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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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.

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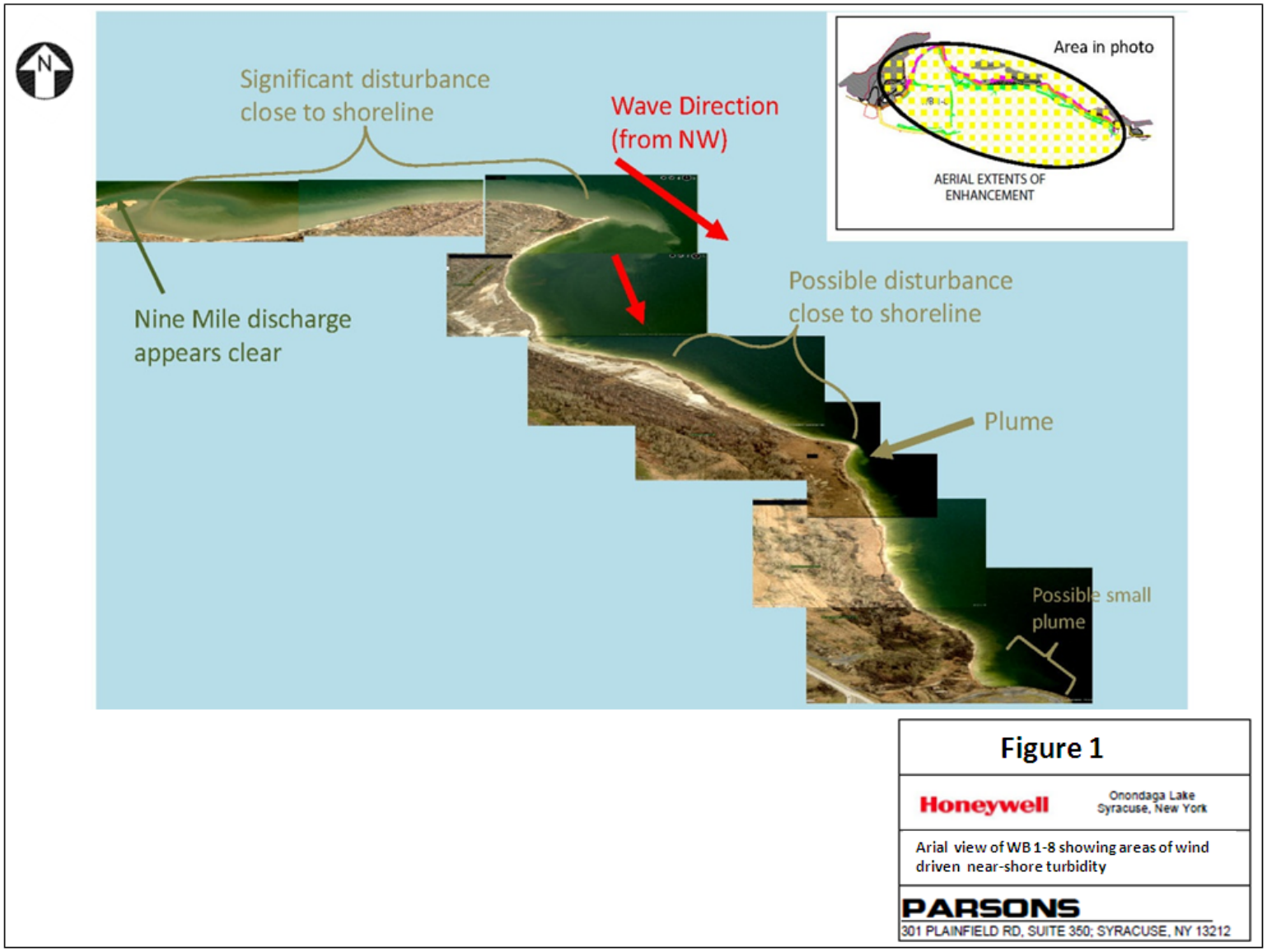
Parsons, Anchor QEA, and Exponent. 2012. *Draft Quality Assurance Project Plan for Onondaga Lake Construction and Post-Construction Monitoring.* Prepared for Honeywell, Morristown, New Jersey. Syracuse, New York.

