WELLS (WEL) National Estuarine Research Reserve
Water Quality Metadata
January-December 2007
Latest Update: September 2, 2010

I. Data Set & Research Descriptors

1). Principal investigator & contact persons:

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

Contact Persons:
Dr. Michele Dionne, Research Coordinator
E-mail: dionne@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) and uploaded to the CDMO where they undergo automated primary QAQC and become part of the CDMO's online provisional database. Excessive pre- and post-deployment data are removed from the file prior to upload with up to 2 hours of pre- and post-deployment data retained to assist in data management. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve 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 graphs the data for review. It allows the user to apply QAQC flags and codes to the data, remove remaining pre- and post-deployment data, append files, and export the resulting data file to the CDMO for tertiary QAQC 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. All data QA\QC is performed by Jeremy Miller.

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.

*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 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:
Two to four week variable sampling periods were chosen for all data sondes due to limitations created by the life of the dissolved oxygen membrane, probe fouling, 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 30 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 (123 NTU). The pH standards are purchased from Fisher Scientific. Conductivity and turbidity standards are purchased from YSI, Inc. The dissolved oxygen membranes are replaced and sit 6-24 hours before each deployment. 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 85 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. The use of the newest (Version 4.0) National Estuarine Research Reserve (NERR) System-Wide Monitoring Program (SWMP) YSI 6-Series Multi-Parameter Water Quality Monitor Standard Operating Procedures began in 2005 when they became available.

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.

6). Data collection period:

Deployment and retrieval dates and times, model YSI 6-series sonde used for 2007:

BEGAN	ENDED	SONDE MODEL
Inlet Site (site code: IN)		
12/21/06, 11:30	01/23/07, 13:45	6600EDS-SV
01/23/07, 14:00	02/06/07, 11:45	6600EDS-SV
02/06/07, 12:00	02/28/07, 10:00	6600EDS-SV
02/28/07, 10:15	03/16/07, 09:00	6600EDS-SV
03/16/07, 09:15	04/04/07, 13:30	6600EDS-SV
04/04/07, 14:00	04/27/07, 08:45	6600EDS-SV
04/27/07, 09:15	05/23/07, 15:45	6600EDS-SV
05/23/07, 16:15	06/15/07, 10:15	600EDS-SV
06/15/07, 12:00	06/29/07, 14:00	6600EDS-SV
06/29/07, 14:15	07/27/07, 08:30	6600EDS-SV
07/27/07, 10:45	08/14/07, 11:15	6600EDS-SV
08/14/07, 14:00	09/07/07, 09:15	6600EDS-SV
09/07/07, 09:45	09/25/07, 10:15	6600EDS-SV
09/25/07, 10:45	10/10/07, 09:15	6600EDS-SV
10/10/07, 09:45	11/13/07, 12:45	6600EDS-SV
11/13/07, 13:00	12/11/07, 11:15	6600EDS-SV
12/11/07, 11:30	01/04/08, 10:15	6600EDS-SV
Head of Tide Site (site code: HT)		
12/06/06, 15:00	01/03/07, 13:30	6600EDS
01/03/07, 13:45	01/12/07, 10:45	6600EDS
03/23/07, 10:00	04/13/07, 12:15	6600EDS
04/13/07, 12:30	05/10/07, 11:45	6600EDS
05/10/07, 14:00	05/31/07, 12:15	6600EDS
05/31/07, 12:30	06/27/07, 11:45	6600EDS
06/27/07, 12:00	07/20/07, 10:00	6600EDS
07/20/07, 10:30	08/08/07, 11:00	6600EDS
08/08/07, 11:15	08/30/07, 10:45	6600EDS
08/30/07, 11:00	09/14/07, 12:45	6600EDS
09/14/07, 13:00	10/04/07, 13:45	6600EDS
10/04/07, 14:00	11/09/07, 09:45	6600EDS
11/09/07, 10:00	12/04/07, 12:15	6600EDS
12/04/07, 12:30	12/10/07, 12:00	6600EDS
Skinner Mill Site (site code: SM)		
12/19/06, 14:30	01/16/07, 14:15	6600EDS-SV
03/28/07, 14:00	04/25/07, 11:30	6600EDS
04/25/07, 11:45	05/22/07, 09:45	6600EDS
05/22/07, 10:15	06/12/07, 12:15	6600EDS-SV
06/12/07, 13:30	07/18/07, 08:45	6600EDS-SV
07/18/07, 09:00	08/07/07, 13:00	6600EDS-SV
08/07/07, 13:15	09/05/07, 12:00	6600EDS-SV
09/05/07, 12:30	10/02/07, 09:30	6600EDS-SV
10/02/07, 09:45	11/02/07, 10:30	6600EDS-SV
11/02/07, 10:45	11/30/07, 10:00	6600EDS-SV
11/30/07, 10:15	12/14/07, 13:00	6600EDS-SV
Little River Mouth Site (site code: LM)		

