# AIR DISPERSION MODELING PROTOCOL FOR ONONDAGA LAKE

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# EXECUTIVE SUMMARY

This modeling protocol document describes the basic approach and methodology for air dispersion modeling analyses to assess potential ambient impacts of air emissions from activities associated with the remediation of Onondaga Lake.

Specifically, the modeling approach for the Onondaga Lake project is intended to provide a comprehensive analysis of potential air impacts associated with emissions that may be generated by the various remediation activities. These activities include, but are not necessarily limited to, sediment dredging, active management of the materials at the sediment consolidation area (SCA), and dewatering of the sediments at the SCA. Additional activities which may generate emissions, such as slurry piping and SCA effluent treatment, will also be assessed. These activities may require control measures, however, it may not be necessary to incorporate these activities into the model.

Additional emission sources and/or activities may be identified beyond those specifically anticipated for the remediation of Onondaga Lake. To ensure that the potential impacts from these additional sources are differentiated from potential impacts caused by Lake remedial activities, it may be necessary to quantify their impacts using dispersion modeling or other evaluation methods such as monitoring. This would ensure that any mitigative strategies for the Lake activities are appropriately designed, and potential impacts from other sources can be considered when developing air quality criteria and monitoring plans for the Lake remediation. Should additional sources associated with other Honeywell remediation projects be identified for which dispersion modeling is determined to be appropriate, modeling analyses for these activities would be conducted consistent with the protocol established in this document or other protocols approved by DEC.

The potential emission sources to be analyzed, and the actual compounds and quantities thereof that may be emitted, are being established and documented in detail as separate study components of the overall design program. Specific contaminants and their estimated flux rates are not discussed in this protocol. Once the sources, compounds, and estimated emission rates are finalized, this information will be separately documented and used to develop the source and emissions data files input to the modeling analysis. Additionally, air quality goals are also being developed as a separate component of the overall investigation. Specific goals recommendations are not included in this report.

The results of the modeling analyses will be used to address four key objectives:

1. Estimate the magnitudes, extent, and spatial and temporal variability of predicted ambient air concentrations (dispersion estimates) of project-related air emissions for the identified Chemicals of Interest (COIs).
2. Identify those sources and emissions having the greatest potential impacts.

3. Design of best management practices, control systems and operations strategies to reduce air emissions resulting from remedial activities to levels less than applicable short-term and long-term ambient air standards, and established threshold levels.
4. Document and communicate the potential impacts of air emissions of COIs and odors from the remedial activities to the community through a series of public outreach and educational programs.

These objectives will be met by conducting a comprehensive series of dispersion modeling analyses to estimate the potential ambient impacts of remediation activity emissions. The analyses will be based on the potential sources identified and on the emission rates and remediation activity schedules as developed via separate remediation design and study components. The analyses will incorporate site-specific meteorological data, and will ultimately account for background air quality levels to be measured as part of an anticipated future data collection activity.

Key components of the actual modeling approach include:

- Use of USEPA's AERMOD model; run in a sequential mode, to assess potential impacts for various averaging periods and in all terrain regimes.
- Use of an onsite meteorological database as the basis for assembling hourly data records suitable for input to AERMOD. The onsite databases will be supplemented by other surface weather observation data from Syracuse (Hancock) International Airport and upper air sounding data from Buffalo, New York.
- Use of AERMOD-related processing programs, including AERSURFACE, AERMET and AERMAP, respectively, to determine land use characteristics and associated boundary layer meteorological parameters, to process the meteorological input data, and to develop the model receptor grid and terrain heights for input to the model.
- Assessment of potential emissions from various remediation activities and scenarios, primarily dredging operations in the lake and management of dredged sediment in the SCA. Other potential emitting activities or sources, such as sediment transfer points or water runoff collection and treatment facilities, will be identified once the final design is completed and included in the analysis.

Dispersion model estimates will be determined for an extensive modeling receptor grid that encompasses the lake, the SCA, and the surrounding environs. Following development of an appropriate set of air quality goals and odor thresholds, the model estimates will be compared to the goals to ensure the final design results in acceptable impacts for all appropriate general and identified sensitive receptor locations. The evaluation of impacts will be conducted as a separate portion of the overall design, and is not addressed in this protocol.

A key component of the analysis is accounting for the variability in potential source locations and emission rates over time. Potential emission sources, including dredging locations, dredge area sizes, containment area size and shape, as well as corresponding emission rates, will likely vary from one activity location to another. Emission rates of various compounds may also vary as a function of wind speed and of air and water temperature variations throughout the year.

Shorter term variations in emissions may be a function of work activity levels from day to night and from weekdays to weekends. In the SCA, emission rates may vary with time as individual containment cells are filled and the volume of dredged material deposited increases.

The modeling approach has been set up such that all of these factors can be accounted for in the set up and execution of the modeling analyses via a "source management" approach to characterizing the source inputs, executing discrete model runs for different sources and source groups, and in integrating and analyzing model results. Although the maximum short-term estimated concentrations of emitted compounds are likely to result from a specific source at a specific time, the long-term average impacts will be represented by the combined results for all sources, emission rates, and variations therein that occur through out a full year of activity.

The following sections describe in more detail the modeling approach and how the specific model inputs will be developed.

# SECTION 1

# PROJECT OVERVIEW AND SITE DESCRIPTION

## 1.1 PROJECT SUMMARY

Onondaga Lake is a 4.6-square-mile lake located just northwest of the city of Syracuse in central New York State. Over 200 years of heavy industrial activity and population growth on shores of the lake and its nearby tributaries have impacted the quality of the lake ecosystem. As a result of the presence of hazardous substances or hazardous wastes, the lake has been identified as a federal Superfund site on the USEPA National Priority List.

In 1992, AlliedSignal (now known as Honeywell) entered into a consent decree with the State of New York to initiate a remedial investigation (RI) and feasibility study (FS) for Onondaga Lake. The Final FS was submitted to New York State Department of Environmental Conservation (NYSDEC) in November 2004 (Parsons, 2004). On July 1, 2005, NYSDEC issued the Record of Decision (ROD) for the Lake, and the Final Consent Decree was issued on January 4, 2007.

The remedy specified in the ROD and CD includes the dredging of 2,653,000 cubic yards (cy) of sediment from the littoral zone (nearshore areas) of the lake and placement of a sediment cap over portions of the lake bottom. These activities will take place in each of several identified Sediment Management Units (SMUs) in the lake, though most of the dredging will occur in the in-lake waste deposit (ILWD), which largely exists in SMU 1 and 2. Sediment dredged from these areas will be deposited in an SCA located to the west of the lake in an area known as Wastebed 13.

As discussed in more detail in Section 2.0, several activities and areas have been identified as potential sources of air emissions that will be the focus of the modeling analyses. These include:

- the removal and onshore management of lake bottom debris;
- the area in and around the sediment dredging operations within the SMUs;
- conveyance of the dredged material to the SCA;
- management of dredged sediment in the SCA; and
- treatment of water generated by the dredging/sediment handling processes as a result of dewatering of the sediments in the SCA.

Separate sampling, analysis, and emission modeling studies are being conducted to identify the specific COIs and the quantities of each that may volatilize to the air from these activities.

## 1.2 STUDY AREA

Figure 1-1 is an aerial photograph of Onondaga Lake and surrounding areas that has been marked to show the key activity areas of interest for the assessment of potential air impacts from project-related emissions.

Most of the dredging activities will be conducted in the southeastern portion of the lake, in SMUs 1, 2, 6, and 7. Material dredged from the lake will be transferred via enclosed pipeline to the SCA at Wastebed 13, which is located about 3.5 miles inland from the southern lakeshore.

Wastebed 13 is part of a large system that was originally utilized as settling basins for the disposal of Solvay waste, and it received the waste material from 1981 to 1986. Wastebed 13 occupies approximately 163 acres and is located in the Town of Camillus, Onondaga County, New York. It is bordered to the north by Ninemile Creek and CSX Railroad tracks; to the west by an Onondaga County Garage property, a formal gravel excavation owned by Honeywell, and a few residential properties; and to the east and south by Wastebeds 12 and 14, respectively. The basin complex of 12-15, of which 13 is a part of, is on property owned by Honeywell, with access restricted by a fence and gated entrance.

The lake surface is at a base elevation of 362.82 ft above Mean Sea Level (MSL). Terrain heights within the first mile of the lakeshore range up to 450 ft MSL. Base elevation in the Wastebed 13 area is about 400 ft MSL with some hills rising to 600 ft MSL within 1 kilometer (km) to the southeast. With the buildup of material deposited over the years, the average elevation of the top of Wastebed 13 is approximately 65 ft above the immediate surrounding offsite grade. It has been covered with soil and planted with various forms of vegetation, including shrubs and stands of trees. The wastebed area is located away from the built-up areas of Syracuse and surrounding towns, but is situated within short distances of nearby residential areas and school properties in Camillus. The wastebed is located about 2.5 miles west of the State Fairgrounds.

## 1.3 ONSITE METEOROLOGICAL MONITORING PROGRAM

As part of the Phase I and Phase II Pre-Design Investigations, an onsite meteorological monitoring program was initiated to support the dispersion modeling analyses and other analytical activities related to the overall Onondaga Lake remediation project. The monitoring program consists of two 10-meter towers instrumented to provide the requisite data for use in the AERMOD model.

The primary goals of the meteorological monitoring program are to (1) collect onsite data directly representative of the potential emission sources and surrounding areas, (2) to obtain measurements of all of the key parameters that are suitable for input to the AERMOD model, and (3) collect measurements using monitoring instrumentation having operating and performance specifications consistent with all US Environmental Protection Agency (USEPA) monitoring requirements and guidelines.

The locations of the two meteorological monitoring sites are shown in Figure 1-1. The first, or primary, Tower Site #1 – designated as the Wastebed 13 site – is situated directly atop the wastebed complex and along the southeastern edge of Wastebed 13. The tower is sited in an openly exposed area such that measurements are considered representative of the conditions prevailing across the entire wastebed. This site was installed and became operational on December 1, 2005. Thus, the first two full calendar years of data for the Wastebed 13 site are available for the years January through December 2006 and January through December 2007.

The secondary Tower Site #2 – designated as the Lakeshore/Willis Avenue Site – is located near the southern lakeshore. The tower is sited in an openly exposed area just off the western side of Route 690 where it intersects with Willis Avenue. Measurements at this site are considered as representative of the southern lake area where most of the dredging activities will take place. This site was installed and became operational on December 1, 2006. The first full calendar year of data at this site is available for the period January through December 2007.

The towers are variously instrumented at surface, 2-meter, and 10-meter heights to obtain measurements of wind speed, wind direction, temperature and delta-temperature, relative humidity, vertical wind speed, stability parameters, solar and net radiation, barometric pressure, and precipitation. Table 1-1 provides a listing of the various parameters and measurement heights for the instrumentation installed on each tower.

The two towers are basically instrumented the same, with two exceptions. First, Net Radiation (which is the preferred radiation parameter in the hierarchy of inputs to AERMET) is measured at Wastebed 13 while Solar Radiation is measured at Lakeshore/Willis Ave. When designing Tower #2 (Lakeshore/Willis Ave), it was believed that Net Radiation values would not vary significantly over the relatively short distance and comparable surface settings of the two sites. Solar radiation is also not expected to vary between the two sites; therefore, it was determined that collection of both Net and Solar Radiation measurements (one parameter at each site) would enhance the overall project database provided by the combined monitoring systems.

Secondly, precipitation measurements are collected at Site #1, but not collected at Site #2. As with the radiation parameters, precipitation measurements are not expected to vary between the two sites; thus, one set of measurements was deemed sufficient for the study area.

The sites are powered via a solar power-charged battery system and are each equipped with a digital data acquisition system and cell-phone based modems for remote data communications via the internet. All sensor outputs are scanned at 1-second intervals, with readings used to calculate 5-minute, hourly, and daily averaged values for each parameter.

Complete details of the meteorological monitoring program, including detailed site descriptions, monitoring equipment specifications, and the routine operating and quality assurance procedures employed to ensure collection of a valid, accurate, and complete database, are contained in the Honeywell – Onondaga Lake Meteorological Monitoring Program SOP/QA Manual (Parsons, 2008).

Data from the two sites are downloaded and subject to preliminary verification 2 to 3 times per week. The databases are subjected to more rigorous quality assurance validation checks and final processing in monthly blocks, which then yield the annual databases used to process the model input files.

Data reports for each site, which include hourly data values for each parameter, plus daily and monthly data summaries, are submitted to NYSDEC on a calendar quarter basis, along with updated tables listing the Data Recovery Rates for each measured and calculated parameter.

For reference purposes, Figures 1-2, 1-3, and 1-4 present wind roses depicting the annual combined frequency distributions of wind speed and direction measurements recorded during 2006 and 2007 at Wastebed 13 and during 2007 at Site #2. The 2006 and 2007 onsite data for Site #1 show that winds from the southwest through northwest were prevalent throughout most of each year, while winds from the north through east to south were recorded much less frequently. At Site #2, there is a much more prevalent peak of winds from the due west, offset by reduced frequencies of both southwesterly and northwesterly winds. There is also a slightly higher frequency of winds from the southeast, albeit at relatively low speeds, at Site #2 than seen for Site #1.

Data collected during each calendar year at the onsite meteorological towers will be combined with concurrent offsite surface weather observation data from Syracuse International Airport and upper air sounding data from Buffalo and input to the AERMOD pre-processor program AERMET to develop complete onsite databases for use in the dispersion modeling analyses of remediation activity air emissions. The details of the data bases generated using the onsite data are presented in Section 3.2.

