**Tijuana River** (TJR) **NERR Nutrient Metadata**

**January to December 2023**

**Latest Update:** June 17, 2024

Note: This is a provisional metadata document; it has not been authenticated as of its download date. Contents of this document are subject to change throughout the QAQC process and it should not be considered a final record of data documentation until that process is complete. Contact the CDMO (cdmosupport@baruch.sc.edu) or reserve with any additional questions.

**I. Data Set and Research Descriptors**

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**2) Research objectives** –

The Tijuana River National Estuarine Research Reserve (TRNERR) represents the largest, most intact coastal marsh system remaining in Southern California. It has contiguous beach, dune, tidal channel, mudflat, marsh, transitional, and upland habitat. It is also home to numerous threatened and endangered species. Because of its highly urbanized setting, situated between the cities of Tijuana, Baja California, Mexico, and San Diego, California, USA, it is heavily impacted. A primary management concern is transboundary flows of the Tijuana River, which convey anthropogenic pollutants (primarily associated with partially-treated and untreated wastewater), nutrients, and sediment. About a quarter of the reserve's 2,531 acres are tidally influenced and few channels are deep enough for datalogger deployment. Currently, there are two SWMP stations located within the TRNERR boundaries, and two SWMP stations are located nearby in south San Diego Bay. Station locations are designed to investigate spatial patterns of water quality parameters, with comparisons between the Tijuana Estuary and San Diego Bay. In addition, telemetry of Tijuana Estuary water quality stations informs management action, particularly related to potential closure of the tidal inlet by wave-driven accumulation of sediment. Mouth closures (detected by cessation of tidal action as indicated with the water level sensors on the dataloggers) can cause anoxia, mortality of fish and shellfish, and flooding.

Two stations were originally set up: a “control” station Oneonta Slough (OS), which is still in place, was established on the northern end of Oneonta Slough, relatively far away from the main source of river-borne pollution. Another station, River Channel (RC), was situated in a site most affected by sewage outflow. Datalogger deployment at RC, however, was continually interrupted by both shifting sediment and massive wracks of kelp (*Macrocystis pyrifera*), which would often bury the deployment set-up on incoming tides. After a number of different deployment designs were implemented without success, data collection at the RC site was terminated in 2004. Another station was located at the inlet to the Model Marsh (MM), a constructed 20-acre restoration site in the southern arm of the estuary. The Model Marsh was opened to tidal flushing in February 2000 and datalogging at the station began in October 2000**.** The site was discontinued in January 2008, again due to heavy sedimentation. The Boca Rio (BR) site is located near the mouth of the Tijuana River, although the mouth has migrated south in recent years. The BR station was established in December 2004 to replace the RC station, and remains active and is the site closest to the interface of the river and ocean.

The South Bay (SB) station was established in January 2008 and is located at the mouth of Otay River, which flows into South San Diego Bay. It is within the San Diego National Wildlife Refuge Complex, which also includes portions of the TRNERR. It was established to document conditions in the south bay, particularly associated with a marsh restoration in the adjacent salt ponds. The Pond Eleven (PE) station was located in a non-tidal salt pond adjacent to the South Bay logger. A tide gate was the only source of water into the pond, which was one of the first in a series of ponds with increasing salinities. The PE sonde was deployed from July 2008 to September 2010. The US Fish and Wildlife Service began restoration of this area, including Pond Eleven, from September 2010 to its completion in October 2011. A levee was breached to open Pond Eleven to the bay, which made the area tidal, and channels were excavated to further enhance circulation. Due to extensive restoration, the site had to be relocated. Datasonde deployments and nutrient data collection began in January 2012 at a new location site named Pond Restored (PR) (the name change was warranted because of the different location and profound differences in the pond before and after restoration). The Pond Restored datalogger is located approximately 560 meters southwest from where the Pond Eleven datalogger was originally. The images below show pre- and post-restoration of the salt ponds and the station locations. The post restoration photo includes the PE site as a reference to the new PR site. No sampling currently occurs at the PE site.



1. Monthly grab sampling program

Grab samples were collected monthly at all SWMP water quality sonde sites. Monthly grab sampling provides information as to the spatial differences in nutrient levels within the system. The placement of these sites also offers the opportunity to better isolate the possible origin of nutrient inputs as well as the degree of tidal flushing.

1. Diel sampling program (mention if samples were taken over a lunar day)

Diel samples were collected monthly at one site. This sampling method provides a temporal perspective of nutrient flux over one tidal cycle at this particular site. Given the location of the site, the diel sampling also provides valuable information as to the degree of tidal flushing of nutrients from the estuary.

**3) Research methods** –

All samples were collected in compliance with the NERRS Nutrient and Chlorophyll Monitoring SOP version 1.7.

Prior to sampling**,** all sample containers (ISCO 1L Polyethylene bottles for diel samples and Nalgene 1L wide mouth amber opaque HDPE bottles for grab samples) were acid washed. The washing procedure consisted of four rinses with DI water, a gentle squirt of Liquinox phosphate free detergent, six rinses with DI water, a soak of ten to twenty minutes in 10% HCl, and, lastly, six rinses with DI water.

1. Monthly grab sampling program

Monthly grab samples were taken at the SWMP sites (Boca Rio, Oneonta Slough, Pond Restored, and South Bay). All samples were collected less than three hours prior to the projected slack low tide ending a diel sampling cycle. Samples were collected vertically, by hand, in amber wide mouth 1 L acid washed (10% HCl) Nalgene bottles. Sample bottles were rinsed three times with ambient water before sampling. Sampling typically followed a dry period of 72 hours or greater, unless otherwise noted (see **Other Remarks** at the end of this document). Duplicate samples were taken at each site sequentially, within one minute of each other and adjacent to the datasonde deployed at each station.

At the time of nutrient sampling, in-situ measurements of temperature, specific conductivity, salinity and dissolved oxygen were taken using an YSI Digital Professional Series water quality handheld instrument. When handheld instrument was not available, nutrient samples were taken as close as possible to a 15-minute mark, when a water quality measurement is taken by the adjacent datasonde. These measurements are included in the datasheet.

1. Diel sampling program

Diel samples were collected at the Boca Rio site. Samples were taken at intervals of 2hrs 15mins for a total of, at least, 11 samples over one lunar day. Samples were collected using an ISCO model 6712 autosampler with a sixty-foot sample tube and polypropylene strainer. The strainer was suspended in a minnow trap (approximately 25 cm above the channel bottom) within 20m of the associated datasonde. The sampler was located approximately 1.5m above the strainer on the channel’s bank. The sampler was programmed to collect 0.5 liter per sample utilizing ISCO’s 24-bottle kit in a standard tub stocked with ice. At the time of retrieval, the sampling program is suspended, the sample bottles are capped and, typically, reach the reserve’s lab within one hour for filtration.

After filtration, all samples were delivered, generally, within 72 hours to the Chemistry Lab at the Oceanographic Data Facility, Scripps Institution of Oceanography (SIO), University of California, San Diego. Samples were frozen at -20°C and analyzed within 28 days (30 days for CHLA) unless indicated in red font in the “Samples collection and analysis date” table (see Other Remarks). The Oceanographic Data Facility’s nutrient analysis procedures can be found at <https://scripps.ucsd.edu/ships/shipboard-technical-support/odf/documentation/nutrient-analysis>.

In addition to required parameters, the TRNERR also began reporting silicate in 2015. Chlorophyll analyses were performed in house at the TRNERR until June 2017. Starting in August 2017, the frozen chlorophyll samples were also delivered to the SIO lab. The chlorophyll analysis method used by SIO lab can be found at <http://calcofi.org/ccpublications/calcofi-methods/8-chlorophyll-methods.html>.

