UPDATED FINAL

Porewater Field Sampling Plan

Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling

Portland Harbor Superfund Site

AECOM Project Number: 60554349
Geosyntec Project Number: PNG0767A

Revision 4 (August 20, 2018)

Prepared for:

United States Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101

On behalf of:

Portland Harbor Pre-RD AOC Group
Portland, Oregon

Prepared by:

AECOM

111 SW Columbia, Suite 1500
Portland, OR 97201
USA

Geosyntec consultants

520 Pike Street, Suite 1375
Seattle, WA 98101
USA

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Kenneth M. Tyrrell

August 8, 2018

Kenneth M. Tyrrell
PDI Project Coordinator
AECOM Technical Services

Date

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

µg/L	microgram per liter
°C	degrees Celsius
AECOM	AECOM Technical Services
ASAOC	Administrative Settlement Agreement and Order on Consent
bml	below mudline
cm	centimeter
CSM	Conceptual Site Model
DGPS	differential global positioning system
DI	deionized
DO	dissolved oxygen
DQOs	data quality objectives
D/U Reach	Downtown/Upriver Reach
EPA	United States Environmental Protection Agency
FC	Field Coordinator
FS	feasibility study
FSP	Field Sampling Plan
Geosyntec	Geosyntec Consultants, Inc.
Germano	Germano and Associates
GPS	global positioning system
ID	identification number
IDW	investigation-derived waste
Integral	Integral Consulting
KBr	potassium bromide
LWG	Lower Willamette Group
mg/kg	milligram per kilogram
mg/L	milligrams per liter
mL	milliliter
mV	millivolts
NaBr	sodium bromide
NOAA	National Oceanic and Atmospheric Administration
ODEQ	Oregon Department of Environmental Quality
ORP	oxidation-reduction potential
PDI	pre-remedial design investigation
PHSS	Portland Harbor Superfund Site
Pre-RD AOC Group	Pre-Remedial Design Agreement and Order on Consent Investigation Group
QA	quality assurance

QAPP	Quality Assurance Project Plan
QC	quality control
RI	remedial investigation
RM	River Mile
RPD	redox potential discontinuity (redox)
ROD	Record of Decision
SiREM	SiREM Laboratories
Site	Portland Harbor Superfund Site
SOP	Standard Operating Procedure
SOW	Statement of Work
SPI	sediment profile imaging
SWI	sediment/water interface
TestAmerica	TestAmerica Laboratories
TOC	total organic carbon

1. INTRODUCTION

The Record of Decision (ROD) described a post-ROD sampling effort for the Portland Harbor Superfund Site (Site or PHSS; Figure 1) located in Portland, Oregon, to delineate and better refine the sediment management area footprints, refine the Conceptual Site Model (CSM), determine baseline conditions, and support remedial design (United States Environmental Protection Agency [EPA] 2017a). Geosyntec Consultants, Inc. (Geosyntec), and AECOM Technical Services (AECOM) developed a detailed Work Plan for Pre-Remedial Design Investigations (PDI) on behalf of a group of industrial parties called the Pre-Remedial Design Agreement and Order on Consent Investigation Group (Pre-RD AOC Group). On December 19, 2017, EPA entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) with the Pre-RD AOC Group to conduct the PDI studies at the Site (EPA 2017b). The ASAOC includes a Statement of Work (SOW) and the Work Plan (as an attachment to the SOW), which generally describe the agreed upon field investigation activities, data analyses, schedule, and deliverables for the PDI.

These PDI studies are a foundational step in what will be a multi-phase effort to update current conditions from the collection of data during the remedial investigation (RI)/feasibility study (FS). The RI/FS was initiated by a group of potentially responsible parties known as the Lower Willamette Group (LWG) and completed by EPA in 2016 (EPA 2016a, 2016b). The RI consisted of three rounds of data collection, including surface and subsurface sediment, bank soils, surface water, sediment traps, porewater, fish tissue, and other media from 2001 through 2007.

This Field Sampling Plan (FSP) was prepared to support the porewater sampling efforts outlined in the PDI Work Plan (Geosyntec 2017) and the project Quality Assurance Project Plan (QAPP) (AECOM and Geosyntec 2018a). To the extent practicable, sampling methods from previously approved FSPs from the RI will be referenced.

1.1 Project Setting

The PHSS is located in Portland, Oregon, on the lower Willamette River immediately downstream of the urban downtown. The Site extends from River Mile (RM) 1.9 near the mouth of the Willamette River upstream to RM 11.8 (Figure 1). There are two reaches located immediately upstream of the Site. The Downtown Reach, which includes the urbanized area of downtown Portland, is defined by EPA as extending from RM 11.8 to RM 16.6. EPA defines the Upriver Reach as extending from RM 16.6 to RM 28.4.

1.2 Data Quality Objectives

The prior RI did not establish background conditions for naturally occurring metals in transition zone or porewater. Arsenic and manganese naturally occur in volcanic rocks that are a significant source to the Willamette River sediments. This porewater FSP will describe the sampling and analysis of data to inform the background metals transition zone/porewater concentrations of arsenic and manganese and refine the CSM regarding these concentrations in the transition zone/porewater up to 30 centimeter (cm) below mudline (bml). Results will inform remedial action objectives, where appropriate, as described in Section 3.2.8 of the PDI Work Plan (Geosyntec 2017).

This FSP is supported by the QAPP (AECOM and Geosyntec 2018a). Data quality objectives (DQOs) for porewater sampling are detailed in Table 3 of the QAPP.

2. SAMPLING DESIGN AND APPROACH

The sampling design, rationale for approach, and data use objectives are described in detail in the PDI Work Plan and in this FSP. Data collected during the work will be used to assist in the development of background metals porewater concentrations and to further inform remedial action objectives. This FSP has been prepared to meet the project DQOs. To the extent possible, this FSP relies on methods adopted and used in previously approved FSPs from the RI (Integral Consulting [Integral] 2002, 2004, 2006) and the *Round 2 Groundwater Pathway Assessment Sampling and Analysis Plan Attachment 2 Transition Zone Water Field Sampling Plan* (Integral 2005).

2.1 Porewater Sampling Rationale

Background metals concentrations in porewater were not fully defined during the RI. The focus of this background porewater study is to characterize the soluble concentrations of naturally occurring metals arsenic and manganese associated with the upstream Downtown/Upriver Reaches. Porewater samples will be analyzed only for arsenic and manganese based upon the rationale provided below and in the PDI Work Plan (Geosyntec 2017), which was incorporated into the ASAOC.

Metals, especially arsenic and manganese, are present in relatively high concentrations in volcanic rocks, which are the primary geological sources of Willamette River sediment (Trimble 1963). Porewater concentrations above ROD cleanup levels (0.018 micrograms per liter [µg/L] for arsenic and 430 µg/L for manganese) may occur in the transitional zone water near the mudline. This occurrence is a result of the geochemistry that favors dissolution of these metals from the solid mineral components of the sediment. Exceedances of ROD cleanup levels for arsenic and manganese in porewater may arise solely due to the natural presence of arsenic and manganese in sediment. As such, the goal of this FSP is to measure the concentrations of arsenic and manganese in sediment porewater under natural conditions (i.e., in sediments without a known contaminant-derived addition of arsenic and manganese) in order to define and establish background concentrations of arsenic and manganese in porewater. The rationale for selection of locations is detailed in Section 2.2.

The target depth for sampling will be 30 cm bml in areas with a shallow oxic zone (targeting anoxic sediments), as discussed below in Section 2.3. A similar depth was sampled in the RI using peepers (0 to 38 cm bml; 0 to 30 cm for Trident peepers). Depending on field conditions, an acceptable depth would be about 20 cm; if that is not possible, it is recommended to move to another target station for better penetration depth. Targeting the upper 30 cm of the sediment column is consistent with sampling depth for porewater in the RI and will match the sediment sampling depth for co-located bulk surface sediment samples (0 to 30 cm).

Vertical stratification of redox conditions results from the oxidation of organic matter, and the interface between oxic and anoxic conditions (measured as apparent redox potential discontinuity [RPD]), is very sensitive to metals availability (Germano & Associates [Germano] 2014). As noted in sediment profile imaging (SPI) studies (Striplin Environmental Associates, Inc. 2002; Germano 2014), the average apparent RPD depths throughout the Site ranged from about 0.4 to 5 cm, with an overall Site average of 2.7 cm (Figures 18a-e in Germano 2014). The deepest RPD layers were observed in the depositional nearshore areas (3 to 6 cm depth), and hardly any stations were deeper than 7 to 8 cm RPD depth. The target depth for porewater sampling is 6 to 30 cm in areas with a shallow RPD depth and anoxic conditions as measured during the historical SPI studies.

2.2 Selection and Rationale for Sampling Locations

The Upriver Reach (defined as RM 16.6 to 28.4) was used in the RI as the reference area for evaluating background sediment concentrations (Figure 1). This area extends from the upstream end of Ross Island Lagoon to approximately 2.5 miles above Willamette Falls, which was considered generally representative of upstream sediment loading to Portland Harbor. However, sediments in the Upriver Reach are generally coarser with lower organic carbon. For the PDI porewater study, the Downtown Reach and Upriver Reach (D/U Reach) were both considered for determination of proposed sampling locations for evaluating porewater background.

Proposed sampling locations will target representative areas of background metals in porewater. Both arsenic and manganese are redox sensitive metals that are naturally elevated in reducing conditions often found in groundwater upwelling or high organic carbon content sediment. These conditions represent areas of elevated naturally occurring background concentrations of these metals. Proposed target areas for porewater sampling that are representative of naturally occurring background concentrations were identified based on the following available criteria:

- Areas of thicker sediment zones (depositional)
- Areas of shallow RPD (< 6 cm)
- Areas of fine-grained, high organic carbon content sediments
- Areas with historic presence of methane bubbles and reducing conditions (based on SPI reports)
- Areas downgradient of wetlands
- Areas within Willamette River provenance, but away from known industrial contaminant sources

- Arsenic concentrations less than 8.8 milligrams per kilogram (mg/kg) in co-located bulk sediment samples
- Spatial coverage across upstream area

Available data from the RI and the more recent Oregon Department of Environmental Quality (ODEQ) investigation in the Upriver Reach (GSI Water Solutions and Hart Crowser 2018) were evaluated to determine target sampling areas in collaboration with EPA. Twelve initial target areas for proposed sampling have been identified based on a review of the above criteria (Table 1 and Figure 2). Eight or nine sampling locations will be selected following evaluation of the co-located surface sediment grab sample data. While only one ODEQ sample was co-located within proposed PDI sampling areas, all samples reported arsenic concentrations less than 8.8 mg/kg in bulk sediments. Percent fines for ODEQ samples ranged from 11% to 30%.

Co-located sediment grab samples collected prior to peeper deployment will allow confirmation of grain size, total organic carbon (TOC), and concentrations of arsenic and manganese in sediment at proposed porewater locations to evaluate if sediment concentrations reflect uncontaminated areas and ambient conditions. Of the 12 currently proposed sampling locations, 10 include a co-located PDI D/U Reach surface sediment sampling location (red dot on Figure 2 series); these will be utilized where possible as the co-located grab sample for porewater. An additional three stations may be sampled for arsenic, manganese, TOC, and grain size (blue dot in Figure 2 series).

Additionally, the redox conditions of sediment will be measured *in situ* and in the grab sample to confirm anoxic conditions are present and to measure the RPD (approximately one month prior to deployment of peepers). Following collection of sediment grab samples, the arsenic concentrations will be analyzed first, and if found to be representative of background, additional sample volume will be analyzed for manganese, grain size, and TOC (if not already targeted for analysis). For reference, the EPA-defined background concentration for arsenic in the Portland Harbor is 3 mg/kg in sediment (EPA 2016a)[1] based on upstream conditions. Mean arsenic background concentrations in Southern Willamette Valley soils are closer to 20 mg/kg based on depositional source material in the area (Hurtado 2015), and ODEQ reports regional arsenic background concentrations in soils as 8.8 mg/kg in the Portland basin and 18 mg/kg in the south Willamette Valley (ODEQ 2013).

2.3 Porewater Collection Approach

Porewater peepers will be deployed in triplicate (for three-point composite samples) at eight or nine locations to define the background ranges of arsenic and manganese in porewater. Each peeper will include an array of five peeper vials secured in a peeper frame for deployment in sediment (Figure 3). Each station will include a fourth peeper to evaluate field water quality parameters.

---

[1] The RI did not establish a background concentration of manganese in sediment.

2.3.1 Confirmation of Anoxic Conditions

A three-step approach will be used to evaluate the redox conditions of porewater/sediment to confirm sample locations and to confirm samples are representative of anoxic conditions. These steps are described briefly below and detailed in Section 4.4.1:

- Step 1 – Approximately 30 Days Prior to Peeper Deployment: During the collection of bulk sediment grab sampling for chemistry at all 12 target locations, an optical dissolved oxygen (DO) probe will be used (i) *in situ* when practicable to confirm the presence/absence of anoxic conditions; and will be used (ii) *ex situ* in the sediment grab sampler brought onboard the vessel deck to measure the sediment vertical profile of DO by depth. An oxidation-reduction potential (ORP) redox probe will be used as a second line of evidence to evaluate anoxic conditions *ex situ*.[2]
- Step 2 – Day 1 Peeper Deployment: Immediately prior to deployment of peepers, the optical DO probe will be used *in situ* when practicable to confirm presence of anoxic conditions (presence/absence and not a DO profile with depth). To minimize the disturbance of sediment in the target area, no sediment sample will be collected for field parameter monitoring.
- Step 3 – Day 30 Peeper Retrieval: Immediately following retrieval, the hand-held DO probe will be used to measure the time-averaged DO of each porewater peeper vial from a dedicated peeper frame, along with other water quality parameters.[3] After a DO profile with depth is determined in the field, only anoxic porewater will be composited for analysis. An ORP redox probe may be used as a second line of evidence to evaluate anoxic conditions.

2.3.2 Porewater Sampling Approach

In situ porewater sampling will be conducted via placement of dialysis equilibrium passive porewater samplers (referred to as peepers) to a target depth of between 6 and 30 cm deep in the sediment bed (bml and below the sediment/water interface [SWI]) in areas that are considered representative of background metals. This target depth was selected because the average apparent RPD below the SWI is approximately 6 cm based on a review of SPI studies (Striplin Environmental Associates, Inc. 2002; Germano 2014). The custom-designed peepers for this project consist of five stacked peeper vials (as described below) contained in a 15-inch-long 3D-printed high-density polyethylene frame. When placed in sediment, the peeper vials sample porewater to the targeted depth (6 to 30 cm bml) (Figure 3). If peepers are unable to be inserted

---

[2] It will be difficult to get vertical resolution *in situ*, so the vertical profiling will only be conducted in the grab samples with both the DO and ORP redox probes. *In situ* probing only evaluated for presence/absence of anoxic conditions. Additional protection will be added to the probes for insertion into sediment to prevent damage to the probe.

[3] The time-averaged water quality measurement in the peeper vials at the end of the deployment will be the most reliable indicator of anoxic versus oxic over the duration of the deployment.

to the full target depth due to resistance or refusal, only porewater collected from depths represented by anoxic sediment will be collected as described above.

Peeper deployment will target August, when surface water flow is lowest and lateral groundwater discharge to the river is highest. Targeting these months allows for porewater samples reflective of background concentrations relating to low redox conditions of groundwater infiltration in porewater.

Peeper construction includes a glass or polyethylene peeper vial covered with a 0.45-micrometer polyether sulfone membrane. The interior of a peeper vial consists of rows of chambers that are filled with deionized (DI) water prior to deployment.

During deployment, concentrations of arsenic and manganese in ambient sediment porewater will diffuse through the peeper vial membrane into the DI water within the peeper vial. This equilibration process will occur over 28 days (4 weeks), whereupon the peepers will be retrieved and the DI water within the peeper vials extracted at the field laboratory and sent to the designated contract laboratory to be analyzed for arsenic and manganese. As with any *in situ* analysis, there is some potential risk for sampler loss over the deployment period; however, the peeper design includes weights to secure peepers in place, and good retrieval has been achieved at previous sites where peepers have been deployed. Previously, during the RI, a 3-week deployment time was used for peeper deployment (Integral 2005); therefore, a 4-week deployment (proposed in this FSP) should be sufficient for equilibrium to be established.

Additionally, a known amount of chemical tracer (bromide) will be placed in the DI water within each peeper vial and measured after deployment to evaluate achievement of equilibrium based on the methods described in Thomas and Arthur (2010). The methods use the relative known diffusion rates across the peeper vial membrane for arsenic, manganese, and bromide to determine the percent of equilibrium achieved. Calculations based on diffusion rates and peeper volumes indicate that arsenic will reach > 90% equilibrium, and manganese will reach 75% to 80% equilibrium within 28 days. Samples will be considered acceptable if 80% to 100% of equilibrium has been achieved, per the definition of steady-state in Kennedy et al. (2010). For samples that have not reached at least 80% equilibrium, the percentage of equilibrium achieved will be used to correct the reported porewater concentration to an equilibrium equivalent value.

2.4 Sample Identification

2.4.1 Sample Locations and Depths

As discussed in Section 2.2, 12 preliminary target areas have been determined based on desktop review of existing information (see Section 2.2) and coordination with EPA to identify areas representative of background levels of naturally occurring metals (Figure 2). Final sample locations will be determined following field reconnaissance and evaluation of co-located bulk sediment grab samples, and in coordination with EPA. All porewater samples will be taken as three-point composite samples of anoxic porewater. The diameter of the peeper vial membrane is relatively small, approximately 3.7 cm (inner diameter of peeper is 3.2 cm); therefore, five peeper vials will be stacked in a 15-inch peeper frame, so that when inserted into the sediment, these peepers will sample from the target depth of 6 to 30 cm bml.

2.4.2 Sample Nomenclature

Sample identification will be performed in a manner similar to the LWG Round 1 FSP (Integral 2002: Section 4.2) and consistent with the QAPP (AECOM & Geosyntec 2018a). All samples will be labeled with an identification number (ID) that uniquely identifies the sample and includes the following:

- Project phase (PDI)
- Sample matrix (WP [water, pore])
- Unique, sequential station number based on co-located sediment grab sample Station ID

For example, a porewater sample that is co-located with baseline sediment sample location B060 will be assigned the sample ID of PDI-WP-B060. Quality assurance/quality control (QA/QC) samples, including field duplicates and rinsate blanks are discussed in the QAPP. Trip blanks are not anticipated for this effort, because no porewater samples are being tested for volatile organic compounds.

2.5 Sampling Schedule

The review and selection of proposed sampling locations occurred in April/May 2018, in collaboration with EPA. Confirmation of concentrations of arsenic and manganese at proposed sampling locations will be targeted during the surface sediment sampling effort in July 2018. Following discussions of pre-screening results with EPA, all sampling locations will be finalized. Field sampling of porewater is targeted for August 2018 during periods of low flow.

2.6 Changes from Previously Approved FSPs

Porewater sampling during the RI was performed according to Integral (2005). Key changes from the LWG RI Round 2 FSP are detailed below:

- The RI used divers for deployment. Custom-designed peepers by Geosyntec/SiREM are being used with a diverless deployment system for this PDI sampling effort. These peepers allow for deployment in sediments from a vessel, thereby limiting the need of divers and potential related health and safety concerns.
- Peepers will be deployed for 4 weeks, instead of 3 weeks used in the RI.
- Monitoring of DO and ORP as a pre-screening step in sediment and in porewater samples; the RI did monitor ORP in the porewater using a Trident Probe at some porewater stations. DO was not measured during the RI.

- Depths of porewater sampling will target the anoxic zone only; the RI sampled the full 0 to 30 cm interval bml.
- Porewater samples will only be analyzed for dissolved arsenic, manganese, and the bromide tracer.

3. PROJECT ORGANIZATION

3.1 Team Organization and Responsibilities

Team organization is presented in detail in Section 2 of the QAPP (AECOM and Geosyntec 2018a). As it relates to this FSP, AECOM and Geosyntec are coordinating activities including management of all subcontractors, field sampling, analysis, and reporting scoping tasks. In brief, the PDI Project Coordinator, Mr. Ken Tyrrell, and PDI Project Manager, Dr. Jennifer Pretare, PhD (AECOM), will be responsible for overall project coordination and providing oversight on all project deliverables.

Dr. Jason Conder, PhD (Geosyntec), and Ms. Jennifer Arblaster (Geosyntec) are the Project Technical Leads specifically for porewater. They have deployed similar samplers for the Lower Duwamish Waterway pre-design studies and numerous other sites nationally. They will ensure that appropriate protocols for sample collection, preservation, and holding times are observed and oversee delivery of samples to the designated laboratory for chemical analyses. Ms. Nicky Moody (AECOM) and Mr. Keith Kroeger (Geosyntec) will be the Project Field Coordinators (FCs) and will be generally responsible for general field QA/QC oversight. Project Chemists include Ms. Julia Klens-Caprio (Geosyntec) and Ms. Amy Dahl (AECOM). The Project Chemists are responsible for coordination with labs regarding detection limits and matrix interferences.

Several subcontractors will be used for sampling and analysis. Gravity Marine, of Fall City, Washington, will perform vessel support, with Mr. Shawn Hinz acting as a point of contact. Analytical laboratories include TestAmerica Laboratories (TestAmerica) in Fife, Washington. Peepers will be prepared by SiREM Laboratories (SiREM) in Guelph, Ontario, Canada, with Mr. Jeff Roberts acting as Project Manager for SiREM.

3.2 Communication/Information Flow

The communication strategy is outlined in Section 2 of the QAPP (AECOM and Geosyntec 2018a). The FCs will be the points of contact for field staff during the implementation of this FSP. Deviations from this FSP or the project-specific QAPP will be reported to the PDI Project Manager for consultation. Significant deviations from the FSP/QAPP will be further reported to representatives of the Pre-RD AOC Group and EPA by the PDI Project Coordinator.

3.3 Coordination with EPA

The PDI Project Coordinator will notify the EPA Project Manager 1 to 2 weeks prior to beginning any field activities so that EPA can schedule any oversight activities required. The PDI Project Coordinator will also notify the EPA Project Manager once field activities have been completed.

Split samples for chemical analyses can be provided to EPA upon request. However, for porewater samples, the PDI team would require advance notice (during peeper preparation) so that adequate volumes can be collected. EPA's Project Manager should contact the PDI Project Coordinator to coordinate this activity and determine appropriate logistics.

4. SAMPLE COLLECTION PROCEDURES

The following sections describe the procedures and methods that will be used during porewater sampling. These procedures include sampling protocol; recordkeeping; sample handling, storage, and shipping; and field QC procedures. This field sampling program will be conducted in accordance with the Project Health and Safety Plan (AECOM and Geosyntec 2018b).

4.1 Sampling Vessels and Equipment

Porewater sampling will be conducted from one of two sampling vessels, R/V *Cayuse* or R/V *Tieton,* supplied by Gravity Marine. These vessels have been installed with a newly developed virtual anchoring system that incorporates autopilot and two small motors to keep the vessel on station without needing to set fixed anchors. The R/V *Cayuse* is a 24-foot research vessel with landing craft design, crew cabin, and forward working area. The R/V *Tieton* is a 32-foot research vessel with landing craft design and crew cabin, pilot house, and forward working area. Both vessels have an A-frame assembly for deployment with custom winch and dynamic positioning system.

The diverless deployment system for peepers requires that sampling vessels be maneuvered directly above the targeted sampling location and held steady while the deployment team uses the push poles (described in detail in Section 4.4) to place the peepers in sediment. The equipment for the diverless deployment can be used in water depths up to 30 feet. Supplemental vessels are available if additional or backup support for in-water sampling is needed. Vessels will be mobilized from Swan Island Launch for stations below the Willamette Falls and Willamette Park Boat Launch near RM 28 for stations above the falls.

Equipment and supplies will include all sampling equipment for positioning, sampling, processing, recording, and shipping samples. Sample containers and preservatives (excluding peepers), as well as coolers and packing material, will be supplied by the analytical laboratory. An equipment checklist is provided in Appendix A.

4.2 Station Positioning and Vertical Control

Station positioning and vertical control will be performed as outlined in detail in the attached Standard Operating Procedure (SOP) for station positioning and vertical control (Appendix B-1). A vessel-mounted differential global positioning system (DGPS) unit will be used to confirm the sampling locations to a horizontal accuracy of 1 to 2 meters. The DGPS accuracy will be confirmed each morning and evening to a known land-based survey point. Confirmed station locations will be recorded to the nearest whole foot in North American Datum 1983 Oregon State Plane North Zone datum.

Vertical control will be established using an on-board fathometer or lead line to measure depth to mudline at sampling locations. As per Integral (2002), water depths will be converted to elevations in feet North American Vertical Datum of 1988 (primary) and/or Columbia River Datum (secondary), used by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Corps of Engineers, depending on the river stage at the time of sampling.[4] Water levels will be recorded to the nearest one tenth of a foot.

4.3 Pre-screening of Redox Conditions and Sediment Grab Sampling

In July 2018, a 3-day field effort will include collection of co-located sediment grab samples for arsenic, manganese, TOC, and grain size. Samples will be analyzed for arsenic to confirm concentrations within background. This step will also include field measurements of DO and redox both *in situ* and in the retrieved sediment material inside the power grab. These analyses will help confirm the appropriate of sampling locations prior to deployment of the passive samplers.

A YSI optical DO meter will be attached to the push pole deployment system and used to probe the surface sediment target area to determine the presence or absence of anoxic conditions (defined as DO < 0.5 milligrams per liter [mg/L]; U.S. Geological Survey 2006) at approximately 10 cm bml. Surface sediment probing will begin in the nearshore shallow areas of each proposed sampling area or at the PDI Primary/Alternate 1 location if a grab sample has already been collected. The optical DO probe will be inserted into the sediment to approximately 10 cm bml, then moving parallel to the shoreline (in 25- to 50-foot increments), and then moving toward the center of the channel as needed (in 25- to 50-foot increments). The DO probe will be rinsed with river water to remove sediments and rinsed with distilled or DI water between probing locations. The YSI optical DO probe will be fitted with a stainless-steel guard and wrapped in stainless-steel mesh as described in Neill et al. (2014). Vertical control of the push pole does not have the precision to accurately determine the RPD (cm) with confidence but will be used to (i) determine presence/absence of redox conditions up to approximately 10 cm bml depending on penetration depths; and (ii) help refine the sampling area. If water depth is greater

---

[4] NOAA records both datums in real time at the Morrison Street Bridge: (https://waterdata.usgs.gov/usa/nwis/uv?site_no=14211720); David Evans and Associates has calculated datum conversion factors for each RM of the Site.

than 28 feet (the limit of push-pole system), then DO may be measured in the grab sample on the vessel deck.

Once the presence of anoxic sediment is confirmed *in situ*, a single grab sample of at least 10 cm recovery will be taken for the *ex situ* measurement of RPD. The same make/model of optical DO probe used *in situ* will be used to measure RPD *ex situ* in the sediment grab sample (in the power grab) while on the vessel. If two different instruments are used, both will be calibrated each morning (see Appendix B-4). The RPD will be measured by inserting the DO probe in an undisturbed portion of the sediment grab sample to a depth of about 2 cm and allowing the reading to stabilize (a stabilized reading is considered no change in the DO measurement over at least 5 seconds, and may take up to 25 to 30 seconds; field staff will use best professional judgement to determine when parameters are stable). Once stable, the DO reading will be recorded in the field logbook. Without removing the probe, the probe will be inserted about 2 cm deeper and allowed to stabilize; the DO measurement will be recorded in the field logbook. This process will be repeated in approximately 2 cm intervals until the 0 to 10 cm profile of sediment has been measured. The DO probe will be rinsed with river water to remove sediments and rinsed with distilled or DI water between locations.

Additionally, an ORP probe will be used as a second line of evidence to evaluate if sediments are anoxic and characterize the RPD (anoxic conditions are defined as ORP less than 0 millivolts [mV]; however, some anoxic processes occur as high as 50 mV [Gerardi 2007]). The percentage of fines will also be visually characterized from this grab sample.

From the first grab sample, if the RPD is equal to or less than 6 cm (+/- 3 cm) and fines are visually characterized as greater than 25%, the location coordinates will be recorded with DGPS. The field staff will then confirm if the location is within 50 feet of a shallow PDI D/U Reach grab sample. If yes, there is no need to collect a sediment grab sample for analysis, and the data from the collected D/U Reach sediment grab sample will be used to support the porewater sampling. If not, a co-located three-point composite surface sediment sample (0 to 30 cm)[5] will be collected and processed for analysis at the porewater sampling location following the Final Surface Sediment FSP protocols and field wet sieving techniques SOP (Appendix B-2). If the RPD is greater than 6 cm (+/- 3 cm), then the sample may not be processed depending on access and site conditions, and the location will be moved to an appropriate sampling location with anoxic conditions if available in the proposed sampling area. If no sampling locations can be identified within a proposed sampling area, this area may be removed from the proposed sampling area list after discussions with the PDI Project Manager and EPA.

Sediment grab samples will be collected as described in the Final Surface Sediment FSP and analyzed for arsenic, manganese, TOC, and grain size. These results, along with the field-

---

[5] Acceptable recovery depth for surface grab sampling in the D/U Reach is outlined in the Final Surface Sediment FSP and will be applied to surface grab samples collected as co-located samples for porewater sampling. The minimum target depth is a three-point average composite depth of 10 cm or greater. The best/deepest three of up to six attempts will be collected and processed. Less than three samples may be retained depending on field conditions.

measured DO and ORP, will be collectively considered to confirm that the target area location is appropriate for porewater peeper sampling. EPA will be notified of the sampling results and selected peeper stations at least 5 days prior to peeper deployment.

4.4 Peeper Deployment

Peepers will be deployed in triplicate for a three-point composite sample and allowed to equilibrate for 28 days. Peepers will be deployed from the sampling vessel using Geosyntec's push pole deployment system, which was designed by the United States Navy's Space and Naval Warfare Systems Command in San Diego, California. This system allows the deployment of the peeper vials to a depth of 30 feet below surface water, housed within 3D-printed peeper frames (Figure 3), into the surface sediment without the use of divers. If any sampling locations are at depths greater than 30 feet or are inaccessible by vessel, then locations will be moved to shallower water or divers may be used to place the peepers in the sediment. Diving support will be provided by Global Diving & Salvage, Inc., if required. If divers are required for peeper placement, a dive health and safety plan will be submitted to EPA for review and approval.

4.4.1 Confirmation of Anoxic Conditions

At each sampling location during peeper deployment (i.e., Day 1), the presence of anoxic sediment *in situ* at the proposed sample location will be confirmed as follows:

- Use the optical DO meter attached to the push pole system to probe the sediment and confirm if sediment conditions are anoxic (DO < 0.5 mg/L) at approximately 10 cm bml (+/- 3 cm) (looking for presence/absence).[6]
- If anoxic conditions are present as expected, then install the peeper (assuming the target depth bml can also be reached).
- If oxic conditions are encountered, attempt an additional location in the sampling area within a 25-foot radius. If, after up to six attempts, a sampling location cannot be confirmed anoxic by probing, one of the other proposed 12 sampling areas may be used. During the review of data after Step 1 (Section 2.3.1), the remainder of the 12 sampling areas not selected as targeted sampling locations will be ranked as alternate locations.
- No sediment grab samples will be collected during peeper deployment.

4.4.2 Measurement of Water Quality Parameters in Overlying Water

At each sampling area prior to deployment, water quality parameters including temperature, ORP, conductivity, DO, and pH will be measured in the water column directly above the mudline using a multi-probe *in situ* water quality meter. Water quality parameters will be measured in overlying water using a multi-probe water quality meter (YSI or equivalent). The water quality

---

[6] Site-wide average discontinuity depth between oxic and anoxic conditions is about 6 cm based on previous SPI studies.

parameters will be recorded before deployment of peepers to avoid recording measurements during potential sediment-disturbing activities.

After water depth is determined, the cable of the water quality meter will be marked with colored tape at the appropriate depth to result in the water quality meter resting 1 foot above the mudline. The water quality meter will be slowly lowered via cable from the vessel to approximately 1 foot above the SWI based on the marked cable. The multi-probe will be operated as described in the Water Quality Parameter SOP (Appendix B-3), the Water Quality Monitoring Equipment Calibration, Operation, and Maintenance SOP (Appendix B-4), and manufacturer's equipment manuals (Appendix B-5). Field parameters will be recorded on the field logs (Appendix A).

4.4.3 Peeper Deployment Procedures

Peeper vials and frames will be prepared by SiREM in Guelph, Ontario, and shipped to Geosyntec's Portland office for deployment at the Site. The peeper vials will be deoxygenated in nitrogen atmosphere by SiREM. Peeper vials will be placed in DI water with a known concentration of sodium bromide and bubbled with nitrogen until DO readings measure 0% or 0 mg/L. The peeper vials will then be filled with the deoxygenated DI water by SiREM. The peeper vials will be shipped in gas impervious mylar bags to avoid oxygenation of the peeper vials.

Peepers will be prepared for deployment as follows:

- The peeper vials with semi-permeable membrane will be placed in a 5-gallon bucket (with lid) of laboratory-supplied DI water and a concentration of sodium bromide (NaBr) or potassium bromide (KBr) equal to that used as a tracer in the peeper (to be supplied by SiREM). The use of NaBr or KBr in the field preparation process will ensure no tracer loss occurs before deployment.
- The 5-gallon bucket will be purged by bubbling high-purity nitrogen gas into it to remove all oxygen from the peeper vials (until a DO meter reads 0% or < 0.5 mg/L). Peeper vials will be purged less than 24 hours before deployment.
- The peeper vials will then be removed from the DI water and secured in the 3D-printed frame.
- To prepare the 3D-printed frame for deployment, two Ziploc® bags will be filled with approximately 500 grams of clean sand and attached to each of the peeper frame wings with zip ties; these sand bags will act as weights to hold the peeper in the sediment. Alternatively, a 10- to 15-pound marine-grade weight may be used, depending on flow conditions.
- A length of rope equal to the measured water depth at the location plus an additional few feet will be attached to the attachment point at the top of the peeper frame, with the other end secured to a weight (typically a gallon-sized Ziploc® bag partially filled with rocks is sufficient, or a 10- to 15-pound marine-grade weight could be used depending on flow

conditions at the target station) as a grapple line. A floating marker buoy can be attached to the weight to assist with retrieval—the floating marker should not be attached to the peeper itself, as this may lift the peeper from the sediment, and the floating marker should not float high enough in the surface water to interfere with or become tangled in vessel traffic. This weight, floating marker, and rope will be used for retrieval.

- The peepers (i.e., peeper assembly, which includes the stack of peeper vials, frame, weights, and retrieval line) are ready for deployment.

Peepers shall be deployed as follows:

- The push pole deployment system consists of multiple 7-foot poles that can be connected to create a single pole of appropriate length to reach the SWI from the sampling vessel.
- At the end of the poles is an attached underwater camera and push pole tail with an approximately 4-inch slot that will hold the peeper. The peeper will be inserted into the slot, so that the hole at the top of the peeper frame is in line with the holes in the push pole frame. Each peeper will be tagged with the Sample ID prior to deployment by attaching a laminated sample ID card to the peeper with a zip tie.
- A spring-loaded pin will then be inserted through the push pole tail and peeper frame and secured with a hitch pin on the opposite side; this will secure the peeper frame to the push pole tail for deployment.
- The push pole tail and peeper frame are then slowly lowered into the water, while the end of the rope that is attached to the hitch pin and the weight are held above water.
- The underwater camera (mounted to the base of the push pole) should be observed to note when the SWI is reached.
- Each peeper frame is fitted with two 6-inch-wide plastic “wings” that rest on the sediment surface to prevent over-penetration. The peeper frame is slowly inserted into the sediment until the frame wings are flush with the sediment surface. Weights are attached to each wing to help secure the peeper in place once deployed.
- The underwater camera will be used to confirm correct placement and vertical orientation of the peeper frame and capture a photograph of the peepers once placed. Correct deployment depth can also be inferred by the degree of resistance to additional pushing. There is a small degree of resistance upon insertion and then a strong degree of resistance once the peeper lander wings reach the SWI.
- Once the peeper frame is in the sediment, a grappling line attached at one end to the peeper frame and at the other end with a weight can be tossed approximately 20 feet downstream. This line will be used for retrieval using a grappling hook as described below. The line direction will be recorded on the field log.
- At this point, the rope secured to the hitch pin can be pulled, releasing the spring-loaded pin and releasing the peeper frame from the push pole tail.

- The peeper frame should remain in the sediment while the push pole tail is lifted out of the surface water; the underwater camera will be used for confirmation.
- The deployment process is then repeated to deploy a second and third peeper frame for a three-point composite sample. The vessel will maintain its position; however, the peeper will be deployed in a circular pattern, targeting 5 to 10 feet from the previously deployed peeper as possible given field conditions (target radius of 25 feet or less).
- A fourth peeper that will be used for dedicated water quality parameter measurements will be deployed in the center of the three-point composite. Redox conditions (DO and ORP) will be measured in each porewater vial (five vertically stacked vials per peeper; see Figure 3) to evaluate DO with depth during retrieval. Other water quality parameters (temperature, pH, conductivity) will be measured from the anoxic composite of these peeper vials and in the overlying water.
- Locations for each peeper sample will be mapped with a global position system (GPS) and recorded in the field logs (Appendix A).
- As a method blank test, three additional peeper vials will be kept in the 5-gallon bucket of DI water with all other peepers (SiREM will supply the appropriate number of extra vials) during deployment. These peeper vials will be used as Time 0 bromide concentrations for the calculations to determine the extent to equilibrium. At the last deployment station, these peeper vials will be removed from the 5-gallon bucket and exposed to the atmosphere for the same length of time as a single peeper deployment (field staff will use their best judgment to determine this time frame). At the end of the exposure period, the deoxygenated DI water will be decanted from the peeper into the appropriate sampling container and sent to the laboratory for analysis of bromine anions by EPA 300.0. This will represent Time 0 deployment conditions.

4.5 Peeper Retrieval and Sample Processing

4.5.1 Measurement of Water Quality Parameters in Overlying Water

At each sampling area prior to retrieval, water quality parameters including temperature, ORP, conductivity, DO, and pH will be measured in the water column directly above the mudline using a multi-probe *in situ* water quality meter (YSI or equivalent) at the locations of the fourth dedicated water quality peeper. The water quality parameters will be recorded before retrieval of peepers to avoid recording measurements during potential sediment-disturbing activities. The water quality measurements will follow the sample procedures described in Section 4.4.2.

4.5.2 Peeper Retrieval

After the equilibration period, peepers will be retrieved per the following protocol:

- At the mapped GPS sampling location, the underwater camera will be used to locate the sampler, marker buoy, or grapple line (if water clarity allows).

- Once the peeper is located, a grappling hook will be used in a perpendicular direction to the noted direction that the weight and retrieval line was tossed.
- The grappling hook should catch on the weighted rope and can then be used to pull the peeper from the sediment after the vessel maneuvers directly over the sampler for straight-pull retrieval.
- Upon retrieval, using new nitrile gloves, peeper vials will be removed from the frame, and any sediment particles will be gently rinsed from the outside of the peeper using laboratory-supplied DI or distilled water.
- Immediately after field retrieval on the sampling vessel, peeper vials will be placed in metal foil-laminated mylar bags purged with nitrogen and placed in coolers filled with ice for transport to the field laboratory for processing. Purging the container with nitrogen displaces oxygen-containing atmospheric air, and metal foil-laminated mylar bags have low gas permeability; therefore, field conditions are not expected to change. Samples will be kept cool at 0 to 6 degrees Celsius (°C) until processed at the field warehouse and will be processed the same day as collection. Mylar bags will be labeled with peeper vial depths. Additionally, the central water quality peeper will be identified and the mylar bags labeled to identify these peeper vials as such. The five mylar bags for each peeper, labeled with depths, will be stored in a large Ziploc® bag, purged with nitrogen, to keep all vials from a single peeper together.
- If one or more of the triplicate field samples is missing, defective, or otherwise not acceptable for processing, then the remaining one or two acceptable samplers/sublocations will be processed and noted in the field logs. If the dedicated water quality parameter peeper is missing, defective, or otherwise not acceptable, one of the triplicate sample peepers will be used for water quality parameters, and a two-point composite sample will be collected. A minimum of four peeper vials is needed for adequate sample volume (280 milliliters [mL] is sufficient volume for primary analysis and for EPA split samples); therefore, if needed, the dedicated water quality parameter peeper may be used for sampling instead. Should this be needed, the measured RPD from the pre-deployment survey will be used as the basis for compositing. The final compositing will be noted in the field logs if different from the three-point composite described in the FSP.

To avoid accidental high bias or sample loss, processing requires the use of needles, and hence for safety precautions should be done in a stable and controlled environment. The porewater compositing and processing will be performed after retrieval of the peepers at the AECOM Sampling Processing Facility at 1115 Caruthers Street, Portland, Oregon. Peepers will be processed at the field laboratory as described in the following section.

4.5.3 Sample Processing: Determination of RPD

- At the field laboratory, select the peeper vials identified as the dedicated water quality peeper vials. Remove the peeper vials from the mylar bags, identify the top vial, and rinse free of sediment using distilled or DI water. DO will be measured in each vial using a narrow (< 3 cm diameter) optical DO probe. The optical DO probe used will be the same make and model as the DO probe used to measure RPD *in situ* and *ex situ* prior to deployment of peepers. Uncap the peeper vial only enough to insert the DO probe. Maintain a low flow of nitrogen over the open peeper vial while measuring DO. Allow instrument to stabilize (a measurement is considered stable in at least 5 seconds without change, and may take up to 25 or 30 seconds) and record the DO measurement on the sampling log form, then re-cap the peeper vial. Rinse the probe with distilled or DI water.
- Uncap the peeper vial under nitrogen flow and insert the Oakton ORP probe. Repeat the same steps for ORP as above.
- Both the DO and ORP meters have uncertainty and variability associated with measurements; therefore, the decision criteria for anoxic porewater will consider both parameters as follows[7]:
    - Scenario 1 (lower DO/higher ORP): DO < 0.5 mg/L is low and ORP < 50 mV = anoxic
    - Scenario 2 (higher DO/lower ORP): DO < 1 mg/L but lower ORP < 0 mV = anoxic
- Repeat this procedure for each peeper vial until the full depth profile has been measured.
- Evaluate the stack of porewater vial measurements to determine the RPD depth. RPD depth is defined as the top of the shallowest peeper determined to be anoxic.
- Use this profile data to select which vials will be composited for analyses, targeting only the vials located in the anoxic zone of sediment. These vials are an integrated measurement over the 30-day exposure period.
- From the fourth water quality monitoring peeper, composite the vials that represent anoxic porewater and measure the remaining water quality parameters (pH, conductivity, and temperature) using the YSI Water Quality Meter. These water parameters best represent the sample aliquots composited for testing from the other three peepers.
- Composite the water from the remaining overlying peeper vials and measure the remaining water quality parameters (pH, conductivity, and temperature) using the YSI Water Quality Meter, if there is adequate water volume (e.g., only one vial is determined to be oxic based on measurements of DO and ORP; the ability to measure other

---

[7] These criteria will also be used during the pre-deployment measurement of DO and ORP in sediment grab samples to determine RPD.

parameters in the oxic zone may be limited). Measurements will be noted in the field logbook.

4.5.4 Sample Processing: Porewater Sample Compositing Procedures

- Following the identification of the RPD depth, select the peeper vials and depths that will represent the anoxic porewater. These depths will be composited among the three remaining peepers.
- Approximately 140 mL of porewater are needed for analyses, each vial contains about 70 mL of water, and each peeper contains about 350 mL of water (6 to 30 cm depth). A minimum of two sample vials (either one peeper and two vials representing two depths or two peepers and one vial representing one depth) is needed for adequate volume for analytical testing. If EPA collects split samples, then a minimum of four peeper vials is required for sufficient volume.
- Remove the first anoxic peeper vial from the mylar bag. Keep peepers in the nitrogen-purged mylar bag until ready to be composited. Place the peeper vial on its side in a custom holder. Draw 70 mL of high-purity nitrogen gas into a clean syringe by pulling the syringe plunger to the 70-mL mark while it is connected to the nitrogen tank or to a bag that has been filled with nitrogen. Using this syringe and needle, pierce the top of the peeper just below the cap. This top needle should remain in the peeper after piercing until all the water in the peeper has been removed.
- Each peeper vial should yield about 70 mL of sample porewater.
- Pierce the bottom of the peeper with another syringe and needle to create a drainage hole and remove the syringe and needle from the bottom of the peeper. Note, needle points when not in use will be stored in a sharps safe holder.
- Next, move the peeper such that the hole in the bottom is directly over a clean laboratory supplied wide-mouth bottle at least 500 mL in volume—large enough for the volume of porewater from all three peepers (compositing vessel). Purge the compositing vessel with nitrogen gas and then begin adding in the water from the peepers (see bullet below). During compositing, a steady, gentle stream of nitrogen gas will be administered to the compositing bottle. Maintaining a constant stream of nitrogen creates a positive pressure of nitrogen in the bottle, preventing oxygen containing atmospheric air from entering the bottle. Cap the compositing vessel between vial additions.
- Transfer/drain the peeper water into the compositing vessel by plunging the first syringe at the top of the peeper to add a nitrogen gas headspace to the peeper, forcing the water out of the hole in the bottom of the peeper. While adding this peeper water into the compositing vessel, maintain a gentle, steady stream of nitrogen gas to the mouth of the compositing vessel.

- Repeat the above steps with the other vials from all three sampling peepers representing anoxic porewater, adding the porewater from the second and third peepers into the compositing vessel.
- Once the depths representing anoxic porewater from all three peepers have been composited, add nitrogen gas to the headspace and cap the compositing vessel. Mix slowly for 10 seconds until uniform. Transfer the porewater from the compositing vessel to the appropriate laboratory-supplied sampling containers with preservatives for analysis (Table 2). The aliquots for metals analysis will be extracted from the composite container while maintaining a nitrogen atmosphere and placed in the sampling container.
- The oxic porewater sample (vials not composited) will not be submitted to the laboratory for analysis.

4.6 Sample Handling and Transport

Chain-of-custody procedures will follow the Round 1 FSP and SOPs (Integral 2002) and the QAPP (AECOM and Geosyntec 2018a). Samples will be stored on ice at 0 to 6 °C in a field cooler and shipped to TestAmerica's Fife, Washington, laboratory for chemical testing, as detailed in the PDI QAPP (AECOM and Geosyntec 2018a). Additional details on sample handling and transport can be found in Section 4.3 of the QAPP (AECOM and Geosyntec 2018a).

4.7 Field Logbook and Forms

All field activities will be recorded in a field logbook and field forms (Appendix A) as outlined in detail in Section 4.10 of the QAPP (AECOM and Geosyntec 2018a).

4.8 Field Decontamination Procedures

Due to the deployment and retrieval methods of the peeper frames and vials, there is minimal equipment that is re-used between stations. Each peeper is unique to its sampling station and not reused. The push pole deployment system is in minimal contact with sediment at a station and will be rinsed with Site water followed by a distilled or DI water rinse between stations. During sample processing, all needles and compositing containers will be single-use only.

Peepers and peeper frames will be washed with detergent, rinsed with DI water, soaked in an acid wash, and then finally rinsed again with DI water at SiREM laboratories prior to deployment to thoroughly clean the equipment and remove any residual metals.

DO and redox probes will be initially rinsed with river water to dislodge any sediment then rinsed with distilled or DI water between discrete measurements.