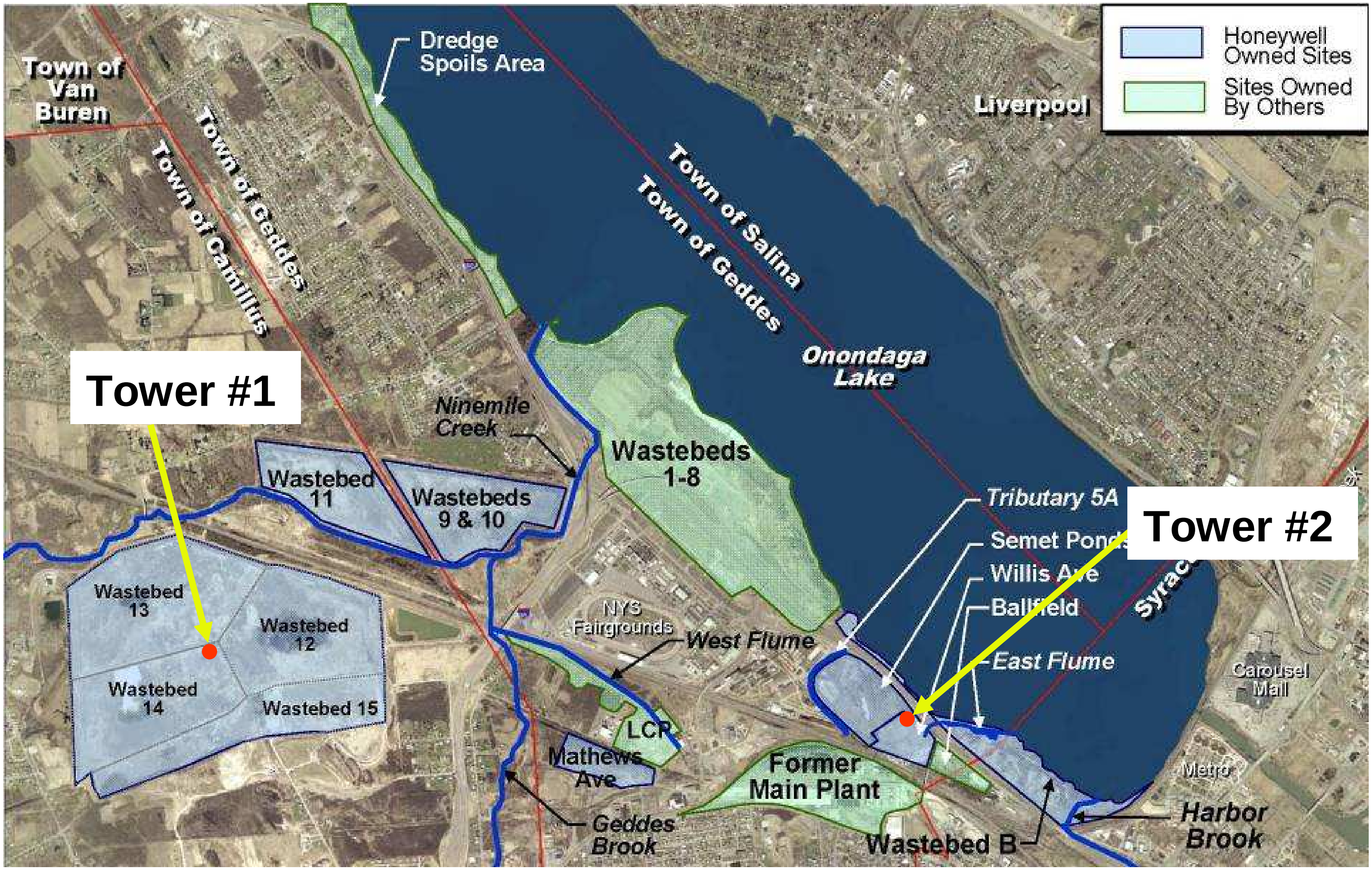


FIGURE 1-1

Honeywell

ONONDAGA LAKE
SYRACUSE, NEW YORK

MET TOWER LOCATION MAP

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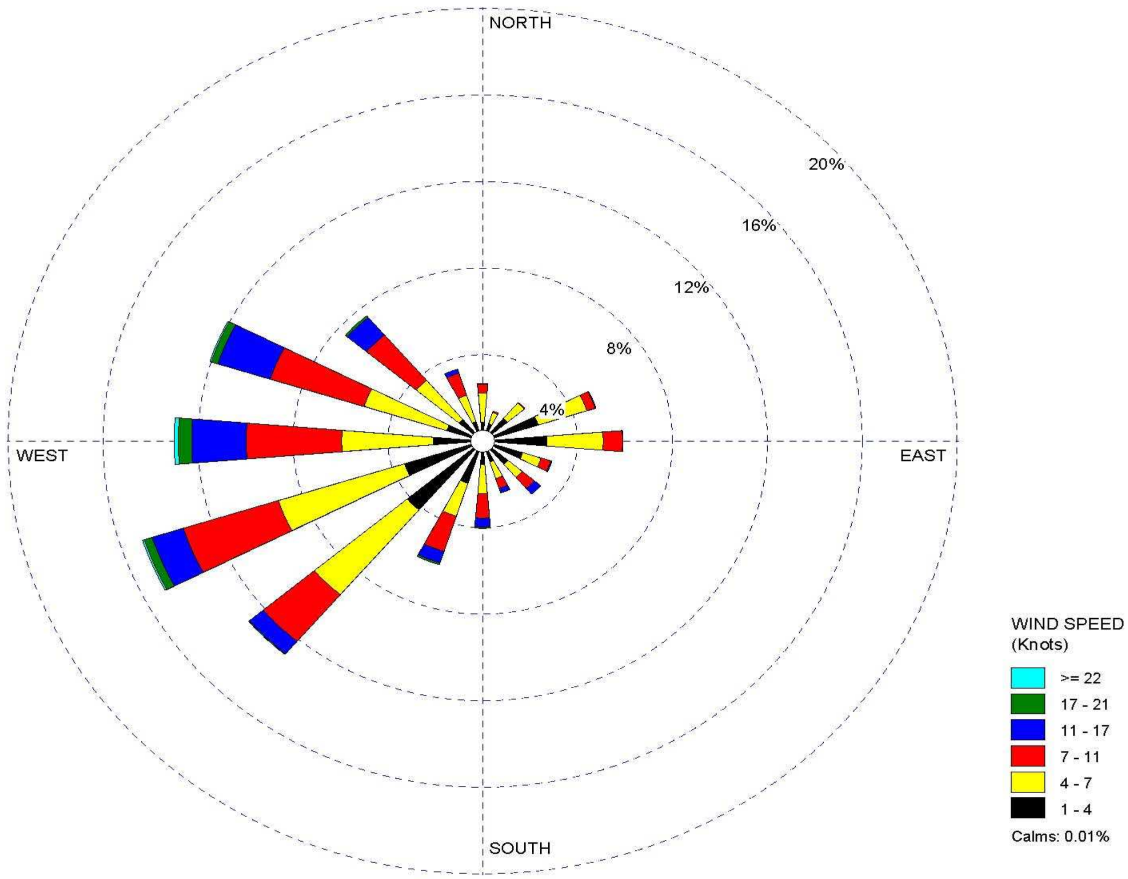
WIND ROSE PLOT:

**Honeywell - Onondaga Lake - Meteorological Monitoring Program**
**Settling Basin 13 Monitoring Site - 10-Meter Tower - 2006**

DISPLAY:

**Wind Speed**
**Direction (blowing from)**




COMMENTS:

DATA PERIOD:

**2006**
**Jan 1 - Dec 31**
**00:00 - 23:00**

| TOTAL COUNT: | CALM WINDS: |
|---|---|
| **8621 hrs.** | **0.01%** |

AVG. WIND SPEED:

**6.02 Knots**

COMPANY NAME:

**PARSONS**

MODELER:

DATE:

**8/23/2007**

PROJECT NO.:

**443584-04252**

FIGURE 1-2

**Honeywell**

**ONONDAGA LAKE**
**SYRACUSE, NEW YORK**

SB-13 TOWER 2006 WIND ROSE

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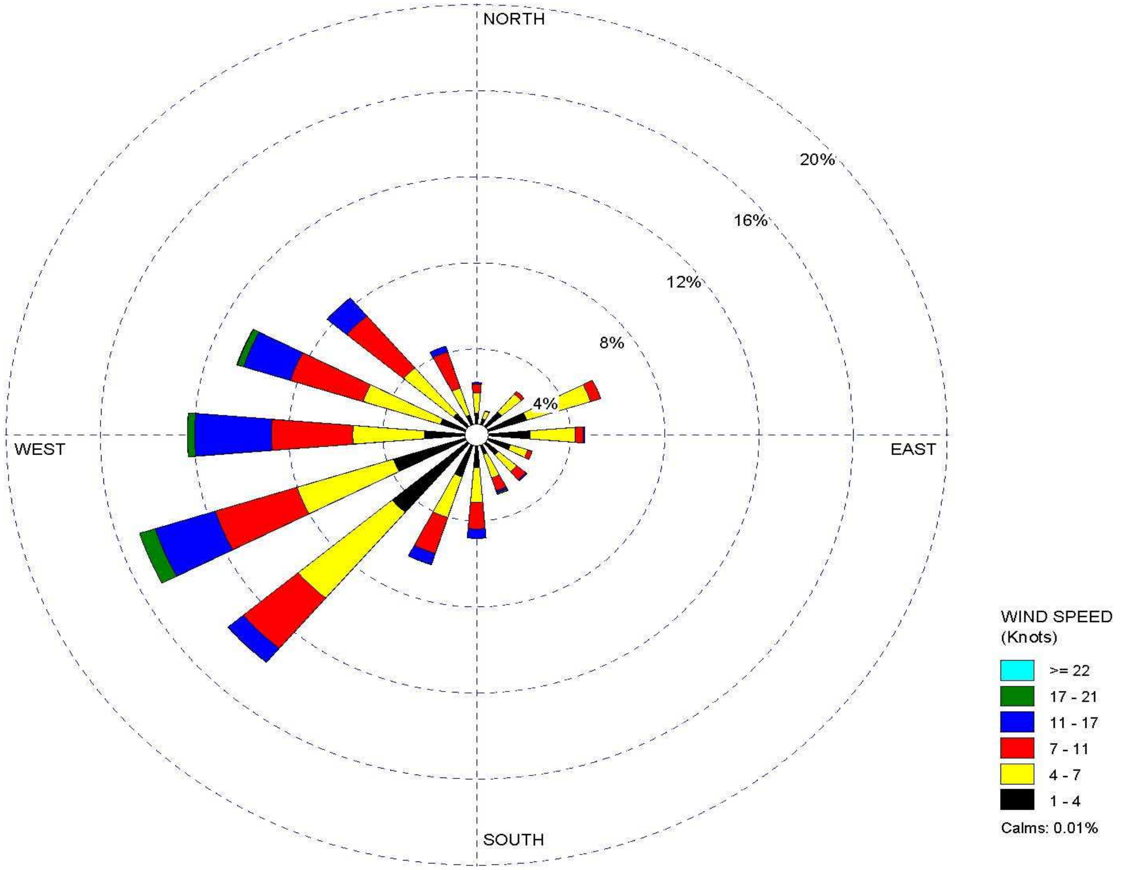
| WIND ROSE PLOT: | DISPLAY: | COMMENTS: |
|---|---|---|
| **Honeywell - Onondaga Lake - Meteorological Monitoring Program**<br>**Wastebed 13 Monitoring Site - 10-meter Tower - 2007** | **Wind Speed**<br>**Direction (blowing from)** | |




| | |
|---|---|
| DATA PERIOD: | **2007**<br>**Jan 1 - Dec 31**<br>**00:00 - 23:00** |
| TOTAL COUNT: | **8623 hrs.** |
| CALM WINDS: | **0.01%** |
| AVG. WIND SPEED: | **6.05 Knots** |
| COMPANY NAME: | **PARSONS** |
| MODELER: | |
| DATE: | **3/17/2008** |
| PROJECT NO.: | **443665-02300** |

