



# Water Quality Vital Signs Monitoring Protocol for the Pacific Island Network

## *Standard Operating Procedures*

### *Version 1.0*

Natural Resource Report NPS/PACN/NRR—2011/420



**ON THE COVER**

Stylishly safe NPS field crew  
Photograph by: NPS

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# **Water Quality Vital Signs Monitoring Protocol for the Pacific Island Network**

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### *Version 1.0*

Natural Resource Report NPS/PACN/NRR—2011/420

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## **Executive Summary**

Within the report narrative of the Water Quality Vital Signs Monitoring Protocol for the Pacific Island Network, the authors explain the rationale for monitoring and the specific objectives to be met by the monitoring program. The standard operating procedures (SOPs) in this document include specific instructions for conducting the water quality monitoring.



## SOP 1. General Preparations for Field Work

*Version 1.0 (April 2008)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision; identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
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## **Purpose**

Prior to conducting field work, observers are required to review the entire water quality protocol, including all SOPs listed in this protocol. Staff experienced in conducting this water quality monitoring protocol should review the protocol at least yearly. This SOP outlines steps to prepare for field work by ensuring the availability of proper equipment prior to the start of monitoring. More detailed descriptions of specific monitoring tasks are given in the SOPs for training technicians (SOP 2), following safety protocols (SOP 3), using the GARMIN global positioning system (GPS) units (SOP 4), preparing pre-sampling equipment (SOP 5), selecting water quality sampling stations (SOP 6), and conducting water quality sampling (SOP 7).

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix 1A of this SOP. The master equipment list should be updated simultaneously if any SOP pertaining to or containing gear lists is revised. A list of equipment required to complete the tasks specified in this SOP has been provided in Appendix 1B.

## **General Preparation and Review**

### ***Notebooks and Field Logs***

Review field notebooks and sampling logs from previous sampling occasions to identify unique events that may be encountered. A field notebook for the current survey year should be prepared with columns indicating sampling schedule, observer names, field hours, and unique happenings. These notations may influence how the data are interpreted and reported. Reports are based on information recorded in field notebooks; therefore it is imperative they are clearly organized for ease of entry in the field. Also, this field notebook should be used to document any problems with equipment (e.g. “Broken YSI probe guard, Need to pack a spare hex wrench.”). These issues should be reviewed and resolved prior to the next field trip.

**Load Waypoints:** Waypoints for each sample site must be loaded onto the Global Positioning System (GPS) unit prior to the start of field sampling. Waypoints are the X and Y coordinates for each station and used to navigate to the sampling stations; SOP 6 (Selecting Water Quality Sampling Stations) contains instructions for generating sample locations in latitude and longitude for each of the PACN parks with their associated Universal Transverse Mercator (UTM) grid coordinates and SOP 4 (Using GARMIN Global Positioning System (GPS) Units) contains instructions on loading sample locations into the GPS unit.

**Prepare Site Descriptions, Compass Headings:** A complementary list of compass headings and site descriptions should be compiled or updated in advance of the field work for each park (see SOP 6)/ A representative photo for each site (oriented properly) should also be included. Paper copies of these compass headings and site descriptions, in addition to the GIS/GPS version, should be carried into the field to ensure that each fixed sample is collected from the same point and described as in previous years.

**Generating Random Number Pairs:** A list of randomly generated number pairs should be made before entering the field. These numbers will be used to determine exactly where samples will be taken when field crews research a GPS waypoint. The numbers will resemble x and y coordinates, with first number indicating how far from the stream’s edge the sample should be

taken from. The second number in the pair is similar to a y coordinate, indicating how far from the GPS waypoint up or downstream the sample should be taken from.

**Consult Tide Tables:** For field sampling in parks with marine and brackish resources, obtain tide information for the site and sampling date prior to sampling. This information should be printed and included in the field notebook.

### ***Scheduling Field Work***

**Sampling Dates:** Sampling dates should be scheduled and logistics organized at least quarterly. Inclement weather and personnel workloads may require flexibility when scheduling sampling events. Water quality monitoring must be scheduled to coincide with other aquatic protocol's sampling (e.g., benthic marine communities, freshwater animal communities, groundwater) to examine any correlations with other data sets.

**Crew:** Monitoring efforts within each PACN park requires a two person crew for safety reasons. Parks may possess different requirements for safety, and field crews should check with resident park staff for updates prior to conducting field work; SOP 3 (Safety Protocol) should be reviewed by all personnel prior to entering the field.

**Timing and Co-location:** When water quality sites are co-located and co-visited with other Vital Signs monitoring for which access is limited, coordination between the field crews is required.

### ***Organizing Supplies and Equipment***

**Review Equipment Lists:** The Aquatic Technician ensures that all equipment listed in the tables of Appendix 1A of this SOP have been compiled, organized, and made ready for the field at least two months in advance. Advance preparation allows time to make needed repairs and order equipment.

**Field Data Forms:** Copies of the field data forms (see Appendix E of the protocol) must be made on waterproof paper.

**Reference Manuals:** Suggested reference manuals facilitating calibration and deployment of the sampling instrumentation should be reviewed by field personnel.

**Camera Gear:** Camera gear will be overhauled and tested as appropriate. Camera functional tests must be performed (see SOP 5. Pre-Sampling Equipment Preparation), and replacement supplies ordered and tested. The Olympus Stylus camera uses its own specific rechargeable battery.

**Field Vehicles:** Availability of field vehicles and research vessels should be independently verified for each park well before scheduled field work.

## Appendix SOP 1A. Master Gear List

Comprehensive list of equipment needed for the Water Quality Vital Signs Protocol

| Equipment (#/quantity)                                            | Preparation and Maintenance                                                                                                                                    |
|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Olympus Stylus 770 SW camera (1)                                  | Charged batteries added into the camera, memory card is in place and empty, picture resolution set to fine.                                                    |
| Battery pack (1–2)                                                | Ensure that this equipment is available.                                                                                                                       |
| Battery charger (1)                                               | Ensure that this equipment is available.                                                                                                                       |
| Olympus USB upload cable (1)                                      | Ensure that this equipment is available.                                                                                                                       |
| Memory Card (at least 1 GB) (2)                                   | Clear cards and insert one into camera (the other is a backup)                                                                                                 |
| Lens cleaner                                                      | Ensure that this equipment is available.                                                                                                                       |
| Lint-free cloth (2)                                               | Ensure that this equipment is clean and available.                                                                                                             |
| ThumbsPlus software                                               | If needed, ensure availability, update software regularly                                                                                                      |
| Extensis Portfolio software                                       | If needed, ensure availability, update software regularly                                                                                                      |
| Adobe Photoshop software                                          | If needed, ensure availability, update software regularly                                                                                                      |
| GARMIN Global Positioning System (G.P.S.) unit (1)                | Ensure that this equipment is available and set-up appropriately (according to SOP 4).                                                                         |
| ArcMap 9.1® software, Garmin Mapsource software                   | Check for software updates regularly                                                                                                                           |
| AA batteries (6)                                                  | Ensure this equipment is available. If rechargeable, ensure fully charged.                                                                                     |
| Waterproof case with dessicant and strap (1)                      | Ensure that this equipment is available. Replace dessicant pack biannually or if saturated.                                                                    |
| Charts and grid layouts                                           | Ensure that this equipment is available. Store in field binder.                                                                                                |
| Random number pair list                                           | Create document and store in the field binder.                                                                                                                 |
| Compass (1)                                                       | Ensure that this equipment is available. Store in field binder.                                                                                                |
| Map of fixed and random sampling sites (2 copies)                 | Update prior to each trip with GIS specialist. Print in color to waterproof paper. Label sites. Store in field binder.                                         |
| Fixed sampling site descriptions (with photo and compass heading) | Print to waterproof paper and store in field binder. Update if necessary prior to subsequent field sampling.                                                   |
| Park brochure and general map                                     | Store in field binder.                                                                                                                                         |
| YSI 6600 multiparameter water quality sonde (1–2)                 | Ensure proper functioning and battery power, calibrate probes, lubricate probe O-rings each trip, update firmware quarterly, change probe sponges when needed. |
| YSI probe guard (1–2)                                             | Ensure that this equipment is available.                                                                                                                       |
| C-size batteries (8–16)                                           | Ensure that this equipment is available.                                                                                                                       |
| YSI 650 Multiparameter Display System (MDS) (1)                   | Ensure proper functioning and battery power.                                                                                                                   |
| Cable for connecting YSI 650 display to 6600 sonde. (1)           | Ensure that this equipment is available and functioning properly.                                                                                              |
| 9/69", 7/69" hex wrench (for YSI probes)                          | Ensure that this equipment is available.                                                                                                                       |
| Extra YSI probe sponges (3)                                       | Ensure that this equipment is available.                                                                                                                       |

Comprehensive list of equipment needed for the Water Quality Vital Signs Protocol (continued).

| Equipment (#/quantity)                                                            | Preparation and Maintenance                                                        |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| .05" hex-wrench (for YSI sponge adjustment)                                       | Ensure that this equipment is available.                                           |
| Towel                                                                             | Ensure that this equipment is clean and available.                                 |
| Spare YSI port plugs                                                              | Ensure that this equipment is available.                                           |
| O-Ring lubricant                                                                  | Ensure that this equipment is available.                                           |
| Phillips-head screwdriver (for YSI battery compartment)                           | Ensure that this equipment is available.                                           |
| Calibration Log                                                                   | Update for each calibration event.                                                 |
| Suite of YSI calibration chemicals.                                               | Ensure that this equipment is available.                                           |
| Wiring, rope (for securing sonde for continuous deployment)                       | Ensure that this equipment is available and in excellent condition.                |
| 125mL acid-washed sampling bottles (3/site)                                       | Ensure that this equipment is available.                                           |
| Niskin bottle (1–2 L) (1)                                                         | Ensure that this equipment is functioning properly.                                |
| Water sample chain of custody (COC) forms (2–5 depending on # of samples)         | Fill out as samples are collected. Sign off as custody changes.                    |
| Water sample sticker labels (waterproof) (3/site)                                 | Ensure sufficient quantities, can be pre-labeled with date and site.               |
| 140mL(cc) syringes (30)                                                           | Ensure sufficient sterile or acid washed syringes are available for site sampling. |
| 4.7cm Glass microfiber filters (GF/F) (100 pack)                                  | Ensure proper placement in filter holders prior to field sampling.                 |
| 10% Aqueous Hydrochloric acid (500mL)                                             | Dilute to 1% concentration for acid washing. Label clearly.                        |
| ACS reagent grade water (4L)                                                      | Ensure proper quantities are available for dilution of HCL and equipment rinsing.  |
| 5.5" Forceps (1)                                                                  | Ensure that this equipment is available                                            |
| 47mm filter holder (24–48 depending on number of sites)                           | Ensure proper quantities are available.                                            |
| Latex exam gloves (100 pack)                                                      | Ensure proper quantities are available.                                            |
| 500mL wash bottles (6 pack)                                                       | Ensure that this equipment is available.                                           |
| Safety goggles                                                                    | Ensure that this equipment is available.                                           |
| Apron                                                                             | Ensure that this equipment is available.                                           |
| Ziploc bags (100 pack)                                                            | Ensure proper quantities are available to store prepared filters.                  |
| Parafilm (1 roll)                                                                 | Ensure that this equipment is available.                                           |
| Plastic dish washing bin (1)                                                      | Ensure that this equipment is available.                                           |
| Dish drying rack (1)                                                              | Ensure that this equipment is available.                                           |
| Paper towels                                                                      | Ensure that this equipment is available.                                           |
| Insulated field daypack (to hold up to 27 125mL samples on ice) (1)               | Ensure that this equipment is available.                                           |
| Wheeled cooler (airline approved, leak-proof, and able to be closed securely) (1) | Ensure that this equipment is available.                                           |

Comprehensive list of equipment needed for the Water Quality Vital Signs Protocol (continued).

| <b>Equipment (#/quantity)</b>                                        | <b>Preparation and Maintenance</b>                                                                                                               |
|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1" plastic 3-ring binder                                             | Ensure that this equipment is available                                                                                                          |
| Field datasheets (25–75 depending on site)                           | Print to waterproof paper, store in field binder.                                                                                                |
| Waterproof/resistant laser printer letter paper (1 pk)               | Ensure that this equipment is available.                                                                                                         |
| Park Permits (2 copies/park)                                         | Ensure currently, print to water proof paper, store in field binder                                                                              |
| Pens (3)                                                             | Ensure that the proper quantities are available.                                                                                                 |
| Ultra-fine tip black Sharpie (3)                                     | Ensure that the proper quantities are available.                                                                                                 |
| Black permanent marker (3)                                           | Ensure that the proper quantities are available.                                                                                                 |
| Mechanical pencils (5)                                               | Ensure that the proper quantities are available. Helpful to attach one to field notebook.                                                        |
| Field notebook/ log (2)                                              | Make sure there is available room in notebook for field sampling and a spare one just in case the logbook ends. Store main copy in field binder. |
| Water                                                                | Ensure that the proper quantities are available.                                                                                                 |
| Water Filter                                                         | Ensure this equipment is available.                                                                                                              |
| First Aid Kit                                                        | Keep stocked (see SOP 3. Safety Protocol)                                                                                                        |
| Sunscreen (non-toxic)                                                | Ensure that the proper quantities are available.                                                                                                 |
| Insect repellant (non-toxic)                                         | Ensure that the proper quantities are available.                                                                                                 |
| Sunglasses (polarized)                                               | Ensure that this equipment is available.                                                                                                         |
| Headlamp                                                             | Ensure this equipment is available.                                                                                                              |
| Headlamp batteries (usually AAA) (6 )                                | Label and charge.                                                                                                                                |
| Appropriate raingear, clothing and footwear (including stream shoes) | Ensure this equipment is available.                                                                                                              |
| Tent, sleeping bag (1/staff)                                         | Ensure this equipment is available.                                                                                                              |
| Personal items                                                       | Ensure this equipment is available.                                                                                                              |
| PACN Metadata Interview Form                                         | Complete annually                                                                                                                                |
| Product Submission Form                                              | Update and complete prior to digital submission of water quality information.                                                                    |
| NPS Natural Resource Publications template                           | Complete with annual reports and trend analysis reports.                                                                                         |
| Natural Resource Report template                                     | Complete with annual reports.                                                                                                                    |
| Natural Resource Technical Report template                           | Complete with trend reports, and peer-reviewed technical reports.                                                                                |

## Appendix SOP 1B. Specific Gear Lists

### *Tables*

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**Table SOP 1B1.** Equipment list for locating and documenting water quality sampling site locations.

| <b>Equipment (#/quantity)</b>                                     | <b>Preparation &amp; Maintenance</b>                                                                                   |
|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| GARMIN Global Positioning System (G.P.S.) unit (1)                | Ensure that this equipment is available and set-up appropriately (according to SOP 4).                                 |
| AA batteries (6)                                                  | Ensure this equipment is available. If rechargeable, ensure fully charged.                                             |
| Waterproof case with dessicant and strap (1)                      | Ensure that this equipment is available. Replace dessicant pack biannually or if saturated.                            |
| Charts and grid layouts                                           | Ensure that this equipment is available. Store in field binder.                                                        |
| Random number pair list                                           | Create document and store in the field binder.                                                                         |
| Compass (1)                                                       | Ensure that this equipment is available. Store in field binder.                                                        |
| Map of fixed and random sampling sites (2 copies)                 | Update prior to each trip with GIS specialist. Print in color to waterproof paper. Label sites. Store in field binder. |
| Fixed sampling site descriptions (with photo and compass heading) | Print to waterproof paper and store in field binder. Update If necessary prior to subsequent field sampling.           |
| Park brochure and general map                                     | Store in field binder.                                                                                                 |
| ArcMap 9.1® software, Garmin Mapsource software,                  | Check for software updates regularly                                                                                   |

**Table SOP 1B2.** Equipment needed for digital imaging of water quality field sites and sampling.

| <b>Equipment (#/quantity)</b>    | <b>Preparation and Maintenance</b>                                                                          |
|----------------------------------|-------------------------------------------------------------------------------------------------------------|
| Olympus Stylus 770 SW camera (1) | Charged batteries added into the camera, memory card is in place and empty, picture resolution set to fine. |
| Battery pack (1–2)               | Ensure that this equipment is available.                                                                    |
| Battery charger (1)              | Ensure that this equipment is available.                                                                    |
| Olympus USB upload cable (1)     | Ensure that this equipment is available.                                                                    |
| Memory Card (at least 1 GB) (2)  | Clear cards and insert one into camera (the other is a backup)                                              |
| Lens cleaner                     | Ensure that this equipment is available.                                                                    |
| Lint-free cloth (2)              | Ensure that this equipment is clean and available.                                                          |

**Table SOP 1B3.** Equipment needed for collecting water quality data and associated environmental data, and for maintaining water quality instrumentation.

| <b>Equipment (#/quantity)</b>                               | <b>Preparation and Maintenance</b>                                                                                                                             |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| YSI 6600 multiparameter water quality sonde (1–2)           | Ensure proper functioning and battery power, calibrate probes, lubricate probe O-rings each trip, update firmware quarterly, change probe sponges when needed. |
| YSI probe guard (1–2)                                       | Ensure that this equipment is available.                                                                                                                       |
| C-size batteries (8–16)                                     | Ensure that this equipment is available.                                                                                                                       |
| YSI 650 Multiparameter Display System (MDS) (1)             | Ensure proper functioning and battery power.                                                                                                                   |
| Cable for connecting YSI 650 display to 6600 sonde. (1)     | Ensure that this equipment is available and functioning properly.                                                                                              |
| 9/69", 7/69" hex wrench (for YSI probes)                    | Ensure that this equipment is available.                                                                                                                       |
| Extra YSI probe sponges (3)                                 | Ensure that this equipment is available.                                                                                                                       |
| .05" hex-wrench (for YSI sponge adjustment)                 | Ensure that this equipment is available.                                                                                                                       |
| Towel                                                       | Ensure that this equipment is clean and available.                                                                                                             |
| Spare YSI port plugs                                        | Ensure that this equipment is available.                                                                                                                       |
| O-Ring lubricant                                            | Ensure that this equipment is available.                                                                                                                       |
| Phillips-head screwdriver (for YSI battery compartment)     | Ensure that this equipment is available.                                                                                                                       |
| Suite of YSI calibration chemicals.                         | Ensure that this equipment is available.                                                                                                                       |
| Wiring, rope (for securing sonde for continuous deployment) | Ensure that this equipment is available and in excellent condition.                                                                                            |

**Table SOP 1B4.** Equipment needed for collecting water samples, preparing filtering equipment, and for filtering water samples in the field.

| Equipment (#/quantity)                                                            | Preparation and Maintenance                                                        |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 125mL acid-washed sampling bottles (3/site)                                       | Ensure that this equipment is available.                                           |
| Niskin bottle (1–2 L) (1)                                                         | Ensure that this equipment is functioning properly.                                |
| Water sample chain of custody (COC) forms (2–5 depending on # of samples)         | Fill out as samples are collected. Sign off as custody changes.                    |
| Water sample sticker labels (waterproof) (3/site)                                 | Ensure sufficient quantities, can be pre-labeled with date and site.               |
| 140mL(cc) syringes (30)                                                           | Ensure sufficient sterile or acid washed syringes are available for site sampling. |
| 4.7cm Glass microfiber filters (GF/F) (100 pack)                                  | Ensure proper placement in filter holders prior to field sampling.                 |
| 10% Aqueous Hydrochloric acid (500mL)                                             | Dilute to 1% concentration for acid washing. Label clearly.                        |
| ACS reagent grade water (4L)                                                      | Ensure proper quantities are available for dilution of HCL and equipment rinsing.  |
| 5.5" Forceps (1)                                                                  | Ensure that this equipment is available                                            |
| 47mm filter holder (24–48 depending on number of sites)                           | Ensure proper quantities are available.                                            |
| Latex exam gloves (100 pack)                                                      | Ensure proper quantities are available.                                            |
| 500mL wash bottles (6 pack)                                                       | Ensure that this equipment is available.                                           |
| Safety goggles                                                                    | Ensure that this equipment is available.                                           |
| Apron                                                                             | Ensure that this equipment is available.                                           |
| Ziploc bags (100 pack)                                                            | Ensure proper quantities are available to store prepared filters.                  |
| Parafilm (1 roll)                                                                 | Ensure that this equipment is available.                                           |
| Plastic dish washing bin (1)                                                      | Ensure that this equipment is available.                                           |
| Dish drying rack (1)                                                              | Ensure that this equipment is available.                                           |
| Paper towels                                                                      | Ensure that this equipment is available.                                           |
| Insulated field daypack (to hold up to 27 125mL samples on ice) (1)               | Ensure that this equipment is available.                                           |
| Wheeled cooler (airline approved, leak-proof, and able to be closed securely) (1) | Ensure that this equipment is available.                                           |

**Table SOP 1B5.** Checklist for documents and items to be included in the water quality field binder.

| <b>Equipment (#/quantity)</b>                                             | <b>Preparation and Maintenance</b>                                                                                                               |
|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1" plastic 3-ring binder                                                  | Ensure that this equipment is available.                                                                                                         |
| Waterproof/resistant laser printer letter paper (1 pk)                    | Ensure that this equipment is available.                                                                                                         |
| Field datasheets (25–75 depending on site)                                | Print to waterproof paper, store in field binder.                                                                                                |
| Map of fixed and random sampling sites (2 copies)                         | Update prior to each trip with GIS specialist. Print in color to waterproof paper. Label sites. Store in field binder.                           |
| Fixed sampling site descriptions (with photo and compass heading)         | Print to waterproof paper and store in field binder. Update if necessary prior to subsequent field sampling.                                     |
| Charts and grid layouts                                                   | Ensure that this equipment is available. Store in field binder.                                                                                  |
| Random number pair list                                                   | Create document and store in the field binder.                                                                                                   |
| Water sample sticker labels (waterproof) (3/site)                         | Ensure sufficient quantities, can be pre-labeled with date and site.                                                                             |
| Park Permits (2 copies/park)                                              | Ensure currently, print to water proof paper, store in field binder                                                                              |
| Pens (3)                                                                  | Ensure that the proper quantities are available.                                                                                                 |
| Ultra-fine tip black Sharpie (3)                                          | Ensure that the proper quantities are available.                                                                                                 |
| Black permanent marker (3)                                                | Ensure that the proper quantities are available.                                                                                                 |
| Mechanical pencils (5)                                                    | Ensure that the proper quantities are available. Helpful to attach one to field notebook.                                                        |
| Field notebook/ log (2)                                                   | Make sure there is available room in notebook for field sampling and a spare one just in case the logbook ends. Store main copy in field binder. |
| Park brochure and general map                                             | Store in field binder.                                                                                                                           |
| Water sample Chain of Custody (COC) forms (2–5 depending on # of samples) | Fill out as samples are collected. Sign off as custody changes.                                                                                  |
| Compass (1)                                                               | Store with field binder.                                                                                                                         |

**Table SOP 1B6.** List of necessary forms for the water quality protocol.

| <b>Equipment (#/quantity)</b>                                             | <b>Preparation and Maintenance</b>                                            |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Field datasheets (25–75 depending on site)                                | Print to waterproof paper, store in field binder.                             |
| Water sample chain of custody (COC) forms (2–5 depending on # of samples) | Fill out as samples are collected. Sign off as custody changes.               |
| Calibration Log                                                           | Update for each calibration event.                                            |
| PACN Metadata Interview Form                                              | Complete annually                                                             |
| Product Submission Form                                                   | Update and complete prior to digital submission of water quality information. |
| NPS Natural Resource Publications template                                | Complete with annual reports and trend analysis reports.                      |
| Natural Resource Report template                                          | Complete with annual reports.                                                 |
| Natural Resource Technical Report template                                | Complete with trend reports, and peer-reviewed technical reports.             |

**Table SOP 1B7.** List of basic field survival equipment for the water quality protocol.

| <b>Equipment (#/quantity)</b>                                        | <b>Preparation and Maintenance</b>               |
|----------------------------------------------------------------------|--------------------------------------------------|
| Water                                                                | Ensure that the proper quantities are available. |
| Water Filter                                                         | Ensure this equipment is available.              |
| First Aid Kit                                                        | Keep stocked (see SOP 3: Safety Protocol)        |
| Sunscreen (non-toxic)                                                | Ensure that the proper quantities are available. |
| Insect repellent (non-toxic)                                         | Ensure that the proper quantities are available. |
| Sunglasses (polarized)                                               | Ensure that this equipment is available.         |
| Headlamp                                                             | Ensure this equipment is available.              |
| Headlamp batteries (usually AAA) (6 )                                | Label and charge.                                |
| Appropriate raingear, clothing and footwear (including stream shoes) | Ensure this equipment is available.              |
| Tent, sleeping bag (1/staff)                                         | Ensure this equipment is available.              |
| Personal items                                                       | Ensure this equipment is available.              |

**Table SOP 1B8.** Useful software for managing water quality digital images.

| <b>Equipment (#/quantity)</b> | <b>Preparation and Maintenance</b>                        |
|-------------------------------|-----------------------------------------------------------|
| ThumbsPlus software           | If needed, ensure availability, update software regularly |
| Extensis Portfolio software   | If needed, ensure availability, update software regularly |
| Adobe Photoshop software      | If needed, ensure availability, update software regularly |



## SOP 2. Training Technicians

*Version 1.0 (April 2008)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision; identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
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## **Purpose**

This SOP outlines the requirements and training procedures that field staff and office analysts should follow. All field personnel should learn how to operate survey gear such as underwater cameras, field filtering apparatus, YSI 6600, and Global Positioning System (GPS) Units in addition to any required certifications for field activities such as helicopter operations and motorboat operations. Office personnel need to know (1) data management principles, infrastructure, and practices associated with this Vital Sign, (2) SOPs associated with field data collection practices, (3) sound statistical background for analyses (4) analysis and reporting principles outlined in the SOPs associated with this protocol.

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix 1A of SOP 1 (General Preparations for Field Work). The master equipment list should be updated simultaneously if any SOP requiring an equipment list is revised.

## **Field Personnel**

Field personnel must be familiar with all chapters and SOPs associated with field data collection and methods. All field personnel will participate in training on the use, care, and maintenance of the water quality instrumentation. The Project Lead is responsible for ensuring adequate training is received by all field personnel for the tasks they are assigned to do as part of this monitoring effort. The project lead will spend at least one sampling event each year with all field personnel to ensure compliance with processes and procedures outlined in the Water Quality protocol.

### ***NPS Motorboat Operator Certification***

All employees slated to operate motorboats must pass the NPS motorboat operator course prior to conducting field operations. Exceptions may be granted for personnel operating a boat under the supervision of an NPS motorboat operator instructor. All motorboat operators must be familiar with reference materials required of an NPS motorboat operator (Table SOP 2.1).

**Table SOP 2.1.** Required reference materials for NPS motorboat operator.

| <b>Reference</b>                                                                                                                                                               | <b>Location</b>                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| DOI Motorboat Operator Certification Course (MOCC) Manual (DOI DM 485, Chapter 22)                                                                                             | <a href="http://elips.doi.gov/elips/release/3252.htm">http://elips.doi.gov/elips/release/3252.htm</a> |
| Chapmans' Piloting Guide: Maloney, E.S. and C.F. Chapman. 1996. Chapman Piloting: Seamanship & Small Boat Handling (62 <sup>nd</sup> ed.). William Morrow and Company. 565 pp. | ?                                                                                                     |

### ***NPS Helicopter Operations Certification***

All employees slated to use helicopters for field access must pass the NPS A1 flight training and B3 dunker training course prior to conducting field operations. All field personnel engaging in helicopter operations must be current and familiar with requirements of an NPS flight certification.

### ***SOPs Associated with Field Data Collection Practices***

The PACN Aquatic Ecologist will ensure that all field personnel thoroughly and adequately understand the SOP's associated with the water quality monitoring protocol. Chapters and SOPs

related to these practices and procedures include Chapter 3 (Field Methods), SOP 5 (Pre-Sampling Equipment Preparation), SOP 6 (Selecting Water Quality Sampling Stations), SOP 7 (Conducting Water Quality Sampling), and SOP 8 (Post-Field Work Procedures and Equipment Maintenance).

### ***Operating Survey Gear***

The PACN Aquatic Ecologist is responsible for ensuring that all field personnel have adequate and proper training in calibration and use of all field equipment associated with this protocol.

- YSI 6600 and YSI 650 datalogger: Field personnel must be familiar with the operation of the YSI 6600 and YSI 650 datalogger in the field. See SOP 7 (Conducting Water Quality Sampling).
- Underwater Camera Gear: Field personnel must be familiar with the operation of the underwater camera. See SOP 7 and SOP 5 for information on how to set up the camera for surveys.
- GPS: Field personnel will need to learn how to operate the GPS to navigate to various waypoints. See SOP 4: “Using GARMIN Global Positioning System (GPS) Units” and practice using the unit before heading out into the field.

Reference materials related to operating survey gear can be found in Table SOP 2.2.

**Table SOP 2.2.** Survey gear reference materials.

| <b>Reference</b>                                                   | <b>Location</b>                    |
|--------------------------------------------------------------------|------------------------------------|
| Operator manual for YSI 6600 and 650                               | I&M Library: hard copy and digital |
| Operator manual for camera (e.g., Olympus Stylus).                 | I&M Library: hard copy and digital |
| Operator manual for GPS to be used in the field (e.g., Garmin 76). | I&M Library: hard copy             |

### ***Computer Software***

All field and office personnel should be familiar with using Microsoft Word, Microsoft Excel, Microsoft Access, and Instrument software Programs (Table SOP 2.3).

The PACN Aquatic Ecologist will ensure that all personnel utilizing instrument software will be fully familiar with the applications and functions.

**Table SOP 2.3.** Computer software references.

| Reference                                           | Location                                                                                                                                                                            |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Microsoft Word manual or third party manual         | I&M library; and: <a href="http://office.microsoft.com/en-us/assistance/default.aspx">http://office.microsoft.com/en-us/assistance/default.aspx</a> (last accessed 26May2006)       |
| Microsoft Excel manual or third party manual        | I&M Library; and visit: <a href="http://office.microsoft.com/en-us/assistance/default.aspx">http://office.microsoft.com/en-us/assistance/default.aspx</a> (last accessed 26May2006) |
| Instrument software (EcoWatch)                      | I&M Library: hard copy and digital                                                                                                                                                  |
| Photoshop CS2 software manual or third party manual | I&M Library: hard copy and digital                                                                                                                                                  |
| Statistica 7.0 instructional manual                 | I&M Library: hard copy and digital                                                                                                                                                  |

### **Office Personnel**

All office personnel will need to be familiar with the PACN monitoring plan. The complete monitoring plan will be posted at:

<http://www1.nature.nps.gov/im/units/pacn/monitoring/index.htm> (last accessed 30 April 2008).

All office personnel associated with this protocol will read and be familiar with all chapters and SOPs of the Water Quality Monitoring Vital Signs Protocol.

Data Management Principles, Infrastructure, and Practices: PACN: All office personnel will be familiarized with the PACN I&M Program infrastructure and practices. All office personnel will be required to read and be familiar with the PACN data management principles and infrastructure, which can be found in Chapters 4 (Data Handling, Analysis and Reporting) and 6 (Operations Requirements) of the protocol narrative.

In the Water Quality Monitoring Protocol, the chapters and SOPs associated with data management include: Chapter 4 of the protocol narrative, SOP10 (Workspace Setup and Project Records Management–), SOP 11 (Data reporting and Analyses).

SOPs Associated with Field Data Collection Practices: All office personnel will need to be familiar with all chapters and SOPs associated with field data collection and methods. Chapters and SOPs related to these practices and procedures include Chapter 3 of the protocol narrative (Field Methods), SOP 5 (Pre-Sampling Equipment Preparation), SOP 6 (Selecting Water Quality Sampling Stations), SOP 7 (Conducting Water Quality Sampling), and SOP 8 (Post-Field Work Procedures and Equipment Maintenance).

Sound Statistical Background for Analyses: All office personnel will be familiar with Microsoft Office, and in particular, MS-Word, MS-Excel and MS-Access. Other software that office personnel will need to be familiar with, include JMP, Statistica, Systat, or other statistical software (Table SOP 2.4).

All office personnel will need to review the manual for Statistica 7.0, the Statistical Software used for data analysis with the water quality protocol data analysis. More information on data analysis can be found in Chapter 4 of the protocol narrative (Data Handling, Analysis, and Reporting) and SOP 19 (Data Analysis and Reporting).

**Table SOP 2.4.** Reference materials for operating computer software.

| Reference                                           | Location                                                                                                                                                                            |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Microsoft Word manual or third party manual         | I&M library; and: <a href="http://office.microsoft.com/en-us/assistance/default.aspx">http://office.microsoft.com/en-us/assistance/default.aspx</a> (last accessed 26May2006,)      |
| Microsoft Excel manual or third party manual        | I&M Library; and visit: <a href="http://office.microsoft.com/en-us/assistance/default.aspx">http://office.microsoft.com/en-us/assistance/default.aspx</a> (last accessed 26May2006) |
| Photoshop CS2 software manual or third party manual | I&M Library: hard copy and digital                                                                                                                                                  |
| Statistica 7.0 instructional manual                 | I&M Library: hard copy and digital                                                                                                                                                  |

Analysis and Reporting Principles: All office personnel will be required to read and be familiar with the chapters and SOPs in the PACN Monitoring Plan associated with analysis and reporting. In particular, Chapter 7 of the protocol narrative (Data Analysis and Reporting).

All office personnel will be required to read and understand all chapters and SOPs associated with analysis and reporting in the Water Quality Protocol. In particular, office personnel will need to be familiar with Chapter 4 in the protocol narrative (Data Handling, Analysis, and Reporting); SOPs 10–18, which cover data management; and SOP 19 (Data Analysis and Reporting). Furthermore, office personnel will need to be familiar with the PACN and this Vital Sign’s reporting needs and audiences both for the network and each park.

## SOP 3. Safety Protocol

*Version 1.0 (April 2008)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision; identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
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## Purpose

This SOP explains the safety protocol for the Water Quality Vital Signs Monitoring Protocol and associated SOPs for the Pacific Island Network. This document outlines safety considerations for conducting any aspect of the protocol. All observers should be familiar with this SOP in order to identify and use the most current procedures and ensure optimum safety.

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix 1A of SOP 1 (General Preparations for Field Work). The master equipment list should be updated simultaneously if any SOP requiring an equipment list is revised.

## General Preparation and Review

Prior to conducting field work, observers are required to review this entire water quality protocol, including all SOPs listed in this protocol. In particular, all participants should be thoroughly familiar with the NPS Occupational Safety and Health Policies, scuba and watercraft manuals, various environmental and chemical safety guidelines, procedures outlined in SOP 2: "Training Technicians," as well as the various equipment lists in SOP 1.

The USGS National Field Manual for the collection of Water-Quality Data (USGS variously dated, (<http://water.usgs.gov/owq/FieldManual/index.html>) is another recommended reference for safety procedures. Table SOP 3.1 provides a partial list of reference material and websites with information on specific safety topics.

**Table SOP 3.1.** List of documents and websites for safety requirements and guidelines related to conducting the water quality monitoring protocol

| Safety Topic                                  | Guidance                                                                                              | Website                                                                                                                                                   |
|-----------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Safety policies, regulations and requirements | DRAFT NPS RM 50B Occupational Safety & Health Program                                                 | <a href="http://inside.nps.gov/waso/custommenu.cfm?lv=2&amp;prg=46&amp;id=5898">http://inside.nps.gov/waso/custommenu.cfm?lv=2&amp;prg=46&amp;id=5898</a> |
|                                               | Safety Smart!                                                                                         | <a href="http://safetysmarts.smis.doi.gov/">http://safetysmarts.smis.doi.gov/</a>                                                                         |
|                                               | USGS National Field Manual Section 9.1 (Lane and Fay 1997).                                           | <a href="http://water.usgs.gov/owq/FieldManual/Chap9/content.html">http://water.usgs.gov/owq/FieldManual/Chap9/content.html</a>                           |
|                                               | 29 CFR, Part 1960, "Elements for Federal Employee Occupational Safety and Health Programs," Subpart C |                                                                                                                                                           |
| Safety training guidelines                    | Departmental Manual (DM), Part 485, "Safety and Health Handbook," Chapter 4                           |                                                                                                                                                           |
|                                               | SMIS Training Materials                                                                               | <a href="https://www.smis.doi.gov/SMISReference/homepage.htm">https://www.smis.doi.gov/SMISReference/homepage.htm</a>                                     |
|                                               | DOI Office of Occupational Health and Safety                                                          | <a href="http://www.doi.gov/ohs/index.html">http://www.doi.gov/ohs/index.html</a>                                                                         |
|                                               | 29 CFR, Part 1960, "Elements for Federal Employee Occupational Safety and Health Programs," Subpart H |                                                                                                                                                           |
|                                               | Departmental Manual (DM), Part 485, "Safety and Health Handbook," Chapter 13                          |                                                                                                                                                           |

**Table SOP 3.1.** List of documents and websites for safety requirements and guidelines related to conducting the water quality monitoring protocol (continued).

| Safety Topic                           | Guidance                                                   | Website                                                                                                                                                             |
|----------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Boating safety                         | NPS Reference Manual 50B, Section 9.0 Watercraft Safety    | <a href="http://inside.nps.gov/waso/custommenu.cfm?lv=3&amp;prg=704&amp;id=2863">http://inside.nps.gov/waso/custommenu.cfm?lv=3&amp;prg=704&amp;id=2863</a>         |
|                                        | DOI Motorboat Operator Certification Course (MOCC)         |                                                                                                                                                                     |
| Transportation                         | NPS Reference Manual 50B, Section 6.0 Motor Vehicles       | <a href="http://www.inside.nps.gov/waso/custommenu.cfm?lv=3&amp;prg=704&amp;id=2860">http://www.inside.nps.gov/waso/custommenu.cfm?lv=3&amp;prg=704&amp;id=2860</a> |
|                                        | USGS National Field Manual Section 9.3                     | <a href="http://water.usgs.gov/owq/FieldManual/Chap9/content.html">http://water.usgs.gov/owq/FieldManual/Chap9/content.html</a>                                     |
|                                        | State, Territory, and Commonwealth traffic laws            |                                                                                                                                                                     |
| Helicopter operations                  | Interagency Aviation Training                              | <a href="https://www.iat.gov/">https://www.iat.gov/</a>                                                                                                             |
| Inclement weather and water activities | USGS National Field Manual Section 9.4                     | <a href="http://water.usgs.gov/owq/FieldManual/Chap9/content.html">http://water.usgs.gov/owq/FieldManual/Chap9/content.html</a>                                     |
|                                        | National Weather Service                                   | <a href="http://www.prh.noaa.gov">http://www.prh.noaa.gov</a>                                                                                                       |
| Environmental conditions               | USGS National Field Manual Section 9.8                     | <a href="http://water.usgs.gov/owq/FieldManual/Chap9/content.html">http://water.usgs.gov/owq/FieldManual/Chap9/content.html</a>                                     |
|                                        | 1992. USDHHS. CDC. HIOSH. "Working in Hot Environments"    |                                                                                                                                                                     |
| Chemical handling and storage          | USGS National Field Manual Section 9.6                     | <a href="http://water.usgs.gov/owq/FieldManual/Chap9/content.html">http://water.usgs.gov/owq/FieldManual/Chap9/content.html</a>                                     |
|                                        | MSDS file, right to know                                   |                                                                                                                                                                     |
| Contaminated water                     | NPS Reference Manual 83D1 Bathing Beaches                  | <a href="http://www.nps.gov/public_health/interinfo/rms/rm83d1.pdf">http://www.nps.gov/public_health/interinfo/rms/rm83d1.pdf</a>                                   |
|                                        | Recreational Waters                                        | <a href="http://www.nps.gov/public_health/inter/rec_water/rw.htm">http://www.nps.gov/public_health/inter/rec_water/rw.htm</a>                                       |
|                                        | USGS National Field Manual Section 9.7                     | <a href="http://water.usgs.gov/owq/FieldManual/Chap9/content.html">http://water.usgs.gov/owq/FieldManual/Chap9/content.html</a>                                     |
|                                        | EPA                                                        | <a href="http://www.epa.gov/OST/beaches/">http://www.epa.gov/OST/beaches/</a>                                                                                       |
| Animals and disease vectors            | NPS Reference Manual 83G Vectorborne and Zoonotic Diseases | <a href="http://www.nps.gov/public_health/interinfo/rms/rm83g.pdf">http://www.nps.gov/public_health/interinfo/rms/rm83g.pdf</a>                                     |
|                                        | USGS National Field Manual Section 9.9                     | <a href="http://water.usgs.gov/owq/FieldManual/Chap9/content.html">http://water.usgs.gov/owq/FieldManual/Chap9/content.html</a>                                     |
|                                        |                                                            | <a href="http://inside.nps.gov/waso/custommenu.cfm?lv=3&amp;prg=533&amp;id=1137">http://inside.nps.gov/waso/custommenu.cfm?lv=3&amp;prg=533&amp;id=1137</a>         |
| Divers/Boat Operators                  | Reference Manual 4 Diving Management                       | <a href="http://inside.nps.gov/waso/custommenu.cfm?lv=3&amp;prg=533&amp;id=1137">http://inside.nps.gov/waso/custommenu.cfm?lv=3&amp;prg=533&amp;id=1137</a>         |

Safety is “the condition of averting or not causing injury, danger, or loss” (Lane and Fay 1997). As a Federal employee, partner, or cooperator, you are required to know and follow safety policies and requirements documented in Reference Manual 50 B Occupational Safety and Health Program (<http://inside.nps.gov/waso/custommenu.cfm?lv=2&prg=46&id=5898>). For divers and boat operators, Reference Manual 4 Diving Management (RM-4 located at <http://inside.nps.gov/waso/custommenu.cfm?lv=3&prg=533&id=1137>) and Reference Manual 9 Watercraft Safety (<http://inside.nps.gov/waso/custommenu.cfm?lv=3&prg=704&id=2863>) should be followed accordingly. In addition, individual parks also have park specific safety

procedures, and operational protocols. This SOP recommends that these and all other available reference materials be used to address the topics below.

