**Estero Bay Aquatic Preserve (EBAP) Water Quality Metadata**

**January 1, 2021-March 31, 2021**

**Latest Update:** April 26, 2021

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 Aquatic Preserve office (Stephanie.Erickson@floridadep.gov) with any additional questions.

**I. Data Set and Research Descriptors**

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**2) Entry verification –**

Deployment data are uploaded from the YSI data sonde to a Personal Computer (IBM compatible). Files are exported from EcoWatch in a comma separated file (CSV) or KOR Software in an Excel File (.XLS). Prior to October 2018, data were organized into files by site, year, and month. All pre- and post-deployment data are removed from the files at this time. Monthly files are then prepared, processed, and reviewed following the procedures in the Centralized Data Management Office’s (CDMO) National Estuarine Research Reserves (NERR) System-wide Monitoring Program (SWMP) Data Management Manual Version 6.6 (February 2015). The monthly files are opened in Microsoft Excel, formatted to match the CDMO template, and processed using the NERRQAQC macro. Since October 2018, data files from each deployment have been uploaded to the NERRS Centralized Data Management Office (CDMO) Non-SWMP Data Upload Service where data undergo automated primary QAQC. All pre- and post-deployment data are removed from the file prior to upload. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Aquatic Preserve office for secondary QAQC where it is opened in Microsoft Excel and processed using the CDMO’s NERRQAQC Excel macro. 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 Aquatic Preserve database. Upload after secondary QAQC results in ingestion into the Aquatic Preserve database as provisional plus data, and finally tertiary QAQC by the Office of Resilience and Coastal Protection’s (RCP) Data Coordinator and assimilation into the Aquatic Preserve database as authenticated data. Where deployment overlap occurs between files, the data produced by the newly calibrated sonde is generally accepted as being the most accurate. For more information on QAQC flags and codes, see Sections 11 and 12. Data management at Estero Bay Aquatic Preserve is currently performed by Rebecca Cray and tertiary review by RCP is conducted by Kathryn Petrinec.

**3) Research objectives –**

In 2004, the Florida Department of Environmental Protection’s (FDEP) Office of Coastal and Aquatic Managed Areas (CAMA), now RCP, began a pilot program using extended deployed water quality monitoring devices, or datasondes, across several of its field offices. After the Estero Bay Aquatic Preserve (EBAP) office was selected, three datasonde monitoring sites were set up within the bay. There were several factors considered when selecting the monitoring sites including salinity gradients, water depth, freshwater inputs, tidal circulation patterns and the location of navigational markers. Additionally, to correlate existing data collection efforts and refrain from duplicating data, locations of other water quality studies were also taken into consideration.

The datasondes, located in a long, shallow estuary, are affected by saltwater inclusion from several Gulf of Mexico inlets and freshwater input from five tributaries. The passes are, from north to south: Hurricane Pass, Matanzas Pass, Big Carlos Pass, New Pass, Big Hickory Pass, and Wiggins Pass in Collier County. The tributaries are, from north to south: Hendry Creek, Mullock Creek, Estero River, Spring Creek, and the Imperial River. The watershed for Estero Bay spans 359.6 square miles and encompasses both the Southern Coastal Plain and Southern Florida Coastal Plain ecoregions, which comprise areas that are typical of low, flat, southern Florida lands dominated by wetlands and characterized by slow, sheet-flow drainage patterns. Natural communities include mangrove-dominated islands along the coast with salt marsh habitats occurring landward of the mangrove zone, pine flatwoods, cypress swamps, and cabbage palm hammocks. The communities within the bay include seagrass beds, mangrove islands, salt marshes, tidal flats, and oyster bars. In the past, the naturally dispersed water patterns distributed nutrients over broad areas of wetland vegetation and seasonal fluctuations in flow from rainfall created the necessary salinity regime in Estero Bay for good estuarine productivity. However, increased development in the area since the 1960’s has led to changes in the natural river systems around Estero Bay, altering freshwater inflow patterns. The watershed activities that potentially impact the bay include point-source wastewater discharge and non-point source runoff or leaching of pollution from roads, agriculture lands, urban areas, and un-vegetated lands which contain fertilizers, pesticides, herbicides, metals, sediments, petroleum compounds, and bacteria.

