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WORK PLAN

Onondaga Lake
Pre-Design Investigation:
Phase III Addendum 7 Work Plan,
Air Emissions and Odors

Honeywell, Inc.

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1. Project Background

1.1. Introduction

This Work Plan summarizes the Onondaga Lake Phase III Addendum 7 Pre-Design Investigation (PDI) activities to further evaluate potential air emissions and odors resulting from remedial activities for Onondaga Lake, including sediment placement within a sediment consolidation area (SCA). The proposed activities presented in this Work Plan will involve bench tests and wind tunnel tests of sediment samples. The objectives of the tests include:

- Provide verification of results from Phase I Wind Tunnel Tests by retesting sediments under similar conditions in a reconfigured wind tunnel.
- Evaluation of potential chemical and odor emissions from exposed sediment at the SCA over a long-term period of time (e.g., 20 days).
- Evaluation of the potential viability and/or efficiency of mitigation techniques to control air emissions and odors from ponded and exposed sediments.

The information obtained from these tests will be used: (1) to further refine chemical and odor emission rate estimates currently being developed using numerical modeling and test results from the Phase I and II PDI activities, and (2) to determine which air emission and odor control strategies may be most effective during the operation of the SCA. Evaluation of emissions and odors is ongoing, and no determination has been made regarding the need for mitigation measures to reduce odors and emissions. However, to expedite the design schedule, evaluation of potential mitigation approaches is proceeding in parallel with the evaluation of the need for mitigation measures. As the potential impacts are further understood, the need to integrate mitigation technologies into the design will be assessed. If necessary, the results of the testing described herein will facilitate the design of a comprehensive mitigation strategy that can be incorporated into the Project's SCA & Dredging Operation Initial Design Submittal. This Work Plan is being submitted to the NYSDEC for approval prior to conducting the Phase III activities.

1.2. Work Plan Organization

This Work Plan is organized into three sections. Section 1 presents relevant background information on Onondaga Lake and an overview of the emission and odor evaluation activities. Section 2 presents the field sampling activities and laboratory evaluation associated with this investigation. Section 3 presents how the testing will be conducted and reported.

1.3. Description and Background

Onondaga Lake is a 4.6 square mile lake located just northwest of the City of Syracuse in central New York. As a result of over 200 years of heavy industrial activity and population growth on the shores of the Lake and its nearby tributaries, the Lake has been identified as a federal Superfund site.

On July 1, 2005, the NYSDEC and USEPA Region 2 issued the Record of Decision (ROD) for the Lake. The remedy specified in the ROD includes the dredging of up to an estimated 2.65 million cubic yards of sediment from the lake, and capping of an estimated 579 acres of remaining sediment. The vast majority of, if not all of, the dredged contaminated sediment will be placed in a SCA on a 163-acre former settling basin, known as Wastebed 13.

Use of geotubes and operation of the SCA as open basins are both currently under consideration. Based on preliminary conceptual design assumptions on how the SCA will be operated if it is operated as open basins, one SCA cell will be filled with sediment during each of four years of dredging. Each SCA cell will be operated during the course of the construction season as a ponded settling basin. During this phase of the cell, the sediments will be covered with a water blanket which may range from 2 to 20 feet in thickness. At the end of the dredging season, the cell will be dewatered, potentially exposing the dredged/settled sediments to the open air. Based on bench testing activities conducted to date, volatile chemical and odor emissions may be released during both operating scenarios.

In order to evaluate the potential for air quality impacts in the vicinity of the SCA and to assess control strategies to minimize the potential impacts, if required, emission rates of volatile chemicals of interest (COIs) and odors must be estimated. Once estimated, these emission rates can be used as input into an atmospheric dispersion model to estimate the potential impacts in the areas surrounding the work activities, identify whether mitigation is required, and to develop a successful mitigation strategy, if required.

To estimate the emission rates from various components of the remedial activities, three models, developed by a team led by Dr. Louis Thibodeaux of Louisiana State University for the Indiana Harbor and Canal project (IHC), are being evaluated for use on this project. They provide means to describe the fate and transport of chemicals of concern, and produce estimated emission rates representative of the various dredging-related activities. The models developed to estimate emissions for dredging activities include:

- Dredge operable unit (DOU),
- Ponded SCA (PSCA), and
- Exposed dredged material within the SCA (EDM).

The PSCA and EDM models estimate COI emissions from the two SCA operating scenarios: ponded sediment and exposed sediment, respectively. However, these models are not designed to estimate odor emissions for complex mixtures of COIs. Therefore, data collected from the Phase I bench scale testing (discussed in Section 1.4) is being used to estimate odor emission rates, as well as to verify modeled COI emission rates. This Work Plan proposes additional bench scale testing to further verify modeled COI emissions and to further estimate odor emissions.

1.4. Previous Pre-Design Investigation Activities

Two previous phases of NYSDEC-approved PDI activities (Phases I and II/III) have been conducted to verify estimated COI emissions and to estimate odor emissions. Phase I activities involved wind tunnel tests designed to measure emission rates for COIs and odors for sediment samples collected from the Lake under a series of five sediment conditions:

- Ponded sediment
  - 10% solids – mixed
  - 10% solids – quiescent
  - 1% solids – mixed
  - 1% solids – quiescent
- Exposed sediment

The results of the Phase I activities were summarized in the Phase I Wind Tunnel Summary Report which was submitted as draft to NYSDEC on March 30, 2006 (Service Engineering Group, 2006). NYSDEC has provided comments on the summary report, and is currently being finalized for resubmission.

Phase I results included COI and odor emission rates for the five sediment conditions during the first 22 hours after sediment placement. However, since exposed sediment emissions may continue beyond the first 22 hours of exposure, additional testing is needed to estimate emission rates of exposed sediment for periods beyond the first day. As discussed in Section 2, this Work Plan proposes measurements of COI and odor emission rates for exposed sediments over an extended period of time. The COI measurements will be used to verify the results of the EDM model. The odor emission rates will be used in the dispersion model to estimate downwind odor impacts.

Phase II/III activities involved bench testing of lake sediment samples to identify representative characteristics of odor and to identify chemical compounds that are the primary potential contributors to the odors. The results of the Phase II/III investigation were summarized and reported in the Phase II/III Odor Characterization Summary Report, which was revised based on NYSDEC comments and resubmitted (Parsons, 2007). Based on the results of the characterization testing, no single compound was identified as the predominant odor causing agent, and therefore the proposed testing will evaluate odor as its own entity as well as potential COIs that may be contributing to odors.

The results of activities from both Phases I and II/III identified the following eleven COIs that constituted the primary emissions and/or were determined to be strongly correlated with odor strength:

- Benzene
- Ethylbenzene
- Chlorobenzene
- Dichlorobenzenes
- Trichlorobenzenes
- Hexachlorobenzene (HCB)
- Xylenes
- Toluene
- Naphthalene
- Dimethyl Disulfide
- Trimethylbenzenes

1.5. Summary of Phase III Addendum 7 PDI Activities

This Work Plan proposes additional bench testing to collect data needed to complete COI and odor emission estimates as discussed above. It also proposes bench testing of several mitigation techniques that may be implemented to reduce volatile and odor emissions, if required. As the evaluation of emissions mitigation continues, additional mitigation techniques other than those proposed in this Work Plan may be evaluated. If warranted, additional bench testing of these mitigation techniques may be proposed in future work plans or addendums. To accomplish the objectives in Section 1.1, the following activities are planned as part of this Addendum:

- Collection of sediments from sediment management units (SMUs), which have a significant potential for volatile air emissions and odors. Samples from SMUs 1, 6 and 7 are proposed for this Phase of testing.

- Collection and analysis of COI and odor samples from 10% quiescent slurry mixtures exposed in the wind tunnel as was conducted in Phase I, for SMUs 1, 6, and 7.

- Collection and analysis of COI and odor samples from sediment samples exposed to the atmosphere for long-term periods, as anticipated for SCA operations.

- Collection and analysis of COI and odor samples from sediment samples with and without application of control techniques, such as counteractant sprays, activated carbon, and exposed sediment sand cap, as described below.

2. Field Investigations

This section discusses the tests that will be conducted to satisfy the objectives presented in Section 1.1. Section 2.1 discusses the data and information needed to complete the evaluations. Section 2.2 describes tests that are designed to collect the data and information. Deviations from this work plan will be proposed to and approved by NYSDEC prior to implementation. NYSDEC will be informed of the testing schedule, after this work plan is approved, and afforded the opportunity to observe any or all of the testing.

2.1. Data and Information Needs

This section summarizes the data and information that is needed to assess the potential COI and odor emission rates that may occur as a result of sediment placement in the SCA and to assess the efficacy of techniques to control COI and odor emissions. 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.

