

**Reserve Name** JOB NERR Water Quality Metadata

**Months and year the documentation covers:** 01/01/2022 to 12/31/2022

**Latest Update:** 05/21/2025

## **I. Data Set and Research Descriptors**

### **1. Principal investigator<s> and contact persons**

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### **2. Entry verification**

Deployment data are uploaded from the YSI data logger to a Personal Computer by Enid Malavé. Files are exported from KOR-EXO (YSI Proprietary) program in a Microsoft Excel format by Enid Malavé and Angel Dieppa then excessive pre- and post-deployment data are removed from the file prior to upload with up to 2 hours of pre- and post-deployment data retained to assist in data management. Then it is converted to a comma delimited file (\*.cdf) and uploaded to the CDMO where they undergo automated primary QAQC and become part of the CDMO's online provisional database. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve where it is opened in Microsoft Excel and processed using the CDMO's NERRQAQC Excel macro by Enid Malavé and Angel Dieppa. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, remove any overlapping deployment data, append files, and export the resulting data file for upload to the CDMO. Upload after secondary QAQC results in ingestion into the database as provisional plus data, recalculation of cDepth or cLevel parameters, and finally tertiary QAQC by the CDMO and assimilation into the CDMO's authoritative online database. Where deployment overlap occurs between files, the data produced by the newly calibrated sonde is generally accepted as being the most accurate. The final yearly file and metadata was submitted by Enid Malavé and Angel Dieppa. For more information on QAQC flags and codes, see Sections 11 and 12.

### **3. Research objectives**

The principal objective is to record and track long-term changes and short term variability in water quality parameters that can be associated to changes in estuarine habitats. Through this, we support management decisions based on scientific data. A secondary objective is to promote the access and use of reliable baseline information by federal and local agencies, universities, researchers, educators and local communities to enhance the process by which they make decisions regarding their daily

activities. This data is also invaluable in the identification and development of future monitoring and research activities.

A total of four data loggers <YSI EXO-2> are deployed in Jobos Bay. Two sondes are deployed in the inner lagoons of the Mar Negro Component and the other two in the Jobos Bay. The instruments are depth-fixed from a pole at a distance at about 0.5 meters from the bottom at each selected site. Data from stations 9, 10, 19 and 20 are being submitted to the Centralized Data Management Office as part of the System-Wide Monitoring Program. Measurements are taken at fifteen-minute intervals for approximately two-week periods. The sites are identified as representative of areas within the reserve and comparable to the sites that may be receiving impact from human activities from surroundings areas or may act as a habitat gradient in the Bay.

Station number nine <9>, subject to impacts from coastal processes <close to a power plant retentions pond>, collects water quality data in a site associated with runoff from littoral and basin mangrove areas. This sampling station is located in the most inland lagoon, closest to the Thermoelectric Power Plant <oil and natural gas>. It is subjected to runoff, which may include potential oil spill contamination from this industrial facility. Information compiled from historical environmental documents, indicate that station nine <9> was used as a disposal site for residues of the previously operating sugar mill operation, and therefore might have high organic input into the sediments.

Station number ten <10>, located in a mangrove lagoon area towards the southwestern section of Mar Negro is considered the reference or non-impacted site.

Station number <19> is located over a sea grass bed <*Thalassia testudinum*> in the inner western part of the bay just northeast of Cayo Colchones. This station is located near the thermal outfall and operating piers of the Aguirre Power Plant Complex, both activities may have significant effects on sea grass communities. This area is exposed to barge stranding, sediment re-suspension and oil spills. Station number <20> is located on the eastern inner bay section of the Cayos Caribe cays. This station is just south of the mangrove islets associated with the Reserve's coral reefs. Water streams coming through the coral platform may help characterize water conditions of the main marine currents reaching Jobos Bay, as well as possible effects of industrial and chemical activities associated with Phillips Core, AES Coal Energy Plant and Pharmaceuticals located just east to this system.

#### 4. Research methods

The National Estuarine Research Reserve Water Quality Monitoring Program began sampling at Station nine <9> on December 20, 1995 and Station ten <10> on February 1, 1996. Monitoring at station 19 began in April 2004 and at station 20 in June 2004. Long term water quality monitoring is being performed at these stations.

Before each YSI 6600 or EXO-2 data logger is deployed, calibration and maintenance is performed following the Standard Operation Procedures of the NERRS. Calibration standards are only required for pH, salinity, and turbidity, all other parameters are done as described in the manual. Buffer solutions for two-point calibration <pH 7 and pH 10> are purchased from a scientific supply company. Salinity is calibrated with a specific conductance standard 50 mS/cm and is purchased from YSI.

The two-point turbidity calibration is performed using a 0 NTU <DI water> and 124 FNU <for EXO-2> standard purchased from a scientific company. EXO-2 are equipped with dissolved oxygen optical sensors, both are allowed to sit at least 24 hours after proper calibration. Weather conditions and tide stage are recorded in the field observation log during deployment. Measurements of DO, pH, salinity, specific conductance, turbidity, and temperature are taken at the deployment time to check the accuracy and functionality of the instruments.

Each YSI data logger hangs inside a 6-inch diameter PVC pipe which is attached to a concrete filled PVC stable pole. Data loggers are at approximately 0.5 meter from the bottom of the selected site. Data is recorded every 15 minutes. The following measurements are recorded: date, time, temperature, specific conductance, salinity, dissolved oxygen saturation, dissolved oxygen concentration, depth, pH, and turbidity, all station have an optical chlorophyll-a sensor. Chl-a is an optional parameter non-required for SWMP program. Approximately, every two weeks the data loggers are retrieved, inspected, cleaned, data is downloaded into a personal computer and re-calibrated as noted previously. The data logger is then ready to be deployed again.

The data is processed through a standard quality control/quality assurance established for all 29 reserves within the system. It consists in submitting the raw data to the Centralized Data Management Office <CDMO> server where data undergoes through a macro to flag anomalies predetermine for each station. The data is sent back to the reserve to pass through a secondary QA/QC and finally resubmitted to CDMO for the final approval. Data may be available in different stages of the QA/QC process.

A Sutron Sat-Link2 transmitter was installed at the JOB20 station on 07/20/06 and a second station JOB09, transmits data to the NOAA GOES satellite, NESDIS ID # 3B0297EC and NESDIS ID # 3B0424AC respectively. The transmissions are scheduled hourly and contain four <4> data sets reflecting fifteen-minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The “real-time” telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO’s authoritative online database. Provisional and authoritative data are available at <http://cdmo.baruch.sc.edu>.

Station 20 and Station 9 telemetry was interrupted on 09/20/17 after Hurricane Maria destroyed the platform losing all the equipment. We are planning to reestablish communication in the near future.

## 5. Site location and character

The Jobos Bay National Estuarine Research Reserve <JBNERR> is located on the southern coastal plain of the island of Puerto Rico, a reserve within the West Indies geographical area. JBNERR is composed of two major areas: <1> Mar Negro, located on the western margin of the Bay, and <2> Cayos Caribe <a chain of 17 tear-shaped islets located to the southeast> and Cayos Barca <a chain of 7 tear-shaped islets located to the southwest boundaries> both with a back-reef system. The Mar Negro area comprises the bulk of the Reserve, and consists of mangrove forests and a complex system of lagoons and channels interspersed with salt and mud flats. Coral reefs and sea grass beds, with small beach deposits and upland areas fringe Cayos Caribe and Cayos Barca mangrove islands. Few areas in the watershed drain directly to the bay. Rio Seco to the north-east of the bay is active only during heavy rain events during the wet season. A small creek, Quebrada Coqui, near JBNERR’s pier to the north of the bay, drains into an extensive mangrove fringe forest in a laminar flow. During heavy rain events, Station 09 received runoff water from upland and finally, a diffuse flow of water reaches the bay from the local aquifer.