### **Safety Policies, Regulations and Requirements**

All individuals participating in activities related to this Vital Signs must adhere to applicable safety policies, regulations, and requirements outlined in RM 50 B Occupational Safety and Health Program. This includes both field and office activities and applies equally to NPS staff, cooperators, partners, volunteers, and others. The applicable policies, regulations, and requirements of each participating agency should be compiled and reviewed each year as part of this SOP. Ensure that all field personnel obtain First Aid, CPR training, and oxygen administration. This is also highly recommended for office personnel. Supervisory staff should ensure that all field staff are well trained in the safety guidelines and policies outlined below.

### **Transportation**

Safety considerations for vehicles used to reach sampling sites should be considered for each park and field location. It is very important to inspect the vehicle before going into the field. Ensure that safety equipment required for the scheduled activity is stowed securely in the vehicle. During driving to and from sampling areas, it is particularly important to consider issues such as night-time driving, fatigue, storms, road flooding, driving in unfamiliar areas, and remote areas where large animals may be crossing the road. Additional details regarding transportation safety procedures and policies are listed in NPS Reference Manual 50B Section 6.0 Motor Vehicles (<http://www.inside.nps.gov/waso/custommenu.cfm?lv=3&prg=704&id=2860>) and the USGS National Field Manual Section 9.3 (USGS, <http://water.usgs.gov/owq/FieldManual/Chap9/content.html>).

In some cases, this protocol may require the transportation of a trailered vessel. Vehicles towing boat trailers should only be operated by individuals who have completed the Department of the Interior (DOI) Motorboat Operator Certification Course (MOCC). All small boat operations must be conducted by DOI MOCC certified operators and must follow the operational and safety guidelines detailed in the NPS Reference Manual 9 “Watercraft Safety” (<http://inside.nps.gov/waso/custommenu.cfm?lv=3&prg=704&id=2863>) in addition to park-specific guidelines. In some cases, approval to operate motorboats may be granted to individuals holding comparable or greater certifications (e.g. US Coast Guard Captain’s License), but this is at the discretion of the Park Safety Officer and/or Park Diving Officer (PDO).

### **Weather**

Sampling during inclement weather is of particular concern in the aquatic environments. Streams can swell drastically without warning and weather can change rapidly on the ocean, creating hazardous conditions in a relatively short time period. Prior to departure, it is the responsibility of all personnel to be aware of the appropriate local weather, tide, and current forecast for the day and to decide whether sampling should commence. Consult the USGS National Field Manual Section 9.4 (<http://water.usgs.gov/owq/FieldManual/Chap9/content.html>) for more weather related safety considerations. Also review Reference Manual 9 “Watercraft Safety” and Reference Manual 4 “Diving Management” (<http://inside.nps.gov/waso/custommenu.cfm?lv=3&prg=533&id=1137>) for additional information regarding inclement weather.

Sampling should be conducted during periods of little rain, mild wind, and small ocean swell. If thunder is heard or lightning seen while boating, sampling will be suspended and personnel should return to shore for at least 30 minutes. Do not stay on the water during a lightning storm. During intense rainfall events, visibility may drop and appropriate precautions should be taken to ensure that the boat does not ground. At any point during sampling, any personnel involved have the right and responsibility to abort a sampling trip if hazardous conditions develop.

### ***Helicopter Operations***

Unique safety hazards of using helicopters as transportation exist and mandatory training (Aviation B3) is required and must be completed before any helicopter use may commence. Each passenger of DOI contracted or operated helicopters must strictly adhere to the DOI aviation and aviation safety guidelines as well as the guidelines required by each park for helicopter operations. DOI helicopter guidance can be obtained through the interagency aviation training website (<https://www.iat.gov>). Park specific aircraft use guidance can be obtained by contacting the safety officer or superintendent at each park where helicopter operations may take place. All helicopter operations will be conducted at the discretion of the Park Aviation Officer (PAO) or designated authority having final approval of all helicopter activity within his/her park. The PAO should be consulted prior to the start of field activities for assistance with park specific requirements and/or safety issues.

### ***Environmental Conditions***

Individual parks have occupant emergency plans which cover safety procedures for medical emergencies, earthquakes, floods, fires, Tsunamis, and bomb threats. Be familiar with the procedures and emergency contact numbers of your duty station park as well as other parks you may visit during field sampling activities. Overall, be aware of your environment, use common sense, do not exceed your limits (for example, operation of equipment; lifting heavy objects and equipment; physical tolerance to exertion, heat, and cold), and trust your instincts (Lane and Fay 1997). The USGS National Field Manual Section 9.8 (<http://water.usgs.gov/owq/FieldManual/Chap9/content.html>) covers environmental hazards in more detail.

Rough, steep, and slippery terrain will be encountered when conducting field work necessary for this protocol. Appropriate footwear should be worn to protect field personnel from foot and leg injuries. Field conditions in the region are likely to expose crews to intense tropical sunlight, wind, and rain. Flash flooding should always be a concern when working near streams. High topographical relief in the region combined with the episodic nature of rainfall in the tropics leads to extreme flood events with little or no warning. The marine environment presents additional unique environmental hazards. Strong currents and ocean swell can present physically challenging and dangerous conditions for boaters and divers. Collecting water quality data from brackish water resources will require hiking over very rough and unstable terrain in hot and arid conditions. Special care needs to be taken to protect field personnel from injuries as well as dehydration and exposure in these environments.

### ***Chemical and Material Safety Considerations***

All chemicals should be handled and stored according to the recommendations found in the Material Safety and Data Sheet (MSDS) provided by the supplier. All persons using or exposed to hazardous substances must be fully informed of the properties and potential hazards of the material in use as well as proper handling and disposal procedures. Park staff should always be consulted about local considerations when handling any chemicals of concern. Chemical users should also consult the park-specific Chemical Hygiene Plan. Other chemical handling procedures can be found in the USGS National Field Manual Section 9.6 (<http://water.usgs.gov/owq/FieldManual/Chap9/content.html>).

### ***Contaminated Water***

Waterborne pathogens that may survive or be transmitted in seawater include *Enterococci* and *Staphylococci* bacteria. Never consume seawater. Aquatic areas being sampled may be contaminated with pathogens or harmful chemicals although this situation is rare in the PACN. Water quality issues in the PACN are outlined in Appendix I of the protocol. As a general rule, when conducting water quality sampling, use extra precautions such as not eating or drinking while sampling. Consuming untreated or unfiltered freshwater may result in the contraction of bacterial diseases or parasites (i.e. *Leptospirosis*, *Giardia*.) In particular, keep hands away from nose, ears and mouth and wash hands thoroughly before eating. If no soap and water are available, use of an antibacterial hand cleanser is highly recommended after handling water sampling equipment. Consult NPS Reference Manual 83D1 Bathing Beaches ([http://www.nps.gov/public\\_health/inter/info/rms/rm83d1.pdf](http://www.nps.gov/public_health/inter/info/rms/rm83d1.pdf)) and the USGS National Field Manual Section 9.7 (<http://water.usgs.gov/owq/FieldManual/Chap9/content.html>) for complete recommended safety procedures concerning contaminated water.

### ***Animal Hazards and Disease Vectors***

Any open cut has a high likelihood of becoming infected and all cuts should be carefully tended and monitored. Terrestrial areas of the PACN are relatively free of pests, although the brown tree snake is a concern on Guam. Mosquitoes, possible vectors, are likely to be encountered in the freshwater and brackish water environments. Personnel should also be aware of spiders and other insects that can bite or sting. Of particular medical concern are the black widow spider and the brown violin spider. Though bites are not common, if they occur, personnel should seek immediate medical attention (Kuwaye, 2002). Hazardous marine life, including jellyfish, scorpion fish, cone snails, and large fish, can sting or bite, and some of these conditions can be life threatening (Thomas and Scott 1997). Corals can scrape and/or cut and care should be taken to avoid contact with the bottom. Appropriate first aid should be administered and professional medical attention sought if necessary. It is the responsibility of all personnel to be familiar with the local hazardous flora and fauna and to understand the appropriate treatment methods.

### ***Field Trip Preparations and Emergency Contacts***

Basic planning is required before each field sampling event. A large component of the planning effort involves gathering safety information and documenting all aspects of field sampling trip plans in advance. All field personnel should complete an Emergency Contact Form (Appendix SOP 3A) and a Medical Information Form (Appendix SOP 3B) prior to conducting field work. A trip plan must be completed. One copy should be left at the office, and additional copies should be given to the park safety officer and field personnel involved in the trip. Weather and marine

forecasts should be obtained prior to departure. Upon completion of the field work it is imperative that personnel check in with the park safety officer at the specified time noted on the plan.

It is the responsibility of all personnel to ensure that the appropriate safety equipment is present and in working condition. Examples of safety equipment checklists are provided below (Appendix SOP 3C). These lists should be customized according to the specific field conditions and the needs of personnel. Additional safety equipment may be required at some parks, and the Park Safety Officer and PDO must be consulted prior to commencing sampling activities. No sampling activities will be conducted without all necessary safety equipment present and in proper working condition.

### ***Emergency Procedure***

In the event of an emergency, the first action is ALWAYS to take care of the injured person and seek help. Once help is on the way and the situation is under control, the team leader or crew member should contact, or have someone else contact, the supervisor to inform them of the incident. The person that sustained the injury, or (if necessary) another team member who was witness to the accident must fill out report forms as soon as feasibly possible. The forms are available online on The United States Department of the Interior Safety Management Information System (SMIS) at <https://www.smis.doi.gov/>. This website contains online accident reports and other documentation to be filled out by the injured crew member, witnesses, and supervisor. These documents must be completed as soon as possible, no later than 24 hours from the time of the accident.

### **Literature**

- Lane, S. L., and R. G. Fay. 1997, Safety in field activities. U.S. Geological Survey techniques of water-resources investigations. Book 9, Chapter A9. University of Hawaii John A. Burns School of Medicine, Department of Pediatrics, Honolulu, Hawaii. Online. (<http://water.usgs.gov/owq/FieldManual/Chap9/content.html>). Accessed 4 January 2010.
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## Appendix SOP 3A. List of Basic Field Survival Equipment for the Water Quality Protocol

Note that a master gear list is located in SOP 1 (General Preparations for Field Work). If any changes are made with regard to equipment type, quantity, or required items, please update SOP 1 simultaneously.

| Equipment (#/quantity)                                               | Preparation & Maintenance                        |
|----------------------------------------------------------------------|--------------------------------------------------|
| Water                                                                | Ensure that the proper quantities are available. |
| Water Filter                                                         | Ensure this equipment is available.              |
| First Aid Kit                                                        | Keep stocked (see SOP 3: Safety Protocol)        |
| Sunscreen (non-toxic)                                                | Ensure that the proper quantities are available. |
| Insect repellent (non-toxic)                                         | Ensure that the proper quantities are available. |
| Sunglasses (polarized)                                               | Ensure that this equipment is available.         |
| Headlamp                                                             | Ensure this equipment is available.              |
| Headlamp batteries (usually AAA) (6 )                                | Label and charge.                                |
| Appropriate raingear, clothing and footwear (including stream shoes) | Ensure this equipment is available.              |
| Tent, sleeping bag (1/staff)                                         | Ensure this equipment is available.              |
| Personal items                                                       | Ensure this equipment is available.              |

## Appendix SOP 3B. Emergency Contact Form

(Modified from USGS National Field Manual, Chapter A9.)

|                                         |       |
|-----------------------------------------|-------|
| Emergency Contact Form                  |       |
| Employee Name:                          | _____ |
| Personal contacts                       |       |
| Name:                                   | _____ |
| Phone (home) (work):                    | _____ |
| Name:                                   | _____ |
| Phone (home) (work):                    | _____ |
| PACN contacts:                          |       |
| WAPA:                                   | _____ |
| NPSA:                                   | _____ |
| KALA:                                   | _____ |
| KAHO:                                   | _____ |
| Local emergency contacts (or call 911): |       |
| Hospital / Phone:                       | _____ |
| Address:                                | _____ |
| Walk-in clinic / Phone:                 | _____ |
| Address:                                | _____ |
| Police:                                 | _____ |
| Fire:                                   | _____ |
| Utility:                                | _____ |
| Health Information Centers:             |       |
| Center Disease Control:                 | _____ |
| Information Hotline:                    | _____ |
| Fax: Disease Directory:                 | _____ |
| Other:                                  | _____ |
|                                         | _____ |
|                                         | _____ |
|                                         | _____ |
|                                         | _____ |

## Appendix SOP 3C. Medical Information Form for Office Personnel

(Modified from USGS National Field Manual, Chapter A9.)

|                                          |  |
|------------------------------------------|--|
| Medical Information for Office Personnel |  |
| Employee Name:                           |  |
| Home Phone:                              |  |
| Treatment preference:                    |  |
| Medical:                                 |  |
| other:                                   |  |
| Doctor                                   |  |
| Name:                                    |  |
| Phone:                                   |  |
| Other Emergency Contact:                 |  |
| Name:                                    |  |
| Phone:                                   |  |
| Relevant Medical History:                |  |
|                                          |  |
|                                          |  |
| Allergies & Medical Conditions:          |  |
| Allergies:                               |  |
|                                          |  |
| Conditions:                              |  |
|                                          |  |
|                                          |  |
| Medications:                             |  |
| Current:                                 |  |
| To avoid:                                |  |
|                                          |  |
| Special Instructions:                    |  |
|                                          |  |
|                                          |  |
|                                          |  |

### Appendix SOP 3D. Example of Standard Safety Checklist

| Standard Safety Checklist                      |        |
|------------------------------------------------|--------|
| Item:                                          | Check: |
| <b>Climatic and UV protection</b>              |        |
| Boots                                          | _____  |
| Fluids (e.g., water, electrolyte drink)        | _____  |
| Hat, wide-brimmed                              | _____  |
| Insect repellent (unscented)                   | _____  |
| Rain gear                                      | _____  |
| Sunglasses                                     | _____  |
| Sunscreen                                      | _____  |
| Antibacterial soap or hand lotion              | _____  |
| Temperature-modifying clothing                 | _____  |
| <b>Items for Vehicles</b>                      |        |
| Vests and jackets w/reflective protection      | _____  |
| First aid kit (see below)                      | _____  |
| Flares                                         | _____  |
| <b>Chemical Protection and Storage</b>         |        |
| Chemical spill kit                             | _____  |
| Eye wash kit (replace old/expired solution)    | _____  |
| Material Safety Data Sheets (MSDS)             | _____  |
| Chemical reagents (stored appropriately)       | _____  |
| Flammable solvents (stored appropriately)      | _____  |
| Pressurized gases (stored appropriately)       | _____  |
| <b>First Aid and Protective Equipment</b>      |        |
| Complete change of clothes (stored dry)        | _____  |
| Fire extinguisher (safely secured)             | _____  |
| First aid kit and manual (ensure full/updated) | _____  |
| Orange reflective vest                         | _____  |
| <b>Communications</b>                          |        |
| Cellular phone/communication equipment         | _____  |
| Field folder (see below)                       | _____  |
| <b>Field Folder:</b>                           |        |
| Maps                                           | _____  |
| Medical facility numbers/location              | _____  |
| Emergency contact numbers                      | _____  |
| <b>Miscellaneous Equipment</b>                 |        |
| Bungee cords (to secure loose articles)        | _____  |
| District flood plan (most current)             | _____  |

| Standard Safety Checklist      |        |
|--------------------------------|--------|
| Item:                          | Check: |
| Flagging                       | _____  |
| Flares                         | _____  |
| Flashlight (include batteries) | _____  |
| Safety cones                   | _____  |
| Tool kit                       | _____  |
| USGS TWRI Book 9 Chapter A9    | _____  |



## **SOP 4. Using Garmin Global Positioning Systems (GPS) Units**

*Version 1.0 (April 2008)*

### **Revision Log**

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

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| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
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## **Purpose**

This SOP explains how to use an autonomous, non-differential GARMIN Global Positioning System (GPS) receiver and GPS transfer software. This protocol may be used for any GARMIN GPS unit that can average a waypoint and store tracklogs. The GPS transfer process uses DNRGarmin Version 5.1.1 and GIS software.

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix 1A of SOP 1 (General Preparations for Field Work). The master equipment list should be updated simultaneously if any SOP requiring an equipment list is revised.

## **Pre-Field Preparation**

### ***GARMIN GPS Preparation***

1. Load fresh batteries and have extra, charged sets available. Extra batteries should be placed in a water tight “dry bag” or a re-sealable plastic bag and stored in an enclosed space or sealed container on the boat.
2. Initialize and download a fresh almanac into a GARMIN GPS unit if more than 1 week has passed since the last collection or if the GPS unit has moved more than a straight-line distance of 150 miles. Downloading the almanac takes roughly 20 minutes in open areas- away from buildings, canopies, and obstructions, and occurs automatically once the unit is powered on.
3. Delete old waypoints and tracks from memory (first download and save data elsewhere if appropriate).
4. Turn off active tracklog.
5. Ensure Simulator Mode is not ON when collecting data.
6. If necessary, transfer data (e.g. background maps) to the GPS unit using DNRGarmin software. See below for DNRGarmin instructions.
7. Set Time and Date on the GPS Unit (note that no PACN parks use daylight savings time, rather the entire PACN is always in ‘standard’ time).
8. Make sure that “Interface Protocol” is set to GARMIN.
9. Make sure that WAAS is enabled.
10. Set the Coordinate System (UTM or LAT/LONG) and Datum to ensure compatibility with any written coordinates you may need to navigate to or map. Recommended settings for UTM are in Table SOP 4.1.
11. Set Heading to Magnetic or True. If set to True, ensure compass has same declination.
12. If needed, use Trimble Planning Software to ensure best time of day for GPS data collection.
13. Prior to use in the field, ensure the GPS unit has been placed in a “dry bag” with a desiccant pack.

**Table SOP 4.1.** Coordinate systems and datums for use in the PACN.

| Location                       | Datum | Projection   |
|--------------------------------|-------|--------------|
| Hawaii County, HI              | NAD83 | UTM zone 5N  |
| KAHO Marine work               | NAD83 | UTM zone 4N  |
| Maui and Honolulu Counties, HI | NAD83 | UTM zone 4N  |
| Guam and Saipan                | WGS84 | UTM zone 55N |
| American Samoa                 | WGS84 | UTM zone 2S  |

### **GPS Transfer Software for DNR Garmin**

1. Uninstall any previous versions of DNRGarmin
2. Download and install Version 5.1.1 to any computer that will receive GPS data from the GARMIN. DNRGarmin can be downloaded from the State of Minnesota Department of Natural Resources  
<http://www.dnr.state.mn.us/mis/gis/tools/arcview/extensions/DNRGarmin/DNRGarmin.html>.
3. In DNRGarmin, set projection to ensure compatibility with data stored in GIS (Table SOP 4.2).
4. In ESRI ArcMap, ensure that the Data Frames are set to the appropriate projection. Data frames for each island are given in the third column of Table SOP 4.2.

**Table SOP 4.2.** Projection settings for islands in the PACN.

| Island                       | ESRI (or EPSG) POSC code | Datum | Projection   |
|------------------------------|--------------------------|-------|--------------|
| Hawaii Island                | 26905                    | NAD83 | UTM zone_5N  |
| KAHO                         | 26905                    | NAD83 | UTM zone_4N  |
| Maui Island                  | 26904                    | NAD83 | UTM zone_4N  |
| Molokai Island               | 26904                    | NAD83 | UTM zone_4N  |
| Oahu Island                  | 26904                    | NAD83 | UTM zone_4N  |
| Guam                         | 32602                    | WGS84 | UTM zone_55N |
| Saipan                       | 32602                    | WGS84 | UTM zone_55N |
| American Samoa (all islands) | 32775                    | WGS84 | UTM zone_2S  |

## **GPS Field Procedures**

### **Data Collection**

Data collection is not anticipated to be a frequent task. Initially, actual data collection locations will need to be documented relative to sample design specifications. Other data collection needs are not anticipated.

1. Hold GPS unit or antenna at or above your head. Use an external antenna to free hands.

2. Electronically store all data (waypoints and tracks). Write down a position for backup.
3. Note that a GARMIN will collect data no matter what the GPS positioning quality is, so you will need to monitor the GPS Satellite Page continuously for anomalies and accuracy. Collect data only when “3D GPS” or “3D Differential” is shown. Do not collect data in “2D GPS” unless absolutely necessary. “2D Differential” should not be used either.
4. Collect waypoints.
  - a. (Optional) Collect all waypoints in “Averaged Position” mode if you are standing still. Obtain a minimum of 10 position points per site, or record for a maximum of 20 minutes at that site. Somewhere in between is enough to generate a quality position in most cases.
  - b. Collect instantaneous waypoints only when moving or in a hurry.
5. TrackLogs
  - a. Use “Stop when Full” or “Fill” Record Mode to prevent overwriting TrackLog points when Active TrackLog becomes full.
  - b. Begin collecting Active TrackLog when you know where you need to go and immediately begin moving when TrackLog begins collecting.
  - c. Stop Active TrackLog when stopped.
  - d. Always stop Active Track when nearing the beginning point of a polygon area you want closed. A line between your last track point and the initial point will automatically be generated in order to close the polygon.
  - e. Always turn Active TrackLog to OFF when finished collecting. If TrackLogs are turned on when you are in the office, ugly data will result, and the data will need to be manually cropped using Garmin Mapsource software.
  - f. NEVER ‘store’ or ‘save’ an active Tracklog unless you need to save space, rather choose to ‘stop’ an active TrackLog. GARMIN III+ receivers remove the ActiveTrack, while modern GARMINs merely make a copy of the Active Track. In any case, saved tracklogs degrade original data, whereas a ‘stopped’ TrackLog retains data quality.

## **Back in the Office: File Management**

### ***Mapsource File Saving Procedure***

1. Connect GPS unit to PC with cable and place GPS unit in Simulator Mode.
2. Open GARMIN Mapsource software (included with the GARMIN unit), and allows the user to spatially view waypoints and make simple edits to coordinate data.
3. Select Transfer: Receive From Device. The waypoints and tracks collected during water quality sampling should upload and appear in the left window.
4. First save a backup of the file using the naming conventions described below.
5. Edits waypoints and tracks to reflect actual water quality sampling that occurred:

- a. By double clicking the waypoint, correct sample site naming errors (e.g. misspellings, extra spaces). Make sure the waypoint names match the field datasheets.
  - b. Add a date signature to each waypoint name (e.g. FPUHO01\_200812).
  - c. Clean-up Track files by removing extra and accidental track information (e.g. turning on the unit in the office will create a linear track from the last sampling site waypoint). Select the “Track” tab, then double click the track of interest. Highlight erroneous regions of the track and select delete.
  - d. Delete waypoints that were not actually sampled. The waypoint file generated before water quality sampling should have been saved separately with the file name “YYYYMMDD\_SITE\_ GPSunit\_waypt\_UTMWGS84\_\_preWQ”. (See SOP 6: Selecting Water Quality Sampling Stations)
6. Clear the GPS unit of all waypoints and tracks, then select Transfer: Send To Device to upload the newly edited waypoints and tracks.
  7. Update Mapsource software regularly, by selecting Help: Check for Software Updates.

***DNRGarmin File Saving Procedure:***

1. Open DNRGarmin from the desktop (for ArcGIS users) or from within ArcView by loading the extension.
2. Check that TrackLog is OFF! Again, do not save Track!
3. Check Projection in DNRGarmin one more time. This will define the projection the GPS file will be stored in.
4. Download waypoints and Tracks and save to a Shapefile (if in ArcGIS) or if saving a Shapefile from the desktop DNR Garmin, save to a projected Shapefile. Use naming conventions as below.
  - a. See SOP 10 (Workspace Setup and Project Records Management) to identify the folder location and hierarchy where this file is to be saved.
  - b. The file-naming convention is to indicate the date (YYYYMMDD) , PARK, the model of the GPS unit, type of data (waypoint or tracks), projection and datum, pre or postWQ, and separated by an underscore (\_). For example, a set of waypoints collected with a GARMIN GPS76c, using UTM and WGS84 as the projection and datum, during a sampling trip on Christmas Day 2005, would be named “20081225\_HALE\_GPS76c\_waypt\_UTMWGS84\_postWQ.”
  - c. If additional notes about GPS data collection exist (such as data collected in ‘2D’ mode) create a simple text file which contains this information. Save the text file in the same locations and name it an identical filename but with a text filename extension (e.g. .txt, .rtf).
5. Delete all waypoints and tracks for the next mapping mission.
6. Turn off the GPS unit, disconnect the cables, and return equipment to its proper storage location.
7. Recharge the batteries if appropriate.

## **Options to Consider**

### ***Extended Antennae***

An external antennae, with long cable and pole will extend the antennae above a thick vegetated canopy.

### ***External Beacon for Improve Accuracy***

An external beacon, such as the Thales Mobile Mapper Beacon, for DGPS (Differential GPS) will improve the accuracy of your GPS location. Averaging will improve your GPS locations, if and only if, the satellite geometry improves during point collection. Otherwise, averaging can sometimes result in a less accurate position.

## **Documentation of Updates**

Note that a master gear list is located in SOP 1. If any changes are made with regard to equipment type, quantity, or required items, please update SOP 1 simultaneously.

## Appendix SOP 4A. Equipment List for Locating and Documenting Water Quality Sampling Site Locations

| Equipment (#/quantity)                                            | Preparation & Maintenance                                                                                              |
|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| GARMIN Global Positioning System (G.P.S.) unit (1)                | Ensure that this equipment is available and set-up appropriately (according to SOP 4).                                 |
| AA batteries (6)                                                  | Ensure this equipment is available. If rechargeable, ensure fully charged.                                             |
| Waterproof case with desiccant and strap (1)                      | Ensure that this equipment is available. Replace desiccant pack biannually or if saturated.                            |
| Charts and grid layouts                                           | Ensure that this equipment is available. Store in field binder.                                                        |
| Random number pair list                                           | Create document and store in the field binder.                                                                         |
| Compass (1)                                                       | Ensure that this equipment is available. Store in field binder.                                                        |
| Map of fixed and random sampling sites (2 copies)                 | Update prior to each trip with GIS specialist. Print in color to waterproof paper. Label sites. Store in field binder. |
| Fixed sampling site descriptions (with photo and compass heading) | Print to waterproof paper and store in field binder. Update If necessary prior to subsequent field sampling.           |
| Park brochure and general map                                     | Store in field binder.                                                                                                 |
| ArcMap 9.1® software, Garmin Mapsource software,                  | Check for software updates regularly                                                                                   |

## SOP 5. Pre-Sampling Equipment Preparation

*Version 1.0 (April 2008)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
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## **Introduction**

This SOP outlines the preparation necessary for:

1. Use of a YSI 6600 multiparameter sonde with pH; temperature/conductivity; optical dissolved oxygen; optical turbidity; and optical chlorophyll probes
2. Collecting and filtering grab water samples
3. Use of an Olympus Stylus 770 digital camera
4. Assembling water quality sampling documents
5. Any water quality associated boating activities

(For further instruction on preparing the equipment and supplies prior to the start of field sampling See SOP 1. General Preparations for Field Work).

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix 1A of SOP 1. The master equipment list should be updated simultaneously if any SOP pertaining to or containing gear lists is revised. A list of equipment required to complete the tasks specified in this SOP has been provided in Appendix SOP 5A.

## **Preparation and Handling of Water Quality Sampling Instrumentation: Overview**

All personnel involved with preparation, deployment, and retrieval of water quality sampling devices should be familiar with the respective operation manual for each piece of equipment prior to its use. Manuals should be readily available at each park where water quality monitoring is conducted.

Note that a master gear list is located in SOP 1. If any changes are made with regard to equipment type, quantity, or required items, please update SOP 1 simultaneously.

## **YSI 6600 Multiparameter Sondes**

### ***Initial Preparation***

Refer to the YSI 6-Series Technical Manual as needed.

1. Connect the sonde to the 650 MDS using the appropriate YSI cable provided.
2. Turn the 650 on and ensure the 650 MDS has adequate battery power and the system date and time are correct.
  - a. Battery power is located in the lower right display of the 650 MDS. If the battery power is less than 1/3 of a bar, replace the batteries with 4 “C” size alkaline type batteries (see manual for complete directions: unscrew the back of the unit and change).
  - b. The date and time are located in the lower left display of the 650 MDS. If either the time or date is not correct, enter system setup and correct the temporal discrepancy (see manual for complete directions: **System setup → Date & Time → scroll to correct**).

3. Ensure that the site list in the 650 MDS is entered for the sites to be sampled. If the sites are not in the 650 MDS site list memory, enter them (see manual for complete directions: **Logging Setup → Use Site List → Edit Site List**).
  - a. In the 650 MDS main menu, press the down key to scroll to Logging Setup.
  - b. Make sure boxes are checked for “use site list box”, “store barometer,” and “store lat & long”, and the box is not checked for “store site number.”
  - c. Scroll down to Edit Site List and press **Enter**.
  - d. Scroll through the site list and check to see that the sites you will be visiting are in the site list files. Site list files follow the format OPPPPSS; where O will be assigned F for fixed sites or R for Random, PPPP indicates the 4 letter park designation, and SS is the site number (e.g. random site number 23 at Kalaupapa NHP would have the filename RKALA23, while the fixed site number 17 would have the filename FKALA17). If the sites you are going to visit are not there, then:
    - e. Highlight **Filename** and press **Enter**.
    - f. Enter the appropriate filename following the designations outlined in step d above.
    - g. Press **Enter** and repeat steps e through g for each site as needed.
    - h. Press **Esc** to return to the 650 main menu.
4. Press the down arrow key until **sonde menu** is highlighted and press **Enter**.
5. Ensure the 6600 sonde has adequate battery power and the system date and time are correct. (Note: The 650 should not be powering the sonde. Select **650 System Setup**: uncheck the **power sonde** box).
  - a. Battery power is located in the lower right display of the 650 MDS. If the battery power is less than 1/3 of a bar, replace the batteries with 8 “C” size alkaline type batteries (see manual for complete directions: unscrew the back of the unit and change).
  - b. The date and time are located in the lower left display of the 650 MDS. If either the time or date is not correct, enter system setup and correct the temporal discrepancy (see manual for complete directions: **System → Date & Time → scroll to correct**).
6. Calibrate the sonde sensors as described in the YSI 6-series technical manual. This will require some time. See calibration methods below.
7. After calibrations, fill the supplied calibration cup with clean, fresh water so the sensors remain wet.
8. Disconnect the 6600 sonde from the 650 MDS and place in the traveling case.

#### ***Preparation for YSI 6600 Calibration***

Note: Specific details for calibrating the YSI instruments should be addressed by consulting the YSI 6-Series Multiparameter Water Quality Sonde manual.

### Chemical Handling and Safety:

- The YSI Water Quality Sonde sensors should be calibrated prior to each sampling event, and in the field if obvious errors in readings occur.
- All chemicals should be used in accordance with the associated Material Safety Data Sheet (MSDS), and with the park-specific Chemical Hygiene Plan. Contact park staff prior to water quality field sampling to obtain and review this document. I&M staff should plan to provide copies of the MSDS for each chemical planning to be used within the park.
- When using the standard solutions for calibrating the YSI sonde, avoid inhalation, skin contact, eye contact or ingestion. For any of these chemicals, if inhalation, eye contact or ingestion occurs, consult the Material Data Safety Sheets (MSDS) for prompt action, and in all cases seek medical attention if suggested.

**Travel with Chemicals:** If chemicals need to be transported via airline for in-the-field calibrations, airline guidelines must be carefully consulted.

1. Consult the airline website or an airline representative for specific guidelines on chemical transport. Pack chemicals carefully according to these guidelines and rules.
2. Carry several copies of the associated MSDS with your travel documents, and in the checked package with the chemicals.
3. Be sure each chemical container is clearly and appropriately labeled.
4. Ensure the temperature of the chemicals will be maintained at an appropriate level throughout transport.

### Before Calibrating:

1. Review the MSDS for each chemical before use.
2. Put on protective equipment and wear while calibrating. Protective equipment should include:
  - disposable gloves
  - goggles
  - an apron
  - closed-toe shoes.

### **General Calibration Tips and Notes**

- For maximum accuracy, use a small amount of old calibration solution to pre-rinse the sonde.
- Rinse the sonde with tap water between calibrations.
- Have paper towels/clean towels nearby to dry the sonde between rinses and calibration solutions.
- Keep all electrical connections dry at all times!!
- A ring stand may be used to secure the sonde and keep it from falling.
- Completely immerse all probes during calibrations because most require input from the temperature sensor.

- Optical sensors **MUST** be calibrated in the upright (probe-down) position.

### **Calibration Logbook**

A logbook should be used to record all maintenance, servicing, and calibrations performed on each YSI instrument. This logbook should include the following:

1. Equipment model number, serial number, property number and ownership of all water quality instruments. (Also include information for individual probes).
2. Contact information for technical support.
3. Date of fresh battery installation for each instrument.
4. Description and date of problems with operation of any instrument.
5. Description and date when maintenance was performed on any instrument.
6. Notes about parts replacement on any instrument.
7. Notes detailing calibration procedures for each instrument including:
  - a. Date, time of calibration
  - b. Initials of technician
  - c. Serial/model numbers for the sonde being calibrated
  - d. Sonde battery voltage (V, %)
  - e. Display battery voltage (V, %)
  - f. Pre-calibration readings for each parameter (sonde deployed in a water bath)
  - g. Calibration solutions used (brand, expiration)
  - h. Post-calibration readings
    - i. Calculate absolute and % error
8. Record Alternate Measurement Sensitivity (AMS).
  - a. Record seven consecutive readings at a set interval (00:00:30) for each parameter in the
  - b. Use Microsoft Excel to create a spreadsheet that averages these seven measurements, then multiplies by 3.708. This calculation creates a 99% confidence interval around the mean (2-sided t-distribution).
  - c. AMS can be averaged over time for each parameter to determine long-term instrument precision.
9. Optional: Record parameter readings after field sampling and compare to readings in known calibration solutions. Use this difference to determine the accuracy of field measurements and sensor drift.

### **Calibrating the YSI 6600**

Specific Conductance: (Conductivity, specific conductance, salinity)

1. Add the 10mS/cm conductivity standard to the calibration cup. (Note: The YSI conductivity system is linear over its range (0-100mS/cm), and it is usually not necessary to use any other calibration solution, regardless of environmental applications.)
2. Be sure the sonde is clean and dry. Rinse the probes with a small amount of conductivity standard (if available).

3. Immerse probes in calibration cup. Gently tap the side of the calibration cup to dislodge any trapped air bubbles.
4. Connect sonde to 650 data display with the field cable.
5. Select **Sonde Menu: Calibrate: Conductivity: 1-SpCond**.
6. Enter the value of the selected standard (at 25 C), and press **Enter**. Be sure the units are correct.
7. Allow readings to stabilize until there is no significant change in readings for at least 30 seconds, then hit **Enter** to calibrate.
8. Remove sonde from calibration standard. Thoroughly rinse and dry the sonde and calibration cap.
9. Log activities in the calibration logbook. (See YSI Calibration and Service Logbook).

ROX Optical Dissolved Oxygen Calibration (% and mg/L):

- Note: The non-linear nature of the measurement response of this optical sensor requires that it be factory-calibrated (using a third-order regression) periodically.
- Note: The ROX Optical DO sensor membrane should be replaced annually using the YSI Optical DO Membrane Replacement Kit.

To calibrate this function:

1. Fill the calibration cup with 1/8" water, or fill a separate container with water being bubbled with an aquarium pump and air stone.
2. Place probes into calibration cup. Only thread one to two threads on the calibration cup.
3. Connect sonde to 650 data display.
4. Select **Sonde menu: Calibrate: Optic X- Dissolved Oxy: ODOsat%: 1-Point**.
5. Enter current **barometric pressure** (in mm Hg). (Readings should NOT be corrected for altitude and can read from the 650 data display (see manual)). Press **Enter**.
6. Live data readings will appear. Wait approximately 10 minutes to allow temperature and oxygen pressure to equilibrate.
7. After the 10 minute period, press **Enter** to calibrate.
8. Press **Enter** to return to the main calibration menu.
9. Remove sonde from the calibration cup. Thoroughly rinse and dry the sonde and calibration cap.
10. Log activities in the calibration logbook. (See YSI Calibration and Service Logbook).

PH 2-Point, 3-Point Calibration:

- Note: A 2-Point calibration (with pH 7.0 and 10.0 buffer solutions) is appropriate for most environmental situations. If more acidic conditions are possible, a 3-Point calibration may be conducted using a pH 4.0 buffer solution.