The datasonde data provides information on the overall health of Estero Bay on a continuous basis. Specifically, the data from these stations provide a baseline of water quality measurements for identifying, monitoring, and comparing differences in the parameters over time. The data also aid in the interpretation of changes observed in indicator organisms, bay communities, and for making comparisons to other geographical areas. The data may also assist with the understanding of effects from anthropogenic changes within the bay. The principle goal of the program is to attain baseline data on the overall water quality of Estero Bay for the purpose of preventing further degradation.

**4) Research methods –**

Beginning July 14, 2004 two water quality stations, EB01 (Tom Winter) in the north end of Estero Bay and EB02 (Spring Creek) in the central portion of the bay, were designated as permanent Continuous Water Quality Monitoring Program sites for Estero Bay Aquatic Preserve. A third water quality station, EB03 (Fish Trap Bay), was added on November 23, 2004 at the southern end of the preserve. On May XX, 2021, a fourth station, EB04 (Hendry & Mullock Creeks) was added in the northeastern part of the bay. The dataset from each monitoring station has been essentially uninterrupted since the first day of deployment.

Until July 2017, all sondes deployed had been YSI 6600 Extended Deployment System (EDS) with three that are the V2-2 model. Beginning on July 5, 2017, YSI EXO2 sondes were deployed at EB01. Beginning on March 29, 2018, YSI EXO3 sondes were deployed at EB02. YSI 6600 EDS sondes continue to be used at EB03. Prior to deployment, the sondes are calibrated for pH, specific conductivity, turbidity, dissolved oxygen, and depth following the procedures outlined in the YSI Operating and Service Manual. Prior to the December 2011 deployment, the depth was calibrated using a barometric pressure value of 760 mmHg for each calibration, actual atmospheric pressure was not calculated. For the December 6, 2011 deployment a NIST certified barometer was used to obtain the actual atmospheric pressure and determine the depth offset value. Prior to the June 29, 2010 deployment, rapid pulse dissolved oxygen sensors were used; from that deployment onward, all YSI 6600 sondes were equipped with optical dissolved oxygen sensors with mechanical cleaning.

A two-point calibration is used for pH (YSI buffers 7 & 10) and turbidity (0 NTU deionized water & 126 NTU YSI, Inc.). A 50 mS/cm solution (YSI conductivity calibrator) is used to calibrate specific conductivity. Beginning March 24, 2020, initial calibration verifications were conducted for each of the following parameters: specific conductivity, pH, and turbidity. For specific conductivity, calibration is verified using a 10 mS/cm solution. For pH, calibration is verified in pH 10 buffer. For turbidity, calibration is verified in the 124 FNU standard. Dissolved oxygen (DO) is calibrated in oxygen saturated water, using a bucket and an aerator. Prior to June 29, 2010, rapid pulse dissolved oxygen sensors were calibrated using water saturated air, using a small amount of water in a vented calibration cup. The percent saturation value is determined by using the current barometric pressure to convert to the adjusted value and entered into EcoWatch. ROX optical DO probes are deployed at all three sites. The depth is also calibrated by using the current barometric pressure to determine the depth offset value and entered into EcoWatch.

All sondes are deployed within 4-inch diameter PVC pipes, which are attached to either a private residential dock (EB01) or “aid-to-navigation” pilings (EB02, EB03, and EB04). The pipes are oriented vertically and attached with stainless steel rods molded to wrap around the piling and bolted to galvanized hangers. Up to three hangers are used depending on the height of the pipe. A stainless steel bolt is also installed at the end of the pipes to keep the sonde from falling through. At EB01, EB02, and EB03 the submerged end of the PVC has two rows of rectangular holes whose short ends are rounded (pill/stadium shaped). There are 4 holes per row measuring vertically approximately 8 inches tall and horizontally 2 inches wide. At EB04, the holes are drilled per YSI recommendations. Sondes are secured by rope to an eyebolt in the top of the PVC caps. An additional hole is drilled through the top of the pipes and caps in order to insert a bolt and lock for security. The bottoms of the pipes are open and positioned such that the sensors are 0.5 meters above the bottom.

The sondes are further protected from crabs and other live organisms by attempting to restrict the openings on the sonde guard with plastic mesh screening. The plastic mesh (with 1/8 inch diamond-shaped holes) is attached to the outside of the sondes guard’s circumference using low- profile zip ties. In 2015, increased antifouling efforts were applied to guards in the form of copper tape on the exterior of the plastic guards plus copper alloy woven mesh (McNichols Co., 4 mesh, 0.047’’ woven square weave, 66% open area). This same copper mesh is applied to the exterior of the copper antifouling sonde guards on EXO sondes as well.

