Wells (WEL) NERR Nutrient Metadata
(May 2002-December 2002)
Latest Update: July 22, 2025

I. Data Set & Research Descriptors

1) Principal investigator(s) and contact persons -

a) Reserve Contacts:

Michele Dionne, Research Director
The Wells National Estuarine Research Reserve
342 Laudholm Farm Road
Wells, Maine 04090
Phone: 207-646-1555 x 136
Email: dionne@WellsNERR.org

Jim Dochtermann, SWMP Research Associate
The Wells National Estuarine Research Reserve
342 Laudholm Farm Road
Wells, Maine 04090
Phone: 207-646-1555 x 104
Email: jdoc@WellsNERR.org

b) Laboratory Contact:

Pallavi Mittal (Research Technician)
Estuarine and Coastal Chemistry Laboratory
Ocean Process Analysis Laboratory
Institute for the Study of Earth, Oceans, and Space (EOS)
University of New Hampshire
Room 381 Morse Hall
39 College Road
Durham, NH 03824-3525
Phone: 603 862 1542
Fax: 603 862 0243
email: pmittal@cisunix.unh.edu
website: http://www.opal.sr.unh.edu/

c) **Other Contacts and Programs:** None

2) Research Objectives –

a) Monthly Grab Program:

The monthly grab samples provide data for 5 additional water quality variables to supplement the 30-minute interval data stream from the YSI 6600's. Grabs are collected from a similar depth stratum as the YSI datalogger (within 1m of the depth of the

probes) at each site. These variables (nitrate, nitrite, ammonium, phosphate, silicate and chlorophyll a) are important indicators of estuarine trophic status and point and non-point sources of nutrient enrichment. Although limited, these data enable estimation of average trophic status, and may demonstrate seasonal patterns. Our datalogger monitoring design allows for gradient analysis from head of tide to inlet in the Webhannet estuary, allowing comparison of the Little River and Webhannet River estuaries at their inlets, where they exchange water directly with the Atlantic Ocean. Monthly grab data provide the basis for investigation of questions regarding watershed and marine inputs of nutrients in Wells NERR estuaries, and nutrient influence on trophic status as indicated by chlorophyll a.

b) Diel Sampling Program:

At the Webhannet Inlet site, the monthly grab samples are augmented with a 24-hour sampling series (at 2 hr intervals for a total of 24 samples – 2 replicate samples per 2 hr interval). These data can provide estimates of temporal variation in nutrients and chlorophyll on the scale of hours, providing a context for interpretation of data collected less frequently. This finer scale information will also inform interpretation SWMP grab sample data. These data can be used to investigate the relationship between nutrients, chlorophyll, and dissolved oxygen, an integrator of water column metabolism.

3) Research Methods –

a) Monthly Grab Program:

Monthly grab samples are collected at 3 sites in the Webhannet River Estuary and 1 site in the Little River Estuary. These sites coincide with the four datasonde sites: Head of Tide (HT), Mile Road (ML), and Inlet (IN) in the Webhannet River; and the Mouth (LM) in the Little River. All grab samples are taken within a 24-hour period, and efforts are made to sample between +/- 3 hours slack-low tide. Efforts are also made to allow for a previous dry period of 72 hours prior to sampling, however this was not always possible due to lengthy periods of inclement weather. Sampling events are staggered each month at the optimal low tide, to the best of the research staff's ability. Replicate (N=2) 1-liter samples are collected with a homemade grab sampler at a depth of 0.5 meters below the water surface at the HT, ML, and LM sites. Replicate (N=2) samples at the IN site are taken by pumping the sample up through the ISCO sampler (except for the 08/28/02 sampling date, where intake tube was misplaced-ISCO could not be deployed on this date). All samples are collected in 1-liter wide-mouth amber nalgene bottles that were previously washed with Fisherbrand Versa-Clean and water, acid washed (10%), rinsed (3x) with distilled-deionized water, dried, and rinsed (3x) with ambient water prior to collection of the sample. Samples are immediately placed on ice in a dark cooler, and returned to the laboratory for immediate processing.

b) Diel Sampling Program:

Diel samples are collected once a month, during the same 24-hour period as our grab sample collection, at the Webhannet River Inlet (IN) datasonde site. An ISCO 6700

automated sampler is deployed on a floating dock at the Wells Harbor Pier. As with the grab samples, efforts are made to begin the automated sampling between +/- 3 hours slack-low tide. Efforts are also made to allow for a previous dry period of 72 hours prior to sampling, however this was not always possible due to lengthy periods of inclement weather. Sampling events are staggered each month at the optimal low tide, to the best of the research staff's ability. Two replicate samples of 1-liter each are taken every 2-hours over the 24-hour period for a total of 24 samples. All samples are pumped into ISCO 1-liter polypropylene wedge sample bottles that were previously washed with Fisherbrand Versa-Clean and water, acid washed (10%), rinsed (3x) with distilled-deionized water and dried prior to collection of the sample. The ISCO sampler is filled with ice prior to deployment, and at the end of the 24-hour period the sample bottles are immediately capped, kept in the dark, and returned to the laboratory for immediate processing.

Once back in the Wells NERR laboratory, samples are shaken and processed for nutrient and Chlorophyll-a analysis. All samples are filtered at the Wells NERR. The Chl-a analysis is completed on-site at the Wells NERR laboratory with a Turner Designs 10-AU Field Fluorometer, and the nutrient analysis takes place at the University of New Hampshire Estuarine and Coastal Chemistry Laboratory.

