

SOP 2.2: Management of Continuous Monitoring Water Quality Data

This document provides procedures for the management of continuous monitoring water quality data including log file transfer, formatting, and storage. Additionally, guidance for the management of related data such as calibration, field fouling check, log file comparisons, and site visit notes is provided. Guidance for record computation and data processing procedures are provided in Wagner et al. (2006) and outlined in SOP 2.3.1 (Continuous Monitoring Record Computation and Data Quality Evaluation).

Management of continuous monitoring related data should take place as soon as practicable after site visits have been completed. Prior to completion of tasks in this SOP the field site visit (SOP 1.10) must be entirely completed including the calibration of the previously deployed sonde.

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I. Equipment

- Field Sonde Controller
 - o YSI 650
 - o Trimble Recon
 - o HOBO Shuttle
- PC adaptor cables
 - o YSI serial port adaptor
 - o Hydrolab printer cable
 - o HOBO mini-USB cable
- MIDN Water Quality Computer

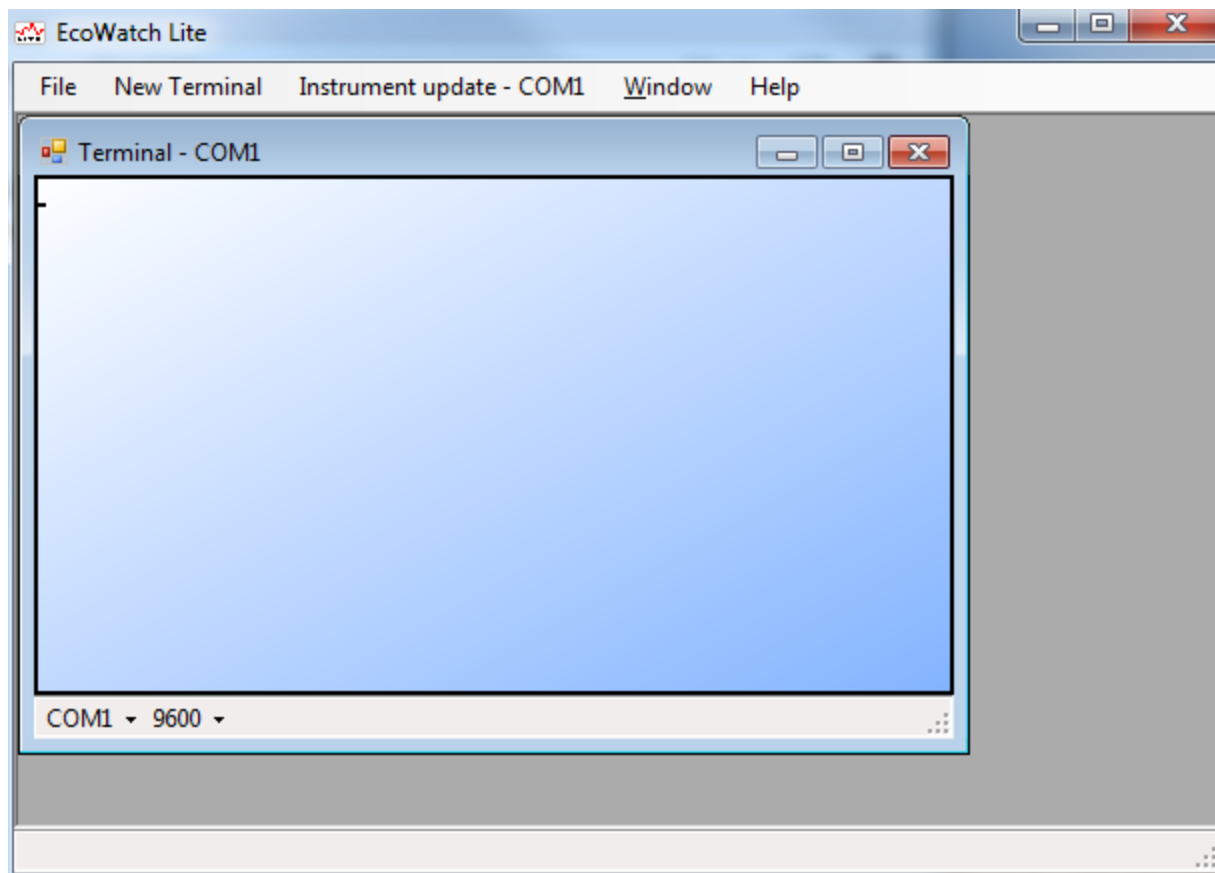
- o USGS Ultimate Spreadsheet v.2.6.1
 - o Access to MIDN Server
 - o Access to WASO GETT1 Server
- Completed Field Data Sheets
 - o Calibration
 - o Log file Comparison
 - o Site Visit Field Notes
 - o Fouling Check
 - o Pre-deployment Check

