

SOP 1.9 – Site Visit Procedures for Collecting Discrete Water Quality Data.

This document provides the guidelines for the monthly procedures to collect discrete water quality samples at designated field sites.

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I. Equipment and Supplies

- Water quality meter/sonde:
 - Calibrated water quality meter with calibration cup and sensor guard
 - Spare batteries (appropriate for the water quality meter)
 - Thermometer
- Documentation and guidance:
 - Equipment and supplies checklist for discrete water quality monitoring
 - Field Data sheets
- See field preparation section below
 - Pencils/sharpies
 - MIDN Water Quality Protocol and SOP's
- Additional items:
 - Wader/hip boots
 - Rain gear
 - Tag line and rebar
 - Hand-held GPS unit (check batteries)
 - Digital camera (if available, check batteries)

- o Cell phone with emergency contact numbers
- o local map and travel directions
- o First Aid Kit
- o Vehicle Safety Kit
- o Field Safety Kit

II. Field Preparation

A. Plan Field Activities

- (1) Review site visit schedule (SOP 1.3)
 - a. As much as is practicable, sampling events should occur monthly (approximately every 30 days)
 - i. Plan sampling event to occur 30 (± 7) days from previous sampling event trying to stay as close to the target date as possible
 1. Contact MIDN Aquatic Ecologist if the sampling window will be missed
 - ii. Record sampling event date on shared Bison Connect calendar for each park
- (2) Check weather and stream conditions
 - a. All sampling should be conducted during base flow recession conditions
 - i. Sampling should not be conducted during periods of rapidly changing conditions within the stream channels (i.e., when a storm pulse is causing stream discharge to rise or fall rapidly)
 - ii. Consult with MIDN Aquatic Ecologist for clarification on when sampling is inappropriate
- (3) Determine the number of field sites to visit and plan a navigation route to sample all field sites in a single trip within each park
 - a. The order in which sites are sampled should be consistent across sampling events (following the same route)
- (4) Collection of water quality data should be limited to daylight hours
 - a. Sampling should be conducted between the hours of 8:00 AM and 4:00 PM

B. Data Management

- (1) Assemble data collection binder (Each park has a separate binder)
 - a. Each binder should contain several logistical sections in addition to calibration and field data sheets
 - i. Title Page with a list of sampling locations
 - ii. Maintenance Log
 - iii. Quick guide to calibration of the YSI ProPlus meter
 - iv. Example data sheets
 - v. Map and directions to sample locations
 - b. Print quality control and field data sheets on 4"x7" all weather paper and place in the binder (see attached)
 - i. Calibration Data Sheet
 - ii. Pre/Post Field Data Collection Calibration Check Sheet

iii. Field Data Sheet

C. Sonde/Field Meter Preparation

- (1) Perform Calibration for water quality meter (see appropriate SOP)
- (2) Perform Pre-Field Data Collection Calibration Check (see appropriate SOP)
 - a. If field meter does not meet sensor check error limits (see appropriate SOP) then field data cannot be collected with that meter until all sensors meet error check limits
- (3) Check the battery level
 - a. If the batteries are more than 75% depleted replace the batteries prior to collecting field data
 - i. All calibrations will be maintained when replacing the batteries
 - ii. The date and time need to be reset after replacing the batteries
- (4) Install calibration cup with a small amount of tap water (10-20 ml) onto meter and package for transportation
- (5) Initiate **Discrete Field Data Sheet**, record:
 - a. Park: 4 character NPS code (e.g., FRSP)
 - b. Date: YYYY-MMM-DD (e.g., 2015-May-15)
 - c. Contact: First initial and last name of official contact (e.g., N. Dammeyer)
 - d. Weather: Use pick list at bottom of Discrete Field Data Sheet (e.g., Cloudless)
 - e. Meter serial #: Record the serial number of the water quality meter used

D. Equipment and Supplies Preparation

- (1) Use discrete water quality monitoring checklist to organize and prepare all equipment and supplies needed to complete field sampling (see equipment and supplies above)
- (2) Place all equipment and supplies in field gear bag
 - a. Ensure proper maintenance of field meter cables
 - i. Care must be taken so that cables are not damaged, cables should be kept in a neat coil with no sections of cable pinched

III. Field Activities

A. Navigating to Field Sites

This section is intended to provide guidance on navigating to field locations at the park level. If guidance is needed to navigate to the park from an alternate location (e.g., MIDN I&M office) please consult online mapping resources.