4.9 Investigation-Derived Waste

Waste disposal will occur as described in the PDI QAPP (AECOM and Geosyntec 2018a) and the SOP for Investigation-Derived Waste (IDW) Management (Appendix B-6). Tyvek, gloves, paper towels, plastic sheeting, peeper frames, and emptied peeper vials and other waste material generated during sampling will be placed in heavyweight garbage bags or other appropriate containers and placed in normal refuse containers for disposal at a solid waste landfill. Needles will be placed in an appropriate sharps disposal container for disposal by a sharps retrieval program (e.g., Sharps Assure). IDW will include residual sediments, distilled or DI rinse water, and DI water with NaBr used to house the peepers. Residual sediments and distilled or DI rinse water will be collected and disposed of in the river prior to leaving a sampling location. DI water containing NaBr will be disposed of in the sanitary sewer.

4.10 Field Quality Control

Field QC samples are collected to assess variability within samples (e.g., duplicates), to evaluate if potential sources of contamination are present (e.g., rinsate blanks), or to confirm proper storage conditions of samples (e.g., temperature blanks). All QA/QC procedures are detailed in the QAPP (AECOM and Geosyntec 2018a).

Field duplicates are additional samples collected at the same location to characterize variability in sampling and analysis results. Field duplicates will be collected as described in Section 4.6.1 of the QAPP (AECOM and Geosyntec 2018a). One field duplicate will be collected for porewater sampling. Enough porewater will be collected from the three-point composite sample to split for a primary and field duplicate sample. Porewater will be composited into a single sample that will then be split into primary and blind field duplicate containers for analysis.

Rinsate blanks will be collected as outlined in Section 4.6.1 of the QAPP (AECOM and Geosyntec 2018a). Split samples for EPA will be determined at the time of sampling. Rinsate blanks will be conducted about one per event (or 5% of total project samples) using DI water poured over the sampling equipment prior to deployment to avoid potential cross-contamination associated with peeper preparation.

Calibration and field checks of the water quality parameter multiprobe will be performed in accordance with Integral 2004 (excerpted in this FSP as Appendix B-3) and per the Water Quality Monitoring Equipment Calibration, Operation, and Maintenance SOP (Appendix B-4) and the equipment-specific instructions (Appendix B-5). The optical DO probe will be calibrated using a two-point calibration process (100% saturation and 0% saturation) prior to measuring concentrations of DO in the porewater peeper vials to determine RPD.

5. LABORATORY ANALYSIS

TestAmerica’s Fife, Washington, laboratory will analyze all porewater samples from *in situ* passive samplers for dissolved arsenic and manganese by EPA Method 6020B and bromide anion by EPA method 300.0. Additional details on the analytical methods, QA/QC requirements and procedures, and laboratory specific QA/QC requirements are detailed in Sections 4.5 and 4.6 of the QAPP (AECOM and Geosyntec 2018a). All samples will be placed in laboratory-supplied sample containers and preserved according to analytical protocols. Sample containers, preservation requirements, holding times, and sample volumes are provided for all analyses in Table 2.

6. DATA MANAGEMENT AND REPORTING

6.1 Data Management

The procedures and activities outlined in this FSP are designed to ensure DQOs are met. Specifically, and as detailed in Section 4 of this FSP and in the QAPP (AECOM and Geosyntec 2018a), the following data management procedures will be performed in the field:

- All samples will be given a unique identifier (Section 2.4 of this FSP).
- All samples will be collected and transported under chain-of-custody control (Section 4.6 of this FSP).
- Field logbooks and data sheets will be maintained (Section 4.7 of this FSP).
- Field QA/QC samples will be collected according to the QAPP (Section 4.10 of this FSP).

Analytical laboratories will be required to adhere to all QA/QC procedures outlined in the QAPP (AECOM and Geosyntec 2018a). Data validation, management, and reporting will be performed according to the QAPP (AECOM and Geosyntec 2018a) and Data Quality Monitoring Plan (AECOM and Geosyntec 2018c).

6.2 Reporting

Results from the implementation of this FSP will be used to support multiple data use objectives as outlined in the PDI Work Plan (Table 5 of the PDI Work Plan). Data summaries and evaluations will be included in the PDI Evaluation Report.

7. REFERENCES

AECOM (AECOM Technical Services) and Geosyntec (Geosyntec Consultants, Inc.). 2018a. Quality Assurance Project Plan Portland Harbor Pre-Remedial Design Investigation Studies Portland Harbor Superfund Site. March.

AECOM and Geosyntec. 2018b. Health and Safety Plan. Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Portland Harbor Superfund Site. March.

AECOM and Geosyntec. 2018c. Data Quality Management Plan Portland Harbor Pre-Remedial Design Investigation Studies Portland Harbor Superfund Site. February.

EPA (United States Environmental Protection Agency). 2016a. Portland Harbor RI/FS, Final Remedial Investigation Report, Portland, Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington. 8 February.

EPA. 2016b. Portland Harbor RI/FS, Final Feasibility Study, Portland, Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington. June.

EPA. 2017a. Record of Decision Portland Harbor Superfund Site, Portland, Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington. January.

EPA. 2017b. ASAOC between EPA and the Pre-RD AOC Group for Pre-Remedial Design Investigation Studies, Portland Harbor Superfund Site, Portland, Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington. 18 December

Geosyntec. 2017. Final Work Plan, Portland Harbor Pre-Remedial Design Investigation Studies, Portland Harbor Superfund Site, Portland, Oregon. Prepared for the Pre-RD AOC Group for submittal to EPA Region 10. Attachment to the Statement of Work. 19 December.

Gerardi, M. H. 2007. ORP Management in Wastewater as an Indicator of Process Efficiency. New England Interstate Water Pollution Control Commission (NEIWPCC), reprinted with permission by YSI, 2008.

Germano (Germano & Associates, Inc.). 2014. Sediment Profile Imaging Report, Characterization of the Lower Willamette River with Sediment Profile Imaging: Changes in Space & Time. Prepared for de maximus, Inc. June.

GSI Water Solutions and Hart Crowser. 2018. Final Field and Data Report Upriver Reach Sediment Characterization Lower Willamette River Portland, Oregon. Prepared for Oregon Department of Environmental Quality.

Hurtado, H.A. 2015. Naturally Occurring Background Levels of Arsenic in the Soils of Southwestern Oregon. Dissertations and Theses. Paper 2996.

Integral (Integral Consulting). 2002. Round 1 Field Sampling Plan. Prepared for the Lower Willamette Group (LWG) for submittal and approval by EPA Region 10. 14 June.

Integral. 2004. Round 2 Field Sampling Plan – Sediment Sampling and Benthic Toxicity Testing Prepared for the Lower Willamette Group (LWG) for submittal and approval by EPA Region 10. August.

Integral. 2005. Round 2 Groundwater Pathway Assessment Sampling and Analysis Plan Attachment 2 Transition Zone Water Field Sampling Plan. Prepared for the Lower Willamette Group (LWG) for submittal and approval by EPA Region 10. 8 July.

Integral. 2006. Preliminary Upstream and Downstream Sediment Data Evaluation and Round 3A Field Sampling Plan for Upstream and Downstream Sediment Sampling.

Kennedy, A.J., G.R. Lotufo, J.A. Steevens, and T.A. Bridges. 2010. Determining Steady-state Tissue Residues for Invertebrates in Contaminated Sediment. Prepared for United States Army Engineer District, New York. ERDC/EL TR-10-2. May.

Neill, M., N. Walsh, and L. Lucey. 2014. Direct measurement of oxygen in river substrates. Water and Environment Journal, 28: 566–571.

ODEQ (Oregon Department of Environmental Quality). 2013. Development of Oregon Background Metals Concentrations in Soil. March.

Striplin Environmental Associates, Inc. 2002. Sediment Profile Image Survey of the Lower Willamette River. Prepared for the Lower Willamette Group (LWG). 26 April.

Thomas, B., and M.A. Arthur. 2010. Correcting porewater concentration measurements from peepers: Application of a reverse tracer. Limnology and. Oceanography: Methods 8, 2010, 403–413.

Trimble, D. 1963. Geology of Portland, Oregon and Adjacent Areas. Geological Survey Bulletin 1119 United States Department of the Interior.

United States Geologic Survey. 2006. Volatile Organic Compounds in the Nation’s Ground Water and Drinking-Water Supply Wells. National Water-Quality Assessment Program.

TABLES

Table 1. Station Location Coordinates and Identification Scheme

Proposed Target Area[a]	Proposed Sample ID[b]	Approximate Location	Estimated Mudline Elevation (CRD - Feet)[c]	Proposed Location Coordinates (NAD 1983; Intl Feet)[d]		Deployment Duration[e]
				Easting	*Northing*	
1	PDI-WP-B441	RM 14.0 E	No Data	7647802	675636	28 days (at 8 or 9 final selected locations)
2	PDI-WP-B455	RM 15.6 E	No Data	7648051	667208	
3	PDI-WP-B453	RM 15.6 W	-8.6396	7646045	667770	
4	PDI-WP-B460	RM 17.0 W	No Data	7647231	660249	
5	PDI-WP-B466	RM 18.5 W	No Data	7651174	654197	
6	PDI-SG-B467 or PDI-WP-B468	RM 18.8 E	No Data	7651328	652982	
7	PDI-SG-S264[f] or PDI-WP-B472	RM 20.0 W	No Data	7648406	647388	
8	PDI-WP-B474	RM 22.7 E	No Data	7655566	636887	
9	PDI-WP-B475 or PDI-WP-B476	RM 23.2 W	No Data	7655744	634467	
10	PDI-WP-B477	RM 24.2 W	No Data	7657537	629980	
11	PDI-WP-S265[f] or PDI-WP-B483	RM 27.3 W	No Data	7654430	619948	
12	PDI-WP-B487 or PDI-WP-S266[f]	RM 28.7 W	No Data	7650213	617199	
Blind Field Duplicates						
TBD	PDI-PW-001-D	TBD				28 days
Total Sample Count for Analysis			9 or 10			

General Notes:

All porewater samples will be collected to a target depth of 30 cm below the sediment/water interface.

All porewater samples will be 3-point composites over a small footprint (< 25 feet between samplers) with a 4th dedicated peeper for water quality parameters.

Co-located surface sediment grab samples will be collected and analyzed for grain size, TOC, and metals (As, Mn).

Rinsate blank samples will be collected once per event during deployment.

Footnotes:

a) Only 8 or 9 of 12 Proposed Target Areas will be sampled, plus one field duplicate.

b) Sample IDs reflect a PDI Surface Sediment Station ID within the Target Area. As some Target Areas have multiple stations, these may be revised when final sample locations are determined. If no surface sediment sampling is planned within an area, a new sample ID has been assigned sequentially using the SMA surface sediment grab sample numbers.

c) Vertical Datum: CRD (Feet); based on 2004 bathymetry.

d) Horizontal Projection: NAD 1983 Oregon State Plane North (International Feet). Coordinates for a centroid of the Porewater Sampling Area or an available D/U Reach Surface Sediment grab sample location are provided as reference for field crews only and are not reflective of targeted sampling locations. Sampling coordinates will be refined following pre-deployment field survey.

e) Samples will be deployed during summer low river flow conditions (August 2018) for a target duration of 28 days.

f) A co-located sediment grab may be added in these areas as these were not included under the PDI surface sediment sampling.

Abbreviations:

CRD = Columbia River Datum
ID = identification number
NAD = North American Datum
RM = river mile
TBD = to be determined

Table 2. Sample Containers, Preservation, Holding Times, and Sample Volume

Porewater Analysis	Container		Preservation	Holding Time	Minimum Sample Volume (mL)
	Type	***Size***			
Metals (EPA Method 6020B)	HPDE	100 mL	HNO_3 to pH <2	180 days from collection to analysis	100
Bromide (EPA 300.0)	HDPE	125 mL	Cool to 0-6℃	28 days	40

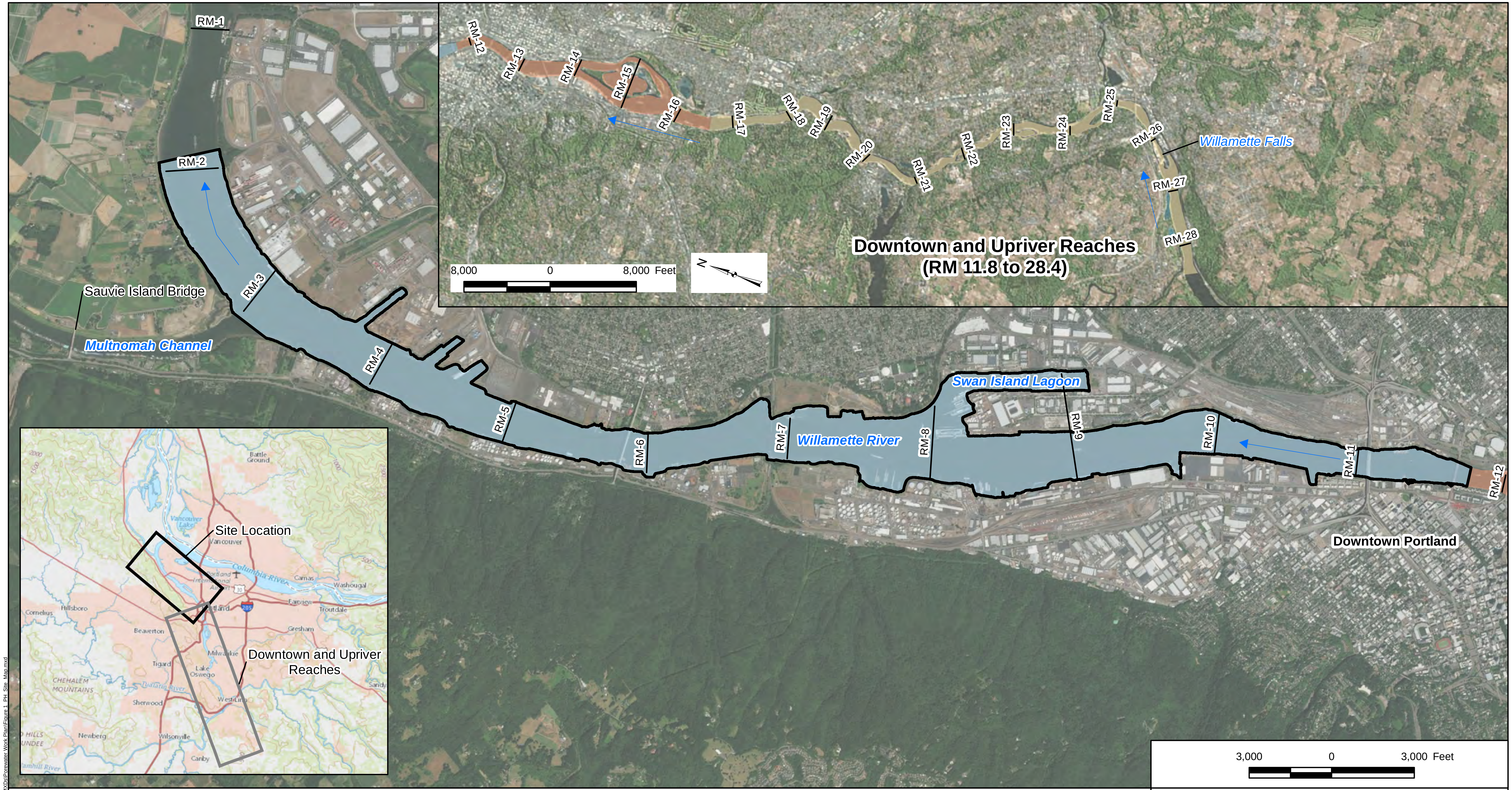
Notes:

1. Only arsenic and manganese will be reported.

Abbreviations:

EPA = [United States] Environmental Protection Agency
HDPE = high-density polyethylene
HNO_3 = nitric acid
mL = milliliter

FIGURES



Legend

→ Flow Direction

— River Mile Marker

☐ Superfund Site Boundary (RM 1.9 to 11.8)

Study Area

🟦 Site Area (RM 1.9 to 11.8)

🟧 Downtown Reach (RM 11.8 to 16.6)

🟨 Upriver Reach (RM 16.6 to 28.4)

Note:
1. Aerial Imagery provided by ESRI Basemaps 2016

Portland Harbor Site Map

Portland Harbor Superfund Site
Porewater FSP

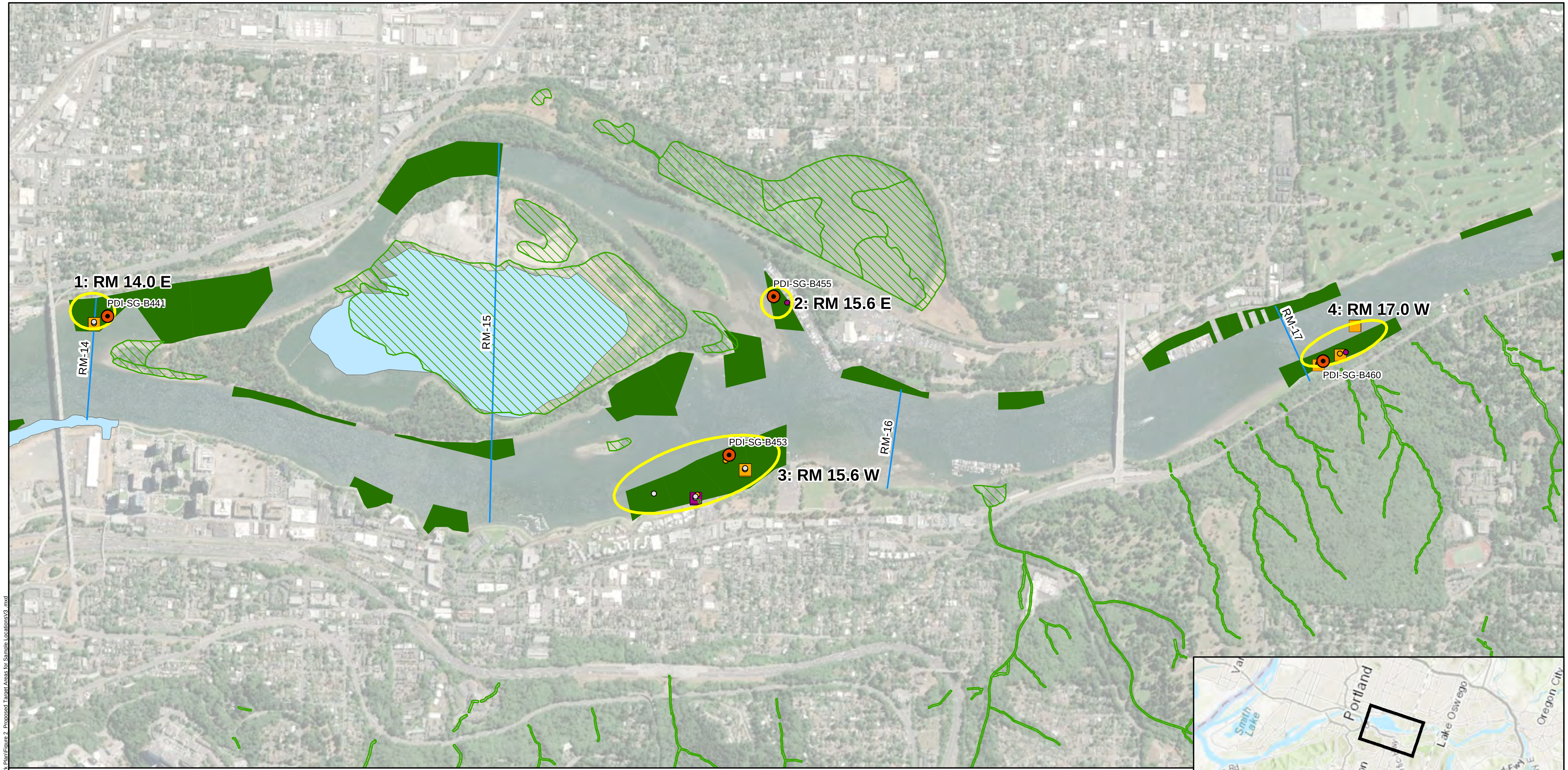
AECOM Geosyntec consultants

Figure 1

MI/SEA

January 18, 2018

Path: P:\Projects\Portland\Portland Pre-Design PNG0767A\900 GIS and CAD\MXDs\Porewater Work Plan\Figure 1_PH_Site_Map.mxd



Legend

▭ Porewater Sample Area

● Proposed D/U Reach Stratified Random Sediment Grab Sample Location

● Co-located Sediment Grab Sample for Porewater Sampling

Percent Fines - Historic and Current RI Surface Sediment

○ < 30 %

● 30 - 60 %

● > 60%

Percent TOC - Historic RI Surface Sediment

□ < 0.5 %

🟧 0.5- 2.5 %

■ > 2.5 %

🟩 Areas of Soft Sediment Based on 2018 Hand Probing Data

▨ Wetland Area

□ Capped Area (Existing)

— River Mile Marker

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Concentrations of Arsenic in all target sampling areas are < 5 mg/kg.
3. Wetlands data from National Wetlands Inventory.
4. RM - river mile.
5. If no D/U Reach surface sediment sampling was planned within an area, a new sample ID has been assigned sequentially using the SMA surface sediment grab sample numbers (S264 and S265).

N

1,000 500 0 1,000 2,000 Feet

Proposed Target Areas for Porewater Sample Locations Areas 1 to 4

Portland Harbor Superfund Site
PDI Pore Water FSP

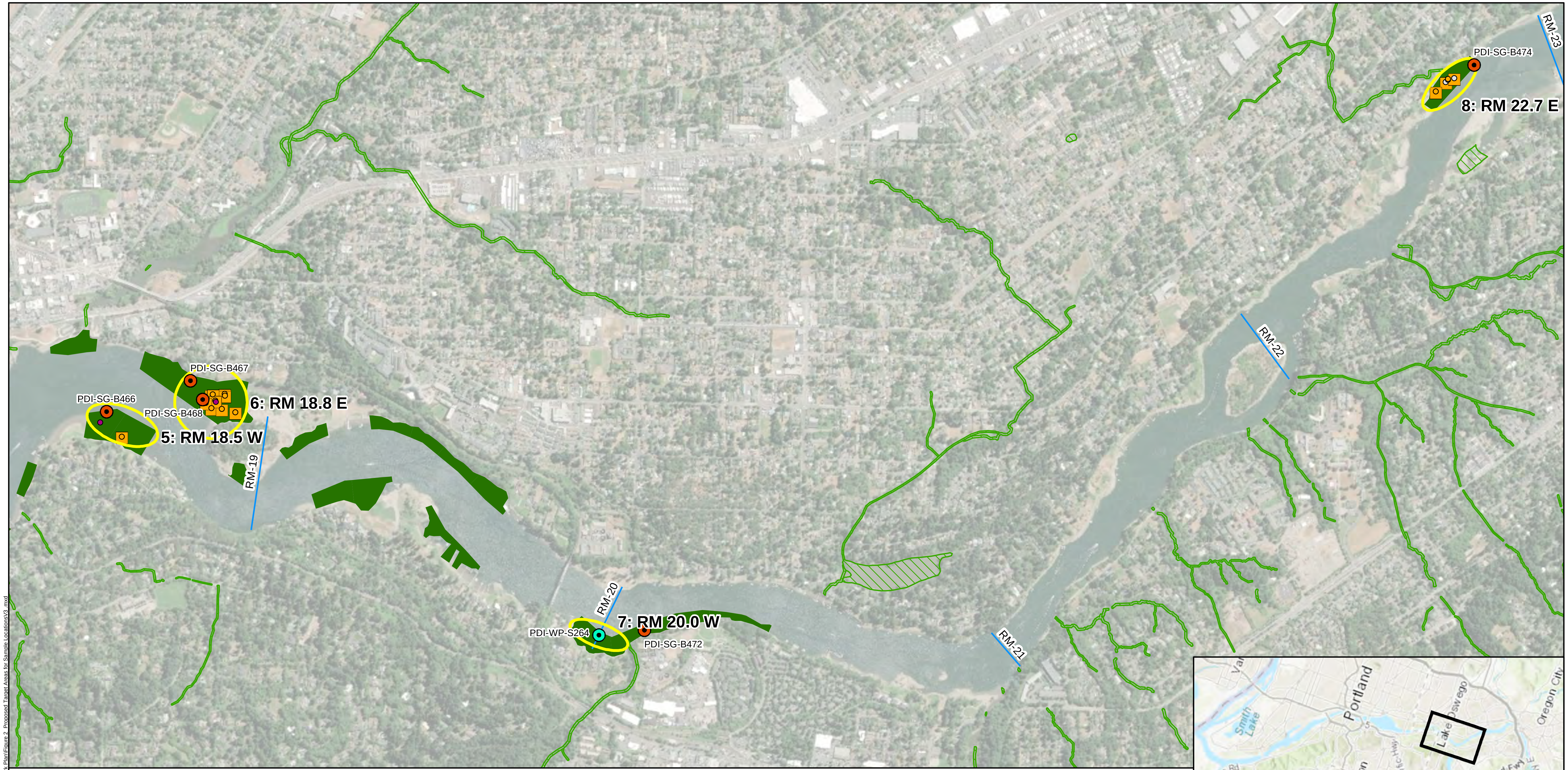
AECOM Geosyntec consultants

MI/SEA

August 8, 2018

Figure
2a

Path: P:\Projects\Portland Pre-Design PNG0767A\900 GIS and CAD\MXDs\Porewater Work Plan\Figure 2 Proposed Target Areas for Sample LocationsV3 .mxd



Legend

🟨 Porewater Sample Area

● Proposed D/U Reach Stratified Random Sediment Grab Sample Location

● Co-located Sediment Grab Sample for Porewater Sampling

Percent Fines - Historic and Current RI Surface Sediment

○ < 30 %

● 30 - 60 %

● > 60%

Percent TOC - Historic RI Surface Sediment

⬜ < 0.5 %

🟧 0.5- 2.5 %

🟪 > 2.5 %

🟩 Areas of Soft Sediment Based on 2018 Hand Probing Data

▨ Wetland Area

⬜ Capped Area (Existing)

— River Mile Marker

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Concentrations of Arsenic in all target sampling areas are < 5 mg/kg.
3. Wetlands data from National Wetlands Inventory.
4. RM - river mile.
5. If no D/U Reach surface sediment sampling was planned within an area, a new sample ID has been assigned sequentially using the SMA surface sediment grab sample numbers (S264 and S265).

N

1,000 500 0 1,000 2,000 Feet

Proposed Target Areas for Porewater Sample Locations Areas 5 to 8

Portland Harbor Superfund Site
PDI Pore Water FSP

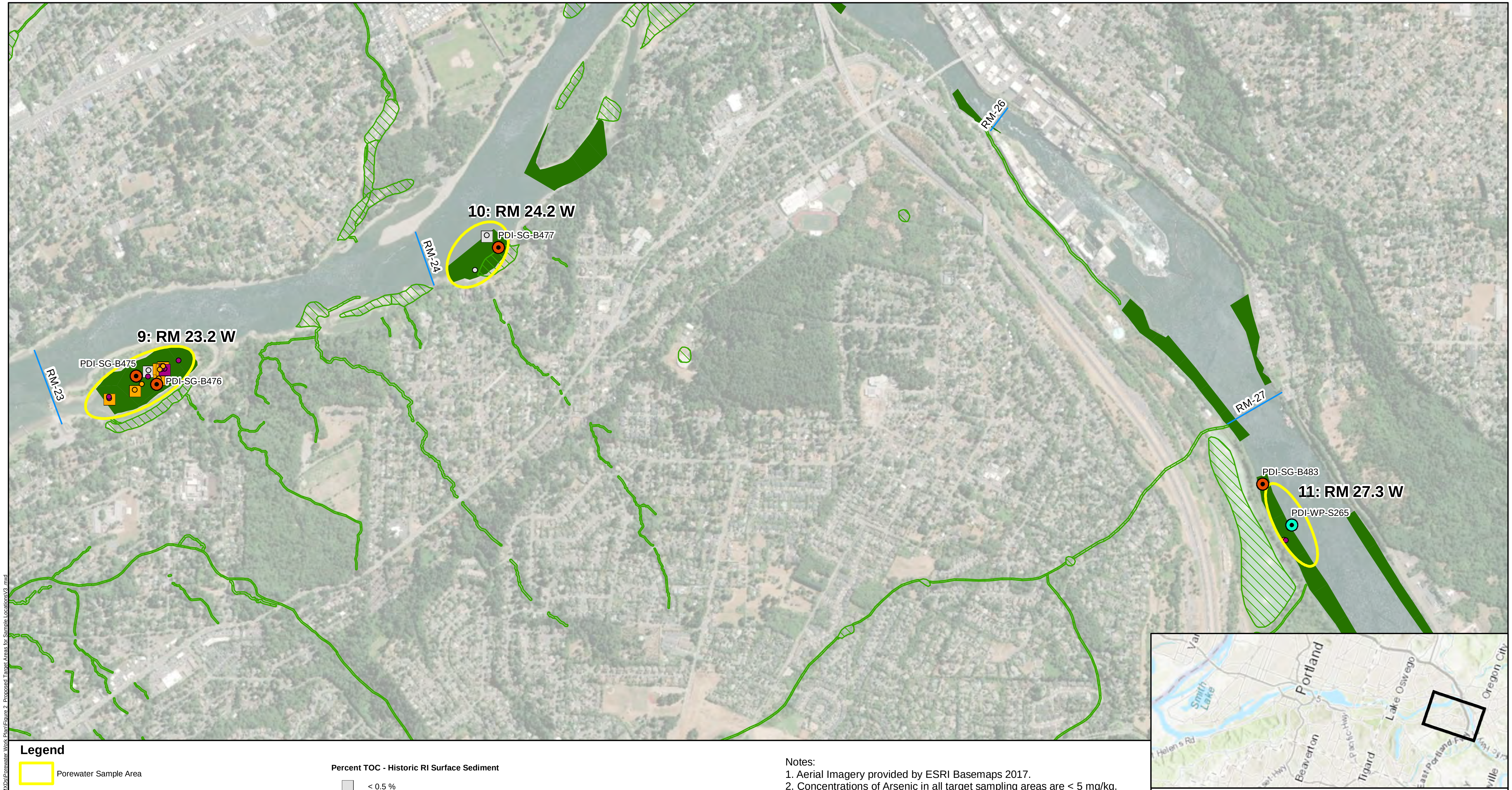
AECOM Geosyntec consultants

Figure 2b

MI/SEA

August 8, 2018

Path: P:\Projects\Portland Pre-Design PNG0767A\900 GIS and CAD\MXDs\Porewater Work Plan\Figure 2 Proposed Target Areas for Sample LocationsV3 .mxd



Legend

- ▭ Porewater Sample Area
- ◉ Proposed D/U Reach Stratified Random Sediment Grab Sample Location
- ◉ Co-located Sediment Grab Sample for Porewater Sampling

Percent Fines - Historic and Current RI Surface Sediment

- ● < 30 %
- ● 30 - 60 %
- ● > 60%

Percent TOC - Historic RI Surface Sediment

- ■ < 0.5 %
- 🟧 0.5- 2.5 %
- ■ > 2.5 %
- 🟩 Areas of Soft Sediment Based on 2018 Hand Probing Data
- ▨ Wetland Area
- ■ Capped Area (Existing)
- — River Mile Marker

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Concentrations of Arsenic in all target sampling areas are < 5 mg/kg.
3. Wetlands data from National Wetlands Inventory.
4. RM - river mile.
5. If no D/U Reach surface sediment sampling was planned within an area, a new sample ID has been assigned sequentially using the SMA surface sediment grab sample numbers (S264 and S265).

N

1,000 500 0 1,000 2,000 Feet

Proposed Target Areas for Porewater Sample Locations Areas 9 to 11

Portland Harbor Superfund Site
PDI Pore Water FSP

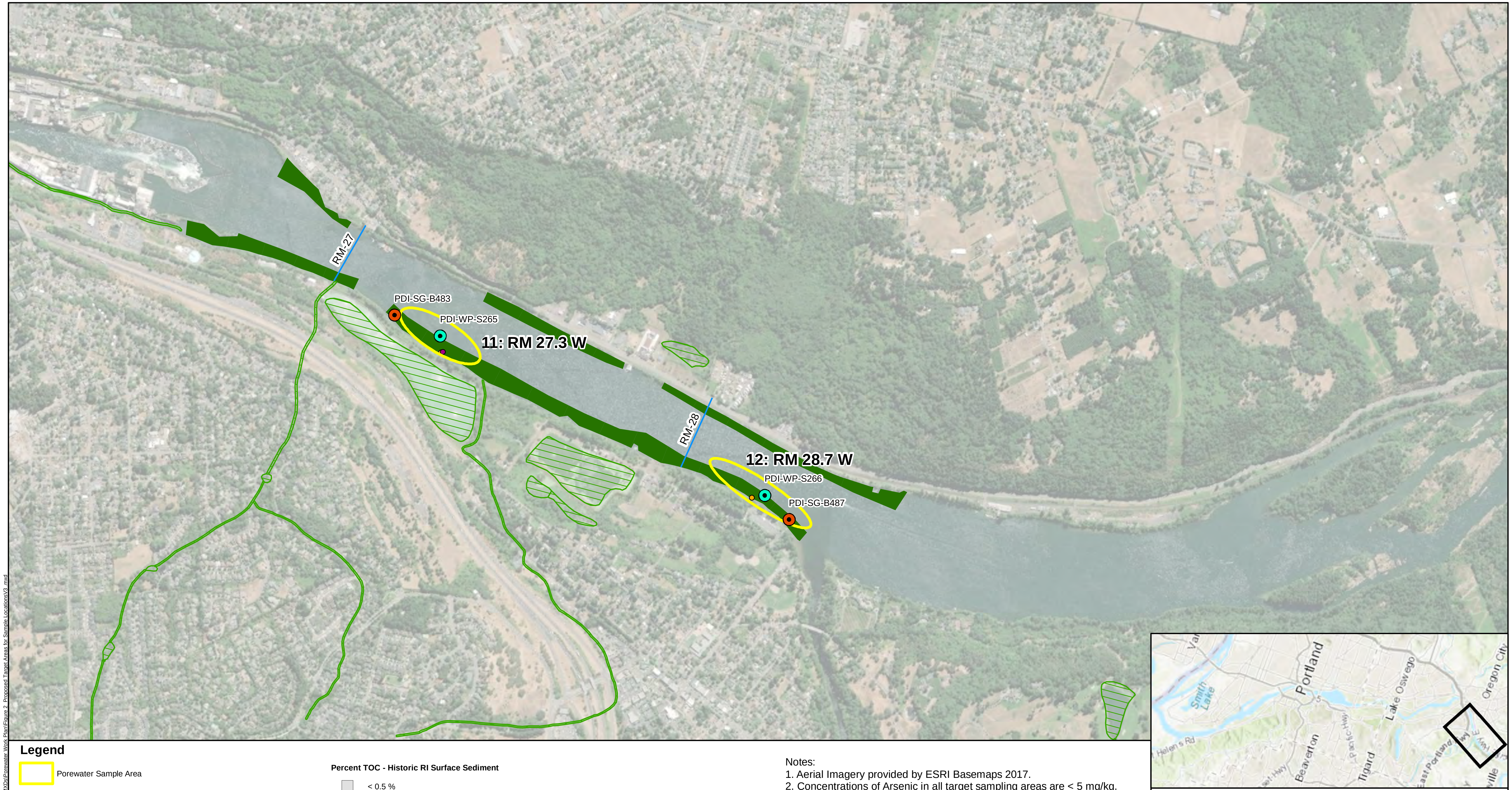
AECOM Geosyntec consultants

Figure 2c

MI/SEA

August 8, 2018

Path: P:\Projects\Portland Pre-Design PNG0767A\900 GIS and CAD\MXDs\Porewater Work Plan\Figure 2 Proposed Target Areas for Sample LocationsV3 .mxd



Legend

▭ Porewater Sample Area

● Proposed D/U Reach Stratified Random Sediment Grab Sample Location

● Co-located Sediment Grab Sample for Porewater Sampling

Percent Fines - Historic and Current RI Surface Sediment

○ < 30 %

● 30 - 60 %

● > 60%

Percent TOC - Historic RI Surface Sediment

◻ < 0.5 %

🟧 0.5- 2.5 %

🟪 > 2.5 %

🟩 Areas of Soft Sediment Based on 2018 Hand Probing Data

▨ Wetland Area

◻ Capped Area (Existing)

— River Mile Marker

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Concentrations of Arsenic in all target sampling areas are < 5 mg/kg.
3. Wetlands data from National Wetlands Inventory.
4. RM - river mile.
5. If no D/U Reach surface sediment sampling was planned within an area, a new sample ID has been assigned sequentially using the SMA surface sediment grab sample numbers (S264 and S265).

N

1,000 500 0 1,000 2,000 Feet

Proposed Target Areas for Porewater Sample Locations Areas 11 to 12

Portland Harbor Superfund Site
PDI Pore Water FSP

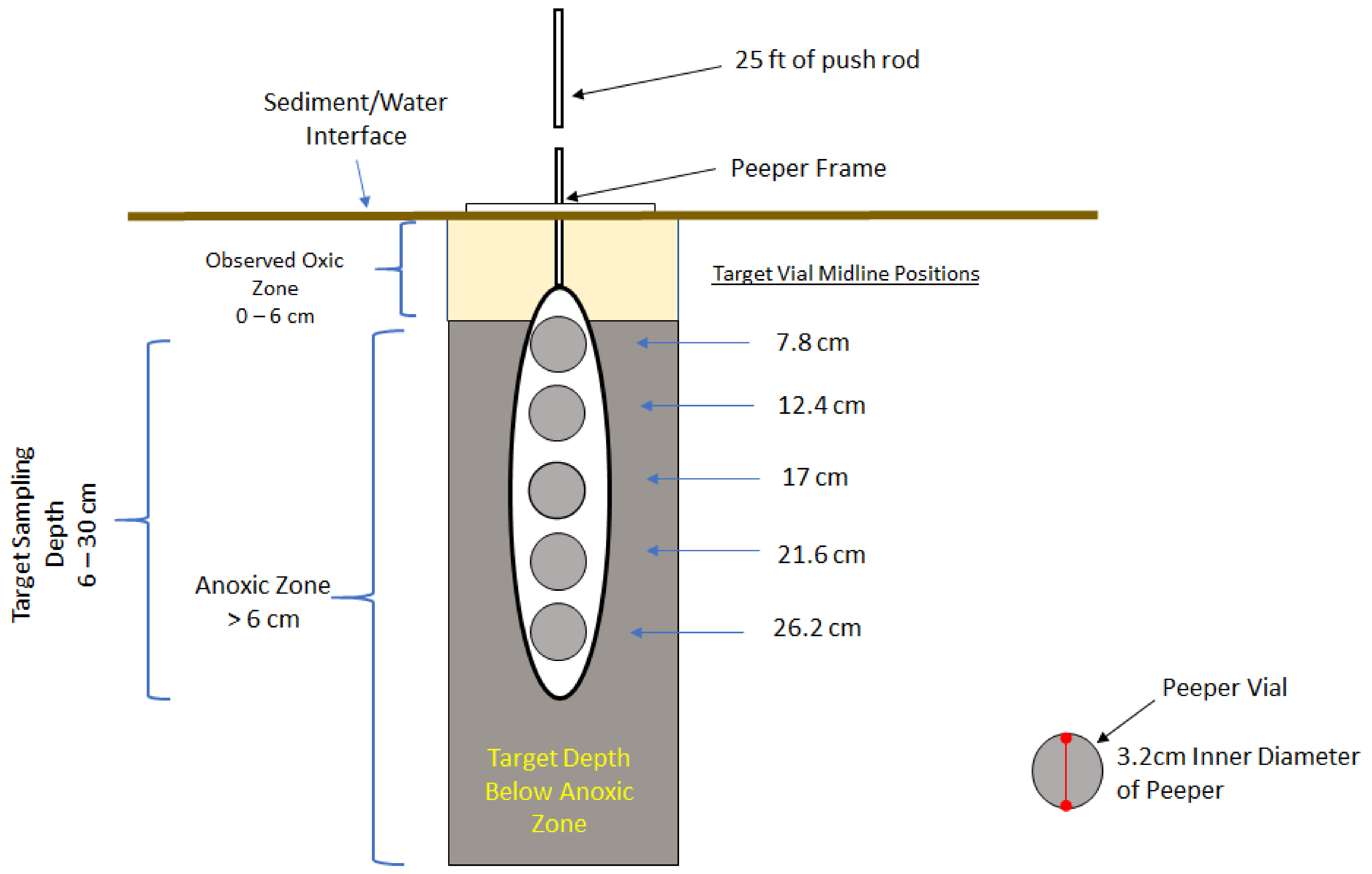
AECOM Geosyntec consultants

Figure 2d

MI/SEA

August 8, 2018

Path: P:\Projects\Portland Pre-Design PNG0767A\900 GIS and CAD\MXDs\Porewater Work Plan\Figure 2 Proposed Target Areas for Sample LocationsV3 .mxd



Vertical Stratification of Redox Conditions and Sampling Depth Intervals

Portland Harbor Superfund Site
PDI Porewater FSP

AECOM Geosyntec consultants

Figure 3

MI/SEA June 10, 2018

Path: P:\Projects\Portland Pre-Design PNG0767A\900 GIS and CAD\MXDs\Porewater Work Plan\Figure 2 Porewater Sample Intervals.mxd

APPENDIX A

Equipment Checklist and Field Forms

Portland Harbor PDI Porewater Peeper Deployment Log **Porewater Station ID:**______________

Deployment Date:		**Sampling Vessel:**	
Peeper Interval:		**Field Personnel:**	
Weather Conditions:		**Water Depth (ft):**	
Proposed Coordinates:	N	**Mudline Elevation (ft)*:**	
	E		

Sediment Conditions (during pre-deployment grab sampling / peeper deployment):

Substrate Description: ______________________________

DO/ Redox/ RPD Depth in Sediment: ______________________________

Presence of Anoxic Conditions During Deployment (Y/N): ______________________

Peeper Deployment:

Triplicate Peeper #	Time	Actual Coordinates		Water Depth (ft)	Drive Depth (ft bml)	Radius Distance to Target Loc. (ft.)	Direction of Retrieval Line/Deployment Notes:
		Northing	Easting				
1							
2							
3							
4 - Water Quality							

* Surface Water Elevation as measured at Morrison Bridge by NOAA:
Water elevation datum:

Overlying Surface Water Quality Parameters:

Water Depth: ________________

Temp: ______________ D.O.:__________________ Other: ________________________

ORP: _______________ Cond: _________________ pH:__________________________

Oversight During Sampling? No Yes: ______________________________

Additional Comments:	**Sketch of Peeper Array:**

last revised August 8, 2018

Portland Harbor PDI Porewater Peeper Field Retrieval **Porewater Station ID:**______________

Peeper Station ID:______________	**Field Personnel:** ______________
Retrieval Date: ______________	**Sampling Vessel:** ______________
Deployment Duration: ______________	
Weather Conditions: ______________	

Peeper #	**Time**	**Coordinates**		**Water Depth (ft)**	**Peeper Condition** (not acceptable, fair, good, very good)	**Retrieval Notes**
		Northing	**Easting**			
1						
2						
3						
4						

* Tide as measured at Morrison Bridge by NOAA Water Elevation Datum:

Overlying Surface Water Quality Parameters

Water Depth: ______________

Temp: ______________ D.O.:______________ Other: ______________

ORP: ______________ Cond: ______________ pH:______________

QA/QC Report			
QA/QC Type	**QA/QC Sample ID**	**Time**	**Parent**

Oversight During Sample Collection? No Yes: ______________

Additional Comments

last revised Aug. 8, 2018

AECOM

Geosyntec consultants

Portland Harbor PDI Porewater Peeper Processing Log **Porewater Location ID:**______________

Peeper Station ID:______________________ **Field Personnel:** ______________________
Retrieval Date: ______________________ **Sampling Vessel:** ______________________
Deployment Duration: ______________
Weather Conditions:

Pore Water Quality Parameters (in vial) Peeper Used: ______________

Parameter(Unit)	Vial 1	Vial 2	Vial 3	Vial 4	Vial 5
DO (mg/L)					
ORP (mV)					

Oxic Composite Water Quality Peeper Vials / Volume: ____

Pore Water Quality Parameters (Oxic Composite)

Temp: ______________ D.O.:___________________
ORP: _______________ Cond: __________________ pH:_________

Anoxic Composite Water Quality Peeper Vials / Volume: ____

Pore Water Quality Parameters (Anoxic Composite)

Temp: ______________ D.O.:___________________
ORP: _______________ Cond: __________________ pH:_________

Sample ID: __________________________________ **Analysis:** _________________________________

Additional Comments/Sketch of Compositing:

last revised Aug. 8, 2018

Porewater Sampler Deployment/Retrieval Packing List

Job Title	Portland Harbor PDI	
Number Peepers (4 peepers per location; 8 locations + 2 Field Duplicates) =	40	
Number of Locations (4 peepers per location)	8 or 9	+ 1 field duplicate
Deployment Duration	28 days	
Deployment Method	Push pole	

Item	Qty	Category
Peeper Deployment		
Push poles (5 ft sections, 7 ft long)	1	Push Pole Deployment
Whale tail	1	Push Pole Deployment
Extra whale tail spring pins	3	Push Pole Deployment
Extra spring pin cotter pins	3	Push Pole Deployment
Underwater camera, padding and mount	1	Push Pole Deployment
Rope, nylon - floating (10-15 ft per peeper + 100 ft extra)	700	Push Pole Deployment
Floats, large - 10 for job. misc. use.	10	Push Pole Deployment
Floats, small - 1 per location + extras	60	Push Pole Deployment
Peeper frames & associated materials (with 10% extra)	44	Push Pole Deployment
Peeper vials - 5 per frame + 20% extra	240	Push Pole Deployment
Peeper filter papers	264	Push Pole Deployment
6-gallon bucket for nitrogen purging	4	Push Pole Deployment
Deionized water (gallons) (enough for 4 x 6-gallon bucket for purging)	24	Push Pole Deployment
Nitrogen tank, high purity gas if possible, and regulator	1	Push Pole Deployment
Misc. flexible tubing for nitrogen tank	1	Push Pole Deployment
YSI Optical DO probe	1	Monitoring
YSI Multiparameter Probe (temperature, conductivity, DO, ORP, and pH)	1	Monitoring
Peeper Retrieval and Sample Processing		
Deionized water - gallons (in squeeze bottle for rinsing)	3	Peeper Retrieval
YSI Optical DO Probe (< 2.7 cm wide)	1	Monitoring
YSI Multiparameter Probe	1	Monitoring
pH and Conductivity Probe (< 2.7 cm wide)	1	Monitoring
ORP probe (< 2.7 cm wide)	1	Monitoring
Packing type tape - 2 rolls	2	Peeper Processing
Nitrogen tank, high purity gas if possible, and regulator	1	Peeper Processing
Misc. flexible tubing for nitrogen tank	1	Peeper Processing
Grapple line and hook	1	Peeper Retrieval
Syringes and sharps containers (1 per peeper vial plus extra)	180	Peeper Processing
Cooler and ice	4	Peeper Retrieval
Mylar bags (1 per peeper vial)	220	Peeper Processing
Compositing vessel (narrow mouth glass jar; 1 L)	1	Peeper Processing
Laboratory-supplied sample bottles	20	Peeper Processing
Supplies & Tools		
Garbage bags	4	General Sampling Equipment
Gloves, 12 X No. locations	96	General Sampling Equipment
Weighted measuring tape (50 ft long)	1	General Sampling Equipment
Measuring tape	1	General Sampling Equipment
Paper towels - 1 role per 8 locations	1	General Sampling Equipment
1-gallon Ziploc bags - 2 per device	80	General Sampling Equipment
Sandwich-size Ziploc bags - 3 per peeper	140	General Sampling Equipment
Cable ties - medium - 10 per location	80	General Sampling Equipment
Cable ties - long - 3 per location	24	General Sampling Equipment
Camera	1	General Sampling Equipment
Field notebook	1	General Sampling Equipment
Pens & Sharpies	3	General Sampling Equipment
Tin snips	1	Tools
Needle-nosed pliers	1	Tools
Slip joint pliers	1	Tools
Phillips head screw driver	2	Tools
3/8-inch wrench	1	Tools
3/8-inch socket on screw driver handle	1	Tools
Knife	1	Tools

Safety Supplies and PPE

Boots, waterproof, steel-toed	pp	PPE
Gloves, nitrile, heavy outer	pp	PPE
Gloves, nitrile, thin inner	pp	PPE
Hard hats	pp	PPE
Hearing protection	pp	PPE
Rain slicks	pp	PPE
Safety glasses/goggles	pp	PPE
Warm/dry clothes	pp	PPE
Work gloves - cut resistant	pp	PPE
US Coast Guard-approved Type III or V PFD or life jacket	pp	PPE
GPS	1	Safety Equipment
Cell phones (fully charged) or satellite phone (if no cell coverage)	1	Safety Equipment
VHF radios	1	Safety Equipment
Rescue rope in throw bag	1	Safety Equipment
Air horns and/or whistles	1	Safety Equipment
Waterproof flashlight	1	Safety Equipment
Secondary “kicker” motor or alternative propulsion	1	Safety Equipment
Bailer or bilge pump/emergency pump	1	Safety Equipment
Length of rope for securing boat	1	Safety Equipment
Type 4 throwable ring or cushion	1	Safety Equipment
Type BC fire extinguisher (10 pound) if extra fuel is carried in portable containers.	1	Safety Equipment
Anchor with appropriate length of line	1	Safety Equipment
First-aid kit and AED	1	Safety Equipment
Oil booms	1	Safety Equipment
PID	1	Safety Equipment
Bottled water	1	Safety Equipment
Snacks	1	Safety Equipment
Float plan	1	Safety Equipment

Notes:
AED = automated external defibrillator
cm = centimeter
DO = dissolved oxygen
ft = foot/feet
GPS = global positioning system
L = liter
ORP = oxidation-reduction potential
PDI = pre-remedial design investigation
PFD = personal flotation device
PID = photoionization detector
pp = per person
PPE = personal protective equipment
VHF = very high frequency

Last revised August 8, 2018

APPENDIX B

Standard Operating Procedures (SOPs)

B-1: Horizontal and Vertical Station Control SOP (revised August 2018)

B-2: Field Wet Sieving for Grain Size SOP

B-3: Water Quality Parameters SOP (Integral 2004)

B-4: Water Quality Monitoring Equipment Calibration, Operation, and Maintenance SOP

B-5: Manufacturer Operation Manuals for Water Quality Parameter Probes

B-6: Management of Investigation-Derived Waste SOP

APPENDIX B – Standard Operating Procedures

B-1. Horizontal and Vertical Station Control

STANDARD OPERATING PROCEDURE

HORIZONTAL AND VERTICAL SURVEY CONTROL

Introduction

This Standard Operating Procedure (SOP) has been developed for the Pre-Remedial Design Sampling and Baseline Investigations (PDI) at the Portland Harbor Superfund Site located in Portland, Oregon to confirm accurate positioning of vessels and samples during sample collection activities. The survey control requirements described in this SOP are specifically for environmental sample collection and will generally comply with map-grade precision and accuracy in contrast to the geodetic-grade precision and accuracy performed for the Bathymetric Survey conducted by David Evans and Associates (DEA). However, the same survey control points and geodetic parameters will be used in both surveys for consistency, and a portion of the quality assurance/quality control (QA/QC) process will involve consultation with DEA Oregon Professional Land Surveyor (PLS) staff to review the map-grade data collected for the environmental sample collection.