II. Log File Transfer Procedures

After completion of a site visit, log files reside in both the memory of the sonde and the sonde controller hand-held unit (YSI 650, Trimble Recon, etc.). Log files must then be transferred to their ultimate repository. Log files should not be deleted from sonde memory until the file has been transferred to the MIDN server. If the MIDN server is not accessible data can be transferred to the MIDN water quality computer temporarily until access to the server is gained (e.g., while in travel status).

A. YSI Log File Transfer

- (1) Connect YSI 650 to MIDN water quality computer
 - a. Use YSI serial port adaptor cable
- (2) Download log file
 - a. Launch YSI EcoWatch Lite Software
 - i. Set park appropriate file download location (see section V.A. below)
 1. Select File menu
 - a. Select “Options...”
 - b. Click “Browse...” button
 - i. Navigate to appropriate file location on the MIDN server
 - ii. Click “OK” button
 - ii. Open new Terminal for communication between 650 and MIDN computer
 1. Select “New Terminal” from tabs



- b. Turn on YSI 650
 - i. Highlight “File” and press enter
 - ii. Highlight “Upload to PC” and press enter
 - iii. Highlight appropriate log file (.dat format) and press enter
- c. Using Windows Explorer to navigate to download file location
 - i. Confirm file downloaded

Best practices for downloading YSI log files require that the files are maintained in YSI's proprietary .dat format so that additional metadata will be included along with the log file

