**Grand Bay (GND) National Estuarine Research Reserve**

**Water Quality Metadata**

**January 1 – December 31, 2012**

**Latest Update:** May 3, 2018

**I. Data Set & Research Descriptors**

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**2) Entry verification:**

Deployment data are uploaded from the YSI data logger to a Personal Computer (PC compatible). Files are exported from EcoWatch in a comma-delimited format (.CDF) and uploaded to the CDMO where they undergo automated primary QAQC, automated depth/level corrections for changes in barometric pressure (cDepth or cLevel parameters), and become part of the CDMO’s online provisional database. 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 Reserve 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 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. For more information on QAQC flags and codes, see Sections 11 and 12. Kim Cressman is responsible for data management.

**3) Research objectives:**

The National Estuarine Research Reserve (NERR) System-wide Monitoring Program (SWMP) was designed to fulfill two major overall goals: 1) to support state-specific non-point pollution control programs by establishing local networks of continuous water quality monitoring stations in representative protected estuarine ecosystems and 2) to develop a nation-wide database of baseline environmental conditions in the NERR system of estuaries. The specific goal of SWMP is to identify and track short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purpose of contributing to effective national, regional, and site specific coastal zone management. This comprehensive program consists of three phased components: 1) abiotic conditions such as water quality and meteorological monitoring; 2) biodiversity monitoring; and 3) habitat mapping and change analysis. With the initial focus of phase 1, the NERR SWMP provides data necessary for intra- and inter- site baseline studies, trend analyses, and impact assessments.

Four long-term monitoring stations have been established across the Grand Bay NERR in order to collect essential baseline water quality information to improve our understanding of the tidal dynamics and freshwater inputs into this system. Specifically, the Grand Bay NERR system wide monitoring program stations collect continuous data to address the following objectives: (1) track short-term variability and long-term changes in estuarine water parameters within four (Bayou Heron, Bayou Cumbest, Bangs Lake, and Point aux Chenes Bay) different regions within the reserve; (2) provide bayou-specific water quality data to be applied towards the development of a hydrologic model for the Grand Bay NERR; and (3) provide background data to design more robust experiments/research projects across the reserve.

Grand Bay research staff, in consultation with local scientists, carefully considered the arrangement of SWMP stations across the Reserve before implementing the program. The weather station was installed in the south-central portion of the Reserve to capture both short-term effects of weather on water quality and long-term trends in Reserve meteorological conditions.

The four water quality monitoring stations are intended to represent a gradient of salinity and habitat conditions within the Reserve. One site is located in each of three sub-watersheds within Reserve boundaries, and the fourth site is located to the south in a more marine-influenced location. This arrangement of monitoring stations allows the research staff to capture effects of both freshwater runoff and marine influence on short-term variability and long-term trends in water quality at the Reserve.

Current and future research projects have been and will be developed around this monitoring program. The four sites identified here monitor areas with varying degrees of human disturbance and impacts, providing an excellent framework for developing reserve-wide research projects focusing on anthropogenic impacts.

**4) Research methods:**

Sonde cleaning and calibrations of the DO, Conductivity, Depth, pH, and Turbidity probes are performed as outlined in the YSI manual. For Conductivity and Salinity, YSI calibrator solution 3169 (50,000 µS/cm) is used without dilution. Fisher pH solutions SB107-20 and SB115-20 are used for pH 7 and 10, respectively. A two-point calibration is used for Turbidity. Distilled water serves as the calibrator solution for 0 NTU and YSI 6073G is used for 126 NTU. Depth is calibrated in air and is barometrically corrected. The DO membrane is replaced and calibrated every deployment. It is allowed to stretch for 16-20 hours, and re-calibrated prior to actual deployment. The sonde is programmed to brush the probes 1 minute prior to the actual measurement. All data are collected every 15 minutes. All data are recorded in Central Standard Time.

One data logger (sonde) is deployed at each permanent monitoring station in the Grand Bay estuary at all times. Two permanently assigned data loggers are interchanged among each site. Sites are accessed using a small skiff equipped with an outboard motor. During transport, each sonde is wrapped in a white towel soaked in tap water and placed horizontally in a cooler for insulation against jarring. For deployment, the data loggers are lowered into a five inch diameter stainless steel (SS) pipe that has been bolted to a 14 inch log piling driven into the mud at each site. The SS pipes have cut outs to ensure adequate tidal flushing and exposure of the probes to ambient water conditions. A grate across the bottom of the pipe prevents the sonde from descending beyond the bottom of the pipe and ensures that the sonde probes are at the same depth on every deployment. The SS pipes, along with the sonde probes, are coated with an anti-fouling paint to minimize biofouling.