Sondes are deployed, generally, for two weeks to one month at a time. The sampling period is set for 15-minute intervals (readings are made every 15 minutes). The following physical water quality parameters are recorded: temperature (degrees Celsius), specific conductivity (mS/cm), salinity (parts per thousand), dissolved oxygen (mg/L and % saturation), depth (m), pH and turbidity (NTU). To test how well the sondes hold calibration, field measurements are performed using a handheld YSI instrument (YSI 85 2004-Feb. 2008, YSI556 Feb. 2008-July 2015, YSI ProDSS July 2015-present) which serves as a “spot check” at the time of deployment and retrieval. The parameters recorded are temperature, specific conductivity, conductivity, salinity, dissolved oxygen (mg/L and % saturation), and depth. Additionally, a post-deployment calibration verification is conducted in the lab. The parameters include temperature, pH (7.0 and 10.0), turbidity (0 NTU and beginning with the 4/16/2019 deployment 124 NTU for EXOs and 126 NTU for 6600s), specific conductivity (50 mS/cm), DO%, depth, and battery volts.

**5) Site location and character –**

**EB01 (Tom Winter):**

Lat/Long (Decimal Degrees): 26.434944 -81.911389

The EB01 datasonde is located on the bay side of Estero Island in Matanzas Pass, across from Julies Island, and is the most northern of the three site locations. The Tom Winter labeling is to clarify the sonde location which is affixed to a residential dock (parcel 28-46-24- W3-0020B.0390) approximately 300 meters across the channel from Julie’s Island. The monitoring site is approximately 5.0 km (linear dimension) from Matanzas Pass Bridge to the northwest and 4.4 km from Big Carlos Pass to the southeast. The closest tributary is the Y- junction of the mouths of Hendry Creek and Mullock Creek, approximately 5.1 km northeast of the sonde location. Matanzas Pass is roughly 8.9 km long and has a mid-channel depth of approximately 1.0 to 3.6 meters at MHW. At the sampling site, the depth is 2.05 meters at MHW and the width of the water body is 335 meters. Tides at EB01 are mixed semidiurnal and range from 0.85 m to 1.39 m according to the NOAA Tides and Currents website; Estero Island, Estero Bay, FL Datum, Station ID 8725351, 1983-2001 Epoch. Salinities range from 2.2 ppt to 34.4 ppt and fluctuate daily with tides, wind, rainfall, and freshwater discharge (USGS Scientific Investigations Report 2007-5217, Estero Bay near Horseshoe Keys data, 10/1/2004 – 09/30/2005). The channel substrate is predominantly fine sand and there is no bottom vegetation. Generally, Estero Island’s shoreline, on the bay side, is sea walled and will not have any vegetation. The closest vegetation are red and black mangrove islands across the channel. The land to the north of the site contains a significant amount of protected state-owned preserve area known as Estero Bay Preserve State Park.

# EB02 (Spring Creek):

Lat/Long (Decimal Degrees): 26.385917 -81.846333

The EB02 site is located northwest of the mouth of Spring Creek and south of Coconut Point. The sonde is affixed to navigational marker 9A within the Spring Creek access channel. The average depth at this site is approximately 1.70 meters at MHW. Tides at EB02 are mixed semidiurnal and range from 0.74 m to 1.27 m according to the NOAA Tides and Currents website; Coconut Point, Estero Bay, FL Datum, Station ID 8725319, 1983-2001 Epoch. Salinities range from 8.2 ppt to 35.9 ppt and fluctuate daily with tides, wind, rainfall, and freshwater discharge (USGS Scientific Investigations Report 2007-5217, Big Carlos Pass data, 10/5/2004 – 09/30/2005). The substrate within the channel is a mixture of sand and silt with no bottom vegetation. However, there is seagrass found in the vicinity. Mature red and black mangrove forests dominate the nearby banks of the bay and several mangrove islands are nearby. The mouth of Spring Creek is approximately 4.4 km downstream from where a six-lane highway (SR 41) crosses over the tributary.