2.1.1. Ponded SCA Emission Rates

As discussed in Section 1.4, initial odor and volatile emission rates were obtained from the Phase I Wind Tunnel Testing for SMU 1, 6, and 7 sediments under a variety of testing scenarios. To provide validation and verification of the results obtained from this testing, three of the original tests will be repeated. The 10% Quiescent tests for SMUs 1, 6, and 7 will be repeated, with samples collected over the same intervals as the previous tests (0-2 hour, 2-6 hour, 6-22 hour). As described below, these tests will be conducted in the modified wind tunnel, using the revised wind speed (1 mph).

2.1.2. Exposed Sediment Long-Term Emission Rates

As discussed in Section 1.3, the EDM model estimates COI emission rates under the exposed sediment scenario. Adaptation of this model to the Onondaga Lake project is continuing, and additional data is needed to verify the model estimated emission rates. As discussed in Section 1.4, previous PDI activities measured emission rates from exposed sediment during the first 22 hours after sediment placement. During Phase I investigations, odor samples were collected over three different time periods: 0 to 1 hours, 2 to 6 hours, and 6 to 22 hours after placement. The results showed a general decline in odors with time. However, sediment may be exposed for longer durations before a temporary or permanent cap is installed. Therefore, additional wind tunnel testing is proposed to estimate COI and odor emission rates for a long-term period. The results from this testing will be used to further evaluate potential emissions from the exposed sediment.

2.1.3. COI and Odor Emissions Control Efficacy

As described above, if currently ongoing evaluations determine that unacceptable ambient air impacts may occur during remediation, mitigation techniques will be implemented during the operation of the SCA to reduce (control) COI and odor emissions. Various techniques have been implemented at other sites and in other applications, but the efficacies of the techniques have not been quantitatively investigated. Quantitative estimates of control efficiency are needed to aid the selection of the appropriate techniques, as discussed in Section 3.3. The mitigation techniques that have been identified to date and are to be investigated as part of this investigation include:

- Odor Counteractant Sprays

- Activated Carbon
- Sand Cap

Odor counteractant sprays will be evaluated using an olfactometer, discussed in Section 2.2.2. Wind tunnel testing will be utilized to evaluate activated carbon and a sand cap, discussed in Section 2.2.3. The conceptual use and theoretical effect of these control techniques are discussed below.

2.1.3.1. Odor Counteractant Sprays

Counteractant sprays are all-natural biodegradable odor neutralizing solutions made entirely of food-grade ingredients. They are used to "remove" odorous compounds in ambient air. The sprays are mixed with water and act to neutralize odorous compounds by removing them from the ambient air. In practice, a network of counteractant spray nozzles may be positioned at certain intervals around the perimeter of the SCA and at certain heights above the ground. The nozzles would atomize a mixture of water and spray product into the atmosphere, thereby creating a curtain of counteractant vapor/mist through which SCA emissions would pass prior to leaving the site. When the counteractant vapor comes in contact with SCA emissions, the odorous compounds attach themselves to the water/spray droplets, and then get dragged to the ground.

Water vapor by itself can be an effective odor neutralizer. Counteractant sprays can increase the neutralizing effectiveness of pure water vapor by decreasing the surface tension of the droplets and increasing the likelihood that the odor molecule will become attached to the droplet. Some products are more effective for different types of odors than others. Therefore, testing is proposed to determine which product is most effective at neutralizing the COI expected from the different SMUs. In addition to water alone, the following spray products were selected for testing based on extensive research and discussions with manufacturers as well as direct experience of the design team with the individual products:

- Eco Sorb 606
- Odex

Testing of pure water and these two products will be conducted by following ASTM 1593-06 *Standard Guide for Assessing the Efficacy of Air Care Products in Reducing Sensorily Perceived Indoor Malodor Intensity* as discussed in Section 2.2.2. The testing uses a mixing chamber to mix the odor counteractants with the sediment odor to determine the amount of counteractant needed to minimize the sediment odors. Therefore, varying volumes of counteractant will be sprayed into a fixed volume of headspace with a known odor strength. Since testing will involve incrementally increasing mixture ratios, the ratio at which the odor starts to be minimized may be used as a future design parameter, discussed in Section 3.3.1. The spray products or pure water with the lowest ratio will indicate the most effective counteractant.

2.1.3.2. Activated Carbon

Activated carbon is an effective media to absorb/capture organic compounds. In its application for controlling SCA emissions, powder activated carbon (PAC) may be pneumatically broadcast, in dry form, on the ponded SCA surface. According to carbon manufacturers, PAC with very fine particle size (minimum of 325 mesh) is known to become suspended in the water column as well as float on the water's surface. This separation is preferred since it increases the contact with COI in the dissolved phase as well as provides an absorption barrier at the water/air interface where volatilization occurs. PAC that sinks and settles on the sediment will be buried with new sediment being discharged to the SCA, and will be less effective at preventing volatilization. Therefore, a product with very fine particle size, Hydrodarco B, was selected for testing because, according to the manufacturer, it is expected to separate roughly in equal proportions between suspension in the water column and floating on the water surface.

Since PAC is expected to reduce volatilization under ponded SCA conditions, the amount of PAC applied to the ponded surface to control volatilization will depend on the amount of COI in the water column. PAC suppliers recommend that for 100 percent absorption (assuming complete contact of the carbon and COI), a dosing ratio of 10 pounds of carbon be applied to one pound of COI. Therefore, the dosing ratio to be used in the proposed testing will be 10 times the amount of COI in the dissolved phase as discussed in further detail in Section 2.2.3.2. Two different ratios (5 and 100 pounds of carbon per pound of COI) will also be tested to evaluate the absorption efficiency at other ratios.

A 10 percent solids mixture of sediment and lake water will be used in the carbon testing to simulate the ponded SCA condition. COI and odor emissions will be measured prior to and after the addition of carbon.

2.1.3.3. Sand Cap

A layer of clean material placed on top of sediment (after an SCA cell is completely filled but prior to dewatering) would serve as a vapor cap, inhibiting volatilization of COI to the atmosphere. Sand is being considered for the clean material. Placement of the sand may be performed through the water column (ponded surface) so that sediment is not exposed upon dewatering. The proposed testing will evaluate the efficacy of the sand cap to serve as a vapor cap.

Emissions of COI and odor will be measured prior to and after the placement of a 3-inch thick layer of sand. A thickness of 3-inches was selected based on recommendation from Dr. Thibodeaux (LSU) that 3-inches should effectively reduce volatile and odor emissions from the exposed sediment. In addition, a 3-inch layer represents a reasonable minimum thickness that could be achieved during placement. Prior to placement, the sand will be saturated with water, generated by decanting off from the mixed sediment after settling, to simulate the anticipated condition of the sand in the SCA immediately upon dewatering. Additional measurements will be made for a week after the sand placement to evaluate any changes in its effectiveness over the longer term. Measurements will also be made after rewetting the sand to simulate the impact that rainfall may have on the sand's effectiveness.

2.2. Data Collection

This section describes the field sampling and bench testing. Field sampling will involve the collection of sediment samples from specific locations in the SMUs previously investigated. Testing will involve use of mixing chamber and wind tunnel testing. Table 1 summarizes the testing, including the types of tests, representative SCA conditions, and the quantity and types of samples to be collected and analyzed. The following subsections reiterate the objectives of the testing and describe the sample collection and analysis methods.

2.2.1. Sediment Sample Collection

Sediment samples are needed to evaluate COI and odor emissions using olfactometry and wind tunnel tests. Composite bulk sediment samples will be collected from SMUs where dredging will be conducted and that contain elevated concentrations of COI and odorous compounds. Locations from

SMUs 1, 6 and 7 were selected for this phase of testing. Locations within these SMUs are consistent with locations tested during the Phase I and/or Phase II/III. Figures 1, 2, and 3 illustrate the sampling locations within each SMU. Sample locations include:

SMU	Location	Depth	Sample Volume
1	10029[1]	0-6.5 ft	10 gallons
	10115	0-6.5 ft	10 gallons
	10117	0-6.5 ft	10 gallons
6	60028[1]	0-3.25 ft	15 gallons
	60030	0-3.25 ft	15 gallons
7	70048	0-6.5 ft	15 gallons
	70007	0-6.5 ft	15 gallons

Bulk sediment samples and lake water will be collected by Parsons following the same procedures utilized in Phases I and II/II, and processed in the following manner for each of the testing procedures described in this Work Plan:

- **Odor counteractant spray testing -** Sediment samples will be collected from each of the SMU locations and composited into one representative sample for each SMU. The three composite samples (SMU 1, 6, and 7) will be shipped to the St. Croix Sensory laboratory in St. Paul, Minnesota for mixing chamber testing. One 5-gallon composite sample for each SMU (1, 6 and 7) will be shipped to St. Croix Sensory. Prior to shipment of the sediment, some of the sediment will be withdrawn and analyzed for COI concentration.
- **Activated carbon and ponded SCA testing -** Onondaga Lake sediment and lake water will be combined to approximately 10% solids by weight for use in activated carbon addition wind tunnel tests. One 5-gallon container of composite samples of each SMU (1, 6, and 7) will be prepared for testing and delivered to the O'Brien & Gere manufacturing facility in Fayetteville, New York. Composite samples for each SMU will be created in a similar manner to the method described for the counteractant spray testing. As done in previous PDI activities, lake water used to create the 10% mixed solutions will be collected off of the Honeywell PDI dock.
- **Exposed sediment and sand cap testing -** Onondaga Lake sediment as collected will be delivered for use in wind tunnel tests to simulate exposed sediment conditions. Two 5-gallon containers of composite samples of SMU 1 will be prepared and delivered to the O'Brien & Gere manufacturing facility.

