WELLS (WEL) National Estuarine Research Reserve
Provisional Water Quality Metadata
January-December 2017
Latest Update: December 10, 2018

## I. Data Set and Research Descriptors

### 1) Principal investigator(s) and contact persons:

Address:
Wells NERR, 342 Laudholm Farm Road Wells, ME 04090
Phone: (207)646-1555
FAX: (207)646-2930

Contact Persons:

Dr. Jason Goldstein
E-mail: jgoldstein@wellsnerr.org
Phone: (207) 646-1555 ext.136

Jeremy Miller, Research Associate
E-mail: jmiller@wellsnerr.org
Phone: (207) 646-1555 ext. 122

### 2) Entry verification –

Deployment data are uploaded from the YSI data logger to a Personal Computer (IBM compatible). Files are exported from EcoWatch in a comma-delimited format (.CDF) , EcoWatch Lite in a comma separated file (CSV) or KOR Software in an Excel File (.XLS) and uploaded to the CDMO where they undergo automated primary QAQC; automated depth/level corrections for changes in barometric pressure (cDepth or cLevel parameters); and 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 cDepth or cLevel parameters, 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 is generally accepted as being the most accurate. For more information on QAQC flags and codes, see Sections 11 and 12.

### 3) Research objectives:

The Webhannet River estuary is located in proximity to heavily used beaches in Wells, Maine. It has a shoreline that is highly developed with residential and commercial structures. The estuary receives water from a 14 sq. mi. watershed that is well forested. We are measuring variations in hydrologic variables in the Webhannet River estuary at the Head of Tide and at the Inlet. Data from Head of Tide will integrate surface and ground water inputs (from both point and non-point sources) from the freshwater watershed into the estuary. Data from the Inlet will integrate surface and ground water inputs from the freshwater watershed and the estuarine watershed. Differences in data between the Head of Tide and the Inlet will

indicate inputs from the estuarine portion of the watershed (on the ebb tide), and inputs from the Gulf of Maine on the flood tide. The instruments will track runoff events via salinity, and will measure pollutant-carrying sediment particles via turbidity. Our working hypothesis is that the freshwater watershed is the primary source of sediment and therefore potential NPS pollutants in the estuary. These two variables will indicate the potential for non-point source pollutants to enter the estuary, and whether they are of upland, estuarine, or Gulf of Maine origin. Other variables measured by the data loggers (DO, temperature, pH, specific conductivity, and water level) will provide important baseline data to track changes in the estuary's physicochemical parameters over the long term. These variables can be affected by changes in human water use, and by natural or human induced changes in Inlet and river channel morphology, climate, and organic loadings. The Inlet site is heavily impacted at the Wells Harbor dock and is our long-term monitoring site. The Head of Tide site is relatively un-impacted, located just east of the US Route One Bridge, and is our roving site. We also collect data at the Skinner Mill site (SM) which acts as the head of tide site for the Little River/Merriland river estuary and at the mouth of the Little River (LM) to have comparative data for a less developed estuary.

**4) Research methods:**

The Wells NERR YSI monitoring program began in April 1995 at one site (Head of Tide site-HT) and May 1995 at a second site (Inlet site-IN) in the Webhannet River estuary. Two additional sites were added in 2002, Mile Road (ML) site began in March in the Webhannet River estuary and Little River Mouth (LM) in April in the Merriland/Branch/Little River Estuary. For 2004, the Mile Road (ML) site was eliminated and a new site at Skinner Mill (SM) in the Merriland/Branch/Little River Estuary was added. All data loggers have 1/4 inch black vexar mesh wrapped on the outside of the probe protective housing (using rubber bands) of the sonde guard to prevent fouling and unwanted animals. All deployment structures (PVC tubes) described below, are labeled with the Wells NERR information.

A Sutron Sat-Link2 transmitter was installed at the Skinner Mill (welsmwq) station on 5/30/2006 and transmits data to the NOAA GOES satellite, NESDIS ID #3B035008. The transmissions are scheduled hourly and contain four (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.

A YSI/Xylem STORM telemetry system was installed at the Inlet (welinwq) station on 01/15/2014 and transmits data to the NOAA GOES satellite, NESDIS ID #3B04A2B8. The transmissions are scheduled hourly and contain four (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.

*IMPORTANT CHANGE TO ALL SITES: In 2004, the YSI Extended Deployment System was used for all deployments. This system consists of a small brush that sweeps all the probes (except for depth) prior to each reading, greatly reducing the problem of biofouling. The Extended Deployment System is reflected in the "EDS" in the sonde model number.

*IMPORTANT CHANGE TO ALL SITES: As of 2014 all sites were upgraded to the EXO2 datasondes and the use of 6600 series sondes for SWMP data collection was discontinued.