12/12/06, 11:00	01/12/07, 12:00	6600EDS
03/30/07, 14:30	05/09/07, 10:15	6600EDS
05/09/07, 10:30	05/30/07, 08:45	6600EDS
05/30/07, 09:00	06/26/07, 13:15	6600EDS
06/26/07, 13:30	07/19/07, 09:30	6600EDS
07/19/07, 09:45	08/07/07, 12:00	6600EDS
08/07/07, 12:15	09/05/07, 12:30	6600EDS
09/05/07, 12:45	10/02/07, 10:15	6600EDS
10/02/07, 10:30	11/01/07, 09:15	6600EDS
11/01/07, 09:45	11/30/07, 10:30	6600EDS
11/30/07, 10:45	12/18/07, 10:30	6600EDS

7). Distribution

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program:

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. 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.

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 http://cdmo.baruch.sc.edu/. Data are available in text tab-delimited format.

8). Associated researchers and projects

WELLS NATIONAL ESTUARINE RESEARCH RESERVE RESEARCH AT THE RESERVE for 2007 (Please visit our website: www.wellsreserve.org/research.htm for further information on the Wells NERR research program):

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 2003-2004 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 a NERRS systemwide monitoring program, as well as bimonthly at 15-20 stations through our WET volunteer monitoring program. The WET program also monitors two important biological parameters: fecal coliform bacterial contamination (an indicator of human health risk) and phytoplankton productivity (an indicator of estuarine health). These data have 1) allowed us to identify several bacterial "hot spots" that we will be working to eliminate, 2) are used to identify and open areas safe for shellfishing, and 3) have uncovered a relation between tides and low dissolved oxygen (a stressful condition for marine life) that needs further study. 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).

HABITAT VALUE FOR FISH, SHELLFISH AND BIRDS

The Reserve combines long-term monitoring with periodic surveys and short-term experiments to identify species and measure trends and changes in populations of fish, crustaceans, clams and birds. We have 10 years of data on upland and shore birds with which to assess the status of resident and migratory avian populations, and several years of wading bird data that we use as a gross level indicator of salt marsh health, which appears to be stable. Our periodic larval, juvenile and adult fish surveys have produced the best available data for fish utilization of salt marsh estuaries in the Gulf of Maine. Since 1994 we have been conducting surveys and field experiments to look at the survival and growth of hatchery seed, juvenile and adult softshell clam with regard to habitat characteristics and predation by the invasive green crab. Benthic invertebrates have been sampled from a number of marshes from Wells to Casco Bay in hopes of gaining a better understanding of invertebrate assemblage and their value to higher trophic levels.

Salt Marsh Degradation and Restoration

Salt marsh ecosystems in the Gulf of Maine have sustained themselves in the face of sea-level rise and other natural disturbances for nearly five thousand years. Since colonial times large areas of salt marsh (up to half of the total area) have been lost through diking, draining and filling. Today, the remaining marshland is fairly well protected from outright destruction, but during the past 100 years, and especially since the 1950's, salt marshes have been divided into fragments by roads, causeways, culverts and tide gates. Most of these fragments have severly restricted tidal flow, leading to chronic habitat degradation and greatly reduced access for fish and other marine species. Since 1991, the Wells Reserve has been studying the impact of these restrictions on salt marsh functions and values, and the response of salt marshes to tidal restoration. We have been working to promote an awareness of the damage being done and the benefits of salt marsh restoration throughout the Gulf of Maine.

