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

**April – December 2017**

**Latest Update: November 12, 2018**

**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 were 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 –**

Datasondes are programmed to obtain measurements of specific conductivity, salinity, dissolved oxygen, percent saturation, pH, temperature, depth, and turbidity every 15 minutes (Eastern Standard Time). Only EXO2 sondes were used in 2017 although in previous years YSI model 6600 sondes were used. All are equipped with non-vented depth sensors. The instruments are deployed continuously during ice-free seasons, except for brief periods when they are removed for cleaning, maintenance and recalibration. Pre- and post-deployment calibrations are performed using the diagnostics menu of the YSI Kor software and QAQC procedures developed by NERR Research Coordinators and YSI engineers.

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.

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

Total Algae sensors (chlorophyll-a, in addition to either blue-green algae/phycocyanin [BGA-PC] or blue-green algae/phycoerythrin [BGA-PE]) and fDOM sensors are now being deployed at Great Bay reserve sites. Only chlorophyll-a data is QAQC’d using the CDMO macro. Blue-green algae and fDOM data are included in the reported dataset but have not been officially QAQC’d. Please contact the reserve for this data and sensor calibration protocols.

Chlorophyll sensors are individually, or gang 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 tables values to obtain the corrected µg/L chl-a value for Rhodamine WT. The corrected value is entered in the KOR software for calibration.

The post-calibration check is completed by running the sensor in deionized water to determine how far it has drifted from a 0 reading. We track carefully on calibrations to see how much drift there is between deployments.

In October 2017, grab samples were collected at sonde depth at the Great Bay, Lamprey River, and Squamscott River sites. Extracted chlorophyll values were in line with the sonde readings.

|  |  |  |  |
| --- | --- | --- | --- |
| Site | Date/Time | Sonde Chl-a µg/L | Extracted Chl-a µg/L |
| GRBLR | 07/19/2017 11:50 | 6.78 | 6.74 |
| GRBGB | 07/19/2017 15:13 | 6.65 | 8.32 |
| GRBSQ | 07/25/2017 09:06 | 21.13 | 31.70 |
| GRBLR | 08/01/2017 11:29 | 8.02 | 15.88 |
| GRBGB | 08/01/2017 12:17 | 5.29 | 6.26 |
| GRBSQ | 08/03/2017 16:00 | 14.68 | 16.34 |
| GRBGB | 08/14/2017 12:21 | 4.97 | 9.43 |
| GRBSQ | 08/15/2017 12:01 | 9.37 | 11.44 |
| GRBSQ | 08/28/2017 14:30 | 8.28 | 10.59 |
| GRBLR | 09/05/2017 13:16 | 4.41 | 4.95 |
| GRBGB | 09/05/2017 14:52 | 8.39 | 9.22 |
| GRBLR | 09/12/2017 09:55 | 2.81 | 4.11 |
| GRBGB | 09/12/2017 14:04 | 11.95 | 6.03 |
| GRBLR | 10/02/2017 08:57 | 3.46 | 11.10 |
| GRBGB | 10/03/2017 14:31 | 7.23 | 5.79 |
| GRBLR | 10/09/2017 12:30 | 3.39 | 4.65 |
| GRBLR | 10/17/2017 13:07 | 3.82 | 2.58 |
| GRBSQ | 10/23/2017 09:15 | 4.79 | 4.31 |
| GRBSQ | 10/31/2017 10:05 | 3.00 | 4.61 |
| GRBLR | 11/06/2017 11:50 | 5.14 | 1.64 |
| GRBGB | 11/06/2017 12:49 | 1.81 | 1.78 |
| GRBSQ | 11/20/2017 13:08 | 2.97 | 3.96 |
| GRBGB | 11/21/2017 11:30 | 2.18 | 1.33 |
| GRBLR | 11/21/2017 11:57 | 2.47 | 0.52 |
| GRBSQ | 12/04/2017 13:20 | 3.35 | 2.39 |

The Great Bay sonde is deployed 0.5 meters off the bottom in a PVC tube that is attached to the stem of a mushroom anchor.

The Lamprey and Squamscott River sondes are deployed inside piling mounted PVC tubes with the sensors 0.5 meters off the bottom.

Due to shallow depths and narrow channels, the Oyster River sonde must be deployed with the least amount of vertical expression above bottom. This was achieved by mounting the sonde inside a short PVC tube that was attached to the stem of a mushroom anchor. 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 sonde is deployed at 0.3 meters off the bottom.

Currently, none of the sites have telemetry.

