# Waquoit Bay NERR (WQB) Nutrient Metadata
# (January 2004 to December 2004)
**Latest Update January 6, 2012**

## I. Data Set and Research Descriptors

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2) **Research objectives**

The main purpose of the SWMP program is to aid Waquoit Bay NERR in one of its priority missions: to perform as a living laboratory and platform for coastal and estuarine research. The long term, continuous detailed monitoring of the estuary's basic hydro-physical, meteorological and chemical parameters are an essential tool and context for any research activities located here. Besides this overarching mission, there are also several specific research interests. One primary issue for the Waquoit Bay ecosystem is the influence of anthropogenic induced alterations by nitrogen enrichment. Waquoit Bay receives nitrogen from several sources, such as septic systems (their leachate percolates into groundwater which then enters the bay), run off from roads, run off containing domestic and agricultural fertilizer and animal waste, and atmospheric sources. This elevated nitrogen loading to the bay has resulted in enhanced eutrophication that has contributed to the alteration of the bay's habitats. For example, thick mats of seaweeds (macroalgae) now cover the bottom where eelgrass meadows thrived in the 1970's. Unfortunately, there are few definitive records of the bay's water quality conditions during that period, which makes it difficult to evaluate the rates of change. To facilitate future evaluation, long-term records from SWMP can be used to track water column conditions. Of obvious interest are measurements of dissolved nutrients in the bay's water column, as well as measurements of dissolved oxygen (DO), turbidity, and chlorophyll concentration. Such records will facilitate evaluation of changes which may come about from a continuation of watershed alteration that result from current development patterns (i.e., non-sewered residential areas served by private septic systems typically consisting of septic tanks and leach fields) as well as non-industrial commercial development, such as golf courses, cranberry bogs, and retail shopping outlets. The records will be useful for evaluating the efficacy of remediation efforts intended to reduce the nitrogen loading from these sources to Waquoit Bay.

Another focus of long-term research interest is the detection of climate change and the determination of its effects on the estuarine environment. Characterizing the variability of the various water column parameters, such as their scale, magnitude and frequency, is likely to be an important aspect of the estuarine ecosystem that may be sensitive to climate change. Related to this focus is an interest in the impact of storms (hurricanes and northeasters) and other extreme meteorological events on the estuary. For example, what temperature and wind field thresholds exist that might bring about or trigger certain conditions within the bay? The observations recorded by the SWMP will allow for these types of studies.

**a) Monthly Grab**

Monthly grab samples are collected to quantify the horizontal spatial and seasonal variability of important nutrients in the water column at the four long-term water quality monitoring sites located throughout the Waquoit Bay system representative of the local salinity and habitat gradients as well as differences in upland and marine influence.

**b) Diel Sampling Program**

Once per month, samples are collected every 135 minutes (2.25 hrs) through a lunar day tidal cycle (24.75 hrs) at the Childs River SWMP long-term water quality monitoring site to quantify the temporal variability of important nutrients in the water column as a function of tidal and daily cycle dynamics. The Childs River site was chosen specifically for this because it is one the most eutrophied.

3) **Research methods**

a) **Monthly Grab Sampling Program**

Monthly grab samples are taken at the four principal long term SWMP stations in the Waquoit Bay watershed (Metoxit Point, Child's River, Menauhant and Sage Lot Pond). Grab samples are taken on the same day, collected between +3 hours before slack low-water and slack low-water. No distinction is made between neap and spring tide conditions. Efforts are made to collect samples at approximately monthly (30 day) intervals (roughly mid-month). Grab samples are reflective of the water mass sampled by the water quality data sonde, at depths approximately 0.5 m above the bottom. Samples were taken following SWMP protocol, with two sequential grab samples (in immediate sequence – 1-3 minute interval between samples) obtained from each site. This resulted in a total of eight grab samples from 4 sites. At the time of sample collection, water temperature, salinity, pH and dissolved oxygen were also measured with an YSI 650. All samples are collected in amber, wide-mouth, Nalgene 1000mL sample bottles that were precleaned with 10% HCL and rinsed 3 times with distilled water. Samples are collected using a 1L van Doren sampler and rinsing the sample bottle 3 times with ambient water prior to collection of the sample. Samples are immediately returned to the lab (within one hour) to be filtered for nutrients and chlorophyll, and frozen (-20° C). The pre-baked (400 C) glass filters that are used for filtering nutrients are also kept and frozen for PC/PN analysis. In 2004, the frozen nutrient samples (including particulate filters) were delivered the to the trace element laboratory at University of Massachusetts-Boston within 1-7 days for analysis. In 2004, samples were not taken from the Sage Lot and Metoxit Point sites during January, February and March due to severe winter conditions and ice over at these two stations. No samples from any of the four stations were taken in July 2004 due to staffing difficulties at the Reserve.