**4) Site location and character –**

The four SWMP sites sit in the southwest corner of San Diego County, just north of the US / Mexico border. Two are located in the Tijuana River Estuary, at the terminus of the multinational (US, Mexico, and indigenous Kumeyaay) Tijuana River watershed. Two are associated with the adjacent watershed of the Otay River in the southern end of San Diego Bay, which has been highly modified by channelization of the river and creation of a salt production facility in the bay, which dates back to the 1870’s. The Tijuana River Estuary and San Diego Bay are both in the Silver Strand Littoral Cell, with their barrier beaches formed by sediment input from the Tijuana River. Historically, the Tijuana River Estuary and San Diego Bay were part of a large costal wetland complex, separated by non-tidal wetland in what is now the City of Imperial Beach.

All estuaries in the region reside in a Mediterranean-climate, and are characterized as low-inflow estuaries, with natural freshwater input largely confined to the rainy season (October – March). Urbanization of watersheds have led to perennialization of many formerly ephemeral streams. In the Tijuana River, flows are typically contaminated with sewage, and infrastructure in the US and Mexico has been built to try and manage these flows. The South Bay International Wastewater Plant began operation in 1999, and was designed to capture dry-weather flows. Any rain or infrastructure failures Mexico typically exceed the capacity of the plant and result in transboundary flows of contaminated water. Persistent transboundary flows in to the Tijuana River Estuary have been especially problematic since 2022.

Tidal exchange at the inlet of the Tijuana Estuary is limited by an intertidal sill, with occasional mouth closures. Excessive sedimentation in the Tijuana River Estuary has greatly decreased tidal prism, which has exacerbated mouth closures. The South San Diego Bay sites are fully tidal. Both the Tijuana River Estuary and south San Diego Bay are characterized by coastal salt marsh, including cordgrass (*Spartina foliosa*) and pickleweed (*Salicornia pacifica*). Both are also sites of ongoing restoration programs aimed at recovering lost salt marsh habitat.

|  |  |
| --- | --- |
| Site name  | **Boca Rio (BR)** |
| Latitude and longitude | 32º 33’ 33.7’’ N, 117º 7’ 44.3” W |
| Tidal range *(meters)* | Approx. 1.6, but variable depending on the heigh of the intertidal sill at the inlet, which limits the extent of low tides in the estuary compared to the open coast. |
| Salinity range *(psu)* | 1(extreme rain events) to 36 (average of 33) |
| Type and amount of freshwater input | The Tijuana River Estuary is low-inflow, and the dominant freshwater source is the Tijuana River. Stream flows in the river vary considerably from season to season and year to year. The naturally-ephemeral Tijuana River now has year-round flow upstream in Tijuana, Mexico, although wastewater infrastructure (when operational) diverts low flows (less than 1 cms) and prevents anthropogenic surface flows from reaching the estuary. Additional freshwater sources are storm drains located mostly in the northern arm of the estuary from runoff from the adjacent military airfield and residential area. |
| Water depth (*meters, MLW*) | 1.3 (estimated) |
| Sonde distance from bottom (*meters*) | Approx. 0.25  |
| Bottom habitat or type | Silt and clay, some sand |
| Pollutants in area | Freshwater discharge with sewage |
| Description of watershed  | The Tijuana River watershed is one of the largest in the region, at 4500 km2, approx. 75% of which is in Mexico. The lower portion is heavily urbanized, with the channelized river flowing through the city of Tijuana, Mexico, before entering the United States. |

|  |  |
| --- | --- |
| Site name  | **Oneonta Slough (OS)** |
| Latitude and longitude | 32º 34’ 6.0” N, 117º 7’ 52.6” W |
| Tidal range *(meters)* | Approx. 1.6, but variable depending on the heigh of the intertidal sill at the inlet, which limits the extent of low tides in the estuary compared to the open coast. |
| Salinity range *(psu)* | 1 (extreme rain events) to 39 (average of 32 ppt) |
| Type and amount of freshwater input | The Tijuana River Estuary is low-inflow, and the dominant freshwater source is the Tijuana River. Stream flows in the river vary considerably from season to season and year to year. The naturally-ephemeral Tijuana River now has year-round flow upstream in Tijuana, Mexico, although wastewater infrastructure (when operational) diverts low flows (less than 1 cms) and prevents anthropogenic surface flows from reaching the estuary. Additional freshwater sources are storm drains located mostly in the northern arm of the estuary from runoff from the adjacent military airfield and residential area. |
| Water depth (*meters, MLW*) | 1.1 (estimated) |
| Sonde distance from bottom (*meters*) | Approx. 0.25 |
| Bottom habitat or type | Silt and clay |
| Pollutants in area | Freshwater discharge with sewage, runoff from streets. |
| Description of watershed  | The Tijuana River watershed is one of the largest in the region, at 4500 km2, approx. 75% of which is in Mexico. The lower portion is heavily urbanized, with the channelized river flowing through the city of Tijuana, Mexico, before entering the United States. |

|  |  |
| --- | --- |
| Site name  | **Pond Restored (PR)** |
| Latitude and longitude | 32º 35’ 45.9”, 117º 7’ 5.5” W |
| Tidal range *(meters)* | Approx. 2.7 |
| Salinity range *(psu)* | 4 (extreme rain event) to 39 (average of 35) |
| Type and amount of freshwater input | Highly seasonal flows from the Otay River, which enters into the extreme south end of San Diego Bay. Salinity can also be affected by occasional leakage from high-salinity ponds of the South Bay Salt Works. |
| Water depth (*meters, MLW*) | 1.6 (estimated) |
| Sonde distance from bottom (*meters*) | Approx. 0.25 |
| Bottom habitat or type | Silt and clay |
| Pollutants in area | Legacy metal and synthetic organics in San Diego Bay. |
| Description of watershed  | The 40 km-long Otay River originates in the mountains of southern San Diego County, and is dammed at the Otay Reservior. The watershed is 410km2, and the lower watershed includes the City of Chula Vista, California. |

|  |  |
| --- | --- |
| Site name  | **South Bay (SB)** |
| Latitude and longitude | 32º 36’ 3.6” N, 117º 06’ 57.0” W |
| Tidal range *(meters)* | Approx. 2.7 |
| Salinity range *(psu)* | 4 (extreme rain event) to 39 (average of 35) |
| Type and amount of freshwater input | Highly seasonal flows from the Otay River, which enters into the extreme south end of San Diego Bay. Salinity can also be affected by occasional leakage from high-salinity ponds of the South Bay Salt Works. |
| Water depth (*meters, MLW*) | 1.8 (estimated) |
| Sonde distance from bottom (*meters*) | Approx. 0.25 |
| Bottom habitat or type | Silt and clay |
| Pollutants in area | Legacy metal and synthetic organics in San Diego Bay. |
| Description of watershed  | The 40 km-long Otay River originates in the mountains of southern San Diego County, and is dammed at the Otay Reservior. The watershed is 410km2, and the lower watershed includes the City of Chula Vista, California. |

