APPENDIX D

ONONDAGA LAKE PRE-DESIGN INVESTIGATION: AIR EMISSION AND ODOR WORK PLAN

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SECTION D1

PROJECT BACKGROUND

D1.1 INTRODUCTION

This Work Plan presents the Phase I Pre-Design Investigation (PDI) activities planned for the Onondaga Lake to gather data that will facilitate evaluation of potential emissions and odors resulting from remedial activities in Onondaga Lake, including sediment placement within a sediment consolidation area (SCA). Objectives of the investigation activities presented in this Work Plan include:

- Identification of chemicals of interest;
- Determination of potential emission sources;
- Estimation of emission rates from dredged sediment in the absence of mitigation measures; and
- Collection of site specific meteorological data.

Following prediction of the overall impacts to air from remedial activities, monitoring and mitigation plans can be integrated into the remedial design. These activities will be developed as part of another phase of work.

D1.2 REPORT ORGANIZATION

This Work Plan is organized into three sections. Section D1 presents relevant background information on Onondaga Lake and an overview of the emission and odor evaluation activities. Section D2 presents the field sampling activities associated with this investigation. Section D3 presents how bench-scale-testing and meteorological data will be analyzed and reported.

D1.3 DESCRIPTION AND BACKGROUND

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.

On July 1, 2005, NYSDEC issued the Record of Decision (ROD) for the Lake. The remedy specified in the ROD includes the dredging of 2.65 million cubic yards (cy) of sediment from the lake bottom, and capping of 579 acres of remaining sediment. Dredged sediment will be placed in an SCA, and Wastebed 13 has been identified as one potential location. Wastebed 13 occupies approximately 163 acres and is located in the Town of Camillus, Onondaga County, New York. It was originally designed as a settling basin for the disposal of Solvay waste and was in operation from 1973 to 1985.

D1.4 HISTORICAL SAMPLING ACTIVITIES

To date, there is no known volatile emission rate, baseline, or ambient air quality data available from previous investigations at Onondaga Lake or Wastebed 13. Sediment samples were collected throughout the Lake during the remedial investigation. Table D1.1 summarizes the physical and chemical properties of contaminants identified as contaminants of interest (COIs) for potential volatile and odor emissions. This list was based on the list of 23 benthic toxicity based chemical parameters of interest (CPOI) developed for the Onondaga Lake Feasibility Study (FS) (Parsons, 2004), and the United States Environmental Protection Agency (USEPA) as Hazardous Air Pollutants (HAPs) (http://www.epa.gov/ttn/atw/188polls.html). In general, contaminants appearing on both CPOI and HAP lists have been retained as COIs. Several exceptions were made to this generalization, however. PCBs appear on both the CPOI list and the HAP list, but due to relatively low volatility, PCB sampling will be limited to one test run on SMU 1 and SMU 7 samples. The sediment sample from these SMUs are expected to have the highest potential for PCB volatilization among the samples tested. Three compounds that are not among the lake CPOIs (which includes those contaminants that appear to have a clear relationship to toxicity on a lakewide basis) have been included on the COI list for assessing air and odor emissions. They include 1,2,4 trichlorobenzene, hexachlorobenzene, and phenol. These three compounds are on USEPA's HAP list, are present in detectable concentrations in the sediment, and have associated air quality guidelines/standards.

D1.5 REMEDIAL ACTIVITIES WITH EMISSION POTENTIAL

There are several components of this remedy which have a significant potential for volatile emission and odor generation. These operations include:

- Dredging of up to 1,566,000 cy of sediment from the top 2 to 3 meters of sediment in SMU 1;
- Dredging of up to 245,000 cy of sediment from nearshore targeted areas in SMU 6;
- Dredging of up to 89,000 cy of sediment from nearshore sediments in SMU 7;
- Consolidation of dredged sediment in an SCA; and
- Treatment of water generated as a result of dewatering the sediments in the SCA.

Data pertaining to volatile emissions and odors generated during these operations will be collected during the investigation activities described in this Work Plan.

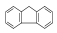
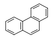
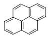
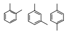
There are other components that are included in the selected remedy that may have a potential for volatile emissions and odor generation. These components, including sediment removal in SMU 2, require further information to define their scope. The emissions and odors that may be generated from these operations in the absence of mitigation measures, along with mitigation methods and other technologies, will be evaluated in a later phase of the PDI. If it is determined during remedial design, based on the PDI, that significant concentrations exist in other areas that would need to be dredged, additional sampling in those areas for air and odor testing may need to be performed in a subsequent phase of the PDI.

D1.6 SUMMARY OF PHASE I ACTIVITIES

To accomplish the objectives in Section D1.1, several activities have been planned as part of the Phase I PDI. These activities include the following:

- The installation of a meteorological monitoring station near the SCA;
- Collection of meteorological data in accordance with the USEPA's standards for ambient dispersion modeling requirements;
- Collection of sediments from areas associated with the remedial activities described in Section D1.5;
- Emissions testing and odor evaluation of sediment samples under conditions representative of those expected in the emitting areas described in Section D1.5; and
- Estimation of volatile and odor emission rates.

TABLE D1.1
PHYSICAL AND CHEMICAL PROPERTIES OF CONTAMINANTS OF INTEREST
(Published Values)

