEPA	US Environmental Protection Agency
USGS	US Geological Survey
UV	ultraviolet
W	watts
WAS	waste-activated sludge
WD	wind direction
WPCP	water pollution control plant
WS	wind speed

EXECUTIVE SUMMARY

The New York City Department of Environmental Protection (DEP), Bureau of Engineering Design & Construction (BEDC), through its engineering consultant, Hazen and Sawyer, P.C., is currently upgrading the wastewater and residuals handling system at the 26th Ward WPCP in the Borough of Brooklyn, New York (DEP Contract 26W-20). This report presents the hydrogen sulfide (H_2S) emissions inventory necessary to support a comprehensive City Environmental Quality Review (CEQR) air quality analysis for this compound.

This report is a revision of the March 2002 report, "Results of a Hydrogen Sulfide Emissions Characterization for the 26th Ward Wastewater Treatment Plant Upgrading." Although the upgrade project that report was intended to support was subsequently cancelled, the DEP determined that the emissions work performed for the original upgrade could be used to satisfactorily support the current upgrade project without additional field measurements. Accordingly, the DEP directed Hazen and Sawyer to modify the March 2002 report (and the corresponding CEQR analysis) to reflect the current upgrade project. Minnich and Scotto, Hazen and Sawyer's air quality consultant for the original emissions measurements and CEQR analyses at this facility, was retained to prepare this revised H_2S emissions characterization. The revised CEQR analysis for H_2S will be prepared upon DEP review and acceptance of this report.

Field work for this H_2S emissions characterization study was performed between July 9 and September 6, 2001 under the direction of Hazen and Sawyer. Emphasis was placed on collecting emissions data during times of dry-weather flow, i.e., during those conditions within the normal range of plant operating limits likely to enhance anaerobic (septic) conditions necessary for H_2S generation. All measurements were made during the summer when influent temperatures were at their annual peak, as anaerobic activity is directly proportional to temperature.

A total of 174 individual H_2S emission-rate estimates spanning a range of facility conditions and operating practices for six source groups are derived from the field measurements. From this information, a technically defensible facility-wide emissions inventory is developed. Sufficient measurement and facility operating data were collected to ensure that "credit" could be taken for each upgrade component shown to materially reduce H_2S emissions. Strict control of all sampling methods and instruments was employed in accordance with the most recent USEPA guidelines and requirements for the collection of evidentiary field-measurement data. Calibrated Jerome meters were employed for all H_2S measurements.

Two emissions-estimation methods were employed: the mass-balance technique and the area-source technique. The mass-balance technique was employed for the buildings (pump station screening rooms, sludge thickeners, and sludge storage tanks); it involves multiplying the volume of ventilated air by a representative H_2S concentration derived from an appropriate treatment of indoor data.

The area-source technique was employed for the process tanks; it involves an assessment of source attribution and the use of an appropriate dispersion model, together with onsite meteorological data, to estimate a unique, conservative emission rate for each 15-minute monitoring event. The principal component of this revised emissions characterization involves replacement of the ISCST3 dispersion model used in the original analysis with USEPA's new guideline model, AERMOD – a much more sophisticated model with improved accuracy in near-source, downwind locations for area-type sources.

Because the ISCST3 Model (and even AERMOD, for that matter) does not perform well in the very stable sea breeze environment, and because much of the H_2S measurement work at the preliminary settling tanks was expected to be performed when the wind was from the south (i.e., blowing from Jamaica Bay), a controlled tracer-gas measurement program was employed to augment the H_2S measurements for this source. Carried out concurrent with the emissions field work, this program improved model accuracy by allowing the vertical dispersion algorithm contained in each model to be bypassed and replaced with measured, site-specific vertical dispersion curves unique to each emission-rate measurement.

Based on this analysis, a revised H_2S emissions inventory is derived for each source group to support the CEQR air quality analysis. This inventory, presented below, will provide the basis for development of a compliant operating scenario to ensure that maximum offsite facility impacts do not exceed applicable H_2S standards.

Source	Emission Rate (g/s)
preliminary settling tanks	0.0679
aeration tanks	0.0003
final settling tanks	0.0002
high-level pump station	0.0002
low-level pump station	0.0002
sludge thickeners	0.0002
sludge storage tank 1	0.0007
sludge storage tank 2	0.0003
sludge storage tank 3	0.0003

SECTION 1 - INTRODUCTION AND OBJECTIVE

The New York City Department of Environmental Protection (DEP), Bureau of Engineering Design & Construction (BEDC), through its engineering consultant, Hazen and Sawyer, P.C., is currently upgrading the wastewater and residuals handling system at the 26th Ward Water Pollution Control Plant (WPCP) in the Borough of Brooklyn, New York (DEP Contract 26W-20). This report presents the hydrogen sulfide (H_2S) emissions inventory necessary to support a comprehensive City Environmental Quality Review (CEQR) air quality analysis for this compound.

This report is a revision of the March 2002 report, “Results of a Hydrogen Sulfide Emissions Characterization for the 26th Ward Wastewater Treatment Plant Upgrading” (hereinafter referred to as the March 2002 report). Although the upgrade project that report was intended to support was subsequently cancelled, the DEP determined that the emissions work performed for the original upgrade could be used to satisfactorily support the current upgrade project without additional field measurements. Accordingly, the DEP directed Hazen and Sawyer to modify the March 2002 report (and the corresponding CEQR analysis) to reflect the current upgrade project. Minnich and Scotto, Inc., Hazen and Sawyer’s air quality consultant for the original emissions measurements and CEQR analyses at this facility, was retained to prepare this revised H_2S emissions characterization. The revised CEQR analysis for H_2S will be prepared upon DEP review and acceptance of this report in accordance with the protocol dated January 2008.

A total of 174 individual H_2S emission-rate estimates spanning a range of facility conditions and operating practices for six source groups are derived from the field measurements. From this information, technically defensible emissions inventories are developed for each source group (build scenario). Sufficient measurement and facility operating data were collected to ensure that “credit” could be taken for each upgrade component shown to materially reduce H_2S emissions.

The area-source technique was employed for the process tanks. Further explained in Section 4, the area-source technique is a type of mass-balance procedure which involves an assessment of source attribution and the use of an appropriate dispersion model, together with onsite meteorological data, to estimate a unique emission rate for each 15-minute monitoring event. The principal component of this revised emissions characterization involves replacement of the ISCST3 dispersion model used in the original analysis with USEPA’s new guideline model, AERMOD – a much more sophisticated model with improved accuracy in near-source, downwind locations for area-type sources.

Field work was carried out between July 9 and September 6, 2001. Because the ISCST3 Model does not perform well in the very stable sea breeze environment, and because much of the H_2S measurement work at the preliminary settling tanks was expected to be performed when the wind was from the south (i.e., blowing from Jamaica Bay), a controlled tracer-gas measurement program was employed to augment the H_2S measurements for this source. Carried out concurrent with the emissions field work, this program improved model accuracy by allowing the vertical dispersion algorithm contained in each model to be bypassed and replaced with measured, site-specific vertical dispersion curves unique to each emission-rate measurement.

To support DEP review of the March 2002 report, the emissions method underwent critical review by D. Bruce Turner, generally considered to be the world's top authority in the application of Gaussian dispersion theory – the underlying basis of the method. Judged still applicable for this revised analysis, his report is reproduced herein as **Appendix 1.**

Large portions of the March 2002 report remain intact and are directly applicable to the new CEQR analysis. However, in addition to the incorporation of AERMOD, there are several other changes and issues of note:

! Section 2 of the March 2002 report (Background) has been replaced with a new Section 2 in order to reflect the current upgrade project.

! The Hendrix Street Canal, a sporadic yet significant H_2S source during the field measurement program, will soon be dredged and thereafter not pose a concern for adverse offsite impacts. Accordingly, this source is eliminated from the monitoring results (Section 6) and associated emissions characterization (Section 7). All quality control data (Section 9), raw analysis data (Attachments A and B), and calculation worksheets (Attachment C) remain unaltered, however, as measurement data from this source is integral to the overall treatment of quality assurance.

! As discussed in the March 2002 report, an ancillary H_2S measurement program was performed for the preliminary settling tanks in an attempt to quantify the conservatism in the predicted concentrations. This limited effort involved collection of a second set of downwind path-averaged H_2S data, concurrent with selected monitoring events, along a parallel measurement path 10 meters downwind of the original path. Because the objective was not achieved, however, and since the measurement data is used for quality control purposes, this data is treated in a manner similar to that for the Hendrix Street Canal.

- New (electronic) versions of all figures in Sections 6 and 7 have been integrated into this report to facilitate document reproduction.

- Attachment E of the March 2002 report (Treatment of Atmospheric Stability to Support Emissions Assessment: Area Sources) is replaced with a new Attachment E (Supplemental Meteorological and Atmospheric Dispersion Analyses: Area Sources) to reflect the fact that AERMOD simulates atmospheric dispersion directly from atmospheric turbulence (without consideration of atmospheric stability).

- Attachments A, B, D, F, and H (which provide original raw field data, AERMOD input and output files for area-source emission-rate estimates, and calibration certificates) are included herein only as electronic files due to their large size.

All work was performed in accordance with the H_2S Emissions Estimation Procedure (February 2001) which, together with the requisite Sampling and Analysis Plan and Quality Assurance Project Plan, provided detailed data-collection methodologies for the generation of the facility-wide H_2S emissions inventory. As stated in these planning documents, the objective of this investigation was the generation of technically defensible estimates of gaseous H_2S emissions emanating from potentially significant process-unit sources at the 26th Ward WPCP.

Section 2 of this report presents the background and project overview. Section 3 identifies the emissions sources investigated. Section 4 presents the emissions-estimation methods employed for each source. Section 5 describes the measurement equipment employed. Section 6 presents the monitoring results. Section 7 presents the emissions characterization (revised work) generated from the monitoring data collected. Section 8 presents development of the emissions inventory (revised work) for subsequent use in the CEQR compliance assessment. Finally, Section 9 details the quality assurance program and the quality control measures employed before, during, and after data collection (unaltered).

SECTION 2 - BACKGROUND AND PROJECT OVERVIEW

The 26th Ward WPCP is located on a 57.3 acre site at the intersection of Flatlands and Van Siclen Avenues in southeastern Brooklyn, New York (Block 4440, Lot 1, and Block 4452, Lot 150). The plant parcel abuts Flatlands Avenue to the north, Van Siclen Avenue to the west, and the Belt Parkway to the south; the Hendrix Street Canal separates the site from the land to the east. The plant, constructed in the 1940s, was upgraded or expanded in the 1950s, 1960s, and 1970s. Sludge dewatering and cake storage facilities were added in the 1990s.

The 26th Ward WPCP is an activated sludge plant that treats combined sewage. The treatment process for the sewage consists of screening, pumping, primary settling, aeration, final settling, and disinfection. The treatment process for the sludge consists of degritting, thickening, digesting, storage, and dewatering (prior to offsite disposal). The plant treats up to 150 percent of the design dry-weather flow (DDWF) of 85 million gallons per day (mgd) (or 127.5 mgd) through secondary treatment. An additional 42.5 mgd (or 170 mgd total, which represents 200 percent of the DDWF) is treated in the preliminary (primary) settling tanks and undergoes disinfection via chlorination.

The wastewater flows to the plant through two interceptor sewers. One interceptor, from Fresh Creek, is referred to as the low-level interceptor and receives about two-thirds of the total plant flow. The other interceptor, from Hendrix Street, is referred to as the high-level interceptor and receives the remaining flow (one-third). Plant effluent is discharged to the Hendrix Street Canal.

Primary combustion sources include two boiler systems (one in the Main Building and the second in the Sludge Dewatering Facility), a digester gas flaring system, and an emergency generator system.

Per requirements of combined sewage overflow (CSO) Order on Consent #CO2-20000107-8, the City of New York and DEP have agreed to treat an additional 50 mgd of wet-weather flow through the primary treatment and disinfection process at this plant. The increase in treatment capacity will be accomplished via plant additions and modifications under several principal construction contract packages, including this Contract 26W-20 Preliminary Treatment & Solids Handling Facilities. Under future Contract 26W-21 Digesters, Thickeners & Administration, upgrade of sludge processing treatment systems and construction of a new Administration Building are planned. Under future Contract 26W-22, a new Raw Sewage Pump Station & Main Substation is planned. Under Contract 26W-23, a wet-weather outfall and potential CSO chlorine contact tank are planned to complement the plant’s existing outfall and two chlorine contact tanks, and to meet the increased plant capacity of 220 mgd.

Following completion of Contracts 26W-20, 26W-22, and 26W-23, the plant's hydraulic capacity will be 220 mgd. Of this flow, 170 mgd will continue to undergo the current level of treatment: 127.5 mgd through secondary treatment and disinfection, and 42.5 mgd through primary treatment and disinfection only, both prior to discharge to the Hendrix Street Canal through the existing plant outfall. As stated above, the remaining 50 mgd will receive primary treatment and potentially undergo disinfection in a new wet-weather chlorine contact tank before discharge to the Hendrix Street Canal via a new outfall.

Major work scope components of this project (Contract 26W-20) include:

- Construction of new Preliminary Settling Tank (PST) Nos. 5 and 6
- Structural rehabilitation of PST Nos. 1 through 4
- Replacement of the existing primary scum transfer system in PST Nos. 1 through 4
- Construction of a covered Flow Division Structure for distribution of raw sewage (screened) to the existing and new PSTs
- Construction of a Primary Sludge Gallery Extension and the Substation and MCC No. 25 Building (atop the Primary Sludge Gallery Extension)
- Construction of a Residuals Handling Building for primary sludge degritting, sludge screening, and scum concentration
- Installation of PST effluent weir covers
- Installation of an odor control system for the PST effluent weirs and Residuals Handling Building
- Demolition of the Ammonia Building

In addition to these Contract 26W-20 plant improvements, there are several improvements under other contracts which will materially reduce H_2S emissions and are either completed, in progress, or soon to be initiated:*

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* These contemporaneous improvements address facility conditions and operating practices, identified in the March 2002 Report, under which observed H_2S emissions were maximized (Section 8). All of these improvements will be completed prior to completion of Contract 26W-20.

Spring Creek CSO Transfer

Remedy to prevent the generation of septic influent has been implemented by DEP (outside of the 26th Ward upgrades); chloride concentrations in the influent have been reduced via reduction of tidal influences at the Spring Creek CSO facility, and CSO transfer now occurs immediately upon collection (or end of rainfall).

Wet-Well Over-Pumping

Remedy to prevent wet-well over-pumping will be completed (Contracts 26W-11 and 26W-12). Three of the six main sewage pumps and motors are being replaced, together with the pump-control system which serves all six pumps.

Final Settling Tank Sludge Removal

Existing step-speed controlled RAS and constant-speed WAS pumps will be replaced with new, variable-speed pumps (Contract 26W-12) to improve siphon operation and sludge draw-off from the tank bottoms.

Sludge Thickener Sludge and Scum Removal

Sludge-removal equipment on the sludge thickeners has been replaced to improve thickened sludge removal (Contract 26W-12), thereby reducing septic conditions and the formation of scum blankets in the thickener tanks, and reducing H_2S formation.

SECTION 3 - EMISSIONS SOURCES INVESTIGATED

H_2S measurements were made to facilitate emission-rate determinations for the following sources:*

- raw sewage pump stations
- preliminary settling tanks
- aeration tanks
- final settling tanks
- sludge thickeners
- sludge storage tanks

Each of these H_2S emissions sources, as currently configured, is discussed below.

Raw Sewage Pump Stations

Currently, there are two raw sewage pump stations: one services the low-level interceptor and the other the high-level interceptor. Each station has three pumps installed to lift the raw sewage to the preliminary settling tanks. The pump stations discharge to headers which combine prior to discharging to the preliminary settling tanks.

Before reaching the pump stations, the wastewater is screened of large objects. Three mechanically cleaned screens, which can be isolated from the flow line with sluice gates, are provided for each interceptor. Each set of screens is located within a room in the Screening Wing of the Main Building; each screening room is mechanically ventilated. It is not uncommon for plant personnel to leave the loading doors open, thus allowing emissions to vent to the atmosphere.

For purposes of this investigation, the raw sewage screens are considered part of this source, and this source is hereinafter referred to as the high- and low-level pump stations.

Preliminary Settling Tanks

The preliminary settling tanks represent the first (or primary) treatment of the screened raw sewage. Heavy solids settle to the bottom and scum and other floatable materials are skimmed from the top. Four, 4-cell preliminary settling tanks exist at the facility. These tanks occupy a total area approximately 271 by 163 feet (83 by 50 meters).

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* Excluding the Hendrix Street Canal as discussed in Section 1.

Aeration Tanks

Following treatment in the preliminary settling tanks, the primary effluent is discharged to aeration tanks where air is added, along with a portion of the RAS, to promote growth of biological cultures which consume dissolved organic materials in the wastewater. This begins the secondary treatment process.

Three, 4-pass aeration tanks exist at the facility. The two westernmost tanks occupy a total area approximately 405 by 257 feet (123 by 78 meters), and the easternmost tank occupies a total area approximately 386 by 115 feet (118 by 35 meters).

Final Settling Tanks

The final settling tanks are part of the secondary treatment system in which the activated sludge is separated from the aerator effluent. Organic floc produced in the aeration process settles to the bottom, and scum and other lighter solids are skimmed from the top.

Eight, 4-cell final settling tanks exist at the facility. The four westernmost tanks occupy a total area approximately 285 by 231 feet (87 by 70 meters), and the four easternmost tanks occupy a total area approximately 283 by 198 feet (86 by 60 meters).

Sludge Thickeners

The sludge thickeners receive sludge from the degritters and the final settling tanks. Flow from the waste sludge well enters a splitter box located on the top floor of the Thickener Building where it is distributed to four thickeners. The primary sludge is mixed with the excess waste-activated sludge (WAS) and thickened in cylindrical gravity thickeners. The thickener overflow is returned to the head of the preliminary settling tanks, and the thickened sludge is subsequently discharged to the sludge digesters. The sludge thickeners are covered and exhaust air is discharged to the atmosphere.

This source is hereinafter referred to as the Sludge Thickener Building.

Sludge Storage Tanks

Three tanks provide the temporary storage of digested sludge generated from the 26th Ward facility as well as from the Jamaica, Coney Island, Rockaway, and Owls Head plants. Tank emissions are routed to the atmosphere via a negative-pressure air flow. The newest of the three tanks is equipped with an activated-carbon odor-control system.

SECTION 4 - EMISSIONS-ESTIMATION METHODS

Table 4-1 identifies the methods employed for estimating H_2S emissions for each source. Two estimation methods were used to develop a facility-wide emissions data base:

- Area-source technique
- Mass-balance technique

The area-source technique was employed for all uncovered area sources. The mass-balance technique was employed for the buildings in which air exchange is the means of H_2S release to the atmosphere.

Each method is discussed in the following subsections.

TABLE 4-1

METHODS EMPLOYED FOR ESTIMATING H_2S EMISSIONS

Source	Method	
	Area-Source	Mass-Balance
preliminary settling tanks	x	
aeration tanks	x	
final settling tanks	x	
high- and low-level pump stations		x
Sludge Thickener Building		x
sludge storage tanks		x

4.1 Area-Source Technique

This technique is applicable to all area-type sources, i.e., homogeneous (uniformly emitting) and non-homogeneous (having "hot spots"). It involves identification of a source "attribution" based on a series of near-ground (1m height) upwind and downwind measurements and the subsequent back-calculation of emission rates based on Gaussian dispersion relationships inherent in most USEPA Guideline models. In addition to the source-attribution information, onsite coincident measurements of wind speed, wind direction, and other parameters relating to atmospheric dispersion and transport are required.

Source-attribution is represented as a path-integrated concentration, and is obtained by subtracting the upwind path-integrated concentration from the downwind path-integrated concentration. Mathematically, a path-integrated concentration (units of mg/m^2) can be derived by integrating a concentration at a point (mg/m^3) across the width (crosswind direction) of the plume (m). The benefit of working with path-integrated (or cross-plume) concentration data lies in its inherent spatial representativeness.

Ideally, path-integrated measurements are generated via some type of optical remote sensing technique which yields such data directly, such as open-path infrared (IR) or ultraviolet (UV) spectroscopy. However, H_2S is a notoriously poor absorber of both IR and UV radiation and, as a result, associated minimum detection levels were not sufficient to meet the measurement quality objectives required for the program. Therefore, a source-attribution approach based on use of rapid-response point monitors was employed in which multiple measurements were made along the downwind (cross-plume) path. Jerome meters were the instrument of choice, as they can measure H_2S in real time (a response time on the order of about 20 or 30 seconds) to levels as low as 1 ppb.

The area-source technique has been accepted in regulatory applications by USEPA and is consistent with guidance provided in the USEPA's "Air/Superfund National Technical Guidance Study Series - Volume II, Estimation of Baseline Air Emissions at Superfund Sites, EPA-450/1-89-002a." It is included in USEPA's "Handbook on Remote Sensing of Stationary Source Emissions" (currently in progress)* The technique, as modified for use with point monitors, is summarized in the following three-step approach:

1. Identify Source Attribution

This step consists of a series of 15-minute-averaged "monitoring events" in which concurrent (or sequential), near-ground-level H_2S measurements are made upwind and immediately downwind

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* Personal communication between Timothy Minnich, Minnich and Scotto, and Dennis Mikel, USEPA, OAQPS, December 22, 2008.

of the source to identify source attribution. Downwind measurements are made at pre-designated locations spaced equally along the source perimeter. Contemporaneous measurements of relevant meteorological parameters are made during each monitoring event. A minor variation of this step was employed in which the accuracy of each downwind path-averaged concentration was improved through the simultaneous collection of two sets of H_2S data. Jerome meter measurements began at opposite ends of each downwind pathlength, and the results were averaged to reduce the error caused by plume meander (i.e., the inability to collect data across the entire measurement path simultaneously).

2. Predict Relative Path-Integrated Concentration Along Measurement Path

This step consists of using an appropriate dispersion model* to predict the relative path-integrated concentration along the downwind measurement path defined in Step 1. This is accomplished by: (a) predicting the point concentration (mg/m^3) at every meter along the measurement path based on a unity emission rate (e.g., 1 mg/m^3) and actual meteorology and source configuration; (b) determining the arithmetic average of the point concentrations (mg/m^3); and (c) multiplying the average point concentration by the downwind pathlength (m).

Process-tank "hot spots" are represented in the unity modeling by assigning a scalar multiplier to the appropriate subarea of the source. This scalar multiplier is based on results of hot-spot monitoring (also using the Jerome meter) during the source-attribution monitoring program.

3. Scale Unity Modeling Results to Estimate Emission Rate

This step involves estimating the actual emission rate, Q_A, in accordance with the following ratio:

$$\frac{C_M}{Q_A} = \frac{C_P}{Q_U}$$

where:

C_M	=	measured path-integrated H_2S concentration (attribution) (mg/m^2)
Q_A	=	actual H_2S emission rate (mg/m^2-s)
C_P	=	predicted relative path-integrated concentration (mg/m^2)
Q_U	=	unity-based emission rate (mg/m^2-s)

* In the earlier work, the unity-based modeling discussed above was based on the USEPA's ISCST3 Model, Version 3 (00101, LF90 Version 4.52, 4/27/00), using regulatory default options with a flat-terrain approach. In this revised work, the ISCST3 Model was replaced by AERMOD, Version 07026. AERMOD provides a more accurate simulation of non-buoyant, ground-level plume dispersion in an urban setting owing to a more representative treatment of boundary layer conditions within the microscale region. It is therefore better suited for predicting the relative path-integrated concentration along the downwind measurement path immediately adjacent to the process tank or tank group, where source-receptor distances are on the order of tens of meters.

A more sophisticated means of generating a path-integrated representation of the measured H_2S point concentrations is required owing to the larger spacing necessitated by the monitoring instrument response time. The numerical technique used for this data was the parabolic assumption (also known as Simpson's three-point rule) in which the line representing the value of the function is replaced by a second-order equation ($y = ax^2 + bx + c$), with unique values of a, b, and c determined for each subregion. The integral,

$$\int_{\alpha}^{\beta} \mathbf{f(x)\,dx}$$

is evaluated as follows:

(a) Break the interval $\alpha \leq x \leq \beta$ into n equal parts of width Δx each, where n is an even number.

(b) Compute $y_k = f(x_k)$, $k = 0, 1, 2, \ldots, n$; $x_0 = \alpha$, $x_n = \beta$.

(c) Then:

$$\int_{\alpha}^{\beta} \mathbf{f(x)\,dx} = a\,\Delta \mathbf{x}\,(\mathbf{y_0 + 4y_1 + 2y_2 + \ldots + 2y_{n-2} + 4y_{n-1} + y_n})$$

where Δx is calculated by dividing the downwind pathlength (m) by the total number of downwind measurements minus one, and y_0 is the H_2S concentration at the first downwind location, y_1 is the H_2S concentration at the next downwind location, etc.

An important component of this approach is collection of the contemporaneous meteorological data (Step 1). For this program, onsite meteorological systems were equipped to monitor a variety of meteorological parameters at heights of 10 meters and 1 meter, all in 15-minute blocks of time coincident with each monitoring event. Together with the requisite atmospheric dispersion data (discussed below), this information was used as input to the appropriate algorithm to support emission-rate back-calculation for all uncovered area sources (Table 4-1).

The meteorological data collected during this program consisted of:

- 1- and 10-meter wind speed
- 10-meter wind direction
- sigma theta (standard deviation of the horizontal wind direction)
- 2-meter temperature

- delta temperature (2-10 meters)
- solar radiation

The 10-meter data was provided by a meteorological system installed at an onsite location representative of the local meteorology as influenced by the facility and its immediate environs. The 1-meter data was provided by a second (portable) meteorological system set up and operated at an onsite location judged representative of the microscale meteorology in the region between each source and the respective measurements.

Treatment of Atmospheric Dispersion

Accurate parameterization of atmospheric dispersion for each 15-minute event is critical to support the H_2S emissions back-calculation process. For a given downwind, path-averaged concentration, the associated emission rate is dependent upon how much H_2S has dispersed in the vertical, above the source, prior to reaching the instrument.

In Gaussian theory, the amount of H_2S lost in the vertical can be estimated through knowledge of the vertical dispersion coefficient – which may be defined as the height one would have to go above a plume centerline before the concentration is reduced by a factor of 1/e, or about 37%. Often referred to as "sigma-z," the vertical dispersion coefficient increases with increasing downwind distance from the source.

Vertical dispersion coefficients are very difficult to measure without the use of optical remote sensing. Prior to the advent of AERMOD, vertical dispersion was typically simulated based on consideration of "atmospheric stability class." The most common representation of atmospheric stability class, Pasquill-Gifford (or P-G), allowed for six individual classes (P-G Stability Class A through F), in which Class A is the least stable (large sigma-z values) and Class F the most stable (small sigma-z values). For each stability class, a unique formula is used to assign a sigma-z value as a function of downwind distance.*

In this revised work, the three-step data-processing approach specified in the AERMOD meteorological pre-processor (AERMET) User's Guide was employed for each monitoring event. Steps 1 and 2 involved the processing of onsite surface observations (i.e., wind speed, wind direction, sigma theta, and temperature), together with concurrent twice-daily, mixing-height data derived from National Weather Service (NWS) surface data (JFK International Airport) and NWS upper-air data (Brookhaven, New York).

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* In the earlier work, two different methods of estimating P-G stability class were employed for each given monitoring event: (a) solar radiation / delta-temperature method; and (b) sigma-theta method (standard deviation of the horizontal wind direction). Detailed descriptions of these methods can be found in Section 6 of USEPA's "Meteorological Monitoring Guidance for Regulatory Modeling Applications," OAQPS, February 2000 (EPA-454/R-99-005).

In Step 3, the resultant meteorological output file was processed together with data needed to estimate the boundary layer conditions (delta temperature and solar radiation). Additionally, the surface characterization data for use in calculating the H_2S emission factor for each monitoring event was developed based upon evaluation of the land use representative of the particular wastewater process-tank group. Each land-use evaluation was limited to the upwind directional sector observed during the corresponding monitoring event. The output from this step was the generation of AERMOD-ready output files.

It should be noted that this revised data-processing approach enables vertical dispersion to be properly treated as a continuous function for all area sources.

Additional Reductions in Conservatism for the Preliminary Settling Tanks

Because the ISCST3 Model does not perform well in the very stable sea breeze environment, and because much of the H_2S measurement work at the preliminary settling tanks was expected to be performed when the wind was from the south (i.e., blowing from Jamaica Bay), the field program for this source was modified consistent with recommendations set forth in the USEPA’s guideline on Air Quality Models; specifically, a unique vertical dispersion coefficient was directly calculated for each 15-minute monitoring event through the employment of a controlled tracer-gas release program, with subsequent measurement via open-path, Fourier-transform infrared (FTIR) spectroscopy. These vertical dispersion coefficients were then used to develop event-specific sigma-z curves which were substituted directly into the dispersion model (ISCST3 in the earlier work and AERMOD in this revised work) used to back-calculate the H_2S emissions (sometimes referred to as “inverse modeling”).

The sigma-z equation – which is the crosswind-integrated form of Turner’s general Gaussian equation for ground-level concentration downwind of a continuously emitting, ground-level point source – was used to define a unique σ_z value for each 15-minute monitoring event:

$$\sigma_z = (2\pi)^{½} Q (\pi C u)^{S1}$$

where:

σ_z	=	vertical dispersion coefficient at the particular downwind distance (m)
Q	=	uniform tracer-gas emission rate (mg/s)
C	=	ground-level crosswind-integrated tracer-gas concentration (mg/m^2)
u	=	mean wind speed (m/s)

4.2 Mass-Balance Technique

H_2S emissions from the raw sewage pump stations, the sludge thickeners, and the sludge storage tanks were assessed based on employment of a mass-balance technique in which the volume of ventilated air (building exchange rate in m^3/s) is multiplied by a conservative H_2S concentration (g/m^3) derived from an appropriate statistical treatment of indoor measurement data.

SECTION 5 - MEASUREMENT EQUIPMENT

Each type of measurement equipment employed in the field investigation is described in the following subsections.

5.1 Jerome H_2S Analyzer

The Jerome Model 631-X Analyzer (Jerome meter) is manufactured by Arizona Instrument Corporation. The instrument employs a gold film sensor which, in the presence of varying H_2S concentrations, undergoes changes in electrical resistivity. It also employs a dilution system which permits operation over four concentration ranges, the lowest of which allows a sensitivity to 3 ppb. H_2S measurements are reported based on "total" reduced sulfur representing the actual H_2S present, plus low-molecular-weight mercaptans, thereby providing concentrations which may be somewhat conservative.

The Jerome meter can measure H_2S in real time (a response time on the order of about 20 or 30 seconds) to levels as low as 1 ppb. When the sample button on the unit is pressed, an internal pump draws air into the instrument where it is analyzed. The electrical potential across the gold film is continually monitored, and the concentration is shown by means of a digital display where it remains until the next sample is taken.

Depending on the concentrations encountered, between 50 and 500 samples may be collected and analyzed before the sensor reaches saturation. Once saturation occurs, the sensor must undergo a brief regeneration process in which the gold film sensor is heated for 10 minutes to remove accumulated H_2S while clean air (which is drawn through a scrubber) is passed over the sensor to remove the desorbed contaminant. After allowing the sensor to cool for 20 to 30 minutes to eliminate the possibility of thermally induced drift, the analyzer is adjusted to zero and is then ready for continuation of sampling.

The Model 631-X can be used with a data logger for periodic downloading to a computer, but the decision was made to manually record all collected data to eliminate any possibility of loss due to computer malfunction. This also minimized battery usage and the associated need for battery recharge.

5.2 FTIR Spectrometer

The open-path FTIR spectrometer employed was an ITT Corporation (formerly EDO Corporation) RAM 2000 Remote Air Monitor. Open-path FTIR spectroscopy is able to provide real-time, simultaneous analysis of several dozen gaseous contaminants. The technology is identical in principle to classical laboratory FTIR spectroscopy, except the cell from which a sample is measured is essentially extended to the open atmosphere. A beam of light spanning a range of wavelengths in the near-IR portion of the electromagnetic spectrum (approximately 2 to 14 microns) is propagated from the transmitter portion of the instrument. In the most common configuration, a “retroreflector,” comprised of an array of corner-cubed mirrors, is positioned to intercept this radiation and redirect it back upon itself to the receiver portion of the instrument.

An interferometer splits the returning beam into two paths and then recombines them in a way to generate an interference from the phase differences. The phase difference, and thus the interference, is dependent on the wavelengths present in the beam. In one path, the radiation is reflected off a moving mirror, resulting in an intensity variation which is measured as a function of the path difference between the two mirrors. The result is an interferogram.

The interferogram obtained from a monochromatic beam is simply a cosine wave. The broadband interferogram is a sum of cosine waves (the Fourier series) for each spectral component as a function of mirror pathlength separation. A spectrum in the optical frequency units, cm^{-1}, is obtained by performing a Fourier transform upon the interferogram.

Contaminants of concern are identified and quantified via a computer-based spectral search involving sequential, compound-specific analysis and comparison to the system’s internal reference spectra library. The most widely employed technique for analyzing FTIR spectral data is the multicomponent classical least squares (CLS) technique. Any gaseous compound which absorbs in the IR region can potentially be monitored using this technology.

One-way pathlengths can range from less than 10 meters (e.g., stack monitoring) to several hundred meters or more (as may be required for many ambient air applications).

Resultant path-integrated concentrations are typically reported in units of parts-per-million-meters (ppm-m). It is often necessary to convert path-integrated concentrations (ppm-m) to units of milligrams per cubic meter times meter (mg/m^3 x m) or mg/m^2. The generation of a path-integrated concentration yields contaminant information along the entire pathlength and not just at a single point (or collection of points) in space as with traditional point-monitoring methods (e.g., flux chambers). This solves the issue of spatial representativeness, as a non-buoyant ground-level plume cannot pass through the beam path undetected.

5.3 Tracer-Gas Release System

Two systems were employed to release carbon tetrafluoride (CF_4) and sulfur hexafluoride (SF_6) at controlled, uniform rates, coincident with each 15-minute monitoring event for the preliminary settling tanks.

Each tracer-gas release system included a cylinder of 99% pure compound which was delivered through a multistage regulator to a calibrated rotameter. Each rotameter is compound-specific with multipoint CF_4 and SF_6 calibration curves. In each system, the gas exits the multistage regulator and travels through 10 or 20 feet of Teflon tubing to a delivery system consisting of the rotameter, a funnel, and a ring stand.

5.4 Meteorological Systems

Two meteorological systems were employed for this investigation. The first system was a portable tower equipped to monitor wind speed at a height of 1 meter. The second system was a 10-meter tower (temporary installation) equipped to monitor wind speed, wind direction, σ_θ, and solar radiation at a height of 10 meters, and delta temperature between 2 and 10 meters.

Each system was calibrated and maintained in conformance with requirements set forth in the USEPA document, "Meteorological Monitoring Guidance for Regulatory Modeling Applications," OAQPS, EPA-454/R-99-005, February 2000. All meteorological data was collected in user-defined, 15-minute blocks with capabilities for real-time, in-field display (both instantaneous and 15-minute-averaged). Additionally, for any given 15-minute period, capabilities existed for the display of 5-minute-averaged data.

All meteorological equipment was manufactured by Climatronics Corporation. Model F-460 wind speed and wind direction sensors were used on each system. These consist of three-cup anemometers with variable frequency output and variable-voltage wind direction sensors with balanced magnesium vanes. Delta temperature was measured using variable-resistance dual thermistors in stainless steel sheaths and housed in motor-aspirated shields.

SECTION 6 - MONITORING RESULTS

Table 6-1 presents a summary of all emissions-assessment work performed during the field investigation. Not depicted in this table are supporting hot-spot or upwind monitoring events. A total of 174 valid H_2S emissions-assessment events (or event pairs in which two Jerome meters were employed simultaneously downwind of the area sources) were completed on 22 separate days between July 9 and September 6, 2001.*

Table 6-2 presents a chronology of all valid monitoring work, including hot-spot and upwind monitoring events. Of the 201 valid events identified, 138 employed the area-source technique (111 downwind, 15 upwind, and 12 hot-spot) and 63 employed the mass-balance technique.

Figure 6-1 depicts the location of the onsite meteorological towers.

Sections 6.1 through 6.6, respectively, present monitoring event results for the following emissions source groups:

- preliminary settling tanks
- aeration tanks
- final settling tanks
- high- and low-level pump stations
- Sludge Thickener Building
- sludge storage tanks

For each source, figures and tables are presented which depict the Jerome meter sampling locations and summarize results of the valid emissions monitoring events.

For the area sources, averaged-upwind and averaged-downwind concentrations are presented, as well as the meteorology (as determined by the onsite meteorological monitoring systems) which occurred during the respective events. Representative averaged upwind concentrations are conservatively determined on a case-by-case basis and, in Section 7, are then subtracted from the respective averaged downwind concentration to yield an appropriate source-attribution term to be used in the area-source emissions-estimation technique (Section 4.1).

All downwind concentrations are averaged along the measurement path which, for each area source, consists of a total of 17 equispaced points in a line spanning the crosswind dimension of

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* Excluded are emissions-assessment data for the Hendrix Street Canal and data from the limited ancillary measurement program for the preliminary settling tanks as discussed in Section 1.

the source. The averaging technique employed is the parabolic assumption (Simpson's three-point rule) in which the line representing the value of the function is replaced by a second-order equation as discussed in Section 4.1.

Attachment A presents a compilation of the raw H_2S analysis data, segregated by event type, for each of the 174 monitoring events (or event pairs) discussed above.

Attachment B presents the raw meteorological data collected from the two onsite systems for all monitoring events. It should be noted that all wind direction data presented in this report is relative to the plant coordinate system and that true north is 30º in the clockwise direction of plant north.

Attachment C presents, on a source-by-source basis, worksheets for all downwind, area-source measurement calculations. Presented are the individual H_2S concentrations for the 17 measurement points comprising each downwind event, as well as the averaged concentrations which are used in subsequent emission-rate back-calculations. Coincident monitoring, involving use of two Jerome meters as discussed above, was performed for all downwind measurements.

