**Great Bay (GRB) NERR Water Quality Metadata**

**April - December 2018**

**Latest Update: December 11, 2019**

**I. Data Set and Research Descriptors**

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**2) Entry verification –**

Deployment data are downloaded from the YSI EXO2 data loggers to a Dell Latitude E5540 laptop (IBM compatible). Files are exported from the KOR Software in an Excel File (.XLS) and uploaded to the CDMO where they undergo automated primary QAQC, automated depth corrections for changes in barometric pressure (cDepth parameter), and then become part of the CDMO’s online provisional database. All pre- and post-deployment data are removed from the file prior to upload. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve for secondary QAQC where it is opened in Microsoft Excel and processed using the CDMO’s NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, remove any overlapping deployment data, append files, and export the resulting data file for upload to the CDMO. Upload after secondary QAQC results in ingestion into the database as provisional plus data, recalculation of the cDepth parameter, and finally tertiary QAQC by the CDMO and assimilation into the CDMO’s authoritative online database. Where deployment overlap occurs between files, the data produced by the newly calibrated sonde are generally accepted as being the most accurate. For more information on QAQC flags and codes, see Sections 11 and 12. Tom Gregory and Lara Martin are responsible for data management. GRB archives all raw and QAQC’d files in Dropbox, in addition to back-up hard drives.

**3) Research objectives –**

YSI EXO2 data loggers, hereafter referred to as sondes, are deployed in Great Bay and in the Squamscott, Oyster and Lamprey Rivers as part of the National Estuarine Research Reserves' (NERRS) System-wide Monitoring Program (SWMP). The goal is to develop and maintain temporally intensive long-term datasets of physio-chemical parameters of water quality at locations that are representative of the Great Bay estuarine system. The Great Bay site is relatively unimpacted, while the three tidal river sites (Lamprey, Oyster and Squamscott) have large drainage basins and are impacted by both point (wastewater treatment plants) and nonpoint sources of pollution. In addition to establishing a baseline of water quality and increasing our understanding of the spatial and temporal variability of important indicators of estuarine water quality, the data is used by researchers in the analysis of physical and biological processes.

**4) Research methods –**

Sondes are programmed to obtain measurements of specific conductivity, salinity, dissolved oxygen mg/L and percent saturation, pH, temperature, depth, and turbidity every 15 minutes (Eastern Standard Time). Only EXO2 sondes were deployed in 2017-2018 although in previous years YSI model 6600 sondes were used. All are equipped with non-vented depth sensors.

Sondes are swapped every three to four weeks although CDMO protocols permit deployments up to 45 days. The sonde in the field is retrieved and a newly-calibrated replacement deployed immediately so there is little to no data gap. The 3-4 week deployment duration may be constrained by battery life (shorter life in colder waters) and fouling of the sensors during the warm summer months. The instruments are deployed continuously during ice-free seasons, except for brief periods when they are removed for cleaning, maintenance and recalibration.

YSI conductivity standard (YSI 3169 – 50 mS/cm) and Fondriest Environmental pH 7 and 10 buffers (FNBU5007-G and FNBU5010-G) are used for calibration. YSI turbidity standard (YSI 6073G – 124 FNU) is used to calibrate turbidity probes. Air-saturated water is used to calibrate percent dissolved oxygen. Temperature sensors are cross-checked every calibration against a NIST traceable certified thermometer. After a deployment, each sonde is brought back to the laboratory for a post-calibration check. Each sensor is run in its respective standard to determine whether calibration values have drifted during deployment.

During each sonde replacement, field measurements of temperature, salinity, specific conductance, and dissolved and percent oxygen are recorded using a handheld YSI PRO 2030 field meter.

Total Algae sensors (chlorophyll-a, in addition to blue-green algae/phycocyanin [BGA-PC]) and fluorescent dissolved organic matter (fDOM) sensors are now being deployed at 3 Great Bay reserve sites. Only chlorophyll-a data is QAQC’d using the CDMO macro. Blue-green algae and fDOM data are not included in the reported dataset but are available by contacting the reserve (these data are not QAQC’d). Along with the data the sensor calibration protocols are available.

Chlorophyll sensors are individually calibrated in µg/L units using a 2-point calibration method. Deionized water is used as a 0 standard and a Rhodamine WT dye as the second standard (0.625 mg/L Rhodamine WT dilution--200:1 dilution of the original liquid concentrate). The effect of temperature on the fluorescence of Rhodamine WT dye is accounted for when calibrating the EXO Total Algae sensor. The temperature correction coefficient of the Rhodamine WT standard solution is determined using a table provided by YSI. The true temperature of the standard is cross referenced to table values to obtain the corrected µg/L chl-a value for Rhodamine WT. The corrected fluorescence value is entered in the KOR software for calibration. We then post-calibrate the sensors in deionized water and standard to determine how much drift there is between deployments. Validation grab samples are collected monthly at each site. Although this data has not yet been analyzed, we hope to do a thorough assessment of the accuracy of this probe later in the year.

The Lamprey and Squamscott River sondes are deployed inside vertical piling mounted 4-inch PVC tubes with the sensors 0.5 meters off the bottom. The bottoms of the pipes have four 10-inch rectangular slots cut out to facilitate water flow.

The Great Bay sonde is deployed 0.5 meters off the bottom inside a 3-foot PVC tube that is attached to the stem of a 50-pound mushroom anchor. This pipe also has slots cut out.