Compound	Chemical Structure	MW (g/mol)	Vapor Pressure (mm Hg)	Odor Threshold (ug/m^3)	Density (g/cm^3 at 20°C)	Water Solubility (mg/L at 25°C)	Henry's Law Constant (atm-m^3/mol)	Organic Carbon / Water Partition Coefficient (log K_{OC})	Organic Matter (Sediment) / Water Partition Coefficient (log K_{OM})
Fluorene		166.23	6.75E-04	nd	1.203	1.90E+00	7.77E-05	3.40	5.47
Naphthalene		128.19	7.80E-02	440	1.0253	3.10E+01	4.24E-04	2.97	5.00
Phenanthrene		178.24	1.50E-04	nd	1.174	1.10E+00	3.20E-05	4.15	4.36
Phenol		94.11	3.51E-01	157	1.0545	8.70E+04	4.00E-07	1.21 - 1.96	nd
Pyrene		202.26	4.50E-06	nd	1.271^{23}	1.32E-01	9.08E-06	4.58	4.92
Benzene		78.11	7.50E+01	4900	0.8786	1.75E+03	5.55E-03	1.79	nd
Ethylbenzene		106.17	9.53E+00	2000-2600	0.8670	1.69E+02	7.88E-03	2.31	nd
1,2,4 Trichlorobenzene		181.46	3.40E-01	24000	1.4542	3.46E+01	4.33E-03	nd	nd
1,4 Dichlorobenzene		147.00	1.77E+00	11000	1.46	8.00E+01	2.41E-03	2.44	nd
Chlorobenzene		112.56	8.80E+00	1000-8000	1.1058	5.00E+02	3.58E-03	2.52	nd
Hexachlorobenzene		284.78	1.09E-05	nd	2.044	6.00E-03	5.80E-04	3.59 - 6.08	nd
Toluene		92.14	2.84E+01	30148	0.8669	5.26E+02	6.64E-03	2.15	nd
Xylenes (o-, m-, p-)		106.17	1.77E+01	4342	0.8685	1.75E+02	6.73E-03	2.24	nd
Mercury	Hg	200.59	2.00E-03	nd	13.534	6.00E-02	nd	nd	nd

Notes:
1. The density of water at 20°C is 0.998234 g/mL.
2. Superscript values indicate the temperature at which the value was obtained if different than the one specified in the column heading.
3. Vapor pressures were converted from units used in original citations (Pascal).
4. na = not applicable; nd = no data
5. Henry's Law Constants were converted using the following equation: atm-m3/mol x 101325 = Pa-m3/mol.
6. Overall media half-lives includes all processes for loss appropriate to the media.

TABLE D1.1 (con't)
REFERENCES FOR CHEMICALS OF CONCERN
(Published Values)

Compound	Chemical Structure	MW (g/mol)	Vapor Pressure (mm Hg)	Odor Threshold (ug/m^3)	Density (g/cm^3 at 20°C)	Water Solubility (mg/L at 25°C)	Henry's Law Constant (atm-m^3/mol)	Organic Carbon / Water Partition Coefficient (log K_{OC})	Organic Matter (Sediment) / Water Partition Coefficient (log K_{OM})
Fluorene	1	7	7	nd	1 (10)	7	7	2	3
Naphthalene	1	7	7	17	1(2)	7	7	1(4)	1(3)
Phenanthrene	1	7	7	nd	1(9)	7	7	1(4)	1(5)
Phenol	19	19	19	19	19	19	19	19	nd
Pyrene	1	7	7	nd	1(11)	7	7	1(4)	1(5)
Benzene	1	1	7	7	3	6	6	6	nd
Ethylbenzene	1	1	9	9	3	6	6	6	nd
1,2,3 Trichlorobenzene	28	25	25	nd	27	25	25	nd	nd
1,2,4 Trichlorobenzene	28	25	25	26	26	25	25	nd	nd
1,3,5 Trichlorobenzene	28	25	25	nd	nd	25	25	nd	nd
1,4 Dichlorobenzene	21	21	21	21	21	21	21	21	nd
Chlorobenzene	22	22	22	22	22	22	22	22	nd
Hexachlorobenzene	23	23	23	23	23	23	23	23	nd
Toluene	1	1	8	8	3	6	6	6	nd
Xylenes (o-, m-, p-)	1	1	10	10	3	6	6	6	nd
Mercury	24	24	24	24	24	24	24	24	nd

Citations in paretheses in the above table, are the original citation quoted in the referenced publication.

References:

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TABLE D1.1 (con't)
REFERENCES FOR CHEMICALS OF CONCERN
(Published Values)

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23 ATSDR (1996) *Toxicological Profile for hexachlorobenzene,* U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, Atlanta, GA, September 2002.

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SECTION D2

FIELD INVESTIGATIONS

D2.1 DATA AND INFORMATION NEEDS

This section summarizes the data and analytical tools that will be used to assess the potential emission rates and impacts of various compounds and odors that may be emitted as a result of the Lake remediation activities discussed in Section D1.5, assuming no mitigation measures are implemented. Some of this information will be compiled from existing resources. Other site-specific information will be collected and developed as described in this work plan.

D2.1.1 Emission Rates for Distinct Source Sediments

The most important data need for the air and odor emissions assessment is the predicted emission rates for the various COIs that may be emitted during the dredging operations, sediment handling and treatment operations, and sediment exposure at the SCA. The dispersion modeling analysis of potential impacts, and prediction of concentrations, requires explicit information regarding the mass emission rates of the various compounds (e.g., grams per second per square meter) and odors (odor units per second per square meter) for a given source or source area (e.g., per dredge area or portion of the SCA).

Emission rates for the different compounds are expected to vary substantially as functions of several factors, including the following:

- By SMU;
- By working areas within a SMU and SCA;
- By COI concentrations;
- By dredging and SCA fill rates;
- By work schedule;
- By month (e.g., as function of air and water temperatures); and
- By wastewater treatment method.

A comprehensive sediment sampling and emissions testing procedure has been devised to experimentally measure the emission rates for a range of sediment samples and to use this information to estimate the variability in the factors noted above. The emissions testing program is described in detail in Section D2.2.

D2.1.2 Site-Specific Meteorological Data

In addition to the potential emission rates for the COIs, the magnitude of ambient air COIs and odor concentrations predicted in the dispersion modeling will be a function of the atmospheric conditions governing the transport and diffusion of the emitted compounds. In order to develop the most realistic predictions of concentrations of remediation related emissions, it is necessary to have meteorological data that is most representative of the specific areas under study.

To ensure the most precise data is used in the analysis, site-specific data will be collected using sensory instrumentation and data acquisition hardware with software that fully meets the performance and operating specifications in USEPA's guidelines for air quality modeling applications, including "Meteorological Monitoring Program Guidance for Regulatory Modeling Applications" (USEPA, 2000). Existing monitoring systems in the area do not meet all of these guideline specifications.