# EB03 (Fish Trap Bay):

Lat/Long (Decimal Degrees): 26.354972 -81.844528

The EB03 site is located east of Broadway Channel and north of Intrepid Waters at the southern end of EBAP. The sonde is affixed to a piling (manatee caution sign) in the center of Big Hickory Bay. The mouth of the Imperial River is approximately 2.1 km to the south of the sonde’s location and is the closest tributary. The average depth at MHW is approximately 1.40 meters. Tides are mixed semidiurnal and range from 0.62m to 0.81m (NOAA Tides and Currents website; Fish trap Bay, Estero Bay, FL Datum, Station ID 8725272, 1983-2001 Epoch). Salinities range from 1.6 ppt to 33.6 ppt and fluctuate daily with tides, wind, rainfall, and freshwater discharge (USGS Scientific Investigations Report 2007-5217, Fishtrap Bay data, 10/1/2004 – 09/30/2005). The substrate within the channel is a mixture of sand and silt with no bottom vegetation. Mature red and black mangrove forests dominate the nearby banks of the preserve. The dominant natural vegetation of the watershed is hydric pine, scrubby flatwoods, and cypress. The mouth of Imperial River is approximately 2.1 km downstream from a six-lane highway (SR 41) and approximately 7.6 km from I-75, both of which cross over the tributary.

# EB04 (Hendry & Mullock Creeks):

Lat/Long (Decimal Degrees): 26.449685, -81.871465

The EB04 site is located in northeast Estero Bay, downstream of the confluence of Hendry Creek and Mullock Creek where they empty into Estero Bay, an area called Rocky Bay. The sonde is affixed to a navigational piling maintained by Lee County, green channel marker #9. The mouth of Hendry & Mullock Creeks are approximately 1.0 km to the northeast of the sonde’s location. The average depth at MHW is approximately 1.45 meters. Tides are mixed semidiurnal and range from 0.89m to 1.34m (NOAA Tides and Currents website; Hendry Creek, Estero Bay FL, Datum: STND, Station ID 8725377, 1983-2001). Salinities range from 1 ppt to 32 ppt and fluctuate daily with tides, wind, rainfall, and freshwater discharge (USGS Scientific Investigations Report 2007-5217, Mullock Creek data, 07/1/2002-01/01/2004). The substrate within the channel is muddy sand, and beyond the channel lies a long oyster bar. Directly beneath the deployment tube lie subtidal oysters. Mature red and black mangrove forests dominate the nearby banks of the preserve. Much of the watersheds lie within the wetlands protected in Estero Bay Preserve State Park, including mangrove forests as well as some areas of salt marsh. Further upstream, the natural vegetation is hydric pine, cypress, and scrubby flatwoods.

**Aquatic Preserve Station Timeline:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Station Code** | **Station Name** | **Location** | **Active Dates** | **Reason Decommissioned** | **Notes** |
| EB01 | Tom Winter | 26.434944, -81.911389 | 07/14/2004-current | NA | NA |
| EB02 | Spring Creek | 26.385917, -81.846333 | 07/14/2004-current | NA | NA |
| EB03 | Fish Trap | 26.354972, -81.844528 | 11/30/2004-current | NA | NA |
| EB04 | Hendry & Mullock Creeks | 26.449685, -81.871465 | 05/XX/2021-current | NA | NA |

**6) Data collection period –**

**EB01:**

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Deployment** | **First Reading** | **Last Reading** |
| 1 | 01121520 | 12/15/2020 11:15 | 1/6/2021 11:00 |
| 2 | eb01010621 | 1/6/2021 11:15 | 1/26/2021 9:00 |
| 3 | eb01012621 | 1/26/2021 9:15 | 2/24/2021 12:45 |
| 4 | eb01022421 | 2/24/2021 13:15 | 3/23/2021 8:30 |
| 5 | eb01032321 | 3/23/2021 8:45 | 4/20/2021 11:00 |
| 6 |  |  |  |
| 7 |  |  |  |
| 8 |  |  |  |
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| 10 |  |  |  |
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**EB02**

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| --- | --- | --- | --- |
| **#** | **Deployment** | **First Reading** | **Last Reading** |
| 1 | 02121520 | 12/15/2020 12:30 | 1/6/2021 10:00 |
|  | eb02010621 | 1/6/2021 10:15 | 1/26/2021 10:00 |
| 2 | eb02012621 | 1/26/2021 10:15 | 2/24/2021 10:15 |
|  | eb02022421 | 2/24/2021 10:30 | 3/23/2021 9:30 |
| 3 | eb02032321 | 3/23/2021 10:15 | 4/20/2021 9:45 |
| 4 |  |  |  |
| 5 |  |  |  |
| 6 |  |  |  |
| 7 |  |  |  |
| 8 |  |  |  |
| 9 |  |  |  |
| 10 |  |  |  |
| 11 |  |  |  |
| 12 |  |  |  |
| 13 |  |  |  |