The organization of this SOP is as follows:

- Methodology Overview
- Project Geodetic Parameters
- Survey Accuracy, Precision, and Control
- Primary Equipment
- Hand-Held GPS Operation
- Vessel Navigation and Equipment Operation
- Data Processing and QA/QC Procedures

Tables, figures, and attachments are presented at the end of the SOP.

Methodology Overview

Horizontal (Map) Data Collection

A combination of vessel-mounted and hand-held GPS receivers will be used to navigate to sampling locations and to collect map location coordinates (Northings, Eastings) for those sampling locations. The vessel-mounted GPS receivers will be the primary tool used for navigation to the pre-planned sampling locations in a GIS file, which will be pre-loaded into the vessel navigational system. The hand-held GPS devices will be used as a backup and confirmation of vessel position only if there are problems with the vessel GPS navigation system or if there is no specific vessel navigation system (i.e., smaller boats). Since the inception of field work, the vessel GPS coordinates have been consistently verified and deemed to be sufficient to meet position and accuracy requirements for the project. The hand-held GPS devices will primarily be used for studies involving small vessels. These devices will also have the pre-loaded basemap content depicting planned sampling locations.

The vessel GPS will operate in two modes, collecting both a separate continuous data stream of positional information (line file) and recording GPS soundings (target file) when a sample is specifically collected. The sample location target file will be recorded when the sampling device is in position for the grab (e.g., when sampler is on the river bottom). The specific Location ID associated with the sample will also be recorded in the GPS device log. Field personnel will be required to write that same Location ID on their field data collection forms at the same time. Both the continuous and episodic dataset will be timestamped to allow comparison of the two types of data. This data will be recorded and maintained on the vessel, and will also be exported from the vessel navigation system and archived to project servers on a daily basis.

The hand-held GPS devices will be operated independently of the vessel's systems and will be used to record a location sounding wherever a sample is collected only for studies unable to use the vessel GPS navigation system. The sample location sounding will be recorded approximately at the same time as when the vessel GPS measurement is collected (e.g., when sampler is in position). The specific Location ID associated with the sample will also be recorded on the GPS device. Field personnel will write this Location ID on the field forms only if the vessel measurement described earlier cannot be collected for some reason (e.g., equipment failure). These measurements will also be timestamped. The data from the hand-held GPS devices will be wirelessly synchronized to a "cloud" web service in near real-time; the data from the "cloud" will also downloaded and saved to project servers daily.

Vertical Data Collection

Vertical (elevation) data is also required for water levels, sample collection depth below surface water, and bottom (mudline) depth location for some types of sample locations. For increased precision and accuracy, it is proposed that bottom (mudline) depth locations (e.g., for sediment cores) be calculated from the 2018 bathymetric surface to be developed by the hydrographic survey performed by DEA (since the data will be collected within a few months of each other). The NAVD88 elevation will be calculated from the intersection of the surface map location coordinates collected as described earlier, projected vertically down to the bathymetric surface (United States Army Corps of Engineers [USACE], 2004). The elevation from the intersection of the bathymetric surface will be used as the final or "best" elevation for the sample.

In contrast, for depth measurements that require less precision (e.g., water levels, depth to samples below water surface), the onboard vessel sonar will be used to record depth and then subsequently calculate elevation. All depths will be recorded relative to the water surface and time tagged to correct with time tagged gauge data for obtaining riverbed elevations. The elevation will be calculated to NAVD88 datum (in feet). To correct elevations, gauge data from the Northwest River Forecast Center will be downloaded for gauge PRT03, which is representative of the former Morrison gauge which has been moved. This gauge does not report NAVD88 elevations but rather reports a value that is 0.3 feet above Columbia River Datum (CRD). Corrections from CRD to NAVD88 differ moving down the river from the gauge due to the fact that NAVD88 is a reference normal to gravity (water does not flow if the elevation is unchanging), and CRD is a gradient datum that follows the lower water surface. In Portland Harbor, the difference between CRD and NAVD88 (Geoid12b) ranges from 0.00 feet CRD = -5.16 feet NAVD88 (Geoid12b) at Willamette River river mile (RM) 2.0, to 0.00 feet CRD = -5.41

feet NAVD88 (Geoid12b) at Willamette River RM 12.8 (approximate location of PRT03 Gauge). Accordingly, a correction to the Willamette Gauge in Portland would be -5.41+0.3 or -5.11 feet at RM 12.8. An approximation would be to subtract 5 feet from the gauge reading for the full length of the study area, but precision will vary depending on tides and river gradient.

For sample locations requiring vertical information, depth will be recorded by field staff on their data collection forms relative to the water surface, and these values will be loaded to the project database as described in the Data Quality Management Plan (DQMP). Final calculated NAVD88 elevation data (feet) will also be entered into a separate data field in the project database after completion of spatial analysis, calculations, and QA/QC. DEA will provide support during the QA/QC process to verify proper calculation of NAVD88 elevation data.

Location Position Recording in Project Database

Discrete Samples

When discrete samples are collected, the Location ID and the location coordinates (Northing/Easting) will be recorded on the GPS device(s) and the field data collection form(s). The location coordinates will be based on the vessel GPS instantaneous target measurement. This target measurement will be the location coordinate pair loaded initially to the project database. After the field event is completed, the target measurement will be compared to the line file (vessel continuous GPS measurement) to confirm that the coordinate pair loaded to the project database is appropriate. If analysis reveals precision or accuracy issues, the loaded location coordinate pair in the project database may be updated and edited with a better value derived from the line file. In general, the hand-held GPS devices will be used as a backup and confirmation of vessel position only if there are problems with the vessel GPS navigation system or an independent navigation system is not available on the vessel. These coordinates will be loaded to the project database only if there is a significant problem with the vessel GPS (e.g., equipment failure) or if there is no vessel GPS.

Composite Samples

When composite samples are collected, location coordinates will also be recorded as both target measurements and continuous measurements using the vessel GPS. The continuous GPS measurements will be recorded during the entire compositing event, and instantaneous target measurements will be collected when the sampler is in position for each individual composite grab. At each compositing location, a target measurement will be recorded in the vessel GPS along with the Location ID with an “a,” “b,” or “c” suffix. These measurements will be recorded on the field forms in the same manner (e.g., there will be three sets of location coordinates, lithologic descriptions, etc.).

When the location data is loaded to the project database, a single set of location coordinates will be recorded in the project database with a Location ID that excludes the “a,” “b,” or “c” suffix. As a presumed middle time point, the “b” set of coordinates will be loaded with the primary Location ID to the project database. After the field event is completed, the target measurement associated with the “b” location composite will be compared to the line file (vessel continuous GPS measurement) to assess vessel position and the timeframe of the entire sampling event to confirm if the coordinate pair loaded to the project database is appropriate. The goal will be to finalize the location coordinate information in the project database based on the most representative position based on this analysis. Similar to discrete sample collection, a hand-held GPS device and related data will only be loaded to the project database if there is a significant problem with operation of the vessel GPS or if the vessel does not have a GPS.

Finally, after field data are collected and surveys are completed, as defined in the DQMP, the location coordinate data will be joined with the tabular data collected by the field teams and loaded to the project database.

Project Geodetic Parameters

The geodetic parameters to be used for the PDI field studies will be as follows:

Horizontal Datum: North American Datum of 1983 (2011)
Projection: State Plane Coordinate System (SPCS) Oregon North Zone
Vertical Datum: North American Vertical Datum of 1988 (NAVD88) Geoid12b
Horizontal Units: International Feet
Vertical Units: Feet

Survey Accuracy, Precision, and Control

The anticipated horizontal accuracy of environmental sampling associated with vessel and hand-held GPS devices is a range of 1 to 5 meters (target 1 to 2 meters for the DGPS unit itself). This should be consistent with RI target accuracy (Integral 2002) and best practices (Puget Sound Estuary Protocols [PSEP] 1998 and US Environmental Protection Agency [EPA] 2008).

The anticipated vertical accuracy of final elevation calculations derived from vessel sonar systems is anticipated to be 1.0 meter.

Table 1 summarizes the survey control locations used in the DEA Bathymetric Survey, which will be used for the environment sample collection work described in this SOP. Figure 1 shows the PH2 piling at the Fred Devine boat dock, and Figure 2 shows the approximate locations of the survey control references for PH1 and PH2. Figure 3 shows approximate location of PH3 for survey control above the Willamette Falls. Attachment 1 contains detailed survey sheets of the following control points: Raindeer, PH1 and PH2, and PH3. Additional information regarding the DEMSI and 2100 control points is available upon request.

Primary Equipment

- Trimble® SPS 461 GPS with dual antennas (vessel GPS)
- A-frame assembly, sampling winch (vessel boom)
- Trimble® R1 (hand held GPS), tethered to Bluetooth® capable smartphone or tablet, ESRI Collector software with Trimble® GNSS Status middleware
- GPS owner's manual
- Writing tools (pencils, Sharpie®)

- Field logbook
- Spare batteries and/or battery charger
- Compass
- Tape measure

Hand-Held GPS Operations

For ease of use, the project team will utilize smartphones tethered to the Trimble® R1 GNSS Receiver via a Bluetooth® connection. The smartphone will be configured with Trimble's middleware software called GNSS Status to convert and stream NMEA satellite data to the smartphone for real-time correction and display to a simple electronic data collection form developed on the ESRI Collector platform. The form will contain a limited number of data fields, including location, study name and operator, date, and notes or comments. This form is not intended to duplicate the content and scope of the field data collection forms, but rather clearly link the GPS data to those forms via the unique Location ID. There are metadata fields available as well from these GPS records, such as estimated horizontal accuracy.

Collected data recorded onto the phone will be transmitted wirelessly via a synchronization process invoked when data is "saved" to the device. The data will be pushed to AECOM Online's Portal and ArcGIS Server for storage of "corrected" location coordinates, Location ID, and other information captured when the GPS sounding is recorded. The sampling event will be trackable in near-real-time as samples are collected on the ArcGIS Portal Interface. Either dedicated, experienced GPS-operators will be collecting the measurements on the smartphones, or, due to the very simple nature of the interface, field personnel will be trained to use the devices. Initial training sessions were already successfully conducted March 19-20, 2018 on use of the smartphone GPS interface. These handheld devices were successfully used for the first 2 weeks of field work. For some studies, such as the smallmouth bass tracking study, these handhelds may be used as the primary GPS due to smaller vessel configuration.

Vessel Navigation and Equipment Operation

Vessel positioning will be conducted through the marine navigation and hydrographic software package HYPACK. This software package allows the visualization of the vessel over navigable charts, the processing of satellite corrections, stored hardware, and vessel parameters, as well as the storing of physical target locations during sampling activities. HYPACK version 2017 will be used for this project.

Vessel position is measured using a Trimble SPS 461 GPS dual antenna receiver. The dual antennas provide precise vessel positioning via both satellite and differential radio corrections along with heading correction to 0.09 degree. GPS data is output through a serial connection into computer running the HYPACK software, for vessel positioning and target collection.

At each sampling location, depth to mudline will be measured using an onboard fathometer (with lead line as confirmation as needed) immediately prior to or during the sampling. Water depths are measured at each station using an Airmar ss510 survey sonar at the sampling point and confirmed daily with a lead line with reference to water surface. Vertical measurements will be recorded to the nearest 0.1 foot. Water depths will be converted to elevations in NAVD88 based on the river stage at the time of sampling as recorded at the closest available tide gage.

Data Processing and QA/QC Procedures

All GPS devices will be subject to a position check to confirm the accuracy of the on-vessel GPS and hand-held GPS devices and to validate the positions derived from each GPS receiver. Correctors will be applied as needed, resulting in a position that is within specified positioning accuracy of the DEA published position for control monuments PH1, PH2, and PH3 (or future control point approved by EPA). At the start and end of each field day, the benchmark location will be visited to perform a position check.

At the piling serving as the PH2 control monument (accessible by boat), the on-vessel GPS calibrated to the top of A-frame assembly will be maneuvered as close to the benchmark piling as possible to record a point. The GPS-derived position of the sampling vessel is compared with the known horizontal location; results will be recorded in HYPACK to confirm that accuracy is within +/- 2 meters.

For handheld GPS, field staff will occupy the PH1 at the Swan Island boat launch parking lot or PH3 at the Willamette Park boat launch. Using the R1 and phone/tablet combination GPS setup, the field staff will hold the R1 above PH1 or PH3 and wait for a satellite “fix,” and when ready, the staff will record the GPS location in Collector. This GPS location will be compared to the known coordinates to confirm the accuracy is within +/- 2 meters. The survey control monuments act as a known location to allow for corrected station location coordinates during post-processing of data as needed. If a need arises to locate another benchmark, there are several USGS control points near the project area and near the AECOM project warehouse. Experienced GPS operators on the project team will be involved in all aspects of field data collection events to troubleshoot devices and assist in daily review of extracted geospatial datasets. Additional details on QA/QC procedures can be found on the DQMP.

References

AECOM (AECOM Technical Services) and Geosyntec (Geosyntec Consultants, Inc.). 2018. Data Quality Management Plan Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Portland Harbor Superfund Site. 22 February.

Integral (Integral Consulting). 2002. Round 1 Field Sampling Plan. Prepared for the Lower Willamette Group (LWG) for submittal and approval by EPA Region 10. June 14.

EPA (United States Environmental Protection Agency). 2008. National Geospatial Data Policy. August 24.

PSEP. 1998. Recommended Guidelines for Station Positioning in Puget Sound. Prepared for United States EPA Region 10 and the Puget Sound Water Quality Action Team. September.

USACE (United States Army Corps of Engineers). 2004. Engineering and Design Hydrographic Surveying Manual, EM 1110-2-1003, U.S. Army Corps of Engineers, April 2004

Tables and Figures

Attachments

Detailed survey sheets of PH Control Points of Portland Harbor (PH1, PH2, and PH3), and Raindeer survey monuments

Table 1. Benchmark Monument Coordinates and Description

Designation	Approx. Location	Description	NAD83 (2011), Oregon SPCS North (ft)		NAVD88 Elevation (ft)
			Northing	Easting	
DEMSI-BASE	Columbia River	Fixed antenna with height at antenna reference point	718172.70	7654431.05	73.58
DEMSI- CHECK	Columbia River	Fixed antenna with height at antenna reference point	718170.73	7654419.84	71.67
RAINDEER	RM 2	USACE Brass Cap	722443.24	7614886.64	35.44
Portland Harbor 1 (PH1)	Swan Island Boat Ramp	1/2" Iron Rod with red plastic cap stamped "DEA Control" Point is 0.3 feet south of the back of curb at the Swan Island Boat Ramp, 10.5 feet north of a cyclone fence, and 60 feet east of a light post	698702.46	7637426.37	33.38
Portland Harbor 2 (PH2)	Fred Devine Boat Dock	Reference point is 0.2 feet SE of the SE side of a 1-1/2-foot diameter steel pile. This is the furthest SE pile at the end of the Fred Devine Diving and Salvage Company dock in the Swan Island Lagoon.	700967.87	7634507.67	NA
Portland Harbor 3 (PH3)	Willamette Park Boat Launch (above the falls)	PK nail in trailer parking lot of boat launch ramp, near center of loop and approximately even with seventh parking space.	617123.76	7649701.80	72.42
2100	RM 13	5/8" bolt on SW corner of screen wall at DEA office 2100 SW River Parkway, Portland, OR	678400.01	7645190.81	159.51

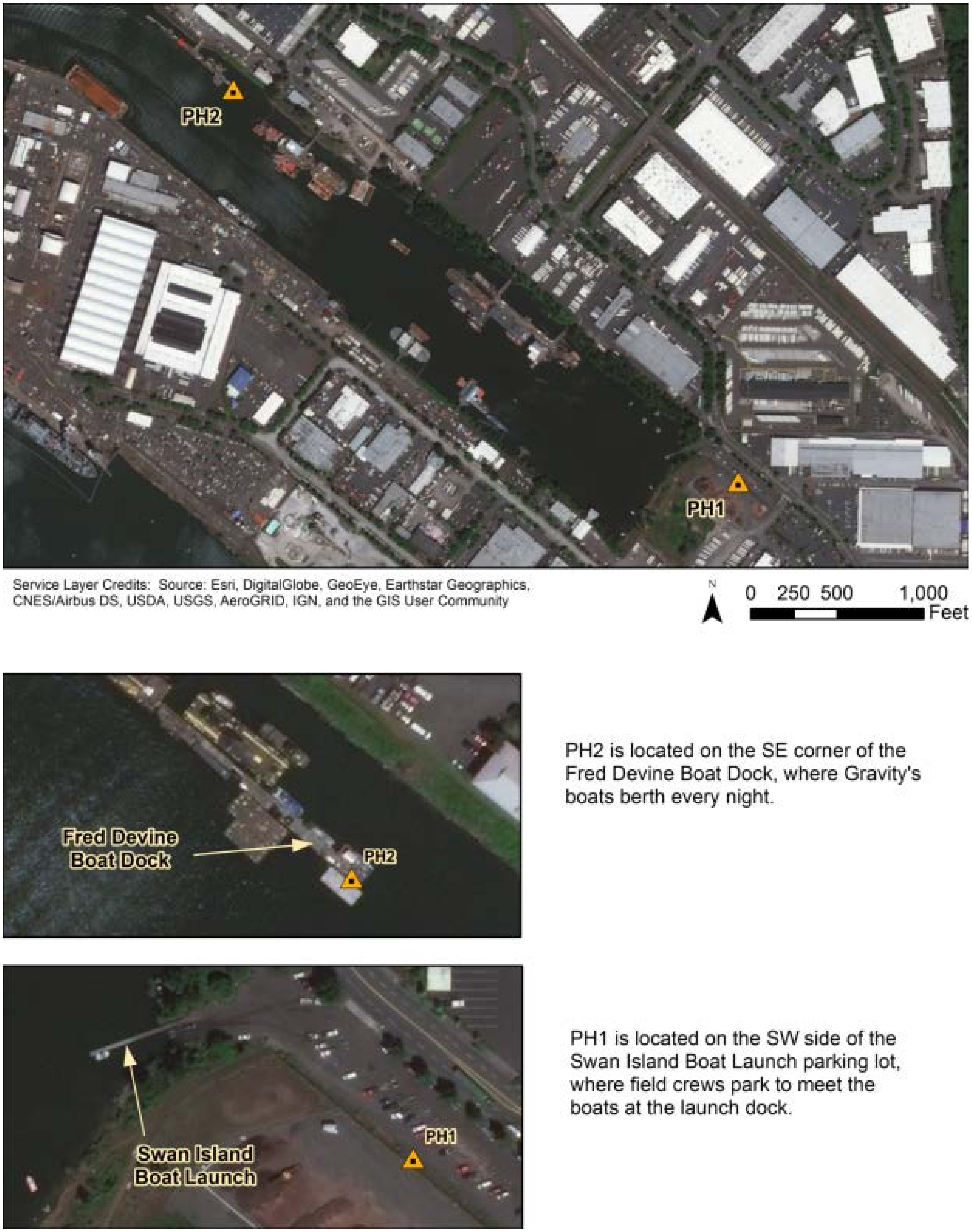
General Notes:

1. The two DEMSI and the 2100 stations (indicated with green shading) are transceiver beacon stations in upland areas. These stations will not be used for daily location control checks by sampling team. More information regarding these stations is available upon request.
2. PH1 is located at the Swan Island boat ramp parking lot and accessible by foot.
3. PH2 is located at a piling at the boat dock where project-related vessels will be docked and is accessible by boat. This pile is to be used for daily position checks for sediment sampling operations. Pile is for position only and not elevation.
4. PH3 is located in the parking lot of the boat launch above the Willamette Falls and is accessible by foot.
5. Raindeer station is located adjacent to the river and accessible by foot (for the hand-held GPS).

Acronyms:

DEA = David Evans and Associates; ft = feet; NAD83 = North American Datum of 1983; NAVD88 = North American Vertical Datum of 1988; PH = Portland Harbor; RM = river mile; PK nail = survey marker; USACE = US Army Corps of Engineers; SPCS = State Plane Coordinate System

Figure 1. Photograph of Piling PH2, at the end of the Fred Devine Boat Dock. Piling was surveyed during and captured in DEA bathymetric survey. Photo is facing northwest.



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

PH2 is located on the SE corner of the Fred Devine Boat Dock, where Gravity's boats berth every night.

PH1 is located on the SW side of the Swan Island Boat Launch parking lot, where field crews park to meet the boats at the launch dock.

Figure 2. Locations of control monuments PH1 and PH2 at Swan Island Boat Launch and Fred Devine Boat Dock, respectively.

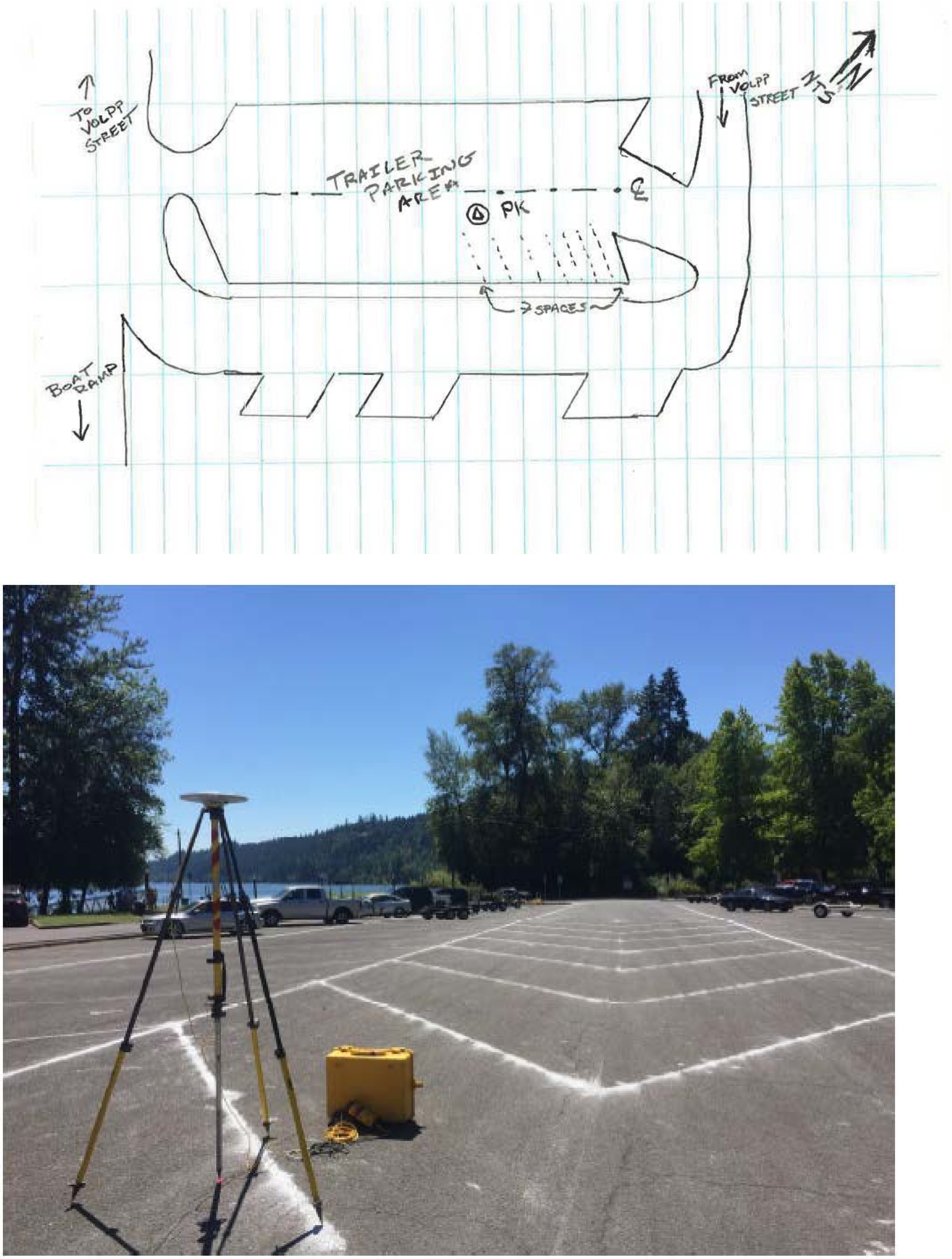


Figure 3. PK nail in the middle of Willamette Park Boat Launch parking marks survey monument PH3. It was land-surveyed by DEA and marked with pink survey tape. Photo shows survey equipment set-up over PH3.

NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

GPS STATION OBSERVATION LOG April 16, 2003	Station Designation: (check applicable:__ FBN__ CBN__ PAC__ SAC __BM) Portland Harbor 1 (PH1)	Station PID, if any:	Date (UTC): 06-Mar-18
	General Location: Swan Island Boat Launch Airport ID, if any:	Station 4-Character ID:	Day of Year: 065
Project Name: Portland Harbor - AETR00000034	Project Number: **GPS-**	Station Serial # (SSN):	Session ID:(A,B,C etc)

NAD83 Latitude o ‘ “	NAD83 Longitude o ‘ “	NAD83 Ellipsoidal Height meters	Agency Full Name: David Evans and Associate, Inc.
Observation Session Times (UTC): Sched. Start ________ Stop ________ Actual Start 19:30 Stop 21:32	Epoch Interval= 1 Seconds Elevation Mask = 10 Degrees	NAVD88 Orthometric Ht. meters GEOID99 Geoid Height meters	Operator Full Name: David T. Moehl Phone #: ( ) (360) 314-3200 e-mail address: dtm@deainc.com

Receiver Brand & Model: Trimble SPS985 82500-60 P/N: S/N: 5616F59510 Firmware Version: 5.30 ☐ CamCorder Battery, ☐ 12V DC, ☐ 110V AC, ☑ Other	Antenna Code*, Brand & Model: Trimble SPS985 Internal P/N: S/N: Cable Length, meters: n/a Vehicle is Parked 10 meters N (direction) from antenna.	Antenna plumb before session? (Y✓ / N) Antenna plumb after session? (Y✓ / N) Antenna oriented to true North? (Y / N✓) Weather observed at antenna ht. (Y / N✓) Antenna ground plane used? (Y / N✓) Circle Yes or No -If no, explain “ Antenna radome used? (Y / N✓) Eccentric occupation (>0.5 mm)? (Y / N✓) Any obstructions above 10°? (Y / N✓) Radio interference source nearby (Y / N✓) If yes, describe. Use Vis. form

Tripod or Antenna Mount: Check one:
☑ Fixed-Leg Tripod, ☐ Collapsible-leg tripod ☐ Fixed Mount
Brand & Model: Seco fixed height
P/N:
S/N: 5115-00-FLY
Last Adjustment date: 2018-03-05

Psychrometer (if used) Brand & Model:
P/N:
S/N:
Last Calibration or check Date:

** ANTENNA HEIGHT **	Before Session Begins: Meters	Before Session Begins: Feet	After Session Ends: Meters	After Session Ends: Feet
A= Datum point to Top of Tripod (Tripod Height)	2.000		2.000	
B=Additional offset to ARP if any (Tribrach/Spacer)	0.000		0.000	
H= Antenna Height **= A + B** **=** Datum Point to Antenna Reference Point (ARP)	2.000	6.56	2.000	6.56

Meters = Feet x (0.3048)
Height Entered Into Receiver = 2.000 meters.
Note &/or sketch **ANY** unusual conditions. Be **Very Explicit** as to where and how Measured!

Barometer (if used) Brand & Model:

S/N:

Weather Data	Weather Codes	Time (UTC)	Dry-Bulb Temp Fahrenheit	Dry-Bulb Temp Celsius	WetBulb Temp Fahrenheit	WetBulb Temp Celsius	Rel. % Humidity	Atm. Pressure inches Hg	Atm. Pressure millibar
Before	00000	19:30							
Middle									
After	00000	21:32							

Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:

Control point is a 1/2" iron rod with red plastic cap stamped "DEA CONTROL" set 0.1' below natural grade. Control point is 0.3' south of the back of curb, 10.5' north of a cyclone fence and 60' easterly of the 2nd light post east of the boat ramp. See detached sketch and photos.

Weather codes are required. Weather data are optional but encouraged. *Antenna code comes from ant_info file furnished by project coordinator.

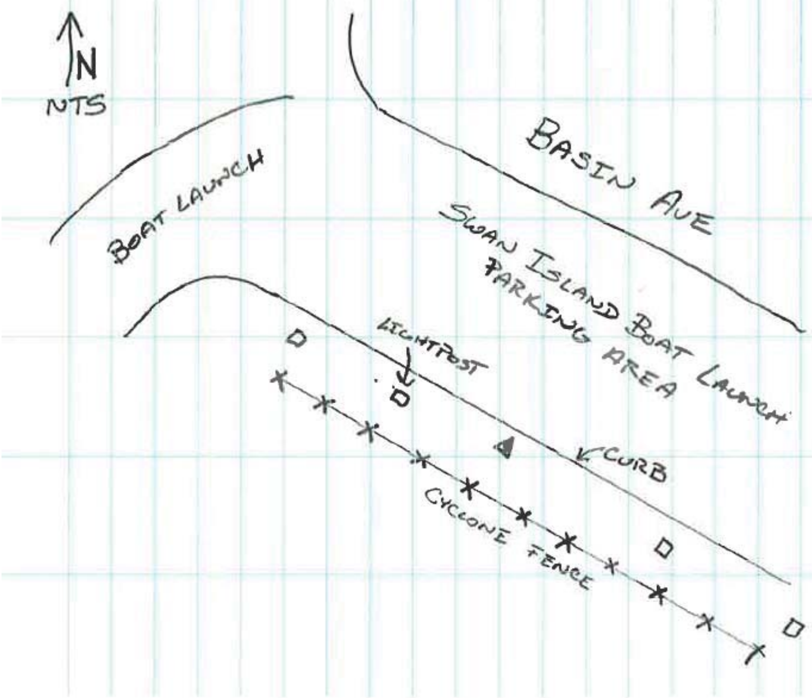
Data File Name(s): 95100650.T02
(Standard NGS Format = aaaaddds.xxx)
where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension

Updated Station Description: ☐ Attached ☐ Submitted earlier
Visibility Obstruction Form: ☐ Attached ☐ Submitted earlier
Photographs of Station: ☑ Attached ☐ Submitted earlier
Pencil Rubbing of Mark: ☐ Attached

LOG CHECKED BY:
Jon Dasler

Table of Weather Codes	**CODE**	**PROBLEM**	**VISIBILITY**	**TEMPERATURE**	**CLOUD COVER**	**WIND**
	0	did not occur	Good, over 15 miles	Normal, 32° F- 80° F	Clear, below 20%	Calm, under 5mph (8km/h)
	1	did occur	Fair, 7-15 miles	Hot, over 80°F (27 C)	Cloudy, 20% to 70%	Moderate, 5 to 15 mph
	2	- not used -	Poor, under 7 miles	Cold, below 32° F (0 C)	Overcast, over 70%	Strong, over15 mph (24km/h)
Examples:	00000 = No problem, good visibility, normal temp, clear, calm wind	12121 = Problems, poor visibility, hot, overcast, moderate wind				

Sketch of Monument PH1



CONTROL POINT IS A ½" IR W/ RED PLASTIC CAP STAMPED "DEA CONTROL" SET 0.1' BELOW NATURAL GRADE.

CONTROL POINT IS 0.3' SOUTH OF BACK OF EXISTING CURB, 10.5' NORTH OF A CYCLONE FENCE, AND 60' EASTERLY OF A LIGHTPOST.

Photo of Monument PH1

GNSS Setup on PH1

NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

GPS STATION OBSERVATION LOG
April 16, 2003

Station Designation: (check applicable:__ FBN__ CBN__ PAC__ SAC __BM) Portland Harbor 2 (PH2)

Station PID, if any:

Date (UTC): 20-Apr-18

General Location: Fred Devine Boat Dock

Airport ID, if any:

Station 4-Character ID:

Day of Year: 111

Project Name: Portland Harbor - AETR00000034

Project Number: GPS-

Station Serial # (SSN):

Session ID:(A,B,C etc)

NAD83 Latitude o ‘ “

NAD83 Longitude o ‘ “

NAD83 Ellipsoidal Height meters

NAVD88 Orthometric Ht. meters

GEOID99 Geoid Height meters

Agency Full Name: David Evans and Associate, Inc.

Operator Full Name: David T. Moehl

Phone #: ( ) (360) 314-3200

e-mail address: dtm@deainc.com

Observation Session Times (UTC):

Sched. Start ________ Stop ________

Actual Start 19:45 Stop 19:49

Epoch Interval= 1 Seconds

Elevation Mask = 10 Degrees

Receiver Brand & Model: Trimble SPS985

P/N: 82500-60

S/N: 5616F59510

Firmware Version: 5.30

☐ CamCorder Battery, ☐ 12V DC, ☐ 110V AC, ☑ Other

Antenna Code*, Brand & Model: Trimble SPS985 Internal

P/N:

S/N:

Cable Length, meters: n/a

Vehicle is Parked n/a meters ____(direction) from antenna.

Antenna plumb before session?	(Y / N) ✓	Circle Yes or No -If no, explain “
Antenna plumb after session?	(Y / N) ✓	
Antenna oriented to true North?	(Y / N) ✓	
Weather observed at antenna ht.	(Y / N) ✓	
Antenna ground plane used?	(Y / N) ✓	
Antenna radome used?	(Y / N) ✓	If yes, describe. Use Vis. form
Eccentric occupation (>0.5 mm)?	(Y / N) ✓	
Any obstructions above 10º?	(Y / N) ✓	
Radio interference source nearby	(Y / N) ✓	

Tripod or Antenna Mount: Check one:

☑ Fixed-Leg Tripod, ☐ Collapsible-leg tripod ☐ Fixed Mount

Brand & Model: Seco fixed height

P/N:

S/N: 5115-00-FLY

Last Adjustment date: 2018-03-05

Psychrometer (if used) Brand & Model:

P/N:

S/N:

Last Calibration or check Date:

** ANTENNA HEIGHT **	Before Session Begins: Meters	Before Session Begins: Feet	After Session Ends: Meters	After Session Ends: Feet
A= Datum point to Top of Tripod (Tripod Height)	2.000		2.000	
B=Additional offset to ARP if any (Tribrach/Spacer)	0.000		0.000	
H= Antenna Height **= A + B** **=** Datum Point to Antenna Reference Point (ARP)	2.000	6.56	2.000	6.56

Meters = Feet x (0.3048)

Height Entered Into Receiver = 2.000 meters.

Note &/or sketch **ANY** unusual conditions. Be **Very Explicit** as to where and how Measured!

Barometer (if used) Brand & Model:

S/N:

Weather Data	Weather Codes	Time (UTC)	Dry-Bulb Temp Fahrenheit	Dry-Bulb Temp Celsius	WetBulb Temp Fahrenheit	WetBulb Temp Celsius	Rel. % Humidity	Atm. Pressure inches Hg	Atm. Pressure millibar
Before	00010	19:45							
Middle									
After	00010	19:49							

Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:

Reference point is 0.2 feet SE of the SE side of a 1-1/2 foot steel pile. This is the furthest SE pile at the end of the Fred Devine Diving and Salvage Company dock in the Swan Island Lagoon. This pile is to be used for daily position checks for sediment sampling operations. Pile is for position only and not elevation.
NAD83(2011) Oregon North Zone International Feet Coordinates
North 700967.9 East 7634507.7

Weather codes are required. Weather data are optional but encouraged. *Antenna code comes from ant_info file furnished by project coordinator.

Data File Name(s):

(Standard NGS Format = aaaaddds.xxx)
where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension

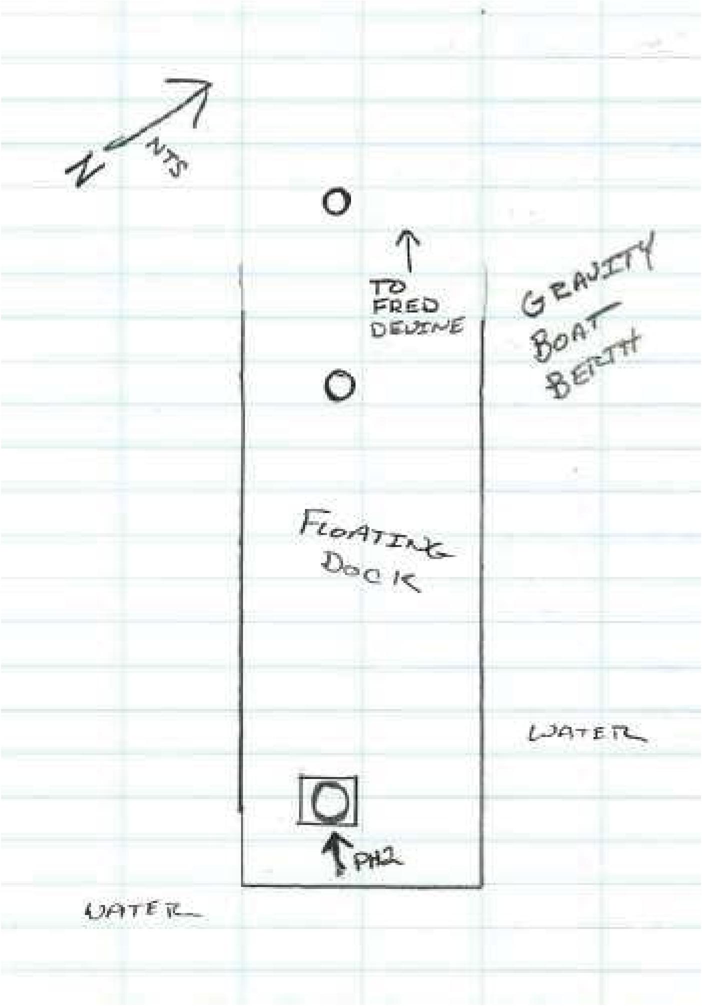
Updated Station Description:	☐ Attached	☐ Submitted earlier
Visibility Obstruction Form:	☐ Attached	☐ Submitted earlier
Photographs of Station:	☑ Attached	☐ Submitted earlier
Pencil Rubbing of Mark:	☐ Attached	

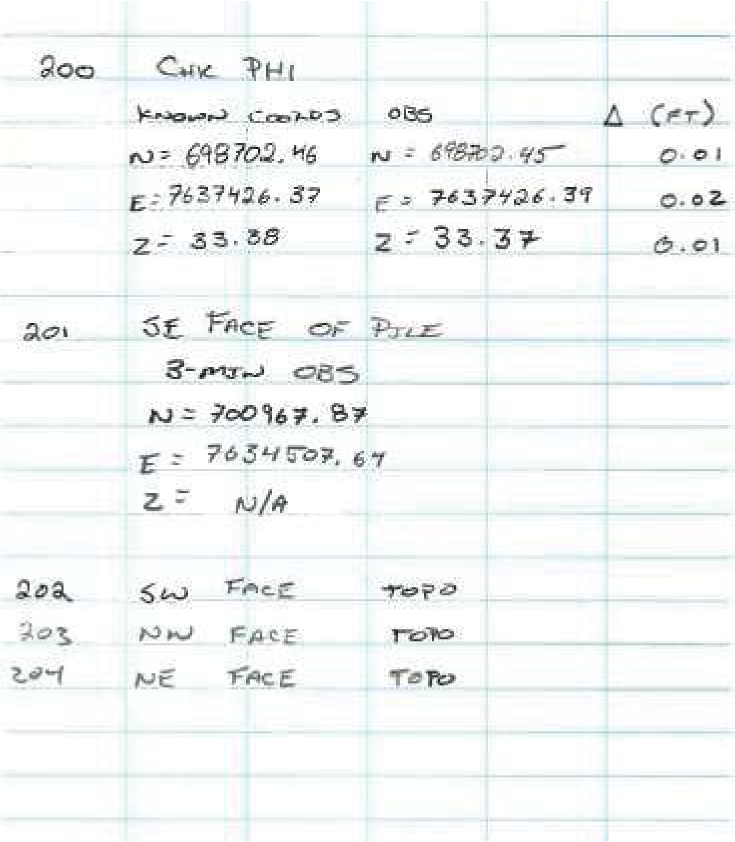
LOG CHECKED BY: Jon Dasler

Table of Weather Codes	CODE	PROBLEM	VISIBILITY	TEMPERATURE	CLOUD COVER	WIND
	0	did not occur	Good, over 15 miles	Normal, 32º F- 80º F	Clear, below 20%	Calm, under 5mph (8km/h)
	1	did occur	Fair, 7-15 miles	Hot, over 80ºF (27 C)	Cloudy, 20% to 70%	Moderate, 5 to 15 mph
	2	- not used -	Poor, under 7 miles	Cold, below 32º F (0 C)	Overcast, over 70%	Strong, over15 mph (24km/h)

Examples: 00000 = No problem, good visibility, normal temp, clear, calm wind 12121 = Problems, poor visibility, hot, overcast, moderate wind

Sketch and Fieldnotes





200 CHK PH1

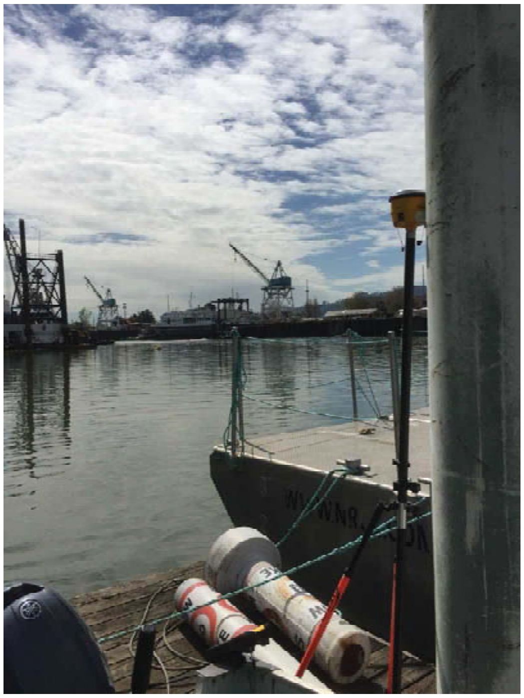
KNOWN COORDS	OBS	Δ (FT)
N= 698702.46	N = 698702.45	0.01
E= 7637426.37	E = 7637426.39	0.02
Z= 33.38	Z = 33.37	0.01

201 SE FACE OF PILE
3-MIN OBS
N = 700967.87
E = 7634507.67
Z = N/A

202	SW	FACE	TOPO
203	NW	FACE	TOPO
204	NE	FACE	TOPO

Overview of PH2 Pile

GNSS Setup on PH2 Pile


View facing south


View facing northwest

NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

--> Click here to clear the sample data <--

GPS STATION OBSERVATION LOG
April 16, 2003

Station Designation: (check applicable: __FBN__CBN__PAC__SAC __BM)
Portland Harbor 3 (PH3)

Station PID, if any:

Date (UTC): 24-Jul-18

General Location: Willamette Park Boat Launch

Airport ID, if any:

Station 4-Character ID:

Day of Year: 205

Project Name: Portland Harbor - AETR00000034

Project Number: **GPS-**

Station Serial # (SSN):

Session ID:(A,B,C etc)

NAD83 Latitude: N45° 20' 21.30094"

NAD83 Longitude: W122° 38' 54.96637"

NAD83 Ellipsoidal Height: -0.752 meters

NAVD88 Orthometric Ht. 22.073 meters

GEOID99 Geoid Height ______ meters

Observation Session Times (UTC):
Sched. Start ________ Stop ________
Actual Start 20:55 Stop 22:58

Epoch Interval= 1 Seconds
Elevation Mask = 10 Degrees

Agency Full Name: David Evans and Associate, Inc.
Operator Full Name: David T. Moehl
Phone #: ( ) (360) 314-3200
e-mail address: dtm@deainc.com

Receiver Brand & Model: Trimble NetR5
P/N: 62800-10
S/N: 4750K11589
Firmware Version: 48.01
☐ CamCorder Battery, ☐ 12V DC, ☐ 110V AC, ☐ Other

Antenna Code*, Brand & Model: Zephyr 3 Base
P/N: 115000-10
S/N: 3121179869
Cable Length, meters: 5
Vehicle is Parked 10 meters E (direction) from antenna.