All [reserve name] NERR historical nutrient/pigment monitoring stations:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station Code | SWMP Status | Station Name | Location | Active Dates | Reason Decommissioned | Notes |
| tjrbrnut | P | Boca Rio | 32° 33' 33.70 N, 117° 7' 44.30 W | 12/01/2004 - current | NA | Grab sample until present;Diel sample from1/18/2007 to 12/6/2012 and from1/20/2016 to present |
| tjrosnut | P | Oneonta Slough | 32° 34' 6.00 N, 117° 7' 52.60 W | 09/01/2002 - current | NA | Grab sample until present; diel sample from 9/1/2002 until 12/06/2006 |
| tjrprnut | P | Pond Eleven Restored | 32° 35' 45.90 N, 117° 07' 5.50 W | 01/01/2012 - current | NA | Grab sample until present; diel sample from 1/8/2013 to 12/18/2015  |
| tjrsbnut | P | South Bay | 32° 36' 3.60 N, 117° 6' 57.00 W | 01/01/2008 - current | NA | Grab sample |
| tjrpenut | P | Pond Eleven | 32° 36' 3.54 N, 117° 6' 58.46 W | 07/01/2008 – 12/31/2011 | Sampling at this site was interrupted due to an extensive Restoration project  | Grab sample; restoration project was concluded in October 2011. Pond Eleven site was relocated and renamed to Pond Eleven Restored. Sampling resumed in January 2013. |
| tjrmmnut | P | Model Marsh | 32° 32' 52.08 N, 117° 7' 22.80 W | 09/01/2002 – 07/30/2008 | Heavy sedimentation compromised the datalogger station | Grab sample |
| tjrtlnut | P | Tidal Linkage | 32° 34' 27.84 N, 117° 7' 37.92 W | 09/01/2002 – 12/06/2007 | Site too shallow for diel samples; heavy sedimentation compromised the datalogger station | Grab sample; diel sample on 7/27/2006 |
| tjrrcnut | P | River Channel | 32° 33' 28.08 N, 117° 6' 21.96 W | 09/01/2002 – 11/30/2004 | Heavy sedimentation compromised the datalogger station | Grab sample; replaced by Boca Rio site |
| tjrhpnut | NA | Helicopter Pad | 32° 33' 31.46 N, 117° 7' 9.34 W | 09/01/2002 - 09/30/2002 | Grab sample collected to test site suitability | Data only available by contacting the reserve directly |
| tjrrmnut | NA | River Mouth | 32° 33' 13.32 N, 117° 7' 34.32 W  | 09/01/2002 – 12/01/2002 | Grab samples collected to test site feasibility | Data only available by contacting the reserve directly |

**5) Coded variable definitions** –

Station code names:

 tjrbrnut = Tijuana River Reserve Boca Rio nutrient data

 tjrosnut = Tijuana River Reserve Oneonta Slough nutrient data

 tjrsbnut = Tijuana River Reserve South Bay nutrient data

 tjrpenut = Tijuana River Reserve Pond Restored nutrient data

Monitoring program codes:

 monthly grab sample program = 1

 diel grab sample program = 2

**6) Data collection period** –

Diel sampling at Boca Rio began with the first of the ISCO samples at the projected low tide. Grab samples were collected 3 hours prior to the low tide corresponding to the end of the ISCO sampling period. Date and time for both Grab and Diel samples are recorded below:

|  |  |  |
| --- | --- | --- |
| **Grab Samples** |  |  |
| **Boca Rio (BR)** |  |  |  |
| **Station** | **Date** | **Rep1** | **Rep 2** |
| tjrbrnut | 1/25/2023 | 15:01 | 15:02 |
| tjrbrnut | 2/22/2023 | 14:46 | 14:47 |
| tjrbrnut | 3/29/2023 | 11:01 | 11:02 |
| tjrbrnut | 4/27/2022 | 9:38 | 9:39 |
| tjrbrnut | 5/17/2023 | 13:37 | 13:38 |
| tjrbrnut | 6/14/2023 | 12:23 | 12:24 |
| tjrbrnut | 7/12/2023 | 10:59 | 11:00 |
| tjrbrnut | 8/16/2023 | 13:07 | 13:08 |
| tjrbrnut | 9/13/2023 | 12:40 | 12:41 |
| tjrbrnut | 10/11/2022 | 13:10 | 13:11 |
| tjrbrnut | 11/21/2022 | 12:12 | 12:13 |
| tjrbrnut | 12/19/2022 | 10:04 | 10:05 |
|  |  |  |  |
| **Oneonta Slough (OS)** |  |  |  |
| **Station** |  |  |  |
| tjrosnut | **Date** | **Rep1** | **Rep 2** |
| tjrosnut | 1/25/2023 | 15:40 | 15:41 |
| tjrosnut | 2/21/2023 | 14:31 | 14:32 |
| tjrosnut | 3/29/2023 | 10:14 | 10:15 |
| tjrosnut | 4/27/2022 | 7:20 | 7:21 |
| tjrosnut | 5/17/2023 | 14:30 | 14:31 |
| tjrosnut | 6/14/2023 | 13:30 | 13:31 |
| tjrosnut | 7/12/2023 | 8:58 | 8:59 |
| tjrosnut | 8/16/2023 | 13:27 | 13:28 |
| tjrosnut | 9/13/2023 | 13:33 | 13:34 |
| tjrosnut | 10/10/2023 | 12:28 | 12:29 |
| tjrosnut | 11/21/2022 | 9:10 | 9:11 |
| tjrosnut | 12/19/2022 | 11:48 | 11:49 |
|  |  |  |  |
| **Pond Restored (PR)** |  |  |  |
| **Station** |  |  |  |
| tjrprnut | **Date** | **Rep1** | **Rep 2** |
| tjrprnut | 1/25/2023 | 15:05 | 15:06 |
| tjrprnut | 2/21/2023 | 13:28 | 13:29 |
| tjrprnut | 3/29/2023 | 9:38 | 9:39 |
| tjrprnut | 4/27/2022 | 9:44 | 9:45 |
| tjrprnut | 5/17/2023 | 12:24 | 12:25 |
| tjrprnut | 6/14/2023 | 11:10 | 11:11 |
| tjrprnut | 7/11/2023 | 9:10 | 9:11 |
| tjrprnut | 8/16/2023 | 12:31 | 12:32 |
| tjrprnut | 9/13/2023 | 12:09 | 12:10 |
| tjrprnut | 10/11/2023 | 12:16 | 12:17 |
| tjrprnut | 11/21/2023 | 10:44 | 10:45 |
| tjrprnut | 12/19/2022 | 13:33 | 13:34 |
|  |  |  |  |
| **South Bay (SB)** |  |  |  |
| **Station** | **Date** | **Rep1** | **Rep 2** |
| tjrsbnut | 1/25/2023 | 15:19 | 15:20 |
| tjrsbnut | 2/21/2023 | 13:50 | 13:51 |
| tjrsbnut | 3/29/2023 | 9:15 | 9:16 |
| tjrsbnut | 4/27/2022 | 9:21 | 9:22 |
| tjrsbnut | 5/17/2023 | 11:50 | 11:51 |
| tjrsbnut | 6/14/2023 | 10:34 | 10:35 |
| tjrsbnut | 7/11/2023 | 9:40 | 9:41 |
| tjrsbnut | 8/16/2023 | 11:50 | 11:51 |
| tjrsbnut | 9/13/2023 | 11:20 | 11:21 |
| tjrsbnut | 10/11/2023 | 11:33 | 11:34 |
| tjrsbnut | 11/21/2023 | 10:03 | 10:04 |
| tjrsbnut | 12/19/2022 | 14:09 | 14:10 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Diel Samples**  |  |  |  |  |
|  |  |  |  |  |
| **Boca Rio Station**  | **Start Date** | **Start Time** | **End Date** | **End Time** |
| tjrbrnut | 1/25/2023 | 5:15 | 1/26/2023 | 3:45 |
| tjrbrnut | 2/21/2023 | 16:15 | 2/22/2023 | 14:45 |
| tjrbrnut | 3/28/2022 | 9:45 | 3/29/2022 | 10:30 |
| tjrbrnut | 4/26/2022 | 8:45 | 4/27/2022 | 9:30 |
| tjrbrnut | 5/16/2023 | 12:30 | 5/17/2023 | 13:15 |
| tjrbrnut | 6/13/2023 | 11:15 | 6/14/2023 | 12:00 |
| tjrbrnut | 7/11/2023 | 9:45 | 7/12/2023 | 10:30 |
| tjrbrnut | 8/15/2023 | 14:15 | 8/16/2023 | 15:00 |
| tjrbrnut | 9/12/2023 | 11:15 | 9/13/2023 | 12:00 |
| tjrbrnut | 10/10/2023 | 10:30 | 10/11/2023 | 11:15 |
| tjrbrnut | 11/20/2022 | 10:15 | 11/21/2022 | 11:00 |
|  | 12/18/2022 | 10:15 | 12/19/2022 | 11:00 |

Note that the time stamps are based on a 24-hour clock and refer to Pacific Standard Time. The date format is mm/dd/yyyy. Water quality parameters such as Specific Conductivity, Salinity, Dissolved Oxygen Saturation and Temperature are measured by YSI Professional Plus water quality instrument upon grab samples collection. These measurements are included in the nutrient datasheet.

