Water Column Transfer Efficiency Report

for the

Dissolved Oxygen Facility Environmental Testing

for the

Savannah Harbor Expansion Project

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EXECUTIVE SUMMARY

As part of the Savannah Harbor Expansion Project (SHEP), dissolved oxygen (DO) injection systems will be needed at two locations (Downriver Site and Upriver Site) on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The Downriver Site, located on Hutchinson Island in Chatham County, Georgia, serves two diffuser sites, one on the Back River and one on the lower Front River. The Upriver Site is located farther upstream on the Savannah River in Effingham County, Georgia. Together these systems are designed to deliver 40,000 lbs (28,000 lbs from the Upriver Site and 12,000 lbs from the Downriver Site) of DO per day to the Savannah River harbor and estuary. The USACE started operating the Downriver Site in January 2019, while as of August 2019, the Upriver Site is still under construction. The systems will be operated seasonally from June 15 through September 30 during the warmest months of the year when DO concentrations in the river are generally at their lowest.

The DO injection systems withdraw river water from the Savannah River, super-oxygenate the water, and then return the super-saturated water to the river. To super-oxygenate the water, high-purity oxygen gas generated on-site and injected into the river water using “Speece” cones, named after the inventor. This super-saturated water will mix with the ambient river water and result in elevated DO levels.

The purpose of this document is to determine the Water Column Transfer Efficiency (WCTE), or what percentage of oxygen injected remains in the river that was injected at the Downriver Site. DO is lost out of the river system when ambient DO levels are above 100% saturation (super-saturated). To estimate how much oxygen was potentially lost across the air-water interface, the amount of oxygen lost out of the system was calculated using data collected during the WCTE data collection period (February 14, 2019 through February 27, 2019) and the Test Run data collection period (March 14, 2019 through May 12, 2019). The calculation will also be applied to data collected during the 60-day Startup Run in the summer of 2020 which will occur during the months of routine seasonal operation (June 15 through September 30). The Upriver Site will be completed prior to the Startup Run data collection.

Data QA/QC checks were performed on the data collected to ensure they were within expected ranges and complied with the QA/QC protocols. The total number of individual data points collected during the two data collection efforts were more than 24 million (24,000,000) at an acceptance rate of 97.4%, greater than required 90% acceptance rate. A variety of data were collected, including depth, water temperature, salinity, specific conductivity, dissolved oxygen, and blue green algae (Rhodamine dye surrogate).

The method determined to calculate DO loss was a site-specific approach, using the locally collected data in the lower Front River and the Back River, and was based on the physics of DO transfer across the air-water interface during times when the water column was at or above super-saturation.

The calculated WCTE during the WCTE study period (February 2019) was approximately of 100%. During the Test Run (March 14, 2019 through May 12, 2019), the calculated WCTE was approximately 98%.

It is recommended that the USACE operate the Downriver Plant assuming a WCTE of 95%. This is to account for the variability in the system (e.g., flows, velocities, temperatures, instream DO concentrations, tidal cycle, etc.) that might be encountered during other periods of the year.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BGA	Phycoerythin blue-green algae
CSV	Comma separated variable
DO	Dissolved oxygen
Excel	Microsoft Excel
GPS	Geospatial positioning system
ID	Identification
OneDrive	Microsoft OneDrive
PCode	Parameter code
Plant	DO Injection Facility
PSI	Pounds per square inch
PVC	Polyvinyl chloride
SHEP	Savannah Harbor Expansion Project
SPCOND	Specific conductivity
QA/QC	Quality assurance/quality control
RCode	Remark code
RFU	Relative fluorescence units
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WRDB	Water Resources Database
WCTE	Water Column Transfer Efficiency

1.0 INTRODUCTION

As part of the Savannah Harbor Expansion Project (SHEP), dissolved oxygen (DO) injection systems will be needed at two locations (Downriver Site and Upriver Site) on the Savannah River to offset potential decreases in DO due to navigation channel deepening (***Figure 1-1***). The Downriver Site, located on Hutchinson Island in Chatham County, Georgia, serves two diffuser sites, one on the Back River and one on the lower Front River. The Upriver Site is located farther upstream on the Savannah River in Effingham County, Georgia. Together these systems are designed to deliver 40,000 lbs (28,000 lbs from the Upriver Site and 12,000 lbs from the Downriver Site) of DO per day to the Savannah River harbor and estuary. The USACE started operating the Downriver Site in January 2019, while as of August 2019, the Upriver Site is still under construction. The systems will be operated seasonally from June 15 through September 30 during the warmest months of the year when DO concentrations in the river are generally at their lowest.

The DO injection systems withdraw river water from the Savannah River, super-oxygenate the water, and then return the super-saturated water to the river. To super-oxygenate the water, high-purity oxygen gas is generated on-site and injected into the river water using “Speece” cones, named after the inventor. This super-saturated water will mix with the ambient river water and result in elevated DO levels.

The purpose of these DO injection systems is to mitigate for the impacts due to harbor deepening. Since the requirement for the DO system is not to achieve a specific DO concentration level, demonstrating success will not be simple. The Settlement Agreement defines success as the DO systems performing as they are intended. Success will require a combination of both monitoring and modeling efforts, or in other words, multiple lines of evidence.

In order to determine if the systems are performing as intended and delivering the required oxygen load to the river, the Water Column Transfer Efficiency (WCTE) was calculated for the Downriver Site. The WCTE was determined by measuring the amount of oxygen supplied from the Speece Cone System and comparing it to the DO that remained in the Savannah River or Estuary water column. An oxygen sensor and flow measuring device were installed on each Speece Cone discharge pipe to provide flow and oxygen measurements of the super-saturated water. The oxygen and flow sensors (Greyline Doppler Flow Meter) were hard-wired into the DO injection systems infrastructure by the construction contractor CDM and measured DO and flow within the DO injection system as Plant data. It was expected that the flow and oxygen discharging through the diffusers would completely mix with the ambient water; however, factors such as the occurrence of effervescence and/or a plume of super-saturated water reaching the surface could occur, both of which would allow oxygen to leave the water column and reduce the WCTE.

The objective of the WCTE study data collection effort was to use high-frequency collected data to develop a methodology to determine how much DO remains in the water after its injection into the water column. The WCTE study data collection was performed from February 14, 2019 through February 27, 2019 around the Downriver Site diffuser sites on the Back River and the lower Front River. In addition to the data collected near the diffuser sites, the WCTE used flow and water quality data from United States Geological Survey (USGS) stations located upstream and downstream of the diffuser sites, and United States Army Corps of Engineers (USACE) DO injection facility (Plant) data which provided information on the operation of the Plant. Similar data were collected during the Test Run, which was performed from March 14, 2019 through May 12, 2019 and these data were also used to calculate the WCTE. Data collection procedures and data QA/QC for the Test Run data collection effort are detailed in the Test Run Data Collection and Modeling Report (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2019c). The WCTE will be calculated for the Upriver Site following its completion in 2019 using data collected during the 2020 Startup Run.

The WCTE report was Task 6 of the contract between LG^2 Environmental Solutions, their sub consultant Tetra Tech, and the USACE Savannah District. WCTE study data collection and quality assurance/quality control (QA/QC) followed the methodology documented in Appendix A and Appendix B of the *Work Plan* for *Dissolved Oxygen Facility Environmental Testing for the Savannah Harbor Expansion Project* (Work Plan (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2019b)). Discussed below are data collection procedures used by the field team for the WCTE study, data QA/QC evaluations conducted by the QA/QC team on the WCTE study data, and a discussion of the method developed to calculate WCTE using the high frequency data collection data. The method was used to calculate WCTE for the WCTE study time period (February 14, 2019 through February 27, 2019) and the Test Run time period (March 14, 2019 through May 12, 2019).

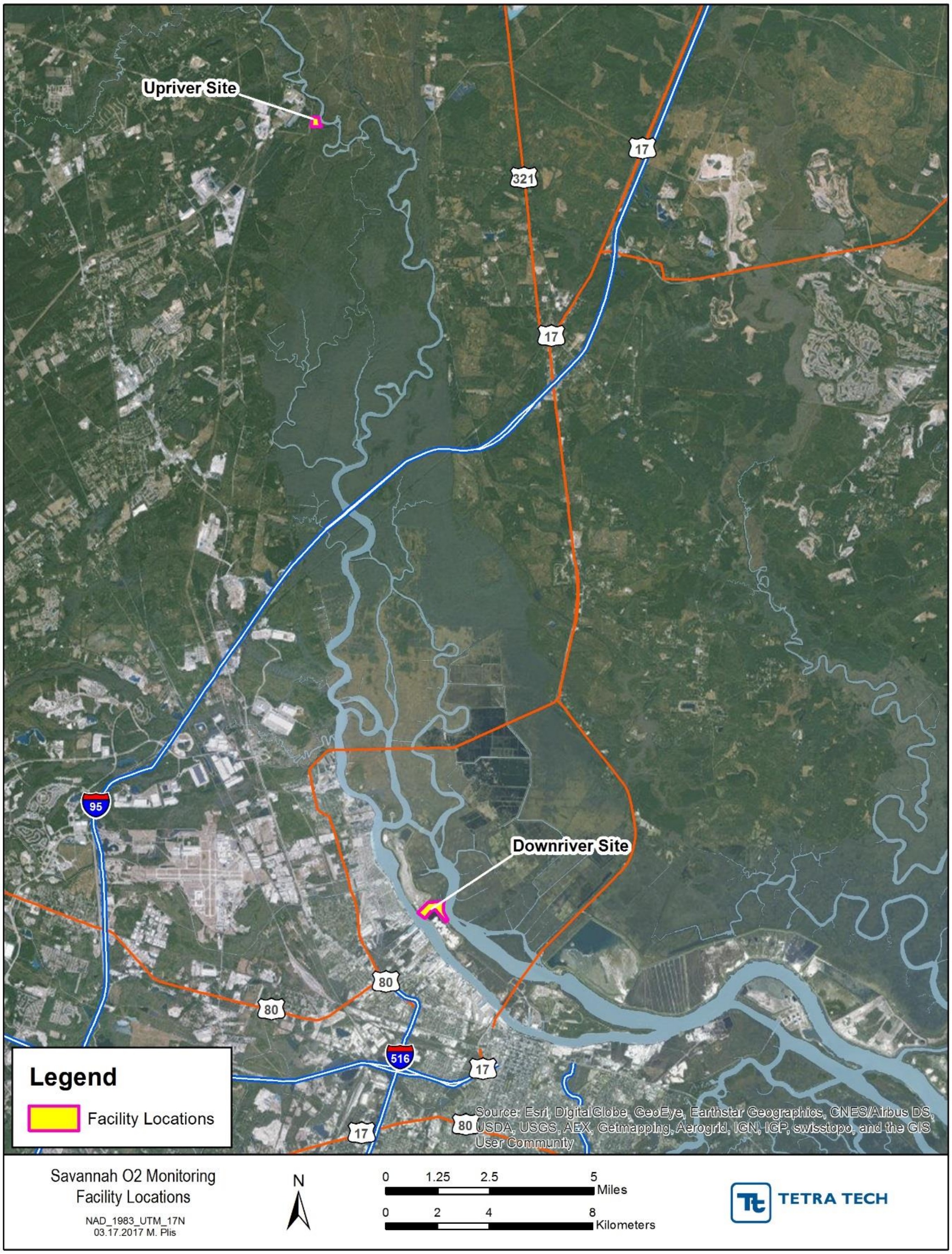


Figure 1-1 Dissolved oxygen injection facility locations

2.0 DATA COLLECTION PROCEDURES

The WCTE study data collection effort consisted of four major data collection efforts which combined provides a comprehensive description of how the lower Front River and Back River injected oxygen impacts the rivers' DO regime. These four efforts are:

- Platform data collection to gather continuous data around the Back River DO plume and at various depths.
- Semi-permanent buoy data collection to gather continuous lower Front River and Back River data upstream and downstream of the diffusers after the plume reaches the surface.
- Profile and drift data collection to gather data approximately one hour before and after slack tides to show how the DO was mixed into the lower Front River and Back River systems and how it travels up and downstream.
- Dye studies to determine the diffuser dilution rates (approximately 40:1) and how the DO plume travels upstream and downstream.

Data collection procedures for the WCTE study followed the data collection procedures that were validated during the Background Data Collection study (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2019a). The data collection provided the data necessary for the project to track and monitor the general movement and trends of the oxygen plume.

All data sondes and associated sonde sensors were prepared and calibrated in accordance with manufacturer's specifications by field team scientists trained by the manufacturer's technicians after having completed training classes. The scientists were supported during the WCTE study data collection task by the manufacturer's onsite field engineer. Preparation and maintenance of the data sondes were performed at the laboratory/work space provided by the USACE at the Army Corps Depot facility located on the east bank of the Savannah River on Hutchinson Island. The data sondes, according to manufacture specifications, are capable of accurately collecting data at a frequency of 1-second intervals.

2.1 PLATFORM MONITORING / DATA COLLECTION

A data sonde platform was deployed on the Back River from which sixteen (16) data sondes were installed and set to continuously monitor water quality conditions above the Back River diffuser pipe. The data sonde platform was fitted with three (3) (polyvinyl chloride) PVC down pipes on all four (4) corners of the platform set at fixed predetermined depths (surface, mid-depth, and bottom of water column). The data sondes were deployed in the PVC down pipes. Additional data sondes were placed in PVC down pipes located on the sides of the platform to monitor water quality constituents at variable depths in the water column between the corner fixed depth locations. Data from the platform-mounted sondes were collected from a central data logger installed on the platform and transmitted via cellular phone modem to a data management website. The platform-mounted sondes provided continuous data collected for the entire data collection event. ***Figure 2-1*** shows the location of the platform on the Back River. Additional information detailing the platform construction and deployment are located in the Background Data Collection Report (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2019a).

The data sondes were delivered to the platform by the field team via project boats on February 11, 2019 during preparation for the WCTE study and were removed from the platform on February 27, 2019 after completion of the WCTE study. The data sondes were set to recorded water quality measurements at 5-minute intervals for DO, DO saturation, salinity, conductivity, water temperature, and depth along with the date and time of each measurement. Several data sondes were outfitted with sensors to detect algae [phycoerythin blue-green algae (BGA) and chlorophyll *a*] in real-time through the in-vivo fluorometry technique. This method directly detected the fluorescence of specific pigments in living algal cells and determined relative algal biomass of BGA and chlorophyll *a*. The BGA pigment does not receive interference from chlorophyll a or turbidity. The BGA sensors were used to detect Rhodamine dye injected into the DO system pipes during planned dye injection events.

Data collected from platform sondes were transmitted to the data management website and retrieved using a proprietary data management software package and website (Xylem Eagle I/O). The field team viewed data recorded and transmitted to this website, which generated “dash boards” for the data sondes that displayed graphs and charts of the raw data. The visual aids allowed tracking of sonde performance and initiated team work between the field team and the QA/QC team to rectify any issues noted during data collection. ***Figure 2-2*** provides examples of the depth and DO timeseries data collected by the cluster of sondes located on the northeast corner of the platform for the WCTE study period.

The data sonde calibration intervals were determined by the manufacturer but could differ from typical recommendations depending on lengths of deployment, site conditions, and any anomalies interpreted from visual aids used to routinely review data (**APPENDIX J**). In cases where the visual review of data indicated that there was data drift or other potential data issues, the entire sonde would be replaced with a backup data sonde, and the particular sensor would be recalibrated according to the manufacturer’s specifications.

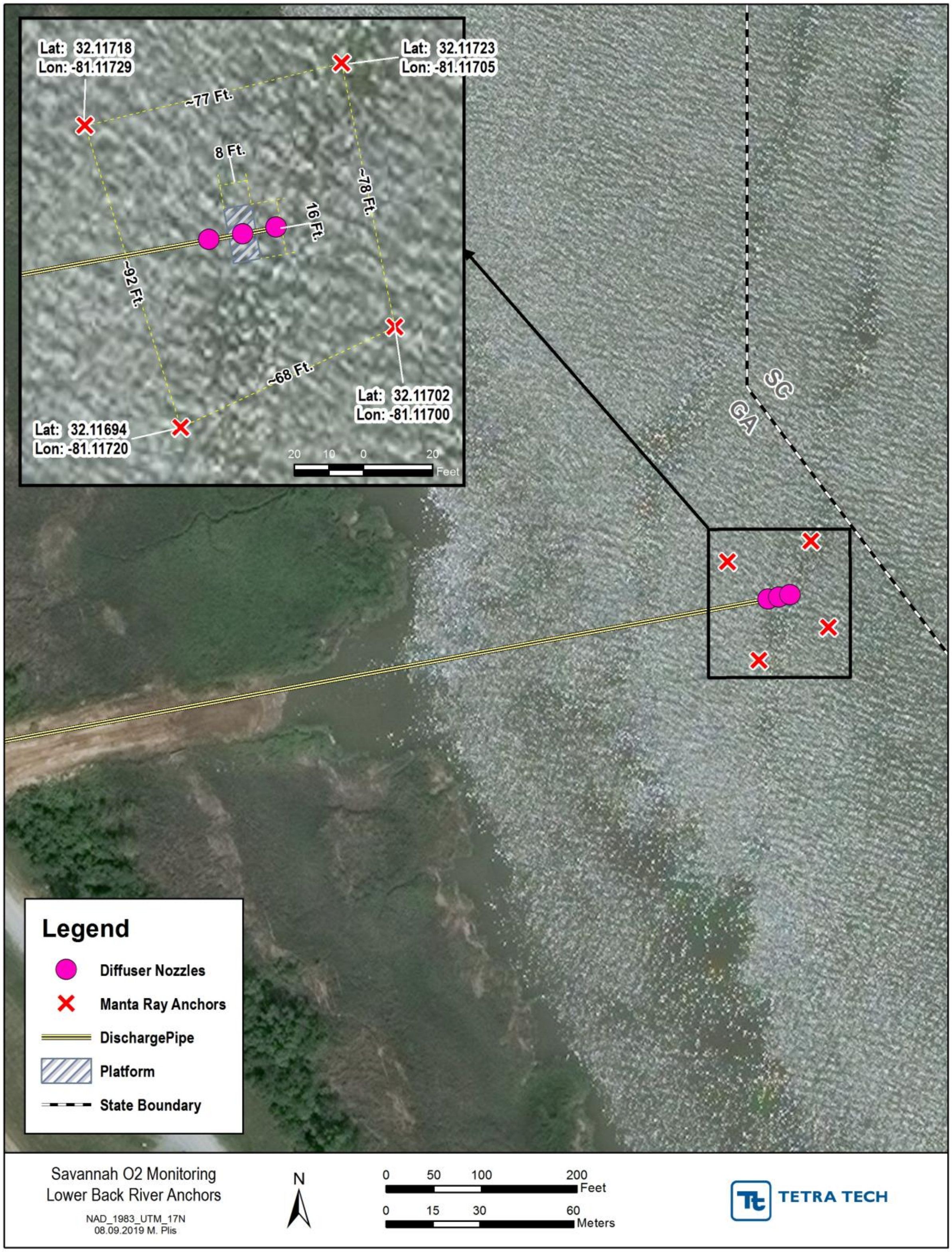


Figure 2-1 Location of platform on the Back River

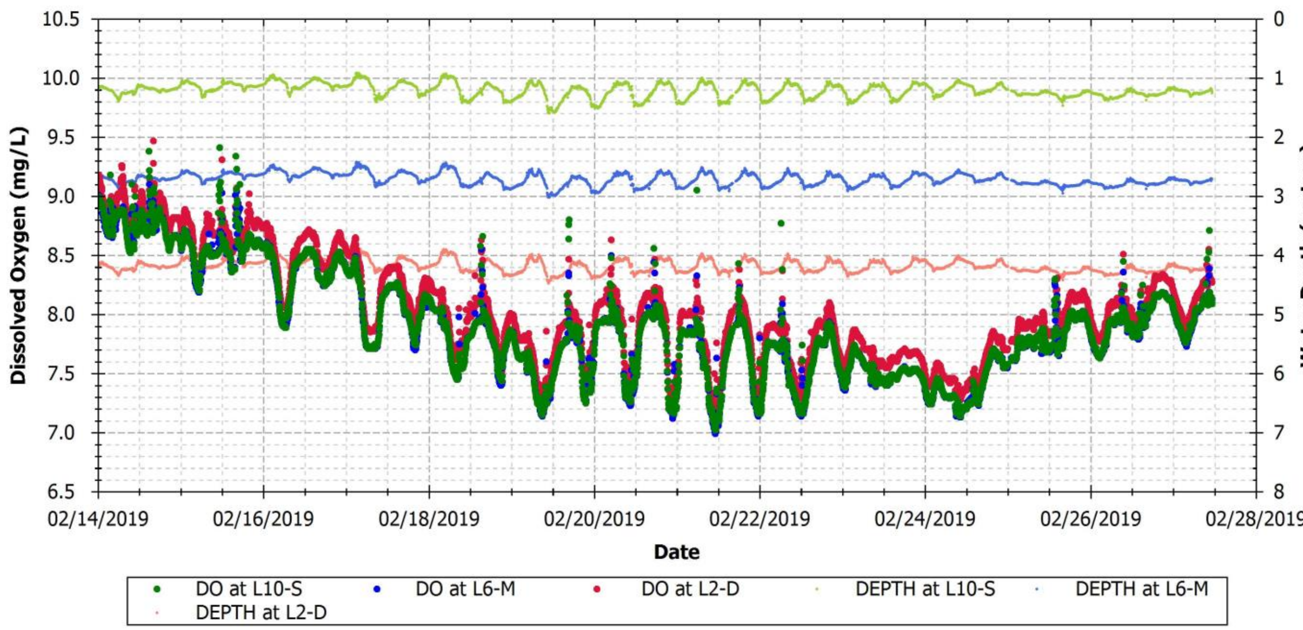


Figure 2-2 Back River northeast corner observed depth and DO

2.2 SEMI-PERMANENT BUOY MONITORING / DATA COLLECTION

Semi-permanent buoy data sondes were designed to be tethered in one (1) location and continuously collect and record data. The exact position of each individual semi-permanent buoy sonde was determined initially by near-field modeling for the Background Data Collection period and were not moved for the WCTE study data collection. Four (4) semi-permanent buoy sondes were installed near the water surface at four (4) separate locations around the Back River platform (***Figure 2-3***) to provide sentinel data outside the focused footprint of the fixed platform. Two (2) semi-permanent buoy sondes were installed near the water surface upstream and downstream from the lower Front River diffuser pipe and diffusers to provide constant sentinel data (***Figure 2-4***). The buoy sondes were located outside of the navigational channel to avoid potential boat strikes. Additional information detailing the buoy construction and deployment are located in the Background Data Collection Report (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2019a).

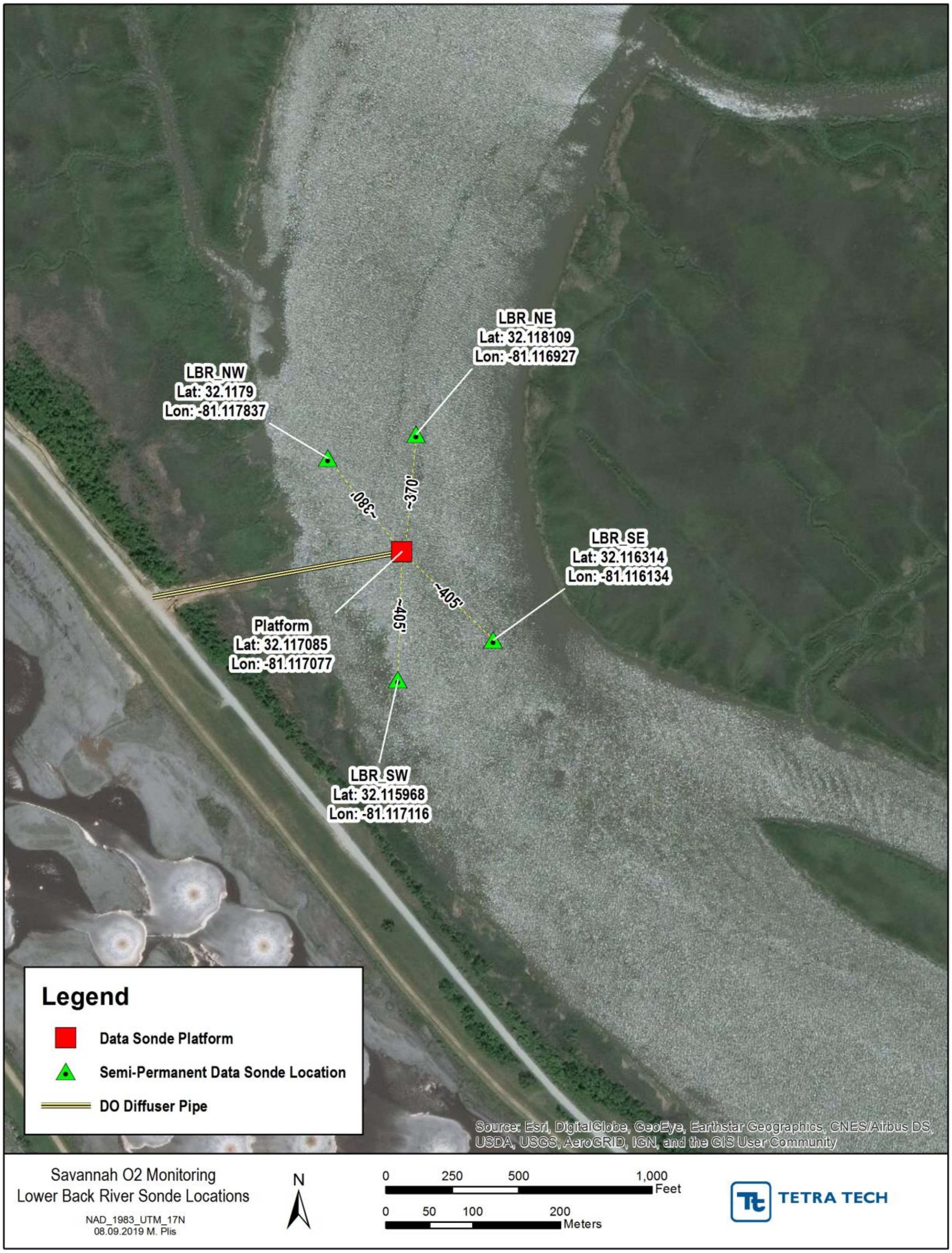


Figure 2-3 Location of semi-permanent buoys on the lower Back River

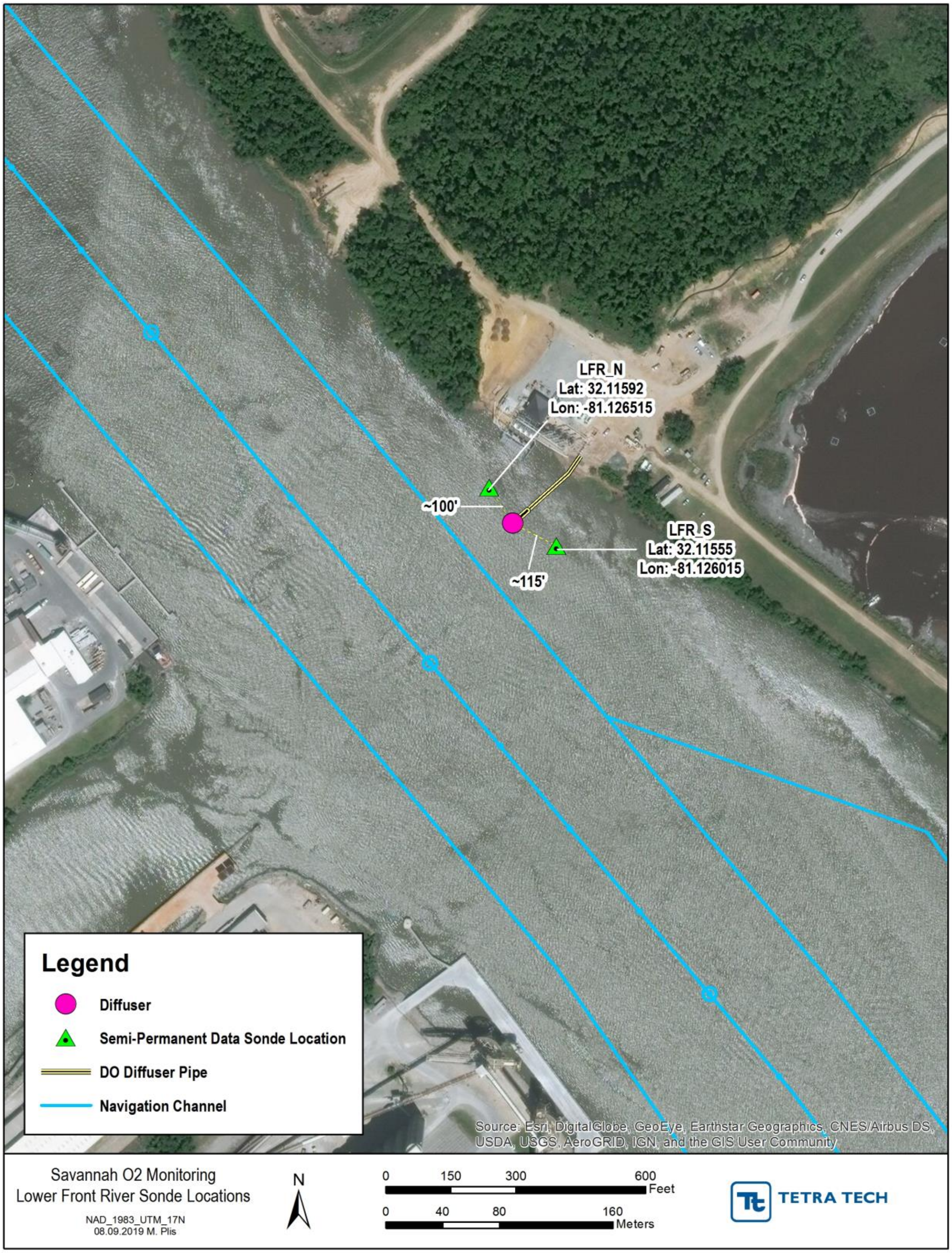


Figure 2-4 Location of semi-permanent buoys on the lower Front River

The data sondes were delivered to the semi-permanent buoys by the field team via project boats on February 13, 2019 during preparation for the WCTE study and were removed from service on February 27, 2019 after completion of the WCTE study. The data sondes were set to recorded water quality measurements at 5-minute intervals for DO, DO saturation, salinity, conductivity, water temperature, and depth along with the date and time of each measurement. Several data sondes were outfitted with sensors to detect BGA and chlorophyll *a* in real-time through the in-vivo fluorometry technique.

The data were stored on each sonde's onboard data logger and were downloaded frequently, approximately every three (3) days of deployment. The downloaded data, including geospatial positioning system (GPS) locations, were transferred to the QA/QC team, following the QA/QC procedures in Appendix B of the Work Plan (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2019b). ***Figure 2-5*** provides an example of the depth and DO timeseries data collected by the Back River northeast buoy sonde and ***Figure 2-6*** provides an example of the depth and DO timeseries data collected by the lower Front River north buoy sonde.

The data sonde calibration intervals were determined by the manufacturer but could differ from typical recommendations depending on lengths of deployment, site conditions, and any anomalies interpreted from visual aids used to routinely review data (**APPENDIX J**). In cases where the visual review of data indicated that there was data drift or other potential data issues, the entire sonde would be replaced with a backup data sonde, and the particular sensor would be recalibrated according to the manufacturer's specifications.

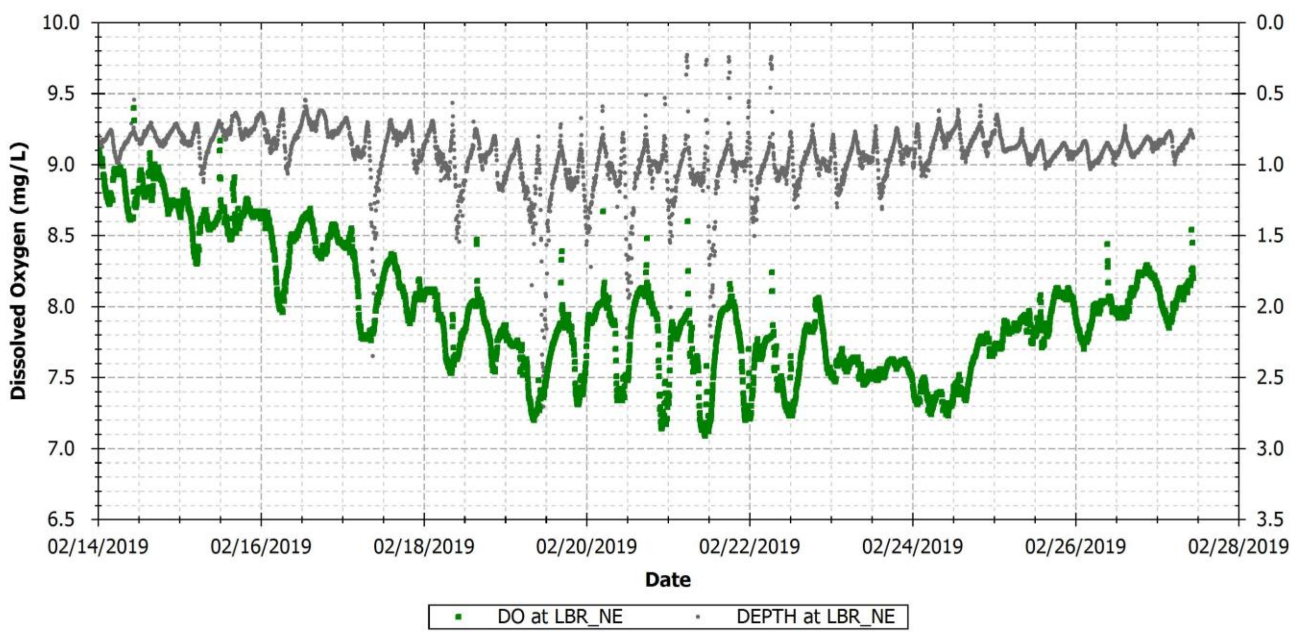


Figure 2-5 Back River northeast observed depth and DO

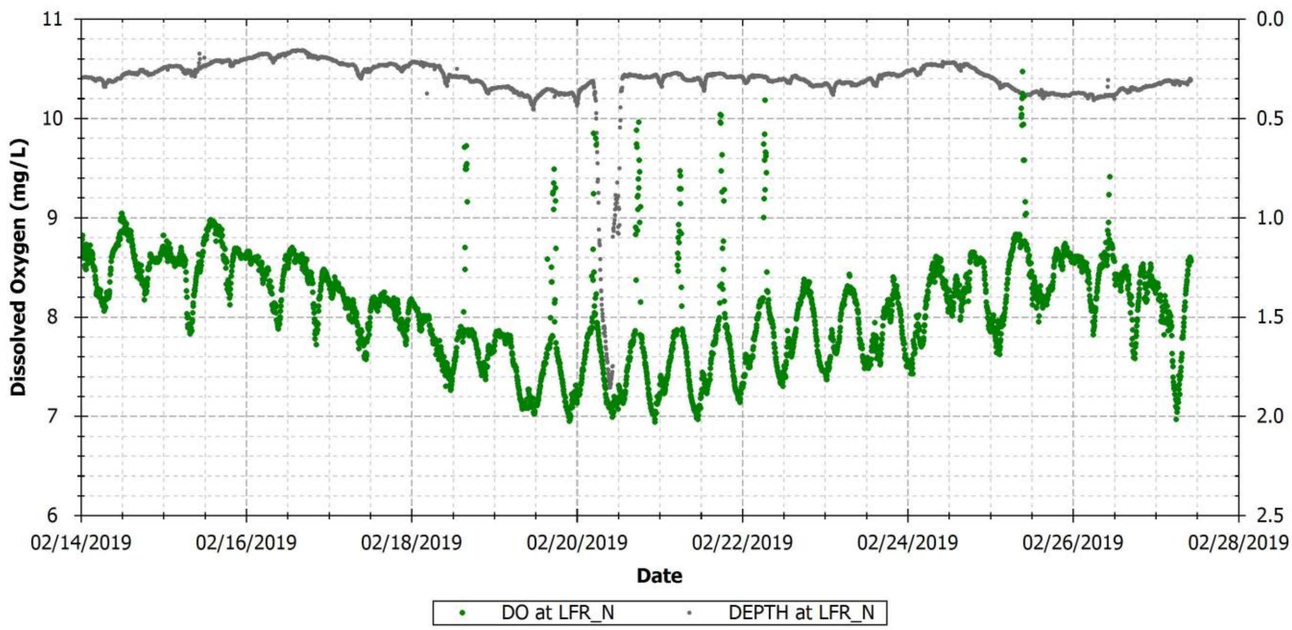


Figure 2-6 Lower Front River north observed depth and DO

2.3 PROFILE AND DRIFT DATA COLLECTION SCHEDULE

A data collection schedule was prepared prior to commencing the WCTE study that identified the dates, tidal conditions, and type of boat data collection that would occur on each river. The data collection schedule ensured that a variety of conditions were monitored during the study that best represented the tidal conditions over the full lunar cycle. The data collection schedule conducted by the field team for the WCTE study is presented in ***Table 2-1***.

Table 2-1 WCTE data collection schedule

Date	Time[1]	Tide	Back River			Lower Front River		
			Profile	Drift	Dye	Profile	Drift	Dye
2/14/2019	10:09 AM	Low	●	●	●			
2/15/2019	11:10 AM	Low		●			●	
2/18/2019	1:56 PM	Low	●			●		
2/19/2019	8:31 AM	High		●			●	
2/19/2019	2:46 PM	Low		●			●	
2/20/2019	9:23 AM	High	●			●		
2/20/2019	3:35 PM	Low	●			●		
2/21/2019	10:12 AM	High				●	●	●
2/22/2019	11:01 AM	High	●			●		
2/25/2019	1:30 PM	High	●			●		
2/26/2019	8:20 AM	Low		●			●	

Date	Time[1]	Tide	Back River			Lower Front River		
			Profile	Drift	Dye	Profile	Drift	Dye
2/26/2019	2:30 PM	High		●			●	
2/27/2019	9:20 AM	Low	●			●		

2.4 PROFILE MONITORING / DATA COLLECTION

Profiling was conducted by the field team via project boats. Each data sonde recorded DO, DO saturation, salinity, specific conductivity, water temperature, BGA and chlorophyll *a*, along with the date, time, depth, and GPS locations of each measurement. The recording of measurements was performed using a hand-held device connected to the data sonde by a communication cable allowing "real-time" viewing of information logged by the data sondes. Profiling data was recorded at a frequency of two (2) seconds.

Profiling consisted of deploying a data sonde over the side of a project boat and lowering and raising it through the water column. Profiling data were collected in two different ways; (1) stationary profiles and (2) traveling profiles. Stationary profiles were collected in a static location (i.e. at each buoy and on the eastern and western sides of the platform) where the sonde was lowered at 1-meter intervals and held at each depth for a minimum of 30 seconds. Data collection was started and stopped at the beginning and end of each static profile thereby creating one data file for each static profile (file was minutes in length). Traveling profiles were collected with spatial, depth, and temporal variability inside and outside of the plume. The project boat either drifted or motored in various ways around, through, or within the plume while sometimes keeping the sonde at a static depth and other times conducting water column profiling. Data collection was started and stopped at the beginning and end of each traveling profile thereby creating one continuous data file for that traveling profile (files were typically hours in length).

Field notes and daily logs were prepared documenting the data collection times and locations, the field crew, the day's weather conditions and any data collection issues (**APPENDIX J**). The downloaded data, including GPS locations, along with the field notes and daily logs, were transferred to the QA/QC team, following the QA/QC procedures in Appendix B of the Work Plan. Microsoft Excel (Excel) files contained raw data uploaded to the project Microsoft OneDrive (OneDrive) and provided in comma-delimited format. The raw data were reviewed and checked by the QA/QC team. ***Figure 2-8*** and ***Figure 2-8*** provide an example of the data collected for a traveling profile data collection run for the lower Front River, and ***Figure 2-9*** and ***Figure 2-10*** provide an example of the data collected for a traveling profile data collection run for the Back River.

Data sonde calibration intervals were determined by the manufacturer but could differ from typical recommendations depending on lengths of deployment, site conditions, and any anomalies interpreted from visual aids used to routinely review data (**APPENDIX J**). In cases where the visual review of data indicated that there was data drift or other potential data issues, the entire sonde would be replaced with a backup data sonde, and the particular sensor would be recalibrated according to the manufacturer's specifications.

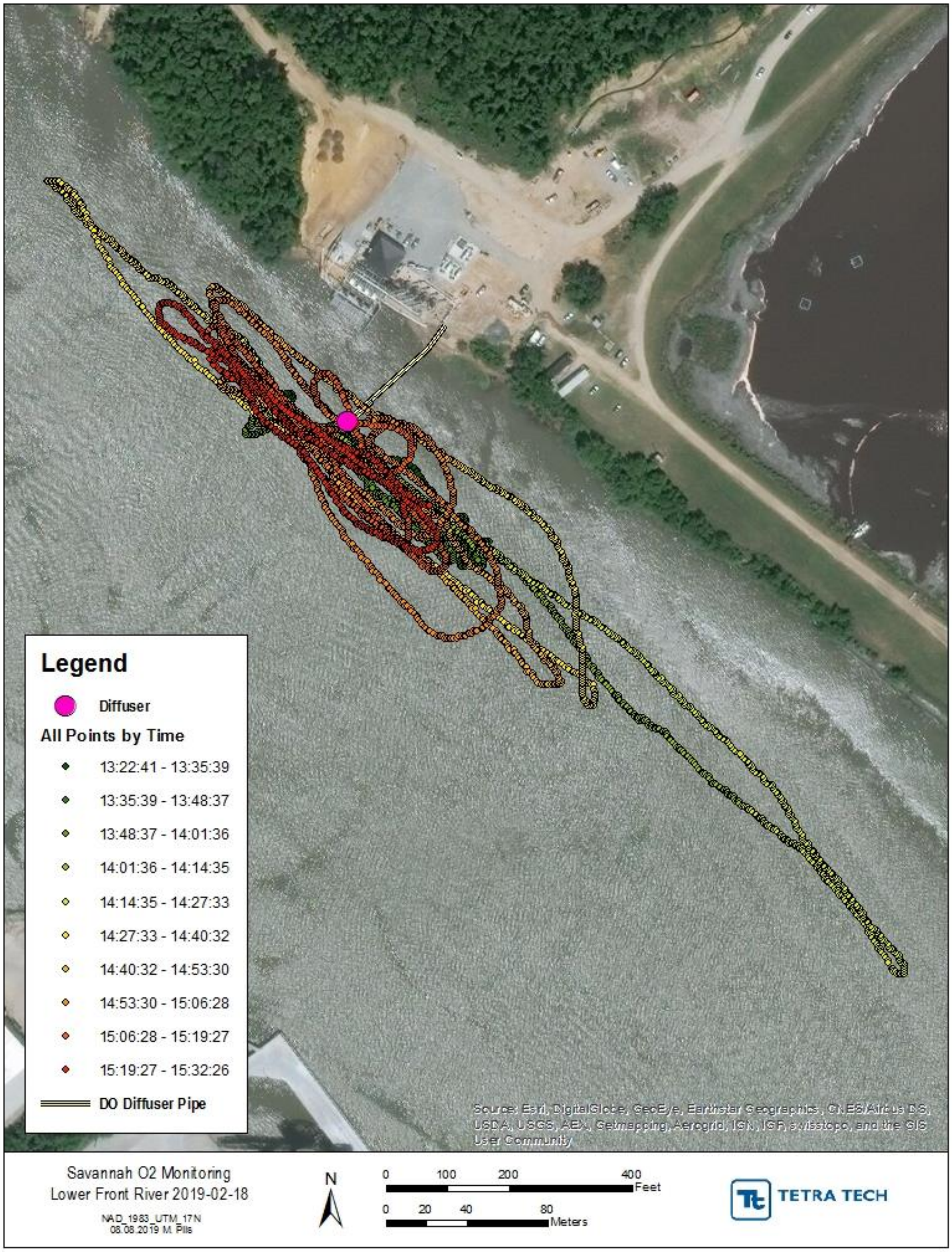


Figure 2-7 Front River February 18, 2019 outgoing tide traveling location map

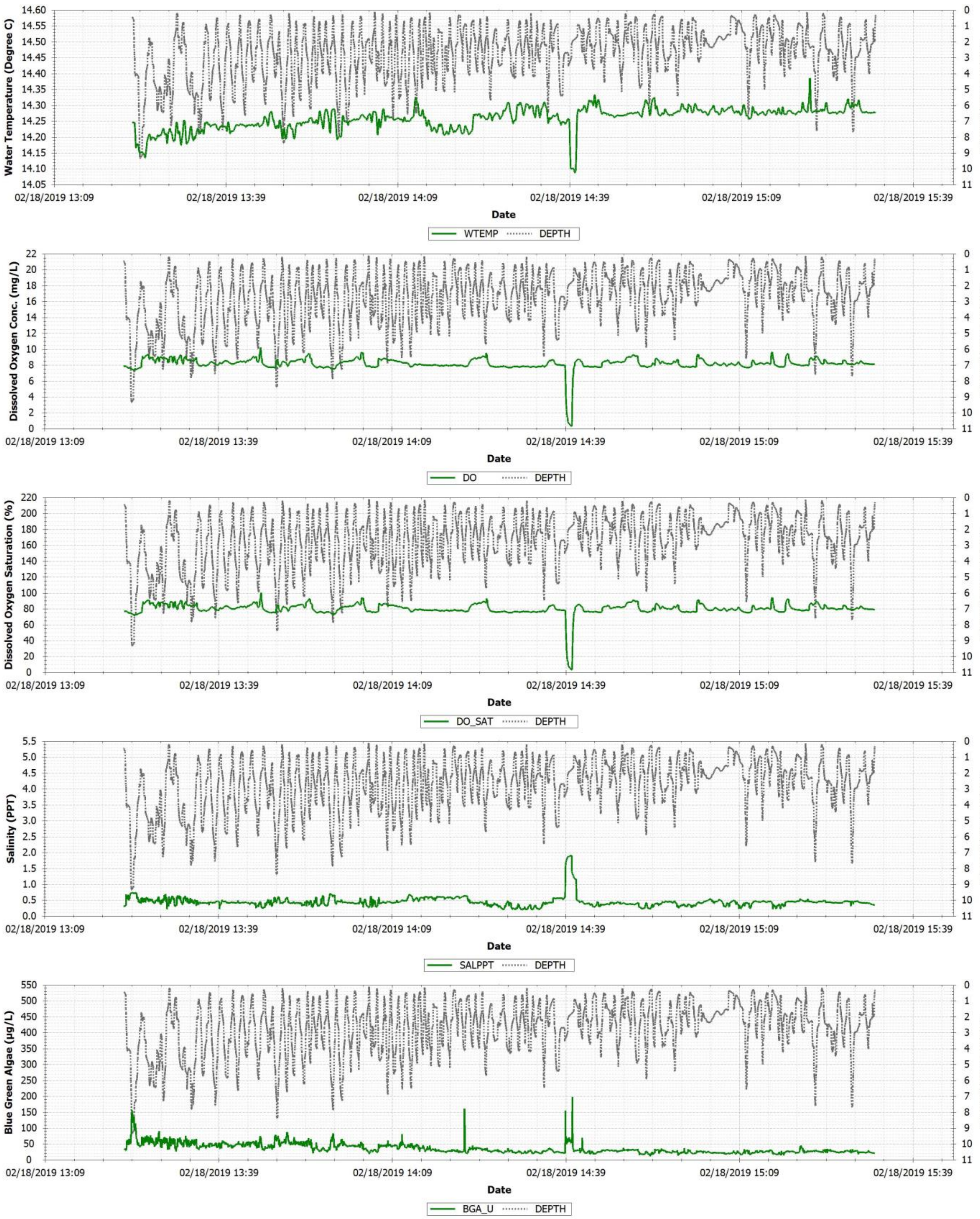


Figure 2-8 Front River February 18, 2019 outgoing tide traveling profile period observations

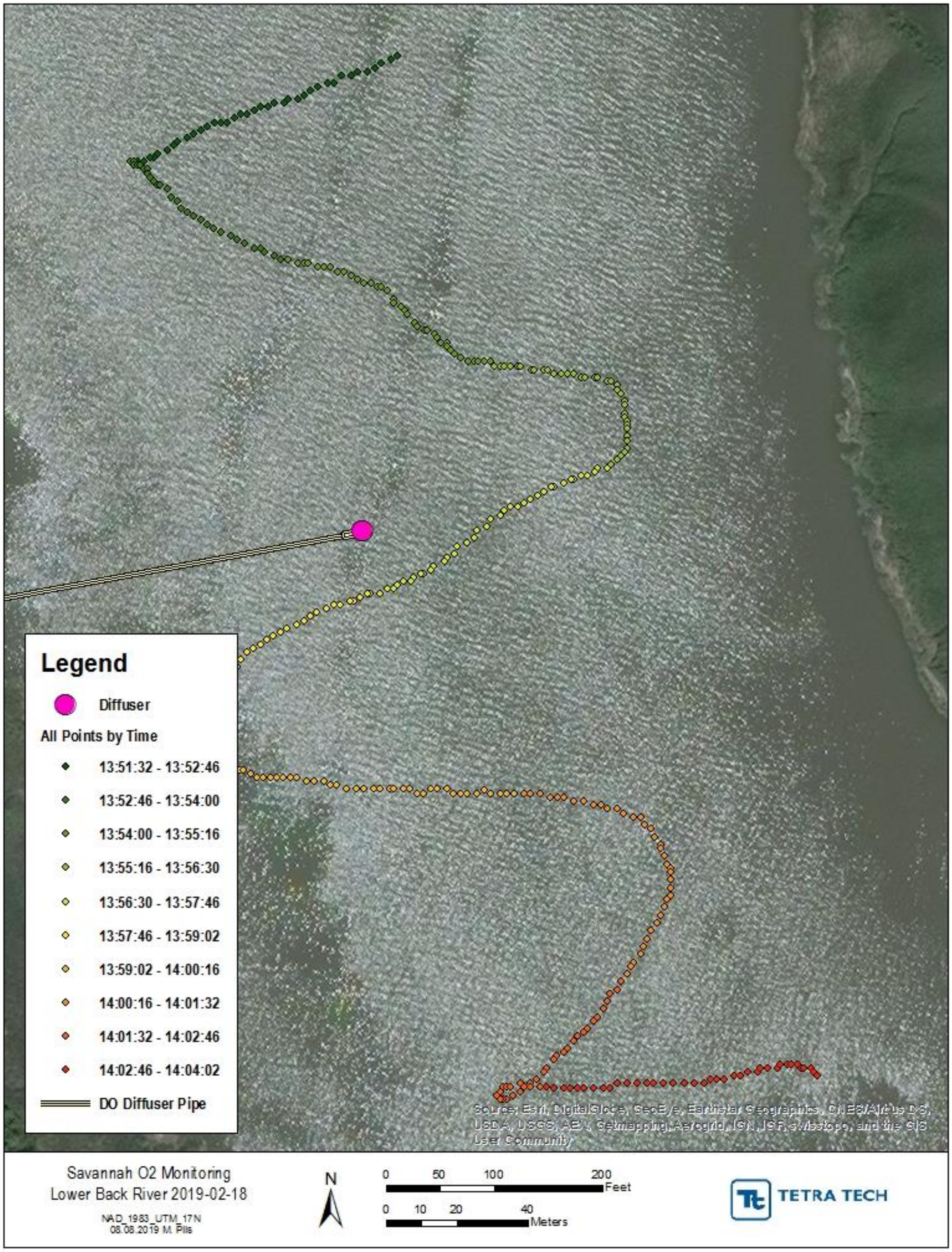


Figure 2-9 Back River February 18, 2019 outgoing tide traveling profile location map

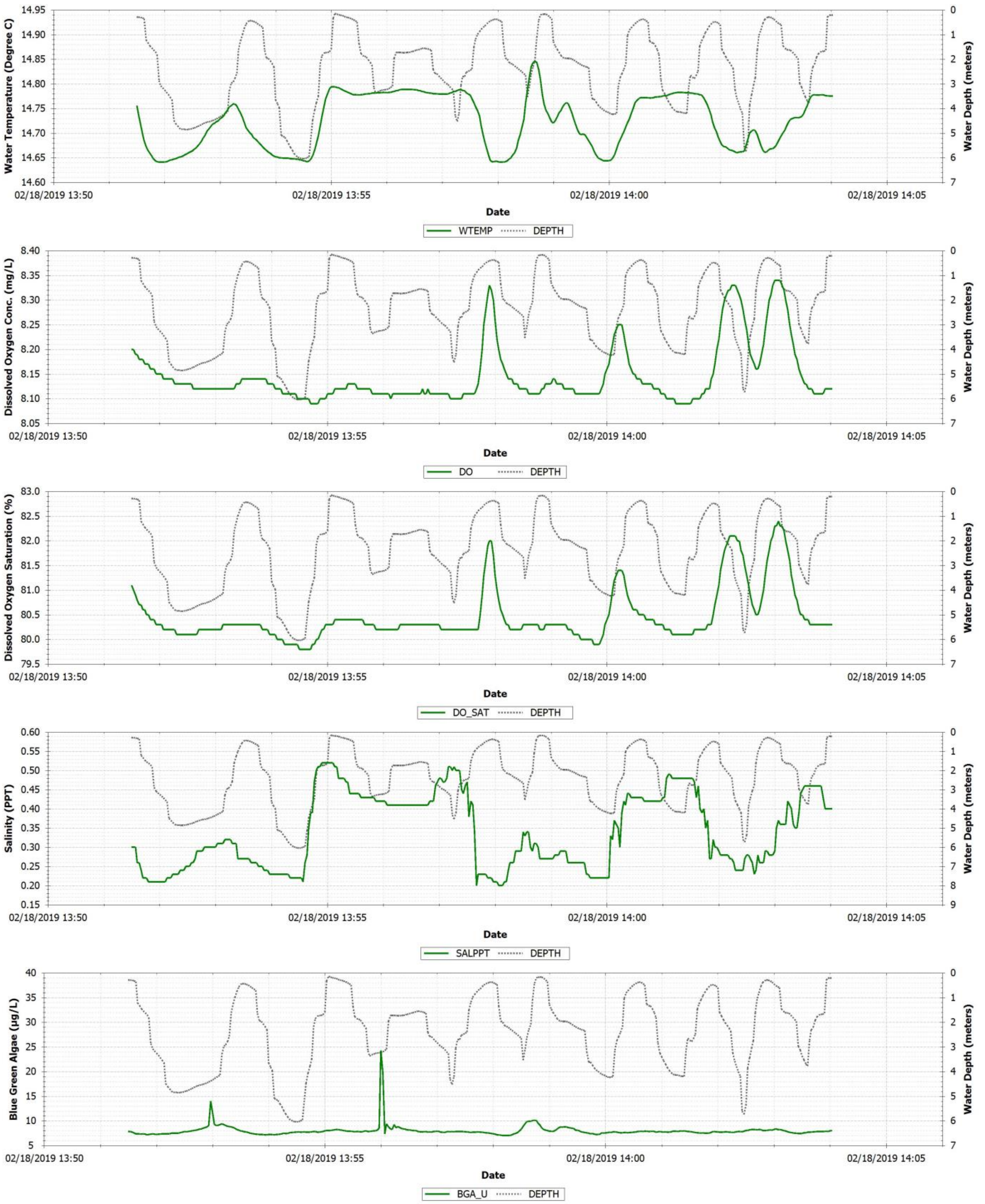


Figure 2-10 Back River February 18, 2019 outgoing tide traveling profile period observations

2.5 DRIFT MONITORING / DATA COLLECTION

Drifting was conducted by the field team via project boats using multiple instruments deployed from a single boat. Up to four (4) data sondes were deployed from a boat with each deployed at four (4) different depth intervals. The four monitoring depths were relative to each other due to the variable depths encountered during data collection, and were designated as surface, shallow, middle, and deep sondes. They were generally deployed at one-half (0.5) meter (surface), one (1) meter (shallow), three (3) meters (middle), and five (5) meters (deep) below the water surface. Data were collected simultaneously from all sondes in use for the duration of the drift event.

Drift data were collected with spatial and temporal variability inside and outside of the plume. The project boat either drifted or motored in various ways around, through, or within the plume. Each data sonde recorded DO, DO saturation, salinity, conductivity, temperature, BGA, and chlorophyll *a* along with the date, time, and depth of each measurement. The recording of measurements was performed in two ways (1) in real-time mode by using a hand-held device connected to one (1) of the data sondes by a communication cable (i.e. like profiling) and (2) in deployment mode by setting the sonde to log data internally (i.e. like a semi-permanent buoy). The hand-held device was usually connected to the shallow sonde allowing “real-time” viewing of information logged by the shallow sonde. The GPS coordinates of the hand-held device were recorded by the hand-held device. Typically, the surface, middle, and deep sondes were set to collect data in deployment mode without real-time viewing (blind recording). GPS coordinates were not recorded for the sondes in deployment mode. However, the water quality data from all sondes were collected simultaneously, therefore the GPS position recorded by the hand-held device was used to establish the GPS position for the deployment mode sondes. Data collection was started and stopped at the beginning and end of each drift thereby creating one continuous data file for each sonde used for that drift (files were typically hours in length).

Field notes and daily logs were prepared documenting the data collection times and locations, the field crew, the day’s weather conditions and any data collection issues (**APPENDIX J**). The downloaded data, including GPS locations, along with the field notes and daily logs, were transferred to the QA/QC team, following the QA/QC procedures in Appendix B of the Work Plan. Excel files contained raw data uploaded to the project OneDrive and provided in comma-delimited format. The raw data were reviewed and checked by the QA/QC team. ***Figure 2-11*** and ***Figure 2-12*** provide an example of the data collected for a drifting data collection run for the lower Front River, and ***Figure 2-13*** and ***Figure 2-14*** provide an example of the data collected for a drifting data collection run for the Back River.

Data sonde calibration intervals were determined by the manufacturer but could differ from typical recommendations depending on lengths of deployment, site conditions, and any anomalies interpreted from visual aids used to routinely review data (**APPENDIX J**). In cases where the visual review of data indicated that there was data drift or other potential data issues, the entire sonde would be replaced with a backup data sonde, and the particular sensor would be recalibrated according to the manufacturer’s specifications.

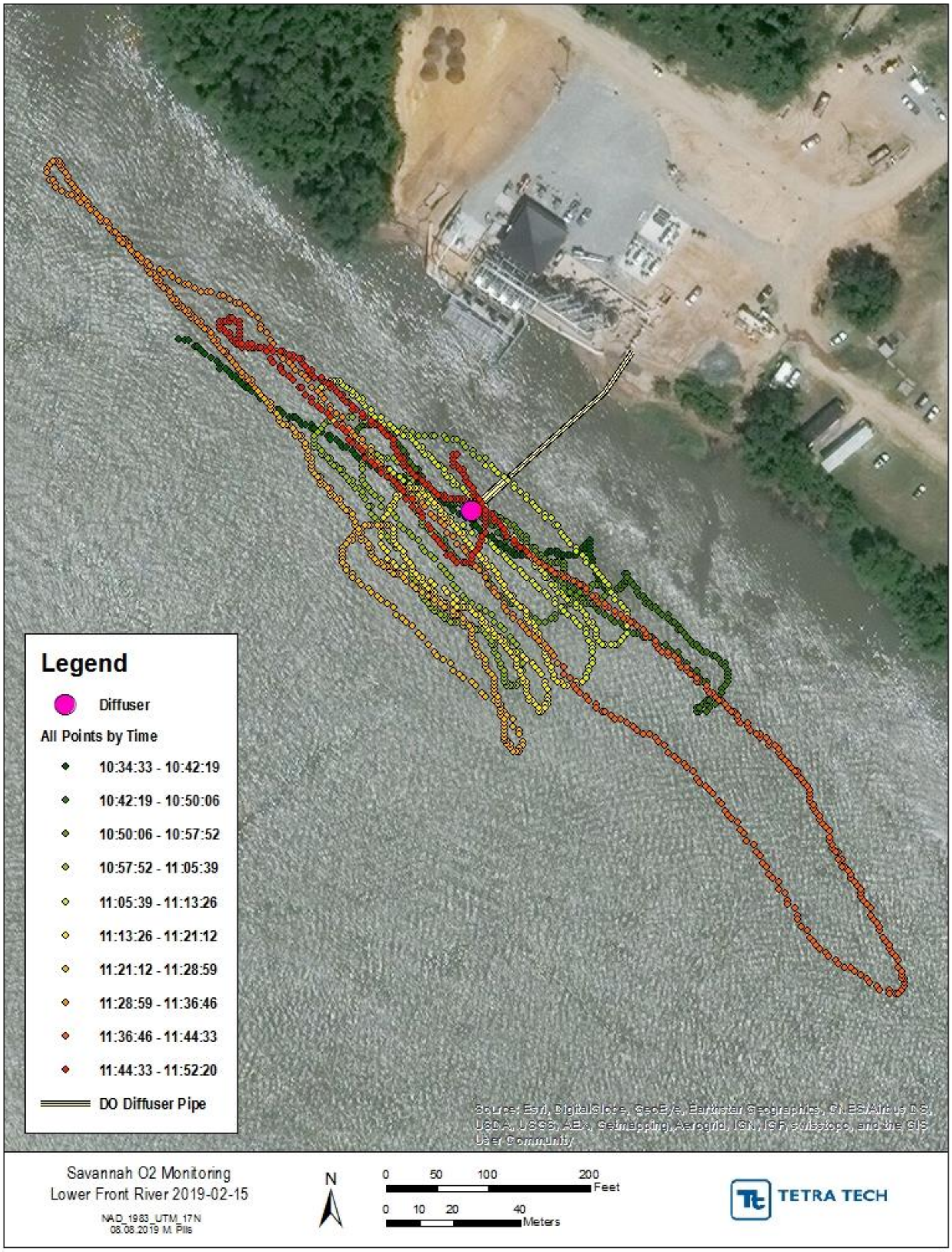


Figure 2-11 Front River February 15, 2019 ebb tide drift location map

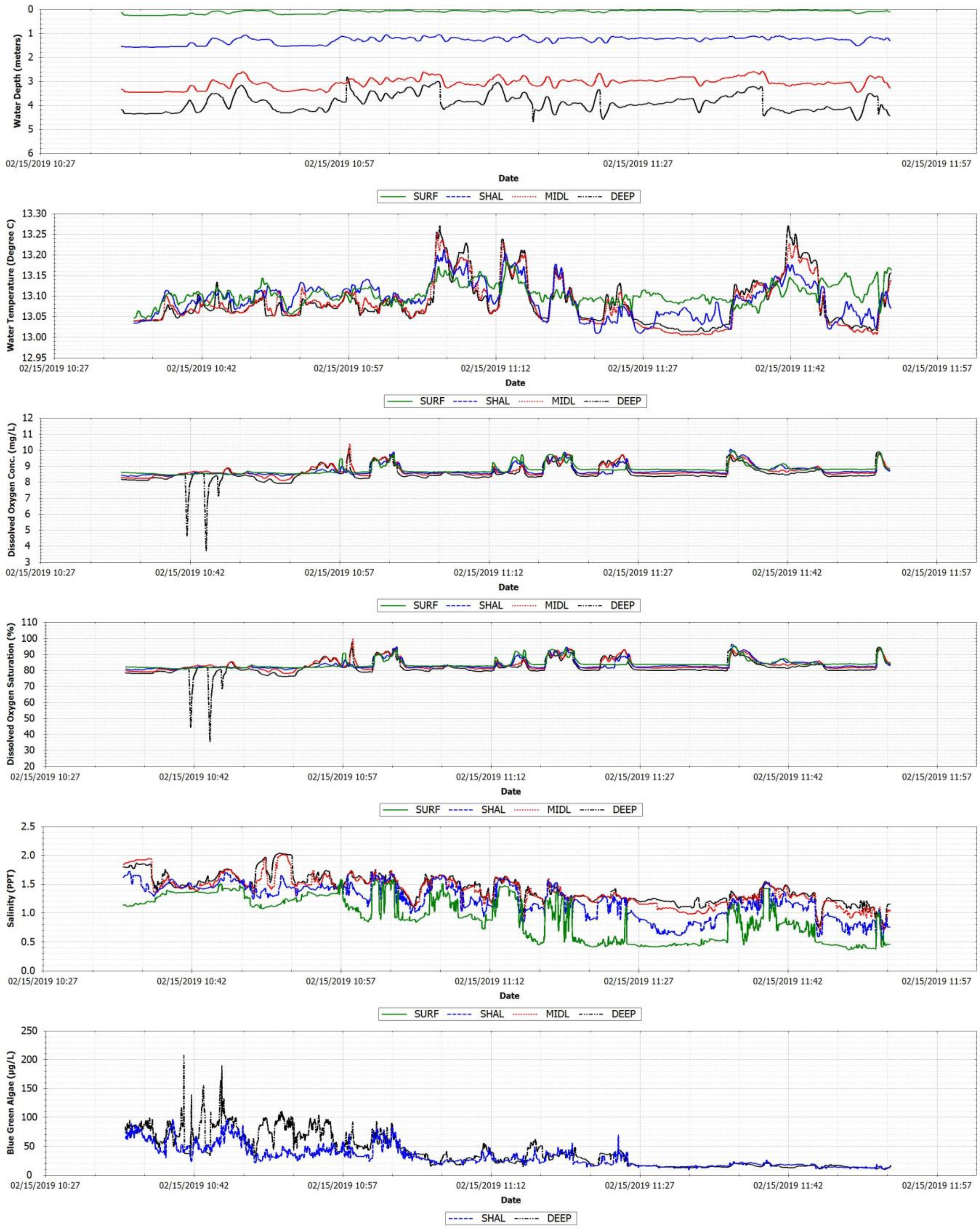


Figure 2-12 Front River February 15, 2019 ebb tide drift observations

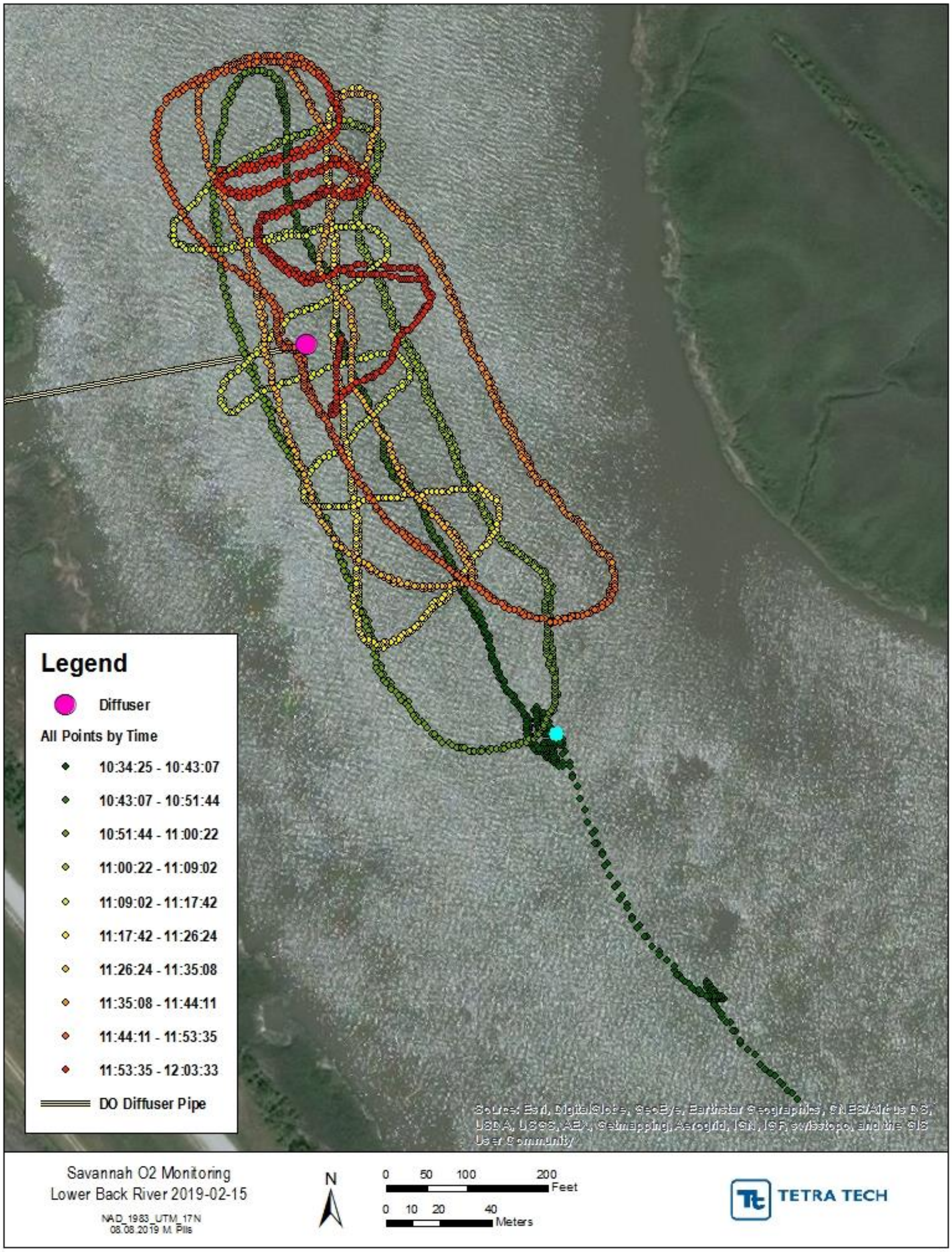


Figure 2-13 Back River February 15, 2019 ebb tide drift location map

Figure 2-14 Back River February 15, 2019 ebb tide drift observations

2.6 DYE RELEASE AND MONITORING

During the WCTE study, Rhodamine dye releases were conducted in the Back River during the ebb tide on February 14, 2019 and in the lower Front River during flood tide on February 21, 2019. Rhodamine WT is a fluorescent xanthene dye and is routinely used as a hydrologic tracer in surface water systems. The dye was injected into the Plant discharge pipes using a stainless-steel drum pump powered by a 120-volt electric motor head and fitted with an impeller capable of pumping containers empty of pumpable contents. The dye injection was regulated at the drum pump with a 1-inch ball valve and electronic flow meter to deliver the dye into the discharge pipe at approximately two (2) gallons per minute.

The February 14, 2019 Back River dye release commenced at 10:10 in the morning during which approximately fifteen (15) gallons of a 20% solution of Rhodamine WT dye were injected into the Back River discharge pipe. The remaining contents of the thirty (30) gallon drum were diluted with water to create a 10% solution of Rhodamine WT dye. The 10% solution was injected between 11:22 and 11:37 in the morning. Dye within the water column was captured by buoy mounted sondes outfitted with BGA sensors and by boat crews who collected data using drift and traveling profile monitoring methodologies with sondes also outfitted with BGA sensors. The boat crews traveled approximately one-half (0.5) miles upstream from the Back River diffuser site during the dye release. ***Figure 2-15*** shows the measured plume movement for this dye study.

The February 21, 2019 lower Front River dye release commenced at 10:20 in the morning and approximately thirty (30) gallons of a 10% solution of Rhodamine WT dye were injected into the lower Front River discharge pipe. A second injection of approximately thirty (30) gallons of a 10% solution of Rhodamine WT dye occurred between 11:20 and 11:38 in the morning. Dye within the water column was captured by buoys sondes outfitted with BGA sensors and by boat crews who collected data using drift and traveling profile monitoring methodologies with sondes also outfitted with BGA sensors. The boat crews traveled approximately two and one-half (2.5) miles downstream from the lower Front River diffuser site during the dye release. ***Figure 2-16*** shows the measured plume movement for this dye study.

The dye releases were used to visually confirm the direction, orientation, and mixing dynamics of the DO plume. The direction and orientation of the plume informed the field team about where in the river to sample so that data collection efforts on days without dye releases were focused around and within the plume.

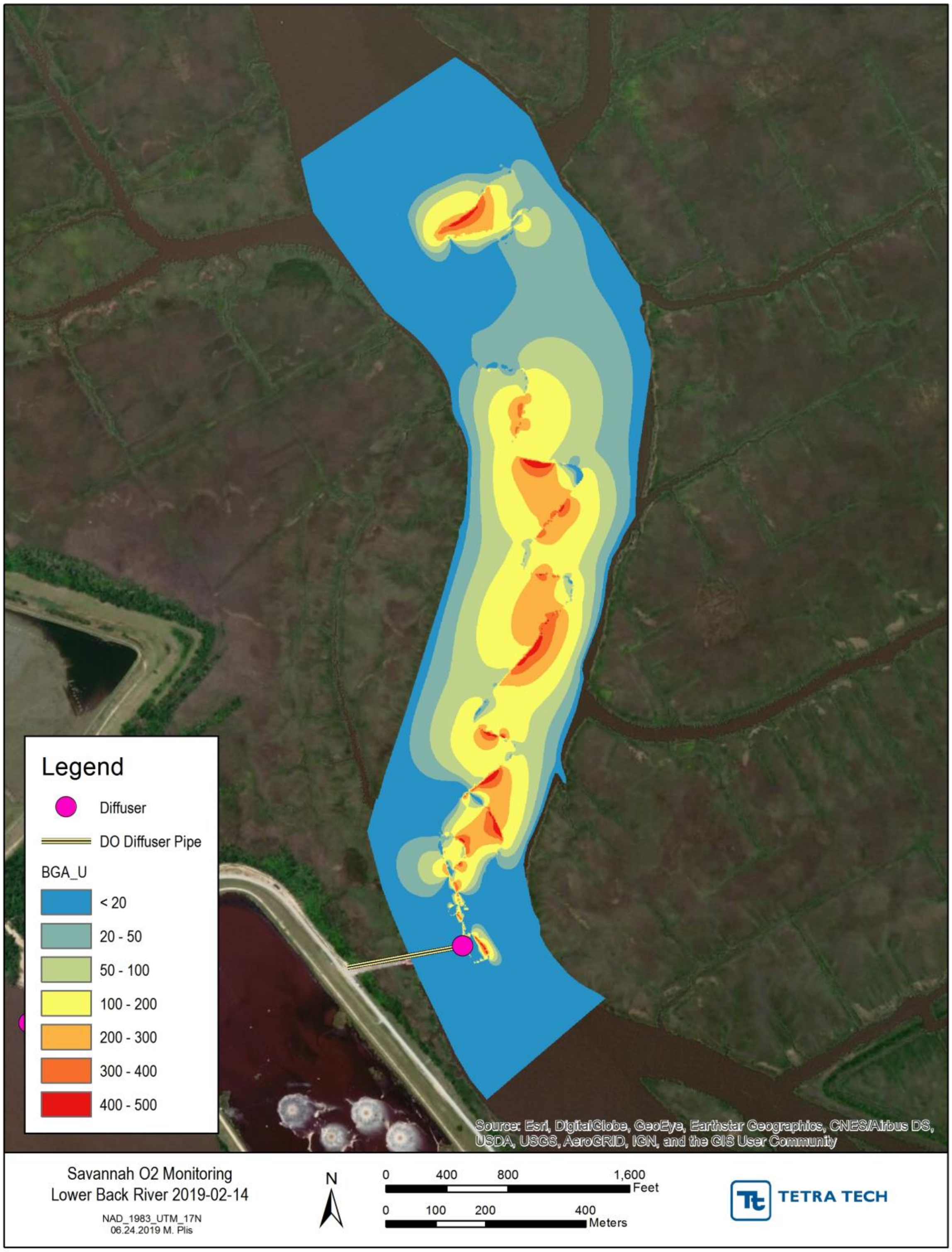


Figure 2-15 Back River February 14, 2019 ebb tide dye drift raster interpolation

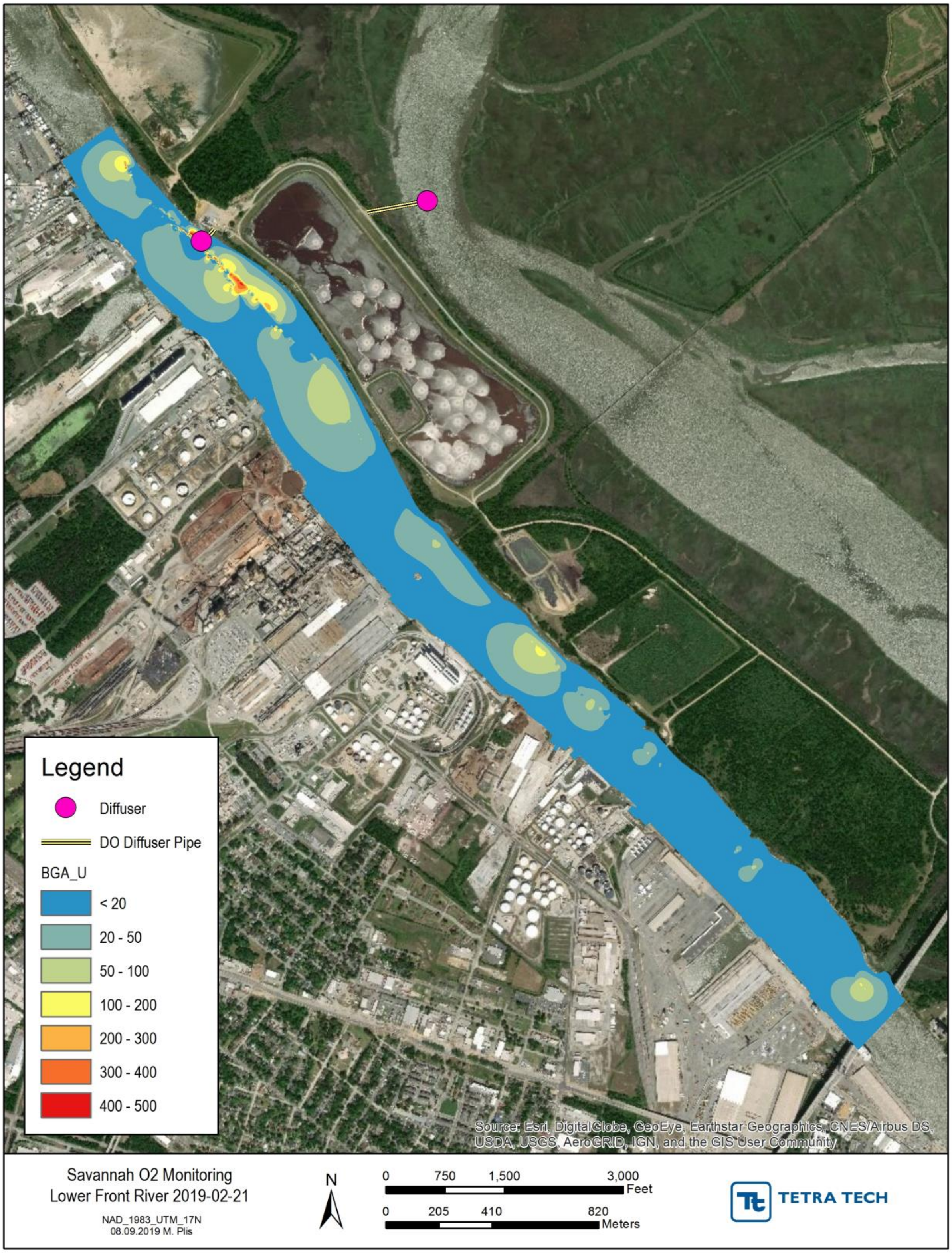


Figure 2-16 Front River February 21, 2019 flood tide dye drift raster interpolation

3.0 DATA COLLECTION QA/QC OVERVIEW

The QA/QC team conducted a review of all of the data collected during the WCTE study data collection effort. During this effort, they followed the QA/QC procedures outlined in Appendix B of the Work Plan (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2019b).

All the data collected for the WCTE study were downloaded by the QA/QC team through various web interfaces. The QA/QC team personnel conducting the downloads were responsible for documenting the date and time the data were received and confirming that all necessary pieces were transferred. This information was documented in a chain of custody form for data directly transferred to the QA/QC team from the field team and an access log for USGS data. These forms served as the first check point during the process of data review. All the downloaded data were stored on Tetra Tech's internal server as raw data files in the file and format received via the download). The access logs and chain of custody form were reviewed to ensure all data collected for the WCTE study data collection were obtained by the QA/QC team.

A project database was created for the WCTE study data. All the raw data files were modified to make them compatible for importing into the project database storage and post-processing tool, Water Resources Database (WRDB). WRDB consists of a set of linked relational database tables which contain the data for a given project. The user interface provides a set of Microsoft Windows-based forms, reports, graphs, and auxiliary programs to ease data entry and viewing.

The QA/QC team maintained data processing logs, like the access logs and chain of custody form, to document and track the modification and processing of the data files. The raw data files were duplicated and converted to Excel workbooks. This was done to ensure that the raw data files were not altered. The duplicated files were used for all further data processing needs. General data modification and processing before importing the data into WRDB included:

1) Removing blank rows and columns
2) Assigning parameter codes (PCode) to the various constituents
    - PCode is a required field in WRDB
    - PCodes are short identifiers provided for the parameter name
3) Identifying remark codes (RCodes) if they existed in the raw data files
    - RCodes is an optional field in WRDB
    - RCodes were used to abbreviate the comment provided by the field personnel
4) Assigning station identification (ID)
    - A unique identifier was used to identify the data from the different data sources and the location

During the process of importing data to WRDB, the total number of records in the modified file and the actual number of records imported into the WRDB database were checked. This QA/QC record count check was included in the data processing logs and compared to the access logs and chain of custody forms to ensure that all data collected for the WCTE study was processed and imported into the WRDB database.

After the data were imported into the WRDB database the data were plotted to visually check for consistency. When potentially inconsistent data were identified, field personnel were interviewed and field notes were reviewed to determine if the data were valid or if they should be removed (i.e., sonde was not in the water when the data were collected). After review of the potentially inconsistent data, the data processing workbooks were updated to separate the verified inconsistent data from the accepted data. Accepted data were re-imported into WRDB and were maintained in tables separate from the raw data previously imported. Verified inconsistent data were not deleted and are maintained in the following three locations:

1) Raw data files,
2) Raw data imported into WRDB, and
3) Verified inconsistent data in the data processing workbooks.

The approach for handling inconsistent data allowed for current and future analysis on both raw/original data and reviewed/cleaned data. The discussion in the following sections provides examples of data QA/QC for each type of data collected. **APPENDIX I** provides more detailed documentation of data QA/QC and focuses on the access of data, QA/QC checks performed on the received data, data manipulations, and the quality and volume of data obtained for each data source.

3.1 PLATFORM DATA

During the QA/QC check, unique observations and some inconsistencies in the data of the system were identified in the measured platform data and were separated from the consistent data in the processed data files and project database.

Based on the header information for specific conductivity (SPCOND) on the Xylem Eagle I/O website, the units were reported as mS/cm. It was confirmed by Xylem that the units for SPCOND were mS/cm. The SPCOND concentrations for all continuously deployed sondes varied between 0.25 mS/cm and 11,083 mS/cm, with an average concentration of 2,143 mS/cm. To verify the range of SPCOND, two USGS monitoring stations located upstream (USGS 021989793) and downstream (USGS 0219897945) of the platform were evaluated. USGS 021989793 is located 1.42 miles upstream of the platform and USGS 0219897945 is located 2.45 miles downstream of the platform. During the period from February 14, 2019 through February 27, 2019, the USGS 0219897945 SPCOND varied between 255 µS/cm and 15,900 µS/cm with an average concentration of 4,739 µS/cm. At USGS 021989793, SPCOND varied between 89 µS/cm and 6,490 µS/cm, with an average concentration of 1,272 µS/cm. Based on the comparison of the platform data to the USGS data, it was determined that the SPCOND concentrations from the data sondes at the platform were in µS/cm, not mS/cm as stated by Xylem, and appropriate corrections were made to data to validate their usage.

All sondes reported all parameters with a value of zero (0) for the measurement taken at 2/21/2019 15:00. These data were not realistic and were deemed to be inconsistent so were separated from the consistent data in the processed data files and project database. It was theorized that a very short-lived issue occurred with central data logger which resulted in this one specific time recording observations of zero (0).

Of the 493,593 platform raw data points collected, greater than 90% were retained after the QA/QC check . **APPENDIX A** presents plots of the processed and accepted data collection data at each corner and side of the platform.

3.2 SEMI-PERMANENT BUOY DATA

The semi-permanent buoy data were reviewed in timeseries plots to identify any sample dates and times which contained observed values which were inconsistent with the observed values sampled before and after the inconsistent values. Comparison of the inconsistent dates and times to field notes revealed that the inconsistent data were strongly correlated to times when the field crew was at a buoy retrieving the data. As an example, ***Figure 3-1*** and ***Figure 3-2*** present the depth and DO timeseries respectively at the lower Front River south buoy. The data points in red were identified as being inconsistent. All of the inconsistent data points were associated with beginning and ending times of the intermittent data retrievals.

Data QA/QC found that the observed depth increase at LFR_N between 2/20/2019 4:46 and 2/20/2019 13:03 corresponds to a real occurrence and was not a sonde malfunction issue. Field notes indicated that when the field team arrived on site the north buoy was not visible, but was submerged just under the water surface. While the team was onsite, the tide receded and the buoy became visible. The field team hypothesized that debris became entangled with the mooring line and pulled the buoy under the water surface. The debris became self-untangled during the tide change and the sonde remained near the surface for the rest of the WCTE data collection period (***Figure 3-3***).

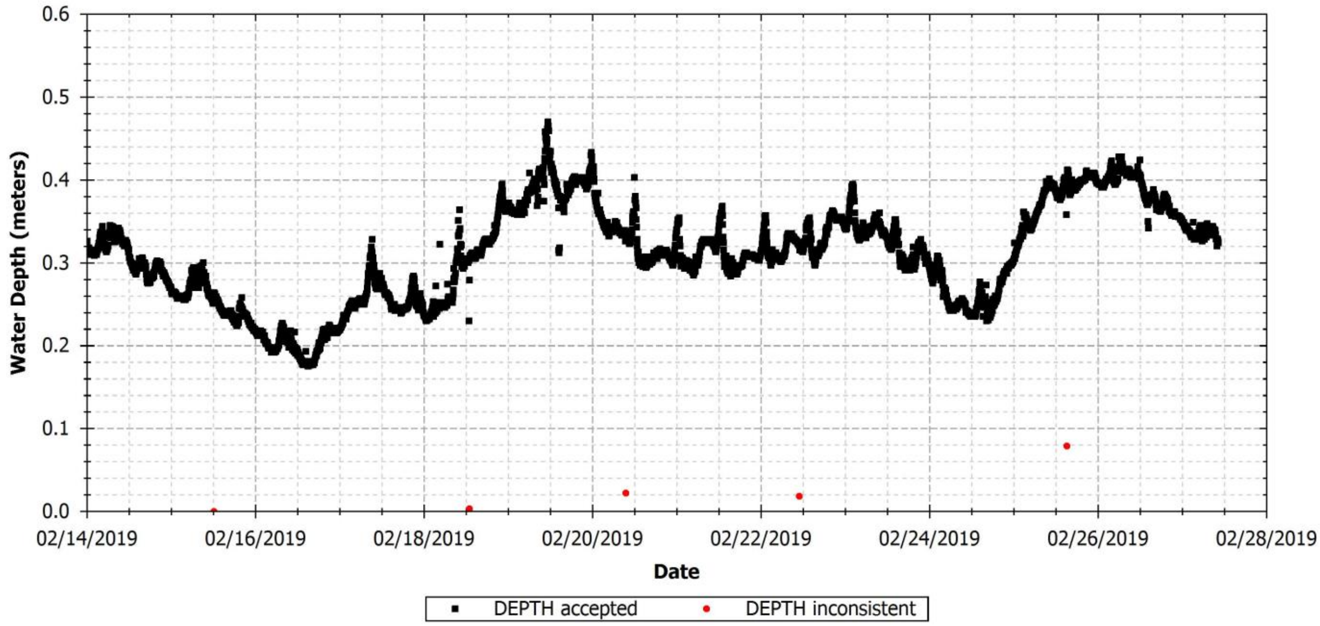


Figure 3-1 Lower Front River south QA/QC data depth

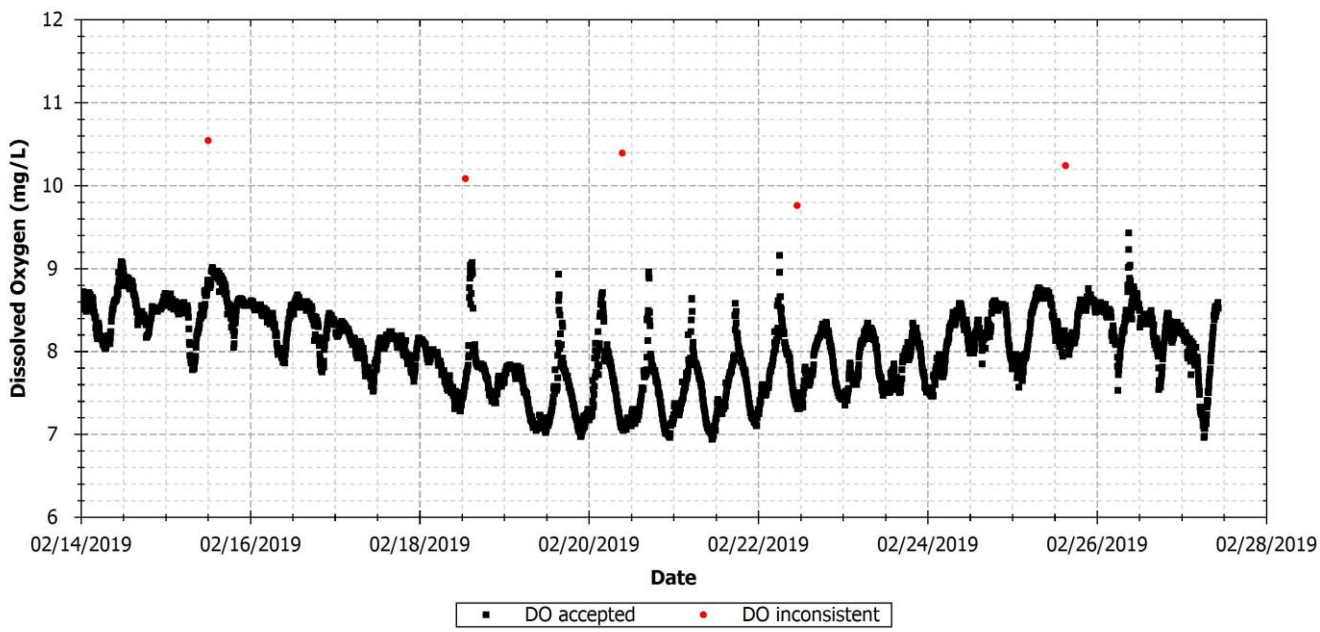
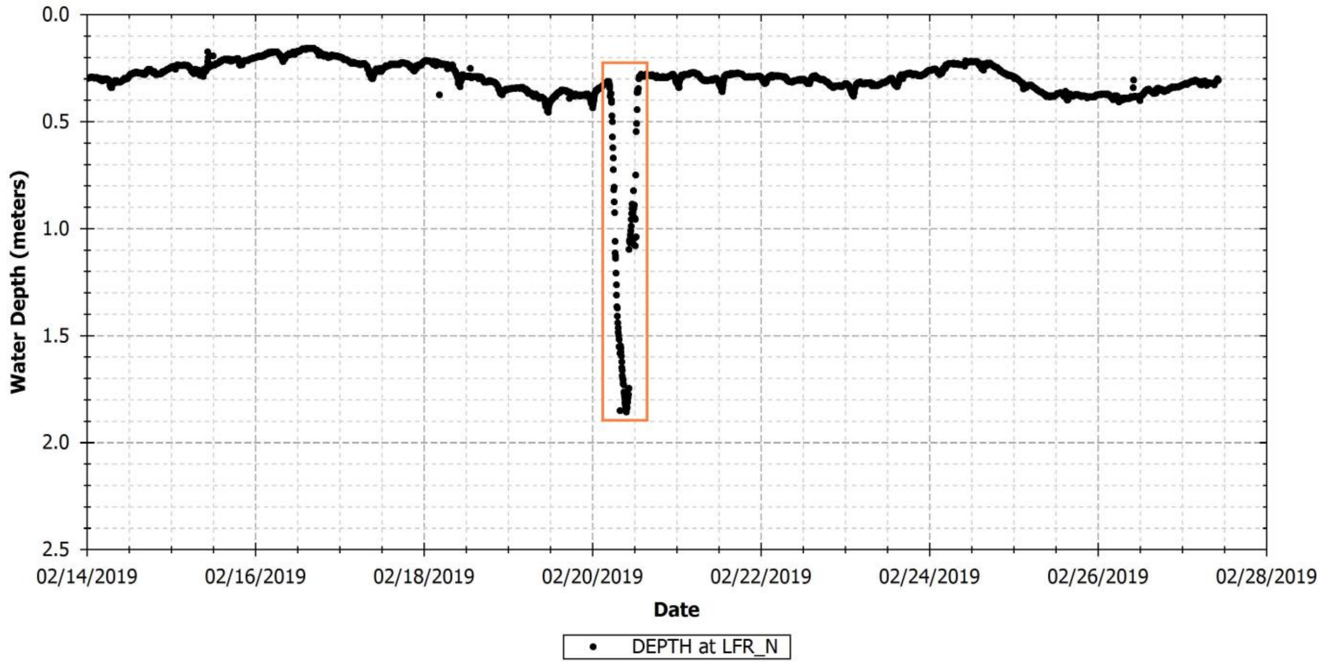


Figure 3-2 Lower Front River south QA/QC data DO



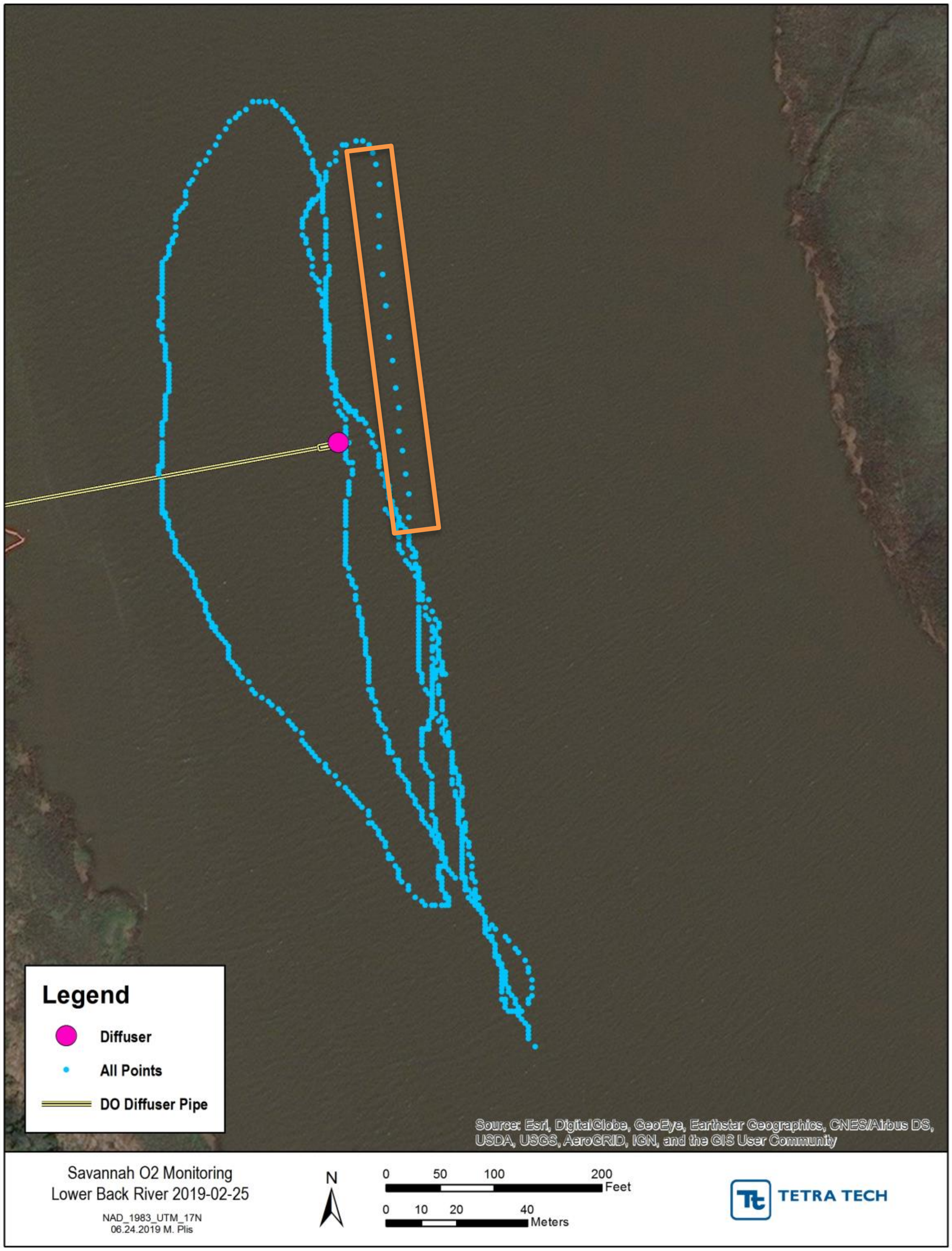
Note: orange box identifies the period of time where buoy was pulled under water by debris

Figure 3-3 Lower Front River north observed depth

Of the 264,485 buoy raw data points collected, greater that 90% were retained after the QA/QC check. **APPENDIX B** presents plots of the processed and accepted data collection data at each semi-permanent buoy.

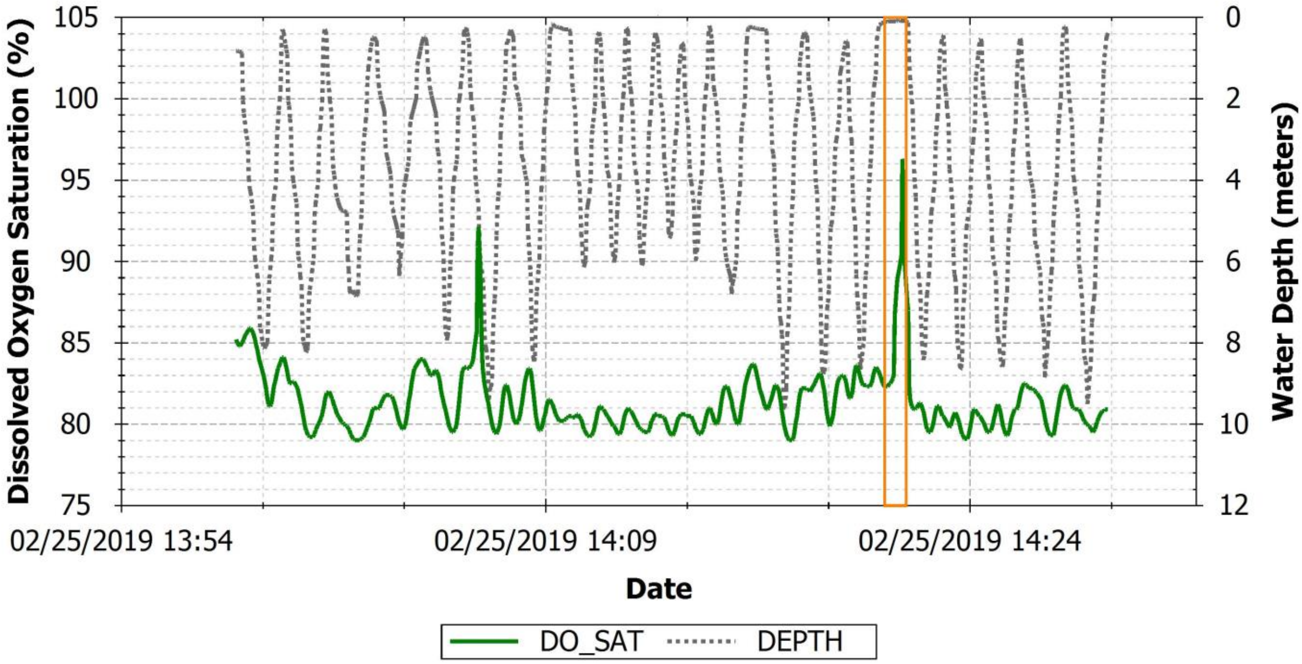
3.3 PROFILE DATA

The profile data were reviewed in timeseries plots to identify any sample dates and times which contained observed values which were inconsistent with the observed values sampled before and after the inconsistent values. The identified inconsistent dates and times were frequently correlated to times when the sondes were out of the water or at the water surface. As an example, ***Figure 3-4*** and ***Figure 3-5*** present the location map and depth and DO saturation timeseries respectively of the LBR_022519_006 travelling profile. The orange box identifies a period of time where the sondes were likely out of the water because during this period of time the boat was travelling nearly twenty (20) miles per hour from one data collection location to another data collection location. Another example of periods of inconsistent data were at the beginning or end of a stationary profile where depths were less than one-tenth (0.1) of a foot where data recording was started or stopped before or exactly coincident with the sonde being inserted or removed from the water (***Figure 3-6***).



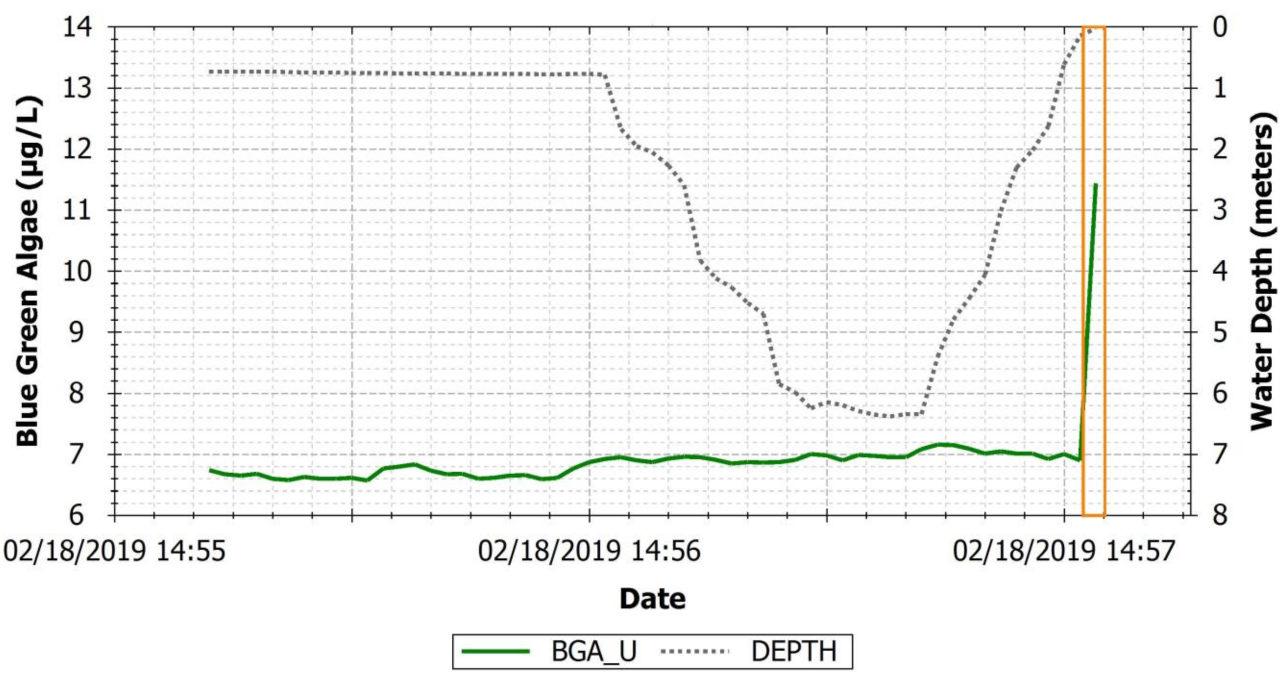
Note: orange box identifies the period of time where boat was traveling over 20 miles per hour and the sonde was out of the water

Figure 3-4 LBR_022519_006 travelling profile location map QA/QC



Note: orange box identifies the period of time where boat was traveling over 20 miles per hour and the sonde was out of the water

Figure 3-5 LBR_022519_006 travelling profile QA/QC depth and DO



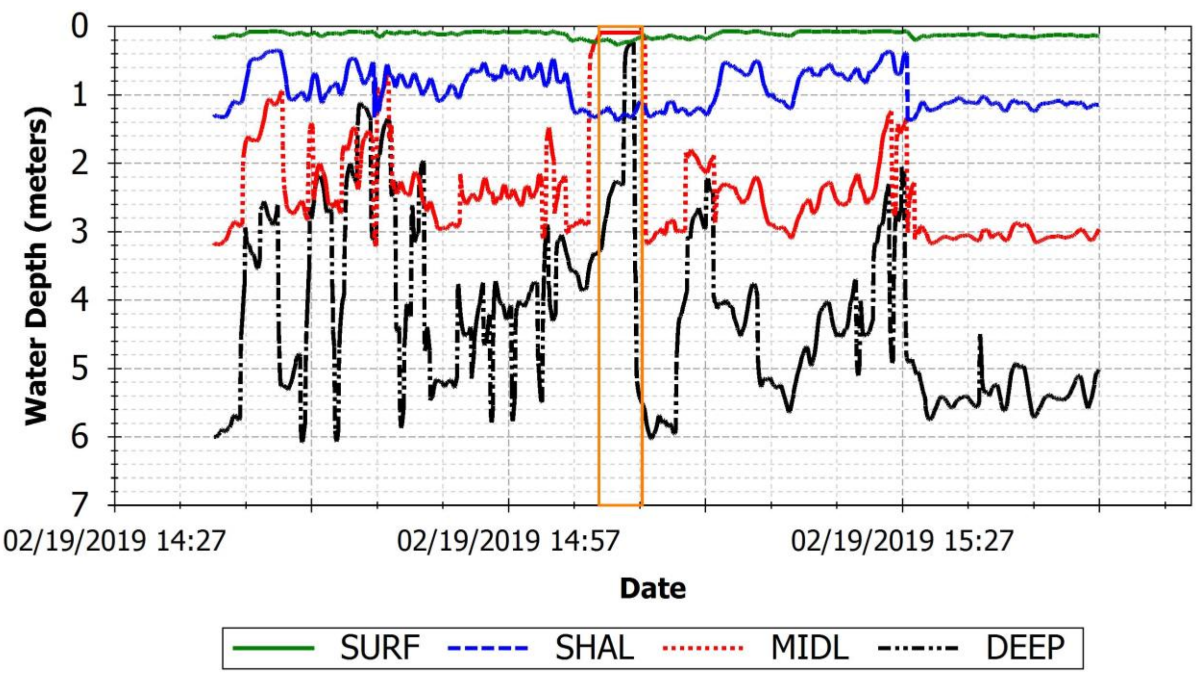
Note: orange box identifies the period of time where sonde was likely pulled out of water before stopping data recording

Figure 3-6 LBR_021819_009 stationary profile QA/QC depth and BGA

Of the 815,061 profile raw data points collected, greater that 90% were retained after the QA/QC check. **APPENDIX C** presents plots of the processed and accepted data collection for each profile.

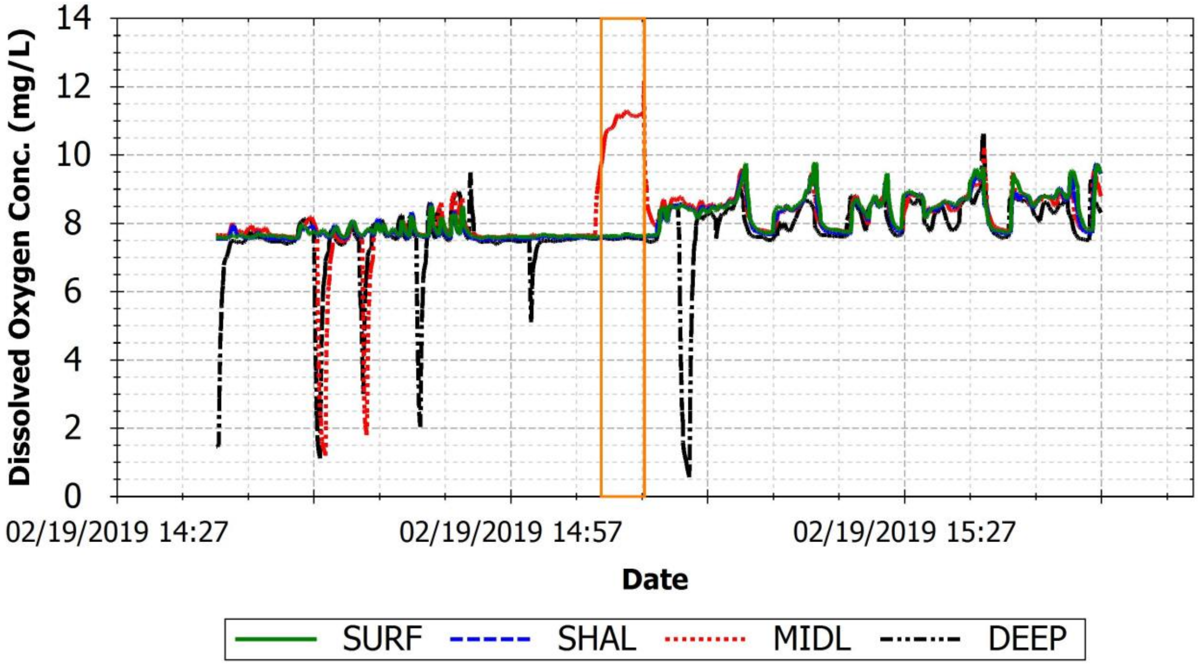
3.4 DRIFT DATA

The drift data were reviewed in timeseries plots to identify any sample dates and times which contained observed values which were inconsistent with the observed values sampled before and after the inconsistent values. The identified inconsistent dates and times were correlated to times when the sondes were likely out of the water or were impacted by strong river currents. As an example, ***Figure 3-7*** and ***Figure 3-8*** present the depth and DO timeseries respectively for the lower Front River, February 2, 2019, ebb tide drift. The orange box identifies a period of time where the middle sonde and deep sonde changed depths in a very short period of time. This could be due to the sondes being physically raised or impacted from river currents, and may not be a good comparison to the response of the shallow and surface sondes.



Note: orange box identifies the period of time where sonde was likely pulled out of water and inconsistent data were recorded

Figure 3-7 Lower Front River, February 19, 2019, ebb tide drift QA/QC depth



Note: orange box identifies the period of time where sonde was likely pulled out of water and inconsistent data was recorded

Figure 3-8 Lower Front River, February 19, 2019, ebb tide drift QA/QC DO

Of the 1,882,689 drift raw data points collected, greater that 90% were retained after the QA/QC check. **APPENDIX D** presents plots of the processed and accepted data collection data for each drift.

3.5 USGS DATA

All of the USGS data was provisional and is assumed to carry the normal amount of uncertainty. **APPENDIX E** presents plots of the WCTE study data collection data at each USGS location.

3.6 USACE PLANT DATA

All of the Plant provided was in line with expectations and was adequate for computing WCTE. **APPENDIX F** presents timeseries plots of the Plant data during the WCTE study and a table presenting daily flow rate and oxygen loads to the lower Front River and Back River diffusers.

3.7 DYE DATA

Dye data were included as a reported constituent (BGA) in the data that were downloaded, processed, and QA/QC'd as previously discussed for the platform data (**Section 3.1**), semi-permanent buoy data (**Section 3.2**), profile data (**Section 3.3**), and drift data (**Section 3.4**). Dye was measured and reported through the surrogate parameter BGA. Timeseries plots of dye response (reported as BGA µg/L) are provided throughout **APPENDIX A**, **APPENDIX B**, **APPENDIX C**, and **APPENDIX D** in the plots developed for those data types. **APPENDIX G** provides maps showing the boat data collection extent with data point coloring rendered based on shallow sample dye response (reported as BGA µg/L) and an GIS raster (one (1) square meter grid) that was created with the ArcGIS topo-to raster-tool. The topo to raster tool interpolated the profile and drift data measured dye response (reported as BGA µg/L) in areas where data collection did not occur and provided a visualization for the size and extent of the plume based on the data collected at the time and immediately following dye release.

4.0 DATA ANALYSIS

In an effort to evaluate the Downriver plant and its impact on both the lower Front River and Back River, the QA/QC data collected during the WCTE data collection period were analyzed to determine 1) if data collected showed the presence of the injected DO, 2) how long the DO was staying within the water column, and 3) if DO plume was mixing in the water column. The following are several examples of the data analyses that helped to answer these questions.

The first example analysis shows that the data sondes are able to measure the presence of the injected oxygen. The lower Front River north buoy sonde was located upstream of the diffuser and routinely intercepted the plume at the beginning of the flood tide when the Plant was injecting super-saturated water into the river (***Figure 4-1***, highlighted with yellow boxes). DO saturation concentrations were above background concentrations during the flood river tidal period, and often close to and occasionally greater than 100% saturation. When the plant was off during the WCTE data collection, the buoy sonde did not record high DO saturation concentrations.

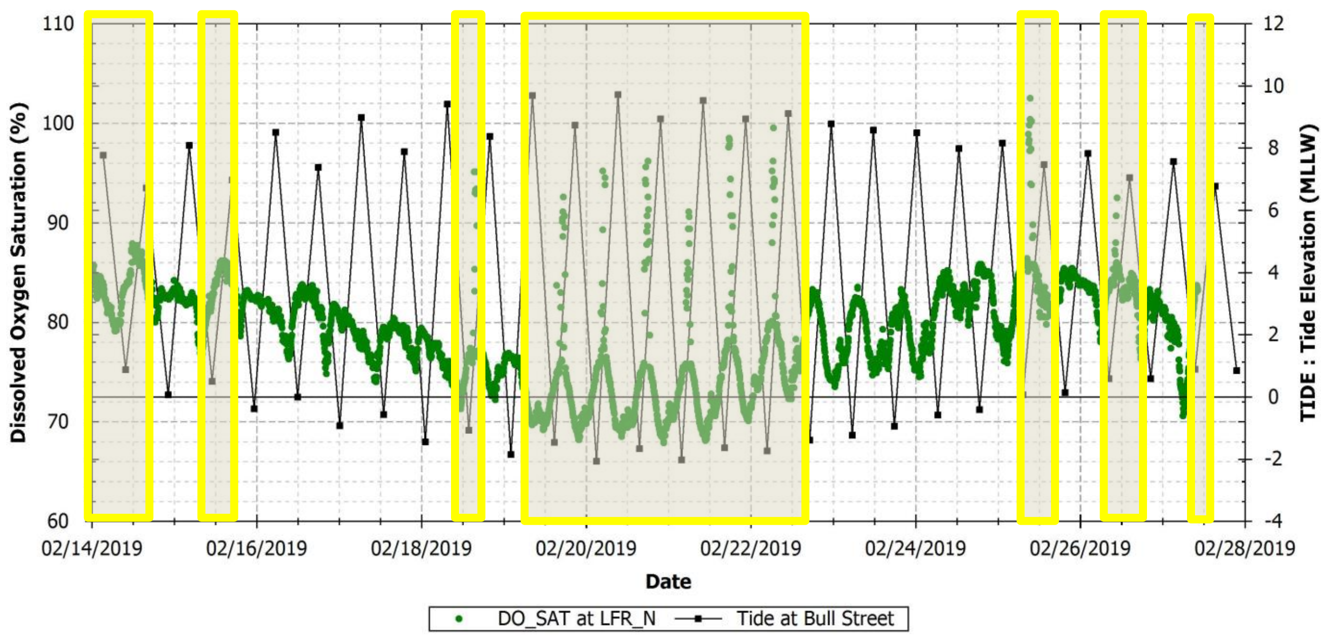
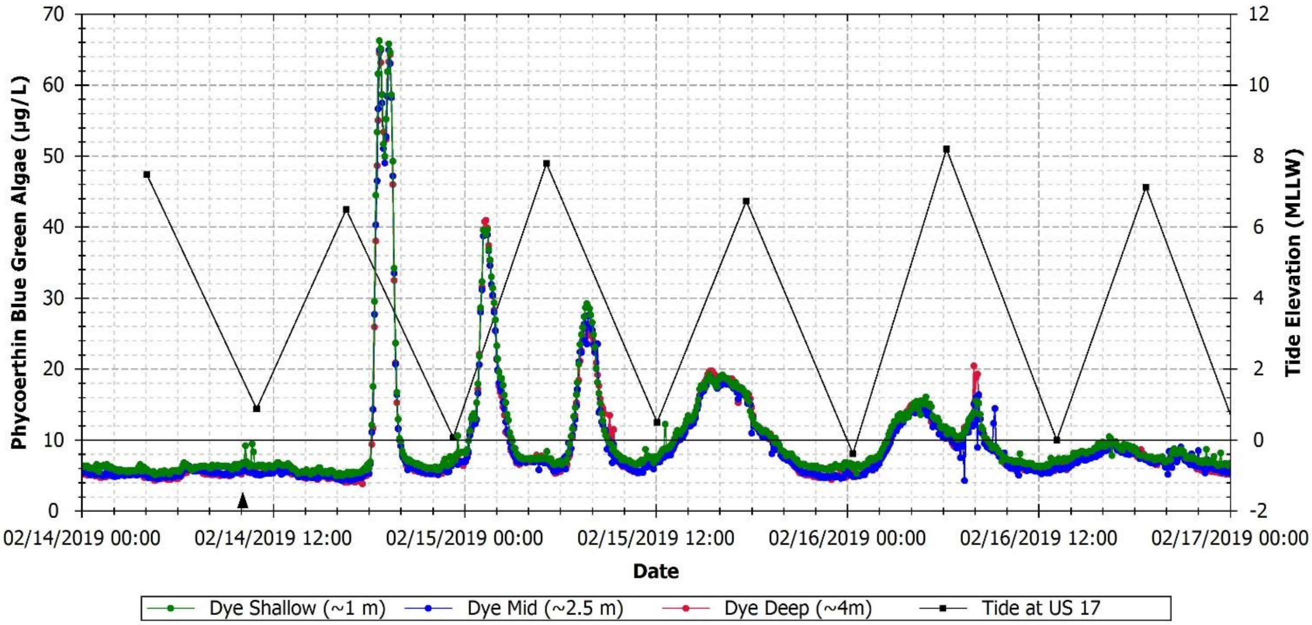


Figure 4-1 Lower Front River north buoy plume interception

The Back River dye study conducted on February 14, 2019 showed that the dye injected into the system, which was not initially captured by the platform sondes, remained present in the water column for several days following the initial dye release (***Figure 4-2***). The released dye was measured by the platform sondes on subsequent ebb and flood tidal swings at increasingly lower concentrations as the plume continued to disperse and mix with ambient water. The figure also shows that all platform data sondes, which were located above the diffuser at three different depths, measured similar values of BGA indicating that the dye, and therefore the oxygen, was well-mixed vertically.



Note black triangle identifies time of dye release

Figure 4-2 Back River platform three-day dye response

The traveling profile data collection associated with the February 14, 2019 dye study showed elevated DO saturation values coincident with elevated dye values (***Figure 4-3***). This confirmed the theory that the BGA values could be used as a good indicator of the DO plume movement both vertically and laterally in water column. The BGA data and dye visual indicators were used to adjust the sampling on days there were no dye releases to ensure that data collection was both in and out of the DO plume.

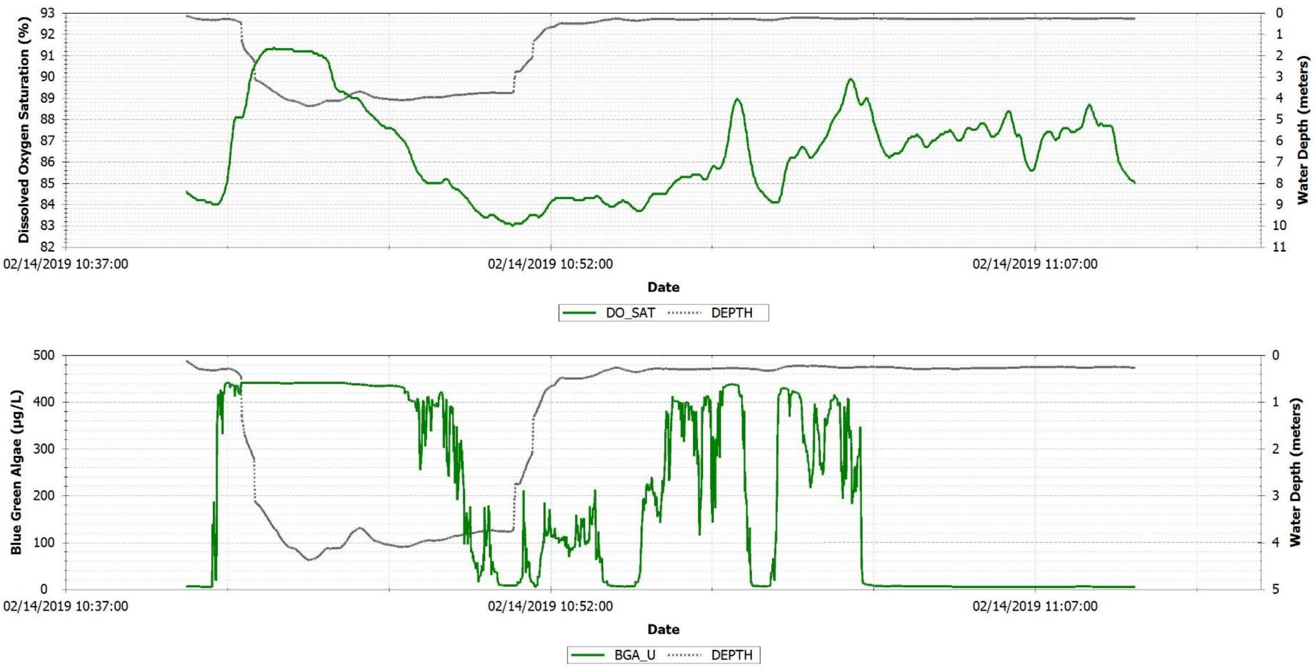


Figure 4-3 Back River February 14, 2019 dye study traveling profile

Stationary profiles were collected near the semi-permanent buoys and on both sides of the platform on profiling days. These profiles were used to verify the stability and calibration of DO saturation, DO concentration, temperature, and salinity values collected by the deployed semi-permanent buoy and platform sondes. ***Table 4-1*** presents the values collected by the profile sonde at a depth similar to the depth of the buoy measurements in comparison to values obtained by semi-permanent buoy sondes at the time closest to the time the profile was measured. ***Table 4-2*** presents the values collected by the profile sonde at a depth similar to the depth of the platform measurements in comparison to values obtained by platform sondes at the time closest to the time the profile was measured. The values had a good agreement (typically less than ±5%) and verified that sondes could be deployed for long periods of time with little to no calibration drift.

Table 4-1 Profile sonde and semi-permanent buoy sonde comparison

Location	Tide	Date	Time	Depth (m)		DO Saturation (%)		DO (mg/L)		Salinity (PPT)		Temperature (°C)	
				Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy
LFR_N	Outgoing	2/18/2019	13:10	0.20	0.29	76.8	75.3	7.85	7.69	0.39	0.45	14.23	14.27
LFR_N	Flood	2/20/2019	10:38	0.66	1.05	69.4	69.6	7.09	7.11	1.42	1.40	13.99	14.03
LFR_N	Flood	2/21/2019	9:59	0.39	0.30	70.5	68.8	7.28	7.07	1.08	1.08	13.60	13.83
LFR_N	Flood	2/22/2019	11:09	0.42	0.30	73.3	72.3	7.42	7.33	1.31	1.20	14.42	14.46
LFR_N	Outgoing	2/25/2019	14:45	0.49	0.36	82.5	81.4	8.30	8.17	0.90	1.16	14.89	14.91
LFR_N	Ebb	2/27/2019	9:57	0.29	0.31	84.6	83.3	8.73	8.57	0.87	0.81	13.68	13.89
LFR_S	Outgoing	2/18/2019	13:00	0.43	0.23	76.3	74.3	7.80	7.59	0.53	0.60	14.22	14.25
LFR_S	Flood	2/20/2019	9:33	0.48	0.33	69.7	69.1	7.14	7.08	1.29	1.14	13.92	13.96
LFR_S	Flood	2/22/2019	11:03	0.55	0.32	73.1	72.5	7.42	7.35	1.27	0.98	14.33	14.44
LFR_S	Outgoing	2/25/2019	15:06	0.40	0.36	83.5	81.3	8.36	8.16	1.37	1.09	14.94	14.90
LFR_S	Ebb	2/27/2019	9:53	0.48	0.32	84.1	83.1	8.69	8.52	0.85	0.87	13.68	13.97

Location	Tide	Date	Time	Depth (m)		DO Saturation (%)		DO (mg/L)		Salinity (PPT)		Temperature (°C)	
				Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy
LBR_NE	Incoming	2/14/2019	10:37	0.64	0.54	88.5	89.3	9.26	9.31	0.07	0.07	13.27	13.46
LBR_NE	Outgoing	2/14/2019	9:50	0.67	0.71	83.3	82.6	8.72	8.62	0.05	0.05	13.29	13.44
LBR_NE	Incoming	2/18/2019	14:40	0.53	0.70	80.5	79.7	8.15	8.04	0.32	0.32	14.74	14.94
LBR_NE	Flood	2/20/2019	10:17	0.78	0.90	73.4	72.8	7.45	7.36	3.53	3.40	13.71	13.90
LBR_NE	Flood	2/22/2019	11:44	0.34	0.89	73.3	72.8	7.29	7.24	2.68	2.66	14.93	14.94
LBR_NE	Flood	2/25/2019	14:52	0.44	0.96	81.1	81.2	7.81	7.83	1.39	1.44	16.77	16.67
LBR_NE	Ebb	2/27/2019	10:45	0.36	0.81	81.4	81.4	8.22	8.20	0.20	0.21	14.93	15.04
LBR_NW	Outgoing	2/14/2019	9:44	0.64	0.65	83.9	81.4	8.78	8.48	0.05	0.05	13.31	13.50
LBR_NW	Outgoing	2/18/2019	14:30	0.62	0.57	80.6	78.3	8.17	7.90	0.16	0.17	14.68	14.90
LBR_NW	Flood	2/20/2019	10:10	0.56	0.75	73.3	71.0	7.44	7.19	3.43	3.38	13.69	13.89
LBR_NW	Flood	2/22/2019	11:39	0.35	0.76	73.3	71.2	7.28	7.08	2.68	2.65	14.94	14.88
LBR_NW	Flood	2/25/2019	14:47	0.62	0.83	80.7	80.0	7.79	7.71	1.56	1.54	16.59	16.67
LBR_NW	Ebb	2/27/2019	10:40	0.36	0.72	82.3	79.5	8.28	8.02	0.16	0.15	15.05	14.94
LBR_SE	Outgoing	2/14/2019	9:30	0.53	0.70	84.1	81.2	8.83	8.47	0.09	0.05	13.15	13.45
LBR_SE	Outgoing	2/18/2019	14:08	0.50	0.71	80.4	80.1	8.13	8.07	0.37	0.38	14.77	14.97
LBR_SE	Flood	2/20/2019	9:53	0.55	0.94	74.7	73.2	7.61	7.42	2.94	3.19	13.69	13.88
LBR_SE	Flood	2/22/2019	11:24	0.22	0.85	72.6	73.4	7.22	7.31	2.53	2.27	14.93	14.95
LBR_SE	Flood	2/25/2019	14:32	0.47	0.85	79.8	80.8	7.73	7.82	1.82	1.86	16.38	16.36
LBR_SE	Ebb	2/27/2019	10:28	0.56	0.74	81.0	81.4	8.17	8.21	0.21	0.20	14.94	14.95
LBR_SW	Outgoing	2/14/2019	9:36	0.55	0.70	83.7	88.3	8.77	9.21	0.05	0.05	13.25	13.42
LBR_SW	Outgoing	2/18/2019	14:20	0.61	0.56	80.2	84.8	8.14	8.57	0.18	0.16	14.66	14.84
LBR_SW	Flood	2/20/2019	10:01	0.87	0.88	74.0	77.7	7.52	7.88	3.25	3.12	13.68	13.86
LBR_SW	Flood	2/22/2019	11:31	0.37	0.89	72.6	77.7	7.22	7.73	2.72	2.42	14.90	14.92
LBR_SW	Flood	2/25/2019	14:40	0.40	0.88	82.4	88.7	7.88	8.47	1.36	1.49	17.12	17.11
LBR_SW	Ebb	2/27/2019	10:34	0.32	0.74	81.4	86.4	8.22	8.74	0.15	0.15	14.86	14.80

Table 4-2 Profile sonde and platform sonde comparison

Location	Tide	Date	Time	Depth (m)		DO Saturation (%)		DO (mg/L)		Salinity (PPT)		Temperature (°C)	
				Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy
L12-S	Incoming	2/14/2019	11:12	1.20	1.25	84.70	83.89	8.86	8.73	0.09	0.09	13.31	13.52
L9-S	Incoming	2/14/2019	11:12	1.20	1.26	84.70	83.94	8.86	8.75	0.09	0.09	13.31	13.46
L13-V	Incoming	2/14/2019	11:12	1.95	1.94	84.60	84.09	8.85	8.77	0.09	0.09	13.27	13.42
L5-M	Incoming	2/14/2019	11:12	2.53	2.78	84.40	84.21	8.84	8.78	0.09	0.08	13.27	13.45
L8-M	Incoming	2/14/2019	11:12	2.53	2.85	84.40	83.02	8.84	8.66	0.09	0.09	13.27	13.43
L15-V	Incoming	2/14/2019	11:12	3.37	3.39	84.40	82.61	8.84	8.61	0.09	0.09	13.27	13.46
L1-D	Incoming	2/14/2019	11:13	4.72	4.26	84.40	85.07	8.84	8.87	0.09	0.08	13.27	13.43
L4-D	Incoming	2/14/2019	11:13	4.72	4.34	84.40	84.60	8.84	8.83	0.09	0.08	13.27	13.43
L12-S	Outgoing	2/18/2019	14:56	0.79	1.17	83.70	79.08	8.50	7.99	0.11	0.11	14.64	14.91
L9-S	Outgoing	2/18/2019	14:56	0.79	1.23	83.70	79.26	8.50	8.01	0.11	0.11	14.64	14.84

Location	Tide	Date	Time	Depth (m)		DO Saturation (%)		DO (mg/L)		Salinity (PPT)		Temperature (°C)	
				Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy
L13-V	Outgoing	2/18/2019	14:56	1.67	1.88	84.10	79.37	8.54	8.03	0.11	0.11	14.64	14.82
L5-M	Outgoing	2/18/2019	14:56	2.59	2.77	83.30	79.45	8.46	8.03	0.10	0.10	14.64	14.85
L8-M	Outgoing	2/18/2019	14:56	2.59	2.77	83.30	78.42	8.46	7.93	0.10	0.10	14.64	14.83
L15-V	Outgoing	2/18/2019	14:56	3.83	3.41	82.80	78.03	8.41	7.89	0.10	0.10	14.64	14.85
L1-D	Outgoing	2/18/2019	14:56	4.27	4.26	81.50	80.32	8.28	8.12	0.10	0.10	14.64	14.85
L4-D	Outgoing	2/18/2019	14:56	4.27	4.28	81.50	79.77	8.28	8.07	0.10	0.10	14.64	14.84
L9-S	Flood	2/20/2019	10:32	1.38	1.22	74.00	72.95	7.52	7.38	3.38	3.41	13.70	13.89
L12-S	Flood	2/20/2019	10:32	1.38	1.24	74.00	72.33	7.52	7.29	3.38	3.69	13.70	13.96
L13-V	Flood	2/20/2019	10:32	1.90	1.91	74.00	72.54	7.52	7.32	3.40	3.83	13.70	13.89
L5-M	Flood	2/20/2019	10:32	2.44	2.76	73.90	72.53	7.49	7.31	3.72	3.98	13.70	13.92
L8-M	Flood	2/20/2019	10:32	2.44	2.92	73.90	71.66	7.49	7.22	3.72	4.01	13.70	13.91
L15-V	Flood	2/20/2019	10:32	3.54	3.41	73.80	71.27	7.48	7.18	3.84	3.97	13.71	13.93
L1-D	Flood	2/20/2019	10:32	4.36	4.26	73.60	73.56	7.45	7.41	3.94	4.00	13.72	13.92
L4-D	Flood	2/20/2019	10:32	4.36	4.34	73.60	72.88	7.45	7.34	3.94	4.01	13.72	13.92
L12-S	Flood	2/22/2019	11:53	1.07	1.20	76.30	72.36	7.53	7.19	2.34	2.61	15.34	14.92
L9-S	Flood	2/22/2019	11:53	1.07	1.22	76.30	72.76	7.53	7.24	2.34	2.52	15.34	14.90
L13-V	Flood	2/22/2019	11:53	1.88	1.88	73.30	72.58	7.29	7.22	2.67	2.73	14.88	14.83
L8-M	Flood	2/22/2019	11:53	2.85	2.74	72.90	71.76	7.25	7.13	2.87	3.02	14.84	14.83
L5-M	Flood	2/22/2019	11:53	2.85	2.77	72.90	72.63	7.25	7.21	2.87	2.98	14.84	14.85
L15-V	Flood	2/22/2019	11:54	3.49	3.45	72.40	71.51	7.19	7.10	2.98	2.99	14.83	14.86
L1-D	Flood	2/22/2019	11:54	4.38	4.28	72.30	73.60	7.19	7.31	2.99	3.07	14.83	14.85
L4-D	Flood	2/22/2019	11:54	4.38	4.30	72.30	72.94	7.19	7.24	2.99	3.07	14.83	14.85
L12-S	Flood	2/25/2019	15:21	1.40	1.21	81.80	80.41	7.95	7.79	1.24	1.35	16.41	16.49
L9-S	Flood	2/25/2019	15:21	1.40	1.32	81.80	80.52	7.95	7.81	1.24	1.37	16.41	16.42
L13-V	Flood	2/25/2019	15:21	1.94	1.93	81.60	80.83	7.92	7.85	1.24	1.38	16.40	16.40
L8-M	Flood	2/25/2019	15:21	2.59	2.76	81.00	79.81	7.87	7.74	1.24	1.39	16.40	16.42
L5-M	Flood	2/25/2019	15:21	2.59	2.85	81.00	80.91	7.87	7.85	1.24	1.40	16.40	16.44
L15-V	Flood	2/25/2019	15:21	3.87	3.49	80.80	79.42	7.85	7.70	1.25	1.38	16.39	16.43
L4-D	Flood	2/25/2019	15:21	4.30	4.31	80.60	81.25	7.83	7.88	1.26	1.40	16.38	16.44
L1-D	Flood	2/25/2019	15:21	4.30	4.36	80.60	81.73	7.83	7.92	1.26	1.41	16.38	16.44
L9-S	Ebb	2/27/2019	10:52	1.37	1.21	82.30	81.40	8.29	8.20	0.20	0.17	15.01	14.99
L12-S	Ebb	2/27/2019	10:52	1.37	1.26	82.30	81.20	8.29	8.17	0.20	0.17	15.01	15.05
L13-V	Ebb	2/27/2019	10:52	1.93	1.92	82.10	81.48	8.28	8.23	0.20	0.18	14.98	14.90
L5-M	Ebb	2/27/2019	10:52	2.52	2.76	81.90	81.29	8.26	8.22	0.19	0.19	14.92	14.84
L8-M	Ebb	2/27/2019	10:52	2.52	2.79	81.90	80.18	8.26	8.11	0.19	0.19	14.92	14.83
L15-V	Ebb	2/27/2019	10:52	3.56	3.41	81.80	79.94	8.25	8.08	0.19	0.19	14.90	14.86
L1-D	Ebb	2/27/2019	10:52	4.26	4.25	81.50	82.10	8.24	8.30	0.19	0.19	14.84	14.81
L4-D	Ebb	2/27/2019	10:52	4.26	4.37	81.50	81.60	8.24	8.26	0.19	0.19	14.84	14.80
L10-S	Incoming	2/14/2019	11:19	1.49	1.16	85.00	83.44	8.90	8.70	0.10	0.09	13.29	13.47
L11-S	Incoming	2/14/2019	11:19	1.49	1.22	85.00	84.02	8.90	8.76	0.10	0.09	13.29	13.45
L16-V	Incoming	2/14/2019	11:19	1.87	1.87	84.90	82.66	8.89	8.62	0.10	0.09	13.28	13.45

Location	Tide	Date	Time	Depth (m)		DO Saturation (%)		DO (mg/L)		Salinity (PPT)		Temperature (°C)	
				Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy
L6-M	Incoming	2/14/2019	11:19	2.95	2.68	84.90	83.39	8.88	8.71	0.10	0.09	13.28	13.39
L7-M	Incoming	2/14/2019	11:19	2.95	2.79	84.90	83.67	8.88	8.74	0.10	0.09	13.28	13.39
L14-V	Incoming	2/14/2019	11:19	3.46	3.42	84.80	83.34	8.88	8.69	0.10	0.09	13.29	13.47
L3-D	Incoming	2/14/2019	11:19	3.82	3.97	84.80	84.22	8.87	8.78	0.10	0.09	13.28	13.46
L2-D	Incoming	2/14/2019	11:19	3.82	4.15	84.80	84.97	8.87	8.86	0.10	0.09	13.28	13.42
L11-S	Outgoing	2/14/2019	9:58	1.09	1.19	87.30	87.43	9.15	9.14	0.09	0.09	13.19	13.34
L10-S	Outgoing	2/14/2019	9:58	1.09	1.22	87.30	83.46	9.15	8.72	0.09	0.09	13.19	13.35
L16-V	Outgoing	2/14/2019	9:59	1.83	1.88	87.50	81.89	9.18	8.57	0.09	0.08	13.18	13.31
L6-M	Outgoing	2/14/2019	9:59	2.35	2.73	87.20	82.12	9.14	8.60	0.08	0.08	13.17	13.28
L7-M	Outgoing	2/14/2019	9:59	2.35	2.78	87.20	82.65	9.14	8.65	0.08	0.08	13.17	13.27
L14-V	Outgoing	2/14/2019	9:59	3.55	3.42	86.80	81.74	9.11	8.55	0.08	0.08	13.17	13.33
L3-D	Outgoing	2/14/2019	9:59	3.99	3.96	85.90	82.92	9.02	8.67	0.08	0.08	13.16	13.32
L2-D	Outgoing	2/14/2019	9:59	4.21	4.22	85.30	83.51	8.95	8.73	0.08	0.08	13.15	13.33
L11-S	Outgoing	2/18/2019	14:50	0.86	1.16	80.50	79.12	8.17	8.00	0.11	0.11	14.64	14.84
L10-S	Outgoing	2/18/2019	14:50	0.86	1.23	80.50	78.56	8.17	7.94	0.11	0.11	14.64	14.86
L16-V	Outgoing	2/18/2019	14:50	1.76	1.86	80.40	77.94	8.17	7.88	0.11	0.11	14.64	14.85
L7-M	Outgoing	2/18/2019	14:50	2.88	2.71	80.40	79.19	8.16	8.02	0.11	0.11	14.64	14.80
L6-M	Outgoing	2/18/2019	14:50	2.88	2.74	80.40	78.73	8.16	7.97	0.11	0.11	14.64	14.79
L14-V	Outgoing	2/18/2019	14:50	3.93	3.40	80.30	78.60	8.16	7.94	0.11	0.11	14.64	14.86
L3-D	Outgoing	2/18/2019	14:50	4.42	3.91	80.30	79.71	8.15	8.06	0.11	0.11	14.64	14.86
L2-D	Outgoing	2/18/2019	14:50	4.42	4.22	80.30	80.55	8.15	8.15	0.11	0.11	14.64	14.82
L11-S	Flood	2/20/2019	10:37	1.30	1.26	74.20	72.95	7.55	7.38	3.43	3.38	13.69	13.89
L10-S	Flood	2/20/2019	10:37	1.30	1.30	74.20	72.17	7.55	7.29	3.43	3.52	13.69	13.91
L16-V	Flood	2/20/2019	10:37	1.88	1.94	74.10	71.36	7.53	7.21	3.51	3.57	13.70	13.90
L7-M	Flood	2/20/2019	10:37	2.25	2.78	74.00	72.22	7.51	7.30	3.60	3.60	13.70	13.85
L6-M	Flood	2/20/2019	10:37	2.25	2.81	74.00	71.83	7.51	7.26	3.60	3.65	13.70	13.85
L14-V	Flood	2/20/2019	10:37	3.54	3.43	73.90	71.77	7.49	7.24	3.66	3.80	13.71	13.93
L3-D	Flood	2/20/2019	10:37	4.12	4.10	73.70		7.47		3.79	3.86	13.72	13.93
L2-D	Flood	2/20/2019	10:37	4.27	4.30	73.70	73.41	7.46	7.41	3.84	3.78	13.72	13.89
L10-S	Flood	2/22/2019	11:50	1.19	1.20	75.60	72.25	7.49	7.18	2.56	2.72	15.11	14.89
L11-S	Flood	2/22/2019	11:50	1.19	1.20	75.60	72.46	7.49	7.21	2.56	2.76	15.11	14.86
L16-V	Flood	2/22/2019	11:50	1.87	1.87	73.90	71.55	7.36	7.11	2.64	2.94	14.85	14.86
L7-M	Flood	2/22/2019	11:50	2.96	2.71	73.80	72.30	7.34	7.19	2.84	3.01	14.84	14.81
L6-M	Flood	2/22/2019	11:50	2.96	2.71	73.80	72.74	7.34	7.23	2.84	3.02	14.84	14.80
L14-V	Flood	2/22/2019	11:50	3.45	3.41	73.40	71.93	7.29	7.14	2.95	3.07	14.83	14.88
L3-D	Flood	2/22/2019	11:50	4.57	4.04	73.10	74.07	7.26	7.41	2.99	3.08	14.83	14.50
L2-D	Flood	2/22/2019	11:50	4.57	4.19	73.10	75.17	7.26	7.47	2.99	3.04	14.83	14.83
L11-S	Flood	2/25/2019	15:23	1.52	1.22	82.10	80.57	7.98	7.82	1.22	1.24	16.40	16.46
L10-S	Flood	2/25/2019	15:23	1.52	1.37	82.10	79.82	7.98	7.74	1.22	1.24	16.40	16.47
L16-V	Flood	2/25/2019	15:23	1.96	1.95	81.70	79.50	7.94	7.71	1.21	1.25	16.41	16.46
L7-M	Flood	2/25/2019	15:23	2.59	2.73	80.70	79.91	7.84	7.76	1.21	1.28	16.40	16.38

Location	Tide	Date	Time	Depth (m)		DO Saturation (%)		DO (mg/L)		Salinity (PPT)		Temperature (°C)	
				Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy	Pro	Buoy
L6-M	Flood	2/25/2019	15:23	2.59	2.86	80.70	79.62	7.84	7.74	1.21	1.29	16.40	16.36
L14-V	Flood	2/25/2019	15:23	3.66	3.45	80.50	79.92	7.82	7.76	1.21	1.29	16.39	16.43
L3-D	Flood	2/25/2019	15:23	4.10	4.05	80.10	81.76	7.79	7.96	1.23	1.30	16.37	16.29
L2-D	Flood	2/25/2019	15:23	4.30	4.34	80.00	81.16	7.78	7.89	1.24	1.33	16.36	16.37
L10-S	Ebb	2/27/2019	10:54	1.26	1.18	82.00	80.94	8.25	8.15	0.21	0.20	15.03	15.04
L11-S	Ebb	2/27/2019	10:54	1.26	1.21	82.00	81.57	8.25	8.21	0.21	0.20	15.03	15.02
L16-V	Ebb	2/27/2019	10:54	1.81	1.86	81.80	80.32	8.24	8.09	0.20	0.20	14.97	14.99
L6-M	Ebb	2/27/2019	10:54	2.99	2.70	81.50	80.43	8.23	8.13	0.20	0.20	14.90	14.86
L7-M	Ebb	2/27/2019	10:54	2.99	2.72	81.50	80.82	8.23	8.16	0.20	0.20	14.90	14.89
L14-V	Ebb	2/27/2019	10:54	3.42	3.46	81.40	80.66	8.22	8.14	0.19	0.20	14.88	14.90
L3-D	Ebb	2/27/2019	10:55	4.06	4.05	81.30	82.84	8.22	8.43	0.19	0.20	14.84	14.51
L2-D	Ebb	2/27/2019	10:55	4.06	4.17	81.30	81.85	8.22	8.28	0.19	0.20	14.84	14.83

5.0 WATER COLUMN TRANSFER EFFICIENCY CALCULATION METHOD

The WCTE calculation estimated the percentage of oxygen supplied by the Speece Cone System that remained in the Savannah River and Estuary water column. Ideally, the flow and oxygen discharged by the Plant through the diffusers would be completely mixed with the ambient water; however, if the plume of super-saturated water reached the surface, oxygen could escape the water column and reduce the WCTE. Various methods of calculating DO loss out of the water column were evaluated. The selected method was based on the physics of DO transfer across the air-water interface during times when the water column was at or above super-saturation. This method is the most easily reproducible and therefore the most defensible.

Initially, the occurrence of effervescence was considered a possible source of oxygen loss to the atmosphere; however, no indication of effervescence was noted during the fourteen (14) days of WCTE or during the sixty (60) days of Test Run data collection. During the three (3) months of data collection, the injected oxygen had an estimated dilution of at least 40:1 and was well mixed within the water column, which likely prevented effervescence from occurring.

The selected WCTE calculation needed two pieces of information: (1) the mass of oxygen injected and (2) the mass of oxygen lost to the atmosphere. The load of oxygen supplied by the Speece Cone System was determined by an oxygen sensor and flow measuring devices that were installed on each Speece Cone discharge pipe. These sensors provided flow and oxygen concentration measurements of the DO super-saturated water that was discharged into the water column.

The monitoring data collected during both the WCTE data collection (February 2019) and Test Run data collection (March to May 2019) were used to estimate the mass of oxygen released to the atmosphere across the air-water interface when conditions were present that allowed for a plume of super-saturated water to reach the water column surface. DO was available for release, or transfer, to the atmosphere when the DO saturation at the air-water interface was greater than 100%. The evaluation used all of the QA/QC data listed in **Section 3.0** in this report and in the Test Run Data Collection and Modeling Report (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2019c).

To estimate the mass of oxygen lost across the air-water interface the following components needed to be calculated: (1) the length of time oxygen could be lost, (2) the area from which oxygen could be lost, (3) the amount of oxygen above atmospheric equilibrium (i.e. the fraction of oxygen that could be lost), and (4) the rate at which oxygen is lost to the atmosphere. These components were estimated from the collected monitoring data. The following sections discuss the assumptions and equations used to calculate WCTE. ***Figure 5-1*** presents a flow chart of the WCTE calculation procedure.

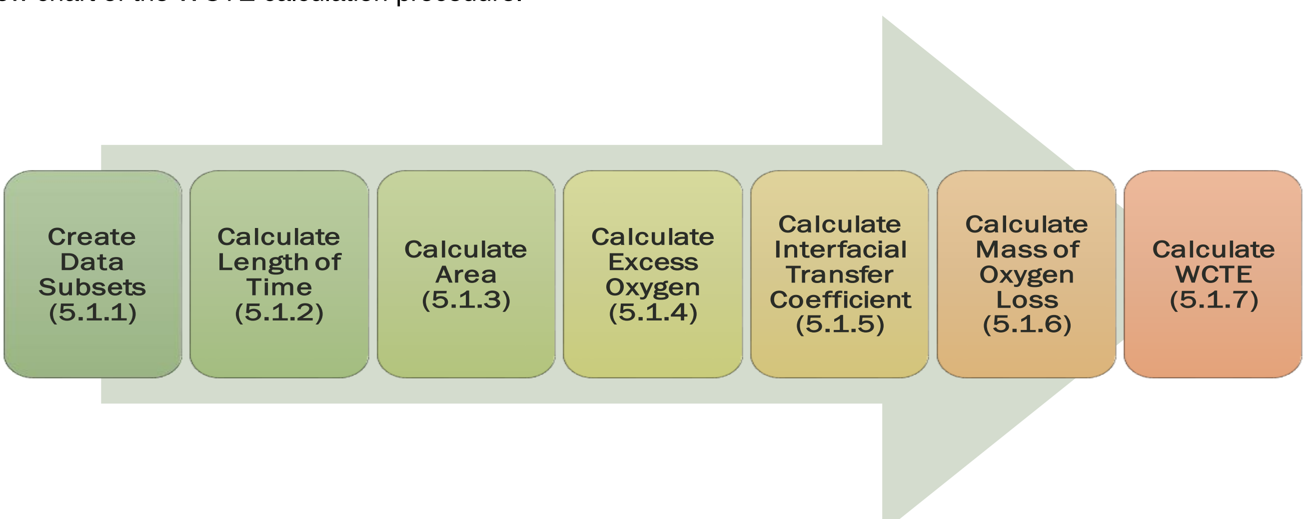


Figure 5-1 WCTE calculation procedure flow chart

5.1 WCTE CALCULATION PROCEDURE

5.1.1 Data

To begin the WCTE calculation procedure, data collected by the field team and USGS were divided into two main datasets: 1) continuous data and 2) intermittent data. The continuous data consisted of platform, semi-permanent buoy, and USGS data. These data were collected at fixed locations (static latitudes and longitudes) and were collected continuously at either 5-minute or 15-minute intervals. The intermittent data consisted of the profile and drift data. These data were collected intermittently, generally over specific tidal conditions, and at variable latitudes and longitudes.

DO loss occurs when super-saturated (100% saturation or greater) water is at the surface of the water column, and data collected in the top one and a half (1.5) meters was assumed to represent surface water conditions. This depth was selected so that any data collected at a buoy or surface platform sonde with a DO saturation value greater than or equal to 100% were included in the data subsets. Buoys typically collected data in the one-half (0.5) meter to one and a half (1.5) meter range and surface platform sondes typically collected data in the one (1) meter to one and a half (1.5) meter range.

Data collected within the top one and a half (1.5) meters or less were then subset into four (4) different datasets. The continuous data was subset into a Continuous DO Loss dataset, which included all accepted platform, semi-permanent buoy, and USGS monitoring data sampled at a depth of one and a half (1.5) meters or less with a DO saturation value greater than or equal to 100% and a Continuous Surface dataset, accepted platform, semi-permanent buoy, and USGS monitoring data sampled at a depth of one and a half (1.5) meters or less. The intermittent data was subset into an Intermittent DO Loss dataset, which included all accepted profile and drift data sampled at a depth of one and a half (1.5) meters or less with a DO saturation value greater than or equal to 100% and an Intermittent Surface dataset, which included all accepted profile and drift data sampled at a depth of one and a half (1.5) meters or less. ***Table 5-1*** provides a listing of the dataset names and definitions used for WCTE calculations.

Table 5-1 Datasets used for WCTE calculations

Dataset ID	Definition
Continuous DO Loss	All accepted platform, semi-permanent buoy, and USGS monitoring data sampled at a depth of 1.5 meters or less with a DO saturation value greater than or equal to 100%
Continuous Surface	All accepted platform, semi-permanent buoy, and USGS monitoring data sampled at a depth of 1.5 meters or less
Intermittent DO Loss	All accepted profile and drift data sampled at a depth 1.5 meters or less with a DO saturation value greater than or equal to 100%
Intermittent Surface	All accepted profile and drift data sampled at a depth of 1.5 meters or less

5.1.2 Daily Time of Supersaturated Conditions Calculation

To estimate how much oxygen was potentially lost across the air-water interface, the length of time that excess DO was available in the top 1.5 meters of the water column was estimated. The length of time calculations estimated the amount of time each day that DO loss conditions (DO saturation greater than 100% in the top 1.5 meters) existed in the Back River and lower Front River. The daily length of time was calculated for each continuous data sonde site, and the site-specific daily results were aggregated to calculate the Continuous Data Daily River DO Loss Time for the Back River and Daily River DO Loss Time for the lower Front River. The length of time calculations used the Continuous DO Loss dataset, and the approach is described below:

1. Daily Site Time calculation

$$Site\ Time = site\ count\ x\ sample\ interval$$

where,

Site Time = daily length of time DO Loss conditions existed for each continuous data sonde site

Site Count = daily number of observations DO Loss conditions existed for each continuous data sonde site

Sample Interval = length of time between observations

2. Daily River DO Loss Time calculation

$$Continuous\ Data\ Daily\ River\ DO\ Loss\ Time\ (minutes) = \frac{\sum(Site\ Time * Site\ Count)}{\sum Site\ Count}$$

The aggregation of daily site times to river time was necessary because there were more than one continuous sample sites on each river. These sites frequently did not record 100% DO saturation values at the same time due to ambient conditions such as tide direction, which moved the super-saturated oxygen plume to different locations in the river. Therefore, the aggregation was not additive, but used a weighted average based on site time and count.

If the Intermittent DO Loss dataset had data greater than 100% DO saturation within a day, an assumed additional sixty (60) minutes was added to the previously calculated Continuous Data Daily River DO Loss Time regardless if DO loss conditions were measured in the continuous data. The 60-minute assumption was an average estimated time that slack tide conditions occurred where potential DO loss would be the greatest. During slack tides, the continuous data sondes did not always record DO loss time conditions due to the plume location and accounting for time from the Intermittent DO Loss dataset ensured the DO loss conditions were represented in the Daily Site Time calculation. On those days if time was not assumed for the Intermittent DO Loss then the time would have been zero which would have resulted in calculating zero DO loss. Further, it was assumed that since time needed to be assumed for at least one day then it should be applied to all days to keep the calculation methodology consistent for all days.

The final calculation, the Final Daily River Time, with units of minutes, was used in the Mass of Loss Calculation (**Section 5.1.6**).

5.1.3 Super-saturated Surface Water Area Calculation

To estimate how much oxygen was potentially lost across the air-water interface, the water surface area of the excess DO plume was estimated. The area calculations estimated the daily surface area that DO loss conditions existed in the Back River and lower Front River (Daily DO Loss Area).

The Intermittent Surface and Intermittent DO Loss datasets were used to estimate the spatial extent of DO loss. The Intermittent Surface dataset, which included DO saturation data greater than and less than 100%, was used to develop contour maps of the DO saturation percentages in the top 1.5 meters of the water column. The contour maps had a one (1) square meter grid resolution and were developed using GIS (**Section 5.1.3.1**). However, some contour maps showed saturation values less than 100% in areas where DO loss conditions were measured because other measurements within the one (1) square meter grid were below 100%. In order to account for these areas, the Intermittent DO Loss dataset, which only included DO saturation data greater than 100%, was used to create a DO loss buffer area (**Section 5.1.3.2**). This buffer area was then intersected with the contour area to ensure all areas where DO loss conditions were measured were accounted for in the Daily Intermittent DO Loss Area (**Section 5.1.3.3**), which was used in the Mass of Loss Calculation (**Section 5.1.6**).

The Continuous DO Loss dataset was also used to identify areas when DO loss conditions were present. Based on review of the collected data it was assumed that each continuous site (platform, semi-permanent buoys, and USGS) represented an individual area of twenty-one (21) square meters for each day with DO loss observations. Twenty-one (21) square meters represents an eight and a half (8.5) foot radius [two and sixth tenths (2.6) meter radius] around each continuous point. The Daily Continuous DO Loss Area was also used in the Mass of Loss Calculation (**Section 5.1.6**).

APPENDIX H provides maps showing the Daily Intermittent DO Loss Area and a table provides the Daily Continuous DO Loss Area. The area loss calculation methodologies are described in more detail in the sections below.

5.1.3.1 Intermittent DO Saturation Contouring Methodology

The DO loss contour maps were developed using the Intermittent Surface dataset to identify the areas in the river where DO loss conditions likely occurred. Using the Intermittent Surface dataset, all profile and drifting data collected on a given day, the ArcGIS topo-to-raster tool was used to create a one (1) square meter grid of the observed DO saturation values (***Figure 5-2***). Contour lines were then developed based on the observed DO saturation grid (***Figure 5-3***). Contour lines with a value greater than or equal to 100% DO saturation were then extracted and merged to develop the daily DO loss contoured area (***Figure 5-4***).