Antenna plumb before session?	([✓ Y] / N)	Circle Yes or No -If no, explain "
Antenna plumb after session?	([✓ Y] / N)	
Antenna oriented to true North?	([✓ Y] / N)	
Weather observed at antenna ht.	(Y / [✓ N])	
Antenna ground plane used?	(Y / [✓ N])	
Antenna radome used?	(Y / [✓ N])	If yes, describe. Use Vis. form
Eccentric occupation (>0.5 mm)?	(Y / [✓ N])	
Any obstructions above 10º?	([✓ Y] / N)	
Radio interference source nearby	(Y / N)	

Tripod or Antenna Mount: Check one:
☐ Fixed-Leg Tripod, ☑ Collapsible-leg tripod ☐ Fixed Mount
Brand & Model: Seco Collapsible
P/N:
S/N: uk
Last Adjustment date: 2018-07-24

Psychrometer (if used) Brand & Model:
P/N:
S/N:
Last Calibration or check Date:

** ANTENNA HEIGHT **	Before Session Begins: Meters	Feet	After Session Ends: Meters	Feet
A= Datum point to Top of Tripod (Tripod Height)	2.003		2.003	
B=Additional offset to ARP if any (Tribrach/Spacer)	0.000		0.000	
H= Antenna Height **= A + B** = Datum Point to Antenna Reference Point (ARP)	2.003	6.57	2.003	6.57

Meters = Feet x (0.3048)
Height Entered Into Receiver = 2.000 meters.
Note &/or sketch **ANY** unusual conditions. Be **Very Explicit** as to where and how Measured!

Barometer (if used) Brand & Model:
S/N:

Weather Data	Weather Codes	Time (UTC)	Dry-Bulb Temp Fahrenheit	Dry-Bulb Temp Celsius	WetBulb Temp Fahrenheit	WetBulb Temp Celsius	Rel. % Humidity	Atm. Pressure inches Hg	Atm. Pressure millibar
Before	00100	20:50							
Middle									
After	00100	23:00							

Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:

Calculate

Control point is a PK nail with pink flagging in the trailer parking lot of the Willamette Park boat ramp. Control point is between the trailer parking and assumed centerline of the loop and approximately even with the seventh parking place on the east side of the parking lot. See detached sketch and photos.
NAD83(2011) Oregon North Zone Coordinates, International Feet
North 617123.76' East 7649701.80' Elevation 72.42' NAVD88(Geoid12b)

Weather codes are required. Weather data are optional but encouraged. *Antenna code comes from ant_info file furnished by project coordinator.

Data File Name(s): 15892050.18o
(Standard NGS Format = aaaaddds.xxx)
where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension

Updated Station Description:	☐ Attached	☐ Submitted earlier
Visibility Obstruction Form:	☐ Attached	☐ Submitted earlier
Photographs of Station:	☑ Attached	☐ Submitted earlier
Pencil Rubbing of Mark:	☐ Attached	

LOG CHECKED BY:
Jon Dasler

Table of Weather Codes	**CODE**	**PROBLEM**	**VISIBILITY**	**TEMPERATURE**	**CLOUD COVER**	**WIND**
	0	did not occur	Good, over 15 miles	Normal, 32° F- 80° F	Clear, below 20%	Calm, under 5mph (8km/h)
	1	did occur	Fair, 7-15 miles	Hot, over 80°F (27 C)	Cloudy, 20% to 70%	Moderate, 5 to 15 mph
	2	- not used -	Poor, under 7 miles	Cold, below 32° F (0 C)	Overcast, over 70%	Strong, over15 mph (24km/h)
Examples:	00000 = No problem, good visibility, normal temp, clear, calm wind			12121 = Problems, poor visibility, hot, overcast, moderate wind		

Sketch of Monument PH3

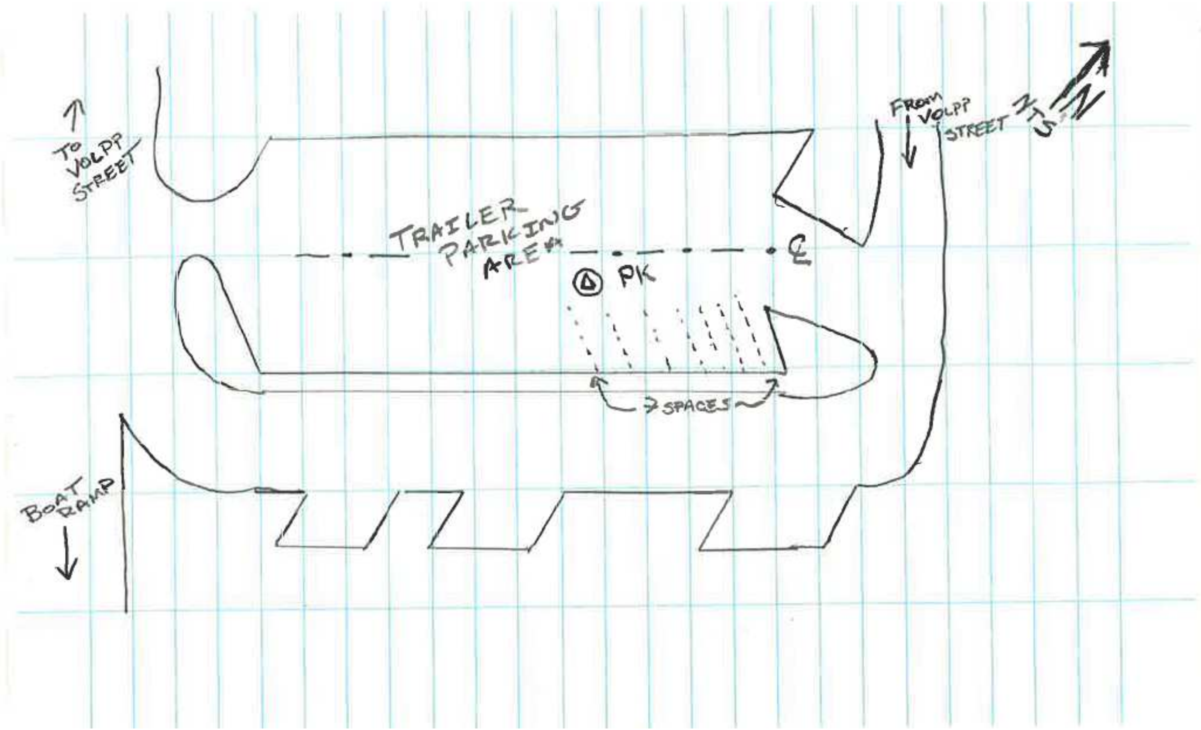


Photo of Monument PH3

GNSS Setup on PH3

NOTE: This form intended for field use. Unsolicited data submitted to NGS must be converted to bluebook format.

GPS STATION OBSERVATION LOG
April 16, 2003

Station Designation: (check applicable:__ FBN__ CBN__ PAC__ SAC __BM) Raindeer

Station PID, if any:

Date (UTC): 06-Mar-18

General Location: Sauvie Island, Willamette River

Airport ID, if any:

Station 4-Character ID:

Day of Year: 065

Project Name: Portland Harbor - AETR00000034

Project Number: GPS-

Station Serial # (SSN):

Session ID:(A,B,C etc)

NAD83 Latitude o ‘ “

NAD83 Longitude o ‘ “

NAD83 Ellipsoidal Height meters

NAVD88 Orthometric Ht. meters

GEOID99 Geoid Height meters

Agency Full Name: David Evans and Associates, Inc.

Operator Full Name: David T. Moehl

Phone #: ( ) (360) 314-3200

e-mail address: dtm@deainc.com

Observation Session Times (UTC):
Sched. Start ________ Stop ________
Actual Start 17:38 Stop 23:45

Epoch Interval= 1 Seconds

Elevation Mask = 10 Degrees

Receiver Brand & Model: Trimble SPS855
P/N: 69855-60
S/N: 5506R0074
Firmware Version: 5.30
☐ CamCorder Battery, ☑ 12V DC, ☐ 110V AC, ☐ Other

Antenna Code*, Brand & Model: Trimble Zephyr 3 Base
P/N: 115000-00
S/N: 1551129193
Cable Length, meters: 10
Vehicle is Parked n/a meters ____(direction) from antenna.

Antenna plumb before session?	(✓/ N)	Circle Yes or No -If no, explain “
Antenna plumb after session?	(✓/ N)	
Antenna oriented to true North?	(✓/ N)	
Weather observed at antenna ht.	(Y / N✓)	
Antenna ground plane used?	(Y / N✓)	
Antenna radome used?	(Y / N✓)	If yes, describe. Use Vis. form
Eccentric occupation (>0.5 mm)?	(Y / N✓)	
Any obstructions above 10°?	(Y / N✓)	
Radio interference source nearby	(Y / N✓)	

Tripod or Antenna Mount: Check one:
☑ Fixed-Leg Tripod, ☐ Collapsible-leg tripod ☐ Fixed Mount
Brand & Model: Seco fixed height
P/N:
S/N: 5115-00-FLY
Last Adjustment date: 2018-03-05

Psychrometer (if used) Brand & Model:
P/N:
S/N:
Last Calibration or check Date:

** ANTENNA HEIGHT **	Before Session Begins: Meters	Before Session Begins: Feet	After Session Ends: Meters	After Session Ends: Feet
A= Datum point to Top of Tripod (Tripod Height)	2.000		2.000	
B=Additional offset to ARP if any (Tribrach/Spacer)	-0.003		-0.003	
H= Antenna Height **= A + B** **=** Datum Point to Antenna Reference Point (ARP)	1.997	6.55	1.997	6.55

Meters = Feet x (0.3048)
Height Entered Into Receiver = 2.000 meters.

Note &/or sketch **ANY** unusual conditions. Be **Very Explicit** as to where and how Measured!

Barometer (if used) Brand & Model:
S/N:

Weather Data	Weather Codes	Time (UTC)	Dry-Bulb Temp Fahrenheit	Dry-Bulb Temp Celsius	WetBulb Temp Fahrenheit	WetBulb Temp Celsius	Rel. % Humidity	Atm. Pressure inches Hg	Atm. Pressure millibar
Before	00000	17:38							
Middle									
After	00000	23:45							

Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:

Weather codes are required. Weather data are optional but encouraged. *Antenna code comes from ant_info file furnished by project coordinator.

Data File Name(s): 00740650.T02
(Standard NGS Format = aaaaddds.xxx)
where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension

Updated Station Description: ☐ Attached ☐ Submitted earlier
Visibility Obstruction Form: ☐ Attached ☐ Submitted earlier
Photographs of Station: ☑ Attached ☐ Submitted earlier
Pencil Rubbing of Mark: ☐ Attached

LOG CHECKED BY: Jon Dasler

Table of Weather Codes	**CODE**	**PROBLEM**	**VISIBILITY**	**TEMPERATURE**	**CLOUD COVER**	**WIND**
	0	did not occur	Good, over 15 miles	Normal, 32° F- 80° F	Clear, below 20%	Calm, under 5mph (8km/h)
	1	did occur	Fair, 7-15 miles	Hot, over 80°F (27 C)	Cloudy, 20% to 70%	Moderate, 5 to 15 mph
	2	- not used -	Poor, under 7 miles	Cold, below 32° F (0 C)	Overcast, over 70%	Strong, over15 mph (24km/h)
Examples:	00000 = No problem, good visibility, normal temp, clear, calm wind			12121 = Problems, poor visibility, hot, overcast, moderate wind		

Photo of Monument RAINDEER

Photo of Monument RAINDEER

GNSS Setup on RAINDEER

APPENDIX B – Standard Operating Procedures

B-2. Field Wet Sieving for Grain Size

STANDARD OPERATING PROCEDURE
FIELD WET SIEVING FOR GRAIN SIZE

INTRODUCTION

This Standard Operating Procedure (SOP) has been developed for the Pre-Remedial Design Sampling and Baseline Investigations (PDI) at the Portland Harbor Superfund Site located in Portland, Oregon. The objective of this SOP is to establish standard procedures for conducting wet sieving of sediment samples in the field for grain size screening. Conducting a wet sieve analysis is a useful field application to understand the percentage of fine grained sediments, by volume. Fine-grained sediments are classified as material that passes through a No. 200 sieve (nominal sieve opening size 0.074 millimeters).

This SOP provides basic steps to guide the process of conducting wet sieving in the field. The intended audience of this document includes all personnel involved in planning, field sampling, and conducting wet sieve analysis.

Equipment will include:

- No. 200 sieve (stainless-steel is preferred)
- 200 milliliter (ml) graduated cylinder with leveling edge at the top (or 100 ml depending on size if sieve screen)
- Disposable gloves
- Mixing bowl and utensil
- Squirt bottle
- Rinse water for helping the material pass through sieve
- Writing tools (pencils, Sharpie®)
- Field log book

FIELD WET SIEVE METHODS

The following sections outline the basic steps involved in conducting wet sieving techniques by the field team.

1. Put on a pair of disposable gloves.
2. Homogenize a representative aliquot of sediment using appropriate nonreactive processing equipment:

    a. Collect an appropriate aliquot of sediment of at least 200 ml and place in a stainless-steel bowl.

    b. Homogenize the sediment by mixing with stainless-steel utensil until uniform consistency and color is reached.

    c. Decant excessive water from homogenized mix.

    d. Visually inspect homogenized composite and record color and texture information in field notes.

3. Measure out 200 ml of sediment and place on No. 200 sieve (100 ml of sediment could also be used depending on the size of the sieve screen):

    a. Remove any large objects that would not be sampled (gravel or larger, clams, large sticks, etc.).

    b. Completely fill a 200 ml graduated cylinder with the homogenized sediment and scrape off any excess sediment so that the sediment is flush with the top of the graduated cylinder.

    c. Empty contents from 200 ml graduated cylinder onto surface of No. 200 sieve. Make sure all sediment from cylinder is in sieve; use a squirt bottle and spray water, if needed, to help ensure all sediment gets onto the sieve.

4. Wet sieving:

    a. Carefully use river water to help push fine-grained sediment through No. 200 sieve, making sure not to splash out any sediment from the sides of the sieve. Wash all sediment in sieve, as fine grain sediment can adhere to coarse sediment, leaves, or other small debris.

    b. Shaking of the sieve from side-to-side to allow passage of material smaller than the sieve openings is appropriate; however, care must be taken not to spill any sediment out the sides of the sieve.

    c. Slow mixing of sediment within the sieve, using a gloved hand or appropriate nonreactive utensil, may be conducted to help work the finer particle-size fractions through the sieve. Care must be taken not to press on the sieve screen or scrape materials, as to prevent compromising sieve openings.

5. Measuring sieved material:

    a. Once all wash water has passed through the sieve, begin collecting material retained on the sieve using a nonreactive spoon, taking care not to damage the screen. Water can again be used to help gather sediment that did not pass through the screen to a single area on the sieve, making it easier to collect sediment with a spoon. Sediment that did not pass through the sieve will be placed back into the 200 ml graduated cylinder for a final volume check. Make sure that all sediment is collected from the sieve and placed in the 200 ml graduated cylinder.

   b. Allow sediment within graduated cylinder to settle, as best as possible, and then record new volume of sediment.

6. Determine percentage of fines in sediment sample:
   a. Record the initial volume of sediment before sieving.
   b. Record the new (residual) sediment volume in the 200 ml graduated cylinder after sieving.
   c. Divide the volume of the sediment remaining in the graduated cylinder by 200 ml (initial volume).
   d. Take the new number and subtract from 1. (For example, if 150 ml remains, then divide 150 by 200 = 0.75. Then, 1 – 0.75 = 0.25, or 25% fines.)
   e. Record the percent fines by volume in the field notebook.

APPENDIX B – Standard Operating Procedures

B-3. Water Quality Parameters (Integral 2004)

Note: Appendix E (MultiProbe YSI 556 SOP) in Integral 2004 (August) is dated April 2, 2004, in the source document.

APPENDIX E

MULTI PROBE YSI 556 SOP

MULTI PROBE YSI 556 PROCEDURES

The purpose of this standard operating procedure (SOP) is to describe the procedures for the measurement of general water quality parameters using a Multi Probe YSI 556 handheld unit. This multi-parameter system will be used to simultaneously measure dissolved oxygen, conductivity, temperature, and optional pH and oxidation-reduction potential while in the field.

This SOP should be used in conjunction with the operating manual supplied by the manufacturer, *YSI 556 MPS Operations Manual* (YSI Environmental, Yellow Springs, Ohio). A goal of this SOP is to ensure that the highest quality, most representative data be collected, and that these data are comparable to data collected by different programs that follow these same guidelines.

For the purpose of this SOP, surface water is defined as water collected from 0.3 meter (1 foot) below the air/water interface and within 1 meter (3 feet) above the river bottom. The actual definition of surface water is typically program-specific and is dependent on the purpose of the study and the regulatory criteria (if any) to which the data will be compared.

SUMMARY OF METHOD

The YSI 556 multi probe is used for measuring conventional water parameters in the field. After surface water samples are collected at each sampling station, the multi probe will be used for measuring parameters such as temperature, pH, dissolved oxygen, conductivity, oxidation-reduction potential. These measurements are then recorded in the same order as described in the water sample log sheet (Appendix F).

Once measurements are made *in situ,* the probe is rinsed with deionized water and replaced into the transport/calibration cup with 1/8 of the volume filled with deionized water. The unit will come pre-calibrated from the laboratory and will be checked daily for proper functioning and drift. If necessary, the multi probe can be calibrated in the field using the procedures provided in the Operations Manual.

PROBE MODULE EQUIPMENT

The YSI 556 multi probe is a rugged handheld unit with the sensors enclosed in a heavy-duty probe sensor guard with attached sinking weight. A 20-meter cable is directly connected to the probe module body making the entire unit waterproof. The following equipment is needed in the field to operate the unit:

- Instrument with barometer option
- 20-m cable and DO/temp/conductivity/pH/ORP probe

- Rechargeable battery pack kit (includes battery, adapter, charger)
- Charger, cigarette lighter (optional)
- Large carrying case, soft-sided (comes with 556 standard)
- Transport/calibration cup
- Probe sensor guard.

PROCEDURES

INSTRUMENT/CABLE CONNECTION

Attach the cable to the instrument as follows:

1. Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the YSI 556 instrument. See Figure 2.1 of the Operations Manual (YSI Environmental, Yellow Springs, Ohio).
2. Holding the cable firmly against the cable connector, turn the locking mechanism clockwise until it snaps into place.
3. Remove the cable from the instrument by turning the cable connector counterclockwise until the cable disengages from the instrument.
4. Remove probe sensor guard from other end of cable, if already installed.
5. Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body.
6. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not overtighten as this could cause damage to the threaded portions. See Figure 3.7 of the Operations Manual (YSI Environmental, Yellow Springs, Ohio).

EQUIPMENT PRE-TESTING

The following steps describe how each probe is checked everyday prior to sampling.

pH Measurements

To test the pH probe, two buffers of pH 4 and pH 7 are used. Different buffers may be used if the general pH range of the water to be sampled is higher. The pH probe will remain in pH 7 buffer solution between measurements. Prior to taking pH measurements, the pH probe is rinsed with deionized water and excess water gently shaken off before insertion into a buffer solution. Once measurement is made, the probe is again rinsed with deionized water and replaced into the container with deionized water. The pH probe is ready for field measurements.

Conductivity Measurements

To test the conductivity probe, a standard conductivity solution is used that is in the general range of conductivities expected from the water to be sampled. Temperature compensation is corrected using the appropriate scale for the temperature and conductivity of the calibration solution. The conductivity meter is adjusted until the conductivity reading agrees with the value of the standard solution. The probe is removed from the standard solution and rinsed with deionized water. The conductivity probe is ready for field measurements.

Dissolved Oxygen (DO) Measurements

The oxygen electrode is measured as % saturation inside a probe-specific measuring cup containing 1/8 inch of water. The probe is ready for measurements after saturation reading.

Temperature Measurements

Temperature is measured using a temperature probe attached to the multiprobe system. An additional certified glass thermometer filled with environmentally safe red liquid and protected with an armor casing is used to confirm accuracy of meter used. After temperature measurement with the probe is compared to reading of glass thermometer, the probe is ready for field measurements.

OPERATION OF THE MULTI PROBE

The unit is removed from its case and attached to the 20-meter cable by inserting the cable connector into the instrument as described above. Care should be taken when handling the probe at the other end of the cable.

Daily Check Procedures

1. Press the **On/off** key OR select Run from the main menu to display the run screen.
2. Make sure the probe transport/calibration cup is installed.

3. Add the appropriate standard solution, as described above, to the transport/calibration cup and gently hold the probe module in the solution. Be sure to completely immerse all the sensors.
4. Watch the readings on the display until they are stable.
5. Press the **Escape** key to display the main menu screen.
6. Use the arrow keys to highlight the **Sensor** selection.
7. Press the **Enter** key to display the sensors enabled screen. A black dot to the left of a sensor indicates that sensor is enabled. Sensors with an empty circle are disabled.
8. Use the arrow keys to highlight the sensor to be changed, then press the **Enter** key to enable or disable it.
9. Repeat step 6 for each sensor to be changed.
10. Press the **Escape** key to return to the main menu screen.
11. Use the arrow keys to highlight the **Report** selection.
12. Press the **Enter** key to display the report setup screen.

    NOTE: A black dot to the left of a parameter indicates that parameter is selected for display. Parameters with an empty circle will not be displayed. It may be necessary to scroll down past the bottom of the screen to see all the parameters.

13. Use the arrow keys to highlight the parameter to be changed, then press the **Enter** key. If a parameter cannot be found, even after scrolling down past the bottom of the screen, the sensor used for that parameter is disabled.
14. If temperature, specific conductivity, conductivity, resistance or total dissolved solids are selected, the Units screen will appear.
15. Use the arrow keys to select the units desired, then press the **Enter** key to return to the report setup screen.
16. If salinity, dissolved oxygen %, dissolved oxygen mg/L, pH, pH mv or ORP mv are selected, the selection dot will simply toggle on or off.
17. Repeat steps 14 and 15 for each parameter needed to be changed.

    NOTE: All parameters may be enabled at the same time.

18. Press the **Escape** key to return to the Main menu screen.
19. Watch the readings on the display until they are stable.

20. Read value for each parameter being measured and check against values of standard solution. Note all measurements in field log book.
21. Once all measurements are read, remove probe from last solution and rinse with deionized water.
22. Gently remove the probe guard and replace it with the transport/calibration cup.
23. Turn off instrument. Blot it dry with a paper towel, unscrew cable from unit and place it back on its case.

NOTE: If the YSI 556 unit displays high drift when measuring standard solutions, it may be required to re-calibrate the probe. See Operations Manual for instructions on calibration procedures (YSI Environmental, Yellow Springs, Ohio).

Real-Time Data

Once all samples are collected, the measurement of general water quality parameters will be taken using the YSI 556 multi probe unit.

Before measuring samples, the probe module must be prepared by removing the transport/calibration cup and replacing it with a probe guard.

1. Press the **On/off** key OR select Run from the main menu to display the run screen.
2. Make sure the probe sensor guard is installed.
3. Place the probe module in the sample (e.g., river water). Be sure to completely immerse all the sensors.
4. Rapidly move the probe module through the sample to provide fresh sample to the DO sensor.
5. Watch the readings on the display until they are stable.
6. Read values top to bottom and from first column second column to a dedicated recordkeeping person.
7. Once all measurements are read, remove probe from water and rinse with deionized water.
8. Gently remove the probe guard and replace it with the transport/calibration cup.
9. Turn off instrument. Blot it dry with a paper towel, unscrew cable from unit and place it back on its case.

APPENDIX B – Standard Operating Procedures

B-4: Water Quality Monitoring Equipment Calibration, Operation, and Maintenance

STANDARD OPERATING PROCEDURE

WATER QUALITY MONITORING EQUIPMENT CALIBRATION, OPERATION, AND MAINTENANCE

Introduction

The standard operating procedure (SOP) for water quality monitoring equipment calibration describes a procedure to confirm that equipment used for measuring water quality parameters (dissolved oxygen [DO], oxidation-reduction potential [ORP], pH, and conductivity) are operating within manufacturer specifications.

Calibration

Water quality probes will have a 1-point or 2-point calibration check (depending on probe capabilities and manufacturer specifications) performed daily, at the beginning of each day prior to field work. Equipment will be recalibrated to operate within the manufacturer specifications as needed on a daily basis. Calibration checks will be performed by inserting each probe into a calibration standard, allowing the reading to stabilize and comparing the reading to the standard value. All probes must read the standard value accurately within the manufacturers' specified accuracy to be considered calibrated. The project-specific target accuracy range of the probes is as follows:

- YSI Pro DO Optical DO meter: ± 2% or 0.2 milligrams per liter (mg/L)
- Oakton ORP meter: ± 2 millivolts (mV)
- YSI 556 Multimeter:
    - pH: ± 0.2 units
    - Conductivity: ± 2.0% of reading or ± 0.001 millisiemens per centimeter (mS/cm)

Any probes that fall outside the range during calibration checks will be recalibrated prior to use. Recalibration will be performed according to manufacturer specifications.

Special attention shall be noted by field crew to instruments that may be affected by the change in the ambient temperature or humidity. Calibration checks should also be performed when sampling conditions change significantly, sample matrix changes, and/or readings are unstable or there is a change of parameter measurements that appear unusual.

Maintenance

All field monitoring equipment and accessories are to be maintained in accordance with manufacturer recommendations and specifications and/or established field practices. All maintenance will be performed by qualified personnel and documented in the field logbook or returned to the manufacturer for maintenance.

Equipment requiring battery charging shall be charged as recommended by the manufacturer. Backup batteries for meters requiring them shall be included as part of the meters' accessories.

Care must be taken to protect meters from adverse elements. Protective measures may involve placing the meter in a large plastic bag to shield it from the weather.

Documentation

All field equipment calibration, maintenance, and operation information shall be recorded in the field logbook to document that appropriate procedures have been followed and to track the equipment operation.

Logbook entries shall contain, but are not necessarily limited to, the following:

- Equipment model and serial numbers
- Date and time of calibration or maintenance performed
- Calibration standard used
- Calibration lot number and expiration date, if listed on bottle
- Calibration procedure used if there are multiple options
- Calibration and calibration check readings, including units used
- Problems and solutions regarding use, calibration, or maintenance of the equipment
- Other pertinent information

Field records should contain sufficient detail to provide a clear understanding of which equipment was used and how equipment was calibrated. All documentation shall be placed in the project files and retained following completion of the project as described in the Data Quality Management Plan.

APPENDIX B – Standard Operating Procedures

B-5: Manufacturer Operating Manuals for Water Quality Probes

YSI

ProODO™

USER MANUAL

Item #626279
Rev C
Drawing # A626279
March 2009

CONTENTS

THIS PAGE LEFT INTENTIONALLY BLANK

WARRANTY

The YSI Professional ODO™ Instrument is warranted for three (3) years from date of purchase by the end user against defects in materials and workmanship, exclusive of batteries and any damage caused by defective batteries. ProODO™ field cable/probe assemblies are warranted for two (2) years from date of purchase by the end user against defects in material and workmanship. ProODO sensor caps are warranted for one (1) year from date of purchase by the end user against defects in material and workmanship. ProODO systems (instrument & cable/probe assemblies) are warranted for 90 days from date of purchase by the end user against defects in material and workmanship when purchased by rental agencies for rental purposes. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio at +1 937 767-7241, 800-897-4151 or visit www.YSI.com (Support tab) for a Product Return Form. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

LIMITATION OF WARRANTY

This Warranty does not apply to any YSI product damage or failure caused by:

1. Failure to install, operate or use the product in accordance with YSI's written instructions;
2. Abuse or misuse of the product;
3. Failure to maintain the product in accordance with YSI's written instructions or standard industry procedure;
4. Any improper repairs to the product;
5. Use by you of defective or improper components or parts in servicing or repairing the product;
6. Modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI'S LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

THIS PAGE LEFT INTENTIONALLY BLANK

INTRODUCTION

Thank you for purchasing the YSI Professional Optical Dissolved Oxygen (Pro ODO) instrument. The YSI ProODO™ measures dissolved oxygen in water using lifetime luminescence technology and uses a digital signal to send information between the instrument and probe. Key advantages of the new ProODO include the elimination of sensor flow dependence and sensor warm-up time, greater stability, the ability to zero the sensor for more accurate measurements at low dissolved oxygen levels, and the elimination of frequent membrane/electrolyte changes. The ProODO also features a waterproof (IP-67) case, a rugged MS-8 cable connector, backlit display and keypad, user-selectable cable lengths, USB connectivity, large memory with extensive site list capabilities, and a rugged, rubber over-molded case. For product specification information, please visit www.ysi.com or contact Technical Support at 800-897-4151 (+1 937 767-7241).

Reading the entire manual before use is recommended for an overall understanding of the instrument's features.

GETTING STARTED

INITIAL INSPECTION

Carefully unpack the instrument and accessories and inspect for damage. Compare received parts with items on the packing list. If any parts or materials are damaged or missing, contact YSI Customer Service at 800-897-4151 (+1 937 767-7241) or the authorized YSI distributor from whom the instrument was purchased.

BATTERY INSTALLATION

The ProODO uses 2 alkaline C-cell batteries. Battery life depends on sampling mode and usage. When used in Manual Sampling mode, under normal conditions, battery life is approximately 80 hours at room temperature. The use of Automatic Sampling mode may slightly reduce the battery life. See the **System** section of this manual for more information on Sampling Modes.

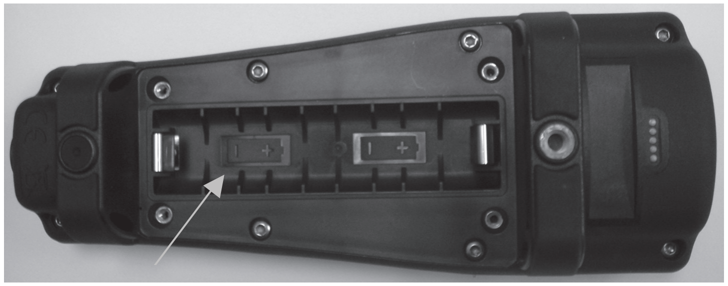


Figure 1. ProODO with battery cover removed. Notice battery symbols indicating polarities.

To install or replace the batteries:

1. Turn the instrument over to view the battery cover on the back.
2. Unscrew the four captive battery cover screws.
3. Remove the battery cover and install the new batteries, ensuring correct polarity alignment on the instrument or the removed cover (Figure 1).
4. Replace the battery cover on the back of the instrument and tighten the four screws. Do NOT over-tighten.

KEY PAD

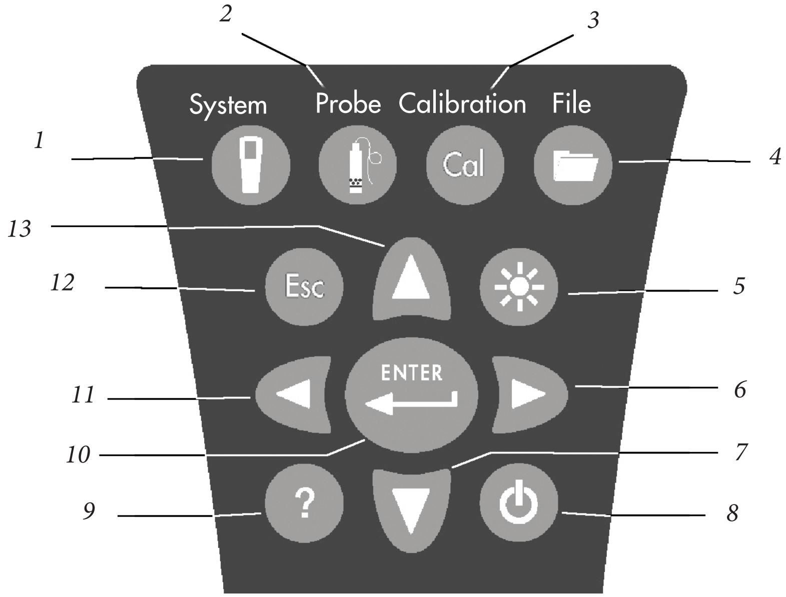


Figure 2

Number	*Key*	*Description*
1		**System** Opens System Menu from any screen. Use to adjust system settings.
2		**Probe** Opens Probe Menu from any screen. Use to setup DO probe, sensor cap, and display units.
3	Cal	**Calibrate** Opens Calibrate Menu from any screen. Use to calibrate dissolved oxygen.

Number	*Key*	*Description*
4	📁	**File** Opens File Menu from any screen. Use to view data and GLP files, set up site and folder lists, and delete data.
5	☼	**Backlight** Press to turn the instrument backlight on and off and to adjust the display contrast when pressed with the left or right arrow key.
6	▶	**Right Arrow** Use to navigate right in alpha/numeric entry screens. Can be pressed simultaneously with Backlight button to increase display contrast.
7	▼	**Down Arrow** Use to navigate through menus and to navigate down in alpha/numeric entry screens.
8	⏻	**Power** Press and hold for 2 seconds to turn the instrument on. Press to turn off.
9	?	**Help** Press to receive hints & tips during operation.
10	ENTER ↵	**Enter** Press to confirm selections, including alpha/numeric key selections.
11	◀	**Left Arrow** Use to navigate left in alpha/numeric entry screens. Press to return to previous menu in all screens except alpha/numeric entry. Can be pressed simultaneously with Backlight button to decrease display contrast.
12	Esc	**Exit/Escape** Exits back to Run Screen. When in alpha/numeric entry screen, escapes to previous menu.
13	▲	**Up Arrow** Use to navigate through menus and to navigate up in alpha/numeric entry screens

INITIAL SETUP

Throughout the manual, the term “probe” refers to the end of the cable where the sensor is located, the term “sensor” refers to the Optical Dissolved Oxygen sensing portion of the cable/probe assembly, and the term “sensor cap” refers to the removable sensing cap that is replaced about once per year (Figure 3).

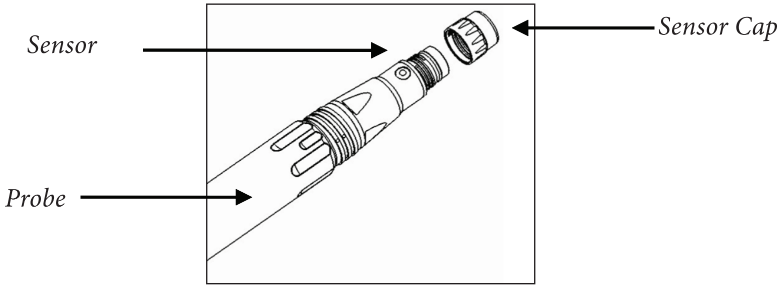


Figure 3

UNPACKING THE ODO PROBE

> ⓘ *Each ProODO cable/probe assembly and replacement ODO sensor cap includes an instruction sheet with important information unique and specific to each individual sensing cap.*

Remove the cable/probe assembly from the shipping container and locate the instruction sheet included with your assembly. This instruction sheet is important because it includes the calibration coefficients for your sensor cap. After using this sheet for general probe setup, be sure to store it in a safe place in case you need to reload these calibration coefficients in the unlikely event that they are ever deleted from the probe.

> ⓘ *Note - A new cable/probe assembly already has a sensor cap installed and the sensor cap coefficients are preloaded into the probe at the factory.*

Preparing the probe for the first time:

1. Remove the metal probe guard from the probe by turning it counterclockwise.
2. Remove the red storage cap which contains a moist sponge from the end of the probe by pulling it straight off the sensor. Save this to use later for long term storage.

3. Reinstall the probe guard by sliding it carefully over the sensor and then threading it onto the cable/probe assembly with a clockwise rotation (Figure 4).
4. Locate the grey calibration/storage sleeve that was shipped with your probe/cable assembly. Moisten the sponge in the grey calibration/storage with a small amount of clean water.
5. Slide the calibration/storage sleeve over the probe guard to keep the probe in a moist atmosphere for storage or calibration (Figure 5). It is important to always keep your sensor in a moist environment so the sensor cap does not dry out. (See Care, Maintenance, and Storage for more information.)

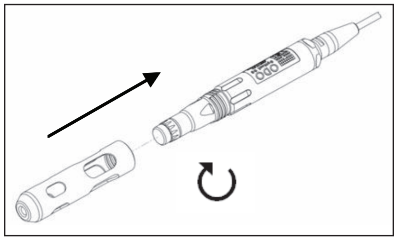


Figure 4

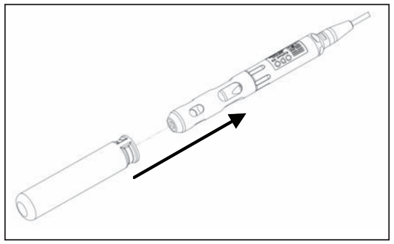


Figure 5

CONNECTING THE PROBE/CABLE ASSEMBLY TO THE INSTRUMENT

To connect the cable, align the keys on the cable connector to the slots on the instrument connector. Push together firmly, then twist the outer ring until it locks into place (Figure 6). This MS-8 (Military Spec) connection is waterproof.

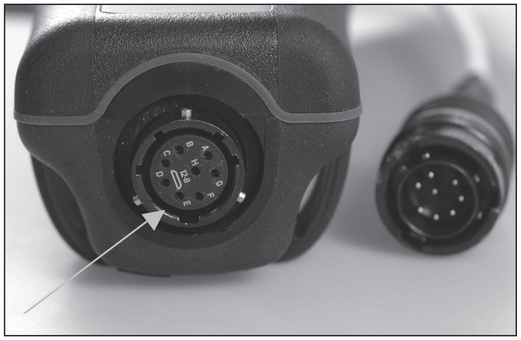
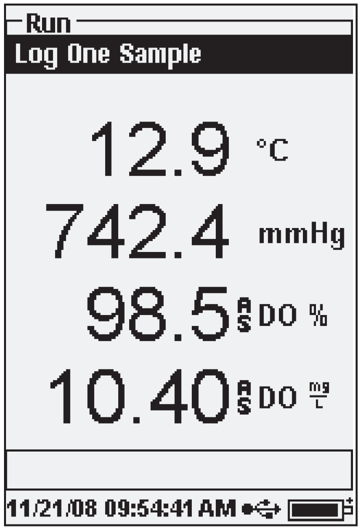


Figure 6. Note the keyed connector. The cable and instrument connectors can only be mated once the keyed sections are properly aligned. When disconnected, the cable connector and the connector on the instrument maintain an IP-67 rating.

MAIN DISPLAY

Press and hold the Power key ⏻ for two seconds to turn the instrument on. The instrument will briefly display two splash screens then go directly to the main run mode screen. The first time the instrument is powered up, you will need to set the date and time. Follow the instructions under the **Setup | System | Date/Time** section of this manual.



Run
Log One Sample
12.9 °C
742.4 mmHg
98.5 DO %
10.40 DO mg/L
11/21/08 09:54:41 AM

The display at the left shows the run mode (main display) with temperature in °C, barometric pressure in mmHg, DO in % and mg/L as the reported parameters. The date, time and battery level are indicated at the bottom of the screen. The logging preference of Log One Sample at a time is indicated at the top of the screen.

This screen also shows the message line towards the bottom of the display above the date and time. In this case, it doesn't show a message. However, messages will appear frequently to indicate successful calibrations, saved configuration changes, etc.

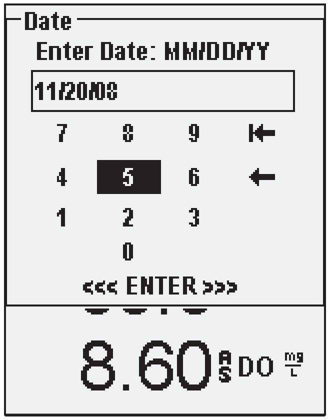
A USB symbol will show up on the bottom of the display when connected through USB with the communications saddle. The instrument will display full battery power when it is receiving power through the USB connection.

ⓘ ***Contrast*** *– the contrast adjustment can be accomplished by repeatedly pressing the backlight key and the left or right arrow key at the same time.*

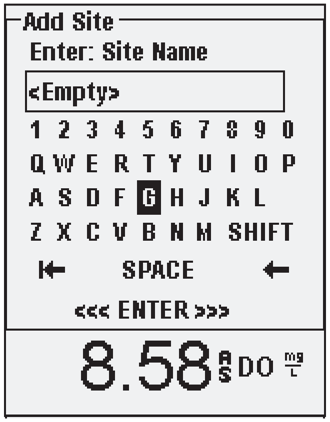
MENU LAYOUT

Press Esc at anytime in the menus to escape back to the Run screen. The left arrow ◀ can be used to go back to the previous menu in all screens except alpha/numeric entry screens. You must use Esc to get out of the alpha/numeric screens if you want to exit before finishing or without saving changes. Functions that are enabled appear as a circle with a dot ⦿. Disabled functions appear as a circle only ○. In addition, some options appear as an empty box ☐ or a box with a check mark ☑.

ALPHA/NUMERIC ENTRY



Date
Enter Date: MM/DD/YY
11/20/08



Add Site
Enter: Site Name
<Empty>

The numeric screens will display numbers only (shown above, left). Alpha/numeric screens will display numbers across the top and letters along the bottom rows (shown above, right). Letters appear as a common keyboard arrangement.

When an alpha or numeric character is required, the display will show the alpha/numeric entry screen. To select a character, highlight it by using the arrows to move the highlight box over the desired selection. Then, press **Enter** on the keypad to confirm the selection. After confirming the selection, it will appear in the line at the top of the display.

For capital letters or lower case entry, highlight "SHIFT" and press **Enter** on the keypad to change the characters from upper to lower case.

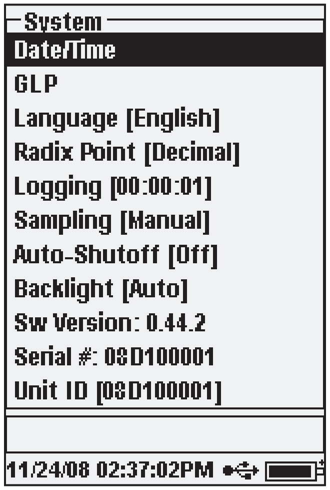
To delete the entire line of the current entry, highlight ⇤ and press **Enter** on the keypad. The ← symbol functions as a backspace key in the alpha/numeric entry screens by deleting one character at a time. Use the "SPACE" function to add a space between characters.

When you have finished entering the correct information (16 character max), highlight <<<ENTER>>> at the bottom of the screen and press **Enter** on the keypad to confirm.

ⓘ *The ◀ key cannot be used to escape to the previous menu from an alpha/numeric entry screen. Instead, use the Esc key to go back to the previous menu when in alpha/numeric entry screens.*

SYSTEM

Press System to access any of the following menu items.



System
Date/Time
GLP
Language [English]
Radix Point [Decimal]
Logging [00:00:01]
Sampling [Manual]
Auto-Shutoff [Off]
Backlight [Auto]
Sw Version: 0.44.2
Serial #: 08D100001
Unit ID [08D100001]
11/24/08 02:37:02PM

The System menu will allow you to access the setup options of the instrument including; **Date/Time**, **GLP**, **Language**, **Radix Point**, **Logging, Sampling, Auto Shutoff**, **Backlight**, **Sw** (Software) **Version**, **Serial #**, and **Unit ID**. Any item with [brackets] shows the current setting inside the brackets. For instance, in the example at the left, Radix Point is currently set to [Decimal].

DATE/TIME

Highlight **Date/Time** from the **System** menu. Press enter to select.

Date Format – Highlight and press enter to open a sub menu for selecting the preferred date format: YY/MM/DD, MM/DD/YY, DD/MM/YY, or YY/DD/MM.

Date – Highlight and press enter to use the numeric entry screen to set the correct date.

Time Format – Highlight and press enter to open a submenu to select the preferred time format from 12-hour or 24-hour.

Time – highlight and press enter to use the numeric entry screen to set the correct time.

GLP

The GLP or 'Good Laboratory Practice' file saves detailed information about calibrations. It also includes diagnostic information about the sensors. Calibrations are logged into a file, the GLP, for later review as needed. A single GLP file is utilized to store all calibration records and is capable of storing 500 records. Once the GLP file is full, the instrument will begin to overwrite the oldest record with each new calibration record.

In order to keep all of your GLP records, periodically download the GLP to Data Manager and export it to another program. Otherwise, the instrument will overwrite the oldest record once the memory is full. Also, since Data Manager saves GLP files under the Unit ID, you must periodically export and rename the GLP file on your PC or it will be overwritten each time you upload the GLP file from the instrument.

Several calibration parameters are saved for each calibration including optional ones that can be enabled by the user. Standard parameters include date/time stamp, calibration method, and sensor information. Optional, user selectable parameters include User ID, Probe ID, and User Fields 1 and 2.

In addition, there will be information specific to the Dissolved Oxygen or Barometer calibration record. A Dissolved Oxygen calibration record will contain the following calibration specific parameters:

DO
Sensor - Serial Number of the Sensor
Calibration Method - Zero, %, or mg/L
Cal Value
Sensor Value - Tangent of the angle between reference and signal LED, must be within 0.2 of the default value in the sensor, typically between -0.53 and -2.17
Salinity Mode - Always manual
Salinity Value - Value entered by the user
Barometer - Barometric Pressure during calibration
Temperature - Temperature during calibration
Calibrate Status - Calibrated

A Barometer calibration record will contain the following calibration specific parameters:

Barometer
Barometer - Calibrate value in kPa
Calibrate Status - Calibrated

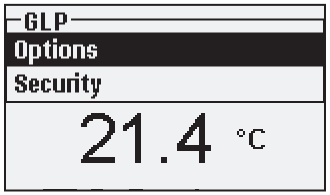
An example of a GLP record

(Operation Performed is % DO Calibration)

*** Calibrate – DO ***

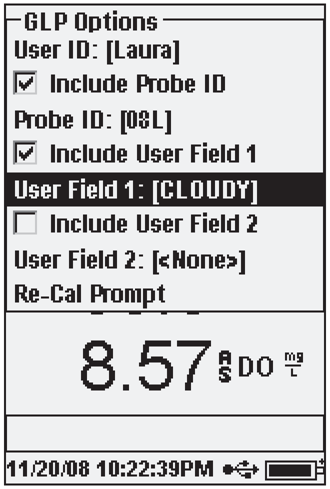
Date:	11/01/2008 MM/DD/YY
Time:	04:03:05 PM
User ID:	Tech0001
Probe ID:	SN: 08D
User Field #1	Cloudy
Sensor:	08F000015
Method:	DO Air Calibrate
Cal Value:	100.0 %
Sensor Value:	-0.591150
Salinity Mode:	Manual
Salinity Value:	0.000000 SAL PSU
Barometer	767.09 mmHg
Temperature	19.2 °C
Calibrate Status:	Calibrated

_ _



In the System menu, highlight **GLP** and press enter to view and modify the GLP settings.

Highlight Options and press enter to access **User ID**, **Probe ID**, **User Defined Fields**, and **Re-Cal Prompt**.