•The nutrient processing methodology includes filtering 50 ml of a sample through 25 mm, 0.45 µm HV Millipore Durapore® membrane filters using a Becton, Dickinson and Co. (BD) 60ml polyethylene syringe with Luer-Lok® tip locked to a Millipore Swinnex 25 mm polypropylene filter holder. If a sample is particularly turbid, a 25 mm PALL A/E Glass Fiber Filter is used to filter the sample prior to filtering through the 0.45 µm Millipore filter. The liquid volume of the filtered sample is collected into a Fisherbrand 50 ml polypropylene centrifuge tube (after rinsing collection tube (3x) with sample) and placed in the freezer until brought down to the University of New Hampshire for analysis.

•The Chl-a processing methodology here at the Wells NERR Research Laboratory follows the non-acidification method, "A Procedure For Measuring Extracted Chlorophyll *a* Free From The Errors Associated With Chlorophyll *b* and Pheopigments", adapted from the EPA Method 445.0: "*In Vitro* Determination of Chlorophyll *a* and Pheophytin *a* in Marine and Freshwater Algae by Fluorescence." This methodology includes filtering 600-1000 ml of a sample through 47 mm Whatman® GF/F filters using a vacuum pump and filter flask apparatus, and to determine the Chl-a concentration we use a Turner Designs 10-AU Field Fluorometer.

•All laboratory glassware, centrifuge tubes, syringes, filter holders, 1-liter graduated cylinders, and forceps were previously washed with Fisherbrand Versa-Clean and water, acid washed (10%), rinsed (3x) with distilled-deionized water and dried prior to filtration of the sample; and rinsed (3x) between samples with distilled-deionized water to avoid any contamination.

4) 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 three sampling sites in the Webhannet River estuary. These are located at the Head of Tide (HT), Mile Road (ML), and at the Inlet (IN). The tidal range at each of these sites is 2.6-2.9 meters. There is one sampling site in the Little River estuary, the Little River Mouth (LM). The tidal range of the Little River estuary is 2.6-3.0 meters (Mariano and FitzGerald, 1988).

(1) The Head of Tide site is located 4 miles south of the Wells Reserve, just downstream of the Webhannet Falls (freshwater) and 10 feet east of Route One (43 deg 17' 54.25227" Latitude, 70 deg 35' 13.82728" Longitude). Route One is used heavily with 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. 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 Route One bridge, and is our roving site.

(2) The Mile Road site is located 3.5 miles south of the Wells Reserve, on Mile Road roughly 300' north of the bridge (N43 deg 18.300' Latitude,W 70 deg 34.583 Longitude). This site has soft mud and a rocky substrate, and the low and high tide depth is relatively shallow. The salinity range here is 3.6-33.4 ppt, with a mean of 27.0 ppt. The Mile Road site is our creek site.

(3) The Inlet site is located 1.5 miles south of the Wells Reserve, at the Wells Harbor pier (43 deg 19' 12.44804" Latitude, 70 deg 33' 13.82728" Longitude). 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. The maximum depth of the Inlet site is 3 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.

(4) The Little River Mouth site is located 1,270.78 meters upstream from the mouth of the estuary, and 813.94 meters direct from the Wells NERR Coastal Ecology Center (43 deg 20.413 Latitude, 70 deg 32.441 Longitude). The tidal range of the Little River estuary is 2.6-3.0 meters (Mariano and FitzGerald, 1988). The Little River sites existed 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. The Little River Mouth site is our comparative system site.
Note: Both original sites were abandoned due to problems with heavy sediment movement in the inlet of the Little River. We were forced to relocate the site twice. The first location (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 (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.

5) Code variable definitions –

Site definitions:

IN = Webhannet River Inlet, ML = Mile Road, HT = Head of Tide, LM = Little River Mouth

Monitoring Programs: 1-Grab Sampling, 2-Diel Sampling.

6) Data collection period –

*Note that all nutrient data were removed from this data set, please see the Other Remarks section for more information.

Diel Sampling

Site	Start Date	Start Time	End Date	End Time
IN	05/01/02	10:10	05/02/02	08:10
IN	05/20/02	10:20	05/21/02	08:20
IN	06/27/02	11:00	06/28/02	09:00
IN	07/18/02	09:05	07/19/02	07:05
IN	ISCO Sampler not functional this month, only grab samples taken			
IN	09/26/02	09:50	09/27/02	07:50
IN	10/22/02	08:55	10/23/02	06:55
IN	11/06/02	10:50	11/07/02	08:50
IN	12/11/02	11:25	12/12/02	09:25

Grab Sampling

Site	Start/End Date	Start Time	End Time
IN	05/01/02	07:35	07:40
IN	05/21/02	10:15	10:20
IN	06/28/02	11:30	11:35
IN	07/18/02	09:00	09:05
IN	08/28/02	08:35	08:40
IN	09/27/02	09:15	09:20
IN	10/23/02	08:50	08:55
IN	11/07/02	08:45	08:50
IN	12/12/02	09:40	09:45

Site	Start/End Date	Start Time	End Time
HT	05/01/02	09:00	09:05
HT	05/21/02	10:50	10:55
HT	06/28/02	14:20	14:25
HT	07/18/02	09:22	09:27