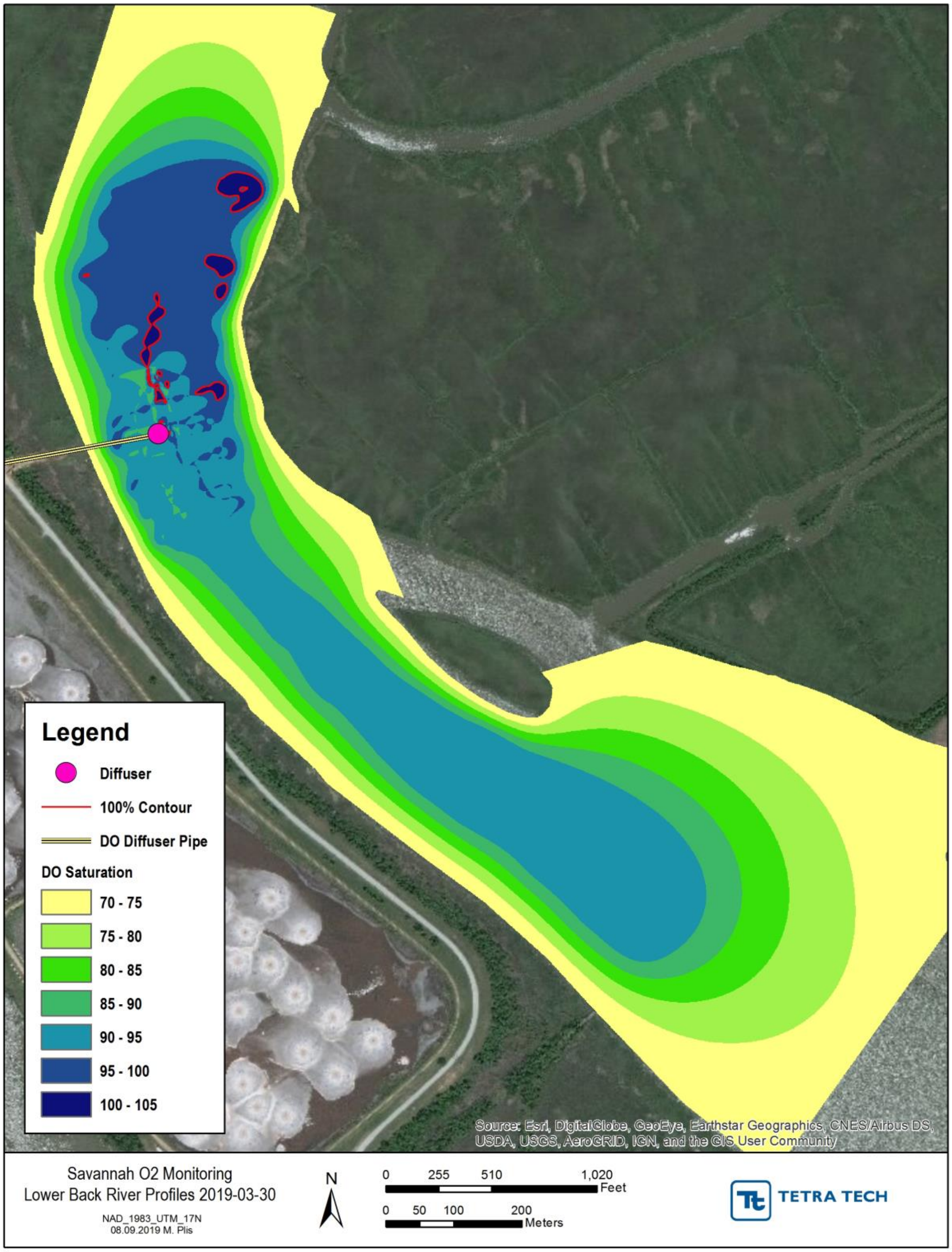


Figure 5-2 Example DO saturation grid generated from the Intermittent Surface dataset for the Back River profiling on March 30, 2019

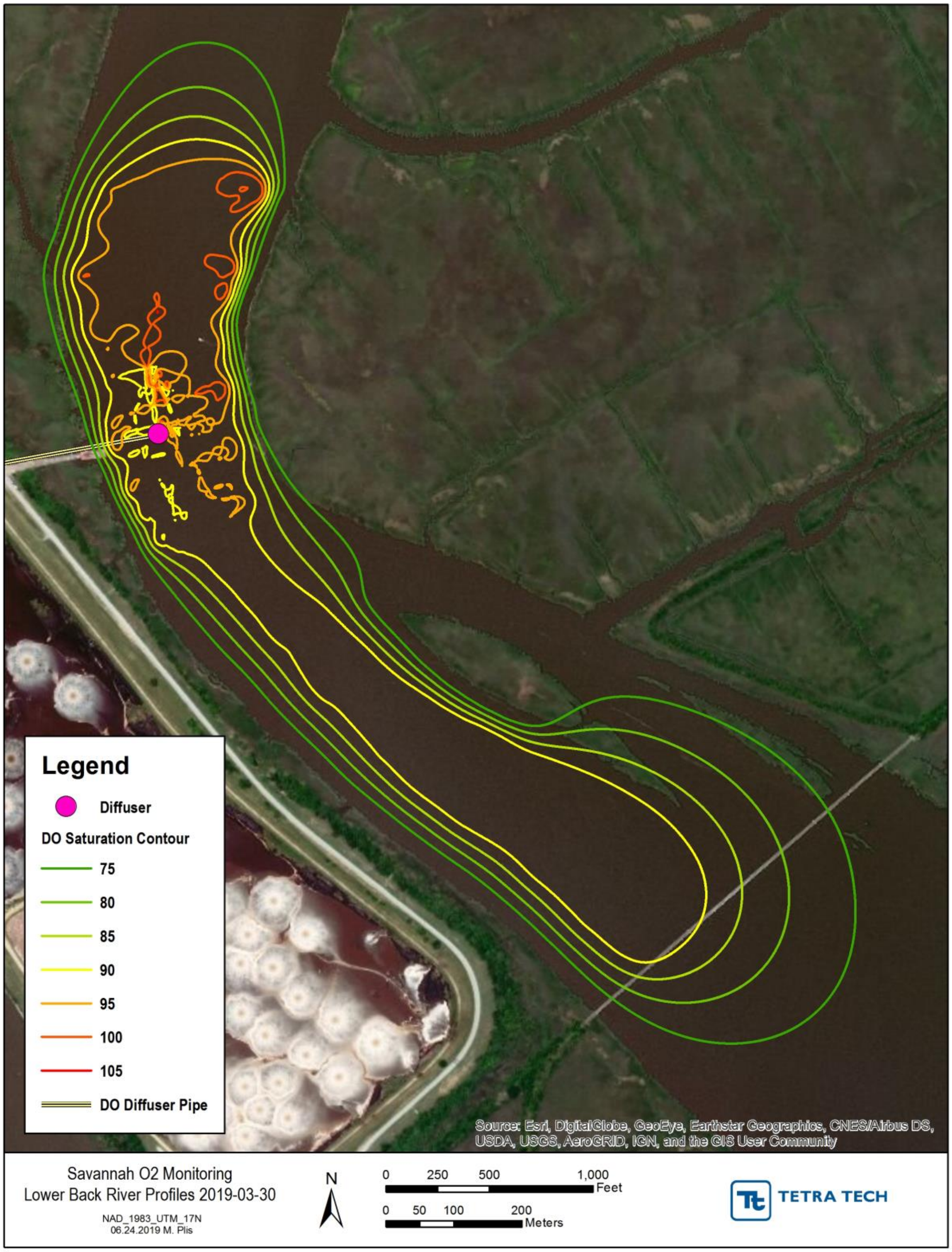


Figure 5-3 Example contours generated from the DO saturation grid generated from the Intermittent Surface dataset for the Back River profiling on March 30, 2019

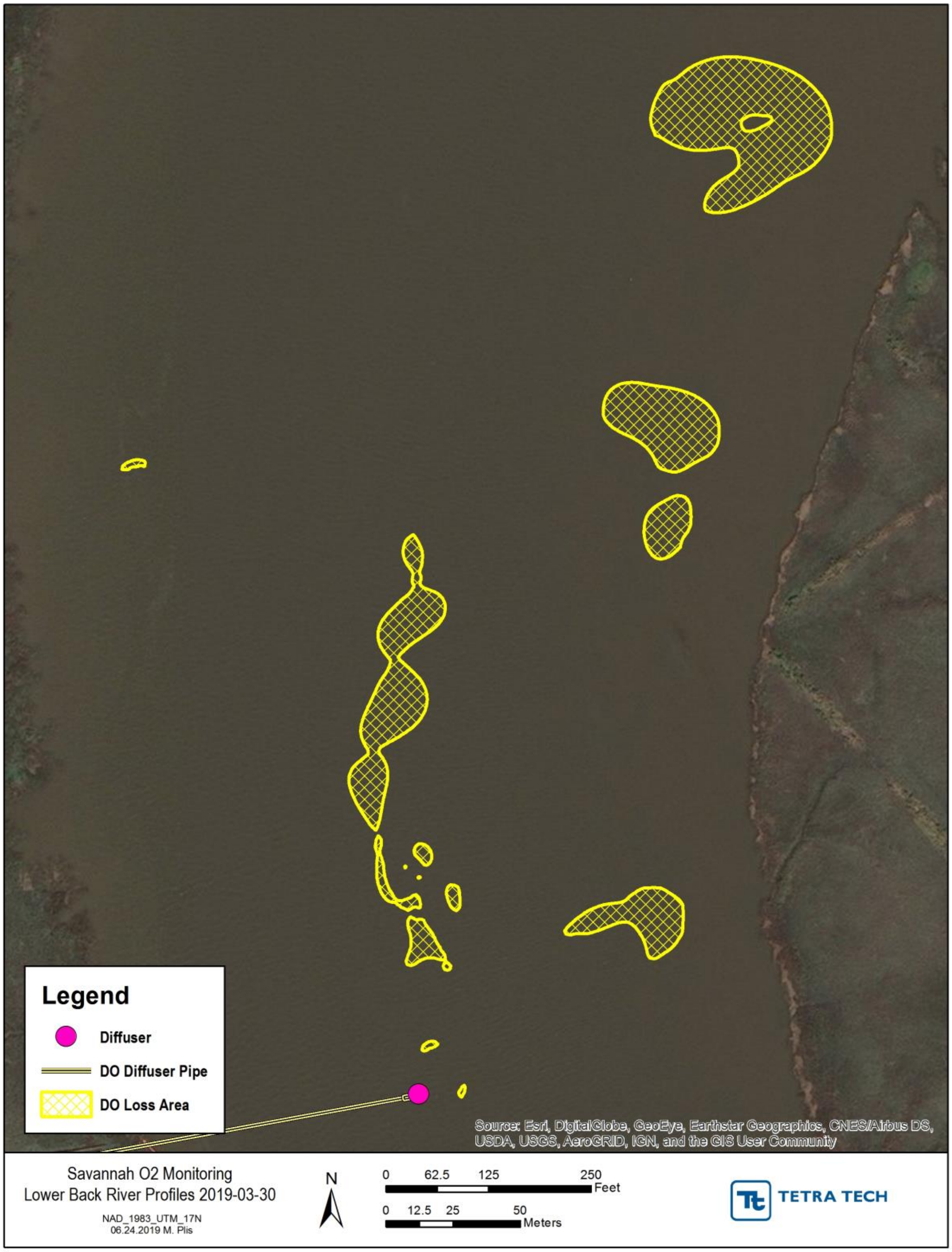


Figure 5-4 Example contouring DO loss area generated from the Intermittent Surface dataset for the Back River profiling on March 30, 2019

5.1.3.2 Intermittent DO Saturation Buffering Methodology

The Intermittent DO Loss dataset was used to define areas where profiling and drifting definitively identified DO loss conditions (***Figure 5-5***). Data where the DO saturation was greater than 100% in the top 1.5 meters of the water column were connected via a contiguous line (***Figure 5-6***) and a one (1) meter buffer was applied around the line (***Figure 5-7***) to assist in identifying and outlining this area. The resulting daily DO loss buffer area represented the physical areas measured by the boat crews in which DO loss conditions were measured in the rivers.

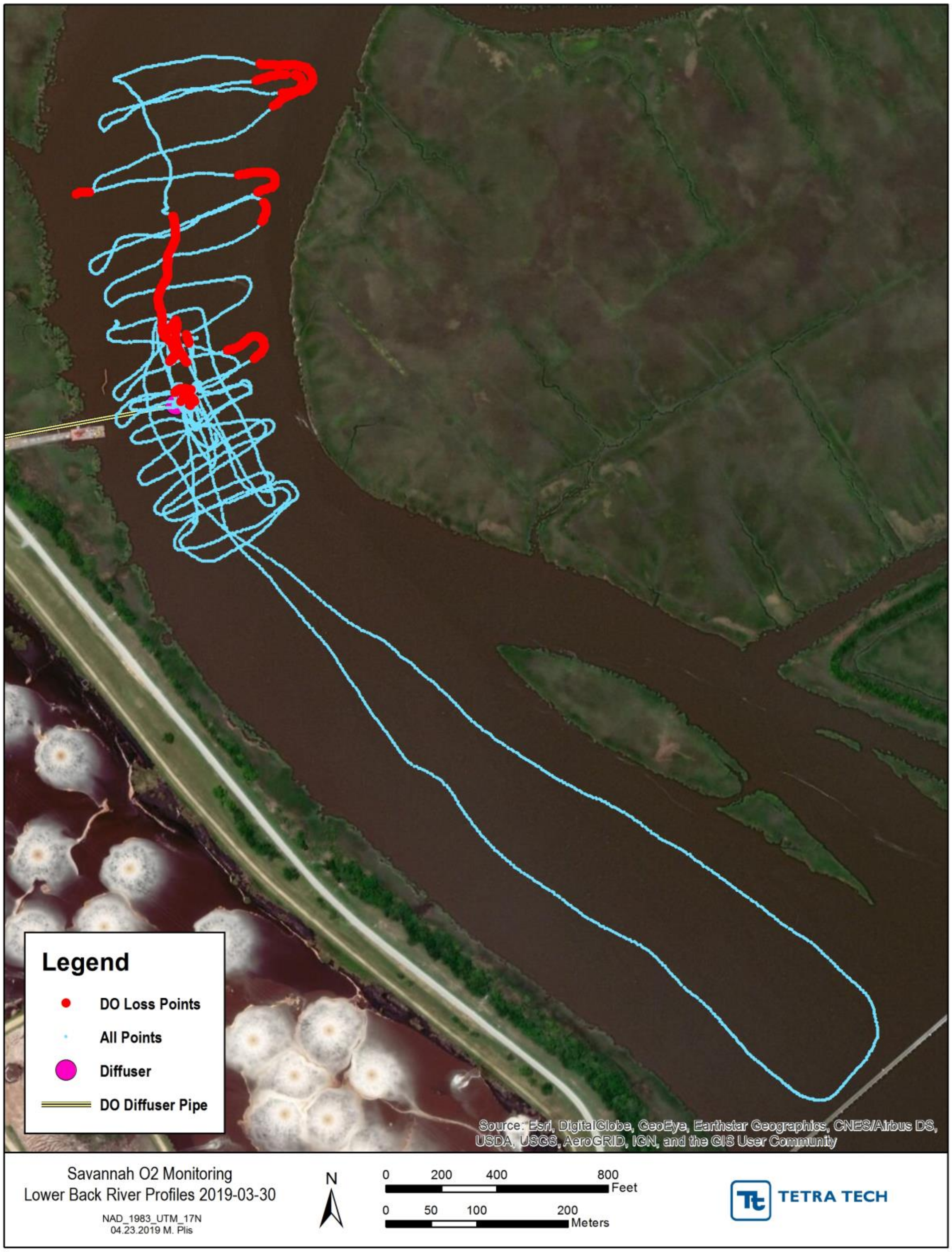


Figure 5-5 All data points collected in the top 1.5 meters of the water column during Back River profiling on March 30, 2019, with red dots identifying DO Loss (DO saturation greater than 100%)

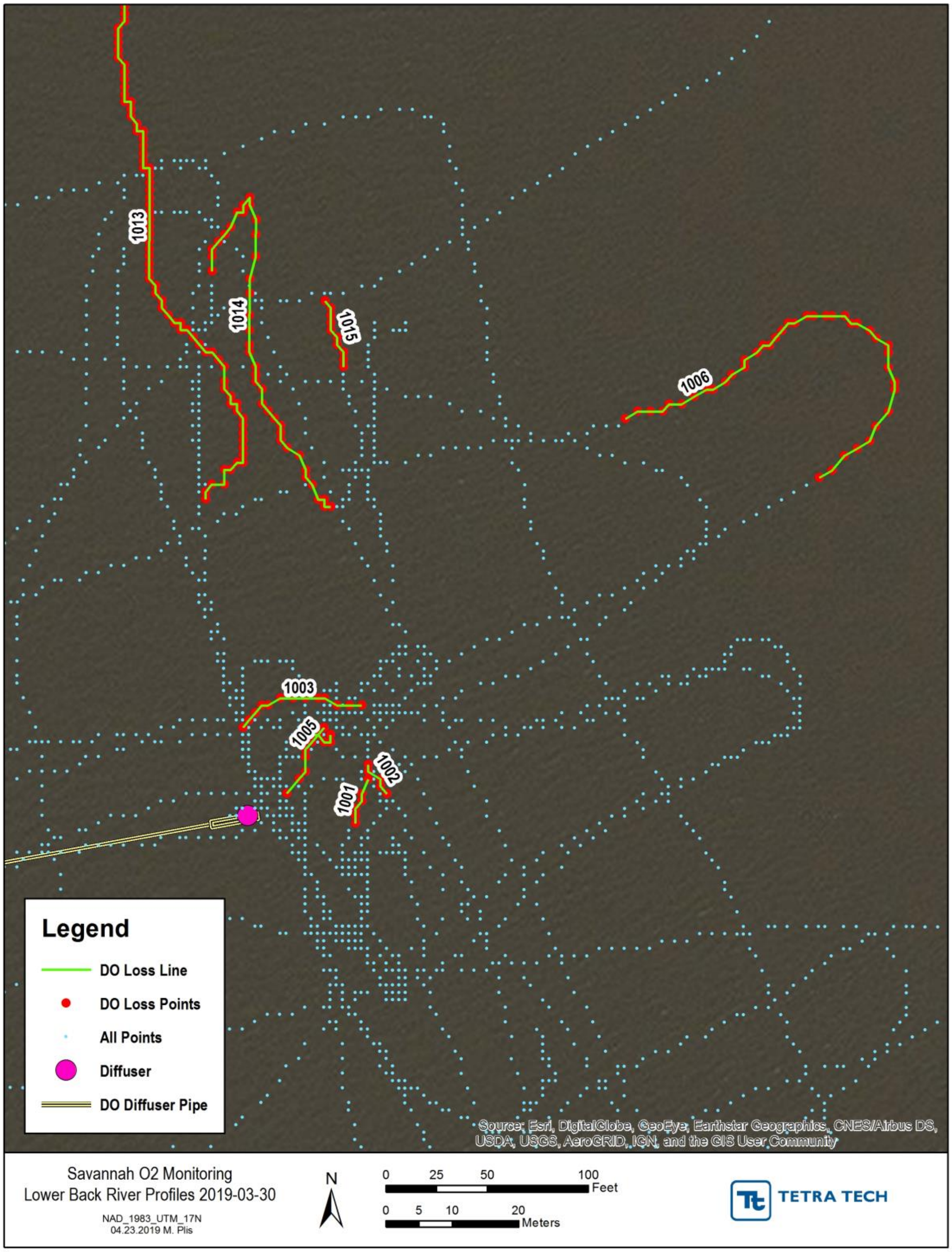


Figure 5-6 Data points collected in the top 1.5 meters of the water column near the diffuser during Back River profiling on March 30, 2019, with red dots identifying DO Loss (DO saturation greater than 100%) and green line identifying the contiguous data collection line

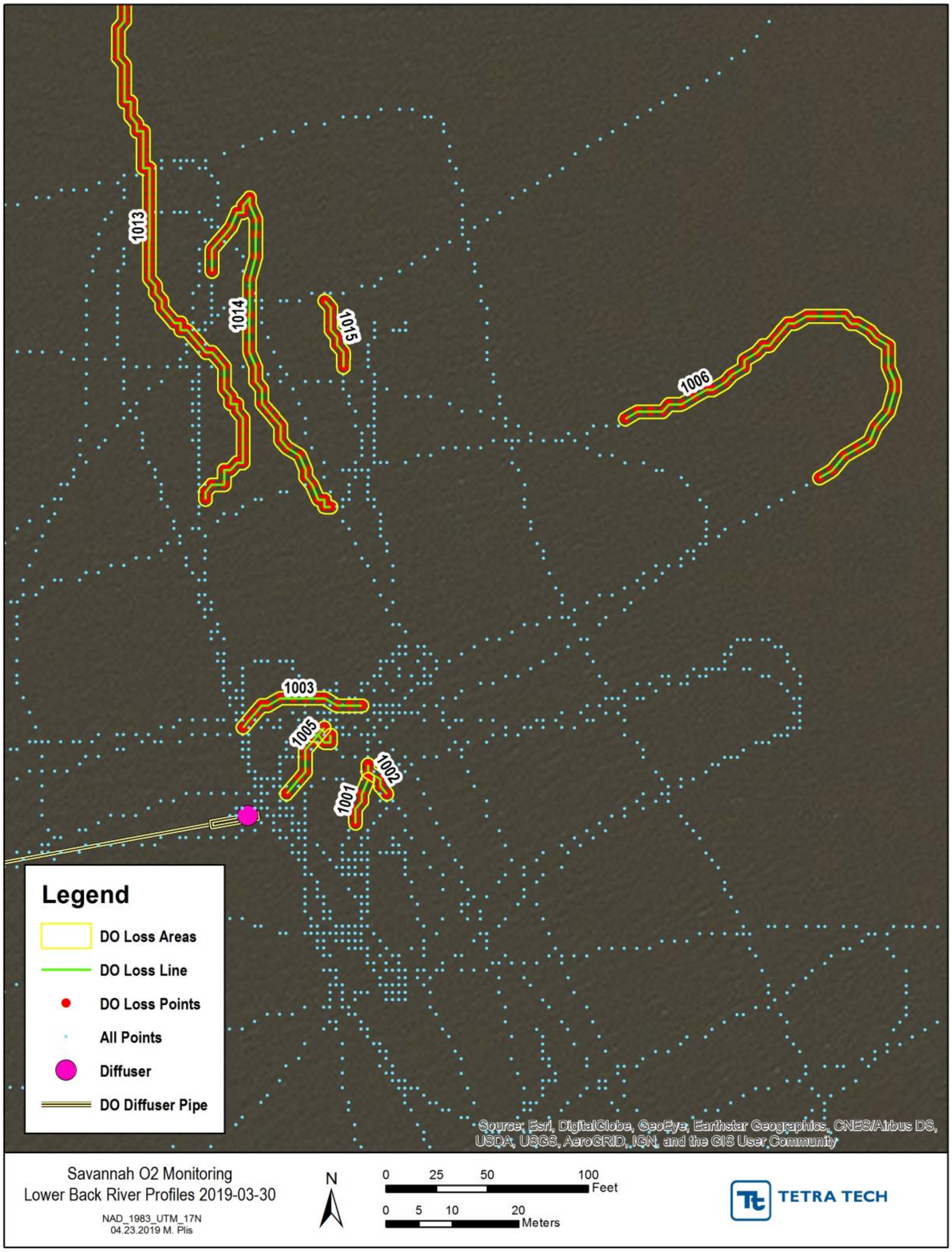


Figure 5-7 Data points collected in the top 1.5 meters of the water column near the diffuser during Back River profiling on March 30, 2019, with red dots identifying DO Loss (DO saturation greater than 100%), green line identifying the contiguous data collection line, and yellow line identifying buffering DO loss area.

5.1.3.3 Buffering and Contouring Merger

The DO loss areas identified each day in the contouring (***Figure 5-4***) and buffering (***Figure 5-7***) were merged to create the Daily Intermittent DO Loss Area (***Figure 5-8***). Combining the two methodologies ensured that all points physically measured by the field crew were accounted for in the DO loss areas and that these points were extrapolated into regions where measurements were not physically collected. The Daily Intermittent DO Loss Area, in units of square meters, was used in the Mass of Loss Calculation (**Section 5.1.6**).

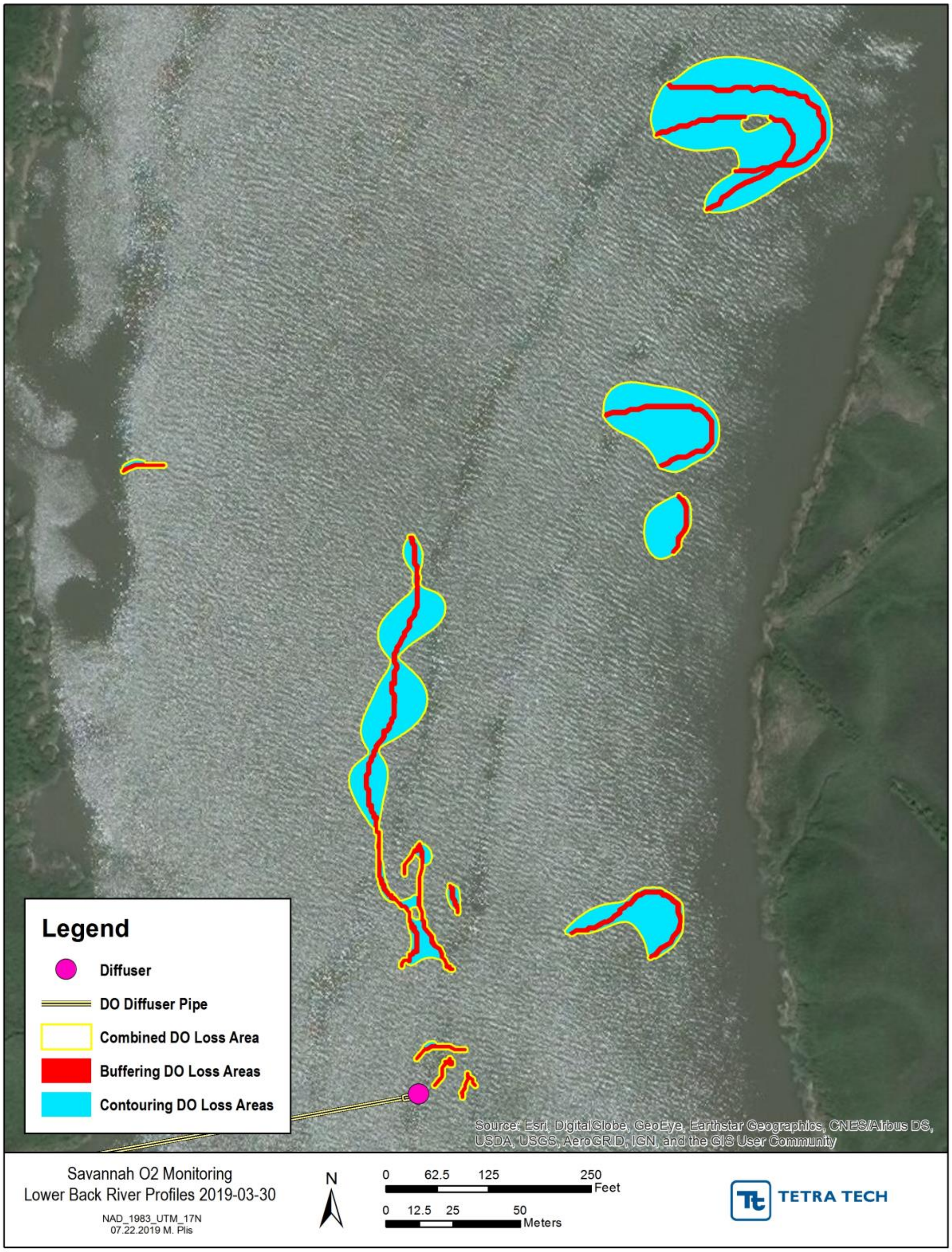


Figure 5-8 Example buffering and contouring combined Daily Intermittent DO Loss Area for Back River profiling on March 30, 2019

5.1.4 Excess Oxygen Calculation

To calculate how much oxygen was potentially lost across the air-water interface, the concentration of DO in excess of 100% saturation was estimated. This was accomplished by determining the concentration of DO above the DO atmospheric solubility concentration for the water temperature and salinity conditions for the Daily Intermittent DO Loss Area and Daily Continuous DO Loss Area. The concentration of DO above atmospheric solubility was determined by finding the average water temperature, salinity, and DO concentration for each loss area. The resulting averages for each area, tabulated by using the DO loss data associated with each area and day, were used to determine the atmospheric solubility concentration of DO using the Thomann & Mueller (1987) saturation equations (equations 1 and 2). The difference of the average DO concentration and the atmospheric solubility concentration of DO (equation 3) resulted in the excess oxygen concentration.

$$(\ln C_{sf}) = -139.34411 + \frac{(1.575701 \times 10^5)}{T} - \frac{(6.642308 \times 10^7)}{T^2} + \frac{(1.243800 \times 10^{10})}{T^3} - \frac{(8.621949 \times 10^{11})}{T^4} \qquad \boxed{1}$$

where,

C_{sf} = freshwater DO concentration at 100% saturation at 1 atm in mg/L

ln = natural logarithm

T = area average temperature in Kelvin

$$(\ln C_{ss}) = (\ln C_{sf}) - S\left(1.7674 \times 10^{-2} - \frac{(1.0754 \times 10^1)}{T} + \frac{(2.1407 \times 10^3)}{T^2}\right) \qquad \boxed{2}$$

where,

C_{ss} = saline water DO concentration at 100% saturation at 1 atm in mg/L

S = area average salinity in ppt

$$Excess\ oxygen\left(\frac{mg}{L}\right) = Average\ DO\ Concentration - C_{SS} \qquad \boxed{3}$$

where,

Excess Oxygen = Concentration of oxygen above DO solubility

Excess oxygen concentration for each area was used in the Mass of Loss Calculation (**Section 5.1.6**).

5.1.5 Interfacial Transfer Coefficient Calculation

To estimate how much oxygen was potentially lost across the air-water interface, the rate of oxygen transfer, or the interfacial transfer coefficient, was calculated (equation 6). This calculation is based on equations found Thomann & Mueller (1987). Equation 4 is a reproduction of Thomann & Mueller (1987) equation 6.20a and equation 5 is a reproduction of Thomann & Mueller (1987) equation 6.20b. Both equations solve for the same variable because equation 5 is the reduced form of equation 4.

$$K_a = \frac{K_L A}{V} \tag{4}$$

where,

K_a	=	volumetric reaeration coefficient (1/time)
K_L	=	interfacial transfer coefficient (length/time)
A	=	surface area between the water and the atmosphere (length squared)
V	=	volume of water (length cubed)

Equation 4 reduces to:

$$K_a = \frac{K_L}{H} \tag{5}$$

where,

H	=	depth (length)

Solving equation 5 for K_L produces the following equation:

$$K_L = K_a H \tag{6}$$

Volumetric reaeration coefficient (K_a) is provided as an output from the Water Quality Analysis Simulation Program (WASP) model of the Savannah Harbor and Estuary (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2019c). This model was developed to assess and evaluate water quality impacts to the Savannah Harbor and Estuary from SHEP projects. A daily K_a value for the Back River and lower Front River were determined by averaging the 2019 SHEP WASP model daily K_a output (ten (10) times per day) for the model cells located around the diffusers. ***Table 5-2*** provides the K_a values used for each day for the lower Front River and Back River.

Table 5-2 Daily average K_a values by river and Date

Date	Period	Lower Front River K_a (1/day)	Back River K_a (1/day)
2/14/2019	WCTE	0.298	0.403
2/15/2019	WCTE	0.318	0.473
2/18/2019	WCTE	0.409	0.568
2/19/2019	WCTE	0.449	0.617
2/20/2019	WCTE	0.418	0.575
2/21/2019	WCTE	0.270	0.426
2/22/2019	WCTE	0.352	0.538
2/25/2019	WCTE	0.408	0.577

Date	Period	Lower Front River K_a (1/day)	Back River K_a (1/day)
2/26/2019	WCTE	0.372	0.535
2/27/2019	WCTE	0.258	0.373
3/14/2019	Test Run	0.485	0.625
3/15/2019	Test Run	0.517	0.629
3/16/2019	Test Run	0.478	0.643
3/17/2019	Test Run	0.340	0.474
3/18/2019	Test Run	0.309	0.478
3/19/2019	Test Run	0.511	0.689
3/20/2019	Test Run	0.408	0.579
3/21/2019	Test Run	0.372	0.567
3/22/2019	Test Run	0.568	0.740
3/23/2019	Test Run	0.398	0.602
3/24/2019	Test Run	0.394	0.593
3/25/2019	Test Run	0.432	0.616
3/26/2019	Test Run	0.424	0.540
3/27/2019	Test Run	0.552	0.670
3/28/2019	Test Run	0.384	0.491
3/29/2019	Test Run	0.315	0.433
3/30/2019	Test Run	0.352	0.496
3/31/2019	Test Run	0.594	0.725
4/1/2019	Test Run	0.551	0.682
4/2/2019	Test Run	0.585	0.739
4/3/2019	Test Run	0.278	0.428
4/4/2019	Test Run	0.397	0.544
4/5/2019	Test Run	0.431	0.612
4/6/2019	Test Run	0.308	0.491
4/7/2019	Test Run	0.309	0.465
4/8/2019	Test Run	0.462	0.613
4/9/2019	Test Run	0.421	0.612
4/10/2019	Test Run	0.410	0.589
4/11/2019	Test Run	0.507	0.647
4/12/2019	Test Run	0.608	0.775
4/13/2019	Test Run	0.512	0.660
4/14/2019	Test Run	0.707	0.884
4/15/2019	Test Run	0.887	1.099

Date	Period	Lower Front River K_a (1/day)	Back River K_a (1/day)
4/16/2019	Test Run	0.410	0.592
4/17/2019	Test Run	0.354	0.552
4/18/2019	Test Run	0.493	0.666
4/19/2019	Test Run	0.905	1.128
4/20/2019	Test Run	0.746	0.963
4/21/2019	Test Run	0.515	0.692
4/22/2019	Test Run	0.310	0.509
4/23/2019	Test Run	0.337	0.532
4/24/2019	Test Run	0.418	0.591
4/25/2019	Test Run	0.390	0.532
4/26/2019	Test Run	0.756	0.932
4/27/2019	Test Run	0.435	0.592
4/28/2019	Test Run	0.456	0.614
4/29/2019	Test Run	0.461	0.646
4/30/2019	Test Run	0.401	0.563
5/1/2019	Test Run	0.432	0.598
5/2/2019	Test Run	0.498	0.702
5/3/2019	Test Run	0.415	0.599
5/4/2019	Test Run	0.354	0.514
5/5/2019	Test Run	0.604	0.828
5/6/2019	Test Run	0.372	0.580
5/7/2019	Test Run	0.493	0.679
5/8/2019	Test Run	0.514	0.700
5/9/2019	Test Run	0.548	0.753
5/10/2019	Test Run	0.496	0.660
5/11/2019	Test Run	0.499	0.697
5/12/2019	Test Run	0.472	0.658

Water depth (H) was assumed to be 1.5 meters due to the slight stratification caused by the DO plume, which was noted during neap slack tides. See **Section 6.2** (***Figure 6-13***) for more discussion pertaining to the 1.5 meter water depth assumption.

K_L was then calculated as the product of the daily average K_a and H. K_L, in units of meters/day, was used in the Mass of Loss Calculation (**Section 5.1.6**).

5.1.6 Mass of Loss Calculation

The DO loss areas, excess oxygen, and interfacial transfer coefficient were used to estimate the mass of oxygen lost each day from each area by using equation 7 (Daily Area DO Loss).

$$Daily\ Area\ DO\ Loss = Area * Excess\ Oxygen\ Concentration\ * K_L * Conversion \tag{7}$$

where,

Daily Area DO Loss was calculated for each individual Daily Intermittent DO Loss Area and Daily Continuous DO Loss Area that was defined for each day (**Section 5.1.3**)

Excess Oxygen Concentration was defined daily for each individual Daily Intermittent DO Loss Area and Daily Continuous DO Loss Area (**Section 5.1.4**)

K_L was defined daily for each individual Daily Intermittent DO Loss Area and Daily Continuous DO Loss Area (**Section 5.1.5**)

Conversion 1000 liters/m^3 x 1 pound/453,592 milligrams

The Daily Area DO Loss was then summarized for each river for the length of daily DO loss time using equation 8 (Daily River DO Loss).

$$Daily\ River\ DO\ Loss = \sum \frac{Daily\ Area\ DO\ Loss * Final\ Daily\ River\ Time}{1440\ minutes/day} \tag{8}$$

where,

Daily River DO Loss is the total mass of oxygen lost (pounds) from all daily areas during the length of time that DO loss conditions existed in each river for each day

Final Daily River Time was defined for each river for each day (**Section 5.1.2**)

5.1.7 WCTE Calculation

Daily river WCTEs were calculated for both the Back River and lower Front River by determining the percent difference in the oxygen loads delivered to the rivers compared to the oxygen loads that were lost to the atmosphere (equation 9). The daily river WCTEs were then area-weighted to account for the difference in DO loads entering the Back River (approximately one-third of the total Plant load) and lower Front River (approximately two-thirds of the total Plan load (equation 10). The resulting values represent the estimated daily WCTEs.

$$River\ WCTE = \frac{Daily\ Plant\ DO\ Load - Daily\ River\ DO\ Loss}{Daily\ Plant\ DO\ Load} \tag{9}$$

where,

Where Daily River DO Loss and Daily Plant DO Load are both associated with each River (i.e. data calculated for Front River was not used on Back River and data calculated for Back River was not used on Front River)

The combined WCTE was calculated as follows:

$$WCTE = (Front\ River\ WCTE * Front\ River\ Flow\ \%) + (Back\ River\ WCTE * Back\ River\ Flow\ \%) \tag{10}$$

5.1.8 Neap Tide WCTE Revisions

The WCTE data collection period ran from February 14, 2019 through February 27, 2019 and captured a partial lunar tidal cycle that included a spring tide. The Test Run data collection period ran from March 14, 2019 through May 12, 2019 (60 days) and captured two complete tidal cycles. Comparison of Back River daily WCTE values to the tidal cycle showed that WCTE was generally greater than 99% with very little DO loss except during the Test Run neap tide conditions. During neap tide conditions, the WCTE for the Back River was estimated be as low as 60% using the previously discussed method. The neap tide WCTE values were 100% in the lower Front River due to the large volume of freshwater flushing.

Neap tides have very little differences between high and low tides due to weak tidal fluctuations resulting in reduced mixing in the Back River. The reduced mixing allows for periods of DO super-saturated water to build up in the Back River plume. During neap tide, a smaller volume of water moved through the Back River and less flushing occurred. This resulted in hydrodynamic conditions that created a large plume of water with DO saturations greater than 100%, along with a slight DO stratification between the top and bottom DO values as measured by the platform sondes. This plume moved from downstream to upstream between ebb and flood tide and moved from upstream to downstream between flood and ebb tide. During these tidal swings the DO plume moved through the diffuser area and the Plant injected more DO super-saturated water into the plume, creating a larger DO plume with DO saturations greater than 100%.

The continuous data indicated that this plume was present throughout the neap tide in the Back River, although its location varied based on tidal conditions. Due to changing tides, the intermittent data, which consisted of profile and drift data, may not have always intersected the full plume of super-saturated water. Therefore, the WCTE calculation for the Back River was modified and re-calculated during neap tides to ensure that the DO plume was accounted for in the DO Loss Areas. It should be noted that DO levels at the Back River USGS stations continued to increase during the neap tide, indicating that a portion of the oxygen injected in the system was remaining in the Back River and not all of the injected oxygen was lost to the atmosphere. At the end of neap tide, the Back River USGS gages' DO levels dropped to below 100% DO saturation due to the increased flushing and mixing. The lower Front River WCTE calculation was not modified for neap tide conditions because flushing prevented a large plume of water with DO saturations greater than 100% to develop in that part of the system.

The Back River WCTE calculation was re-calculated for the three (3) days before and after the central neap tide condition. During the Test Run, the central neap tides occurred on March 30, 2019 and April 28, 2019, and the Test Run neap tide periods were defined as March 27, 2019 through April 2, 2019 and April 25, 2019 through May 1, 2019. The DO loss area for each neap tide period was determined by merging together all of the Daily Intermittent DO Loss Areas (**Section 5.1.3**) for the days within each neap tide period. Excess oxygen was tabulated for each day by finding average temperature, salinity and DO concentration using all data for a day in the Continuous DO Loss and Intermittent DO Loss datasets. The average temperature, salinity and DO concentration were used to tabulate excess oxygen with equations 1, 2, and 3 in **Section 5.1.4**. Water depth of 1.5 m was multiplied by the daily average Back River K_a value to generate K_L (equation 6 in **Section 5.1.5**). Equation 7 in **Section 5.1.6** was then used to tabulate the Daily DO Loss for the neap tide area. Finally, the Daily DO Loss values were reduced by the fraction of the day that the Back River USGS gages showed DO Loss conditions and the WCTE during the neap tide seven (7) day periods were updated with the revised approach.

The neap tide approach was not used during the WCTE study data collection period because a neap tidal condition did not occur during the fourteen (14) day data collection period.

6.0 WCTE RESULTS AND DISCUSSION

6.1 WCTE STUDY PERIOD (FEBRUARY 14, 2019 TO FEBRUARY 27, 2019)

Table 6-1 and ***Table 6-2*** present average inputs tabulated across river specific DO loss areas and the resulting Daily River DO Loss and WCTE for the lower Front River and Back River respectively. ***Table 6-3*** presents the river specific Plant loads, river specific WCTE, and the downriver systems combined WCTE results. The WCTE calculations for the WCTE study period resulted in WCTE values of 100%. The total amount of oxygen loss between the Back River and lower Front River for the entire WCTE study period was 0.02 pounds. During the WCTE study period the Plant injected approximately 65,100 pounds of oxygen.

Table 6-1 WCTE period Front River daily WCTE calculation inputs and outputs summary

Date	DO Loss Area (m^2)	Final Daily River Time (min)	Area weighted average Excess Oxygen (mg/L)	Depth (m)	K_a (1/day)	K_L (m/day)	Daily River DO Loss (pounds/day)	Daily Plant DO Load (pounds/day)	Front River WCTE
2/14/2019	0	0	0.000	1.5	0.298	0.4	0.0000	3,849	100.0%
2/15/2019	0	0	0.000	1.5	0.318	0.5	0.0000	3,455	100.0%
2/18/2019	0	0	0.000	1.5	0.409	0.6	0.0000	2,284	100.0%
2/19/2019	0	0	0.000	1.5	0.449	0.7	0.0000	5,069	100.0%
2/20/2019	0	0	0.000	1.5	0.418	0.6	0.0000	8,002	100.0%
2/21/2019	0	0	0.000	1.5	0.270	0.4	0.0000	7,688	100.0%
2/22/2019	0	0	0.000	1.5	0.352	0.5	0.0000	5,895	100.0%
2/25/2019	21	20	0.080	1.5	0.408	0.6	0.0000	2,295	100.0%
2/26/2019	638	60	0.477	1.5	0.372	0.6	0.0156	2,791	100.0%
2/27/2019	0	0	0.000	1.5	0.258	0.4	0.0000	1,388	100.0%

Note Daily River DO Loss and resulting WCTE values are actual calculated loss (summed from individual areas) and not based on averages as presented in table

Table 6-2 WCTE period Back River daily WCTE calculation inputs and outputs summary

Date	DO Loss Area (m^2)	Final Daily River Time (min)	Area weighted average Excess Oxygen (mg/L)	Depth (m)	K_a (1/day)	K_L (m/day)	Daily River DO Loss (pounds/day)	Daily Plant DO Load (pounds/day)	Back River WCTE
2/14/2019	200	60	0.761	1.5	0.403	0.6	0.0085	2,314	100.0%
2/15/2019	13	60	0.036	1.5	0.473	0.7	0.0000	2,017	100.0%
2/18/2019	0	0	0.000	1.5	0.568	0.9	0.0000	1,190	100.0%
2/19/2019	0	0	0.000	1.5	0.617	0.9	0.0000	2,750	100.0%
2/20/2019	0	0	0.000	1.5	0.575	0.9	0.0000	4,011	100.0%
2/21/2019	0	0	0.000	1.5	0.426	0.6	0.0000	3,881	100.0%
2/22/2019	0	0	0.000	1.5	0.538	0.8	0.0000	2,956	100.0%
2/25/2019	0	0	0.000	1.5	0.577	0.9	0.0000	1,149	100.0%
2/26/2019	0	0	0.000	1.5	0.535	0.8	0.0000	1,418	100.0%
2/27/2019	0	0	0.000	1.5	0.373	0.6	0.0000	702	100.0%

Note Daily River DO Loss and resulting WCTE values are actual calculated loss (summed from individual areas) and not based on averages as presented in table

Table 6-3 WCTE period River combination WCTE results

Date	Front River Daily Plant DO Load (pounds/day)	Front River WCTE	Back River Daily Plant DO Load (pounds/day)	Back River WCTE	River Combination WCTE
2/14/2019	3,849	100.0%	2,314	100.0%	100.0%
2/15/2019	3,455	100.0%	2,017	100.0%	100.0%
2/18/2019	2,284	100.0%	1,190	100.0%	100.0%
2/19/2019	5,069	100.0%	2,750	100.0%	100.0%
2/20/2019	8,002	100.0%	4,011	100.0%	100.0%
2/21/2019	7,688	100.0%	3,881	100.0%	100.0%
2/22/2019	5,895	100.0%	2,956	100.0%	100.0%
2/25/2019	2,295	100.0%	1,149	100.0%	100.0%
2/26/2019	2,791	100.0%	1,418	100.0%	100.0%
2/27/2019	1,388	100.0%	702	100.0%	100.0%

DO loss conditions in the Back River were found in the Intermittent Surface dataset on February 14, 2019 and February 15, 2019 (circled in orange in ***Figure 6-1***), but these conditions were not identified in the Continuous Surface dataset (***Figure 6-2***). DO loss conditions in the lower Front River were found in the Intermittent Surface dataset on February 26, 2019 (circled in orange in ***Figure 6-3***) and in the Continuous Surface dataset on February 25, 2019 (circled in orange in ***Figure 6-4***). While the intermittent and continuous data collections regularly intercepted the plume in the lower Front River, very few DO loss data points were detected.

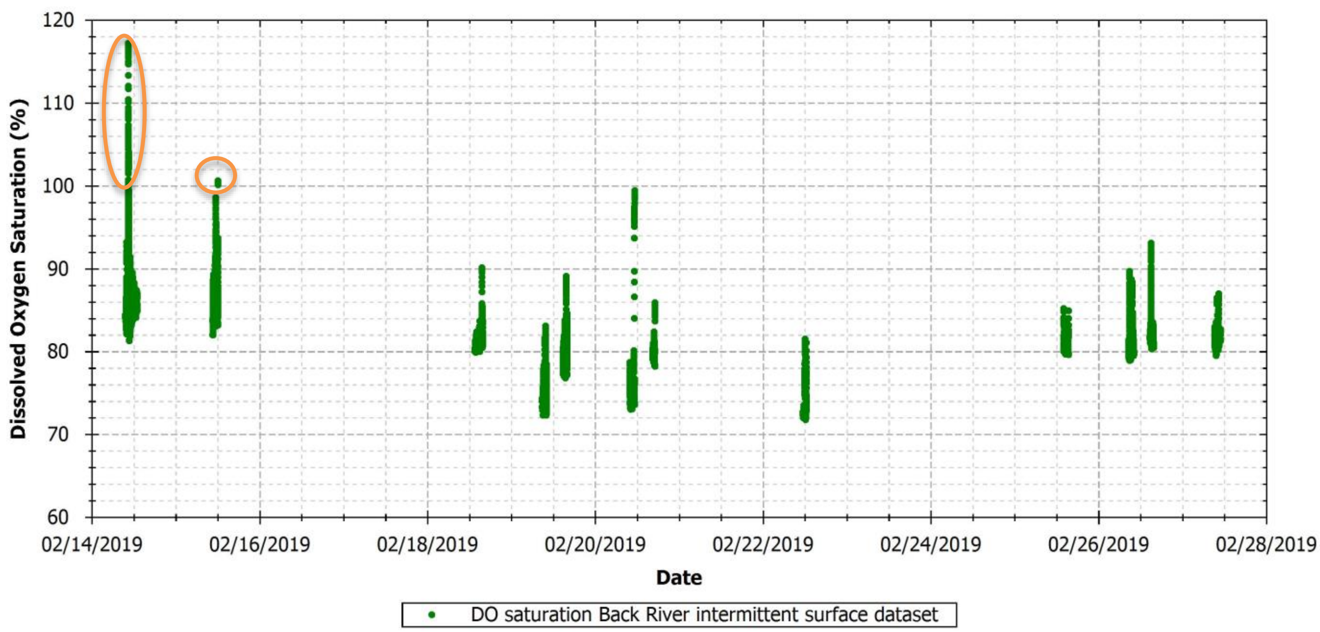


Figure 6-1 Back River DO saturation in the intermittent surface dataset for WCTE period

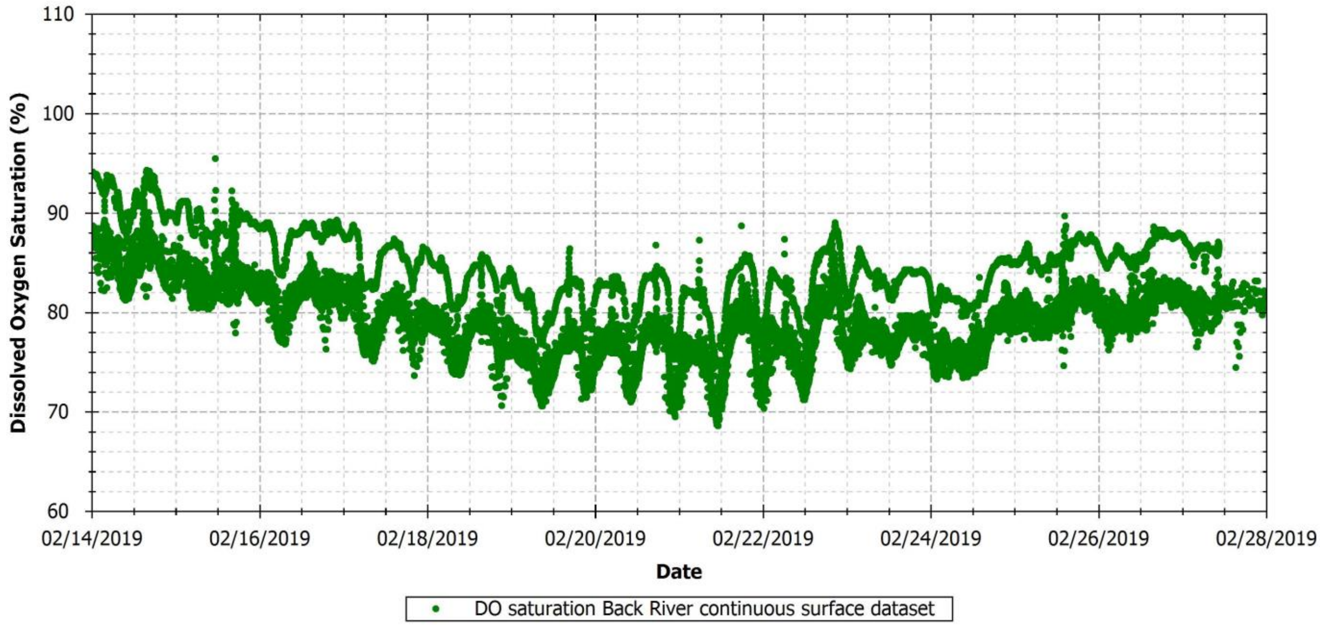


Figure 6-2 Back River DO saturation in the continuous surface dataset for WCTE period

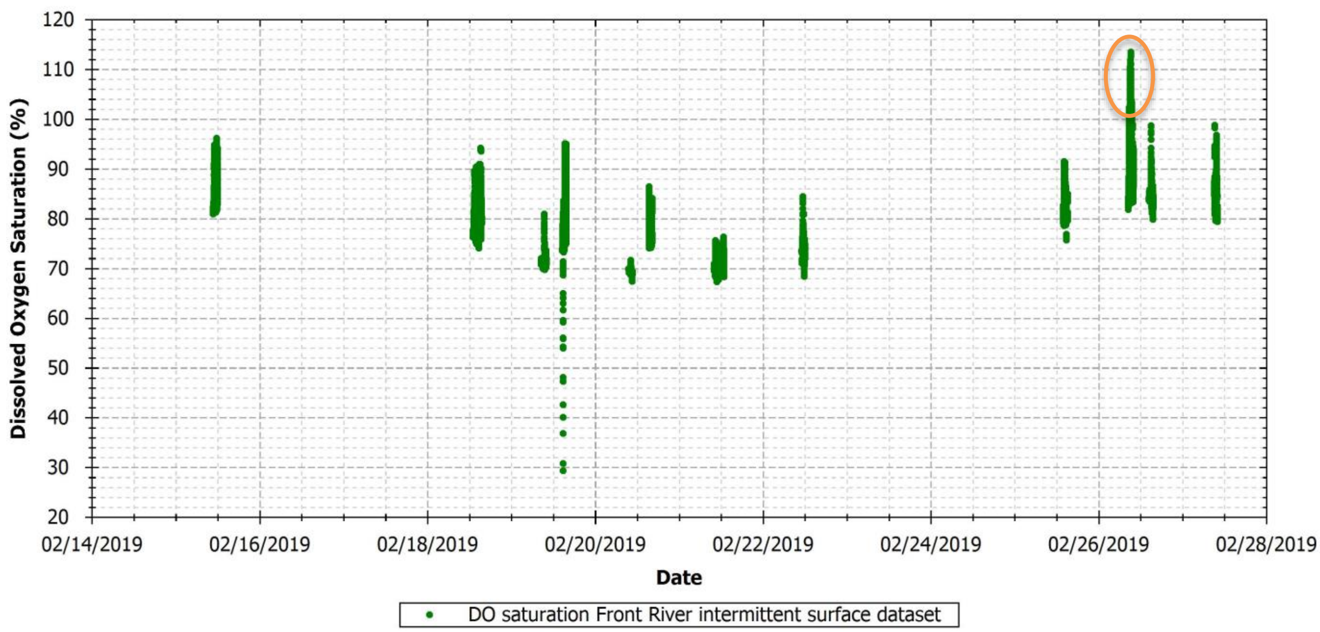


Figure 6-3 Lower Front River DO saturation in the intermittent surface dataset for WCTE period

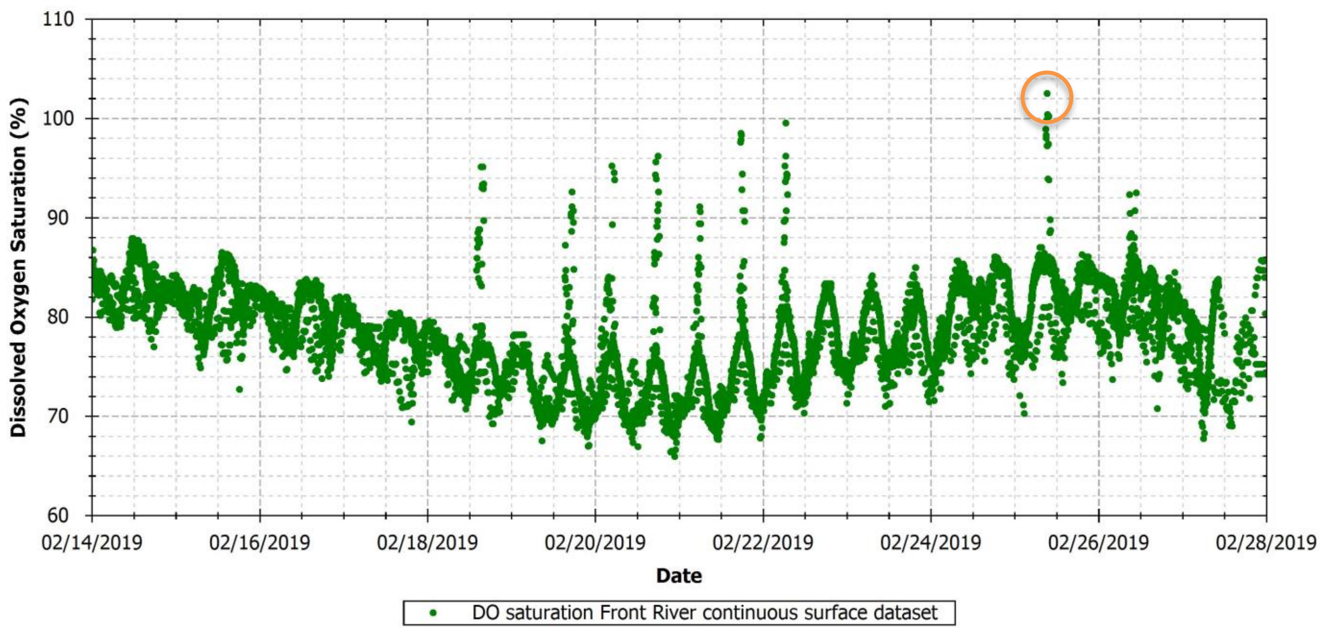


Figure 6-4 Lower Front River DO saturation in the continuous surface dataset for WCTE period

6.2 TEST RUN PERIOD (MARCH 14, 2019 TO MAY 12, 2019)

Table 6-4 and ***Table 6-5*** present average inputs tabulated across river-specific DO loss areas and the resulting Daily River DO Loss and WCTE for the lower Front River and Back River respectively. ***Table 6-6*** presents the river specific Plant loads, river specific WCTE, and the downriver systems combined WCTE results. ***Figure 6-5*** presents the results for the WCTE calculations for the Test Run period in comparison to the Back River predicted tidal and lunar cycles. In the figure, the orange line shows the daily WCTE results for the Back River diffuser, the blue line shows the daily WCTE results for the Front River diffuser, and the green line shows the daily WCTE results for the Back River and lower Front River combined WCTE. The Test Run average combined WCTE equals 98% (12,293 pounds of DO lost in comparison to 768,385 pounds of DO injected). During the Test Run period, the average operating plant load under normal conditions injected by the Downriver Plant was 13,385 pounds/day.

Table 6-4 Test Run Front River daily WCTE calculation inputs and outputs summary

Date	DO Loss Area (m^2)	Final Daily River Time (min)	Area weighted average Excess Oxygen (mg/L)	Depth (m)	Ka (1/day)	KL (m/day)	Daily River DO Loss (pounds/day)	Daily Plant DO Load (pounds/day)	Front River WCTE
3/14/2019	86	45	0.313	1.5	0.485	0.7	0.001	5,978	100.0%
3/15/2019	404	100	0.304	1.5	0.517	0.8	0.015	9,697	100.0%
3/16/2019	21	25	0.287	1.5	0.478	0.7	0.000	9,375	100.0%
3/17/2019	35	65	0.121	1.5	0.340	0.5	0.000	9,386	100.0%
3/18/2019	0	0	0.000	1.5	0.309	0.5	0.000	4,263	100.0%
3/19/2019	0	0	0.000	1.5	0.511	0.8	0.000	1,638	100.0%
3/20/2019	233	60	0.402	1.5	0.408	0.6	0.005	8,883	100.0%
3/21/2019	209	85	0.319	1.5	0.372	0.6	0.005	9,170	100.0%

Date	DO Loss Area (m^2)	Final Daily River Time (min)	Area weighted average Excess Oxygen (mg/L)	Depth (m)	Ka (1/day)	KL (m/day)	Daily River DO Loss (pounds/day)	Daily Plant DO Load (pounds/day)	Front River WCTE
3/22/2019	42	17	0.138	1.5	0.568	0.9	0.000	9,554	100.0%
3/23/2019	42	17	0.463	1.5	0.398	0.6	0.000	9,608	100.0%
3/24/2019	71	105	0.257	1.5	0.394	0.6	0.002	9,377	100.0%
3/25/2019	128	148	0.240	1.5	0.432	0.6	0.005	9,140	100.0%
3/26/2019	1,329	110	0.423	1.5	0.424	0.6	0.060	9,015	100.0%
3/27/2019	0	0	0.000	1.5	0.552	0.8	0.000	8,950	100.0%
3/28/2019	0	0	0.000	1.5	0.384	0.6	0.000	8,289	100.0%
3/29/2019	0	0	0.000	1.5	0.315	0.5	0.000	8,742	100.0%
3/30/2019	0	0	0.000	1.5	0.352	0.5	0.000	9,073	100.0%
3/31/2019	76	60	0.577	1.5	0.594	0.9	0.004	8,084	100.0%
4/1/2019	0	0	0.000	1.5	0.551	0.8	0.000	7,212	100.0%
4/2/2019	0	0	0.000	1.5	0.585	0.9	0.000	9,244	100.0%
4/3/2019	184	60	0.236	1.5	0.278	0.4	0.002	9,226	100.0%
4/4/2019	340	86	0.731	1.5	0.397	0.6	0.019	9,666	100.0%
4/5/2019	21	5	0.315	1.5	0.431	0.6	0.000	9,350	100.0%
4/6/2019	42	20	0.170	1.5	0.308	0.5	0.000	9,068	100.0%
4/7/2019	21	15	0.079	1.5	0.309	0.5	0.000	9,034	100.0%
4/8/2019	0	0	0.000	1.5	0.462	0.7	0.000	9,136	100.0%
4/9/2019	0	0	0.000	1.5	0.421	0.6	0.000	9,189	100.0%
4/10/2019	0	0	0.000	1.5	0.410	0.6	0.000	9,475	100.0%
4/11/2019	0	0	0.000	1.5	0.507	0.8	0.000	9,939	100.0%
4/12/2019	0	0	0.000	1.5	0.608	0.9	0.000	9,910	100.0%
4/13/2019	0	0	0.000	1.5	0.512	0.8	0.000	10,250	100.0%
4/14/2019	0	0	0.000	1.5	0.707	1.1	0.000	10,220	100.0%
4/15/2019	0	0	0.000	1.5	0.887	1.3	0.000	9,889	100.0%
4/16/2019	0	0	0.000	1.5	0.410	0.6	0.000	8,352	100.0%
4/17/2019	0	0	0.000	1.5	0.354	0.5	0.000	9,421	100.0%
4/18/2019	0	0	0.000	1.5	0.493	0.7	0.000	9,684	100.0%
4/19/2019	0	0	0.000	1.5	0.905	1.4	0.000	9,460	100.0%
4/20/2019	0	0	0.000	1.5	0.746	1.1	0.000	9,543	100.0%
4/21/2019	0	0	0.000	1.5	0.515	0.8	0.000	9,938	100.0%
4/22/2019	0	0	0.000	1.5	0.310	0.5	0.000	10,038	100.0%
4/23/2019	21	5	0.152	1.5	0.337	0.5	0.000	10,113	100.0%
4/24/2019	0	0	0.000	1.5	0.418	0.6	0.000	10,008	100.0%
4/25/2019	0	0	0.000	1.5	0.390	0.6	0.000	10,057	100.0%
4/26/2019	0	0	0.000	1.5	0.756	1.1	0.000	9,937	100.0%
4/27/2019	0	0	0.000	1.5	0.435	0.7	0.000	9,738	100.0%
4/28/2019	0	0	0.000	1.5	0.456	0.7	0.000	9,946	100.0%
4/29/2019	0	0	0.000	1.5	0.461	0.7	0.000	9,762	100.0%
4/30/2019	0	0	0.000	1.5	0.401	0.6	0.000	8,362	100.0%
5/1/2019	0	0	0.000	1.5	0.432	0.6	0.000	9,494	100.0%

Date	DO Loss Area (m^2)	Final Daily River Time (min)	Area weighted average Excess Oxygen (mg/L)	Depth (m)	Ka (1/day)	KL (m/day)	Daily River DO Loss (pounds/day)	Daily Plant DO Load (pounds/day)	Front River WCTE
5/2/2019	0	0	0.000	1.5	0.498	0.7	0.000	9,166	100.0%
5/3/2019	0	0	0.000	1.5	0.415	0.6	0.000	9,433	100.0%
5/4/2019	0	0	0.000	1.5	0.354	0.5	0.000	9,296	100.0%
5/5/2019	0	0	0.000	1.5	0.604	0.9	0.000	9,260	100.0%
5/6/2019	0	0	0.000	1.5	0.372	0.6	0.000	9,614	100.0%
5/7/2019	0	0	0.000	1.5	0.493	0.7	0.000	10,034	100.0%
5/8/2019	0	0	0.000	1.5	0.514	0.8	0.000	10,122	100.0%
5/9/2019	0	0	0.000	1.5	0.548	0.8	0.000	10,011	100.0%
5/10/2019	0	0	0.000	1.5	0.496	0.7	0.000	9,976	100.0%
5/11/2019	0	0	0.000	1.5	0.499	0.7	0.000	9,920	100.0%
5/12/2019	0	0	0.000	1.5	0.472	0.7	0.000	9,732	100.0%

Note Daily River DO Loss and resulting WCTE values are actual calculated loss (summed from individual areas) and not based on averages as presented in table

Table 6-5 Test Run Back River daily WCTE calculation inputs and outputs summary

Date	DO Loss Area (m^2)	Final Daily River Time (min)	Area weighted average Excess Oxygen (mg/L)	Depth (m)	Ka (1/day)	KL (m/day)	Daily River DO Loss (pounds/day)	Daily Plant DO Load (pounds/day)	Back River WCTE
3/14/2019	289	160	0.067	1.5	0.625	0.9	0.004	2,443	100.0%
3/15/2019	204	201	0.151	1.5	0.629	0.9	0.009	3,707	100.0%
3/16/2019	372	195	0.128	1.5	0.643	1.0	0.014	3,592	100.0%
3/17/2019	0	0	0.000	1.5	0.474	0.7	0.000	3,538	100.0%
3/18/2019	0	0	0.000	1.5	0.478	0.7	0.000	1,574	100.0%
3/19/2019	0	0	0.000	1.5	0.689	1.0	0.000	777	100.0%
3/20/2019	168	75	0.098	1.5	0.579	0.9	0.002	3,530	100.0%
3/21/2019	153	70	0.129	1.5	0.567	0.8	0.002	3,631	100.0%
3/22/2019	105	62	0.090	1.5	0.740	1.1	0.001	3,744	100.0%
3/23/2019	168	182	0.067	1.5	0.602	0.9	0.003	3,609	100.0%
3/24/2019	189	320	0.210	1.5	0.593	0.9	0.017	3,663	100.0%
3/25/2019	3,277	557	0.190	1.5	0.616	0.9	0.489	3,557	100.0%
3/26/2019	92,793	613	0.210	1.5	0.540	0.8	14.792	3,473	99.6%
3/27/2019	92,884	810	0.721	1.5	0.670	1.0	83.416	3,369	97.5%
3/28/2019	92,884	1,095	0.942	1.5	0.491	0.7	107.968	3,057	96.5%
3/29/2019	92,884	990	0.702	1.5	0.433	0.6	64.162	3,723	98.3%
3/30/2019	92,884	960	0.628	1.5	0.496	0.7	63.804	3,964	98.4%
3/31/2019	92,884	1,050	0.696	1.5	0.725	1.1	112.976	3,645	96.9%
4/1/2019	92,884	480	0.214	1.5	0.682	1.0	14.959	3,054	99.5%
4/2/2019	92,884	375	0.379	1.5	0.739	1.1	22.391	3,675	99.4%
4/3/2019	7,353	271	0.237	1.5	0.428	0.6	0.465	3,786	100.0%

Date	DO Loss Area (m^2)	Final Daily River Time (min)	Area weighted average Excess Oxygen (mg/L)	Depth (m)	Ka (1/day)	KL (m/day)	Daily River DO Loss (pounds/day)	Daily Plant DO Load (pounds/day)	Back River WCTE
4/4/2019	73,239	345	0.270	1.5	0.544	0.8	8.536	3,895	99.8%
4/5/2019	189	181	0.352	1.5	0.612	0.9	0.017	3,857	100.0%
4/6/2019	147	65	0.082	1.5	0.491	0.7	0.001	3,833	100.0%
4/7/2019	189	154	0.235	1.5	0.465	0.7	0.007	3,872	100.0%
4/8/2019	189	230	0.142	1.5	0.613	0.9	0.009	3,932	100.0%
4/9/2019	21	30	0.025	1.5	0.612	0.9	0.000	3,951	100.0%
4/10/2019	42	5	0.138	1.5	0.589	0.9	0.000	4,069	100.0%
4/11/2019	0	0	0.000	1.5	0.647	1.0	0.000	4,238	100.0%
4/12/2019	0	0	0.000	1.5	0.775	1.2	0.000	4,237	100.0%
4/13/2019	0	0	0.000	1.5	0.660	1.0	0.000	4,298	100.0%
4/14/2019	0	0	0.000	1.5	0.884	1.3	0.000	4,247	100.0%
4/15/2019	0	0	0.000	1.5	1.099	1.6	0.000	4,089	100.0%
4/16/2019	0	0	0.000	1.5	0.592	0.9	0.000	3,333	100.0%
4/17/2019	0	0	0.000	1.5	0.552	0.8	0.000	3,682	100.0%
4/18/2019	0	0	0.000	1.5	0.666	1.0	0.000	3,606	100.0%
4/19/2019	0	0	0.000	1.5	1.128	1.7	0.000	3,525	100.0%
4/20/2019	0	0	0.000	1.5	0.963	1.4	0.000	3,590	100.0%
4/21/2019	0	0	0.000	1.5	0.692	1.0	0.000	3,727	100.0%
4/22/2019	189	46	0.096	1.5	0.509	0.8	0.001	3,733	100.0%
4/23/2019	189	346	0.307	1.5	0.532	0.8	0.025	3,639	100.0%
4/24/2019	189	503	0.640	1.5	0.591	0.9	0.083	3,540	100.0%
4/25/2019	1,443,125	1,140	0.659	1.5	0.532	0.8	1,324.021	3,658	63.8%
4/26/2019	1,443,125	1,200	0.551	1.5	0.932	1.4	2,040.559	3,791	46.2%
4/27/2019	1,443,125	930	0.872	1.5	0.592	0.9	1,592.466	3,734	57.4%
4/28/2019	1,443,125	1,170	0.647	1.5	0.614	0.9	1,540.298	3,821	59.7%
4/29/2019	1,443,125	1,275	0.813	1.5	0.646	1.0	2,219.005	3,839	42.2%
4/30/2019	1,443,125	1,365	0.722	1.5	0.563	0.8	1,839.029	3,370	45.4%
5/1/2019	1,443,125	990	0.591	1.5	0.598	0.9	1,160.489	3,824	69.6%
5/2/2019	388,815	281	0.469	1.5	0.702	1.1	82.598	3,745	97.8%
5/3/2019	42	10	0.049	1.5	0.599	0.9	0.000	3,871	100.0%
5/4/2019	0	0	0.000	1.5	0.514	0.8	0.000	3,831	100.0%
5/5/2019	0	0	0.000	1.5	0.828	1.2	0.000	3,738	100.0%
5/6/2019	0	0	0.000	1.5	0.580	0.9	0.000	3,816	100.0%
5/7/2019	0	0	0.000	1.5	0.679	1.0	0.000	3,959	100.0%
5/8/2019	21	45	0.295	1.5	0.700	1.0	0.000	3,978	100.0%
5/9/2019	42	107	0.103	1.5	0.753	1.1	0.001	3,941	100.0%
5/10/2019	17,498	152	0.137	1.5	0.660	1.0	0.552	4,063	100.0%
5/11/2019	84	33	0.102	1.5	0.697	1.0	0.000	4,049	100.0%
5/12/2019	0	0	0.000	1.5	0.658	1.0	0.000	3,909	100.0%

Note Daily River DO Loss and resulting WCTE values are actual calculated loss (summed from individual areas) and not based on averages as presented in table

Table 6-6 Test Run combination WCTE results

Date	Front River Daily Plant DO Load (pounds/day)	Front River WCTE	Back River Daily Plant DO Load (pounds/day)	Back River WCTE	River Combination WCTE
3/14/2019	5,978	100.0%	2,443	100.0%	100.0%
3/15/2019	9,697	100.0%	3,707	100.0%	100.0%
3/16/2019	9,375	100.0%	3,592	100.0%	100.0%
3/17/2019	9,386	100.0%	3,538	100.0%	100.0%
3/18/2019	4,263	100.0%	1,574	100.0%	100.0%
3/19/2019	1,638	100.0%	777	100.0%	100.0%
3/20/2019	8,883	100.0%	3,530	100.0%	100.0%
3/21/2019	9,170	100.0%	3,631	100.0%	100.0%
3/22/2019	9,554	100.0%	3,744	100.0%	100.0%
3/23/2019	9,608	100.0%	3,609	100.0%	100.0%
3/24/2019	9,377	100.0%	3,663	100.0%	100.0%
3/25/2019	9,140	100.0%	3,557	100.0%	100.0%
3/26/2019	9,015	100.0%	3,473	99.6%	99.9%
3/27/2019	8,950	100.0%	3,369	97.5%	99.3%
3/28/2019	8,289	100.0%	3,057	96.5%	99.0%
3/29/2019	8,742	100.0%	3,723	98.3%	99.5%
3/30/2019	9,073	100.0%	3,964	98.4%	99.5%
3/31/2019	8,084	100.0%	3,645	96.9%	99.0%
4/1/2019	7,212	100.0%	3,054	99.5%	99.9%
4/2/2019	9,244	100.0%	3,675	99.4%	99.8%
4/3/2019	9,226	100.0%	3,786	100.0%	100.0%
4/4/2019	9,666	100.0%	3,895	99.8%	99.9%
4/5/2019	9,350	100.0%	3,857	100.0%	100.0%
4/6/2019	9,068	100.0%	3,833	100.0%	100.0%
4/7/2019	9,034	100.0%	3,872	100.0%	100.0%
4/8/2019	9,136	100.0%	3,932	100.0%	100.0%
4/9/2019	9,189	100.0%	3,951	100.0%	100.0%
4/10/2019	9,475	100.0%	4,069	100.0%	100.0%
4/11/2019	9,939	100.0%	4,238	100.0%	100.0%
4/12/2019	9,910	100.0%	4,237	100.0%	100.0%
4/13/2019	10,250	100.0%	4,298	100.0%	100.0%
4/14/2019	10,220	100.0%	4,247	100.0%	100.0%
4/15/2019	9,889	100.0%	4,089	100.0%	100.0%
4/16/2019	8,352	100.0%	3,333	100.0%	100.0%
4/17/2019	9,421	100.0%	3,682	100.0%	100.0%
4/18/2019	9,684	100.0%	3,606	100.0%	100.0%
4/19/2019	9,460	100.0%	3,525	100.0%	100.0%
4/20/2019	9,543	100.0%	3,590	100.0%	100.0%
4/21/2019	9,938	100.0%	3,727	100.0%	100.0%
4/22/2019	10,038	100.0%	3,733	100.0%	100.0%
4/23/2019	10,113	100.0%	3,639	100.0%	100.0%

Date	Front River Daily Plant DO Load (pounds/day)	Front River WCTE	Back River Daily Plant DO Load (pounds/day)	Back River WCTE	River Combination WCTE
4/24/2019	10,008	100.0%	3,540	100.0%	100.0%
4/25/2019	10,057	100.0%	3,658	63.8%	90.3%
4/26/2019	9,937	100.0%	3,791	46.2%	85.1%
4/27/2019	9,738	100.0%	3,734	57.4%	88.2%
4/28/2019	9,946	100.0%	3,821	59.7%	88.8%
4/29/2019	9,762	100.0%	3,839	42.2%	83.7%
4/30/2019	8,362	100.0%	3,370	45.4%	84.3%
5/1/2019	9,494	100.0%	3,824	69.6%	91.3%
5/2/2019	9,166	100.0%	3,745	97.8%	99.4%
5/3/2019	9,433	100.0%	3,871	100.0%	100.0%
5/4/2019	9,296	100.0%	3,831	100.0%	100.0%
5/5/2019	9,260	100.0%	3,738	100.0%	100.0%
5/6/2019	9,614	100.0%	3,816	100.0%	100.0%
5/7/2019	10,034	100.0%	3,959	100.0%	100.0%
5/8/2019	10,122	100.0%	3,978	100.0%	100.0%
5/9/2019	10,011	100.0%	3,941	100.0%	100.0%
5/10/2019	9,976	100.0%	4,063	100.0%	100.0%
5/11/2019	9,920	100.0%	4,049	100.0%	100.0%
5/12/2019	9,732	100.0%	3,909	100.0%	100.0%

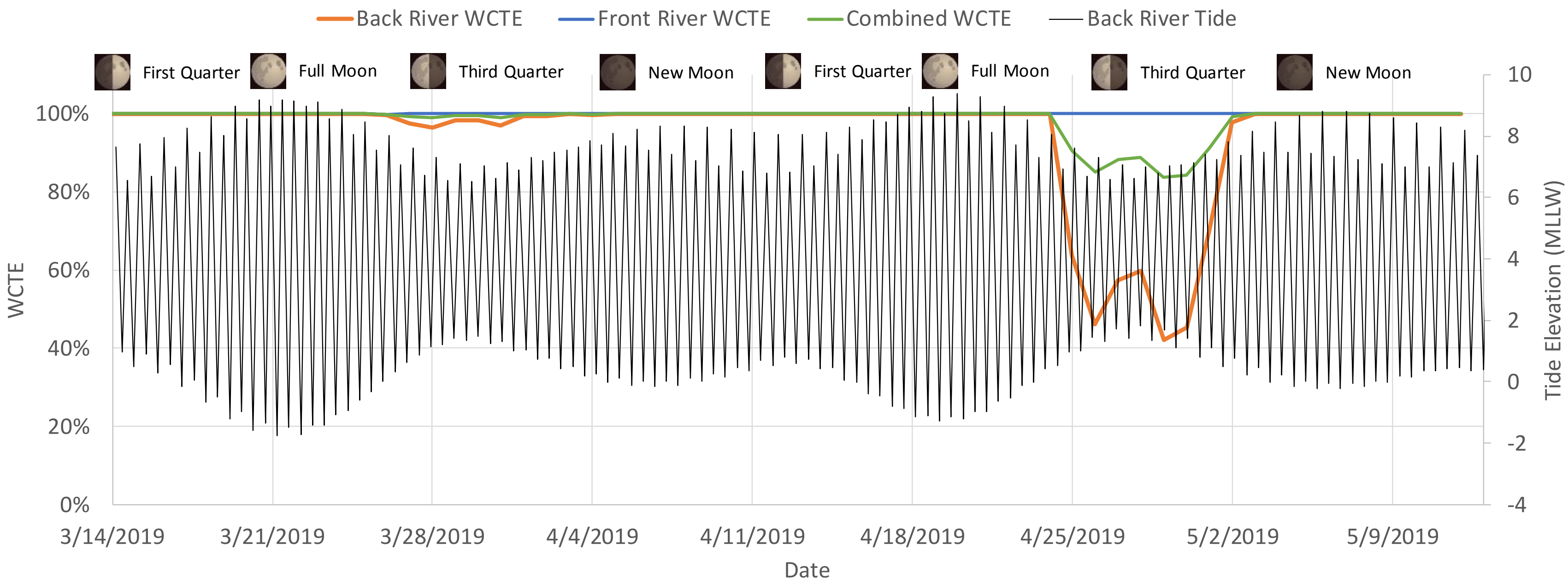


Figure 6-5 Test Run WCTE results in comparison to tidal and lunar cycle

During the Test Run data collection, DO loss conditions in the Back River were identified throughout the 60 days in the Back River Intermittent Surface dataset (orange box in ***Figure 6-6***) and Continuous Surface dataset (orange box in ***Figure 6-7***). Most of the DO loss conditions occurred during neap tide conditions when both the daily minimum and maximum DO saturation values were typically higher than other periods.

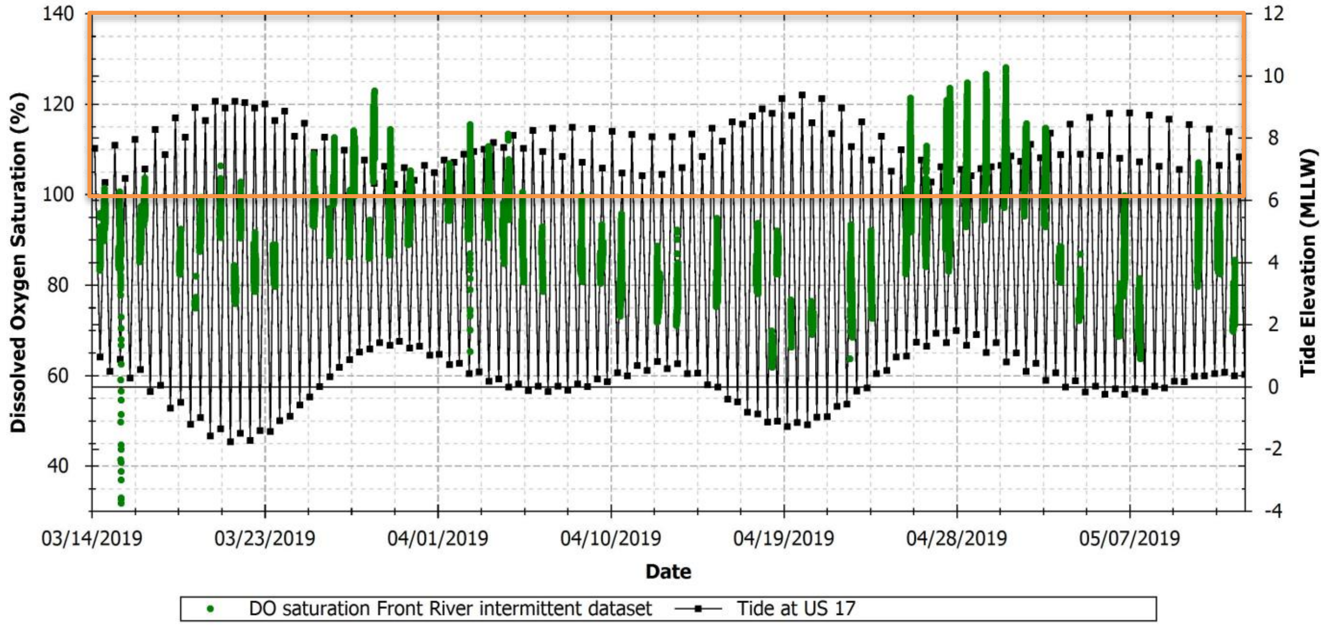


Figure 6-6 Back River DO saturation in the intermittent surface dataset

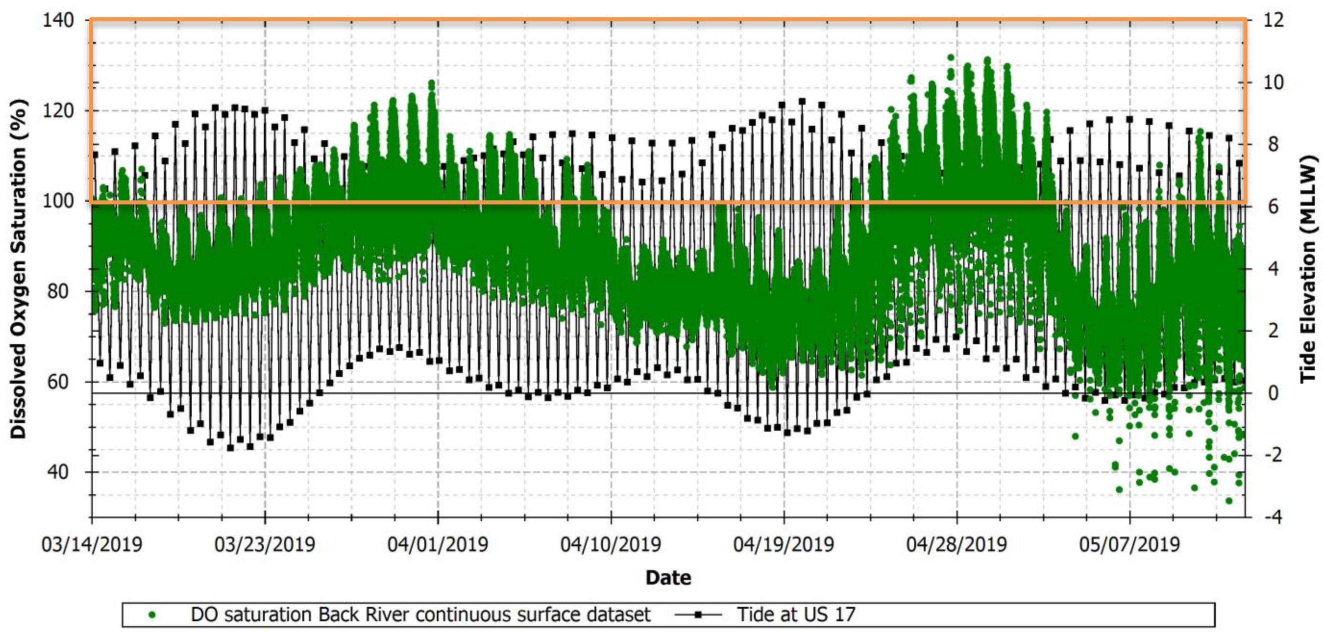


Figure 6-7 Back River DO saturation in the continuous surface dataset

DO loss conditions in the lower Front River were found in the Intermittent and Continuous Surface datasets during the first four weeks of the Test Run study (orange box in ***Figure 6-8*** and ***Figure 6-9***). This higher DO saturation period trend was not related to the tidal cycles and was likely related to the seasonality of DO concentrations and saturations. Therefore, lower Front River DO loss may be more dependent on seasonality of background DO levels and the ambient water columns' ability to dilute and assimilate the injected oxygen than tidal conditions.

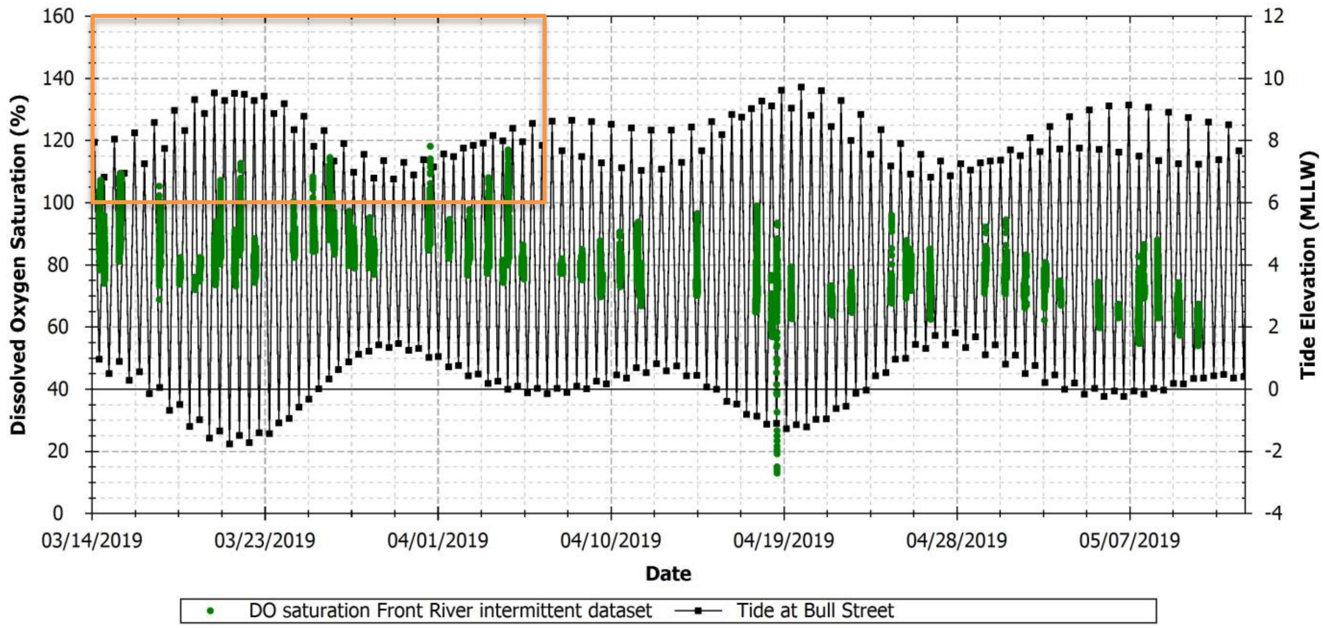


Figure 6-8 Lower Front River DO saturation in the intermittent surface dataset

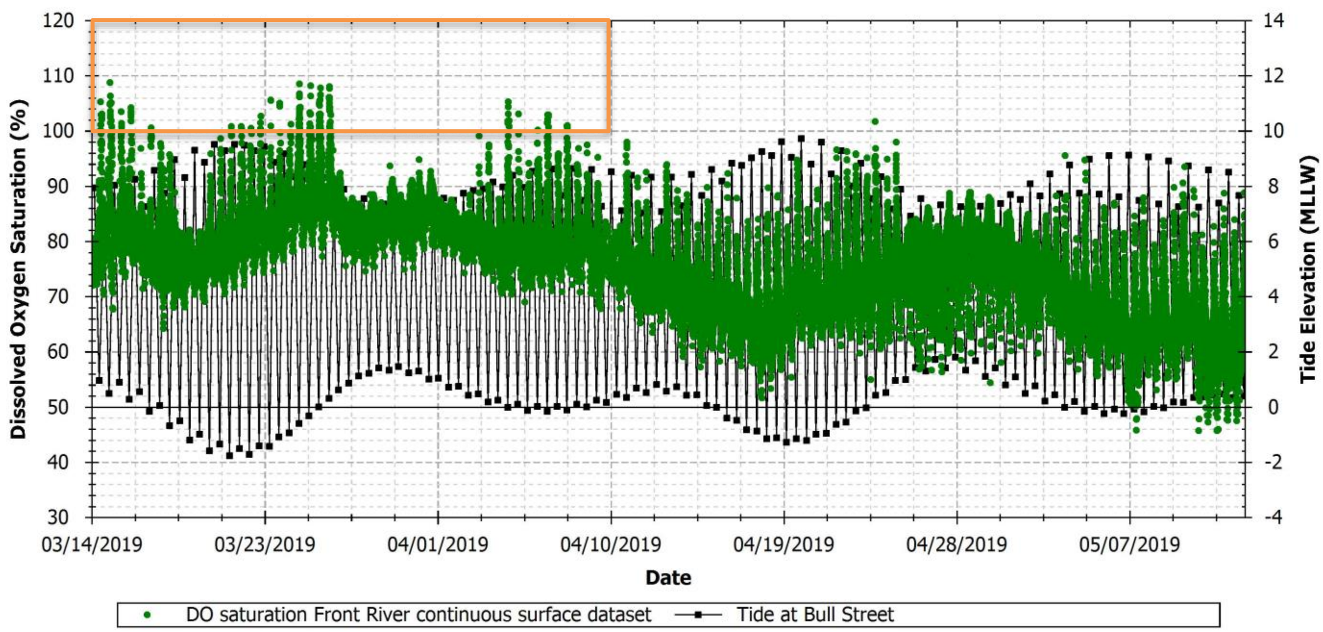


Figure 6-9 Lower Front River DO saturation in the continuous surface dataset

Drift data were collected throughout the tidal cycle to capture variations in mixing and plume movement due to changes in the tidal forces. Spring tides are stronger than neap tides due to the increased gravitation forces from the moon and the sun, resulting in greater high tides and lower low tides. A spring tide was sampled on April 17, 2019 which traversed both downstream and upstream of the diffuser (***Figure 6-10***), and a neap tide was sampled on April 27, 2019 which traversed a similar path (***Figure 6-11***).

During the spring tide drift, the observed DO saturation values were similar throughout the water column and were also less than 100% (***Figure 6-12***). In contrast, during neap tide the observed DO saturation values varied throughout the water column and were frequently measured above 100% in the shallow layer (top 0.5 meters) (***Figure 6-12***). In both data collection events, the boat moved in and out of the plume as it traversed the channel. During the spring tide, DO saturation values in the plume varied between 85% and 95%, while values outside of the plume were around 80%. The limits of the plume were less defined in the neap tide sampling, partially due to the tidal dynamics during sampling, but in general the DO saturation values in the surface layer of the plume were between 110% and 120%, while values outside of the plume varied between 90% and 110%.

The spring tide data collection confirmed that increased mixing dynamics from the stronger tides allowed for the Back River water column to dilute and assimilate the injected DO. This was confirmed by the lower range of observed DO saturations, nearly homogeneous mixing vertically in the water column, and the absence of DO saturation values greater than 100% near the surface of the water. The neap tide data collection indicated that mixing dynamics present during the neap tides did not allow the Back River water column to completely dilute and assimilate the injected DO. This was confirmed by the higher range of observed DO saturation, heterogeneous mixing vertically in the water column, and the presence of DO saturation values greater than 100% near the surface of the water.

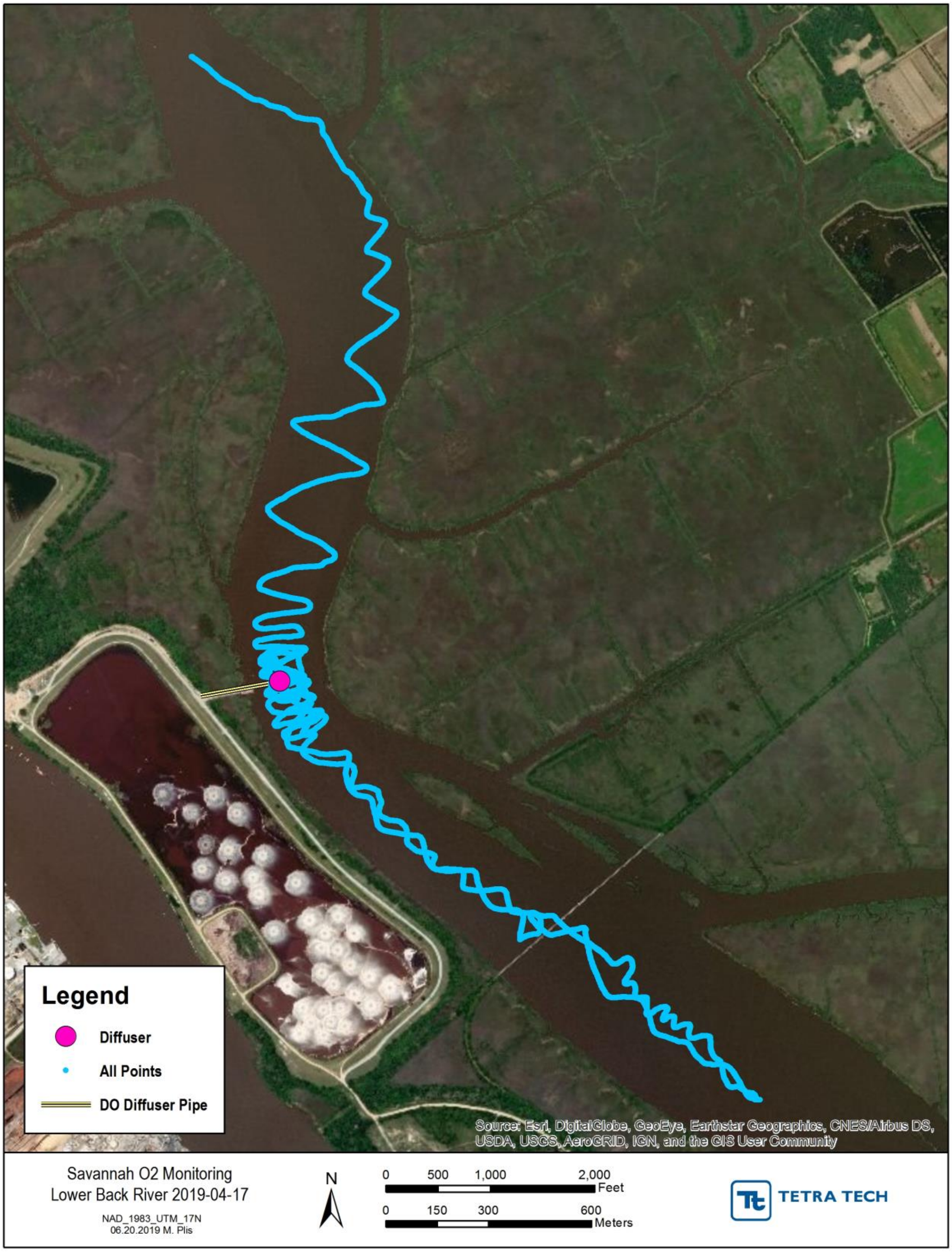


Figure 6-10 Back River April 17, 2019 spring ebb tide drift location map

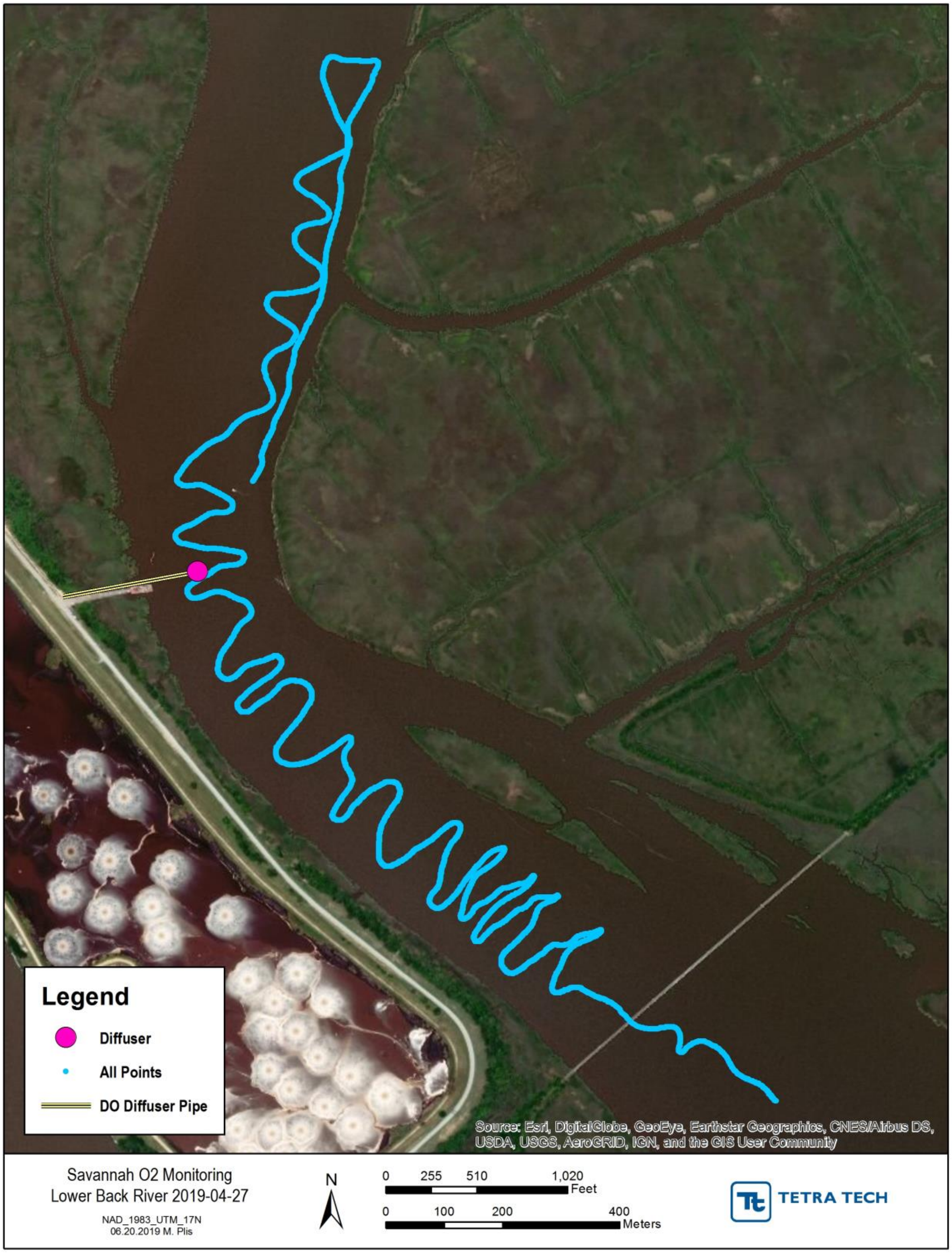


Figure 6-11 Back River April 27, 2019 neap ebb tide drift location map

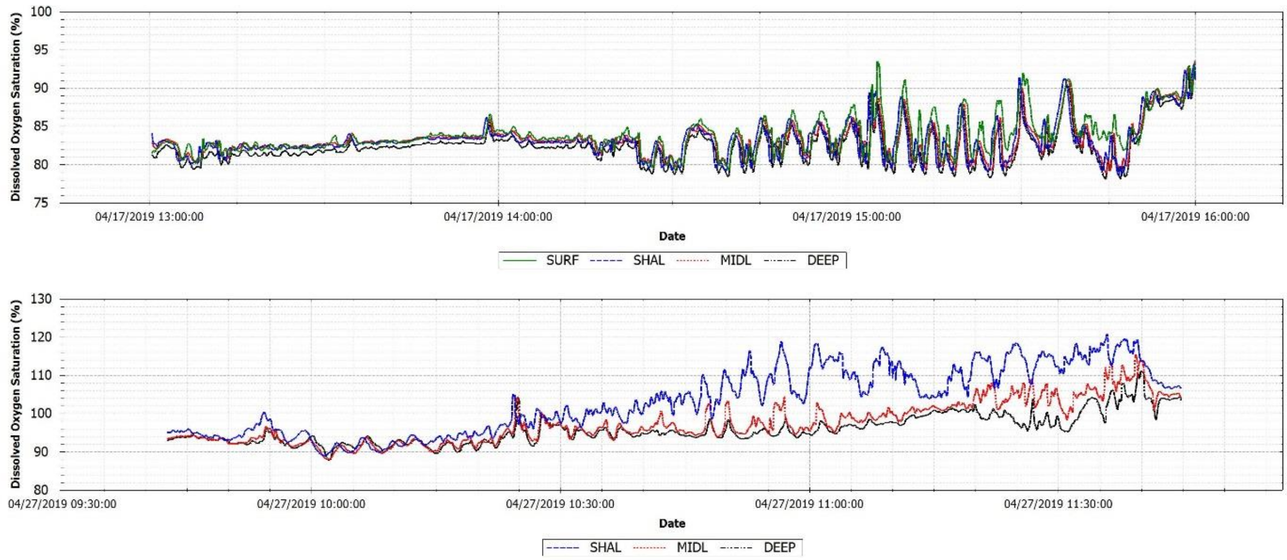


Figure 6-12 Lower Back River ebb tide drift DO saturation for spring tide (top) and neap tide (bottom)

Drift data collected during the neap tide also confirmed that the DO saturation values greater than 100% were almost always measured at water depths shallower than one and a half (1.5) meters. Water depths during the April 27, 2019 drift data collection were low, so the drift sondes were set at the following depths: approximately one half (0.5) meter for the shallow sonde, one and a half (1.5) meters for the middle sonde, and two and a half (2.5) meters for the deep sonde (***Figure 6-13***). Within the plume, the shallow sonde measured DO saturation values greater than 100%, the middle sonde regularly measured values greater than 100%, and the deep sonde measured values sporadically measured values greater than 100% (***Figure 6-13***). Most of the higher DO saturation values measured by the deep sonde occurred when it was lifted toward the surface at the end of the drift sampling. This confirmed the assumption that top 1.5 meters represented the average depth at which DO super saturated conditions existed in the Back River, which corresponded to the depth of water which would potentially lose oxygen to the atmosphere when DO loss conditions were present.

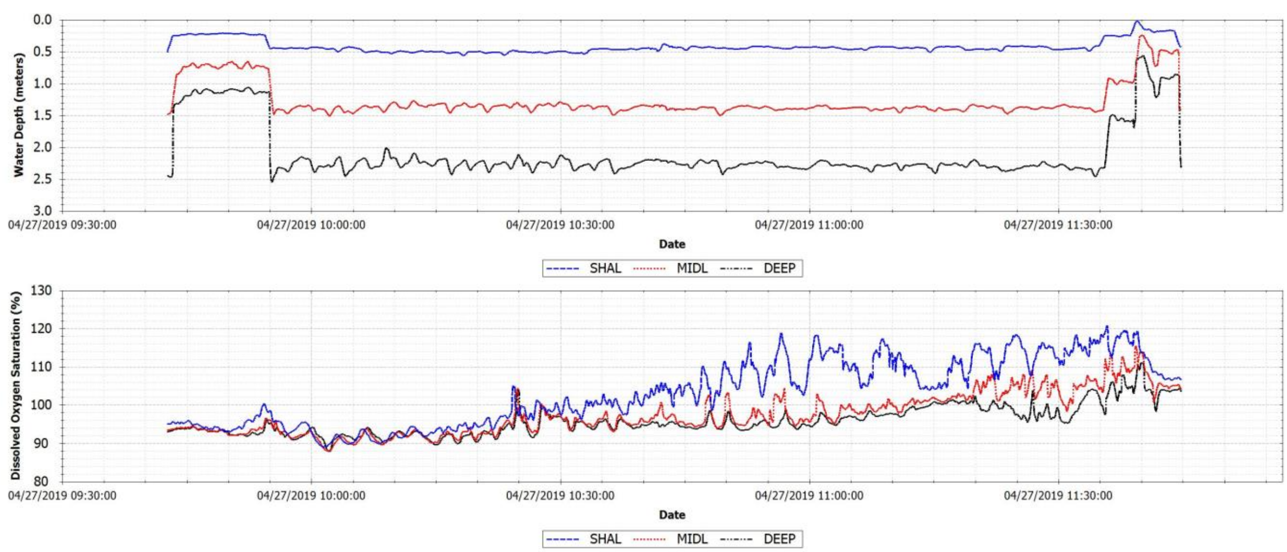


Figure 6-13 Back River April 27, 2019 neap ebb tide drift DO saturation and depth

7.0 CONCLUSION

The field team successfully conducted monitoring on the lower Front River and Back River for the WCTE study period (February 14 through February 27, 2019) and during the Test Run period (March 14 through May 12, 2019). The acceptance rate for the data collected during the data collection periods were 97.4%, greater than the required 90% acceptance rate.

The data collected were analyzed and were able to show the following: 1) the injected DO was present in the water column, 2) the DO stayed in the water column, and 3) the DO vertically and laterally mixed in the water column.

The monitoring data was successfully used to develop a method to calculate WCTE. Various methods of calculating DO loss out of the water column were evaluated. The selected method was a site-specific approach, using the locally collected data in the lower Front River and the Back River, and was based on the physics of DO transfer across the air-water interface during times when the water column was at or above super-saturation. The selected method estimated the mass of injected oxygen lost to the atmosphere on a daily basis.

During the WCTE study period approximately 61,500 pounds of oxygen were injected by the Plant and only 0.02 pounds were lost to the atmosphere. This low level of loss resulted in a WCTE of approximately 100% for the WCTE study period.

The data collected during the Test Run period were also used to calculate the WCTE. During the Test Run period, the average operating plant load under normal conditions injected by the Downriver Plant was 13,385 pounds/day. The WCTE calculations for the Test Run period showed an average combined WCTE of approximately 98%. The slightly lower Test Run WCTE calculation is due to the fact that the Test Run study period captured two (2) neap tide time periods. Dye injection and water quality data showed that during neap tides there is reduced flushing of the Back River system which allowed super-saturated DO water to build up in the Back River. This super-saturated DO plume moved from downstream to upstream between ebb and flood tide and moved from upstream to downstream between flood and ebb tide. During these tidal swings the DO plume moved through the diffuser area and the Plant injected more DO super-saturated water into the plume, creating an even larger DO plume with DO saturations greater than 100%.

It is recommended that the USACE operate the Downriver Plant assuming a WCTE of 95%. This is to account for the variability in the system (e.g., flows, velocities, temperatures, instream DO concentrations, tidal cycle, etc.) that might be encountered during other periods of the year.

8.0 BIBLIOGRAPHY

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APPENDIX A PLATFORM FIGURES

APPENDIX A TABLE OF CONTENTS

APPENDIX A LIST OF FIGURES

APPENDIX A LIST OF TABLES

A.1 DEFINITIONS AND LOCATION MAPS

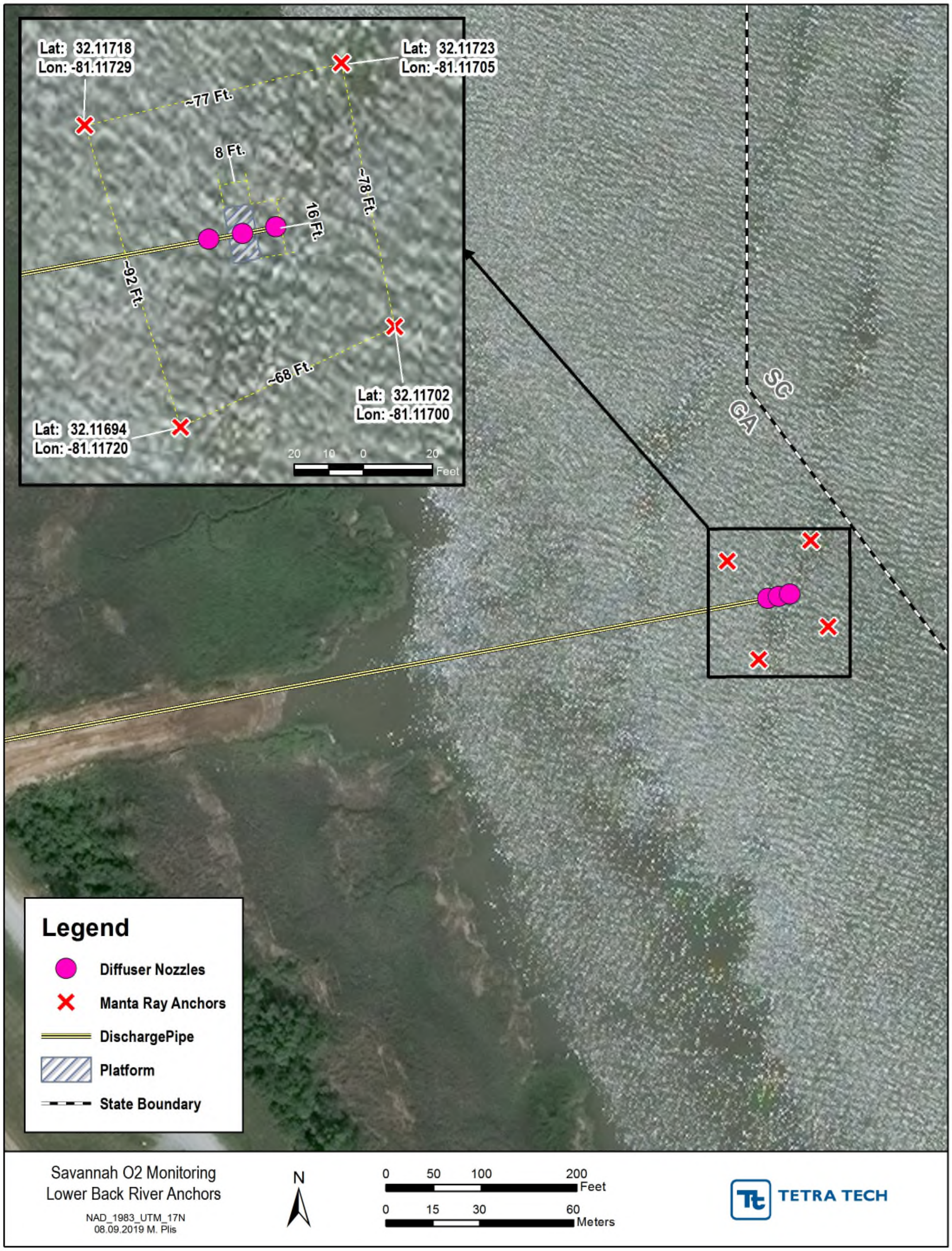


Figure A-1 Location of platform on the Back River

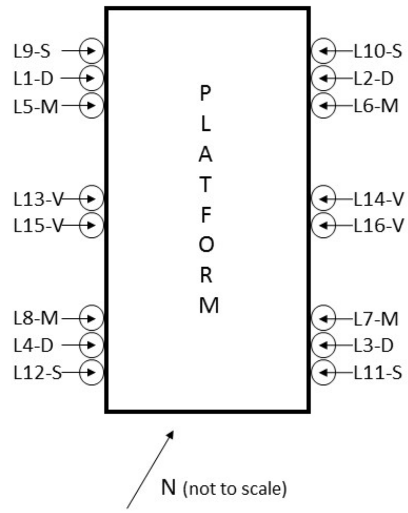


Figure A-2 Data sonde locations on the Back River platform

Table A-1 Data sondes used on the platform for WCTE study sampling

Sonde ID	Platform Location	Description	Deployment Period
L10-S	Northeast	Shallow sonde with algae-sensor	February 14, 2019 to February 28, 2019
L6-M	Northeast	Mid-depth sonde with algae-sensor	February 14, 2019 to February 28, 2019
L2-D	Northeast	Deep sonde with algae-sensor	February 14, 2019 to February 28, 2019
L9-S	Northwest	Shallow sonde	February 14, 2019 to February 28, 2019
L5-M	Northwest	Mid-depth sonde	February 14, 2019 to February 28, 2019
L1-D	Northwest	Deep sonde	February 14, 2019 to February 28, 2019
L11-S	Southeast	Shallow sonde	February 14, 2019 to February 28, 2019
L7-M	Southeast	Mid-depth sonde	February 14, 2019 to February 28, 2019
L3-D	Southeast	Deep sonde	February 14, 2019 to February 28, 2019
L12-S	Southwest	Shallow sonde	February 14, 2019 to February 28, 2019
L8-M	Southwest	Mid-depth sonde	February 14, 2019 to February 28, 2019
L4-D	Southwest	Deep sonde	February 14, 2019 to February 28, 2019
L13-V	Between the northwest and southwest sondes	Sonde with algae-sensor placed ~1.8 meters below the platform	February 14, 2019 to February 28, 2019
L14-V	Between the northeast and southeast sondes	Sonde placed ~1.8 meters below the platform	February 14, 2019 to February 28, 2019
L15-V	Between the northwest and southwest sondes	Sonde placed ~3.4 meters below the platform	February 14, 2019 to February 28, 2019
L16-V	Between the northeast and southeast sondes	Sonde with algae-sensor placed at ~3.4 meters below the platform	February 14, 2019 to February 28, 2019

Table A-2 Definitions of abbreviations

Abbreviation	Definition
BGA	blue green algae concentration (surrogate for dye)
CABLE	power level to sonde
CHLA	chlorophyll a concentration
DEPTH	depth below water surface
DO	dissolved oxygen concentration
DO%	dissolved oxygen percent saturation
SAL	salinity concentration
SPCOND	specific conductivity
WTEMP	water temperature