TABLE 6-1

SUMMARY OF EMISSIONS MEASUREMENTS

Date	Number of Valid Events or Event Pairs									
	Preliminary Settling Tanks	Aeration Tanks	Final Settling Tanks	High-Level Pump Stations	Low-Level Pump Stations	Sludge Thickeners	Sludge Storage Tanks			Total
							1	2	3	
07/09/01	8									**8**
07/12/01			5							**5**
07/16/01	9					1				**10**
07/17/01	6					2				**8**
07/19/01						1				**1**
07/23/01	16									**16**
07/24/01	7									**7**
07/30/01						1				**1**
08/01/01	8									**8**
08/02/01	7					1				**8**
08/06/01	16									**16**
08/09/01	7									**7**
08/14/01			7			1				**8**
08/15/01		4		1	1	1				**7**
08/16/01				2	2	2			1	**7**
08/21/01		5		1	1	1				**8**
08/22/01				3	3	1				**7**
08/27/01				2	2	2	1	1		**8**
08/30/01				3	3	2	2	2		**12**
09/04/01				1	1	1				**3**
09/05/01				2	2	2	1	1		**8**
09/06/01			6	2	2	1				**11**
Total	**84**	**9**	**18**	**17**	**17**	**20**	**4**	**4**	**1**	**174**

TABLE 6-2

IDENTIFICATION OF VALID MONITORING EVENTS

No.	Type	Source	Date	Time (EDT)
H - 1	hot-spot	preliminary settling tanks	07/09/01	11:29 - 11:55
E - 1, 2	emissions (downwind)	preliminary settling tanks	07/09/01	15:45 - 16:00
E - 3, 4	emissions (downwind)	preliminary settling tanks	07/09/01	16:00 - 16:15
E - 5, 6	emissions (downwind)	preliminary settling tanks	07/09/01	16:15 - 16:30
E - 7, 8	emissions (downwind)	preliminary settling tanks	07/09/01	16:30 - 16:45
E - 9, 10	emissions (downwind)	preliminary settling tanks	07/09/01	18:45 - 19:00
E - 11, 12	emissions (downwind)	preliminary settling tanks	07/09/01	19:00 - 19:15
E - 13, 14	emissions (downwind)	preliminary settling tanks	07/09/01	19:15 - 19:30
E - 15, 16	emissions (downwind)	preliminary settling tanks	07/09/01	19:30 - 19:45
E - 17	emissions (upwind)	preliminary settling tanks	07/09/01	19:52 - 19:57
H - 2	hot-spot	preliminary settling tanks	07/10/01	12:04 - 12:26
H - 3	hot-spot	final settling tanks	07/12/01	10:10 - 10:46
E - 18, 19	emissions (downwind)	final settling tanks	07/12/01	11:30 - 11:45
E - 20, 21	emissions (downwind)	final settling tanks	07/12/01	11:45 - 12:00
E - 22, 23	emissions (downwind)	final settling tanks	07/12/01	12:00 - 12:15
E - 24, 25	emissions (downwind)	final settling tanks	07/12/01	12:15 - 12:30
E - 26, 27	emissions (downwind)	final settling tanks	07/12/01	12:30 - 12:45
E - 28	emissions (upwind)	final settling tanks	07/12/01	12:50 - 12:52
H - 4	hot-spot	preliminary settling tanks	07/12/01	13:49 - 14:11
H - 5	hot-spot	preliminary settling tanks	07/13/01	10:00 - 10:25
E - 29, 30	emissions (downwind)	preliminary settling tanks	07/16/01	13:15 - 13:30
E - 31, 32	emissions (downwind)	preliminary settling tanks	07/16/01	13:30 - 13:45
E - 33, 34	emissions (downwind)	preliminary settling tanks	07/16/01	13:45 - 14:00
E - 35, 36	emissions (downwind)	preliminary settling tanks	07/16/01	16:15 - 16:30
E - 37, 38	emissions (downwind)	preliminary settling tanks	07/16/01	16:30 - 16:45
E - 39, 40	emissions (downwind)	preliminary settling tanks	07/16/01	16:45 - 17:00
E - 41, 42	emissions (downwind)	preliminary settling tanks	07/16/01	17:00 - 17:15

TABLE 6-2 (Cont'd)

IDENTIFICATION OF VALID MONITORING EVENTS

No.	Type	Source	Date	Time (EDT)
E - 43	emissions (upwind)	preliminary settling tanks	07/16/01	17:22 - 17:27
E - 44, 45	emissions (downwind)	preliminary settling tanks	07/16/01	19:15 - 19:30
E - 46, 47	emissions (downwind)	preliminary settling tanks	07/16/01	19:30 - 19:45
E - 48	emissions (mass-balance)	sludge thickeners	07/16/01	19:52 - 19:55
E - 49	emissions (mass-balance)	sludge thickeners	07/17/01	11:55 - 11:58
H - 6	hot-spot	preliminary settling tanks	07/17/01	12:18 - 12:44
E - 50	emissions (mass-balance)	sludge thickeners	07/17/01	14:30 - 14:33
E - 51, 52	emissions (downwind)	preliminary settling tanks	07/17/01	15:00 - 15:15
E - 53, 54	emissions (downwind)	preliminary settling tanks	07/17/01	15:15 - 15:30
E - 55, 56	emissions (downwind)	preliminary settling tanks	07/17/01	15:30 - 15:45
E - 57, 58	emissions (downwind)	preliminary settling tanks	07/17/01	15:45 - 16:00
E - 59, 60	emissions (downwind)	preliminary settling tanks	07/17/01	17:15 - 17:30
E - 61, 62	emissions (downwind)	preliminary settling tanks	07/17/01	17:30 - 17:45
E - 74	emissions (mass-balance)	sludge thickeners	07/19/01	14:34 - 14:37
E - 75, 76	emissions (downwind)	preliminary settling tanks	07/23/01	12:15 - 12:30
E - 77, 78	emissions (downwind)	preliminary settling tanks	07/23/01	12:30 - 12:45
E - 79, 80	emissions (downwind)	preliminary settling tanks	07/23/01	12:45 - 13:00
E - 81, 82	emissions (downwind)	preliminary settling tanks	07/23/01	13:00 - 13:15
E - 83, 84	emissions (downwind)	preliminary settling tanks	07/23/01	13:15 - 13:30
E - 85, 86	emissions (downwind)	preliminary settling tanks	07/23/01	13:30 - 13:45
E - 87, 88	emissions (downwind)	preliminary settling tanks	07/23/01	13:45 - 14:00
E - 89, 90	emissions (downwind)	preliminary settling tanks	07/23/01	14:00 - 14:15
E - 91, 92	emissions (downwind)	preliminary settling tanks	07/23/01	14:15 - 14:30
E - 93, 94	emissions (downwind)	preliminary settling tanks	07/23/01	14:30 - 14:45
E - 95	emissions (upwind)	preliminary settling tanks	07/23/01	14:50 - 14:55
E - 96, 97	emissions (downwind)	preliminary settling tanks	07/23/01	17:00 - 17:15
E - 98, 99	emissions (downwind)	preliminary settling tanks	07/23/01	17:15 - 17:30

TABLE 6-2 (Cont'd)

IDENTIFICATION OF VALID MONITORING EVENTS

No.	Type	Source	Date	Time (EDT)
E - 100, 101	emissions (downwind)	preliminary settling tanks	07/23/01	17:30 - 17:45
E - 102, 103	emissions (downwind)	preliminary settling tanks	07/23/01	17:45 - 18:00
E - 104, 105	emissions (downwind)	preliminary settling tanks	07/23/01	18:00 - 18:15
E - 106, 107	emissions (downwind)	preliminary settling tanks	07/23/01	18:15 - 18:30
E - 108, 109	emissions (downwind)	preliminary settling tanks	07/24/01	12:30 - 12:45
E - 110, 111	emissions (downwind)	preliminary settling tanks	07/24/01	12:45 - 13:00
E - 112, 113	emissions (downwind)	preliminary settling tanks	07/24/01	13:00 - 13:15
E - 114, 115	emissions (downwind)	preliminary settling tanks	07/24/01	13:15 - 13:30
E - 116, 117	emissions (downwind)	preliminary settling tanks	07/24/01	15:30 - 15:45
E - 118, 119	emissions (downwind)	preliminary settling tanks	07/24/01	15:45 - 16:00
E - 120, 121	emissions (downwind)	preliminary settling tanks	07/24/01	16:00 - 16:15
E - 122	emissions (upwind)	preliminary settling tanks	07/24/01	16:17 - 16:21
H - 7	hot-spot	aeration tanks	07/30/01	13:15 - 13:46
H - 8	hot-spot	final settling tanks	07/30/01	13:50 - 14:22
E - 134	emissions (mass-balance)	sludge thickeners	07/30/01	17:25 - 17:28
E - 135, 136	emissions (downwind)	preliminary settling tanks	08/01/01	13:45 - 14:00
E - 137, 138	emissions (downwind)	preliminary settling tanks	08/01/01	14:00 - 14:15
E - 139, 140	emissions (downwind)	preliminary settling tanks	08/01/01	14:15 - 14:30
E - 141, 142	emissions (downwind)	preliminary settling tanks	08/01/01	14:30 - 14:45
E - 143	emissions (upwind)	preliminary settling tanks	08/01/01	14:47 - 14:50
E - 144, 145	emissions (downwind)	preliminary settling tanks	08/01/01	16:45 - 17:00
E - 146, 147	emissions (downwind)	preliminary settling tanks	08/01/01	17:00 - 17:15
E - 148, 149	emissions (downwind)	preliminary settling tanks	08/01/01	17:15 - 17:30
E - 150, 151	emissions (downwind)	preliminary settling tanks	08/01/01	17:30 - 17:45
E - 152, 153	emissions (downwind)	preliminary settling tanks	08/02/01	15:30 - 15:45
E - 154, 155	emissions (downwind)	preliminary settling tanks	08/02/01	15:45 - 16:00
E - 156, 157	emissions (downwind)	preliminary settling tanks	08/02/01	16:00 - 16:15

TABLE 6-2 (Cont'd)

IDENTIFICATION OF VALID MONITORING EVENTS

No.	Type	Source	Date	Time (EDT)
E - 158, 159	emissions (downwind)	preliminary settling tanks	08/02/01	16:15 - 16:30
E - 160, 161	emissions (downwind)	preliminary settling tanks	08/02/01	16:30 - 16:45
E - 162, 163	emissions (downwind)	preliminary settling tanks	08/02/01	16:45 - 17:00
E - 164, 165	emissions (downwind)	preliminary settling tanks	08/02/01	17:00 - 17:15
E - 166	emissions (upwind)	preliminary settling tanks	08/02/01	17:17 - 17:20
E - 167	emissions (mass-balance)	sludge thickeners	08/02/01	17:25 - 17:28
E - 168	emissions (upwind)	preliminary settling tanks	08/06/01	11:26 - 11:29
E - 169, 170	emissions (downwind)	preliminary settling tanks	08/06/01	11:45 - 12:00
E - 171, 172	emissions (downwind)	preliminary settling tanks	08/06/01	12:00 - 12:15
E - 173, 174	emissions (downwind)	preliminary settling tanks	08/06/01	12:15 - 12:30
E - 175, 176	emissions (downwind)	preliminary settling tanks	08/06/01	12:30 - 12:45
E - 177, 178	emissions (downwind)	preliminary settling tanks	08/06/01	12:45 - 13:00
E - 179, 180	emissions (downwind)	preliminary settling tanks	08/06/01	13:00 - 13:15
E - 181, 182	emissions (downwind)	preliminary settling tanks	08/06/01	13:15 - 13:30
E - 183, 184	emissions (downwind)	preliminary settling tanks	08/06/01	13:30 - 13:45
E - 185	emissions (upwind)	preliminary settling tanks	08/06/01	15:23 - 15:27
E - 186, 187	emissions (downwind)	preliminary settling tanks	08/06/01	15:30 - 15:45
E - 188, 189	emissions (downwind)	preliminary settling tanks	08/06/01	15:45 - 16:00
E - 190, 191	emissions (downwind)	preliminary settling tanks	08/06/01	16:00 - 16:15
E - 192, 193	emissions (downwind)	preliminary settling tanks	08/06/01	16:15 - 16:30
E - 194, 195	emissions (downwind)	preliminary settling tanks	08/06/01	16:30 - 16:45
E - 196, 197	emissions (downwind)	preliminary settling tanks	08/06/01	16:45 - 17:00
E - 198, 199	emissions (downwind)	preliminary settling tanks	08/06/01	17:00 - 17:15
E - 200, 201	emissions (downwind)	preliminary settling tanks	08/06/01	17:15 - 17:30
E - 202	emissions (upwind)	preliminary settling tanks	08/09/01	13:25 - 13:28
E - 203, 204	emissions (downwind)	preliminary settling tanks	08/09/01	13:30 - 13:45
E - 205, 206	emissions (downwind)	preliminary settling tanks	08/09/01	13:45 - 14:00

TABLE 6-2 (Cont'd)

IDENTIFICATION OF VALID MONITORING EVENTS

No.	Type	Source	Date	Time (EDT)
E - 207, 208	emissions (downwind)	preliminary settling tanks	08/09/01	14:00 - 14:15
E - 209, 210	emissions (downwind)	preliminary settling tanks	08/09/01	14:15 - 14:30
E - 211, 212	emissions (downwind)	preliminary settling tanks	08/09/01	14:30 - 14:45
E - 213, 214	emissions (downwind)	preliminary settling tanks	08/09/01	14:45 - 15:00
E - 215, 216	emissions (downwind)	preliminary settling tanks	08/09/01	15:00 - 15:15
H - 9	hot-spot	preliminary settling tanks	08/14/01	11:00 - 11:30
E - 218	emissions (upwind)	final settling tanks	08/14/01	12:34 - 12:37
E - 219, 220	emissions (downwind)	final settling tanks	08/14/01	12:45 - 13:00
E - 221, 222	emissions (downwind)	final settling tanks	08/14/01	13:00 - 13:15
E - 223, 224	emissions (downwind)	final settling tanks	08/14/01	13:15 - 13:30
E - 225, 226	emissions (downwind)	final settling tanks	08/14/01	13:30 - 13:45
E - 227, 228	emissions (downwind)	final settling tanks	08/14/01	13:45 - 14:00
E - 229, 230	emissions (downwind)	final settling tanks	08/14/01	14:00 - 14:15
E - 231, 232	emissions (downwind)	final settling tanks	08/14/01	14:15 - 14:30
E - 233	emissions (upwind)	final settling tanks	08/14/01	14:33 - 14:36
E - 234	emissions (mass-balance)	sludge thickeners	08/14/01	14:45 - 14:49
H - 10	hot-spot	final settling tanks	08/14/01	14:48 - 15:16
E - 235, 236	emissions (downwind)	aeration tanks	08/15/01	10:45 - 11:00
E - 237, 238	emissions (downwind)	aeration tanks	08/15/01	11:00 - 11:15
E - 239, 240	emissions (downwind)	aeration tanks	08/15/01	11:15 - 11:30
E - 241, 242	emissions (downwind)	aeration tanks	08/15/01	11:30 - 11:45
E - 243	emissions (upwind)	aeration tanks	08/15/01	11:50 - 11:54
E - 244	emissions (mass-balance)	sludge thickeners	08/15/01	12:01 - 12:06
H - 11	hot-spot	aeration tanks	08/15/01	12:29 - 13:14
E - 245	emissions (mass-balance)	high-level pump station	08/15/01	13:47 - 13:51
E - 246	emissions (mass-balance)	low-level pump station	08/15/01	13:52 - 13:55
E - 247	emissions (mass-balance)	high-level pump station	08/16/01	10:11 - 10:15

TABLE 6-2 (Cont'd)

IDENTIFICATION OF VALID MONITORING EVENTS

No.	Type	Source	Date	Time (EDT)
E - 248	emissions (mass-balance)	low-level pump station	08/16/01	10:32 - 10:36
E - 249	emissions (mass-balance)	sludge storage tank (No. 5803)	08/16/01	11:02 - 11:07
E - 250	emissions (mass-balance)	sludge thickeners	08/16/01	11:12 - 11:15
E - 258	emissions (mass-balance)	high-level pump station	08/16/01	13:13 - 13:17
E - 259	emissions (mass-balance)	low-level pump station	08/16/01	13:18 - 13:22
E - 260	emissions (mass-balance)	sludge thickeners	08/16/01	13:36 - 13:40
E - 261	emissions (mass-balance)	high-level pump station	08/21/01	11:23 - 11:26
E - 262	emissions (mass-balance)	low-level pump station	08/21/01	11:27 - 11:30
E - 263	emissions (mass-balance)	sludge thickeners	08/21/01	11:48 - 11:52
E - 264, 265	emissions (downwind)	aeration tanks	08/21/01	13:00 - 13:15
E - 266, 267	emissions (downwind)	aeration tanks	08/21/01	13:30 - 13:45
E - 268, 269	emissions (downwind)	aeration tanks	08/21/01	13:45 - 14:00
E - 270, 271	emissions (downwind)	aeration tanks	08/21/01	14:00 - 14:15
E - 272, 273	emissions (downwind)	aeration tanks	08/21/01	14:15 - 14:30
E - 274	emissions (upwind)	aeration tanks	08/21/01	14:37 - 14:41
E - 275	emissions (mass-balance)	high-level pump station	08/22/01	10:02 - 10:07
E - 276	emissions (mass-balance)	low-level pump station	08/22/01	10:08 - 10:12
E - 277	emissions (mass-balance)	sludge thickeners	08/22/01	10:22 - 10:25
E - 278	emissions (mass-balance)	high-level pump station	08/22/01	11:07 - 11:11
E - 279	emissions (mass-balance)	low-level pump station	08/22/01	11:12 - 11:15
E - 280	emissions (mass-balance)	high-level pump station	08/22/01	12:19 - 12:23
E - 281	emissions (mass-balance)	low-level pump station	08/22/01	12:24 - 12:28
E - 282	emissions (mass-balance)	high-level pump station	08/27/01	13:06 - 13:11
E - 283	emissions (mass-balance)	low-level pump station	08/27/01	13:11 - 13:15
E - 284	emissions (mass-balance)	sludge thickeners	08/27/01	13:25 - 13:30
E - 285	emissions (mass-balance)	sludge storage tank (No. 5802)	08/27/01	13:45 - 13:52
E - 286	emissions (mass-balance)	sludge storage tank (No. 5801)	08/27/01	13:53 - 14:00

TABLE 6-2 (Cont'd)

IDENTIFICATION OF VALID MONITORING EVENTS

No.	Type	Source	Date	Time (EDT)
E - 287	emissions (mass-balance)	high-level pump station	08/27/01	15:30 - 15:35
E - 288	emissions (mass-balance)	low-level pump station	08/27/01	15:35 - 15:42
E - 289	emissions (mass-balance)	sludge thickeners	08/27/01	15:45 - 15:50
E - 290	emissions (mass-balance)	high-level pump station	08/30/01	11:30 - 11:34
E - 291	emissions (mass-balance)	low-level pump station	08/30/01	11:35 - 11:38
E - 292	emissions (mass-balance)	sludge thickeners	08/30/01	11:41 - 11:45
E - 293	emissions (mass-balance)	sludge storage tank (No. 5802)	08/30/01	12:00 - 12:07
E - 294	emissions (mass-balance)	sludge storage tank (No. 5801)	08/30/01	12:08 - 12:15
E - 295	emissions (mass-balance)	high-level pump station	08/30/01	13:03 - 13:08
E - 296	emissions (mass-balance)	low-level pump station	08/30/01	13:09 - 13:13
E - 297	emissions (mass-balance)	sludge thickeners	08/30/01	13:20 - 13:25
E - 298	emissions (mass-balance)	sludge storage tank (No. 5802)	08/30/01	13:30 - 13:36
E - 299	emissions (mass-balance)	sludge storage tank (No. 5801)	08/30/01	13:37 - 13:45
E - 300	emissions (mass-balance)	high-level pump station	08/30/01	14:15 - 14:19
E - 301	emissions (mass-balance)	low-level pump station	08/30/01	14:20 - 14:25
E - 302	emissions (mass-balance)	high-level pump station	09/04/01	12:15 - 12:18
E - 303	emissions (mass-balance)	low-level pump station	09/04/01	12:19 - 12:23
E - 304	emissions (mass-balance)	sludge thickeners	09/04/01	12:27 - 12:30
E - 305	emissions (mass-balance)	high-level pump station	09/05/01	10:15 - 10:18
E - 306	emissions (mass-balance)	low-level pump station	09/05/01	10:18 - 10:22
E - 307	emissions (mass-balance)	sludge thickeners	09/05/01	10:26 - 10:30
E - 308	emissions (mass-balance)	sludge storage tank (No. 5802)	09/05/01	10:32 - 10:44
E - 309	emissions (mass-balance)	sludge storage tank (No. 5801)	09/05/01	10:45 - 10:55
E - 310	emissions (mass-balance)	high-level pump station	09/05/01	11:16 - 11:21
E - 311	emissions (mass-balance)	low-level pump station	09/05/01	11:21 - 11:25
E - 312	emissions (mass-balance)	sludge thickeners	09/05/01	11:40 - 11:45
E - 313	emissions (mass-balance)	high-level pump station	09/06/01	07:00 - 07:03

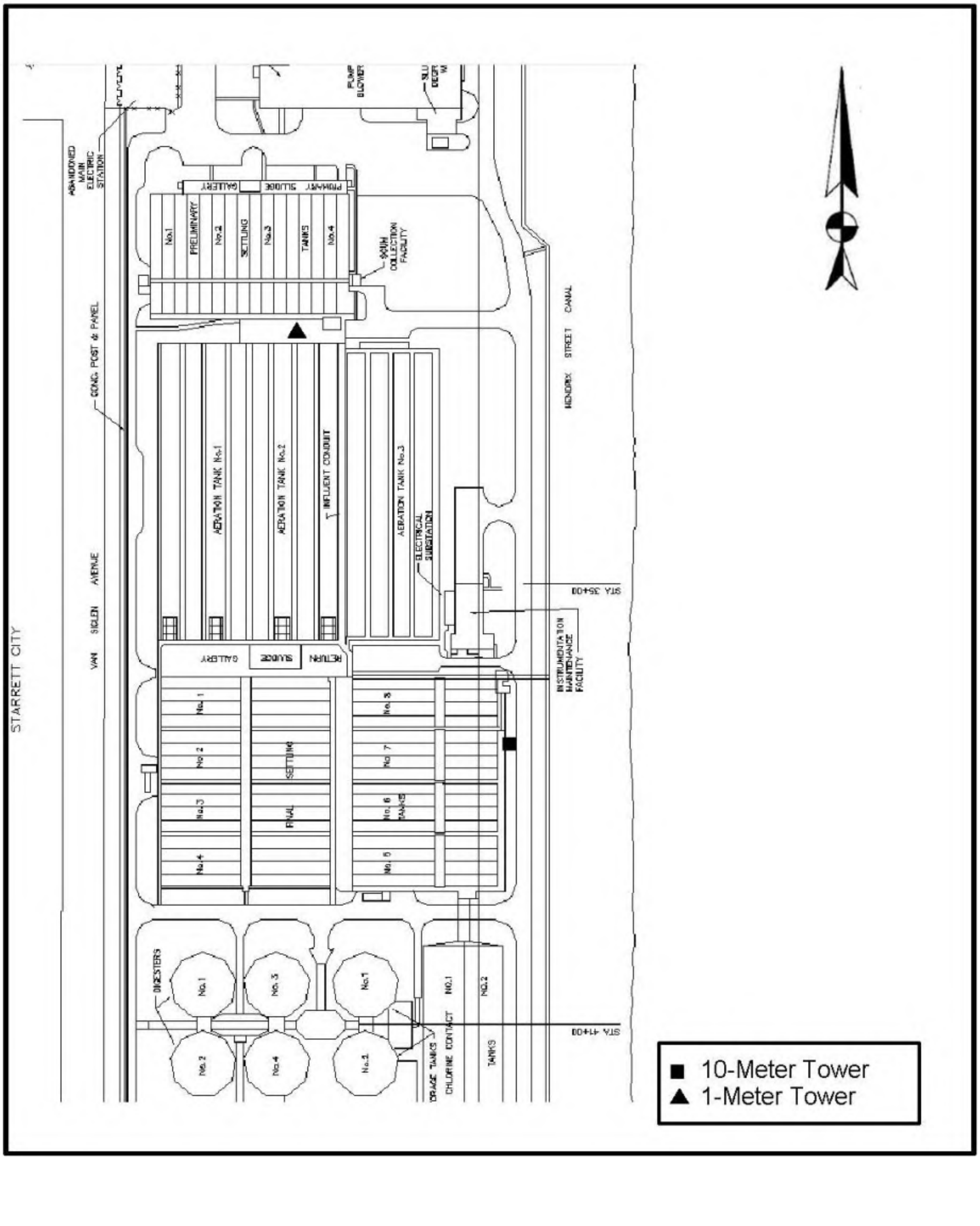
TABLE 6-2 (Cont'd)

IDENTIFICATION OF VALID MONITORING EVENTS

No.	Type	Source	Date	Time (EDT)
E - 314	emissions (mass-balance)	low-level pump station	09/06/01	07:03 - 07:07
E - 315, 316	emissions (downwind)	final settling tanks	09/06/01	07:45 - 08:00
E - 317, 318	emissions (downwind)	final settling tanks	09/06/01	08:00 - 08:15
E - 319, 320	emissions (downwind)	final settling tanks	09/06/01	08:15 - 08:30
E - 321, 322	emissions (downwind)	final settling tanks	09/06/01	08:30 - 08:45
E - 323, 324	emissions (downwind)	final settling tanks	09/06/01	08:45 - 09:00
E - 325, 326	emissions (downwind)	final settling tanks	09/06/01	09:00 - 09:15
E - 327	emissions (upwind)	final settling tanks	09/06/01	09:19 - 09:22
E - 328	emissions (mass-balance)	high-level pump station	09/06/01	09:30 - 09:34
E - 329	emissions (mass-balance)	low-level pump station	09/06/01	09:35 - 09:40
E - 330	emissions (mass-balance)	sludge thickeners	09/06/01	09:45 - 09:50
H - 12	hot-spot	final settling tanks	09/06/01	09:31 - 10:00

FIGURE 6-1

LOCATION OF ONSITE METEOROLOGICAL TOWERS



6.1 Preliminary Settling Tanks

The following monitoring data for the preliminary settling tanks are presented in this section:

- downwind data
- upwind data
- hot-spot data
- sigma-z data

6.1.1 Downwind Data

Figure 6-2 depicts the downwind monitoring event locations for the preliminary settling tanks. A total of 17 equispaced, H_2S sampling locations (5.19m spacing) are identified in a straight line (pathlength of 83.0m) oriented parallel to the source's northern side in order to accommodate winds from a southerly quadrant. The emissions-assessment path is 1 meter downwind of the source edge.

Table 6-3 presents a summary of all downwind monitoring events for the preliminary settling tanks. A total of 84 emissions-assessment event-pairs over 9 monitoring days are identified. Average downwind concentrations, determined via Simpson's three-point rule, are presented in units of both ppb-m and ug/m^2. Each downwind monitoring event was precisely 15 minutes in duration, during which time coincident measurements were made of downwind H_2S (1 meter height) and requisite meteorology. As discussed in Section 4.1, requisite meteorology for subsequent emissions back-calculation are: wind direction and solar radiation at a height of 10 meters; temperature at 2 meters; change in temperature (delta or ΔT) between 2 and 10 meters, where a negative value indicates a temperature decrease with height; and wind speed at heights of 1 and 10 meters.*

All raw downwind data for this source can be found beginning on pages A-4, A-14, A-24, and A-34 of Attachment A. Downwind event calculations for this source can be found beginning on page C-4 of Attachment C.

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* Sigma theta (standard deviation of the wind direction), although also measured, was not employed in these calculations. Section 3.3 of the March 19, 2009 AERMOD Implementation Guide recommends that site-specific turbulence measurements should not be used when applying the urban option.

FIGURE 6-2

DOWNWIND MONITORING EVENT LOCATIONS: PRELIMINARY SETTLING TANKS

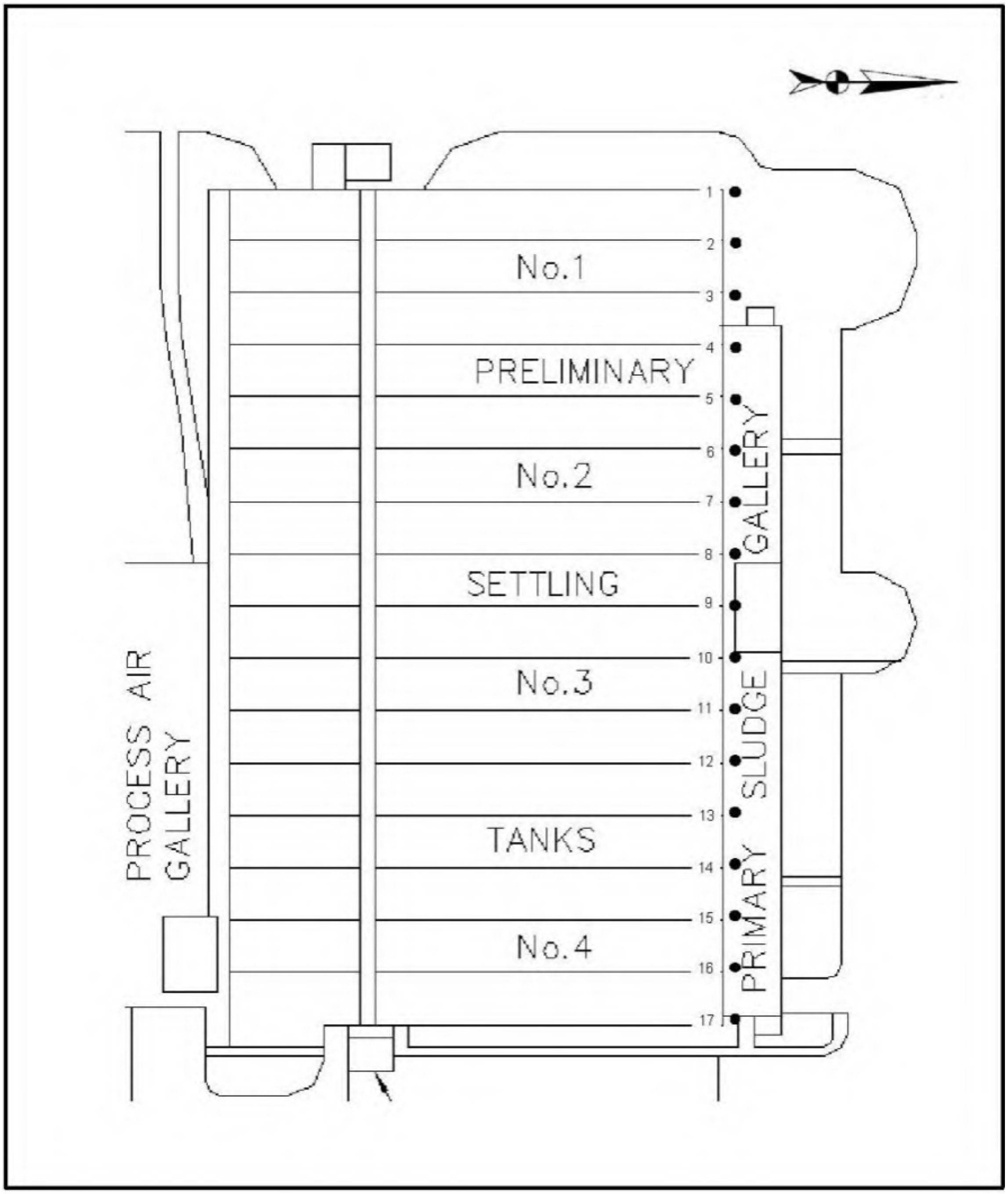

TABLE 6-3

SUMMARY OF DOWNWIND MONITORING EVENTS: PRELIMINARY SETTLING TANKS

Event			Average H_2S Conc.		Requisite Meteorology					
No.	Date	Averaging Time (EDT)	ppb-m	ug/m^2	WD @ 10m (º)	WS @ 1m (mph)	WS @ 10m (mph)	Solar Rad. (W/m^2)	2m Temp. (ºF)	2-10m ΔT (ºF)
E - 1, 2	07/09/01	15:45 - 16:00	5536.0	7717.2	192	6.5	8.8	648	79.2	– 1.8
E - 3, 4	07/09/01	16:00 - 16:15	3785.2	5276.6	194	5.6	7.6	629	79.4	– 1.7
E - 5, 6	07/09/01	16:15 - 16:30	4226.4	5891.6	188	6.3	8.4	608	79.4	– 1.6
E - 7, 8	07/09/01	16:30 - 16:45	4065.5	5667.3	194	5.5	8.3	578	79.4	– 1.5
E - 9, 10	07/09/01	18:45 - 19:00	5617.3	7830.5	184	4.4	7.4	115	76.0	– 0.7
E - 11, 12	07/09/01	19:00 - 19:15	6186.5	8624.0	185	3.2	6.6	61	75.3	– 0.5
E - 13, 14	07/09/01	19:15 - 19:30	3945.3	5499.7	194	3.1	5.1	141	76.1	– 0.4
E - 15, 16	07/09/01	19:30 - 19:45	4407.2	6143.6	204	3.7	5.2	109	76.0	– 0.4
E - 29, 30	07/16/01	13:15 - 13:30	8353.3	11644.5	180	5.8	9.7	675	78.7	– 1.7
E - 31, 32	07/16/01	13:30 - 13:45	6923.5	9651.4	167	5.8	9.6	645	78.5	– 2.0
E - 33, 34	07/16/01	13:45 - 14:00	7098.2	9894.9	171	6.6	9.8	492	78.1	– 1.8
E - 35, 36	07/16/01	16:15 - 16:30	9733.0	13567.8	182	4.7	6.4	611	78.3	– 1.8
E - 37, 38	07/16/01	16:30 - 16:45	10162.0	14165.8	192	5.8	5.9	499	78.3	– 1.6
E - 39, 40	07/16/01	16:45 - 17:00	10360.1	14442.0	181	3.8	5.7	516	78.6	– 1.7
E - 41, 42	07/16/01	17:00 - 17:15	9235.6	12874.4	173	4.1	6.1	513	78.6	– 1.6
E - 44, 45	07/16/01	19:15 - 19:30	7632.8	10640.1	204	4.1	6.1	49	76.0	– 0.3
E - 46, 47	07/16/01	19:30 - 19:45	7480.5	10427.8	228	2.7	5.1	30	76.4	– 0.3
E - 51, 52	07/17/01	15:00 - 15:15	11122.2	15504.3	171	4.6	9.0	368	80.3	– 1.6
E - 53, 54	07/17/01	15:15 - 15:30	9967.4	13894.6	177	4.3	9.4	327	79.5	– 1.3
E - 55, 56	07/17/01	15:30 - 15:45	9956.2	13878.9	176	4.8	7.3	473	79.4	– 1.4
E - 57, 58	07/17/01	15:45 - 16:00	9314.3	12984.1	177	4.7	6.6	537	80.2	– 1.7
E - 59, 60	07/17/01	17:15 - 17:30	8991.7	12534.4	154	4.1	6.7	130	79.7	– 1.0
E - 61, 62	07/17/01	17:30 - 17:45	11990.6	16714.9	171	3.7	6.9	49	78.8	– 0.7
E - 75, 76	07/23/01	12:15 - 12:30	27130.7	37820.2	186	6.5	9.1	772	82.4	– 2.4
E - 77, 78	07/23/01	12:30 - 12:45	23597.2	32894.5	184	5.8	8.5	781	81.5	– 2.5
E - 79, 80	07/23/01	12:45 - 13:00	22447.6	31292.0	179	5.6	8.2	784	81.5	– 2.6

TABLE 6-3 (Cont'd)

SUMMARY OF DOWNWIND MONITORING EVENTS: PRELIMINARY SETTLING TANKS

Event			Average Conc.		Requisite Meteorology					
No.	Date	Averaging Time (EDT)	ppb-m	ug/m²	WD @ 10m (°)	WS @ 1m (mph)	WS @ 10m (mph)	Solar Rad. (W/m²)	2m Temp. (°F)	2-10m ΔT (°F)
E - 81, 82	07/23/01	13:00 - 13:15	19091.4	26613.4	181	6.5	10.1	786	80.6	– 2.5
E - 83, 84	07/23/01	13:15 - 13:30	18588.9	25912.9	194	6.6	10.1	782	79.3	– 2.1
E - 85, 86	07/23/01	13:30 - 13:45	16317.4	22746.5	184	5.5	9.9	774	79.4	– 2.3
E - 87, 88	07/23/01	13:45 - 14:00	19650.2	27392.4	191	6.0	10.1	764	79.1	– 2.1
E - 89, 90	07/23/01	14:00 - 14:15	21088.7	29397.6	186	5.7	10.2	746	79.2	– 2.4
E - 91, 92	07/23/01	14:15 - 14:30	22425.1	31260.6	185	5.8	11.0	730	79.3	– 2.4
E - 93, 94	07/23/01	14:30 - 14:45	19994.5	27872.3	185	5.6	10.7	712	79.8	– 2.4
E - 96, 97	07/23/01	17:00 - 17:15	10388.7	14481.8	194	6.3	8.1	485	79.0	– 1.5
E - 98, 99	07/23/01	17:15 - 17:30	10891.2	15182.3	205	6.4	9.9	452	78.8	– 1.3
E - 100, 101	07/23/01	17:30 - 17:45	8195.9	11425.1	208	6.5	10.1	405	78.5	– 1.0
E - 102, 103	07/23/01	17:45 - 18:00	10007.2	13950.0	207	7.2	8.9	360	78.8	– 1.1
E - 104, 105	07/23/01	18:00 - 18:15	9201.0	12826.2	203	7.8	8.5	318	78.0	– 1.0
E - 106, 107	07/23/01	18:15 - 18:30	9156.9	12764.7	208	7.9	10.0	273	77.6	– 0.9
E - 108, 109	07/24/01	12:30 - 12:45	12631.6	17608.5	184	6.7	10.7	792	84.0	– 2.3
E - 110, 111	07/24/01	12:45 - 13:00	11699.1	16308.5	179	6.0	10.4	784	84.1	– 2.4
E - 112, 113	07/24/01	13:00 - 13:15	12419.7	17313.1	178	4.9	10.2	792	85.0	– 2.7
E - 114, 115	07/24/01	13:15 - 13:30	11089.3	15458.5	185	5.1	8.2	760	85.8	– 2.4
E - 116, 117	07/24/01	15:30 - 15:45	9597.2	13378.5	179	5.9	9.7	639	85.1	– 2.5
E - 118, 119	07/24/01	15:45 - 16:00	8299.7	11569.8	184	5.6	8.2	617	85.1	– 2.2
E - 120, 121	07/24/01	16:00 - 16:15	9201.0	12826.2	179	6.7	9.0	596	85.2	– 2.3
E - 135, 136	08/01/01	13:45 - 14:00	8158.7	11373.2	178	6.1	9.7	159	83.0	– 0.8
E - 137, 138	08/01/01	14:00 - 14:15	7450.2	10385.6	173	5.2	8.7	135	82.4	– 0.6
E - 139, 140	08/01/01	14:15 - 14:30	7594.7	10587.0	180	5.3	7.5	279	83.5	– 0.8
E - 141, 142	08/01/01	14:30 - 14:45	7413.1	10333.9	204	4.4	6.2	220	83.6	– 0.6
E - 144, 145	08/01/01	16:45 - 17:00	4584.5	6390.8	191	4.9	8.8	499	80.9	– 1.4
E - 146, 147	08/01/01	17:00 - 17:15	5498.8	7665.3	198	4.7	7.6	459	80.2	– 1.3

TABLE 6-3 (Cont'd)

SUMMARY OF DOWNWIND MONITORING EVENTS: PRELIMINARY SETTLING TANKS

Event			Average Conc.		Requisite Meteorology					
No.	Date	Averaging Time (EDT)	ppb-m	ug/m^2	WD @ 10m (º)	WS @ 1m (mph)	WS @ 10m (mph)	Solar Rad. (W/m^2)	2m Temp. (ºF)	2-10m ΔT (ºF)
E - 148, 149	08/01/01	17:15 - 17:30	5778.2	8054.8	204	5.1	7.6	340	80.2	– 0.9
E - 150, 151	08/01/01	17:30 - 17:45	9089.4	12670.6	208	4.8	8.2	349	80.6	– 0.9
E - 152, 153	08/02/01	15:30 - 15:45	7804.9	10880.0	184	7.1	9.9	625	84.8	– 2.2
E - 154, 155	08/02/01	15:45 - 16:00	7167.4	9991.4	184	6.6	10.0	599	83.9	– 2.3
E - 156, 157	08/02/01	16:00 - 16:15	6869.8	9576.5	183	6.3	10.2	571	83.0	– 2.0
E - 158, 159	08/02/01	16:15 - 16:30	7328.3	10215.7	184	5.9	8.5	549	83.0	– 2.0
E - 160, 161	08/02/01	16:30 - 16:45	7072.2	9858.6	183	5.0	8.9	521	83.1	– 2.1
E - 162, 163	08/02/01	16:45 - 17:00	6343.9	8843.4	180	4.9	8.4	489	82.7	– 1.8
E - 164, 165	08/02/01	17:00 - 17:15	6651.0	9271.5	188	4.9	7.9	480	83.0	– 1.7
E - 169, 170	08/06/01	11:45 - 12:00	10335.0	14407.0	181	6.5	8.3	702	85.5	– 2.5
E - 171, 172	08/06/01	12:00 - 12:15	10054.8	14016.4	199	5.4	6.8	714	85.7	– 2.3
E - 173, 174	08/06/01	12:15 - 12:30	9793.5	13652.1	210	5.0	7.4	732	85.7	– 2.3
E - 175, 176	08/06/01	12:30 - 12:45	6029.1	8404.6	206	4.9	7.1	738	86.0	– 2.0
E - 177, 178	08/06/01	12:45 - 13:00	10829.8	15096.7	184	5.8	9.9	726	86.0	– 2.3
E - 179, 180	08/06/01	13:00 - 13:15	8729.6	12169.1	187	6.4	10.9	725	85.4	– 2.4
E - 181, 182	08/06/01	13:15 - 13:30	8438.1	11762.7	184	5.6	10.1	704	85.7	– 2.3
E - 183, 184	08/06/01	13:30 - 13:45	5380.3	7500.1	181	4.9	10.3	699	86.0	– 2.3
E - 186, 187	08/06/01	15:30 - 15:45	8397.4	11706.0	204	6.2	8.3	549	84.2	– 1.8
E - 188, 189	08/0601	15:45 - 16:00	7164.8	9987.7	192	5.2	7.2	527	84.2	– 1.7
E - 190, 191	08/06/01	16:00 - 16:15	6287.7	8765.1	189	4.7	7.6	543	84.9	– 1.8
E - 192, 193	08/06/01	16:15 - 16:30	6343.9	8843.4	193	5.1	7.4	513	84.6	– 1.8
E - 194, 195	08/06/01	16:30 - 16:45	9713.1	13540.1	200	5.4	7.5	485	84.2	– 1.6
E - 196, 197	08/06/01	16:45 - 17:00	8345.5	11633.6	190	5.4	7.4	471	83.9	– 1.5
E - 198, 199	08/06/01	17:00 - 17:15	7320.5	10204.8	205	5.6	7.3	422	83.9	– 1.4
E - 200, 201	08/06/01	17:15 - 17:30	7602.5	10597.9	201	6.5	6.8	357	83.5	– 1.2
E - 203, 204	08/09/01	13:30 - 13:45	10630.0	14818.2	184	6.0	10.1	729	97.7	– 2.0

TABLE 6-3 (Cont'd)

SUMMARY OF DOWNWIND MONITORING EVENTS: PRELIMINARY SETTLING TANKS

Event			Average Conc.		Requisite Meteorology					
No.	Date	Averaging Time (EDT)	ppb-m	ug/m^2	WD @ 10m (°)	WS @ 1m (mph)	WS @ 10m (mph)	Solar Rad. (W/m^2)	2m Temp. (°F)	2-10m ΔT (°F)
E - 205, 206	08/09/01	13:45 - 14:00	7713.2	10752.2	196	6.8	8.7	672	97.3	– 1.4
E - 207, 208	08/09/01	14:00 - 14:15	7203.7	10042.0	198	5.9	8.3	598	97.7	– 1.6
E - 209, 210	08/09/01	14:15 - 14:30	7709.7	10747.3	183	7.7	11.2	679	96.4	– 2.1
E - 211, 212	08/09/01	14:30 - 14:45	10085.9	14059.7	181	7.8	10.3	679	95.9	– 2.2
E - 213, 214	08/09/01	14:45 - 15:00	9918.1	13825.8	185	6.5	9.4	659	95.6	– 2.1
E - 215, 216	08/09/01	15:00 - 15:15	10424.1	14531.2	186	6.7	11.9	644	93.9	– 2.0

6.1.2 Upwind Data

Figure 6-3 depicts the upwind monitoring event locations for the preliminary settling tanks. Four locations are identified, but most events consisted of measurements from a single location judged representative of upwind conditions.

Table 6-4 presents a summary of upwind monitoring events for the preliminary settling tanks. A total of nine monitoring events were performed. The average upwind concentration, determined via straight arithmetic averaging, is presented in units of both ppb and ug/m^3. Each upwind event is comprised of four or five successive, collocated measurements; however, for some events, selected measurements are conservatively eliminated from consideration because of suspected attribution from the preliminary settling tank weirs (July 9, July 16, July 24, and the second event of August 6). Each upwind monitoring event was 3 to 5 minutes in duration, during which time measurements of upwind H_2S (1 meter height) and requisite meteorology were made. Requisite meteorology for subsequent assessment of source-attribution are wind direction and wind speed at a height of 10 meters.

Based on the above data, the following upwind concentrations are employed:

- 07/09/01 - 6.0 ppb (8.4 ug/m^3) for all events
- 07/16/01 - 5.5 ppb (7.7 ug/m^3) for all events
- 07/17/01 - 0.0 ppb (0.0 ug/m^3) for all events (no upwind measurements taken)
- 07/23/01 - 5.9 ppb (8.2 ug/m^3) for all events
- 07/24/10 - 6.5 ppb (9.1 ug/m^3) for all events
- 08/01/01 - 11.5 ppb (16.0 ug/m^3) for all events
- 08/02/01 - 11.5 ppb (16.0 ug/m^3) for all events
- 08/06/01 - 7.0 ppb (9.8 ug/m^3) for Events E-169 through E-184
  10.4 ppb (14.5 ug/m^3) for Events E-186 through E-201
- 08/09/01 - 13.5 ppb (18.8 ug/m^3) for all events

All raw upwind data for this source can be found on pages A-58, A-60, A-62, A-63, and A-65 through A-69 of Attachment A.

FIGURE 6-3

UPWIND MONITORING EVENT LOCATIONS: PRELIMINARY SETTLING TANKS

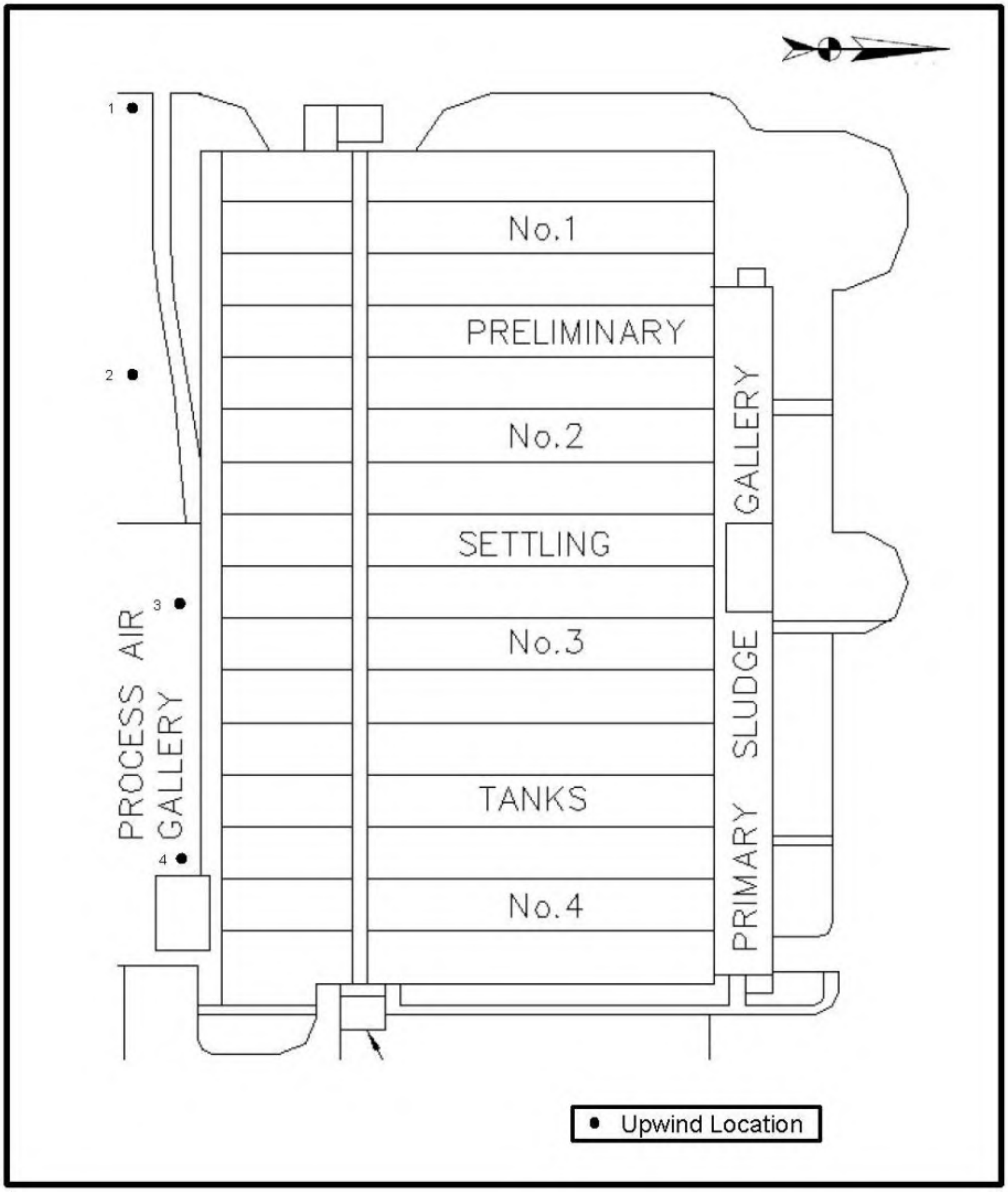

TABLE 6-4

SUMMARY OF UPWIND MONITORING EVENTS: PRELIMINARY SETTLING TANKS

Event			Average Conc.		Requisite Meteorology		
No.	Date	Time (EDT)	ppb	ug/m^3	Time (EDT)	WD @ 10m (º)	WS @ 10m (mph)
E - 17	07/09/01	19:52 - 19:57	6.0	8.4	19:45 - 20:00	185	4.6
E - 43	07/16/01	17:22 - 17:27	5.5	7.7	17:15 - 17:30	153	6.3
E - 95	07/23/01	14:50 - 14:55	5.9	8.2	14:45 - 15:00	191	11.5
E - 122	07/24/01	16:17 - 16:21	6.5	9.1	16:15 - 16:30	184	9.1
E - 143	08/01/01	14:47 - 14:50	11.5	16.0	14:45 - 15:00	210	6.6
E - 166	08/02/01	17:17 - 17:20	11.5	16.0	17:15 - 17:30	187	7.5
E - 168	08/06/01	11:26 - 11:29	7.0	9.8	11:15 - 11:30	184	8.1
E - 185	08/06/01	15:23 - 15:27	10.4	14.5	15:15 - 15:30	190	7.8
E - 202	08/09/01	13:25 - 13:28	13.5	18.8	13:15 - 13:30	204	7.8

6.1.3 Hot-Spot Data

Figure 6-4 depicts a total of 27 hot-spot monitoring event locations for the preliminary settling tanks. Hot-spot data was collected to support source-strength apportionment during subsequent emissions back-calculations. A total of 17 of the 27 locations (Locations 1 through 17) were assigned to assess emissions from the higher-emitting weir (turbulent) areas; the remaining 10 locations were in the lower-emitting quiescent areas.