Reference locations for all parks are established from a central office, which serves that particular park unit. If there is a Natural Resource Office in the park, this will serve as the central location, otherwise the visitor center or administrative office will serve as the reference location. This point serves as a central location to plan a route around.

- (1) Navigate to reference location:

- a. APCO: Natural Resource Specialists Office
 - b. BOWA: Visitor Center
 - c. FRSP: Natural Resource Management Office
 - d. GETT/EISE: Natural Resource Management Office
 - e. HOFU: Visitor Center
 - f. PETE: Natural Resource Management Office
 - g. RICH: Natural Resource Management Office
 - h. VAFO: Natural Resource Management Office
- (2) Follow specified order to field site locations (See Appendix C)
- a. The same route should be followed to field sites during each sampling event
 - b. Consult field site documentation (Appendix D) and online mapping resources to plan route between field sites in the specified order
- (3) Follow guidance from NPSTORET Site Documentation (Appendix D) or quick guide in field data binder to navigate to sampling location demarcated by an aluminum tag mounted on a tree adjacent to stream
- a. Experienced personnel should guide any new staff to field locations
 - b. Use GPS units (see SOP 1.7) to navigate to field site and tree tag if site is unknown

B. Data Acquisition Procedures

The procedures listed here should be followed for each of the field sites that have been established for monitoring in this protocol.

- (1) Locate tree tag indicating field site location
- a. Determine the exact location to obtain field observations with the water quality meter
 - i. Select a site as close to a perpendicular transect from the tree tag as possible
 - ii. Location should be as close to the center of the channel as possible in an area where the stream is well mixed
- (2) Ensure field meter has been running for a minimum of 15 minutes (if using YSI ProPlus)
- **Meter can be turned off or on throughout the day, if using YSI ProPlus meter must be powered on for 15 minutes prior to recording observations****
- (3) Remove calibration cup from the sensor housing and replace it with the sensor guard
- (4) Rinse sensor housing with stream water at field site
- (5) Place sensor housing in the stream ensuring all the sensors are submerged and are in the middle of the water column
- (6) Record observational field data on **Discrete Field Data Sheet**:
- a. Site ID: 2 digit site ID (e.g., 02)
 - i. Confirm site ID number using site descriptions in either the Field Data Binder or site documentation

*****Each site has a six-character code that uniquely identifies the field location. The first four characters are determined by the NPS park code (e.g., FRSP) and the last two characters are***

*the two digit site ID number. The park code is recorded once on the Discrete Field Data Sheet***

- b. Time: 24-hour time code (e.g., 16:34)
- c. Tree Tag: Was tree tag located (e.g., Y or N)
- d. Populate field data fields from water quality meter:
 - i. Ensure all readings are stable before recording any data on the Discrete Field Data Sheet.
 - 1. Observe data and wait for either the Auto Stability indicator (if available) to stop flashing or ensure that the observed values are not drifting in a particular direction (i.e., it is acceptable for the observed value to change slightly when the data is recorded as long as that change is varying around a central point.)
 - a. If using a non-optical Dissolved Oxygen sensor (e.g., YSI ProPlus meter) **a minimum** of 6 inches of water passing the sensor per second is required. This can be accomplished by moving the sensor housing through the water if stream discharge is too low
 - 2. Auto Stability should only be used as one indication of stability of readings not a strict guide
 - 3. Each parameter is considered stable when observations vary by less than:
 - a. Temp: 0.1 °C in 10 seconds
 - b. Specific Conductance: 1 µS/cm in 10 seconds
 - c. Dissolved Oxygen: 0.1 °C and DO values do not change more than 0.1 mg/L within 10 seconds
 - d. pH: 0.02 units in 10 seconds
 - 4. Professional judgement must be used in the field when conditions are changing rapidly as the above stabilization criteria might not be met for certain parameters (e.g., pronounced diel cycles)

