Project Management and Objectives Elements

1.1Quality Assurance Project Plan Approval Sheet (1.0)

Program Title: Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey and Pennsylvania, Version 1.0 (MACWA SSIM Umbrella QAPP V1.0)

Project Title: Planning for the Next Big Storm: Wetland Shoreline and Coastal Resilience Planning for Strategic Investment (MACWA SSIM R2 QAPP 1.2)

Note: QAPP Nomenclature. Any future modifications to the Version 1.0 Umbrella QAPP for MACWA SSIM (site specific intensified monitoring) efforts will require approval and necessitate renaming as new versions (e.g. 2.0, etc.) Addendum QAPP's for projects will be sequentially referenced as Version 1.1, 1.2, etc. in line with the most current version of the umbrella QAPP. The QAPPs for MACWA SSIM efforts (Tier 4 studies) are not to be confused with separate QAPPs for MACWA Rapid Assessment Methods (Tier 2 studies.)

Organization names:	Partnership for the Delaware Estuary & Barnegat Bay Partnership
Effective date:	June 1, 2014[1]
Approval:	
Project Start Date:	October, 1, 2013
Project End Date:	December 31, 2015
Project Manager & QA Officer	Danielle Kreeger, PhD, Science Director, Partnership for the Delaware Estuary — Date: 6/30/15
	Martha Maxwell-Doyle, Project Coordinator, Barnegat Bay Partnership — Date: 7/6/15
EPA Project Officer:	Kathleen Drake, EPA Wetland Protection Team, USEPA Region 2 — Date: 3/4/15
EPA QA Officer:	Carol Lynes, USEPA Region 2 — Date: 3/4/15

[1] Effective date may be changed to reflect the date of signature of agreement between EPA Region 2, and the Partnerships

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Project Start Date: October, 1, 2013

Project End Date: December 31, 2015

Project Manager & QA Officer: ______________________ Date: ________
Danielle Kreeger, PhD, Science Director
Partnership for the Delaware Estuary

______________________ Date: ________
Martha Maxwell-Doyle, Project Coordinator
Barnegat Bay Partnership

EPA Project Officer: Kathleen Drake (signature) Date: 3/4/15
Kathleen Drake
EPA Wetland Protection Team, USEPA Region 2

EPA QA Officer: Carol Lynes (signature) Date: 3/4/15
Carol Lynes
USEPA Region 2

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Addendum to Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania (MACWA RAM Umbrella QAPP 1.0)
**

for the

Planning for the Next Big Storm: Wetland Shoreline and Coastal Resilience Planning for Strategic Investment (CRDA: CD-96294700-0)

Quality Assurance Project Plan
MACWA SSIM Project QAPP v1.3

Barnegat Bay Partnership & Partnership for the Delaware Estuary

Note: The Mid-Atlantic Coastal Wetland Assessment (MACWA) consists of two components: rapid assessment methods (RAM) and site-specific intensive monitoring (SSIM). A general QAPP is available that describes methods and data quality objectives for each of the two components, referred to as the MACWA RAM Umbrella QAPP and the MACWA SSIM Umbrella QAPP. Project-specific statements of work with details such as location information, sampling density and timelines are omitted from the two umbrella QAPPs. These details are included in supplemental, project-specific QAPP's that are considered as addenda to the umbrella QAPPs. This document is Project QAPP 1.2, which is the second addendum to the MACWA SSIM Umbrella QAPP v1.0. Any future revision of the umbrella QAPP will be denoted as a new version number (whole number to the left of the decimal; e.g. from 1.0 to 2.0) and be applied to all addenda (e.g., from 1.1 to 2.1 for this QAPP.)

Date:	May 15, 2014
Prepared by:	Danielle Kreeger, PhD, Science Director and Angela Padeletti Senior Coordinator of Science, Partnership for the Delaware Estuary, with Martha Maxwell-Doyle Project Coordinator, Barnegat Bay Partnership
Prepared for:	United States Environmental Protection Agency, Region II

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Project Manager &: QA Officer	____________________ Date: ________ Danielle Kreeger, PhD, Science Director Partnership for the Delaware Estuary
	____________________ Date: ________ Martha Maxwell-Doyle, Project Coordinator Barnegat Bay Partnership
EPA Project Officer:	____________________ Date: ________ Kathleen Drake EPA Wetland Protection Team, USEPA Region 2
EPA QA Officer :	____________________ Date: ________ Donna Ringel USEPA Region 2

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Table of Contents (2.0)

**SPECIAL NOTE: Due to this QAPP references an "umbrella QAPP" (described in more detail below) and the umbrella QAPP had to fulfill both USEPA Region 2 and USEPA Head Quarters requirements, the heading numbers of the following QAPP are slightly off from those required by USEPA Region 2. To clarify which Region 2 section is being addressed a number will follow the heading in parentheses indicating this, ie; 1.2 Distribution List (3.0), where Region 2 classifies the list as their section 3.0.

1.2 Distribution List (3.0)

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1.3 Project/Task Organization (4.0)

The relationships of the principal investigators and project managers below are summarized in Figure 1.

<u>Project Managers</u>

Martha Maxwell-Doyle, Project Coordinator of the Barnegat Bay Partnership (BBP) will be responsible for overall organization and implementation of projects that are funded by this grant received by the BBP.

Danielle Kreeger, PhD, Science Director of the Partnership for the Delaware Estuary (PDE) will be responsible for the helping to organize and implement the various metrics of the project. Dr. Kreeger will take be the official QA officer for the project and PDE will maintain an officially approved QA Project Plan.

<u>Collaborator - Subawardee</u>

David Velinsky, PhD, Vice President and Director of the Patrick Center for Environmental Research, Academy of Natural Sciences of Drexel University is a subawardee for this project and will help has years of experience in the region as well as being involved in MACWA since the beginning. Dr. Velnisky will be consulted on data analysis.

Tracy Quirk PhD, Patrick Center for Environmental Research, Academy of Natural Sciences of Drexel University (ANS) is expected to assist in coordinating various data streams and operations among the fixed stations to ensure consistency of methodologies and to help the NEPs meet quality assurance goals, contingent on funding.

State Partners

Thomas Belton and Dorina Frizzera, New Jersey Department of Environmental Protection (NJDEP), will work with PDE and BBP to coordinate with other monitoring in New Jersey and help with any state-specific needs of the project.