b) **Diel Sampling Program**

Diel (24.75 hr or 2-full tidal cycles) grab samples are taken monthly at the Child's River long-term SWMP water quality station, and diel sampling is scheduled to overlap with the monthly grab sampling. Diel sampling generally begins in the morning and is scheduled without regard for tide state as it captures 2 full tidal cycles in any case (also no distinction is made between neap and spring tide conditions). Twelve samples are collected over a lunar day (24hr and 45min) time period at 2.25 hour intervals using an ISCO auto-sampler. Sampling depth of the ISCO ranges between 0.5 to 1.2 meters depending on the tidal stage, but the sampling height above the bottom is fixed at 0.4 meters, where the adjacent YSI data sonde sensors are located. Samples are collected in 1000mL clear polypropylene bottles (kept dark inside the ISCO until returning to the lab) that are pre-cleaned with 10% HCl and rinsed 3 times with distilled water. Due to the use of ISCO auto samplers, ambient water rinses prior to sample collection are not possible. During the summer months ice is added inside the ISCO sampler in an effort to decrease sample alteration by providing cold storage conditions. All samples are filtered for nutrients and chlorophyll once the ISCO has completed the sampling cycle. The frozen nutrient samples (-20° C) are delivered to the trace metal element lab at UMass Boston for analysis within 1-7 days along with the grabs samples.

4) **Site location and character**

a) General description of Waquoit Bay estuarine system:

The Waquoit Bay National Estuarine Research Reserve (WBNERR) is located in the northeastern United States on the southern coast of Cape Cod, Massachusetts. About 8,000

people maintain permanent residency in Waquoit Bay's drainage area, which covers parts of the towns of Falmouth, Mashpee, and Sandwich. During summer months, the population swells 2-3 times with the greatest housing concentrations immediate to the coastline (water views and frontage). In addition, the upper portions of the watershed include a military base, Otis Air Force Base and the Massachusetts Military Reservation, portions of which have been designated by the EPA as Superfund sites due to past practices of dumping jet fuel and other volatile groundwater contaminants.

WBNERR's estuaries are representative of shallow tidal lagoons that occur from Cape Cod to Sandy Hook, New Jersey. WBNERR is within the northern edge of the Virginian biogeographic province, on the transitional border (Cape Cod) with the Acadian biogeographic province to the north and east. Like many embayments located on glacial outwash plains, Waquoit Bay is shallow (< 5 m), fronted by prominent barrier beaches (i.e., those of South Cape Beach State Park and Washburn Island), and is backed by salt marshes and upland coastal forests of scrub pine and oak. Two narrow, navigable inlets, reinforced with granite jetties, pass through two barrier beaches to connect Waquoit Bay with Vineyard Sound to the south. A third shallow and generally un-navigable inlet opened through the Washburn Island barrier beach during Hurricane Bob in August 1991, finally closed up in February 2002.