In order to establish a site-specific meteorological database comprised of the parameters specified for potential input into a dispersion model, a 10-meter meteorological tower will be installed and operated near the source of concern. The tower will be installed near Wastebed 13, such that data will be representative of the initial transport of emissions from the SCA and related activities. A second tower may be installed in the vicinity of dredging activities as part of a later Phase of the investigation.

The specific design and operational components of the meteorological monitoring program is detailed in the Meteorological Monitoring Program Manual.

D2.2 FIELD AND BENCH DATA COLLECTION

D2.2.1 Bench-Scale Test Sample Collection

Composite sediment samples will be collected from locations within SMUs 1, 6, and 7 to account for matrix, chemical, and odor differences between the SMUs. Samples will be collected from areas identified as most likely to have the highest levels of contamination and most likely to produce odors within the known dredge prism for that SMU. (Figure D2.1). This will be done to improve the chances of avoiding "non-detects" in measuring the emitted mass. The measured emissions can be scaled down to actual dredging concentrations upon completion of the test and more accurate determination of representative dredge material concentrations.

The sample core locations and depth intervals were selected to target the highest concentrations of three primary volatile chemical groups/compounds: 1) benzene and chlorobenzenes; 2) naphthalene; and 3) total mercury. Benzene, chlorobenzenes (1,4-dichlorobenzene, chlorobenzene, and hexachlorobenzene), and naphthalene have relatively low regulatory air emission guidelines, and therefore, the potential air emissions may be important factors in project decision-making. For mercury, the levels in the air and its distribution in the local environment is of particular interest at this site.

Ten gallons of sediment will be collected from each of the following; SMUs 1, 6, and 7. These locations represent the highest known concentrations of the above mentioned compounds within the anticipated dredge prism for each respective SMU. Higher sediment concentrations of these compounds may be present in other portions of each SMU, however these areas are not currently included in the dredge scope, and have not been considered. In addition, if it is determined during remedial design, based on the PDI, that significantly higher concentrations exist in other areas that would need to be dredged, additional sampling in those areas for air and odor testing may need to be performed in a subsequent phase of the PDI. The sample locations are presented in Figure D2.1 and are summarized below:

- SMU 1 – 5 gal near P15 (0-1.5 meters) and 5 gal near S341 (1-2 meters).
- SMU 6 – 4 gal near S322 (0-0.3 meters), 3 gal offshore of the Metro WWTP discharge (0-2 meter), and 3 gal offshore of the Onondaga Creek discharge (0-2 meter).
- SMU 7 – 10 gal near S314 (0-3 meters).

Sediment and dilution water samples will be collected as discussed in the SAP. Samples will be collected from these sediments as necessary for headspace analysis as part of the safety program for odor testing as described in Section D2.2.4. Final sample locations may vary from those shown in Figure D2.1 based on preliminary Phase 1 chemical data or field screening.

D2.2.2 Meteorology Data Acquisition

As presented in Section D2.1.2, an onsite meteorological monitoring program will be established to collect representative, site-specific data suitable for dispersion modeling analysis of air COIs and odors.

D2.2.2.1 Basis For Proposed Program

Specifically, the program is intended to provide data that meets the following objectives:

- Provide representative data of the transport and dispersion conditions affecting the key identified sources of remediation-related air emissions described in Section D1.4.
- Provides appropriate, specific meteorological parameters measurements needed for potential input to a dispersion model.
- Employs monitoring instrumentation that fully meets USEPA performance and operating specifications, and is operated in accordance with procedures that meet USEPA guidelines for data completeness and validity.

In order to meet these objectives, a 10 meter tall tower will be installed and instrumented to continuously measure the parameters needed for model input. A minimum 1 year database will be compiled to ensure the full range of conditions affecting the dispersion of remediation activity emissions is compiled and used in the modeling of potential impacts.

D2.2.2.2 Monitoring Location Selection

The meteorological tower will be installed at a “source-oriented” location near the areas and activities expected to generate the highest levels of emissions. Specifically, this tower will be installed near the SCA at Wastebed 13. This location is approximately two miles inland from the western shore of Onondaga Lake.

Figure D2.2 is a topographic map section marked to delineate the general area in which the tower will be sited. The actual tower location will be selected based on field conditions. USEPA guidance states that measurement locations must be placed away from obstructions to the wind flow (either manmade or natural) at a distance of at least ten times the height difference between the measurement level and the obstruction height. The final site selection process will consider this guidance plus other technical, practical, and logistical tower siting factors, including:

- Availability of and access to site;
- Power availability;
- Safety; and
- Security.

The goal is to select a site that satisfies the siting criteria noted above and other logistical considerations.

D2.2.2.3 Parameters Measured

Table D2.1 lists the specific meteorological parameters that will be measured. These parameters include the following:

- Horizontal wind speed and direction;
- Orthogonal wind components (horizontal and vertical);
- Horizontal and vertical wind variability;
- Temperature and temperature differential with height;
- Relative humidity and dew point;
- Net radiation;
- Precipitation, and
- Barometric pressure.

Meteorological measurements will be taken at "standard" heights established for acquiring data for dispersion model input. The standard height for wind measurements is 10 meters. "Surface" based measurements (i.e., temperature, humidity, and pressure) are typically measured at a height of 2 meters above ground, although this may be adjusted to 3 meters to account for winter season snow cover. Precipitation will be measured at actual ground level. The tower will be instrumented at both the surface and 10 meter levels for temperature in order to obtain measurements of temperature differential with height in the lowest air layers.

All parameters will be measured continuously. A digital data acquisition and recording system will scan each output at 5 second intervals and use these values to calculate 5 minute, 15 minute, and hourly averaged values for each measured parameter. In addition, certain digitallycalculated values will be derived from the directly measured parameters. Wind speed and direction outputs will be used to calculate values of the standard deviation of horizontal wind direction (i.e., sigma-theta) and horizontal and vertical wind speeds (i.e., sigma u, v, and w).