**Station 9** is an impacted site and is located on the northeastern section of the Mar Negro component. This sampling station is associated with mangrove lagoon areas and receives runoff from mudflats, the Thermoelectric Power Plant, and adjacent areas. The tidal range varies from 12 to 14 inches near the monitoring station. The salinity at the vicinity of the monitoring station during this quarter varies from 1.2 ppt to 43.8 ppt. The average depth and total depth at station 09 is 0.37 and 1.16 meters respectively. The bottom is covered by a thick layer of thin sediments with a high content of organic material. *Microcoleus sp.* <blue-green algae>, brown and green algae <*Caulerpa sp.*> are also present at this site, but a better assessment is needed. The station pole was located at 17°56'34.87"N and 66°14'18.64"W until 09/02/2010 12:00PM, then it was relocated to 17° 56'

35.0" N and 66° 14' 18.9" W approximately 65.0 meters from original position. The relocation was due to sedimentation issues and the construction of a new telemetry station. Fresh water input to the station comes only from runoff and rain. This station has been subject of several studies indicating the presence of relatively high level of cooper and pesticides compared to other stations. Since 2015 an invasive seagrass, *Halophila stipulacea* was reported at Jobos Bay, it was after the pass of Hurricane Maria in September 21, 2017 that it was more evident and wide distributed. Although it is not present at Station 9, it is present in the channels toward the station and we expect it will colonize the area in the near future.

Station 10 is located in a mangrove lagoon not impacted directly by any upland or marine activities. It provides a reference for comparison of data obtained in other stations, especially to the station in Mar Negro lagoon. The tidal range varies from 12 to 14 inches. The salinity at the vicinity of the monitoring station during this quarter varies from 28.1 ppt to 37.5 ppt. The average depth and total depth at station 10 is 0.36 and 0.86 meters respectively. The bottom is covered with a layer of fine sediments with organic material, followed by a layer of calcareous material mainly from shells and oysters. At this site, we can find sea grass <*Thalassia testudinum*>, calcareous algae <*Halimeda sp.*>, green algae <*Caulerpa sp.*> and brown algae <*Dictyota sp.*> among others. The pole is located at 17° 56' 19.00 N, 66° 15' 27.85 W. Fresh water input to the station comes only from runoff and rain. There is not any direct source of fresh water. Since 2015 an invasive seagrass, *Halophila stipulacea* was reported at Jobos Bay, it was after the pass of Hurricane Maria in September 21, 2017 that it was more evident and wide distributed been observed in the perimeter of the station. See notes below regarding Sargassum arrivals. (Note: Due to problems with sondes and sensors, we stop deploying instruments at this station on 01/30/2022).

Station 19 is located on the western inner section of the bay at a distance of 233 meters from Cayo Colchones Mangroves over sea grass beds <*Thalassia testudinum*>. Tidal ranges in this area vary from 12 to 14 inches. The salinity at the vicinity of the monitoring station during this quarter varies from 30.2 ppt to 35.5 ppt. The average depth and total depth at this station is 0.31 and 1.10 meters respectively. The YSI sonde is deployed at about .05 meter from the bottom. The bottom is of sandy composition. Sea grass, algae, echinoderms and other related organisms could be found in the area. The pole is located at 17° 56' 34.49"N, 66° 13' 43.77"W. There is no freshwater input to this area. Since 2015 an invasive seagrass, *Halophila stipulacea* was reported at Jobos Bay, it was after the pass of Hurricane Maria in September 21, 2017 that it was more evident and wide distributed been observed in the perimeter of the station. (Note: Due to problems with sondes and sensors, we stop deploying instruments at this station on 02/07/2022).

Station 20 is located in the inner eastern section at about 190 meters of Cayos Caribe Mangrove islets and at about 688 meters from the coral reef barrier. This station is the closest to Mar Caribe. It has a sandy bottom, with calcareous and coral fragments, sea grass <*Thalassia testudinum*> communities, echinoderms and other associated organisms. Tidal ranges in this area vary from 12 to 14 inches. The salinity at the vicinity of the monitoring station during this quarter varies from 26.2 ppt to 41.5 ppt. The average depth and total depth at this station is 0.28 and 1.11 meters respectively. There is no surface freshwater input to this area. The pole is located at 17° 55' 49.14"N, 66° 12' 41.30"W. Since 2015 an invasive seagrass, *Halophila stipulacea* was reported at Jobos Bay, it was after the pass of Hurricane Maria in September 21, 2017 that it was more evident and wide distributed been observed in the perimeter of the station.

Data from stations 9, 10, 19 and 20 is being submitted to the CDMO. Eight sondes are permanently devoted to taking readings from these two sites, to assure continuous readings while sondes are taken out of the water for data upload and maintenance. This will avoid data gaps for the stations between sonde maintenance procedures. Due to errors in calibration, turbidity data in these files is considered inadequate. All monitoring is considered long term.

#### SWMP Station Timeline

| Station Code | SWMP Status | Station Name | Location                 | Active Dates          | Reason Decommissioned                      | Notes |
|--------------|-------------|--------------|--------------------------|-----------------------|--------------------------------------------|-------|
| JOB09 WQ     | P           | Station 9    | 17.94306 N<br>66.23858 W | 12/20/1995<br>Present | NA                                         | NA    |
| JOB10 WQ     | P           | Station 10   | 17.93861 N<br>66.25774 W | 02/01/1996<br>Present | NA                                         | NA    |
| JOB19 WQ     | P           | Station 19   | 17.94291 N<br>66.22883 W | 04/01/2004<br>Present | NA                                         | NA    |
| JOB20 WQ     | P           | Station 20   | 17.93032 N<br>66.21147 W | 03/13/2004<br>Present | NA                                         | NA    |
| JOB06WQ      | P           | Station 06   | 17.93499 N<br>66.22793 W | 12/1996-<br>12/1998   | Affected by<br>thermal outfall             | NA    |
| JOB11WQ      | P           | Station 11   | 17.94461 N<br>66.26203 W | 03/1996-<br>12/1998   | Exposed to<br>vandalism                    | NA    |
| JOB18WQ      | P           | Station 18   | 17.94443 N<br>66.23188 W | 10/1998-<br>11/1998   | Does not<br>represent normal<br>conditions | NA    |

## 6. Data collection period

Station nine <9> water quality monitoring began on December 20, 1995.

Station ten <10> water quality monitoring began on February 1, 1996.

Station nineteen <19> water quality monitoring began on April 1, 2004.

Station twenty <20> water quality monitoring began on May 13, 2004.