To calibrate this function:

1. Fill the clean and dry calibration cup with the selected pH standard (start with pH 7.0).
2. Rinse the pH sensor with a small amount of buffer solution (if available), then gently submerge the probes in the calibration cup. Gently tap the side of the calibration cup to dislodge any air bubbles trapped inside the cell.
3. Connect sonde to 650 data display.
4. Select **Sonde Menu: Calibrate: ISE1 pH: 2-point or 3-point**. Press **Enter**.
5. At prompt, enter the value of the calibration solution. (Note: Check temperature, then consult the label on the back of the calibration solution to adjust for temperature. (e.g. A YSI brand pH 7.0 calibration solution is 7.00 at 25 C, and 7.02 at 20 C.)) Press **Enter**.
6. Live data readings will appear. Gently tap the side of the calibration cup to dislodge any trapped air bubbles. Allow readings to stabilize until there is no significant change in the readings for at least 30 seconds. Once stabilized, press **Enter** to calibrate.
7. Press **Enter** to begin the second point of the calibration.
8. Rinse the sonde with tap water and dry.
9. Fill the clean and dry calibration cup with the next selected pH standard (pH 10.0).
10. Rinse the pH sensor with a small amount of calibration solution (if available), then submerge the probes in the calibration cup. Gently tap the side of the calibration cup to dislodge any air bubbles trapped inside the cell.
11. Press **Enter** and enter the value of the second buffer solution. (Note: Again, check the label to adjust for temperature.) Press **Enter**.
12. Live data readings will appear. Allow readings to stabilize until there are no significant changes in the readings for at least 30 seconds. Once stabilized, press **Enter** to calibrate.
13. Press **Enter** to begin the third point of the pH calibration and repeat the above steps with a pH 4.0 buffer solution.
14. When finished calibrating the third point, remove the sonde from the calibration cup. Thoroughly rinse and dry the sonde and calibration cap.
15. Log activities in the calibration logbook. (See YSI Calibration and Service Logbook).

Turbidity 2-Point Calibration:

- Note: Turbidity standards MUST be prepared according to *Standards in Methods for the Treatment of Water and Wastewater* (Section 2130 B). Check [www.ysi.com](http://www.ysi.com) for approved vendors.
- Note: The optimal calibration vessel for turbidity is the provided/purchased extended YSI calibration cup with a BLACK bottom. The extended cup length eliminates reflective interference during calibration, but requires substantially more calibration solution.

To calibrate this function:

1. Rinse and dry the sonde and the calibration cup. Rinse probes with a small amount of calibration solution. Be sure there are NO particulates or debris on the sonde; solid materials of any kind will contaminate the calibration standard.
2. Fill the calibration cup with 0 NTU standard solution (deionized or distilled water). (This calibration must occur FIRST).
3. Carefully immerse the sonde and engage only one or two threads of the calibration cup to maximize distance from the bottom of the cup. (Readings from the YSI calibration cup will be about - 0.5 NTU from the actual reading, so can be slightly negative in very clear water). Gently tap the side of the calibration cup to dislodge any air bubbles trapped inside the cell.
4. Connect sonde to 650 data display.
5. Select **Sonde menu: Calibrate**: Select the turbidity probe (**Optic X-Turbidity- 6136**), and **2-Point**.
6. Enter the first standard value (0 NTU), and press **Enter**.
7. Live data readings will appear.
8. Activate the wiper 1-2 times by selecting **3-Clean Optics**.
9. Allow readings to stabilize until there is no significant change in the readings for at least 30 seconds. Once stabilized, press **Enter** to calibrate.
10. Discard the 0 NTU solution and dry sonde.
11. Empty and dry the calibration cup, then fill with the second turbidity calibration solution (100 NTU or 123 NTU).
12. At prompt, enter the value of the second calibration solution and press **Enter**. (Note: Check the label of the selected turbidity standard. Some brands (e.g. AMCO-AEPA) have a different value depending on the probe type.)
13. Live data readings will appear.
14. Activate the wiper 1-2 times by selecting **3-Clean Optics**.
15. Allow readings to stabilize until there are no significant changes in the readings for at least 30 seconds. Once stabilized, press **Enter** to calibrate.
16. Press **Enter** to return to the main calibration menu.
17. Remove sonde from the calibration cup. Thoroughly rinse and dry the sonde and calibration cap.
18. Log activities in the calibration logbook. (See YSI Calibration and Service Logbook)

Chlorophyll 1-Point Calibration:

- Note: The 1-point calibration allows for semi-quantitative relative chlorophyll measurements between sites. To increase accuracy of the chlorophyll measurements, use a 2-Point or 3-Point calibration. Standards with known chlorophyll concentrations (10ug/L, 100ug/L) must be specially ordered locally.

To calibrate this function:

1. Rinse and dry the sonde and the calibration cup. Fill the calibration cup with deionized water (or distilled water).
2. Rinse the sensor with a small amount of deionized water, then gently submerge the probes in the calibration cup. Gently tap the side of the calibration cup to dislodge any trapped air bubbles.
3. Connect the sonde to the 650 data display.
4. Select **Sonde Menu: Calibrate: Optic X-Chlorophyll: Chl ug/L- 1-point**. Press **Enter**.
5. At prompt, enter the value of the calibration solution (0ug/L).
6. Press **Enter**. Live data readings will appear.
7. Activate the wiper 1-2 times (**Select: 3-Clean Optics**)
8. Allow readings to stabilize until there is no significant change in the readings for at least 30 seconds. Once stabilized, press **Enter** to calibrate.
9. Remove sonde from the calibration cup. Thoroughly rinse and dry the sonde and calibration cap.
10. If other chlorophyll standards are available, a 2-Point or 3-Point calibration may be conducted by selecting, **Sonde Menu: Calibrate: Optic X-Chlorophyll: Chl ug/L- 2-point or 3-point**.
11. Log activities in the calibration logbook. (See YSI Calibration and Service Logbook)

#### **YSI 6600 Temperature-Data Quality Assurance**

The temperature sensor needs to be checked for accuracy against a thermometer that is traceable to the National Institute of Standards and Technology (NIST).

1. Place the YSI sonde in a room temperature tap water bath,
2. Connect the sonde to the 650 data display.
3. Place a thermometer (NIST-traceable) into the water and wait for both temperature readings to stabilize.
4. Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer within the accuracy of the sensor (+/- 0.15°C). If the measurements do not agree, the instrument may not be working correctly and principal investigator should be contacted.
5. Log activities in the calibration logbook. (See YSI Calibration and Service Logbook)

#### **Marine Equipment Preparation**

Use light-colored electric tape to mark 1 meter intervals on the YSI field cable, and on the lowering line for both the YSI and the Niskin bottle. Tape should be looped around each line at 1meter intervals, and the actual depth should be marked on each side with a sharpie. (Note: Be sure to re-do these measurements and markings, and check the overall integrity of the lowering line between field sampling trips. NEVER use a lowering line that is compromised!)

## Camera Equipment Preparation and Handling

The following section explains the steps required to set up the camera. See Appendix SOP 5A for a complete equipment list for preparing the digital still camera. These protocols have been written specifically for the Olympus Stylus 770 SW digital camera. For detailed instructions on camera operation, see the Olympus Stylus camera instruction manual.

**Camera Batteries:** Ensure the batteries (at least two sets) are fully charged by recharging them the day prior to sample collection. Although batteries may have been charged after the camera's last use "top" them off. If the batteries have sat for awhile since they were last charged, they may discharge more quickly during use. The Stylus camera comes with its own rechargeable battery. Check the camera clock, and reset it if necessary so that the camera stamps the proper time code on the file.

### *Prepare the Camera (Olympus Stylus)*

1. Install the battery in the underside of the camera. The battery compartment door will pop open when you press and slide the release hatch. Align the batteries as indicated on the inside of the camera and slide them into the battery compartment. The compartment door will click shut when closed properly.
2. The Olympus Stylus 770SW comes with its own rechargeable battery pack. Keep an extra battery pack on hand so that one is always charged and prepared in the event that the camera is needed on consecutive field days or runs low on battery power while in the field.
3. Ensure that an xD memory card has been inserted into the camera. The card compartment is located on the underside of the camera next to the battery compartment. Use a card with at least 1 GB capacity to ensure adequate storage space. The card will fit into the camera in only one direction.
4. Turn the camera on using the power button located on the top center of the camera
5. Ensure the Flash Card is empty.
  - a. With the power on, select the  review button. Press the square menu button and then the trash/timer icon  (once) to scroll down to the "erase" menu option
  - b. Press **OK**.
  - c. Select "ALL ERASE" and press the **OK** button.
  - d. Select "yes" and press the **OK** button.
6. Ensure that the photo quality has been set to the highest compressed resolution (HQ 3072x2304). Pictures should be saved with the highest possible compressed resolution for the camera.
  - a. Press the **Menu** button on the back of the camera. Scroll up using the  button to the image quality setting.
  - b. Press the **OK** button.
  - c. Select "HQ 3072x2304" using the arrow buttons.
  - d. Press the **OK** button.

7. Turn the camera off.
8. Put the camera in its case.

If there are any irregularities or hardware problems discovered during the operation of the camera, consult the Olympus Stylus 770 SW manual for solutions. If the answers are not available in the manual, consult Olympus technicians (available through [www.olympusamerica.com](http://www.olympusamerica.com)). If the manual indicates that it is necessary to return the unit to Olympus, notify the PACN Aquatic Ecologist and begin preparations to return the camera.

### **Prepare Equipment for Water Sample Field Filtering**

1. While wearing gloves, use forceps to place a GF/F filter on each of 24-48 filter holders (depending on the number of sites), ensuring proper final placement of the filter and O-ring. (Note: More caps may be prepared if additional site sampling is anticipated, or if filter clogging/multiple filter usage is anticipated (e.g. inland stream sites at Pu'ukoholā Heiau NHP).
2. Assembled caps should be stored in a sealed plastic bag (e.g. Ziploc) and packed in a secure location with other water sampling supplies.
  - a. Three caps with filters and one 140cc syringe should be packed for each anticipated sampling site, plus several spares.
  - b. Note: Individual caps only be used for one water sample, and individual syringes will only be used for one site, but both can be reused between sampling trips after acid-washing (see SOP 8 for Post-field Work Procedures and Equipment Maintenance).

### **Assemble Water Quality Sampling Field Binder**

A three ring binder with pockets should be used to transport all water quality sampling documents including. (See Appendix SOP 5D. Checklist of Documents and Items to be Included in the Water Quality Field Binder). The binder should include:

1. Enough field datasheets to have 1/sampling site (print to waterproof paper).
2. A list of emergency phone numbers, a park-specific emergency plan, and completed Emergency Contact forms and Medical Information forms for all staff that will be participating. (See SOP 3: Safety Protocol)
3. A field notebook/ logbook.
4. A mechanical pencil (preferably attached to binder with fishing line). Keep spare pencils with pens, black ultra-fine tip sharpies, and regular black sharpies in a daypack that will also be in the field.
5. Chain of custody (COC) forms for water samples, printed to waterproof paper.
6. Waterproof sample sticker labels. Labels can be pre-printed with blanks for **Date:**, **Site:**, **Sample ID:**, and **Sampler Initials:**.
7. A random and fixed sampling site map printed to waterproof paper (in color with sites labeled). This map should be generated using ArcMap9.1 (See SOP 6: Selecting Water Quality Sampling Stations.)

8. Fixed sampling site descriptions (with photo and compass heading), printed to waterproof paper.
9. Current park research permits and a general park brochure and map.
10. Generated random number pairs list and chart and grid layouts for specific water quality sampling site selection (printed to waterproof paper). (See SOP 6: Selecting Water Quality Sampling Stations )

### **Boat Preparation**

Boat, trailer, and motor servicing should be independently verified for each park where field operations will occur. Ensure that this required preparation has been done in accordance with NPS Motorboat Operator Certification Course Manual and park specific guidelines. Park-specific guidelines can be obtained from the Park Dive Officer or the certified motorboat operator at each park. Care and maintenance of the boat, motor, and trailer is also detailed in SOP 8 (Post-Field Work Procedures and Equipment Maintenance).

1. Ensure that there is adequate fuel for the planned activities.
2. Verify that all required safety equipment is present and in proper working condition. A list of this equipment is available in SOP 3 (Safety Protocol) and in the NPS Motorboat Operator Certification Course Manual.

## Appendix SOP 5A. Gear List for Equipment Needed for Digital Imaging of Water Quality Field Sites and Sampling

| Equipment (#/quantity)           | Preparation & Maintenance                                                                                   |
|----------------------------------|-------------------------------------------------------------------------------------------------------------|
| Olympus Stylus 770 SW camera (1) | Charged batteries added into the camera, memory card is in place and empty, picture resolution set to fine. |
| Battery pack (1-2)               | Ensure that this equipment is available.                                                                    |
| Battery charger (1)              | Ensure that this equipment is available.                                                                    |
| Olympus USB upload cable (1)     | Ensure that this equipment is available.                                                                    |
| Memory Card (at least 1 GB) (2)  | Clear cards and insert one into camera (the other is a backup)                                              |
| Lens cleaner                     | Ensure that this equipment is available.                                                                    |
| Lint-free cloth (2)              | Ensure that this equipment is clean and available.                                                          |

## Appendix SOP 5B. Equipment Needed for Collecting Water Quality Data and Associated Environmental Data and for Maintaining Water Quality Instrumentation

| Equipment (#/quantity)                                      | Preparation & Maintenance                                                                                                                                      |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| YSI 6600 multiparameter water quality sonde (1–2)           | Ensure proper functioning and battery power, calibrate probes, lubricate probe O-rings each trip, update firmware quarterly, change probe sponges when needed. |
| YSI probe guard (1–2)                                       | Ensure that this equipment is available.                                                                                                                       |
| C-size batteries (8–16)                                     | Ensure that this equipment is available.                                                                                                                       |
| YSI 650 Multiparameter Display System (MDS) (1)             | Ensure proper functioning and battery power.                                                                                                                   |
| Cable for connecting YSI 650 display to 6600 sonde. (1)     | Ensure that this equipment is available and functioning properly.                                                                                              |
| 9/69", 7/69" hex wrench (for YSI probes)                    | Ensure that this equipment is available.                                                                                                                       |
| Extra YSI probe sponges (3)                                 | Ensure that this equipment is available.                                                                                                                       |
| .05" hex-wrench (for YSI sponge adjustment)                 | Ensure that this equipment is available.                                                                                                                       |
| Towel                                                       | Ensure that this equipment is clean and available.                                                                                                             |
| Spare YSI port plugs                                        | Ensure that this equipment is available.                                                                                                                       |
| O-Ring lubricant                                            | Ensure that this equipment is available.                                                                                                                       |
| Phillips-head screwdriver (for YSI battery compartment)     | Ensure that this equipment is available.                                                                                                                       |
| Suite of YSI calibration chemicals.                         | Ensure that this equipment is available.                                                                                                                       |
| Wiring, rope (for securing sonde for continuous deployment) | Ensure that this equipment is available and in excellent condition.                                                                                            |

## Appendix SOP 5C. Equipment Needed for Collecting Water samples, Preparing Filtering Equipment, and for Filtering Water Samples in the Field

| Equipment (#/quantity)                                                            | Preparation & Maintenance                                                          |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 125mL acid-washed sampling bottles (3/site)                                       | Ensure that this equipment is available.                                           |
| Niskin bottle (1–2 L) (1)                                                         | Ensure that this equipment is functioning properly.                                |
| Water sample chain of custody (COC) forms (2–5 depending on # of samples)         | Fill out as samples are collected. Sign off as custody changes.                    |
| Water sample sticker labels (waterproof) (3/site)                                 | Ensure sufficient quantities, can be pre-labeled with date and site.               |
| 140mL(cc) syringes (30)                                                           | Ensure sufficient sterile or acid washed syringes are available for site sampling. |
| 4.7cm Glass microfiber filters (GF/F) (100 pack)                                  | Ensure proper placement in filter holders prior to field sampling.                 |
| 10% Aqueous Hydrochloric acid (500mL)                                             | Dilute to 1% concentration for acid washing. Label clearly.                        |
| ACS reagent grade water (4L)                                                      | Ensure proper quantities are available for dilution of HCL and equipment rinsing.  |
| 5.5" Forceps (1)                                                                  | Ensure that this equipment is available                                            |
| 47mm filter holder (24–48 depending on number of sites)                           | Ensure proper quantities are available.                                            |
| Latex exam gloves (100 pack)                                                      | Ensure proper quantities are available.                                            |
| 500mL wash bottles (6 pack)                                                       | Ensure that this equipment is available.                                           |
| Safety goggles                                                                    | Ensure that this equipment is available.                                           |
| Apron                                                                             | Ensure that this equipment is available.                                           |
| Ziploc bags (100 pack)                                                            | Ensure proper quantities are available to store prepared filters.                  |
| Parafilm (1 roll)                                                                 | Ensure that this equipment is available.                                           |
| Plastic dish washing bin (1)                                                      | Ensure that this equipment is available.                                           |
| Dish drying rack (1)                                                              | Ensure that this equipment is available.                                           |
| Paper towels                                                                      | Ensure that this equipment is available.                                           |
| Insulated field daypack (to hold up to 27 125mL samples on ice) (1)               | Ensure that this equipment is available.                                           |
| Wheeled cooler (airline approved, leak-proof, and able to be closed securely) (1) | Ensure that this equipment is available.                                           |

## Appendix SOP 5D. Checklist for Documents and Items to be included in the Water Quality Field Binder

| Equipment (#/quantity)                                                    | Preparation & Maintenance                                                                                                                        |
|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1" plastic 3-ring binder                                                  | Ensure that this equipment is available.                                                                                                         |
| Waterproof/resistant laser printer letter paper (1 pk)                    | Ensure that this equipment is available.                                                                                                         |
| Field datasheets (25–75 depending on site)                                | Print to waterproof paper, store in field binder.                                                                                                |
| Map of fixed and random sampling sites (2 copies)                         | Update prior to each trip with GIS specialist. Print in color to waterproof paper. Label sites. Store in field binder.                           |
| Fixed sampling site descriptions (with photo and compass heading)         | Print to waterproof paper and store in field binder. Update if necessary prior to subsequent field sampling.                                     |
| Charts and grid layouts                                                   | Ensure that this equipment is available. Store in field binder.                                                                                  |
| Random number pair list                                                   | Create document and store in the field binder.                                                                                                   |
| Water sample sticker labels (waterproof) (3/site)                         | Ensure sufficient quantities, can be pre-labeled with date and site.                                                                             |
| Park Permits (2 copies/park)                                              | Ensure currently, print to water proof paper, store in field binder                                                                              |
| Pens (3)                                                                  | Ensure that the proper quantities are available.                                                                                                 |
| Ultra-fine tip black Sharpie (3)                                          | Ensure that the proper quantities are available.                                                                                                 |
| Black permanent marker (3)                                                | Ensure that the proper quantities are available.                                                                                                 |
| Mechanical pencils (5)                                                    | Ensure that the proper quantities are available. Helpful to attach one to field notebook.                                                        |
| Field notebook/ log (2)                                                   | Make sure there is available room in notebook for field sampling and a spare one just in case the logbook ends. Store main copy in field binder. |
| Park brochure and general map                                             | Store in field binder.                                                                                                                           |
| Water sample Chain of Custody (COC) forms (2-5 depending on # of samples) | Fill out as samples are collected. Sign off as custody changes.                                                                                  |
| Compass (1)                                                               | Store with field binder.                                                                                                                         |

## Appendix SOP 5E. List of Necessary Forms for the Water Quality Protocol

| Equipment (#/quantity)                                                    | Preparation & Maintenance                                       |
|---------------------------------------------------------------------------|-----------------------------------------------------------------|
| Field datasheets (25-75 depending on site)                                | Print to waterproof paper, store in field binder.               |
| Water sample chain of custody (COC) forms (2-5 depending on # of samples) | Fill out as samples are collected. Sign off as custody changes. |

## Appendix SOP 5F. Equipment List for Calibrating the YSI Multiparameter Sonde

| Equipment (#/quantity)                                                                                                                                            | Preparation & Maintenance                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Laboratory total nitrogen, nitrate and total phosphorus standard solutions. (volume dependent on number of samples)                                               | Ensure that this equipment is available.                                                                                                             |
| Thermometer (with NIST trace) (1)                                                                                                                                 | Ensure that this equipment is available.                                                                                                             |
| Calibration Logbook (1)                                                                                                                                           | Ensure that this equipment is available. Complete during sonde sensor calibrations, servicing and pre-field checks.                                  |
| pH buffer standards (7.00 [required], 4.00 [suggested] and 10.00 [suggested]) (volume dependent on amount of field sampling)                                      | Ensure that this equipment is available, approved for use with the instrument, and properly stored when not in use. Review and provide MSDS to park. |
| Turbidity standards (0NTU [required], 10/11.2NTU [suggested], 100/123NTU [optional])(volume dependent on amount of field sampling)                                | Ensure that this equipment is available, approved for use with the instrument, and properly stored when not in use. Review and provide MSDS to park. |
| Conductivity standards (10mS/cm [required], 100mS/cm [optional], 1mS/cm [use only if necessary; see YSI manual]) (volume dependent on amount of field sampling)   | Ensure that this equipment is available, approved for use with the instrument, and properly stored when not in use. Review and provide MSDS to park. |
| Deionized water (required)(volume dependent on amount of field sampling)                                                                                          | Ensure that this equipment is available, approved for use with the instrument, and properly stored when not in use. Review and provide MSDS to park. |
| Standards with known chlorophyll concentration (10ug/L, 100ug/L) (recommended), must be specially ordered locally) (volume dependent on amount of field sampling) | Ensure that this equipment is available, approved for use with the instrument, and properly stored when not in use. Review and provide MSDS to park. |
| YSI optical DO Membrane Replacement Kit                                                                                                                           | Order and install annually                                                                                                                           |
| YSI Calibration cup                                                                                                                                               | Ensure this equipment is available. Replace gasket if needed.                                                                                        |
| YSI Calibration and Service Logbook                                                                                                                               | Ensure that this equipment is available. Complete during YSI calibrations and servicing.                                                             |
| Pen                                                                                                                                                               | Ensure that this equipment is available.                                                                                                             |
| Latex exam gloves (100 pack)                                                                                                                                      | Ensure proper quantities are available.                                                                                                              |
| Safety goggles                                                                                                                                                    | Ensure that this equipment is available.                                                                                                             |
| Apron                                                                                                                                                             | Ensure that this equipment is available.                                                                                                             |
| Closed-toe shoes                                                                                                                                                  | Ensure that this equipment is available.                                                                                                             |

## Appendix SOP 5G. Equipment List for Marine Water Quality Sampling

| Equipment (#/quantity)                                                                                                                                              | Preparation & Maintenance                                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Niskin bottle with lowering line and messenger (1–2 L) (1)                                                                                                          | Ensure that this equipment is functioning properly and that line is in excellent condition. Replace worn line. Clearly mark 1m depth intervals on line. |
| Lowering line (or winch system) for YSI (100 m) (1)                                                                                                                 | Ensure that this equipment is functioning properly and that line is in excellent condition. Replace worn line. Clearly mark 1m depth intervals on line. |
| "Long" (20+ m) cable for connecting YSI 650 display to 6600 sonde. (1)                                                                                              | Ensure that this equipment is available and functioning properly.                                                                                       |
| Marine depth finder or depth sounder (mounted to boat console)                                                                                                      | Ensure that this equipment is functioning properly.                                                                                                     |
| Primary and secondary method for securely attaching the sonde to the lowering line.(E.g. 3" Stainless carabiners, stainless wiring or other stainless hardware) (4) | Ensure that this equipment is available.                                                                                                                |
| YSI Probe Guard (1–2)                                                                                                                                               | Ensure that this equipment is available.                                                                                                                |
| Industrial strength 10" cable ties (100 pk)                                                                                                                         | Ensure that this equipment is available.                                                                                                                |
| Light-Colored Electrical Tape (several roles)                                                                                                                       | Ensure that this equipment is available.                                                                                                                |
| Black permanent marker (1)                                                                                                                                          | Ensure that the proper quantities are available.                                                                                                        |

## SOP 6. Selecting Water Quality Sampling Stations

*Version 1.0 (April 2008)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
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## Purpose

This SOP describes how to select water quality sampling stations. Sample stations will be selected within three different sampling frames: accessible reaches of perennial streams, marine waters with potential park impacts, and brackish water resources (anchialine pools, fishponds, and a saline lake).

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix 1A of SOP 1 (General Preparations for Field Work). The master equipment list should be updated simultaneously if this or any SOP requiring an equipment list is revised. A list of equipment required to complete the tasks specified in this SOP has been provided in Appendix 6A in this SOP.

## Selecting Water Quality Sampling Locations

The following steps will be done prior to conducting any field work.

### Generating Random Points for Fixed Sampling Stations

You will generate random points for sampling using ArcMap 9.1 software.

Generating Random Points for Fixed Sampling Stations within ArcMap 9.1®:

1. Open ArcMap 9.1® on your computer.
2. Open park specific project file and associated layers as outlined (streams, pools, marine, etc.) in Table SOP 6.1.
3. Select **Analysis Tools** from the toolbar.  
**Note:** If the Analysis Tools button does not appear in the ArcMap toolbar, you may not have Hawth's Analysis Tools loaded into your computer. Hawth's Analysis Tools is a free extension that can be downloaded from:  
<http://www.spatialecology.com/htools/download.php>.
4. Select **Generate Random Points**. A new window will open titled "*Random Point Generator*."
5. Generate random points.
  - a. There are four sections in the "*Random Point Generator*" screen: Input, Minimum Distance, Sample Size, and Output.
  - b. Under Input, make sure the "polygon layers" radio button is on.
  - c. In the select layer menu, choose the open file layer for that park as indicated in Table SOP 6.1.
  - d. Under Sample Size select "unstratified sampling design" radio button.
  - e. Input the amount of sites you would like to generate in the "generate random points" box. This should be twice the number needed, one alternate for each point.
  - f. All Minimum Distance options should be unselected and unchecked.
  - g. Under Output type in the output shape filename using the following format: FPPPP\_point\_locations where PPPP is the park name (e.g. Haleakala fixed sampling station sites would be saved as FHALE\_point\_locations).
  - h. Click **OK**.
  - i. Random points should now appear in the map section of the ArcMap window

**Table SOP 6.1.** GIS layers for water quality protocol sampling.

| <b>Park</b>  | <b>Layer</b>                                             | <b>Type</b> |
|--------------|----------------------------------------------------------|-------------|
| ALKA         | I:\Maps\WaterQuality\ArcMap\Sampling_ALKA_points.shp     | point       |
| AMME         | I:\Maps\WaterQuality\ArcMap\Sampling_AMME_wetland.shp    | polygon     |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_AMME_streams.shp    | line        |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_AMME_marine.shp     | polygon     |
| HALE         | I:\Maps\WaterQuality\ArcMap\Sampling_HALE_bogs.shp       | point       |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_HALE_streams.shp    | line        |
| HAVO         | I:\Maps\WaterQuality\ArcMap\Sampling_HAVO_anchialine.shp | point       |
| KAHO         | I:\Maps\WaterQuality\ArcMap\Sampling_KAHO_marine.shp     | polygon     |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_KAHO_ponds.shp      | polygon     |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_KAHO_anchialine.shp | point       |
| KALA         | I:\Maps\WaterQuality\ArcMap\Sampling_KALA_marine.shp     | polygon     |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_KALA_streams.shp    | line        |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_KALA_ponds.shp      | polygon     |
| NPSA-Ofu     | I:\Maps\WaterQuality\ArcMap\Sampling_Ofu_marine.shp      | polygon     |
| NPSA-Tau     | I:\Maps\WaterQuality\ArcMap\Sampling_Tau_marine.shp      | polygon     |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_Tau_streams.shp     | line        |
| NPSA-Tutuila | I:\Maps\WaterQuality\ArcMap\Sampling_Tut_marine.shp      | polygon     |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_Tut_streams.shp     | line        |
| PUHE         | I:\Maps\WaterQuality\ArcMap\Sampling_PUHE_streams.shp    | line        |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_PUHE_ponds.shp      | polygon     |
| PUHO         | I:\Maps\WaterQuality\ArcMap\Sampling_PUHO_anchialine.shp | point       |
| USAR         | I:\Maps\WaterQuality\ArcMap\Sampling_USAR_marine.shp     | polygon     |
| WAPA-Agat    | I:\Maps\WaterQuality\ArcMap\Sampling_Agat_marine.shp     | polygon     |
| WAPA-Asan    | I:\Maps\WaterQuality\ArcMap\Sampling_Asan_marine.shp     | polygon     |
|              | I:\Maps\WaterQuality\ArcMap\Sampling_Asan_streams.shp    | line        |

6. Transform the random points into decimal degrees.
  - a. Click on the ArcToolbox symbol in the toolbar. A toolbox window will open in the lower left of the screen.
  - b. Double click *Data Management Tools*, then double click *Projections and Transformations*.
  - c. Double click *Features*, then double click *Project*. A popup window will open.
  - d. Under Input dataset select the newly generated layer of random points.
  - e. Specify the output location (Water Quality Monitoring Points folder).
  - f. Under *Output coordinate system* click on the radio button to the right. A window title “*Spatial Reference Properties*” pops up.
  - g. Click on the select button.
  - h. Double click on ***Geographic Coordinate System***.
  - i. Double click on ***North America***.
  - j. Double click on ***North American Datum 1983.prj***.
  - k. Click **OK**.
  - l. Click **OK** (again). A new layer will appear in the “*Layers*” window.
7. Add XY coordinates to the random points.
  - a. Click on the ArcToolbox symbol in the toolbar.
  - b. Double click *Data Management Tools*.
  - c. Double click *Features*.

- d. Double click *XY Coordinates*. A new window titled “*Add XY Coordinates*” will appear.
  - e. Input feature will be the newly generated layer from Step 6 of this protocol.
  - f. Click **OK**.
8. Export the random points to Excel.
  - a. Right click on the newly generated layer from Step 7 of this protocol.
  - b. Select *Open Attributes Table*.
  - c. Click on **Options**.
  - d. Select *Export*.
  - e. Make sure Export indicates *All Records*. If not, select this from the scroll menu to the right.
  - f. Specify the output location (Water Quality Monitoring Points folder).
  - g. Input name using the format F\_PPPP\_Sites where PPPP indicates the four letter designation of the park (i.e. for War in the Pacific, the file should read F\_WAPA\_Sites).
  - i. Check to make sure that the save as file type indicates dBase table (or.dbf extension).
  - j. Click **OK**.
9. Open Excel.
10. Open the site file for the park (files titled F\_PPPP\_Sites.dbf where PPPP indicates the four letter designation of the park).
  - a. File→Open
  - b. Under files of type option, select dBase files.
  - c. Find the file for the park of interest titled F\_PPPP\_Sites.dbf where PPPP indicates the four letter designation of the park (see step 8 of this protocol) and double click.
  - d. Click Open.
11. Randomly select points for fixed sites.
  - a. Sequentially label the all of the generated points (1,2,3 and so on).
  - b. In an adjacent cell, enter the formula =Randbetween (1, #). The # depends on the number of points you have.

Note: if NAME#? comes up in the cell after entering this formula, you will need to add in the Analysis ToolPak (**Tools→Add ins→ Analysis ToolPak**).
  - c. Copy and paste this adjacent to all labeled points.
  - d. Highlight all and copy.
  - e. Select Paste Special.

**Edit→Paste Special**
  - f. Check the box “*Values*.”
  - g. Click **OK**.
  - h. Highlight all of the data.
  - i. From the toolbar above select **Data→Sort**.

A new window titled “*Sort*” will appear.
  - j. Under the *Sort by* option select the column in which the random numbers were generated and make sure the radio button ascending is marked.

- k. Click **OK**.

The coordinate pairs indiscriminately placed at the top of the list will be considered first as possible fixed site locations. The remaining will be used as alternatives should any of the points be deemed unsuitable (e.g., water body too small, unsafe to sample, or inaccessible) during the initial field sampling. The first acceptable sites will be chosen as permanent fixed sites.

#### Generating Random Points for Random Stations within ArcMap 9.1®

No random sites need to be generated for anchialine pool environments in any park. It is too difficult to successfully randomize sites within any PACN park; therefore, all sampling sites in anchialine pools will be fixed.

1. Generate double the amount of points needed (half will be random points plus additional points for alternative station locations, if needed) that will be sampled during that month using the same procedure as above (“Generating random points for fixed stations within ARC Map 9.1®”) replacing the F in all filenames with R (e.g. under step 5, Haleakala **random** sampling station sites would be saved as RHALE\_point\_locations in stead of FHALE\_point\_locations).
2. Each sampling month a new set of random points will be generated and sampled.
3. In the marine and freshwater sampling frames, if the generated random points have been used previously for either fixed or random stations then automatically use the alternative station locations. In subsequent months you may have to generate more points to ensure that the random stations have not been used as points.

#### **Printing Sampling Coordinates**

1. Print the random points for fixed station locations.
  - a. Print out X and Y coordinates for the established primary fixed station locations as successively numbered points in a list. To maximize efficiency in the field, the list should be ordered according to proximity of the station locations to each other. Clearly label the list so that the primary points are not confused with the alternative points printed out in Step 2.
  - b. Print the GIS map(s) showing the station locations relative to each other.
  - c. Laminate (two-sided: map on one side, list on the other) for field use.
  - d. **Note:** Coordinates should be in Latitude and Longitude decimal degrees format.
2. Print sufficient random points for alternative fixed station locations.
  - a. Print out X and Y coordinates for the alternative sites as successively numbered points in a list. Clearly label the list so that the alternative points are not confused with the primary points printed out in Step 1.
  - b. Print the GIS map(s) showing the station locations relative to each other. Include all the points for fixed stations. This will allow field personnel to better plan sampling if an alternative site needs to be used.
  - c. Laminate (two-sided: map on one side, list on the other) for field use.  
**Note:** Coordinates should be in Latitude and Longitude decimal degrees format.
3. Repeat steps 1 and 2 using points for random station locations.
4. Enter the X and Y coordinates, with station location number into GPS.

- a. Fixed sites should have the letter F as a prefix to the station location number.
- b. Random sites should have the letter R as a prefix to the station location number.
- c. Waypoints for each water quality station within a park are stored in the database which resides on the I drive of the PACN data server at HAVO.

### ***Generating Random Number Pairs with Microsoft Excel***

1. Open Excel on your computer
2. On a blank document, generate a list of random numbers in the first column
  - a. From the toolbar (at the top of the screen): Click **Insert**.
  - b. Scroll down the insert menu to **function**, click it.
  - c. Type “RANDBETWEEN” in the insert function text box: Click **Go**.
  - d. The program should find the function RANDBETWEEN, highlight: Click **OK**.
  - e. In the Function Arguments, enter “0” for the bottom and “10” for the top in text boxes provided: Click **OK**.
  - f. A random number should appear in the upper left cell on the blank spreadsheet. Move cursor to the lower right corner of that cell (your cursor will change from a thick white crosshairs to a thin, black one).
  - g. Click and hold down the mouse button while dragging the cursor down as many boxes as you want randomly generated numbers (If you drag your cursor to cell #10, you should have 10 randomly generated numbers).
3. Generate another column of random numbers to make coordinate pairs
  - a. Highlight the first column of random numbers that you generated by holding down the cursor button and dragging from the first cell with a number to the last cell with a number.
  - b. Click on the bottom right corner of the last cell, click and drag your cursor over to the same location in the cell directly to the right of it.
  - c. Another column of random numbers should appear next to the original list of random numbers.

### **Before Entering the Field**

1. Collect the equipment necessary to complete all tasks that will be conducted.
2. Ensure all random points have been generated, printed, and downloaded into the GPS.
3. Copy relevant forms (random number pairs, maps, permits, etc.) to plastic coated paper.

### **Driving Directions to Park Units**

#### ***Maui***

##### **Haleakala National Park, Maui:**

- From Kahului Airport on route 36, travel northeast until 36 becomes 360 (Hana HWY). This road is long, very narrow and winding.
- Continue past Hana town to Kipahulu, past the park’s Visitor’s Center (located adjacent to the lower pools of ‘Ohe‘o Gulch) to the gated maintenance yard on the left. The bunkhouse and camping area is located within those gates.

### ***Hawaii Island***

Kaloko-Honokohau National Historical Park: Kaloko-Honokohau NHP is located south of the Kona Airport, off of the Queen Ka'ahumanu Highway (HWY 19).

- To reach the park headquarters from HWY 19: travel south, take a left on Hina Lani Street, then an immediate right on Kanalani. The office is located at 73-4786 Kanalani Street in the Kaloko Industrial Park.
- The park entrance is also off of HWY 19 a mile or two south of Hina Lani street on the right. A large rock wall and sign mark the entrance.

Pu'ukohola Heiau National Historical Site: Pu'ukohola Heiau is located on Hawaii 270, just outside of Kawaihae town.

- From Kailua-Kona, travel north on the Queen Ka'ahumanu Highway (19) to the junction of route 270.
- Follow 270 north to the Spencer Beach Park access road on the left. The park entrance road is the first right off the Spencer Beach Park access road.

Pu'uhonua o Honaunau National Historical Park:

- The park can be found from Kailua-Kona by traveling south on highway 19, which becomes Highway 11.
- Take Highway 11 to the junction of Hawaii 160 (in between mile marker 103 and 104) and continue on 160 downhill to the park entrance.

### ***Molokai***

Kalaupapa National Historical Park: The park headquarters is located on the leeward side of Kalaupapa peninsula on the island of Moloka'i. From the Kalaupapa airport, a park employee/local resident must escort field crew along the dirt road leading to the settlement. The peninsula may also be accessed by boat or by trail, but all visitors must be accompanied by a local sponsor. Park headquarters is located directly across from the Bayside accommodations.

### ***Guam***

War in the Pacific National Historical Park:

- From Guam's International Airport, follow signs to Hagatna, the island's capital and location of park headquarters.
- From Hagatna follow route 1 to the Asan unit of the park.
- The entrance to the Asan unit will be off of route 1(Marine Drive) to the left, with the Asan Beach Unit to the right on the ocean side.

### ***Saipan, Commonwealth of the Northern Mariana Islands***

**American Memorial Park:** American Memorial Park is located just outside of the city of Garapan on the western shoreline of the island of Saipan. Park headquarters is located next to the amphitheater off of Micro Beach Road in Garapan Village.

- From the airport, proceed north on Airport Rd until the road ends at Monsignor Guerrero Road (16 Highway).
- Turn left and continue until road ends at Beach Rd. Turn right on Beach Rd and continue to end.
- Follow signs for park and turn left onto Micro Beach Rd to reach park headquarters.

### ***American Samoa***

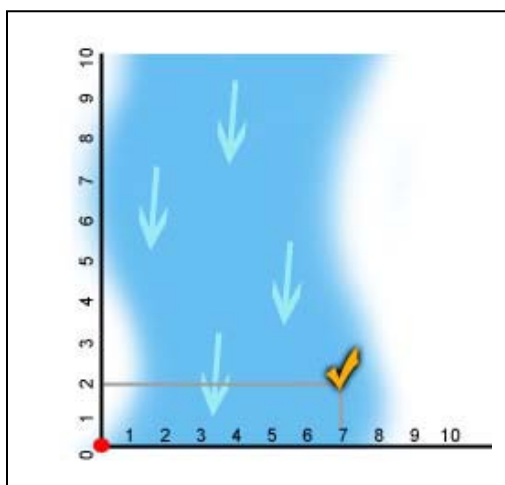
**National Park of American Samoa:** The Pago Pago International Airport on the island of Tutuila is the closest airport to NPSA. Currently two roundtrip flights from Honolulu are offered weekly. The visitor's center is located in downtown Pago Pago. Flights to other park sites on Ofu and Ta'u are offered irregularly on small inter island planes.