**7) Associated researchers and projects–**

The research program at the TRNERR focuses on adaptive approaches to wetlands management, which involves coupling scientific investigation with management action. One focal area of research continues to be adaptive restoration, and the TRNERR has a long history of science-based restoration efforts. These programs incorporate descriptive and experimental approaches to investigate biotic and abiotic responses to marsh restoration, including ways to better achieve desired ecosystem responses. Two SWMP sites, based in South San Diego Bay, are associated with a marsh restoration in that area. Another active area of research is invasive species ecology and management. Although estuaries are typically invaded by a broad suite of species from many habitat types, current research is focusing on terrestrial and riparian invaders able to cross ecotones and invade salt marsh habitats. Researchers at the TRNERR are investigating mechanisms of invasions, impacts of invaders, and ecosystem recovery after exotic species control.

NERR SWMP water quality and weather data are used in a variety of reserve-based and external research and education programs. Water quality data from the Tijuana River, which rarely experiences mouth closures, provides an interesting contrast to data from other regional systems that experience frequent closure events. Also, SWMP water quality data are incorporated into a high school curriculum developed at the reserve. Tier 1 nutrient sampling is being conducted at all water quality datalogger stations. NERR SWMP meteorological sampling is being conducted at 1 station which is located near the former Tidal Linkage water quality station. In addition, much of the reserve is used as a test bed for research related to adaptive marsh restoration. NERR SWMP WQ and MET data are collected every 15-minutes and may be correlated with this nutrient/pigment dataset. These data are available at [www.nerrsdata.org](http://www.nerrsdata.org).

**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 2022.

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](http://cfcdmo.baruch.sc.edu/). Data are available in comma separated version format.

**II. Physical Structure Descriptors**

**9) Entry verification** –

TJR NERR staff collected, filtered and delivered the samples to the chemistry lab at the Oceanographic Data Facility, Scripps Institution of Oceanography, University of California, San Diego, where lab analyses were performed. The results are reported in µM. For purposes of consistency in the NERR System, the TJR NERR calculates the concentrations as mg/l based on atomic weights of 14.01, 30.97, and 28.09 for N, P, and Si, respectively. Therefore, TJR NERR multiplies the concentrations reported by 0.01401, 0.03097, and 0.02809 to yield concentrations in mg/L as N, P, and Si, respectively.

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.

Data entry and verification was performed by Monica Almeida (please see **Principal investigators and contact persons**).

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

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

Data Category Parameter Variable Name Units of Measure

Phosphorus and Nitrogen:

 \*Orthophosphate PO4F mg/L as P

 \*Ammonium, Filtered NH4F mg/L as N

 \*Nitrite + Nitrate, Filtered NO23F mg/L as N

 Dissolved Inorganic Nitrogen DIN mg/L as N

Plant Pigments:

 \*Chlorophyll a CHLA\_N µg/L

Carbon:

Other Lab Parameters:

 Silicate, Filtered SiO4F mg/L as SI

Field Parameters (Grab samples):

 Water Temperature WTEM\_N ºC

 Specific Conductivity SCON\_N mS/cm

 Salinity SALT\_N ppt

 Dissolved Oxygen DO\_N mg/L

 Dissolved Oxygen Saturation DO\_S\_N %

Notes:

1. Time is coded based on a 2400 clock and is referenced to Pacific Standard Time.

2. Reserves have the option of measuring either NO2 and NO3 or they may substitute NO23 for individual analyses if they can show that NO2 is a minor component relative to NO3. NO2 levels are predominately low at TJR Reserve, and individual analysis results have been measured but not reported. Results of individual analyses for NO2 are available upon request from the Research Coordinator at the specific NERR site. Please refer to the Principal investigators and contact persons for more information.

**11) Measured or calculated laboratory parameters** –

1. **Parameters measured directly**

Nitrogen species: NH4F, NO2F, NO23F

Phosphorus species: PO4F

Other: CHLA\_N, SiO4F

1. **Calculated parameters**

DIN NO23F+NH4F

**12) Limits of detection** –

Method detection limit as defined in the Code of Federal Regulations, 40 CFR 136, Appendix B, as: “the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.”

MDLs were reported by the Chemistry Lab at the Oceanographic Data Facility, Scripps Institution of Oceanography, University of California, San Diego. The lab determines MDLs by running a minimum of seven samples prepared at low concentrations, and multiplying the calculated standard deviation by 3 (approximately, this factor depends on the number of measurements). The lab MDL SOP is based on the methodology described in the “**Definition and Procedure for the Determination of the Method Detection Limit, Revision 2**” by the U.S. Environmental Protection Agency, which can be found at:

<https://www.epa.gov/sites/production/files/2016-12/documents/mdl-procedure_rev2_12-13-2016.pdf>

These values are revisited annually.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Start Date** | **End Date** | **MDL** | **Revisited** |
| PO4F | 1/1/2023 | 7/28/2023 | 0.0005 |  |
| PO4F | 7/29/2023 | 12/31/2023 | 0.0003 | 7/28/2023 |
| NH4F | 1/1/2023 | 7/28/2023 | 0.0001 |  |
| NH4F | 7/29/2023 | 12/31/2023 | 0.002 | 7/28/2023 |
| NO23F | 1/1/2023 | 7/28/2023 | 0.0002 |  |
| NO23F | 7/29/2023 | 12/31/2023 | 0.0008 | 7/28/2023 |
| CHLA\_N | 1/1/2023 | 8/9/2023 | 0.00 |  |
| CHLA\_N | 8/10/2023 | 12/31/2023 | 0.00 | 8/9/2023 |
| SiO4F | 1/1/2023 | 7/28/2023 | 0.003 |  |
| SiO4F | 7/29/2022 | 12/31/2022 | 0.005 | 7/28/2023 |

**13) Laboratory methods** –

* 1. **Parameter: PO4F**

Method Reference: Orthophosphate is analyzed using a modification of the Bernhardt and Wilhelms method. Bernhardt, H., and Wilhelms, A., 1967. "The continuous determination of low level iron, soluble phosphate and total phosphate with the AutoAnalyzer," Technicon Symposia, I,pp.385-389.

 Method Descriptor: Acidified ammonium molybdate is added to a water sample to produce phosphomolybdic acid, which is then reduced to phosphomolybdous acid (a blue compound) following the addition of dihydrazine sulfate. The sample is passed through a 10mm flowcell and absorbance is measured at 820nm. The absorbance is proportional to the concentration of orthophosphate in the sample.

Preservation Method: Filtered through both Whatman glass fiber filter (.7µm pore size) and MF-Millipore (.45µm pore size) membrane filter, and stored at or below -20°C.

Instrumentation: AA3 Autoanalyzer made my SEAL Analytical.

* 1. **Parameter: NH4F**

Method Reference: Ammonia is analyzed using the method described by Kerouel and Aminot. Kerouel, R. and Aminot, A., 1997. “Fluorometric determination of ammonia in sea and estuarine waters by direct segmented flow analysis.” Marine Chemistry, vol 57, no. 3-4, pp. 265-275.

 Method Descriptor: The sample is combined with a working reagent made up of ortho-phthalaldehyde, sodium sulfite and borate buffer and heated to 75ºC. Fluorescence proportional to the ammonia concentration is emitted at 460nm following excitation at 370nm.

