WORK PLAN FOR BASELINE MONITORING OF SEDIMENT RESUSPENSION ALONG THE WASTEBEDS 1-8 SHORELINE OF ONONDAGA LAKE

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EXECUTIVE SUMMARY

The ROD for Onondaga Lake identified an estimated 1.5 miles (2.4 km) of lake shoreline adjacent to Wastebeds 1-8 (WB 1-8) where habitat enhancement activities would be applied to stabilize calcite deposits and reduce nearshore sediment resuspension and related turbidity. This enhancement was included in the Lake Final Design (Parsons and Anchor QEA, 2012) and integrated with the remedy for WB 1-8. This work plan presents the scope of remedial goal monitoring along the WB 1-8 shoreline, which is designed to characterize pre-enhancement sediment resuspension events so that post-enhancement reductions in nearshore turbidity can be distinguished.

The development of this work plan included a reconnaissance effort that provided information used to select final *in situ* monitoring stations. This will be followed by an intensive field effort that will characterize the temporal and spatial features of resuspension events. Following completion of the field effort, data analysis, interpretation and reporting will be completed to correlate the characteristics of documented events with variations in wind speed and direction and make recommendations for future monitoring.

SECTION 1

INTRODUCTION

This work plan describes the objectives, sample areas, data collection methods, and analyses to be performed as part of remedial goal monitoring of turbidity along the Wastebeds 1-8 (WB 1-8) shoreline prior to enhancement efforts. Descriptions of the field and analytical methods and quality assurance program supporting the field work are provided.

The remedy for Onondaga Lake is being completed in accordance with a Consent Decree (United States District Court, Northern District of New York, 2007; 89-CV-815) between Honeywell and the New York State Department of Environmental Conservation (NYSDEC). The Record of Decision (ROD) for the Onondaga Lake subsite (NYSDEC and EPA, 2005) identified areas where habitat enhancement activities would be applied. One of these areas is along approximately 1.5 miles (2.4 km) of the Sediment Management Unit (SMU) 3 shoreline (which for the purposes of the remedial design was extended to include a portion of the SMU 4 shoreline). One of the primary goals of habitat enhancement in SMU 3 and 4 is to reduce wind driven resuspension of shallow water material from the WB 1-8 shoreline (which can result in localized areas of observable increased turbidity) by stabilizing these easily disturbed sediments. This will be achieved by placing a layer of gravel over the existing substrate. The shoreline stabilization is specific to the shallow water portion of SMU 3 and SMU 4, extending up to the existing elevation of approximately 365 ft. (NAVD88), which is close to the highest high water mark for Onondaga Lake (i.e., 95 percent of all recorded water surface elevations are at or below 365 ft. [NAVD88]).

Visual and photographic evidence suggests that, under certain wind conditions, near shore material is resuspended by wave action along WB 1-8 causing turbid plumes to form along the shoreline (Figure 1). However, there are little data to characterize the frequency, extent, and variability of such turbidity events. One of the anticipated benefits of shoreline stabilization in this area is a reduction in the frequency and magnitude of these turbidity events. Because the turbidity signature is likely coupled to variations in wind speed and direction, it is both spatially heterogeneous and temporally irregular. Monitoring will be completed, both before and after remediation, to demonstrate reductions in turbidity associated with the shoreline stabilization and enhancement effort. A statistically based approach will be used to assess and interpret data to verify that reductions in turbidity from baseline levels have been achieved following completion of the shoreline stabilization, this approach will be presented in the Onondaga Lake Monitoring and Maintenance Scoping Document.

This work plan has been developed by Parsons, Upstate Freshwater Institute, and Anchor QEA on behalf of Honeywell to develop a sampling strategy that will document the characteristics of pre-remediation nearshore turbidity events associated with wind driven sediment resuspension along the WB 1-8 shoreline so that post remediation reductions in turbidity associated with these events can be demonstrated.

1.1 OBJECTIVES

The objectives of monitoring the WB 1-8 shoreline are to:

- Provide sufficient data to support a post-remediation evaluation of the effectiveness of shoreline stabilization at decreasing wind driven near-shore turbidity.
- Characterize the temporal and spatial extent of wind driven turbidity events along the WB 1-8 shoreline.
- Assess the ability to differentiate turbidity caused by wind driven calcite resuspension from other sources of turbidity such as inflows from Nine Mile Creek.
- Categorize turbidity events based on wind velocity and direction so that comparisons can be made to post-stabilization turbidity during similar events.

SECTION 2

WORK SCOPE FOR 2012

2.1 DATA COLLECTION

The irregular temporal character of turbidity events associated with sediment resuspension presents challenges for traditional fixed-frequency monitoring programs and necessitates the use of automated sampling equipment. Accordingly, collection of continuous, high frequency (15 min.) measurements will be completed through deployment of three data sondes equipped with turbidity sensors. Sondes will be placed at three spatially diverse stations that likely experience turbidity impacts associated with resuspension of near shore material and that are not within the boundaries of dredging and/or capping areas (e.g., not within Remediation Areas A, B, or C). Each sonde will be located in approximately 2.5 feet of water with the probe approximately 1.2 feet above the sediment. Sonde locations were identified during a reconnaissance effort from a combination of available aerial photography (e.g., Figure 1), a boat-based visual survey conducted on August 28, 2012, and review of data from sondes deployed at candidate stations from August 31 through September 7, 2012. The three monitoring stations were selected based on the following factors: waves generated by winds originating from approximately the northwest to southeast direction will impact at least one of the sites; each station is located in an area accessible by boat where stabilization would occur; and observation of visible turbidity plumes made during the field reconnaissance. Figure 2 depicts the location of the three selected monitoring stations. Figure 3, 4, and 5 show sonde data results from the reconnaissance effort used to determine final site locations.

Because deployment locations will be in shallow water (e.g., less than 3 ft.), the sondes will likely be affixed to stakes rather than buoys. Sondes will be replaced at a minimum of every two weeks to allow for downloading of data, calibration, and maintenance. The maintenance frequency may be increased to weekly if the bi-weekly schedule results in fouling of the probes and issues with data quality. This will be assessed through inspection of the turbidity data and collection of water samples that will be analyzed for turbidity in the laboratory. To ensure that the sonde deployments will be of sufficient duration to capture a wide range of driving conditions; sondes will be deployed continuously from September to November 2012. Data from the robotic monitoring buoy at the South Deep station and turbidity sondes currently being used to monitor remediation will serve as controls for lake wide variations in turbidity caused by algae blooms, clear water phases, and major runoff events. In addition, the long-term monitoring stations in Onondaga Creek, and the monitoring upstream of the Ninemile Creek remediation may also provide useful information on tributary associated turbidity.

The spatial features of turbidity impacts along the WB 1-8 shore will also be characterized by conducting event-based monitoring that will target periods of high near-shore turbulence and conspicuous visual impacts during three sampling events. Field crews already on the lake on most week days will routinely inspect the WB 1-8 shoreline for evidence of visual turbidity impacts. If significant turbidity is observed emanating from the shoreline, monitoring will be conducted to characterize its spatial extent. Monitoring will consist of *in situ* turbidity measurements, Secchi disc measurements, logging of GPS coordinates, and digital photographs of impacted areas.

The Ninemile Creek inflow is in close proximity to the northern end of WB 1-8 (Figure 1), and turbidity from this source could mask turbidity reductions associated with shoreline stabilization. Fortunately, the Ninemile Creek inflow has signatures that distinguish it from the ambient lake water. First, the specific conductance of Ninemile Creek is higher than the lake during dry weather and lower during runoff events. High turbidity and low specific conductance measured during a runoff event would indicate Ninemile Creek as the source rather than resuspension of material from along the WB 1-8 shoreline. Specific conductance measurements will be made continuously from the same data sondes used to measure turbidity. Second, the turbidity associated with Ninemile Creek is caused mostly by clay particles, while calcium-rich particles dominate in the waste beds. These differences in particle type are readily differentiated through individual particle analysis by scanning electron microscopy interfaced with automated image and X-ray analyses (IPA/SAX), which has been successfully applied to Onondaga Lake (Effler and Peng, 2012). The field team will attempt to collect of a minimum of five IPA/SAX during periods of visible nearshore resuspension to confirm sources of elevated turbidity. The timing and locations of this sampling will be determined based on field conditions. Because high turbidity intervals are the focus of this monitoring effort, samples for IPA/SAX will only be collected during periods when turbidity is high.

2.2 DATA ANALYSIS

Data from periods of elevated turbidity that result from resuspension of near-shore wastebed sediments will be compared to meteorological data collected by a robotic monitoring buoy at South Deep as well as other remote meteorological stations located near the lake, and to data obtained from the National Weather Service Station located at the nearby Syracuse Hancock International Airport. These comparisons will be used to categorize turbidity events based on wind velocity and direction so that data from post-stabilization turbidity events can be directly compared to wind events of similar magnitude and direction to help ascertain the relative improvement associated with stabilization efforts (i.e., reductions in frequency, magnitude, duration, and/or spatial extent of turbidity impacts). A statistically based approach will be used to assess and interpret data to verify that reductions in turbidity from baseline levels have been achieved following completion of the shoreline stabilization. In addition, the data set will be examined and recommendations made regarding the need for possible additional data collection during the spring of 2013.

2.3 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Quality Assurance/Quality Control (QA/QC) procedures are presented in the Quality Assurance Project Plan (QAPP) (Parsons, Anchor QEA, and Exponent, 2012). Standard operating procedures (SOP) for data collection and sonde maintenance are included in Appendix A.

2.4 HEALTH AND SAFETY

Subcontractor Safety Plans (SSP) and the Project Safety, Health, And Environmental Plan (PSHEP) for the Nitrate Addition Project will be used as appropriate for this investigation and will be strictly followed by all field personnel. Any task outside of the previous field efforts will have a new Job Safety Analysis (JSA) completed before the task begins. Minor modifications to the SSPs have been made to account for the activities identified in this work plan. Copies of the Subcontractor Safety Plans will be maintained at the support zone and on each vessel.

SECTION 3

DATA MANAGEMENT AND REPORTING

Field data will be downloaded or entered into a database that includes turbidity, and specific conductance measurements. Data will be managed by UFI throughout the monitoring period and final data sets will be stored by Parsons. Data summaries, assessments, and recommendations will be discussed with NYSDEC and summarized in report form following sampling completion.