Table 6-5 presents a summary of hot-spot monitoring events for the preliminary settling tanks. A total of six events were performed over the course of the measurement program. For each event, mean, high, and low concentrations are identified for the turbulent areas and the quiescent areas, together with the sample size and the requisite meteorology. Meteorological data are shown for the 15-minute period during which the quiescent-area measurements were made, as attribution from the weirs was a concern.

For Event H-1, the ratio of the mean concentration over the turbulent areas to the mean concentration over the quiescent areas is 19.9 to 1. This event was judged unrepresentative, and therefore excluded, as quiescent area measurements were generally impacted by emissions from the weirs owing to a southerly wind.

For Event H-2, the ratio is 85.4 to 1. Minor weir attribution upon the quiescent area measurements was possible, however, owing to a very high sigma-theta value (42.0º).

For Event H-4, the ratio is 54.9 to 1.

For Event H-5, the ratio is 111.9 to 1.

For Event H-6, the ratio is 59.8 to 1.

For Event H-9, the ratio is 95.5 to 1.

A hot-spot ratio of 97.6 to 1 was assigned, which is the average of the three highest ratios. The two lowest ratios (Events H-4 and H-6) were dropped because the mean quiescent-area concentrations for each was significantly affected by a few localized, high readings associated with the wastewater influent points along the north side of the tanks. Assignment of this hot-spot ratio means that the turbulent (weir) area emits at a source strength 97.6 times greater than the remainder of the preliminary settling tanks.

Raw hot-spot data for this source can be found on pages A-77, A-78, A-80 through A-82, and A-85 of Attachment A.

FIGURE 6-4

**HOT-SPOT MONITORING EVENT LOCATIONS:
PRELIMINARY SETTLING TANKS**

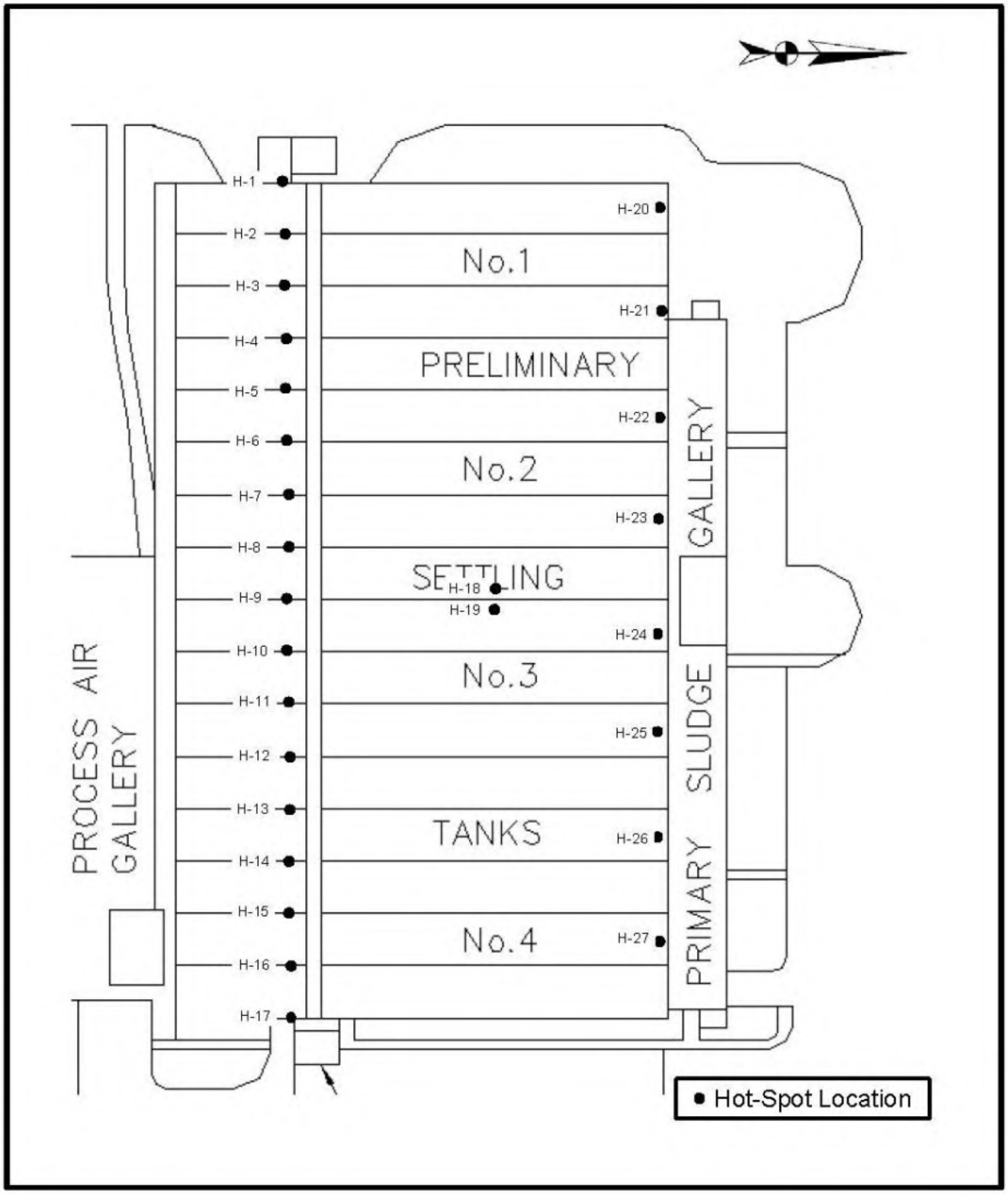

TABLE 6-5

SUMMARY OF HOT-SPOT MONITORING EVENTS: PRELIMINARY SETTLING TANKS

Event			Turbulent Area				Quiescent Area				Requisite Meteorology		
			Sample Size	Concentration (ppb)			Sample Size	Concentration (ppb)			Time (EDT)	WD @ 10m (º)	WS @ 10m (mph)
No.	Date	Time (EDT)		Mean	High	Low		Mean	High	Low			
H - 1	07/09/01	11:29 - 11:55	17	1330	3300	240	10	67	130	34	11:45 - 12:00	181	7.7
H - 2	07/10/01	12:04 - 12:25	17	11450	28000	1400	10	134	300	22	12:15 - 12:30	293	5.0
H - 4	07/12/01	13:49 - 14:11	17	9060	24000	2600	10	165	480	51	14:00 - 14:15	304	6.2
H - 5	07/13/01	10:00 - 10:25	17	5820	12000	2100	10	52	120	15	10:15 - 10:30	317	5.4
H - 6	07/17/01	12:18 - 12:44	17	7240	14000	3800	10	121	270	22	12:15 - 12:30	308	7.2
H - 9	08/14/01	11:00 - 11:30	17	2770	6400	680	10	29	120	11	11:15 - 11:30	039	8.0

6.1.4 Sigma-z Data

Sigma-z (σ_z) measurements were made coincident with each emissions-assessment event for the preliminary settling tanks. **Attachment D** presents all raw CF_4 and SF_6 data collected to support the sigma-z calculations for this source.

Figure 6-5 depicts the open-path FTIR monitoring configuration along the northern side of the preliminary settling tanks. The beam was positioned at an elevation of 1 meter, approximately 1 meter downwind of the source's northern boundary, with a one-way pathlength of 81.5 meters. The location of each tracer-gas release system is also depicted. The CF_4 was released 22.3 meters south of the beam, and the SF_6 was released 46.9 meters south of the beam. Each tracer gas was released at an elevation of 1 meter.

Table 6-6 and **Table 6-7** present the sigma-z calculations based on the CF_4 and SF_6 data, respectively. Initial σ_z values are presented for each 15-minute monitoring event based on the crosswind-integrated form of Turner's equation on page 4-7. (All calculations are performed in a computer spreadsheet, so slight rounding discrepancies may exist when attempting to replicate these numbers.) Based on the departure of mean (actual) wind direction from normal, adjustments are made to the distances downwind of the tracers at which each σ_z value applies. These adjustments are made by dividing the normal downwind distances of the tracers (22.3 and 46.9 meters) by the cosine of the absolute value of the difference between the mean wind direction and 180º.

Plume capture (horizontal) of the tracer gases was assessed by modeling each event using actual meteorology. Minor plume-capture adjustments (discussed below) were made, as required, to account for the fact that the FTIR beam was generally not long enough to capture the outer edges of the tracer plumes owing to the departure from normal of the mean wind direction and to horizontal dispersion. In the earlier work, horizontal dispersion was simulated in the ISCST3 Model by assigning a P-G stability class which corresponded to a specific dispersion coefficient curve. In the current work, the horizontal plume capture was simulated using AERMOD directly.

Dispersion coefficients (both vertical and horizontal) were assigned to each monitoring event by selecting the "Stable Boundary Layer Treatment" within the "Rural Mode" as discussed in Attachment E (introduced below) in order to best simulate the extremely stable sea-breeze conditions observed during all events. For each event, AERMET (AERMOD's meteorological pre-processor) was employed to generate the surface and profile input files based on onsite meteorological and surface-characteristic data.

AERMOD was configured to predict concentrations at every meter along both the beam path and appropriate beam-path extensions. Plume-capture estimates were made for each monitoring event by dividing the path-averaged concentration along the beam by the path-averaged concentration along the entire crosswind direction of the plume. Finally, adjustments were made to the CF_4 and SF_6 concentrations simply by dividing the measured value by the percent plume capture. A final σ_z value was calculated for each monitoring event by substituting the adjusted CF_4 or SF_6 concentration into the crosswind-integrated form of Turner's equation (page 4-7).

For the CF_4 and SF_6 data, five monitoring event pairs (E-5, 6; E-7, 8; E-9, 10; E-11, 12; and E-13, 14) on 07/09/01 were eliminated from consideration because the flow rates were unstable for one or both of the tracer gases (Attachment D). Also not presented was one monitoring event pair (E-46, 47) on 07/16/01 due to calculated plume captures below an arbitrary acceptance level of 80 percent, and one monitoring event pair (E-141, 142) on 08/01/01 due to an FTIR analysis problem.

Attachment E presents supplemental meteorological and atmospheric dispersion analyses to support area-source emission calculations. This includes the supporting meteorological data input files from which the horizontal plume-capture assessments (Tables 6-6 and 6-7) are calculated.

Attachment F presents the dispersion modeling input and output files for all area-source emission-rate estimates. Although most of this attachment pertains to Section 7, it also includes the plume-capture modeling to support site-specific σ_z determinations.

FIGURE 6-5

OPEN-PATH FTIR SPECTROMETER MONITORING CONFIGURATION: PRELIMINARY SETTLING TANKS

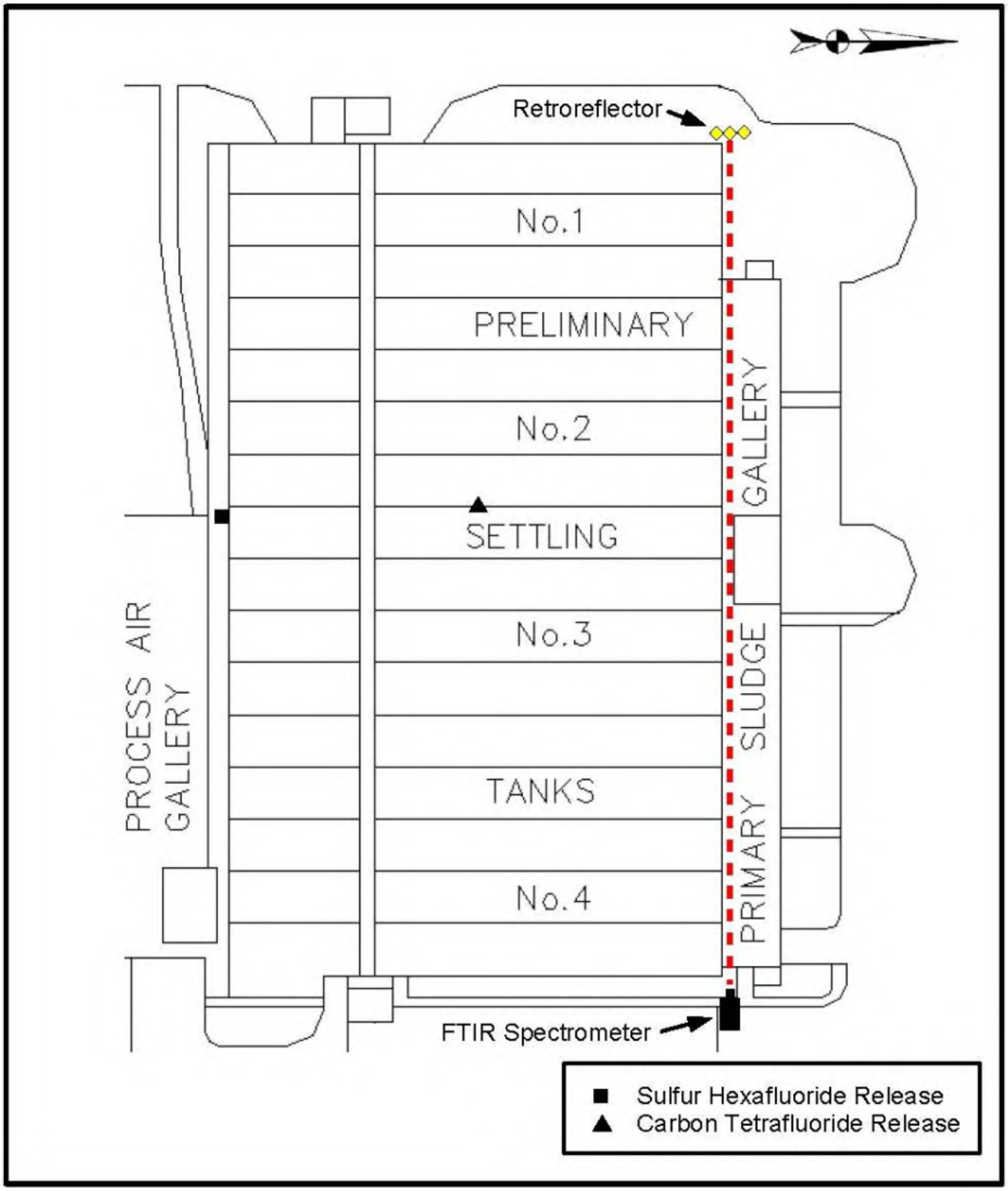

TABLE 6-6

SIGMA-Z CALCULATIONS FOR THE PRELIMINARY SETTLING TANKS: CARBON TETRAFLUORIDE

Event			Requisite Meteorology					Measured CF_4 Conc.					Plume-Capture Adjustment		
		Start	WD	WS @ 1m		WS @ 10m					Initial	Adjusted	Plume	Adjusted	Final
No.	Date	Time (EDT)	@ 10m (°)	(mph)	(m/s)	(mph)	(m/s)	ug/m^3	g/m^2	Q (g/s)	σz @ 22.3m (m)	Downwind Distance (m)	Capture (%)	CF_4 Conc. (g/m^2)	σz (m)
E-1, 2	07/09/01	15:45	192	6.5	2.9	8.8	3.9	99.3227	0.01619	0.1185	2.01	22.8	98.7	0.01640	1.98
E-3, 4	07/09/01	16:00	194	5.6	2.5	7.6	3.4	94.7779	0.01545	0.1235	2.55	23.0	98.4	0.01570	2.51
E-15, 16	07/09/01	19:30	204	3.7	1.7	5.2	2.3	48.6433	0.00793	0.0528	3.21	24.4	97.8	0.00811	3.14
E-29, 30	07/16/01	13:15	180	5.8	2.6	9.7	4.3	47.1659	0.00769	0.0380	1.52	22.3	98.6	0.00780	1.50
E-31, 32	07/16/01	13:30	167	5.8	2.6	9.6	4.3	51.6776	0.00842	0.0380	1.39	22.9	93.6	0.00900	1.30
E-33, 34	07/16/01	13:45	171	6.6	3.0	9.8	4.4	45.2888	0.00738	0.0380	1.39	22.6	93.9	0.00786	1.31
E-35, 36	07/16/01	16:15	182	4.7	2.1	6.4	2.9	41.5390	0.00677	0.0380	2.13	22.3	98.0	0.00691	2.09
E-37, 38	07/16/01	16:30	192	5.8	2.6	5.9	2.6	43.5707	0.00710	0.0380	1.65	22.8	98.3	0.00722	1.62
E-39, 40	07/16/01	16:45	181	3.8	1.7	5.7	2.5	52.1568	0.00850	0.0380	2.10	22.3	97.5	0.00872	2.05
E-41, 42	07/16/01	17:00	173	4.1	1.8	6.1	2.7	45.7636	0.00746	0.0380	2.22	22.5	90.7	0.00822	2.01
E-44, 45	07/16/01	19:15	204	4.1	1.8	6.1	2.7	33.2666	0.00542	0.0289	2.32	24.4	98.2	0.00552	2.28
E-51, 52	07/17/01	15:00	171	4.6	2.1	9.0	4.0	46.3157	0.00755	0.0380	1.95	22.6	92.6	0.00815	1.81
E-53, 54	07/17/01	15:15	177	4.3	1.9	9.4	4.2	43.5045	0.00709	0.0380	2.22	22.3	92.4	0.00767	2.06
E-55, 56	07/17/01	15:30	176	4.8	2.1	7.3	3.3	50.5624	0.00824	0.0380	1.71	22.4	92.0	0.00896	1.58
E-57, 58	07/17/01	15:45	177	4.7	2.1	6.6	3.0	49.4383	0.00806	0.0380	1.79	22.3	91.7	0.00879	1.64
E-59, 60	07/17/01	17:15	154	4.1	1.8	6.7	3.0	60.2769	0.00983	0.0380	1.68	24.8	90.8	0.01082	1.53

TABLE 6-6 (Cont'd)

SIGMA-Z CALCULATIONS FOR THE PRELIMINARY SETTLING TANKS: CARBON TETRAFLUORIDE

Event			Requisite Meteorology					Measured CF_4 Conc.					Plume-Capture Adjustment		
		Start	WD	WS @ 1m		WS @ 10m					Initial	Adjusted	Plume	Adjusted	Final
		Time	@ 10m							Q	σz @ 22.3m	Downwind Distance	Capture	CF_4 Conc.	σz
No.	Date	(EDT)	(°)	(mph)	(m/s)	(mph)	(m/s)	ug/m^3	g/m^2	(g/s)	(m)	(m)	(%)	(g/m^2)	(m)
E-61, 62	07/17/01	17:30	171	3.7	1.7	6.9	3.1	75.3533	0.01228	0.0380	1.49	22.6	90.1	0.01363	1.34
E-75, 76	07/23/01	12:15	186	6.5	2.9	9.1	4.1	42.5880	0.00694	0.0380	1.50	22.4	98.7	0.00703	1.48
E-77, 78	07/23/01	12:30	184	5.8	2.6	8.5	3.8	46.7861	0.00763	0.0380	1.53	22.4	98.5	0.00774	1.51
E-79, 80	07/23/01	12:45	179	5.6	2.5	8.2	3.7	49.5465	0.00808	0.0380	1.50	22.3	93.0	0.00868	1.39
E-81, 82	07/23/01	13:00	181	6.5	2.9	10.1	4.5	43.9903	0.00717	0.0380	1.46	22.3	98.7	0.00726	1.44
E-83, 84	07/23/01	13:15	194	6.6	3.0	10.1	4.5	42.0690	0.00686	0.0380	1.50	23.0	98.8	0.00694	1.48
E-85, 86	07/23/01	13:30	184	5.5	2.5	9.9	4.4	30.7645	0.00501	0.0380	2.46	22.4	98.6	0.00509	2.42
E-87, 88	07/23/01	13:45	191	6.0	2.7	10.1	4.5	44.5579	0.00726	0.0380	1.56	22.7	98.7	0.00736	1.54
E-89, 90	07/23/01	14:00	186	5.7	2.5	10.2	4.6	38.0764	0.00621	0.0380	1.92	22.4	98.6	0.00629	1.89
E-91, 92	07/23/01	14:15	185	5.8	2.6	11.0	4.9	36.2986	0.00592	0.0380	1.98	22.4	98.7	0.00599	1.95
E-93, 94	07/23/01	14:30	185	5.6	2.5	10.7	4.8	39.3638	0.00642	0.0380	1.89	22.4	98.7	0.00650	1.86
E-96, 97	07/23/01	17:00	194	6.3	2.8	8.1	3.6	28.6136	0.00466	0.0380	2.31	23.0	98.6	0.00473	2.28
E-98, 99	07/23/01	17:15	205	6.4	2.9	9.9	4.4	28.9227	0.00471	0.0380	2.25	24.6	98.8	0.00477	2.22
E-100, 01	07/23/01	17:30	208	6.5	2.9	10.1	4.5	25.8068	0.00421	0.0380	2.48	25.3	98.9	0.00425	2.45
E-102, 03	07/23/01	17:45	207	7.2	3.2	8.9	4.0	25.9746	0.00423	0.0380	2.22	25.0	98.9	0.00428	2.20
E-104, 05	07/23/01	18:00	203	7.8	3.5	8.5	3.8	25.9061	0.00422	0.0380	2.06	24.2	98.9	0.00427	2.04

TABLE 6-6 (Cont'd)

SIGMA-Z CALCULATIONS FOR THE PRELIMINARY SETTLING TANKS: CARBON TETRAFLUORIDE

Event			Requisite Meteorology					Measured CF_4 Conc.					Plume-Capture Adjustment		
		Start	WD	WS @ 1m		WS @ 10m					Initial	Adjusted	Plume	Adjusted	Final
		Time	@ 10m							Q	σz @ 22.3m	Downwind Distance	Capture	CF_4 Conc.	σz
No.	Date	(EDT)	(°)	(mph)	(m/s)	(mph)	(m/s)	ug/m^3	g/m^2	(g/s)	(m)	(m)	(%)	(g/m^2)	(m)
E-106, 07	07/23/01	18:15	208	7.9	3.5	10.0	4.5	28.7704	0.00469	0.0380	1.83	25.3	99.0	0.00474	1.81
E-108, 09	07/24/01	12:30	184	6.7	3.0	10.7	4.8	42.4533	0.00692	0.0380	1.46	22.4	98.8	0.00700	1.45
E-110, 11	07/24/01	12:45	179	6.0	2.7	10.4	4.6	43.7518	0.00713	0.0380	1.59	22.3	93.9	0.00759	1.49
E-112, 13	07/24/01	13:00	178	4.9	2.2	10.2	4.6	49.5554	0.00808	0.0380	1.71	22.3	93.7	0.00862	1.61
E-114, 15	07/24/01	13:15	185	5.1	2.3	8.2	3.7	49.1667	0.00801	0.0380	1.66	22.4	98.5	0.00814	1.63
E-116, 17	07/24/01	15:30	179	5.9	2.6	9.7	4.3	44.4563	0.00725	0.0380	1.59	22.3	93.5	0.00775	1.48
E-118, 19	07/24/01	15:45	184	5.6	2.5	8.2	3.7	45.7283	0.00745	0.0380	1.62	22.4	98.5	0.00757	1.60
E-120, 21	07/24/01	16:00	179	6.7	3.0	9.0	4.0	43.9219	0.00716	0.0380	1.41	22.3	93.7	0.00764	1.32
E-135, 36	08/01/01	13:45	178	6.1	2.7	9.7	4.3	56.5028	0.00921	0.0380	1.21	22.3	93.5	0.00985	1.13
E-137, 38	08/01/01	14:00	173	5.2	2.3	8.7	3.9	51.3640	0.00837	0.0380	1.56	22.5	92.6	0.00904	1.44
E-139, 40	08/01/01	14:15	180	5.3	2.4	7.5	3.4	49.0452	0.00799	0.0380	1.60	22.3	98.5	0.00812	1.58
E-144, 45	08/01/01	16:45	191	4.9	2.2	8.8	3.9	36.3384	0.00592	0.0380	2.34	22.7	98.4	0.00602	2.30
E-146, 47	08/01/01	17:00	198	4.7	2.1	7.6	3.4	31.2857	0.00510	0.0380	2.83	23.4	98.3	0.00519	2.78
E-148, 49	08/01/01	17:15	204	5.1	2.3	7.6	3.4	27.6684	0.00451	0.0380	2.95	24.4	98.5	0.00458	2.90
E-150, 51	08/01/01	17:30	208	4.8	2.1	8.2	3.7	36.8816	0.00601	0.0380	2.35	25.3	98.5	0.00610	2.32
E-152, 53	08/02/01	15:30	184	7.1	3.2	9.9	4.4	32.3059	0.00527	0.0380	1.81	22.4	98.8	0.00533	1.79

TABLE 6-6 (Cont'd)

SIGMA-Z CALCULATIONS FOR THE PRELIMINARY SETTLING TANKS: CARBON TETRAFLUORIDE

Event			Requisite Meteorology					Measured CF_4 Conc.		Q	Initial σz @ 22.3m	Adjusted Downwind Distance	Plume-Capture Adjustment		
		Start Time	WD @ 10m	WS @ 1m		WS @ 10m							Plume Capture	Adjusted CF_4 Conc.	Final σz
No.	Date	(EDT)	(°)	(mph)	(m/s)	(mph)	(m/s)	ug/m^3	g/m^2	(g/s)	(m)	(m)	(%)	(g/m^2)	(m)
E-154, 55	08/02/01	15:45	184	6.6	3.0	10.0	4.5	35.4771	0.00578	0.0380	1.78	22.4	98.8	0.00585	1.76
E-156, 57	08/02/01	16:00	183	6.3	2.8	10.2	4.6	39.1761	0.00639	0.0380	1.69	22.3	98.7	0.00647	1.66
E-158, 59	08/02/01	16:15	184	5.9	2.6	8.5	3.8	38.4385	0.00627	0.0380	1.83	22.4	98.5	0.00636	1.81
E-160, 61	08/02/01	16:30	183	5.0	2.2	8.9	4.0	37.3741	0.00609	0.0380	2.23	22.3	98.4	0.00619	2.19
E-162, 63	08/02/01	16:45	180	4.9	2.2	8.4	3.8	31.6721	0.00516	0.0380	2.68	22.3	98.4	0.00525	2.64
E-164, 65	08/02/01	17:00	188	4.9	2.2	7.9	3.5	39.6178	0.00646	0.0380	2.14	22.5	98.3	0.00657	2.11
E-169, 70	08/06/01	11:45	181	6.5	2.9	8.3	3.7	47.0378	0.00767	0.0380	1.36	22.3	98.6	0.00778	1.34
E-171, 72	08/06/01	12:00	199	5.4	2.4	6.8	3.0	45.8740	0.00748	0.0380	1.68	23.6	98.3	0.00761	1.65
E-173, 74	08/06/01	12:15	210	5.0	2.2	7.4	3.3	42.3429	0.00690	0.0380	1.97	25.7	98.4	0.00701	1.93
E-175, 76	08/06/01	12:30	206	4.9	2.2	7.1	3.2	42.4224	0.00691	0.0380	2.00	24.8	98.3	0.00703	1.97
E-177, 78	08/06/01	12:45	184	5.8	2.6	9.9	4.4	40.9384	0.00667	0.0380	1.75	22.4	98.6	0.00677	1.73
E-179, 80	08/06/01	13:00	187	6.4	2.9	10.9	4.9	40.3090	0.00657	0.0380	1.61	22.5	98.8	0.00665	1.59
E-181, 82	08/06/01	13:15	184	5.6	2.5	10.1	4.5	33.7458	0.00550	0.0380	2.20	22.4	98.6	0.00558	2.17
E-183, 84	08/06/01	13:30	181	4.9	2.2	10.3	4.6	29.7663	0.00485	0.0380	2.85	22.3	98.5	0.00493	2.81
E-186, 87	08/06/01	15:30	204	6.2	2.8	8.3	3.7	35.0421	0.00571	0.0380	1.92	24.4	98.7	0.00579	1.89
E-188, 89	08/06/01	15:45	192	5.2	2.3	7.2	3.2	31.8797	0.00520	0.0380	2.51	22.8	98.3	0.00529	2.47

TABLE 6-6 (Cont'd)

SIGMA-Z CALCULATIONS FOR THE PRELIMINARY SETTLING TANKS: CARBON TETRAFLUORIDE

Event			Requisite Meteorology					Measured CF_4 Conc.					Plume-Capture Adjustment		
		Start Time	WD @ 10m	WS @ 1m		WS @ 10m				Q	Initial σz @ 22.3m	Adjusted Downwind Distance	Plume Capture	Adjusted CF_4 Conc.	Final σz
No.	Date	(EDT)	(°)	(mph)	(m/s)	(mph)	(m/s)	ug/m³	g/m²	(g/s)	(m)	(m)	(%)	(g/m²)	(m)
E-190, 91	08/06/01	16:00	189	4.7	2.1	7.6	3.4	34.9030	0.00569	0.0380	2.54	22.6	98.2	0.00579	2.49
E-192, 93	08/06/01	16:15	193	5.1	2.3	7.4	3.3	32.5974	0.00531	0.0380	2.50	22.9	98.3	0.00541	2.46
E-194, 95	08/06/01	16:30	200	5.4	2.4	7.5	3.4	35.8018	0.00584	0.0380	2.15	23.7	98.5	0.00592	2.12
E-196, 97	08/06/01	16:45	190	5.4	2.4	7.4	3.3	34.6954	0.00566	0.0380	2.22	22.6	98.4	0.00575	2.19
E-198, 99	08/06/01	17:00	205	5.6	2.5	7.3	3.3	34.6733	0.00565	0.0380	2.14	24.6	98.5	0.00574	2.11
E-200, 01	08/06/01	17:15	201	6.5	2.9	6.8	3.0	34.0616	0.00555	0.0380	1.88	23.9	98.6	0.00563	1.85
E-203, 04	08/09/01	13:30	184	6.0	2.7	10.1	4.5	39.1562	0.00638	0.0380	1.77	22.4	98.7	0.00647	1.75
E-205, 06	08/09/01	13:45	196	6.8	3.0	8.7	3.9	37.0340	0.00604	0.0380	1.65	23.2	98.7	0.00612	1.63
E-207, 08	08/09/01	14:00	198	5.9	2.6	8.3	3.7	41.6892	0.00680	0.0380	1.69	23.4	98.6	0.00689	1.67
E-209, 10	08/09/01	14:15	183	7.7	3.4	11.2	5.0	41.1835	0.00671	0.0380	1.31	22.3	98.9	0.00679	1.30
E-211, 12	08/09/01	14:30	181	7.8	3.5	10.3	4.6	39.4367	0.00643	0.0380	1.35	22.3	98.9	0.00650	1.34
E-213, 14	08/09/01	14:45	185	6.5	2.9	9.4	4.2	41.6715	0.00679	0.0380	1.54	22.4	98.7	0.00688	1.52
E-215, 16	08/09/01	15:00	186	6.7	3.0	11.9	5.3	39.8276	0.00649	0.0380	1.56	22.4	98.9	0.00656	1.54

TABLE 6-7

SIGMA-Z CALCULATIONS FOR THE PRELIMINARY SETTLING TANKS: SULFUR HEXAFLUORIDE

Event			Requisite Meteorology					Measured SF_6 Conc.					Plume-Capture Adjustment		
		Start Time	WD @ 10m	WS @ 1m		WS @ 10m				Q	Initial σz @ 46.9m	Adjusted Downwind Distance	Plume Capture	Adjusted SF_6 Conc.	Final σz
No.	Date	(EDT)	(°)	(mph)	(m/s)	(mph)	(m/s)	ug/m³	g/m²	(g/s)	(m)	(m)	(%)	(g/m²)	(m)
E-1, 2	07/09/01	15:45	192	6.5	2.9	8.8	3.9	93.9207	0.01531	0.1651	2.96	47.9	98.4	0.01556	2.91
E-3, 4	07/09/01	16:00	194	5.6	2.5	7.6	3.4	93.0851	0.01517	0.1496	3.14	48.3	98.1	0.01547	3.08
E-15, 16	07/09/01	19:30	204	3.7	1.7	5.2	2.3	73.9402	0.01205	0.1419	5.68	51.3	97.0	0.01243	5.51
E-29, 30	07/16/01	13:15	180	5.8	2.6	9.7	4.3	110.3674	0.01799	0.1421	2.43	46.9	98.4	0.01828	2.39
E-31, 32	07/16/01	13:30	167	5.8	2.6	9.6	4.3	98.2385	0.01601	0.1421	2.73	48.1	89.7	0.01785	2.45
E-33, 34	07/16/01	13:45	171	6.6	3.0	9.8	4.4	92.8054	0.01513	0.1421	2.54	47.5	90.7	0.01668	2.30
E-35, 36	07/16/01	16:15	182	4.7	2.1	6.4	2.9	82.2151	0.01340	0.1421	4.03	46.9	97.7	0.01372	3.93
E-37, 38	07/16/01	16:30	192	5.8	2.6	5.9	2.6	100.1563	0.01633	0.1421	2.68	47.9	98.0	0.01666	2.62
E-39, 40	07/16/01	16:45	181	3.8	1.7	5.7	2.5	109.1085	0.01778	0.1421	3.75	46.9	97.1	0.01832	3.64
E-41, 42	07/16/01	17:00	173	4.1	1.8	6.1	2.7	69.7623	0.01137	0.1421	5.44	47.3	86.8	0.01310	4.72
E-44, 45	07/16/01	19:15	204	4.1	1.8	6.1	2.7	54.4825	0.00888	0.1087	5.33	51.3	97.7	0.00909	5.21
E-51, 52	07/17/01	15:00	171	4.6	2.1	9.0	4.0	123.2399	0.02009	0.1087	2.10	47.5	89.5	0.02244	1.88
E-53, 54	07/17/01	15:15	177	4.3	1.9	9.4	4.2	94.4545	0.01540	0.1087	2.93	47.0	89.7	0.01716	2.63
E-55, 56	07/17/01	15:30	176	4.8	2.1	7.3	3.3	109.1932	0.01780	0.1087	2.27	47.0	88.6	0.02009	2.01
E-57, 58	07/17/01	15:45	177	4.7	2.1	6.6	3.0	85.7526	0.01398	0.1087	2.95	47.0	88.2	0.01585	2.60
E-59, 60	07/17/01	17:15	154	4.1	1.8	6.7	3.0	122.9675	0.02004	0.1087	2.36	52.2	79.8	0.02512	1.88

TABLE 6-7 (Cont'd)

SIGMA-Z CALCULATIONS FOR THE PRELIMINARY SETTLING TANKS: SULFUR HEXAFLUORIDE

Event			Requisite Meteorology					Measured SF_6 Conc.					Plume-Capture Adjustment		
				WS @ 1m		WS @ 10m									
No.	Date	Start Time (EDT)	WD @ 10m (°)	(mph)	(m/s)	(mph)	(m/s)	ug/m³	g/m²	Q (g/s)	Initial σz @ 46.9m (m)	Adjusted Downwind Distance (m)	Plume Capture (%)	Adjusted SF_6 Conc. (g/m²)	Final σz (m)
E-61, 62	07/17/01	17:30	171	3.7	1.7	6.9	3.1	157.8155	0.02572	0.1087	2.04	47.5	87.0	0.02957	1.77
E-75, 76	07/23/01	12:15	186	6.5	2.9	9.1	4.1	75.2801	0.01227	0.1087	2.43	47.2	98.4	0.01247	2.39
E-77, 78	07/23/01	12:30	184	5.8	2.6	8.5	3.8	85.4507	0.01393	0.1087	2.40	47.0	98.2	0.01418	2.36
E-79, 80	07/23/01	12:45	179	5.6	2.5	8.2	3.7	97.9772	0.01597	0.1087	2.17	46.9	89.8	0.01778	1.95
E-81, 82	07/23/01	13:00	181	6.5	2.9	10.1	4.5	80.7243	0.01316	0.1087	2.27	46.9	98.5	0.01336	2.23
E-83, 84	07/23/01	13:15	194	6.6	3.0	10.1	4.5	77.7979	0.01268	0.1087	2.32	48.3	98.5	0.01287	2.28
E-85, 86	07/23/01	13:30	184	5.5	2.5	9.9	4.4	52.8739	0.00862	0.1087	4.09	47.0	98.3	0.00877	4.02
E-87, 88	07/23/01	13:45	191	6.0	2.7	10.1	4.5	76.1636	0.01241	0.1087	2.60	47.8	98.4	0.01262	2.56
E-89, 90	07/23/01	14:00	186	5.7	2.5	10.2	4.6	62.3856	0.01017	0.1087	3.35	47.2	98.4	0.01033	3.29
E-91, 92	07/23/01	14:15	185	5.8	2.6	11.0	4.9	62.7979	0.01024	0.1087	3.27	47.1	98.5	0.01039	3.22
E-93, 94	07/23/01	14:30	185	5.6	2.5	10.7	4.8	70.3108	0.01146	0.1087	3.02	47.1	98.4	0.01165	2.97
E-96, 97	07/23/01	17:00	194	6.3	2.8	8.1	3.6	59.3966	0.00968	0.1087	3.18	48.3	98.3	0.00985	3.13
E-98, 99	07/23/01	17:15	205	6.4	2.9	9.9	4.4	48.3536	0.00788	0.1087	3.85	51.7	98.1	0.00803	3.77
E-100, 01	07/23/01	17:30	208	6.5	2.9	10.1	4.5	53.5549	0.00873	0.1087	3.42	53.1	97.0	0.00900	3.32
E-102, 03	07/23/01	17:45	207	7.2	3.2	8.9	4.0	60.6813	0.00989	0.1087	2.72	52.6	97.3	0.01017	2.65
E-104, 05	07/23/01	18:00	203	7.8	3.5	8.5	3.8	64.0604	0.01044	0.1087	2.38	51.0	98.4	0.01061	2.34

TABLE 6-7 (Cont'd)

SIGMA-Z CALCULATIONS FOR THE PRELIMINARY SETTLING TANKS: SULFUR HEXAFLUORIDE

Event			Requisite Meteorology					Measured SF_6 Conc.					Plume-Capture Adjustment		
		Start	WD	WS @ 1m		WS @ 10m					Initial	Adjusted	Plume	Adjusted	Final
		Time	@ 10m							Q	σz @ 46.9m	Downwind Distance	Capture	SF_6 Conc.	σz
No.	Date	(EDT)	(°)	(mph)	(m/s)	(mph)	(m/s)	ug/m^3	g/m^2	(g/s)	(m)	(m)	(%)	(g/m^2)	(m)
E-106, 07	07/23/01	18:15	208	7.9	3.5	10.0	4.5	80.9194	0.01319	0.1087	1.86	53.1	97.3	0.01356	1.81
E-108, 09	07/24/01	12:30	184	6.7	3.0	10.7	4.8	69.6703	0.01136	0.1087	2.55	47.0	98.6	0.01152	2.51
E-110, 11	07/24/01	12:45	179	6.0	2.7	10.4	4.6	71.0139	0.01158	0.1087	2.79	46.9	91.1	0.01271	2.54
E-112, 13	07/24/01	13:00	178	4.9	2.2	10.2	4.6	86.6397	0.01412	0.1087	2.80	46.9	91.0	0.01552	2.55
E-114, 15	07/24/01	13:15	185	5.1	2.3	8.2	3.7	89.6103	0.01461	0.1087	2.60	47.1	98.3	0.01486	2.56
E-116, 17	07/24/01	15:30	179	5.9	2.6	9.7	4.3	77.0875	0.01257	0.1087	2.62	46.9	90.7	0.01385	2.37
E-118, 19	07/24/01	15:45	184	5.6	2.5	8.2	3.7	87.1882	0.01421	0.1087	2.44	47.0	98.2	0.01447	2.39
E-120, 21	07/24/01	16:00	179	6.7	3.0	9.0	4.0	84.4716	0.01377	0.1087	2.10	46.9	90.7	0.01518	1.91
E-135, 36	08/01/01	13:45	178	6.1	2.7	9.7	4.3	102.1919	0.01666	0.1087	1.91	46.9	90.7	0.01837	1.73
E-137, 38	08/01/01	14:00	173	5.2	2.3	8.7	3.9	92.3416	0.01505	0.1087	2.48	47.3	89.7	0.01678	2.22
E-139, 40	08/01/01	14:15	180	5.3	2.4	7.5	3.4	78.0372	0.01272	0.1087	2.88	46.9	98.2	0.01295	2.83
E-144, 45	08/01/01	16:45	191	4.9	2.2	8.8	3.9	81.4274	0.01327	0.1087	2.98	47.8	98.2	0.01352	2.93
E-146, 47	08/01/01	17:00	198	4.7	2.1	7.6	3.4	83.3378	0.01358	0.1087	3.04	49.3	98.0	0.01386	2.98
E-148, 49	08/01/01	17:15	204	5.1	2.3	7.6	3.4	73.8225	0.01203	0.1087	3.16	51.3	97.7	0.01232	3.09
E-150, 51	08/01/01	17:30	208	4.8	2.1	8.2	3.7	93.1845	0.01519	0.1087	2.66	53.1	96.1	0.01581	2.56
E-152, 53	08/02/01	15:30	184	7.1	3.2	9.9	4.4	78.4384	0.01279	0.1087	2.14	47.0	98.6	0.01297	2.11

TABLE 6-7 (Cont'd)

SIGMA-Z CALCULATIONS FOR THE PRELIMINARY SETTLING TANKS: SULFUR HEXAFLUORIDE

Event			Requisite Meteorology					Measured SF_6 Conc.					Plume-Capture Adjustment		
		Start Time	WD @ 10m	WS @ 1m		WS @ 10m				Q	Initial σz @ 46.9m	Adjusted Downwind Distance	Plume Capture	Adjusted SF_6 Conc.	Final σz
No.	Date	(EDT)	(°)	(mph)	(m/s)	(mph)	(m/s)	ug/m³	g/m²	(g/s)	(m)	(m)	(%)	(g/m²)	(m)
E-154, 55	08/02/01	15:45	184	6.6	3.0	10.0	4.5	74.7206	0.01218	0.1087	2.41	47.0	98.5	0.01236	2.38
E-156, 57	08/02/01	16:00	183	6.3	2.8	10.2	4.6	73.3513	0.01196	0.1087	2.58	47.0	98.5	0.01214	2.54
E-158, 59	08/02/01	16:15	184	5.9	2.6	8.5	3.8	73.7488	0.01202	0.1087	2.74	47.0	98.3	0.01223	2.69
E-160, 61	08/02/01	16:30	183	5.0	2.2	8.9	4.0	86.9636	0.01418	0.1087	2.74	47.0	98.2	0.01443	2.69
E-162, 63	08/02/01	16:45	180	4.9	2.2	8.4	3.8	73.9623	0.01206	0.1087	3.28	46.9	98.1	0.01229	3.22
E-164, 65	08/02/01	17:00	188	4.9	2.2	7.9	3.5	83.0470	0.01354	0.1087	2.92	47.4	98.0	0.01381	2.87
E-169, 70	08/06/01	11:45	181	6.5	2.9	8.3	3.7	101.6471	0.01657	0.1087	1.80	46.9	98.3	0.01686	1.77
E-171, 72	08/06/01	12:00	199	5.4	2.4	6.8	3.0	89.5403	0.01460	0.1087	2.46	49.6	97.9	0.01491	2.41
E-173, 74	08/06/01	12:15	210	5.0	2.2	7.4	3.3	91.8520	0.01497	0.1087	2.59	54.2	92.1	0.01626	2.39
E-175, 76	08/06/01	12:30	206	4.9	2.2	7.1	3.2	82.2115	0.01340	0.1087	2.95	52.2	96.3	0.01392	2.85
E-177, 78	08/06/01	12:45	184	5.8	2.6	9.9	4.4	77.7758	0.01268	0.1087	2.64	47.0	98.4	0.01288	2.60
E-179, 80	08/06/01	13:00	187	6.4	2.9	10.9	4.9	86.8642	0.01416	0.1087	2.14	47.3	98.6	0.01436	2.11
E-181, 82	08/06/01	13:15	184	5.6	2.5	10.1	4.5	71.8936	0.01172	0.1087	2.96	47.0	98.4	0.01191	2.91
E-183, 84	08/06/01	13:30	181	4.9	2.2	10.3	4.6	46.7929	0.00763	0.1087	5.19	46.9	98.3	0.00776	5.10
E-186, 87	08/06/01	15:30	204	6.2	2.8	8.3	3.7	71.1316	0.01159	0.1087	2.70	51.3	97.9	0.01184	2.64
E-188, 89	08/06/01	15:45	192	5.2	2.3	7.2	3.2	74.3636	0.01212	0.1087	3.08	47.9	98.0	0.01237	3.02

TABLE 6-7 (Cont'd)

SIGMA-Z CALCULATIONS FOR THE PRELIMINARY SETTLING TANKS: SULFUR HEXAFLUORIDE

Event			Requisite Meteorology					Measured SF_6 Conc.					Plume-Capture Adjustment		
		Start	WD	WS @ 1m		WS @ 10m					Initial	Adjusted	Plume	Adjusted	Final
		Time	@ 10m							Q	σz	Downwind	Capture	SF_6 Conc.	σz
No.	Date	(EDT)	(°)	(mph)	(m/s)	(mph)	(m/s)	ug/m³	g/m²	(g/s)	@ 46.9m (m)	Distance (m)	(%)	(g/m²)	(m)
E-190, 91	08/06/01	16:00	189	4.7	2.1	7.6	3.4	68.2273	0.01112	0.1087	3.71	47.5	97.9	0.01136	3.63
E-192, 93	08/06/01	16:15	193	5.1	2.3	7.4	3.3	57.3426	0.00935	0.1087	4.07	48.1	98.0	0.00954	3.99
E-194, 95	08/06/01	16:30	200	5.4	2.4	7.5	3.4	72.4899	0.01182	0.1087	3.04	49.9	98.1	0.01204	2.98
E-196, 97	08/06/01	16:45	190	5.4	2.4	7.4	3.3	76.9329	0.01254	0.1087	2.87	47.6	98.1	0.01278	2.81
E-198, 99	08/06/01	17:00	205	5.6	2.5	7.3	3.3	73.8998	0.01205	0.1087	2.88	51.7	97.4	0.01237	2.80
E-200, 01	08/06/01	17:15	201	6.5	2.9	6.8	3.0	80.3378	0.01310	0.1087	2.28	50.2	98.1	0.01335	2.24
E-203, 04	08/09/01	13:30	184	6.0	2.7	10.1	4.5	76.5059	0.01247	0.1087	2.59	47.0	98.5	0.01266	2.55
E-205, 06	08/09/01	13:45	196	6.8	3.0	8.7	3.9	76.7378	0.01251	0.1087	2.28	48.8	98.4	0.01271	2.24
E-207, 08	08/09/01	14:00	198	5.9	2.6	8.3	3.7	83.0102	0.01353	0.1087	2.43	49.3	98.3	0.01376	2.39
E-209, 10	08/09/01	14:15	183	7.7	3.4	11.2	5.0	71.7648	0.01170	0.1087	2.15	47.0	98.7	0.01185	2.13
E-211, 12	08/09/01	14:30	181	7.8	3.5	10.3	4.6	85.2446	0.01389	0.1087	1.79	46.9	98.7	0.01408	1.77
E-213, 14	08/09/01	14:45	185	6.5	2.9	9.4	4.2	81.1697	0.01323	0.1087	2.26	47.1	98.5	0.01343	2.22
E-215, 16	08/09/01	15:00	186	6.7	3.0	11.9	5.3	86.8900	0.01416	0.1087	2.04	47.2	98.7	0.01435	2.02

6.2 Aeration Tanks

The following monitoring data for the aeration tanks are presented in this section:

- ! downwind data
- ! upwind data
- ! hot-spot data

6.2.1 Downwind Data

Figure 6-6 depicts the downwind monitoring event locations for the aeration tanks. A total of 17 equispaced, H_2S sampling locations (7.70m spacing) are identified in each of two straight lines (pathlengths of 123.14m) oriented parallel to the western side of Aeration Tank No. 1 and the eastern side of Aeration Tank No. 2 in order to accommodate winds from an easterly and westerly quadrant, respectively. Each path is 1 meter downwind of its respective source edge.