The remaining volume of Onondaga Lake sediment will be held by Parsons in the PDI lakeside refrigeration unit for potential future mitigation testing described above.

2.2.2. Mixing Chamber Testing

A mixing chamber will be used to evaluate odor counteractant sprays. The testing will be conducted by St. Croix Sensory, which has conducted all previous odor analyses for Phases I and II/III PDIs. The testing is designed to assess two objectives:

[1] As of December 6, 2007, these sediment sample locations could not be collected due to early onset of snow and ice.

- Evaluate the relative effectiveness of pure water and different spray products to minimize sediment odors.
- Estimate the volumetric ratio of spray to sediment odor needed to minimize sediment odors.

Two different counteractant spray products have been selected to date, as discussed in Section 2.1.2.1. Pure water and the two products will be tested with odor samples from SMUs 1, 6 and 7. Pure water and each product will be tested at three different ratios of spray volume to odor volume. One ratio will be that recommended by the spray product vendors, while the other two ratios will be one-half and two times the recommended ratio. Only one dilution strength, recommended by the product vendor, of each spray product will be tested.

Sediment odors used in the mixing chamber testing will be generated on-site at St. Croix Sensory's laboratory. Sediment samples will be delivered to St. Croix Sensory as described in Section 2.2.1. St. Croix Sensory will place a portion of the sediment sample in a container and allow the sediment to volatilize into headspace air until the maximum odor concentration is reached. This method of odor production is similar to the method utilized during the NYSDEC approved Phase II/III odor characterization testing. Once the air sample has been brought into equilibrium with the sediment, a known volume of sediment odor will be extracted and injected into the mixing chamber (poly-liner of a 55-gallon drum). An aliquot of the injected odor will be collected and analyzed for odor strength. Immediately thereafter, a known volume of counteractant spray (pure water or one of the two spray products) will be injected into the top of the mixing chamber by use of a vendor-supplied nozzle. Odor samples will then be collected from the chamber over certain time periods following the spray injection (such as 5, 10, 20, 30, 60, and 120 minutes) in order to assess how the resulting odor changes over time.

Odor samples collected from the mixing chamber will be evaluated by a laboratory method that follows ASTM 1593-06 *Standard Guide for Assessing the Efficacy of Air Care Products in Reducing Sensorily Perceived Indoor Malodor Intensity*. The testing determines odor thresholds using olfactometry procedures ("triangular forced-choice") similar to those described in Section 2.2.6, except the presentation of sediment odor will also contain a known amount of counteractant spray (diluted with water following manufacturer's instructions). However, the first dilution presentation to the assessors will consist of just the sediment odor without the addition of pure water or counteractant spray. For each progressive presentation thereafter, the sediment odor presented to the assessors will remain the same while the counteractant spray dose will progressively increase. The dilution level at which the assessors perceive an odor change will determine the ratio of sediment odor to counteractant spray that will minimize the sediment odor.

2.2.3. Wind Tunnel Testing

Wind tunnel testing will be used for:

- Verification and validation of the Phase I results,
- Estimating emission rates from exposed sediment over the long term, and
- Estimating the efficacy of activated carbon and sand cap to control air emissions.

Wind tunnel testing will be conducted using the same wind tunnel chamber used in the Phase I PDI, which will be modified based on evaluation of the Phase I results, and the new testing facility. The wind tunnel will be set up and operated at the O'Brien & Gere manufacturing facility in Fayetteville, New York. Baseline testing has demonstrated a background odor level of the tunnel intake air. This background odor is inherent in indoor air and, generally to a lesser extent, outdoor air. To minimize the levels of these background odors, several mitigative steps will be taken. Sediment preparation and mixing will be conducted outside the test room. Fresh outdoor air will be brought directly to the testing room, and heated to room temperature, to ensure fresh air turnover. Furthermore, the air intake to the tunnel will be filtered through granular activated carbon, to attempt to remove any residual odors and chemical concentrations that may impact the results.

Based on an evaluation of the wind tunnel setup, it was determined that the airflow-to-exposed surface ratio of the previous tunnel setup was too large to achieve the necessary precision to produce results that can clearly illustrate the differences in odor levels between background vs. downstream scenarios and unmitigated vs. mitigated scenarios. To modify this ratio and effectively increase the detection limit of the tunnel, several modifications will be made to the tunnel. To reduce the airflow, tunnel air velocity will be reduced from 6 mph to 1 mph, and tunnel cross-sectional area will be reduced from 12 inches tall by 6 inches wide to 1 inch tall by 4 inches wide. To increase sediment surface area, the sample chamber will be lengthened from 32 inches long to 96 inches long. As a result of these changes, odors and emissions attributable to the sediment/slurry exposure will be magnified, enabling a clearer distinction from the background odor levels. Due to increased sediment requirements in the longer sample chamber, the sample chamber depth has also been modified (reduced) to hold a 7.6-centimeter (3-inch) depth of slurry or sediment with a surface area of 2,477 square centimeter (384 square inches). The chamber will be sealed with an airtight fit. The process flow diagram for the wind tunnel and emission test apparatus is shown in Figure 4.

A sediment or slurry sample will be collected before of each test to determine the baseline concentration of COI and/or percent solids. The percent solids of the slurries will be calculated based on the percent solids of the composite sediment, volume of sediment and volume of water used for the slurry. Upon completion of each test, a sample of the tested sediment (re-mixed) or slurry overlying water will be collected again and analyzed for COI. The COI results will be used for mass balance calculations for sediment tests and change in overlying water COI in slurry tests. All end-of-test samples will be taken within four hours of the completion of the test. The bulk samples will be enclosed with minimal headspace to minimize volatile loss and chemical degradation.

To begin each test, the sample chamber will be filled with approximately 5 gallons of sediment slurry at 10% solids or saturated sediment. Saturated sediment samples will be prepared from sediment samples described in Section 2.2.1, by decanting water from the sediment and placing sediment in the sample chamber such that there is no water layer above the sediment (that is, exposed sediment).

Air will be passed over the sediment sample surface at approximately 1 mile per hour (mph) and at room temperature. The temperature and humidity of the air will be the monitored but not modified from ambient conditions, except for the exposed sediment testing where one or more area room humidifiers will be used to prevent over drying of the sediment surface. Airflow over the middle of the sediment sample chamber will be measured by means of a flow meter at least once during each test.

To straighten and evenly distribute the airflow, the wind tunnel intake will extend for a length of at least eight effective diameters upstream of the sediment sample chamber. Dimensions of the wind tunnel are shown in Figure 4. A thermohygrometer will be connected to the exit port at least once during each test to measure exit air temperature and relative humidity. Due to the short tunnel height to sediment chamber length, physical air mixing is not expected to be necessary to homogenize the airflow.

Samples for COI and odor will be collected from the chamber exit ports, after the air mixer as shown in Figure 4. As discussed in the succeeding subsections, samples of inlet air to the wind tunnel will also be collected to determine background levels of COI and odors. Odor and COI air samples will be collected at least eight effective diameters downstream and two effective diameters upstream of major flow disturbances. Samples will be collected and analyzed as described in Sections 2.2.5 and 2.2.6. In addition, continuous real-time measurements of total hydrocarbons of the wind tunnel emissions will be made as discussed in Section 2.2.7.

2.2.3.1. Ponded SCA Testing

Three tests are proposed to verify and validate results obtained during the Phase I Wind Tunnel Testing. One 10% slurry sample from SMUs 1, 6, and 7 each will be placed in the wind tunnel sample chamber for testing under quiescent conditions. Prior to the testing, a sample of the sediment and overlying water will be analyzed for COI using methods described in Section 2.2.4. The 10% slurry mixture will be mixed immediately prior to testing for a period of one hour to ensure representativeness. Tests will be conducted for 22 hours, and samples will be collected over the same intervals (0-2 hour, 2-6 hour, and 6-22 hour) was conducted in the Phase I testing. Samples will be analyzed for COIs and odor parameters. Although the wind tunnel setup for these tests will be different than the original Phase I tests, these results can still be compared to the Phase I tests. Based on the sample surface area, the tunnel airflow, and the analytical results of a particular air sample, a flux rate (ug/m3-s) can be calculated for each testing scenario in the same fashion as was done in the Phase I testing. Through this calculation, the results of the Phase III can be compared to the Phase I.