WRPLOT View - Lakes Environmental Software

FIGURE 1-3

**Honeywell**

**ONONDAGA LAKE**
**SYRACUSE, NEW YORK**

SB-13 TOWER 2007 WIND ROSE

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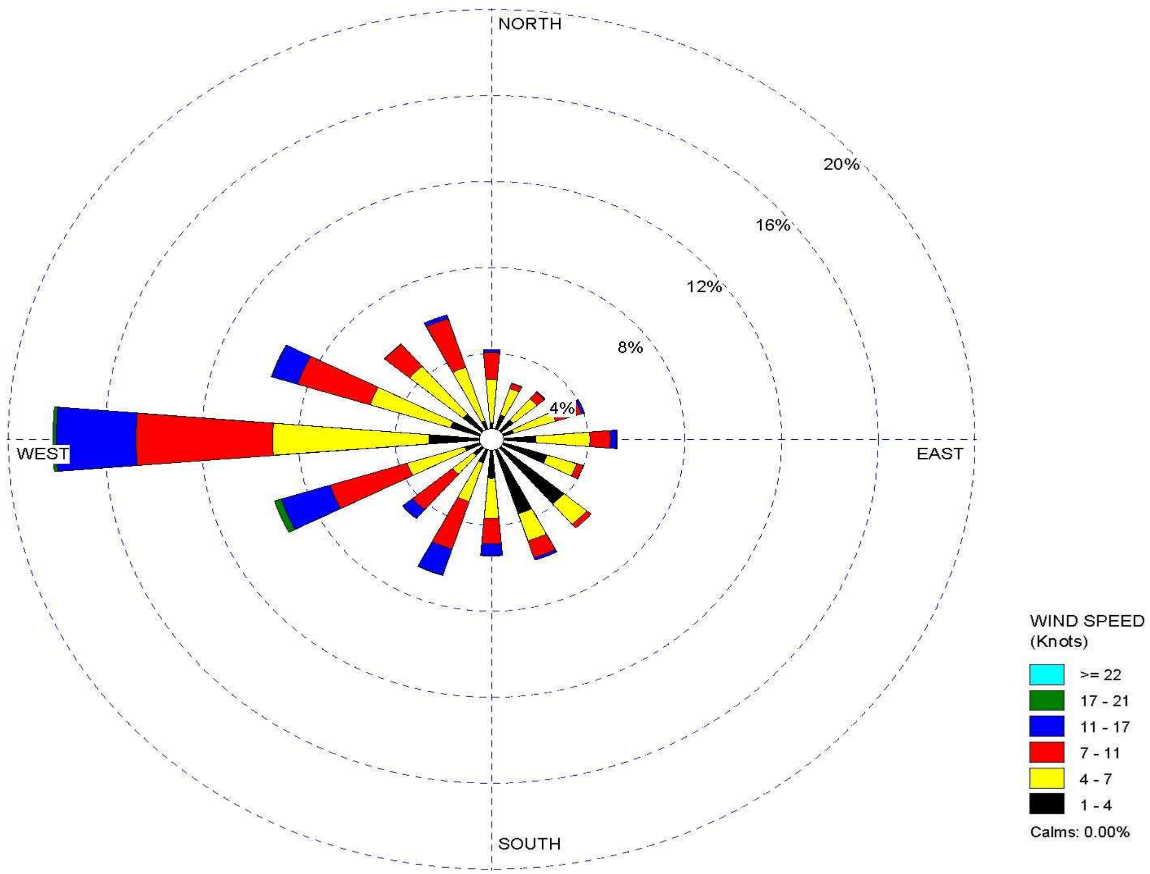
WIND ROSE PLOT:

**Honeywell - Onondaga Lake - Meteorological Monitoring Program**
**Lakeshore/Willis Ave Monitoring Site - 10-meter Tower - 2007**

DISPLAY:

**Wind Speed**
**Direction (blowing from)**

COMMENTS:




DATA PERIOD:

**2007**
**Jan 1 - Dec 31**
**00:00 - 23:00**

TOTAL COUNT: **8594 hrs.**

CALM WINDS: **0.00%**

AVG. WIND SPEED: **5.89 Knots**

COMPANY NAME: **PARSONS**

MODELER:

DATE: **3/17/2008**

PROJECT NO.: **443665-02300**

FIGURE 1-4

Honeywell

**ONONDAGA LAKE**
**SYRACUSE, NEW YORK**

WILLIS TOWER 2007 WIND ROSE

**PARSONS**

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## TABLE 1-1
## Air Dispersion Modeling Protocol for Onondaga Lake
## Meteorological Monitoring Program - Parameters Measured

**TOWER NO. 1 - Wastebed 13 Site - Primary Tower - Start-Up December 1, 2005**

**Ground-Based Measurements**

Precipitation

**2-Meter Level Measurements**

Temperature
Relative Humidity
Dew Point Temperature (computed)
Net Radiation
Barometeric Pressure

**10-Meter Level Measurements**

Horizontal Wind Speed
Horizontal Wind Direction
Standard Deviation of Horizontal WD or Sigma-Theta (computed)
Vertical Wind Speed
Standard Deviation of Vertical Wind Speed (Sigma w) -computed
Temperature
Delta Temperature (10m - 2m)

**TOWER NO. 2 - Lakeshore/Willis Avenus Site - Secondary Tower - Start-Up December 1, 2006**

**2-Meter Level Measurements**

Temperature
Relative Humidity
Dew Point Temperature (computed)
Solar Radiation
Barometric Pressure

**10-Meter Level Measurements**

Horizontal Wind Speed
Horizontal Wind Direction
Standard Deviation of Horizontal WD or Sigma-Theta (computed)
Vertical Wind Speed
Standard Deviation of Vertical Wind Speed (Sigma w) -computed
Temperature
Delta Temperature (10m - 2m)

# SECTION 2

# MODEL AND MODEL OPTIONS

## 2.1 AERMOD MODEL

The dispersion modeling analysis will be conducted using the USEPA's AERMOD dispersion model. This model has recently been developed and formally approved by USEPA as the replacement for the previous ISCST3 model for regulatory and other impact analysis purposes.

AERMOD is a current state-of-the-art dispersion model for assessment of pollutant concentrations from a variety of source types, including point, area, and volume sources, and from both surface-based and elevated source release heights. AERMOD is appropriate for modeling in all terrain regimes by implementing USEPA guidance for assessing impacts in simple, complex, and intermediate terrain.

AERMOD is a steady-state plume model, using Gaussian distributions in the vertical and horizontal for stable conditions, and in the horizontal for convective conditions. The vertical concentration distribution for convective conditions results from an assumed bi-Gaussian probability density function of the vertical velocity.

AERMOD's advantages include the ability to model impacts in simple, complex, and "intermediate" terrain. Intermediate terrain in this context refers to receptors that are above the source release height, but below the plume height predicted by AERMOD model algorithms. AERMOD also uses an arbitrarily large number of meteorological data levels to create profiles of wind, temperature, and turbulence that can vary with height.

Surface parameters such as roughness length, albedo, and Bowen Ratio, which have a large influence on atmospheric boundary layer dispersion conditions, can be selected by direction sector and by month to provide a more accurate characterization of the modeling domain than predecessor models such as ISC3.

AERMOD is considered to be the model that will provide the most representative and realistic estimates of impacts of emissions from Onondaga Lake remediation activity sources.

The most up-to-date Windows-based BEE-LINE Software version of AERMOD will be used for the modeling. (Current versions are BEEST version 9.72 with USEPA AERMOD version 07026). The current version of AERMOD also includes the most recent generation of building downwash algorithms known as "PRIME" (Plume Rise Model Enhancement). In general, "AERMOD-PRIME" will not be invoked for this analysis due to the area and/or volume source characterization of the remediation activities and locations and the lack of major building structures in the activity area. However, if the project ultimately includes any operational or control system structures with release vents or stacks below Good Engineering Practice (GEP) stack height, then the locations and dimensions of these and any nearby structures will be input to the model and the PRIME algorithms will be invoked.

Model options corresponding to the regulatory default settings within the model that will be used in this analysis include the use of:

- the parameter DFAULT in the MODELOPT record on the Control Pathway;
- elevated terrain algorithms requiring input of terrain height data;
- buoyancy induced dispersion;
- an iterative approach to estimate stable boundary layer plume rise;
- rural dispersion coefficients based on examination of land use patterns and characteristics in the vicinity of the source and meteorological measurement location;
- calm hour processing routines;
- missing-data processing routines; and
- sequential date checking.

## 2.2 METEOROLOGICAL DATA PRE-PROCESSOR

### 2.2.1 AERMET

The AERMOD Meteorological Pre-processor (AERMET) is the companion program of AERMOD that is used to pre-process the meteorological data required to run the model. AERMET pre-processing utilizes surface meteorological data from site-specific (onsite) data collection programs and offsite stations such as those run by the National Weather Service (NWS), along with NWS sounding data from upper air measurement locations, to calculate the planetary boundary layer parameters required by AERMOD to perform dispersion and transport computations.

For this modeling analysis, the most recent version of AERMET will be used to pre-process the meteorological data used as input to the model. (Current AERMET version is 06341 and is compatible with the current version of AERMOD - 07026).

Additional details describing the meteorological databases and the AERMET pre-processing procedures used for this analysis are provided in Section 3.2 (Meteorological Data Inputs).

### 2.2.2 AERSURFACE

USEPA's recently issued updated version of the AERSURFACE pre-processor is a program that utilizes digital maps of land use and cover to help define the land use characteristics of the study area and to assign land-use specific values of associated key micrometeorological parameters that are then incorporated into the meteorological data processing via AERMET. Values for the key micrometeorological variables can be defined on a seasonal basis. In addition, the surface roughness values can be defined for different directional sectors from the meteorological measurement source to account for varying land use and cover patterns throughout the study area.

AERSURFACE assigns albedo and Bowen ratio values based on a simple unweighted average land cover type over a representative domain, which by default is a 10 by 10 km region centered on the measurement location. For surface roughness, AERSURFACE assigns values based on an inverse-distance weighted average land cover type defined by wind direction sector out to 1 km from the measurement site. The radius can be varied between 0.1 and 5.0 km, however, 1 km is the recommended default value. Wind direction sectors as small as 30 degrees (0-30, 30-60, 60-90, 330-360) can be employed for determining surface roughness values. Additional details describing the use of the AERSURFACE pre-processing procedures used for this analysis are provided in Sections 3.2.2 and 3.2.3 (AERMET pre-processing and Surface Characteristics).

## 2.3 AERMAP TERRAIN PRE-PROCESSOR

The AERMOD Terrain Pre-processor (AERMAP) is the companion program of AERMOD that is used to pre-process the model receptor grid. AERMAP pre-processing routines utilize electronic digital elevation model (DEM) files corresponding to 7.5-minute US Geological Survey (USGS) topographic map quadrangles, along with a project-specific model receptor grid, to calculate the parameters required by AERMOD to handle air flow through complex terrain. The primary parameter calculated by AERMAP is the height scale (hc), or hill height. The height scale is used to calculate the critical dividing streamline height (Hcrit) for each receptor point based on the controlling terrain feature for the receptor. In addition, AERMAP optionally computes receptor elevations from the DEM file data.

For this modeling analysis, the most current version of AERMAP (version 06341_or greater) will be used to pre-process the receptor model grid. The latest versions of AERMAP contain the USGS approved NADCON 2.1 program that converts North American Datum (NAD) of 1927 to NAD of 1983.

AERMAP will be run with the “TERRHGTS/EXTRACTED” keywords selected, which allows interpolation of model receptor point elevations directly from the DEM data.

Additional details on the AERMAP pre-processing procedures used for this analysis are provided in Section 3.3 (Model Receptor Grid).

# SECTION 3

# MODEL INPUT DATA

## 3.1 SOURCE CHARACTERIZATION AND EMISSION RATES

### 3.1.1 Source Identification

As discussed in Section 1, several remedial activities have been identified as potential sources of emissions. These activities include removal and management of debris, dredging of the lake sediments, conveyance of the dredged material, management of the dredged material in the SCA, and treatment of the SCA effluent water. Potential compounds emitted and their associated flux rates are being evaluated as a separate part of the overall investigation, and will be documented in a separate report.

Additional emission sources and/or activities may be identified beyond those specifically anticipated for the remediation of Onondaga Lake. To ensure that the potential impacts from these additional sources are differentiated from potential impacts caused by lake remedial activities, it may be necessary to quantify their impacts using dispersion modeling or other evaluation methods such as monitoring. This would ensure that any mitigative strategies for the lake activities are appropriately designed, and potential impacts from other sources can be considered when developing air quality criteria and monitoring plans for the lake remediation. Should additional sources associated with other Honeywell remediation projects be identified for which dispersion modeling is determined to be appropriate, modeling analyses for these activities would be conducted consistent with the protocol established in this document or other protocols approved by DEC.

### 3.1.2 Source Characterization

Depending on the nature of the activity, emission sources will be represented as either area sources, or point sources. Area sources will likely consist of activities such as the dredging and SCA operations, while activities such as the water treatment facility, that include a vent or stack through which emissions are exhausted, will be input to the model as a point source.

Area sources are specified in terms of dimensions and/or coordinates defining the locations and sizes of square, rectangular, circular, or irregularly shaped polygonal areas. Emissions may be presumed to be evenly emitted over the entire area of each defined source, or varying rates may be determined for multiple sub units of the source. The locations, sizes, and shapes of area sources are specified and input to the AERMOD model in one of three ways:

1. The horizontal dimensions (length and width) defining a square or rectangular emitting area, along with the coordinates (UTM coordinates derived from USGS maps) defining the location of the SW corner of the rectangular or square area, or
2. The diameter of a circular shaped area source, along with the UTM coordinates of the centerpoint of the area, or

3. The UTM coordinates of a series of points defining the outline of an irregular, or polygon shaped emitting area.

For point sources, each source will be input with a single set of coordinates denoting the actual location of each stack or vent.

For area sources, the AERMOD model uses the dimensions of rectangular and circular area sources to directly calculate the actual total size of the area (e.g., square meters) of the source. For irregularly shaped polygon sources, designated as Area-Poly sources, the AERMOD model has a subroutine to integrate the sizes of subcells in the area based on the input coordinates in order to determine the overall size of the area source.

Unlike industrial exhaust stacks, emissions from area sources typically have no vertical momentum or relatively warm/hot temperatures that would otherwise impart a vertical velocity or buoyancy to an emitted air stream. Emissions will be presumed to be released at ambient temperature.

### 3.1.3 Source Emission Rates

The actual emission rates to be input to the model for each source are being evaluated as a separate component of the overall investigation. In general, emission rates for the specified COIs will be provided for model input in terms of mass per unit time per unit area, such as grams per second per square meter (g/sec/m$^2$) for area sources, and mass per unit time (g/sec) for point sources.

The emission rate data, including variations, will be used to help populate a Source Identification matrix that will account for all of the sources and all of the time, location, and activity level variations in emissions from all identified sources.

In order to appropriately estimate both short-term peak and long-term average ambient concentrations and levels of air contaminants accounting for the various factors that will affect actual emission rates, two sets of model runs will be made for each source or set of sources. Maximum short-term (e.g.; 1-hour) impacts will be determined based on modeling the maximum anticipated hourly emission rate(s) for each source for all hours in the meteorological data record. This will ensure capturing the maximum predicted impact since it cannot otherwise be specified at what time or under what meteorological dispersions the maximum impact(s) may occur.