Due to shallow depths and a narrow channel, the Oyster River sonde must be deployed with the least amount of vertical expression above bottom, 0.3 meters. This is achieved by deploying the sonde inside a 3-foot PVC tube that is attached to the stem of a 50-pound mushroom anchor, similar to the Great Bay site. This allows for the sonde to be stationed in an upright position but also makes the anchor less susceptible to dragging than the previous deployment method. The bottom of this pipe has many 1.5-inch diameter holes cut out for flow.

The Squamscott River sonde is telemetered via Nexsens transmitters using cellular technology. The transmissions are scheduled hourly and contain 4 data sets reflecting fifteen-minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The “real-time” telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO’s authoritative online database. Provisional and authoritative data are available at <http://cdmo.baruch.sc.edu>.

**5) Site location and character –**

**Site #1 Great Bay (GB)**

Location: Central area of Great Bay proper.

Coordinates are 43º 04' 20" N latitude and 70º 52' 10" W longitude.

Salinity range: 5-32 ppt (seasonally); 0-5 ppt from high to low tide.

Temperature range: -1º C to 24º C (seasonally); 0-3 (from high to low tide)

Depth: 6.5 meters at MLW

Tidal height: 2.7 meters

Bottom type: Mud and rock channel bottom

Tidal velocity: maximum 50 cm/sec

Watersheds: Squamscott, Lamprey and Winnicut Rivers plus smaller streams.

High tide influence from Little Bay and associated rivers

Pollutant influence: clean reference site

**Site #2 Squamscott River (SQ)**

Location: Mid channel of the Squamscott River at the Boston and Maine Railroad Bridge, Stratham, NH.

Coordinates are 43º 02' 30" N latitude and 70º 55' 20" W longitude

Salinity range: 0-30 ppt (seasonally); 5-20 ppt from high to low tide.

Temperature range: -1º C to 27º C (seasonally); difference of 0-5º between high and low tide

Depth: 3.5 meters at MLW

Tidal height: 2.7 meters

Bottom type: Mud/oyster channel bottom

Tidal velocity: maximum 50 cm/sec

Watersheds: Exeter River, adjacent marshes

Pollutant influence: Urban stormwater, agriculture, two municipal wastewater treatment plants, residential septic systems

**Site #3 Lamprey River (LR)**

Location: West bank of the tidal portion of the Lamprey River, approximately 300 m downstream of the dam at Route 108 in Newmarket, NH.

Coordinates are 43º 04' 48" N latitude and 70º 56' 04" W longitude.

Salinity range: 0 - 27 ppt (seasonally); difference of up to 15 ppt between high and low tides.

Temperature range: -1º C to 27º C (seasonally); difference of up to 5º C between high and low tides.

Depth: 3.5 meters

Tidal height: 2.7 meters

Bottom type: Mud/rock

Tidal velocity: maximum 40 cm/sec

Watershed: Lamprey River

Pollutant influence: Urban stormwater, adjacent marina, upstream and downstream wastewater treatment plants, upstream agriculture

**Site #4 Oyster River (OR)**

Location: In the center channel of the tidal portion of the Oyster River, approximately 300 m downstream of the head of tide dam adjacent to Jackson’s Landing in Durham, NH.

Coordinates are 43° 8' 2.40 N latitude 70° 54' 39.60 W longitude

Salinity range: 0 –32 ppt (seasonally); difference of up to 15 ppt between high and low tides

Temperature range: -1º C to 27º C (seasonally); difference of up to 5° C between high and low tides

Depth: 0.3 meters at MLW, 3 meters at highest high tides

Tidal height: 2.7 meters (maximum)

Bottom type: Mud

Tidal velocity: maximum 40 cm/sec

Watershed: Oyster River

Pollutant influence: Urban stormwater, mooring field and crew dock, downstream wastewater treatment plant, upstream agriculture, residential on-site sewage disposal.

SWMP Station Timeline

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station Code | SWMP Status | Station Name | Location | Active Dates | Reason Decommissioned | Notes |
| GB | P | Great Bay | 43º 04’ 20" N, 70º 52' 10" W | Current | NA | NA |
| LR | P | Lamprey River | 43º 04' 48" N, 70º 56' 04" W | Current | NA | NA |
| OR | P | Oyster River | 43.134º N, 70.911º W | Current | NA | NA |
| SQ | P | Squamscott River | 43º 02' 30" N, 70º 55' 20" W | Current | NA | NA |

**6) Data collection period –**

Great Bay data collection began July 24, 1995. This sonde was originally on a floating buoy,

approximately one meter below the surface.

Squamscott River data collection began July 1997.

Lamprey River data collection began May 1998.

Oyster River data collection began June 2000.

The instruments are removed from the water during the winter months due to non-navigable conditions caused by ice and the removal of channel markers. Icing is particularly severe in the rivers and is harmful to instruments, boats, and telemetry equipment.