2.2.3.2. Long-Term Exposed Sediment Testing

One test is proposed to assess the COI and odor emission rates of exposed sediments over the long term (30 days). One sediment sample from SMU 1 (dredging area with the highest COI and odor content) will be placed in the wind tunnel sample chamber. All ponded water will be decanted such that the sediment will be exposed to the atmosphere in the sample chamber (sediment will be saturated with lake water at the beginning of the test and will eventually dry throughout the 30-day test). A sample of the sediment will also be collected for analysis of COI for use in mass balance calculations.

As discussed in Section 1.4, Phase I PDI activities included exposed sediment testing within the first 22 hours after sediment placement. Samples were taken during three time periods: 0 to 2 hours, 2 to 6 hours and 6 to 22 hours. The wind tunnel was operated at a wind speed of approximately 2.7 mph. In order to simulate this Phase I testing and to provide verification of the Phase I test results, the Phase III testing will begin with samples over the same three time periods. However, in order to maintain wind tunnel detection limits, as discussed previously, the wind tunnel will be operated at 1 mph instead of 2.7 mph. Also, based on input from Dr. Thibodeaux, increased humidity may have an impact on emissions from exposed sediment. To address this potential, humidity of the wind tunnel inflow will be increased by moisturizing the air in the room using room humidifiers.

The sediment sample will remain in the wind tunnel under a constant wind speed for the entire 30-day period. Wind tunnel emission samples of COIs and odor will be collected during the same three time periods as the Phase I testing for the first 22 hours (Day 1). One inlet air sample will be collected over the first 22-hour period for the same COIs and odor. Wind tunnel emission and inlet odor samples (except HCB) will be collected over a 2-hour integrated period every third day (Days 4, 7, 10 etc.). HCB samples will be collected over a 24-hour time period. 2-hour integrated samples have been selected for routine daily sampling instead of 24-hour integrated samples to allow for sufficient odor sample rates, and to reduce sample hold time before analysis. Wind tunnel emission and inlet COI samples (2-hour integrated except 24-hour HCB) will be collected every third day for the first ten days (Days 4, 7, 10) and then every nine days thereafter (Days 19, 28). Prior to the sampling of Day 19, distilled water will be sprinkled evenly over the sand cap to simulate a moderate rainfall event of one-half inch. The purpose of the longer term sampling is to assess emission variations under drying and re-wetting conditions that are expected to occur in the real scenario.

In addition, a real-time total hydrocarbon (THC) analyzer will be used to measure the THC concentrations of the wind tunnel's exhaust during the 30-day test period. Variation in the THC analyzer over multiple hours of operation do not permit measurements at the low concentrations expected in the tunnel. Therefore, THC measurements will be used as a spot check as needed to compare tunnel concentrations to background air concentrations. The analyzer data will also provide real-time information relative to COI and odor emissions, and, may provide data during periods when COI and odor samples are not being taken. It is anticipated that THC air emissions will decrease over the 30-day test period. However, if the analyzer detects a significant increase in emission concentrations, additional 24-hour samples of both COI and odor may be collected in order to understand/confirm the unexpected emission increase. The THC analyzer will be operated as discussed in Section 2.2.7.

2.2.3.3. Activated Carbon Testing

The objective of testing activated carbon is to assess the efficacy of activated carbon broadcast on to a ponded surface to control emissions of COI and odor, as discussed in Section 2.1.2.2. The first set of tests will involve sediment slurry samples from SMU 1 adjusted to 10% solids as described in Section 2.2.1. Prior to the testing, a sample of the sediment and overlying water will be analyzed for COI using methods described in Section 2.2.4.

The PAC dosing rate, as discussed in Section 2.1.2.2, will be determined using the Phase I post-test slurry concentrations of COI. Table 2 provides the slurry COI concentrations and proposed PAC dosing amounts. The PAC dosing rate is based on the dissolved concentrations of contaminants. To calculate the total volume of PAC needed, the water volume of the sample (approximately 3.3 gallons for a 10% solids solution) is used, as noted on Table 2. To begin the testing, approximately 5 gallons of the sediment slurry will be placed in the wind tunnel's sample chamber. Samples of untreated emissions of COI and odor will be collected during the first one hour after placement. Immediately afterward, a dose of Hydrodarco B, a powder activated carbon (PAC) product, will be broadcasted on the ponded surface using a kitchen sieve, and samples of treated emissions of COI and odor will be collected over the subsequent one hour period. According to the distributor of Hydrodarco B, PAC will absorb most effectively within the first 15 to 20 minutes following application. After that period, the absorption rate begins to slow and turns asymptotic at approximately 60 minutes.

Immediately after the first set of samples of treated emissions, a second dose of PAC will be added to the sediment slurry sample, and a second set of one-hour samples for COI and odor will be collected. Immediately thereafter, a third and final does of PCA will be added and a third set of samples for COI and odor will be collected. Concurrent with the four 1-hour samples (1 untreated and 3 treated), one sample of inlet air will be collected to cover the entire testing period. Collection and analysis of COI and odor samples will be conducted as described in Section 2.2.5 and 2.2.6, respectively.

Additional tests are proposed to evaluate PAC's ability to control emissions from SMU 7 (SMU with second highest odor emissions). The dosing rate will be selected after preliminary results of the SMU

1 tests are received. After NYSDEC approves the selected dosing rate, testing for SMU 7 will proceed as described above, that is one 1-hour odor emissions sample of untreated ponded sediment followed by one 1-hour odor emissions sample of treated ponded sediment (no COI samples are proposed).

After the last sample collection (SMU 7), the treated sediment will remain in the wind tunnel to evaluate emissions over a two week period. The purpose of this longer term test is to evaluate if and when chemical transport from sediment to the dissolved phase and from dissolved phase to the atmosphere causes breakthrough of PAC in the ponded sediment condition. Odor samples will be collected over 24-hour periods every other day for two weeks. COI samples will be collected over 24-hour periods every fourth day for two weeks.

2.2.3.4. Sand Cap Testing

As discussed in Section 2.1.2.3, testing is proposed to evaluate the efficacy of sand to serve as a vapor cap. One test is proposed using SMU 1 sediment. A sample of sediment will be prepared for testing as described for the long-term exposed sediment testing (Section 2.2.3.1). A 3-inch layer of sand, saturated with lake water (from the same container as the sediment sample), will be immediately placed over the top of the sediment. The sand will be held in place using a 3-inch deep extension collar that will fit between the slurry sample chamber and the bottom of the wind tunnel. The first sample from the long-term exposed sediment testing discussed in Section 2.1.2.3 will provide an emissions baseline of the uncovered exposed sediment.

Immediately after covering the sediment with sand, 2-hour integrated samples of COI and odor in wind tunnel emissions will be collected. Sampling will continue for 7 days with 2-hour integrated samples of odor collected each day and 2-hour integrated samples of COI collected every other day. Concurrent with each emission sample, a 2-hour integrated sample of inlet air will also be collected. Prior to the sampling of Day 5, distilled water will be sprinkled evenly over the sand cap to simulate a moderate rainfall event of one-half inch. The purpose of the longer term sampling is to assess emission variations under drying and re-wetting conditions that are expected to occur in the real scenario.

2.2.3.5. 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 submitted as part of the Phase I PDI (Parsons, 2005a). To minimize the potential for contaminant migration and/or cross contamination, the wind tunnel testing apparatus will also be decontaminated after each test using a mild unscented detergent and rinsed with de-ionized or distilled water. Prior to starting the wind tunnel testing and after each cleaning of the wind tunnel (between tests), an equipment blank test will be performed. The test will involve inlet and outlet sample collection over a one-hour period for COI and odor.

2.2.4. Sediment Sample Analysis

All bulk sediment samples will be prepared, labeled, handled, and shipped as described in the PDI QAPP (Parsons, 2005). Sample analysis will be done in accordance with the analytical methods described in the QAPP.

2.2.5. COI Sample Collection and Analysis

Air samples for COI analyses, defined in Section 1.4, will involve analysis of whole air samples via gas chromatography. Samples for VOCs (all COIs except for dimethyl disulfide and hexachlorobenzene) will be collected in pre-evacuated 6-liter Summa™ canisters and analyzed following USEPA Method TO-15. A split stream of wind tunnel emissions will be continuously pulled at a constant flow rate through Teflon tubing, a laboratory-supplied flow controller, and into a canister. A new piece of tubing will be used for each test's outlet sample. The flow controller and canister will be batch certified clean by the laboratory in accordance with Method TO-15. The canister vacuum before and after sample collection will be recorded on field forms along with other pertinent information such as sample identification code, start and end times, and serial numbers of the canister and flow controller.