**EB03**

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Deployment** | **First Reading** | **Last Reading** |
| 1 | 03121520 | 12/15/2020 13:00 | 1/6/2021 9:30 |
| 2 | eb03010621 | 1/6/2021 9:45 | 1/26/2021 10:15 |
| 3 | eb03012621 | 1/26/2021 10:45 | 2/20/2021 22:00 |
| 4 | eb03022421 | 2/24/2021 11:00 | 3/23/2021 10:15 |
| 5 | eb03032321 | 3/23/2021 10:45 | 4/7/2021 16:30 |
| 6 |  |  |  |
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| 15 |  |  |  |

**7) Distribution –**

Considerable effort has been made to ensure the accuracy of the information provided and meet quality assurance guidelines used by the Florida’s Department of Environmental Protection Estero Bay Aquatic Preserve program. Please note that the included data are estimates of actual conditions subject to improvements in accuracy and precision of field methods over time as well as infrequencies in sampling duration, rendering data in some instances, to be unsuitable for temporal or spatial comparisons. As a result, the user is responsible for interpretations based on supplied data.

Neither the State of Florida nor the Florida Department of Environmental Protection makes any warranty, expressed or implied, including the warranties of merchantability and fitness for a particular purpose arising out of the use or inability to use the data, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.

The Principle Investigators (PI) retains the right to be fully credited for having collected and process the data.  Following academic courtesy standards, the Aquatic Preserve 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.

Aquatic Preserve water quality data and metadata can be obtained from the Principal Investigators and Contact Persons (see section 1) and online at the Aquatic Preserves data portal home page [www.floridaapdata.org](http://www.floridaapdata.org). Data are available in comma delimited format.

**8) Associated researchers and projects** (link to other products or programs) **–**

In addition to this water quality dataset, Estero Bay Aquatic Preserve conducts epibenthic monitoring of five seagrass sites. Starting in 2002, five fixed stations located throughout the aquatic preserve are monitored twice a year, once in the dormant season and once in the growing season, using Braun-Blanquet techniques. Beginning in 2016, macroalgae has been collected at each of these transects during seagrass surveys. These samples are analyzed to determine species present and biomass of each species. Abundance scores are also applied to algae as part of the seagrass monitoring. Two of these seagrass sites are located within close proximity of the EB02 and EB03 sonde locations.

Since 1998, volunteers with the Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network (CHEVWQMN) have collected water quality data once a month at up to 7 sites within Estero Bay (or 46 sites within the greater Charlotte Harbor region). This program is currently coordinated through the Charlotte Harbor Aquatic Preserves office in Punta Gorda, FL.

In 2008, EBAP began monitoring the nesting effort of wading and diving birds which use mangrove islands within the bay as rookeries.

In 2018, EBAP established a protocol for annual mapping and assessment of eight oyster bars around Estero Bay to establish a baseline for oyster health within the bay and track its trends through time. In addition, during the Fall of 2018, sampling to collect death assemblage specimens from three oyster bars was completed to examine the age and changes in historical body size.

Beginning in February 2012, red tide samples for Florida Fish and Wildlife Conservation Commission’s (FWC) Fish and Wildlife Research Institute (FWRI) have been collected by Estero Bay Aquatic Preserve staff during datasonde retrieval, by the CHEVWQMN volunteers, and/or more often as requested by FWRI.

Lee County and FDEP’s Division of Environmental Assessment and Restoration collect water quality samples within Estero Bay and the watershed.

**II. Physical Structure Descriptors**

**9) Sensor specifications –**

EBAP deploys YSI 6600 EDS and YSI 6600 – V2 (2) EDS as well as YSI EXO2 and YSI EXO3 datasondes. YSI EXO2 sondes were deployed at EB01 and EB02 throughout 2020. YSI 6600 series sondes were deployed at EB03 from Jan. 1-Jul. 9 at 9:00, after which EXO2 datasondes were deployed.