**Great Bay Reserve Deployment Dates 2018**

Great Bay

Deploy date and time Retrieval date and time

04/10/2018 15:45 05/08/2018 12:30

05/08/2018 12:45 06/06/2018 10:15

06/06/2018 10:45 07/02/2018 14:00

07/02/2018 14:30 08/02/2018 09:45

08/02/2018 10:15 09/05/2018 14:45

09/05/2018 15:00 10/04/2018 08:45

10/04/2018 09:00 10/31/2018 11:15

10/31/2018 11:45 11/15/2018 11:30

11/15/2018 11:45 11/20/2018 11:30

Lamprey River

Deploy date and time Retrieval date and time

04/10/2018 13:15 05/08/2018 11:00

05/08/2018 11:30 06/06/2018 09:00

06/06/2018 09:15 07/02/2018 15:00

07/02/2018 15:15 07/31/2018 13:15

07/31/2018 13:30 08/28/2018 14:00

08/28/2018 14:30

09/24/2018 13:45

09/24/2018 14:00 10/23/2018 12:00

10/23/2018 12:30 11/12/2018 09:15

11/12/2018 09:30 12/03/2018 14:30

Oyster River

Deploy date and time Retrieval date and time

04/13/2018 12:30 05/17/2018 12:00

05/17/2018 12:30 06/19/2018 15:15

06/19/2018 15:45 07/16/2018 13:15

07/16/2018 13:45 08/14/2018 12:15

08/14/2018 12:45 09/13/2018 14:15

09/13/2018 14:45 10/10/2018 15:00

10/10/2018 15:15 11/07/2018 12:45

11/07/2018 13:15 11/08/2018 10:45

11/08/2018 11:15 11/20/2018 09:45

Squamscott River

Deploy date and time Retrieval date and time

04/17/2018 08:45 05/16/2018 14:00

05/16/2018 14:30 06/06/2018 10:00 (Batteries died 06/03/2018 17:45)

06/06/2018 10:15 06/11/2018 10:30

06/11/2018 10:45 07/10/2018 10:30

07/10/2018 11:00 08/06/2018 15:30

08/06/2018 16:15 09/04/2018 11:15 (Batteries died 09/03/2018 18:15)

09/04/2018 11:30 10/01/2018 15:45

10/01/2018 16:15 10/29/2018 13:15 (Batteries died 10/27/2018 17:30)

10/29/2018 13:45 11/15/2018 10:45

11/15/2018 11:00 12/05/2018 12:15

**7) Distribution –**

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data.  The NERRS retains the right to be fully credited for having collected and process the data.  Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used.  The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement.  The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons.  The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:

NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: <http://www.nerrsdata.org/>; *accessed* 12 October 2012.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page [www.nerrsdata.org](http://www.nerrsdata.org).  Data are available in comma delimited format.

**8) Associated researchers, projects, and data end-users**

As part of the SWMP long-term monitoring program, GRB NERR also monitors 15-minute meteorological along with monthly grab samples and diel sampling for nutrient data which may be correlated with this water quality dataset. These data are available at [www.nerrsdata.org](http://www.nerrsdata.org).

Submerged Aquatic Vegetation (SAV) research - Dr. David Burdick; Dr. Gregg Moore; Dr. Fred Short - Jackson Estuarine Laboratory. Supported by Piscataqua Region Estuaries Partnership and NH Department of Environmental Services.

Bathymetric modeling and tidal elevation studies conducted by the NOAA - Dr. Larry Mayer, UNH Center for Coastal Ocean Mapping. Supported by the UNH-NOAA Joint Hydrographic Center.

Oyster reef mapping and restoration - Dr. Ray Grizzle, Jackson Estuarine Laboratory. Supported by NH Fish and Game, the NOAA-UNH Joint Hydrographic Center and the Center for Coastal and Ocean Mapping.

EPA National Coastal Assessment Program - Dr. Stephen H. Jones, Jackson Estuarine Laboratory. Funded by the US-EPA.

Anadromous and juvenile fish population assessments - Cheri Patterson, NH Fish and Game Department and Great Bay NERRS. Supported by NH Fish and Game.

Oyster spawning and recruitment trends - The Nature Conservancy, University of New Hampshire, Great Bay NERR, NH Fish and Game utilize temperature and salinity data for predictions.

**II. Physical Structure Descriptors**

**9) Sensor specifications –**

Great Bay NERR deployed only EXO2 sondes this monitoring year. Most of the sondes and probes were manufactured in 2016 and 2017. The reserve is still using one EXO2 from 2013 and three from 2014 and several probes from similar time periods. Typically, the sondes are outfitted with the same set of sensors throughout the monitoring season. The reserve is now using chlorophyll and fDOM probes which are a part of the sensor configuration. The Oyster River sonde does not have chlorophyll or fDOM probes. Sondes are rotated between all the sites.

YSI EXO2 Sonde:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Wiped probe; Thermistor

Model#: 599827

Range: -5 to 50º C

Accuracy: ±0.2º C

Resolution: 0.001º C

Parameter: Conductivity

Units: milli-Siemens per cm (mS/cm)

Sensor Type: Wiped probe; 4-electrode cell with autoranging

Model#: 599827

Range: 0 to 100 mS/cm

Accuracy: ±1% of the reading or 0.002 mS/cm, whichever is greater

Resolution: 0.0001 to 0.01 mS/cm (range dependent)

Parameter: Salinity

Units: practical salinity units (psu)/parts per thousand (ppt). Values calculated using conductivity and temperature data

Model#: 599827

Sensor Type: Wiped probe

Range: 0 to 70 ppt

Accuracy: ±2% of the reading or 0.2 ppt, whichever is greater

Resolution: 0.01 psu

Parameter: Dissolved Oxygen % saturation

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 599100-01

Range: 0 to 500% air saturation

Accuracy: 0-200% air saturation: +/- 1% of the reading or 1% air saturation, whichever is greater.

