

Jacques Cousteau (JAC) NERR 2020 Nutrient Metadata
January 2020-December 2020
Latest Update: October 15, 2025

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

a) Reserve contact

Thomas M. Grothues
Associate Research Professor
JAC NERR Research Coordinator
Rutgers University Marine Field Station
800 c/o 132 Great Bay Blvd.
Tuckerton, NJ 08087
609-249-8802
grothues@marine.rutgers.edu

b) Laboratory contact

Ron J. Lauck
Lab Manager / Program Assistant
Department of Ecology, Evolution, and Natural Resources (DEENR)
Rutgers, The State University of New Jersey
14 College Farm Road
New Brunswick, NJ 08901
848-932-5788
lauck@envsci.rutgers.edu

c) Other contacts

Gregg P. Sakowicz
Field Researcher IV, SWMP Technician
Jacques Cousteau National Estuarine Research Reserve
N.J. Agricultural Experiment Station
Rutgers University
130 Great Bay Blvd.
Tuckerton, NJ 08087
609-249-8805
e-mail: sakowicz@marine.rutgers.edu

2) Research objectives

a) Monthly grab sampling program

Monthly grab samples for the Jacques Cousteau National Estuarine Research Reserve (JAC NERR) are taken along a well-defined salinity gradient of the Mullica River-Great Bay estuarine system. The sites where the samples are taken along this salinity gradient include Lower Bank and Chestnut Neck in the Mullica River and Buoy 126 and Buoy 139 in Great Bay (see site descriptions below). These four sampling sites span a distance of more than 30 km. In addition a monthly grab sample is taken in Little Egg Harbor estuary at Buoy 115 (see site description below). A major objective of this monitoring program is to determine the nutrient concentrations along the aforementioned salinity gradient over a long-term time series. Previous studies have shown that nitrogen standing stocks in the Mullica River-Great Bay Estuary largely consist of nitrate, ammonium, and nitrogen in organic combination. The nitrogen enters at the head of the estuary largely in inorganic form, but in Great Bay it is transformed mainly to organic combination. However, more data are needed to accurately assess the concentrations of the various nitrogen forms along the salinity gradient, and to determine seasonal variations in the concentrations over a protracted period of several years. It is also necessary to obtain continuous monthly measurements of phosphate, which is also a macronutrient of considerable importance to the system.

Monthly grab samples are needed to obtain accurate measurements of nitrate, ammonium, and phosphate because of their overriding importance to primary production in waters of the JAC NERR. These data can then be compared to chlorophyll *a* measurements to assess their relationship to phytoplankton biomass. A major goal of JAC NERR is to characterize biotic communities along the salinity gradient of the Mullica River-Great Bay Estuary, and it is therefore vital to obtain physical-chemical measurements (including nutrient concentrations) along the gradient. A part of this effort is to determine the nutrient concentrations along the salinity gradient, and how these concentrations are influencing biotic processes down-estuary. In addition, a long-term objective of monthly grab sampling is to develop a nutrient (nitrogen) budget for JAC NERR. To develop a budget, data (concentrations) are needed on the various nitrogen species monitored at the SWMP sites as well as data collected on the nitrogen forms associated with atmospheric deposition. An accurate nutrient budget will be useful for analyzing the overall productivity of estuarine waters in the JAC NERR, which will be important to resource managers of the system.

b) Diel sampling program

Diel sampling is conducted via an ISCO automated sampler at Chestnut Neck in the Mullica River to assess nutrient concentrations and changes in concentrations over tidal cycles. These data augment/are augmented by monthly grab samples taken at Chestnut Neck (see above). This is a change from prior years when the ISCO sampler was located at Channel Marker 126; this change was opted to study and better understand the influence of nutrients (particularly runoff) on the lower Mullica River, an area of interest for natural shellfish recruitment as well as nearby shellfish farms. This location is co-located with the jacnewq water-monitoring station, as well as being the closest option to the JAC NERR's jacnemet meteorological station.

3) Research methods

a) Monthly grab sampling program

Monthly grab samples were taken at four stations within the Mullica River-Great Bay estuary and at one station in the Little Egg Harbor estuary. Samples were taken at four primary SWMP JAC NERR datasonde stations (Buoy 126, Buoy 139, Chestnut Neck and Lower Bank) and at one station in Little Egg Harbor estuary (Buoy 115), which is considered a secondary SWMP station for nutrient/pigments. Samples were collected at approximately 30-day intervals. Effort was made to obtain grab samples at or before slack low tide conditions (+3 hour before low tide), approximately one month after the previous sampling period. No distinction was made between neap and spring tide conditions. Water-related field parameters were measured in situ with a YSI/Xylem EXO2 datasonde paired with a YSI/Xylem 599150 EXO handheld display unit and manually recorded on a field datasheet. Weather-related field parameters were assessed by observation and estimation. Replicate (N=2) samples were collected by hand with a bucket at an approximate depth of 10 cm. All samples were collected in amber 500 ml Nalgene sample bottles that were previously acid washed (15 % H_2SO_4), rinsed (5x) with distilled-deionized water, and rinsed (1x) with ambient water prior to collection of the sample. Samples were immediately placed on ice in a cooler and returned to the laboratory at the Rutgers Marine Field Station. Once in the laboratory, samples were inverted several times to homogenize the sample and processed for nutrient and Chl a analysis. Samples were then frozen in a -20°C freezer at RMFS and transported to the Department of Ecology, Evolution, and Natural Resources (DEENR) at Rutgers University as soon as possible thereafter. Once the filtered samples arrived at DEENR, the processed samples were stored in a -20°C freezer until analyses were performed.