For assessment of long-term (i.e., annual average) impacts, the source data and emission rates inputs to the model will be set up to explicitly account for the scheduling of the various dredging and SCA operational activities. This includes specifying time of year and the duration that certain areas of each SMU will undergo dredging, the anticipated dredging rates and SCA deposition volumes, the sizes of each area to be dredged, and the number and size of the SCA cells to be filled, along with anticipated daily and weekly work schedules (e.g., if there are no activities on weekends). This will be accomplished by preparing an external hourly emission rate file based on these variables that will be used as the emission rate input file to AERMOD.

To ensure the schedule assumed for the model matches current schedule and design assumptions made by other groups, the Emission and Odor Technical Work Group will continue to coordinate with other work groups to ensure updated schedule assumptions are continuingly used for modeling.

## 3.2 METEOROLOGICAL DATA INPUTS

Sequential (i.e., hour-by-hour) air quality dispersion modeling with AERMOD requires the input of suitable meteorological data. These data include hourly values of variables including wind speed, wind direction, ambient surface temperature, stability parameters, and mixing height that are directly measured from both onsite (i.e., local) and offsite (i.e., regional) representative sources or derived from the directly measured variables. These data are assembled and then "pre-processed" into a single database suitable for direct input to the model. This component of the model input preparation will be accomplished via use of the USEPA meteorological preprocessing program AERMET, which is the companion "meteorological pre-processor" to AERMOD. This section addresses the various elements of the meteorological database to be assembled, the basis for the selection or derivation of a particular data value or set of values, and the pre-processing routine.

### 3.2.1 Meteorological Data Sources

The meteorological database will be assembled from the following three types of data sources:

- Onsite Surface Data: Two Site-Specific Meteorological Towers
- Offsite Surface Data: NWS Syracuse, NY Surface Station
- Upper Air Data: NWS Buffalo, NY Upper Air Station

Table 3-1 presents summary information on the monitoring stations that will be used in the meteorological pre-processing.

**Table 3-1**

**Site-Specific and NWS Data Stations**

| Data Station | Identifier/WBAN | Latitude | Longitude | Elevation | Format |
|---|---|---|---|---|---|
| Camillus, New York (Site-Specific) | Wastebed 13 Station | 43.071 N | 76.255 W | 476 ft | User Defined |
| Geddes, New York (Site-Specific) | Lakeshore/Willis Ave | 43.068 N | 76.201 W | 387 ft | User Defined |
| Syracuse, New York (Surface) | SYR/14771 | 43.117 N | 76.100 W | 410 ft | ISHD/SCRAM |
| Buffalo, New York (Upper Air) | BUF/14733 | 42.933 N | 78.733 W | 705 ft | FSL |

Data from the two onsite Onondaga Lake meteorological monitoring stations are being collected specifically in support of the ambient air quality modeling and data analysis activities comprising the overall air quality impact assessment. These two stations, the first (Wastebed 13) installed near Wastebed 13 in December 2005; and the other (Lakeshore/Willis Ave) installed at the southern lakeshore near SMU's 1, 6, and 7 in December 2006, are intended to provide model input data directly representative of the key identified emission sources in these two areas.

As described in Section 1.3, the towers are equipped with instrumentation at the surface and 10-meter levels for measuring the specific parameters to be used as input to AERMOD, including wind speed, wind direction, temperature and temperature profiles, wind turbulence, solar/net radiation, and barometric pressure. Data collection at both of these stations is expected to continue through the end of the remediation program. Modeling analyses conducted during the course of the program will utilize data for as many calendar years as are available for processing at the time the modeling is conducted.

When modeling emissions from the remedial activities within the lake, data from the Lakeshore/Willis Ave Site (Site #2) at the south end of the lake will be used as input. When modeling emissions from the SCA, databases comprised of surface data from the Wastebed 13 station (Site #1) will be used. When multiple sources are modeled in both areas, a decision may be made as to which data source best represents the overall dispersion conditions for the area. This decision will further consider the extent to which emissions from one source area or another are dominating the overall magnitude of predicted impacts, and/or which portions of the receptor grid are of greatest interest.

The onsite meteorological data will be supplemented with National Weather Service (NWS) aviation surface weather observations recorded at the Hancock International Airport in Syracuse. Data from this NWS station will be included in the meteorological pre-processing for two purposes: (1) to provide supplemental data for AERMOD that is not collected via the onsite monitoring program; and (2) to fill in any missing data gaps that might occur in the onsite data records. The primary parameters utilized from Syracuse Airport (i.e., those that will not be available from the onsite program) are hourly observations of cloud ceiling height and sky cover. These parameters are mandatory for inclusion as input to the AERMET pre-processor.

Upper air sounding data from the NWS Buffalo, NY upper air measurement station will also be included in the AERMET pre-processing. Parameters used as input include the morning soundings of atmospheric pressure, dry bulb temperature, dew-point temperature, wind speed, and wind direction. These parameters are also mandatory for inclusion as input to the AERMET pre-processor.

The following sections describe the AERMET pre-processing in more detail, the specific sources for each meteorological parameter required for the air quality modeling analysis, the data substitution methodology used in the event of missing data, and the frequency with which various data sources were used to develop the meteorological database for modeling.

### 3.2.2 AERMET Pre-Processing

The meteorological data from the three meteorological data sources noted above will be pre-processed via the AERMOD Meteorological Pre-Processor (AERMET). AERMET pre-processing utilizes surface meteorological data from site-specific (onsite) data collection programs and offsite stations such as those run by the NWS, along with NWS sounding data from upper air measurement locations, to calculate the planetary boundary layer parameters required by AERMOD to perform dispersion and transport computations.

AERMET version 06341 or greater will be used to pre-process the meteorological data used as input to the model. The AERMET preprocessing of the data from the three sources selected for this analysis is performed in three stages that are further described as follows:

Stage 1

- In the first step of pre-processing, the onsite meteorological data will be processed. Electronic files of onsite meteorological database will be converted into a format suitable for input to AERMET and converting the data measurement units into those required by AERMET processed the data. One file will be created for each year for each of the two measurement stations. Each file will contain only the data collected from the individual station except for solar and net radiation data. Net radiation data from Wastebed-13 and solar radiation data from Lakeshore/Willis Ave will be included in all input files as these data are considered to be representative of the entire local study area and will be used by AERMET if provided.
- The second step of pre-processing involves the surface data from Syracuse Airport. This data is generally available from the National Climatic Data Center (NCDC) in the Integrated Surface Hourly Data (TD3505 - ISHD) format with fixed length records. This format is suitable for input to AERMET.
- The third step of pre-processing consists of processing the upper air morning sounding data from the NWS Buffalo, NY Station. The sounding data will be obtained from NCDC in the FSL format, which allows it to be directly input to AERMET.
- In each of the first three steps of AERMET pre-processing, all data will be checked against quality assurance criteria contained within the AERMET program. Automatic corrections and substitutions are employed as appropriate and as recommended in the AERMET User's Guide.

Stage 2

- The files generated from the three steps described above are then merged into a single file for the final step of the meteorological pre-processing.

Stage 3

- Utilizing USEPA's AERSURFACE tool, land use characteristics are defined and micrometeorological parameters objectively selected within a representative domain centered on the meteorological measurement location within the overall study area. This is performed individually for each measurement site for each full year of data collection in order to account for the year to year variability in snow cover and annual precipitation amounts that would affect surface moisture conditions. A discussion of the process followed and surface values determined is presented in Section 3.2.3 below.

- The final step of the meteorological pre-processing utilizes the merged data file to create two files suitable for direct use in AERMOD. The two files are the surface data file (".SFC"), which contains the planetary boundary layer parameters used to compute dispersion conditions, and the atmospheric profile data file (".PFL"), which contains the multi-level wind and temperature data used to compute plume rise and transport conditions.
- If the data being pre-processed does not represent a full calendar year, it will be necessary to develop a "single calendar year" model input database. To do this, the last X months of the first year in which data is collected (e.g., August – December) will be placed at the end of the January through July portion of the record and the dates in the file will be changed to reflect the current year.

### 3.2.3 Surface Characteristics

AERMOD modeling analyses require the input of certain surface conditions that influence boundary layer parameter estimates at the primary meteorological measurement location. These surface conditions are quantified by three characteristics, namely: surface roughness length, Bowen ratio and surface albedo, which relate to the height of obstacles to the wind flow, the amount of moisture at the surface, and the reflectivity of the surface, respectively.

The surface roughness length is related to the height of obstacles to the wind flow and is, in theory, the height at which the mean horizontal wind speed is zero. For this modeling analysis, the surface roughness will be objectively determined via the AERSURFACE tool and will reflect terrain and land use characteristics in a subset of the study area out to 1 km from the onsite meteorological measurement locations, as well as any seasonal variations, in accordance with guidance contained in the AERSURFACE User's Guide (EPA-454/B-08-001, January 2008).

The daytime Bowen ratio is an indicator of moisture present in the surface surrounding the meteorological measurement location. It is the ratio of the sensible heat flux to the latent heat flux and is used for determining planetary boundary layer parameters for convective conditions. Information in the AERSURFACE User's Guide suggests that the Bowen ratio be determined as a function of the time of year, the average land-use type over a 10 by 10 km domain centered on the measurement locations, and whether dry, wet or average moisture conditions are prevalent in the area under consideration. For this analysis, average moisture conditions will be used, but only after confirming against a current 30-year climatological record for the Syracuse area on a year-by-year basis. If a particular data collection year or season is determined to be abnormally wet or dry, then the Bowen ratios for wet or dry moisture conditions will be used as appropriate.

The albedo is the fraction of total incident solar radiation reflected by the ground surface back into space without absorption. Typical values range from 0.1 for thick deciduous forests to 0.90 for fresh snow. Appropriate seasonal values for the albedo for processing the meteorological database will determined as described herein. Information in the AERSURFACE User's Guide suggests that the albedo value be determined as a function of the time of year and the average land-use type over a 10 by 10 km domain centered on the measurement locations.

Because surface characteristics vary as a function of time (i.e., seasonality) and land-use, AERMOD requires the input of surface characteristic data based on user–defined time periods (annual, seasonal or monthly) and directional sectors from a minimum of 1 to a maximum of 12 30-degree sectors (for surface roughness only). For the purpose of determining appropriate surface characteristic values for the two meteorological towers in the Onondaga Lake study area, AERMET pre-processing will employ the use of 12 monthly time periods and 12 30-degree directional sectors within a 1 km radius of the tower locations for surface roughness and within a 10 by 10 km domain centered on the tower locations for albedo and Bowen ratio. Specifying the use of AERSURFACE in this fashion will accurately account for major differences in seasonal conditions and differential land use patterns throughout the study area.

Monthly time periods are used so that site-specific seasons can be defined for every year being processed. Consistent with AERSURFACE guidance, the site-specific seasons will correspond to annual vegetative growth cycles as well as whether continuous snow over exists for one or more months. This approach allows use of the surface characteristic values contained in the AERSURFACE User's Guide – Appendix A, Tables A-1 through A-3. The site-specific seasons for 2006 and 2007 are defined in Table 3-2 as follows:

**Table 3-2**
**Site-Specific Seasons for Use in AERSURFACE**

| Seasons | Months in 2006 | # of Months | Months in 2007 | # of Months |
|---|---|---|---|---|
| Late Fall or Winter w/ No Snow | Dec, Jan | 2 | Not Used | -- |
| Winter w/ Snow | Feb, Mar | 2 | Dec to Mar | 4 |
| Spring | Apr, May | 2 | Apr, May | 2 |
| Summer | Jun to Sep | 4 | Jun to Sep | 4 |
| Autumn | Oct, Nov | 2 | Oct, Nov | 2 |

The basis for using the Late Fall/Winter with no snow category in 2006 is confirmation via historical weather observations that little to no continuous snow cover existed in the Syracuse area in January and December of 2006. In contrast, all the winter months in 2007 had significant continuous snow cover.

The basis for using a four-month summer season that includes September, is the fact that we have observed no drop-off in vegetative cover at the meteorological tower locations through the end of September.

The maximum number of directional sectors (12) will be employed because land-use type varies appreciably within the environs of the study area

To objectively define the land use characteristics and micrometeorological parameters of the Onondaga Lake study area, USEPA's AERSURFACE tool (January 2008 release) will be applied to a digital mapping version of land use and cover based on U.S. Geological Survey (USGS) National Land Cover Data 1992 archives (NLCD92) for the Syracuse, NY area. The NLCD92 archive provides land cover data at a spatial resolution of 30 meters and mapped using an Albers Conic Equal Area projection. The land cover data is based on a 21-category classification scheme.

The objective analysis resolves fractional land use/cover data into predominant land use/cover data utilizing a grid cell process for a domain extending 5 km in all directions from the center of the study area (10 by 10 km grid centered on measurement locations). AERSURFACE computes the inverse-distance weighted geometric mean land cover type for an upwind distance of 1 km to determine the associated surface roughness within twelve 30-degree wind direction sectors (0-30, 30-60, 60-90, 330-360). Albedo and Bowen ratio determinations are based on simple unweighted arithmetic and geometric means, respectively, within the entire 10 by 10 km domain.

For reference purposes, Table 3-3 summarizes the seasonal input values for different land use categories and seasons used in the AERSURFACE tool.

For modeling the SCA emissions, AERSURFACE has been run with these seasonal input values and with a centroid corresponding to the coordinates of the Wastebed 13 meteorological station. The results are presented in Table 3-4, which summarizes the seasonal average output values for albedo, Bowen Ratio, and surface roughness within each of the 12 30 degree wind sectors extending 3 km out from the study area (Wastebed 13 station location). These are the values input to AERMET to process with the rest of the meteorological data.