Complete details of the meteorological monitoring program, including monitoring instrumentation specifications, routine field standard operating and data quality assurance program elements, and data validation procedures are provided in the Meteorological Monitoring Program Manual.

D2.2.3 Bench Testing of Emissions

D2.2.3.1 Emissions Scenarios

Based on the dredging alternatives being evaluated, literature review and previous projects, the following sources of potential air emissions were identified:

1. Areas being actively raked to remove debris prior to dredging (Costello 2003).
2. Immediate active dredging areas (Valsaraj 1997, Costello 2003, Fountain 2005).
3. The larger isolated area around the dredge area (Costello 2003, Fountain 2005).
4. The immediate discharge area in the SCA (Price 1998, Valsaraj 1997, Costello 2003).
5. The remainder of the active SCA where settling is occurring (Price 1998, Valsaraj 1997, Costello 2003).
6. Exposed sediment as would be found on a barge, in a stockpile, or above the water line in the SCA (Price 1999, Price 1998, Costello 2003, Fountain 2005).

These source types would be included in the ambient air dispersion modeling analysis, which may be conducted during a subsequent phase of the investigation.

To provide emission rates for ambient air modeling of chemical compounds and odors, these sources can be grouped for characterization by their physical nature and degree of disturbance during the test. Emission rates will be measured from the following:

- A 10% solids solution mixed continuously under aggressive mixing conditions. This represents active areas of operations such as the immediate dredging area and a portion of the SCA in the vicinity of the slurry discharge. In these areas, the sandy portion of the slurry quickly settles out, leaving the silts and clays in suspension to dissolve COIs into the water column. As in the full-scale condition, inert sand is expected to fall out during the test leaving a lower solids content at the end of the test that will also be measured. The settled sand is unlikely to contain any significant contaminant mass. Most of the soluble contaminants will be associated with the remaining suspended fines.
- A 10% solids solution under quiescent conditions. Starting with a mixture as described above, mixing of this sample will stop at the beginning of the test, allowing solids to settle during the test. This conservatively represents the emissions after

shutdown in active dredging and SCA discharge areas at the end of a shift or for the first part of the weekend.

- A 1% solids solution mixed continuously using the minimum amount of mixing for a constant solids resuspension into the water column. This conservatively represents the emissions from areas adjacent to the dredge and the slurry discharge area of the SCA, where natural convection is the primary cause of suspended solids.
- A 1% solids solution under quiescent conditions. This represents emissions from areas adjacent to the dredge and the slurry discharge area of the SCA after operations are shutdown at the end of a shift.
- *In situ* solids under quiescent conditions. This represents instances where sediment is exposed to the open air as might be found in portions of the SCA above the pool elevation, barges, or in stockpiles.

These five conditions will be evaluated in the wind tunnel source emissions experiment outlined in the following sections. These experiments are consistent with and exceed the recommendations of Tier 3 of the USACE Upland Testing Manual (USACE, 2003), which is the most vigorous level of analysis.

Analytical air and odor samples will be collected for the following periods after starting the test apparatus: 0- to 2-hour, 2- to 6-hour, and 6- to 22-hour. These values can be combined on a time-weighted basis to reflect numerous other time intervals such as 0 to 24 hours. The various emission rates for the COIs described in Section D1.4 and from the SMUs described in Section D1.5, and time intervals can be combined to represent temporal and physical changes in emissions caused by the emitting activities listed above and the sediment being handled.

D2.2.3.2 Testing Mechanisms and Operation

Measuring Emissions

Sediment samples and lake water received at the test laboratory will be mixed based on the formulas described below:

- Onondaga Lake sediment as collected, which is assumed to be approximately 30% solids by weight, to simulate exposed sediment (e.g., uncovered sediment within the SCA).
- Onondaga Lake sediment mixed with lake water to 10% solids by weight to simulate forced mechanical convection in active dredge and deposition areas (e.g., the sediment/slurry mixture being pumped into the SCA). This sample will be split and emissions measured while agitated and quiescent.
- Onondaga Lake sediment mixed with lake water to 1% solids by weight to simulate natural convection adjacent to active dredge areas (e.g., water not in the immediate vicinity of the dredge and discharge area). This sample will be split and emissions measured while agitated and quiescent.

All testing will be conducted using a bench-scale wind tunnel chamber similar to the larger model used by US Army Corps of Engineers and Louisiana State University (LSU) (Fountain 2005). The sample chamber was devised to hold a 22.9-cm (9 inch) depth of sediment or slurry with a surface area of 1238.7 cm^2 (192 in^2). The chambers will be sealed with an airtight fit. The process flow diagram for the air emission test apparatus is shown in Figure D2.3.

A mixer will be used during the test to mix sediment and water slurry in the chamber for the agitated tests only. Slow mixing will be used to maintain natural convection conditions for the 1% mixed test, and higher speed mixing will be used to simulate forced mechanical convection in the 10% mixed test. Jar tests and turbidity measurements will be used to set the mixer speed for the two mixed conditions.

A sample of the sediment will be collected at the beginning of the test to document the concentration of COIs, grain size, TOC, and percent solids. The percent solids of the slurries will be tested on-site and adjusted to obtain the proper content. A sample of the pre-test slurries will be analyzed for TSS. One pre-test sediment sample will be taken prior to the 1% and 10% solids slurry tests and analyzed for COIs. The results will be used for both respective quiescent and mixed mass balance calculations.. The flux chamber will be filled with approximately 28.3 liters (7.48 gal) of slurry and sealed. Bricks or other inert material will be placed in the bottom of the flux chamber when testing the “as collected” bulk sediment keeping the total sediment material for all five tests down to about 10 gallons. Air will be passed over the sample surface at 2.24 m/s (5 mph) with saturated humidity for all slurries using an in-line bubble trap to add moisture vapor. The temperature and humidity will be monitored and adjusted throughout the test to prevent condensation. Inlet airflow will be monitored by means of a flow meter. The turbidity of the slurry will be monitored during testing. The sediment samples will be tested at 50% relative humidity to measure emissions during sediment drying. Testing will be conducted at room temperature. The assumed 5 MPH wind speed and room-temperature conditions are considered conservative and are expected to produce the highest measurable results. The wind speed of 5 MPH has been selected because: it is high enough to prevent or minimize “air side resistance” that occurs at lower speeds in the test apparatus, but not in the field; and low enough to reflect relatively calm conditions when dispersion is minimal and concentrations are highest. Air side resistance occurs in the apparatus when the air approaches saturation with the contaminant and there is not enough fresh air moving through the device to allow additional volatilization. If air side resistance is significant, the measured emissions would underrepresent what would actually happen in the field. Thus, the 5 MPH speed was selected as the best balance point to conservatively reflect reality. Similarly, emission rates are inversely proportional to temperature. Sediment temperatures are generally not expected to reach room temperature in the lake, nor during the 24-hour period after placement in the SCA, so the measured emissions at room temperature are conservative estimates of field emissions at lower temperatures. All tests will be conducted under these conditions, however, condition variation may be considered in future Phases of the investigation.