SECTION 4

REFERENCES

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FIGURES

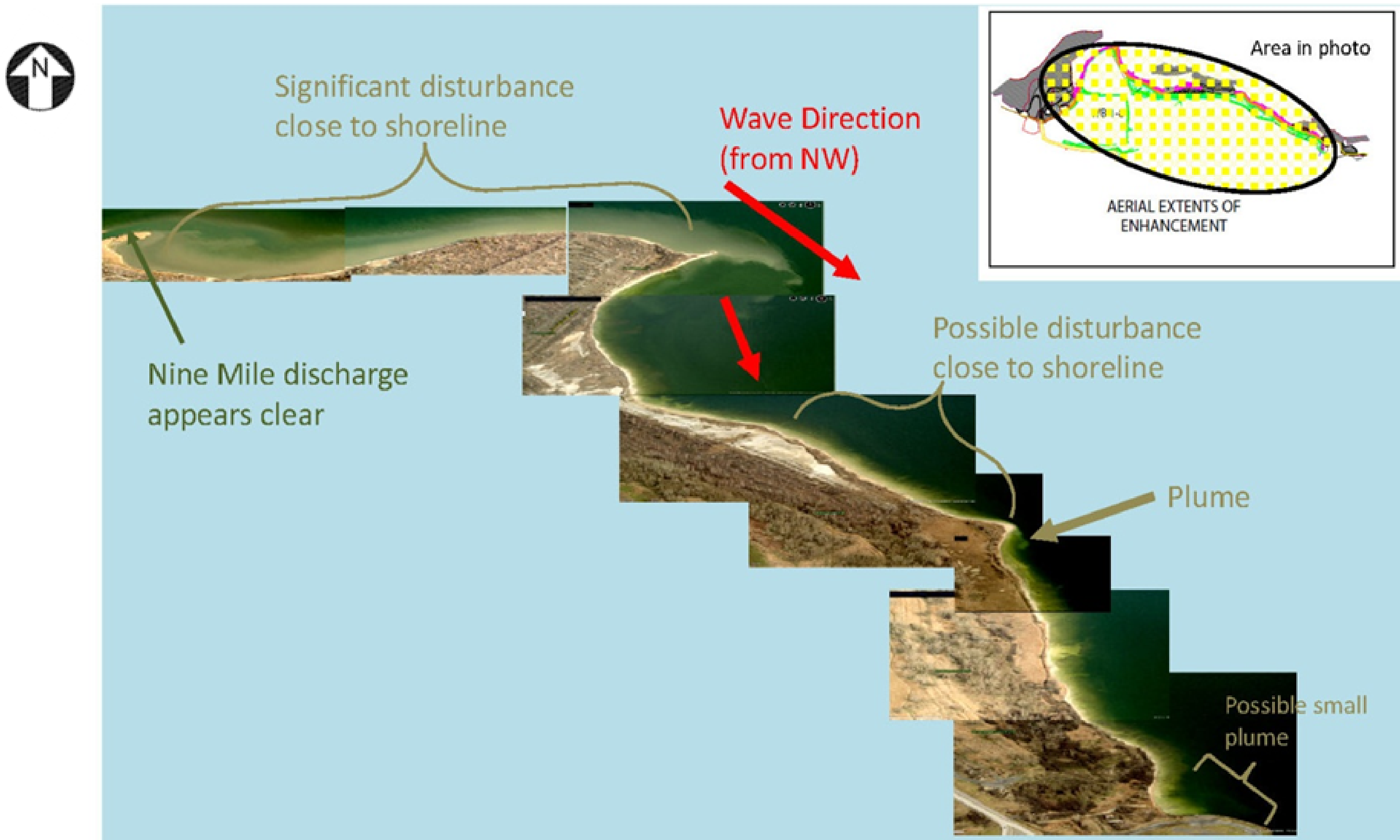

Figure 1

Honeywell — Onondaga Lake Syracuse, New York

Arial view of WB 1-8 showing areas of wind driven near-shore turbidity

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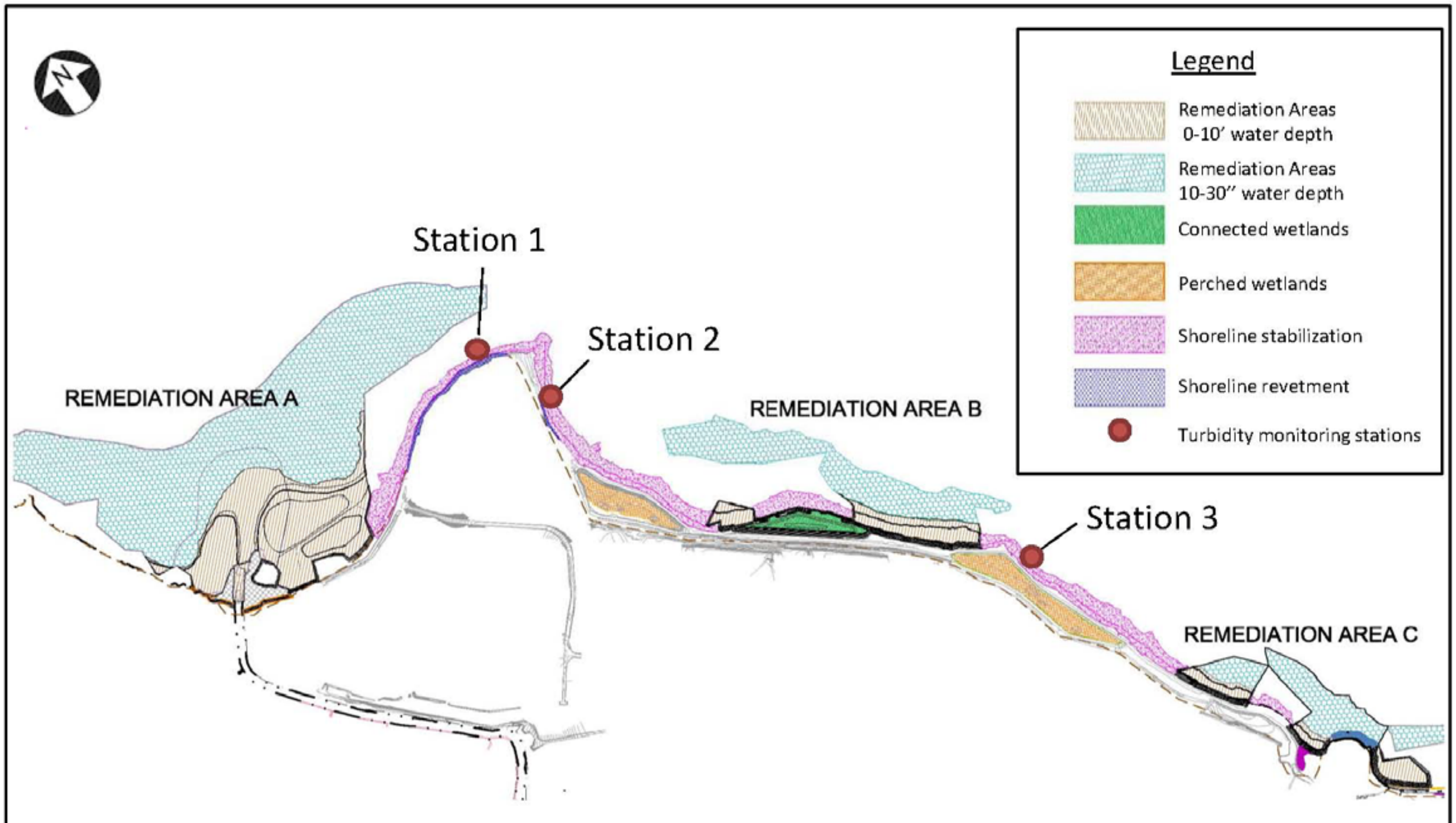

Figure 2

Honeywell — Onondaga Lake, Syracuse, New York

Locations of monitoring sondes along the Wastebeds 1-8 shoreline.

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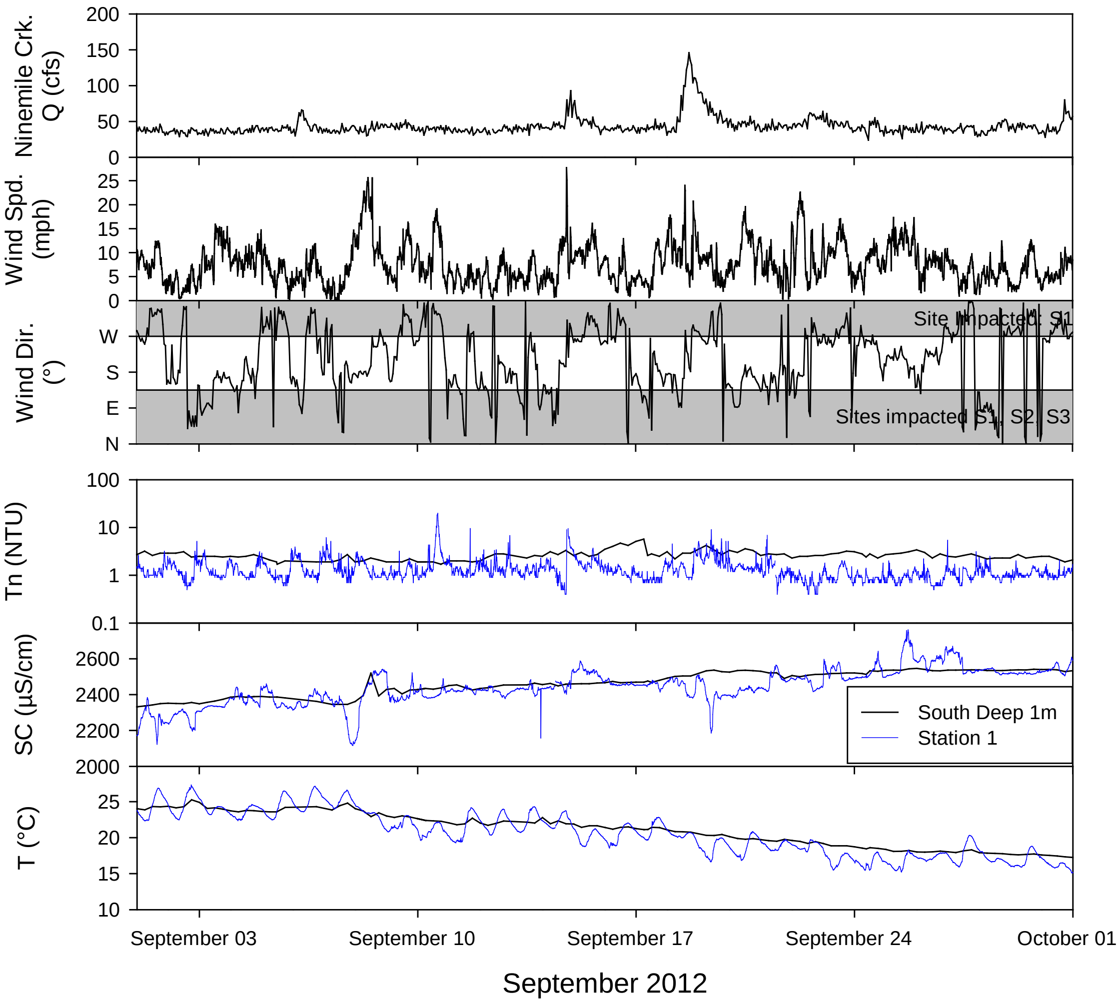

Figure 3. Station 1 preliminary time series data collected during reconnaissance period (August 31- October 1) with drivers and South Deep 1m reference. Note: these data have received minimal QC review and are thus subject to change.

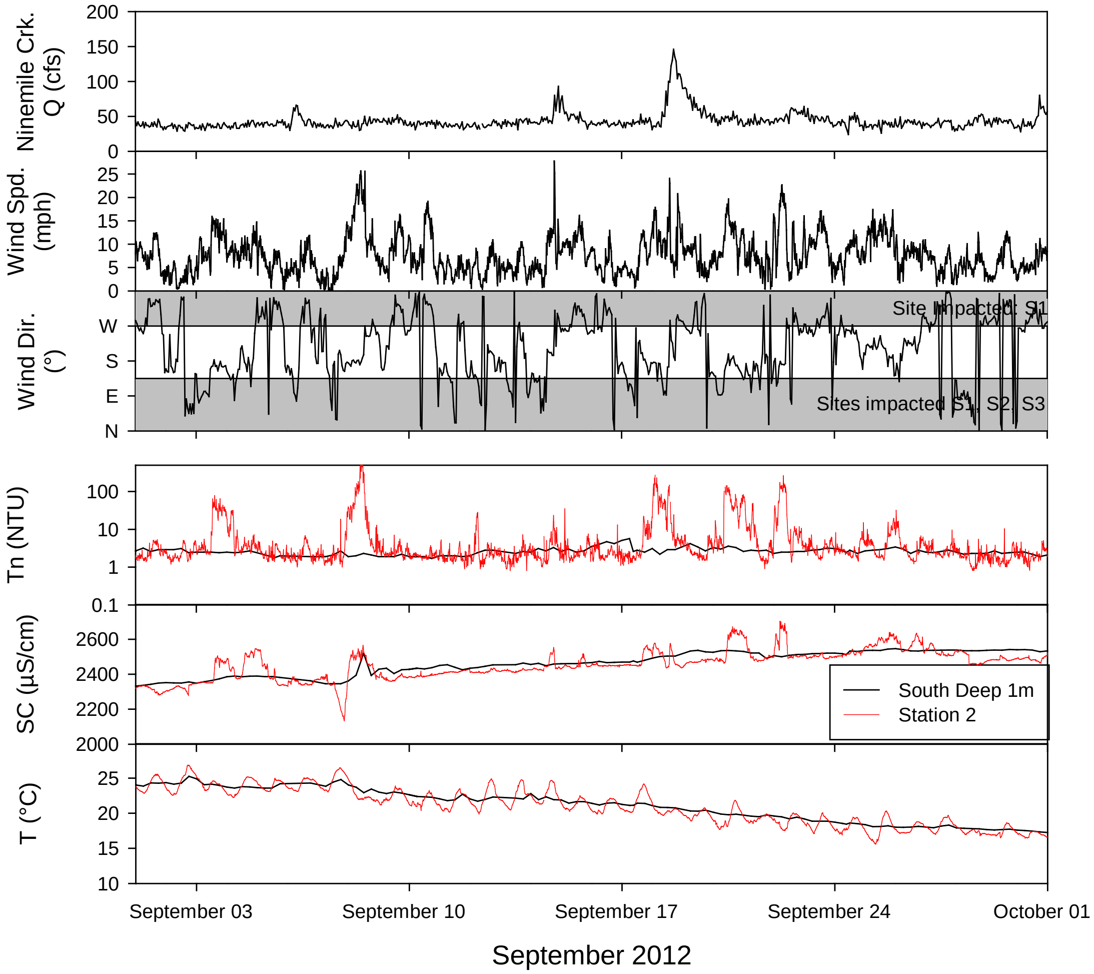

Figure 4. Station 2 preliminary time series data collected during reconnaissance period (August 31- October 1) with drivers and South Deep 1m reference. Note: these data have received minimal QC review and are thus subject to change.