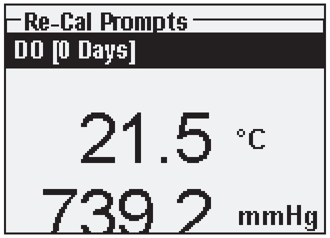


User ID: [Laura]
☑ Include Probe ID
Probe ID: [08L]
☑ Include User Field 1
User Field 1: [CLOUDY]
☐ Include User Field 2
User Field 2: [<None>]

User ID may be used to identify the person calibrating the instrument. Highlight **User ID** and press enter to select or edit a User ID from a list of previously entered IDs. Or, highlight **Add New** and press enter to create a new User ID using the alpha/numeric entry screen. The User ID may also be changed in the **Calibration** menu during the calibration process. The selected User ID will be stored in the GLP file with each calibration record. A User ID could be a person's initials or badge number. The character limit is 16 characters.

Probe ID is stored with the calibration record and may be used to distinguish one cable/probe assembly from another, typically by serial number. Highlight **Include Probe ID** and press enter to turn this function on and off. There will be a check mark in the box when the function is enabled. Highlight **Probe ID** and press enter to add, view, edit, or select a Probe ID. Probe ID may also be changed in the **Calibration** menu during the calibration process. The character limit is 16 characters.

User Fields 1 and 2 are stored with the calibration record and may be used to enter other parameters pertinent to the user, such as weather conditions, elevation, etc. Highlight **Include User Field 1** or **Include User Field 2** and press enter to turn this function on and off. Highlight **User Field 1** or **User Field 2** and press enter to add, view, edit, or select a User Field. The character limit is 16 characters. When enabled, a prompt for selecting a User Defined Field will appear during the calibration process.



DO [0 Days]

Re-Cal Prompt may be used to remind the user to perform a calibration. To set a time interval, highlight DO and press enter to access the numeric entry screen. Enter a value in days and press enter to confirm the reminder time. To turn off the Re-cal prompt, set the reminder to zero (0) days (this is the default).

The **Security** section of the GLP menu is a password protected area. This area includes options to set a new password and to lock access to the calibration menu. When first viewing the security menu, you will be required to enter a password. Use the "shift" on the alpha/numeric screen to switch to lower case and enter "ysi123". This is the default password.

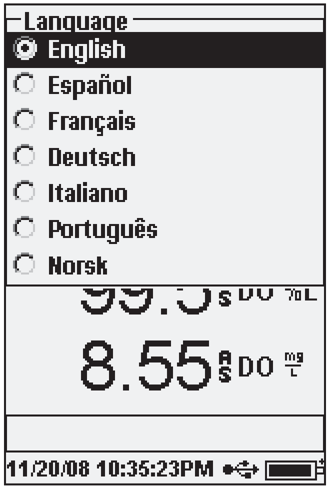
Protect Cal can be enabled or disabled. When enabled, the user must know and enter the instrument's password to enter the calibration menu option. Highlight **Protect Cal** and press enter to enable (☑) or disable (☐) this feature.

Set Password allows a user to set the security password. Highlight **Set Password** and press enter. Using the alpha/numeric entry screen, enter the new password. The password can have up to 16 characters.

Contact YSI Technical Support at environmental@ysi.com or +1 937 767-7241 if you forget or misplace your password.

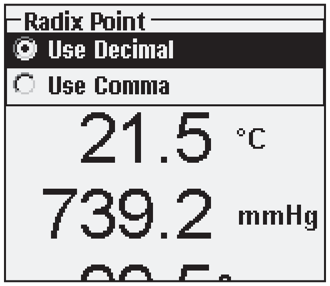
ⓘ *Once a password is set, and the GLP security screen exited, a password must be entered to make changes under GLP security. Keep passwords in a safe place.*

LANGUAGE



To change the instrument's language setting, highlight **Language** in the **System** menu and press Enter. Highlight the desired language and press enter to confirm. Languages include English, Spanish, French, German, Italian, Portuguese, and Norwegian.

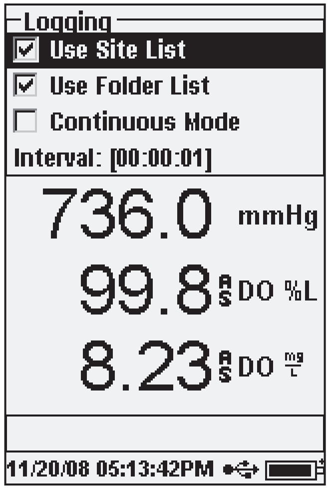
RADIX POINT



Radix Point allows the user to select between a comma or a decimal in numeric radix point for displayed values. For example, 1.00 becomes 1,00 when **Use Comma** is selected. Highlight **Use Decimal** or **Use Comma** and press enter to make your selection.

LOGGING

From the System menu, highlight **Logging** and press enter to view or change the logging options. Logging options include **Use Site List**, **Use Folder List**, **Continuous Mode**, and **Interval**.



☑ Use Site List
☑ Use Folder List
☐ Continuous Mode
Interval: [00:00:01]

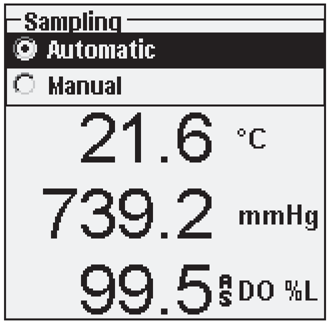
Use Site List and **Use Folder List** are optional ways of filing or 'tagging' your logged data points. If these settings are enabled, you will be prompted to select a Site and/or Folder to 'tag' to logged data points. See the **File and Site Lists** section of this manual for information on creating Site and Folder Lists.

Check the box for **Continuous Mode** if you want to log samples continuously at a specific time interval. To set the length of time between logged samples, highlight **Interval** and press Enter. Enter the interval as HH:MM:SS. This interval will display at the top of the screen when you select the **Start Logging** option in run mode. If operating the unit in Manual mode, see next section, the continuous logging interval must be set to 10 seconds or greater in order to log data.

To log one sample at a time, uncheck **Continuous Mode**.

SAMPLING MODE

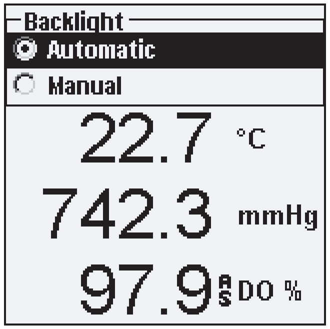
The **Sampling** mode can be set to **Automatic** or **Manual**. In **Automatic** mode, which is the default mode, the readings are constantly updated. In **Manual** mode, the readings are held or 'locked' on the display once they reach the stability of the **Auto Stable** setting in the **Probe** menu. The user must then press a key to either log the held data or update the measurements. Selecting Manual mode may increase the instrument's battery life. Highlight either Automatic or Manual and press enter to make your selection. If continuously logging in Manual mode, the logging interval must be set to 10 seconds or greater.



AUTO SHUTOFF

Auto Shutoff powers the instrument off after a user specified time period. Highlight **Auto Shutoff** and press enter. Using the numeric entry screen, enter a value between 0 and 360 minutes. To disable auto shutoff, set the value to 0 (zero).

BACKLIGHT



Backlight
● Automatic
○ Manual
22.7 °C
742.3 mmHg
97.9 DO %

Backlight can be set to **Automatic** or **Manual**. Automatic turns the backlight on when you turn the instrument on and when you press any key. Manual allows you to turn the backlight on or off with the backlight key ☼. When in Automatic mode, the instrument will turn the backlight off after 60 seconds without any keys being pressed. If a key is pressed during that time, the instrument will “reset” the 60 second time period. The lighted keypad will turn off after approximately 20 seconds.

SW VERSION (SOFTWARE VERSION)

SW Version shows the instrument’s software version.

SERIAL

Serial # shows the instrument’s serial number and allows you to match it with the number engraved on the back of the instrument’s case. The Serial # is also the default Unit ID.

UNIT ID

Unit ID is used to identify instruments in the Data Manager software included with your instrument. It is also used to identify GLP files, Site Lists, Configuration Files, and Data files transferred from the instrument to the PC. The default Unit ID is the Instrument’s serial number. To modify the Unit ID, highlight **Unit ID**, press enter and use the alpha/numeric entry screen. The character limit is 16 characters.

OPTICAL DISSOLVED OXYGEN (ODO™)

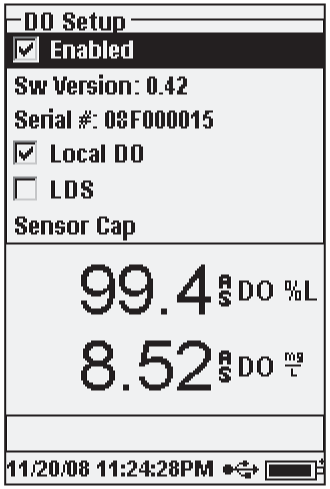
Each ProODO cable/probe assembly and replacement ODO sensor cap includes an instruction sheet with important information unique and specific to each individual sensing cap. This instruction sheet is important because it includes the calibration coefficients for the sensor cap. After using this sheet for general probe setup, be sure to store it in a safe place in case you need to reload these calibration coefficients in the unlikely event that they are ever deleted from the probe.

See **Initial Setup | Unpacking the ODO Probe** for initial setup instructions.

It is important to always keep your sensor in a moist environment so the sensor cap does not dry out. (See Maintenance and Storage for more information.)

ODO PROBE SETUP

Press Probe, Highlight DO, press enter.



DO Setup
☑ Enabled
Sw Version: 0.42
Serial #: 08F000015
☑ Local DO
☐ LDS
Sensor Cap
99.4 DO %L
8.52 DO mg/L
11/20/08 11:24:28PM

Enabled allows you to enable or disable the DO sensor. Highlight **Enabled** and press enter to activate or deactivate dissolved oxygen.

The DO Setup menu also displays the ODO probe’s **SW Version** and **Serial #**. This information is programmed into the probe at the factory and digitally sent to the instrument when the cable is connected.

Local DO allows for localized DO% measurements. This sets the calibration value to 100% regardless of the altitude or barometric pressure. Highlight **Local DO** and press enter to enable or disable this function. Local DO is a method for the ProODO to factor in the barometric pressure on each DO measurement. In essence, even if the barometric pressure changes you wouldn’t notice the difference with the DO% readings in air-saturated water or water-saturated air.

Local DO is ideal for EU compliance. When Local DO is enabled, an L will appear next to DO% on the run screen. DO mg/L readings are unaffected by the selection of DO Local.

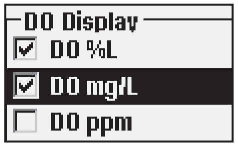
LDS (Last Digit Suppression) rounds the DO value to the nearest tenth; i.e. 8.27 mg/L becomes 8.3 mg/L. Highlight LDS and press enter to activate or deactivate LDS. Some users may not want to read out to the hundredths place since the DO mg/L accuracy spec is to the tenths place.

Sensor Cap allows you to view and enter information specific to the sensor cap installed on the probe. Highlight Sensor Cap and press enter to view the sensor cap's Serial #, Temperature Coefficient, and Sensor Cap Coefficients. This information is programmed into the sensor at the factory and sent to the instrument when the cable is connected. Since the Temperature Coefficient is programmed into the sensor at the factory, it should not be modified unless instructed by YSI Technical Support.

The **Sensor Cap Coefficients** need to be updated when the sensor cap is replaced. The sensor cap should be replaced about once per year. See the Dissolved Oxygen **Sensor Maintenance** section of this manual or the instruction sheet included with replacement sensor cap for instructions on updating the Sensor Cap Coefficients. When updating the Coefficients, the sensor cap serial # will be updated automatically based on your entries.

DISPLAY - DISSOLVED OXYGEN

Press Probe , highlight **Display** and press enter. Highlight **DO** and press enter. Note, you will not be able to display dissolved oxygen unless it is **Enabled** in the DO Setup menu first, see previous section.



DO Display
☑ DO %L
☑ DO mg/L
☐ DO ppm

DO % will show DO readings in a percent scale from 0 to 500%.

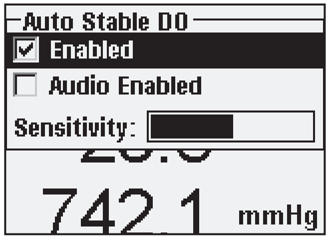
DO mg/L will show DO readings in milligrams per liter (equivalent to ppm) on a scale from 0 to 50 mg/L.

DO ppm will show DO readings in parts per million (equivalent to mg/L) on a scale from 0 to 50 ppm.

All units can be displayed simultaneously on the screen. Highlight the desired unit(s) and press enter to select. A check mark in the box next to the unit will indicate that it is enabled.

AUTO STABLE - DISSOLVED OXYGEN

Press Probe , highlight **Auto Stable** and press enter. Highlight **DO** and press enter.



Auto Stable DO
☑ Enabled
☐ Audio Enabled
Sensitivity:
742.1 mmHg

Auto Stable indicates when a reading is stable. Highlight **Enabled** and/or **Audio Enabled** (instrument will beep when the stability is achieved) and press enter to confirm. When Auto Stable is enabled, **AS** will blink next to the parameter until it is stable. Once the parameter is stable, **AS** will stop blinking.

The Auto Stable **Sensitivity** can be decreased or increased. Highlight **Sensitivity** and use the left and right arrow keys to slide the bar. The more sensitive you make it (larger black bar) the harder it is to achieve stability in a changing environment.

The **Auto Stable** system works by examining the previous 5 readings, computing the percent change in the data and comparing that change against a % threshold value. The % threshold value is determined by the **Sensitivity** bar setting. The following chart can be used as a guide when setting the Sensitivity bar.

Sensitivity selected by User	*% Data Variance Threshold*
100 - Most Sensitive, Sensitivity bar is set to the far right	0.05%
75	0.62525%
50	1.275%
25	1.8875%
0 - Least Sensitive, Sensitivity bar is set to the far left	2.5%

Example:

The instrument obtained the following data:

Reading #1 95.5 DO%
Reading #2 95.7 DO%
Reading #3 95.8 DO%
Reading #4 96.1 DO%
Reading #5 95.3 DO%

The instrument is programmed to determine the minimum and maximum data value over the previous 5 samples, and to compute the percent difference between those values. In this example, that gives a percent change of:

% Change = 100 * ((96.1 – 95.3) / 95.3)
% Change = 0.83%

In this example, if the Sensitivity Bar is set to the far right, the Auto Stable requirement would not be met and AS would continue to blink. However, if the sensitivity bar is set to the median threshold (1.275%), the Auto Stable requirement would be met and AS would display steadily on the display.

If the **Manual Sampling** mode in the System menu is enabled, the Auto Stable function will automatically be enabled and the sensitivity setting will be used to determine when to hold the readings on the display. See Sampling Mode in the System section of this manual for more information on the two Sampling mode options.

SALINITY CORRECTION

The last feature in the **Probe** menu is the **Salinity** correction value for the mg/L readings. Press Probe, highlight Salinity, and press enter. Then, use the numeric entry screen to enter the Salinity value of the water you will be testing from 0 to 70 ppt.

The value entered here will be used when calculating mg/L from the temperature and % saturation readings. As the salinity of water increases, its ability to dissolve oxygen decreases. For example, fully oxygenated 20 °C water at sea level with zero salinity will hold 9.092 mg/L of dissolved oxygen. If that same sample had a salinity value of 9 ppt, then it would hold 8.621 mg/L of dissolved oxygen. Therefore, to obtain accurate mg/L readings, it is important that you know the salinity of the water you will be testing and input the value into the instrument. The salinity of fresh water is typically 0-0.5 ppt and seawater is typically 35 ppt. You will also have the opportunity to enter or modify the Salinity correction value during DO calibration. Appendix B shows the oxygen solubility table.

CALIBRATION - DISSOLVED OXYGEN

The ProODO sensor is an optical luminescent sensor which has greater stability and is less susceptible to calibration drift than traditional electrochemistry sensors. This increased stability means that the instrument may hold its calibration for many months. However, for the highest data accuracy, YSI recommends verifying the instrument's calibration on a daily basis. To verify the instrument's calibration, place the sensor in its calibration environment and check to see that the DO% is reading its calibration value based on the

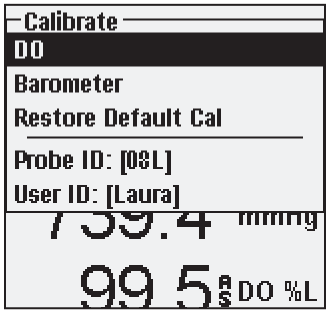
barometric pressure. Refer to Appendix A for the DO% calibration values based on barometric pressure.

The ProODO offers several options for calibrating dissolved oxygen. The first and second methods calibrate the DO % saturation value to either water saturated air or air saturated water. The third and fourth calibrates in mg/L or ppm to a solution with a known DO concentration (usually determined by a Winkler Titration). The fifth option is a zero calibration. If performing a zero calibration, you must also perform a %, mg/L, or ppm calibration following the zero calibration. For both ease of use and accuracy, YSI recommends performing the following DO % water saturated air calibration:

ⓘ *It is not necessary to calibrate in both % and mg/L or ppm. Calibrating in % will simultaneously calibrate mg/L and ppm and vice versa.*

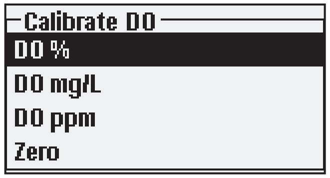
CALIBRATING DO % IN WATER SATURATED AIR: **1-POINT CALIBRATION**

Moisten the sponge in the storage sleeve with a small amount of clean water. The sponge should be clean since bacterial growth may consume oxygen and interfere with the calibration. Make sure there are no water droplets on the sensor cap and temperature sensor and then install the storage sleeve over the probe. Make sure the DO and temperature sensors are not immersed in water. The storage sleeve ensures venting to the atmosphere. Wait approximately 5 to 10 minutes for the storage container to become completely saturated and to allow the temperature and dissolved oxygen sensors to stabilize.



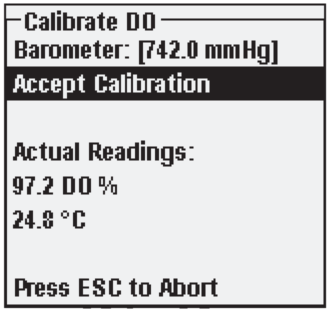
Press Calibration Cal. If Probe ID or User ID are enabled in the System GLP menu you will be able to highlight these features and add, select, edit, or delete an ID. When enabled these IDs are stored with each calibration record in the GLP file.

After selecting the Probe ID and/or User ID if appropriate, highlight DO and press enter.



Highlight **DO %** and press enter to confirm.

The instrument will use the value from the internal barometer during calibration and will display this value in brackets at the top of the


Calibrate DO
Barometer: [742.0 mmHg]
Accept Calibration

Actual Readings:
97.2 DO %
24.8 °C

Press ESC to Abort

display. Highlight the barometer value and press enter to adjust it if needed. If the barometer reading is incorrect, it is recommended that you calibrate your barometer. Note - the barometer should be reading "true" barometric pressure (see Barometer section for more information on "true" barometric pressure). If the value is acceptable, there is no need to change it or perform a barometer calibration.

Wait for the temperature and DO% values under "Actual Readings" to stabilize, then highlight **Accept Calibration** and press enter to calibrate. If User Field 1 or 2 are enabled, you will be prompted to select the fields and then press Cal Cal to complete the calibration. The message line at the bottom of the screen will display "Calibrating Channel..." followed by "Calibration Successful". Press Esc Esc to cancel the calibration.

CALIBRATING DO % IN AIR SATURATED WATER: **1-POINT CALIBRATION**

Continuously sparge water with air using an air stone or some type of aerator until the water becomes completely saturated with air. For 500 ml of water at room temperature, it may take 60 minutes or more for the water to become completely saturated. Place the sensor in the air saturated water, be sure to immerse both the ODO and Temperature sensor into the water, and wait for the readings to stabilize (at least 2 minutes).

Press Calibration Cal. If Probe ID or User ID are enabled in the System GLP menu you will be able to highlight these features and add, select, edit, or delete an ID. When enabled these IDs are stored with each calibration record in the GLP file.

After selecting the Probe ID and/or User ID if appropriate, highlight DO and press enter. Highlight **DO %** and press enter to confirm.

The instrument will use the value from the internal barometer and will display this value in brackets at the top of the display. Highlight the barometer value and press enter to adjust it if needed. If the barometer reading is incorrect, it is recommended that you calibrate your barometer. Note - the barometer should be reading "true" barometric pressure (see Barometer section for more information on "true" barometric pressure). If the value is acceptable, there is no need to change it or perform a barometer calibration.

Wait for the temperature and DO% values under "Actual Readings" to stabilize, then highlight **Accept Calibration** and press enter to calibrate. If User Field 1 or 2 are enabled, you will be prompted to select the fields and then press Cal Cal to complete the calibration. The message line at the bottom of the screen will display "Calibrating Channel..." followed by "Calibration Successful". Press Esc Esc to cancel the calibration.

CALIBRATING IN AIR SATURATION PERCENT (DO %): **2-POINT CALIBRATION WITH ZERO SOLUTION**

Place the sensor in a solution of zero DO. Be sure to immerse both the ODO and Temperature sensor into the water.

A zero DO solution can be made by dissolving approximately 8 - 10 grams of sodium sulfite (Na_2SO_3) into 500 mL tap water or DI water. Mix the solution thoroughly. It may take the solution 60 minutes to be oxygen-free.

Press Calibration Cal. If Probe ID or User ID are enabled in the System GLP menu you will be able to highlight these features and add, select, edit, or delete an ID. When enabled these IDs are stored with each calibration record in the GLP file.

After selecting the Probe ID and/or User ID if appropriate, highlight DO and press enter. Highlight **Zero** and press enter. Wait for the temperature and DO% values under "Actual Readings" to stabilize, then press enter to **Accept Calibration**. If User Field 1 or 2 are enabled, you will be prompted to select the fields and then press Cal Cal to complete the calibration. The screen will then prompt for a follow-up second point calibration.

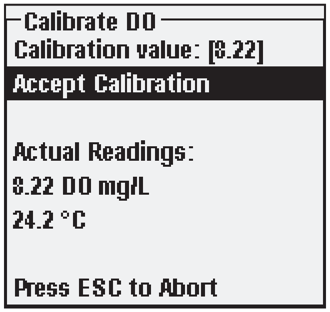
Highlight **DO%** for the second calibration point and press enter to continue with the next point at full saturation. Rinse the sensor of any zero oxygen solution using clean water. Follow the steps under either of the DO % Saturation methods previously discussed to complete the second point.

CALIBRATING IN MG/L OR PPM AS A TITRATION: **1-POINT CALIBRATION**

Place the sensor into a water sample that has been titrated by the Winkler method to determine DO concentration. Allow the sensor to stabilize.

Press Calibration Cal. If Probe ID or User ID are enabled in the System GLP menu you will be able to highlight these features and add, select, edit, or delete an ID. When enabled these IDs are stored with each calibration record in the GLP file.

After selecting the Probe ID and/or User ID if appropriate, highlight DO and press enter. Highlight **DO mg/L or ppm** and press enter.


Calibrate DO
Calibration value: [8.22]
Accept Calibration

Actual Readings:
8.22 DO mg/L
24.2 °C

Press ESC to Abort

Highlight **Calibration value** and press enter to manually input the sample's dissolved oxygen value. Highlight **Accept Calibration** and press enter once the temperature and Dissolved Oxygen readings have stabilized. If User Field 1 or 2 are enabled, you will be prompted to select the fields and then press Cal to complete the calibration. After completing the calibration, the message line will display "Calibration Successful". Press Esc to cancel the calibration.

CALIBRATING IN MG/L OR PPM AS A TITRATION: **2-POINT CALIBRATION WITH ZERO SOLUTION**

Place the sensor in a solution of zero DO. Be sure to immerse both the ODO and Temperature sensor into the water.

A zero DO solution can be made by dissolving approximately 8 - 10 grams of sodium sulfite (Na_2SO_3) into 500 mL tap water. Mix the solution thoroughly. It may take the solution 60 minutes to be oxygen-free.

Press Calibration . If Probe ID or User ID are enabled in the System GLP menu you will be able to highlight these features and add, select, edit, or delete an ID. When enabled these IDs are stored with each calibration record in the GLP file.

After selecting the Probe ID and/or User ID if appropriate, highlight DO and press enter. Highlight **Zero** and press enter. Wait for the temperature and DO% values under "Actual Readings" to stabilize, then press enter to **Accept Calibration**. If User Field 1 or 2 are enabled, you will be prompted to select the fields and then Press Cal to complete the calibration. The screen will then prompt for a follow-up second point calibration.

Highlight the desired calibration units (mg/L or ppm) and press enter to continue with the next point in a known titrated value. Rinse the sensor of any zero oxygen solution using clean water. Follow the steps under One Point Calibration for mg/L or ppm for the second point.

BAROMETER

All ProODO instruments contain an internal barometer.

DISPLAY - BAROMETER

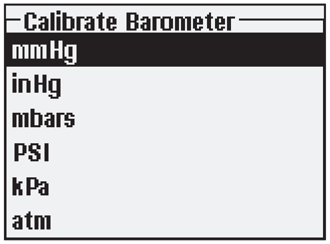
Press Probe , highlight **Display**, and press enter. Highlight **Barometer**, press enter. The measurement unit options are: mmHg, inHg, mBar, PSI, kPa, or Atm. Only one unit can be displayed at a time. Select **None** if you do not want to display a barometric pressure reading.

Whether or not you choose to display the barometer reading, the barometric pressure will still be used for calibrating DO and for compensating for pressure changes if **Local DO** is enabled.

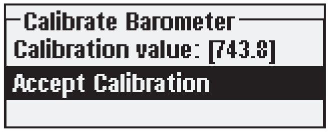
CALIBRATION - BAROMETER

The barometer in the instrument is calibrated at the factory. If the barometer requires calibration, press **Calibrate** . If Probe ID or User ID are enabled in the System GLP menu you will be able to highlight these features and add, select, edit, or delete an ID. When enabled these IDs are stored with each calibration record in the GLP file.

After selecting the Probe ID and/or User ID if appropriate, highlight barometer and press enter.



Highlight the desired unit and press enter.


Calibrate Barometer
Calibration value: [743.8]
Accept Calibration

Highlight **Calibration Value** and press enter to manually enter the correct "true" barometric pressure. Next, highlight **Accept Calibration**, and press enter. If User Field 1 or 2 are enabled, you will be prompted to select the fields and then press Cal to complete the calibration. After completing the calibration, the message line will display "Calibration Successful". Press Esc to cancel the calibration.

Laboratory barometer readings are usually "true" (uncorrected) values of air pressure and can be used "as is" for barometer calibration. Weather service readings are usually not "true", i.e., they are corrected to sea level, and therefore cannot be used until they are "uncorrected". An approximate formula for this "uncorrection" is below:

True BP = [Corrected BP] – [2.5 * (Local Altitude in ft. above sea level/100)]

TEMPERATURE

All probe/cable assemblies have built-in temperature. Temperature calibration is not required nor is it available. To set the units, press Probe , and select **Display**. Highlight **Temperature** and press enter. Highlight the desired temperature units of °**F**, °**C**, or **K** and press enter to confirm the selection. Only one temperature unit may be displayed at a time. You may also choose to not display temperature. If you choose not to display temperature, dissolved oxygen readings will still be temperature compensated.

TAKING MEASUREMENTS

1. To take readings, insert the probe into the sample. Move the probe in the sample to release any air bubbles and to provide a fresh sample to the sensor cap. This movement is only necessary when first inserting the probe into the sample. Since the ProODO utilizes optical luminescent technology, continuous sample movement or stirring is not required. The probe will fit into a 300 mL BOD bottle for taking initial and final BOD readings. For best results in a BOD bottle, a stirring device should be used to properly mix the sample and to keep solids from settling at the bottom.

2. Allow the temperature readings to stabilize and wait approximately 25-35 seconds for the DO readings to stabilize.

3. Log One Sample is already highlighted in Run mode. Press Enter to open a submenu. Highlight Sites or Folders and press Enter to select the site or folder to log the sample to.

4. If necessary, use the keypad to create a new Site or Folder name. If Site List and Folder List are disabled in the **System** menu, you will not see these options when logging a sample.

5. Once the Site and/or Folder name is selected, highlight **Log Now** and press Enter. The instrument will confirm that the data point was successfully logged.

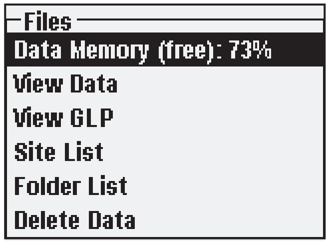
If you would like to log at a specific interval vs. logging one sample at a time or vice versa, press **System**, then highlight **Logging** and press Enter. Select **Continuous Mode** and adjust the time Interval if necessary. On the Run screen, the option to log will change from Log One Sample to Start Logging based on the time interval entered in the Logging Menu. Note – When utilizing the Manual sampling mode, the Continuous Logging Interval must be set to 10 seconds or greater.

During a continuous log, the Start Logging dialog box on the Run screen will change to Stop Logging. Press Enter to stop continuous logging.

Note - There is NO WARM-UP period associated with the ProODO sensor so you may wish to turn off the ProODO instrument between readings to conserve battery power.

FILES AND SITE LISTS

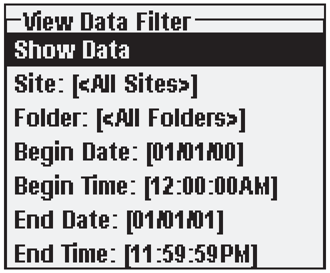
FILE MEMORY


Files
Data Memory (free): 73%
View Data
View GLP
Site List
Folder List
Delete Data

To view the file memory, press **File** .

The **Data Memory** shows a percentage indicating the amount of memory available. If the file memory is near 0%, files should be downloaded to a PC and/or deleted to free up memory.

VIEW DATA

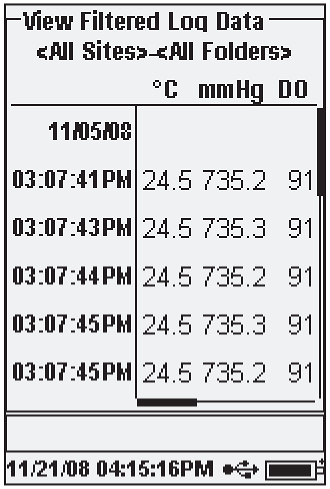

View Data Filter
Show Data
Site: [<All Sites>]
Folder: [<All Folders>]
Begin Date: [01/01/00]
Begin Time: [12:00:00AM]
End Date: [01/01/01]
End Time: [11:59:59PM]

Press **File** , highlight **View Data**, press enter. Configuring your data view:

Site: will allow you to view data from one particular site or all sites. Highlight Site, press enter, and select the site you wish to view data from or select All Sites to view data from all sites.

Folder: will allow you to view data from one particular folder or all folders. Highlight **Folder**, press enter, and select the file you wish to view data from or select All Folders to view data from all folders.

Begin and **End** will allow you to view data that was collected between two dates. Highlight Begin and/or End, press enter, and use the numeric entry screen to select the dates you wish to view.



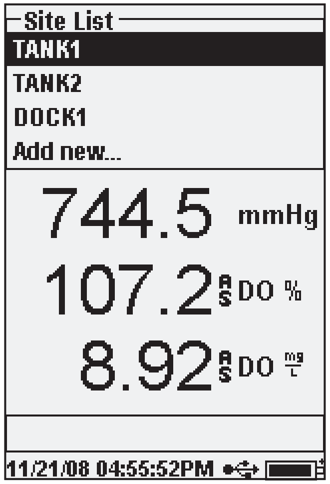
View Filtered Log Data
<All Sites>-<All Folders>

	°C	mmHg	DO
11/05/08			
03:07:41PM	24.5	735.2	91
03:07:43PM	24.5	735.3	91
03:07:44PM	24.5	735.2	91
03:07:45PM	24.5	735.3	91
03:07:45PM	24.5	735.2	91

11/21/08 04:15:16PM

After making your selections in the Data Filter, highlight **Show Data** and press enter. The data will have date and time stamps. You will likely have to scroll up and down and side to side using the arrow keys to completely view the data file.

SITE LIST



Site List
TANK1
TANK2
DOCK1
Add new...

744.5 mmHg
107.2 DO %
8.92 DO mg/L

11/21/08 04:55:52PM

To modify the Site List, press **File**, highlight **Site List**, and press enter. Enter new site names or edit existing sites with the alpha/numeric entry screen. Site lists can also be created and edited on your PC with Data Manager and then downloaded to the instrument.

FOLDER

To modify the Folder List, press **File**, highlight **Folder List**, and press enter. Enter new Folder names or edit existing folders with the alpha/numeric entry screen.

DELETE DATA

Press **File**, highlight **Delete Data**, and press enter. Enter the criteria for the data you wish to delete in the Delete Data Filter, then highlight Delete Data and press enter.

DATA MANAGER DESKTOP SOFTWARE

Data Manager is provided with the purchase of a ProODO Instrument. Data Manager is a powerful Windows® based software that will allow you to easily manage logged data, set up instruments, and conduct real time studies.

Data Manager needs to be installed on a PC before use. Once the communications saddle is connected to an instrument and the PC, the Data Manager software will recognize the attached instruments. Data Manager will identify the connected instruments by their Unit ID.

From the 'home' screen of Data Manager, you can select one of the following functions: Retrieve Instrument Data, Real Time Instrument Data, Instrument Configuration, or View Saved File/Data.

USING THE COMMUNICATIONS SADDLE

⚠ **WARNING**: *DO NOT connect the Communications Saddle to your PC before installing Data Manager. The Communication Saddle drivers MUST be installed prior to connecting it to your PC. The drivers will install automatically during the Data Manager installation. The first time the saddle is connected to the PC, you may have to walk through a couple of installation wizards. For detailed instruction, please refer to the Readme file located on the CD that was included with your instrument.*

A PC will recognize the Communications Saddle (saddle) as a YSI water quality instrument with or without the handheld installed in the saddle.

To connect to a ProODO, simply align the saddle to the oval section on top of the instrument and push it down to snap it in place (Figure 7).

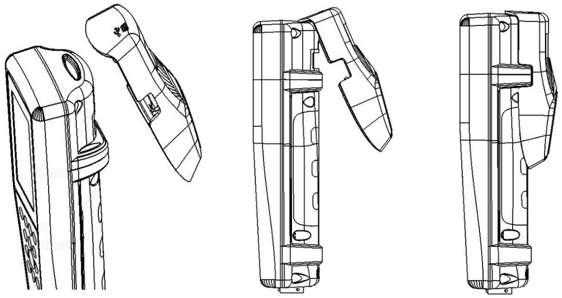


Figure 7. Locate the oval alignment groove at the top of the instrument and inside the saddle. Insert the saddle into this oval groove. Press the saddle towards the back of the instrument until it snaps into place.

Connect the USB cable to the top of the saddle and to a USB port on the PC. Once Data Manager is launched, the program will recognize all saddles with instruments connected to the PC.

The instrument will be powered through the saddle and USB connection when connected to the PC.

MANAGE LOGGED DATA

Data that has been logged to the ProODO can be uploaded to the PC via the provided USB saddle. You can upload sensor data, GLP files, site lists, and instrument configuration files individually or all at once. After connecting the instrument to the PC via the USB saddle and cable and launching Data Manager, click the **Retrieve Instrument Data** tab. Click on the Instrument's Unit ID you would like to retrieve data from, then select the files you would like to retrieve and click Start.

Once the sensor data is uploaded to the PC, you can graph and view tabular data by instrument Unit ID, date/time, site name, and/or folder name. This allows you to configure the report according to your needs. You can select to view all data from all instruments, or select a certain date/time range for only a few specific instruments, there are multiple ways to view the data. Once the report has been defined, you will be able to print the graph and/or export the table.

Data Manager takes information management one step further and allows you to delete specific points instead of entire files. This allows you to clean up data that is no longer needed or that may have been collected erroneously, for example, when the sensor was out of the water. If you can not delete data due to regulation and compliance purposes, Data Manager has the solution. While viewing logged data or real time data, you have the ability to 'tag' individual data points with comments.

In addition to sensor data, you will be able to view GLP files, site lists, and configuration files that have been uploaded from the instrument. These can be printed and exported as well.

REAL TIME DATA COLLECTION

Data Manager allows you to view real time data on the PC.

After selecting your instrument, click the Real Time Instrument Data tab. Next, input your sample interval, site/folder name, select the parameters you wish to view and click OK. You must click Start on the next screen to begin your real time study. Choose to hide the table or graph by unchecking the box next to these options. Click Stop, then Edit Setup to change the Y-scale min/max of the graph, to select different colors, or to name your graph. Add a comment to a data point, by clicking in the comment field of the table next to the data point. You may also Print the graph and Export the data for viewing in another program.

CONFIGURE INSTRUMENTS

Data Manager allows for easy and quick configuration of single or multiple instruments. Once you have uploaded a site list or configuration file, you can edit it as needed, save it, and download it to other instruments. You no longer need to configure each instrument individually. By using the same configuration file for all instruments, you can rest assured that all instruments will have identical settings.

New site lists and configuration files can be created in Data Manager. These lists and files can be downloaded to one or multiple instruments. Save time by creating these files on your PC and downloading them to the instrument as opposed to creating them on the instrument.

Minimum system requirements for Data Manager are a system with Windows® 2000 with SP4 (minimum) or Windows® XP with SP2 (minimum), 300 MHz or higher Pentium®-compatible CPU, 128 MB of RAM or higher, 80 MB or more of free hard-disk space, USB 2.0, and Microsoft® .NET.

MAINTENANCE AND STORAGE

This section describes the proper procedures for care, maintenance and storage of the ProODO. The goal is to maximize their lifetime and minimize down-time associated with improper sensor usage.

UPDATING INSTRUMENT AND PROBE FIRMWARE

The instrument and probe's firmware can be updated via www.ysi.com. There you will find the new firmware files and instructions on how to update the instrument and/or probe. There is no need to send the instrument back to the factory for upgrades.

GENERAL MAINTENANCE - BATTERY COMPARTMENT GASKET

The instrument utilizes a gasket as a seal to prevent water from entering the battery compartment. If the gasket and sealing surfaces are not maintained properly, it is possible that water can enter the battery compartment. This could severely damage the battery terminals causing loss of battery power and corrosion to the battery terminals. Therefore, when the battery compartment lid is removed, the gasket that provides the seal should be carefully inspected for contamination (e.g. debris, grit, etc.) and cleaned if necessary. If contamination is evident, clean the gasket and nearby plastic parts with lens cleaning tissue or equivalent lint-free cloth. Alcohol can be used to clean the plastic parts, but use only water and mild detergent on the o-ring itself. Also, inspect the gasket for nicks and imperfections.

ⓘ *Using alcohol on a gasket may cause a loss of elasticity and may promote cracking.*

SENSOR MAINTENANCE - DISSOLVED OXYGEN

CLEANING THE SENSOR CAP

The Sensor Cap should be kept clean since some types of fouling may consume oxygen which could affect the dissolved oxygen measurements. To clean the Sensor Cap, gently wipe away any fouling with a lens cleaning tissue that has been moistened with water. Do not use organic solvents to clean the Sensor Cap. Using an organic solvent to clean the Sensor Cap may cause permanent damage to the cap. For example, alcohol will dissolve the outer paint layer and other organic solvents will likely dissolve the dye in the cap

SENSOR CAP REPLACEMENT

The Sensor Cap should be replaced about once per year but may last longer. It should also be replaced if it is cracked or damaged (see Troubleshooting section for instruction on how to inspect the cap for damage). The instruction sheet shipped with the replacement ODO sensor cap includes the calibration coefficients specific to your sensor cap.

ⓘ *IMPORTANT - Be sure to save the ODO Sensor Cap instruction sheet in case you need to reload the calibration coefficients.*

The replacement ODO Sensor Cap is shipped in a humidified container and the package should not be opened until immediately before sensor cap replacement. Once the sensor cap has been installed on the ODO sensor as described below, it is important to keep the sensor in a 100% humid environment. Therefore, the ODO sensor should be stored either in the grey calibration/storage sleeve with the sponge moistened or immersed in water, see Sensor Storage for more information. If the sensor dries out, refer to the Rehydration procedure in this manual.

Refer to Figure 8 below when following the instructions for replacing the cap.

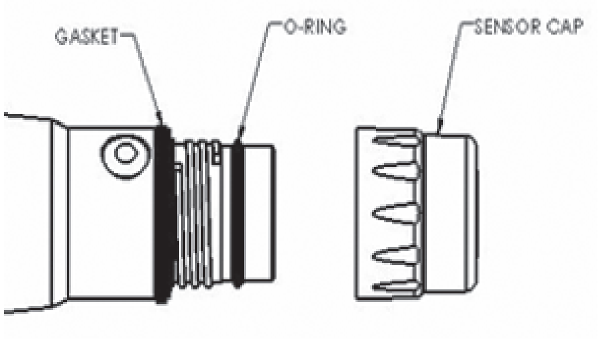


Figure 8

⚠ *Caution: Avoid touching the sensing end of the sensor cap during the following maintenance procedures.*

1. Remove the old sensor cap assembly from the sensor by grasping the probe body with one hand and then rotating the sensor cap counterclockwise until it is completely free. Do not use any tools for this procedure.

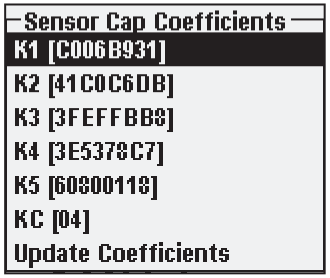
2. Inspect the o-ring on the probe for damage. If there is any indication of damage, carefully remove the o-ring and replace it with the new o-ring included with the replacement sensor cap. Do not use any tools to remove the o-ring.
3. Ensure that the o-ring installed on the probe is clean. If necessary, wipe clean with a lint free cloth or replace the o-ring as described in the previous step.
4. Locate the o-ring lubricant included with the new sensor cap. Apply a thin coat of o-ring lubricant to the installed o-ring. After application, there should be a thin coat of o-ring lubricant on the o-ring only. Remove any excess o-ring lubricant from the o-ring and/or probe with a lens cleaning tissue.
5. Remove the new sensor cap from its hydrated container and dry the inside cavity of the sensor cap with lens cleaning tissue. Make sure that the cavity is completely dry before proceeding with the installation. Next, clean the clear surface of the sensor on the end of the probe with lens cleaning tissue.
6. Using clockwise motion, thread the new sensor cap onto the probe assembly until it is finger-tight. The o-ring should be compressed between the sensor cap and probe. Do not over-tighten the sensor cap and do not use any tools for the installation process.
7. After installing the new sensor cap, store the sensor in either water or in humidified air in the calibration sleeve.
8. Follow the procedures below for configuring the ProODO instrument for the new Sensor Cap.

CONFIGURING PROODO INSTRUMENT FOR NEW SENSOR CAP

After installing a new Sensor Cap, connect the probe/cable assembly to the ProODO instrument and turn the instrument on. Locate the Calibration Code Label at the top of the instruction sheet and note the six numbers which are listed as K1 through K5 and KC. These six numbers contain the calibration code for this particular sensor cap. Follow the instructions below to enter the new calibration coefficients into your existing ODO instrument.

1. Press the **Probe**, highlight DO, and press enter.
2. Highlight **Sensor Cap** and press enter.
3. Highlight **Sensor Cap Coefficients** and press enter.


Sensor Cap
Serial #: 08f000280
Temp Coefficient: [0.01550]
Sensor Cap Coefficients


Sensor Cap Coefficients
K1 [C006B931]
K2 [41C0C6DB]
K3 [3FEFFBB8]
K4 [3E5378C7]
K5 [60800118]
KC [04]
Update Coefficients

4. Highlight each coefficient in turn (K1 through KC) and use the numeric entry screen to enter the corresponding new coefficient from the Calibration Code Label. Press Enter after each entry and then proceed to the next K selection.
5. After all the new coefficients have been entered, highlight Update Sensor Cap Coefficients and press the Enter.
6. A message will appear warning that you will be overwriting the current sensor cap coefficients and you should confirm that you wish to carry out this action. Highlight Yes and press enter to confirm the new coefficients.

After updating the Coefficients, the Serial # in the Sensor Cap menu will be updated automatically based on your entries. The Temperature Coefficient listed in the Sensor Cap menu is programmed into the sensor at the factory and should not be modified unless instructed by YSI Technical Support.

If errors are made in entering the Sensor Cap Coefficients, the instrument will block the update and an error message will appear on the display. If you see this error message, re-enter the coefficients and check them carefully for correct transcription from the Calibration Code Label prior to selecting Update Sensor Cap Coefficients. If you continue to get an error message after several entry attempts, contact YSI Technical Support for assistance.

After entering the new Sensor Cap coefficients, perform a 1-point DO calibration.

REHYDRATING THE SENSOR CAP

The Sensor Cap must remain in a moist environment; see Sensor Storage for storage recommendations. If you inadvertently leave your sensor exposed to ambient air for a period of more than approximately 8 hours it may dry out. If the sensor cap is allowed to dry out, it is likely to drift slightly at the beginning of your next study unless it is rehydrated. If the cap dries out, you can rehydrate it by soaking the probe tip with the sensor cap installed in warm tap water for 24 hours. After rehydration is complete, recalibrate and be sure to store the probe in a moist environment.

SENSOR MAINTENANCE - TEMPERATURE

You must keep the temperature portion of the sensor free of build up. Other than that, the sensor requires no maintenance. A soft bristle brush, like a tooth brush can be used to scrub the temperature sensor if needed.

SENSOR STORAGE

SHORT-TERM STORAGE

When the ODO Sensor is not in use, it MUST BE STORED IN A MOIST ENVIRONMENT, i.e., either in water or in water-saturated air. If the sensor cap is allowed to dry out by exposure to ambient air, it is likely to drift slightly at the beginning of your next study unless it is rehydrated.

For short-term storage (<30 days), moisten the sponge in the calibration/storage sleeve with a small amount of clean water and place this over the probe with the sensor cap installed. This will provide a 100% saturated air environment.

LONG-TERM STORAGE

For long-term storage (>30 days), remove the batteries from the instrument. Moisten the sponge in the red protective plastic cap that was provided with the probe and place it over the sensor with the sensor cap installed. Inspect the sponge every 30 days to make sure it is still moist. If you no longer have the red protective cap, then moisten the sponge in the calibration/transport sleeve and place this over the probe.

Alternatively, you can place the probe with sensor cap directly in a beaker or other container of water, making sure that the water does not evaporate over time.

Long-term Storage: -5 to 70°C (23 to 158°F)

TROUBLESHOOTING

DISSOLVED OXYGEN READINGS

Erroneous dissolved oxygen readings typically indicate a need to clean the sensor cap, replace the sensor cap, and/or recalibrate the instrument. First, verify the sensor is properly setup in the Probe menu. Next, clean the sensor cap following the instructions in the Maintenance and Storage section of this manual and then perform a calibration. If erroneous readings persist, follow the steps on the next page to inspect the sensor cap for damage and then attempt to recalibrate the instrument. If the problem continues, try to rehydrate the sensor cap then recalibrate. If you are still getting erroneous dissolved oxygen readings, try replacing the sensor cap and then recalibrate. If the erroneous readings continue, contact YSI Technical Support to help determine the next step.

INSPECTING THE SENSOR CAP FOR DAMAGE

⚠ *Caution: Avoid touching the sensing end of the sensor cap during the following maintenance procedures.*

If readings seem to be in error or are jumpy, remove the sensor cap from the sensor by grasping the probe body with one hand and then rotating the sensor cap counterclockwise until it is completely free. Avoid using tools for the removal of the cap if at all possible.

Inspect the sensor cap assembly for any cracks or damage. If damage has occurred, contact YSI Customer Service to order a replacement sensor cap.