### 3.2.4 Transport Wind Speed and Direction

The primary source of reference wind speed will be the 10-meter level data measured at the onsite towers. If any 10-meter wind speed data values are missing, data from the other onsite tower will be substituted. If data from both towers are missing, then data from Syracuse Airport will be substituted. However, if onsite wind data were missing for only one or two hours, data for the missing hour(s) will be interpolated from onsite data for the hour before and the hour after the missing hour(s). Wind speed is a scalar quantity, and for short periods (one or two hours), it is considered appropriate to fill in the missing onsite wind speed data by linear interpolation. If three or more consecutive hours of wind data were missing from the onsite records, then wind data from either the other onsite tower or from Syracuse Airport will be substituted.

The primary source of transport wind direction will be the 10-meter level data measured at the onsite meteorological towers. If onsite wind data are missing for one or two hours, data for the missing hour(s) will be substituted with data from the other tower or will be interpolated from onsite data for the hour before and the hour after the missing hour(s).

Since wind direction is a vector quantity, direct linear interpolation to fill in missing hourly values is not strictly appropriate. Rather, a multi-step interpolation scheme is applied for wind direction data. Short periods of missing onsite wind direction data are filled in the following manner.

First, the onsite wind data for the hour preceding and the hour following the missing hour(s) are resolved into orthogonal easterly and northerly (u and v) components. Values of easterly and northerly wind components for the missing hour(s) are then calculated through linear interpolation based on the hours preceding and following the missing period. Finally, the interpolated orthogonal components for each of the missing hours are recombined into a vector wind, and the direction of the resultant vector wind is used for the missing hour.

If three or more consecutive hours of wind direction data are missing from both of the onsite data records, then wind data from Syracuse Airport will be used. Standard USEPA meteorological preprocessing procedures are used to randomize any offsite wind direction data that are not reported to the nearest degree.

### 3.2.5 Temperature

Ambient temperature values will be based on 2-meter level measurements from the onsite meteorological towers. If onsite temperature data are missing from both towers for periods between one and four hours, the gaps were filled by linear interpolation based on the hour preceding and following the period of missing data. Longer gaps will be filled in with data from Syracuse Airport.

### 3.2.6 Atmospheric Stability

Atmospheric stability parameters such as the surface friction velocity ($u_*$), sensible heat flux (H); Monin-Obukhov length (L, a stability parameter relating $u_*$ to H) and mixing heights are computed each hour based on the best available data as determined by a series of hierarchal algorithms contained in AERMET.

Unlike the meteorological input requirements for the ISC model, AERMOD does not require that Pasquill-Gifford stability classes be determined. Rather, as defined in AERMET, the atmosphere is considered unstable if the flux of sensible heat is upward at the surface and the time of day is approximately between sunrise and sunset. Specifically, atmospheric conditions are defined as being unstable when $L < 0$. Otherwise, the atmosphere is considered stable ($L>0$).

The sections directly below briefly describe the calculations used to compute the stability parameters based on the onsite and offsite data available for this modeling analysis.

<u>Unstable Atmosphere</u>

When atmospheric conditions are determined to be unstable (i.e., when $L < 0$), both the convective and mechanical mixing heights are calculated. To get to this point, AERMET first estimates the sensible heat flux (H) hour-by-hour by estimating it from the Net Radiation measurements and Bowen ratio. The computations are performed by AERMET following the equations presented in the AERMET User’s Guide (Section 5.4.3).

Once the heat flux is known, the $u_*$ and Monin-Obukhov length (L) for the convective boundary layer (CBL) are computed via an iterative algorithm in AERMET whereby $u_*$ and L change with each iteration, but the heat flux remains constant. The iteration continues until consecutive values of L differ by 1% or less.

Lastly, the mixing heights are calculated. The convective mixing height (Zic) is estimated by a formulation that is based on a one-dimensional (height) energy balance approach. In this approach, the heat flux in the CBL at the surface, and entrained from the stable air aloft, leads to vertical mixing, a rise in the base of the elevated temperature inversion, and an increase of the energy of the boundary layer air. The convective mixing height created by this dynamic is computed from the potential temperature distribution ($\theta(z)$) from the morning sounding and the estimated heat flux (H). AERMET restricts the growth of the convective mixing height to 4,000 meters.

The mechanical mixing height (Zim) is determined from the diagnostic expression:

$\text{Zim} = 2{,}300\ (u_*^{3/2})$.

Stable Atmosphere

When atmospheric conditions are determined to be stable (i.e., when $L > 0$), only the mechanical mixing height is calculated. To get to this point, AERMET estimates the sensible heat flux (H) for the stable atmosphere hour-by-hour by using estimates of the surface friction velocity ($u_*$) and a temperature scale ($\theta_*$). The surface friction velocity and temperature scale are computed directly from NWS cloud cover data and onsite wind speed and surface temperature. The computations are performed by AERMET following the equations presented in the AERMET User's Guide (Section 5.4.4). Because the heat flux may become unrealistically large in the case of strong winds, a limit of $-64\ \text{W/m}^2$ is placed on the heat flux value for any hour.

Once the heat flux is known, the Monin-Obukhov length (L) for the stable boundary layer (SBL) is directly computed using the surface friction velocity, ambient temperature and heat flux. No iterations are performed.

Lastly, the mixing height is calculated. The mechanical mixing height (Zim) is determined from the diagnostic expression $\text{Zim} = 2{,}300\ (u_*^{3/2})$.

### 3.2.7 Mixing Heights

The calculations above produce a continuous record of mechanical mixing heights, along with a record of convective mixing heights that is restricted to daytime hours of upward heat flux. Once these mixing heights are computed, the mechanical mixing heights are subjected to an algorithm in AERMET that smoothes all hours - both those determined to be stable and unstable - so that the effect of any large hour-to-hour fluctuations of the surface friction velocity on the mixing height is minimized.

### 3.2.8 Sounding Data

Calculation of the convective mixing height is based on the twice-daily (morning and afternoon) upper-air sounding data from Buffalo, NY. When pre-processing the meteorological database, AERMET retrieves data up to and including the first measurement level above 5,000 meters.

For the occasional cases where the sounding is lost at a level well below 5,000 meters, there may not be adequate upper air data to allow AERMET to compute the convective mixing height for late afternoon hours. When this situation exists, AERMET extends the sounding to 5,000 meters by computing the potential temperature gradient for the upper 500 meters of the existing sounding data and extending this to the 5,000-meter level.

If a sounding is missing, a value equal to the monthly average morning or afternoon mixing height, as appropriate, is substituted.

### 3.2.9 AERMOD Meteorological Input Files

The meteorological database, including all of the parameters developed as described above for each hour in each yearly record via the AERSURFACE and AERMET processing routines, are created as one boundary layer file (*.sfc) and one atmospheric profile file (*.pfl) for subsequent input to AERMOD.

## 3.3 MODEL RECEPTOR GRID

With the exception of any stacks or vents associated with a wastewater treatment facility or other emissions control devices, virtually all of the sources currently anticipated to be modeled are surfaced-based and will not have any significant upward exhaust momentum or buoyancy (as an industrial stack would have). Therefore, it is expected that maximum concentrations of source emissions will occur very near to the sources themselves and then decrease with distance. The potential for maximum impacts to occur somewhat farther away from the sources will exist for cases where additive impacts from multiple sources at different locations may occur at more distance model receptor points. This condition is most likely to occur in the estimation of long-term (i.e., annual) average impacts at a given model receptor, which will represent the combined impacts of several sources that may be emitting anytime during the year.

As a result, the model receptor grid for the modeling analyses is focused on establishing a fairly dense grid of model receptor points around the SCA and in and around the dredging areas at the lake. Since the potential magnitude of estimated concentrations is not yet known, it is not yet possible to definitively determine how far the final grid should extend.

However, an initial grid extending out to a distance of 3-4 km to the north, east, and south from the lake shoreline, and 5 km to the west of Wastebed 13, has been developed to ensure that the magnitude and variability of estimated concentrations of modeled air contaminants are adequately described, and to demonstrate that estimated concentrations at the outer edges of the grid are well below any applicable ambient air quality standard and/or threshold values.

Based on the above, Figure 3-1 depicts a plot of the initial Cartesian Coordinate model receptor grid system developed for this analysis. The overall grid encompasses an area that is 16 km (east-west) x 12 km (north-south) roughly centered on a mid-point between the southwestern lakeshore and the SCA. The grid is comprised of discrete receptors and is defined by a series of nested sub-grids of varying density and also by strings of property line model receptors surrounding the source areas.

There are a total of 12,625 receptor points in the overall grid. Figure 3-2 is a similar plot of the model receptor grid superimposed over a topographic map section of the area that shows the grid's geographical coverage

**Nested Grids**

The innermost grid consists of model receptors placed at 50-meter intervals out to distances of at least 1 km in each direction from the N-E-S-most edges of the lake dredging area and from the S-W-N-most boundaries of Wastebed 13, as well as covering the entire area in between these two potential emission source locations. This grid includes analysis points placed on the lake surface that are outside of the dredging work areas.

The next sub-grids have receptors placed at 250-meter intervals out to distances roughly 3-4 km from each of the source areas, followed by model receptor points at 500-meter spacing intervals out to the outer edges of the grid.

**Property Line Model Receptors**

A series of property line model receptor points are placed at 25-meter intervals around the entire wastebed boundary and around the initial SMU (i.e., SMU1) scheduled for dredging operations. These are seen in the close-up views of the model receptor grid in Figures 3-3 and 3-4. For this analysis, the property lines define the areas representing Honeywell property in the wastebed area with restricted (fenced and gated) access, and work areas in the dredge zone that will be cordoned off during dredging operations.

As seen in Figure 3-2, the Wastebed area consists of four separate Wastebeds, designated as Wastebeds 12, 13 (the SCA), 14, and 15, plus a Lagoon and Open Area. This entire wastebed area is fenced in with access controlled via a locked gate. Honeywell has, however, granted limited access to a local municipality for depositing waste in a portion of Wastebed 15. Thus, this portion of the wastebed has been excluded from the site property and receptor points have been placed in this area.

Additional receptors representing specifically identified locations may be added to the grid. First, any sensitive receptors, such as schools, hospitals, outdoor recreation areas, or other major public facilities may be represented by discrete receptor points if not deemed to be adequately represented by one or more of the primary receptor points. The locations of any such receptors will be jointly determined by members of the Emissions and Odors Work Group (i.e., determined Honeywell and NYSDEC technical staff representatives).

Second, during the course of model execution, additional receptors may be added with a denser spacing interval in areas of maximum predicted concentrations if needed to better define the point(s) of maximum impact and/or concentration gradients in critical impact areas. Given the density and coverage of the initial grid, the need for such additional receptors is unlikely.

Once some initial modeling results are available and examined in detail, the overall size and spacing of the receptor grid may be modified to eliminate unnecessary receptors if it is determined that no resolution of results is lost. (Given the large total number of receptors on the initial grid, reducing the overall numbers of receptors would substantially reduce computer run times.)

**Workplace Model Receptors**

A series of onsite worker exposure model receptors are also included in the base grid to directly assess levels of air emissions potential experienced by personnel working directly onsite at the SCA and in-lake areas. Modeled impacts at these analysis points will be used to analyze short-term impacts to onsite workers. Analysis point spacing is assumed to be approximately 50 meters for these areas.

Note: For various modeling objectives, model runs may be executed using portions of the overall grid. For example, modeling of worker exposure levels will be limited to the portion of the grids covering the direct work activity areas. In contrast, offsite impact analyses will exclude the work area receptors.

**AERMAP Pre-Processing**

In addition to the X-Y coordinates of each designated model receptor point on the grid, the model input includes the terrain height for each point. The terrain elevations have been defined using the AERMAP Terrain Pre-processor of AERMOD. AERMAP pre-processing utilizes digital elevation model (DEM) files corresponding to 7.5-minute topographic quadrangles, along with a project-specific receptor grid, to calculate the following parameters:

- A height scale ($h_c$) for each receptor point. The height scale, or hill height, is required as input to the AERMOD model. The height scale is used to calculate the critical dividing streamline height ($H_{crit}$) for each receptor based on the controlling terrain for the receptor. These are also calculated based on the data contained in the nine DEM files.
- The terrain elevation of each receptor extracted from the DEM files corresponding to the 7.5-minute series USGS topographic quadrangles defining the modeling analysis domain.

For this analysis, AERMAP is used to calculate both the required height scale data, as well as the model receptor elevations. The AERMAP preprocessing of the model receptor grid for this analysis can be further described as follows:

- AERMAP version 06341 or greater will be used to preprocess the model receptor grid described above.