United States District Court, Northern District of New York. 2007. State of New York and Denise M. Sheehan against Honeywell International, Inc. Consent Decree Between the State of New York and Honeywell International, Inc. Senior Judge Scullin. Dated October 11, 2006. Filed January 4, 2007.

FIGURES


Significant disturbance close to shoreline
Wave Direction (from NW)
Area in photo
AERIAL EXTENTS OF ENHANCEMENT
Nine Mile discharge appears clear
Possible disturbance close to shoreline
Plume
Possible small plume
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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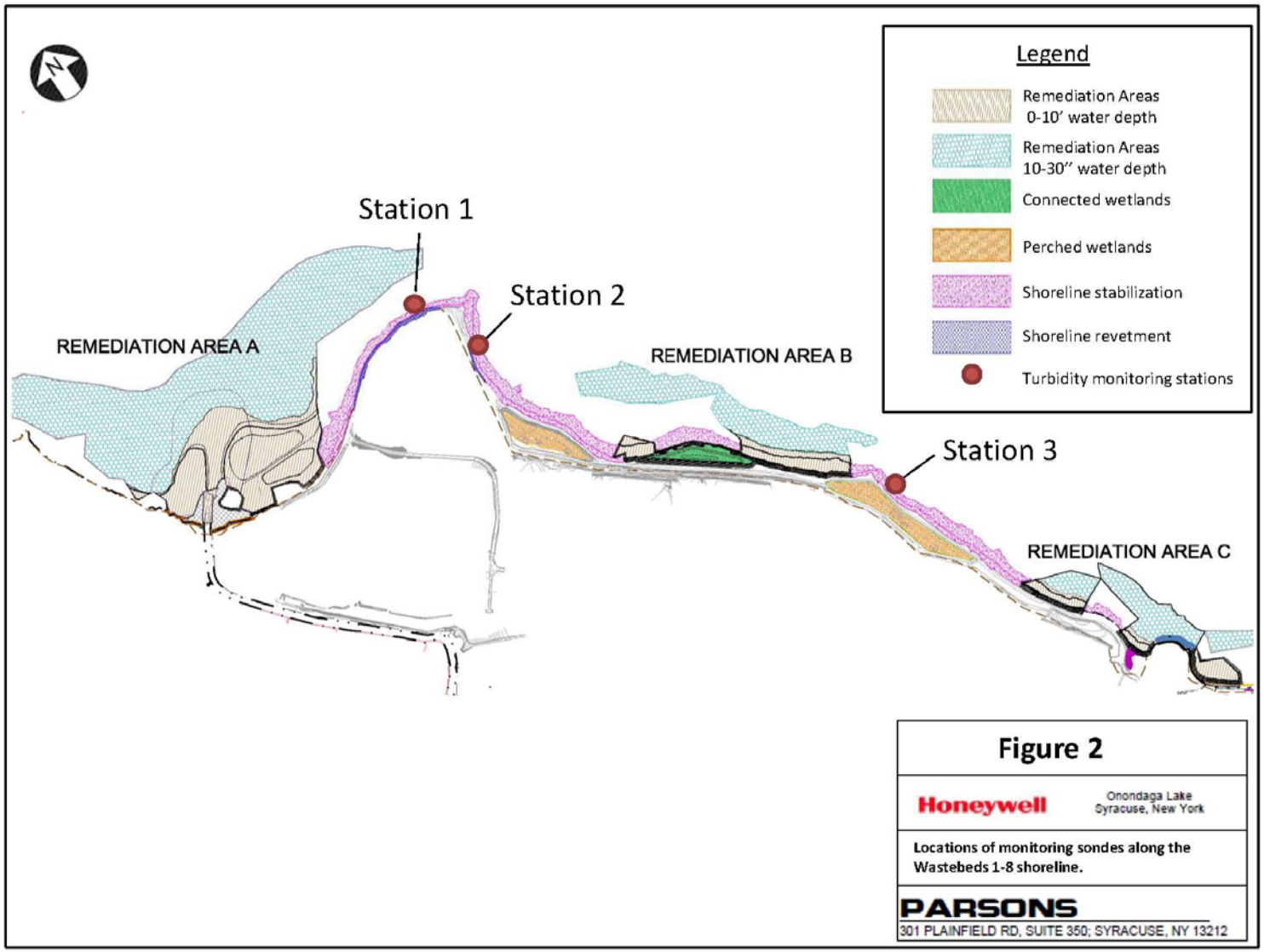
Legend
Remediation Areas 0-10' water depth