Federal Partners

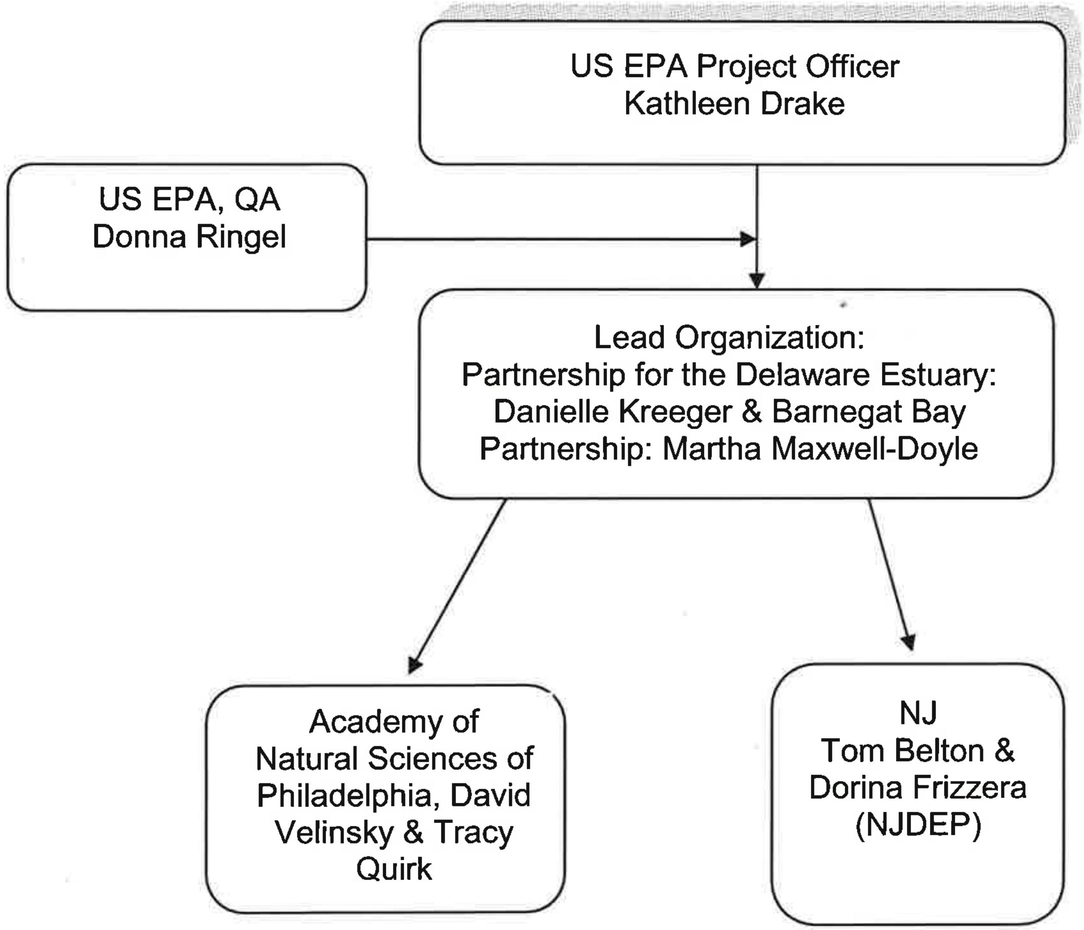
US EPA Quality Assurance Officer: Donna Ringel, EPA Region 2, will perform the responsibilities as Quality Assurance Officers for the US Environmental Protection Agency.

US EPA Project Officer: Kathleen Drake Wetland Protection Team, USEPA Region 2, will perform responsibilities as Project Officers for wetland assessment grants administered to BBP through US EPA Region 2.

US EPA Region 2: Kathleen Drake, Wetlands Protection Team, will facilitate regional interagency coordination between Region 2 and Headquarters, within Region 2, and between Regions 2 and 3. This coordination will facilitate implementation of MACWA, including QAPP review, data sharing, and reporting with regard to rapid assessment outcomes to groups such as the Mid-Atlantic Wetland Workgroup, National Wetland Monitoring and Assessment Work Group, and other federal resource managers.

US Fish and Wildlife Service: Edwin B. Forsythe National Wildlife Refuge; Paul Castelli, will help to coordinate monitoring within the refuge.

Figure 1: Organizational Chart for this Project.



1.4 Problem Definition/Background (6.0)

1.4.1 Problem Definition (6.1)

Climate change and associated increases in sea level and storminess are predicted to lead to increasing rates of loss of much (if not most) of our current tidal salt marshes in many mid-Atlantic estuaries, such as the Delaware Estuary and Barnegat Bay, by 2100. Recent rates of loss in the Delaware Estuary exceed an acre per day, with >2.2% having been lost between 1996-2006 (PDE 2012) and most remaining marshes appear to be stressed (Kreeger et al. 2013). In addition, coastal storms (sub-tropical/nor'easter and hurricanes) continue to dramatically impact our coastal wetlands. Coastal managers need to be equipped with knowledge about wetland management practices and "climate adaptation tactics" which provide the most cost-effective approaches to stem salt marsh losses and sustain the crucial ecosystem services that they provide, especially flood protection. Importantly, this effort fills a vital niche as a Tier 3 intensive study (within the MACWA 4-tier strategy) that will provide useful new "marsh futures" maps to guide coastal management investments to enhance and sustain greatest marsh-associated resilience. All study sites in both estuaries will be MACWA monitoring stations, enhancing outcomes by tying into existing data streams (e.g. SET arrays).

Nor'easter and hurricanes have exacerbated an already urgent need along NJ's coasts to adapt to changing weather/water related conditions. Anecdotal data and aerial map comparisons suggest that large tracts of tidal marshes were inundated by Hurricane Sandy, and waterways are now wider. Some of the worst flood damages were observed were in communities that had lost their protective wetlands, but we do not yet have on-the-ground assessment strategies to monitor shoreline erosion and retreat post-storm. This study will perform a random probabilistic shoreline assessment to quantify erosion conditions in our representative MACWA watersheds and to establish permanent monitoring transects as part of MACWA SSIM to track future changes in shorelines in relation to other parameters being studied in those same wetlands. We expect to learn which stressors and natural factors (nutrients, TSS, biological conditions) are associated with elevated erosion and decreased resilience.

Additionally, research suggests that salt marsh resilience can be further compromised by high nutrient loadings such as occur in these estuaries. Salt marshes serve as sinks for nutrients and other pollutants and their importance for water quality maintenance is only beginning to be understood. Therefore, it is important to develop a better understanding of the interactions between salt marsh health, acreage, nutrient loading and removal services, and the consequences of nutrient loadings on their ability to accrete and keep pace with sea level rise.

Finally, integrating RTK-GPS surveying, ecosystem service maps, remote sensing data and other current BMPs management practices and restoration approaches to outline alternatives for managers in areas of interest. Coastal managers will thus be equipped with guidance on how best to adapt to climate change and preserve greatest tidal wetland acreage, and this approach could then be extrapolated to other areas with tidal wetlands once the tools and outcomes are piloted in these representative areas of interest.

The current project is based off of work done through WPDG over the last seven years in the region. The general background for the aforementioned Mid-Atlantic Coastal Wetlands Assessment (MACWA) work can be found in "Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0*". That over arching "umbrella" program QAPP was signed off by EPA Region 2 QA officer Dona Ringle, NJ DEP QA officer Mark Ferko, as well as EPA HQ Project Officer Greg Serenbetz.