Preservation Method: Filtered through both Whatman glass fiber filter (.7µm pore size) and MF-Millipore (.45µm pore size) membrane filter, and stored at or below -20°C.

Instrumentation: AA3 Autoanalyzer made my SEAL Analytical.

c) **Parameters: NO23F**

Method Reference: A modification of the Armstrong et al. procedure is used for the analysis of nitrate and nitrite. Armstrong, F.A.J., Stearns, C.A., and Strickland, J.D.H., 1967. "The measurement of upwelling and subsequent biological processes by means of the Technicon Autoanalyzer and associated equipment," Deep-Sea Research, 14, pp.381-389.

Method Descriptor: For the nitrate analysis, a water sample is passed through a cadmium column where the nitrate is reduced to nitrite. This nitrite is then diazotized with sulfanilamide and coupled with N-(1-naphthyl)-ethylenediamine to form a red dye. The sample is then passed through a 10mm flowcell and the absorbance is measured at 540nm. The procedure is the same for the nitrite analysis but without the cadmium column.

Preservation Method: Filtered through both Whatman glass fiber filter (.7µm pore size) and MF-Millipore (.45µm pore size) membrane filter, and stored at or below -20°C.

Instrumentation: AA3 Autoanalyzer made my SEAL Analytical.

d) **Parameter: CHLA**

Method Reference: Chlorophyll was analyzed using the California Cooperative Oceanic Fisheries Investigations (CalCOFI) methods, which is based on several references such as:

Holm\_Hansen, O., Lorenzen, C.J., Holms, R.W., Strickland, J.D.H. (1965). Fluorometric Determination of Chlorophyll. J. Cons.perm.int Explor. Mer. 30: 3-15.

Lorenzen, C. J. (1967) Determination of chlorophylls and phaeopigments: spectrophotometric equations. Limnol. Oceanogr. 12: 343–346.

Yentsch, C.S., Menzel, D.W. (1963). A method for the determination of phytoplankton chlorophyll and phaeophytin by fluorescence. Deep-Sea Res. 10: 221-231.

Method Descriptor: Samples are filtered through Whatman .7μm particle retention glass fiber filters. Chlorophyll *a* is extracted in an acetone solution. Chlorophyll and phaeopigments are then measured fluorometrically using an acidification technique.

Preservation Method: Filtered through a Whatman .7μm particle retention glass fiber filter and stored in a container with desiccant at or below -20°C.

Instrumentation: Turner 10-005R fluorometer

e) **Parameter: SiO4F**

Method Reference: Silicate is analyzed using the basic method of Armstrong et al. Armstrong, F.A.J., Stearns, C.A., and Strickland, J.D.H., 1967. "The measurement of upwelling and subsequent biological processes by means of the Technicon Autoanalyzer and associated equipment," Deep-Sea Research, 14, pp.381-389.

Method Descriptor: Acidified ammonium molybdate is added to a water sample to produce silicomolybdic acid which is then reduced to silicomolybdous acid (a blue compound) following the addition of stannous chloride. The sample is passed through a 10mm flowcell and measured at 660nm.

Preservation Method: Filtered through both Whatman glass fiber filter (.7µm pore size) and MF-Millipore (.45µm pore size) membrane filter, and stored at or below -20°C.

Instrumentation: AA3 Autoanalyzer made my SEAL Analytical.

**14) Field and Laboratory QAQC programs** –

* 1. **Precision**
		1. **Field variability** – Duplicate samples (i.e., two successive samples in different bottles) were collected at all sites.
		2. **Laboratory variability** – NONE
		3. **Inter-organizational splits** – NONE
	2. **Accuracy**
		1. **Sample spikes** – NONE
		2. **Standard reference material analysis –** Accuracy is based on the quality of the following standards, supplied from Johnson Matthey Chemical Co. and Fisher Scientific. Primary standards for silicate (Na2SiF6), nitrate (KNO3), nitrite (NaNO2), phosphate (KH2PO4), and ammonia (NH3) have purities of >99%, 99.999%, 98%, 99.999% and > 99.0%, respectively, as reported by the supplier.

Reference materials for nutrients in seawater (RMNS) are also used as a check sample and run periodically (approximately once a month). The RMNS preparation, verification, and suggested protocol for use of the material are described by (Aoyama et al., 2006, 2007, 2008) and Sato (2010). See the end of this document for these citations.

Results of these analyses are within the stated accuracy for the reference materials.

* + 1. **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

 *Wind speed*

 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/notes –**

Data may be missing due to problems with sample collection or processing. Laboratories in the NERR 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.

**Sample hold times for 2023:** Samples were 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.

|  |  |
| --- | --- |
| **Sample Descriptor** | **Date Analyzed** |
| **PO4F** | **NH4F** | **NO23F** | **CHLA\_N** | **SiO4F** |
| 1/25 - 1/26/2023, all diel samples | 2/10/2023 | 2/10/2023 | 2/10/2023 | 2/15/2023 | 2/10/2023 |
| 1/26/2023 all grab samples | 2/10/2023 | 2/10/2023 | 2/10/2023 | 2/15/2023 | 2/10/2023 |
| 2/21 - 2/22/2023, all diel samples | 3/2/2023 | 3/2/2023 | 3/2/2023 | 3/8/2023 | 3/2/2023 |
| 2/21 - 2/22/2023 all grab samples | 3/2/2023 | 3/2/2023 | 3/2/2023 | 3/8/2023 | 3/2/2023 |
| 3/28 - 3/29/2023, all diel samples | 4/6/2023 | 4/6/2023 | 4/6/2023 | 4/12/2023 | 4/6/2023 |
| 3/29/2023, all grab samples | 4/6/2023 | 4/6/2023 | 4/6/2023 | 4/12/2023 | 4/6/2023 |
| 4/26 - 4/27/2023, all diel samples | 5/9/2023 | 5/9/2023 | 5/9/2023 | 5/11/2023 | 5/9/2023 |
| 4/27/2023, all grab samples | 5/9/2023 | 5/9/2023 | 5/9/2023 | 5/11/2023 | 5/9/2023 |
| 5/16 - 5/17/2023, all diel samples | 6/1/2023 | 6/1/2023 | 6/1/2023 | 6/7/2023 | 6/1/2023 |
| 5/17/2023, all grab samples | 6/1/2023 | 6/1/2023 | 6/1/2023 | 6/7/2023 | 6/1/2023 |
| 6/13 - 6/14/2023, all diel samples | 6/28/2023 | 6/28/2023 | 6/28/2023 | 6/28/2023 | 6/28/2023 |
| 6/14/2023, all grab samples | 6/28/2023 | 6/28/2023 | 6/28/2023 | 6/28/2023 | 6/28/2023 |
| 7/11 - 7/12/2023, all diel samples | 7/28/2023 | 7/28/2023 | 7/28/2023 | 8/10/2023 | 7/28/2023 |
| 7/11 - 7/12/2023, all grab samples | 7/28/2023 | 7/28/2023 | 7/28/2023 | 8/10/2023 | 7/28/2023 |
| 8/15 - 8/16/2023, all diel samples | 8/25/2023 | 8/25/2023 | 8/25/2023 | 8/29/2023 | 8/25/2023 |
| 8/16/2023, all grab samples | 8/25/2023 | 8/25/2023 | 8/25/2023 | 8/29/2023 | 8/25/2023 |
| 9/12 - 9/13/2023, all diel samples | 9/27/2023 | 9/27/2023 | 9/27/2023 | 9/27/2023 | 9/27/2023 |
| 9/13/2023, all grab samples | 9/27/2023 | 9/27/2023 | 9/27/2023 | 9/27/2023 | 9/27/2023 |
| 10/10 - 10/11/2023, all diel samples | 10/18/2023 | 10/18/2023 | 10/18/2023 | 10/25/2023 | 10/18/2023 |
| 10/10 - 10/11/2023, all grab samples | 10/18/2023 | 10/18/2023 | 10/18/2023 | 10/25/2023 | 10/18/2023 |
| 11/20 - 11/21/2023, all diel samples | 12/8/2023 | 12/8/2023 | 12/8/2023 | 12/20/2023 | 12/8/2023 |
| 11/21/2023, all grab samples | 12/8/2023 | 12/8/2023 | 12/8/2023 | 12/20/2023 | 12/8/2023 |
| 12/18 - 12/19/2023, all diel samples | 1/12/2024 | 1/12/2024 | 1/12/2024 | 1/24/2024\*(2 days) | 1/12/2024 |
| 12/19/2023, all grab samples | 1/12/2024 | 1/12/2024 | 1/12/2024 | 1/24/2024\*(1 day) | 1/12/2024 |