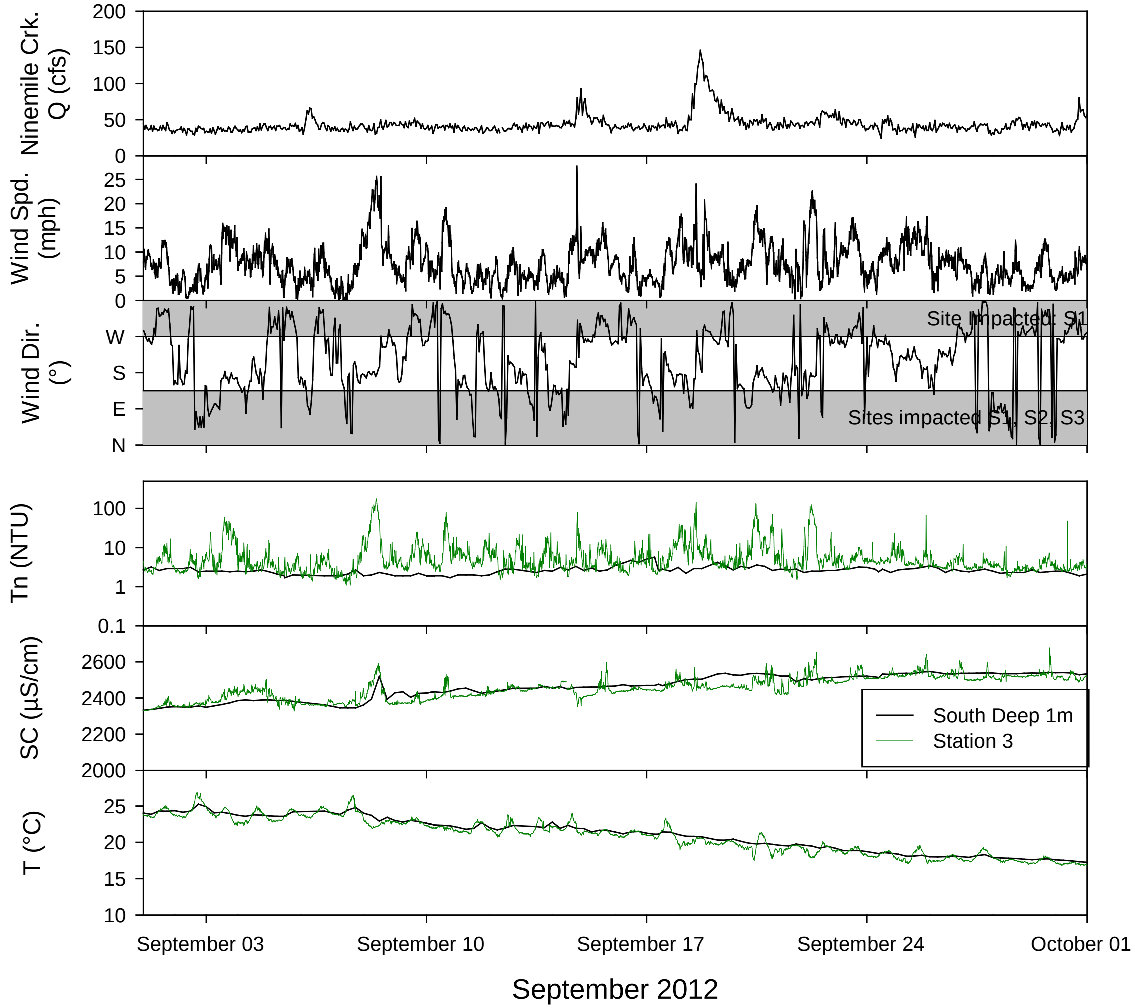

Figure 5. Station 3 preliminary time series data collected during reconnaissance period (August 31- October 1) with drivers and South Deep 1m reference. Note: these data have received minimal QC review and are thus subject to change.

APPENDIX A

STANDARD OPERATING PROCEDURES (SOP)

- **YSI SONDE CALIBRATION AND MAINTENANCE**
- ***IN SITU* DEPLOYMENT OF YSI SONDES**
- **YSI SONDE PROFILING**

SOP No. 315: YSI Sonde Calibration and Maintenance

1. Test method: YSI Sonde Calibration and Maintenance
2. Applicable matrix or matrices: Water.
3. Detection limit: see Table 1 below.

Table 1. Detection limits for YSI Parameters

Parameter	Manufacturer	Range of Detection	Accuracy	Resolution
Temperature, T (°C)	YSI	-5 to 45 °C	±0.15°C	0.01°C
Specific Conductance, SC (µS/cm)	YSI	0 to 100 mS/cm	±0.5% reading/0.001 mS/cm	0.001 mS/cm to 0.1 mS/cm range dependent
pH, (units)	YSI	0 to 14 units		
Dissolved Oxygen, DO (mg/L) – 6562 Standard	YSI	0 to 50 mg/L		
Dissolved Oxygen, DO (mg/L) – 6150 Optical	YSI	0 to 50 mg/L	0-20 mg/L ± 1% of reading, 20-50mg/L ±15% of reading	0.01 mg/L
Percent Saturation, DO % Sat (%)	YSI	0 to 500 % air sat		
Turbidity, Tn (NTU)	YSI	0 to 1000 NTU	± 2% of reading or 0.3NTU whichever is worse	0.1 NTU
Chlorophyll Fluorescence, CHL (µg/L)	YSI	0 to 400 µg/L	none provided	0.1 µg/L
Oxidation Reduction Potential, ORP (mV)*	YSI	-999 to 999 mV		
Depth (pressure), z (m)	YSI	0 to 200 m	0.12m	0.0003m

*ORP not currently calibrated on YSI sondes

4. Scope and application: Drinking, surface and saline waters.
5. Summary of test method:
   YSI sondes need to be fully calibrated before field installation on robotic monitoring platforms, incorporation into an stream automated sampling unit, use with a datalogger and/or standalone deployment. The following parameters need to be calibrated before each deployment: specific conductance, pH, dissolved oxygen, turbidity, chlorophyll, and ORP. Calibration is system dependent (i.e., not all parameters are sampled on all systems). Calibration involves adjusting the values of parameters to that of known standards. Calibration needs to be performed only on clean multiprobes and all calibration information needs to be recorded in the log book.
6. Definitions:
   Specific Conductance – the ability of a solution to conduct an electrical current normalized to 25 °C
   Fluorescence – the emission of light radiation by algae and organic matter stimulated by the absorption of incident light
   Turbidity – a measure of light scattering by particles at an angle of 90°
   Oxidation Reduction Potential – the tendency of a chemical species to acquire electrons and be reduced.

7. Interferences: see YSI User's Manual for probe specific information.
8. Safety:
   Wear protective glasses and latex gloves. Wear covered shoes, and if possible wear long sleeved shirts, and long pants. For specific information on each chemical used in the maintenance or calibration of a sonde, see the Material Safety Data Sheets located in the sonde room.
9. Equipment and supplies:
   YSI multiprobe sonde, communication cable, computer, ring stand, DI water, paper towels, Kim wipes, pH buffers (7 and 10), specific conductivity standard, turbidity reference solutions (low range and high range NTU), rhodamine dye, Zobell solution, appropriate clothing, eye protection, and latex gloves.
10. Reagents and standards:
    1.409 mS/cm specific conductivity standard, 7.00 and 10.00 pH buffer standards, YSI 6072 low range NTU and YSI 6073G high range NTU turbidity standards, Rhodamine dye solution, and Zobell solution.
11. Reference Solution: None.
12. Sample collection, preservation, shipment and storage: NA.
13. Quality Control:
    An annual review will be performed to ensure proper functioning of the temperature probes. The review will include temperature verification with an ASTM thermometer. The sondes all come equipped with internal QC measures (i.e., it will not accept a calibration that deviates from a certain range for each parameter). It is vital that UFI keep accurate records of sonde readings of standards before and after deployment as well as detailed records of sonde deployment locations.
14. Calibration and standardization: This is the topic of this SOP.
15. Procedure:
    I. Maintenance
       i. rinse probes thoroughly several time with tap water
       ii. remove calibration cup
       iii. invert sonde and place securely in ring stand
       iv. gently begin the process of removing dirt and debris from the sonde housing and probes.
       v. use optic wipes or Kim wipes to clean optical windows on the turbidity and chlorophyll probes
       vi. be careful while cleaning the ORP/pH reference bulb. It is fragile.
       vii. intermittently, remove sonde from stand and flush with tap water
       viii. continue this process until the probes and sonde housing are clean
       ix. wipe pH and ORP probes with DI water
       x. rinse with tap water
       xi. fill calibration cup with tap water and secure on sonde.
       xii. store until needed
       xiii. flush pressure sensor
          1. DO Probe Maintenance
             a. Standard 6562 Probe
                i. remove black O-ring
                ii. remove and throw away old membrane
                iii. very gently rub the probe's metal surface with very fine sandpaper if metal looks tarnished
                iv. rinse inside of probe with DI
                v. flush inside of probe with YSI DO electrolyte 3 times
                vi. Place sonde on ring stand

- vii. fill DO probe basin with DO electrolyte so that a meniscus is formed
- viii. put a YSI Standard ½ membrane sheet over meniscus
- ix. place O-ring over membrane and fit around probe
- x. check that the membrane is smooth (no wrinkles)
- xi. check for bubbles under the membrane by shaking the YSI gently upside down if there are bubbles repeat procedure from step 7)
- xii. fill cup ½ fill with tap water

b. Optical 6150 Probe

- i. remove optical probe wiper
- ii. inspect for damage and wear
- iii. replace wiper if needed
- iv. rinse probe with DI
- v. fill cup ½ fill with tap water

II. Calibration [The manufacturer has set internal controls on the criteria of calibration acceptance. UFI follows the guidelines of calibration as directed by the manufacturer]

- i. turn on computer
- ii. connect bench cable labeled YSI to serial port and YSI unit.
- iii. plug in power cable labeled YSI
- iv. select the YSI Terminal icon located on the desktop
- v. at the # sign type menu
- vi. select 2 for the Calibration menu
- vii. note: calibration should only be performed on cleaned sondes
- viii. it is important to calibrate Specific Conductance before calibrating pH. pH buffer solutions are highly saline and therefore can cause Specific Conductance calibration problems.

1. Calibration of Specific Conductance

- a. rinse probes with DI water. Repeat.
- b. fill cup with DI water and record DI SC value on calibration form (this is just a check, not a calibration). If the DI value is greater than 5 µS/cm, corrective action is required.
- c. add a small portion of standard to rinse the sensors. Repeat.
- d. add enough standard to cover the probes.
- e. choose conductivity calibration from the menu
- f. choose spCond
- g. press <enter> -- probe data should be showing on the screen.
- h. find conductivity value and record on calibration sheet. [If the specific conductivity reading is more than ± 40 µS/cm of standard, do not calibrate. Re-clean probes with DI. Retry. If specific conductivity reading is still more than ± 40 µS/cm of the standard, empty contents from the pour bottle and obtain new specific conductivity standard from the storage container Re-clean the probes and try again. If the problem persists then corrective action is required.
- i. type <enter> -- this will update the conductivity calibration
- j. type <enter> to continue
- k. type <0> -- this will return you to the sensor selection list for calibration

l. reuse standard.
m. record information on calibration sheets

2. pH
    a. rinse probes with DI water. Repeat.
    b. rinse probes with 7 pH buffer. Repeat.
    c. add enough 7 pH buffer to cover the probes.
    d. choose pH calibration from the menu
    e. choose 2-point calibration
    f. type 7.0 at prompt <enter> -- probe data should be showing on the screen.
    g. find pH value and record on calibration sheet.
    h. <enter> -- this will update the pH calibration for point 1 (7 pH)
    i. <enter>
    j. reuse buffer.
    k. rinse probes with DI water. Repeat.
    l. rinse probes with 10 pH buffer. Repeat.
    m. add enough 10 pH buffer to cover the probes.
    n. type 10.0 at the prompt <enter>
    o. find pH value and record on calibration sheet.
    p. <enter> -- this will update the pH calibration for point 2 (10)
    q. <enter>
    r. type <0>
    s. reuse buffer
    t. record information on calibration sheets
3. Dissolved Oxygen
    a. Standard 6562 Probe
        i. calibration of DO should only be done 12-24 hours after DO probe maintenance
        ii. rinse probes with DI water. Repeat.
        iii. fill calibration cup with DI water up to, but below Temperature probe.
        iv. if water is on membrane surface, gently dab with clean Kimwipe.
        v. loosely place cap on calibration cup, allowing space for air equilibrium.
        vi. choose Dissolved Oxygen calibration from the menu
        vii. choose %DO Sat
        viii. type the atmospheric pressure in mmHg at the prompt
        ix. <enter> -- probe data should be showing on the screen.
        x. find %DO Sat value.
        xi. allow several minutes (at least 5 minutes, 10-15 ideally) for values to stabilize
        xii. <enter> -- this will update the DO calibration (note that DO will not necessarily read 100 % Saturation.)
        xiii. <enter>
        xiv. type <0>
        xv. record information on calibration sheets
    b. Optical 6150 Probe
        i. rinse probes with DI water. Repeat.

ii. fill calibration cup with DI water up to, but below Temperature probe.
iii. if water is on membrane surface, gently dab with clean Kimwipe.
iv. loosely place cap on calibration cup, allowing space for air equilibrium.
v. choose Optical Dissolved Oxygen calibration from the menu
vi. choose %DO Sat
vii. type the atmospheric pressure in mmHg at the prompt
viii. <enter> -- probe data should be showing on the screen.
ix. find %DO Sat value.
x. allow several minutes (at least 5 minutes, 10-15 ideally) for values to stabilize
xi. <enter> -- this will update the DO calibration (note that DO will not necessarily read 100 % Saturation.)
xii. <enter>
xiii. type <0>
xiv. record information on calibration sheets

4. Chlorophyll
   a. Two point calibration [Note: 2 point calibrations are only done prior to initial deployment and may be done mid-field season to verify proper functioning]
      i. go to the Advanced menu
      ii. select Sensors
      iii. set CHL Temp Co % to ZERO (0.0)
      iv. go back to the calibration menu.
      v. rinse probes with DI water. Repeat.
      vi. when conducting chlorophyll calibration use dark calibration cup.
      vii. fill cup nearly completely full of DDI water and secure cap.
      viii. invert unit so that the CHL sensor is completely covered with water.
      ix. gently tap YSI unit to free any bubble attached to sensor surface.
      x. choose CHL calibration from the menu
      xi. choose ug/L
      xii. choose or 2 point calibration
      xiii. type 0.0 at prompt <enter> -- probe data should be showing on the screen.
      xiv. type ‘3’ to cause wiper to clean (remove micro-bubbles from) chlorophyll sensor’s surface.
      xv. find CHL value and record on calibration sheet.
      xvi. <enter> -- this will update the fluorometer calibration for point 1 (0 ug/L)
      xvii. after completing 0 ug/L calibration replace, DI water with Dye solution (obtained from lab).
      xviii. type dye equivalent ug/L at prompt for point 2.