b) The Metoxit Point station (MP) (41$^{o}$ 34.131' N 070$^{o}$ 31.294' W, 2.2 m deep) is located in the main basin of Waquoit Bay and was selected to be within or near the outer regions of the gyre (described above) and more or less represents "typical" water mass conditions and residence times for the bay. The location is at least a half mile from shore, well flushed by tides, and is in an area that is minimally disturbed by routine activities on the bay (e.g. boat traffic, shell fishing, etc.). Bottom sediments at the site are organic rich muds overlain by thick algal mats. Because of this site's fairly open exposure to south (greatest fetch over the bay), we have observed that when sustained southerly winds are greater than about 20 kts, the Metoxit Point site experiences increased turbidity (sediment suspension event). A mean tidal range of 0.46m (SD = 0.17) is calculated based on one month of data (May 2003), with a minimum of 0.13 m and a maximum of 0.91 m. Mean monthly salinity range for 2002 is 4.2 ppt from a mean monthly minimum of 27.8 ppt to 32.0 ppt.

c) The Menauhant station (MH) (41$^{o}$ 33.156' N 070$^{o}$ 32.912' W, 1.2 m deep) is located within the Eel Pond Inlet at the Menauhant Yacht Club dock. Eel Pond Inlet is the westernmost of the two main tidal inlets into the Waquoit Bay system. The site was chosen because it occupies one of the strategic locations for gauging the system's water mass characteristics. Entering waters represent the marine end-member while outflows represent the final product of estuarine water mass modification and export to shelf waters. The site also has easy walk-in access to a secure private pier that extends into the throat of the inlet. Also, because of the turbulent tidal flow within the inlet, conditions are vertically well mixed, and the site can be maintained year round even through ice-over conditions in the rest of the bay. Bottom sediments at this site are clean sands and gravels with almost no attached bottom vegetation. Since inception, we have noted that strong south to southeast (onshore) winds tend to produce turbidity events at this site from the wave induced suspension of fine sediments and organic material in the upstream near-shore zone. While we have found that these types of turbidity events are localized to windward near-shore areas in the bay, the transport of these sediments at inlet mouths during such times is perhaps a dominant sedimentation process within the estuarine system. In other words while the choice of our location may be producing a localized signal in one of our measured parameters that signal may reflect key processes in the system at large. A mean tidal range of 0.48m (SD = 0.19) is calculated based on one month of data (May 2003), with a minimum of 0.11 m and a maximum of 0.99 m. Mean

monthly salinity range for 2002 is 3.9 ppt from a mean monthly minimum of 28.5 ppt to 32.4 ppt.

d) The Child's River station (CR) (41° 34.793' N 070° 31.854' W, 1.2 m deep) is located on a dock piling at Edwards Boat Yard, a commercial marina near the upper tidal reaches of Child's River— the second largest input of surface freshwater to the bay. It runs through densely developed residential areas. The Childs River sub-watershed receives the highest nitrogen loading and is the largest nitrogen contributor to the Waquoit Bay system of all the sub-watersheds. In the upper tidal portions of the river we have consistently recorded the highest chlorophyll levels and the lowest dissolved oxygen readings of any region in the bay and so this location represents an end-member for looking at anthropogenic inputs and impacts on the system. This location is very strongly stratified, characterized by a salt wedge with fresher river water overlying saline ocean water. Vertical salinity ranges can run from 0-10 ppm at the surface to more than 30 ppm just 1 m below. The sonde sensors are usually well within the salt wedge portion of the water column, nonetheless this location is also our freshest SWMP site, and is at the opposite end of Child's River from the seaward Menauhant station. Bottom sediments are fine organic rich muds. This location represents the most terrigenously and anthropogenically-impacted SWMP site. Monthly water quality, collected near this location for the past decade, shows very high chlorophyll concentrations during the warmer months and more recent dissolved nutrient records show very high nutrient-loads. Boat traffic at the marina likely leads to increased turbidity during the boating season as well. As this site is dockside at a private marina, general security is high along with easy access. The station is also serviceable year-round and usually not subject to seasonal shutdown due to ice over. A mean tidal range of 0.46 m (SD = 0.17) is calculated based on one month of data (May 2003), with a minimum of 0.11 m and a maximum of 0.95 m. Mean monthly salinity range for 2002 is 14.7 ppt from a mean monthly minimum of 15.8 ppt to 30.5 ppt.