\*sample held longer than allowed by NERRS protocols

During storm events, when the flow in the Tijuana River exceeds 1300 liters per second, or during maintenance and/or infrastructure failure, the International Boundary and Water Commission’s CILA pump station is shut off. This causes rainwater, urban runoff, and raw sewage to flow over the United States – Mexico border and into the Tijuana River Estuary. As a result, this can disrupt the sample collection process, leading to missed sampling sessions at the affected sites (Boca Rio and Oneonta Slough) or higher-than-usual nutrient values. Although we didn't miss any sample sessions this year due to this issue, we consistently had water samples with high nutrient levels throughout 2023. In the case of nutrient-rich samples, they need to be diluted during analysis. Below is a list of missing samples, dilution ratios, and rain events that occurred within the last 72 hours before a sampling session. Total precipitation values are measured by the tipping bucket as part of our SWMP Tidal Linkage meteorological station. Data on transboundary flows can be found at the [IBWC Data Portal](https://waterdata.ibwc.gov/AQWebportal/Data/Dashboard/8).

***Rain events within 72 hours of sampling****:*

**Date .in**

2/21 0.06

2/22 0.22

6/11 – 6/13 0.04

***Sample dilution details:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Station Code** | **Date/Time** | **Monitoring Program** |  |
|  |  |  |  |
| tjrbrnut | 1/25/2023 05:15 | Diel | NO3 determined by 1:6 dilution, PO4 determined by 1:30 dilution, NO2 determined by 1:30 dilution, NH4 determined by 1:120 dilution |
| tjrbrnut | 1/25/2023 07:30 | Diel | NO3 determined by 1:6 dilution, PO4 determined by 1:30 dilution, SIL determined by 1:6 dilution, NO2 determined by 1:30 dilution, NH4 determined by 1:200 dilution |
| tjrbrnut | 1/25/2023 09:45 | Diel | PO4 determined by 1:6 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:200 dilution |
| tjrbrnut | 1/25/2023 14:15 | Diel | PO4 determined by 1:6 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:200 dilution |
| tjrbrnut | 1/25/2023 16:30 | Diel | PO4 determined by 1:30 dilution, NO2 determined by 1:30 dilution, NH4 determined by 1:200 dilution |
| tjrbrnut | 1/25/2023 18:45 | Diel | PO4 determined by 1:30 dilution, NO2 determined by 1:30 dilution, NH4 determined by 1:200 dilution |
| tjrbrnut | 1/25/2023 21:00 | Diel | PO4 determined by 1:30 dilution, NO2 determined by 1:30 dilution, NH4 determined by 1:200 dilution |
| tjrbrnut | 1/25/2023 23:15 | Diel | PO4 determined by 1:6 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:200 dilution |
| tjrbrnut | 1/26/2023 01:30 | Diel | NH4 determined by 1:6 solution |
| tjrbrnut | 1/26/2023 03:45 | Diel | PO4 determined by 1:6 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:200 dilution |
| tjrbrnut | 1/25/2023 15:01 | Grab | PO4 determined by 1:30 dilution, NO2 determined by 1:30 dilution, NH4 determined by 1:200 dilution |
| tjrbrnut | 1/25/2023 15:02 | Grab | PO4 determined by 1:30 dilution, NO2 determined by 1:30 dilution, NH4 determined by 1:200 dilution |
| tjrosnut | 1/25/2023 15:40 | Grab | NO3 determined by 1:6 dilution, PO4 determined by 1:30 dilution, SIL determined by 1:6 dilution, NO2 determined by 1:30 dilution, NH4 determined by 1:200 dilution |
| tjrosnut | 1/25/2023 15:41 | Grab | NO3 determined by 1:6 dilution, PO4 determined by 1:30 dilution, SIL determined by 1:6 dilution, NO2 determined by 1:30 dilution, NH4 determined by 1:200 dilution |
|  |  |  |  |
| tjrbrnut | 2/21/2023 16:15 | Diel | PO4 determined by 1:6 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:30 dilution |
| tjrbrnut | 2/21/2023 18:30 | Diel | PO4 determined by 1:6 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:120 dilution |
| tjrbrnut | 2/21/2023 20:45 | Diel | PO4 determined by 1:6 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:120 dilution |
| tjrbrnut | 2/21/2023 23:00 | Diel | PO4 determined by 1:10 dilution, NH4 determined by 1:60 dilution |
| tjrbrnut | 2/22/2023 01:15 | Diel | PO4 determined by 1:6 dilution, NH4 determined by 1:30 dilution |
| tjrbrnut | 2/22/2023 03:30 | Diel | PO4 determined by 1:6 dilution, NH4 determined by 1:120 dilution |
| tjrbrnut | 2/22/2023 05:45 | Diel | PO4 determined by 1:30 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:120 dilution |
| tjrbrnut | 2/22/2023 08:00 | Diel | PO4 determined by 1:30 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:120 dilution |
| tjrbrnut | 2/22/2023 10:15 | Diel | PO4 determined by 1:6 dilution, NH4 determined by 1:30 dilution |
| tjrbrnut | 2/22/2023 12:30 | Diel | NH4 determined by 1:6 dilution |
| tjrbrnut | 2/22/2023 14:45 | Diel | NH4 determined by 1:6 dilution |
| tjrbrnut | 2/22/2023 14:46 | Grab | PO4 determined by 1:6 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:120 dilution |
| tjrbrnut | 2/22/2023 14:47 | Grab | PO4 determined by 1:6 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:120 dilution |
| tjrosnut | 2/21/2023 14:31 | Grab | PO4 determined by 1:30, NO2 determined by 1:6 dilution, NH4 determined by 1:120 dilution |
| tjrosnut | 2/21/2023 14:32 | Grab | PO4 determined by 1:30, NO2 determined by 1:6 dilution, NH4 determined by 1:120 dilution |
|  |  |  |  |
| tjrbrnut | 3/28/2022 09:45 | Diel | PO4 determined by 1:10 dilution; SIL determined by 1:10 dilution; NO2 determined by 1:10 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/28/2022 12:00 | Diel | SIL determined by 1:10 dilution; PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/28/2022 14:15 | Diel | SIL determined by 1:10 dilution; PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/28/2022 16:30 | Diel | SIL determined by 1:10 dilution; NO2 determined by 1:10 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/28/2022 18:45 | Diel | SIL determined by 1:10 dilution; PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/28/2022 21:00 | Diel | SIL determined by 1:10 dilution; PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/28/2022 23:15 | Diel | SIL determined by 1:10 dilution; PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/29/2022 01:30 | Diel | SIL determined by 1:10 dilution; PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/29/2022 03:45 | Diel | SIL determined by 1:10 dilution; PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/29/2022 06:00 | Diel | SIL determined by 1:10 dilution; PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/29/2022 08:15 | Diel | NO2 determined by 1:10 dilution; PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/29/2022 10:30 | Diel | PO4 determined by 1:10 dilution; SIL determined by 1:10 dilution; NO2 determined by 1:10 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/29/2023 11:01 | Grab | PO4 determined by 1:10; SIL determined by 1:10 dilution; NO2 determined by 1:10 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 3/29/2023 11:02 | Grab | PO4 determined by 1:10 dilution; SIL determined by 1:10 dilution; NO2 determined by 1:10 dilution; NH4 determined by 1:100 dilution |
| tjrosnut | 3/29/2023 10:14 | Grab | PO4 determined by 1:10 dilution; NO2 determined by 1:10 dilution; NH4 determined by 1:100 dilution |
| tjrosnut | 3/29/2023 10:15 | Grab | PO4 determined by 1:10 dilution; NO2 determined by 1:10 dilution; NH4 determined by 1:100 dilution |
|  |  |  |  |
| tjrbrnut | 4/26/2022 08:45 | Diel | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 4/26/2022 11:00 | Diel | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 4/26/2022 13:15 | Diel | SIL determined by 1:30 dilution; PO4 determined by 1:100 dilution; NH4 determined by 1:200 dilution |
| tjrbrnut | 4/26/2022 15:30 | Diel | SIL determined by 1:30 dilution; PO4 determined by 1:100 dilution; NH4 determined by 1:200 dilution |
| tjrbrnut | 4/26/2022 17:45 | Diel | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 4/26/2022 20:00 | Diel | PO4 determined by 1:30 dilution; NH4 determined by 1:30 dilution |
| tjrbrnut | 4/26/2022 22:15 | Diel | PO4 determined by 1:30 dilution; NH4 determined by 1:30 dilution |
| tjrbrnut | 4/27/2022 00:30 | Diel | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 4/27/2022 02:45 | Diel | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 4/27/2022 05:00 | Diel | PO4 determined by 1:30 dilution; NH4 determined by 1:30 dilution |
| tjrbrnut | 4/27/2022 07:15 | Diel | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 4/27/2022 09:30 | Diel | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 4/27/2022 09:38 | Grab | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 4/27/2022 09:39 | Grab | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrosnut | 4/27/2022 07:20 | Grab | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
| tjrosnut | 4/27/2022 07:21 | Grab | PO4 determined by 1:30 dilution; NH4 determined by 1:100 dilution |
|  |  |  |  |
| tjrbrnut | 5/16/2023 12:30 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 5/16/2023 14:45 | Diel | PO4 determined by 1:100 dilution, NH4 determined by 1:100 dilution |
| tjrbrnut | 5/16/2023 17:00 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 5/16/2023 19:15 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 5/16/2023 21:30 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 5/16/2023 23:45 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 5/17/2023 02:00 | Diel | PO4 determined by 1:100 dilution, NH4 determined by 1:100 dilution |