HT	08/28/02	09:02	09:07
HT	09/27/02	09:40	09:45
HT	10/23/02	09:10	09:15
HT	11/07/02	09:22	09:27
HT	12/12/02	09:57	10:02

Site	Start/End Date	Start Time	End Time
ML	05/01/02	08:30	08:35
ML	05/21/02	11:10	11:15
ML	06/28/02	14:35	14:40
ML	07/18/02	09:33	09:38
ML	08/28/02	09:24	09:29
ML	09/27/02	10:00	10:05
ML	10/23/02	09:25	09:30
ML	11/07/02	09:07	09:12
ML	12/12/02	10:15	10:20

Site	Start/End Date	Start Time	End Time
LM	05/01/02	09:24	09:29
LM	05/21/02	12:10	12:15
LM	06/28/02	15:20	15:25
LM	07/18/02	10:00	10:05
LM	08/28/02	10:04	10:09
LM	09/27/02	10:30	10:35
LM	10/23/02	09:55	10:00
LM	11/07/02	08:00	08:05
LM	12/12/02	10:45	10:50

7) Associated researchers and projects –

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 2000-2001 twenty-three different studies (involving 79 scientists, students, and staff from the Reserve, 26 academic institutions and 19 resource management groups) 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, and 5) restoration of salt marsh habitat degraded through human actions.

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.

Coastal Conservation Strategies

The Coastal Mosaic Project is a new program developed in response to requests for support from the conservation community to increase the quantity, quality and ecological integrity of conserved lands in our region. Research staff organize and facilitate meetings, workshops, and communications for 18 partner conservation groups. A key element of the Project is the Conservation Resource Center, a Reserve staffed GIS facility with a growing database able to provide maps of property, natural features and other data needed to develop effective conservation goals and strategies. The Project is nearing completion of conservation lands maps for 13 Southern Maine coastal towns, and is undertaking an initiative to develop coastal watershed conservation strategies for 12 coastal watersheds within these towns. The Reserve has a particular interest in educating communities about the ecologic and economic benefits of land conservation, especially along estuarine and riverine shorelines.

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 8 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. In the coming year we plan to develop a long-term monitoring program for finfish that will be coordinated with other sites within the Gulf of Maine and along the east coast. 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.

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 severely 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.

•The Wells NERR Research Dept. is working on the following projects: "Ecological processes, energy pathways, and the impact of human activities on Maine marsh-estuarine secondary production: a salt marsh panne model". We used stable isotopic tracers (15N additions and naturally abundant 13C) coupled with secondary production measurements (nekton, invertebrates) to track energy flow on the high marsh surface in southern Maine salt marsh systems. The project is still under way.

"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.

"BENTHIC HABITAT CORRELATES OF JUVENILE FISH DISTRIBUTION IN THE BIGELOW BIGHT AND ADJACENT ESTUARIES: LINKAGES BETWEEN FISH, HABITATS, SUBSTRATE AND HUMAN ACTIVITY". This project was a collaboration between the Wells N.E.R.R. and several members of the local fishing community. Through the use of beam trawls, gill nets, fish traps, van veen ponar, and a sediment profile imager (SPI camera), we are attempting to correlate benthic habitat type to juvenile groundfish and invertebrate assemblages in estuarine, nearshore, and offshore habitat. Stations were also established near dredge spoil dump sites as well as sewage outflow to determine the impacts of human activity on the coast to benthic habitat. The project is still under way.

•The Wells NERR Research Dept. also completed the work 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-

I. 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.

II. Project Title: Microbial Source Tracking in Two Southern Maine Watersheds. A two-year project written by Maine Sea Grant associate Kristen Whiting-Grant, and funded by Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), involving Wells NERR, UNH Jackson Estuarine Lab (JEL), USM Muskie School, AmeriCorps and the Maine Conservation Corps. We are pioneering the use in Maine of genetic analysis as a means of determining the source species associated with bacterial contamination in the Webhannet and Little River Estuary. Volunteers collect water samples from streams and the estuaries, staff test for and isolate E. coli. At JEL, a genetic technique (ribotyping) creates a genetic fingerprint of the bacteria which is compared to known sources. The project is still underway.

*The following information on CICEET taken directly from its website: (http://www.ciceet.unh.edu)

Other Onsite Research:
Michele Dionne, Wells NERR, Nancy McReel, Chuck Lubelczyk.
Project Title: Effect of herbivory by deer on forest regeneration

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.

8) Distribution –

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 Section 1. 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, Microsoft Excel spreadsheet format and comma-delimited format.

II. Physical Structure Descriptors

9) Entry verification –

Excel data files containing measured values (except for Chl-a which is analyzed on site) received from the University of New Hampshire (UNH) Estuarine and Coastal Chemistry Laboratory are used to generate calculated parameter values. Both directly measured and calculated values were entered into this document by Scott Orringer. Scott is also responsible for a visual QA/QC to make sure no entry errors are present. The original Excel files received from UNH are archived on the Wells NERR server. Edited files containing additional calculated parameters, are archived on the Wells NERR server and sent to CDMO for additional archiving.

10) Parameter Titles and Variable Names by Data Category –
Required NOAA/NERRS System-wide Monitoring Program water quality parameters are denoted by an asterisks "*". Nutrient parameters currently sampled at the Wells NERR are the Tier I parameters: ammonium (NH_4^+), nitrate (NO_3^-), nitrite (NO_2^-), ortho-phosphate, and Chla; and the Tier II parameter: Silicate.