### **Navigating to Selected Sites**

1. Using a Global Positioning System (GPS) unit in which the random station location points are already stored, navigate to the location using the GPS's navigation feature if
2. As approaching the random point, assess the area for safety. If the point is not a location that is safe for deploying sampling instrumentation, discard the point and adopt alternative points. Move on to the next location. Repeat steps 1 and 2 until a random point is found that is determined to be safe for field work.

### **Determining Exact Sampling Spots at Fixed and Random Sites in Streams**

Once a fixed or random stream site is located a using the GPS, a randomly generated number pair will be used to find the exact sampling spot. The first column of numbers on the list is x coordinates and the second column is the y coordinates; the number scale is in meter measurements on the y axis and percentage of the distance across the stream on the x axis. Imagine a 10m x 10m square, with the lower left corner originating at the GPS waypoint. From that origin, the x axis extends 10m across the stream and the y axis extends 10m upstream. Using the number pair like coordinates, move up and across the stream 0–10 meters. For example: if the number pair was (2, 7), you would go upstream 2m and across 7 m (almost all of the way to the opposite side of the stream) to sample. See Figure SOP 6.1 below.



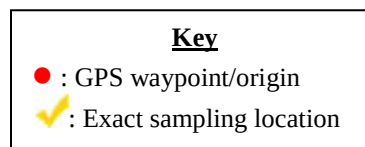


**Figure SOP 6.1.** Using number pairs to locate an exact stream sampling location from a GPS waypoint.

### **Determining Exact Sampling Spots at Fixed and Random Sites in Wetlands**

Once a fixed or random wetland site is located using the GPS, a randomly generated number pair will be used to find the exact sampling spot. The first column of numbers on the list is x coordinates and the second column is the y coordinates; the number scale is in meter measurements. Imagine a 10m x 10m square, with the lower left corner originating at the GPS waypoint. From that origin, the x axis extends 10m across the stream and the y axis extends 10m upstream. Using the number pair like coordinates, move up and across the wetland 0–10 meters. For example: if the number pair was (2, 7), you would go up 2m and across 7 m (almost all of the way to the opposite side of the stream) to sample.

### **Determining Exact Sampling Spots at Fixed and Random Sites in Marine Areas**

Once a fixed or random marine site is located using the GPS, a randomly generated number will be used to find the exact sampling depth. The number generated on the list is the z coordinate and represents the percentage of the depth from which to take the sample. For example: if the number was 7 and you were in 100 ft of water, you would sample the water column 70% of the total depth, or 70 ft.

### **Determining Exact Sampling Spots in Anchialine Pools**

Once a fixed or random anchialine pool is located using the GPS, the pool will be sampled as close to the center as possible, targeting the surface water.

## Appendix SOP 6A. Equipment Necessary to Install Fixed or Random Water Quality Sampling Locations

| Equipment (#/quantity)                                            | Preparation & Maintenance                                                                                              |
|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| GARMIN Global Positioning System (G.P.S.) unit (1)                | Ensure that this equipment is available and set-up appropriately (according to SOP 4).                                 |
| AA batteries (6)                                                  | Ensure this equipment is available. If rechargeable, ensure fully charged.                                             |
| Waterproof case with dessicant and strap (1)                      | Ensure that this equipment is available. Replace dessicant pack biannually or if saturated.                            |
| Charts and grid layouts                                           | Ensure that this equipment is available. Store in field binder.                                                        |
| Random number pair list                                           | Create document and store in the field binder.                                                                         |
| Compass (1)                                                       | Ensure that this equipment is available. Store in field binder.                                                        |
| Map of fixed and random sampling sites (2 copies)                 | Update prior to each trip with GIS specialist. Print in color to waterproof paper. Label sites. Store in field binder. |
| Fixed sampling site descriptions (with photo and compass heading) | Print to waterproof paper and store in field binder. Update If necessary prior to subsequent field sampling.           |
| Park brochure and general map                                     | Store in field binder.                                                                                                 |
| ArcMap 9.1® software, Garmin Mapsource software,                  | Check for software updates regularly                                                                                   |



## SOP 7. Conducting Water Quality Sampling

*Version 1.0 (April 2008)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
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## Purpose

This SOP outlines the water quality sampling directions for: (1) use of a YSI 6600 multiparameter sonde with pH, temperature/conductivity, optical dissolved oxygen (DO), optical turbidity, and optical chlorophyll probes (2) collecting and filtering grab water samples (3) use of an Olympus Stylus 770 digital camera, (4) recording water quality sampling with documents in the field binder, and (4) using associated boating equipment. See SOP 1 (General Preparations for Field Work) for further instruction on preparing the equipment and supplies needed prior to the start of each round of sampling.

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix 1A of SOP 1. The master equipment list should be updated simultaneously if this or any SOP requiring an equipment list is revised. A list of equipment required to complete the tasks specified in this SOP has been provided in Appendix SOP 7A.

## Instrument Operation: Basic Principles

Note: These are basic operating instructions only. For full procedures on how to operate the field equipment, please read the appropriate instrument manuals.

### YSI 6600 Multiparameter Sonde

Refer to the YSI 6-Series Technical Manual as needed

1. Make sure the sonde is connected to the 650 MDS.
  - a. Use the appropriate YSI cable provided.
2. Remove the calibration cup and place the probe guard over the sensors.
3. Turn the 650 on, and ensure the 650 MDS has adequate battery power and the system date and time are correct.
  - a. Battery power is located in the lower right display of the 650 MDS. If the battery power is less than 1/3 of a bar, replace the batteries with 4 “C” size alkaline type batteries (see manual for complete directions: unscrew the back of the unit and change).
  - b. The date and time are located in the lower left display of the 650 MDS. If either the time or date is not correct, enter system setup and correct the temporal discrepancy (see manual for complete directions: **System setup → Date & Time → scroll to correct**).
4. Ensure **Use Site List** is active (see manual for complete directions: **Logging Setup → Use Site List**).
5. Activate the **650 Run** display by selecting **Sonde Run** from “**650 Main Menu**.”
6. Monitor sonde readings, and once they are stabilized, select a continuous data stream (**Start logging**) from the 650 logging window.

Note: There will be two start logging options. Chose the one on the left of the screen under the number 650 (the other is under sonde).

7. Press **Enter**.
  - a. The site list will appear on the display.

8. Select the proper site.
  - a. Scroll through the site list until the sampling site appears and highlight it. Site list files follow the format OPPPPSS where O will be F for fixed sites or R for Random, PPPP indicates the 4 letter park designation, and SS will be the site number (e.g. random site number 23 at Kalaupapa NHP would have the filename RKALA23, while the fixed site number 17 would have the filename FKALA17).
  - b. Press **Enter** to log data to the 650 memory.
9. Press **Enter** to stop logging when logging is complete.
10. Press **ESC** to disconnect the sonde and return to the main menu.
11. Turn the power off.
12. After testing, fill the supplied calibration cup with freshwater so the sensors remain wet.

### Field Filtering Instructions

1. Rinse the sterile (or acid washed) 140cc syringe 3 times at the selected site, each time disposing of the 'rinse water' downstream and/or at least a few meters from the site.
2. After drawing the water sample, place a filter holder with a GF/F filter over the syringe.
3. Rinse the sample bottle 3 times with filtered sample water (rinse water should be dumped away from the sampling site).
4. Slowly and carefully plunge the site water through the syringe and filter into the rinsed 125mL bottle.
5. If the filter becomes clogged (passing sample water through the cap is difficult/impossible), the filter holder should be immediately replaced with a fresh filter holder. Sample water should never be forced through a clogged filter, as it may differentially affect the nutrient quality of the sample.
6. Cap and store on ice in the dark (in a cooler).
7. Label bottles individually with site, date, and replicate letter while in the field.
8. Log each sample on the chain of custody form (COC) in the field binder.

Three replicate samples will be taken at each field site using the same procedure, each time rinsing the syringe once with site water, rinsing the 125mL sample bottle 3 times with filtered water, and replacing the filter holder on the syringe between samples. Used filters, filter holders, and syringes should be saved in a labeled plastic baggie for acid-washing.

Sample bottles should be individually labeled with site, sampler initials, date and sample ID while in the field, and stored on ice in the dark (e.g. in a cooler), and later cold-shipped to the nutrient analysis lab, or stored in a freezer.

### The Camera Olympus Stylus

1. Turn the camera on using the power button located on the top of the camera.
2. Press the square  **SCN** button.

3. Press the left side of the zoom button (wide “W” button) in the upper right corner of the camera to zoom all the way out to the maximum zoom.
4. Take a photo of the water quality sampling site.
5. When all pictures are finished for the site, review by pressing the  button and scrolling back with the  function button.
6. Scroll through the pictures for that site and note down the photo numbers on the field datasheet.
7. Turn the camera off.

### **Water Quality Sampling: Protocols for Different Water Quality Types**

Water quality sampling should be conducted in such a manner that continuous data is collected concurrently with point samples. Collecting constant with quarterly fixed site data provides a calibration control and will aid in the interpretation of inconsistencies. At locations where extended deployment sondes will be placed, deploy before taking any point samples. Use guy wires to secure the instrument at the desired location. Considerations must be made when securing sondes or taking samples so that no cross contamination occurs.

Refer to the appropriate section below for specific instructions on conducting monitoring for each resource type.

- In anchialine pools, randomly select a fixed sampling station for extended deployment and navigate there first.
- In freshwater streams, work from the mouth of the river towards the source. An extended deployment station should be near the mouth of the stream.
- In marine waters, randomly select a fixed sampling station for extended deployment and navigate there first.

Extended deployment data will be collected every 30 minutes for 6 months out of the year in each park (3 months in the summer and 3 in the winter). Every 3 months, the data from each working sonde will be uploaded then cleared from memory, batteries replaced, and the instruments will be recalibrated then switched to another location and/or park.

Whenever co-sampling occurs with another protocol, ALWAYS collect water quality samples and place the 6600 sonde in the water, prior to beginning any other Vital Signs monitoring processes.

All water samples collected will be analyzed in the lab as soon as possible.

#### ***Anchialine Pools***

Fixed point sampling in anchialine pools must take place at low tide.

1. Using a GPS, navigate to the sampling location.
2. Take a digital picture of the sampling site and log on the field datasheet.
3. Collect the grab surface water sample.

- a. Collect and filter triplicate water samples from the surface layer in 3 separate 125mL bottles (See Field filtering instructions below). Rinse water is always dumped away from the sampling location.
  - b. Store the samples in a dark, cool, and secure location for transport, freeze as soon as possible
4. Place the YSI 6600 EDS in the water and begin sampling.
  - a. Sample for 5 minutes.  
\*\*If this is the site chosen for extended deployment, place the YSI 6600 EDS in the water and begin logging.
5. Complete the field datasheet in the field binder.
6. Take any additional pictures of environmental concern/interest, and log them on the datasheet.
7. End YSI 6600 EDS sampling.

### ***Freshwater and Wetland***

1. Using a GPS, navigate to the sampling location. Approach from downstream or with as little disturbance to the water body as possible in the case of a wetland.
2. Using three random number pairs, find the exact sampling locations. Locations should be determined and then approached so as not to contaminate other water sampling locations (i.e. work upstream in a stream).
  - a. For a freshwater stream, this should be done by creating a coordinate system where x is the total distance across the stream in percentages (0 is the bank you are on and 100 is the opposite bank)(Figure SOP 7.1). Looking upstream, y extends 10 meters. The three random number pairs are then used as a percentage for x and a distance in meters upstream for y. If any location falls on a rock outcropping or other unsampleable area, an alternate coordinate is used.
  - b. For a wetland, this should be done by creating a coordinate system where x and y extend 10 meters from your location into the wetland. The three random number pairs are then used as a coordinates in meters for x and y. If any location falls on a rock outcropping, tree, or other unsampleable area, an alternate coordinate is used (Figure SOP 7.1).
3. Collect the surface water samples.
  - a. Collect and filter triplicate water samples from the surface layer in 3 separate 125mL bottles (See Field filtering instructions below). Rinse water is always dumped away from the sampling locations.
  - b. Store the samples in a dark, cool, and secure location for transport, freeze as soon as possible.
4. Place the YSI 6600 EDS in the water and begin sampling.
  - a. Sample for 5 minutes  
\*\*If this is the site chosen for extended deployment, place the YSI 6600 EDS in the water and begin logging.
5. Take a digital picture of the sampling site and log on the field datasheet.
6. Complete the sample site datasheet in the field binder.

7. Take additional pictures of environmental concern/interest, and log them on the datasheet.
  - a. Include at a minimum upstream and downstream photos.
8. End YSI 6600 EDS sampling.

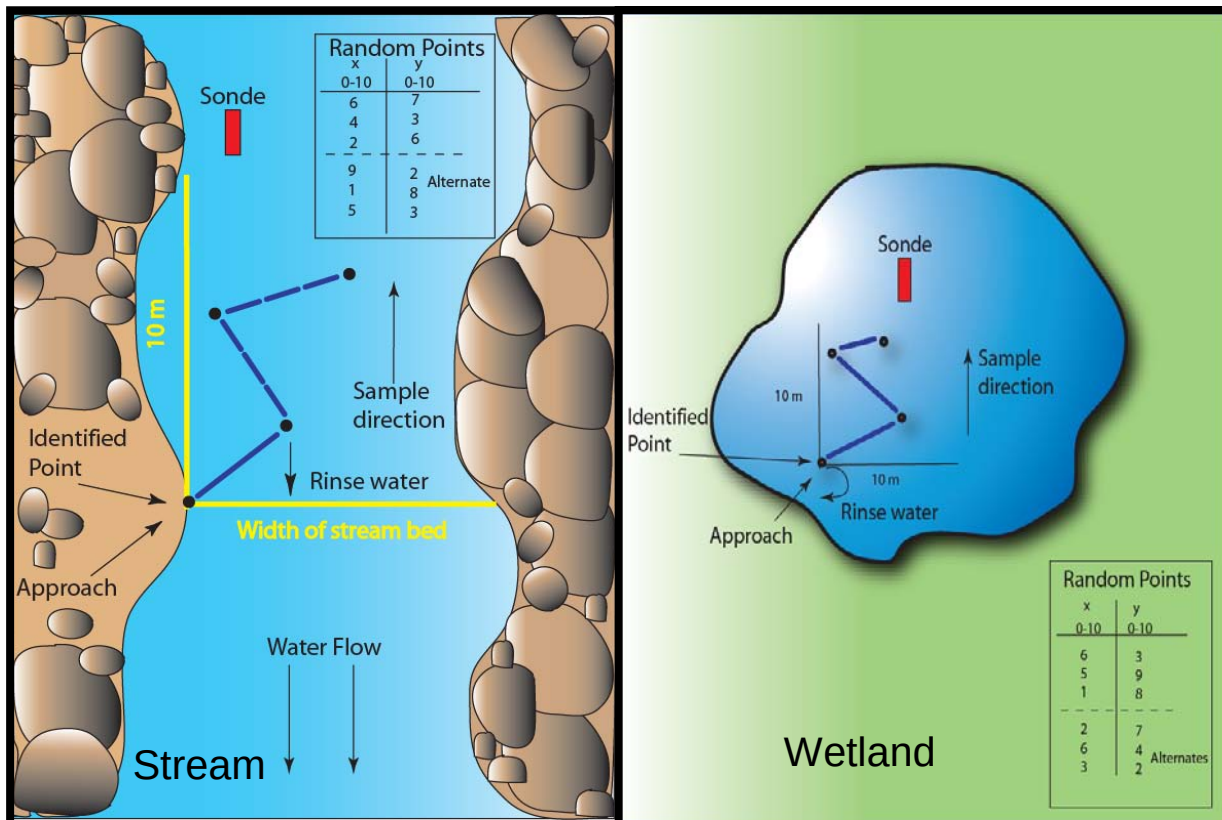


**Figure SOP 7.1.** Sampling process for streams and wetland areas. Dark blue line indicates personnel travel path to specific replicate water sample sites.

### Marine

Boat drift during sampling will further randomize the random marine sites in the same way the number pairs randomize freshwater random sites.

1. Using the GPS (with sampling station waypoints pre-loaded), navigate to the selected water quality field sampling station, and secure boat (or live boat) according to the captains preferences.
  - Note: A sampling site must be within a safe area, in no less than 10m deep water, and within authorized bounds of the park. If these conditions are not satisfied, the site should not be sampled.
  - Note: Boat drift during sampling is expected, and will further randomize the random marine sites in the same way the number pairs randomize freshwater random sites.
2. Collect three water replicate samples with the Niskin bottle at the randomly selected sampling depth.

- a. Be sure the Niskin bottle is securely attached to the lowering line (with both a primary and secondary means).
- b. Activate/set the Niskin bottle according to the manufacturer's instructions.
- c. Once the boat is stabilized and conditions are safe, carefully lower the activated Niskin bottle over the gunwale or transom of the boat and into the water. Note: Be very careful not to activate the closure mechanism when contacting the ocean surface.
- d. Lower the Niskin bottle to the selected depth by monitoring the markings on the lowering line. Note: If at any time, it is suspected that the Niskin bottle has prematurely closed, the bottle should be brought back on board the boat, the sample discarded, and the bottle reset for sampling.
- e. At the selected depth, drop the Niskin messenger to enclose the desired water sample, then bring the bottle back on board with the line.
- f. Withdraw water from the Niskin bottle (see the manufacturers instructions), rinse a 125mL sample bottle with filtered water, then filter a complete water sample into the rinsed 125mL bottle (See SOP 7: Conducting Field Sampling: Field Filtering).
- g. Discard any remaining water, reactivate the Niskin bottle, and repeat for the other two water samples.
- h. Store the samples in a dark, cool, and secure location for transport. (See SOP 7: Conducting Field Sampling: Field Filtering).

3. YSI 6600 Sonde water quality sampling:

**Important:** Before lowering the sonde, know the actual bottom depth, and monitor bottom depth and sonde depth at all times. During sampling, the boat will likely drift off station slightly, and bottom depth will change! The sonde should not be lowered to less than 1–2 meters from the bottom depth, and the boat depth-finder should be monitored constantly during sampling, particularly during deeper sampling. **Contact with the benthos can result in serious damage or total loss to the ysi sonde and/or field cable.**

a. Prepare the Sonde

If field cable **is available** (field cable is long enough to reach the desired sampling depth):

- i. Connect the YSI 6600 sonde to the 660 computer with the field cable and power **ON**.
- ii. Select: **Logging setup**. Set Interval to 00:00:05 if a water column vertical profile will be sampled (Fixed sites), or Set to 00:00:30 for same-depth sampling (Random sites).
- iii. **Select: Sonde Run: 650: Start Logging: select Field Station ID: Enter.**
- iv. After sampling at desired depth, select **Stop Logging** on the data display.

If field cable **is not available** (field cable is not long enough to reach the desired sampling depth):

- i. Connect the YSI 6600 sonde to the 660 computer with the field cable and power **ON**.
- ii. **Select: Sonde Menu: Run: Unattended Sample.**

- iii. Set Interval to 00:00:05 if a water column vertical profile will be sampled (Fixed sites), or Set to 00:00:30 for same-depth sampling (Random sites).
  - iv. Set Start Date/ Start Time/ Duration/ File (name)/ Site (ID). Confirm that battery voltage and battery life is enough to cover the desired sampling interval. If not, upload all files to the 650 and clear the sonde memory and/or replace the sonde batteries.
  - v. **Highlight Start Sampling: Enter: Yes.** Data will log for the set Duration.
- b. Attach the YSI sonde securely to the lowering line (or a winch system). Use both a primary attachment method, and a backup method (e.g. 2 stainless steel carabineers).
  - c. Place the probe guard on the sonde.
  - d. Once the boat is stabilized and conditions are safe, carefully lower the YSI sonde over the gunwale or transom of the boat and into the water.
  - e. Record sampling Start Time and Bottom Depth on the field datasheet.
  - f. At Fixed sites, the entire water column will be sampled, and samples will be collected every 5 seconds.
    - i. The sonde should be lowered at a rate of 1m/ min until within 1–2 meters of the bottom.
    - ii. At 2 meters from the bottom, the technician should either raise the sonde to a pre-selected random sampling depth for a 5 minute sampling at that depth, OR a 5-min sample should be collected at 1–2 meters above the bottom.
    - iii. After sampling, raise the sonde to the boat and carefully bring it onboard (at a normal rate).  
Note: Site depth will influence the total sampling time at fixed sites and should be accounted for when planning field sampling.
  - g. At Random sites, a sampling depth will be randomly selected (or will occur at 1–2 meters from the bottom), and the YSI will sample at this depth for 5 minutes with 30 second sampling intervals.
    - i. The sonde should be lowered to the desired sampling depth (No lower than approximately 1–2 meters from the bottom).
    - ii. Sample at the desired depth for at least 5 minutes. If the field cable is attached, begin sampling after readings stabilize at the desired depth.
    - iii. After sampling, raise the sonde to the boat and carefully bring it onboard.
4. Extended deployment/continuous water quality sampling:
- a. Connect the YSI 6600 sonde to the 660 data display with the field cable and power **ON**.
  - b. **Select: Sonde Menu: Run: Unattended Sample.** Set the Sampling interval to 00:00:05, Set Start Date/ Start Time/ Duration/ File (name)/ Site (ID). Confirm that battery voltage and battery life is enough to cover the desired

sampling interval. If not, upload all files to the 650 and clear the sonde memory and/or replace the sonde batteries.

- c. **Highlight Start Sampling: Enter: Yes.** Data will log for the set Duration.
  - d. A scuba diver will install the activated sonde along the bottom by attaching the sonde on or near the rebar marking the beginning of the Benthic Marine Community and Marine Fish Vital Signs fixed transects. The sonde should be securely attached, probe-down to secure rebar, using stainless steel wiring, cable ties, and additional stainless steel hardware, if needed. Note: Water quality sondes should be placed for extended deployment in areas where the threat of theft is minimal.
5. Take at least one digital photograph of the sampling site and record the photo number on the field datasheet. Take additional pictures of environmental concerns/interests, and log them on the datasheet. Optional: Take a photograph of the benthic habitat vertically below the selected sampling site.
  6. Complete the field datasheet in the field binder for each sampling site.

### **Equipment Lists for Materials Needed in this SOP**

Note that a master gear list is located in SOP 1 (Before the Field Preparations). If any changes are made with regard to type, quantity, or required items in the lists in the appendixes to this SOP, please simultaneously update SOP 1.

## Appendix SOP 7A. Gear List for Equipment Needed for Digital Imaging of Water Quality Field Sites and Sampling

| Equipment (#/quantity)           | Preparation & Maintenance                                                                                   |
|----------------------------------|-------------------------------------------------------------------------------------------------------------|
| Olympus Stylus 770 SW camera (1) | Charged batteries added into the camera, memory card is in place and empty, picture resolution set to fine. |
| Battery pack (1–2)               | Ensure that this equipment is available.                                                                    |
| Battery charger (1)              | Ensure that this equipment is available.                                                                    |
| Olympus USB upload cable (1)     | Ensure that this equipment is available.                                                                    |
| Memory Card (at least 1 GB) (2)  | Clear cards and insert one into camera (the other is a backup)                                              |
| Lens cleaner                     | Ensure that this equipment is available.                                                                    |
| Lint-free cloth (2)              | Ensure that this equipment is clean and available.                                                          |

## Appendix SOP 7B. Equipment Needed for Collecting Water Quality Data and Associated Environmental Data and for Maintaining Water Quality Instrumentation

| Equipment (#/quantity)                                      | Preparation & Maintenance                                                                                                                                      |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| YSI 6600 multiparameter water quality sonde (1–2)           | Ensure proper functioning and battery power, calibrate probes, lubricate probe O-rings each trip, update firmware quarterly, change probe sponges when needed. |
| YSI probe guard (1–2)                                       | Ensure that this equipment is available.                                                                                                                       |
| C-size batteries (8–16)                                     | Ensure that this equipment is available.                                                                                                                       |
| YSI 650 Multiparameter Display System (MDS) (1)             | Ensure proper functioning and battery power.                                                                                                                   |
| Cable for connecting YSI 650 display to 6600 sonde. (1)     | Ensure that this equipment is available and functioning properly.                                                                                              |
| 9/69", 7/69" hex wrench (for YSI probes)                    | Ensure that this equipment is available.                                                                                                                       |
| Extra YSI probe sponges (3)                                 | Ensure that this equipment is available.                                                                                                                       |
| .05" hex-wrench (for YSI sponge adjustment)                 | Ensure that this equipment is available.                                                                                                                       |
| Towel                                                       | Ensure that this equipment is clean and available.                                                                                                             |
| Spare YSI port plugs                                        | Ensure that this equipment is available.                                                                                                                       |
| O-ring lubricant                                            | Ensure that this equipment is available.                                                                                                                       |
| Phillips-head screwdriver (for YSI battery compartment)     | Ensure that this equipment is available.                                                                                                                       |
| Suite of YSI calibration chemicals.                         | Ensure that this equipment is available.                                                                                                                       |
| Wiring, rope (for securing sonde for continuous deployment) | Ensure that this equipment is available and in excellent condition.                                                                                            |

## Appendix SOP 7C. Equipment Needed for Collecting Water Samples, Preparing Filtering Equipment, and for Filtering Water Samples in the Field

| Equipment (#/quantity)                                                            | Preparation & Maintenance                                                          |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| 125mL acid-washed sampling bottles (3/site)                                       | Ensure that this equipment is available.                                           |
| Niskin bottle (1–2 L) (1)                                                         | Ensure that this equipment is functioning properly.                                |
| Water sample chain of custody (COC) forms (2–5 depending on # of samples)         | Fill out as samples are collected. Sign off as custody changes.                    |
| Water sample sticker labels (waterproof) (3/site)                                 | Ensure sufficient quantities, can be pre-labeled with date and site.               |
| 140mL(cc) syringes (30)                                                           | Ensure sufficient sterile or acid washed syringes are available for site sampling. |
| 4.7cm Glass microfiber filters (GF/F) (100 pack)                                  | Ensure proper placement in filter holders prior to field sampling.                 |
| 10% Aqueous Hydrochloric acid (500mL)                                             | Dilute to 1% concentration for acid washing. Label clearly.                        |
| ACS reagent grade water (4L)                                                      | Ensure proper quantities are available for dilution of HCL and equipment rinsing.  |
| 5.5" Forceps (1)                                                                  | Ensure that this equipment is available                                            |
| 47mm filter holder (24–48 depending on number of sites)                           | Ensure proper quantities are available.                                            |
| Latex exam gloves (100 pack)                                                      | Ensure proper quantities are available.                                            |
| 500mL wash bottles (6 pack)                                                       | Ensure that this equipment is available.                                           |
| Safety goggles                                                                    | Ensure that this equipment is available.                                           |
| Apron                                                                             | Ensure that this equipment is available.                                           |
| Ziploc bags (100 pack)                                                            | Ensure proper quantities are available to store prepared filters.                  |
| Parafilm (1 roll)                                                                 | Ensure that this equipment is available.                                           |
| Plastic dish washing bin (1)                                                      | Ensure that this equipment is available.                                           |
| Dish drying rack (1)                                                              | Ensure that this equipment is available.                                           |
| Paper towels                                                                      | Ensure that this equipment is available.                                           |
| Insulated field daypack (to hold up to 27 125mL samples on ice) (1)               | Ensure that this equipment is available.                                           |
| Wheeled cooler (airline approved, leak-proof, and able to be closed securely) (1) | Ensure that this equipment is available.                                           |

## Appendix SOP 7D. Checklist for Documents and Items to be Included in the Water Quality Field Binder

| Equipment (#/quantity)                                                    | Preparation & Maintenance                                                                                                                        |
|---------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1" plastic 3-ring binder                                                  | Ensure that this equipment is available.                                                                                                         |
| Waterproof/resistant laser printer letter paper (1 pk)                    | Ensure that this equipment is available.                                                                                                         |
| Field datasheets (25–75 depending on site)                                | Print to waterproof paper, store in field binder.                                                                                                |
| Map of fixed and random sampling sites (2 copies)                         | Update prior to each trip with GIS specialist. Print in color to waterproof paper. Label sites. Store in field binder.                           |
| Fixed sampling site descriptions (with photo and compass heading)         | Print to waterproof paper and store in field binder. Update if necessary prior to subsequent field sampling.                                     |
| Charts and grid layouts                                                   | Ensure that this equipment is available. Store in field binder.                                                                                  |
| Random number pair list                                                   | Create document and store in the field binder.                                                                                                   |
| Water sample sticker labels (waterproof) (3/site)                         | Ensure sufficient quantities, can be pre-labeled with date and site.                                                                             |
| Park Permits (2 copies/park)                                              | Ensure currently, print to water proof paper, store in field binder                                                                              |
| Pens (3)                                                                  | Ensure that the proper quantities are available.                                                                                                 |
| Ultra-fine tip black Sharpie (3)                                          | Ensure that the proper quantities are available.                                                                                                 |
| Black permanent marker (3)                                                | Ensure that the proper quantities are available.                                                                                                 |
| Mechanical pencils (5)                                                    | Ensure that the proper quantities are available. Helpful to attach one to field notebook.                                                        |
| Field notebook/ log (2)                                                   | Make sure there is available room in notebook for field sampling and a spare one just in case the logbook ends. Store main copy in field binder. |
| Park brochure and general map                                             | Store in field binder.                                                                                                                           |
| Water sample Chain of Custody (COC) forms (2–5 depending on # of samples) | Fill out as samples are collected. Sign off as custody changes.                                                                                  |
| Compass (1)                                                               | Store with field binder.                                                                                                                         |

## Appendix SOP 7E. List of Necessary Forms for the Water Quality Protocol

| Equipment (#/quantity)                                                    | Preparation & Maintenance                                       |
|---------------------------------------------------------------------------|-----------------------------------------------------------------|
| Field datasheets (25–75 depending on site)                                | Print to waterproof paper, store in field binder.               |
| Water sample chain of custody (COC) forms (2–5 depending on # of samples) | Fill out as samples are collected. Sign off as custody changes. |

## **Appendix SOP 7F. Field Datasheet**

Fill out the data sheet as described below (see example datasheet in Figure SOP 7F1.)

### ***Basic Site and Environmental Information***

Date: Fill out field using the format mm/dd/yyyy.

Park: Enter the four letter designation for the park in which you are working.

Station number: Enter the station number.

Station type: Circle Fixed site if this is a fixed monitoring station or Random site if it is not.

Time: Enter the starting time next to s: and the ending time next to e:

Resource type: Circle the resource type being monitored. Anchialine pools are brackish.

Names: Enter the names of the field personnel present at the sampling site.

Site location: Enter the Latitude and Longitude (in decimal degrees) and error (in meters) as displayed by the GPS.

Environmental Conditions: Circle the appropriate cloud cover as described. Sunny weather is less than 25% cloud cover, Partly cloudy is between 25% and 75% cloud cover, mostly cloudy is greater than 75% cloud cover, overcast is complete overcast, and rain indicates that it is raining.

**SOP 7 F1. Water Quality Sampling Data Sheet.**

|                                                                                                                                                    |                        |                                                              |                                                              |                                |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------|--|--|
| <b>Date:</b>                                                                                                                                       | <b>Park:</b>           | <b>Station Number:</b>                                       | <b>Names:</b>                                                |                                |  |  |
| <b>Station Type (circle)</b><br>Fixed site<br>Random site                                                                                          | <b>Time</b>            | <b>Resource Type (circle):</b><br>Marine Brackish Freshwater |                                                              |                                |  |  |
|                                                                                                                                                    | <b>s:</b><br><b>e:</b> |                                                              |                                                              |                                |  |  |
| <b>Site location:</b>                                                                                                                              | <b>Latitude</b>        |                                                              | <b>Longitude</b>                                             | <b>Error ±</b>                 |  |  |
|                                                                                                                                                    |                        |                                                              |                                                              |                                |  |  |
| <b>Environmental Conditions (circle):</b><br>Sunny (≥75% sun)    Partly Cloudy (≥25% and ≤75% sun)    Mostly Cloudy (≤25% sun)    Overcast    Rain |                        |                                                              | <b>Wind Direction (N/E/W/S)</b>                              | <b>Wind Force Beaufort</b>     |  |  |
|                                                                                                                                                    |                        |                                                              |                                                              |                                |  |  |
| <b>Digital Photograph Information:</b>                                                                                                             | Picture #              | Direction                                                    | Comments:<br>This is a required picture of the sampling site |                                |  |  |
| Picture #    Direction    Comments                                                                                                                 |                        |                                                              |                                                              |                                |  |  |
| <b>Water Condition Assessment: (Circle or estimate)</b><br>Dry    No Flow    Low<br>Normal    Above Normal    Flood                                |                        | <b>Tidal Stage</b>                                           | <b>Direction</b>                                             | <b>Wave Height (Estimated)</b> |  |  |
|                                                                                                                                                    |                        | High<br>Low<br>Mid                                           | Ebb<br>Flood<br>Slack                                        |                                |  |  |
| Sampling Depth (meters):                                                                                                                           | Relative Depth:        | Surface    Bottom<br>Midwater                                | Water Depth (meters):                                        |                                |  |  |
| <b>Habitat Description and site comments:</b>                                                                                                      |                        |                                                              |                                                              |                                |  |  |
| Estimated Canopy Cover                                                                                                                             |                        |                                                              |                                                              |                                |  |  |
| <b>Sampling activity comments:</b>                                                                                                                 |                        |                                                              | <b>Calibration check</b>                                     |                                |  |  |
|                                                                                                                                                    |                        |                                                              | Standard    Before Field    After Field                      |                                |  |  |
|                                                                                                                                                    |                        |                                                              | pH                                                           |                                |  |  |
|                                                                                                                                                    |                        |                                                              | Conductivity                                                 |                                |  |  |
|                                                                                                                                                    |                        |                                                              | DO                                                           |                                |  |  |
|                                                                                                                                                    |                        |                                                              | Turbidity                                                    |                                |  |  |
|                                                                                                                                                    |                        |                                                              | Entered into database?<br>Check when yes -->                 |                                |  |  |
| <b>Water Sample Container Labels:</b>                                                                                                              |                        |                                                              |                                                              |                                |  |  |

Wind Direction: Enter the direction from which the wind is blowing using 8 point cardinal direction (N/NE/E etc.).

Speed: Beaufort scale. Use force classifications (Table SOP 7F1).

**Table SOP 7F1.** Beaufort force classifications.

| Force | Wind (Knots) | WMO Classification | Appearance of Wind Effects On the Water                                                                                                                |
|-------|--------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0     | under 1      | Calm               | Sea is like a mirror                                                                                                                                   |
| 1     | 1–3          | Light air          | Ripples with appearance of scales; no foam crests                                                                                                      |
| 2     | 4–7          | Light breeze       | Small wavelets; crests of glassy appearance, not breaking                                                                                              |
| 3     | 8–12         | Gentle breeze      | Large wavelets; crests begin to break; scattered whitecaps                                                                                             |
| 4     | 13–18        | Moderate breeze    | Small waves, becoming longer; numerous whitecaps                                                                                                       |
| 5     | 19–24        | Fresh breeze       | Moderate waves, taking longer form; many whitecaps; some spray                                                                                         |
| 6     | 25–31        | Strong breeze      | Larger waves forming; whitecaps everywhere; more spray                                                                                                 |
| 7     | 32–38        | Near gale          | Sea heaps up; white foam from breaking waves begins to be blown in streaks                                                                             |
| 8     | 39–46        | Gale               | Moderately high waves of greater length; edges of crests begin to break into spindrift; foam is blown in well-marked streaks                           |
| 9     | 47–54        | Strong gale        | High waves; sea begins to roll; dense streaks of foam; spray may begin to reduce visibility                                                            |
| 10    | 55–63        | Storm              | Very high waves with overhanging crests; sea takes white appearance as foam is blown in very dense streaks; rolling is heavy and visibility is reduced |
| 11    | 64–72        | Violent storm      | Exceptionally high waves; sea covered with white foam patches; visibility further reduced                                                              |
| 12    | 73 and over  | Hurricane          | Air filled with foam; sea completely white with driving spray; visibility greatly reduced                                                              |

### **Digital Photograph Information**

- The number of the initial picture of the sampling station should be entered in the outlined box. Indicate the direction you are facing when taking the picture. Direction can be eight-point cardinal, or upstream/downstream.
- For any other pictures taken, indicate the picture number, the direction you are facing, and any comments regarding the description of what the picture is of (i.e. oil cans near site, dead bloated cow in stream, etc.)

### **Water Condition Assessment**

- Tidal Stage: Circle the appropriate tidal stage at the time of sampling (this will primarily apply to brackish water and marine samples).
- Direction: Circle the direction of tidal flow at the time of sampling (this will primarily apply to brackish water and marine samples).

- Wave height: Estimate the wave height in meters, and enter it in the space provided (this will primarily apply to marine samples).
- Flow Level: Circle the appropriate Flow Level using the STORET terminology (Table SOP 7F2), available at <http://www.nature.nps.gov/water/infoanddata/index.cfm/> Flow level data will primarily apply to freshwater samples.
- Sampling Depth: Enter the sampling depth in meters.
- Relative Depth: Circle the appropriate sampling depth.
- Water Depth: Enter the total water depth in meters.

**Table SOP 7F2.** STORET terminology for flow level.

| Choices      | Description                                                                                                                                                                                                        |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dry          | No visible water in stream (typical of dry period for an ephemeral/intermittent stream).                                                                                                                           |
| No Flow      | Discrete pools of water with no apparent connecting flow (at surface).                                                                                                                                             |
| Low          | Base flow for a stream or flow within roughly 10% to 20% of base flow condition.                                                                                                                                   |
| Normal       | When stream flow is considered normal (greatest time that stream is characterized by this in terms of flow quantity, level, or general range of flow during a falling or rising hydroperiod, but above base flow). |
| Above Normal | Bank full flow or approaching bank full (generally within upper 20% of bank full flow condition).                                                                                                                  |
| Flood        | Flow extends outside normal bank full condition or spreads across floodplain.                                                                                                                                      |

### ***Habitat Description and Site Comments***

- Enter a general habitat description of the sampling site, including as much information as possible. If there are any general site issues or comments that may affect the sampling activities or results within this station, enter them here.
- Estimated canopy cover: Estimate the total canopy cover as a percent and enter it in the area provided.
- Elevation: Use estimates given on GPS unit to fill in the elevation of the site

### ***Water Quality Sampling***

Record water temperature, pH, turbidity, dissolved oxygen (% an mg/L), conductivity, and salinity. Enter in any comments directly related to any sampling activity occurring at this site. For example, if the instrument battery dies or the QC on the flow checker indicates a problem, you would note that here. Also enter any issues surrounding the sampling activity that deviate from the standard outlined procedures. Time of sample processing would be indicated here.

***Water Sample Container Label Number***

Indicate the labeling on the water sample vial collected at the site.