Inspect the o-ring on the probe and the gasket at the top of the threads for damage. If there is any indication of damage, carefully remove these parts and contact YSI Technical Support to obtain a new o-ring and/or gasket. Avoid using tools to remove the o-ring as damage to the sealing surfaces could result.

Before reinstalling the sensor cap, make sure that the cavity is completely dry before proceeding with the installation. If water is found, dry the cavity with lens cleaning tissue. Finally, clean the clear window on the end of the probe with lens cleaning tissue.

After reinstalling the sensor cap, perform a calibration and then reevaluate the quality of the dissolved oxygen readings. If problems persist, try rehydrating or replacing the sensor cap.

HELP

During use of the ProODO instrument press **Question** ? from any screen to view help messages directly on the display.

ERROR/STATUS MESSAGES

If readings for a certain parameter are over range you will see a series of +++++ and if the readings are under range you will see a series of ----- plus the error message along the bottom of the screen. If you see a series of ?????, that will indicate that a certain parameter cannot be calculated. This could be due to a connection issue between the cable and instrument. The following are some of the potential messages:

Message	*Description and Recommended Action*
Probe Temp over range	Temperature is over 100° C or reading erroneously. Check cable connection and ensure Temp sensor is clean.
Probe Temp under range	Temperature is under -10° C or reading erroneously. Check cable connection and ensure Temp sensor is clean.
DO over range	DO% saturation is over 550%. Check sensor cap and recalibrate.
DO under range	DO% saturation is under -5%. Check sensor cap and recalibrate.
Barometer over range	Barometric pressure is reading over 988 mmHg. Calibrate barometer.
Barometer under range	Barometric pressure is reading under 375 mmHg. Calibrate barometer.
ODO Communications Error	No communication between the instrument and cable. Check cable connection.
Clock Battery Low	Internal battery for real time clock has low voltage. Contact Technical Support.
Measurements Locked!	Measurements are held in Manual Sampling mode. Select Update Measurements or Log Held Data.

Illegal Value may appear during alpha/numeric entry on the message line. This only appears if the values entered do not match the formatting. This will also appear in the GLP security area if the password is incorrect.

RESTORE DEFAULT CALIBRATION VALUES

Occasionally, the instrument may need to have the factory calibration default values restored. In order to accomplish this press Calibrate Cal, highlight **Restore Default Cal** and press enter. Select the parameter you wish to restore, either DO or Barometer, and press enter. After selecting barometer or DO, you will be asked to confirm the operation. Highlight Yes and press enter.

ACCESSORIES / PART NUMBERS

Part Number	*Description*
626281	ProODO Instrument 
626250-1, -4, -10, -20, -30, -40, -50, -60, or -100	1, 4, 10, 20, 30, 40, 50, 60, or 100-meter probe/cable assembly*
626320	Replacement Sensor Cap
605604	Communications saddle kit 
605515	Data Manager desktop software
603075	Carrying case, soft-sided 
603076 and 603078	Extended length flow cell and single port adapter. Both items are required for use with a ProODO

Part Number	*Description*
603074	Carrying case, hard-sided 
603069	Belt clip 
063517	Ultra clamp 
063507	Tripod clamp 

Part Number	*Description*
603062	Cable management kit 
605978	Weight, sensor/cable, 4.9 oz. 
063019	Weight, sensor/cable, 24 oz., 3”
063020	Weight, sensor/cable, 51 oz., 6”
603070	Shoulder strap

*All cables include a temperature and dissolved oxygen sensor. Special order cables in 10 meter increments from 60 to 100 meters are available.

DECLARATION OF CONFORMITY

The undersigned hereby declares on behalf of the named manufacturer under our sole responsibility that the listed product conforms to the requirements for the listed European Council Directive(s) and carries the CE mark accordingly.

Manufacturer:	YSI Incorporated 1725 Brannum Lane Yellow Springs, OH 45387 USA
Product Name:	Professional ODO Water Quality Instrument
Model Numbers	
Instrument/Accessory:	ProODO (626281) / ProComm (605604)
Probe/Cable Assemblies:	626250
Conforms to the following:	
Directives:	EMC 2004/108/EC RoHS 2002/95/EC WEEE 2002/96/EC
Harmonized Standards:	• EN61326-1:2006, Electrical equipment for measurement, control, and laboratory use – EMC requirements – Part 1: General Requirements • EN61326-2-3:2006, Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-3: Particular Requirements – Test configuration, operational conditions, and performance criteria for transducers with integrated or remote signal conditioning. • EN61000-3-2:2006, Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current < 16A per phase). • EN61000-3-3:1995 +A1:2001 +A2:2005, Electromagnetic compatibility (EMC) – Part 3: Limits – Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current < 16A.
Supplementary Information:	All performance met the continuous unmonitored operation criteria as follows: 1. ESD, EN61000-4-2, Performance Criterion B 2. Radiated Immunity, EN61000-4-3, Performance Criterion A 3. EFT, EN61000-4-4, (EFT) Performance Criterion B 4. Surge, EN61000-4-5, Performance Criterion B 5. Conducted Immunity, EN61000-4-6, Performance Criterion A 6. Voltage Interrupts, EN61000-4-11, Performance Criterion B 7. RF Emissions, EN55011:1998, A1:1999 Class B equipment
Authorized EU Representative	YSI Hydrodata Ltd Unit 8, Business Centre West, Avenue 1 Letchworth, Hertfordshire, SG6 2HB UK

Signed: Lisa M. Abel Date: 26 November 2008
Title: Director of Quality

The undersigned hereby declares on behalf of the named manufacturer under our sole responsibility that the listed product conforms to the requirements for electrical equipment under US FCC Part 15 and ICES-003 for unintentional radiators.

Manufacturer:	YSI Incorporated 1725 Brannum Lane Yellow Springs, OH 45387 USA
Product Name:	Professional ODO Water Quality Instrument
Model Numbers	
Instrument/Accessory:	ProODO (626281) / ProComm (605604)
Probe/Cable Assemblies:	626250
Conforms to the following:	
Standards:	• FCC 47 CFR Part 15-2008, Subpart B, Class B, Radio Frequency Devices • ICES-003:2004, Digital Apparatus
Supplementary Information:	Tested using ANSI C63.4-2003 (excluding sections 4.1, 5.2, 5.7, 9, and 14)

Signed: Lisa M. Abel Date: 26 November 2008
Title: Director of Quality

The undersigned hereby declares on behalf of the named manufacturer under our sole responsibility that the listed product conforms with the Australian and New Zealand Electromagnetic Compatibility (EMC) requirements for generic products to be used in residential, commercial, and light industrial environments.

Manufacturer:	YSI Incorporated 1725 Brannum Lane Yellow Springs, OH 45387 USA
Product Name:	Professional ODO Water Quality Instrument
Model Numbers	
Instrument/Accessory:	ProODO (626281) / ProComm (605604)
Probe/Cable Assemblies:	626250
Conforms to the following:	
Standards:	• AS/NZS 4251.1:1999, Electromagnetic Compatibility (EMC) – Generic emission standard – Part 1: Residential, commercial, and light industry.

Signed: Lisa M. Abel Date: 26 November 2008
Title: Director of Quality

RECYCLING

YSI is committed to reducing the environmental footprint in the course of doing business. Even though materials reduction is the ultimate goal, we know there must be a concerted effort to responsibly deal with materials after they've served a long, productive life-cycle. YSI's recycling program ensures that old equipment is processed in an environmentally friendly way, reducing the amount of materials going to landfills.

- Printed Circuit Boards are sent to facilities that process and reclaim as much material for recycling as possible.
- Plastics enter a material recycling process and are not incinerated or sent to landfills.
- Batteries are removed and sent to battery recyclers for dedicated metals.

When the time comes for you to recycle, follow the easy steps outlined at www.ysi.com.

CONTACT INFORMATION

ORDERING AND TECHNICAL SUPPORT

Telephone:	800 897 4151 (US) +1 937 767 7241 (Globally) Monday through Friday, 8:00 AM to 5:00 ET
Fax:	+1 937 767 9353 (orders) +1 937 767 1058 (technical support)
Email:	environmental@ysi.com or proseries@ysi.com
Mail:	YSI Incorporated 1725 Brannum Lane Yellow Springs, OH 45387 USA
Internet:	www.ysi.com

When placing an order please have the following available:
1.) YSI account number (if available)
2.) Name and phone number
3.) Purchase Order or Credit Card
4.) Model Number or brief description
5.) Billing and shipping addresses
6.) Quantity

SERVICE INFORMATION

YSI has authorized service centers throughout the United States and Internationally. For the nearest service center information, please visit www.ysi.com and click 'Support' or contact YSI Technical Support directly at 800-897-4151.

When returning a product for service, include the Product Return form with cleaning certification. The form must be completely filled out for a YSI Service Center to accept the instrument for service. The form may be downloaded from www.ysi.com by clicking on the 'Support" tab, then the Product Return Form button.

APPENDIX A-DO% CALIBRATION VALUES

Calibration Value	Pressure			
D.O. %	in Hg	mmHg	kPa	mbar
101%	30.22	767.6	102.34	1023.38
100%	29.92	760.0	101.33	1013.25
99%	29.62	752.4	100.31	1003.12
98%	29.32	744.8	99.30	992.99
97%	29.02	737.2	98.29	982.85
96%	28.72	729.6	97.27	972.72
95%	28.43	722.0	96.26	962.59
94%	28.13	714.4	95.25	952.46
93%	27.83	706.8	94.23	942.32
92%	27.53	699.2	93.22	932.19
91%	27.23	691.6	92.21	922.06
90%	26.93	684.0	91.19	911.93
89%	26.63	676.4	90.18	901.79
88%	26.33	668.8	89.17	891.66
87%	26.03	661.2	88.15	881.53
86%	25.73	653.6	87.14	871.40
85%	25.43	646.0	86.13	861.26
84%	25.13	638.4	85.11	851.13
83%	24.83	630.8	84.10	841.00
82%	24.54	623.2	83.09	830.87
81%	24.24	615.6	82.07	820.73
80%	23.94	608.0	81.06	810.60
79%	23.64	600.4	80.05	800.47
78%	23.34	592.8	79.03	790.34
77%	23.04	585.2	78.02	780.20
76%	22.74	577.6	77.01	770.07
75%	22.44	570.0	75.99	759.94
74%	22.14	562.4	74.98	749.81
73%	21.84	554.8	73.97	739.67
72%	21.54	547.2	72.95	729.54

THIS PAGE LEFT INTENTIONALLY BLANK

APPENDIX B-OXYGEN SOLUBILITY TABLE

Solubility of Oxygen in mg/L in Water Exposed to Water-Saturated Air at 760 mm Hg Pressure.
Salinity = Measure of quantity of dissolved salts in water.
Chlorinity = Measure of chloride content, by mass, of water.
S(0/00) = 1.80655 x Chlorinity (0/00)

Temp °C	Chlorinity : 0 Salinity: 0	5.0 ppt 9.0 ppt	10.0 ppt 18.1 ppt	15.0 ppt 27.1 ppt	20.0 ppt 36.1 ppt	25.0 ppt 45.2 ppt
0.0	14.62	13.73	12.89	12.10	11.36	10.66
1.0	14.22	13.36	12.55	11.78	11.07	10.39
2.0	13.83	13.00	12.22	11.48	10.79	10.14
3.0	13.46	12.66	11.91	11.20	10.53	9.90
4.0	13.11	12.34	11.61	10.92	10.27	9.66
5.0	12.77	12.02	11.32	10.66	10.03	9.44
6.0	12.45	11.73	11.05	10.40	9.80	9.23
7.0	12.14	11.44	10.78	10.16	9.58	9.02
8.0	11.84	11.17	10.53	9.93	9.36	8.83
9.0	11.56	10.91	10.29	9.71	9.16	8.64
10.0	11.29	10.66	10.06	9.49	8.96	8.45
11.0	11.03	10.42	9.84	9.29	8.77	8.28
12.0	10.78	10.18	9.62	9.09	8.59	8.11
13.0	10.54	9.96	9.42	8.90	8.41	7.95
14.0	10.31	9.75	9.22	8.72	8.24	7.79
15.0	10.08	9.54	9.03	8.54	8.08	7.64
16.0	9.87	9.34	8.84	8.37	7.92	7.50
17.0	9.67	9.15	8.67	8.21	7.77	7.36
18.0	9.47	8.97	8.50	8.05	7.62	7.22
19.0	9.28	8.79	8.33	7.90	7.48	7.09
20.0	9.09	8.62	8.17	7.75	7.35	6.96
21.0	8.92	8.46	8.02	7.61	7.21	6.84
22.0	8.74	8.30	7.87	7.47	7.09	6.72
23.0	8.58	8.14	7.73	7.34	6.96	6.61
24.0	8.42	7.99	7.59	7.21	6.84	6.50
25.0	8.26	7.85	7.46	7.08	6.72	6.39
26.0	8.11	7.71	7.33	6.96	6.62	6.28
27.0	7.97	7.58	7.20	6.85	6.51	6.18
28.0	7.83	7.44	7.08	6.73	6.40	6.09
29.0	7.69	7.32	6.93	6.62	6.30	5.99
30.0	7.56	7.19	6.85	6.51	6.20	5.90
31.0	7.43	7.07	6.73	6.41	6.10	5.81
32.0	7.31	6.96	6.62	6.31	6.01	5.72
33.0	7.18	6.84	6.52	6.21	5.91	5.63
34.0	7.07	6.73	6.42	6.11	5.82	5.55
35.0	6.95	6.62	6.31	6.02	5.73	5.46
36.0	6.84	6.52	6.22	5.93	5.65	5.38
37.0	6.73	6.42	6.12	5.84	5.56	5.31
38.0	6.62	6.32	6.03	5.75	5.48	5.23
39.0	6.52	6.22	5.98	5.66	5.40	5.15
40.0	6.41	6.12	5.84	5.58	5.32	5.08
41.0	6.31	6.03	5.75	5.49	5.24	5.01
42.0	6.21	5.93	5.67	5.41	5.17	4.93
43.0	6.12	5.84	5.58	5.33	5.09	4.86
44.0	6.02	5.75	5.50	5.25	5.02	4.79
45.0	5.93	5.67	5.41	5.17	4.94	4.72

Item # 626279
Rev C
Drawing # A626279
March 2009

Notes

Write down the name and information of your OAKTON distributor here.

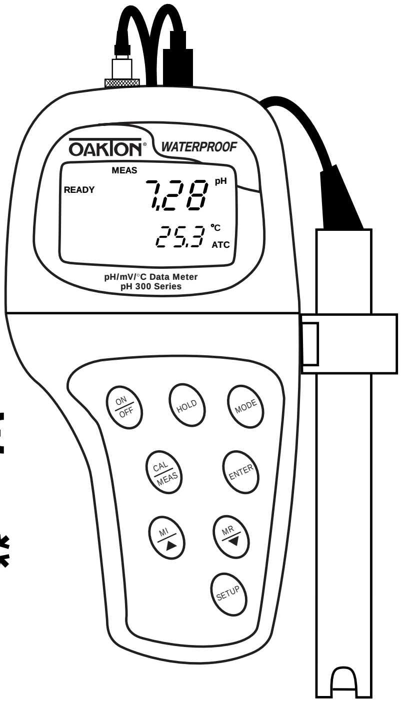
00806-23
68X248903

OAKTON®

OPERATING INSTRUCTIONS

OAKTON® 35618-Series

pH 300 and 310 Portable Waterproof pH/mV/°C Meter



R1 1/01

OAKTON®

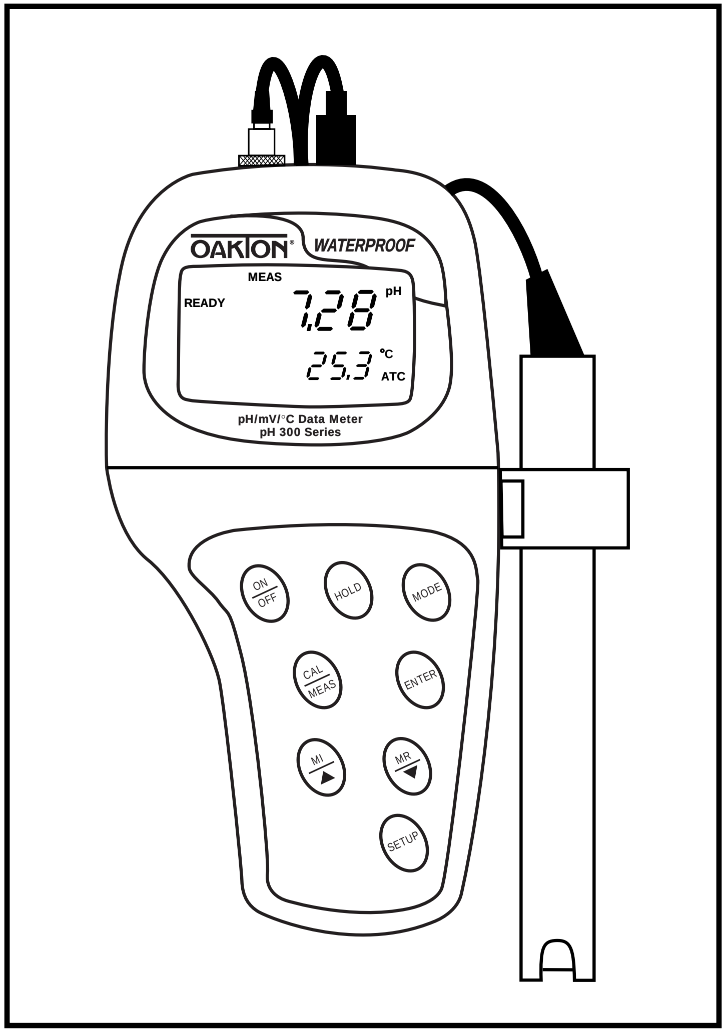
Table of Contents

1. Introduction

Thank you for selecting an OAKTON meter. This OAKTON portable meter is a microprocessor-based instrument that measures pH, mV, and temperature. It’s completely waterproof—and it floats! Your meter has many user-friendly features, all of which are accessible through the membrane keypad.

This meter includes two electrode holders and batteries.

Please read this manual thoroughly before operating your meter.



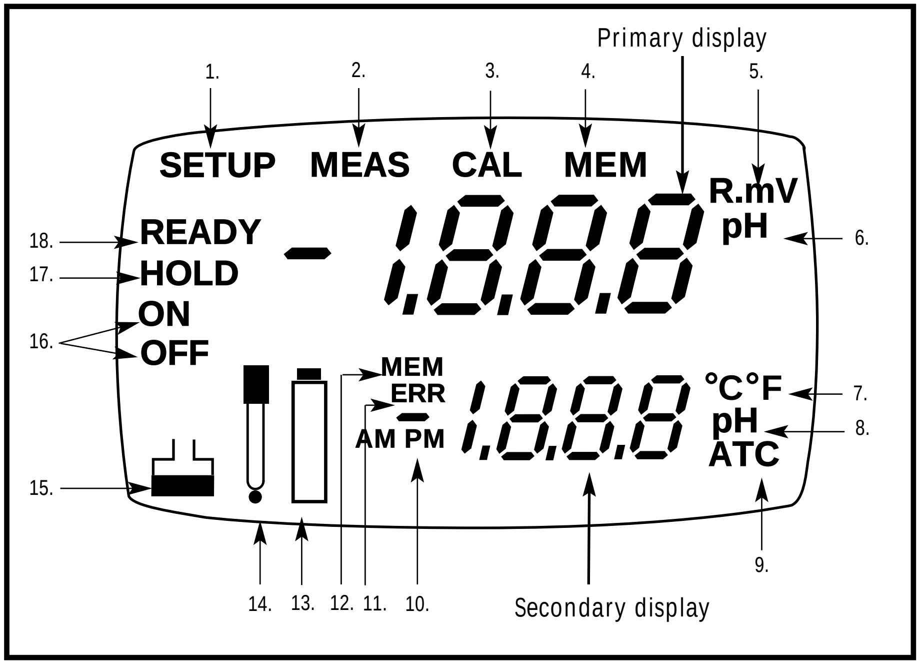
2. Display and Keypad Functions

2.1 Display

The LCD has a primary and secondary display.

- The primary display shows the measured pH, mV or Relative mV reading.
- The secondary display shows the temperature.

The display also shows error messages, keypad functions and program functions.



1. SETup mode indicator
2. MEASurement mode indicator
3. CALibration indicator
4. MEMory recall mode indicator
5. mV or relative mV indicator
6. pH indicator
7. Temperature indicator *(°F available on pH 310 meter only)*
8. pH buffer selection indicator
9. Automatic Temperature Compensation indicator
10. Clock indicator *(pH 310 meter only)*
11. ERRor indicator
12. MEMory location indicator
13. Low battery indicator
14. Probe indicator
15. Buffer indicator
16. Function ON / OFF indicator
17. HOLD indicator
18. READY indicator

2.2 Keypad

The large membrane keypad makes the instrument easy to use. Each button, when pressed, has a corresponding graphic indicator on the LCD.

ON/OFF............Powers and shuts off the meter.

HOLD ....Freezes the measured reading. To activate, press **HOLD** while in measurement mode. To release, press **HOLD** again.
pH 310 model only: When auto endpoint feature is switched on, it automatically holds reading after 5 seconds of stability. The HOLD indicator appears on the display. Press HOLD to release auto endpoint feature.

MODE..............Selects the measurement parameter. Press MODE to toggle between pH; mV (or relative mV); and date / time *(date/time available on pH 310 model only)*. In pH calibration mode, press MODE to access temperature calibration.

CAL/MEAS......Toggles user between Calibration and Measurement mode.
- If you were in pH measurement mode, press **CAL/MEAS** to enter pH calibration mode.
- If you were in mV measurement mode, press **CAL/MEAS** to enter mV calibration mode.

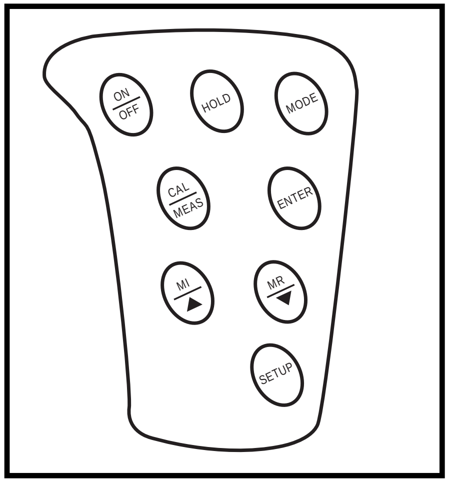
NOTE: Temperature calibration is available from pH calibration mode; see page 17 for directions.
In advanced set-up mode: Press **CAL/MEAS** to return to main menu from sub menus. Press **CAL/MEAS** again to return to measurement mode from main menu.

ENTER ....Press to confirm values in Calibration mode and to confirm selections in Setup mode.

MI ▲ / MR ▼ ....Press ▲/▼ in setup mode to scroll through subgroups. Also press ▲/▼ in mV calibration mode to adjust the calibration value.

MI/MR work in the measurement mode. **MI** (memory input) stores the measured value into memory. **MR** (memory recall) recalls the sets of values stored in the memory.

SET....................Press to enter SETUP mode. SETUP mode lets you customize meter preferences and defaults, and view calibration and electrode offset data.

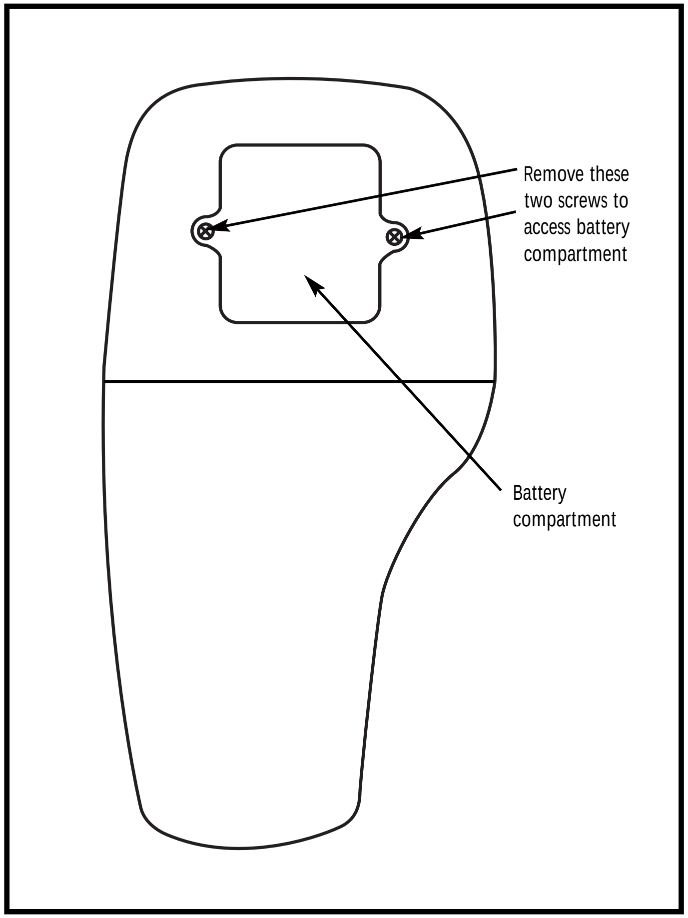


3. Preparation

3.1 Inserting the Batteries

Four AAA batteries are included with your meter.

1. Use a Phillips screwdriver to remove the two screws holding the battery cover. See figure below.
2. Lift off battery cover to expose batteries.
3. Insert batteries. Follow the diagram inside the cover for correct polarity.
4. Replace the battery cover into its original position. Screw cover back into place.



3.2 Connecting the Electrode and Temperature Probe

The OAKTON pH / mV meter can use any standard pH, ORP, or ISE electrode with a BNC connector. For automatic temperature compensation (ATC), this meter requires a temperature probe with a specialty 6-pin connector.

Use either:

- any electrode with a BNC connector and a separate temperature probe with 6-pin connector (part number 35618-05)
- an “All-in-One” combination pH electrode / temperature probe designed specifically for the pH 300 and pH 310 waterproof meters

NOTE: Keep connectors clean. Do not touch connector with soiled hands.

See the “Accessories” section on page 45 for a temperature probe and “All in One” electrodes for use with the pH 300 and pH 310 meters.

To connect the pH, ORP or ISE electrode:

1. Slide the BNC connector of the probe over the BNC connector socket on the meter. Make sure the slots of the connector are in line with the posts of the socket. Rotate and push the connector clockwise until it locks.

See figure below.

2. To remove probe, push and rotate the connector counterclockwise. While holding onto the metal part of the connector, pull probe away from the meter.

CAUTION: Do not pull on the probe cord or the probe wires might disconnect.

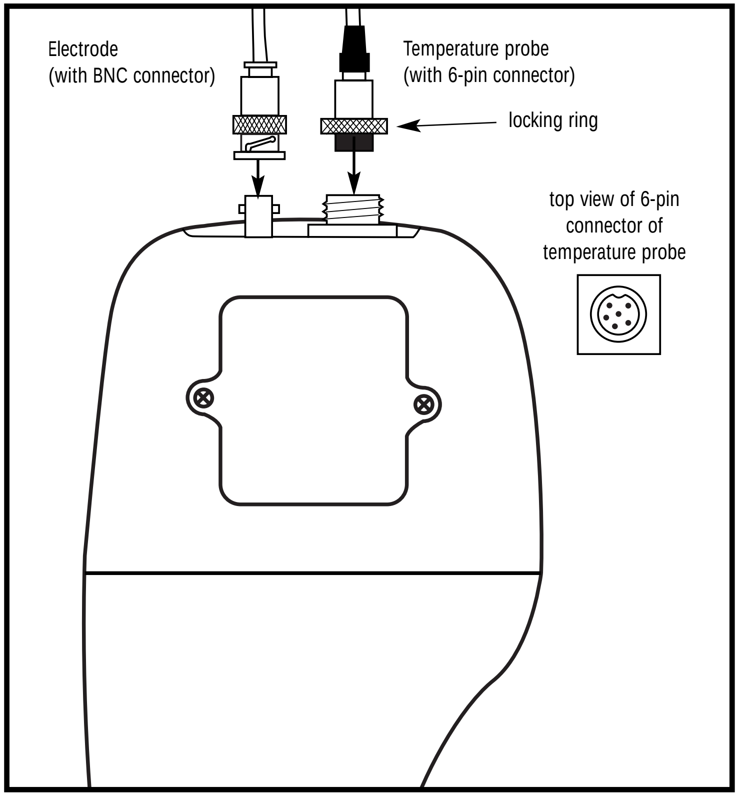
To connect the temperature probe:

1. Line up the notch and 6 pins on the meter with the holes in the 6-pin connector. Push down and turn the locking ring clockwise to lock into place.

See figure below.

2. To remove probe, turn the locking ring counterclockwise on the probe connector. Pull probe away from the meter.

CAUTION: Do not pull on the probe cord or the probe wires might disconnect.



3.3 Attaching the Electrode Holder to the Meter

Attaching the electrode holder to the meter facilitates one-hand operation. Attach two electrode holders if you have a separate electrode and temperature probe.

1. Locate the slot on the left hand side of the meter.
2. Gently slide the flange of the holder into the slot on the meter. Make sure the holder is secured properly into the slot.

See figure Ⓐ

You can attach the electrode holder in different positions.

See figure Ⓑ

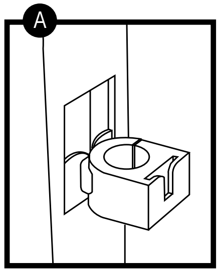
To attach a second electrode holder:

3. Align the flange of the second electrode holder with the slot of the first holder.

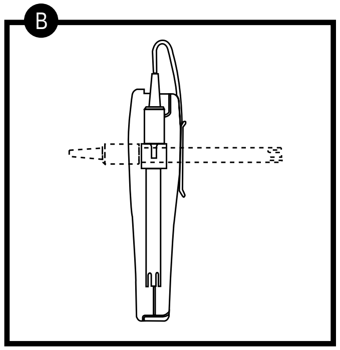
See figure Ⓒ

4. Slide the flange of the second holder into the slot of the first holder until the tops of the holders are aligned and secure.

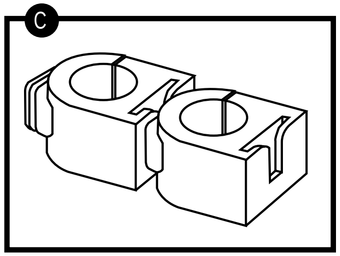
Ⓐ



Ⓑ



Ⓒ



3.4 Inserting the Electrode into the Electrode Holder

Do not use excessive force when inserting electrodes into the holders.

1. Insert the pH electrode into the opening of the first holder until the top housing of the electrode touches the top of the holder.
2. If you are using a separate temperature probe, insert the probe into the opening of the second holder until the ridge on the housing touches the top of the holder.

NOTE: The holder is designed for probes 12 mm in diameter. Electrodes larger than 12 mm may not fit in the holder. Forcing the electrode into the opening may damage the holder or your electrode.

4. Calibration

4.1 Important Information on Meter Calibration

When you recalibrate your meter, old pH, Rel mV and mV calibration points are replaced on a point by point basis. For example, if you previously calibrated your meter at pH 4.01, 7.00, and 10.01, and you recalibrate at pH 7.00, the meter retains the old calibration data at pH 4.01 and pH 10.01. To view current calibration points, see Program P2.0 in the SETUP section, page 29.

To completely recalibrate your meter, or when you use a replacement probe, it is best to set the meter to its factory defaults and recalibrate the meter at all points. To reset the meter to its factory defaults, see the SETUP section Program P5.0, page 36 (for pH 300 meter) or Program P6.0, page 39 (for pH 310 meter).

For information on how to calibrate your meter:

- See section 4.3 on pages 14-15 for pH calibration
- See section 4.4 on page 16 for Relative mV calibration
- See section 4.5 on pages 17 for Temperature Calibration of replacement temperature probes or replacement “All-in-One” electrodes

4.2 Preparing the Meter for Calibration

Before starting calibration, make sure you are in the correct measurement mode. When you switch on the meter, the meter starts up in the units last used. For example, if you shut the meter off in "mV" units, the meter will read "mV" units when you switch the meter on.

Be sure to remove the protective electrode storage bottle or rubber cap of the probe before calibration or measurement. If the electrode has been stored dry, wet the probe in tap water for 10 minutes before calibrating or taking readings to saturate the pH electrode surface and minimize drift.

Wash your probe in deionized water after use, and store in electrode storage solution. If storage solution is not available, use pH 4.0 or 7.0 buffer.

Do not reuse buffer solutions after calibration. Contaminants in the solution can affect the calibration, and eventually the accuracy of the measurements. See page 41 for information on our high-quality OAKTON pH buffers.

pH 300 meter calibration

The pH 300 meter is capable of up to 5-point pH calibration to ensure accuracy across the entire pH range of the meter. Select from the following buffer options:

pH 1.68, 4.01, 7.00, 10.01, and 12.45.

The meter automatically recognizes and calibrates to these standard buffer values, which makes pH calibration faster and easier.

pH 310 meter calibration

The pH 310 meter features three separate buffer sets. Select the buffer set you require in Set Up mode Program 4.0 (see page 34 for more information). The pH 310 meter is capable of up to 6-point pH calibration, depending on the buffer set. Select from the following buffer options:

USA buffers (pH 1.68, 4.01, 7.00, 10.01, 12.45)
NIST buffers (pH 1.68, 4.01, 6.86, 9.18, 12.45)
DIN buffers (pH 1.09, 3.06, 4.65, 6.79, 9.23, 12.75)

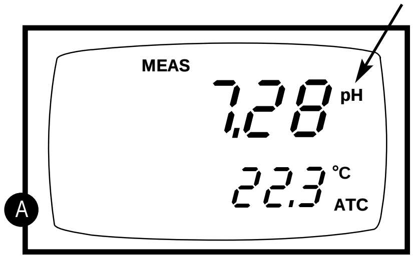
The meter automatically recognizes and calibrates to these standard buffer values, which makes pH calibration faster and easier.

4.3 pH calibration

NOTE: We recommend that you perform at least a 2-point calibration using standard buffers that bracket (one above and one below) the expected sample range. You can perform a 1-point calibration, but make sure that the buffer value is close to the sample value you are measuring.

1. **If necessary, press the MODE key to select pH mode**. The pH indicator appears in the upper right hand corner of the display.

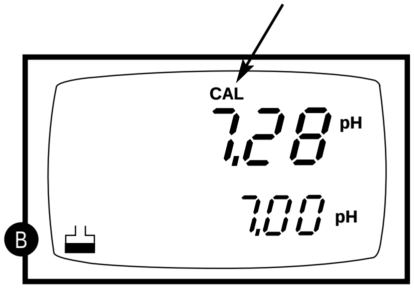
See figure Ⓐ



A

2. **Rinse the probe thoroughly with de-ionized water or a rinse solution.** Do not wipe the probe; this causes a build-up of electrostatic charge on the glass surface.
3. **Dip the probe into the calibration buffer.** The end of the probe must be completely immersed into the sample. Stir the probe gently to create a homogeneous sample.
4. **Press CAL/MEAS** to enter pH calibration mode. The CAL indicator lights. The primary display will show the measured reading while the smaller secondary display will indicate the pH standard buffer solution.

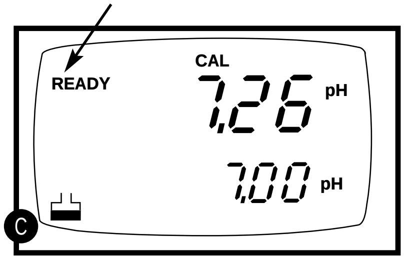
See figure Ⓑ



B

5. **Wait for the measured pH value to stabilize.**

See figure Ⓒ

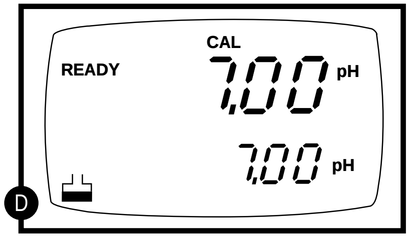


C

If the READY indicator has been activiated (set up program P4.1—see page 32), the READY annunciator lights when the reading is stable.

6. **Press ENTER to confirm calibration**. The meter is now calibrated to the current buffer.

See figure Ⓓ



D

- If you are performing multipoint calibration, go to step 7.
- If you are performing one-point calibration, go to step 9.

7. **Rinse the probe with de-ionized water or a rinse solution, and place it in the next pH buffer.**
8. Follow steps 5 to 8 for additional calibration points.
9. When calibration is complete, **press CAL/MEAS to return to pH measurement mode**.

Notes

To exit from pH Calibration mode without confirming calibration, DO NOT press **ENTER** in step 6. Press **CAL/MEAS** instead.

If the selected buffer value is not within ±1.0 pH from the measured pH value: the electrode and buffer icon blink and the ERR annunciator appears in the lower left corner of the display.

To limit the number of pH buffer values available during calibration, see section P4.2 on page 33.

4.4 Relative mV Calibration

1. **While in the measurement function, press MODE** to enter the mV mode. The mV indicator appears in the upper right hand corner.

See figure Ⓐ

2. **Press the CAL/MEAS key.** The **CAL** indicator appears above the primary display. The primary display shows the relative mV reading and the secondary display shows the absolute mV value.

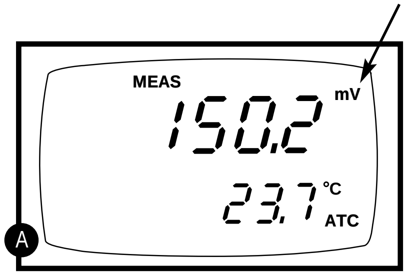
   NOTE: If you have never calibrated relative mV or if the meter has been reset, the value shown in the primary display is the same as the absolute mV value.

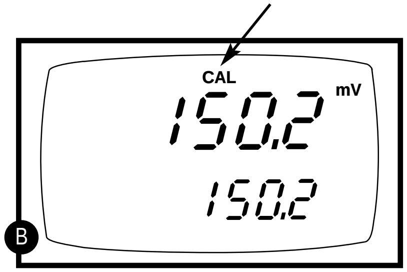
See figure Ⓑ

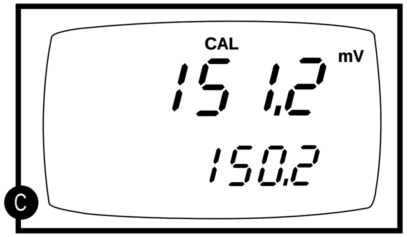
3. **Press the ▲ or ▼ keys** to enter the relative mV value that matches your desired reading.

See figure Ⓒ

4. **Press the ENTER key** to confirm the reading and to return to the measurement mode. The primary display now shows the relative mV reading. The RmV indicator appears in the upper right hand corner.







Notes

To view the mV offset value, use the **SETUP** mode Program P3.1. See page 30 for instructions.

The relative mV (RmV) indicator appears whenever the mV offset is not zero.

To reset the all calibration and offset values in memory to the factory default settings, use:
- *pH 300 meter*: SETUP Program P 5.0. See page 36.
- *pH 310 meter:* SETUP Program P6.0. See page 39.

4.5 Temperature Calibration

The temperature sensor is factory calibrated. Calibrate your sensor only if you suspect temperature errors that may have occurred over a long period of time or if you have a replacement probe.

Temperature calibration

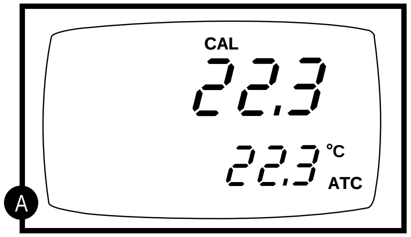
1. Make sure the ATC probe (or temperature connector of the “All-in-One” electrode) is attached to the 6-pin connector. The ATC annunciator will appear at the right-hand side of the LCD.
2. Switch the meter on. **Press the MODE key** to select pH mode.
3. **Press the CAL/MEAS key** to enter pH calibration mode. The CAL indicator will appear above the primary display.
4. While in pH calibration mode, **press the MODE key** to enter temperature calibration mode. The primary display shows the temperature value with the last set offset and the secondary display shows the factory default temperature value.

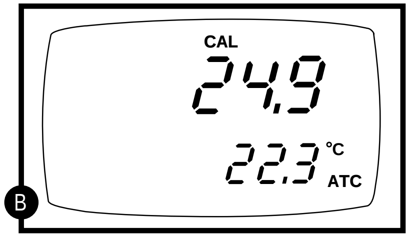
See figure Ⓐ

5. **Dip the ATC probe** (or “All-in-One” electrode) **into a solution of known temperature** (i.e. a temperature bath). Allow time for the temperature probe to stabilize.
6. **Scroll with the ▼ and ▲ keys** to set the correct temperature value (i.e. the temperature of the temperature bath). You can adjust the reading in increments of 0.1°C.

See figure Ⓑ

7. Once you have selected the correct temperature, **press the ENTER key.** The meter automatically returns to pH measurement mode.





Notes

- You can offset the temperature reading up to ±5°C from the original reading.
- To exit this program without confirming the temperature calibration value, DO NOT press **ENTER** in step 7. Press **CAL/MEAS** instead.

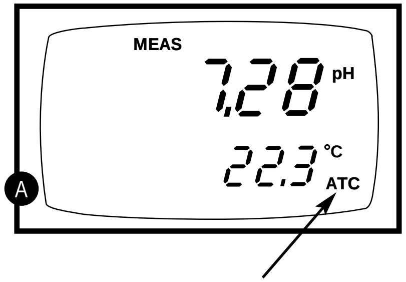
5. Measurement

This meter is capable of taking measurements with automatic or manual temperature compensation. Automatic temperature compensation only occurs when a temperature sensor is plugged into the meter. If there is no temperature sensor plugged into the meter, the default manual temperature setting is automatically 25°C. You can manually set the temperature to match your working conditions using a separate thermometer.

5.1 Automatic Temperature Compensation

For automatic temperature compensation (ATC) simply plug the temperature probe into the meter (see page 9 for directions). The ATC indicator will light on the LCD.

See figure Ⓐ



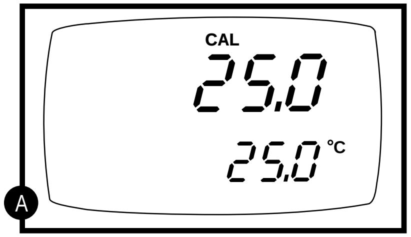
NOTE: If you are using a temperature probe, the probe must be submersed in the liquid you are measuring.

5.2 Manual Temperature Compensation

IMPORTANT: For manual compensation, you must disconnect the temperature probe (see page 9).

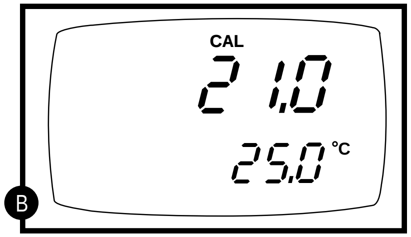
1. Switch the meter on. **Press the MODE key** to select pH mode.
2. **Press the CAL/MEAS key** to enter pH calibration mode. The CAL indicator will appear above the primary display.
3. While in pH calibration mode, **press the MODE key** to enter temperature calibration mode. The primary display and secondary display show the last set value.

See figure Ⓐ



4. **Check the temperature of your sample** using an accurate thermometer.
5. **Press the ▲ or ▼ keys** to offset the temperature to the measured value from step 4.

See figure Ⓑ



6. **Press ENTER** to confirm the selected temperature and to return to the pH measurement mode.

The meter will now compensate pH readings for the manually set temperature.

Notes

To exit this program without confirming the manual temperature compensation value, DO NOT press **ENTER** in step 6. Press **CAL/MEAS** instead.

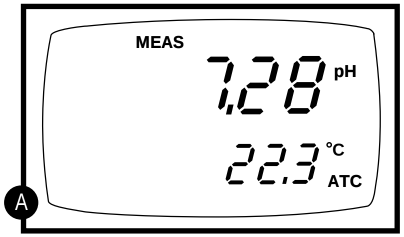
5.3 Taking Measurements

Be sure to remove the electrode soaker bottle or protective rubber cap on the electrode before measurement.

To take readings:

1. **Rinse the probe with deionized or distilled water before use** to remove any impurities adhering to the probe body. If the pH electrode has dehydrated, soak it for 30 minutes in OAKTON electrode storage solution or a 2M–4M KCl solution.
2. **Press ON to switch on meter.** The **MEAS** annunciator appears on the top center of the LCD. The ATC indicator appears in the lower right hand corner to indicate Automatic Temperature Compensation (See page 19 to set Manual Temperature Compensation).

See figure Ⓐ



3. **Dip the probe into the sample.**

When dipping the probe into the sample, the sensor or the glass bulb of the electrode must be completely immersed into the sample. Stir the probe gently in the sample to create a homogenous sample.

4. **Allow time for the reading to stabilize.** Note the reading on the display.
5. To toggle between pH and mV (or Rel mV) readings, **press the MODE key.**

Taking measurements with READY indicator selected on

If the READY indicator has been activated, the **READY** annunciator lights when the reading is stable*. Switch the READY indicator on or off in Set up program P4.1—see page 32 for directions.

*The READY indicator appears and the reading holds until the measured value exceeds the tolerance (± 0.02 pH; ± 0.8 mV <400; ±1.2 mV >400). Then, the **READY** annunciator turns off.

Taking measurements with the auto endpoint feature selected on

NOTE: this feature is available on model pH 310 only.

When a reading is stable for more than 5 seconds, the auto endpoint feature will automatically “hold” the reading. The “hold” indicator appears on the left side of the display. Press the HOLD key to release the reading. Switch the Auto endpoint feature on or off in Set up program P4.1—see page 32 for directions.

6. HOLD function

This feature lets you freeze the value of the pH, mV (or Relative mV) and temperature readings for a delayed observation. **HOLD** can be used any time when in **MEAS** mode.

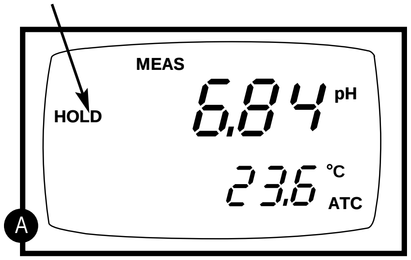
1. To hold a measurement, press the **HOLD** key while in measurement mode. "**HOLD**" will appear on the display.

See figure Ⓐ

2. To release the held value, press **HOLD** again. Continue to take measurements.

NOTE: This meter shuts off automatically after 30 minutes of nonuse.
If the meter is shut off either automatically or manually, the HOLD value will be lost. For longer storage, use the memory functions (see pages 23-24).

NOTE: *For pH 310 model only*: The pH 310 meter has an auto endpoint feature. When this feature is switched on, the display will automatically "hold" a reading that has been stable for more than 5 seconds. The "hold" indicator appears. Press the HOLD key to release the reading. To switch on or off the auto endpoint feature, see Set up program P4.1 on page 32.



7. Memory functions

7.1 Memory Input

Your meter stores data in sets:

- pH and temperature
- mV (or relative mV) and temperature.

pH 300 meter: The pH 300 meter can store up to 16 sets of data in any combination of values. For example, you can store 7 pH and 9 mV values.

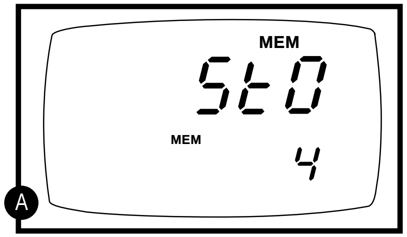
pH 310 meter: The pH 310 meter can store up to 50 sets of data in any combination of values. In addition to the standard data set, the pH 310 meter also stores the date and time the reading was stored.