b) Diel sampling program

Monthly diel samples were taken at the principle long-term datasonde station Chestnut Neck (jacnewq). This constitutes a change from previous years during which diel sampling was conducted at the Buoy 126 (jacb6wq) station. This change was done to sample waters exchanged by/in the mouth of the Mullica River, targeting areas of natural and commercial shellfish beds. Samples were collected at approximately 30-day intervals. Sampling occurred during any tidal condition and no distinction was made between spring and neap tide conditions. Twelve samples were collected over a lunar day at 2-hour-and-15-minute intervals using an ISCO auto-sampler. Samples were taken at a fixed depth, approximately 2.0 meters from the bottom. All samples were collected in clear, plastic, 1000 ml ISCO sample bottles that were previously acid washed (15 % H_2SO_4), rinsed (5x) with distilled-deionized water. Samples were retrieved as soon as possible after completion of the auto-sampler program. Samples bottles were then immersed in ice in an opaque cooler at the Rutgers Marine Field Station to shield samples from light. Once in the laboratory, samples were inverted several times to homogenize the sample and processed (e.g. filtered) for nutrient and Chl a analysis. Samples were then frozen in a -20°C freezer at RMFS and transported to the Department of Ecology, Evolution, and Natural Resources (DEENR) at

Rutgers University as soon as possible thereafter. Once the filtered samples arrived at DEENR, the samples were stored in a -20°C freezer until analyses were performed.

4) Site location and character

The Jacques Cousteau National Estuarine Research Reserve (JAC NERR) at Mullica River/Great Bay is located on the northeast coast of the United States on the Atlantic Ocean. The estuary is near Tuckerton, New Jersey about 14 kilometers north of Atlantic City. There were four active sampling stations in 2017. All four locations can be characterized by having little macroalgae (few to no established beds in the immediate locale; only occasional seasonal and structurally-dependent fouling-type macroalgal communities), fast moving tidal currents, and tidal ranges of approximately 1m (although this can vary significantly depending on moon phase, storm events, and coastal wind conditions (e.g.- “blow out tides” associated with strong offshore winds). All sites are in a relatively undisturbed area with minimal impact from development or pollution.

1) Buoy 115 (B5) - 39° 31' 07.68" N, 74° 17' 13.92" W - This most recent monitoring site is in Little Egg Harbor Bay, bordering the Edwin B. Forsythe Refuge on Holgate (Long Beach Island) about 3 km northeast of the Rutgers University Marine Field Station. Full-time water-quality monitoring of this non-SWMP station was discontinued in 2003 after ice-floes tore the hardware and housings from the structure, however nutrient/pigment data are still collected at this site which is considered a secondary SWMP NUT station. The following site description is from 2002 (the more recent year-long dataset); we do not expect this description to differ significantly from present conditions: The depth of the bay at this site is approximately 3 meters. The bottom consists predominantly of sand with little shell or organic material. Salinity values average about 30.8 psu, with a range of 29.3 to 32.5 psu. Groundwater inputs from margins of the estuary, as well as surface flow from Mullica River, account for most of the freshwater entering that affects this site. The input of freshwater from local precipitation and marsh surface runoff is of secondary importance. Flocculent material, possibly decaying alga from up-current (during ebb tides) SAV (submerged aquatic vegetation) beds located in the Little Egg Harbor section of Barnegat Bay, was occasionally observed as flotsam and in the water column during the collection of samples at the B5 sampling station (jacb5nut) and should be considered a characteristic of this sampling station. This site is not monitored via multiparameter datasonde, so no environmental water quality (WQ) data beyond what it obtained at the time of nutrient grab sample collection are available for 2020. Estimated tidal range is 2 m.

2) Buoy 126 (B6) - 39° 30'28.44"N, 74° 20'18.67"W- located 3 km from Little Egg Inlet on the eastern side of Great Bay and is 100 meters from the nearest land that is a natural marsh island. This is a naturally deep area that has never been dredged, but it is located about 0.5 km from an area in the Intracoastal Waterway that is dredged regularly. The datasonde at this location is attached to Intracoastal Waterway Channel Marker 126 and is the closest monitoring station to Little Egg Inlet. This site can be characterized by having strong tidal currents, 2-3 knots, fine to coarse sand bottom with an extensive blue mussel bed surrounding the area. Groundwater inputs from margins of the estuary as well as surface

flow from Mullica River account for the majority of freshwater coming into the system at this site, followed by input from rainwater from the marsh surface. Monitoring at this station began on 08/06/1996. In 2019, the reported temperature at this station ranged from -0.9°C to 29.0°C, with an average of 16.3°C (NOTE: the sonde at this station was removed prior to winter icing and was not replaced for a protracted period of time as the station was rebuilt so the average temperature value is biased towards warmer conditions). The reported salinity at this station ranged from 18.5 psu to 31.7 psu, with an average of 28.5 psu. It is important to note that fouling may have occasionally depressed some salinity readings and are “flagged” as such in the dataset, so the aforementioned average and range may not be accurate. The maximum tidal range (including storm surge and drought-level data), as recorded by the datasonde, was 2.00 m. It has been some time since the actual depth at this station has been surveyed (sediment deposition and erosion around the structure has substantial effect on the actual depth of the water column at this station), but in 2008 average depth at the B6 station was assessed at 3.91 m, with a range of 2.72 to 5.09 m.