- xix. type ‘3’ to cause wiper to clean (remove micro-bubbles from) chlorophyll sensor’s surface.
- xx. find CHL value Find CHL value and record on calibration sheet.
- xxi. <enter> -- this will update the fluorometer calibration for point 2 (dye ug/L)
- xxii. <enter>
- xxiii. type <0>
- xxiv. discard solution.
- xxv. go back to Filters under the advanced menu and turn CHL Temp Co % to previous value.
- xxvi. record information on calibration sheets

b. One point calibration [Note: 1 point calibrations are done every time the sonde is calibrated]

- i. rinse probes with DDI water. Repeat.
- ii. when conducting chlorophyll calibration use dark calibration cup.
- iii. fill cup nearly completely full of DDI water and secure cap.
- iv. invert unit so that the CHL sensor is completely cover with water.
- v. gentle tap YSI unit to free any bubble attached to sensor surface.
- vi. choose CHL calibration from the menu
- vii. choose ug/L
- viii. choose 1 point calibration
- ix. type 0.0 at prompt <enter> -- probe data should be showing on the screen.
- x. type ‘3’ to cause wiper to clean (remove micro-bubbles from) chlorophyll sensor’s surface.
- xi. find CHL value and record on calibration sheet.
- xii. <enter> -- this will update the fluorometer calibration for point 1 (0 ug/L)

Table 2. T and CHL relationship for Rhodamine dye

T (°C)	CHL (µg/L)	T (°C)	CHL (µg/L)
30.00	100.00	18.50	121.00
29.50	100.75	18.00	122.00
29.00	101.50	17.50	123.00
28.50	102.25	17.00	124.00
28.00	103.00	16.50	125.00
27.50	103.75	16.00	126.00
27.00	104.50	15.50	127.25
26.50	105.25	15.00	128.50
26.00	106.00	14.50	129.75
25.50	107.00	14.00	131.00
25.00	108.00	13.50	132.25
24.50	109.00	13.00	133.50
24.00	110.00	12.50	134.75
23.50	110.75	12.00	136.00
23.00	111.50	11.50	137.00
22.50	112.25	11.00	138.00
22.00	113.00	10.50	139.00
21.50	114.25	10.00	140.00
21.00	115.50	9.50	141.00
20.50	116.75	9.00	142.00
20.00	118.00	8.50	143.00
19.50	119.00	8.00	144.00
19.00	120.00		

Rhodamine dye is reported to be a possible carcinogen therefore handle appropriately!!!

5. Turbidity
    a. dry YSI Multiprobe completely
    b. remove Tn and Chl wipers (DO wiper if present)
    c. fill calibration cup with DI water
    d. place inverted sonde in calibration cup 5 cm above cup bottom
    e. chose Turbidity calibration from the menu
    f. chose 2-point calibration
    g. type 0.0 at prompt <enter> -- probe data should be showing on the screen.
    h. find turbidity value and record on calibration sheet.
    i. <enter> -- this will update the turbidity calibration for point 1 (0.0 NTU)
    j. <enter>
    k. invert sonde and place in a calibration cup with high NTU standard obtained from YSI 6073G Tn Standard container
    l. gently tap YSI unit to free any bubbles attached to sensor surface.
    m. type high NTU value at prompt <enter> -- probe data should be showing on the screen.
    n. find turbidity value and record on calibration sheet.
    o. 1<enter> -- this will update the turbidity calibration for point 2 (high range NTU)

p. <enter>
q. reuse standard.
r. dry YSI Multiprobe completely
s. invert sonde and place in a calibration cup with low NTU standard obtained from YSI 6072 Tn Standard container
t. observe and record Tn reading in low NTU Standard on calibration sheet
u. re-attach Tn and Chl wipers

6. Oxidation Reduction Potential
   a. rinse Probes with DDI water. Repeat.
   b. add a small portion of ORP standard to rinse the sensors. Repeat.
   c. add enough ORP standard to cover the probes.
   d. check that ORP values are within +/- 20 mV of the value found in table 2.

Table 3: Expected ORP reading when using Zobell Solution as a function of temperature.

Temperature (C)	Zobell Solution Value (mV)
5	257.0
10	250.5
15	244.0
20	237.5
25	231.0
30	224.5
35	218.0

III. Replacing Wipers
   i. using the appropriate Allen wrench, remove the wipers on both the turbidity and chlorophyll probes
   ii. remove old wiping foam from wiper
   iii. replace with new wiping foam
   iv. reattach wipers to probes with appropriate Allen wrench

16. <u>Calculations:</u>
Raw data are converted to units of scientific measure internally by the sensor.

17. <u>Method performance:</u> Performed according to manufacturer’s recommendations.

18. <u>Pollution prevention:</u>
All calibration solutions are flushed down the drain in the sink with tap water.

19. <u>Data assessment and acceptance criteria for quality control measures:</u>
YSI multiprobe sondes all come equipped with internal QC measures (i.e., it will not accept a calibration that deviates from a certain range for each parameter).

20. <u>Corrective actions for out-of-control or unacceptable data:</u>
If a probe or sonde continually fails calibration then the instrument will be replaced with a new one or returned to the manufacturer for repair.

21. <u>Contingencies for handling out of control or unacceptable data:</u>
Identify data that fail QA/QC, record throughout data transfer to client. Analyze cause of unacceptable data (i.e., instrument error or interferences). Return instrument to manufacturer for repair and recalibration if deemed necessary.

22. <u>Waste management:</u>
All calibration solutions are flushed down the drain in the sink with tap water.

23. <u>References:</u>

- YSI Environmental Operations Manual version B (01/2002), 1700/1725 Brannum Lane, Yellow Springs, OH 45387, www.ysi.com

SOP No. 318: In situ Deployment of YSI Sondes

1. Test method: In situ Deployment of YSI Sondes
2. Applicable matrix or matrices: Water.
3. Detection limit: see SOP # 315.
4. Scope and application: Drinking, surface and saline waters.
5. Summary of test method:
   All YSI sondes have the option to be deployed for long time periods without the user being present. Initially the YSI is connected to a computer at UFI at which time the sampling regiment is entered to the sonde's internal software. Using 8 C batteries as a power source, the sonde is then taken to the deployment site and left for an extended period to sample according to the pre-described sampling interval. Sampling can be conducted for a given period of time (user defined) or can be left until there is no longer enough power to support sampling. The sonde is then brought back to UFI for data uploading and calibration.
6. Definitions: see SOP # 315.
7. Interferences: see SOP # 315.
8. Safety:
   Use caution if using grab sample techniques from a boat. Always use proper boating safety techniques when sampling from boats (see 2009 New York State Boater's Safety Guide). Use caution and best judgment if working from bridges. Be sure to park as far on the shoulder as possible. Use parking cones, wear reflective vests, and use truck emergency warning lights, and affix warning light to top of truck. Standard field procedures involving moderate lifting should be applied.
9. Equipment and supplies:
   Computer with appropriate YSI software, YSI communication cable, YSI multiprobe sonde, and 8 C batteries, field cup, deployment platform, rope (or cable), quick clasps, locks, and log sheet.
10. Reagents and standards: None.
11. Reference Solution: None.
12. Sample collection, preservation, shipment and storage: NA.
13. Quality Control:
    YSI sonde is calibrated prior to deployment and checked after retrieval to verify successful operation.
14. Calibration and standardization: See YSI sonde calibration SOP 315.
15. Procedure:
    I. Logging Setup
       i. inset 8 C batteries into sonde
       ii. turn on computer
       iii. connect bench cable labeled YSI to serial port and YSI unit.
       iv. plug in power cable labeled YSI
       v. select the YSI Terminal icon located on the desktop
       vi. at the # sign type 1 to enter the RUN menu
       vii. select 2 inside the Run menu
       viii. a 12 option menu will appear. Change menu options according to your sampling needs
       ix. sampling interval in HHMMSS
       x. start Date in MMDDYY
       xi. start Time in HHMMSS
       xii. duration is the number of days that the sonde will be deployed

xiii. file – name a file to describe sonde deployment
xiv. site – Enter the system name that the sonde will be deployed on
xv. bat. Volts – the YSI sonde reports the voltage of the 8 C batteries
xvi. bat. Life – the YSI sonde calculates the maximum number of days the sonde can log data based on battery voltage
xvii. free mem – the YSI sonde calculates the maximum number of days the sonde can log data available internal memory
xviii. A. The YSI sonde reports time until sampling begins
xix. B. View parameters that will be included in sampling report
xx. C. Start logging. Press C to begin logging at indicated start date and time. Type 1 to verify start logging
xxi. exit YSI software by pressing ESC until past the main menu
xxii. detach YSI from computer and apply the dummy cover on pins

II. Deployment
i. secure all connections on the datasondes (battery compartment, probes, etc …)
ii. connect appropriate dummy plugs to all exposed connector pins
iii. remove the calibration cup and replace with a field cup
iv. secure cable or chain to platform (rock, bridge, flotation buoy, or etc …) with a quick clip and lock
v. attach datasondes to the other end of the cable or chain with a quick clip and lock. Be sure to lock both the sonde and quick clip to the cable or chain
vi. place the sonde in the water and vigorously shake to dislodge air bubbles and debris from SC sensor (also, try to deploy SC facing up to prevent bubbles from getting trapped in the sensor and creating erroneous readings).
vii. be sure the sonde is placed in such a way that it will be covered with water during the duration of its deployment
viii. record deployment information on the log sheet (sonde type and number, place of deployment, time of deployment, lock number or type, and other field notes)

III. Data Retrieval
i. turn on computer
ii. connect bench cable labeled YSI to serial port and YSI unit.
iii. plug in power cable labeled YSI
iv. select the YSI Terminal icon located on the desktop
v. at the # sign type 1 to enter the RUN menu
vi. select 3 inside the Run menu to Quick Upload the data file
vii. select 3 to convert data to an ACSI Text file [the file will automatically upload to the computer's C: directory
viii. minimize the YSI Terminal software
ix. view the file with WORDPAD to ensure the data transfer was successful
x. in the YSI Terminal window, press esc to back up one level
xi. type 6 to delete the file just uploaded

16. <u>Calculations:</u>
Raw data are converted to units of scientific measure internally by the sensor.

17. <u>Method performance:</u>
This procedure is in accordance with the manufacturer's recommendations.

18. <u>Pollution prevention:</u>
This procedure has no discernible negative impact on the environment.

19. <u>Data assessment and acceptance criteria for quality control measures:</u>

Assessment of results is done at UFI facilities (post collection). Acceptance criteria for quality control include consideration of field notation concerning interferences, presence of data points outside parameter detection range values, and comparison to other data sources (i.e. ground truth).

20. Corrective actions for out-of-control or unacceptable data:
If unacceptable data is determined to be a result of instrument malfunction, then instrument will be returned for repair. If unacceptable data is determined to be due to inappropriate use by the field crew, then a review of the procedure will be conducted to ensure the problem will not happen again.

21. Contingencies for handling out of control or unacceptable data:
Identify data that fail QA/QC, record throughout data transfer to client. Analyze cause of unacceptable data (i.e., instrument error or interferences). Return instrument to manufacturer for repair and recalibration if deemed necessary.

22. Waste management: None.

23. References:

- YSI Environmental Operations Manual version B (01/2002), 1700/1725 Brannum Lane, Yellow Springs, OH 45387, www.ysi.com
- YSI Sonde Calibration SOP 315

SOP No. 319: YSI Sonde Profiling using the YSI 650

1. Test method: YSI Sonde Profiling using the YSI 650
2. Applicable matrix or matrices: Water.
3. Detection limit: see SOP # 315.
4. Scope and application: Drinking, surface and saline waters.
5. Summary of test method:
   A calibrated YSI sonde is attached to the YSI 650 datalogger and used to measure water quality parameters at discrete depths in the water column or specific locations in a creek or stream.
6. Definitions: None.
7. Interferences: None.
8. Safety:
   Use caution if profiling from a boat. Always use proper boating safety techniques when sampling from boats (see 2009 New York State Boater's Safety Guide). Use caution and best judgment if working from bridges. Be sure to park as far on the shoulder as possible. Use parking cones, wear reflective vests, and use truck emergency warning lights, and affix warning light to top of truck. Standard field procedures involving moderate lifting should be applied.
9. Equipment and supplies:
   YSI multiprobe sonde, 4 C batteries, profiling cable, YSI 650 data logger, field sheets.
10. Reagents and standards: None.
11. Reference Solution: None.
12. Sample collection, preservation, shipment and storage: NA.
13. Quality Control:
    The probes must be allowed to equilibrate. Data collected are reviewed by the field crew upon return for initial qualitative acceptability (do the data make sense). Final determination of data acceptability will be handled during analysis at a later time.
14. Calibration and standardization: see SOP # 315.
15. Procedure:
    I. Collecting a profile from a boat
       i. attach the YSI 650 datalogger to a fully calibrated YSI Multiprobe
       ii. remove the calibration cup and fit the sonde with a field cup
       iii. using the key pad, turn the unit on
       iv. from the main menu, select RUN and press enter
       v. lower the YSI multiprobe to the first depth interval [Note: the profile interval is system dependent].
       vi. gently shake to dislodge any debris, bubbles
       vii. it is absolutely critical that the unit be allowed to equilibrate before taking a measurement (depends on parameter stabilization times)
       viii. record measurements on the field sheet
    II. Collecting discrete measurements in a stream
       i. wade approximately mid-way into the stream channel (lower from a bridge if wading is not possible or collect from stream bank)
       ii. facing upstream, submerge the probes a few inches below the water surface
       iii. wait until readings stabilize
       iv. read and record data
16. Calculations:
    Raw data are converted to units of scientific measure internally by the data logger.
17. Method performance:

This procedure is in accordance with the manufacturer's recommendations.

18. Pollution prevention:
This procedure has no discernible negative impact on the environment.

19. Data assessment and acceptance criteria for quality control measures:
Assessment of results should be done on location. Acceptance criteria for quality control include consideration field conditions, presence of data points outside parameter detection range values, comparison to other data sources (i.e. ground truth), and field judgment in context of conditions and specific system.