Table 6-8 presents a summary of all downwind monitoring events for the aeration tanks. A total of 9 event-pairs over 2 monitoring days are identified. Average downwind concentrations, determined via Simpson's three-point rule, are presented in units of both ppb-m and ug/m^2. Each downwind monitoring event was precisely 15 minutes in duration, during which time coincident measurements of downwind H_2S (1 meter height) and requisite meteorology were made. As discussed in Section 4.1, requisite meteorology for subsequent emissions back-calculation are: wind direction and solar radiation at a height of 10 meters; change in temperature (delta or ΔT) between 2 and 10 meters, where a negative value indicates a temperature decrease with height; and wind speed at heights of 1 and 10 meters.

Of the nine downwind event-pairs, the first four were collected along the western path (easterly wind), and the last five along the eastern path (westerly wind). On each monitoring day, one or more individual Jerome meter readings for each event (principally over the northern half of each measurement path) were elevated due to impact from the preliminary settling tank weir areas (Attachment C). Comparison of the 5-minute-averaged wind-direction data (10 meters) comprising each of these nine event-pairs (pages B-21 and B-24 of Attachment B) with the raw downwind data from Attachment A shows the direct correlation between a particular high individual Jerome meter measurement and the occurrence of a northerly component in the 5-minute-averaged wind direction observed during that measurement. Impacted concentrations are, therefore, conservatively "reconstructed" to support the assessment of source attribution (Attachment C) by defaulting to the higher of the two adjacent (non-impacted) concentrations.

All raw downwind data for this source can be found beginning on pages A-49 and A-53 of Attachment A. Downwind event calculations for this source can be found beginning on page C-28 of Attachment C.

FIGURE 6-6

DOWNWIND MONITORING EVENT LOCATIONS: AERATION TANKS

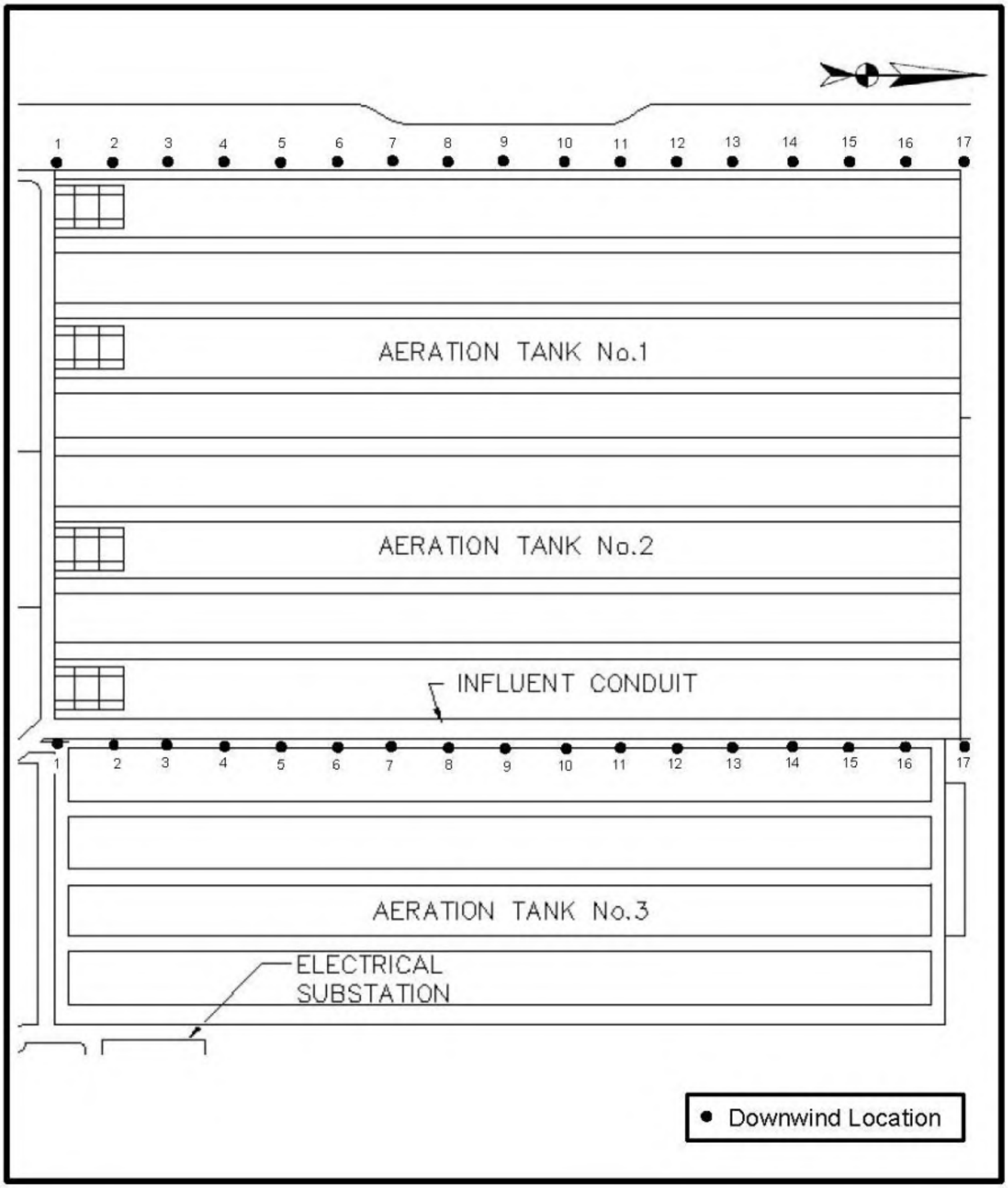

TABLE 6-8

SUMMARY OF DOWNWIND MONITORING EVENTS: AERATION TANKS

Event			Average H_2S Conc.		Requisite Meteorology					
No.	Date	Averaging Time (EDT)	ppb-m	ug/m^2	WD @ 10m (º)	WS @ 1m (mph)	WS @ 10m (mph)	Solar Rad. (W/m^2)	2m Temp. (ºF)	2-10m ΔT (ºF)
E - 235, 36	08/15/01	10:45 - 11:00	1101.2	1535.1	079	2.9	5.2	653	76.9	– 0.8
E - 237, 38	08/15/01	11:00 - 11:15	884.1	1232.4	075	2.8	4.1	673	77.6	– 0.9
E - 239, 40	08/15/01	11:15 - 11:30	898.2	1252.1	109	2.9	4.2	638	78.6	– 1.2
E - 241, 42	08/15/01	11:30 - 11:45	921.3	1284.3	098	2.9	4.7	694	78.6	– 0.8
E - 264, 65	08/21/01	13:00 - 13:15	1335.1	1861.1	281	2.6	5.5	498	81.2	– 1.9
E - 266, 67	08/21/01	13:30 - 13:45	1165.5	1624.7	264	3.5	6.2	543	80.9	– 1.7
E - 268, 69	08/21/01	13:45 - 14:00	949.6	1323.7	278	3.6	4.9	504	81.2	– 1.6
E - 270, 71	08/21/01	14:00 - 14:15	993.3	1384.7	251	3.4	6.0	434	81.5	– 1.4
E - 272, 73	08/21/01	14:15 - 14:30	1038.3	1447.4	294	3.5	8.6	539	81.8	– 1.6

6.2.2 Upwind Data

Figure 6-7 depicts the upwind monitoring event locations for the aeration tanks. Location 1 was used for events on the first monitoring day with an easterly wind (Events E-235 through E-242), and Location 2 was used on the second day with a westerly wind (Events E-264 through E-273).

Table 6-9 presents a summary of upwind monitoring events for the aeration tanks. A total of two monitoring events were performed. The average upwind concentration, determined via straight arithmetic averaging, is presented in units of both ppb and ug/m^3.

Each upwind event is comprised of five or six successive, collocated measurements. However, the upwind concentration for one of the days (August 21) is conservatively defined as the lowest single, collocated measurement based on consideration of that day's measured downwind concentrations. All raw upwind data for this source can be found on pages A-72 and A-74 of Attachment A.

Each upwind monitoring event was 4 minutes in duration during which time measurements of upwind H_2S (1 meter height) and requisite meteorology were made. Requisite meteorology for subsequent assessment of source-attribution are wind direction and wind speed at a height of 10 meters.

Based on the above data, the following upwind concentrations are employed:

- 08/15/01 - 6.9 ppb (9.6 ug/m^3) for all events
- 08/21/01 - 6.0 ppb (8.4 ug/m^3) for all events

FIGURE 6-7

UPWIND MONITORING EVENT LOCATIONS: AERATION TANKS

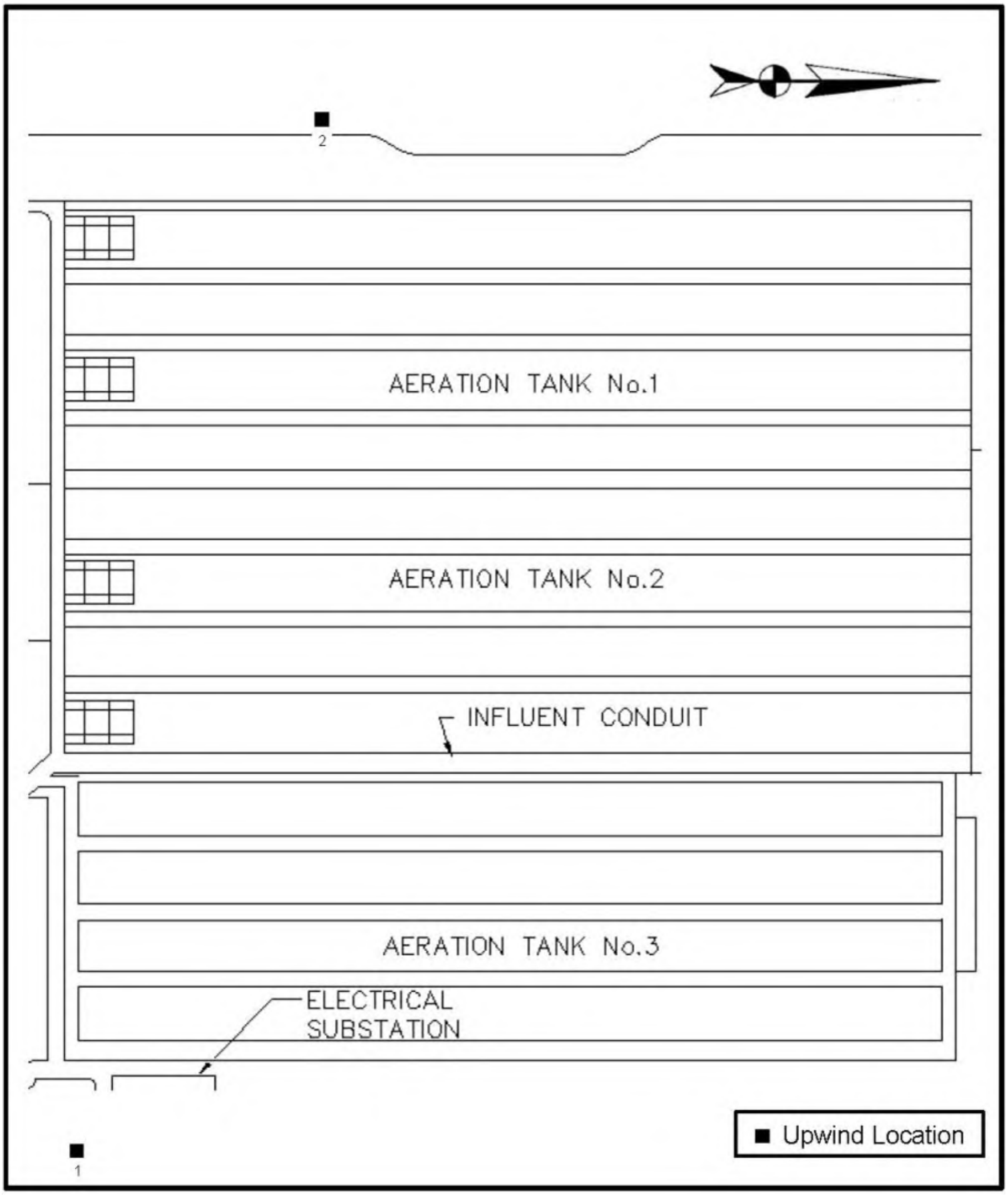

TABLE 6-9

SUMMARY OF UPWIND MONITORING EVENTS: AERATION TANKS

Event			Average Conc.		Requisite Meteorology		
No.	Date	Time (EDT)	ppb	ug/m^3	Time (EDT)	WD @ 10m (º)	WS @ 10m (mph)
E - 243	08/15/01	11:50 - 11:54	6.9	9.6	11:45 - 12:00	098	5.5
E - 274	08/21/01	14:37 - 14:41	6.0	8.4	14:30 - 14:45	293	6.0

6.2.3 Hot-Spot Data

Figure 6-8 depicts a total of 28 hot-spot monitoring event locations for the aeration tanks. Hot-spot data was collected to support source-strength apportionment during subsequent emissions back-calculations. Locations 1, 10, 15, 19, and 24 through 28 correspond to wastewater feeds from the preliminary settling tanks.

Table 6-10 presents a summary of hot-spot monitoring events for the aeration tanks. A total of two events were performed over the course of the measurement program. For each event, mean, high, and low concentrations are identified for the high-emitting and areas and the low-emitting areas, together with the sample size and the requisite meteorology. Meteorological data are averaged over the 15-minute periods spanning the hot-spot measurements. Locations 24 through 27 (Figure 6-8) were not sampled during the first event. During the first event, Sample 24 (page A-83) corresponds to Location 28, and Sample 25 corresponds to a location along the southern side of the eastern-most tank (not depicted in Figure 6-8).

Based on review of the hot-spot data, the high-emitting areas are limited to the regions near Locations 1 and 19. The readings between Locations 1 and 6 suggest a hot-spot influence extending from Location 1 (influent point) to about Location 3 (downstream distance of 6.1 meters). This spatial extent is assumed for both regions. The mean hot-spot concentrations for the high-emitting areas are calculated by averaging the mean concentrations for each of the two hot-spot subareas. For the first subarea (near Location 1), this is simply the mean of the three readings (Locations 1, 2, and 3). Because corresponding downstream information is lacking for Location 19, however, the mean concentration for this second subarea is conservatively obtained by dividing the reading from Location 19 by the peak-to-mean ratio from the first subarea. Peak-to-mean ratios are calculated to be 1.74 (97 ÷ 55.7) for Event H-7 and 1.63 (137 ÷ 84.3) for Event H-11.

For Event H-7, the ratio of the mean concentration over the high-emitting areas to the mean concentration over the low-emitting areas is 6.8 to 1.

For Event H-11, the ratio is 8.0 to 1.

A hot-spot ratio of 7.4 to 1 was assigned, which is the average (rounded) of the two ratios.

Raw hot-spot data for this source can be found on pages A-83 and A-87 of Attachment A.

FIGURE 6-8

HOT-SPOT MONITORING EVENT LOCATIONS: AERATION TANKS

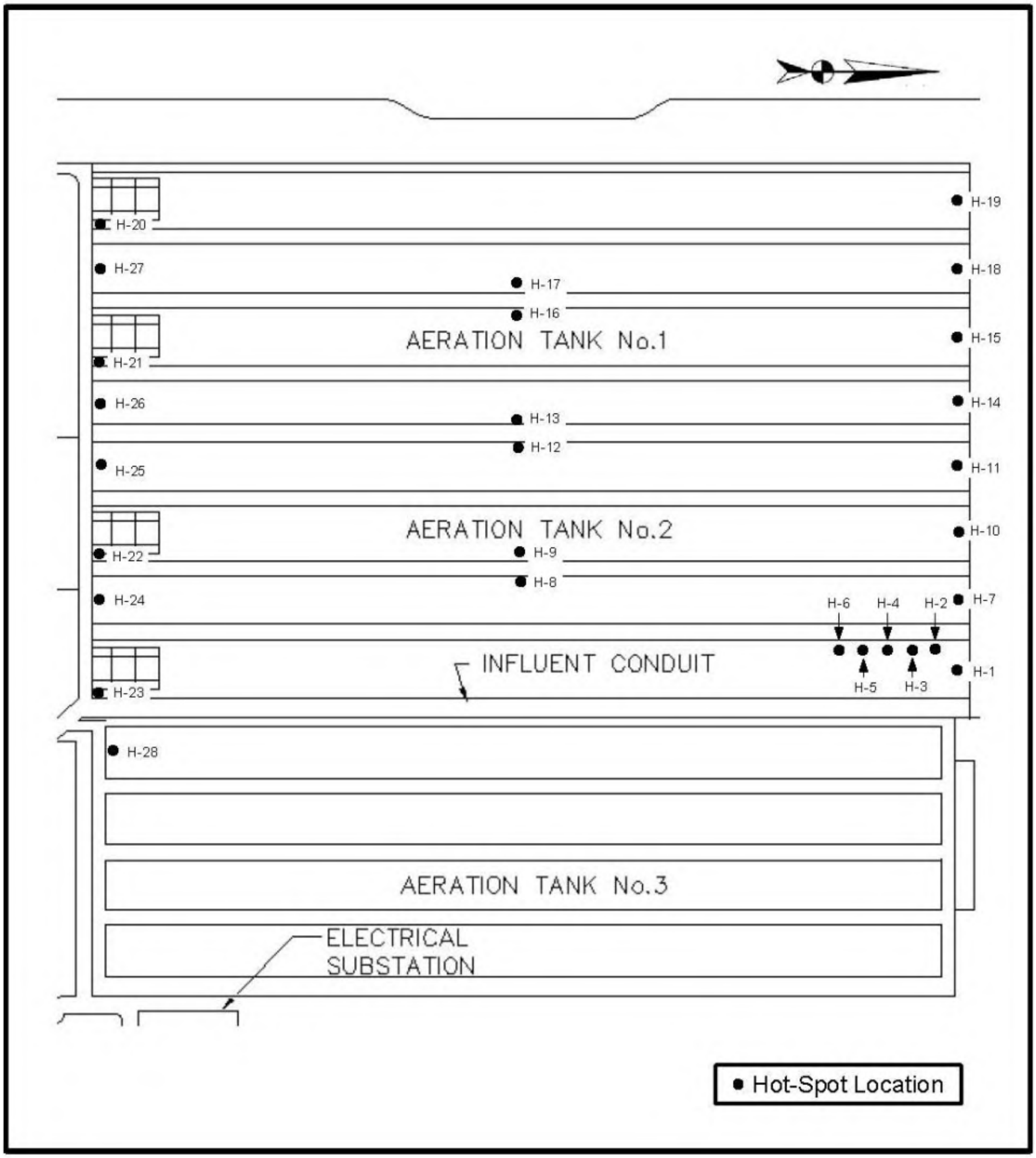

TABLE 6-10

SUMMARY OF HOT-SPOT MONITORING EVENTS: AERATION TANKS

Event			High-Emitting Area				Low-Emitting Area				Requisite Meteorology		
			Sample Size	Concentration (ppb)			Sample Size	Concentration (ppb)			Time (EDT)	WD @ 10m (º)	WS @ 10m (mph)
No.	Date	Time (EDT)		Mean	High	Low		Mean	High	Low			
H - 7	07/30/01	13:15 - 13:46	4	59.4	110	13	21	8.7	22	4	13:15 - 13:45	092	8.5
H - 11	08/15/01	12:29 - 13:14	4	88.2	150	57	24	11.0	25	6	12:30 - 13:15	164	9.5

6.3 Final Settling Tanks

The following monitoring data for the final settling tanks are presented in this section:

- downwind data
- upwind data
- hot-spot data

6.3.1 Downwind Data

Figure 6-9 depicts the downwind monitoring event locations for the final settling tanks. A total of 17 equispaced, H_2S sampling locations (5.39m spacing) are identified in each of two straight lines (pathlengths of 86.26m) oriented parallel to the source's western and eastern sides in order to accommodate winds from an easterly and westerly quadrant, respectively. Each path is 1 meter downwind of its respective source edge.

Table 6-11 presents a summary of all downwind monitoring events for the final settling tanks. A total of 18 event-pairs (3 monitoring days) are identified. Average downwind concentrations, determined via Simpson's three-point rule, are presented in units of both ppb-m and ug/m^2. Each downwind monitoring event was precisely 15 minutes long during which time coincident measurements of downwind H_2S (1 meter height) and requisite meteorology were made. As discussed in Section 4.1, requisite meteorology for subsequent emissions back-calculation are: wind direction and solar radiation at a height of 10 meters; temperature at 2 meters; change in temperature (delta or ΔT) between 2 and 10 meters, where a negative value indicates a temperature decrease with height; and wind speed at heights of 1 and 10 meters.

Of the 18 downwind event-pairs, the first 5 were collected along the eastern path (westerly wind), and the last 13 along the western path (easterly wind). For the eastern-path events, one or more individual Jerome meter readings were elevated due to impact from the preliminary settling tank weir areas for four of the event-pairs (Attachment C). Comparison of the 5-minute-averaged wind direction data (10 meters) comprising each of these four event-pairs (page B-6 of Attachment B) with the raw downwind data from Attachment A shows the direct correlation between an elevated Jerome meter measurement and the occurrence of a northerly component in the 5-minute-averaged wind direction observed during that measurement. Impacted concentrations are, therefore, conservatively "reconstructed" to support the assessment of source attribution (Attachment C) by defaulting to the higher of the two adjacent (non-impacted) concentrations.

For the western-path events, one or more individual Jerome meter readings were elevated due to impact from stagnant water in the scum-collection troughs at the west end of the inactive, southern-most tank (Tank 4) for three of the event-pairs (Attachment C). Impacted concentrations are conservatively “reconstructed” as discussed above.

All raw downwind data for this source can be found beginning on pages A-12, A-47, and A-55 of Attachment A. All downwind event calculations for this source can be found beginning on page C-30 of Attachment C.

FIGURE 6-9

DOWNWIND MONITORING EVENT LOCATIONS:
FINAL SETTLING TANKS

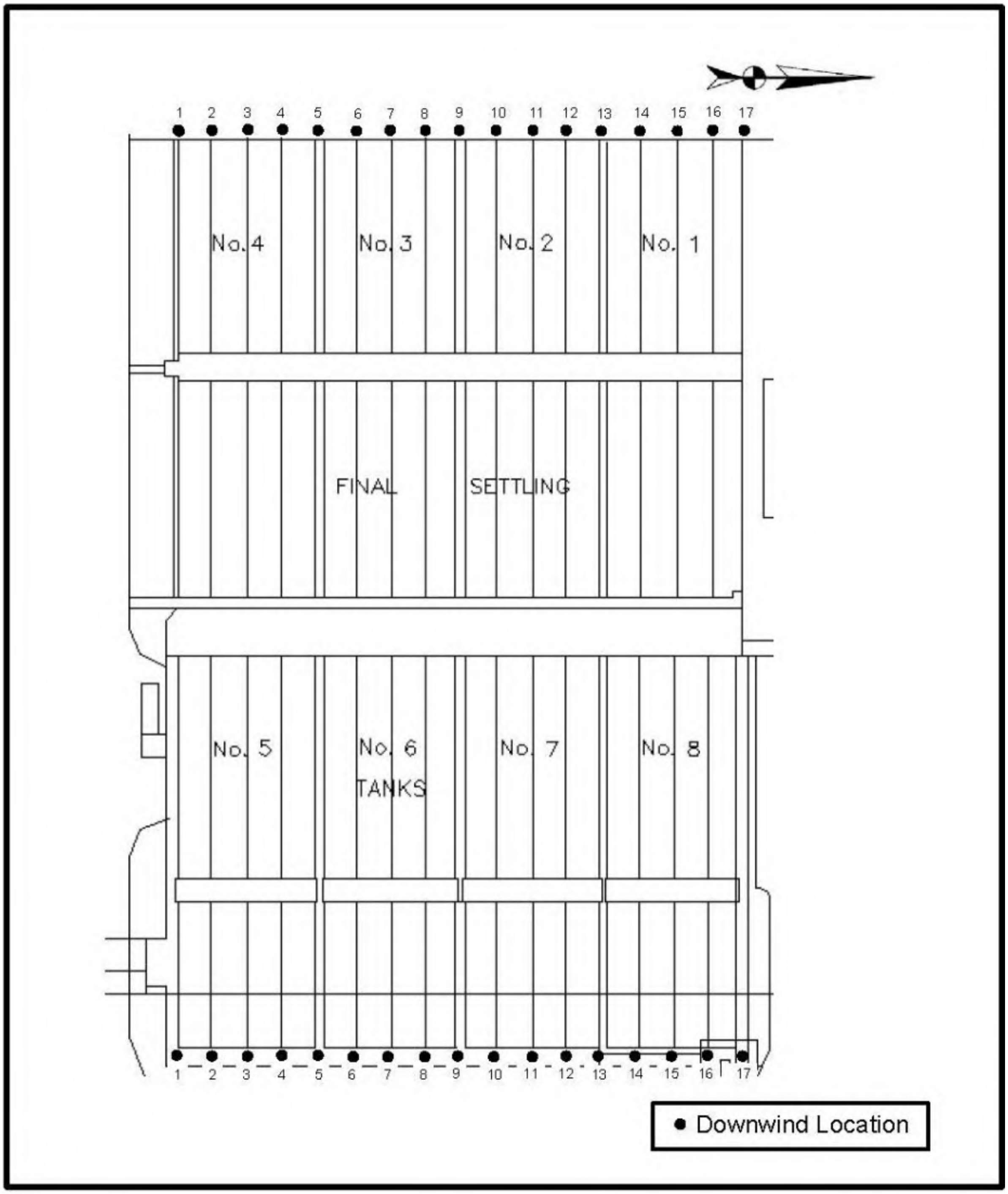

TABLE 6-11

SUMMARY OF DOWNWIND MONITORING EVENTS: FINAL SETTLING TANKS

Event			Average H_2S Conc.		Requisite Meteorology					
No.	Date	Averaging Time (EDT)	ppb-m	ug/m^2	WD @ 10m (º)	WS @ 1m (mph)	WS @ 10m (mph)	Solar Rad. (W/m^2)	2m Temp. (ºF)	2-10m ΔT (ºF)
E-18, 19	07/12/01	11:30 - 11:45	530.1	739.0	284	4.3	7.1	633	74.9	– 2.0
E-20, 21	07/12/01	11:45 - 12:00	558.9	779.1	299	4.6	7.1	534	74.6	– 1.8
E-22, 23	07/12/01	12:00 - 12:15	566.1	789.1	289	3.7	6.7	692	75.4	– 1.9
E-24, 25	07/12/01	12:15 - 12:30	522.0	727.7	287	4.9	6.5	874	76.6	– 2.6
E-26, 27	07/12/01	12:30 - 12:45	551.7	769.1	288	4.7	8.2	621	76.5	– 1.9
E-219, 20	08/14/01	12:45 - 13:00	681.3	949.7	062	4.1	9.8	754	80.0	– 0.7
E-221, 22	08/14/01	13:00 - 13:15	639.9	892.0	059	3.8	8.6	756	80.5	– 0.7
E-223, 24	08/14/01	13:15 - 13:30	708.3	987.4	059	4.6	8.2	755	80.9	– 0.6
E-225, 26	08/14/01	13:30 - 13:45	647.1	902.1	060	3.8	7.5	749	81.5	– 0.6
E-227, 28	08/14/01	13:45 - 14:00	667.8	930.9	052	3.7	6.5	661	82.3	– 0.9
E-229, 30	08/14/01	14:00 - 14:15	621.9	866.9	051	4.2	9.2	591	82.1	– 0.7
E-231, 32	08/14/01	14:15 - 14:30	637.2	888.3	052	3.3	6.3	740	82.3	– 1.0
E-315, 16	09/06/01	07:45 - 08:00	283.5	395.2	048	2.7	4.5	253	63.7	– 0.7
E-317, 18	09/06/01	08:00 - 08:15	323.1	450.4	041	2.6	4.5	308	64.5	– 1.0
E-319, 20	09/06/01	08:15 - 08:30	375.3	523.2	060	2.6	3.8	354	65.5	– 0.8
E-321, 22	09/06/01	08:30 - 08:45	372.6	519.4	079	2.7	4.8	389	66.3	– 0.8
E-323, 24	09/06/01	08:45 - 09:00	357.3	498.1	085	2.8	5.3	414	67.0	– 0.8
E-325, 26	09/06/01	09:00 - 09:15	380.7	530.7	091	2.8	5.4	440	67.5	– 0.8

6.3.2 Upwind Data

Figure 6-10 depicts the upwind monitoring event locations for the final settling tanks. Location 1 was used for events on the first monitoring day with a westerly wind (Events E-18 through E-27), and Location 2 was used on the remaining two days with an easterly wind (Events E-219 through E-232 and Events E-315 through E-326).

Table 6-12 presents a summary of upwind monitoring events for the final settling tanks. A total of four monitoring events were performed. The average upwind concentration, determined via straight arithmetic averaging, is presented in units of both ppb and ug/m^3. Each upwind event is comprised of between three and five successive, collocated measurements. Two upwind events were completed for one of the monitoring days (August 14). However, based on review of that day's downwind data, an upwind concentration is conservatively assigned for the entire day's downwind measurements based only on the second event. Each upwind monitoring event was between 2 and 3 minutes long during which time measurements of upwind H_2S (1 meter height) and requisite meteorology were made. Requisite meteorology for subsequent assessment of source-attribution are wind direction and wind speed at a height of 10 meters.

Based on the above data, the following upwind concentrations are employed:

- 07/12/01 - 5.0 ppb (7.0 ug/m^3) for all events
- 08/14/01 - 5.9 ppb (8.2 ug/m^3) for all events
- 09/06/01 - 3.9 ppb (5.4 ug/m^3) for all events

All raw upwind data for this source can be found on pages A-59, A-70, A-71, and A-75 of Attachment A.

FIGURE 6-10

UPWIND MONITORING EVENT LOCATIONS: FINAL SETTLING TANKS

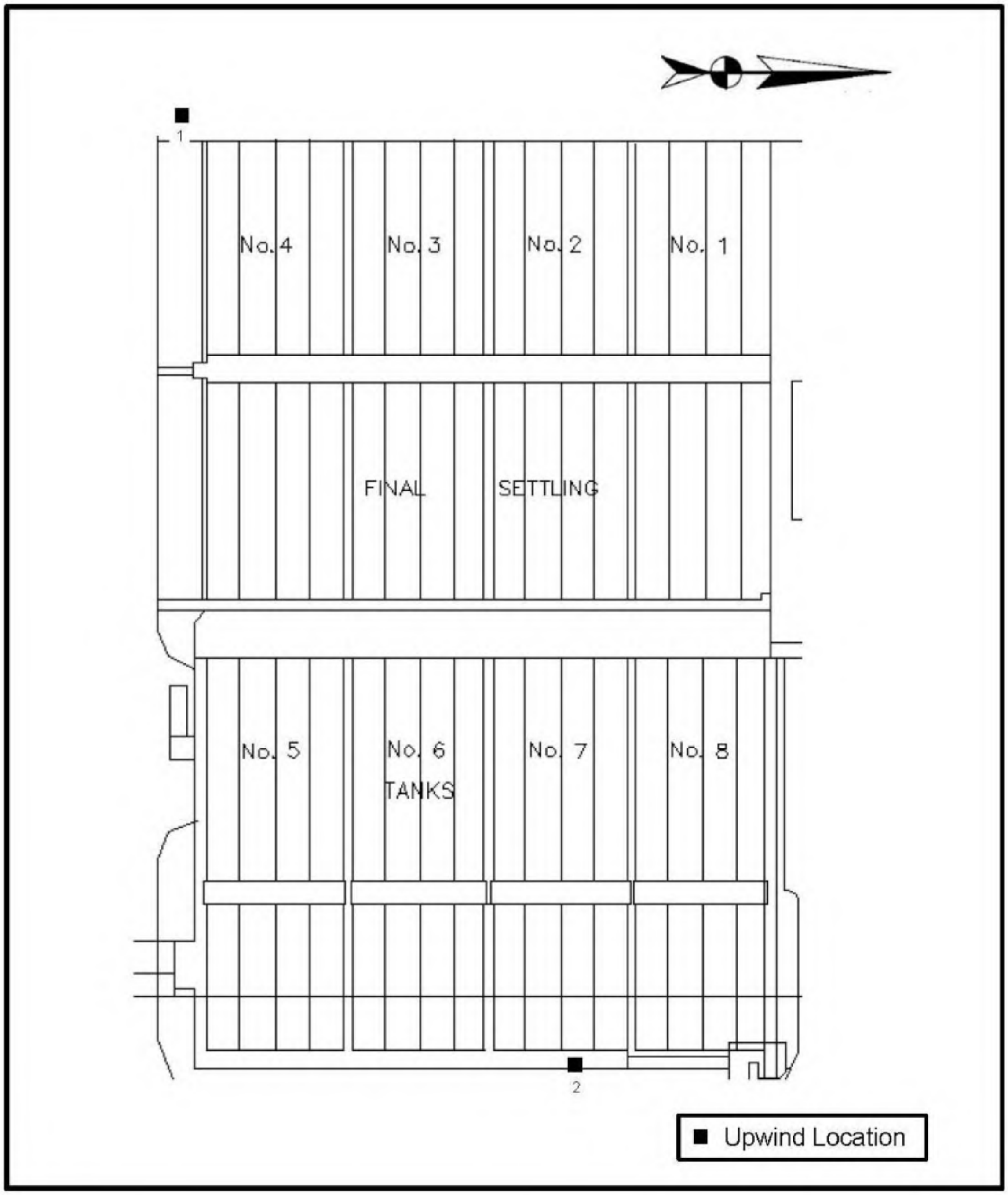

TABLE 6-12

SUMMARY OF UPWIND MONITORING EVENTS: FINAL SETTLING TANKS

Event			Average Conc.		Requisite Meteorology		
No.	Date	Time (EDT)	ppb	ug/m^3	Time (EDT)	WD @ 10m (º)	WS @ 10m (mph)
E - 28	07/12/01	12:50 - 12:52	5.0	7.0	12:45 - 13:00	291	9.3
E - 218	08/14/01	12:34 - 12:37	9.1	12.7	12:30 - 12:45	055	8.8
E - 233	08/14/01	14:33 - 14:36	5.9	8.2	14:30 - 14:45	070	6.8
E - 327	09/06/01	09:19 - 09:22	3.9	5.4	09:15 - 09:30	079	4.5

6.3.3 Hot-Spot Data

Figure 6-11 depicts a total of 31 hot-spot monitoring event locations for the final settling tanks. Hot-spot data was collected to support source-strength apportionment during subsequent emissions back-calculations. Locations 15 through 22 correspond to small grates covering sludge draw-off syphons, which were expected to be high-emitting areas as the syphons handle accumulated sludge from the bottom of the final settling tanks. Location 31 was not sampled, as the adjacent tank (Tank No. 4) was empty.

Table 6-13 presents a summary of hot-spot monitoring events for the final settling tanks. A total of four events were performed over the course of the measurement program. For each event, mean, high, and low concentrations are identified for the high-emitting and areas and the low-emitting areas, together with the sample size and the requisite meteorology. Meteorological data are averaged over the 15-minute periods spanning the hot-spot measurements. Readings from Locations 6, 7, and 8 are dropped from Event H-3, as attribution from the preliminary settling tank weir areas is suspected. Based on review of the hot-spot data, the high-emitting areas are limited to Locations 16 through 22, as the sludge draw-off syphon corresponding to Location 15 did not exhibit elevated readings during any of the four hot-spot events.

For Event H-3, the ratio of the mean concentration over the high-emitting areas to the mean concentration over the low-emitting areas is 5.0 to 1.

For Event H-8, the ratio is 2.7 to 1.

For Event H-10, the ratio is 2.4 to 1.

For Event H-12, the ratio is 1.4 to 1.

A hot-spot ratio of 2.9 to 1 was assigned, which is the average (rounded) of the four ratios.

Raw hot-spot data for this source can be found on pages A-79, A-84, A-86, and A-88 of Attachment A.

FIGURE 6-11

HOT-SPOT MONITORING EVENT LOCATIONS:
FINAL SETTLING TANKS

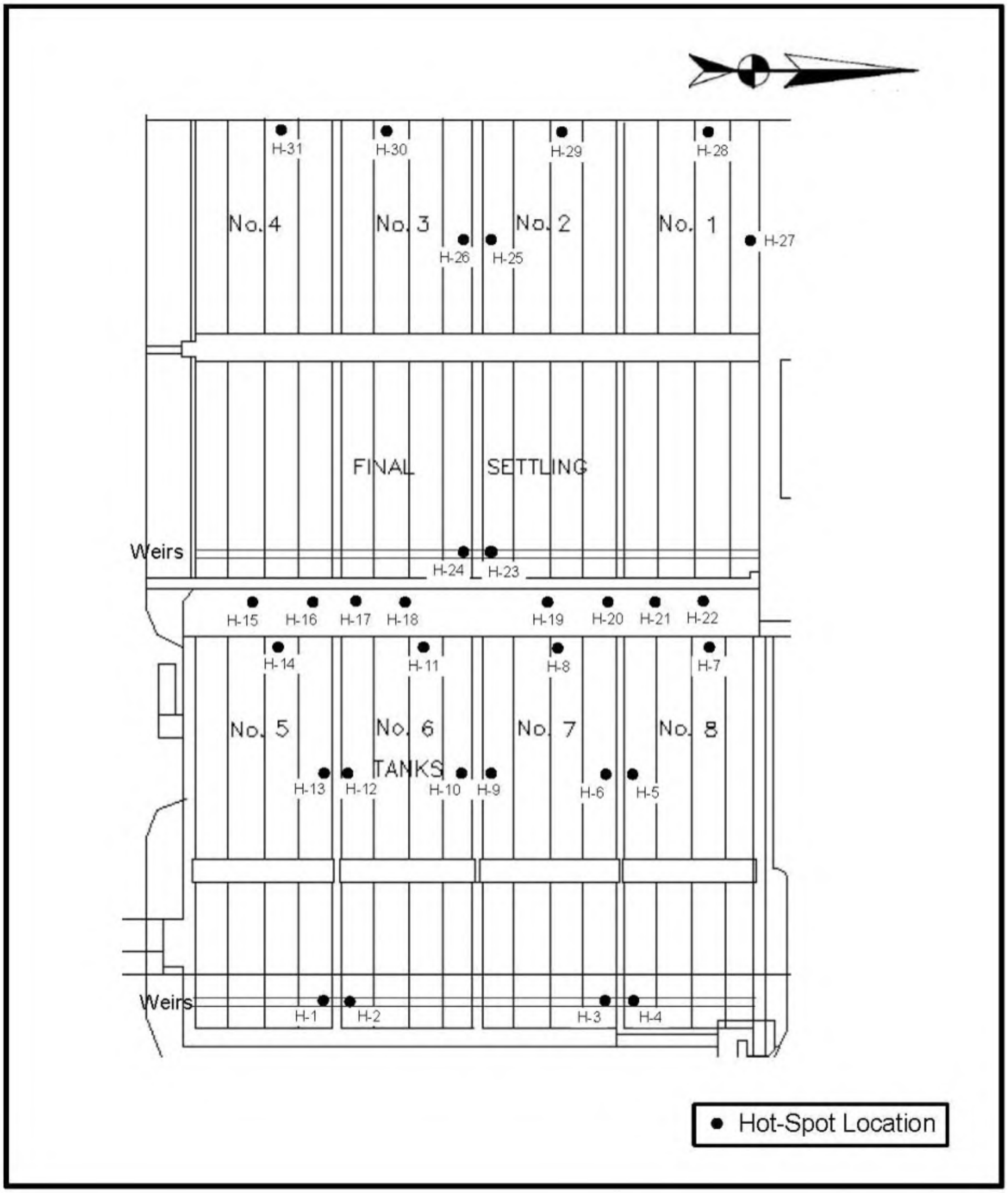

TABLE 6-13

SUMMARY OF HOT-SPOT MONITORING EVENTS: FINAL SETTLING TANKS

Event			High-Emitting Area				Low-Emitting Area				Requisite Meteorology		
			Sample Size	Concentration (ppb)			Sample Size	Concentration (ppb)					
No.	Date	Time (EDT)		Mean	High	Low		Mean	High	Low	Time (EDT)	WD @ 10m (°)	WS @ 10m (mph)
H - 3	07/12/01	10:10 - 10:46	7	37.9	110	10	20	7.6	14	6	10:15 - 10:45	300	6.6
H - 8	07/30/01	13:50 - 14:22	7	11.4	17	7	23	4.3	6	2	13:45 - 14:30	093	8.3
H - 10	08/14/01	14:48 - 15:16	7	17.3	44	9	23	7.3	14	6	14:45 - 15:15	054	6.2
H - 12	09/06/01	09:31 - 10:00	7	11.0	19	7	23	7.9	27	4	09:30 - 10:00	110	4.0

6.4 High- and Low-Level Pump Stations

Monitoring data for the high- and low-level pump stations are presented in this section.