To straighten the airflow, the wind tunnel intake will extend for a length of approximately eight effective diameters. Dimensions of the wind tunnel are shown in Figure D2.3. A honeycomb panel will be placed immediately before the sediment/slurry tank in order to evenly distribute the airflow. A thermohygrometer will be connected to the exit port to monitor exit air temperature and relative humidity. An air mixer will be used prior to the sampling trains to homogenize the airflow.

Contaminant-specific adsorbent-filled air sampling traps will be attached to the chamber exit ports, as demonstrated in Figure D2.3. Collected samples will be prepared, handled, and labeled in accordance with all applicable guidelines. Airflow through each sampling train will be controlled using a valve and measured with a calibrated pump or pump and flow meter combination. To assure all of the contaminants are captured, a second absorbent tube will be used in series for each train except for the hexachlorobenzene, which is present only in low concentrations and is one of the two least volatile COIs (Table D1.1).

Odor samples will be collected for sequential periods of 2-, 4-, and 16-hours (for a total of 22-hours), using a VAC'SCENT sample vessel supplied by St. Croix Sensory. Upon collection, the tedlar bag containing the sample will be submitted to St. Croix Sensory within 30 hours of sampling.

Finally, measurements of hydrogen sulfide, ammonia and mercaptans will be made using Gastec and Sensidyne tubes during selected bench tests to determine the potential concentrations of hydrogen sulfide and ammonia during enclosed wastewater treatment, and to assess the potential role of mercaptans in the measured odors.

For each sample type, volatile emissions samples will be collected for sequential periods of 2-, 4-, and 16-hours (for a total of 22-hours), then sent to the appropriate analytical laboratory for analysis. The results of the analysis will be used for flux rate and mass balance calculations. Upon completion of each test, the tested sediment or slurry will be sampled again to evaluate depletion of the COIs and, where appropriate, for TSS. The slurry from the 10% mixed slurries from SMU 1 and SMU 7 will be filtered with an appropriate sub-micron filter to determine the dissolved concentration of VOCs and naphthalene, respectively, along with TOC/DOC to assess the mass balance. All end-of-test samples will be taken within four hours of the completion of the test. This time frame is needed to allow the wind tunnel device to be decontaminated and prepared for the subsequent test run within the first two hours to keep the tests on a 24-hour schedule. The bulk samples will be enclosed with minimal headspace following completion of the test until the final sample is collected, to minimize volatile loss and chemical degradation. .

The expected number of tests by media, time intervals , and analyses are described in Table D2.2. These data will be summarized in the Air Quality Report.

Decontamination Procedures

Equipment (e.g., Pyrex or stainless steel mixing bowls, spatulas, spoons, split spoons and other reusable sampling devices) used to homogenize or collect samples for chemical testing will be decontaminated prior to re-use in accordance with SOPs.. To minimize the potential for contaminant migration and/or cross contamination, the wind tunnel testing apparatus will also be decontaminated after each test. One sample of the decontamination rinsate will be collected and analyzed for COIs to verify cleanliness.

D2.2.3.3 Sampling and Lab Methods

All bulk sediment samples will be prepared, labeled, handled, and shipped as described in the QAPP. Sample analysis will be done in accordance with the analytical methods described in the QAPP.

D2.2.3.4 Quality Control

Laboratory quality control checks will be in place to ensure the reliability and validity of the analyses performed at each laboratory. The QA/QC program, including applicable QA/QC sampling, will be in compliance with the specifications of the QAPP. Laboratory equipment will be inspected, maintained, and calibrated in accordance with the QA/QC program.

D2.2.4 Evaluation of Odor

Odor samples will be collected using a VAC'SCENT sample vessel supplied by St. Croix Sensory. Upon delivery, St. Croix Sensory will assess the sample using a certified odor panel in accordance with ASTM E 679-04: "Standard Practice for Determination of Odor and Taste Thresholds By a Forced-Choice Ascending Concentration Series Method of Limits," and the compatible, but more specific European Odor Testing Standard EN13725:203 "Air Quality – Determination of Odor Concentration by Dynamic Olfactometry."

The odor panel will evaluate the odor using certified assessors and following all elements of ASTM E 679-04 and EN13725:203. Assessors are tested with a standard odorant (n-butanol) and are required to meet specific sensitivity criteria outlined in the European testing standard. Assessors must maintain a defined standard deviation of n-butanol threshold measurements in order to satisfy repeatability requirements of the standard.

A certified odor panel session uses five trained, experienced, and certified assessors. These assessors will be presented each odor sample twice. Final results will be retrospectively screened in order to evaluate and identify assessors who may have a specific hypersensitivity to the odor sample presented.

Odor thresholds will be determined using a presentation method called the "3-alternative forced choice" (3-AFC) method or the "triangular forced-choice" (TFC) method. The assessor will sniff three sample presentations; one contains the odor while the other two are odor-free blanks. The assessor is required to choose one of the three and acknowledge their response as a "guess," "detection," or "recognition," as defined by ASTM E679-04.