| tjrbrnut | 5/17/2023 04:15 | Diel | PO4 determined by 1:100 dilution, NH4 determined by 1:100 dilution |
| tjrbrnut | 5/17/2023 06:30 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 5/17/2023 08:45 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 5/17/2023 11:00 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 5/17/2023 13:15 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 5/17/2023 13:37 | Grab | PO4 determined by 1:100 dilution, NH4 determined by 1:100 dilution |
| tjrbrnut | 5/17/2023 13:38 | Grab | PO4 determined by 1:100 dilution, NH4 determined by 1:100 dilution |
| tjrosnut | 5/17/2023 14:30 | Grab | PO4 determined by 1:100 dilution, NH4 determined by 1:100 dilution |
| tjrosnut | 5/17/2023 14:31 | Grab | PO4 determined by 1:100 dilution, NH4 determined by 1:100 dilution |
| tjrprnut | 5/17/2023 12:24 | Grab | NH4 determined by 1:100 dilution |
| tjrprnut | 5/17/2023 12:25 | Grab | NH4 determined by 1:100 dilution |
| tjrsbnut | 5/17/2023 11:50 | Grab | NH4 determined by 1:100 dilution |
| tjrsbnut | 5/17/2023 11:51 | Grab | NH4 determined by 1:100 dilution |
|  |  |  |  |
| tjrbrnut | 6/13/2023 11:15 | Diel | PO4 determined by 1:10x dilution; NH4 determined by 1:100x dilution |
| tjrbrnut | 6/13/2023 13:30 | Diel | PO4 determined by 1:10x dilution; NH4 determined by 1:100x dilution |
| tjrbrnut | 6/13/2023 15:45 | Diel | PO4 determined by 1:10x dilution; NH4 determined by 1:10x dilution |
| tjrbrnut | 6/13/2023 18:00 | Diel | NH4 determined by 1:10x dilution |
| tjrbrnut | 6/13/2023 20:15 | Diel | NH4 determined by 1:10x dilution |
| tjrbrnut | 6/13/2023 22:30 | Diel | PO4 determined by 1:10x dilution; NH4 determined by 1:10x dilution; NO2 determined by 1:10x dilution |
| tjrbrnut | 6/14/2023 00:45 | Diel | PO4 determined by 1:10x dilution; NH4 determined by 1:100x dilution; NO2 determined by 1:10x dilution |
| tjrbrnut | 6/14/2023 03:00 | Diel | PO4 determined by 1:10x dilution; NH4 determined by 1:100x dilution; NO2 determined by 1:10x dilution |
| tjrbrnut | 6/14/2023 05:15 | Diel | PO4 determined by 1:10x dilution; NH4 determined by 1:100x dilution; NO2 determined by 1:10x dilution |
| tjrbrnut | 6/14/2023 07:30 | Diel | PO4 determined by 1:10x dilution; NH4 determined by 1:10x dilution |
| tjrbrnut | 6/14/2023 09:45 | Diel | PO4 determined by 1:10x dilution; NH4 determined by 1:10x dilution |
| tjrbrnut | 6/14/2023 12:00 | Diel | PO4 determined by 1:10x dilution; NH4 determined by 1:100x dilution; NO2 determined by 1:10x dilution |
| tjrbrnut | 6/14/2023 12:23 | Grab | PO4 determined by 1:10x dilution; NH4 determined by 1:100x dilution; NO2 determined by 1:10x dilution |
| tjrbrnut | 6/14/2023 12:24 | Grab | PO4 determined by 1:10x dilution; NH4 determined by 1:100x dilution; NO2 determined by 1:10x dilution |
| tjrosnut | 6/14/2023 13:30 | Grab | PO4 determined by 1:10x dilution; NH4 determined by 1:100x dilution; NO2 determined by 1:10x dilution |
| tjrosnut | 6/14/2023 13:31 | Grab | PO4 determined by 1:10x dilution; NH4 determined by 1:100x dilution; NO2 determined by 1:10x dilution |
|  |  |  |  |
| tjrbrnut | 7/11/2023 09:45 | Diel | NO2 determined by 1:6 dilution, NH4 determined by 1:30 dilution |
| tjrbrnut | 7/11/2023 12:00 | Diel | PO4 determined by 1:30 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:30 dilution |
| tjrbrnut | 7/11/2023 14:15 | Diel | NH4 determined by 1:6 dilution |
| tjrbrnut | 7/11/2023 21:00 | Diel | NO2 determined by 1:6 dilution, NH4 determined by 1:6 dilution |
| tjrbrnut | 7/11/2023 23:15 | Diel | NO2 determined by 1:10 dilution, NH4 determined by 1:10 dilution |
| tjrbrnut | 7/12/2023 01:30 | Diel | NO2 determined by 1:10 dilution, NH4 determined by 1:10 dilution |
| tjrbrnut | 7/12/2023 03:45 | Diel | PO4 determined by 1:30 dilution, NO2 determined by 1:6 dilution, NH4 determined by 1:30 dilution |
| tjrbrnut | 7/12/2023 06:00 | Diel | NH4 determined by 1:30 dilution |
| tjrbrnut | 7/12/2023 08:15 | Diel | NH4 determined by 1:6 dilution |
| tjrbrnut | 7/12/2023 10:30 | Diel | NO2 determined by 1:6 dilution, NH4 determined by 1:30 dilution  |
| tjrbrnut | 7/12/2023 10:59 | Grab | NO2 determined by 1:6 dilution, NH4 determined by 1:30 dilution |
| tjrbrnut | 7/12/2023 11:00 | Grab | NO2 determined by 1:6 dilution, NH4 determined by 1:30 dilution |
| tjrosnut | 7/12/2023 08:58 | Grab | NO2 determined by 1:10 dilution, NH4 determined by 1:30 dilution |
| tjrosnut | 7/12/2023 08:59 | Grab | NO2 determined by 1:10 dilution, NH4 determined by 1:30 dilution |
|  |  |  |  |
| tjrbrnut | 8/15/2023 14:15 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 8/15/2023 16:30 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 8/15/2023 18:45 | Diel | PO4 determined by 1:30 dilution, NH4 determined by 1:100 dilution |
| tjrbrnut | 8/15/2023 21:00 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 8/16/2023 03:45 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 8/16/2023 06:00 | Diel | NO2 determined by 1:6 dilution, NH4 determined by 1:100 dilution |
| tjrbrnut | 8/16/2023 08:15 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 8/16/2023 15:00 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 8/16/2023 13:07 | Grab | NH4 determined by 1:100 dilution |
| tjrbrnut | 8/16/2023 13:08 | Grab | NH4 determined by 1:100 dilution |
| tjrosnut | 8/16/2023 13:27 | Grab | NH4 determined by 1:100 dilution |
| tjrosnut | 8/16/2023 13:28 | Grab | NH4 determined by 1:100 dilution |
|  |  |  |  |
| tjrbrnut | 10/10/2023 10:30 | Diel | NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/10/2023 12:45 | Diel | NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/10/2023 15:00 | Diel | PO4 determined by 1:30 dilution, NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/10/2023 17:15 | Diel | NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/10/2023 19:30 | Diel | NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/10/2023 21:45 | Diel | NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/11/2023 00:00 | Diel | NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/11/2023 02:15 | Diel | NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/11/2023 04:30 | Diel | NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/11/2023 11:15 | Diel | NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/11/2022 13:10 | Grab | NH4 determined by 1:60 dilution  |
| tjrbrnut | 10/11/2022 13:11 | Grab | NH4 determined by 1:60 dilution  |
| tjrosnut | 10/10/2023 12:28 | Grab | NO2 determined by 1:30 dilution, NH4 determined by 1:60 dilution  |
| tjrosnut | 10/10/2023 12:29 | Grab | NH4 determined by 1:60 dilution  |
|  | 10/10/2022 13:37 | Grab | NH4 determined by 1:60 dilution  |
|  |  |  |  |
| tjrbrnut | 11/20/2022 12:30 | Diel | PO4 determined by 1:20 dilution; SIL determined by 1:20 dilution; NH4 determined by 1:200 dilution |
| tjrbrnut | 11/20/2022 14:45 | Diel | PO4 determined by 1:20 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 11/20/2022 17:00 | Diel | NH4 determined by 1:100 dilution |
| tjrbrnut | 11/20/2022 19:15 | Diel | PO4 determined by 1:20 dilution; NH4 determined by 1:20 dilution |
| tjrbrnut | 11/20/2022 21:30 | Diel | PO4 determined by 1:20 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 11/20/2022 23:45 | Diel | PO4 determined by 1:20 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 11/21/2022 02:00 | Diel | PO4 determined by 1:20 dilution; SIL determined by 1:20 dilution; NH4 determined by 1:200 dilution |
| tjrbrnut | 11/21/2022 04:15 | Diel | PO4 determined by 1:20 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 11/21/2022 08:45 | Diel | PO4 determined by 1:20 dilution; NH4 determined by 1:20 dilution |
| tjrbrnut | 11/21/2022 11:00 | Diel | PO4 determined by 1:20 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 11/21/2022 12:12 | Grab | PO4 determined by 1:20 dilution; NH4 determined by 1:100 dilution |
| tjrbrnut | 11/21/2022 12:13 | Grab | PO4 determined by 1:20 dilution; NH4 determined by 1:100 dilution |
| tjrosnut | 11/21/2022 09:10 | Grab | PO4 determined by 1:20 dilution; NH4 determined by 1:100 dilution |
| tjrosnut | 11/21/2022 09:11 | Grab | PO4 determined by 1:20 dilution; NH4 determined by 1:100 dilution |
|  |  |  |  |
| tjrbrnut | 12/18/2022 12:30 | Diel | NO2 determined by 1:10x dilution, NH4 determined by 1:10x dilution |
| tjrbrnut | 12/18/2022 14:45 | Diel | NH4 determined by 1:10x dilution |
| tjrbrnut | 12/18/2022 17:00 | Diel | PO4 determined by 1:10x dilution, NO2 determined by 1:10x dilution, NH4 determined by 1:100x dilution |
| tjrbrnut | 12/19/2022 02:00 | Diel | NH4 determined by 1:100x dilution |
| tjrbrnut | 12/19/2022 04:15 | Diel | NH4 determined by 1:10x dilution |
| tjrbrnut | 12/19/2022 08:45 | Diel | PO4 determined by 1:10x dilution, NO2 determined by 1:10x dilution, NH4 determined by 1:100x dilution |
| tjrbrnut | 12/19/2022 10:04 | Grab | PO4 determined by 1:30x dilution, NO2 determined by 1:30x dilution, NH4 determined by 1:100x dilution |
| tjrbrnut | 12/19/2022 10:05 | Grab | PO4 determined by 1:30x dilution, NO2 determined by 1:30x dilution, NH4 determined by 1:100x dilution |
| tjrosnut | 12/19/2022 11:48 | Grab | PO4 determined by 1:30x dilution, NO2 determined by 1:30x dilution, NH4 determined by 1:100x dilution |
| tjrosnut | 12/19/2022 11:49 | Grab | PO4 determined by 1:30x dilution, NO2 determined by 1:30x dilution, NH4 determined by 1:100x dilution |