**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.

**Primary and Secondary SWMP Stations**

Latitude and longitude for secondary SWMP sites are approximate. Sondes are deployed at these sites April/May through December.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |
| BR | S | Bellamy River | 43.15994,  -70.85350 | Current |  |  |
| CR | S | Cocheco River | 43.183891,  -70.837240 | Current |  |  |
|  |  |  |  |  |  |  |
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**6) Data collection period –**

Great Bay data collection began March 31, 2015 at 10:00.

Squamscott River data collection began March 31, 2015 at 10:15.

Lamprey River data collection began April 6, 2016 at 9:30.

Oyster River data collection began April 6, 2016 at 12:00.

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 2017**

Great Bay

Deploy date and time Retrieval date and time

04/24/2017 14:00 05/24/2017 11:30

05/24/2017 14:00 06/19/2017 15:15

06/19/2017 15:45 07/19/2017 09:15

07/19/2017 15:30 08/14/2017 12:00

08/14/2017 12:30 09/12/2017 10:30

09/12/2017 14:15 10/10/2017 07:30

10/10/2017 15:00 11/06/2017 12:45

11/06/2017 14:45 12/11/2017 13:45

Lamprey River

Deploy date and time Retrieval date and time

04/27/2017 14:15 05/25/2017 10:30

05/25/2017 10:45 06/19/2017 10:15

06/19/2017 10:30 07/19/2017 11:45

07/19/2017 12:00 08/15/2017 10:45

08/15/2017 11:00 09/12/2017 09:45

09/12/2017 10:00 10/09/2017 12:15

10/09/2017 12:30 11/06/2017 11:45

11/06/2017 12:00 12/07/2017 14:45

Oyster River

Deploy date and time Retrieval date and time

04/27/2017 13:15 05/25/2017 12:45

05/25/2017 13:15 06/19/2017 08:45

06/19/2017 09:15 07/12/2017 15:45

07/12/2017 16:00 08/07/2017 11:00

08/07/2017 13:30 09/04/2017 11:30

09/04/2017 12:00 10/02/2017 11:45

10/02/2017 12:00 10/30/2017 09:15

10/30/2017 09:45 11/21/2017 10:45

11/21/2017 11:00 12/11/2017 10:30

Squamscott River

Deploy date and time Retrieval date and time

04/24/2017 13:45 05/16/2017 11:00

05/16/2017 13:00 06/13/2017 09:30

06/13/2017 10:00 07/10/2017 11:15

07/10/2017 11:30 08/03/2017 15:45

08/03/2017 16:15 08/28/2017 14:15

08/28/2017 14:30 09/25/2017 08:00

09/25/2017 08:30 10/08/2017 23:30

10/23/2017 09:15 11/20/2017 10:15

11/20/2017 13:15 12/07/2017 08:00

**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 and projects** (link to other products or programs) **–**

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).

Evaluation of remote data acquisition technologies and advanced water quality sensors. Dr. Richard Langan, CICEET director, and Jeremy LeClair, U.N.H. Funded by CICEET.

Advanced optical monitoring technologies. Ru Morrison. Funded by Center for Ocean Observing and Analysis, U.N.H.

Smelt spawning studies. Kathy Mills, NH Fish & Game, and David Berlinsky, U.N.H. Funded by NOAA Office of Protected Resources via a sub-contract from Maine Department of Marine Resources

Comprehensive water quality, organic nitrogen and photosynthetically active radiation (PAR) monitoring studies – Dr. Jonathan Pennock, Jackson Estuarine Laboratory. Supported by the New Hampshire Estuaries Project

Eelgrass modeling studies - Dr. Fred Short, Jackson Estuarine Laboratory. Supported by the New Hampshire Estuaries Project and the New Hampshire Port Authority.

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.

Microbial source tracking studies using ribotyping - Dr. Stephen Jones, Jackson Estuarine Laboratory. Supported by NH DES, NHEP and CICEET

Lobster migration and behavior research - Dr. Winsor Watson and Dr. Hunting Howell, UNH Zoology Department. Ten years of studies supported by USDA and Sea Grant that track lobster abundance, movement and behavior in relation to physical and biological variables in the Great Bay Estuary.

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.