*** It might take several minutes for field meter observations to stabilize. If drift is excessive, consideration should be given to replacing individual sensors where this drift is occurring.***

- e. Populate additional data fields on Discrete Field Data Sheet:
 - i. Air Temperature: Acquire using thermometer held away from your body out of direct sunlight
 - ii. Stream Width: Estimate stream width at a perpendicular transect from tree tag (circle unit of measure used to estimate)
 - iii. Stream Depth: Estimate mean stream depth across a perpendicular transect from tree tag (circle unit of measure used to estimate)
 - iv. Discharge: Use options from pick list printed on the bottom of the Discrete Field Data Sheet (see quick guide in Field Data Binder for guidance on pick list options)

- v. Turbidity: 0-4 categorical value (see quick guide in Field Data Binder for guidance on pick list options)
- (7) Check that each column is populated for the field site
 - a. Record any relevant notes about site conditions (etc.) on data sheet or additional field notes form
- (8) Repeat Data Acquisition Procedures for each field site

IV. Post-Field Activities

- (1) Upon arrival at home office complete Post-Field Data Calibration Check immediately (SOP 1.4)
 - a. Complete **Pre and Post Field Data Calibration Check Data Sheet** (SOP 1.4)
 - b. On **Discrete Field Data Sheet** populate Post Field Data Calibration Check Table
 - i. If any of the parameters fall outside of the sensor check error limits:
 - 1. Strike through all data recorded for that parameter on Discrete Field Data Sheet and record a note describing the calibration check failure
 - 2. the data for that parameter must be censored or recollected with a recalibrated sensor

*** If possible, the failing sensor should be brought back into working order and the field data should be recollected (see SOP 1.4 for guidance). If this is not an option only the data associated with the failing sensor should be censored and discarded.***

- (2) Review Discrete Field Data Sheet for completeness
 - a. If any information missing enter notes to document why
- (3) Follow short-term storage procedure and store the meter in a climate controlled area until the next sampling event (per manufacturer)
- (4) Complete Post-Field Data Management Procedures (SOP 2.1)

Appendix A. Discrete Field Data Binder Materials.

Water Quality Monitoring Program

-MIDN-

FRSP

If found please contact:

MIDN Aquatic Ecologist
National Park Service
120 Chatham Lane
Fredericksburg, VA 22405
(202) 380-8370

FRSP Sample Schedule:

	# of Field Sites
Jan.	
Feb. (Qtr)	
March	
April	
May (Qtr)	
Jun.	
July	
Aug. (Qtr)	
Sept.	
Oct.	
Nov. (Qtr)	
Dec.	

Sampling Sites:

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Quick Guide for WQ Calibration/Check Sheets:

Calibration:

- **YSI serial #:** Enter # found on the top section of the back of the unit under the data port
- **Date:** YYYY-MM-DD
- **Contact:** Enter first initial and last name
- **Location:** Enter park code (eg PETE)

*****Refer to YSI ProPlus Calibration SOP for
detailed guidance*****

*****Follow guidance for rinse procedure
between each parameter *****

- **Temperature:** Enter value from traceable thermometer and ProPlus sensor value
- **Specific Conductance (SPC):**
Form: Enter actual reading value and temp. from calibration screen.

Cal: press Cal → Conductivity → Sp. Conductance → SPC $\frac{\mu S}{cm}$ → Calibration value → **Enter standard value (1413)**; record values from calibration screen → Accept Calibration
- **pH:**
Form: Enter actual reading, temp., and mV from calibration page for each buffer.