e) The Sage Lot station (SL) (41° 33.254' N 070° 30.612' W, 1.2 m deep) is located in deeper portion of Sage Lot Pond – a small sub-estuary of Waquoit Bay (20 ha) surrounded by salt marsh and barrier beach. Its small watershed is the least developed of all of Waquoit Bay's sub-watersheds and Sage Lot Pond is considered to be its least impacted and most pristine sub-estuary. Bottom sediments are organic rich muds. Sage Lot Pond possesses one of the few remaining eelgrass beds in the Waquoit Bay system. Indeed the Child's River and Sage Lot Pond sites are considered to represent opposite end-members of nutrient-loading and human-induced influence. Researchers often locate their experiments in these two locations to take advantage of this difference. However, Sage Lot Pond is hydrologically connected to an upstream brackish source -- Flat Pond – via a series of tidal creeks, drainage ditches and culverts. Flat Pond borders a country club and golf course and some concern exists for its impact on the water quality of Sage Lot Pond. A mean tidal range of 0.40m (SD = 0.14) is calculated based on one month of data (May 2003), with a minimum of 0.11 m and a maximum of 0.67 m. Mean monthly salinity range for 2002 is 4.9 ppt from a mean monthly minimum of 27.2 ppt to 32.1 ppt.

5) **Code Variable Definitions**

Wqbcrnut – Waquoit Bay NERR Child's River nutrients
Wqbmhnut – Waquoit Bay NERR Menauhant Yacht Club nutrients
Wqbmpnut – Waquoit Bay NERR Metoxit Point nutrients
Wqbslnut – Waquoit Bay NERR Sage Lot Pond nutrients

1 – grab sample (collected with van Doren sampler)
2 – diel sample (collected with ISCO)

6) **Data collection period**

**Diel Sampling:**

| Site | Start Date | Start Time | End Date | End Time |
|---|---|---|---|---|
| CR | 1/13/04 | 10:30 | 1/13/04 | 19:30 |
| CR | 2/11/04 | 10:25 | 2/12/04 | 11:10 |
| CR | 3/10/04 | 10:25 | 3/11/04 | 8:55 |
| CR | 4/14/04 | 10:27 | 4/15/04 | 11:12 |
| CR | 5/11/04 | 9:23 | 5/12/04 | 10:08 |
| CR | 6/21/04 | 8:10 | 6/22/04 | 8:55 |
| CR | 8/25/04 | 10:10 | 8/26/04 | 11:40 |
| CR | 9/21/04 | 9:55 | 9/22/04 | 11:25 |
| CR | 10/27/04 | 10:12 | 10/28/04 | 10:57 |
| CR | 11/22/04 | 14:15 | 11/23/04 | 15:00 |
| CR | 12/20/04 | 9:20 | 12/21/04 | 10:05 |

**Grab Sampling:**

Sage Lot Pond

| Site | Start Date | Start Time | End Date | End Time |
|---|---|---|---|---|
| SL | 4/14/04 | 14:45 | 4/14/04 | 14:48 |
| SL | 5/11/04 | 10:11 | 5/11/04 | 10:14 |
| SL | 6/21/04 | 10:01 | 6/21/04 | 10:04 |
| SL | 8/26/04 | 13:50 | 8/26/04 | 13:53 |
| SL | 9/22/04 | 10:50 | 9/22/04 | 10:53 |
| SL | 10/27/04 | 14:08 | 10/27/04 | 14:11 |
| SL | 11/23/04 | 13:24 | 11/23/04 | 13:27 |
| SL | 12/21/04 | 13:05 | 12/21/04 | 13:08 |

Metoxit Point

| Site | Start Date | Start Time | End Date | End Time |
|---|---|---|---|---|
| MP | 4/14/04 | 15:45 | 4/14/04 | 15:48 |
| MP | 5/11/04 | 8:42 | 5/11/04 | 8:45 |
| MP | 6/21/04 | 8:58 | 6/21/04 | 9:01 |
| MP | 8/26/04 | 13:08 | 8/26/04 | 13:11 |
| MP | 9/22/04 | 12:15 | 9/22/04 | 12:18 |
| MP | 10/27/04 | 15:05 | 10/27/04 | 15:08 |
| MP | 11/23/04 | 14:20 | 11/23/04 | 14:23 |
| MP | 12/21/04 | 14:20 | 12/21/04 | 14:23 |