Sampled canisters will be shipped overnight to Test America, Inc. in Knoxville, TN for sample analysis. Test America is certified by the New York State Department of Health for TO-15 analyses. The reporting limits are expected to be approximately 1 micrograms per cubic meter.

Dimethyl disulfide samples will be collected in a Tedlar bag and also potentially in the same Summa™ canisters as the VOCs. If dimethyl disulfide results can be obtained from the canister samples and the initial tests compare well with Tedlar bag sample results, then if approved by NYSDEC, dimethyl disulfide sampling for the remainder of the testing will collected in canisters only. Tedlar bag samples for dimethyl disulfide will be collected in 10-liter Tedlar bags using a lung sampler. A split stream of wind tunnel emissions will be continuously pulled at a constant flow rate through Teflon tubing into a bag. A new piece of tubing will be used for each test's outlet sample. A pump will pull a vacuum on the lung sampler to create a constant and continuous sample flow rate to obtain approximately 7-liters of sample over each sampling period.

Tedlar bag samples will be shipped overnight to Test America for analysis via ASTM D 5505 (gas chromatography with sulfur chemiluminescence detection (GC/SCD). The analysis will be conducted within approximately 24 hours after sample collection. The reporting limits are expected to be approximately 2.5 to 5 parts per billion by volume (ppbv). As mentioned above, canister samples for the VOCs will also be analyzed for dimethyl disulfide, at least in the initial set of samples until the method comparison is complete. Dimethyl disulfide in canisters will also be analyzed via ASTM D 5505.

Samples for hexachlorobenzene (exposed sediment tests only) will be collected on charcoal sorbent tubes. A split stream of wind tunnel emissions will be continuously pulled at a constant flow rate of approximately 1-liter per minute through Teflon tubing and the sorbent tube. A new piece of tubing will be used for each test. The sampling flow rates will be measured at the beginning and end of each sampling period, and monitored during the sampling periods. All samples will be collected over 24-hour periods yielding approximately 1,440 liters of split stream sample being drawn through each charcoal tube. Hexachlorobenzene samples will be shipped overnight to Test America or Braun InterTec for analysis via in-house methods which are expected to utilize gas chromatography (GC) with dual capillary columns and flame ionization detectors (FID). The reporting limits are expected to be approximately 0.7 micrograms per cubic meter for 24-hour samples.

2.2.6. Odor Sample Collection and Analysis

Samples for odor analysis will be collected in 10-liter Tedlar bags using a lung sampler. A split stream of wind tunnel emissions will be pulled through Teflon tubing into a bag. A new piece of tubing will be used for each test (outlet only). A pump will pull a vacuum on the lung sampler to create a constant and continuous sample flow rate to obtain approximately 7-liters of sample over each sampling period.

St. Croix Sensory will receive odor samples collected from the wind tunnel tests discussed in Section 2.2.3. Odor samples will be shipped overnight. 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." This is the methodology used for odor analyses during the previous phases of testing.

2.2.7. THC Measurements

Real-time measurements of total hydrocarbons (THC) will be made during the long-term exposed sediment testing discussed in Section 2.2.3.1. Using Phase I test results for individual compound concentrations and their estimated response factors from a flame ionization detector, THC concentrations at the beginning of the proposed test period are expected to be approximately 100 parts per billion by volume (ppbv). Therefore, high sensitivity instrument is required. The THC analyzer selected is the ppbRAE (Model PGM 7240) manufactured by RAE Systems. The analyzer has the following specifications:

- Range: 1 to 999 ppbv
- Resolution: 1 ppbv
- Response time: <5 sec
- Sample Flow Rate: 400 cc/minute
- Accuracy: 10 ppb (10-eV lamp) or 10% of observed
- Operating Time: 10 hours (rechargeable); 12-14 hours (alkaline); unlimited w/charger (not intrinsically safe when used with charger)
- Survey (spot check) or Data logging (One-hour averages, downloadable to Excel formatted spreadsheet)

Calibration of the ppbRAE will be conducted every test day using the following:

- Single-use zero air tubes (RAE P/N 025-2000-010)
- Certified iso-butane gas standard

2.2.8. Quality Control

Laboratory quality control checks will be in place to ensure the reliability and validity of the analyses performed at each laboratory. Air samples submitted for chemical analysis will include duplicate samples at a rate of at least 5 percent. Field and trip blanks of the canister and bag sample media (canisters and bags) will not be collected or analyzed. Field blanks of charcoal tubes will be collected and analyzed at a rate of 10 percent. The QA/QC program, including other applicable QA/QC sampling, will be in compliance with the specifications of the QAPP (Parsons, 2005). Laboratory equipment will be inspected, maintained, and calibrated in accordance with the QAPP.

3. Test Results Evaluation

3.1. Introduction

This section reiterates the objectives and anticipated data of the proposed testing and discusses how the data may be used in the design of the SCA, its operations, and potential air emission control strategies.

A complete report will be submitted to NYSDEC for review after completion of the testing and receipt of laboratory results. In addition to the test results, the report will include sample collection documentation, sample analysis reports, and data assessment.

3.2. Ponded SCA Testing

Results of the 10% slurry testing are anticipated to be used for three purposes:

- Verification and validation of Phase I Wind Tunnel Results
- Comparison to emission rates estimated by the PSCA emissions model
- Estimation of odor emission rates for use in dispersion modeling to estimate downwind impacts

Data collected from the testing will include:

- COI emission rates (0-2 hour, 2-6 hour, and 6-22 hour samples)
- Odor emission rates (0-2 hour, 2-6 hour, and 6-22 hour samples)
- COI concentrations in tested sediments

3.3. Exposed Sediment Long-Term Emissions Rates

Results of the long-term exposed sediment testing are anticipated to be used for two purposes:

- Comparison of COI emission rates with results of the EDM model
- Estimation of odor emission rates for use in dispersion modeling to estimate downwind impacts

Data collected from the testing will include:

- COI emission rates (24-hour averages and maximum, 7-day rolling average and maximum, and 30-day average)
- Odor emission rates over 30 days (24-hour averages (from daily 2-hour integrated samples and maximum, 7-day rolling average and maximum, and 30-day average)
- Total hydrocarbon concentrations over 30 days (from test day survey samples)
- COI concentrations in tested sediments

Testing will use SMU 1 sediments only. It will be assumed that the comparison evaluation of the testing results with the EDM model results will be equally relevant with EDM model results of the other SMUs. Following completion of the test, and comparison of the data to the EDM estimates, the value of conducting similar tests for SMUs 6 and/or 7 may be evaluated.

Odor emission rates measured from SMU 1 exposed sediments will be used in dispersion modeling. If there is a correlation between the rate of decline of the measured odor emission rates with the rate of decline of COI emission rates estimated from the EDM model, then the rate of decline of COI emission rates estimated from the EDM model for other SMUs may be used to estimate odor emission rates for SMUs 6 and 7.

3.4. COI and Odor Emission Control Efficacy

3.4.1. Odor Counteractant Sprays

The testing will estimate the amount of counteractant needed to neutralize the SCA odors, specifically the volumetric ratio of counteractant to SCA odor. The lowest ratio will indicate the most effective counteractant. The ratio will provide input to the evaluation of a spray network as a potential mitigation approach with respect to:

- Volumetric flow rate of the sprays relative to the SCA emission rates and
- Spacing and heights of the spray nozzles.

The testing proposed in Section 2.1.2 will involve complete mixing of the counteractant and SCA emissions and therefore, the spray network evaluation will need to consider less than complete mixing expected in practice.

3.4.2. Activated Carbon

Testing proposed in Sections 2.1.2.2 and 2.2.3.2 will evaluate the efficacy of powder activated carbon (PAC) to control (reduce) emissions from a ponded sediment surface. Data generated from the testing will include COI and odor emission rates for untreated ponded sediment and for three different dosing rates of one PAC product. The data is anticipated to be used in the selection of emission control strategies and in the design of PAC dosing rates, if PAC is a selected strategy.

3.4.3. Sand Cap

The proposed testing will generate COI and odor emission rate data that will evaluate the efficacy of sand as a vapor barrier above sediments from SMU 1. Test results may also reveal the sand's effectiveness during drying and re-wetting scenarios.

4. References

Parsons, 2005. *Onondaga Lake Pre-Design Investigation: Quality Assurance Project Plan*, Parsons Corporation, September 2005.

Parsons, 2005a. *Onondaga Lake Pre-Design Investigation: Standard Operating Procedures*, Parsons Corporation, November 2005.