As a quality assurance measure, a discrete reading is taken with a freshly calibrated sonde or other handheld logger and recorded on a data sheet during sonde deployment and retrieval. During retrieval, the data loggers are again wrapped in a saturated white towel and placed in a cooler for transport to the lab. At least two data points are recorded while the sonde is wrapped in the towel to record post-deployment dissolved oxygen in 100% water-saturated air. Other post-deployment calibrations are performed in the laboratory prior to cleaning to determine if instrument drift has occurred and to evaluate the validity of the data. After post-deployment calibrations, the sondes are cleaned and stored in calibration cups until the next deployment.

A Sutron Sat-Link2 transmitter was installed at the Bangs Lake station from 6/21/06 to August 2009 and transmitted data to the NOAA GOES satellite, NESDIS ID #3B02A276.

The YSI EcoNet telemetry system was installed at all four sites in 2007. Data are transmitted every 15 minutes via cell modem to the YSI website. Data can be accessed through the EcoNet website as well as through the CDMO. The near real-time telemetry data become part of the provisional dataset until data are downloaded from the loggers upon retrieval. Data then undergoes 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.

**5) Site location and character:**

The Grand Bay Delta was created by sediments from both the Pascagoula and Escatawpa Rivers several thousand to hundreds of years ago. Soon after the delta was created, the Escatawpa became a major tributary to the Pascagoula River when its flow was captured by the larger river system. With the Escatawpa’s freshwater inflow shunted to the Pascagoula River, sediment discharge to Grand Bay Delta and the delta’s further growth was terminated. The meandering delta channels of the Escatawpa became exclusively tidal water courses a few hundred years ago, after cessation of river flow (Otvos 2007). In 1999, the retrograding delta became home to the 24th National Estuarine Research Reserve, the Grand Bay NERR.

The Grand Bay NERR is part of the Coastal Streams Basin watershed, which consists of three primary sub-watersheds that provide much of the freshwater inputs into the system: Bayou Heron, Bayou Cumbest, and Bangs Lake.

The four water quality monitoring sites within the Grand Bay NERR have a tidal range of approximately 0.5 meter. Additional site specific characteristics are as follows:

a) Bayou Heron (BH): [30° 25.068’ N, 88° 24.324’W]

The Bayou Heron site, located in the middle reaches of the Bayou Heron sub-watershed, monitors water quality for a semi-pristine area with little development and serves as a reference site for the reserve. Freshwater input is derived from several sources including networks of hydric drains, sheet flow from pine flatwoods/savannas, and groundwater. Hydric drains import large amounts of surface water from the sub-watershed, including water originating north of Hwy 90 and Interstate 10. Franklin Creek, located northeast of the reserve, flows WNW into the Escatawpa River. Franklin Creek drains a large portion of agricultural land on the Grand Bay plateau and periodically crests into the Bayou Heron sub-watershed during high water events via a small network of hydric drains. These drains eventually deposit water into numerous tidal creeks that enter Bayou Heron. Little is known about the quantity and quality of water flowing through these drains.

* Depth range: 0.16 – 1.69 m
* Salinity range in 2012: 0 – 28.5 ppt
* Typical salinity range: 5.9 – 27.6 ppt

The above typical salinity range represents 90% of the data points collected from 2005-2011 (n=217,996)

* Median salinity from 2005-2011: 20.9 ppt
* Bottom habitat: soft sediments

Due to water column stratification and poor mixing, this site can become naturally hypoxic during warmer months (March – October).

b) Point Aux Chenes (PC): [30° 20.916’N, 88° 25.112’W].

This is the most southern water quality site within the boundaries of Grand Bay NERR. It is located in Point Aux Chenes Bay, which is highly influenced by the Mississippi Sound and also receives inputs from waters to the east, including Mobile Bay. PC was established in 2005 to replace the Crooked Bayou water quality monitoring station. This site provides baseline data on the relative influence of marine inputs and tidal influence from the East Mississippi Sound.

* Depth range: 0.3 – 1.6 m
* Salinity range in 2012: 4.3 – 31.7 ppt
* Typical salinity range: 12.4 – 29.7 ppt

The above typical salinity range represents 90% of the data points collected from 2005-2011 (n=195,836)

* Median salinity from 2005-2011: 24.2
* Bottom habitat: soft sediments

c) Bayou Cumbest (BC): [30° 23.016’N, 88° 26.184’W].

The Bayou Cumbest site monitors water quality for the Bayou Cumbest sub-watershed, which is a moderately impacted area with some residential housing development and non-point source pollution issues related to failing septic tanks (i.e., elevated levels of fecal coliforms; LaSalle 1997). A substantial canal, called the Nine Mile Canal, was built in the late 1930’s and connects the Escatawpa River to Bayou Cumbest upstream from the water quality station. Nutrient and flow data are currently being collected through a collaborative project between the Grand Bay NERR, Dauphin Island Sea Lab, and the EPA-Gulf Breeze Laboratory to better understand the water quality impacts of watershed development on coastal watersheds.