20. Corrective actions for out-of-control or unacceptable data:
If unacceptable data is determined to be a result of instrument malfunction, then instrument will be returned for repair. If unacceptable data is determined to be due to inappropriate use by the field crew, then a review of the procedure will be conducted to ensure the problem will not happen again. If necessary, the profile may need to be recollected.

21. Contingencies for handling out of control or unacceptable data:
Identify data that fail QA/QC, record throughout data transfer to client. Analyze cause of unacceptable data (i.e., instrument error or interferences). Return instrument to manufacturer for repair and recalibration if deemed necessary.

22. Waste management: None.

23. References:

- YSI Environmental Operations Manual version B (01/2002), 1700/1725 Brannum Lane, Yellow Springs, OH 45387, www.ysi.com
- YSI Sonde Calibration SOP 315

2012 AND 2013 SOURCE CONTROL SUMMARY FOR THE ONONDAGA LAKE BOTTOM SUBSITE
Syracuse, New York

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In association with

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DECEMBER 2013

OVERVIEW

As documented in the Onondaga Lake Record of Decision (NYSDEC, 2005), the remediation of Onondaga Lake is being coordinated with upland remedial activities. This report provides a summary of the lake capping and dredging activities performed in 2012 and anticipated to be performed in 2013, and documents the extent to which potential sources of recontamination to the 2012 and 2013 remediation areas that are controlled by Honeywell have been addressed.

The schedule goal for the lake remediation is to complete dredging to the extent practical in four years (beginning in 2012), and capping in five years (beginning 2012). A sequencing plan for the dredging and capping activities has been developed by the design team with input from the remediation contractor, as detailed in the Onondaga Lake Capping, Dredging, Habitat and Profundal Zone (SMU 8) Final Design (Parsons, 2012). Based on this sequencing plan and subsequent updates, the areas in Remediation Areas C, D, and E are anticipated to be in process or completed by the end of 2013 and are shown in Figure 1. Honeywell-controlled sources addressed in this report include:

- Area Groundwater – Attachment A
- Tributary 5A – Attachment B
- I-690 Storm Drain System – Attachment B
- Upper Harbor Brook IRM - Attachment B
- East Flume - Attachment B

As detailed in Attachments A and B, these remedial activities have been, or will be, sufficiently completed, consistent with NYSDEC-approved designs, such that the potential for lake recontamination from these sources has been mitigated.

REFERENCES

New York State Department of Environmental Conservation and United States Environmental Protection Agency Region 2. 2005. *Record of Decision. Onondaga Lake Bottom Subsite of the Onondaga Lake Superfund Site*. July 2005.

ATTACHMENT A

AREA GROUNDWATER

WILLIS AVENUE/SEMET TAR BEDS SITES IRM & WASTEBED B / HARBOR BROOK IRM HYDRAULIC BARRIER WALL AND GROUNDWATER COLLECTION SYSTEMS

Area groundwater has been addressed through construction of the Willis Avenue/Semet Tar Beds Sites (Willis/Semet) IRM and the Wastebed B/Harbor Brook IRM hydraulic control systems. These systems, each of which includes a sheet pile barrier wall and a groundwater collection system, were constructed in three phases beginning in 2006 and finishing in 2012. The systems were designed and constructed to eliminate, to the extent practicable, the discharge of contaminated groundwater and non-aqueous phase liquids (NAPL) to Onondaga Lake from the Southwest Shoreline area of Onondaga Lake (Figure 1). As detailed below, these systems were constructed consistent with the NYSDEC-approved designs. They prevent the discharge of contaminated groundwater and NAPL to the lake from this area, and have addressed the potential for groundwater upwelling to impact the Onondaga Lake sediment cap consistent with the cap design assumptions for this area.

In addition to the IRMs discussed below, dense non-aqueous-phase liquid (DNAPL) collection was initiated along the lakeshore in 1993. The system was expanded to include additional collection wells in 1995 and 2002. In 2012, the system was again expanded and the entire system upgraded and optimized. To date, over 40,000 gallons of DNAPL have been recovered and transported off-site for disposal/incineration.

Construction of the IRMs included the following elements:

- Grading, as required, to establish a work platform to allow for implementation of the IRMs
- Installation of a sealed interlock sheet pile barrier wall along the lakeshore to prevent migration of contaminated groundwater and NAPL to Onondaga Lake
- Installation of a shallow (bottom elevation of 358 ft. (NAVD 88)) groundwater collection trench with wick drains to work in conjunction with the barrier wall to prevent the discharge of contaminated groundwater and NAPL to Onondaga Lake from the shallow and intermediate depth hydrogeologic units
- Backfilling, as required, behind the barrier wall to establish required grades
- Removal/abandonment of defunct utilities in conflict with the barrier wall/trench alignment
- Realignment of the Harbor Brook channel
- Pumping collected groundwater to the Willis/Semet Groundwater Treatment Plant (GWTP) for treatment

The hydraulic control systems were constructed from west to east beginning in the vicinity of Tributary 5A and extended to the area adjacent to the CSX rail line east of Harbor Brook. The construction was completed in the following phases (Figure 1):

- Phase 1 – Installation of 1,288 linear feet of barrier wall and groundwater collection system from October 2006 to May 2007.
- Phase 2 – Installation of 1,612 linear feet of barrier wall and groundwater collection system, placement of approximately 43,000 cy of light-weight aggregate behind the barrier wall, abandonment of existing 72 inches and 84 inches diameter Allied intake pipelines from the barrier wall alignment to the shoreline, installation of an HDPE liner system along portions of the barrier wall subject to flooding during high lake water events, and installation of a tie-back anchorage system to mitigate deflection of the barrier wall in areas with deep water present outboard of the wall from August 2008 to May 2012.
- Phase 3 –Construction of a work platform, installation of a total of 4,678 linear feet of barrier wall and a groundwater collection system (1,630 ft. for the East Wall and 3,048 ft. for the West Wall), realignment of the lower reach of Harbor Brook, and replacement of the lower Harbor Brook culvert were completed from December 2009 to March 2012.

HYDRAULIC BARRIER/GROUNDWATER COLLECTION SYSTEM DESCRIPTION

The barrier walls were completed consistent with the design and prevent the discharge of contaminated groundwater and NAPL to the lake from this area by ensuring that the performance goal of creating an inward groundwater gradient is maintained. The hydraulic barrier wall is constructed of coated steel sheet piling. Every other interlock was factory seal welded to reduce the number of joints and minimize the potential for interruptions in the hydraulic barrier. Interlocks that are not seal welded were sealed with a hydrophilic material that swells 200 percent when in contact with water. All seal welds and interlocks were inspected by quality control technicians prior to installation. Sheet piling was installed a minimum of 3 ft. into a clay layer present across the site at depths ranging from 35 to 70 ft. below grade.

The groundwater collection system was installed up-gradient of the wall to collect groundwater captured behind the barrier wall. The collection system consists of the following components:

- 6-inch diameter perforated collection pipe installed at elevation 358.00 ft. (NAVD 88) in a trench backfilled with granular material
- Wick drains to transmit intermediate depth groundwater to the collection piping
- Groundwater conveyance piping
- Groundwater pump stations

- Shallow piezometers for monitoring groundwater levels adjacent to the collection trench

All groundwater collected by the system is pumped from the groundwater pump stations through the conveyance piping to the "Lakeshore Pump Station" and then to the Honeywell Willis-Semet GWTP where it is treated prior to discharge.

Based on the containment of groundwater provided by the system as described above, concerns related to potential recontamination of the cap have been addressed.

SYSTEM OPERATION

The groundwater collection system was activated as the respective phases of construction were completed. A description of system operational status for each phase is provided below.

Phase 1

- Completion of construction/activation of collection system: May 2007
- System shut-down for upgrade of collection sump piping and re-route of conveyance piping and electrical/signal wiring: October 2009 - December 2009
- System shutdown due to Onondaga Lake flooding and subsequent electrical repair: April 19, 2011 – June 1, 2011
- System shutdown due to re-route of conveyance piping and electrical/signal conduit during construction of the Phase 2 tie-back anchorage system: January 2012 – April 2012

Phase 2

- Completion of construction/activation of collection system: November 2009
- System shutdown due to Onondaga Lake flooding: April 19, 2011 – June 1, 2011
- Begin supplemental pumping utilizing a trailer mounted diesel pump extracting groundwater from a well point adjacent to the groundwater pump station to augment the groundwater collection system due to damage to collection piping: August 2011
- System shutdown due to collection piping repair and re-routing of electrical/signal conduit during construction of the Phase 2 tie-back anchorage system. Supplemental pumping (as described above) continued throughout shutdown: December 2011 – April 2012.

Phase 3

- Start-up of pumping from Collection Sumps (CS) 4 & 5 to offset construction water volumes during trench installation: August 2011
- Completion of construction/activation of collection system: April 2012

- Corrective action taken to clear obstructions within collection system: July 9 through 20, 2012

SYSTEM PERFORMANCE

Overall system performance is assessed based on groundwater elevations that are monitored in the shallow piezometers and based on the volume of groundwater collected/treated. The design goal is to maintain groundwater levels below lake levels. If discrepancies in the data are noted, they are investigated to determine their significance and if response actions are needed. Weekly average Onondaga Lake and groundwater (piezometer) elevation data for the Phases 1, 2, and 3 collection system adjacent to areas anticipated to be remediated by the end of 2013 are provided in Figures 2, 3, and 4, respectively. All elevations are presented in the NAVD 88 datum.

The ability to contain groundwater behind the wall has been demonstrated. As shown on the figures, following initial system start-up, and during normal operating periods, most Phases 1 and 2 data demonstrate groundwater levels below lake level, indicating that hydraulic capture and an inward hydraulic gradient were achieved. Occasionally water levels in the collection trench rise above lake level for short periods of time. These short term increases do not affect the ability of the overall system to maintain an inward gradient and do not pose a concern unless contaminated groundwater from the trench overtops the barrier wall and reaches the lake. The wall has never been overtopped by groundwater and the cause is investigated whenever collection trench water levels are observed rising rapidly or when they approach lake levels. Findings related to collection trench groundwater level increases or unexplained piezometer data include:

- Piezometer #3, located in the Phase 1 wall section, occasionally exceeds lake levels due to additional contributions from the I-690 storm underdrain and the west section of the temporary collection trench (a French drain) during storm events. Both of these drain into Transition Sump #2 (located in the vicinity of Piezometer #3) and flows from storm events can temporarily raise water levels in the nearby sections of the trench where Piezometer #3 is located.
- Groundwater levels along Phase 2 trench were affected by leaks in the Wastebeds 1-8 force main caused by ground settlement during the fall of 2013. A bypass pipe was installed to divert flows around the affected area in the event of future Wastebeds 1-8 force main leaks.
- Piezometers # 4 and #5 were damaged during construction of the tie-back wall and were repaired in July, 2013. Both piezometers have been functional since then, however only Piezometer 4 has been providing consistently usable data. In November 2013 both wells were examined and it was determined that sand from the nearby roadway was being washed into the wells when dust control water trucks passed. Both wells were flushed the week of November 11, 2013. The pull box on Piezometer 5 was

raised 6-inches and Piezometer 4 raised 3-inches to prevent sediment from reaching the well. In addition an extension has been added to the Piezometer 5 riser and the wire piezometer was set to match the previous depth. Both piezometers are now functioning and providing data.

- During start-up of Phase 3 in April 2012, obstructions were located in portions of the Phase 3 collection system and corrective actions taken. Immediately following implementation of the corrective actions and completion of startup in July 2012, inward hydraulic gradients consistent with those demonstrated for the Phase 1 and Phase 2 portions were documented. Power was lost to the Phase 3 data loggers in mid-October 2012 and restored in mid-December 2012; procedures have been implemented, including weekly data downloads, to verify piezometer function on a regular and frequent basis so that periods of data loss do not occur in the future.

Beginning in early 2013, to facilitate Harbor Brook remedial construction activities that will be completed this season, water from Harbor Brook construction activities was diverted into the Phase 3 collection system, which conveys the collected water to the treatment plant. During short periods in April and June this additional water resulted in an increase in groundwater levels behind some sections of the barrier wall that were higher than elevations along the sections of wall with lowest top of wall elevations. Observations at the time verified that the pumping systems were sufficient and prevented groundwater from reaching the surface and overtopping the barrier wall. As detailed above, the containment of groundwater provided by the barrier wall and the groundwater collection system addresses concerns related to potential recontamination of the cap. The ability to contain groundwater and maintain an inward gradient, even during periods where external contributions influence groundwater levels, has been demonstrated for all three Phases of the IRM and is expected to continue indefinitely.

ATTACHMENT B

TRIBUTARY 5A

I-690 STORM DRAINS

EAST FLUME

UPPER HARBOR BROOK IRM

This remediation project was undertaken to address groundwater influences to Tributary 5A and Onondaga Lake, as well as sediment migration to Onondaga Lake (Figure 5). To achieve these remedial action objectives, the project included shallow groundwater collection, sediment removal, isolation layer installation, and tributary restoration, as further described in the NYSDEC-approved Design report and subsequent revisions (O'Brien & Gere 2008). Based on work completed to date and water samples collected from the culvert in October2011 the potential for recontamination of the Onondaga Lake cap has been mitigated.