Figure 6-12 depicts the monitoring event locations for the high- and low-level pump stations. Five locations are identified for each source.

Table 6-14 and **Table 6-15** present summaries of monitoring events for the high- and low-level pump stations, respectively. A total of 17 monitoring events over 9 days were completed for each source. Bolded entries indicate data used in subsequent emissions calculations (Section 7.4). With one exception, all events are comprised of measurements at the five locations depicted in Figure 6-12; for the first event at the low-level pump station (Event E-246), five measurements were made from a single location in the interior doorway (not depicted in figure) because the room was unsafe for entry, as evidenced by the fact that the H_2S alarm was sounding. Mean, high, and low concentrations are presented, in units of both ppb and ug/m^3, for each event for the two sources. Each monitoring event was between 3 and 7 minutes long, during which time measurements of H_2S (1 meter height) and supporting meteorology were made. Supporting meteorology, to demonstrate that winds are sufficiently light to avoid increased ventilation beyond the exhaust-fan ratings, are wind direction and wind speed at a height of 10 meters.

All raw data for this source can be found on pages A-99, A-100, A-103, A-105, A-107, A-109 through A-111, A-115, A-117, A-121, A-125, A-126, A-128, A-132, A-134, and A-135 of Attachment A.

FIGURE 6-12

MONITORING EVENT LOCATIONS:
HIGH- AND LOW-LEVEL PUMP STATIONS

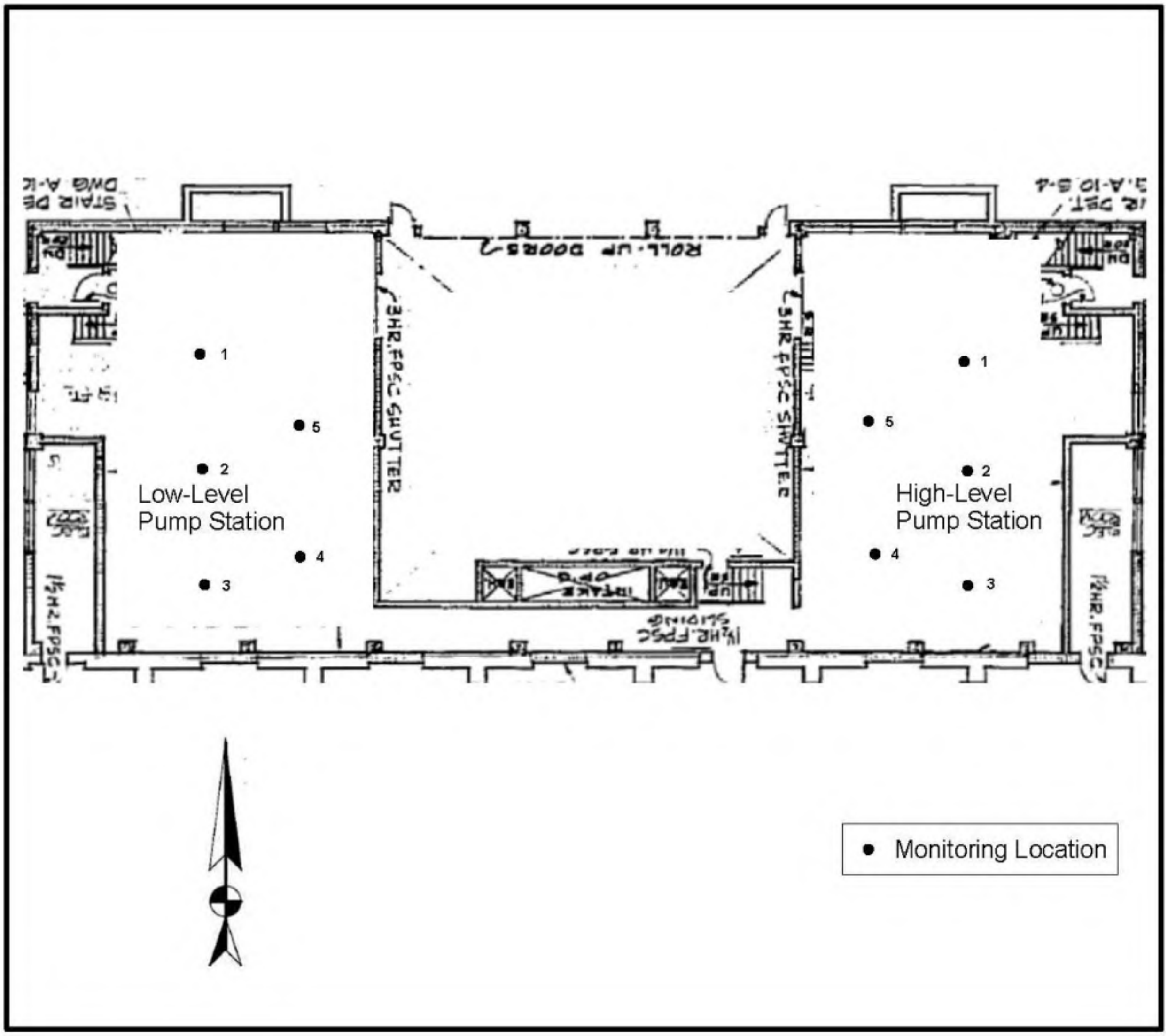

TABLE 6-14

SUMMARY OF MONITORING EVENTS: HIGH-LEVEL PUMP STATION

Event			Sample Size	Average Concentration						Supporting Meteorology		
				Mean		High		Low				
No.	Date	Time (EDT)		ppb	ug/m^3	ppb	ug/m^3	ppb	ug/m^3	Time (EDT)	WD @ 10m (°)	WS @ 10m (mph)
E-245	08/15/01	13:47 - 13:51	5	4260	**5940**	5600	7810	2400	3350	13:45 - 14:00	173	8.8
E-247	08/16/01	10:11 - 10:15	5	245	**342**	350	490	106	148	10:00 - 10:15	173	5.8
E-258	08/16/01	13:13 - 13:17	5	176	**245**	320	450	81	113	13:15 - 13:30	167	7.9
E-261	08/21/01	11:23 - 11:26	5	120	**170**	150	210	110	150	11:15 - 11:30	291	5.9
E-275	08/22/01	10:02 - 10:07	5	17	**24**	23	32	13	18	10:00 - 10:15	324	5.3
E-278	08/22/01	11:07 - 11:11	5	69	**96**	79	110	51	71	11:00 - 11:15	273	4.0
E-280	08/22/01	12:19 - 12:23	5	45	**63**	83	116	32	45	12:15 - 12:30	296	6.0
E-282	08/27/01	13:06 - 13:11	5	900	**1250**	2000	2790	490	680	13:00 - 13:15	206	7.3
E-287	08/27/01	15:30 - 15:35	5	600	**840**	880	1230	200	280	15:30 - 15:45	187	8.9
E-290	08/30/01	11:30 - 11:34	5	3160	**4410**	3700	5160	2600	3620	11:30 - 11:45	174	4.8
E-295	08/30/01	13:03 - 13:08	5	1120	**1560**	1800	2510	720	1000	13:00 - 13:15	168	8.0
E-300	08/30/01	14:15 - 14:19	5	620	**860**	830	1160	350	490	14:15 - 14:30	169	11.0
E-302	09/04/01	12:15 - 12:18	5	250	**350**	400	560	120	170	12:15 - 12:30	241	5.7
E-305	09/05/01	10:15 - 10:18	5	1430	**1990**	1900	2650	1070	1490	10:15 - 10:30	020	7.9
E-310	09/05/01	11:16 - 11:21	5	620	**860**	810	1130	450	630	11:15 - 11:30	026	8.0
E-313	09/06/01	07:00 - 07:03	5	160	**220**	200	280	110	150	07:00 - 07:15	029	2.5
E-328	09/06/01	09:30 - 09:34	5	1760	**2450**	2100	2930	1300	1810	09:30 - 09:45	100	4.6

TABLE 6-15

SUMMARY OF MONITORING EVENTS: LOW-LEVEL PUMP STATION

Event			Sample Size	Average Concentration						Supporting Meteorology		
				Mean		High		Low				
No.	Date	Time (EDT)		ppb	ug/m³	ppb	ug/m³	ppb	ug/m³	Time (EDT)	WD @ 10m (º)	WS @ 10m (mph)
E-246	08/15/01	13:52 - 13:55	5	5600	**7810**	7000	9760	2400	3350	13:45 - 14:00	173	8.8
E-248	08/16/01	10:32 - 10:36	5	182	**254**	770	1070	31	43	10:30 - 10:45	171	6.6
E-259	08/16/01	13:18 - 13:22	5	141	**197**	440	610	46	64	13:15 - 13:30	167	7.9
E-262	08/21/01	11:27 - 11:30	5	160	**220**	350	490	110	150	11:15 - 11:30	291	5.9
E-276	08/22/01	10:08 - 10:12	5	15	**21**	23	32	13	18	10:00 - 10:15	324	5.3
E-279	08/22/01	11:12 - 11:15	5	77	**107**	230	320	33	46	11:00 - 11:15	273	4.0
E-281	08/22/01	12:24 - 12:28	5	92	**128**	260	360	41	57	12:15 - 12:30	296	6.0
E-283	08/27/01	13:11 - 13:15	5	630	**880**	940	1310	470	660	13:00 - 13:15	206	7.3
E-288	08/27/01	15:35 - 15:42	5	2240	**3120**	4100	5720	780	1090	15:30 - 15:45	187	8.9
E-291	08/30/01	11:35 - 11:38	5	4850	**6760**	9600	13380	1070	1490	11:30 - 11:45	174	4.8
E-296	08/30/01	13:09 - 13:13	5	630	**880**	790	1100	480	670	13:00 - 13:15	168	8.0
E-301	08/30/01	14:20 - 14:25	5	780	**1090**	940	1310	640	890	14:15 - 14:30	169	11.0
E-303	09/04/01	12:19 - 12:23	5	430	**600**	520	720	300	420	12:15 - 12:30	241	5.7
E-306	09/05/01	10:18 - 10:22	5	1540	**2150**	2100	2930	210	290	10:15 - 10:30	020	7.9
E-311	09/05/01	11:21 - 11:25	5	1250	**1740**	1900	2650	130	180	11:15 - 11:30	026	8.0
E-314	09/06/01	07:03 - 07:07	5	100	**140**	140	200	62	86	07:00 - 07:15	029	2.5
E-329	09/06/01	09:35 - 09:40	5	820	**1140**	1100	1530	290	400	09:30 - 09:45	100	4.6

6.5 Sludge Thickener Building

Monitoring data for the Sludge Thickener Building is presented in this section.

Figure 6-13 depicts the monitoring event locations for the Sludge Thickener Building. All measurements were taken from a location within about 6 inches of the fan exhaust serving the four sludge thickeners.

Table 6-16 presents a summary of monitoring events for the Sludge Thickener Building. A total of 20 monitoring events (15 days) were completed. All events consisted of at least five individual measurements. Mean, high, and low concentrations are presented, in units of both ppb and ug/m^3, for each event. Bolded entries indicate data used in subsequent emissions calculations (Section 7.5). Each monitoring event was between 3 and 5 minutes in duration, during which time measurements of H_2S (1 meter height) and supporting meteorology were made. Supporting meteorology, to demonstrate that winds are sufficiently light to avoid increased ventilation beyond the exhaust-fan ratings, are wind direction and wind speed at a height of 10 meters.

All raw data for this source can be found on pages A-91 through A-98, A-102, A-104, A-106, A-108, A-112, A-116, A-118, A-122, A-127, A-129, A-133, and A-136 of Attachment A.

FIGURE 6-13

MONITORING EVENT LOCATIONS:
SLUDGE THICKENER BUILDING

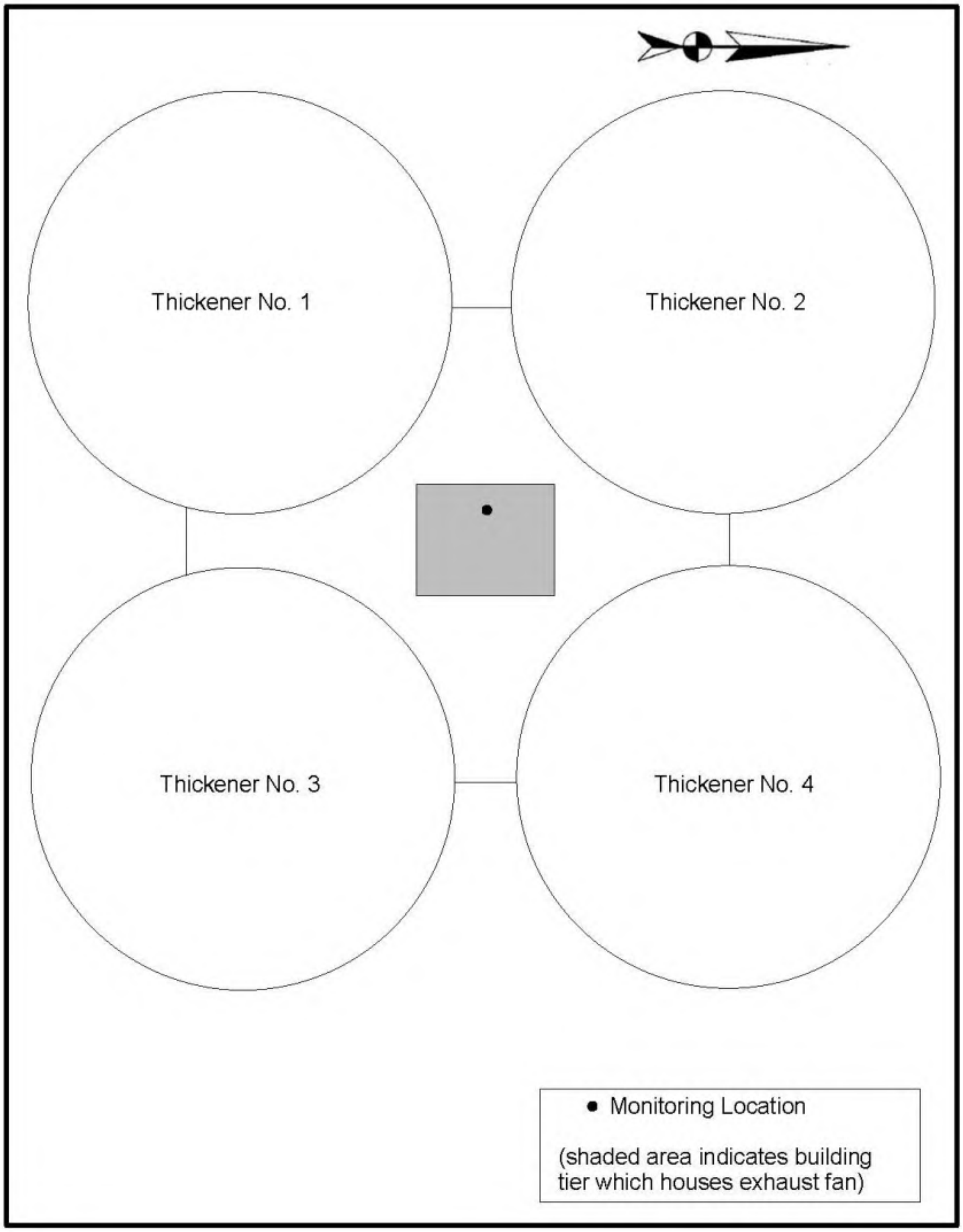

TABLE 6-16

SUMMARY OF MONITORING EVENTS: SLUDGE THICKENER BUILDING

Event			Sample Size	Average Concentration						Supporting Meteorology		
				Mean		High		Low				
No.	Date	Time (EDT)		ppb	ug/m^3	ppb	ug/m^3	ppb	ug/m^3	Time (EDT)	WD @ 10m (°)	WS @ 10m (mph)
E-48	07/16/01	19:52 - 19:55	5	160	**220**	200	280	130	180	19:45 - 20:00	210	5.9
E-49	07/17/01	11:55 - 11:58	5	107	**149**	120	170	93	130	11:45 - 12:00	275	5.7
E-50	07/17/01	14:30 - 14:33	5	78	**109**	95	132	66	92	14:30 - 14:45	278	4.3
E-74	07/19/01	14:34 - 14:37	5	96	**134**	114	159	77	107	14:30 - 14:45	043	8.1
E-134	07/30/01	17:25 - 17:28	5	130	**180**	130	180	120	170	17:15 - 17:30	209	5.4
E-167	08/02/01	17:25 - 17:28	5	83	**116**	98	137	64	89	17:15 - 17:30	187	7.5
E-234	08/14/01	14:45 - 14:49	5	21	**29**	24	33	18	25	14:45 - 15:00	055	6.7
E-244	08/15/01	12:01 - 12:06	9	350	**490**	1600	2230	97	135	12:00 - 12:15	148	7.4
E-250	08/16/01	11:12 - 11:15	5	84	**117**	90	125	79	110	11:00 - 11:15	170	6.8
E-260	08/16/01	13:36 - 13:40	5	81	**113**	102	142	72	100	13:30 - 13:45	173	8.6
E-263	08/21/01	11:48 - 11:52	6	83	**116**	120	170	58	81	11:45 - 12:00	315	5.5
E-277	08/22/01	10:22 - 10:25	5	103	**144**	130	180	84	117	10:15 - 10:30	339	5.8
E-284	08/27/01	13:25 - 13:30	5	53	**74**	64	89	44	61	13:15 - 13:30	186	10.9
E-289	08/27/01	15:45 - 15:50	5	160	**220**	190	260	145	202	15:45 - 16:00	198	8.4
E-292	08/30/01	11:41 - 11:45	5	200	**280**	240	330	180	250	11:30 - 11:45	174	4.8
E-297	08/30/01	13:20 - 13:25	5	160	**220**	180	250	140	200	13:15 - 13:30	167	8.6
E-304	09/04/01	12:27 - 12:30	5	35	**49**	42	59	30	42	12:15 - 12:30	241	5.7
E-307	09/05/01	10:26 - 10:30	5	45	**63**	48	67	42	59	10:15 - 10:30	020	7.9
E-312	09/05/01	11:40 - 11:45	5	53	**74**	58	81	48	67	11:30 - 11:45	035	8.8
E-330	09/06/01	09:45 - 09:50	5	23	**32**	24	33	22	31	09:45 - 10:00	120	3.5

6.6 Sludge Storage Tanks

Monitoring data for the sludge storage tanks is presented in this section.

Figure 6-14 depicts the monitoring event locations for the sludge storage tanks. Tank 1 (5801) and Tank 2 (5802) are identical in design. Each tank has eight openings, equispaced around the circumference, from which samples were collected. Each opening has an area of 0.42 square meters, and averages about 1.5 meters above grade.

Sludge Storage Tank 3 (5803), the newer tank, is similar in design, but has 18 openings. Sampling was limited to the six northern-most openings, which are accessible only from the roof of the Digester Building. Each opening has an area of 0.42 square meters, and each accessible opening is about 0.5 meters above the roof top.

Each measurement was taken from a position about 0.2 meters inside the respective opening.

Table 6-17 presents a summary of monitoring events for the sludge storage tanks. A total of four monitoring events (3 days) were completed for each of the first two tanks, and one event for Tank 3. All events consisted of eight individual measurements for Tanks 1 and 2, and six measurements for Tank 3. Mean, high, and low concentrations are presented, in units of both ppb and ug/m^3, for each event. For each event, low-end outliers are dropped when calculating the above concentrations. This conservative treatment is employed to account for the fact that clean air is periodically entrained into the tank. Bolded entries indicate data used in subsequent emissions calculations (Section 7.6).

Each monitoring event was between 5 and 12 minutes long, during which time measurements of H_2S and supporting meteorology were made. Supporting meteorology, to evidence the validity of assumptions about building-air exchange rates (Section 7.6), are wind direction and wind speed at a height of 10 meters.

All raw data for this source can be found on pages A-101, A-113, A-114, A-119, A-120, A-123, A-124, A-130, and A-131 of Attachment A.

FIGURE 6-14

MONITORING EVENT LOCATIONS: SLUDGE STORAGE TANKS

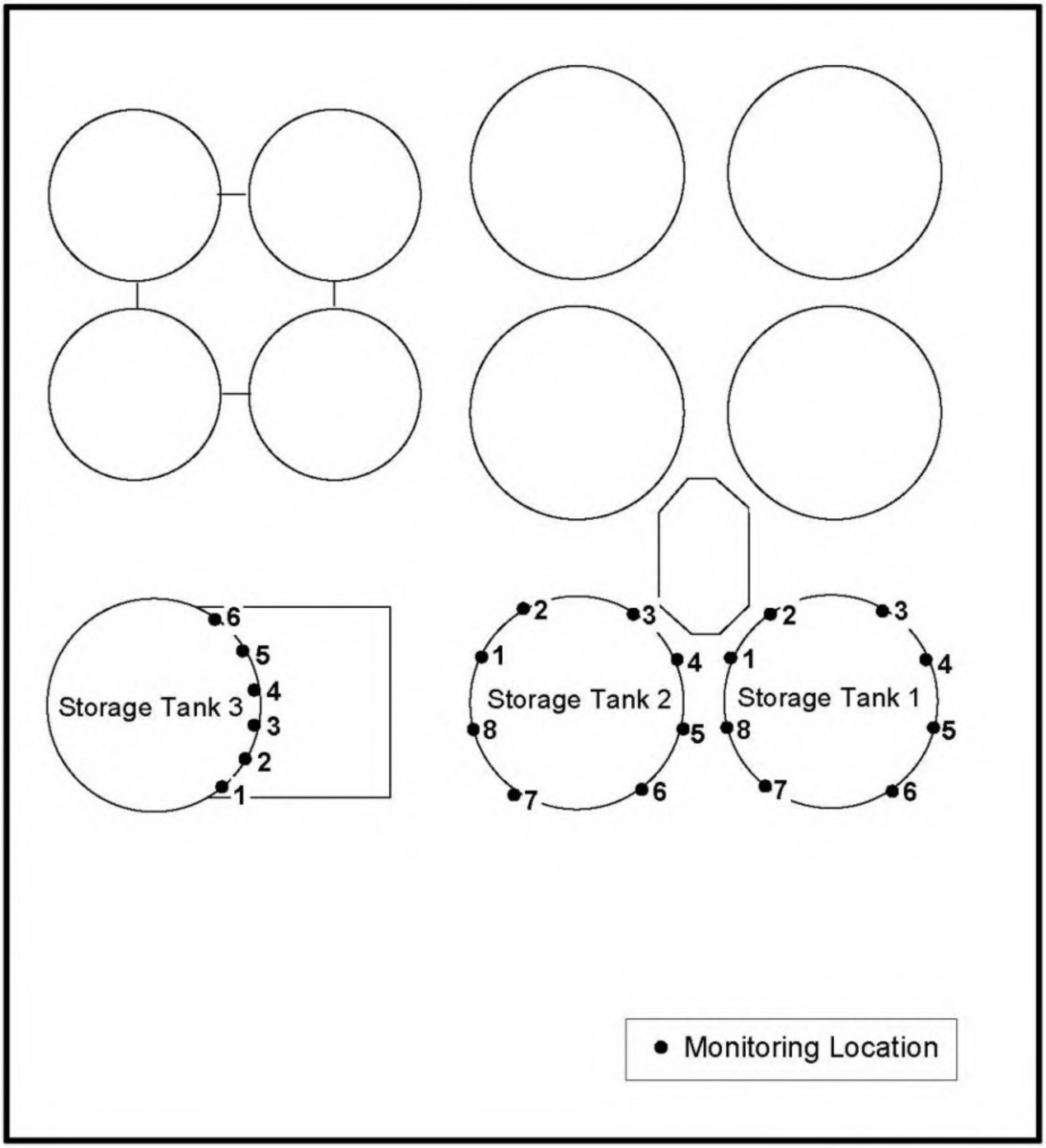

TABLE 6-17

SUMMARY OF MONITORING EVENTS: SLUDGE STORAGE TANKS

Sludge Storage Tank 1

Event			Sample Size	Average Concentration						Supporting Meteorology		
				Mean		High		Low				
No.	Date	Time (EDT)		ppb	ug/m³	ppb	ug/m³	ppb	ug/m³	Time (EDT)	WD @ 10m (º)	WS @ 10m (mph)
E-286	08/27/01	13:53 - 14:00	6	310	**430**	530	740	220	310	13:45 - 14:00	184	9.6
E-294	08/30/01	12:08 - 12:15	5	240	**330**	430	600	110	153	12:00 - 12:15	163	7.0
E-299	08/30/01	13:37 - 13:45	7	210	**290**	340	470	130	180	13:30 - 13:45	167	9.9
E-309	09/05/01	10:45 - 10:55	5	170	**240**	320	450	110	150	10:45 - 11:00	027	8.1

Sludge Storage Tank 2

E-285	08/27/01	13:45 - 13:52	7	720	**1000**	1300	1810	450	630	13:45 - 14:00	184	9.6
E-293	08/30/01	12:00 - 12:07	5	3900	**5440**	6500	9060	1400	1950	12:00 - 12:15	163	7.0
E-298	08/30/01	13:30 - 13:36	5	3440	**4800**	3800	5300	3000	4180	13:30 - 13:45	167	9.9
E-308	09/05/01	10:32 - 10:44	5	73	**102**	110	150	33	46	10:30 - 10:45	028	7.7

Sludge Storage Tank 3

E-249	08/16/01	11:02 - 11:07	6	41	**57**	46	64	28	39	11:00 - 11:15	170	6.8

SECTION 7 - EMISSIONS CHARACTERIZATION

This section presents a characterization of H_2S emissions for each source based on the emissions data from Section 6.

Sections 7.1 through 7.6, respectively, present all emissions-characterization results for the following sources:*

- preliminary settling tanks
- aeration tanks
- final settling tanks
- high- and low-level pump stations
- Sludge Thickener Building
- sludge storage tanks

Included in the emissions-characterization for the preliminary settling tanks are results of the program component involving the direct estimation of vertical dispersion coefficients.

AERMOD input and output files for all area-source emission-rate estimates are provided in Attachment F.

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* Excluded are emissions-characterization results for the Hendrix Street Canal and from the limited ancillary measurement program for the preliminary settling tanks as discussed in Section 1.

7.1 Preliminary Settling Tanks

Section 7.1.1 presents the source-measurement representation employed in the emissions back-calculation modeling. Section 7.1.2 presents data analysis and discussion.

7.1.1 Source-Measurement Representation

Figure 7-1 depicts the source-measurement relationship used in AERMOD emissions back-calculation modeling for the preliminary settling tanks. Based on the hot-spot data (Section 6.1), this source is represented as a group of 52 rectangles: 16 comprising the quiescent area and 36 comprising the turbulent area. The measurement path is parallel to the northern edge of the source, and the path-source separation distance is 1.0m.

Table 7-1 and **Table 7-2** depict, for the quiescent and turbulent areas, respectively, the locations and dimensions as input to AERMOD. The height above flat terrain is set to zero for all subareas. The total areas are also depicted. All orientations are with respect to plant north.

Table 7-3 depicts the receptor locations for the preliminary settling tank unity-based modeling. A total of 84 receptors (1m spacing, 1m flagpole height) are used to represent the 83m cross-plume pathlength.

FIGURE 7-1

SOURCE-MEASUREMENT RELATIONSHIP: PRELIMINARY SETTLING TANKS

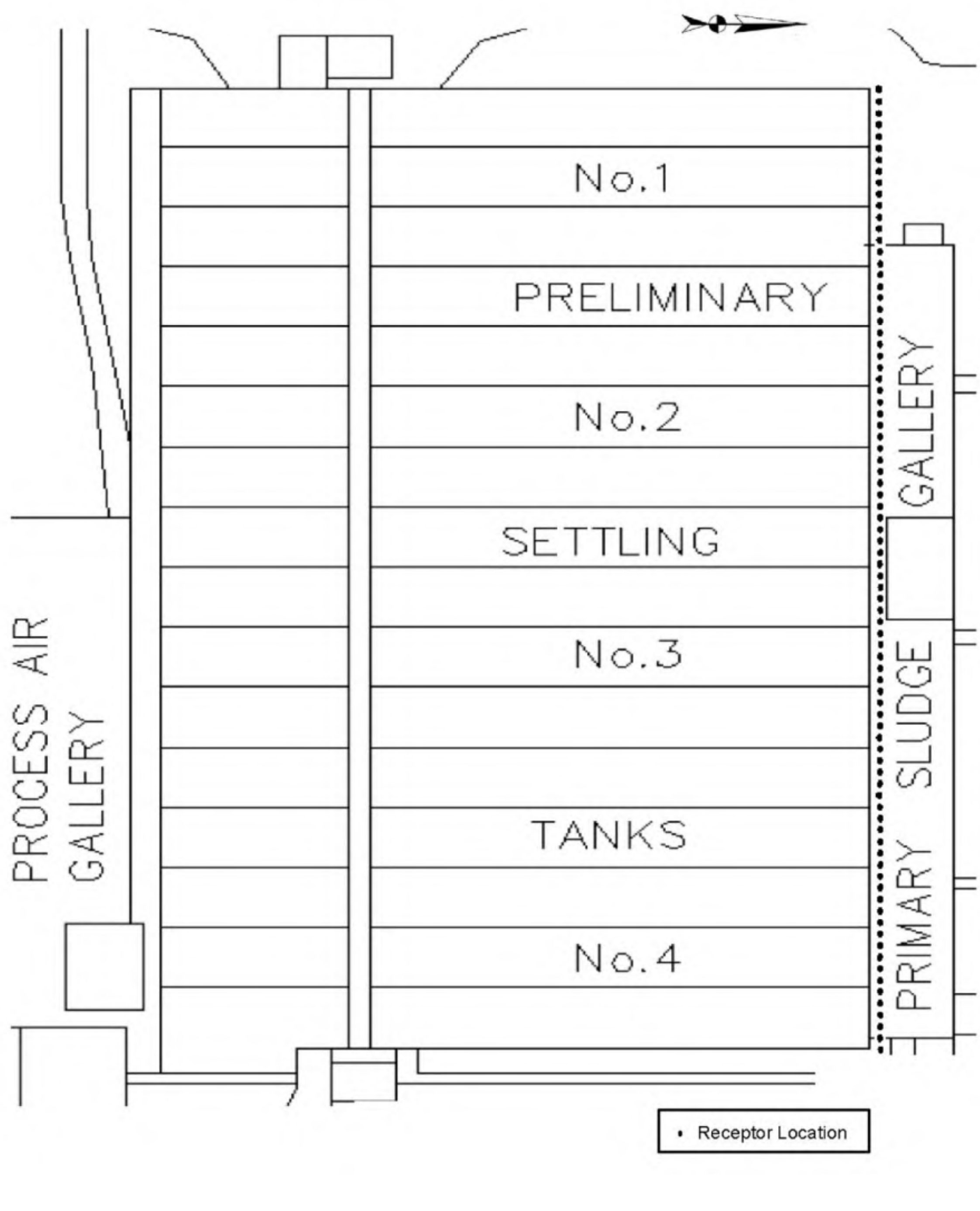

TABLE 7-1

LOCATIONS AND DIMENSIONS OF QUIESCENT AREAS: PRELIMINARY SETTLING TANKS

AERMOD ID	Coordinates (m) (Southwest Corner)		Dimensions (m)		Area (m^2)
	x	y	x	y	
PTQ01	10000.06	10000.00	4.72	45.06	212.68
PTQ02	10005.24	10000.00	4.72	45.06	212.68
PTQ03	10010.42	10000.00	4.72	45.06	212.68
PTQ04	10015.60	10000.00	4.57	45.06	205.92
PTQ05	10020.93	10000.00	4.57	45.06	205.92
PTQ06	10025.96	10000.00	4.72	45.06	212.68
PTQ07	10031.14	10000.00	4.72	45.06	212.68
PTQ08	10036.32	10000.00	4.57	45.06	205.92
PTQ09	10041.65	10000.00	4.57	45.06	205.92
PTQ10	10046.68	10000.00	4.72	45.06	212.68
PTQ11	10051.86	10000.00	4.72	45.06	212.68
PTQ12	10057.04	10000.00	4.57	45.06	205.92
PTQ13	10062.37	10000.00	4.57	45.06	205.92
PTQ14	10067.40	10000.00	4.72	45.06	212.68
PTQ15	10072.58	10000.00	4.72	45.06	212.68
PTQ16	10077.76	10000.00	4.72	45.06	212.68
			Total: Quiescent Areas		**3362.38**

TABLE 7-2

LOCATIONS AND DIMENSIONS OF TURBULENT AREAS: PRELIMINARY SETTLING TANKS

AERMOD ID	Coordinates (m) (Southwest Corner)		Dimensions (m)		Area (m^2)
	x	y	x	y	
PTT01S	9999.84	10000.00	0.58	5.00	2.90
PTT01C	9999.84	10005.00	0.58	5.00	2.90
PTT01N	9999.84	10010.00	0.58	3.74	2.17
PTT02S	10004.84	10000.00	0.76	7.00	5.32
PTT02N	10004.84	10007.00	0.76	6.74	5.12
PTT03S	10010.03	10000.00	0.76	7.00	5.32
PTT03N	10010.03	10007.00	0.76	6.74	5.12
PTT04S	10015.21	10000.00	0.76	7.00	5.32
PTT04N	10015.21	10007.00	0.76	6.74	5.12
PTT05S	10020.39	10000.00	0.76	7.00	5.32
PTT05N	10020.39	10007.00	0.76	6.74	5.12
PTT06S	10025.57	10000.00	0.76	7.00	5.32
PTT06N	10025.57	10007.00	0.76	6.74	5.12
PTT07S	10030.75	10000.00	0.76	7.00	5.32
PTT07N	10030.75	10007.00	0.76	6.74	5.12
PTT08S	10035.93	10000.00	0.76	7.00	5.32
PTT08N	10035.93	10007.00	0.76	6.74	5.12
PTT09S	10041.12	10000.00	0.76	7.00	5.32
PTT09N	10041.12	10007.00	0.76	6.74	5.12
PTT10S	10046.30	10000.00	0.76	7.00	5.32
PTT10N	10046.30	10007.00	0.76	6.74	5.12
PTT11S	10051.48	10000.00	0.76	7.00	5.32
PTT11N	10051.48	10007.00	0.76	6.74	5.12

TABLE 7-2 (Cont'd)

LOCATIONS AND DIMENSIONS OF TURBULENT AREAS: PRELIMINARY SETTLING TANKS

AERMOD ID	Coordinates (m) (Southwest Corner)		Dimensions (m)		Area (m^2)
	x	y	x	y	
PTT12S	10056.66	10000.00	0.76	7.00	5.32
PTT12N	10056.66	10007.00	0.76	6.74	5.12
PTT13S	10061.84	10000.00	0.76	7.00	5.32
PTT13N	10061.84	10007.00	0.76	6.74	5.12
PTT14S	10067.02	10000.00	0.76	7.00	5.32
PTT14N	10067.02	10007.00	0.76	6.74	5.12
PTT15S	10072.21	10000.00	0.76	7.00	5.32
PTT15N	10072.21	10007.00	0.76	6.74	5.12
PTT16S	10077.39	10000.00	0.76	7.00	5.32
PTT16N	10077.39	10007.00	0.76	6.74	5.12
PTT17S	10082.57	10000.00	0.58	5.00	2.90
PTT17C	10082.57	10005.00	0.58	5.00	2.90
PTT17N	10082.57	10010.00	0.58	3.74	2.17
			Total: Turbulent Areas		**172.57**

TABLE 7-3

RECEPTOR LOCATIONS FOR UNITY MODELING: PRELIMINARY SETTLING TANKS

No.	Coordinates (m)	
	x	y
1	10000.00	10046.06
2	10001.00	10046.06
3	10002.00	10046.06
4	10003.00	10046.06
5	10004.00	10046.06
6	10005.00	10046.06
7	10006.00	10046.06
8	10007.00	10046.06
9	10008.00	10046.06
10	10009.00	10046.06
11	10010.00	10046.06
12	10011.00	10046.06
13	10012.00	10046.06
14	10013.00	10046.06
15	10014.00	10046.06
16	10015.00	10046.06
17	10016.00	10046.06
18	10017.00	10046.06
19	10018.00	10046.06
20	10019.00	10046.06
21	10020.00	10046.06
22	10021.00	10046.06
23	10022.00	10046.06

No.	Coordinates (m)	
	x	y
24	10023.00	10046.06
25	10024.00	10046.06
26	10025.00	10046.06
27	10026.00	10046.06
28	10027.00	10046.06
29	10028.00	10046.06
30	10029.00	10046.06
31	10030.00	10046.06
32	10031.00	10046.06
33	10032.00	10046.06
34	10033.00	10046.06
35	10034.00	10046.06
36	10035.00	10046.06
37	10036.00	10046.06
38	10037.00	10046.06
39	10038.00	10046.06
40	10039.00	10046.06
41	10040.00	10046.06
42	10041.00	10046.06
43	10042.00	10046.06
44	10043.00	10046.06
45	10044.00	10046.06
46	10045.00	10046.06

TABLE 7-3 (Cont'd)

RECEPTOR LOCATIONS FOR UNITY MODELING: PRELIMINARY SETTLING TANKS

No.	Coordinates (m)	
	x	y
47	10046.00	10046.06
48	10047.00	10046.06
49	10048.00	10046.06
50	10049.00	10046.06
51	10050.00	10046.06
52	10051.00	10046.06
53	10052.00	10046.06
54	10053.00	10046.06
55	10054.00	10046.06
56	10055.00	10046.06
57	10056.00	10046.06
58	10057.00	10046.06
59	10058.00	10046.06
60	10059.00	10046.06
61	10060.00	10046.06
62	10061.00	10046.06
63	10062.00	10046.06
64	10063.00	10046.06
65	10064.00	10046.06

No.	Coordinates (m)	
	x	y
66	10065.00	10046.06
67	10066.00	10046.06
68	10067.00	10046.06
69	10068.00	10046.06
70	10069.00	10046.06
71	10070.00	10046.06
72	10071.00	10046.06
73	10072.00	10046.06
74	10073.00	10046.06
75	10074.00	10046.06
76	10075.00	10046.06
77	10076.00	10046.06
78	10077.00	10046.06
79	10078.00	10046.06
80	10079.00	10046.06
81	10080.00	10046.06
82	10081.00	10046.06
83	10082.00	10046.06
84	10083.00	10046.06

7.1.2 Data Analysis and Discussion

Development of a customized version of AERMOD was necessary for application to the preliminary settling tanks in order to create the unique equation governing vertical dispersion for each monitoring event (i.e., site-specific σ_z curve). Model customization involved the addition of a new dispersion subroutine which, in effect, bypasses the existing treatment of vertical dispersion. Because AERMOD does not allow for realistic simulation of dispersion in a sea-breeze environment when run in the urban mode, simulation of horizontal dispersion was addressed using the rural mode.*

Derivation of event-specific σ_z curves using the CF_4- and SF_6-based σ_z calculations (Tables 6-6 and 6-7, respectively) is presented in Attachment E (Table E-3). As indicated on page 6-26, seven of the 84 event-pairs were eliminated from further consideration, yielding a total of 77 event-pairs for subsequent analysis.

Table 7-4 presents the input data for each emission-rate determination for the aeration tanks. The measured downwind concentrations (ug/m^2) are from Table 6-3. The measured upwind concentrations (ug/m^2) are calculated by multiplying the respective average upwind concentrations presented on page 6-19 (ug/m^3) by the appropriate downwind pathlength for this source (83.0 meters). Also presented in Table 7-4 is the meteorological data used in AERMOD to predict the relative (unity) path-integrated concentrations along the downwind measurement path. These data were processed together with twice-daily, upper-air NWS observations for each measurement event day using the AERMET preprocessing program.

Table 7-5 presents emission-rate determinations based on use of measured vertical dispersion coefficients. The *unity-based emission rate* used in the AERMOD analysis is derived by considering a unity emission rate (0.0001 g/s-m^2) over the quiescent areas (3,362.38 m^2 from Table 7-1) together with a "hot-spot-adjusted" unity emission rate (0.00976 g/s-m^2 from page 6-22) over the turbulent areas (172.57 m^2 from Table 7-2) which yields a total unity-based emission rate of 2.020521 g/s (0.336238 g/s + 1.684283 g/s).

The *predicted unity-based source attribution* is obtained by running AERMOD with the above source strengths, the requisite source-receptor relationships (Tables 7-1 through 7-3), and the

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* Although the use of AERMOD results in a significant improvement over ISCST3 for near-source predictions from area sources, it is acknowledged to have problems in very stable sea-breeze regimes (personal communication between Robert Scotto, Minnich and Scotto, and Alan Cimorelli, USEPA Region 2, August 17, 2006). In the regulatory-default urban mode, AERMOD does not allow for proper simulation of dispersion in a daytime sea-breeze environment, nor does it allow for proper treatment of surface roughness or plume meander in the microscale environment for non-buoyant sources.

AERMET-generated meteorological profile and surface input files for each measurement event (from the meteorological data presented in Table 7-4). This attribution may be thought of as the path-integrated concentration which would result based on source emission rates of unity for the quiescent areas and 97.6 times unity for the turbulent (weir) areas.

The *measured source attribution* is obtained from Table 7-4.

The *total actual emission rate* is obtained by rearranging the equation on page 4-4 to solve for the actual emission rate (Q_A).

Finally, the *quiescent- and turbulent-area actual emission rates* are derived by adjusting the total emissions in proportion to the unity-based emission rates for these areas. For example, for Events E-1 and E-2, the actual emission rate for the quiescent areas is (0.336238 g/s ÷ 2.020521 g/s) × 0.2161 g/s = 0.0360 g/s. Similarly, the actual emission rate for the turbulent areas is (1.684283 g/s ÷ 2.020521 g/s) × 0.2161 g/s = 0.1802 g/s. (All calculations are performed in a computer spreadsheet, so slight rounding discrepancies may exist when attempting to replicate these numbers.) This source-strength apportionment is necessary to support subsequent dispersion modeling efforts for assessment of offsite H_2S impacts.