* Depth range: 0.0 – 1.10 m
* Salinity range in 2012: 0.2 – 31.0 ppt
* Typical salinity range: 3.8 – 28.4 ppt

The above typical salinity range represents 90% of the data points collected from 2005-2011 (n=211,045)

* Median salinity from 2005-2011: 19.1
* Bottom habitat: soft sediments with fringing oyster shell reefs

d) Bangs Lake (BL): [30° 21.426’N, 88° 27.774’W].

The Bangs Lake site is located towards the southern end of the Bangs Lake sub-watershed, an area with minimal residential development. Adjacent parcels include Chevron USA oil and gas refinery and the Mississippi Phosphates industrial facility. Both sites are surrounded by containment levees constructed to direct any contaminant spills towards Bayou Casotte, an heavily industrialized and impacted area to the west of these facilities. However, a spill from a gypsum pile at the phosphate facility was discharged into Bangs Lake in 2005 and had substantial negative impacts. A man-made drainage ditch runs into the north part of Bangs Lake and is believed to drain a residential area, which may have failing septic tanks (LaSalle 1997). The ditch is also adjacent to the Jackson County Industrial Water Plant. Bangs Lake has been impacted by high fecal coliform counts and a fecal coliform TMDL was developed for the Bayou Cumbest and Bangs Lake watersheds in 2000 (MSU-CREC 2000).

* Depth range: 0.0 – 1.37 m
* Salinity range in 2012: 5.1 – 31.6 ppt
* Typical salinity range: 13.1 – 29.6 ppt

The above typical salinity range represents 90% of the data points collected from 2005-2011 (n=201,833)

* Median salinity from 2005-2011: 23.1
* Bottom habitat: soft sediments

*Sources cited within this section:*

LaSalle, M.W. (1997). Water Quality Monitoring of Shellfish Growing Waters and Residential Rock-Reed Wastewater Treatment Systems at Bayou Cumbest, Mississippi. Final Report to the Gulf of Mexico Program. 58 pp.

Mississippi State University Coastal Research and Extension Center (MSU-CREC). (2000). Fecal Coliform TMDL for Bayou Cumbest/Bangs Lake Watershed, Coastal Streams Basin, Jackson County, MS. Prepared for the Mississippi Department of Environmental Quality. Approved Final Version May 5, 2000.

Otvos, E.G. (2007). Geological Framework and Evolution History. Pages 22-46 in Grand Bay National Estuarine Research Reserve: An Ecological Characterization (Peterson, M.S., G.L. Waggy and M.S. Woodrey, editors). Grand Bay National Estuarine Research Reserve, Moss Point, Mississippi.

**6) Data Collection Periods:**

Data loggers were first deployed at Bayou Heron (BH) and Crooked Bayou (CR) on January 22, 2004. Additional data loggers were deployed at Bayou Cumbest (BC) and Bangs Lake (BL) on March 25, 2004. Bayou Heron, Bayou Cumbest, and Bangs Lake have been in service continuously since inception. Crooked Bayou (CR) was relocated to the weather station across the bayou in August 2004 [30° 21.551’N, 88° 25.202’W] due to the loss of the permanent log piling at the original site [30° 21.597’N, 88° 25.143’W]. During August 2005, the Crooked Bayou site was discontinued due to the magnitude of data lost during low tide events. The Point Aux Chenes site (PC) [30° 20.916’N, 88° 25.112’W] was designated to replace the Crooked Bayou site. Also during August 2005, all sites were lowered from 0.5m to 0.25m above the bottom to increase data collection during low tide events.

2012 data collection periods were:

**Bayou Heron**

Deploy Date Time Retrieve Date Time

12/13/11 09:15 01/20/12 14:15

01/20/12 14:30 03/01/12 09:45

03/01/12 10:00 04/13/12 07:00

04/13/12 07:15 05/16/12 16:30

05/16/12 16:45 06/01/12 10:45

06/01/12 11:00 06/13/12 16:45

06/13/12 17:00 06/27/12 08:30

06/27/12 09:00 07/13/12 11:15

07/13/12 11:30 07/27/12 08:00

07/27/12 08:45 08/22/12 10:15

08/22/12 10:30 10/17/12 11:15

10/17/12 11:30 11/26/12 13:45

11/26/12 14:00 01/22/13 13:45

**Point Aux Chenes**

Deploy Date Time Retrieve Date Time

12/28/11 14:00 01/20/12 12:45

01/20/12 13:15 03/01/12 10:15

03/01/12 10:30 04/18/12 13:45

04/18/12 14:15 05/16/12 14:00

05/16/12 14:30 06/01/12 11:30

06/01/12 11:45 06/13/12 15:15

06/13/12 15:30 07/13/12 11:45

07/13/12 12:00 08/16/12 09:00

08/16/12 09:30 08/22/12 08:00

08/22/12 08:30 09/18/12 08:30\*

09/18/12 08:45 10/17/12 09:15

10/17/12 09:30 11/26/12 12:30

11/26/12 12:45 01/22/13 14:45

\*sonde retrieved 9/18, but file ends 8/29 because batteries died after Hurricane Isaac.