Research Program Update: In addition to the Reserve-sponsored projects outlined above, numerous visiting investigators will be involved in on-site research. Topics include: the effects of land use, sea level, and climate on estuarine productivity; the relationship between soil nutrients and plant community patterns; the influence of soil salinity on plant community interactions; the effect of tidal restriction on marsh peat accretion; the comparative ecology of fringe marshes and back barrier marshes; habitat use by upland birds, and the ecology of lyme disease.

"Ecological Functions of Fringing Salt Marshes Susceptible to Oil Spills in Casco Bay, Maine". We examined the ecological function of 9 different fringing marsh systems in Casco Bay that ranged from undisturbed to disturbed. Physical parameters measured included sedimentation rates, total suspended solids, and tidal range. Biological parameters included primary production, macroinvertebrate community composition and secondary production (4cm sediment cores), and resident and transient nekton community composition (fyke net). The project is still under way.

The Wells NERR Research Department also worked on the following project: In partnership with the York Rivers Association and the Town of York, the Wells Reserve conducted a survey of the York River watershed. In this survey, volunteers looked for sources of pollution within a 250-foot buffer of the river and

its tributaries (erosion, trash and debris and runoff from roads and lawns could have a negative impact on water quality). Most pollutants entering water bodies come from such undefined sources. Therefore, this type of survey is the best way to begin to address the problems of pollution in a water body. The idea of the project was to work with the community and landowners to help them understand the problems that come from these types of pollution and learn activities they might be able to do on their own land that would help prevent this pollution from entering the water. The results of the survey will become part of a Watershed Management Plan to improve and restore the water quality of the York River.

The Wells NERR Research Dept. is involved with the following CICEET* Projects:

Project Title: Estuarine Responses to Dredging: Analysis of Sedimentary and Morphological Change in Back Barrier Marsh to Aid Local Management and Develop a Regional Management Tool Principal Investigator (s): Michele Dionne, Wells NERR, ME; Duncan Fitzgerald, Boston University; Joe Kelley, University of Maine; David Burdick and Larry Ward, University of New Hampshire
Management Issue: Coastal management tool for assessing the impacts of dredging in estuaries. Project Summary: An adequate supply of sediment is essential for maintaining salt marshes. Human activities, such as channel dredging and tidal restriction due to road construction, can alter water flows in estuaries and result in dramatic changes in salt marsh sediment supply, affecting the speed of salt marsh erosion. The objective of this project is to determine the impact of dredging and tidal restriction on salt marshes in the Wells NERR. A digital coastal management guide will be created on CD ROM, providing coastal managers with useful conceptual models for predicting the impacts of dredging and other activities that affect water flow and sediment deposition in salt marshes.

June Ficker Project Title: Monitoring avian productivity and survivorship

Outside Researchers: Theresa Theodose, Ph.D., University of Southern Maine Project Title: Relationships between soil nutrient availability and species composition of a high salt marsh in southern Maine.

David Burdick, Ph.D. and Roelof Boumans, Ph.D. University of New Hampshire, University of Maryland Project Title: Sediment dynamics in salt marshes: functional assessment of accretionary biofilters

Peter Rand, M.D., Chuck Lubelczyk, Robert Smith, M.D. Maine Medical Center Project Title: Ecological determinants of the spread of the tick vector of Lyme disease and other pathogens.

II. Physical Structure Descriptors

9). Sensor Specifications

DEPTH QUALIFIER: The NERR System-Wide Monitoring Program utilizes YSI data sondes that can be equipped with either depth or water level sensors. Both sensors measure water depth, but by convention, level sensors refer to atmospherically vented measurements and depth refers to non-vented measurements. 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 1.03 cm for every 1 millibar change in atmospheric pressure, and is eliminated for level 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 site can be corrected. The Research Coordinator at the specific NERR site should be contacted in order to obtain information regarding atmospheric pressure data availability.