A.2 BACK RIVER NORTHEAST CORNER OF THE PLATFORM

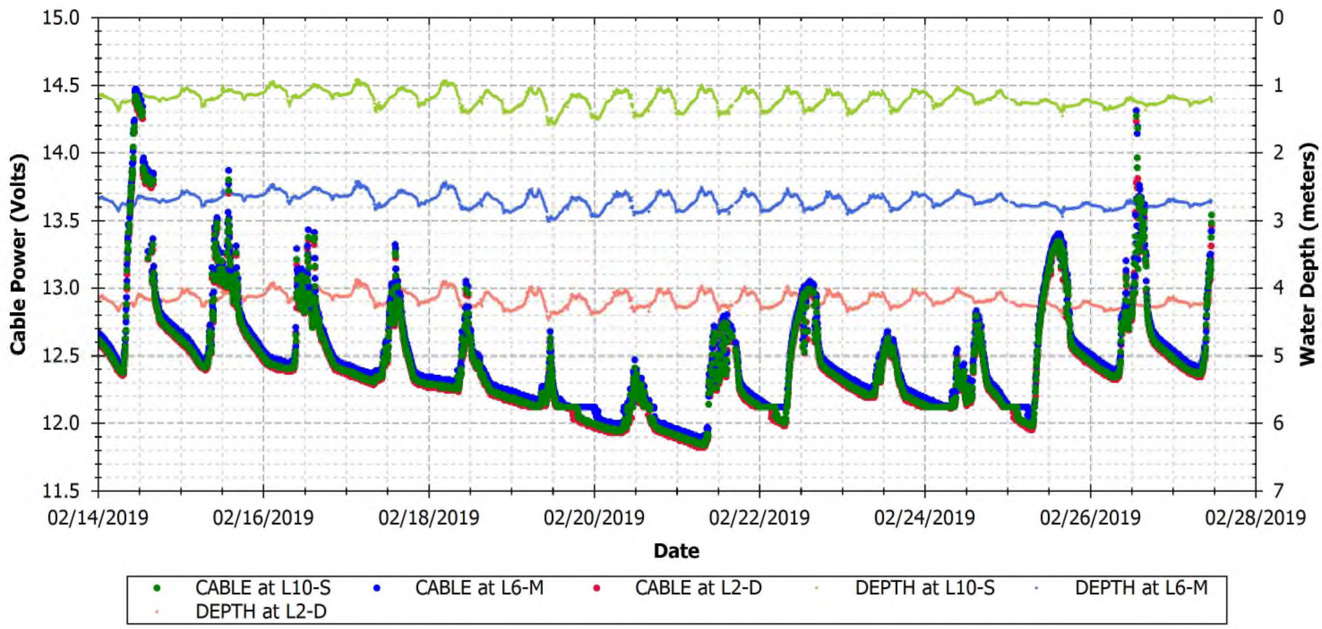


Figure A-3 Back River northeast corner observed cable power

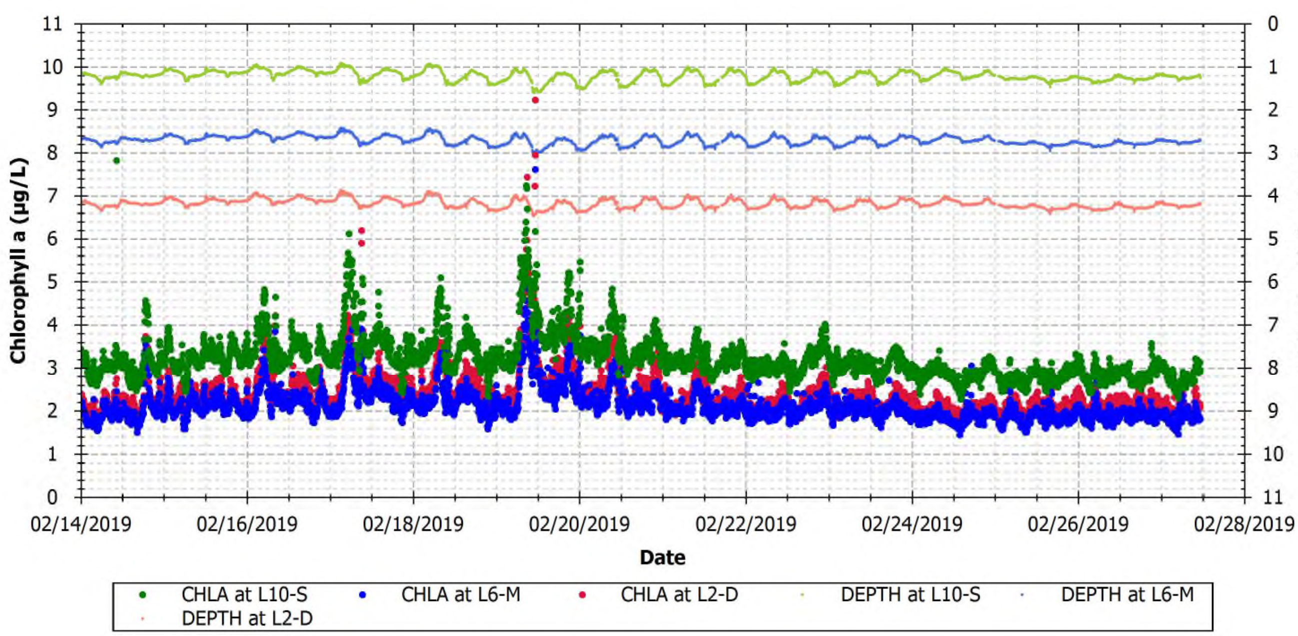


Figure A-4 Back River northeast corner observed chlorophyll a

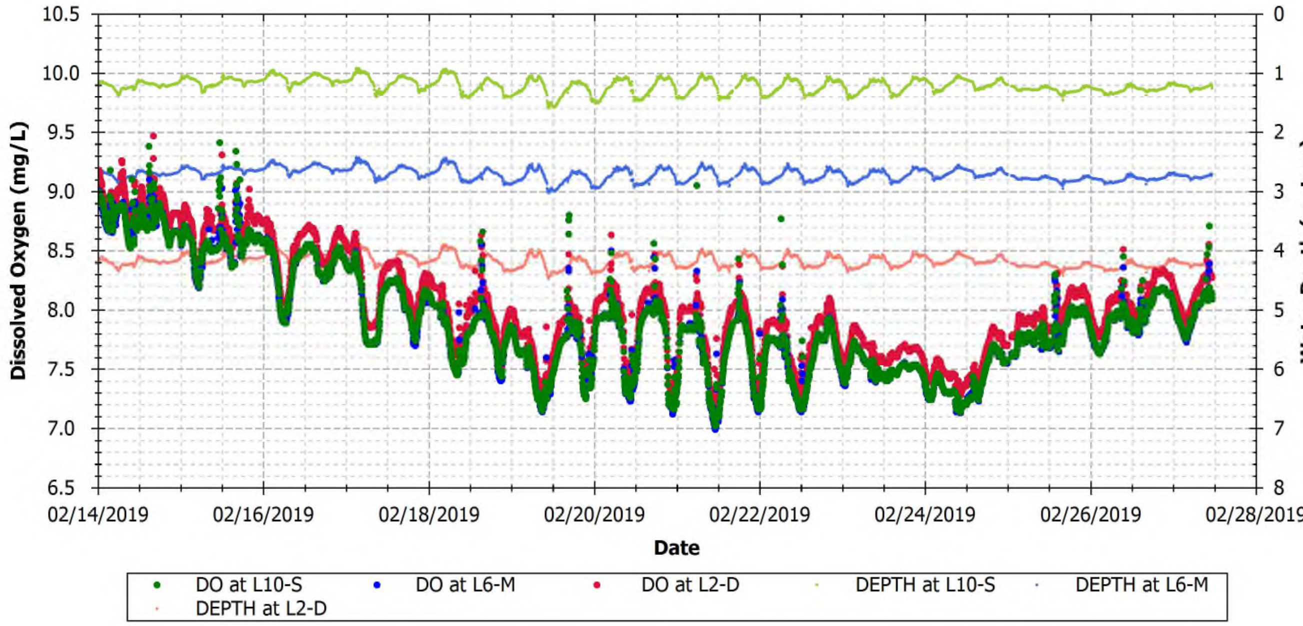


Figure A-5 Back River northeast corner observed DO

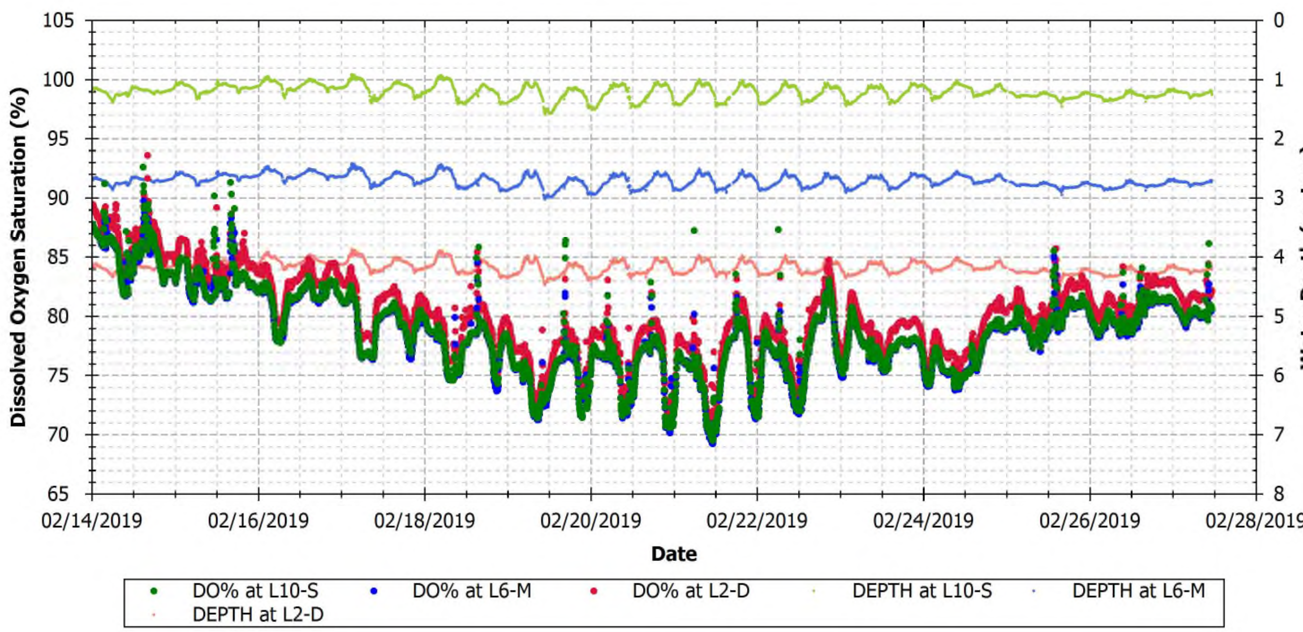


Figure A-6 Back River northeast corner observed DO saturation

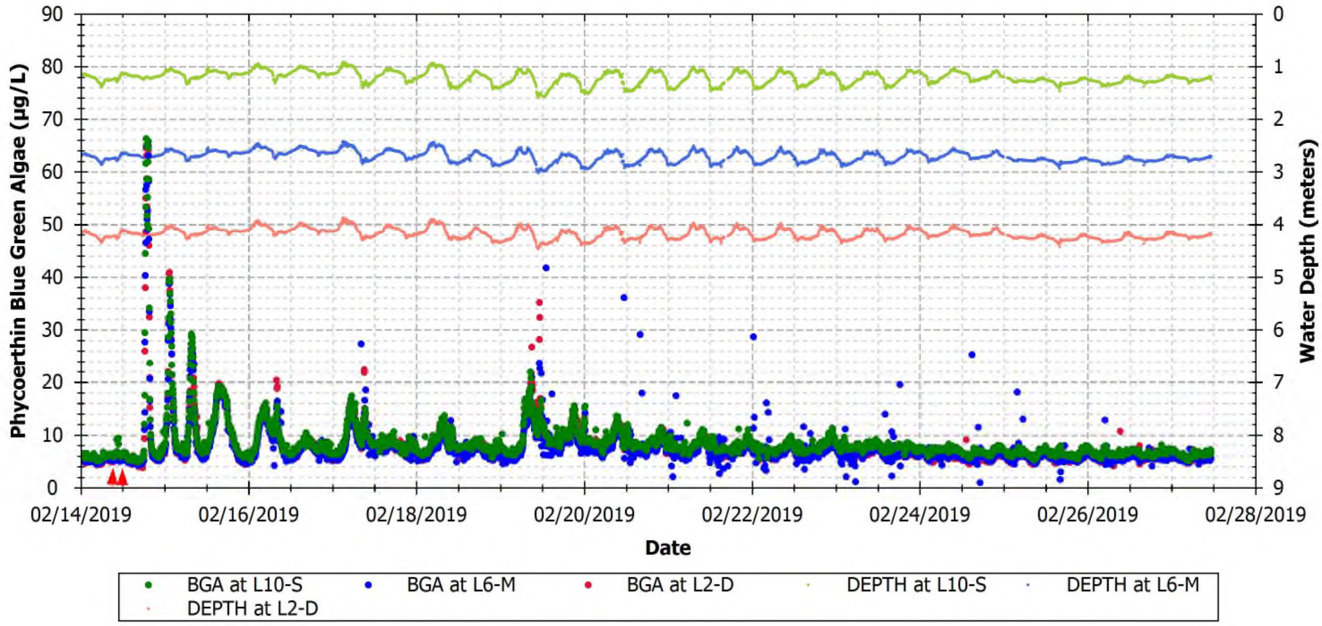


Figure A-7 Back River northeast corner observed BGA

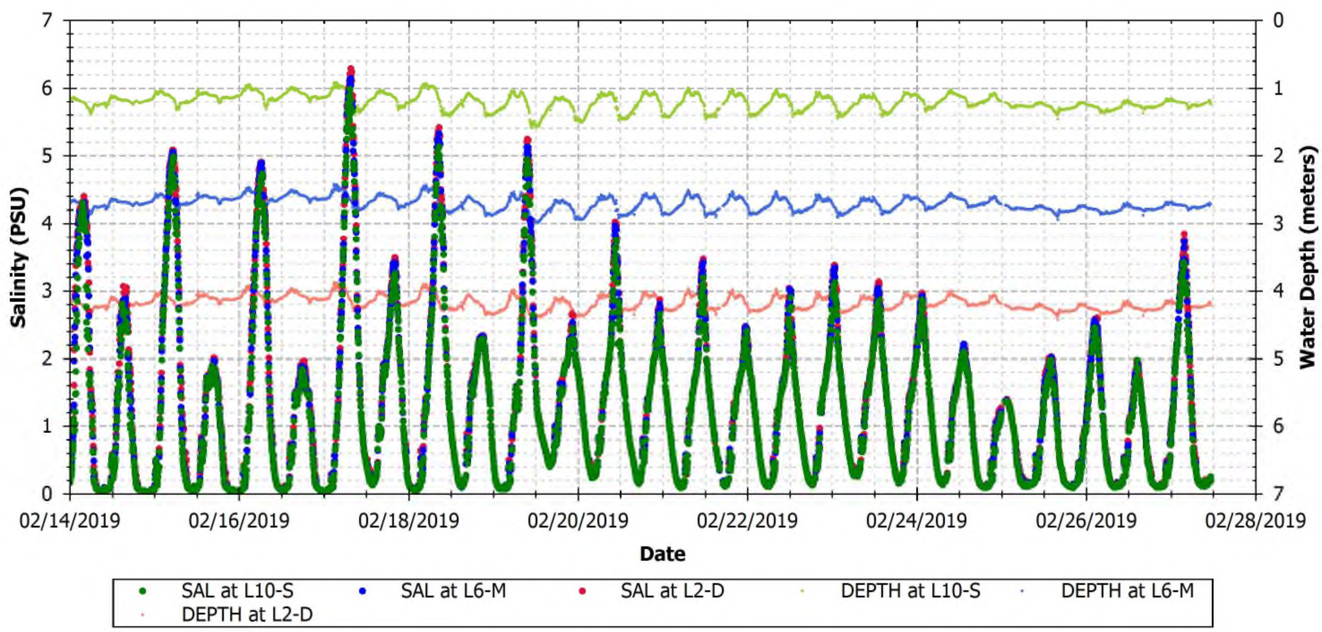


Figure A-8 Back River northeast corner observed salinity

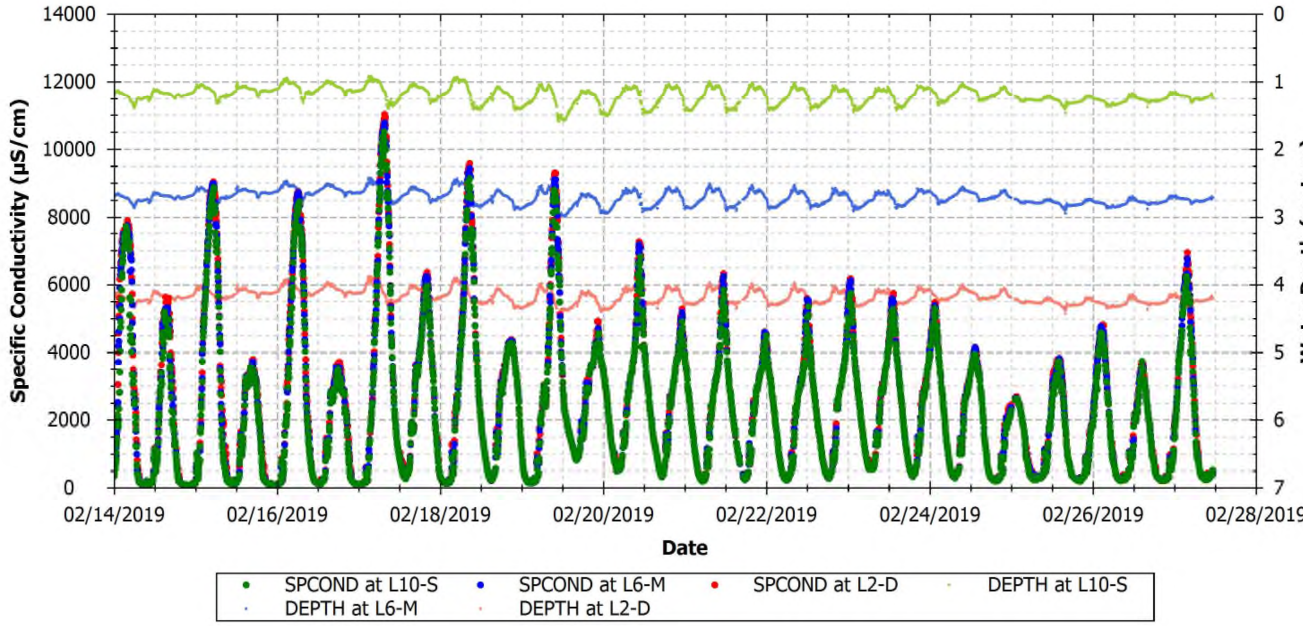


Figure A-9 Back River northeast corner observed specific conductivity

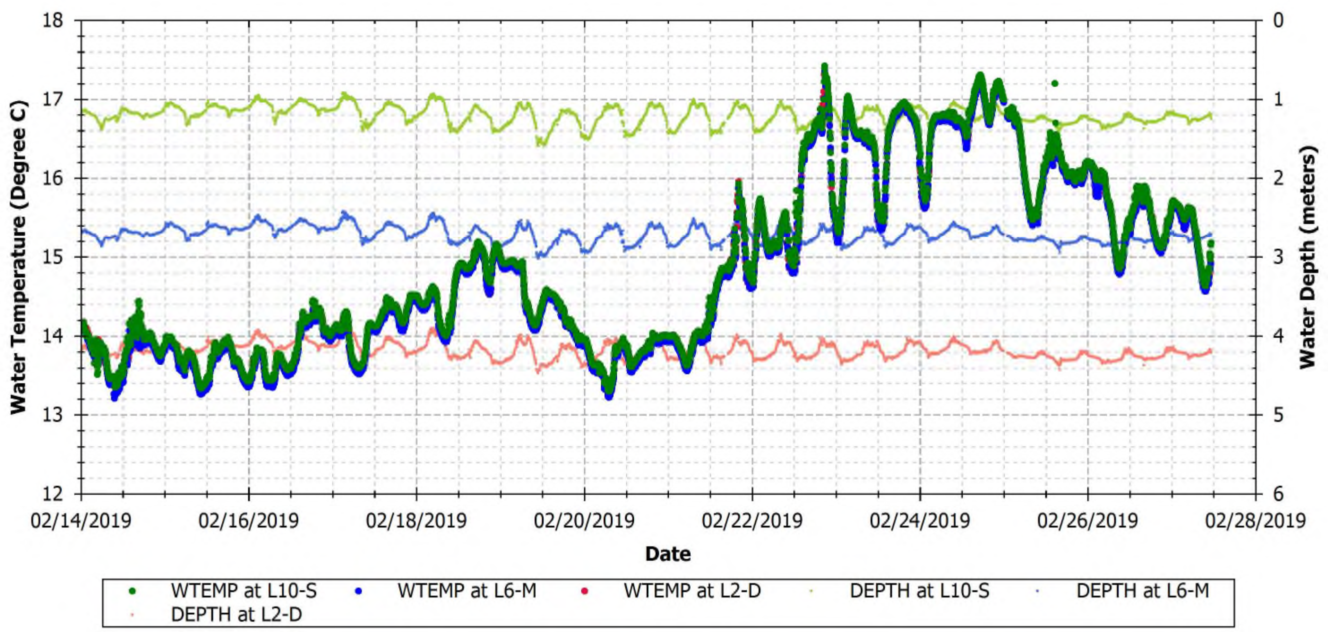


Figure A-10 Back River northeast corner observed water temperature

A.3 BACK RIVER NORTHWEST CORNER OF THE PLATFORM

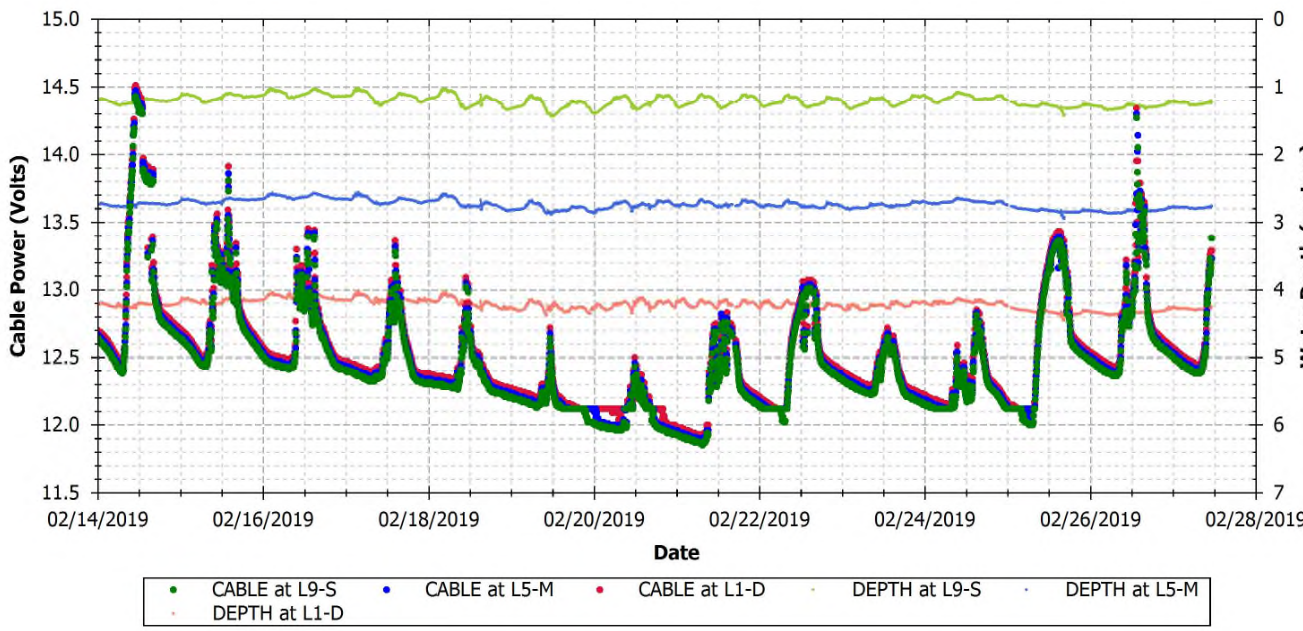


Figure A-11 Back River northwest corner observed cable power

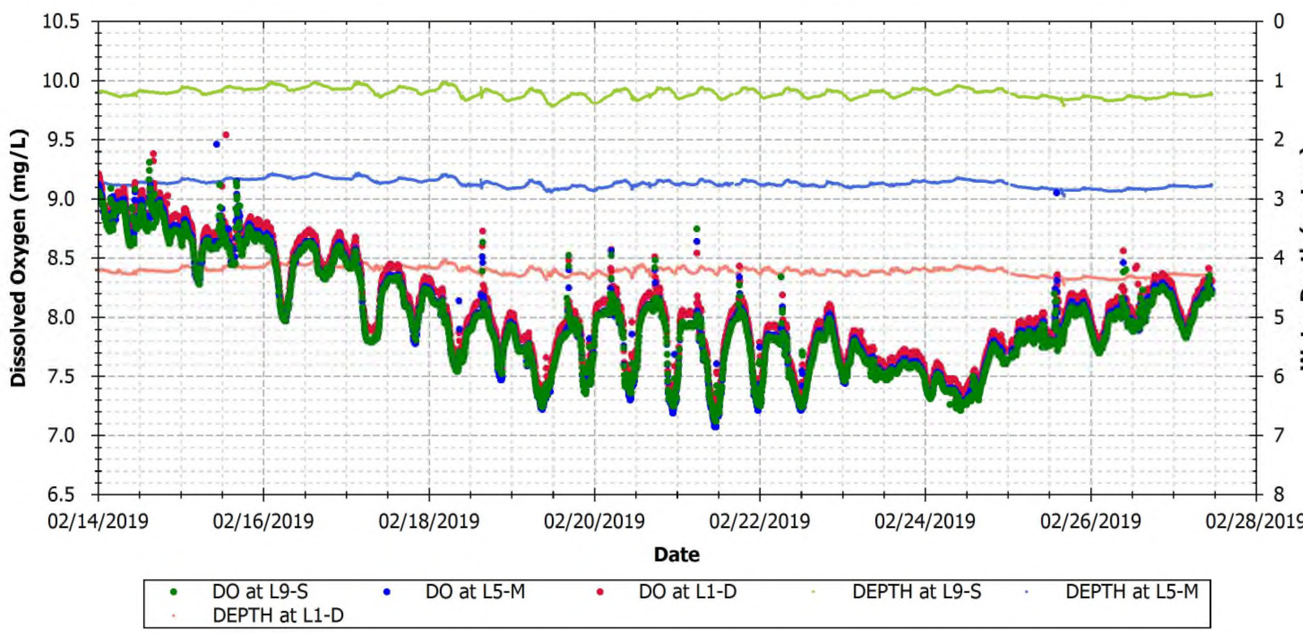


Figure A-12 Back River northwest corner observed DO

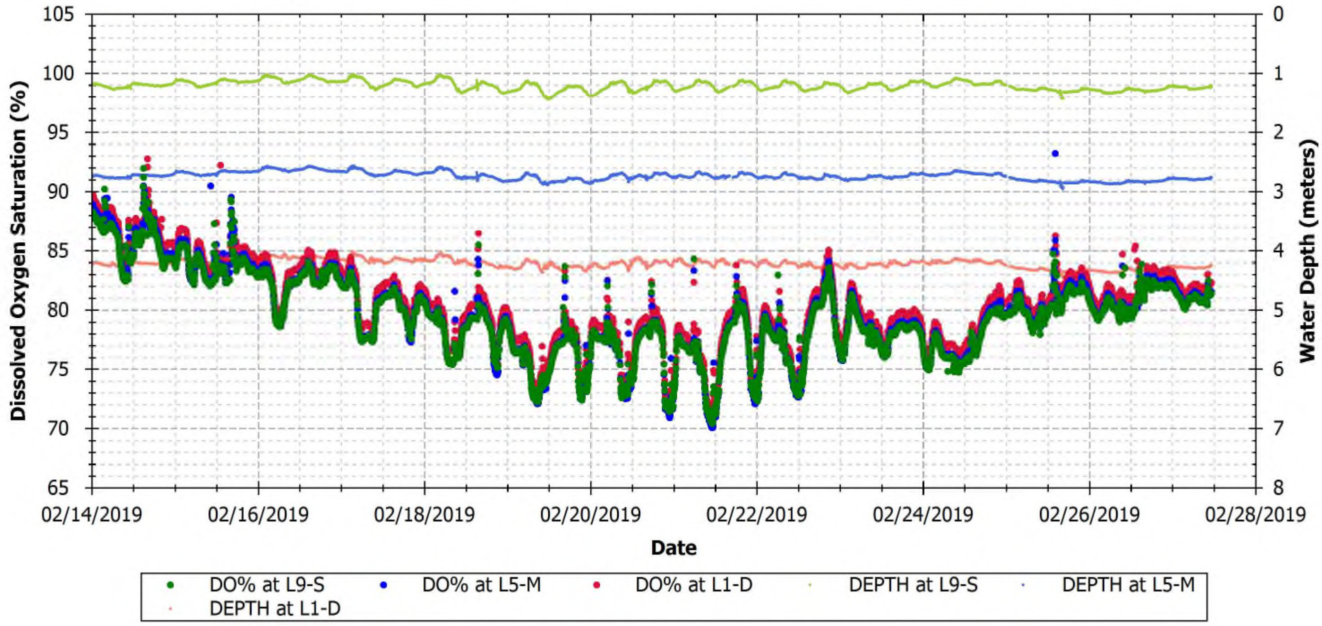


Figure A-13 Back River northwest corner observed DO saturation

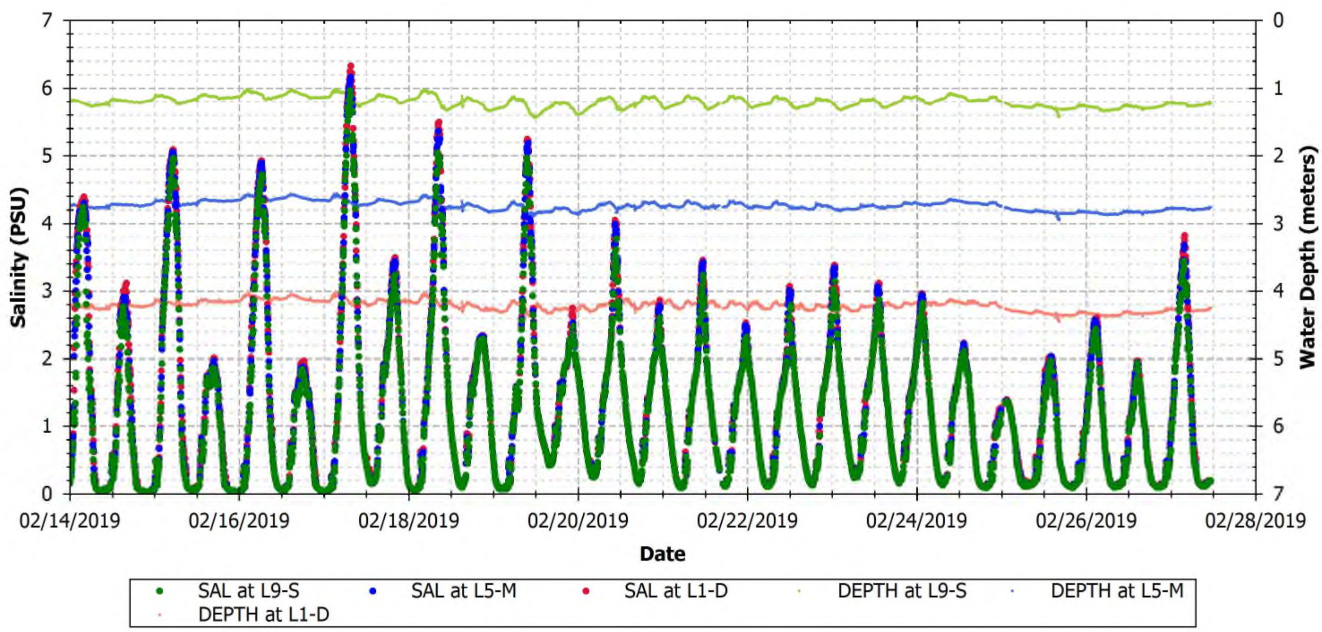


Figure A-14 Back River northwest corner observed salinity

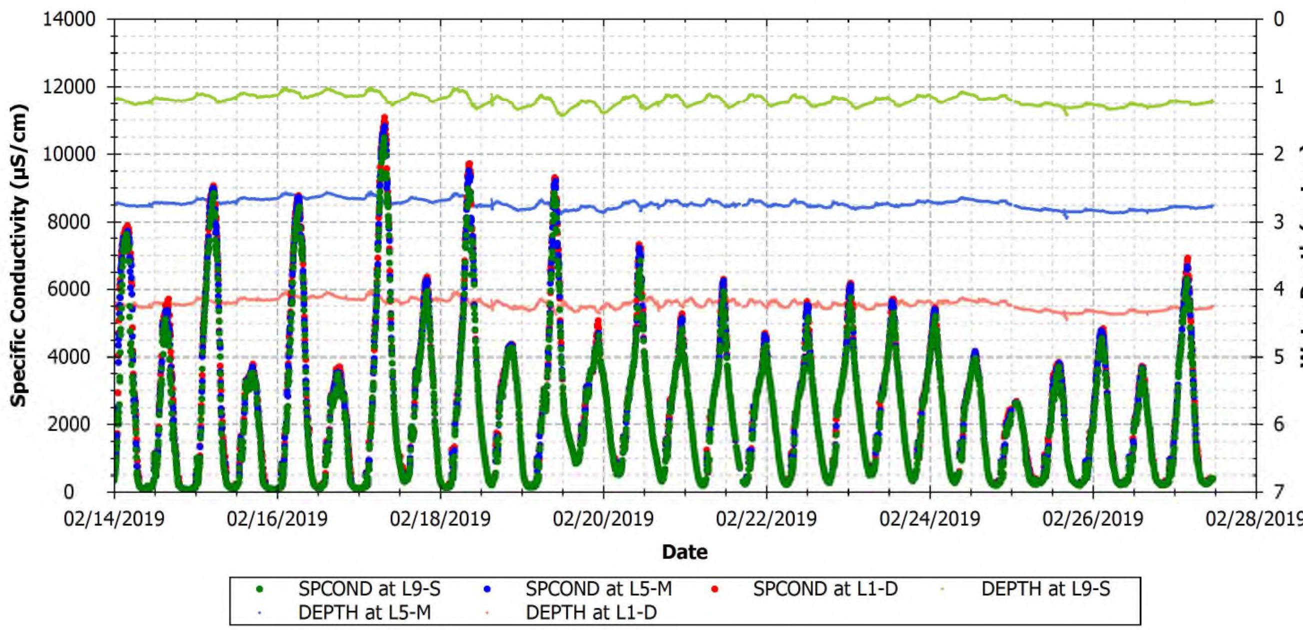


Figure A-15 Back River northwest corner observed specific conductivity

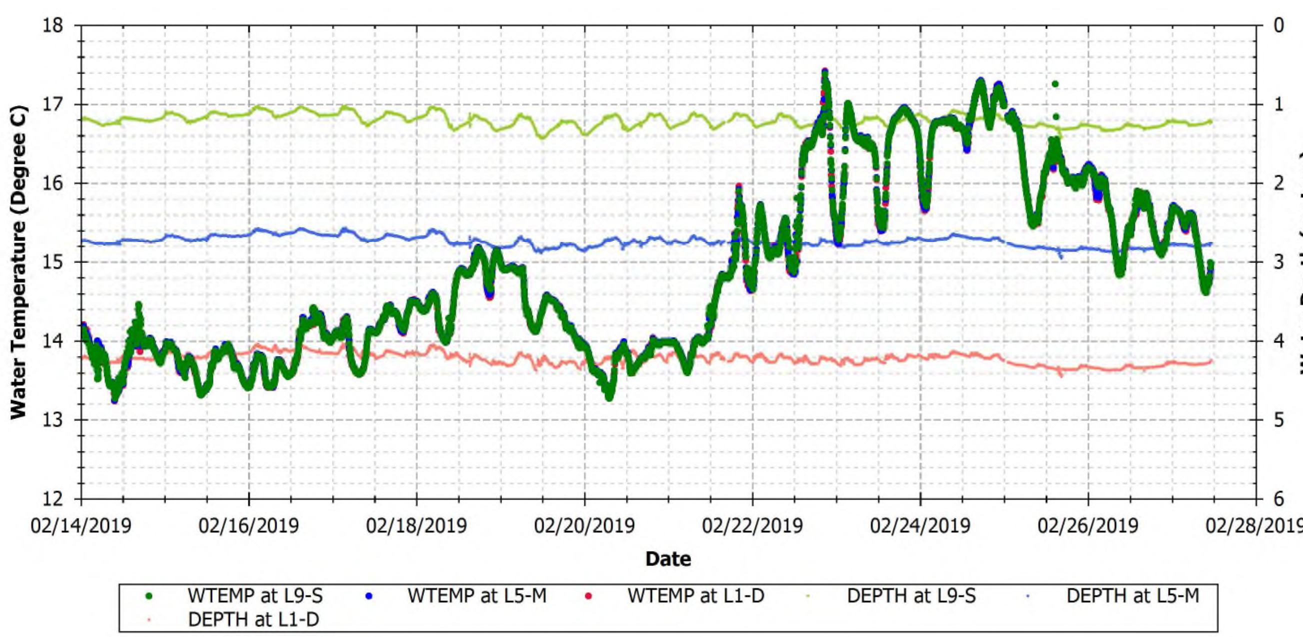


Figure A-16 Back River northwest corner observed water temperature

A.4 BACK RIVER SOUTHEAST CORNER OF THE PLATFORM

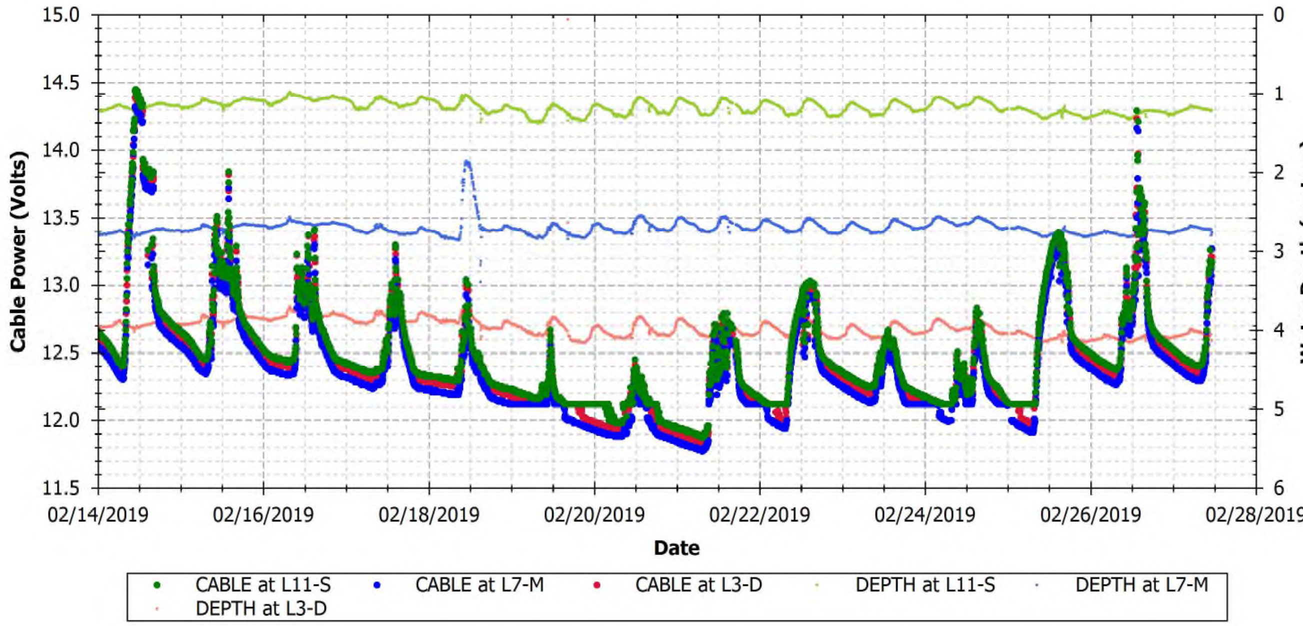


Figure A-17 Back River southeast corner observed cable power

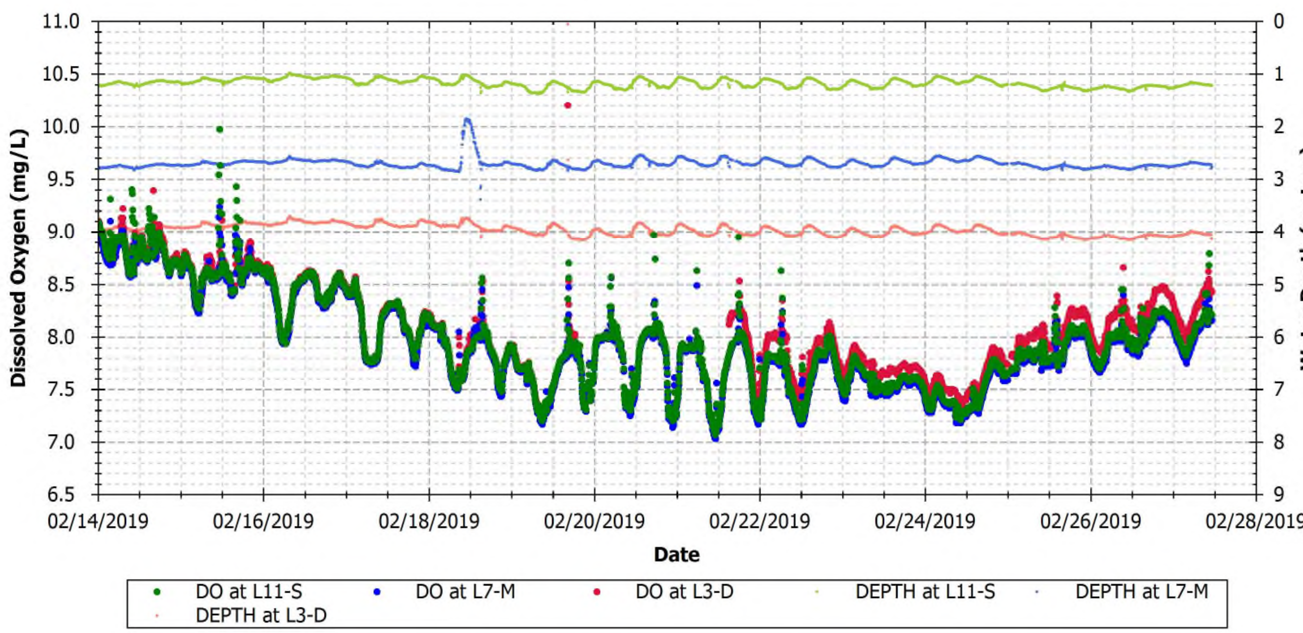


Figure A-18 Back River southeast corner observed DO

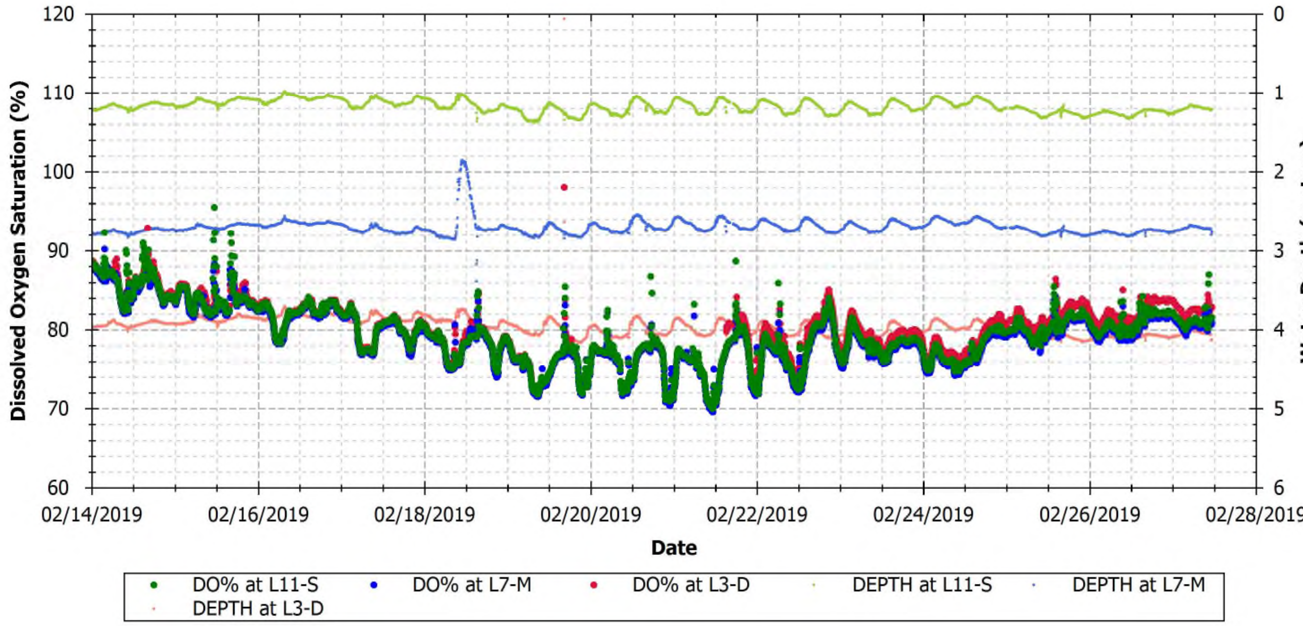


Figure A-19 Back River southeast corner observed DO saturation

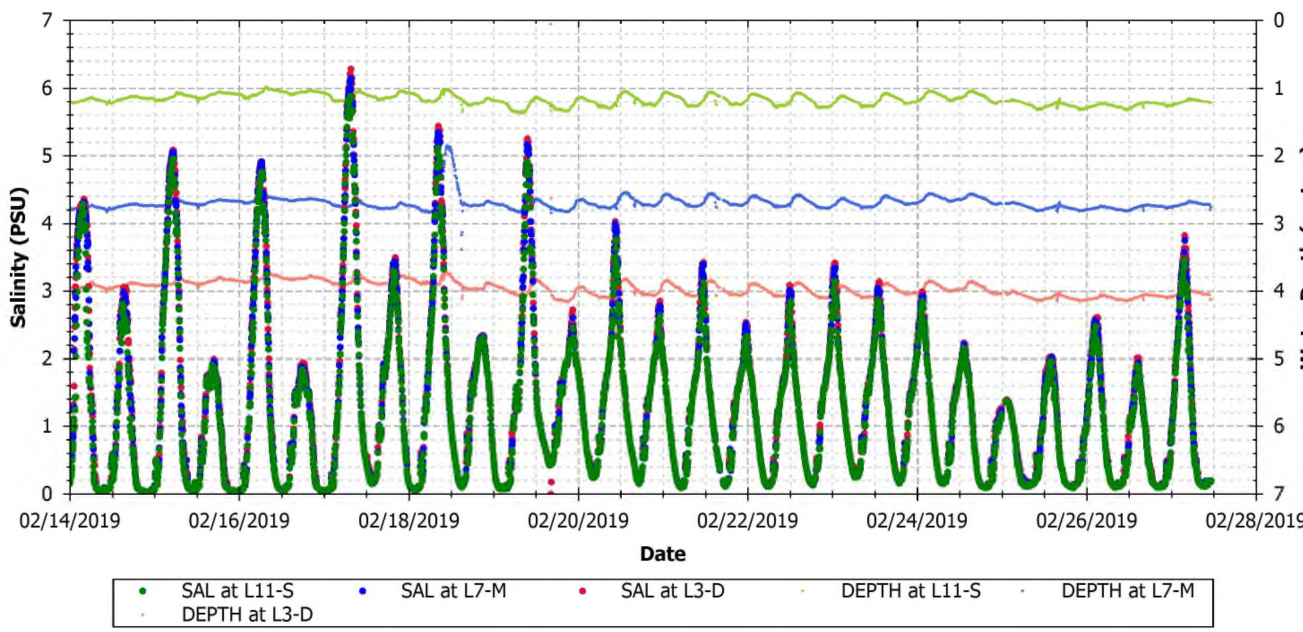


Figure A-20 Back River southeast corner observed salinity

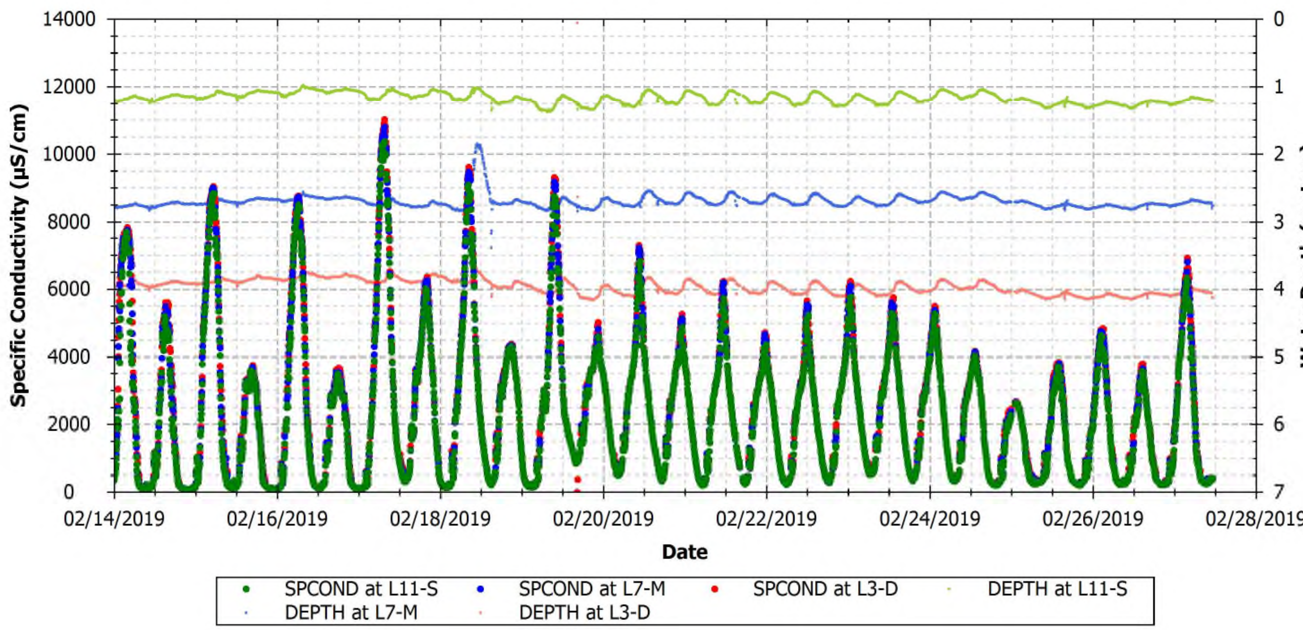


Figure A-21 Back River southeast corner observed specific conductivity

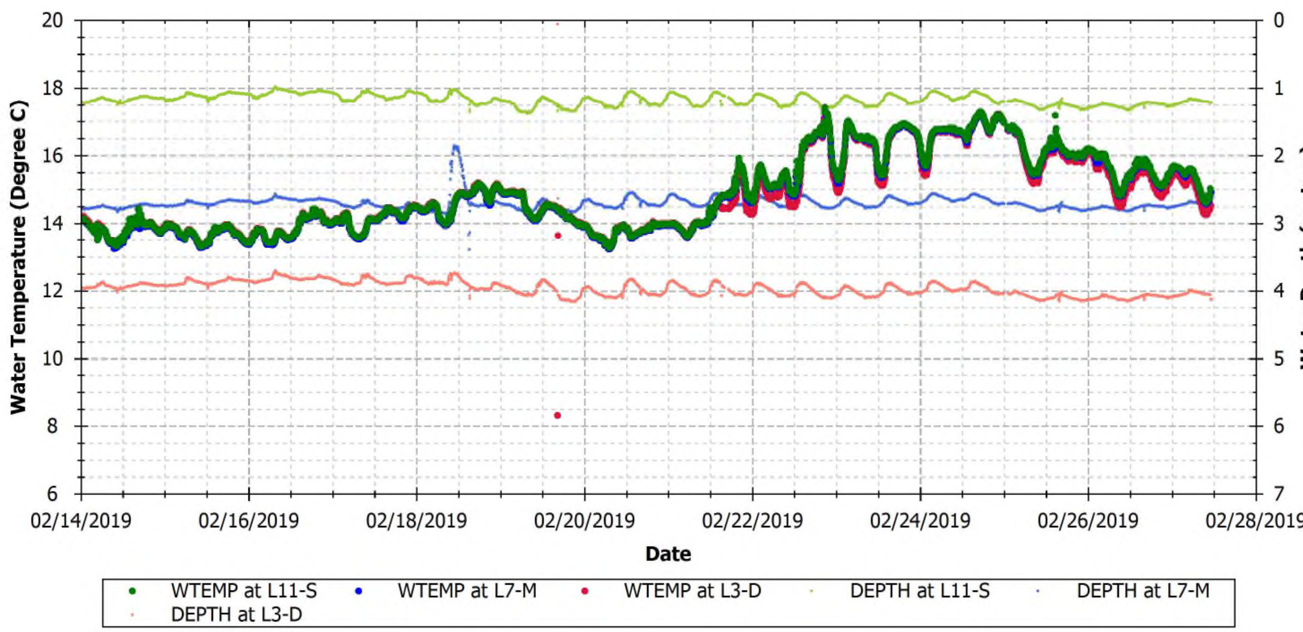


Figure A-22 Back River southeast corner observed water temperature

A.5 BACK RIVER SOUTHWEST CORNER OF THE PLATFORM

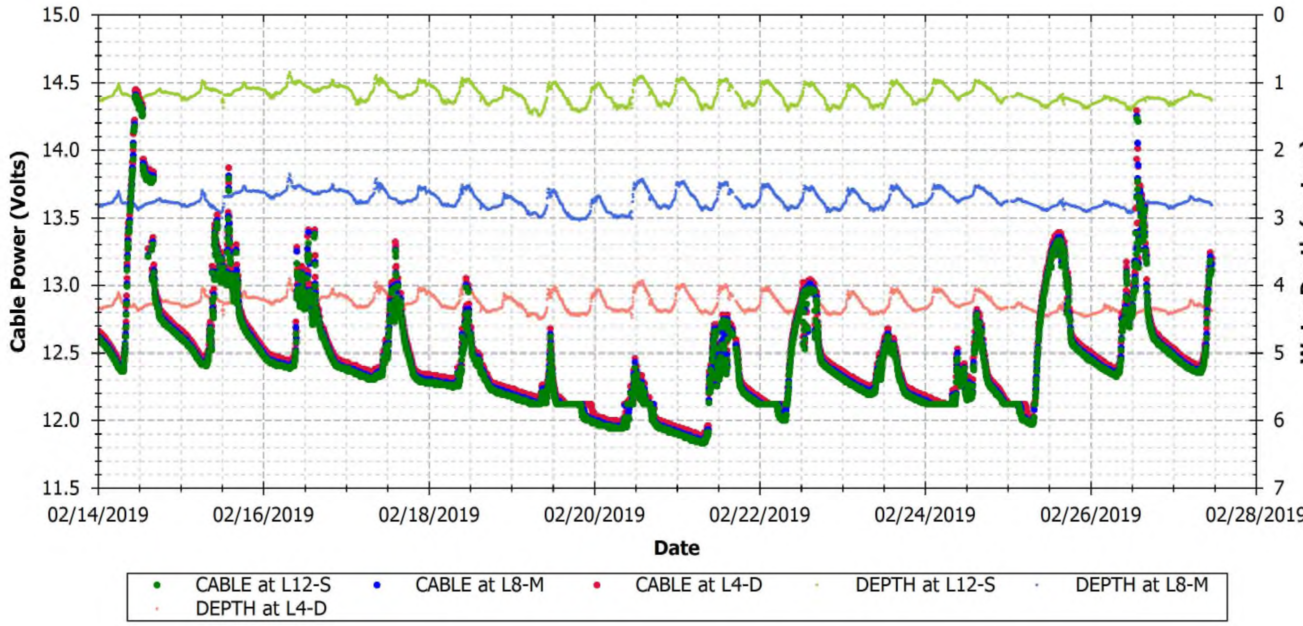


Figure A-23 Back River southwest corner observed cable power

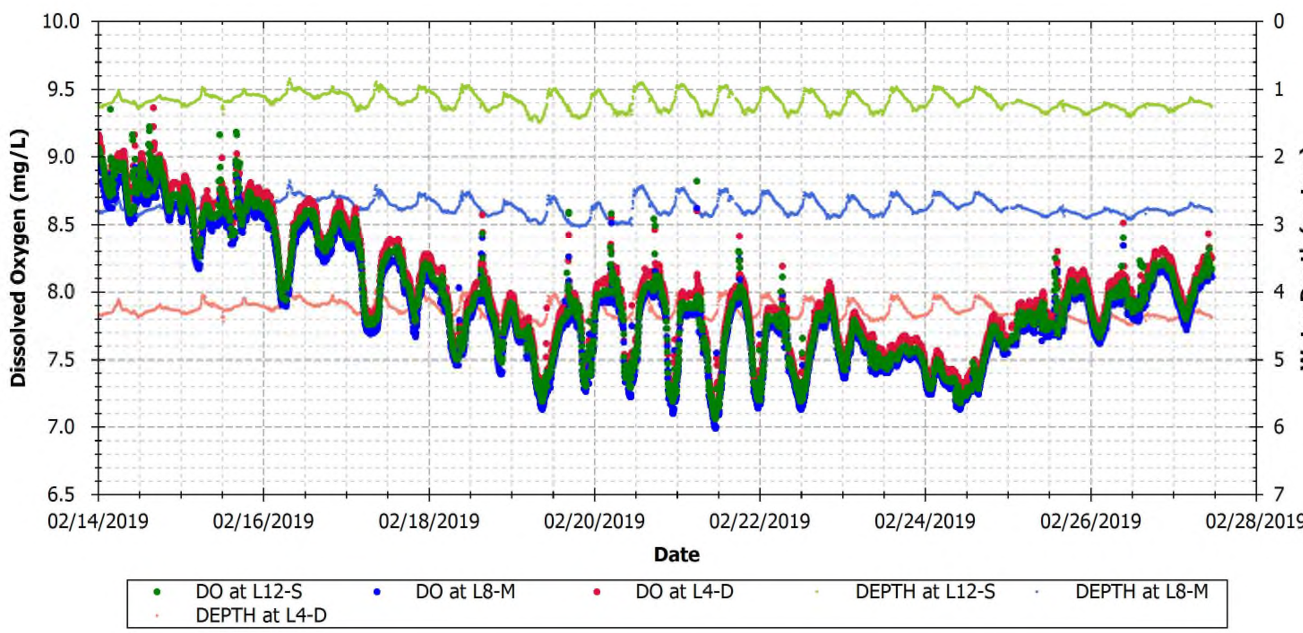


Figure A-24 Back River southwest corner observed DO

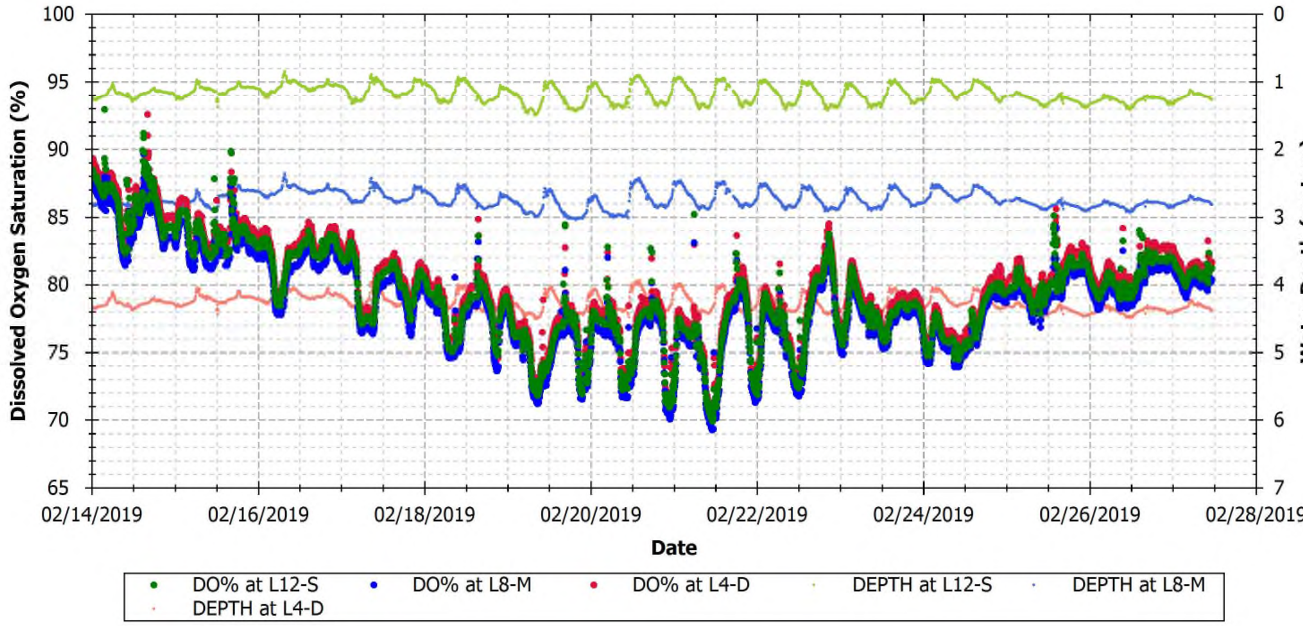


Figure A-25 Back River southwest corner observed DO saturation

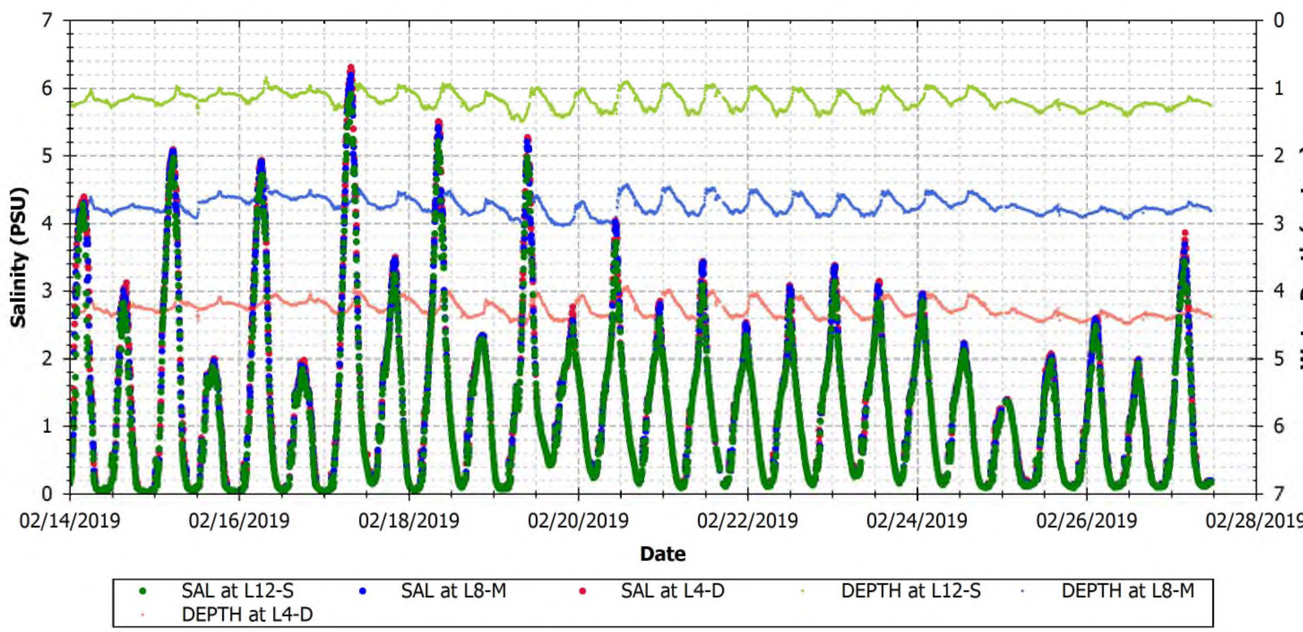


Figure A-26 Back River southwest corner observed salinity

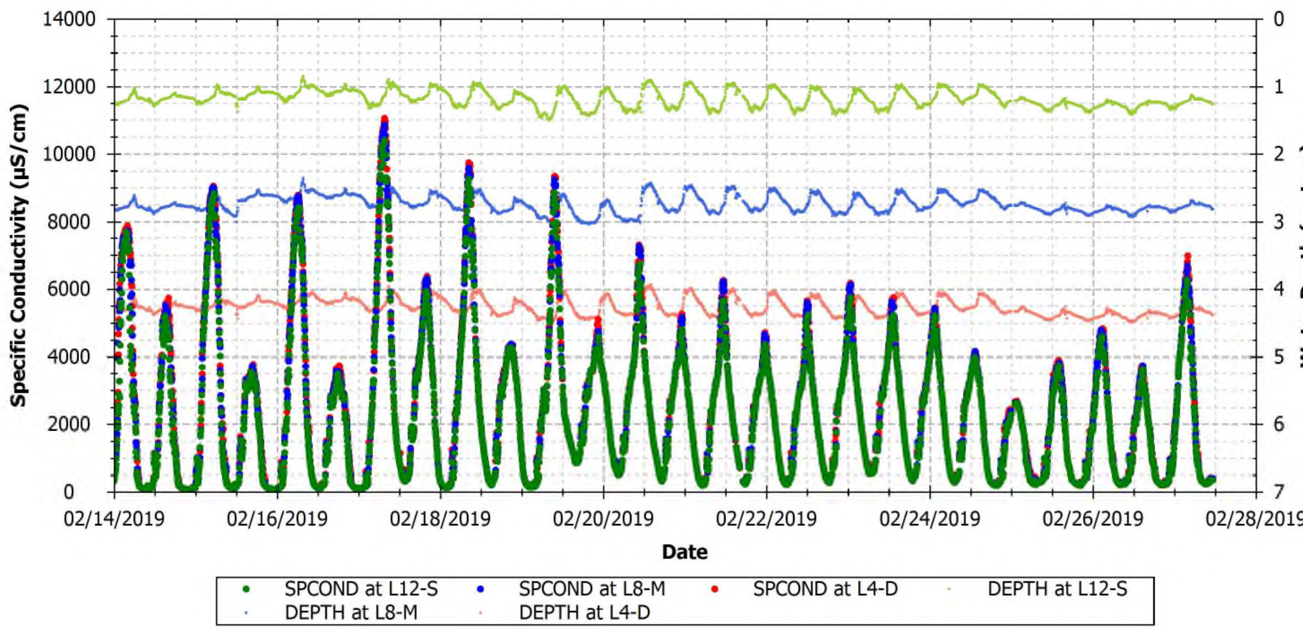


Figure A-27 Back River southwest corner observed specific conductivity

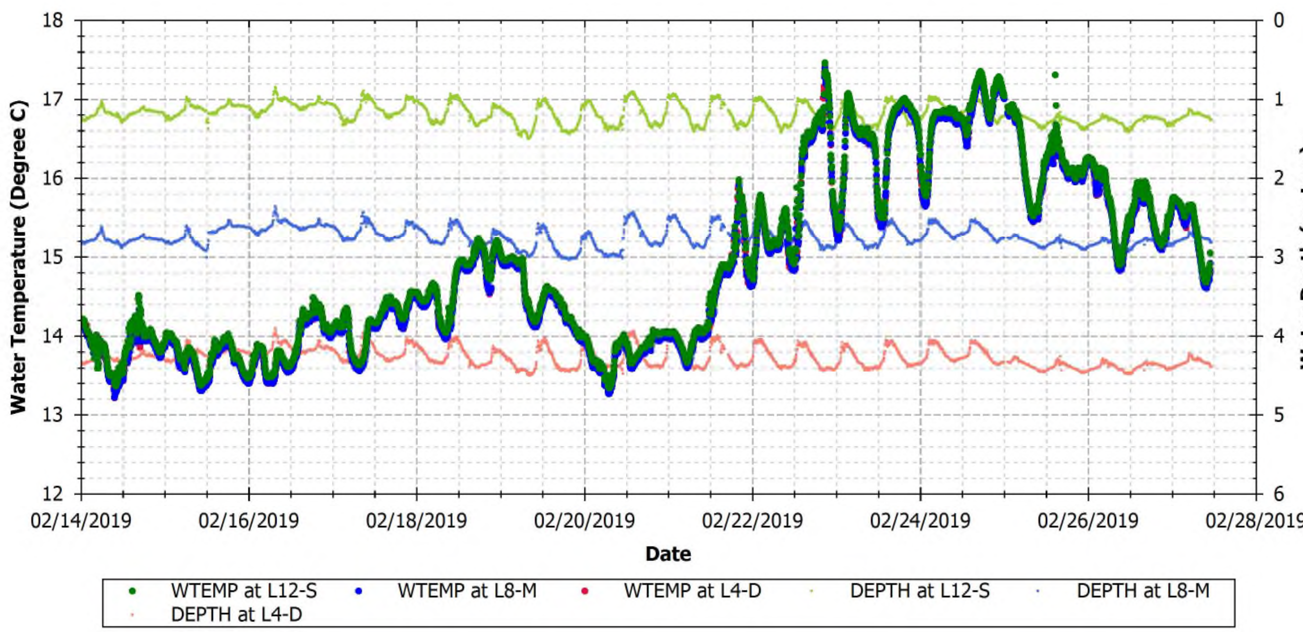


Figure A-28 Back River southwest corner observed water temperature

A.6 BACK RIVER EAST (VARIABLE DEPTHS) SIDE OF THE PLATFORM

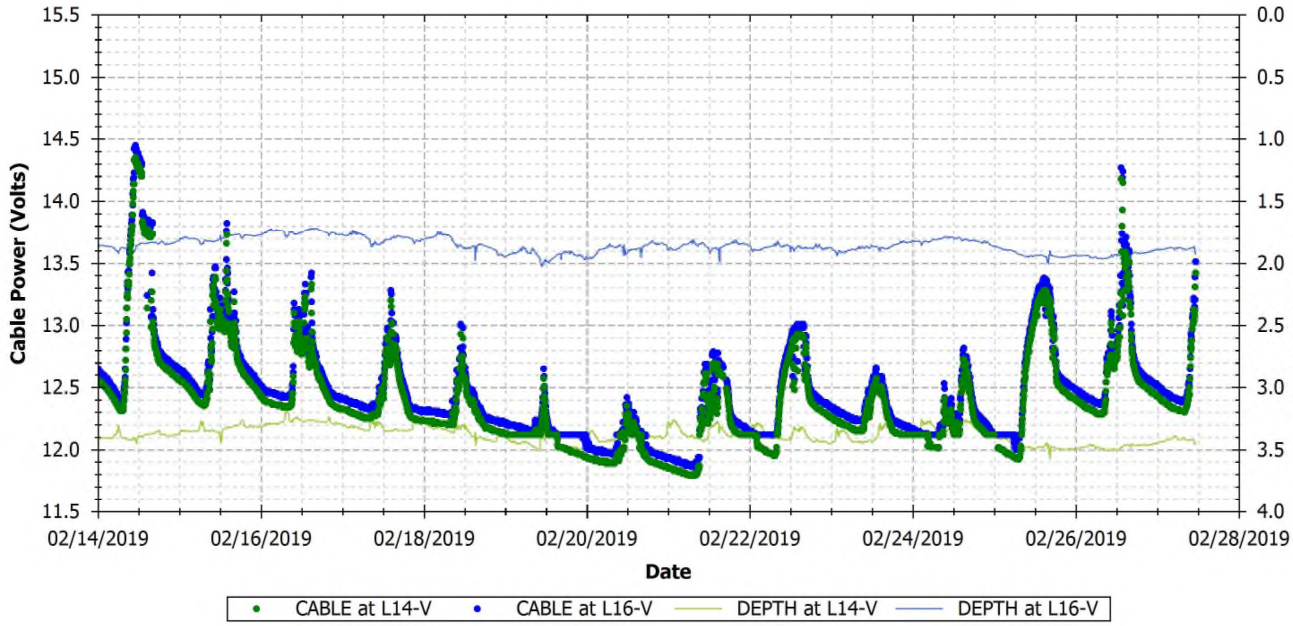


Figure A-29 Back River east (variable depths) side observed cable power

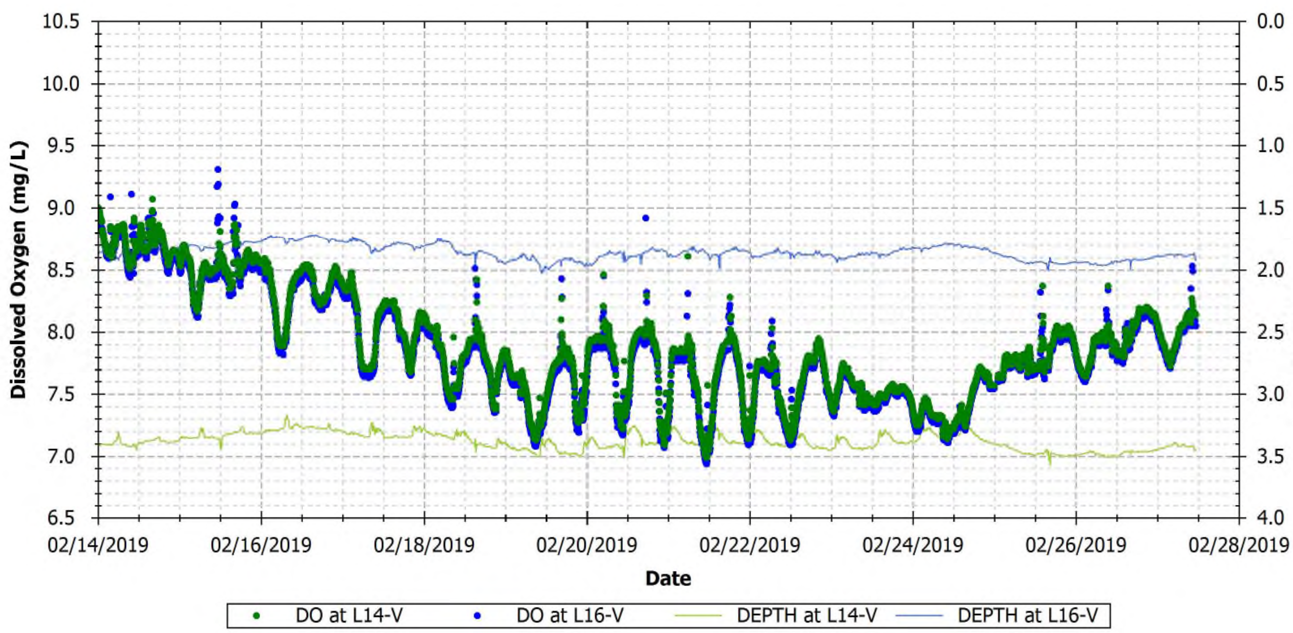


Figure A-30 Back River east (variable depths) side observed DO

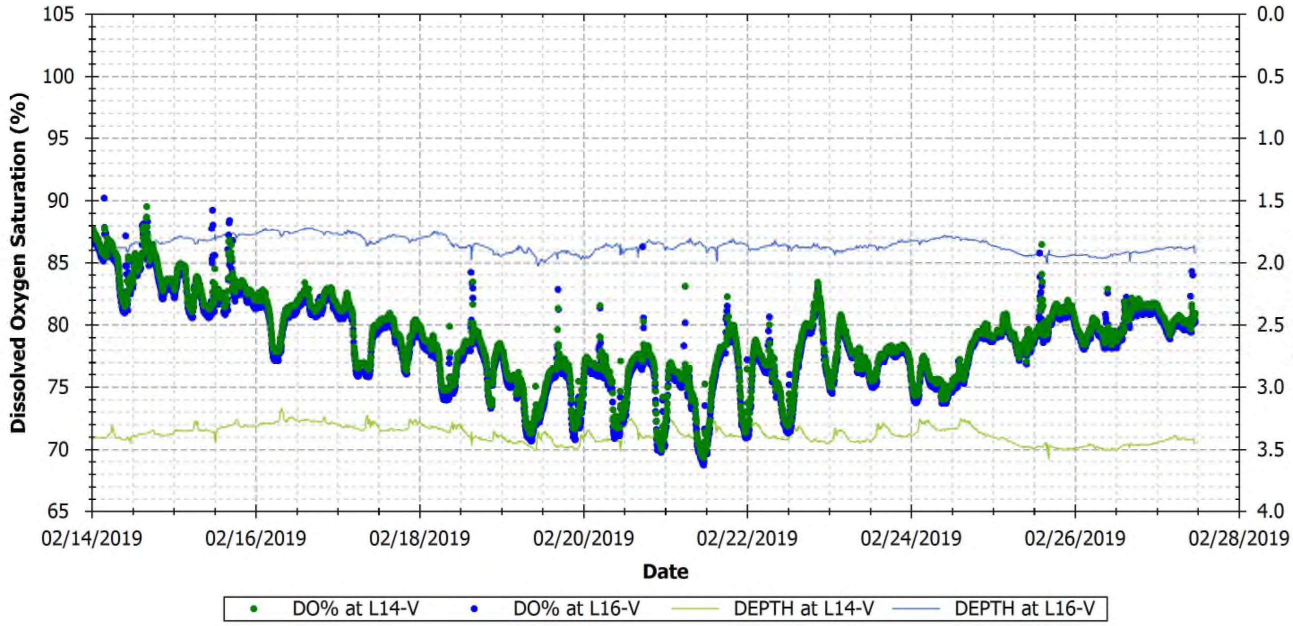


Figure A-31 Back River east (variable depths) side observed DO saturation

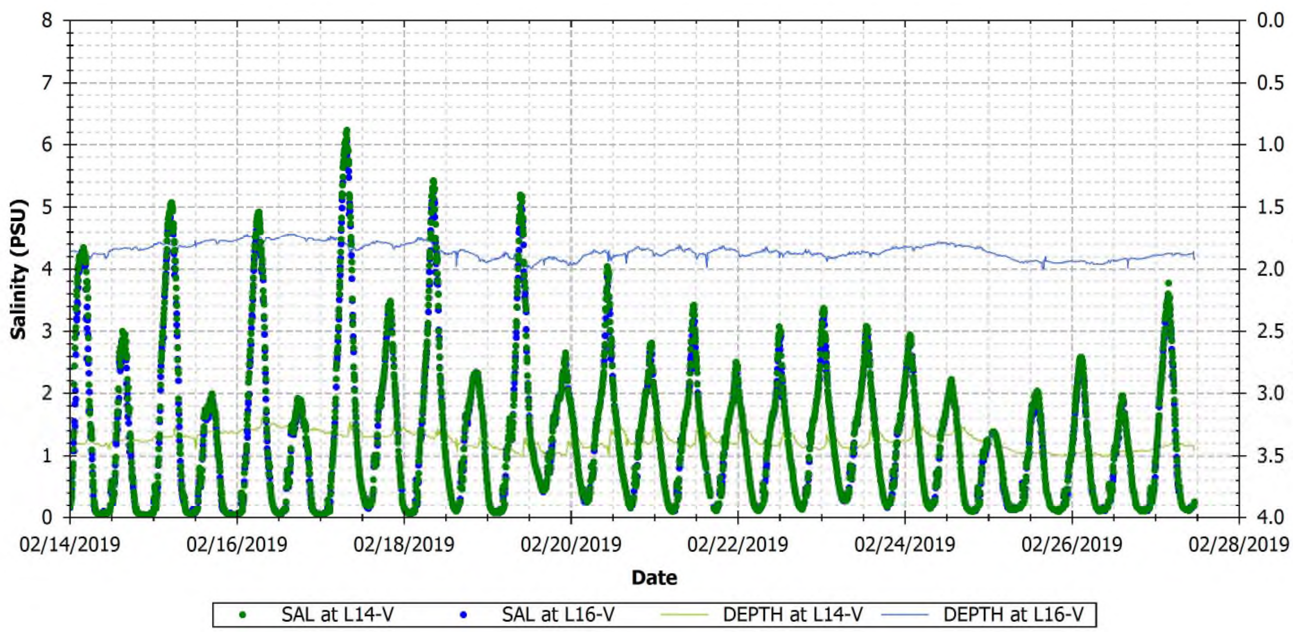


Figure A-32 Back River east (variable depths) side observed salinity

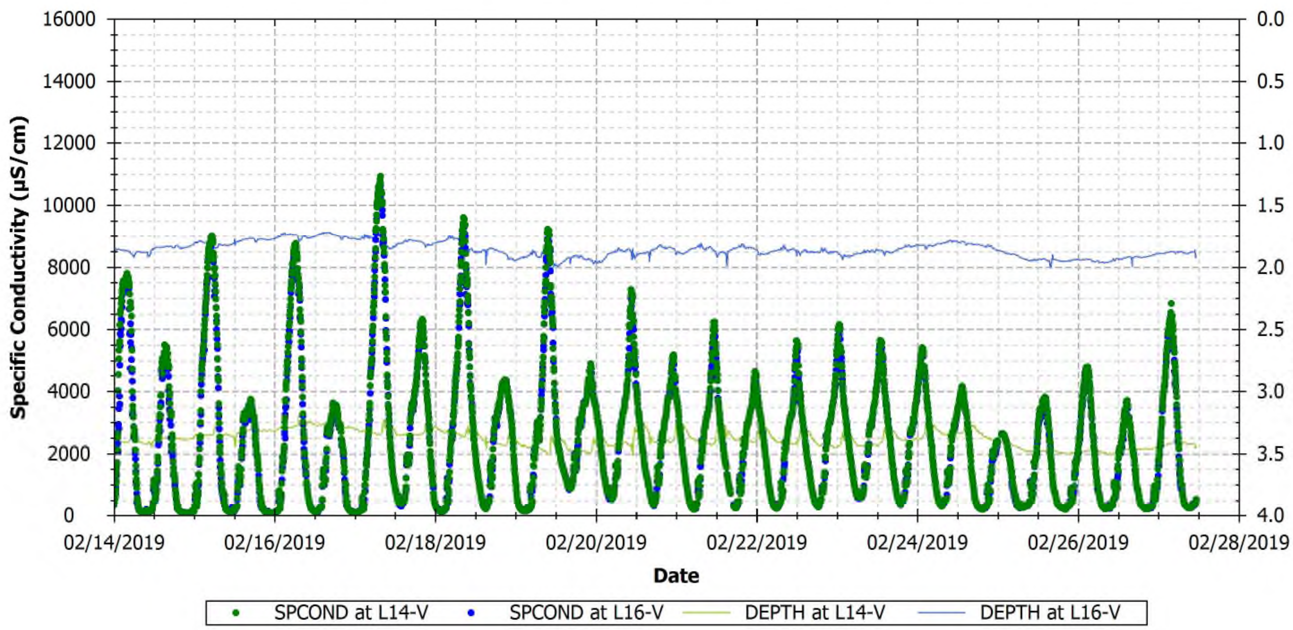


Figure A-33 Back River east (variable depths) side observed specific conductivity

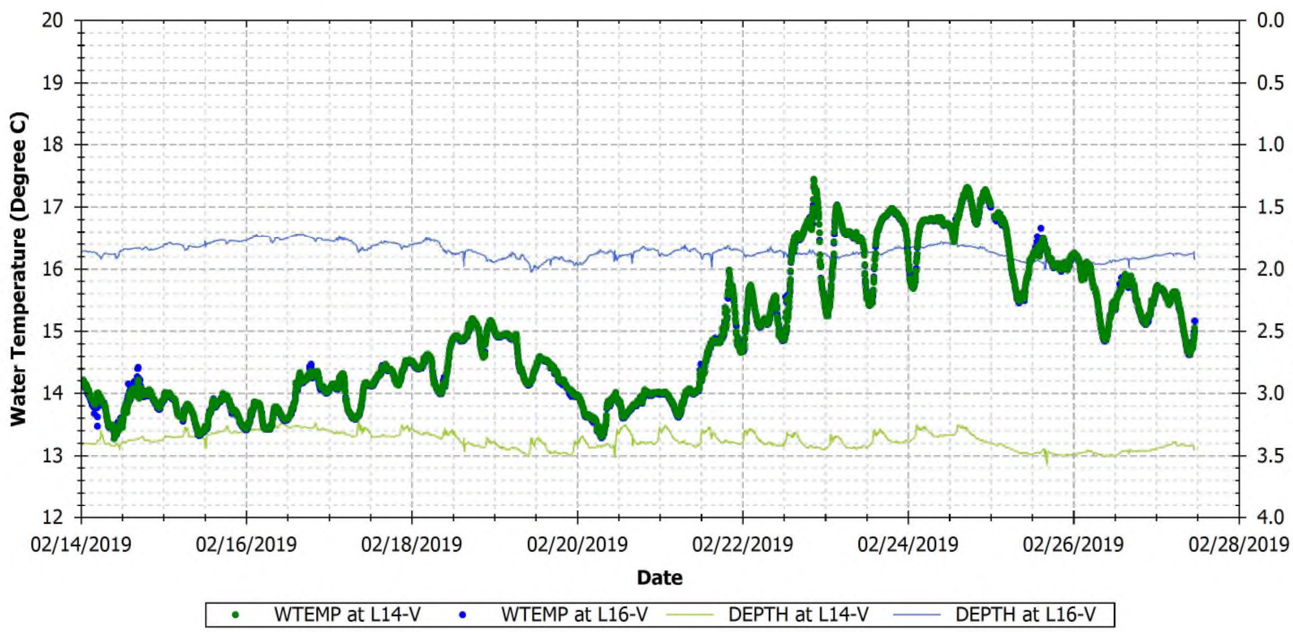


Figure A-34 Back River east (variable depths) side observed water temperature

A.7 BACK RIVER WEST (VARIABLE DEPTHS) SIDE OF THE PLATFORM

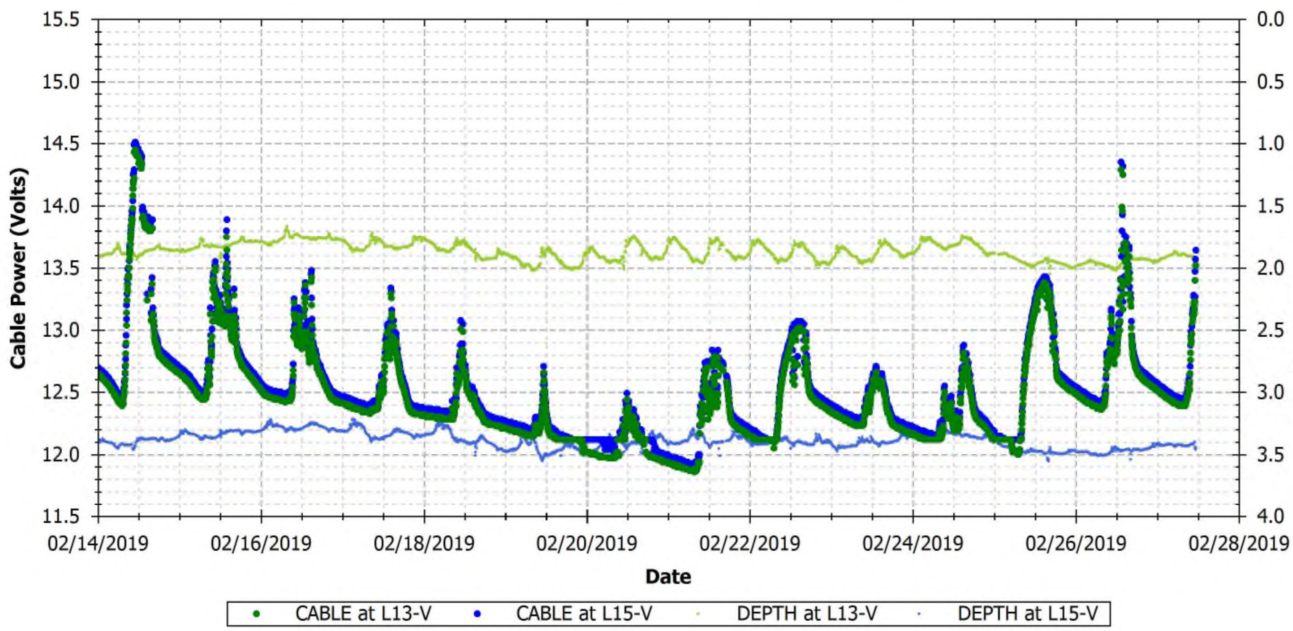


Figure A-35 Back River west (variable depths) side observed cable power

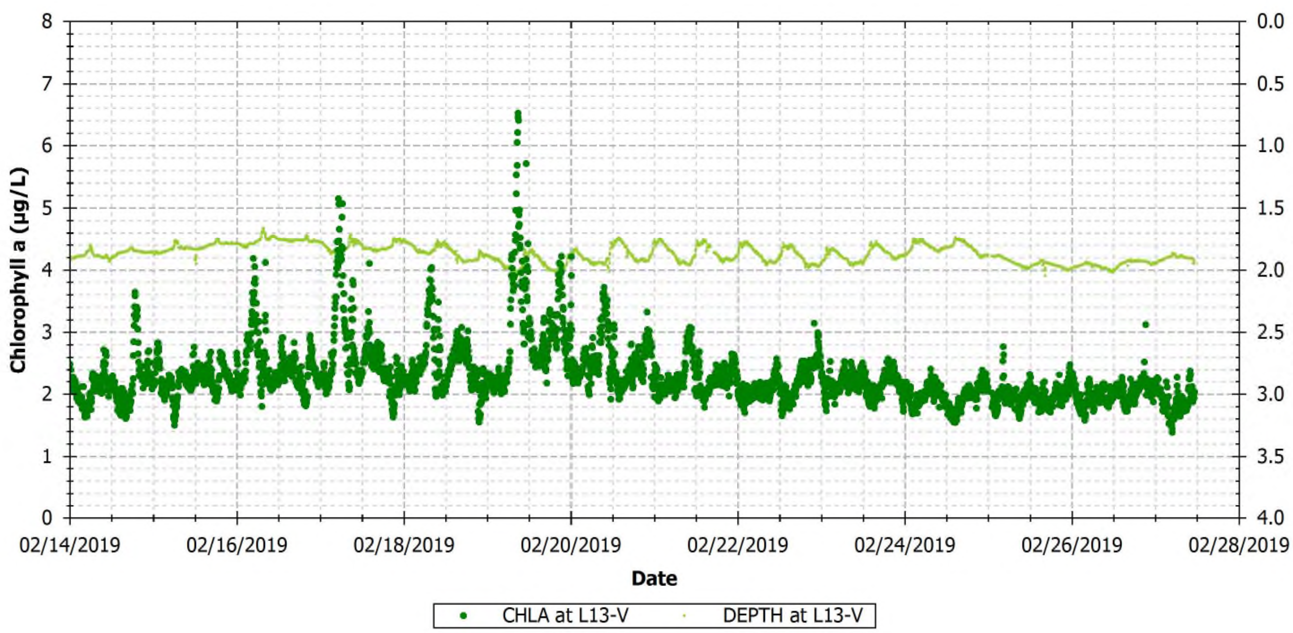


Figure A-36 Back River west (variable depths) side observed chlorophyll a

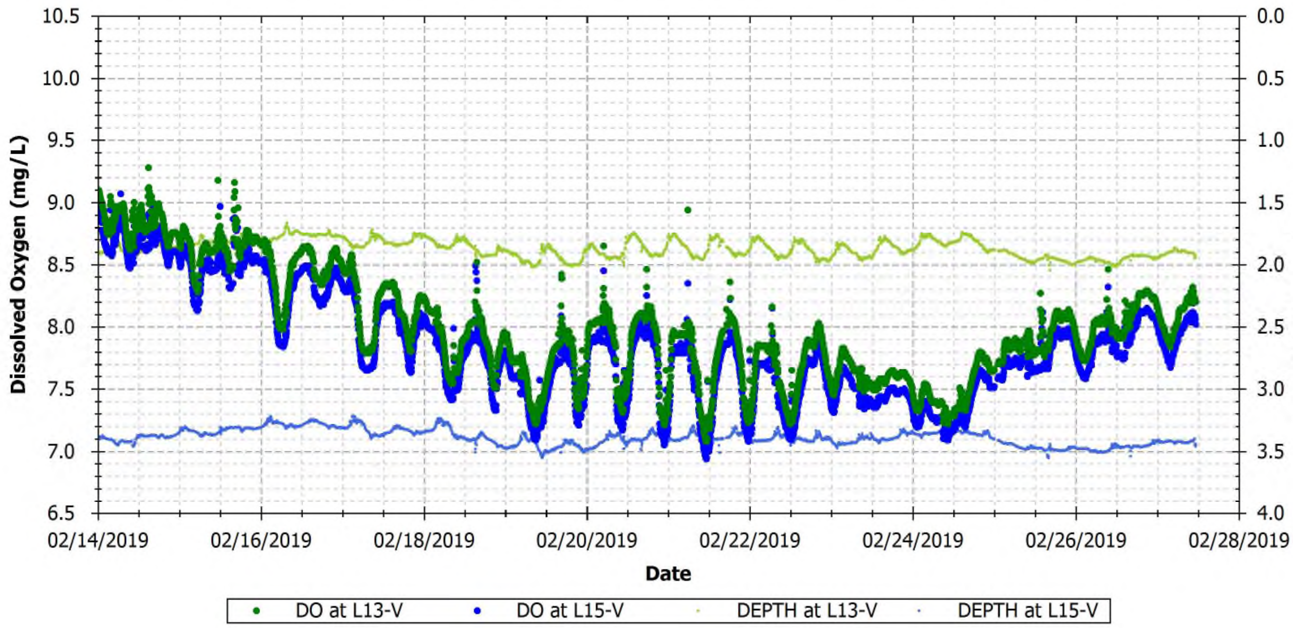


Figure A-37 Back River west (variable depths) side observed DO

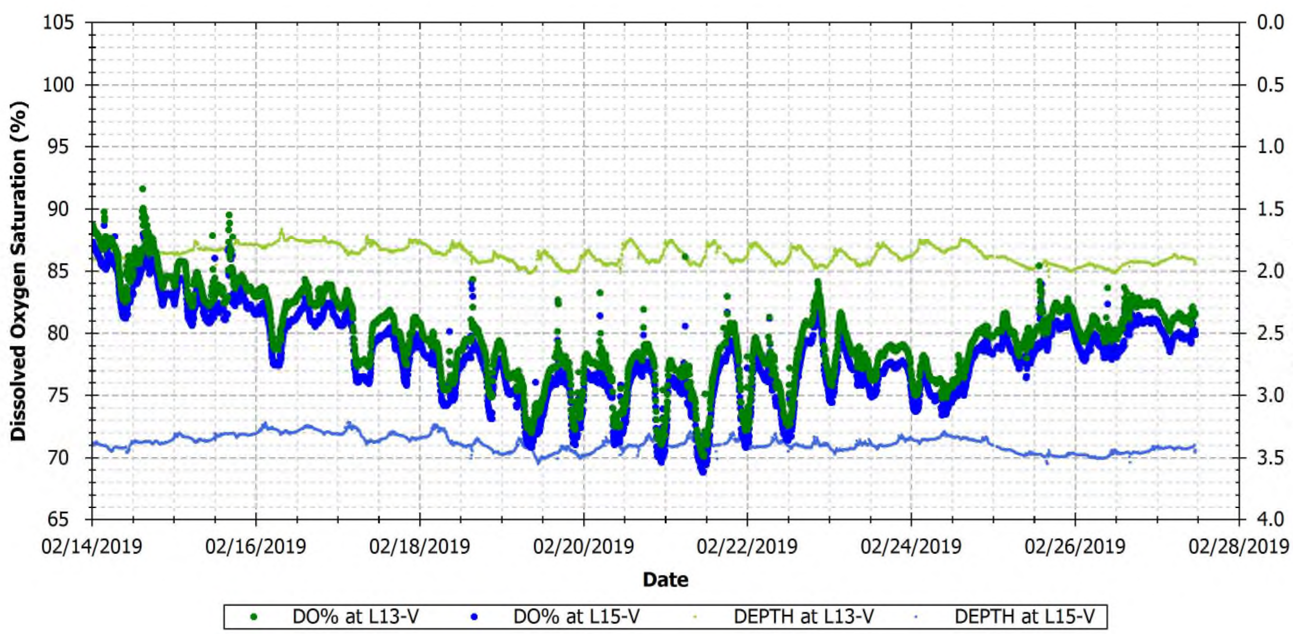


Figure A-38 Back River west (variable depths) side observed DO saturation

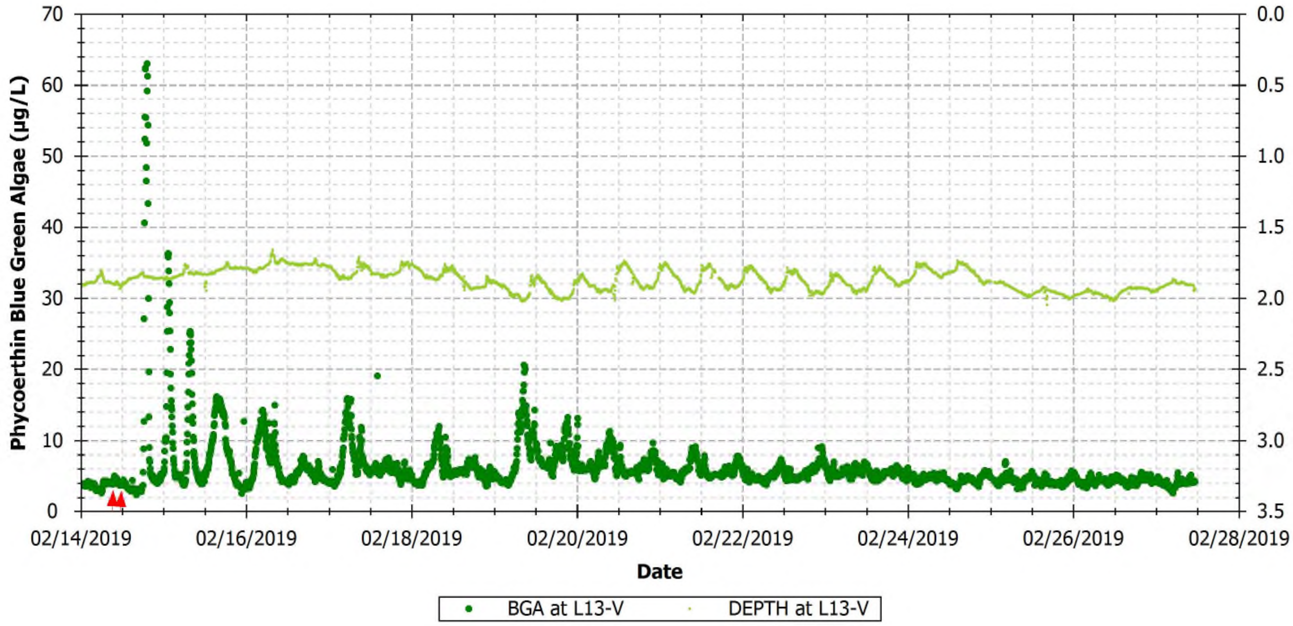


Figure A-39 Back River west (variable depths) side observed BGA

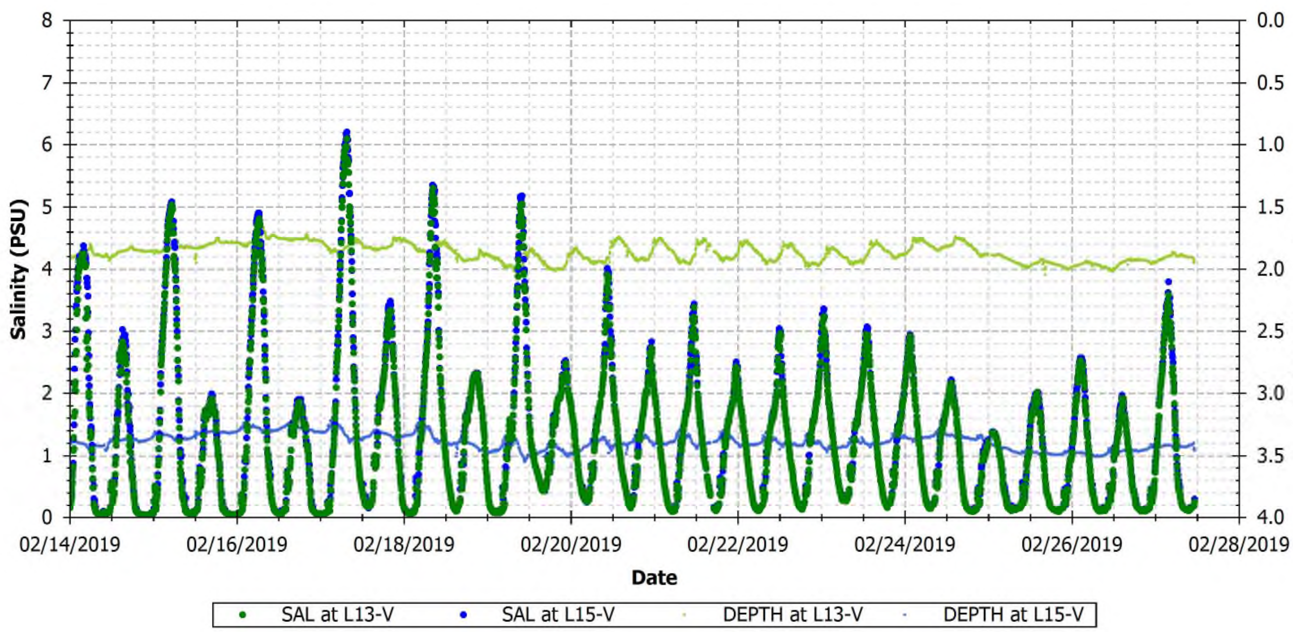


Figure A-40 Back River west (variable depths) side observed salinity

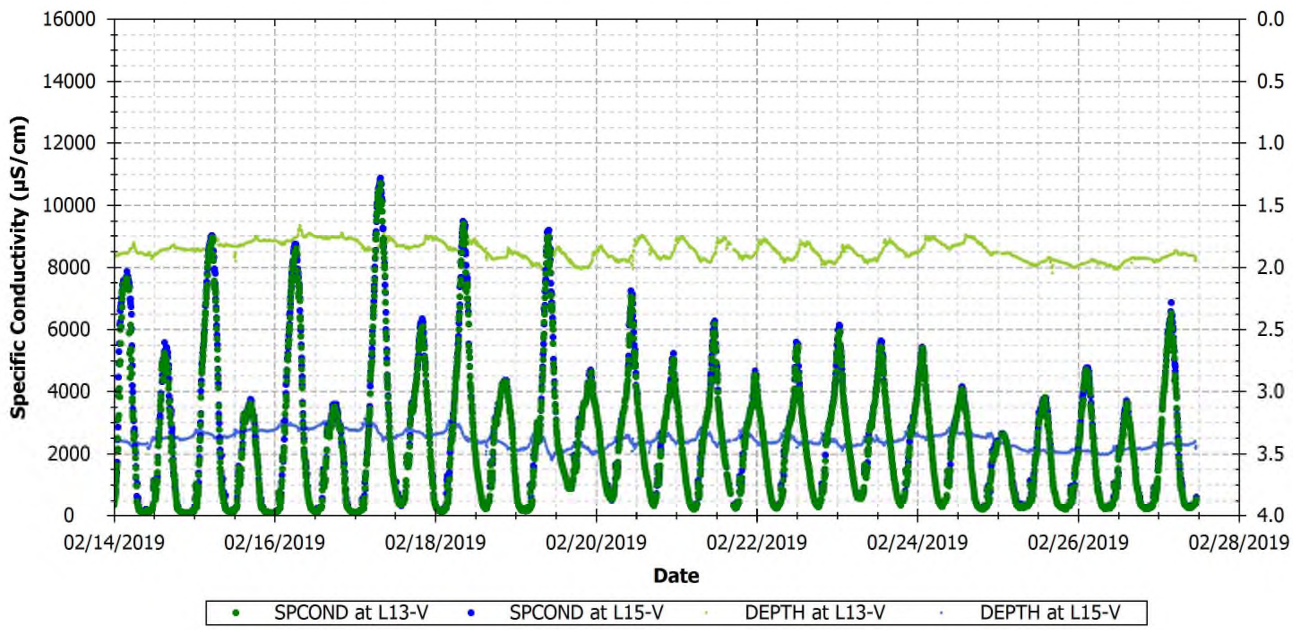


Figure A-41 Back River west (variable depths) side observed specific conductivity

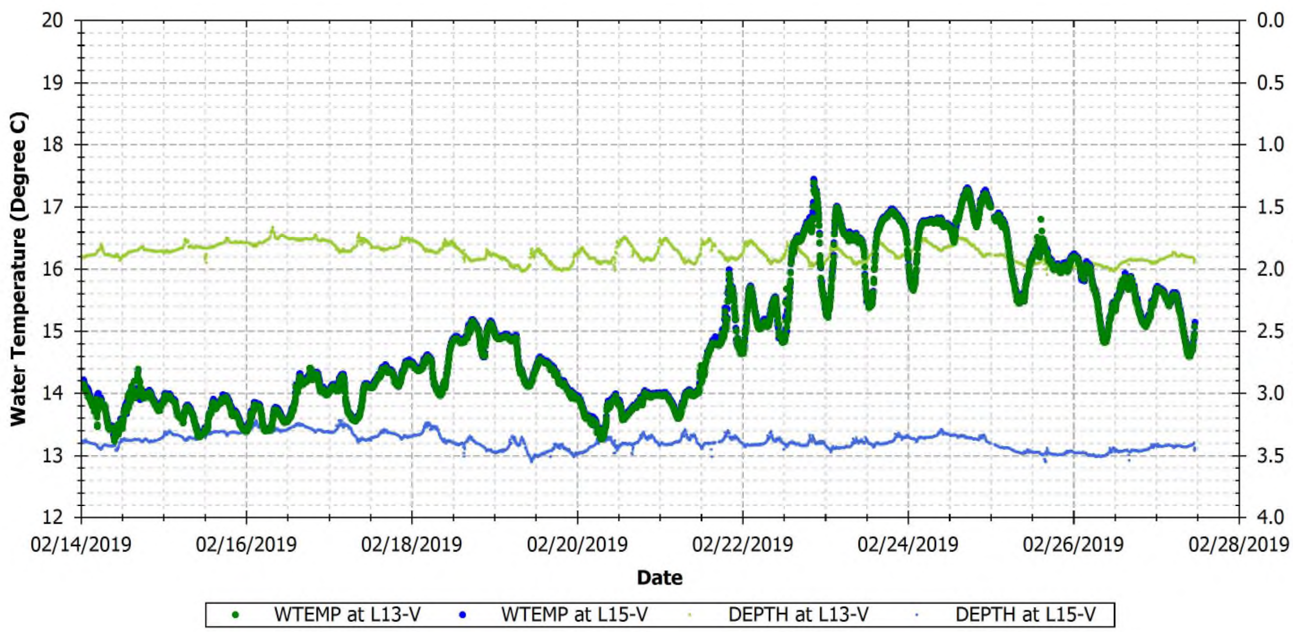


Figure A-42 Back River west (variable depths) corner observed water temperature

APPENDIX B SEMI-PERMANENT BUOY FIGURES

APPENDIX B TABLE OF CONTENTS

APPENDIX B LIST OF FIGURES

APPENDIX B LIST OF TABLES

B.1 DEFINITIONS AND LOCATION MAPS

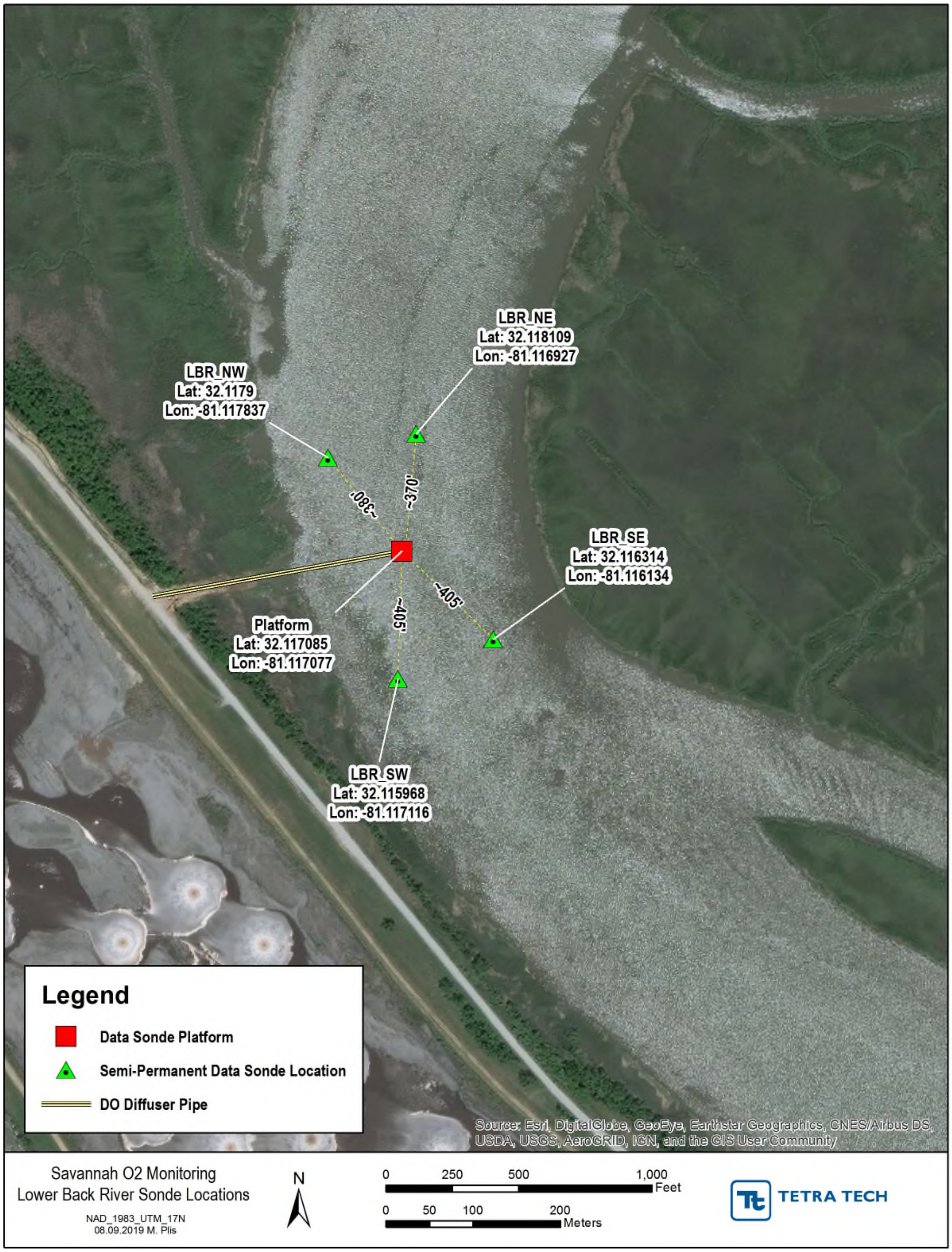


Figure B-1 Location of semi-permanent buoys on the lower Back River

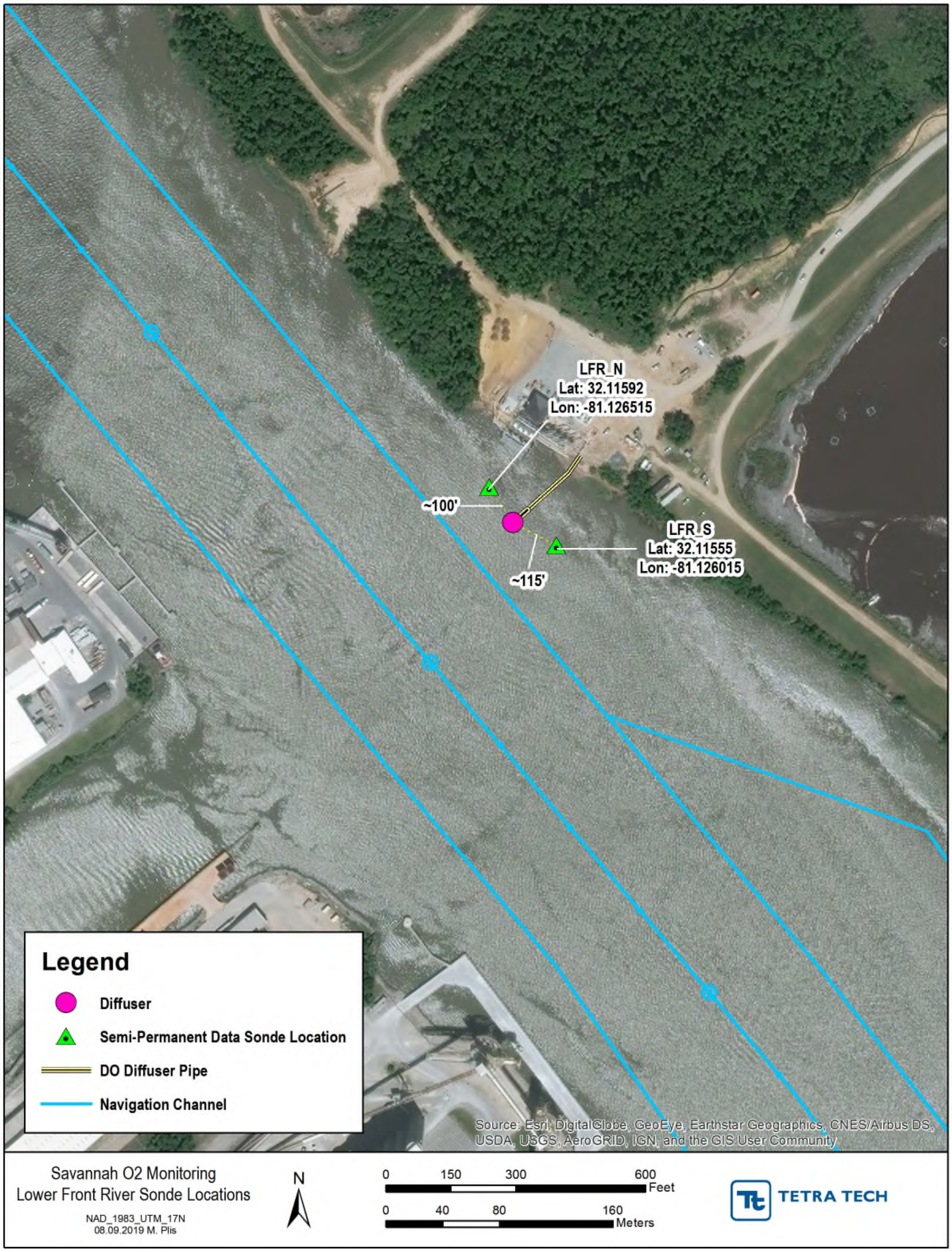


Figure B-2 Location of semi-permanent buoys on the lower Front River

Table B-1 Attributes of semi-permanent buoys used for the test run data collection

Station ID	Description	Deployment Period
LBR_NE	Back River northeast	February 14, 2019 to February 28, 2019
LBR_NW	Back River northwest	February 14, 2019 to February 28, 2019
LBR_SE	Back River southeast	February 14, 2019 to February 28, 2019
LBR_SW	Back River southwest	February 14, 2019 to February 28, 2019
LFR_N	Lower Front River north	February 14, 2019 to February 28, 2019
LFR_S	Lower Front River south	February 14, 2019 to February 28, 2019

Table B-2 Definitions of abbreviations

Abbreviation	Definition
BATTERY	power level to sonde
BGA_U	blue green algae concentration (surrogate for dye)
CHLA_U	chlorophyll a concentration
DEPTH	depth below water surface
DO	dissolved oxygen concentration
DO_SAT	dissolved oxygen percent saturation
SALPPT	salinity concentration
SPCOND	specific conductivity
WTEMP	water temperature

B.2 BACK RIVER NORTHEAST

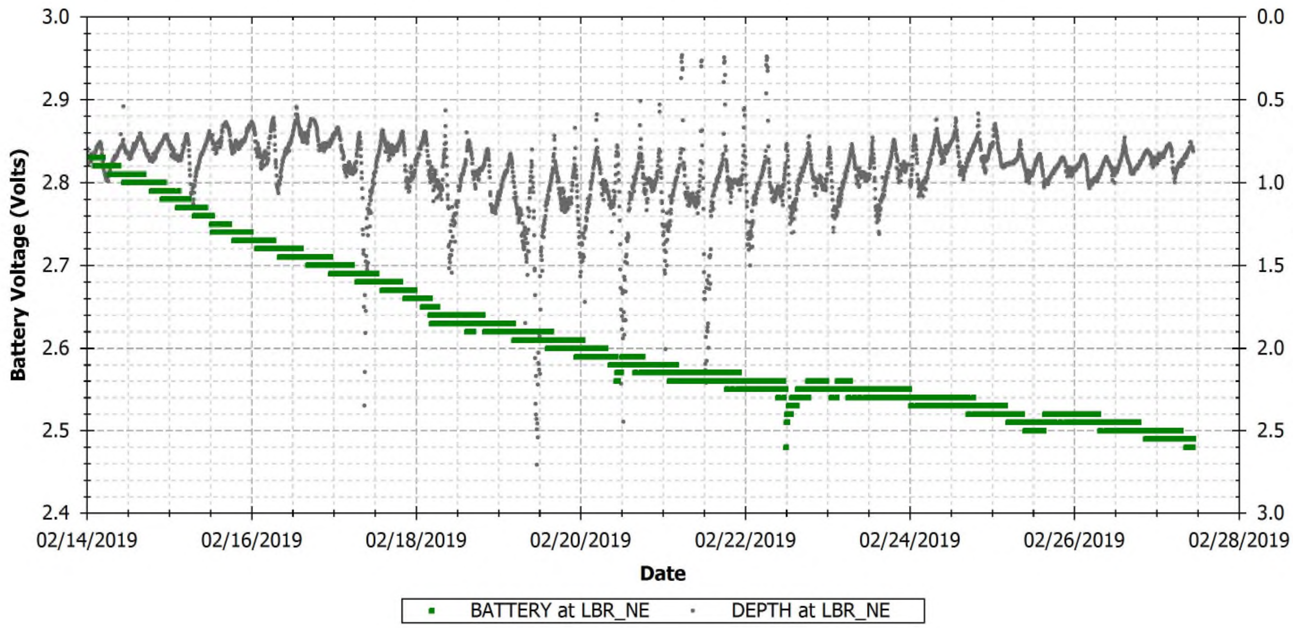
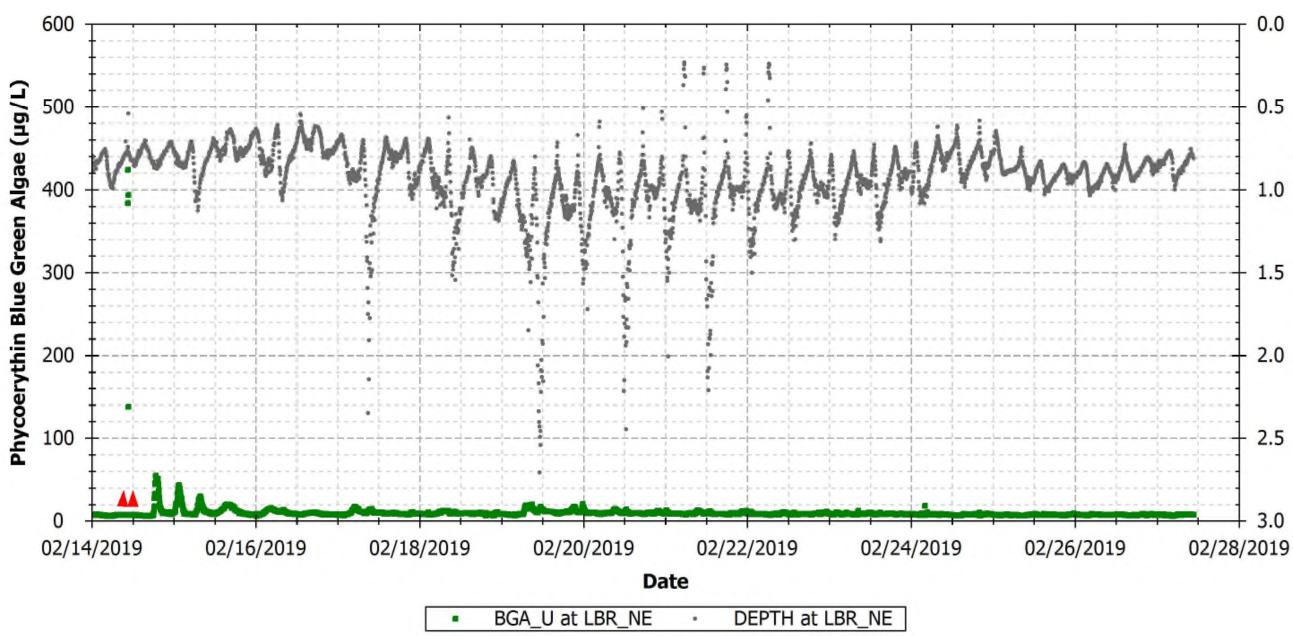


Figure B-3 Back River northeast observed battery



Note red triangles identify timing of dye release

Figure B-4 Back River northeast observed BGA

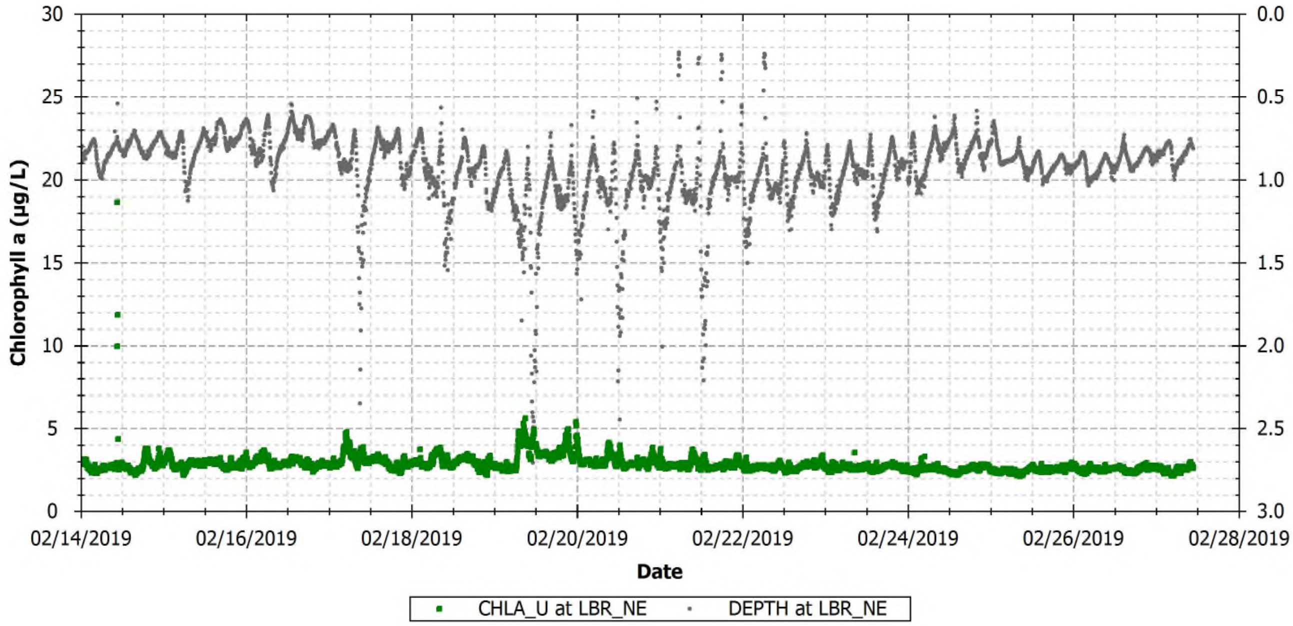


Figure B-5 Back River northeast observed chlorophyll a

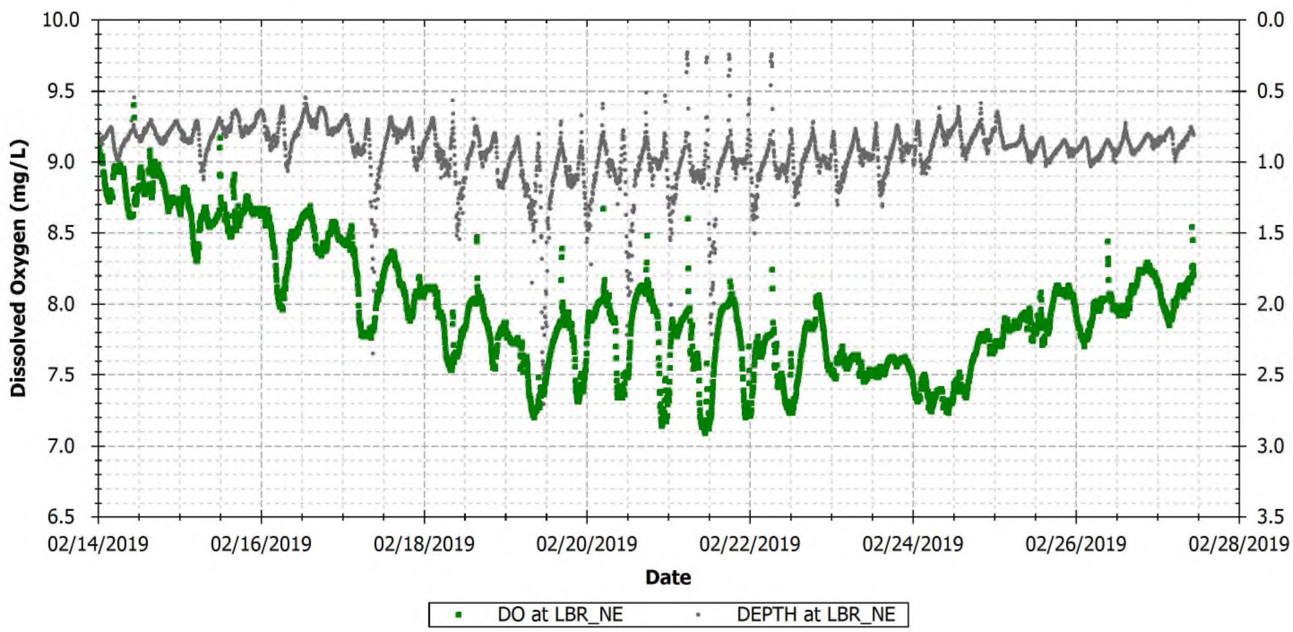


Figure B-6 Back River northeast observed DO concentration

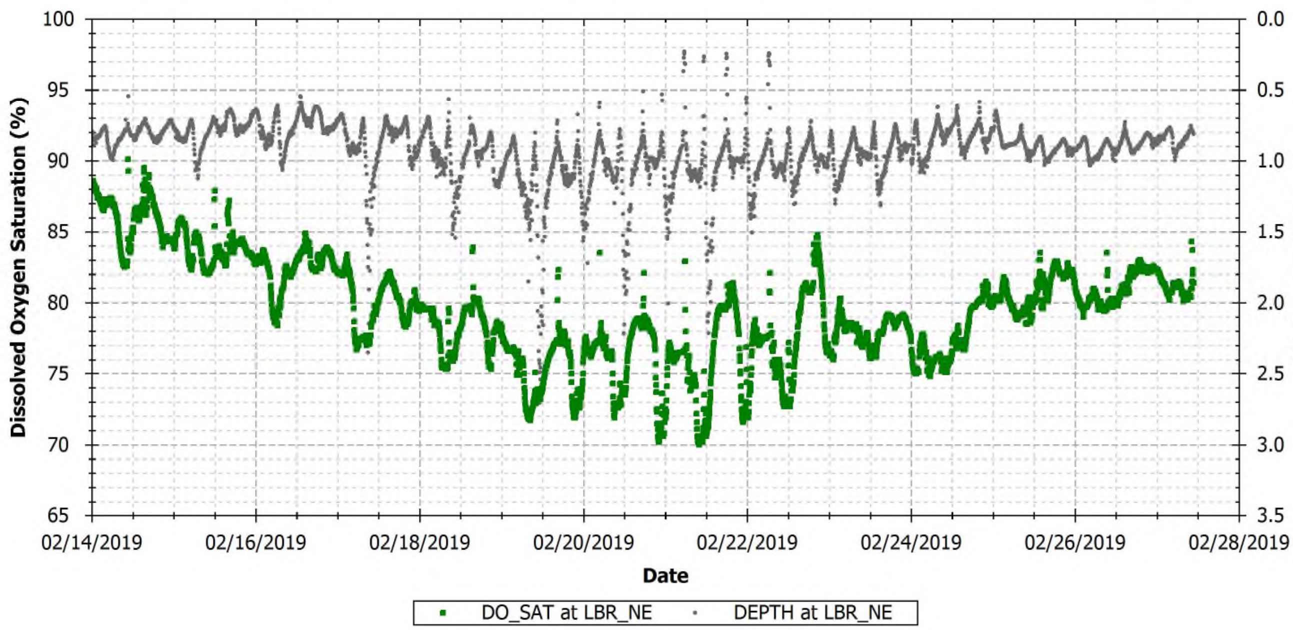


Figure B-7 Back River northeast observed DO saturation

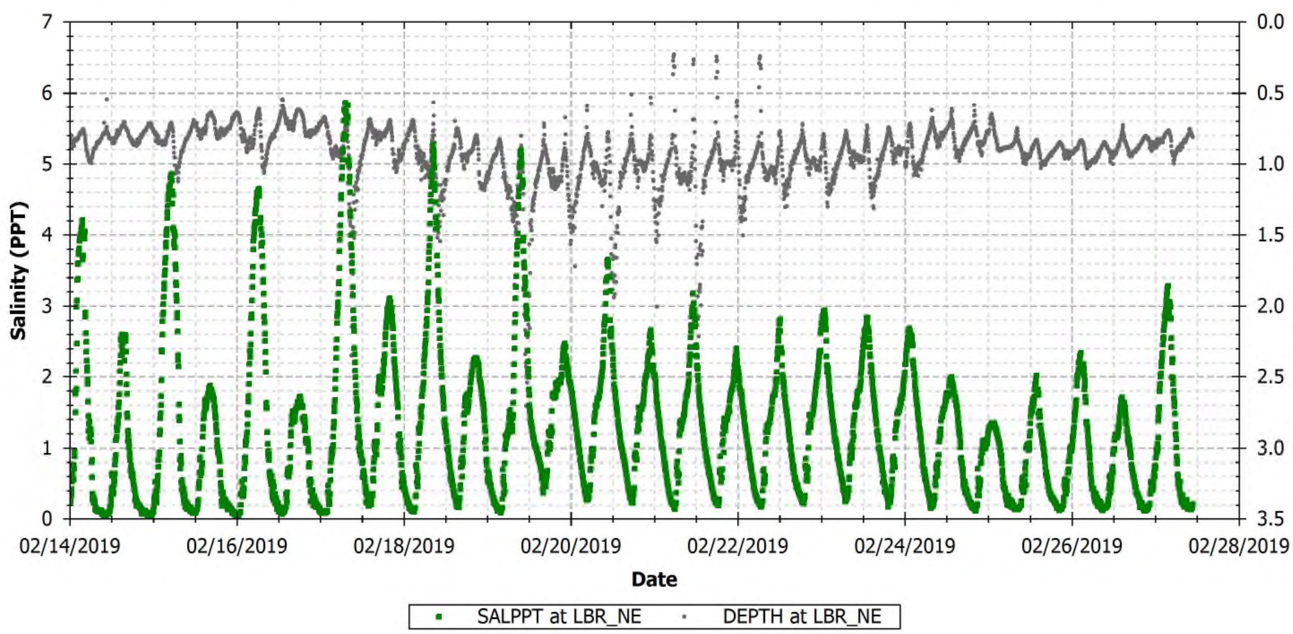


Figure B-8 Back River northeast observed salinity

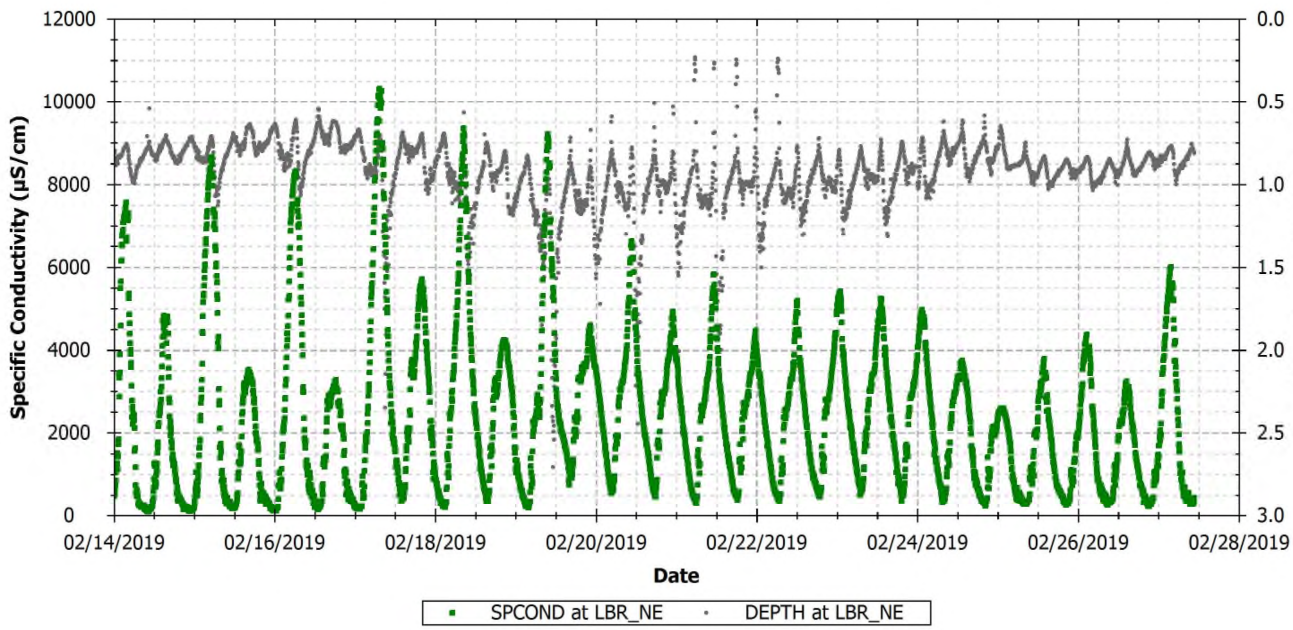


Figure B-9 Back River northeast observed specific conductivity

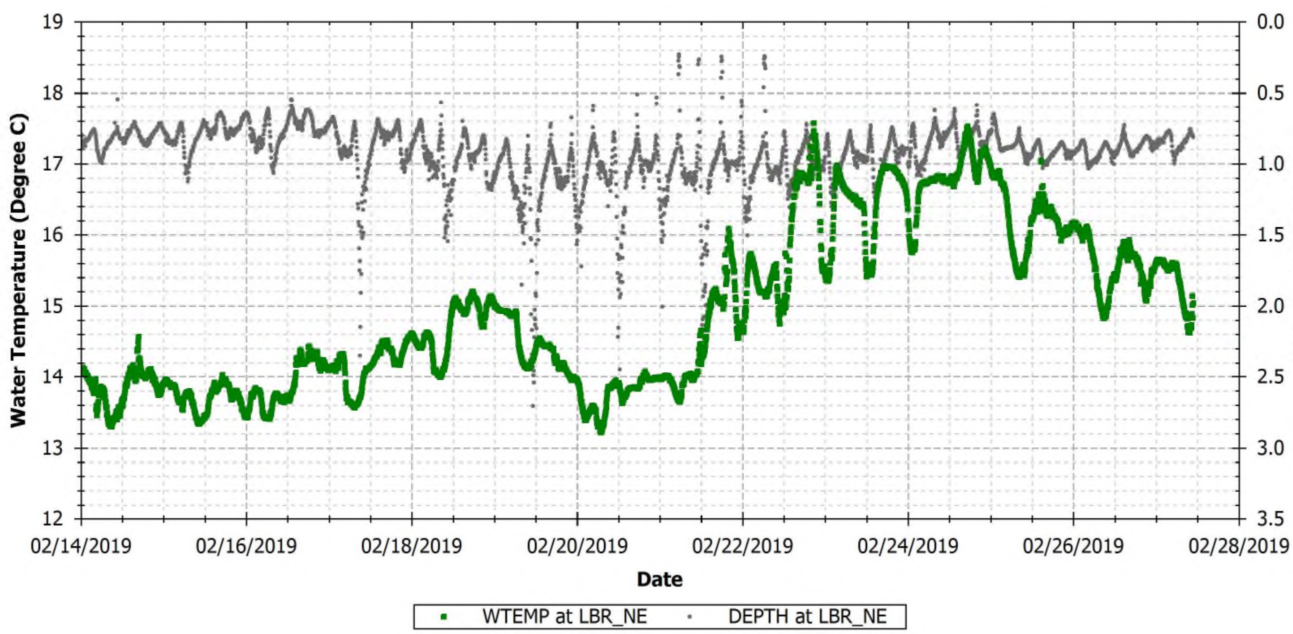


Figure B-10 Back River northeast observed water temperature

B.3 BACK RIVER NORTHWEST

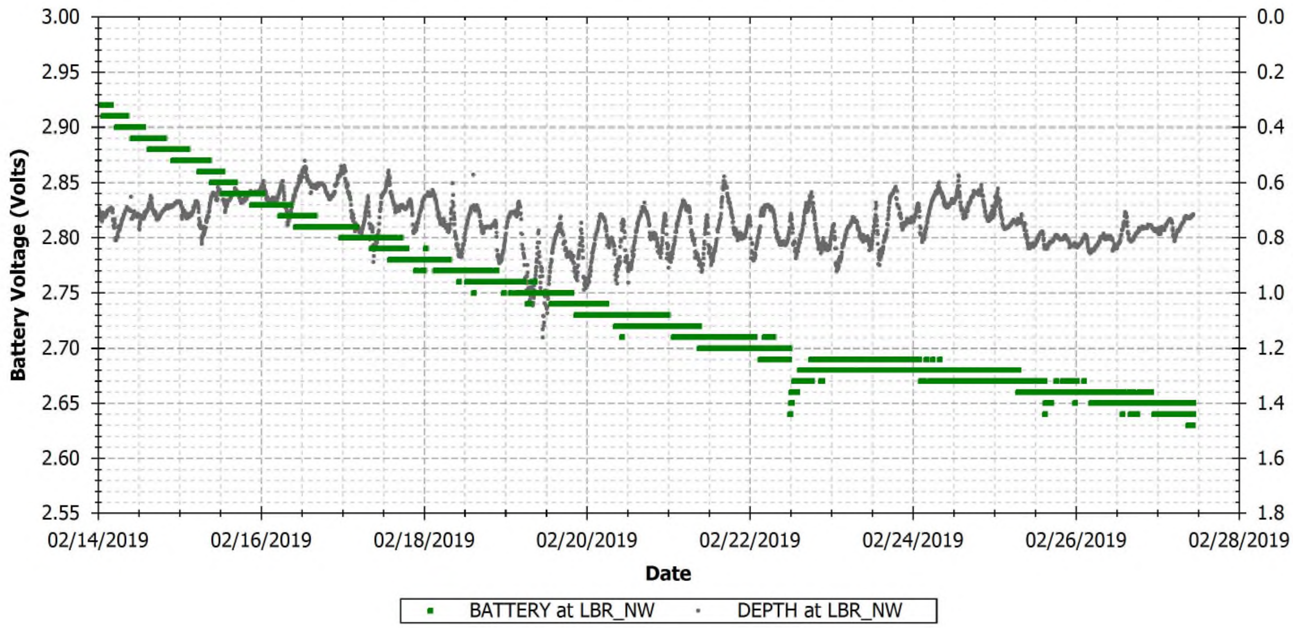


Figure B-11 Back River northwest observed battery

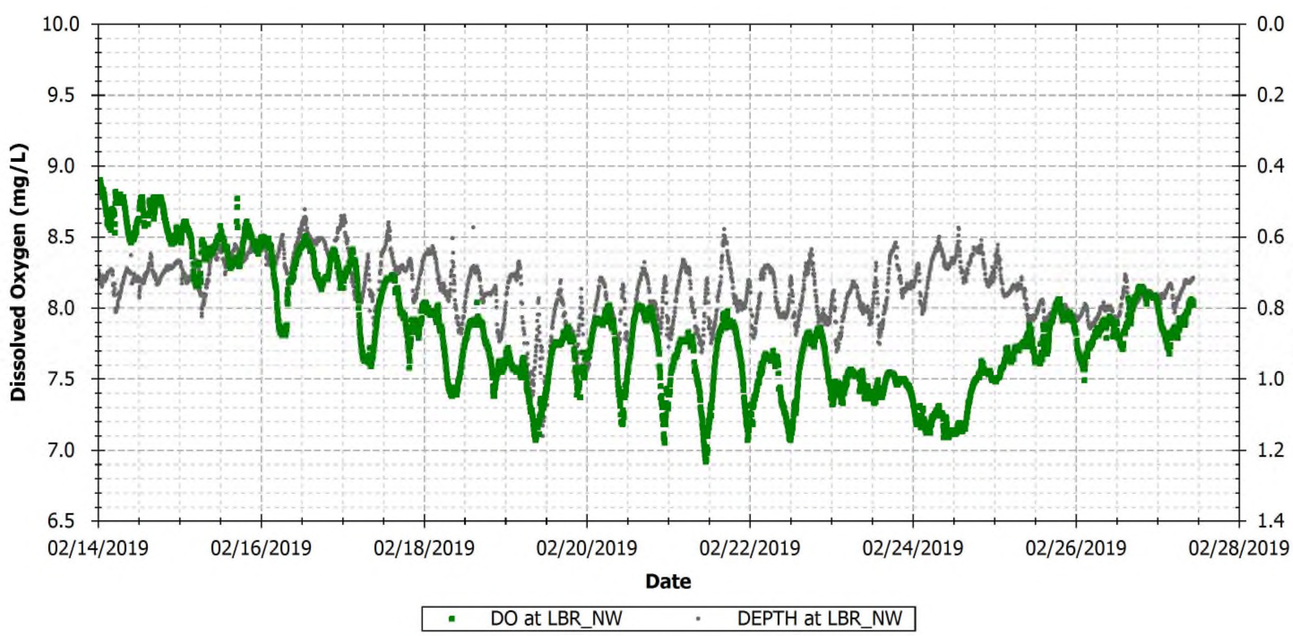


Figure B-12 Back River northwest observed DO concentration

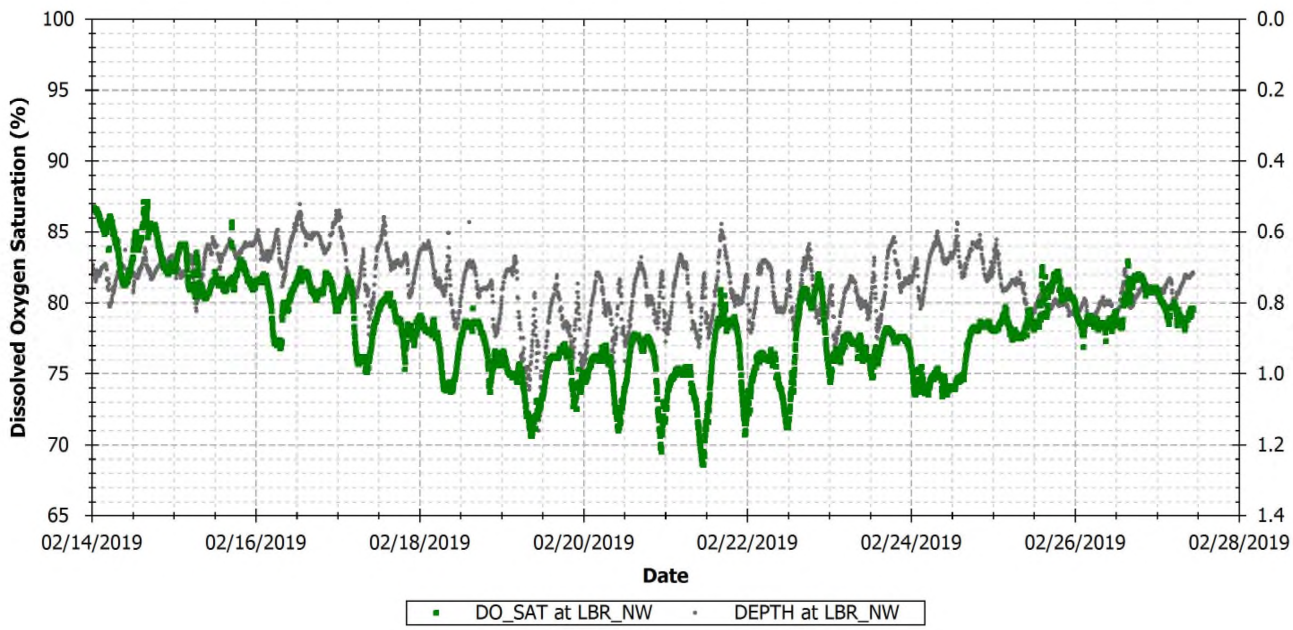


Figure B-13 Back River northwest observed DO saturation

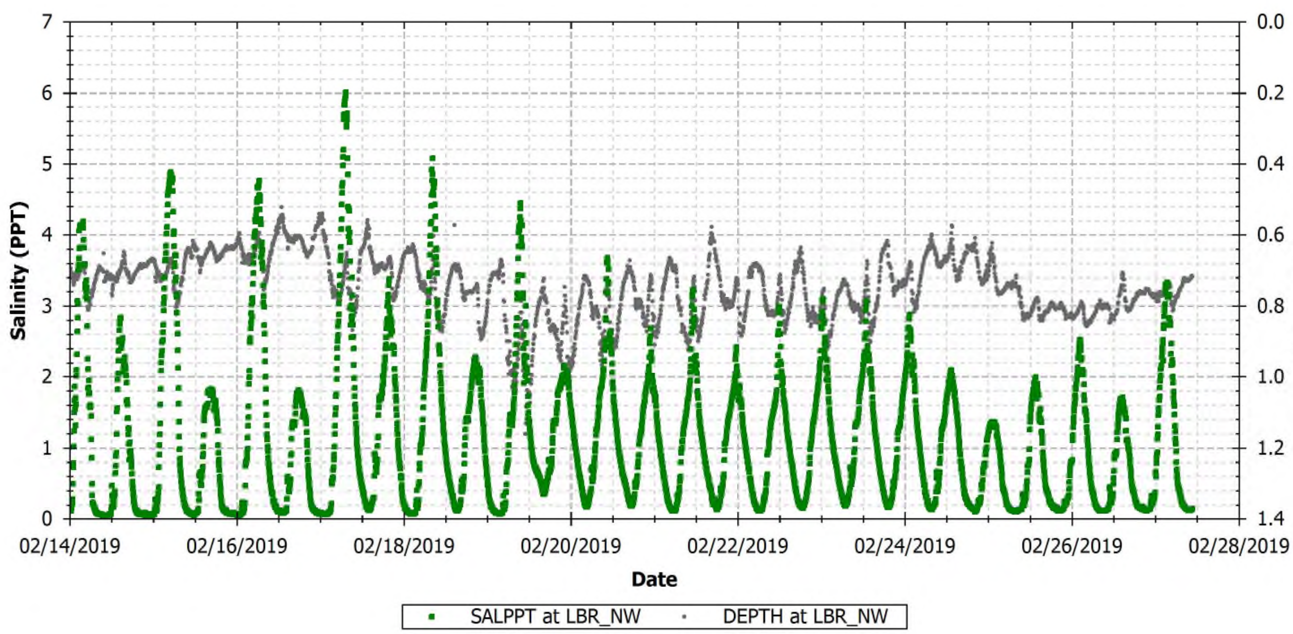


Figure B-14 Back River northwest south observed salinity

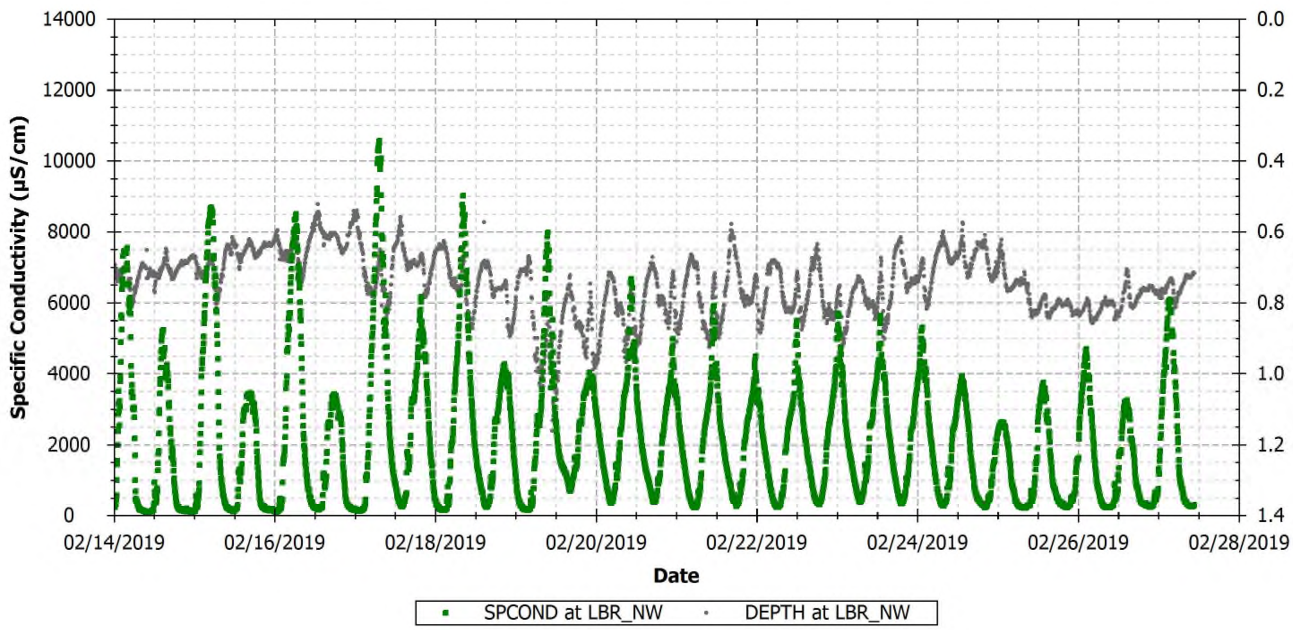


Figure B-15 Back River northwest observed specific conductivity

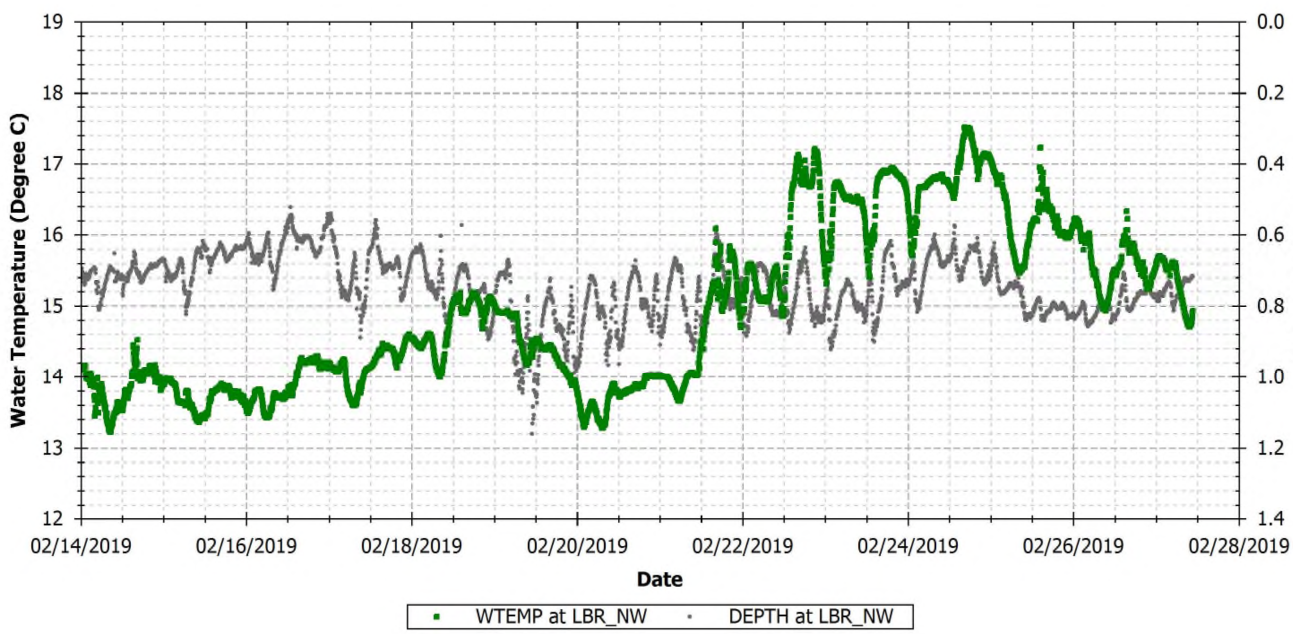


Figure B-16 Back River northwest observed water temperature

B.4 BACK RIVER SOUTHEAST

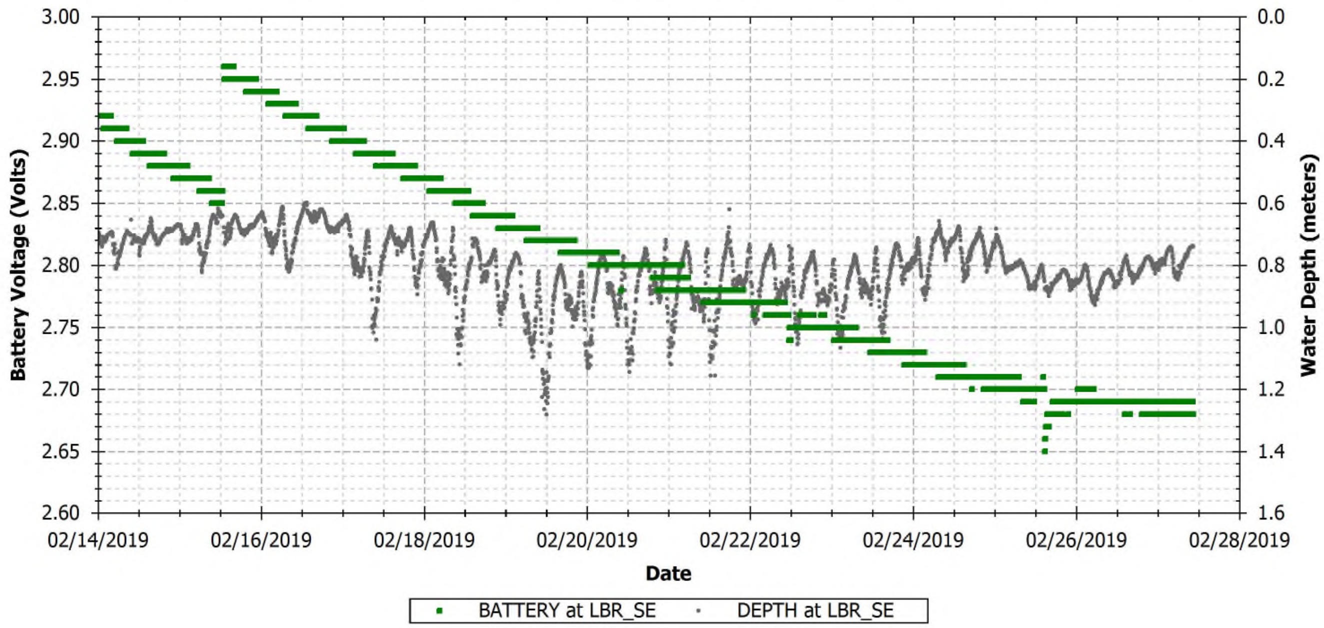


Figure B-17 Back River southeast observed battery

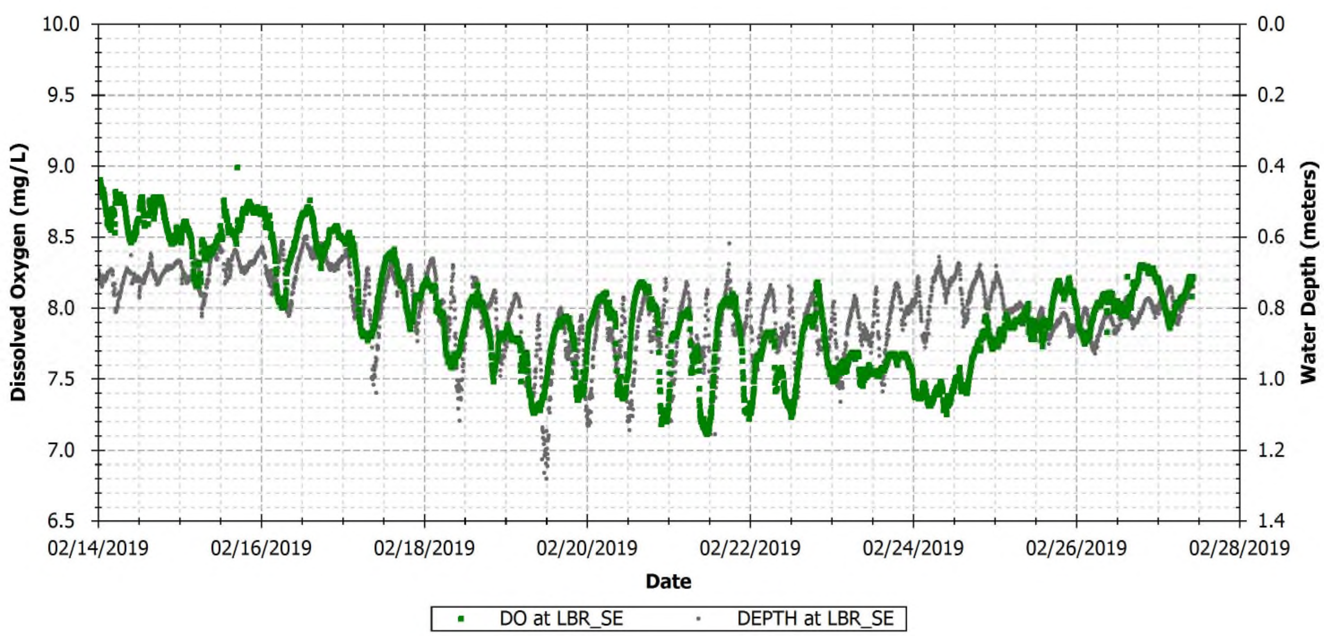


Figure B-18 Back River southeast observed DO concentration

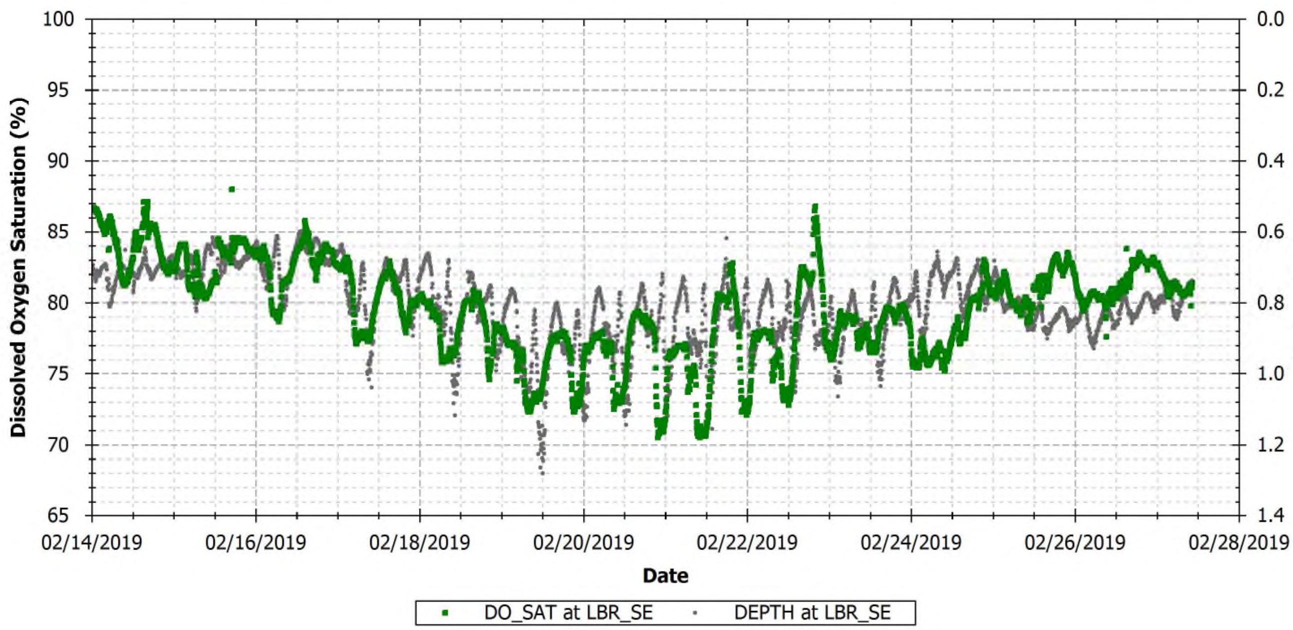


Figure B-19 Back River southeast observed DO saturation

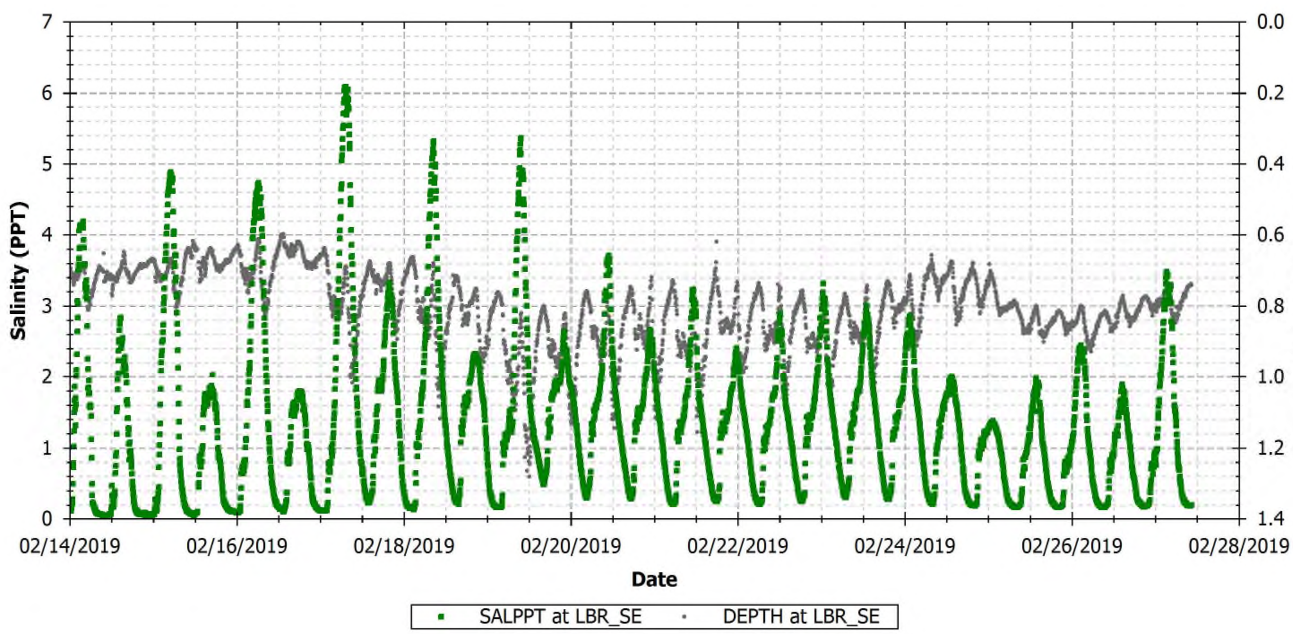


Figure B-20 Back River southeast observed salinity

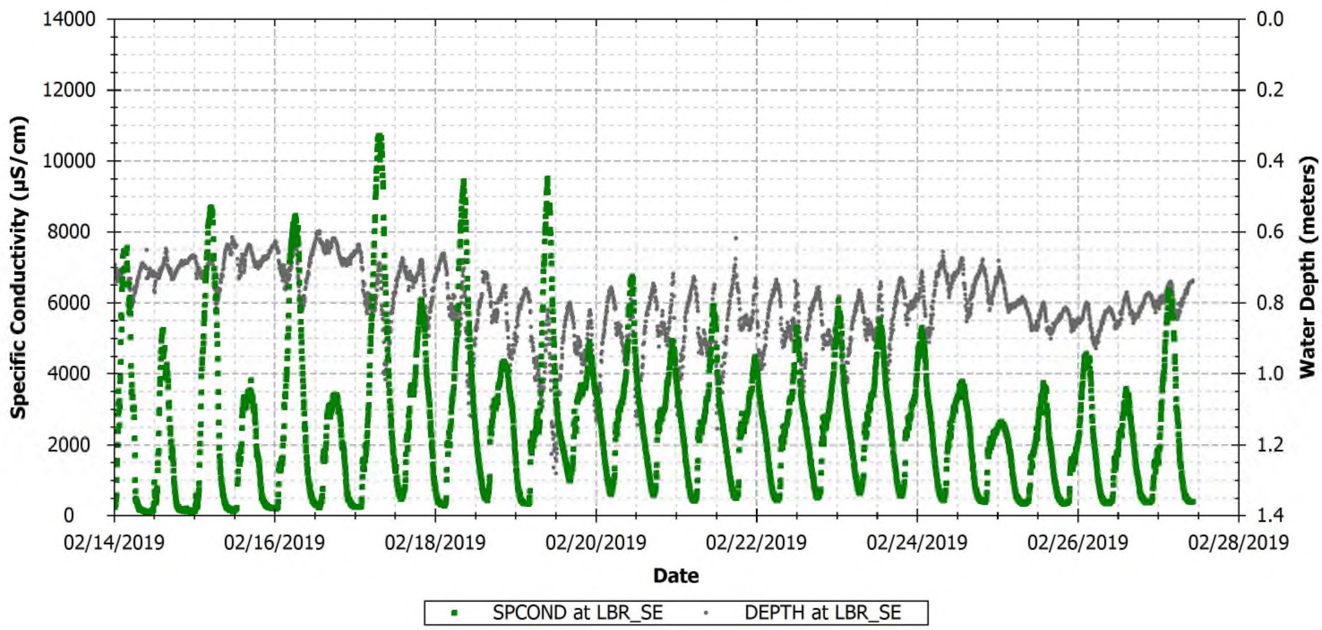


Figure B-21 Back River southeast observed specific conductivity

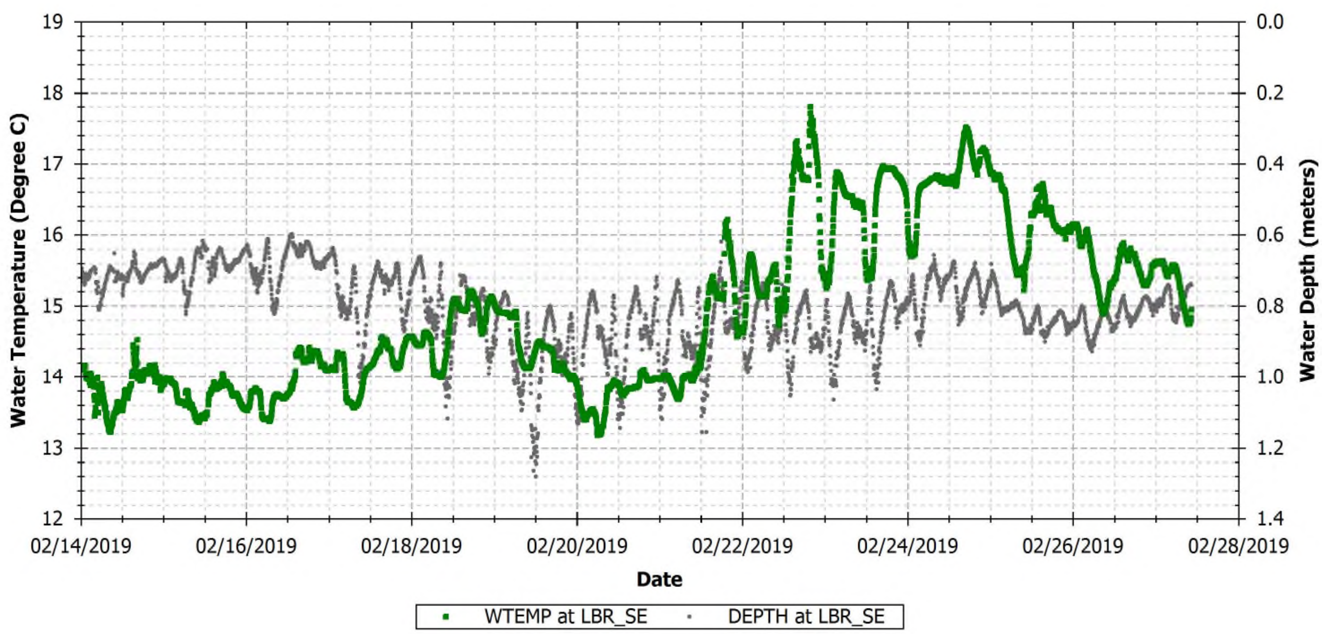


Figure B-22 Back River southeast observed water temperature

B.5 BACK RIVER SOUTHWEST

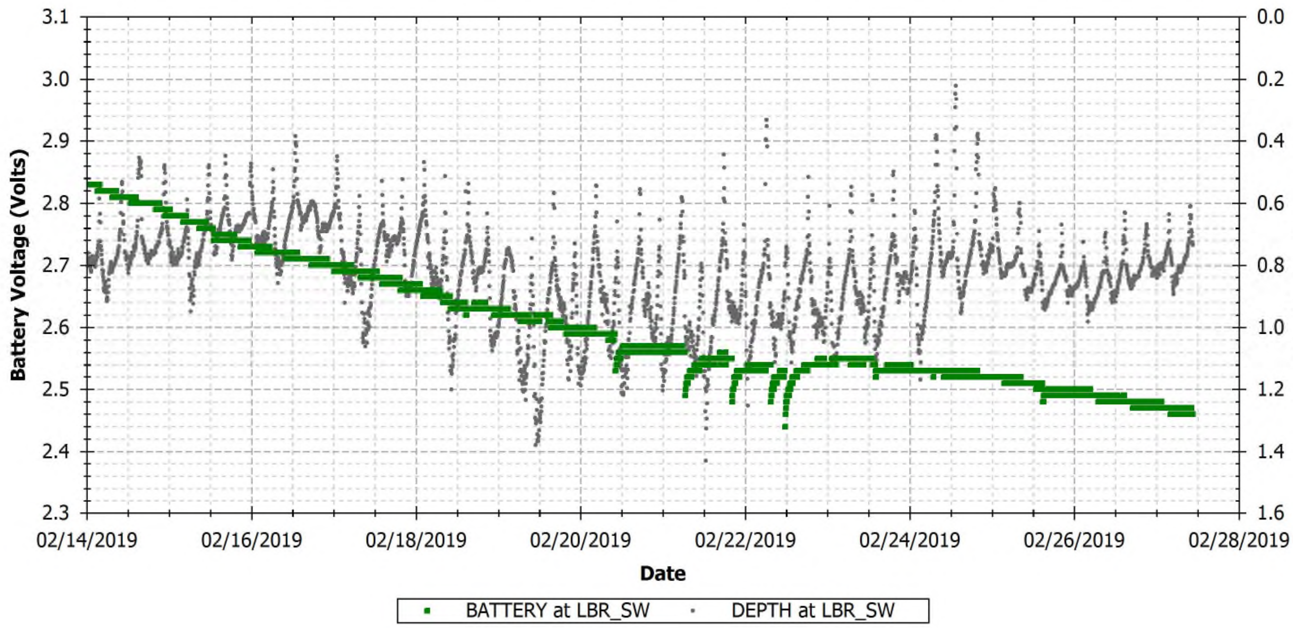
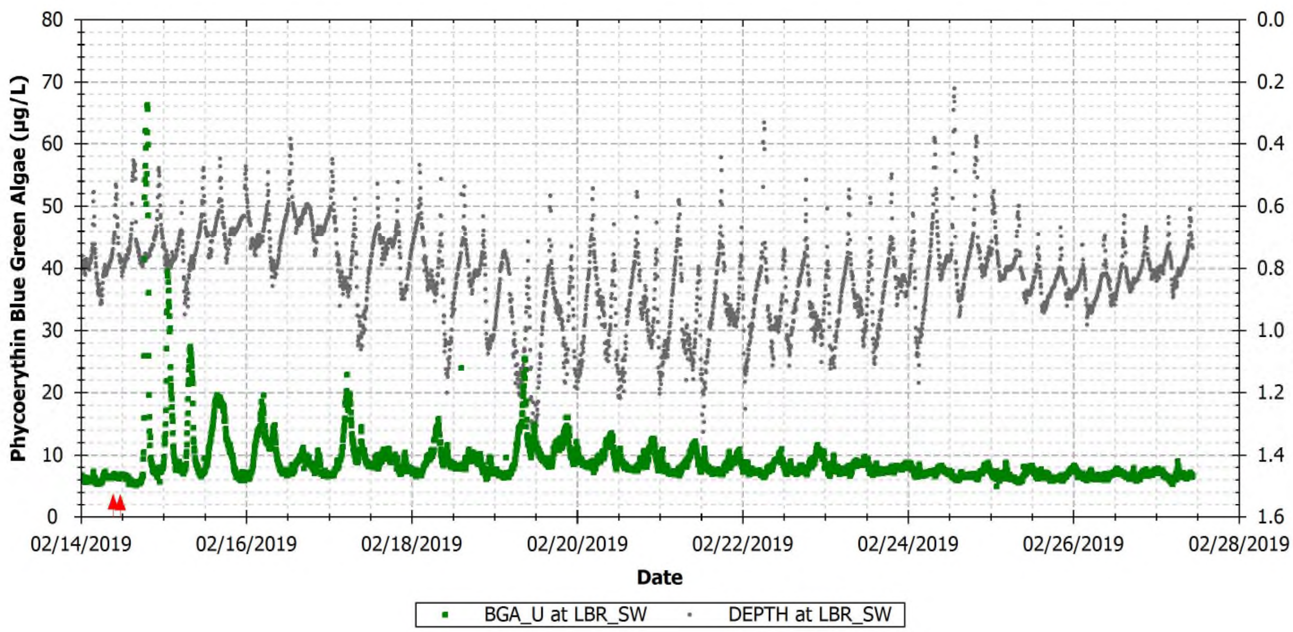


Figure B-23 Back River southwest observed battery



Note red triangles identify timing of dye release

Figure B-24 Back River southwest observed BGA

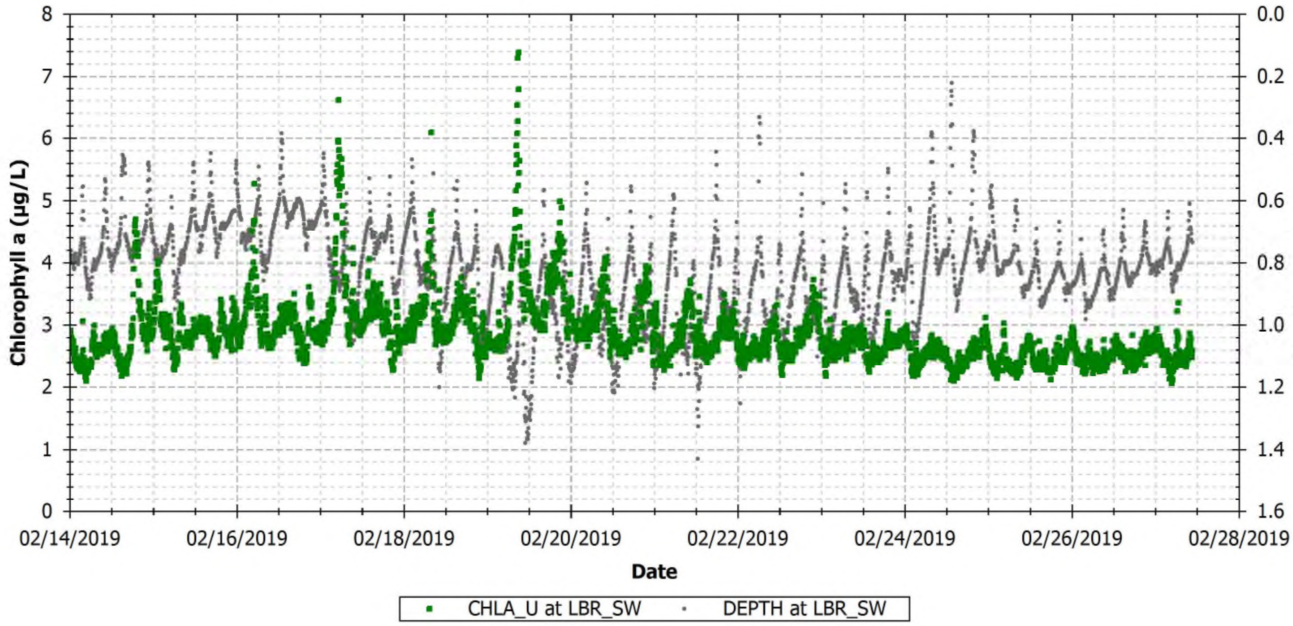


Figure B-25 Back River southwest observed chlorophyll a

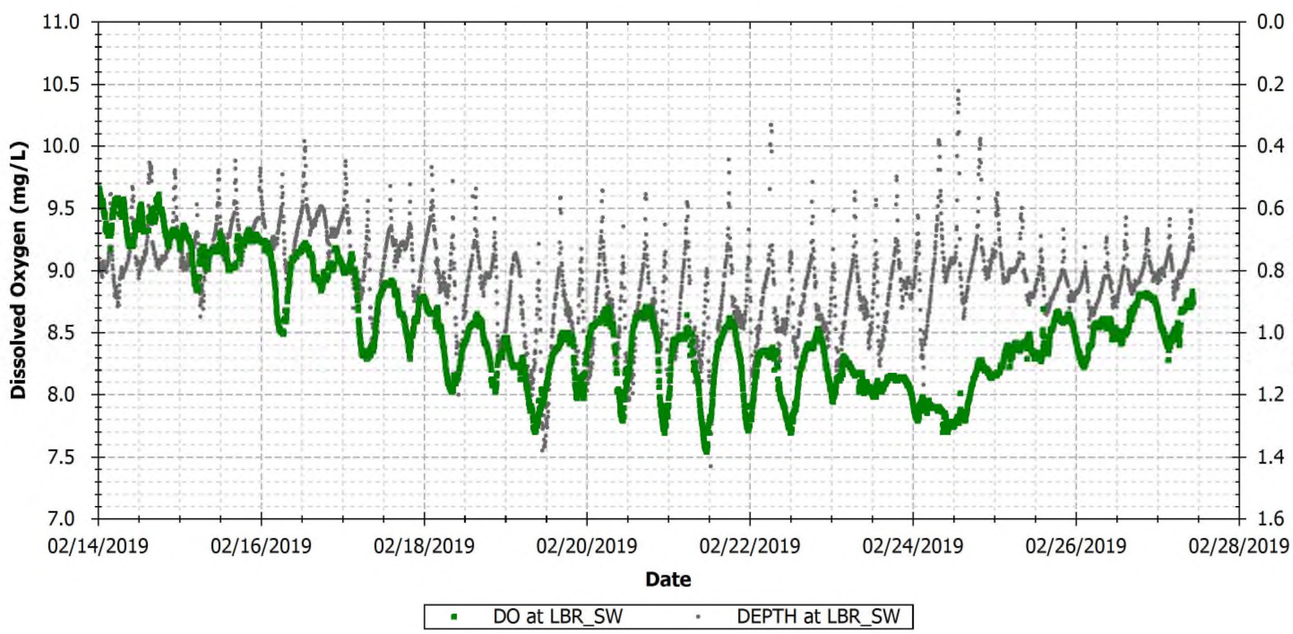


Figure B-26 Back River southwest observed DO concentration

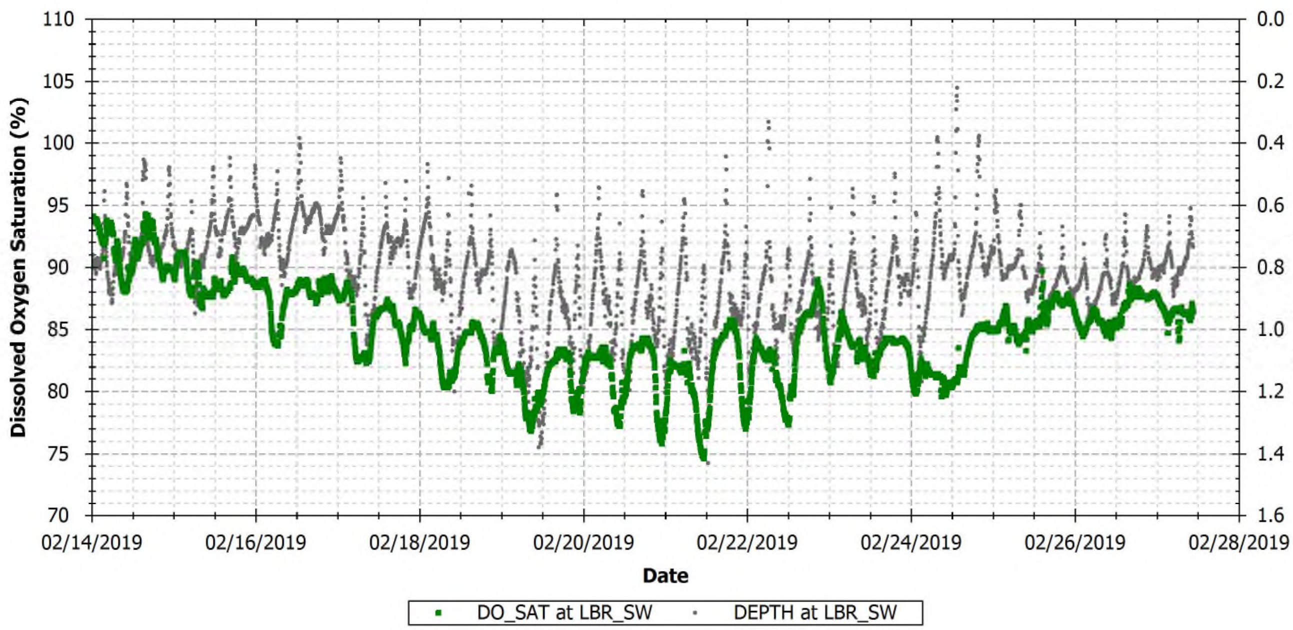


Figure B-27 Back River southwest observed DO saturation

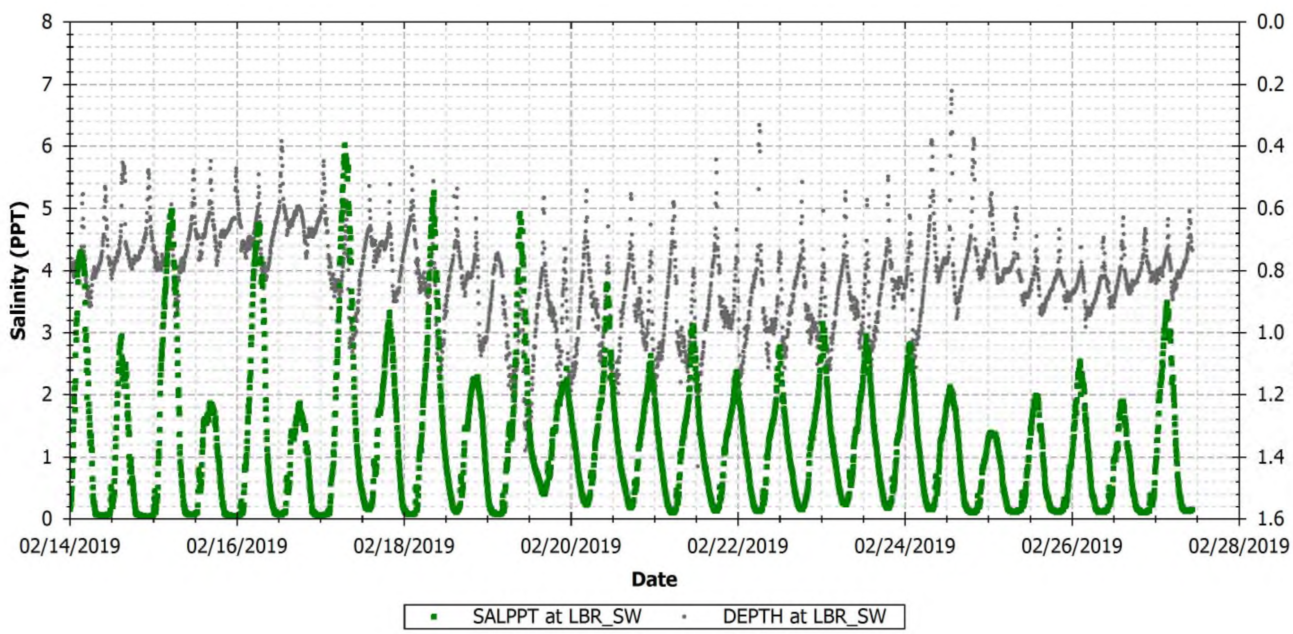


Figure B-28 Back River southwest observed salinity

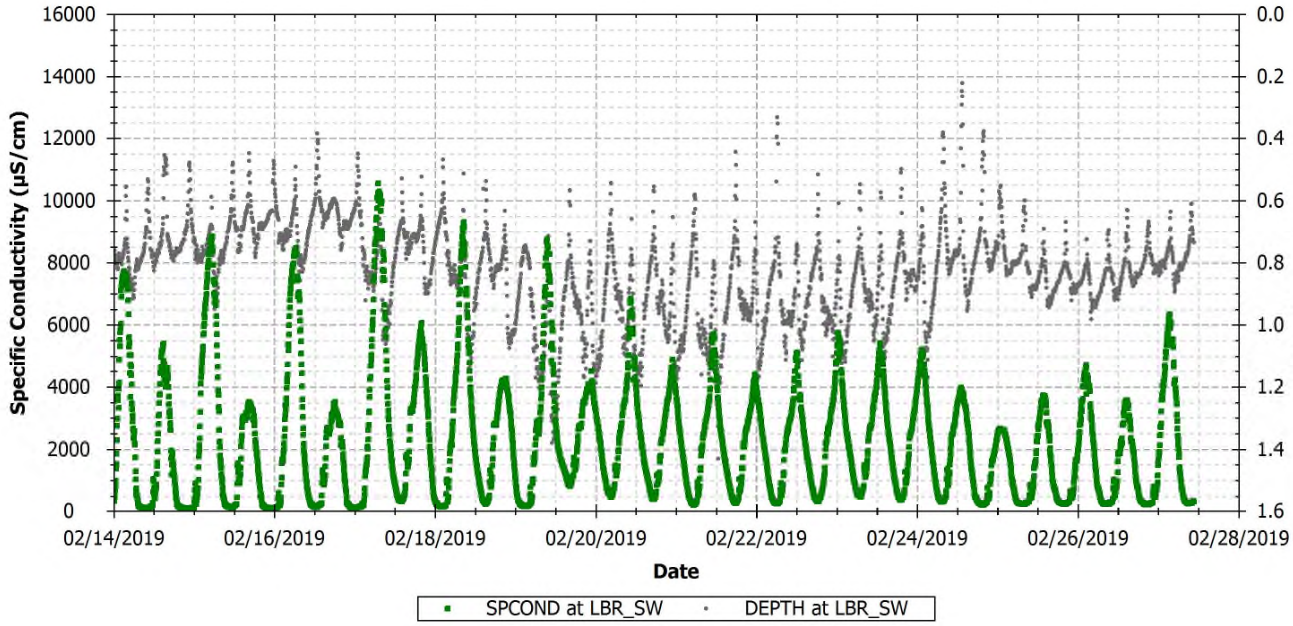


Figure B-29 Back River southwest observed specific conductivity

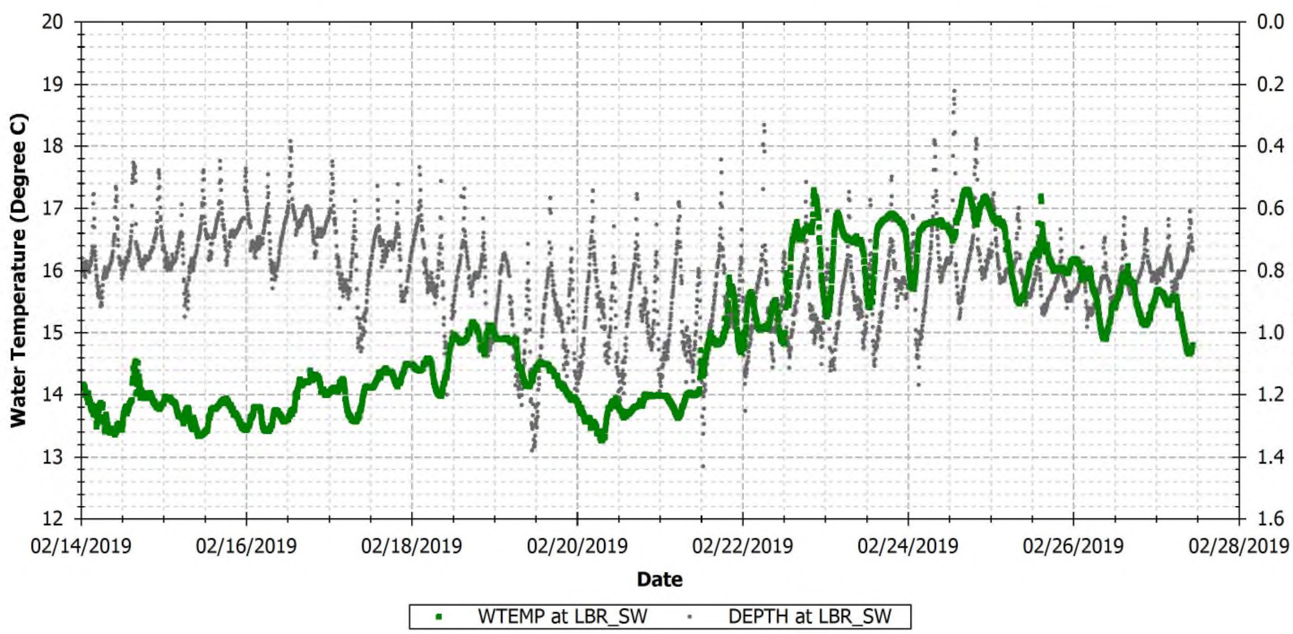


Figure B-30 Back River southwest observed water temperature

B.6 LOWER FRONT RIVER NORTH

See section 3.2 paragraph 2 for discussion about the observed depth increase and why it was retained

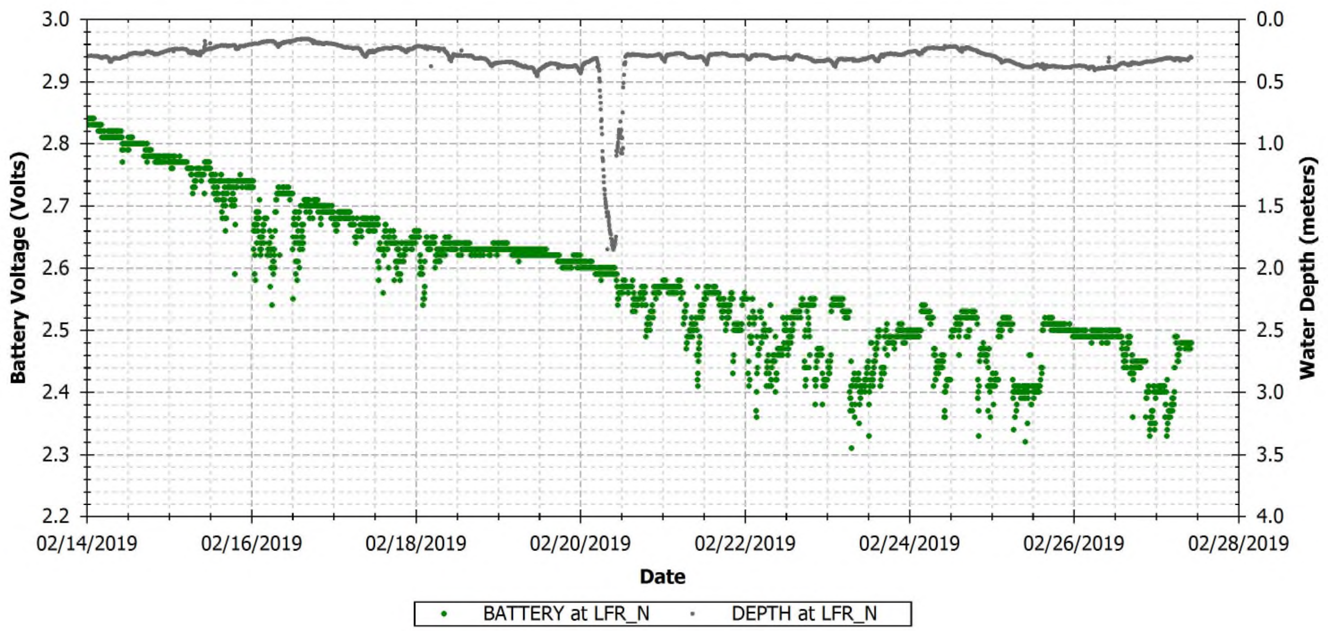
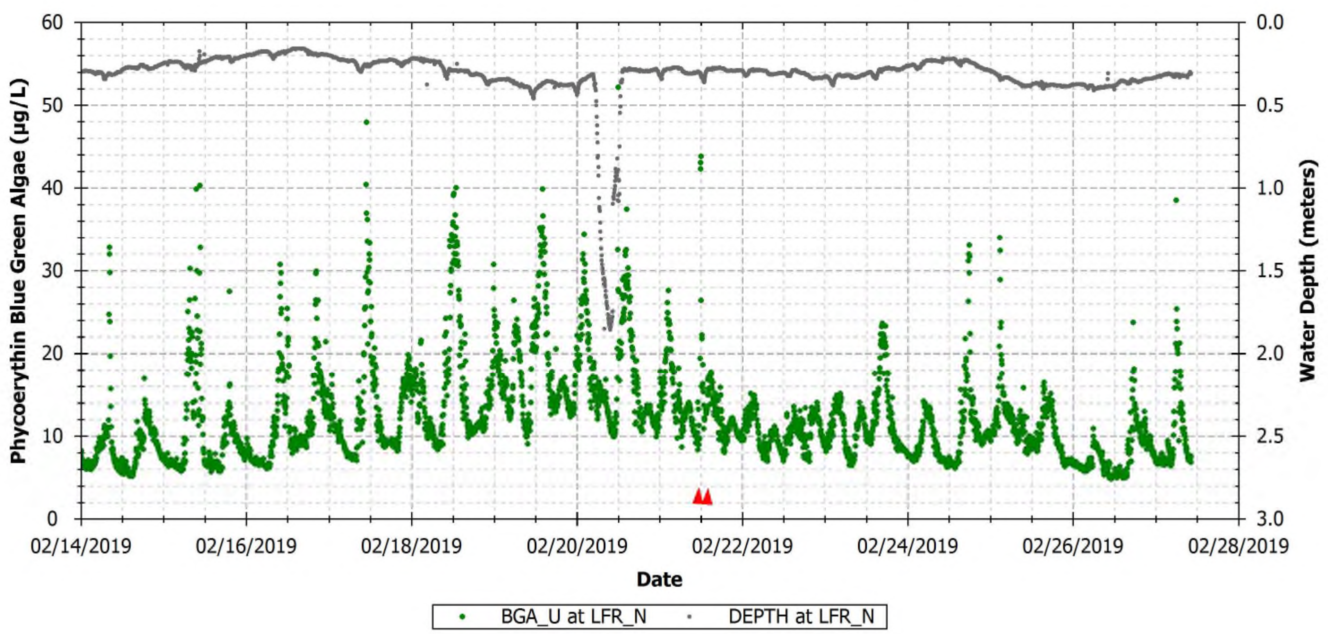