Cal: Press Cal → ISE1 (pH) → (for each of the three buffer solutions in any order); Record values from calibration screen; **Ensure that Calibration value is correct, if needed adjust** (temp. specific buffer values can be found on buffer label) → Accept calibration → Repeat for second and third buffer → Press Cal button to finish pH calibration
- **DO:**
Form: **Circle** calibration method (air or wet). Enter values for **start time** (air: when cap is attached to probe and vented to atmosphere; wet: when aquarium air pump placed in water) and **calibration time**. Enter actual reading values for %DO, mm Hg, and temp. from calibration screen; post calibration: Enter %DO and $\frac{mg}{L}$

Cal: press Cal → DO → DO%L → Record values from calibration screen (mm Hg at top of screen); Accept calibration → Record %DO and $\frac{mg}{L}$ from main screen for post-calibration

Calibration Check:

- Perform a **PRE** (front of Cal. Check form) and **POST** (back of Cal. Check form) cal. checks for each sampling event. If sampling occurs over more than one day **pre and post calibration checks**

should be preformed each day however the unit **does not** need to be **recalibrated** each day (unless calibration check failure)

- **YSI serial #:** Enter # found on the top section of the back of the unit under the data port
- **Date:** YYYY-MM-DD
- **Contact:** Enter first initial and last name
- **Location:** Enter park code (e.g. PETE)

- **Specific Conductance (SPC):** Record SPC $\frac{\mu S}{cm}$ value from display screen when AS[†] reached
PRE: Recalibrate if value is <79.0 or >89.0; record new calibration check
Post: Note that post check failed if value is <79.0 or >89.0

- **pH:** Record temp. and pH value from display screen when AS[†] reached
PRE: Recalibrate if value is <4.30 or >4.90; record new calibration check
Post: Note that post check failed if value is <4.30 or >4.90

DO: Form: **Circle** calibration method (air or wet), enter values for **start time** (air: when cap is attached to probe and vented to atmosphere; wet: when aquarium air pump placed in water) and **time observed**, enter values from display for %DO, $\frac{mg}{L}$, mm Hg, and temp. when AS[†] reached
PRE: Recalibrate if value for DO %L <95.0 or >105.0; record new calibration check
Post: Note that post check failed if value is <95.0 or >105.0

- **Notes:** Enter any relevant information (eg sensor check failure, maintenance preformed, etc.)

† AS may be reduced incrementally from 100→75% if stability cannot be achieved (see quick guide for WQ Data Sheets to adjust)

*****See attached example data sheet*****

Quick Guide for Water Quality Data Sheets:

- **Start new data sheet for each sampling event (ie each month start a new data sheet)**
- **Park:** Enter park code (e.g. PETE)
- **Date:** YYYY-MM-DD
- **Contact:** Enter first initial and last name
- **Weather:** Enter one of the categories listed at the bottom of each data sheet
- **YSI serial #:** Enter # found on the top section of the back of the unit under the data port
- **Site ID:** Enter site number (eg 04)
- **Time:** 24-hour (eg 15:33)
- **Tree tag:** Indicate if tag located in field or NA
- **H₂O temp.:** Enter value as read from display

- **Barr. Pressure:** Enter value as read from display
- **DO (% and $\frac{mg}{L}$):** Enter value as read from display once auto stability (AS) has been achieved; AS may be reduced incrementally from 100→75% if stability cannot be achieved†
- **Conductivity:** Enter value measured as **specific conductance (SPC)** from display when auto stability (AS) has been achieved; see DO
- **pH:** Enter value as read from display once auto stability (AS) has been achieved; see DO
- **Air Temp.:** Measure in shade with traceable thermometer
- **Stream Width:** ~ Wetted stream width
- **Stream Depth:** ~ Mean stream depth along transect of stream width
- **Discharge:** Enter one category from list found at bottom of data sheet; note if weather conditions change throughout day on rear of data sheet (at which sites)
 - **Dry stream bed**-No water present
 - **No flow**- Water present in discrete pools but no flow between pools
 - **Interstitial**- Water flow between discrete pools through substrate
 - **Low**- Less than base flow; less flow than “normal” conditions but pools connected by surface flow
 - **Normal**- Base flow conditions, well within banks
 - **High**- Flow approaching bank full; above normal high water line
 - **Flood**- Flow over banks of stream onto floodplain
- **Turbidity***
 - **0**- Clear water, substrate clearly visible
 - **1**- Slight cloudiness or coloration, substrate visible with some obscuring of clarity
 - **2**- Moderate cloudiness or coloration, substrate visible but more difficult to see
 - **3**- Strong cloudiness or coloration, substrate difficult to see due to turbidity
 - **4**- Extreme cloudiness or coloration, substrate obscured by water clarity