Data Category	Parameter	Variable Name	Units of Measure
Phosphorus:	*Orthophosphate	PO4F	mg/l as P
Nitrogen:			
	*Nitrite + Nitrate, Filtered	NO23F	mg/l as N
	*Nitrite, Filtered	NO2F	mg/l as N
	*Nitrate, Filtered	NO3F	mg/l as N
	*Ammonium, Filtered	NH4F	mg/l as N
	*Dissolved Inorganic Nitrogen	DIN	mg/l as N
i) Other Lab Parameters:			
	Silicate, Filtered	SiO4F	mg/l as SI
	Chlorophyll a	CHLA	µg/l

Notes:
1. Time is coded based on a 2400 hour clock and is referenced to Eastern Standard Time (EST).
2. Reserves have the option of measuring either NO23 or NO2 or NO3.

11) Measured and Calculated Laboratory Parameters

a) **Variables Measured Directly**

Nitrogen species:	NO2F, NO3F, NH4F
Phosphorus species:	PO4F
Other:	SiO4F, CHLA

b) **Computed Variables**

NO23F:	NO2F+NO3F
DIN:	NO23F+NH4F

12) Limits of Detection

Method Detection Limits (MDL), the lowest concentration of a parameter that an analytical procedure can reliably detect, have been established by the University of New Hampshire Estuarine and Coastal Chemistry Laboratory and at the Lachat Instrument website (http://www.lachatinstruments.com/applications/AppsSearch.asp). Table 1 lists the current MDL values, which are reviewed and revised periodically.

Table 1. Method Detection Limits (MDL) for measured water quality parameters.

Parameter	**Variable**	**Range: µM**	**Range: mg (N/L)**	**MDL: µM**	**MDL: mg/L of N or P**	**Dates in use**
Ammonium	NH4F	0.07-3.57	0.1-20.0	0.10	0.0014	2002
Nitrite	NO2F	NA	NA	0.05	0.0007	2002
Nitrate	NO3F	NA	NA	0.08	0.0011	2002
Orthophosphate	PO4F	1-100 (µM P/L) 0.03-3.23 µM P	NA	0.25	0.0078	2002
Silicate	SiO4F	0.03-5 µM SiO4/L 0.5-100 µM SiO4/L	NA	0.01	NA in mg/L units	2002
Chlorophyll a	CHLA	0-9999.999 Fluorescent Signal Units (not µM)	NA See note below	NA See note below	NA See note below	2002

NOTE regarding Chlorophyll *a* limits of measurement:
Method 445.0 *In Vitro* Determination of Chlorophyll *a* and Pheophytin *a* in Marine and Freshwater Algae by Fluorescence"
Elizabeth J. Arar and Gary B. Collins
Revision 1.2, September 1997
National Exposure Research Laboratory, Office of Research and Development, USEPA, Cincinnati, OH 45268
"Instrument detection limits of 0.05 µg chl *a*/L and 0.06 µg pheo *a*/L in a solution of 90% acetone were determined by this laboratory. **Method detection limits (MDL) using mixed assemblages of algae provide little information because the fluorescence of other pigments interferes in the fluorescence of chlorophyll *a* and pheophytin *a*.** A single lab estimated detection limit for chlorophyll *a* was determined to be 0.11 µg/L in 10 mL of final extraction solution. The upper limit of the linear dynamic range for the instrumentation used in this method evaluation was 250 µg chl *a*/L."

13) Laboratory Methods –

The following information is taken from the website below as directed from Pallavi Mittal (Research Technician) from the UNH Estuarine and Coastal Chemistry Laboratory.

http://www.lachatinstruments.com/applications/AppsSearch.asp

NH4 QuickChem Method 31-107-06-1-A 0.07 to 3.57 uM

NO3 and NO2 31-107-04-1-A 0.005 to 5 uM N/L 0.07 to 70 mg N/L

PO4 31-115-01-1-1 1 to 100 uM P/L 0.03 to 3.23 uM P

SiO2 31-114-27-1-B 0.03 to 5 uM SiO2/L 0.5 to 100uM SiO2/L

i) Parameter: Orthophosphate

Method References:
University of New Hampshire Estuarine and Coastal Chemistry Laboratory

Revision Date: 6/27/2001
PO4 31-115-01-1-1 1 to 100 uM P/L 0.03 to 3.23 uM P

Orthophosphate in Seawaters
Method No: 31-115-01-1-I
Product Line: Flow Injection Analysis
Matrix: Brackish or seawater

Range

Analyte	**Range**	**MDL**	**Units**
Phosphate, ortho	1 to 100	0.25	µ P/L

Principle
Ammonium molybdate and antimony potassium tartrate reacts in an acid medium with phosphate to form an antimony-phospho-molybdate complex. This complex is reduced to an intensely blue-colored complex by ascorbic acid. The color produced is proportional to the phosphate concentration in the sample. Though there is a density difference between seawater and reagent water the bias is less than 2%. Though the method is written for seawater and brackish water it is also applicable to non-saline sample matrixes. The method is calibrated using standards prepared in deionized water. Once calibrated, samples of varying salinities (0 to 35 ppt) may be analyzed. The determination of background absorbance is necessary only for samples, which have color absorbing at 880 nm.

Interferences
1. Silica forms a pale blue complex, which also absorbs at 880 nm. This interference is generally insignificant as a silicate concentration of approximately 5 mg SiO2/L would be required to produce a 0.14 µg P/L positive error in orthophosphate. See Section 11.2.
2. High iron can cause precipitation of and subsequent loss of phosphate from the dissolved phase.