3) Buoy 139 (B9) – 39° 29'52.59"N, 74° 22'52.07"W*- is located 4 kilometers from Buoy 126 on the western side of Great Bay and is located about 1.0-1.5 km from land. The datasonde at this location is attached to Intracoastal Waterway Channel Marker 139. The closest landform is an extensive salt marsh approximately 1.5 km wide, which borders the upland area. This area is dredged by the U.S. Army Corp of Engineers approximately every five to six years to maintain the channel at a depth of approximately 2.5 meters. The surrounding depth of the bay is approximately 1.5 to 2 meters. This site is characterized by having maximum currents of about 1.5 knots with a muddy sand bottom and with little structure or shell. Groundwater inputs from margins of the estuary as well as surface flow from Mullica River account for the majority of freshwater coming into the system at this site, followed by input from rainwater from the marsh surface and above. Monitoring at this station began on 08/02/1996. In 2019, the reported temperature at this station ranged from 0.0°C to 30.0°C, with an average of 17.5°C (NOTE: the sonde at this station was removed prior to winter icing and was not replaced for a protracted period of time as the station was rebuilt so the average temperature value is biased towards warmer conditions). The reported salinity at this station ranged from 16.3 psu to 31.8 psu, with an average of 27.5 psu. It is important to note that fouling may have occasionally depressed some salinity readings and are “flagged” as such in the dataset, so the aforementioned average and range may not be accurate. The maximum tidal range (including storm surge and drought-level data), as recorded by the datasonde, was 2.22 m. It has been some time since the actual depth at this station has been surveyed (sediment deposition and erosion around the structure has effect on the actual depth of the water column at this station), in 2008 average depth at the B9 station was assessed at 3.18 m, with a range of 2.13 to 4.55 m.

*= these coordinates are a correction to the location reported in past years' metadata reports; the coordinates (39° 29'24.65"N, 74° 22'53.83"W) of the #141 channel marker were attributed to this (#139) channel marker.

4) Chestnut Neck (NE) - 39° 32'52.37"N, 74° 27'38.77"W - located 12 km up the Mullica River from the mouth of the river. The river begins at a line drawn between Graveling Point

and Oysterbed Point on the northwestern side of Great Bay. The Mullica River at this location is quite wide, about 250 meters. The datasonde is attached to the dock of a small marina along the southern shore of the river adjacent to the main channel. This location has never been dredged. The site is characterized by having tidal currents of less than one knot, during both ebb and flood tide, and has a mixed organic mud/sand bottom. Freshwater input is primarily from groundwater and watershed runoff. Monitoring at this station began on 08/01/1996. In 2019, the reported temperature at this station ranged from -0.8°C to 30.9°C, with an average of 15.5°C. The reported salinity at this station ranged from 1.2 psu to 27.6 psu, with an average of 14.0 psu. It is important to note that fouling may have occasionally depressed some salinity readings and are “flagged” as such in the dataset, so the aforementioned average and range may not be accurate. The maximum tidal range (including storm surge and drought-level data), as recorded by the datasonde, was 2.23 m. It has been some time since the actual depth at this station has been surveyed (sediment deposition and erosion around the structure has effect on the actual depth of the water column at this station), but in 2008 average depth at the NE station was assessed at 2.32 m, with a range of 1.11 to 3.45 m.

5) Lower Bank (BA) - 39° 35'37.18"N, 74° 33'05.44"W- located 13 kilometers upriver of the Chestnut Neck location. The Mullica River at this site is about 200 m wide. The datasonde is located at the center of a bridge spanning the Mullica River. The northern bank of the river is sparsely developed with single-family houses and has a steep bank about 5 m high. The southern shore has an extensive marsh and fresh water wetland area about 3 km wide. This site can be characterized by having fast tidal currents, just over one knot, deep water, and fine mixed organic mud and sandy sediment. Freshwater input is primarily from groundwater and watershed runoff. Monitoring at this station began on 10/10/1996. In 2019, the reported temperature at this station ranged from -0.1°C to 32.3°C, with an average of 15.5°C (NOTE: the sonde at this station was removed prior to winter icing and was not replaced for a protracted period of time as the station was rebuilt so the average temperature value is biased towards warmer conditions). The reported salinity at this station ranged from 0.0 psu to 19.1 psu, with an average of 2.1 psu. It is important to note that fouling may have occasionally depressed some salinity readings and are “flagged” as such in the dataset, so the aforementioned average and range may not be accurate. The maximum tidal range (including storm surge and drought-level data), as recorded by the datasonde, was 2.20 m. It has been some time since the actual depth at this station has been surveyed (sediment deposition and erosion around the structure has effect on the actual depth of the water column at this station), but in 2008 average depth at the BA station was assessed at 2.77 m, with a range of 1.43 to 3.98 m.

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
B5	S	jacb5nut	39.51853, -74.28737	Feb 2002-present	NA	Optional/ Secondary SWMP

B6	P	jacb6nut	39.50790, - 74.33850	Feb 2002- present	NA	NA
B9	P	jacb9nut	39.49794, - 74.38113	Feb 2002- present	NA	NA
NE	P	jacnenut	39.54790, - 74.46080	Feb 2002- present	NA	NA
BA	P	jacbanut	39.59370, - 74.55150	Feb 2002- present	NA	NA

5) Code variable definitions

jacb5nut = Jacques Cousteau Reserve Buoy 115 nutrient station
 jacb6nut = Jacques Cousteau Reserve Buoy 126 nutrient station
 jacb9nut = Jacques Cousteau Reserve Buoy 139 nutrient station
 jacnenut = Jacques Cousteau Reserve Chestnut Neck nutrient station
 jacbanut = Jacques Cousteau Reserve Lower Bank nutrient station

The monitoring codes are set as “1” to indicate grab samples and “2” to indicate diel samples. Replicates are also given specific codes. Grab samples in which duplicates sample are taken utilize a “1” for the first sample and a “2” for the second sample. Diel samples are always labeled with a “1” since only one sample is taken at each 2:15 interval.