Service Engineering Group, 2006. *Wind Tunnel Testing Report*, Service Engineering Group, March 30, 2006.

Table 1
Test Summary
Phase III Addendum 7 Work Plan, Air Emissions and Odors
Onondaga Lake Pre-Design Investigation

Mixing Chamber Testing

Counteractant Sprays	SMU1	SMU6	SMU 7
Water	X	X	X
Eco Sorb 606	X	X	X
Odex	X	X	X

Wind Tunnel Testing

Test #	Carbon Dosing			Wind Speed (mph)	Representative SCA Conditions	SMU	No. of Samples (note 11)			
	1/2x	1x	10x				COI - Bulk	Odor	COI - Air	
Activated Carbon Tests										
1	X			6	PCDF	1	1	2	2	1-hour untreated & treated samples collected sequentially
2		X		6	PCDF	1	0	1	1	1-hour treated sample, continuation of Test #1
3			X	6	PCDF	1	1	1	1	1-hour treated sample, continuation of Test #2
4	TBD			6	PCDF	7	1	2	0	1-hour untreated & treated samples collected sequentially
5	TBD			6	PCDF	7	1	7	3	24-hour treated samples every other day over two weeks, continuation of Test #4.
Sand Cap Test										
6				6	ES	1	1	7	4	24-hour samples each day for 7 days
Long-Term Exposed Sediment Test										
7				6	ES	1	2	10	5	2-hour, 4-hour and 16-hour samples for the first 24 hours; 24-hour samples over the remaining 30 days
							9	30	16	Total No. of Samples

Notes:

1. Mixing Chamber Testing: Sample odors will be generated in the headspace of sediment samples (contained in a 55-gallon drum liner). Pure water and counteractant sprays (diluted in accordance with manufacturer's specifications) will be sprayed into the sample odor. Samples of the odor will be extracted at various time periods and tested via olfactometery. Varying volumes of spray will be tested individually to assess the removal efficiency of the sprays as a function of spray volume.
2. Wind Speed: Selected to represent average wind speed measured with the on-site SCA meteorological station for the period between April 15 to November 15, 2006 (anticipated period of SCA operation each year).
3. Activated Carbon Tests: Hydrodarco B powder activated carbon will be applied at a dosing rate of 10 lbs of carbon per 1 lb of COI (1x) in dissolved phase (see Table 2). Test# 1 will begin with a 1-hour sample of untreated ponded sediment, followed by a 1-hour sample of treated ponded sediment. Test #4 and #5 dosing rates will be determined upon review of Tests #1 through #3 results.
4. Sand Cap Test: 3 inches of sand will be placed on saturated but exposed (no water layer) sediment. Integrated 24-hour samples will be collected daily for odor and every two days for COI. Test #7 test results will be used as the uncapped baseline emissions for this test.
5. Long-Term Exposed Sediment Test: Saturated but exposed (no water layer) sediment will be sampled. 24-hour odor samples will be collected every three days. 24-hour COI samples will be collected every 3 days for the first 9 days and every 9 days thereafter. In addition, real-time continuous total hydrocarbon analyzer will monitor emissions over the entire period. Additional odor and COI samples may be collected during periods when analyzer readings significantly increase.
6. COI (Compounds of Interest): benzene, ethylbenzene, chlorobenzene, dichlorobenzenes, trichlorobenzenes, xylenes, toluene, naphthalene, dimethyl disulfide and trimethylbenzenes. Hexachlorobenzene will also be included in the long-term sediment test.
7. PCDF: ponded CDF, freshly placed sediment and lake water, 10% solids, quiesecent
8. ES: exposed sediment, freshly placed, saturated but without a water layer
9. Odor Samples: Recognition threshold (RT) and detection trheshold (DT)
10. COI - Bulk Samples: Samples of slurry (Test #s 1 through 5) or sediment (Test #s 6 and 7) will be collected at the beginning and end of each set of tests and analyzed for COI and percent solids (slurrly samples only).
11. No. of Samples include just wind tunnel emission samples. There will also be wind tunnel inlet air samples collected at a rate of one per day collected over the sample time period as the emission samples and for the same parameters.

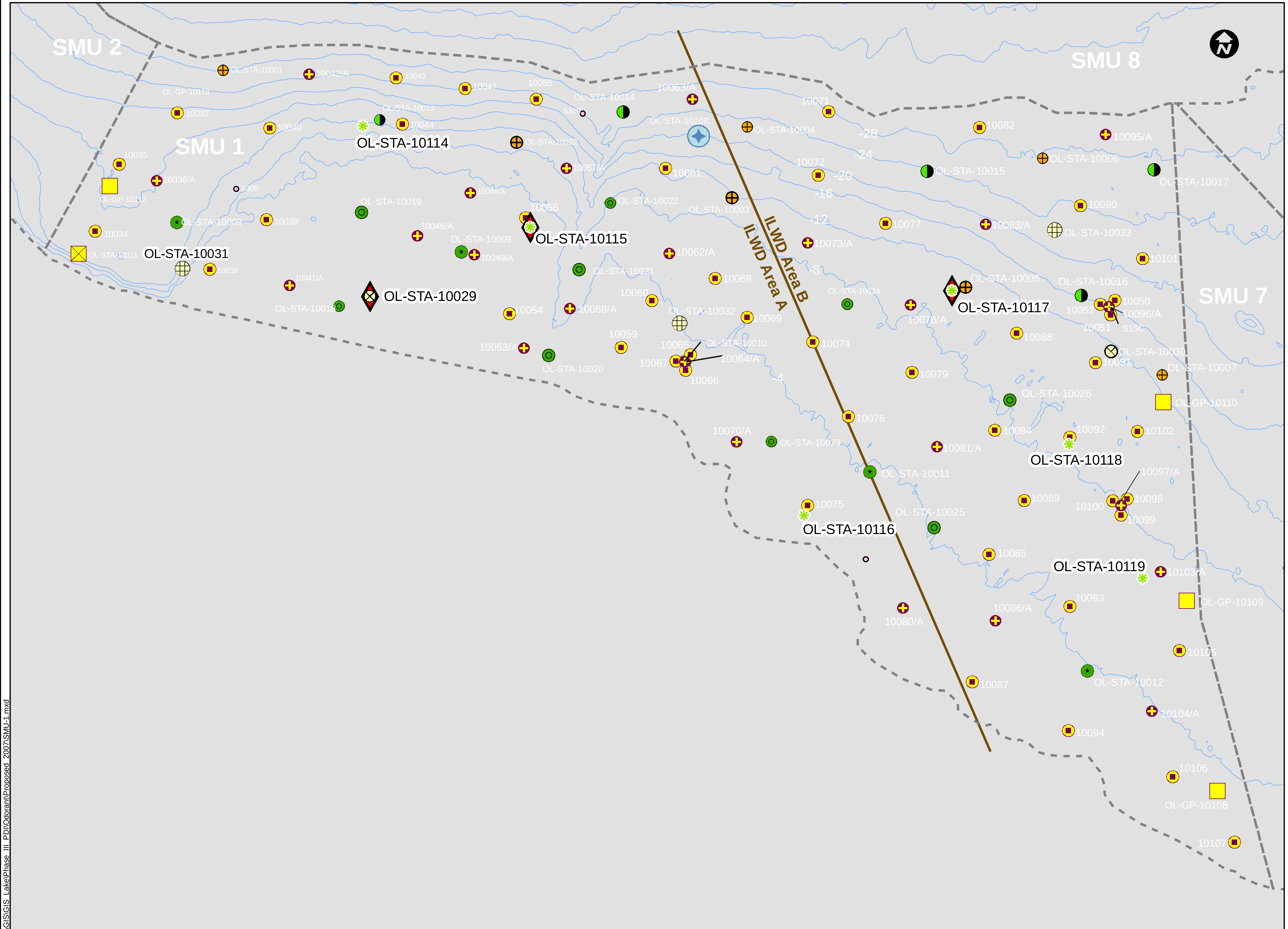
Table 2
Activated Carbon Dosing Calculations
Phase III Addendum 7 Work Plan, Air Emissions and Odors
Onondaga Lake Pre-Design Investigation

Design Goal: Dosing of PAC at a ratio of 10 pounds of PAC to 1 pound of COI in water (1 x dose)

	Phase I PDI Post Test Slurry Concentrations (ug/L)	
	SMU 1	SMU7
Benzene	835	62
Chlorobenzene	1350	390
Ethylbenzene	45	15
1,4 Dichlorobenzene	765	380
Trichlorobenzenes	108	24
Hexachlorobenzene	3	3
Toluene	550	86
Xylenes	940	136
Naphthalene	2450	303
Total COI	**7046**	**1398**