To store a reading:

1. **During any measurement function (MEAS),** press the **MI** key to input any data into the memory
2. **MEM, "Sto" and memory number will flash.** The meter then returns to measurement mode.

See figure Ⓐ

NOTE: If the memory is full, the first value stored will be erased to create space for the new value.



7.2 Memory Recall

This function recalls the previous readings stored in the memory. You can only access **MR** from the **MEAS**urement mode. Memory recall is in “Last In First Out” order.

To recall readings:

1. **Press the MR key once** to retrieve the last reading stored. The memory location screen—**MEM, “Loc” and the memory number**—will flash on the display.

See figure B

2. **Press the ENTER key** to recall the reading stored under that memory number.

See figure C

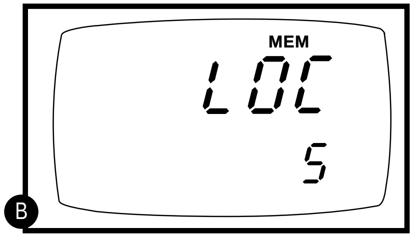
3. *pH 300 meter only:* **Press the ENTER key** again to return to the “memory location” screen.
   pH 310 meter only: **Press the ENTER key** again to view the date and time the reading was taken. **Press the ENTER key** again to return to the “memory location” screen.

See figure D

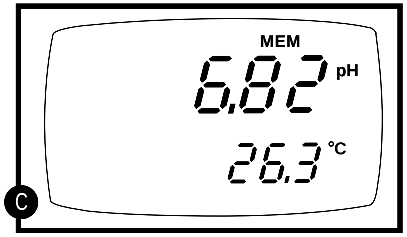
4. The display automatically moves to the next memory location screen.

See figure E

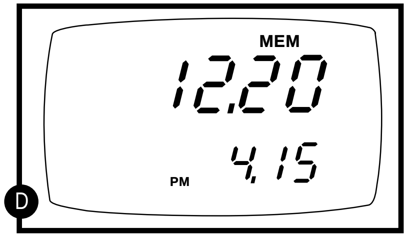
5. **If necessary, press the ▲ key** to select the next “memory location” screen; **press the ▼ key** to select the previous “memory location” screen.
6. Repeat steps 2-5 to review additional stored data sets.
7. To exit Memory Recall, **press the MEAS key** to return to the Measurement mode.



B

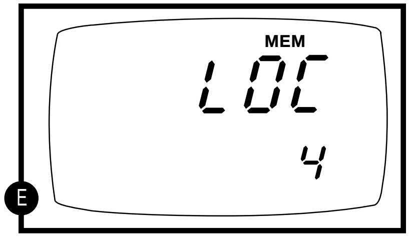


C



D

Time/date appears on pH 310 meter display only



E

Notes

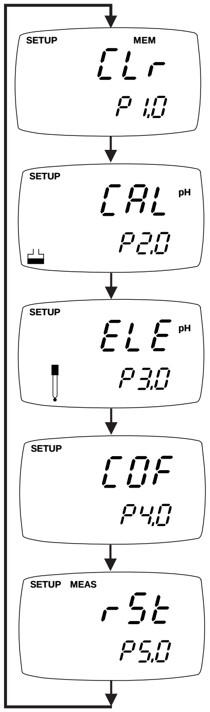
Readings stored in memory are retained even if the unit is turned off. To erase all readings stored in memory, use the **SETUP** mode P1.0 on page 28.

8. Advanced set up functions

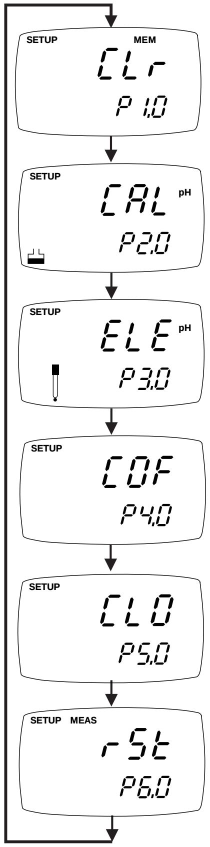
The advanced set up mode lets you customize your meter’s preferences and defaults. Your OAKTON waterproof meter features different sub groups that organize all set-up parameters.

The sub groups are:

1. P1.0: Memory clear (CLR)
2. P2.0: Viewing calibration data (CAL)
3. P3.0: Viewing electrode data (ELE)
4. P4.0: Unit configuration (COF)
5. *pH 300 only:* P5.0: Reset to factory default settings (rSt)
   pH 310 only: P5.0: Setting clock (CLO)
6. *pH 310 only:* P6.0: Reset to factory default settings (rSt)



pH 300 Advanced set up subgroups

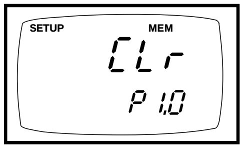


pH 310 Advanced set up subgroups

8.1 Advanced set-up mode overview

Press the SETUP key to enter Set up mode.
Press the ▲ and ▼ keys to scroll through sub groups.

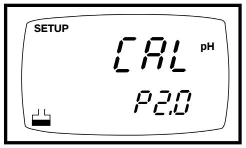
pH 300 meter set up mode



Instructions on page 28

P1.0: Memory clear

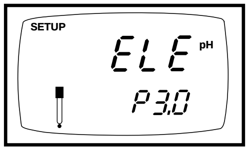
- P1.0 Clear all stored readings



Instructions on page 29

P2.0: Viewing previous calibration data

- P2.1: First calibration point
- P2.2: Second calibration point
- P2.3: Third calibration point
- P2.4: Fourth calibration point
- P2.5: Fifth calibration point

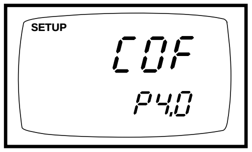


Instructions on page 30-31

P3.0: Viewing electrode data

In pH measurement mode:
- P3.1: pH electrode offset
- P3.2: pH electrode slope

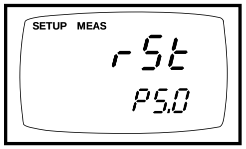
In mV (or relative mV) measurement mode:
- P3.1: relative mV offset



Instructions on pages 32-33

P4.0: Unit configuration

- P4.1: Ready indicator on or off
- P4.2: # of calibration points: 2, 3, 4, or 5

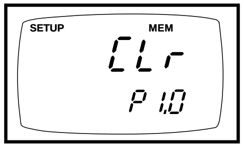


Instructions on page 36

P5.0: Reset to factory default

- P5.0: Reset to factory default settings

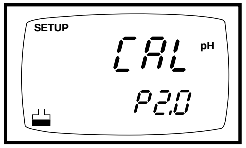
pH 310 meter set up mode



Instructions on page 28

P1.0: Memory clear

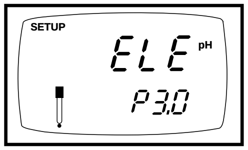
- P1.0 Clear all stored readings



Instructions on page 29

P2.0: Viewing previous calibration data

- P2.1: First calibration point (plus time / date)
- P2.2: Second calibration point (plus time / date)
- P2.3: Third calibration point (plus time / date)
- P2.4: Fourth calibration point (plus time / date)
- P2.5: Fifth calibration point (plus time / date)
- P2.6: Sixth calibration point (plus time / date)-only available when DIN buffer set is selected in P4.3

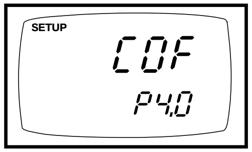


Instructions on page 30-31

P3.0: Viewing electrode data

In pH measurement mode:
- P3.1: pH electrode offset
- P3.2: pH electrode slope

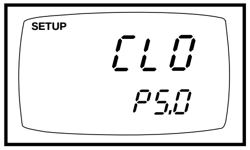
In mV (or relative mV) measurement mode:
- P3.1: relative mV offset



Instructions on pages 32-35

P4.0: Unit configuration

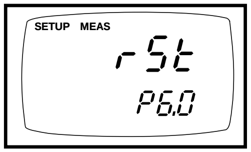
- P4.1: Ready indicator on or off
- P4.2: # of calibration points: 2, 3, 4, 5, or 6 (6th point available for DIN buffer set only)
- P4.3: Select calibration buffer set: USA, DIN, or NIST
- P4.4: Select °C or °F



Instructions on pages 37-38

P5.0: Setting Clock

- Setting year
- Setting date (month / day)
- Setting time (hour / minute / second)



Instructions on page 39

P6.0: Reset to factory default

- P6.0: Reset to factory default settings

8.2 P1.0: Memory Clear

Use this parameter to clear all memory values when you need to store a new series of values. This lets you avoid confusing the old values with the new ones. NO is the default setting.

NOTE: Selecting YES will wipe out all memory.

From measurement mode:

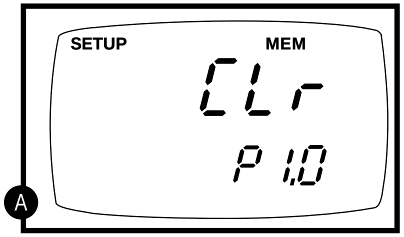
1. **Press the Set up key** to enter Set Up mode.
2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P1.0.

See figure Ⓐ

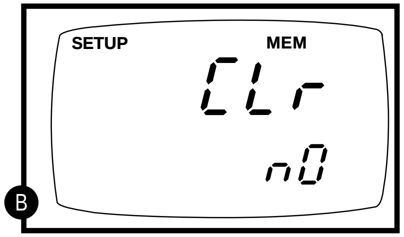
3. **Press the ENTER key** to enter parameter P1.0.
4. **Press the ▲ and ▼ keys** to toggle between NO and YES.
   - NO retains current memory
   - YES clears all memory

See figure Ⓑ

5. **Press the ENTER key** to confirm selection and return to the subgroup menu. Press the CAL / MEAS key to return to measurement mode.



Ⓐ



Ⓑ

8.3 P2.0: Viewing previous calibration data

This mode lets you recall previous calibration data, which helps you know when to recalibrate your meter. This is a “view only” mode.

From measurement mode:

1. **Press the Set up key** to enter Set Up mode.

See figure Ⓐ

2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P2.0.
3. *pH 300 meter only:* **Press the ENTER key repeatedly** to view previous calibration data.

See figure Ⓑ

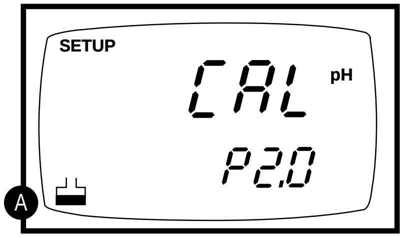
pH 310 meter only: **Press the ENTER key repeatedly** to view previous calibration data. The meter will first display the calibration point, and then display the date and time of calibration.

See figures Ⓑ *and* Ⓒ

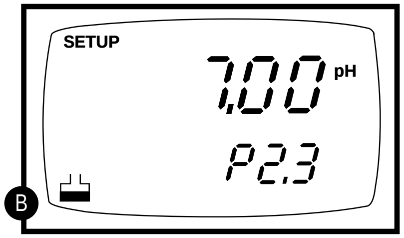
4. When you have scrolled through all calibration data, you will automatically return to the subgroup menu. Press the CAL / MEAS key to return to measurement mode.

Notes

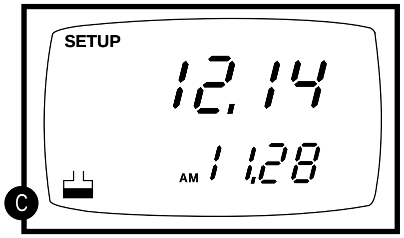
If there is no previous calibration data at a particular point, the primary display will show “----”.



Ⓐ



Ⓑ



Ⓒ

Time/date appears on pH 310 meter display only

8.4 P3.0: Viewing electrode data

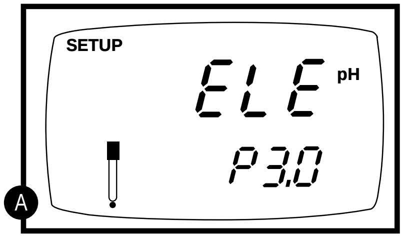
Program 3 has two “view only”options that lets you check the electrode parameters for diagnostic purposes.

P3.1: Electrode offset

From measurement mode

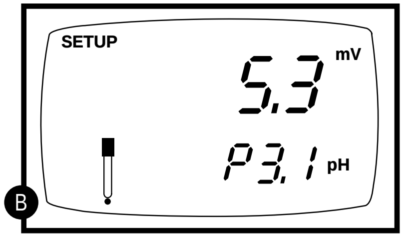
1. **Press the Setup key** to enter Set Up mode.
2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P3.0.

See figure Ⓐ



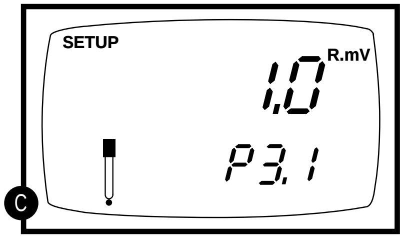
3. **Press the ENTER key** to select parameter 3.1.
4. **The display shows the electrode offset value.**
   - *If you are in pH measurement mode,* the display shows the mV offset at pH 7.00. If you have not calibrated at any buffer, the primary display shows 0.0 mV.

See figure Ⓑ



   - *If you are in mV measurement mode,* the display shows the relative mV offset. You can adjust the relative mV offset in relative mV calibration mode—see page 16 for instructions.

See figure Ⓒ



5. **Press the ENTER key** to to proceed to step 4 of P3.2. Or, press the CAL / MEAS key to return to measurement mode.

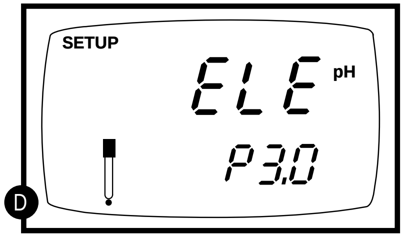
P3.2: Electrode slope

NOTE: this parameter is available in pH measurement mode only.

From measurement mode

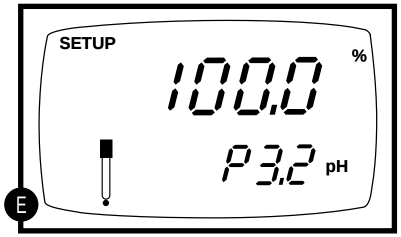
1. If necessary, **press the MODE key** to select pH measurement mode. **Press the Setup key** to enter Set Up mode.
2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P3.0.

See figure Ⓓ



3. **Press the ENTER key** twice to select parameter 3.2.
4. The display shows electrode slope in percentage. Slope displayed is the average slope based on the pH calibrations. Default setting is 100.0.

See figure Ⓔ



5. **Press the ENTER key** to return to the subgroup menu. Press the CAL / MEAS key to return to measurement mode.

8.5 P4.0: Unit configuration

P4.1: READY indicator and auto endpoint function

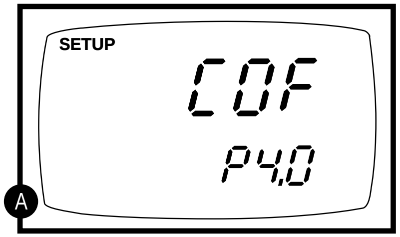
Program P4.1 lets you select “READY indicator on” to indicate when the reading is stable*, or select “READY indicator off” for faster meter response.

pH 310 meter only: Program P4.1 also lets you switch the Auto endpoint function on or off. Select auto endpoint on to “hold” the reading when it is stable for more than 5 seconds. The display automatically freezes, and the HOLD indicator appears on the left side of the display. Press the HOLD key to release the display and access other functions. Select auto endpoint off to deactivate this feature.

From measurement mode

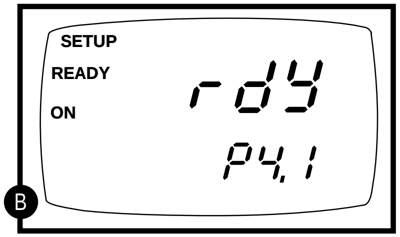
1. **Press Setup key** to enter Set Up mode.
2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P4.0.

See figure Ⓐ



3. **Press the ENTER key** to select parameter 4.1.

See figure Ⓑ



4. **Press the ▲ and ▼ keys** to select the configuration you require.
   - OFF switches the READY indicator off.
   - ON switches the READY indicator on.
   - _pH 310 meter only:_ ON and HOLD together switches the auto endpoint feature on.
5. **Press the ENTER key** to confirm selection and to proceed to step 4 of P.4.2. Press the CAL / MEAS key to return to measurement mode.

Notes

Meter default is set for Ready indicator on, and auto endpoint function off.

---

*The READY indicator appears and the reading holds until the measured value exceeds the tolerance (± 0.02 pH; ± 0.8 mV <400; ±1.2 mV >400). Then, the **READY** annunciator turns off.

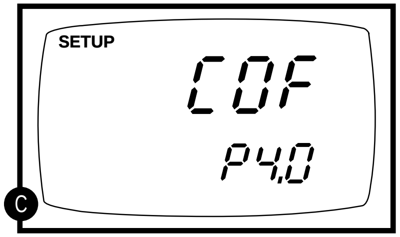
P4.2: Selecting number of pH calibration points

Program P4.2 lets you select the number of calibration points that appear in pH calibration mode: 2, 3, 4, or 5. This lets the meter scroll through the calibration points more quickly if you regularly calibrate at less than 5 points.

From measurement mode

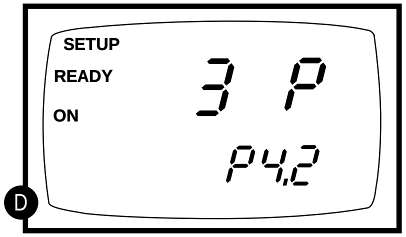
1. **Press Setup key** to enter Set Up mode.
2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P4.0.

See figure Ⓒ



3. **Press the ENTER key** twice to select parameter 4.2.

See figure Ⓓ



4. **Press the ▲ and ▼ keys** to select 2, 3, 4, or 5 point pH calibration.
5. **Press the ENTER key** to confirm selection and to return to the subgroup menu. Press the CAL / MEAS key to return to measurement mode.

P4.3 Calibration buffer selection sets

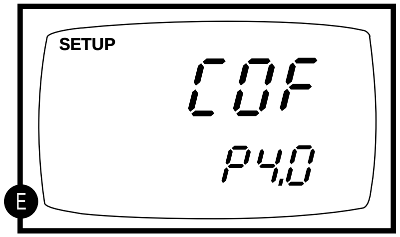
Available in pH 310 meter only

The pH 310 meter lets you select between three standard calibration buffer sets, depending on your requirements. The available sets are USA, NIST, and DIN standard calibration buffers.

From measurement mode

1. **Press Setup key** to enter Set Up mode.
2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P4.0.

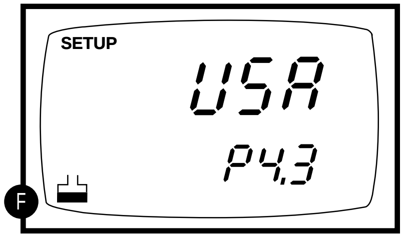
See figure E



E

3. **Press the ENTER key** three times to select parameter 4.3.

See figure F



F

4. **Press the ▲ and ▼ keys** to select the buffer set you require:
   - USA buffers (pH 1.68, 4.01, 7.00, 10.01, 12.45)
   - NIST buffers (pH 1.68, 4.01, 6.86, 9.18, 12.45)
   - DIN buffers (pH 1.09, 3.06, 4.65, 6.79, 9.23, 12.75)
5. **Press the ENTER key** to confirm selection and to return to the subgroup menu. Press the CAL / MEAS key to return to measurement mode.

P4.4 Selecting °C or °F

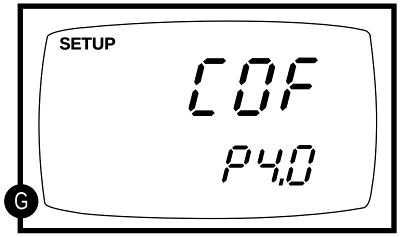
Available in pH 310 meter only

The pH 310 meter lets you select between °C and °F units for temperature readings.

From measurement mode

1. **Press Setup key** to enter Set Up mode.
2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P4.0.

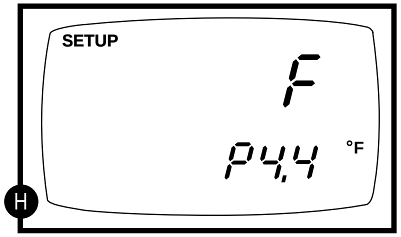
See figure G



G

3. **Press the ENTER key** four times to select parameter 4.4.

See figure H



H

4. **Press the ▲ and ▼ keys** to toggle between °C and °F.
5. **Press the ENTER key** to confirm selection and to return to the subgroup menu. Press the CAL / MEAS key to return to measurement mode.

8.6 P5.0: Resetting to factory default settings

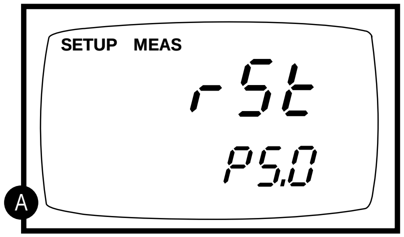
Available in pH 300 meter only

In the pH 300 meter, Program 5 lets you reset all parameters to factory default settings. This clears all calibration data, memory, and any other setup functions you might have changed.

From measurement mode

1. **Press Setup key** to enter Set Up mode.
2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P5.0.

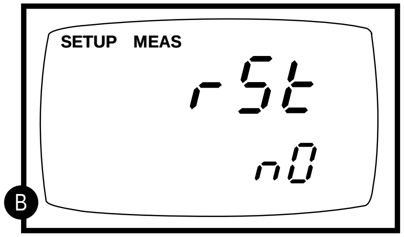
See figure Ⓐ



Ⓐ

3. **Press the ENTER key** to enter parameter P5.0.

See figure Ⓑ



Ⓑ

4. **Press the ▲ and ▼ keys** to toggle between NO and YES.
   - NO retains current settings
   - YES resets to factory default settings
5. **Press the ENTER key** to confirm selection and to return to the subgroup menu. Press the CAL / MEAS key to return to measurement mode.

8.7 P5.0: Setting the real-time clock

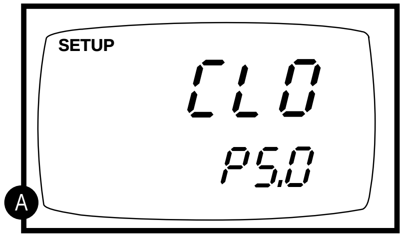
Available in pH 310 meter only

The pH 310 meter features a real-time calendar and clock. This helps you meet GLP (Good Laboratory Practice) standards.

From measurement mode

1. **Press Setup key** to enter Set Up mode.
2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P5.0.

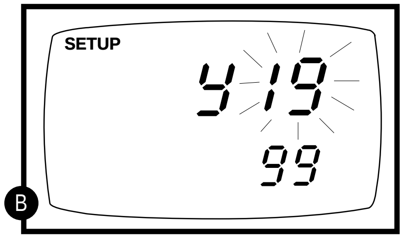
See figure Ⓐ



Ⓐ

3. **Press the ENTER key** to enter parameter P5.0. The meter lets you select the century: “19-” or “20-”. The century digits will flash.

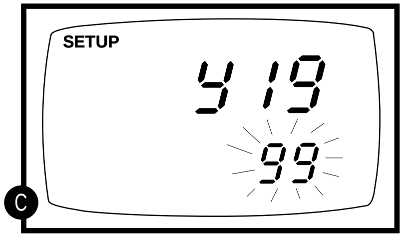
See figure Ⓑ



Ⓑ

4. **Press the ▲ and ▼ keys** to toggle to the correct century.
5. **Press the ENTER key** to confirm the century and move to “year” selection. The “year” digits will flash.

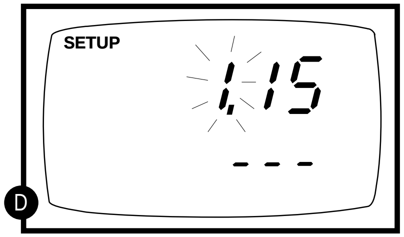
See figure Ⓒ



Ⓒ

6. **Press the ▲ and ▼ keys** to toggle to the correct year.
7. **Press the ENTER key** to confirm the year and move to “month” selection. The “month” digits will flash.

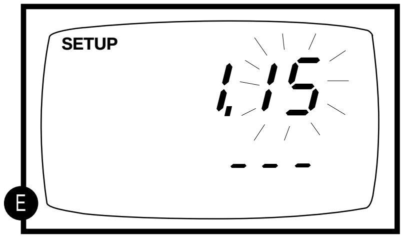
See figure Ⓓ



Ⓓ

8. **Press the ▲ and ▼ keys** to toggle to the correct month.
9. **Press the ENTER key** to confirm the month and move to “date” selection. The “date” digits will flash.

See figure Ⓔ



Ⓔ

10. **Press the ▲ and ▼ keys** to toggle to the correct date.

continued on next page

11. **Press the ENTER key** to confirm the date and move to “hour” selection. The “hour” digits will flash.

See figure F

12. **Press the ▲ and ▼ keys** to toggle to the correct hour. Note the “AM” and “PM” indicator on the lower portion of the display.
13. **Press the ENTER key** to confirm the hour and move to “minute” selection. The “minute” digits will flash.

See figure G

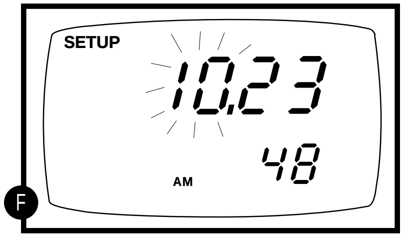
14. **Press the ▲ and ▼ keys** to toggle to the correct minutes.
15. **Press the ENTER key** to confirm the minutes and move to “second” selection. The “second” digits will flash.

See figure H

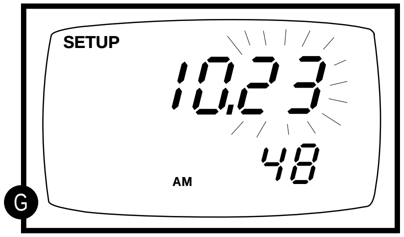
16. **Press the ▲ and ▼ keys** to toggle to the correct seconds.
17. **Press the ENTER key** to confirm the seconds and return to “century” selection.
18. **Press the CAL/MEAS key** to return to the subgroup menu. Press the CAL / MEAS key again to return to measurement mode.

Notes

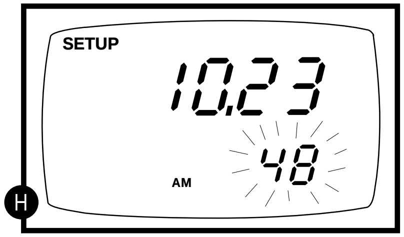
Press the CAL / MEAS key at any point while setting the time to return to the subgroup menu.



F



G



H

8.8 P6.0: Resetting to factory default settings

Available in pH 310 meter only

In the pH 310 meter, Program 6 lets you reset all parameters to factory default settings. This clears all calibration data, memory, and any other setup functions you might have changed.

From measurement mode

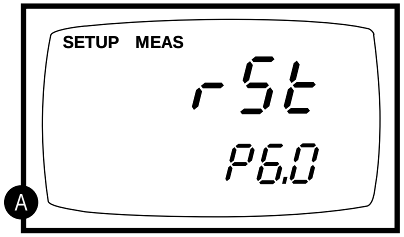
1. **Press Setup key** to enter Set Up mode.
2. **Press the ▲ and ▼ keys** to scroll through subgroups until you view parameter P6.0.

See figure A

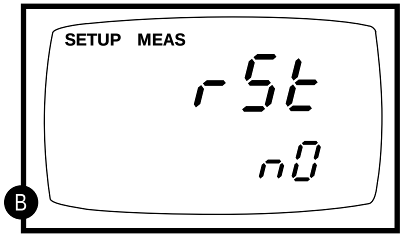
3. **Press the ENTER key** to enter parameter P6.0.

See figure B

4. **Press the ▲ and ▼ keys** to toggle between NO and YES.
   - NO retains current settings
   - YES resets to factory default settings
5. **Press the ENTER key** to confirm selection and to return to the subgroup menu. Press the CAL / MEAS key to return to measurement mode.



A



B

9. Probe Care and Maintenance

Since your pH electrode is susceptible to dirt and contamination, clean it every one to three months depending on the extent and condition of use.

NOTE: for specialty electrode care, consult the instruction manual included with your electrode.

pH electrode storage

For best results, always keep the pH bulb wet. Use the protective electrode storage bottle or rubber cap filled with OAKTON electrode storage solution to store your electrode (see page 45 for ordering information). Also, you can store in a pH 4 buffer with 1/100 part of saturated KCl. Other pH buffers are OK for storage, but NEVER use distilled water for storage.

After measuring

1. Rinse the pH electrode and reference junction in de-ionized water.
2. **Store the electrode as recommended above in "pH electrode storage," or as recommended by the manufacturer.**
3. Prior to next use, rinse the liquid junction with de-ionized water and tap dry—**never wipe electrode.**

NOTE: If this does not restore electrode to normal response, see "Reactivating the pH electrode" section below.

pH electrode cleaning

Salt deposits: dissolve the deposits by immersing the electrode in tap water for ten to fifteen minutes. Ten thoroughly rinse with distilled water.

Oil/grease film: wash electrode pH bulb gently in some detergent and water. Rinse electrode tip with distilled water or use a general purpose electrode cleaner (see page 40 for ordering information).

Clogged reference junction: heat a diluted KCl solution to 60 to 80°C. Place the sensing part of the electrode into the heated solution for about 10 minutes. Allow the electrode to cool in some unheated KCl solution.

Protein deposits: prepare a 1% pepsin solution in 0.1 M of HCl. Set the electrode in the solution for five to ten minutes. Rinse the electrode with distilled water.

Reactivating the pH electrode

If stored and cleaned properly, your pH electrode should be ready for immediate use. However, a dehydrated bulb may cause sluggish response. To rehydrate the bulb, immerse the electrode in a pH 4 buffer solution for 10 to 30 minutes. If this fails, the electrode requires activation. **Never touch or rub glass bulb. Contact builds up an electrostatic charge.**

pH electrode activation (for glass bodied electrodes only)

WARNING: Only qualified persons proficient with the safe handling of dangerous chemicals should perform the procedure below. Provide proper containers, fume hoods, ventilation, and waste disposal. Safety goggles and protective clothing must be worn while performing this procedure. If possible, replace with another electrode instead of performing this reactivation procedure.

1. **Dip or stir the pH electrode** in alcohol for 5 minutes.
2. **Leave the electrode in tap water** for 15 minutes.
3. **Dip and stir the electrode** in concentrate acid (such as HCl or H_2SO_4) for five minutes.
4. **Repeat step 2.**
5. **Dip and stir in strong base** (NaOH) for five minutes.
6. **Leave for 15 minutes** in distilled or deionized water.
7. **Now test with standard calibration buffer solutions** to see if the electrode yields acceptable results. You may repeat step 3 through 6 up to three times for better response. If the response does not improve, then your electrode is no longer functioning. Replace with a new electrode—call your OAKTON Distributor for more information.

10. Troubleshooting

Problem	Cause	Solution
Power on but no display	a) Batteries not in place.	a) Check that batteries are in place and making good contact.
	b) Batteries not in correct polarity (+ and –).	b) Reinsert batteries with correct polarity.
	c) Weak batteries.	c) Replace batteries or attach optional AC adapter.
Unstable readings	a) Air bubbles in probe.	a) Tap probe to remove bubbles.
	b) Dirty probe.	b) Clean the probe and recalibrate.
	c) Probe not deep enough in sample.	c) Make sure sample entirely covers the probe sensors.
	d) External noise pickup or induction caused by nearby electric motor.	d) Move or switch off interfering motor.
	e) Broken probe.	e) Replace probe. See page 45.
Slow response	a) Dirty / Oily probe.	a) Clean probe. See "Probe Care & Maintenance", page 40.

11. Error Messages

LCD Display	**Indicates**	**Cause**	**Solution**
Err annunciator	Unrecognized input from keypad	Wrong input in selected mode.	Release key. Select valid operations depending on mode.
CAL & Err annunciators on/ Buffer and electrode indicators blink	Calibration error	Wrong buffer value input at calibration. Dirty probe.	Check your buffer input value, clean probe. See Calibration sections or Probe Maintenance section.
Battery indicator blinks	Low battery level	Need new batteries or battery connection is bad	Clean battery contacts. Replace batteries with fresh ones, noting polarity

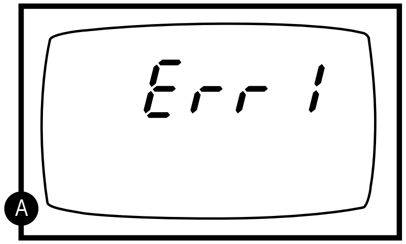
* See "Warranty" and "Return of Items" on page 47

If an error message appears in the primary display (the upper row of larger digits), switching off the meter and switching it on again may eliminate the error message.

See figure Ⓐ

If error persists, or the meter shows incorrect values, return the meter.

For a complete diagram of the display, see page 5.



ERR 1 in primary display

12. Specifications

Mode	pH	Temperature	mV
Range	-2.00 to 16.00 pH	–10.0 to 110.0˚C (also 14.0 to 230.0°F for pH 310 meter)	-2000 to 2000 mV (same for Rel mV)
Resolution	0.01 pH	0.1˚C (also 0.1°F for pH 310 meter)	0.1 mV between ±199.9 mV 1 mV beyond ±199.9 mV
Accuracy	±0.01 pH	±0.5˚C (also ±0.5˚F for pH 310 meter)	±0.2 mV between ±199.9 mV ±2 mV beyond ±199.9 mV
Input	BNC connector	6-pin plug	BNC connector

Calibration
pH 300 meter: Up to five points (pH1.68, 4.01, 7.00, 10.01, 12.45)
pH 310 meter: Up to six points—select from three different buffer sets:
USA buffers (pH 1.68, 4.01, 7.00, 10.01, 12.45)
NIST buffers (pH 1.68, 4.01, 6.86, 9.18, 12.45)
DIN buffers (pH 1.09, 3.06, 4.65, 6.79, 9.23, 12.75)
Temperature: Offset in 0.1°C increments
mV: Offset up to ±150 mV

Memory:
pH 300 meter: up to 16 data sets (pH or mV plus temperature)
pH 310 meter: up to 50 data sets (pH or mV plus temperature, date, and time)

pH slope range: 80% to 110%

Temperature compensation: automatic (ATC) or manual from 0 to 100°C

Operating temperature: 0 to 50°C

Power: four 1.5 V AAA batteries (included)

Battery life: > 100 hours

Housing: meets IP67 standards for waterproof and dustproof housing

Dimensions:
Meter: 7.5"L x 3.5"W x 1.75"H
(19.1 cm x 8.9 cm x 4.5 cm)
Boxed: 9.2"L x 8.5"W x 2.75"H
(23.3 cm x 21.6 cm x 7 cm)

Shipping weight: 1.3 lbs (0.6 kg)

13. Accessories

Replacement meters

35618-02 Replacement waterproof pH 300 meter

35618-70 Waterproof pH 300 meter kit. Includes “All-in-One” probe, five each of pH “Singles” buffer pouches pH 4.01; 7.00; 10.01; and rinse water, one squeeze bottle for deionized rinse water, batteries, instructions and two electrode brackets, all in a hard shell carrying case

35618-12 Replacement pH 310 meter

35618-72 Waterproof pH 310 meter kit. Includes “All-in-One” probe, five each of pH “Singles” buffer pouches pH 4.01; 7.00; 10.01; and rinse water, one squeeze bottle for deionized rinse water, batteries, instructions and two electrode brackets, all in a hard shell carrying case

Electrodes and probes

35618-05 Temperature probe. For pH 300 and pH 310 meters

35808-71 Replacement “All-in-One” combination pH/temperature probe, single junction, sealed, 145 mm L x 12 mm diameter (0.5 lb)

35801-00 pH electrode, epoxy body, single-junction, 145 mm L x 12 mm diameter (0.5 lb)

35805-13 ORP electrode, epoxy body, single-junction, 145 mm L x 12 mm diameter (0.5 lb)

00653-04 Electrode storage solution, 1 pint bottle. Keeps electrode bulb moist for faster, more accurate readings. (1.1 lbs)

00653-06 Electrode cleaning solution, 1 pint bottle. Removes buildup from electrodes and maintains electrode sensitivity. (1.1 lbs)

NOTE: Remember to check the temperature calibration when replacing the ATC probe or when using with an OAKTON® "All-in-One" combined pH and temperature probe. See section 4.5, "Temperature calibration" (page 17).

Continued on next page

OAKTON calibration solutions

pH solutions have ±0.01 pH accuracy at 25°C. Shpg wt 1.1 lb (510 g).

00654-01 pH 1.68 calibration buffer, 1 pint.

00654-00 pH 4.01 calibration buffer, 1 pint.

00654-04 pH 7.01 calibration buffer, 1 pint.

00654-08 pH 10.01 calibration buffer, 1 pint.

00654-12 pH 12.45 calibration buffer, 1 pint.

OAKTON “Singles” calibration solution pouches

pH solutions have ±0.01 pH accuracy at 25°C. Shpg wt 1.1 lb (510 g) per box.

35653-00 Deionized rinse water solution pouches, 20 / box.

35653-01 pH 4.01 calibration buffer solution pouches, 20 / box.

35653-02 pH 7.00 Calibration buffer solution pouches, 20 / box.

35653-03 pH 10.00 Calibration buffer solution pouches, 20 / box.

35653-04 Assortment pack, 5 each deionized water, pH 4.01, pH 7.00, and pH 10.00 solution pouches.

To order OAKTON accessories, contact your OAKTON distributor.

14. Warranty

OAKTON warrants this meter to be free from significant deviations in material and workmanship for a period of three years from date of purchase. OAKTON warrants this probe to be free from significant deviations in material and workmanship for a period of six months from date of purchase. If repair or adjustment is necessary and has not been the result of abuse or misuse within the warrantied time period, please return—freight prepaid—and correction will be made without charge. OAKTON alone will determine if the product problem is due to deviations or customer misuse.

Out-of-warranty products will be repaired on a charge basis.

15. Return of items

Authorization must be obtained from our Customer Service Department before returning items for any reason. When applying for authorization, please include data regarding the reason the items are to be returned. For your protection, items must be carefully packed to prevent damage in shipment and insured against possible damage or loss. We will not be responsible for damage resulting from careless or insufficient packing. A restocking charge will be made on all unauthorized returns.

NOTE: We reserve the right to make improvements in design, construction, and appearance of products without notice.

Part of Thermo Fisher Scientific

EUTECH INSTRUMENTS
Technology Made Easy ...

OAKTON®

150 & 450 Series Waterproof Handheld Meter

pH/mV Operation Instructions

Models:

pH 150
pH/mV

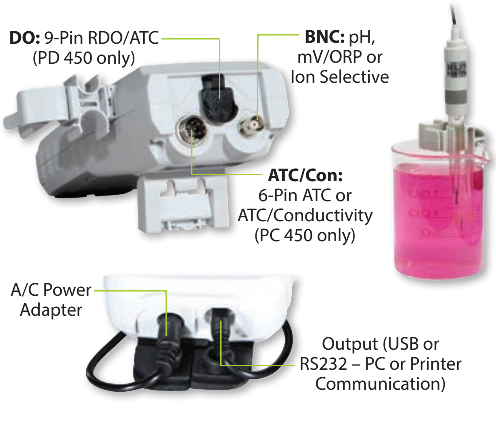
pH 450
pH/mV/ISE

PC 450
pH/mV/Con

PD 450
pH/mV/DO

Getting Started/Connections

After installing (2) AA batteries and/or connecting the optional 110/220 VAC power supply, connect the desired sensors to the corresponding ports.



12 mm and 16 mm probes can utilize the **Grip-Clip™** to attach one or more sensors to a beaker and to the instrument as needed. The stand can be extended as shown above or used for wall-mounting.

Keypad Functions

⏻ 💡	Press once to power ON in the mode that was previously used. Press again to turn backlight on for one minute or off (450 series only). Hold for 3 seconds to power OFF.
CAL MEAS BACK	Toggle between measurement and calibration modes. In SETUP mode, BACK serves to return to the previous menu option or setting.
ENTER HOLD	Confirm calibration values in CAL mode. Confirm selections in SETUP mode. Freeze or release the measured reading.
SETUP	Customize instrument settings and preferences. (See also **Setup Programs**)
MODE	Toggle between available measurement types.
▲ SAVE	Save measurement into memory. Increase value or scroll up in SETUP or manual calibration.
VIEW ▼	Recall saved values from memory. Decrease value or scroll down in SETUP or manual calibration.
🖨	Send output data to printer or computer. (450 series only).

Setup Programs

To access the settings below, press **SETUP**. Up/down arrows will display the available options. Press **ENTER** to accept the desired setting, or **BACK** to return to the previous option and/or exit.

Configuration Options

- Ready indicator **ON** / **OFF** / or Automatic **HOLD** when stable
- Choose **ºC**elsius or **ºF**ahrenheit

pH Buffer Options

- Select the desired pH Buffer Calibration Group:
  USA (1.68, 4.01, 7.00, 10.01, 12.45) or
  NIST (1.68, 4.01, 6.86, 9.18, 12.45) or
  DIN (1.09, 3.06, 4.65, 6.79, 9.23, 12.75) or
  MAN (manual adjustment of any custom pH values that are ≥1 pH unit apart. 450 series only)
- Select number of calibration points

Select Calibration Due Reminder

- Set number of days from **0-60** for desired parameter

View Calibration Data

- Press **ENTER** to view each point that is calibrated.

View Electrode Data

- Press **ENTER** to view mV **Offset** and **Slope %** of the measured reading.

System Settings

- Data Logging:
  MANUAL upon key press only
  TIMED interval. Choose (**SEC** / **MIN** / **HOUR**) interval.
- Automatic shut off after 10 minutes. Choose **ON** or **OFF**.
- Clock Settings:
  Date: Choose **USA** (MM/DD/YYYY) or **Euro** (DD/MM/YYYY).
  Time: Choose (**24HR or 12HR**). If 12HR, choose **AM** or **PM**.
- Set Printer Type:
  CSV (Comma Separated Values) – best format for computer
  Printer (Text) – best format for printer.
  Choose Manual (**MAN**) upon key press or **TIMED** interval.
  If timed, choose (**SEC** / **MIN** / **HOUR**).

Reset

- **NO**. Exits from reset menu options without action.
- **FACTORY RESET**. Returns all settings except date/time and ATC calibration to factory default values after **ENTER** is pressed then restarts meter.
- **DATA RESET**. Erases data stored in memory while retaining other settings after **ENTER** is pressed.
- **CALIBRATION RESET**. Erases non-ATC calibration data while retaining other settings after **ENTER** is pressed.

pH Calibration

For best results, periodic calibration with known, accurate standards is recommended. Calibrate with standards that bracket your intended measuring range while including a neutral standard (pH 7.00 or 6.86). For example, if you expect to measure samples from pH 6.2 to pH 9.5, calibration with 4.01, 7.00, and 10.01 standards will work well. Provide stirring for best results. After calibration with two or more points, the active slope segment of the measurement will be visible on the bottom display during measurement. 100 % slope will be shown if only one calibration point is performed and "- - -" if no calibration is performed. The meter will automatically return to measurement mode upon successful completion of the number of specified calibration points. To specify a different number of pH calibration points, see **pH Buffer Options**.

Using Automatic Buffer Recognition

1. While in pH measurement mode, dip the pH and ATC sensor(s) into your first standard, then press **CAL**. The primary display will search for the nearest standard value, while the secondary display will show the un-adjusted value.
2. When the "**READY**" indicator appears, press **ENTER** to accept. The primary reading will flash "**DONE**".
3. Rinse your electrode(s) then dip into the next pH standard. The primary display will search for the nearest standard value that has not yet been calibrated, while the secondary display will show the unadjusted value. When the "**READY**" indicator appears, press **ENTER** to accept.
4. To calibrate another pH standard repeat Step 3 or press **MEAS** to return to pH measurement mode.

Using Manual Recognition / Custom Buffers (450 Series Only)

1. While in pH measurement mode, dip the pH and ATC sensor(s) into your first standard then press **CAL**.
2. When the **READY** indicator appears, use up/down arrows to adjust the primary reading to match the standard value at the measured temperature, then press **ENTER**.
3. Rinse your electrode(s) then repeat Step 2 with a standard that is ≥1 pH unit from the previous standard value.
4. To calibrate another pH standard, repeat Step 3 or press **MEAS** to return to pH measurement mode.

mV Offset Adjustment

1. While in mV measurement mode, dip the ORP and ATC sensors into a solution with a known mV value (i.e. Zobel, Light's, quinhydrone, or iodide/triiodide) and stir.
2. When the "**READY**" indicator appears, use up/down arrows to adjust the primary reading to match the mV value at the measured temperature, then press **ENTER**. The meter allows an adjustable maximum value of ±200 mV from the factory default mV value. When an offset has been stored successfully, R.mV replaces mV.

Temperature Calibration/Manual ATC

1. Press **CAL** from any measurement, then press **MODE**.
2. Skip to step 3 for manual ATC, otherwise, dip the temperature sensor into a solution with a known accurate temperature. The upper display shows the active temperature while the lower display shows the factory default temperature without adjustment.
3. Use up/down arrows to adjust the upper display. Press **ENTER** to accept the calibration temperature. The maximum adjustable value is ±10 ºC (or ±18 ºF) from factory default.

Error Messages

ERR "ERR" will appear when an error condition exists or the incorrect key is pressed. Common examples include:

- Pressing **ENTER** during calibration before the "**READY**" indicator appears. Wait for the "**READY**" indicator before pressing **ENTER**.
- **UR** (Under Range) • **OR** (Over Range)

Intended Use, Maintenance & Precautions

These handheld meters use sensors to detect various parameters for water-based measurements. For routine maintenance disconnect the power cord or battery, then dust or wipe the display using a damp cloth. If necessary, warm water or a mild water based detergent can be used. Immediately remove any spilled substance from contact with the meter using the proper cleaning procedure for the type of spill.

- Do not use this equipment in potentially explosive atmospheres.
- Refer to the electrode instructions for use, storage and cleaning.
- Ensure that no liquid enters the instrument.
- Do not use any aggressive cleaning chemicals (solvents or similar agents).
- There are no user serviceable parts inside. Attempts to service internal parts may void the warranty.
- **WARNING:** No modification of this equipment is allowed.

Instrument Operating Conditions	
Operating Ambient Temp.	5 to 45 ºC
Operating Relative Humidity	5 to 85 %, non-condensing
Storage Temp.	-20 to +60 ºC
Storage Relative Humidity	5 to 85 %, non-condensing
Pollution	Degree 2
Overvoltage	Category II
Weight	500 g
Size (L x W x H)	21.15 x 9.87 x 5.85 cm
Regulatory & Safety	CE, TUV 3-1, FCC Class A
Power Rating	DC Input: 9 VDC 1 A
Battery Requirement	2 x AA (LR6) 1.5 V batteries (replace batteries when battery sign blinks)
Vibration	Shipping/handling per ISTA #1A
Shock	Drop test in packaging per ISTA #1A
Enclosure (Designed To Meet)	IP67 (using rubber covers)
Universal Power Adapter Operating Conditions	
Operating Ambient Temp.	0 to 50 ºC
Operating Relative Humidity	0 to 90 %, non-condensing
Storage Temp.	-20 to +75 ºC
Storage Relative Humidity	0 to 90 %, non-condensing
Pollution	Degree 2
Overvoltage	Category II
Power Rating	I/P: 100 - 240 V, 50/60 Hz, 0.3A O/P: 9 VDC 1 A

Eutech Instruments Pte Ltd
Blk 55, Ayer Rajah Crescent,
#04-16/24, Singapore 139949
Tel: (65) 6778-6876
Fax: (65) 6778-0086
eutech@thermofisher.com
www.eutechinst.com

Oakton Instruments
625 East Bunker Court,
Vernon Hills, IL, 60061, USA
Tel: 1-888-462-5866
Fax: 1-847-247-2984
info@4oakton.com
www.4oakton.com

Parte de Thermo Fisher Scientific

150 & 450 Series Medidor de manoresistente al agua

pH/mV Instrucciones de funcionamiento

EUTECH INSTRUMENTS
Technology Made Easy ...