Sequence of both 6600EDS and 6600EDS-SV dataloggers:
Date, Time, Temperature, Specific Conductivity, Salinity, dissolved oxygen %, dissolved oxygen mg/L, Depth (in meters), pH, Turbidity, Battery voltage

Following specifications for 6600EDS and 6600EDS-SV data loggers are taken from YSI 6-Series Environmental Monitoring Manual, Appendix M (undated).

Date
Sensor Type: NA
Range: 1-12, 1-31, 00-99 (Mo,Day,Yr)
Resolution: 1 mo, 1 day, 1 yr
Accuracy: NA

Time
Sensor Type: NA
Range: 0-24, 0-60, 0-60 (Hr,Min,Sec)
Resolution: 1 hr, 1 min, 1 s
Accuracy: NA

Temperature
Sensor Type: Thermistor
Range: -5 to 45 (c)
Resolution: 0.01 C
Accuracy: +/-0.15C
Depth: 200 m

Specific Conductivity
Sensor Type: 4 electrode cell with autoranging
Range: 0-100(mS/cm)
Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependent)
Accuracy: +/-0.5% of reading + 0.001mS/Cm
Depth: 200 m

Salinity
Sensor Type: calculated from conductivity and temperature
Range: 0-70 ppt
Resolution: 0.01 ppt
Accuracy: +/-1.0% of reading or + 0.1 ppt whichever is greater

Dissolved oxygen, % saturation
Sensor Type: Rapid pulse – Clarke type, polarographic
Range: 0 – 500% air saturation
Resolution: 0.1% air saturation
Accuracy: 0-200% air saturation, +/-2% of the reading or 2% air saturation, whichever is greater; 200-500% air saturation, +/-6% of reading
Depth: 200 m

Dissolved oxygen, mg/L (calculated from % air saturation, temperature and salinity)
Sensor Type: Rapid pulse – Clarke type, polarographic
Range: 0 – 50 mg/L
Resolution: 0.01 mg/L
Accuracy: 0-20 mg/L, +/-2% of the reading or 2 mg/L, whichever is greater; 200-20-50 mg/L, +/-6% of reading
Depth: 200 m

Level for 6600EDS shallow (non-vented):
Sensor Type: stainless steel strain gauge
Range: 0 – 30 ft (9.1 m)
Resolution: 0.001 ft (0.001 m)
Accuracy: +/-0.06 ft (0.018 m)

Level for 6600EDS-SV (vented):
Sensor Type: stainless steel strain gauge
Range: 0 – 30 ft (9.1 m)
Resolution: 0.001 ft (0.001 m)
Accuracy, 0-10ft: +/-0.01 ft (0.003 m)
Accuracy, 10-30ft: +/-0.06 ft (0.018 m)

pH
Sensor Type: Glass combination electrode
Range: 0-14 units
Resolution: 0.01 units
Accuracy: +/-0.2 units
Depth: 200 m

Turbidity (probe model 6136)
Sensor Type: Optical, 90 degree scatter, with mechanical cleaning
Range: 0-1000 NTU
Resolution: 0.1 NTU
Accuracy: +/- 5% of reading or 2 NTU (whichever is greater), relative to calibration standards
Depth: 66 m

Chlorophyll
Sensor Type: Optical, fluorescence, with mechanical cleaning
Range: 0-400µg/L Chl; 0-100 Percent Full Scale (%FS) Fluorescence Units
Resolution: 0.1 µg/L Chl; 0.1 %FS
Accuracy: No specifications provided
Depth: 66 m

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-

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, -2, 2, and 3 flags are applied automatically to indicate data that is above or below sensor range, missing, or outside 2 or 3 standard deviations from the historical seasonal mean. All remaining data are then flagged 0, as "good". 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 *Open - reserved for later flag*
4 Historical Data: Pre-Auto QAQC
5 Corrected Data

12) QAQC code definitions – This section details the secondary QAQC Code definitions used in combination with the flags above.