* IMPORTANT CHANGE TO THE SKINNER (SM) SITE:
On 5/30/2006 the location of the Skinner Mill (SM) was changed to better reflect a head of tide and head of estuary scenario. The site was moved approximately 100 meters downstream from the original site

described in 2004-5 metadata. In addition, a Sutron Sat-Link2 transmitter was installed at this station, and transmits data to the NOAA GOES satellite, NESDIS ID #3B035008. The transmissions are scheduled hourly and contain four (4) datasets reflecting fifteen minute data sampling intervals. The telemetry data is "Provisional" data and not the "Authentic" dataset used for long term monitoring and study. This data can be viewed by going to http://cdmo.baruch.sc.edu."

* IMPORTANT INFORMATION PERTAINNING TO THE INLET (IN) SITE:
The Inlet site (IN) deployment methods are different than the other sites (SM, HT, LM). A 23 foot, 4 inch diameter high grade PVC tube was installed against a dock piling. Four steel flat bars with bolts were used to attach this 23 foot PVC tube against the dock piling. A 3 by 1.5 inch PVC transducer was glued on the inside bottom of the PVC tube to allow the sonde to sit exactly 1.0 meter (3.28 ft) off the bottom. Several vertical holes, representative of the sonde guard, were cut out the circumference near the bottom of the PVC pipe to allow water flow to the probes. An "L" shaped steel bar with two end-holes is placed through two created slits about a half of foot from the top of the PVC tube. A stainless steel wire (1/16") is attached to the sonde bail using two stainless steel clips; and to one end of the "L" shaped steel bar for sonde deployment and retrieval. A marine lock is attached through the other end of the "L" shaped steel bar to hold the bar, wire, and sonde in place and for security. A PVC threaded cap screws in to the threaded top of the PVC tube, also for security. A hole was created in the PVC cap to allow the sonde to hook up with the telemetry unit using the 50 foot vented cable. The telemetry unit was removed in 2004 and is no longer in service at this site.

All other sites, Head of Tide (HT), Little River Mouth (LM), and Skinner Mill (SM) are deployed similarly to each other as of 5/30/2006. These sites use a 5 foot, 4 inch diameter, high grade PVC tube. The PVC tube is attached to a 12 foot, heavy steel sign post using a stainless steel bolt at the bottom of the tube, a stainless steel cable wrap at the top, and several thick electrical cable ties in between. The steel sign post was pounded in about 6 feet into the river bottom, such that the bottom of the PVC tube was flat on the river bottom. The PVC tube has one 3 by 1.5 inch PVC transducer glued on the inside bottom of the PVC tube to allow the sonde to sit exactly at a certain height off the bottom (see below). Several vertical holes, representative of the sonde guard, were cut out the circumference near the bottom of the PVC pipe to allow water flow to the probes. An "L" shaped steel bar with two end-holes is placed through two created slits about a half of foot from the top of the PVC tube. A stainless steel wire (1/16") is attached to the sonde bail using two stainless steel clips; and to one end of the "L" shaped steel bar for sonde deployment and retrieval. A marine lock is attached through the other end of the "L" shaped steel bar to hold the bar, wire, and sonde in place and for security. A flotation buoy is tied to the PVC tubes incase the deployment structure ever gets dislodged. The deployment depth for these sites is such that the probe-end of the data logger is secured 0.15 meters (6 inches) off the bottom.

Deployment and Data Intervals:
Four to five week variable sampling periods were chosen for all data sondes due to probe fouling, Sensor drift, limited battery power, and to minimize risk of lost data in the event of a malfunction. Measurements of temperature, specific conductivity, salinity, percent saturation, dissolved oxygen, depth, pH, and turbidity are recorded at 15 minute intervals throughout the deployment period.

Calibration and Standards Used:
After the deployment period, the data logger is brought back into the Wells NERR Laboratory for downloading, cleaning, and calibration. These procedures are carried out to the methods described in the YSI Operating Manual. Calibration standards are used for specific conductivity (10 mS/cm), pH (buffer solutions of pH 4, 7, and 10), and turbidity (126 NTU). All calibration standards are purchased from YSI. Conductivity and turbidity standards are purchased from YSI, Inc. During periods when we have an idle YSI logger, the deployments are continuous (retrieved logger is immediately swapped with a newly deployed logger). If no idle logger is available (for example, it is away for repair), after approximately 6-24 hours of down time for cleaning, maintenance and recalibration, the YSI Data logger is redeployed for another sampling period.

QA/QC of Instruments:
At each deployment and retrieval, a YSI Model PRO2030 handheld unit collects temperature, DO mg/L, DO %, and salinity. These parameters are recorded on the calibration/deployment/retrieval data sheets and compared to the sonde data. In addition, at the end of each deployment, the data is immediately downloaded and a graph viewed of the data to look for periods of missing or anomalous data. "Post-calibration" data (using calibration standards) are also recorded, to verify that the probes are still measuring accurately after retrieval. Wells NERR staff follows all post-deployment procedures outlined in the CDMO's Water Quality Monitoring SOP.