6) Data Collection Period

GRAB SAMPLING

Station Code	Date Collected	Time Replicate 1	Time Replicate 2
jacb5nut	1/7/2020	11:05	11:07
jacb5nut	2/12/2020	14:12	14:14
jacb5nut	3/18/2020	9:01*	9:03*
jacb5nut	4/7/2020	13:14*	13:16*
jacb5nut	8/27/2020	9:24	9:26
jacb5nut	9/16/2020	12:20	12:22
jacb5nut	10/14/2020	10:52	10:54
jacb5nut	11/10/2020	9:53	9:55
jacb5nut	12/15/2020	12:48*	12:50*
jacb6nut	1/7/2020	11:16	11:18
jacb6nut	2/12/2020	13:42	13:44
jacb6nut	3/18/2020	8:01*	8:03*
jacb6nut	4/7/2020	12:16*	12:18*
jacb6nut	8/27/2020	8:46	8:48
jacb6nut	9/16/2020	11:10	11:12

jacb6nut	10/14/2020	9:37	9:39
jacb6nut	11/10/2020	9:12	9:14
jacb6nut	12/15/2020	12:01	12:03
jacb9nut	1/7/2020	11:25	11:27
jacb9nut	2/12/2020	13:56	13:58
jacb9nut	3/18/2020	8:31*	8:33*
jacb9nut	4/7/2020	12:44*	12:46*
jacb9nut	8/27/2020	9:03	9:05
jacb9nut	9/16/2020	11:50	11:52
jacb9nut	10/14/2020	10:18	10:20
jacb9nut	11/10/2020	8:53	8:55
jacb9nut	12/15/2020	12:18	12:20
jacnenut	1/7/2020	13:46	13:48
jacnenut	2/12/2020	15:18	15:20
jacnenut	3/18/2020	11:40	11:42
jacnenut	4/7/2020	14:25	14:27
jacnenut	8/27/2020	10:31	10:33
jacnenut	9/16/2020	14:02	14:04
jacnenut	10/14/2020	12:18	12:20
jacnenut	11/10/2020	11:33	11:35
jacnenut	12/15/2020	13:44	13:46
jacbanut	1/7/2020	14:35	14:37
jacbanut	2/12/2020	15:51	15:53
jacbanut	3/18/2020	12:33	12:35
jacbanut	4/7/2020	15:22	15:24
jacbanut	8/27/2020	11:16	11:18
jacbanut	9/16/2020	15:20	15:22
jacbanut	10/14/2020	13:09	13:11
jacbanut	11/10/2020	12:24	12:26
jacbanut	12/15/2020	14:22	14:24

DIEL (ISCO) SAMPLING

Station Code	Month	Start Date	Start Time	End Date	End Time
jacnenut	January	1/27/2020	11:00	1/28/2020	11:45
jacnenut	February	2/03/2020	11:00	2/04/2020	11:45
jacnenut	March	3/17/2020	10:45	3/18/2020	11:30
jacnenut	April	4/8/2020	04:00	4/09/2020	04:45
jacnenut	August	8/26/2020	09:30	8/27/2020	10:15
jacnenut	September	9/23/2020	09:00	9/24/2020	09:45
jacnenut	October	10/22/2020	07:45	10/23/2020	08:30

jacnenut	November	11/24/2020	11:30	11/25/2020	12:15
jacnenut	December	12/10/2020	11:45	12/11/2020	12:30

*= Samples not actually collected; these date and timestamps are approximately when the sample in question would have been collected.

7) Associated researchers and projects

A few researchers have expressed interest in our 2019 nutrient data but prefer to wait until the review process is complete.

Water Quality (WQ) and Meteorological (MET) data associated with these Nutrient (NUT) data can be obtained via download from the at www.nerrsdata.org . It is recommended that users utilize the new Advanced Query System (www.nerrsdata.org/aqs) to merge the nutrient and water-quality data into one seamless file.

8) Distribution

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:

NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: www.nerrsdata.org; *accessed* 12 October 2021.

NERR nutrient data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma separated version format.

II. Physical Structure Descriptors

9) Entry verification

Monthly nutrient and plant pigment data files, in excel format, are sent to JAC NERR by the Rutgers University, IMCS, Ecosystems Lab. Files consist of sampling station ID, date and time and parameter values expressed in micro moles; these are converted to milligrams per liter (mg/l) (with the exception of Chlorophyll A, which is reported as micrograms per liter) (µg/l). The Laboratory Supervisor, Ronald Lauck, verifies all parameter values in the excel file through cross comparison with the laboratory data sheets. The data are reviewed for values that appear erroneous or illogical. Any samples found to have questionable results are reanalyzed. JNEERR staff (Gregg P. Sakowicz, SWMP Technician/Field Researcher) then performs the following:

Nutrient data are entered into a Microsoft Excel worksheet and processed using the NutrientQAQC Excel macro. The NutrientQAQC macro sets up the data worksheet, metadata worksheets, and MDL worksheet; adds chosen parameters and facilitates data entry; allows the user to set the number of significant figures to be reported for each parameter and rounds using banker's rounding rules; allows the user to input MDL values and then automatically flags/codes measured values below MDL and inserts the MDL; calculates parameters chosen by the user and automatically flags/codes for component values below MDL, negative calculated values, and missing data; allows the user to apply QAQC flags and codes to the data; produces summary statistics; graphs selected parameters for review; and exports the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database.