Child's River

| Site | Start Date | Start Time | End Date | End Time |
|---|---|---|---|---|
| CR | 1/13/04 | 10:25 | 1/13/04 | 10:28 |
| CR | 2/12/04 | 10:51 | 2/12/04 | 10:54 |

| | | | | |
|---|---|---|---|---|
| CR | 3/10/04 | 11:32 | 3/10/04 | 11:37 |
| CR | 4/14/04 | 14:15 | 4/14/04 | 14:18 |
| CR | 5/11/04 | 9:14 | 5/11/04 | 9:17 |
| CR | 6/21/04 | 8:07 | 6/21/04 | 8:11 |
| CR | 8/26/04 | 11:08 | 8/26/04 | 11:11 |
| CR | 9/22/04 | 11:20 | 9/22/04 | 11:23 |
| CR | 10/27/04 | 13:22 | 10/27/04 | 13:25 |
| CR | 11/23/04 | 12:56 | 11/23/04 | 12:59 |
| CR | 12/21/04 | 11:15 | 12/21/04 | 11:18 |

Menauhant

| Site | Start Date | Start Time | End Date | End Time |
|---|---|---|---|---|
| MH | 1/13/04 | 10:05 | 1/13/04 | 10:08 |
| MH | 2/12/04 | 10:25 | 2/12/04 | 10:28 |
| MH | 3/10/04 | 10:53 | 3/10/04 | 10:58 |
| MH | 4/14/04 | 14:00 | 4/14/04 | 14:03 |
| MH | 5/11/04 | 9:35 | 5/11/04 | 9:38 |
| MH | 6/21/04 | 8:27 | 6/21/04 | 8:30 |
| MH | 8/26/04 | 10:50 | 8/26/04 | 10:53 |
| MH | 9/22/04 | 9:45 | 9/22/04 | 9:48 |
| MH | 10/27/04 | 13:08 | 10/27/04 | 13:11 |
| MH | 11/23/04 | 12:41 | 11/23/04 | 12:44 |
| MH | 12/21/04 | 10:40 | 12/21/04 | 10:43 |

7) **Associated researchers and projects**

a) SWMP Water Quality Monitoring data
In order to understand long-term changes in water quality, YSI 6600UPG data loggers are deployed. Measurements of dissolved oxygen, salinity, temperature, pH, depth and turbidity are taken every 30 minutes, continuously at each of the 4 sites. The data collected provides background data for other research about the ecology of these habitats. Visit http://cdmo.baruch.sc.edu/ if you are interested in the data.

b) Bay Watchers
Bay Watchers is a Citizen Water Quality Monitoring group based in Waquoit Bay. Volunteers measure for dissolved oxygen concentration, salinity, temperature (air and water), water clarity (using secchi depth), chlorophyll-a and nutrients at 7 sites throughout the Reserve. Visit http://www.waquoitbayreserve.org/baywatch.htm to view the data.

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 and weather 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.

9) **Entry verification** –

The nutrient data is imported directly from the instrument into an excel file. Therefore, it is not possible for human error to occur during data entry. The data is then checked over by Gordon Wallace at the UMASS lab before being sent to WQB as an excel spreadsheet. The data units are converted to mg/L from uM/L by WQB's lab technician Heather Tschaekofske. She also checked the chlorophyll and field parameters 100% against the field notebooks and data sheets.