3. Using ascorbic acid as the reductant, the color intensity is not influenced by variations in salinity. Stannous chloride reductant does show a significant salt effect.
4. Turbidity is removed by filtration.
5. Hydrogen sulfide effects, such as those occurring in samples from deep anoxic basins, can be treated by simple dilution since high sulfide concentrations are most often associated with high phosphate values.

Special Apparatus
Please see Parts and Price list for Ordering Information
1. Heating Unit
2. Glass calibration vials must be used for this method (Lachat Part No. 21304)

Preservation Method:
The nutrient processing methodology includes filtering 50 ml of a sample through 25 mm, 0.45 µm HV Millipore Durapore® membrane filters using a Becton, Dickinson and Co. (BD) 60ml polyethylene syringe with Luer-Lok® tip locked to a Millipore Swinnex 25 mm polypropylene filter holder. If a sample is particularly turbid, a 25 mm PALL A/E Glass Fiber Filter is used to filter the sample prior to filtering through the 0.45 µm Millipore filter. The liquid volume of the filtered sample is collected into a Fisherbrand 50 ml polypropylene centrifuge tube (after rinsing collection tube (3x) with sample) and placed in the freezer until brought down to the University of New Hampshire for analysis.

ii) Parameter: Nitrate + Nitrite

Method References:
University of New Hampshire Estuarine and Coastal Chemistry Laboratory

Revision Date: 2/27/2001
NO3 and NO2 31-107-04-1-A 0.005 to 5 uM N/L 0.07 to 70 mg N/L

Nitrate/Nitrite in Brackish Waters or Seawater
Method No: 31-107-04-1-A
Product Line: Flow Injection Analysis
Matrix: Brackish or seawater

Range

Analyte	**Range**	**MDL**	**Units**
Nitrate + Nitrite	1.25 to 5.0	0.03	µM N

Principle
Nitrate is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotization with sulfanilamide under acidic conditions to form a diazonium ion. The resulting diazonium ion is coupled with N-(1-naphthyl)ethylenediamine dihydrochloride. The resulting pink dye absorbs at 520 nm. Nitrate concentrations are obtained by

subtracting nitrite values, which have been previously analyzed, from the nitrite + nitrate values.

Though the method is written for seawater and brackish water, it is also applicable to non-saline sample matrixes.
The method is calibrated using standards prepared in deionized water. Once calibrated, samples of varying salinities (0 to 35 ppt) may be analyzed. The determination of background absorbance is necessary only for samples which have color absorbing at 540 nm. The salt effect is less than 2%.

Interferences
No Interferences

Special Apparatus
Please see Parts and Price list for Ordering Information
No Special Apparatus

Preservation Method:
The nutrient processing methodology includes filtering 50 ml of a sample through 25 mm, 0.45 µm HV Millipore Durapore® membrane filters using a Becton, Dickinson and Co. (BD) 60ml polyethylene syringe with Luer-Lok® tip locked to a Millipore Swinnex 25 mm polypropylene filter holder. If a sample is particularly turbid, a 25 mm PALL A/E Glass Fiber Filter is used to filter the sample prior to filtering through the 0.45 µm Millipore filter. The liquid volume of the filtered sample is collected into a Fisherbrand 50 ml polypropylene centrifuge tube (after rinsing collection tube (3x) with sample) and placed in the freezer until brought down to the University of New Hampshire for analysis.

iii) Parameter: Ammonia

Method References:
University of New Hampshire Estuarine and Coastal Chemistry Laboratory

Revision Date: 6/6/2001
NH4 QuickChem Method 31-107-06-1-A 0.07 to 3.57 uM

Ammonia (Phenolate) in Brackish Waters

Method No: 30-107-06-1-A
Product Line: Flow Injection Analysis
Matrix: Brackish waters
EPA Ref No: 350.1

Range

Analyte	**Range**	**MDL**	**Units**
Ammonia	0.1 to 20.0	N/A	mg N/L

Principle

This method is based on the Berthelot reaction. Ammonia reacts with alkaline phenol, then with sodium hypochlorite to form indophenol blue. Sodium nitroprusside (nitroferricyanide) is added to enhance sensitivity. The absorbance of the reaction product is measured at 630 nm, and is directly proportional to the ammonia concentration.

Interferences

1. EDTA is added to the sample in-line to prevent precipitation of calcium and magnesium as the hydroxides.
2. Color, and turbidity may interfere. Turbidity is removed by manual filtration. Sample color may be corrected for by running the samples through the manifold without color formation.
3. Residual chlorine must be removed prior to analysis.
4. The matrix can vary from fresh to deep-sea water salinity with no effect.