**Bayou Cumbest**

Deploy Date Time Retrieve Date Time

12/13/11 11:45 01/20/12 11:45

01/20/12 12:15 04/17/12 09:00

04/18/12 15:15 05/16/12 15:00

05/16/12 15:15 06/01/12 12:30

06/01/12 12:45 06/13/12 16:00

06/13/12 16:15 06/27/12 09:15

06/27/12 09:30 07/13/12 12:15

07/13/12 12:30 07/27/12 09:00

07/27/12 09:15 08/22/12 09:30

08/22/12 09:45 09/28/12 09:15

09/28/12 11:30 10/17/12 10:30

10/17/12 10:45 11/26/12 13:15

11/26/12 13:30 01/15/13 10:00

**Bangs Lake**

Deploy Date Time Retrieve Date Time

12/13/11 11:00 01/20/12 12:30

01/20/12 12:45 04/18/12 14:30\*

04/18/12 14:45 05/16/12 14:45

05/16/12 15:00 06/01/12 12:00

06/01/12 12:15 06/13/12 15:30

06/13/12 16:00 06/27/12 09:45

06/27/12 10:00 07/13/12 13:45

07/13/12 14:00 07/27/12 09:15

07/27/12 09:30 08/22/12 08:45

08/22/12 09:15 09/18/12 09:00

09/18/12 09:30 10/17/12 09:45

10/17/12 10:00 11/26/12 12:45

11/26/12 13:00 01/15/13 10:30

\*This sonde was not able to be retrieved until 4/18/12, when it was discovered the batteries had died on 3/19.

**7) Distribution**

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

NERR water quality 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 [http://cdmo.baruch.sc.edu/](http://cfcdmo.baruch.sc.edu/). Data are available in text tab-delimited format.

**8) Associated researchers and projects:**

Several research and monitoring projects are currently using the water quality data from the Grand Bay NERR. In addition to water quality data, the NERR SWMP program also generates meteorological and nutrient data sets that are available for use.

Some projects that utilize SWMP water quality data are listed below:

* **Characterizing Stormwater Nitrogen Inputs To Mississippi’s Coastal Waters: A Landscape Approach** – Dr. Kevin Dillon (Gulf Coast Research Lab, University of Southern Mississippi)
* **Shorebird and other waterbird use of wetlands and aquaculture ponds in the Mississippi Alluvial Valley and Gulf Coast region** – Dr. Francisco Vilella (Mississippi State University)
* **Monitoring breeding marsh bird populations at the Grand Bay NERR and Pascagoula River Marshes Coastal Preserve** – Dr. Mark Woodrey (Grand Bay NERR/Mississippi State University) Dr. Bob Cooper (University of Georgia), Dr. Scott Rush (Mississippi State University)
* **Nekton Habitat Use Patterns along an Intertidal Gradient in Micro-tidal Saltmarshes** – Dr. Mark Peterson, Bradley Ennis (Gulf Coast Research Laboratory, University of Southern Mississippi)
* **Ecological Effects of Sea Level Rise** – Dr. Scott Hagan (University of Central Florida), Dr. Linda Walters (University of Central Florida), Dr. Jim Morris (University of Central Florida)
* **Testing habitat model assumptions for the Seaside Sparrow (Ammodramus maritimus) in Northern Gulf of Mexico Tidal Salt Marshes** - Dr. Bob Cooper (University of Georgia), Dr. Mark Woodrey (Grand Bay NERR/Mississippi State University)
* **Effects of Landscape-Level Metrics on Marsh Bird Occupancy and Abundance within Tidal Marshes of the Northern Gulf of Mexico** – Dr. Bob Cooper (University of Georgia), Ali Leggett (Mississippi Department of Marine Resources), Dr. Mark Woodrey (Grand Bay NERR/Mississippi State University)
* **Mercury burden of selected biota within the Grand Bay National Estuarine Research Reserve** – Dr. Chuck Jagoe (Florida A&M University), Christina Mohrman (Florida A&M University), Dr. Mark Woodrey (Grand Bay NERR/Mississippi State University)
* **Resolving Drivers of Variability in Estuarine Metabolism from Sustained Observations of Water Quality in the SE US** - Dr. Jane Caffrey (University of West Florida)
* **The Response of Phytoplankton Communities to Nutrient Enrichment Experiments in Three Northern Gulf of Mexico Estuaries** - Kendra Straub (University of West Florida), Dr. Jane Caffrey (University of West Florida)
* **Initial observations of Colored Dissolved Organic Matter (CDOM) in the Grand Bay National Estuarine Research Reserve (GBNERR), Southeastern Mississippi** – Kim Cressman (Grand Bay NERR), Christina Mohrman (Florida A&M University/Grand Bay NERR)
* **Erosion Monitoring - 6 Monitoring Stations Used to Estimate the Rate of Erosion at Sites Representing Varying Degrees of Wave Exposure and Geological Substrates** - Tom Strange (Grand Bay NERR), Will Underwood (Grand Bay NERR)
* **Legacy Effects of Land-use Change and Nitrogen Source Shifts on a Benchmark System: Building Capacity for Collaborative Research Leadership at the Grand Bay Reserve** - Lead PI Dr. Ruth Carmichael (Dauphin Island Sea Lab, University of South Alabama); collaborators: Elizabeth Condon (PhD student, Dauphin Island Sea Lab, University of South Alabama), Capt William Burkhardt (USFDA Office of Food Safety), Cdr Kevin Calci (USFDA Office of Food Safety), Dr. Wei Wu (Gulf Coast Research Laboratory, University of Southern Mississippi), Dave Ruple (Grand Bay NERR), Dr. William Walton (Auburn University Shellfish Laboratory)
* **Development of a Decision-Support Tool to Assess the Risk of Habitat Degradation Following Watershed Land Use Changes** – Dr. Mark Woodrey (Grand Bay NERR), Chris May (Grand Bay NERR), Dr. Just Cebrian (Dauphin Island Sea Lab), Dr. Ruth Beard (NOAA), Dr. A.R. Parsons (NOAA)
* **Developing Optimal Survey Techniques for Monitoring Population Status of Rails, Snipe, Coots, and Gallinules** - Dr. Mark S. Woodrey (Co-PI; coauthor of grant proposal with Dr. C.J. Conway, U.S.G.S. (PI);
* **Fish Communities of Nearshore Habitats within the Grand Bay NERR/NWR** – Jake Walker (Grand Bay NERR), Ron Cole (Grand Bay NERR), Brenna Ehmen (Grand Bay NERR), Dr. Mark Woodrey (Grand Bay NERR/Mississippi State University);
* **Nesting ecology of the diamondback terrapin (Malaclemys terrapin pileata) at the Grand Bay National Estuarine Research Reserve, Mississippi** - Collaborators - Christina Mohrman (Florida A&M University/Grand Bay NERR) and Dr. Mark Woodrey (Grand Bay NERR/Mississippi State University).