10) **Parameter Titles and Variable Names by Data Category**

Required NOAA/NERRS System-wide Monitoring Program water quality parameters are denoted by an asterisks "*".

| 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 |
| | Total Dissolved Nitrogen | TDN | mg/L as N |
| | Dissolved Organic Nitrogen | DON | mg/L as N |
| | Particulate Organic Nitrogen | PON | mg/L as N |
| | Total Nitrogen | TN | mg/L as N |
| Carbon: | Particulate Organic Carbon | POC | mg/L as C |
| Other Lab Parameters: | | | |
| | Chlorophyll a | CHLA | µg/L |
| | Phaeophytin | PHEA | µg/L |
| | Silicate | SiO4F | mg/L as Si |

Field Parameters:

| | | |
|---|---|---|
| Dissolved Oxygen | DO_N | mg/L |
| %Dissolved Oxygen Saturation | DO_S_N | % |
| pH | PH_N | standard units |
| Salinity | SALT_N | ppt |
| Water Temperature | WTEM_N | °C |

Notes:
1. Time is coded based on a 2400 hour clock and all times are changed to Eastern Standard Time (EST).
2. Waquoit Bay Reserve was measured NO2 until July 2003 after one year of monthly measurements, when it was determined that NO2 was usually an insignificant component of DIN. Since July 2003 NO23 and NH4 were the only measured DIN species.
3. PON/POC began to be measured in April 2003, allowing calculation of TN.

11) **Measured and Calculated Laboratory Parameters –**

i) **Variables Measured Directly**

| | |
|---|---|
| Nitrogen species: | NO23F, NH4F, TDN, PON |
| Carbon species: | POC |
| Phosphorus species: | PO4F |
| Other: | CHLA, PHAE, SiO4F |

ii) Computed Variables

| | |
|---|---|
| DIN: | NO23F+NH4F |
| DON: | TDN-NH4F-NO23F |
| TN: | TDN+PON |

12) **Limits of Detection**

Table 1. **Method Detection Limits** (MDL) for measured water quality parameters for each sample month's nutrient analysis

| | NO23 F (mg/L) | NH4 F (mg/L) | PO4 F (mg/L) | PON / POC mg on filter | TDN (mg/L) | Chla (ug/L) | Phea (ug/L) |
|---|---|---|---|---|---|---|---|
| January 2004 | 0.001 | 0.001 | 0.002 | 0.03/0.07 | .044 | 3.85 | 5.32 |
| February 2004 | 0.002 | 0.005 | 0.001 | 0.03/0.07 | .044 | 2.13 | 6.01 |
| March 2004 | 0.001 | 0.002 | 0.001 | - | .044 | 1.94 | 2.93 |
| April 2004 | 0.002 | 0.005 | 0.001 | 0.003/0.004 | .044 | 2.41 | 3.56 |
| May 2004 | 0.002 | 0.004 | 0.002 | 0.002/0.004 | .044 | 3.36 | 4.59 |
| June 2004 | 0.002 | 0.002 | 0.002 | 0.002 | .019 | 1.85 | 1.85 |
| August 2004 | 0.001 | 0.004 | 0.001 | 0.003/0.002 | .013 | 0.11 | 0.18 |
| September 2004 | 0.001 | 0.005 | 0.004 | 0.004/0.002 | .013 | 0.08 | 0.13 |
| October 2004 | 0.000 | 0.002 | 0.003 | 0.004/0.002 | .013 | 0.19 | 0.35 |
| November 2004 | 0.000 | 0.002 | 0.003 | 0.002/0.004 | .013 | 0.09 | 0.16 |
| December 2004 | 0.001 | 0.004 | 0.000 | 0.001/0.003 | .013 | 0.09 | 0.16 |

MDLs for NO23F, NH4F, PO4F, PON/POC and TDN are determined by the UMASS laboratory. Monthly MDLs for Chla and Phae are calculated by WBNERR as 3 times the Standard Deviation of the blank Chla values (ug/L) using the range of sample volumes filtered for each month. Note that

prior to July 2004, only 3 blanks were run at the start of monthly analyses versus 6 blanks from July onward.