1. Work completed to date includes the following:

- Reach-1
  - » Groundwater collection and treatment at the Willis GWTP was initiated in November 2011
  - » Sediment removal and isolation layer installation was completed in May 2012
  - » Substrate and topsoil placement was completed in May 2012
- Reach-2
  - » Groundwater collection and treatment at the Willis GWTP was initiated in December 2011
  - » Sediment removal and isolation layer installation was completed in December 2011
  - » Substrate and topsoil placement was completed in March 2012
- Relocation of Semet material from Stringer Ponds to Semet Pond #2 was completed in July 2010
- CCTV inspection of culvert between Reach-2 and Onondaga Lake with subsequent wet and dry weather sampling was completed in October 2011.
- Replacement of the culvert between Reach-1 and Reach-2 was completed in September 2012
- Final restoration, including seeding and shrub planting of Reach-1 and Reach-2 was completed in March 2013.
- Reach-1 and Reach-2 pump station start-up and commissioning was completed in March 2012 for R1 and December 2012 for R2.

2. Conclusions

The work completed to date addresses the potential groundwater impacts to Tributary 5A and subsequently to Onondaga Lake. Based on the work that has been completed to date and the results of the October 2011 culvert sampling as part of this project, sources of contamination from Tributary 5A to Onondaga Lake have been addressed, thereby, mitigating the potential for recontamination of the Onondaga lake cap.

As part of the ongoing Site monitoring activities, surface water and sediment samples will be collected annually, starting in 2013. Samples will be evaluated to assess the potential impacts of Site groundwater, surface water run-off from the Site, storm sewer inputs to the tributary, potential upgradient sources, and the potential for migration of Site-related and other constituents to Onondaga Lake.

We understand that subsequent to the work described above, releases to Tributary 5A from operations related to Crucible Specialty Metals are being documented. We further understand that these releases are being addressed by Crucible Specialty Metals under the direction of NYSDEC Region 7 personnel, and that NYSDEC may enter into a consent order with Crucible Specialty Materials to address any additional releases to the tributary in the future.

REFERENCES

O’Brien & Gere. 2008. 95% Remedial Design Report, Semet Residue Ponds Remedial Design Groundwater Remedial Alternative, Geddes, New York. Prepared for Honeywell, Morristown, NJ. December 2008.

The I-690 Storm Drain IRM has been a phased remediation. This remediation was undertaken to address groundwater influences to the eastern and western storm drain systems downgradient of the Willis Avenue and Semet Ponds Sites (Figure 6). To date, three phases have been completed that have mitigated potential impacts to the Onondaga Lake cap. A fourth phase was initiated in 2012 and was completed in 2013 to address soluble constituents detected at trace levels in the storm drain system.

1. Work completed to date includes the following:

The eastern and western I-690 storm drainage systems were investigated using closed circuit television (CCTV) prior to the implementation of Phase 1 remedial work.

<u>Phase 1 – Eastern Portion</u>

- Grouted joints and sealed catch basins
- Installed new manholes MH-1 and MH-2
- Rerouted Tap to DR-42
- Installed new 18-inch ductile iron pipe from DR-42x to DR-42
- Installed cured in-place pipe (CIPP) from DR-42 to MH-1

<u>Phase 1 – Western Portion</u>

- Installed CIPP at off-set joint downgradient of DR-40

Subsequent to the Phase 1 rehabilitation work a completion report was completed by O'Brien & Gere. The I-690 Storm Drainage System Rehabilitation Completion Report (O'Brien & Gere, 2000) was submitted to the NYSDEC in March 2000.

<u>Phase 2 – Eastern Portion</u>

- Re-routed taps downgradient of catch basins DR-44 and DR-46 into catch basins

Subsequent to the re-routing of the taps, a pilot study was undertaken in the eastern portion of the storm drainage system. The I-690 Storm Drainage System Phase 2 Underdrain Pilot Study was completed in July 2005. Sampling of underdrain water indicated that this water was a source of contamination and as such, needed to be separated from storm water discharges.

<u>Phase 3 – Eastern Portion</u>

- Installed underdrain conveyance piping and CIPP
- Conveyed underdrain water to Willis/Semet Barrier wall collection system
- Treatment of underdrain water at the Willis GWTP

<u>Phase 3 – Western Portion</u>

Installed CIPP from catch basin DR-40B to DR-40

Phase 4

- Cleaning and CCTV of eastern and western portions of system including sediment sumps in catch basins
- Epoxy coating of 16 catch basins and 3 manholes to address groundwater infiltration into these structures
- Soil removal and geomembrane lining of the State Fair Blvd drainage ditch
- Installation of a groundwater collection trench beneath the State Fair Blvd drainage ditch
- Treatment of collected water at the Willis GWTP.
- CIPP lining of remaining unlined portions of the eastern system
- CIPP lining of the remaining unlined portions of the western system

2. Flow monitoring/Sampling

Flow monitoring and analytical sampling was initiated in August 2011, subsequent to completion of Phase 3 construction. Flow was monitored continuously (except for a period from January 4, 2011 to March 27, 2012) in the eastern and western storm drain systems. Analytical samples have been collected twice per month (1 wet weather, 1 dry weather). The data indicates that trace concentrations of benzene, chlorobenzene, dichlorobenzenes, and mercury are still entering the system. However, flow monitoring and visual observation indicate that dry weather flows within the eastern portion have been reduced to approximately 0.5 gpm from 5-10 gpm prior to the first three phases of remediation. These concentrations are not anticipated to have an adverse effect on the Onondaga Lake cap. Catch basins MH-1 and MH-2 are also equipped with sumps to minimize the transport of sediment to Onondaga Lake.

3. Conclusions

Based on the completed Phase 1 through 4 work, it is anticipated that the potential impacts to the Onondaga Lake cap from the I-690 Storm Drain system are mitigated.

REFERENCES

Honeywell. 2006. Letter from Honeywell to NYSDEC regarding I-690 Storm Drain System Phase 3 Proposed recommendations. December 7, 2006.

Honeywell. 2011. Letter Work Plan from Honeywell to NYSDEC regarding I-690 Storm Drain System Flow Monitoring and Sampling. June 9, 2011.

O'Brien & Gere. 1997. I-690 Storm Drainage System (Eastern Portion) Conceptual Design Report. Geddes, New York. August 1997.

O'Brien & Gere, 1997a. I-690 Storm Drainage System Investigation (western portion) Report. Geddes, New York December 1997.

O'Brien & Gere. 2002. I-690 Storm Drainage System Underdrain Isolation Pilot Study Revised Work Plan. Geddes, New York. March 2002.

O'Brien & Gere. 2008. I-690 Storm Drainage System Phase 3 Design. Geddes, New York. May 2008.

This remediation project was undertaken to address groundwater influences to the existing 42”, 60” and 72” storm sewers and Onondaga Lake. To achieve these remedial action objectives, the project included installation of a 48” storm sewer pipe through the steel barrier wall along the lakeshore, cleaning and lining the 60” and 72” storm sewers, abandonment of an additional 60” storm sewer, elimination of the East Flume along the lakeshore, abandonment of a section of the 42” storm sewer and installation of a pump station and force main as further described in the NYSDEC-approved Design documents. Based on the work completed to date the potential for recontamination of the Onondaga Lake cap has been mitigated.

1. Work completed to date includes the following:

   - Installation of a 48” steel pipe with cathodic protection through the steel barrier wall was completed in early 2010
   - Installation of additional 48” steel pipe with cathodic protection was completed in December 2010
   - Cleaning and lining of the 60” and the 72” storm sewers was completed in December 2010
   - Abandonment by filling an additional 60” storm sewer with concrete was completed in December 2010
   - Elimination of the East Flume was completed in 2011
   - Abandonment of a section of the 42” storm sewer and installation of a pump station and force main is scheduled to be completed by January 2014

2. Conclusions

The work completed to date and the work that will be completed by January 2014 addresses the potential groundwater impacts to the existing storm sewers described above and subsequently to Onondaga Lake. Based on the work that has been completed to date and that will be completed by January 2014, sources of contamination from the storm sewers to Onondaga Lake will be addressed, thereby, mitigating the potential for recontamination of the Onondaga Lake cap.

REFERENCES

O’Brien & Gere. 2010. East Flume IRM Storm Sewer Outfall Relocation and Modifications Contract Documents. Geddes, New York. January 2010.

This remediation project was undertaken to address groundwater influences to Upper Harbor Brook and Onondaga Lake as well as impacted sediment migration to Onondaga Lake. To achieve these remedial action objectives, the project included a shallow groundwater collection system and treatment at the Willis GWTP, sediment removal, isolation layer installation, sealing of leaks in the culverts, and ditch/stream/wetland restoration, as further described in the NYSDEC-approved Design documents and in subsequent field modifications conducted during the field activities. Based on the work completed to date the potential for recontamination of the Onondaga Lake cap has been mitigated.

1. Work completed to date includes the following:

   - A groundwater collection system and two pump stations with force mains were completed in October 2013
   - Sediment removal and isolation layer installation at the open water areas of Harbor Brook was completed in October 2013
   - Sealing of leaks in the culverts along Harbor Brook (except Culvert #3) was completed in October 2013
   - Substrate placement in open water areas and placement of clay and topsoil in wetland areas was completed in November 2013
   - CCTV inspection of culverts that discharge to Upper Harbor Brook via the 690 ditch with subsequent sampling was completed in November 2012
   - Final restoration, including seeding and planting of shrubs in the wetland areas (except the Penn Can area) and other impacted areas was completed in October 2013
   - Pump station start-up was completed in November 2013
   - Sealing of the leaks in Culvert #3 is scheduled to be completed in December 2013

2. Conclusions

The work completed to date addresses the potential groundwater impacts to Upper Harbor Brook and subsequently to Onondaga Lake. Based on the work that has been completed to date, sources of contamination from Upper Harbor Brook to Onondaga Lake have been addressed, thereby, mitigating the potential for recontamination of the Onondaga Lake cap.

REFERENCES

O'Brien & Gere. 2007. Remedial Investigation Wastebed B/ Harbor Brook Site Report. Geddes and Syracuse, New York. November 2007.

O'Brien & Gere. 2012. Upper Harbor Brook IRM Final Design Report. Geddes, New York. March 2012.

FIGURES

Piezometer Location

Area where remediation is anticipated to be in progress or completed by end of 2013

Note: Not to scale. Locations approximate.