The Analytical Laboratory at Rutgers University calculates and reports results in µM. For purposes of consistency in the NERR System, the Jacques Cousteau NERR calculates the concentrations as mg/ l-1 based on atomic weights of 14.01 and 30.97 for Nitrogen and Phosphorous, respectively. Therefore, Jacques Cousteau NERR staff multiplies the concentrations reported by the Rutgers University Laboratory by 0.01401, 0.03097 to yield concentrations in mg/L as N and P, respectively.

10) **Parameter titles and variable names by data category**

Required NOAA/NERRS System-wide Monitoring Program nutrient parameters are denoted by an asterisks “*”.

Data Category	Parameter	Variable Name	Units of Measure
Phosphorus and Nitrogen:			
	Orthophosphate	PO4F	mg/L as P
	Nitrite + Nitrate, Filtered	NO23F	mg/L as N
	Ammonium, Filtered	NH4F	mg/L as N
	Dissolved Inorganic Nitrogen	DIN	mg/L as N
Plant Pigments:			
	Chlorophyll a	CHLA_N	µg/L

Field Parameters:

Water Temperature	WTEM_N	°C
Specific Conductivity	SCON_N	mS/cm ³
Salinity	SALT_N	ppt
Dissolved Oxygen	DO_S_N	%
Dissolved Oxygen	DO_N	mg/L
pH	PH_N	pH units
Turbidity	TURB_N	FNU

Notes:

1. Time is coded based on a 2400 clock and is referenced to Standard Time.
2. Reserves have the option of measuring either NO₂ and NO₃ or they may substitute NO₂ for individual analyses if they can show that NO₂ is a minor component relative to NO₃. JAC NERR and analytical laboratory staff determined that analysis to isolate individual concentrations for NO₂ and NO₃ is not necessary. The concentration of NO₂ is negligible when compared to the concentration of NO₃.

11) Measured and calculated laboratory parameters

a) Variables measured directly

Nitrogen species: NO₂3F, NH₄F
Phosphorus species: PO₄F
Other: CHLA

b) Computed variables

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 Rutgers University, IMCS, Ecosystems Laboratory. The MDL is determined as 3 times the standard deviation of a minimum of 7 replicates of a single low concentration sample. Table 1 presents the current MDL's; these values are reviewed and revised periodically. Methods are from Lachat Instruments QuikChem methods.

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

Parameter	Start Date	End Date	MDL	Revisited
NH ₄ F	01/01/2019	12/31/2019	0.001 (mg/L)	09/20/2018

NO23F	01/01/2019	12/31/2019	0.001 (mg/L)	04/11/2018 (NO2)
PO4F	01/01/2019	12/31/2019	0.003 (mg/L)	04/18/2018
CHLA	01/01/2019	12/31/2019	0.310 (µg/L)	2019

13) Laboratory methods

i) **Parameter: PO4F**

Rutgers University, IMCS, Ecosystems Lab Laboratory Method
Method Reference: Lachat Instruments, 1993. QuikChem Method 31-115-01-3-A.
Method Descriptor: Samples were filtered with a 0.45 µm membrane filter and subjected to ammonium molybdate and antimony potassium tartate under acidic conditions to form a complex. The complex is reduced with ascorbic acid to form a blue complex that absorbs light at 880 nm.
Preservation Method: Stored in dark at –20°C for up to 30 days.

ii) **Parameter: NO23F**

Rutgers University, IMCS, Ecosystems Lab Laboratory Method
Method Reference: Lachat Instruments, 1992. QuikChem Method 30-107-04-1-A.
Method Descriptor: Samples were filtered with a 0.45 µm membrane filter. Nitrate is reduced to nitrite by passage of sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined with sulfanilamide under acidic conditions to form a diazonium ion. The diazonium ion is coupled with N-(1-naphthyl)ethylenediamine dihydrochloride, which results in a pink dye that absorbs at 520 nm.
Preservation Method: Stored in dark at -20°C for up to 14 days.

iii) **Parameter: NH4F**

Rutgers University, IMCS, Ecosystems Lab Laboratory Method
Method Reference: Lachat Instruments, 1993. QuikChem Method 31-107-06-1-A.
Method Descriptor: Samples were filtered with a 0.45 µm membrane filter. The method used is based on the Berthelot reaction. Samples are subjected to hypochlorite-phenol, which results in indophenol blue. The indophenol blue is measured at 630 nm and is proportional to the ammonium concentration.
Preservation Method: Stored in dark at –20°C for up to 3 days.

iv) **Parameter: CHLA**

Rutgers University, IMCS, Ecosystems Lab Laboratory Method
Method Reference: US.EPA 1997. Method 445.0
Method Descriptor: Samples with a known volume were filtered with a 0.45 µm membrane filter. Samples were dissolved in 5 ml 90% acetone/ 10% MgCO₃ solution. Fluorescence determined using a Shimadzu RF-1501 spectrofluorometer.
Preservation Method: Filter is drawn dry, removed, placed in a glass tube with a phenolic screw cap, wrapped in aluminum foil and stored at –20°C for up to 30 days.

14) Field and Laboratory QA/QC programs

a) Precision

i) Field variability

JAC NERR collects two successive grab samples for the monthly grab sample program.

ii) Laboratory variability

Rutgers University, IMCS, Ecosystems Lab analyzes a laboratory duplicate once for every nine samples.

iii) Inter-organizational splits

None

b) Accuracy

i) Sample spikes

Rutgers University, IMCS, Ecosystems Lab analyzes a matrix spike once for every ten samples.

ii) Standard reference material analysis

None

iii) Cross calibration exercises

None

15) QAQC flag definitions

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). QAQC flags are applied to the nutrient data during secondary QAQC to indicate data that are out of sensor range low (-4), rejected due to QAQC checks (-3), missing (-2), optional and were not collected (-1), suspect (1), and that have been corrected (5). All remaining data are flagged as having passed initial QAQC checks (0) when the data are uploaded and assimilated into the CDMO ODIS as provisional plus data. The historical data flag (4) is used to indicate data that were submitted to the CDMO prior to the initiation of secondary QAQC flags and codes (and the use of the automated primary QAQC system for WQ and MET data). This flag is only present in historical data that are exported from the CDMO ODIS.