Remediation Areas 10-30'' water depth
Connected wetlands
Perched wetlands
Shoreline stabilization
Shoreline revetment
Turbidity monitoring stations
Station 1
Station 2
Station 3
REMEDIATION AREA A
REMEDIATION AREA B
REMEDIATION AREA C
Figure 2
Honeywell
Onondaga Lake
Syracuse, New York
Locations of monitoring sondes along the Wastebeds 1-8 shoreline.
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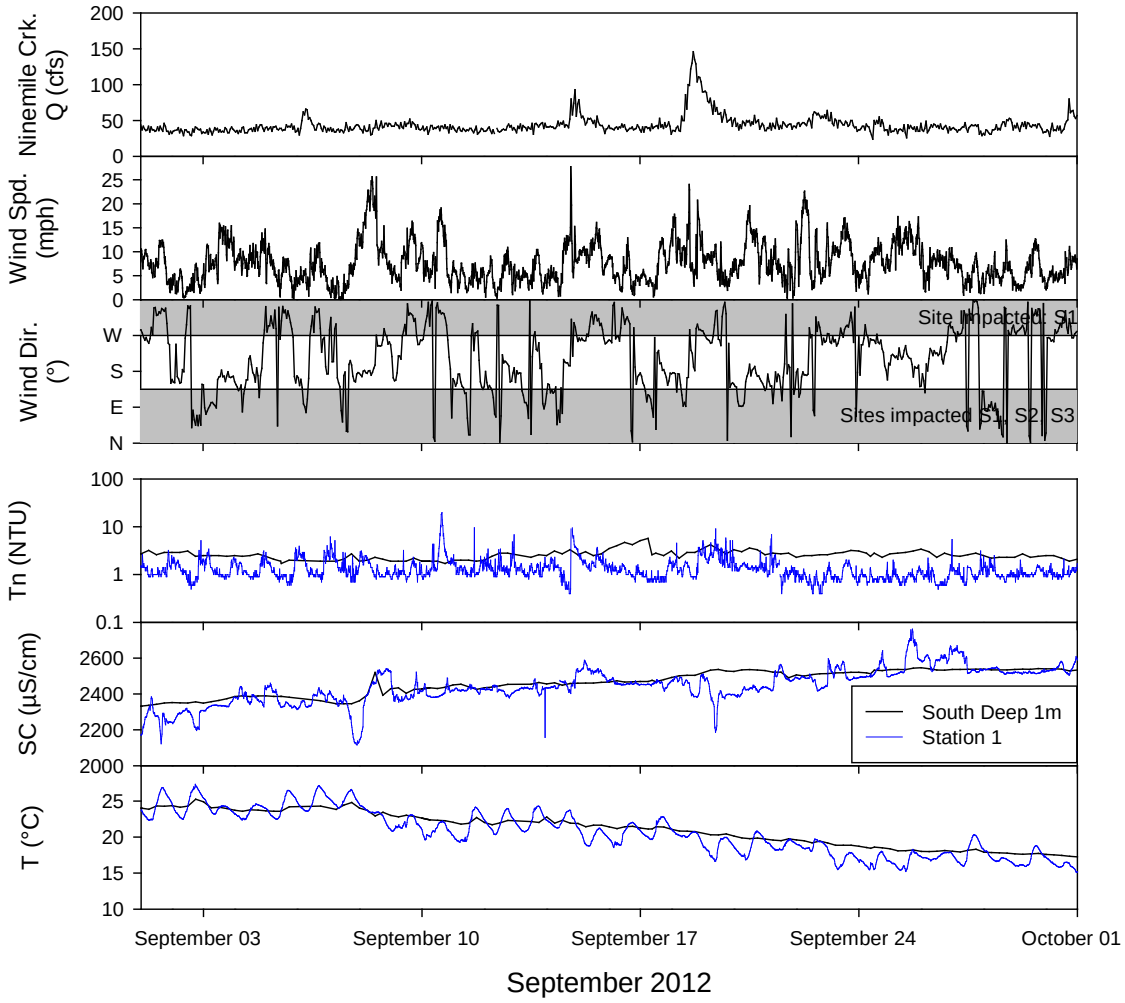

Figure 3. Station 1 preliminary time series data collected during reconnaissance period (August 31- October 1) with drivers and South Deep 1m reference. Note: these data have received minimal QC review and are thus subject to change.