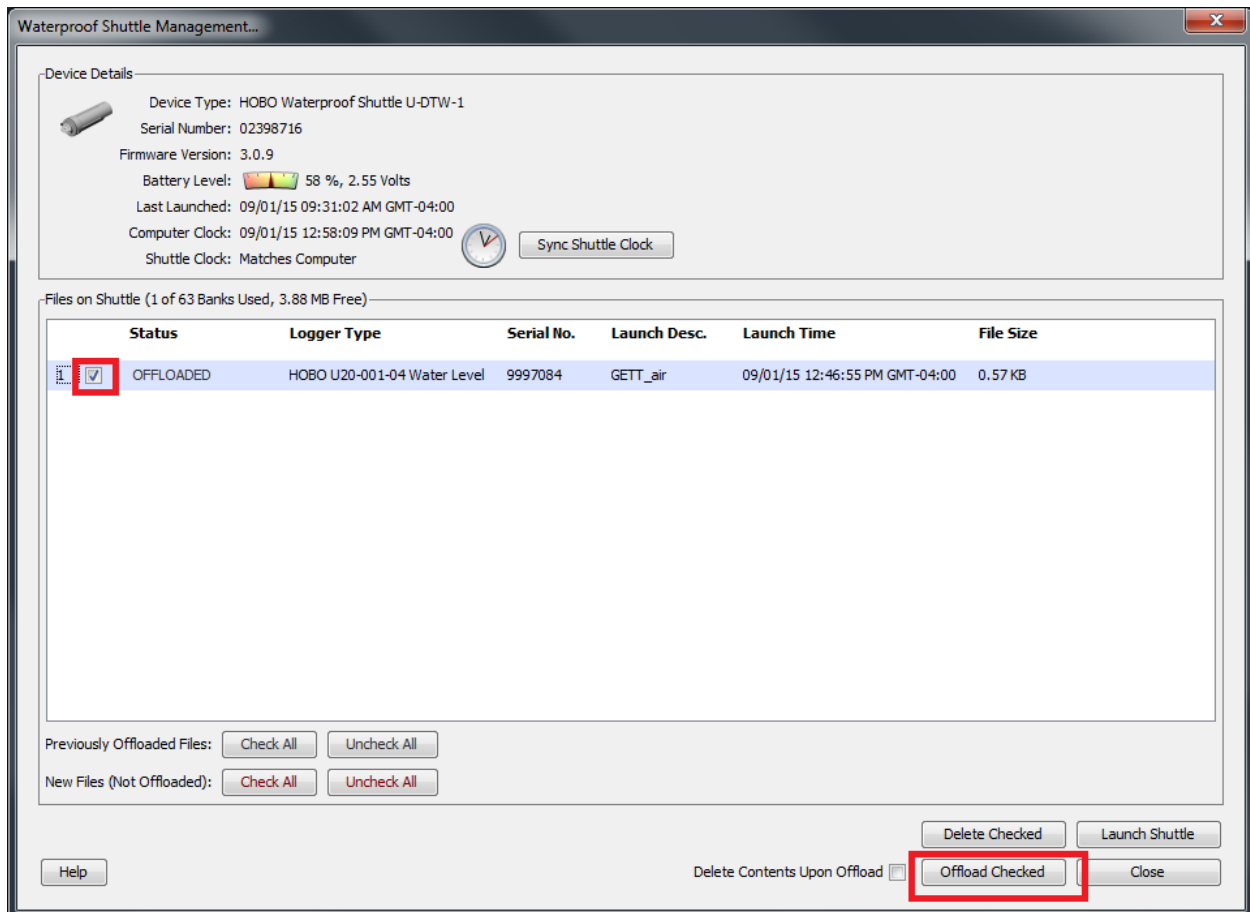
B. Hydrolab Log File Transfer

- (1) Connect Trimble Recon to MIDN water quality computer
 - a. USB printer cable
- (2) Download log file
 - a. Open Windows Explorer and navigate to Trimble Recon
 - i. Navigate to appropriate file within park specific folder
 - ii. Copy appropriate log file
 - iii. Paste log file in appropriate folder on MIDN server (see section V.A. below)
 - 1. Open file to ensure successful download