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.

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

Sensor Errors

SBO	Blocked Optic
SCF	Conductivity Sensor Failure
SDF	Depth Port Frozen
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
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

13). Post Calibration Information:

End of Deployment "post-calibration" readings in the following standard solutions:

DO% is recorded in a 5 gallon bucket of water with two air stones (100% saturated water)
SpCond (specific conductivity) solution is 10 mS/cm.
pH solution is 7.0
turb (turbidity) is recorded in deionized water (pre-deployment calibrated to 0.0).

site	Date	SpCond	DO%	DOchg	level	pH	Turb
IN	01/23/07	10.17	97.8	44.1	0	7.04	-0.2
IN	02/06/07	9.964	101.6	52.3	-0.004	6.99	-8.5
IN	02/28/07	9.976	124.8	47	-0.003	6.98	-0.1
IN	03/16/07	9.956	102.8	50.2	-0.004	7.06	1.2
IN	04/04/07	9.949	101.5	47.1	-0.002	7.06	-0.1
IN	04/27/07	10.07	99.6	44.1	-0.002	7.03	0.3
IN	05/23/07	10.06	107.7	62.5	0.002	7.05	-0.8
IN	06/15/07	9.98	107.9	98.2	-0.002	6.81	0.2
IN	06/29/07	10.13	124.1	99.2	-0.002	6.95	0
IN*	07/27/07	11.33	N/A	N/A	N/A	N/A	N/A
IN	08/14/07	10.04	162.5	99.2	0.001	6.86	1.3
IN	09/07/07	10.87	188.5	99.2	-0.001	7.18	0.2
IN	09/25/07	9.89	114.8	81.9	-0.001	7.02	0.1
IN	10/10/07	10.02	115.9	95.1	-0.001	7.02	0.5
IN	11/13/07	10.05	114.4	99.2	-0.002	7.05	0.6
IN	12/11/07	9.863	101.4	99.2	0	6.97	-0.5
IN	01/04/08	9.83	85.6	100.2	-0.002	6.90	0.5

NOTES on IN post deployment information:
There was a general trend of bad DO charges and values on post deployment calibration for this site. The reason for this is unclear as all sondes were properly calibrated before deployment and some had bad DO post cal info after only 10 days in the water. It is most likely related to the DO readings we are seeing at this site which regularly reach anoxic levels (> 29% Saturation) however quickly rebound with the turning tide. A sP. Cond probe failure led to no post calibration numbers for 7/27/07. Optical turbidity error on the February deployment.

Site	Date	DO %	DO Charge	Depth	mS/cm	pH	NTU
HT	1/3/2007	101.5	47.1	-0.066	9.987	7.03	-0.1
HT	01/12/07	Torn membrane	n/a	0.058	10.01	7	0.3
HT	04/13/07	104.5	56.3	-0.141	10.09	6.89	1.6
HT	05/10/07	102.8	43.1	-0.021	10.01	7.16	-0.1
HT	05/31/07	95.5	50.2	0.065	10.01	7.03	-0.2
HT	06/27/07	115.1	53.3	0.006	9.923	6.88	0.2
HT	07/20/07	103.4	45.1	-0.122	10.03	7.03	0.2
HT	08/08/07	98.0	44.1	-0.117	9.93	6.97	-0.1
HT	08/30/07	104.7	51.2	-0.019	10.07	7.10	-0.1

HT	09/14/07	99.3	47.1	0.060	10.09	7.04	-0.1
HT	10/04/07	101.0	60.4	0.042	10.11	-2.82	0.5
HT	11/09/07	107.6	41.1	0.069	9.978	7.06	1.0
HT	12/04/07	95.6	41	-0.245	9.99	7.14	-1.1
HT	12/10/07	119..8	47	0.072	9.963	7.08	-0.1