**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 or PE)

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

Deployment date SpCond pH 7 pH 10 DO% Turb 0 Turb 124

04/24/2017 49.67 7.11 10.08 101.2 1.23 127.6

05/24/2017 50.32 6.66 9.59 100.1 -0.24 124

06/19/2017 50.05 7.01 10.07 101.9 -0.01 125.24

07/19/2017 49.52 7.07 10.04 87.8 0.02 124.03

08/14/2017 49.72 7.05 10.04 100.8 0.30 Not collected

09/12/2017 50.13 7.05 9.97 99.7 0.22 125.12

10/10/2017 49.23 7.06 10.06 99.8 0.4 117.4

11/06/2017 49.91 7.08 10.08 100.2 0.33 124.63

Lamprey River

Deployment date SpCond pH 7 pH 10 DO% Turb 0 Turb 124

04/27/2017 50.6 7.05 10.10 100.7 -0.08 126.1

05/25/2017 50.6 7.13 10.07 100.6 0.03 123.8

06/19/2017 49.81 7.11 10.16 99.5 -0.20 119.0

07/19/2017 50.01 6.97 9.97 98.8 0.14 124.6

08/15/2017 49.75 7.12 10.08 100.0 0.55 Not collected

09/12/2017 50.15 7.09 10.02 99.7 0.08 123.8

10/09/2017 49.35 7.03 9.97 100.2 0.04 122.9

11/06/2017 50.09 7.02 10.08 100.8 0.40 125.98

Oyster River

Deployment date SpCond pH 7 pH 10 DO% Turb 0 Turb 124

04/27/2017 50.7 7.08 10.15 100.7 -0.71 132.4

05/25/2017 49.82 7.27 10.08 103.0 0.49 124.1

06/19/2017 50.72 7.15 10.18 101.6 0.06 124.46

07/12/2017 49.82 7.03 10.05 98.9 0.28 124.0

08/07/2017 50.1 7.05 10.01 101.4 0.20 125.8

09/04/2017 49.76 6.98 9.98 101.0 0.11 124.9

10/02/2017 49.95 7.08 9.97 97.5 0.10 123.1

10/30/2017 50.34 7.08 10.10 100.6 0.02 126.83

11/21/2017 49.92 7.11 10.07 100.4 0.01 123.15

Squamscott River

Deployment date SpCond pH 7 pH 10 DO% Turb 0 Turb 124

04/24/2017 49.89 7.09 10.11 101.5 -0.31 123.0

05/16/2017 49.9 7.19 10.09 100.1 -0.09 123.9

06/13/2017 49.95 7.16 10.10 101.5 -0.11 117.83

07/10/2017 49.94 7.08 10.11 99.9 0.01 128.76

08/03/2017 49.97 7.02 10.08 101.9 0.13 124.18

08/28/2017 49.87 7.10 10.04 100.8 0.35 125.04

09/25/2017 49.97 7.05 9.99 100.7 0.89 122.5

10/23/2017 49.82 7.03 10.04 101.0 0.70 125.3

11/20/2017 49.99 7.11 10.10 100.6 0.5 124.70

**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. A negative chlorophyll data point is flagged <-3> [SNV] according to CDMO flagging rules. 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.

**All sites**

Significant periods of rain between April 25 and June 6 created noticeable patterns at many of the sites. Rainfall exceeding 1-2 inches over a couple days typically causes the specific conductivity/salinity in the riverine sites to drop to zero.

May 14 – June 6 - Approximately 4-5 inches of rain fell. This was most visible in Great Bay (DO% and mg/L) and Lamprey River (pH, SpCond, salinity, turbidity, DO% and mg/L), Oyster River (SpCond, salinity)

Most stations, in particular Lamprey River, show unusual patterns in many parameters (pH, SpCond, salinity, DO % saturation and mg/L) October 25 through November 5. Three to four inches of rain fell during this period. In addition, there were 35 mph winds, with gusts up to 56 mph.

**Great Bay**

08/10/2017 11:30 – 08/14/2017 12:00 (end of deployment)

Wiper fell off and sonde was heavily fouled with algae and bryozoans when retrieved. Turbidity, chlorophyll, DO% saturation and mg/L data were labeled suspect or rejected. DO% post calibrated out of range (87.8% post/100.4% true).

09/03/2017 07:45 – 09/04/2017 01:00 [SCS]

Chlorophyll readings elevated. Data rejected. Rainfall during this period 0.9 inches, 20 – 30 mph winds. Sediment and organic matter from the bottom of the bay were likely suspended in the water column.

Throughout the dataset there are individual and time series data of high chlorophyll readings (~15-30 µg/L) that we believe are not representative of true water column chlorophyll biomass but rather of suspended organic matter or sediment from the bay bottom. There is often a corresponding rise in turbidity which reinforces our hypothesis. There are no signs of sensor malfunctions so it was decided not to flag this data as suspect or rejected. This is the first year we have collected chlorophyll data on a large-scale and anticipate that we will have a better understanding of trends and variability after another collection season.