Special Apparatus

Please see Parts and Price list for Ordering Information

1. Heating Unit (Lachat Part No. A85100)

Preservation Method:

The nutrient processing methodology includes filtering 50 ml of a sample through 25 mm, 0.45 µm HV Millipore Durapore® membrane filters using a Becton, Dickinson and Co. (BD) 60ml polyethylene syringe with Luer-Lok® tip locked to a Millipore Swinnex 25 mm polypropylene filter holder. If a sample is particularly turbid, a 25 mm PALL A/E Glass Fiber Filter is used to filter the sample prior to filtering through the 0.45 µm Millipore filter. The liquid volume of the filtered sample is collected into a Fisherbrand 50 ml polypropylene centrifuge tube (after rinsing collection tube (3x) with sample) and placed in the freezer until brought down to the University of New Hampshire for analysis.

iv) Parameter: Silicate

Method References:

University of New Hampshire Estuarine and Coastal Chemistry Laboratory

Revision Date: 4/3/2001
SiO2 31-114-27-1-B 0.03 to 5 uM SiO2/L 0.5 to 100uM SiO2/L

Silicate in Brackish or Seawater

Method No: 31-114-27-1-B
Product Line: Flow Injection Analysis
Matrix: Brackish or seawater

Range

Analyte	**Range**	**MDL**	**Units**
Silicate	1.25 to 5.0	0.01	µM Si

Principle

Soluble silica species react with molybdate at 37 °C and pH of 1.2 to form a yellow silicamolybdate complex. This complex is subsequently reduced with stannous chloride to form a heteropoly blue complex which has an absorbance maximum at 820 nm. The intensity of the color is proportional to the concentration of "molybdate reactive" silica.

Though the method is written for Brackish and Seawater, it is also applicable to non-saline sample matrixes.

The method is calibrated using standards prepared in deionized water. Once calibrated, samples of varying salinities (0 to 35 ppt) may be analyzed. The determination of background absorbance is necessary only for samples which have color absorbing at 820 nm.

Interferences

1. Sample turbidity may interfere. Remove turbidity by filtration with a 0.45 µm pore diameter membrane filter prior to analysis.
2. Sample color may be subtracted by analyzing the samples with a substitute color reagent which does not contain molybdate. This is done by replacing the molybdate/sulfuric acid reagent with a solution containing 16 mL of sulfuric acid per liter.

Special Apparatus

Please see Parts and Price list for Ordering Information

1. Heating Unit (Lachat Part No. A85100)

Preservation Method:

The nutrient processing methodology includes filtering 50 ml of a sample through 25 mm, 0.45 µm HV Millipore Durapore® membrane filters using a Becton, Dickinson and Co. (BD) 60ml polyethylene syringe with Luer-Lok® tip locked to a Millipore Swinnex 25 mm polypropylene filter holder. If a sample is particularly turbid, a 25 mm PALL A/E Glass Fiber Filter is used to filter the sample prior to filtering through the 0.45 µm Millipore filter. The liquid volume of the filtered sample is collected into a Fisherbrand 50 ml polypropylene centrifuge tube (after rinsing collection tube (3x) with sample) and placed in the freezer until brought down to the University of New Hampshire for analysis.

v) Parameter: Chlorophyll *a*

Method References:

Wells National Estuarine Research Reserve Coastal Ecology Center Laboratory

Strickland, J.D.H., and Parson, T.R. 1972. A Practical Handbook of Seawater Analysis. Fish. Res. Bd. Canada 167:310.

TD-10-AU-005-CE Field Fluorometer Operating Manual. Version 1.4. April 1999. Turner Designs, 845 West Maude Avenue, Sunnyvale, CA 94086.

EPA - Method 445.0. *In Vitro* Determination of Chlorophyll a and Pheophytin a in Marine and Freshwater Algae by Fluorescence.

Using the Turner Designs Model 10 Analog, The 10AU Digital, Or the TD-700 Fluorometer with EPA Method 445.0. January 19, 1999. Turner Designs, 845 West Maude Avenue, Sunnyvale, CA 94086.

A Procedure For Measuring Extracted Chlorophyll *a* Free From The Errors Associated With Chlorophyll *b* and Pheopigments. Turner Designs, 845 West Maude Avenue, Sunnyvale, CA 94086. This method was developed by Dr. Nicholas A. Welschmeyer of Moss Landing Marine Laboratories, Moss Landing, CA. A paper by Dr. Welschmeyer, Fluorometric Analysis of Chlorophyll *a* in the presence of Chlorophyll *b* and Pheopigments, which details his research, appears in Limnology and Oceanography (June 1994).

Method Description:
Instrumentation: Turner Designs 10-AU-005-CE Field fluorometer.
The Chl-a processing methodology here at the Wells NERR Research Laboratory follows the non-acidification method, "A Procedure for Measuring Extracted Chlorophyll *a* Free From The Errors Associated With Chlorophyll *b* and Pheopigments", adapted from the EPA Method 445.0: "*In Vitro* Determination of Chlorophyll *a* and Pheophytin *a* in Marine and Freshwater Algae by Fluorescence." The method used requires filtering a known quantity of water through a glass fiber filter (47 mm GF/F). The sample is steeped in 90% acetone at least 2 hours and not exceeding 24 hours at 4ºC, in the dark. The samples are centrifuged and read on the fluorometer. If the samples cannot be read within that time period, they are stored in the research freezer.

Preservation Method:
This methodology includes filtering 600-1000 ml of a sample through 47 mm Whatman® GF/F filters using a vacuum pump and filter flask apparatus. The Whatman type GF/F filter is either folded immediately after sample filtering, enclosed in a waxine envelope, placed in a petri dish, wrapped with aluminum foil, placed in a sealed freezer bag, and placed in the freezer until it is ready for analysis, or directly placed in 90% acetone for 2-24 hours for immediate analysis. The final concentration of Chl-a = (F x v)/V; where F = the direct fluorescence reading, v = volume of the extract, and V = volume of sample filtered.