## Deployment and Retrieval Dates 2022:

| Station 09 |         |            |          |
|------------|---------|------------|----------|
| Date/      | Time In | Date/      | Time Out |
|            |         |            |          |
| 01/13/2022 | 11:00   | 01/24/2022 | 12:45    |
| 01/27/2022 | 12:30   | 02/07/2022 | 14:00    |
| 02/09/2022 | 09:15   | 02/22/2022 | 10:30    |
| 02/23/2022 | 09:00   | 03/07/2022 | 15:00    |
| 03/09/2022 | 09:00   | 03/23/2022 | 08:00    |
| 03/24/2022 | 08:30   | 04/05/2022 | 09:45    |
| 04/06/2022 | 09:30   | 04/18/2022 | 15:15    |

| Station 19 |         |            |          |
|------------|---------|------------|----------|
| Date/      | Time In | Date/      | Time Out |
|            |         | 01/13/2022 | 09:30    |
| 01/13/2022 | 09:45   | 01/24/2022 | 10:30    |
| 01/27/2022 | 13:15   | 02/07/2022 | 13:00    |
| 12/21/2022 | 11:15   | 01/09/2023 | 10:30    |
|            |         |            |          |
|            |         |            |          |
|            |         |            |          |
|            |         |            |          |

|            |       |            |       |
|------------|-------|------------|-------|
| 04/20/2022 | 09:45 | 05/02/2022 | 11:30 |
| 05/04/2022 | 12:00 | 05/16/2022 | 10:45 |
| 05/17/2022 | 9:15  | 05/31/2000 | 14:15 |
| 06/02/2022 | 09:00 | 06/13/2022 | 10:15 |
| 06/15/2022 | 11:15 | 06/27/2022 | 11:15 |
| 06/28/2022 | 11:45 | 07/18/2022 | 08:30 |
| 07/19/2022 | 11:00 | 08/08/2022 | 08:45 |
| 08/09/2022 | 12:15 | 08/23/2022 | 09:15 |
| 08/24/2022 | 10:45 | 09/06/2022 | 09:15 |
| 09/07/2022 | 15:30 | 09/26/2022 | 14:15 |
| 09/26/2022 | 14:30 | 10/04/2022 | 04:30 |
| 10/05/2022 | 14:00 | 10/17/2022 | 15:15 |
| 10/19/2022 | 10:15 | 10/31/2022 | 12:15 |
| 11/02/2022 | 10:15 | 11/14/2022 | 10:30 |
| 11/15/2022 | 14:15 | 11/28/2022 | 10:00 |
| 11/29/2022 | 10:15 | 12/12/2022 | 11:30 |
| 12/14/2022 | 08:30 | 01/09/2023 | 07:30 |

[illegible]

| Station 20 |         |            |          |
|------------|---------|------------|----------|
| Date/      | Time In | Date/      | Time Out |
| 12/15/2021 | 09:30   | 01/10/2022 | 10:30    |
| 01/13/2022 | 09:15   | 01/24/2022 | 10:15    |
| 01/27/2022 | 08:45   | 02/07/2022 | 08:45    |
| 02/09/2022 | 08:45   | 02/22/2022 | 09:15    |
| 02/23/2022 | 08:45   | 02/25/2022 | 16:30    |
| 03/09/2022 | 08:30   | 03/23/2022 | 07:45    |
| 03/24/2022 | 08:15   | 04/05/2022 | 08:45    |
| 04/06/2022 | 10:00   | 04/18/2022 | 09:00    |
| 04/20/2022 | 09:00   | 05/02/2022 | 08:00    |
| 05/04/2022 | 11:00   | 05/16/2022 | 09:15    |
| 05/17/2022 | 14:15   | 05/31/2022 | 09:45    |
| 06/01/2022 | 08:30   | 06/13/2022 | 11:45    |
| 06/15/2022 | 10:00   | 06/16/2022 | 23:30    |
| 06/28/2022 | 10:15   | 07/18/2022 | 07:45    |
| 07/19/2022 | 10:30   | 08/08/2022 | 09:00    |
| 08/09/2022 | 12:00   | 08/23/2022 | 08:45    |
| 08/24/2022 | 09:30   | 09/06/2022 | 08:45    |
| 09/07/2022 | 14:30   | 09/26/2022 | 13:00    |
| 09/26/2022 | 13:15   | 10/04/2022 | 03:45    |

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|            |       |            |       |
|------------|-------|------------|-------|
| 10/05/2022 | 13:30 | 10/17/2022 | 15:00 |
| 10/19/2022 | 10:30 | 10/26/2022 | 20:00 |
| 11/02/2022 | 09:45 | 11/14/2022 | 10:15 |
| 11/15/2022 | 14:00 | 11/28/2022 | 09:30 |
| 11/29/2022 | 09:00 | 12/12/2022 | 11:00 |
| 12/14/2022 | 05:30 | 01/09/2023 | 06:00 |

## 7. 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: <http://www.nerrsdata.org/>; accessed 12 October 2022.

NERR water quality data and metadata can be obtained from the Research Coordinator at the individual NERR site <please see Principal Investigators and Contact Persons>, from the Data Manager at the Centralized Data Management Office <please see personnel directory under the general information link on the CDMO home page> and online at the CDMO home page [www.nerrsdata.org](http://www.nerrsdata.org). Data are available in text tab-delimited format.

## 8. Associated researchers and projects

The Jobos Bay NERR maintains four water quality monitoring stations as part of the System Wide Monitoring Program <SWMP> to monitor variability in the estuarine environment. Meteorological station collects continuous information that support water quality data intended to address short-term variability and long-term changes in estuarine water parameters within the bay <i.e., localized impacts of seasonal storms and hurricane events, variability due to tidal circulation, seasonal and interannual differences in rainfall, magnitude and influence of major events such hurricanes, spatial extent of oceanic and tidal forcing.

Our water quality monitoring program is a key component of SWMP. Variables measured include Temperature, Dissolved Oxygen, Turbidity, pH, Salinity and Depth in 4 permanent stations equipped with YSI data sondes. The program supports a nutrient monitoring at the same stations, nitrogen, phosphorus, and chlorophyll are measured in a monthly basis. Also, a diel nutrient sampling is performed in a monthly basis.

SWMP data has been used by:

- Caribbean Regional Association for the Caribbean Regional Coastal Ocean Observing System <CariCOOS> who monitors Real Time data from our SWMP stations.
- Environmental Quality Board for their biennial Puerto Rico 305<b>/303<d> Integrated Report
- Puerto Rico Energy Power Authority <PREPA>
- Department of Natural and Environmental Resources
- Ocean Physics Education (OPE) an educational effort by physical oceanographer Dr. Edwin Alfonso-Sosa.

## II. Physical Structure Descriptors

### 9. Sensor specifications

JOB NERR used EXO-2 sondes at all sites in 2022.