**5) Site location and character**

The Wells National Estuarine Research Reserve is located in York County, within the Town of Wells, on the coast of southern Maine and faces the Atlantic Ocean. The Wells NERR is approximately 31 km (20 miles) south of Portland, Maine and 110 km (70 miles) north of Boston, Massachusetts. The Reserve encompasses 1,690 acres along the Gulf of Maine coastline of tidally-flushed wetlands, riparian and transitional upland fields and forests within the Little River Estuary and the larger Webhannet River Estuary. Both estuaries arise in the sandy glacial outwash plain about eight miles inland. Both rivers empty into Wells Bay, a sandy basin stretching for approximately ten miles along the Atlantic coast. Bordering each river's Inlet are double spit barrier beaches attached to the mainland. The backbarrier system in the Webhannet River Estuary is approximately 5 sq. km and is composed of large intertidal marshes (predominantly S. patens and S. alterniflora), intertidal sand and mud flats, and tidal channels. The watershed for the Webhannet River estuary covers an area of 35 sq. km and has a total of 6 streams, brooks or creeks, which enter the estuary. These tributaries flow across sand and gravel deposits near the headwaters and the impermeable sandy muds of the Presumpscot Formation in the lower reaches. The watershed for the Little River estuary covers an area of 84 sq. km and has a total of 2 tributaries. The backbarrier system in the Little River Estuary is approximately 2.51 sq. km and is composed of large intertidal marshes (predominantly S. patens and S. alterniflora), intertidal sand and mud flats, and tidal channels. The Webhannet River is connected to the ocean via Wells Inlet, which has a spring tidal prism of 28,200,000 cub. m (Ward 1993).

The Little River is connected to the ocean by an unstructured, double spit system and is one of the few tidal Inlets along the southern Maine coast that is not stabilized by either natural outcrops or artificial jetties. The force and volume of tidal action affect the salinity level of both rivers. In the Wells region, the annual mean wave height is almost 20 inches. These estuarine systems are dominated by semi-diurnal tides having a range of 8.5 to 9.8 feet. The volume of freshwater influx into both estuaries is moderate to low (on the order of 0.5 cubic meters/second), especially in the summer, because of the rivers' relatively small drainage areas and the presence of deep glacial deposits. The relatively low flows from these two rivers taken in with the 20 inch per year average runoff of the area surrounding the estuaries combine to form a fresh water flow which is dwarfed by tidal flushing. Twelve-foot tides dwarf the freshwater flow into the Webhannet estuary, which has a drainage area of 14.1 square miles. The Merriland River and Branch Brook meet south of Route 9 to form the Little River which drains an area of 10.75 sq. miles. The Webhannet estuary, fed by both Blacksmith and Depot Brooks, is adjacent to the harbor and greatly developed land. It offers a valuable opportunity for comparison with the relatively pristine Little River estuary. The land use of the Webhannet estuary include a total of 15% for wetland, fresh water, and tidal marsh; a total of 63.7 % for woodland; and a total of 18.6% for developed land compared to a total of 5.7% development in the Little River estuary (WNERR RMA 1996; Holden 1997).

The following information regarding annual weather patterns in the area was supplied by Maine State Climatologist Professor Gregory A. Zielinski extracted from "Monthly Station Normals of Temperature, Precipitation, Heating and Cooling Degree Days 1971-2000", Climatography of the United States No. 81, National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC. and "Daily Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1971-2000",

Climatography of the United States No. 84: "Average monthly temperatures range from 21.6F in January to 66.7F in July with daily highs averaging just below freezing in January and lows around 11F. Daily highs in July average around 76F and daily lows around 57F. The sea breeze often keeps daily highs lower during the summer than areas inland. Annual average temperature is 44.6F. Annual precipitation is 47.07 inches, including the water equivalent of snowfall, with monthly averages ranging from 3.01 inches in July to 4.77 inches in October. August receives just 3.02 inches on average. Annual snowfall is around 66 inches." According to Zielinski, "cool ocean temperatures keep down the number of afternoon showers and especially thunderstorms resulting in low summer precipitation amounts."

There are two sampling sites in the Webhannet River estuary. These are located at the Head of Tide (HT) and at the Webhannet Harbor Inlet (IN). The tidal range at each of these sites is 2.6-2.9 meters.

The Head of Tide site (43 deg 17' 54.05" North, 70 deg 35' 13.54" West) is located 4 miles south of the Wells Reserve, just downstream of the Webhannet Falls (freshwater) and 10 feet east of U.S. Route One. U.S. Route One is used heavily by traffic all year, especially during the summer tourist months. This site has soft mud, sand, and a rocky substrate, and the low and high tide depth is relatively shallow. Depth at mean high water is 1.1 meters. Max and min measured depths are 0.2 to 1.6 meters, giving a max tidal range of 1.4 meters. The salinity range here is 0-31 ppt, with a mean of 3.6 ppt. These headwaters of the Webhannet are relatively undeveloped. This site is located just 10 feet east of the U.S. Route One bridge, and is our roving site.