Figure B-31 Lower Front River north observed battery



Note red triangles identify timing of dye release

Figure B-32 Lower Front River north observed BGA

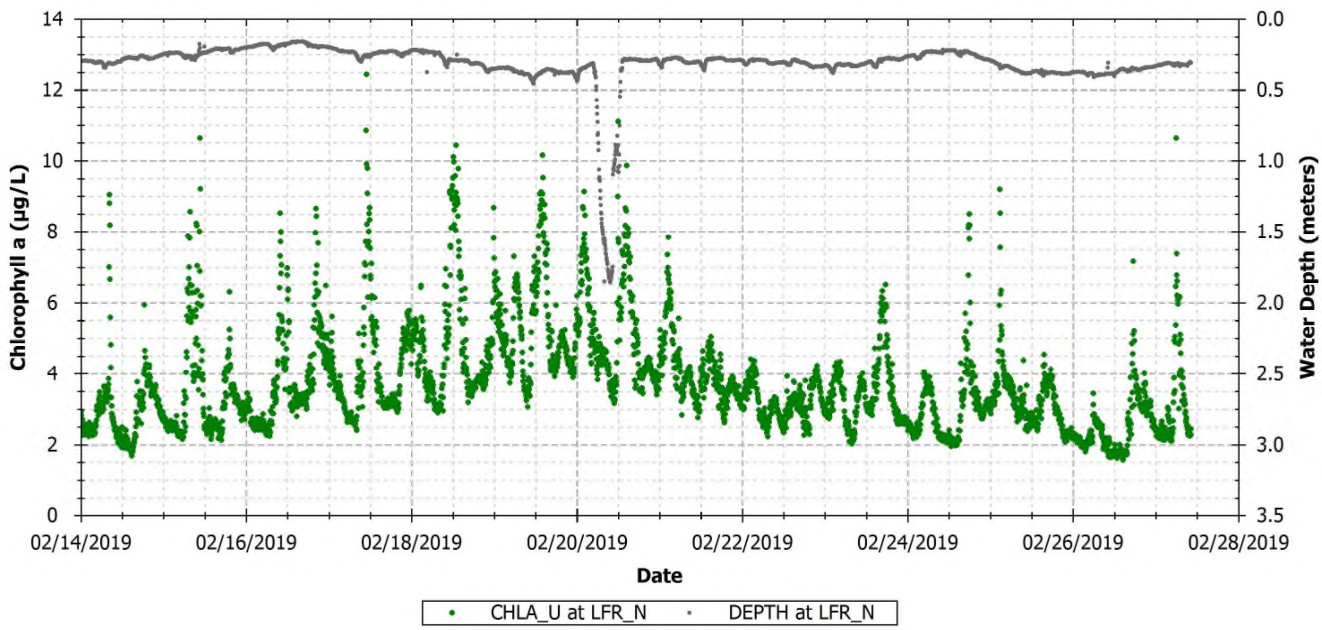


Figure B-33 Lower Front River north observed chlorophyll a

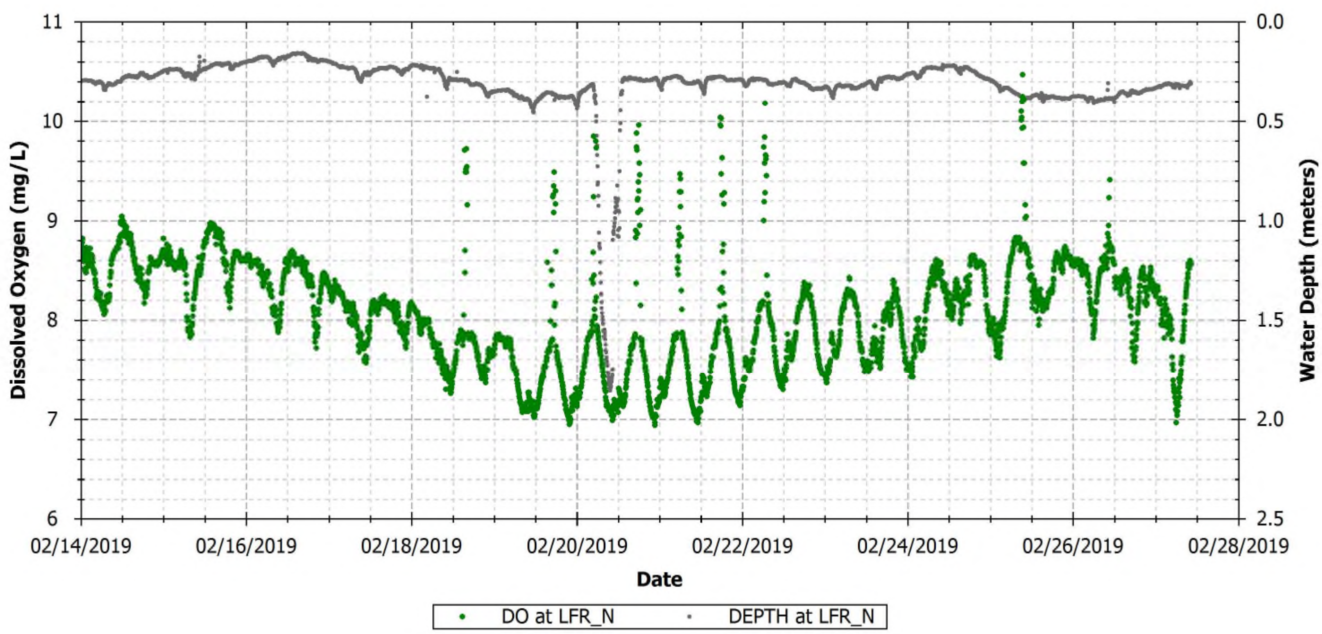


Figure B-34 Lower Front River north observed DO concentration

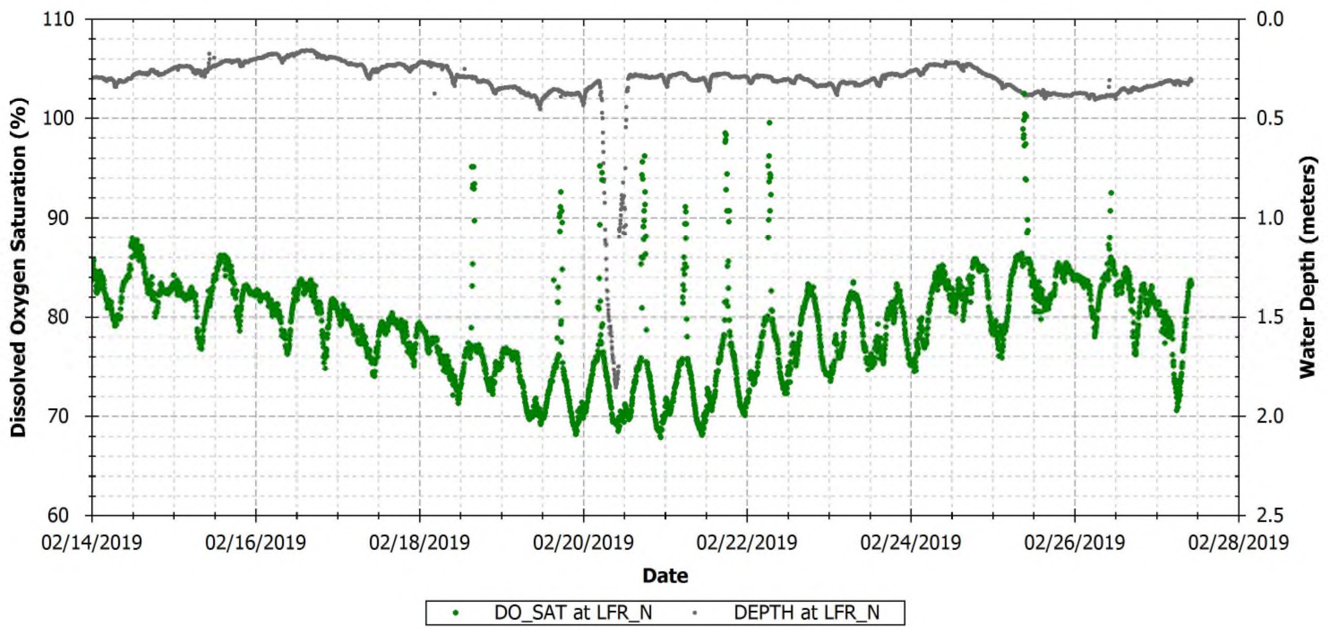


Figure B-35 Lower Front River north observed DO saturation

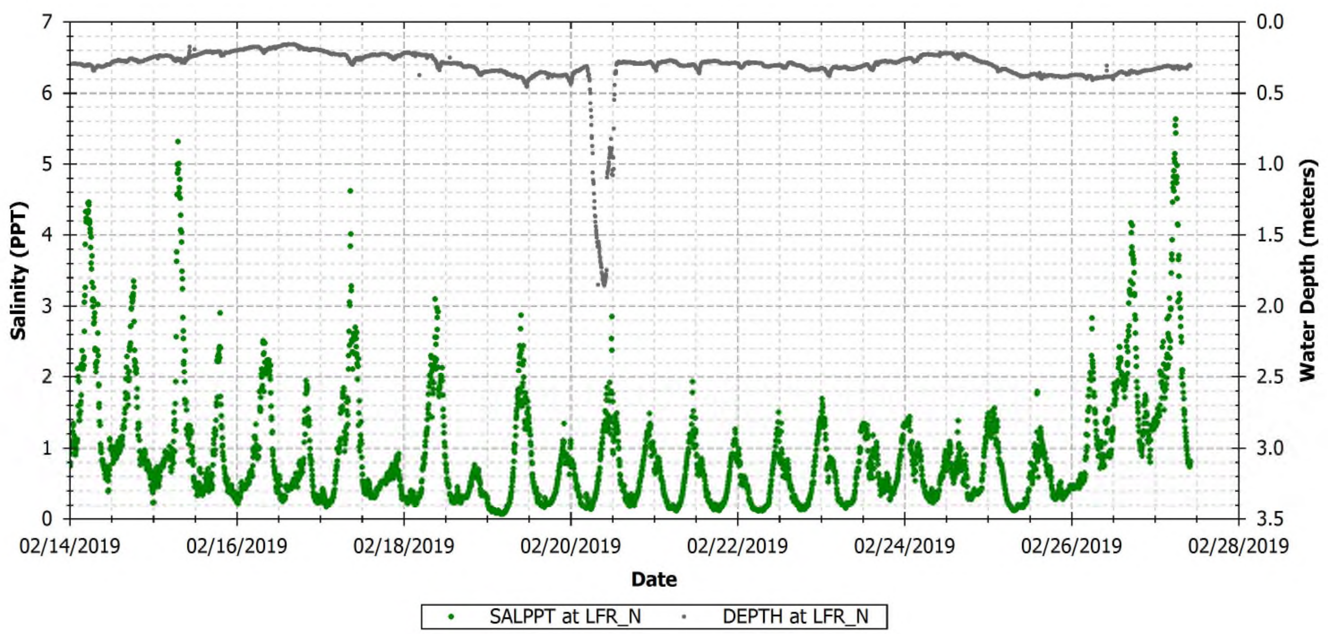


Figure B-36 Lower Front River north observed salinity

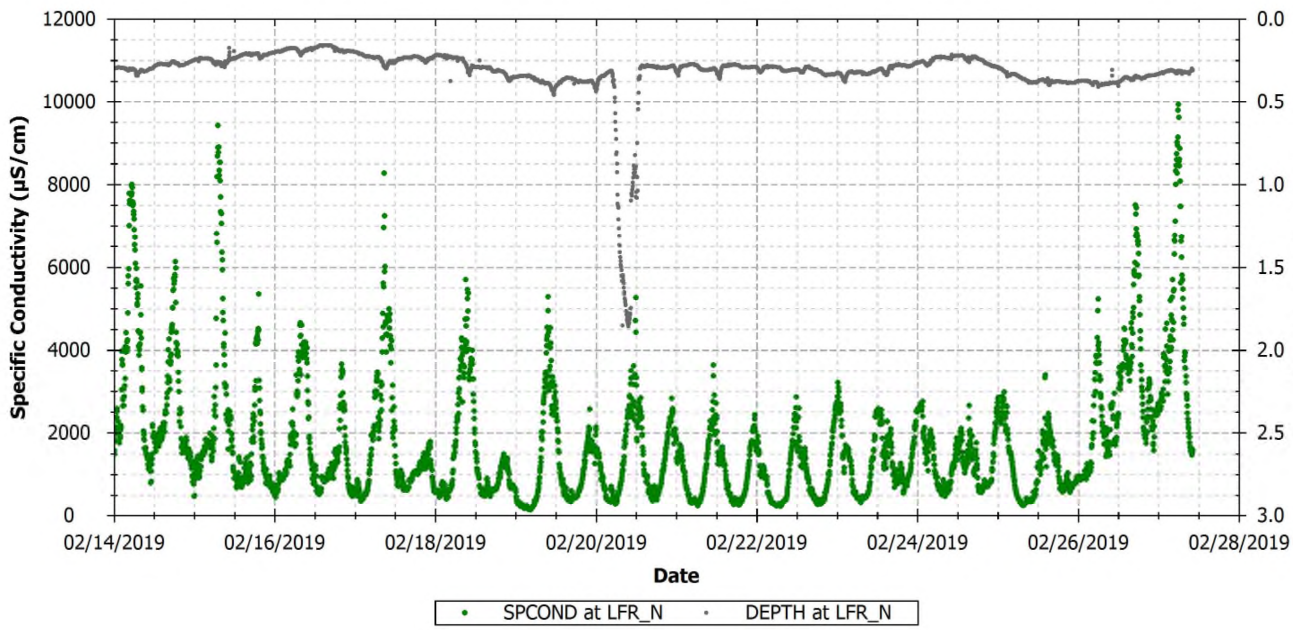


Figure B-37 Lower Front River north observed specific conductivity

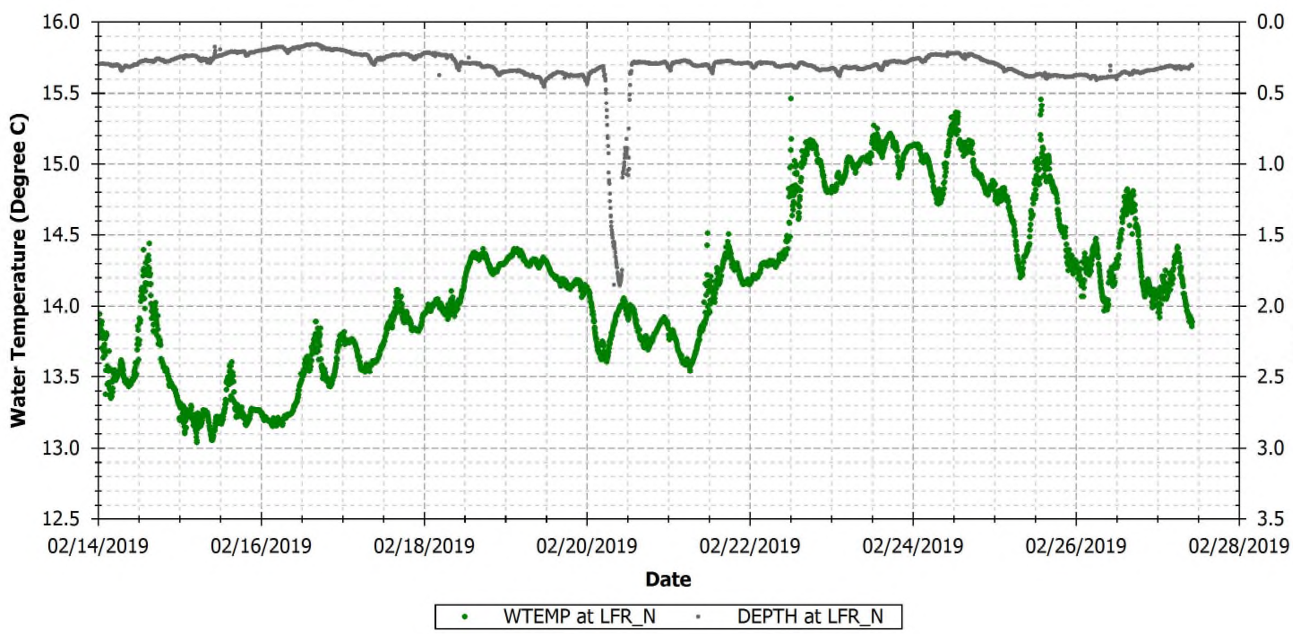


Figure B-38 Lower Front River north observed water temperature

B.7 LOWER FRONT RIVER SOUTH

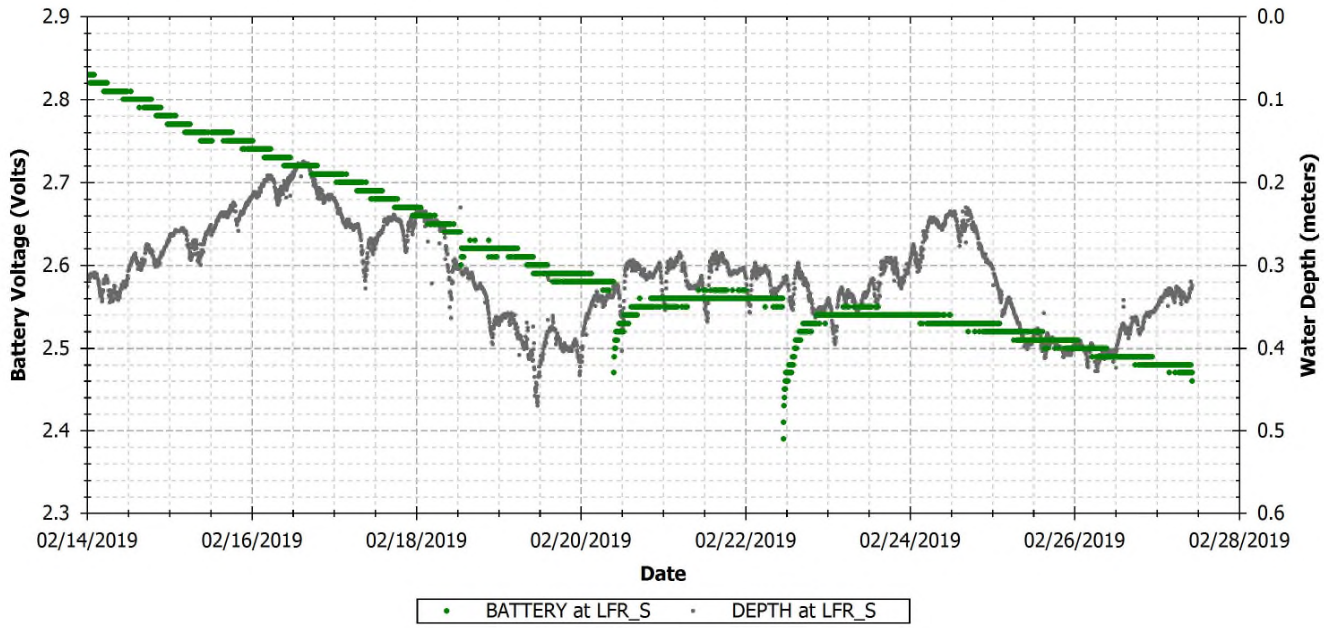
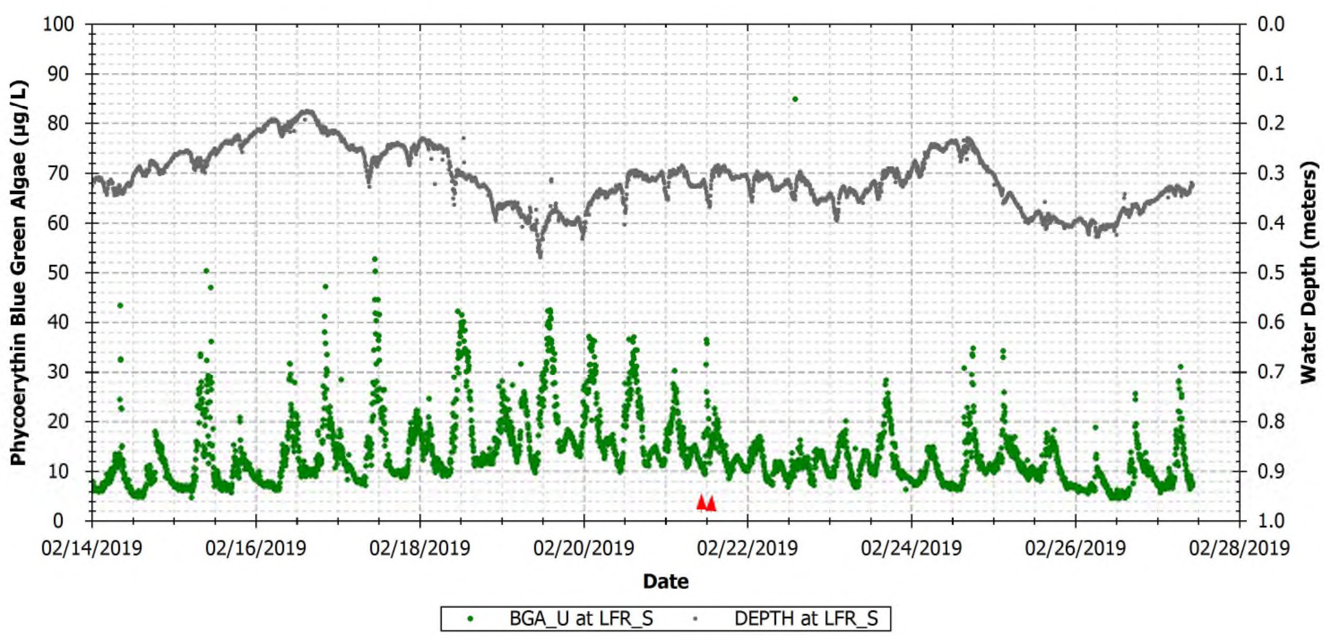


Figure B-39 Lower Front River south observed battery



Note red triangles identify timing of dye release

Figure B-40 Lower Front River south observed BGA

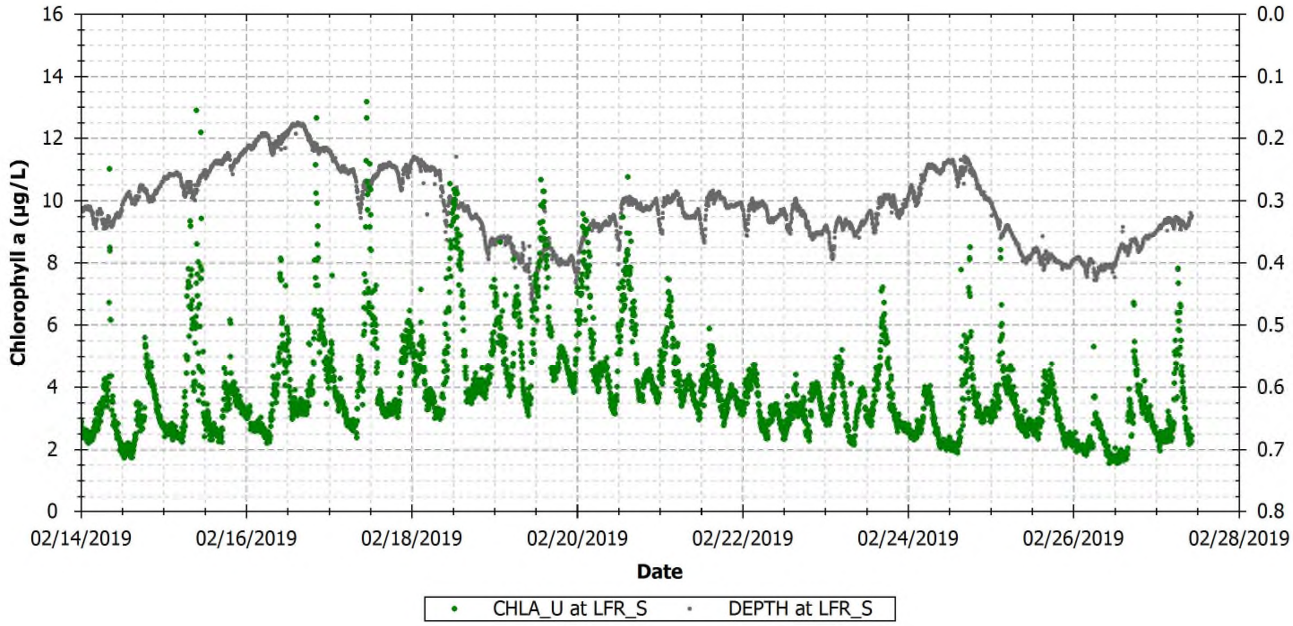


Figure B-41 Lower Front River south observed chlorophyll a

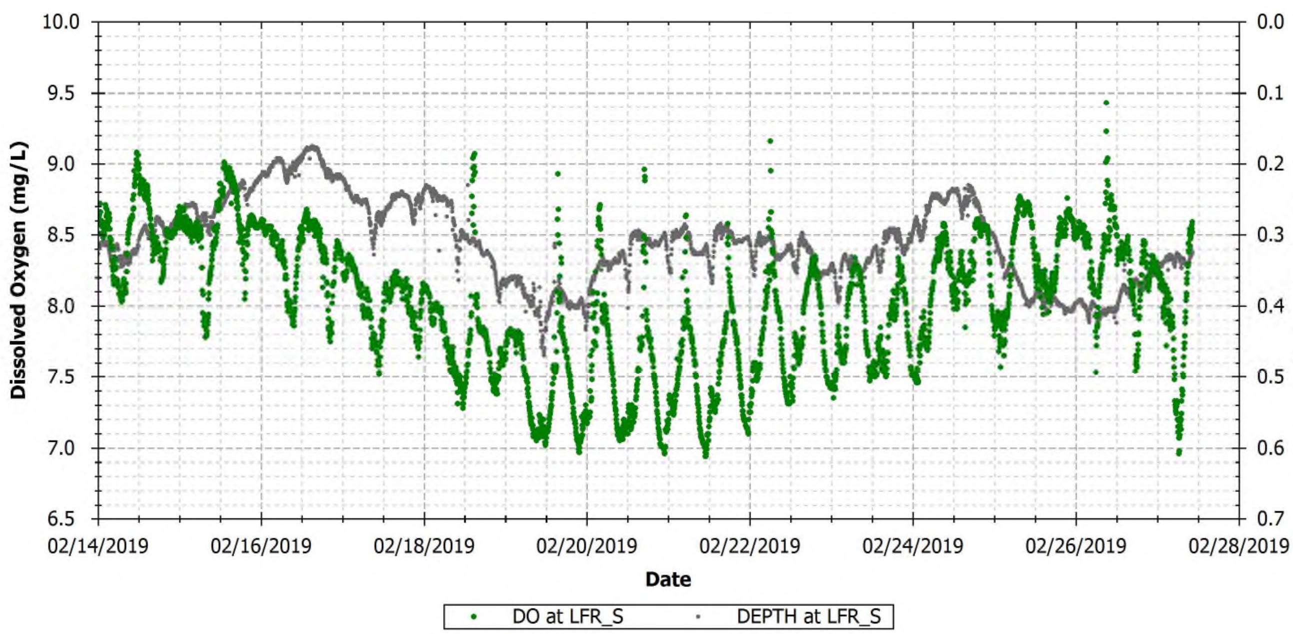


Figure B-42 Lower Front River south observed DO concentration

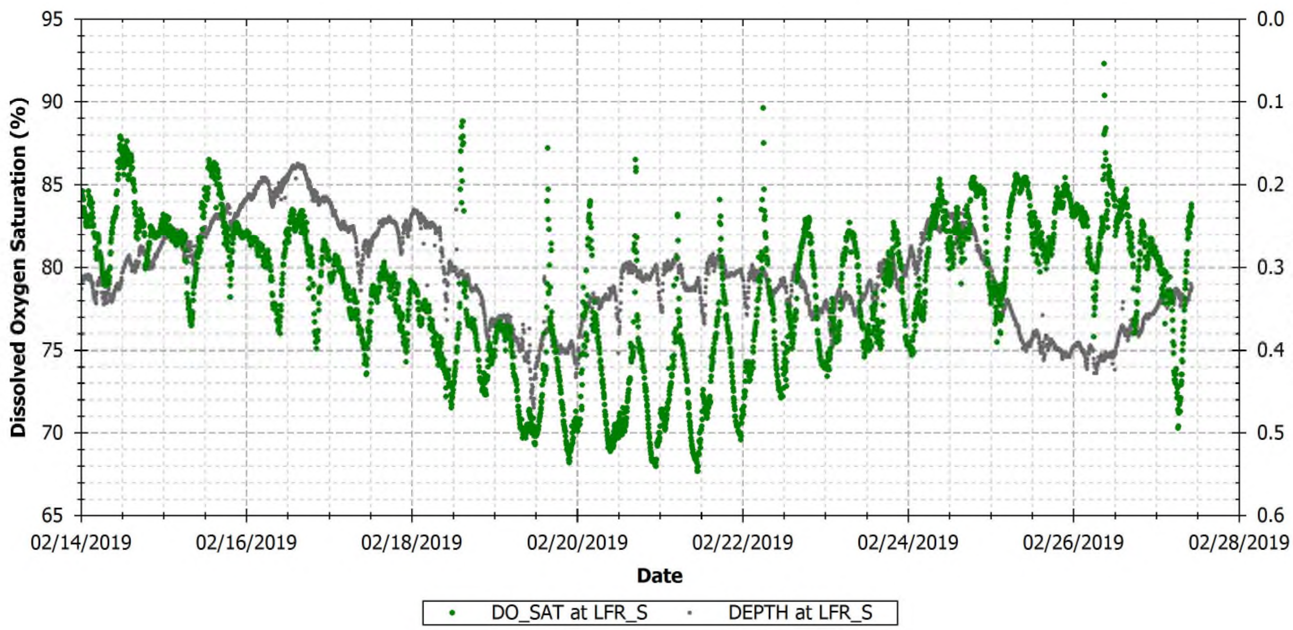


Figure B-43 Lower Front River south observed DO saturation

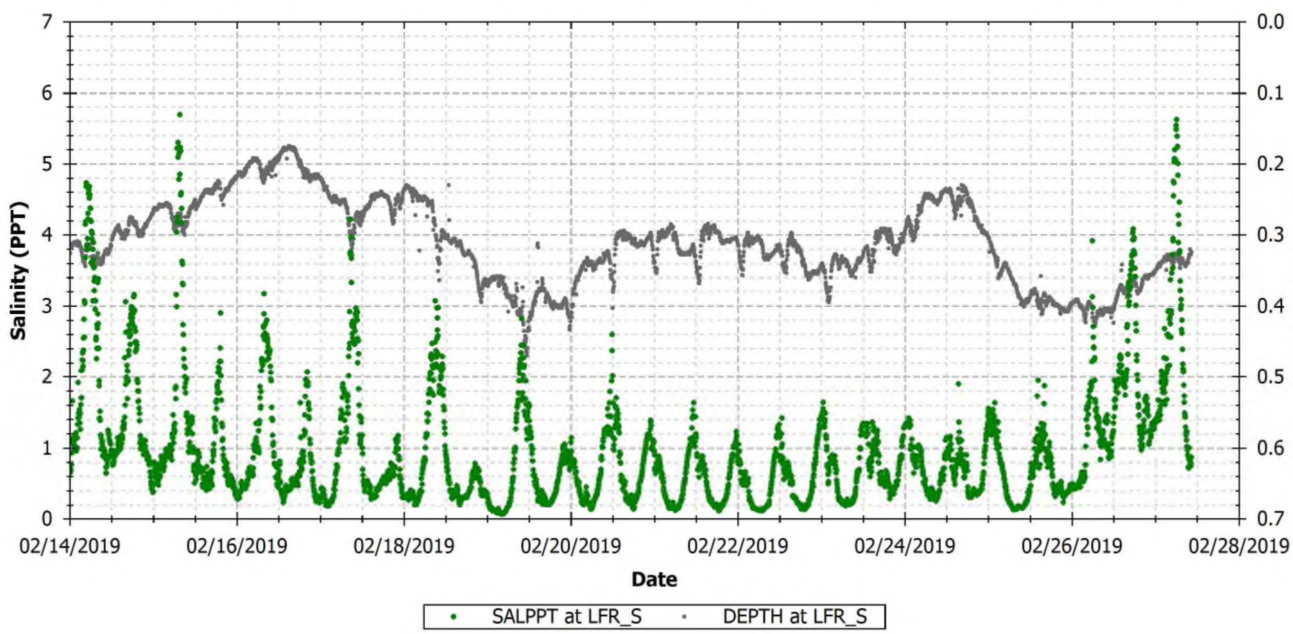


Figure B-44 Lower Front River south observed salinity

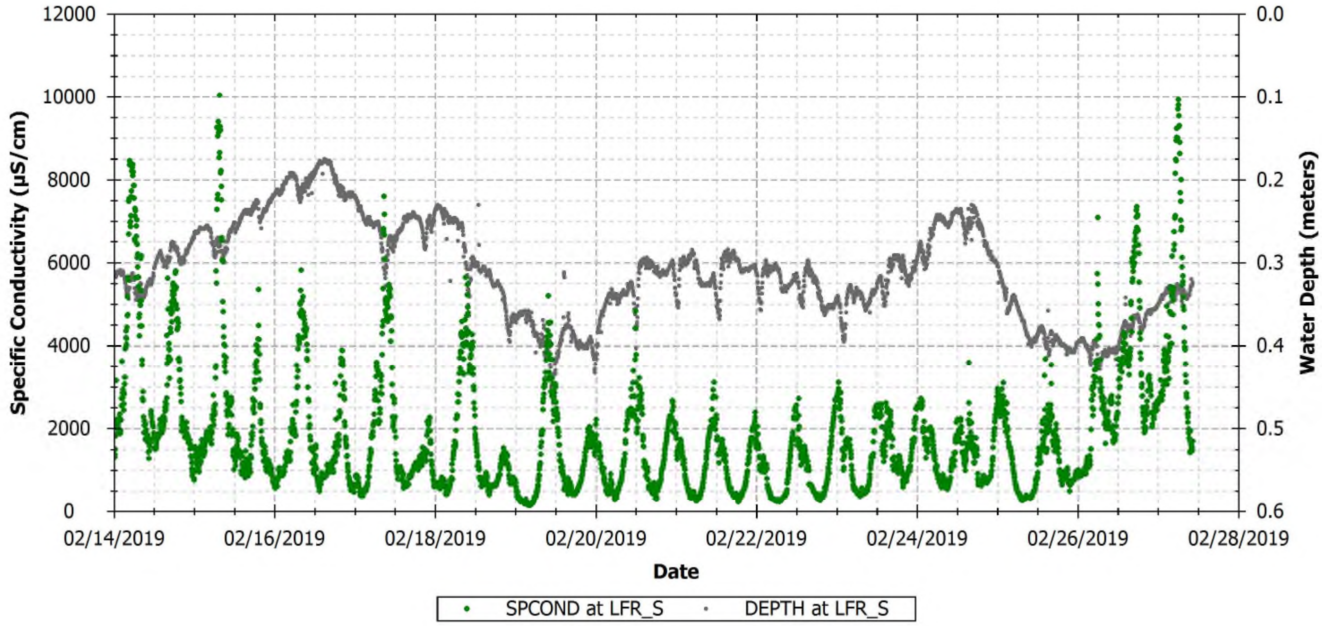


Figure B-45 Lower Front River south observed specific conductivity

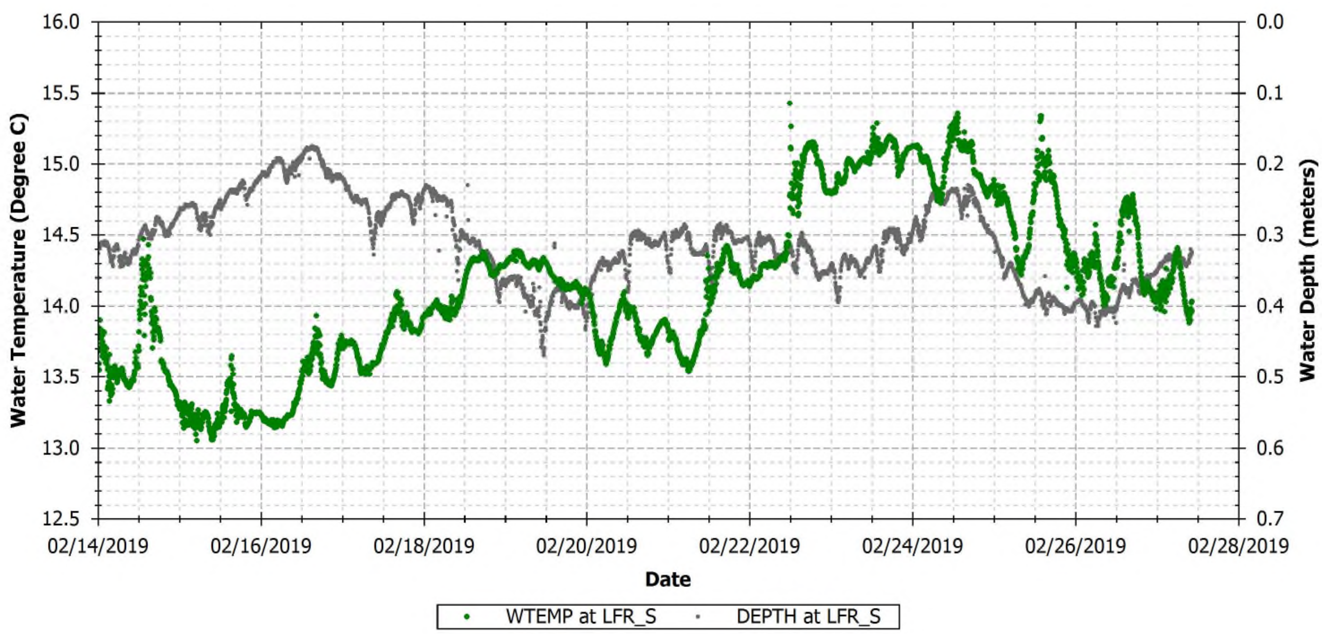


Figure B-46 Lower Front River south observed water temperature

APPENDIX C PROFILE FIGURES

APPENDIX C TABLE OF CONTENTS

APPENDIX C LIST OF FIGURES

C.1 BACK RIVER

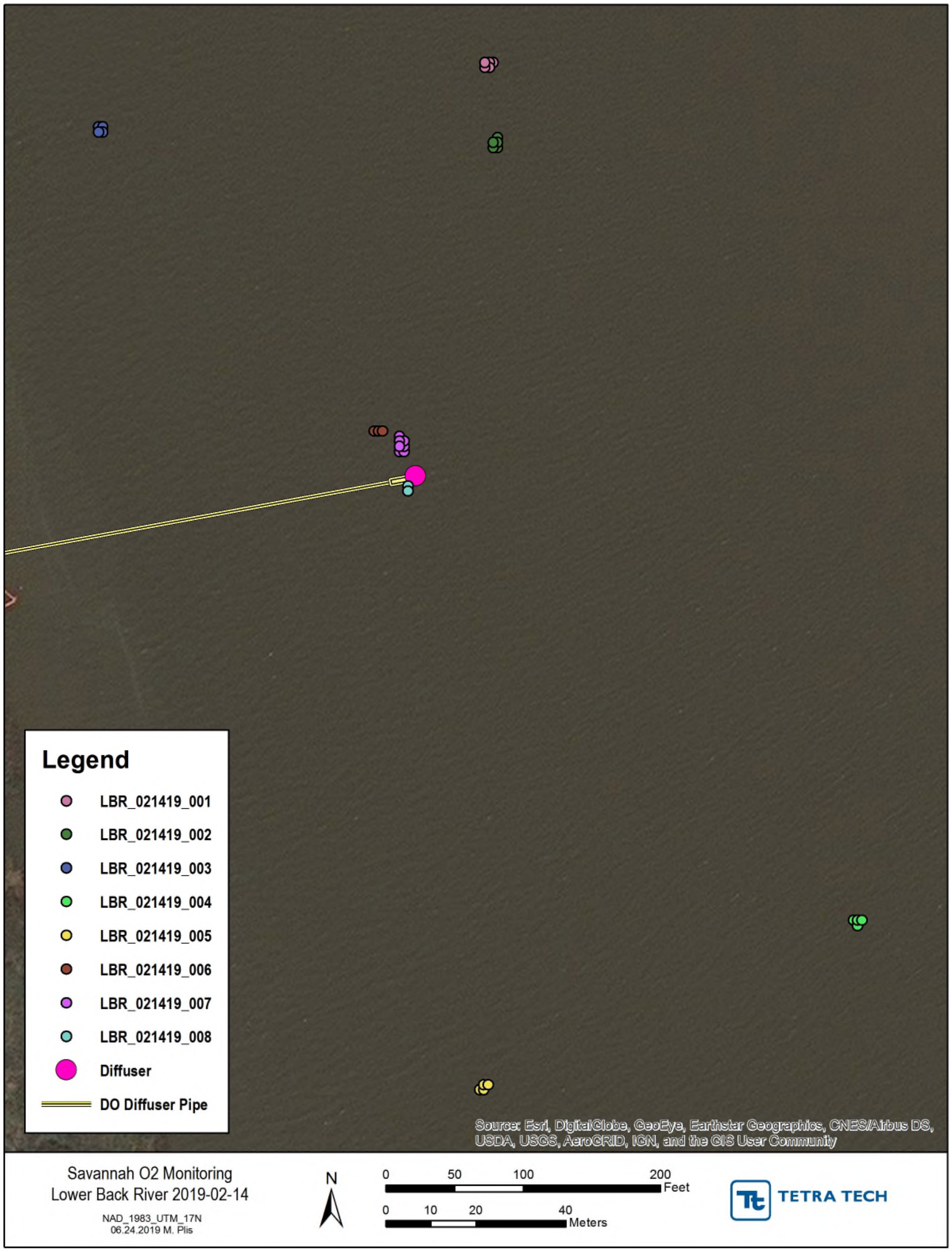


Figure C-1 Back River February 14, 2019 stationary profiles location map

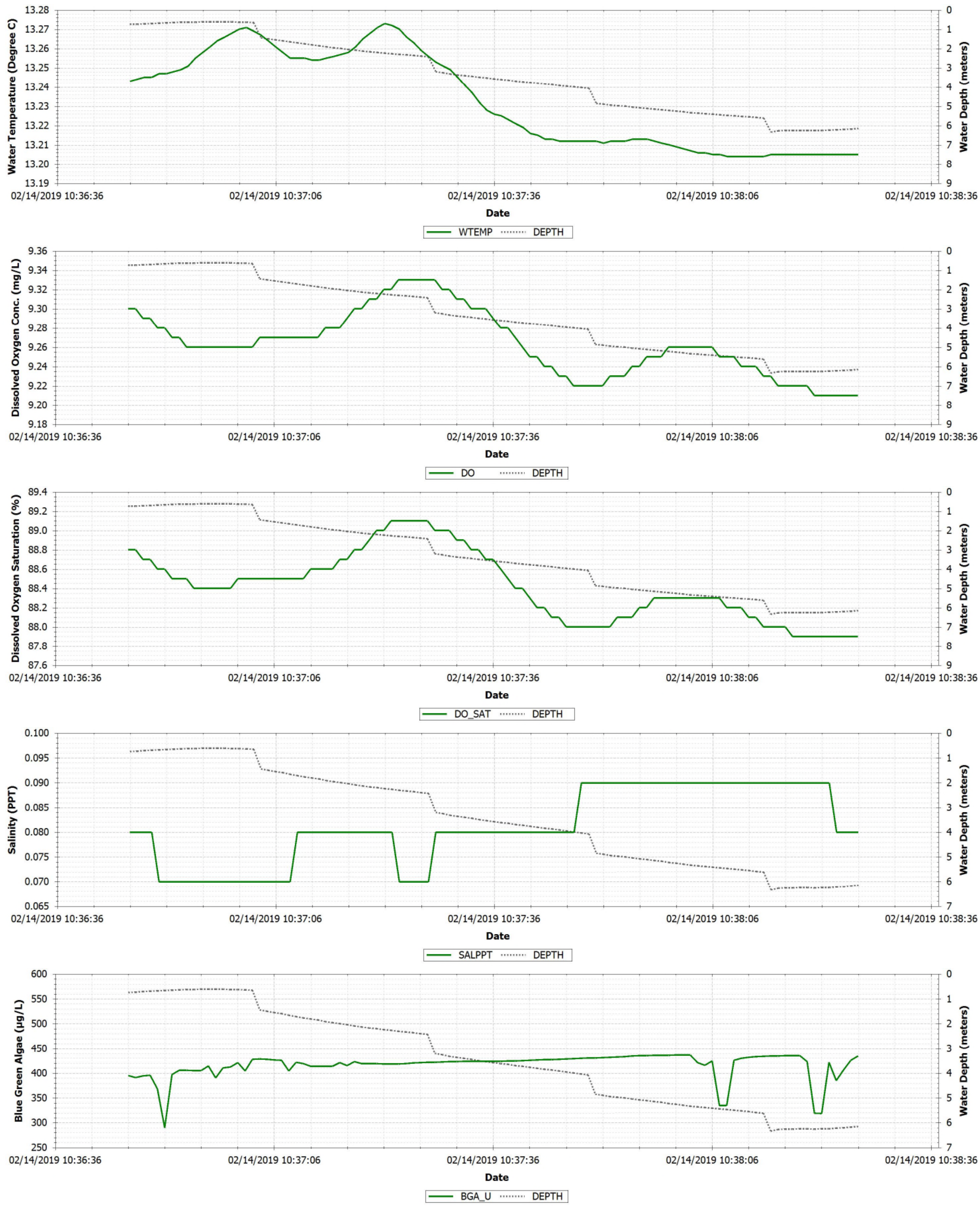


Figure C-2 Back River February 14, 2019 northeast buoy incoming tide stationary profile observations (LBR_021419_001)

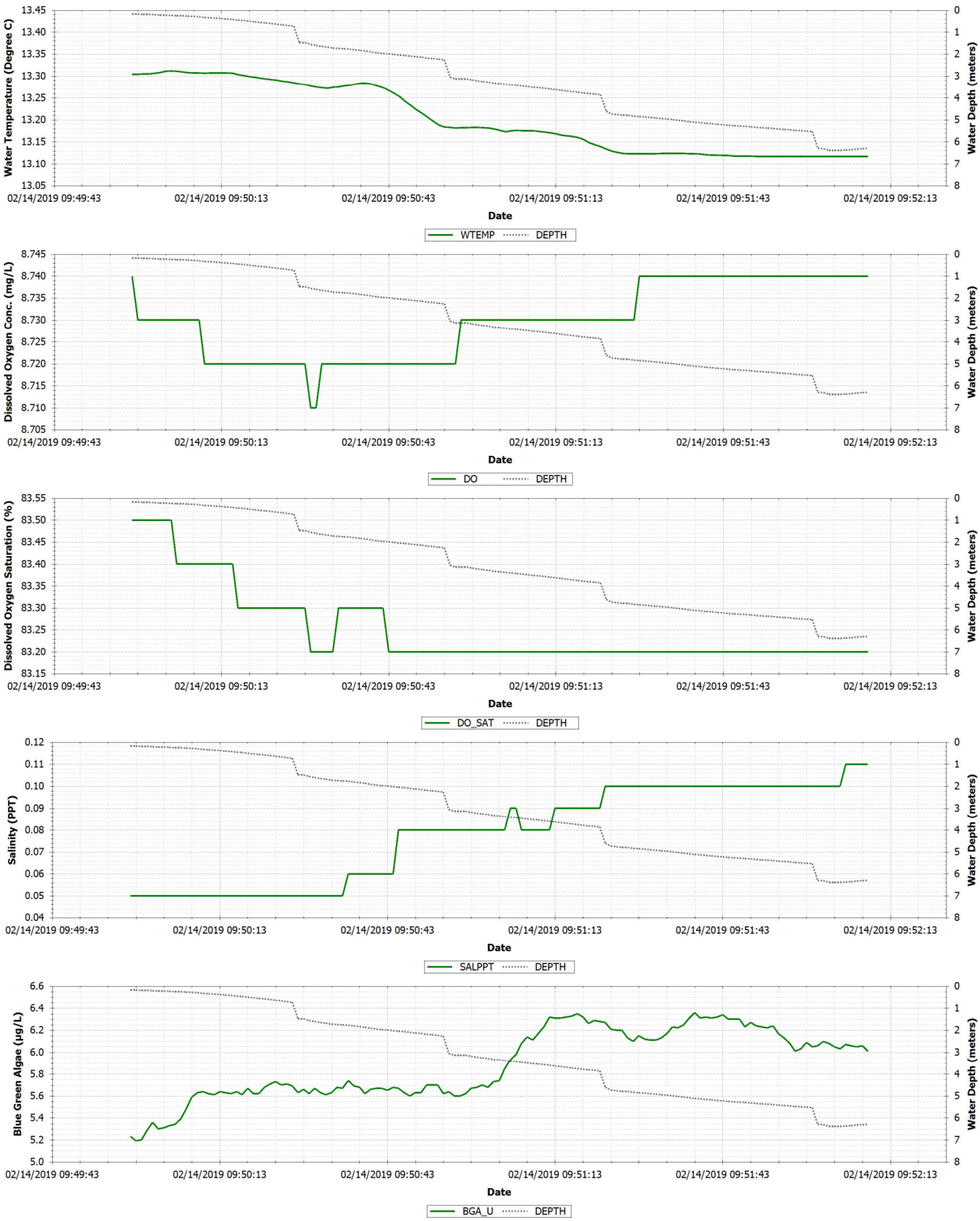


Figure C-3 Back River February 14, 2019 northeast buoy outgoing tide stationary profile observations (LBR_021419_002)

Figure C-4 Back River February 14, 2019 northwest buoy outgoing tide stationary profile observations (LBR_021419_003)

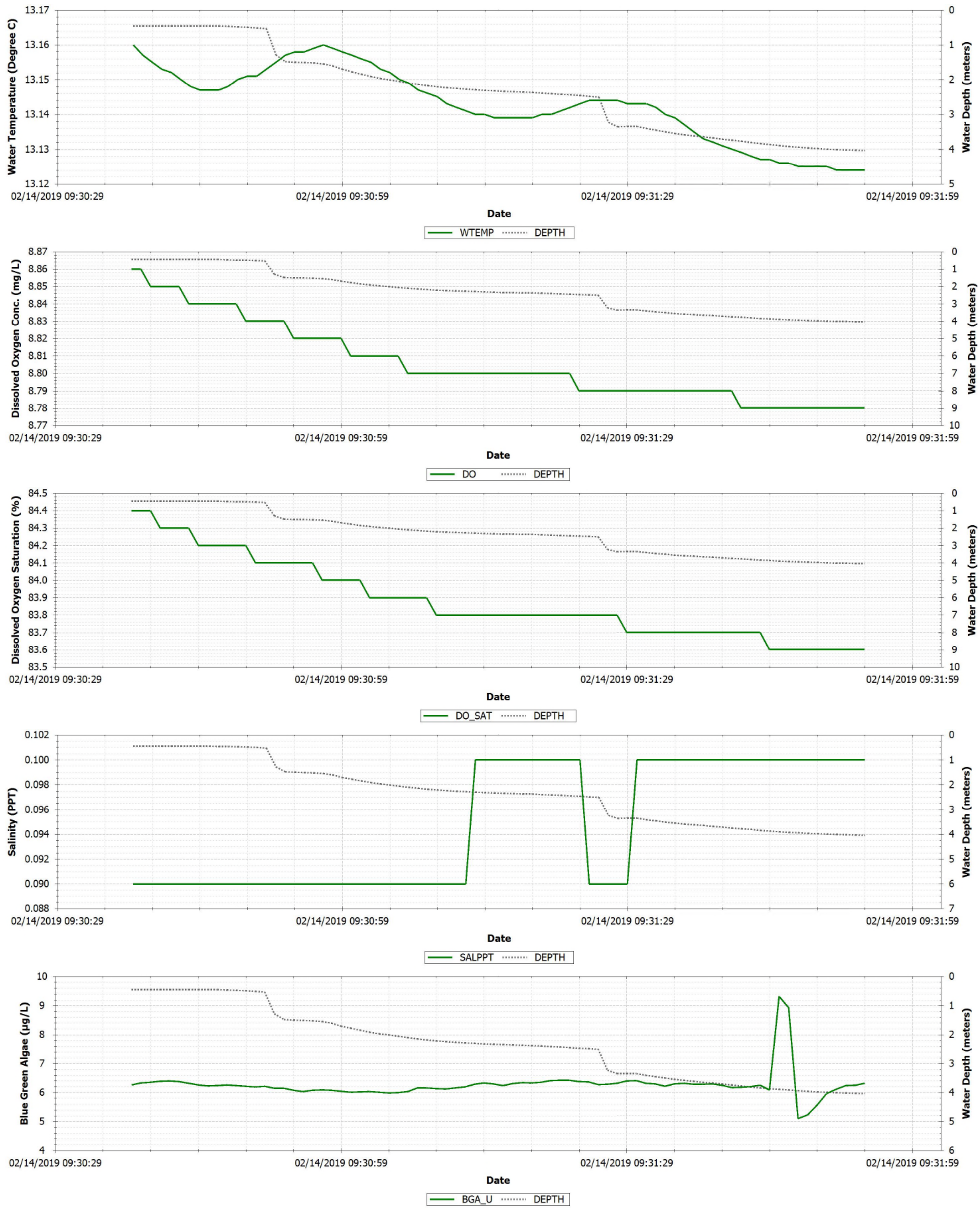


Figure C-5 Back River February 14, 2019 southeast buoy outgoing tide stationary profile observations (LBR_021419_004)

Figure C-6 Back River February 14, 2019 southwest buoy outgoing tide stationary profile observations (LBR_021419_005)

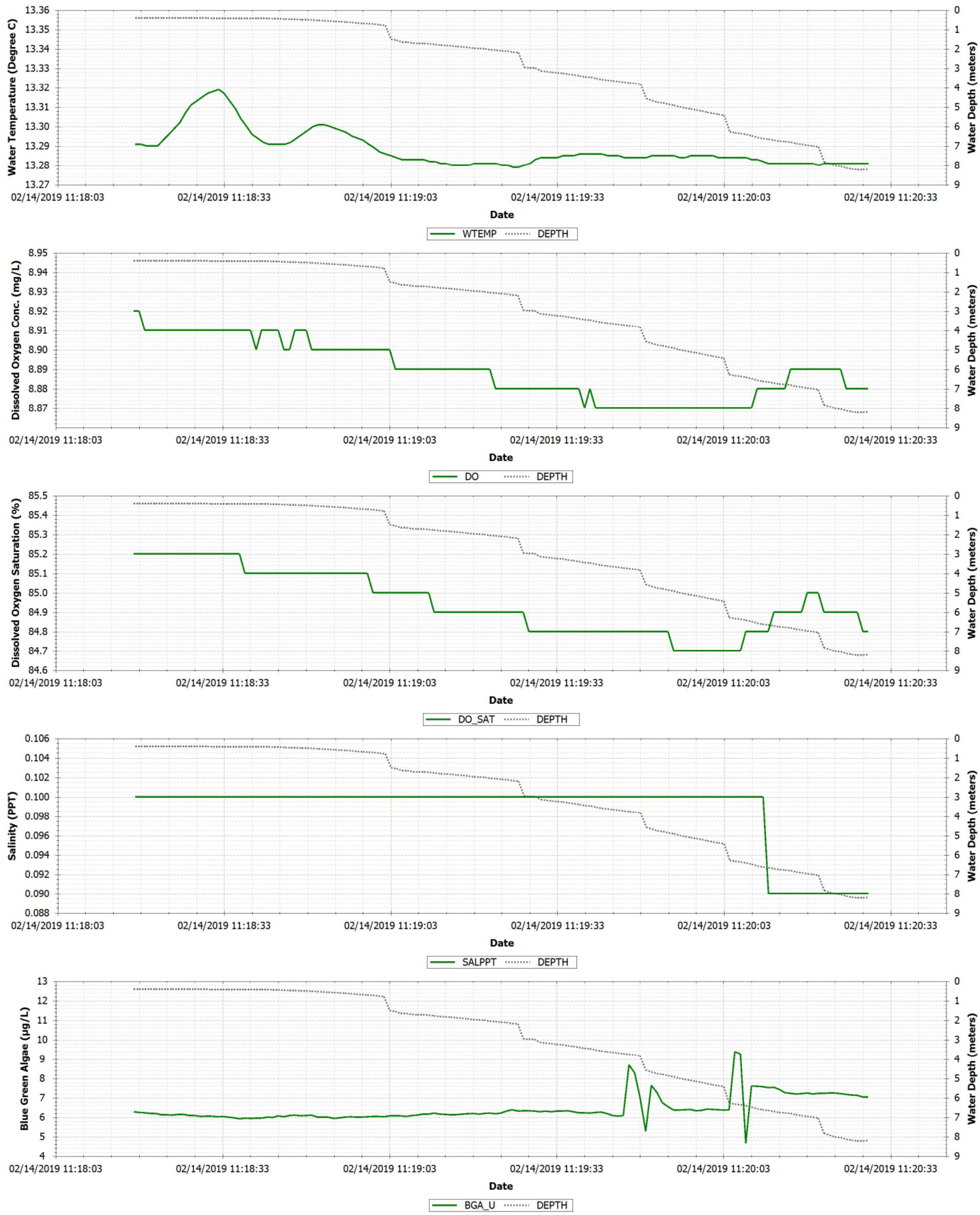


Figure C-7 Back River February 14, 2019 southeast platform incoming tide stationary profile observations (LBR_021419_007)

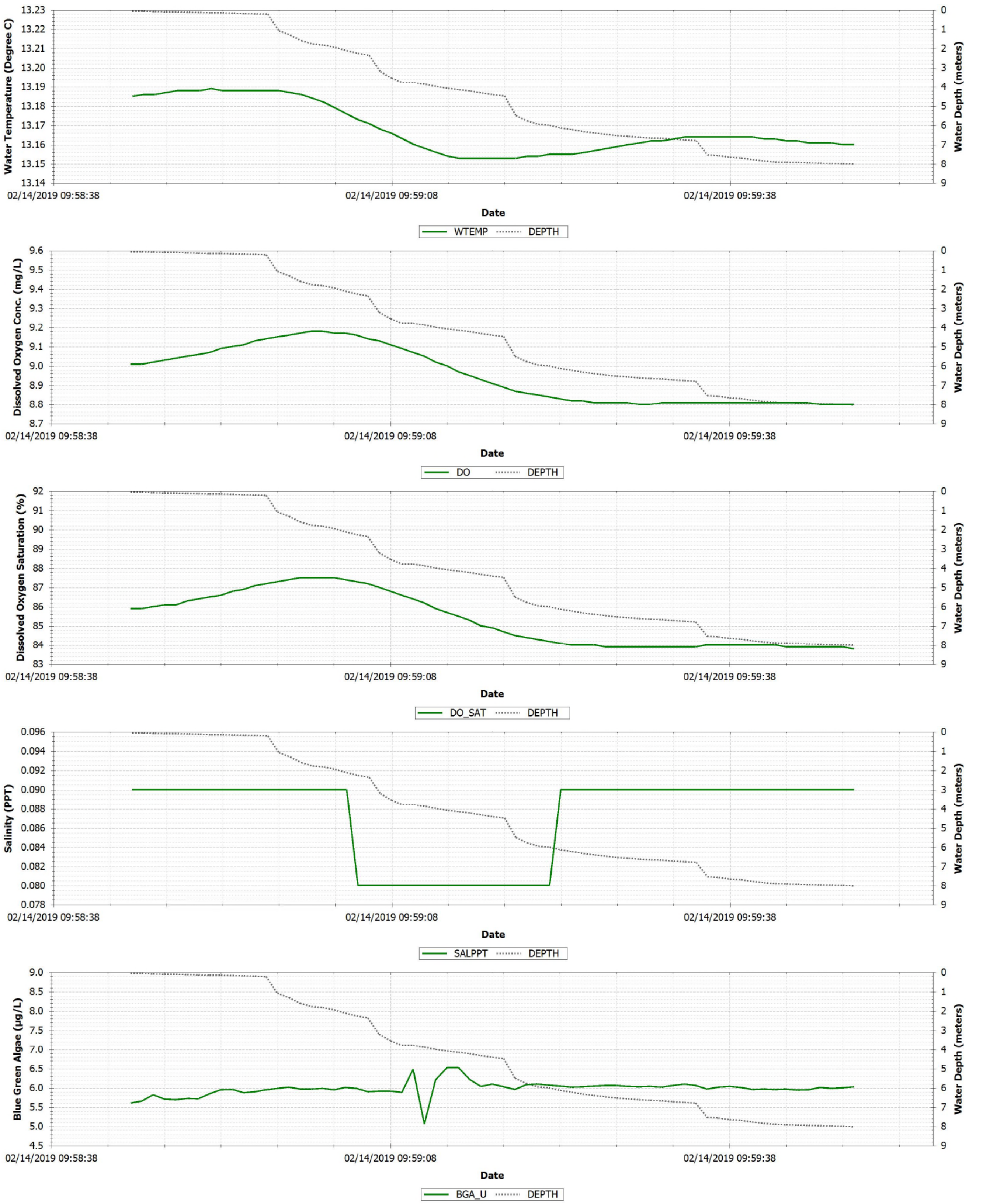


Figure C-8 Back River February 14, 2019 southeast platform outgoing tide stationary profile observations (LBR_021419_008)

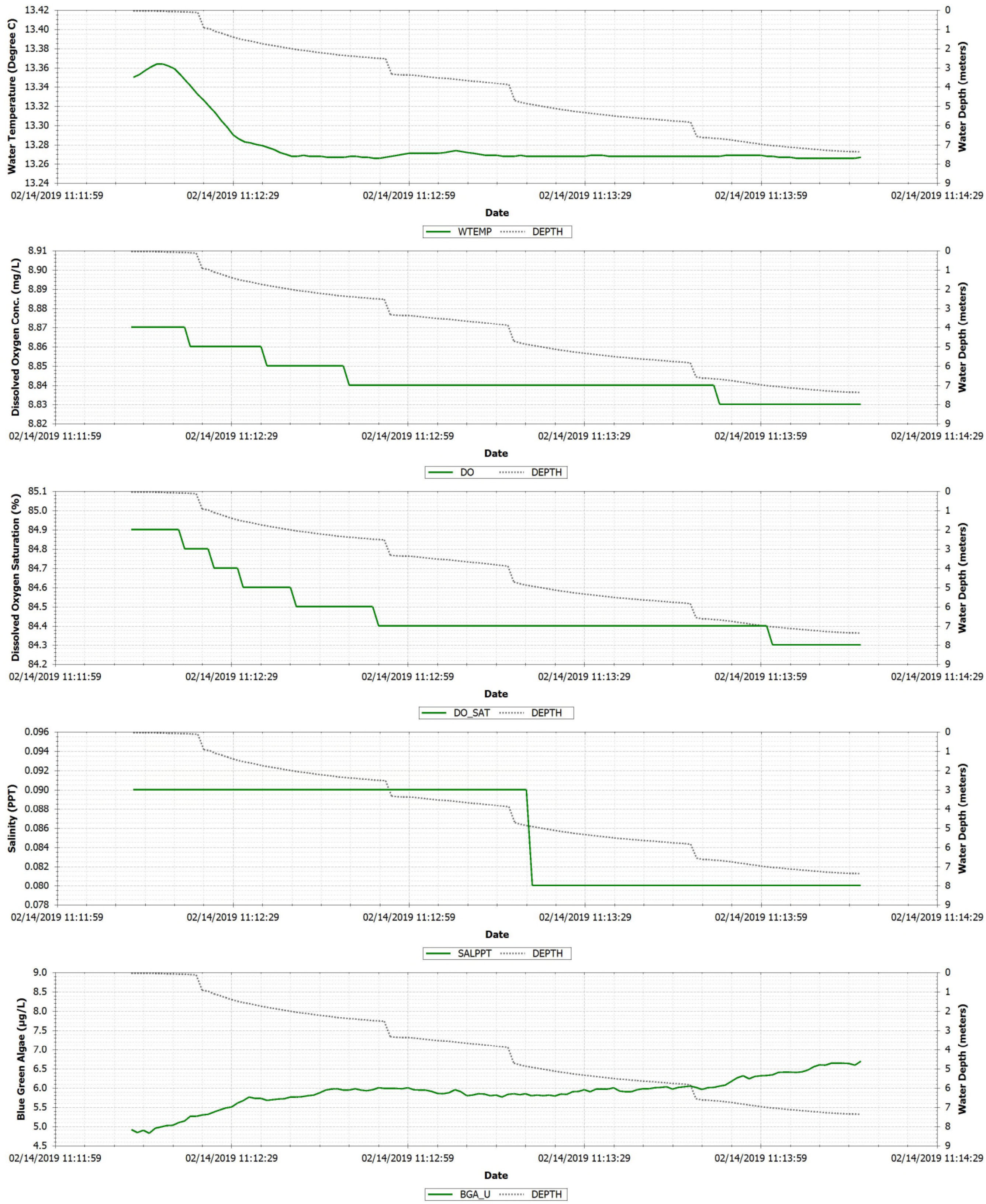


Figure C-9 Back River February 14, 2019 northwest platform incoming tide stationary profile observations (LBR_021419_006)

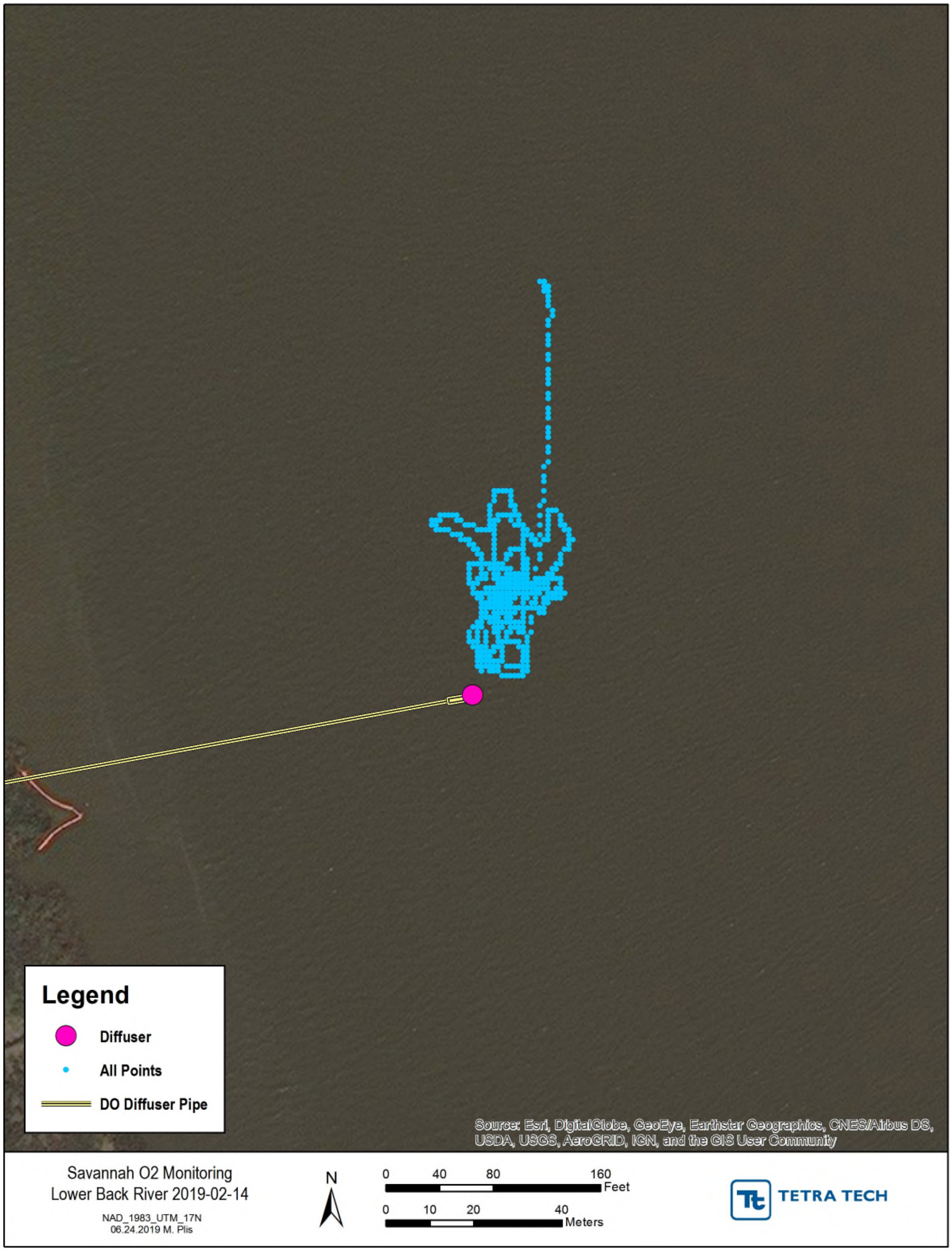


Figure C-10 Back River February 14, 2019 ebb tide traveling dye profile location map (LBR_021419_DT_001)

Figure C-11 Back River February 14, 2019 ebb tide traveling dye profile observations (LBR_021419_DT_001)

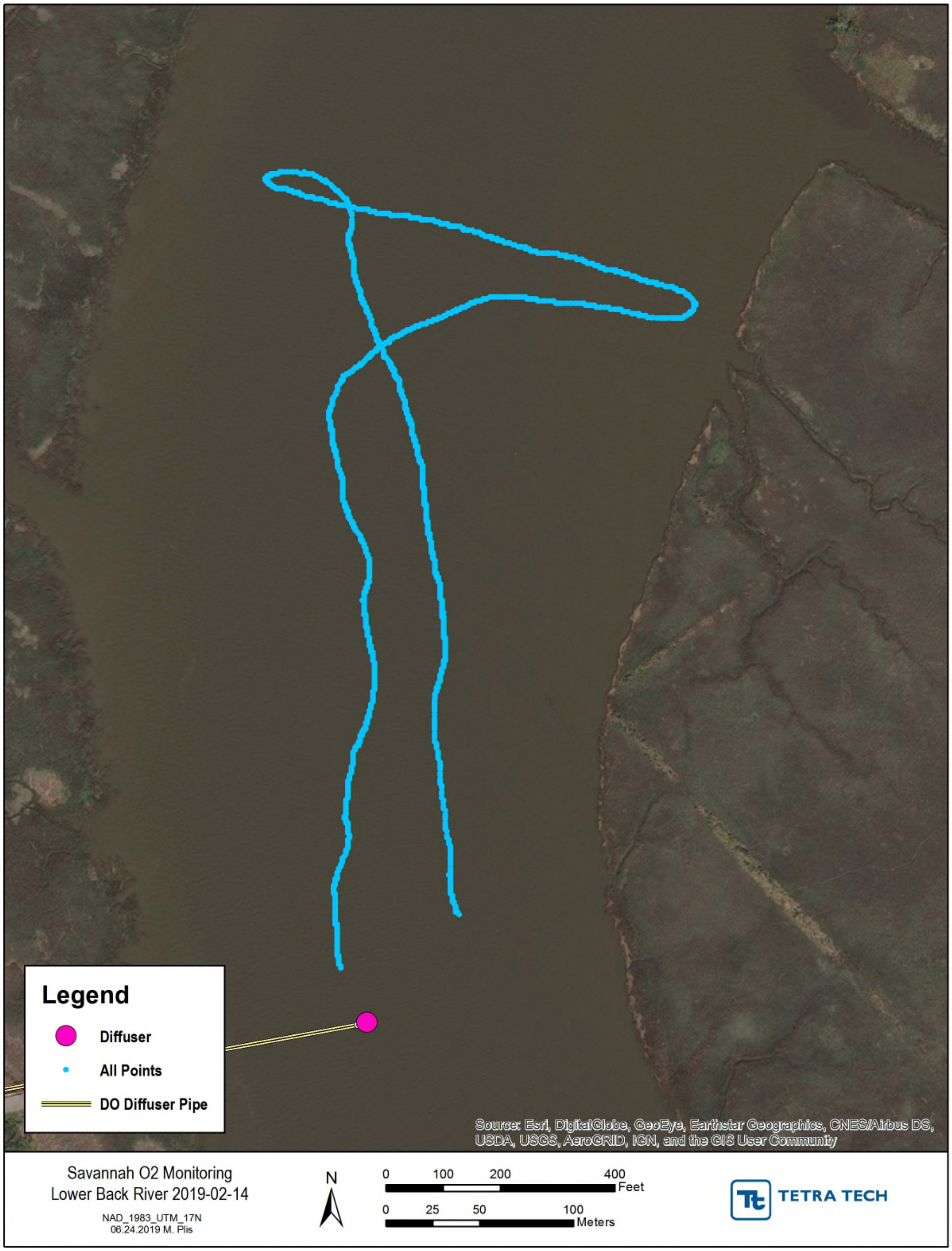


Figure C-12 Back River February 14, 2019 incoming tide traveling dye profile period 1 location map (LBR_021419_DT_002)

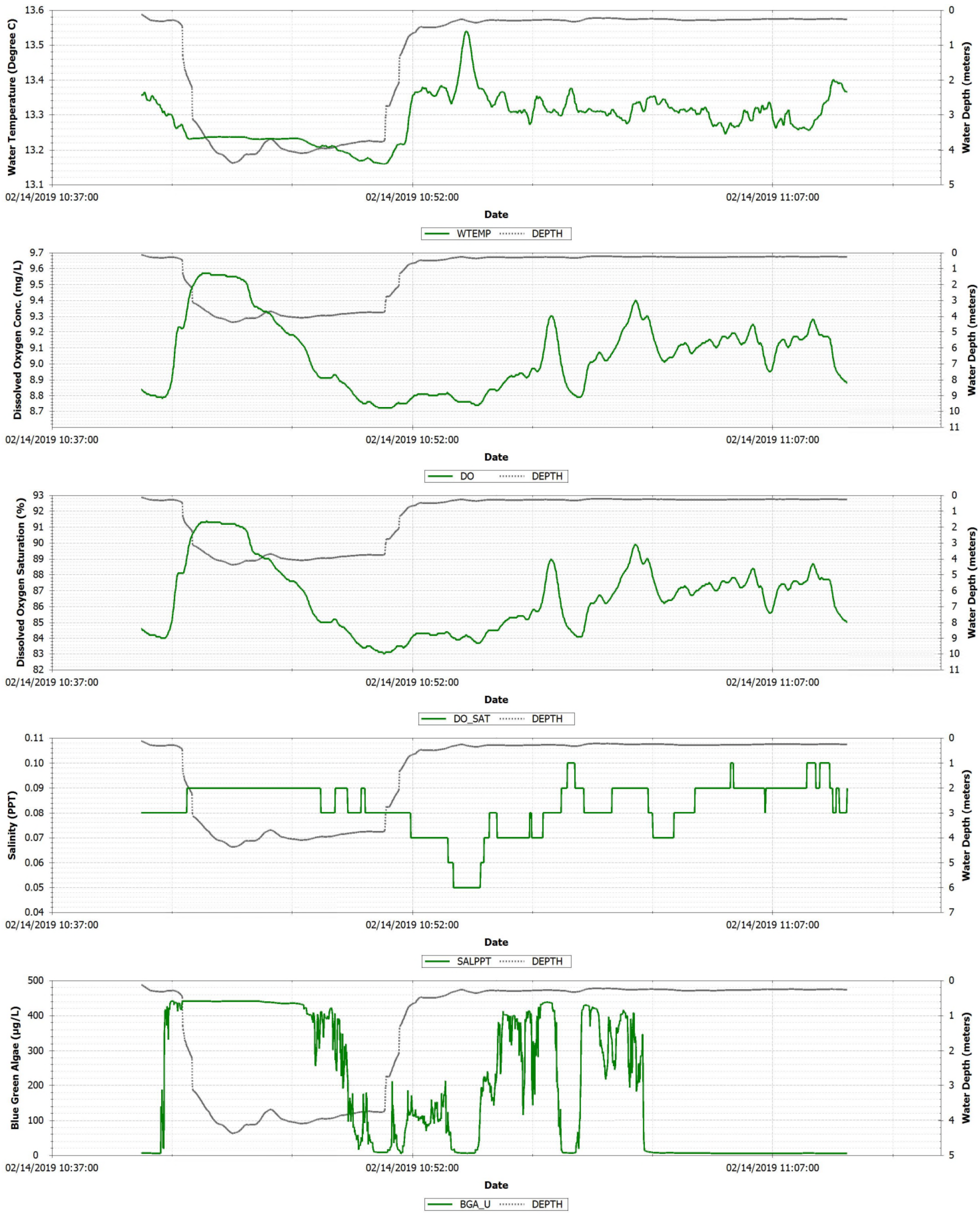


Figure C-13 Back River February 14, 2019 incoming tide traveling dye profile period 1 observations (LBR_021419_DT_002)

Figure C-14 Back River February 14, 2019 incoming tide traveling dye profile period 2 location map (LBR_021419_DT_003)

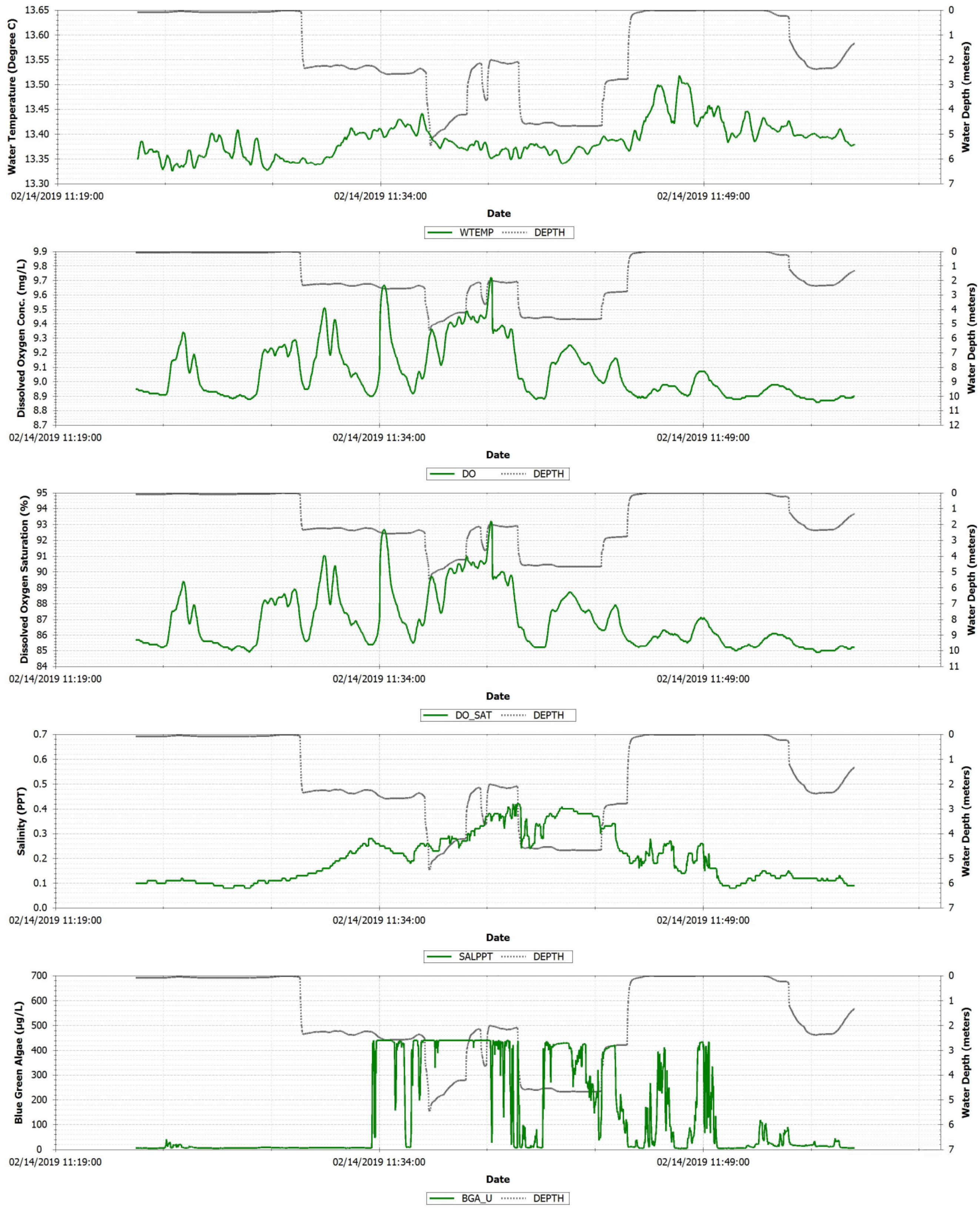


Figure C-15 Back River February 14, 2019 incoming tide traveling dye profile period 2 observations (LBR_021419_DT_003)

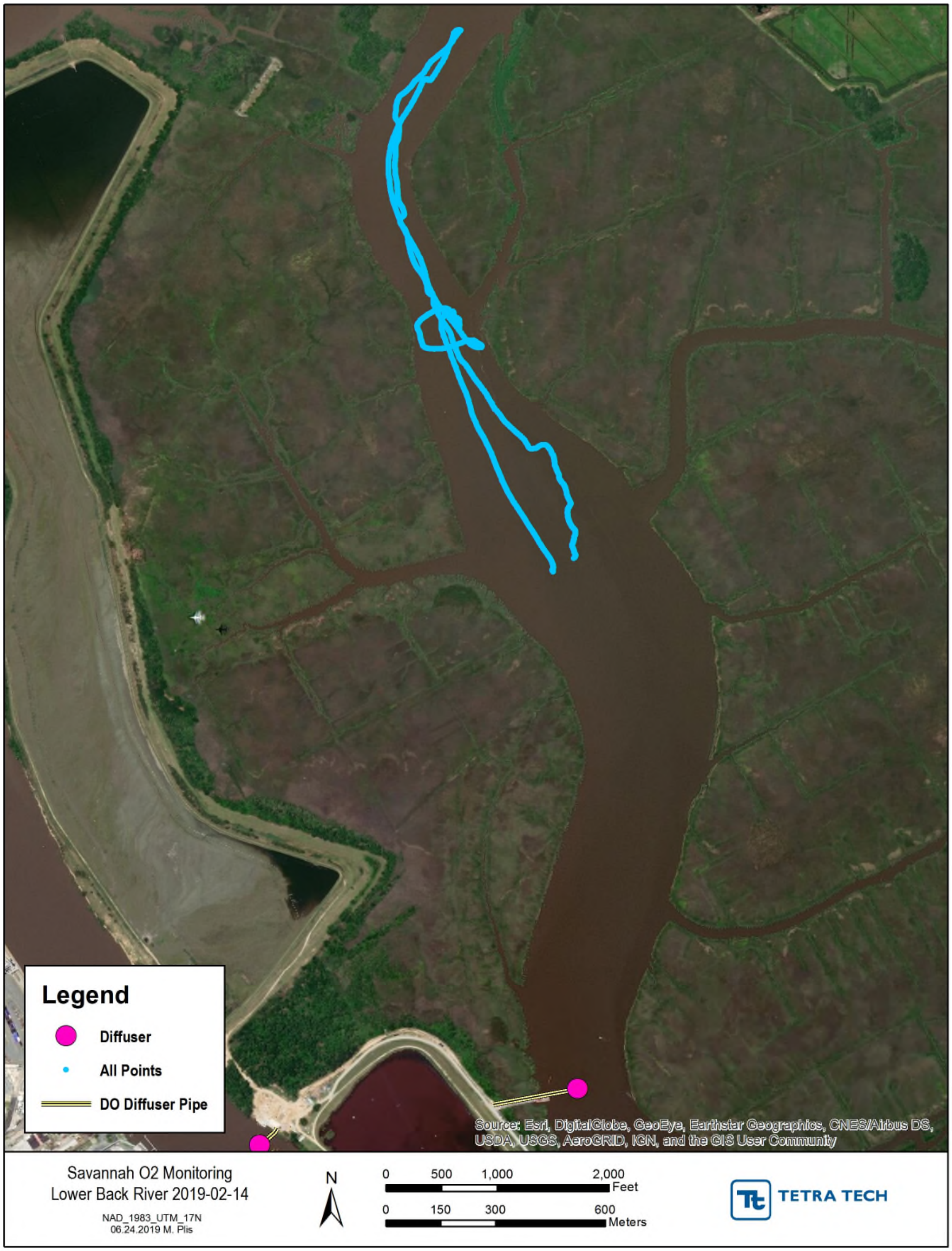


Figure C-16 Back River February 14, 2019 incoming tide traveling dye profile period 3 location map (LBR_021419_DT_004)

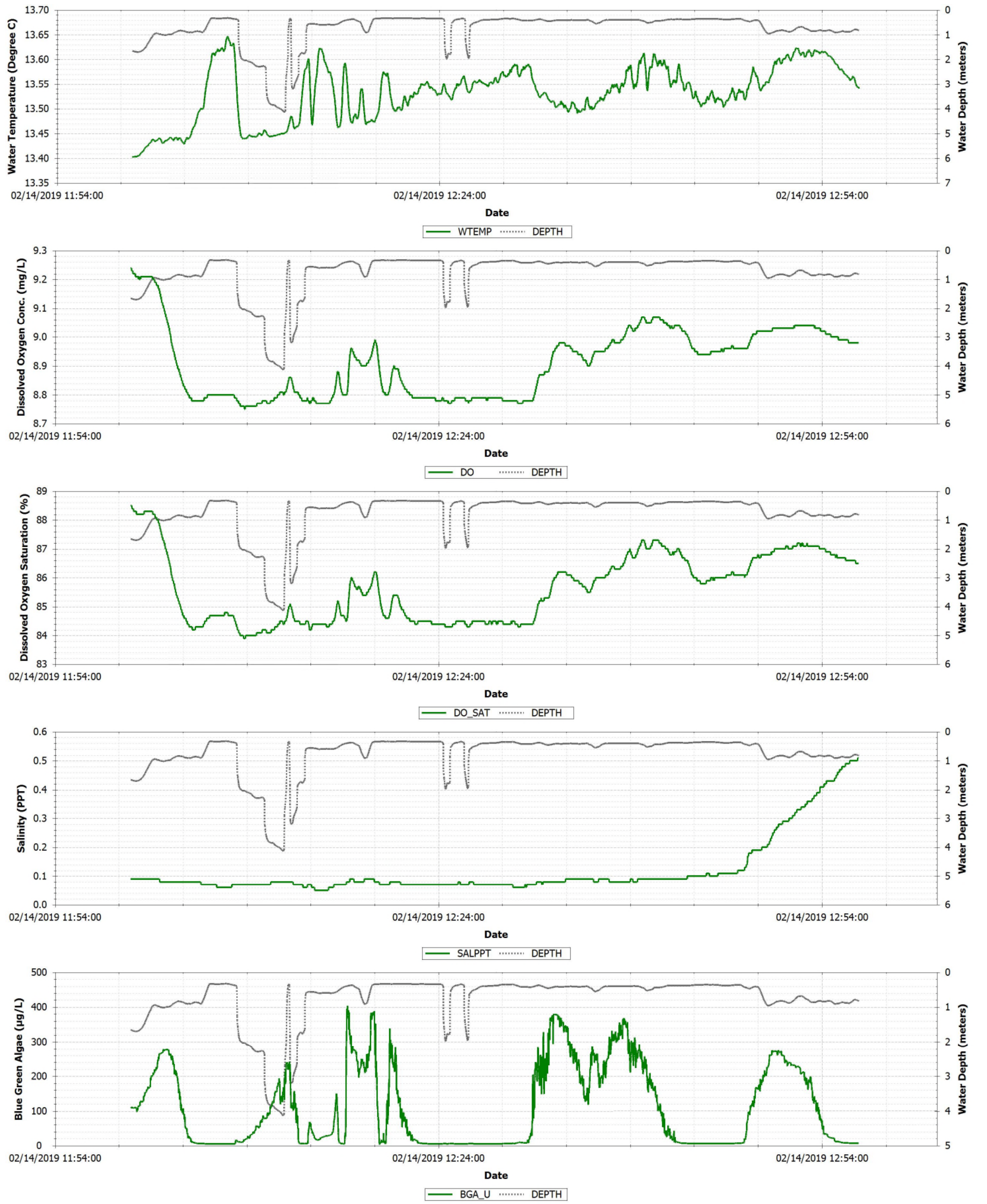


Figure C-17 Back River February 14, 2019 incoming tide traveling dye profile period 3 observations (LBR_021419_DT_004)

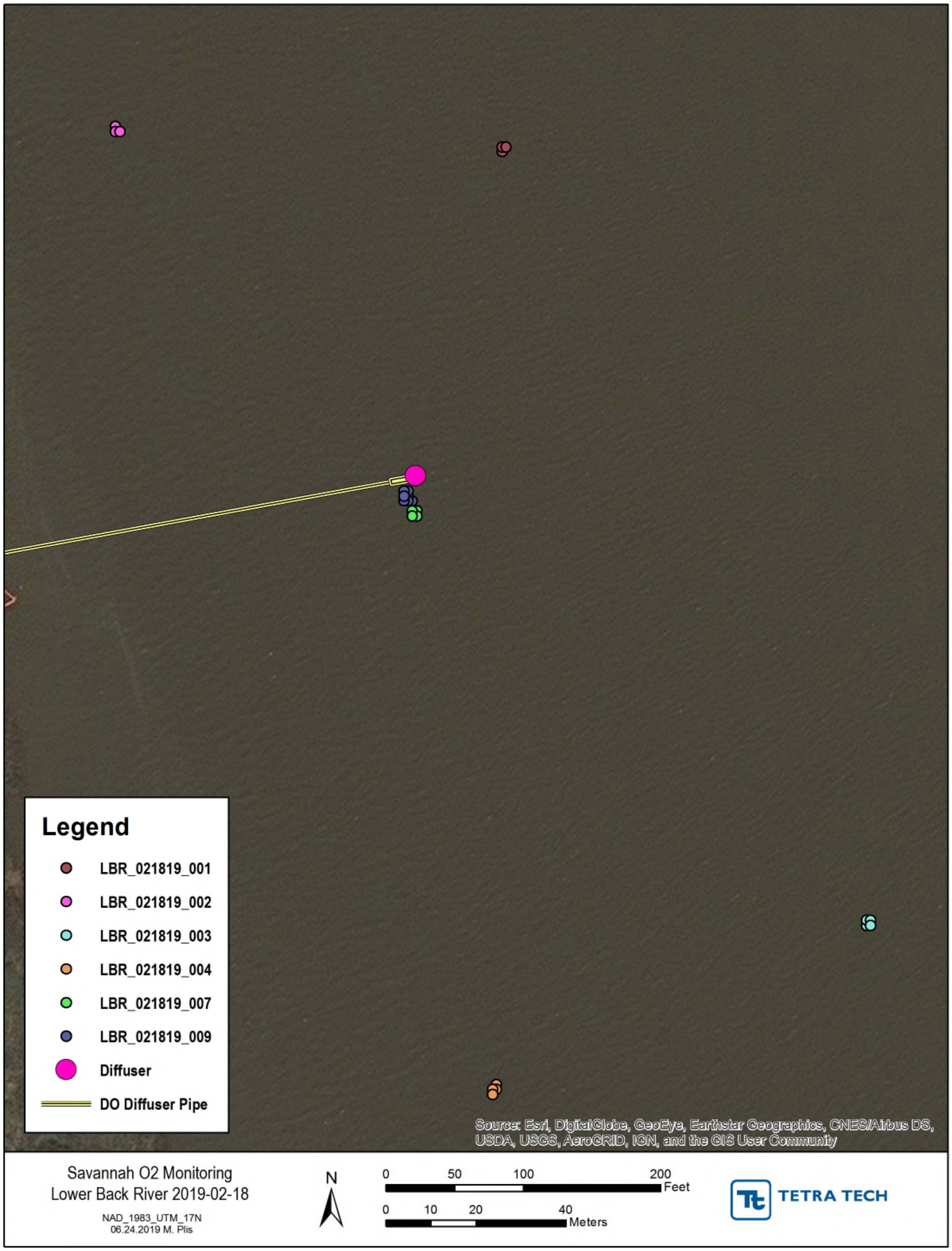


Figure C-18 Back River February 18, 2019 stationary profiles location map

Figure C-19 Back River February 18, 2019 northeast buoy outgoing tide stationary profile observations (LBR_021819_001)

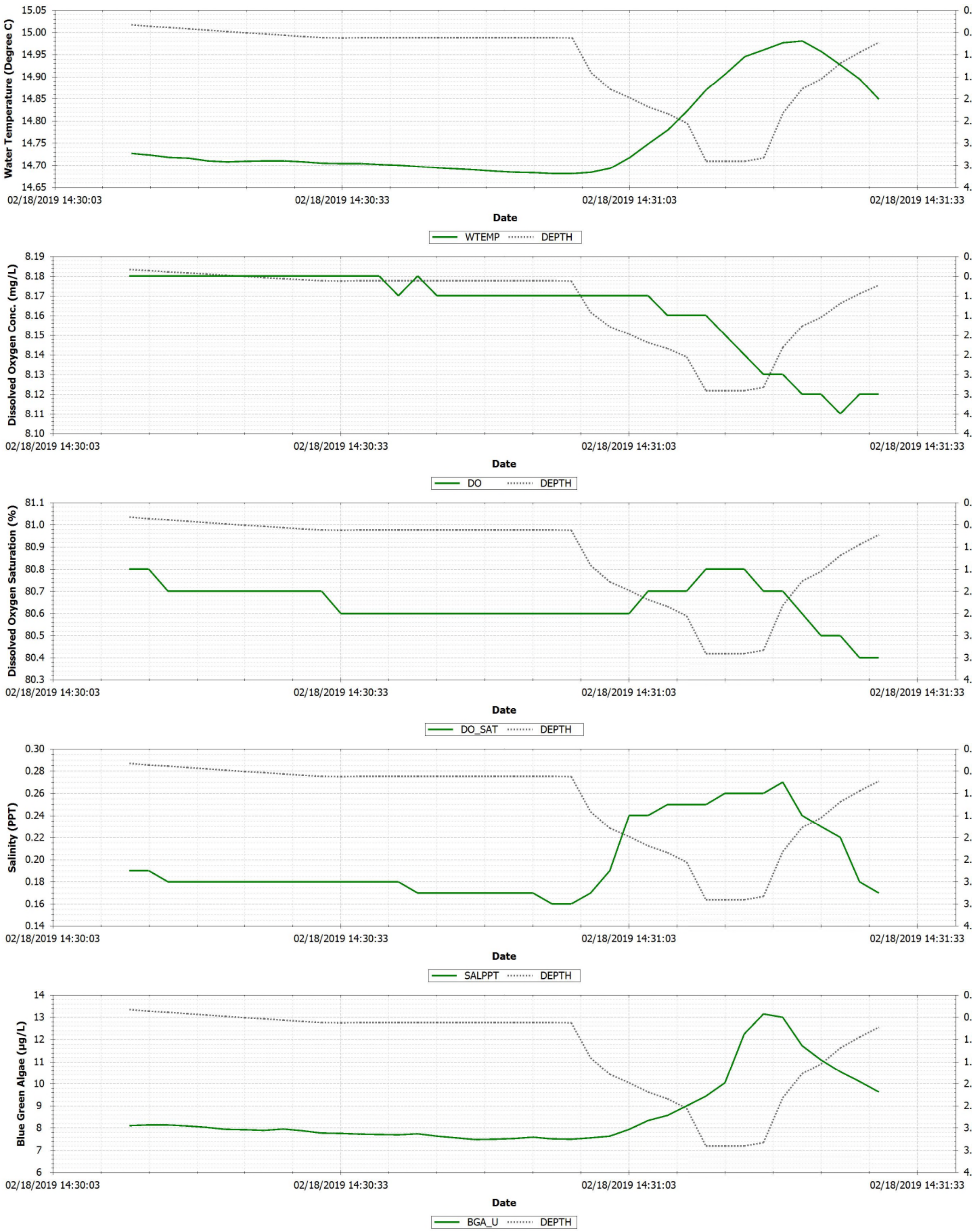


Figure C-20 Back River February 18, 2019 northwest buoy outgoing tide stationary profile observations (LBR_021819_002)

Figure C-21 Back River February 18, 2019 southeast buoy outgoing tide stationary profile observations (LBR_021819_003)

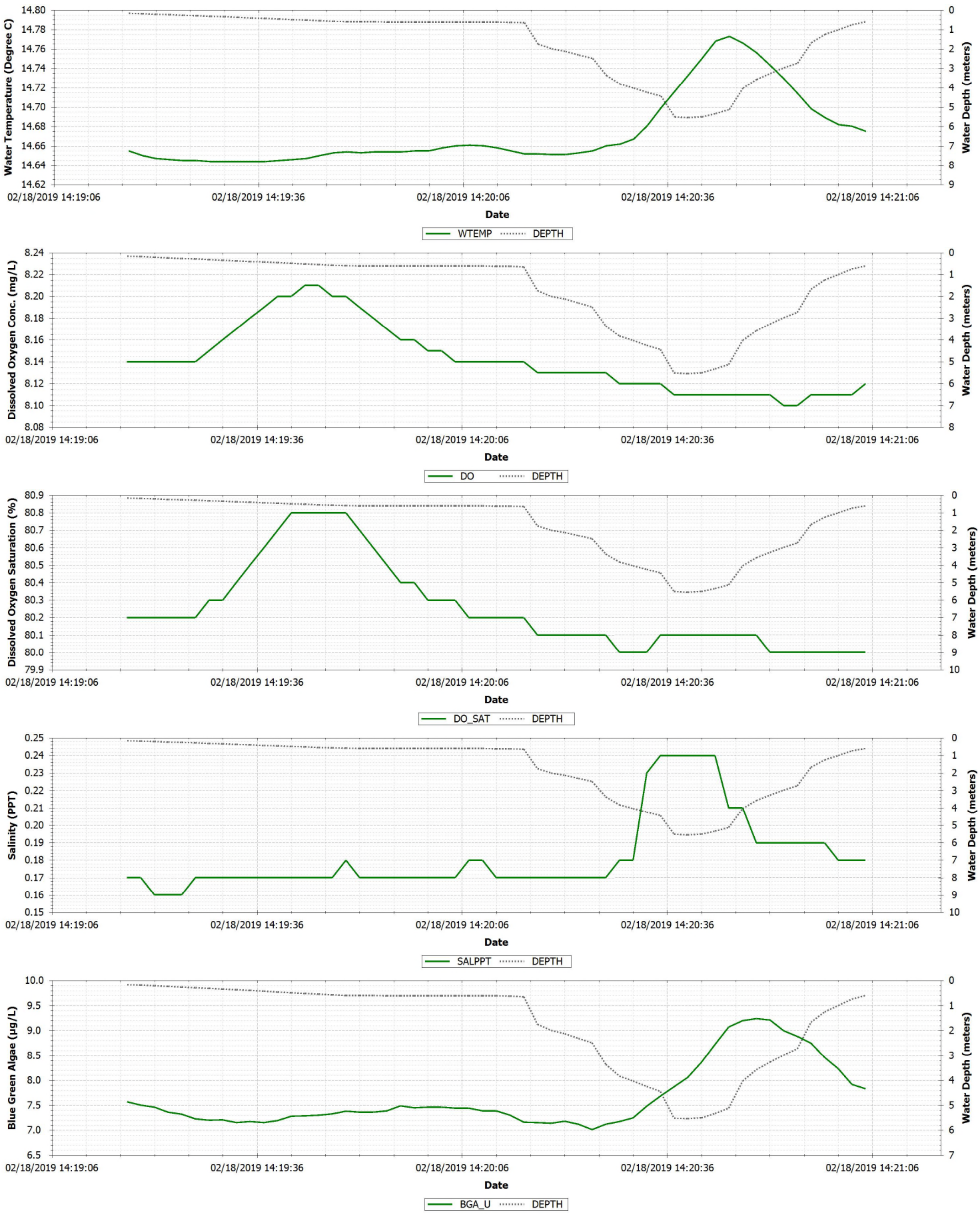


Figure C-22 Back River February 18, 2019 southwest buoy outgoing tide stationary profile observations (LBR_021819_004)

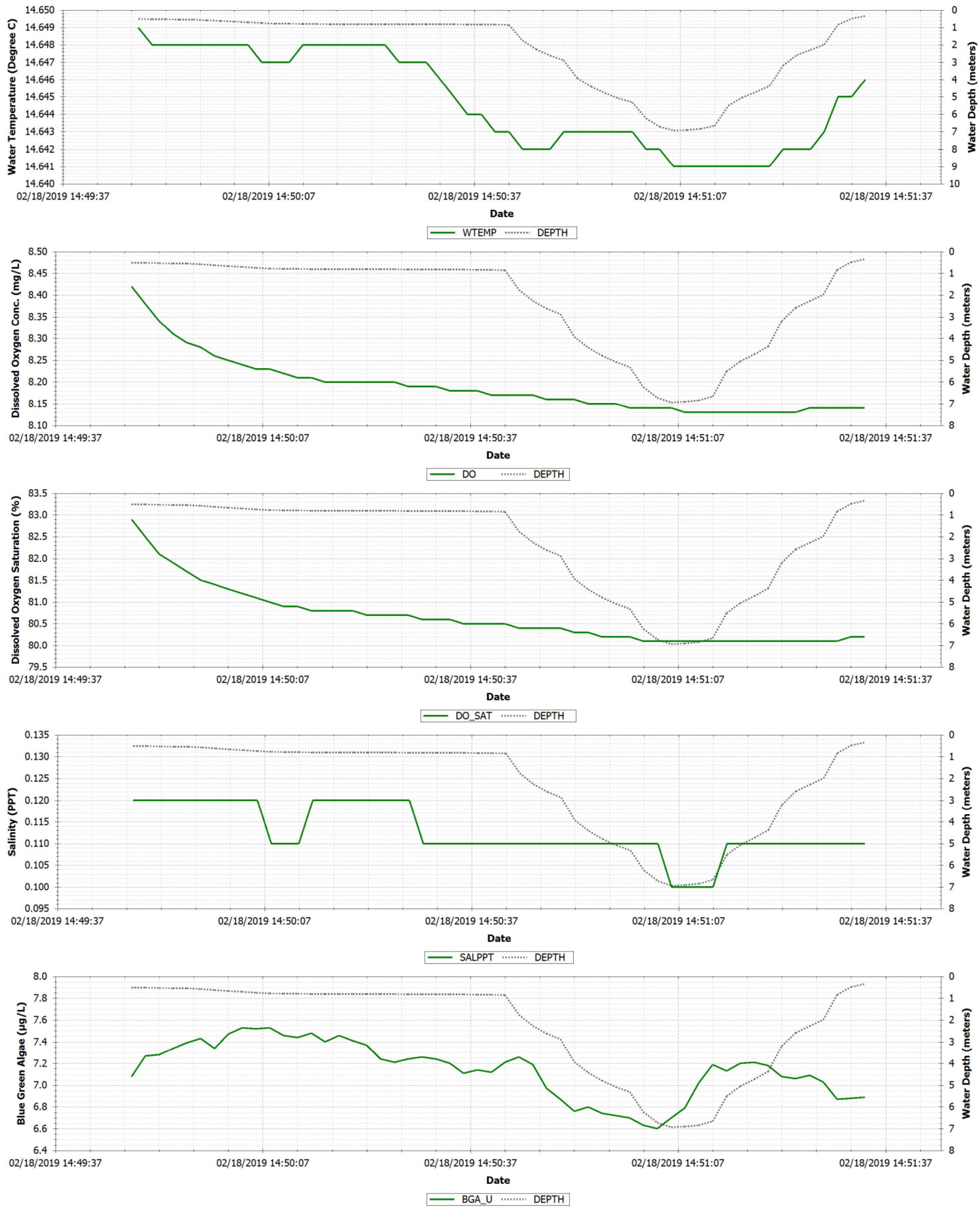


Figure C-23 Back River February 18, 2019 east platform outgoing tide stationary profile observations (LBR_021819_007)

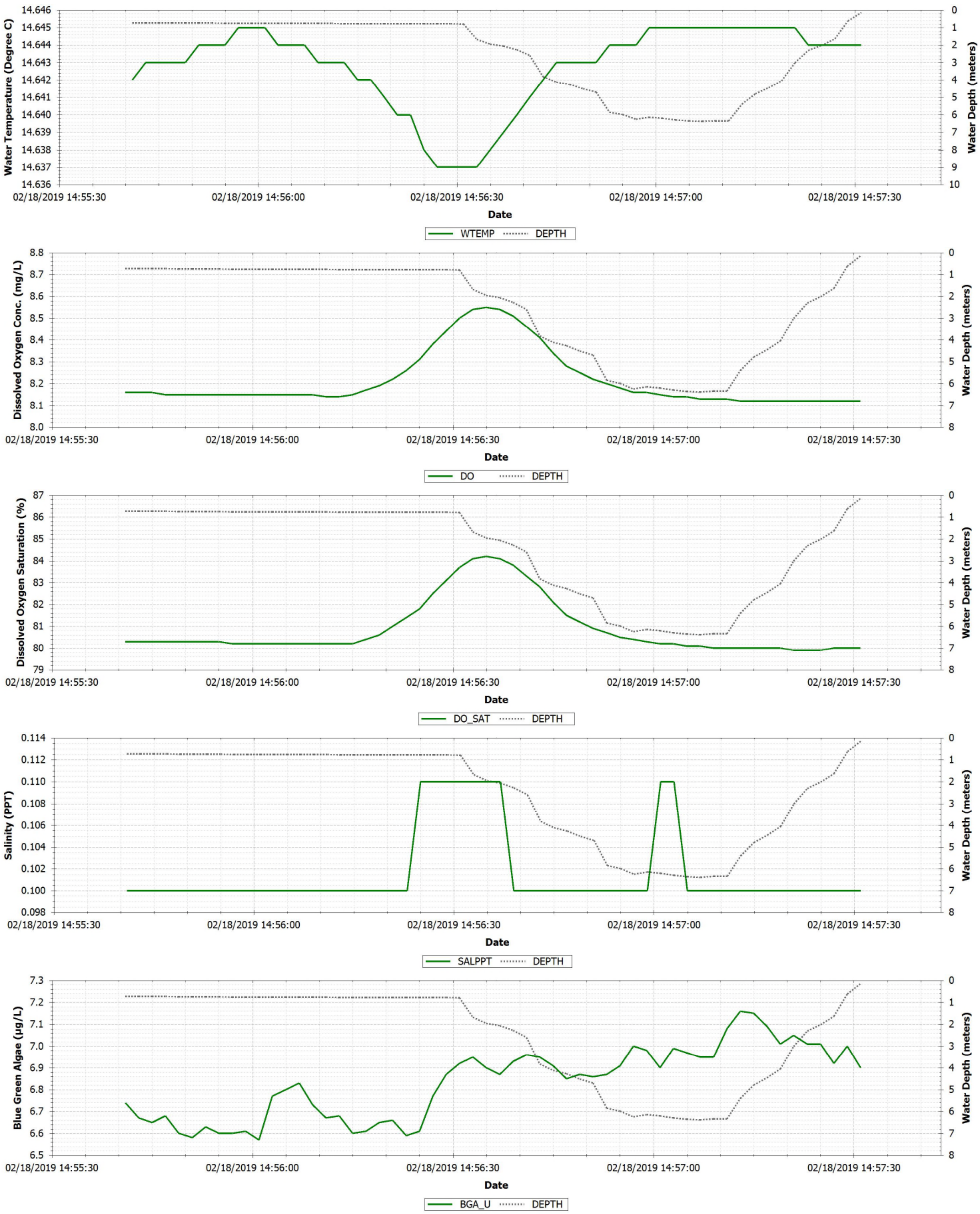


Figure C-24 Back River February 18, 2019 west platform outgoing tide stationary profile observations (LBR_021819_009)

Figure C-25 Back River February 18, 2019 outgoing tide traveling profile period 1 location map (LBR_021819_010)

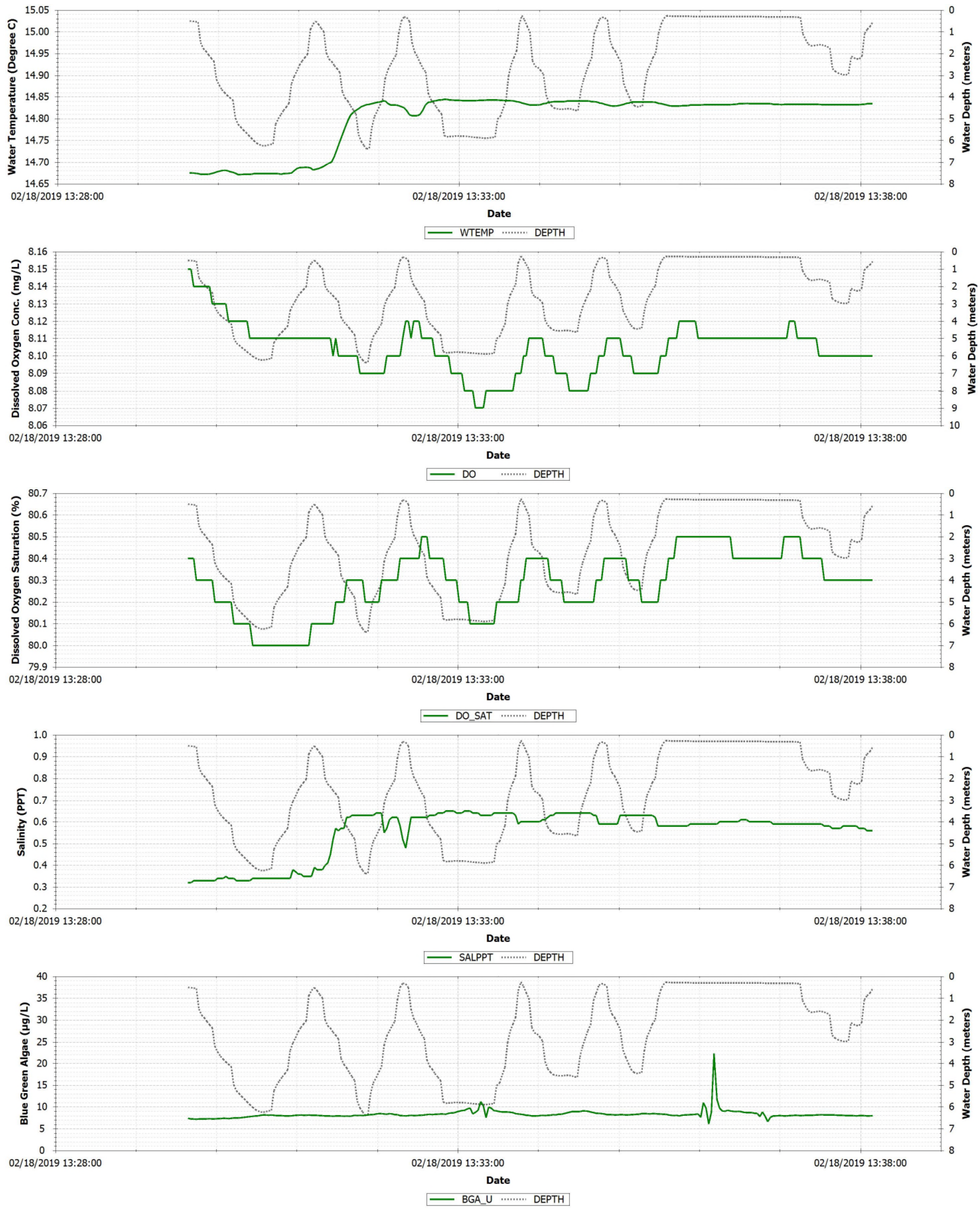


Figure C-26 Back River February 18, 2019 outgoing tide traveling profile period 1 observations (LBR_021819_010)

Figure C-27 Back River February 18, 2019 outgoing tide traveling profile period 2 location map (LBR_021819_006)

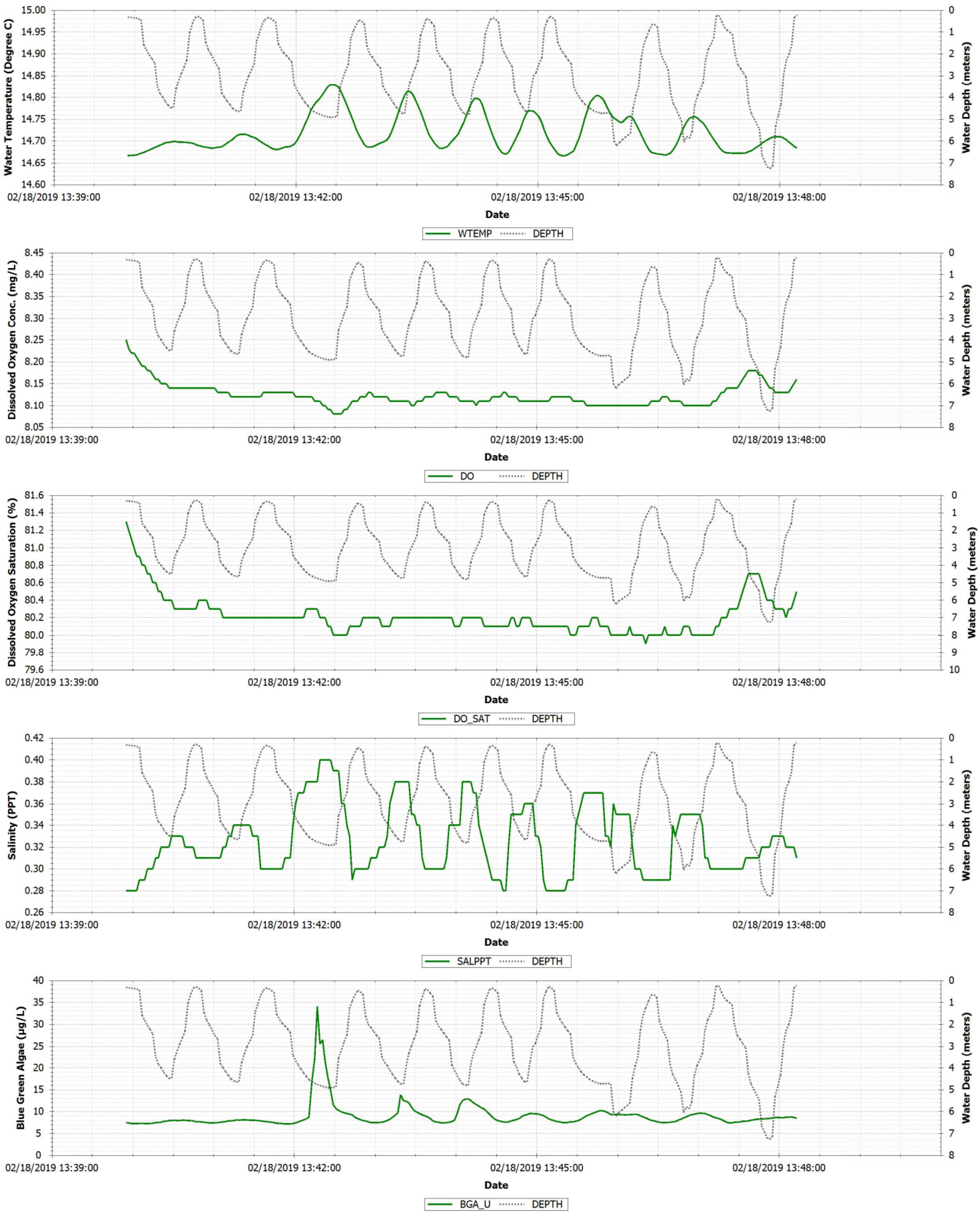


Figure C-28 Back River February 18, 2019 outgoing tide traveling profile period 2 observations (LBR_021819_006)

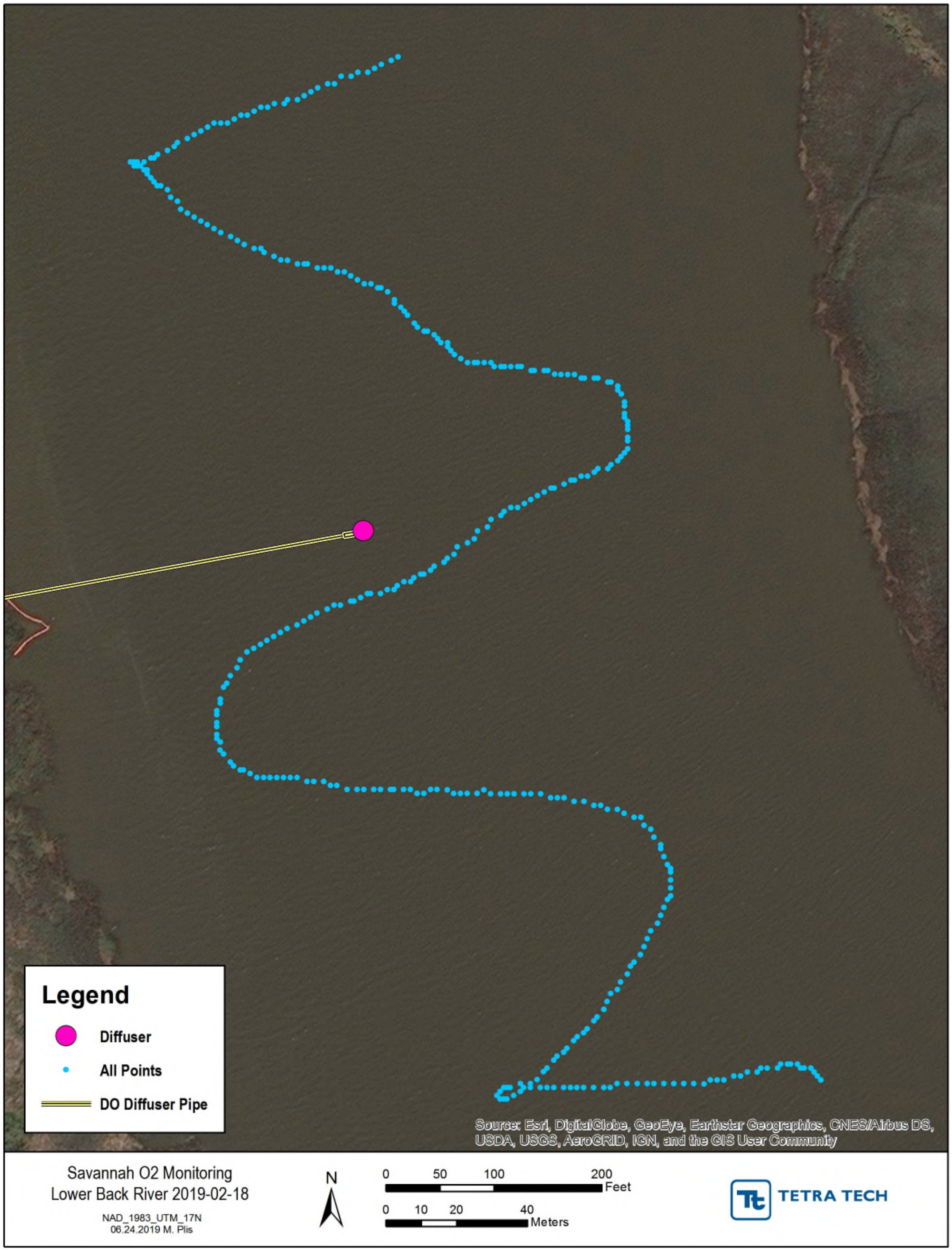


Figure C-29 Back River February 18, 2019 outgoing tide traveling profile period 3 location map (LBR_021819_008)

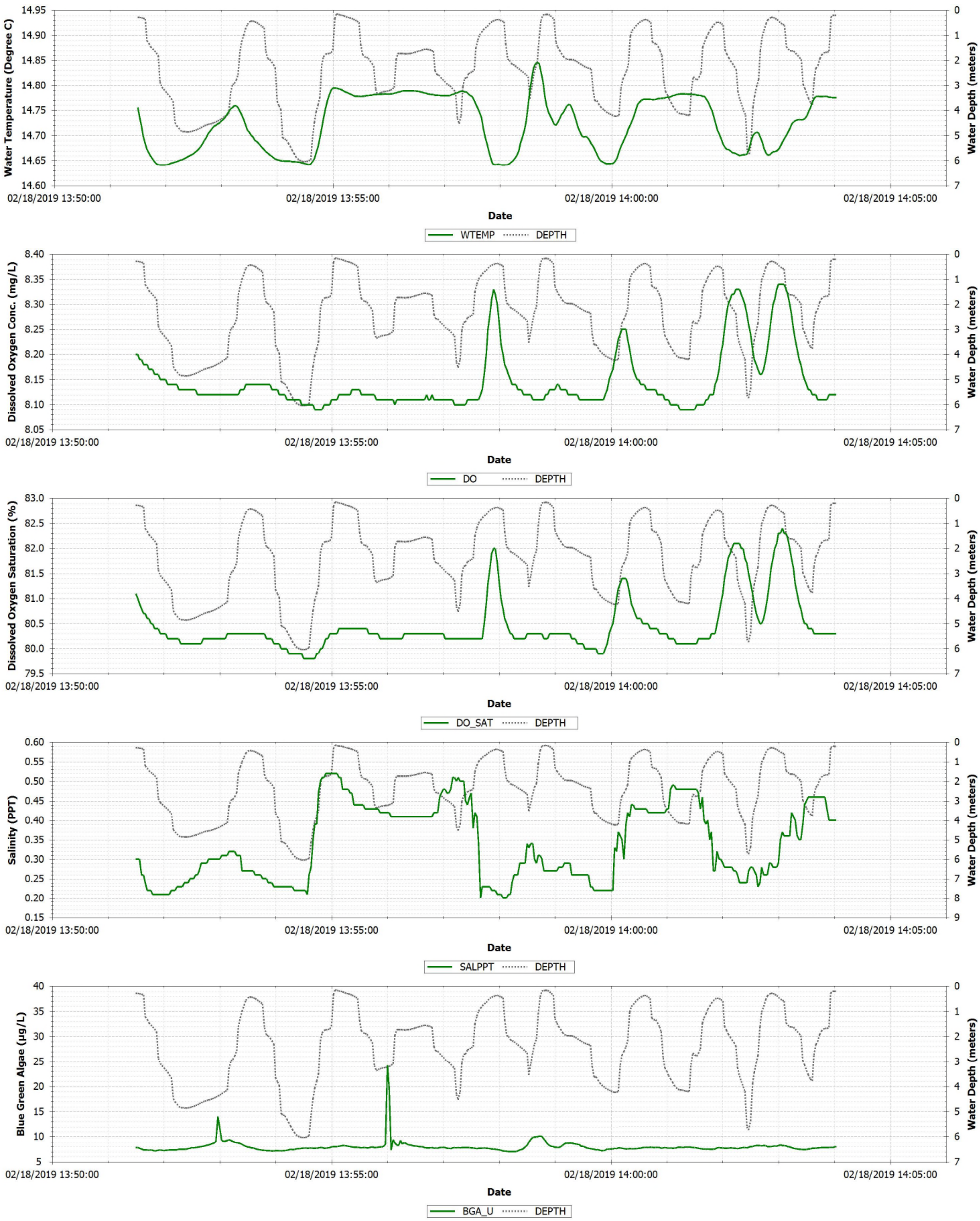


Figure C-30 Back River February 18, 2019 outgoing tide traveling profile period 3 observations (LBR_021819_008)

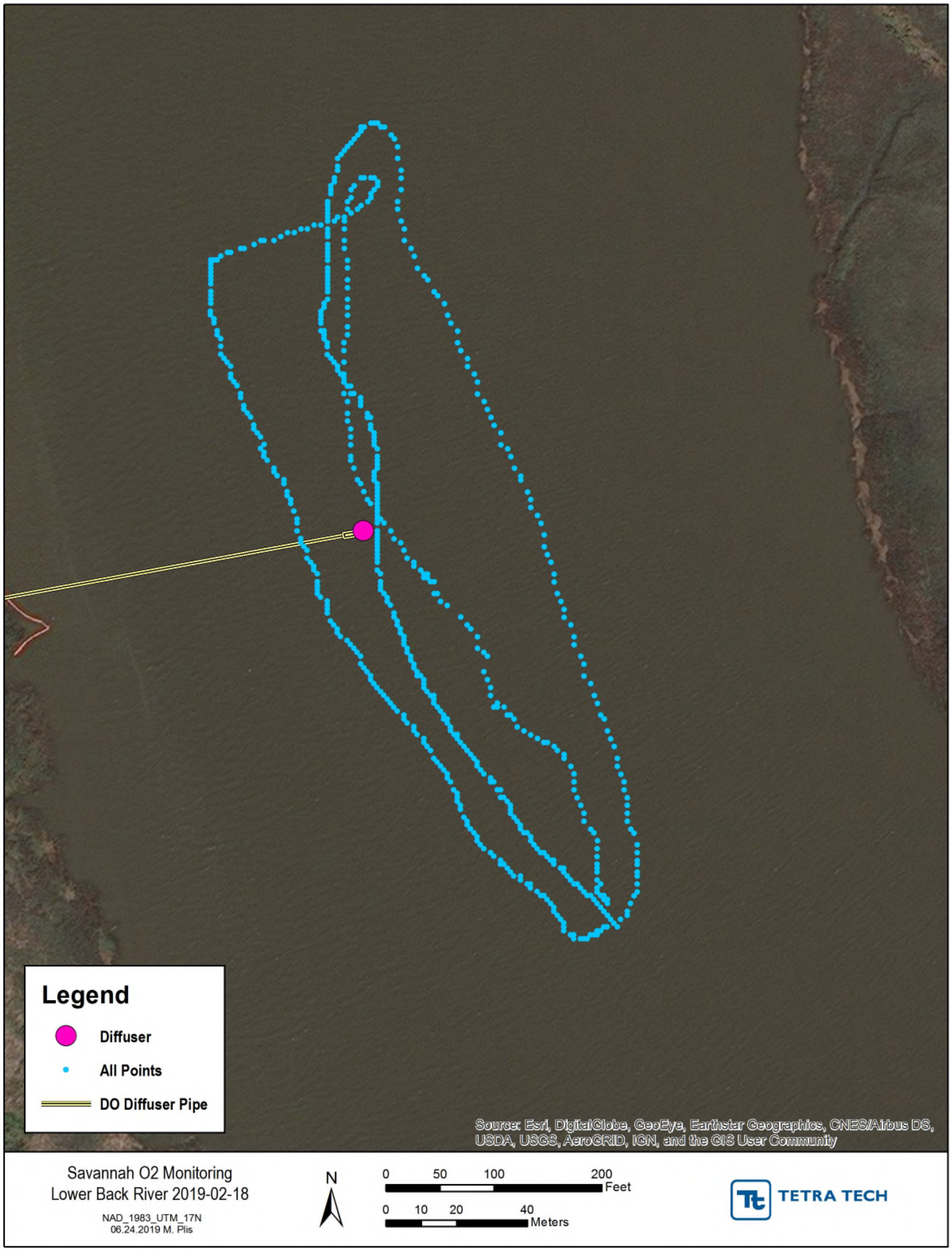


Figure C-31 Back River February 18, 2019 incoming tide traveling profile location map (LBR_021819_005)

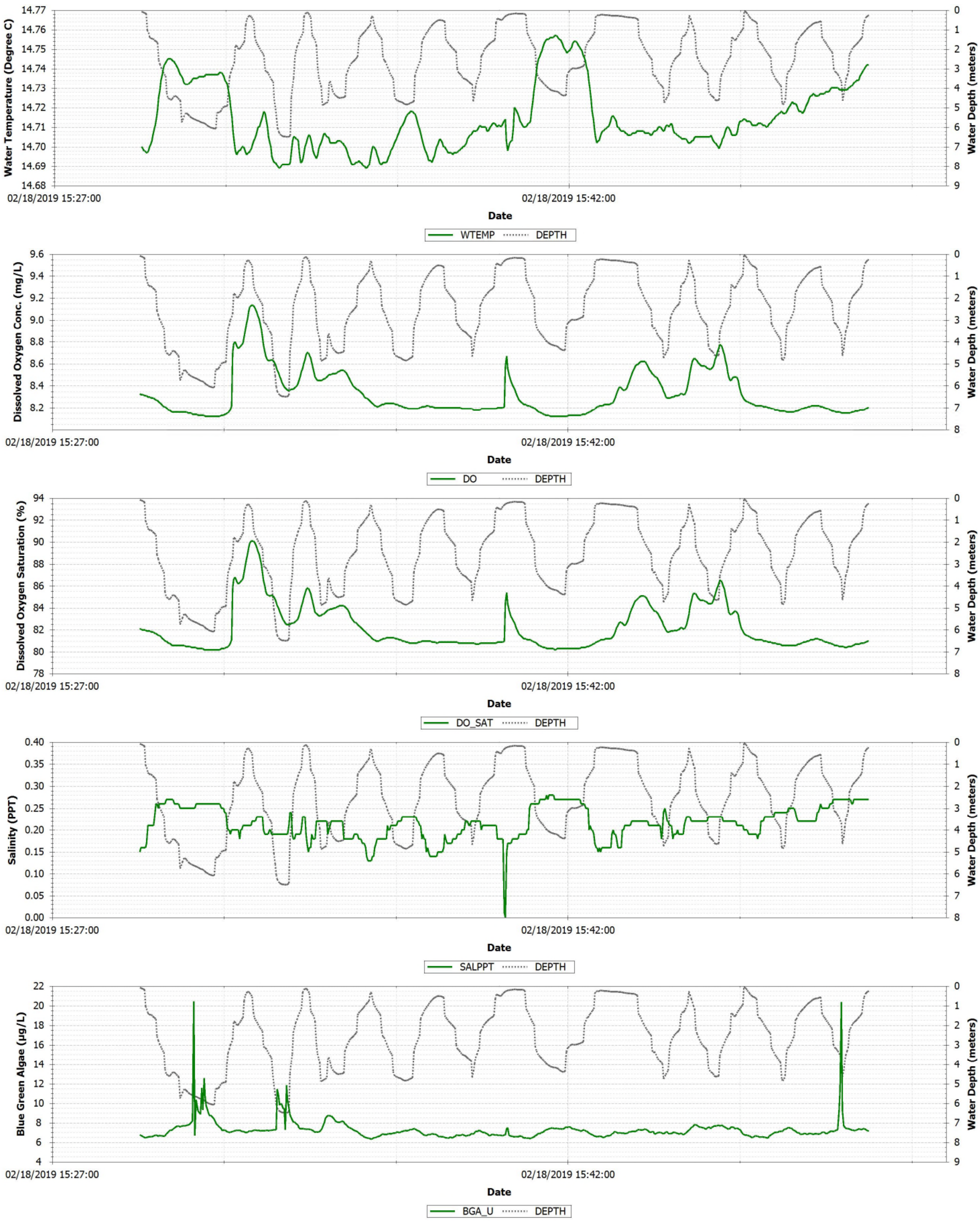


Figure C-32 Back River February 18, 2019 incoming tide traveling profile observations (LBR_021819_005)

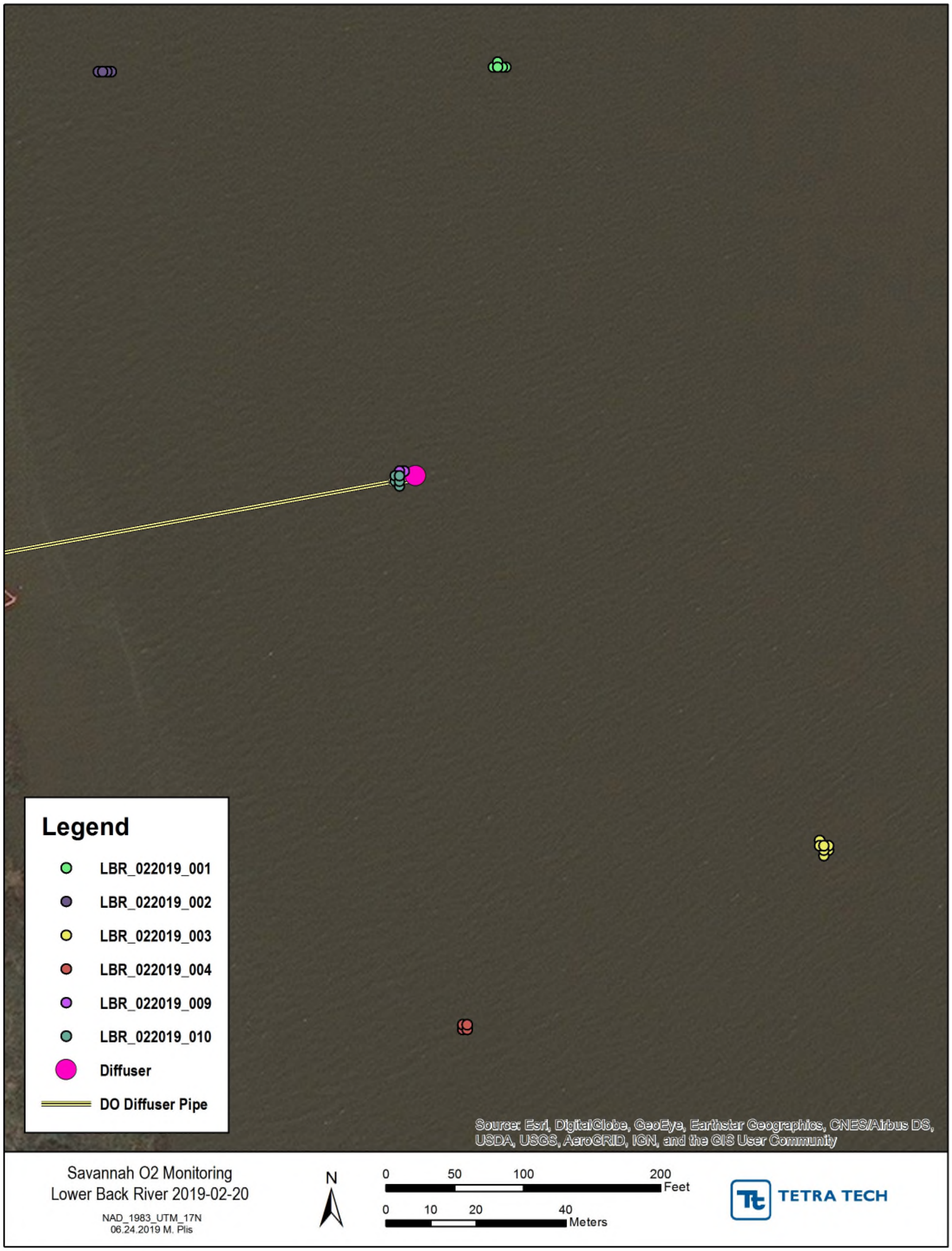


Figure C-33 Back River February 20, 2019 stationary profiles location map

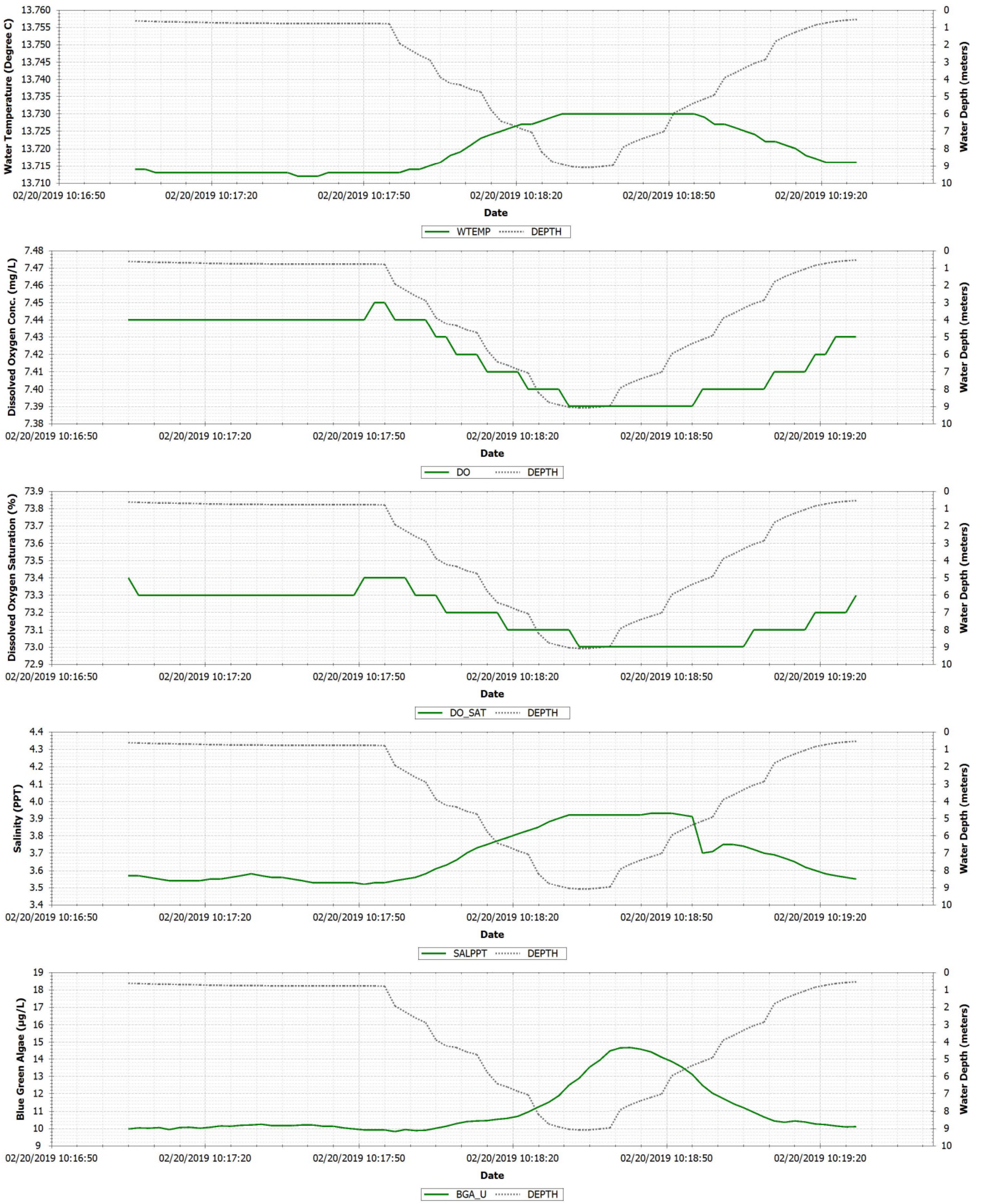


Figure C-34 Back River February 20, 2019 northeast buoy flood tide stationary profile observations (LBR_022019_001)

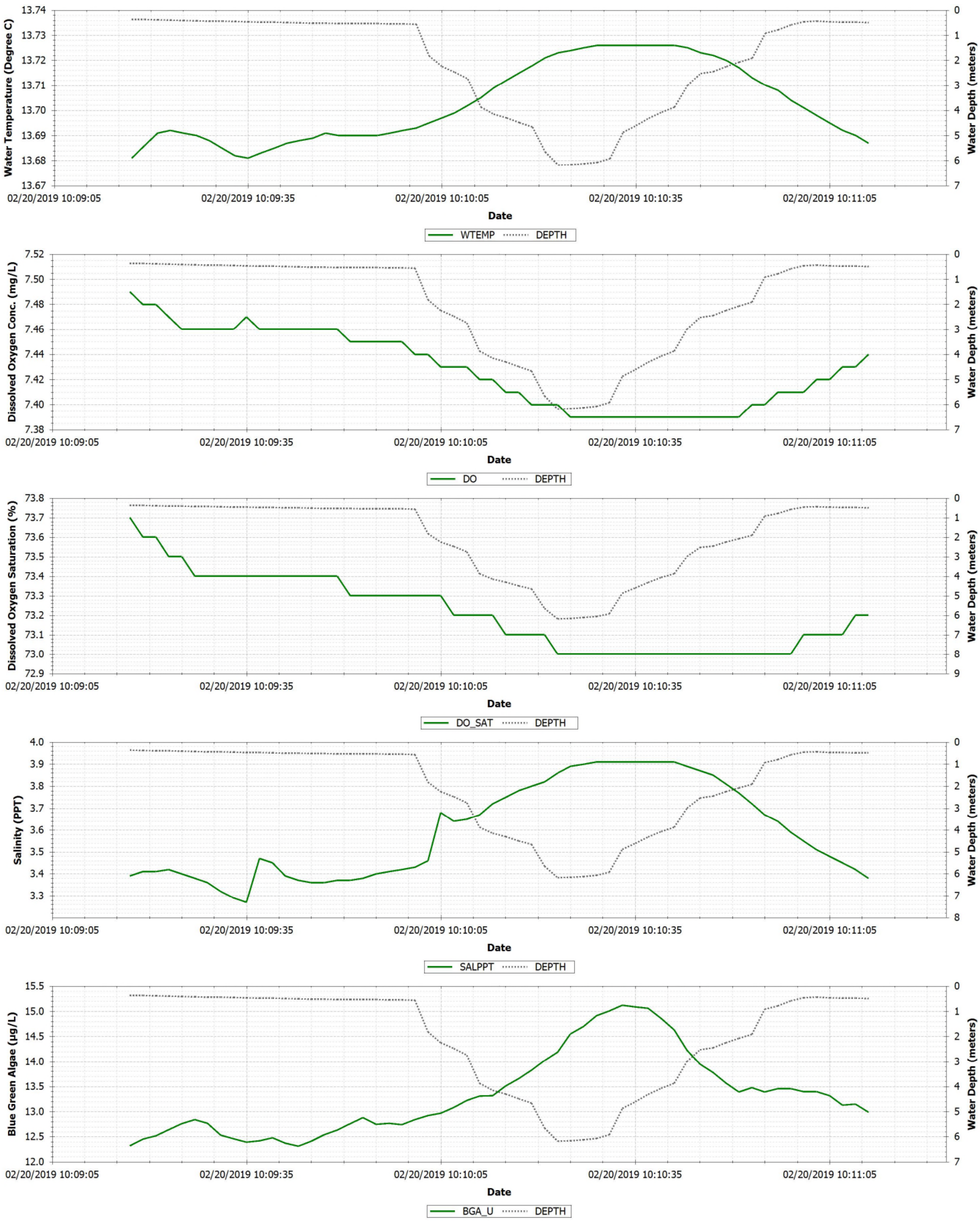


Figure C-35 Back River February 20, 2019 northwest buoy flood tide stationary profile observations (LBR_022019_002)

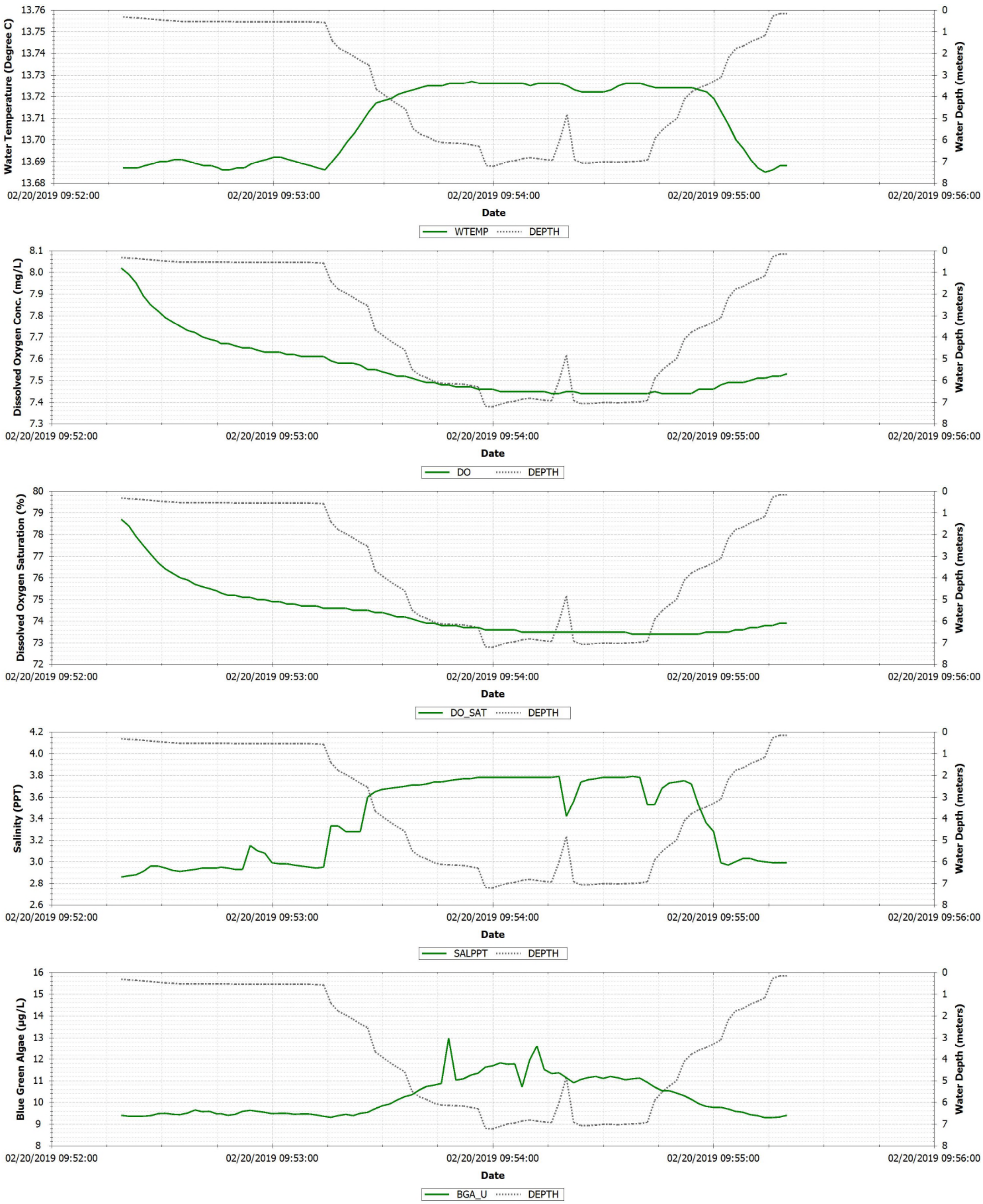


Figure C-36 Back River February 20, 2019 southeast buoy flood tide stationary profile observations (LBR_022019_003)

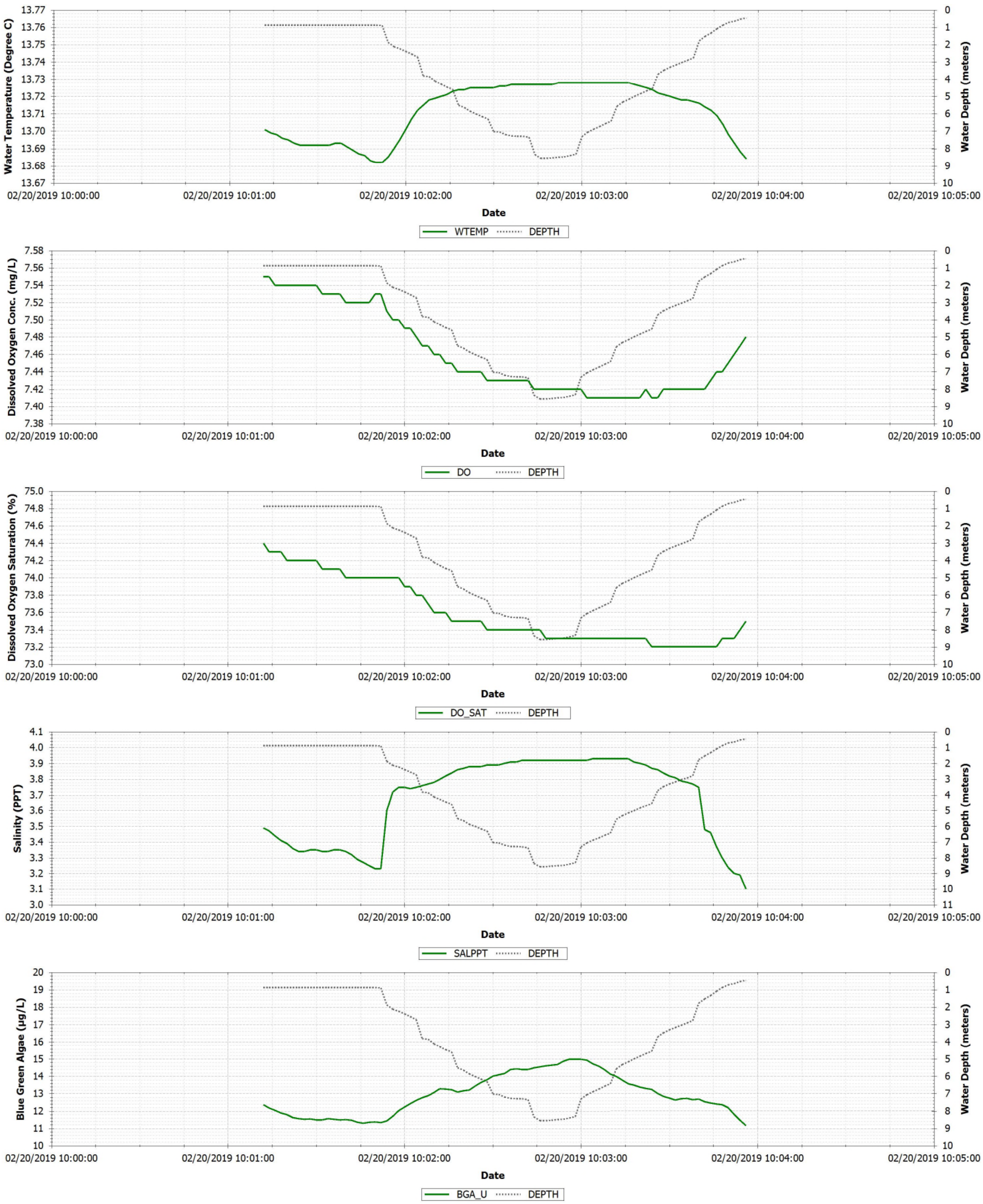


Figure C-37 Back River February 20, 2019 southwest buoy flood tide stationary profile observations (LBR_022019_004)

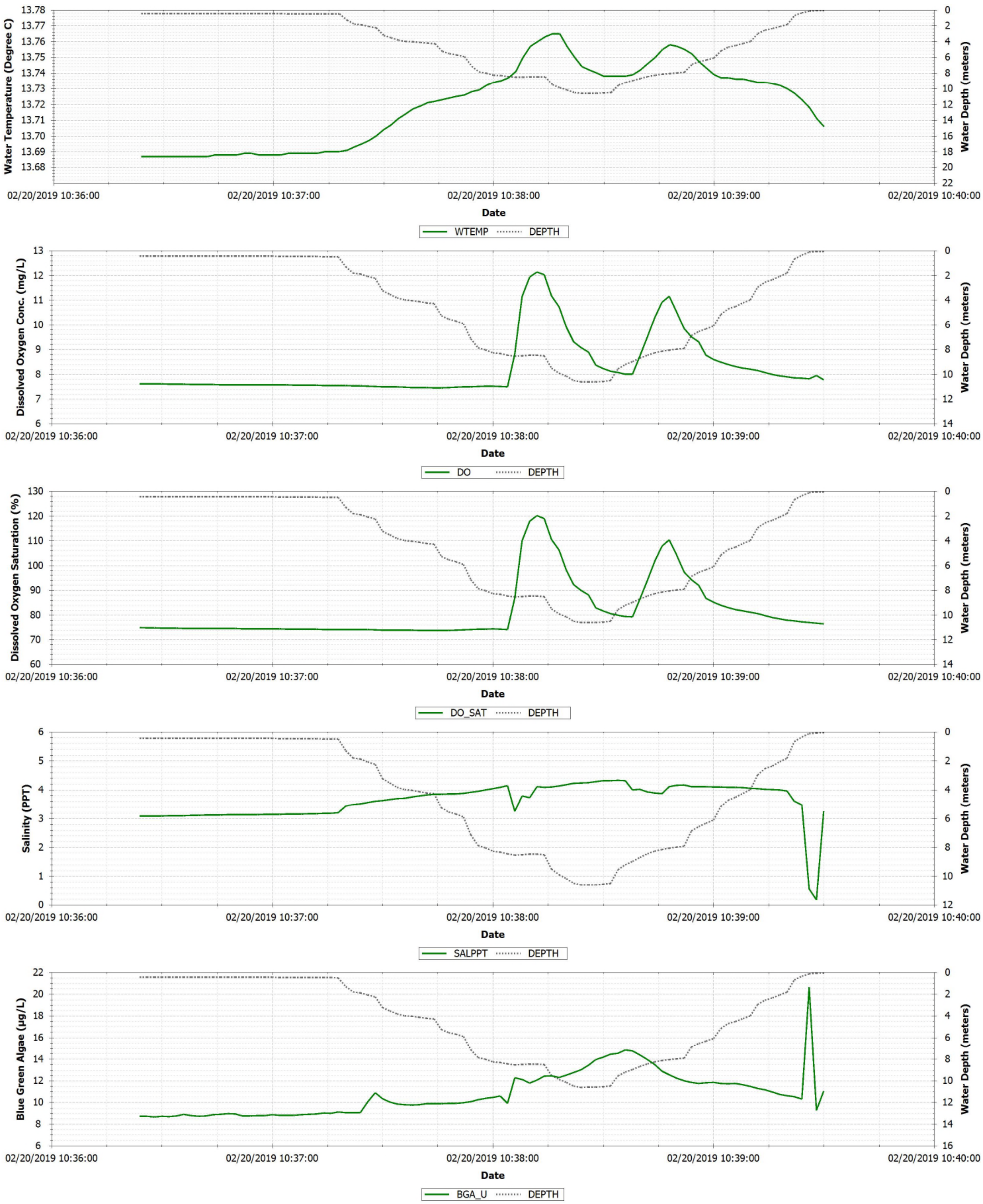


Figure C-38 Back River February 20, 2019 east platform flood tide stationary profile observations (LBR_022019_009)

Figure C-39 Back River February 20, 2019 west platform flood tide stationary profile observations (LBR_022019_010)

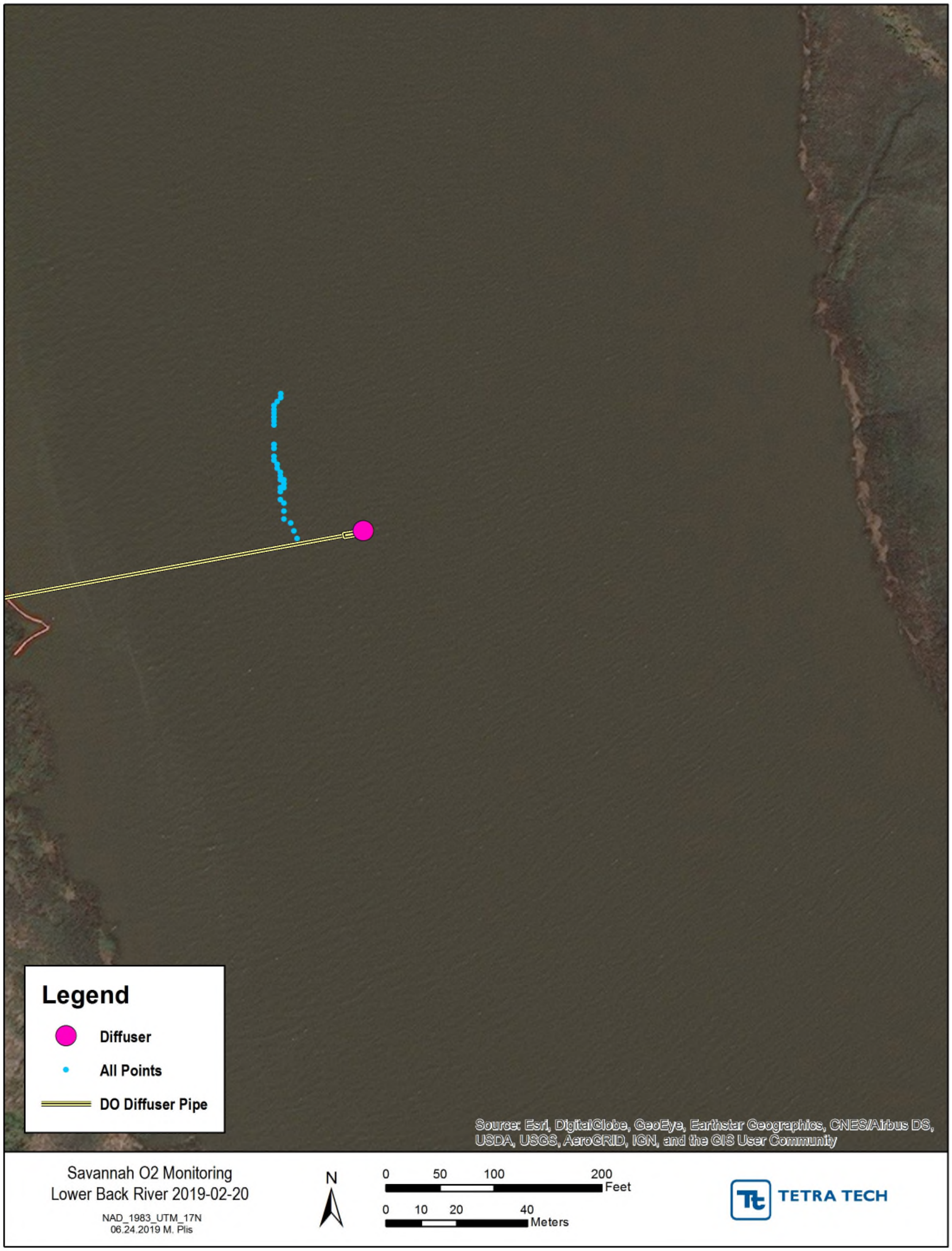


Figure C-40 Back River February 20, 2019 flood tide traveling profile period 1 location map (LBR_022019_007)

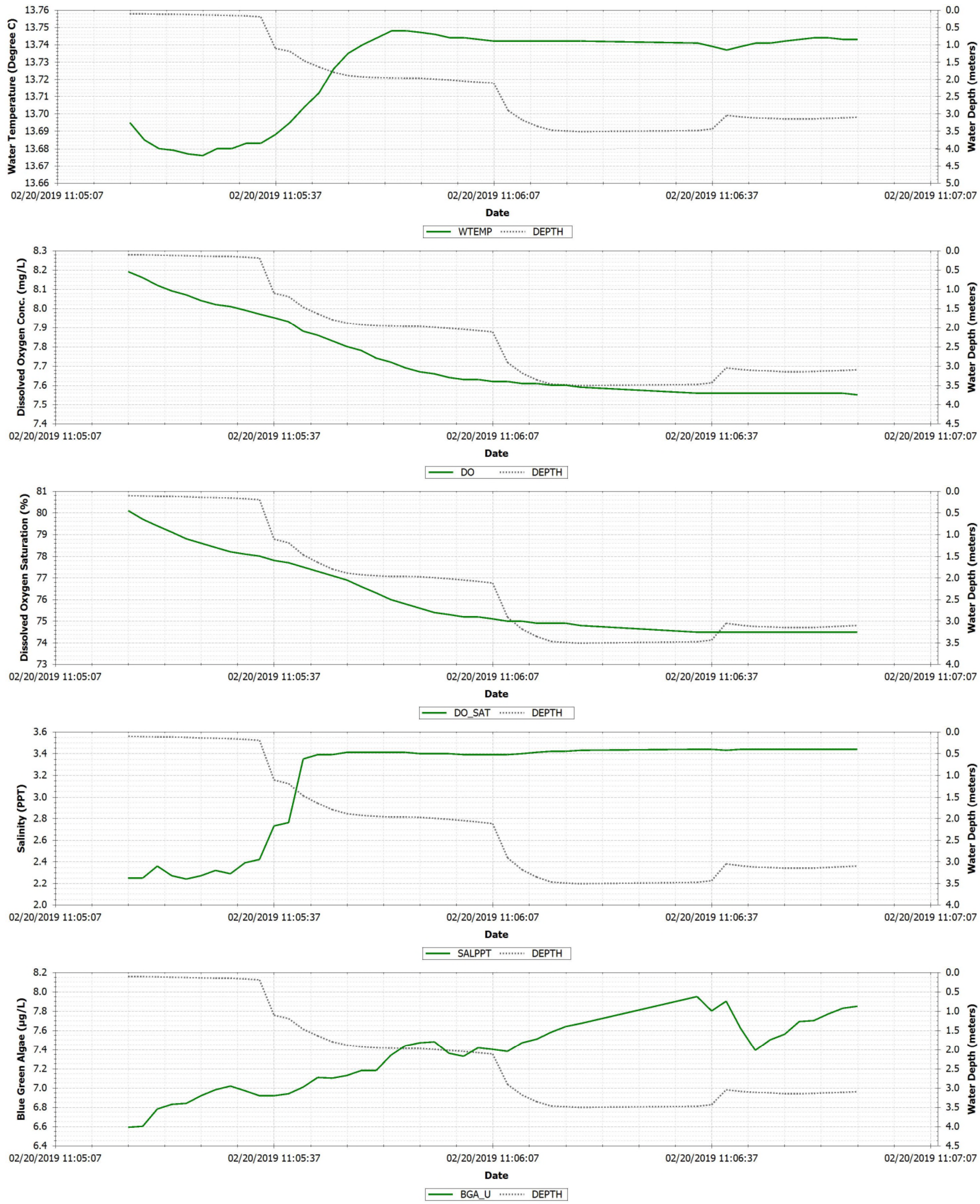


Figure C-41 Back River February 20, 2019 flood tide traveling profile period 1 observations (LBR_022019_007)

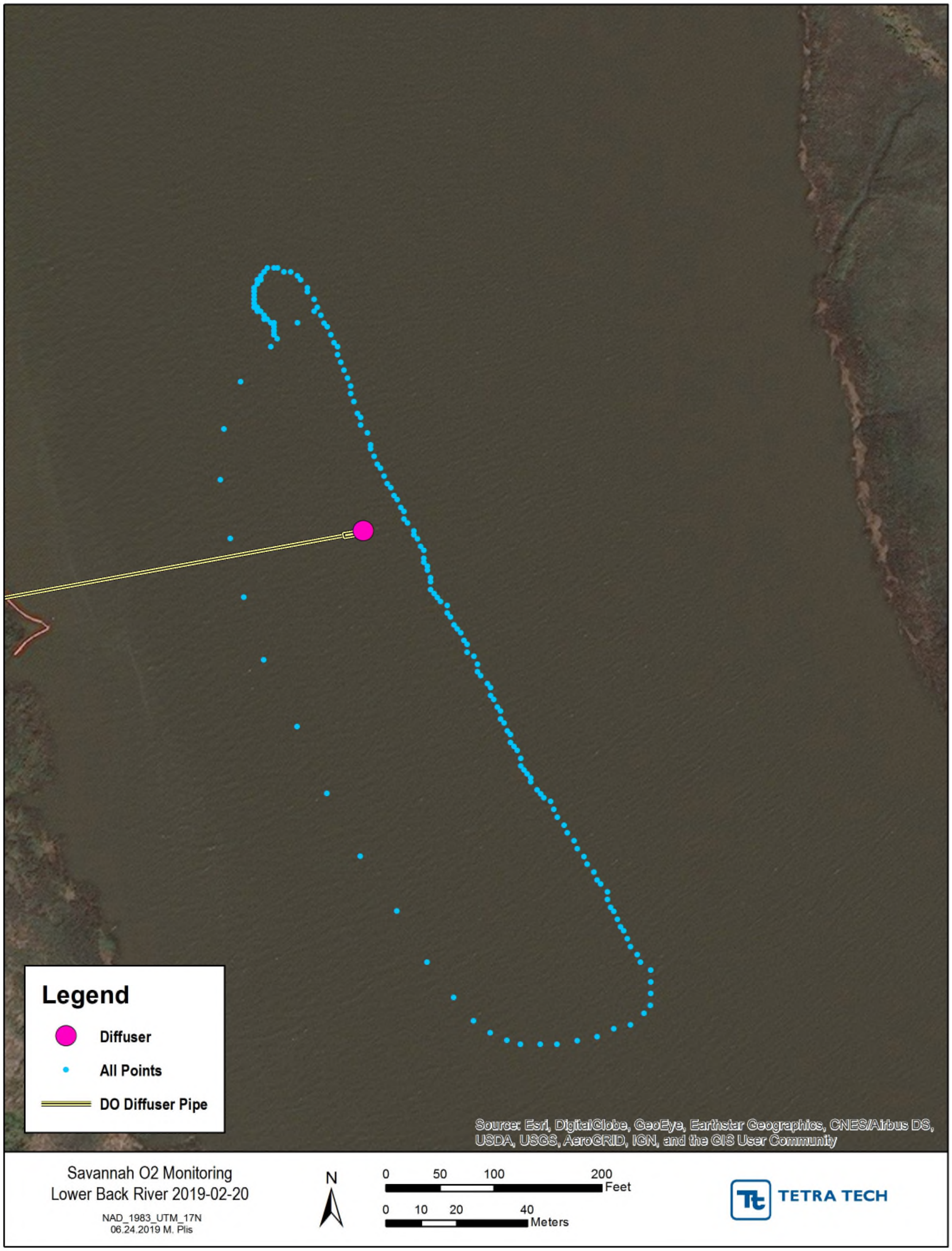


Figure C-42 Back River February 20, 2019 flood tide traveling profile period 2 location map (LBR_022019_005)