Turbidity malfunction during October deployment

Site	Date	DO %	DO Charge	Depth	mS/cm	pH	NTU
LM	01/12/07						
LM	05/09/07	1.2	15.5	0.010	10.03	7.49	0
LM	05/30/07	106	58.4	0.049	10.07	7.10	0
LM	06/26/07	106.2	43.1	0.011	10.11	6.98	0
LM	07/19/07	102.2	46.1	-0.061	9.88	7.1	0
LM	08/07/07	100.2	51.2	-0.037	10.11	6.94	0.1
LM	09/05/07	75	41	0.052	10.10	6.95	-0.1
LM	10/02/07	93.9	48.2	0.138	10.12	6.98	0.3
LM	11/01/07	98.9	43.1	0.141	9.992	7.07	0.4
LM	11/30/07	95.4	53.3	0.026	10.14	7.12	0.1
LM	12/18/07	99.2	47.1	0.070	10.05	7.06	-0.4

NOTES on LM post deployment information:
Post cal could not be performed on 1/12 due to sonde damage and communication error between sonde and CPU
DO malfunction during deployment ending 5/9/07 year.

Site	Date	DO%	DO Charge	Level	mS/cm	pH	Turb
SM	01/16/07	10.07	99.4	51.2	-0.006	7.09	0
SM	04/25/07	105.3	49.2	0.002	10.07	6.97	0.6
SM	05/22/07	102.8	47.1	0.109	10.14	7.01	-0.2
SM	06/12/07	99.5	45.1	0	10.01	7.02	0
SM	07/18/07	105.2	43.1	-0.001	10.16	7.04	0.3
SM	08/07/07	99.3	41.0	-0.001	9.483	6.96	-0.2
SM	09/05/07	97.8	40	-0.002	10.11	7.19	-0.1
SM	10/02/07	106.8	46.1	-0.003	10.06	7.13	0.1
SM	11/02/07	107.2	44.1	0	9.981	7.06	-0.1
SM	11/30/07	97.7	58.4	-0.005	9.981	7	1.3
SM	12/14/07	97.8	61.4	-0.005	9.987	7.06	0.1

NOTES on SM post deployment information:

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.

***Webhannet Inlet (IN) site:** There was an anomalous trend happening at our IN site for the entire deployment season and seemed to get worse as the season went on. A trend has appeared of very low DO readings during the ebbing tide and hits a low for that tide right about and hour into incoming tide then shoots back up to reasonable readings. This does not seem to be a probe malfunction in most cases, because the trend has been observed with different probes and sondes, and until June the probes post-calibrated fine on most of the retrievals. Although we have no explanation for this trend we do believe it is an actual event and merits further investigation. This trend can be seen in the entire year's data. The deployment tube was inspected by a diver and cleaned of any visible fouling (which was minimal) and the problem persisted. Much of the DO % and mg/l data from this site has been flagged as suspect or Rejected. Further question regarding DO data from the Inlet site should be directed to the author of this document.

Webhannet Inlet (IN) Site: There seemed to be a lot of suspect turbidity values in the data. Suspect due to the fact that there were no rain events or low tidal shifts during the sometimes extended periods of elevated readings. Fish and crabs have been noted inside the sonde tube before but are likely not making it to the sensors as we use a 2mm vexar mesh to inhibit the visitation of little critters. These data have been labeled suspect.

Webhannet Inlet (IN) Site: The salinity data was not downloaded from the sonde on the 05/23/07 deployment. This data is missing.

Webhannet Inlet (IN) Site:There was some suspect pH data on 06/07/07 from 04:00 to 06/15/07 at 10:15. There was a steady drop to 6.8 then this number stabilized throughout changing tides.

Webhannet Inlet (IN) Site: From 06/29/07 at 13:00 to 09/07/07 at 09:00 new ROX optical DO probes from YSI were deployed on the sondes along with the Rapid Pulse probes in an effort to "confirm" the suspect DO data we were collecting at that site. This was before the probes were released to the general public and were on load via YSI for us to Demo. The probes seemed to interfere with our rapid pulse probes sending reading into the hundreds of percent saturation at points, while other periods seemed to be fine. Most of this data was rejected due to "probe malfunction" and the deployment of the ROX sensors was discontinued on 9/7/07 and rapid pulse readings stabilized again.