The Inlet site is located 1.5 miles south of the Wells Reserve, at the Wells Harbor pier (43 deg 19' 12.32" North, and 70 deg 33' 48.39" West). The mouth of the Webhannet estuary forms an extensive wetland/salt marsh area which is surrounded by development. Wells Harbor, which was most recently dredged in 1971, has moorings for approximately 200 commercial fishing and recreational boats. The mouth of the river flows between two jetties to the Atlantic Ocean. This channel was dredged in 1974. This site has a predominately sand substrate and is characterized by strong current during incoming and outgoing tides. Max and min measured depths at the Inlet site are 1.2 to 5.9 meters, giving a max tidal range of 4.7 meters. The maximum depth of the Inlet site is 6.8 meters. The salinity range here is 7-35 ppt, with a mean of 31 ppt. The Inlet site is heavily impacted at the Wells Harbor dock and is our long-term monitoring site.

The Skinner Mill (SM) site is located approximately 100 meters downstream from the intersection of the Merriland River (tributary to Merriland/Branch/Little River estuary) and Skinner Mill Road (at 43 deg 20' 40.96" north and 70 deg 32' 57.18" West). This site is approximately 70 meters downstream from the Watershed Evaluation Team (Educational water quality program at Wells NERR) site L5. Substrate is mud/sand bottom, salinities range from 0 ppt on low or outgoing tides and as high as 27ppt on high tides. Max and min measured depths are 0.1 to 1.9 meters, giving a max tidal range of 1.8 meters. Depth at mean high water is 1.3 meters. Data prior to 5/30/2006 is from the original SM site located approximately 70 meters upstream from the current site, which is approximately 20-30 meters beyond the head of the estuary where mixing between fresh and marine waters occur. Please see the 2005 Water quality metadata for a better description of the original site.

The Little River Mouth site is located 0.4 miles from the Wells Reserve. Due to problems with heavy sediment movement in the Inlet of the Little River, we were forced to relocate the site (see 2002 metadata). We designated a new location for the 2003 sampling season, and it has remained since then. It is located just off the bank of the marsh, in the main channel of the river (43 deg 20' 24.55" North, and 70 deg 32' 26.17" West). The first location attempted in 2002 (N 43 deg 20.176 Latitude, W 70 deg 32.497 Longitude) was located in the main channel of the river, just inland of a spit, beside a bank. The second location attempted in 2002 (N 43 deg 20.083 Latitude, W 70 deg 32.585 Longitude) was located 1/8 mi. southwest of the first site, within an Inlet, just inland of a spit. The second site was located in an area of much lower current than the first site and often drains completely during low tides. It was also placed within a pool next to incipient low marsh peat that retains calm water during low tides. Max and min measured depths at this site are 0.3 to 2.4 meters, giving a max tidal range of 2.1 meters. The Little River sites exist in a shallow and relatively

pristine system with a sandy to mud bottom and a salinity range of 0-32 ppt. There are two major freshwater inputs, the Merriland and Branch Brook Rivers, which converge to form the Little River.

SWMP Station Timeline

| Station Code | SWMP Status | Station Name | Location | Active Dates | Reason Decommissioned | Notes |
|---|---|---|---|---|---|---|
| welhtwq | P | Head of Tide | 43° 17' 54.05 N, 70° 35' 13.54 W | 04/01/1995 00:00 - current | NA | NA |
| welinwq | P | Inlet | 43° 19' 12.32 N, 70° 33' 48.39 W | 05/01/1995 00:00 - current | NA | NA |
| wellmwq | P | Little River Mouth | 43° 20' 24.55 N, 70° 32' 26.17 W | 04/01/2002 00:00 - current | NA | NA |
| welsmwq | P | Skinner Mill | 43° 20' 40.96 N, 70° 32' 57.18 W | 04/01/2004 00:00 – current | NA | NA |
| weldnwq | P | Drake Island Downstream | 43° 19' 44.04 N, 70° 33' 37.08 W | 04/01/1996 00:00 - 12/01/1997 00:00 | Moved to other WEL projects | The Wells NERR two Drakes Island sites were monitored after 1997 for another project (CICEET-Wells Harbor dredge); they were no longer collecting the dissolved oxygen, percent saturation, and pH parameters. |
| welmlwq | P | Mile Road | 43° 18' 18.00 N, 70° 34' 35.04 W | 03/01/2002 00:00 - 12/01/2003 00:00 | Unknown | No information available |
| welupwq | P | Drake Island Upstream | 43° 19' 50.16 N, 70° 33' 25.92 W | 04/01/1996 00:00 - 12/01/1997 00:00 | Moved to other WEL projects | The Wells NERR two Drakes Island sites were monitored after 1997 for another project (CICEET-Wells Harbor dredge); they were no longer collecting the dissolved oxygen, percent saturation, and pH parameters. |