*** Take into consideration depth of water when assessing turbidity; consider cloudiness/coloration of water in large sample bottle to increase consistency across sample sites when possible**
- **Notes:** Anything that may be of interest such as a change in channel morphology, missing tree tag etc., change in weather conditions, replicate info., etc.
Additional blank pages in rear of binder

† Adjust AS: Press sonde button (second button from left on top row)→Select AS→Select parameter (e.g. DO)→Toggle down to sensitivity bar→Toggle left/right to adjust→Press esc to return to original screen

*****See attached example data sheet*****

Troubleshooting Guide

- **DO, pH calibration/check failure:**
Recalibrate ensuring there are no air bubbles (pH) or water droplets (DO) lodged against sensor
- **DO out of range; unit will not calibrate:**
Check probe current and slope through GLP file

Press file button (top row far right) → View GLP → Toggle down screen looking for error message and associated DO current or slope value

- If out of range (see table below) replace DO membrane (see SOP or instruction sheet associated with DO replacement membranes)
- If within range and calibration problems persist: check maintenance schedule and replace DO membrane

	Error! Bookmark not defined. $\bar{x}$	Range
Probe Current (μA)	6.15	4.31-8.00
Probe Slope (sat/ μA)	16.26	12.51-23.23

*YSI 5203 Polargraphic; YSI 5908 1.25 PE Membrane (Yellow)

- **Specific Conductance calibration check failure:**
Ensure main display of ProPlus is displaying Specific conductance, **SPC** $\frac{\mu\text{S}}{\text{cm}}$ (conductance corrected for temperature), and **not measured conductance** **C** $\frac{\mu\text{S}}{\text{cm}}$;

To add SPC to main display:

Press sonde button (top row second from left) → Display → Conductivity → Sp. Conductance → SPC $\frac{\mu\text{S}}{\text{cm}}$ → Esc

To remove C from main display:

Press sonde button (top row second from left) → Display → Conductivity → Conductivity → none → Esc

Appendix B. Discrete Site Visit Equipment Checklist.

Appendix C. Specified Order for Sampling Field Sites by Park.

APCO:

Sampling Order	Site ID
1	APCO_03
2	APCO_01
3	APCO_02

BOWA:

Sampling Order	Site ID
1	BOWA_01
2	BOWA_02
3	BOWA_03
4	BOWA_04
5	BOWA_05

FRSP:

Sampling Order	Site ID
1	FRSP_06
2	FRSP_08
3	FRSP_14
4	FRSP_16
5	FRSP_15
6	FRSP_17
7	FRSP_02
8	FRSP_01
9	FRSP_03
10	FRSP_04
11	FRSP_09
12	FRSP_10
13	FRSP_11
14	FRSP_18

GETT:

Sampling Order	Site ID
1	GETT_01
2	GETT_03
3	GETT_04
4	GETT_07
5	GETT_06

HOFU:

Sampling Order	Site ID
1	HOFU_01
2	HOFU_02

PETE:

Sampling Order	Site ID
1	PETE_01
2	PETE_02
3	PETE_03
4	PETE_04
5	PETE_05
6	PETE_06
7	PETE_07
8	PETE_08
9	PETE_09
10	PETE_10

RICH:

Sampling Order	Site ID
1	RICH_08
2	RICH_06
3	RICH_07
4	RICH_04
5	RICH_03
6	RICH_01
7	RICH_02
8	RICH_05

VAFO:

Sampling Order	Site ID
1	VAFO_01

Appendix D. NPStoret Site Descriptions.

*****See PDF of Storet sites*****