***Water Sample Field Test Results***

After the samples are processed by the lab, enter the results on the sampling datasheet.

***Enter into Database***

Check this box to indicate that this datasheet has been entered into the PACN Water Quality database.

## SOP 8. Post-Field Work Procedures and Equipment Maintenance

*Version 1.0 (April 2008)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

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| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
|--------------------------|------------------|--------|--------------|-----------------------|---------------------------------------------|-------------------------------|
|--------------------------|------------------|--------|--------------|-----------------------|---------------------------------------------|-------------------------------|

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## **Purpose**

This SOP covers post-field work equipment maintenance for water quality instrumentation and photographic equipment. It also covers post-field work handling of water samples, data, and data sheets.

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix 1A of SOP 1 (General Preparations for Field Work). The master equipment list should be updated simultaneously if this or any SOP requiring an equipment list is revised.

## **Equipment Maintenance**

### ***Rinse Equipment***

1. Following each field day, all instrumentation and equipment must be rinsed with fresh water. Seawater left on the equipment for an extended period of time will reduce the operational life of the equipment.
2. Rinse all sampling equipment and instrumentation with fresh water according to the specific directions for each in this SOP.
3. Rinse the field vehicle and research vessels as appropriate. Apply WD40 or other lubricant to moving parts on the trailer (e.g., winch) and boat engine. Rinse the engine, and use a motor flusher for the internal parts.
4. Rinse each data sheet with fresh water, and hang with clothes pins to dry.
5. Rinse all other gear used each day.
6. Upload all collected data from the instruments to the designated computer according to the specific procedures for each outlined below.

Once dry, all equipment should be stored until needed again (if this is the final collection of the month).

### ***YSI 6600 Multiparameter Sonde***

1. Rinse the 650, the sonde, and the cable in fresh water.  
Note: Do not get the metal contacts wet.
2. Dry the area around the cable, and disconnect from the sonde.  
Note: Do not let the contacts of the sonde or the cable get wet.
3. Place the caps on the end of both the sonde and cable.
4. Fill the YSI calibration cup with fresh water and screw on over the sensors to keep them moist.  
Note: Do not use deionized water.
5. Allow the unit to completely dry.
6. Upload data to the computer as described below.
7. Put the 650 and the sonde in the storage case and place in the assigned storage location.
8. The optical DO probes will be sent to the manufacturer annually for recalibration.

### **Camera**

1. Rinse the camera in clean, fresh water. If the Olympus Stylus 770 was used in the water, power it on and off several times while rinsing, so the lens cover opens and closes. Be sure the lens cover doesn't "stick" when the camera is powered on.
2. Dry with a soft towel.  
Note: Do not touch or scratch the lens area.
3. Upload pictures to the computer as described below.
4. Remove the camera batteries, recharge, and store them as appropriate.  
Note: Never store the camera with batteries in it. Camera batteries can potentially leak, damaging the camera.
5. Put the camera in its case for storage.

### **Field Filtering Equipment**

Chemical Handling: (To be conducted at the Kaloko-Honokohau National Historical Park (KAHO), following the current Chemical Hygiene Plan located at: [S:\Chemical Hygiene Plan\Final\\_Chemical Hygiene Plan.pdf](#)).

All I&M chemicals stored at KAHO will be documented in the Chemical Inventory, and subsequent use of the chemical (by volume) should also be recorded in the Chemical Inventory. A Material Safety Data Sheet (MSDS) will be provided for each chemical, and kept in each of three MSDS binders available around the office and maintenance bay. Chemicals will be used and disposed of according to the KAHO Chemical Hygiene Plan and the associated MSDS.

Acid Washing: Syringes and syringe caps should be acid washed between field sampling visits. Used filters can be disposed of. If sample bottles are reused, they should also be acid-washed, although washing will likely be completed by the analysis laboratory.

1. Wear goggles, an apron, chemically protective gloves, and closed-toe shoes while acid-washing.
2. Use a 10% HCL solution and carefully pour it into a clearly labeled wash bottle. Use the wash bottle to thoroughly rinse each cap and syringe.  
Note: Wash equipment over a rinse bin; the acid solution should not go down the drain!
3. After acid washing, rinse labware twice with deionized water (using a separate labeled wash bottle over the rinse bin), then place labware in a drying rack to dry.
4. Neutralize the rinse bin solution and any leftover acid solution from the wash bottle by adding a few spoonfuls of baking soda (or until the reactive fizzing stops). After neutralization, the solution can be poured down the drain with running water.

If acid-washing will need to occur at other parks within the PACN, the Chemical Hygiene Plan specific to that park must be consulted and followed. Three copies of the MSDS should travel with each chemical. As a visiting chemical user, the following or similar can be expected: 1) written approval of chemical use must be obtained 30 days in advance of the

chemical use, and 2) complete chemical details must be provided, including the manufacturer, anticipated quantities, intended use, a complete MSDS and other requirements indicated by the park.

### **Post-Field Procedures for Water Samples**

Samples should be kept cold at all times. Upon return from the field, water samples will be logged-in on a chain of custody (COC) form, then either cold-shipped to the nutrient analysis laboratory, or placed in a labeled plastic bag and frozen until later processing and analysis. A representative from the analysis lab must sign off on the COC form upon sample arrival. The signed COC form should be scanned and saved electronically with the title, YYYYMMDD\_SITE\_COC.

### **Post-Field Procedures for Handling Data**

At the completion of this step, data and images should then be treated according to SOP 10 (Workspace Setup and Project Records Management) and SOP 12 (Managing Photographic Images).

### **Downloading Data from YSI 6600 Multiparameter Sonde**

Refer to the YSI 6-Series Technical Manual as needed

1. Connect the 650 MDS to the extended deployed sonde using the YSI cable.
2. Upload the recorded info (see manual for complete directions: **Sonde menu → File → Quick upload → Enter**). Select PC6000 as the file type.
3. Disconnect the sonde.
  - a. Return to the main menu by pressing **Esc**.
  - b. Disconnect the sonde cable and put the sonde away.
4. Connect the 650 MDS to the designated computer using the cable provided.
5. Open **EcoWatch** on the computer.
6. Connect to the 650.
  - a. Select the sonde icon in the toolbar.
  - b. Choose COM 1.
  - c. Press **Enter**.
  - d. The computer will establish a connection.
7. Select **Upload to PC** on the 650 menu screen and press the **Enter** button.
8. Select all files listed on the 650 screen (.dat) individually and press **Enter**.
9. Open all files on the computer to ensure that data was accurately transmitted.
10. Each file must be exported from Ecowatch as a text file. Click the **Export** icon in the upper left toolbar, then select a location to save the file.
11. Save all files to the data files folder for that sampling trip, using the naming convention, YYYYMMDD\_PARK for the folder, and YYYYMMDD\_PARK\_SITEID for each individual Ecowatch file (.dat) and text file (.txt). These should be located in the water quality monitoring folder on the designated computer (see SOP 10). All subsequent

analysis files (e.g. Excel, Statistica) should be saved in the same folder with the same naming convention.

12. Backup the data files in the designated location before deleting from the 650 memory.
13. Delete all files from the 650 memory.
  - a. Select **Delete all files** and press Enter.
  - b. Confirm **really delete?** by selecting **Yes** and pressing **Enter**.
14. Turn off 650 by pressing the power button.
15. Put the 650 in the storage case and place in the assigned storage location.

### **Downloading Photographs**

1. Connect the Olympus Stylus to the computer using its USB cable.
2. Turn on the Olympus Stylus camera.
3. Upload the images.
  - a. Select **Start→My Computer→(drive letter)**.
  - b. The camera will appear under **Devices with Removable Storage**.
  - c. Open the data files folder for that month. This should be located in the Water Quality Monitoring folder.
  - d. Highlight all images.
  - e. Drag the images into the data files folder.
4. Open all photos on the computer to ensure that data was accurately transmitted. Correct orientation.
5. Save photos in the water quality monitoring folder on the designated computer, in a WQ\_PHOTOS folder with a subfolder named, YYYYMMDD\_PARK. Rename site photos with the naming convention YYYYMMDD\_PARK\_SITEID\_000. Use a batch renaming software program for the bulk of the trip photos with the naming convention. YYYYMMDD\_PARK\_000. (see SOP 12)
6. Delete all files from the camera.
  - a. In the camera folder, drag all folders to the trash can.
  - b. Click on **Yes** when **Really delete?** appears.
7. Disconnect the Olympus Stylus from the computer.
8. Turn the camera off.
9. Remove the camera batteries, recharge, and store them as appropriate.
  - a. Never store the camera with batteries in it. Camera batteries can potentially leak, damaging the camera.
10. Put the camera in its case for storage.

### **Data Sheets**

1. Once data sheets are dry, scan them into the computer to save as a PDF file. Print copies of all the data sheets and store them in a three ring binder.
2. Save the PDF file in the water quality monitoring folder on the designated computer, in a folder named WQ fieldsheets, in a subfolder named YYYYMMDD\_PARK. Rename site

photos with the naming convention YYYYMMDD\_PARK\_SITEID\_000. Use a batch renaming software program for the bulk of the trip photos, YYYYMMDD\_PARK\_000. (For more information see SOP 10.)

3. Original field data sheets should be stored in the designated water quality filing cabinet for three years (see SOP 11. Field Form Handling Procedures).



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## **Purpose**

This Standard Operating Procedure explains the quality assurance and quality control project plan for the Water Quality Vital Signs Monitoring Protocol and associated Standard Operating Procedures (SOPs) for the Pacific Island Network. Field work for this protocol cannot begin until the selection and verification of water quality stations is completed. Water quality sampling can then be conducted in a systematic fashion. Observers should be familiar with and follow this SOP after each month of sampling is completed. This SOP outlines the proper quality assurance procedures and quality control processes necessary to fully account for water quality instrumentation, data handling, and results for each objective of the protocol.

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix 1A of SOP 1 (General Preparations for Field Work). The master equipment list should be updated simultaneously if any SOP pertaining to or containing equipment lists is revised.

## **Summary Information**

Data used to establish the sampling design for this protocol was gathered from multiple sources based on historical data dating back to the 1970s. This data is from research projects within the national parks of the tropical Pacific, it is outlined in Appendix F of this protocol. This data was initially summarized Appendix I of this protocol (DeVerse and DiDonato 2006) and then compiled and used to identify potential trends and variability associated with selected water quality parameters as outlined in Chapter 2 of the protocol report narrative. Included in the background research for determining the scope and sampling strategy of this protocol was the most current listing of 303(d) waters known to exist within and immediately adjacent to park waters (Appendix I). Potential threats to each of the parks' water resources were identified and outlined in Chapter 1 of the PACN Water Quality Vital Signs Monitoring Protocol. Additionally, state, territory, and commonwealth water quality standards (WQS) were identified and compiled (Appendix H) to be used as a basis for management concerns in regards to monitoring objectives. This protocol should, at a minimum, be able to identify frequency and degree to which monitored water quality parameters exceed the minimum thresholds of local governmental WQS, in addition to providing the parks with the answers to the objectives outlined in Chapter 1 of the protocol narrative (i.e. seasonal trends in selected water quality parameters).

## **Data Quality Objectives**

Measurement quality objectives for the water quality parameters measured by the PACN water quality protocol (both field and laboratory) are expressed in terms of bias, precision, and completeness goals (Table SOP 9.1). Bias is defined as the difference between a measured value and the true value (representation of net bias); precision is defined as variation among individual identical measurements (representation of random error); and completeness is the number of samples taken relative to the number of samples expected. These objectives were established by estimating the most likely realistic achievable data quality based on instrument manufacturer's specifications, scientific experience, or historical data.

**Table SOP 9.1.** Measurement quality objectives for the PACN Water Quality Vital Signs Monitoring Protocol.

| Water Quality Parameter | Bias Goal   | Precision Goal | Expected sample failure rate | Completeness Goal | Samples per park per Quarter (per year) |
|-------------------------|-------------|----------------|------------------------------|-------------------|-----------------------------------------|
| Temperature             | ± 1.0 °C    | 10%            | 2%                           | 98%               | 8 (32)                                  |
| pH                      | ± 0.3 units | 10%            | 2%                           | 98%               | 8 (32)                                  |
| Salinity                | ± 1.0‰      | 10%            | 2%                           | 98%               | 8 (32)                                  |
| Conductivity            | ± 30 µS     | 10%            | 2%                           | 98%               | 8 (32)                                  |
| Turbidity               | 10%         | 10%            | 2%                           | 98%               | 8 (32)                                  |
| Dissolved Oxygen        | ± 0.5mg/L   | 10%            | 2%                           | 98%               | 8 (32)                                  |
| Chlorophyll             | 10%         | 30%            | 2%                           | 98%               | 8 (32)                                  |
| Nitrate                 | 10%         | 30%            | 5%                           | 95%               | 8 (32)                                  |
| Total Nitrogen          | 10%         | 30%            | 5%                           | 95%               | 8 (32)                                  |
| Total Phosphorous       | 10%         | 30%            | 5%                           | 95%               | 8 (32)                                  |

### Representativeness

As described in Chapter 2 of the protocol narrative, the incorporated sampling design includes randomly chosen fixed and variable station locations which should represent a spatially unbiased characterization of the daytime water quality parameters of monitored water bodies of the PACN. In addition, some fixed locations will be placed near the mouths of streams to assess the total load of measured parameters that a stream delivers/removes to/from the ecosystem. These characterizations represent a complete daytime census, every quarter, of the water resources located in AMME, PUHE, PUHO, and HAVO, and the freshwater streams of WAPA. In addition, this sampling design should give an accurate, spatially unbiased representation of the daytime water quality of marine waters in WAPA, KALA, NPSA, and KAHU, as well as the anchialine pools in KAHU, and the lower reaches of several freshwater streams in NPSA, KALA, and HALE. The statistical robustness of the design is described in Chapter 2 of this protocol and should be sufficient to: 1) make a statistically sound determination of the parks' water quality compliance according to each region's WQS, and 2) to inform park resource managers of both the status and trend of their water quality resource.

### Site Location

The sampling locations for each park will be provided to the field crews as coordinates of latitude/longitude in decimal degrees. The crews will use global positioning system (GPS) equipment to locate the site. The acceptable tolerance goal for locating sampling stations is within ±100 ft of the given coordinates. This reflects the accuracy expected from a properly functioning Garmin 76Cxx GPS unit.

Unless there are substantiated reasons that prevent sampling within that defined area, field crews will strictly adhere to the above guidelines for establishing a sampling station. The potential exists for some of the randomly generated sites to fall in locations not suitable to sampling (i.e., shallow conditions, inaccessible, unsafe, etc.). If this situation occurs, the field team will note the current environmental conditions and proceed to the next random point. Because additional

random points were generated, there should be a sufficient number of generated points to ensure that all of the sampled stations were randomly chosen.

### **Water Measurements**

This protocol was created after assessing the practicality of utilizing existing state and regional monitoring programs currently in use in this region (USGS and EPA EMAP). Several components of the EPA EMAP protocol are incorporated into this monitoring protocol, and the instrumentation used, even if not identical, should yield comparable results with instrumentation being used by the EPA EMAP, USGS, Hawaii State Department of Health, Department of Marine and Wildlife Resources (American Samoa), and the Department of Environmental Quality (Commonwealth of the Northern Mariana Islands).

Collection of the water samples for nutrient testing is the first activity that should take place once the sampling station is located before disturbing any sediments by placing instruments in the water. Samples will be collected in a 125 ml polypropylene sample vial pre-labeled with site code, location, date, and collector and placed on ice until laboratory analysis is possible (see SOP 7. Conducting Water Quality Sampling). Upon return to the lab, samples will be analyzed within 24 hours to obtain nutrient data. Samples should be stored on ice or refrigerated until processed within 24 hours from the time of collection. Quality assurance will include replicate samples, blanks, and standard calibrations for the Hach 890 colorimeter (Table SOP 9.2).

**Table SOP 9.2.** Quality assurance plan for quality control (QC) process measurements and for water quality parameters monitored under PACN Water Quality Vital Signs Monitoring Protocol.

| <b>Water Quality Parameter</b> | <b>QC Process</b>                                    | <b>Calibration Frequency/<br/>Replicates</b>               | <b>QC Data Measurement</b>                             |
|--------------------------------|------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------------|
| Temperature                    | factory calibration, QC check with thermometer       | Prior to park sampling trip                                | Difference between probe and thermometer               |
| pH                             | calibration with standard                            | Prior to park sampling trip                                | Difference between probe and standard                  |
| Salinity                       | calibration with standard                            | Prior to park sampling trip                                | Difference between probe and standard                  |
| Conductivity                   | calibration with standard                            | Prior to park sampling trip                                | Difference between probe and standard                  |
| Turbidity                      | calibration with standard                            | Prior to park sampling trip                                | Difference between instrument and calibration standard |
| Dissolved Oxygen               | water-saturated air calibration                      | Prior to park sampling trip, Annual manufacturer servicing | Difference between reference and instrument measure    |
| Chlorophyll                    | factory calibration, calibration with blank standard | Prior to park sampling trip                                | Difference between probe and standard                  |
| Nitrate                        | Calibration with standards, blanks, triplicates,     | 3/sampling trip                                            | Blanks and standard variation differences              |
| Total Nitrogen                 | Calibration with standards, blanks, triplicates,     | 3/sampling trip                                            | Blanks and standard variation differences              |
| Total Phosphorous              | Calibration with standards, blanks, triplicates,     | 3/sampling trip                                            | Blanks and standard variation differences              |

The maximum range of allowable differences that the multiparameter sonde or one of its probes may deviate from the calibration standard during the quality control (QC) process is established in Table SOP 9.3. During the daily QC check, the instrument should be set as near to the standard value as possible. QC checks should require no more than slight adjustments to bring the YSI or associated probe into agreement. If instrument or probe performance becomes erratic or requires significant adjustments to calibrate, time should be taken to thoroughly troubleshoot the situation using the appropriate manual (i.e. low battery voltage, faulty connections, cleaning, etc.). Maintenance and cleaning should be performed according to the manufacturer's recommendation. After any required maintenance, the unit will be re-calibrated with documentation as appropriate.

**Table SOP 9.3.** Maximum differences acceptable for parameter probes.

| Measurement      | Maximum Difference |
|------------------|--------------------|
| Temperature      | ± 1.0 °C           |
| pH               | ± 0.1 units        |
| Salinity         | ±0 .2 ppt          |
| Conductivity     | ± 10%              |
| Turbidity        | ± 1.0 °C           |
| Dissolved Oxygen | ± 3.0 %            |
| Chlorophyll      | ± 10%              |

If one or more parameters remain suspect, fully document the nature of the problem on a calibration log or on the field datasheet and report the situation to the PACN Aquatic Ecologist who will take the appropriate measures concerning maintenance, repair, or replacement according to manufacturer recommendations. The extended deployment sonde may be used in situations where the primary data collection sonde is malfunctioning and no replacement parts are available, provided there is sufficient memory (if not download the data) and the sonde is available.

Water quality parameters will be measured using a YSI multiparameter water quality sondes with cable connection a data display. The instruments will be allowed to stabilize, then log data continuously for a minimum of five minutes at each sampling site.

Observations of site conditions will be documented to characterize the overall ecological health and to aid in interpreting the results.

All field data forms must be identified with the station ID code and dated (see SOP 7). Field data forms with field activity notes will be kept electronically and in hard copy and entered into the PACN water quality database at a minimum of once quarterly (preferably within a week of the sampling period).

The minimum detectable limits of each instrument used in this protocol will need to be correctly identified for field use in a manner consistent with the current protocol. This process will be done through the initial field testing and implementation of the protocol. Table SOP 9.4 depicts the manufacturer estimated measurement sensitivity (MS) under laboratory conditions, and the expected MSs in the field setting. These estimated values will be updated to actual MSs and precisions once field testing and implementation proceeds.

## Training

All field participants in water quality monitoring must first successfully demonstrate proficiency in each component of field sampling and data collection before they will be authorized to collect field data and samples. The PACN Aquatic Ecologist will be responsible for ensuring that all personnel are adequately trained in all aspects of field operations. Training will include selecting and locating sites and the operations of field equipment. See SOP 2 (Training Technicians). Review of training processes and procedures will be conducted annually.

**Table SOP 9.4.** Manufacturers' expected measurement sensitivities (MS) and precisions for the current water quality instrumentation that will be used to implement the PACN Water Quality Vital Signs Monitoring Protocol.

| Water Quality Parameter | Lab MS     | Lab Precision | Expected MS | Expected Precision | Measurement Instrument |
|-------------------------|------------|---------------|-------------|--------------------|------------------------|
| Temperature             | 0.01 °C    | ± 0.15 °C     | 0.01 °C     | ± 0.15 °C          | YSI 6600 EDS           |
| pH                      | 0.01 units | 0.2 Units     | 0.01 units  | 0.2 Units          | YSI 6600 EDS           |
| Salinity                | 0.01 ‰     | ±1%           | 0.03 ‰      | ± 1.5%             | YSI 6600 EDS           |
| Conductivity            | 0.001 µS   | ± .5%         | .001 µS     | ±0.7%              | YSI 6600 EDS           |
| Turbidity               | 0.1 NTU    | ± 2%          | 0.15 NTU    | ± 3%               | YSI 6600 EDS           |
| Dissolved Oxygen        | 0.01 mg/L  | ±1%           | 0.05 mg/L   | ± 1.5%             | YSI 6600 EDS           |
| Chlorophyll             | 0.1 µg/L   | ± 0.1 µg/L    | 0.15 µg/L   | ±0.15 µg/L         | YSI 6600 EDS           |

### Changes in Instrumentation

Any changes in instrumentation must follow the following requirements:

- Equipment must currently be under use by the other agencies doing comparable water quality work in the Pacific Island region. This includes long-term extended deployment (3 months or more) in oceanic and nearshore coastal waters.
- Equipment must have been certified through the International Organization for Standardization
- Equipment must have been verified as performing to manufacturer published specifications through an external program such as the EPA sponsored Environmental Technology Verification (ETV) program.
- All probes must be field replaceable without opening the sonde or exposing the internal electronics to the environment.
- Batteries must be field replaceable without exposing the internal electronics to the environment.
- The equipment as listed must meet all standards set by the government, including partner agencies such as EPA and USGS.
- Equipment sensors must have anti-fouling capabilities to protect against bio-fouling under extended deployment operations.

### *Multi-Parameter Water Quality Datalogging Sonde*

Oceanic grade multiparameter water quality datalogging sondes must be capable of extended deployment in harsh marine and fouling conditions. Unit must be capable of collecting the following parameters simultaneously: Dissolved oxygen, turbidity, chlorophyll, pH, temperature, and salinity/conductivity.

## **Equipment Standards**

### ***ROX Optical Oxygen Sensors***

Oceanic grade optical oxygen sensors. Sensor must make use of the luminescence lifetime method of oxygen detection. Sensor must be marine compatible and have anti-fouling capabilities.

Technical criteria minimum: In percent saturation: Range 0 to 500%, Resolution 0.1%, Accuracy 0 to 200%:  $\pm 1\%$  of reading or 1% air saturation, whichever is greater; 200 to 500%:  $\pm 15\%$  of reading. In mg/L: Range 0 to 50 mg/L, Resolution 0.1%, Accuracy 0 to 20mg/L:  $\pm 0.1\text{mg/L}$  or 1% of reading, whichever is greater; 20 to 50 mg/L:  $\pm 15\%$  of reading.

### ***Turbidity Probes***

Oceanic grade optical turbidity probe. Sensor must be marine compatible and have anti-fouling capabilities.

Technical criteria minimum: Range 0 to 1000 NTU, Resolution 0.1 NTU, Accuracy  $\pm 2\%$  of reading or 0.3 NTU, whichever is greater.

### ***Fluorescence Chlorophyll Probe Assemblies***

Oceanic grade optical chlorophyll probe. Sensor must be marine compatible and have anti-fouling capabilities.

Technical criteria minimum: Range  $\sim 0$  to 400 $\mu\text{L}$  and 0 to 100 RFU, Detection Limit  $\sim 0.1\mu\text{L}$ , Resolution 0.1  $\mu\text{L}$  Chl and 0.1% RFU, Accuracy  $R^2 > 0.9999$ .

### ***pH Probes***

Oceanic grade pH probe. Sensor must be marine compatible.

Technical criteria minimum: Range 0 to 14 units, Resolution 0.01 unit, Accuracy  $\pm 0.2$  unit

### ***Temperature Probes***

Oceanic grade temperature probe. Sensor must be marine compatible.

Technical criteria minimum: Range  $-5$  to  $+50^\circ\text{C}$ , Resolution  $0.01^\circ\text{C}$ , Accuracy  $\pm 0.15^\circ\text{C}$ .

### ***Salinity/Conductivity Probes***

Oceanic grade salinity/conductivity probe. Sensor must be marine compatible.

Salinity:

Technical criteria minimum: Range 0 to 70ppt, Resolution 0.01ppt, Accuracy  $\pm 1\%$  of reading or 0.1ppt, whichever is greater.

Conductivity:

Technical criteria minimum: Range 0 to 100 mS/cm, Resolution 0.001 to 0.1 mS/cm (range dependent), Accuracy  $\pm 0.5\%$  of reading + 0.001mS/cm.

### ***External, Waterproof, Downloading and Calibration System for Sondes***

Datalogging sondes must have an external, waterproof, downloading and calibration system. This system must have the capability of determining sonde status, performing calibration functions, data collection, data storage, and data review. The system must be capable of starting and stopping logging functions and erasing data from sonde memory files. The system must be capable of showing real-time data, and driving logging functions externally.

### **Monitoring Process**

For detailed instructions on conducting water quality monitoring under this protocol, see SOP 5 (Pre-Sampling Equipment Preparation), SOP 6 (Selecting Water Quality Sampling Stations), SOP 7, and SOP 8 (Post-Field Work Procedures and Equipment Maintenance).

All field conditions are noted in the field data form located in Appendix E of this protocol (Field Data Form).

Any irregularities in any process of the sampling will be noted in the field data form.

Field data forms are scanned and saved electronically. See SOP 8 and SOP 11 (Field Form Handling Procedures). Information from the field data form is entered in the water quality database; see SOP 10 (Workspace Setup and Project Records Management) and SOP 13 (Data Entry and Verification).

### ***YSI 6600 Multiparameter Sonde***

The YSI 6600 multiparameter sonde measures turbidity, dissolved oxygen (DO), chlorophyll, temperature, specific conductance/salinity, and pH.

For detailed instructions on the operation of the YSI 6600 Multiparameter Sonde, see SOP 5, SOP 7, and SOP 8.

Each YSI sonde will be calibrated prior to entering the field (see SOP 5). Optical DO probes will be sent to YSI for recalibration annually.

Multiple sampling results will be collected at each site over the course of approximately 5 minutes (see SOP 7). Average results for each sampling station will be reported along with the min, max, and variance for each parameter. Raw data files of all records will be stored according to SOP 8 and SOP 10.

Comparative measurements between the two or more YSI instruments will be made at the extended deployment sites each month that field sampling takes place. Deviations greater than 5% will be noted in the metadata for that instrument. Deviations greater than 10% will be noted in the metadata and a further test with a different probe or sensor will be used to identify the offending unit. The offending probe/sensor will be recalibrated in the laboratory, sent back to YSI for servicing or be replaced.

Raw data files collected by the extended deployment sonde will be used to calculate average result values for the sampling event. Because of the large size of these raw data files, they will

not be stored in the water quality database, but will be accessible for viewing from the database (see Appendix N. Water Quality Database User's Guide).

Data is uploaded after returning from the field (see SOP 8).

### **Nutrient Samples**

All sampling vials are marked with the station name prior to collecting the sample. Triplicate samples will be collected at every site. Time of sample collection is noted in the field data form. Nutrient samples are stored in the dark, transported on ice and processed or frozen immediately after returning from the field. Samples are then prepared for transport to the lab, and a chain of custody form is filled out. Samples are then sent next day air to the same lab for processing. The PACN will initially use the University of Hawaii (UH) at Hilo analytical laboratory (Table SOP 9.5) which uses methods outlined in National Environmental Methods Index (NEMI) (Table SOP 9.6). It is expected that any change in laboratory will include similar methods for data comparability. Also there should be an overlap of sample processing for a minimum of one sampling location and date (i.e. 8 sites with 3 replicates each for both labs) to establish the degree of difference between labs and calibrate reporting accordingly. Descriptions of protocols for individual nutrients (below) will summarize methods according to NEMI.

The UH Hilo analytical laboratory lab uses the methods and reports detailed in Tables SOP 9.5–6.

**Table SOP 9.5.** UH Hilo Analytical Laboratory methods and instrumentation.

| <b>Nutrient</b>                                                                                      | <b>Required volume (ml)</b> | <b>Instrument/method</b>                   | <b>Detection limits (uM)</b> | <b>Detection limits (ug/L)</b> | <b>Method Reference **</b> |
|------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------|------------------------------|--------------------------------|----------------------------|
| Nitrate +Nitrite                                                                                     | 15                          | AutoAnalyzer (Pulse), colorimetric         | 0.1                          | 2                              | EPA 353.2                  |
| Total Phosphorus                                                                                     | 15                          | AutoAnalyzer (Pulse), colorimetric         | 0.1                          | 3                              | USGS I-4650-03             |
| Total Dissolved Nitrogen                                                                             | 50                          | ShimadzuTNM-1, chemiluminescence detection | 1                            | 14                             | ASTM D5176                 |
| ** Methods available at <a href="http://www.nemi.gov">www.nemi.gov</a> (National Env. Methods Index) |                             |                                            |                              |                                |                            |

**Table SOP 9.6.** NEMI report on the methods used by the UH Hilo Analytical Laboratory.

| Method Number | Source | Analyte    | Detection Level | Bias            | Precision       | Spiking Level | Instrumentation                           |
|---------------|--------|------------|-----------------|-----------------|-----------------|---------------|-------------------------------------------|
| D5176         | ASTM   | Nitrogen   | .5 mg/L         | 91 % Rec (ML)   | 13.5 % RSD (ML) | 11.1 mg/L     | Pyrolysis and Chemiluminescence Detection |
| I-4650-03     | USGS   | Phosphorus | .007 mg/L       | N/A             | 7.1 RSD         | .02 mg/L      | Automated Spectrophotometer               |
| 353.2         | EPA    | Nitrate    | .05 mg/L        | 99.2 % Rec (ML) | 11.7 % RSD (ML) | 1 mg/L        | Automated Spectrophotometer               |

### **Phosphorus Sampling**

Total Phosphorous will be sampled using USGS I-4650-03 method. Whole-water samples are dispensed into glass culture tubes, dosed with alkaline persulfate reagent, capped tightly, and digested in an autoclave at 250°F (121°C) and 17 lb/in<sup>2</sup> (117.2 kPa) for 1 hour. The alkaline persulfate digestion procedure oxidizes all forms of inorganic and organic nitrogen to nitrate and hydrolyzes all forms of inorganic and organic phosphorus to orthophosphate. Nitrate and orthophosphate in alkaline persulfate digests are determined in parallel with a 2-channel photometric, air-segmented continuous flow analyzer. Orthophosphate was determined by a

phosphoantimonymolybdenum blue method, which is equivalent to the 2-reagent variants of USEPA method 365.1 and USGS method I-2601-90.

### ***Nitrogen Sampling***

Total Nitrogen will be processed using ASTM D5176. The sample of water is introduced into a stream of oxygen or inert gas/oxygen mix flowing through a quartz pyrolysis tube. Oxidative pyrolysis converts chemically bound nitrogen to nitric oxide (NO). The gas stream is dried and the NO is contacted with ozone (O<sub>3</sub>) producing metastable nitrogen dioxide (NO<sub>2</sub><sup>\*</sup>). As the NO<sub>2</sub><sup>\*</sup> decays, light is emitted and detected by a photomultiplier tube. The resulting signal is a measure of the total chemically bound nitrogen in the sample.

### ***Nitrate Sampling***

Nitrate will be processed using EPA 353.2. A filtered sample is passed through a column containing granulated copper-cadmium to reduce nitrate to nitrite. The nitrite (that originally present plus that reduced to nitrate) is determined by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye which is measured colorimetrically. Separate, rather than combined nitrate-nitrite, values are readily obtained by carrying out the procedure first with, and then without, the Cu-Cd reduction step.

Blank control bias tests will be performed on all sample batches analyzed each sampling period. Blank samples will be made out of deionized water and include a trip blank, carried in the field throughout the day, and a laboratory blank. This information will be included in the metadata associated with that sample batch.

### ***Data Verification***

The PACN Aquatic Ecologist will compare the database and data forms for a minimum of 10% of the PACN nutrient records from each sampling month for data entry errors. If more than 10% of the reviewed records show data entry errors into the database, all records for that month will be reentered and reviewed for a maximum of 10% error. The data entry error rate is entered into the metadata files.

### ***Images***

Images are collected at each sampling site for reference regarding conditions. See SOP 7 for instructions on collecting images. Photographs are downloaded and named appropriately after returning from the field, and placed in a folder in the project workspace (see SOP 8 and SOP 12. Managing Photographic Images).

The image data files are linked to the appropriate sampling sites in the PACN database (see Appendix N for more information).

### ***Reporting Standards***

Both field measurements and results of laboratory analyses should be reported in standardized formats. Table SOP 9.7 lists the preferred data reporting formats for the water quality parameters. It is anticipated that measurements recorded by the instruments will need to be truncated to the same number of significant figures to maintain uniformity.

**Table SOP 9.7.** Reporting standards for water quality parameters monitored under the PACN Water Quality Vital Signs Monitoring Protocol.

| Measurement       | Units   | Significant Digits |
|-------------------|---------|--------------------|
| Temperature       | °C      | 0.1                |
| pH                | units   | 0.1                |
| Salinity          | ppt     | 0.1                |
| Conductivity      | µS      | 0.1                |
| Turbidity         | NTU     | 0.0                |
| Dissolved Oxygen  | mg/L    | 0.1                |
| Chlorophyll       | µg/L    | 0.1                |
| Nitrate           | mE/m2/s | 0.0                |
| Total Nitrogen    | µg/L    | 0.1                |
| Total Phosphorous | µg/L    | 0.1                |

**Data Validation**

If field personnel encounter any situation where they question the validity of data they are collecting, they should immediately attempt to resolve the problem. Any unresolved validity situations should be described in writing on the appropriate data form and the PACN Aquatic Ecologist notified.

Upon return from the field, raw data forms should be dried then scanned as PDFs. The originals should then be placed in a secure file while the PDFs are used for entering the data. All field data will be entered into the database as soon as possible after collection (within the week is recommended), preferably by the field personnel. During the data entry process, the personnel entering data will screen the field data for missing or errant information. Any observed deficits should be notated in the database. Any corrective actions initiated (i.e., correcting a spelling error on the copied data form), must be documented in the database with identifying initials and date. Once the field data are transcribed into the PACN database, they will be scanned for outliers and checked for units and completeness by the PACN Aquatic Ecologist. Data will then be verified by the PACN Aquatic Ecologist.

The data contained in a randomly selected subset of 10% of the field data forms for each month will be manually compared against the electronic version on a field-by-field basis. Any errors will be noted and a final tally derived for the month. The total number of transcription errors for a complete set of data forms should not exceed 10% of the total number of data forms for that month (i.e. if there are 100 data forms and 10% of those data forms are verified for transcription errors, the total number of errors shall not exceed 10). If greater than 10% transcription error occurs, the entire dataset for that month will be re-entered into the database and revalidated. The total transcription error will be noted in the metadata for all data collected for that month.

Instrument measurements of water quality parameters taken directly in the field will be evaluated for accuracy by verifying the results of calibration and QC checks. Precision estimates will be recalculated annually to determine if an instrument's or probe's reading is drifting and in need of maintenance. These checks should have been performed by the field crews on a daily basis and if

out of tolerance, recalibrated. Any data that was collected, when the instruments were out of compliance, will be flagged with a qualifier code.

### ***Changes to Equipment***

Recognizing that water quality equipment is constantly changing and improving, provisions must be made for the upgrading and integration of new technologies and/or equipment. Should any new technology be applied to this water quality monitoring protocol, it must be tested concurrently with the existing instrumentation for a period of no less than one year or six sampling intervals. The concurrent measurements will be used to develop a side by side comparison and, subsequently, a correction factor that can be applied to the old data collected using the methodologies originally outlined in this protocol.

The overall sampling strategy however, may not be changed, other than the addition of new stations in pairs of random and fixed to maintain equal proportion of fixed to random sampling sites (e.g. 50% fixed and 50% random). The removal of any fixed sampling sites must be done with concurrence from the technical committee, the PACN Aquatic Ecologist, and the regional NPS I&M Water Resources Division representative. The total number of sites should not be reduced without sufficient evidence that the removal of such sites will not negatively affect the statistical robustness of this sampling design.