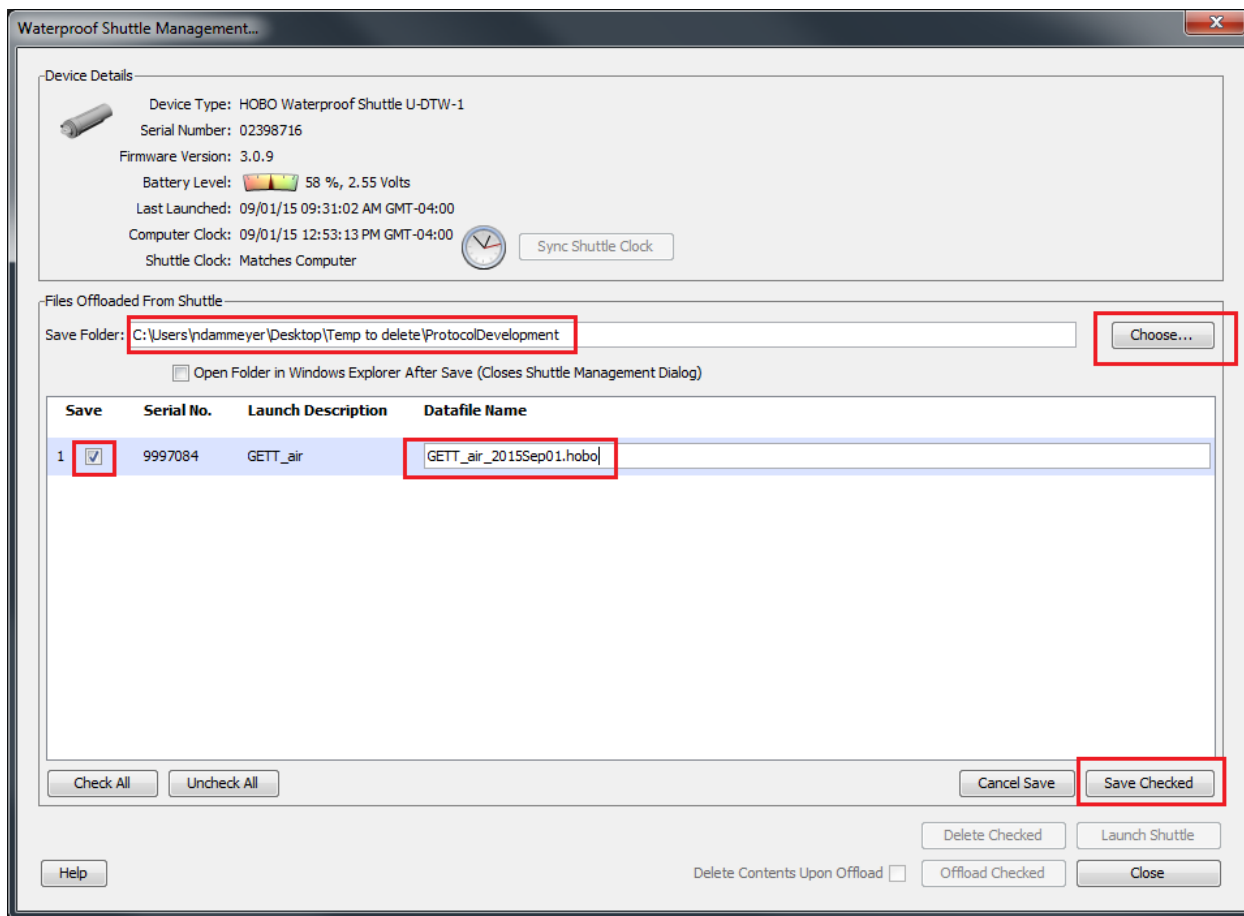
HOBO Log File Transfer

- (1) Connect HOBO Shuttle to MIDN water Quality computer

- a. Use mini-USB cable
- (2) Download log files
 - a. Launch HOBOWare Pro Software
 - b. Select "Device" from Tab menu
 - i. Select "Manage Shuttle..."
 1. Check all appropriate files for site visit
 2. Click "Offload Checked" button



3. In "Save Folder:" field:
 - a. Click "Choose..."
 - i. Browse to appropriate park folder on MIDN Server (see section V.A. below)
 - b. Rename file in "Datafile Name" field (.hobo format)
 - i. PARK_air or wet_YYYYMMDD_stage
 1. e.g., GETT_air_2015SEP01_stage
4. Click "Save Checked" button



- ii. Click “Close” to exit “Waterproof Shuttle Management...” screen
- c. Browse to file to ensure successful download
 - i. Select “File” from Tab menu
 - ii. Select “Open Datafile(s)...”
 1. Browse to download appropriate folder location and open appropriate file
 - iii. Click “Plot” button
 1. Confirm successful download

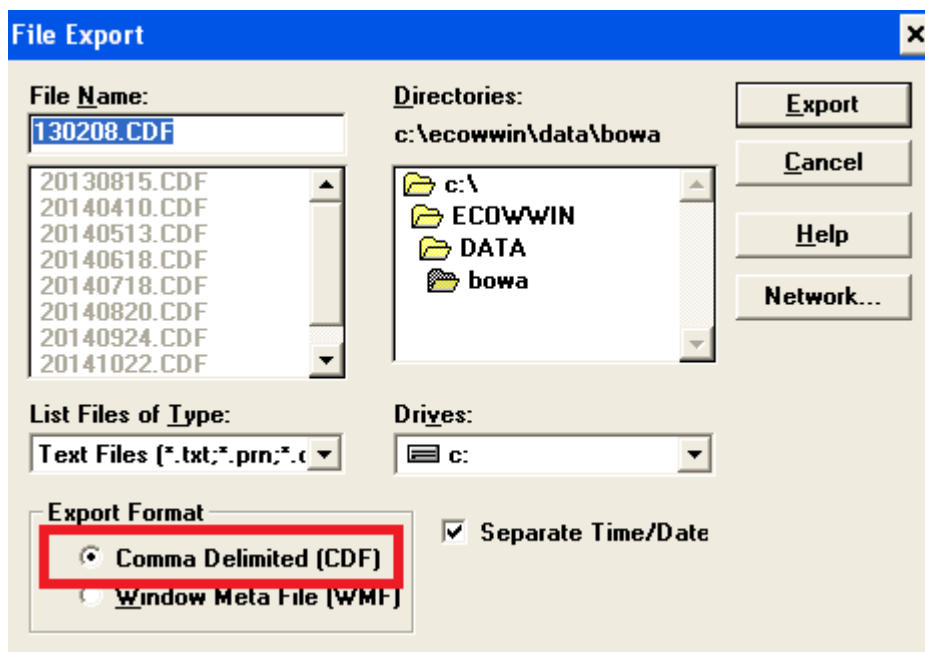
III. Formatting Log Files

All log files must be formatted from their raw form prior to importing into the continuous monitoring database. MIDN uses the Aquarius software package from Aquatic Informatics to maintain continuous monitoring data. Log files must be formatted to match specific configuration parser files that streamline data import into the database.

A. Formatting YSI Log Files

YSI’s .dat file format must be opened using YSI’s EcoWatch software for which a fully functioning release for Windows 7 has not occurred. Therefore, MIDN water quality computer maintains a virtual Windows XP operating system so that the EcoWatch software can be utilized.