TABLE 7-4

INPUT DATA FOR EMISSION-RATE DETERMINATIONS: PRELIMINARY SETTLING TANKS

Event			Requisite Meteorology											Measured Concentration (ug/m²)		
No.	Date	Start Time (EDT)	Solar Rad. (W/m²)	WD @ 10m (°)	WS @ 1m (mph)	WS @ 1m (m/s)	WS @ 10m (mph)	WS @ 10m (m/s)	2m Temp. (°F)	2m Temp. (°K)	2-10m ΔT (°F)	2-10m ΔT (°K)	Downwind	Upwind	Attribution
E-1, 2	07/09/01	15:45	648	192	6.5	2.9	8.8	3.9	79.2	299.4	-1.8	-1.0	7717.2	697.2	**7020.0**
E-3, 4	07/09/01	16:00	629	194	5.6	2.5	7.6	3.4	79.4	299.5	-1.7	-0.9	5276.6	697.2	**4579.4**
E-15, 16	07/09/01	19:30	109	204	3.7	1.7	5.2	2.3	76.0	297.6	-0.4	-0.2	6143.6	697.2	**5446.4**
E-29, 30	07/16/01	13:15	675	180	5.8	2.6	9.7	4.3	78.7	299.1	-1.7	-0.9	11644.5	639.1	**11005.4**
E-31, 32	07/16/01	13:30	645	167	5.8	2.6	9.6	4.3	78.5	299.0	-2.0	-1.1	9651.4	639.1	**9012.3**
E-33, 34	07/16/01	13:45	492	171	6.6	3.0	9.8	4.4	78.1	298.8	-1.8	-1.0	9894.9	639.1	**9255.8**
E-35, 36	07/16/01	16:15	611	182	4.7	2.1	6.4	2.9	78.3	298.9	-1.8	-1.0	13567.8	639.1	**12928.7**
E-37, 38	07/16/01	16:30	499	192	5.8	2.6	5.9	2.6	78.3	298.9	-1.6	-0.9	14165.8	639.1	**13526.7**
E-39, 40	07/16/01	16:45	516	181	3.8	1.7	5.7	2.5	78.6	299.0	-1.7	-0.9	14442.0	639.1	**13802.9**
E-41, 42	07/16/01	17:00	513	173	4.1	1.8	6.1	2.7	78.6	299.0	-1.6	-0.9	12874.4	639.1	**12235.3**
E-44, 45	07/16/01	19:15	49	204	4.1	1.8	6.1	2.7	76.0	297.6	-0.3	-0.2	10640.1	639.1	**10001.0**
E-51, 52	07/17/01	15:00	368	171	4.6	2.1	9.0	4.0	80.3	300.0	-1.6	-0.9	15504.3	0.0	**15504.3**
E-53, 54	07/17/01	15:15	327	177	4.3	1.9	9.4	4.2	79.5	299.5	-1.3	-0.7	13894.6	0.0	**13894.6**
E-55, 56	07/17/01	15:30	473	176	4.8	2.1	7.3	3.3	79.4	299.5	-1.4	-0.8	13878.9	0.0	**13878.9**
E-57, 58	07/17/01	15:45	537	177	4.7	2.1	6.6	3.0	80.2	299.9	-1.7	-0.9	12984.1	0.0	**12984.1**

TABLE 7-4 (Cont'd)

INPUT DATA FOR EMISSION-RATE DETERMINATIONS: PRELIMINARY SETTLING TANKS

Event			Requisite Meteorology										Measured Concentration (ug/m²)		
No.	Date	Start Time (EDT)	Solar Rad. (W/m²)	WD @ 10m (º)	WS @ 1m (mph)	WS @ 1m (m/s)	WS @ 10m (mph)	WS @ 10m (m/s)	2m Temp. (ºF)	2m Temp. (ºK)	2-10m ΔT (ºF)	2-10m ΔT (ºK)	Downwind	Upwind	Attribution
E-59, 60	07/17/01	17:15	130	154	4.1	1.8	6.7	3.0	79.7	299.7	-1.0	-0.6	12534.4	0.0	**12534.4**
E-61, 62	07/17/01	17:30	49	171	3.7	1.7	6.9	3.1	78.8	299.2	-0.7	-0.4	16714.9	0.0	**16714.9**
E-75, 76	07/23/01	12:15	772	186	6.5	2.9	9.1	4.1	82.4	301.2	-2.4	-1.3	37820.2	680.6	**37139.6**
E-77, 78	07/23/01	12:30	781	184	5.8	2.6	8.5	3.8	81.5	300.7	-2.5	-1.4	32894.5	680.6	**32213.9**
E-79, 80	07/23/01	12:45	784	179	5.6	2.5	8.2	3.7	81.5	300.7	-2.6	-1.4	31292.0	680.6	**30611.4**
E-81, 82	07/23/01	13:00	786	181	6.5	2.9	10.1	4.5	80.6	300.2	-2.5	-1.4	26613.4	680.6	**25932.8**
E-83, 84	07/23/01	13:15	782	194	6.6	3.0	10.1	4.5	79.3	299.4	-2.1	-1.2	25912.9	680.6	**25232.3**
E-85, 86	07/23/01	13:30	774	184	5.5	2.5	9.9	4.4	79.4	299.5	-2.3	-1.3	22746.5	680.6	**22065.9**
E-87, 88	07/23/01	13:45	764	191	6.0	2.7	10.1	4.5	79.1	299.3	-2.1	-1.2	27392.4	680.6	**26711.8**
E-89, 90	07/23/01	14:00	746	186	5.7	2.5	10.2	4.6	79.2	299.4	-2.4	-1.3	29397.6	680.6	**28717.0**
E-91, 92	07/23/01	14:15	730	185	5.8	2.6	11.0	4.9	79.3	299.4	-2.4	-1.3	31260.6	680.6	**30580.0**
E-93, 94	07/23/01	14:30	712	185	5.6	2.5	10.7	4.8	79.8	299.7	-2.4	-1.3	27872.3	680.6	**27191.7**
E-96, 97	07/23/01	17:00	485	194	6.3	2.8	8.1	3.6	79.0	299.3	-1.5	-0.8	14481.8	680.6	**13801.2**
E-98, 99	07/23/01	17:15	452	205	6.4	2.9	9.9	4.4	78.8	299.2	-1.3	-0.7	15182.3	680.6	**14501.7**

TABLE 7-4 (Cont'd)

INPUT DATA FOR EMISSION-RATE DETERMINATIONS: PRELIMINARY SETTLING TANKS

Event			Requisite Meteorology										Measured Concentration (ug/m²)		
		Start Time	Solar Rad.	WD @ 10m	WS @ 1m		WS @ 10m		2m Temp.		2-10m ΔT				
No.	Date	(EDT)	(W/m²)	(°)	(mph)	(m/s)	(mph)	(m/s)	(°F)	(°K)	(°F)	(°K)	Downwind	Upwind	Attribution
E-100, 01	07/23/01	17:30	405	208	6.5	2.9	10.1	4.5	78.5	299.0	-1.0	-0.6	11425.1	680.6	**10744.5**
E-102, 03	07/23/01	17:45	360	207	7.2	3.2	8.9	4.0	78.8	299.2	-1.1	-0.6	13950.0	680.6	**13269.4**
E-104, 05	07/23/01	18:00	318	203	7.8	3.5	8.5	3.8	78.0	298.7	-1.0	-0.6	12826.2	680.6	**12145.6**
E-106, 07	07/23/01	18:15	273	208	7.9	3.5	10.0	4.5	77.6	298.5	-0.9	-0.5	12764.7	680.6	**12084.1**
E-108, 09	07/24/01	12:30	792	184	6.7	3.0	10.7	4.8	84.0	302.0	-2.3	-1.3	17608.5	755.3	**16853.2**
E-110, 11	07/24/01	12:45	784	179	6.0	2.7	10.4	4.6	84.1	302.1	-2.4	-1.3	16308.5	755.3	**15553.2**
E-112, 13	07/24/01	13:00	792	178	4.9	2.2	10.2	4.6	85.0	302.6	-2.7	-1.5	17313.1	755.3	**16557.8**
E-114, 15	07/24/01	13:15	760	185	5.1	2.3	8.2	3.7	85.8	303.0	-2.4	-1.3	15458.5	755.3	**14703.2**
E-116, 17	07/24/01	15:30	639	179	5.9	2.6	9.7	4.3	85.1	302.7	-2.5	-1.4	13378.5	755.3	**12623.2**
E-118, 19	07/24/01	15:45	617	184	5.6	2.5	8.2	3.7	85.1	302.7	-2.2	-1.2	11569.8	755.3	**10814.5**
E-120, 21	07/24/01	16:00	596	179	6.7	3.0	9.0	4.0	85.2	302.7	-2.3	-1.3	12826.2	755.3	**12070.9**
E-135, 36	08/01/01	13:45	159	178	6.1	2.7	9.7	4.3	83.0	301.5	-0.8	-0.4	11373.2	1328.0	**10045.2**
E-137, 38	08/01/01	14:00	135	173	5.2	2.3	8.7	3.9	82.4	301.2	-0.6	-0.3	10385.6	1328.0	**9057.6**
E-139, 40	08/01/01	14:15	279	180	5.3	2.4	7.5	3.4	83.5	301.8	-0.8	-0.4	10587.0	1328.0	**9259.0**

TABLE 7-4 (Cont'd)

INPUT DATA FOR EMISSION-RATE DETERMINATIONS: PRELIMINARY SETTLING TANKS

Event			Requisite Meteorology										Measured Concentration (ug/m²)		
		Start Time	Solar Rad.	WD @ 10m	WS @ 1m		WS @ 10m		2m Temp.		2-10m ΔT				
No.	Date	(EDT)	(W/m²)	(°)	(mph)	(m/s)	(mph)	(m/s)	(°F)	(°K)	(°F)	(°K)	Downwind	Upwind	Attribution
E-144, 45	08/01/01	16:45	499	191	4.9	2.2	8.8	3.9	80.9	300.3	-1.4	-0.8	6390.8	1328.0	**5062.8**
E-146, 47	08/01/01	17:00	459	198	4.7	2.1	7.6	3.4	80.2	299.9	-1.3	-0.7	7665.3	1328.0	**6337.3**
E-148, 49	08/01/01	17:15	340	204	5.1	2.3	7.6	3.4	80.2	299.9	-0.9	-0.5	8054.8	1328.0	**6726.8**
E-150, 51	08/01/01	17:30	349	208	4.8	2.1	8.2	3.7	80.6	300.2	-0.9	-0.5	12670.6	1328.0	**11342.6**
E-152, 53	08/02/01	15:30	625	184	7.1	3.2	9.9	4.4	84.8	302.5	-2.2	-1.2	10880.0	1328.0	**9552.0**
E-154, 55	08/02/01	15:45	599	184	6.6	3.0	10.0	4.5	83.9	302.0	-2.3	-1.3	9991.4	1328.0	**8663.4**
E-156, 57	08/02/01	16:00	571	183	6.3	2.8	10.2	4.6	83.0	301.5	-2.0	-1.1	9576.5	1328.0	**8248.5**
E-158, 59	08/02/01	16:15	549	184	5.9	2.6	8.5	3.8	83.0	301.5	-2.0	-1.1	10215.7	1328.0	**8887.7**
E-160, 61	08/02/01	16:30	521	183	5.0	2.2	8.9	4.0	83.1	301.5	-2.1	-1.2	9858.6	1328.0	**8530.6**
E-162, 63	08/02/01	16:45	489	180	4.9	2.2	8.4	3.8	82.7	301.3	-1.8	-1.0	8843.4	1328.0	**7515.4**
E-164, 65	08/02/01	17:00	480	188	4.9	2.2	7.9	3.5	83.0	301.5	-1.7	-0.9	9271.5	1328.0	**7943.5**
E-169, 70	08/06/01	11:45	702	181	6.5	2.9	8.3	3.7	85.5	302.9	-2.5	-1.4	14407.0	813.4	**13593.6**
E-171, 72	08/06/01	12:00	714	199	5.4	2.4	6.8	3.0	85.7	303.0	-2.3	-1.3	14016.4	813.4	**13203.0**
E-173, 74	08/06/01	12:15	732	210	5.0	2.2	7.4	3.3	85.7	303.0	-2.3	-1.3	13652.1	813.4	**12838.7**

TABLE 7-4 (Cont'd)

INPUT DATA FOR EMISSION-RATE DETERMINATIONS: PRELIMINARY SETTLING TANKS

Event			Requisite Meteorology											Measured Concentration (ug/m²)		
		Start Time	Solar Rad.	WD @ 10m	WS @ 1m		WS @ 10m		2m Temp.		2-10m ΔT				
No.	Date	(EDT)	(W/m²)	(°)	(mph)	(m/s)	(mph)	(m/s)	(°F)	(°K)	(°F)	(°K)	Downwind	Upwind	Attribution
E-175, 76	08/06/01	12:30	738	206	4.9	2.2	7.1	3.2	86.0	303.2	-2.0	-1.1	8404.6	813.4	**7591.2**
E-177, 78	08/06/01	12:45	726	184	5.8	2.6	9.9	4.4	86.0	303.2	-2.3	-1.3	15096.7	813.4	**14283.3**
E-179, 80	08/06/01	13:00	725	187	6.4	2.9	10.9	4.9	85.4	302.8	-2.4	-1.3	12169.1	813.4	**11355.7**
E-181, 82	08/06/01	13:15	704	184	5.6	2.5	10.1	4.5	85.7	303.0	-2.3	-1.3	11762.7	813.4	**10949.3**
E-183, 84	08/06/01	13:30	699	181	4.9	2.2	10.3	4.6	86.0	303.2	-2.3	-1.3	7500.1	813.4	**6686.7**
E-186, 87	08/06/01	15:30	549	204	6.2	2.8	8.3	3.7	84.2	302.2	-1.8	-1.0	11706.0	1203.5	**10502.5**
E-188, 89	08/06/01	15:45	527	192	5.2	2.3	7.2	3.2	84.2	302.2	-1.7	-0.9	9987.7	1203.5	**8784.2**
E-190, 91	08/06/01	16:00	543	189	4.7	2.1	7.6	3.4	84.9	302.5	-1.8	-1.0	8765.1	1203.5	**7561.6**
E-192, 93	08/06/01	16:15	513	193	5.1	2.3	7.4	3.3	84.6	302.4	-1.8	-1.0	8843.4	1203.5	**7639.9**
E-194, 95	08/06/01	16:30	485	200	5.4	2.4	7.5	3.4	84.2	302.2	-1.6	-0.9	13540.1	1203.5	**12336.6**
E-196, 97	08/06/01	16:45	471	190	5.4	2.4	7.4	3.3	83.9	302.0	-1.5	-0.8	11633.6	1203.5	**10430.1**
E-198, 99	08/06/01	17:00	422	205	5.6	2.5	7.3	3.3	83.9	302.0	-1.4	-0.8	10204.8	1203.5	**9001.3**
E-200, 01	08/06/01	17:15	357	201	6.5	2.9	6.8	3.0	83.5	301.8	-1.2	-0.7	10597.9	1203.5	**9394.4**
E-203, 04	08/09/01	13:30	729	184	6.0	2.7	10.1	4.5	97.7	309.7	-2.0	-1.1	14818.2	1560.4	**13257.8**

TABLE 7-4 (Cont'd)

INPUT DATA FOR EMISSION-RATE DETERMINATIONS: PRELIMINARY SETTLING TANKS

Event			Requisite Meteorology										Measured Concentration (ug/m²)		
		Start	Solar	WD	WS @ 1m		WS @ 10m		2m Temp.		2-10m ΔT				
No.	Date	Time (EDT)	Rad. (W/m²)	@ 10m (°)	(mph)	(m/s)	(mph)	(m/s)	(°F)	(°K)	(°F)	(°K)	Downwind	Upwind	Attribution
E-205, 06	08/09/01	13:45	672	196	6.8	3.0	8.7	3.9	97.3	309.4	-1.4	-0.8	10752.2	1560.4	**9191.8**
E-207, 08	08/09/01	14:00	598	198	5.9	2.6	8.3	3.7	97.7	309.7	-1.6	-0.9	10042.0	1560.4	**8481.6**
E-209, 10	08/09/01	14:15	679	183	7.7	3.4	11.2	5.0	96.4	308.9	-2.1	-1.2	10747.3	1560.4	**9186.9**
E-211, 12	08/09/01	14:30	679	181	7.8	3.5	10.3	4.6	95.9	308.7	-2.2	-1.2	14059.7	1560.4	**12499.3**
E-213, 14	08/09/01	14:45	659	185	6.5	2.9	9.4	4.2	95.6	308.5	-2.1	-1.2	13825.8	1560.4	**12265.4**
E-215, 16	08/09/01	15:00	644	186	6.7	3.0	11.9	5.3	93.9	307.5	-2.0	-1.1	14531.2	1560.4	**12970.8**

TABLE 7-5

EMISSION-RATE DETERMINATIONS: PRELIMINARY SETTLING TANKS

	Unity AERMOD Analysis		Measured Source Attribution		Actual Emission Rate (g/s)		
Event No.	Emission Rate (g/s)	Predicted Source Attribution (g/m^2)	(ug/m^2)	(g/m^2)	Quiescent Areas	Turbulent Areas	Total
E-1, 2	2.020521	0.065630	7020.0	0.0070200	0.0360	0.1802	0.2161
E-3, 4	2.020521	0.068058	4579.4	0.0045794	0.0226	0.1133	0.1360
E-15, 16	2.020521	0.066748	5446.4	0.0054464	0.0274	0.1374	0.1649
E-29, 30	2.020521	0.083261	11005.4	0.0110054	0.0444	0.2226	0.2671
E-31, 32	2.020521	0.220477	9012.3	0.0090123	0.0137	0.0688	0.0826
E-33, 34	2.020521	0.212893	9255.8	0.0092558	0.0146	0.0732	0.0878
E-35, 36	2.020521	0.078712	12928.7	0.0129287	0.0552	0.2766	0.3319
E-37, 38	2.020521	0.087780	13526.7	0.0135267	0.0518	0.2595	0.3114
E-39, 40	2.020521	0.100118	13802.9	0.0138029	0.0464	0.2322	0.2786
E-41, 42	2.020521	0.195127	12235.3	0.0122353	0.0211	0.1056	0.1267
E-44, 45	2.020521	0.068277	10001.0	0.0100010	0.0493	0.2467	0.2960
E-51, 52	2.020521	0.268468	15504.3	0.0155043	0.0194	0.0973	0.1167
E-53, 54	2.020521	0.237244	13894.6	0.0138946	0.0197	0.0986	0.1183
E-55, 56	2.020521	0.282087	13878.9	0.0138789	0.0165	0.0829	0.0994
E-57, 58	2.020521	0.252558	12984.1	0.0129841	0.0173	0.0866	0.1039
E-59, 60	2.020521	0.324007	12534.4	0.0125344	0.0130	0.0652	0.0782
E-61, 62	2.020521	0.388928	16714.9	0.0167149	0.0145	0.0724	0.0868
E-75, 76	2.020521	0.078158	37139.6	0.0371396	0.1598	0.8003	0.9601
E-77, 78	2.020521	0.087053	32213.9	0.0322139	0.1244	0.6233	0.7477
E-79, 80	2.020521	0.256783	30611.4	0.0306114	0.0401	0.2008	0.2409
E-81, 82	2.020521	0.079345	25932.8	0.0259328	0.1099	0.5505	0.6604
E-83, 84	2.020521	0.073654	25232.3	0.0252323	0.1152	0.5770	0.6922
E-85, 86	2.020521	0.067798	22065.9	0.0220659	0.1094	0.5482	0.6576

TABLE 7-5 (Cont'd)

EMISSION-RATE DETERMINATIONS: PRELIMINARY SETTLING TANKS

Event No.	Unity ISCST3 Analysis		Measured Source Attribution		Actual Emission Rate (g/s)		
	Emission Rate (g/s)	Predicted Source Attribution (g/m^2)	(ug/m^2)	(g/m^2)	Quiescent Areas	Turbulent Areas	Total
E-87, 88	2.020521	0.075466	26711.8	0.0267118	0.1190	0.5962	0.7152
E-89, 90	2.020521	0.067401	28717.0	0.0287170	0.1433	0.7176	0.8609
E-91, 92	2.020521	0.064445	30580.0	0.0305800	0.1595	0.7992	0.9588
E-93, 94	2.020521	0.070261	27191.7	0.0271917	0.1301	0.6518	0.7820
E-96, 97	2.020521	0.062971	13801.2	0.0138012	0.0737	0.3691	0.4428
E-98, 99	2.020521	0.051261	14501.7	0.0145017	0.0951	0.4765	0.5716
E-100, 01	2.020521	0.051791	10744.5	0.0107445	0.0698	0.3494	0.4192
E-102, 03	2.020521	0.057412	13269.4	0.0132694	0.0777	0.3893	0.4670
E-104, 05	2.020521	0.059494	12145.6	0.0121456	0.0686	0.3438	0.4125
E-106, 07	2.020521	0.064128	12084.1	0.0120841	0.0634	0.3174	0.3807
E-108, 09	2.020521	0.071693	16853.2	0.0168532	0.0790	0.3959	0.4750
E-110, 11	2.020521	0.202490	15553.2	0.0155532	0.0258	0.1294	0.1552
E-112, 13	2.020521	0.206236	16557.8	0.0165578	0.0270	0.1352	0.1622
E-114, 15	2.020521	0.080544	14703.2	0.0147032	0.0614	0.3075	0.3688
E-116, 17	2.020521	0.222879	12623.2	0.0126232	0.0190	0.0954	0.1144
E-118, 19	2.020521	0.088302	10814.5	0.0108145	0.0412	0.2063	0.2475
E-120, 21	2.020521	0.234231	12070.9	0.0120709	0.0173	0.0868	0.1041
E-135, 36	2.020521	0.277941	10045.2	0.0100452	0.0122	0.0609	0.0730
E-137, 38	2.020521	0.269435	9057.6	0.0090576	0.0113	0.0566	0.0679
E-139, 40	2.020521	0.085523	9259.0	0.0092590	0.0364	0.1823	0.2187
E-144, 45	2.020521	0.075734	5062.8	0.0050628	0.0225	0.1126	0.1351
E-146, 47	2.020521	0.073715	6337.3	0.0063373	0.0289	0.1448	0.1737
E-148, 49	2.020521	0.065255	6726.8	0.0067268	0.0347	0.1736	0.2083

TABLE 7-5 (Cont'd)

EMISSION-RATE DETERMINATIONS: PRELIMINARY SETTLING TANKS

Event No.	Unity ISCST3 Analysis		Measured Source Attribution		Actual Emission Rate (g/s)		
	Emission Rate (g/s)	Predicted Source Attribution (g/m^2)	(ug/m^2)	(g/m^2)	Quiescent Areas	Turbulent Areas	Total
E-150, 51	2.020521	0.078900	11342.6	0.0113426	0.0483	0.2421	0.2905
E-152, 53	2.020521	0.071529	9552.0	0.0095520	0.0449	0.2249	0.2698
E-154, 55	2.020521	0.071107	8663.4	0.0086634	0.0410	0.2052	0.2462
E-156, 57	2.020521	0.073202	8248.5	0.0082485	0.0379	0.1898	0.2277
E-158, 59	2.020521	0.077854	8887.7	0.0088877	0.0384	0.1923	0.2307
E-160, 61	2.020521	0.080972	8530.6	0.0085306	0.0354	0.1774	0.2129
E-162, 63	2.020521	0.071089	7515.4	0.0075154	0.0355	0.1781	0.2136
E-164, 65	2.020521	0.082436	7943.5	0.0079435	0.0324	0.1623	0.1947
E-169, 70	2.020521	0.093583	13593.6	0.0135936	0.0488	0.2447	0.2935
E-171, 72	2.020521	0.091082	13203.0	0.0132030	0.0487	0.2441	0.2929
E-173, 74	2.020521	0.086837	12838.7	0.0128387	0.0497	0.2490	0.2987
E-175, 76	2.020521	0.082234	7591.2	0.0075912	0.0310	0.1555	0.1865
E-177, 78	2.020521	0.076675	14283.3	0.0142833	0.0626	0.3138	0.3764
E-179, 80	2.020521	0.076294	11355.7	0.0113557	0.0500	0.2507	0.3007
E-181, 82	2.020521	0.069230	10949.3	0.0109493	0.0532	0.2664	0.3196
E-183, 84	2.020521	0.052376	6686.7	0.0066867	0.0429	0.2150	0.2580
E-186, 87	2.020521	0.069241	10502.5	0.0105025	0.0510	0.2555	0.3065
E-188, 89	2.020521	0.075094	8784.2	0.0087842	0.0393	0.1970	0.2364
E-190, 91	2.020521	0.072890	7561.6	0.0075616	0.0349	0.1747	0.2096
E-192, 93	2.020521	0.065193	7639.9	0.0076399	0.0394	0.1974	0.2368
E-194, 95	2.020521	0.073517	12336.6	0.0123366	0.0564	0.2826	0.3391
E-196, 97	2.020521	0.078068	10430.1	0.0104301	0.0449	0.2250	0.2699
E-198, 99	2.020521	0.072754	9001.3	0.0090013	0.0416	0.2084	0.2500

TABLE 7-5 (Cont'd)

EMISSION-RATE DETERMINATIONS: PRELIMINARY SETTLING TANKS

	Unity ISCST3 Analysis		Measured Source Attribution		Actual Emission Rate (g/s)		
Event No.	Emission Rate (g/s)	Predicted Source Attribution (g/m^2)	(ug/m^2)	(g/m^2)	Quiescent Areas	Turbulent Areas	Total
E-200, 01	2.020521	0.077341	9394.4	0.0093944	0.0408	0.2046	0.2454
E-203, 04	2.020521	0.074634	13257.8	0.0132578	0.0597	0.2992	0.3589
E-205, 06	2.020521	0.074993	9191.8	0.0091918	0.0412	0.2064	0.2477
E-207, 08	2.020521	0.080984	8481.6	0.0084816	0.0352	0.1764	0.2116
E-209, 10	2.020521	0.071341	9186.9	0.0091869	0.0433	0.2169	0.2602
E-211, 12	2.020521	0.076685	12499.3	0.0124993	0.0548	0.2745	0.3293
E-213, 14	2.020521	0.079823	12265.4	0.0122654	0.0517	0.2588	0.3105
E-215, 16	2.020521	0.074665	12970.8	0.0129708	0.0584	0.2926	0.3510

7.2 Aeration Tanks

Section 7.2.1 presents the source-measurement representation employed in the emissions back-calculation modeling. Section 7.2.2 presents data analysis and discussion.

7.2.1 Source-Measurement Representation

Figure 7-2 depicts the source-measurement relationships used in AERMOD emissions back-calculation modeling for the aeration tanks. Based on the hot-spot data (Section 6.2), this source is represented as a group of 26 rectangles: 24 comprising the low-emitting area and two comprising the high-emitting area. One measurement path is oriented parallel to the western side of Aeration Tank No. 1, and the other parallel to the eastern side of Aeration Tank No. 2 in order to accommodate winds from an easterly and westerly quadrant, respectively. The path-source separation distance, in each case, is 1.0m.

Table 7-6 and **Table 7-7** depict, for the low-emitting and high-emitting areas, respectively, the locations and dimensions as input to AERMOD. The height above flat terrain is set to zero for all subareas. The total areas are also depicted. All orientations are with respect to plant north.

Table 7-8 depicts the receptor locations for the aeration tank unity-based modeling. A total of 124 receptors (1m spacing, 1m flagpole height) are used to represent each of the two 123.14m cross-plume pathlengths, i.e., easterly and westerly winds.

FIGURE 7-2

SOURCE-MEASUREMENT RELATIONSHIP: AERATION TANKS

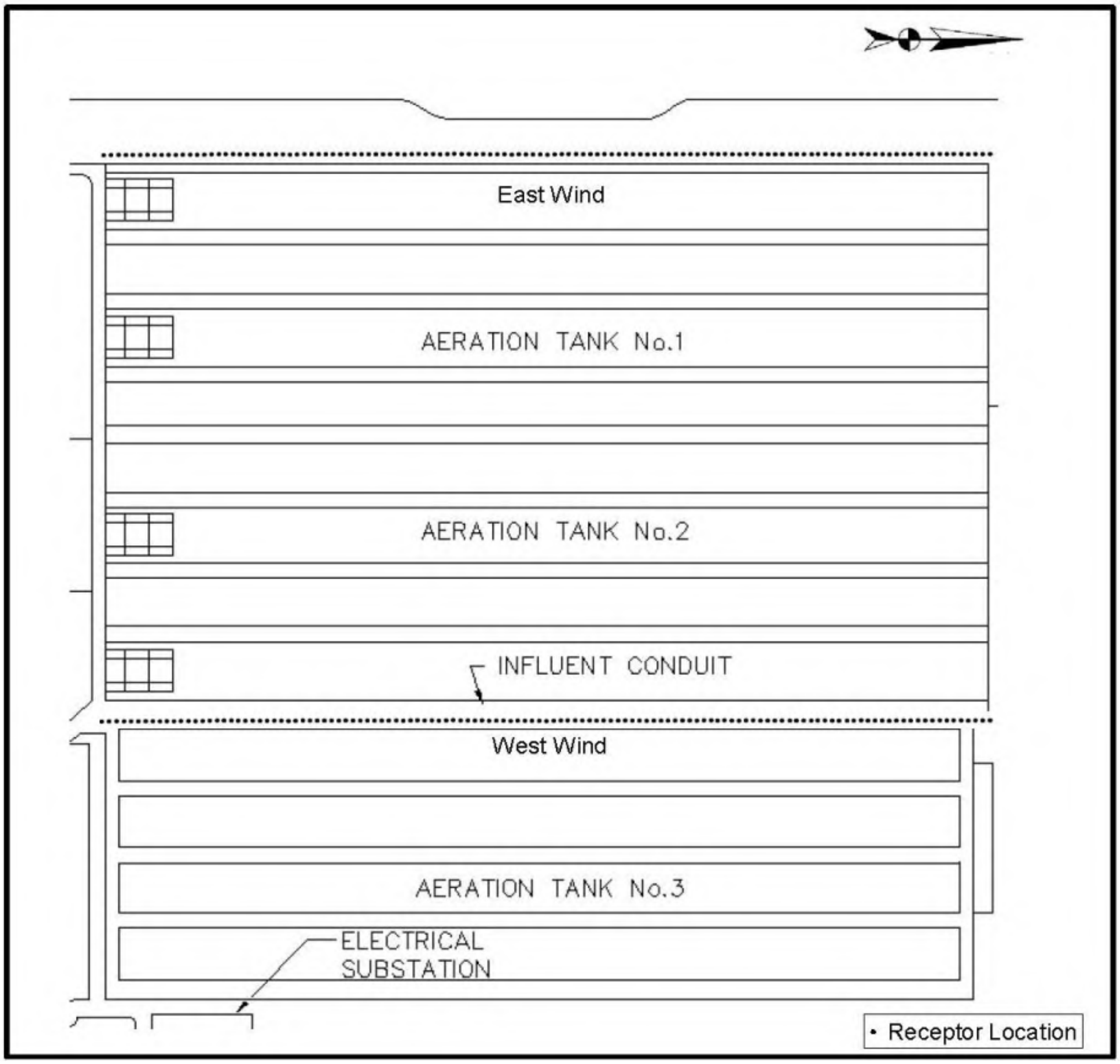

TABLE 7-6

LOCATIONS OF LOW-EMITTING AREAS: AERATION TANKS

AERMOD ID	Coordinates (m) (Southwest Corner)		Dimensions (m)		Area (m^2)
	x	y	x	y	
ATL01S	10004.43	9865.28	7.32	70.00	512.40
ATL01N	10004.43	9935.28	7.32	47.04	344.33
ATL02S	10013.88	9865.28	7.32	70.00	512.40
ATL02N	10013.88	9935.28	7.32	53.14	388.98
ATL03S	10023.33	9865.28	7.32	70.00	512.40
ATL03N	10023.33	9935.28	7.32	53.14	388.98
ATL04S	10032.78	9865.28	7.32	70.00	512.40
ATL04N	10032.78	9935.28	7.32	53.14	388.98
ATL05S	10042.22	9865.28	7.32	70.00	512.40
ATL05N	10042.22	9935.28	7.32	53.14	388.98
ATL06S	10051.67	9865.28	7.32	70.00	512.40
ATL06N	10051.67	9935.28	7.32	53.14	388.98
ATL07S	10061.11	9865.28	7.32	70.00	512.40
ATL07N	10061.11	9935.28	7.32	53.14	388.98
ATL08S	10070.56	9865.28	7.32	70.00	512.40
ATL08N	10070.56	9935.28	7.32	47.04	344.33
ATL09S	10081.92	9867.41	7.16	70.00	501.20
ATL09N	10081.92	9937.41	7.16	46.43	332.44
ATL10S	10091.17	9867.41	7.16	70.00	501.20
ATL10N	10091.17	9937.41	7.16	46.43	332.44
ATL11S	10100.41	9867.41	7.16	70.00	501.20
ATL11N	10100.41	9937.41	7.16	46.43	332.44
ATL12S	10109.66	9867.41	7.16	70.00	501.20
ATL12N	10109.66	9937.41	7.16	46.43	332.44
				Total: Low-Emitting Areas	**10456.33**

TABLE 7-7

LOCATIONS OF HIGH-EMITTING AREAS: AERATION TANKS

AERMOD ID	Coordinates (m) (Southwest Corner)		Dimensions (m)		Area (m^2)
	x	y	x	y	
ATH01	10004.43	9982.32	7.32	6.10	44.65
ATH02	10070.56	9982.32	7.32	6.10	44.65
				Total: High-Emitting Areas	**89.30**

TABLE 7-8

RECEPTOR LOCATIONS FOR UNITY MODELING: AERATION TANKS

No.	Coordinates (m)			No.	Coordinates (m)		
	x (E Wind)	x (W Wind)	y		x (E Wind)	x (W Wind)	y
1	10003.43	10078.88	9865.28	24	10003.43	10078.88	9888.28
2	10003.43	10078.88	9866.28	25	10003.43	10078.88	9889.28
3	10003.43	10078.88	9867.28	26	10003.43	10078.88	9890.28
4	10003.43	10078.88	9868.28	27	10003.43	10078.88	9891.28
5	10003.43	10078.88	9869.28	28	10003.43	10078.88	9892.28
6	10003.43	10078.88	9870.28	29	10003.43	10078.88	9893.28
7	10003.43	10078.88	9871.28	30	10003.43	10078.88	9894.28
8	10003.43	10078.88	9872.28	31	10003.43	10078.88	9895.28
9	10003.43	10078.88	9873.28	32	10003.43	10078.88	9896.28
10	10003.43	10078.88	9874.28	33	10003.43	10078.88	9897.28
11	10003.43	10078.88	9875.28	34	10003.43	10078.88	9898.28
12	10003.43	10078.88	9876.28	35	10003.43	10078.88	9899.28
13	10003.43	10078.88	9877.28	36	10003.43	10078.88	9900.28
14	10003.43	10078.88	9878.28	37	10003.43	10078.88	9901.28
15	10003.43	10078.88	9879.28	38	10003.43	10078.88	9902.28
16	10003.43	10078.88	9880.28	39	10003.43	10078.88	9903.28
17	10003.43	10078.88	9881.28	40	10003.43	10078.88	9904.28
18	10003.43	10078.88	9882.28	41	10003.43	10078.88	9905.28
19	10003.43	10078.88	9883.28	42	10003.43	10078.88	9906.28
20	10003.43	10078.88	9884.28	43	10003.43	10078.88	9907.28
21	10003.43	10078.88	9885.28	44	10003.43	10078.88	9908.28
22	10003.43	10078.88	9886.28	45	10003.43	10078.88	9909.28
23	10003.43	10078.88	9887.28	46	10003.43	10078.88	9910.28

TABLE 7-8 (Cont'd)

RECEPTOR LOCATIONS FOR UNITY MODELING: AERATION TANKS

No.	Coordinates (m)		
	x (E Wind)	x (W Wind)	y
47	10003.43	10078.88	9911.28
48	10003.43	10078.88	9912.28
49	10003.43	10078.88	9913.28
50	10003.43	10078.88	9914.28
51	10003.43	10078.88	9915.28
52	10003.43	10078.88	9916.28
53	10003.43	10078.88	9917.28
54	10003.43	10078.88	9918.28
55	10003.43	10078.88	9919.28
56	10003.43	10078.88	9920.28
57	10003.43	10078.88	9921.28
58	10003.43	10078.88	9922.28
59	10003.43	10078.88	9923.28
60	10003.43	10078.88	9924.28
61	10003.43	10078.88	9925.28
62	10003.43	10078.88	9926.28
63	10003.43	10078.88	9927.28
64	10003.43	10078.88	9928.28
65	10003.43	10078.88	9929.28
66	10003.43	10078.88	9930.28
67	10003.43	10078.88	9931.28
68	10003.43	10078.88	9932.28
69	10003.43	10078.88	9933.28

No.	Coordinates (m)		
	x (E Wind)	x (W Wind)	y
70	10003.43	10078.88	9934.28
71	10003.43	10078.88	9935.28
72	10003.43	10078.88	9936.28
73	10003.43	10078.88	9937.28
74	10003.43	10078.88	9938.28
75	10003.43	10078.88	9939.28
76	10003.43	10078.88	9940.28
77	10003.43	10078.88	9941.28
78	10003.43	10078.88	9942.28
79	10003.43	10078.88	9943.28
80	10003.43	10078.88	9944.28
81	10003.43	10078.88	9945.28
82	10003.43	10078.88	9946.28
83	10003.43	10078.88	9947.28
84	10003.43	10078.88	9948.28
85	10003.43	10078.88	9949.28
86	10003.43	10078.88	9950.28
87	10003.43	10078.88	9951.28
88	10003.43	10078.88	9952.28
89	10003.43	10078.88	9953.28
90	10003.43	10078.88	9954.28
91	10003.43	10078.88	9955.28
92	10003.43	10078.88	9956.28

TABLE 7-8 (Cont'd)

RECEPTOR LOCATIONS FOR UNITY MODELING:
AERATION TANKS

No.	Coordinates (m)		
	x (E Wind)	x (W Wind)	y
93	10003.43	10078.88	9957.28
94	10003.43	10078.88	9958.28
95	10003.43	10078.88	9959.28
96	10003.43	10078.88	9960.28
97	10003.43	10078.88	9961.28
98	10003.43	10078.88	9962.28
99	10003.43	10078.88	9963.28
100	10003.43	10078.88	9964.28
101	10003.43	10078.88	9965.28
102	10003.43	10078.88	9966.28
103	10003.43	10078.88	9967.28
104	10003.43	10078.88	9968.28
105	10003.43	10078.88	9969.28
106	10003.43	10078.88	9970.28
107	10003.43	10078.88	9971.28
108	10003.43	10078.88	9972.28

No.	Coordinates (m)		
	x (E Wind)	x (W Wind)	y
109	10003.43	10078.88	9973.28
110	10003.43	10078.88	9974.28
111	10003.43	10078.88	9975.28
112	10003.43	10078.88	9976.28
113	10003.43	10078.88	9977.28
114	10003.43	10078.88	9978.28
115	10003.43	10078.88	9979.28
116	10003.43	10078.88	9980.28
117	10003.43	10078.88	9981.28
118	10003.43	10078.88	9982.28
119	10003.43	10078.88	9983.28
120	10003.43	10078.88	9984.28
121	10003.43	10078.88	9985.28
122	10003.43	10078.88	9986.28
123	10003.43	10078.88	9987.28
124	10003.43	10078.88	9988.28

7.2.2 Data Analysis and Discussion

Table 7-9 presents the input data for each emission-rate determination for the aeration tanks. The measured downwind concentrations (ug/m^2) are from Table 6-8. The measured upwind concentrations (ug/m^2) are calculated by multiplying the respective average upwind concentrations presented on page 6-41 (ug/m^3) by the appropriate downwind pathlength for this source (123.14 meters for each pathlength). Also presented in Table 7-9 is the meteorological data used in AERMOD to predict the relative (unity) path-integrated concentrations along each downwind measurement path. These data were processed together with twice-daily, upper-air NWS observations for each measurement event day using the AERMET preprocessing program.

Table 7-10 presents emission-rate determinations for the aeration tanks. The *unity-based emission rate* used in the AERMOD analysis is derived by considering a unity emission rate (0.0001 g/s-m^2) over the low-emitting areas (10,456.33 m^2 from Table 7-6) together with a "hot-spot-adjusted" unity emission rate (0.00074 g/s-m^2 from page 6-44) over the high-emitting areas (89.30 m^2 from Table 7-7) which yields a total unity-based emission rate of 1.111715 g/s (1.045633 g/s + 0.066082 g/s).

The *predicted unity-based source attribution* is obtained by running AERMOD with the above source strengths, the requisite source-receptor relationships (Tables 7-6 through 7-8), and the AERMET-generated meteorological profile and surface input files for each measurement event (from the meteorological data presented in Table 7-9). This attribution may be thought of as the path-integrated concentration which would result based on a source emissions of unity for the low-emitting areas and 7.4 times unity for the high-emitting areas.

The *measured source attribution* is obtained from Table 7-9.

The *total actual emission rate* is obtained by rearranging the equation on page 4-4 to solve for the actual emission rate (Q_A).

Finally, the *low-emitting and high-emitting actual emission rates* are derived by adjusting the total emissions in proportion to the unity-based emission rates for these areas. For example, for Events E-235 and E-236, the actual emission rate for the low-emitting areas is (1.045633 g/s ÷ 1.111715 g/s) x 0.0024 g/s = 0.0023 g/s. Similarly, the actual emission rate for the high-emitting areas is (0.066082 g/s ÷ 1.111715 g/s) x 0.0024 g/s = 0.0001 g/s. (All calculations are performed in a computer spreadsheet, so slight rounding discrepancies may exist when attempting to replicate these numbers.) This source-strength apportionment is necessary to support subsequent dispersion modeling efforts for assessment of off-site H_2S impacts.

TABLE 7-9

INPUT DATA FOR EMISSION-RATE DETERMINATIONS: AERATION TANKS

Event			Requisite Meteorology											Measured Concentration (ug/m²)		
		Start Time	Solar Rad.	WD @ 10m	WS @ 1m		WS @ 10m		2m Temp.		2-10m ΔT					
No.	Date	(EDT)	(W/m²)	(º)	(mph)	(m/s)	(mph)	(m/s)	(ºF)	(ºK)	(ºF)	(ºK)	Downwind	Upwind	Attribution
E-235, 36	08/15/01	10:45	653	079	2.9	1.3	5.2	2.3	76.9	298.1	-0.8	-0.4	1535.1	1182.1	**353.0**
E-237, 38	08/15/01	11:00	673	075	2.8	1.3	4.1	1.8	77.6	298.5	-0.9	-0.5	1232.4	1182.1	**50.3**
E-239, 40	08/15/01	11:15	638	109	2.9	1.3	4.2	1.9	78.6	299.0	-1.2	-0.7	1252.1	1182.1	**70.0**
E-241, 42	08/15/01	11:30	694	098	2.9	1.3	4.7	2.1	78.6	299.0	-0.8	-0.4	1284.3	1182.1	**102.2**
E-264, 65	08/21/01	13:00	498	281	2.6	1.2	5.5	2.5	81.2	300.5	-1.9	-1.1	1861.1	1034.4	**826.7**
E-266, 67	08/21/01	13:30	543	264	3.5	1.6	6.2	2.8	80.9	300.3	-1.7	-0.9	1624.7	1034.4	**590.3**
E-268, 69	08/21/01	13:45	504	278	3.6	1.6	4.9	2.2	81.2	300.5	-1.6	-0.9	1323.7	1034.4	**289.3**
E-270, 71	08/21/01	14:00	434	251	3.4	1.5	6.0	2.7	81.5	300.7	-1.4	-0.8	1384.7	1034.4	**350.3**
E-272, 73	08/21/01	14:15	539	294	3.5	1.6	8.6	3.8	81.8	300.8	-1.6	-0.9	1447.4	1034.4	**413.0**

TABLE 7-10

EMISSION-RATE DETERMINATIONS: AERATION TANKS

Event No.	Unity AERMOD Analysis		Measured Source Attribution		Actual Emission Rate (g/s)		
	Emission Rate (g/s)	Predicted Source Attribution (g/m^2)	(ug/m^2)	(g/m^2)	Low-Emitting Areas	High-Emitting Areas	Total
E-235, 36	1.111715	0.164055	353.0	0.0003530	0.0023	0.0001	0.0024
E-237, 38	1.111715	0.161994	50.3	0.0000503	0.0003	0.0000	0.0003
E-239, 40	1.111715	0.148367	70.0	0.0000700	0.0005	0.0000	0.0005
E-241, 42	1.111715	0.152510	102.2	0.0001022	0.0007	0.0000	0.0007
E-264, 65	1.111715	0.064313	826.7	0.0008267	0.0134	0.0008	0.0143
E-266, 67	1.111715	0.049688	590.3	0.0005903	0.0124	0.0008	0.0132
E-268, 69	1.111715	0.052686	289.3	0.0002893	0.0057	0.0004	0.0061
E-270, 71	1.111715	0.050873	350.3	0.0003503	0.0072	0.0005	0.0077
E-272, 73	1.111715	0.044461	413.0	0.0004130	0.0097	0.0006	0.0103

7.3 Final Settling Tanks

Section 7.3.1 presents the source-measurement representation employed in the emissions back-calculation modeling. Section 7.3.2 presents data analysis and discussion.

7.3.1 Source-Measurement Representation

Figure 7-3 depicts the source-measurement relationships used in AERMOD emissions back-calculation modeling for the final settling tanks. Based on the hot-spot data (Section 6.3), this source is represented as a group of 27 rectangles: 8 comprising the low-emitting area and 19 comprising the high-emitting area. One measurement path is oriented parallel to the western side of Final Settling Tank Nos. 1 through 4, and the other parallel to the eastern side of Final Settling Tank Nos. 5 through 8 in order to accommodate winds from an easterly and westerly quadrant, respectively. The path-source separation distance, in each case, is 1.0m.

Table 7-11 and **Table 7-12** depict, for the low-emitting and high-emitting areas, respectively, the locations and dimensions as input to AERMOD. The height above flat terrain is set to zero for all subareas. The total areas are also depicted. All orientations are with respect to plant north.

Table 7-13 depicts the receptor locations for the final settling tank unity-based modeling. A total of 87 receptors (1m spacing, 1m flagpole height) are used to represent each of the two 86.26m cross-plume pathlengths, i.e., easterly and westerly winds.