**II. Physical Structure Descriptors**

**9) Sensor Specifications:**

GND NERR deployed 6600EDS and 6600-V2 sondes in 2012. Rapid-pulse DO sensors were deployed at Point Aux Chenes Bay (PC) for all of 2012 and Bayou Cumbest (BC) for all deployments except 9/28 and 11/26, when ROX DO sensors were used. ROX DO sensors were deployed at Bayou Heron (BH) for all of 2012 and at Bangs Lake (BL) for all deployments except 6/27 and 10/17, when Rapid-pulse sensors were used.

YSI 6600EDS data sonde:

Parameter: Temperature

Units: Celsius (C)

Sensor Type: Thermistor

Model #: 6560

Range: -5 to 50 °C

Accuracy: +/-0.15 °C

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 dependent)

Parameter: Salinity

Units: parts per thousand (ppt)

Sensor Type: Calculated from conductivity and temperature

Range: 0 to 70 ppt

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

Resolution: 0.01 ppt

Parameter: Dissolved Oxygen % saturation

Units: percent air saturation (%)

Sensor Type: Rapid Pulse – Clark type, polarographic

Model #: 6562

Range: 0 to 500 % air saturation

Accuracy: 0-200 % air saturation, +/- 2 % of the reading or 2 % air saturation, whichever is greater; 200-500 % air saturation, +/- 6 % of the reading

Resolution: 0.1 % air saturation

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

Units: milligrams per Liter (mg/L)

Sensor Type: Rapid Pulse – Clark type, polarographic

Model #: 6562

Range: 0 to 50 mg/L

Accuracy: 0 to 20 mg/L, +/- 2 % of the reading or 0.2 mg/L, whichever is greater; 20 to 50 mg/L, +/- 6 % of the reading

Resolution: 0.01 mg/L

Parameter: Dissolved Oxygen % saturation

Units: percent air saturation (%)

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 % of the reading

Resolution: 0.1 % air saturation

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

Units: milligrams per Liter (mg/L)

Sensor Type: Optical probe w/ mechanical cleaning

Model #: 6150 ROX

Range: 0 to 50 mg/L

Accuracy: 0 to 20 mg/L, +/- 1 % of the reading or +/- 0.1 mg/L, whichever is greater; 20 to 50 mg/L, +/- 15 % of the reading

Resolution: 0.01 mg/L

Parameter: Non-Vented Depth – Shallow

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 – EDS flat glass and bulb style probes

Units: units

Sensor Type: Glass combination electrode

Model #: 6561

Range: 0 to 14 units

Accuracy: +/- 0.2 units

Resolution: 0.01 units

Parameter: Turbidity

Units: nephelometric turbidity units (NTU)

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

Model #: 6136

Range: 0 to 1000 NTU

Accuracy: +/- 5 % reading or 2 NTU (whichever is greater)

Resolution: 0.1 NTU

**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.

**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 1.03 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.

**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:

Bayou Heron BH gndbhwq

Point Aux Chenes PC gndpcwq

Bayou Cumbest BC gndbcwq

Bangs Lake BL gndblwq

**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:**

End of deployment post-calibration readings in standard solutions prior to probe cleaning.