#### **YSI EXO-2 Sonde:**

Parameter: Temperature

Units: Celsius <C>

Sensor Type: Thermistor

Model#: 599870-01

Range: -5 to 50 C

Accuracy: -5 to 35: +/- 0.01, 35 to 50: +/- .005

Resolution: 0.01 C

Parameter: Conductivity

Units: milli-Siemens per cm <mS/cm>

Sensor Type: 4-electrode cell with auto ranging

Model#: 599870-01

Range: 0 to 200 mS/cm

Accuracy: 0 to 100: +/- 0.5% of reading or 0.001 mS/cm; 100 to 200: +/- 1% of reading

Resolution: 0.001 mS/cm to 0.1 mS/cm <range dependent>

Parameter: Salinity

Units: practical salinity units <psu>/parts per thousand <ppt>

Sensor Type: Calculated from conductivity and temperature

Range: 0 to 70 psu

Accuracy: +/- 1.0% of reading pr 0.1 ppt, whichever is greater

Resolution: 0.01 psu

Parameter: Dissolved Oxygen % saturation

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 599100-01

Range: 0 to 500% air saturation

Accuracy: 0-200% air saturation: +/- 1% of the reading or 1% air saturation, whichever is greater 200-500% air saturation: +/- 5% of reading

Resolution: 0.1% air saturation

Parameter: Dissolved Oxygen mg/L <Calculated from % air saturation, temperature, and salinity>

Units: milligrams/Liter <mg/L>

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 599100-01

Range: 0 to 50 mg/L  
Accuracy: 0-20 mg/L: +/-0.1 mg/l or 1% of the reading, whichever is greater  
20 to 50 mg/L: +/- 5% of the reading  
Resolution: 0.01 mg/L

Parameter: Non-vented Level - Shallow <Depth>  
Units: feet or meters <ft or m>  
Sensor Type: Stainless steel strain gauge  
Range: 0 to 33 ft <10 m>  
Accuracy: +/- 0.013 ft <0.004 m>  
Resolution: 0.001 ft <0.001 m>

Parameter: pH  
Units: pH units  
Sensor Type: Glass combination electrode  
Model#: 599701<guarded> or 599702<wiped>  
Range: 0 to 14 units  
Accuracy: +/- 0.01 units within +/- 10° of calibration temperature, +/- 0.02 units for entire temperature range  
Resolution: 0.01 units

Parameter: Turbidity  
Units: formazin nephelometric units <FNU>  
Sensor Type: Optical, 90-degree scatter  
Model#: 599101-01  
Range: 0 to 4000 FNU  
Accuracy: 0 to 999 FNU: 0.3 FNU or +/-2% of reading <whichever is greater>; 1000 to 4000 FNU +/-5% of reading  
Resolution: 0 to 999 FNU: 0.01 FNU, 1000 to 4000 FNU: 0.1 FNU

Parameter: Chlorophyll  
Units: micrograms/Liter  
Sensor Type: Optical probe  
Model#: 599102-01  
Range: 0 to 400 ug/Liter  
Accuracy: Dependent on methodology  
Resolution: 0.1 ug/L chl a, 0.1% FS

### **Depth Qualifier:**

The NERR System-Wide Monitoring Program utilizes YSI data sondes that can be equipped with either vented or non-vented depth/level sensors. Readings for both vented and non-vented sensors are automatically compensated for water density change due to variations in temperature and salinity; but for all non-vented depth measurements, changes in atmospheric pressure between calibrations appear as changes in water depth. The error is equal to approximately 1.02 cm for every 1 millibar change in atmospheric pressure, and is eliminated for vented sensors because they are vented to the atmosphere throughout the deployment time interval.

Beginning in 2006, NERR SWMP standard calibration protocol calls for all non-vented depth sensors to read 0 meters at a (local) barometric pressure of 1013.25 mb (760 mm/hg). To achieve this, each site calibrates their depth sensor with a depth offset number, which is calculated using the actual atmospheric pressure at the time of calibration and the equation provided in the SWMP calibration sheet or digital calibration log. This offset procedure standardizes each depth calibration for the entire NERR System. If accurate atmospheric pressure data are available, non-vented sensor depth measurements at any NERR can be corrected.

In 2010, the CDMO began automatically correcting Depth/Level data for changes in barometric pressure as measured by the reserve's associated meteorological station during data ingestion. These corrected Depth/Level data are reported as cDepth and cLevel, and are assigned QAQC flags and codes based on QAQC protocols. Please see sections 11 and 12 for QAQC flag and code definitions.

**NOTE: older Depth data cannot be corrected without verifying that the depth offset was in place and whether a vented or non-vented depth sensor was in use. No SWMP data prior to 2006 can be corrected using this method.** The following equation is used for corrected Depth/Level data provided by the CDMO beginning in 2010:  
$$((1013-BP)*0.0102)+\text{Depth/Level} = \text{cDepth/cLevel}.$$

#### **Salinity Units Qualifier:**

In 2013, EXO sondes were approved for SWMP use and began to be utilized by reserves. While the 6600 series sondes report salinity in parts per thousand (ppt) units, the EXO sondes report practical salinity units (psu). These units are essentially the same and for SWMP purposes are understood to be equivalent, however psu is considered the more appropriate designation. Moving forward the NERR System will assign psu salinity units for all data regardless of sonde type.

#### **Turbidity Qualifier:**

In 2013, EXO sondes were approved for SWMP use and began to be utilized by reserves. While the 6600 series sondes report turbidity in nephelometric turbidity units (NTU), the EXO sondes use formazin nephelometric units (FNU). These units are essentially the same but indicate a difference in sensor methodology, for SWMP purposes they will be considered equivalent. Moving forward, the NERR System will use FNU/NTU as the designated units for all turbidity data regardless of sonde type. If turbidity units and sensor methodology are of concern, please see the Sensor Specifications portion of the metadata.

#### **Chlorophyll Fluorescence Disclaimer:**

YSI chlorophyll sensors (6025 or 599102-01) are designed to serve as a proxy for chlorophyll concentrations in the field for monitoring applications and complement traditional lab extraction methods; therefore, there are accuracy limitations associated with the data that are detailed in the YSI manual including interference from other fluorescent species, differences in

calibration method, and effects of cell structure, particle size, organism type, temperature, and light on sensor measurements.

## 10. Coded variable definitions

| Sampling station: | Sampling site code: | Station code: |
|-------------------|---------------------|---------------|
| Station 9         | ST09                | job09wq       |
| Station 10        | ST10                | job10wq       |
| Station 19        | ST19                | job19wq       |
| Station 20        | ST20                | job20wq       |

## 11. QAQC flag definitions

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column <header preceded by an F\_>. During primary automated QAQC <performed by the CDMO>, -5, -4, and -2 flags are applied automatically to indicate data that is missing and above or below sensor range. All remaining data are then flagged 0, passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

- 5 Outside High Sensor Range
- 4 Outside Low Sensor Range
- 3 Data Rejected due to QAQC
- 2 Missing Data
- 1 Optional SWMP Supported Parameter
- 0 Data Passed Initial QAQC Checks
- 1 Suspect Data
- 2 *Open - reserved for later flag*
- 3 Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
- 4 Historical Data: Pre-Auto QAQC
- 5 Corrected Data

## 12. 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 deployment or YSI data sonde, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point, but some comment codes <marked with an \* below> can be applied to the entire record in the FRecord column.