14) Reporting of Missing Data and Data with Concentrations Lower than Method Detection Limits –

Nutrient/Chla comment codes and definitions are provided in the following table. Missing data are denoted by a blank cell " " and commented coded with an "M". Laboratories in the NERRS System submit data that are censored at a lower detection rate limit, called the Method Detection Limit or MDL. MDL's for specific parameters are listed in the Laboratory Methods and Detection Limits Section (Section II, Part 14) of this document. Measured concentrations that are less than this limit are replaced with the minimum detection limit value and comment coded with a "B" in the variable code comment column. For example, the measured concentration of NO23F was 0.0005 mg/L as N (MDL=0.0008), the reported value would be 0.0008 with a "B" placed in the NO23F comment code column. Calculated parameters are comment coded with a "C" and if any of the components used in the calculation are below the MDL, the calculated value is removed and also comment coded with a "B". If a calculated value is negative, the value is removed and comment coded with an "N".

Note: The way below MDL values are handled in the NERRS SWMP dataset was changed in November of 2011. Previously, below MDL data from 2002-2006 were also coded with a B, but replaced with -

9999 place holders. Any 2002-2006 nutrient/pigment data downloaded from the CDMO prior to December November of 2011 will contain -9999s representing below MDL concentrations.

Comment Code	Definition
A	Value above upper limit of method detection
B	Value below method detection limit
C	Calculated value
D	Data deleted or calculated value could not be determined due to deleted data, see metadata for details
H	Sample held beyond specified holding time
K	Check metadata for further details
M	Data missing, sample never collected or calculated value could not be determined due to missing data
P	Significant precipitation (>/=0.25 inches occurred within 24 hours of sampling, >/=0.5 inches within 48 hours of sampling, and >/=0.75 inches occurred within 72 hours of sampling)
U	Lab analysis from unpreserved sample
S	Data suspect, see metadata for further details

Deleted data June 8, 2018 update:

In late 2017 and early 2018, inquiries were made about the accuracy of the 2002 nutrient data and it was determined that the data were extremely unreliable and mostly likely erroneous. As noted below, some samples were held until some point in 2004, long past NERRS accepted hold times. In addition, individual data points and averages were extremely elevated as compared to subsequent years indicating the potential for a unit conversion or similar error. There were no raw files to verify. 2002 was the first year of data collection and processing for the Wells NERR and the UNH lab that was initially utilized appeared unable to process samples in a timely manner and left the accuracy of their analyses in doubt. Wells NERR switched to a different laboratory in subsequent years and it was determined that all 2002 nutrient data should be removed from the record and coded with the letter D. Only chlorophyll-a data, which were processed in-house, remain in the data set. Users of this data were notified of the update.

May 2002 Notes:

•Missing nutrient data-5/1/02

There are missing nutrient data (except Chl-a) for HT site (replicates 1 and 2) and LM site (replicates 1 and 2) due to overfilling of the liquid volume of the filtered sample collected into a Fisherbrand 50 ml polypropylene centrifuge tube. The centrifuge tube broke open after the sample was frozen. The samples became exposed and were discarded.

•Missing nutrient data-5/21/02

There are missing nutrient data (except Chl-a) for HT site (replicates 1 and 2) and on 5/20 ISCO bottle 4B (replicate 2) due to overfilling of the liquid volume of the filtered sample collected into a Fisherbrand 50 ml polypropylene centrifuge tube. The centrifuge tube broke open after the sample was frozen. The samples became exposed and were discarded.

•Missing PO4F data-5/21/02
There is a missing PO4F datum for ISCO bottle 12B (replicate 2). This datum never was recorded in the spreadsheet created by the UNH Estuarine and Coastal Chemistry Laboratory.

June 2002 Notes:

•Missing Chl-a data-6/27/02
There is a missing Chl-a datum for ISCO bottle 2A (replicate 2) @ 13:00, as the filter on the filter apparatus was not set properly (it was off from center). The fluorescence reading was inaccurate and was deleted.

•Missing PO4F data-6/27/02
There is a missing PO4F datum for ISCO bottle 2A (replicate 1) @ 13:00. This datum never was recorded in the spreadsheet created by the UNH Estuarine and Coastal Chemistry Laboratory.

•Missing nutrient data-6/28/02
There are missing nutrient data (except Chl-a) for HT site (replicates 1 and 2) due to overfilling of the liquid volume of the filtered sample collected into a Fisherbrand 50 ml polypropylene centrifuge tube. The centrifuge tube broke open after the sample was frozen. The samples became exposed and were discarded.

July 2002 Notes:

•Missing Chl-a data-7/18/02
There is a missing Chl-a datum for ISCO bottle 6B (replicate 2), as the sample spilled before filtering.

•Missing nutrient data-7/19/02
There are missing nutrient data (except Chl-a) for HT site (replicates 1 and 2) due to overfilling of the liquid volume of the filtered sample collected into a Fisherbrand 50 ml polypropylene centrifuge tube. The centrifuge tube broke open after the sample was frozen. The samples became exposed and were discarded.

August 2002 Notes:

•ISCO Deployment-08/28/02
The ISCO could not be deployed this sample month, due to a missing intake tube. Two new intake tubes were ordered for the following month. The missing intake tube was never recovered.

•Missing data-08/28/02
We currently have not received (as of January 9, 2004) the nutrient data from the UNH Estuarine and Coastal Chemistry Laboratory from the grab samples for this month. The only nutrient data we currently have for this set is Chl-a, as we analyze this parameter on site. This missing data are due to the UNH instrument currently being down.