The following variable codes are used to explain missing post-calibration readings:

PA probe absent/not functioning

NA reading not available

**Bayou Heron**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Deployment Date | SpCond | DO 1 | DO 2 | pH | pH | Turb | Turb | Depth |
| m/d/y | 50 mS/cm | 100% sat | 100% sat | 7 | 10 | 0 NTU | 126 NTU | m |
|  |  |  |  |  |  |  |  |  |
| 1/20/2012 | 50.82 | 100 | 100.8 | 6.84 | 8.13 | 0 | 127.2 | 0.036 |
| 3/1/2012 | 50.2 | 100.1 | 100.1 | 7.7 | 8.6 | 2 | 126.6 | 0.06 |
| 4/13/2012 | 49.7 | 99.8 | 99.8 | 7.3 | 10.29 | -0.7 | 122 | 0.025 |
| 5/16/2012 | 49.49 | 99.3 | 99.6 | 7.69 | 9.55 | 0.1 | 121.8 | -0.017 |
| 6/1/2012 | 48.66 | 101.2 | 101.4 | 7.03 | 10.18 | 2.1 | 124.1 | -0.089 |
| 6/13/2012 | 47.07 | 99.1 | 99.3 | PA | PA | 1 | 121.3 | 0.055 |
| 6/27/2012 | 49.95 | 99.1 | 99 | 6.99 | 9.98 | -2.2 | 124.6 | 0.025 |
| 7/13/2012 | 50.05 | 99.8 | 99.9 | 7.11 | 9.97 | 0.8 | 125.4 | 0.006 |
| 7/27/2012 | 48.77 | 101.3 | 101.6 | 6.81 | 9.67 | -1.9 | 121.9 | 0.062 |
| 8/22/2012 | NA | 96.1 | 96.2 | NA | NA | NA | NA | NA |
| 10/17/2012 | 45.06 | 13.8 | 13.8 | PA | PA | 0.7 | 124.3 | 0.033 |
| 11/26/2012 | 49.79 | 102.8 | 103.5 | 7.25 | 9.9 | 31.1 | 127.9 | 0.112 |

**Point Aux Chenes**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Deployment Date | SpCond | DO 1 | DO 2 | pH | pH | Turb | Turb | Depth |
| m/d/y | 50 mS/cm | 100% sat | 100% sat | 7 | 10 | 0 NTU | 126 NTU | m |
|  |  |  |  |  |  |  |  |  |
| 1/20/2012 | 43.51 | 211.4 | 213.1 | 7.51 | 10.33 | 1.1 | 126.1 | 0.037 |
| 3/1/2012 | 10.76 | -44.4 | -44.8 | 7.54 | 7.6 | 2 | 131 | 0.023 |
| 4/18/2012 | 46.58 | 4.6 | 4.5 | 7.42 | 7.72 | 1.7 | 132.5 | 0.021 |
| 5/16/2012 | 46.95 | -2.1 | -2 | 6.99 | 9.6 | 0.6 | 123.9 | -0.029 |
| 6/1/2012 | 47.44 | 89.1 | 89.3 | 7 | 9.92 | -0.1 | 124.1 | -0.123 |
| 6/13/2012 | 47.54 | 74 | 75.1 | 6.88 | 9.2 | 0 | 124.3 | 0.024 |
| 7/13/2012 | 51.7 | 45.9 | 45.4 | 7.2 | 9.35 | 2.8 | 127.6 | 0.002 |
| 8/16/2012 | 52.06 | 93 | 93.2 | 7 | 9.86 | 1.2 | 126.2 | 0.059 |
| 8/22/2012 | 46.45 | 83.2 | 80.2 | 8.08 | 8.16 | 0.2 | 126.5 | 0.042 |
| 9/18/2012 | 43.58 | 61.7 | 62.7 | 7.21 | 8.7 | 0.5 | 122 | 0.035 |
| 10/17/2012 | 48.57 | 102 | 102.1 | 7.19 | 10.12 | 0.2 | 124.1 | 0.04 |
| 11/26/2012 | 50.42 | 105 | 105.1 | 7.11 | 10.08 | 0 | 128.1 | 0.104 |