- (1) Export .dat log file to comma delimited file
 - a. Navigate to appropriate download location of .dat log file (see section V.A. below) in Windows Explorer
 - b. Launch Virtual Windows XP mode
 - i. Open “Shortcut to Data” folder
 1. Open appropriate park folder
 - ii. Copy .dat file from download folder location to appropriate folder
 - c. Launch EcoWatch Software within XP mode
 - i. Open appropriate .dat log file
 - ii. Export log file from EcoWatch
 1. Select “File” from the Tab menu
 - a. Select “Export” from File menu
 - i. Ensure “Comma Delimited (CDF)” file type is selected
 - ii. Click “Export” button



- iii. Navigate to Exported file and copy to appropriate file location on MIDN Server (see section V.A. below)
 1. Replace temporary file name with final naming convention:
 - a. PARKYYYYMMDD_QW
 - i. e.g., HOFU2015JAN05_QW.csv
 - d. Close all programs within Windows XP mode and hibernate the virtual operating system
- (2) Convert .CDF to .csv
 - a. Launch Microsoft Excel
 - i. Navigate to log file location (III.A.1.c.iii above) and open file
 - ii. Use the Excel “Text Import Wizard” to parse the log file

1. Select “comma” as Delimiter

(3) Check log file

- a. Verify expected range and number of observations were obtained
 - i. Calculate expected number of observations

1. From “Site Visit Field Notes” data sheet” calculate:

# of complete days	×	24 hours	÷	sample interval*	+	# of observations in partial day	= Total Expected Observations
-----------------------	---	-------------	---	---------------------	---	-------------------------------------	----------------------------------

*convert to samples per hour (e.g., 15 min = 0.25)

- a. Compare expected number of observations to log file
- b. Compare date range, log file start, and stop time
- b. Note any discrepancies between expected values and log file in additional notes section of “Site Visit Field Notes” data sheet

(4) Format log file

- a. Trim initial and final observations
 - i. Delete initial 2 hours of observations from start time of log file to allow sonde to acclimate to stream environment (see “Site Visit Field Notes” data sheet)
 - ii. Delete any observations after the time the sonde was removed from deployment structure (see “Site Visit Field Notes” data sheet)
- b. Format log file to match Aquarius .cfg parser file
 - i. See current NPS-WRD and Aquatic Informatics guidance for up-to-date procedures for working in the Aquarius environment
 1. e.g., correct # of header rows, column labels, columns in correct order, etc.

*** Specific guidance for working in the Aquarius environment is not presented in the MIDN procedures as the software is an evolving product. NPS-WRD and Aquatic Informatics regularly provide updated guidance to working in this environment. MIDN Aquatic Ecologist is responsible for staying up-to-date with procedures for importing, manipulating, and exporting products from the Aquarius database***

- c. Save log file as .csv on MIDN server (see section V.A. below)
- d. Import formatted .csv log file into Aquarius database on the WRD GETT1 server
 - i. See current NPS-WRD and Aquatic Informatics guidance for up-to-date procedures for working in the Aquarius environment

B. Formatting Hydrolab Log Files

Log files recorded by Hydrolab equipment are stored in .txt format and can be opened directly in Microsoft Excel using the “Text Import Wizard” tool. Metadata regarding the deployment period and sonde are included in the header rows of .txt log file.

- (1) Convert .txt log file to .csv

- a. Launch Microsoft Excel
 - i. Navigate to log file location (see section V.A. below) and open file
 - ii. Use the Excel “Text Import Wizard” to parse the log file
 1. Select “comma” as Delimiter

(2) Check log file

- a. Verify expected range and number of observations were obtained
 - i. Calculate expected number of observations
 1. From “Site Visit Field Notes” data sheet calculate:

# of complete days	×	24 hours	÷	sample interval*	+	# of observations in partial day	= Total Expected Observations
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*convert to samples per hour (e.g., 15 min = 0.25)

- a. Compare expected number of observations to log file
 - b. Compare date range, log file start, and stop time
 - b. Note any discrepancies between expected values and log file in additional notes section of “Site Visit Field Notes” data sheet

(3) Format log file

- a. Trim initial and final observations
 - i. Delete initial 2 hours of observations from start time of log file to allow sonde to acclimate to stream environment (see “Site Visit Field Notes” data sheet)
 - ii. Delete any observations after the time the sonde was removed from deployment structure (see “Site Visit Field Notes” data sheet)
 - iii. Delete any observations where battery voltage drops below 6.4V
- b. Format log file to match Aquarius .cfg parser file
 - i. See current NPS-WRD and Aquatic Informatics guidance for up-to-date procedures for working in the Aquarius environment
 1. e.g., correct # of header rows, column labels, columns in correct order, etc.