**6) Data collection period –**

**<u>Head of Tide:</u>**

| Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Sonde Model Number (Nickname) |
|---|---|---|---|---|
| 4/4/2017 | 13:00 | 5/9/2017 | 10:45 | EXO2 (EXO6) |
| 5/9/2017 | 11:15 | 6/26/2017 | 12:00 | EXO2 (EXO 8) |
| 6/26/2017 | 12:15 | 7/25/2017 | 12:00 | EXO2 (EXO1) |
| 7/25/2017 | 12:15 | 9/5/2017 | 12:15 | EXO2 (EXO2) |
| 9/5/2017 | 12:30 | 10/13/2017 | 14:00 | EXO2 (EXO 8) |
| 10/13/2017 | 14:15 | 11/9/2017 | 12:45 | EXO2 (EXO6) |
| 11/9/2017 | 13:00 | 12/13/2017 | 11:30 | EXO2 (EXO 8) |

**Inlet:**

| Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Sonde Model Number (Nickname) |
|---|---|---|---|---|
| 11/21/2016 | 14:45 | 1/4/2017 | 14:15 | EXO2 (EXO4) |
| 1/4/2017 | 14:45 | 2/14/2017 | 13:45 | EXO2 (EXO7) |
| 2/14/2017 | 14:00 | 3/8/2017 | 15:00 | EXO2 (EXO4) |
| 3/8/2017 | 15:30 | 4/19/2017 | 13:15 | EXO2 (EXO7) |
| 4/19/2017 | 13:45 | 6/13/2017 | 13:15 | EXO2 (EXO4) |
| 6/13/2017 | 13:30 | 7/17/2017 | 12:00 | EXO2 (EXO3) |
| 7/17/2017 | 12:30 | 8/31/2017 | 13:45 | EXO2 (EXO4) |
| 8/31/2017 | 14:00 | 10/6/2017 | 10:45 | EXO2 (EXO1) |
| 10/6/2017 | 11:00 | 11/3/2017 | 12:00 | EXO2 (EXO4) |
| 11/3/2017 | 12:15 | 12/6/2017 | 14:30 | EXO2 (EXO3) |
| 12/6/2017 | 14:45 | 1/11/2018 | 11:45 | EXO2 (EXO7) |

**Little River Mouth:**

| Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Sonde Model Number (Nickname) |
|---|---|---|---|---|
| 4/17/2017** | 10:00 | 6/15/2017** | 9:15 | EXO2 (EXO5) |
| 6/15/2017 | 8:45 | 7/12/2017 | 9:15 | EXO2 (EXO2) |
| 7/12/2017 | 9:45 | 8/24/2017 | 8:00 | EXO2 (EXO7) |
| 8/24/2017 | 8:15 | 10/3/2017 | 15:15 | EXO2 (EXO5) |
| 10/3/2017 | 15:30 | 11/16/2017 | 15:30 | EXO2 (EXO2) |
| 11/16/2017 | 15:45 | 12/13/2017 | 13:00 | EXO2 (EXO4) |

**Skinner Mill:**

| Deploy Date | Deploy Time | Retrieve Date | Retrieve Time | Sonde Model Number (Nickname) |
|---|---|---|---|---|
| 4/18/2017 | 11:45 | 5/30/2017 | 11:45 | EXO2 (EXO3) |
| 5/30/2017 | 12:00 | 6/30/2017 | 10:15 | EXO2 (EXO7) |
| 6/30/2017 | 10:45 | 8/17/2017 | 12:00 | EXO2 (EXO 8) |
| 8/17/2017 | 12:15 | 9/15/2017 | 13:00 | EXO2 (EXO6) |
| 9/15/2017 | 13:30 | 10/27/2017 | 10:30 | EXO2 (EXO7) |

| | | | | |
|---|---|---|---|---|
| 10/27/2017 | 11:00 | 12/13/2017 | 12:15 | EXO2 (EXO5) |

** - No raw file exists for this deployment. There was a sonde deployed however due to a malfunction it did not collect data.

**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. Data are available in comma delimited format.

**8) Associated researchers and projects**

Please visit our website: www.wellsreserve.org/research.htm for further information on the Wells NERR research program and for specific research projects and reports.

The Research Program at the Wells NERR conducts and supports research, monitoring, workshops, and research/resource management planning of relevance at local, regional and national levels. The overall aim of our work is to produce science-based information needed to sustain or restore Gulf of Maine coastal habitats and resources, especially those found in salt marsh estuaries and watersheds. During 2016 many different studies involving scores of scientists, students, staff and volunteers focused on several related themes: 1) the quality of water resources in salt marsh estuaries and watersheds 2) land conservation strategies to protect coastal watersheds 3) factors controlling salt marsh accretion, erosion and plant community vigor 4) the value of salt marsh as habitat for fish, shellfish and birds, 5) restoration of salt marsh habitat degraded through human actions, and 6) understanding the ecology and functions of salt marsh habitat.