SMU	Volume in Wind Tunnel Sample Chamber (gal)	Amount of PAC Dosing (mg)		
		1 x dose	1/2 x dose	10 x dose
1	3.3	887	443	8,866
7	3.3	176	88	1,760

SMU	Test 1 Dosing (1/2x)	Test 2 Dosing (1x)	Test 3 Dosing (10x)
1	443	443	7,979
7	88	88	1,584



Proposed Phase III PDI Locations

- Odor Bench Test Sample Location

Phase II PDI Sample Locations

- Water Treatment, CST, EET and Odor Bench Test Sample Location
- 20 Ft (6 m) Core (Sample on 3.3 Ft intervals to 20 Ft)
- 20 Ft (6 m) Colocated Core (Sample on 3.3 Ft intervals to 20 Ft)
- Conductivity / Temperature Probe
- Conductivity / Temperature Probe + 10 Ft Core (Sample on 1 Ft intervals)
- Deep Boring to Till / Top of Bedrock

Phase I PDI Sample Locations

- 13 Ft (4 m) Core
- 20 Ft (6 m) Core
- 72 Ft (22 m) Boring, CPT and 13 Ft (4 m) Core
- 72 Ft (22 m) Boring, CPT and 20 Ft (6 m) Core
- Bulk Sediment and Water Sample for Emissions and Supernatant Water Treatment Evaluations (two locations, one composite)
- Bulk Sediment Sample for Column Settling and Effluent Elutriate Testing

RI/FS Locations

- 0 - 6.6 Ft (0 - 2 m)
- 20 - 26 Ft (6 - 8 m)

NOTES

1. Bathymetry contours are in 4 foot intervals.
2. Water depth based on average lake elevation of 362.82 feet.
3. Colocated cores will be less than 1 meter apart.
4. Clustered cores will be 25 feet from center core.

0 55 110 220 330 440 550
Feet

FIGURE 1

Honeywell
Onondaga Lake
Syracuse, New York

SMU 1
Phase III PDI Bench Test
Sample Locations

PARSONS

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

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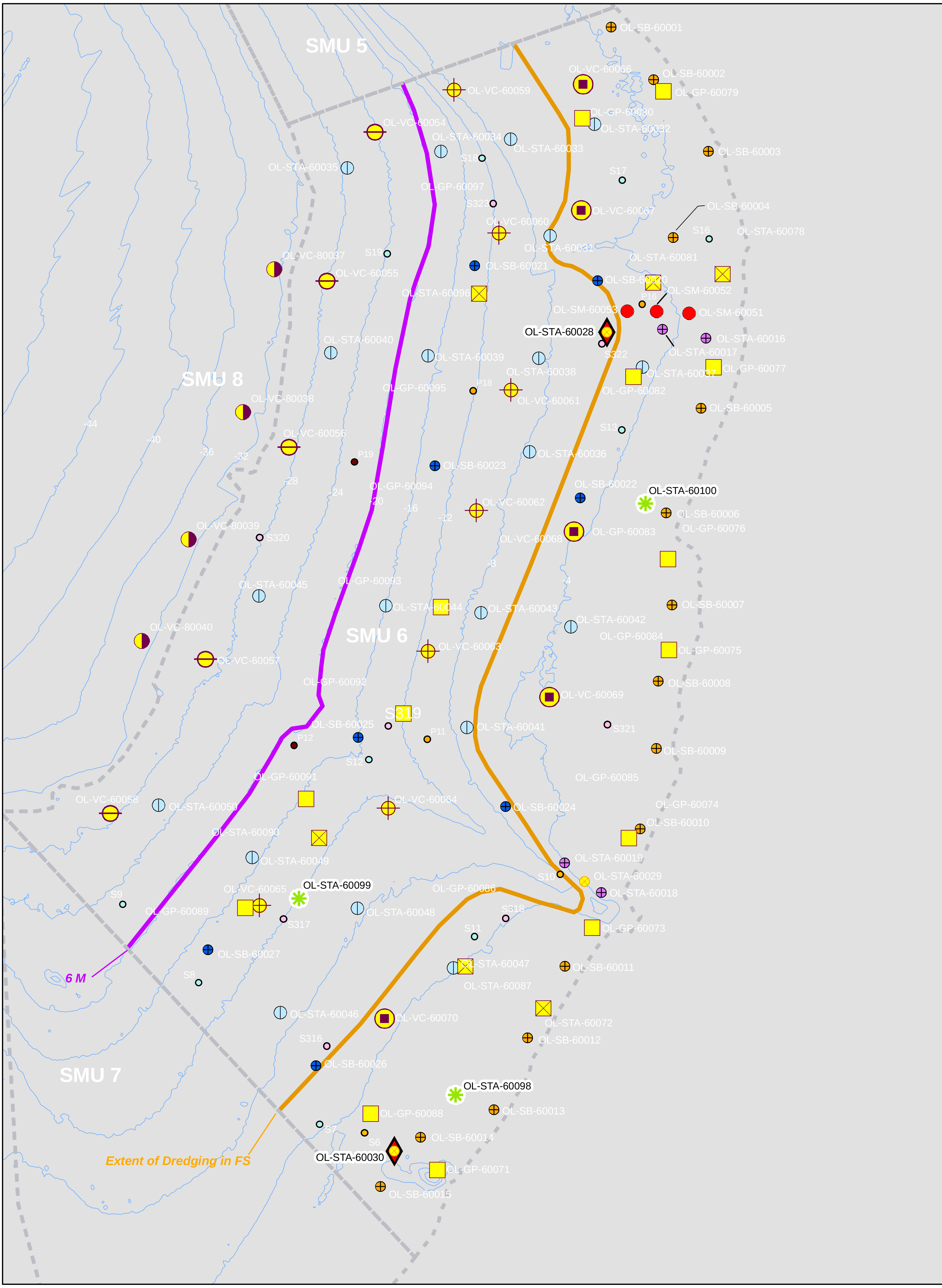

RI/FS Locations

- 0.07 - 0.16 Ft (0 - 5 cm)
- 0.17 - 0.50 Ft (5 - 15 cm)
- 0.5 - 1.0 Ft (15 - 30 cm)
- 1.0 - 3.3 Ft (30 - 100 cm)
- 3.3 - 7.0 Ft (1 - 2 m)
- 7 - 13 Ft (2 - 4 m)
- 13 - 17 Ft (4 - 5 m)
- 17 - 26 Ft (5 - 8 m)

Phase I PDI Sample Locations

- 13 Ft (4 m) Core
- 33 Ft (10 m) Boring, 13 Ft (4 m) Core, and Porewater Samples (Groundwater Model)
- Vane Shear/Atterberg Limits
- Bulk Sediment and Water Sample for Emissions, Column Settling and Effluent Ellutriate Testing (3 Locations, 1 Composite)
- Porewater Sample (Cap Model)
- Seepage Meter

Phase II PDI Sample Locations

- 20 Ft (6 m) Core (Sample 0-0.5 Ft and 0.5-3.3 Ft)
- 20 Ft (6 m) Core (Sample on 3.3 Ft intervals to 10 Ft)
- 20 Ft (6 m) Core (Sample on 3.3 Ft intervals to 20 Ft)
- 3.3 Ft (1 m) Core (Sample 0-0.5 Ft and 0.5-3.3 Ft)
- Conductivity / Temperature Probe
- Conductivity / Temperature Probe + 10 Ft Core (Sample on 1 Ft intervals)
- Water Treatment, CST, EET, and Odor Bench Test Sample Location