13) **Laboratory Methods**

i) **Parameter: NH4F**
UMass Boston Laboratory SOP # Nut_03
See Appendix A

ii) **Parameter: NO23F**
UMass Boston Laboratory SOP # Nut_02
See Appendix B

iii) **Parameter: PO4F**
UMass Boston Laboratory SOP # Nut_04
See Appendix C

iv) **Parameter: POC/PON**
UMass Boston Laboratory
See Appendix E

v) **Parameter: Silicate**
Waquoit Bay NERR Laboratory
See Appendix F

vi) **Parameter: Chlorophyll *a* and Phaeophytin**
Waquoit Bay NERR Laboratory
See Appendix G

Changes in the analysis of this year's samples include a switch from the Bran-Luebbe Traacs 800 Nutrient Analyzer to a new Lachat QuikChem 8500 Flow Injection Nutrient Analyzer recently added to the Trace Element Analytical Facility (TEAF) at UMass-Boston. The QuikChem 8500 chemistry is only slightly different than the Traacs chemistry and the method consistent with and approved by the EPA. The laboratory benchmark for performance continues to be the available NIST or other reference standards. The same 'multi-standard' is used as with the Bran Leubbe nutrient analyzer. The SOP's methods are similar between the two machines, except that the QuikChem 8500 utilizes slow injection. The new SOP is expected to be completed this year.

14) **Reporting of Missing Data, Data with Concentrations Lower than Method Detection Limits *etc***

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 (reserve defined, see metadata for further details) |
| U | Lab analysis from unpreserved sample |
| S | Data suspect, see metadata for further details |

The Comment code "K" for the 2004 metadata represents a value that is the average of the 'first' run and the analytical duplicate run when analyzed at the UMass laboratory.

**Missing Data:**

January 2004:

No grab samples were collected from Sage Lot and Metoxit Point in January due to complete ice over and removal of water quality instrumentation from these water access only sites.

February 2004:

No grab samples were collected from Sage Lot and Metoxit Point in January due to complete ice over and removal of water quality instrumentation from these water access only sites.

The Childs River D4 sample for TDN was contaminated, therefore TN and DON were also contaminated, and data were not included.

March 2004:

No grab samples were collected from Sage Lot and Metoxit Point in March due ice over and removal of water quality instrumentation from these water access only sites.

All PON and POC data are missing for all sites in March, lost at lab.

July 2004:

No grab or diel samples were taken due to staff turnover.

**Suspect data:**

August 2004:

Probable contamination of PON sample for Metoxit Point A, data suspect as is derived TN value.

October 2004:

PO4F concentration high due to air spike for Menauhant B, data suspect.

November 2004:

Probable contamination of NH4F sample for Childs River D11, data suspect.

15) **QA/QC Programs –**

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a) **Precision –**

i) **Field Variability** – WQBNERR collects two successive grab samples for the monthly grab sample program.

ii) **Laboratory Variability** – The UMass laboratory analyzed replicates on 10%of our samples.

iii) **Inter-organizational splits** – none.

b) **Accuracy –**

i) **Sample Spikes** – see lab protocols

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

iii) **Cross Calibration Exercises** – September 2003-NERRs-wide inter-lab reference comparison.

16) **Other Remarks**

**Precipitation Totals**

| **January** | **2004** |
|---|---|
| 15 | 0.5 |
| 18 | 14.5 |
| 28 | 3.6 |
| Monthly Total | 18.6 |

| **February** | **2004** |
|---|---|
| 3 | 11.9 |
| 6 | 37.6 |
| 7 | 5.6 |
| 18 | 13 |
| 21 | 3.3 |
| Monthly Total | 71.4 |

| **March** | **2004** |
|---|---|
| 4 | 1 |
| 5 | 0.5 |
| 6 | 13.7 |
| 8 | 4.1 |
| 11 | 12.7 |
| 16 | 12.2 |
| 17 | 3 |
| 18 | 1.3 |
| 19 | 7.1 |
| 20 | 3.3 |
| 21 | 12.2 |
| 25 | 1.8 |
| 26 | 0.3 |
| 27 | 6.6 |
| 28 | 0.3 |
| 31 | 5.6 |
| Monthly Total | 85.7 |

| **April** | **2004** |
|---|---|
| 1 | 41.4 |
| 3 | 0.5 |
| 4 | 22.6 |
| 5 | 4.3 |
| 11 | 0.5 |
| 12 | 2.8 |
| 13 | 17.5 |

| | |
|---|---|
| 14 | 16 |
| 15 | 0.3 |
| 23 | 2 |
| 24 | 10.4 |
| 26 | 16 |
| 27 | 5.1 |
| 28 | 10.2 |
| Monthly Total | 149.6 |