### General Errors

|     |                                                       |
|-----|-------------------------------------------------------|
| GIC | No instrument deployed due to ice                     |
| GIM | Instrument malfunction                                |
| GIT | Instrument recording error; recovered telemetry data  |
| GMC | No instrument deployed due to maintenance/calibration |
| GNF | Deployment tube clogged / no flow                     |
| GOW | Out of water event                                    |
| GPF | Power failure / low battery                           |
| GQR | Data rejected due to QA/QC checks                     |

|                                  |                                                                  |
|----------------------------------|------------------------------------------------------------------|
| GSM                              | See metadata                                                     |
| Corrected Depth/Level Data Codes |                                                                  |
| GCC                              | Calculated with data that were corrected during QA/QC            |
| GCM                              | Calculated value could not be determined due to missing data     |
| GCR                              | Calculated value could not be determined due to rejected data    |
| GCS                              | Calculated value suspect due to questionable data                |
| GCU                              | Calculated value could not be determined due to unavailable data |

#### Sensor Errors

|     |                                               |
|-----|-----------------------------------------------|
| SBO | Blocked optic                                 |
| SCF | Conductivity sensor failure                   |
| SCS | Chlorophyll spike                             |
| SDF | Depth port frozen                             |
| SDG | Suspect due to sensor diagnostics             |
| SDO | DO suspect                                    |
| SDP | DO membrane puncture                          |
| SIC | Incorrect calibration / contaminated standard |
| SNV | Negative value                                |
| SOW | Sensor out of water                           |
| SPC | Post calibration out of range                 |
| SQR | Data rejected due to QAQC checks              |
| SSD | Sensor drift                                  |
| SSM | Sensor malfunction                            |
| SSR | Sensor removed / not deployed                 |
| STF | Catastrophic temperature sensor failure       |
| STS | Turbidity spike                               |
| SWM | Wiper malfunction / loss                      |

#### Comments

|      |                                                         |
|------|---------------------------------------------------------|
| CAB* | Algal bloom                                             |
| CAF  | Acceptable calibration/accuracy error of sensor         |
| CAP  | Depth sensor in water, affected by atmospheric pressure |
| CBF  | Biofouling                                              |
| CCU  | Cause unknownCDA* DO hypoxia <<3 mg/L>                  |
| CDB* | Disturbed bottom                                        |
| CDF  | Data appear to fit conditions                           |
| CFK* | Fish kill                                               |
| CIP* | Surface ice present at sample station                   |
| CLT* | Low tide                                                |
| CMC* | In field maintenance/cleaning                           |
| CMD* | Mud in probe guard                                      |
| CND  | New deployment begins                                   |
| CRE* | Significant rain event                                  |
| CSM* | See metadata                                            |
| CTS  | Turbidity spike                                         |
| CVT* | Possible vandalism/tampering                            |
| CWD* | Data collected at wrong depth                           |
| CWE* | Significant weather event                               |

### 13. Post deployment information

| STATION 09 |            |            | Post Deployment Calibration Values |       |                     |
|------------|------------|------------|------------------------------------|-------|---------------------|
|            | Date In    | Date Out   | SpCond<br><50mS/cm>                | DO%   | pH <7> Turb <0 NTU> |
|            | 12/15/2021 | 01/10/2022 | 50.25                              | 100   | 7.06 -0.30          |
|            | 01/13/2022 | 01/24/2022 | 50.04                              | 100.1 | 7.05 0.90           |
|            | 01/27/2022 | 02/07/2022 | 49.10                              | 99.5  | 7.01 0.55           |
|            | 02/09/2022 | 02/22/2022 | 49.40                              | 99.4  | 7.08 0.35           |
|            | 02/23/2022 | 03/07/2022 | 49.66                              | 109.3 | 7.11 0.07           |
|            | 03/09/2022 | 03/23/2022 | 25.10**                            | 100.2 | 7.07 0.07           |
|            | 03/24/2022 | 04/05/2022 | 50.27                              | 100.8 | 7.16 0.19           |
|            | 04/06/2022 | 04/18/2022 | 49.00                              | 98.0  | 7.90 0.37           |
|            | 04/20/2022 | 05/02/2022 | 15.05**                            | 103.4 | 7.21 0.07           |
|            | 05/04/2022 | 05/16/2022 | 49.16                              | 100.3 | 7.00 0.05           |
|            | 05/17/2022 | 05/31/2022 | 49.85                              | 100.9 | 7.03 -0.01          |
|            | 06/02/2022 | 06/13/2022 | 49.81                              | 100.1 | 7.22 0.17           |
|            | 06/15/2022 | 06/27/2022 | 49.42                              | 101.2 | 7.32 0.25           |
|            | 06/28/2022 | 07/18/2022 | 50.37                              | 99.8  | 7.00 0.26           |
|            | 07/19/2022 | 08/08/2022 | 50.16                              | 99.1  | 6.90 0.04           |
|            | 08/09/2022 | 08/23/2022 | 50.05                              | 99.8  | 7.19 0.17           |
|            | 08/24/2022 | 09/06/2022 | 49.60                              | 100   | 7.05 0.23           |
|            | 09/07/2022 | 09/26/2022 | ***                                | ***   | *** ***             |
|            | 09/26/2022 | 10/04/2022 | 49.51                              | 100.1 | *-3.99 0.15         |
|            | 10/05/2022 | 10/17/2022 | 49.72                              | 98.2  | 6.84 0.03           |
|            | 10/19/2022 | 10/31/2022 | 39.69                              | 89.3  | 7.00 0.13           |
|            | 11/02/2022 | 11/14/2022 | 50.03                              | 97.9  | 7.10 0.43           |
|            | 11/15/2022 | 11/28/2022 | 49.99                              | 99.2  | 7.09 0.06           |
|            | 11/29/2022 | 12/12/2022 | 50.76                              | 99.9  | 6.94 0.10           |
|            | 12/14/2022 | 01/09/2022 | 22.76**                            | 99.8  | 7.02 0.27           |

| STATION 10 |            |            | Post Deployment Calibration Values |       |                     |
|------------|------------|------------|------------------------------------|-------|---------------------|
|            | Date In    | Date Out   | SpCond<br><50mS/cm>                | DO%   | pH <7> Turb <0 NTU> |
|            | 12/15/2021 | 01/10/2022 | 48.03                              | 99.5  | 8.41** -0.32        |
|            | 01/13/2022 | 01/24/2022 | 40.73                              | 99.5  | 7.18 0.40           |
|            | 01/27/2022 | 02/07/2022 | 48.0                               | 100.1 | 7.08 0.21           |
|            | 12/19/2022 | 01/09/2023 | 51.04                              | 104.4 | 7.02 0.04           |

| STATION 19 |         |          | Post Deployment Calibration Values |     |                     |
|------------|---------|----------|------------------------------------|-----|---------------------|
|            | Date In | Date Out | SpCond<br><50mS/cm>                | DO% | pH <7> Turb <0 NTU> |

| Date In    | Date Out   | SpCond<br><50mS/cm> | DO%   | pH <7> | Turb <0 NTU> |
|------------|------------|---------------------|-------|--------|--------------|
| 12/15/2021 | 01/10/2022 | 50.36               | 100.1 | 7.26   | 0.23         |
| 01/13/2022 | 01/24/2022 | 49.27               | 98.1  | 7.39   | 1.10         |
| 01/27/2022 | 02/07/2022 | 6.0*                | 100.8 | 7.0    | 0.0          |
| 12/19/2022 | 01/09/2023 | 49.70               | 99.3  | 7.02   | 0.22         |