## **Appendix SOP 9A. List of Necessary Forms for Water Quality Assurance**

| <b>Equipment (#/quantity)</b> | <b>Preparation &amp; Maintenance</b>  |
|-------------------------------|---------------------------------------|
| Calibration Log               | Update during each calibration event. |

**Appendix SOP 9B. NEMI Methods Description for Chemical Analyses**

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>Method Source</u>                  | U.S. EPA National Exposure Research Laboratory (NERL) [formerly EMSL]                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <u>Method Number</u>                  | 353.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <u>Revision Information</u>           | Revision 2.0, August 1993                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <u>Method Name</u>                    | <b>Descriptive Name:</b> Nitrate-Nitrite Nitrogen by Colorimetry<br><b>Official Name:</b> Nitrogen, Nitrate-Nitrite (Colorimetric, Automated, Cadmium Reduction)                                                                                                                                                                                                                                                                                                                                                                           |
| <u>Media</u>                          | <b>Media:</b> WATER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <u>Subcategory</u>                    | Inorganic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <u>Citation</u>                       | Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600/R-93/100)                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <u>Method Download</u>                | <a href="#">Download full method now (PDF file)</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <u>Summary of Method</u>              | A filtered sample is passed through a column containing granulated copper-cadmium to reduce nitrate to nitrite. The nitrite (that originally present plus that reduced to nitrate) is determined by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye which is measured colorimetrically. Separate, rather than combined nitrate-nitrite, values are readily obtained by carrying out the procedure first with, and then without, the Cu-Cd reduction step. |
| <u>Scope and Application</u>          | This method pertains to the determination of nitrite singly, or nitrite and nitrate combined in surface and saline waters; and domestic and industrial wastes.                                                                                                                                                                                                                                                                                                                                                                             |
| <u>Applicable Concentration Range</u> | 0.05 - 10 mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <u>Interferences</u>                  | (1) Build up of suspended matter in the reduction column will restrict sample flow. Since nitrate-nitrogen is found in a soluble state, the sample may be pre-filtered.<br>(2) High concentrations of iron, copper, or other metals.<br>(3) Large concentrations of oil and grease will coat the surface of the cadmium.                                                                                                                                                                                                                   |
| <u>QC Requirements</u>                | Not included.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <u>Sample Handling</u>                | If analysis can be made within 24 hours, refrigerating samples at 4°C is sufficient. If samples are kept more than 24 hours, preserve with 2 mL of sulfuric acid per liter of sample and refrigerate.<br>Do not preserve sample with mercuric chloride if they will be run through the reduction column.                                                                                                                                                                                                                                   |
| <u>Max Holding Time</u>               | 28 Days (nitrate+nitrite)<br>48 hours (nitrate or nitrite, singly)<br>(MCAWW, Table 1).                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

Appendix SOP 9B. NEMI Methods Description for Chemical Analyses (continued)

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>Method Source</u>                  | <u>ASTM International</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <u>Method Number</u>                  | D5176                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <u>Revision Information</u>           | Reapproved 1995. Current edition approved Sept. 15, 1991. Published February 1992.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <u>Method Name</u>                    | <b>Descriptive Name:</b> Nitrogen, Chemically Bound, in Water<br><b>Official Name:</b> Standard Test Method for Total Chemically Bound Nitrogen in Water by Pyrolysis and Chemiluminescence Detection                                                                                                                                                                                                                                                                                                                                                    |
| <u>Media</u>                          | <b>Media:</b> WATER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <u>Subcategory</u>                    | Organic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <u>Citation</u>                       | <u>Annual Book of ASTM Standards, Section 11, Water and Environmental Technology, Volume 11.02, Water (I)</u>                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <u>Method Download</u>                | This is a proprietary method.<br><a href="#">Please visit the method owner's site for method documentation</a>                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <u>Summary of Method</u>              | The sample of water is introduced into a stream of oxygen or inert gas/oxygen mix flowing through a quartz pyrolysis tube. Oxidative pyrolysis converts chemically bound nitrogen to nitric oxide (NO). The gas stream is dried and the NO is contacted with ozone (O <sub>3</sub> ) producing metastable nitrogen dioxide (NO <sub>2</sub> <sup>*</sup> ). As the NO <sub>2</sub> <sup>*</sup> decays, light is emitted and detected by a photomultiplier tube. The resulting signal is a measure of the total chemically bound nitrogen in the sample. |
| <u>Scope and Application</u>          | This test method covers the determination of the total nitrogen content of water in concentrations from 0.5 to 1000 mg/L. Higher nitrogen concentrations may be determined by making the proper dilutions. This test method does not determine molecular nitrogen (N <sub>2</sub> ).                                                                                                                                                                                                                                                                     |
| <u>Applicable Concentration Range</u> | 0.5-1000 mg/L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <u>Interferences</u>                  | If water samples contain high concentrations of suspended matter or dissolved nonvolatile compounds, the syringe needle may tend to plug or the precision and bias of the test method may be degraded. In such a case, the sample boat system should be used .                                                                                                                                                                                                                                                                                           |
| <u>QC Requirements</u>                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <u>Sample Handling</u>                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <u>Max Holding Time</u>               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## Appendix SOP 9B. NEMI Methods Description for Chemical Analyses (continued)

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>Method Source</u>         | USGS National Water Quality Laboratory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <u>Method Number</u>         | I-4650-03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <u>Revision Information</u>  | 2003                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <u>Method Name</u>           | <b>Descriptive Name:</b> Nitrogen and Phosphorus, Total, in whole-water by Alkaline Persulfate Digestion<br><br><b>Official Name:</b> Evaluation of Alkaline Persulfate Digestion as an Alternative to Kjeldahl Digestion for Determination of Total and Dissolved Nitrogen and Phosphorus in Water                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <u>Media</u>                 | <b>Media:</b> WATER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <u>Subcategory</u>           | Inorganic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <u>Citation</u>              | Patton, C.J., and Kryskalla, J.R., Methods of Analysis of the U.S. Geological Survey National Water Quality Laboratory -- Evaluation of Alkaline Persulfate Digestion as an Alternative to Kjeldahl Digestion for Determination of Total and Dissolved Nitrogen and Phosphorus in Water, U.S. Geological Survey Water-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <u>Method Download</u>       | <a href="#">Download full method now (PDF file)</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <u>Summary of Method</u>     | Whole-water samples are dispensed into glass culture tubes, dosed with alkaline persulfate reagent, capped tightly, and digested in an autoclave at 250°F (121°C) and 17 lb/in <sup>2</sup> (117.2 kPa) for 1 hour. The alkaline persulfate digestion procedure oxidizes all forms of inorganic and organic nitrogen to nitrate and hydrolyzes all forms of inorganic and organic phosphorus to orthophosphate. Nitrate and orthophosphate in alkaline persulfate Orthophosphate was determined by a phosphoantimonymolybdenum blue method, which is equivalent to the 2-reagent variants of USEPA method 365.1 and USGS method I-2601-90.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <u>Scope and Application</u> | This method was validated for determination of total phosphorus in drinking water, wastewater, and water-suspended sediment. Their applicability to bottom materials was not investigated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <u>Interferences</u>         | Chloride concentrations higher than 10,000 mg/L are likely to interfere because of reaction with persulfate to form oxychlorides or chlorine that might deplete persulfate required to oxidize inorganic and organic nitrogen species to nitrate. Resulting active chlorine species can also interfere in colorimetric reactions used to Organic carbon concentrations greater than 150 mg/L interfere because of reaction with persulfate to form carbon dioxide, depleting persulfate required to oxidize inorganic and organic nitrogen species to nitrate. Overacidification of samples at collection sites can result in low recovery of inorganic and organic nitrogen, which can be avoided by exclusive use of the sulfuric acid field-amendment solution (see text for details). Nitrate and nitrite do not contribute to Kjeldahl dissolved and total nitrogen concentrations in principle, but in practice, positive and negative interferences by these ions are well known. This interference can confound comparison of Kjeldahl nitrogen and alkaline persulfate digestion nitrogen when dissolved nitrate concentrations Suspended particles remaining in digests must be removed by sedimentation and decantation or filtration prior Barium, lead, and silver can interfere by forming insoluble phosphates, but their concentrations in natural-water samples usually are less than the interference threshold.<br><br>Arsenate, AsO <sub>4</sub> <sup>3-</sup> , (but not arsenite, AsO <sub>3</sub> <sup>3-</sup> ) can interfere by forming reduced heteropoly acids analogous to those found by orthophosphate. Because of the possibility that arsenite might be oxidized to arsenate by persulfate, both species at concentrations up to 20 mg-As/L in deionized water were digested and analyzed, |
| <u>QC Requirements</u>       | Calibrate instrument using calibration standards (CAL); quality control samples (QCS); and laboratory blanks (LB) analyzed at a minimum of 1 for every 10 samples, as described in OFR 95-443. The method report (WRIR 03-4174) provides detailed instructions for preparing calibrants, matrix spike solution, quality-control check                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <u>Sample Handling</u>       | Field rinse and fill sample bottles. Add 1 mL of 4.5 N H <sub>2</sub> SO <sub>4</sub> per 120 mL of sample. Chill sample immediately                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## SOP 10. Workspace Setup and Project Records Management

*Version 1.01 (November 2009)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New Version Number | Revision Date | Author      | Changes Made                                                         | Reasons for Change                                                                                | Network Regional Reviewer Approval | Previous Version Number |
|--------------------|---------------|-------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------|-------------------------|
| 1.0                | 11/24/09      | Kelly Kozar | Updated workspace setup for images and YSI files linked to database. | To reflect updates for files linked to database. To reflect updates for files linked to database. |                                    | 1.01                    |

## Figures

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| <b>Figure SOP 10.2.</b> Required file structure for images linked to the water quality<br>database. .... | 122  |

## Purpose

This Standard Operating Procedure document describes how to set up a project workspace, and describes the PACN Digital Library, which is used for archival of finished water quality monitoring products.

## Setup of Project Workspace

A section of the networked PACN file server is reserved for this project, and access permissions are established so that project staff members have access to needed files within this workspace. Prior to each season, the Project Lead should make sure that network accounts are established for each new staff member, and that the Data Manager is notified to ensure access to the project workspace and databases. If network connections are too slow for efficient data entry and processing, individual staff members may set up a workspace on their own workstation, with periodic data transfer to the PACN server. Daily back ups of the workstation to an external hard drive will ensure that no data is lost.

The recommended file structure within this workspace is shown in Figure SOP 10.1. Certain subfolders, especially those for GPS data and images, should be retained in separate folders for each calendar year. This will make it easier to identify and move these files to the project archives at the end of each season (see section 4.12 of the protocol narrative, Season Close-out).

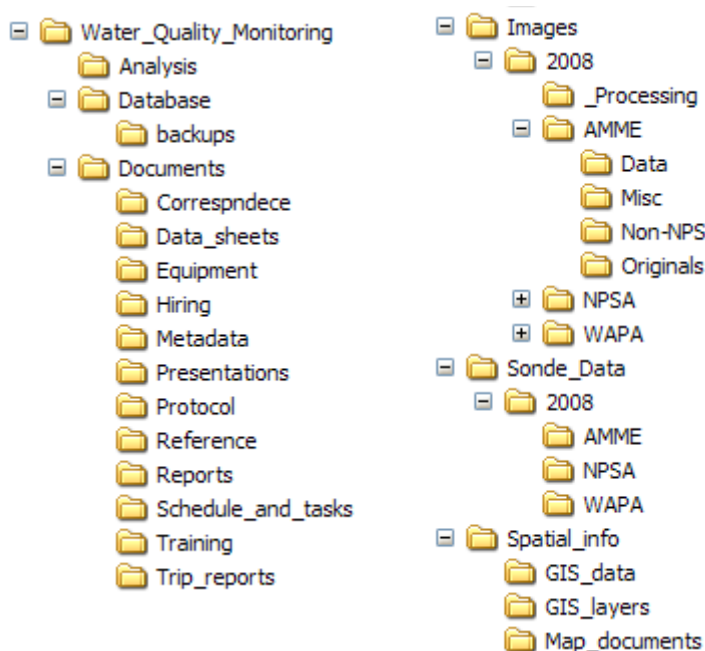


**Figure SOP 10.1.** Recommended file structure for project workspace.

Within the Database folder there should be a folder called “Database\_images” (see Figure SOP 10.2). Within this folder, there should be two more folders, “1\_Station\_images” and “2\_Sampling\_event\_images”. Within these folders should be a folder for the current monitoring year. Each of the year folders will have a folder for each park. Images for stations and sampling event images that are to be linked to the database should go into the appropriate folder for the year and park. All other images should go into the image folder in the main directory.

For YSI files that will be imported into the database, create a folder for each sampling event for each park. Place clean YSI text files in these sampling event folders before importing to the database.

Following these steps will ensure that the files will be re-linked to the database upon moving as long as the structure is maintained.

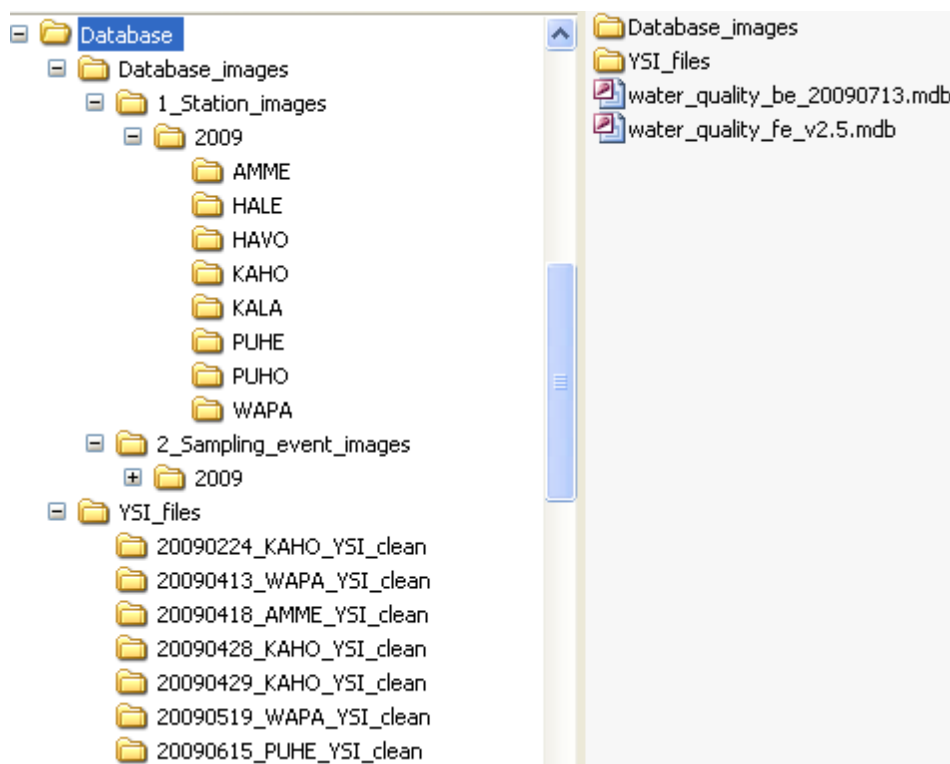


**Figure SOP 10.2.** Required file structure for images linked to the water quality database.

Each major subfolder is described as follows:

- Analysis: Contains working files associated with data analysis
- Database: Contains the working database file for the season, the folder for linked images, and the folder for imported YSI files. The master database for the project is stored in the PACN Digital Library.
- Documents: Contains subfolders to categorize documents as needed for various stages of project implementation.
- GPS data: Contains GPS data dictionaries, and raw and processed GPS data files. Note that this folder contains subfolders to arrange files by year.
- Images: For storing images associated with the project (refer to **SOP 12**). Note that this folder contains subfolders to arrange files by year.

- Spatial info: Contains files related to visualizing and interacting with GIS data.
  - o GIS data: New working shapefiles and geodatabases specific to the project.
  - o GIS layers: Pointer files to centralized GIS base themes.
  - o Map documents: Map composition files (.mxd).

## **Naming Conventions**

### ***Folder Naming Standards***

In all cases, folder names should follow these guidelines:

- No spaces or special characters in the folder name.
- Use the underbar (“\_”) character to separate words in folder names.
- Try to limit folder names to 20 characters or fewer.
- Dates should be formatted as YYYYMMDD.

### ***File Naming Standards***

In all cases, file names should follow these guidelines:

- No spaces or special characters in the file name.
- Use the underbar (“\_”) character to separate file name components.
- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters.
- Dates should be formatted as YYYYMMDD.
- Correspondence files should be named as YYYYMMDD\_AuthorName\_subject.ext.

## **Archival and Records Management**

All project files should be reviewed, cleaned up and organized by the Project Lead on a regular basis (e.g., annually in January). Decisions on what to retain and what to destroy should be made following guidelines stipulated in [NPS Director’s Order 19](http://www.nps.gov/refdesk/DOrders/DOrder19.html) (NPS 2001, <http://www.nps.gov/refdesk/DOrders/DOrder19.html>), which provides a schedule indicating the amount of time that the various kinds of records should be retained. Although many of the files for this project may be scheduled for permanent retention, it is important to isolate and protect these important files and not lose them in the midst of a large, disordered array of miscellaneous project files. Because this is a long-term monitoring project, good records management practices are critical for ensuring the continuity of project information. Files will be more useful to others if they are well organized, well named, and stored in a common format. In addition, it is important that files containing sensitive information be stored in a manner that will enable quick identification. Refer to SOP 16 (Sensitive Information Procedures) for more information. Hard copies of field data forms should be stored in the designated water quality filing cabinet for three years as specified by NPS Director’s Order 19.

To help ensure safe and organized electronic file management, PACN has implemented a system called the PACN Digital Library, which is a hierarchical digital filing system stored on the PACN file servers. The typical arrangement is by project, then by year to facilitate easy access. Network users have read-only access to these files, except where information sensitivity may

preclude general access. Submission of certified products occurs in the PACN Digital Library by uploading the certified products in the “Submissions” folder and notifying the Data Manager.

As digital products are delivered for long-term storage, according to the schedule in SOP 17 (Product Delivery Specifications), they will be catalogued in the PACN project tracking database and filed within the PACN Digital Library by the Data Manager. The master versions of all digital files relating to the Water Quality protocol are stored within the PACN Digital Library, with regular file backups accomplished automatically. Presently, the master protocol files include the protocol narrative, the protocol appendixes, the SOPs, and the water quality database files. Analog (non-digital) materials are to be handled according to current practices of the individual park collections.

### **Maintenance of Archived Data**

Any editing of archived data is accomplished jointly by the Project Lead or designee and PACN Data Manager. Prior to any major changes of a dataset, a copy is stored with the appropriate version number to allow for tracking of changes over time. Likewise, any time a revision of the protocol requires a revision to the database, a complete copy of the database will be made and stored in an archive directory. In addition to this copy in its native database format, all tables will be archived in a comma-delimited ASCII format that is platform-independent by using the `Access_to_ascii.mdb` utility developed by Northern Colorado Plateau Network.

Versioning of archived datasets is handled by adding a three digit number to the file name, with the first version being numbered 001 (e.g., `water_quality_be_2008_validated_v001`, for the first version of a back-end data file validated by the Project Lead and Data Manager at the end of the 2008 field season). The two text files generated by the `Access_to_ascii.mdb` utility, `FieldDef.txt` and `TableDef.txt`, will be stored in a similarly named folder (e.g., `water_quality_be_2008_validated_v001_text`). Each additional version is assigned a sequentially higher number. Frequent users of the data are notified of the updates, and provided with a copy of the most recently archived version.

Every change must be documented in the edit log and accompanied by an explanation that includes pre- and post-edit data descriptions. All data collected using this protocol is subject to the following three caveats:

- Only make changes that improve or update the data while maintaining data integrity.
- Once archived, document any changes made to the dataset through an edit log. At end of each fiscal year, the database manager will update the central database and will post read-only versions.
- Mistakes can be made during editing so updates must be compared with the original data form prior to validating the data.

### **Literature**

National Park Service (NPS). 2001. Director’s order 19: Records management. Version 17 January 2001. U.S. Department of the Interior, National Park Service, Washington, D.C. Online. (<http://www.nps.gov/policy/DOrders/DOrder19.html>). Accessed 1 January 2010.







## **Purpose**

This Standard Operating Procedure describes how to process field data forms.

## **Field Form Handling Procedures**

As the field data forms are part of the permanent record for project data, they should be handled in a way that preserves their future interpretability and information content. If changes to data on the forms need to be made either during or after field data acquisition, the original values should not be erased or otherwise rendered illegible. Instead, changes should be made as follows:

- Draw a horizontal line through the original value, and write the new value adjacent to the original value with the date and initials of the person making the change.
- All corrections should be accompanied by a written explanation in the appropriate notes section on the field form. These notes should also be dated and initialed.
- If possible, edits and revisions should be made in a different color ink to make it easier for subsequent viewers to be able to retrace the edit history.
- Edits should be made on the original field forms and on any photocopied forms.

These procedures should be followed throughout data entry and data revision. After each field collection trip, data sheets are to be scanned as PDF documents. The PDF documents should be stored in the correct folder in the PACN project workspace, and the hard copy data sheets stored in the designated filing cabinet for retention (SOP 10. Workspace Setup and Project Records Management). The PDF files may then serve as a convenient digital reference of the original if needed.

## SOP 12. Managing Photographic Images

*Version 1.01 (November 2009)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New Version Number | Revision Date | Author      | Changes Made                                                         | Reasons for Change                               | Network Regional Reviewer Approval | Previous Version Number |
|--------------------|---------------|-------------|----------------------------------------------------------------------|--------------------------------------------------|------------------------------------|-------------------------|
| 1.0                | 11/24/09      | Kelly Kozar | Updated workspace setup for images and YSI files linked to database. | To reflect updates for files linked to database. |                                    | 1.01                    |

## **Appendixes**

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## Purpose

This Standard Operating Procedure describes how to process photographic images collected by project staff or volunteers during the course of conducting project-related activities. Images that are acquired by other means—e.g., downloaded from a website or those taken by a cooperating researcher—are not project records and should be handled separately.

Care should be taken to distinguish data photos from incidental or opportunistic photos taken by project staff. Data photos are those taken for at least one of the following reasons:

- To document a particular feature or perspective for the purpose of site relocation
- To capture site habitat characteristics and possibly to indicate gross structural changes over time

Data photos are linked to specific records within the database, and are stored in a manner that permits the preservation of those database links. Other photos—e.g., of field crew members at work—may also be retained but are not necessarily linked with database records.

Effectively managing hundreds of photographic images requires a consistent method for downloading, naming, editing, and documenting. The general process for managing data photos proceeds as follows:

1. File Structure Setup: Set up the file organization for images prior to acquisition
2. Image Acquisition
3. Download and Process
  - Download the files from the camera.
  - Rename the image files according to convention.
  - Copy and store the original, unedited versions
  - Review and edit or delete the photos
  - Move files into appropriate folders for storage
4. Establish Database Links
5. Deliver Image Files for Final Storage

## File Structure Setup

Prior to data collection for any given year, project staff will need to set up a new folder under the Images folder in the project workspace as follows:

|               |                                                     |
|---------------|-----------------------------------------------------|
| [Year]        | The appropriate year – 2007, 2008, etc.             |
| _Processing   | Processing workspace                                |
| [Park code]   | Arrange files by park – HAVO, NPSA, etc.            |
| Data          | Data images                                         |
| [Site_code]   | Arranged by sampling locations, or                  |
| [Date]        | by date, for images not taken at sampling locations |
| Miscellaneous | Non-data images taken by project staff              |
| [Site_code]   | Arranged by sampling locations, or                  |
| [Date]        | by date, for images not taken at sampling locations |

|             |                                                     |
|-------------|-----------------------------------------------------|
| Originals   | Renamed but otherwise unedited image file copies    |
| [Site_code] | Arranged by sampling locations, or                  |
| [Date]      | by date, for images not taken at sampling locations |
| Non-NPS     | Images acquired from other sources                  |

This folder structure permits data images to be stored and managed separately from non-record and miscellaneous images collected during the course of the project. It also provides separate space for image processing and storage of originals. For all images that are to be linked to the database, the image files will need to be copied to the appropriate image folder under the database folder, as shown below. This will ensure that the links to the database are preserved at all times. See below for database image workspace structure. Note: For additional information about the project workspace, refer to SOP 10 (Workspace Setup and Project Records Management).

#### Database

```

Database_images
  1_Station_images
    [Year]
      [Park]
  2_Sampling_event_images
    [Year]
      [Park]
    
```

#### **Folder Naming Standards**

In all cases, folder names should follow these guidelines:

- No spaces or special characters in the folder name
- Use the underscore (“\_”) character to separate words in folder names.
- Try to limit folder names to 20 characters or fewer.
- Dates within folder names should be formatted as YYYYMMDD (for better sorting).

#### **Image Acquisition**

Capture images at an appropriate resolution that balances space limitations with the intended use of the images. Although photographs taken to facilitate future navigation to the site do not need to be stored at the same resolution as those that may be used to indicate gross environmental change at the site, it may be more efficient to capture all images at the same resolution initially. A recommended minimum raw resolution is 1,600 x 1,200 pixels (approximately 2 megapixels).

#### **Downloading and Processing Procedures**

1. Download the raw, unedited images from the camera into the appropriate “\_Processing” folder.
2. Rename the images according to convention (refer to the image file naming standards section below. If image file names were noted on the field data forms, be sure to update

these to reflect the new image file name prior to data entry. See SOP 11 (Field Form Handling Procedures).

3. Process the images in the \_Processing folder. At a minimum, the following processing steps should be performed on all image files:
  - Copy the images to the “Originals” folder and set the contents as read-only by right-clicking in Windows Explorer and checking the appropriate box. These originals are the image backup to be referred to in case of unintended file alteration or deletion.
  - Delete any poor quality photos, repeats, blurred or otherwise unnecessary photos. Low quality photos might be retained if the subject is highly unique, or the photo is an irreplaceable data photo.
  - Rotate the image to make the horizon level.
  - Photos of people should have ‘red-eye’ glare removed.
  - Photos should be cropped to remove edge areas that grossly distract from the subject.
4. When finished, move the image files that are to be retained and possibly linked in the database to the appropriate folder; data images under the “Data” folder, other images under the “Miscellaneous” folder. Photos of interest to a greater audience should be copied to the park Digital Image Library. To minimize the chance for accidental deletion or overwriting of needed files, no stray files should remain in the processing folder between downloads.
5. Images that are to be linked to the database should be moved into the appropriate image folder within the database folder.
6. Depending on the size of the files and storage limitations, contents of the “Originals” folder may be deleted if all desired files are accounted for after processing.

Large groups of photos acquired under sub-optimal exposure or lighting can be batch processed to enhance contrast or brightness. Batch processing can also be used to resize groups of photos for use on the web. Batch processing may be done in ThumbsPlus, Extensis Portfolio, or a similar image software package.

### ***Image File Naming Standards***

In all cases, image names should follow these guidelines:

- No spaces or special characters in the file name
- Use the underscore (“\_”) character to separate file name components
- Try to limit file names to 30 characters or fewer, up to a maximum of 50 characters
- Park code and year should either be included in the file name or conclusive by the directory structure

The image file name should consist of the following parts:

- The date of data capture (formatted as YYYYMMDD)
- The sampling location (if recorded at a sampling location)
- Optional: a brief descriptive word or phrase
- Optional: a sequential number if multiple images were captured

- Optional: time (formatted as HHMM)

Examples:

- 20070621\_Waihanau\_habitat\_001.jpg: The habitat at Waihanau Valley taken on June 21, 2007
- 20070518\_training\_004.jpg: 4th photo taken during training on May 18, 2007

In cases where there are small quantities of photos it is practical to individually rename these files. However, for larger numbers it may be useful to rename files in batches. This may be done in ThumbsPlus, Extensis Portfolio or a similar image software package. A somewhat less sophisticated alternative is to batch rename files in Windows Explorer, by first selecting the files to be renamed and then selecting File > Rename. The edits made to one file will be made to all others, although with the unpleasant side effect of often adding spaces and special characters (e.g., parentheses) which will then need to be removed manually.

Renaming photos may be most efficient as a two-part event: one step performed as a batch process which inserts the date and transect number at the beginning of the photo name, and a second step in which a descriptive component is manually added to each file name.

### **Establishing Database Links**

During data entry and processing, the database application will provide the functionality required to establish a link between each database record and the appropriate image file(s). To establish the link, the database will obtain the root project workspace directory path, the specific image folder within the project workspace, and the specific file name from the image file the user chooses to link. This way, the entire workspace may be later moved to a different directory (i.e., the PACN Digital Library) and the links will still be valid after changing only the root path. For additional details on establishing these links, refer to SOP 13 (Data Entry and Verification).

Note: It is important that the files keep the same name and relative organization, once these database links have been established. Users should not rename or reorganize the directory structure for linked image files without first consulting with the Data Manager.

### **Delivering Image Files for Final Storage**

Note: Please refer to SOP 17 (Product Delivery Specifications).

At the end of the season, and once the year's data are certified, data images for the year may be delivered along with the working copy of the database to the Data Manager on a CD or DVD. To do this, simply copy the folder for the appropriate year(s) and all associated subfolders and images onto the disk. These files will be loaded into the project section of the PACN Digital Library, and the database links to data images will be updated accordingly.

Prior to delivery, make sure that all processing folders are empty. Upon delivery, the delivered folders should be made read-only to prevent unintended changes.

**General Use Instructions**

To view detailed instructions for entering and editing data, see Appendix N (Water Quality Database Users Guide).

## Appendix SOP 12A. Useful Software for Managing Water Quality Digital Images

| Equipment (#/quantity)      | Preparation & Maintenance                                 |
|-----------------------------|-----------------------------------------------------------|
| ThumbsPlus software         | If needed, ensure availability, update software regularly |
| Extensis Portfolio software | If needed, ensure availability, update software regularly |
| Adobe Photoshop software    | If needed, ensure availability, update software regularly |



## **Purpose**

This Standard Operating Procedure document describes the general procedures for entry and verification of field data in the working project database. Refer to protocol sections Overview of Database Design (section 4.3 of the protocol narrative), and Data Entry and Processing (4.4) for related guidance and a clarification of the distinction between the working database and the master database. The following are general guidelines to keep in mind:

1. Data entry will be conducted by the Field Lead at their duty station.
2. Data entry should occur as soon after data collection as possible so that field crews keep current with data entry tasks, and catch any errors or problems as close to the time of data collection as possible.
3. The working database application will be found in the project workspace. If the workspace resides on the networked server, it is recommended that users copy the front-end database onto their workstation hard drives and open it there for enhanced performance. This front-end copy may be considered “disposable” because it does not contain any data, but rather acts as an interface with data residing in the back-end working database. The database may be in the project workspace on the user’s computer if the connection to the networked server is too slow (see SOP 10. Workspace Setup and Project Records Management), with periodic uploads to the network server.
4. Each data entry form is patterned after the layout of the field form, and has built-in quality assurance components such as pick lists and validation rules to test for missing data or illogical combinations. The database allows the users to view only the pre-built forms and does not permit users to view the raw data tables and other database objects as a way of ensuring the maximum level of quality assurance.
5. As data are being entered or imported, the person entering the data should visually review each data form to make sure that the data on screen match the field forms. This should be done for each record prior to moving to the next form for data entry.
6. At regular intervals and at the end of the field season the Field Lead should inspect the data that have been entered to check for completeness and perhaps catch avoidable errors.
7. After each data entry session for a tour, the Field Lead should upload the working copy of the database onto the networked server if the database has been stored on their computer.

## **Database Instructions**

### ***Getting Started***

The first action to be taken is to make sure the data entry workspace is set up properly either on a networked drive or the user’s computer if networked server connections are too slow for efficient data entry. If you are unclear about where the data entry workspace should be contact the Data Manager (see SOP 10 for more information).

- Store the back-end database file in the database folder in the project workspace. The back-end file has “\_be\_” as part of its name.
- The user’s copy of the front-end database should also be stored in the same folder.

- If it doesn't already exist, also create a folder in the same network folder named "backups" for storing daily backups of the back-end database file. If this step is neglected, a backup folder will automatically be created during the first back up.
- Open the front-end database. The first thing it will do is to ask to update the links to the back-end database file. This will only need to be done once for each new issue of the front-end database.

### ***Important Reminders for Daily Database Use***

- A copy of the front-end will need to be copied to your workstation if the project workspace is set up on the networked server. Do not open up and use the front-end on the network as this 'bloats' the database file and makes it run more slowly.
- The front-end application will automatically prompt you to make a backup upon initially opening the application.
- To save drive space and network resources, backup files should be compacted by right-clicking on the backup file in Windows Explorer and selecting the option: "Add to Zip file". Older files may be deleted at the discretion of the project crew lead.
- New issues of the front-end application may be released as needed through the course of the field season. If this happens, there should be no need to move or alter the back-end file. Instead, the front-end file may be deleted and replaced with the new version, which will be named in a manner reflecting the update (e.g., water\_quality\_2008\_v2.mdb).
- If the front-end database gets bigger and slower, compact it periodically by selecting Tools > Database Utilities > Compact and Repair Database.

### ***General Use Instructions***

To view detailed instructions for entering and editing data, see Appendix N of this protocol (Water Quality Database User's Guide).



## SOP 14. Post-season Data Quality Review and Certification

*Version 1.0 (April 2008)*

## Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
|--------------------------|------------------|--------|--------------|-----------------------|---------------------------------------------|-------------------------------|
|                          |                  |        |              |                       |                                             |                               |

## **Purpose**

This Standard Operating Procedure document describes the procedures for validation and certification of data in the working project database. Refer also to protocol sections Overview of Database Design (section 4.3 of the protocol narrative), Data Quality Review (4.5), and Data Certification and Delivery (4.7) for related guidance and a clarification of the distinction between the working database and the master database.

After the season's field data have been entered and processed, they need to be reviewed and certified by the Project Lead for quality, completeness and logical consistency. Data validation is the process of checking data for completeness, structural integrity, and logical consistency.

Once the data have been through the validation process and metadata have been developed for them, they are to be certified by completing the [PACN Project Data Certification Form](http://science.nature.nps.gov/im/units/pacn/data/data_sop/PACN_Project_Data_Certification_Form.doc) (PACN 2007,

[http://science.nature.nps.gov/im/units/pacn/data/data\\_sop/PACN\\_Project\\_Data\\_Certification\\_Form.doc](http://science.nature.nps.gov/im/units/pacn/data/data_sop/PACN_Project_Data_Certification_Form.doc)), available on the PACN website. The completed form, certified data, and updated metadata may then be delivered to the NPS Lead and the Data Manager according to the timeline in Appendix L of this protocol (Yearly Project Task List).

## **Data Quality Review**

At the end of each field season, the Project Lead and the PACN data management staff are collectively responsible for finalizing a validated dataset for that field season. The Project Lead or Aquatic Biological Technician will complete all data validation. Some validation (ensuring that the data make sense) methods have been incorporated into the marine fish database. Other, more specific validation routines will be worked out with the protocol Project Lead and/or project staff and incorporated into the database as appropriate. These modifications will be described in the edit log and the functionality of the validation routines will be explained in detail in the water quality database user manual.

## **Completing Data Certification**

Data certification is a benchmark in the project information management process that indicates that:

1. The data are complete for the period of record.
2. They have undergone and passed the quality assurance checks.
3. That they are appropriately documented and in a condition for archiving, posting and distribution as appropriate. Certification is not intended to imply that the data are completely free of errors or inconsistencies which may or may not have been detected during quality assurance reviews.

To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. The Project Lead is primarily responsible for completing a PACN Project Data Certification Form, available on the PACN website. This brief form and the certified data should be submitted according to the timeline in Appendix L of the protocol (Yearly Project Task List). Refer to SOP 17 (Product Delivery Specifications) for delivery instructions.

## **Literature**

Pacific Island Network (PACN). 2007. PACN Project data certification form. Version 3 August 2007. PACN, Hawaii National Park, Hawaii. Online.  
([http://science.nature.nps.gov/im/units/pacn/data/data\\_sop/PACN\\_Project\\_Data\\_Certification\\_Form.doc](http://science.nature.nps.gov/im/units/pacn/data/data_sop/PACN_Project_Data_Certification_Form.doc)). Accessed 4 January 2010.



## SOP 15. Metadata Development

*Version 1.0 (April 2008)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
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## **Appendixes**

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## Purpose

This Standard Operating Procedure document describes the guidelines for documenting data and how it should be accomplished.

## Metadata Documentation

Data documentation is a critical step toward ensuring that data sets are usable for their intended purposes well into the future. This involves the development of metadata, which can be defined as structured information about the content, quality, condition and other characteristics of a given data set. Additionally, metadata provide the means to catalog and search among data sets, thus making them available to a broad range of potential data users. Metadata for all PACN monitoring data will conform to Federal Geographic Data Committee (FGDC) guidelines and will contain all components of supporting information such that the data may be confidently manipulated, analyzed and synthesized.

Updated metadata is a required deliverable that should accompany each season's certified data. For long-term projects such as this one, metadata creation is most time consuming the first time it is developed; after which most information remains static from one year to the next. Metadata records in subsequent years then only need to be updated to reflect changes in contact information and taxonomic conventions, to include recent publications, to update data disposition and quality descriptions, and to describe any changes in collection methods, analysis approaches or quality assurance for the project.

Specific procedures for creating, parsing, and posting the metadata record are found in PACN [Metadata Development Guidelines](#) (PACN 2007a, [http://science.nature.nps.gov/im/units/pacn/data/data\\_sop/PACN\\_Metadata\\_Guidelines.pdf](http://science.nature.nps.gov/im/units/pacn/data/data_sop/PACN_Metadata_Guidelines.pdf)). The general flow is as follows:

1. After the annual data quality review has been performed and the data are ready for certification, the Project Lead (or a designee) updates the [PACN Metadata Interview Form](#) (PACN 2007b, [http://science.nature.nps.gov/im/units/pacn/data/data\\_sop/PACN\\_Metadata\\_Interview\\_Form.doc](http://science.nature.nps.gov/im/units/pacn/data/data_sop/PACN_Metadata_Interview_Form.doc)).
  - a. The metadata interview form greatly facilitates metadata creation by structuring the required information into a logical arrangement of 15 main questions, many with additional sub-questions.
  - b. The first year, a new copy of the metadata interview form should be downloaded. Otherwise the form from the previous year can be used as a starting point, in which case the Track Changes tool in MS Word should be activated in order to make edits obvious to the person who will be updating the XML record.
  - c. Complete the metadata interview form and maintain it in the project workspace. Much of the interview form can be filled out by cutting and pasting material from other documents (e.g., reports, protocol narrative sections, and SOPs).
  - d. The Data Manager can help answer questions about the metadata interview form.
2. Deliver the completed interview form to the Data Manager according to SOP 17 (Product Delivery Specifications).

3. The Data Manager (or GIS Specialist for spatial data) will then extract the information from the interview form and use it to create and update an FGDC- and NPS-compliant metadata record in XML format. Specific guidance for creating the XML record is contained in PACN [Metadata Development Guidelines](#) (PACN 2007).
4. The Data Manager will post the record and the certified data to the NPS Data Store, and maintain a local copy of the XML file for subsequent updates. The NPS Data Store has help files to guide the upload process.
5. The Project Lead should update the metadata interview content as changes to the protocol are made, and each year as additional data are accumulated.

### ***Identifying sensitive information***

Part of metadata development includes determining whether or not the data include any sensitive information. Prior to completing the metadata interview form, the Project Lead should identify any sensitive information in the data after first consulting SOP 16 (Sensitive Information Procedures). The Project Lead's findings may be documented and communicated to the Data Manager through the metadata interview form.

### **Literature**

- Pacific Island Network (PACN). 2007a. PACN Metadata development guidelines. Version 13 August 2007. PACN, Hawaii National Park, Hawaii. Online.  
([http://science.nature.nps.gov/im/units/pacn/data/data\\_sop/PACN\\_Metadata\\_Guidelines.pdf](http://science.nature.nps.gov/im/units/pacn/data/data_sop/PACN_Metadata_Guidelines.pdf)). Accessed 4 January 2010.
- Pacific Island Network (PACN). 2007b. PACN Metadata interview form. Version 3 August 2007. Online.  
([http://science.nature.nps.gov/im/units/pacn/data/data\\_sop/PACN\\_Metadata\\_Interview\\_Form.doc](http://science.nature.nps.gov/im/units/pacn/data/data_sop/PACN_Metadata_Interview_Form.doc)). Accessed 4 January 2010.

## **Appendix SOP 15A. Equipment Needed to Record Data Quality Review Metadata**

| <b>Equipment (#/quantity)</b> | <b>Equipment (#/quantity)</b> |
|-------------------------------|-------------------------------|
| PACN Metadata Interview Form  | Complete annually             |



## SOP 16. Sensitive Information Procedures

*Version 1.0 (April 2008)*

## Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
|--------------------------|------------------|--------|--------------|-----------------------|---------------------------------------------|-------------------------------|
|                          |                  |        |              |                       |                                             |                               |

## Purpose

Although it is the general NPS policy to share information widely, the NPS also realizes that providing information about the location of park resources may sometimes place those resources at risk of harm, theft, or destruction. This can occur, for example, with regard to caves, archeological sites, tribal information, and rare plant and animal species. Therefore, information will be withheld when the NPS foresees that disclosure would be harmful to an interest protected by an exemption under the Freedom of Information Act (FOIA). The National Parks Omnibus Management Act, Section 207, 16 U.S.C. 5937, is interpreted to prohibit the release of information regarding the “nature or specific location” of certain cultural and natural resources in the national park system. Additional details and information about the legal basis for this policy can be found in the [NPS Management Policies](#) (NPS 2006), and in [Director’s Order 66](#) (NPS 2005).

These guidelines apply to all PACN staff, cooperators, contractors, and other partners who are likely to obtain or have access to information about protected NPS resources. The Project Lead has primary responsibility for ensuring adequate protection of sensitive information related to this project.