-4	Outside Low Sensor Range
-3	Data Rejected due to QAQC
-2	Missing Data
-1	Optional SWMP Supported Parameter
0	Data Passed Initial QAQC Checks
1	Suspect Data
4	Historical Data: Pre-Auto QAQC
5	Corrected Data

16) QAQC code definitions.

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the sample or sample collection, sensor errors document common sensor or parameter specific problems, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point. However, a record flag column (F_Record) in the nutrient data allows multiple comment codes to be applied to the entire data record.

General errors

GCM	Calculated value could not be determined due to missing data
GCR	Calculated value could not be determined due to rejected data
GDM	Data missing or sample never collected
GQD	Data rejected due to QA/QC checks
GQS	Data suspect due to QA/QC checks
GSM	See metadata

Sensor errors

SBL	Value below minimum limit of method detection
SCB	Calculated value could not be determined due to a below MDL

component

SCC	Calculation with this component resulted in a negative value
SNV	Calculated value is negative
SRD	Replicate values differ substantially
SUL	Value above upper limit of method detection

Parameter Comments

CAB	Algal bloom
CDR	Sample diluted and rerun
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity
CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Record comments

CAB	Algal bloom
CHB	Sample held beyond specified holding time
CIP	Ice present in sample vicinity

CIF	Flotsam present in sample vicinity
CLE	Sample collected later/earlier than scheduled
CRE	Significant rain event
CSM	See metadata
CUS	Lab analysis from unpreserved sample

Cloud cover

CCL	clear (0-10%)
CSP	scattered to partly cloudy (10-50%)
CPB	partly to broken (50-90%)
COC	overcast (>90%)
CFY	foggy
CHY	hazy
CCC	cloud (no percentage)

Precipitation

PNP	none
PDR	drizzle
PLR	light rain
PHR	heavy rain
PSQ	squally
PFQ	frozen precipitation (sleet/snow/freezing rain)
PSR	mixed rain and snow

Tide stage

TSE	ebb tide
TSF	flood tide
TSH	high tide
TSL	low tide

Wave height

WH0	0 to <0.1 meters
WH1	0.1 to 0.3 meters
WH2	0.3 to 0.6 meters
WH3	0.6 to > 1.0 meters
WH4	1.0 to 1.3 meters
WH5	1.3 or greater meters

Wind direction

N	from the north
NNE	from the north northeast
NE	from the northeast
ENE	from the east northeast
E	from the east
ESE	from the east southeast
SE	from the southeast
SSE	from the south southeast
S	from the south
SSW	from the south southwest
SW	from the southwest
WSW	from the west southwest

W	from the west
WNW	from the west northwest
NW	from the northwest
NNW	from the north northwest
<i>Wind speed</i>	
WS0	0 to 1 knot
WS1	> 1 to 10 knots
WS2	> 10 to 20 knots
WS3	> 20 to 30 knots
WS4	> 30 to 40 knots
WS5	> 40 knots

17) Other remarks

Data may be missing due to problems with sample collection or processing. Laboratories in the NERRS System submit data that are censored at a lower detection rate limit, called the Method Detection Limit or MDL. MDLs for specific parameters are listed in the Laboratory Methods and Detection Limits Section (Section II, Part 12) of this document. Concentrations that are less than this limit are censored with the use of a QAQC flag and code, and the reported value is the method detection limit itself rather than a measured value. For example, if the measured concentration of NO₂₃F was 0.0005 mg/l as N (MDL=0.0008), the reported value would be 0.0008 and would be flagged as out of sensor range low (-4) and coded SBL. In addition, if any of the components used to calculate a variable are below the MDL, the calculated variable is removed and flagged/coded -4 SCB. If a calculated value is negative, it is rejected and all measured components are marked suspect. If additional information on MDL's or missing, suspect, or rejected data is needed, contact the Research Coordinator at the reserve submitting the data.

Note: The way below MDL values are handled in the NERRS SWMP dataset was changed in November of 2011. Previously, below MDL data from 2007-2010 were also flagged/coded, but either reported as the measured value or a blank cell. Any 2007-2011 nutrient/pigment data downloaded from the CDMO prior to November of 2011 will reflect this difference.

NOTE: the Buoy 115 (jacob5nut) in Southern Barnegat Bay is not a required SWMP station, but is collected as additional secondary SWMP station as a compliment/comparison to the SWMP samples collected in the Mullica River/Great Bay complex.

NOTE: The B6 station sits within an interface between two bodies of water (Little Egg Harbor and Mullica River) that are often physically and chemically distinct, so some of the discrepancies between some replicates at this station may be accurate and "real" if the replicates were obtained from the two different "plumes" of water; this is something those

performing collections attempt to avoid but visual cues may not be distinct enough to discern waters from each source at the time of collection.

No physical (“water quality”) parameters are included in this dataset for the diel sample program because these data can be obtained via download from the Buoy 126 station (jacb6wq) at www.nerrsdata.org . It is recommended that users utilize the Advanced Query System (www.nerrsdata.org/aqs) to merge these nutrient and water-quality data into one seamless file.