- Receptor elevation data will be extracted by AERMAP. Receptor elevations via AERMAP are actual terrain heights.
- 7.5-minute DEM files corresponding to the nine topographic quadrangles containing and surrounding the Onondaga Lake study area will be used as input. These nine quads also define the modeling domain. The nine quads (DEM files) to be used for the analysis are:

Syracuse West
Syracuse East
Jamesville
South Onondaga
Marcellus
Camillus
Baldwinsville
Brewerton
Cicero

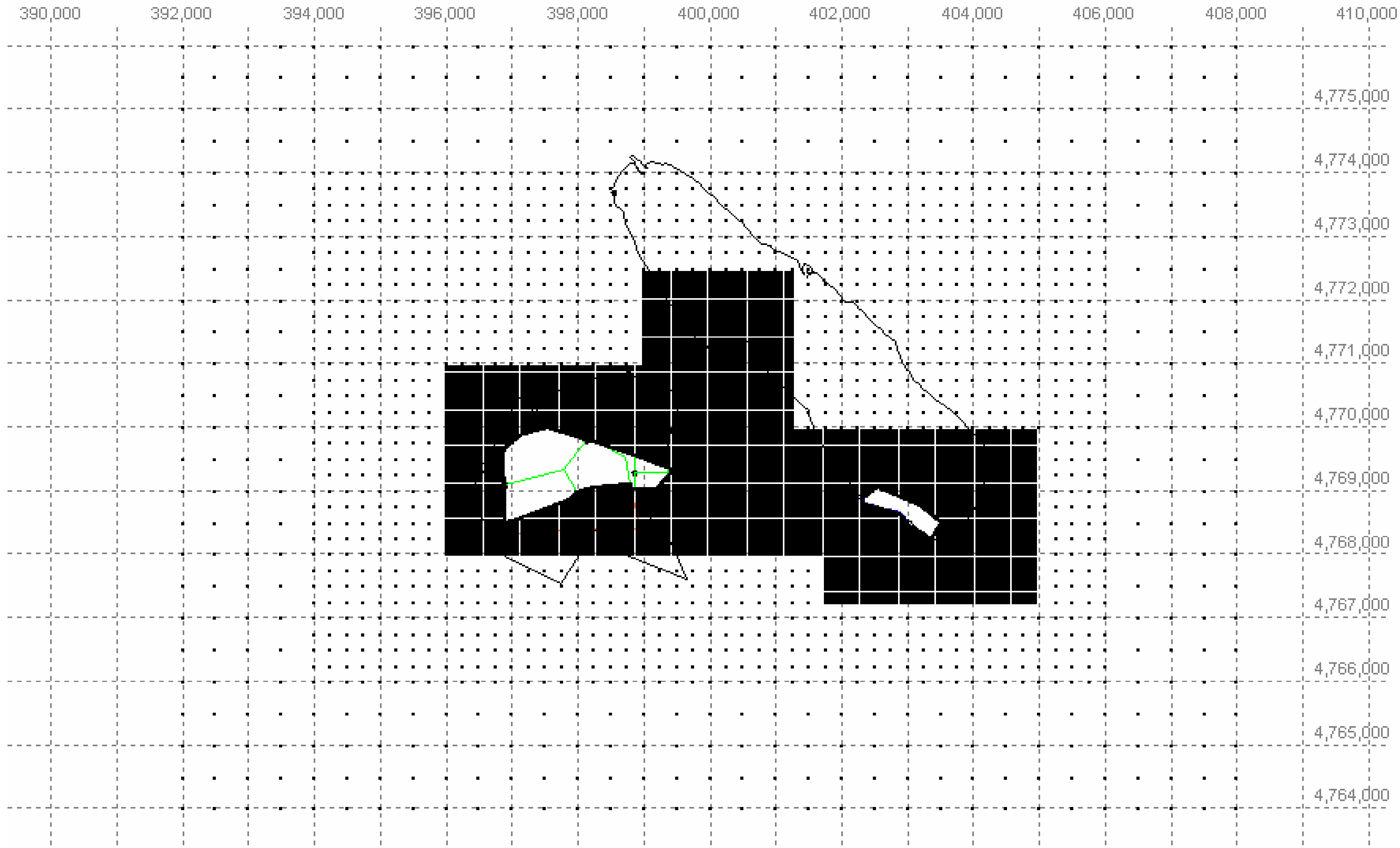


FIGURE 3-1

Honeywell

ONONDAGA LAKE
SYRACUSE, NEW YORK

BASE MODEL RECEPTOR GRID

PARSONS

290 ELWOOD DAVIS RD, SUITE 312, LIVERPOOL, NY 13088 PHONE: (315) 451-9560

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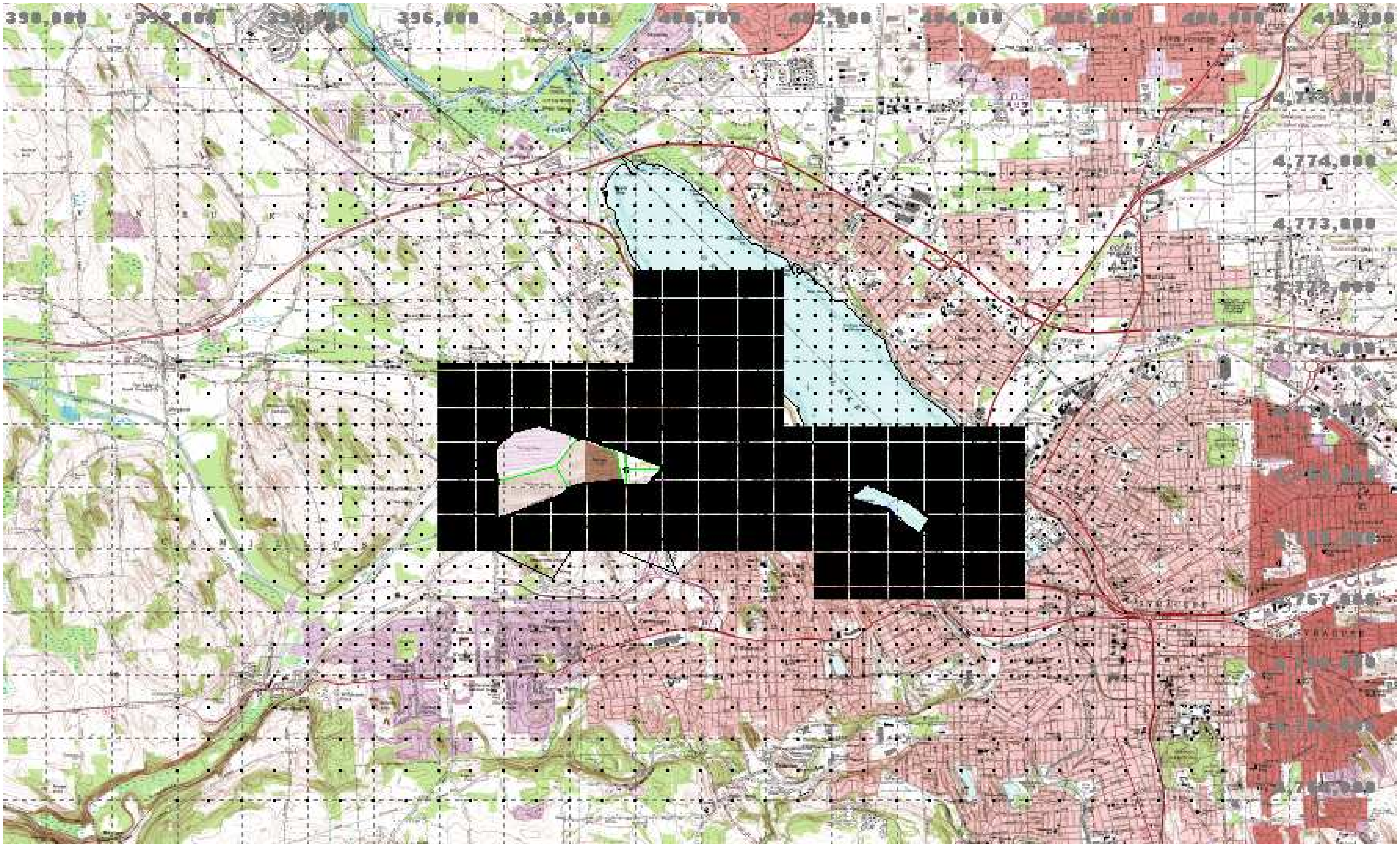


FIGURE 3-2

**Honeywell**

**ONONDAGA LAKE**
**SYRACUSE, NEW YORK**

BASE RECEPTOR GRID

**PARSONS**

290 ELWOOD DAVIS RD, SUITE 312, LIVERPOOL, NY 13088 PHONE: (315) 451-9560

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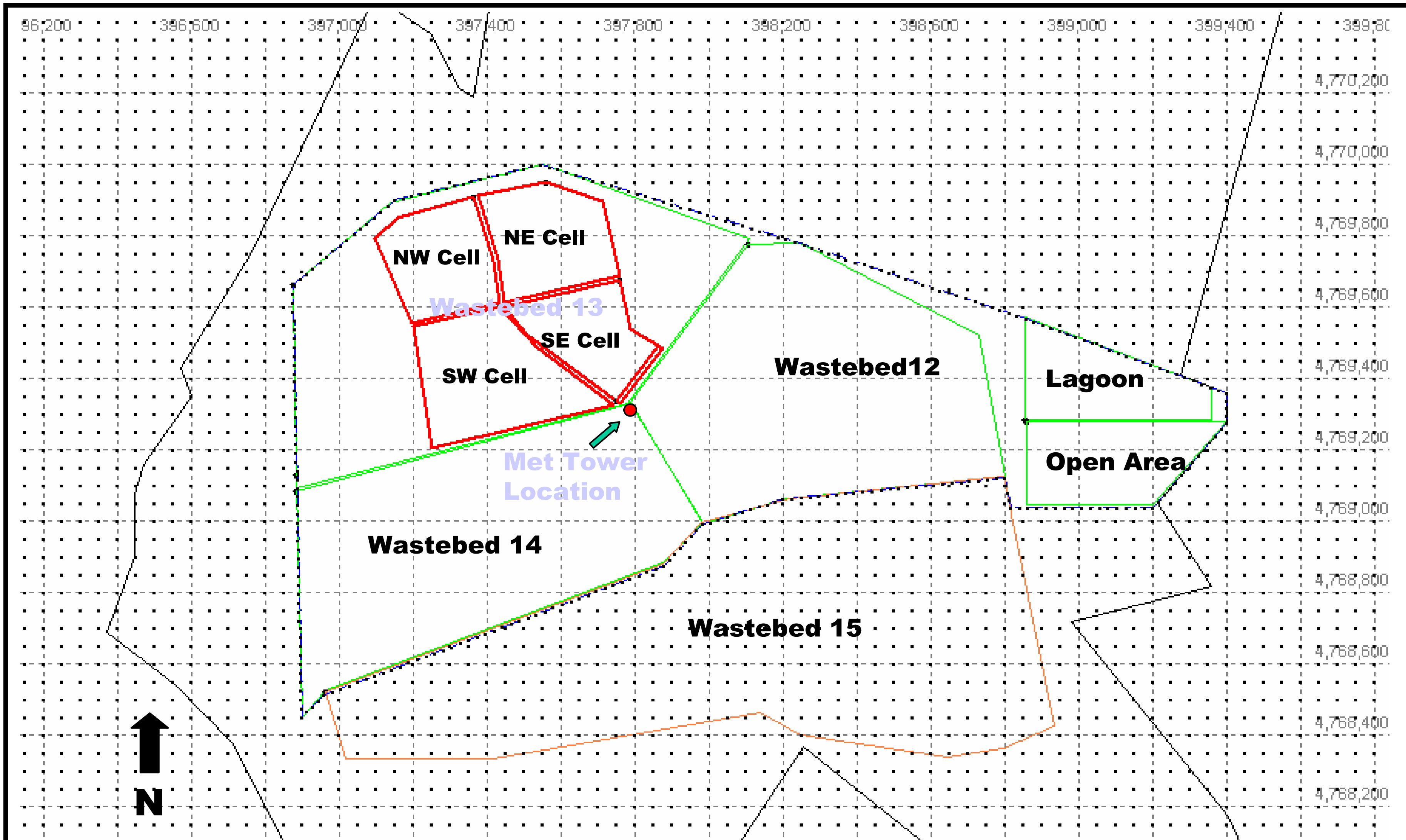


Grid in meters (1 in. = 400 m)

FIGURE 3-3

Honeywell

ONONDAGA LAKE
SYRACUSE, NEW YORK

SCA BASE MODEL RECEPTOR GRID

PARSONS

290 ELWOOD DAVIS RD, SUITE 312, LIVERPOOL, NY 13088 PHONE: (315) 451-9560

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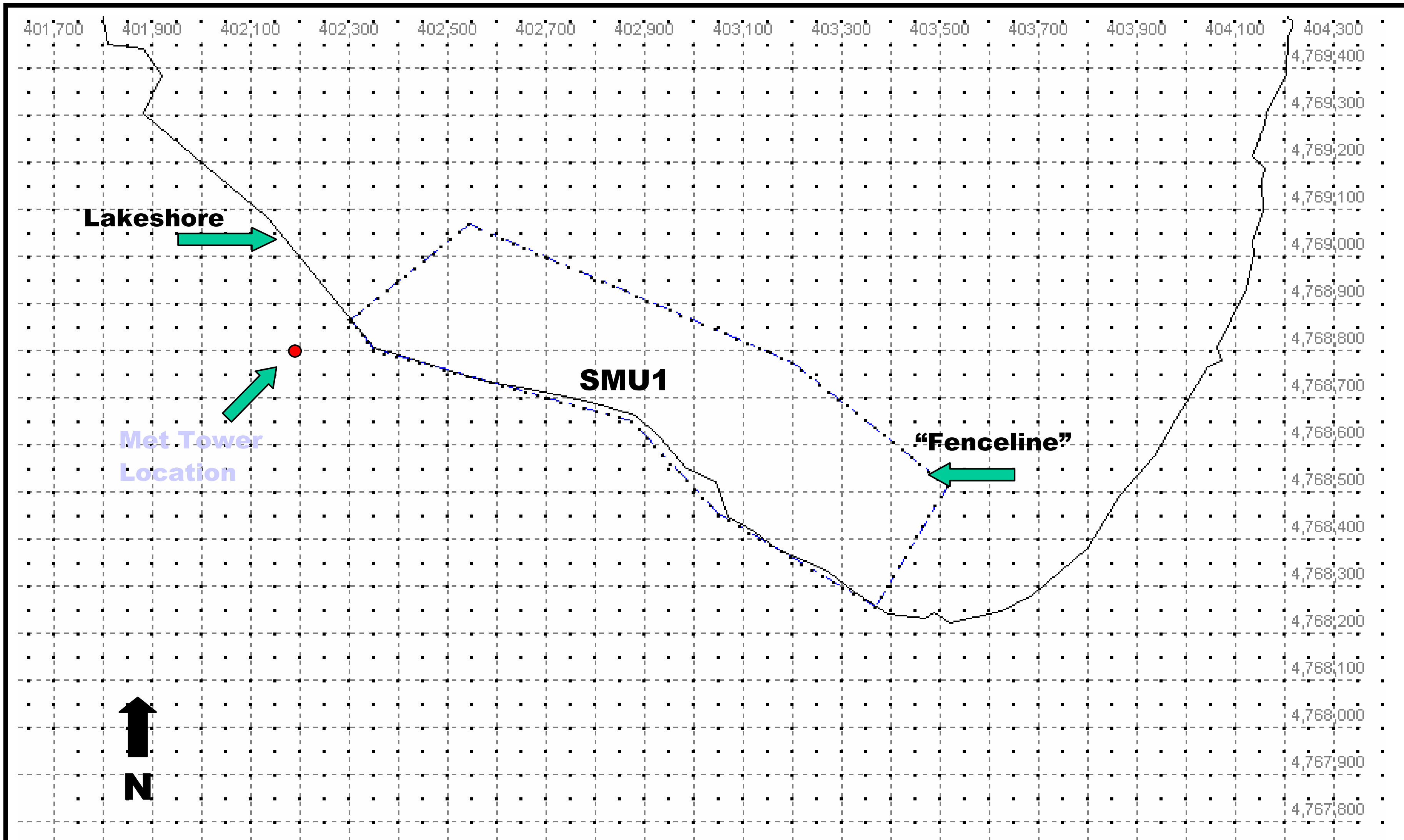