200-500% air saturation: +/- 5% or reading

Resolution: 0.1% air saturation

Parameter: Dissolved Oxygen mg/L (Calculated from % air saturation, temperature, and salinity)

Units: milligrams/Liter (mg/L)

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 599100-01

Range: 0 to 50 mg/L

Accuracy: 0-20 mg/L: +/-0.1 mg/l or 1% of the reading, whichever is greater

20 to 50 mg/L: +/- 5% of the reading

Resolution: 0.01 mg/L

Parameter: Non-vented Level - Shallow (Depth)

Units: feet or meters (ft or m)

Sensor Type: Stainless steel strain gauge

Range: 0 to 33 ft (10 m)

Accuracy: +/- 0.013 ft (0.04 m)

Resolution: 0.001 ft (0.001 m)

Parameter: pH

Units: pH units

Sensor Type: Glass combination electrode

Model#: 599702 (wiped)

Range: 0 to 14 units

Accuracy: +/- 0.01 units within +/- 10° of calibration temperature, +/- 0.02 units for entire temperature range

Resolution: 0.01 units

Parameter: Turbidity

Units: formazin nephelometric units (FNU)

Sensor Type: Optical, 90º scatter

Model#: 599101-01

Range: 0 to 4000 FNU

Accuracy: 0 to 999 FNU: 0.3 FNU or +/-2% of reading (whichever is greater).

1000 to 4000 FNU +/-5% of reading

Resolution: 0 to 999 FNU: 0.01 FNU, 1000 to 4000 FNU: 0.1 FNU

Parameter: Chlorophyll/Total Algae (BGA-PC)

Units: micrograms/Liter (µg/Liter)

Sensor Type: Optical probe with mechanical cleaning

Model#: 599102-01

Range: 0 to 400 µg/Liter

Accuracy: Dependent on methodology

Resolution: 0.1 µg/Liter chl-a, 0.1% FS

Parameter: fDOM (fluorescent dissolved organic matter)

Units: Quinine sulfate units (QSU)

Sensor Type: Optical probe with mechanical cleaning

Model#: 599104-01

Range: 0 to 300 parts per billion (ppb) Quinine Sulfate equivalent (QSE)

Accuracy: Dependent on methodology

Resolution: 0.01 ppb QSE

Detection Limit: 0.07 ppb QSE

**Depth Qualifier:**

The NERR System-Wide Monitoring Program utilizes YSI data sondes that can be equipped with either vented or non-vented depth/level sensors.  Readings for both vented and non-vented sensors are automatically compensated for water density change due to variations in temperature and salinity; but for all non-vented depth measurements, changes in atmospheric pressure between calibrations appear as changes in water depth.  The error is equal to approximately 1.02 cm for every 1 millibar change in atmospheric pressure and is eliminated for vented sensors because they are vented to the atmosphere throughout the deployment time interval.

Beginning in 2006, NERR SWMP standard calibration protocol calls for all non-vented depth sensors to read 0 meters at a (local) barometric pressure of 1013.25 mb (760 mm/Hg).  To achieve this, each site calibrates their depth sensor with a depth offset number, which is calculated using the actual atmospheric pressure at the time of calibration and the equation provided in the SWMP calibration sheet or digital calibration log.  This offset procedure standardizes each depth calibration for the entire NERR System.  If accurate atmospheric pressure data are available, non-vented sensor depth measurements at any NERR can be corrected.

In 2010, the CDMO began automatically correcting depth/level data for changes in barometric pressure as measured by the Reserve’s associated meteorological station during data ingestion. These corrected depth/level data are reported as cDepth and cLevel and are assigned QAQC flags and codes based on QAQC protocols. Please see sections 11 and 12 for QAQC flag and code definitions.

**NOTE: Older depth data cannot be corrected without verifying that the depth offset was in place and whether a vented or non-vented depth sensor was in use. No SWMP data prior to 2006 can be corrected using this method.** The following equation is used for corrected depth/level data provided by the CDMO beginning in 2010:

((1013-BP)\*0.0102)+Depth/Level = cDepth/cLevel.

**Salinity Units Qualifier:**

In 2013, EXO sondes were approved for SWMP use and began to be utilized by Reserves. While the 6600 series sondes report salinity in parts per thousand (ppt) units, the EXO sondes report practical salinity units (psu). These units are essentially the same and for SWMP purposes are understood to be equivalent, however psu is considered the more appropriate designation. Moving forward the NERR System will assign psu salinity units for all data regardless of sonde type.

**Turbidity Qualifier:**

In 2013, EXO sondes were approved for SWMP use and began to be utilized by Reserves. While the 6600 series sondes report turbidity in nephelometric turbidity units (NTU), the EXO sondes use formazin nephelometric units (FNU). These units are essentially the same but indicate a difference in sensor methodology, for SWMP purposes they will be considered equivalent. Moving forward, the NERR System will use FNU/NTU as the designated units for all turbidity data regardless of sonde type. If turbidity units and sensor methodology are of concern, please see the Sensor Specifications portion of the metadata.

**Chlorophyll Fluorescence Disclaimer:**

YSI chlorophyll sensors (6025 or 599102-01) are designed to serve as a proxy for chlorophyll concentrations in the field for monitoring applications and complement traditional lab extraction methods; therefore, there are accuracy limitations associated with the data that are detailed in the YSI manual including interference from other fluorescent species, differences in calibration method, and effects of cell structure, particle size, organism type, temperature, and light on sensor measurements.