**Bayou Cumbest**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Deployment Date | SpCond | DO 1 | DO 2 | pH | pH | Turb | Turb | Depth |
| m/d/y | 50 mS/cm | 100% sat | 100% sat | 7 | 10 | 0 NTU | 126 NTU | m |
|  |  |  |  |  |  |  |  |  |
| 1/20/2012 | 40.4 | -0.8 | 0.2 | 7.26 | 7.38 | 0.6 | 116 | 0.021 |
| 4/18/2012 | 41.23 | 116.7 | 116.7 | 7.48 | 9.73 | 3.5 | 135.2 | 0.027 |
| 5/16/2012 | 42.5 | 0.3 | 0.3 | 6.9 | 9.71 | -0.2 | 124.2 | -0.024 |
| 6/1/2012 | 47.24 | 98.8 | 98.9 | 7.1 | 9.93 | 2.2 | 123.2 | -0.09 |
| 6/13/2012 | 47.71 | 104.3 | 104.2 | 7.03 | 10.1 | 0.7 | 126 | 0.054 |
| 6/27/2012 | 50.2 | 116.7 | 116.5 | 7.09 | 9.92 | -0.8 | 123.4 | 0.025 |
| 7/13/2012 | 49.01 | 102 | 101.8 | 6.78 | 9.63 | 1.3 | 125.6 | 0.001 |
| 7/27/2012 | 48.36 | 142 | 112 | 6.81 | 8.83 | 1.6 | 125.6 | 0.053 |
| 8/22/2012 | 48.48 | 104.6 | 104.3 | 6.87 | 9.54 | 0.1 | 125.5 | -0.023 |
| 9/28/2012 | 49.72 | 96.2 | 96 | 7.17 | 9.92 | -1.3 | 123.7 | 0.031 |
| 10/17/2012 | 49.02 | 96.6 | 96.7 | 6.97 | 9.84 | -1.6 | 125 | 0.057 |
| 11/26/2012 | 52.32 | 97 | 97.4 | 7.29 | 10.45 | -0.3 | 134.1 | 0.192 |

**Bangs Lake**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Deployment Date | SpCond | DO 1 | DO 2 | pH | pH | Turb | Turb | Depth |
| m/d/y | 50 mS/cm | 100% sat | 100% sat | 7 | 10 | 0 NTU | 126 NTU | m |
|  |  |  |  |  |  |  |  |  |
| 1/20/2012 | 44.33 | 102.4 | 102.6 | 7.13 | 10.1 | 1.3 | 123.7 | 0.028 |
| 4/18/2012 | 39.04 | 99.4 | 99.2 | 7.66 | 8.85 | -0.4 | 104.9 | 0.026 |
| 5/16/2012 | 45.57 | 99.6 | 99.8 | 7 | 9.96 | -0.9 | 119.7 | -0.018 |
| 6/1/2012 | 47.6 | 100.7 | 100.9 | 7.06 | 9.96 | 1.6 | 147.5 | -0.091 |
| 6/13/2012 | 48.18 | 99.4 | 99.3 | 7.05 | 10.03 | 0.4 | 124.7 | 0.054 |
| 6/27/2012 | 50.35 | 102.8 | 103.2 | 7 | 9.87 | -2.9 | 122.8 | 0.026 |
| 7/11/2012 | 49.23 | 99.3 | 99.3 | 7.11 | 9.58 | -2.5 | 121.3 | -0.003 |
| 7/27/2012 | 44.35 | 22.6 | 22.3 | 6.61 | 9.48 | 2.7 | 127.7 | 0.053 |
| 8/22/2012 | 48.64 | 99.2 | 98.7 | 6.19 | 6.19 | -0.8 | 125.3 | 0.037 |
| 9/18/2012 | 51.48 | 92.1 | 92.5 | 7.01 | 9.51 | 171 | 171 | 0.042 |
| 10/17/2012 | 48.41 | 93.7 | 93.6 | 6.5 | 9.23 | 1 | 124.3 | 0.041 |
| 11/26/2012 | 49.73 | 103.1 | 103.2 | 7.11 | 10.2 | 1 | 127.7 | 0.185 |

**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.

Field logs for the 2012 deployment year were not filled out according to NERRS CDMO SOPs. Rather than having each field sheet follow one deployment, one field date was filled out on one sheet. Please note this difference when using information on the field logs.

**General Remarks:**

6/8-6/10 – significant rain event, with 214.6 mm (8.4 in) recorded at SWMP weather station in Crooked Bayou and 274 mm (10.8 in) recorded at TS770, a weather station maintained by USFWS next to the NERR office.

Tides ran approximately 1 foot higher than predicted levels throughout the month of June.

6/22-6/25 – Tropical Storm Debby churned in the Gulf. While coastal MS did not get rain from the storm, tides were extremely high (3 feet higher than predicted levels at one point). This had observable effects on water quality in the Reserve.

7/14 – Significant rain event; 38 mm (1.5 in) of rain recorded at the SWMP weather station in Crooked Bayou.

7/19 – Significant rain event; 100 mm (3.9 in) of rain at TS770/GRBM6.