Grid in meters (1 in. = 300 m)

FIGURE 3-4

Honeywell

ONONDAGA LAKE
SYRACUSE, NEW YORK

SMU 1 BASE MODEL RECEPTOR GRID

PARSONS

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P:\HON-SYR\443584 - Operations\09 Reports\9.01 - Dispersion Modeling Protocol\Figures

## TABLE 3-3
## Air Dispersion Modeling Protocol for Onondaga Lake
## Seasonal Values of Micrometeorological Parameters

| Season | Land Use Classification (EPA MRLC) | Albedo | Bowen Ratio | Surface Roughnes |
|---|---|---|---|---|
| | Water | 0.1 | 0.1 | 0.001 |
| | Low Intensity Residential | 0.45 | 0.5 | 0.5 |
| | High Intensity Residential | 0.35 | 0.5 | 1 |
| | High Intensity Commercial/Industrial | 0.35 | 0.5 | 0.8 |
| | Pasture/Hay | 0.6 | 0.5 | 0.01 |
| | Row Crops | 0.6 | 0.5 | 0.01 |
| | Parks, Lawns, Golf Courses | 0.6 | 0.5 | 0.005 |
| Winter | Evergreen Forest | 0.35 | 0.5 | 1.3 |
| | Mixed Forest | 0.42 | 0.5 | 0.9 |
| | Deciduous Forest | 0.5 | 0.5 | 0.5 |
| | Woody Wetlands | 0.3 | 0.5 | 0.5 |
| | Emergent Wetlands | 0.3 | 0.5 | 0.1 |
| | Barren; Quarries, Strip Mines, Gravel Pits | 0.6 | 0.5 | 0.3 |
| | Barren; Bare Rock and Sand | 0.6 | 0.5 | 0.05 |
| | Barren; Transitional | 0.45 | 0.5 | 0.2 |
| | Water | 0.1 | 0.1 | 0.001 |
| | Low Intensity Residential | 0.16 | 0.8 | 0.52 |
| | High Intensity Residential | 0.18 | 1.5 | 1 |
| | High Intensity Commercial/Industrial | 0.18 | 1.5 | 0.8 |
| | Pasture/Hay | 0.14 | 0.3 | 0.03 |
| | Row Crops | 0.14 | 0.3 | 0.03 |
| | Parks, Lawns, Golf Courses | 0.15 | 0.3 | 0.015 |
| Spring | Evergreen Forest | 0.12 | 0.7 | 1.3 |
| | Mixed Forest | 0.14 | 0.7 | 1.15 |
| | Deciduous Forest | 0.16 | 0.7 | 1 |
| | Woody Wetlands | 0.14 | 0.2 | 0.7 |
| | Emergent Wetlands | 0.14 | 0.1 | 0.2 |
| | Barren; Quarries, Strip Mines, Gravel Pits | 0.2 | 1.5 | 0.3 |
| | Barren; Bare Rock and Sand | 0.2 | 1.5 | 0.05 |
| | Barren; Transitional | 0.18 | 1 | 0.2 |
| | Water | 0.1 | 0.1 | 0.001 |
| | Low Intensity Residential | 0.16 | 0.8 | 0.54 |
| | High Intensity Residential | 0.18 | 1.5 | 1 |
| | High Intensity Commercial/Industrial | 0.18 | 1.5 | 0.8 |
| | Pasture/Hay | 0.2 | 0.5 | 0.15 |
| | Row Crops | 0.2 | 0.5 | 0.2 |
| | Parks, Lawns, Golf Courses | 0.15 | 0.5 | 0.02 |
| Summer | Evergreen Forest | 0.12 | 0.3 | 1.3 |
| | Mixed Forest | 0.14 | 0.3 | 1.3 |
| | Deciduous Forest | 0.16 | 0.3 | 1.3 |
| | Woody Wetlands | 0.14 | 0.2 | 0.7 |
| | Emergent Wetlands | 0.14 | 0.1 | 0.2 |
| | Barren; Quarries, Strip Mines, Gravel Pits | 0.2 | 1.5 | 0.3 |
| | Barren; Bare Rock and Sand | 0.2 | 1.5 | 0.05 |
| | Barren; Transitional | 0.18 | 1 | 0.2 |
| | Water | 0.1 | 0.1 | 0.001 |
| | Low Intensity Residential | 0.16 | 1 | 0.54 |
| | High Intensity Residential | 0.18 | 1.5 | 1 |
| | High Intensity Commercial/Industrial | 0.18 | 1.5 | 0.8 |
| | Pasture/Hay | 0.2 | 0.7 | 0.15 |
| | Row Crops | 0.2 | 0.7 | 0.2 |
| | Parks, Lawns, Golf Courses | 0.15 | 0.7 | 0.015 |
| Autumn | Evergreen Forest | 0.12 | 0.8 | 1.3 |
| | Mixed Forest | 0.14 | 0.9 | 1.3 |
| | Deciduous Forest | 0.16 | 1 | 1.3 |
| | Woody Wetlands | 0.14 | 0.2 | 0.7 |
| | Emergent Wetlands | 0.14 | 0.1 | 0.2 |
| | Barren; Quarries, Strip Mines, Gravel Pits | 0.2 | 1.5 | 0.3 |
| | Barren; Bare Rock and Sand | 0.2 | 1.5 | 0.05 |
| | Barren; Transitional | 0.18 | 1 | 0.2 |

# Table 3-4A
## Seasonal Average Micrometeorological Parameters Around WB-13 Tower in 2006 by Wind Sector

| Season | Land Cover | Albedo | Bowen Ratio* | Surface Roughness |
|---|---|---|---|---|
| Sector 1 000 to 030 | Late Autumn | 0.17 | 0.75 | 0.338 |
| | Winter | 0.45 | 0.43 | 0.268 |
| | Spring | 0.15 | 0.51 | 0.490 |
| | Summer | 0.16 | 0.44 | 0.765 |
| | Autumn | 0.16 | 0.74 | 0.761 |
| Sector 2 030 to 060 | Late Autumn | 0.17 | 0.75 | 0.254 |
| | Winter | 0.45 | 0.43 | 0.195 |
| | Spring | 0.15 | 0.51 | 0.346 |
| | Summer | 0.16 | 0.44 | 0.630 |
| | Autumn | 0.16 | 0.74 | 0.630 |
| Sector 3 060 to 090 | Late Autumn | 0.17 | 0.75 | 0.184 |
| | Winter | 0.45 | 0.43 | 0.132 |
| | Spring | 0.15 | 0.51 | 0.269 |
| | Summer | 0.16 | 0.44 | 0.564 |
| | Autumn | 0.16 | 0.74 | 0.561 |
| Sector 4 090 to 120 | Late Autumn | 0.17 | 0.75 | 0.284 |
| | Winter | 0.45 | 0.43 | 0.216 |
| | Spring | 0.15 | 0.51 | 0.427 |
| | Summer | 0.16 | 0.44 | 0.736 |
| | Autumn | 0.16 | 0.74 | 0.734 |
| Sector 5 120 to 150 | Late Autumn | 0.17 | 0.75 | 0.190 |
| | Winter | 0.45 | 0.43 | 0.137 |
| | Spring | 0.15 | 0.51 | 0.274 |
| | Summer | 0.16 | 0.44 | 0.565 |
| | Autumn | 0.16 | 0.74 | 0.564 |
| Sector 6 150 to 180 | Late Autumn | 0.17 | 0.75 | 0.182 |
| | Winter | 0.45 | 0.43 | 0.132 |
| | Spring | 0.15 | 0.51 | 0.248 |
| | Summer | 0.16 | 0.44 | 0.541 |
| | Autumn | 0.16 | 0.74 | 0.541 |
| Sector 7 180 to 210 | Late Autumn | 0.17 | 0.75 | 0.262 |
| | Winter | 0.45 | 0.43 | 0.199 |
| | Spring | 0.15 | 0.51 | 0.382 |
| | Summer | 0.16 | 0.44 | 0.692 |
| | Autumn | 0.16 | 0.74 | 0.692 |

**Table 3-4A (cont)**
**Seasonal Average Micrometeorological Parameters**
**Around WB-13 Tower in 2006 by Wind Sector**

| Season | Land Cover | Albedo | Bowen Ratio* | Surface Roughness |
|---|---|---|---|---|
| Sector 8 210 to 240 | Late Autumn | 0.17 | 0.75 | 0.368 |
| | Winter | 0.45 | 0.43 | 0.310 |
| | Spring | 0.15 | 0.51 | 0.481 |
| | Summer | 0.16 | 0.44 | 0.678 |
| | Autumn | 0.16 | 0.74 | 0.677 |
| Sector 9 240 to 270 | Late Autumn | 0.17 | 0.75 | 0.255 |
| | Winter | 0.45 | 0.43 | 0.199 |
| | Spring | 0.15 | 0.51 | 0.339 |
| | Summer | 0.16 | 0.44 | 0.547 |
| | Autumn | 0.16 | 0.74 | 0.537 |
| Sector 10 270 to 300 | Late Autumn | 0.17 | 0.75 | 0.132 |
| | Winter | 0.45 | 0.43 | 0.090 |
| | Spring | 0.15 | 0.51 | 0.196 |
| | Summer | 0.16 | 0.44 | 0.437 |
| | Autumn | 0.16 | 0.74 | 0.430 |
| Sector 11 300 to 330 | Late Autumn | 0.17 | 0.75 | 0.250 |
| | Winter | 0.45 | 0.43 | 0.184 |
| | Spring | 0.15 | 0.51 | 0.402 |
| | Summer | 0.16 | 0.44 | 0.744 |
| | Autumn | 0.16 | 0.74 | 0.739 |
| Sector 12 330 to 360 | Late Autumn | 0.17 | 0.75 | 0.273 |
| | Winter | 0.45 | 0.43 | 0.205 |
| | Spring | 0.15 | 0.51 | 0.433 |
| | Summer | 0.16 | 0.44 | 0.743 |
| | Autumn | 0.16 | 0.74 | 0.736 |

For WB-13 2006 input to AERMET, the seasons were defined as follows:

| | | |
|---|---|---|
| Late Fall: | Dec, Jan | 2 months |
| Winter: | Feb-Mar | 2 months |
| Spring: | Apr-May | 2 months |
| Summer: | Jun-Sep | 4 months |
| Fall: | Oct-Nov | 2 months |

# Table 3-4B
## Seasonal Average Micrometeorological Parameters
## Around WB-13 Tower in 2006 by Wind Sector

| Season | Land Cover | Albedo | Bowen Ratio* | Surface Roughness |
|---|---|---|---|---|
| Sector 1 000 to 030 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.268 |
| | Spring | 0.15 | 0.51 | 0.490 |
| | Summer | 0.16 | 0.44 | 0.765 |
| | Autumn | 0.16 | 0.74 | 0.761 |
| Sector 2 030 to 060 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.195 |
| | Spring | 0.15 | 0.51 | 0.346 |
| | Summer | 0.16 | 0.44 | 0.630 |
| | Autumn | 0.16 | 0.74 | 0.630 |
| Sector 3 060 to 090 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.132 |
| | Spring | 0.15 | 0.51 | 0.269 |
| | Summer | 0.16 | 0.44 | 0.564 |
| | Autumn | 0.16 | 0.74 | 0.561 |
| Sector 4 090 to 120 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.216 |
| | Spring | 0.15 | 0.51 | 0.427 |
| | Summer | 0.16 | 0.44 | 0.736 |
| | Autumn | 0.16 | 0.74 | 0.734 |
| Sector 5 120 to 150 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.137 |
| | Spring | 0.15 | 0.51 | 0.274 |
| | Summer | 0.16 | 0.44 | 0.565 |
| | Autumn | 0.16 | 0.74 | 0.564 |
| Sector 6 150 to 180 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.132 |
| | Spring | 0.15 | 0.51 | 0.248 |
| | Summer | 0.16 | 0.44 | 0.541 |
| | Autumn | 0.16 | 0.74 | 0.541 |
| Sector 7 180 to 210 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.199 |
| | Spring | 0.15 | 0.51 | 0.382 |
| | Summer | 0.16 | 0.44 | 0.692 |
| | Autumn | 0.16 | 0.74 | 0.692 |