NERRS SWMP Program
As part of the SWMP long-term monitoring program, WEL NERR also monitors meteorological and nutrient/chlorophyll data which may be correlated with this water quality dataset. These data are available from the Research Coordinator or online at http://cdmo.baruch.sc.edu/.

Estuarine Water Resource Quality

Water quality is monitored continuously at several stations with automated instruments as part of the NERRS system wide monitoring program, as well as bimonthly at 15-20 stations through our WET volunteer monitoring program. Our water quality work has contributed to the designation of several Priority Watersheds in coastal Southern Maine by the Maine Department of Environmental Protection.

Seacoast Watershed Information Manager (Project S.W.I.M.)

The Seacoast Watershed Information Manager (Project S.W.I.M.) will be an online resource to help local planners and the public evaluate, conserve, and restore coastal watershed resources along the Maine and New Hampshire seacoast by developing a website that describes the region and its resources, provides access to GIS data and other relevant information, and includes a decision-support tool that examines the impact of growth and development on water resources. It will include:

- A Narrative that informs local resource planners and the public by describing development impacts, water resources, and land use.
- Socioeconomic Analysis focused on water resource use as it relates to human activities.
- Land Use Change Assessments focusing on shoreland and permeability.
- A Data Clearinghouse providing users access to key data needed for local and regional-scale resource management.
- A GIS-based Decision Support Tool to help communities manage and protect water resources by considering how water supply, water quality and land use change are affected by land use planning decisions.

The Project focuses on the coastal watersheds from the Cocheco and Salmon Falls River in New Hampshire to the Kennebunk River in Maine. These 15 watersheds include 38 municipalities and cover 1,800 square miles. The Wells National Estuarine Research Reserve is the lead partner with support from NOAA's Coastal Services Center Landscape Characterization and Restoration Program and the Great Bay National Estuarine Research Reserve.

Salt Marsh Habitats and Communities

Factors that control the dynamics and vigor of salt marsh plant communities and marsh peat formation consequently determine the ability of a salt marsh to persist in the face of sea level rise. Through a combination of experimental manipulations and long term monitoring, a number of multi-year studies are currently producing data to answer questions concerning the sustainability of salt marsh habitats in this region. These studies are looking at nutrient-plant relations, plant community responses to physical and hydrologic disturbance, and the relative contribution of short-term natural events (e.g. storms) and human activities (dredging, tidal restriction) on patterns of sediment accretion and erosion. The Reserve's marshes and beaches are already among the best studied sites in the U.S. with regard to long term accretion and erosion (over thousands of years).

## II. Physical Structure Descriptors

### 9) Sensor specifications –

WEL NERR deployed EXO2 datasondes only during 2017 at all 4 monitoring locations.

Sequence of EXO2 dataloggers:
date, time, temperature, specific conductivity, salinity, dissolved oxygen %, dissolved oxygen mg/L, Depth (in meters), pH, turbidity, Chl_a*, and battery voltage.
*(collected at IN site only)

Following specifications for EXO2 data sondes and probes were taken from the EXO manual.

YSI EXO2 probe specifications:

Parameter: Temperature
Units: Celsius (C)
Sensor Type: Thermistor
Model#: 599870-01
Range: -5 to 50 C
Accuracy: -5 to 35: +/- 0.01, 35 to 50: +/- .005
Resolution: 0.01 C

Parameter: Conductivity
Units: milli-Siemens per cm (mS/cm)
Sensor Type: 4-electrode cell with autoranging
Model#: 599870-01
Range: 0 to 200 mS/cm
Accuracy: 0 to 100: +/- 0.5% of reading or 0.001 mS/cm; 100 to 200: +/- 1% of reading
Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependant)

Parameter: Salinity
Units: practical salinity units (psu)/parts per thousand (ppt)
Sensor Type: Calculated from conductivity and temperature
Range: 0 to 70 psu
Accuracy: +/- 1.0% of reading pr 0.1 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 (0.004 m)
Resolution: 0.001 ft (0.001 m)

Parameter: pH
Units: pH units
Sensor Type: Glass combination electrode
Model#: 599701(guarded) or 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, 90 degree 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
Units: micrograms/Liter
Sensor Type: Optical probe
Model#: 599102-01
Range: 0 to 400 ug/Liter
Accuracy: Dependent on methodology
Resolution: 0.1 ug/L chl a, 0.1% FS

**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

Site definitions:

Sampling Station: Inlet at Webhannet River Mouth, at Wells Harbor
Sampling Site Code: IN
Station Code: welinwq

Sampling Station: Head of Tide of Webhannet River
Sampling Site Code: Sampling Site Code: HT
Station Code: welhtwq

Sampling Station: Little River Mouth (Merriland/Branch/Little River estuary)
Sampling Site Code: LM
Station Code: wellmwq

Sampling Station: Skinner Mill (on Merriland R, tributary to Merriland/Branch/Little R estuary)
Sampling Site Code: SM
Station Code: welsmwq

File definitions: 3 letter NERR site code (WEL for Wells NERR); 2 letter YSI deployment site code (see above); data type code (WQ for water quality), month, day, year of deployment (ex: WELINWQ071406 = Webhannet Inlet water quality data from 14 July 2006).