Sensor specifications for YSI 6600 datasondes are as follows:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Thermistor

Model#: 6560

Range: -5 to 50 C

Accuracy: +/- 0.15

Resolution: 0.01 C

Parameter: Conductivity

Units: milli-Siemens per cm (mS/cm)

Sensor Type: 4-electrode cell with autoranging

Model#: 6560

Range: 0 to 100 mS/cm

Accuracy: +/- 0.5% of reading + 0.001 mS/cm

Resolution: 0.001 mS/cm to 0.1 mS/cm (range dependant)

Parameter: Salinity

Units: parts per thousand (ppt)

Sensor Type: Calculated from conductivity and temperature

Range: 0 to 70 ppt

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

Resolution: 0.01 ppt

Sensor Type: Optical probe w/ mechanical cleaning

Model#: 6150 ROX

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: +/- 15% or 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#: 6150 ROX

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: +/- 15% 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 30 ft (9.1 m)

Accuracy: +/- 0.06 ft (0.018 m)

Resolution: 0.001 ft (0.001 m)

Parameter: pH – bulb probe or EDS flat glass probe

Units: pH units

Sensor Type: Glass combination electrode

Model#: 6561 or 6561FG

Range: 0 to 14 units

Accuracy: +/- 0.2 units

Resolution: 0.01 units

Parameter: Turbidity

Units: nephelometric turbidity units (NTU)

Sensor Type: Optical, 90 degree scatter, with mechanical cleaning

Model#: 6136

Range: 0 to 1000 NTU

Accuracy: +/- 2% of reading or 0.3 NTU (whichever is greater)

Resolution: 0.1 NTU

Sensor specifications for EXO2 and EXO3 datasondes are as follows:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Wiped probe; Thermistor

Model#: 599827

Range: -5 to 50 C

Accuracy: ±0.2 C

Resolution: 0.001 C

Parameter: Conductivity

Units: milli-Siemens per cm (mS/cm)

Sensor Type: Wiped probe; 4-electrode cell with autoranging

Model#: 599827

Range: 0 to 100 mS/cm

Accuracy: ±1% of the reading or 0.002 mS/cm, whichever is greater

Resolution: 0.0001 to 0.01 mS/cm (range dependent)

Parameter: Salinity

Units: practical salinity units (psu)/parts per thousand (ppt)

Model#: 599827

Sensor Type: Wiped probe; Calculated from conductivity and temperature

Range: 0 to 70 ppt

Accuracy: ±2% of the reading or 0.2 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% or 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: +/- 0.1 units within +/- 10° of calibration temperature, +/- 0.2 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

**Dissolved Oxygen Qualifier (Rapid Pulse / Clark type sensor):**

The reliability of dissolved oxygen (DO) data collected with the rapid pulse / Clark type sensor after 96 hours post-deployment for non-EDS (Extended Deployment System) data sondes may be problematic due to fouling which forms on the DO probe membrane during some deployments (Wenner et al. 2001). Some Reserves utilize the YSI 6600 EDS data sondes, which increase DO accuracy and longevity by reducing the environmental effects of fouling. Optical DO probes have further improved data reliability. The user is therefore advised to consult the metadata for sensor type information and to exercise caution when utilizing rapid pulse / Clark type sensor DO data beyond the initial 96-hour time period. Potential drift is not always problematic for some uses of the data, i.e. periodicity analysis. It should also be noted that the amount of fouling is very site specific and that not all data are affected. If there are concerns about fouling impacts on DO data beyond any information documented in the metadata and/or QAQC flags/codes, please contact the Research Coordinator at the specific NERR site regarding site and seasonal variation in fouling of the DO sensor. EBAP transitioned all dissolved oxygen sensors from rapid pulse to optical type sensors during the June 30, 2010 deployment.

**Depth Qualifier:**

YSI data sondes 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.

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 Aquatic Preserve calibration sheet or digital calibration log.  This offset procedure standardizes each depth calibration. If accurate atmospheric pressure data are available, non-vented sensor depth measurements can be corrected. The Principal Investigator should be contacted in order to obtain information regarding atmospheric pressure data availability. EBAP began calibrating depth with an offset with the December 6, 2011 deployment.

**Salinity Units Qualifier:**

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 Aquatic Preserve purposes are understood to be equivalent, however psu is considered the more appropriate designation. Moving forward the Aquatic Preserve program will assign psu salinity units for all data regardless of sonde type.

**Turbidity Qualifier:**

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 Aquatic Preserve purposes they will be considered equivalent. Moving forward, the Aquatic Preserve program 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.