| STATION 20 |            |                     | Post Deployment<br>Calibration Values |        |              |
|------------|------------|---------------------|---------------------------------------|--------|--------------|
| Date In    | Date Out   | SpCond<br><50mS/cm> | DO%                                   | pH <7> | Turb <0 NTU> |
| 12/15/2021 | 01/10/2022 | 70.22*              | 122.3                                 | 7.11   | 0.37         |
| 01/13/2022 | 01/24/2022 | 49.41               | 112.4                                 | 7.08   | 0.90         |
| 01/27/2022 | 02/07/2022 | 75.16*              | 125.7                                 | 7.10   | 0.09         |
| 02/09/2022 | 02/22/2022 | 49.99               | 98.3                                  | 7.09   | 0.22         |
| 02/23/2022 | 03/07/2022 | 45.55               | 100.3                                 | 7.36   | ***          |
| 03/09/2022 | 03/23/2022 | 65.10**             | 99.7                                  | 7.90*  | 0.85         |
| 03/24/2022 | 04/05/2022 | 49.85               | 100                                   | 7.50   | 0.13         |
| 04/06/2022 | 04/18/2022 | 50.04               | 103.5                                 | 7.10   | 0.11         |
| 04/20/2022 | 05/02/2022 | 50.00               | 100.0                                 | 11.53* | 0.07         |
| 05/04/2022 | 05/16/2022 | 18.61**             | 99.7                                  | 7.09   | 0.11         |
| 05/17/2022 | 05/31/2022 | 47.10               | 99.9                                  | 7.06   | 0.06         |
| 06/01/2022 | 06/13/2022 | 26.27**             | 101.3                                 | 7.09   | 0.67         |
| 06/15/2022 | 06/16/2022 | 24.84*              | 52.6                                  | 7.02   | 0.40         |
| 06/28/2022 | 07/18/2022 | 50.07               | 109.3                                 | 7.16   | 0.15         |
| 07/19/2022 | 08/08/2022 | 50.29               | 100.8                                 | 7.06   | 0.21         |
| 08/09/2022 | 08/23/2022 | 50.18               | 100.1                                 | 7.08   | 0.09         |
| 08/24/2022 | 09/06/2022 | 49.96               | 99.9                                  | 7.03   | 0.16         |
| 09/07/2022 | 09/26/2022 | ***                 | ***                                   | ***    | ***          |
| 09/26/2022 | 10/04/2022 | 49.81               | 99.9                                  | 7.12   | 0.34         |
| 10/05/2022 | 10/17/2022 | 49.16               | 99.4                                  | 7.04   | 0.15         |
| 10/19/2022 | 10/31/2022 | 49.45               | 100.8                                 | 7.07   | 0.05         |
| 11/02/2022 | 11/14/2022 | 49.33               | 98.8                                  | 7.10   | -0.01        |
| 11/15/2022 | 11/28/2022 | 49.77               | 99.8                                  | 7.06   | 0.40         |
| 11/29/2022 | 12/12/2022 | 50.27               | 99.1                                  | 7.02   | 0.16         |
| 12/14/2022 | 01/09/2023 | 30.13**             | 99.5                                  | 7.03   | 0.69         |

\*Bad sensor, \*\*Fouling, \*\*\*No Data

#### 14. Other remarks/notes

Data are missing due to equipment or associated specific probes not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NaNs in the dataset stand for “not a number” and are the result of low power,

disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

**Conductivity/Salinity comments:**

**JOB09WQ:** The Cond/Temp sensor malfunction shows low values from 05/11/2022 at 1:30 to 05/15/2022 at 14:15 intermittent data. <-3> SCF.

**JOB09WQ:** The Cond/Temp sensor malfunction from 06/21/2022 at 5:00 to 6/22/2022 at 05:45. <-3> SSM.

**JOB09WQ:** New Conductivity sensor SN 17K103475 new model 599831 for EXO sonde SN 14K101410 on 11/01/2022.

**JOB09WQ:** The Cond/Temp sensor malfunction shows low values from 12/17/2022 at 3:00 to 12/31/2022 at 23:45 intermittent data. <-3> SCF.

**JOB10WQ:**

**JOB19WQ:** Conductivity sensor failure on 01/15/2022 between 01:30 to 20:00 <-2> SCF

**JOB19WQ:** From 01/27/2022 at 19:15 to 01/28/2022 at 04:30 sensor malfunction <-3> SSM.

**JOB19WQ:** From 02/04/2022 at 04:00 to 02/07/2022 at 13:00 sensor malfunction <-3> SSM.

**JOB20WQ:** From 01/01/2022 at 00:00 low temperature values. Conductivity/Temp from 01/01/2022 at 00:00 to 01/10/2022 at 10:30 read bad values sensor malfunction <-3> STF.

**JOB20WQ:** From 01/13/2022 at 09:15 to 01/24/2022 at 10:15 Cond/Temp sensor read high values. The cell constant was out of range at 4.81 and the pre-calibration value was high.

**JOB20WQ:** From 01/27/2022 at 08:45 to 02/07/2022 at 08:45 Cond/Temp sensor read high values <-3> STF. The conductivity post for this deployment read 75.16/50 and the cell constant was out of range at 4.89.

**JOB20WQ:** The Cond/Temp sensor malfunction shows low values from 05/08/2022 at 0:00 until 5/16 9:15 possibly due to the presence of carbonates accumulated in the sensor. The post for this data read 18.61/50. Data are marked <-3> SPC CBF during this time.

**JOB20WQ:** The Cond/Temp sensor malfunction shows low values from 06/01/2022 at 18:45 to 06/05/2022 at 6:15. Data are marked <-3> SCF during this time. From 06/05/2022 at 6:30 to 06/13/2022 11:45 <-2> STF. The post read 26.27 with a cell constant of 4.91.

**JOB20WQ:** From 06/15/2022 at 15:45 to 06/16/2022 at 23:30 sensor malfunction <-3> STF. The conductivity post read 24.84/50 for this deployment and the cell constant was out of range at 4.68.

**JOB20WQ:** Low Conductivity and Salinity values in certain periods from 11/17/2022 to 11/27/2022. There was a malfunction causing these values and the intermittent values are marked <-3> SCF.

**DO Data comments:**

**JOB09WQ:**

**JOB10WQ:** From 12/22/2022 at 11:00 to finish DO sensor malfunction <-3> SSM on EXO3 20H104610.

**JOB19WQ:**

**JOB20WQ:** On 04/18/2022 DO membrane replaced in 16F103428 sensor with 18H109518.

**JOB20WQ:** The DO sensor malfunction from 06/15/2022 at 15:45 to 06/16/2022 at 23:30 <-3> STF. The post for this deployment read 52.6%.

#### **pH Data comments:**

**JOB09WQ:** The same sonde and pH probe were used from 3/9 to 7/18 at Station 09. During this time pH data was consistently higher than is normal for this site. After the probe was changed in July data started to fluctuate more normally. All pH data during this time are marked <1> [SSM] (CSM) with more impacted values being rejected.

**JOB09WQ:** The pH sensor malfunction from 06/15/2022 at 11:00 to 6/20/2022 at 14:00, value over 8.7 <-3> SSM.

**JOB09WQ:** All Values over 8.7 flag with <-3> SSM.

**JOB09WQ:** The pH sensor malfunction from 09/09/2022 at 06:45 to 09/26/2022 at 14:15, <-3> SSM.

**JOB09WQ:** The pH sensor malfunction from 09/26/2022 at 14:30 to 10/04/2022 at 04:30, <-3> SSD.

**JOB09WQ:** Change pH sensor 13K102582 for 19L101549 for EXO sonde SN 14K101410 on 10/05/2022.

**JOB09WQ:** On 12/19/2022 pH sensor 19L101549 was replaced in field for a new pH sensor 22L101168. However that pH probe also failed and no data was collected after 12/19. The pH sensor malfunction from 12/19/2022 at 07:00 to 01/09/2023 at 07:30, <-2> [SSM])

**JOB20WQ:** The pH sensor malfunction from 04/20/2022 at 9:00 to 05/02/2022 at 08:00, the cal, post and mV were all off for this deployment. All data are marked <-3> [SSM] (CSM).