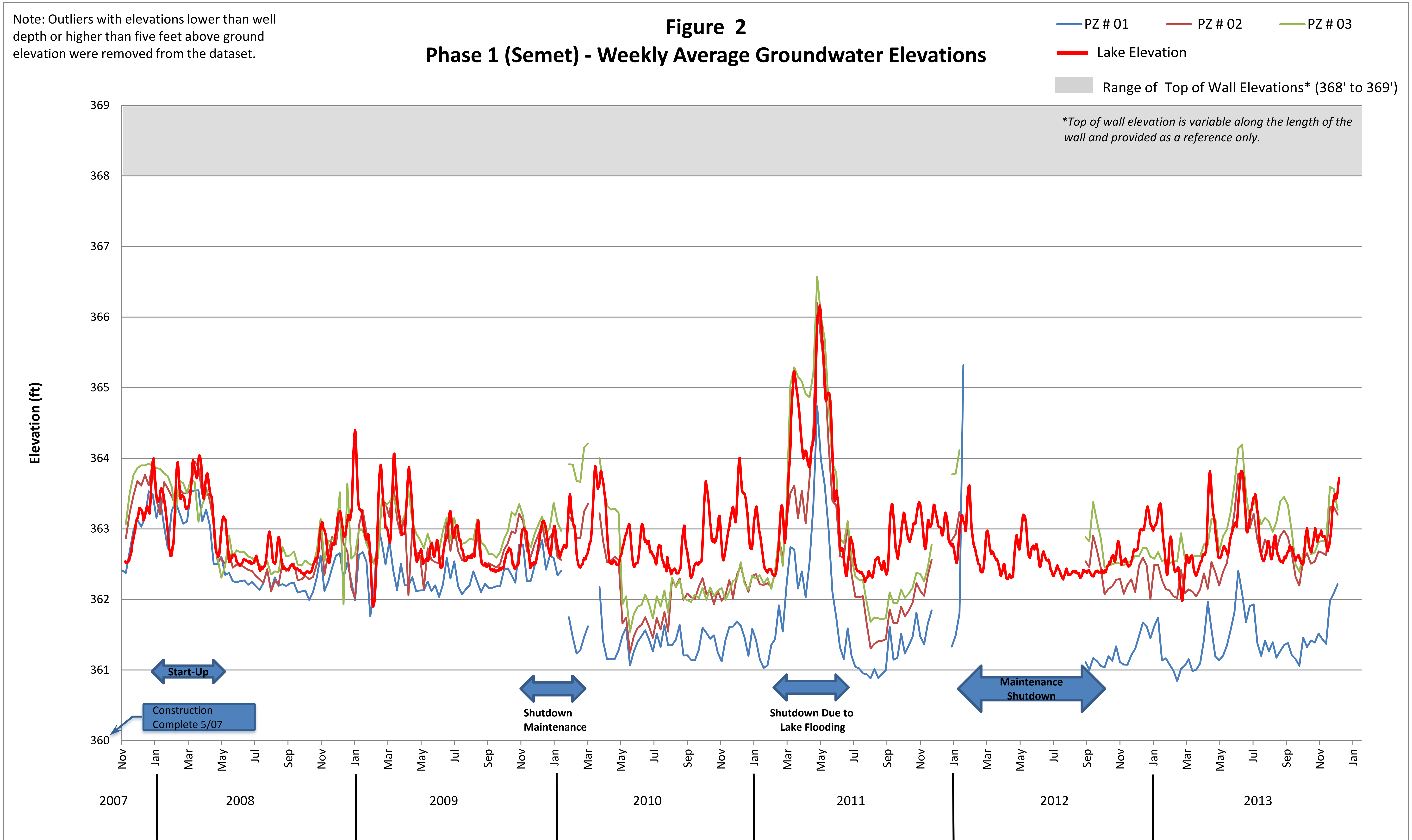
FIGURE 1

Honeywell

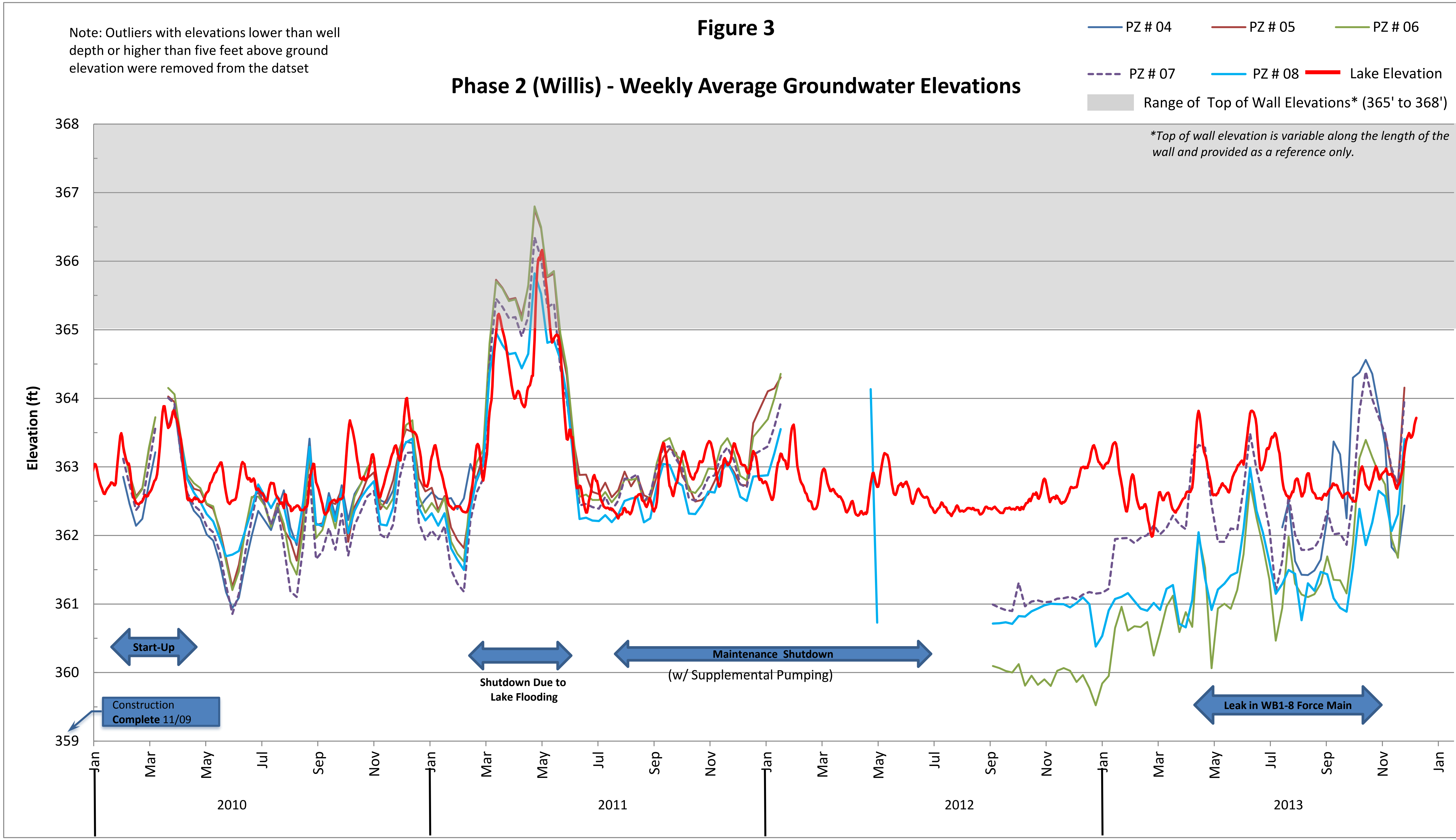
Onondaga Lake 2012 and 2013 Remediation Areas

PARSONS

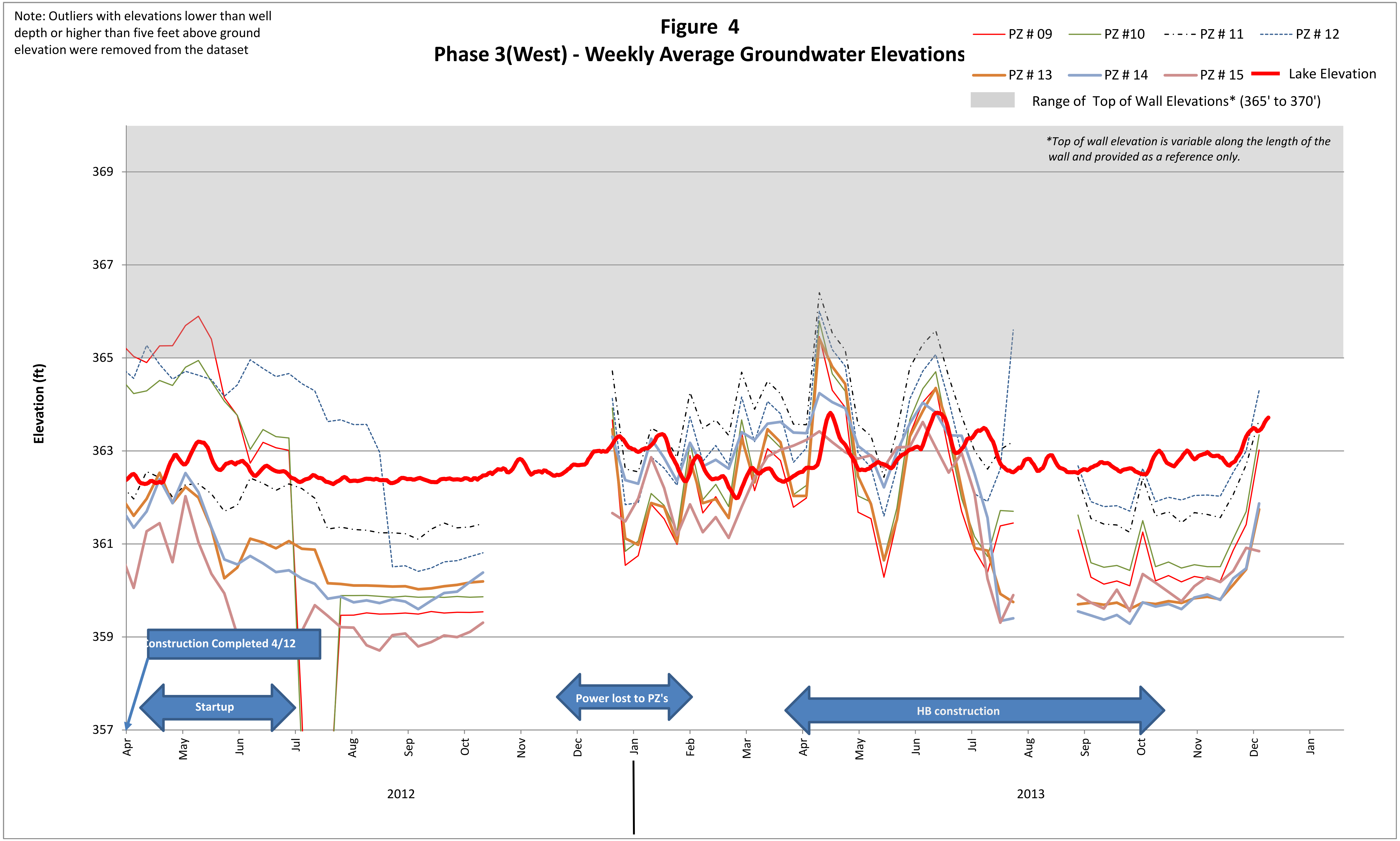
301 Plainfield Road, Suite 350, Syracuse, NY 13212



Note: Outliers with elevations lower than well depth or higher than five feet above ground elevation were removed from the dataset.
Figure 2
Phase 1 (Semet) - Weekly Average Groundwater Elevations
PZ # 01
PZ # 02
PZ # 03
Lake Elevation
Range of Top of Wall Elevations* (368' to 369')
*Top of wall elevation is variable along the length of the wall and provided as a reference only.
Elevation (ft)
369
368
367
366
365
364
363
362
361
360
Start-Up
Construction Complete 5/07
Shutdown Maintenance
Shutdown Due to Lake Flooding
Maintenance Shutdown
Nov
Jan
Mar
May
Jul
Sep
2007
2008
2009
2010
2011
2012
2013

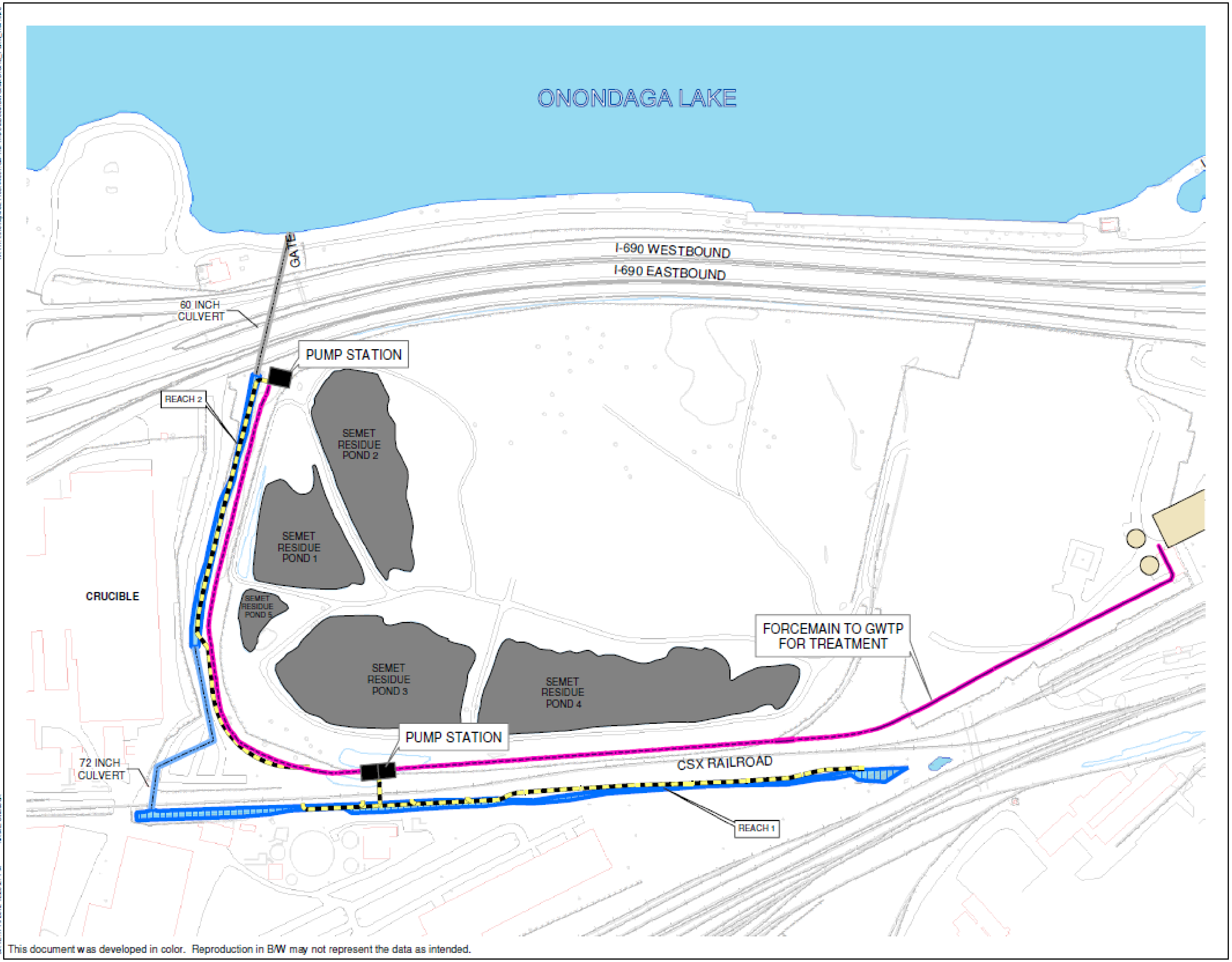


Note: Outliers with elevations lower than well depth or higher than five feet above ground elevation were removed from the datset
Figure 3
Phase 2 (Willis) - Weekly Average Groundwater Elevations
PZ # 04
PZ # 05
PZ # 06
PZ # 07
PZ # 08
Lake Elevation
Range of Top of Wall Elevations* (365' to 368')
*Top of wall elevation is variable along the length of the wall and provided as a reference only.
Elevation (ft)
368
367
366
365
364
363
362
361
360
359
Start-Up
Shutdown Due to Lake Flooding
Maintenance Shutdown
(w/ Supplemental Pumping)
Construction Complete 11/09
Leak in WB1-8 Force Main
Jan
Mar
May
Jul
Sep
Nov
2010
2011
2012
2013



Note: Outliers with elevations lower than well depth or higher than five feet above ground elevation were removed from the dataset
Figure 4
Phase 3(West) - Weekly Average Groundwater Elevations
PZ # 09
PZ #10
PZ # 11
PZ # 12
PZ # 13
PZ # 14
PZ # 15
Lake Elevation
Range of Top of Wall Elevations* (365' to 370')
*Top of wall elevation is variable along the length of the wall and provided as a reference only.
Elevation (ft)
369
367
365
363
361
359
357
Construction Completed 4/12
Startup
Power lost to PZ's
HB construction
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
2012
2013