**10) Coded variable definitions –**

|  |  |  |
| --- | --- | --- |
| Sampling Station: | Sampling Site Code: | Station Code: |
| Tom Winter | EB01 | EB01 |
| Spring Creek | EB02 | EB02 |
| Fish Trap Bay | EB03 | EB03 |

**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 datasonde, 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 F\_Record 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 unknown

 CDA\* 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** –

**EB01**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Deployment** | **SpCond** | **pH 7** | **pH 10** | **mV slope** | **Turb (0)** | **Turb (124)** | **Depth (cal val)** | **DO% (cal val)** |
| 01121520 | 50.2528 | 7.09 | 10.05 | 175.8 | 0.02 | 124.04 | 0.085 (0.027) | 100.2 (100.3) |
| eb01010621 | 49.3690 | 7.04 | 10.02 | 178.9 | 0.74 | 121.98 | 0.019 (0.041) | 100.2 (100.4) |
| eb01012621 | 50.1560 | 7.10 | 10.04 | 175.7 | 0.31 | 119.44 | 0.061 (0.054) | 104.5 (100.5) |
| eb01022421 | 50.4870 | 6.91 | 9.97 | 180.1 | 0.25 | 109.35 | 0.006 (0.014) | 104.3 (100.2) |
| eb01032321 | 49.9880 | 7.10 | 10.03 | 175.0 | 0.08 | 119.28 | 0.001 (0.014) | 102.8 (100.1) |
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**EB02**

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| **Deployment** | **SpCond** | **pH 7** | **pH 10** | **mV slope** | **Turb (0)** | **Turb (124)** | **Depth (cal val)** | **DO% (cal val)** |
| 02121520 | 50.3227 | 7.09 | 10.07 | 175.50 | 0.04 | 123.75 | 0.062 (0.027) | 100.0 (100.3) |
| eb02010621 | 49.6220 | 7.18 | 10.14 | 174.50 | -0.25 | 123.62 | 0.043 (0.041) | 100.0 (100.4) |
| eb02012621 | 49.9840 | 7.19 | 10.21 | 178.70 | 0.22 | 124.30 | 0.083 (0.054) | 100.2 (100.5) |
| eb02022421 | 50.3780 | 7.1 | 10.12 | 179.10 | 0.73 | 124.41 | 0.055 (0.014) | 101.1 (100.2) |
| eb02032321 | 49.7370 | 7.13 | 10.09 | 174.90 | -0.04 | 125.57 | -0.017 (0.000) | 100.2 (100.0) |
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**EB03**

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| **Deployment** | **SpCond** | **pH 7** | **pH 10** | **mV slope** | **Turb (0)** | **Turb (124)** | **Depth (cal val)** | **DO% (cal val)** |
| 03121520 | 50.0677 | 6.95 | 9.91 | 176.10 | 0.30 | 123.98 | 0.039 (0.027) | 100.4 (100.3) |
| eb03010621 | 49.611 | 7.04 | 10.03 | 175.90 | -0.55 | 122.70 | 0.050 (0.041) | 100.8 (100.4) |
| eb03012621 | 49.880 | 7.07 | 10.10 | 178.30 | 0.29 | 123.48 | 0.062 (0.054) | 99.0 (100.5) |
| eb03022421 | 50.191 | 7.09 | 10.09 | 176.50 | 0.75 | 125.08 | 0.017 (0.014) | 100.1 (100.1) |
| eb03032321 | 49.459 | 7.05 | 10.02 | 177.90 | 0.77 | 118.97 | -0.007 (-0.014) | 99.7 (99.9) |
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**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 Aquatic Preserve office.

All data files are QAQC’d using the 2012 CDMO Excel macro. This macro automatically flags negative turbidity values between 0 and -2 NTU as Suspect <1> with the comment Acceptable Calibration/Accuracy Error of Sensor (CAF). In addition, the macro automatically flags DO values less than 3 mg/L as Passed Initial QAQC Checks <0> with the comment DO Hypoxia (<3 mg/L) (CDA). The DO flag is based on Federal standards. During the primary QAQC session, any reading that falls outside a sensor’s range (see section II. Physical Structure descriptors) is rejected (-3). For example, all turbidity readings over 1000 NTU are rejected (-3, SBO). Small negative depth readings where all other data is in line are marked suspect (1, SNV, CAP) per the CDMO manual since this is within the accuracy of the sensor. The shallow depth sensor is a non-vented probe that is susceptible to changes in barometric pressure when deployed in shallow estuaries, please refer to the depth qualifier under Section II. Additionally, negative turbidity readings between 0 and -2 have been flagged as suspect data (1, SNV, CAF) since the value is within the accuracy of the probe per the CDMO operations manual. Data from all out of water events (distinguished by both low SpCond values and low/negative depths) has all been rejected (-3, GOW, CLT)