**11) QAQC flag definitions –**

[Instructions/Remove: This section details the automated and secondary QAQC flag definitions. Include the following excerpt**:]**

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** –

[Instructions/Remove: This section details the secondary QAQC Code definitions used in combination with the flags above. Include the following excerpt:]

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 –**
**Inlet:**

| Deploy | Sonde | SpCond | ROXDO1 | pH7 | pH10 | Turb | Turb | Depth | CHL(0) |
|---|---|---|---|---|---|---|---|---|---|

| Date | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1/4/2017 | EXO7 | 10.08(10.0) | 100.6 | 7.06 | 10.03 | 0.2(0.0) | 124.9(124.0) | -0.049(-0.054) | -0.03 |
| 2/14/2017 | EXO4 | 10.02(10.0) | 96.4 | 6.98 | 9.96 | -0.0(0.0) | 124.35(124.0) | -0.063(-0.068) | 0.03 |
| 3/8/2017 | EXO7 | 10.0(10.0) | 100.2 | 6.96 | 9.92 | 0.12(0.0) | 124.04(124.0) | 0.149(0.19) | 0.95 |
| 4/19/2017 | EXO4 | 9.98(10.0) | 100.6 | 6.95 | 9.91 | -0.01(0.0) | 123.98(124.0) | 0.063(0.027) | |
| 6/13/2017 | EXO3 | 9.9(10.0) | 100.4 | 7.08 | 10.1 | 0.3(0.0) | 124.8(124.0) | 0.027(0.0) | |
| 7/17/2017 | EXO4 | 10.04() | 100.1 | 7.16 | 10.09 | 0.07(0.0) | 124.51(124.0) | -0.077(-0.068) | 0.24 |
| 8/31/2017 | EXO1 | 10.08(10.0) | 101.5 | 7.08 | 10.05 | 0.14(0.0) | 124.12(124.0) | 0.031(0.027) | -0.05 |
| 10/6/2017 | EXO4 | 9.98(10.0) | 100.7 | 7.08 | 10.09 | 0.13(0.0) | 124.2(124.0) | -0.038(-0.014) | 0.19 |
| 11/3/2017 | EXO3 | 10.01(10.0) | 99.4 | 6.84 | 9.82 | -0.03(0.0) | 123.96(124.0) | -0.043(-0.054) | |
| 12/6/2017 | EXO7 | 9.96(10.0) | 101.3 | 7.08 | 10.06 | -0.3(0.0) | 123.86(124.0) | 0.086(0.109) | |

**Head of Tide:**

| Deploy Date | Sonde | SpCond | ROXDO1 | pH7 | pH10 | Turb | Turb | Depth |
|---|---|---|---|---|---|---|---|---|
| 4/4/2017 | EXO6 | 10.04(10.0) | | 7.05 | 10.02 | 0.3(0.0) | 124.4(124.0) | 0.067(0.054) |
| 5/9/2017 | EXO 8 | 10.01(10.0) | 100.6 | 7.04 | 10.03 | -0.07(0.0) | 123.05(124.0) | 10.35(-0.014) |
| 6/26/2017 | EXO1 | 9.93(10.0) | 101.6 | 7.14 | 10.1 | 0.17(0.0) | 125.1(124.0) | 0.6(0.041) |
| 7/25/2017 | EXO2 | 10.01(10.0) | 99.8 | 7.07 | 10.01 | 0.11(0.0) | 124.09(124.0) | -0.031(-0.027) |
| 9/5/2017 | EXO 8 | 9.97(10.0) | 103.9 | 7.04 | 10.01 | 0.08(0.0) | 124.1(124.0) | 0.149(0.19) |
| 10/13/2017 | EXO6 | 10.08(10.0) | 100.3 | 7.1 | 10.15 | -0.02(0.0) | 123.95(124.0) | 0.053(0.082) |
| 11/9/2017 | EXO 8 | 10.07(10.0) | 101.7 | 7.04 | | 0.01(0.0) | 124.05(124.0) | -0.112(-0.122) |