1.4.2 Background (6.2)

The background for this project can be found in the program umbrella QAPP, "Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0*". As well as in the QAPP "Importance of Ribbed Mussels for Salt Marsh Climate Adaptation and Water Quality Management in Atlantic Estuaries". This project incorporates these two previous studies.

1.5 Project/Task Description (7.0)

It is widely understood that our coastal wetlands are imperiled due to a number of natural and anthropogenic causes. Additionally, Hurricanes Sandy and Irene, and Tropical Storm Lee, have exacerbated an already urgent need along New Jersey's coasts to adapt to changing weather/water related conditions. Along the New Jersey Bayshore and Barnegat Bay erosion has accelerated with increased storms and sea level rise, with typical non-storm shoreline retreat rates averaging 1 m per year. This project will build upon and expand ongoing New Jersey Mid Atlantic Coastal Wetlands Assessment (MACWA) work being by the Barnegat Bay Partnership and the Partnership for the Delaware Estuary by: 1) Assessing marsh elevations platforms in relation to increasing sea levels and storm frequency at representative tidal marshes; 2) Assessing the current status of those marshes with new edge erosion measures; characterizing how key ecosystem services vary spatially; 3) Relating these findings to ecosystem services and wetland condition across the region; 4) Translating these findings to best management practices, restoration/conservation priorities, and resilience-building options; and 5) Providing recommendations and map guidance for managers on how to sustain current marsh extent , performance and resilience under future scenarios associated with nutrient loadings, sea level rise and increasing storm frequency/intensity.

All sites for this project are previously studied wetland complexes under MACWA. Six specific salt-water sites have been choosen for this particular project they include; Dennis Creek, Maurice River, Dividing Creek, of Delaware bay and West Creek, Island Beach State Park and Reedy Creek in Barnegat Bay. Maps of these sites can be found in the umbrella QAPP entitled "Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0 (SSIM Umbrella QAPP).

Most data will be obtained during the course of this project. Data that could be used to extrapolate data obtained during the project for ecosystem services will include data that was obtained under an EPA RARE funding mechanism. This data was obtained under an approved QAPP with EPA ORD AED entitled "Importance of Ribbed Mussels for Salt Marsh Climate Adaptation and Water Quality Management in Atlantic Estuaries". A copy can be furnished upon request. Other data that may be used for the analysis of this data would be historical data on the site specific intensive monitoring at the six wetland sites. All this data has been obtained while under various EPA QAPPs approved by EPA Region 2. If time and funds permit a comparison of shoreline erosion collected during this program could be compared to historical shoreline data, this data will be obtained through the Department of Environmental Protection of New Jersey.

	Task	Timeframe	Completion Date
1	**Elevation Capital assessment** *Barnegat Bay (3 sites) Delaware Estuary (3sites)*	Spring-Summer 2014	10/1/2014
2	**Shoreline Erosion evaluation** *Barnegat Bay (3 sites) Delaware Estuary (3sites)*	Spring 2013-Fall 2014	12/1/2014
3	**Ecosystem service measurements** *Barnegat Bay (2 sites) Delaware Estuary (2sites)*	Summer 2014- Spring 2015	7/1/2015
4	**Wetland Condition monitoring** *Barnegat Bay (3 sites) Delaware Estuary (3sites)*	Winter 2013- Fall 2015	12/1/2015

5	**Evaluate resilience tactics at Areas of Interest** *Delaware Estuary (1 site) Barnegat Bay (1 site)*	Spring 2014- Fall 2015	12/1/2015
	Create/Analyze monitoring matrix	Summer 2014- Fall 2015	10/31/2015
6	**GIS Ecoservice and Marsh Futures Maps**	Spring 2015-Winter 2015	12/31/2015
7	**Management, Reporting, Result Dissemination**	continuous	12/31/2015

Special personnel that is required for this work include people who; have worked with RTK GPS devices specifically using the geobase system; are familiar with saltwater tidal wetlands plants; have experience with hydroperiod sensors; knowledge in bivalve physiology; and have extensive understanding and knowledge of ARC GIS technology.

1.6 Quality Objectives and Criteria for Measurement Data (8.0)

The project quality objective is to collect accurate and precise data in order to determine the conditions of wetlands throughout the Delaware and Barnegat Bay Estuaries. Further description of specific methodologies used to ensure quality objectives for this project can be found in greater detail in the umbrella QAPP entitled "Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0 (SSIM Umbrella QAPP), as well Importance of ribbed mussels for salt marsh climate adaptation and water quality management in Atlantic estuaries QAPP. Specific formulas and descriptions on how we will achieve precision, accuracy, bias, representativeness, completeness, comparability, and sensitivity can also be found in these two approved QAPPs.

1.7 Special Training Needs/Certification (5.0)

There is no special certification needed for this project. Special training will be needed to participate in any fixed station intensive sampling (SSIM). Training will be done by any of the project managers or scientific partners who may be previously trained in a metric. Further description of special training please reference the umbrella QAPP entitled "Intensive Monitoring and Assessment

Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0 (SSIM Umbrella QAPP).

1.8 Reporting, Documents and Records (17)

All reporting, documents and records will follow the approved umbrella QAPP entitled "Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0 (SSIM Umbrella QAPP). New data sheets for the ecosystem services work are in Appendix H. "Importance of ribbed mussels for salt marsh climate adaptation and water quality management in Atlantic estuaries QAPP".

2 Data Generation and Acquisition

2.2 Sampling Methods/Field Monitoring Requirements (10.0)

2.2.1 Monitoring Process Design (10.1)

Four tasks will have field monitoring components. The monitoring design is mostly probablility with some judgement based. The sites for each of the four tasks are previously studied wetland complexes found throughout the Delaware and Barnegat Bay Estuaries. The sites are Maruice, Dennis, Dividing, West Creek, Island Beach State Park and Reedy Creek. Maps of these sites can fe found in the umbrella QAPP in the appendix. The first addresses elevation capital in the vicinity of the 6 established wetlands monitoring sites of Dennis, Dividing, Maurice, West Creek, IBSP, and Reedy Creek. This methodology expands on the "line transects" methodology described in the umbrella QAPP entitled "Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0 (SSIM Umbrella QAPP), SOP #30 "Surveys of elevation along wetland monitoring transects". Approximately 15 transects will be established per watershed, 9 of these will be those already established running through and parallel to the Surface Elevation Tables (SETs). By pairing with established SET data, we will be able to directly pair new data on ecosystem services and shoreline condition with other results from ongoing SSIM efforts. An additional 6 transects (2 more per SET) will be established in the vicinity of SETs but further apart to capture different conditions. The two additional transects will be approximately 100m's from the original transects. At each transect, a RTK-GPS will be used to survey topography, slopes, and biological features. Error rates of the RTK GPS are spelled out in the umbrella QAPP in the appendix section. The transects will be assessed at least once per year, a higher frequency will be sampled if timing permits.