**May** **2004**

| | |
|---|---|
| 2 | 1 |
| 3 | 9.7 |
| 4 | 9.1 |
| 5 | 0.3 |
| 9 | 2.3 |
| 19 | 0.5 |
| 22 | 0.3 |
| 23 | 0.5 |
| 24 | 18.5 |
| 26 | 3.6 |
| 27 | 4.1 |
| 28 | 26.4 |
| Monthly Total | 76.3 |

**June** **2004**

| | |
|---|---|
| 1 | 19.3 |
| 3 | 2.8 |
| 6 | 14 |
| 7 | 0.3 |
| 14 | 9.1 |
| 17 | 0.5 |
| 18 | 1.8 |
| 19 | 1.8 |
| 22 | 2.5 |
| 29 | 3 |
| Monthly Total | 55.1 |

**July** **2004**

| | |
|---|---|
| 2 | 8.6 |
| 5 | 12.4 |
| 11 | 0.8 |
| 13 | 6.9 |
| 14 | 1.5 |
| 28 | 21.3 |
| 29 | 0.5 |

| | |
|---|---|
| Monthly Total | 52.0 |

| **August** | **2004** |
|---|---|
| 1 | 0.5 |
| 5 | 7.6 |
| 13 | 14.2 |
| 15 | 53.8 |
| 16 | 10.7 |
| 18 | 0.8 |
| 21 | 5.6 |
| 27 | 0.3 |
| 30 | 0.3 |
| 31 | 53.6 |

| | |
|---|---|
| Monthly Total | 147.4 |

| **September** | **2004** |
|---|---|
| 7 | 0.5 |
| 9 | 0.5 |
| 14 | 0.3 |
| 15 | 6.4 |
| 16 | 10.9 |
| 18 | 40.1 |
| 28 | 36.8 |
| 29 | 83.6 |
| 1 | 0.5 |

| | |
|---|---|
| Monthly Total | 179.6 |

| **October** | **2004** |
|---|---|
| 1 | 0.3 |
| 2 | 2 |
| 10 | 0.5 |
| 12 | 0.3 |
| 14 | 0.8 |
| 15 | 11.2 |
| 16 | 9.7 |
| 17 | 0.3 |
| 19 | 23.4 |
| 20 | 0.3 |
| 22 | 0.3 |
| 23 | 0.3 |
| 24 | 0.8 |
| 25 | 0.5 |
| 26 | 0.3 |
| 31 | 0.3 |

| | |
|---|---|
| Monthly Total | 51.3 |

**November 2004**

| | |
|---|---|
| 3 | 0.8 |
| 4 | 19.6 |
| 5 | 7.9 |
| 12 | 18.3 |
| 13 | 30.2 |
| 20 | 2.8 |
| 21 | 4.1 |
| 24 | 3.6 |
| 25 | 16 |
| 28 | 14 |

Monthly Total 117.3

**December 2004**

| | |
|---|---|
| 1 | 22.4 |
| 3 | 3.3 |
| 7 | 29.5 |
| 8 | 0.8 |
| 9 | 2.5 |
| 10 | 24.4 |
| 11 | 0.3 |
| 12 | 0.5 |
| 13 | 3.8 |
| 18 | 2.5 |
| 19 | 0.5 |
| 20 | 0.8 |
| 23 | 17.3 |
| 24 | 1.5 |
| 26 | 18.8 |
| 27 | 6.4 |
| 28 | 3 |
| 29 | 0.3 |

Monthly Total 138.6

**Annual Total** 1142.9 mm (45.0 in)