After the first set of three presentations, the assessor will then be presented with the next dilution level. The next dilution level presents the odor at a higher concentration. The first dilution level presented to the assessors will be below the odor threshold (subthreshold). The assessor will proceed to higher levels (odor concentrations) of sample presentation following these methods. This statistical approach is called an "ascending concentration series."

Results will be computed for each assessor based on the dilution levels where correct "detection" or "recognition" responses are recorded. The responses of all assessors will be averaged to determine the sample's detection and recognition thresholds. The dilution ratio is an estimate of the number of dilutions needed to make the actual odor emission just detectable. This is known as the Detection Threshold (DT). The Recognition Threshold (RT) is the dilution ratio at which the assessor first detects the odor's character ("smells like...").

The odor intensity (I) is the relative strength of the odor above the RT (suprathreshold). The odor referencing is accomplished by a comparison of the odor intensity of the odor sample to the odor intensity of a series of concentrations of the reference odorant, which is butanol. The olfactometer has eight sniffing ports that make up a series of increasing concentrations of the butanol. The series has an increasing concentration ratio of two (binary scale). Odor intensity of an odor sample is expressed in parts per million (ppm) of butanol.

The Odor Intensity Referencing Scale serves as a standard method to quantify the intensity of odors for documentation and comparison purposes. The average value of the odor evaluation is the reported I for the odor sample.

Odor persistency is a term used to describe the rate at which an odor’s perceived intensity decreases as the odor is diluted. The rate of change in intensity verses odor concentration is not the same for all odors.

The odor DTs, RTs, odor intensity, and persistency values will be reported for each of the samples tested. As summarized in Table D2.2, odor samples will be collected from each of the tested SMUs (1, 6, and 7), at three time intervals, corresponding to the time intervals for the air emission chemistry testing. Additionally, samples of amines and reduced sulfur compounds will be collected on the 10% mixed run for each SMU. These Category A odorants will be measured on the runs most likely to exhibit the highest emissions to further characterize the odors being measured.”

TABLE D2.1
METEOROLOGICAL PARAMETERS TO BE MEASURED

TOWER NO. 1 - Primary Tower
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) Orthogonal Wind Components Standard Deviation of Wind Components or Vertical/Lateral Turbulence (computed) Temperature Delta Temperature (10m - 2m)

TABLE D2.2
SAMPLING PLAN FOR BENCH TEST SAMPLING
TOTAL NUMBER OF TESTS BY MEDIA, TIME INTERVAL, AND ANALYSIS

Sample	Before		0-2 hr		2-6 hr		6-22 hr		After		Total
Sediment (A) (B)											
VOCs (C)	1	(H)	0		0		0		1		2
PAHs (L)	1	(H)	0		0		0		0		1
PCBs (N)	1	(N)	0		0		0		0		1
Mercury	1	(H)	0		0		0		0		1
Hexachlorobenzene (L)	1	(H)	0		0		0		0		1
Phenol (L)	1	(H)	0		0		0		0		1
% Solids, On Site (J)	0		0		0		0		1		1
TOC (J)	0		0		0		0		1		1
Grain Size	0		0		0		0		0		0
Temperature, On Site	0		0		0		0		0		0
Slurry (D)											
VOCs (C)	0	(E)	0		0		0		3	(G), (I), (K)	3
PAHs (L)	0	(E)	0		0		0		2	(G), (I)	2
Mercury	0	(E)	0		0		0		2	(G), (I)	2
Hexachlorobenzene (L)	0	(E)	0		0		0		2	(G), (I)	2
Phenol (L)	0	(E)	0		0		0		2	(G), (I)	2
DOC	0		0		0		0		1	(G)	1
Temperature, On Site	1		1		1		1		1		5
% Solids, On Site (J)	1		0		0		0		0		1
TOC (J)	1		0		0		0		1	(K)	2
Grain Size	0		0		0		0		0		0
TSS	1	(F)	0		0		0		1	(K)	2
Turbidity, On Site	1		1		1		1		1		5
Air											
DT and RT	0		1		1		1		0		3
Intensity	0		1		1		1		0		3
Persistance	0		1		1		1		0		3
Amine & Reduced Sulfur Gases (M)	0		1		0		0		0		1
VOCs (C)	0		1		1		1		0		3
PAHs (L)	0		1		1		1		0		3
PCBs (N)	0		1		1		1		0		3
Mercury	0		1		1		1		0		3
Hexachlorobenzene (L)	0		1		1		1		0		3
Phenol (L)	0		1		1		1		0		3
Hydrogen Sulfide, On Site	0		1		1		1		0		3
Ammonia, On Site	0		1		1		1		0		3
Temperature, On Site	1		1		1		1		1		5
Humidity, On Site	1		1		1		1		1		5
Air Flow, On Site	1		1		1		1		1		5
Weights											
Sample Tank, Empty	1		0		0		0		0		1
Sample Tank, Full	1		0		0		0		1		2
Sample Tank, After decanting slurry	0		0		0		0		1		1
Graduated Cylinder, Empty	0		0		0		0		1		1
Graduated Cylinder, w/ Slurry	0		0		0		0		1		1
Volumes											
Sample Tank, Full	1		0		0		0		1		2
Decanted Slurry	0		0		0		0		1		1

Notes:

(A) Requires a 200 gram sample for COIs, percent solids, and TOC, and a 500 gram sample is required for Grain Size analysis.
(B) MS and MSD samples collected from Exposed Sediment for each SMU.
(C) Dichlorobenzenes and Trichlorobenzenes will be analyzed as part of the VOC analysis.
(D) Require a 1 liter sample each for PAHs, VOCs, TOC, and the remaining chemistry analyses.
(E) Use diluted "Before" sediment concentrations as beginning slurry concentrations
(F) Requires a 200 mL sample for TSS.
(G) One sample will be filtered before analyzing for all COIs and DOC.
(H) Combined pe-test sediment sample for 1% Quiescent and Mixed, and for 10% Quiescent and Mixed.
(I) One rinsate (water) sample will be collected for COIs after each decontamination of the apparatus and at the end of the testing.
(J) Percent Solids, on site, and TOC will be analyzed from COIs samples. No additional lab samples taken.
(K) Unfiltered
(L) Tested together as part of the SVOC Analysis for sediment and water, but separately for air.
(M) Test will be conducted on the 10% Mixed scenario only.
(N) 1 sediment and 3 air samples will be collected and analyzed for PCBs from the 10% Mixed Test Run for SMU 7 only