While basic and notable weather information was inserted into the F_Record column for all grab samples, it is recommended that users of these data refer to the JAC NERR’s meteorological dataset from the Nacote Creek Meteorological station (jacncmet) for weather information. The meteorological dataset can be accessed online at the CDMO home page <http://cdmo.baruch.sc.edu/> or www.nerrsdata.org . It is recommended that users utilize the new Advanced Query System (www.nerrsdata.org/aqs) to merge nutrient, weather, and water-quality data into one seamless file

Additionally, regarding inserting comment codes concerning weather, only significant rain events potentially influencing the data were inserted into the diel portion of the dataset. If users seek to correlate the diel samples with weather conditions, it is recommended that they refer to the JAC NERR’s meteorological dataset. The meteorological dataset can be accessed online at the CDMO home page <http://cdmo.baruch.sc.edu/> or www.nerrsdata.org .

If discrepancies between replicate grab samples are observed, they are flagged in the dataset with an “[SRD]” (denoting “Replicate values differ substantially”) code in the dataset. It is up to the user to retain or discard these data during analyses.

Samples were not collected at the jacb5nut, jacb6nut, and jacb9nut stations in March and April due to COVID-related restrictions (staff were not allowed to be aboard the same vessel due to COVID, and staff are not allowed to travel in vessels alone for general safety reasons).

No nutrient samples were collected in May, June, and July 2020 due to a university-wide shut down of field and laboratory operations due to COVID.

There is a high volume of missing data from this submission due to a sudden shut-down of the analytical laboratory resultant of unannounced defunding and laying-off of staff. The JAC NERR attempted to obtain as much data from analyzed samples as possible. We also attempted to recover unanalyzed samples to be sent to alternate analytical laboratories, but were unsuccessful.

It is unclear when the December NH₄ samples were analyzed by the lab and due to the lab shut down we were unable to obtain that information. Because so many of the samples were analyzed past their allowable hold times in 2020 (listed below), and it’s possible that these also were, we have opted to flag these data suspect as a precaution.

Sample hold times for 2020: Samples are held at -20°C. NERRS SOP allows nutrient samples to be held for up to 28 days (CHLA for 30) at -20°C, plus allows for up to 5 days for collecting, processing, and shipping samples. Samples held beyond that time period are flagged suspect <1>and coded (CHB). If measured values were below MDL, this resulted in <-4> [SBL] (CHB) flagging/coding. Samples held beyond the allowable time are shaded gray.

Grab Sample Analysis Dates

Station code	DateTimestamp	PO4 Analysis Date	NH4 Analysis Date	NO23 Analysis Date	Chl a Analysis Date
jacb5nut	01/07/2020 11:05	02/26/2020	03/18/2020	02/26/2020	N/A
jacb5nut	01/07/2020 11:07	02/26/2020	03/18/2020	02/26/2020	N/A
jacb6nut	01/07/2020 11:16	02/26/2020	03/18/2020	02/26/2020	N/A
jacb6nut	01/07/2020 11:18	02/26/2020	03/18/2020	02/26/2020	N/A
jacb9nut	01/07/2020 11:25	02/26/2020	03/18/2020	02/26/2020	N/A
jacb9nut	01/07/2020 11:27	02/26/2020	03/18/2020	02/26/2020	N/A
jacnenut	01/07/2020 13:46	02/26/2020	03/18/2020	02/26/2020	N/A
jacnenut	01/07/2020 13:48	02/26/2020	03/18/2020	02/26/2020	N/A
jacbanut	01/07/2020 14:35	02/26/2020	03/18/2020	02/26/2020	N/A
jacbanut	01/07/2020 14:37	02/26/2020	03/18/2020	02/26/2020	N/A
jacb5nut	02/12/2020 14:12	N/A	03/18/2020	N/A	N/A
jacb5nut	02/12/2020 14:14	N/A	03/18/2020	N/A	N/A
jacb6nut	02/12/2020 13:42	N/A	03/18/2020	N/A	N/A
jacb6nut	02/12/2020 13:44	N/A	03/18/2020	N/A	N/A
jacb9nut	02/12/2020 13:56	N/A	03/18/2020	N/A	N/A
jacb9nut	02/12/2020 13:56	N/A	03/18/2020	N/A	N/A
jacnenut	02/12/2020 15:18	N/A	03/18/2020	N/A	N/A
jacnenut	02/12/2020 15:20	N/A	03/18/2020	N/A	N/A
jacbanut	02/12/2020 15:51	N/A	03/18/2020	N/A	N/A
jacbanut	02/12/2020 15:53	N/A	03/18/2020	N/A	N/A
jacb5nut	03/18/2020 09:01	N/A	N/A	N/A	N/A
jacb5nut	03/18/2020 09:03	N/A	N/A	N/A	N/A
jacb6nut	03/18/2020 08:01	N/A	N/A	N/A	N/A
jacb6nut	03/18/2020 08:03	N/A	N/A	N/A	N/A
jacb9nut	03/18/2020 08:31	N/A	N/A	N/A	N/A
jacb9nut	03/18/2020 08:33	N/A	N/A	N/A	N/A
jacnenut	03/18/2020 11:40	N/A	N/A	N/A	N/A
jacnenut	03/18/2020 11:42	N/A	N/A	N/A	N/A
jacbanut	03/18/2020 12:33	N/A	N/A	N/A	N/A
jacbanut	03/18/2020 12:35	N/A	N/A	N/A	N/A
jacb5nut	04/07/2020 13:14	N/A	N/A	N/A	N/A
jacb5nut	04/07/2020 13:16	N/A	N/A	N/A	N/A