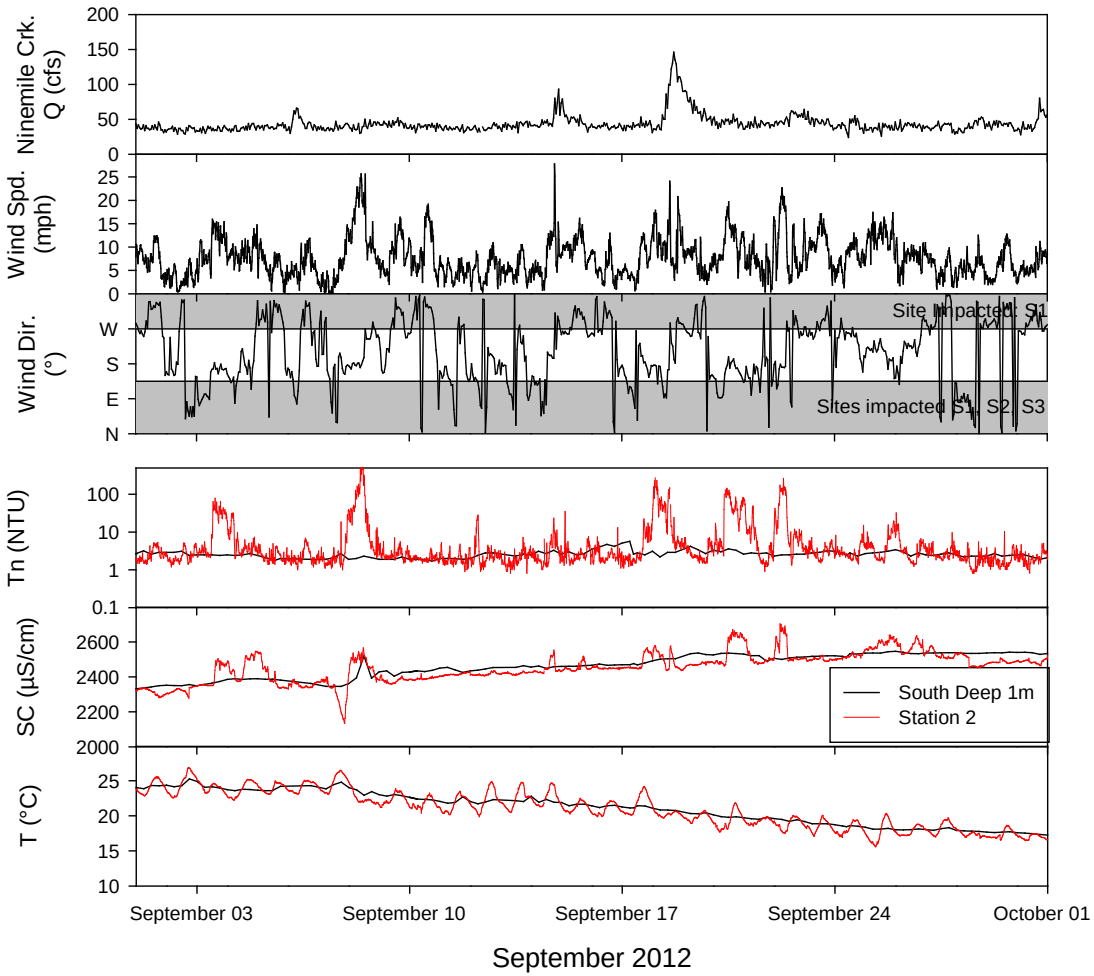

Figure 4. Station 2 preliminary time series data collected during reconnaissance period (August 31- October 1) with drivers and South Deep 1m reference. Note: these data have received minimal QC review and are thus subject to change.