FIGURE 5



LEGEND

- 60 INCH CULVERT
- 72" CULVERT REHABILITATION
- FORCEMAIN
- COLLECTION TRENCH
- TRIBUTARY 5A
- GROUNDWATER TREATMENT PLANT
- SEMET PONDS

HONEYWELL
TRIBUTARY 5A
GEDDES, NEW YORK

SITE PLAN

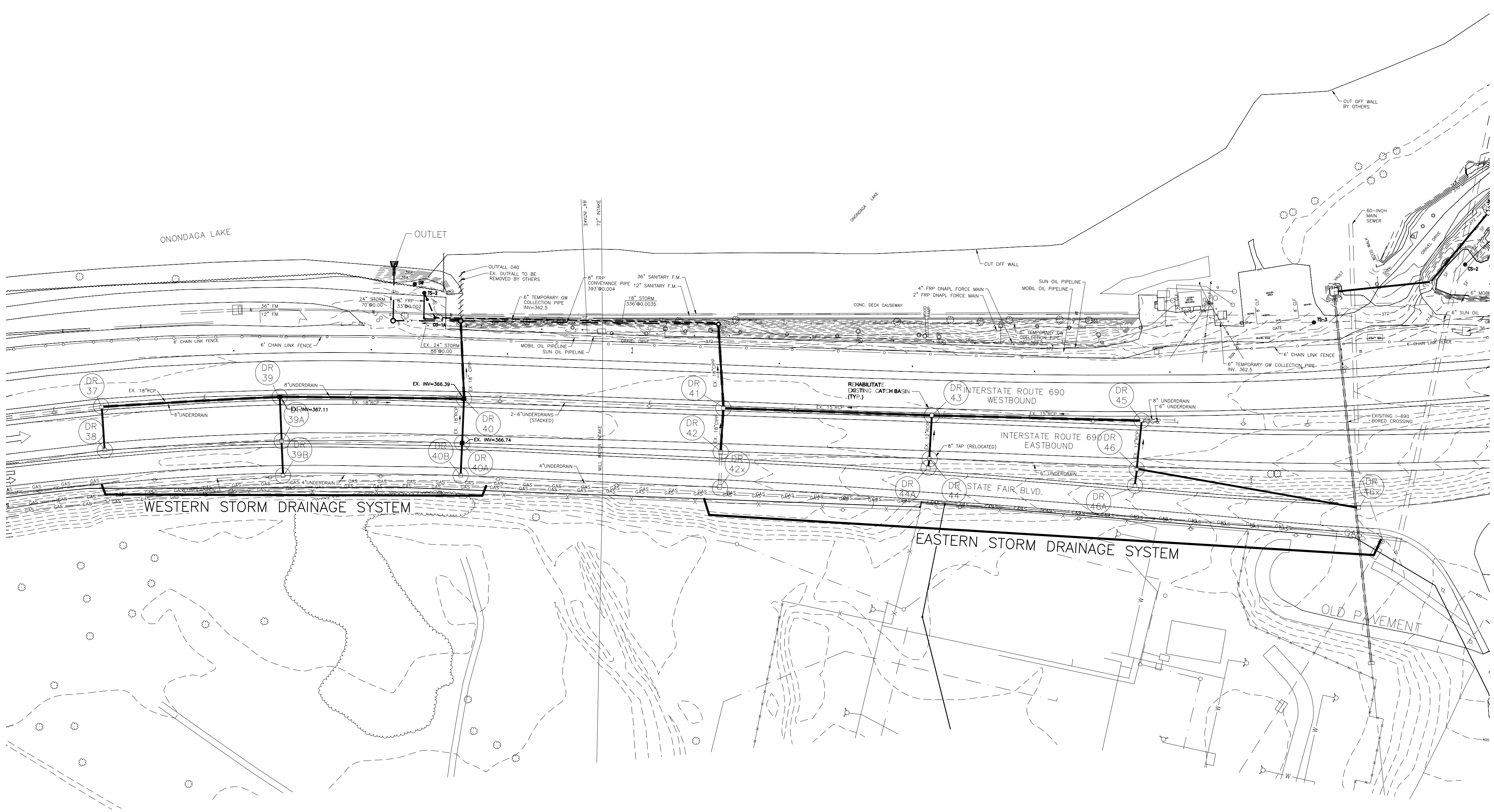
0 125 250 500
Feet

JULY 2012
1163.44951

O'BRIEN & GERE

Dec 18, 2013 – 2:20pm

FIGURE 6



LEGEND

CIPP INSTALLED

HONEYWELL INTERNATIONAL INC.
TOWN OF GEDDES
SYRACUSE, NEW YORK

I–690 STORM DRAINAGE SYSTEM

1"=160'
160 0 160

FILE NO. 1163.46699–020–FIG6
DECEMBER 2013

O'BRIEN & GERE

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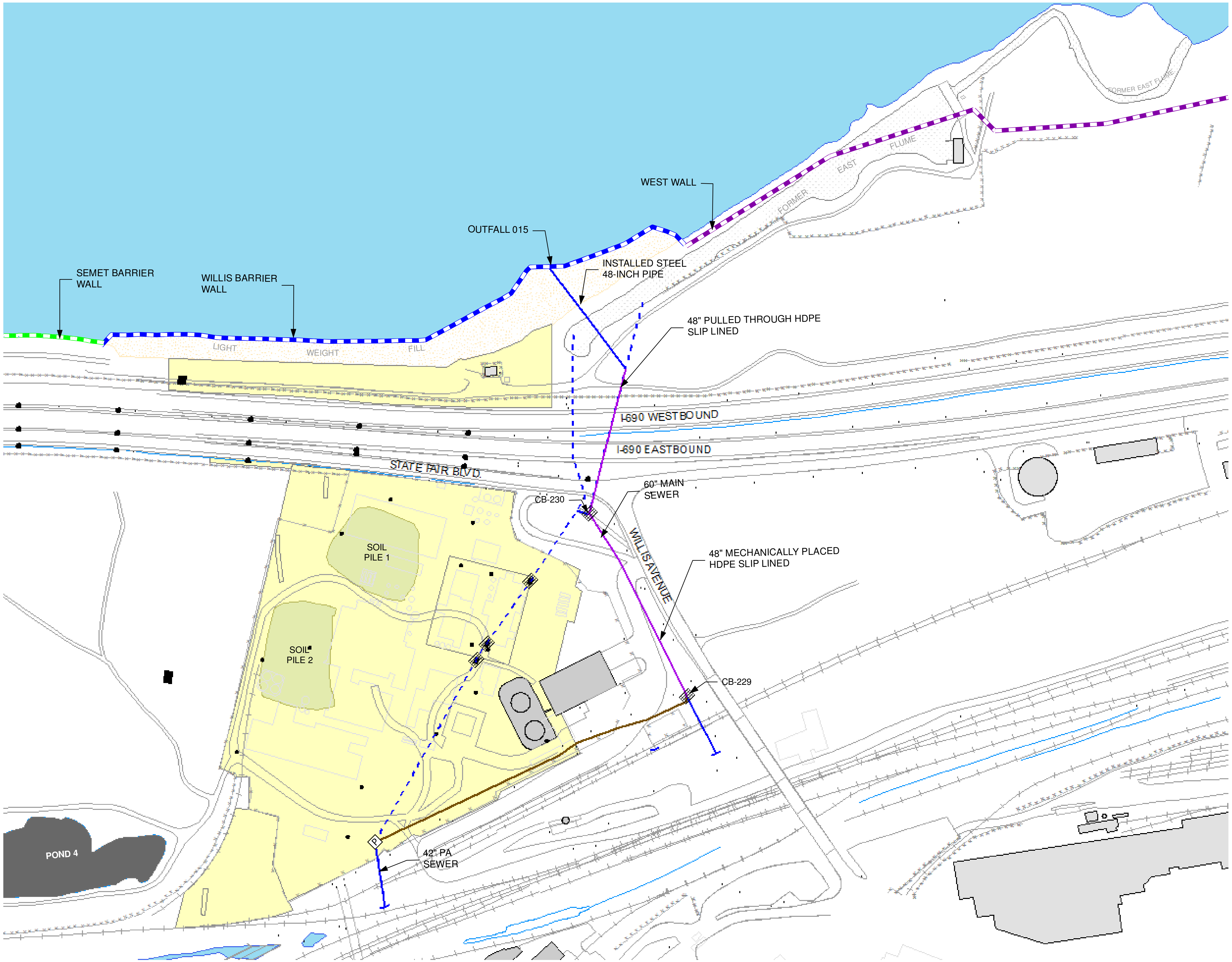
FIGURE 7



LEGEND

- CATCH BASIN
- P PUMP STATION
- ORIGINAL SEWER
- ABANDONED PA SEWER
- 48" SLIP LINED PIPE
- NEWLY INSTALLED CONVEYANCE PIPE

WILLIS AVENUE
CHLOROBENZENE SITE
REMEDIAL INVESTIGATION
GEDDES, NEW YORK

PA SEWER REMEDIATION

0 125 250 500
Feet

DECEMBER 2013
1163.44042

O'BRIEN & GERE

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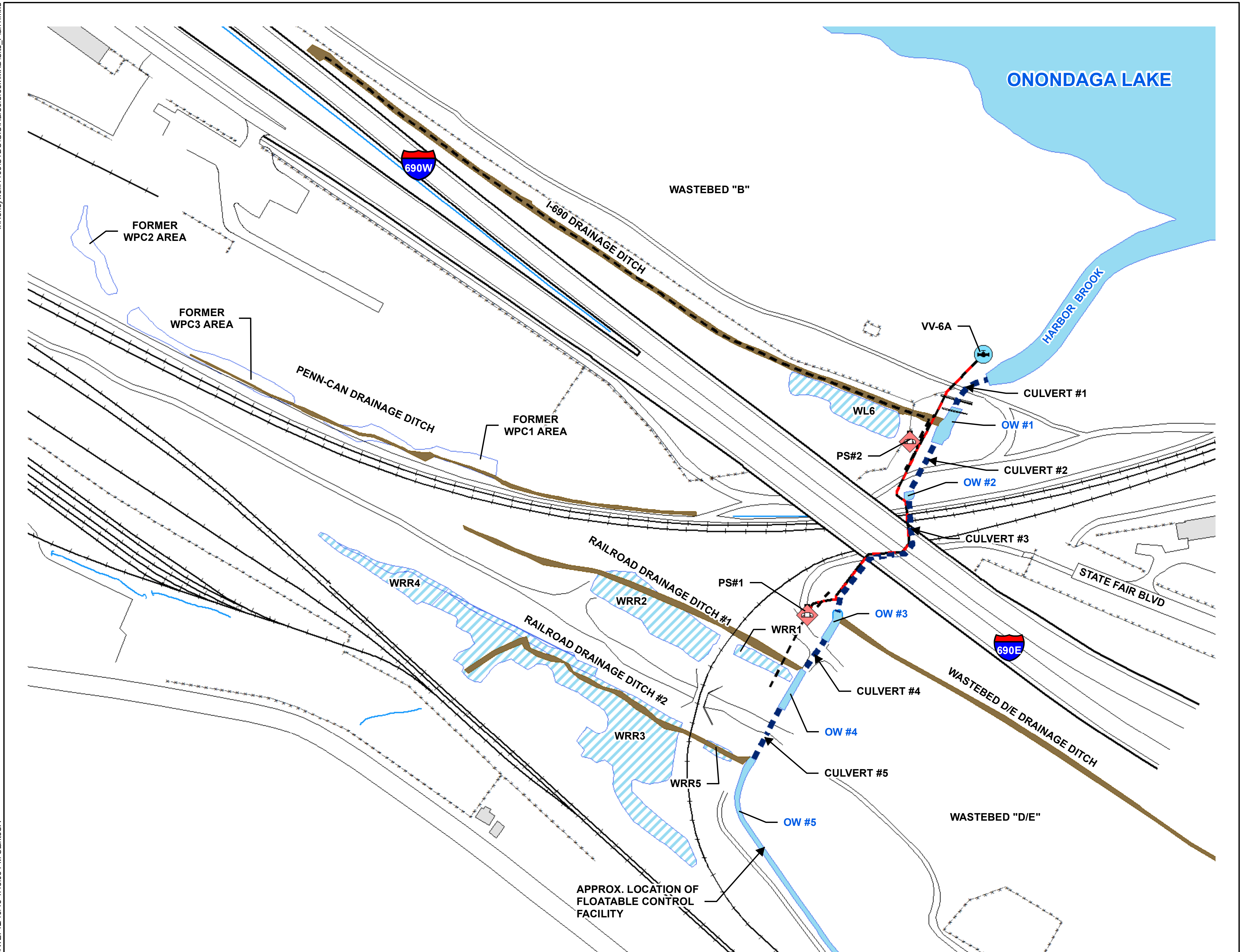

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FIGURE 8

N

LEGEND

- PUMP STATION
- VALVE VAULT
- GROUNDWATER COLLECTION PIPE
- CULVERT
- FORCE MAIN
- FENCELINE
- RAILROAD
- HIGHWAY
- ROAD
- WETLAND
- OPEN WATER
- DITCH
- BUILDINGS

NOTE:
REFER TO FIGURE 3 FOR SITE PLAN SHOWING THE GROUNDWATER COLLECTION AND FORCE MAIN PIPING.

HONEYWELL INTERNATIONAL INC.
UPPER HARBOR BROOK IRM
SYRACUSE, NEW YORK

SITE PLAN

0 100 200 400
Feet

DECEMBER 2013
1163.49142

O'BRIEN & GERE