**10) Coded variable definitions –**

Sampling station: Sampling site code: Station code:

Great Bay GB grbgbwq

Lamprey River LR grblrwq

Oyster River OR grborwq

Squamscott River SQ grbsqwq

**11) QAQC flag definitions –**

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter’s associated flag column (header preceded by an F\_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that is missing and above or below sensor range. All remaining data are then flagged 0, passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

-5 Outside High Sensor Range

-4 Outside Low Sensor Range

-3 Data Rejected due to QAQC

-2 Missing Data

-1 Optional SWMP Supported Parameter

0 Data Passed Initial QAQC Checks

1 Suspect Data

2 *Open - reserved for later flag*

3 Calculated data: non-vented depth/level sensor correction for changes in barometric pressure

4 Historical Data: Pre-Auto QAQC

5 Corrected Data

**12) QAQC code definitions** –

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the deployment or YSI datasonde, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point, but some comment codes (marked with an \* below) can be applied to the entire record in the F\_Record column.

General Errors

GIC No instrument deployed due to ice

GIM Instrument malfunction

GIT Instrument recording error; recovered telemetry data

GMC No instrument deployed due to maintenance/calibration

GNF Deployment tube clogged / no flow

GOW Out of water event

GPF Power failure / low battery

GQR Data rejected due to QA/QC checks

GSM See metadata

Corrected Depth/Level Data Codes

GCC Calculated with data that were corrected during QA/QC

GCM Calculated value could not be determined due to missing data

GCR Calculated value could not be determined due to rejected data

GCS Calculated value suspect due to questionable data

GCU Calculated value could not be determined due to unavailable data

Sensor Errors

SBO Blocked optic

SCF Conductivity sensor failure

SCS Chlorophyll spike

SDF Depth port frozen

SDG Suspect due to sensor diagnostics

SDO DO suspect

SDP DO membrane puncture

SIC Incorrect calibration / contaminated standard

SNV Negative value

SOW Sensor out of water

SPC Post calibration out of range

SQR Data rejected due to QAQC checks

SSD Sensor drift

SSM Sensor malfunction

SSR Sensor removed / not deployed

STF Catastrophic temperature sensor failure

STS Turbidity spike

SWM Wiper malfunction / loss

Comments

CAB\* Algal bloom

CAF Acceptable calibration/accuracy error of sensor

CAP Depth sensor in water, affected by atmospheric pressure

CBF Biofouling

CCU Cause unknown

CDA\* DO hypoxia (<3 mg/L)

CDB\* Disturbed bottom

CDF Data appear to fit conditions

CFK\* Fish kill

CIP\* Surface ice present at sample station

CLT\* Low tide

CMC\* In field maintenance/cleaning

CMD\* Mud in probe guard

CND New deployment begins

CRE\* Significant rain event

CSM\* See metadata

CTS Turbidity spike

CVT\* Possible vandalism/tampering

CWD\* Data collected at wrong depth

CWE\* Significant weather event

**13) Post deployment information**

Great Bay

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Date**  **Deployed** | **DO% adjusted for BP** | **Baro. Press. mmHg** | **Depth m** | **Depth Offset m** | **SpCond 50.0 mS/cm** | **pH**  **7.0** | **pH 10.0** | **Turbidity 0 FNU** | **Turbidity**  **124.0** | **Chl 0 DI ug/L** | **Chl Rhodamine**  **ug/L** | **Rhodamine**  **Standard ug/L** |
| 04/10/2018 | 103.5 | 767.8 | 0.098 | 0.106 | 50.19 | 7.01 | 9.97 | 0.28 | 123.8 |  |  |  |
| 05/08/2018 | 98.8 | 764.3 | 0.058 | 0.058 | 49.5 | 7.10 | 10.12 | 0.04 | 122.8 |  |  |  |
| 06/06/2018 | 99.1 | 763.3 | 0.050 | 0.045 | 50.5 | 7.05 | 10.03 | 0.80 | 124.9 | 0 | 60.3 | 60.7 |
| 07/02/2018 | 99.7 | 762.5 | 0.035 | 0.034 | 49.75 | 7.12 | 10.10 | 0.20 | 123.8 | 0.04 | 59.6 | 61.1 |
| 08/02/2018 | 101.2 | 766.1 | 0.079 | 0.083 | 50.23 | 7.12 | 10.05 | 0.14 | 123.7 | 0.05 | 62.4 | 63.0 |
| 09/05/2018 | 99.8 | 760.2 | 0.010 | 0.0 | 49.92 | 6.97 | 10.02 | 0.50 | 124.3 | 0.1 | 67.1 | 66.2 |
| 10/04/2018 | 100.0 | 763.0 | 0.042 | 0.041 | 50.04 | 6.96 | 10.00 | 0.10 | 124.1 | 0.1 | 72.2 | 71.1 |
| 10/31/2018 | 102.1 | 772.6 | 0.168 | 0.171 | 50.18 | 7.02 | 10.04 | 0.10 | 124.2 | 0.04 | 75.0 | 73.6 |
| 11/15/2018 | 99.7 | 756.4 | -0.050 | -0.049 | 50.03 | 7.07 | 10.10 | 0.10 | 124.8 | 0.02 | 62.7 | 63.1 |