Proposed Phase III PDI Locations

- Odor Bench Test Sample Location

NOTES

1. Bathymetry contours are in 4 foot intervals.
2. Water depth based on average lake elevation of 362.82 feet.

0 70 140 280 420 560
Feet

FIGURE 2

Honeywell

Onondaga Lake
Syracuse, New York

SMU 6
Phase III PDI Bench Testing
Sample Locations

PARSONS

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

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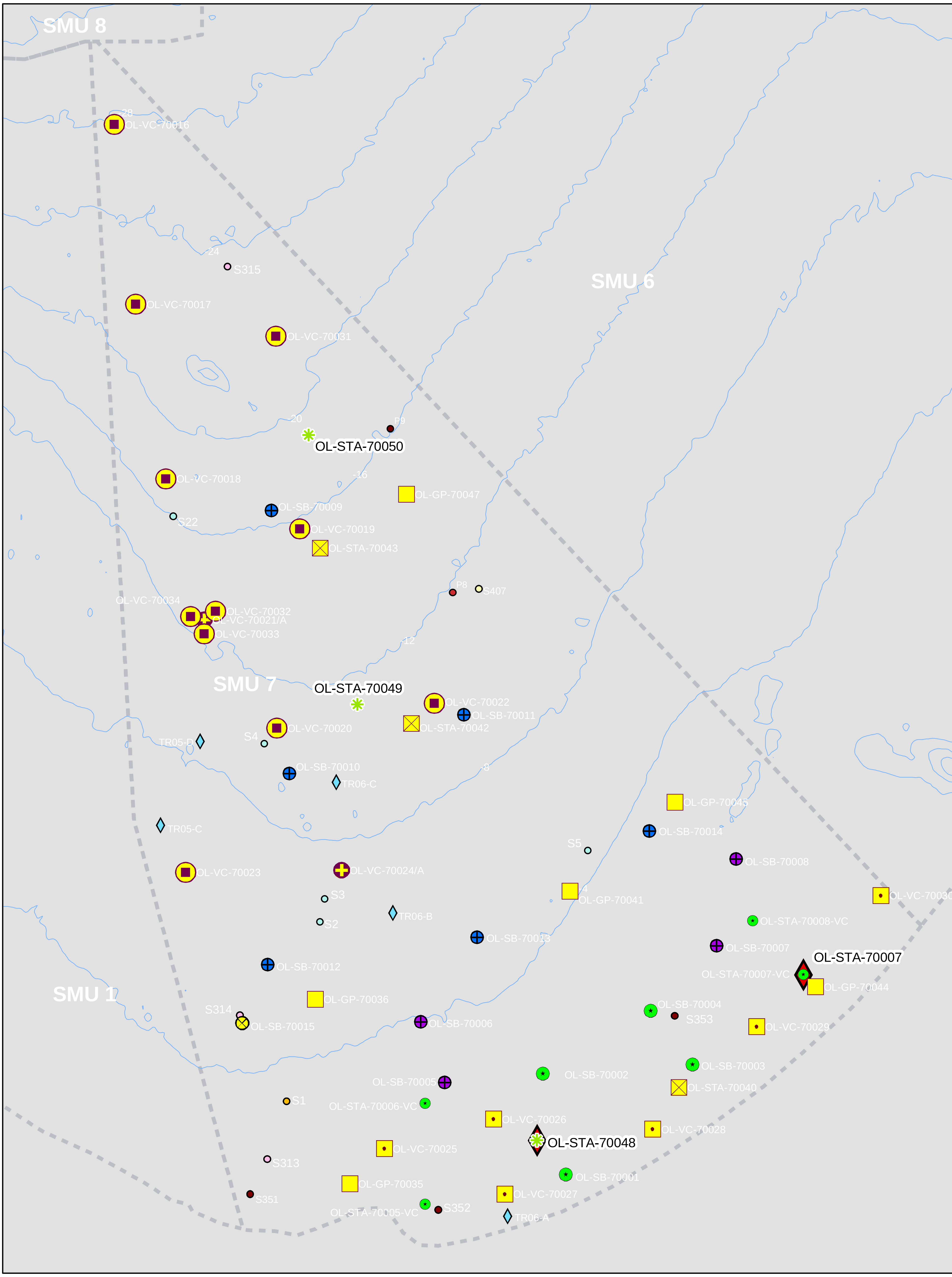

RI/FS Locations

- 0.07 - 0.16 Ft (0 - 5 cm)
- 0.17 - 0.50 Ft (5 - 15 cm)
- 0.5 - 1.0 Ft (15 - 30 cm)
- 1.0 - 3.3 Ft (30 - 100 cm)
- 3.3 - 7.0 Ft (1 - 2 m)
- 7 - 13 Ft (2 - 4 m)
- 13 - 17 Ft (4- 5 m)
- 17 - 26 Ft (5 - 8 m)
- Upwelling Sample Station

Phase I PDI Sample Locations

- 20 Ft (6 m) Core
- 33 Ft (10 m) Boring, 20 Ft (6 m) Core, and Porewater Samples (Groundwater Model)
- Vane Shear/Atterberg Limits
- Bulk Sediment Sample for Emissions Testing and Odor

Phase II PDI Sample Locations

- 20 Ft (6 m) Core (Sample on 3.3 Ft intervals to 13 Ft)
- 20 Ft (6 m) Core (Sample on 3.3 Ft intervals to 20 Ft)
- 20 Ft (6 m) Co-located Core (Sample on 3.3 Ft intervals to 20 Ft)
- Conductivity / Temperature Probe
- Conductivity / Temperature Probe + 10 Ft Core (Sample on 1 Ft intervals)
- Water Treatment, CST, EET, and Odor Bench Test Sample Location

Proposed Phase III PDI Locations

- Odor Bench Test Sample Location

NOTES

1. Bathymetry contours are in 4 foot intervals.
2. Water depth based on average lake elevation of 362.82 feet.

0 35 70 140 210 280 350

Feet

FIGURE 3

Honeywell

Onondaga Lake
Syracuse, New York

SMU 7
Phase III PDI Bench Testing
Sample Locations

PARSONS

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

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Process Flow Diagram

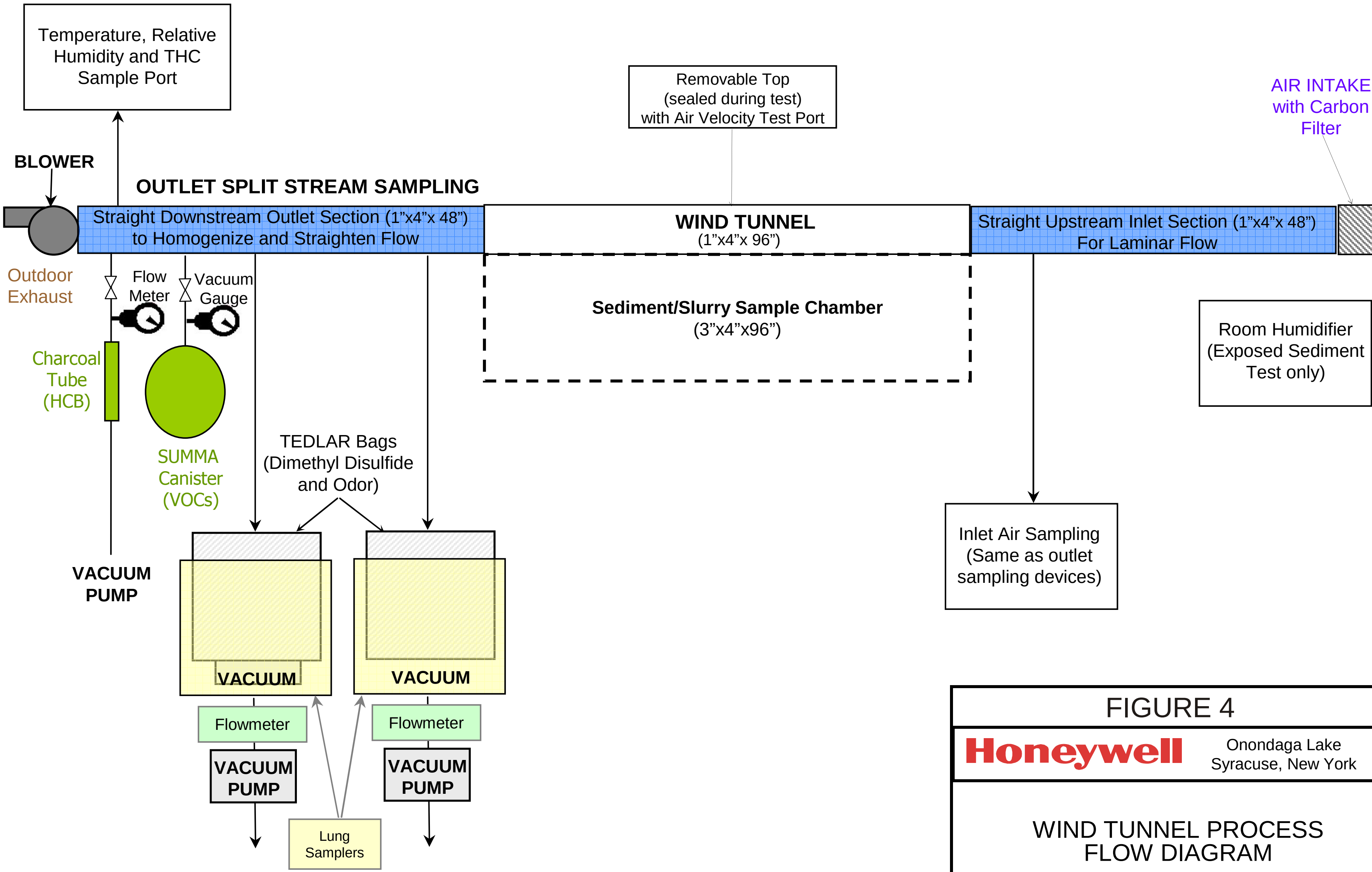

FIGURE 4

Honeywell

Onondaga Lake
Syracuse, New York

WIND TUNNEL PROCESS FLOW DIAGRAM

PARSONS

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