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- c. Save log file as .csv on MIDN server (see section V.A. below)

(4) Import formatted .csv log file into Aquarius database on the WRD GETT1 server

- a. See current NPS-WRD and Aquatic Informatics guidance for up-to-date procedures for working in the Aquarius environment

C. Formatting HOBO Log Files

HOBO pressure transducers are deployed in pairs at continuous monitoring field sites to obtain data regarding stage (a proxy for discharge) which is used to aid in the record processing. Transducers are deployed in the stream (wet) and in the air so that variation in atmospheric pressure can be used to increase the accuracy of the stream stage record.

(1) Process wet and dry HOBO log files

- a. Launch HOBOWare Pro
- b. Select "File" from Tab menu
 - i. Select "Open Datafile(s)..."
 - ii. Navigate to appropriate folder (see section V.A. below) and open "wet" transducer file
 - iii. In "Plot Setup" window:
 1. Select appropriate "Series":
 - a. "Abs Pres"
 - i. Select "mm Hg" from "Units" pick list
 - b. "Temp"
 - i. Select "°C" from "Units" pick list
 2. Click "None" button for "Internal Logger Events to Plot"
 3. Set correct GMT offset
 - a. EST = -5
 - b. EDT = -4

Plot Setup [X]

Description:

Select Series to Plot

☒ All ☐ None

Series	Measurement	Units	Label
☒ 1	Abs Pres	mm Hg	
☒ 2	Temp	°C	
☐ 3	Batt	V	

Select Internal Logger Events to Plot

☒ All ☐ None

Event	Event Type	Units
☐ 1	Coupler Detached	
☐ 2	End Of File	

Offset from GMT (+/- 13.0 hours, 0 = GMT)

▼ Data Assistants

	Barometric Compensation Assistant
	Growing Degree Days Assistant

Process... What's This? Manage... Load...

Help Cancel Plot

4. Highlight Barometric Compensation Assistant from "Data Assistants"
 - a. Click "Process..." button
 - b. In "Barometric Compensation Assistant" window:
 - i. Fluid Density
 1. Select "Derived From Temp. channel, assuming fresh water"
 - ii. Barometric compensation Parameters
 1. Click "Use Barometric Datafile" button
 2. Click "Choose..." button
 - a. Navigate to appropriate folder (II.C.2.b.i.a.i above) and open paired "air" datafile
 - iii. Click "Create New Series" button

Barometric Compensation Assistant

Fluid Density

☐ Fresh Water (62.428 lb/ft³)
☐ Salt Water (63.989 lb/ft³)
☐ Brackish Water (63.052 lb/ft³)
☐ Manual Input lb/ft³
☒ Derived From Temp. Channel, assuming fresh water

Barometric Compensation Parameters

☐ Use a Reference Water Level
 Reference Water Level: Feet
 Reference Time:

Barometric Datafile:

Constant Barometric Pressure: psi

Resultant Series Name:

User Notes:

5. Click "Plot" button
- c. Export new series created above
 - i. Select "File" from Tab menu
 - ii. Select "Export Table Data..."
 1. Only select new time series "Sensor Depth"
 - iii. Click "Export" button
 1. Navigate to appropriate folder location (see V.A. below)
 2. Name file and save in .csv format
 - a. PARK_air or wet_YYYYMMDD_stage.csv
 - i. e.g., GETT_air_2015SEP01_stage.csv

- (2) Navigate to exported file and ensure successful export
- (3) Format log file
 - a. Trim Log File
 - i. Delete initial 2 hours of observations from start time of log file to allow sonde to acclimate to stream environment (see “Site Visit Field Notes” data sheet)
 - ii. Delete any observations after the time the sonde was removed from deployment structure (see “Site Visit Field Notes” data sheet)
 - b. Format log file to match Aquarius .cfg parser file
 - i. See current NPS-WRD and Aquatic Informatics guidance for up-to-date procedures for working in the Aquarius environment
 1. e.g., correct # of header rows, column labels, columns in correct order, etc.