The following are highlights of our strategy for protecting this information:

- *Protected resources*, in the context of the PACN Inventory and Monitoring Program, include species that have state- or federally listed status, and other species deemed rare or sensitive by local park taxa experts.
- *Sensitive information* is defined as information about protected resources which may reveal the “nature or specific location” of protected resources. Such information must not be shared outside the National Park Service, unless a signed confidentiality agreement is in place.
- In general, if information is withheld from one requesting party, it must be withheld from anyone else who requests it, and if information is provided to one requesting party without a confidentiality agreement, it must be provided to anyone else who requests it.
- To share information as broadly as legally possible, and to provide a consistent, tractable approach for handling sensitive information, the following shall apply if a project is likely to collect and store sensitive information:
  - Random coordinate offsets of up to 2 km for data collection locations, and
  - Removal of data fields from the released copy that are likely to contain sensitive information.

## What Kinds of Information Can and Cannot Be Shared?

### ***Do Not Share***

Project staff and cooperators should not share any information outside NPS that reveals details about the “nature or specific location” of protected resources, unless a confidentiality agreement is in place. Specifically, the following information should be omitted from shared copies of all data, presentations, reports, or other published forms of information.

- *Exact Coordinates*: Instead, public coordinates are to be generated that include a random offset azimuth and distance. These offset coordinates can be shared freely.
- *Other Descriptive Location Data*: Examples may include travel descriptions, location descriptions, or other fields that contain information which may reveal the specific location of the protected resource(s).
- *Protected Resource Observations at Disclosed Locations*: If specific location information has already been made publicly available, the occurrence of protected resources at that location cannot be shared outside NPS without a confidentiality agreement. For example, if the exact coordinates for a monitoring station location are posted to a website or put into a publication, then at a later point in time an endangered fish species is observed at that monitoring station, that monitoring station location in reference to the endangered fish species cannot be mentioned or referred to in any report, presentation, data set, or publication that will be shared outside NPS.

### **Do Share**

All other information about the protected resource(s) may be freely shared, so long as the information does not reveal details about the “nature or specific location” of the protected resource(s) that aren’t already readily available to the general public in some form (e.g., other published material). Species tallies and other types of data presentations that do not disclose the precise locations of protected resources may be shared, unless by indicating the presence of the species the specific location is also revealed (i.e., in the case of a small park).

### **Details for Specific Products**

Whenever products such as databases and reports are being generated, handled and stored, they should be created explicitly for one of the following purposes:

1. *Public or general-use*: Intended for general distribution, sharing with cooperators, or posting to public websites. They may be derived from products that contain sensitive information so long as the sensitive information is either removed or otherwise rendered in a manner consistent with other guidance in this document.
2. *Internal NPS use*: These are products that contain sensitive information and should be stored and distributed only in a manner that ensures their continued protection. These products should clearly indicate that they are solely for internal NPS use by containing the phrase: “Internal NPS Use Only – Not For Release.” These products can only be shared within NPS or in cases where a confidentiality agreement is in place. They do not need to be revised in a way that conceals the location of protected resources.

Data Sets: To create a copy of a data set that will be posted or shared outside NPS:

1. Make sure the public offset coordinates have been populated for each sample or observation location in tbl Locations.
2. Delete any database objects that may contain specific, identifying information about locations of protected resources.

The local, master copy of the database contains the exact coordinates and all data fields. The Data Manager and/or GIS Specialist can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

**Maps and Other GIS Output:** General use maps and other geographic representations of observation data that will be released or shared outside NPS should be rendered using offset coordinates, and should only be rendered at a scale that does not reveal their exact position (e.g., 1:100,000 maximum scale).

If a large-scale, close-up map is to be created using exact coordinates (e.g., for field crew navigation, etc.), the map should be clearly marked with the following phrase: “Internal NPS Use Only – Not For Release.”

The Data Manager and/or GIS Specialist can provide technical assistance as needed to apply coordinate offsets or otherwise edit data products for sensitive information.

**Presentations and Reports:** Public or general-use reports and presentations should adhere to the following guidelines:

1. Do not list exact coordinates or specific location information in any text, figure, table, or graphic in the report or presentation. If a list of coordinates is necessary, use only offset coordinates and clearly indicate that coordinates have been purposely offset to protect the resource(s) as required by law and NPS policy.
2. Use only general use maps as specified in the section on maps and other GIS output.

If a report is intended for internal use only, these restrictions do not apply. However, each page of the report should be clearly marked with the following phrase: “Internal NPS Use Only – Not For Release.”

### ***Procedures for Coordinate Offsets***

1. Process GPS data, upload into the database, and finalize coordinate data records.
2. Set the minimum and maximum offset distances (project-specific, typically up to 2 km).
3. Apply a random offset and random azimuth to each unique set of coordinates.
4. Coordinates may then be either rounded or truncated so the UTM values end in zeros to give a visual cue that the values are not actual coordinates.
5. Do not apply independent offsets to clustered or otherwise linked sample locations (e.g., multiple sample points along a transect). Instead, either apply a single offset to the cluster so they all remain clustered after the offset is applied, or apply an offset to only one of the points in the cluster (e.g., the transect origin) and store the result in the public coordinates for each point in that cluster.
6. In the absence of a confidentiality agreement, these “public” coordinates are then the only ones to be shared outside NPS, including all published maps, reports, publications, presentations, and distribution copies of the data.

The following components can be used to create individual offsets rounded to the nearest 100 meters in MS Excel:

- $\text{Angle} = \text{rand}() * 359$
- $\text{Distance} = ((\text{Max\_offset} - \text{Min\_offset}) * \text{rand}() + \text{Min\_offset})$
- $\text{Public\_UTME} = \text{Round}(\text{UTME\_final} + (\text{Distance} * \cos(\text{Radians}(\text{Angle} - 90))), -2)$
- $\text{Public\_UTMN} = \text{Round}(\text{UTMN\_final} + (\text{Distance} * \sin(\text{Radians}(\text{Angle} + 90))), -2)$

### **Sharing Sensitive Information**

Note: For a more complete description of how to post and distribute products, and to keep a log of data requests, refer to SOP 18 (Product Posting and Distribution).

No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to the NPS Data Store or another publicly accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Only products that are intended for public/general-use may be posted to public websites and clearinghouses; these may not contain sensitive information.

### **Responding to Data Requests**

If requests for distribution of products containing sensitive information are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (e.g., the full data set that includes sensitive information) may only be shared after a confidentiality agreement is established between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. All data requests will be tracked according to procedures in SOP 18.

Once a confidentiality agreement is in place, products containing sensitive information may be shared following these guidelines:

- Always clearly indicate in accompanying correspondence that the products contain sensitive information, and specify which products contain sensitive information.
- Indicate in all correspondence that products containing sensitive information should be stored and maintained separately from non-sensitive information, and protected from accidental release or re-distribution.
- Indicate that NPS retains all distribution rights; copies of the data should not be redistributed by anyone but NPS.
- Include the following standard disclaimer in a text file with all digital media upon distribution: “The following files contain protected information. This information was provided by the National Park Service under a confidentiality agreement. It is not to be published, handled, re-distributed or used in a manner inconsistent with that agreement.” The text file should also specify the file(s) containing sensitive information.

- If the products are being sent on physical media (e.g., CD or DVD), the media should be marked in such a way that clearly indicates that media contains sensitive information provided by the National Park Service.

### **Confidentiality Agreements**

Confidentiality agreements may be created between NPS and another organization or individual to ensure that protected information is not inadvertently released. When contracts or other agreements with a non-federal partner do not include a specific provision to prevent the release of protected information, the written document must include the following standard Confidentiality Agreement:

**Confidentiality Agreement:** I agree to keep confidential any protected information that I may develop or otherwise acquire as part of my work with the National Park Service. I understand that with regard to protected information, I am an agent of the National Park Service and must not release that information. I also understand that by law I may not share protected information with anyone through any means except as specifically authorized by the National Park Service. I understand that protected information concerns the nature and specific location of endangered, threatened, rare, commercially valuable, mineral, paleontological, or cultural patrimony resources such as threatened or endangered species, rare features, archeological sites, museum collections, caves, fossil sites, gemstones, and sacred ceremonial sites. Lastly, I understand that protected information must not be inadvertently disclosed through any means including websites, maps, scientific articles, presentation, and speeches.

### **Freedom of Information (FOIA) Requests**

All official FOIA requests will be handled according to NPS policy. The NPS Lead will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

### **References**

- National Park Service (NPS). 2006. Management policies 2006. U.S. Department of the Interior, National Park Service, Washington, D.C. Online.  
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## Purpose

This Standard Operating Procedure document provides details on the process of submitting completed data sets, reports and other project deliverables. Prior to submitting digital products, files should be named according to the naming conventions appropriate to each product type (see below for general naming conventions).

All digital file submissions that are sent by email should be accompanied by a [Product Submission Form](#) (PACN 2007c, [http://science.nature.nps.gov/im/units/pacn/data/data\\_sop/PACN\\_Product\\_Submissions\\_Form.doc](http://science.nature.nps.gov/im/units/pacn/data/data_sop/PACN_Product_Submissions_Form.doc)), which briefly captures the following information about the products:

- Submission date
- Name of the person submitting the product(s)
- Name and file format of each product
- Indication of whether or not each product contains sensitive information (for more details, see SOP 16. Sensitive Information Procedures).

This form can be obtained from the Data Manager. Upon notification and/or receipt of the completed products, the Data Manager or GIS Specialist will check them into the PACN project tracking application.

**Table SOP 17.1.** Product delivery schedule and specifications

| Deliverable Product        | Primary Responsibility           | Target Date                                                 | Instructions                                                                                                                                                                                        |
|----------------------------|----------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Field season report        | Project Lead                     | September 15 of the same year                               | Upload digital file in MS Word format to the PACN Digital Library <sup>1</sup> submissions folder.                                                                                                  |
| Raw GPS data files         | Field Crew Lead                  | September 15 of the same year                               | Zip and send all digital files to the GIS Specialist who will post it to the PACN Digital Library <sup>1</sup> .                                                                                    |
| Processed GPS data files   | GIS Specialist                   | September 15 of the same year                               | Zip and upload files to the PACN Digital Library <sup>1</sup> .                                                                                                                                     |
| Digital photographs        | Project Lead                     | November 30 of the same year                                | Organize, name and maintain photographic images in the project workspace according to SOP 12. (Managing Photographic Images).                                                                       |
| Field data forms           | Project Lead                     | After each tour. No later than November 30 of the same year | Scan original, marked-up field forms as PDF files and upload these to the PACN Digital Library <sup>1</sup> submissions folder. Originals go to the Park Curator for archival.                      |
| Certified working database | Project Lead                     | November 30 of the same year                                | Refer to the following section on delivering certified data and related materials. Data will be uploaded to the NPS Data Store <sup>2</sup> , and stored in the PACN Digital Library <sup>1</sup> . |
| Certified geospatial data  | Project Lead with GIS Specialist |                                                             |                                                                                                                                                                                                     |
| Data certification report  | Project Lead                     |                                                             |                                                                                                                                                                                                     |
| Metadata interview form    | Project Lead                     |                                                             |                                                                                                                                                                                                     |
| Full metadata (parsed XML) | Data Manager and                 | March 15 of the                                             | Upload the parsed XML record to                                                                                                                                                                     |

**Table SOP 17.1.** Product delivery schedule and specifications (continued).

|                        |                            |                                    |                                                                                                                                                                                                                                                                   |
|------------------------|----------------------------|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | GIS Specialist             | following year                     | the NPS Data Store <sup>2</sup> , and store in the PACN Digital Library <sup>1</sup> .                                                                                                                                                                            |
| Annual I&M report      | Project Lead               | April 30 of the following year     | Refer to the following section on reports and publications. Final reports will be entered in NatureBib <sup>3</sup> , and stored in the PACN Digital Library <sup>1</sup> .                                                                                       |
| 5-year analysis report | Project Lead, Data Analyst | Every 5 years by April 30          |                                                                                                                                                                                                                                                                   |
| Other publications     | Project Lead, Data Analyst | as completed                       |                                                                                                                                                                                                                                                                   |
| Other records          | Project Lead               | review for retention every January | Organize and send analog files to Park Curator for archival. Digital files that are slated for permanent retention should be uploaded to the PACN Digital Library. Retain or dispose of records following <a href="#">NPS Director's Order #19</a> <sup>4</sup> . |

<sup>1</sup>The PACN Digital Library is a hierarchical digital filing system stored on the PACN file servers. Network users have read-only access to these files, except where information sensitivity may preclude general access.

<sup>2</sup>NPS Data Store is a clearinghouse for natural resource data and metadata (<http://science.nature.nps.gov/nrdata>). Only non-sensitive information is posted to NPS Data Store. Refer to the protocol section on sensitive information for details.

<sup>3</sup>NatureBib is the NPS bibliographic database (<http://www.nature.nps.gov/nrbib/index.htm>). This application has the capability of storing and providing public access to image data (e.g., PDF files) associated with each record.

<sup>4</sup>NPS Director's Order 19 (NPS 2001) provides a schedule indicating the amount of time that the various kinds of records should be retained. Available at: <http://data2.itc.nps.gov/npspolicy/DOrders.cfm>

### Specific Instructions for Delivering Certified Data and Related Materials

Data certification is a benchmark in the project information management process that indicates that: 1) the data are complete for the period of record; 2) they have undergone and passed the quality assurance checks; and 3) that they are appropriately documented and in a condition for archiving, posting and distribution as appropriate. To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all tabular and spatial data. For more information refer to SOP 14 (Post-season Data Quality Review and Certification).

The following deliverables should be delivered as a package:

- *Certified Working Database*: Database in MS Access format containing data for the current season that has been through the quality assurance checks documented in SOP 14.
- *Certified Geospatial Data*: GIS themes in ESRI coverage or shapefile format.
- *Data Certification Form*: A brief questionnaire in MS Word that describes the certified data product(s) being submitted (PACN 2007b, [http://science.nature.nps.gov/im/units/pacn/data/data\\_sop/PACN\\_Project\\_Data\\_Certification\\_Form.doc](http://science.nature.nps.gov/im/units/pacn/data/data_sop/PACN_Project_Data_Certification_Form.doc)).

- *Metadata Interview Form*: The metadata interview form is an MS Word questionnaire that greatly facilitates metadata creation (PACN 2007a, [http://science.nature.nps.gov/im/units/pacn/data/data\\_sop/PACN\\_Metadata\\_Interview\\_Form.doc](http://science.nature.nps.gov/im/units/pacn/data/data_sop/PACN_Metadata_Interview_Form.doc)). For more details, refer to SOP 15 (Metadata Development).

After the quality review is completed, the Project Lead should package the certification materials for delivery as follows:

1. Open the certified back-end database file and compact it (in Microsoft Access, Tools > Database Utilities > Compact and Repair Database). This will make the file size much smaller. Back-end files are typically indicated with the letters “\_be” in the name (e.g., water\_quality\_be\_2008.mdb).
2. Rename the certified back-end file with the project name (“water\_quality”), the year or span of years for the data being certified, and the word “certified”. For example: water\_quality\_2008\_certified.mdb.
3. Create a compressed file (using WinZip® or similar software) and add the back-end database file to that file. Note: The front-end application does not contain project data and as such should not be included in the delivery file.
4. Add the completed metadata interview and data certification forms to the compressed file. Both files should be named in a manner consistent with the naming conventions described elsewhere in this document.
5. Add any geospatial data files that aren’t already in the possession of the GIS Specialist. Geospatial data files should be developed and named according to PACN GIS Naming Conventions.
6. Upload the compressed file containing all certification materials to the submissions folder of the PACN Digital Library. If the Project Lead does not have access to the PACN Digital Library, then certification materials should be delivered as follows:
  - a. If the compressed file is under 5 mb in size, it may be delivered directly to the NPS Lead and Data Manager by email.
  - b. If the compressed file is larger than 5 mb, it should be copied to a CD or DVD and delivered in this manner. Under no circumstances should products containing sensitive information be posted to an FTP site or other unsecured web portal (for more information, refer to SOP 16. Sensitive Information Procedures).
7. Notify the Data Manager by email that the certification materials have been uploaded or otherwise sent.

Upon receiving the certification materials, the Data Manager will:

1. Review them for completeness and work with the Project Lead if there are any questions.
2. Notify the GIS Specialist if any geospatial data are submitted. The GIS Specialist will then review the data, and update any project GIS data sets and metadata accordingly.
3. Check in the delivered products using the PACN project tracking application.
4. Store the certified products together in the PACN Digital Library.

5. Upload the certified data to the master project database.
6. Notify the Project Lead that the year's data have been uploaded and processed successfully. The Project Lead may then proceed with uploading data to NPSTORET, data summarization, analysis, and reporting.
7. Develop, parse and post the XML metadata record to the NPS Data Store.
8. After a holding period of 2 years, the Data Manager will upload the certified data to the NPS Data Store. This holding period is to protect professional authorship priority and to provide sufficient time to catch any undetected quality assurance problems (see SOP 18. Product Posting and Distribution).

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## **Appendix SOP 17A. Forms Needed for Water Quality Data Delivery and Digital File Submissions**

| <b>Equipment (#/quantity)</b> | <b>Preparation &amp; Maintenance</b>                                          |
|-------------------------------|-------------------------------------------------------------------------------|
| Product Submission Form       | Update and complete prior to digital submission of water quality information. |





## **Purpose**

This Standard Operating Procedure document provides details on the process of posting and otherwise distributing finalized data, reports and other project deliverables. For a complete list of project deliverables, refer to SOP 17 (Product Delivery Specifications).

## **Product Posting and Distribution**

Once digital products have been delivered and processed, the following steps will be taken by the Data Manager to make them generally available:

1. Full metadata records will be posted to the NPS Data Store, which is the NPS clearinghouse for natural resource data and metadata that is available to the public at: <http://science.nature.nps.gov/nrdata>. Refer to the website for upload instructions.
2. A record for reports and other publications will be created in NatureBib, which is the NPS bibliographic database (<http://www.nature.nps.gov/nrbib/index.htm>). The digital report file in PDF format will then be uploaded and linked to the NatureBib record. Refer to the NatureBib website for record creation and upload instructions.
3. Species observations will be extracted from the database and entered into NPSpecies, which is the NPS database and application for maintaining park-specific species lists and observation data (<http://science.nature.nps.gov/im/apps/npspp/>).

These three applications serve as the primary mechanisms for sharing reports, data, and other project deliverables with other agencies, organizations, and the general public.

### **Holding period for project data**

To protect professional authorship priority and to provide sufficient time to complete quality assurance measures, there is a two-year holding period before posting or otherwise distributing finalized data. This means that certified data sets are first posted to publicly accessible websites (i.e., the NPS Data Store) approximately 24 months after they are collected (e.g., data collected in June 2006 becomes generally available through the NPS Data Store in June 2008). In certain circumstances, and at the discretion of the NPS Lead and Park Biologists, data may be shared before a full 2 years have elapsed.

Note: This hold only applies to raw data; all metadata, reports or other products are to be posted to NPS clearinghouses in a timely manner as they are received and processed.

## **Responding to Data Requests**

Occasionally, a park or project staff member may be contacted directly regarding a specific data request from another agency, organization, scientist, or from a member of the general public. The following points should be considered when responding to data requests:

- NPS is the originator and steward of the data, and the NPS Inventory and Monitoring Program should be acknowledged in any professional publication using the data.
- NPS retains distribution rights; copies of the data should not be redistributed by anyone but NPS.
- The data that project staff members and cooperators collect using public funds are public records and as such cannot be considered personal or professional intellectual property.

- No sensitive information (e.g., information about the specific nature or location of protected resources) may be posted to the NPS Data Store or another publicly accessible website, or otherwise shared or distributed outside NPS without a confidentiality agreement between NPS and the agency, organization, or person(s) with whom the sensitive information is to be shared. Refer to the section in this document about sensitive information and also to SOP 16 (Sensitive Information Procedures).
- For quality assurance, only the certified, finalized versions of data sets should be shared with others.

The Project Lead will handle all data requests as follows:

1. Discuss the request with other Park Biologists as necessary to make those with a need to know aware of the request and, if necessary, to work together on a response.
2. Notify the Data Manager of the request if s/he is needed to facilitate fulfilling the request in some manner.
3. Respond to the request in an official email or memo.
4. In the response, refer the requestor to the NPS Data Store (<http://science.nature.nps.gov/nrdata>), so they may download the necessary data and/or metadata. If the request can not be fulfilled in that manner—either because the data products have not been posted yet, or because the requested data include sensitive information—work with the Data Manager to discuss options for fulfilling the request directly (e.g., burning data to CD or DVD). Ordinarily, only certified data sets should be shared outside NPS.
5. If the request is for a document, it is recommended that documents be converted to PDF format prior to distributing it.
6. If the request is for data that may reveal the location of protected resources, refer to the section in this document about sensitive information and also to SOP 16.
7. After responding, provide the following information to the Data Manager, who will maintain a log of all requests in the PACN Project Tracking database:
  - a. Name and affiliation of requestor
  - b. Request date
  - c. Nature of request
  - d. Responder
  - e. Response date
  - f. Nature of response
  - g. List of specific data sets and products sent (if any)

All official FOIA requests will be handled according to NPS policy. The NPS Lead will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

### ***Special Procedures for Sensitive Information***

Products that have been identified upon delivery by the Project Lead and/or NPS Lead as containing sensitive information will either be revised into a form that does not disclose the

locations of sensitive resources, or withheld from posting and distribution. When requests for distribution of the unedited version of products are initiated by the NPS, by another federal agency, or by another partner organization (e.g., a research scientist at a university), the unedited product (e.g., the full data set that includes protected information) may only be shared after a confidentiality agreement is established between NPS and the other organization. Refer to SOP 16 for more information.

All official FOIA requests will be handled according to NPS policy. The Project Lead will work with the Data Manager and the park FOIA representative(s) of the park(s) for which the request applies.

## SOP 19. Data Analysis and Reporting

*Version 1.0 (April 2008)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision; identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
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## **Purpose**

This SOP addresses data analysis and reporting for the water quality Vital Signs in the Pacific Island Network. Data analysis for physical and chemical water quality parameters are outlined with examples to show data structure, statistical tests, and graphical plots. Integrated reporting of these three components is also identified. This protocol outlines two initial steps of data analysis at each of the unit, landscape, and trend-assessment levels. These steps summarize and determine the range of variation. Reporting types are identified according to the categories in the PACN monitoring plan, with most reporting occurring on an annual basis. Additional, multi-vital sign synthesis analysis and reporting is not addressed in this SOP.

## **Analysis Overview**

Data analysis is defined here as the processes by which observations of the environment are interpreted into meaningful information. Data analysis also includes quality assurance and control efforts that occur in the field, during exploratory analysis, in summarization, during interpretation, and when drawing conclusions.

The general process for all parameters not outlined below will follow the methods outlined by the USGS in Chapter A3 Statistical methods in Water Resources, Book 4 Hydrologic Analysis and Interpretation, of Techniques of Water-Resources Investigations of the United States Geological Survey (Helsel and Hirsch 2002). These methods will not be written out here or in the SOPs as there is already an entire book dedicated to water-resource analyses and the authors feel redundancy is not necessary. However, simple analyses and those outside of the methods outlined in the Helsel and Hirsch are described below.

For all parameters, the first step will be to summarize measures of mean, median, and variance at each site using the replicates for chemical analyses and the stabilized sensor readings from the sonde. Non-detects and censored data will be used only in non-parametric analyses. These data will be used to calculate a site mean, median, and variance. This information will then be separated into two categories: fixed sites and random sites. Values will be compared to determine if there is a statistically significant difference between the two categories. If there is no difference, the two categories will be grouped and analyzed together. If a difference exists, the following analyses will be done on both groups separately as appropriate (i.e. fixed will not be used for status). Status of the water resource for the park will be calculated by summarizing the mean, median, and variance of the data. Data will be described both annually and seasonally. This data will be compared to applicable water quality criteria standards and the differences noted. Any parameters exceeding the applicable water criteria standard will be highlighted. Those approaching (i.e. within 5%-10% of criteria value) will be noted.

Data from the extended deployment sonde will be used to normalize all physical parameters (this cannot be done for nutrient analyses). For example, DO changes throughout the day, so measurements at the beginning of the day are not comparable to measurements taken at midday. The differences between the extended deployment sonde and the point sample sonde will be compared, and the data then normalized to the first sampling period. Normalized data will then be imported into GIS for spatial analyses. Using the spatial analyst tool, the data for each parameter will be plotted and interpolated, using land mass masking, to give a graphical representation of parameter variance across the park unit as a whole. This is a graphical

representation to aid management in identifying areas that would be potential target areas if there was management concern over an aquatic resource. It is intended for identification of potential management target areas only.

All data will be plotted (pH is log data and must be treated as such) with a regression around the points. Correlograms of raw data, data with seasonality removed, and seasonality and trend data removed along with 95 % confidence intervals will be plotted for reporting (McBride2005). Fixed sites will be used to examine trend. Using the Sen slope estimator and the Seasonal Kendall trend test, fixed sites will be examined for changes to resource quality and the direction of change. Each season will be evaluated in addition to annual trend analyses. This data will be done on a park by park basis. Parks within Hawaii with similar resources will then be compared in similar fashion, followed by a PACN park wide analysis as applicable (i.e. marine components).

### **Analytical Strategies**

Two basic steps are identified in data analysis for all water quality monitoring data: summarization and establishing the range of variation. These steps are encompassed in the larger construct of data management and data stewardship which is discussed in SOPs 10–18. All data for physical and chemical water quality parameters will undergo these two initial steps of data analysis at each of the unit, landscape, trend-assessment, and synthesis levels.

#### ***Step One: Summarization***

This step includes identification and documentation of outliers, missing data, quality control and quality assurance issues, mean or median values, and other descriptive statistics. Data visualization (see Cleveland 1993, 1994; Tufte 1983, 1990, 1997) and exploratory data analyses are an integral component of this process.

#### ***Step Two: Range of Variation***

This step establishes expected boundaries for response variables, typically as quartiles, and identifies data that falls outside these expected bounds. Establishing a range of normal variation may take years or decades for many parameters, but providing managers and decision-makers with the best available information will strengthen adaptive management feedback.

### **Analytical Approach**

This protocol identifies four basic levels of analytical methods for our monitoring data: unit level, landscape level, trend assessment level, and synthesis (Table SOP 19.1). The unit level, the most basic element, addresses sample design questions regarding use of finite or infinite populations, and the establishment of relative, absolute, or index response variables. The landscape level identifies the spatial nature of sampling and the temporal allocation of samples, such as the revisit scheme in use. The trend assessment level integrates unit or landscape level data over time, where typically some form of regression or repeated measures ANOVA is used to identify the slope or trend over time. Finally, synthesis examines patterns within and across Vital Signs and ecological factors to gain broad insight on ecological processes and integrity. The basic statistical basis for unit level, landscape level, and trend assessment level are addressed here. Synthesis will be addressed within and across multiple Vital Signs and is therefore left for network level consideration.

The analysis outlined below will be applied to each of the monitored parameters that are components of this Vital Sign: water temperature, salinity/conductivity, pH, turbidity, dissolved oxygen, chlorophyll, nitrate, total nitrogen, and total phosphate. These analyses should be completed a minimum of once per year.

### Non-Detects

Non-Detects will be handled according to recommendations outlined in Helsel's Nondetects and Data Analysis (2005) book. Generally they will not be used for parametric statistics. Also, values higher than the MDL but less than the ML will not be uploaded to NPSTORET as per WRD recommendations (Irwin 2004). \*Present <QL will be used when uploading these data to NPSTORET.

**Table SOP 19.1.** Three approaches at the park level for analyzing water quality Vital Signs data.

| Level of Analysis      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Responsible Party                                                                     |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Unit Level             | <p>Quality assurance and control routines and calculation of individual, site specific statistics from monitoring data</p> <p>Step 1 (Summarization): Measures of mean, median, variation, and other basic statistics. Include graphical presentation of data.</p> <p>Step 2 (Range of Variation): Establish historical or expected range of values, relation to regulatory levels, confidence estimates.</p> <p>Indices or other site specific metrics may also be developed.</p>                                                                                                                                                           | Biological Technician with oversight by PI and with assistance from Park Leads        |
| Landscape Level        | <p>Integration of unit level data across appropriate landscapes to address ecological status.</p> <p>Step 1: Integration of unit level summarization results across multiple locations and sites.</p> <p>Step 2: Integration of unit level variation results across multiple locations and sites. Additional refinement of spatial pattern analyses.</p> <p>Sample design, assumptions about the target population, actual data relationships, and evolving status determination methods will guide selection of appropriate methods.</p>                                                                                                    | Biological Technician with oversight by PI and with assistance from Park Leads        |
| Trend Assessment Level | <p>Evaluation of Vital Signstrends over time to detect change. Typically some form of regression will be among the methods used.</p> <p>Step 1: Integration of landscape level summarization over time.</p> <p>Step 2: Integration of landscape level variation results over time. Include establishing a direction and rate of change or variation that may be used to provide early warning. Confidence levels of documenting trend will be established.</p> <p>Parametric, nonparametric (design based), and models will be used. Trend assessment will also include accounting for influence from drivers and stressors as feasible.</p> | PI and Biological Technician, with assistance and oversight by PACN Aquatic Ecologist |

## Analysis Procedures

Analysis procedures are to be documented, for each park on an annual basis, in a compiled document (such as MS Word), referred to hereafter as an analysis log file. This file would essentially be a ‘log’ of all the quantitative and qualitative steps taken, such as various transformations tested and screen shots of data visualization. Each year, ten such files (One for each park that is slated for implementation of the water quality monitoring protocol) will be generated. These analysis log files are internal working documents, that while not subject to explicit peer-review for most reporting other than protocol and programmatic reviews, will serve as the documentation and foundation for reports which are peer-reviewed. Table SOP 19.2 summarizes these analytical approaches for the parameters measured at the park level.

**Table SOP 19.2.** Summary of analytical approaches including parameters measured at the park level.

| Level of Analysis | Data Analysis Approach                                                                                                                                                                                                                         | Frequency of Analysis                                                                          | Responsible Party      |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|------------------------|
| Unit              | Monthly summarization and range-of-variation for water quality parameters by site and water body(ies) including comparison with state, territorial, or commonwealth water quality criteria                                                     | Annually, preferably within three months of field data collection for each of the three levels | Principal Investigator |
| Landscape         | Annual status and trends of monitored water quality parameters for each area of interest (e.g. individual water bodies, watersheds, entire parks, etc.), including comparisons with state, territorial, or commonwealth water quality criteria | Annually, preferably within six months of field data collection for each of the three levels   | Principal Investigator |
| Trend Assessment  | Multi-year change in water quality parameters for both unit level data (sampling stations) and landscape level areas of interest (water bodies, parks)                                                                                         | Annually, preferably within six months of field data collection for each of the three levels   | Principal Investigator |

A single log file will be kept for each park unit. The log file will reflect the following organization: parameters or response variables of interest by park unit for each of the assessment levels.

### **Unit Level Analysis**

This level is applied for all parameters in the current-year only and includes all months. Text and graphic plots of mean, geometric mean, median, skew, kurtosis, standard deviation, outliers, normal probability plot, frequency histogram, and correlations (between sampling periods) of the distribution for individual sampling stations will be included. If multiple observers have been collecting data, the summaries should be grouped by observer to evaluate potential observer bias.

### **Landscape Level Analysis**

This level is applied to each parameter of interest in the current-year only and includes all months. Text and graphic plots grouped by area(s) of interest (e.g., multiple sampling stations on individual islands in NPSA or individual watersheds in KAHN) of mean (or median), standard

deviation (or skew and kurtosis), outliers, normal probability plot, and frequency histogram of the distribution. A graphical map of park that displays values for each water quality parameter will be included.

### ***Trend Assessment Level Analyses***

This level is applied to the current year, previous year, five year, and ten year, complete historical dataset, and other to-be-determined integration intervals for each parameter. Text and graphic plots are grouped by specific sampling stations of mean (or median), standard deviation (or skew and kurtosis). Change detection will include repeated measures ANOVA, regression, evaluation of time-series, and other appropriate technique. Trend assessments will also be done using seasonal Kendall trend test and the Sen slope estimator as appropriate. Generally, most trend tests are expected to be nonparametric. Text and graphic plots are grouped by area(s) of interest (e.g., entire park such as KAHO, individual islands in NPSA, or individual park units in WAPA) of: mean (or median), standard deviation (or skew and kurtosis), and parameter trend. Change detection will include repeated measures ANOVA, regression, evaluation of time-series, or other appropriate technique. It includes a graphical map by park that displays changes in percent coral and algal cover.

### ***Example Procedure for Basic Data Analysis***

It should be noted that the following analytical procedures should only be conducted by an individual with advanced statistical training. In addition, many of the procedures described below may change over time due to advancements and updates in statistical techniques and software. Consequently, the example merely serves to illustrate the desirable sequence of steps necessary to examine and present the data. For any questions on detailed analyses, consult a statistical reference for water quality analyses such as *Using Statistical Methods of Water Quality Management: Issues, Options, and Solutions* (McBride 2005) or *Statistical Methods in Water Resources* US Geological Survey *Techniques of Water Resource Investigations* (Helsel and Hirsch 2002); no specific endorsement is implied.

## Water Quality Vital Signs Monitoring Protocol for the Pacific Island Network: Standard Operating Procedures

Microsoft Excel - Trend Analysis Kaho N data.xls

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Type a question for help

100%

Times New Roman 10

Reply with Changes... End Review...

D11 0.69

|    | A        | B       | C       | D        | E       | F       | G       | H       | I       | J       | K       | L       | M        | N       | O       | P       | Q       |
|----|----------|---------|---------|----------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---------|---------|---------|---------|
| 1  | Site     | 7/23/04 | 10/1/04 | 12/15/04 | 1/12/05 | 2/23/05 | 3/16/05 | 4/27/05 | 5/18/05 | 7/20/05 | 8/25/05 | 9/20/05 | 10/21/05 | 12/7/05 | 1/11/06 | 2/21/06 | 4/11/06 |
| 2  | F17      |         | 20.67   | 10.44    | 5.71    | 9.04    | 10.43   | 15.69   | 23.61   | 1.39    | 38.49   | 17.19   | 39.80    | 18.68   | 2.79    | 31.72   | 41.64   |
| 3  | G6       |         | 0.10    | 1.25     | 6.14    | 1.10    | 7.55    | 2.40    | 4.92    | 2.27    | 15.14   | 37.86   | 8.30     | 11.16   | 0.10    | 12.12   | 0.10    |
| 4  | G18      |         | 38.10   | 20.97    | 39.72   | 1.99    | 16.47   | 11.46   | 24.96   | 4.08    | 23.62   | 32.01   | 30.18    | 49.98   | 28.80   | 56.40   | 45.75   |
| 5  | M6       |         | 0.10    | 22.92    | 34.38   | 34.00   | 49.95   | 8.78    | 0.10    | 1.29    | 41.37   | 27.05   | 32.88    | 30.45   | 21.36   | 26.20   | 9.74    |
| 6  | O6       |         | 17.50   | 50.90    | 29.64   | 17.30   | 35.70   | 3.72    | 2.25    | 0.20    | 25.38   | 33.10   | 33.80    | 10.86   | 28.56   | 12.60   | 5.82    |
| 7  | Q3       |         | 50.16   | 168.40   | 119.50  | 91.90   | 44.60   | 41.16   | 41.09   | 33.65   | 51.75   | 39.00   | 40.90    | 51.08   | 43.10   | 64.70   | 20.40   |
| 8  | 21       | 1.86    | 6.76    | 0.97     | 0.10    | 0.10    | 0.10    | 3.07    | 0.10    | 0.10    | 0.10    | 0.10    | 3.12     | 1.54    | 3.82    | 1.24    | 0.10    |
| 9  | 25       | 1.63    | 0.10    | 0.10     | 0.78    | 0.70    | 0.10    | 3.43    | 2.43    | 0.83    | 0.10    | 0.10    | 4.12     | 1.31    | 2.36    | 2.83    | 0.10    |
| 10 | 34       | 0.10    | 1.87    | 0.10     | 2.07    | 3.55    | 0.10    | 3.60    | 1.99    | 0.66    | 2.64    | 15.86   | 1.05     | 5.58    | 1.52    | 0.10    | 0.10    |
| 11 | 38       | 2.75    | 0.10    | 0.69     | 5.92    | 0.10    | 0.10    | 4.09    | 3.18    | 0.84    | 0.10    | 1.14    | 1.17     | 0.10    | 4.85    | 0.10    | 0.10    |
| 12 | 39       | 4.86    | 2.50    | 0.10     | 9.65    | 0.10    | 0.10    | 5.04    | 2.83    | 0.75    | 0.10    | 0.10    | 1.02     | 0.10    | 9.08    | 1.37    | 0.10    |
| 13 | 40       | 0.10    | 3.07    | 3.27     | 11.70   | 0.38    | 0.10    | 2.58    | 3.46    | 1.12    | 0.10    | 22.98   | 0.82     | 1.39    | 6.46    | 0.10    | 0.10    |
| 14 | 41       | 0.10    | 0.10    | 0.10     | 14.00   | 0.10    | 0.10    | 1.13    | 3.27    | 0.54    | 10.36   | 35.52   | 5.11     | 9.77    | 4.33    | 0.10    | 0.10    |
| 15 | 45       | 17.26   | 10.63   | 0.10     | 77.00   | 4.24    | 5.20    | 7.99    | 0.10    | 2.02    | 15.58   | 90.30   | 70.80    | 29.05   | 0.10    | 4.22    | 0.10    |
| 16 | 51       | 15.09   | 0.10    | 0.10     | 53.10   | 6.24    | 0.10    | 0.10    | 4.08    | 0.66    | 19.80   | 57.75   | 23.35    | 1.05    | 3.09    | 8.59    | 0.10    |
| 17 | 52       | 0.28    | 12.15   | 8.34     | 40.40   | 53.00   | 16.53   | 7.42    | 6.36    | 0.97    | 19.49   | 41.31   | 40.74    | 15.75   | 6.14    | 15.97   | 0.10    |
| 18 | 59       | 20.01   | 28.65   | 6.18     |         | 31.90   | 0.10    | 0.10    | 3.89    | 2.79    | 38.85   | 83.60   | 50.40    | 39.25   | 0.10    | 11.03   | 0.10    |
| 19 | 60       | 20.50   | 17.17   | 2.64     | 72.00   | 3.21    | 2.63    | 6.18    | 0.10    | 0.10    | 40.25   | 57.75   | 62.80    | 28.25   | 0.10    | 11.12   | 0.10    |
| 20 | Site 11  |         |         |          | 122.40  | 79.80   | 70.40   | 66.90   | 84.60   | 77.80   | 73.90   | 72.00   | 81.90    | 82.80   | 82.80   | 79.40   | 77.30   |
| 21 | Site 13  | 93.75   |         | 79.30    | 89.90   | 93.70   | 78.00   | 66.90   | 111.00  | 94.50   | 90.90   | 94.10   | 70.80    | 94.70   | 84.80   | 87.40   | 76.10   |
| 22 | Site 14  | 99.65   |         | 169.60   | 125.30  | 110.50  | 80.40   | 75.70   | 111.40  | 101.90  | 85.20   | 125.00  | 106.90   | 101.40  | 96.20   | 84.70   | 88.40   |
| 23 | Site 15  | 98.25   | 81.20   | 99.10    | 175.20  | 176.40  | 82.20   | 62.60   | 96.50   | 96.60   | 90.95   | 127.00  | 72.70    | 86.50   | 73.00   | 92.70   | 96.70   |
| 24 | Site 16  | 97.55   | 89.10   | 87.20    | 109.40  | 115.00  | 83.20   | 63.80   | 93.00   | 93.10   | 106.60  | 126.90  | 74.50    | 85.80   | 91.40   | 99.20   | 79.20   |
| 25 | Site 17  | 98.30   | 92.90   | 98.10    | 110.80  | 107.30  | 83.90   | 64.70   | 105.40  |         | 61.80   | 139.70  | 70.10    | 112.70  | 99.30   | 87.80   | 81.80   |
| 26 | Site 34  | 95.25   | 100.30  | 130.70   | 127.70  | 86.40   | 104.10  | 66.50   | 103.50  | 103.50  | 94.45   | 144.40  | 72.20    | 107.00  | 109.10  | 133.30  | 85.20   |
| 27 | Site 123 |         |         |          | 392.00  | 183.00  | 158.80  | 88.50   | 102.80  | 100.90  | 45.05   | 73.30   | 64.70    | 87.78   | 93.80   | 97.60   | 43.47   |
| 28 | W4258-03 |         |         |          |         |         | 55.90   | 56.65   | 77.70   | 66.80   | 69.70   | 52.70   | 75.30    | 71.46   | 82.90   | 78.90   | 74.30   |
| 29 | W4158-02 |         | 85.30   | 93.40    | 151.60  | 87.90   | 64.30   | 101.90  | 82.10   | 73.85   | 67.00   | 66.50   | 90.48    | 89.10   | 94.30   | 81.20   |         |
| 30 | 4061-01  |         |         |          | 60.10   | 81.20   | 52.00   | 86.30   | 72.10   | 50.55   | 121.40  | 51.60   | 53.20    | 81.80   | 97.40   | 92.70   |         |
| 31 | 4161-01  |         |         |          | 50.40   | 62.70   | 60.50   | 92.70   | 78.60   | 88.90   | 124.90  | 70.10   | 86.60    | 84.80   | 86.00   | 74.50   |         |
| 32 | 4161-02  |         |         |          | 88.40   | 103.40  | 91.40   | 117.80  | 110.90  | 131.00  | 160.60  | 90.20   | 116.20   | 112.40  | 113.60  | 108.80  |         |

Ready NUM

**Figure SOP 19.1.** Screenshot of a sample raw dataset from Kaho (Bienfang data 2006).

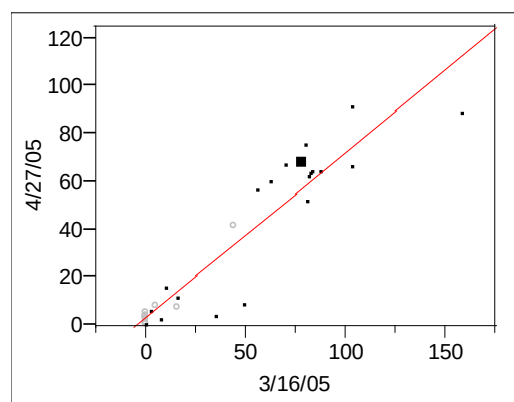
*Step 1:* Copy annual data for a park from an Access query into Excel and save the spreadsheet. Assemble the data in columns by date (Figure SOP 19.1) and rows by site.