## Table 3-4B (cont)
## Seasonal Average Micrometeorological Parameters
## Around WB-13 Tower in 2006 by Wind Sector

| Season | Land Cover | Albedo | Bowen Ratio* | Surface Roughness |
|---|---|---|---|---|
| Sector 8<br>210 to 240 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.310 |
| | Spring | 0.15 | 0.51 | 0.481 |
| | Summer | 0.16 | 0.44 | 0.678 |
| | Autumn | 0.16 | 0.74 | 0.677 |
| Sector 9<br>240 to 270 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.199 |
| | Spring | 0.15 | 0.51 | 0.339 |
| | Summer | 0.16 | 0.44 | 0.547 |
| | Autumn | 0.16 | 0.74 | 0.537 |
| Sector 10<br>270 to 300 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.090 |
| | Spring | 0.15 | 0.51 | 0.196 |
| | Summer | 0.16 | 0.44 | 0.437 |
| | Autumn | 0.16 | 0.74 | 0.430 |
| Sector 11<br>300 to 330 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.184 |
| | Spring | 0.15 | 0.51 | 0.402 |
| | Summer | 0.16 | 0.44 | 0.744 |
| | Autumn | 0.16 | 0.74 | 0.739 |
| Sector 12<br>330 to 360 | Late Autumn | -- | -- | -- |
| | Winter | 0.45 | 0.43 | 0.205 |
| | Spring | 0.15 | 0.51 | 0.433 |
| | Summer | 0.16 | 0.44 | 0.743 |
| | Autumn | 0.16 | 0.74 | 0.736 |

For WB-13 2007 input to AERMET, the seasons were defined as follows:

| | | |
|---|---|---|
| Late Fall: | Not Used | 0 months |
| Winter: | Dec-Mar | 4 months |
| Spring: | Apr-May | 2 months |
| Summer: | Jun-Sep | 4 months |
| Fall: | Oct-Nov | 2 months |

# Table 3-4C
## Seasonal Average Micrometeorological Parameters
## Around Lakeshore Tower in 2007 by Wind Sector

| Season | Land Cover | Albedo | Bowen Ratio* | Surface Roughness |
|---|---|---|---|---|
| Sector 1 000 to 030 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.002 |
| | Spring | 0.16 | 0.65 | 0.003 |
| | Summer | 0.16 | 0.60 | 0.003 |
| | Autumn | 0.16 | 0.81 | 0.003 |
| Sector 2 030 to 060 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.002 |
| | Spring | 0.16 | 0.65 | 0.002 |
| | Summer | 0.16 | 0.60 | 0.002 |
| | Autumn | 0.16 | 0.81 | 0.002 |
| Sector 3 060 to 090 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.002 |
| | Spring | 0.16 | 0.65 | 0.002 |
| | Summer | 0.16 | 0.60 | 0.002 |
| | Autumn | 0.16 | 0.81 | 0.002 |
| Sector 4 090 to 120 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.073 |
| | Spring | 0.16 | 0.65 | 0.099 |
| | Summer | 0.16 | 0.60 | 0.110 |
| | Autumn | 0.16 | 0.81 | 0.108 |
| Sector 5 120 to 150 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.292 |
| | Spring | 0.16 | 0.65 | 0.428 |
| | Summer | 0.16 | 0.60 | 0.484 |
| | Autumn | 0.16 | 0.81 | 0.461 |
| Sector 6 150 to 180 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.564 |
| | Spring | 0.16 | 0.65 | 0.638 |
| | Summer | 0.16 | 0.60 | 0.664 |
| | Autumn | 0.16 | 0.81 | 0.652 |
| Sector 7 180 to 210 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.697 |
| | Spring | 0.16 | 0.65 | 0.733 |
| | Summer | 0.16 | 0.60 | 0.746 |
| | Autumn | 0.16 | 0.81 | 0.739 |

**Table 3-4C (cont)**
**Seasonal Average Micrometeorological Parameters**
**Around Lakeshore Tower in 2007 by Wind Sector**

| Season | Land Cover | Albedo | Bowen Ratio* | Surface Roughness |
|---|---|---|---|---|
| Sector 8 210 to 240 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.547 |
| | Spring | 0.16 | 0.65 | 0.625 |
| | Summer | 0.16 | 0.60 | 0.651 |
| | Autumn | 0.16 | 0.81 | 0.639 |
| Sector 9 240 to 270 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.339 |
| | Spring | 0.16 | 0.65 | 0.462 |
| | Summer | 0.16 | 0.60 | 0.510 |
| | Autumn | 0.16 | 0.81 | 0.488 |
| Sector 10 270 to 300 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.431 |
| | Spring | 0.16 | 0.65 | 0.613 |
| | Summer | 0.16 | 0.60 | 0.693 |
| | Autumn | 0.16 | 0.81 | 0.676 |
| Sector 11 300 to 330 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.343 |
| | Spring | 0.16 | 0.65 | 0.495 |
| | Summer | 0.16 | 0.60 | 0.560 |
| | Autumn | 0.16 | 0.81 | 0.541 |
| Sector 12 330 to 360 | Late Autumn | -- | -- | -- |
| | Winter | 0.40 | 0.41 | 0.010 |
| | Spring | 0.16 | 0.65 | 0.011 |
| | Summer | 0.16 | 0.60 | 0.012 |
| | Autumn | 0.16 | 0.81 | 0.012 |

For Lake/Willis Ave 2007 input to AERMET, the seasons were defined as follows:

| | | |
|---|---|---|
| Late Fall: | Not Used | 0 months |
| Winter: | Dec-Mar | 4 months |
| Spring: | Apr-May | 2 months |
| Summer: | Jun-Sep | 4 months |
| Fall: | Oct-Nov | 2 months |

# SECTION 4

## DISPERSION MODELING RESULTS REPORTING

Dispersion model runs will be set up and executed as discrete runs for each appropriate combination of sources and/or source groups, operating scenario(s) defining dredging and SCA activities, air contaminant, model receptor grid, and meteorological data record. As appropriate, source groups will be designated within each run in order to segregate the impacts of the different sources or groups of sources modeled, and for the variations in emission rates for each source as a function of time and/or activity level (this includes sources being turned "off" if no emissions are anticipated for a particular time period.).

The dispersion estimates from the modeling analyses will be summarized in a comprehensive series of tables and graphs that present dispersion estimates for the above runs as follows:

- for each individual source and source group;
- for all sources combined;
- for each year in the meteorological data input file (if more than 1 year of onsite data is available and used in the analysis);
- for each contaminant and averaging period (short-term and long-term) for which an ambient air standard or threshold has been established; and
- for model receptor grid.

These modeling results will then be used to:

- identify those sources and emissions having the greatest potential impacts;
- design of best management practices, control systems and operation strategies to reduce air emissions resulting from remedial activities to levels less than applicable short-term and long-term ambient air standards, and established threshold levels; and
- document and communicate the potential impacts of air emissions of COIs and odors from the remedial activities to the community through a series of public outreach and educational programs.

To evaluate the impact from the remedial activities, a set of site-specific air goals will be developed for the project. The goals will address risks associated with exposures to both onsite (workers) and offsite receptors (general public). Development of these goals and comparison of the estimated ambient air impacts to the goals will be conducted as a separate portion of the overall design process.

## TABLE 1-1
## Air Dispersion Modeling Protocol for Onondaga Lake
## Meteorological Monitoring Program - Parameters Measured

**TOWER NO. 1 - Wastebed 13 Site - Primary Tower - Start-Up December 1, 2005**

**Ground-Based Measurements**

Precipitation

**2-Meter Level Measurements**

Temperature
Relative Humidity
Dew Point Temperature (computed)
Net Radiation
Barometeric Pressure

**10-Meter Level Measurements**

Horizontal Wind Speed
Horizontal Wind Direction
Standard Deviation of Horizontal WD or Sigma-Theta (computed)
Vertical Wind Speed
Standard Deviation of Vertical Wind Speed (Sigma w) -computed
Temperature
Delta Temperature (10m - 2m)

**TOWER NO. 2 - Lakeshore/Willis Avenus Site - Secondary Tower - Start-Up December 1, 2006**

**2-Meter Level Measurements**

Temperature
Relative Humidity
Dew Point Temperature (computed)
Solar Radiation
Barometric Pressure

**10-Meter Level Measurements**

Horizontal Wind Speed
Horizontal Wind Direction
Standard Deviation of Horizontal WD or Sigma-Theta (computed)
Vertical Wind Speed
Standard Deviation of Vertical Wind Speed (Sigma w) -computed
Temperature
Delta Temperature (10m - 2m)

## TABLE 3-3
## Air Dispersion Modeling Protocol for Onondaga Lake
## Seasonal Values of Micrometeorological Parameters

| Season | Land Use Classification (EPA MRLC) | Albedo | Bowen Ratio | Surface Roughnes |
|---|---|---|---|---|
| | Water | 0.1 | 0.1 | 0.001 |
| | Low Intensity Residential | 0.45 | 0.5 | 0.5 |
| | High Intensity Residential | 0.35 | 0.5 | 1 |
| | High Intensity Commercial/Industrial | 0.35 | 0.5 | 0.8 |
| | Pasture/Hay | 0.6 | 0.5 | 0.01 |
| | Row Crops | 0.6 | 0.5 | 0.01 |
| | Parks, Lawns, Golf Courses | 0.6 | 0.5 | 0.005 |
| Winter | Evergreen Forest | 0.35 | 0.5 | 1.3 |
| | Mixed Forest | 0.42 | 0.5 | 0.9 |
| | Deciduous Forest | 0.5 | 0.5 | 0.5 |
| | Woody Wetlands | 0.3 | 0.5 | 0.5 |
| | Emergent Wetlands | 0.3 | 0.5 | 0.1 |
| | Barren; Quarries, Strip Mines, Gravel Pits | 0.6 | 0.5 | 0.3 |
| | Barren; Bare Rock and Sand | 0.6 | 0.5 | 0.05 |
| | Barren; Transitional | 0.45 | 0.5 | 0.2 |
| | Water | 0.1 | 0.1 | 0.001 |
| | Low Intensity Residential | 0.16 | 0.8 | 0.52 |
| | High Intensity Residential | 0.18 | 1.5 | 1 |
| | High Intensity Commercial/Industrial | 0.18 | 1.5 | 0.8 |
| | Pasture/Hay | 0.14 | 0.3 | 0.03 |
| | Row Crops | 0.14 | 0.3 | 0.03 |
| | Parks, Lawns, Golf Courses | 0.15 | 0.3 | 0.015 |
| Spring | Evergreen Forest | 0.12 | 0.7 | 1.3 |
| | Mixed Forest | 0.14 | 0.7 | 1.15 |
| | Deciduous Forest | 0.16 | 0.7 | 1 |
| | Woody Wetlands | 0.14 | 0.2 | 0.7 |
| | Emergent Wetlands | 0.14 | 0.1 | 0.2 |
| | Barren; Quarries, Strip Mines, Gravel Pits | 0.2 | 1.5 | 0.3 |
| | Barren; Bare Rock and Sand | 0.2 | 1.5 | 0.05 |
| | Barren; Transitional | 0.18 | 1 | 0.2 |
| | Water | 0.1 | 0.1 | 0.001 |
| | Low Intensity Residential | 0.16 | 0.8 | 0.54 |
| | High Intensity Residential | 0.18 | 1.5 | 1 |
| | High Intensity Commercial/Industrial | 0.18 | 1.5 | 0.8 |
| | Pasture/Hay | 0.2 | 0.5 | 0.15 |
| | Row Crops | 0.2 | 0.5 | 0.2 |
| | Parks, Lawns, Golf Courses | 0.15 | 0.5 | 0.02 |
| Summer | Evergreen Forest | 0.12 | 0.3 | 1.3 |
| | Mixed Forest | 0.14 | 0.3 | 1.3 |
| | Deciduous Forest | 0.16 | 0.3 | 1.3 |
| | Woody Wetlands | 0.14 | 0.2 | 0.7 |
| | Emergent Wetlands | 0.14 | 0.1 | 0.2 |
| | Barren; Quarries, Strip Mines, Gravel Pits | 0.2 | 1.5 | 0.3 |
| | Barren; Bare Rock and Sand | 0.2 | 1.5 | 0.05 |
| | Barren; Transitional | 0.18 | 1 | 0.2 |
| | Water | 0.1 | 0.1 | 0.001 |
| | Low Intensity Residential | 0.16 | 1 | 0.54 |
| | High Intensity Residential | 0.18 | 1.5 | 1 |
| | High Intensity Commercial/Industrial | 0.18 | 1.5 | 0.8 |
| | Pasture/Hay | 0.2 | 0.7 | 0.15 |
| | Row Crops | 0.2 | 0.7 | 0.2 |
| | Parks, Lawns, Golf Courses | 0.15 | 0.7 | 0.015 |
| Autumn | Evergreen Forest | 0.12 | 0.8 | 1.3 |
| | Mixed Forest | 0.14 | 0.9 | 1.3 |
| | Deciduous Forest | 0.16 | 1 | 1.3 |
| | Woody Wetlands | 0.14 | 0.2 | 0.7 |
| | Emergent Wetlands | 0.14 | 0.1 | 0.2 |
| | Barren; Quarries, Strip Mines, Gravel Pits | 0.2 | 1.5 | 0.3 |
| | Barren; Bare Rock and Sand | 0.2 | 1.5 | 0.05 |
| | Barren; Transitional | 0.18 | 1 | 0.2 |