Additionally, for Estero Bay, anomalous turbidity readings >126 NTU (the high calibration value), not within a well-defined turbidity peak (e.g., neighboring readings are not close), are marked as a suspect turbidity spike (1, STS). These readings may either be caused by optical interference by animals or fouling, or an unknown local disturbance. A description of all other flag/code combinations that appear in the dataset are noted below.

**EB01**

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| **Deployment** | **Other Notes** |
| 01121520 | Red tide continues. All depth readings flagged rejected since they did not pass post-deployment verification. |
| eb01010621 | All depth readings rejected as sensor did not pass post-deployment verification. |
| eb01012621 | Neither DO nor Turbidity sensors passed post-deployment calibration verification checks, so all readings rejected for both parameters.  |
| eb01022421 | Neither DO nor Turbidity sensors passed post-deployment calibration verification checks, so all readings rejected for both parameters.  |
| eb01032321 | Turbidity sensor did not pass post-deployment calibration verification checks, so all readings rejected for that parameter. |
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**EB02**

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| **Deployment** | **Other Notes** |
| 02121520 | Red tide continues. Depth did not pass post-deployment verifications so all readings flagged as rejected. One missing data point on 12/30/2020 at 6:30, cause unknown. |
| eb02010621 | pH readings rejected because the sensor did not pass post-deployment verification: readings were too high in both standards. Two data drop-outs occurred for one sampling interval each on 1/16/2021 at 15:00 and 17:30; the cause is unknown. |
| eb02012621 | All pH and Depth readings rejected because the sensors did not pass post-deployment calibration verification. All turbidity readings >1000 FNU were flagged rejected; all turbidity readings >124 FNU were flagged as suspect unless they were within a defined turbidity peak. |
| eb02022421 | pH passed post-cal with temperature adjustment. Depth did not pass post-deployment calibration verifications, so all readings were rejected. Missing data from 3/8/2021 8:30 and 8:45 cause unknown. |
| eb02032321 | pH did not pass post-deployment calibration verification, so all readings were flagged as rejected. All turbidity readings >1000 FNU flagged rejected. All turbidity readings >124 FNU, with the exception of one of 142 FNU within a distinct turbidity peak, were flagged as suspect. Missing data on 4/1/2021 at 21:30; cause unknown.  |
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**EB03**

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| **Deployment** | **Other Notes** |
| 03121520 | Red tide continues. All turbidity readings >124 FNU flagged suspect. Several out of water events flagged during low tides. Negative depth readings flagged suspect. |
| eb03010621 | No additional notes. |
| eb03012621 | Deployment truncated due to unknown instrument malfunction, final readings at 22:00 on 2/20/2021. Several out of water events flagged as rejected. All turbidity readings >1000 FNU were flagged as rejected. All turbidity readings >124 FNU were flagged as suspect unless within a defined turbidity peak. All negative depth readings flagged suspect (unless within out of water event). |
| eb03022421 | At retrieval, wiper was not parked in the garage, but before post-cal it was; may not always be parking correctly. Several out of water events flagged as either rejected or suspect. Several instances of missing data; cause unknown. All turbidity readings >1000 NTU flagged rejected. All turbidity readings >124 FNU flagged suspect if outside a distinct turbidity peak. |
| eb03032321 | Turbidity readings were all rejected because the sensor did not pass post-deployment calibration checks. Deployment ended prematurely on 4/7/2021 at 16:30. Before ending, there are also multiple data gaps. When retrieved, sensors were moderately fouled with tube worms and algae. It appears the wiper must have stopped running at some point to allow the extent of fouling seen. Three out of water events occured in conjunction with low tide; all three were rejected.  |
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**15) Acknowledgement:**

The data included with this document were collected by the staff of the Florida Department of Environmental Protection at the Estero Bay Aquatic Preserve. Any products derived from these data should clearly acknowledge this source (please use the attached logo). This recognition is important for ensuring that this long-term monitoring program continues to receive the necessary political and financial support.