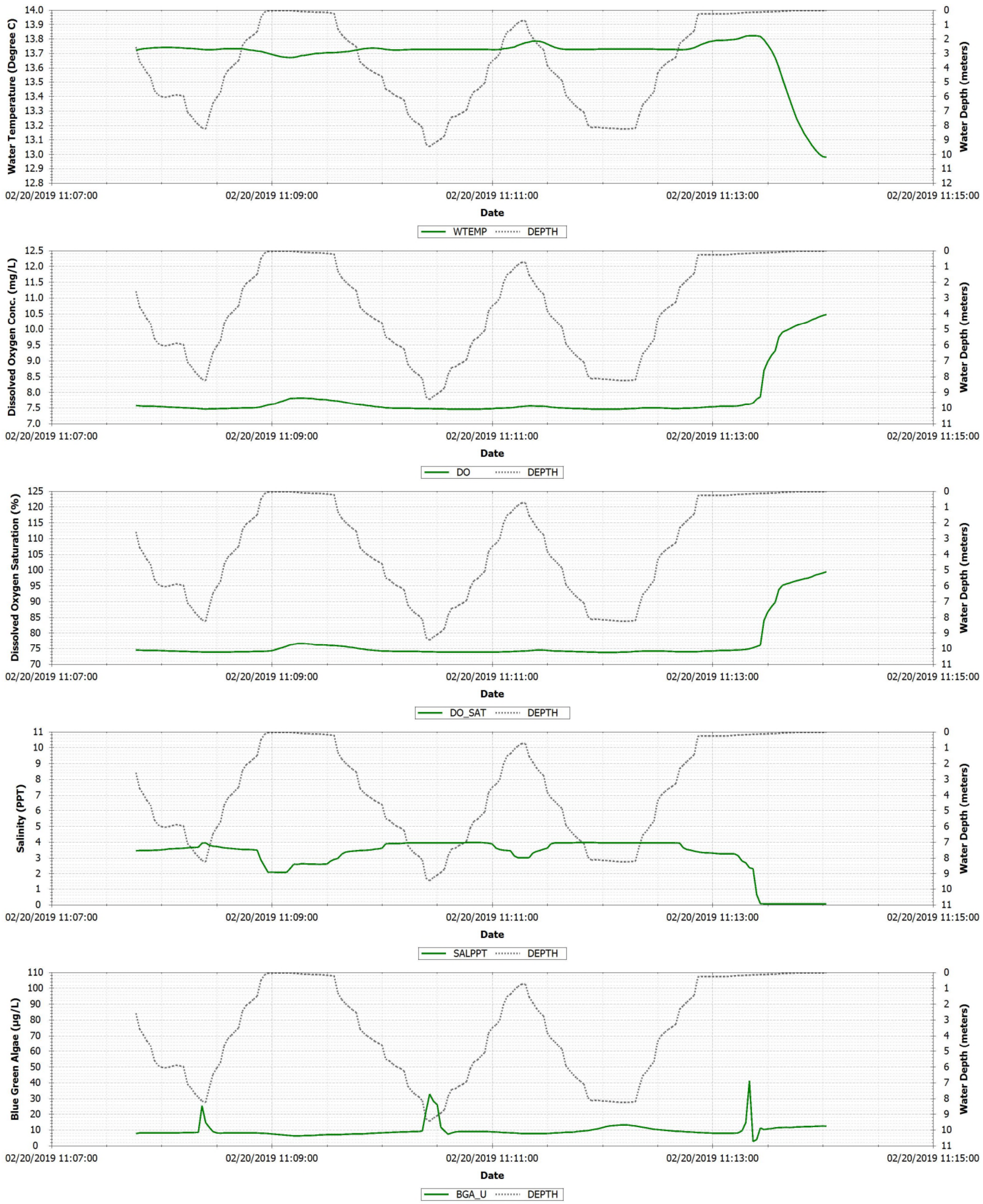


Figure C-43 Back River February 20, 2019 flood tide traveling profile period 2 observations (LBR_022019_005)

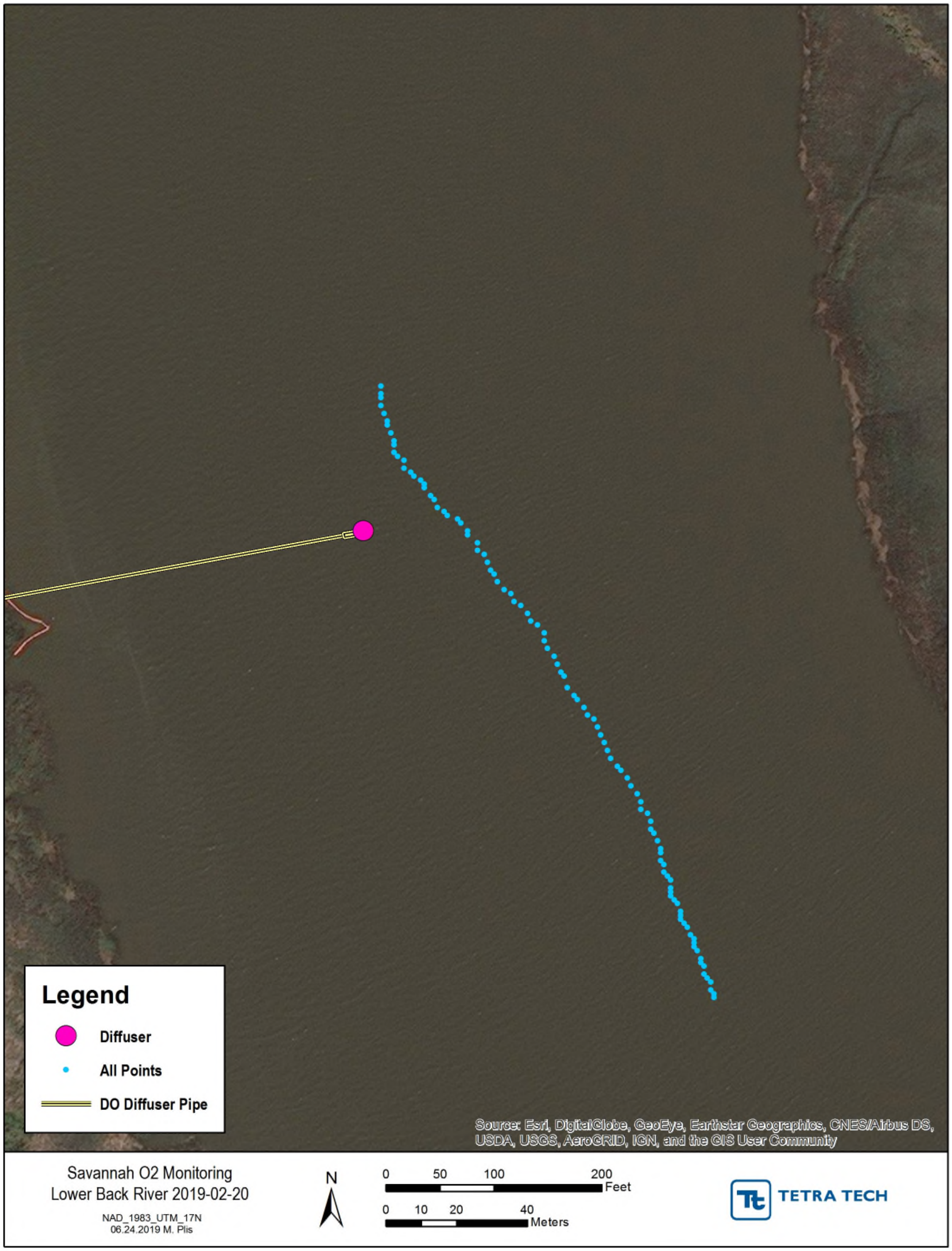


Figure C-44 Back River February 20, 2019 flood tide traveling profile period 3 location map (LBR_022019_006)

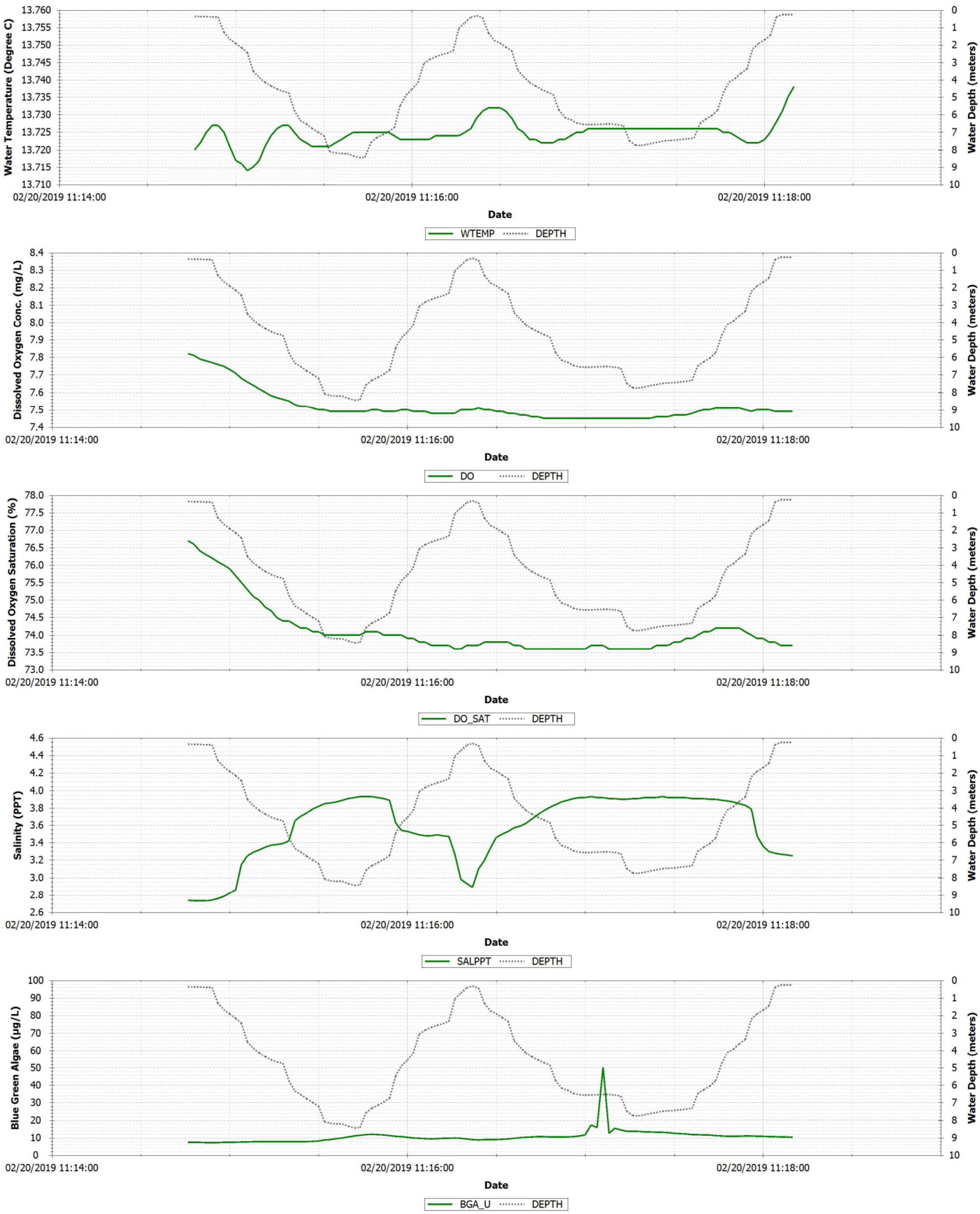


Figure C-45 Back River February 20, 2019 flood tide traveling profile period 3 observations (LBR_022019_006)

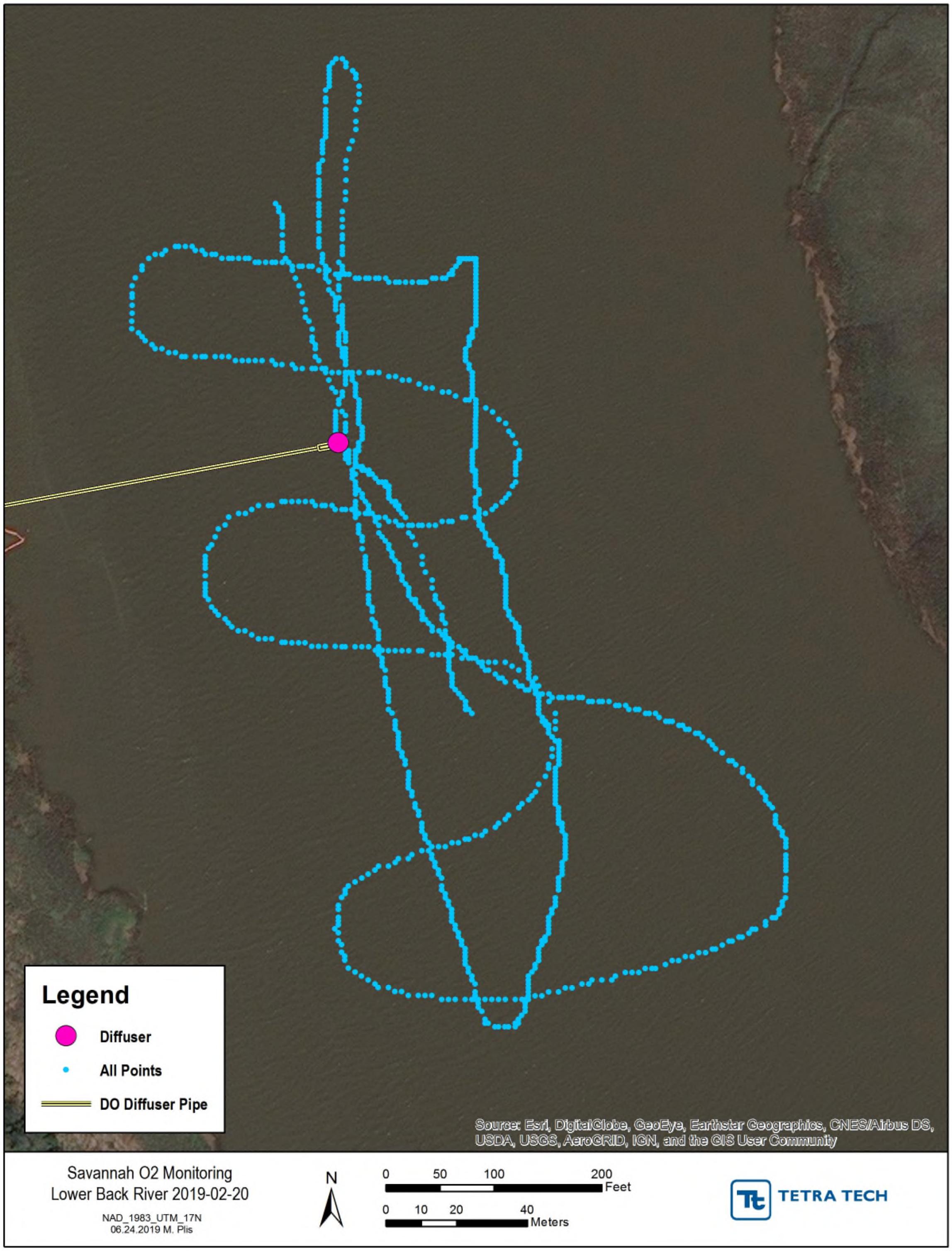


Figure C-46 Back River February 20, 2019 ebb tide traveling profile location map (LBR_022019_008)

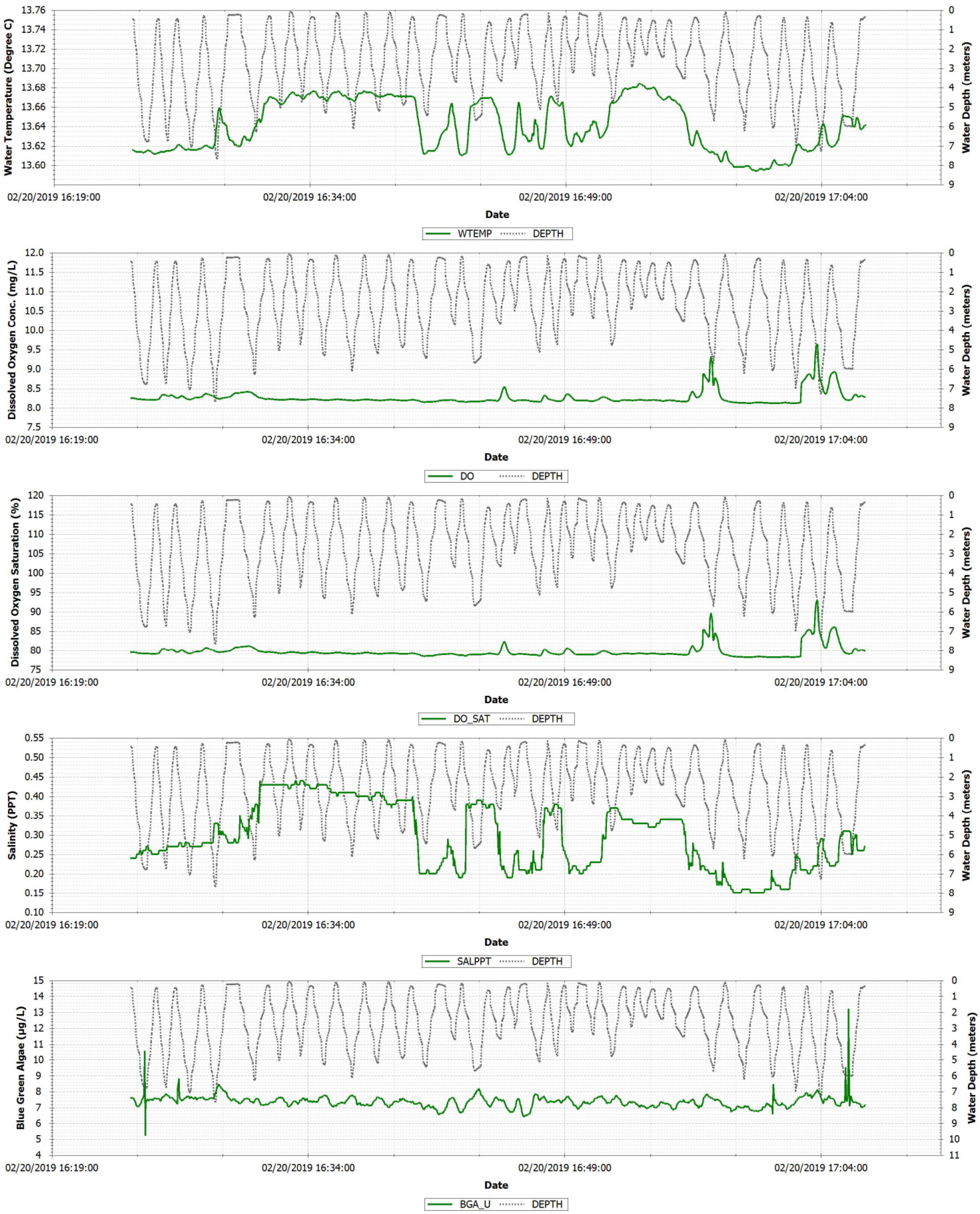


Figure C-47 Back River February 20, 2019 ebb tide traveling profile observations (LBR_022019_008)

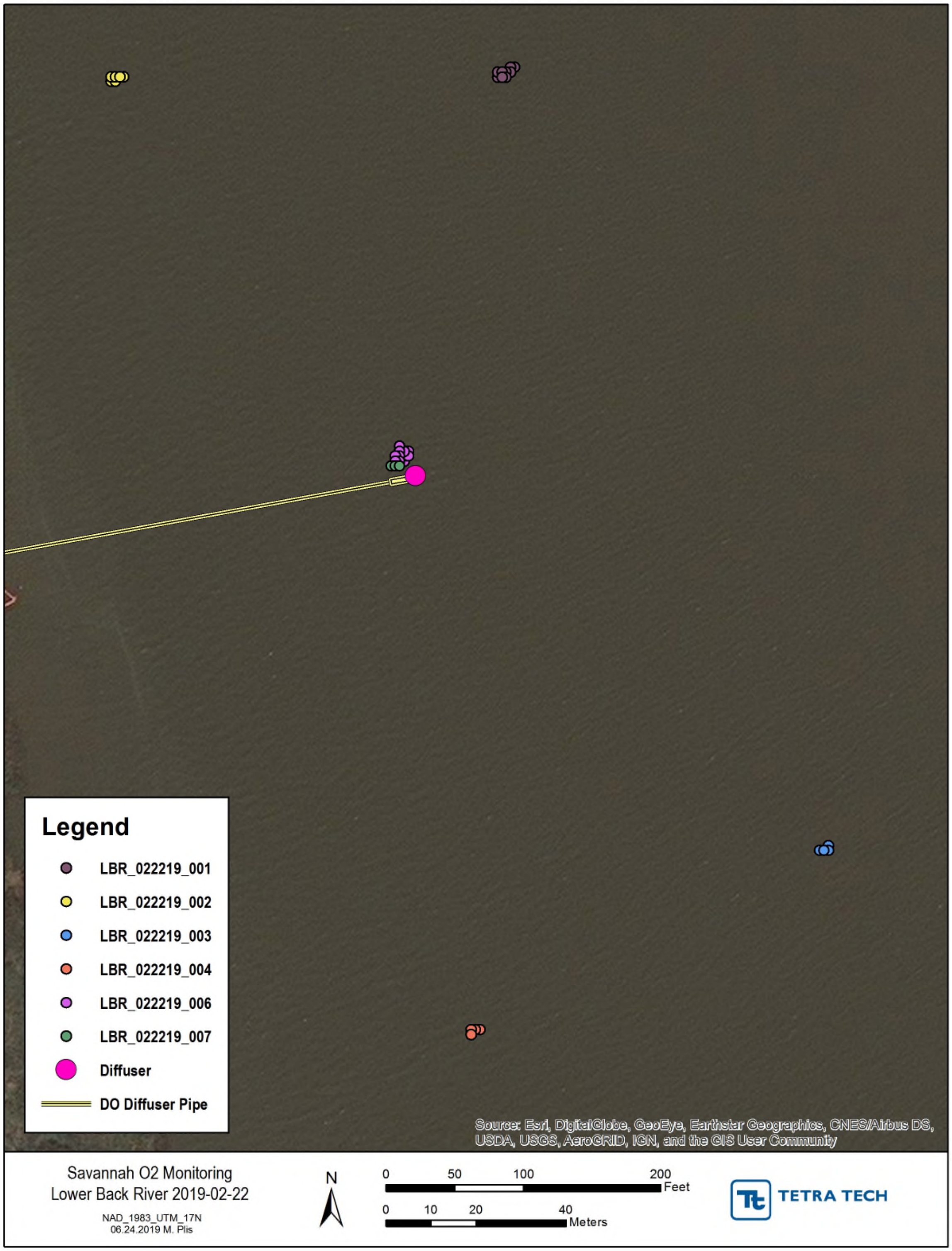


Figure C-48 Back River February 22, 2019 stationary profiles location map

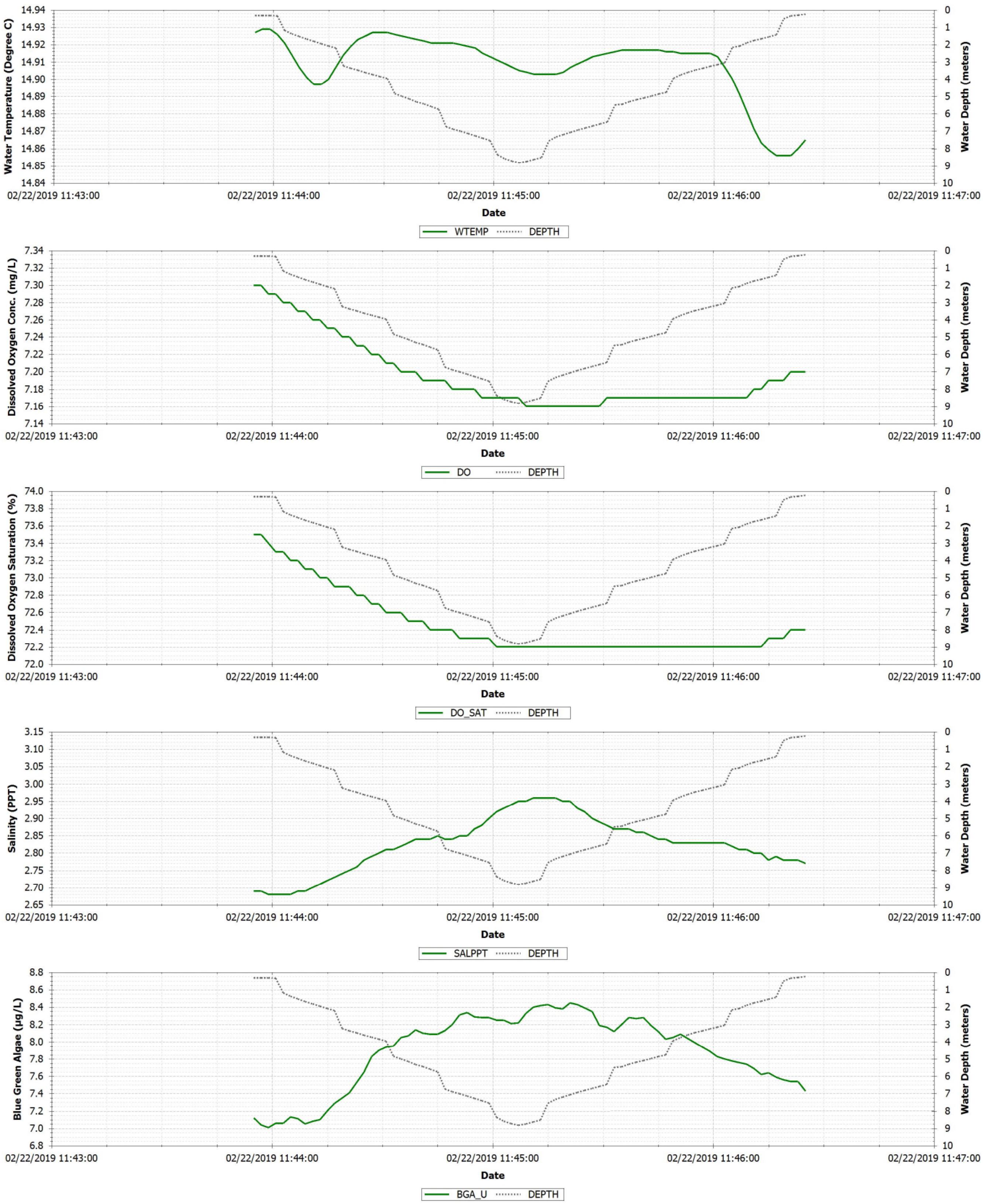


Figure C-49 Back River February 22, 2019 northeast buoy flood tide stationary profile observations (LBR_022219_001)

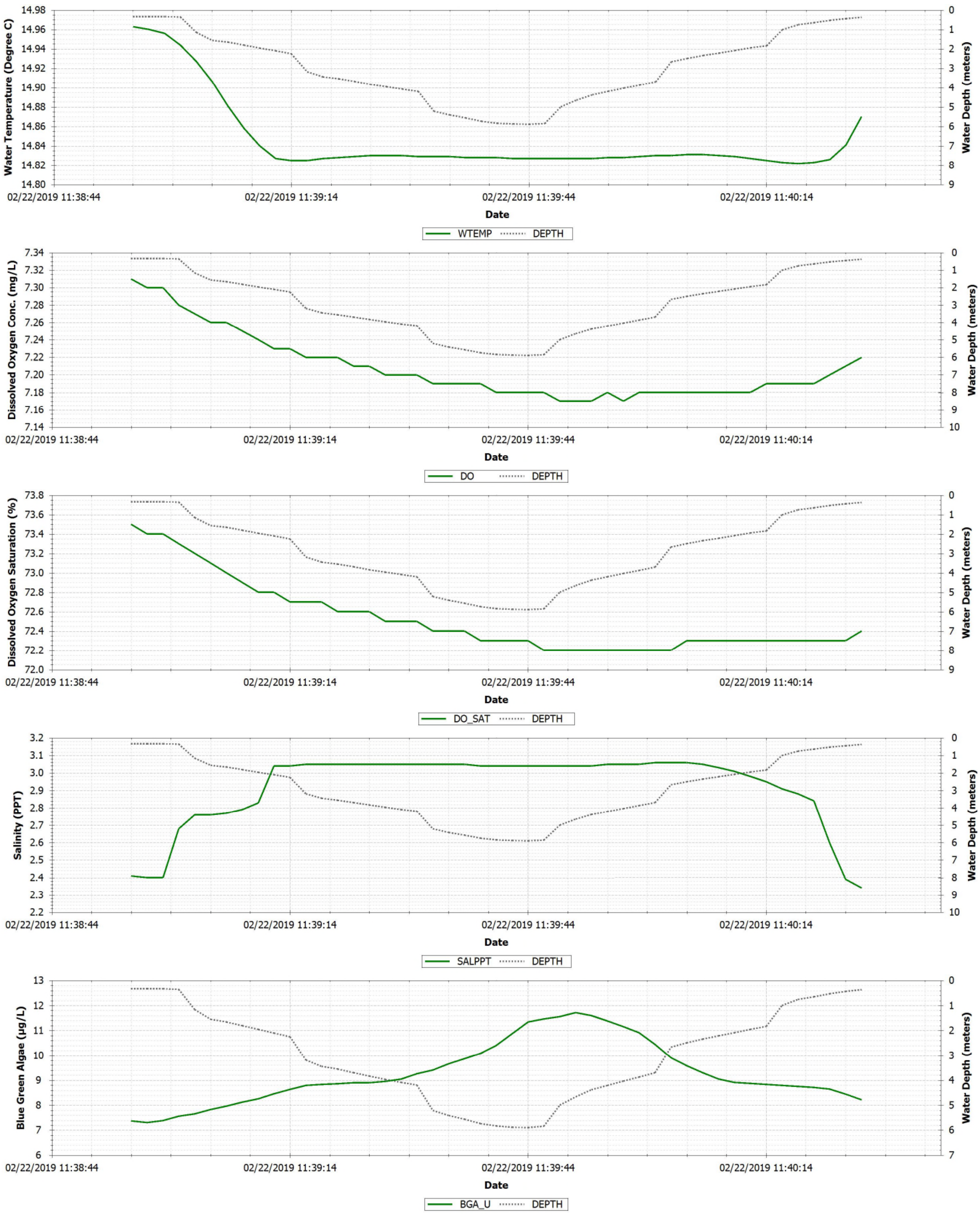


Figure C-50 Back River February 22, 2019 northwest buoy flood tide stationary profile observations (LBR_022219_002)

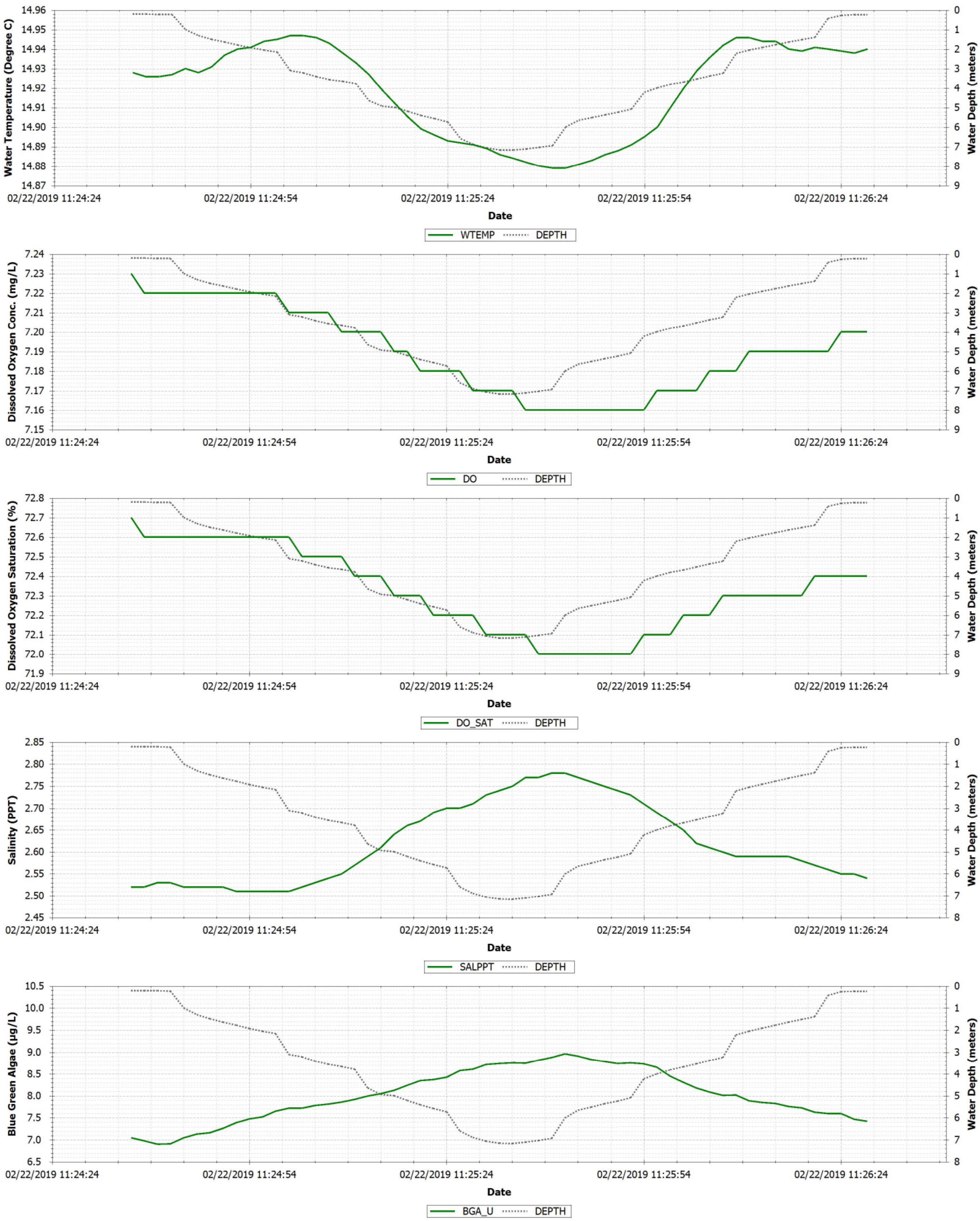


Figure C-51 Back River February 22, 2019 southeast buoy flood tide stationary profile observations (LBR_022219_003)

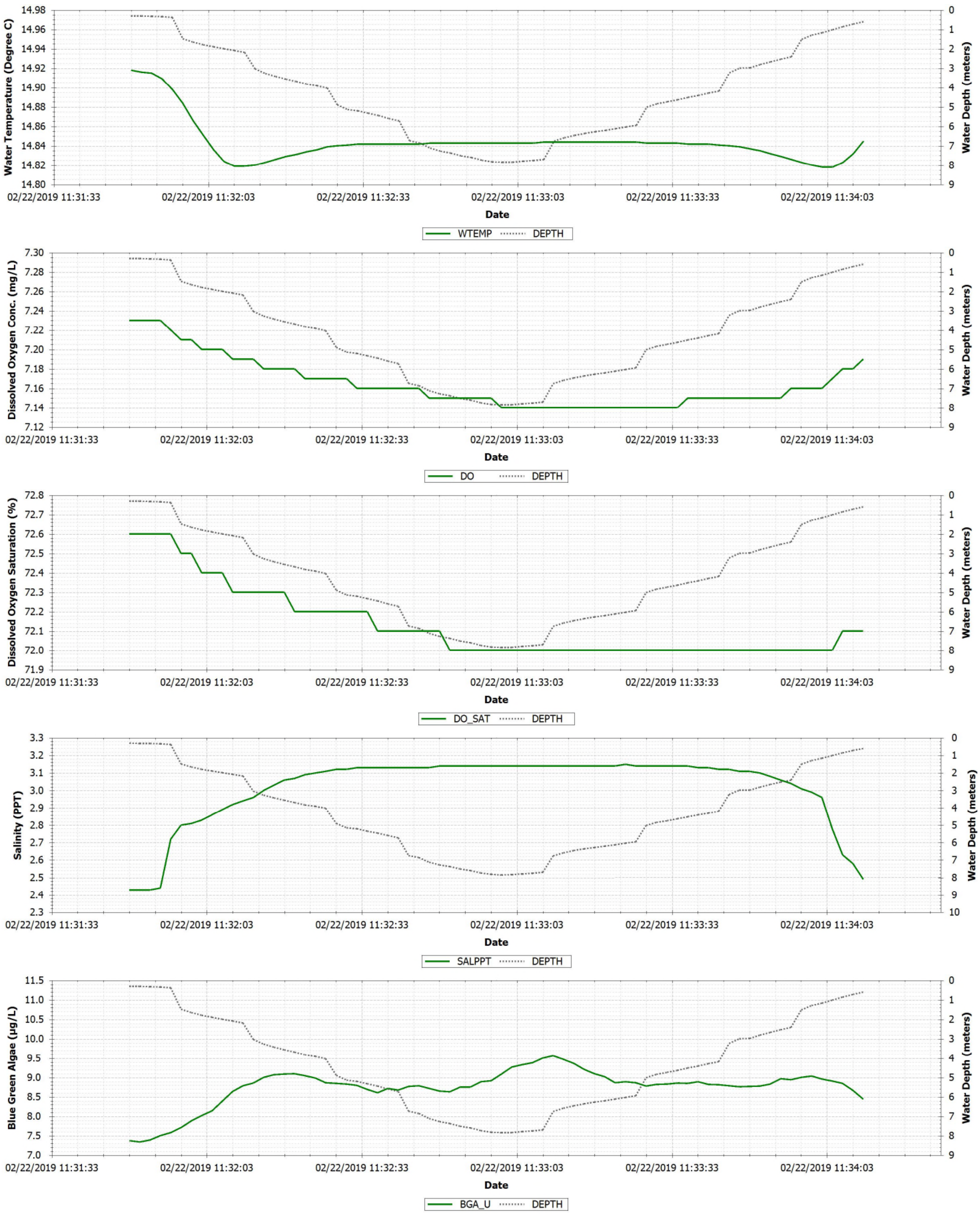


Figure C-52 Back River February 22, 2019 southwest buoy flood tide stationary profile observations (LBR_022219_004)

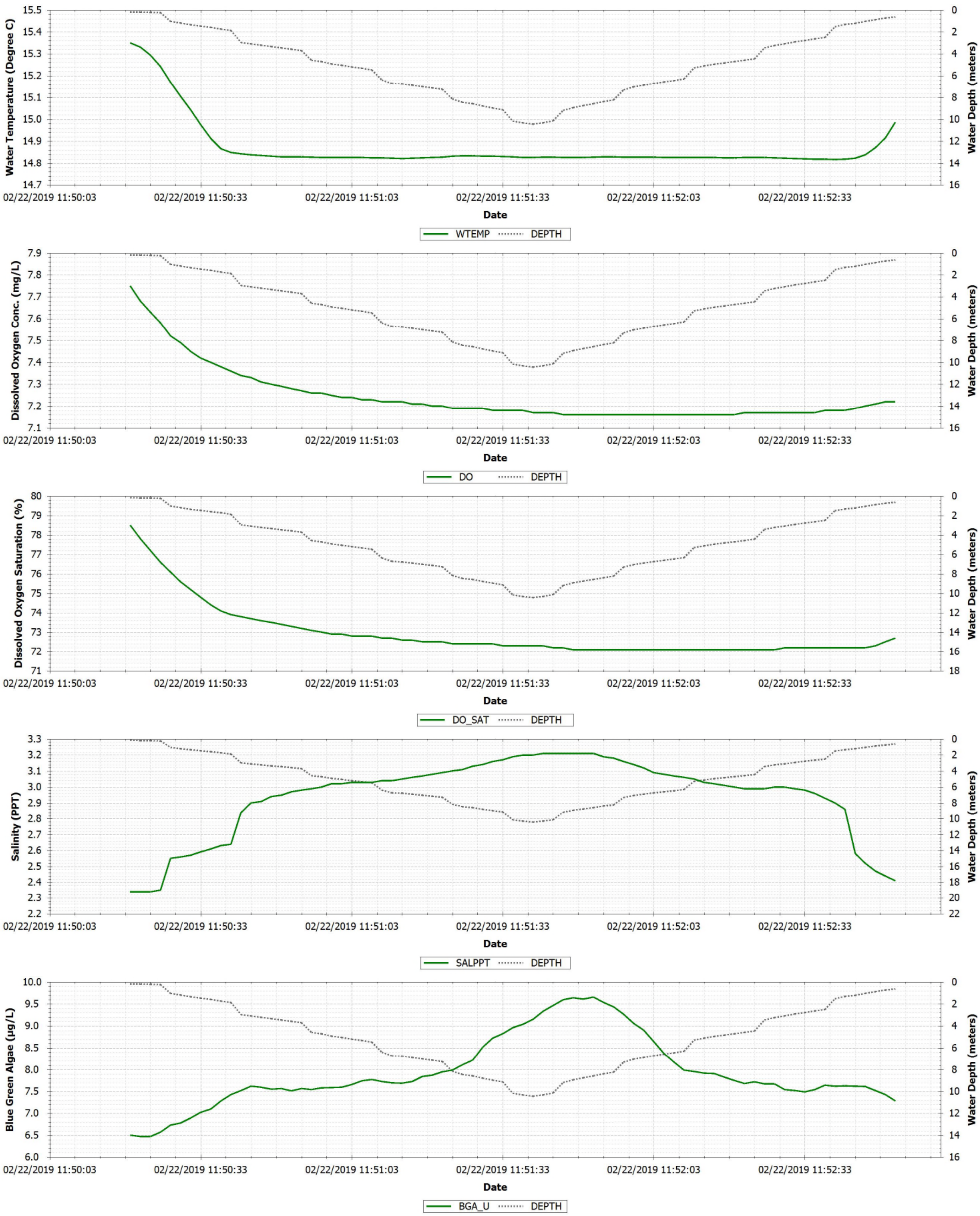


Figure C-53 Back River February 22, 2019 east platform flood tide stationary profile observations (LBR_022219_006)

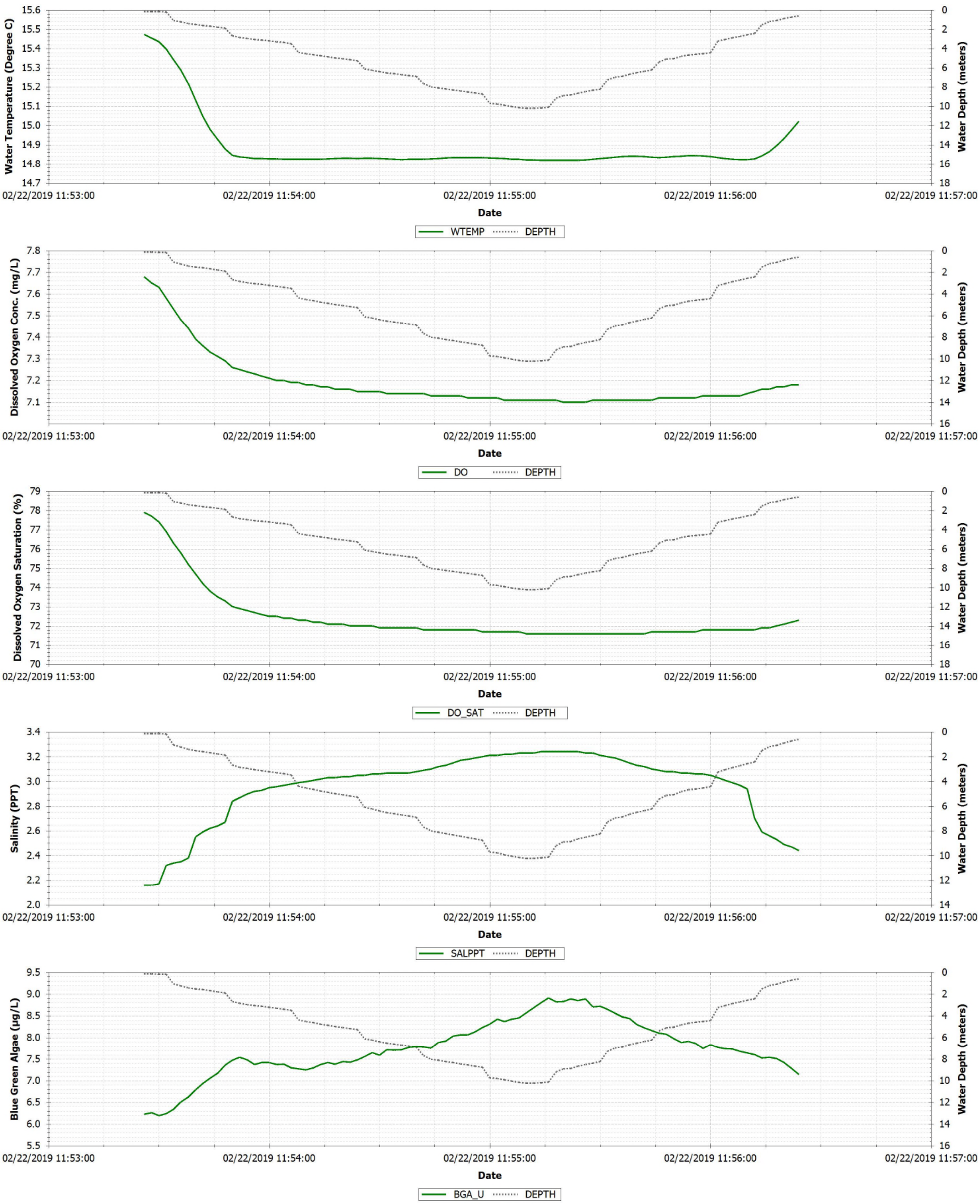


Figure C-54 Back River February 22, 2019 west platform flood tide stationary profile observations (LBR_022219_007)

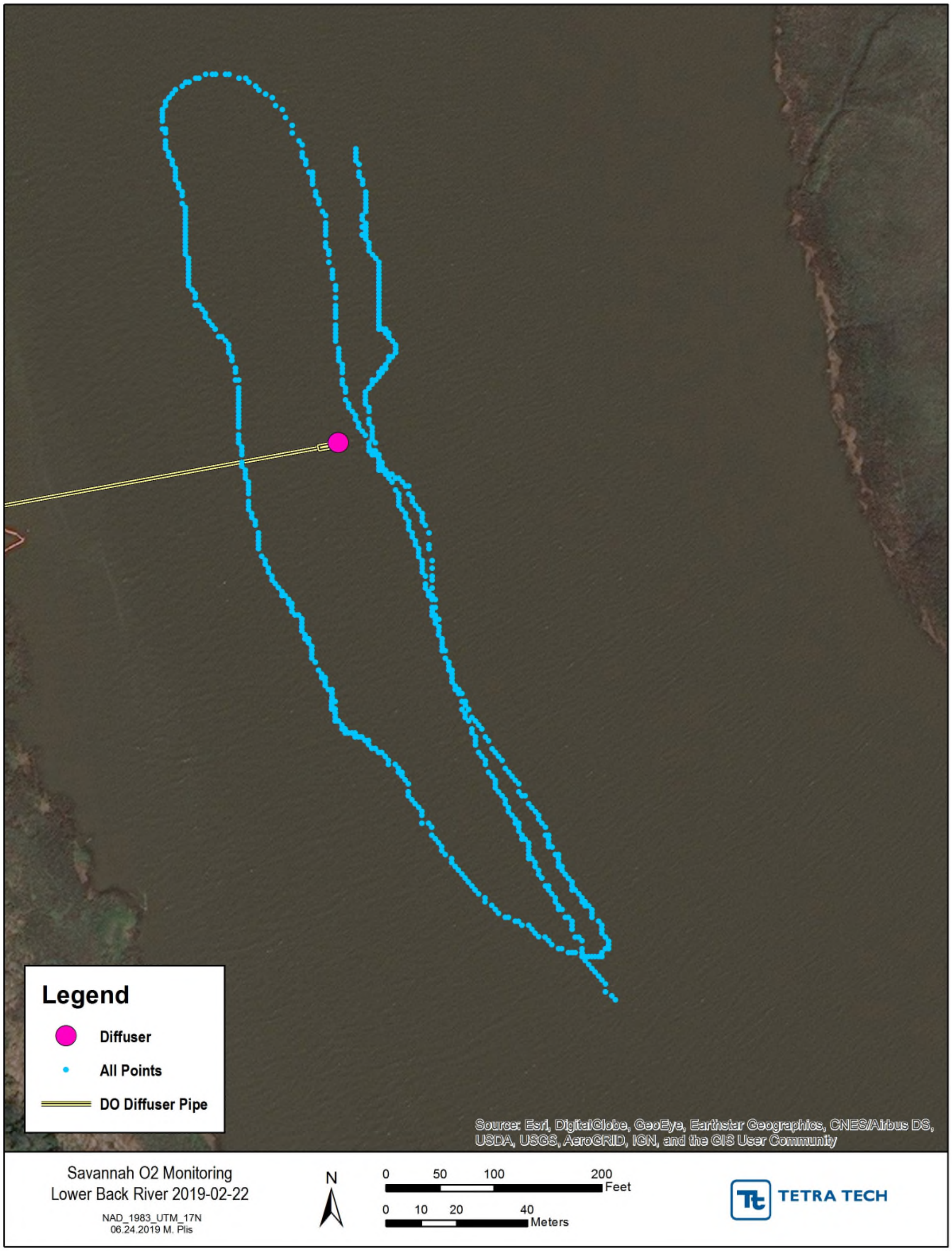


Figure C-55 Back River February 22, 2019 flood tide traveling profile location map (LBR_022219_005)

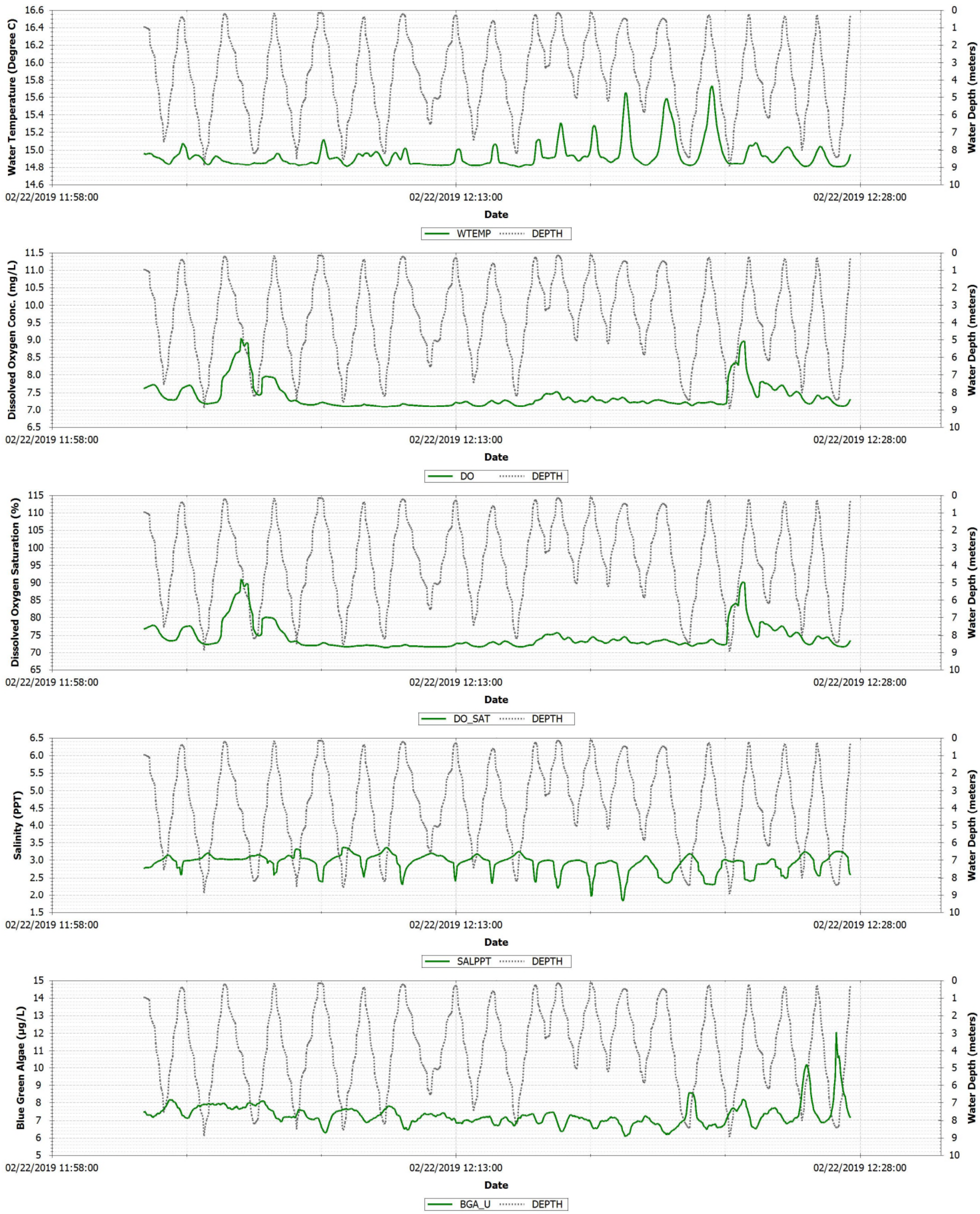


Figure C-56 Back River February 22, 2019 flood tide traveling profile observations (LBR_022219_005)

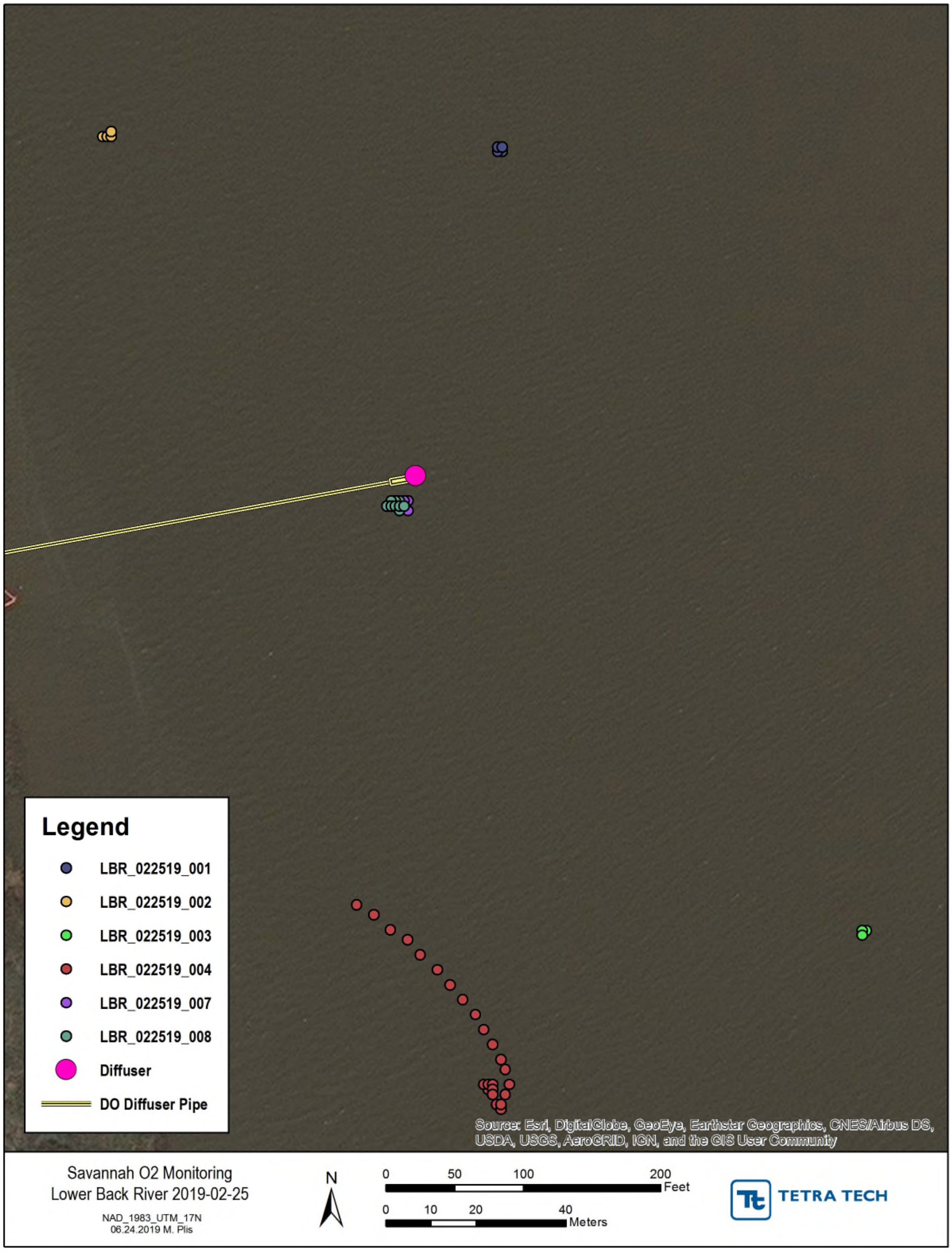


Figure C-57 Back River February 25, 2019 stationary profiles location map

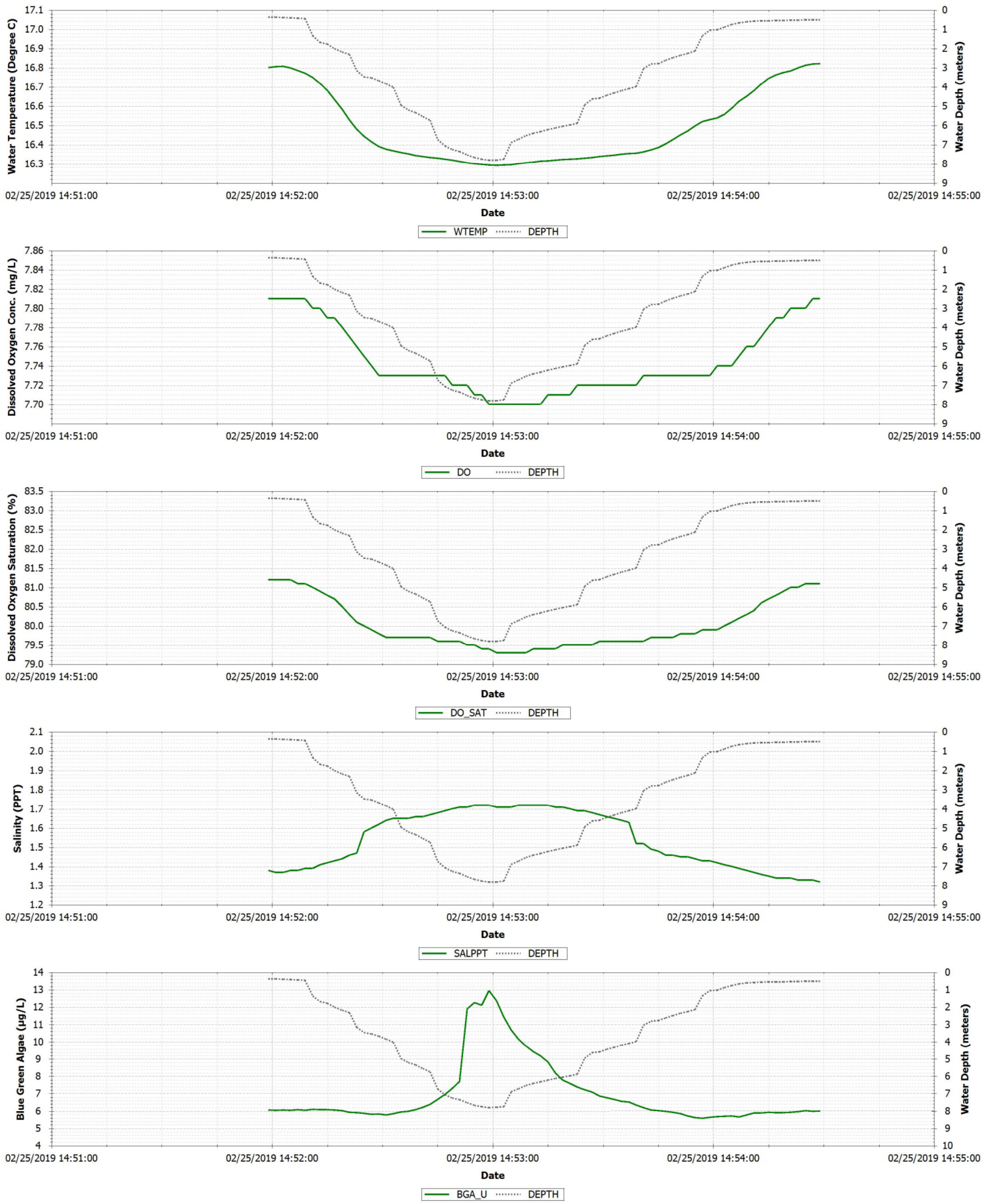


Figure C-58 Back River February 25, 2019 northeast buoy flood tide stationary profile observations (LBR_022519_001)

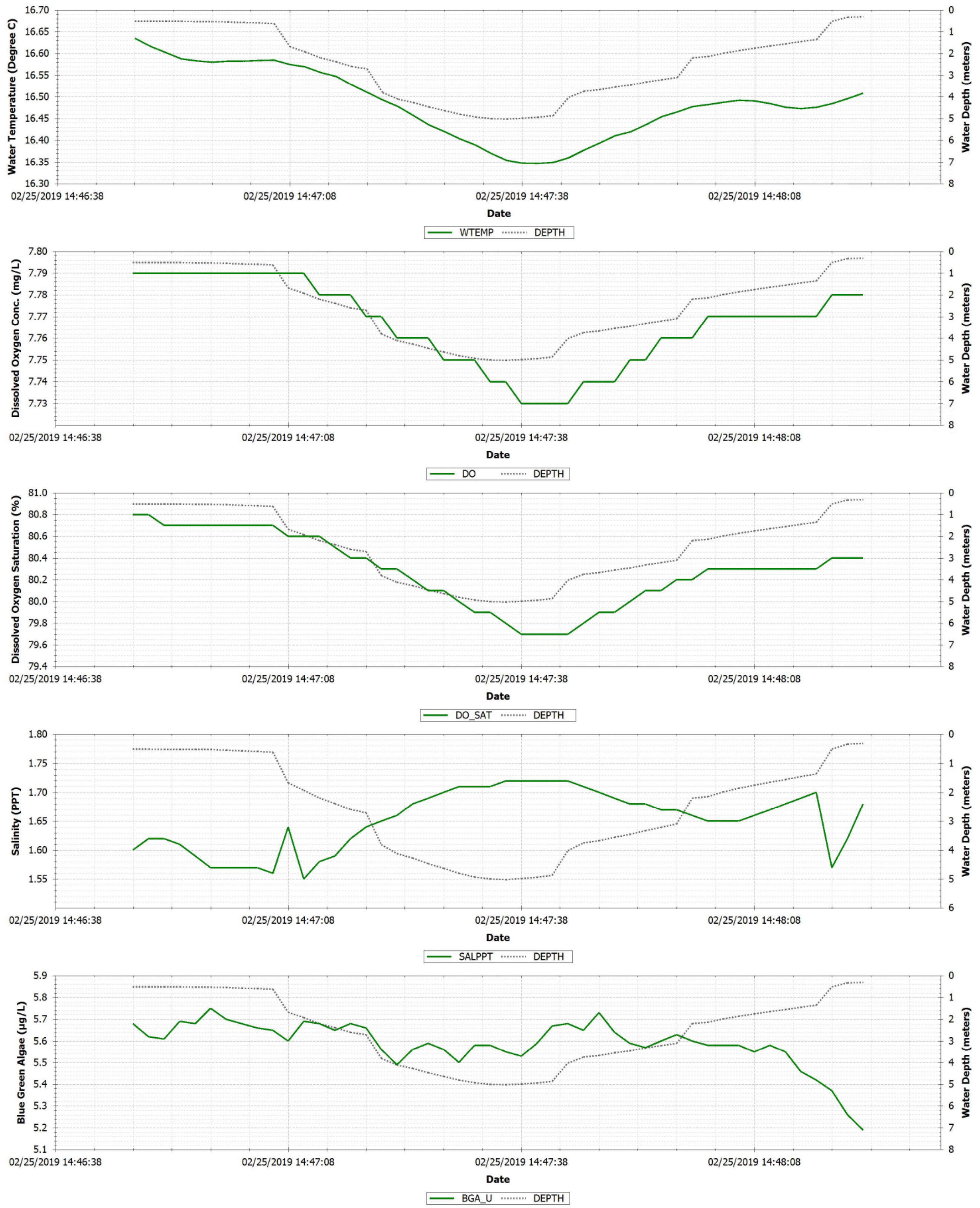


Figure C-59 Back River February 25, 2019 northwest buoy flood tide stationary profile observations (LBR_022519_002)

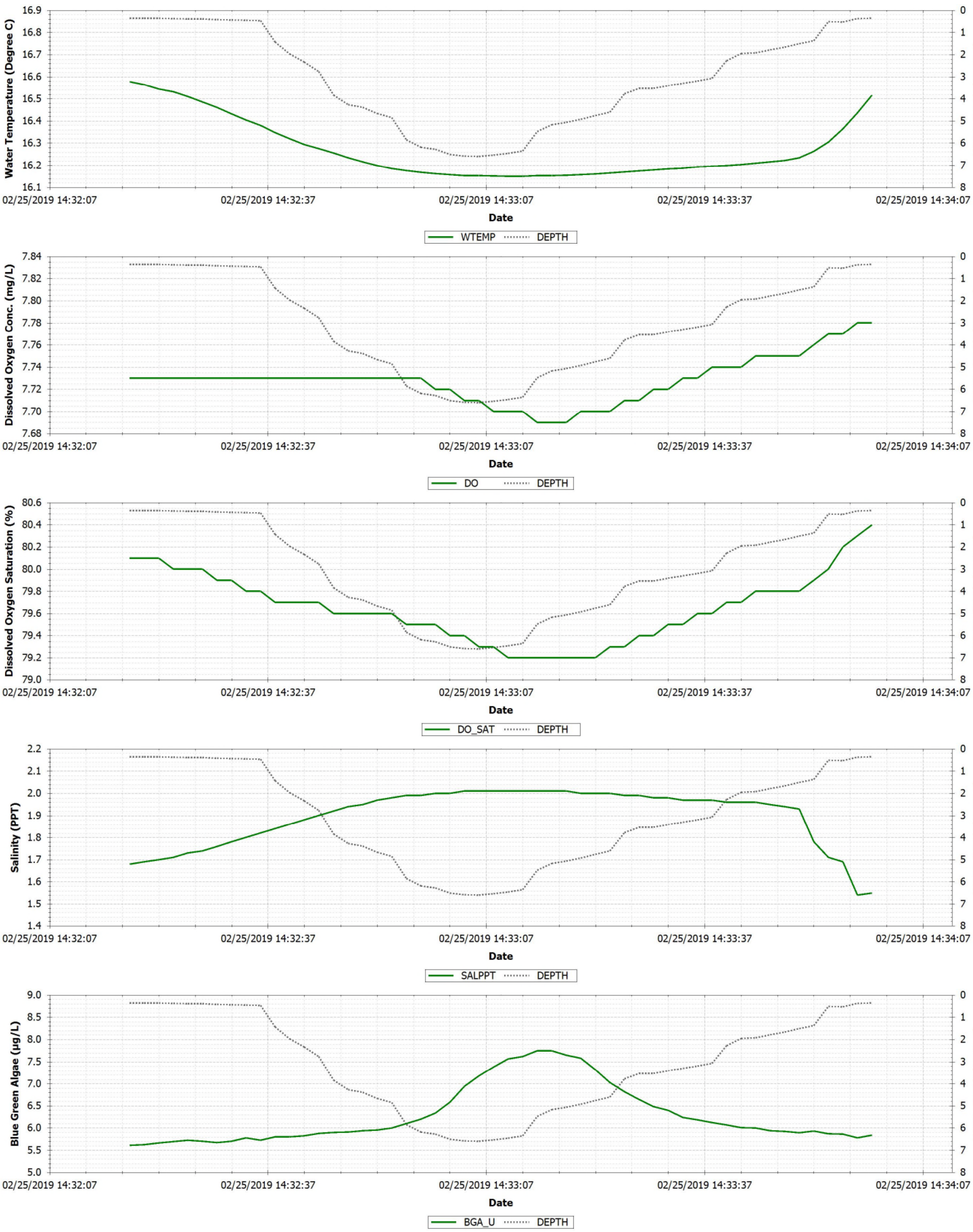


Figure C-60 Back River February 25, 2019 southeast buoy flood tide stationary profile observations (LBR_022519_003)

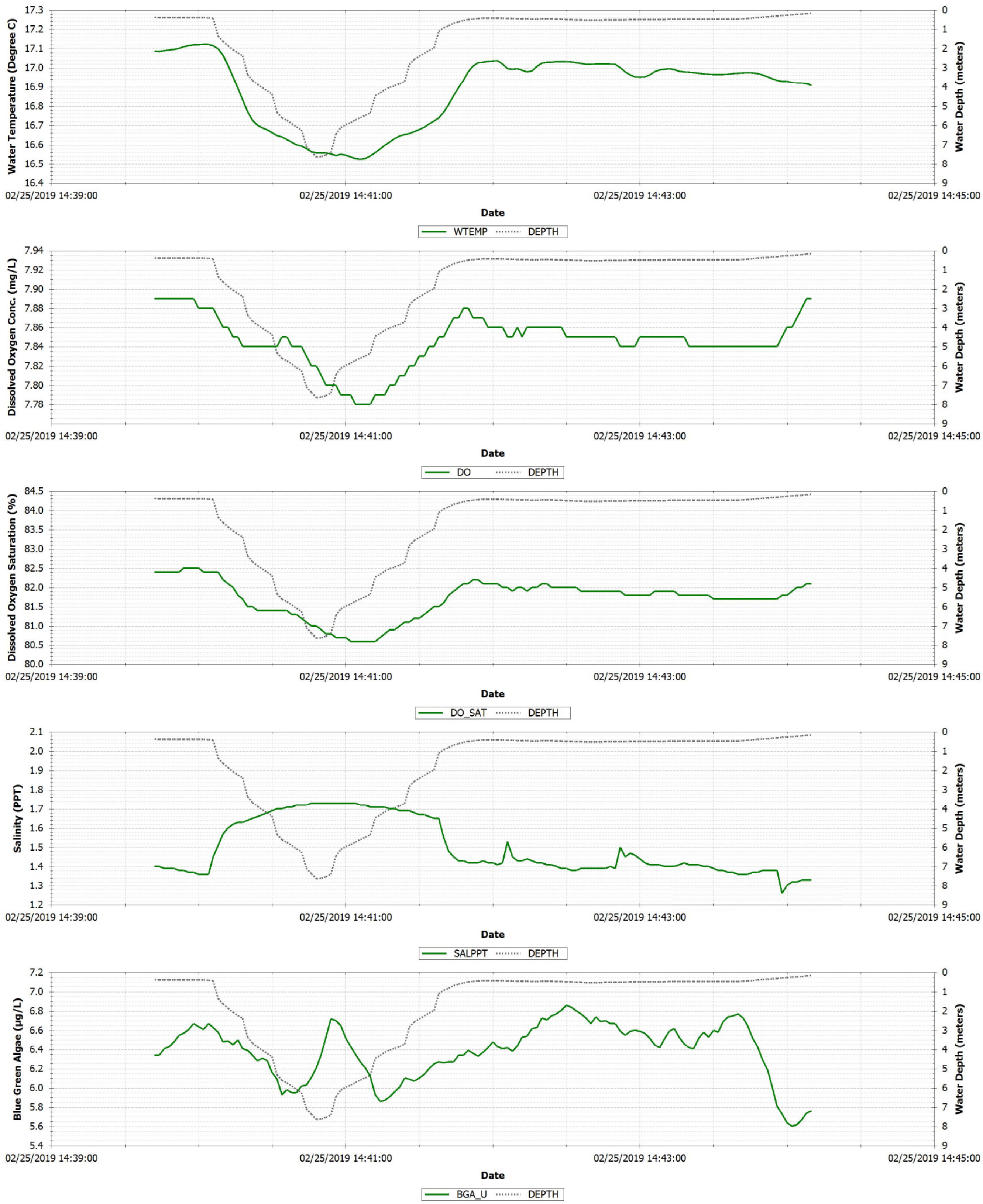


Figure C-61 Back River February 25, 2019 southwest buoy flood tide stationary profile observations (LBR_022519_004)

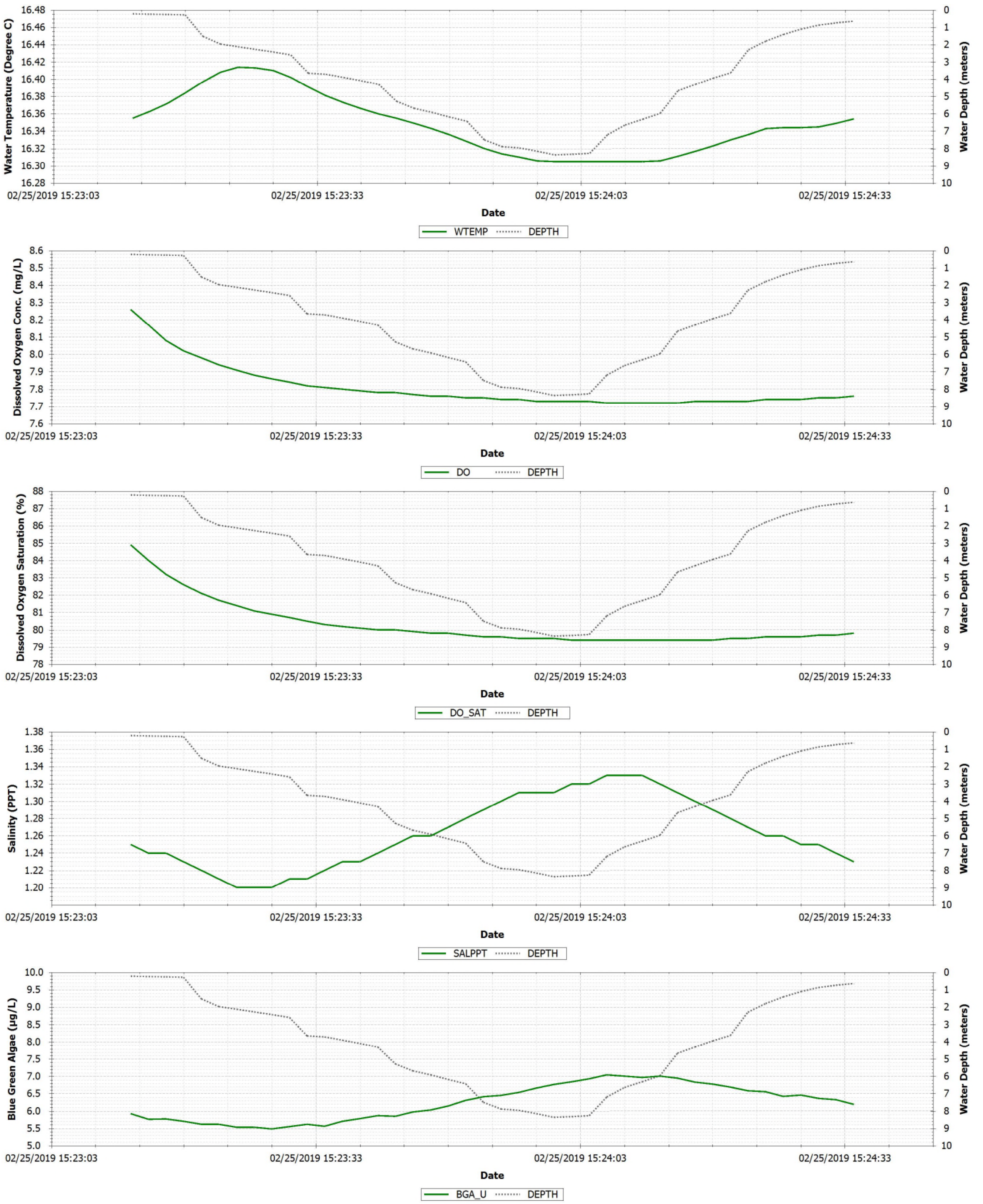


Figure C-62 Back River February 25, 2019 east platform flood tide stationary profile observations (LBR_022519_007)

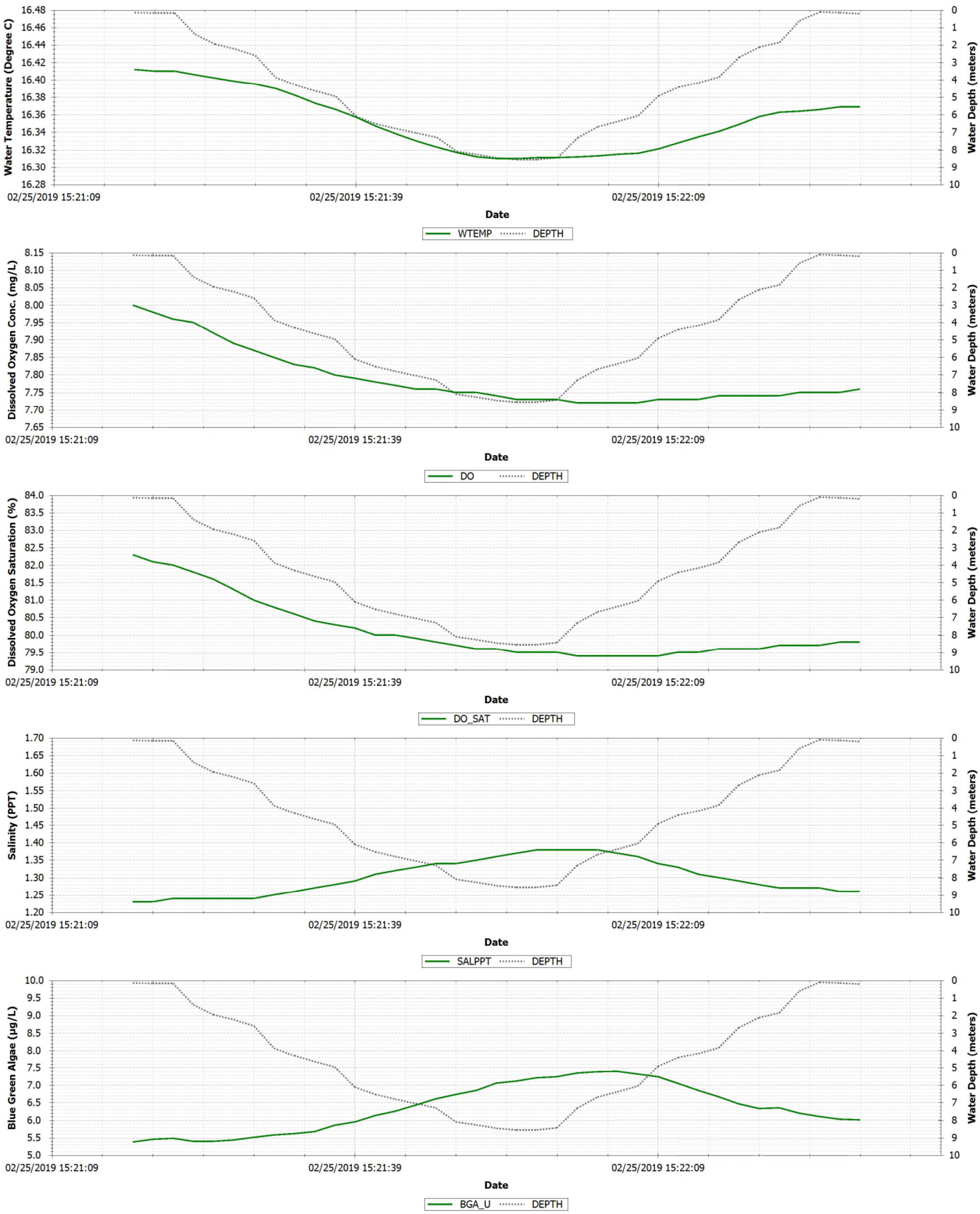


Figure C-63 Back River February 25, 2019 west platform flood tide stationary profile observations (LBR_022519_008)

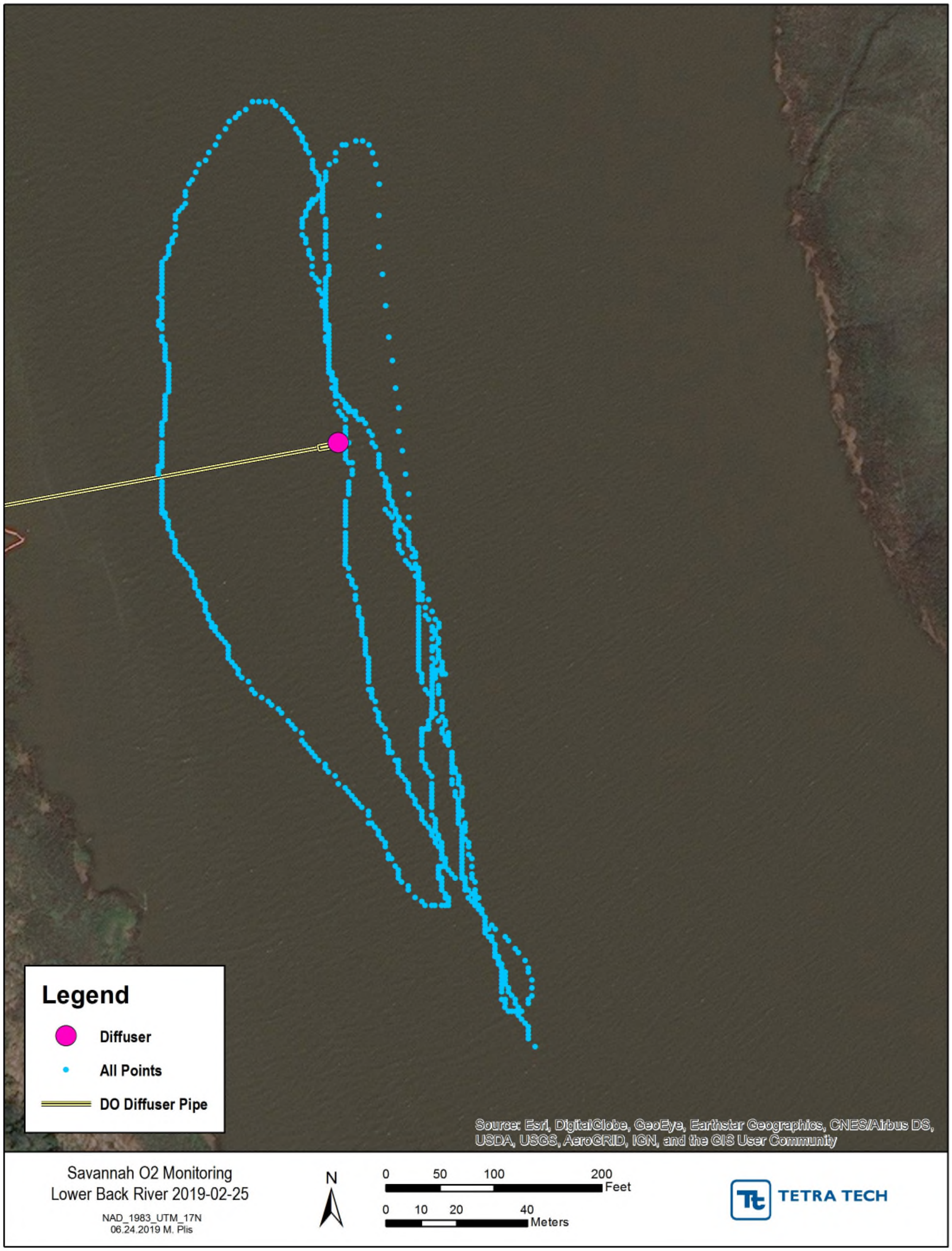


Figure C-64 Back River February 25, 2019 flood tide traveling profile period 1 location map (LBR_022519_006)

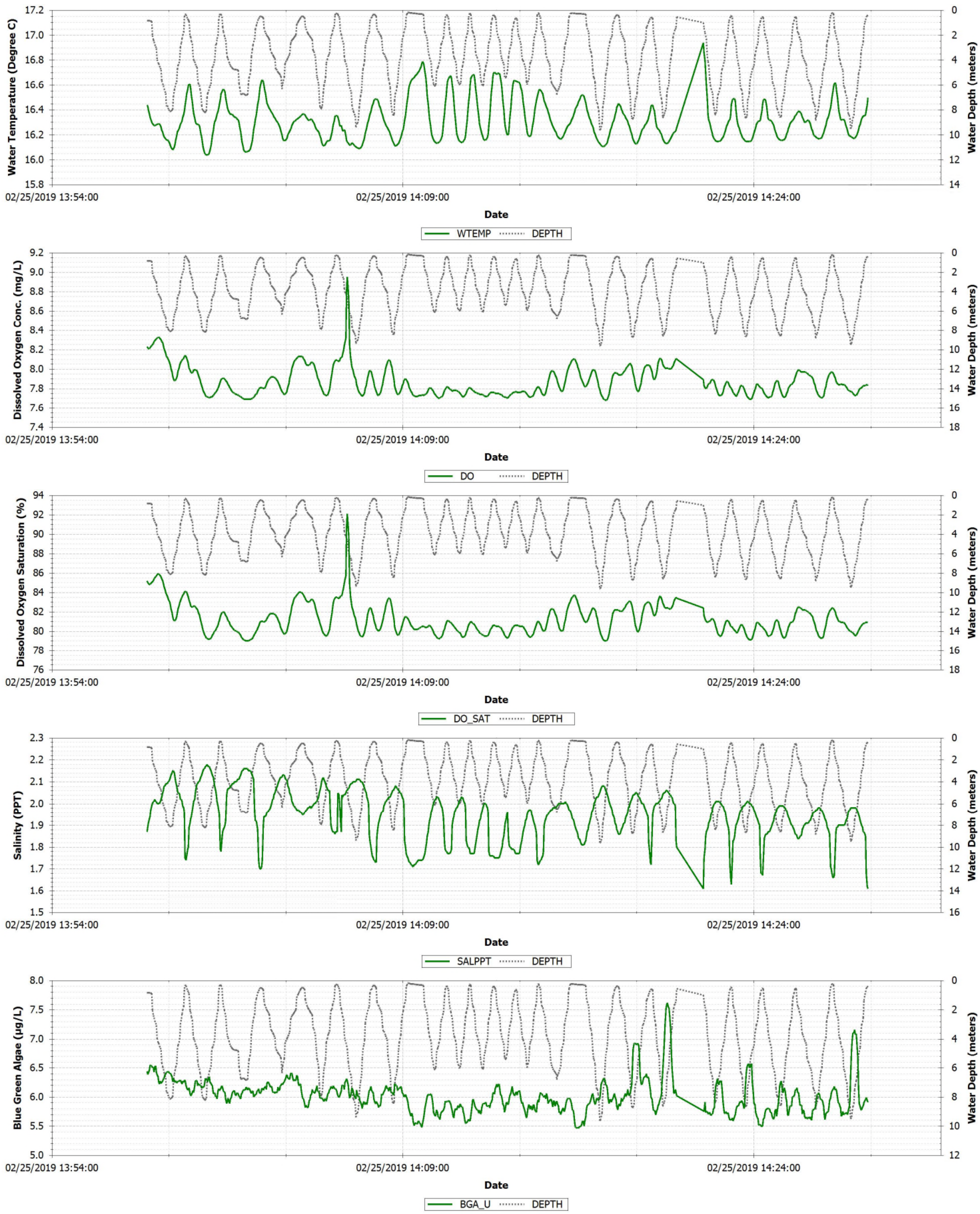


Figure C-65 Back River February 25, 2019 flood tide traveling profile period 1 observations (LBR_022519_006)

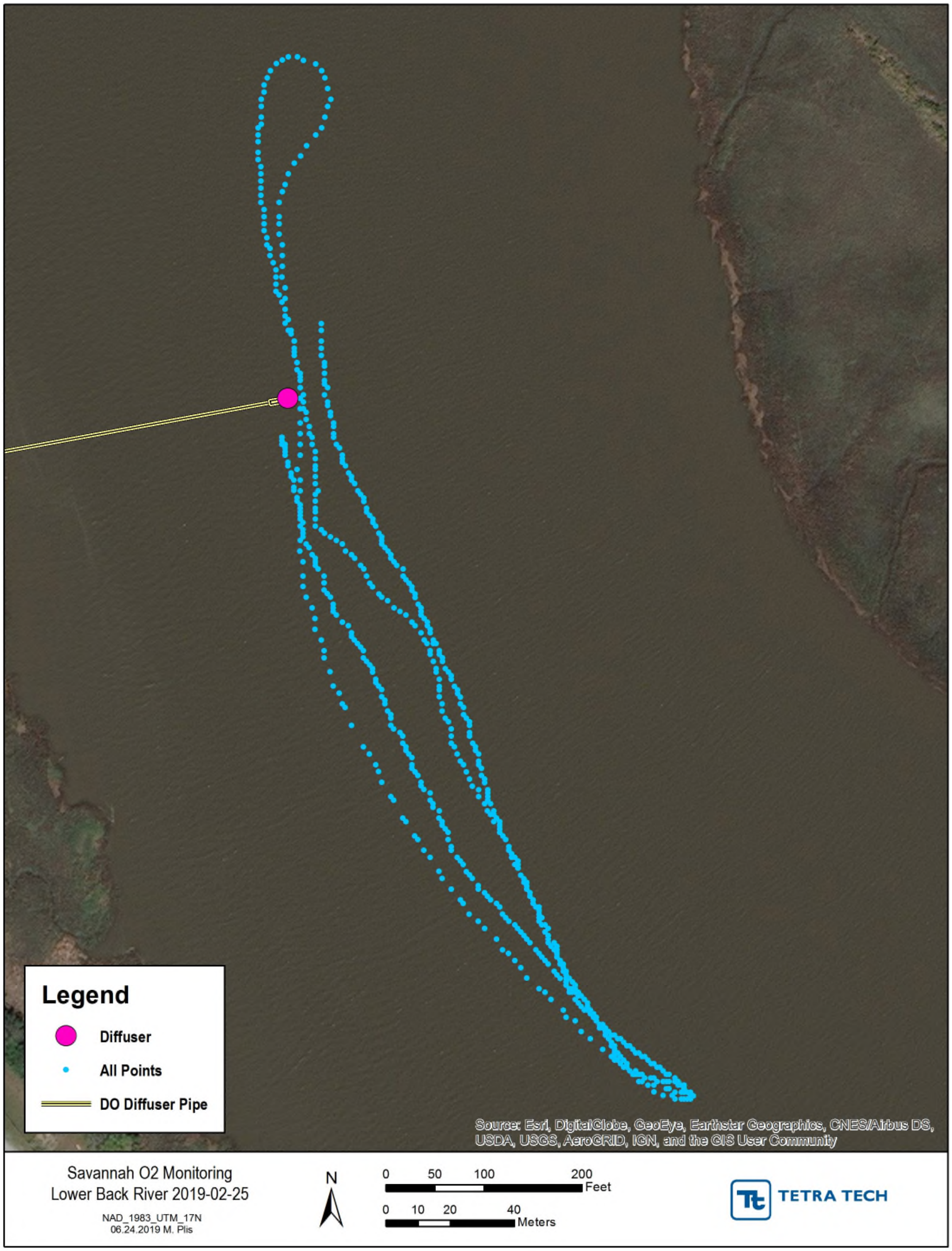


Figure C-66 Back River February 25, 2019 flood tide traveling profile period 2 location map (LBR_022519_005)

Figure C-67 Back River February 25, 2019 flood tide traveling profile period 2 observations (LBR_022519_005)

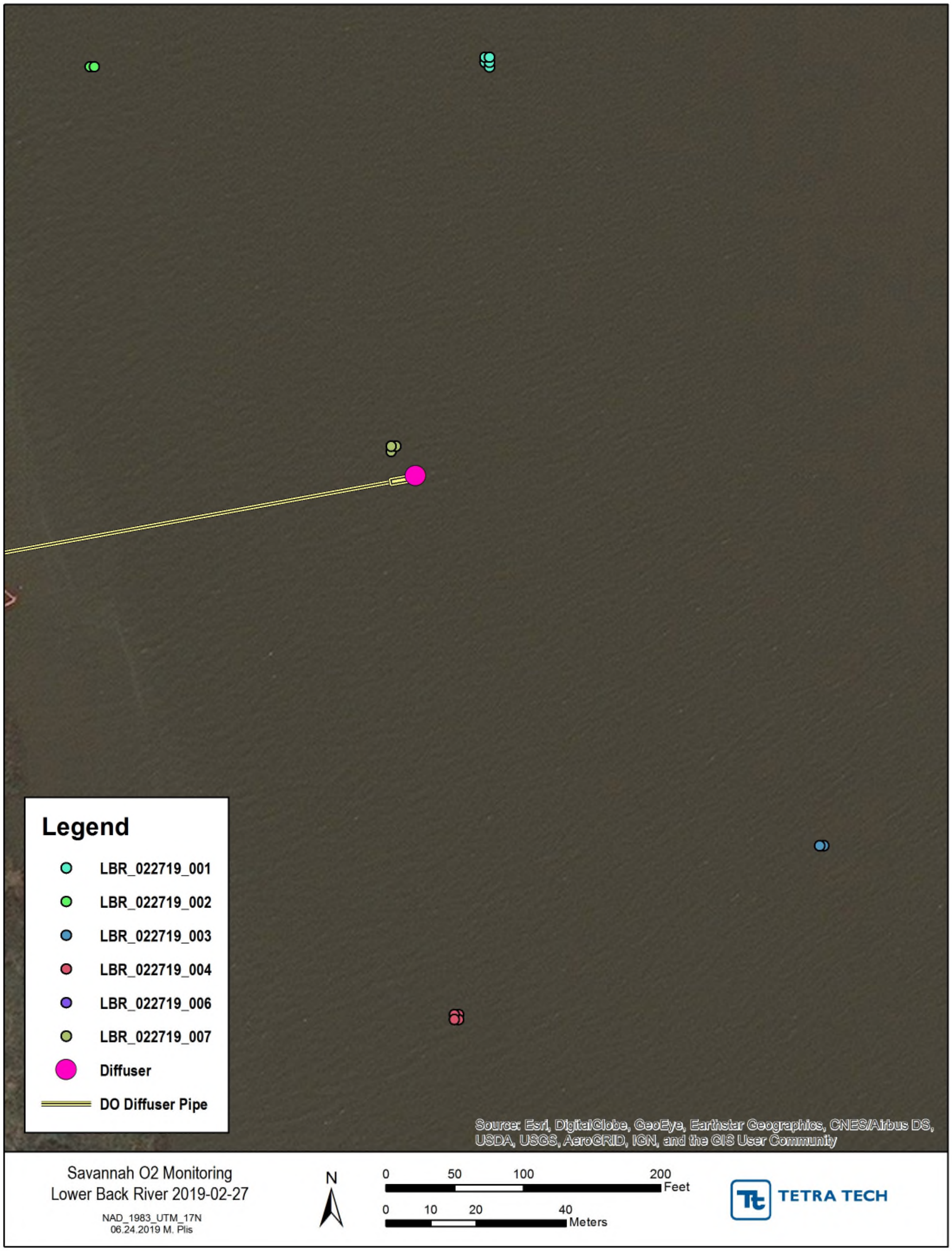


Figure C-68 Back River February 27, 2019 stationary profiles location map

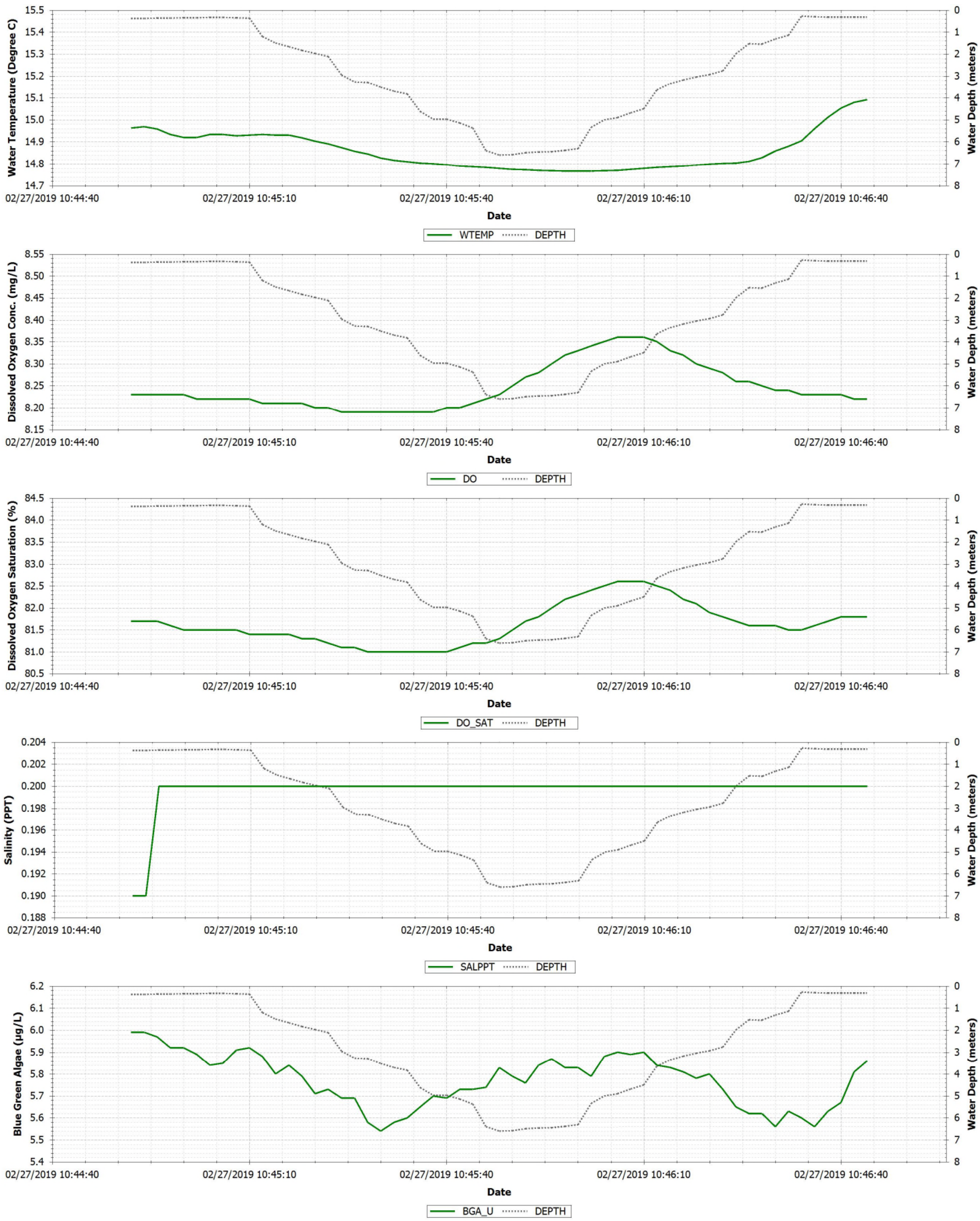


Figure C-69 Back River February 27, 2019 northeast buoy ebb tide stationary profile observations (LBR_022719_001)

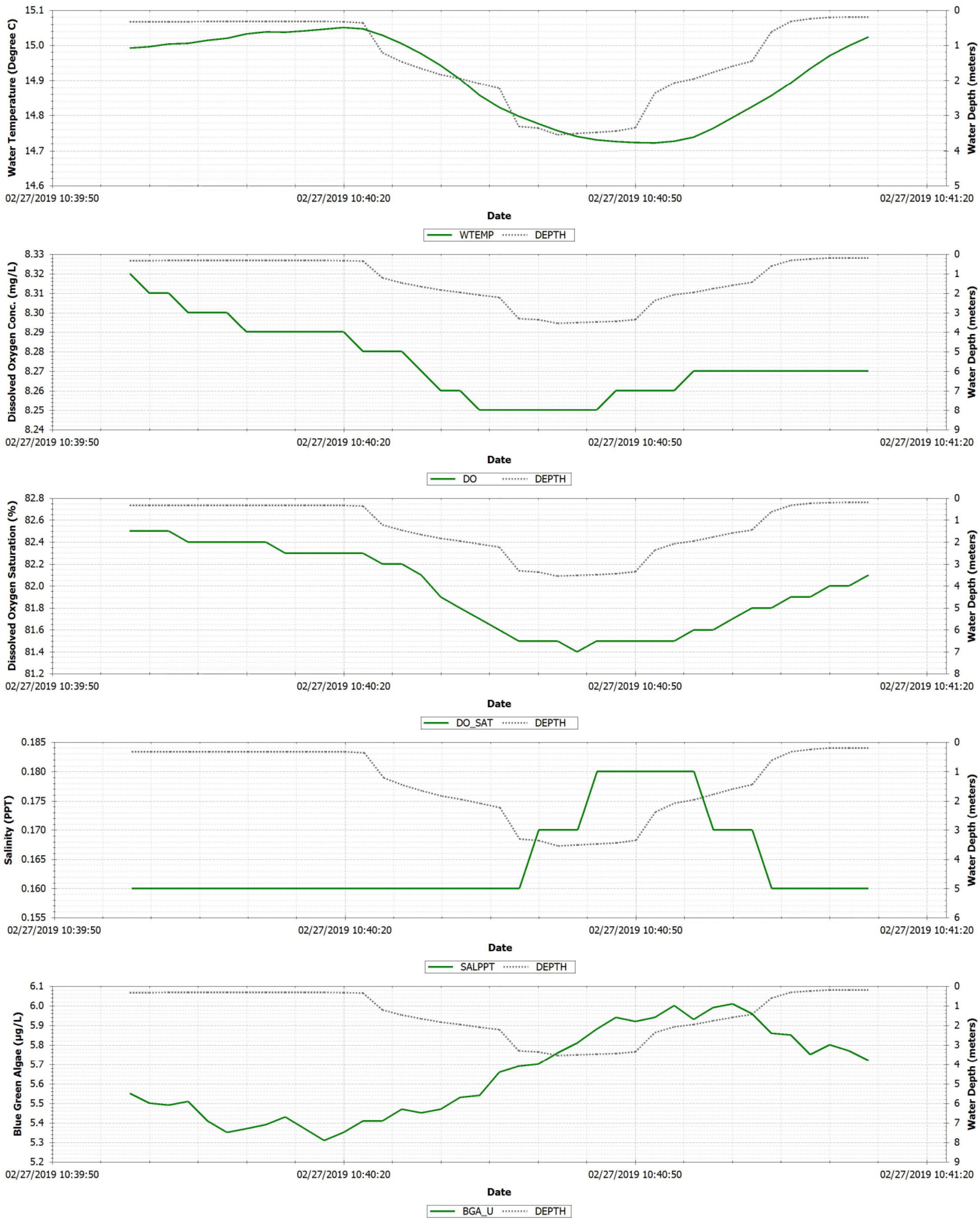


Figure C-70 Back River February 27, 2019 northwest buoy ebb tide stationary profile observations (LBR_022719_002)

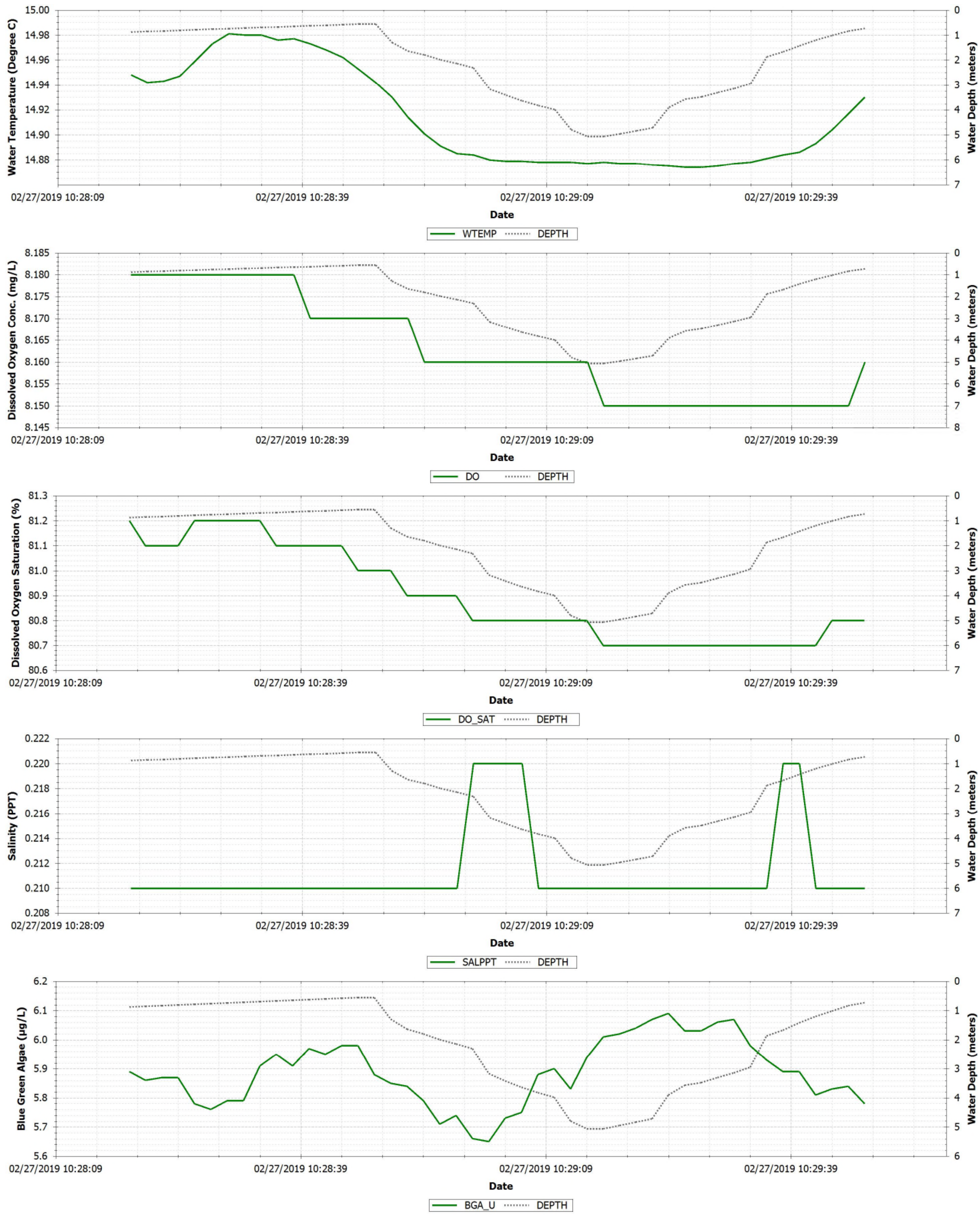


Figure C-71 Back River February 27, 2019 southeast buoy ebb tide stationary profile observations (LBR_022719_003)

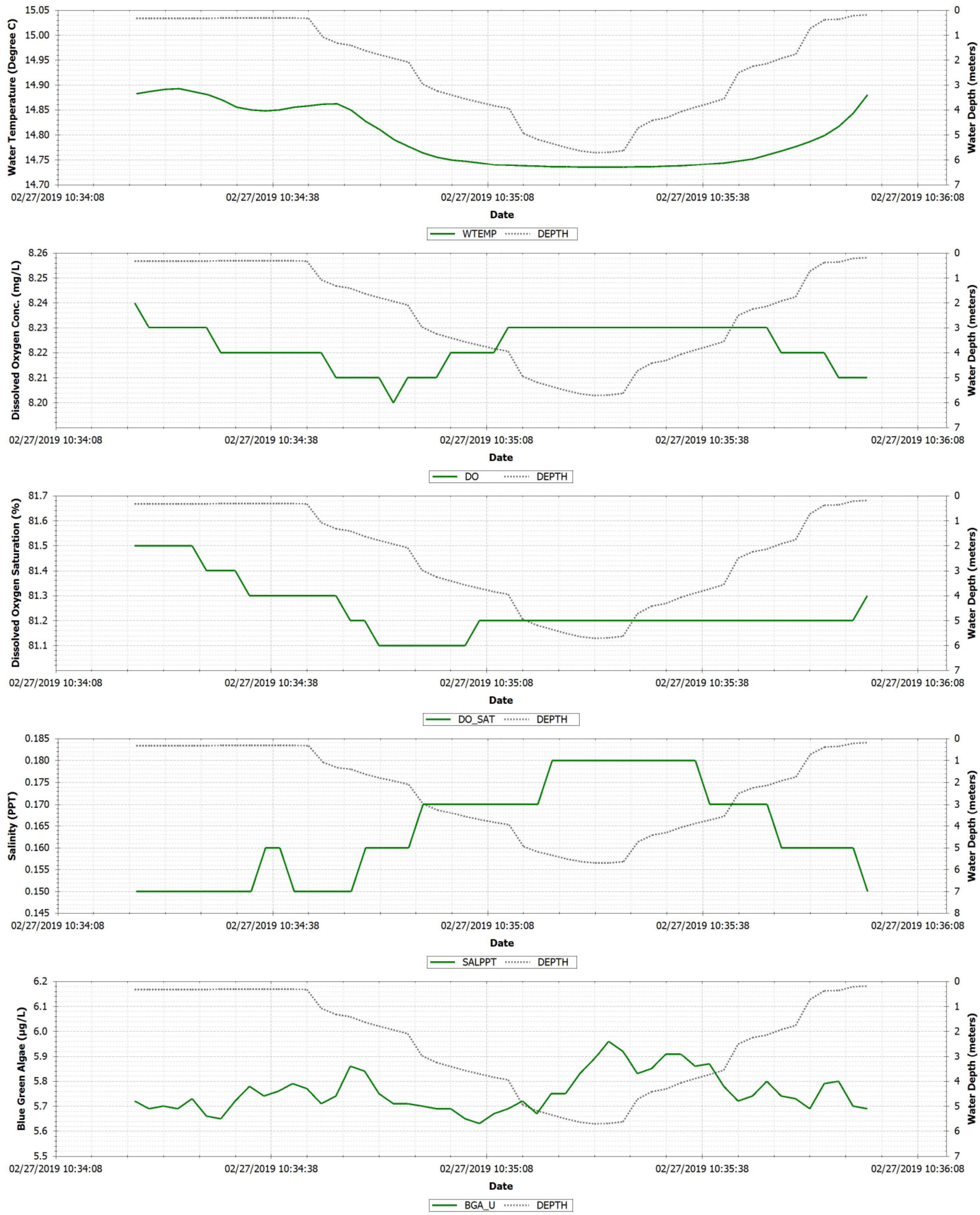


Figure C-72 Back River February 27, 2019 southwest buoy ebb tide stationary profile observations (LBR_022719_004)

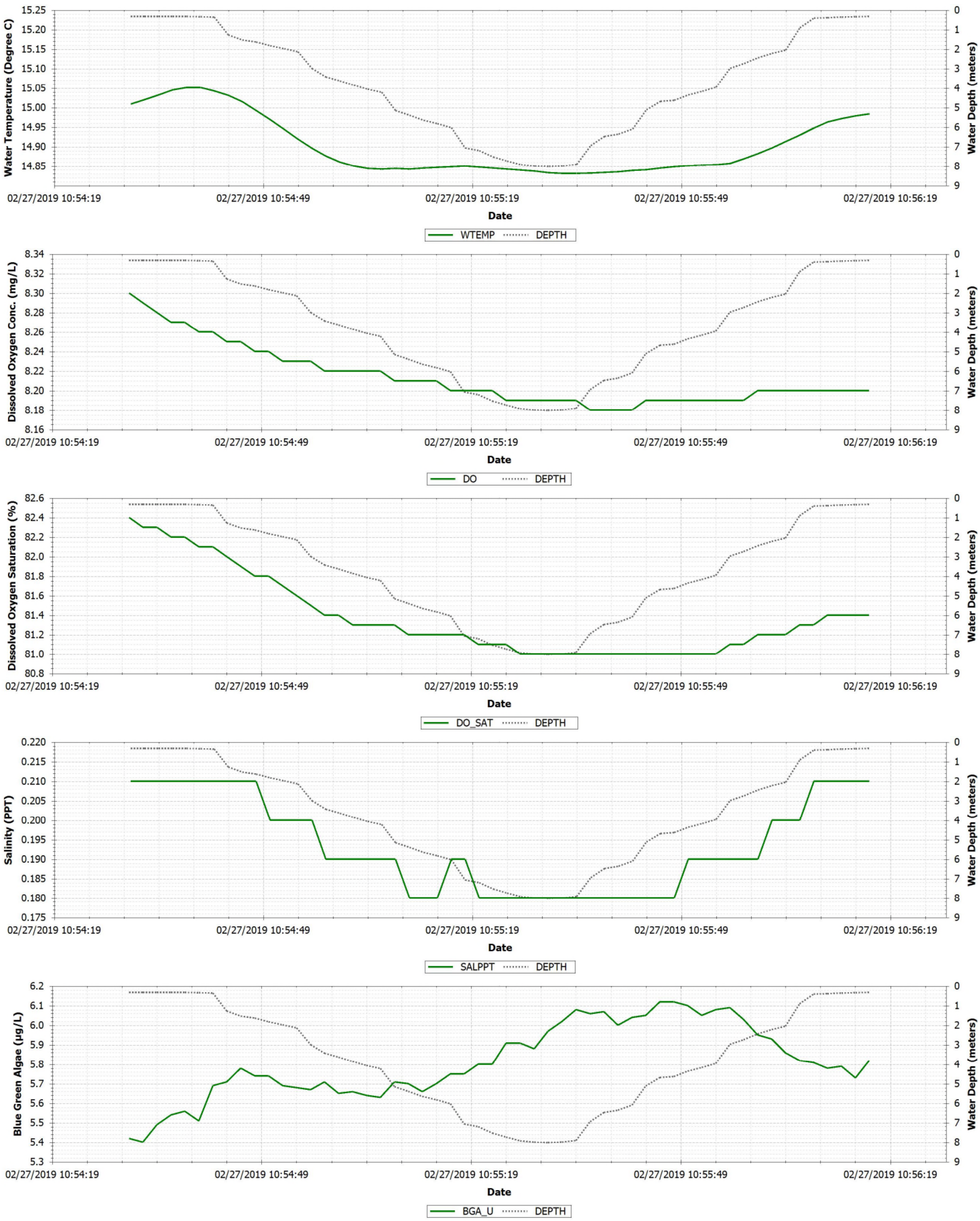


Figure C-73 Back River February 27, 2019 east platform ebb tide stationary profile observations (LBR_022719_006)

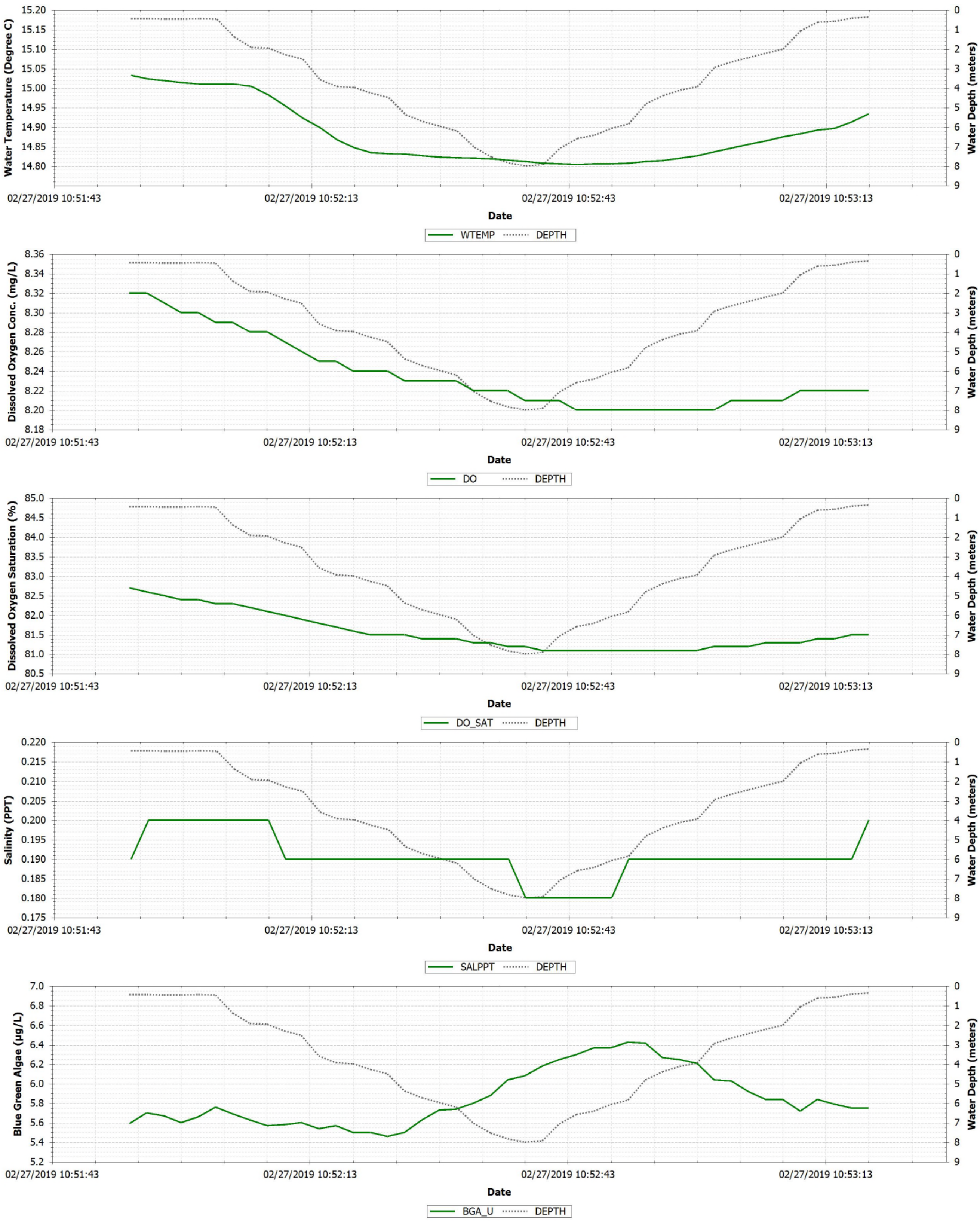


Figure C-74 Back River February 27, 2019 west platform ebb tide stationary profile observations (LBR_022719_007)

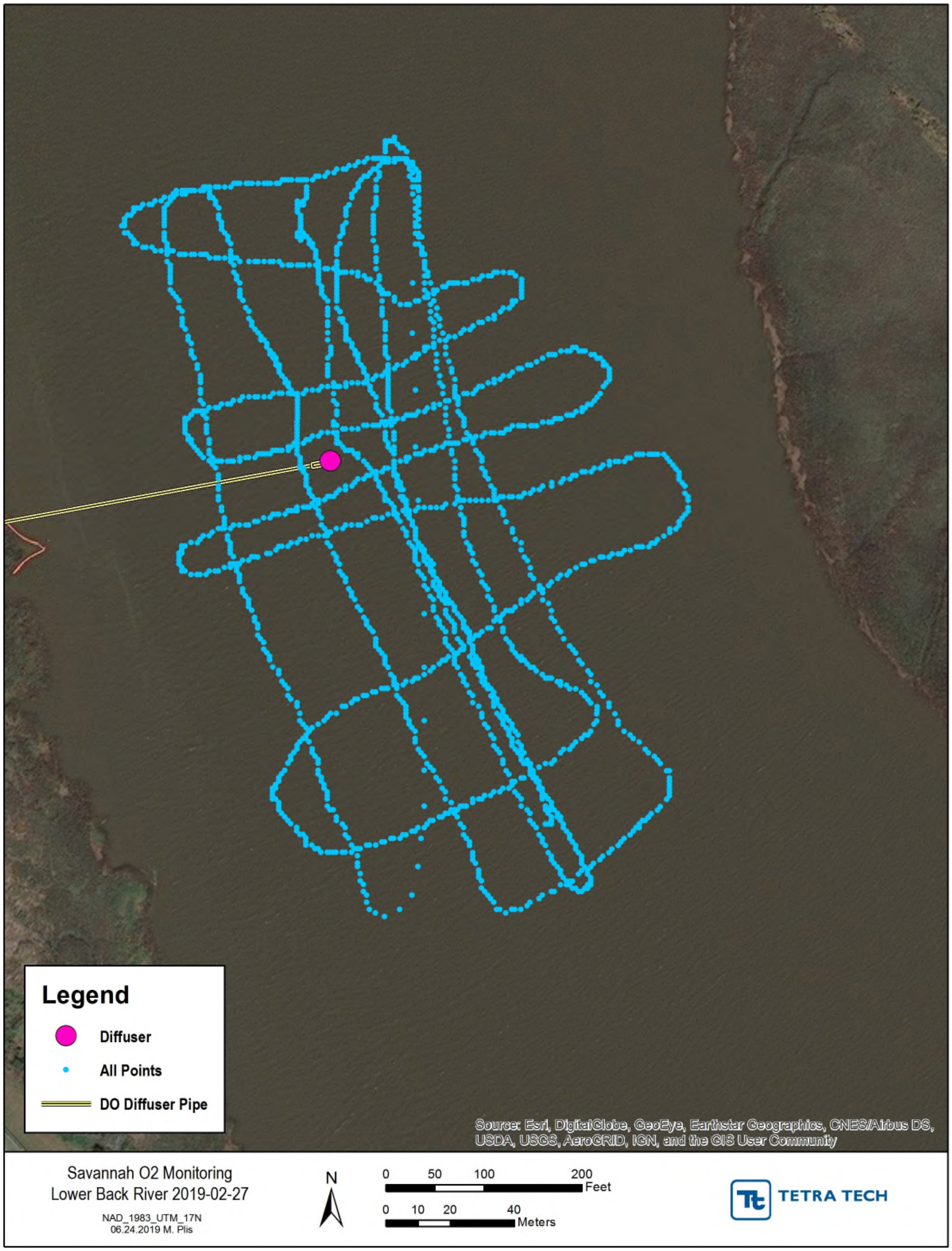


Figure C-75 Back River February 27, 2019 ebb tide traveling profile location map (LBR_022719_005)

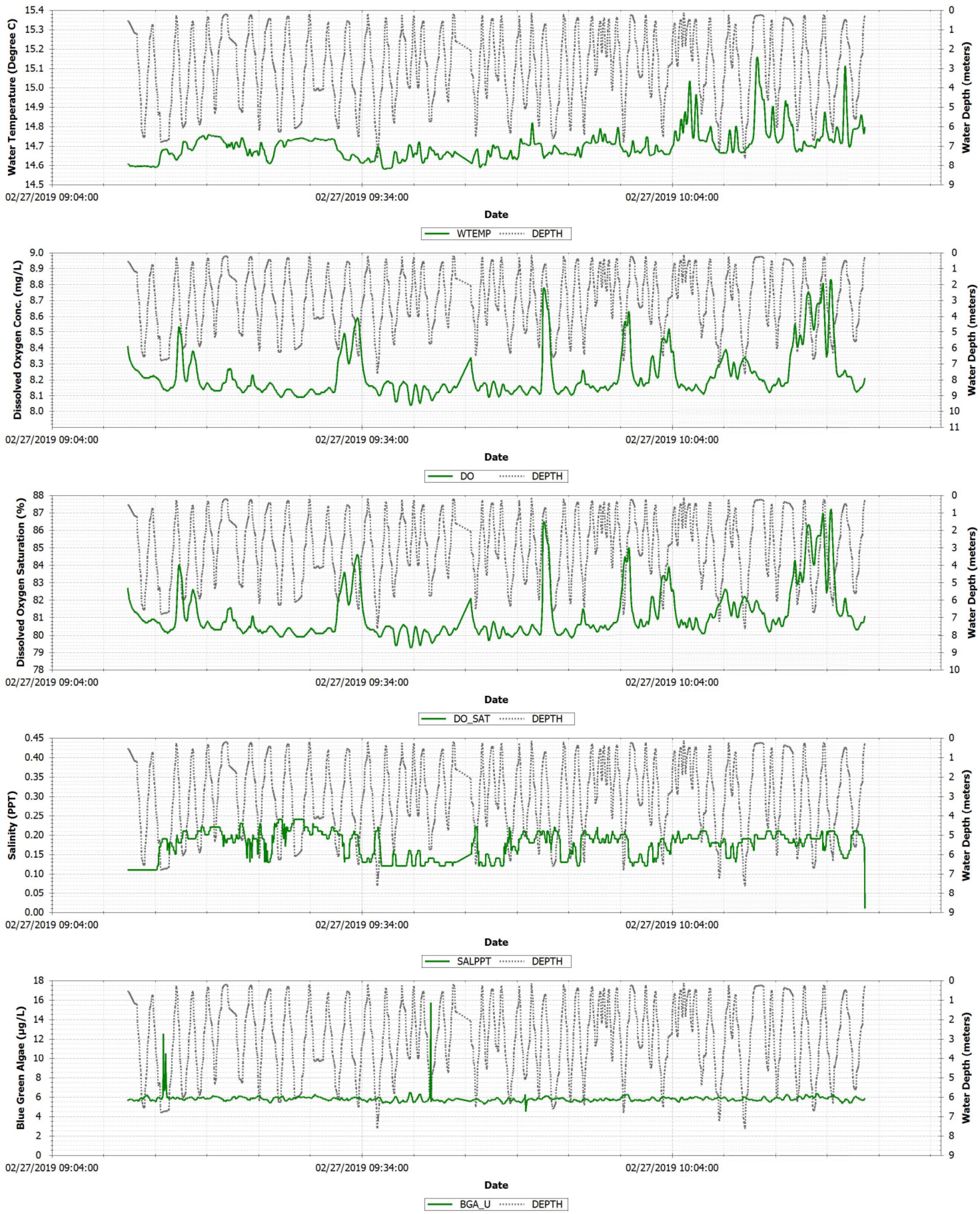


Figure C-76 Back River February 27, 2019 ebb tide traveling profile observations (LBR_022719_005)

C.2 FRONT RIVER

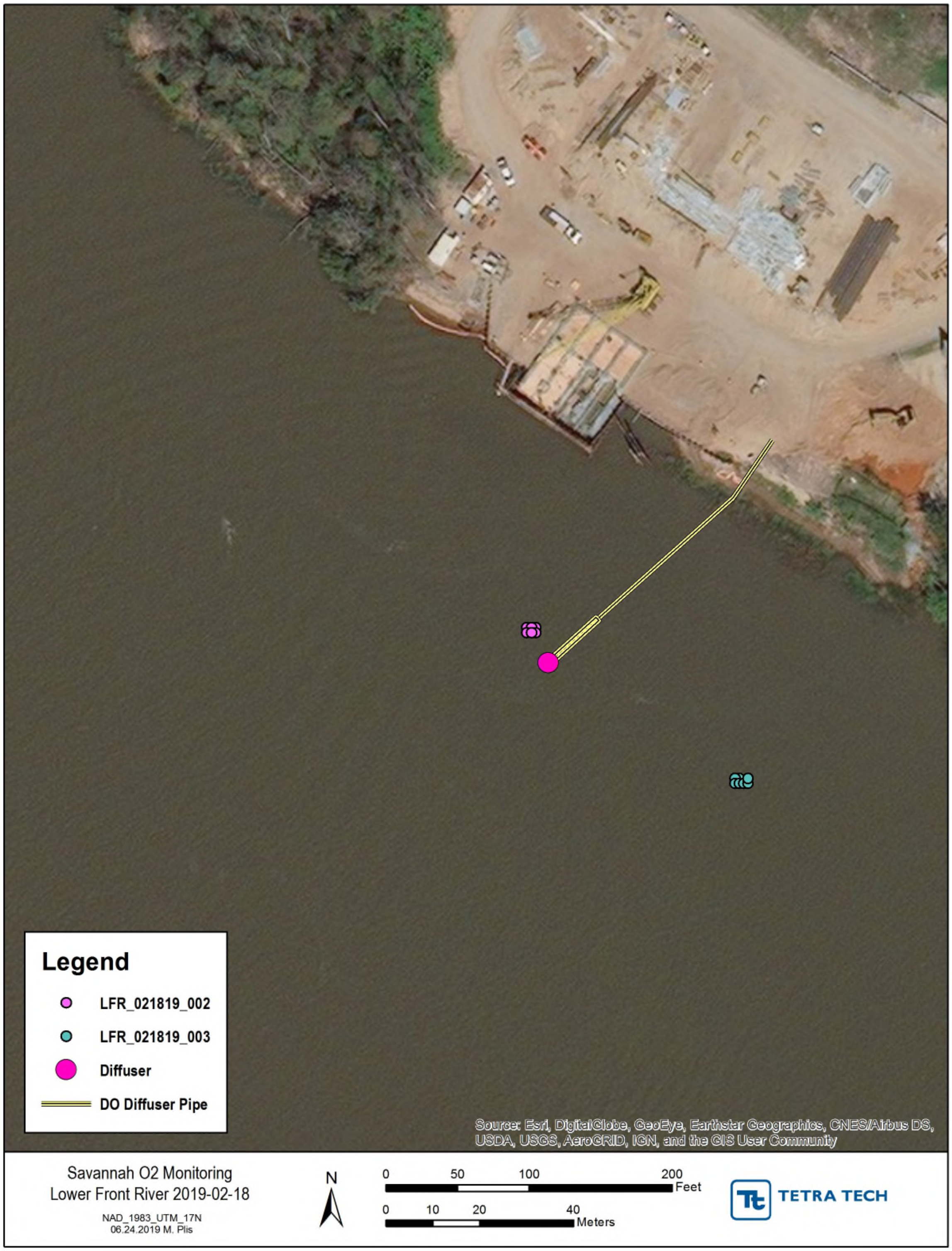


Figure C-77 Front River February 18, 2019 stationary profiles location map

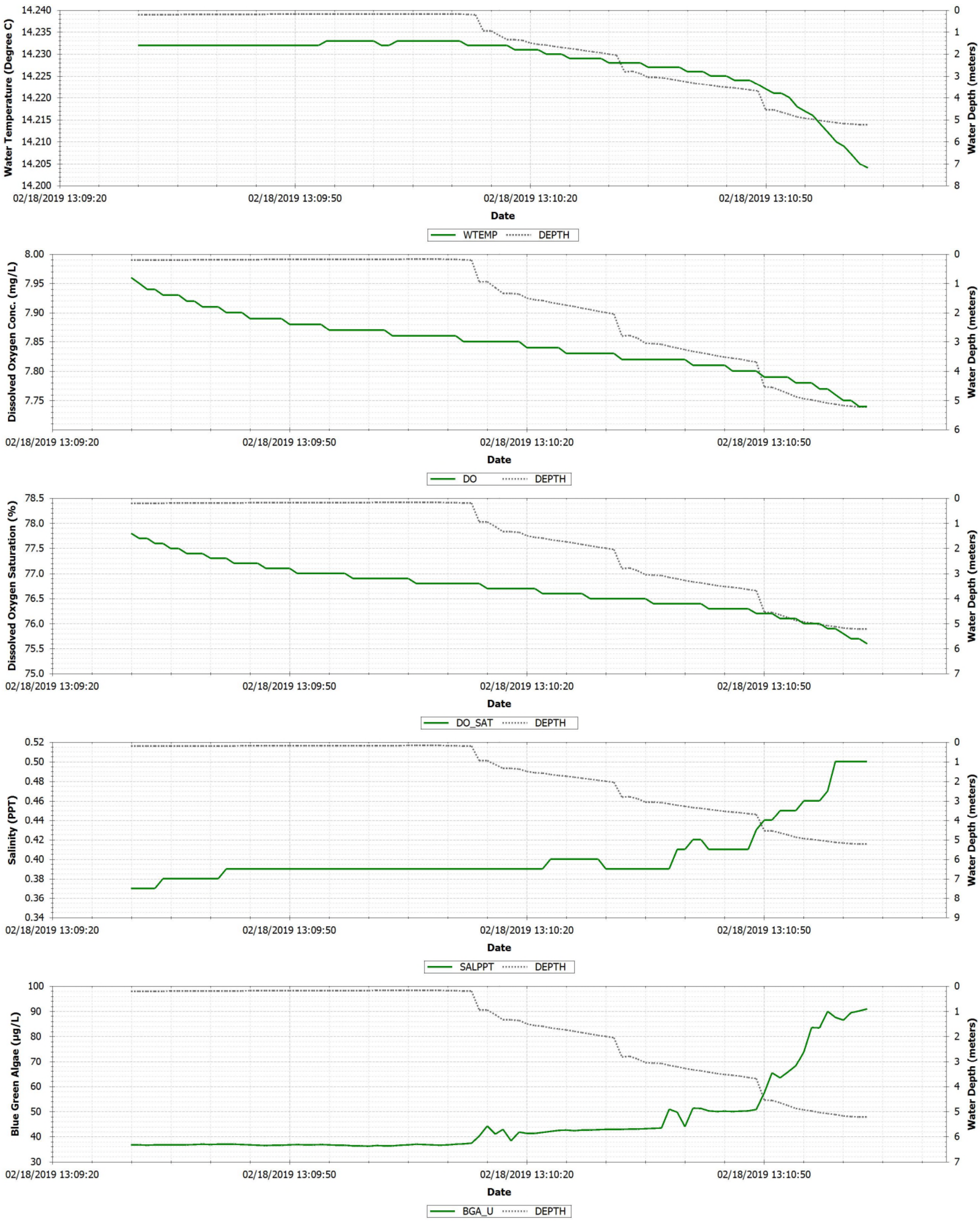


Figure C-78 Front River February 18, 2019 north buoy outgoing tide stationary profile observations (LFR_021819_002)

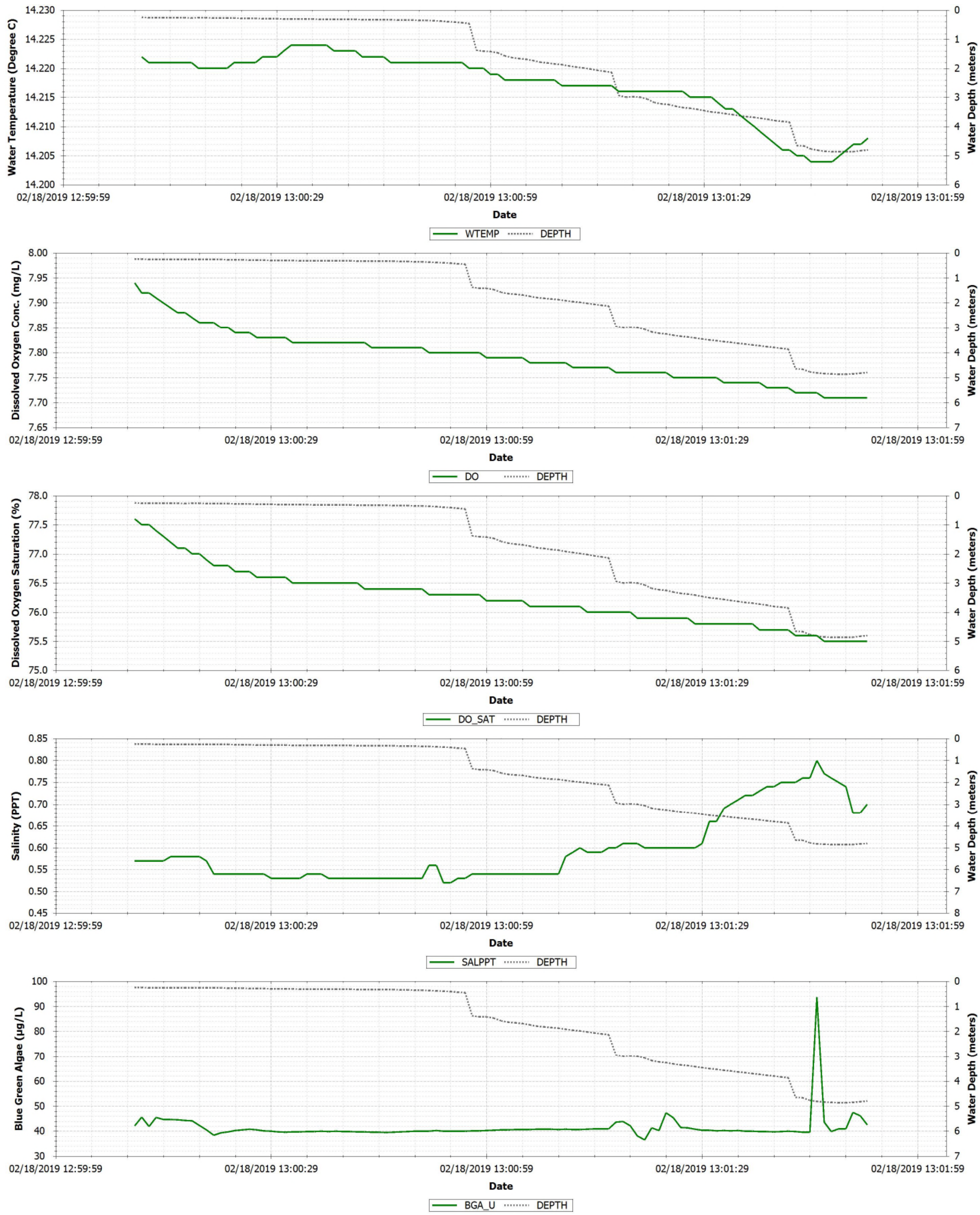


Figure C-79 Front River February 18, 2019 south buoy outgoing tide stationary profile observations (LFR_021819_003)

Figure C-80 Front River February 18, 2019 outgoing tide traveling profile period 1 location map (LFR_021819_004)

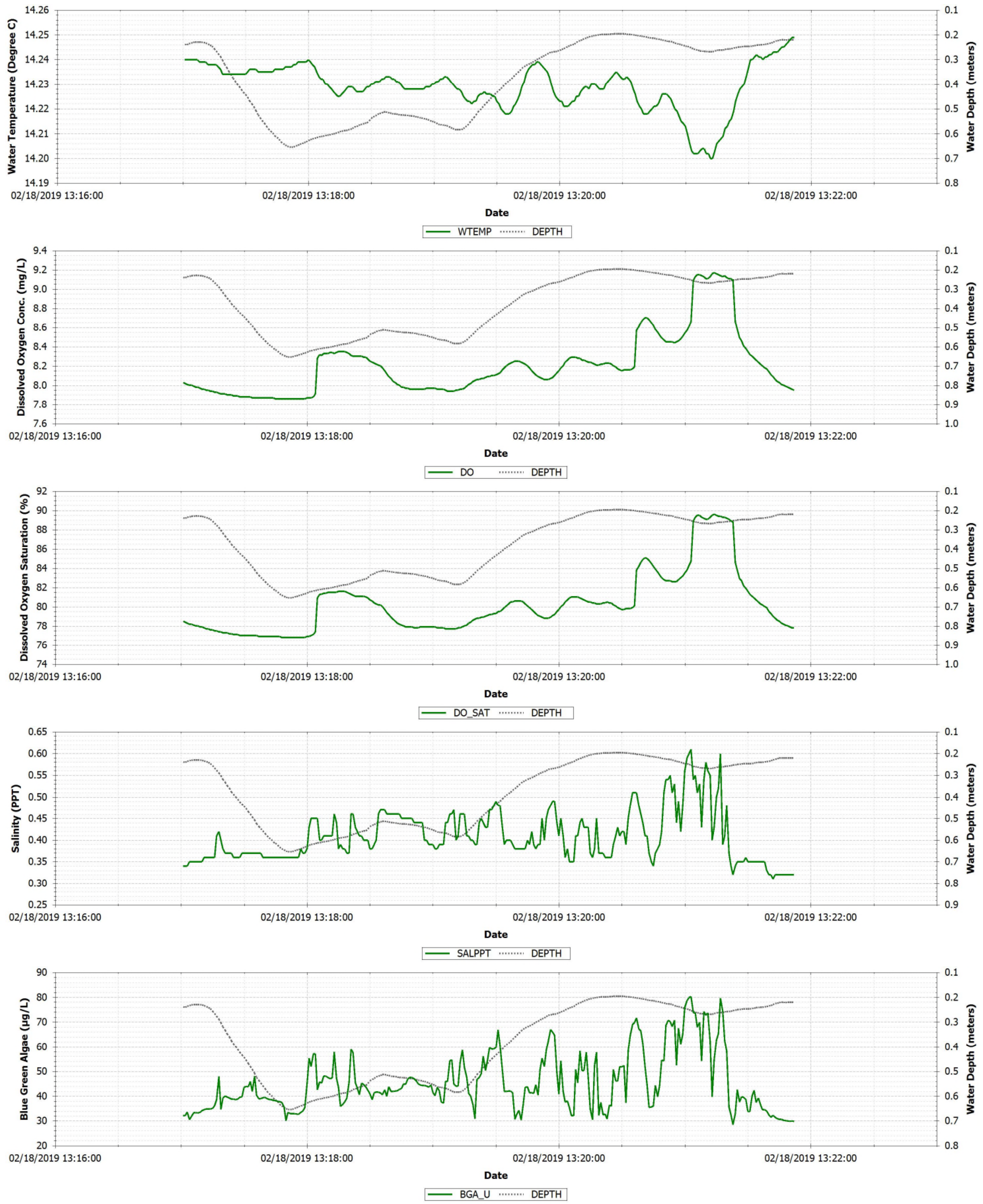


Figure C-81 Front River February 18, 2019 outgoing tide traveling profile period 1 observations (LFR_021819_004)

Figure C-82 Front River February 18, 2019 outgoing tide traveling profile period 2 location map (LFR_021819_001)

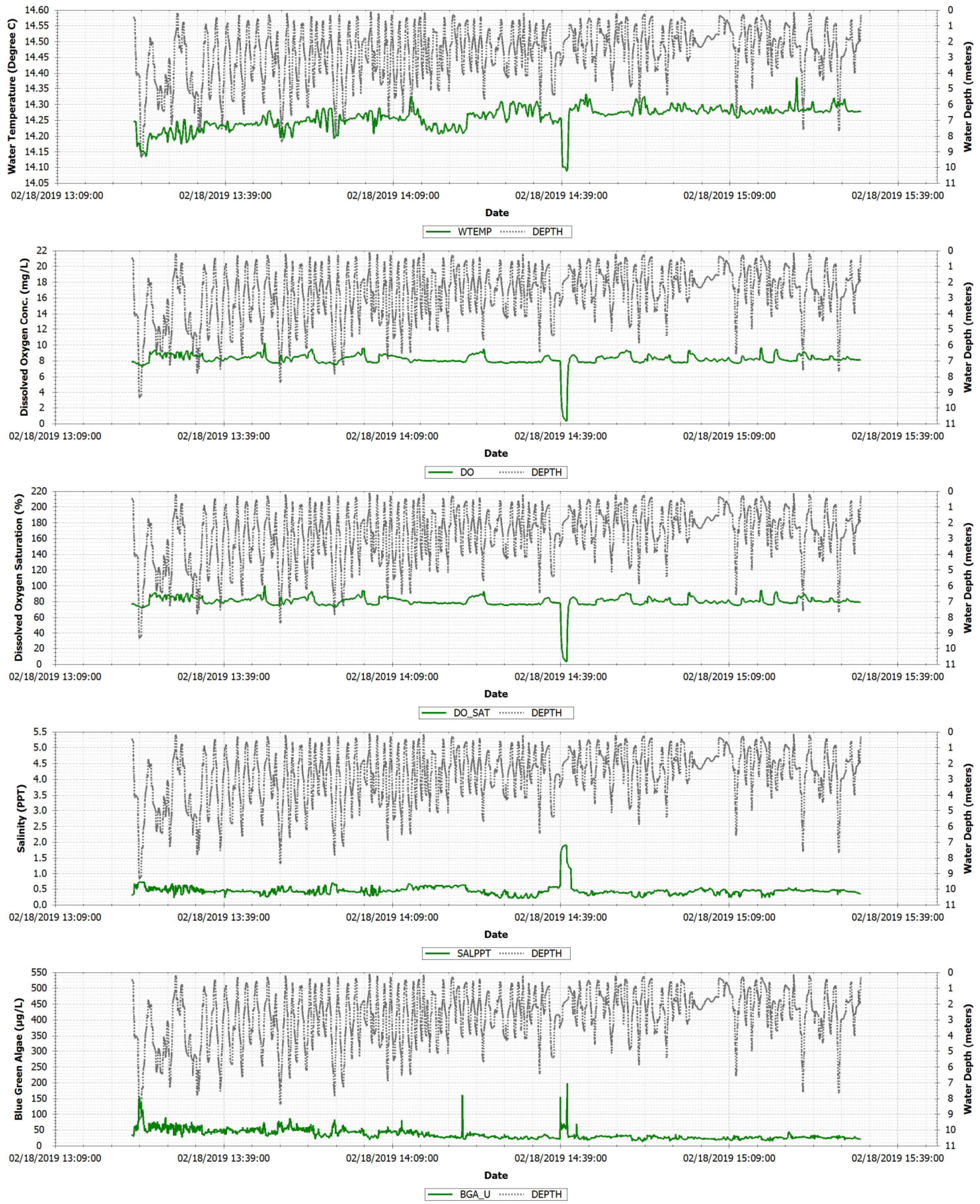


Figure C-83 Front River February 18, 2019 outgoing tide traveling profile period 2 observations (LFR_021819_001)

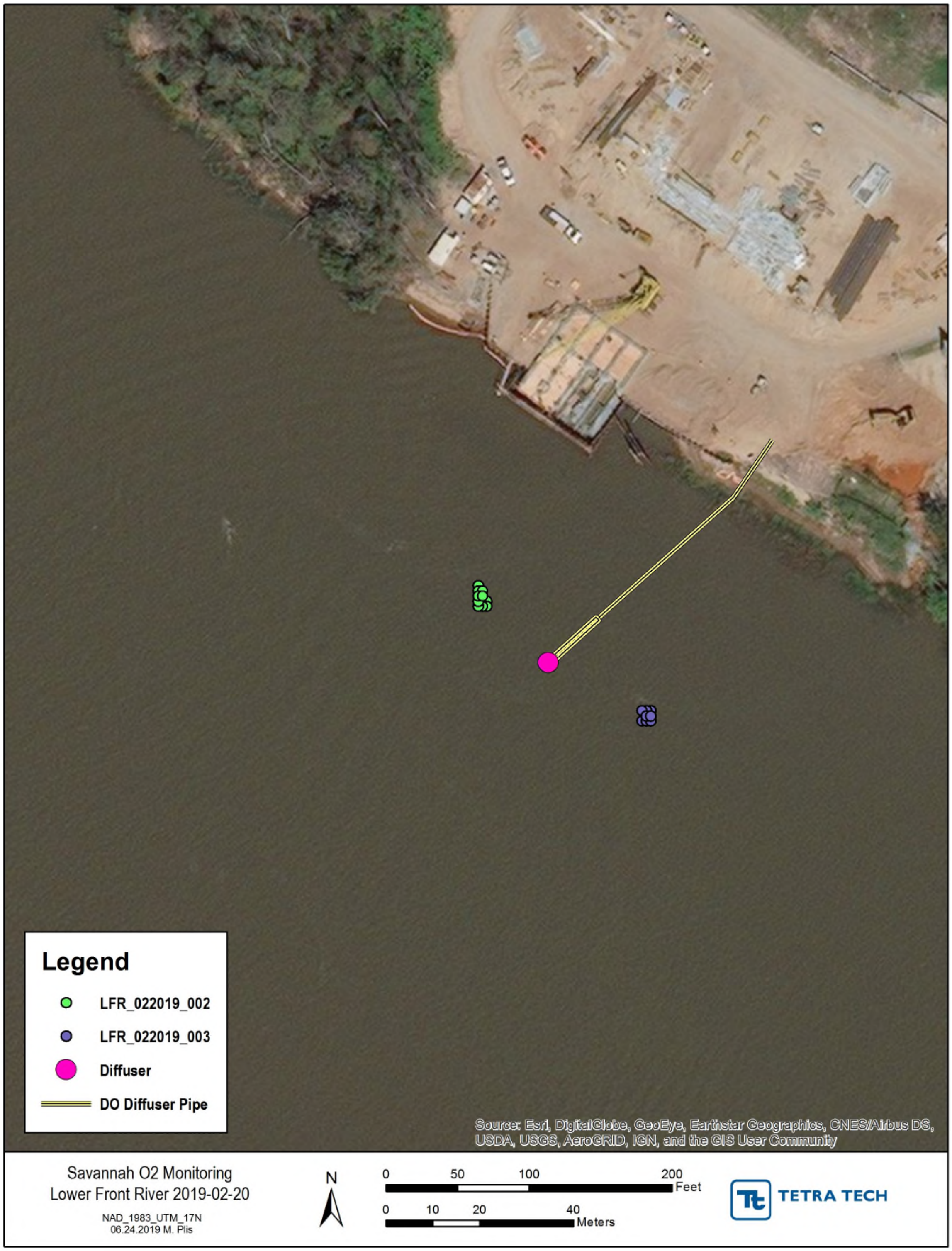


Figure C-84 Front River February 20, 2019 stationary profiles location map

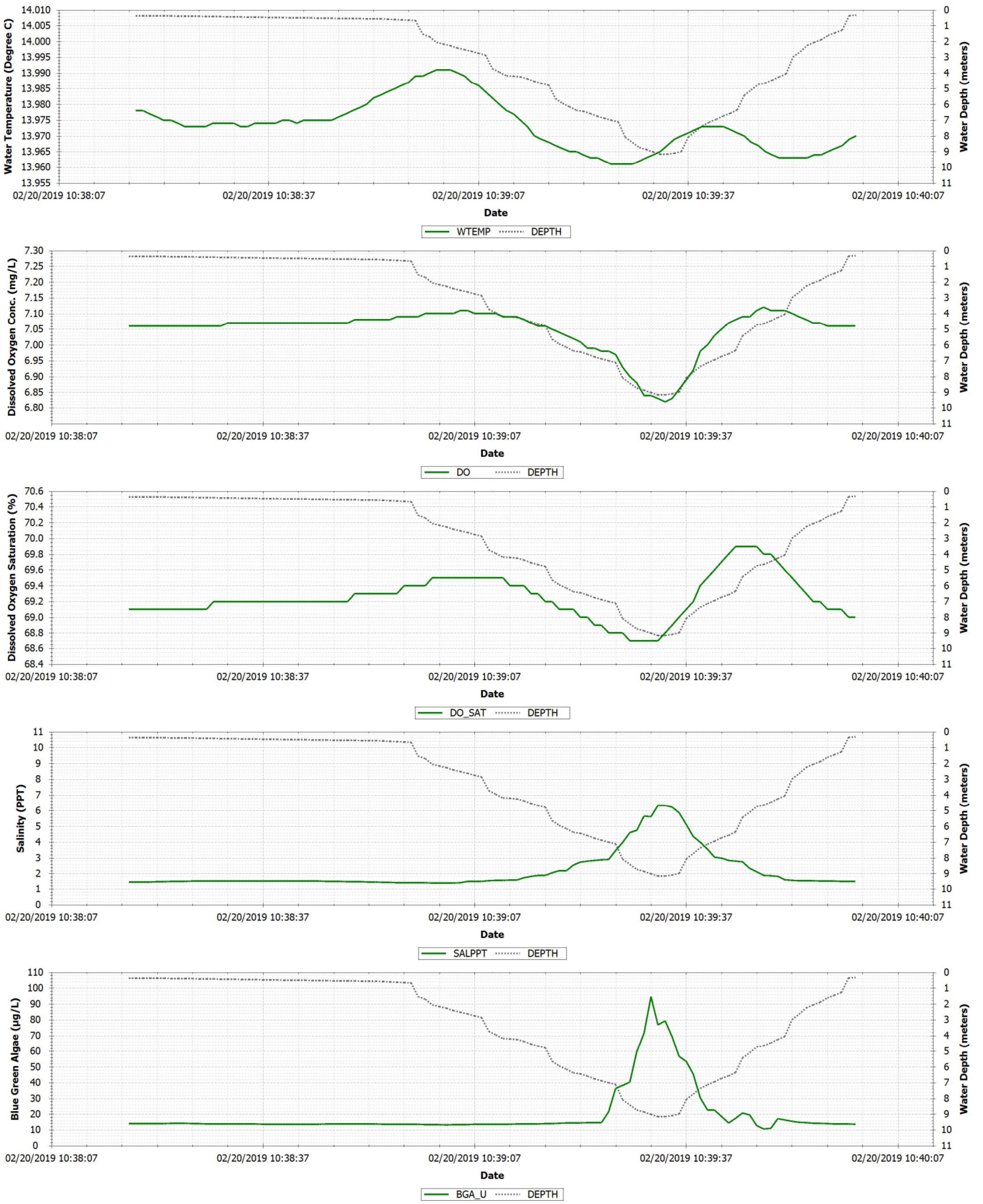


Figure C-85 Front River February 20, 2019 north buoy flood tide stationary profile observations (LFR_022019_002)

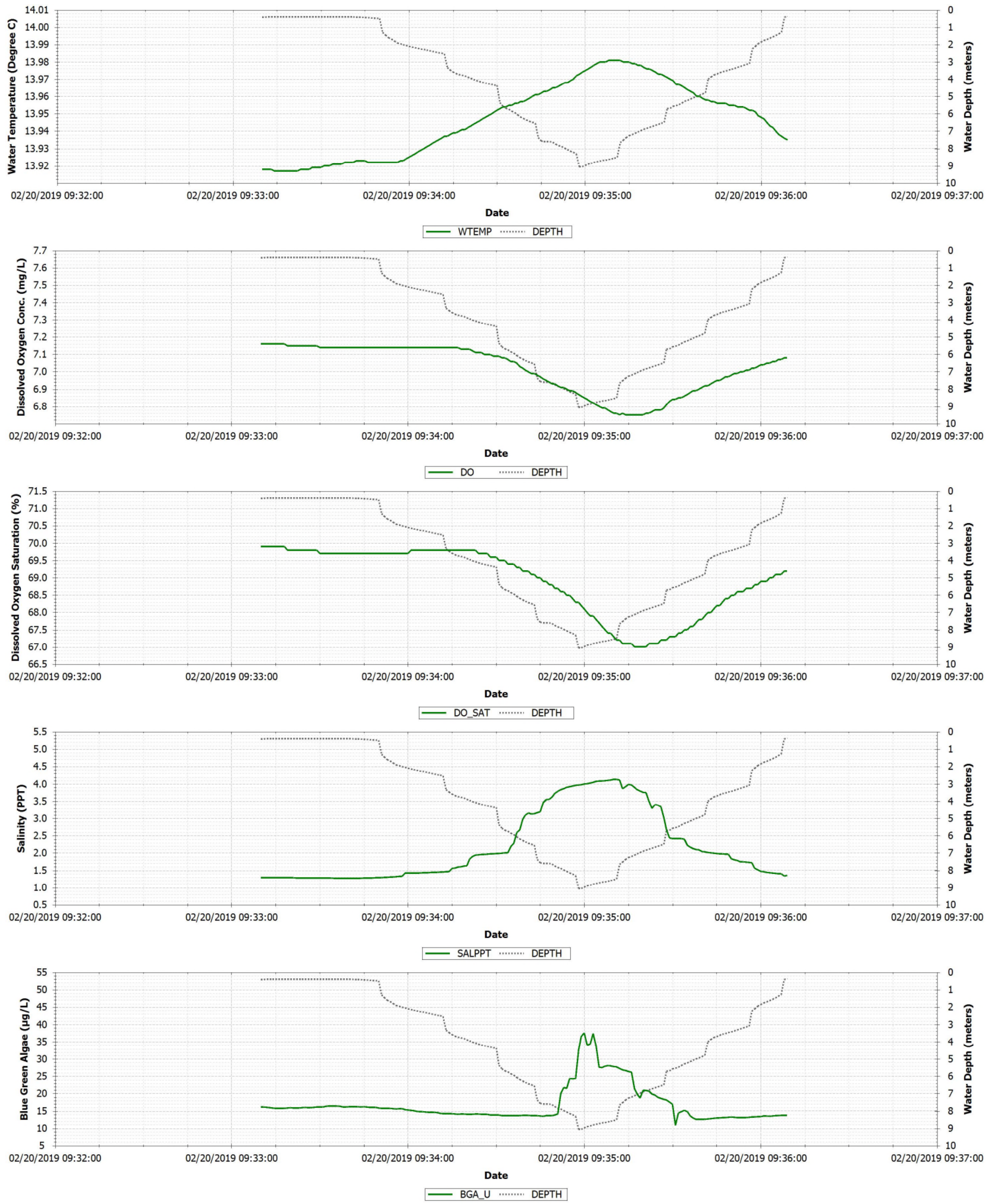


Figure C-86 Front River February 20, 2019 south buoy flood tide stationary profile observations (LFR_022019_003)

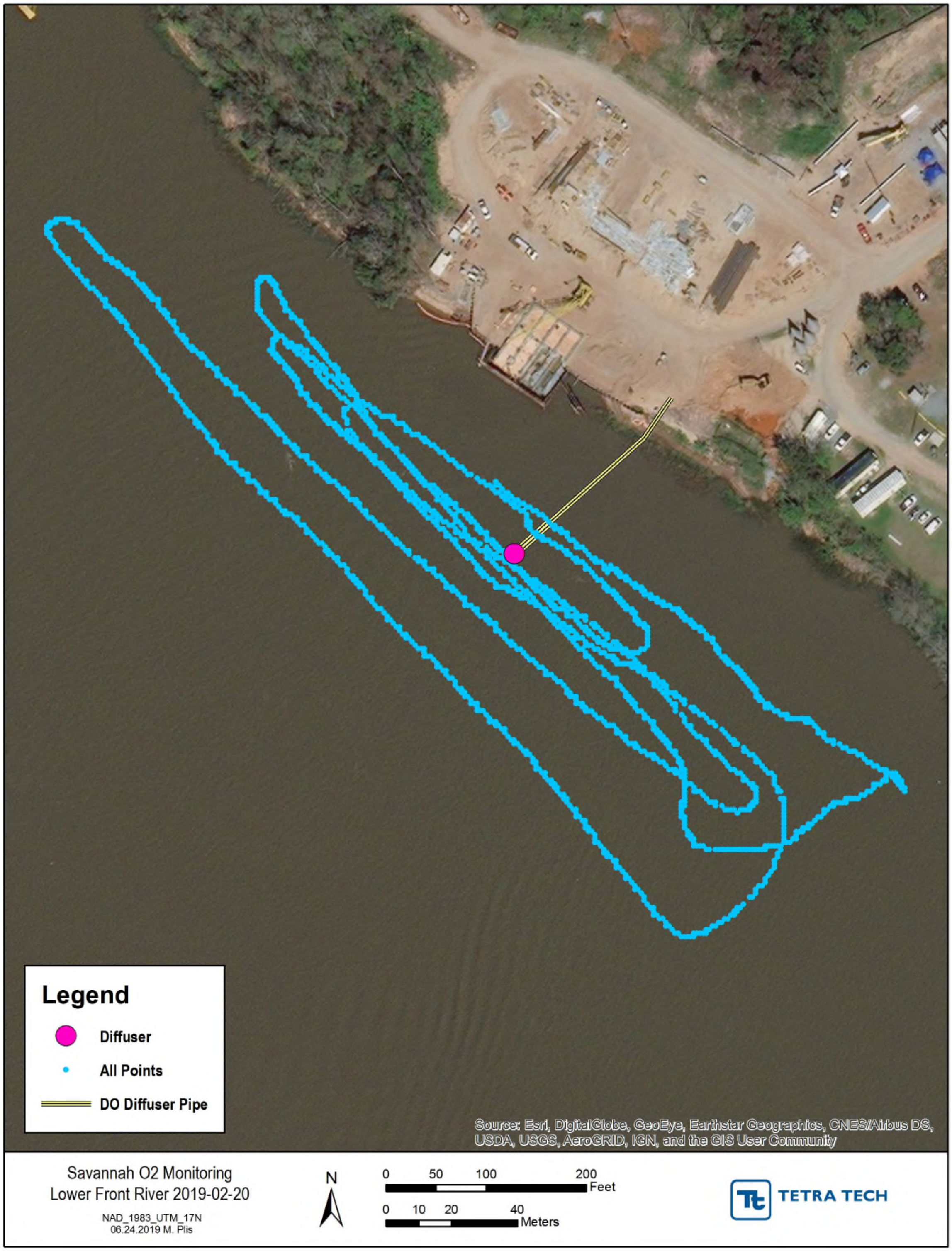


Figure C-87 Front River February 20, 2019 flood tide traveling profile location map (LFR_022019_001)