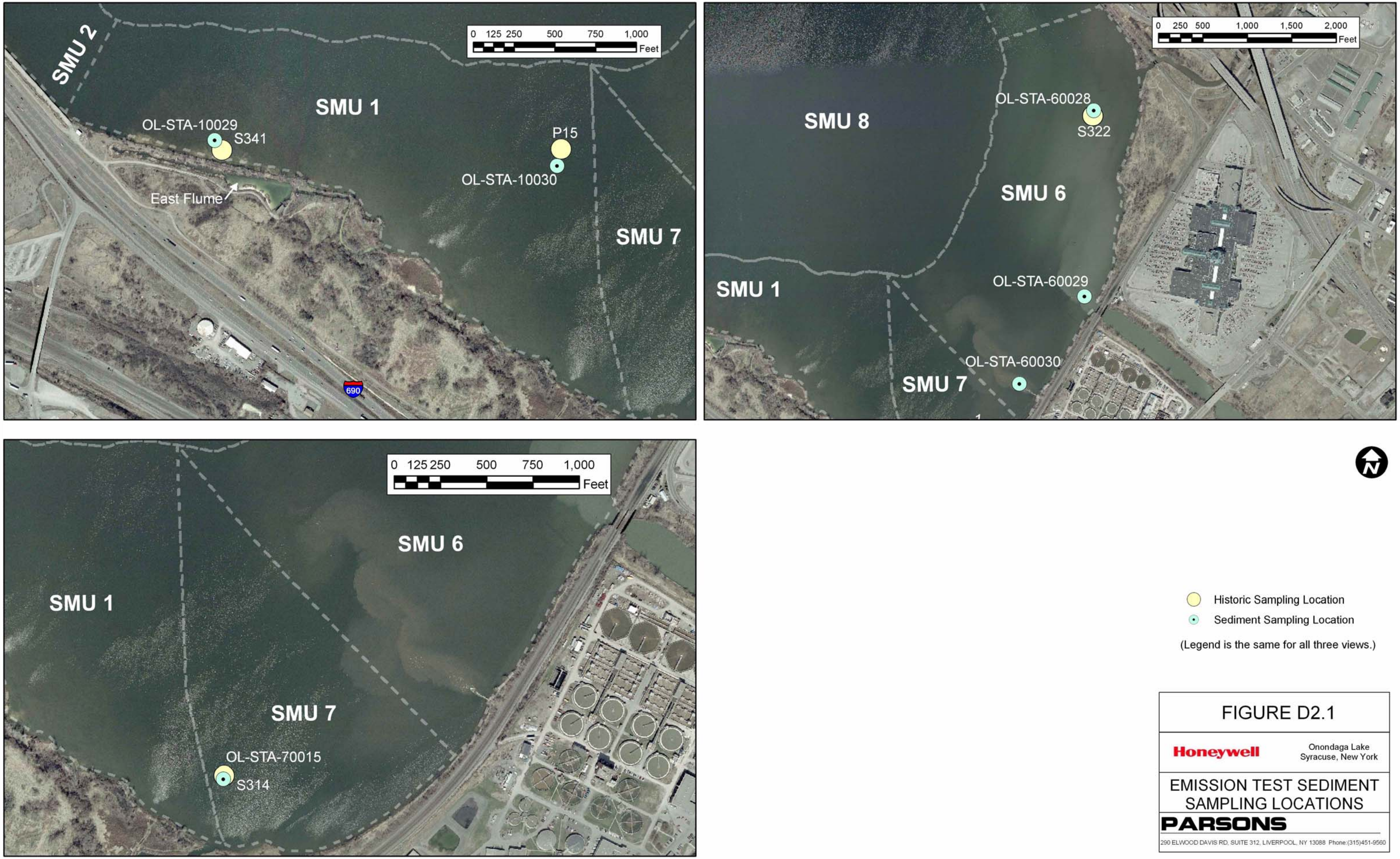

FIGURE D2.1

Honeywell

Onondaga Lake
Syracuse, New York

EMISSION TEST SEDIMENT
SAMPLING LOCATIONS

PARSONS

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

N

▨ Candidate Siting Areas

FIGURE D2.2

Honeywell

Onondaga Lake
Syracuse, New York

CANDIDATE SITING AREAS
FOR METEOROLOGICAL
MONITORING STATION 1

PARSONS

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

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Process Flow Diagram

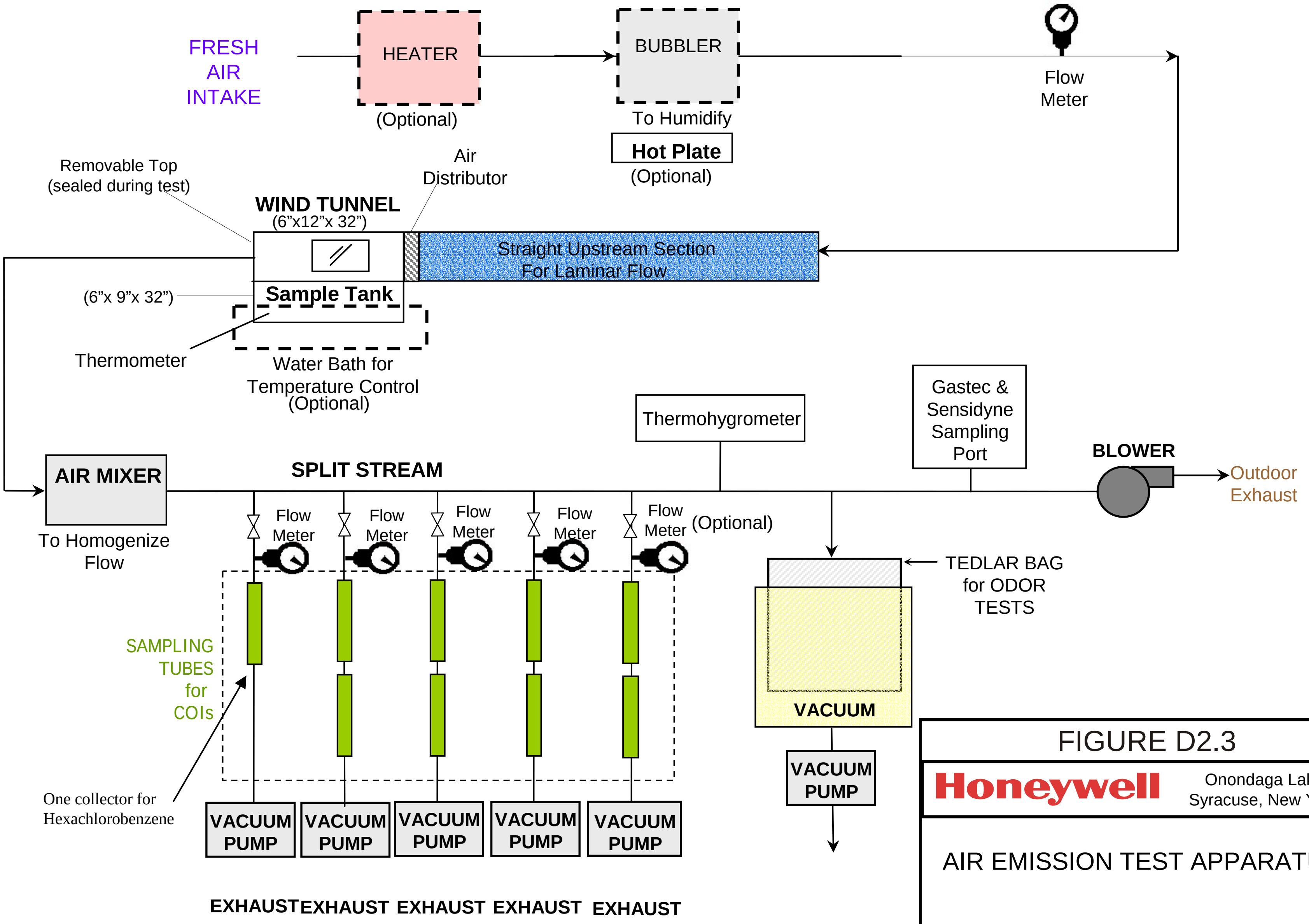

FIGURE D2.3

Honeywell

Onondaga Lake
Syracuse, New York

AIR EMISSION TEST APPARATUS

PARSONS

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

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SECTION D3

EMISSION ESTIMATION

D3.1 INTRODUCTION

The results obtained from the air and odor emissions testing described in Section D2 will be used to estimate potential emission rates and odor intensity and persistence factors for potential use in a dispersion modeling analysis. Following the completion of the experiments and calculation of the measured laboratory emission rates, further analysis will be required to relate the experimental results to expected field scale and field conditions. The following sections describe the procedures to be used to process and evaluate the data collected.

D3.2 ZONE DEFINITIONS

Experimental scenarios were defined to best characterize the events that occur from dredging operations. The primary sources of emissions to be represented were described in Section D2.2.3.1.

Both the dredging and dredged material placement operations can be divided into two source areas. The Forced Convective Zone (FCZ) is a zone located near the dredging area and in the vicinity of the discharging equipment where the disturbance of the equipment "forces" additional suspension of solids and increases the supply of volatiles for dissolution and volatilization (Fountain 2005). For this project, estimations for the FCZ will utilize the results of the 10% solids solution. The size of this area for dredging can be estimated through an empirical relationship of dredge power (Fountain 2005). This enhanced level of emissions due to dredge activity corresponds to higher levels of Total Suspended Solids (TSS) and higher Mass Transfer Coefficients[1] (MTC). In the SCA, the area of the FCZ varies substantially with the placement method and pool size.