Lamprey River

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Date**  **Deployed** | **DO% adjusted for BP** | **Baro. Press. mmHg** | **Depth m** | **Depth Offset m** | **SpCond 50.0 mS/cm** | **pH**  **7.0** | **pH 10.0** | **Turbidity 0 FNU** | **Turbidity**  **124.0** | **Chl**  **0 DI ug/L** | **Chl Rhodamine**  **ug/L** | **Rhodamine**  **Standard ug/L** |
| 04/10/2018 | 101.6 | 767.8 | 0.106 | 0.106 | 50.20 | 7.12 | 10.20 | 0.02 | 125.9 |  |  |  |
| 05/08/2018 | 99.2 | 758.0 | -0.026 | -0.027 | 49.3 | 7.11 | 10.11 | 0.1 | **130.9** |  |  |  |
| 06/06/2018 | 99.6 | 763.5 | 0.049 | 0.048 | 50.3 | 7.02 | 10.02 | 0.2 | 123.8 |  |  |  |
| 07/02/2018 | 100.0 | 765.4 | 0.079 | 0.075 | 49.70 | 7.14 | 10.14 | 0.4 | 124.0 | 0.1 | 78.9 | 76.4 |
| 07/31/2018 | 100.8 | 758.9 | -0.014 | -0.015 | 50.1 | 7.15 | 10.10 | 0.04 | 123.7 | -0.08 | 59.8 | 59.8 |
| 08/28/2018 | 101.2 | 777.2 | 0.237 | 0.234 | 49.96 | 6.99 | 9.97 | 0.3 | **131.2** | -0.05 | 60.7 | 60.4 |
| 09/24/2018 | 100.0 | 760.2 | -0.021 | 0.003 | 50.13 | 7.00 | 10.02 | 0.3 | 124.8 | -0.02 | 71.5 | 69.4 |
| 10/23/2018 | 101.8 | 770.9 | 0.149 | 0.149 | 50.23 | 6.94 | 9.98 | 0.14 | 125.0 | 0.01 | 70.9 | 69.0 |
| 11/12/2018 | 99.6 | 749.4 | -0.153 | -0.143 | 49.92 | 7.01 | 10.02 | -0.03 | 123.2 | -0.04 |  |  |

Oyster River

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| **Date**  **Deployed** | **DO% adjusted for BP** | **Baro. Press. mmHg** | **Depth m** | **Depth Offset m** | **SpCond 50.0 mS/cm** | **pH**  **7.0** | **pH 10.0** | **Turbidity 0 FNU** | **Turbidity**  **124.0** | **Chl 0 DI ug/L** | **Chl Rhodamine**  **ug/L** | **Rhodamine**  **Standard ug/L** |
| 04/13/2018 | 100.3 | 766.2 | 0.082 | 0.084 | 49.67 | 7.16 | 10.12 | 0.0 | 120.7 |  |  |  |
| 05/17/2018 | **28.1** | 758.0 | -0.018 | -0.027 | 47.9 | 7.07 | 9.93 | **171.3** |  |  |  |  |
| 06/19/2018 | 99.3 | 760.7 | 0.010 | 0.009 | 48.26 | 7.08 | 10.05 | **4.8** | **102.5** |  |  |  |
| 07/16/2018 | 99.5 | 758.7 | -0.041 | -0.018 | 49.82 | 7.20 | 10.27 | 0.4 | 124.1 |  |  |  |
| 08/14/2018 | 100.4 | 767.3 | 0.110 | 0.099 | 50.23 | 7.15 | 10.06 | **5.3** | **96.6** |  |  |  |
| 09/13/2018 | 99.5 | 760.0 | 0.002 | 0.0 | 50.06 | 7.18 | 10.16 | 0.5 | 127.5 |  |  |  |
| 10/10/2018 | 98.7 | 757.2 | -0.040 | -0.039 | 50.25 | 7.05 | 10.06 | 0.2 | 124.1 |  |  |  |
| 11/08/2018 | 100.1 | 756.4 | -0.050 | -0.049 | 50.12 | 6.93 | 9.96 | 0.4 | 123.99 |  |  |  |

Squamscott River

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Date**  **Deployed** | **DO% adjusted for BP** | **Baro. Press. mmHg** | **Depth m** | **Depth Offset m** | **SpCond 50.0 mS/cm** | **pH**  **7.0** | **pH 10.0** | **Turbidity 0 FNU** | **Turbidity**  **124.0** | **Chl 0 DI ug/L** | **Chl Rhodamine**  **ug/L** | **Rhodamine**  **Standard ug/L** |
| 04/17/2018 | 100.2 | 766.4 | 0.091 | 0.087 | 49.5 | 7.04 | 10.03 | 1.1 | 121.3 | -0.04 | 75.2 | 78.6 |
| 05/16/2018 | 100.4 | 764.8 | 0.068 | 0.068 | 50.02 | 7.09 | 10.07 | 0.3 | **135.2** | 0.04 | 67.5 | 68.3 |
| 06/11/2018 | 99.0 | 757.1 | -0.032 | -0.040 | 49.7 | 7.00 | 9.99 | 0.4 | 122.1 | 0.03 | 61.1 | 60.8 |
| 07/10/2018 | 100.1 | 757.9 | -0.027 | -0.027 | 49.75 | 7.08 | 10.03 | 0.04 | 124.8 | -0.01 | 60.6 | 61.2 |
| 08/06/2018 | 100.7 | 763.3 | 0.035 | 0.045 | 50.14 | 7.09 | 10.02 | 0.14 | 123.1 | 0.1 | 68.9 | 70.8 |
| 09/04/2018 | 101.4 | 770.4 | 0.148 | 0.141 | 49.94 | 7.06 | 10.07 | 0.2 | 124.9 | 0.03 | 61.4 | 60.4 |
| 10/01/2018 | 99.9 | 759.7 | -0.014 | -0.005 | 49.98 | 7.05 | 10.08 | 0.27 | 124.7 | 0.1 | 70.4 | 71.4 |
| 10/29/2018 | 101.6 | 772.6 | 0.176 | 0.174 | 50.21 | 6.98 | 10.03 | 0.3 | 126.8 | 0.0 | 77.9 | 74.8 |
| 11/15/2018 | 101.0 | 763.4 | 0.045 | 0.046 | 49.99 | 7.02 | 10.02 | 0.06 | 123.4 | -0.01 |  |  |