8/28-8/30 – Hurricane Isaac dumped approximately 13” of rain on our area; up to 20” in some spots along the coast. Effects from this event persisted in water quality data for at least a week following the storm.

9/4-9/5 – Significant rain event; 59 mm (2.3 in) of rain recorded at the SWMP weather station in Crooked Bayou.

9/29 -9/30 – Significant rain event; 58 mm (2.3 in) of rain recorded at the SWMP weather station in Crooked Bayou.

**Bayou Heron:**

2/22 7:15 – cleaned in field. There was a significant amount of scaly fouling on the turbidity probe, so readings were rejected between the time data began an upward drift to the time the probe was cleaned.

6/13 – 6/27 – pH probe did not calibrate properly. Data rejected.

10/17 – 11/26 - pH probe was not calibrating; cleaned pH port. pH probe still would not calibrate correctly. Sonde deployed anyway and pH readings from this deployment were rejected.

**Point Aux Chenes:**

2/22 7:38 – cleaned in field; out of water for 7:45 reading. Barnacles were found growing on the DO membrane. All DO data after this cleaning were rejected. Data were rejected before the cleaning based on the start of the downward drift in readings. This was assumed to be the point where the barnacles attached.

6/1 11:45 - 6/2 4:45 - Data logger believed to be at wrong depth, possibly due to fouling in the deployment tube. Timing of the event was determined from abrupt depth changes at and after the start of the new deployment. Depth data were flagged as suspect. Because the water column at PC is well-mixed, other parameters were assumed to be representative of conditions and were accepted with a (CWD) flag – data collected at wrong depth.

8/1 8:45 – 9:15 – cleaned in field. Sonde was out of water for 9:00 reading; these data were rejected. Bryozoans growing on DO membrane; everything else could be cleaned.

8/1 – 8/16 – After sonde was cleaned in field, depth readings became inconsistent with typical conditions. It’s possible the sonde came to rest above the bottom of the sonde sleeve. Depth data were flagged as suspect. Because the water column at PC is well-mixed, other parameters were assumed to be representative of conditions and were accepted with a (CWD) flag – data collected at wrong depth.

8/29 – 9/18 – Real-time transmission stopped during Hurricane Isaac, on 8/28. This was believed to be a telemetry problem rather than a sonde logging problem. Unfortunately, when the sonde was retrieved on 9/18, we discovered that logging had stopped on 8/29.

10/17-11/26 – Prior to deployment, the C/T port was cleaned due to problems with Specific conductivity and Salinity readings even with a new C/T probe. During this deployment, there were many instances of SpC/Salinity reading erroneously low (confirmed after retrieval by letting sonde run in 50 us/cm SpC standard overnight and looking at the data file in the morning). These low readings were all rejected. Associated DO (mg/L) and depth data were rejected. All other SpC and Salinity readings are believed to be accurate.

10/17-12/31 – Data logger believed to be at wrong depth due to barnacles in sonde sleeve. Depth data were flagged as suspect. Because the water column at PC is well-mixed, other parameters were assumed to be representative of conditions and were accepted with a (CWD) flag – data collected at wrong depth. Based on post-calibration of sensors (all depths correct within 0.006 m) as well as the difference between the last depth readings on the properly placed sonde and the first depth readings of the improperly placed sonde, we infer that the sonde was approximately 0.44 m higher in the sonde sleeve than it should have been. While this is not an exact measurement, researchers may consider adding the estimated difference to the collected depth readings if they wish to approximate a correction of depth data. Regardless, these data should be used with caution.

**Bayou Cumbest:**

2/22 8:30 – cleaned in field.

3/14 3:30 – sonde had a malfunction and stopped recording data. Data was able to be recovered from the telemetry system until telemetry problems on 3/28. Sonde started recording data again on 4/15 at 23:30.

4/17 9:00 – 4/18 15:15 – No sonde deployed because a pin in the data cable broke off into the removed sonde’s connector on 4/17, and there was no way to secure a fresh sonde. Had to go out the next day to deploy the fresh sonde.

**Bangs Lake:**

2/22 8:10 – cleaned in field.

3/19 13:45 – 4/18 14:30 – batteries died. Sonde was not able to be retrieved until 4/18, when this problem was discovered.

8/12 – 8/22 – Turbidity values were very high, how they might look after a very large rain or wind event, then dropped back to a normal level during the same deployment. However, no corresponding weather event could be found in the meteorological data. Taking into account the magnitude of the turbidity values (>400 NTU at one point), the lack of a weather event, and the later effects of Hurricane Isaac (<100 NTU), these turbidity values were presumed to be from biofouling or a wiper malfunction and readings through the end of the deployment were rejected.

9/18 – 10/17 deployment – DO (% saturation and mg/L) readings were somewhat scattered, with some readings as low as 0. The lowest readings (<1.1 mg/L), which were all well outside the range of scatter, were rejected. These readings began 9/23. All other DO readings for this deployment were marked suspect.