Head of Tide (HT) site: 15-minute data from 1/1 00:15 – 1/3 13:15 are missing because the sonde was programmed to collect at 30-minute intervals.

Head of Tide (HT) site: There was a torn DO membrane upon retrival. DO data from 1/07 to 1/08 is flagged as suspect.

Head of Tide (HT) site: Data were rejected from 1/8 15:45 – 1/12 10:45 due to the sonde and post being dislodged by ice on the afternoon of 1/8. The logger remained in situ for another 4 days until staff were able to safely remove it from the ice. The site was discontinued until March.

Head of Tide (HT) site: The pH data from 7/20 10:30 – 7/22 13:45 are considered suspect because the data did not match up well with the previous deployment's data which could be caused by sensor drift from the previous deployment. pH probe post calibrated okay upon retrieval.

Head of Tide (HT) site: 8/30 11:00 – 9/11 14:15 Extremely high tides and a lack of flushing at this site caused a back-up of brackish to salt water in the upper reaches of the estuary causing Sp. Cond and Salinity data to remain higher than usual throughout changing tides. Other parameters also fell outside of averages values.

Head of Tide (HT) site: DO data for 9/9 1:00 – 9/11 14:15 were rejected, there was a tear in the membrane upon retrieval.

Head of Tide (HT) site: The turbidity data from 10/12 - 9:45 – 11/9 9:45 are considered suspect due to a lot of "noise" or variation in the data every 15 minutes. This could have been caused by a blocked optic in situ, or a probe error. However the turbidity probe post calibrated correctly.

Little River Mouth (LM) site: On 12/17/2006, the sonde was uplifted by ice and removed from its location. All data were rejected from 1/1 at 00:00 through 1/12 at 12:00 when the sonde was retrieved.

Little River Mouth (LM) site: Turbidity data from 10/20 – 11/1 and on 11/16 are considered suspect as the readings seem to stabilize at an unusually high number in the absence of any rain or disturbance. This could be caused by the optic being partially blocked or simple drift occurring in the probe. Normally Turb values run close to zero (+/- 5 NTUs) in the absence of rain events or strong tidal changes. Once the data reached higher levels (50+) steadily with no drops to or near zero throughout slack and high tides, the data were rejected and it was assumed that the optic was indeed blocked preventing proper readings, however the probe seemed to post-calibrate fine.

Skinner Mill (SM) site: Turbidity data from 4/25 – 5/22 have been considered suspect as there was a lot of "noise" or variation in the 15 minute data causing a lot of variation in the data. Readings are generally pretty stable in the absence of rain events and/or tidal events and the data in question does not stabilize throughout the entire deployment.

Skinner Mill (SM) site: Some DO data from 9/17 and 9/22 were flagged as suspect as it climbed to unusually high levels of saturation. This could be caused by a change in barometric pressure since the probe was calibrated. The data should be considered suspect due to the fact that the readings are well out of range from historical data from this site. Post cal readings were slightly elevated, but reasonable (106.8/100.0%)

The following rain events are considered significant and are visible in the corresponding data sets. The parameters affected most are turbidity, pH, and depth. However, there may be other changes in the aforementioned parameters (and others) which were effected by smaller rain events **NOT** listed below.

There was a Major coastal storm over patriots day (April 15th through the 17th) were heavy rains in excess of 8 inches in some locations fell in 24 hours. This heavy rain was accompanied by strong winds and high tides to batter the seacoast. This event is visible at all 4 sites as turbidity increases, salinity decreases along with pH and do is affected as well.

04/27/07 through 04/29/07
05/11/07 through 05/13/07
05/16/07
06/02/07 through 06/04/07
07/05/07 through 07/09/07
07/15/07 through 07/18/07
07/19/07, 07/28/07, and 08/06/07
09/09/07 and 09/11/07, and 09/28/07
10/19/07