**14) Other remarks/notes –**

**Turbidity anomalies – Biological**

This type of anomaly includes turbidity readings that are outside of the normal range or greatly elevated above background baseline and unrelated to increased sediment suspension or decreased water column clarity. We believe this data is real and not a sensor malfunction, although not reflective of actual water column turbidity. These extreme values are likely due to biological factors (e.g., fish, crabs, other marine organisms). Our general guideline for flagging single-point spikes which are ≥200 FNU and more than 10 times greater than the surrounding values is to flag the point suspect <1> or to reject <-3> and label it with a turbidity spike [STS] code.

**Turbidity anomalies - Suspension**

This type of anomaly includes turbidity readings that are either outside the normal range or greatly elevated above background baseline and related to flow or weather-induced suspension. We believe this data is real and not a sensor malfunction, although not reflective of actual water column turbidity. These values are likely due to floating organic matter (e.g., eelgrass, leaves, detritus) suspended in the water column. Our general guideline for flagging this data is to closely analyze readings that are over 200 FNU and more than 5 times the magnitude of the surrounding values and linked to wind or high/changing water currents. These readings may be declared suspect <1> or rejected <-3> and labeled with a turbidity spike [STS] code.

**Chlorophyll fluorescence anomalies**

Biofouling, floating detritus, and/or a disturbed bottom can cause chlorophyll fluorescence optical sensors to record values which are outside the normal environmental range. Data points over five times the magnitude of surrounding values may be flagged as suspect <1> and labeled with a chlorophyll spike [SCS] code. Additionally, sustained values over 100 µg/L are considered suspect or rejected unless unusual conditions at the site can be verified. Spikes that exceed 400 µg/L are rejected <-3> and labeled with the [SCS] code.

**Flagged data**

**All sites**

Significant rain events on April 16, 2018 (2.5 inches) and April 25-27, 2018 (1.6 inches) created noticeable patterns at many of the sites (LR, SQ, OR) in the days following the rain. Rainfall exceeding 1-2 inches over a couple days typically causes the specific conductivity and salinity in the riverine sites to drop to zero.

**Great Bay**

08/20/2018 16:15 - 09/05/2018 14:45 <0> <1> [GSM] (CWD) (CVT)

We believe the sonde was caught in a boat’s prop or pulled up and then dragged to a different location. The logger was moved approximately 400 meters. Depth decreased by 1.7 meters. Other data were not significantly affected as this site is 5-8 meters deep and well-mixed.

11/15/2018 11:45 - 11/20/2018 11:30 <1> [GSM] (CWD)

The sonde was deployed at an incorrect GPS point, approximately 20 meters away from its normal location. Depth increased by 0.6 meters. The sonde stayed at this location through the end of the deployment. Although corresponding data does not seem to be affected, all data has been labeled suspect.

**Lamprey River**

08/04/2018 11:15 – 08/09/2018 22:30 <0> [GSM] (CRE)

08/14/2018 06:15 – 08/18/2018 14:15 <0> [GSM] (CRE)

09/18/2018 13:30 – 09/22/2018 00:00 <0> [GSM] (CRE)

Aug 3-4 – Rained 2 inches.

Aug 7-8 – Rained 0.6 inches and there were heavy thunderstorms. Temperatures in the 90s. There was a heavy layer of foam on the river around the marina.

Aug 11-14 – Rained 1 inch.

Sept 18 – Rained 2.5-3 inches during a neap tide cycle.

For many days following these rain events, specific conductivity and salinity dropped to zero. Dissolved oxygen (% saturation and mg/L) tidal fluctuations were significantly dampened. pH dropped in response to the freshwater input.

10/27/2018 – 12/03/2018 <0> [GSM] (CRE)

Starting 10/27/2018 it began to rain.

Additionally, in the two weeks leading up to this period, temperatures had dropped from 16ºC to 6ºC.

11/5-8/2018 and 11/22-28/2018 there were king tides.

|  |  |
| --- | --- |
| **Date** | **Rainfall amount (inches)** |
| 10/27/2018 | 1.2 |
| 10/29/2018 | 0.4 |
| 11/1-3/2018 | 2.4 |
| 11/5-6/2018 | 0.7 |
| 11/9-10/2018 | 1.1 |
| 11/13/2018 | 1.2 |
| 11/15-16/2018 | 0.9 |
| 11/19-20/2018 | 0.8 |
| 11/26-27/2018 | 1.8 |

This combination of events impacted most parameters. Specific conductance and salinity fell to zero and remained that way until we pulled the sonde at the end of the season on 12/03/2018. The tidal variability in most other parameters became greatly muted or non-existent (pH, turbidity, chlorophyll, dissolved oxygen saturation and mg/L). The extreme amount of run-off and water flowing down the river, in conjunction with the king tides, raised the minimum sonde depth.

**Oyster River**

06/10/2018 03:45 – 06/19/2018 15:15 <-3> [SWM] (CBF)

During the 05/17/2018 deployment, the wiper on the central brush assembly fell off. This led to significant barnacle biofouling on the sensor faces. Dissolved oxygen and turbidity post-calibration values were very out of range (DO % 28.1 @ 99.7 and Turbidity FNU 171.3 @ 0). Therefore, we rejected data for each parameter from 06/10/2018 03:45 – 06/19/2018 15:15 (end of deployment).