The second field task involves assessing the shoreline of the six sites. A unique component of this project is incorporating shoreline measurements to elevational studies, which a majority of SSIM is design to capture. These studies ultimately focus on the vertical changes which take place on the marsh platform, which are thought to be a major driving factor in allowing the marsh to keep pace with sea level rise. Many studies find that limitations in sediment load have serious implications for a marsh's abilities to maintain its vertical relationship with sea level rise. Accretionary sedimentation, however, is also proportional to shoreline erosion processes. Horizontal erosion, or the erosion of marsh shorelines, may contribute significantly to overall loss of marsh acreage when erosion is disproportionately larger than accretion. The balance between erosion and accretion is used as one of many proxies for marsh condition in Rapid Assessment Method (RAM) studies. By utilizing methods already described in RAM protocol as a framework for this project, we hope to relate how horizontal erosion (shoreline erosion) contributes to the functioning of a marsh, and more specifically, how these effects are related to the ability of a marsh to keep pace with rising sea levels. Six shoreline transects will be established within each watershed. Transects will be paired- on transect on each shoreline of the major channel associated with each SET. SET configurations vary at each SSIM location, so shoreline transects will be positioned where the shoreline (via flood water, erosion, etc…) is most likely to contribute to each SET's study area.

RAM protocol (see Appendix I) uses a 600 m transect (parallel to the shoreline—"shoreline transects") with 5 perpendicular transects (150 m apart, 20 m in length—"profile transects") at one assessment site. Since 6 shoreline transects will be completed in this study, it will be more effective to use 300 m, since they will be coupled across a channel, with 7 profile transects (50 m apart, 20 m in length) for better resolution. Shoreline and profile transects will be marked with PVCs to assist in relocating the exact same location in the future. Shoreline and profile transects will be contoured using RTK GPS for successive years to assess the change in the shape and position of the shoreline. These data will be coupled with all the vertical data trends to elucidate relationships between shoreline processes and elevational changes. The collection of these metrics is not dependent on vegetation, so may be completed any time from May to October.

The third field objective is to assess the ecosystem services provided in a typical salt marsh wetland by salt water mussels. Several regressions and other statistics will be carried out to discern spatial patterns in mussel distribution and its effects on ecosystem service estimations at each of the six sites. A hierarchical sampling design will be used to ensure that data are representative of salt marshes within the sample frame and capture some of the most important geospatial variability in targeted ecosystem services associated with distance from bay, elevation, and creek size. The design will consist of the following elements at each of the six watersheds:

- 3 Sites per Study Marsh located in close proximity to already established SET locations(lower nearest bay, middle, upriver)
- 3 parallel Transects per Site (extending from water edge to high marsh)

Hence, a total of 54 transects will be examined for this project. Along these transects, survey plots will be established within one of three habitat types: low marsh along big rivers (LMR), low marsh along small tidal creeks (LMC), and high marsh.

Further description and diagrams of transects and plot set-ups can be found in Appendix G- "Importance of ribbed mussels for salt marsh climate adaptation and water quality management in Atlantic estuaries QAPP".

The methodology described in Appendix G will be followed at the three Barnegat Bay sites, West Creek, IBSP, and Reedy Creek. Because these plots have already been established in the three Delaware Bay sites a variation of the methodology will be followed at these watersheds. Data collection for the Delaware Bay sites was collected in 2013 and since we estimate that mussel density are unlikely to change vastly from year to year, these data are still relevant to this project. To maximize efficiency and time, we propose to conduct a revised method to assess mussel densities that will provide data for the calibration of ecosystem service models. These methodologies will be designed to collect important distribution data which will ultimately be used to elucidate inherent variation within study areas and serve as a framework for future monitoring.

The study areas for this part of the study, will be delineated by the wetlands surrounding the SSIM metrics, as well as the locations previously used for the mussel work in Delaware Bay. General sub-habitats will be delineated (edge, low or high marsh, creek edge, etc) using GIS within the study areas. Several (number TBD) random 1 m^2 plot sites will be generated using this layer and distributed among each sub-habitat within the study area. Sampling will be prioritized by importance of sub-habitat for mussels based on previous work. Lip counts will be preformed within each plot, yet foregoing any excavation as previous findings suggest lip counting are sufficient for sampling mussel density. RTK GPS will be taken at each random plot (using the 5 point method). HOBOs water level loggers will be launched to discern the extent of the tidal prism, for approximately 3 weeks (in order to fully capture 1 spring and 1 neap tide). This sampling will occur once over the course of this project.

The fourth and final field task is to continue the long term marsh monitoring at the above mentioned six sites. This work will be important to layer the three previous data sets on top of. This data should help us determine stressors at the various sites as well as the site specific advantages against things like sea level rise. Complete methodology for this part of the project can be found in the approved QAPP entitled "Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0 (SSIM Umbrella QAPP).

2.2.2 Monitoring Methods (10.2)

Monitoring methodologies can be found in the two QAPP's in the appendix of this QAPP and are listed per task below;

Task #	Task	QAPP	SOP#	SOP Title
1	Elevation Capital	Importance of Ribbed Mussels…	9	Determination of Elevation of Wetland Surface
2	Shoreline Assessment	Importance of Ribbed Mussels…	9	Determination of Elevation of Wetland Surface
		Rapid Assessment Monitoring…		Appendix B-Mid Atlantic Rapid Assessment Method (Metric S1&2)
3	Ecosystem Services	Importance of Ribbed Mussels…	10	*Non-Destructive determination of mussel density
			9	Determination of Elevation of Wetland Surface
			12	Determination of Hydoperiod**
1,2,3		Importance of Ribbed Mussels	13	Construction of GIS map
4	Site Specific Intensive Monitoring	Intensive Monitoring and Assessment…	1-30	

*The diagram for layout of this metric can be found on page 25 of the mentioned QAPP. For the three sites in the Delaware (Maurice, Dennis and Dividing), as previously stated we will delineate these sites by the wetlands surrounding the SSIM metrics. General sub-habitats will be delineated (edge, low or high marsh, creek edge, etc) using GIS within the study areas. Several (number TBD) random 1 m^2 plot sites will be generated using this layer and distributed among each sub-habitat within the study area. Sampling will be prioritized by importance of sub-habitat for mussels based on previous work. Lip counts will be preformed at these random plots and over layered with the data previously recorded at the transects to determine if the mussel density numbers found on the transect hold to the larger wetland platform.

** Note since the writing of SOP 12 in QAPP "Importance of Ribbed Mussels.." it has been determined that the HOBO U20L water level logger by onset is a better instrument to use. The same methodology will be used as described in SOP 12 and further detail of the specifications of the HOBO can be found in this documents appendix.

Monitoring equipment and supplies include; RTK-GPS, color coded PVC, 1m^2 quadrants, 1/4m^2 quadrants, 1m measuring stick, vegetation board, 2m long pvc, maps, camera, data sheets, HOBO water level loggers, Surface Elevation Table arm, boardwalks, hand held gps, aluminum foil, sharpie, cooler, knife, clean 1 gallon cuitaners YSI water quality meter, water containers, 10cm diameter soil coir and 1cm Chlorophyl a core.