**Squamscott**

04/24/2017 13:45 – 05/16/2017 11:00 (GSM, CWD)

During a sonde swap on 05/16/2017 11:15, we discovered the pipe had slid down to the bottom of the piling. The logger was hanging above the bolt in the bottom of the tube. The pipe was reattached 5/16/2017 13:00 at the correct depth. This leads us to believe that for the first deployment 04/24/2017 13:45 through 05/16/2017 11:00, the sonde pipe may have been attached to the piling at a lower point than normal which caused the increased depth readings.

05/28/2017 14:45 – 06/09/2017 10:30 (GSM, CWD, CVT)

On 05/28/2017 14:45 the depth of the logger increased 0.5 meters. We think the sonde was pulled up by a non-staff member and when returned to the water was not put in the pipe. It hung outside the pipe collecting data until 06/09/2017 10:30 when it was pulled up for maintenance. When returned to the sonde tube and its correct depth 06/09/2017 10:45, it was higher in the water column, thus the decreased depth measurements. For this period, the data was not collected per SWMP standard operating procedures.

Most of the data collected when the logger was at the wrong depth, 04/24/2017 13:45 - 05/16/2017 11:00 and 05/28/2017 14:45 - 06/9/2017 10:30 doesn’t seem that unusual. There was less variability in dissolved oxygen (% and mg/L) and temperature because the sonde was closer to the bottom thus less subject to tidal fluctuations. It also appears that the deeper location may have contributed to slightly depressed temperatures.

Sonde batteries ran out of voltage at the Squamscott River station 10/08/2017. There was no data collected from 10/08/2017 24:00 through 10/23/2017 09:00.

Deployment period: 11/20/2017 through 12/07/2017 – This deployment has many turbidity and chlorophyll spikes. There was only occasional rain and moderate winds throughout these weeks. Sonde when retrieved was clean although logs indicate a lot of loose algae and eelgrass present in and around the sonde. In addition, many of the spikes and elevated readings occurred when the tide was approaching low or starting to flood. The change in water direction may have temporarily stirred up algae and eelgrass from the bottom causing increased turbidity and chlorophyll. This site is surrounded by a very shallow area and as the tide starts to ebb, organic matter coming off the mudflat passes by the sonde. Much of this data was labeled suspect or rejected.

**Oyster River**

08/25/2017 05:30 – 08/31/2017 00:00 (CSM)

There are six instances in this period where on an ebbing tide, dissolved oxygen measured <4 mg/L. There pattern shows a rapid decrease in dissolved oxygen and then a dramatic 15-minute point rebound, often a 20-40% jump. This is a shallow site and we believe that as the warmer, super-saturated water slowly recedes from the mudflats, it may temporarily stagnate around the sensors and thus the dissolved oxygen decreases. Once the tide recedes further, the river water is contained in the deeper channel where the sonde is located and as the current begins to increase, the low dissolved oxygen water is quickly washed away and values jump back to normal.

This tidal pattern is consistent throughout most of this deployment although dissolved oxygen data does not always drop to such low levels.

09/20/2017 03:00 – 09/25/2017 19:15 (CSM)

There are nine instances in this period where on an ebbing tide, dissolved oxygen measured <4 mg/L. There pattern shows a rapid decrease in dissolved oxygen and then a dramatic 15-minute point rebound, often a 20-40% jump. This is a shallow site and we believe that as the warmer, super-saturated water slowly recedes from the mudflats, it may temporarily stagnate around the sensors and thus the dissolved oxygen decreases. Once the tide recedes further, the river water is contained in the deeper channel where the sonde is located and as the current begins to increase, the low dissolved oxygen water is quickly washed away and values jump back to normal.

This tidal pattern is consistent throughout most of this deployment although dissolved oxygen data does not always drop to such low levels.

10/2/2017 12:45 - 10/05/2017 23:30 [SWM]

There were numerous wiper malfunctions in this period. Most did not affect the data. The specific conductivity probe was most affected by the incorrectly parked wiper. This caused a dramatic decrease in a single 15-minute reading and then a return to normal values.

Data are 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.

Great Bay Reserve also had 9 non-SWMP sites in 2017. Please contact the reserve for data, calibration records, and site descriptions. See link for more information on all additional monitoring sites

https://scholars.unh.edu/cgi/viewcontent.cgi?article=1036&context=prep

UPR – Upper Piscataqua River

LPR – Lower Piscataqua River

SF – Salmon Falls

LB/SFDP – Little Bay (mouth of the Oyster River)

GW/GB81 – Great Bay West

CM – Coastal Marine Lab

HH – Hampton Harbor