**JOB20WQ:** On 12/19/2022 at 05:45 pH sensor 15G101000 replaced in field for a new pH sensor 22L101170. However this new probe malfunction and no data was collected for the rest of this deployment. Data are marked -2 SSM CSM.

#### **Chlorophyll Data comments:**

**JOB09WQ:**

**JOB10WQ:**

**JOB19WQ:**

**JOB20WQ:**

#### **Turbidity Data comments:**

**JOB09WQ:**

**JOB10WQ:**

**JOB19WQ:**

**JOB20WQ:**

#### **Depth Data Comment**

**Notes:**

**JOB09WQ:** From 01/02/2022 at 18:15 to 01/10/2022 low battery, <-2> GPF.

**JOB09WQ:** From 01/10/2022 to 01/13/2022 at 10:45 missing data in between deployment due to maintenance, <-2> GMC.

**JOB09WQ:** From 01/24/2022 at 13:00 to 01/27/2022 at 12:15 missing data in between deployment due to maintenance, <-2> GMC.

**JOB09WQ:** On 12/19/2022 pH sensor 19L101549 replaced in field for a new pH sensor 22L101168, but don't read, (1,SSR)

**JOB10WQ:** No data collect from 01/01/2022 at 0:00 to 01/10/2022.

**JOB10WQ:** From 01/10/2022 to 01/13/2022 at 10:00 missing data in between deployment due to maintenance, <-2> GMC.

**JOB10WQ:** From 01/24/2022 at 12:45 to 01/27/2022 at 11:45 missing data in between deployment due to maintenance, <-2> GMC.

**JOB10WQ:** No data collect from 01/31/2022 at 12:45 to 12/21/2022 10:15

**JOB19WQ:** No data collect from 01/15/2022 at 20:30 to 01/24/2022 at 12:30.

**JOB19WQ:** From 01/10/2022 to 01/13/2022 at 09:30 missing data in between deployment due to maintenance, <-2> GMC.

**JOB19WQ:** From 01/24/2022 to 01/27/2022 at 13:00 missing data in between deployment due to maintenance, <-2> GMC.

**JOB20WQ:** From 01/10/2022 at 10:45 to 01/13/2022 at 09:00 missing data in between deployment due to maintenance, <-2> GMC.

**JOB20WQ:** From 01/24/2022 at 10:30 to 01/27/2022 at 08:30 missing data in between deployment due to maintenance, <-2> GMC.

**JOB20WQ:** From 09/20/2022 at 0:00 to 09/22/2022 at 23:15 (CSM) Significant rain events from Hurricane Fiona continue impacts data.

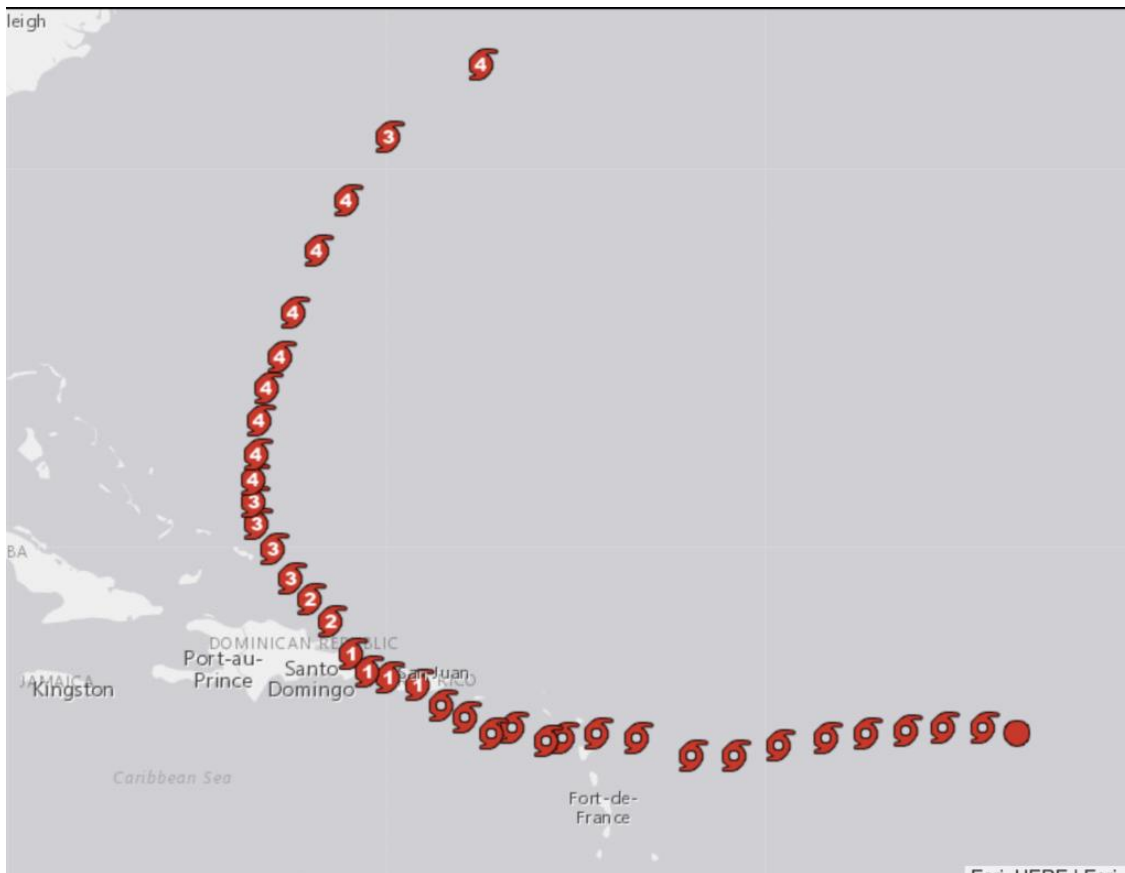
**JOB20WQ:** On 12/19/2022 at 6:00 to 01/09/2023 pH sensor 15G101000 replaced in field for a new pH sensor 22L101170 but don't read, (1,SSR)

**Other:**

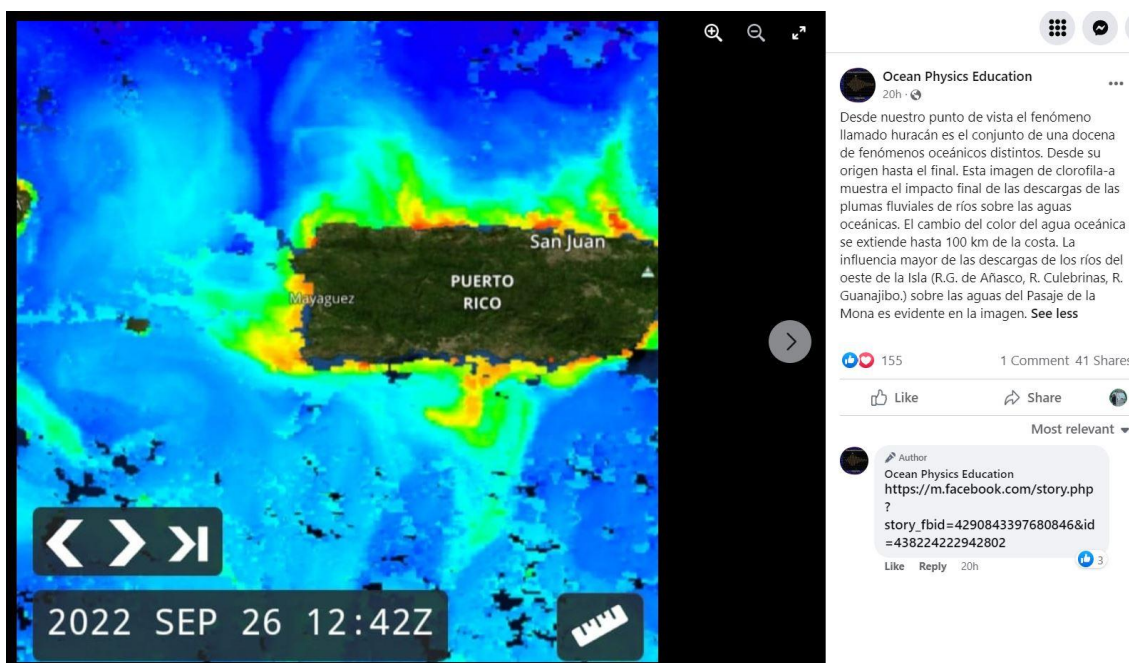
**Other Events:****Significant rain events:**