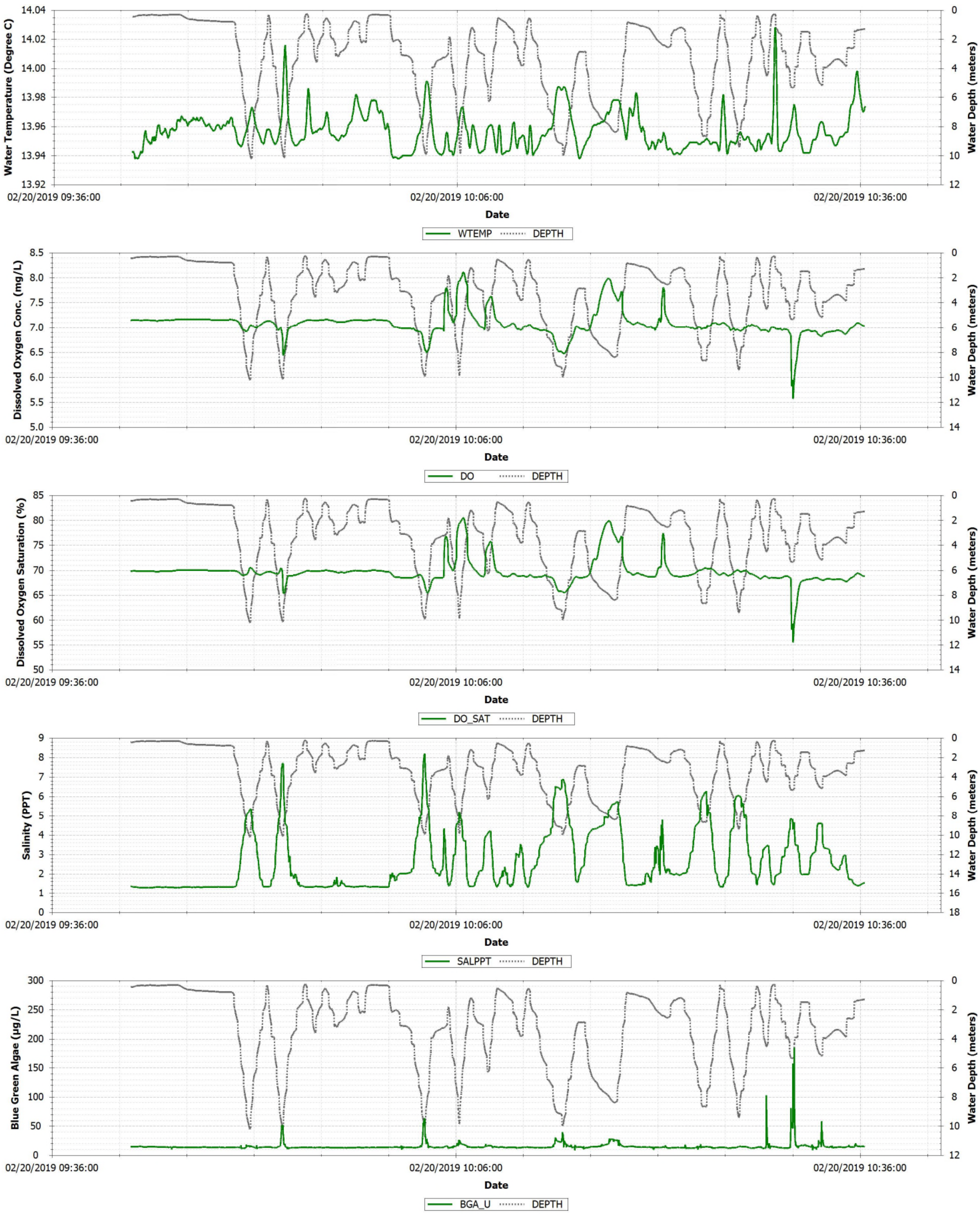


Figure C-88 Front River February 20, 2019 flood tide traveling profile observations (LFR_022019_001)

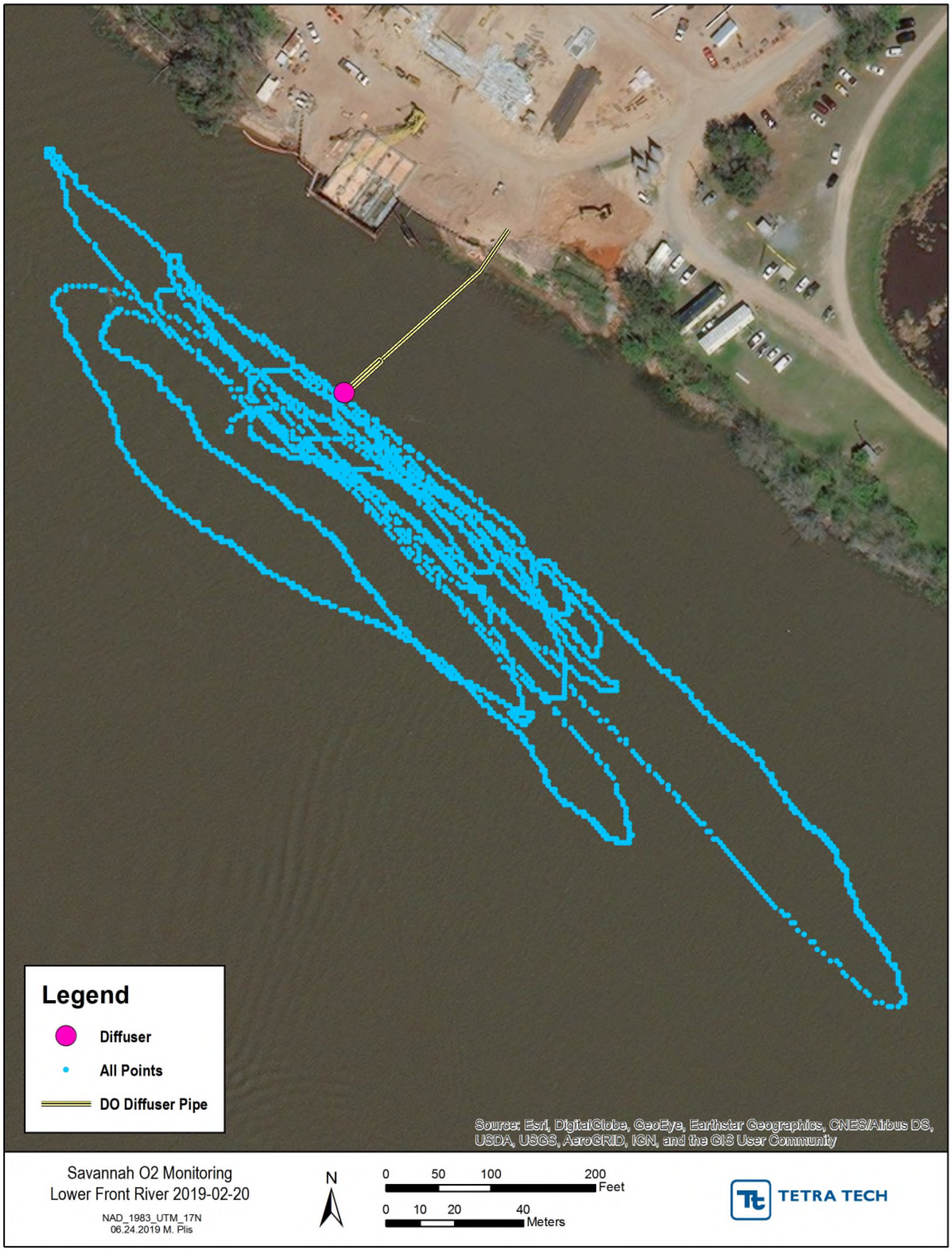


Figure C-89 Front River February 20, 2019 ebb tide traveling profile location map (LFR_022019_004)

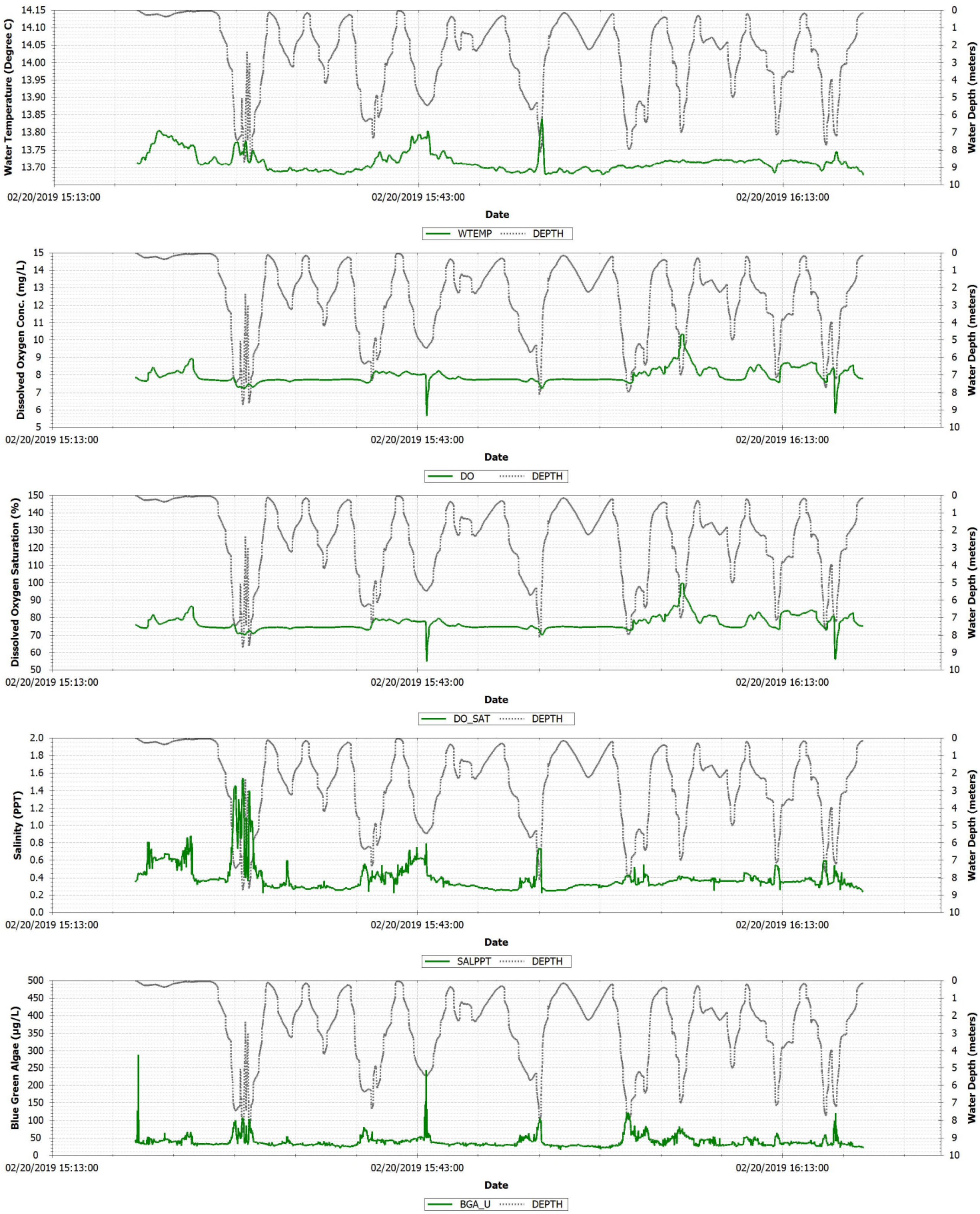


Figure C-90 Front River February 20, 2019 ebb tide traveling profile observations (LFR_022019_004)

Figure C-91 Front River February 21, 2019 stationary profiles location map

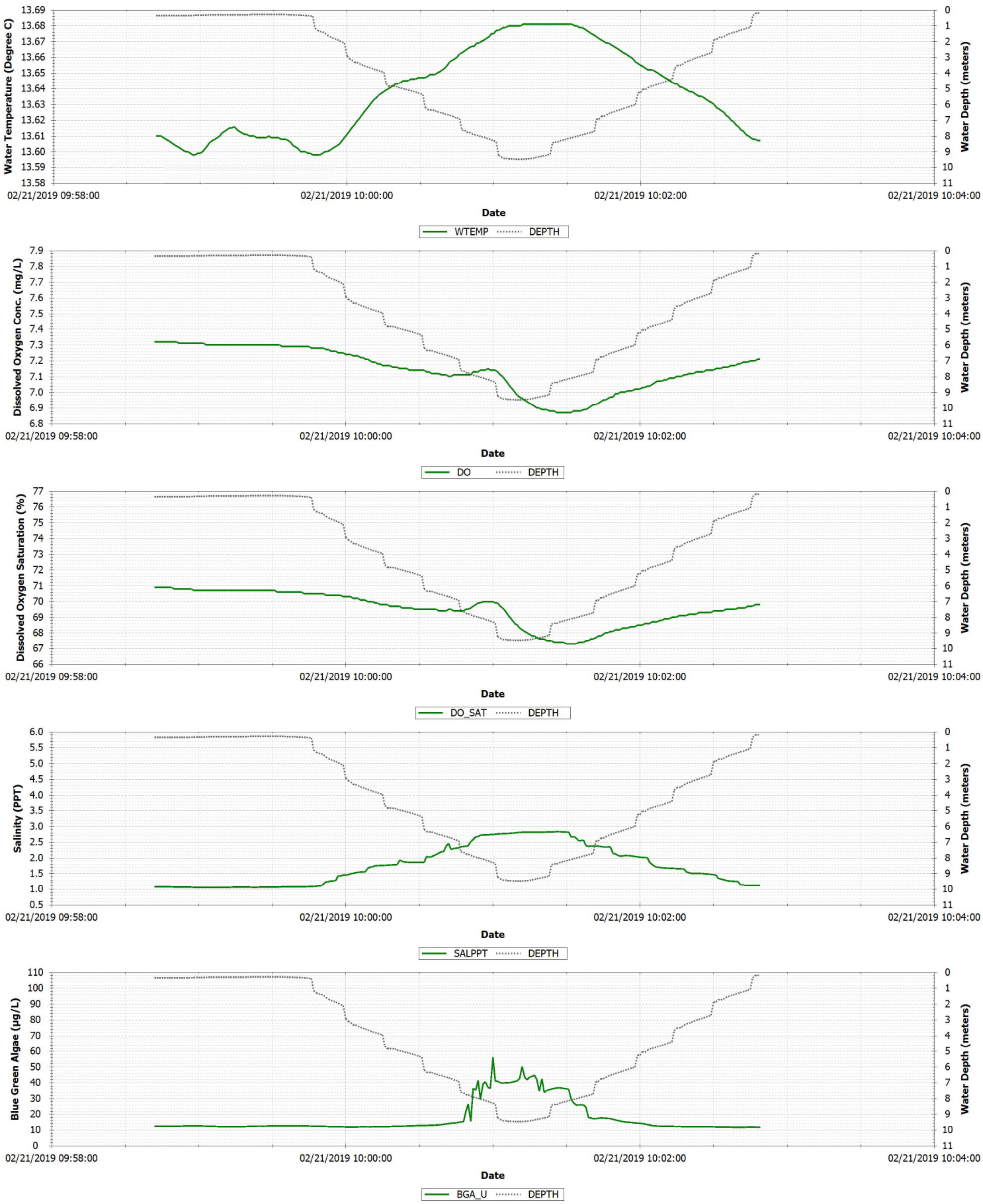


Figure C-92 Front River February 21, 2019 north buoy flood tide stationary profile observations (LFR_022119_001)

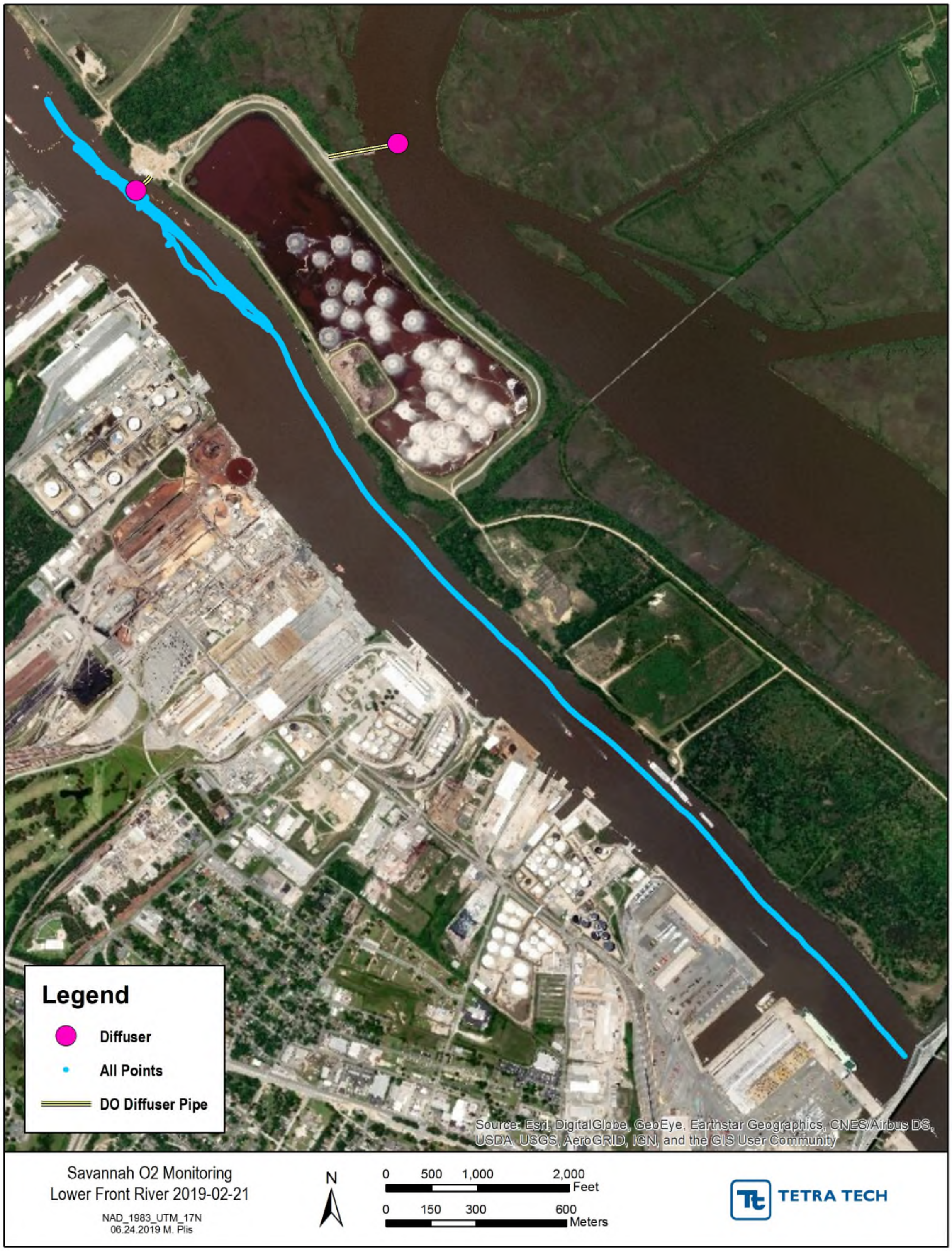


Figure C-93 Front River February 21, 2019 flood tide traveling dye profile location map (LFR_022119_DT_001)

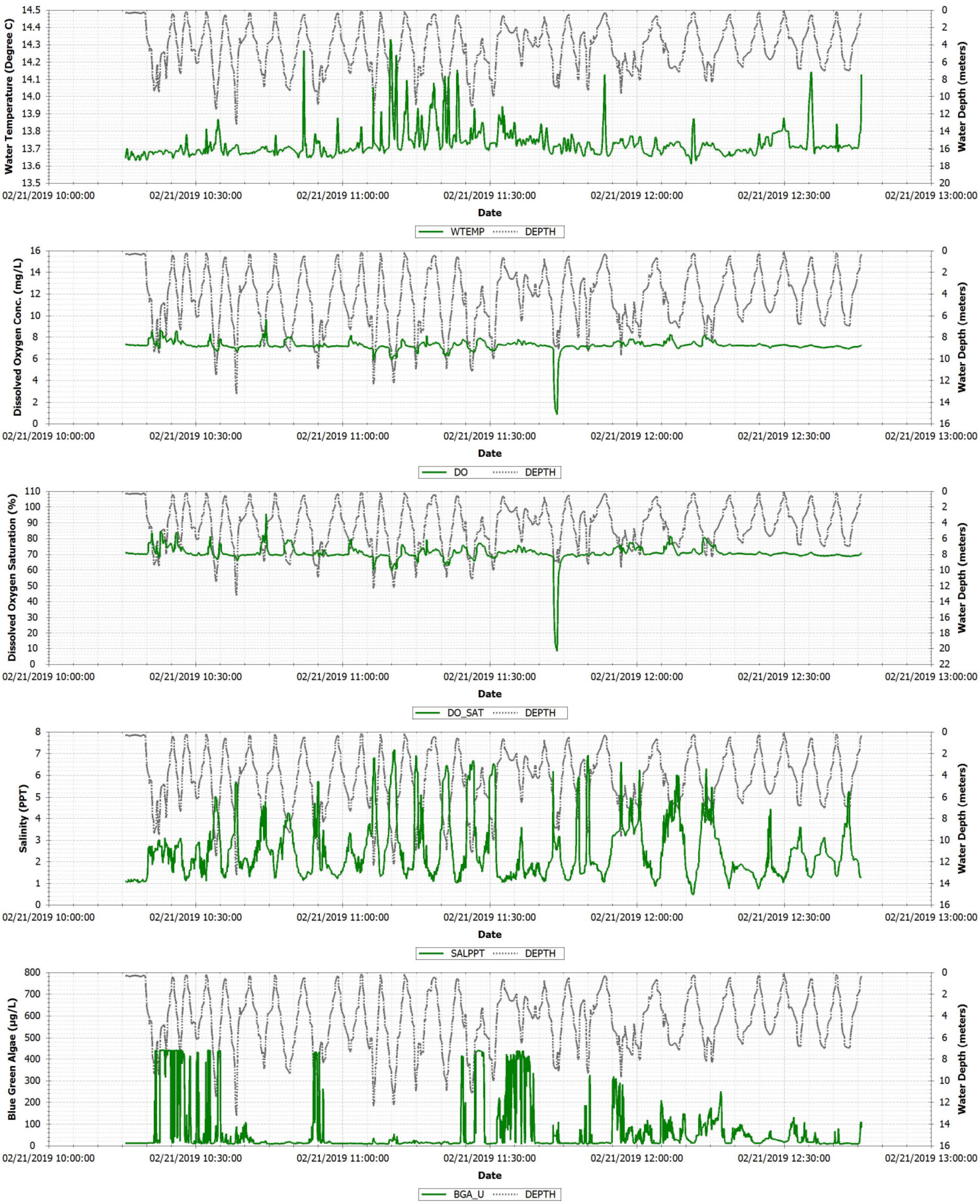


Figure C-94 Front River February 21, 2019 flood tide traveling dye profile observations (LFR_022119_DT_001)

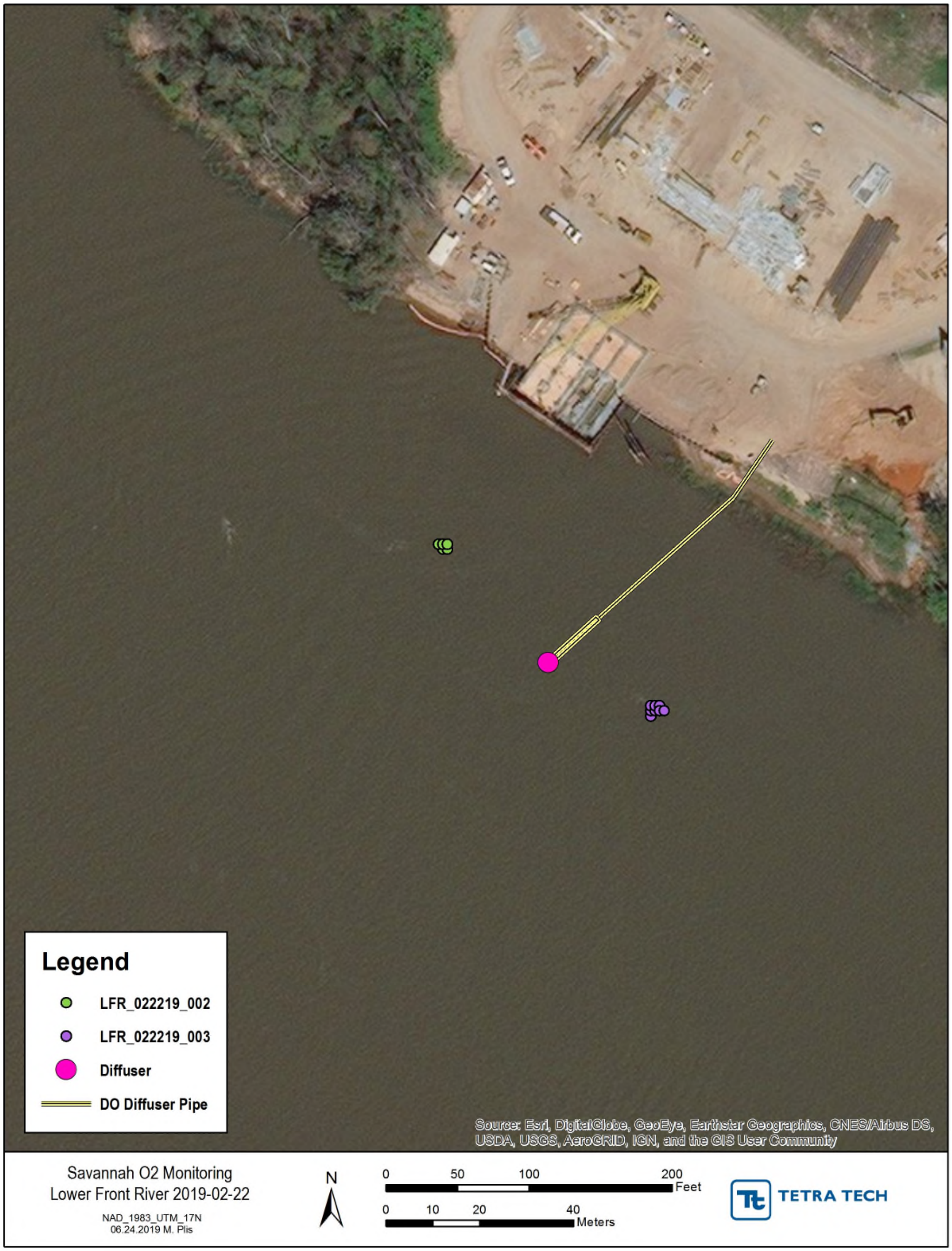


Figure C-95 Front River February 22, 2019 stationary profiles location map

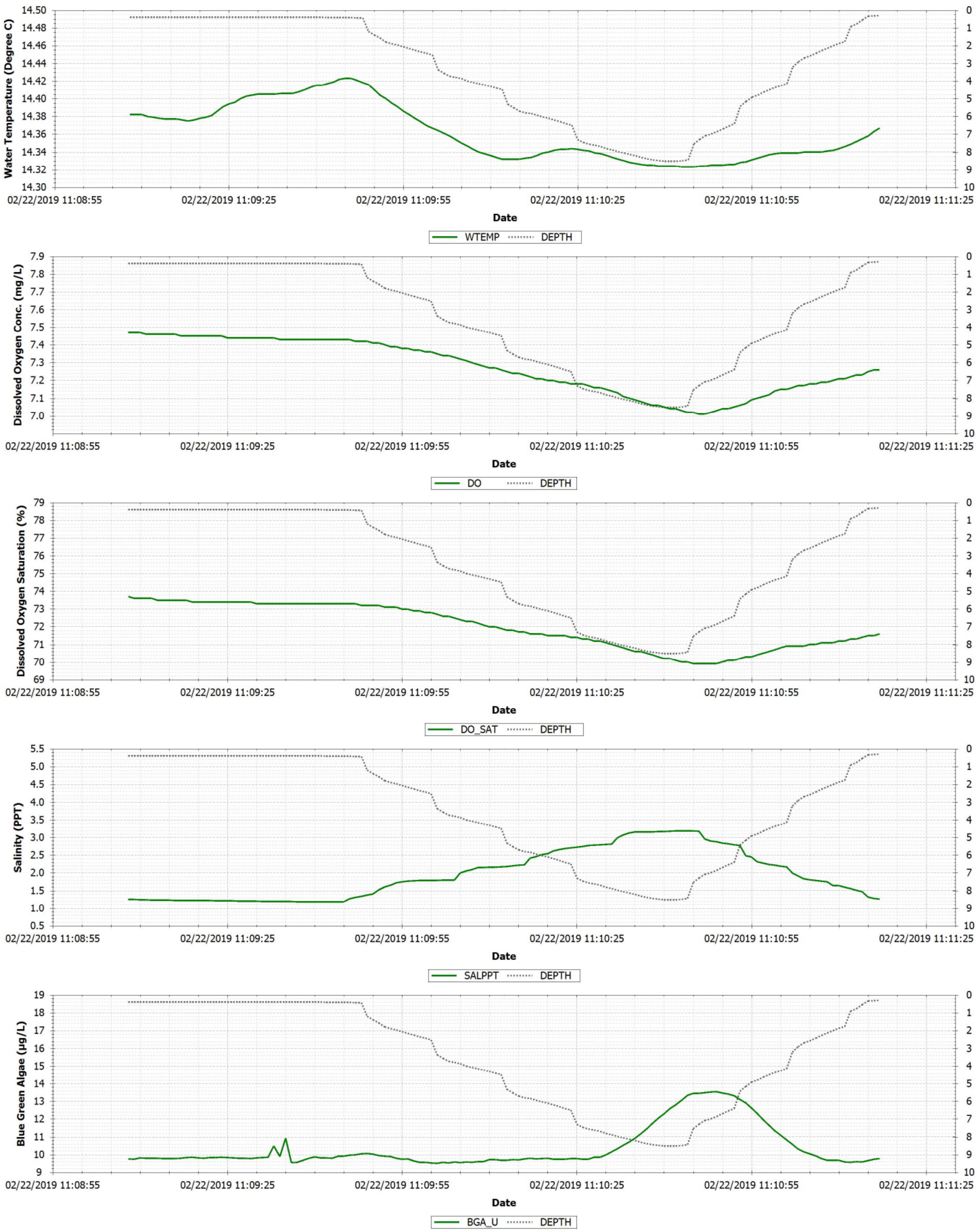


Figure C-96 Front River February 22, 2019 north buoy flood tide stationary profile observations (LFR_022219_002)

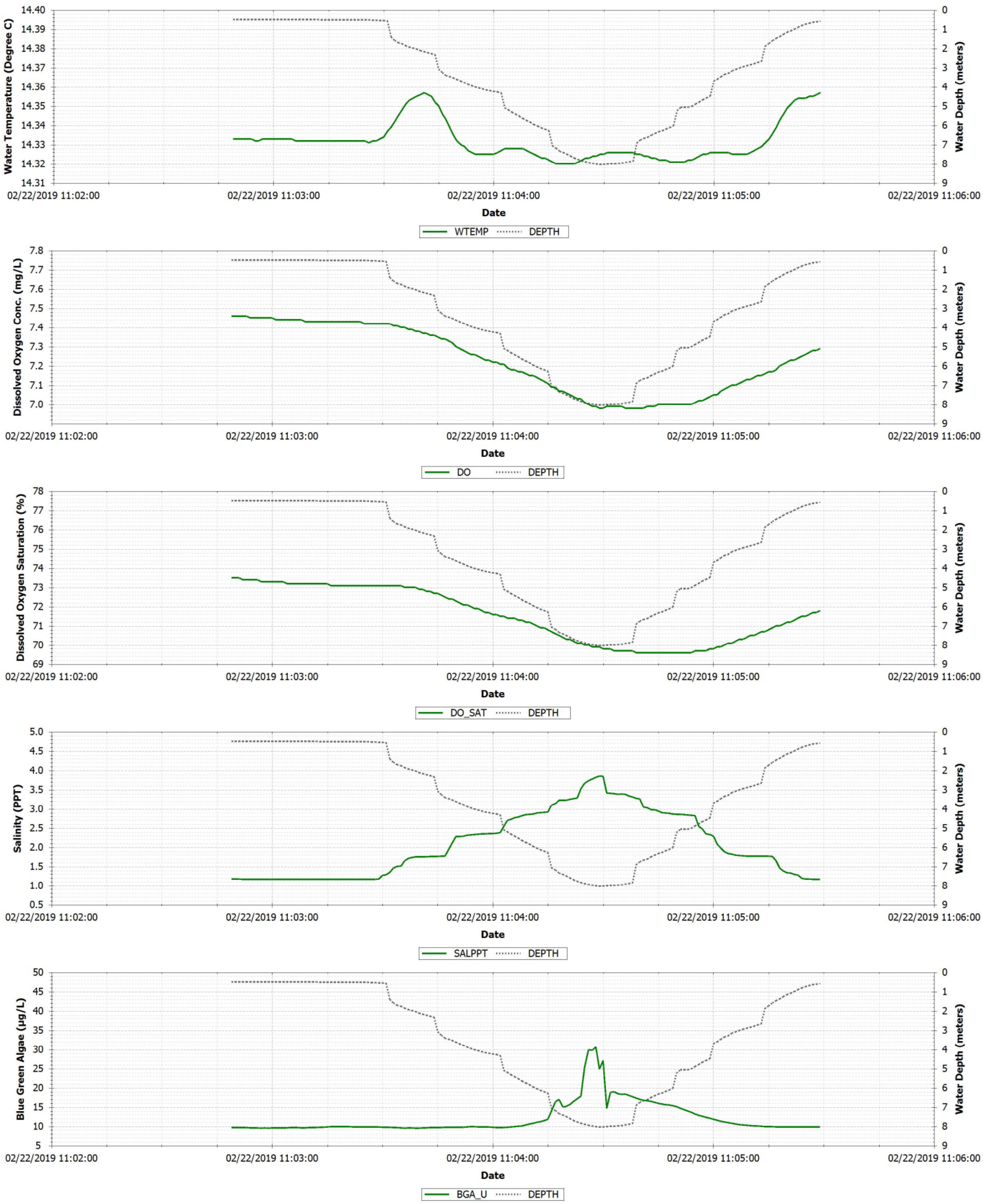


Figure C-97 Front River February 22, 2019 south buoy flood tide stationary profile observations (LFR_022219_003)

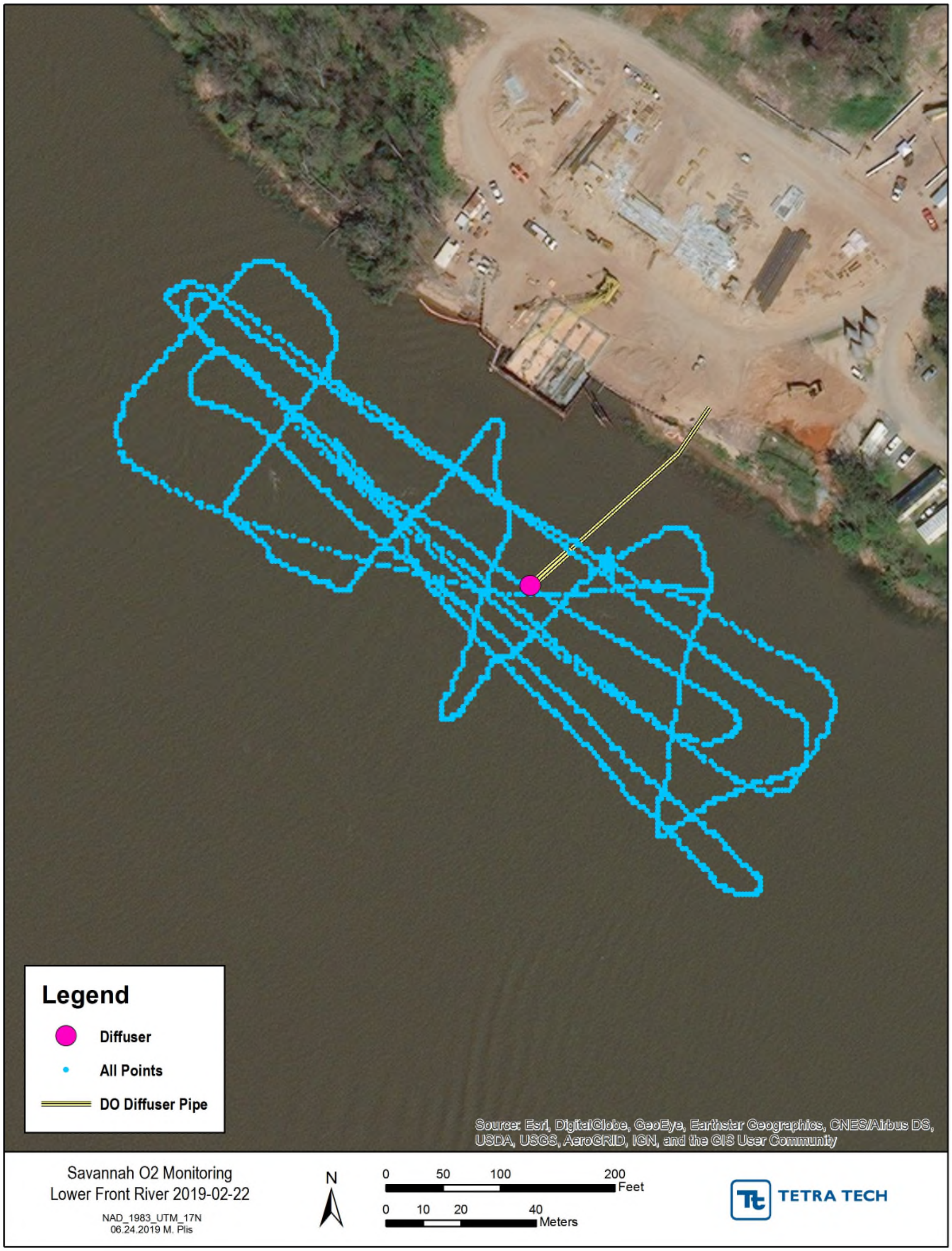


Figure C-98 Front River February 22, 2019 flood tide traveling profile location map (LFR_022219_001)

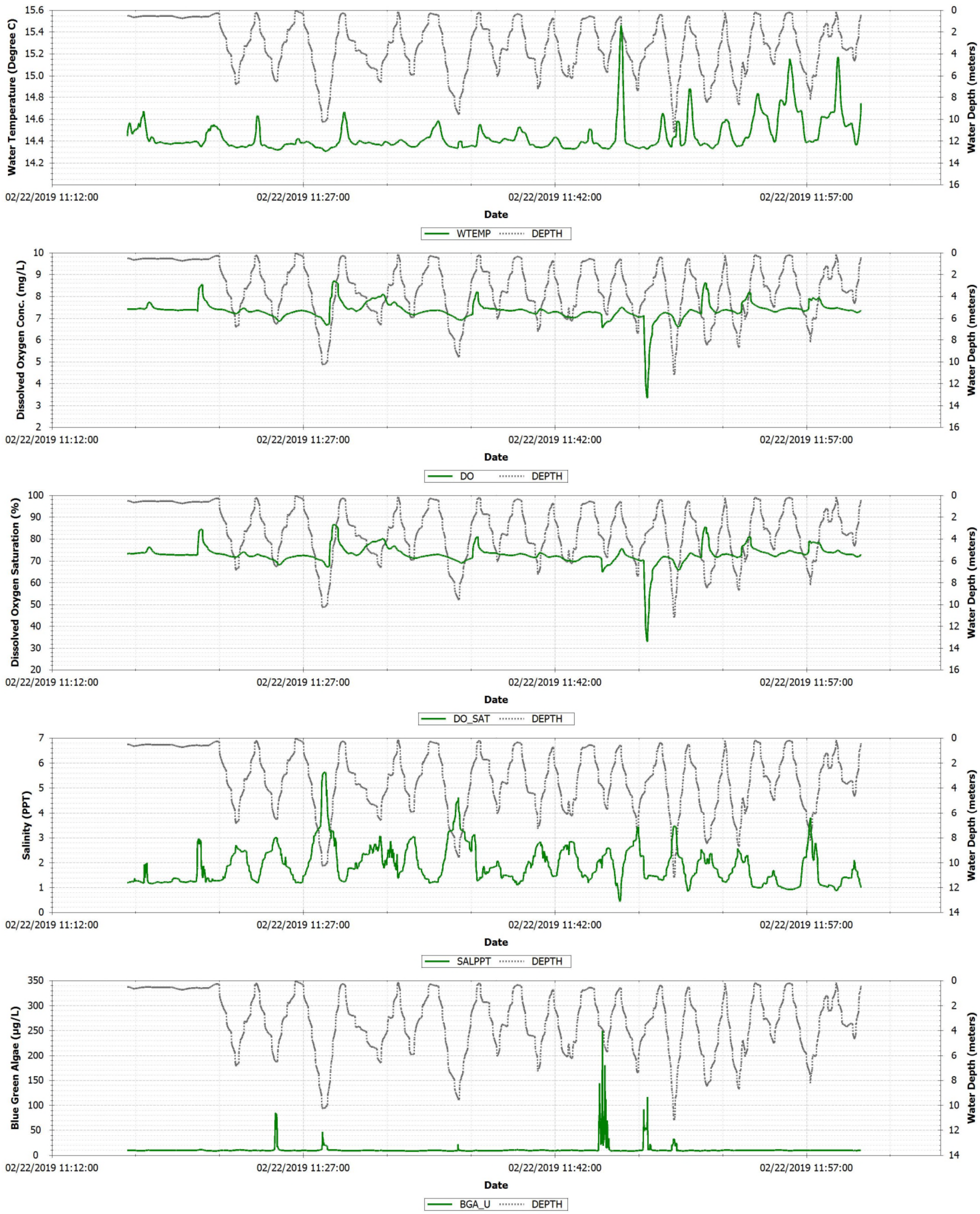


Figure C-99 Front River February 22, 2019 flood tide traveling profile observations (LFR_022219_001)

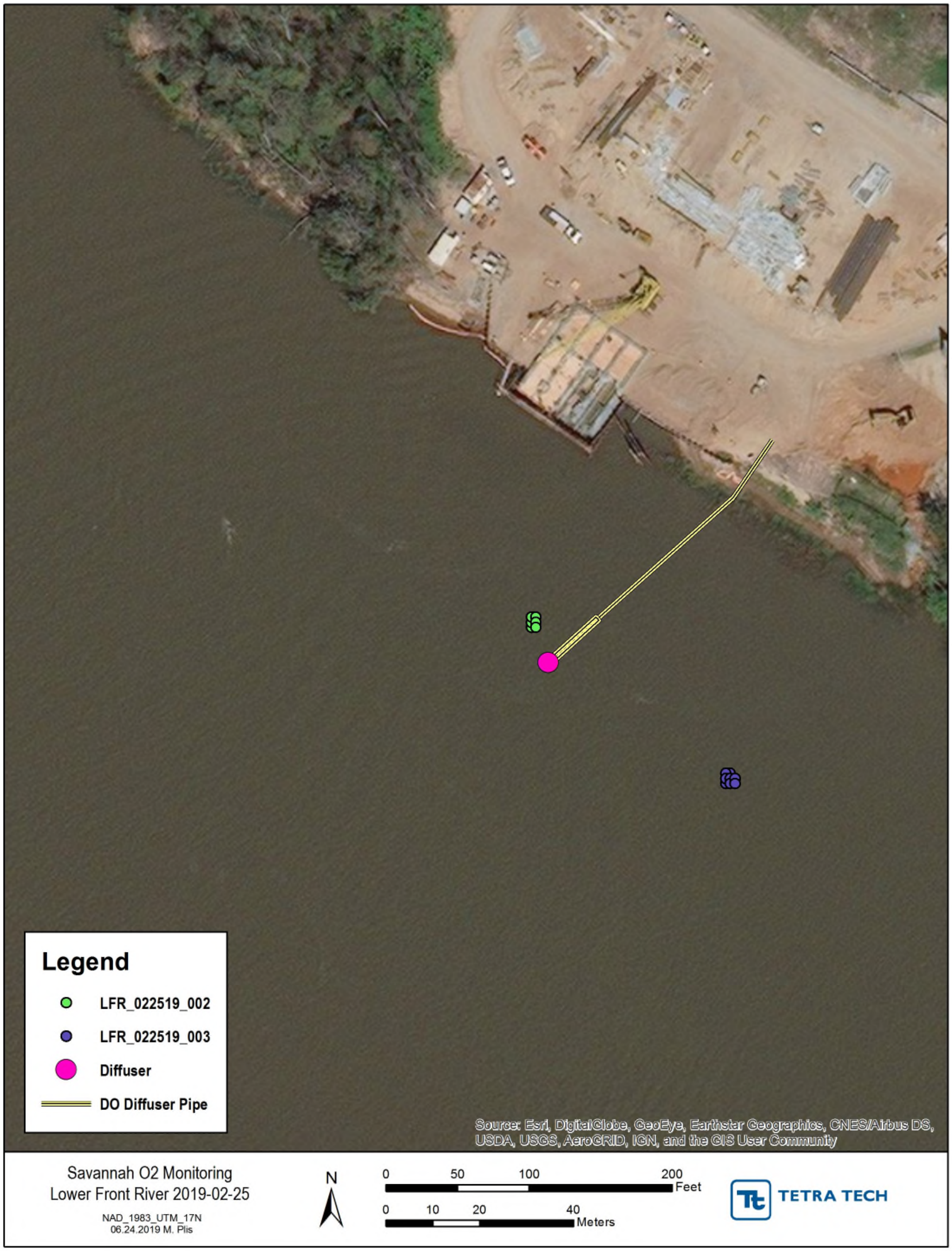
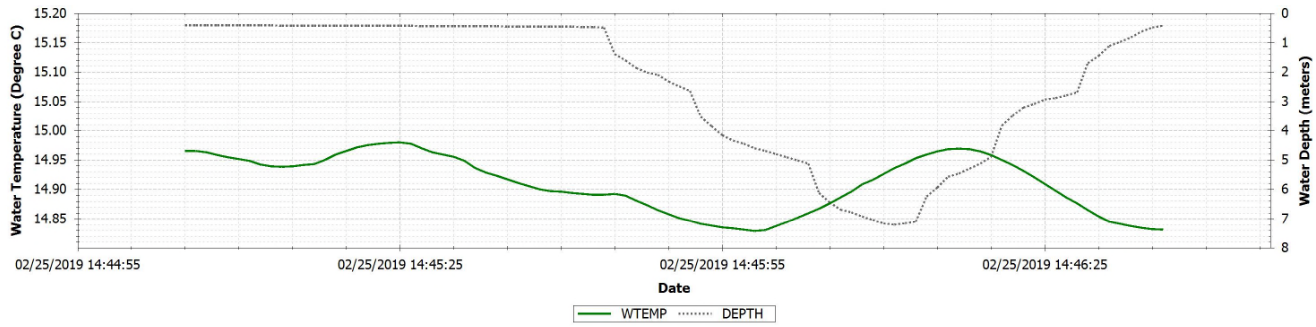
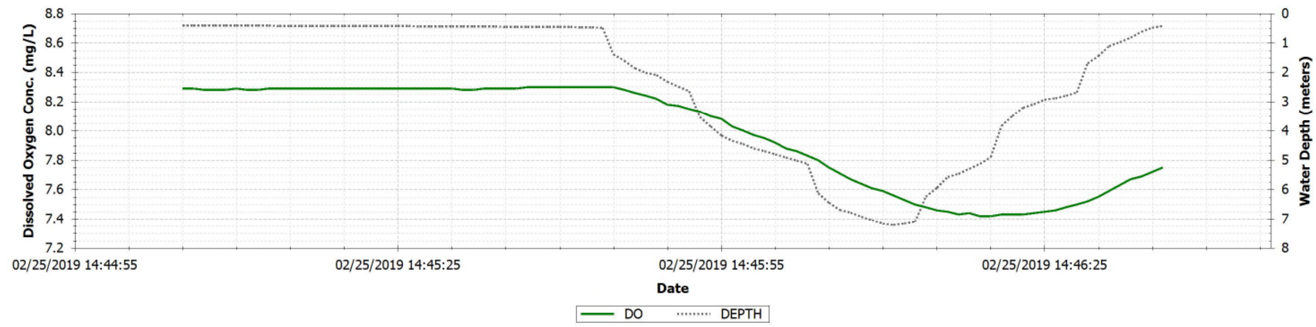
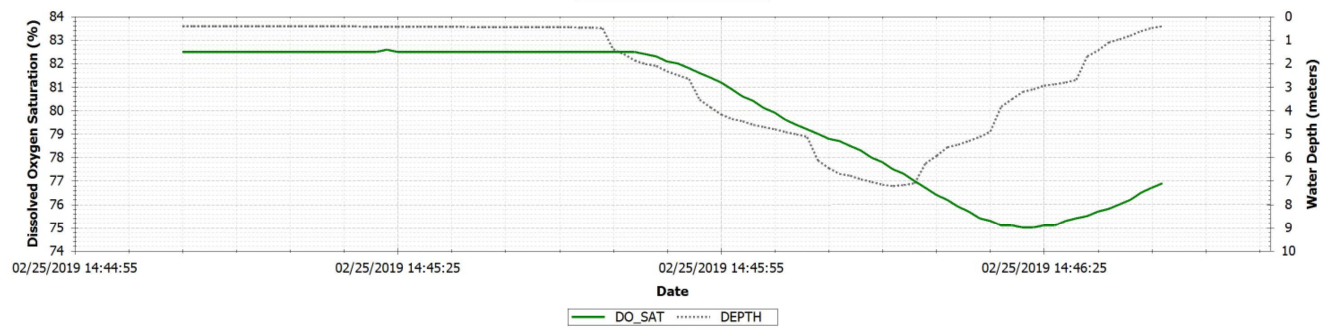
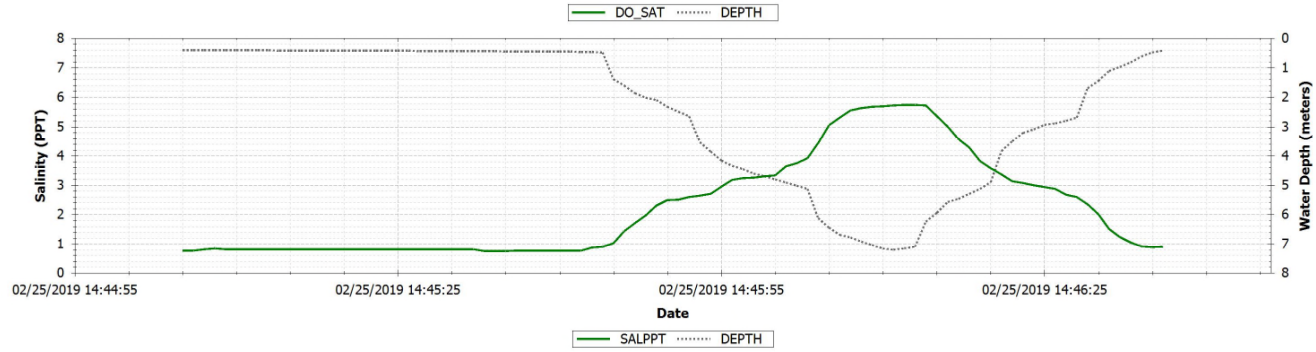


Figure C-100 Front River February 25, 2019 stationary profiles location map









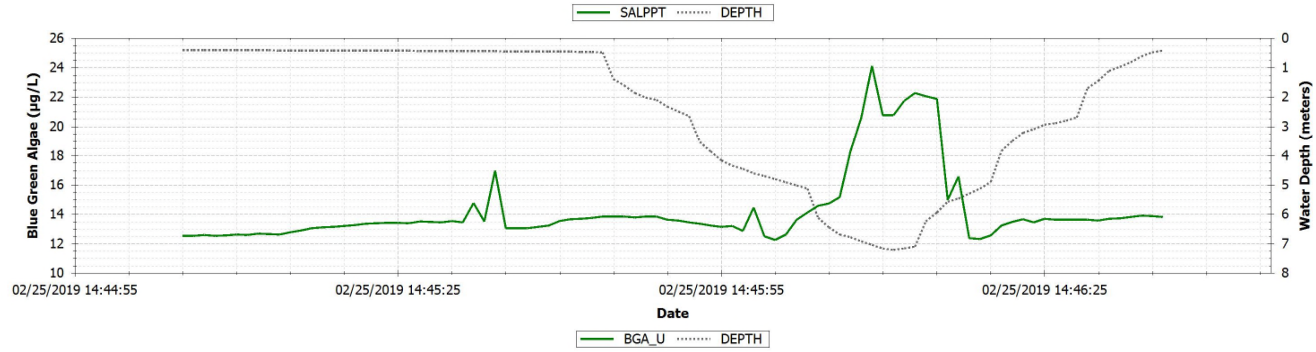


Figure C-101 Front River February 25, 2019 north buoy outgoing tide stationary profile observations (LFR_022519_002)

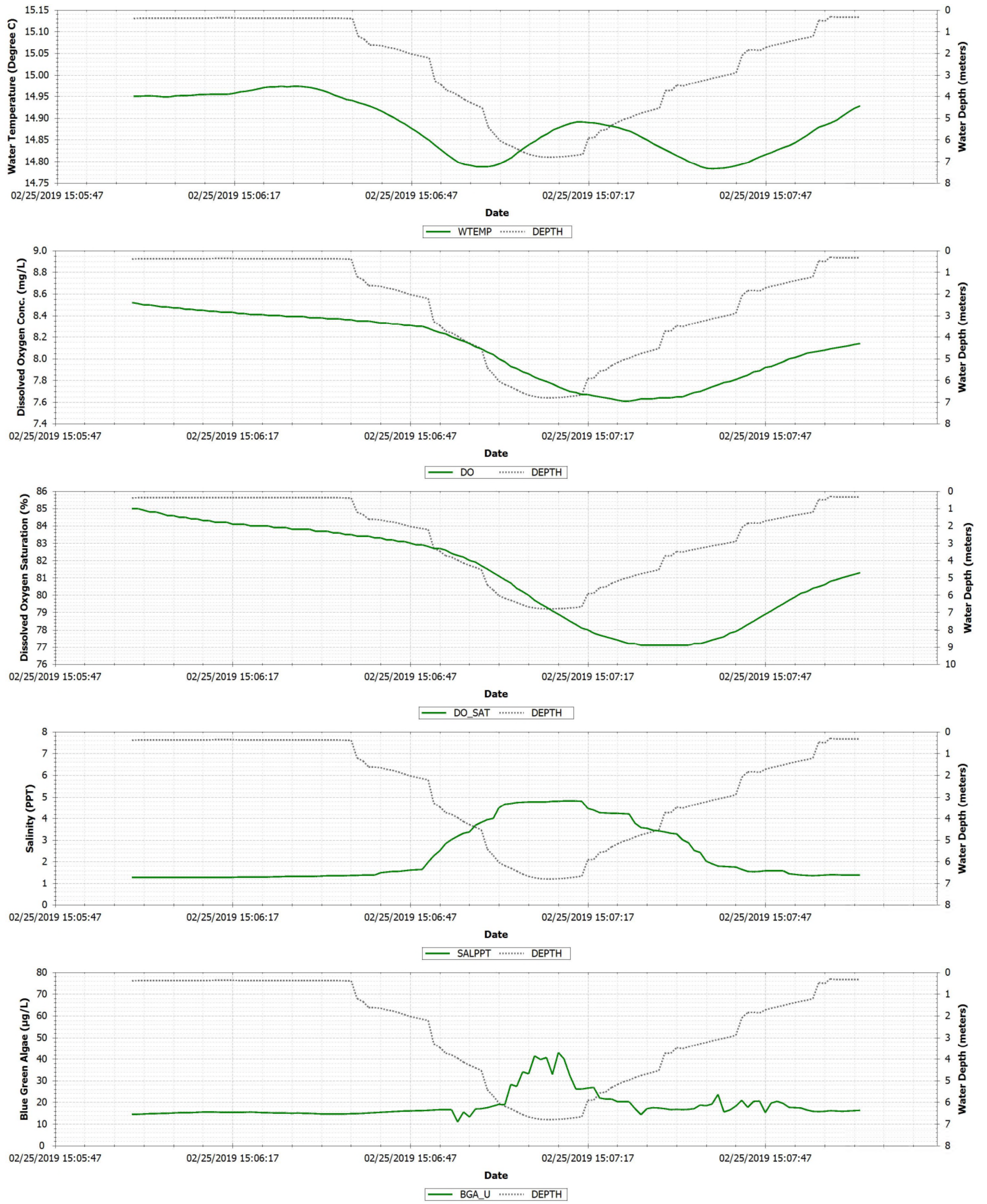


Figure C-102 Front River February 25, 2019 south buoy outgoing tide stationary profile observations (LFR_022519_003)

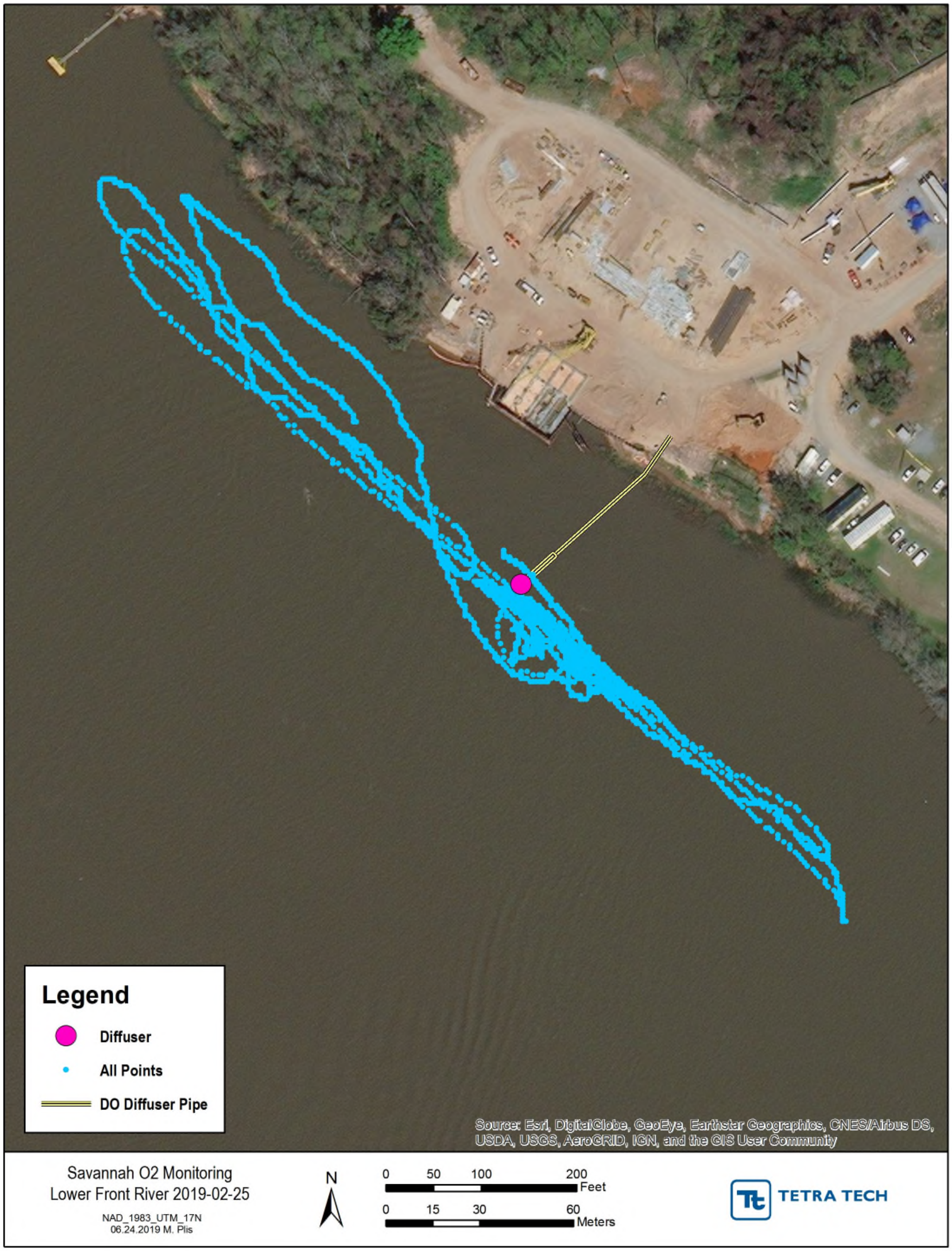


Figure C-103 Front River February 25, 2019 flood tide traveling profile location map (LFR_022519_001)

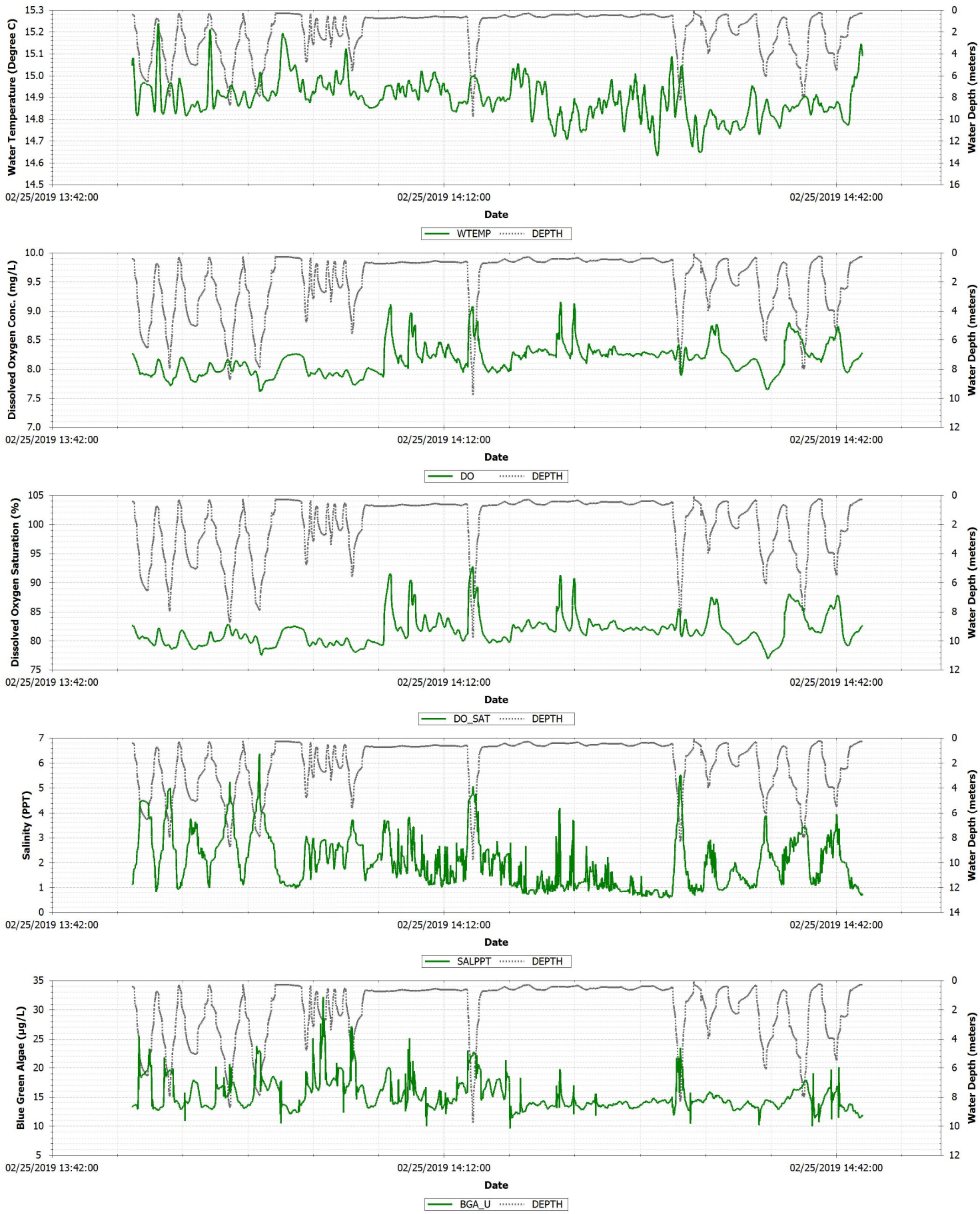


Figure C-104 Front River February 25, 2019 flood tide traveling profile observations (LFR_022519_001)

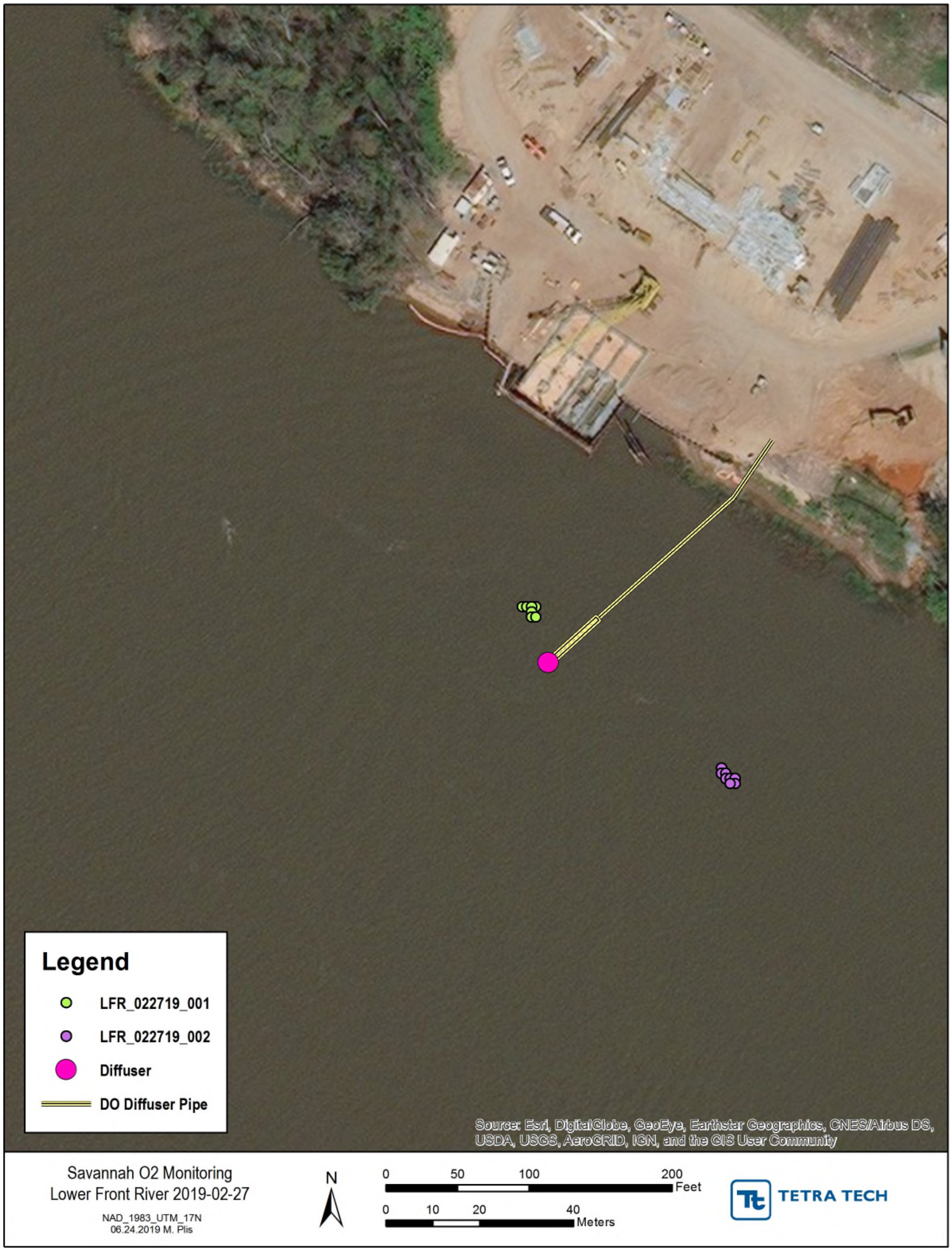


Figure C-105 Front River February 27, 2019 stationary profiles location map

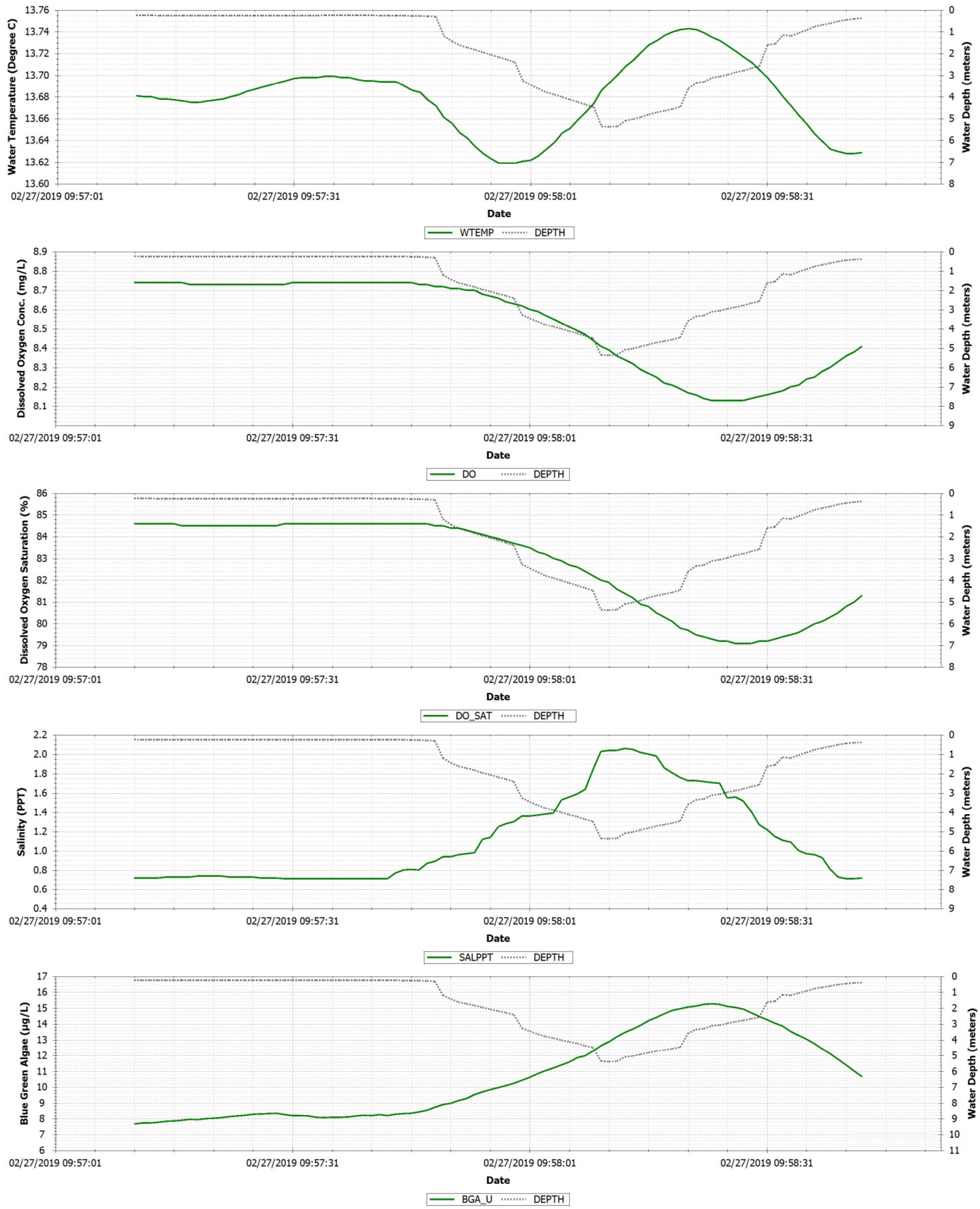


Figure C-106 Front River February 27, 2019 north buoy ebb tide stationary profile observations (LFR_022719_001)

Figure C-107 Front River February 27, 2019 south buoy ebb tide stationary profile observations (LFR_022719_002)

Figure C-108 Front River February 27, 2019 ebb tide traveling profile location map (LFR_022719_003)

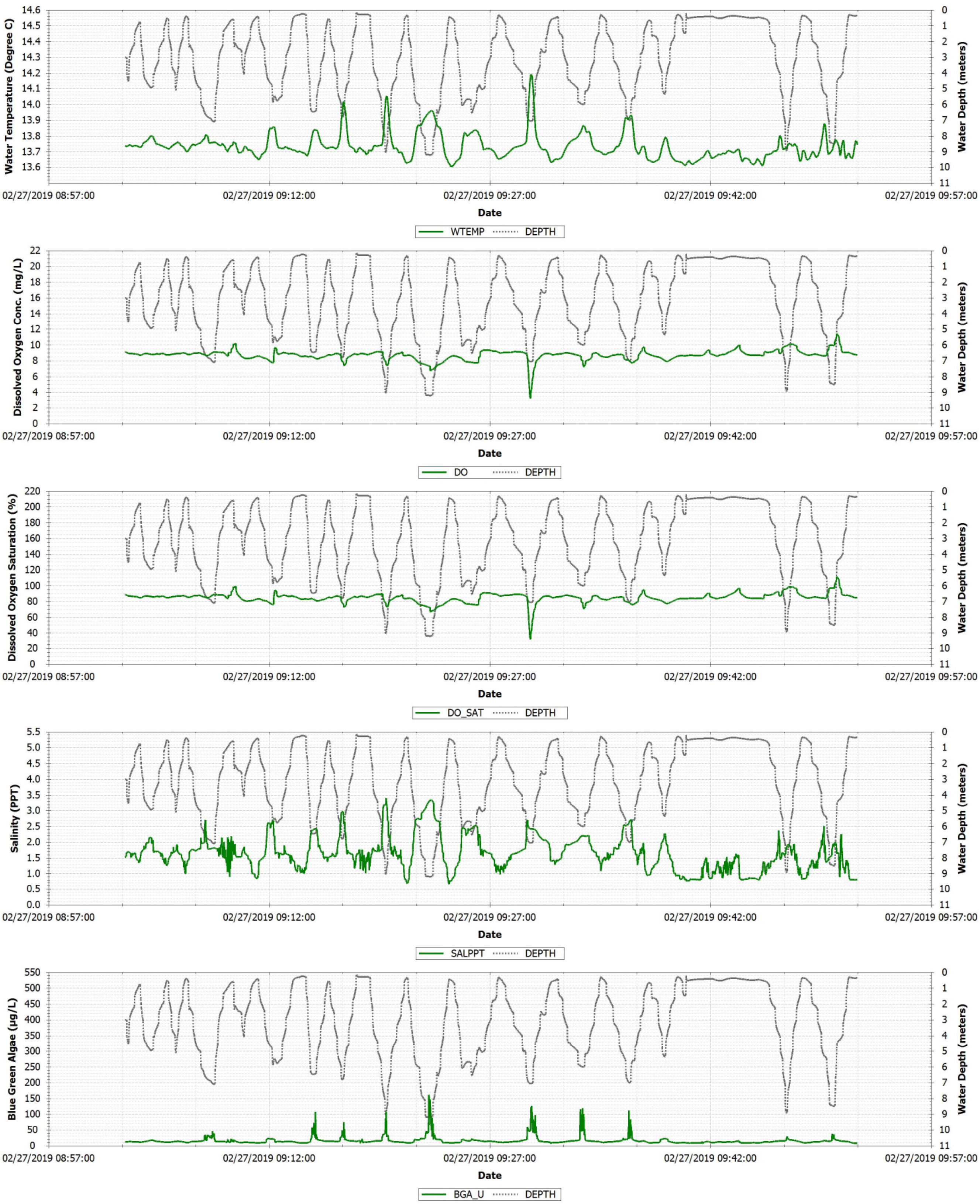


Figure C-109 Front River February 27, 2019 ebb tide traveling profile observations (LFR_022719_003)

APPENDIX D DRIFT FIGURES

APPENDIX D TABLE OF CONTENTS

APPENDIX D LIST OF FIGURES

D.1 BACK RIVER

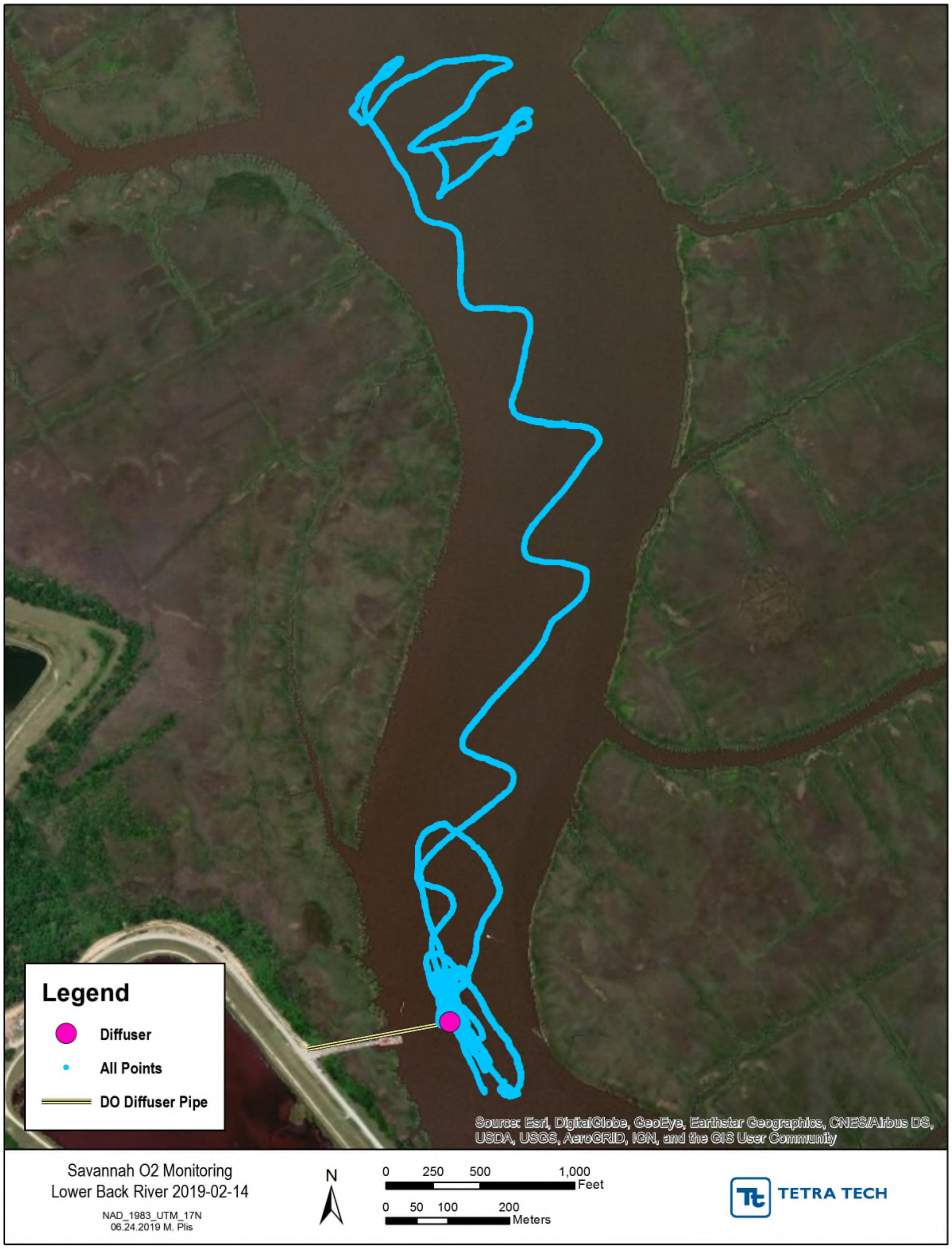


Figure D-1 Back River February 14, 2019 ebb tide dye drift location map

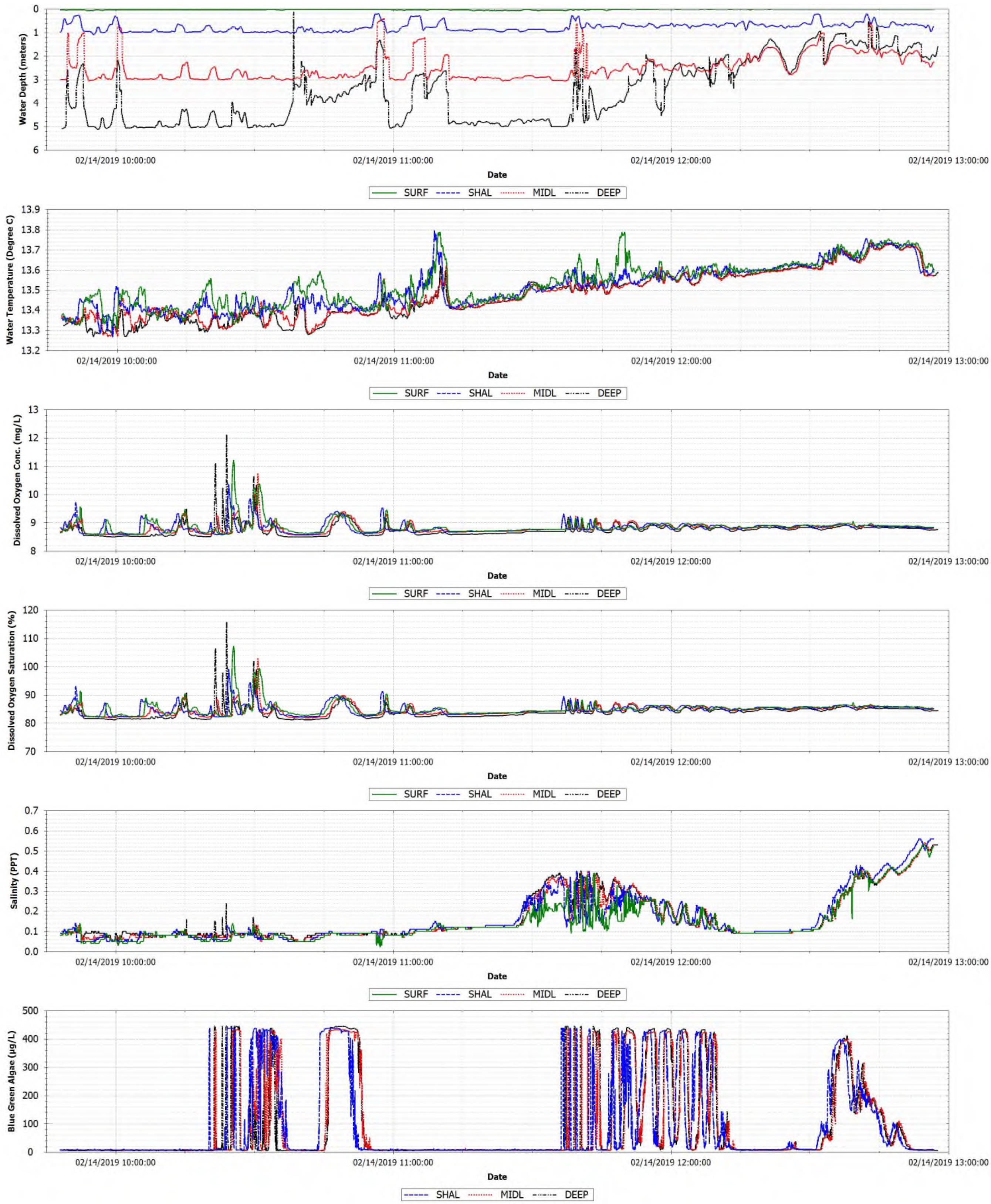


Figure D-2 Back River February 14, 2019 ebb tide dye drift observations

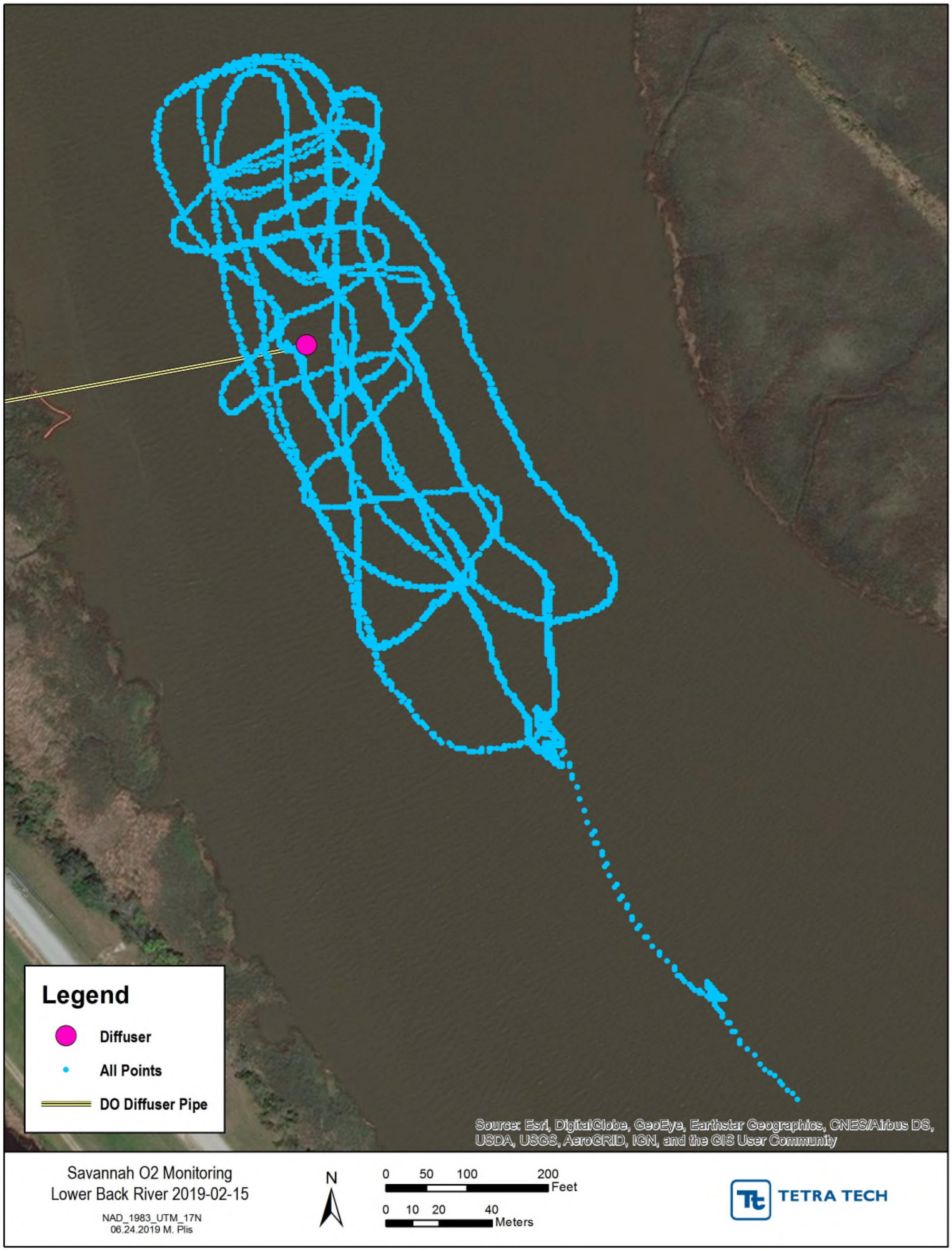


Figure D-3 Back River February 15, 2019 ebb tide drift location map

Figure D-4 Back River February 15, 2019 ebb tide drift observations

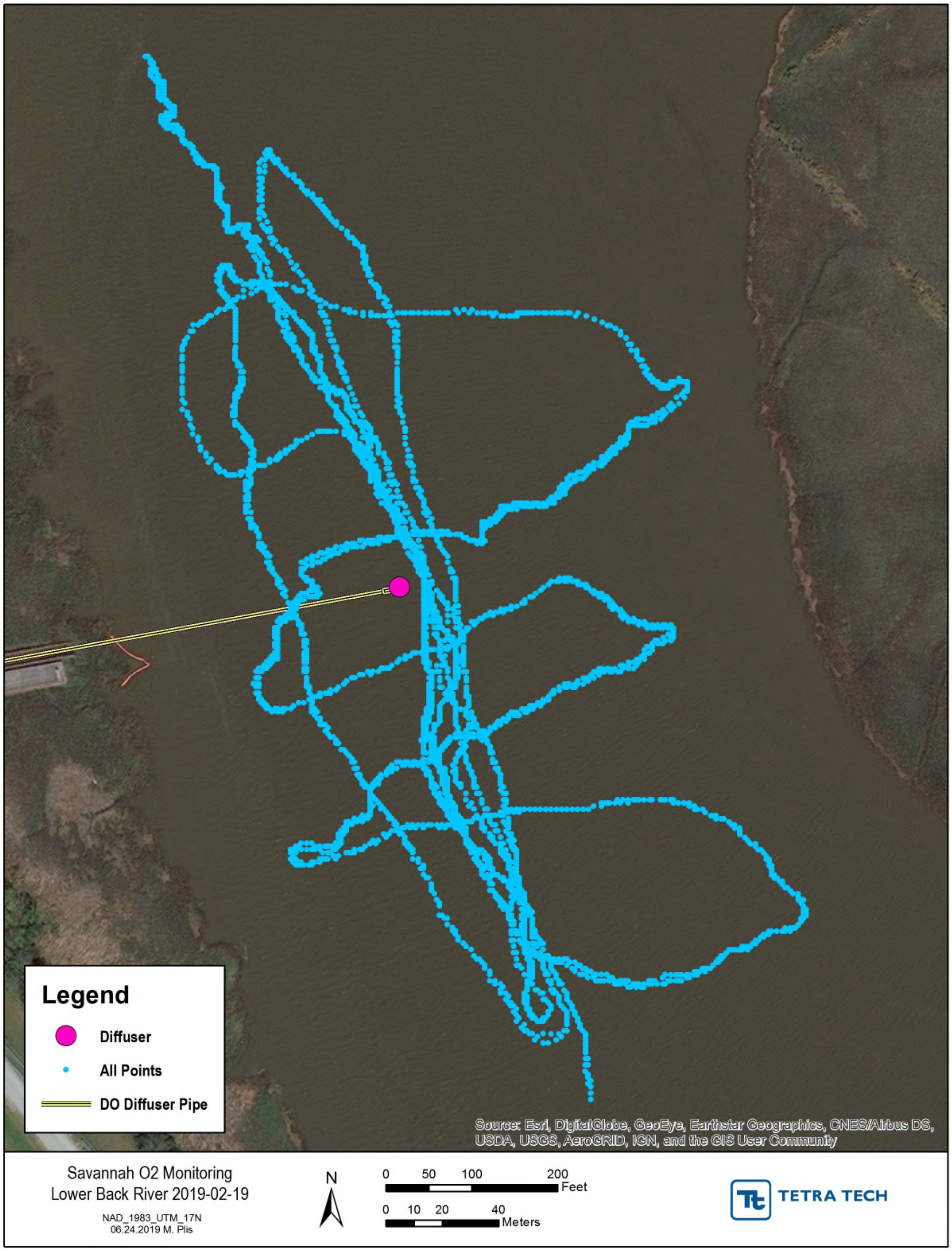


Figure D-5 Back River February 19, 2019 flood tide drift location map

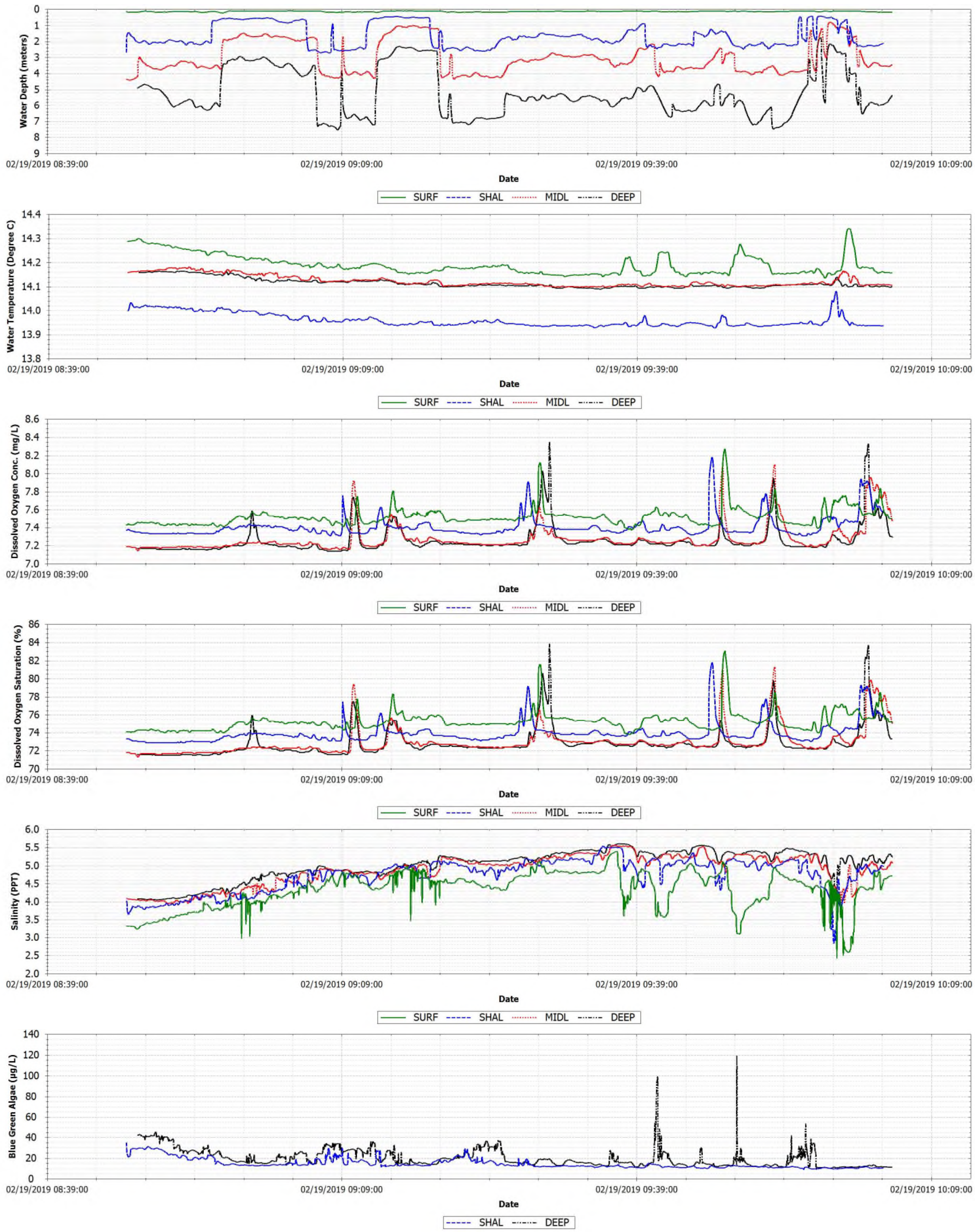


Figure D-6 Back River February 19, 2019 flood tide drift observations

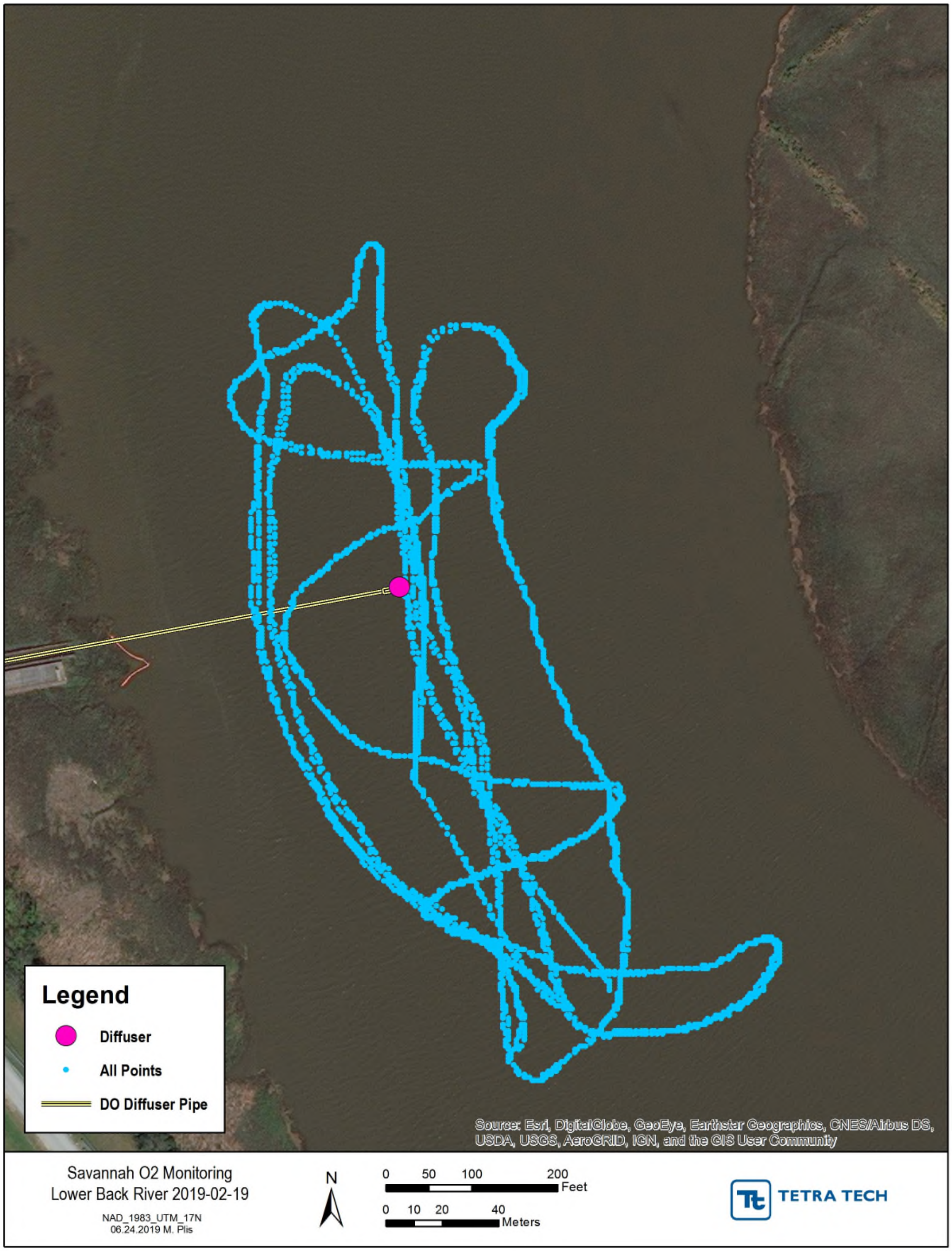


Figure D-7 Back River February 19, 2019 ebb tide drift location map

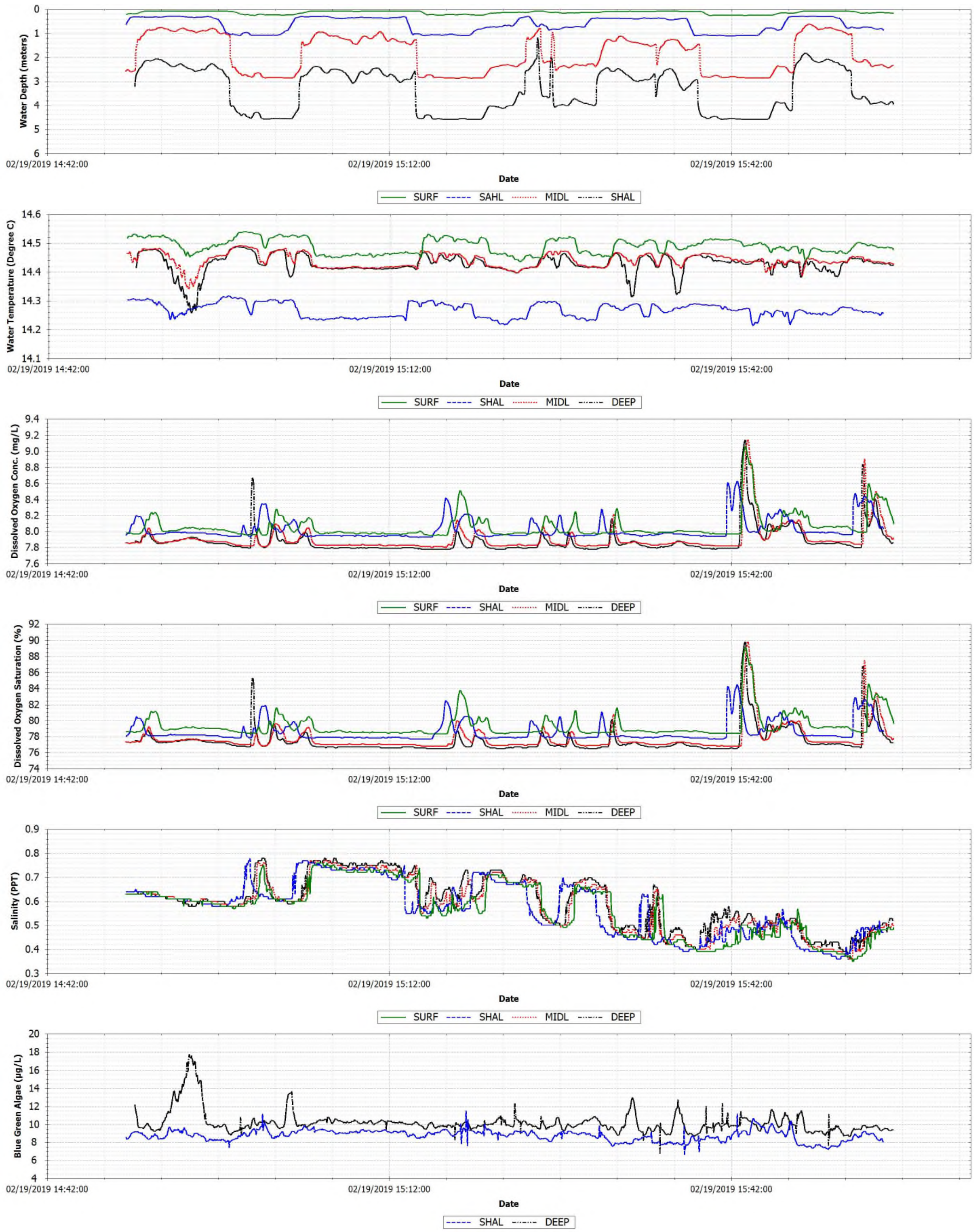


Figure D-8 Back River February 19, 2019 ebb tide drift observations

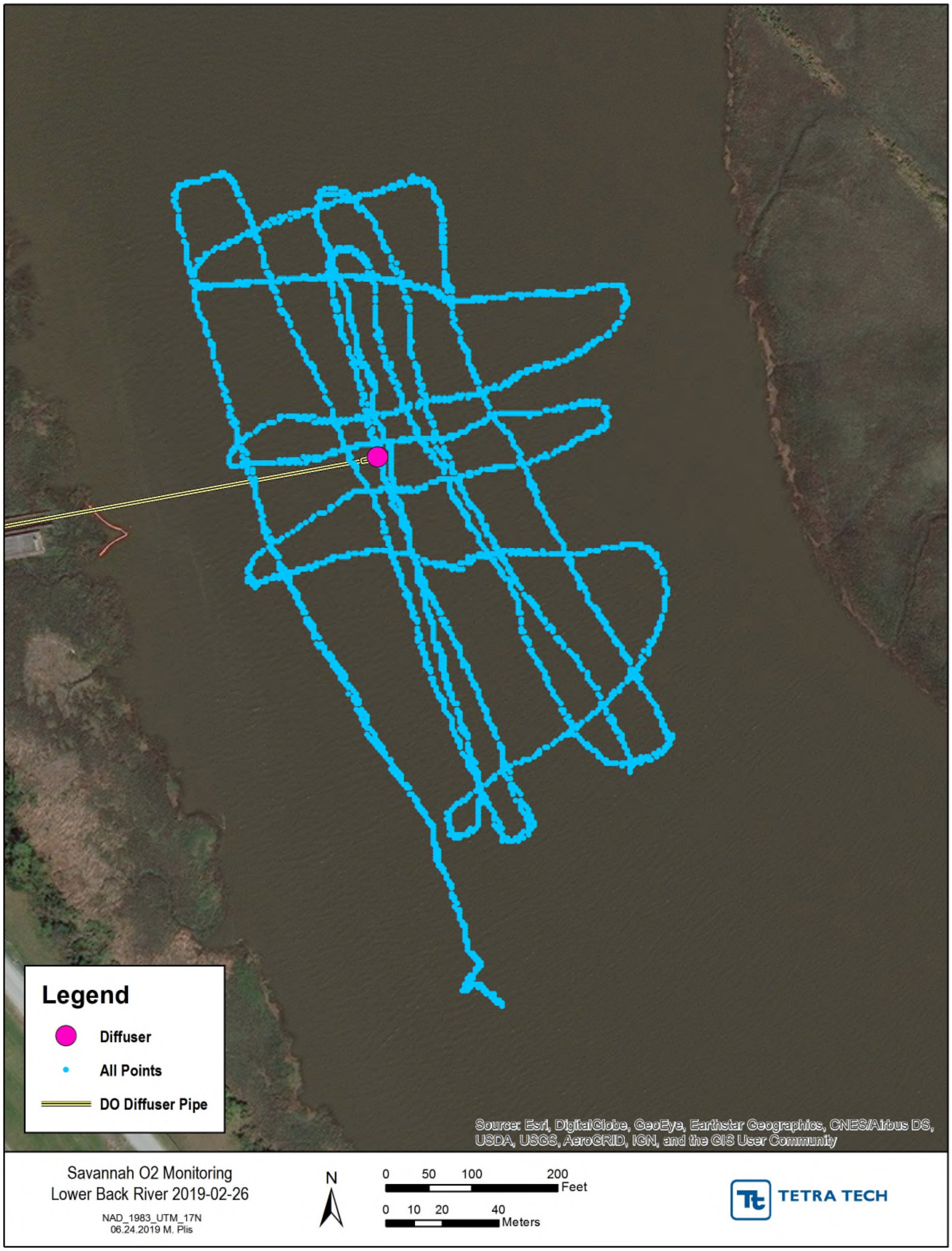


Figure D-9 Back River February 26, 2019 flood tide drift location map

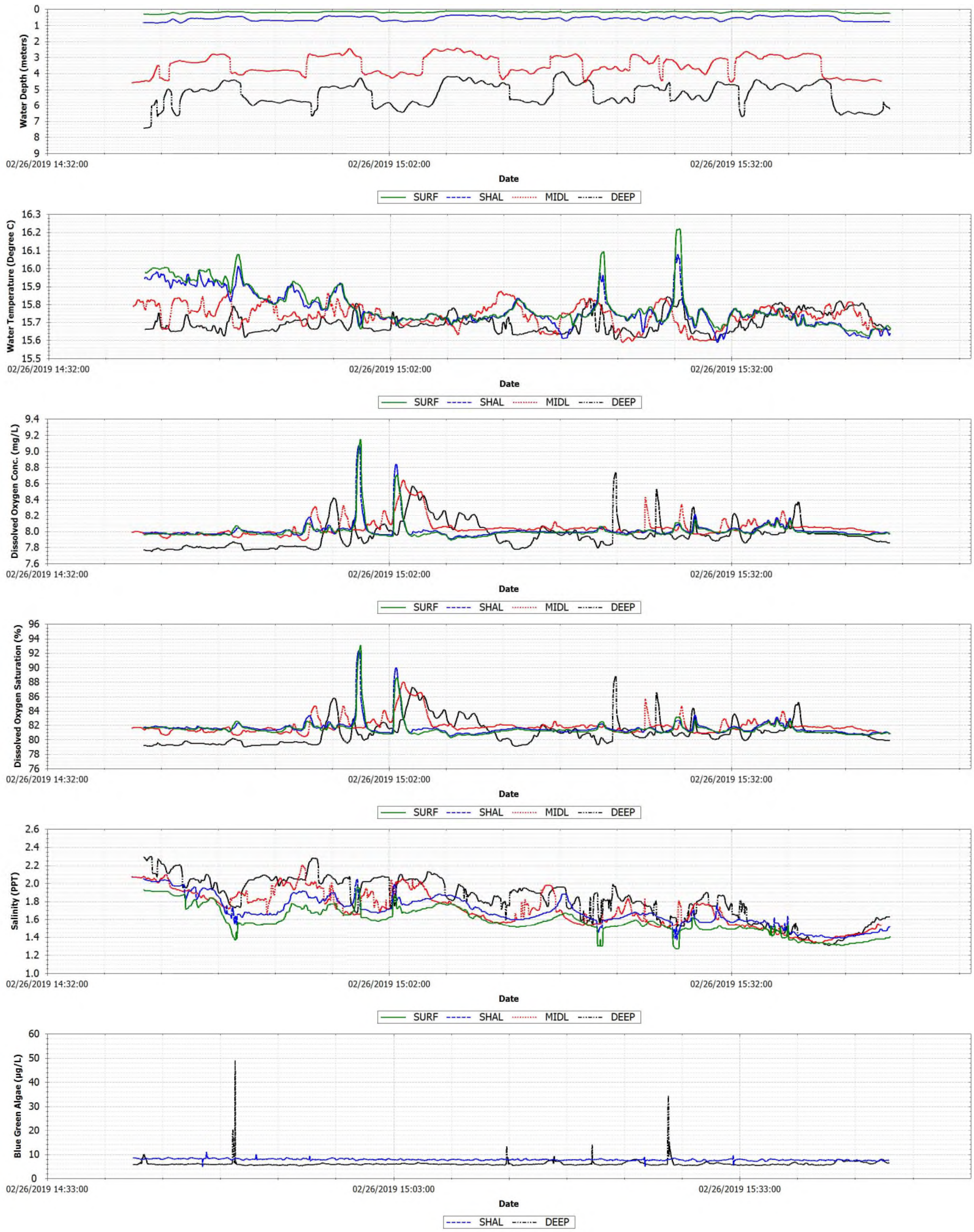


Figure D-10 Back River February 26, 2019 flood tide drift observations

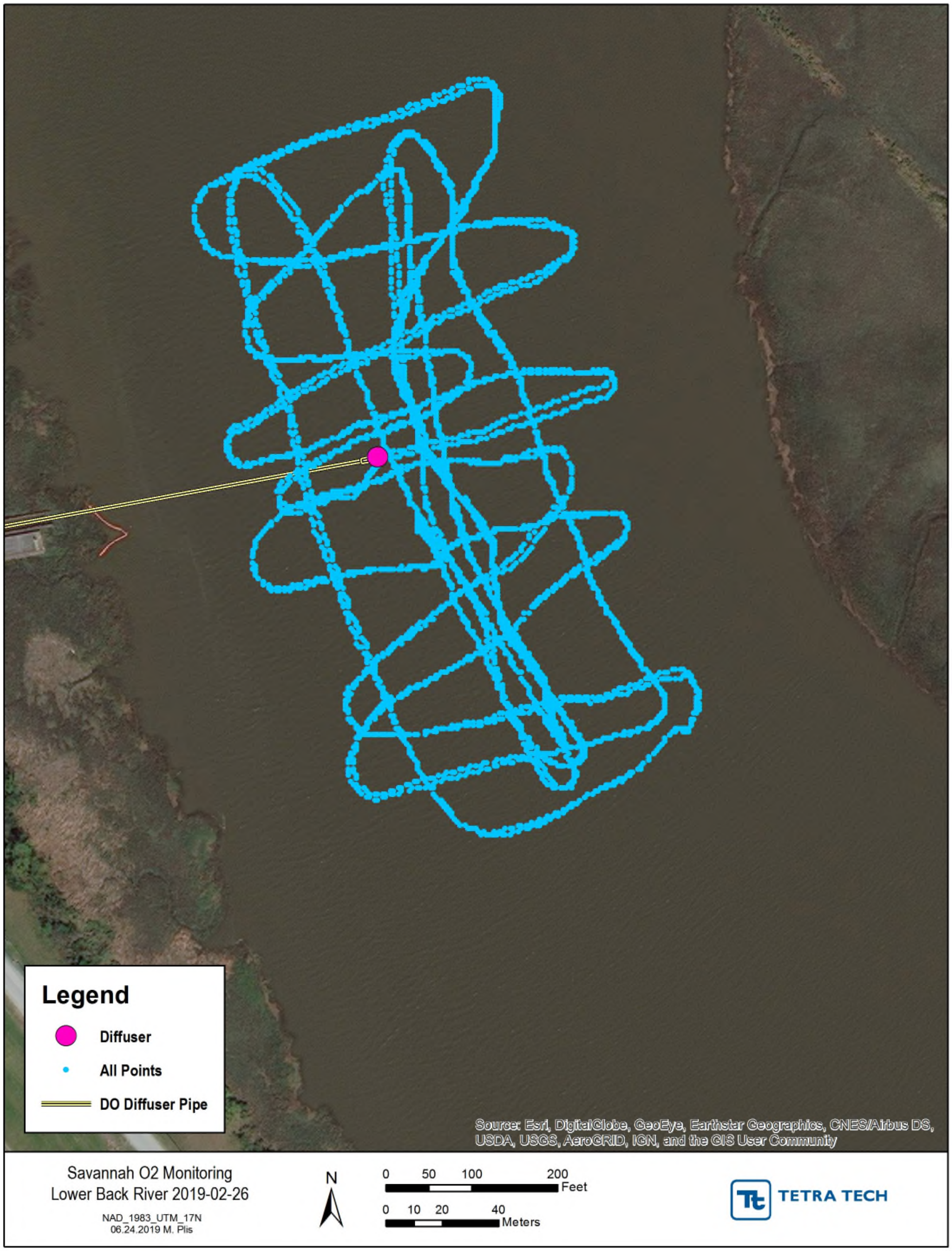


Figure D-11 Back River February 26, 2019 ebb tide drift location map

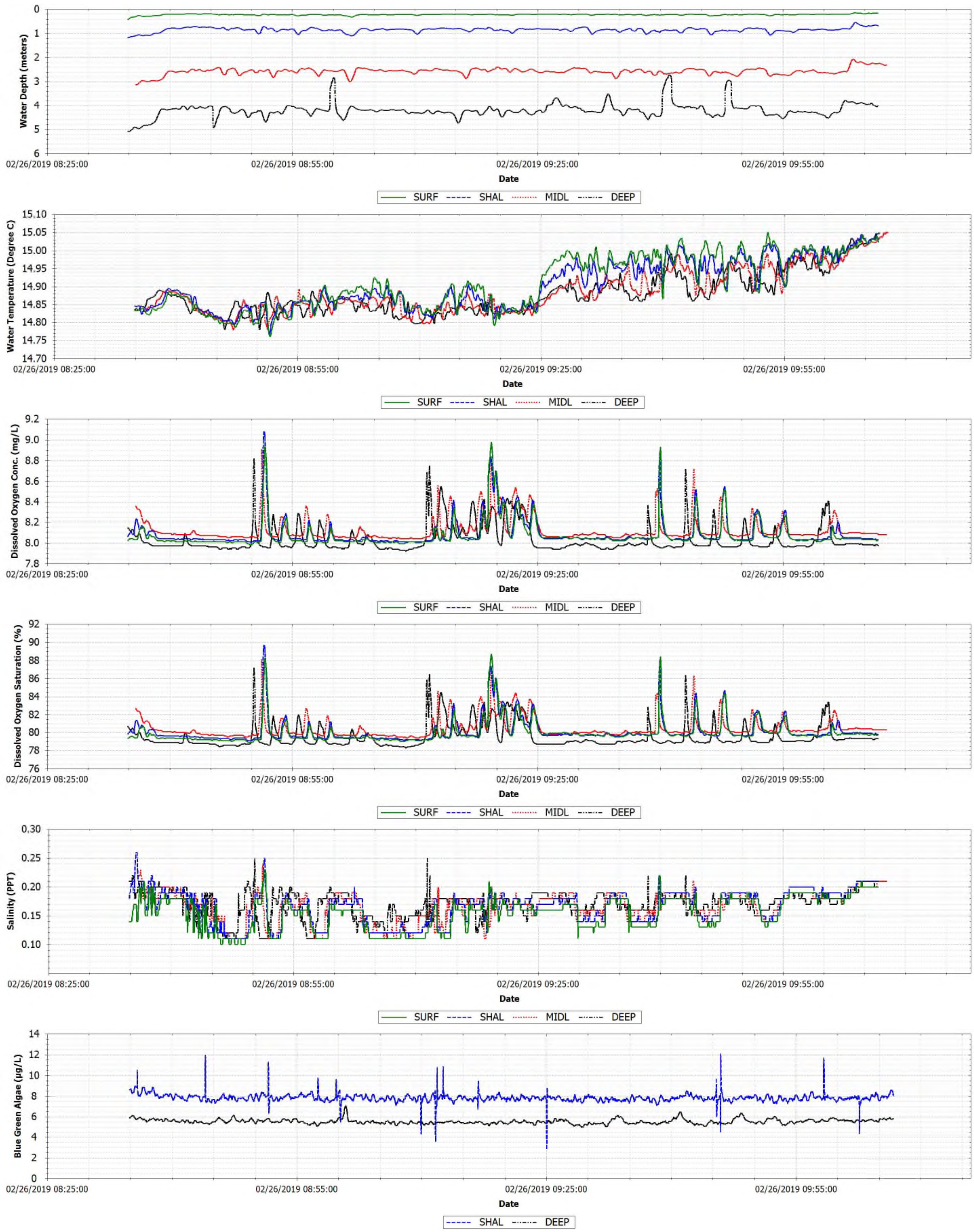


Figure D-12 Back River February 26, 2019 ebb tide drift observations

D.2 FRONT RIVER

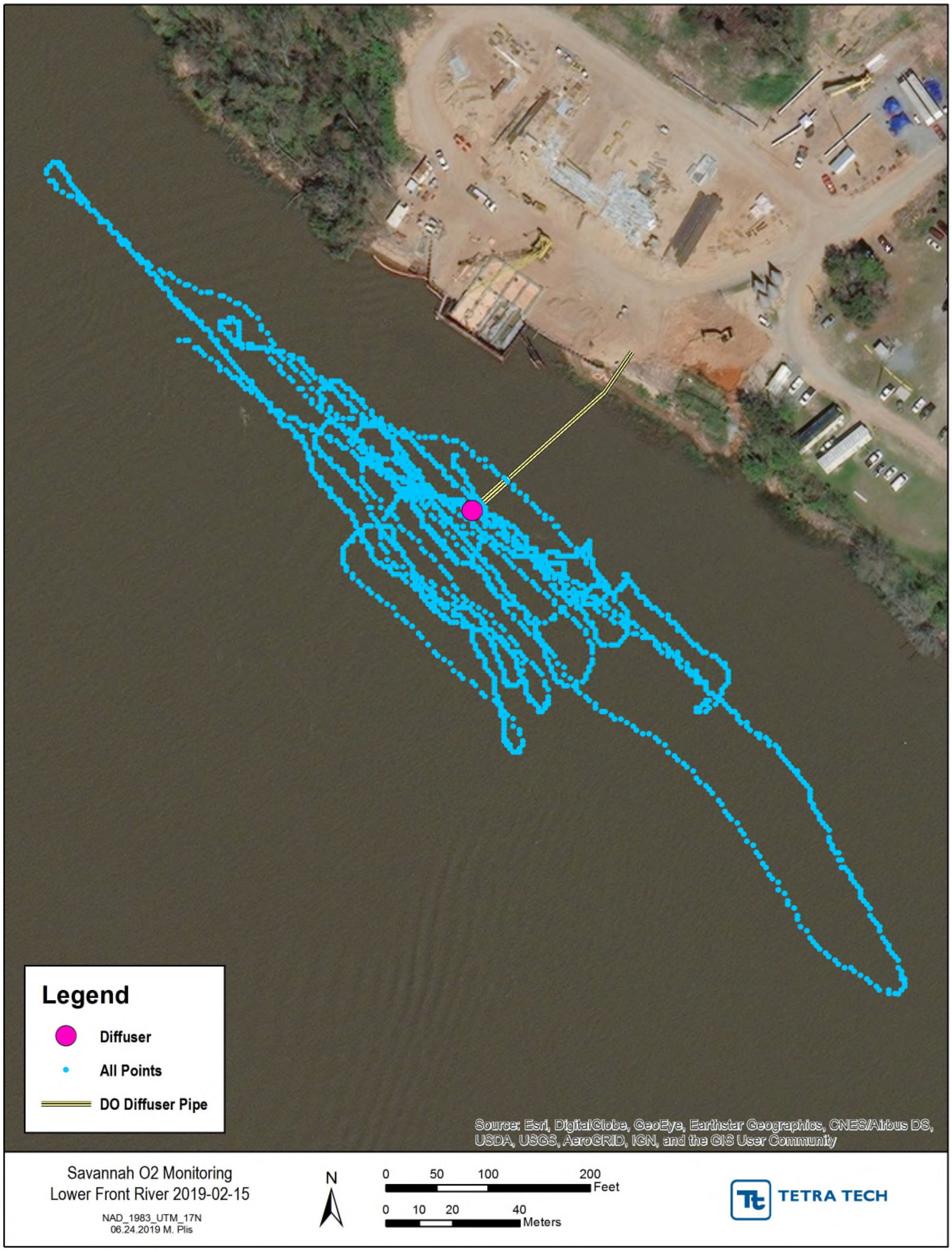


Figure D-13 Front River February 15, 2019 ebb tide drift location map

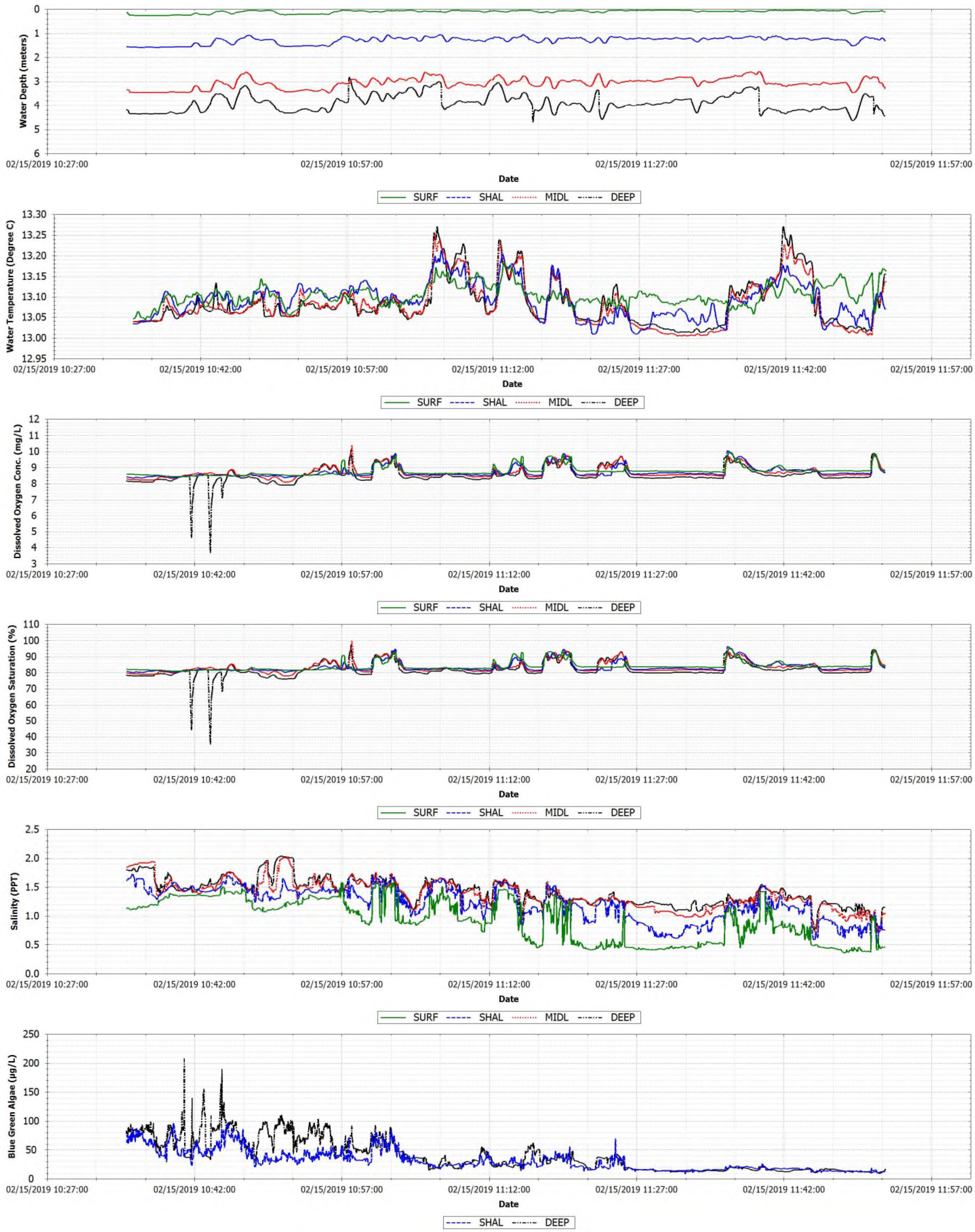


Figure D-14 Front River February 15, 2019 ebb tide drift observations

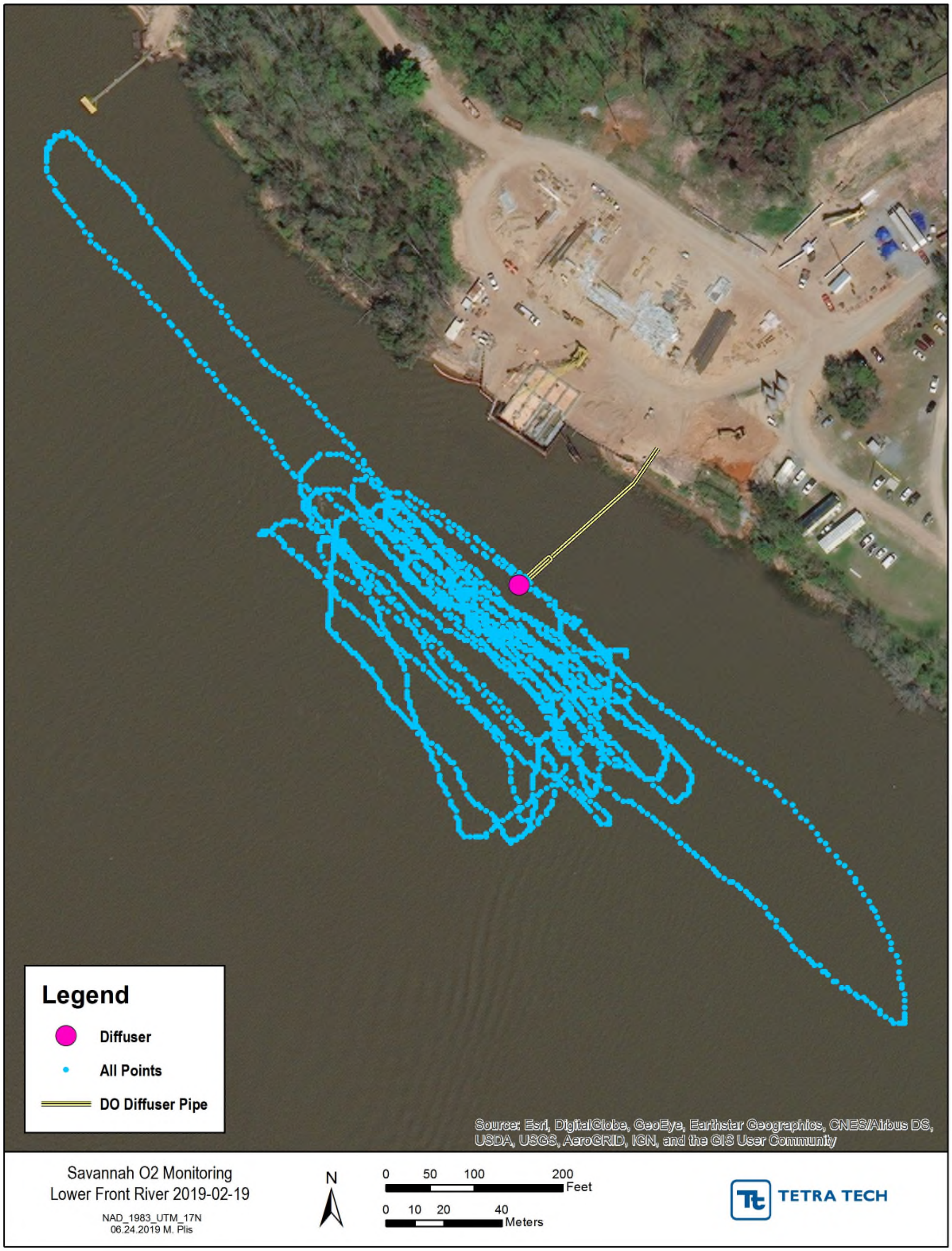


Figure D-15 Front River February 19, 2019 flood tide drift location map

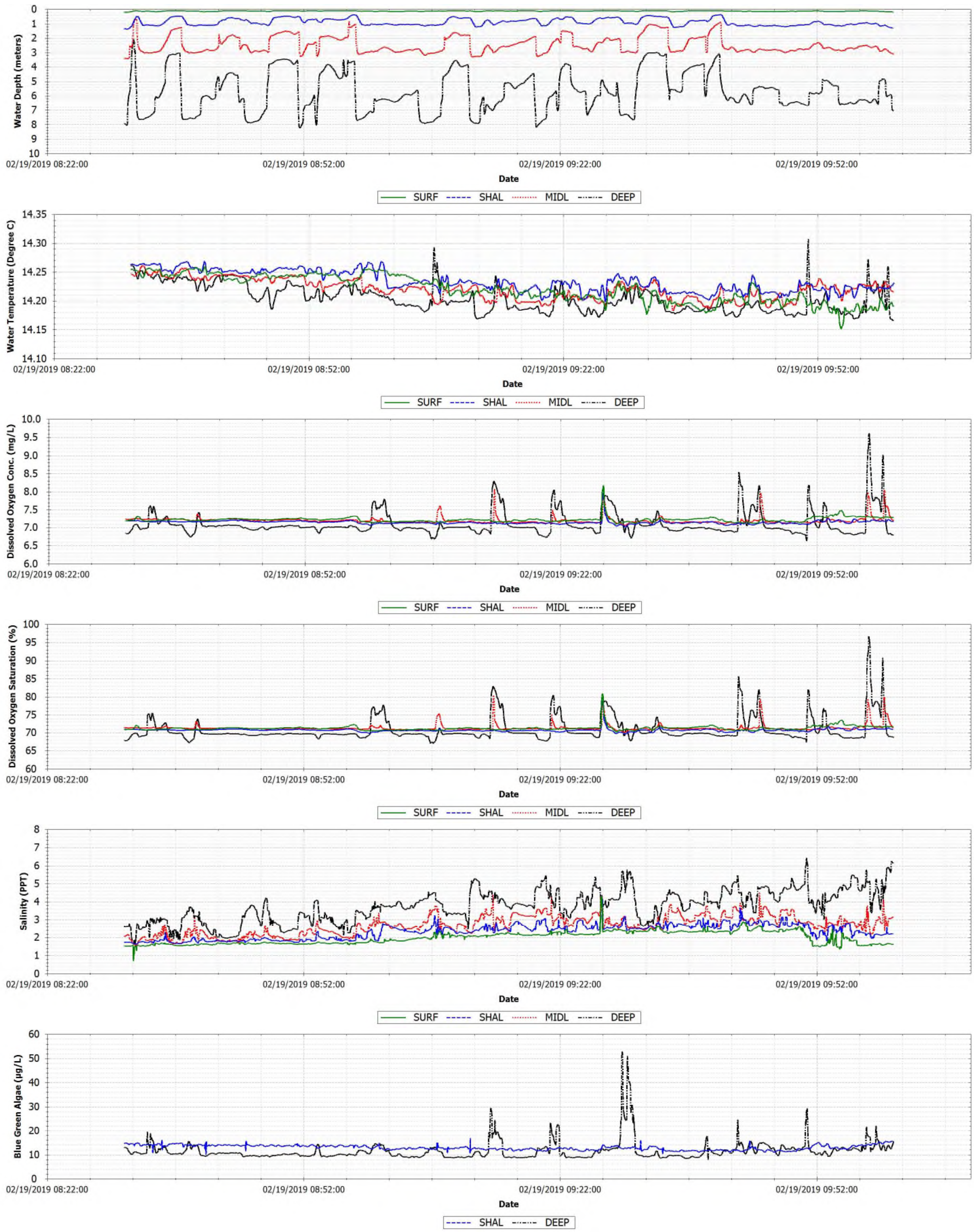


Figure D-16 Front River February 19, 2019 flood tide drift observations

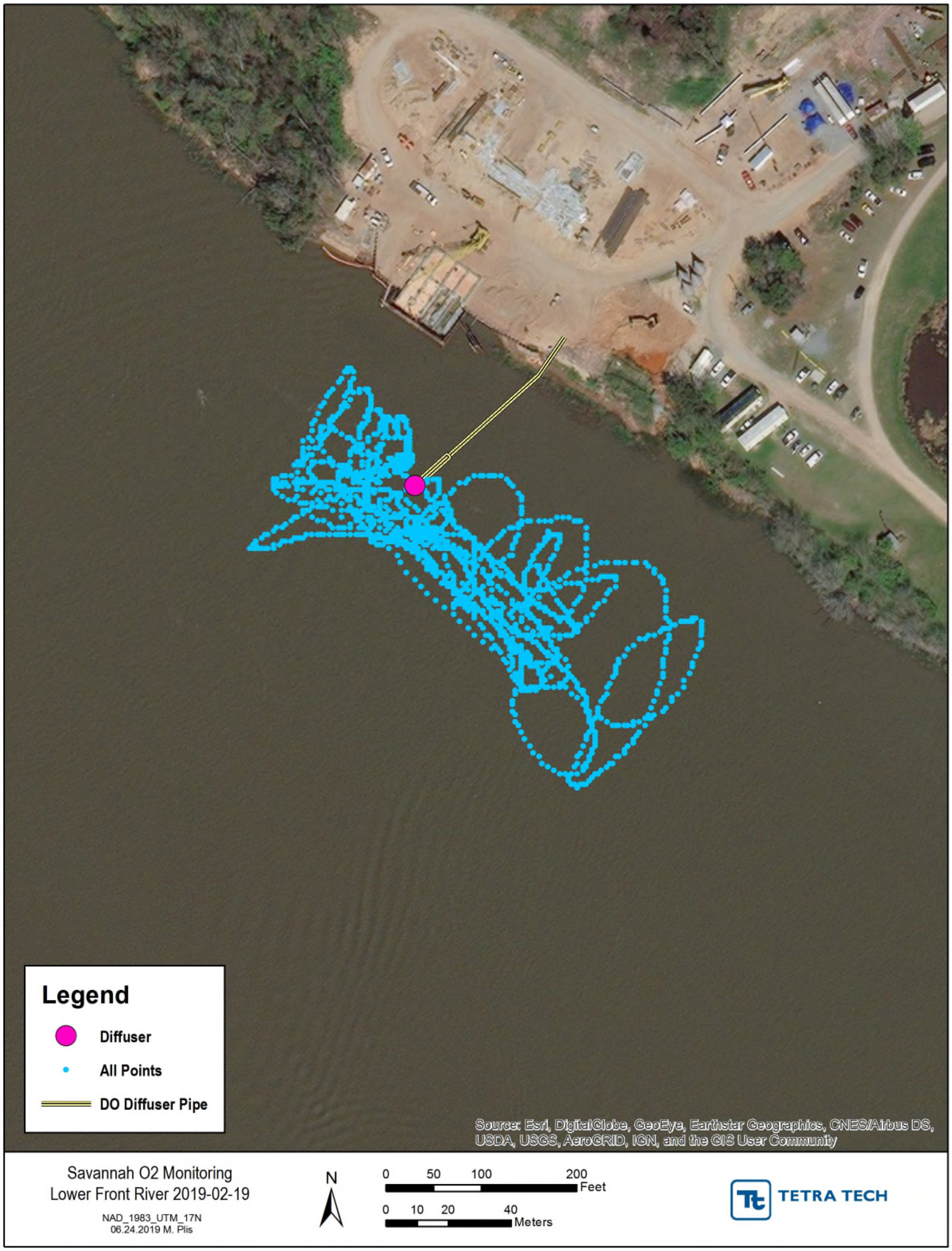


Figure D-17 Front River February 19, 2019 ebb tide drift location map

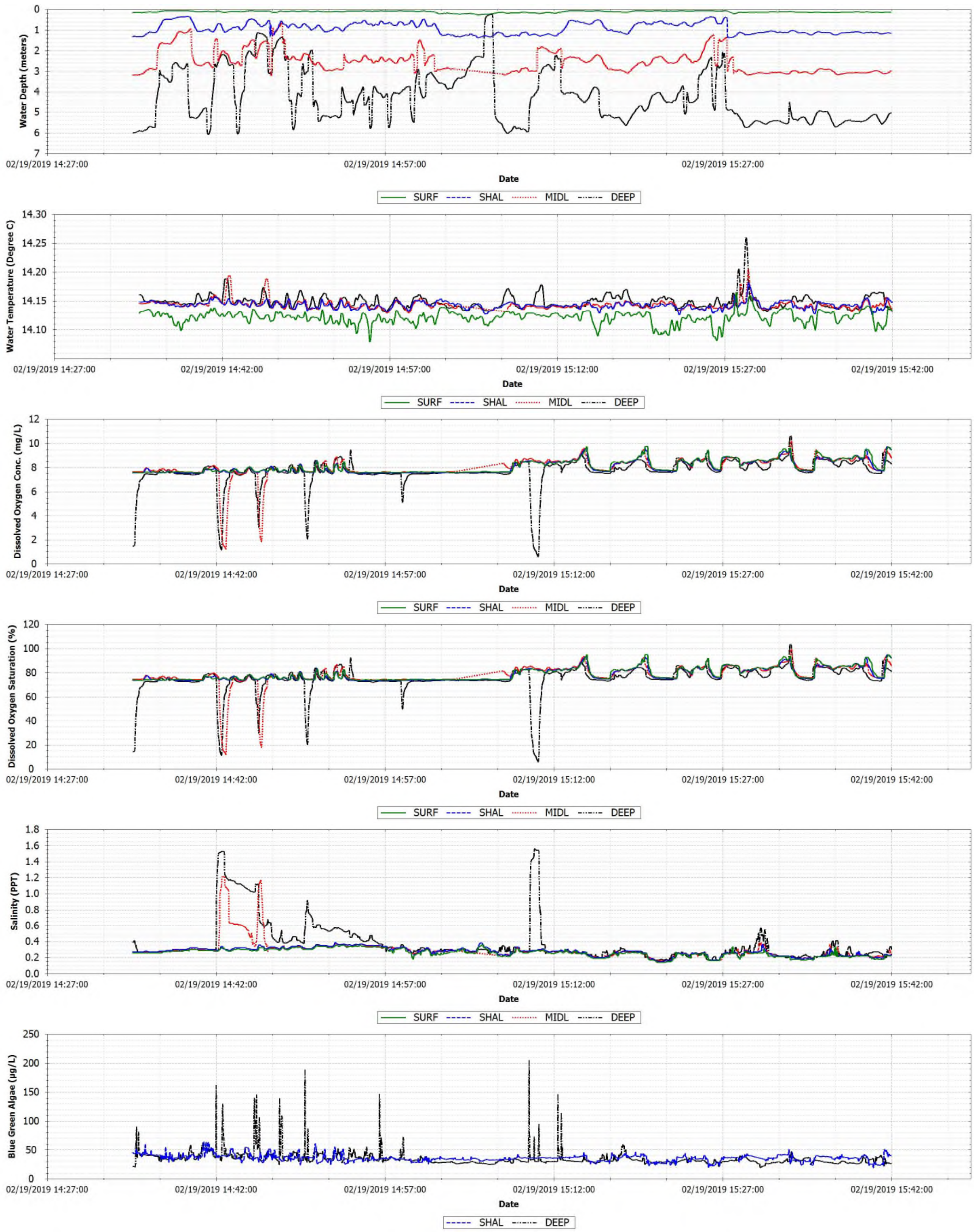


Figure D-18 Front River February 19, 2019 ebb tide drift observations

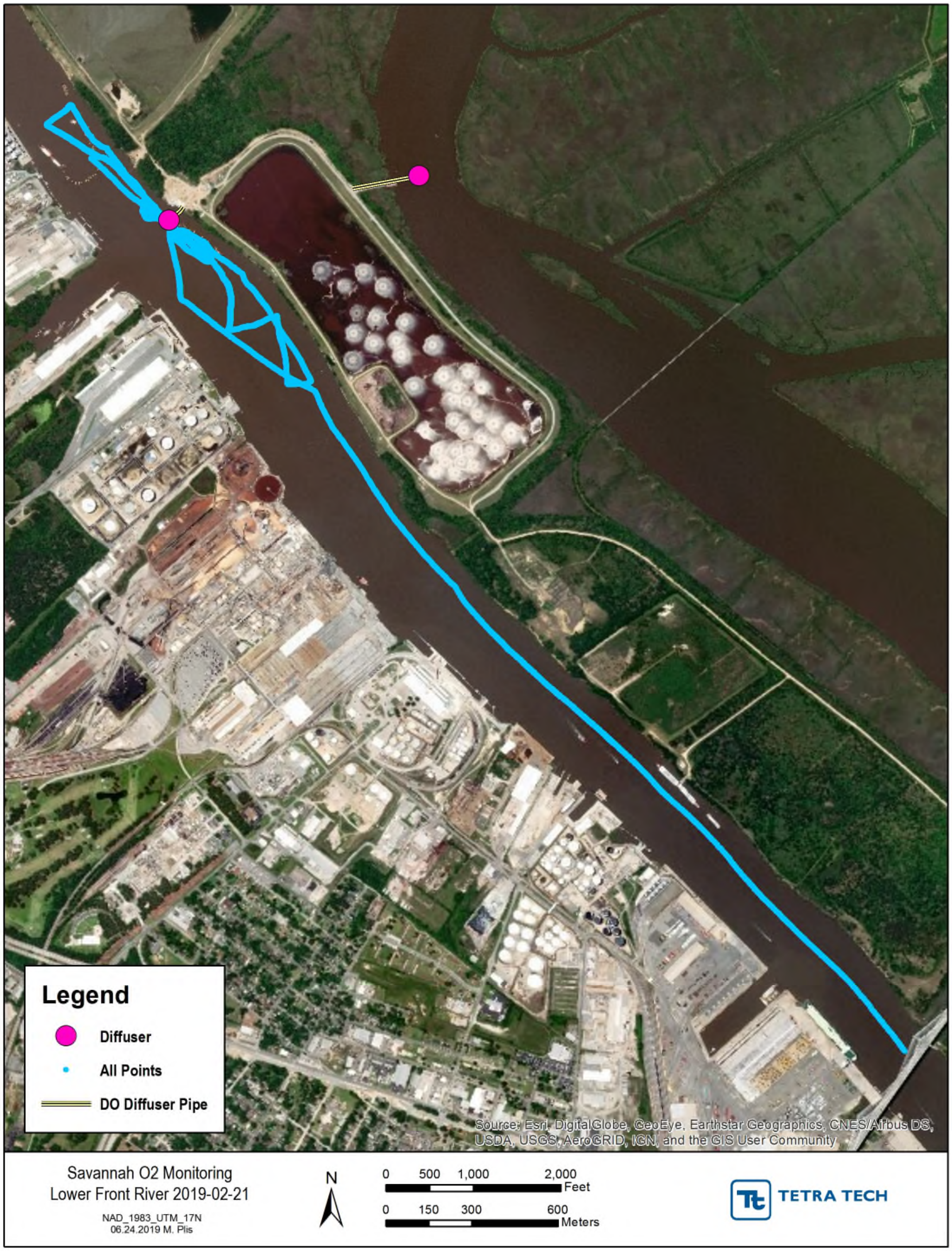


Figure D-19 Front River February 21, 2019 flood tide dye drift location map

Figure D-20 Front River February 21, 2019 flood tide dye drift observations

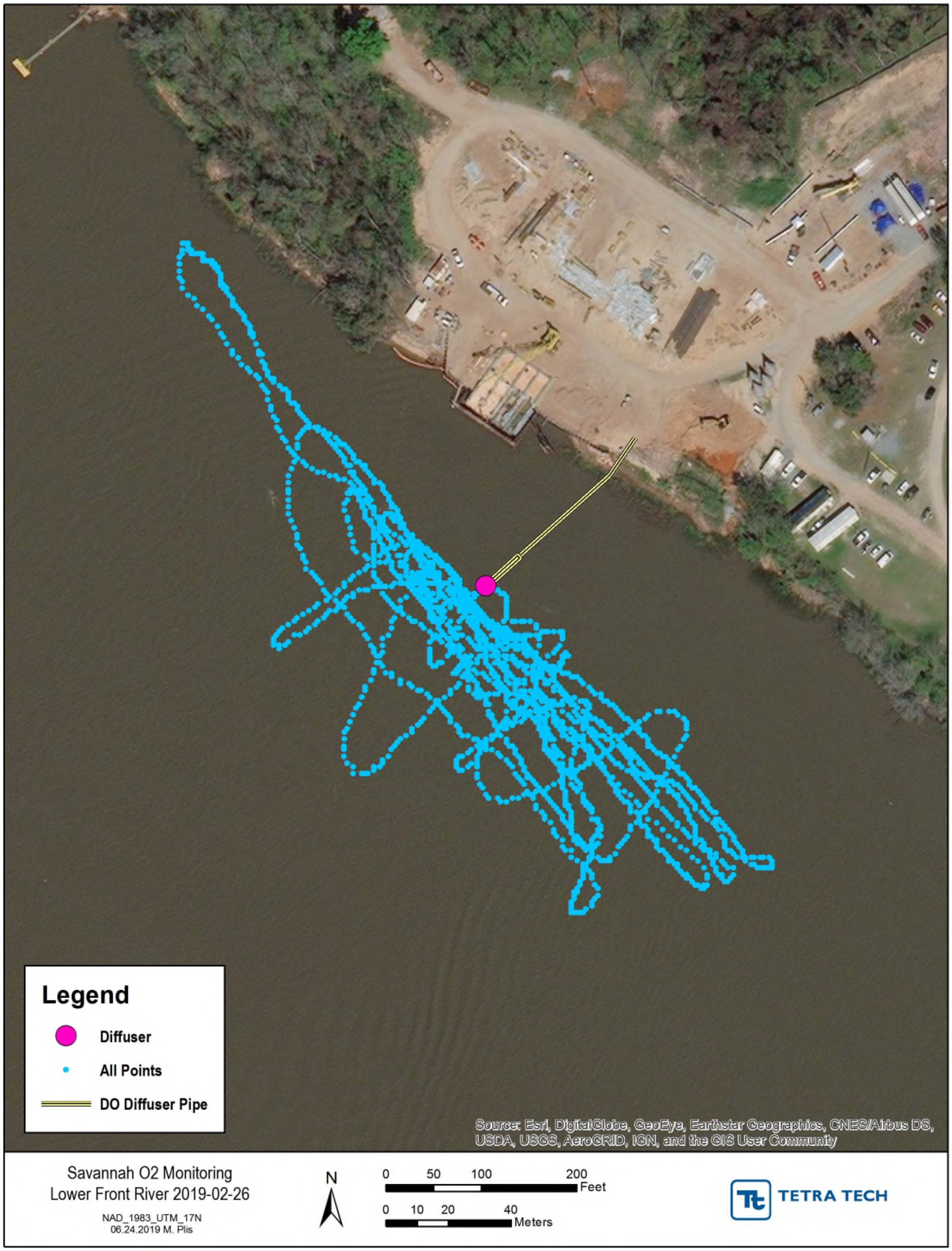


Figure D-21 Front River February 26, 2019 flood tide drift location map

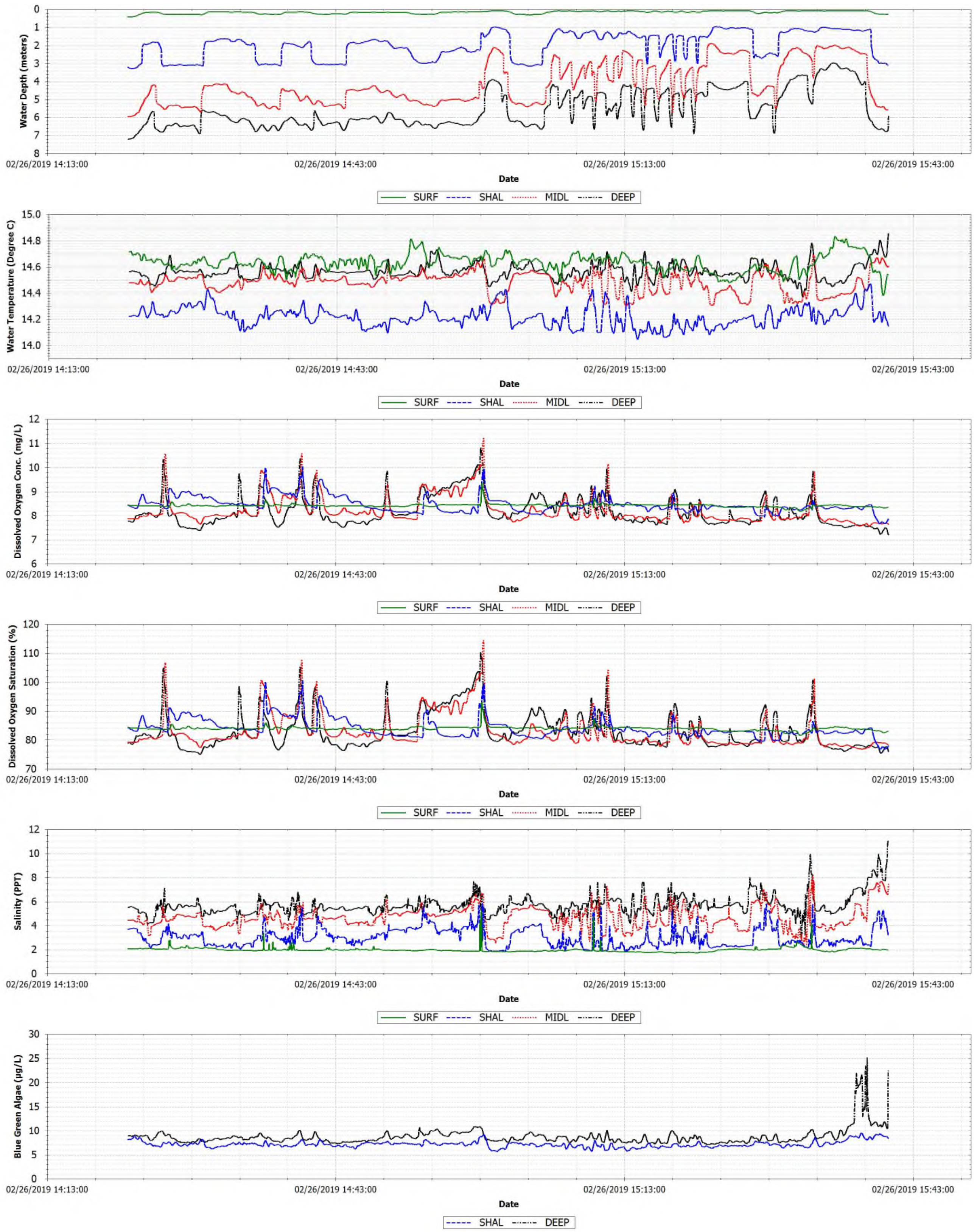


Figure D-22 Front River February 26, 2019 flood tide drift observations

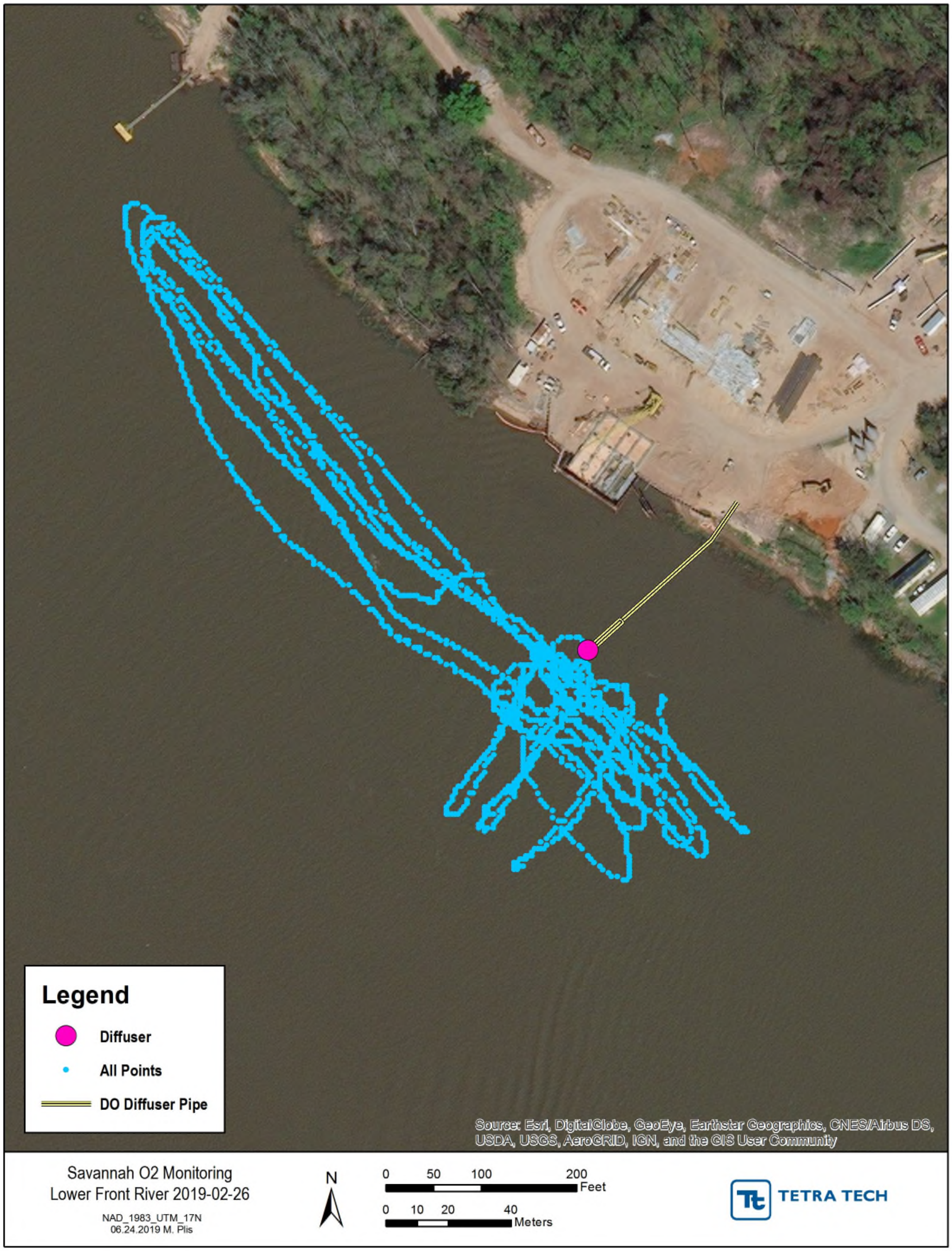


Figure D-23 Front River February 26, 2019 ebb tide drift location map

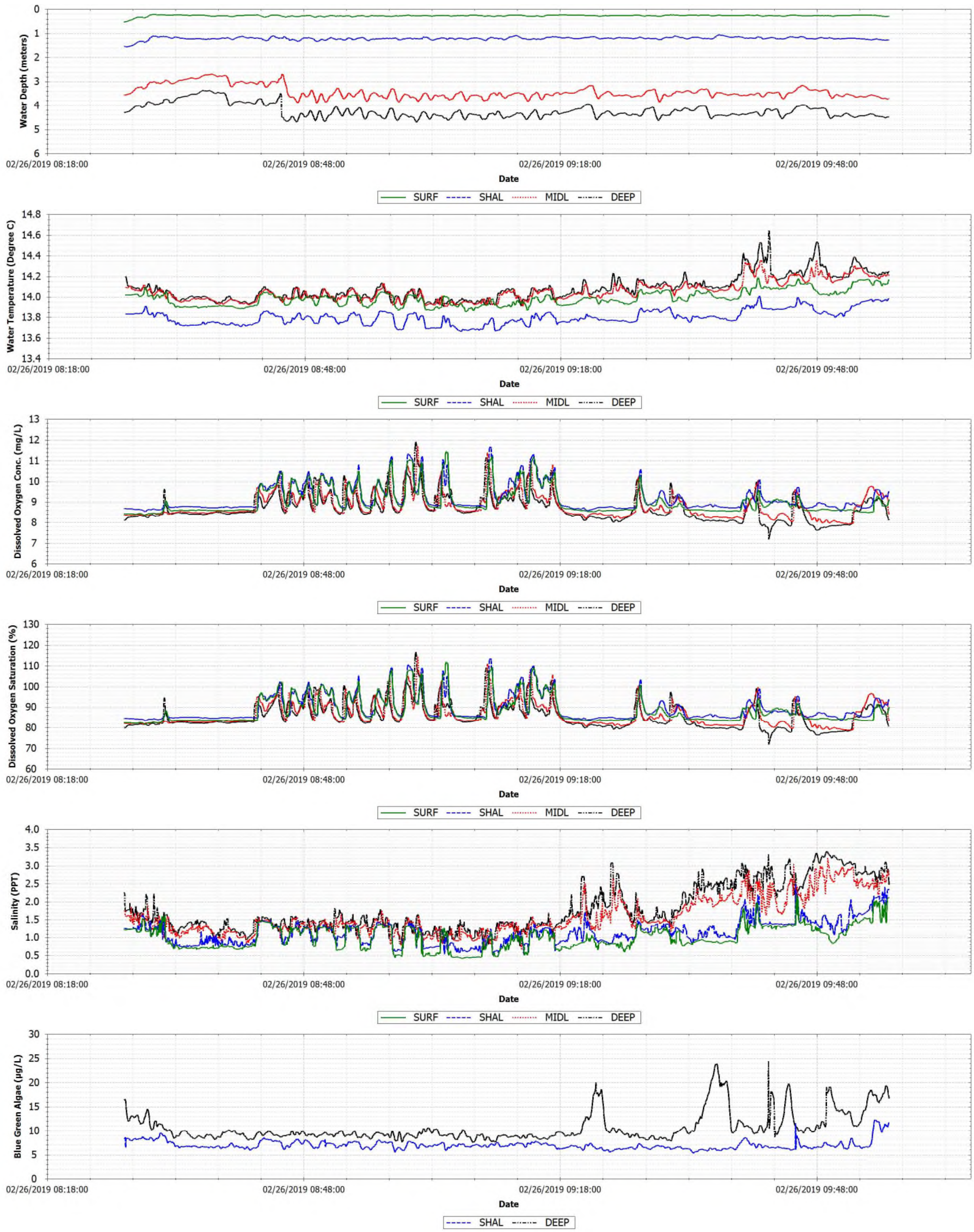


Figure D-24 Front River February 26, 2019 ebb tide drift observations

APPENDIX E USGS DATA

APPENDIX E TABLE OF CONTENTS

APPENDIX E LIST OF FIGURES

APPENDIX E LIST OF TABLES

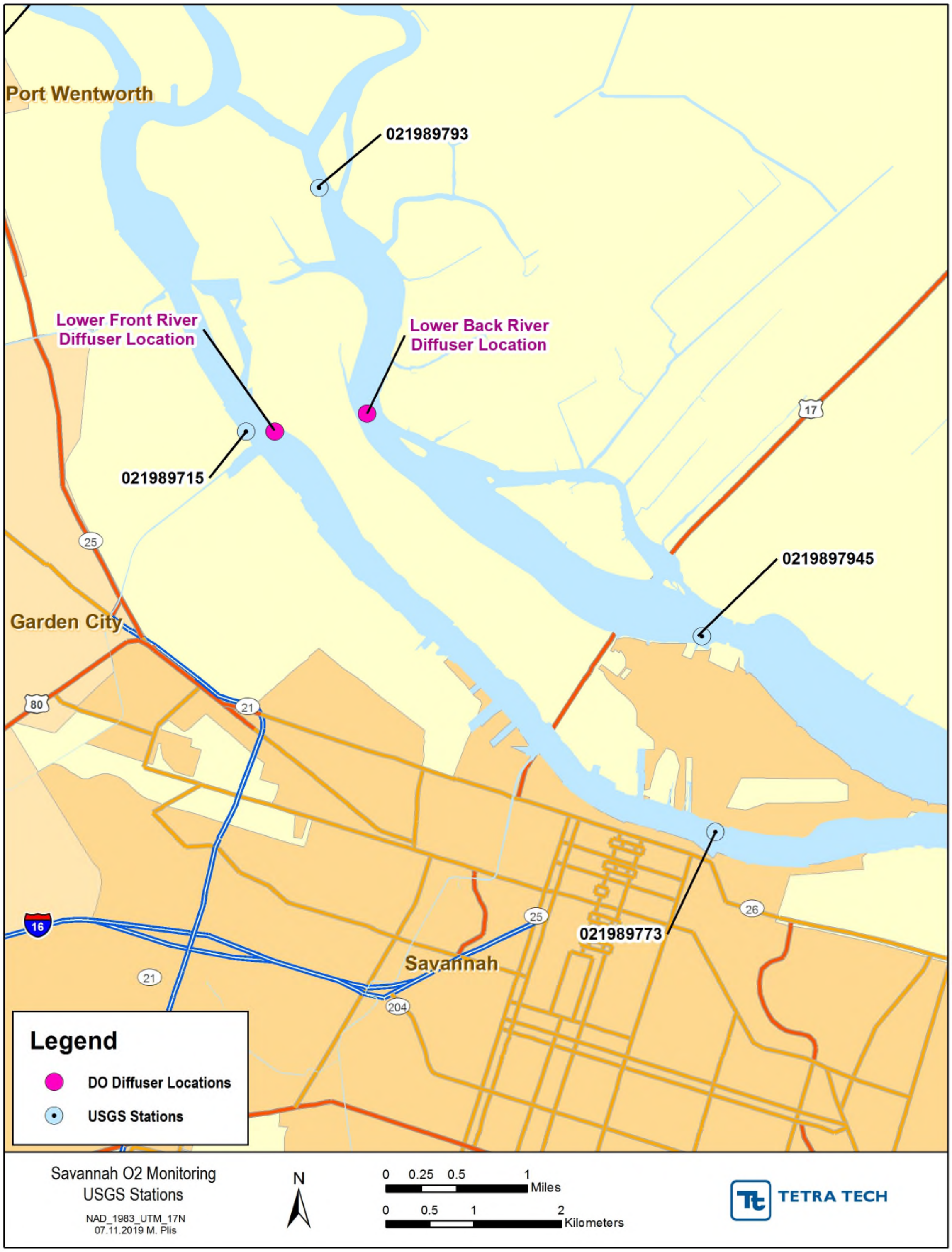


Figure E-1 Location of USGS gages used for water column transfer efficiency sampling