07/11/2018 18:00 – 07/16/2018 13:45 <-3> [SWM] (CBF)

During the 06/19/2018 deployment, the wiper on the central brush assembly fell off. This led to biofouling on the sensor faces. Therefore, we rejected impacted data for turbidity from 07/11/2018 18:00 – 07/16/2018 13:45 and specific conductance and its dependent parameters (salinity, DO mg/L) from 07/13/2018 19:00 – 07/16/2018 13.45 (end of deployment).

07/16/2018 13:45 – 08/14/2018 12:15 <-3> [SSM] (CSM)

A pH/ORP replacement tip (Model 577613-02) was accidentally installed on our standard pH sensor (Model 577602). YSI Tech Support initially assured us that they would be compatible. The sensor pre- and post-calibrated slightly high and although the data is within range, the series pattern is dissimilar to surrounding deployments. The data lacks its typical variability. When we contacted YSI again, they told us that we needed to disable the ORP function for the sensor to work properly.

09/03/2018 12:00 – 09/13/2018 14:15 <1> <-3> [SPC] (CBF)

During the 08/14/2018 deployment, the wiper on the central brush assembly fell off. This led to biofouling on the sensor faces. Turbidity post-calibration was out of range (5.3 @ 0, 96.6 @ 124). Therefore, we rejected or labeled as suspect this period of turbidity data.

09/07/2018 03:30 – 09/13/2018 14:15 <1> [GSM] (CBF)

During the 08/14/2018 deployment, the wiper on the central brush assembly fell off. This led to light biofouling on the sensor faces. In addition, it rained 09/06/2018 (0.6 inches) and 09/10-11/2018 (1.5 inches) which normally causes decreased dissolved oxygen readings in the river. We suspect that the combination of the rain and biofouling may have decreased dissolved oxygen (% and mg/L). A similar pattern can be seen in response to a 09/18/2018 rain (2.5-3 inches) although in this case the logger was not fouled.

10/10/2018 15:15 – 11/20/2018 09:45 [GSM] (CWD)

When the sonde was deployed 10/10/2018 15:15, it was accidentally placed in a location 0.75 meters shallower than previous deployments. The logger stayed at this location through the end of the field season.

10/10/2018 – 11/07/2018 <1> [GSM] (CWD)

The incorrect depth of the sonde noted above may have caused 8 out-of-water events during this deployment, although depths, corrected for barometric pressure, do not indicate that this was the case. We suspect that the low salinity data recorded during these periods were due to the fresh water lens at the surface of the river.

10/27/2018 07:45 – 12:30 <1> [GSM] (CDB)

In this time period, wind speeds rapidly increased, reaching 10 m/s, as a low-pressure front moved in. The wind, in conjunction with the incoming tide, increased turbidity.

This deployment also exhibited large turbidity spikes.

<-3> and <1> [STS] (CSM), <-3> and <1> [STS] (CBF), <-3> and <1> [STS] (CRE)

There was significant rainfall 10/27/2018, 10/29/2018, 11/1-3/2018, and 11/5-6/2018. (See table above.) In addition, there were seventeen 1-2 cm crabs in the sonde guard when the logger was retrieved 11/07/2018. We hypothesize that the shallow placement of the sonde, in addition to the sediment suspended by rain, contributed to the turbidity spikes although the significant rainfall continued into the next deployment and the turbidity spikes did not. This leads us to believe that most of the elevated turbidity was due to the movement of the crabs.

During this same deployment, the central wiper malfunctioned and fell off although the turbidity values at the end of the 10/10/2017 deployment are only slightly elevated and match up fairly well with the beginning of the 11/07/2018 deployment suggesting that the biofouling on the turbidity probe face must have been minimal.

11/07/2018 13:15 – 11/08/2018 10:45 <0> [GSM]

The incorrect sonde was deployed at the station. Data collected is valid but the datalogger had extra sensors on it which belonged at a separate station. Upon retrieval, no post calibration was performed.

11/14/2018 10:30 – 13:30 <1> [GSM] (CIP)

11/14/2018 22:00 – 11/15/2018 02:45 <1> [GSM] (CIP)

During these 2 periods, the depth of the sonde at low tide, in combination with very low air temperatures and minor surface ice, created unusual patterns in most parameters. During the month of November 2018, the bay received significant rainfall creating very low salinity environments which led to increased freezing.

**Squamscott River**

06/03/2018 18:00 – 06/06/2018 10:00 <-2> [GPF]

Sonde batteries ran out of voltage at the Squamscott River station 06/03/2018.

Turbidity

08/27/2018 21:45 – 09/03/2018 18:00 <-3> (CBF)

Chlorophyll

08/27/2018 21:30 – 09/03/2018 18:00 <-3> (CBF)

Sensors and sonde guard were heavily fouled with bryozoans. Sensor faces were clean when sonde was retrieved and all post-calibrated within range.

09/03/2018 18:15 – 09/04/2018 11:15 <-2> [GPF]

Sonde batteries ran out of voltage at the Squamscott River station 09/03/2018.

10/27/2018 17:30 – 10/29/2018 13:15 <-2> [GPF]

Sonde batteries ran out of voltage at the Squamscott River station 10/27/2018.

Data may be missing due to equipment or associated specific probes not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NANs in the dataset stand for “not a number” and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.