The only homogenized samples are task 4 the Site Specific Intensive Monitoring. Chlorphyl a surface samples are taken with a 1cm core, and the soil cores that are a 10cm diameter to the depth of 30cm are also homogenized. The soil sample is homogenized for soil chemistry.

All field equipment will be cleaned on site so that no invasive species will be transported between sites. All field gear will be left to dry so that no invasive speices can be transported. Laboratory cleaning is described in further detail in SOP # 22 in the "Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania Version1.0.

2.2.3 Field Quality Control (10.3)
The respective SOPs in the attached QAPP "Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0*"address QC activities.

2.3 Sample Handling and Custody Requirements (12)

Data collected on data sheets and log books will be kept in project specific bags that will be taken on each field day so that all data will be kept in one place. PDE has implemented a QA/QC protocol for tracking data sheets. Please reference the appendix for an example of this protocol. The protocol addresses where all digital data should be stored and accounts for the date and person (initials) in all steps of data analysis such as copying originals, data input and QC. PDE science staff will collect all data sheets and log books to be copied twice to ensure backup of all data, and these copies will be kept at the PDE office.

Samples will be taken from the field following their respective SOPs and will be handled and transported accordingly. All sample types will be tracked using PDE chain-of-custody forms that will be filled out fully and delivered with the samples to the Academy of Natural Sciences of Philadelphia (ANSP) or other partners (e.g. Rutgers, Drexel Universities) to be analyzed. Many QC activities for the laboratory can be found in their respective SOPs in the appendix of this QAPP. A representative from the partner entity will sign the chain-of-custody form when receiving all samples and verify that they have been handled according to the form. The Project Manager and PDE science staff will be in charge of this.

As described in the sampling methods above, MACWA Stations and associated samples will be named by year and state-number (i.e. 09DE-008).The samples taken from each of these sites will be clearly labeled with this information.

2.4 Analytical Methods (11.1)

All analytical methods are described in the QAPP entitled “Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0, found in the appendix. Further detail of the HOBO water level logger can also be found in the appendix.

2.4.1 Analytical Quality Control (11.2)
All analytical quality control methods are described in the QAPP entitled “Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0, specifically in the SOPs, found in the appendix. Further detail of the HOBO water level logger can also be found in the appendix.

2.5 Testing, Inspection, Maintenance and Calibration Requirements

2.5.1 Instrument/Equipment Testing, Inspection and Maintenance (13.1)

Instruments for water and sediment quality testing will follow attached SOPs in; “Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0”. The GPS unit will be calibrated at a known benchmark at least one every month or more frequently if a problem is suspected.

Any GPS unit that is used will be calibrated by using the “calibrate compass” function found on all GPS units. This function will be performed at the start of each field day as well as if a need arises to change the batteries in the middle of the day, the GPS unit will then be re-calibrated. At any site where data is collected a GPS mark will be input into the unit and those coordinates will be written into the log book as well. The written coordinates will be read back to another field crew to check that the lat/long was recorded correctly. The RTK GPS is + or – 1-2cm horizontally and vertically. The precision wil be assessed by repeated measurements of the same benchmark location on successive days.

2.5.1 Instrument/Equipment Calibration and Frequency (13.2)

The RTK GPS is calibrated at a known benchmark at least once every moth.
The YSI meter will be calibrated before each use.

2.5.1 Inspection/Acceptance of Supplies and Consumables (13.3)

All supplies will be inspected by the Project Officer to ensure they are suitable for the project. The only consumables come with Task 4 the Site Specific Intensive Monitoring and details for those can be found in the QAPP “Intensive Monitoring and Assessment Program for Tidal Wetlands of Delaware, New Jersey & Pennsylvania, Version 1.0” found in the appendix.

2.6 Data Management (14)

The data management plan for this study is as follows; field crews will collect data, then the data sheets as well as log books will be delivered to PDE offices. The Project Manager will make two copies of this data and will check ~20% of the data. Data will then be entered into a computer database, such as MS Excel. This data will then be checked by an independent observer. Data will then be analyzed for content and of this final data ~20% will be checked by the Project Manager or PDE science staff as well as the PDE QA officer. PDE staff will put all electronic data to be saved and backed up on the PDE server. All data will be kept on the PDE server under S:/Science Stuff/Projects/Wetlands. All documents will be named with WETLANDS followed by a description of their content. All raw data will be kept at PDE offices and copies will be given to partners in this project and to US EPA at the end of the project. The Project Manager or trained science staff will be in charge of filing all data.

3 Assessment and Oversight

3.1 Assessments and Response Actions (15)

Preparation for each field outing will initiate with a check of equipment functionality as well as a review of the task checklist. To ensure accuracy and precision all field crew members will have been trained previous to working. Because each of the site-specific intensified methodologies is specific there will not be a readiness review of the crew members, at each field outing there will be an ANSP or PDE representative who has been properly trained in that methodology who is responsible for that specific method. If problems arise the representative will note so in the log book

All field assessments and schedules will routinely be shared with the PDE QA officer. Annually the QA officer, or a trained alternate PDE staff member, will verify the accuracy of data being collected. If the proper assessments are not being preformed, further data collection will be stopped until proper procedures can be followed.

The Project Managers, lead science staff at PDE and BBP, and the QA officer will meet annually to discuss the project's progress and ensure that all approved assessment procedures are being followed. If corrective actions need to be made, then the Project Manager and QA officer will work in jointly to address any changes deemed necessary.

4 Data Validation and Usability

4.1 Data Review, Verification, Validation and Usability (16.1)

All data, laboratory and field, will be recorded electronically or manual and will be checked for accuracy by the Project Manager. Any laboratory data received from subcontractors will be QA checked by their internal systems as well. Regardless of the means with which data were initially recorded, all field data will be entered into a computer system within one week after collection.

A subset of data will then be checked for completeness and accuracy by the QA Manager. Data will only be considered valid if all datasheets are completely filled out or all information from an analytical lab is complete.

Data will be accepted if they meet the following criteria:

1. Field data sheets are complete.
2. Field data and laboratory data were validated
3. Actual sample locations and collection procedures match the proposed sample locations and collection procedures identified in section "Data Generation and Acquisition"
4. Sample handling procedures documented on chain-of-custody forms, the field activity report, and case narrative match the proposed sample handling procedures identified in section "Data Generation and Acquisition"
5. Field QC was conducted as planned

Any incomplete data or deviations will be reported on the quality assurance audits or the analytical report. The Project Managers will verify the content of the reports and will flag any data that fails to meet the QA requirement.