**Little River Mouth:**

| Deploy Date | Sonde | SpCond | ROXDO1 | pH7 | pH10 | Turb | Turb | Depth |
|---|---|---|---|---|---|---|---|---|
| 4/17/2017 | EXO5 | 9.82(10.0) | | 7.01 | 10.04 | -0.17(0.0) | 123.6(124.0) | 0.031(0.041) |
| 6/15/2017 | EXO2 | 9.97(10.0) | 102.6 | 7.25 | 10.34 | 0.08(0.0) | 124.07(124.0) | -0.0090(-0.014) |
| 7/12/2017 | EXO7 | 9.78(10.0) | 99.2 | 7.06 | 10.02 | 0.01(0.0) | 124.16(124.0) | -0.047(-0.014) |
| 8/24/2017 | EXO5 | 10.02(10.0) | 103.2 | 6.94 | 9.93 | 0.03(0.0) | 124.22(124.0) | 0.064(0.109) |
| 10/3/2017 | EXO2 | 9.952(10.0) | 98.9 | 7.07 | 10.04 | 0.05(0.0) | 124.71(124.0) | -0.037(-0.027) |
| 11/16/2017 | EXO4 | 10.03(10.0) | 99.3 | 7.02 | 10.01 | 0.3(0.0) | 124.25(124.0) | -0.063(-0.122) |

**Skinner Mill:**

| Deploy Date | Sonde | SpCond | ROXDO1 | pH7 | pH10 | Turb | Turb | Depth |
|---|---|---|---|---|---|---|---|---|
| 4/18/2017 | EXO3 | 10.03(10.0) | 100.2 | 7 | 9.97 | -0.09(0.0) | 127.38(124.0) | 0.062(0.082) |
| 5/30/2017 | EXO7 | 10.03(10.0) | 96.4 | 7.08 | 10 | 0.2(0.0) | 124.9(124.0) | -0.034(-0.014) |
| 6/30/2017 | EXO 8 | 9.92(10.0) | 105.1 | 7.11 | 10.1 | 0.08(0.0) | 124.19(124.0) | -0.011(0.014) |
| 8/17/2017 | EXO6 | 9.94(10.0) | 101.1 | 6.94 | 10.1 | 0.12(0.0) | 124.1(124.0) | 0.011(0.027) |
| 9/15/2017 | EXO7 | 10.02(10.0) | 99.5 | 7.07 | 10 | 0.05(0.0) | 124.12(124.0) | 0.0060(-0.014) |
| 10/27/2017 | EXO5 | 9.98(10.0) | 100 | 6.99 | 9.94 | 0.51(0.0) | 124.88(124.0) | -0.101(-0.014) |

**14) Other remarks/notes**

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.

Three of our four sites (SM, LM, and HT) are discontinued through the winter months due to icing in the rivers. See section 6 data collection period for times of site deployment

**Significant Rain Events:** 3/27 6:45-15:00, 4/4 5:45 – 4/5 01:30, 4/6 10:45 – 23:45, 4/21 4:45-23:45, 4/25 19:30 – 4/26 16:30, 5/5 13:00 – 22:00, 5/14 00:00 – 5/15 04:00, 5/25 15:15 – 5/26 09:15, 6/6 03:00 – 6/7 02:00, 7/24 18:00, 8/19 17:00, 9/3, 9/7, 10/9, 10/26-10/27, 10/30, and 11/16.

- Well Head of Tide (HT): DO data from 05/04/2017 20:00 to 05/09/2017 11:00 are marked -3 GIM CDA. There was a firmware failure that caused an issue with DO data.

- Well Head of Tide (HT): Depth data during the 05/09/2017 deployment are marked -3 SIC CSM. The depth was not calibrated before deployment during the 05/09/2017 deployment.

- Well Head of Tide (HT): Depth data during the 06/26/2017 deployment are marked -3 SIC CSM. During calibration there was an unknown issue with depth. The reserve believes there was an error made when entering the offset for this station.

- Wells Harbor Inlet (IN): ALL data from 05/28/2017 02:30 through 06/13/2017 01:15 is affected by biofouling and is considered suspect. Also many instances of turb spikes and high values on next deployment but not as bad or consistent. Tube is new and freshly painted with anti-fouling paint so perhaps animals/crabs/fish?

- Wells Harbor Inlet (IN): Sp. Cond. And Salinity data from 04/19/2017 13:45 through 04/19/2017 22:45 is considered suspect and the cause for this anomalous dip in Salinity is unknown. There was a minor rain event during the episode but does not seem likely to be the cause…salinities dip down into the teens then rapidly shoot back up to 30psu in one 15 minute interval…

- Wells Harbor Inlet (IN): Sp. Cond. And Salinity data from 07/21/2017 at 18:30 through 7/26/2017 at 04:45 is considered suspect and the cause for this anomalous dip in Salinity is unknown. There was a minor rain event during the episode but does not seem likely to be the cause… salinities dip down into the teens then rapidly shoot back up to 30psu in one 15 minute interval…This trend was seen in April as well (see above).