*** Specific guidance for working in the Aquarius environment is not presented in the MIDN procedures as the software is an evolving product. NPS-WRD and Aquatic Informatics regularly provide updated guidance to working in this environment. MIDN Aquatic Ecologist is responsible for staying up-to-date with procedures for importing, manipulating, and exporting products from the Aquarius database***

- c. Save log file as .csv on MIDN server (see section V.A. below)
- (4) Import formatted .csv log file into Aquarius database on the WRD GETT1 server
 - a. See current NPS-WRD and Aquatic Informatics guidance for up-to-date procedures for working in the Aquarius environment

IV. Maintenance of Continuous Monitoring Related Data

QA/QC data are collected throughout the procedures for carrying out continuous monitoring related to this protocol. These data are used to accomplish QA/QC tasks (e.g., calibrations and sensor checks), inform record processing (e.g., field notes and fouling checks), and develop corrections for biased data (correct signals based on fouling/calibration drift). This section provides guidance for the maintenance of these data.

A. Field Form Data Maintenance

All field and laboratory data related to continuous monitoring records are captured on paper data sheets. All forms are scanned and maintained on the MIDN server and a subset of the data is entered into MS Excel based spreadsheets to develop correction values used in record computation (SOP 2.3). The remaining data is used to inform record processing and is referred to by consulting the original paper data sheet or scanned copy.

- (1) Scan all field and calibration data sheets
 - a. Calibration forms
 - b. Site Visit Field Notes forms
 - c. Log File Comparison forms
 - d. Fouling Check forms
 - e. Pre-deployment Check forms

- (2) Save scanned forms in the park appropriate folder (see section V.A. below)

B. Populate Data Correction Form

Record computation procedures developed by the USGS (Wagner et al. 2006) guide the processing of continuous water quality data. MIDN uses equations developed by USGS (QW_Ultimate Spreadsheet v.2.6.1) to apply corrections to continuous monitoring data and rate the quality of these data. This section provides guidance for entering data into this spreadsheet to be used in the record computation SOP (2.3).

- (1) Open park appropriate QW_Ultimate spreadsheet
 - a. Maintained on MIDN Sever (see section V.A. below)
 - b. A separate QW_Ultimate spreadsheet will be created each water year
- (2) Obtain relevant data sheets (see section IV.A.1 above) and
- (3) populate QW_Ultimate spreadsheet for appropriate site visit

*****Tabs for each parameter should be populated in the order they are found in the spreadsheet*****

-Temperature, SpC, pH, DO, and then Turbidity (if applicable)

*****Temperature Tab must be completed prior to any other tab to make cells editable*****

- a. Temperature:
 - i. Enter metadata fields from “Site Visit Field Notes” data sheet, formatted log file, or general knowledge
 1. Station Name- Enter Station Name
 2. Water Year- Enter Water Year
 3. Station #- Site Visit Field Notes: Site
 4. Date- Site Visit Field Notes: Date
 - a. MM/DD/YY
 5. Time arrived- first record of formatted sonde log file
 - a. HHMM (no colon; 24-hr clock)
 6. Time left- last record of formatted sonde log file
 - a. HHMM (no colon; 24-hr clock)
 - ii. Enter Fouling Correction data from “Fouling Check” data sheet
 1. Site Monitor Dirty- Deployed Meter Before Cleaning
 2. Site Monitor Clean- Deployed Meter After Cleaning
 3. Field Probe Before- Calibrated meter Before Cleaning
 4. Field Probe After- Calibrated meter After Cleaning
- b. Specific Conductance:
 - i. Enter Fouling Correction data from “Fouling Check” data sheet

*****Station Name, Water Year, and Station # only need to be entered when the sheet is first initiated each water year*****