4.3 Reconciliation with user Requirements (16.2)

Data will be QA checked according to this document. Then, a meeting of the project group (PI's and advisors) will be called to discuss, reconcile, and refine any data analyses. This group will then determine if any parts of the data need to be adjusted or discarded because of any documented errors, field constaints, or equipment malfunctions. Since any changes or omissions of original data may limit the utility of study results by scientists and managers, any such alterations of data or data products will be fully disclosed to anyone who procures the data.

4.4 Non-Direct Measurements (9)

Potential sources of data include those collected under the auspices of the three approved QAPPs in the appendix. The only other secondary data that could be utilized during this project is shoreline retreat data that will be obtained through NJDEP. PDE and BBP will work in concert with the state to ensure that the data used for this project has been thoroughly QA/QCed by the state before using the data to compare it to the primary shoreline retreat data obtained by this project.

Appendix A: Chain of custody form

Project Name	Chief Scientist(s):
Samplers:	

ırtnership for the Delaware Estuary
One Riverwalk Plaza
!10 South Poplar Street, Suite 202
Wilmington, DE 19801
(800) 445-4935 or (302) 655-4990

Sta. No.	Date	Time	Station location	Asian Clams	Ribbed Mussels	other			Notes

Relinquished by:	Date/Time	Storage/Conditions Notes	Received by:	Remarks:
Relinquished by:	Date/Time	Storage/Conditions Notes	Received by:	
Relinquished by:	Date/Time	Storage/Conditions Notes	Received by:	

Appendix B. Sampling Datasheets

Team 1: Marker Horizon Readings, Vegetation Board Readings, and Mussel Lip Counts

River: Maurice Dennis Dividing RI **Site:** 1 2 3

Transect: 1 2 3 **Habitat:** LMR HM LMC

Names: ______________________________ **Date/Time:** ______________________________

Task 1: Read Feldspar Marker Horizon (mm) Orange (Non Des. Quads)

Take 2 measurements/side located 2cm in from each corner; n=8 measurements/sample

1_______ **2**________ **3**________ **4**_______**5**_______ **6**______
7_______ **8**_________

Observations: No Few Many Bioturbation (Crab Burrows)
Y N Standing Water **Y N** Wrack

Task 2: Vegetation Board Reading Orange and Blue Quads

Read number of bars observed at ground level, 0.25m, 0.5m and 0.75m above ground

Orange: 0.25______________ **0.5**______________ **0.75**______________

Blue : 0.25______________ **0.5**______________ **0.75**______________

Observations: Y N Wrack **Y N** Debris
Vegetation Type (Dominant First)________________________________

Task 3: Mussel Lip Counts Orange and Blue Quads

Count all mussels in each sub-quad and mark on data sheet

Orange Total:________________ **Blue Total:**____________

Observations:

No Few Many Dead Shells
No Few Many Bioturbation

Notes:

All Data Collected by (initial)___________________________ **Date:**___________

Team 2: Destructive Quad Excavation, Mussel Density, and Mussel Measurements

All collections take place in each Blue Destructive Quad at each site in all 3 habitats (n= 9 quads/site)

River: Maurice Dennis Dividing RI

Site: 1 2 3

Transect: 1 2 3

Habitat: LMR HM LMC

Names: ______

Date: ______

Destructive Quad (DQ)

Total Number of mussels Counted in 0.25m² quad ______

Ribbed Mussels Size Measurements (mm, logest axis = shell length); n=25 or all present < 25.

Observations:

☐ **Evident Mortality (shells)**

Is 0.25m² quad representative of outter 1m² quad?

☐ **Yes** ☐ **No** ☐ **Uncertain**

If No, why?)Mussel Patchiness? Non-vegetated area? ______

Notes:

All Data Collected by (initial) ______ **Date:** ______

Appendix C: YSI Calibration Work Sheet

CALIBRATION WORK SHEET

Date of Calibration: ________________ Technician: ________________________

DO membrane changed? Y N — Note: Should wait 6 to 8 hours before final DO calibration, run sensor for 15 minutes in Discrete Run to accelerate burn-in.

Turbidity wiper changed? Y N Wiper parks ≈ 180° from optics? Y N Note: Change wiper if probe will not park correctly.

Chlorophyll wiper changed? Y N Wiper parks ≈ 180° from optics? Y N Note: Change wiper if probe will not park correctly.

Record battery voltage: ____________

Record the following diagnostic numbers <u>after/during</u> calibration.

					Record Calibration Values: Actual	After calibration
Conductivity cell constant	______	Range 5.0	± .5	Conductivity	______	______
pH MV Buffer 7	______	Range 0 MV	± 50 MV	pH 7	______	______
pH MV Buffer 4	______	Range +177 from 7 buffer MV		pH 4	______	______
pH MV Buffer 10	______	Range −177 from 7 buffer MV		pH 10	______	______
NOTE: Span between pH 4 and 7 and 7 and 10 millivolt numbers should be ≈ 165 to 180 MV				ORP	______	______
NOTE: Check response time in buffer change & in Tap Water				Depth	______	______
DO charge	______	Range 50	± 25	Turbidity	______	______
DO gain	______	Range 1.0	.7 to 1.5	Turbidity	______	______
				Chlorophyll	______	______
Pressure Offset	______	Range −14.7	± 6 (non-vented)	Chlorophyll	______	______
Pressure Offset	______	Range 0	± 6 (vented)	DO	______	______
ORP mV Offset	______	Range 0	± 100			

DISSOLVED OXYGEN SENSOR OUTPUT TEST (after DO calibration probe in saturated air)

The following tests will confirm the proper operation of your DO sensor. The DO charge and gain must meet spec before proceeding.

610/650– Turn off the 610/650, wait 60 seconds. Power up 610/650 and go to the Run mode, watch the DO % output; it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

PC – Stop discrete and unattended sampling. Confirm that auto-sleep RS-232 is enabled (found in Advanced Menu under Setup). Wait 60 seconds. Start discrete sampling at 4 seconds. Watch the DO % output, it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. **Note:** You can disregard the first two samples they can be affected by the electronics warm-up.

The **ACCEPT/REJECT** criteria as follows:
The DO output in % must start at a positive number and decrease during the warm up. Example: 117, 117, 114, 113, 110, 107, 104, 102, 101, 100, 100. Should the output display a negative number or start at a low number and climb up to the cal point, the probe is rejected and <u>must not be deployed</u>.