Table E-1 Attributes of semi-permanent buoys used for the WCTE study data collection

Station ID	Description
021989793	Little Back River at Hog Island, near Savannah, GA
0219897945	Back River 0.4 miles downstream US17, near Savannah, GA
021989715	Savannah River at Garden City, GA
021989773	Savannah River at USACE Dock, at Savannah, GA

Table E-2 Definitions of abbreviations

Abbreviation	Definition
BARO	barometric pressure
DOSAT	dissolved oxygen percent saturation
DOSAT (-23.28ft, NAVD88)	dissolved oxygen percent saturation [sampled at elevation -23.28ft, NAVD88]
DOSAT (-13.25ft NAVD88)	dissolved oxygen percent saturation [sampled at elevation -13.25ft NAVD88]
DO	dissolved oxygen, water, unfiltered
DO (-23.28ft, NAVD88)	dissolved oxygen, water, unfiltered [sampled at elevation -23.28ft, NAVD88]
DO (-13.25ft NAVD88)	dissolved oxygen, water, unfiltered [sampled at elevation -13.25ft NAVD88]
DEPTH	depth of sensor below water surface
FLOW	discharge
GH	gage height
pH	pH, water, unfiltered
pH (-13.25ft NAVD88)	pH, water, unfiltered [sampled at elevation -13.25ft NAVD88]
SAL	salinity, unfiltered
SAL (-23.28ft, NAVD88)	salinity, unfiltered [sampled at elevation -23.28ft, NAVD88]
SAL (-13.25ft NAVD88)	salinity, unfiltered [sampled at elevation -13.25ft NAVD88]
SPCOND	specific conductance, water, unfiltered, at 25 degrees Celsius
SPCOND (-23.28ft, NAVD88)	specific conductance, water, unfiltered, at 25 degrees Celsius [sampled at elevation -23.28ft, NAVD88]
SPCOND (-13.25ft NAVD88)	specific conductance, water, unfiltered, at 25 degrees Celsius [sampled at elevation -13.25ft NAVD88]
TURB	turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +-2.5 degrees
TURB (-13.25ft NAVD88)	turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +-2.5 degrees [sampled at elevation -13.25ft NAVD88]
VEL	mean water velocity
WTEMP	temperature, water
WTEMP (-23.28ft, NAVD88)	Temperature, water [sampled at elevation -23.28ft, NAVD88]
WTEMP (-13.25ft NAVD88)	Temperature, water [sampled at elevation -13.25ft NAVD88]

E.1 USGS 021989715 – GARDEN CITY – FRONT RIVER

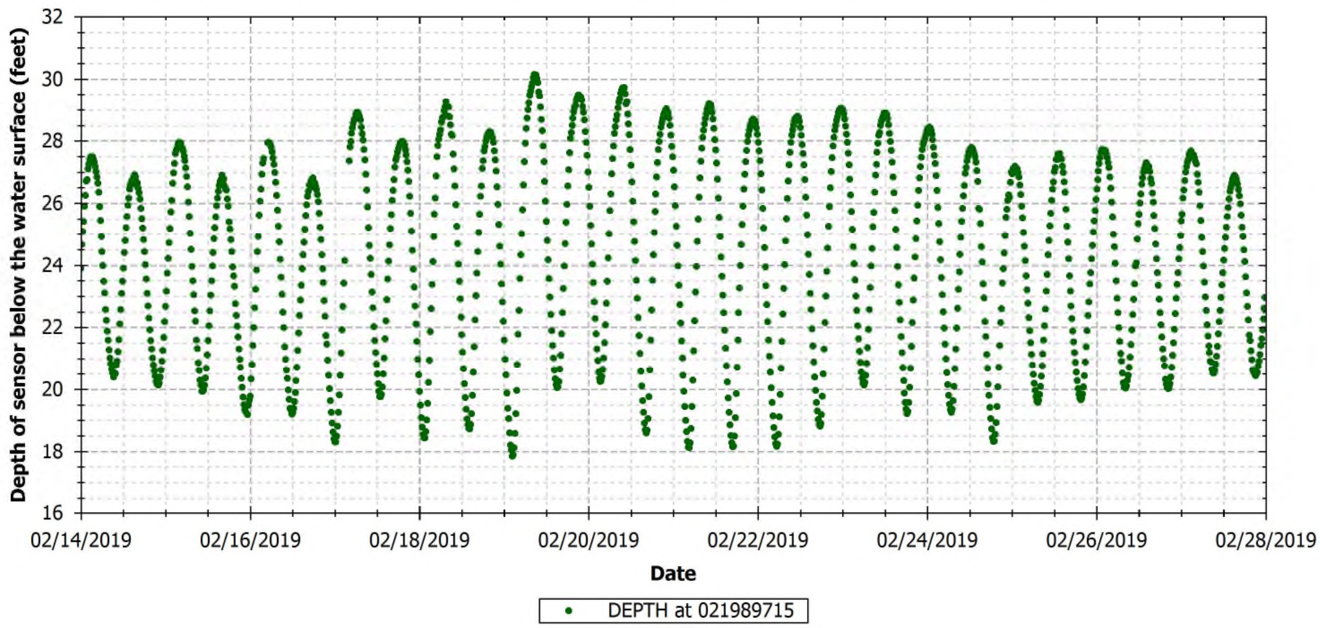


Figure E-2 USGS 021989715 (Front River) observed depth

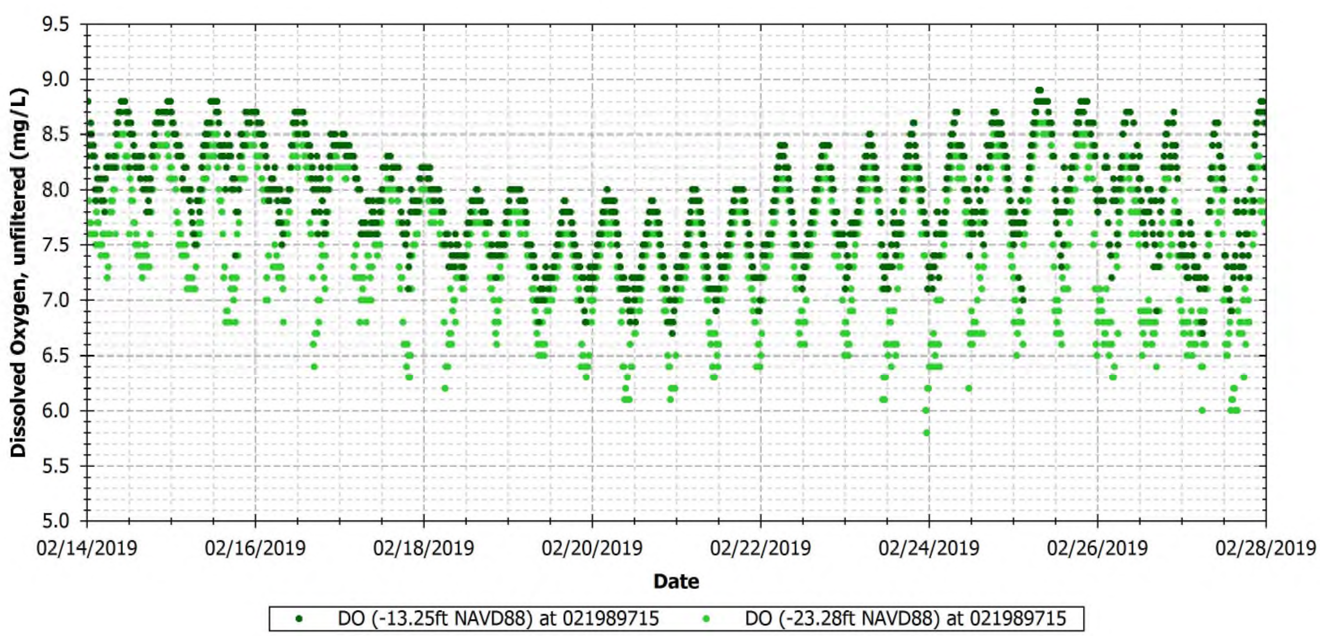


Figure E-3 USGS 021989715 (Front River) observed DO concentration

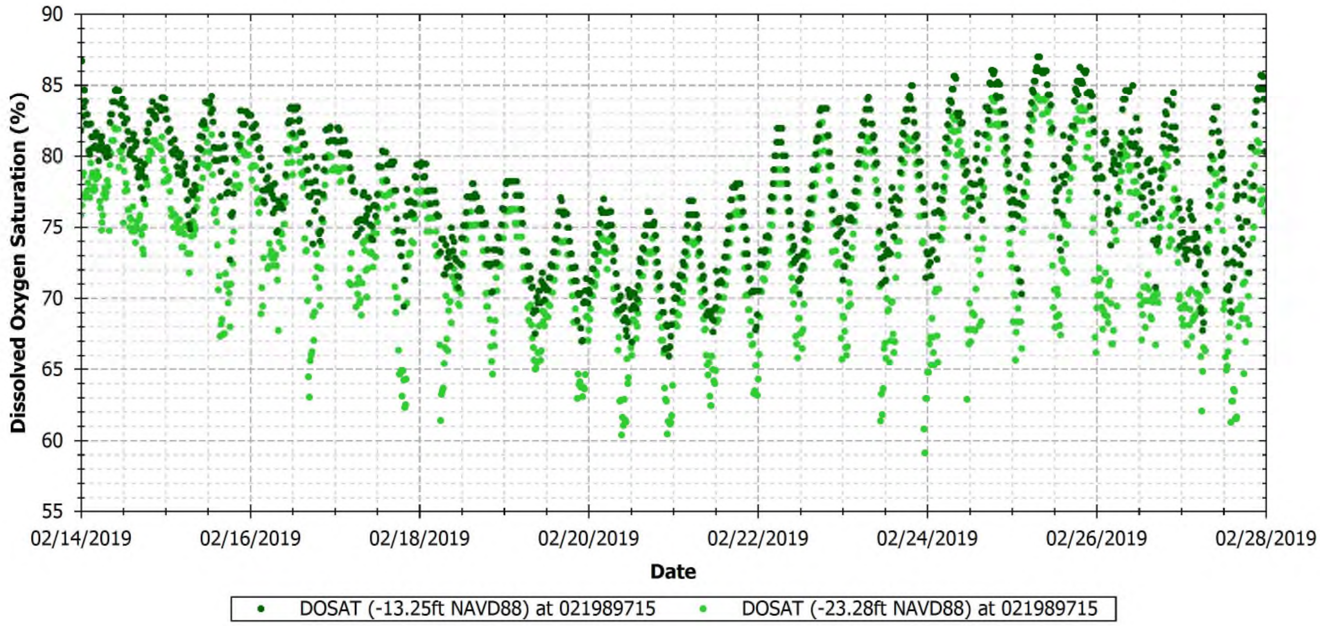


Figure E-4 USGS 021989715 (Front River) calculated DO saturation

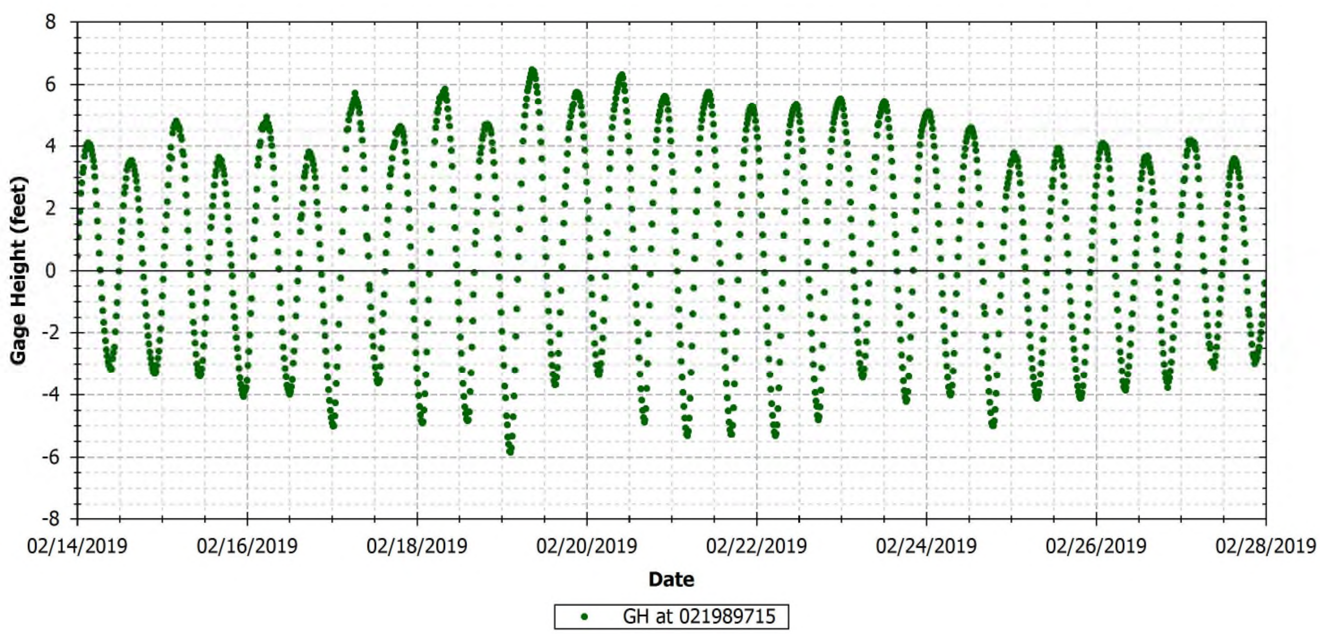


Figure E-5 USGS 021989715 (Front River) observed gage height

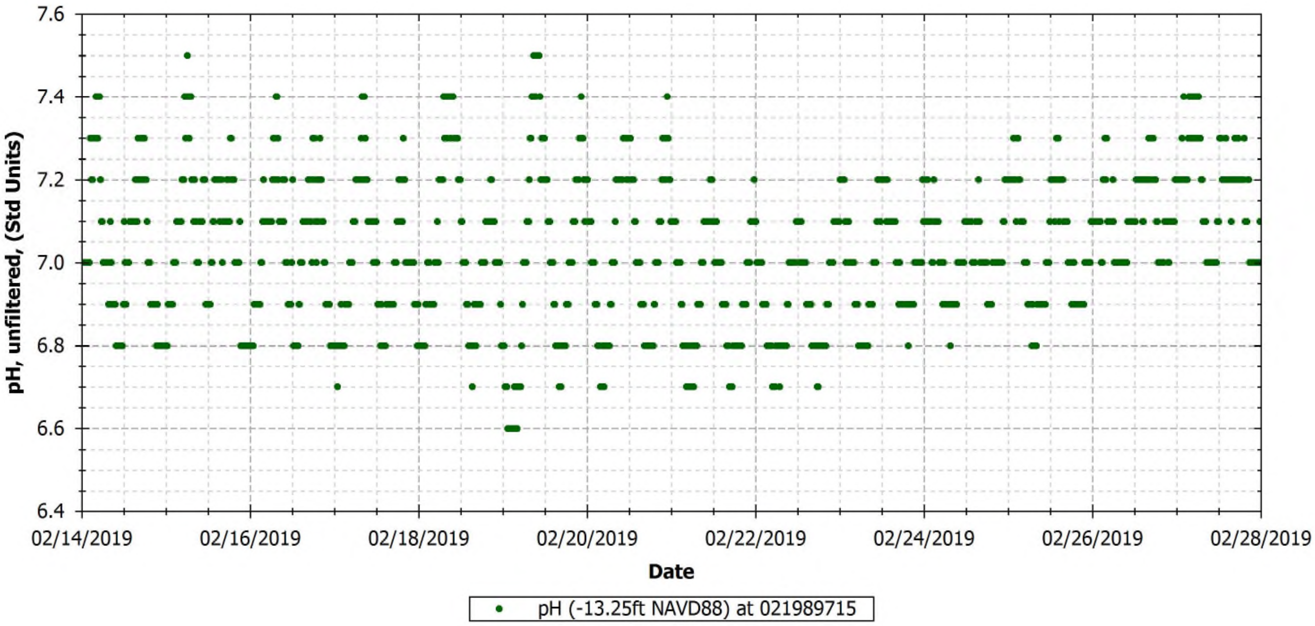


Figure E-6 USGS 021989715 (Front River) observed pH

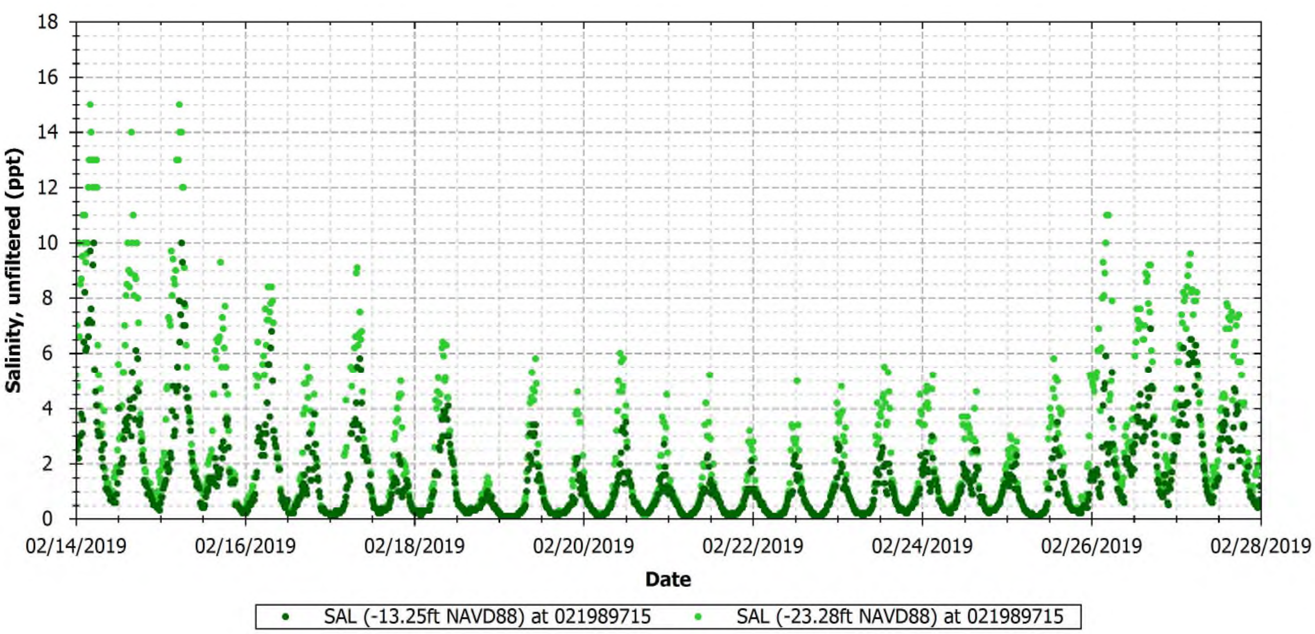


Figure E-7 USGS 021989715 (Front River) observed salinity

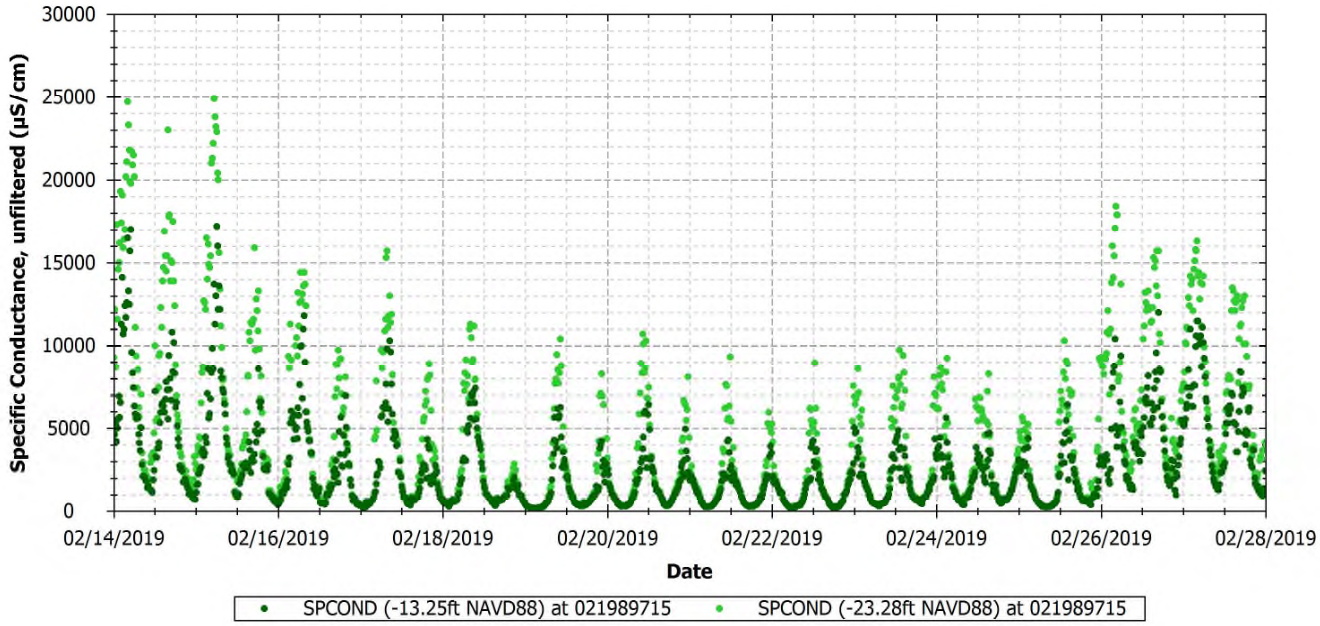


Figure E-8 USGS 021989715 (Front River) observed specific conductivity

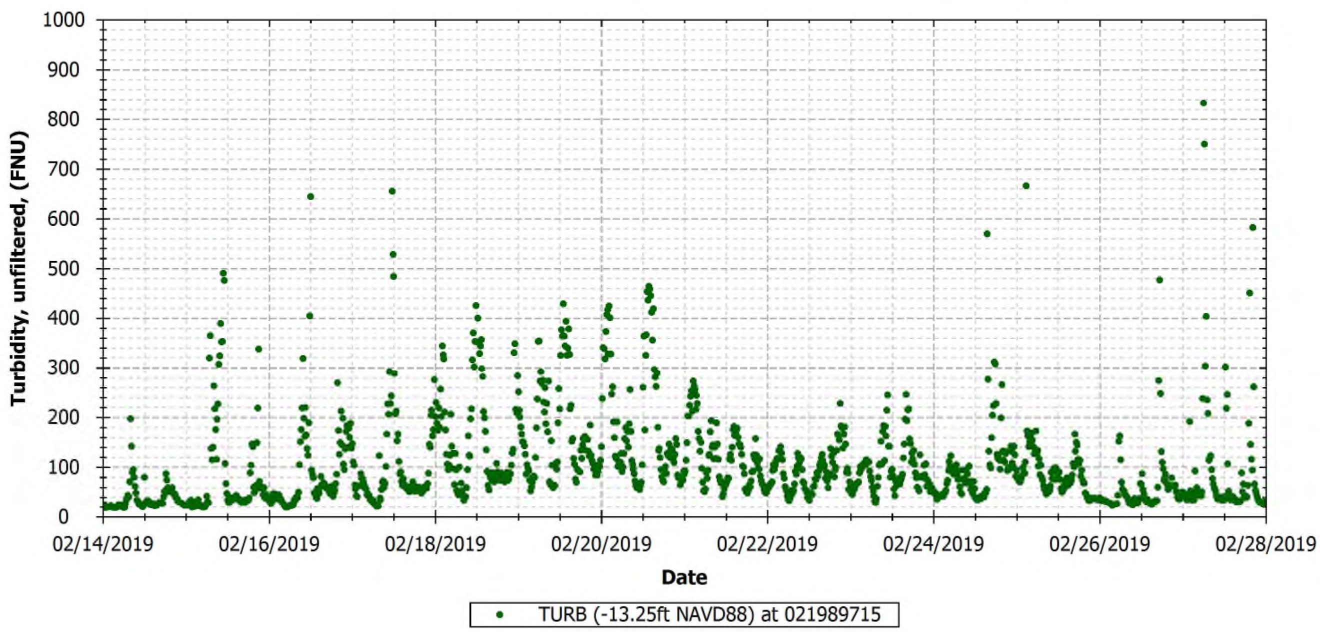


Figure E-9 USGS 021989715 (Front River) observed turbidity

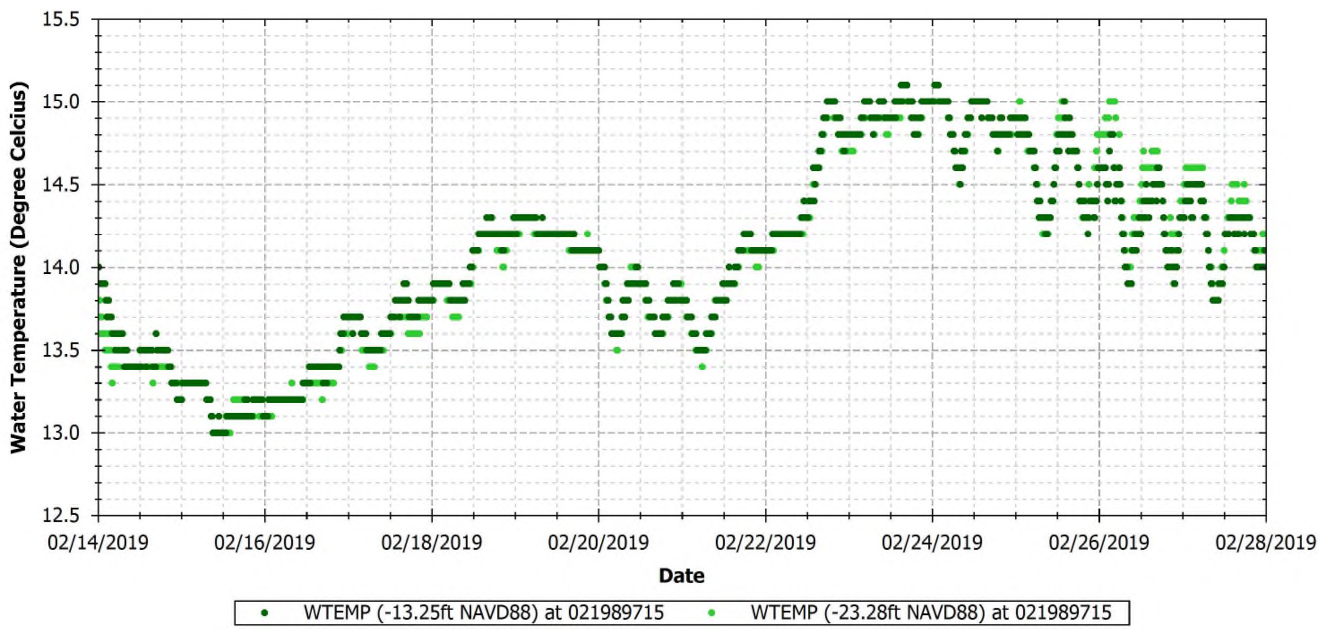


Figure E-10 USGS 021989715 (Front River) observed water temperature

E.2 USGS 021989773 – USACE DOCK – FRONT RIVER

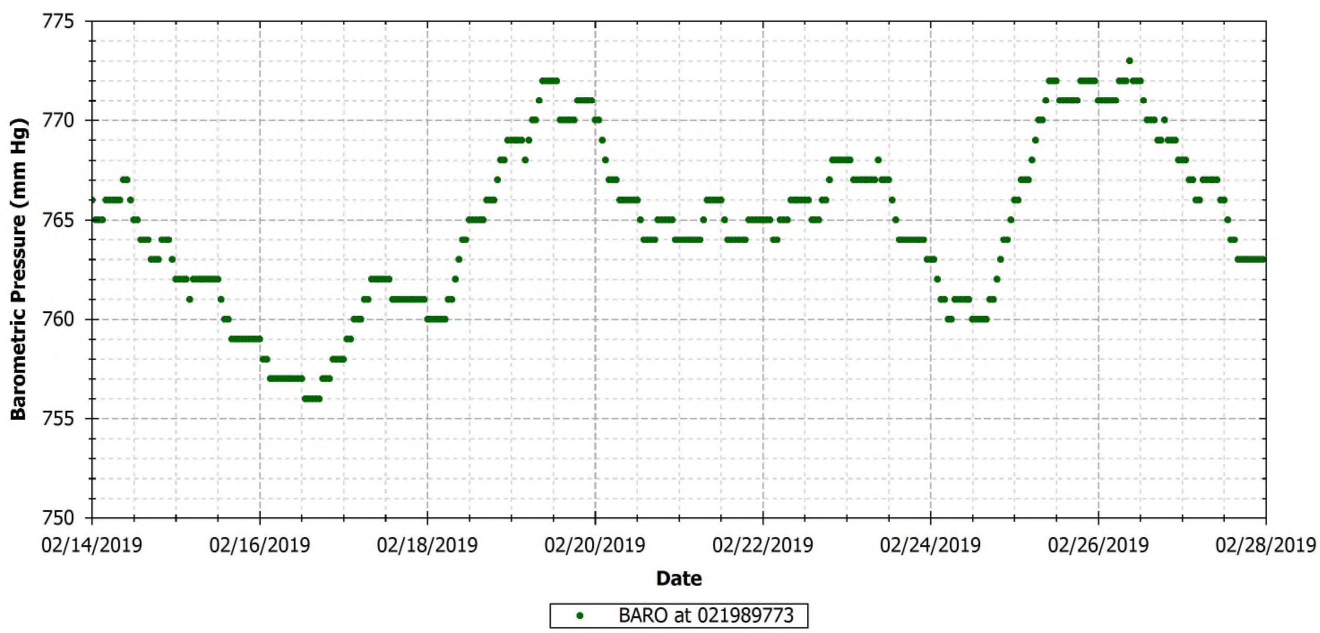


Figure E-11 USGS 021989773 (Front River) observed barometric pressure

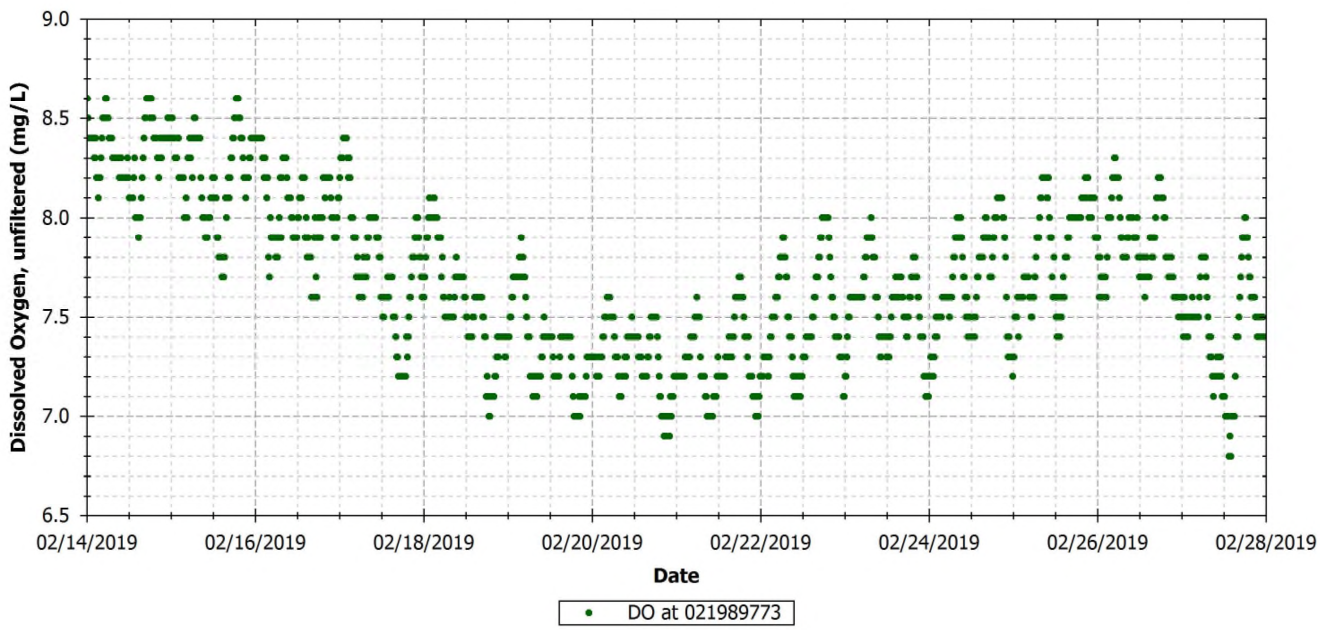


Figure E-12 USGS 021989773 (Front River) observed DO concentration

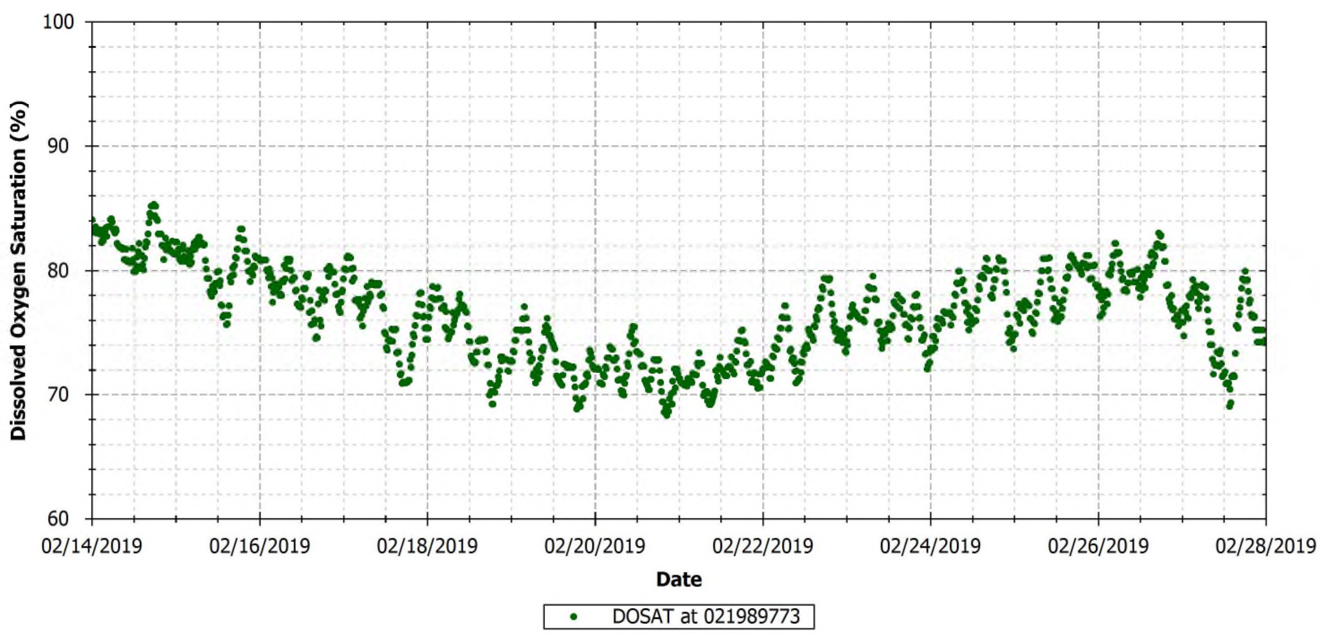


Figure E-13 USGS 021989773 (Front River) calculated DO saturation

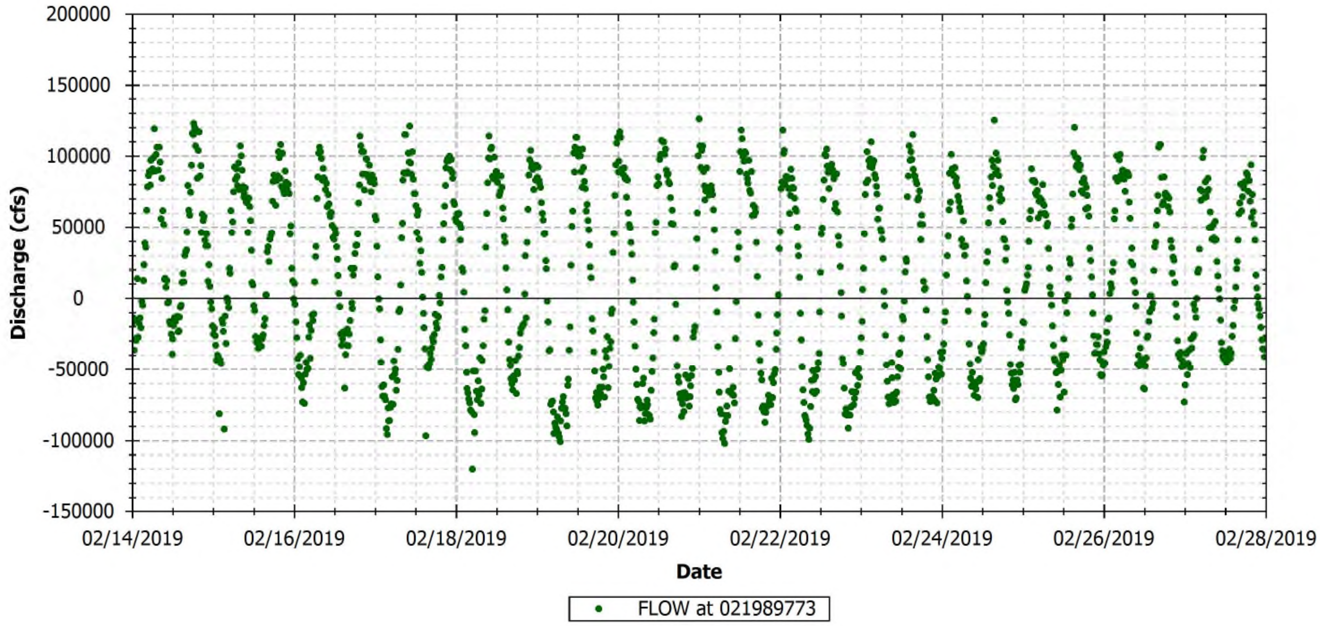


Figure E-14 USGS 021989773 (Front River) observed discharge

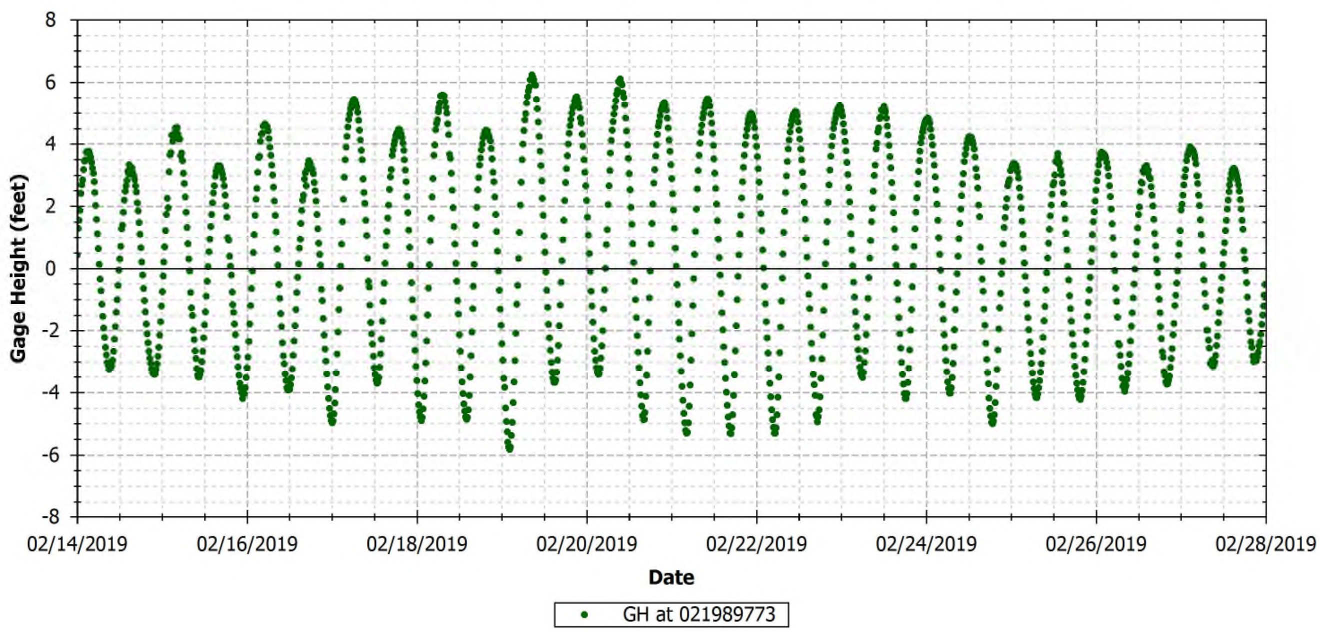


Figure E-15 USGS 021989773 (Front River) observed gage height

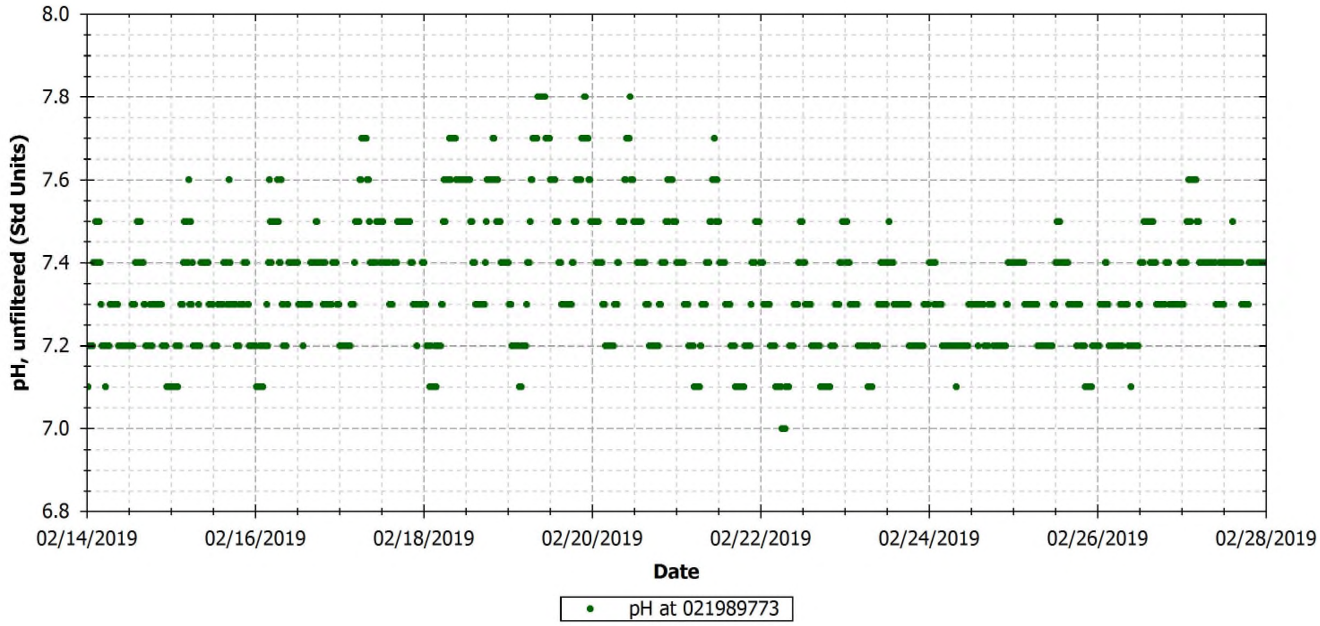


Figure E-16 USGS 021989773 (Front River) observed pH

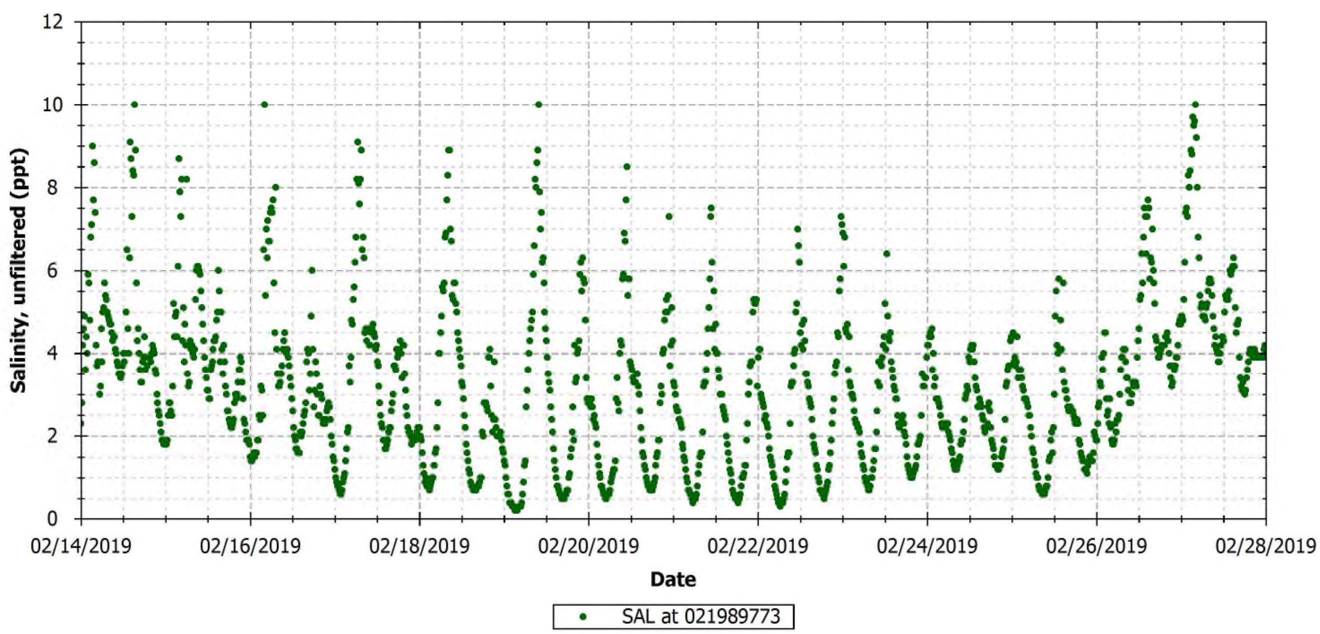


Figure E-17 USGS 021989773 (Front River) observed salinity

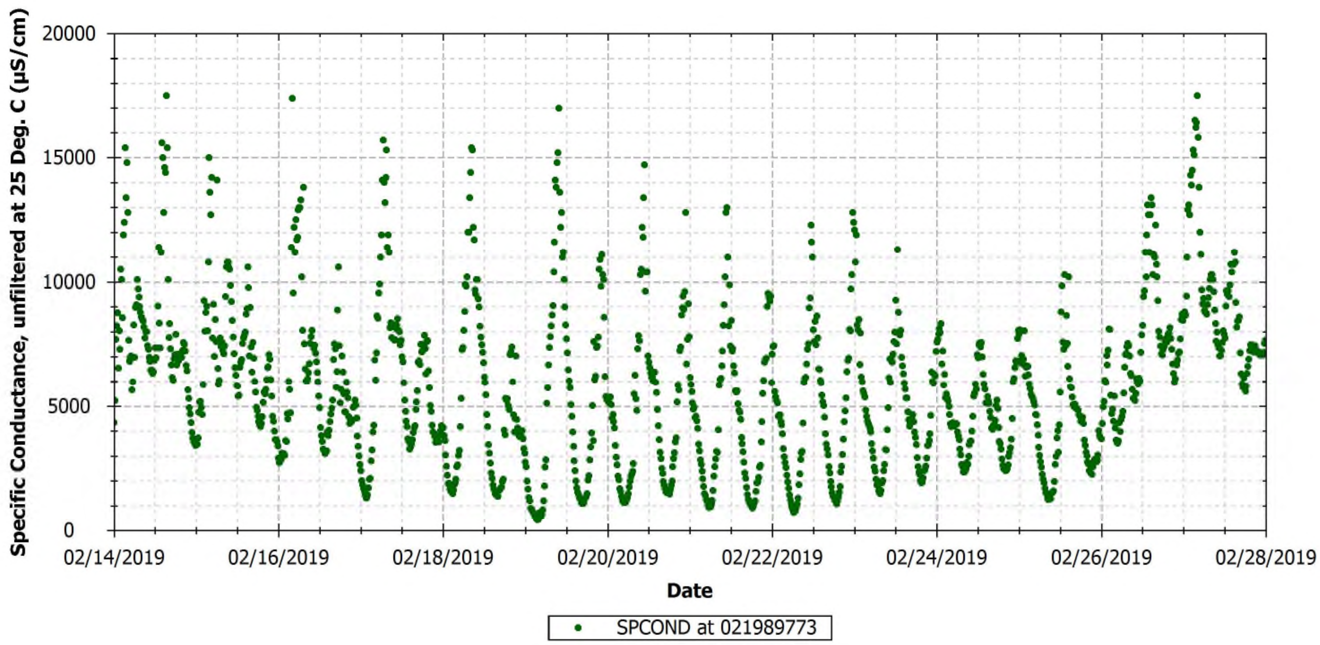


Figure E-18 USGS 021989773 (Front River) observed specific conductivity

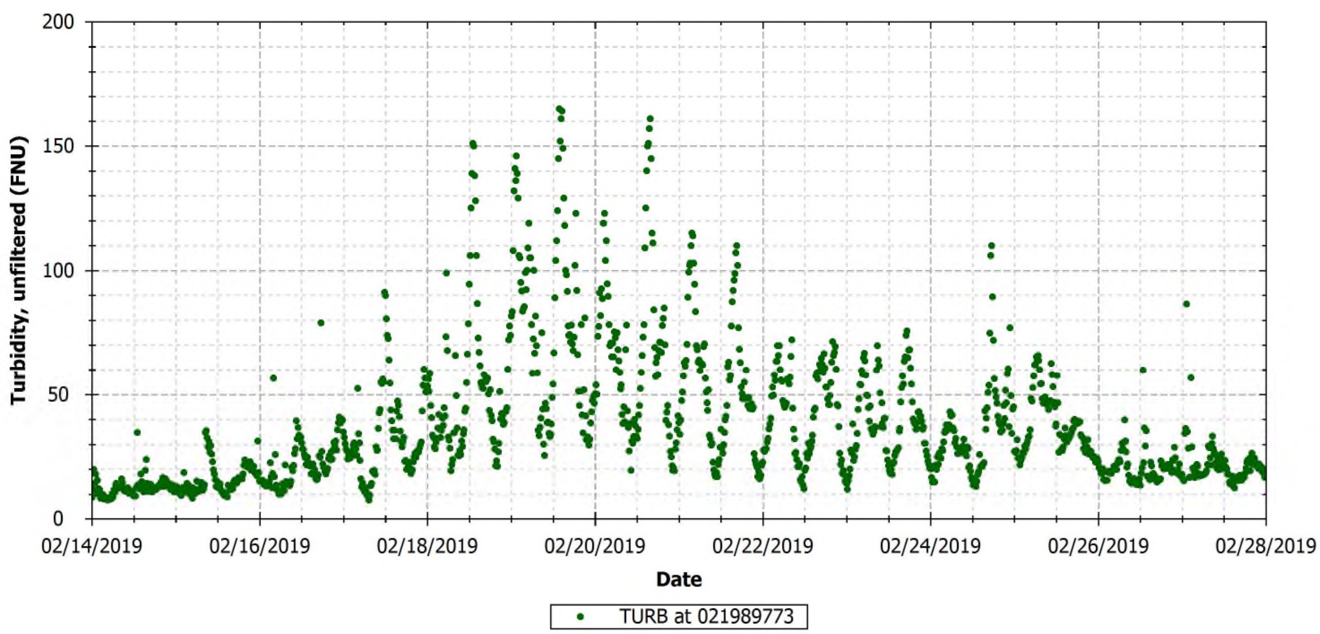


Figure E-19 USGS 021989773 (Front River) observed turbidity

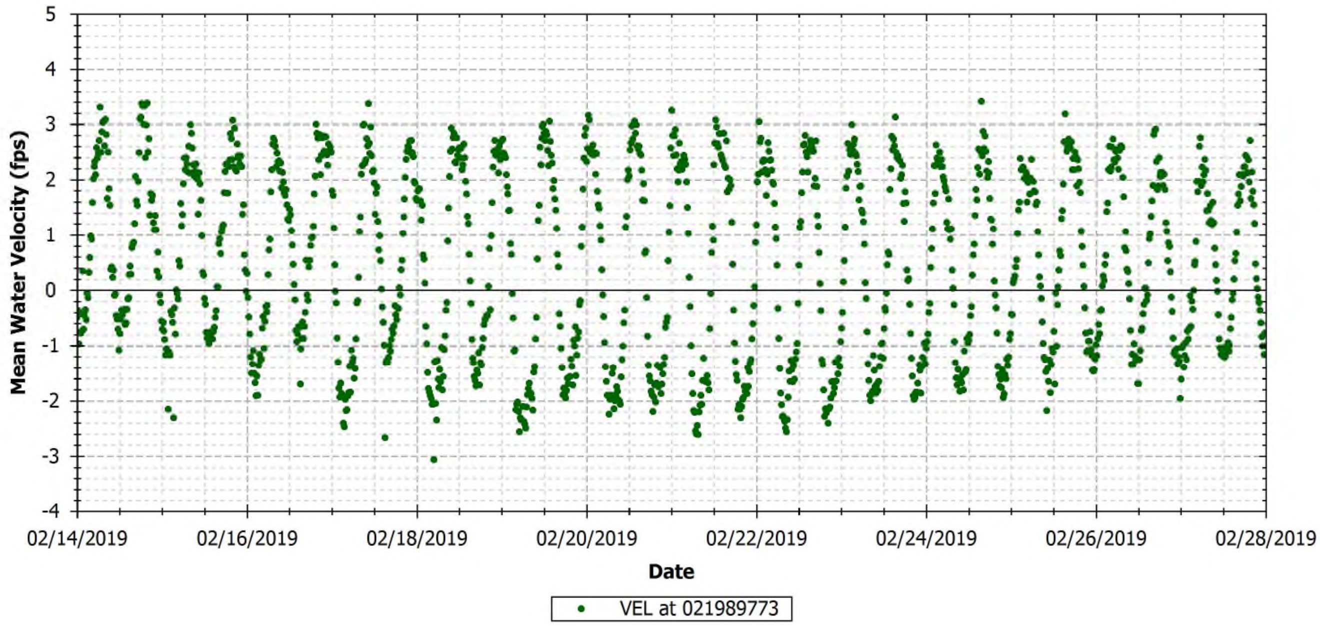


Figure E-20 USGS 021989773 (Front River) observed velocity

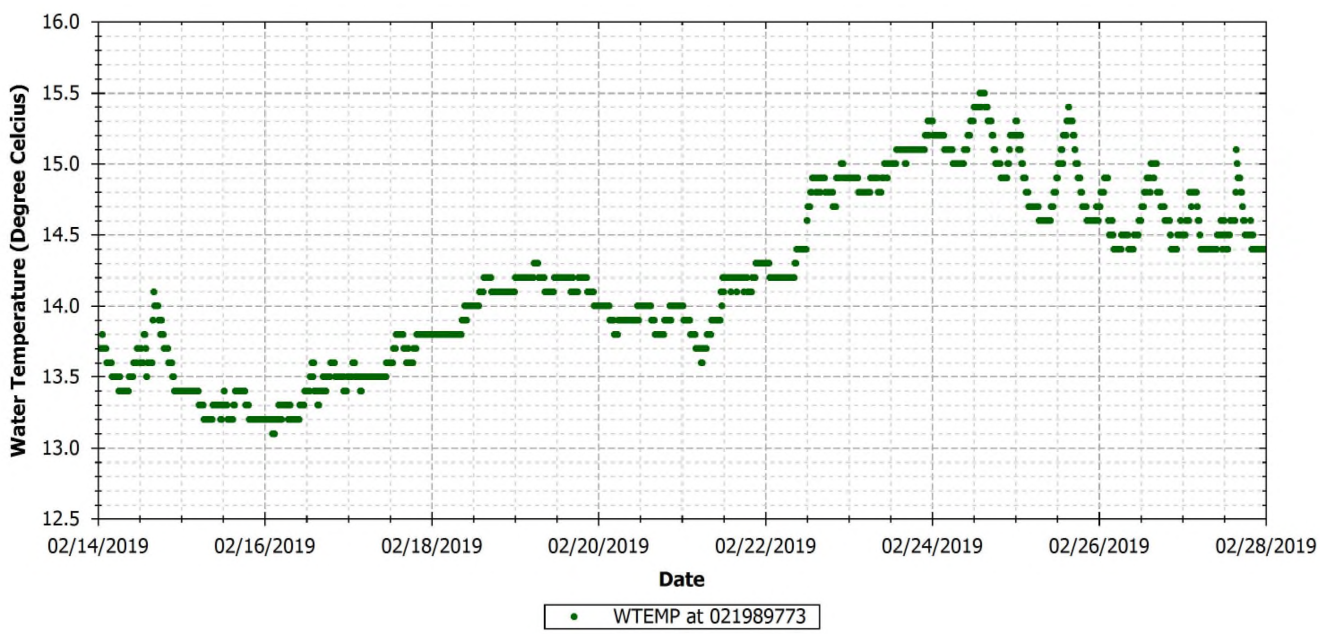


Figure E-21 USGS 021989773 (Front River) observed water temperature

E.3 USGS 021989793 – HOG ISLAND – BACK RIVER

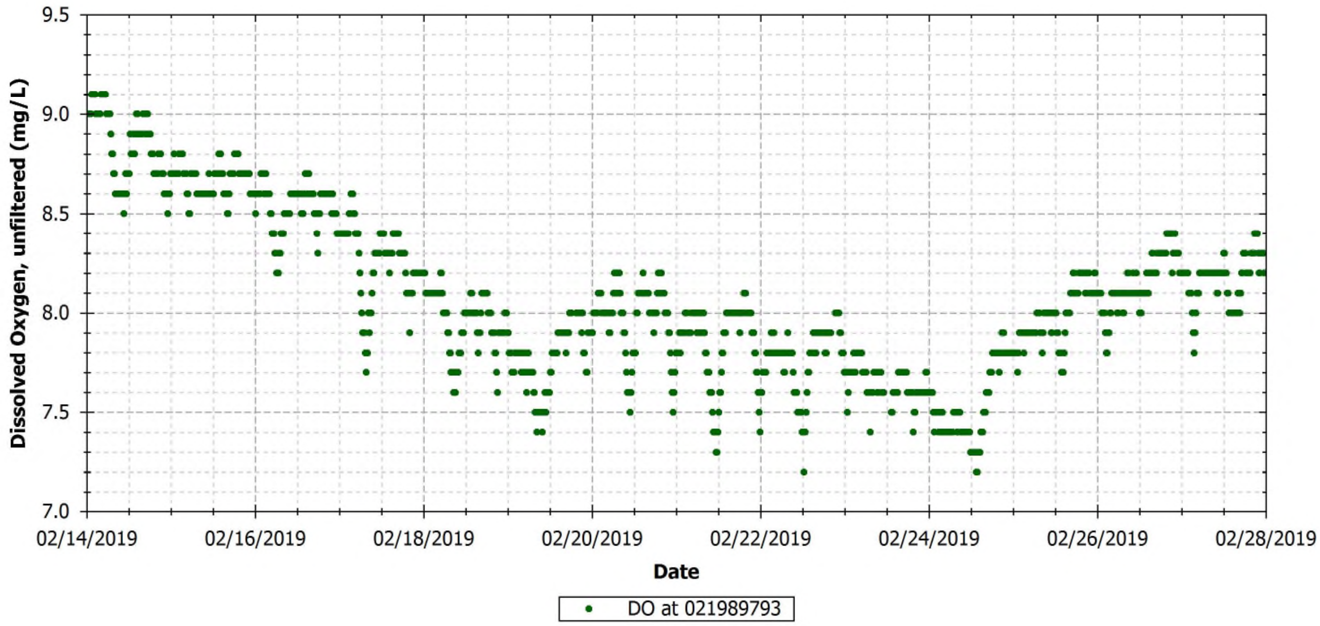


Figure E-22 USGS 021989793 (Back River) observed DO concentration

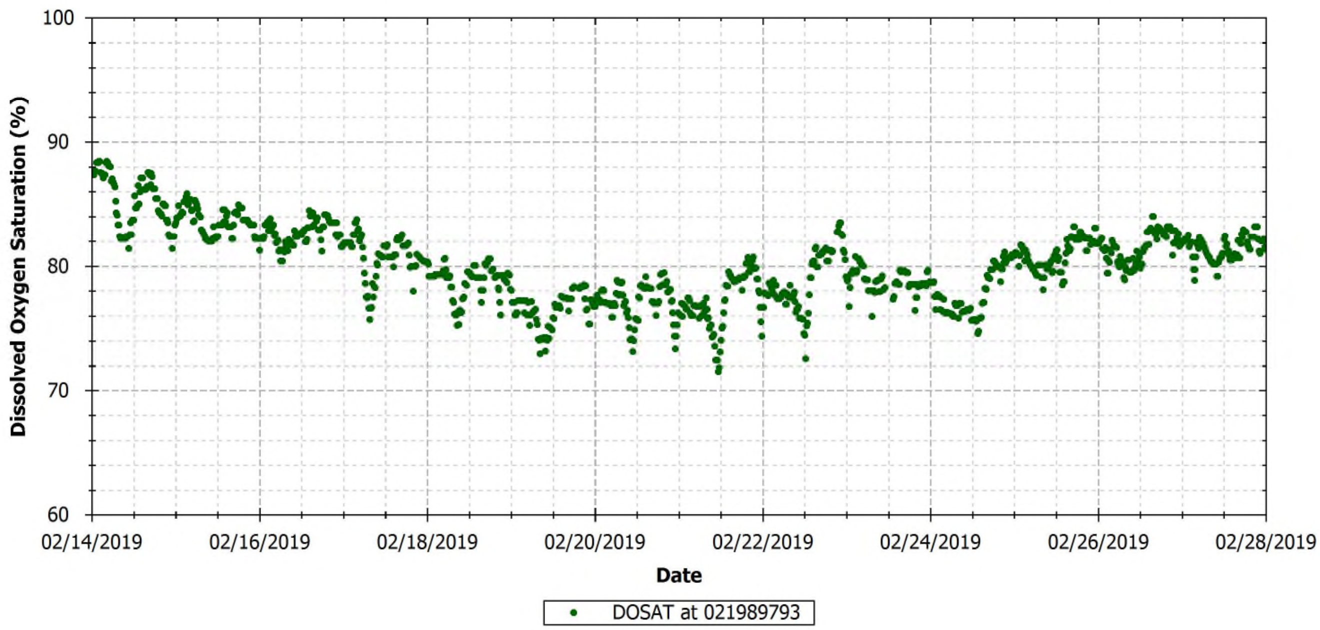


Figure E-23 USGS 021989793 (Back River) calculated DO saturation

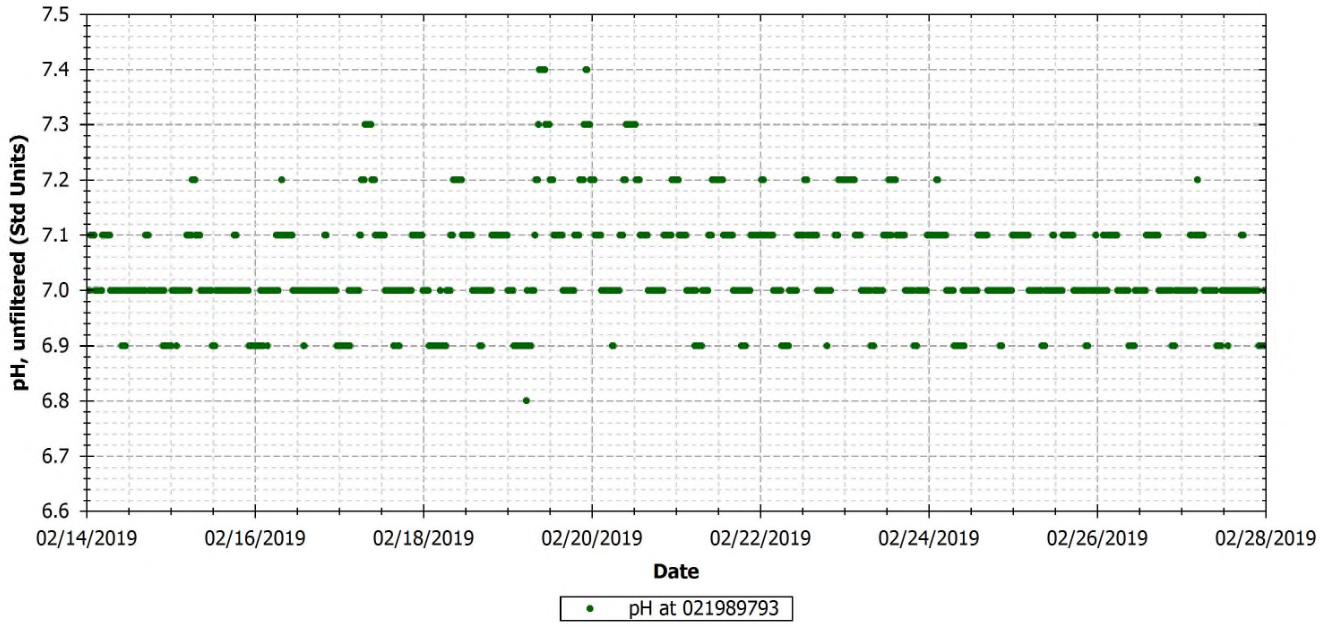


Figure E-24 USGS 021989793 (Back River) observed pH

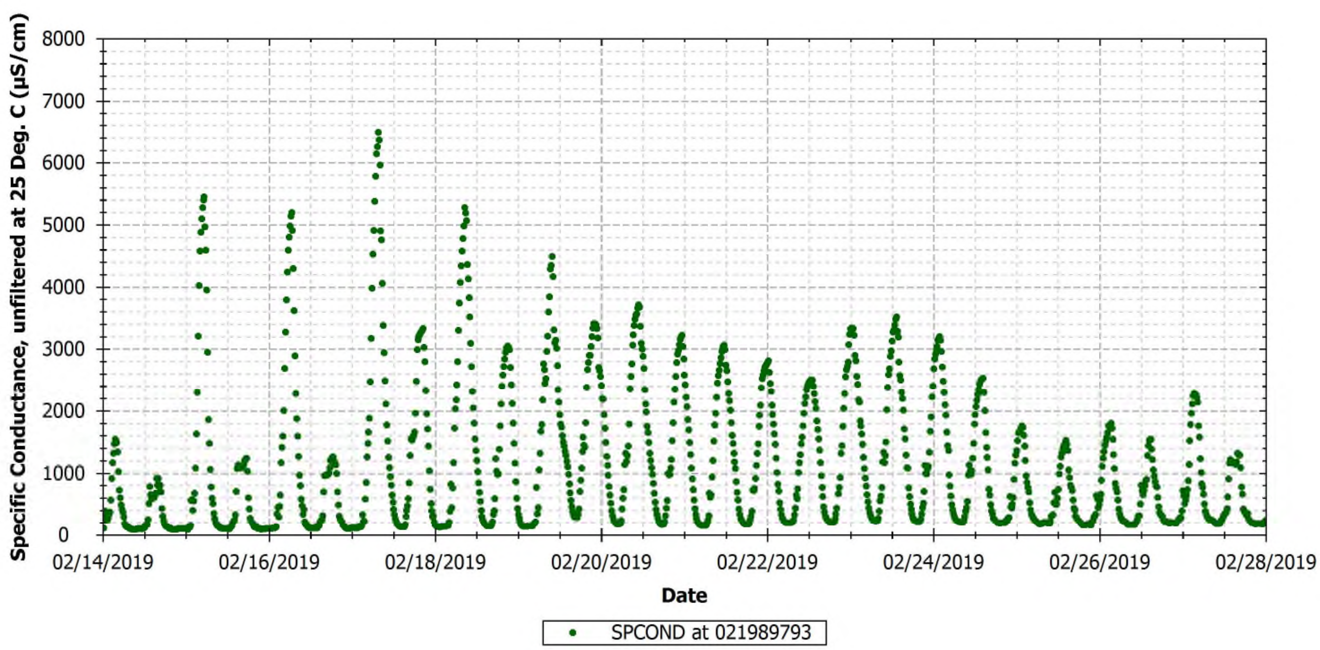


Figure E-25 USGS 021989793 (Back River) observed specific conductivity

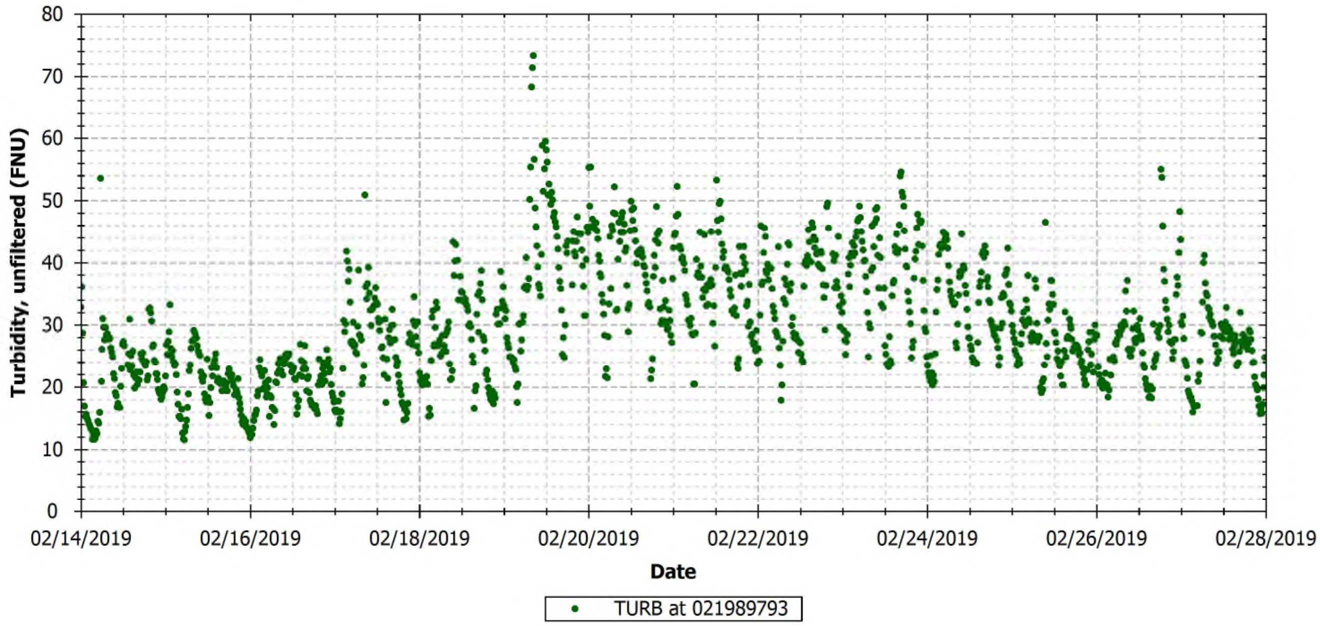


Figure E-26 USGS 021989793 (Back River) observed turbidity

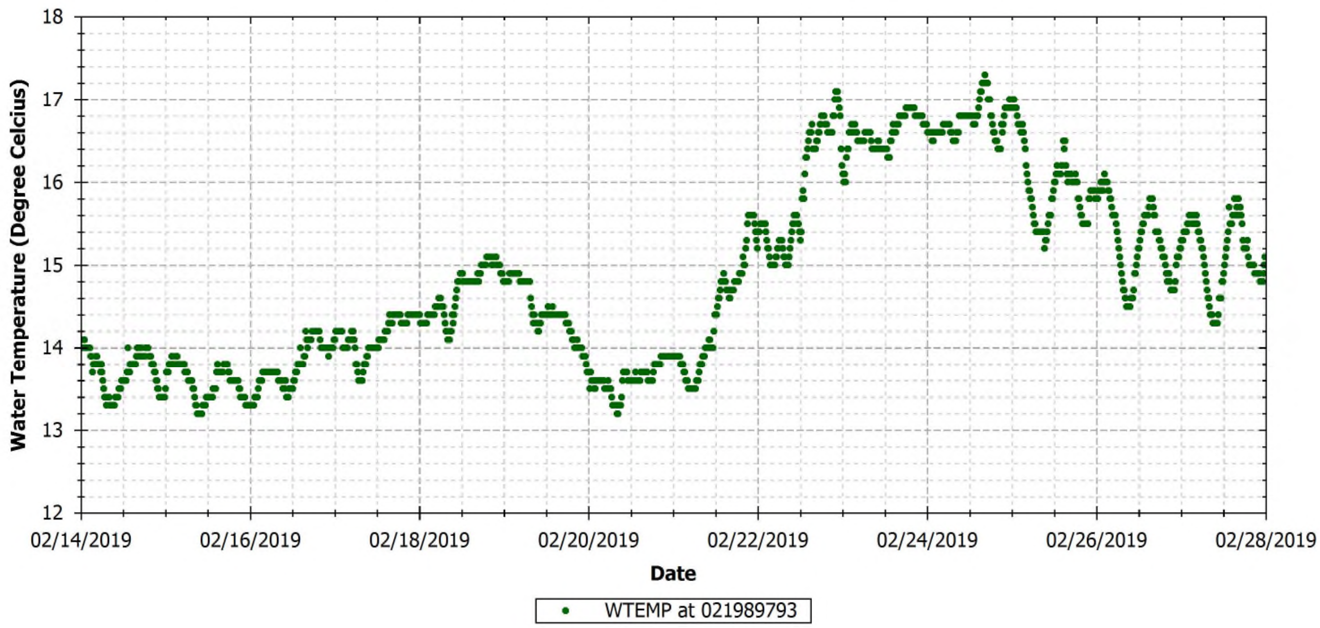


Figure E-27 USGS 021989793 (Back River) observed water temperature

E.4 USGS 0219897945 – US17 – BACK RIVER

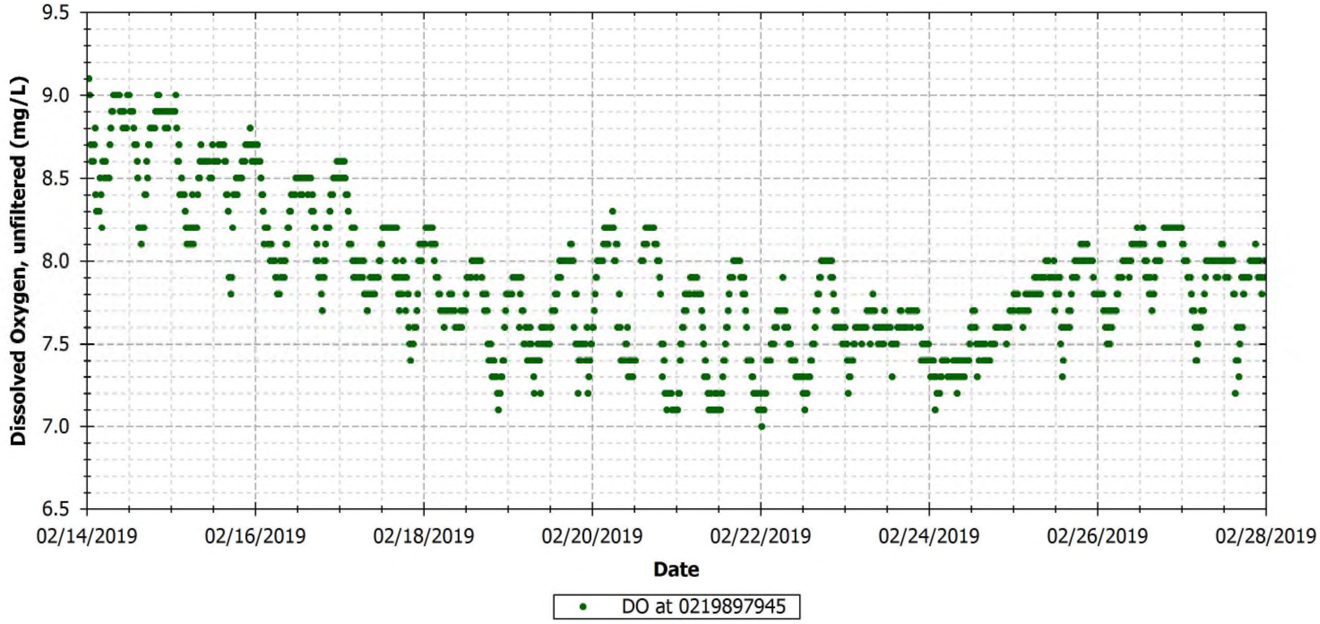


Figure E-28 USGS 0219897945 (Back River) observed DO concentration

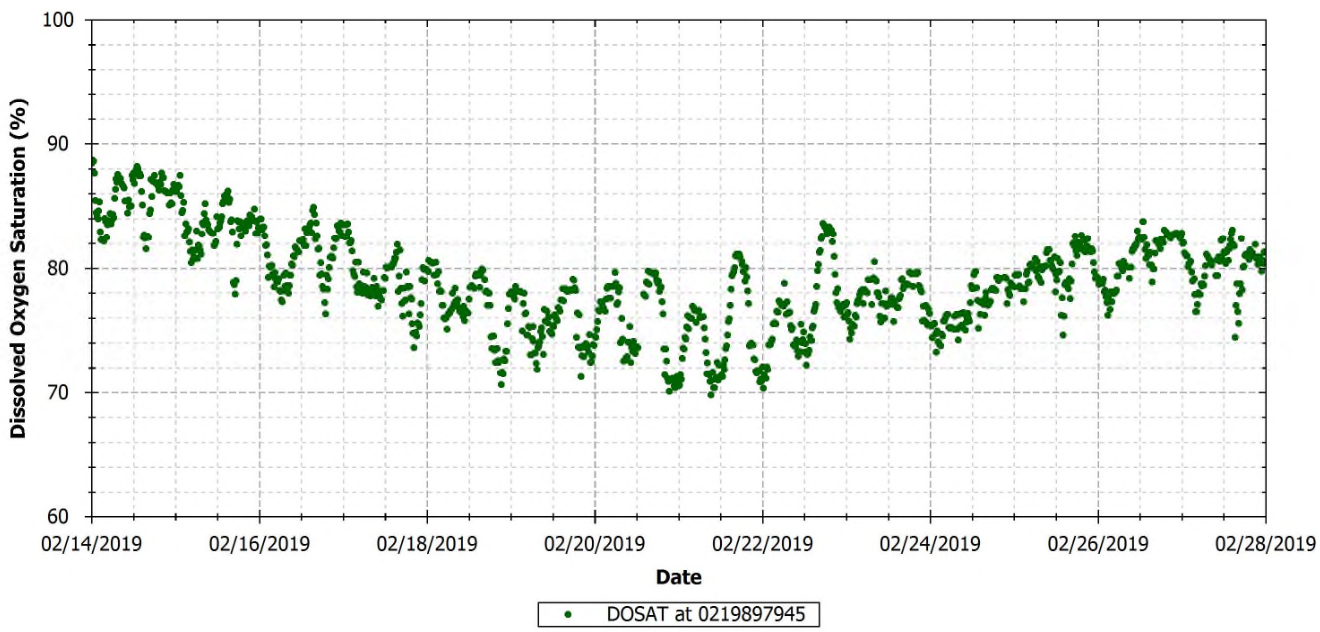


Figure E-29 USGS 0219897945 (Back River) calculated DO saturation

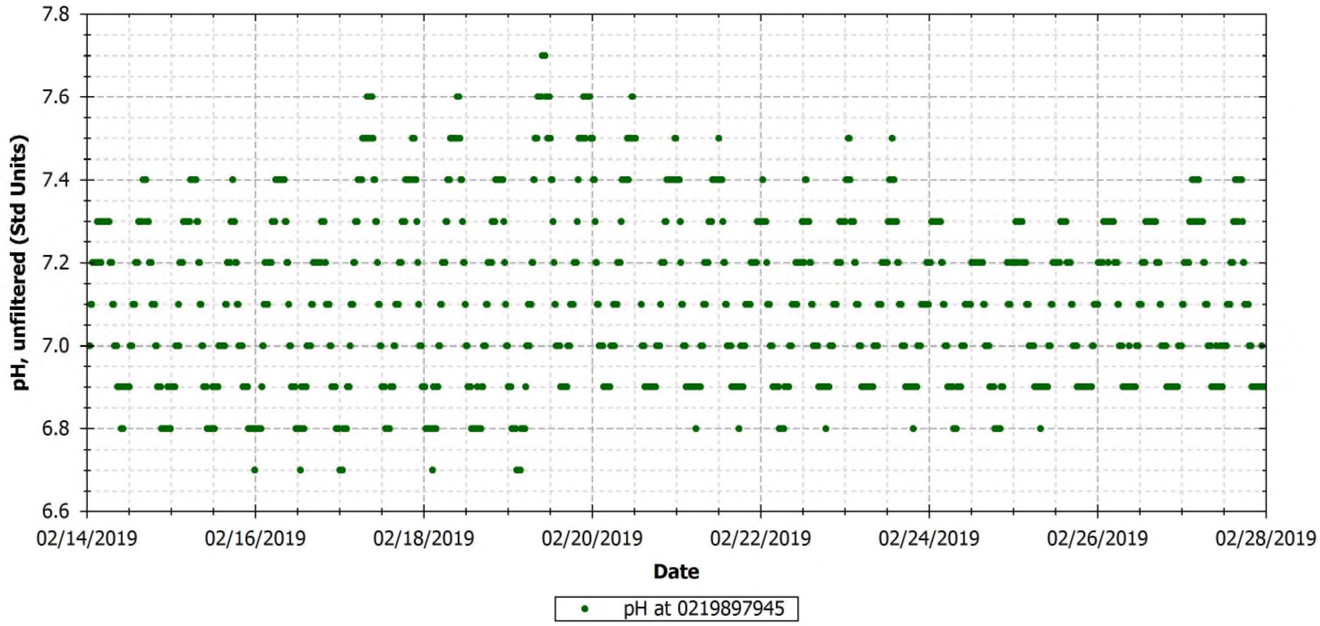


Figure E-30 USGS 0219897945 (Back River) observed pH

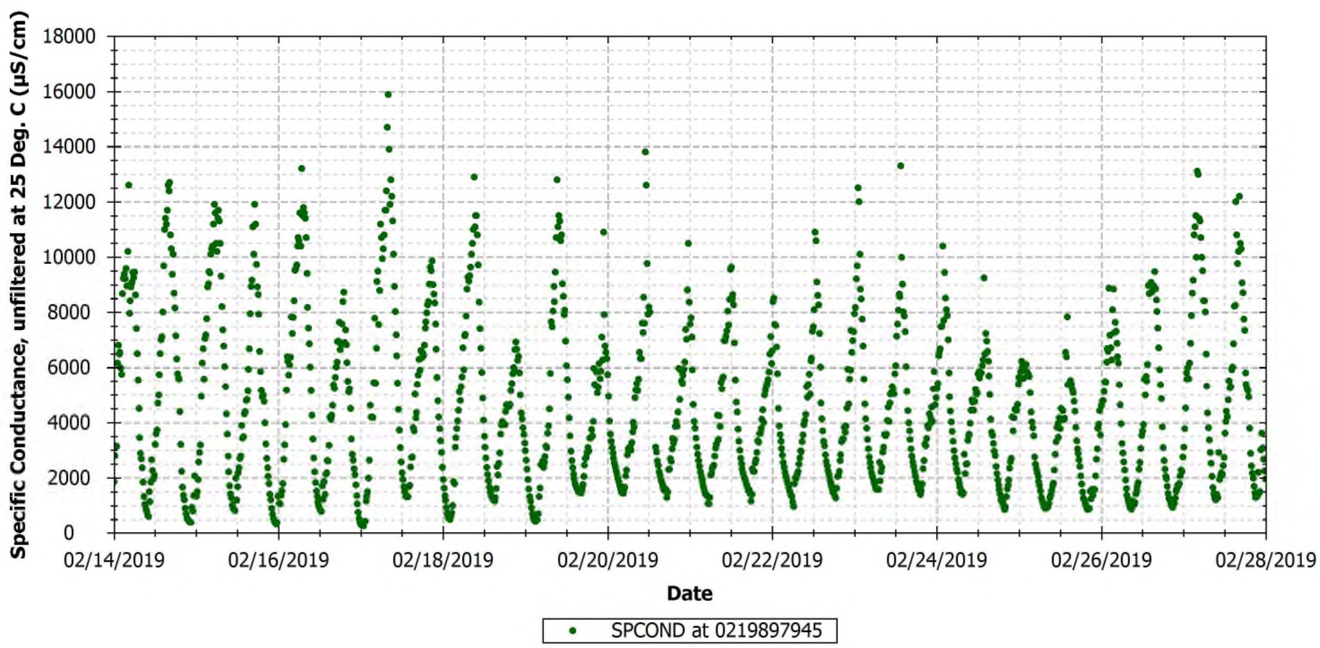


Figure E-31 USGS 0219897945 (Back River) observed specific conductivity

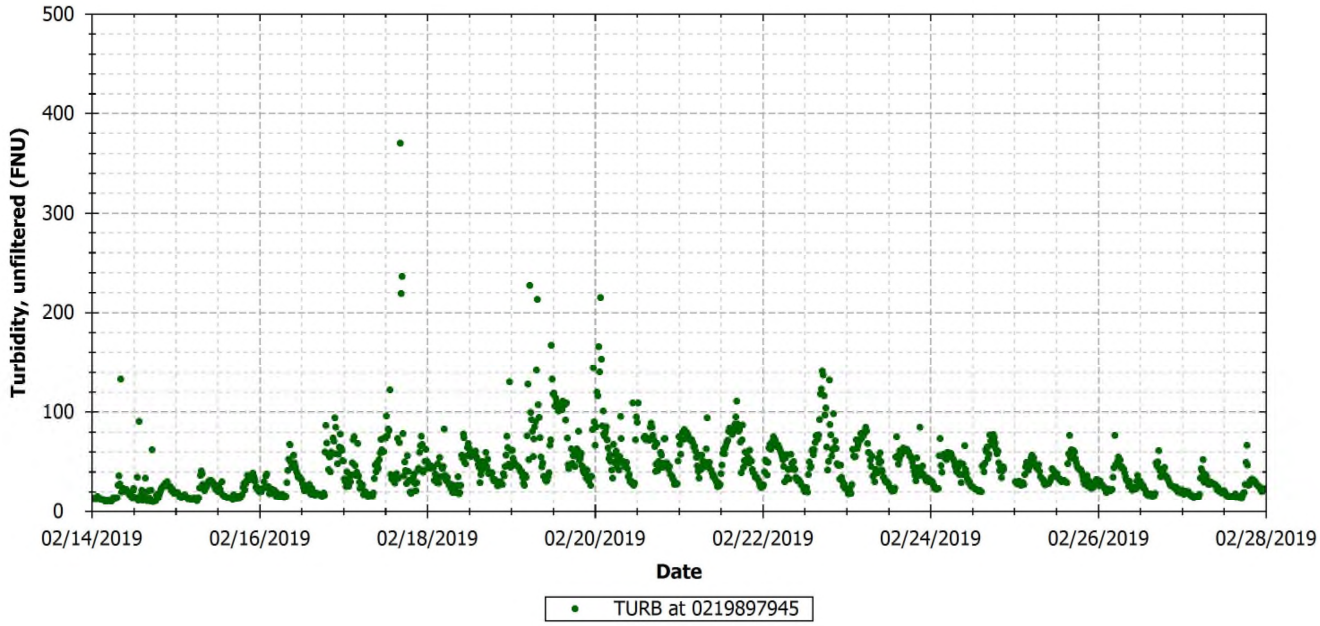


Figure E-32 USGS 0219897945 (Back River) observed turbidity

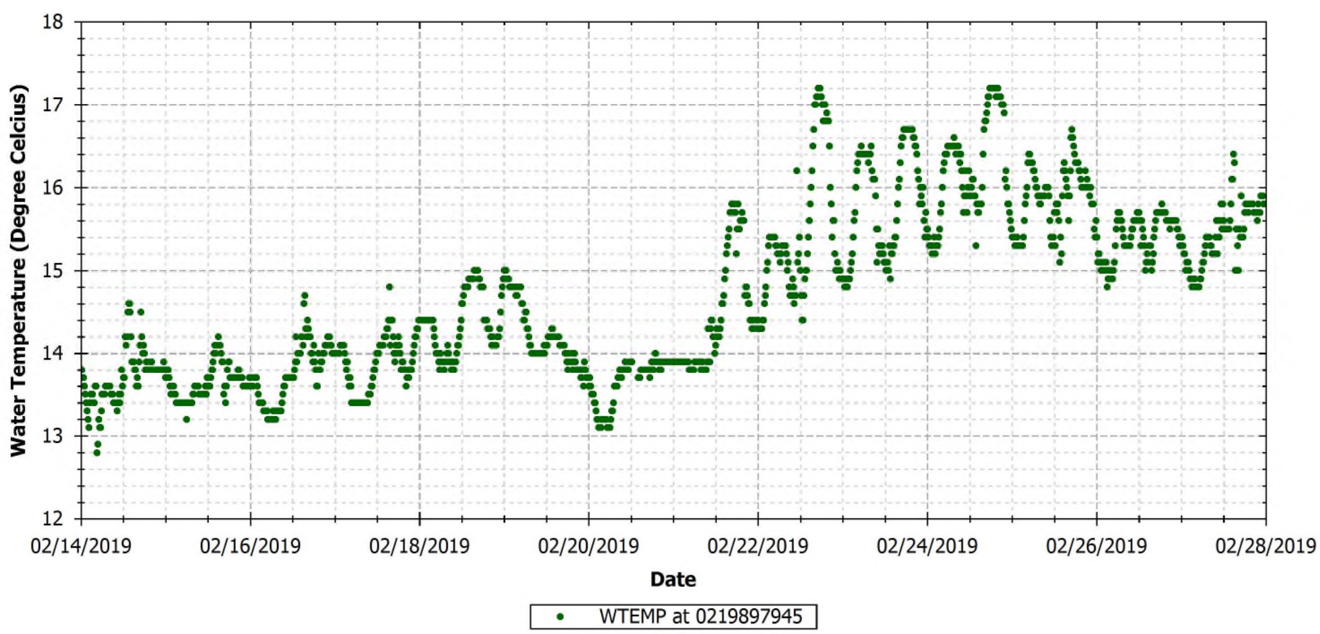


Figure E-33 USGS 0219897945 (Back River) observed water temperature

APPENDIX F USACE PLANT DATA

APPENDIX F TABLE OF CONTENTS

APPENDIX F LIST OF FIGURES

APPENDIX F LIST OF TABLES

F.1 USACE PLANT DATA

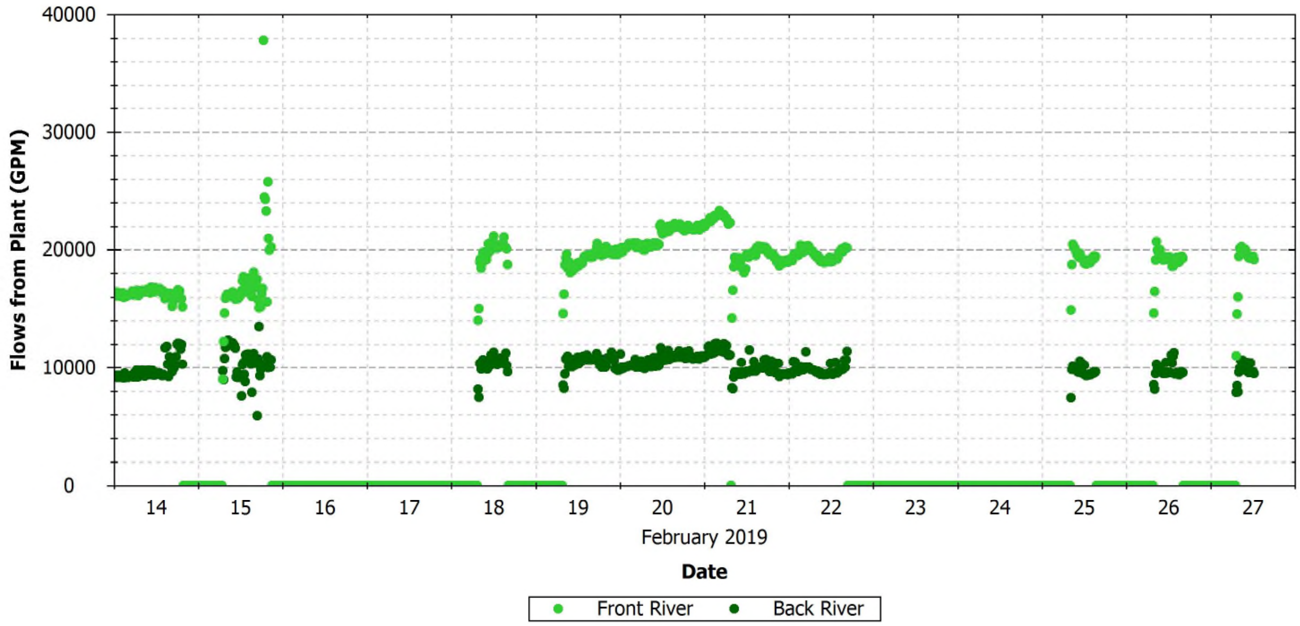


Figure F-1 Flows to Back River and lower Front River from the Plant for the WCTE study

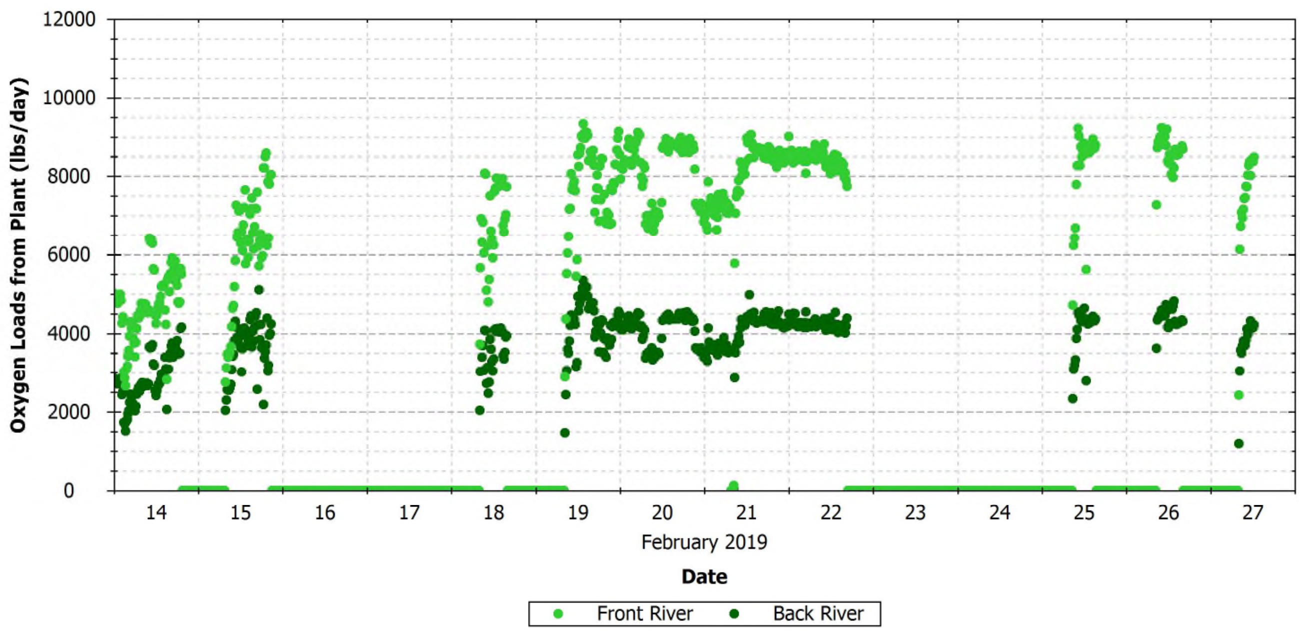


Figure F-2 Oxygen load to Back River and lower Front River from the Plant for the WCTE study

Table F-1 WCTE study daily flows and loads

Date	Plant Time on (min)	Lower Front River		Back River	
		Flow (gallons/day)	Oxygen Load (pounds/day)	Flow gallons/day)	Oxygen Load (pounds/day)
2/14/2019	1,170	19,075,854	3,849	11,440,444	2,314
2/15/2019	795	14,142,509	3,455	8,324,336	2,017
2/18/2019	480	9,626,227	2,284	5,019,461	1,190
2/19/2019	945	18,312,434	5,069	9,928,758	2,750
2/20/2019	1,410	29,770,876	8,002	14,923,807	4,011
2/21/2019	1,395	28,531,624	7,688	14,395,881	3,881
2/22/2019	1,005	19,664,907	5,895	9,866,395	2,956
2/25/2019	405	7,838,812	2,295	3,923,350	1,149
2/26/2019	465	8,982,902	2,791	4,566,323	1,418
2/27/2019	270	5,304,852	1,388	2,684,530	702

APPENDIX G DYE STUDY DATA

APPENDIX G TABLE OF CONTENTS

APPENDIX G LIST OF FIGURES

G.1 BACK RIVER

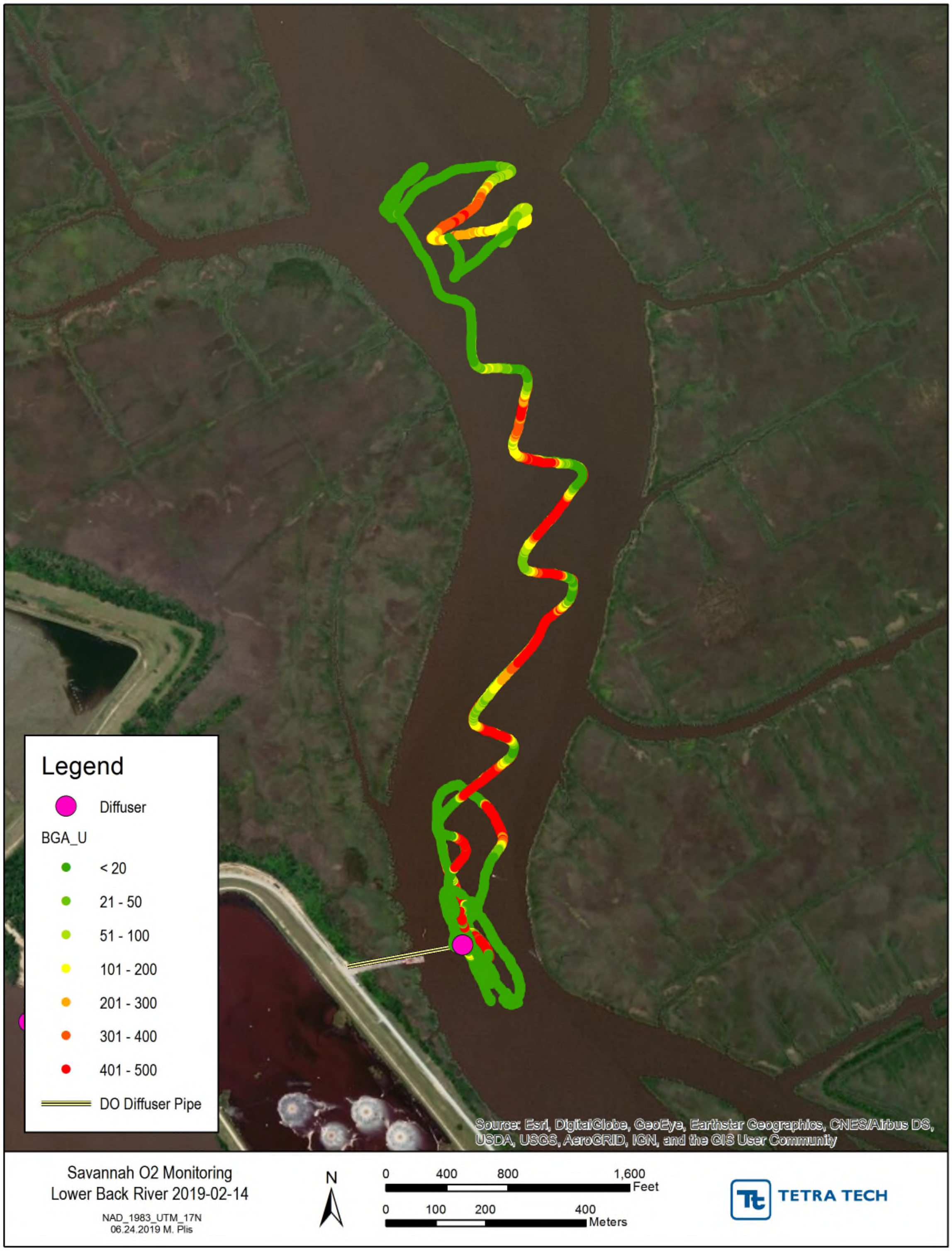


Figure G-1 Back River February 14, 2019 ebb tide dye drift points

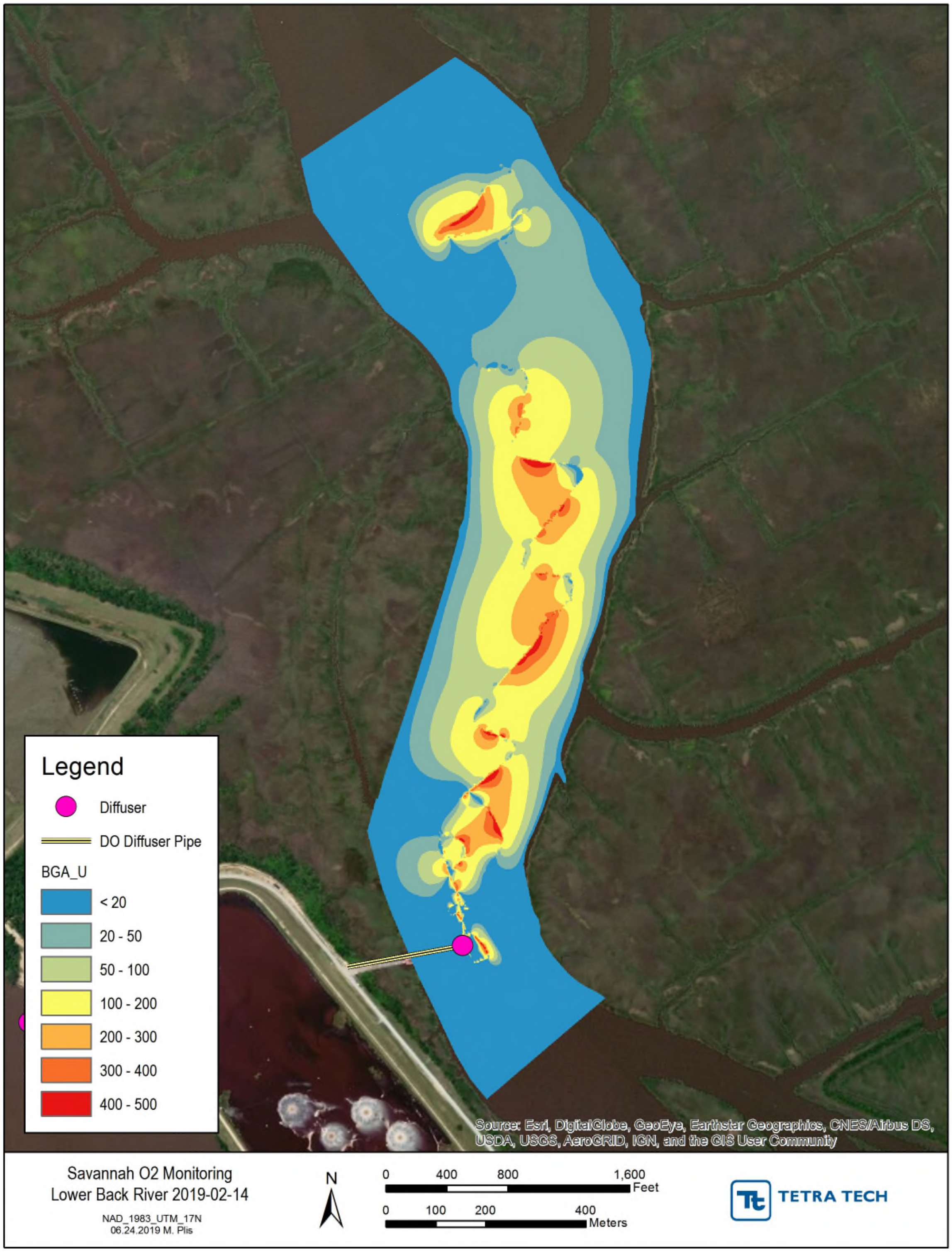


Figure G-2 Back River February 14, 2019 ebb tide dye drift raster interpolation

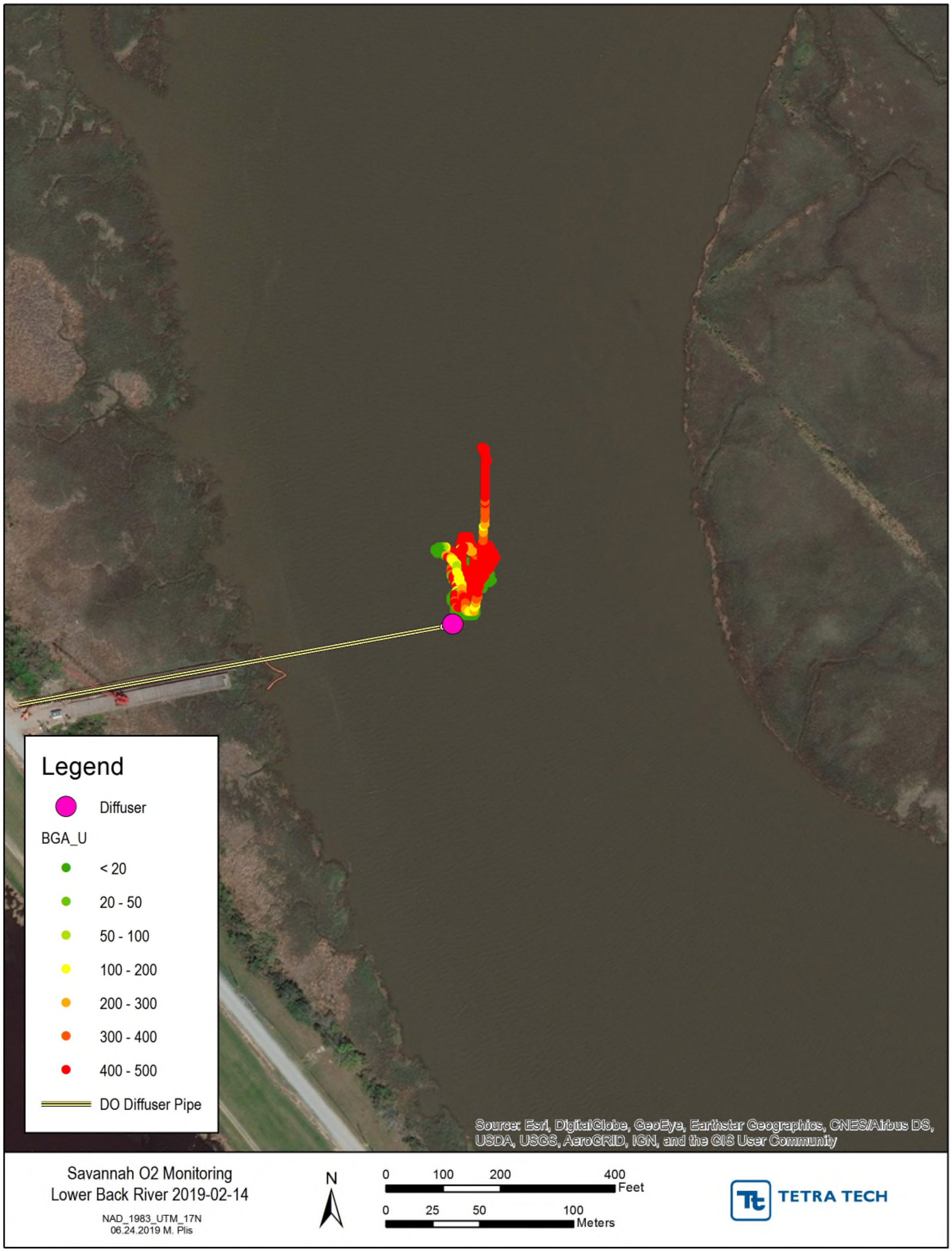


Figure G-3 Back River February 14, 2019 ebb tide traveling dye profile points (LBR_021419_DT_001)

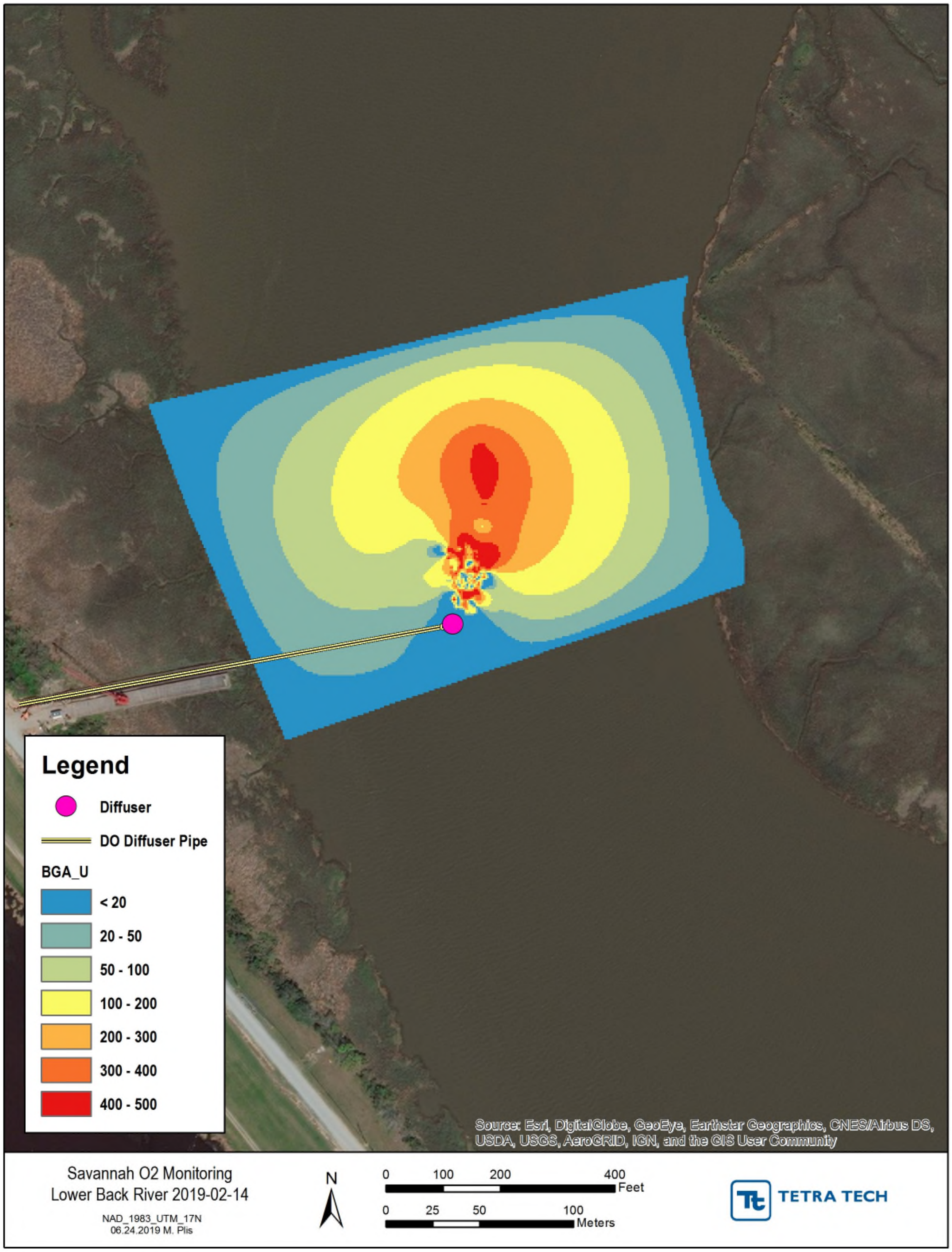


Figure G-4 Back River February 14, 2019 ebb tide traveling dye profile raster interpolation (LBR_021419_DT_001)

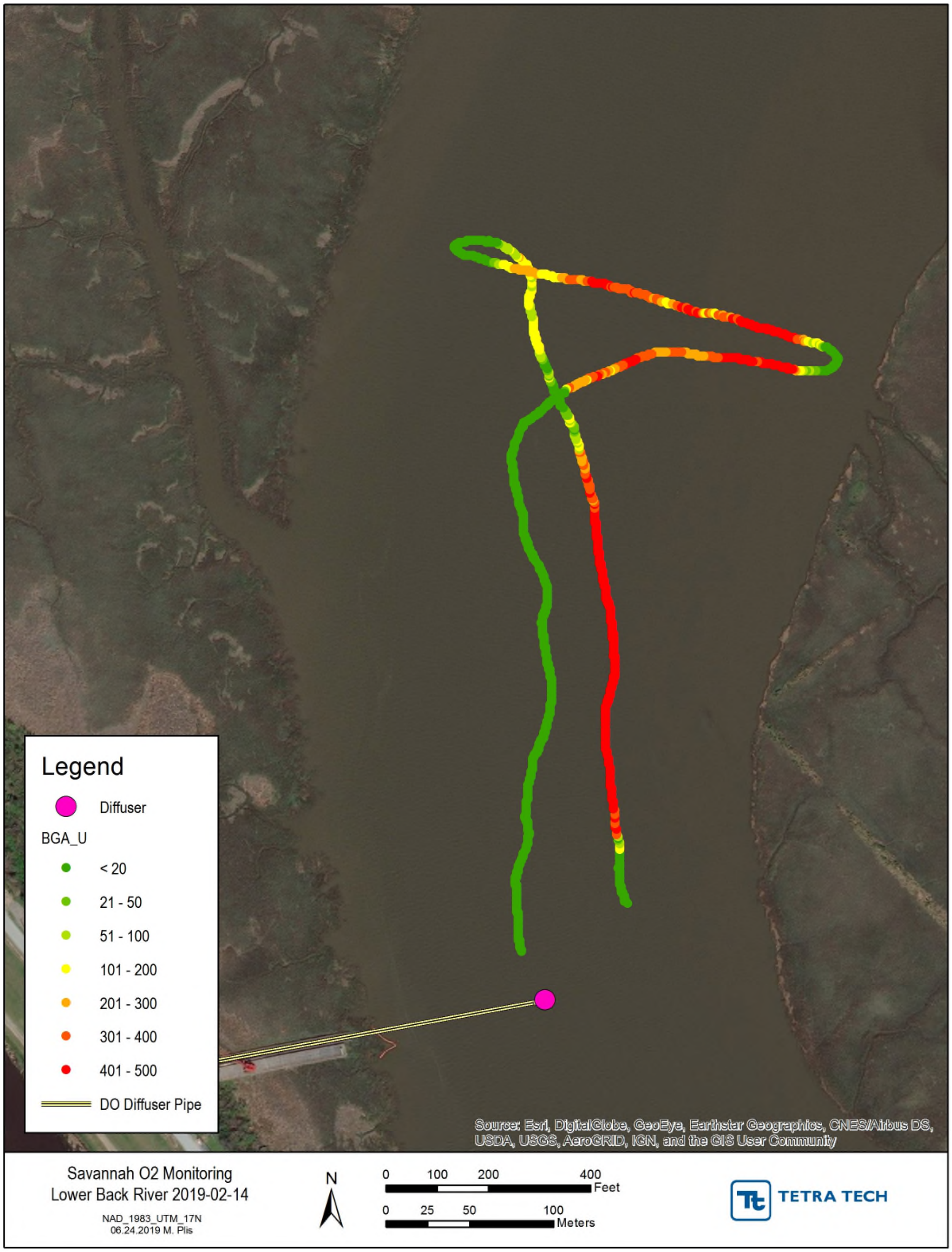


Figure G-5 Back River February 14, 2019 incoming tide traveling dye profile period 1 points (LBR_021419_DT_002)

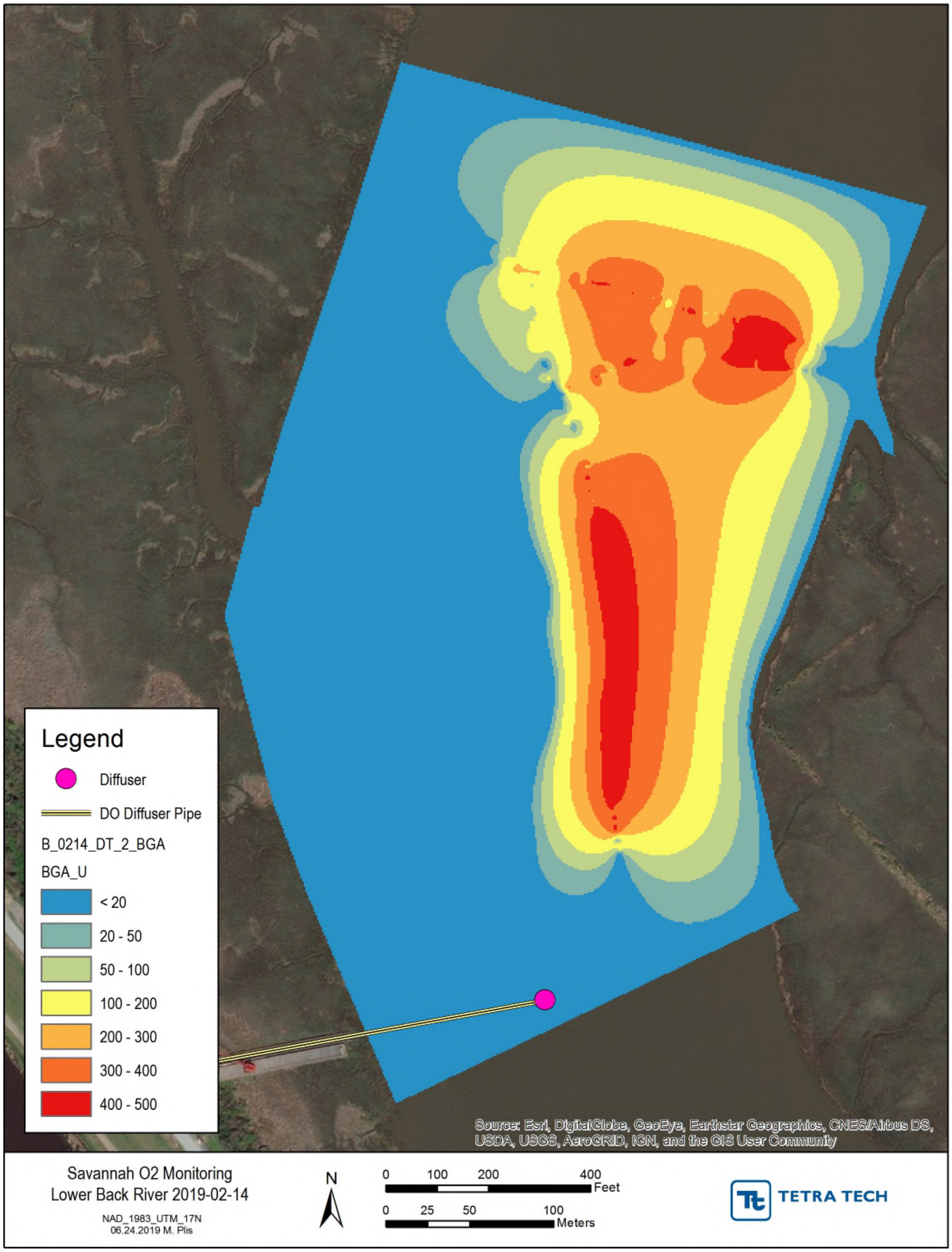


Figure G-6 Back River February 14, 2019 incoming tide traveling dye profile period 1 raster interpolation (LBR_021419_DT_002)

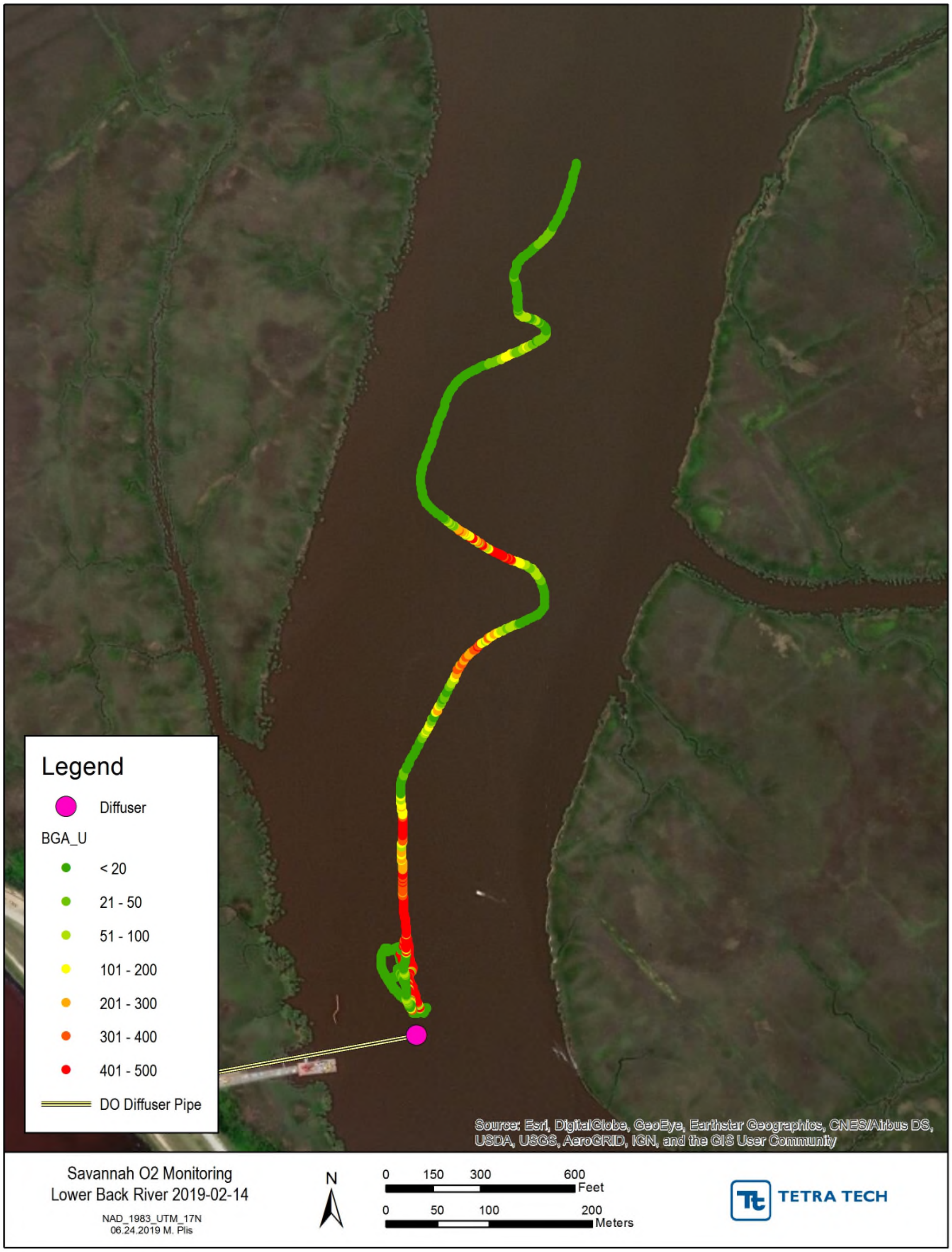


Figure G-7 Back River February 14, 2019 incoming tide traveling dye profile period 2 points (LBR_021419_DT_003)

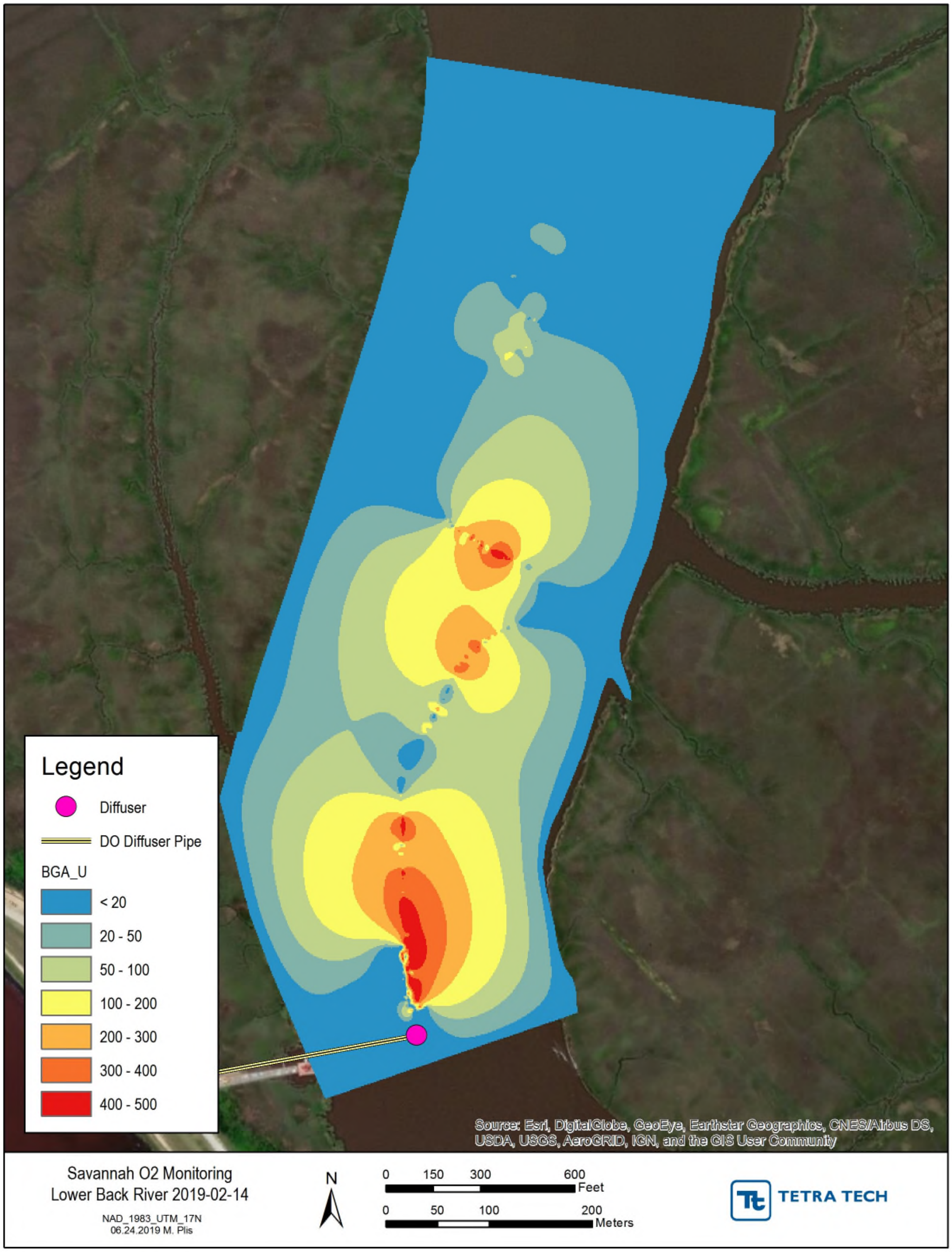


Figure G-8 Back River February 14, 2019 incoming tide traveling dye profile period 2 raster interpolation (LBR_021419_DT_003)

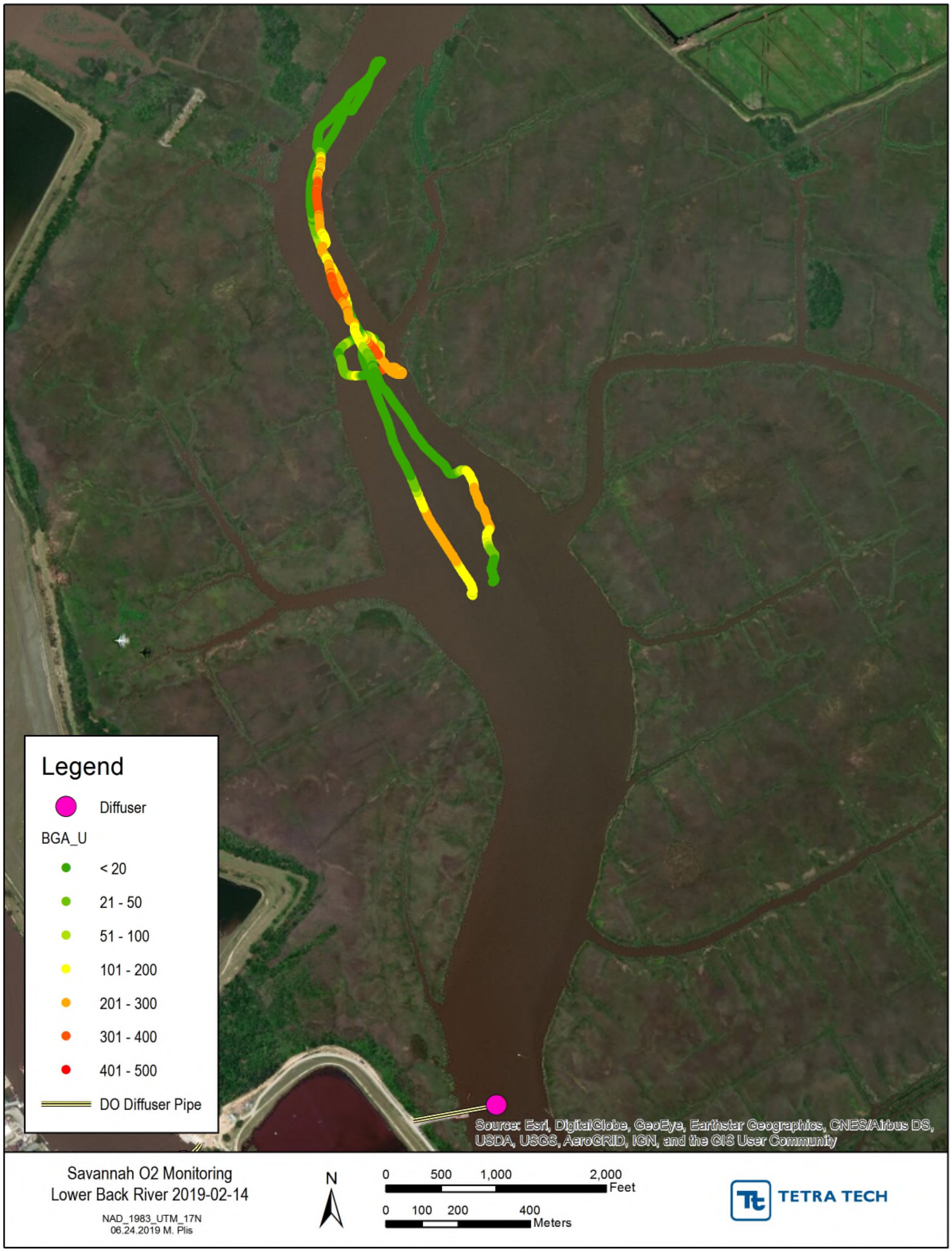


Figure G-9 Back River February 14, 2019 incoming tide traveling dye profile period 3 points (LBR_021419_DT_004)

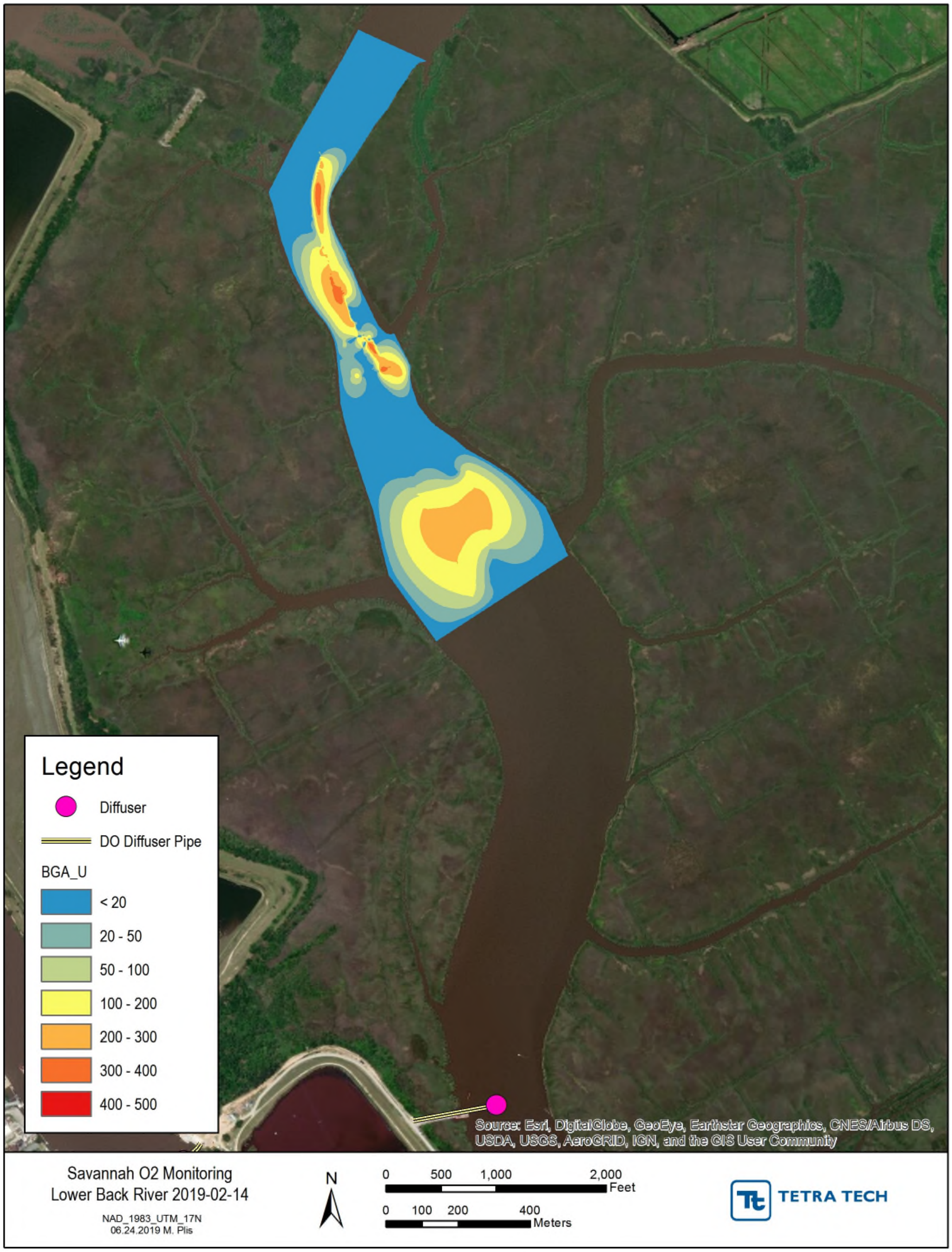


Figure G-10 Back River February 14, 2019 incoming tide traveling dye profile period 3 raster interpolation (LBR_021419_DT_004)

G.2 FRONT RIVER

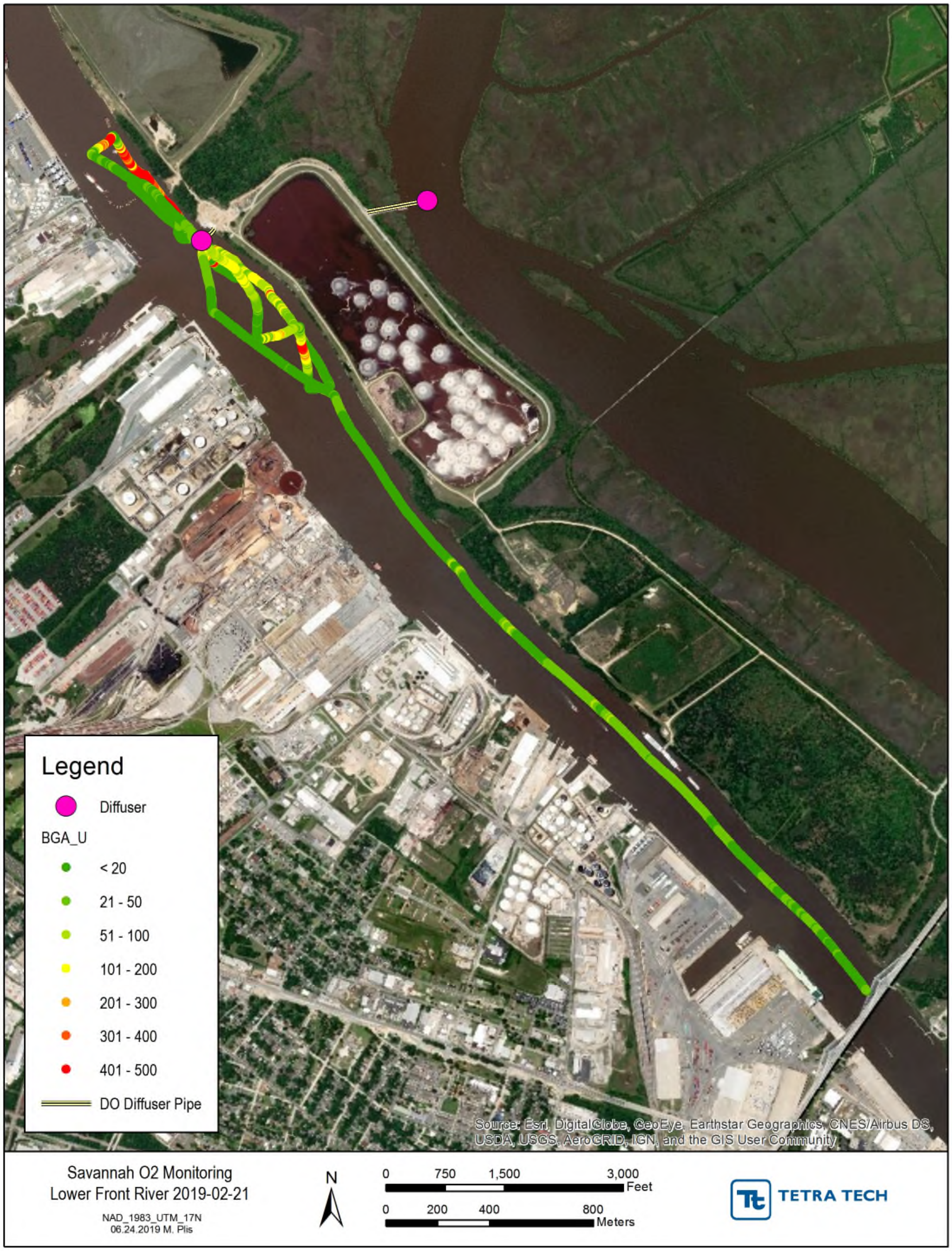


Figure G-11 Front River February 21, 2019 flood tide dye drift points

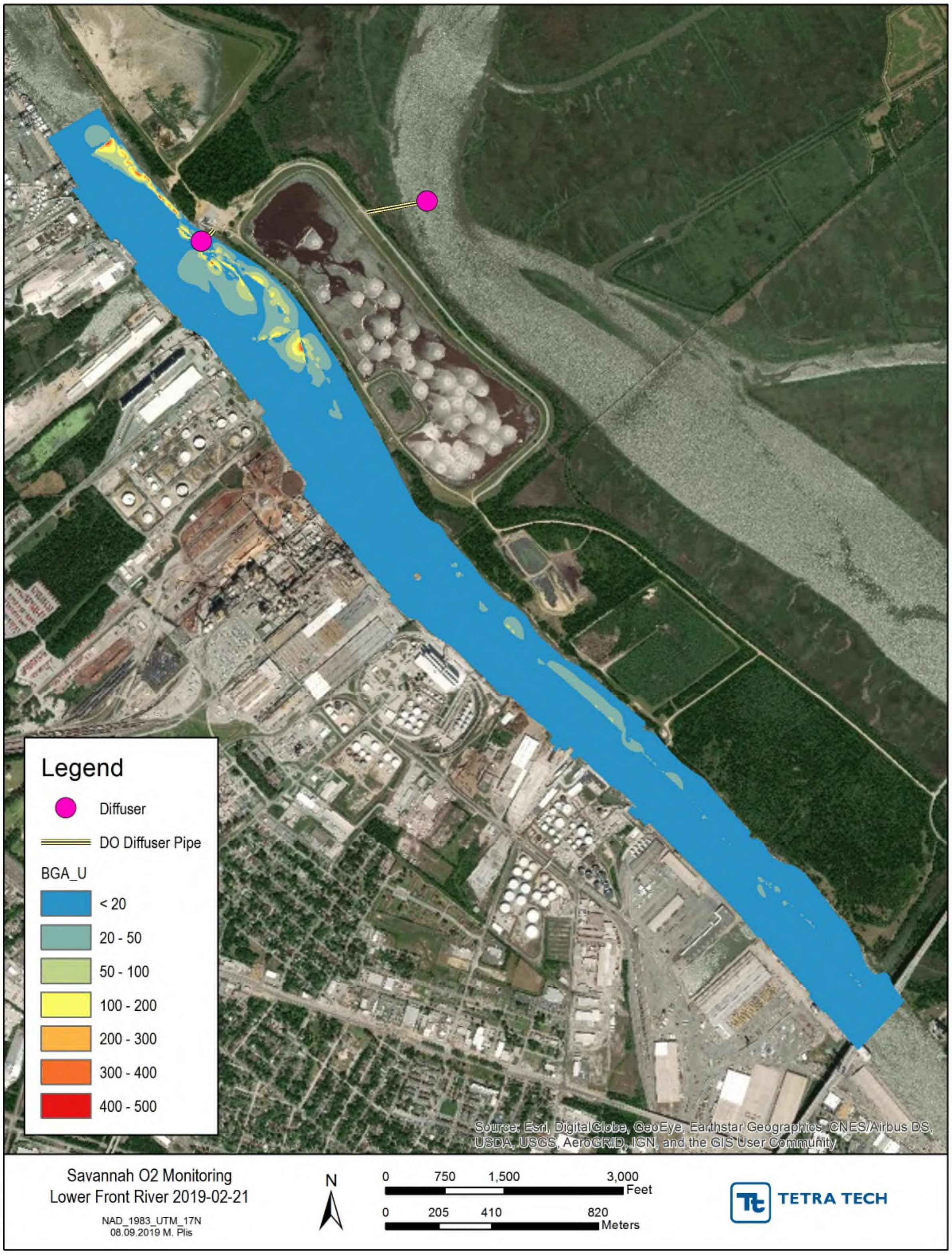


Figure G-12 Front River February 21, 2019 flood tide dye drift raster interpolation

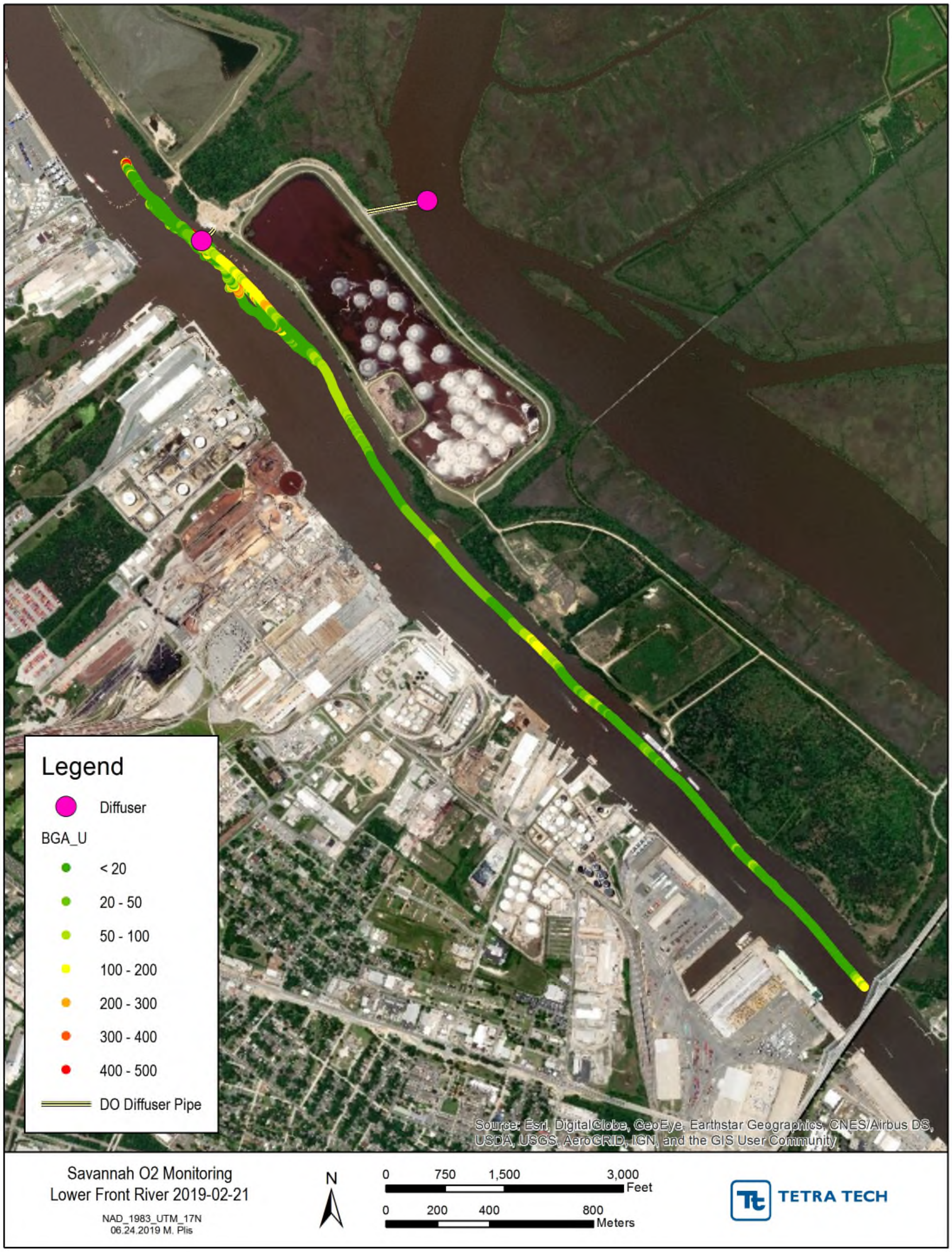


Figure G-13 Front River February 21, 2019 flood tide traveling dye profile points (LFR_022119_DT_001)

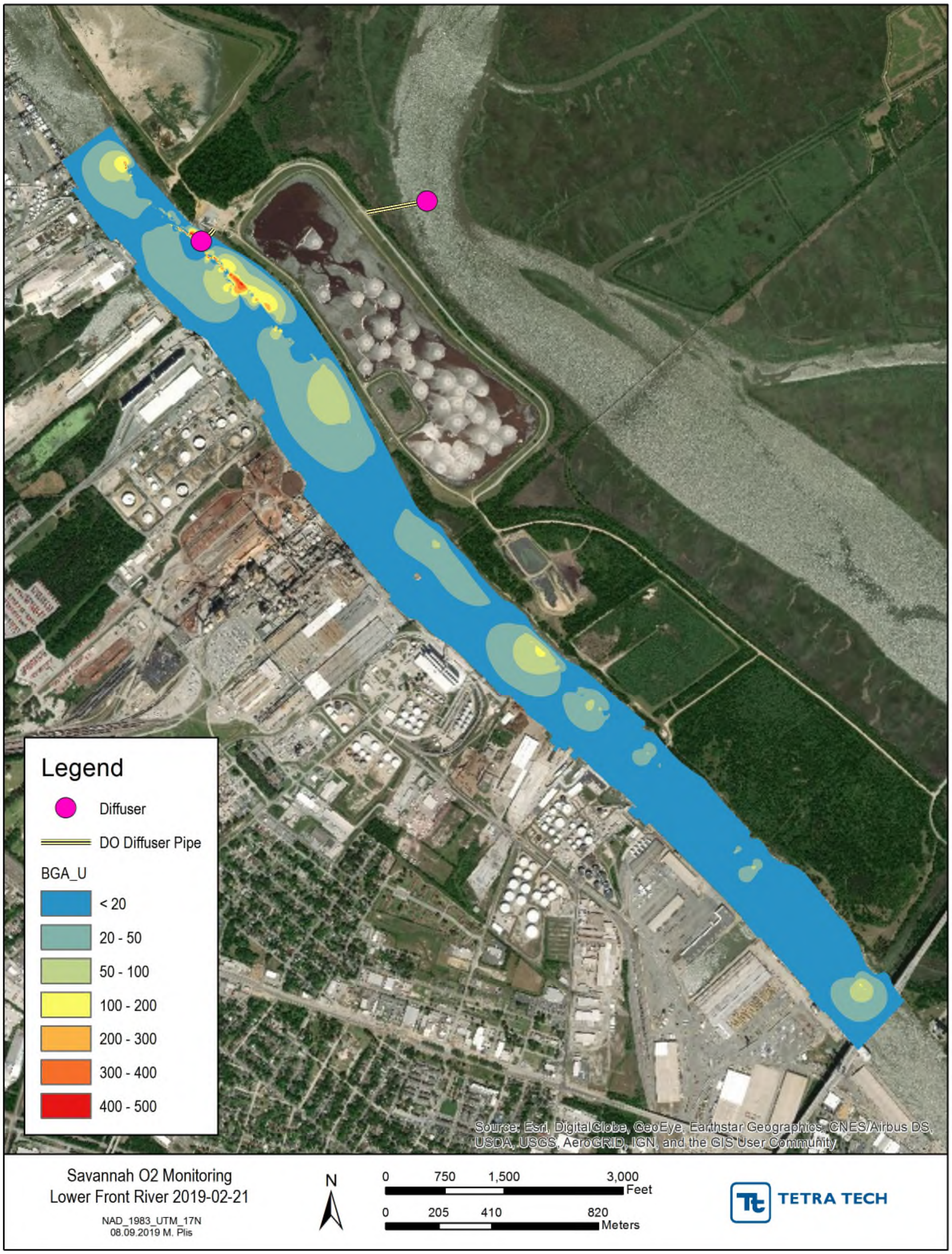


Figure G-14 Front River February 21, 2019 flood tide traveling dye profile raster interpolation

APPENDIX H WATER COLUMN TRANSFER EFFICIENCY

APPENDIX H TABLE OF CONTENTS

APPENDIX H LIST OF FIGURES

APPENDIX H LIST OF TABLES

H.1 WCTE CALCULATION SUMMARY TABLES

Table H-1 Front River daily WCTE inputs and outputs

Date	DO Loss Area (m^2)	Final Daily River Time (min)	Area weighted average Excess Oxygen (mg/L)	Depth (m)	K_a (1/day)	K_L (m/day)	Daily River DO Loss (pounds/day)	Daily Plant DO Load (pounds/day)	Front River WCTE
2/14/2019	0	0	0.000	1.5	0.298	0.4	0.0000	3,849	100.0%
2/15/2019	0	0	0.000	1.5	0.318	0.5	0.0000	3,455	100.0%
2/18/2019	0	0	0.000	1.5	0.409	0.6	0.0000	2,284	100.0%
2/19/2019	0	0	0.000	1.5	0.449	0.7	0.0000	5,069	100.0%
2/20/2019	0	0	0.000	1.5	0.418	0.6	0.0000	8,002	100.0%
2/21/2019	0	0	0.000	1.5	0.270	0.4	0.0000	7,688	100.0%
2/22/2019	0	0	0.000	1.5	0.352	0.5	0.0000	5,895	100.0%
2/25/2019	21	20	0.080	1.5	0.408	0.6	0.0000	2,295	100.0%
2/26/2019	638	60	0.477	1.5	0.372	0.6	0.0156	2,791	100.0%
2/27/2019	0	0	0.000	1.5	0.258	0.4	0.0000	1,388	100.0%

Note Daily River DO Loss and resulting WCTE values are actual calculated loss (summed from individual areas) and not based on averages as presented in table

Table H-2 Back River daily WCTE inputs and outputs

Date	DO Loss Area (m^2)	Final Daily River Time (min)	Area weighted average Excess Oxygen (mg/L)	Depth (m)	K_a (1/day)	K_L (m/day)	Daily River DO Loss (pounds/day)	Daily Plant DO Load (pounds/day)	Back River WCTE
2/14/2019	200	60	0.761	1.5	0.403	0.6	0.0085	2,314	100.0%
2/15/2019	13	60	0.036	1.5	0.473	0.7	0.0000	2,017	100.0%
2/18/2019	0	0	0.000	1.5	0.568	0.9	0.0000	1,190	100.0%
2/19/2019	0	0	0.000	1.5	0.617	0.9	0.0000	2,750	100.0%
2/20/2019	0	0	0.000	1.5	0.575	0.9	0.0000	4,011	100.0%
2/21/2019	0	0	0.000	1.5	0.426	0.6	0.0000	3,881	100.0%
2/22/2019	0	0	0.000	1.5	0.538	0.8	0.0000	2,956	100.0%
2/25/2019	0	0	0.000	1.5	0.577	0.9	0.0000	1,149	100.0%
2/26/2019	0	0	0.000	1.5	0.535	0.8	0.0000	1,418	100.0%
2/27/2019	0	0	0.000	1.5	0.373	0.6	0.0000	702	100.0%

Note Daily River DO Loss and resulting WCTE values are actual calculated loss (summed from individual areas) and not based on averages as presented in table

Table H-3 River combination WCTE results

Date	Front River Daily Plant DO Load (pounds/day)	Front River WCTE	Back River Daily Plant DO Load (pounds/day)	Back River WCTE	River Combination WCTE
2/14/2019	3,849	100.0%	2,314	100.0%	100.0%
2/15/2019	3,455	100.0%	2,017	100.0%	100.0%
2/18/2019	2,284	100.0%	1,190	100.0%	100.0%
2/19/2019	5,069	100.0%	2,750	100.0%	100.0%
2/20/2019	8,002	100.0%	4,011	100.0%	100.0%
2/21/2019	7,688	100.0%	3,881	100.0%	100.0%
2/22/2019	5,895	100.0%	2,956	100.0%	100.0%
2/25/2019	2,295	100.0%	1,149	100.0%	100.0%
2/26/2019	2,791	100.0%	1,418	100.0%	100.0%
2/27/2019	1,388	100.0%	702	100.0%	100.0%

H.2 DO LOSS AREA

Table H-4 WCTE period DO Loss Area

Date	Front River		Back River	
	Continuous Data Area (square meters)	Intermittent Data Area (square meters)	Continuous Data Area (square meters)	Intermittent Data Area (square meters)
2/14/2019	0	0	0	200
2/15/2019	0	0	0	13
2/18/2019	0	0	0	0
2/19/2019	0	0	0	0
2/20/2019	0	0	0	0
2/21/2019	0	0	0	0
2/22/2019	0	0	0	0
2/25/2019	21	0	0	0
2/26/2019	0	638	0	0
2/27/2019	0	0	0	0

Figure H-1 February 14, 2019 Intermittent data (blue) and DO loss points (red) for lower Front River and Back River

Figure H-2 February 14, 2019 Daily Intermittent DO Loss Area for lower Front River and Back River

Figure H-3 February 15, 2019 Intermittent data (blue) and DO loss points (red) for lower Front River and Back River

Figure H-4 February 15, 2019 Daily Intermittent DO Loss Area for lower Front River and Back River

Figure H-5 February 18, 2019 Intermittent data (blue) and DO loss points (red) for lower Front River and Back River

Figure H-6 February 18, 2019 Daily Intermittent DO Loss Area for lower Front River and Back River

Figure H-7 February 19, 2019 Intermittent data (blue) and DO loss points (red) for lower Front River and Back River

Figure H-8 February 19, 2019 Daily Intermittent DO Loss Area for lower Front River and Back River

Figure H-9 February 20, 2019 Intermittent data (blue) and DO loss points (red) for lower Front River and Back River

Figure H-10 February 20, 2019 Daily Intermittent DO Loss Area for lower Front River and Back River

Figure H-11 February 21, 2019 Intermittent data (blue) and DO loss points (red) for lower Front River and Back River

Figure H-12 February 21, 2019 Daily Intermittent DO Loss Area for lower Front River and Back River

Figure H-13 February 22, 2019 Intermittent data (blue) and DO loss points (red) for lower Front River and Back River

Figure H-14 February 22, 2019 Daily Intermittent DO Loss Area for lower Front River and Back River

Figure H-15 February 25, 2019 Intermittent data (blue) and DO loss points (red) for lower Front River and Back River

Figure H-16 February 25, 2019 Daily Intermittent DO Loss Area for lower Front River and Back River

Figure H-17 February 26, 2019 Intermittent data (blue) and DO loss points (red) for lower Front River and Back River

Figure H-18 February 26, 2019 Daily Intermittent DO Loss Area for lower Front River and Back River

Figure H-19 February 27, 2019 Intermittent data (blue) and DO loss points (red) for lower Front River and Back River

Figure H-20 February 27, 2019 Daily Intermittent DO Loss Area for lower Front River and Back River

APPENDIX I DATA COLLECTION QA/QC

APPENDIX I TABLE OF CONTENTS

APPENDIX I LIST OF FIGURES

APPENDIX I LIST OF TABLES

I.1 PLATFORM DATA

Data from sixteen (16) sondes were downloaded from the Xylem Eagle I/O website (https://xylem.eagle.io/ui/xyle510/LG2_Environmental). The data were recorded at a sampling interval of 5 minutes and spanned the period from February 14, 2019 through February 27, 2019 for the WCTE study sampling effort. ***Table I-1*** provides the sonde ID, location of the data sonde on the platform, and description of the data sondes used for the WCTE study sampling. ***Figure I-1*** shows the arrangement of sondes around the platform.