1. Site Monitor Dirty- Deployed Meter Before Cleaning
2. Site Monitor Clean- Deployed Meter After Cleaning
3. Field Probe Before- Calibrated meter Before Cleaning
4. Field Probe After- Calibrated meter After Cleaning
- ii. Enter Calibration Check data from "Calibration" data sheet
 1. Standard 1:
 - a. Standard- Enter 0 for air value
 - b. Reading- Enter air standard Pre-Calibration value
 2. Standard 2:
 - a. Standard- Enter second standard value
 - b. Reading- Enter second standard Pre-Calibration value
- c. pH:
 - i. Enter Fouling Correction data from "Fouling Check" data sheet
 1. Site Monitor Dirty- Deployed Meter Before Cleaning
 2. Site Monitor Clean- Deployed Meter After Cleaning
 3. Field Probe Before- Calibrated meter Before Cleaning
 4. Field Probe After- Calibrated meter After Cleaning
 - ii. Enter Calibration Check data from "Calibration" data sheet
 1. Standard 1:
 - a. Standard- Enter first standard value
 - b. Reading- Enter first standard Pre-Calibration value
 2. Standard 2:
 - a. Standard- Enter second standard value
 - b. Reading- Enter second standard Pre-Calibration value
 3. Standard 3:
 - a. Standard- Enter third standard value
 - b. Reading- Enter third standard Pre-Calibration value
- d. Dissolved Oxygen:
 - i. Enter Fouling Correction data from "Fouling Check" data sheet
 1. Site Monitor Dirty- Deployed Meter Before Cleaning **mg/l**
 2. Site Monitor Clean- Deployed Meter After Cleaning **mg/l**
 3. Field Probe Before- Calibrated meter Before Cleaning **mg/l**
 4. Field Probe After- Calibrated meter After Cleaning **mg/l**

All Dissolved Oxygen correction values should be developed as DO concentration data (i.e., mg/l) and not percentage of saturation. If percentage of saturation signal is desired this should be calculated from the fully processed concentration after the procedures in the record computation SOP (2.3) per Wagner et al. (2006).

- ii. Enter Calibration Check data from "Calibration" data sheet
 1. 100% Calibration Initial- Pre-Calibration **mg/l**
 2. 100% Calibration Initial Adjusted- Post-Calibration **mg/l**

3. Leave Manual field blank
- e. Turbidity (if applicable):
 - i. Enter Fouling Correction data from “Fouling Check” data sheet
 1. Site Monitor Dirty- Deployed Meter Before Cleaning
 2. Site Monitor Clean- Deployed Meter After Cleaning
 3. Field Probe Before- Calibrated meter Before Cleaning
 4. Field Probe After- Calibrated meter After Cleaning
 - ii. Enter Calibration Check data from “Calibration” data sheet
 1. Standard 1:
 - a. Standard- Enter first standard value
 - b. Reading- Enter first standard Pre-Calibration value
 2. Standard 2:
 - a. Standard- Enter second standard value
 - b. Reading- Enter second standard Pre-Calibration value
- (4) Complete 100% verification of data entered into QW_Ultimate sheet
 - a. Review each tab for accuracy with paper field data sheets
- (5) Save QW_Ultimate spreadsheet back to MIDN server (see section V.A. below) for use in data quality evaluations and record computation (SOP 2.3)

V. Data Storage

A. Folder Structure:

The folder structure below can be found on the server in the yearly monitoring folder at the following path Z:\Monitoring\WaterQuality\20XX. In each folder each park’s data will be maintained in a separate subfolder.

All data converted to an electronic format is maintained under the Database subfolder while all scanned data sheets are maintained under the Fieldforms subfolder.

- \ 03_Data – Stores all documentation of field data collection, electronic data, PDFs, photographs, and spatial data
 - \ Database – Stores all electronic documentation of the data collected during the field season.
 - \ Continuous
 - \ Annual_Reports
 - \ Aquarius_Change_List- Log of data editing activities
 - \ Aquarius_Data_Quality_Rating- Log of data quality ratings applied in Aquarius
 - \ Hobo_Formatted- Formatted HOB0 files
 - \ Hobo_Raw - raw log files from HOB0 loggers
 - \ Record_Processing_Review_Logs- Excel log files of record processing actions
 - \ Sonde_Formatted- formatted log files from deployed sondes
 - \ Sonde_Raw- raw log files from deployed sondes
 - \ Ultimate_USGS- Excel spreadsheets with data correction values

\FieldForms – Stores PDF scanned copies of field data sheets
 \Continuous
 \Calibration- scanned Calibration forms
 \Fouling_Check- scanned Fouling Check forms
 \Log_File_Comparison- scanned Log File Comparison forms
 \Predeployment_Check- scanned Pre-Deployment Check forms
 \Site_Visit_Field_Notes- scanned Site Visit Field Notes form

Literature Cited

Wagner, R. J., R. W. Boulger Jr, C. J. Oblinger, and B. A. Smith. 2006. Guidelines and standard procedures for continuous water-quality monitors-Station operation, record computation, and data reporting. U.S. Geological Survey Techniques and Methods. U.S. Geological Survey, Reston, VA.