jacb6nut	04/07/2020 12:16	N/A	N/A	N/A	N/A
jacb6nut	04/07/2020 12:17	N/A	N/A	N/A	N/A
jacb9nut	04/07/2020 12:44	N/A	N/A	N/A	N/A
jacb9nut	04/07/2020 12:46	N/A	N/A	N/A	N/A
jacnenut	04/07/2020 14:25	N/A	N/A	N/A	N/A
jacnenut	04/07/2020 14:27	N/A	N/A	N/A	N/A
jacbanut	04/07/2020 15:22	N/A	N/A	N/A	N/A
jacbanut	04/07/2020 15:24	N/A	N/A	N/A	N/A
jacb5nut	08/27/2020 09:24	N/A	12/11/2020	N/A	N/A
jacb5nut	08/27/2020 09:26	N/A	12/11/2020	N/A	N/A
jacb6nut	08/27/2020 08:46	N/A	12/11/2020	N/A	N/A
jacb6nut	08/27/2020 08:48	N/A	12/11/2020	N/A	N/A
jacb9nut	08/27/2020 09:03	N/A	12/11/2020	N/A	N/A
jacb9nut	08/27/2020 09:05	N/A	12/11/2020	N/A	N/A
jacnenut	08/27/2020 10:31	N/A	12/11/2020	N/A	N/A
jacnenut	08/27/2020 10:33	N/A	12/11/2020	N/A	N/A
jacbanut	08/27/2020 11:16	N/A	12/11/2020	N/A	N/A
jacbanut	08/27/2020 11:18	N/A	12/11/2020	N/A	N/A
jacb5nut	09/16/2020 12:20	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb5nut	09/16/2020 12:22	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb6nut	09/16/2020 11:10	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb6nut	09/16/2020 11:12	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb9nut	09/16/2020 11:50	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb9nut	09/16/2020 11:52	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacnenut	09/16/2020 14:02	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacnenut	09/16/2020 14:04	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacbanut	09/16/2020 15:20	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacbanut	09/16/2020 15:22	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb5nut	10/14/2020 10:52	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb5nut	10/14/2020 10:54	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb6nut	10/14/2020 09:37	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb6nut	10/14/2020 09:39	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb9nut	10/14/2020 10:18	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb9nut	10/14/2020 10:20	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacnenut	10/14/2020 12:18	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacnenut	10/14/2020 12:20	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacbanut	10/14/2020 13:09	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacbanut	10/14/2020 13:11	11/21/2020	12/11/2020	11/21/2020	11/05/2020
jacb5nut	11/10/2020 09:53	11/21/2020	12/11/2020	11/21/2020	11/25/2020
jacb5nut	11/10/2020 09:55	11/21/2020	12/11/2020	11/21/2020	11/25/2020
jacb6nut	11/10/2020 09:12	11/21/2020	12/11/2020	11/21/2020	11/25/2020
jacb6nut	11/10/2020 09:14	11/21/2020	12/11/2020	11/21/2020	11/25/2020
jacb9nut	11/10/2020 08:53	11/21/2020	12/11/2020	11/21/2020	11/25/2020
jacb9nut	11/10/2020 08:55	11/21/2020	12/11/2020	11/21/2020	11/25/2020
jacnenut	11/10/2020 11:33	11/21/2020	12/11/2020	11/21/2020	11/25/2020

jacnenut	11/10/2020 11:35	11/21/2020	12/11/2020	11/21/2020	11/25/2020
jacbanut	11/10/2020 12:24	11/21/2020	12/11/2020	11/21/2020	11/25/2020
jacbanut	11/10/2020 12:26	11/21/2020	12/11/2020	11/21/2020	11/25/2020
jacb5nut	12/15/2020 12:48	N/A	N/A	N/A	N/A
jacb5nut	12/15/2020 12:50	N/A	N/A	N/A	N/A
jacb6nut	12/15/2020 12:01	N/A	Unknown	N/A	N/A
jacb6nut	12/15/2020 12:03	N/A	Unknown	N/A	N/A
jacb9nut	12/15/2020 12:18	N/A	Unknown	N/A	N/A
jacb9nut	12/15/2020 12:20	N/A	Unknown	N/A	N/A
jacnenut	12/15/2020 13:44	N/A	Unknown	N/A	N/A
jacnenut	12/15/2020 13:44	N/A	Unknown	N/A	N/A
jacbanut	12/15/2020 14:22	N/A	Unknown	N/A	N/A
jacbanut	12/15/2020 14:24	N/A	Unknown	N/A	N/A

Diel Sample Analysis Dates

Station code	DateTimestamp	PO4 Analysis Date	NH4 Analysis Date	NO23 Analysis Date	Chl a Analysis Date
jacnewq	1/27/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	1/27/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	1/27/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	1/27/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	1/27/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	1/27/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	1/28/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	1/28/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	1/28/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	1/28/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	1/28/20	2/26/20	3/18/20	2/26/20	N/A
jacnewq	2/3/20	N/A	3/18/20	N/A	N/A
jacnewq	2/3/20	N/A	3/18/20	N/A	N/A
jacnewq	2/3/20	N/A	3/18/20	N/A	N/A
jacnewq	2/3/20	N/A	3/18/20	N/A	N/A
jacnewq	2/3/20	N/A	3/18/20	N/A	N/A
jacnewq	2/3/20	N/A	3/18/20	N/A	N/A
jacnewq	2/4/20	N/A	3/18/20	N/A	N/A
jacnewq	2/4/20	N/A	3/18/20	N/A	N/A
jacnewq	2/4/20	N/A	3/18/20	N/A	N/A
jacnewq	2/4/20	N/A	3/18/20	N/A	N/A
jacnewq	2/4/20	N/A	3/18/20	N/A	N/A
jacnewq	2/4/20	N/A	3/18/20	N/A	N/A
jacnewq	3/17/20	N/A	N/A	N/A	N/A

[illegible]

[illegible]