FIGURE 7-3

**SOURCE-MEASUREMENT RELATIONSHIP:
FINAL SETTLING TANKS**

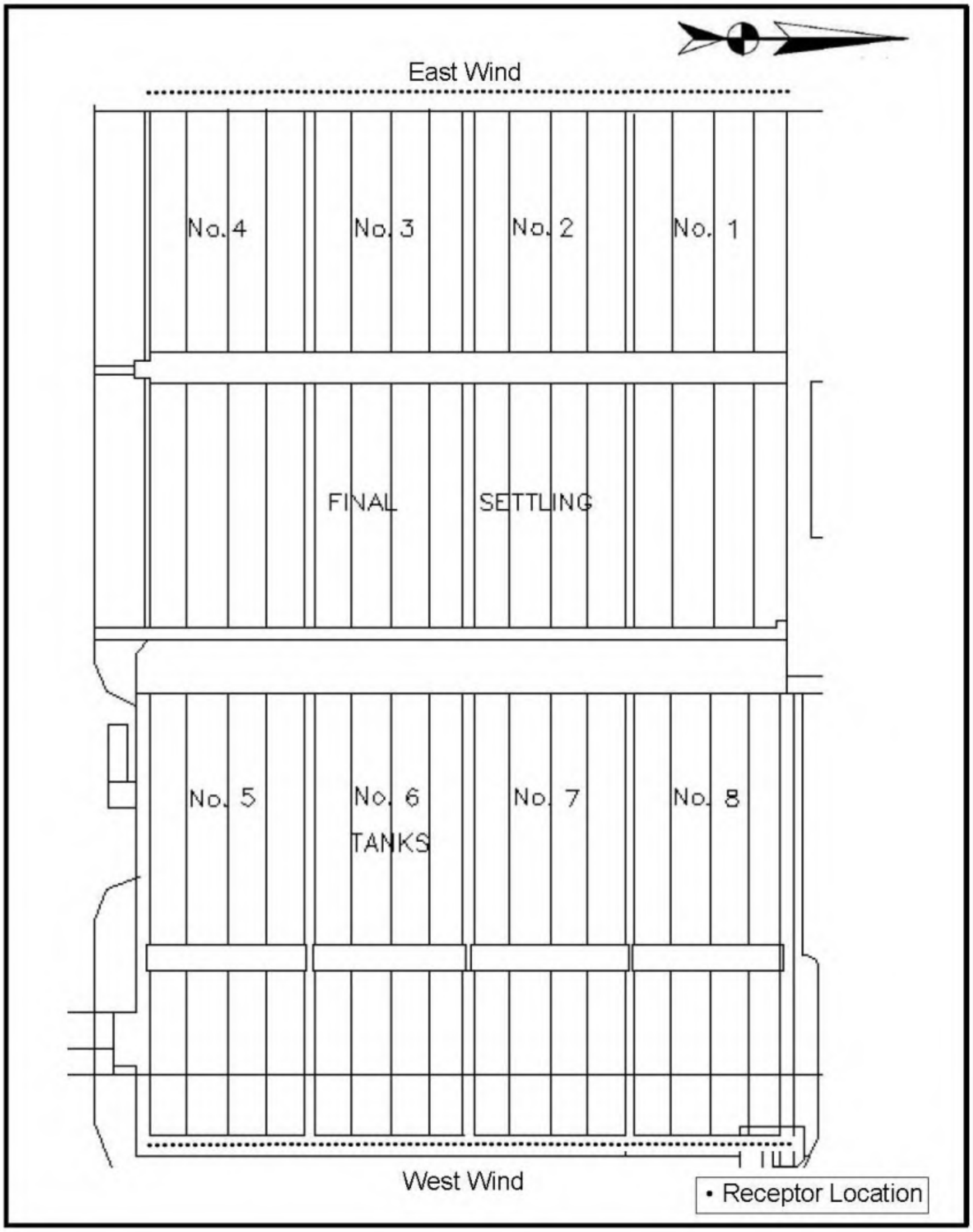

TABLE 7-11

LOCATIONS AND DIMENSIONS OF LOW-EMITTING AREAS: FINAL SETTLING TANKS

AERMOD ID	Coordinates (m) (Southwest Corner)		Dimensions (m)		Area (m^2)
	x	y	x	y	
FTL01	10006.10	9763.17	71.17	21.49	1529.44
FTL02	10006.10	9784.66	71.17	21.64	1540.12
FTL03	10006.10	9806.30	71.17	21.64	1540.12
FTL04	10006.10	9827.94	71.17	21.49	1529.44
FTL05	10085.04	9763.17	60.96	21.49	1310.03
FTL06	10085.04	9784.66	60.96	21.64	1319.17
FTL07	10085.04	9806.30	60.96	21.64	1319.17
FTL08	10085.04	9827.94	60.96	21.49	1310.03
Total: Low-Emitting Areas					**11397.53**

TABLE 7-12

LOCATIONS AND DIMENSIONS OF HIGH-EMITTING AREAS: FINAL SETTLING TANKS

AERMOD ID	Coordinates (m) (Southwest Corner)		Dimensions (m)		Area (m^2)
	x	y	x	y	
FTH01W	10079.56	9781.76	2.03	1.22	2.48
FTH01E	10082.35	9781.76	1.22	1.22	1.49
FTH02W	10079.56	9784.20	2.03	1.22	2.48
FTH02E	10082.35	9784.20	1.22	1.22	1.49
FTH03	10081.89	9785.72	1.68	7.62	12.80
FTH04W	10079.56	9793.65	1.98	1.22	2.42
FTH04E	10082.30	9793.65	1.22	1.22	1.49
FTH05S	10081.84	9795.17	1.68	10.67	17.93
FTH05N	10081.69	9805.84	1.68	10.67	17.93
FTH06W	10079.56	9816.81	1.83	1.22	2.23
FTH06E	10082.15	9816.81	1.22	1.22	1.49
FTH07	10081.59	9818.33	1.68	7.62	12.80
FTH08W	10079.56	9826.26	1.73	1.22	2.11
FTH08E	10082.04	9826.26	1.22	1.22	1.49
FTH09W	10079.56	9828.70	1.73	1.22	2.11
FTH09E	10082.04	9828.70	1.22	1.22	1.49
FTH10	10081.49	9830.23	1.68	5.33	8.95
FTH11W	10079.56	9835.86	1.63	1.22	1.99
FTH11E	10081.94	9835.86	1.22	1.22	1.49
				Total: High-Emitting Areas	**96.64**

TABLE 7-13

RECEPTOR LOCATIONS FOR UNITY MODELING: FINAL SETTLING TANKS

No.	Coordinates (m)			No.	Coordinates (m)		
	x (E Wind)	x (W Wind)	y		x (E Wind)	x (W Wind)	y
1	10005.01	10147.00	9763.17	24	10005.01	10147.00	9786.17
2	10005.01	10147.00	9764.17	25	10005.01	10147.00	9787.17
3	10005.01	10147.00	9765.17	26	10005.01	10147.00	9788.17
4	10005.01	10147.00	9766.17	27	10005.01	10147.00	9789.17
5	10005.01	10147.00	9767.17	28	10005.01	10147.00	9790.17
6	10005.01	10147.00	9768.17	29	10005.01	10147.00	9791.17
7	10005.01	10147.00	9769.17	30	10005.01	10147.00	9792.17
8	10005.01	10147.00	9770.17	31	10005.01	10147.00	9793.17
9	10005.01	10147.00	9771.17	32	10005.01	10147.00	9794.17
10	10005.01	10147.00	9772.17	33	10005.01	10147.00	9795.17
11	10005.01	10147.00	9773.17	34	10005.01	10147.00	9796.17
12	10005.01	10147.00	9774.17	35	10005.01	10147.00	9797.17
13	10005.01	10147.00	9775.17	36	10005.01	10147.00	9798.17
14	10005.01	10147.00	9776.17	37	10005.01	10147.00	9799.17
15	10005.01	10147.00	9777.17	38	10005.01	10147.00	9800.17
16	10005.01	10147.00	9778.17	39	10005.01	10147.00	9801.17
17	10005.01	10147.00	9779.17	40	10005.01	10147.00	9802.17
18	10005.01	10147.00	9780.17	41	10005.01	10147.00	9803.17
19	10005.01	10147.00	9781.17	42	10005.01	10147.00	9804.17
20	10005.01	10147.00	9782.17	43	10005.01	10147.00	9805.17
21	10005.01	10147.00	9783.17	44	10005.01	10147.00	9806.17
22	10005.01	10147.00	9784.17	45	10005.01	10147.00	9807.17
23	10005.01	10147.00	9785.17	46	10005.01	10147.00	9808.17

TABLE 7-13 (Cont'd)

RECEPTOR LOCATIONS FOR UNITY MODELING: FINAL SETTLING TANKS

No.	Coordinates (m)		
	x (E Wind)	x (W Wind)	y
47	10005.01	10147.00	9809.17
48	10005.01	10147.00	9810.17
49	10005.01	10147.00	9811.17
50	10005.01	10147.00	9812.17
51	10005.01	10147.00	9813.17
52	10005.01	10147.00	9814.17
53	10005.01	10147.00	9815.17
54	10005.01	10147.00	9816.17
55	10005.01	10147.00	9817.17
56	10005.01	10147.00	9818.17
57	10005.01	10147.00	9819.17
58	10005.01	10147.00	9820.17
59	10005.01	10147.00	9821.17
60	10005.01	10147.00	9822.17
61	10005.01	10147.00	9823.17
62	10005.01	10147.00	9824.17
63	10005.01	10147.00	9825.17
64	10005.01	10147.00	9826.17
65	10005.01	10147.00	9827.17
66	10005.01	10147.00	9828.17
67	10005.01	10147.00	9829.17

No.	Coordinates (m)		
	x (E Wind)	x (W Wind)	y
68	10005.01	10147.00	9830.17
69	10005.01	10147.00	9831.17
70	10005.01	10147.00	9832.17
71	10005.01	10147.00	9833.17
72	10005.01	10147.00	9834.17
73	10005.01	10147.00	9835.17
74	10005.01	10147.00	9836.17
75	10005.01	10147.00	9837.17
76	10005.01	10147.00	9838.17
77	10005.01	10147.00	9839.17
78	10005.01	10147.00	9840.17
79	10005.01	10147.00	9841.17
80	10005.01	10147.00	9842.17
81	10005.01	10147.00	9843.17
82	10005.01	10147.00	9844.17
83	10005.01	10147.00	9845.17
84	10005.01	10147.00	9846.17
85	10005.01	10147.00	9847.17
86	10005.01	10147.00	9848.17
87	10005.01	10147.00	9849.17

7.3.2 Data Analysis and Discussion

Table 7-14 presents the input data for each emission-rate determination for the final settling tanks. The measured downwind concentrations (ug/m^2) are from Table 6-11. The measured upwind concentrations (ug/m^2) are calculated by multiplying the respective average upwind concentrations presented on page 6-51 (ug/m^3) by the appropriate downwind pathlength for this source (86.26 meters for each pathlength). Event-pairs E-315, E-316 and E-317, E-318 are eliminated from further consideration, as no attribution exists (i.e., the upwind concentrations exceed the downwind concentrations). Also presented in Table 7-14 is the meteorological data used in AERMOD to predict the relative (unity) path-integrated concentrations along each downwind measurement path. These data were processed together with twice-daily, upper-air NWS observations for each measurement event day using the AERMET preprocessing program.

Table 7-15 presents emission-rate determinations for the final settling tanks. The *unity-based emission rate* used in the AERMOD analysis is derived by considering a unity emission rate (0.0001 g/s-m^2) over the low-emitting areas (11,397.53 m^2 from Table 7-11) together with a "hot-spot-adjusted" unity emission rate (0.00029 g/s-m^2 from page 6-54) over the high-emitting areas (96.64 m^2 from Table 7-12) which yields a total unity-based emission rate of 1.167779 g/s (1.139753 g/s + 0.028026 g/s).

The *predicted unity-based source attribution* is obtained by running AERMOD with the above source strengths, the requisite source-receptor relationships (Tables 7-11 through 7-13), and the AERMET-generated meteorological profile and surface input files for each measurement event (from the meteorological data presented in Table 7-14). This attribution may be thought of as the path-integrated concentration which would result based on a source emissions of unity for the low-emitting areas and 2.9 times unity for the high-emitting areas.

The *measured source attribution* is obtained from Table 7-14.

The *total actual emission rate* is obtained by rearranging the equation on page 4-4 to solve for the actual emission rate (Q_A).

Finally, the *low-emitting and high-emitting actual emission rates* are derived by adjusting the total emissions in proportion to the unity-based emission rates for these areas. For example, for Events E-18 and E-19, the actual emission rate for the low-emitting areas is (1.139753 g/s ÷ 1.167779 g/s) x 0.0033 g/s = 0.0032 g/s. Similarly, the actual emission rate for the high-emitting areas is (0.028026 g/s ÷ 1.167779 g/s) x 0.0033 g/s = 0.0001 g/s. (All calculations are performed in a computer spreadsheet, so slight rounding discrepancies may exist when attempting to replicate these numbers.) This source-strength apportionment is necessary to support subsequent dispersion modeling efforts for assessment of offsite H_2S impacts.

TABLE 7-14

INPUT DATA FOR EMISSION-RATE DETERMINATIONS: FINAL SETTLING TANKS

Event			Requisite Meteorology										Measured Concentration (ug/m^2)		
		Start	Solar	WD	WS @ 1m		WS @ 10m		Temp.		2-10m ΔT				
No.	Date	Time (EDT)	Rad. (W/m^2)	@ 10m (°)	(mph)	(m/s)	(mph)	(m/s)	(°F)	(°K)	(°F)	(°K)	Downwind	Upwind	Attribution
E-18, 19	07/12/01	11:30	633	284	4.3	1.9	7.1	3.2	74.9	297.0	-2.0	-1.1	739.0	603.8	**135.2**
E-20, 21	07/12/01	11:45	534	299	4.6	2.1	7.1	3.2	74.6	296.8	-1.8	-1.0	779.1	603.8	**175.3**
E-22, 23	07/12/01	12:00	692	289	3.7	1.7	6.7	3.0	75.4	297.3	-1.9	-1.1	789.1	603.8	**185.3**
E-24, 25	07/12/01	12:15	874	287	4.9	2.2	6.5	2.9	76.6	297.9	-2.6	-1.4	727.7	603.8	**123.9**
E-26, 27	07/12/01	12:30	621	288	4.7	2.1	8.2	3.7	76.5	297.9	-1.9	-1.1	769.1	603.8	**165.3**
E-219, 20	08/14/01	12:45	754	062	4.1	1.8	9.8	4.4	80.0	299.8	-0.7	-0.4	949.7	707.3	**242.4**
E-221, 22	08/14/01	13:00	756	059	3.8	1.7	8.6	3.8	80.5	300.1	-0.7	-0.4	892.0	707.3	**184.7**
E-223, 24	08/14/01	13:15	755	059	4.6	2.1	8.2	3.7	80.9	300.3	-0.6	-0.3	987.4	707.3	**280.1**
E-225, 26	08/14/01	13:30	749	060	3.8	1.7	7.5	3.4	81.5	300.7	-0.6	-0.3	902.1	707.3	**194.8**
E-227, 28	08/14/01	13:45	661	052	3.7	1.7	6.5	2.9	82.3	301.1	-0.9	-0.5	930.9	707.3	**223.6**
E-229, 30	08/14/01	14:00	591	051	4.2	1.9	9.2	4.1	82.1	301.0	-0.7	-0.4	866.9	707.3	**159.6**
E-231, 32	08/14/01	14:15	740	052	3.3	1.5	6.3	2.8	82.3	301.1	-1.0	-0.6	888.3	707.3	**181.0**
E-319, 20	09/06/01	08:15	354	060	2.6	1.2	3.8	1.7	65.5	291.8	-0.8	-0.4	523.2	465.8	**57.4**
E-321, 22	09/06/01	08:30	389	079	2.7	1.2	4.8	2.1	66.3	292.2	-0.8	-0.4	519.4	465.8	**53.6**
E-323, 24	09/06/01	08:45	414	085	2.8	1.3	5.3	2.4	67.0	292.6	-0.8	-0.4	498.1	465.8	**32.3**
E-325, 26	09/06/01	09:00	440	091	2.8	1.3	5.4	2.4	67.5	292.9	-0.8	-0.4	530.7	465.8	**64.9**

TABLE 7-15

EMISSION-RATE DETERMINATIONS: FINAL SETTLING TANKS

	Unity AERMOD Analysis		Measured Source Attribution		Actual Emission Rate (g/s)		
Event No.	Emission Rate (g/s)	Predicted Source Attribution (g/m^2)	(ug/m^2)	(g/m^2)	Low-Emitting Areas	High-Emitting Areas	Total
E-18, 19	1.167779	0.048227	135.2	0.0001352	0.0032	0.0001	0.0033
E-20, 21	1.167779	0.035353	175.3	0.0001753	0.0057	0.0001	0.0058
E-22, 23	1.167779	0.049846	185.3	0.0001853	0.0042	0.0001	0.0043
E-24, 25	1.167779	0.040603	123.9	0.0001239	0.0035	0.0001	0.0036
E-26, 27	1.167779	0.040665	165.3	0.0001653	0.0046	0.0001	0.0047
E-219, 20	1.167779	0.084170	242.4	0.0002424	0.0033	0.0001	0.0034
E-221, 22	1.167779	0.065584	184.7	0.0001847	0.0032	0.0001	0.0033
E-223, 24	1.167779	0.055359	280.1	0.0002801	0.0058	0.0001	0.0059
E-225, 26	1.167779	0.088423	194.8	0.0001948	0.0025	0.0001	0.0026
E-227, 28	1.167779	0.062115	223.6	0.0002236	0.0041	0.0001	0.0042
E-229, 30	1.167779	0.053723	159.6	0.0001596	0.0034	0.0001	0.0035
E-231, 32	1.167779	0.067661	181.0	0.0001810	0.0030	0.0001	0.0031
E-319, 20	1.167779	0.137052	57.4	0.0000574	0.0005	0.0000	0.0005
E-321, 22	1.167779	0.205008	53.6	0.0000536	0.0003	0.0000	0.0003
E-323, 24	1.167779	0.200194	32.3	0.0000323	0.0002	0.0000	0.0002
E-325, 26	1.167779	0.237835	64.9	0.0000649	0.0003	0.0000	0.0003

7.4 High- and Low-Level Pump Stations

Emissions from the high- and low-level pump stations are presented in this section.

Table 7-16 and **Table 7-17** present emission-rate determinations for the high- and low-level pump stations, respectively. Emission rates are determined for each monitoring event simply by multiplying the rating of the respective exhaust fan (m^3/s) by the mean indoor concentration (ug/m^3) from Table 6-14 and Table 6-15. (Emission-rate calculations are performed in a computer spreadsheet, so slight rounding discrepancies may exist when attempting to replicate these numbers.)

The exhaust-fan ratings are 21,600 CFM (10.19 m^3/s) for the high-level pump station and 24,400 CFM (11.52 m^3/s) for the low-level pump station.

TABLE 7-16

EMISSION-RATE DETERMINATIONS: HIGH-LEVEL PUMP STATION

Event			Mean Conc. (ug/m^3)	Exhaust-Fan Rating		Emission Rate (g/s)
No.	Date	Time (EDT)		cfm	m^3/s	
E-245	08/15/01	13:47 - 13:51	5940	21600	10.19	0.0606
E-247	08/16/01	10:11 - 10:15	342	21600	10.19	0.0035
E-258	08/16/01	13:13 - 13:17	245	21600	10.19	0.0025
E-261	08/21/01	11:23 - 11:26	170	21600	10.19	0.0017
E-275	08/22/01	10:02 - 10:07	24	21600	10.19	0.0002
E-278	08/22/01	11:07 - 11:11	96	21600	10.19	0.0010
E-280	08/22/01	12:19 - 12:23	63	21600	10.19	0.0006
E-282	08/27/01	13:06 - 13:11	1250	21600	10.19	0.0127
E-287	08/27/01	15:30 - 15:35	840	21600	10.19	0.0086
E-290	08/30/01	11:30 - 11:34	4410	21600	10.19	0.0450
E-295	08/30/01	13:03 - 13:08	1560	21600	10.19	0.0159
E-300	08/30/01	14:15 - 14:19	860	21600	10.19	0.0088
E-302	09/04/01	12:15 - 12:18	350	21600	10.19	0.0036
E-305	09/05/01	10:15 - 10:18	1990	21600	10.19	0.0203
E-310	09/05/01	11:16 - 11:21	860	21600	10.19	0.0088
E-313	09/06/01	07:00 - 07:03	220	21600	10.19	0.0022
E-328	09/06/01	09:30 - 09:34	2450	21600	10.19	0.0250

TABLE 7-17

EMISSION-RATE DETERMINATIONS: LOW-LEVEL PUMP STATION

Event			Mean Conc. (ug/m^3)	Exhaust-Fan Rating		Emission Rate (g/s)
No.	Date	Time (EDT)		cfm	m^3/s	
E-246	08/15/01	13:52 - 13:55	7810	24400	11.52	0.0899
E-248	08/16/01	10:32 - 10:36	254	24400	11.52	0.0029
E-259	08/16/01	13:18 - 13:22	197	24400	11.52	0.0023
E-262	08/21/01	11:27 - 11:30	220	24400	11.52	0.0025
E-276	08/22/01	10:08 - 10:12	21	24400	11.52	0.0002
E-279	08/22/01	11:12 - 11:15	107	24400	11.52	0.0012
E-281	08/22/01	12:24 - 12:28	128	24400	11.52	0.0015
E-283	08/27/01	13:11 - 13:15	880	24400	11.52	0.0101
E-288	08/27/01	15:35 - 15:42	3120	24400	11.52	0.0359
E-291	08/30/01	11:35 - 11:38	6760	24400	11.52	0.0778
E-296	08/30/01	13:09 - 13:13	880	24400	11.52	0.0101
E-301	08/30/01	14:20 - 14:25	1090	24400	11.52	0.0126
E-303	09/04/01	12:19 - 12:23	600	24400	11.52	0.0069
E-306	09/05/01	10:18 - 10:22	2150	24400	11.52	0.0248
E-311	09/05/01	11:21 - 11:25	1740	24400	11.52	0.0200
E-314	09/06/01	07:03 - 07:07	140	24400	11.52	0.0016
E-329	09/06/01	09:35 - 09:40	1140	24400	11.52	0.0131

7.5 Sludge Thickener Building

Emissions from the Sludge Thickener Building are presented in this section.

Table 7-18 presents emission-rate determinations for the Sludge Thickener Building. Emission rates are determined for each monitoring event simply by multiplying the rating of the exhaust fan (m^3/s) by the mean indoor concentration (ug/m^3) from Table 6-16. (Emission-rate calculations are performed in a computer spreadsheet, so slight rounding discrepancies may exist when attempting to replicate these numbers.)

Although two exhaust fans exist for the Sludge Thickener Building, only one was operating during the measurement program. The rating of the operating exhaust fan is 15,440 CFM (7.29 m^3/s).

TABLE 7-18

EMISSION-RATE DETERMINATIONS: SLUDGE THICKENER BUILDING

Event			Mean Conc. (ug/m^3)	Exhaust-Fan Rating		Emission Rate (g/s)
No.	Date	Time (EDT)		cfm	m^3/s	
E-48	07/16/01	19:52 - 19:55	220	15440	7.29	0.0016
E-49	07/17/01	11:55 - 11:58	149	15440	7.29	0.0011
E-50	07/17/01	14:30 - 14:33	109	15440	7.29	0.0008
E-74	07/19/01	14:34 - 14:37	134	15440	7.29	0.0010
E-134	07/30/01	17:25 - 17:28	180	15440	7.29	0.0013
E-167	08/02/01	17:25 - 17:28	116	15440	7.29	0.0008
E-234	08/14/01	14:45 - 14:49	29	15440	7.29	0.0002
E-244	08/15/01	12:01 - 12:06	490	15440	7.29	0.0036
E-250	08/16/01	11:12 - 11:15	117	15440	7.29	0.0009
E-260	08/16/01	13:36 - 13:40	113	15440	7.29	0.0008
E-263	08/21/01	11:48 - 11:52	116	15440	7.29	0.0008
E-277	08/22/01	10:22 - 10:25	144	15440	7.29	0.0010
E-284	08/27/01	13:25 - 13:30	74	15440	7.29	0.0005
E-289	08/27/01	15:45 - 15:50	220	15440	7.29	0.0016
E-292	08/30/01	11:41 - 11:45	280	15440	7.29	0.0020
E-297	08/30/01	13:20 - 13:25	220	15440	7.29	0.0016
E-304	09/04/01	12:27 - 12:30	49	15440	7.29	0.0004
E-307	09/05/01	10:26 - 10:30	63	15440	7.29	0.0005
E-312	09/05/01	11:40 - 11:45	74	15440	7.29	0.0005
E-330	09/06/01	09:45 - 09:50	32	15440	7.29	0.0002

7.6 Sludge Storage Tanks

Emissions from the sludge storage tanks are presented in this section.

Table 7-19 presents a summary of emission-rate determinations for the sludge storage tanks. Emission rates are determined for each monitoring event by multiplying the estimated air-exchange volume through the vent openings (m^3/s) by the mean inside concentration (ug/m^3) from Table 6-17. (Emission-rate calculations are performed in a computer spreadsheet, so slight rounding discrepancies may exist when attempting to replicate these numbers.)

The air-exchange volume (m^3/s) is estimated following the methodology developed by Hazen and Sawyer for emissions control sizing, in which an effective inlet/outlet area (m^2) is multiplied by the wind speed (m/s). The effective inlet/outlet area assumes that one-quarter of the vents allow the wind in, one-quarter of the vents allow the wind out, and the remaining one-half of the vents are inactive, regardless of the wind direction. Therefore, because Tanks 1 and 2 each have eight equispaced $0.42m^2$ openings (Section 6.6), the effective inlet/outlet area for these tanks is 0.84 m^2. Because Tank 3 has 18 equispaced $0.42m^2$ openings, the effective inlet/outlet area for this tank is 1.89 m^2.

TABLE 7-19

EMISSION-RATE DETERMINATIONS: SLUDGE STORAGE TANKS

Sludge Storage Tank 1

Event			Mean Conc. (ug/m^3)	WS @ 10m		Effective Inlet / Outlet Area (m^2)	Air-Exchange Volume (m^3/s)	Emission Rate (g/s)
No.	Date	Time (EDT)		mph	m/s			
E-286	08/27/01	13:53 - 14:00	430	9.6	4.3	0.84	3.60	0.0016
E-294	08/30/01	12:08 - 12:15	330	7.0	3.1	0.84	2.63	0.0009
E-299	08/30/01	13:37 - 13:45	290	9.9	4.4	0.84	3.72	0.0011
E-309	09/05/01	10:45 - 10:55	240	8.1	3.6	0.84	3.04	0.0007

Sludge Storage Tank 2

E-285	08/27/01	13:45 - 13:52	1000	9.6	4.3	0.84	3.60	0.0036
E-293	08/30/01	12:00 - 12:07	5440	7.0	3.1	0.84	2.63	0.0143
E-298	08/30/01	13:30 - 13:36	4800	9.9	4.4	0.84	3.72	0.0178
E-308	09/05/01	10:32 - 10:44	102	7.7	3.4	0.84	2.89	0.0003

Sludge Storage Tank 3

E-249	08/16/01	11:02 - 11:07	57	6.8	3.0	1.89	5.75	0.0003

SECTION 8 - EMISSIONS INVENTORY DEVELOPMENT

This section presents development of the H_2S emissions inventory for subsequent AERMOD modeling to support the build scenario. Identified are four systemic conditions at the 26th Ward WPCP which contribute to the H_2S emissions. Each condition either has been or will be remedied; all remedies outside of the scope of the upgrade (Contract 26W-20) will be in place prior to upgrade completion.

- receipt of septic influent from the Spring Creek CSO facility
- ineffective control of wet-well pumping rates
- preliminary settling tank influent-flow imbalances and structural deterioration
- ineffective removal of sludge from the final settling tanks and sludge thickeners

With the exception of the receipt of septic influent from the Spring Creek CSO facility, all conditions were present throughout the field measurement program; receipt of septic influent was only a periodic event as discussed below. Following is a discussion of each condition as it relates to the formation of H_2S at the plant.

Receipt of Septic Influent from Spring Creek

The Spring Creek CSO facility is located about 1 mile east of the 26th Ward WPCP. It consists of several large holding tanks which serve to regulate CSO transfer to the plant by means of the low-level interceptor. Although the water level is sufficient to allow the transfer to begin via gravity, pumping is eventually required as the water level drops. Wastewater transfer takes about 7 hours and is followed by tank-bottom rinsing, which generally takes from 4 to 6 hours.

As discussed in Section 2, remedy to eliminate septic influent from Spring Creek has been implemented by DEP (outside of the 26th Ward upgrades). Two factors leading to the formation of H_2S in the septic influent were identified. The first was the regular seepage of salt water into the CSO holding tanks caused by tidal influences, thus enhancing H_2S formation through the presence of chlorides. This problem has been virtually eliminated, as chloride concentrations in the influent have been reduced via reduction of tidal influences.

The second factor concerned the schedule of wastewater transfer to 26th Ward, which now occurs immediately upon collection (or end of rainfall). Previously, in the absence of rain, wastewater transfer routinely commenced each Tuesday at about midnight. In the event of rain, transfer was delayed until dry-weather flow conditions were re-established. Conditions under which H_2S generation was maximized were a dry period followed by a moderate rainfall which occurred several days prior to transfer. This allowed much of the septic solids which had been accumulating in the sewers to be scoured out and introduced into Spring Creek. The several-day wastewater residence time at Spring Creek (pre-transfer) enabled the occurrence of maximum septic conditions.

The volume of wastewater transferred from Spring Creek can be as much as 10 million gallons. For the 7 hours of transfer, this corresponds to an average flow of 1.4 million gallons per hour or, on a daily-adjusted basis, an hourly flow rate equivalent to about 34 mgd. When compared to 26th Ward's average daily dry-weather flow volume of about 62 mgd at the time, it is evident that the Spring Creek contribution was significant.

The rinsate water accounts for another 2 or 3 million gallons of flow to 26th Ward. However, its contribution to the total facility flow is less, as this volume is spread out over 4 to 6 hours (hourly flow rate equivalent to about 12 mgd).

Wet-Well Over-Pumping

As discussed in Section 2, wastewater is conveyed to the plant through two interceptor sewers. The low-level interceptor handles about two-thirds of the total plant flow, and the high-level interceptor handles the remainder. Wastewater from each interceptor passes through screening chambers before entering the two large pits (wet wells). One wet well serves each pump station (high- and low-level). During weekdays under dry-weather flow conditions, pumping is routinely increased in the early mornings and early evenings to coincide with a flow increase characteristic of weekday residential activity. Pumping is also increased during times of significant rainfall. Under dry-weather flow conditions, nighttime operation of the high-level pump station is generally not required; during such times, the high-level flow is diverted, via a tie gate, to the low-level wet well.

All pumping is currently performed manually using step-speed, dry-pit centrifugal pumps. This precludes the ability to precisely control the pumping rate (and, hence, the wet-well water levels). Maintenance of proper wet-well water levels is essential. If the wells are allowed to overflow, the screening chamber area will flood; if there is too little water, the pumps will become air-bound and subject to possible damage. When water is pumped too fast, large amounts of septic solids (which typically accumulate in the bottom of the wet wells and adjacent portions of the interceptor networks) can become dislodged over a very short time period and be introduced into the plant, thus causing sharp spikes of H_2S emissions. H_2S release from over-pumping can be especially significant after a prolonged dry period when large amounts of septic solids have had the opportunity to accumulate.

As discussed in Section 2, wet-well over-pumping will be eliminated (Contracts 26W-11 and 26W-12). Three of the six main sewage pumps and motors are being replaced, together with the pump-control system which serves all six pumps.

Preliminary Settling Tank Flow Imbalances and Structural Deterioration

Flow imbalances and structural deterioration in the preliminary settling tanks at 26th Ward have resulted in persistent septic conditions which have occurred with varying degrees of severity. The flow imbalances are caused by poor performance of the (upstream) influent-distribution system; they prevent achievement of optimum process efficiency, as two of the tanks are consistently overloaded while the other two are underutilized. These imbalances lead directly to increased wastewater detention time (two tanks) which, in turn, allows for a grease-like scum layer to form on submerged surfaces such as tank walls and the cross-collector mechanism. In addition to the scum formation on these surfaces, an increase in the accumulation of septic solids on the tank bottoms can sometimes occur due to the tank overloading, as the solids cannot be removed quickly enough. The scum and septic solids can each be a significant source of H_2S emissions. The flow imbalances will be remedied under the upgrade (Contract 26W-20) by the construction of the covered Flow Division Structure for distribution of raw sewage (screened) to the existing and new preliminary settling tanks (Section 2).

Structural deterioration of the preliminary settling tanks is of concern. The tank condition has deteriorated to the point where leakage exists at the expansion joints and overall operating efficiency has been affected. There are several sections of tank-bottom surface which have become uneven, and these also act to accumulate H_2S-emitting septic solids as the cross-collector mechanisms cannot reach them. H_2S formation will be minimized under the upgrade (Contract 26W-20) through the structural rehabilitation of the four existing tanks and the construction of two new tanks (Section 2).

Removal of Sludge From the Final Settling Tanks and Sludge Thickeners

The final settling tank sludge-collection/return systems often do not function properly, as the siphons which handle the sludge draw-off from the tank bottoms cannot be adjusted. This can lead to long system residence times, resulting in increased H_2S emissions when solids loading is significant. Sludge cascading over the telescoping valves in the center of the siphons can also result in increased emissions. Under Contract 26W-12, existing step-speed controlled RAS and constant-speed WAS pumps will be replaced with new, variable-speed pumps which will serve to reduce H_2S formation.

For the sludge thickeners, sludge-removal equipment has been replaced to improve thickened sludge removal (Contract 26W-12), thereby reducing septic conditions and the formation of scum blankets in the thickener tanks, and reducing H_2S formation.

Table 8-1 depicts the reduction of H_2S emissions as a function of remedy for the four systemic conditions identified above. Each source is affected by at least one continuously occurring systemic condition which will be (or already has been) remedied; therefore, it is a reasonable postulate that the plant is always in some degree of upset and no build-scenario emissions "floor" can be discerned.

Table 8-2 presents the facility H_2S emissions inventory to support the CEQR air quality analysis. Based on the above considerations, the lowest measured emission rate for each source (Section 7) is assigned.

Attachment G provides data from the March 2002 report which evidences the occurrence of these systemic conditions and the corresponding fact that the plant is always in some degree of upset. Correlation analyses were performed to demonstrate the appropriateness of retaining the earlier (ISCST3-based) emissions data contained in Attachment G for this purpose. For the preliminary settling tanks, the correlation coefficient (r) for the two sets of emissions data (ISCST3- and AERMOD-based) was calculated as 0.915, with a coefficient of determination (r^2) of 0.837. For the aeration tanks, the r and r^2 values were 0.976 and 0.952, respectively, and 0.948 and 0.899 for the final settling tanks. These data indicate an excellent correlation between the ISCST3- and AERMOD-based emissions, thus demonstrating the appropriateness of retaining the earlier (ISCST3) results.

TABLE 8-1

REDUCTION OF H_2S EMISSIONS AS A FUNCTION OF REMEDY

Systemic Condition Remedy	Affected Source				
	Pump Stations	Preliminary Settling Tanks	Aeration Tanks	Final Settling Tanks	Sludge Thickeners
Spring Creek CSO tank repair and revision of wastewater transfer schedule	x	x	x		x
wet-well pumping system repair / replacement	x	x	x		x
construction of Flow Division Structure and PST structural rehabilitation		x	x		x
upgrade of FST sludge-removal system				x	
replacement of sludge thickener tank sludge-removal system					x

TABLE 8-2

FACILITY EMISSIONS INVENTORY TO SUPPORT THE CEQR AIR QUALITY ANALYSIS

Source	Event			Emission Rate (g/s)
	No.	Date	Start Time	
preliminary settling tanks	E-137, 38	08/01/01	14:00	0.0679
aeration tanks	E-237, 38	08/15/01	11:00	0.0003
final settling tanks	E-323, 24	09/06/01	08:45	0.0002
high-level pump station	E-275	08/22/01	10:02	0.0002
low-level pump station	E-276	08/22/01	10:08	0.0002
sludge thickeners	E-234	08/14/09	14:45	0.0002
sludge storage tank 1	E-309	09/05/01	10:45	0.0007
sludge storage tank 2	E-308	09/05/01	10:32	0.0003
sludge storage tank 3	E-249	08/16/01	11:02	0.0003

SECTION 9 - QUALITY ASSURANCE AND QUALITY CONTROL

This investigation was conceived and carried out in conformance with USEPA-recommended guidance for investigations of sites containing potentially hazardous substances under the Comprehensive Environmental Restoration, Compensation and Liability Act of 1990 (CERCLA or Superfund program). Because this guidance facilitates collection of the highest quality data, it is frequently employed in the design and execution of complex field programs for which evidentiary data is required, regardless of whether hazardous sites or substances are involved. This same level of attention to quality was deemed necessary for this investigation, as the data generated will be used to assess regulatory compliance.

The cornerstone of this guidance is the implementation of the data quality objective (DQO) process which involves the establishment of appropriate DQOs and measurement quality objectives (MQOs). DQOs are statements which specify the quality of the data required to support the decision-making process. MQOs are specifications which detail precisely how the required data quality will be achieved and are typically presented in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC). PARCC may be defined as follows:

Precision - a measure of the reproducibility of analyses under a given set of conditions.

Accuracy - a measure of the bias which exists in a measurement method.

Representativeness - how well sampling data represent selected characteristics about the media or phenomenon being measured.

Completeness - the amount of valid data obtained from the measurement method as compared to the amount required to meet the predefined DQOs.

Comparability - the degree to which one data set can be compared to another.

The entire DQO process is conceived and set forth in planning documents prepared and approved prior to commencement of field activities. Typically, either two or three such documents are developed. The first, which may or may not be required depending on the reader's familiarity with the project, is a program plan laying out the investigation effort in its broadest perspective.

The next planning document is the sampling and analysis plan (SAP) which details the sampling strategy and the analysis techniques and equipment to be used, and which contains the DQOs to be achieved.

The final planning document is the quality assurance project plan (QAPjP) which involves the highest level of specificity. It addresses all aspects of quality, including the means for achieving it through identification of appropriate MQOs. The QAPjP format is standardized and is intended to comprehensively address how the five elements comprising quality control (PARCC) are achieved.

For this investigation, an H_2S emissions-estimation procedure was prepared (H_2S Emissions Estimation Procedure in Support of the 26th Ward WPCP Interim Upgrade, Air Quality Compliance Assessment, February 2001) which provided a broad overview of our approach. The SAP was prepared as an attachment to this procedure, and the QAPjP as an appendix to the SAP. The DQOs for the investigation were to provide the information necessary to assess compliance with the DEC 10-ppb off-site standard and the DEP 1-ppb sensitive-receptor standard. The MQOs were identified in terms of PARCC for each measurement component.

In this section, all aspects pertaining to quality assurance and quality control for the investigation are discussed. Quality assurance and quality control form a dynamic relationship, in which quality assurance defines the management plan or system for achieving a required level of monitoring data quality, and quality control can be viewed as the means by which the program's success in achieving that quality level is measured.

Section 9.1 describes the quality assurance program for the investigation. **Section 9.2** presents the quality control measures taken to ensure the required data quality was achieved.

9.1 Quality Assurance

Section 9.1.1 presents an assessment of the problem. **Section 9.1.2** identifies the measurement program requirements based on the data-collection needs. **Section 9.1.3** discusses selection of the measurement system.

9.1.1 Assessment of the Problem

Design of the data-collection program had to address a wide variety of point and area sources from which representative and comparable emissions data could be generated, while accommodating stringent logistical and resource limitations. As part of the sampling design and sampling method evaluation for this investigation, available source characterization data (principally from field work at the Bowery Bay WPCP in 1997 and 2000) was reviewed. Several facts about the origin and fate of H_2S, useful to the design of a successful program, were ascertained during the review of this data:

- Dissolved H_2S in raw sewage is predominantly the result of anaerobic conditions which, in large part, occur in the sewage pipe systems prior to entering the plant. As a result, most of the H_2S is released to the atmosphere during the primary settling and sludge treatment stages.

- The principal source of H_2S emissions is a heterogeneous complex of open area sources comprised of wastewater treatment tanks and associated weirs and channels.

- Spikes of malodorous emissions frequently occur as a result of hydrolic imbalances and other systemic conditions (Section 8) to be remedied within the context of the upgrade itself.

- Malodorous emissions vary diurnally and seasonally, with the highest emissions generally associated with dry-weather flow conditions during summer through early autumn (when the temperature of the wastewater is at its highest level).

- Ambient H_2S concentrations in the immediate vicinity of wastewater process areas can run as high as several thousand ppb over the preliminary settling tank weirs.

Based on this information and the logistical and resource constraints inherent in the investigation, a sampling strategy and approach was developed which could generate data of a quality sufficient to produce reliable and reasonably conservative estimates of H_2S emission rates. Scheduling, planning, design, and instrumentation constraints were addressed within the experimental design as follows:

Scheduling

H_2S emissions monitoring had to coincide with the existence of plant conditions likely to generate the highest levels of malodorous emissions (i.e, between June and mid- to late October). The resultant data could therefore be deemed “reasonably worst-case.”

Planning

The sampling effort had to be prioritized from the highest-emitting sources (preliminary settling tanks and pump stations) to the lowest-emitting sources (aeration tanks, final settling tanks, buildings).

Sampling Design

Emphasis had to be placed on generating spatially representative, cross-plume source-attribution data from the process tank area sources utilizing an upwind/downwind measurement approach. Use of this data to estimate emission rates required concurrent measurement of atmospheric transport and dispersion in the microscale region between the source and the measurement path. A measurement period suitable to address the inherent variability of facility operating practices and micrometeorological conditions had to be identified.

Instrumentation

Instrument selection had to be based on the following needs: (a) expected low-ppb to low-ppm H_2S levels in the immediate vicinity downwind of the source; (b) required quantitative grab sampling, with near-real-time results to support prioritization of field-sampling campaigns; (c) data of a quality sufficient to meet the DQOs; and (d) accommodation of available project resources.

9.1.2 Measurement Program Requirements

Table 9-1 presents the measurement quality objectives for the program as presented in the QAPjP. Precision, accuracy, practical quantitation limit (PQL), and completeness MQOs are provided for the measurement data collected during the investigation. The MQOs were determined to have been achieved when data of sufficient quantity and quality were collected during times representative of normal plant operating conditions and during times of reasonably worst-case emission and meteorological (atmospheric transport and dispersion) conditions.

Table 9-2 through **Table 9-5** present the completeness objectives (also from the QAPjP) for the Jerome meter source measurements, the SF_6 measurements, the tracer-gas flow-rate measurements (SF_6), and the meteorological measurements, respectively.

Table 9-6 presents the precision objective in terms of response characteristics for the meteorological measurement systems. As discussed in the QAPjP, *starting speed* is defined as the wind speed at which the anemometer or vane first performs within its quality specifications (Table 9-1). *Distance constant* is defined as the length of fluid flow past a sensor to cause it to respond to 63.2% (1 - 1/e) of the step-wise change in wind speed. *Delay distance* is defined as the length of a column of air which passes a wind vane such that the vane will respond to 50% of a sudden angular change in wind direction. *Damping ratio* is defined as the ratio of actual damping to critical damping and represents the ratio of the amplitude of successive damped oscillation swings; a damping ratio of 1.0 means there is no overshoot response to sudden changes in wind direction. *Time constant* is defined as the period required for a temperature sensor to respond to 63.2% (1 - 1/e) of the step-wise change in temperature.

The most important measurement program requirement was identification of the sample type and availability, data quality, and number and duration of events which would generate 15-minute, cross-plume H_2S measurements downwind of the process-type area sources. Data specifications presented in the above tables were used in the review and selection of measurement equipment for this investigation.

For the cross-plume and point H_2S measurement systems, manufacturers were evaluated based on their ability to meet the MQOs and PQLs identified. In addition to meeting the data requirements, manufacturers of the wind-measurement systems were also required to demonstrate that their systems meet applicable requirements set forth in USEPA's document, "Quality Assurance Handbook for Air Pollution Measurement Systems."

TABLE 9-1

MEASUREMENT QUALITY OBJECTIVES

Measurement/ Parameter	Sampling Method	Objective			
		Precision	Accuracy	PQL	Completeness
H_2S	Jerome meter	5% [(a)]	± 3.0 ppb	3.0 ppb	see Table 9-2
SF_6	open-path FTIR spectroscopy	< 5 % [(b)]	< 25 % [(b)]	0.17 ppm-m [(c)]	see Table 9-3
Tracer flow (SF_6)	rotameter	NA	± 6%	NA	see Table 9-4
Wind speed (WS)	cup anemometer	± 0.1 m/s	± 0.2 m/s [(d)]	NA	see Table 9-5
Wind direction (WD)	vane	± 1.0 °	± 5.0 °	NA	see Table 9-5
Temperature (T)	aspirated thermistor	0.5 °C	± 0.1 °C	N/A	see Table 9-5
Delta temperature (ΔT)	aspirated thermistor	0.1 °C	± 0.02 °C	N/A	see Table 9-5

Notes:

(a) Relative standard deviation.