The remainder of the work area, defined by such things as the limits of the silt curtains, the active ponding area in the SCA, etc. are defined as the Natural Convective Zone (NCZ). These areas receive some additional suspended sediment from the FCZ and are higher than background, but the activity that causes the suspension is limited to the natural forces such as currents, waves, etc. (Fountain 2005). The NCZ will be defined by the total enclosed work area minus the FCZ. This source of emissions within the actively dredged SMU will be evaluated using the results from the 1% solids solution experiments.

Predictions for the SCA with a water layer may utilize the experimental results for both the 1% and 10% slurries. The point of discharge with high water turbulent activity along with high

---

[1] The Mass Transfer Coefficient is the inverse resistance to the forces transferring volatile compounds from solution in the water into the overlying air.

TSS concentrations will be characterized with the highest solids. These estimations will also account for inactive disposal periods such as the end of the workday or weekend.

The experiment of exposed dredged material will be used to estimate emissions from the area of the SCA containing dredged material without a layer of water, if any. The emissions for the evaporative fluxes of chemical from drying dredged material has been developed based on results from measured PAH fluxes from a large-scale wind tunnel experiment (Fountain 2005).

D3.3 AIR EMISSIONS

For each sample the total mass of chemical adsorbed to the chemical traps will be determined by extraction and analysis as described in Section D2.2.3.3.

Contaminant flux from the emitting area of the wind tunnel will be calculated by scaling up the total mass of the compound emitted during a given time interval by the ratio of the total volume of air flow divided by the volume of the air sample, and then dividing that value by the time interval and the emitting area of the sediment- or slurry-air interface. From this calculation, an estimated emission rate with the units of mass/unit area/unit time will be obtained. This process will be completed for each of the scenarios.

D3.4 ODOR EMISSIONS

Odor evaluations will be completed for each of the three tested SMUs, five configurations, and three time periods. This will yield 45 odor threshold values (Detection and Recognition Thresholds) and odor intensity (as ppm 1-butanol) for each tested sediment/slurry mix.

SECTION D4

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