_____ **ACCEPT** _____ **REJECT**

<u>Notes:</u>

1

Appendix D: YSI quality objectives

Temperature
Sensor Type...........Thermistor
Range.....................-5 to 50 □C
Accuracy................+/- 0.15 □C
Resolution..............0.01 □C
Depth...............200 meters

ROX Optical Dissolved Oxygen, % saturation
Sensor Type...........Optical, Luminescence Lifetime
Range.....................0 to 500 % air saturation
Accuracy ....0-200 % air saturation, +/- 1 % of the reading or 1 % air saturation, whichever is greater
200-500 % air saturation, +/- 15 % of reading; Relative to Calibration Gases.
Resolution..............0.1 % air saturation
Temperature Range -5 to 50 C
Depth............... 61 meters

ROX Optical Dissolved Oxygen, mg/L (Calculated from % air saturation, temperature and salinity)
Sensor Type.......... Optical, Luminescence Lifetime
Range.....................0 to 50 mg/L
Accuracy................0 to 20 mg/L, +/- 1 % of the reading or 0.1 mg/L, whichever is greater
20 to 50 mg/L, +/- 15 % of the reading; Relative to Calibration Gases.
Resolution..............0.01 mg/L
Temperature Range -5 to 50 C
Depth............... 61 meters

pH
Sensor Type...........Glass combination electrode
Range.....................0 to 14 units
Accuracy................+/- 0.2 units
Resolution..............0.01 units
Temperature Range -5 to 50 C
Depth...............200 meters

Turbidity
Sensor type............ Optical, 90 □ scatter, with mechanical cleaning

Range.................... 0 to 1000 NTU
Accuracy...............+/- 2% of the reading or 0.3 NTU (whichever is greater), in YSI AMCO-AEPA standards
Resolution..............0.1 NTU
Temperature Range -5 to 50 C
Depth…………… 61 meters

Conductivity
Sensor Type..........4 electrode cell with autoranging
Range....................0 to 100 mS/cm
Accuracy...............+/- 0.5% of reading + 0.001 mS/cm
Resolution.............0.001 mS/cm to 0.1 mS/cm (range dependent)
Temperature Range -5 to 60 C
Depth……………200 meters

Salinity
Sensor Type...........Calculated from conductivity and temperature
Range.....................0 to 70 ppt
Accuracy................+/- 1.0% of reading or 0.1 ppt, whichever is greater
Resolution..............0.01 ppt
Temperature Range -5 to 50 C
Depth……………..200 meters

Appendix E HOBO Manual and Specifications

HOBO® Water Temp Pro v2 (U22-001) Manual

onset
HOBO Data Loggers

The HOBO Water Temp Pro v2 logger is designed with a durable, streamlined, UV-stable case for extended deployments measuring temperature in fresh or salt water. The small size of the logger allows it to be easily mounted and/or hidden in the field. It is waterproof up to 120 m (400 feet) and rugged enough to withstand years of use, even in stream conditions. It has enough memory to record over 42,000 12-bit temperature measurements.

The logger uses an optical USB communications interface for launching and reading out the logger. The optical interface allows the logger to be offloaded without compromising the integrity of the seals. The USB compatibility allows for easy setup and fast downloads.

HOBO Water Temp Pro v2

U22-001

Included Item:

- Communications window protective cap

Required Items:

- Coupler (COUPLER-C) and USB Optic Base Station (BASE-U-4) or HOBO Waterproof Shuttle (U-DTW-1)
- HOBOware®

Accessories:

- Protective boot; black (BOOT-BLK) or white (BOOT-WHT)
- Replacement communications window protective caps (U22-U24-CAP)

Specifications

Temperature Sensor

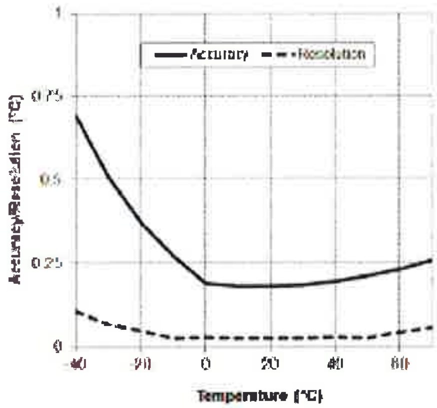
Operation Range	-40° to 70°C (-40° to 158°F) in air; maximum sustained temperature of 50°C (122°F) in water
Accuracy	±0.21°C from 0° to 50°C (±0.38°F from 32° to 122°F), see Plot A
Resolution	0.02°C at 25°C (0.04°F at 77°F), see Plot A
Response Time (90%)	5 minutes in water; 12 minutes in air moving 2 m/sec (typical)
Stability (Drift)	0.1°C (0.18°F) per year

Logger

Real-time Clock	± 1 minute per month 0° to 50°C (32° to 122°F)
Battery	2/3 AA, 3.6 Volt Lithium, factory-replaceable ONLY
Battery Life (Typical Use)	6 years with 1 minute or greater logging interval
Memory (Non-volatile)	64K bytes memory (approx. 42,000 12-bit temperature measurements)
Weight	42 g (1.5 oz)
Dimensions	3.0 cm (1.19 in.) maximum diameter, 11.4 cm (4.5 in.) length; mounting hole 6.3 mm (0.25 inches) diameter
Wetted Materials	Polypropylene case, EPDM o-rings, stainless steel retaining ring
Buoyancy (Fresh Water)	+13 g (0.5 oz.) in fresh water at 25°C (77°F); +17 g (0.6 oz.) with optional boot
Waterproof	To 120 m (400 ft.)
Shock/Drop	1.5 m (5 ft.) drop at 0°C to 70°C (32°F to 150°F)
Logging Interval	Fixed-rate or multiple logging intervals, with up to 8 user-defined logging intervals and durations; logging intervals from 1 second to 18 hours. Refer to the HOBOware software manual.
Launch Modes	Immediate start and delayed start
Offload Modes	Offload while logging; stop and offload
Battery Indication	Battery voltage can be viewed in status screen and optionally logged in datafile. Low battery indication in datafile.
NIST Certificate	Available for additional charge
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

10366-G MAN-U22-001

Specifications (continued)

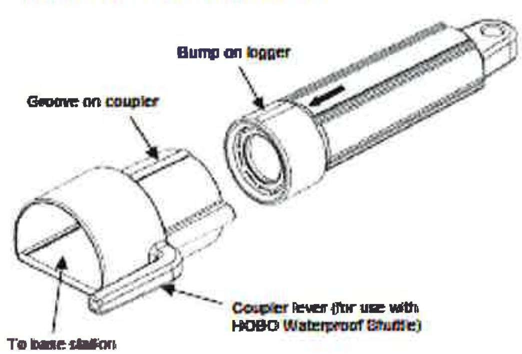


Plot A

Connecting the Logger

The HOBO Water Temp Pro v2 requires a coupler and USB Optic Base Station or HOBO Waterproof Shuttle to connect to the computer.

1. Install the logger software on your computer before proceeding.
2. Follow the instructions that came with your base station or shuttle to attach the base station or shuttle to a USB port on the computer.
3. Make sure the logger's communications window is clean and dry. (Use a clean, nonabrasive cloth, if necessary.) If the logger is wet, wipe off excess moisture.
4. Attach the coupler to the base station or shuttle, then insert the logger into the coupler so that the bump on the logger slides into the groove of the coupler. There is also an arrow etched on the logger case showing the direction the logger should be inserted into the coupler.



If you are using an older model of this logger and the arrow is not visible, hold the curved side of the coupler up as shown above. Insert the logger with the flat side up (the side in line with the flat side of the mounting hole).