| Date       | Precipitation<br>(mm) | Event associated with                                  |
|------------|-----------------------|--------------------------------------------------------|
| 02/01/2022 | 8.13                  |                                                        |
| 02/06/2022 | 15.49                 |                                                        |
| 04/30/2022 | 27.7                  |                                                        |
| 05/12/2022 | 8.4                   |                                                        |
| 06/26/2022 | 11.4                  |                                                        |
| 07/02/2022 | 71.1                  | Tropical storm over the tropical Atlantic 7/1 and 7/2. |
| 07/25/2022 | 8.0                   |                                                        |
| 08/19/2022 | 13.7                  |                                                        |
| 08/21/2022 | 7.1                   |                                                        |
| 08/27/2022 | 22.1                  |                                                        |
| 09/04/2022 | 33.0                  | Tropical Storm EARL North of Puerto Rico.              |
| 09/05/2022 | 68.6                  | Tropical Storm EARL North of Puerto Rico.              |
| 09/18/2022 | 442                   | Hurricane Fiona                                        |
| 09/19/2022 | 87.6                  | Hurricane Fiona                                        |
| 09/23/2022 | 13.2                  | Tropical depression #9 South of Puerto Rico.           |
| 10/02/2022 | 14.99                 |                                                        |
| 10/10/2022 | 10.2                  |                                                        |
| 10/26/2022 | 90.9                  | Tropical Storm                                         |
| 10/27/2022 | 79.0                  |                                                        |
| 10/29/2022 | 11.7                  |                                                        |
| 10/30/2022 | 48.5                  |                                                        |
| 11/04/2022 | 41.9                  |                                                        |
| 11/05/2022 | 127                   | Tropical Storm                                         |
| 11/09/2022 | 8.6                   |                                                        |
| 11/14/2022 | 37.1                  |                                                        |
| 11/15/2022 | 13.7                  |                                                        |
|            |                       |                                                        |

**Images associated to Hurricane Fiona (Landfall 09/18/2022)**



Accessed from PBS News Hours (<https://www.pbs.org/newshour/science/live-map-track-the-path-of-hurricane-fiona>) on 10/31/2022

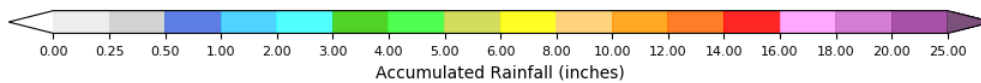
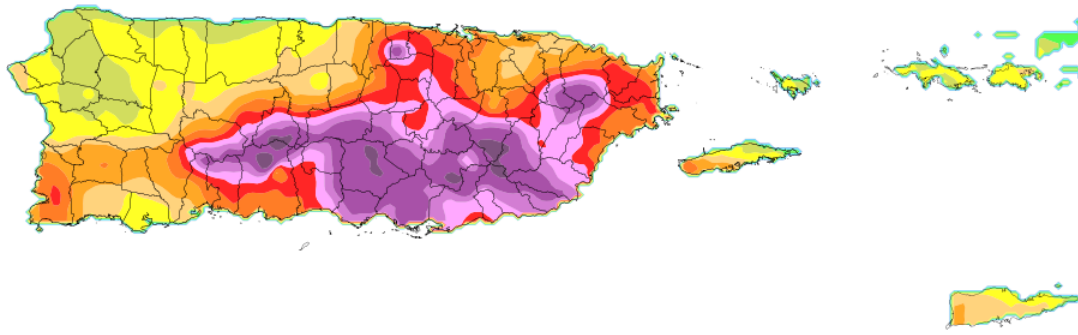


Satellite image showing river discharges around Puerto Rico after Hurricane Fiona rain events. Taken from Facebook page Ocean Physics Education by Dr. Edwin Alfonso-Sosa.

## Preliminary Rainfall Totals for Puerto Rico and the U.S. Virgin Islands

Data Source: MPE (Radar Estimates & Rain Gages)

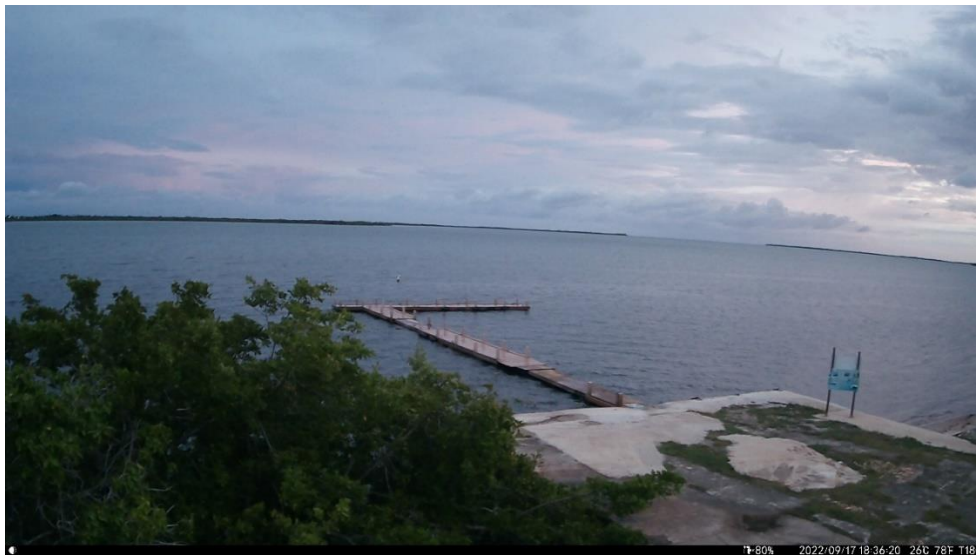
Valid from 09/16/2022 18Z to 09/20/2022 12Z



**National Weather Service**  
**San Juan, PR**  
**09/20/2022 16:38 GMT**

**Follow Us:**     
**weather.gov/sju**

Accessed from National Weather Service (<https://www.weather.gov/sju/fiona2022>) on 10/31/2022





Pictures of JBNERR's pier before, during, and after Hurricane Fiona.

**Other events:**

| Date       | Parameters affected | Event associated with          |
|------------|---------------------|--------------------------------|
| 01/15/2022 | Barometric Pressure | Tonga Island Volcano Explosion |