(b) Accuracy is calculated by: $[(C_M - C_A) / C_A] \times 100$, where C_M is a measured concentration and C_A is the actual concentration of the test gas.

Precision is calculated by: $100 \times [(1/(n-1)) (\sum_1^n \Delta A_i{}^2 - (1/n) (\sum_1^n \Delta A_i)^2]^{½}$ where n is the number of test points, A_i is the individual test-point surrogate compound values, and ΔA_i equals $A_{avg} - A_i$.

(c) The actual practical quantitation limit (PQL) is dependent upon atmospheric conditions and the number of interferants present; PQLs shown are based on an anticipated pathlength of 100 meters, and assume a 15-minute time-integrated sample.

(d) Accuracy is 0.2 m/s plus 5% of observed.

TABLE 9-2

COMPLETENESS MQO: JEROME METER SOURCE MEASUREMENTS

Source	Number of Monitoring Events	Number of Measurements per Event		Total Number of Measurements
		1 Meter	Surface	
Emissions-Assessment Measurements: Process Area Sources				
hot-spot: all process area sources (before or after)	10	-	25	250
upwind/downwind: preliminary settling tanks	30	21	-	630
upwind/downwind: aeration tanks	5	21	-	105
upwind/downwind: final settling tanks	5	21	-	105
upwind/downwind: Hendrix Street Canal	20	21	-	420
Emissions-Assessment Measurements: Buildings				
raw sewage pump stations	20	9	-	180
sludge thickeners	5	9	-	45
sludge storage tanks	5	9	-	45
Emissions-Refinement Measurements				
preliminary settling tanks	10	17	-	170
QC Measurements: Comparability Between Four Meters				
in-office (pre-field) testing	1	-	40	40
routine daily checks (between two or more meters)	15	-	5	75

TABLE 9-3

COMPLETENESS MQO: SF_6 MEASUREMENTS

Source	Number of Monitoring Events		Total Number of 15-Minute Measurements
	Emissions-Assessment	Emissions-Refinement	
preliminary settling tanks	20	10	30

TABLE 9-4

COMPLETENESS MQO: TRACER-GAS FLOW-RATE MEASUREMENTS

Source	Number of Monitoring Events		Total Number of 15-Minute Measurements
	Emissions-Assessment	Emissions-Refinement	
preliminary settling tanks	20	10	30

TABLE 9-5

COMPLETENESS MQO: METEOROLOGICAL MEASUREMENTS

	Meteorological Monitoring System				
	10-meter				1-meter
Source	**WS**	**WD, σθ**	**T (2m)**	**ΔT @ 2-10m**	**WS @ 1m**
Emissions-Assessment Measurements: Area Sources					
Upwind/downwind: preliminary settling tanks	30	30	30	30	30
Upwind/downwind: aeration tanks	5	5	5	5	5
Upwind/downwind: final settling tanks	5	5	5	5	5
Upwind/downwind: Hendrix Street Canal	20	20	20	20	20
Emissions-Refinement Measurements: Area Sources					
Downwind: preliminary settling tanks	10	10	10	10	10

TABLE 9-6

PRECISION MQO: RESPONSE CHARACTERISTICS FOR METEOROLOGICAL MEASUREMENT SYSTEMS

Parameter	Starting Speed	Distance Constant	Delay Distance	Damping Ratio	Time Constant
Wind speed (WS)	≤ 0.5 m/s	≤ 0.5 m	NA	NA	NA
Wind direction (WD)	≤ 0.5 m/s @ 10m	NA	≤ 0.5 m	0.4 to 0.7	NA
Temperature (T)	NA	NA	NA	NA	≤ 1 min.
Delta temperature (ΔT)	NA	NA	NA	NA	≤ 1 min.

9.1.3 Measurement System Selection

Selection of the H_2S, tracer-gas, and meteorological measurement systems are discussed below.

9.1.3.1 Hydrogen Sulfide

Available H_2S measurement systems were evaluated in terms of the following criteria:

- Measurement output (both point and path-averaged concentrations)
- Measurement quality (precision, accuracy, and range)
- System mobility
- Instrument response time
- Cost (procurement, field work, data reduction)
- National acceptance
- Previous experience

The Arizona Instrument Jerome Meter (Model 631-X) was selected as the H_2S measurement method of choice.

9.1.3.2 Tracer-Gas

Available path-integrated CF_4 and SF_6 measurement systems were evaluated in terms of the following criteria:

- Measurement output (path-integrated concentration)
- Measurement quality (precision, accuracy, and range)
- System mobility
- Instrument response time
- Cost (procurement, field work, data reduction)
- Vendor references
- National acceptance
- Previous experience

The ITT Corporation (formerly EDO Corporation) open-path FTIR spectrometer (Model RAM 2000 Remote Air Monitor) was the tracer-gas measurement system of choice.

9.1.3.3 Meteorological

Available meteorological measurement systems were evaluated in terms of the following criteria:

- Ability to characterize atmospheric transport and dispersion in the microscale region between the downwind measurement paths and the area-type sources
- Ability to accommodate user-defined, 15-minute averaging times
- Data output in real time
- Cost (procurement, field work, data reduction)
- National acceptance
- Previous experience

Climatronics Corporation was selected as the vendor of choice to supply the meteorological measurement system. This system included: two sets of Model F-460 wind speed and wind direction sensors, one MMS temperature / delta temperature translator, two Odessa Engineering Model DSM-3260/AQM data loggers for primary data recording, and two meteorological towers configured to accommodate sensor mounting at heights of 1 meter (1-meter tower) and 2 and 10 meters (10-meter tower).

9.2 Quality Control

The quality control measures taken for the Jerome meters, the open-path FTIR spectrometer, and the meteorological monitoring system are described below.

9.2.1 Jerome Meters

For the Jerome meters, two levels of quality control were performed. The first comprised rigorous in-office instrument acceptance testing upon receipt from the vendor (and prior to use in the field) to ensure that comparably performing Jerome meters were available at all times for project use. The second level of quality control involved assessment of how well the measurement program requirements (identified in Section 9.1.2) were met, once acceptable instruments were selected.

9.2.1.1 Instrument Acceptance Testing

A small aerosol cylinder containing approximately 500 ppm of H_2S (instrument response check gas) was supplied by the NorLab/Norco, Inc. and used in conjunction with a simple test chamber to facilitate instrument acceptance testing. The test chamber consisted of a square, plastic (Rubbermaid) 4-quart container with four small holes positioned around the sides for easy insertion of the Jerome meter probes. For each test, a small amount of gas was introduced into the chamber via a simple Tygon-tube gas-delivery system, also supplied by NorLab/Norco. The chamber was then sealed, and simultaneous H_2S measurements using the four Jerome meters were continually made while the concentration gradually decreased (due to leakage and wall-effect chemistry). The lid was periodically removed and replaced to allow entrainment of clean air into the chamber whenever a lower concentration range was desired.

Additional acceptance testing was performed using the Jerome Hydrogen Sulfide Functional Test Module supplied by Arizona Instrument (the Jerome meter manufacturer). This device is essentially a thermally controlled permeation tube designed to release H_2S at a constant concentration of 250 ppb (±20%). However, a problem was later shown to exist with the thermostat, which caused the concentration to slowly increase to above 340 ppb by the end of the 40-measurement testing period. Because the module can accommodate only one Jerome meter at a time, meaningful instrument comparisons were, therefore, not possible and results are not presented.

Table 9-7 presents results of all test-chamber instrument acceptance testing. Simultaneous, side-by-side concentrations are presented, and average concentrations for each testing period are indicated as shaded entries. The single bolded entry on June 22 (13:56) is a reconstructed value, as the instrument displayed an anomalously high reading (instrument artifact).

The first three instrument acceptance tests were performed prior to commencement of field work. The decision was made to repeat the acceptance testing four more times during the field measurement program to ensure the instruments continued to perform comparably. Only two Jerome meters were involved in the final test, as the other two were no longer needed and had already been returned to the supplier.

The instrument acceptance testing evidenced excellent comparability between all four Jerome meters, both overall and on a measurement-by-measurement basis. The need for reliable Jerome meter operation in the sub-100-ppb range was made clear to the instrument supplier before commencement of the field work. It is evident by the data presented in Table 9-7 and the fact that no units required replacement at any time during the program that adequate testing was performed prior to instrument shipment.

TABLE 9-7

TEST-CHAMBER INSTRUMENT ACCEPTANCE TESTING RESULTS (ppb)

Date	Time (EDT)	Unit and Serial No.			
		1 (1150)	2 (1220)	3 (1519)	4 (1546)
06/22/01	13:55	130	120	140	140
	13:56	**120**	120	130	120
	13:57	24	22	26	20
	13:58	21	20	24	19
	13:59	20	18	22	18
	14:00	18	17	21	16
	14:01	18	15	20	15
	14:03	15	13	18	13
	14:04	10	10	12	6
	14:05	9	6	10	7
	14:06	8	7	10	6
	14:07	3	1	3	2
	Avg.	**33.0**	**30.8**	**36.3**	**31.8**
07/06/01	12:20	200	210	170	180
		200	200	200	210
		18	18	19	17
		17	17	18	15
		16	16	17	15
		17	15	16	13
		6	6	5	4
		6	5	5	5
		5	4	7	5
		5	3	3	3
		3	4	3	2
		3	8	3	2
		3	2	3	2
		3	2	2	1
	12:48	2	0	2	1
	Avg.	**33.6**	**34.0**	**31.5**	**31.7**

Date	Time (EDT)	Unit and Serial No.			
		1 (1150)	2 (1220)	3 (1519)	4 (1546)
07/06/01	12:52	65	55	54	54
		95	87	95	90
		86	83	69	85
		80	78	81	79
		73	73	77	74
		68	70	71	69
		68	65	68	64
		61	61	62	60
		58	56	60	55
	13:03	53	53	55	53
	13:05	11	11	11	9
		11	9	10	9
		10	9	10	8
		9	9	9	8
	13:09	9	8	8	7
	13:11	8	8	7	7
	13:12	4	4	5	2
		5	5	5	3
	13:16	3	2	2	2
		3	2	5	2
	13:17	3	2	3	2
		3	2	3	1
		3	2	3	2
	13:21	5	4	5	3
		4	4	5	3
		5	4	4	3
	13:25	5	4	4	3
	13:27	5	5	5	3
	13:28	5	3	4	2
	13:29	4	3	3	2
	Avg.	**27.4**	**26.0**	**26.8**	**25.5**

TABLE 9-7 (Cont'd)

TEST-CHAMBER INSTRUMENT ACCEPTANCE TESTING RESULTS (ppb)

Date	Time (EDT)	Unit and Serial No.			
		1 (1150)	2 (1220)	3 (1519)	4 (1546)
07/11/01	13:46	40	38	40	38
		40	35	38	33
		39	33	37	34
		38	31	35	36
		33	30	34	28
		32	28	31	27
		29	26	30	26
		28	25	27	24
	13:53	27	23	28	23
		24	22	25	20
		23	21	24	20
		21	20	22	19
		20	19	20	17
		19	19	20	17
		19	17	19	16
	13:59	17	17	16	15
		16	15	16	14
		15	14	16	14
		15	13	14	12
		14	13	14	12
		14	12	13	11
		12	12	11	10
		12	11	12	10
	14:06	12	10	11	10
		10	9	11	10
		11	9	10	9
		10	9	10	8
		9	8	10	8
		9	8	9	7
		8	8	9	7
	Avg.	**20.5**	**18.5**	**20.4**	**17.8**

Date	Time (EDT)	Unit and Serial No.			
		1 (1150)	2 (1220)	3 (1519)	4 (1546)
07/18/01	11:36	111	112	114	104
	11:37	79	81	90	78
	11:38	55	52	61	54
	11:39	34	33	38	32
	11:41	25	25	28	24
	11:42	18	16	19	17
	11:44	14	12	18	15
	11:45	13	14	16	14
	11:47	12	11	14	12
	11:50	11	9	13	11
	11:52	9	9	13	10
	11:53	9	9	13	10
	11:54	10	8	12	10
	11:55	9	7	10	8
	11:58	5	5	7	5
	11:59	6	4	7	4
	12:00	6	4	6	4
	12:01	7	4	6	2
	12:02	8	4	7	2
	12:03	8	5	7	2
	Avg.	**22.5**	**21.2**	**25.0**	**20.9**

TABLE 9-7 (Cont'd)

TEST-CHAMBER INSTRUMENT ACCEPTANCE TESTING RESULTS (ppb)

Date	Time (EDT)	Unit and Serial No. 1 (1150)	2 (1220)	3 (1519)	4 (1546)
07/31/01	12:15	160	130	120	130
		160	130	120	130
		105	120	119	109
		96	109	113	102
		88	104	102	96
		77	97	95	91
		73	89	91	83
		67	83	83	77
		62	79	77	73
		58	72	71	68
		54	68	67	66
		50	63	63	59
		48	59	60	59
		44	54	58	52
		40	52	51	49
		38	48	48	46
		35	45	45	44
		33	43	42	41
		31	39	40	37
		29	38	37	36
	12:40	28	36	36	33
		26	33	33	31
		24	31	32	30
		23	30	30	28
		23	26	28	27
		22	26	25	24
		20	23	24	22
		19	23	24	22
		18	19	19	19
		16	18	18	18

Date	Time (EDT)	Unit and Serial No. 1 (1150)	2 (1220)	3 (1519)	4 (1546)
07/31/01 (Cont'd)		14	17	17	16
		13	17	16	15
		13	16	16	15
		11	14	14	13
		11	13	13	13
		11	12	13	13
		10	12	13	12
		7	9	9	9
		7	9	9	9
	12:55	5	8	7	6
	Avg.	**41.7**	**47.9**	**47.5**	**45.6**
08/29/01	14:55	102	110		
		95	88		
		94	85		
		100	94		
		48	52		
		43	46		
		47	46		
		41	41		
		40	46		
		38	41		
		35	37		
		39	42		
		35	38		
	15:10	35	39		
		7	10		
		7	7		
		6	7		
		6	7		
		7	6		
		6	6		
	15:15	5	6		
	Avg.	**39.8**	**40.7**		

9.2.1.2 Measurement Program Requirements

Precision and Accuracy

Attachment G provides the calibration certificates for all measurement systems employed in this investigation, including the four Model 631-X Jerome meters from which valid H_2S monitoring data were collected (Serial Nos. 1150, 1220, 1519, and 1546). The precision and accuracy MQOs identified in Table 9-1 are based on manufacturer specifications and are addressed through the annual calibration process.

Representativeness

Representativeness is assessed in terms of the spatial and temporal considerations discussed below.

Spatial

Table 9-8 presents an assessment of spatial representativeness for all Jerome meter area-type source measurements, i.e., preliminary settling tanks, aeration tanks, final settling tanks, and the Hendrix Street Canal. Emissions from the Hendrix Street Canal are based only on measurements made along Path 3, as discussed in Section 7.4.2.

For the point-type source measurements (pump station screening rooms, Sludge Thickener Building, and sludge storage tanks), the goal was not to demonstrate spatial representativeness within a given building, but was instead to identify the highest indoor H_2S concentration for subsequent use in volume-exchange calculations. Within the constraints of site access, all building monitoring was conducted at locations judged to have the highest concentrations by virtue of their proximity to the H_2S source.

Temporal

Temporal representativeness is evaluated in terms of wastewater flow and influent temperature. Anaerobic (septic) conditions necessary for H_2S generation are generally associated with dry-flow regimes (less precipitation) and warmer wastewater influent temperatures (summer and early autumn).

Table 9-9 presents an assessment of temporal representativeness for all Jerome meter source measurements, except for the Hendrix Street Canal. As intended, all emissions-assessment data were collected during reasonable worst-case conditions (i.e., during dry-weather flow conditions when effluent temperatures were relatively high).

Information for the Hendrix Street Canal is omitted from this table, as emissions are independent of flow conditions and effluent temperature. All measurements for this source were taken during worst-case conditions, i.e., during times of low tide.

TABLE 9-8

ASSESSMENT OF SPATIAL REPRESENTATIVENESS FOR ALL JEROME METER AREA-TYPE SOURCE MEASUREMENTS

Source	Pathlength (m)	Number of Downwind Sampling Locations	Sampling Density [(a)] (m)
preliminary settling tanks	83.0	17	5.2
aeration tanks	123.1	17	7.7
final settling tanks	86.3	17	5.4
Hendrix Street Canal (Path 1)	458.1	17	28.6
Hendrix Street Canal (Path 2)	82.3	7	13.7
Hendrix Street Canal (Path 3)	66.4	17	4.2

Note:

(a) Calculated by dividing the pathlength by the number of sampling locations less 1, and expressed as sample-point spacing in meters.

TABLE 9-9

ASSESSMENT OF TEMPORAL REPRESENTATIVENESS FOR ALL JEROME METER SOURCE MEASUREMENTS

Wastewater Flow and Effluent Temperatures: Annual Data						
	Flow (mgd)			Effluent Temperature (ºC)		
Month	Monthly Avg.	Highest Day	Lowest Day	Monthly Avg.	Highest Day	Lowest Day
October 2000	56	76	48	20.7	23	17
November 2000	62	104	42	17.4	20	15
December 2000	59	111	45	13.9	18	9
January 2001	61	116	49	12.3	15	10
February 2001	58	96	50	12.7	15	11
March 2001	70	120	54	12.8	16	9
April 2001	62	84	53	16.9	20	13
May 2001	61	110	52	20.3	22	19
June 2001	63	108	51	23.1	26	20
July 2001	61	100	51	23.5	27	21
August 2001	63	90	50	24.8	26	23
September 2001	61	103	47	23.1	26	18

Wastewater Flow and Effluent Temperatures: Daily Emissions-Assessment Data			
Date (2001)	Source	Flow (mgd)	Effluent Temp. (ºC)
July 9	preliminary settling tanks	62	23
July 12	final settling tanks	55	23
July 16	preliminary settling tanks	60	24
July 17	preliminary settling tanks	76	24
July 23	preliminary settling tanks	57	24
July 24	preliminary settling tanks	55	25
August 1	preliminary settling tanks	53	24
August 2	preliminary settling tanks	54	24
August 6	preliminary settling tanks	61	25
August 9	preliminary settling tanks	74	26
August 14	final settling tanks	88	25
August 15	aeration tanks	61	24
August 21	aeration tanks	59	26
September 6	final settling tanks	52	24

Completeness

Table 9-10 presents an assessment of completeness for all Jerome meter source measurements (as set forth in Table 9-2). A total of 7,420 individual Jerome meter measurements were made to support this investigation.

In terms of the total measurements, all completeness objectives were exceeded except for upwind monitoring for the process areas and emissions monitoring for the raw sewage pump stations.

TABLE 9-10

ASSESSMENT OF COMPLETENESS
FOR ALL JEROME METER SOURCE MEASUREMENTS

Source	MQO			Actual		
	Monitoring Events	**Measurements per Event**	**Total Measurements**	**Monitoring Events**	**Measurements per Event**	**Total Measurements**
Emissions-Assessment Measurements: Process Area Sources						
hot-spot: all process area sources (before or after)	10	25	250	12	25 - 30	335
upwind: all process area sources (before or after)	60	4	240	18	6 - 12	164
downwind: preliminary settling tanks	30	17	510	168	17	2856
downwind: aeration tanks	5	17	85	18	17	306
downwind: final settling tanks	5	17	85	36	17	612
downwind: Hendrix Street Canal	20	17	340	27	14 - 17	456
Emissions-Assessment Measurements: Buildings						
raw sewage pump stations	20	9	180	34	5	170
sludge thickeners	5	9	45	20	5 - 9	105
sludge storage tanks	5	9	45	9	6 - 8	70
Emissions-Refinement Measurements						
preliminary settling tanks	10	17	170	64	17	1088
QC Measurements: Comparability Between Meters						
in-office testing (four meters) (including test module)	1	40	40	7	40 - 160	628
in-office testing (two meters)	not applicable	not applicable	not applicable	1	21	42
routine in-field daily checks (four meters)	15	5	75	30	12 - 28	544
routine in-field daily checks (two meters)	not applicable	not applicable	not applicable	5	8 - 12	44

Comparability

A high degree of comparability between Jerome meter measurement data was required in order to estimate emissions over a variety of facility processes and operating conditions. Strict control of sampling methods and instrument performance was necessary to support all investigative findings. In addition to the in-office instrument acceptance testing, comparability was further assessed in the field through frequent intercomparability checks and a more extensive intercomparability analysis for each source.

Intercomparability Checks

Multipoint intercomparability checks were performed in the field immediately after instrument regeneration (at least once per day). All checks were performed at locations not significantly impacted by emissions from the preliminary settling tanks or other high-emitting sources based on consideration of wind direction. On occasion, results of these in-field checks indicated unacceptable performance of one of the instruments. This was generally remedied by re-zeroing or performing additional regeneration.

Table 9-11 presents results of all Jerome meter intercomparability checks performed in the field during the investigation, as recorded in the field sampling log book. The date and start time for each set of measurements are indicated.

A total of 35 intercomparability checks were performed over the course of the investigation. The first 30 involved use of all four meters, and the remaining 5 involved use of only two meters as the other two were no longer needed and were returned to the supplier. Anomalously high readings (instrument artifacts), which were occasionally observed, are included.

Results of the in-field intercomparability checks were used to determine Jerome meter assignment for the day. The two units which performed most comparably were generally assigned for use in downwind emissions monitoring, while the other two units were reserved for hot-spot measurements or indoor (building) measurements. Jerome meter assignments for all monitoring events appear on the raw data forms in Attachment A.

TABLE 9-11

RESULTS OF JEROME METER INTERCOMPARABILITY CHECKS (ppb)

Date	Unit and Serial No.			
	1 (1150)	2 (1220)	3 (1519)	4 (1546)
07/09/01 (15:10)	12	3	9	3
	32	18	26	20
	18	8	13	8
	17	8	13	6
07/09/01 (18:20)	9	7	8	3
	8	6	7	3
	9	6	7	3
	8	6	7	3
07/10/01 (11:54)	10	7	8	2
	11	8	6	3
	8	7	7	3
	10	7	7	5
	9	9	7	2
07/10/01 (14:50)	4	4	6	4
	10	4	7	4
	10	5	7	4
	11	7	8	4
	12	8	7	5
07/12/01 (10:00)	6	4	4	4
	4	4	4	3
	5	4	3	2
	5	3	4	3
	6	4	4	4
07/13/01 (09:44)	7	6	7	5
	8	7	7	4
	8	6	7	5
	11	9	10	8
	9	8	9	6

Date	Unit and Serial No.			
	1 (1150)	2 (1220)	3 (1519)	4 (1546)
07/16/01 (12:15)	11	9	9	7
	10	9	9	7
	9	7	7	5
	9	7	7	4
07/16/01 (16:00)	8	4	7	0
	7	4	6	0
	4	4	5	6
	11	4	5	4
	200	5	6	3
	7	3	4	4
07/16/01 (19:00)	11	8	11	7
	11	8	11	8
	11	8	11	7
07/17/01 (11:38)	8	8	11	6
	9	7	9	6
	32	7	9	4
	7	7	9	5
	11	7	9	210
	9	5	9	7
	22	15	20	16
07/17/01 (17:04)	13	8	11	6
	13	8	9	5
	11	7	10	6
07/19/01 (10:15)	3	1	4	1
	2	1	4	1
	6	1	3	1
	4	2	3	0

Date	Unit and Serial No.			
	1 (1150)	2 (1220)	3 (1519)	4 (1546)
07/23/01 (11:15)	6	2	7	0
	4	3	6	2
	6	3	7	3
	7	4	7	3
	34	27	33	30
07/23/01 (16:45)	5	4	6	4
	4	4	5	3
	6	4	5	3
	6	4	5	4
07/24/01 (11:05)	4	3	4	3
	5	3	5	3
	6	5	5	5
	6	2	8	5
07/24/01 (15:15)	4	3	4	1
	5	4	5	3
	5	4	4	4
07/26/01 (18:52)	4	3	4	2
	4	2	4	2
	4	3	4	2
	3	2	4	2
07/30/01 (13:00)	7	4	6	3
	7	4	6	3
	6	5	7	3
	6	5	6	3
08/01/01 (12:22)	11	12	12	11
	13	11	13	10
	8	10	9	8
	17	16	15	16
	15	15	14	13

TABLE 9-11 (Cont'd)

RESULTS OF JEROME METER INTERCOMPARABILITY CHECKS (ppb)

Date	Unit and Serial No.			
	1 (1150)	2 (1220)	3 (1519)	4 (1546)
08/01/01 (16:30)	12	6	10	9
	11	7	10	7
	11	7	8	4
	11	6	9	5
08/02/01 (12:22)	9	4	9	4
	8	9	8	6
	13	11	12	11
	10	7	9	6
	11	7	9	8
	11	8	9	4
08/06/01 (11:24)	5	4	6	4
	5	3	6	4
	5	4	7	4
08/06/01 (15:16)	9	7	9	6
	10	7	9	9
	10	7	8	7
	9	7	9	6
08/07/01 (11:40)	18	17	21	19
	15	10	10	11
	13	9	9	9
	14	7	9	8
08/09/01 (11:49)	12	12	13	10
	10	8	11	8
	8	9	9	6
08/14/01 (10:06)	14	11	14	9
	43	40	55	50
	21	18	24	21
	29	33	36	36
	25	27	26	26

Date	Unit and Serial No.			
	1 (1150)	2 (1220)	3 (1519)	4 (1546)
08/15/01 (10:05)	5	4	8	5
	4	4	4	4
	3	3	5	4
	6	4	7	6
	5	4	6	4
	4	3	5	4
08/16/01 (09:50)	7	3	8	5
	2	2	6	3
	0	2	4	3
	4	2	5	0
	2	4	6	0
	1	1	4	2
08/21/01 (10:22)	7	5	8	6
	6	5	8	6
	4	7	8	6
	4	5	7	5
	4	4	7	5
08/22/01 (09:32)	8	9	11	10
	11	11	13	12
	12	11	12	11
08/27/01 (12:33)	8	7		
	6	4		
	6	9		
	7	4		
08/30/01 (11:10)	7	8		
	8	7		
	4	7		
	5	7		

Date	Unit and Serial No.			
	1 (1150)	2 (1220)	3 (1519)	4 (1546)
09/04/01 (11:45)	0	2		
	0	2		
	0	3		
	0	2		
	0	2		
	1	4		
09/05/01 (09:50)	4	5		
	5	7		
	7	5		
	0	3		
09/06/01 (06:40)	5	6		
	3	6		
	2	5		
	0	4		

Intercomparability Analyses

The data-collection procedure downwind of each area source facilitated an additional demonstration of Jerome meter data comparability. Because the Jerome meters were used in a crisscross pattern for each event-pair, sampling was coordinated such that the mid-point samples (Location 9 of 17) were collected coincident in space (within 6 inches of each other) and time. These collocated sample pairs provide an ideal means of assessing data comparability and are examined below on a source-by-source basis.

Table 9-12 through **Table 9-15** present results of the Jerome meter intercomparability analysis for the preliminary settling tanks, aeration tanks, final settling tanks, and the Hendrix Street Canal, respectively. For a given day, the first set of event pairs for which concentration averages are shown corresponds to initial use of the Jerome meters, prior to in-field regeneration. Additional sets of event pairs for that day, where presented, correspond to instrument use after regeneration was performed.

Generally, instrument comparability was judged satisfactory for the preliminary settling tanks and the Hendrix Street Canal, and excellent for the aeration tanks and final settling tanks. Instrument comparability is discussed below for the preliminary settling tanks and the Hendrix Street Canal.

Preliminary Settling Tanks

For the preliminary settling tanks, there were several instances (individual measurements) in which the comparability was poor, due principally to the entrainment of localized plumes of higher-concentration H_2S into one of the meters, even though the probes were positioned within 6 inches of one another.

Table 9-16 presents a comparison between intercomparability analysis results for emissions-assessment and emission-refinement events for the preliminary settling tanks. For each day that emissions-refinement monitoring was performed, the sum of the differences between the emissions-assessment and emissions-refinement intercomparability data, as identified in Table 9-12, is presented. For example, for July 9, the difference is 19 ppb between Events E-1 and E-2, 12 ppb between Events E-3 and E-4, etc.; and the difference is 10 ppb between Events R-1 and R-2, 9 ppb between Events R-3 and R-4, etc. The number of event-pairs for each type of emissions measurement is the same on any given day.

The data presented in Table 9-16 demonstrates the superior intercomparability of the emissions-refinement data. This is despite the fact that the two most comparably performing Jerome meters (based on the in-field intercomparability checks) were, at all times, assigned for use in the emissions-assessment work. These results provide compelling evidence of the existence of localized plumes of higher-concentration H_2S, as the plumes had more opportunity to mix before impacting the Jerome meters along the further downwind measurement path (used for emissions-refinement measurements).

Hendrix Street Canal

For the Hendrix Street Canal, the intercomparability on August 16 appears to be not good based on the average concentration difference of 30 ppb (Table 9-15). However, all data collected on this day was in the 500-ppb range of the instrument for which the manufacturer-provided precision is ±30 ppb (vs. 3 ppb for lower concentrations).

TABLE 9-12

RESULTS OF JEROME METER INTERCOMPARABILITY ANALYSIS: PRELIMINARY SETTLING TANKS

	Event Pairs		Conc. (ppb)	
Date	Unit 1	Unit 2	Unit 1	Unit 2
07/09/01	E-1	E-2	76	57
	E-3	E-4	61	49
	E-5	E-6	27	22
	E-7	E-8	40	31
		Average	51.0	39.8
	Unit 3	Unit 4	Unit 3	Unit 4
	R-1	R-2	34	24
	R-3	R-4	22	13
	R-5	R-6	20	15
	R-7	R-8	22	17
		Average	24.5	17.3
07/09/01	Unit 1	Unit 4	Unit 1	Unit 4
	E-9	E-10	50	39
	E-11	E-12	57	36
	E-13	E-14	28	28
	E-15	E-16	68	60
		Average	50.8	40.8
	Unit 2	Unit 3	Unit 2	Unit 3
	R-9	R-10	20	25
	R-11	R-12	20	23
	R-13	R-14	16	18
	R-15	R-16	36	38
		Average	23.0	26.0

	Event Pairs		Conc. (ppb)	
Date	Unit 2	Unit 3	Unit 2	Unit 3
07/16/01	E-29	E-30	77	94
	E-31	E-32	105	119
	E-33	E-34	41	22
		Average	74.3	78.3
	Unit 1	Unit 4	Unit 1	Unit 4
	R-29	R-30	78	67
	R-31	R-32	36	32
	R-33	R-34	45	29
		Average	53.0	42.7
07/16/01	Unit 2	Unit 3	Unit 2	Unit 3
	E-35	E-36	120	130
	E-37	E-38	210	230
	E-39	E-40	61	110
	E-41	E-42	220	220
		Average	152.8	172.5
	Unit 1	Unit 4	Unit 1	Unit 4
	R-35	R-36	49	44
	R-37	R-38	160	170
	R-39	R-40	42	37
	R-41	R-42	122	128
		Average	93.3	94.8
07/16/01	Unit 2	Unit 3	Unit 2	Unit 3
	E-44	E-45	13	13
	E-46	E-47	130	130
		Average	71.5	71.5
	Unit 1	Unit 4	Unit 1	Unit 4
	R-44	R-45	38	34
	R-46	R-47	8	5
		Average	23.0	19.5

	Event Pairs		Conc. (ppb)	
Date	Unit 1	Unit 3	Unit 1	Unit 3
07/17/01	E-51	E-52	135	104
	E-53	E-54	130	86
	E-55	E-56	120	140
	E-57	E-58	46	45
		Average	107.8	93.8
07/17/01	Unit 2	Unit 3	Unit 2	Unit 3
	E-59	E-60	130	130
	E-61	E-62	130	130
		Average	130.0	130.0
07/23/01	Unit 1	Unit 2	Unit 1	Unit 2
	E-75	E-76	550	600
	E-77	E-78	400	380
	E-79	E-80	380	350
	E-81	E-82	240	230
	E-83	E-84	130	160
		Average	340.0	344.0
07/23/01	Unit 4	Unit 3	Unit 4	Unit 3
	E-85	E-86	56	110
	E-87	E-88	200	190
	E-89	E-90	410	400
	E-91	E-92	230	240
	E-93	E-94	150	120
		Average	209.2	212.0
07/23/01	Unit 1	Unit 2	Unit 1	Unit 2
	E-96	E-97	48	53
	E-98	E-99	128	128
	E-100	E-101	170	160
		Average	115.3	113.7

TABLE 9-12 (Cont'd)

RESULTS OF JEROME METER INTERCOMPARABILITY ANALYSIS: PRELIMINARY SETTLING TANKS

Date	Event Pairs		Conc. (ppb)	
	Unit 4	Unit 3	Unit 4	Unit 3
07/23/01	E-102	E-103	130	120
	E-104	E-105	210	200
	E-106	E-107	280	240
		Average	206.7	186.7
07/24/01	Unit 2	Unit 3	Unit 2	Unit 3
	E-108	E-109	124	139
	E-110	E-111	230	210
	E-112	E-113	120	110
	E-114	E-115	144	32
		Average	154.5	122.8
	Unit 1	Unit 4	Unit 1	Unit 4
	R-108	R-109	51	54
	R-110	R-111	110	110
	R-112	R-113	72	83
	R-114	R-115	44	45
		Average	69.3	73.0
07/24/01	Unit 2	Unit 3	Unit 2	Unit 3
	E-116	E-117	160	160
	E-118	E-119	133	144
	E-120	E-121	92	103
		Average	128.3	135.7
	Unit 1	Unit 4	Unit 1	Unit 4
	R-116	R-117	49	52
	R-118	R-119	62	71
	R-120	R-121	33	36
		Average	48.0	53.0

Date	Event Pairs		Conc. (ppb)	
	Unit 2	Unit 3	Unit 2	Unit 3
08/01/01	E-135	E-136	30	130
	E-137	E-138	39	28
	E-139	E-140	120	110
	E-141	E-142	61	81
		Average	62.5	87.3
	Unit 1	Unit 4	Unit 1	Unit 4
	R-135	R-136	58	60
	R-137	R-138	53	61
	R-139	R-140	64	79
	R-141	R-142	49	55
		Average	56.0	63.8
08/01/01	Unit 2	Unit 3	Unit 2	Unit 3
	E-144	E-145	43	51
	E-146	E-147	47	54
	E-148	E-149	141	150
	E-150	E-151	180	150
		Average	102.8	101.3
	Unit 1	Unit 4	Unit 1	Unit 4
	R-144	R-145	43	38
	R-146	R-147	37	41
	R-148	R-149	56	74
	R-150	R-151	86	114
		Average	55.5	66.8

Date	Event Pairs		Conc. (ppb)	
	Unit 2	Unit 3	Unit 2	Unit 3
08/02/01	E-152	E-153	130	140
	E-154	E-155	43	40
	E-156	E-157	43	52
		Average	72.0	77.3
08/02/01	Unit 4	Unit 1	Unit 4	Unit 1
	E-158	E-159	49	49
	E-160	E-161	122	98
	E-162	E-163	130	120
	E-164	E-165	116	84
		Average	104.3	87.8
08/06/01	Unit 2	Unit 3	Unit 2	Unit 3
	E-169	E-170	150	130
	E-171	E-172	62	70
	E-173	E-174	120	110
	E-175	E-176	114	131
		Average	111.5	110.3
08/06/01	Unit 1	Unit 4	Unit 1	Unit 4
	E-177	E-178	170	180
	E-179	E-180	20	110
	E-181	E-182	28	29
	E-183	E-184	46	52
		Average	66.0	92.8
08/06/01	Unit 2	Unit 3	Unit 2	Unit 3
	E-186	E-187	180	180
	E-188	E-189	128	134
	E-190	E-191	17	16
	E-192	E-193	47	49
		Average	93.0	94.8

TABLE 9-12 (Cont'd)

RESULTS OF JEROME METER INTERCOMPARABILITY ANALYSIS: PRELIMINARY SETTLING TANKS

Date	Event Pairs		Conc. (ppb)	
	Unit 1	Unit 4	Unit 1	Unit 4
08/06/01	E-194	E-195	81	84
	E-196	E-197	23	17
	E-198	E-199	68	94
	E-200	E-201	22	37
		Average	**48.5**	**58.0**

Date	Event Pairs		Conc. (ppb)	
	Unit 1	Unit 2	Unit 1	Unit 2
08/09/01	E-203	E-204	110	120
	E-205	E-206	91	109
	E-207	E-208	53	62
	E-209	E-210	83	114
		Average	**84.3**	**101.3**

Date	Event Pairs		Conc. (ppb)	
	Unit 3	Unit 4	Unit 3	Unit 4
08/09/01	E-211	E-212	130	150
	E-213	E-214	103	107
	E-215	E-216	135	114
		Average	**122.7**	**123.7**

TABLE 9-13

RESULTS OF JEROME METER INTERCOMPARABILITY ANALYSIS: AERATION TANKS

Date	Event Pairs		Conc. (ppb)	
	Unit 2	Unit 3	Unit 2	Unit 3
08/15/01	E-235	E-236	9	10
	E-237	E-238	6	6
	E-239	E-240	8	7
	E-241	E-242	7	6
		Average	7.5	7.3

Date	Event Pairs		Conc. (ppb)	
	Unit 1	Unit 2	Unit 1	Unit 2
08/21/01	E-264	E-265	8	10
	E-266	E-267	13	13
	E-268	E-269	7	5
	E-270	E-271	6	7
	E-272	E-273	8	6
		Average	8.4	8.2

TABLE 9-14

RESULTS OF JEROME METER INTERCOMPARABILITY ANALYSIS: FINAL SETTLING TANKS

Date	Event Pairs		Conc. (ppb)	
	Unit 2	Unit 3	Unit 2	Unit 3
07/12/01	E-18	E-19	5	4
	E-20	E-21	11	10
	E-22	E-23	6	5
	E-24	E-25	10	12
	E-26	E-27	5	5
		Average	7.4	7.2

Date	Event Pairs		Conc. (ppb)	
	Unit 1	Unit 2	Unit 1	Unit 2
08/14/01	E-219	E-220	8	9
	E-221	E-222	8	8
	E-223	E-224	8	6
	E-225	E-226	7	6
	E-227	E-228	8	7
	E-229	E-230	7	6
	E-231	E-232	9	9
		Average	7.9	7.3

Date	Event Pairs		Conc. (ppb)	
	Unit 1	Unit 2	Unit 1	Unit 2
09/06/01	E-315	E-316	1	4
	E-317	E-318	1	4
	E-319	E-320	2	3
	E-321	E-322	3	4
	E-323	E-324	3	4
	E-325	E-326	4	5
		Average	2.3	4.0

TABLE 9-15

RESULTS OF JEROME METER INTERCOMPARABILITY ANALYSIS: HENDRIX STREET CANAL

Date	Event Pairs		Conc. (ppb)	
	Unit 1	Unit 2	Unit 1	Unit 2
07/19/01	E-63	E-64	6	4
	E-66	E-67	8	4
	E-68	E-69	8	5
	E-70	E-71	9	5
	E-72	E-73	9	7
		Average	8.0	5.0

Date	Event Pairs		Conc. (ppb)	
	Unit 2	Unit 3	Unit 2	Unit 3
07/26/01	E-123	E-124	2	4
	E-127	E-126	2	4
	E-129	E-128	2	4
	E-131	E-130	2	3
	E-133	E-132	1	3
		Average	1.8	3.6

Date	Event Pairs		Conc. (ppb)	
	Unit 1	Unit 2	Unit 1	Unit 2
08/16/01	E-251	E-252	820	630
	E-253	E-254	580	610
	E-255	E-256	420	490
		Average	607	577

TABLE 9-16

COMPARISON BETWEEN INTERCOMPARABILITY ANALYSIS RESULTS FOR EMISSIONS-ASSESSMENT AND EMISSIONS-REFINEMENT EVENTS: PRELIMINARY SETTLING TANKS

	Sum of Differences (ppb)	
Date	**Emissions-Assessment**	**Emissions-Refinement**
07/09/01	85	41
07/16/01	129	64
07/24/01	179	30
08/01/01	195	86
Average	**147.0**	**55.3**

9.2.2 Open-Path FTIR Spectrometer

Achievement of the measurement program requirements for the open-path FTIR spectrometer is discussed below.

Precision and Accuracy

Table 9-17 presents the daily precision and accuracy for all open-path FTIR spectrometer measurements, as provided by our subcontractor. Precision and accuracy are calculated in accordance with the methods presented in the notes to Table 9-1. For the entire program, the average precision was 1.25% and the average accuracy was 2.91%, well within the stated measurement quality objectives (Table 9-1).

Two gas cylinders were used for the daily precision and accuracy assessments. One cylinder contained a known amount of CF_4 in clean air (44.9 ppm), and the other a known amount of SF_6 in clean air (9.62 ppm). Each gas was received via a calibrated flow tube through an internal cell within the spectrometer for requisite measurements. Each precision determination involved measurement of CF_4 (16 runs), and each accuracy determination involved measurement of SF_6.

Original factory flow-tube certificates are included in Attachment G, as are the flow-tube calibration curves, the NIST-traceable certificate for the Gilian flow cell used to calibrate the flow tubes, and certificates of accuracy for the precision and accuracy tracer gases. Also included are the certificates of analysis for the pure tracer gases released in the field.

Representativeness

From a spatial perspective, the open-path FTIR spectrometer data was judged very representative, as spatial representativeness is the main advantage of the path-integrated concentration output. From a temporal perspective, the open-path FTIR spectrometer data was again judged very representative, as all CF_4 and SF_6 releases were coincident with all downwind measurements.

Completeness

As discussed on page 7-9, a total of 77 combined CF_4 and SF_6 measurements were ultimately used to support emission-rate assessments for the preliminary settling tanks. This more than meets the completeness measurement quality objective of 30 SF_6 measurements for this source.

Comparability

A high degree of comparability between sigma-z measurements was required in order to account for the influence of local plant features (topography and wastewater process tanks) on plume dispersion and transport. Strict control of measurement methods (FTIR and meteorological systems) was necessary to support the use of sigma-z measurements as a more accurate means of estimating stability when compared to traditional methods.

TABLE 9-17

DAILY PRECISION AND ACCURACY FOR ALL OPEN-PATH FTIR SPECTROMETER MEASUREMENTS

Date	Precision (%)	Accuracy (%)
07/09/01	3.3789	7.5788
07/16/01	1.1426	2.5987
07/17/01	0.5904	3.2987
07/23/01	0.8201	0.0763
07/24/01	0.6815	4.0407
08/01/01	0.3497	3.0275
08/02/01	0.2431	3.1889
08/06/01	1.0289	0.3657
08/09/01	3.0017	2.0174
Average	**1.2485**	**2.9103**

9.2.3 Meteorological Monitoring System

Achievement of the measurement program requirements for the meteorological monitoring system is discussed below.

Precision and Accuracy

Calibration records for the meteorological monitoring system used during the investigation are included in Attachment G. The precision and accuracy MQOs identified in Table 9-1 are based on manufacturer specifications and are addressed through the annual calibration process. They are also based on minimum specifications recommended by USEPA (i.e., guidelines presented in USEPA's document, "Meteorological Monitoring Guidance for Regulatory Modeling Applications," OAQPS, EPA-454/R-99-005, February 2000.

Prior to use of the equipment in the field, a calibration process was implemented to evidence that the data collected achieves these MQOs. Sensor and data logger performance audits were completed by Enviroplan Consulting for wind direction and wind speed, and calibration certificates were provided by the instrument manufacturers to evidence the validity of the standards employed in the performance of these audits.

Representativeness

To ensure the representativeness of the meteorological data collected, two towers were employed. The 10-meter tower was sited to provide data representative of the local meteorology as influenced by the facility and its immediate environs. The 1-meter tower was sited to provide data representative of the microscale region between the sources and the respective measurements.

For each system, care was taken to avoid the downwash influence of buildings and obstacles. The heights at which data was collected were selected because they were representative of respective meteorological regions of interest.

Each system was sited in accordance with applicable requirements set forth in USEPA's document, "Meteorological Monitoring Guidance for Regulatory Modeling Applications," OAQPS, EPA-454/R-99-005, February 2000.

Completeness

Valid meteorological data were collected during all monitoring events. The completeness criteria presented in Table 9-5 was exceeded.

Comparability

A high degree of comparability between meteorological measurements was required in order to account for the influence of plant features and nearby land-use and topographical influences on plume transport and dispersion. Strict control of measurement methods was necessary to support the use of meteorological data for generation of emissions estimates.