5. If you are using the HOBO Waterproof Shuttle, briefly press the coupler lever to put the shuttle into base station mode.
6. If the logger has never been connected to the computer before, it may take a few seconds for the new hardware to be detected by the computer.
7. Use the logger software to launch the logger. You can check the logger's status, read out the logger while it continues to log, stop it manually with the software, or let it record data until the memory is full.

Refer to the software user's guide for complete details on launching, reading out, and viewing data from the logger, including multiple logging intervals.

Important: USB communications may not function properly at temperatures below 0°C (32°F) or above 50°C (122°F).

Note: The logger consumes significantly more power when it is "awake" and connected to a base station or shuttle. To conserve power, the logger will go into a low-power (sleep) mode if there has been no communication with your computer for 30 minutes. To wake up the logger, remove the logger from the coupler, wait a moment, then re-insert the logger.

Note: The first time you launch the logger, the deployment number will be greater than zero. Onset launches the loggers to test them prior to shipping.

Operation

A light (LED) in the communications window of the logger confirms logger operation. (In brightly lit areas, it may be necessary to shade the logger to see the LED blink.) The following table explains when the light blinks during logger operation:

When:	The Light Does this:
The logger is logging	Blinks once every one to four seconds (the shorter the logging interval, the faster the light blinks); blinks when logging a sample.
The logger is awaiting a start because it was launched in Start At Interval or Delayed Start mode	Blinks once every eight seconds until logging begins

Sample and Event Logging

The logger can record two types of data: samples and events. Samples are the sensor measurements recorded at each logging interval (for example, temperature every minute). Events are independent occurrences triggered by a logger activity, such as Bad Battery or Host Connected. Events help you determine what was happening while the logger was logging.

The logger stores 64K of data, and can record over 42,000 12-bit temperature measurements.

Deploying and Protecting the Logger

Follow these guidelines for deploying and protecting the logger:

Some monitoring applications require precise placement of the temperature sensor, such as measuring the temperature of a flow at the bottom of a stream or river. Ensure that the logger is appropriately secured so that the temperature sensor is in the desired measurement location.

Important: The plastic case will become brittle at temperatures lower than -20°C. If the logger is deployed in a location where the temperature drops below -20°C, make sure the logger remains stationary and is not pulled on or struck. Return the logger to above -20°C before handling.

- The opening at the sensor end of the logger accepts 1/4 inch (6.35mm) diameter nylon cord or other strong cable. If wire is wrapped through the sensor end to secure the logger, make sure the wire loop is snug to the sensor end. Any slack in the loop may cause excessive wear.
- The logger is slightly positive buoyant so that it will float if it is inadvertently dropped in the water or breaks free from its mooring. You may want to mark or label the logger with contact information in case the logger is lost.
- Use the included cap to protect the communications window in the logger from fouling and abrasion. Place the protective cap over the communications window before deploying the logger.
- As an alternative to the included protective cap, use the optional boot (Part # BOOT-BLK or BOOT-WHT) for high fouling environments and for protection against very cold temperatures (which can make the case brittle and prone to fracture) or repeated pounding and abrasion caused by turbulent flow. The boot slides over the logger, has a removable end cap, and is flexible enough to allow you to attach the coupler without removing the boot. To attach the base station, remove the end cap and firmly insert the logger until the boot folds back. Insert the logger into the coupler so that the bump on the logger slides into the groove of the coupler as shown on page 2.

  Although the boot does not cover the sensor end of the logger, the temperature response time (to 90% of final value) in water increases slightly from 5 to 8 minutes due to the increased mass.
- Depending on water conditions and desired measurement location, the logger should be appropriately weighted, secured, and protected.
- An alternative to the optional boot in high fouling environments is to protect the logger with plastic wrap that can be removed and replaced as needed.
- This logger should not be immersed for extended periods in any liquid other than fresh or salt water. To do so may void the warranty (refer to the Service and Support section). If you have any questions about chemical resistance, call Onset.
- Prolonged exposure to chlorinated water is not recommended.
- To clean the logger, rinse it in warm water. Use a mild dishwashing detergent if necessary. Do not use harsh chemicals, solvents, or abrasives, especially on the communications window.

Battery

The battery in the HOBO Water Temp Pro v2 is a 3.6 Volt lithium battery. The battery life of the logger should be about six years. Actual battery life is a function of the number of deployments, logging interval, and operation/storage temperature of the logger. To obtain a six-year battery life, a logging interval of one minute or greater should be used and the logger should be operated and stored at temperatures between 0° and 25°C (32° and 77°F). Frequent deployments with logging intervals of less than one minute, and continuous storage/operation at temperatures above 35°C, will result in significantly lower battery life. For example, continuous logging at a one-second logging interval will result in a battery life of approximately one month.

The logger can report and log its own battery voltage. If the battery falls below 3.1 V, the logger will record a "bad battery" event in the datafile. If the datafile contains "bad battery" events, or if logged battery voltage repeatedly falls below 3.3 V, the battery is failing and the logger should be returned to Onset for battery replacement.

To have your logger's battery replaced, contact Onset or your place of purchase for return arrangements. Do not open the case or attempt to replace the battery yourself. There are no user-serviceable parts inside. If you open the case, the warranty will be voided, and the logger may no longer be waterproof.

WARNING: Do not cut open, incinerate, heat above 100°C (212°F), or recharge the lithium battery. The battery may explode if the logger is exposed to extreme heat or conditions that could damage or destroy the battery case. Do not dispose of the logger or battery in fire. Do not expose the contents of the battery to water. Dispose of the battery according to local regulations for lithium batteries.

Appendix F Example of Data Accountability Form

SSIM DATA ACCOUNTABILITY CHECKLIST Page __ of __

Relevant SOPs: PDE-SOP-39 Procedure for Archiving Photo Data; PDE-SOP-40 Procedure for Entering Waypoints; PDE-SOP-41 Procedure for Entering SSIM Data; PDE-SOP-42 Field protocols SSIM

MACWA QAPP (pp.29-31) (http://delawareestuary.org/pdf/Restoration/MACWA_QAPP_Umbrella_SSIM_09_24_2010.pdf)

Project Folders: T:\Data\Wetland Assessment\SSIM\SSIM 'Year' Data; T:\Science Stuff\Photos\Wetlands\Data SSIM 'Year'; T:\Science Stuff\Photos\Wetlands\'Year';
T:\Data\Waypoints

Enter appropriate values into Field Date and Location. INITIAL AND DATE tasks (shaded) as they are completed.

Watershed / Station	Field Date	Scan copies of original datasheets	Put originals into library Put copies into bullpen binder	Download GPS points to computer	(#40) Enter GPS points to waypoint database	(#39) Download photos, place into project's photo folder	(#39) Apply metadata to photos	(#41) Digitize data from copies into project spreadsheet	Quality control measures on digitized spreadsheet	Merge data into SSIM database

Field Data Workflow