September 2002 Notes:

•Missing data-9/27/02

There were no grab samples taken at the IN site (replicates 1 and 2) this month.

November 2002 Notes:

•Missing data-11/07/02

We currently have not received (as of January 9, 2004) the Ammonium data for ISCO bottle 12A (replicate 1) from the UNH Estuarine and Coastal Chemistry Laboratory. A direct quote from the lab in their raw data spreadsheet: "One sample, 12A 11/7/02, will be rerun for NH4 soon". This missing datum is due to the UNH instrument currently being down.

15) QA/QC Programs – [This section describes field variability, laboratory variability, the use of inter-organizational splits, sample spikes, standards and cross calibration exercises.]

.

a) Precision:

vi) **Field Variability** – True field replicates are taken at each site during grab sampling. Both replicate grabs are taken simultaneously.

vii) **Laboratory Variability** – none

viii) **Inter-organizational splits** – samples were not split or analyzed by two different labs

b) Accuracy:

i) **Sample Spikes** – information unavailable

ii) **Standard Reference Material Analysis –** see lab protocols

ix) Cross Calibration Exercises – WNERR did not participate in cross calibration exercises.

16) Other Remarks –

On 07/22/2025 this dataset was updated to include embedded QAQC flags and codes for anomalous/suspect, rejected, missing, and below detection limit data. System-wide monitoring data beginning in 2007 were processed to allow for QAQC flags and codes to be embedded in the data files rather than using the original single letter codes used for the nutrient and pigment dataset along with the detailed sections in the metadata document for suspect, missing, and rejected data. Please note that prior to 2007, rejected data were deleted from the dataset so they are unavailable to be used at all. Suspect, missing, rejected and below minimum detection flags and appropriate three letter codes were embedded retroactively for dataset consistency. The QAQC flag/codes corresponding to the original letter codes are detailed below.

		Historic	
Flag/code	***If also C***	**Letter Code**	Historic Code Definition
<1> [SUL]		A	Value above upper limit of method detection
<-4> [SBL]	<-4> [SCB]	B	Value below method detection limit
no need to flag/code unless combined		C	Calculated value
<-3> [GQD]	<3> [GCR]	D	Data deleted or calculated value could not be determined due to deleted data, see metadata for details
<1> (CHB)		H	Sample held beyond specified holding time
<0> (CSM) unless other flag		K	Check metadata for further details
<-2> [GDM]	<-2> [GCM]	M	Data missing, sample never collected or calculated value could not be determined due to missing data
<-3> [SNV] and <1> [SCC] for components (CRE) or F_Record {CRE}		N	Negative calculated value
<0> (CUS)		P	Significant precipitation (reserve defined, see metadata for further details)
<1> (CSM)		U	Lab analysis from unpreserved sample
		S	Data suspect, see metadata for further details

August 2002 Notes:

•IN Site-08/28/02
Replicate (N=2) samples at the IN site are taken by pumping the sample up through the ISCO sampler. This method was followed on all sampling dates except for the 08/28/02 sampling date, where the ISCO intake tube was misplaced – the ISCO could not be deployed on this date. Grab samples were taken on this date 0.5 meters below the surface, as at the other sites.
-Because of not being able to deploy ISCO this month, we took two extra grab samples at the IN site for a total of 4 replicates.

Data Reporting & Rounding

According to Lachat Instruments (1-800-247-7613), the Quick Chem 8000, while running with the 2.0 software, has a precision to 4 decimal places (rounding up from 5).

Rainfall for 2002 (Bolded Dates are actual sample dates):

Month	Daily Precipitation Total (mm)
Apr 28	9.9
Apr 29	6.4
Apr 30	0.0
May 1	**0.0**
May 2	**17.3**
May 3	0.0
May 4	0.0
May 5	0.0
May 17	0.0
May 18	18.8
May 19	0.0
May 20	**0.0**
May 21	**0.0**
May 22	0.0
May 23	0.0
May 24	0.0
Jun 24	0.3
Jun 25	0.0
Jun 26	0.0
Jun 27	**5.3**
Jun 28	**8.1**
Jun 29	0.0
Jun 30	0.0
Jul 1	0.0
Jul 15	6.4
Jul 16	0.0
Jul 17	0.0
Jul 18	**0.0**

Jul 19	**1.0**
Jul 20	0.8
Jul 21	0.0
Jul 22	0.0
Aug 25	0.3
Aug 26	0.0
Aug 27	0.0
Aug 28	**0.0**
Aug 29	0.0
Aug 30	0.0
Aug 31	0.0
Sep 23	29.0
Sep 24	0.0
Sep 25	0.0
Sep 26	**0.3**
Sep 27	**15.2**
Sep 28	5.3
Sep 29	0.0
Sep 30	0.0
Oct 19	0.0
Oct 20	0.0
Oct 21	0.0
Oct 22	**0.0**
Oct 23	**7.1**
Oct 24	0.0
Oct 25	0.0
Oct 26	29.2
Nov 3	0.0
Nov 4	0.5
Nov 5	0.0
Nov 6	**23.1**
Nov 7	**0.0**
Nov 8	0.0
Nov 9	0.0
Nov 10	0.0
Dec 8	0.0
Dec 9	0.0
Dec 10	0.0
Dec 11	**0.0**
Dec 12	**8.9**
Dec 13	0.0
Dec 14	41.4
Dec 15	0.0