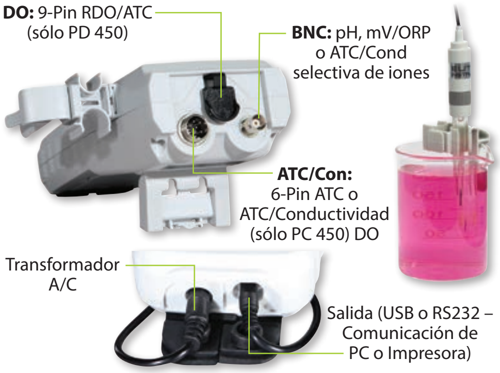
OAKTON®

Modelos:

pH 150	pH 450	PC 450	PD 450
pH/mV	pH/mV/ISE	pH/mV/Con	pH/mV/DO

Primeros pasos/Conexiones

Luego de insertar (2) baterías AA y/o conectar el suministro de energía opcional de 110/220 VAC conecte los sensores deseados a los puertos correspondientes.



Sondas de 12 mm y 16 mm pueden utilizar **Grip-Clip™** para sujetar uno o más sensores a un vaso y si es necesario al instrumento. El pie puede ser extendido como se muestra arriba o puede ser montado a la pared.

Funciones del teclado

⏻ / ☀	Presione una vez, para encender en el modo usado previamente. Presione otra vez, para encender la retroiluminación por un minuto o apagar (sólo serie 450). Mantenga apretado por 3 segundos.
CAL MEAS BACK	Alterne entre los modos medición y calibración. En el modo CONFIGURACIÓN la tecla VOLVER sirve para volver a la opción previa del menú o ajuste.
ENTER HOLD	Confirmar los valores de calibración en el modo CAL. Confirmar selecciones en el modo CONFIGURACIÓN. Congelar o liberar el valor medido.
SETUP	Personalizar los ajustes del instrumento y las preferencias. (Vea también los **programas de configuración**)
MODE	Alterne entre los tipos de medición disponibles.
▲ SAVE	Guardar la medición en la memoria. Aumente el valor o desplace hacia arriba en CONFIGURACIÓN o calibración manual.
VIEW ▼	Volver a mostrar valores guardados en la memoria. Reduzca el valor o desplace hacia abajo en CONFIGURACIÓN o calibración manual.
🖶	Envíe los datos de salida a una impresora o computadora. (Sólo serie 450)

Programmes de configuration

Para acceder a los ajustes abajo presione **CONFIGURACIÓN**, Las flechas arriba/abajo van a hacer aparecer las opciones disponibles. Presione **ENTER** para aceptar el ajuste deseado o **BACK** (Volver) para volver a la opción anterior y/o salir.

Opciones de Configuración

- Indicador listo **ON** / **OFF** / o **HOLD** (Mantenimiento) automático si estable
- Elija **ºC**elsius o **ºF**ahrenheit

Opciones de buffer de pH

- Seleccione el grupo de calibración del buffer de pH deseado:
  USA (1.68, 4.01, 7.00, 10.01, 12.45) or
  NIST (1.68, 4.01, 6.86, 9.18, 12.45) or
  DIN (1.09, 3.06, 4.65, 6.79, 9.23, 12.75) o
  MAN (ajuste manual de valores de ph personalizados que están a ≥1 unidad de pH. Sóloserie 450)
- Seleccione la cantidad de puntos de calibración

Seleccione Notificación de Calibración Pendiente

- Fije la cantidad de días entre **0 y 60** para el parámetro deseado

Ver Datos de Calibración

- Presione **ENTER** para ver cada punto que va a ser calibrado.

Ver Datos de Electrodos

- Presione **ENTER** para ver el **offset** de mV y **el % de pendiente** (Slope) del valor medido.

Ajustes del Sistema

- Registro de datos:
  MANUAL al apretar un botónsólo intervalo **TIMED** (Cronometrado). Elija (**SEG** / **MIN** / **HORA**) intervalo.
- Apagado automático después de 10 minutos. Elija **ON** oder **OFF**.
- Ajustes del reloj:
  Fecha: Elija **USA** (MM/DD/AAAA) o **Euro** (DD/MM/AAAA).
  Tiempo: Elija (**24HR o 12HR**). Si 12HR elija **AM** o **PM**.
- Ajustartipo de impresora:
  CSV (Valores Separados por Coma) – mejor formato para la computadora.
  Impresora (texto) – mejor formato para impresora.
  Elija Manual (**MAN**) al apretar un botón o intervalo **TIMED** (Cronometrado).
  Si cronometrado, elija (**SEG** / **MIN** / **HORA**).

Resetear

- **NO** (NRO). de salidas de las opciones del menú de reseteo sin acción.
- **FACTORY RESET** (RESETEO DE FÁBRICA). Retorna todos los ajustes von excepción de fecha/tiempo y calibración ATC a los valores estándares de fábrica luego de oprimir **ENTER** y el medidor es reseteado.
- **DATA RESET** (RESETEO DE DATOS). Elimina datos guardados en la memoria mientras otros ajustes se conservan luego de oprimir **ENTER**.
- **CALIBRATION RESET** (RESETEO DE CALIBRACIÓN). Elimina datos de calibración no-ATC mientras otros ajustes se conservan luego de oprimir **ENTER**.

Calibración de pH

Para mejores resultados se recomienda una calibración periódica con estándares conocidos y precisos. Calibre con estándares que encuadren su rango de medición deseado mientras incluye un estándar neutro (pH 7,00 o 6,86). Por ejemplo si usted espera medir muestras con un pH de entre 6,2 y 9,5 la calibración con los estándares 4,01, 7,00 y 10,01 van a funcionar bien. Revuelva para los mejores resultados. Luego de la calibración con dos o más puntos el segmento de pendiente activo de la medición va a ser visible en la visualización inferior durante la medición. Una pendiente de 100 % va a aparecer si solamente se utiliza un punto de calibración y "- - -" si no se lleva a cabo ninguna calibración. El medidor va volver automáticamente al modo de medición luego de una finalización exitosa de la cantidad de puntos de calibración especificada. Para especificar una cantidad distinta de puntos de calibración de pH vea Opciones de **Buffer de pH**.

Utilizando Reconocimiento Automático de Buffer

1. Mientras esté en el modo de medición pH sumerja los sensores de pH y ATC en su primer estándar, luego presione **CAL**. La visualización primaria va a buscar al valor estándar más cercano mientras que la pantalla secundaria va a mostrar el valor no ajustado.
2. Cuando aparece el indicador "**READY**" (Listo) presione **ENTER** para aceptar. En la medición primaria va a brillar "**READY**" (Listo).
3. Lave sus electrodos y sumérjalos en el siguiente estándar de pH. La visualización primaria va a buscar al valor estándar más cercano, que no ha sido calibrado aún, mientras que la visualización secundaria va a mostrar el valor no ajustado. Cuando aparece el indicador "**READY**" (Listo) presione **ENTER** para aceptar.
4. Para calibrar otro estándar de pH, repita el paso 3 o presione **MEAS**, para regresar al modo de medición de pH.

Utilizar Reconocimiento Manual / Buffers Personalizados (Sólo Serie 450)

1. Mientras esté en el modo de medición pH sumerja los sensores de pH y ATC en su primer estándar, luego presione **CAL**.
2. Cuando aparezca el indicador "**READY**" (Listo) utilice las flechas arriba/abajo para ajustar la medición primaria para que sea igual que el valor estándar a la temperatura medida, luego presione **ENTER**.
3. Lave sus electrodos y luego repita el paso 2 con un estándar que sea ≥1 unidad de pH a partir del valor estándar anterior.
4. Para calibrar otro estándar de pH, repita el paso 3 o presione **MEAS**, para regresar al modo de medición de pH.

Ajuste del offset de mV

1. En el modo de medición mV sumerja los sensores ORP y ATZ en una solución con un valor mV conocido (z. B. Zobel, Light, quinhydrona o ioduro/triioduro) y revuelva.
2. Cuando aparezca el indicador "**READY**" (Listo) use las flechas arriba/abajo para ajustar la lectura primaria para ajustar el valor mV a la temperatura medida, luego oprima **ENTER**. El medidor permite un valor máximo ajustable de ±200 mV a partir del valor mV estándar de fábrica. Cuando un offset se haya guardado exitosamente, mV es reeplazado por R.mV.

Calibración de temperatura/ATC Manuel

1. Oprima **CAL** de cualquier medición, luego oprima **MODE** (Modo).
2. Siga con el paso 3 por una ATC manual, de otra manera sumerja el sensor de temperatura en una solución con una temperatura determinada conocida. La visualización superior muestra la temperatura activa mientras que la visualización inferior muestra la temperatura estándar de fábrica sin ajuste.
3. Use las flechas arriba/abajo para ajustar la visualización superior. Oprima **ENTER** para aceptar la temperatura de calibración. El valor ajustable máximo es ±10 ºC (o ±18 ºF) desde el valor de fábrica.

Mensajes de error

ERR "ERR" va a aparecer si existe una condición de error o si se presionada la tecla equivocada. Ejemplos comunes son entre otros:

- Apretar **ENTER** durante la calibración antes de que aparezca la indicación "**READY**" (Listo). Espere a que aparezca la indicación "**READY**" (Listo) antes de apretar **ENTER**.
- **RI** (Rango inferior)
- **RS** (Rango superior)

Uso intencionado, mantenimiento y precauciones

Estos medidores portables utilizan sensores para detectar varios parámetros para mediciones basadas en agua. Para el mantenimiento de rutina disconecte el cable de alimentación o la batería y luego pase un trapo húmedo por la pantalla. Si es necesario puede utilizarse agua tibia o un detergente suave basado en agua. Remueve inmediatamente cualquier substancia derramada sobre el medidor con el procedimiento de limpieza correcto para el tipo de substancia derramada.

- No utilice este equipo en atmósferas potencialmente peligrosas.
- Vea las instrucciones del electrodo para su uso, almacenamiento y limpieza.
- Asegúrese de que ningún liquido ingrese al instrumento.
- No use químicos de limpieza agresivos (solventes o substancias similares).
- No hay partes en el interior que pueden ser mantenidos por el usuario. El intento de mantener partes internas puede anular la garantía.
- **ADVERTENCIA:** No está permitido ninguna modificación de este equipo.

Condiciones de funcionamiento del instrumento	
Temperatura de ambiente de funcionamiento	5 a 45 ºC
Humedad relativa de funcionamiento	5 a 85 %, no condensada
Temperatura de almacenamiento	-20 a +60 ºC
Humedad relativa de almacenamiento	5 a 85 %, no condensada
Contaminación	Grado de 2
Sobretensión	Categoría de II
Peso	500 g
Tamaño (L x A x A)	21,15 x 9,87 x 5,85 cm
Ordenanzas y Seguridad	CE, TUV 3-1, FCC Class A
Potencia Nominal	Entrada de CC: 9 VDC 1 A
Requerimientos de batería	2 x AA (LR6) 1,5 V batterías (reemplazar batterías cuando parpadea el cartel de la batería)
Vibración	Envío/Manejo conforme a ISTA #1A
Shock	Test de caída en envase conforme a ISTA #1A
Carcasa (diseñado para cumplir)	IP67 (utilizando cubiertas de goma)
Transformador universal Condiciones de funcionamiento	
Temperatura de Ambiente de funcionamiento	5 a 50 ºC
Humedad relativa de funcionamiento	0 a 90 %, no condensada
Temperatura de almacenamiento	-20 a +75 ºC
Humedad relativa de almacenamiento	0 a 90 %, no condensada
Contaminación	Grado de 2
Sobretensión	Categoría de II
Potencia Nominal	I/P: 100 - 240 V, 50/60 Hz, 0.3A O/P: 9 VDC 1 A

Eutech Instruments Pte Ltd
Blk 55, Ayer Rajah Crescent,
#04-16/24, Singapore 139949
Tel: (65) 6778-6876
Fax: (65) 6778-0086
eutech@thermofisher.com
www.eutechinst.com

Oakton Instruments
625 East Bunker Court,
Vernon Hills, IL, 60061, USA
Tel: 1-888-462-5866
Fax: 1-847-247-2984
info@4oakton.com
www.4oakton.com

68X651901 08/14 Rev0

Filiale de Thermo Fisher Scientific

Série 150 et 450 Instrument de mesure de poche étanche

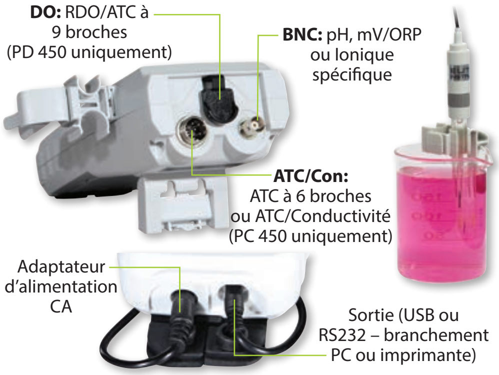
pH/mV Mode d'emploi

Modèles proposés:

pH 150	**pH 450**	**PC 450**	**PD 450**
pH/mV	pH/mV/ISE	pH/mV/Con	pH/mV/DO

Mise en route/branchements

Après avoir installé (2) piles AA et/ou raccordé l'alimentation électrique en option de 110/220 VCA, connecter les capteurs souhaités aux ports correspondants.



Les sondes de 12 mm et 16 mm peuvent utiliser le **Grip-Clip™** pour fixer un ou plusieurs capteurs à un bécher et à l'instrument, selon les besoins. Le support peut être étendu comme indiqué ci-dessus ou utilisé pour le montage mural.

Fonctions du clavier

⏻	Appuyer une fois sur le bouton ON (Marche) dans le mode qui a été précédemment utilisé. Appuyer à nouveau pour activer le rétroéclairage pendant une minute ou pour le désactiver (série 450 uniquement). Maintenir enfoncé pendant trois secondes pour éteindre (OFF).
CAL MEAS BACK	Permet de basculer entre les modes de mesure et d'étalonnage. En mode SETUP (Configuration), BACK (Retour) permet de revenir à l'option de menu ou au réglage précédent.
ENTER HOLD	Confirmer les valeurs d'étalonnage en mode CAL (Étalonnage). Confirmer les sélections en mode SETUP (Configuration). Bloquer ou libérer la valeur mesurée.
SETUP	Permet de personnaliser les paramètres et les préférences de l'instrument. (Voir aussi **Programmes de configuration**)
MODE	Permet de basculer entre les différents types de mesure disponibles.
▲ SAVE	Permet d'enregistrer la mesure dans la mémoire. Permet d'accroître la valeur ou de défiler vers le haut en mode SETUP (Configuration) ou étalonnage manuel.
VIEW ▼	Permet de rappeler les valeurs enregistrées dans la mémoire. Permet de réduire la valeur ou de défiler vers le bas en mode SETUP (Configuration) ou étalonnage manuel.
🖨	Permet d'envoyer les données de sortie à l'imprimante ou à l'ordinateur. (série 450 uniquement).

Programmes de configuration

Pour accéder aux paramètres ci-dessous, appuyez sur **SETUP** (Configuration). Les flèches haut/bas affichent les options disponibles. Appuyer sur **ENTER** (Entrée) pour valider le réglage désiré, ou sur **BACK** (Retour) pour revenir à l'option précédente et/ou quitter.

Options de configuration

- Indicateur de préparation **ON** / **OFF** / ou automatiquement figé (**HOLD**) si stable
- Sélectionner le **ºC**elsius ou le **ºF**ahrenheit

Options de tampon pH

- Sélectionner le tampon pH désiré Groupe d'étalonnage:

  USA (1.68, 4.01, 7.00, 10.01, 12.45) ou
  NIST (1.68, 4.01, 6.86, 9.18, 12.45) ou
  DIN (1.09, 3.06, 4.65, 6.79, 9.23, 12.75) ou
  MAN (réglage manuel de toutes les valeurs de pH personnalisées qui sont à ≥ 1 unité pH l'une de l'autre. série 450 uniquement).
- Choisir le nombre de points d'étalonnage

Choisir le rappel d'étalonnage

- Définir le nombre de jours de **0-60** pour le paramètre désiré

Afficher les données d'étalonnage

- Appuyer sur **ENTER** (Entrée) pour afficher chaque point étalonné.

Afficher les données d'électrode

- Appuyer sur **ENTER** (Entrée) pour afficher le Décalage mV et le **%** de Pente de la valeur mesurée.

Réglages système

- Enregistrement des données:

  MANUAL (Manuel) en appuyant simplement sur le bouton

  TIMED (Chronométré). Choisir l'intervalle (**SEC** / **MIN** / **HOUR**) (Sec./min./heure).
- Arrêt automatique après 10 minutes. Sélectionner **ON** ou **OFF**.
- Réglages de l'horloge:

  Date: Sélectionner le système **USA** américain (MM/JJ/AAAA) ou **Euro** européen (JJ/MM/AAAA).

  Durée: Choisir (**24HR ou 12HR**). Pour 12HR, sélectionner **AM** (du matin) ou **PM** (du soir).
- Régler le type d'imprimante:

  CSV (Comma Separated Values) – meilleur format pour l'ordinateur.

  Imprimante (Texte) – meilleur format pour l'impression.

  Sélectionner MANUEL (**MAN**) en appuyant sur le bouton ou **TIMED** (Chronométré).

  Pour le chronométrage, choisir (**SEC** / **MIN** / **HOUR**) (sec./min./heure).

Réinitialisation

- **NO** (Aucune). Permet de quitter les options du menu de réinitialisation sans aucune modification.
- **FACTORY RESET** (Réinitialisation usine). Permet de remettre tous les réglages, à l'exception du paramètre date/heure et de l'étalonnage ATC, aux valeurs d'usine par défaut lorsque le bouton **ENTER** (Entrée) est enfoncé, puis de redémarrer l'instrument de mesure.
- **DATA RESET** (Réinitialisation données). Permet d'effacer les données stockées dans la mémoire tout en conservant les autres paramètres lorsque vous appuyez sur **ENTER** (Entrée).
- **CALIBRATION RESET** (Réinitialisation étalonnage). Permet d'effacer les données d'étalonnage non ATC tout en conservant les autres paramètres lorsque vous appuyez sur **ENTER** (Entrée).

Étalonnage pH

Pour de meilleurs résultats, l'étalonnage périodique au moyen d'étalons précis est recommandé. Étalonner au moyen d'étalons qui encadrent votre gamme de mesure recherchée tout en incluant un étalon neutre (pH 7,00 ou 6,86). Par exemple, si vous souhaitez mesurer des échantillons compris entre pH 6,2 et pH 9,5, l'étalonnage au moyen d'étalons de 4,01, 7,00 et 10,01 sera adéquat. Remuer pour de meilleurs résultats. Après l'étalonnage avec deux ou plusieurs points, le segment de pente active de la mesure sera visible sur l'écran inférieur pendant la mesure. Une pente de 100 % sera affichée uniquement si un seul point d'étalonnage est utilisé et "- - -" apparaîtra si aucun étalonnage n'est effectué. L'appareil de mesure revient automatiquement au mode de mesure après la réussite du nombre de points d'étalonnage spécifiés. Pour indiquer un autre nombre de points d'étalonnage du pH, voir **Options de tampon pH**.

Utilisation de la reconnaissance automatique de tampon

1. En mode de mesure de pH, tremper le capteur (ou les capteurs) de pH et ATC dans votre premier étalon, puis appuyer sur **CAL** (Étalonner). L'écran principal recherchera la valeur d'étalon la plus proche, tandis que l'écran secondaire indiquera la valeur non ajustée.
2. Lorsque l'indicateur "**READY**" (Prêt) apparaît, appuyer sur **ENTER** (Entrée) pour valider. L'écran principal indique "**DONE**" (Effectué).
3. Rincer l'électrode (ou les électrodes), puis la tremper dans votre prochain étalon pH. L'écran principal recherchera la valeur d'étalon la plus proche qui n'a pas encore été étalonnée, tandis que l'écran secondaire indiquera la valeur non ajustée. Lorsque l'indicateur "**READY**" (Prêt) apparaît, appuyer sur **ENTER** (Entrée) pour valider.
4. Pour étalonner un autre étalon pH, reprendre l'étape 3 ou appuyer sur **MEAS** (Mesure) pour retourner au mode de mesure de pH.

Utilisation de la reconnaissance manuelle / Tampons personnalisés (Série 450 uniquement)

1. En mode de mesure de pH, tremper le capteur (ou les capteurs) de pH et ATC dans votre premier étalon, puis appuyer sur **CAL** (Étalonner).
2. Lorsque l'indicateur **READY** (Prêt) apparaît, utiliser les flèches haut/bas pour ajuster la lecture principale en fonction de la valeur de l'étalon à la température mesurée, puis appuyer sur **ENTER** (Entrée).
3. Rincer votre électrode (ou vos électrodes), puis reprendre l'étape 2 avec un étalon qui est à ≥1 unité pH de la valeur d'étalon précédente.
4. Pour étalonner un autre étalon pH, reprendre l'étape 3 ou appuyer sur **MEAS** (Mesure) pour retourner au mode de mesure de pH.

Ajustement du décalage mV

1. En mode de mesure mV, plonger les capteurs ORP et ATC dans une solution ayant une valeur mV connue (Zobel, Light, quinhydrone, iodure ou triiodure) et remuer.
2. Lorsque l'indicateur "**READY**" (Prêt) apparaît, utiliser les flèches haut/bas pour ajuster la lecture principale en fonction de la valeur mV à la température mesurée, puis appuyer sur **ENTER** (Entrée). L'instrument de mesure accepte une valeur de réglage maximale de ±200 mV par rapport à la valeur mV par défaut. Lorsqu'un décalage est enregistré avec succès, R.mV remplace mV.

Étalonnage de température/ATC manuel

1. Appuyer sur **CAL** (Étalonnage) à partir de n'importe quelle mesure, puis appuyer sur **MODE**.
2. Passer à l'étape 3 pour l'ATC manuel, ou plonger le capteur de température dans une solution ayant une température précise connue. L'écran supérieur indique la température active, tandis que l'écran inférieur indique la température par défaut sans aucun ajustement.
3. Utiliser les flèches haut/bas pour ajuster l'écran supérieur. Appuyer sur **ENTER** (Entrée) pour valider la température d'étalonnage. La valeur de réglage maximale est de ±10 °C (ou ±18 °F) par rapport à la valeur par défaut.

Messages d'erreur

ERR "ERR" s'affiche lorsqu'une condition d'erreur est détectée ou si la mauvaise touche est enfoncée. Exemples courants:

- Appuyer sur **ENTER** (ENTRÉE) pendant l'étalonnage avant que l'indicateur "**READY**" (Prêt) ne s'affiche. Attendre que l'indicateur "**READY**" (Prêt) s'affiche pour appuyer sur **ENTER** (ENTRÉE).
- **UR** (Gamme inférieure)
- **OR** (Gamme supérieure)

Utilisation prévue, entretien et précautions

Ces instruments de mesure de poche utilisent des capteurs pour détecter les différents paramètres dans le cadre de mesures à base d'eau. Pour l'entretien de routine, débrancher le cordon d'alimentation ou la batterie, puis épousseter ou nettoyer l'écran à l'aide d'un chiffon humide. Si nécessaire, de l'eau tiède ou un détergent doux à base d'eau peut être utilisé. Enlever immédiatement les substances déversées qui entrent en contact avec l'appareil suivant la procédure de nettoyage appropriée en fonction du type de déversement.

- Ne pas utiliser cet appareil dans des atmosphères potentiellement explosives.
- Consulter les instructions d'utilisation, de stockage et de nettoyage des électrodes.
- Veiller à ce qu'aucun liquide ne pénètre dans l'appareil.
- Ne pas utiliser de produits chimiques de nettoyage agressifs (solvants ou produits similaires).
- L'appareil ne contient aucune pièce réparable par l'utilisateur. Toute tentative de réparation des pièces internes est susceptible d'annuler la garantie.
- **AVERTISSEMENT:** Aucune modification du présent appareil n'est autorisée.

Conditions de fonctionnement de l'instrument	
Temp. de fonctionnement amb.	5 à 45 ºC
Humidité de fonctionnement relative	5 à 85 %, sans condensation
Temp. de stockage	-20 à +60 ºC
Humidité relative de stockage	5 à 85 %, sans condensation
Pollution	Degré 2
Surtension	Catégorie II
Poids	500 g
Dimensions (L x l x H)	21,15 x 9,87 x 5,85 cm
Réglementation et sécurité	CE, TUV 3-1, FCC Classe A
Puissance nominale	CC Entrée: 9 VCC 1 A
Exigences de piles	2 piles AA 1,5 V (remplacer les piles lorsque l'indicateur de pile clignote)
Vibrations	Expédition/manutention conformément à ISTA N°1A
Chocs	Épreuve de chute dans l'emballage conformément à ISTA N°1A
Enceinte (conçue en conséquence)	IP67 (avec caches en caoutchouc)
Conditions d'utilisation de l'adaptateur universel	
Temp. amb. De fonctionnement	0 à 50 ºC
Humidité relative de fonctionnement	0 à 90 %, sans condensation
Temp. de stockage	-20 à +75 ºC
Humidité relative de stockage	0 à 90 %, sans condensation
Pollution	Degré 2
Surtension	Catégorie II
Puissance nominale	Entrée: 100 - 240 V, 50/60 Hz, 0.3A Sortie: 9 VCC 1 A

Eutech Instruments Pte Ltd
Blk 55, Ayer Rajah Crescent,
#04-16/24, Singapore 139949
Tel: (65) 6778-6876
Fax: (65) 6778-0086
eutech@thermofisher.com
www.eutechinst.com

Oakton Instruments
625 East Bunker Court,
Vernon Hills, IL, 60061, USA
Tel: 1-888-462-5866
Fax: 1-847-247-2984
info@4oakton.com
www.4oakton.com

150 & 450 Series Wasserdichtes Handmessgerät

pH/mV Betriebsanleitung

Modelle:

pH 150
pH/mV

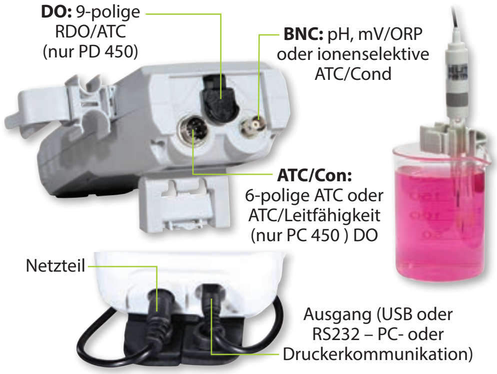
pH 450
pH/mV/ISE

PC 450
pH/mV/Con

PD 450
pH/mV/DO

Erste Schritte/Anschlüsse

Nach Einsetzen (2) der AA-Batterien und/oder Anschließen der optionalen 110/220 VAC Netzspannung, schließen Sie die gewünschten Sensoren an den entsprechenden Anschlüssen an.



12 mm und 16 mm Sonden können den **Grip-Clip™** verwenden, um einen oder mehrere Sensoren an einem Messbecher und wenn erforderlich am Gerät zu befestigen. Der Ständer kann verlängert werden, wie oben gezeigt, oder für die Wandmontage verwendet werden.

Tastenfunktionen

⏻	Einmal drücken, um im vorher verwendeten Modus einzuschalten. Erneut drücken, um die Hintergrundbeleuchtung für eine Minute ein oder auszuschalten (nur 450-Serie). 3 Sekunden lang gedrückt halten, um auszuschalten.
CAL MEAS BACK	Zwischen Mess- und Kalibrierungsmodi schalten. Im SETUP-Modus dient ZURÜCK, um zur vorherigen Menüoption oder Einstellung zurückzukehren.
ENTER HOLD	Kalibrierungswerte im CAL-Modus bestätigen. Auswahlen im SETUP-Modus bestätigen Den gemessenen Wert einfrieren oder freigeben.
SETUP	Instrumenteneinstellungen und Präferenzenanpassen. (Siehe auch **Setupprogramme**)
MODE	Zwischen den verfügbaren Messtypen schalten.
▲ SAVE	MesswertimSpeicherspeichern. Wert erhöhen oder aufwärts scrollen im SETUP oder manuelle Kalibrierung.
VIEW ▼	Gespeicherte Werte aus dem Speicher aufrufen. Wert reduzieren oder nach unten scrollen im SETUP oder manuelle Kalibrierung.
🖨	Ausgangsdaten an Drucker oder Computer senden. (Nur 450-Serie)

Setupprogramme

Um auf die nachstehenden Einstellungen zuzugreifen, drücken Sie **SETUP**. Die Aufwärts-/Abwärtspfeile werden die verfügbaren Optionen anzeigen. Drücken Sie **ENTER**, um die gewünschte Einstellung zu akzeptieren oder **BACK** (Zurück), um zur vorherigen Option zurückzukehren und/oder zu beenden.

Konfigurationsoptionen

- Bereit-Anzeige **ON** / **OFF** / oder Automatisch **HOLD** (Halten) wenn stabil
- **°C**elsius oder **°F**ahrenheit

pH-Puffer-Optionen

- Wählen Sie die gewünschte pH-Puffer-Kalibrierungsgruppe:

  USA (1.68, 4.01, 7.00, 10.01, 12.45) oder

  NIST (1.68, 4.01, 6.86, 9.18, 12.45) oder

  DIN (1.09, 3.06, 4.65, 6.79, 9.23, 12.75) oder

  MAN (manuelle Anpassung aller benutzerdefinierten pH-Werte, die ≥1 pH-Einheit entfernt sind. Nur 450-Serie)
- Wählen Sie die Anzahl der Kalibrierungspunkte

Wählen Sie Erinnerung an fällige Kalibrierung

- Stellen Sie die Anzahl der Tage zwischen **0-60** für den gewünschten Parameter

Kalibrierungsdaten einsehen

- Drücken Sie **ENTER**, um jeden zu kalibrierenden Punkt zu sehen.

Elektrodendaten einsehen

- Drücken Sie **ENTER**, um mV Offset und Steigung % des Messwertes zu sehen.

Systemeinstellungen

- Messwerterfassung:

  MANUELL bei Betätigen der Taste nur **TIMED** (Zeitlich Festgelegtes) Intervall. Wählen Sie ein Intervall (**SEK** / **MIN** / **STUNDE**).
- Automatisches Ausschalten nach 10 Minuten. Wählen Sie **ON** oder **OFF**.
- Uhreinstellungen:

  Datum: Wählen Sie **USA** (MM/TT/JJJJ) oder **Europa** (TT/MM/JJJJ).

  Uhrzeit: Wählen Sie (**24STD oder 12STD**). Falls 12STD, wählen Sie **AM** oder **PM**.
- Druckertyp einstellen:

  CSV (durch Komma getrennte Werte) – bestes Format für den Computer.

  Drucker (Text) – bestes Format für den Drucker.

  Manuell (**MAN**) wählen bei Betätigen der Taste oder **TIMED** (Zeitlich Festgelegtes) Intervall.

  Wenn zeitlich festgelegt (**SEK** / **MIN** / **STUNDE**) wählen.

Zurückstellen

- **NO** (ANZAHL). Ausgänge aus dem Reset-Menü ohne Handlungen.
- **FACTORY RESET** (WERKSEITIGE RÜCKSTELLUNG). Stellt alle Einstellungen mit Ausnahme von Datum/Uhrzeit und ATC-Kalibrierung auf die werkseitigen Standardwerte zurück, sobald **ENTER** gedrückt und das Messgerät neugestartet wird.
- **DATA RESET** (DATENRÜCKSTELLUNG). Löscht im Speicher gespeicherte Daten, während andere Einstellungen beibehalten werden, nachdem **ENTER** gerückt wurde.
- **CALIBRATION RESET** (KALIBRIERUNGSRÜCKSTELLUNG). Löscht Nicht-ATC-Kalibrierungsdaten, während andere Einstellungen beibehalten werden, nachdem **ENTER** gedrückt wird.

pH-Kalibrierung

Für beste Ergebnisse wird eine regelmäßige Kalibrierung mit bekannten, genauen Standards empfohlen. Kalibrieren Sie mit Standards, die Ihren geplanten Messbereich einbeziehen, während sie einen neutralen Standard (pH 7,00 oder 6,86) einbeziehen. Sollten Sie z. B. davon ausgehen, dass Sie Proben zwischen pH 6,2 und pH 9,5 messen werden, wird eine Kalibrierung mit den Standards 4,01, 7,00 und 10,01 gut funktionieren. Mischen Sie für beste Ergebnisse. Nach der Kalibrierung mit zwei oder mehr Punkten wird das aktive Steigungssegment der Messung während der Messung auf der unteren Anzeige sichtbar sein. 100 % Steigung wird angezeigt, wenn nur ein Kalibrierungspunkt durchgeführt wird, und "- - -", wenn keine Kalibrierung durchgeführt wird. Das Messgerät wird nach einem erfolgreichen Abschluss der Anzahl der festgelegten Kalibrierungspunkte automatisch zum Messmodus zurückkehren. Um eine andere Anzahl von pH-Kalibrierungspunkten anzugeben, siehe **pH-Pufferoptionen**.

Automatische Puffererkennung verwenden

1. Während im pH-Messmodus tauchen Sie die pH- und ATC-Sensoren in den ersten Standard und drücken Sie **CAL**. Das primäre Display wird nach dem nächstgelegenen Standardwert suchen, während die sekundäre Anzeige den unangepassten Wert anzeigen wird.
2. Sobald die Anzeige "**READY**" (Bereit) erscheint, drücken Sie **ENTER**, um zu akzeptieren. Die primäre Anzeige wird "**FERTIG**" anzeigen.
3. Spülen Sie Ihre Elektroden und tauchen Sie in den nächsten pH-Standard. Das primäre Display wird nach dem nächstgelegenen Standardwert, der noch nicht kalibriert wurde, suchen, während die sekundäre Anzeige den unangepassten Wert anzeigen wird, Sobald die Anzeige "**READY**" (Bereit) erscheint, drücken Sie **ENTER**, um zu akzeptieren.
4. Um einen anderen pH-Standard zu kalibrieren, wiederholen Sie Schritt 3 oder drücken Sie **MEAS**, um zum pH-Messmodus zurückzukehren.

Manuelle Erkennung / Benutzerdefinierte Puffer verwenden (Nur 450 Serie)

1. Während im pH-Messmodus tauchen Sie die pH- und ATC-Sensoren in den ersten Standard und drücken Sie **CAL**.
2. Sobald die Anzeige "**READY**" (Bereit) erscheint, passen Sie die primären Messwerte mit den Aufwärts-/Abwärtspfeilen an, damit sie dem Standardwert bei der gemessenen Temperatur entsprechen, und drücken Sie **ENTER**.
3. Spülen Sie Ihre Elektroden und wiederholen Sie Schritt 2 mit einem Standard, der ≥1 pH-Einheit vom vorherigen Standardwert entfernt ist.
4. Um einen anderen pH-Standard zu kalibrieren, wiederholen Sie Schritt 3 oder drücken Sie **MEAS**, um zum pH-Messmodus zurückzukehren.

mV-Messwertanpassung

1. Während im mV-Messmodus tauchen Sie die ORP- und ATC-Sensoren in eine Lösung mit einem bekannten mV-Wert (z. B. Zobel, Quinhydron nach Light oder Iodid/Triiodid) und rühren Sie.
2. Sobald die Anzeige "**READY**" (Bereit) erscheint, verwenden Sie die Aufwärts-/Abwärtspfeile um den primären Messwert anzupassen, sodass er dem mV-Wert bei der gemessenen Temperatur entspricht, und drücken Sie dann **ENTER**. Das Messgerät lässt einen anpassbaren Maximalwert von ±200 mV ab dem werkseitigen Standard-mV-Wert zu. Wenn ein Offset erfolgreich gespeichert wurde, wird mV durch R.mV ersetzt.

Temperaturkalibrierung/Manuelle ATC

1. Drücken Sie **CAL** bei einer beliebigen Messung und drücken Sie dann **MODE** (Modus).
2. Fahren Sie für manuelle ATC mit Schritt 3 fort, ansonsten tauchen Sie den Temperatursensor in eine Lösung mit einer bekannten, genauen Temperatur. Die obere Anzeige zeigt die aktive Temperatur an, während die untere Anzeige die werkseitige Standardtemperatur ohne Anpassung anzeigt.
3. Verwenden Sie die Pfeile oben/unten, um die obere Anzeige anzupassen. Drücken Sie **ENTER**, um die Kalibrierungstemperatur anzunehmen. Der maximale anpassbare Wert beträgt ±10 °C (oder ±18 °F) ab dem werkseitigen Standardwert.

Fehlermeldungen

ERR "ERR" wird erscheinen, wenn ein Fehlerzustand auftritt oder die falsche Taste betätigt wird. Übliche Beispiele sind:

- Während der Kalibrierung **ENTER** zu drücken, bevor die Anzeige "**READY**" (Bereit) erscheint. Warten Sie auf die Anzeige "**READY**" (Bereit), bevor Sie **ENTER** drücken.
- **UB** (Unterer Bereich)
- **OB** (Oberer Bereich)

Anwendungszweck, Wartung und Vorsichtsmaßnahmen

Diese tragbaren Messgeräte verwenden Sensoren, um verschiedene Parameter für wasserbasierte Messungen zu erkennen. Trennen Sie für die Routinewartung das Netzkabel oder die Batterie und wischen Sie die Anzeige mit einem feuchten Tuch ab, Bei Bedarf kann warmes Wasser oder mildes, wasserhaltiges Spülmittel verwendet werden. Entfernen Sie umgehend jegliche verschüttete Substanz vom Kontakt mit dem Messgerät, indem Sie entsprechende Reinigungsverfahren für die Art der Verschüttung verwenden.

- Verwenden Sie dieses Gerät nicht in potentiell explosiven Atmosphären.
- Siehe Anweisungen zu Elektroden für deren Gebrauch, Lagerung und Reinigung.
- Vergewissern Sie sich, dass keine Flüssigkeit in das Gerät eindringt.
- Verwenden Sie keine aggressiven Reinigungschemikalien (Lösungsmittel oder ähnliche Substanzen).
- Das Gerät enthält keine vom Benutzer zu wartende Teile. Versuche, die Innenteile zu warten, könnte die Garantie ungültig machen.
- **WARNUNG:** Keine Modifizierung dieses Gerätes erlaubt.

Betriebsbedingungen des Instrumentes	
Umgebungstemperatur bei Betrieb	5 bis 45 °C
Relative Feuchtigkeit bei Betrieb	5 bis 85 %, nicht kondensierend
Lagertemperatur	-20 bis +60 °C
Lagerung Relative Luftfeuchtigkeit	5 bis 85 %, nicht kondensierend
Belastungs	Grad 2
Überspannungs	kategorie II
Gewicht	500 g
Abmessungen (L x B x H)	21,15 x 9,87 x 5,85 cm
Behördliche Vorschriften und Sicherheit	CE, TUV 3-1, FCC Klasse A
Nennleistung Gleichstromeingang	9 VDC 1 A
Batterianforderungen	2 x AA (LR6) 1,5 V Batterien (Batterien wechseln wenn Batteriezeichen blinkt)
Vibrationen	Versand/Handhabung gemäß ISTA #1A
Stöße	Falltest in Verpackung gemäß ISTA #1A
Gehäuse (Auf die Bedürfnisse ausgerichtet)	IP67 (mit Gummiabdeckungen)
Universeller Stromadapter Betriebsbedingungen	
Betriebsumgebungstemperatur	0 bis 50 °C
Relative Feuchtigkeit bei Betrieb	0 bis 90 %, nicht kondensierend
Lagertemperatur	-20 bis +75 °C
Lagerung Relative Luftfeuchtigkeit	0 bis 90 %, nicht kondensierend
Belastungs	Grad 2
Überspannungs	kategorie II
Nennleistung	I/P: 100 - 240 V, 50/60 Hz, 0,3A O/P: 9 VDC 1 A

Eutech Instruments Pte Ltd
Blk 55, Ayer Rajah Crescent,
#04-16/24, Singapore 139949
Tel: (65) 6778-6876
Fax: (65) 6778-0086
eutech@thermofisher.com
www.eutechinst.com

Oakton Instruments
625 East Bunker Court,
Vernon Hills, IL, 60061, USA
Tel: 1-888-462-5866
Fax: 1-847-247-2984
info@4oakton.com
www.4oakton.com

APPENDIX B – Standard Operating Procedures

B-6. Management of Investigation-Derived Waste

STANDARD OPERATING PROCEDURE

MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Introduction

Investigation derived wastes (IDW) generated during the Pre-Remedial Design Investigations at the Portland Harbor Superfund Site may include:

- Soils/sediments
- Surface water
- Other materials:
    - Personal protective equipment
    - Disposable sampling equipment
    - Spent decontamination liquids
    - Plastic sheeting, containers, etc.

The management of these wastes will be conducted to limit exposure of Site personnel to hazardous materials, and to prevent introduction of contaminated materials to uncontaminated environmental media at the Site (soils, sediment). The following Standard Operating Procedures (SOPs) establish protocols for testing, storage, and disposal of these materials.

Disposal of laboratory test equipment and supplies will be handled in accordance with the laboratory Quality Assurance Project Plan (QAPP).

General

IDW management will follow guidance described in the Office of Solid Waste and Emergency Response (OSWER) document, Guide to Management of Investigation-Derived Wastes (United States Environmental Protection Agency [EPA] 1992). This guidance discusses factors to consider as part of an IDW management program. These factors include protectiveness of human health and the environment, compliance with applicable and relevant or appropriate requirement (ARAR)-based cleanup levels, land disposal restrictions, storage requirements, recordkeeping and manifesting, and handling of non- Resource Conservation and Recovery Act (RCRA) hazardous wastes. The IDW management program described in this section incorporates these factors in the program.

All IDW identified as potentially contaminated with hazardous materials will be stored in a designated and clearly marked IDW management area located at the AECOM Technical Services (AECOM) Field Laboratory. All vessels will also be clearly labeled to indicate the source of the IDW. The IDW storage area will be inspected daily to ensure that storage procedures (as outlined below) are being followed. Any violations of these procedures will be documented and remedied as quickly as possible. Potentially contaminated IDW will be identified based on its origin, olfactory evidence, and visual evidence. Laboratory testing will be required to determine the proper disposition of these IDW.

Media Specific IDW Management

Sediment/Soils

Waste soils and sediments will be generated as excess sample material. The required testing and handling of this IDW will depend on its origin and characteristics. Olfactory and visual observations will be used to determine if the soils contain potentially elevated levels of hazardous materials. The amount of sediment generated will be minimized to the volume necessary for sampling and analysis, if possible. During field operations, leftover sediment material will be returned to the location it was generated from unless a significant sheen or non-aqueous phase liquid (NAPL) is observed. If significant sheen or NAPL is observed, sediment on the vessel or laboratory processing area will be temporally stored in 5-gallon buckets with lids, then transferred to 55-gallon drums. Each drum will be labeled using a grease pencil or paint pen to indicate the date sealed, location, and contents. Each of the sealed drums will then be staged at a designated solid waste management unit location for later disposal characterization.

Surface Water

Sampling activities may result in the creation of surface water sheens. Sorbent booms will be deployed if significant sheen is encountered on the water surface during coring/grab sampling. A small support boat may be used to manage the boom so the sampling vessel can operate without interruption. AECOM will coordinate with the Office of Spill Prevention Section on additional mitigation measures and agency notifications for releases. Surface water generated during sediment collection will be returned to the lake unless a significant sheen is observed. If a sheen is observed, water will be contained in 55-gallon drums or plastic containers and managed accordingly.

Personal Protective Equipment (PPE)

Investigation-derived PPE consists of gloves, chemically protective clothing, respirator canisters, and other one-time use equipment used during the field investigation. All used PPE will be containerized in plastic garbage bags and disposed of on-site for subsequent transport to the municipal landfill.

Decontamination Fluids

Decontamination fluids will be drummed up in either 55-gallon drums or disposed of in sanitary sewers if no significant sheen is observed. Alconox used on the boat will be discarded overboard if no significant sheen is observed. The decontamination containers will be kept on-site until the water has been analyzed for hazardous materials, at which time the water will be discarded appropriately.

Chemical Liquid Wastes

Chemical liquid wastes will include the spent solvents and acids and other residual chemicals generated during the decontamination process.

Waste acids and solvents will be collected in (dedicated) satellite containers as follows:

- Waste acids (e.g., hydrogen chloride, nitric acid) will be collected in a plastic storage carboy (20-L) SEPARATE FROM WASTE SOLVENTS, labeled with a Class 8 Corrosive Liquid label and containing a tag that indicates acid name, concentration, and volume along with users' initials and date/time.
- Waste solvents (e.g., acetone, methanol, and hexane) will be collected in Type I or II UL-approved galvanized steel disposal can, SEPARATE FROM WASTE ACIDS, labeled with a Class 3 Flammable Liquid label and containing a tag that indicates solvent name, concentration, and volume along with users' initials and date/time.

Solvent Waste (Acetone, Methanol, Hexane)

- Assign a unique identification number to the Type I or II UL-approved steel disposal can (clearly marked on the top and sides).
- Prepare a log for the drum, listing the volume and concentration of each solvent transferred to the drum along with date/time.
- Place a label indicating that the drum contains IDW pending characterization and a Class 3 Flammable Liquid label on the drum.
- Close the drum after each transfer.
- Store the drum in a secure area at the field facility until pickup by an authorized waste handler at the end of the field phase. Drums containing hazardous waste will be removed from the facility within the time mandated for the governing hazardous waste generator status (large quantity generator, small quantity generator, or conditionally except generator).

Other Materials

All plastic sheeting, sampling containers, and other disposable equipment that is free from hazardous materials will be containerized in plastic garbage bags and disposed of on-site for subsequent transport to the municipal landfill. Materials that have visible NAPL will also be drummed and shipped off-site for disposal at an approved facility. Non-disposable or bulky materials may be decontaminated and re-used or disposed as solid waste (see SOP for decontamination). Other disposable materials used on-site (tarps covering non-contaminated soils, caution tape, potable water containers) that have not contacted contaminated media will be disposed as solid waste.

Testing and Disposal

All drummed materials will be tested to determine the proper disposal method. Composite samples will be collected from each drum for analysis. Composite samples will be collected such that reasonable likelihood exists that the entire volume of material in a drum is represented in the sample.

Composite samples will be tested for the parameters identified in the QAPP. Modifications of this analyte list may be made based on specific knowledge of the origin and likely contaminants in the materials.

Soils contaminated above hazardous waste criteria will be shipped to a licensed disposal facility following any further required waste characterization or stabilization.

References

United States Environmental Protection Agency (EPA). 1992. Guide to Management of Investigation-Derived Wastes. Office of Solid Waste and Emergency Response. 9345-03FS.

AECOM
111 SW Columbia Avenue
Suite 1500
Portland
OR, 97217
USA
aecom.com

Geosyntec
520 Pike Street
Suite 1375
Seattle
WA, 98101
USA
geosyntec.com