*Step 2:* Import the data into a statistical analysis program (Figure SOP 19.2) for analysis by date. Also create a second file for analysis by site.

| Site             | 7/23/04 | 10/1/04 | 12/15/04 | 1/12/05 | 2/23/05 | 3/16/05 | 4/27/05 | 5/18/05 | 7/20/05 | 8/25/05 | 9/20/05 | 10 |
|------------------|---------|---------|----------|---------|---------|---------|---------|---------|---------|---------|---------|----|
| 1 F17 Kaloko     | •       | 20.67   | 10.44    | 5.71    | 9.04    | 10.43   | 15.69   | 23.61   | 1.39    | 38.49   | 17.19   |    |
| 2 G6 Kaloko      | •       | 0.1     | 1.25     | 6.14    | 1.1     | 7.55    | 2.4     | 4.92    | 2.27    | 15.14   | 37.86   |    |
| 3 G18 Kaloko     | •       | 38.1    | 20.97    | 39.72   | 1.99    | 16.47   | 11.46   | 24.96   | 4.08    | 23.62   | 32.01   |    |
| 4 M6 Kaloko      | •       | 0.1     | 22.92    | 34.38   | 34      | 49.95   | 8.78    | 0.1     | 1.29    | 41.37   | 27.05   |    |
| 5 O6 Kaloko      | •       | 17.5    | 50.9     | 29.64   | 17.3    | 35.7    | 3.72    | 2.25    | 0.2     | 25.38   | 33.1    |    |
| 6 Q3 Kaloko      | •       | 50.16   | 168.4    | 119.5   | 91.9    | 44.6    | 41.16   | 41.09   | 33.65   | 51.75   | 39      |    |
| 7 21 Aimakapa    | 1.86    | 6.76    | 0.97     | 0.1     | 0.1     | 0.1     | 3.07    | 0.1     | 0.1     | 0.1     | 0.1     |    |
| 8 25 Aimakapa    | 1.63    | 0.1     | 0.1      | 0.78    | 0.7     | 0.1     | 3.43    | 2.43    | 0.83    | 0.1     | 0.1     |    |
| 9 34 Aimakapa    | 0.1     | 1.87    | 0.1      | 2.07    | 3.55    | 0.1     | 3.6     | 1.99    | 0.66    | 2.64    | 15.86   |    |
| 10 38 Aimakapa   | 2.75    | 0.1     | 0.69     | 5.92    | 0.1     | 0.1     | 4.09    | 3.18    | 0.84    | 0.1     | 1.14    |    |
| 11 39 Aimakapa   | 4.86    | 2.5     | 0.1      | 9.65    | 0.1     | 0.1     | 5.04    | 2.83    | 0.75    | 0.1     | 0.1     |    |
| 12 40 Aimakapa   | 0.1     | 3.07    | 3.27     | 11.7    | 0.38    | 0.1     | 2.58    | 3.46    | 1.12    | 0.1     | 22.98   |    |
| 13 41 Aimakapa   | 0.1     | 0.1     | 0.1      | 14      | 0.1     | 0.1     | 1.13    | 3.27    | 0.54    | 10.36   | 35.52   |    |
| 14 45 Aimakapa   | 17.26   | 10.63   | 0.1      | 77      | 4.24    | 5.2     | 7.99    | 0.1     | 2.02    | 15.58   | 90.3    |    |
| 15 51 Aimakapa   | 15.09   | 0.1     | 0.1      | 53.1    | 6.24    | 0.1     | 0.1     | 4.08    | 0.66    | 19.8    | 57.75   |    |
| 16 52 Aimakapa   | 0.28    | 12.15   | 8.34     | 40.4    | 53      | 16.53   | 7.42    | 6.36    | 0.97    | 19.49   | 41.31   |    |
| 17 59 Aimakapa   | 20.01   | 28.65   | 6.18     | •       | 31.9    | 0.1     | 0.1     | 3.89    | 2.79    | 38.85   | 83.6    |    |
| 18 60 Aimakapa   | 20.5    | 17.17   | 2.64     | 72      | 3.21    | 2.63    | 6.18    | 0.1     | 0.1     | 40.25   | 57.75   |    |
| 19 11 Pools      | •       | •       | •        | 122.4   | 79.8    | 70.4    | 66.9    | 84.6    | 77.8    | 73.9    | 72      |    |
| 20 13 Pools      | 93.75   | •       | 79.3     | 89.9    | 93.7    | 78      | 66.9    | 111     | 94.5    | 90.9    | 94.1    |    |
| 21 14 Pools      | 99.65   | •       | 169.6    | 125.3   | 110.5   | 80.4    | 75.7    | 111.4   | 101.9   | 85.2    | 125     |    |
| 22 15 Pools      | 98.25   | 81.2    | 99.1     | 175.2   | 176.4   | 82.2    | 62.6    | 96.5    | 96.6    | 90.95   | 127     |    |
| 23 16 Pools      | 97.55   | 89.1    | 87.2     | 109.4   | 115     | 83.2    | 63.8    | 93      | 93.1    | 106.6   | 126.9   |    |
| 24 17 Pools      | 98.3    | 92.9    | 98.1     | 110.8   | 107.3   | 83.9    | 64.7    | 105.4   | •       | 61.8    | 139.7   |    |
| 25 34 Pools      | 95.25   | 100.3   | 130.7    | 127.7   | 86.4    | 104.1   | 66.5    | 103.5   | 103.5   | 94.45   | 144.4   |    |
| 26 123 Pools     | •       | •       | •        | 392     | 183     | 158.8   | 88.5    | 102.8   | 100.9   | 45.05   | 73.3    |    |
| 27 W4258-03 W    | •       | •       | •        | •       | •       | 55.9    | 56.65   | 77.7    | 66.8    | 69.7    | 52.7    |    |
| 28 W4158-02 W    | •       | •       | 85.3     | 93.4    | 151.6   | 87.9    | 64.3    | 101.9   | 82.1    | 73.85   | 67      |    |
| 29 4061-01 Wells | •       | •       | •        | 213.2   | 60.1    | 81.2    | 52      | 86.3    | 72.1    | 50.55   | 121.4   |    |
| 30 4161-01 Well  | •       | •       | •        | 369.6   | 50.4    | 62.7    | 60.5    | 92.7    | 78.6    | 88.9    | 124.9   |    |
| 31 4161-02 Well  | •       | •       | •        | 279     | 88.4    | 103.4   | 91.4    | 117.8   | 110.9   | 131     | 160.6   |    |

**Figure SOP19.2.** JMP formatted data for analysis by date (Beinfang data 2006).

*Step 3:* Create a scatterplot of each new date for all stations in each park plotted against the prior sampling period. Include in the scatterplot a linear regression of the data and the  $r^2$  value. The results should look something like Figure SOP 19.3. If the correlation ( $r^2$ ) between the two sampling periods is less than 0.5, examine the plot for sampling station results that are far away from the linear regression line. You may need to return to the original sampling data sheets or images to determine if there were any errors that were associated with the sampling process and determine if the value is correct and whether to include in the data set. In this example,  $r = 0.88$  so it appears that the data are reasonable.

**Bivariate Fit of 4/27/05 By 3/16/05****Linear Fit**

$$4/27/05 = 2.9870269 + 0.6927009 \text{ } 3/16/05$$

**Summary of Fit**

|                            |          |
|----------------------------|----------|
| RSquare                    | 0.880206 |
| RSquare Adj                | 0.876075 |
| Root Mean Square Error     | 11.27622 |
| Mean of Response           | 32.52871 |
| Observations (or Sum Wgts) | 31       |

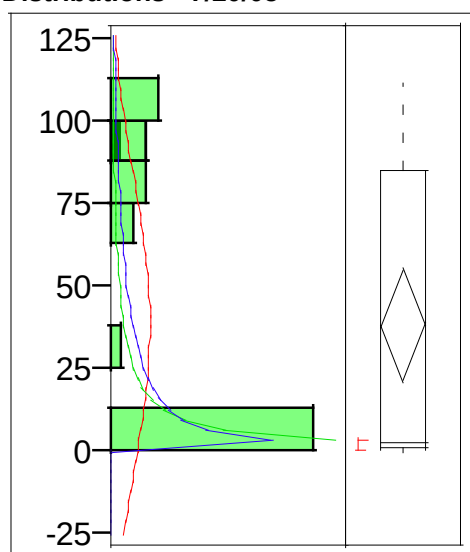
**Analysis of Variance**

| Source   | DF | Sum of Squares | Mean Square | F Ratio  |
|----------|----|----------------|-------------|----------|
| Model    | 1  | 27094.020      | 27094.0     | 213.0819 |
| Error    | 29 | 3687.439       | 127.2       | Prob > F |
| C. Total | 30 | 30781.459      |             | <.0001   |

**Parameter Estimates**

| Term      | Estimate  | Std Error | t Ratio | Prob> t |
|-----------|-----------|-----------|---------|---------|
| Intercept | 2.9870269 | 2.863105  | 1.04    | 0.3054  |
| 3/16/05   | 0.6927009 | 0.047454  | 14.60   | <.0001  |

**Figure SOP 19.3.** JMP output for KAH0 NO<sub>3</sub> data showing linear regression, slope, and  $r^2$  values (Bienfang data 2006).

**Distributions - 7/20/05**

— Normal — LogNormal — Gamma

**Fitted Normal Parameter Estimates**

| Type       | Parameter | Estimate | Lower 95% | Upper 95% |
|------------|-----------|----------|-----------|-----------|
| Location   | Mu        | 37.76867 | 21.13903  | 54.39830  |
| Dispersion | Sigma     | 44.53497 | 35.46796  | 59.86904  |

**Goodness-of-Fit Test** Shapiro-Wilk W Test

| W        | Prob<W |
|----------|--------|
| 0.731019 | <.0001 |

**Fitted LogNormal Parameter Estimates**

| Type  | Parameter | Estimate | Lower 95% | Upper 95% |
|-------|-----------|----------|-----------|-----------|
| Scale | Mu        | 1.789101 | 0.867428  | 2.710775  |
| Shape | Sigma     | 2.468287 | 2.037555  | 3.158679  |

**Goodness-of-Fit Test**

|          |          |          |
|----------|----------|----------|
| KSL Test | D        | Prob>D   |
|          | 0.235824 | < 0.0100 |

**Fitted Gamma Parameter Estimates**

| Type      | Parameter | Estimate | Lower 95% | Upper 95% |
|-----------|-----------|----------|-----------|-----------|
| Shape     | Alpha     | 0.3628   | 0.23612   | 0.5328    |
| Scale     | Sigma     | 104.0894 | 55.38008  | 242.1798  |
| Threshold | Theta     | 0.0000   | .         | .         |

Note: unable to converge on all confidence limits.

**Figure SOP 19.4.** JMP histogram with output for tests of normal (red), log-normal (green) and gamma (blue) distributions and goodness of fit for KAH0 NO<sub>3</sub> data (Bienfang data 2006). Plot includes boxplot indicating skewness.

*Step 4:* Test the data for normality. Most water quality data should have a normal distribution, unless the data is located near the MDL in which case a gamma distribution is expected. Fit the distribution of points to a normal distribution using your statistical program. In JMP this is accomplished by selecting Analyze distribution. When the histogram appears, click on the red triangle, and select fit distribution then choose normal. Then under the fitted normal box, click on the red triangle and select goodness of fit. Normally distributed data will have p values in the range of  $p > 0.05$  (Figure SOP 19.4). The repeated measures ANOVA is fairly robust to departures from normality, especially with a large sample size. Consequently, don't worry too much if the plots are slightly skewed; nevertheless it is important to note the gamma distribution, because that will affect the statistical approach later.

*Step 5:* Generate a table of mean and standard deviations for each station. This is done from a table within the Access database.

*Step 6:* Generate scatter plots of each parameter regressed on the other parameters to examine correlation between parameters. Include the outputs of each of these scatter plots including the results of linear regressions.

### ***Determining the Effect of Serial Correlation***

*Step 1:* Copy annual data for a park from an Access query into a statistical software package or paste the data into Excel and save the spreadsheet. Assemble the data in columns by date (Figure SOP 19.1).

*Step 2:* Because serial correlation is potentially a factor in analysis of bimonthly water quality data, characterize the serial correlation of the water quality data using a correlogram with the serial coefficient  $r_k$  taken as the Pearson's coefficient for the relevant watershed unit and plotted against time lag  $k$  where lag  $k$  is an integer (Figure SOP 19.5).

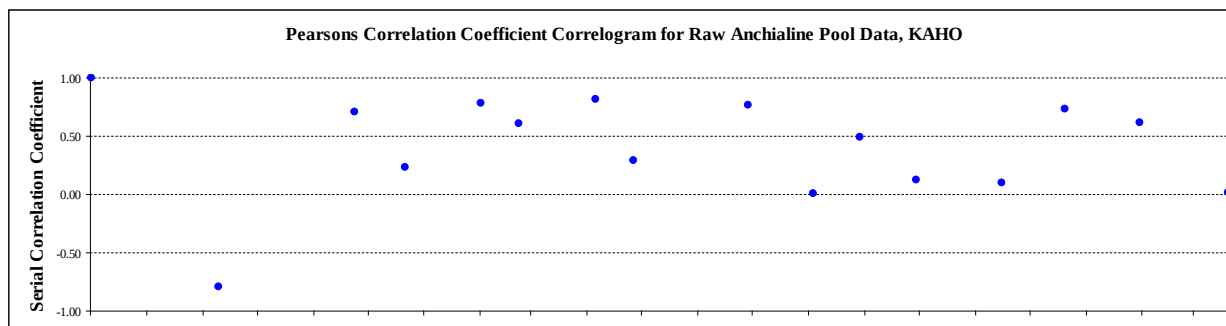


**Figure SOP 19.5.** Correlogram of Pearson's correlation coefficient for KAHO anchialine pool data (Bienfang data 2006).

This is done in excel using the Pearson command formula: =Pearson (array1, array2) with arrays equaling the sampling stations in the associated water resource. This can also be done in JMP using the pair-wise correlations for each month.

*Step 3:* Remove the seasonality of the correlogram by subtracting the mean monthly suspended solids (SS) value over the sampling time frame from the raw Pearson's correlogram and plotting

the results again in the form of a correlogram (Figure SOP 19.6). This will leave you with the trend and error components of the raw data associated with the resource type in that park.

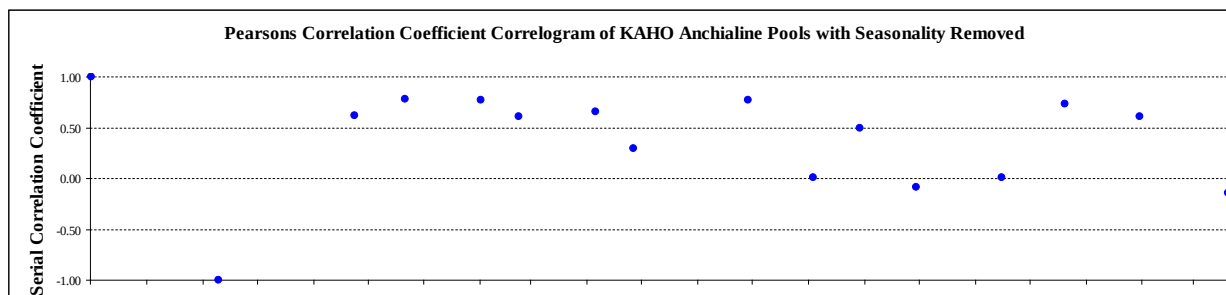


**Figure SOP 19.6.** Correlogram of the Kaho anchialine pool data with the seasonality component removed by subtracting the mean monthly SS value over the sampling time frame from each monthly value (Bienfang data 2006).

*Step 4:* Subtract the trend data from the “deseasonalized” data by plotting the residuals of a linear regression fitted to the correlogram data with the seasonality removed. Plot within this graph the 95% confidence intervals. This should give a correlogram with the error component of the raw data showing the serial correlation of data points and the 95% CI bounding (Figure SOP 19.7). Coefficients residuals constrained within the confidence limits can be treated as random with no serial correlation and we can safely ignore serial correlation in further analysis (McBride 2005). When points exhibit a serial correlation or extend beyond the CI boundaries, it is safe to ignore serial correlation in performing trend analysis provided the analysis is restricted to the period of record and the analysis model assumes independent observations (McBride 2005).

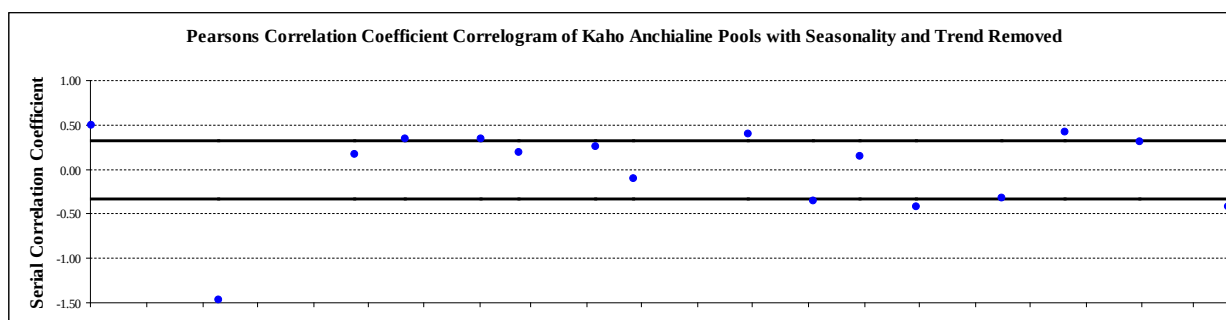


**Figure SOP 19.7.** Error component of the raw data collected from a serially correlated dataset exhibiting a slight to no systematic pattern and a tendency towards constraint within a 95% CI bounding interval (generated by plotting the residuals of a linear regression fitted to the correlation coefficient data with seasonality removed–Bienfang data 2006). This is a relatively small dataset with few data points, making a complete analysis of the error difficult, though it appears that the serial correlation within the data may be relatively safely ignored provided the analysis is restricted to the time of record.

## Reporting Overview

### Reporting Types

We anticipate that all reports generated in association with this vital sign will encompass park water quality parameters and their associated relevance with GPRA goals, state, commonwealth, or territorial water quality criteria, and a status and trend assessment of the state of the parks

aquatic resources. The trend assessment of park aquatic resources will be limited in the first five years as a result of inadequate data to conduct an adequate trend assessment. However, as data begins to accumulate, it will be possible to add in Sen Slope estimators and seasonal Kendall trend assessments.

Unlike the analysis log files which will generate individual files for each park and each of the three analysis strategies (unit, landscape, and trend assessment levels), reporting documents will integrate both parks and analysis strategies. Table SOP 19.3 identifies product type, purpose, targeted audience, responsible party, production frequency, and review process. We have identified a cohesive suite of seven product categories: (1) program and protocol reviews, (2) monitoring protocol and project reports, (3) status and trends reports, (4) scientific writing and presentations, (5) management briefings, (6) website communication, and (7) interpretation and outreach.

**Table SOP 19.3.** Summary of anticipated products, grouped by type and frequency

| Type of Report                                     | Purpose of Report                                                                                                                                                                                                                                                                                                                                                  | Targeted Audience                                                                                             | Initiated by                                  | Frequency of Reporting                                          | Review Process                                                        |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------|
| Program and Protocol Reviews                       |                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                               |                                               |                                                                 |                                                                       |
| Protocol Review Reports                            | Document where actual procedures fall short or exceed expectations, recommend necessary changes, document changes since last protocol review report; and document overall quality of protocol, particularly in terms of protocol objectives and implementation, effectiveness, and data management                                                                 | Superintendents, park resource staff, I&M staff, service-wide program managers, external scientists, partners | PACN Aquatic Ecologist                        | Within 1-3 years of implementation, 5-year intervals thereafter | Peer review at network and regional level                             |
| Monitoring Protocol and Project Reports            |                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                               |                                               |                                                                 |                                                                       |
| Vital Signs Monitoring Protocol Reports            | Document and archive annual monitoring activities and data, describe current resource condition and core analysis results, document related data management activities, document changes in monitoring protocol, communicate monitoring efforts to resource managers. During protocol development stages, will emphasize progress made and challenges encountered. | Park resource staff, PACN staff, external scientists, partners                                                | PACN Aquatic Ecologist, Biological Technician | Annually, compiled each March                                   | Peer review at network level                                          |
| Summary of Vital Signs Monitoring Protocol Reports | Same as annual "Vital Signs Monitoring Protocol Reports" above, but highlights key points for non-technical audiences                                                                                                                                                                                                                                              | Superintendents, NPS interpreters, public, partners                                                           | PACN Aquatic Ecologist, Biological Technician | Annually, compiled each March                                   | Peer review at network level                                          |
| Pilot Projects and Monitoring Research Reports     | Provide background and methods of monitoring protocol development and other methods related investigations                                                                                                                                                                                                                                                         | Park resource managers, PACN Staff, external scientists, partners                                             | PACN Aquatic Ecologist                        | Variable with annual status reporting                           | Peer review at network level plus review appropriate to final product |

**Table SOP 19.3.** Summary of anticipated products, grouped by type and frequency (continued).

| Type of Report                                            | Purpose of Report                                                                                                                                                                                                                                                                                                                                                                                                          | Targeted Audience                                                        | Initiated by                                                                    | Frequency of Reporting                                                        | Review Process                              |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------|
| Status and Trends Reports                                 |                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                          |                                                                                 |                                                                               |                                             |
| Trend Analysis and Synthesis Reports                      | Describe and interpret patterns/trends of monitored resources, identify new characteristics of resource and correlations among monitored resources, identify relationships between drivers/stressors and responses at various scales, recommend changes to management of resources (adaptive management feedback). Analysis and reporting will occur at multiple scales, including park, multi-park, and network/regional. | Park resource managers, PACN staff, external scientists, partners        | PACN Aquatic Ecologist, Park Lead                                               | 3-5 year intervals. Abbreviated annual edition for PACN Vital Signs Program   | Peer review at the network level and region |
| Summary of: Trend Analysis and Synthesis Report           | Executive summary of "Trend Analysis and Synthesis Report" above with key points on one page for non-technical audiences. Usually this is a bulleted list.                                                                                                                                                                                                                                                                 | Superintendents, NPS interpreters, public, partners                      | PACN Aquatic Ecologist, Park Lead                                               | Commensurate with reporting activity of "Trend Analysis and Synthesis Report" | Peer review at the network level            |
| PACN contribution to NPS-wide "State of the Parks" Report | Describes current conditions of park resources, report interesting trends and highlights of monitoring activities' identifies resource issues of concern, explores future issues and directions                                                                                                                                                                                                                            | Congress, budget office, NPS leadership, Superintendents, general public | Compiled by the Washington Support Office (WASO) from data provided by networks | Annual                                                                        | Peer review at national level               |
| Scientific Writing and Presentations                      |                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                          |                                                                                 |                                                                               |                                             |
| PACN Vital Signs Monitoring Conference                    | Review and summarize information on this Vital Sign, help identify emerging issues and generate new ideas                                                                                                                                                                                                                                                                                                                  | Park resource staff, network staff, external scientists, partners        | PACN Aquatic Ecologist, Biological Technician, Network Coordinator              | Biennial (around time PACN "Status and Trends Report" is published            | Peer review at national level               |

**Table SOP 19.3.** Summary of anticipated products, grouped by type and frequency (continued).

| Type of Report                                | Purpose of Report                                                                                                                     | Targeted Audience                                                                                                                                                         | Initiated by                                                       | Frequency of Reporting                                                          | Review Process                                                     |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------|
| Scientific journal articles and book chapters | Document and communicate advances in knowledge, provides a broader perspective on quality assurance and peer review                   | External scientists, Park resource managers, and professional staff                                                                                                       | PACN Aquatic Ecologist                                             | Variable                                                                        | Peer review according to journal or book standards                 |
| Other symposia, conferences and workshops     | Review and summarize information on this Vital Sign, help identify emerging issues and generate new ideas                             | External scientists, professional staff, and other resource managers.                                                                                                     | PACN Aquatic Ecologist,                                            | Variable (e.g., Hawaii Conservation Conference, George Wright Society)          | Peer review at network level; for papers may also be peer reviewed |
| Management Briefings                          |                                                                                                                                       |                                                                                                                                                                           |                                                                    |                                                                                 |                                                                    |
| Protected area managers briefing              | Communicate highlights and potential management action items, with 1-2 page briefing statements for each protocol                     | Park resource staff, Network staff, agency academia scientists, other Federal, State, and Territorial Protected Area managers, discipline specialists, interpretive staff | Network Coordinator, PACN Aquatic Ecologist, Biological Technician | Annually, likely in conjunction with Board of Directors administrative meetings | Peer review by network and monitoring staff                        |
| Executive briefings                           | Update Superintendents and other VIPs on park-specific findings and potential resource issues; suggest action items where appropriate | Individual Superintendents and other VIPs                                                                                                                                 | PACN Aquatic Ecologist                                             | As needed                                                                       | Peer review by network and monitoring staff                        |

**Table SOP 19.3.** Summary of anticipated products, grouped by type and frequency (continued).

| Type of Report                        | Purpose of Report                                                                                                                                                                                                                        | Targeted Audience                                                                                                                | Initiated by                                                                     | Frequency of Reporting                          | Review Process                                                                    |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------|
| Website Posting                       |                                                                                                                                                                                                                                          |                                                                                                                                  |                                                                                  |                                                 |                                                                                   |
| Web-based media                       | Centralized repository of all final reports to ensure products are easily accessible in commonly-used electronic formats; other synthesized information on the PACN                                                                      | Superintendents, Park resource staff, PACN staff, service-wide program managers, external scientists, partners, students, public | Variable, typically network webmaster                                            | As media is completed                           | Peer review at network level to NPS web standards as finalized, reviewed products |
| Interpretation and Outreach           |                                                                                                                                                                                                                                          |                                                                                                                                  |                                                                                  |                                                 |                                                                                   |
| Science Days                          | Communicate main monitoring findings as well as underlying data; discuss potential significance for management, further monitoring, additional research potential, and for outreach                                                      | Superintendents, park resource staff, PACN staff, protocol managers, partners                                                    | Biological Technician, PACN Aquatic Ecologist, and others as needed              | Variable by park, annual when possible          | Meeting / presentation itself is a form of review                                 |
| Interpretive Conversations            | Interactive conversation with park interpretive staff to discuss main monitoring findings as well as underlying data; discuss potential significance for management, further monitoring, additional research potential, and for outreach | Park interpretive staff, environmental educators, PACN staff                                                                     | PACN Aquatic Ecologist, Technician, and others as needed                         | Variable by park, at least annual when possible | Meeting / presentation itself is a form of review                                 |
| Park Interpretive / outreach sessions | Review and summarize information on PACN Vital Signs; engage and involve greater participation in monitoring efforts                                                                                                                     | Park staff, public, partners                                                                                                     | Principal Investigator, Technician, PACN Aquatic Ecologist, and others as needed | Variable                                        | Peer review by network staff                                                      |

**Table SOP 19.3.** Summary of anticipated products, grouped by type and frequency (continued).

| <b>Type of Report</b>                   | <b>Purpose of Report</b>                                                                                                                                              | <b>Targeted Audience</b>                                                                                       | <b>Initiated by</b>                                                              | <b>Frequency of Reporting</b>  | <b>Review Process</b>        |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------|------------------------------|
| Park staff meetings (results synthesis) | Communicate results to a non-technical audience, discuss potential significance for management, receive feedback on resource and monitoring issues in park operations | All park staff, volunteers, and partners, especially those not typically encountered in I&M program operations | Principal Investigator, Technician, PACN Aquatic Ecologist, and others as needed | Annually for each network park | Peer review by network staff |

### **Reporting Preparation Process**

Reports identified in Table SOP 19.3 are to be based on collected data and other science-based documentation. These reports will provide context and explanations for the results presented, as well as include any additional analyses that may result from initial investigations. The ‘analysis log’ files will serve as the basis for most of the reporting results. The biological technician for this vital sign is identified as the primary individual responsible for updating the analysis log file and will also be pivotal in preparation of subsequent reports. It is anticipated that the Principal Investigator or another statistically trained individual will be responsible for the statistical analyses.

Drafts of the reporting products will be organized according to the categories outlined above, with key versions and review comments archived, and final versions clearly communicated to PACN network staff to ensure distribution via websites and other channels.

### **Specific Instructions for Reports and Publications**

Annual reports and trend analysis reports will use the [NPS Natural Resource Publications](#) template, a pre-formatted Microsoft Word template document based on current NPS formatting standards. Annual reports will use the [Natural Resource Report](#) template, and trend analysis and other peer-reviewed technical reports will use the [Natural Resource Technical Report](#) template. Instructions for acquiring a series number and other information about NPS publication standards can be found at: <http://www.nature.nps.gov/publications/NRPM/index.cfm>. In general, the procedures for reports and publications are as follows:

1. The document should be formatted using the NPS Natural Resource Publications template. Formatting according to NPS standards is easiest when using the template from the very beginning, as opposed to reformatting an existing document.
2. The document should be peer reviewed at the appropriate level. For example, I&M Annual Reports should be reviewed by other members of the appropriate project work group. The Program Manager will also review all annual reports for completeness and compliance with I&M standards and expectations.
3. Upon completing the peer review, acquire a publication series number from the NPS Technical Information Center or the appropriate local or regional key official (currently the Regional I&M Coordinator).
4. Upload the file in PDF and MS Word formats to the PACN Digital Library submissions folder.
5. Send a printout to each Park Curator.
6. The Data Manager or a designee will create a bibliographic record and upload the PDF document to NatureBib according to document sensitivity.

### **Literature**

Cleveland, W. S. 1993. Visualizing data. Hobart Press, New Jersey.

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- Dennis R. Helsel, 2005. Nondetects and data analysis: Statistics for censored environmental data. Wiley Interscience, Wiley, New York, 250p.
- Helsel, D. R. and R. M. Hirsch. 2002. Statistical Methods in Water Resources. US Geological Survey Techniques of Water Resources Investigations, Book 4, Chapter A3. (<http://water.usgs.gov/pubs/twri/twri4a3/pdf/twri4a3.pdf>). Accessed 15 November 2010.
- McBride, Graham B. 2005. Using Statistical Methods of Water Quality Management. Wiley Interscience, Wiley, New York, 313 pp.
- Tufte, E. R. 1983. The visual display of quantitative information. Graphics Press, Connecticut.
- Tufte, E. R. 1990. Envisioning information. Graphics Press, Connecticut.
- Tufte, E. R. 1997. Visual explanations. Images and quantities, evidence and narrative. Graphics Press, CT.

## Appendix SOP 19A. Forms Needed for Submitting Water Quality Annual Reports, Trend Analysis Reports, and Technical Reports.

| Equipment (#/quantity)                                                                                                                                                                                                                            | Preparation & Maintenance                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| <a href="http://www.nature.nps.gov/publications/NRPM/NRRNRTR.cfm">NPS Natural Resource Publications template</a><br><a href="http://www.nature.nps.gov/publications/NRPM/NRRNRTR.cfm">http://www.nature.nps.gov/publications/NRPM/NRRNRTR.cfm</a> | Complete with annual reports and trend analysis reports.          |
| <a href="http://www.nature.nps.gov/publications/NRPM/NRRNRTR.cfm">Natural Resource Report template</a><br><a href="http://www.nature.nps.gov/publications/NRPM/NRRNRTR.cfm">http://www.nature.nps.gov/publications/NRPM/NRRNRTR.cfm</a>           | Complete with annual reports.                                     |
| <a href="http://www.nature.nps.gov/publications/NRPM/NRRNRTR.cfm">Natural Resource Technical Report template</a><br><a href="http://www.nature.nps.gov/publications/NRPM/NRRNRTR.cfm">http://www.nature.nps.gov/publications/NRPM/NRRNRTR.cfm</a> | Complete with trend reports, and peer-reviewed technical reports. |



## SOP 20. Revising the Protocol

*Version 1.0 (April 2008)*

### Revision Log

Only changes in this specific Standard Operating Procedure (SOP) will be logged here. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, who approved the revision, and the reason for making the changes along with the new version number.

| New<br>Version<br>Number | Revision<br>Date | Author | Changes Made | Reasons for<br>Change | Network<br>Regional<br>Reviewer<br>Approval | Previous<br>Version<br>Number |
|--------------------------|------------------|--------|--------------|-----------------------|---------------------------------------------|-------------------------------|
|--------------------------|------------------|--------|--------------|-----------------------|---------------------------------------------|-------------------------------|

## **Purpose**

This Standard Operating Procedure explains how to make and document changes to the Water Quality Vital Signs Monitoring Protocol narrative and associated SOPs for the Pacific Island Network. Anyone editing the protocol narrative or any one of the SOPs needs to follow this outlined procedure in order to eliminate confusion in how data is collected, managed, analyzed, or reported. All observers should be familiar with this SOP in order to identify and use the most current methodologies.

A master equipment list for the entire Water Quality Vital Signs Monitoring Protocol can be found in Appendix 1A of SOP 1 (General Preparations for Field Work). The master equipment list should be updated simultaneously if this or any SOP requiring an equipment list is revised.

## **Rationale**

The Water Quality Vital Signs Monitoring Protocol narrative and associated SOPs for the Pacific Island Network represents an effort to document and employ scientifically rigorous methodologies for collecting, managing, analyzing, and reporting water quality monitoring data and information. However, all protocols regardless of initial rigor require editing as new and different information becomes available. Required edits should be made in a timely manner and appropriate reviews undertaken. Careful documentation of changes to the protocol, and a library of previous protocol versions are essential for maintaining consistency in data collection and for appropriate treatment of the data during data summary and analysis. The MS Access database for each monitoring component contains a field that identifies which version of the protocol was used when the data were collected.

In this context of revising the protocol, the rationale for dividing this into a protocol narrative with supporting SOPs is based on the following:

- The protocol narrative is a general overview of the protocol that gives the history and justification for monitoring and an overview of the sampling methods, but does not provide all of the methodological details. The protocol narrative will only be revised if major changes are made to the protocol.
- The SOPs, in contrast, are very specific step-by-step instructions for performing a given task. They are expected to be revised more frequently than the protocol narrative.
- When a SOP is revised, in most cases, it is not necessary to revise the protocol narrative to reflect the specific changes made to the SOP.
- All versions of the protocol narrative and SOPs will be archived in a Protocol Library.

## **Procedure**

All edits require review for clarity and technical soundness. Small changes or additions to existing methods should be reviewed in-house by Pacific Island Network staff (e.g., version changes by hundredths). However, if there is a complete or major change in methods, then an outside review may be required (e.g., version changes by whole numbers). If there is a major change in methodology, either to the entire protocol or individual SOP or narrative components, the Pacific West Region Inventory and Monitoring Program coordinator should be consulted to determine the appropriate level of peer review required. Typically, regional and national staff of

the NPS, and outside experts in government, private sector, and academia with familiarity in water quality monitoring in the Pacific Islands will be utilized as reviewers.

### **Revision Log**

Edits and revisions to the protocol narrative and associated SOPs will be documented by version in the Revision History Log that is found on the first page of each SOP and Appendix B of the protocol. Log changes only in the protocol narrative or SOP being edited. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02...) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 ...). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.

### **Metadata**

Any changes to associated database design and organization are documented in the Metadata of the project database(s).

### **Notification**

The Data Manager should be informed about changes to the protocol narrative or SOP so the new version number can be incorporated in the Metadata of the project database. The database may have to be edited by the Data Manager to accompany changes in the protocol narrative and SOPs.

The appropriate PACN staff should be notified of the changes and appropriate level review process initiated as determined in collaboration between the network staff and protocol principal investigator.

Once review comments are received and incorporated, post revised versions on the internet. Forward copies to all individuals with a previous version of the effected protocol narrative or SOP, and include the PACN Data Manager in the network's protocol library.



The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 988/108135, June 2011

**National Park Service**  
**U.S. Department of the Interior**



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**Natural Resource Stewardship and Science**

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