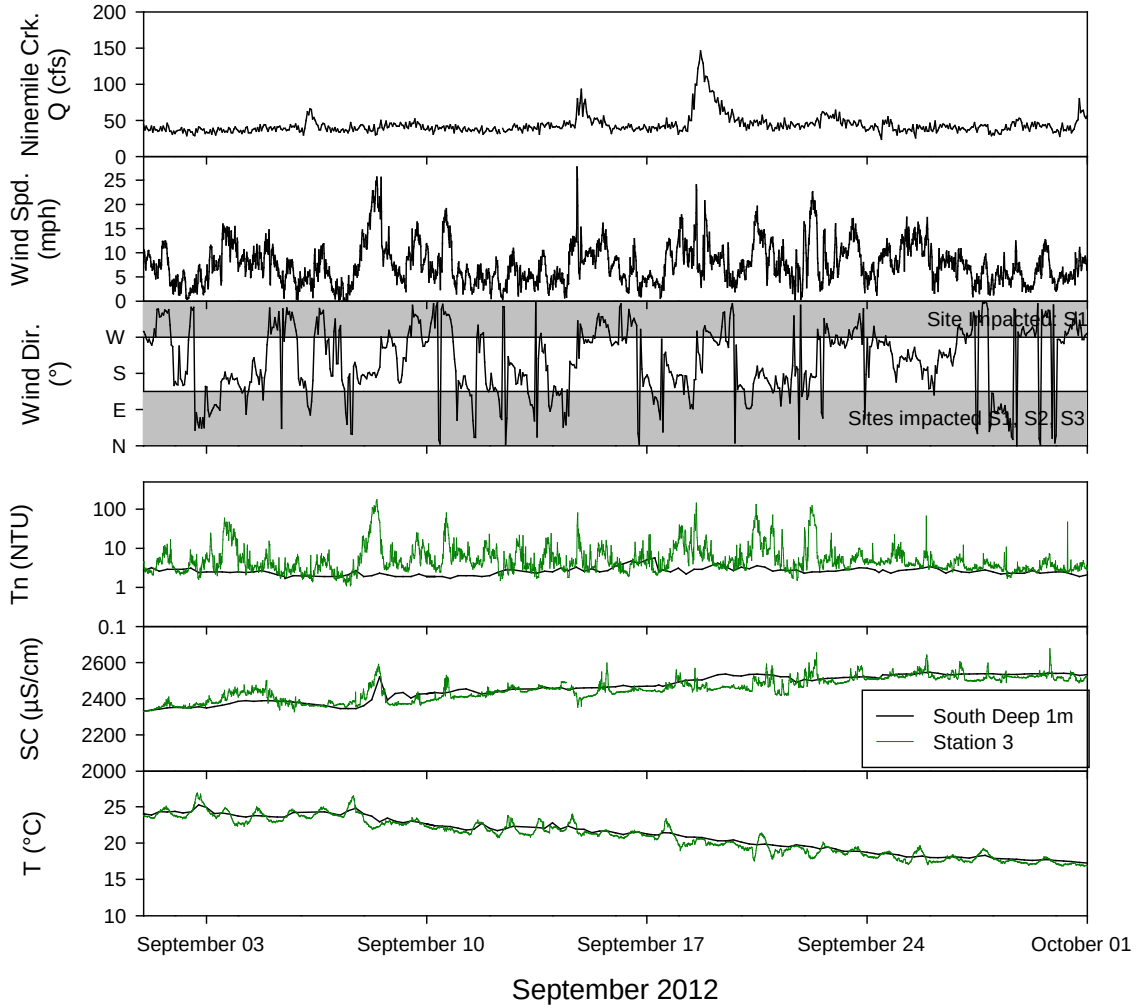

Figure 5. Station 3 preliminary time series data collected during reconnaissance period (August 31- October 1) with drivers and South Deep 1m reference. Note: these data have received minimal QC review and are thus subject to change.

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. Calculations:
Raw data are converted to units of scientific measure internally by the sensor.
17. Method performance: Performed according to manufacturer's recommendations.
18. Pollution prevention:
All calibration solutions are flushed down the drain in the sink with tap water.
19. Data assessment and acceptance criteria for quality control measures:
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. Corrective actions for out-of-control or unacceptable data:
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. 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:
All calibration solutions are flushed down the drain in the sink with tap water.
23. References:

- 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. Calculations:
Raw data are converted to units of scientific measure internally by the sensor.

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 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