***Other notes:***

The samples below were missing due autosampler power failure/malfunctioning

|  |  |
| --- | --- |
| tjrbrnut | 11/20/2023 10:15 |
| tjrbrnut | 12/18/2023 10:15 |
| tjrbrnut | 12/18/2023 19:15 |
| tjrbrnut | 12/18/2023 21:30 |
| tjrbrnut | 12/18/2023 23:45 |
| tjrbrnut | 12/19/2023 06:30 |

The May samples (below) were flagged as suspect because the lab fluorometer (software) kept crashing due to their high ammonium concentrations, and the field blank measurement for ammonia was high. All the other nutrients seemed fine.

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| --- | --- |
| tjrbrnut | 05/16/2023 12:30 |
| tjrbrnut | 05/16/2023 14:45 |
| tjrbrnut | 05/16/2023 17:00 |
| tjrbrnut | 05/16/2023 19:15 |
| tjrbrnut | 05/16/2023 21:30 |
| tjrbrnut | 05/16/2023 23:45 |
| tjrbrnut | 05/17/2023 02:00 |
| tjrbrnut | 05/17/2023 04:15 |
| tjrbrnut | 05/17/2023 06:30 |
| tjrbrnut | 05/17/2023 08:45 |
| tjrbrnut | 05/17/2023 11:00 |
| tjrbrnut | 05/17/2023 13:15 |
| tjrbrnut | 05/17/2023 13:37 |
| tjrbrnut | 05/17/2023 13:38 |
| tjrosnut | 05/17/2023 14:30 |
| tjrosnut | 05/17/2023 14:31 |
| tjrprnut | 05/17/2023 12:24 |
| tjrprnut | 05/17/2023 12:25 |
| tjrsbnut | 05/17/2023 11:50 |
| tjrsbnut | 05/17/2023 11:51 |