Table I-1 Data sondes used on the platform for WCTE study sampling

Sonde ID	Location on the platform	Description
L10-S	Northeast	Shallow sonde with algae-sensor
L6-M	Northeast	Mid-depth sonde with algae-sensor
L2-D	Northeast	Deep sonde with algae-sensor
L9-S	Northwest	Shallow sonde
L5-M	Northwest	Mid-depth sonde
L1-D	Northwest	Deep sonde
L11-S	Southeast	Shallow sonde
L7-M	Southeast	Mid-depth sonde
L3-D	Southeast	Deep sonde
L12-S	Southwest	Shallow sonde
L8-M	Southwest	Mid-depth sonde
L4-D	Southwest	Deep sonde
L13-V	Between the northwest and southwest sondes	Sonde with algae-sensor placed ~1.8 meters below the platform
L14-V	Between the northeast and southeast sondes	Sonde placed ~1.8 meters below the platform
L15-V	Between the northwest and southwest sondes	Sonde placed ~3.4 meters below the platform
L16-V	Between the northeast and southeast sondes	Sonde placed ~3.4 meters below the platform

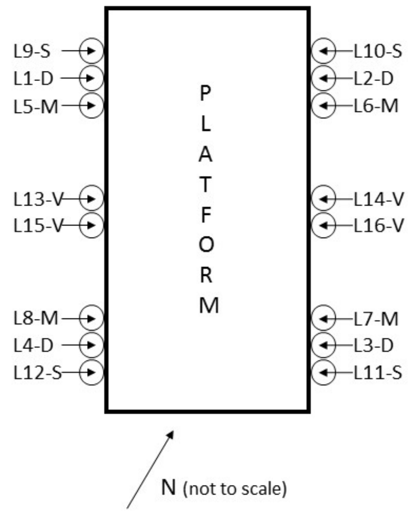


Figure I-1 Data sonde locations on the Back River platform

When downloading the data from the website, the following steps were taken to ensure a successful download:

1) The intermittent data downloads (i.e. data were obtained at various points during the WCTE study sampling period) did not overlap with previous data downloads,
2) The data for all the constituents at the sondes were selected prior to the download, and
3) The data for no more than three sondes were selected at the same time

During the data download process, the website created a zipped folder in the format “export_YYYY-mm-dd_hrmnss” containing a *.csv (comma-separated value) file with the file name of “export-xyle510.LG2 Environmental.Lower River.Campbell PakBus Logger.csv”. Neither the folder name nor the file name indicated which file contained which data sonde information, so the folders were unzipped and the *.csv file were opened to check the data sonde information. The files were resaved as Excel workbooks with the sonde name in the file name.

Table I-2 through ***Table I-6*** provide the constituents measured at the platform data sondes, PCodes assigned to the constituents for the database, and the raw data count for each sonde and constituent.

Table I-2 Data counts for sondes located on the northeast corner of the platform

PCode	Parameter Name	Units	Raw Data Count		
			L10-S	L6-M	L2-D
BGA_R	phycoerythin BGA	RFU	3,856	3,856	3,856
BGA_U	phycoerythin BGA	µg/L	3,856	3,856	3,856
CABLE	cable power	Volts	3,856	3,856	3,856
CHLA_R	chlorophyll a	RFU	3,856	3,856	3,856
CHLA_U	chlorophyll a	µg/L	3,856	3,856	3,856
DEPTH	water depth	meters	3,856	3,856	3,856
DO	dissolved oxygen	mg/L	3,856	3,856	3,856
DO_SAT	dissolved oxygen saturation	%	3,856	3,856	3,856
SAL	salinity	PSU	3,856	3,856	3,856
SPCOND_M	specific conductivity	mS/cm	3,856	3,856	3,856
WTEMP	water temperature	Degree C	3,856	3,854	3,855
Total			**42,416**	**42,414**	**42,415**

Table I-3 Data counts for sondes located on the northwest corner of the platform

PCode	Parameter Name	Units	Raw Data Count		
			L9-S	L5-M	L1-D
BGA_R	phycoerythin BGA	RFU	*	*	*
BGA_U	phycoerythin BGA	µg/L	*	*	*
CABLE	cable power	Volts	3,856	3,856	3,856
CHLA_R	chlorophyll a	RFU	*	*	*
CHLA_U	chlorophyll a	µg/L	*	*	*
DEPTH	water depth	meters	3,856	3,856	3,856
DO	dissolved oxygen	mg/L	3,856	3,856	3,856
DO_SAT	dissolved oxygen saturation	%	3,856	3,856	3,856
SAL	salinity	PSU	3,856	3,856	3,856
SPCOND_M	specific conductivity	mS/cm	3,856	3,856	3,856
WTEMP	water temperature	Degree C	3,854	3,853	3,853
Total			**26,990**	**26,989**	**26,989**

*Sonde not equipped with sensor, reported value was zero (0)

Table I-4 Data counts for sondes located on the southeast corner of the platform

PCode	Parameter Name	Units	Raw Data Count		
			L11-S	L7-M	L3-D
BGA_R	phycoerythin BGA	RFU	*	*	*
BGA_U	phycoerythin BGA	µg/L	*	*	*
CABLE	cable power	Volts	3,856	3,856	3,856
CHLA_R	chlorophyll a	RFU	*	*	*
CHLA_U	chlorophyll a	µg/L	*	*	*
DEPTH	water depth	meters	3,856	3,856	3,856
DO	dissolved oxygen	mg/L	3,856	3,856	3,856
DO_SAT	dissolved oxygen saturation	%	3,856	3,856	3,856
SAL	salinity	PSU	3,856	3,856	3,856
SPCOND_M	specific conductivity	mS/cm	3,856	3,856	3,856
WTEMP	water temperature	Degree C	3,852	3,854	3,853
Total			**26,988**	**26,990**	**26,989**

*Sonde not equipped with sensor, reported value was zero (0)

Table I-5 Data counts for sondes located on the southwest corner of the platform

PCode	Parameter Name	Units	Raw Data Count		
			L12-S	L8-M	L4-D
BGA_R	phycoerythin BGA	RFU	*	*	*
BGA_U	phycoerythin BGA	µg/L	*	*	*
CABLE	cable power	Volts	3,856	3,856	3,856
CHLA_R	chlorophyll a	RFU	*	*	*
CHLA_U	chlorophyll a	µg/L	*	*	*
DEPTH	water depth	meters	3,856	3,856	3,856
DO	dissolved oxygen	mg/L	3,856	3,856	3,856
DO_SAT	dissolved oxygen saturation	%	3,856	3,856	3,856
SAL	salinity	PSU	3,856	3,856	3,856
SPCOND_M	specific conductivity	mS/cm	3,856	3,856	3,856
WTEMP	water temperature	Degree C	3,851	3,852	3,852
Total			**26,987**	**26,988**	**26,988**

*Sonde not equipped with sensor, reported value was zero (0))

Table I-6 Data counts for sondes located on the sides of the platform

PCode	Parameter Name	Units	Raw Data Count			
			L13-V	L14-V	L15-V	L16-V
BGA_R	phycoerythin BGA	RFU	3,856	*	*	*
BGA_U	phycoerythin BGA	µg/L	3,856	*	*	*
CABLE	cable power	Volts	3,856	3,856	3,856	3,856
CHLA_R	chlorophyll a	RFU	3,856	*	*	*
CHLA_U	chlorophyll a	µg/L	3,856	*	*	*
DEPTH	water depth	meters	3,856	3,856	3,856	3,856
DO	dissolved oxygen	mg/L	3,856	3,856	3,856	3,856
DO_SAT	dissolved oxygen saturation	%	3,856	3,856	3,856	3,856
SAL	salinity	PSU	3,856	3,856	3,856	3,856
SPCOND_M	specific conductivity	mS/cm	3,856	3,856	3,856	3,856
WTEMP	water temperature	Degree C	3,855	3,855	3,856	3,856
Total			**42,415**	**26,991**	**26,992**	**26,992**

*Sonde not equipped with sensor, reported value was zero (0)

During the QA/QC check, unique observations and some inconsistencies in the data of the system were identified in the measured platform data and were separated from the consistent data in the processed data files and project database.

Based on the header information for specific conductivity (SPCOND) on the Xylem Eagle I/O website, the units were reported as mS/cm. It was confirmed by Xylem that the units for SPCOND were mS/cm. The SPCOND concentrations for all continuously deployed sondes varied between 0.25 mS/cm and 11,083 mS/cm, with an average concentration of 2,143 mS/cm. To verify the range of SPCOND, two USGS monitoring stations located upstream (USGS 021989793) and downstream (USGS 0219897945) of the platform were evaluated. USGS 021989793 is located 1.42 miles upstream of the platform and USGS 0219897945 is located 2.45 miles downstream of the platform. During the period from February 14, 2019 through February 27, 2019, the USGS 0219897945 SPCOND varied between 255 µS/cm and 15,900 µS/cm with an average concentration of 4,739 µS/cm. At USGS 021989793, SPCOND varied between 89 µS/cm and 6,490 µS/cm, with an average concentration of 1,272 µS/cm. Based on the comparison of the platform data to the USGS data, it was determined that the SPCOND concentrations from the data sondes at the platform were in µS/cm, not mS/cm as stated by Xylem.

All sondes and all parameters were reported with a value of zero for the measurement taken at 2/21/2019 15:00. These data are not realistic and were deemed to be inconsistent so were separated from the consistent data in the processed data files and project database. It was theorized that a very short-lived issue occurred with central data logger which resulted in this one specific time recording observations of zero (0).

The percentage of data that were removed during data QA/QC and will not be used for data analysis at each data sonde location is provided in ***Table I-7***.

Table I-7 Percentage of values removed from the platform data set

Location	Sonde ID	Percent removed values (%)†
Back River northeast corner	L10-S	0.03
	L6-M	0.03
	L2-D	0.03
Back River northwest corner	L9-S	0.03
	L5-M	0.03
	L1-D	0.03
Back River southeast corner	L11-S	0.03
	L7-M	0.03
	L3-D	4.62
Back River southwest corner	L12-S	0.03
	L8-M	0.03
	L4-D	0.03
Variable depths	L13-V	0.03
	L14-V	0.03
	L15-V	0.03
	L16-V	0.03

†Zeroes (0) reported BGA and chlorophyll a sondes was also removed but were not counted

I.2 SEMI-PERMANENT BUOY DATA

A total of thirty-six (36) semi-permanent buoy sonde datafiles were collected during the WCTE study sampling, with twenty-four (24) associated with the Back River diffuser and twelve (12) associated with the lower Front River diffuser. Data collection was logged at five-minute intervals and spanned the period from February 14, 2019 through February 27, 2019. Data were retrieved from the semi-permanent buoy sondes and uploaded by the field team to the OneDrive. Each semi-permanent buoy datafile was named with a consistent file naming convention as follows:

Location_Direction_BeginDate_EndDate, where:

- Location = LBR (Lower Back River) or LFR (Lower Front River)
- Direction = N (north), NE (northeast), NW (northwest), S (south), SE (southeast), and SW (southwest)
- BeginDate = beginning date of data within the file
- EndDate = ending date of data within the file

The QA/QC team downloaded each data file from the project OneDrive, archived the raw data on their server, reviewed and processed the data, uploaded the processed data into the project WRDB database, and plotted the data in timeseries format. ***Table I-8*** provides attribute information for each semi-permanent buoy used for the WCTE study data collection, including the location, station ID, latitude, longitude, and the number of raw data records collected at each location. ***Table I-9*** provides a list of constituents obtained for semi-permanent buoys and the number of raw records in the WRDB database for each constituent.

Table I-8 Attributes of semi-permanent buoys used for the WCTE study data collection

Location	Station ID	Latitude	Longitude	Raw Data Count
Back River northeast	LBR_NE	32.118109	-81.116927	50,170
Back River northwest	LBR_NW	32.117900	-81.117837	34,223
Back River southeast	LBR_SE	32.116314	-81.116134	34,168
Back River southwest	LBR_SW	32.115968	-81.117116	50,092
Lower Front River north	LFR_N	32.115920	-81.126515	47,880
Lower Front River south	LFR_S	32.115550	-81.126015	47,952
Total				**264,485**

Table I-9 Data counts for semi-permanent buoys constituents collected on the Front River and Back River

PCode	Parameter Name	Units	Raw Data Count
BATTERY	battery voltage	volts	23,898
BGA_R†	phycoerythin BGA	RFU	15,944
BGA_U†	phycoerythin BGA	µg/L	15,944
CHLA_R†	chlorophyll a	RFU	15,944
CHLA_U†	chlorophyll a	µg/L	15,944
COND	conductivity	µS/cm	9,525
DEPTH	water depth	meters	23,898
DEP_PSIA	water depth (pressure)	PSI	23,898
DO	dissolved oxygen	mg/L	23,898
DO_SAT	dissolved oxygen saturation	%	23,898
SALPPT	salinity	ppt	23,898
SPCOND	specific conductance	µS/cm	23,898
WTEMP	water temperature	°C	23,898
Total			**264,485**

†Sondes equipped to measure BGA and chlorophyll *a* were installed at LFR_N, LFR_S, LBR_NE and LBR_SW

The semi-permanent buoy data were reviewed in timeseries plots to identify any sample dates and times which contained observed values which were inconsistent with the observed values sampled before and after the inconsistent values. Comparison of the inconsistent dates and times to field notes revealed that the inconsistent data were strongly correlated to times when the field crew was at a buoy retrieving the data. As an example, ***Figure I-2*** and ***Figure I-3*** present the depth and DO timeseries respectively at the lower Front River south buoy. The data points in red were identified as being inconsistent. All of the inconsistent data points were associated with beginning and ending times of the intermittent data retrievals.

Data QA/QC found that the observed depth increase at LFR_N between 2/20/2019 4:46 and 2/20/2019 13:03 corresponds to a real occurrence and was not a sonde malfunction issue. Field notes indicate that when the field team arrived on site the north buoy was not present. While the team was onsite, the tide receded and the buoy was visible at the surface. The field team hypothesized that debris became entangled with the mooring line and pulled the buoy under the water surface. The debris became self-untangled during the tide change and the sonde remained near the surface for the rest of the WCTE data collection period (***Figure I-4***).

At each semi-permanent buoy, all dates and times identified as verified inconsistent were separated from the consistent data in the processed data files and project database. The percentage of inconsistence data for each semi-permanent buoy is provided in ***Table I-10***.

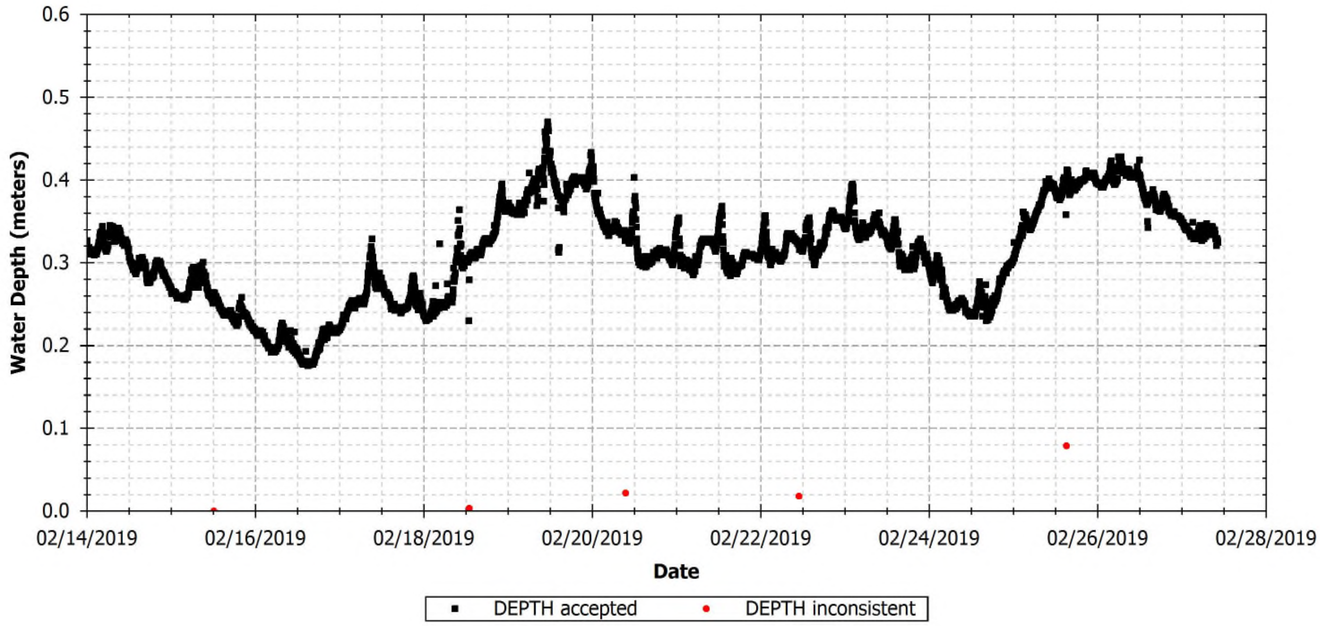


Figure I-2 Lower Front River south depth QA/QC timeseries

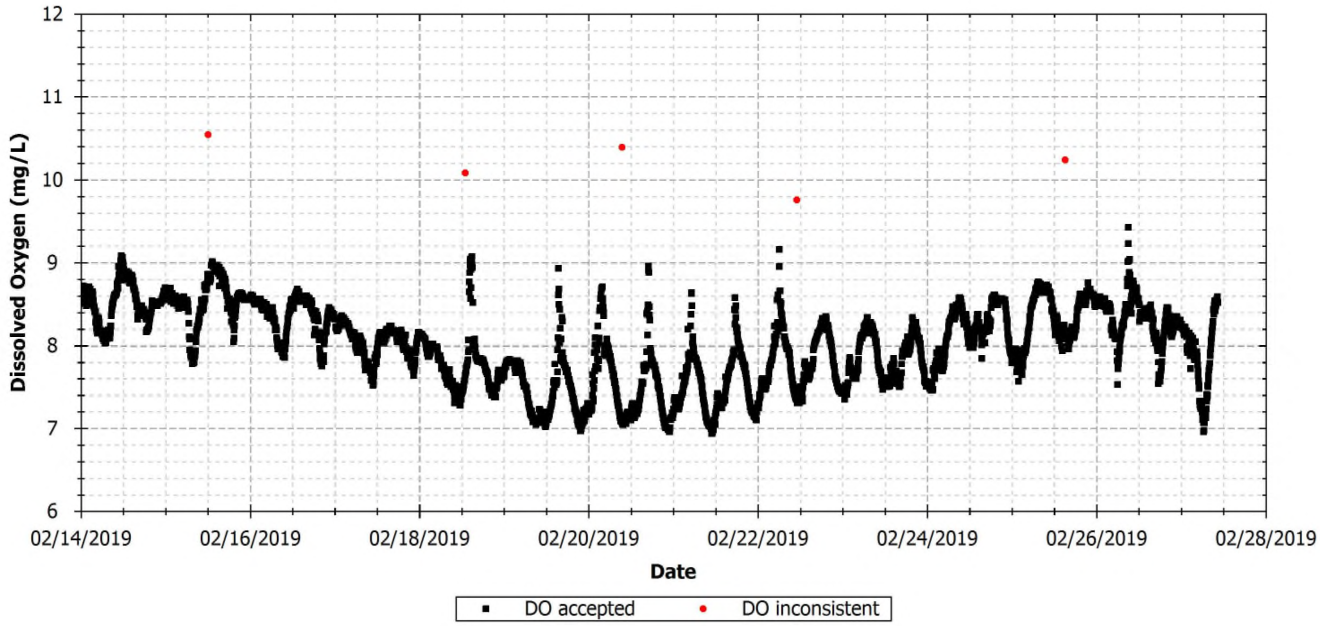
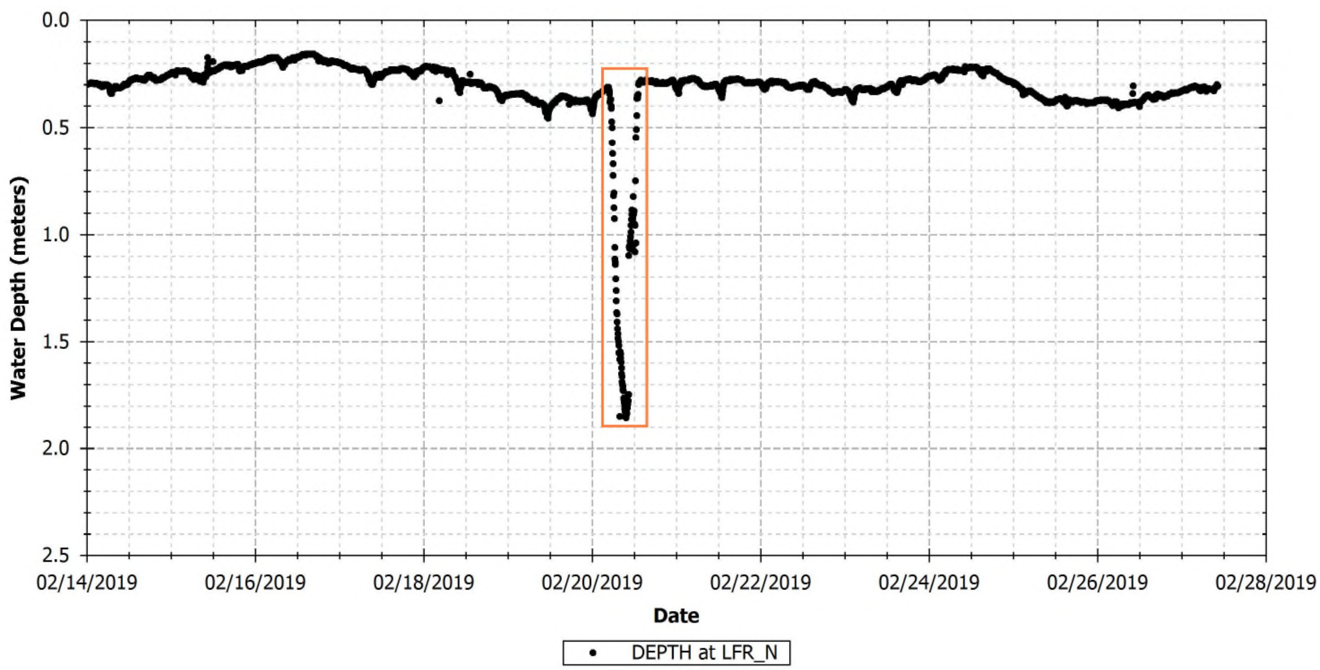


Figure I-3 Lower Front River south DO QA/QC timeseries



Note: orange box identifies the period of time where buoy was pulled under water by debris

Figure I-4 Lower Front River north depth timeseries

Table I-10 Percentage of inconsistent values for semi-permanent buoys

Location	Station ID	Inconsistent values (%)
Back River northeast	LBR_NE	0.17
Back River northwest	LBR_NW	0.17
Back River southeast	LBR_SE	0.15
Back River southwest	LBR_SW	0.15
Front River north	LFR_N	0.20
Front River south	LFR_S	0.15

I.3 PROFILE DATA

A total of seventy-three (73) profiles were collected during the WCTE study with fifty-four (54) collected near the Back River diffuser and nineteen (19) collected near the lower Front River diffuser. The profile data were uploaded by the field team to the project OneDrive. Each profile was contained within its own *.csv or Excel workbook and was named with a consistent file naming convention as follows:

Location_Profile_Date_Sub-location_TT (#), where:

- Location = LBR (Lower Back River) or LFR (Lower Front River)
- Date = Sample Date
- Sub-location = location within river BNE (northeast buoy), BNW (northwest), BSE (southeast buoy), BSW (southwest buoy), Platform W (west side of platform), Platform E (east side of platform) (west side of platform), LFR N (north buoy), LFR S (south buoy) or "blank" (traveling profile in and out of plume)
- TT = OT (outgoing tide), IT (incoming tide), LT (ebb tide), or HT (flood tide)
- # = sequential number to identify identically named profiles but at separate locations

The QA/QC team downloaded each data file from the project OneDrive, archived the raw data on their server, reviewed and processed the data, uploaded the data into the project WRDB database, and plotted the data in timeseries format. ***Table I-11*** and ***Table I-12*** provide identifying attribute information for each profile collected on the Back River and lower Front River respectively. Each profile was assigned a unique station ID for the WRDB databases that consisted of a fourteen (14) digit character string. The station ID attribute captures the location and date and was assigned a chronological number based on the alphabetical sorting of the names of the files for each day. The station name was assigned the name used in the raw data files sans the file extension (i.e. *.csv and *.xlsx). The tables also provide the profile type (i.e. stationary or traveling) as an attribute. ***Table I-13*** provides a list of constituents obtained for depth profiles and the number of raw records in the WRDB database for each constituent.

Table I-11 Attributes of depth profiles collected on the Back River

Station ID	Begin Date Time	End Date Time	Station Name	Type
LBR_021419_001	2/14/2019 10:36:46	2/14/2019 10:38:26	LBR_Profile_021419_BNE_IT	Stationary
LBR_021419_002	2/14/2019 09:49:57	2/14/2019 09:52:09	LBR_Profile_021419_BNE_OT	Stationary
LBR_021419_003	2/14/2019 09:43:58	2/14/2019 09:45:33	LBR_Profile_021419_BNW_OT	Stationary
LBR_021419_004	2/14/2019 09:30:37	2/14/2019 09:31:54	LBR_Profile_021419_BSE_OT	Stationary
LBR_021419_005	2/14/2019 09:36:21	2/14/2019 09:38:09	LBR_Profile_021419_BSW_OT	Stationary
LBR_021419_006	2/14/2019 11:12:12	2/14/2019 11:14:16	LBR_Profile_021419_Platform NW_IT	Stationary

Station ID	Begin Date Time	End Date Time	Station Name	Type
LBR_021419_007	2/14/2019 11:18:17	2/14/2019 11:20:29	LBR_Profile_021419_Platform SE_IT	Stationary
LBR_021419_008	2/14/2019 09:58:45	2/14/2019 09:59:49	LBR_Profile_021419_Platform SE_OT	Stationary
LBR_021419_DT_001	2/14/2019 10:03:01	2/14/2019 10:36:15	LBR_Profile_021419_Dye Test_LT	Traveling
LBR_021419_DT_002	2/14/2019 10:40:44	2/14/2019 11:10:06	LBR_Profile_021419_Dye Test_IT	Traveling
LBR_021419_DT_003	2/14/2019 11:22:44	2/14/2019 11:56:01	LBR_Profile_021419_Dye Test 2	Traveling
LBR_021419_DT_004	2/14/2019 11:59:55	2/14/2019 12:56:53	LBR_Profile_021419_Dye Follow_IT	Traveling
LBR_021819_001	2/18/2019 14:39:41	2/18/2019 14:41:19	LBR_Profile_021819_BNE_IT	Stationary
LBR_021819_002	2/18/2019 14:30:11	2/18/2019 14:31:29	LBR_Profile_021819_BNW_OT	Stationary
LBR_021819_003	2/18/2019 14:07:22	2/18/2019 14:08:52	LBR_Profile_021819_BSE_OT	Stationary
LBR_021819_004	2/18/2019 14:19:17	2/18/2019 14:21:05	LBR_Profile_021819_BSW_OT	Stationary
LBR_021819_005	2/18/2019 15:29:33	2/18/2019 15:50:45	LBR_Profile_021819_Platform E_IT	Traveling
LBR_021819_007	2/18/2019 14:49:48	2/18/2019 14:51:34	LBR_Profile_021819_Platform E_OT	Stationary
LBR_021819_006	2/18/2019 13:39:55	2/18/2019 13:48:13	LBR_Profile_021819_Platform E_OT (2)	Traveling
LBR_021819_009	2/18/2019 14:55:41	2/18/2019 14:57:33	LBR_Profile_021819_Platform W_OT	Stationary
LBR_021819_008	2/18/2019 13:51:30	2/18/2019 14:04:02	LBR_Profile_021819_Platform W_OT (2)	Traveling
LBR_021819_010	2/18/2019 13:29:39	2/18/2019 13:38:09	LBR_Profile_021819_Plume_OT	Traveling
LBR_022019_001	2/20/2019 10:17:05	2/20/2019 10:19:27	LBR_Profile_022019_BNE_HT	Stationary
LBR_022019_002	2/20/2019 10:09:17	2/20/2019 10:11:11	LBR_Profile_022019_BNW_HT	Stationary
LBR_022019_003	2/20/2019 09:52:19	2/20/2019 09:55:20	LBR_Profile_022019_BSE_HT	Stationary
LBR_022019_004	2/20/2019 10:01:12	2/20/2019 10:03:56	LBR_Profile_022019_BSW_HT	Stationary
LBR_022019_007	2/20/2019 11:05:17	2/20/2019 11:06:57	LBR_Profile_022019_HT	Traveling
LBR_022019_005	2/20/2019 11:07:46	2/20/2019 11:14:02	LBR_Profile_022019_HT (2)	Traveling
LBR_022019_006	2/20/2019 11:14:46	2/20/2019 11:18:10	LBR_Profile_022019_HT (3)	Traveling
LBR_022019_008	2/20/2019 16:23:36	2/20/2019 17:06:36	LBR_Profile_022019_LT	Traveling
LBR_022019_009	2/20/2019 10:36:24	2/20/2019 10:39:30	LBR_Profile_022019_Platform E_HT	Stationary
LBR_022019_010	2/20/2019 10:31:38	2/20/2019 10:34:14	LBR_Profile_022019_Platform W_HT	Stationary
LBR_022219_001	2/22/2019 11:43:55	2/22/2019 11:46:25	LBR_Profile_022219_BNE_HT	Stationary
LBR_022219_002	2/22/2019 11:38:54	2/22/2019 11:40:26	LBR_Profile_022219_BNW_HT	Stationary
LBR_022219_003	2/22/2019 11:24:36	2/22/2019 11:26:28	LBR_Profile_022219_BSE_HT	Stationary
LBR_022219_004	2/22/2019 11:31:48	2/22/2019 11:34:10	LBR_Profile_022219_BSW_HT	Stationary
LBR_022219_005	2/22/2019 12:01:25	2/22/2019 12:27:39	LBR_Profile_022219_HT	Traveling
LBR_022219_006	2/22/2019 11:50:19	2/22/2019 11:52:51	LBR_Profile_022219_Platform_E_HT	Stationary
LBR_022219_007	2/22/2019 11:53:26	2/22/2019 11:56:26	LBR_Profile_022219_Platform_W_HT	Stationary
LBR_022519_001	2/25/2019 14:51:59	2/25/2019 14:54:29	LBR_Profile_022519_BNE_HT	Stationary
LBR_022519_002	2/25/2019 14:46:48	2/25/2019 14:48:22	LBR_Profile_022519_BNW_HT	Stationary
LBR_022519_003	2/25/2019 14:32:18	2/25/2019 14:34:00	LBR_Profile_022519_BSE_HT	Stationary

Station ID	Begin Date Time	End Date Time	Station Name	Type
LBR_022519_004	2/25/2019 14:39:42	2/25/2019 14:44:10	LBR_Profile_022519_BSW_HT	Stationary
LBR_022519_006	2/25/2019 13:58:04	2/25/2019 14:28:53	LBR_Profile_022519_HT	Traveling
LBR_022519_005	2/25/2019 14:57:02	2/25/2019 15:19:47	LBR_Profile_022519_HT (2)	Traveling
LBR_022519_007	2/25/2019 15:23:12	2/25/2019 15:24:34	LBR_Profile_022519_Platform_E_HT	Stationary
LBR_022519_008	2/25/2019 15:21:17	2/25/2019 15:22:29	LBR_Profile_022519_Platform_W_HT	Stationary
LBR_022719_001	2/27/2019 10:44:52	2/27/2019 10:46:44	LBR_Profile_022719_BNE_LT	Stationary
LBR_022719_002	2/27/2019 10:39:58	2/27/2019 10:41:14	LBR_Profile_022719_BNW_LT	Stationary
LBR_022719_003	2/27/2019 10:28:18	2/27/2019 10:29:48	LBR_Profile_022719_BSE_LT	Stationary
LBR_022719_004	2/27/2019 10:34:19	2/27/2019 10:36:01	LBR_Profile_022719_BSW_LT	Stationary
LBR_022719_005	2/27/2019 09:11:20	2/27/2019 10:22:40	LBR_Profile_022719_LT	Traveling
LBR_022719_006	2/27/2019 10:54:30	2/27/2019 10:56:16	LBR_Profile_022719_Platform_E_LT	Stationary
LBR_022719_007	2/27/2019 10:51:52	2/27/2019 10:53:18	LBR_Profile_022719_Platform_W_LT	Stationary

Table I-12 Attributes of depth profiles collected on the lower Front River

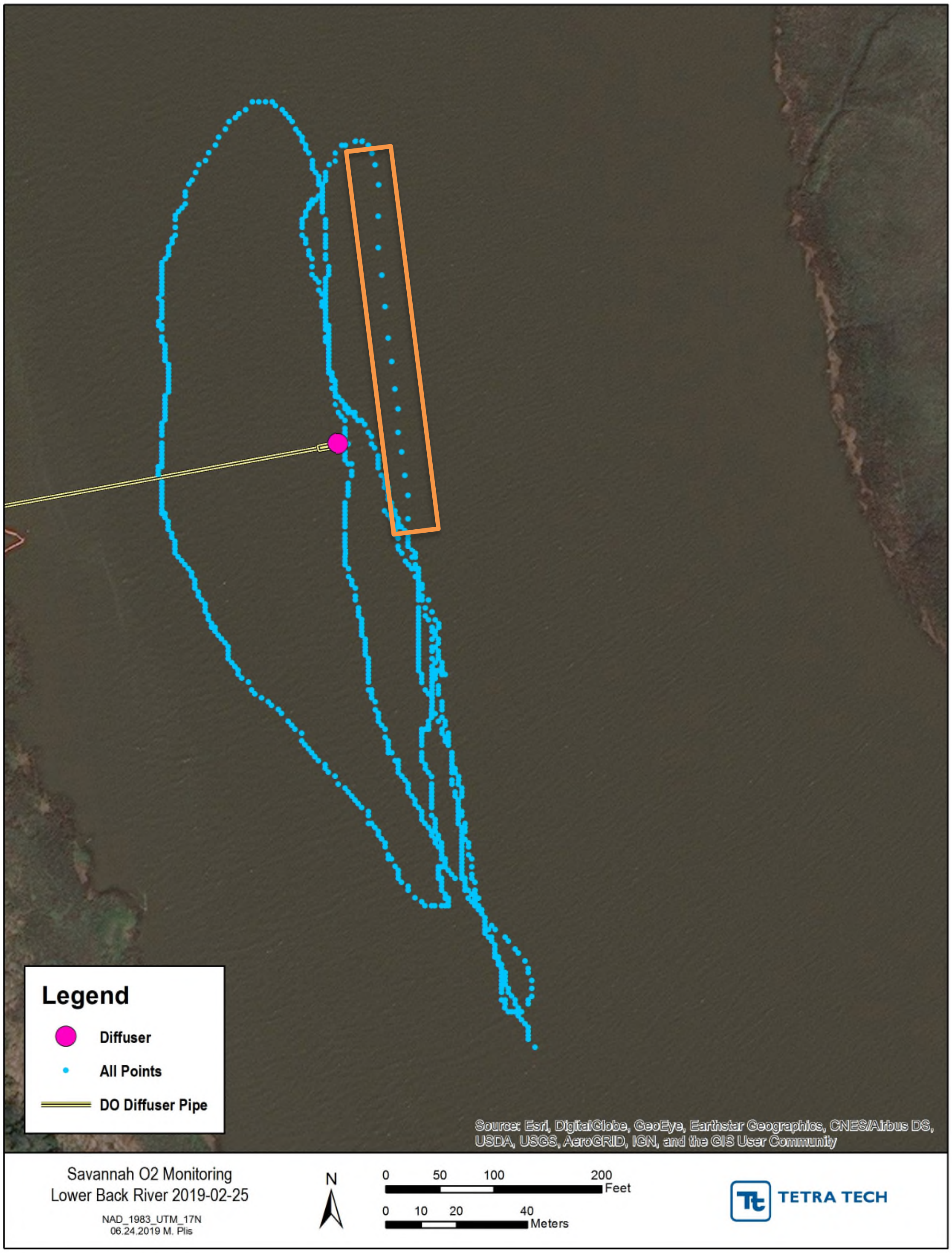
Station ID	Begin DateTime	End DateTime	Station Name	Type
LFR_021819_001	2/18/2019 13:22:40	2/18/2019 15:32:26	LFR_Profile_021819	Traveling
LFR_021819_002	2/18/2019 13:09:30	2/18/2019 13:11:03	LFR_Profile_021819_LFR N_OT	Stationary
LFR_021819_003	2/18/2019 13:00:10	2/18/2019 13:01:52	LFR_Profile_021819_LFR S_OT	Stationary
LFR_021819_004	2/18/2019 13:17:01	2/18/2019 13:21:52	LFR_Profile_021819_Plume_OT	Traveling
LFR_022019_001	2/20/2019 09:41:52	2/20/2019 10:36:22	LFR_Profile_022019_HT	Traveling
LFR_022019_002	2/20/2019 10:38:18	2/20/2019 10:40:01	LFR_Profile_022019_LFR N_HT	Stationary
LFR_022019_003	2/20/2019 09:33:10	2/20/2019 09:36:09	LFR_Profile_022019_LFR S_HT	Stationary
LFR_022019_004	2/20/2019 15:19:52	2/20/2019 16:19:38	LFR_Profile_022019_LT	Traveling
LFR_022119_DT_001	2/21/2019 10:15:44	2/21/2019 12:45:48	LFR_Profile_022119_Dye Test_HT	Traveling
LFR_022119_001	2/21/2019 09:58:42	2/21/2019 10:02:49	LFR_Profile_022119_LFR N_HT	Stationary
LFR_022219_001	2/22/2019 11:16:30	2/22/2019 12:00:16	LFR_Profile_022219_HT	Traveling
LFR_022219_002	2/22/2019 11:09:08	2/22/2019 11:11:17	LFR_Profile_022219_LFR N_HT	Stationary
LFR_022219_003	2/22/2019 11:02:49	2/22/2019 11:05:29	LFR_Profile_022219_LFR S_HT	Stationary
LFR_022519_001	2/25/2019 13:48:08	2/25/2019 14:44:01	LFR_Profile_022519_HT	Traveling
LFR_022519_002	2/25/2019 14:45:05	2/25/2019 14:46:36	LFR_Profile_022519_LFR N_OT	Stationary
LFR_022519_003	2/25/2019 15:06:00	2/25/2019 15:08:03	LFR_Profile_022519_LFR S_OT	Stationary
LFR_022719_001	2/27/2019 09:57:11	2/27/2019 09:58:43	LFR_Profile_022719_LFR N_LT	Stationary
LFR_022719_002	2/27/2019 09:53:01	2/27/2019 09:54:28	LFR_Profile_022719_LFR S_LT	Stationary
LFR_022719_003	2/27/2019 09:02:13	2/27/2019 09:51:59	LFR_Profile_022719_LT	Traveling

Table I-13 Data counts for profile constituents collected on the Back River and lower Front River

PCode	Parameter Name	Units	Raw Data Count
BARO	barometric pressure	mm Hg	53,919
BATTERY	battery voltage	volts	53,912
BGA_R	phycoerythin BGA	RFU	53,912
BGA_U	phycoerythin BGA	µg/L	53,912
CHLA_R	chlorophyll a	RFU	53,912
CHLA_U	chlorophyll a	µg/L	53,912
COND	conductivity	µS/cm	6,360
DEPTH	water depth	meters	53,912
DEP_PSIA	water depth (pressure)	PSI	53,912
DO	dissolved oxygen	mg/L	53,912
DO_SAT	dissolved oxygen saturation	%	53,912
LAT	latitude	degrees	53,919
LON	longitude	degrees	53,919
SALPPT	salinity	PPT	53,912
SPCOND	specific conductance	µS/cm	53,912
WTEMP	water temperature	°C	53,912
	Total		**815,061**

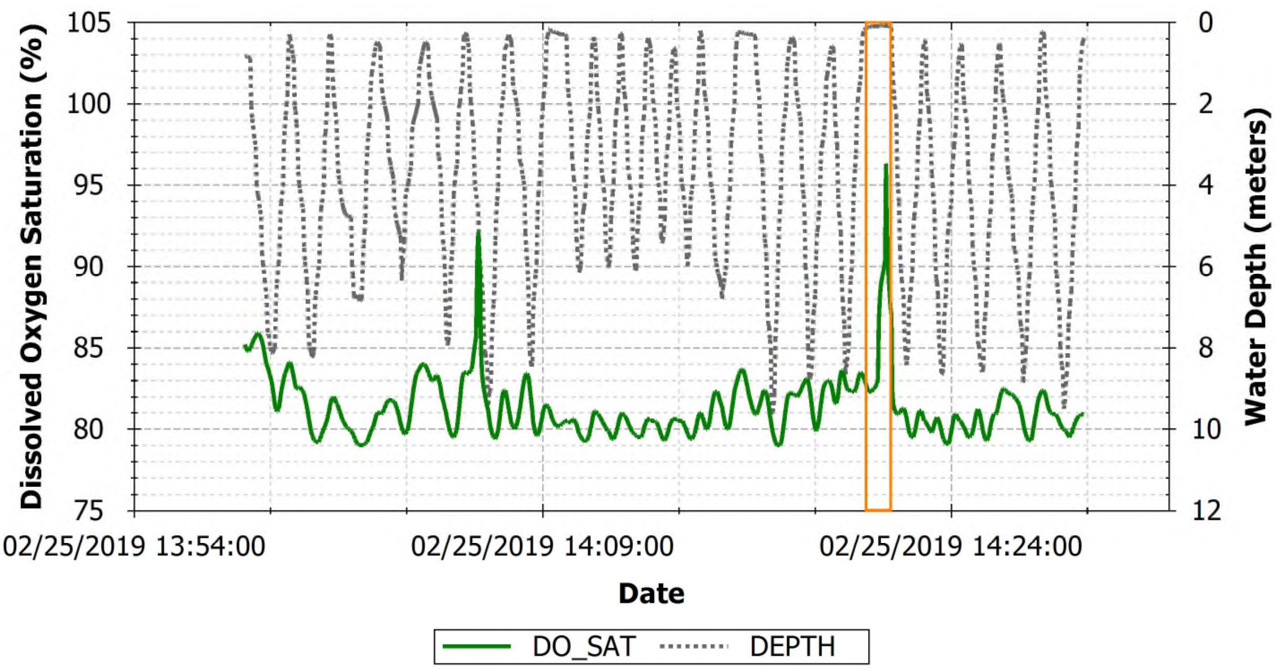
The profile data were reviewed in timeseries plots to identify any sample dates and times which contained observed values which were inconsistent with the observed values sampled before and after the inconsistent values. The identified inconsistent dates and times were correlated to times when the sondes were likely out of the water. As an example, ***Figure I-5*** and ***Figure I-6*** present the location map and depth and DO saturation timeseries respectively of the LBR_022519_006 travelling profile. The orange box identifies a period of time where the sondes were likely out of the water because during this period of time the boat was travelling nearly twenty (20) miles per hour. Another example of periods of inconsistent data were at the beginning or end of a stationary profile where depths were less than one-tenth (0.1) of a foot where data recording was started or stopped before or exactly coincident with the sonde being inserted or removed from the water (***Figure I-7***).

For each profile, all dates and times identified as verified inconsistent were separated from the consistent data in the processed data files and project database. The percentage of inconsistence data for each profile is provided in ***Table I-14***.



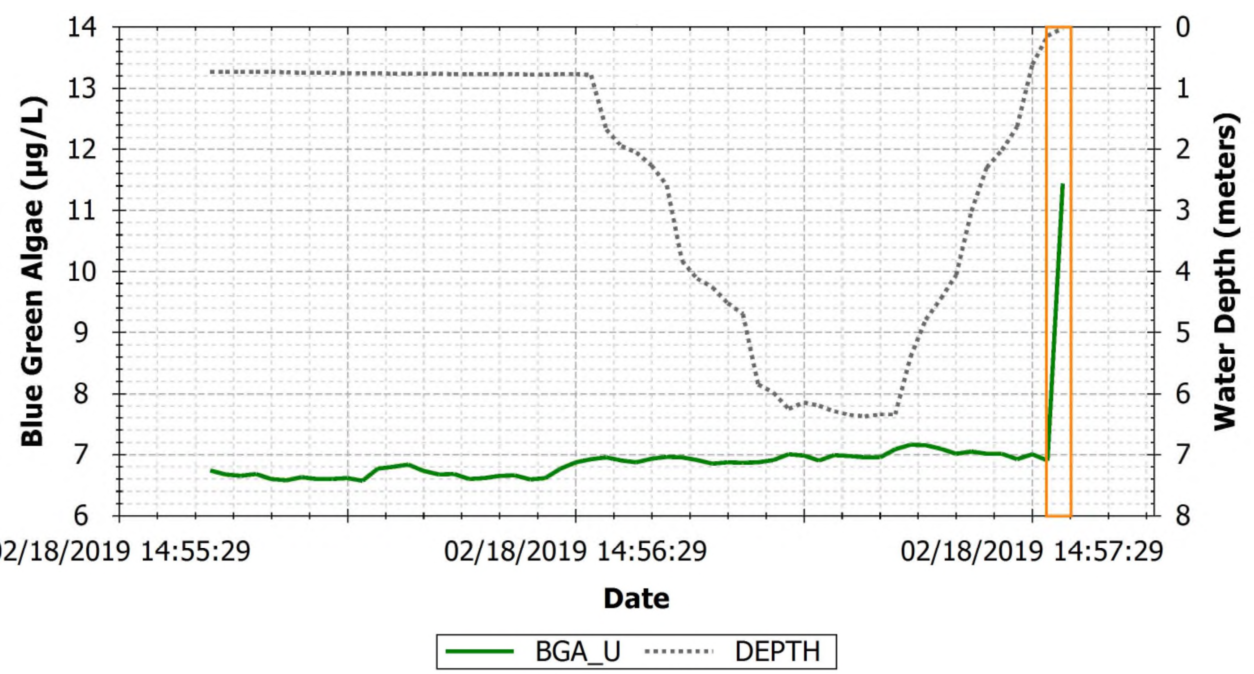
Note: orange box identifies the period of time where boat was traveling over 20 miles per hour and the sonde was out of the water

Figure I-5 LBR_022519_006 travelling profile location map QA/QC



Note: orange box identifies the period of time where boat was traveling over 20 miles per hour and the sonde was out of the water

Figure I-6 LBR_022519_006 travelling profile depth and DO QA/QC



Note: orange box identifies the period of time where sonde was likely pulled out of water before stopping data recording

Figure I-7 LBR_021819_009 stationary profile depth and BGA QA/QC

Table I-14 Percentage of inconsistent values for profile data

Station ID	Station Name	Inconsistent values (%)
LBR_021419_001	LBR_Profile_021419_BNE_IT	0.00
LBR_021419_002	LBR_Profile_021419_BNE_OT	0.00
LBR_021419_003	LBR_Profile_021419_BNW_OT	0.00
LBR_021419_004	LBR_Profile_021419_BSE_OT	0.00
LBR_021419_005	LBR_Profile_021419_BSW_OT	0.00
LBR_021419_006	LBR_Profile_021419_Platform NW_IT	0.00
LBR_021419_007	LBR_Profile_021419_Platform SE_IT	0.00
LBR_021419_008	LBR_Profile_021419_Platform SE_OT	0.00
LBR_021419_DT_001	LBR_Profile_021419_Dye Test_LT	0.00
LBR_021419_DT_002	LBR_Profile_021419_Dye Test_IT	0.00
LBR_021419_DT_003	LBR_Profile_021419_Dye Test 2	0.00
LBR_021419_DT_004	LBR_Profile_021419_Dye Follow_IT	0.00
LBR_021819_001	LBR_Profile_021819_BNE_IT	0.00
LBR_021819_002	LBR_Profile_021819_BNW_OT	0.00
LBR_021819_003	LBR_Profile_021819_BSE_OT	0.00
LBR_021819_004	LBR_Profile_021819_BSW_OT	0.00
LBR_021819_005	LBR_Profile_021819_Platform E_IT	0.00
LBR_021819_007	LBR_Profile_021819_Platform E_OT	0.00
LBR_021819_006	LBR_Profile_021819_Platform E_OT (2)	0.00
LBR_021819_009	LBR_Profile_021819_Platform W_OT	1.75
LBR_021819_008	LBR_Profile_021819_Platform W_OT (2)	0.00
LBR_021819_010	LBR_Profile_021819_Plume_OT	0.00
LBR_022019_001	LBR_Profile_022019_BNE_HT	0.00
LBR_022019_002	LBR_Profile_022019_BNW_HT	0.00
LBR_022019_003	LBR_Profile_022019_BSE_HT	0.00
LBR_022019_004	LBR_Profile_022019_BSW_HT	0.00
LBR_022019_007	LBR_Profile_022019_HT	0.00
LBR_022019_005	LBR_Profile_022019_HT (2)	0.00
LBR_022019_006	LBR_Profile_022019_HT (3)	0.00
LBR_022019_008	LBR_Profile_022019_LT	0.00
LBR_022019_009	LBR_Profile_022019_Platform E_HT	0.00
LBR_022019_010	LBR_Profile_022019_Platform W_HT	0.00
LBR_022219_001	LBR_Profile_022219_BNE_HT	0.00
LBR_022219_002	LBR_Profile_022219_BNW_HT	0.00
LBR_022219_003	LBR_Profile_022219_BSE_HT	0.00

Station ID	Station Name	Inconsistent values (%)
LBR_022219_004	LBR_Profile_022219_BSW_HT	0.00
LBR_022219_005	LBR_Profile_022219_HT	0.00
LBR_022219_006	LBR_Profile_022219_Platform_E_HT	0.00
LBR_022219_007	LBR_Profile_022219_Platform_W_HT	1.10
LBR_022519_001	LBR_Profile_022519_BNE_HT	0.00
LBR_022519_002	LBR_Profile_022519_BNW_HT	0.00
LBR_022519_003	LBR_Profile_022519_BSE_HT	0.00
LBR_022519_004	LBR_Profile_022519_BSW_HT	0.00
LBR_022519_006	LBR_Profile_022519_HT	3.56
LBR_022519_005	LBR_Profile_022519_HT (2)	0.00
LBR_022519_007	LBR_Profile_022519_Platform_E_HT	0.00
LBR_022519_008	LBR_Profile_022519_Platform_W_HT	0.00
LBR_022719_001	LBR_Profile_022719_BNE_LT	0.00
LBR_022719_002	LBR_Profile_022719_BNW_LT	0.00
LBR_022719_003	LBR_Profile_022719_BSE_LT	0.00
LBR_022719_004	LBR_Profile_022719_BSW_LT	0.00
LBR_022719_005	LBR_Profile_022719_LT	1.91
LBR_022719_006	LBR_Profile_022719_Platform_E_LT	0.00
LBR_022719_007	LBR_Profile_022719_Platform_W_LT	0.00
LFR_021819_001	LFR_Profile_021819	0.00
LFR_021819_002	LFR_Profile_021819_LFR N_OT	0.00
LFR_021819_003	LFR_Profile_021819_LFR S_OT	0.00
LFR_021819_004	LFR_Profile_021819_Plume_OT	0.00
LFR_022019_001	LFR_Profile_022019_HT	0.00
LFR_022019_002	LFR_Profile_022019_LFR N_HT	0.00
LFR_022019_003	LFR_Profile_022019_LFR S_HT	0.00
LFR_022019_004	LFR_Profile_022019_LT	0.00
LFR_022119_DT_001	LFR_Profile_022119_Dye Test_HT	0.00
LFR_022119_001	LFR_Profile_022119_LFR N_HT	0.00
LFR_022219_001	LFR_Profile_022219_HT	0.00
LFR_022219_002	LFR_Profile_022219_LFR N_HT	0.00
LFR_022219_003	LFR_Profile_022219_LFR S_HT	0.00
LFR_022519_001	LFR_Profile_022519_HT	0.00
LFR_022519_002	LFR_Profile_022519_LFR N_OT	0.00
LFR_022519_003	LFR_Profile_022519_LFR S_OT	0.00
LFR_022719_001	LFR_Profile_022719_LFR N_LT	0.00

Station ID	Station Name	Inconsistent values (%)
LFR_022719_002	LFR_Profile_022719_LFR S_LT	0.00
LFR_022719_003	LFR_Profile_022719_LT	0.00
Total		**0.*15***

I.4 DRIFT DATA

A total of forty-eight (48) drift datafiles were collected during the WCTE study sampling with twenty-four (24) associated with the Back River diffuser and twenty-four (24) associated with the lower Front River diffuser. The drift datafiles were uploaded by the field team to the OneDrive. Each drift datafile was named with a consistent file naming convention as follows:

Location_Drift_Date_X _TT, where:

- Location = LBR (Lower Back River) or LFR (Lower Front River)
- Date = Sample Date
- X = qualitative depth (deep drift, middle drift, shallow drift, or surface drift)
- TT = OT (outgoing tide), IT (incoming tide), LT (ebb tide), or HT (flood tide)

The QA/QC team downloaded each data file from the project OneDrive and archived the raw data on their server, reviewed and processed the data, uploaded the data into the project WRDB database, and plotted the data in timeseries format. Each drift had the potential of having up to four (4) files that were collected simultaneously with one of the files attributed with latitude and longitude information. The QA/QC team grouped each individual drift data file in an Excel data file with each file copied into its own individual tab. The Excel file was then named as follows:

Location_Date_TT _Drift_Y, where:

- Location = LBR (Lower Back River) or LFR (Lower Front River)
- Date = Sample Date
- TT = OT (outgoing tide), IT (incoming tide), LT (ebb tide), or HT (flood tide)
- Y = drift number (1, 2, 3, etc. to account for potentially more than one set of drift sampling on the same river and tidal cycle)

Proper drift ID groupings were ensured by comparing the date and time constituents contained within the individual tabs in each Excel file. Grouping data by drift ID was necessary so that the data collected within the same drift could be linked together for further assessment and was used for data organization structure external of the WRDB database.

For each drift ID file, the latitude and longitude attributes from the tab collected with the hand-held device (i.e. typically the shallow data file) were attributed into the tabs collected in deployment mode (i.e. typically the deep, middle, and surface datafiles) based on time. Additionally, the data within each tab was assigned a unique station ID for the WRDB databases that consisted of an eighteen (18) digit character string. The station ID attribute captured the location and date and was assigned the drift number from the drift ID and the qualitative depth from the file naming convention.

For the sondes used in deployment mode, data logging was started and stopped before and after logging was started and stopped with the hand-held device. This resulted in data records in the deployment mode data files that were not associated with location information. For those data records the station ID was assigned a value of NONE since the locations of those data points were unknown.

Table I-15 and ***Table I-16*** provide attribute information for drift data collected on the Back River and lower Front River, respectively, including the drift ID, station ID, time of the beginning and ending of the collection period, and the average depth. ***Table I-17*** provides a list of constituents obtained for drift data and the number of raw records in the WRDB database for each constituent.

Table I-15 Attributes of drift data collected on the Back River

Drift ID	Station ID	Date Time Begin	Date Time End	Average Depth (meters)
LBR_021419_DYE_Drift_1	LBR_021419_D1_DEEP	2/14/2019 09:48:25	2/14/2019 12:57:46	3.5
	LBR_021419_D1_MIDL	2/14/2019 09:48:01	2/14/2019 12:56:53	2.5
	LBR_021419_D1_SHAL	2/14/2019 09:48:01	2/14/2019 12:56:52	0.8
	LBR_021419_D1_SURF	2/14/2019 09:48:01	2/14/2019 12:56:53	0.0
LBR_021519_Drift_1	LBR_021519_D1_DEEP	2/15/2019 10:34:56	2/15/2019 12:03:32	3.8
	LBR_021519_D1_MIDL	2/15/2019 10:34:25	2/15/2019 12:03:33	2.4
	LBR_021519_D1_SHAL	2/15/2019 10:34:25	2/15/2019 12:01:31	0.7
	LBR_021519_D1_SURF	2/15/2019 10:34:25	2/15/2019 12:03:33	0.0
LBR_021919_HT_Drift_1	LBR_021919_HT_D1_DEEP	2/19/2019 08:48:11	2/19/2019 10:05:03	5.3
	LBR_021919_HT_D1_MIDL	2/19/2019 08:47:03	2/19/2019 10:05:03	3.0
	LBR_021919_HT_D1_SHAL	2/19/2019 08:47:03	2/19/2019 10:04:09	1.7
	LBR_021919_HT_D1_SURF	2/19/2019 08:47:02	2/19/2019 10:05:02	0.1
LBR_021919_LT_Drift_1	LBR_021919_LT_D1_DEEP	2/19/2019 14:49:41	2/19/2019 15:56:15	3.4
	LBR_021919_LT_D1_MIDL	2/19/2019 14:48:53	2/19/2019 15:56:15	1.9
	LBR_021919_LT_D1_SAHL	2/19/2019 14:48:54	2/19/2019 15:55:22	0.6
	LBR_021919_LT_D1_SURF	2/19/2019 14:48:54	2/19/2019 15:56:16	0.1
LBR_022619_HT_Drift_1	LBR_022619_HT_D1_DEEP	2/26/2019 14:40:27	2/26/2019 15:45:57	5.3
	LBR_022619_HT_D1_MIDL	2/26/2019 14:39:25	2/26/2019 15:45:11	3.5
	LBR_022619_HT_D1_SHAL	2/26/2019 14:40:26	2/26/2019 15:45:56	0.6
	LBR_022619_HT_D1_SURF	2/26/2019 14:40:27	2/26/2019 15:45:57	0.2
LBR_022619_LT_Drift_1	LBR_022619_LT_D1_DEEP	2/26/2019 08:34:52	2/26/2019 10:06:44	4.2
	LBR_022619_LT_D1_MIDL	2/26/2019 08:35:49	2/26/2019 10:07:46	2.6
	LBR_022619_LT_D1_SHAL	2/26/2019 08:34:52	2/26/2019 10:06:44	0.9
	LBR_022619_LT_D1_SURF	2/26/2019 08:34:51	2/26/2019 10:06:43	0.2
N/A	NONE	2/14/2019 09:31:09	2/26/2019 15:50:45	N/A

Table I-16 Attributes of drift data collected on the lower Front River

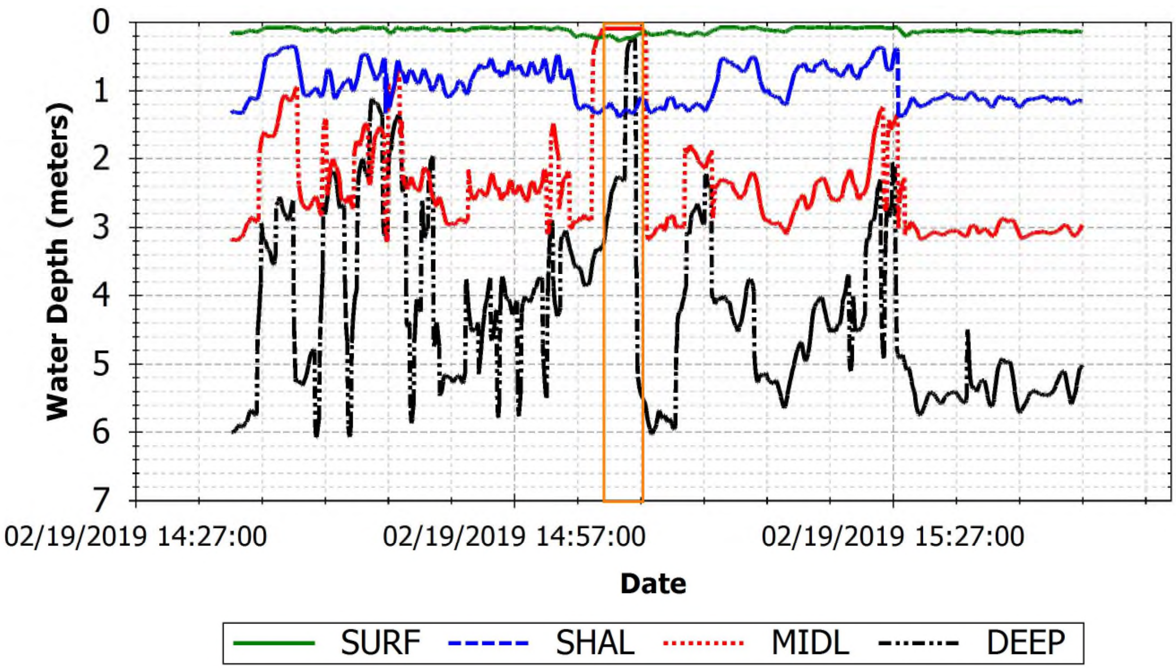
Drift ID	Station ID	Date Time Begin	Date Time End	Average Depth (meters)
LFR_021519_Drift_1	LFR_021519_D1_DEEP	2/15/2019 10:34:34	2/15/2019 11:52:20	3.9
	LFR_021519_D1_MIDL	2/15/2019 10:34:33	2/15/2019 11:52:19	3.1
	LFR_021519_D1_SHAL	2/15/2019 10:34:33	2/15/2019 11:52:19	1.3
	LFR_021519_D1_SURF	2/15/2019 10:34:33	2/15/2019 11:52:19	0.1
LFR_021919_HT_Drift_1	LFR_021919_HT_D1_DEEP	2/19/2019 08:31:02	2/19/2019 10:00:58	5.7
	LFR_021919_HT_D1_MIDL	2/19/2019 08:31:02	2/19/2019 10:00:58	2.5
	LFR_021919_HT_D1_SHAL	2/19/2019 08:31:01	2/19/2019 10:00:57	0.9
	LFR_021919_HT_D1_SURF	2/19/2019 08:31:02	2/19/2019 10:00:58	0.1
LFR_021919_LT_Drift_1	LFR_021919_LT_D1_DEEP	2/19/2019 14:34:36	2/19/2019 15:41:59	4.3
	LFR_021919_LT_D1_MIDL	2/19/2019 14:34:35	2/19/2019 15:41:59	2.4
	LFR_021919_LT_D1_SHAL	2/19/2019 14:34:35	2/19/2019 15:41:59	0.9
	LFR_021919_LT_D1_SURF	2/19/2019 14:34:35	2/19/2019 15:41:59	0.1
LFR_022119_DYE_Drift_1	LFR_022119_D1_DEEP	2/21/2019 10:13:05	2/21/2019 12:49:57	6.7
	LFR_022119_D1_MIDL	2/21/2019 10:11:53	2/21/2019 12:49:57	3.8
	LFR_022119_D1_SHAL	2/21/2019 10:11:54	2/21/2019 12:49:05	1.3
	LFR_022119_D1_SURF	2/21/2019 10:11:53	2/21/2019 12:49:57	0.1
LFR_022619_HT_Drift_1	LFR_022619_HT_D1_DEEP	2/26/2019 14:21:24	2/26/2019 15:40:27	5.6
	LFR_022619_HT_D1_MIDL	2/26/2019 14:21:23	2/26/2019 15:40:27	4.1
	LFR_022619_HT_D1_SHAL	2/26/2019 14:21:23	2/26/2019 15:40:27	2.0
	LFR_022619_HT_D1_SURF	2/26/2019 14:21:23	2/26/2019 15:40:27	0.2
LFR_022619_LT_Drift_1	LFR_022619_LT_D1_DEEP	2/26/2019 08:27:00	2/26/2019 09:56:28	4.2
	LFR_022619_LT_D1_MIDL	2/26/2019 08:27:00	2/26/2019 09:56:28	3.4
	LFR_022619_LT_D1_SHAL	2/26/2019 08:27:00	2/26/2019 09:56:28	1.2
	LFR_022619_LT_D1_SURF	2/26/2019 08:26:59	2/26/2019 09:56:27	0.3
N/A	NONE	2/15/2019 10:23:27	2/26/2019 15:48:35	N/A

Table I-17 Data counts for drifting constituents collected on the Back River and the lower Front River

PCode	Parameter Name	Units	Raw Data Count
BARO	barometric pressure	mm Hg	56,231
BATTERY	battery voltage	volts	147,630
BGA_R	phycoerythin BGA sensor	RFU	81,629
BGA_U	phycoerythin BGA sensor	ug/L	81,629
CHLA_R	chlorophyll a	RFU	81,629
CHLA_U	chlorophyll a	ug/L	81,629
COND	conductivity	uS/cm	45,072
DEPTH	water depth	meters	147,630
DEP_PSIA	water depth	psia	147,630
DO	dissolved oxygen	mg/L	147,630
DO_SAT	dissolved oxygen saturation	%	147,630
LAT	latitude	degrees	136,915
LON	longitude	degrees	136,915
SALPPT	salinity	PPT	147,630
SPCOND	specific conductance	uS/cm	147,630
WTEMP	water temperature	°C	147,630
Total			**1,882,689**

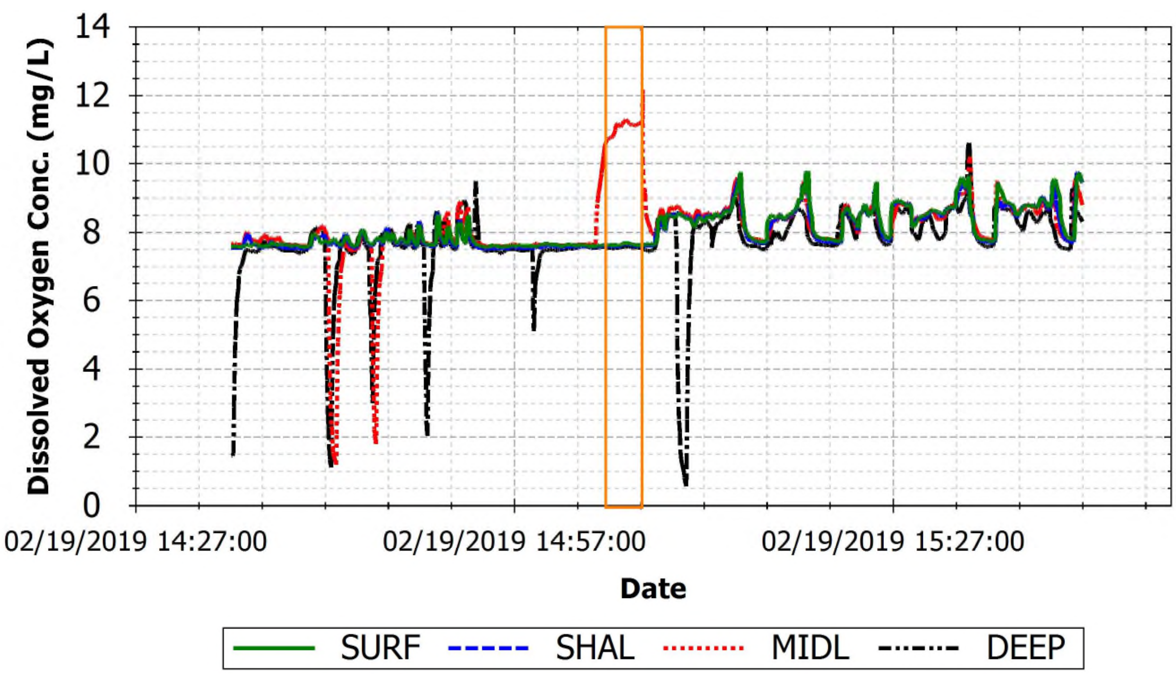
The drift data were reviewed in timeseries plots to identify any sample dates and times which contained observed values which were inconsistent with the observed values sampled before and after the inconsistent values. The identified inconsistent dates and times were correlated to times when the sondes were likely out of the water. As an example, ***Figure I-8*** and ***Figure I-9*** present the depth and DO timeseries respectively of the LFR_021919_LT_Drift_1 drift. The orange box identifies a period of time where the middle sonde (LFR_021919_LT_D1_MIDL) was likely out of the water based on comparison of the response of the middle sonde to the response of the deep, shallow, and surface sondes.

For each profile, all dates and times identified as verified inconsistent were separated from the consistent data in the processed data files and project database. The percentage of inconsistence data for each semi-permanent buoy is provided in ***Table I-18***.



Note: orange box identifies the period of time where sonde was likely pulled out of water and inconsistent data was recorded

Figure I-8 LFR_021919_LT_Drift_1 drift depth QA/QC timeseries



Note: orange box identifies the period of time where sonde was likely pulled out of water and inconsistent data was recorded

Figure I-9 LFR_021919_LT_Drift_1 drift DO QA/QC timeseries

Table I-18 Percentage of inconsistent values for drift data

Drift ID	Station ID	Inconsistent values (%)
LBR_021419_DYE_Drift_1	LBR_021419_D1_DEEP	0.00
	LBR_021419_D1_MIDL	0.00
	LBR_021419_D1_SHAL	0.00
	LBR_021419_D1_SURF	0.00
LBR_021519_Drift_1	LBR_021519_D1_DEEP	0.38
	LBR_021519_D1_MIDL	0.00
	LBR_021519_D1_SHAL	0.00
	LBR_021519_D1_SURF	0.75
LBR_021919_HT_Drift_1	LBR_021919_HT_D1_DEEP	0.00
	LBR_021919_HT_D1_MIDL	0.00
	LBR_021919_HT_D1_SHAL	0.00
	LBR_021919_HT_D1_SURF	0.00
LBR_021919_LT_Drift_1	LBR_021919_LT_D1_DEEP	0.00
	LBR_021919_LT_D1_MIDL	0.00
	LBR_021919_LT_D1_SAHL	0.00
	LBR_021919_LT_D1_SURF	0.00
LBR_022619_HT_Drift_1	LBR_022619_HT_D1_DEEP	0.00
	LBR_022619_HT_D1_MIDL	0.00
	LBR_022619_HT_D1_SHAL	0.00
	LBR_022619_HT_D1_SURF	0.00
LBR_022619_LT_Drift_1	LBR_022619_LT_D1_DEEP	0.00
	LBR_022619_LT_D1_MIDL	0.00
	LBR_022619_LT_D1_SHAL	0.00
	LBR_022619_LT_D1_SURF	0.00
LFR_021519_Drift_1	LFR_021519_D1_DEEP	0.64
	LFR_021519_D1_MIDL	0.69
	LFR_021519_D1_SHAL	0.69
	LFR_021519_D1_SURF	0.69
LFR_021919_HT_Drift_1	LFR_021919_HT_D1_DEEP	0.00
	LFR_021919_HT_D1_MIDL	0.00
	LFR_021919_HT_D1_SHAL	0.00
	LFR_021919_HT_D1_SURF	0.00

Drift ID	Station ID	Inconsistent values (%)
LFR_021919_LT_Drift_1	LFR_021919_LT_D1_DEEP	0.00
	LFR_021919_LT_D1_MIDL	6.48
	LFR_021919_LT_D1_SHAL	0.00
	LFR_021919_LT_D1_SURF	0.00
LFR_022119_DYE_Drift_1	LFR_022119_D1_DEEP	0.00
	LFR_022119_D1_MIDL	0.00
	LFR_022119_D1_SHAL	0.00
	LFR_022119_D1_SURF	0.00
LFR_022619_HT_Drift_1	LFR_022619_HT_D1_DEEP	0.00
	LFR_022619_HT_D1_MIDL	0.00
	LFR_022619_HT_D1_SHAL	0.00
	LFR_022619_HT_D1_SURF	0.00
LFR_022619_LT_Drift_1	LFR_022619_LT_D1_DEEP	0.00
	LFR_022619_LT_D1_MIDL	0.00
	LFR_022619_LT_D1_SHAL	0.00
	LFR_022619_LT_D1_SURF	0.00
NONE		100.00
Total		5.43%

I.5 USGS DATA

USGS monitoring data were obtained from four gages located upstream and downstream of the Back River and lower Front River diffuser locations (***Figure I-10***). These stations were selected to evaluate the water quality further away from the DO injection diffusers. ***Table I-19*** provides the location, gage ID, and name of the USGS gages used for the WCTE study. Data were downloaded from the National Water Information System Web Interface (https://waterdata.usgs.gov/ga/nwis/) with a sampling interval of fifteen (15) minutes and spanned the period from February 14, 2019 through February 27, 2019. The specific QA/QC process for the USGS gage data were to ensure: (1) the requested period of data and requested constituents were received, and (2) the start of the next period of downloaded data coincided with the end of the previous periods download. All of the USGS data were assumed to be error free and were accepted as having no inconsistent data.

Table I-19 USGS gages data compiled for WCTE study sampling

Location	Gage ID	Name
Front River	USGS 021989715	Savannah River at Garden City, GA
Front River	USGS 021989773	Savannah River at USACE Dock, at Savannah, GA
Back River	USGS 021989793	Little Back River at Hog Island, near Savannah, GA
Back River	USGS 0219897945	Back River 0.4 miles downstream US17, near Savannah, GA

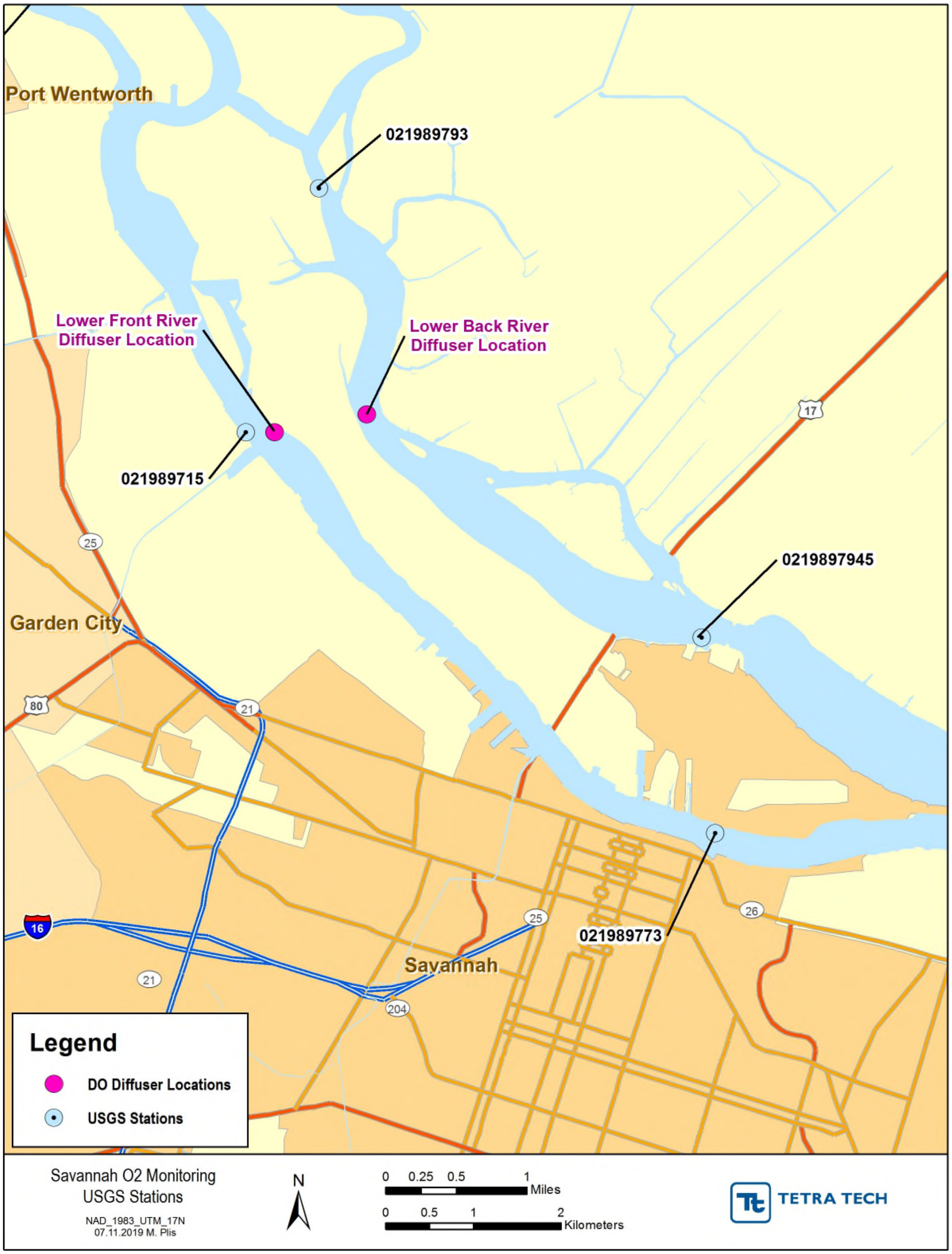


Figure I-10 Location of USGS gages used for WCTE study sampling

Table I-20 through ***Table I-23*** provide the constituents obtained and calculated for each USGS gage and the PCode assigned in the project WRDB database. Each constituent and value flagged as “provisional data subject to revision” by the USGS was flagged similarly in WRDB. The USGS assigns provisional designations to data they have not had a chance to fully QA/QC, and this designation is normally retained for a period of six months after data collection. In order for this flag to removed, the USGS data would need to be obtained again after the USGS has fully reviewed the data and removed the provisional flag.

The USGS did not report DO saturation values but the constituents needed to manually calculate DO saturation were reported (i.e. temperature, salinity, and DO). Therefore, DO saturation for each USGS measurement was calculated based on the following equations (Thomann & Mueller, 1987):

$$(\ln C_{sf}) = -139.34411 + \frac{(1.575701 \times 10^{5})}{T} - \frac{(6.642308 \times 10^{7})}{T^2} + \frac{(1.243800 \times 10^{10})}{T^3} - \frac{(8.621949 \times 10^{11})}{T^4} \quad \boxed{1}$$

where,

C_{sf} = freshwater DO concentration at 100% saturation at 1 atm in mg/L

ln = natural logarithm

T = temperature in Kelvin

$$(\ln C_{ss}) = (\ln C_{sf}) - S\left(1.7674 \times 10^{-2} - \frac{(1.0754 \times 10^{1})}{T} + \frac{(2.1407 \times 10^{3})}{T^2}\right) \quad \boxed{2}$$

where,

C_{ss} = saline water DO concentration at 100% saturation at 1 atm in mg/L

S = salinity in ppt

$$DOSAT = \frac{Observed\ DO\ Concentration}{C_{SS}} * 100 \quad \boxed{3}$$

where,

DOSAT = DO percent saturation

Table I-20 Data counts for USGS 021989715 Savannah River at Garden City, GA

PCode	Parameter Name	Units	Data Count
DEPTH_B	Depth of sensor below water surface [-23.28ft NAVD88]	feet	1,336
DOSAT_B†	DO Saturation [-23.28ft, NAVD88]	%	1,332
DOSAT_S†	DO Saturation [-13.25ft NAVD88]	%	1,344
DOSOLATM_B†	Saline water DO saturation concentration at 1 atm [-23.28ft, NAVD88]	mg/L	1,332
DOSOLATM_S†	Saline water DO saturation concentration at 1 atm [-13.25ft NAVD88]	mg/L	1,344
DOUNF_B	Dissolved oxygen, water, unfiltered [-23.28ft, NAVD88]	mg/L	1,336
DOUNF_S	Dissolved oxygen, water, unfiltered, [-13.25ft NAVD88]	mg/L	1,344
GH	Gage height	feet	1,344
pHUNF_S	pH, water, unfiltered, field [-13.25ft NAVD88]	Standard Units	1,344
SALPPT_B	Salinity, water, unfiltered [-23.28ft, NAVD88]	ppt	1,332
SALPPT_S	Salinity, water, unfiltered [-13.25ft NAVD88]	ppt	1,344
SPCOND25_B	Specific conductance, water, unfiltered, at 25 degrees Celsius [-23.28ft, NAVD88]	µS/cm	1,332
SPCOND25_S	Specific conductance, water, unfiltered, at 25 degrees Celsius, [-13.25ft NAVD88]	µS/cm	1,344
TURB_S	Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +-2.5 degrees [-13.25ft NAVD88]	FNU	1,344
WTEMP_B	Temperature, water [-23.28ft, NAVD88]	Degree C	1,332
WTEMP_S	Temperature, water [-13.25ft NAVD88]	Degree C	1,344
Total			**21,428**

†DOSAT_B, DOSAT_S, DOSOLATM_B, and DOSOLATM_S calculated by QA/QC team

Table I-21 Data counts for USGS 021989773 Savannah River at USACE Dock, at Savannah, GA

PCode	Parameter Name	Units	Data Count
ATEMP	Temperature, air[1]	Degree C	336
BARO	Barometric pressure[1]	mm of Hg	336
DOSOL_ATM[†]	Saline water DO saturation concentration at 1 atm	mg/L	1,344
DO_SAT[†]	DO saturation	%	1,344
DO_UNFIL	Dissolved oxygen, water, unfiltered	mg/L	1,344
FLOW	Discharge	cfs	1,344
GH	Gage height	feet	1,344
pH_UNFIL	pH, water, unfiltered, field	Standard Units	1,344
RAIN	Precipitation, total	inches	1,344
SALPPT_UN	Salinity, water, unfiltered	ppt	1,344
SPCOND_25	Specific conductance, water, unfiltered, at 25 degrees Celsius	µS/cm	1,344
TURB	Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +-2.5 degrees	FNU	1,344
VEL	Mean water velocity for discharge computation	fps	1,344
WDIR	Wind direction[‡]	degrees clockwise from true north	336
WSPD	Wind speed[‡]	mph	336
WTEMP	Temperature, water	Degree C	1,344
Total			**17,472**

[†]DOSAT and DOSOLATM calculated by QA/QC team
[‡]Reported at an hourly interval

Table I-22 Data counts for USGS 021989793 Little Back River at Hog Island, near Savannah, GA

PCode	Parameter Name	Units	Data Count
DOSOL_ATM†	Saline water DO saturation concentration at 1 atm	mg/L	1,343
DO_SAT†	DO saturation	%	1,325
DO_UNFIL	Dissolved oxygen, water, unfiltered	mg/L	1,325
pH_UNFIL	pH, water, unfiltered, field	Standard Units	1,340
SPCOND_25	Specific conductance, water, unfiltered, at 25 degrees Celsius	µS/cm	1,343
TURB	Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +-2.5 degrees	FNU	1,327
WTEMP	Temperature, water	Degree C	1,344
Total			**9,347**

†DOSAT and DOSOLATM calculated by QA/QC team

Table I-23 Data counts for USGS 0219897945 Back River 0.4 miles downstream US17, near Savannah, GA

PCode	Parameter Name	Units	Data Count
DOSOL_ATM†	Saline water DO saturation concentration at 1 atm	mg/L	1,338
DO_SAT†	DO saturation	%	1,334
DO_UNFIL	Dissolved oxygen, water, unfiltered	mg/L	1,334
pH_UNFIL	pH, water, unfiltered, field	Standard Units	1,334
SPCOND_25	Specific conductance, water, unfiltered, at 25 degrees Celsius	µS/cm	1,338
TURB	Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +-2.5 degrees	FNU	1,326
WTEMP	Temperature, water	Degree C	1,338
Total			**9,342**

†DOSAT and DOSOLATM calculated by QA/QC team

I.6 USACE PLANT DATA

The Plant was constructed to be an off-stream system to increase DO concentrations in the Savannah River and estuary by introducing DO super-saturated water to the Back River and lower Front River. The Plant uses Speece Cones to increase the DO levels of water withdrawn from the lower Front River. The Plant contains four Speece Cones, although only a maximum of three Speece Cones will be on and operational at any given time. The Plant operation data provides information on water temperature, conductivity, and DO of the water drawn from lower Front River; oxygen flow level from the Speece Cones; and the flow distribution of the DO super-saturated water to the Back River and lower Front River. For the WCTE study sampling effort, the Plant data were used to determine when the Plant was discharging DO super-saturated water (on), and not discharging DO super-saturated water (off). The Plant operation was also used in the calculation of WCTE.

Plant data with a fifteen (15) minute interval were obtained at the completion of the WCTE study on February 27, 2019 by USACE staff and uploaded to the project OneDrive. A *.csv file contained the data for multiple parameters of the plant operation and the *.hdr file contained the corresponding header information. The Plant data files were downloaded from the OneDrive and the raw data files were archived on the QA/QC team internal server. During processing, the *.csv files were converted to Excel workbooks and the headers were inserted in the first row on the sheet. The Plant data contains output for three hundred twenty-one (321) parameters. The most useful raw plant data headers, and their corresponding definition, for calculating Plant oxygen loads and flows, are provided in ***Table I-24***.

Table I-24 Raw plant data headers and definitions

Raw Plant Header	Definition
DEV.RW_SUPPLY_TEMP.SCALED_VALUE	Raw Water Temp (F)
DEV.RW_SUPPLY_COND.SCALED_VALUE	Raw Water Conductivity
DEV.RW_SUPPLY_DO.SCALED_VALUE	Raw Water DO
DEV.O2_FLOW_TOTAL	Total Oxygen Flow Into Cones (lbs/day)
DEV.H2O_FLOW_TOTAL	Total Effluent Water Flow (GPM)
DEV.O2_DAY_FLOW1	Oxygen Into River (lbs/day)
DEV.SPEECE_FLOW_T	Total SC Water Flow (GPM)
DEV.CONE1_EFF	Speece Cone 1 Efficiency
DEV.SPEECE1.SC_EFF_O2	Speece Cone 1 DO Out
DEV.SC1_OUT_TEMP_SCL.SCALED_VALUE	Speece Cone 1 Temperature (F)
DEV.SPEECE1.SC_FLOW	Speece Cone 1 Water Flow (PV)
DEV.SPEECE1.SPEECE_02_PV	Speece Cone 1 Oxygen Flow (PV)
DEV.CONE2_EFF	Speece Cone 2 Efficiency
DEV.SPEECE2.SC_EFF_O2	Speece Cone 2 DO Out
DEV.SC2_OUT_TEMP_SCL.SCALED_VALUE	Speece Cone 2 Temperature (F)
DEV.SPEECE2.SC_FLOW	Speece Cone 2 Water Flow (PV)
DEV.SPEECE2.SPEECE_02_PV	Speece Cone 2 Oxygen Flow (PV)
DEV.CONE3_EFF	Speece Cone 3 Efficiency
DEV.SPEECE3.SC_EFF_O2	Speece Cone 3 DO Out
DEV.SC3_OUT_TEMP_SCL.SCALED_VALUE	Speece Cone 3 Temperature (F)
DEV.SPEECE3.SC_FLOW	Speece Cone 3 Water Flow (PV)
DEV.SPEECE3.SPEECE_02_PV	Speece Cone 3 Oxygen Flow (PV)
DEV.CONE4_EFF	Speece Cone 4 Efficiency
DEV.SPEECE4.SC_EFF_O2	Speece Cone 4 DO Out
DEV.SC4_OUT_TEMP_SCL.SCALED_VALUE	Speece Cone 4 Temperature (F)

Raw Plant Header	Definition
DEV.SPEECE4.SC_FLOW	Speece Cone 4 Water Flow (PV)
DEV.SPEECE4.SPEECE_02_PV	Speece Cone 4 Oxygen Flow (PV)
DEV.EFF_COND_1_SCL.SCALED_VALUE	Effluent Conductivity
DEV.SR_FLOW_PID.PV	Savannah River Flow PID (PV) (GPM)
DEV.BR_FLOW_PID.PV	Back River Flow PID (PV) (GPM)

The parameter DEV.O2_DAY_FLOW1 [O2 Into River (lbs/day)] was used to assess Plant operation. If DEV.O2_DAY_FLOW1 was greater than zero then the Plant was considered to be on and if it was zero or less then the Plant was considered to be off. The parameters DEV.BR_FLOW_PID.PV [Back River Flow (GPM)] and DEV.SR_FLOW_PID.PV [Savannah River Flow (GPM)] were used to determine the percentage of the total flow going to the Back River and lower Front River respectively. The load of DO going to the Back River and lower Front River were calculated by finding the product of DEV.O2_DAY_FLOW1 [O2 Into River (lbs/day)] and the percentage of the flow going to the Back River and lower Front River respectively.

APPENDIX J FIELD NOTE LOGS AND CALIBRATION REPORTS

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring
Daily Log

Date: 2/14/19	**Task:** 6B – Transfer Efficiency (TE)	**All Daily Items Completed?** ☒ (see below)

Daily Items for TE: 1) Check tomorrow's tides 2) Download data from sondes & upload to OneDrive 3) Check EagleIO 4) Upload field notes

Weather: 38°F Partly Cloudy, SSE 1 mph	**Tides:** L-0959 H-1538

Client/Stakeholder Interaction (if any):
Bryan Robinson rode on black boat with Sam and Eric to drift in the back river during dye test.

Personnel/Visitors on site:

Hayley DiGiano, Sam Booth, Lisa Heise, Eric Huss, Bryan Robinson, Rick McCann, Jim Greenfield, representative from Corps Corporate Communications

Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒

Boat(s) Used:
- ☒ Black Boat – Duration: 5.5 hrs
- ☒ White Boat – Duration: 3.5 hrs
- ☐ Yellow Boat – Duration:

Other Equipment Used:
Corps forklift to put dye in Rick's truck

Work Completed:

0800-0835 - RM, SB, JG at Down River O2 plant to set up for BR dye injection.

0835 – SB and JG leave plant site to board monitoring boats. RM remains onsite to complete set up.

0900 – 2 boats (SB, EH, BR Drift boat and HD, LH, JG Profiling boat) depart for Back River monitoring around platform as part of dye injection event.

1010 – Start dye injection @ ~1.5-2.0 gpm using BR port (in vault at plant site) and drum pump injecting dye at full-strength (~20% Rhodamine dye).

Both boats profiled and drifted in and around plume

1018 – End dye injection – injected ~15.1 gals.

RM diluted remaining contents of the ~30-gal drum with water to create ~10% strength dye solution.

1122 - Start dye injection @ ~2.0 gpm using BR port and drum pump injecting ~10% Rhodamine dye).

Both boats profiled and drifted in and around plume

1137 - End dye injection – injected ~32.5 gals.

Injected 47.5 gals total at two different strengths.

1158 – Chased dye from dye event #1 north up river approximately 0.5 miles.

1422 - upload profile and drift data

Notes:

Daily Log Completed by: Lisa Heise	**Signature:**

Photos Attached? ☐	**# of Photos** ____

Photo 1: Dye Test 1 plume with view of platform facing southwest.

Photo 2: Dye Test 1 with view of platform facing southwest.

Photo 3: Dye Test 1 with facing east.

Photo 4: Dye Test 2 with view of platform facing southwest.

1557 B. Robinson leave depot
1615 Check Eagle ZO
1639 SB, EH Return to depot ; upload data
1649 JG leave depot
1717 EH leave depot
1730 LH, HD, SB leave depot

S. Booth H. DiGiano L. Heise
R. McCann E. Huss
J. Greenfield B. Robinson

38°F
ptly cloudy
SSE 1mph

0722 SB, HD, LH arrive at depot.
0724 RM arrive at depot.
0730 EH arrive at depot
0745 JG arrive at depot
0753 RM, SB leave to setup
Dye pump at plant
0800 JG leave depot for plant
0826 BR arrive at depot
0834 Corps. Corporate Comm. rep arrive
0851 JG return to depot
0904 JG, LH, HD leave depot for LBR
0925 arrive at BSE OT
0935 arrive @ BSW OT
0943 arrive @ BNW OT
~~0950 arrive @ Plat NW HD~~
BNE OT
platform SE
1008 Dye injected (dye 1)
Profile through plume
~~1030~~ continue profile / drift
1036 BNE IT

1039 profile drift II (dye 1)
during dye dump 1:
- drifting profiles were conducted to "follow" dye + incoming Tide. Spots were picked at random to "profile". boat traveled both bank-to-bank (E↔W) and North↔South.
1110 profile platform NW (II)
~~1115 dye injected to system~~ HD
1117 profile platform SE (II)
1122 begin profile/drift for dye (2)
Dye injected into System
• 2 gal/min; 30 gal mixed from 15 gal (pure)
Followed plume until 1156
1158 Identified dye from event 1
Profile-drift
- following plumes up LBR
1257 end sampling event
1258 LH JG, HD leave LBR for depot
1322 arrive back at depot
1324 BR, EH, SB arrive back at depot from LBR (black boat)
1345 leave for lunch

1543 BR leave depot
1422 upload profiling/drift data
1545 JG, EH leave in black boat for LBR
1725 KM leave depot
1743 JG, EH return to depot
1753 EH & JG leave depot
1800 SB, LH, HD leave depot

disconnect + left BSE @ 1530
Arrive @ platform for minor maitenance
@ 1533
left platform at 1613

0730 Help RM load up supplies
for dye test.
0800 SM departs for DO Plant to setup
for test.
0900 On water heading for BR.
0945 all Sonde's setup for Drifting
Conduct Drifting + Transects
around + upriver of BR platform
1300 complete drift operation + pack
up Equipment return to dock.
1345 leave for lunch
1545 EH + JG depart for BR to
check if dye was still visible
Note Dye tinting of water still
visible in portions of BR. also
elevated Sonde reading noted upriver
to Route 25 crossing (as far as
boat travelled upriver).
1745 return to docks unload equip
1800 EH - offsite for day

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring
Daily Log

Date: 2/15/19	**Task:** 6B – Transfer Efficiency (TE)	**All Daily Items Completed?** ☒ (see below)

Daily Items for TE: 1) Check tomorrow's tides 2) Download data from sondes & upload to OneDrive 3) Check EagleIO 4) Upload field notes

Weather: 57°F Partly Cloudy, S 3 mph | **Tides:** L-1103 H-1648

Client/Stakeholder Interaction (if any):
None

Personnel/Visitors on site:
Hayley DiGiano, Sam Booth, Lisa Heise, Eric Huss

Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒

Boat(s) Used:
☒ Black Boat – Duration: 3.5 hrs
☒ White Boat – Duration: 2 hrs
☐ Yellow Boat – Duration:

Other Equipment Used:
None

Work Completed:

- Front and back river drifting
- Uploaded buoy data
- Uploaded data from drifting

Notes:

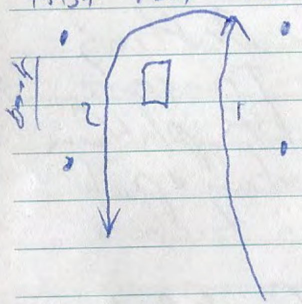
Daily Log Completed by: Lisa Heise

Signature: Lisa Heise

Photos Attached? ☐ **# of Photos** ____

 Savannah O_2 2016-059 cloudy cool 2/15/19

SB + EH depart Depot in Black boat
@ ~1000 ; arrive back river ~1020
Set up sondes for drift
A shallow 1; B mid 3; C deep 4.5
first run N→S between platform & E buoys



Started ~1035

observed an otter swimming @ 1045
made turn S @ ~1050
1233 Collect B NE bouy Sonde Data
Light Cracked needs to be replaced
1240 Collect B NW bouy Sonde Data
1246 Collect B SW bouy Sonde Data
1251 Collect B SE bouy Sonde Data
1325 arrive back @ dock, unload

2/15/19

0808 EH arrives @ depot
0845 HD, SB, LH arrive at depot
57°F, ptly cloudy, S 3mph
0957 LH, HD leave depot for
LFR drift
1010 arrive at LFR
1024 start drift
D; approx 1.5m (shallow)
E; approx 3m (mid)
F; approx 4.5m (deep)
; surface
initial drift N->S (OT)
1103 LT N->S
1152 end drift
collect - LFR_~~N~~ oops Buoy
- LFR_S Buoy
1209 leave LFR
1219 arrive at depot
1312 uploaded data from LFR
~~profiling~~ 2A drifting
1325 EH, SB return to depot
1345 uploaded data from LBR
drifting + chain of custody
1350 Completed daily log
1430 Left depot for Jax

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring
Daily Log

Date: 2/18/19	**Task:** 6B – Transfer Efficiency (TE)	**All Daily Items Completed?** ☒ (see below)

Daily Items for TE: 1) Check tomorrow's tides 2) Download data from sondes & upload to OneDrive 3) Check EagleIO 4) Upload field notes

Weather: 60°F Partly Cloudy, NNW 10 mph	**Tides:** L-1353 H-0733

Client/Stakeholder Interaction (if any):
None

Personnel/Visitors on site:

Hayley DiGiano, Sam Booth, Lisa Heise, Rick McCann

Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒

Boat(s) Used:
- ☒ Black Boat – Duration: 4 hrs
- ☒ White Boat – Duration: 3.5 hrs
- ☐ Yellow Boat – Duration:

Other Equipment Used:

None

Work Completed:

- See field notes

Notes: M7 pipe had slipped out of the top bracket before we arrived at LBR. Fixed around 1500.

Daily Log Completed by: Lisa Heise

Signature: Lisa Heise

Photos Attached? ☐ **# of Photos** ____

2/15/19

0808 EH arrive @ depot
0845 HD, SB, LH arrive at depot
57°F, ptly cloudy, S 3mph
0957 LH, HD leave depot for
LFR drift
1010 arrive at LFR
1024 start drift
D; approx 1.5m (shallow)
E; approx 3m (mid)
F; approx 4.5m (deep)
; surface
initial drift N->S (OT)
1103 LT N->S
1152 end drift
collect - LFR - ~~N~~ oops Buoy
- LFR - S Buoy
1209 leave LFR
1219 arrive at depot
1312 uploaded data from LFR
~~profiling~~ LH drifting
1325 EH, SB return to depot
1345 uploaded data from LBR
drifting + chain of custody
1350 Completed daily log
1430 Left depot for Jax

2/18/19

R. McCann, L. Heise, H. DiGiano, S. Booth
60°F NNW 10 mph
1000 LH arrive @ depot
1023 SB + HD arrive @ depot
1100 SB put gas in both boats
1233 SB + LH leave in black boat
for LBR for profiling
1233 RM + HD leave in White boat
for LFR for profiling
1313 Practice profile
1314 Start 2nd ~~moving~~ procedures profile, S->N
1316 called Jim G. w/ TT to verify
sampling interval; 2 sec. interval
1323 1st started
1406 stopped drift/profile
1407 BSE profile started
1416 left BSE profile - collected BSE buoy
1419 BSW profile started
1421 BSW profile end
1423 collected BSW buoy data
1429 BNW profile start
1433 BNW profile end
1434 collect BNW Buoy data
1439 BNE Profile start
1441 BNE Profile end

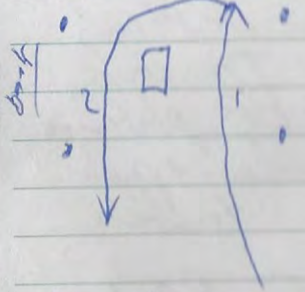
1443 BNE data collected
1449 Arrived @ platform
1450 started E platform profile
1452 E platform profile end
1453 W platform profile start
145 W platform profile end
1500 started minor platform maintenance
~~pipe~~ pipe M7 had slipped a bit
fixed pipe m7, removed 64GB SD card
from Datalogger; per SB's phone
call w/ Jon Fagans (YSI) at 15~~13~~ 13
must be 16GB SD card
left platform @ 1527
1529 ~~drift~~ profile began from
.5nm from buoy to buoy along
E side of platform
1552 stopped drift profile & departed
for Depot
1600 Buoy + profile data uploaded
from ~~LBR~~ LFR
1800 leave depot
1630 Buoy + profile data uploaded
from LBR

S. Booth L. Heise 58°F
H. DeIano R. McCann Cloudy
ENE 11mph

0700 SB, HD arrive at depot
0705 LH arrive at depot

8 Savannah O2 2016-059 cloudy cool 2/15/19

SB + EH depart Depot in Black boat
@ ~1000 arrive back river ~1020
Set up sondes for drift
A shallow 1; B mid 3; C deep 4.5
first run N→S between first Arm & E buoys



Started ~1035

observed an otter swimming @ 1045
made turn S @ ~1050
1233 Collect B NE buoy Sonde Data
Light Cracked needs to be replaced
1240 Collect B NW buoy Sonde Data
1246 Collect B SW buoy Sonde Data
1251 Collect B SE buoy Sonde Data
1325 arrive back @ dock, unload

2/18/19 9

1234 RM, HD leave for LFR in white boat. Raining
1242 arrive
collect LFR_S Buoy
1300 profile LFR_S Buoy OT
1307 Collect LFR_N Buoy
1309 profile LFR_N Buoy OT
1317 (S) profile/drift surface plume OT
1319 (N) " " " " "
1532 end profile drift
1554 RM, HD return to depot

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring
Daily Log

Date: 2/19/19	**Task:** 6B – Transfer Efficiency (TE)	**All Daily Items Completed?** ☒ (see below)

Daily Items for TE: 1) Check tomorrow's tides 2) Download data from sondes & upload to OneDrive 3) Check EagleIO 4) Upload field notes

Weather: 58°F Cloudy, ENE 13 mph	**Tides:** L-1444 H-0826

Client/Stakeholder Interaction (if any):
Rick 1300 weekly call

Personnel/Visitors on site:

Hayley DiGiano, Sam Booth, Lisa Heise, Rick McCann, Jim Greenfield

Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒

Boat(s) Used:
- ☒ Black Boat – Duration: 5.5 hrs
- ☒ White Boat – Duration: 4.5 hrs
- ☐ Yellow Boat – Duration:

Other Equipment Used:

None

Work Completed:

- See field notes

Notes: Noticed DO drop to 0% at 0915 in D3 sonde on Eagleio. DO probe on D3 exchanged for DO probe on Sonde 23 at approximately 1610.

Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise

Photos Attached? ☒	**# of Photos** ____

1443 BNE data collected
1449 Arrived @ platform
1450 Started E platform profile
1452 E plat form profile end
1453 W platform profile start
145 w platform profile end
1500 started minor platform maintenence
~~SB~~ pipe M7 had slipped a bit
fixed pipe M7, removed 64GB SD card
from Datalogger; per SB's phone call w/ Jon Fagans (YSI) at 15~~..~~13 must be 16GB SD card
left platform @ 1527
1529 ~~...~~ profile began from
.5?N from buoy to buoy sbus
E side of platform
1552 stopped drift profile + departed for Depot
1600 Buoy + profile data uploaded from ~~LBR~~ LFR
1800 leave depot
1630 Buoy + profile data uploaded from LBR

S. Booth L. Heise 58°F
H. Dciano R. McCann Cloudy
ENE 11mph

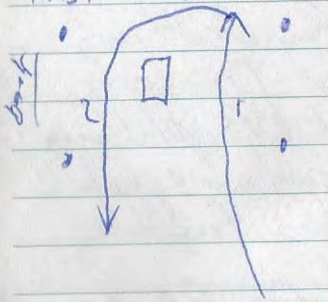
0700 SB, HD arrive at depot
0705 LH arrive at depot
0715 Daily Log for 2/18 completed
0726 Notes from 2/18 uploaded
0824 arrive @ LBR
extreme *high tide*
H3 A 3 m
B 6 m
H1 C 8 m Bottom @ 9.2
23 S
-very choppy + windy-
Ready @ 0851
Started w/ N→S across "plume"
plume not visible though
0905 S→N plume
[white caps on waves]
0913 N→S east of plume
0920 S→N w of plat
0928 N→S plume, somewhat visible
0936 (start zig zag bank to bank
0943 plume visible
1004 N→S Plume
1007 ~~..~~ Stop logging + deployments
1015 left LBR for depot
1050 Arrive at depot

1051 Upload LFR Drift data
1100 upload LBR drift data
1121 J. Greenfield arrive at depot
1125 Break for lunch
1320 checked EagleIO
- D3 sonde showing 0% DO
1400 - leave for ~~dep~~ LBR
1433 - arrive @ LBR
~~H3~~ A - ~~H~~ H3 - 1m
2H B - deployed - 2.5m
~~H1~~ C - H1 - 4m
At 23 - deployed - S
Start logging @ 1451
~~1451~~ 2A S → N W platform 1451
- end 1458
1459 N → S E plat - ~~end~~ No plume visible
- end 1504
1505 S → N E plat - closer to buoys
- end 1516
1516 N → S E Plat - E of "plume" + in
- end 1520
1521 start zig zag ~~At~~ S → N
- end 1540
1540 N → S E plate "plume"
end 1548 Plume just appeared @ 1542
just E of plat

1548 S → N W of plat
- end 1553
1553 N → S E of plat Plume
- end 1556
1555 Stop logging + deployment H1B 43S
1605 Headed for Plat to investigate
D3 sonde
At first glance, nothing appeared to be wrong but we swapped out DO probe w/ the one on sonde 23 (surface ~~probe~~)
1619 heading back to depot
1645 back ~~to~~ depot
1655 Uploaded LBR drift data
1730 leave depot

8 Savannah 02 2016-059 cloudy cool 2/15/19

SB + EH depart Depot in Black boat
@ ~1000 arrive back river ~1020
Set up sondes for drift
A shallow 1; B mid 3; C deep 4.5
first run N→S between plat form & E buoys



Started ~1035

observed an otter swimming @1045
made turn S @ ~1050
1233 Collect BNE buoy Sonde Data
Light Cracked needs to be replaced
1240 Collect BNW buoy Sonde Data
1246 Collect BSW buoy Sonde Data
1251 Collect BSE buoy Sonde Data
1325 arrive back @ dock, unload

2/18/19 9

1234 RM, HD leave for LFR in white boat. Raining
1242 arrive
collect LFR_S Buoy
1300 Profile LFR_S Buoy OT
1307 Collect LFR_N Buoy
1309 profile LFR_N Buoy OT
1317 (S) profile / drift surface plume OT
1319 (N) " " " "
1532 end profile drift
1554 RM, HD return to depot

2/19/19

802 RM, HD leave depot white
814 arrive at LFR
831 begin drift (IT) starting with tide (North)
D, Shallow ≈ 1m
E, mid ≈ 4.5m
F, deep ≈ 8m
Z, Surface
• drift conducted via N→S transects between buoys, to the west into the channel, and additional transects extending N & S of Buoys

Rite in the Rain

1000 end drift
1013 RM, HD leave LFR
1027 arrive at depot
1402 JG, RM, HD leave for LFR
1416 arrive at LFR
1434 begin LT drift traveling N
D, shallow ≙ 1m
E, middle ≙ 3.5m
F, deep ≙ 6m
Z, surface
- at times when traveling E<->W
Sondes (~~shall~~ middle / deep) pulled to prevent drag
1503 - deep sonde attached to LFR_N
removed middle + deep to release
1506 - continued drift
1542 end drift
1555 leave LFR for depot
1613 arrive at depot

LG2 ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log

Date: 2/20/19	**Task:** 6B – Transfer Efficiency (TE)	**All Daily Items Completed?** ☒ (see below)

Daily Items for TE: 1) Check tomorrow's tides 2) Download data from sondes & upload to OneDrive 3) Check EagleIO 4) Upload field notes

Weather: 54°F Cloudy, NNE 6 mph	**Tides:** L-1533 H-0918

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Hayley DiGiano, Sam Booth, Eric Huss, Rick McCann, Jim Greenfield, Emily Johnson, Ethan Bright.

Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒

Boat(s) Used:

☒ Black Boat – Duration: 2.5 hrs

☒ White Boat – Duration: 4 hrs

☒ Yellow Boat – Duration: 2 hrs

Other Equipment Used:

None

Work Completed:

- See field notes

Notes: Black boat remove and taken to Hale Marine for repair, Yellow boat put in as replacement. Buoy light replaced on BNE. LFR_N Buoy was not present upon arrival (0920) visible by 1033.

Daily Log Completed by: Hayley DiGiano

Signature: Hayley DiGiano

Photos Attached? ☒ **# of Photos** ____

1708 Depart LBR for Depot
1728 Arrive @ Depot

1000 end drift
1013 RM, HD leave LFR
1027 arrive at depot
1402 JG, RM, HD leave for LFR
1416 arrive at LFR
1434 begin LT drift traveling N
D, shallow ≙ 1m
E, middle ≙ 3.5m
F, deep ≙ 4m
Z, surface
- at times when traveling E⟷W
Sondes (~~shallow~~ /deep) pulled to prevent
drag
1503 - deep Sonde attached to LFR_N
removed middle + deep to release
1506 - continued drift
1542 end drift
1555 leave LFR for depot
1613 arrive at depot

0920 EB SB left for back river 02/20/19
black boat has broken bilge
pump, ~~also~~
0945 arrive at SE buoy in back river
H1 profile, H3 pulled buoy data
5lb weight

Ethan did not stop deployment for SE buoy
SW → NW → NE → Platform E → Platform
- performed some platform maintenance
- pulled up SW mooring pipe that
had slipped; added larger washers
to u-bolts
performed drift profiling S→N,
N→S, N→S
departed for Depot
arrived at Depot
launched yellow boat
hauled black boat
washed black boat
SB left to take Black Boat
to Hase Marine for repairs
bilge, depth finder, speedometer,
fuel leak
SB returned to depot
EB + SB depart depot @ 1520
1540 arrive @ platform
perform platform maintenance
until 1620
1st drift begins ~1625 N→S
S→N, 3 transects, through plume,
1706 end drift profiles

 54°F, Cloudy, NNE6mpH 2/20/19

0745 EH + JM arrive @ Depot
0758 RM arrive @ Depot
HD, SB arrive at depot
0805 Emily Johnson [EJ] arrive at depot
0808 EB arrive at depot
0845 RM, JG leave depot, for plant
0908 HD, EH, EJ leave depot for LFR (White boat)
0921 arrive at LFR Buoy S
- LFR_N Buoy Not present
0927 retrieve LFR Buoy S (re-deploy
0933 LFR Buoy S profile
0942 LFR Profile begin
1033 LFRN buoy spotted - position moved

1036 stop profiling
1038 LFR_N Buoy profiled
1042 LFR_N Buoy data collected
1051 Leave LFR
1104 arrive back at Depot
1140 - EB, SB arrive back at depot
• Black boat removed from H_2O
1147 begin dye experiment w/JG

1150 put yellow boat in at depot.
1209 RM leave
1230 upload LFR data
1240 SB leave to drop black boat
1403 SB return to depot
1435 RM return to depot
1500 EH, EJ, HD leave white LFR boat
1511 arrive at LFR
1520 start logging profile LFR
1620 end logging
1623 left LFR to depot
1640 arrive at depot
1650 upload LFR data
1735 EH leave depot
1738 EB, SB Arrive at depot
1750 upload LFR data
1800 leave for evening

ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log

Date: 2/21/19	**Task:** 6B – Transfer Efficiency (TE)	**All Daily Items Completed?** ☒ (see below)

Daily Items for TE: 1) Check tomorrow's tides 2) Download data from sondes & upload to OneDrive 3) Check EagleIO 4) Upload field notes

Weather: 59°F Fog, NNE 6 mph	**Tides:** L-1533 H-0918

Client/Stakeholder Interaction (if any):

Bryan Robinson on site for Dye Test

Personnel/Visitors on site:

Hayley DiGiano, Sam Booth, Eric Huss, Rick McCann, Jim Greenfield, Emily Johnson, Ethan Bright.

Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒

Boat(s) Used:

☐ Black Boat – Duration:

☒ White Boat – Duration: 4.5 hrs

☒ Yellow Boat – Duration: 3 hrs

Other Equipment Used:

None

Work Completed:

- See field notes

McCann's notes:

0800-0825 - RM, Eric Huss (Tt) arrive at Depot to load /prep for FR dye injection.
0830 – Leave Depot for Down River D.O. Plant site. Begin set up at perimeter fence adjacent to the FR dye injection port pre-orifice plate.
0845-0940 – RM and Eric Huss finished connections to FR dye injection port. Dye drums in back of truck, drum pump connected to port, valve on system pipe to be controlled by EH, valve and dye injection flow controlled by RM.
0930 – 2 boats (BRob on Hayley's boat, JimG on Ethan's boat) depart from Depot for positions in Front River around the diffusers to monitor during dye injection event.
0950 - LG2 drone onsite (Chad Drury) to capture video.
1020 – Start dye injection using ~15 gals of 20% strength RhodamineWT dye diluted 1:1 resulting in ~30 gals of 10% strength.
1035 – End dye injection – injected ~30.5 gals of 10% RhodamineWT dye.
1058 – Begin diluting ~15 gals of 20% dye solution in second drum using water from dye port to create ~10% strength dye solution.
1120 - Start dye injection @ ~1.8-2.0 gpm using FR port and drum pump injecting ~10% RhodamineWT dye.
1138 - End dye injection – injected ~27.75 gals.
Injected ~58.25 gals total at half strength over two release events.

Notes: Sonde #3 DO sensor not reading, noticed around 1400, switched to new port and now reading. Installed MicroSD card in BrainBox – won't activate function until data retrieved (will wipe data on logger).

Daily Log Completed by: Hayley DiGiano	**Signature:** Hayley DiGiano

Photos Attached? ☐ **# of Photos** ____

1708 Depart LBR for Depot
1718 arrive @ Depot

Signature

SB, EB, JG depart depot @950
~~0~~ 1005 arrive @ system (PFR) yellow boat
1015 all sondes are setup and ready
to go C - shallow, D - intermediate, F deep
25 surface
1020 Rick yelled that he's starting
the dye pump
dye spotted at 1022 approx
location of diffuser 4 1st
drifting continues
1027 dye still pumping, less
color than back row test
1036 RM signals that dye
pumping has completed
drifted primarily NW along
SC side coast and were seeing
high (200-450) ~~xx~~ ug/L PE on deep
sonde
headed back towards system @ 1105
1120 Dye Test # 2 started
1123 Dye Visible @ surface
1133 RM signals that dye has stopped
Drift up + down river until
hit mud w/ deep sonde ~1143/44 +46 near bank
1252 stopped logging, ~~left~~ ~~xRR~~
1302 arrive at depot

2/21/19

0755 RM arrive @ Depot | 59°F
0802 EH. arrive @ Depot | Fog
Load up Dye test Supplies | NW 2 MPH
0845 EB, SB, HD, JG arrive at depot
0851 EJ arrive at depot
0909 B Robinson arrive at depot
0939 Depart for LFR EJ, HD, BJR
0950 Arrived at LFR
0958 LFR_N Buoy profile
1015 start profiling
1020 Dye injection
1022 Dye visible
1120 2gpm half strength Start
1138 end 27.75 gal
1215 begin trip back (while profile)
1245 end profiling
1252 arrive at depot
1300 deploy sonde at USGS on deck at depot
1310 Upload LFR profile - dye test data
1330 Upload LFR drone footage - computer
1350 RM leave; BR, EB leave to plant
1419 SB, JG, EJ, HD leave depot for LBR

1440 arrive at LBR platform
1451 installed DO sensor on sonde 3 to port 4
1453 Shut off brain box to install microSD
1457 turned brain box back on
1510 departed LBR platform to depot
1533 returned to depot
1538 JG leaves
1630 EH, HD, EB, SB, EJ leave depot

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log

Date: 2/22/19	**Task:** 6B – Transfer Efficiency (TE)	**All Daily Items Completed?** ☒ (see below)

Daily Items for TE: 1) Check tomorrow's tides 2) Download data from sondes & upload to OneDrive 3) Check EagleIO 4) Upload field notes

Weather: 73°F Sunny, SW 4 mph	**Tides:** L-1708 H-1057

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Hayley DiGiano, Sam Booth, Eric Huss, Emily Johnson, Ethan Bright.

Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒

Boat(s) Used:

☐ Black Boat – Duration:

☒ White Boat – Duration: 1.5 hrs

☒ Yellow Boat – Duration: 2 hrs

Other Equipment Used:

None

Work Completed:

- See field notes

Notes: Significant amount of debris hanging around LFR Buoys, possible to have impact on transected profiling data.

Daily Log Completed by: Hayley DiGiano	**Signature:** Hayley DiGiano

Photos Attached? ☒	**# of Photos** ____

 Sunny, warm, clear 79° 02/22/19 2016-0014
Savannah O_2

1058 depart depot for LBR, EJ SB EB
1121 arrive at BSE buoy
H3 - profiling ; H1 - buoy data
1122 EB collect BSE buoy data
1125 EJ starts BSE profile; 1127 stop
1128 leave BSE buoy
1130 arrive @ BSW buoy; EB collected buoy data; EJ starts BSW profile 1132 profile end 1135; depart BSW @ 1135
1138 arrive @ BNW buoy; EB collected buoy data; EJ starts BNW profile 1140 end profile @ 1142; depart BNW buoy 1143
1144 arrive @ BNE buoy; EB collected buoy data; EJ begins 1145 (profile); profile ends @ 1147; depart BNE buoy @ 1147
1150 arrive @ platform ;
1151 EJ starts E platform profile
1153 profile ends
1154 EJ starts W platform profile
1157 profile ends
1158 depart platform
1202 start profile moving N→S W of platform
1228 stop logging
1230 depart LBR to depot
1258 arrive @ depot

2/22/19

0915 E Hammer @ Depot | 73°F Sunny SW 4mpH
0933 SB, LH, EB, EJ arrive
0945 retrieve sonde from Depot
dock and send data to J.G
1006 upload / correct data upload
issue from 02/19/19 LFR
1043 EH, HD leave for LFR in white
1053 arrive at LFR
Retrieve LFR_S Buoy
1100 LFR-S profile
1108 LFR_N profile
1112 LFR_N Buoy data retrieved
1116 LFR profile
begin N → S through plume
at surface, N↔S transects
in addition to E↔W transects
1200 end profiling: significant amount of Debris
1204 leave LFR
1216 arrive at depot
1236 upload LFR data
1258 EB, EJ, SB arrive back at depot
1313 upload LBR data
1326 EB leave depot
1345 SB, HD leave depot; EJ leave
1533 EH leave

LG2 ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log

Date: 2/25/19	**Task:** 6B – Transfer Efficiency (TE)	**All Daily Items Completed?** ☒ (see below)

Daily Items for TE: 1) Check tomorrow's tides 2) Download data from sondes & upload to OneDrive 3) Check EagleIO 4) Upload field notes

Weather: 68°F Sunny, NE 4 mph	**Tides:** L – 0824 H – 1415

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Hayley DiGiano, Sam Booth, Lisa Heise, Ethan Bright.

Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒

Boat(s) Used:

☐ Black Boat – Duration:

☒ White Boat – Duration: 2 hrs

☒ Yellow Boat – Duration: 3 hrs

Other Equipment Used:

None

Work Completed:

- See field notes

Notes: Tides provided in email from Jim Greenfield on Saturday, February 23 2019 did not appear to be correct. We will adjust for the remainder of WCTE.

Daily Log Completed by: Hayley DiGiano

Signature: Hayley DiGiano

Photos Attached? ☐ **# of Photos** ____

 Sunny, warm, clear 79° 02/22/19 2016-094
Savannah O_2

1058 depart depot for LBR, EJ SB EB
1121 arrive at BSE buoy
H3 - profiling ; H1 - buoy data
1122 EB collect BSE buoy data
1125 EJ starts BSE profile; 1127 stop
1128 leave BSE buoy
1130 arrive @ BSW buoy; EB collected
buoy data; EJ starts BSW profile 1132
profile end 1135; depart BSW @ 1135
1138 arrive @ BNW buoy; EB collected
buoy data; EJ starts BNW profile 1140
end profile @ 1142; depart BNW buoy 1143
1144 arrive @ BNE buoy; EB collected buoy
data; EJ begins 1145 (profile); profile ends
@ 1147; depart BNE buoy @ 1147
1150 arrive @ platform;
1151 EJ starts E platform profile
1153 profile ends
1154 EJ starts W platform profile
1157 profile ends
1158 depart platform
12:02 start profile moving N→S W of platform
12:28 stop logging
12:30 depart LBR to depot
1258 arrive @ depot

02/25/19 Savannah O_2 2016-094
Sunny, warm, clear
1335 EB + SB leave depot on yellow boat
1355 Arrive LBR
1359 Start drift profile
1430 end drift profile
1435 arrive @ BSE buoy/download
data; perform profile
1438 leave BSE buoy
1440 arrive + collect data BSW buoy
perform profile @ BSW
1444 leave BSW buoy
1447 arrive @ BNW buoy
collect data, perform BNW profile
1450 leave BNW buoy
1452 arrive @ BNE buoy; collect
data, perform BNE profile
1456 leave BNE buoy
1457 begin surface sonde drift
1520 stop surface sonde drift
1522 begin W platform profile
1524 end W platform profile
1524 begin E platform profile
1525 end E platform profile
1525-1622 perform platform maintenance
1623 Depart LBR
1645 Arrive @ Depot

2/22/19

0915 E Hammes @ Depot | 73°F Sunny SW 4mph
0933 SB, LH, EB, EJ arrive
0945 retrieve sonde from Depot dock and send data to J.G
1006 upload/correct data upload issue from 02/19/19 LFR
1043 EH, HD leave for LFR in white
1053 arrive at LFR
Retrieve LFR_S Buoy
1100 LFR_S profile
1108 LFR_N profile
1112 LFR_N Buoy data retrieved
1116 LFR profile
begin N→S through plume at surface, N↔S transects in addition to E↔W transects
1200 end profiling: significant amount of Debris
1204 leave LFR
1216 arrive at depot
1236 upload LFR data
1258 EB, EJ, SB arrive back at depot
1313 upload LBR data
1326 EB leave depot
1345 SB, HD leave depot; EJ leave
1533 EH leave

2/25/19

L. Heise S. Booth E. Bright H. DiGiano
57°F p'lly cloudy NE 5-10mph

1024 LH, SB, HD, EB arrive at depot
1030 upload fieldnotes: 2/22/19
warehouse organization
prep hardware for LBR platform
gas up boats
Lunch
1329 LH, HD leave for LFR - white
1344 arrive at LFR
1348 begin profile in area N of LFR buoys
1407 continue surface profile through plume
1444 end profile
1445 Profile LFR_N Buoy
1448 LFR_N Buoy data retrieved
1503 LFR_S Buoy data retrieved
1506 profile LFR_S Buoy
1512 leave LFR
1523 arrive at depot
1534 upload LFR data
1706 upload LBR data
1730 leave depot.

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring
Daily Log

Date: 2/26/19	**Task:** 6B – Transfer Efficiency (TE)	**All Daily Items Completed?** ☒ (see below)

Daily Items for TE: 1) Check tomorrow's tides 2) Download data from sondes & upload to OneDrive 3) Check EagleIO 4) Upload field notes

Weather: 68°F Sunny, NE 4 mph	**Tides:** L – 0840 H – 1430

Client/Stakeholder Interaction (if any):
Lon (at Back River pipe)

Personnel/Visitors on site:

Hayley DiGiano, Sam Booth, Lisa Heise, Ethan Bright.

Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒

Boat(s) Used:		**Other Equipment Used:**
☐ Black Boat – Duration:		None
☒ White Boat – Duration:	4.5 hrs	
☒ Yellow Boat – Duration:	5.5 hrs	

Work Completed:

- See field notes

Notes:

Daily Log Completed by: Hayley DiGiano	**Signature:** Hayley DiGiano

Photos Attached? ☒	**# of Photos** ____

2/26/19 Savannah O_2 2016-094
Cloudy, cold ~54°F
0745 depart Depot - EB + SB in yellow boat
0815 arrive LBR
0835 begin drift - Sondes: D-shallow (1m)
E-mid (3m), F-deep (5m), - surface; started @ outgoing tide
N → S from 0835-0847 + 0904-0930
E → W from 0847-0904; 0930-0955
Slack at 0850; no bubbles in "plumes"; some bubbles observed near the W side of platform; ~3 feet W
Tide stated to come in at ~0910 SB
0955 - drift from N → S
1008 - stop drift
1010 - depart LBR
1030 - arrive @ Depot
1405 depart Depot for LBR; SB & EB in yellow boat
1430 arrive LBR
1432 begin deploying sondes
D-shallow (1m) E-mid (4m) F-deep ~~(5m)~~ 6.5m SB
Z4-surface
1440 begin drift N → S
1445 Slack Tide appeared to start
1512 end N → S; begin E → W and 1534
1534 begin more N → S drifts

1545 stop drifting
1553 arrive at platform for minor maintenance
1559 Depart LBR
1629 arrive @ Depot

SB

2/26/19

50°F Cloudy W 1mph
0730 LH, EB, SB, HD arrive at depot
0757 LH, HD leave for LFR (white)
0810 arrive at LFR
0827 Start drift in LFR → North
Sondes A, 4.5m deep
B, 3.0m middle
C, 1.5m shallow
25 - Surface
0840-0845 Slack tide at LFR
No bubbles present in plume
0956 end drift
1011 leave LFR for depot.
1023 arrive at depot
1105 upload LFR data
1134 LH, HD, SB, EB leave depot for LBR OPT
1200 Set up for LBR OPT
1206 begin First sample before opt
1215 Lon
1217 end first sample
1220 begin second sample before OPT
1231 end second sample
1234 Lon leave to make change/alteration at plant to assist testing

1237 begin 3rd test before OPT
1330 Lon's changes did not allow for testing after OPT; leave LBR plant OPT
1343 return to depot
68°F, mostly cloudy, E 11mph
1358 LH, HD leave for LFR (white)
1411 arrive at LFR
1421 begin drift
1435-1440 slack tide, LFR (wind/chop)
1540 end drift
1552 leave LFR
1605 arrive at depot
1635 upload LFR data; prep sondes for short term storage
1656 upload LBR data
1715 leave depot

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring
Daily Log

Date: 2/27/19	**Task:** 6B – Transfer Efficiency (TE)	**All Daily Items Completed?** ☒ (see below)

Daily Items for TE: 1) Check tomorrow's tides 2) Download data from sondes & upload to OneDrive 3) Check EagleIO 4) Upload field notes

Weather: 59°F Cloudy, E 3 mph | **Tides:** L – 0940 H – 1525

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Hayley DiGiano, Sam Booth, Lisa Heise, Ethan Bright.

Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒

Boat(s) Used:

☐ Black Boat – Duration:

☒ White Boat – Duration: 2 hrs

☒ Yellow Boat – Duration: 3 hrs

Other Equipment Used:

None

Work Completed:

- See field notes

Notes: All sondes were removed from Platform, Front and Back River Buoys.

Daily Log Completed by: Hayley DiGiano

Signature: Hayley DiGiano

Photos Attached? ☐ | **# of Photos** ____

Revised 2/8/2019

02/27/19 Savannah Oz 2016-294
cloudy 65
leave depot
0905 arrive at CBR
0911 begin profiling w/ H1
slack started ~0935
1023 stop profiling
1026 tie to SE buoy grab data and profile
1032 SW "
1040 NW "
1045 NE "
1048 move to platform
1051 sample W side
1055 sample E side
begin pulling sondes off of platform
1118 finish " "
1125 leave LBR
1145 arrive at dock

2/27/19

59° F Cloudy E 3mph
0756 LH, HD, EB, SB arrive at depot
0843 LH, HD leave for LFR (white)
0854 arrive at LFR
0859 start profiling (LT)
0902 restart profile incorrect timing
0940/0945 Slack tide
0952 end profile
0953 profile LFR_S
0957 profile LFR_N
1017 retrieve LFR_N Buoy
1022 retrieve LFR_S Buoy
1025 leave LFR
1039 arrive at depot
1056 upload LFR data
1201 prepare sondes for short term storage
1230 upload LBR data
1315 take white boat out / wash
1345 take yellow boat out / wash
1430 SB, LH, EB, HD leave depot

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:26:09 PM

Calibration End Time: 2/4/2019 2:33:27 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.06 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.612 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:26:09 PM

Calibration End Time: 2/4/2019 2:33:27 PM

Parameter: Chlorophyll (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105656
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.00 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.616 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:26:09 PM

Calibration End Time: 2/4/2019 2:33:27 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105654

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.01 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.626 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5241218

Is Stable: False

Calibration Report

Last Calibration Time: 1/30/2019 11:03:08 AM

Calibration Start Time: 2/4/2019 2:26:09 PM

Calibration End Time: 2/4/2019 2:33:27 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105664

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.09 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.632 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5241218

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 10:38:46 AM

Calibration Start Time: 2/4/2019 3:39:31 PM

Calibration End Time: 2/4/2019 3:46:20 PM

Parameter: Chlorophyll (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101640
- **Serial Number:** 17G101640
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F102814
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.00 RFU

Post Calibration Value: 0.01 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.986 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5241218

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 10:38:46 AM

Calibration Start Time: 2/4/2019 3:39:31 PM

Calibration End Time: 2/4/2019 3:46:20 PM

Parameter: Chlorophyll (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101640
- **Serial Number:** 17G101640
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105655
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.01 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.987 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5241218

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 10:38:46 AM

Calibration Start Time: 2/4/2019 3:39:31 PM

Calibration End Time: 2/4/2019 3:46:20 PM

Parameter: Chlorophyll (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101640
- **Serial Number:** 17G101640
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105663
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.01 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.992 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M05241218

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 4:46:47 PM

Calibration Start Time: 2/4/2019 2:19:20 PM

Calibration End Time: 2/4/2019 2:39:25 PM

Parameter: Chlorophyll (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105657
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.04 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.787 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 1:26:52 PM

Calibration Start Time: 2/4/2019 2:19:20 PM

Calibration End Time: 2/4/2019 2:39:25 PM

Parameter: Chlorophyll (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105658
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.09 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.800 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 4:46:47 PM

Calibration Start Time: 2/4/2019 2:19:20 PM

Calibration End Time: 2/4/2019 2:39:25 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F102813

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.01 RFU

Post Calibration Value: 0.01 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.869 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: False

Calibration Report

Last Calibration Time: 1/30/2019 10:38:46 AM

Calibration Start Time: 2/4/2019 2:19:20 PM

Calibration End Time: 2/4/2019 2:39:25 PM

Parameter: Chlorophyll (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105653
- **Firmware Version:** 3.0.5

Status: Completed With Warnings

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.06 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.928 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 10:38:46 AM

Calibration Start Time: 2/4/2019 2:19:20 PM

Calibration End Time: 2/4/2019 2:39:25 PM

Parameter: Chlorophyll (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F102815
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.01 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.906 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:42:01 PM

Calibration End Time: 2/4/2019 2:48:42 PM

Parameter: Chlorophyll (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105662
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.12 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 21.684 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:42:01 PM

Calibration End Time: 2/4/2019 2:48:42 PM

Parameter: Chlorophyll (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105656
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.07 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 21.686 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:42:01 PM

Calibration End Time: 2/4/2019 2:48:42 PM

Parameter: Chlorophyll (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105654
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.04 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 21.698 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:42:01 PM

Calibration End Time: 2/4/2019 2:48:42 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105664

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.10 µg/L

Post Calibration Value: 0.01 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 21.705 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 3:52:35 PM

Calibration End Time: 2/4/2019 3:59:35 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F102814

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.95 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 21.996 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 3:52:35 PM

Calibration End Time: 2/4/2019 3:59:35 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105655

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.00 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.000 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 3:52:35 PM

Calibration End Time: 2/4/2019 3:59:35 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105663

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -1.48 µg/L

Post Calibration Value: 0.01 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.004 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:53:47 PM

Calibration End Time: 2/4/2019 3:15:44 PM

Parameter: Chlorophyll (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105657
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -1.03 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.135 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:53:47 PM

Calibration End Time: 2/4/2019 3:15:44 PM

Parameter: Chlorophyll (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105658
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.57 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.150 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:53:47 PM

Calibration End Time: 2/4/2019 3:15:44 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F102813

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.02 µg/L

Post Calibration Value: 0.01 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.343 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: False

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:53:47 PM

Calibration End Time: 2/4/2019 3:15:44 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105653

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.07 µg/L

Post Calibration Value: -0.01 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.263 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:53:47 PM

Calibration End Time: 2/4/2019 3:15:44 PM

Parameter: Chlorophyll (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F102815
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.03 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.277 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: 10/8/2018 3:59:04 PM

Calibration Start Time: 2/4/2019 12:06:16 PM

Calibration End Time: 2/4/2019 12:37:48 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100164

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10021.2 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.210 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/8/2018 3:59:04 PM

Calibration Start Time: 2/4/2019 12:06:16 PM

Calibration End Time: 2/4/2019 12:37:48 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104024

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.46

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10008.9 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.210 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/8/2018 3:59:04 PM

Calibration Start Time: 2/4/2019 12:06:16 PM

Calibration End Time: 2/4/2019 12:37:48 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100167

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10013.6 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.209 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/8/2018 3:59:04 PM

Calibration Start Time: 2/4/2019 12:06:16 PM

Calibration End Time: 2/4/2019 12:37:48 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100183

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10038.4 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.208 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 3:15:19 PM

Calibration Start Time: 2/4/2019 12:06:16 PM

Calibration End Time: 2/4/2019 12:37:48 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100176

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10000.2 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.207 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 3:15:19 PM

Calibration Start Time: 2/4/2019 12:06:16 PM

Calibration End Time: 2/4/2019 12:37:48 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100165

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10004.1 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.168 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: False

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 12:06:16 PM

Calibration End Time: 2/4/2019 12:37:48 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Conductivity
- **Serial Number:** 17F104073
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 5.39

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9459.9 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.179 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 3:15:19 PM

Calibration Start Time: 2/4/2019 12:41:05 PM

Calibration End Time: 2/4/2019 1:03:02 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Wiped Conductivity And Temperature
- **Serial Number:** 17L100175
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10007.8 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.482 °C

Standard Value: 10000.0 µS/cm

Type: NonYSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 3:15:19 PM

Calibration Start Time: 2/4/2019 12:41:05 PM

Calibration End Time: 2/4/2019 1:03:02 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100171

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9978.7 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.483 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 3:15:19 PM

Calibration Start Time: 2/4/2019 12:41:05 PM

Calibration End Time: 2/4/2019 1:03:02 PM

Parameter: Sp Cond (μS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Wiped Conductivity And Temperature
- **Serial Number:** 17L100174
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10013.2 μS/cm

Post Calibration Value: 10000.0 μS/cm

Raw Calibration Value: 0.0 μS/cm

Temperature: 21.484 °C

Standard Value: 10000.0 μS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 1:46:48 PM

Calibration Start Time: 2/4/2019 12:41:05 PM

Calibration End Time: 2/4/2019 1:03:02 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Wiped Conductivity And Temperature
- **Serial Number:** 17L100166
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10044.3 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.505 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 1:46:48 PM

Calibration Start Time: 2/4/2019 12:41:05 PM

Calibration End Time: 2/4/2019 1:03:02 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Wiped Conductivity And Temperature
- **Serial Number:** 17L100181
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10037.3 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.508 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 1:46:48 PM

Calibration Start Time: 2/4/2019 12:41:05 PM

Calibration End Time: 2/4/2019 1:03:02 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Wiped Conductivity And Temperature
- **Serial Number:** 17L100182
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10046.4 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.510 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 12:41:05 PM

Calibration End Time: 2/4/2019 1:03:02 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.73

Sensor:

Type: Conductivity

Serial Number: 17F104074

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 5.13

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9947.5 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.510 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 1:46:48 PM

Calibration Start Time: 2/4/2019 12:51:13 PM

Calibration End Time: 2/4/2019 12:59:00 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Wiped Conductivity And Temperature
- **Serial Number:** 17L100170
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10068.9 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.285 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 1:46:48 PM

Calibration Start Time: 2/4/2019 12:51:13 PM

Calibration End Time: 2/4/2019 12:59:00 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100178

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10048.7 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.288 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 2:21:28 PM

Calibration Start Time: 2/4/2019 12:51:13 PM

Calibration End Time: 2/4/2019 12:59:00 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100173

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9919.7 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.290 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/10/2018 2:21:28 PM

Calibration Start Time: 2/4/2019 12:51:13 PM

Calibration End Time: 2/4/2019 12:59:00 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Wiped Conductivity And Temperature
- **Serial Number:** 17L100172
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10019.4 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.292 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 9:44:58 AM

Calibration Start Time: 2/4/2019 12:51:13 PM

Calibration End Time: 2/4/2019 12:59:00 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100180

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9986.9 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.292 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/8/2018 3:59:04 PM

Calibration Start Time: 2/4/2019 12:51:13 PM

Calibration End Time: 2/4/2019 12:59:00 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100168

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10054.6 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.294 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 12:51:13 PM

Calibration End Time: 2/4/2019 12:59:00 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: Conductivity

Serial Number: 17F103298

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 5.25

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9714.9 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.294 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 12:49:39 PM

Calibration Start Time: 2/4/2019 1:07:49 PM

Calibration End Time: 2/4/2019 1:14:53 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101761

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10230.9 µS/cm

Post Calibration Value: 9999.9 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.181 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 12:49:39 PM

Calibration Start Time: 2/4/2019 1:07:49 PM

Calibration End Time: 2/4/2019 1:14:53 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Wiped Conductivity And Temperature
- **Serial Number:** 17L100179
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10081.0 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.184 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 9:44:58 AM

Calibration Start Time: 2/4/2019 1:07:49 PM

Calibration End Time: 2/4/2019 1:14:53 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100177

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9983.0 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.186 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 12:59:57 PM

Calibration Start Time: 2/4/2019 1:07:49 PM

Calibration End Time: 2/4/2019 1:14:53 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104031

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9967.3 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.188 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 12:59:57 PM

Calibration Start Time: 2/4/2019 1:07:49 PM

Calibration End Time: 2/4/2019 1:14:53 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104022

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9999.5 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.190 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 12:59:57 PM

Calibration Start Time: 2/4/2019 1:07:49 PM

Calibration End Time: 2/4/2019 1:14:53 PM

Parameter: Sp Cond (μS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100169

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10072.7 μS/cm

Post Calibration Value: 10000.0 μS/cm

Raw Calibration Value: 0.0 μS/cm

Temperature: 21.191 °C

Standard Value: 10000.0 μS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 9:44:58 AM

Calibration Start Time: 2/4/2019 1:07:49 PM

Calibration End Time: 2/4/2019 1:14:53 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Conductivity
- **Serial Number:** 17F104075
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 5.17

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9991.9 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.195 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 9:44:58 AM

Calibration Start Time: 2/4/2019 3:11:40 PM

Calibration End Time: 2/4/2019 3:14:27 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102021
- **Serial Number:** 17G102021
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Conductivity
- **Serial Number:** 17F103296
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 5.19

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9935.4 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.029 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 9:44:58 AM

Calibration Start Time: 2/4/2019 3:11:40 PM

Calibration End Time: 2/4/2019 3:14:27 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102021

Serial Number: 17G102021

Firmware Version: 1.0.73

Sensor:

Type: Conductivity

Serial Number: 17F103297

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 5.21

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9965.0 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.030 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 9:44:58 AM

Calibration Start Time: 2/4/2019 3:11:40 PM

Calibration End Time: 2/4/2019 3:14:27 PM

Parameter: Sp Cond (µS/cm)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102021
- **Serial Number:** 17G102021
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Conductivity
- **Serial Number:** 17F103295
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

Cell Constant: 5.17

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9937.6 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 21.032 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 18G100371

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:11:44 PM

Calibration Start Time: 2/6/2019 8:33:31 AM

Calibration End Time: 2/6/2019 8:33:44 AM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17G101989
- **Serial Number:** 17G101989
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17E104624
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.170 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.417 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:16:44 PM

Calibration Start Time: 2/6/2019 8:39:48 AM

Calibration End Time: 2/6/2019 8:39:58 AM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17G101992
- **Serial Number:** 17G101992
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17E104628
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.165 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.585 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:19:21 PM

Calibration Start Time: 2/6/2019 9:01:03 AM

Calibration End Time: 2/6/2019 9:01:44 AM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102930

Serial Number: 17L102930

Firmware Version: 1.0.73

Sensor:

Type: Depth

Serial Number: 17K104910

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.171 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.315 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:23:08 PM

Calibration Start Time: 2/6/2019 3:54:14 PM

Calibration End Time: 2/6/2019 3:54:29 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17G102013
- **Serial Number:** 17G102013
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17E104614
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.132 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.713 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:25:43 PM

Calibration Start Time: 2/6/2019 4:02:01 PM

Calibration End Time: 2/6/2019 4:02:07 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17G102004
- **Serial Number:** 17G102004
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17E104608
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.149 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.687 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:31:48 PM

Calibration Start Time: 2/6/2019 4:00:40 PM

Calibration End Time: 2/6/2019 4:01:11 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17G101996
- **Serial Number:** 17G101996
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17E104630
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.152 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.668 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:34:19 PM

Calibration Start Time: 2/6/2019 4:05:09 PM

Calibration End Time: 2/6/2019 4:05:37 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17L102944
- **Serial Number:** 17L102944
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17K104916
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.155 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.659 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:36:29 PM

Calibration Start Time: 2/6/2019 4:06:13 PM

Calibration End Time: 2/6/2019 4:07:05 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17G102009
- **Serial Number:** 17G102009
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17E104611
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.148 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.725 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:39:08 PM

Calibration Start Time: 2/6/2019 4:09:30 PM

Calibration End Time: 2/6/2019 4:10:09 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101997

Serial Number: 17G101997

Firmware Version: 1.0.73

Sensor:

Type: Depth

Serial Number: 17E104631

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.151 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.777 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:41:58 PM

Calibration Start Time: 2/6/2019 4:13:03 PM

Calibration End Time: 2/6/2019 4:13:44 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101993

Serial Number: 17G101993

Firmware Version: 1.0.73

Sensor:

Type: Depth

Serial Number: 17E104632

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.136 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.770 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:44:12 PM

Calibration Start Time: 2/6/2019 4:09:52 PM

Calibration End Time: 2/6/2019 4:10:25 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17L102940
- **Serial Number:** 17L102940
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17K104915
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.136 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.730 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:48:28 PM

Calibration Start Time: 2/6/2019 4:12:58 PM

Calibration End Time: 2/6/2019 4:13:25 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17L102942
- **Serial Number:** 17L102942
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17K104904
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.135 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.828 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:51:21 PM

Calibration Start Time: 2/6/2019 4:25:43 PM

Calibration End Time: 2/6/2019 4:26:16 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17G102010
- **Serial Number:** 17G102010
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17E104610
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.151 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.817 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:54:55 PM

Calibration Start Time: 2/6/2019 4:34:07 PM

Calibration End Time: 2/6/2019 4:35:04 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17G102008
- **Serial Number:** 17G102008
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17E104613
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.155 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.918 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:56:57 PM

Calibration Start Time: 2/6/2019 4:30:37 PM

Calibration End Time: 2/6/2019 4:31:11 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102003

Serial Number: 17G102003

Firmware Version: 1.0.73

Sensor:

Type: Depth

Serial Number: 17E104601

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.155 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.851 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/11/2018 2:58:56 PM

Calibration Start Time: 2/6/2019 4:40:48 PM

Calibration End Time: 2/6/2019 4:41:33 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17G102000
- **Serial Number:** 17G102000
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17E104605
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.154 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.960 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 11:21:53 AM

Calibration Start Time: 2/6/2019 4:40:06 PM

Calibration End Time: 2/6/2019 4:40:49 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17L102939
- **Serial Number:** 17L102939
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17K104905
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.093 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.953 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 12/8/2017 10:43:02 PM

Calibration Start Time: 2/6/2019 4:56:43 PM

Calibration End Time: 2/6/2019 4:57:45 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17L102938
- **Serial Number:** 17L102938
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17K104906
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.007 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.981 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 2:28:24 PM

Calibration Start Time: 2/6/2019 4:45:01 PM

Calibration End Time: 2/6/2019 4:45:39 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101988

Serial Number: 17G101988

Firmware Version: 1.0.73

Sensor:

Type: Depth

Serial Number: 17E104623

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.010 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.578 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 2:07:22 PM

Calibration Start Time: 2/6/2019 5:31:48 PM

Calibration End Time: 2/6/2019 5:32:16 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17L102935
- **Serial Number:** 17L102935
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17K104900
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.005 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.765 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 11:34:50 AM

Calibration Start Time: 2/6/2019 4:52:20 PM

Calibration End Time: 2/6/2019 4:53:12 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102946

Serial Number: 17L102946

Firmware Version: 1.0.73

Sensor:

Type: Depth

Serial Number: 17K104917

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.068 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.319 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 2:14:58 PM

Calibration Start Time: 2/6/2019 4:59:45 PM

Calibration End Time: 2/6/2019 5:00:24 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17L102932
- **Serial Number:** 17L102932
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17K104903
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.004 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.426 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 12:52:44 PM

Calibration Start Time: 2/6/2019 5:09:07 PM

Calibration End Time: 2/6/2019 5:09:15 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17L102931
- **Serial Number:** 17L102931
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17K104912
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: □0.045 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.□71 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 12:52:47 PM

Calibration Start Time: 2/6/2019 5:08:38 PM

Calibration End Time: 2/6/2019 5:08:46 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102941

Serial Number: 17L102941

Firmware Version: 1.0.73

Sensor:

Type: Depth

Serial Number: 17K104914

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.038 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.778 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 11:04:59 AM

Calibration Start Time: 2/6/2019 5:25:46 PM

Calibration End Time: 2/6/2019 5:26:09 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO3
- **Name:** Sonde 17L102945
- **Serial Number:** 17L102945
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17K104909
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.070 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.673 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 10:41:44 AM

Calibration Start Time: 2/4/2019 3:10:09 PM

Calibration End Time: 2/4/2019 3:10:24 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102021
- **Serial Number:** 17G102021
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17G100273
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.167 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.029 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 11:43:45 AM

Calibration Start Time: 2/4/2019 3:37:03 PM

Calibration End Time: 2/4/2019 3:38:16 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.73

Sensor:

Type: Depth

Serial Number: 17G100250

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.053 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.949 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 2/6/2019 5:13:50 PM

Calibration Start Time: 2/6/2019 5:14:30 PM

Calibration End Time: 2/6/2019 5:15:25 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102336
- **Serial Number:** 17G102336
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17G100277
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.000 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.168 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 8/22/2017 1:30:03 PM

Calibration Start Time: 2/4/2019 12:04:31 PM

Calibration End Time: 2/4/2019 12:04:50 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17G100292
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.006 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.211 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 8/22/2017 3:53:53 PM

Calibration Start Time: 2/4/2019 12:50:10 PM

Calibration End Time: 2/4/2019 12:50:20 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17G100253
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.015 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.279 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 8/22/2017 1:17:04 PM

Calibration Start Time: 2/4/2019 12:07:37 PM

Calibration End Time: 2/4/2019 12:07:51 PM

Parameter: Depth (m)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** Depth
- **Serial Number:** 17G100276
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.008 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.529 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 10/9/2018 9:31:19 AM

Calibration Start Time: 2/4/2019 1:35:44 PM

Calibration End Time: 2/4/2019 1:44:40 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G100743
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100557

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.09

DO (mg/L): 9.10 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.0 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.498 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.5 mmHg

Calibration Report

Last Calibration Time: 10/9/2018 9:31:19 AM

Calibration Start Time: 2/4/2019 1:35:44 PM

Calibration End Time: 2/4/2019 1:44:40 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G101846
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100596

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.08

DO (mg/L): 9.06 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.5 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.540 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.5 mmHg

Calibration Report

Last Calibration Time: 10/9/2018 9:31:19 AM

Calibration Start Time: 2/4/2019 1:35:44 PM

Calibration End Time: 2/4/2019 1:44:40 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G100752
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100588

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.09

DO (mg/L): 9.05 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.2 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.571 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.5 mmHg

Calibration Report

Last Calibration Time: 10/9/2018 9:31:19 AM

Calibration Start Time: 2/4/2019 1:35:44 PM

Calibration End Time: 2/4/2019 1:44:40 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G100749
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100560

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.10

DO (mg/L): 9.02 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.0 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.601 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.5 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 4:03:21 PM

Calibration Start Time: 2/4/2019 1:35:44 PM

Calibration End Time: 2/4/2019 1:44:40 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G100736
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104237

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.07

DO (mg/L): 9.01 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.3 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.629 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.5 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 4:03:21 PM

Calibration Start Time: 2/4/2019 1:57:29 PM

Calibration End Time: 2/4/2019 2:06:52 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G100746
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104235

DO Cap Replacement Date: 7/21/2017

DO Gain: 0.99

DO (mg/L): 8.97 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.0 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.387 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.2 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 3:03:04 PM

Calibration Start Time: 2/4/2019 1:57:29 PM

Calibration End Time: 2/4/2019 2:06:52 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G101851
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100606

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.07

DO (mg/L): 8.98 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.7 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.499 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.2 mmHg

Calibration Report

Last Calibration Time: 10/9/2018 9:31:19 AM

Calibration Start Time: 2/4/2019 1:57:29 PM

Calibration End Time: 2/4/2019 2:06:52 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17L101463

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K101906

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.08

DO (mg/L): 8.96 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.3 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.602 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.2 mmHg

Calibration Report

Last Calibration Time: 10/15/2018 1:16:41 PM

Calibration Start Time: 2/4/2019 1:57:29 PM

Calibration End Time: 2/4/2019 2:06:52 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17L101472
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102903

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.09

DO (mg/L): 9.02 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.1 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.667 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.2 mmHg

Calibration Report

Last Calibration Time: 1/30/2019 11:17:17 AM

Calibration Start Time: 2/4/2019 1:57:29 PM

Calibration End Time: 2/4/2019 2:06:52 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17L101469
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102897

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.10

DO (mg/L): 8.89 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.4 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.747 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.2 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 4:03:21 PM

Calibration Start Time: 2/4/2019 1:36:04 PM

Calibration End Time: 2/4/2019 1:52:20 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G100742
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100556

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.05

DO (mg/L): 9.01 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.8 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 19.707 °C

Standard Value: 100.0 % Sat

Type: Tap water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.6 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 4:03:21 PM

Calibration Start Time: 2/4/2019 1:36:04 PM

Calibration End Time: 2/4/2019 1:52:20 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17G101858

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100627

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.07

DO (mg/L): 8.96 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.8 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 19.889 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.6 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 4:03:21 PM

Calibration Start Time: 2/4/2019 1:36:04 PM

Calibration End Time: 2/4/2019 1:52:20 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17G100744

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104233

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.04

DO (mg/L): 8.98 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.8 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.137 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.6 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 3:03:04 PM

Calibration Start Time: 2/4/2019 1:36:04 PM

Calibration End Time: 2/4/2019 1:52:20 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17G100740

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100558

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.08

DO (mg/L): 9.00 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.5 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.305 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.6 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 3:03:04 PM

Calibration Start Time: 2/4/2019 1:36:04 PM

Calibration End Time: 2/4/2019 1:52:20 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G101861
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100630

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.07

DO (mg/L): 9.09 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.3 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.615 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.6 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 3:03:04 PM

Calibration Start Time: 2/4/2019 2:01:17 PM

Calibration End Time: 2/4/2019 2:10:09 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G101853
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100607

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.09

DO (mg/L): 8.79 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.1 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.549 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.3 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 3:03:04 PM

Calibration Start Time: 2/4/2019 2:01:17 PM

Calibration End Time: 2/4/2019 2:10:09 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G100745
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104234

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.02

DO (mg/L): 8.79 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.8 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.745 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.2 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 3:42:02 PM

Calibration Start Time: 2/4/2019 2:01:17 PM

Calibration End Time: 2/4/2019 2:10:09 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G101848
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100600

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.08

DO (mg/L): 8.80 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.8 % Sat

Post Calibration Value: 100.5 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.834 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.2 mmHg

Calibration Report

Last Calibration Time: 10/10/2018 3:42:02 PM

Calibration Start Time: 2/4/2019 2:01:17 PM

Calibration End Time: 2/4/2019 2:10:09 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G101857
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100626

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.07

DO (mg/L): 8.79 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.1 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.876 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.2 mmHg

Calibration Report

Last Calibration Time: 1/30/2019 10:16:59 AM

Calibration Start Time: 2/4/2019 2:01:17 PM

Calibration End Time: 2/4/2019 2:10:09 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17G101862

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100631

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.10

DO (mg/L): 8.79 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 96.8 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.893 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.2 mmHg

Calibration Report

Last Calibration Time: 10/15/2018 1:15:17 PM

Calibration Start Time: 2/4/2019 1:49:23 PM

Calibration End Time: 2/4/2019 1:57:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17G100748

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104238

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.12

DO (mg/L): 9.45 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 94.8 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.990 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.5 mmHg

Calibration Report

Last Calibration Time: 10/15/2018 1:15:17 PM

Calibration Start Time: 2/4/2019 1:49:23 PM

Calibration End Time: 2/4/2019 1:57:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17G100750

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100562

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.11

DO (mg/L): 8.93 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.0 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.114 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.5 mmHg

Calibration Report

Last Calibration Time: 1/30/2019 10:16:59 AM

Calibration Start Time: 2/4/2019 1:49:23 PM

Calibration End Time: 2/4/2019 1:57:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17L101458

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102877

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.08

DO (mg/L): 8.91 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 95.9 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.175 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.4 mmHg

Calibration Report

Last Calibration Time: 10/15/2018 1:16:41 PM

Calibration Start Time: 2/4/2019 1:49:23 PM

Calibration End Time: 2/4/2019 1:57:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17G100737

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100559

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.13

DO (mg/L): 8.89 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.7 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.255 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.4 mmHg

Calibration Report

Last Calibration Time: 10/15/2018 1:16:41 PM

Calibration Start Time: 2/4/2019 1:49:23 PM

Calibration End Time: 2/4/2019 1:57:51 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G100747
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104236

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.09

DO (mg/L): 8.89 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.2 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.309 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 762.3 mmHg

Calibration Report

Last Calibration Time: 1/30/2019 10:16:59 AM

Calibration Start Time: 2/4/2019 3:20:03 PM

Calibration End Time: 2/4/2019 3:27:51 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G101849
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100601

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.09

DO (mg/L): 8.97 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 95.3 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.782 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 761.6 mmHg

Calibration Report

Last Calibration Time: 1/30/2019 10:16:59 AM

Calibration Start Time: 2/4/2019 3:20:03 PM

Calibration End Time: 2/4/2019 3:27:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17G101860

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100629

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.11

DO (mg/L): 8.95 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 95.5 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.881 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 761.6 mmHg

Calibration Report

Last Calibration Time: 1/30/2019 10:16:59 AM

Calibration Start Time: 2/4/2019 3:20:03 PM

Calibration End Time: 2/4/2019 3:27:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17G101854

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100608

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.08

DO (mg/L): 8.93 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 95.4 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.970 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 761.6 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 3:20:03 PM

Calibration End Time: 2/4/2019 3:27:51 PM

Parameter: DO (% Sat)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G102335
- **Serial Number:** 17G102335
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** DO
- **Serial Number:** 17G100751
- **Firmware Version:** 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100563

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.15

DO (mg/L): 8.93 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 87.2 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.020 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 761.7 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 3:20:03 PM

Calibration End Time: 2/4/2019 3:27:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17L101471

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102902

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.09

DO (mg/L): 8.92 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 91.6 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.078 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 761.6 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/11/2019 11:25:38 AM

Calibration End Time: 2/11/2019 11:25:55 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.73

Sensor:

Type: DO

Serial Number: 17L101461

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102909

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.09

DO (mg/L): 9.07 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 91.6 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.152 °C

Standard Value: 100.0 % Sat

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:34:44 PM

Calibration End Time: 2/4/2019 2:40:43 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.94 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.666 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:34:44 PM

Calibration End Time: 2/4/2019 2:40:43 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105656

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.54 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.649 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:34:44 PM

Calibration End Time: 2/4/2019 2:40:43 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105654

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.20 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.654 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 11:04:08 AM

Calibration Start Time: 2/4/2019 2:34:44 PM

Calibration End Time: 2/4/2019 2:40:43 PM

Parameter: Phycoerythrin (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105664
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.19 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.660 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 10:51:18 AM

Calibration Start Time: 2/4/2019 3:47:40 PM

Calibration End Time: 2/4/2019 3:51:06 PM

Parameter: Phycoerythrin (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101640
- **Serial Number:** 17G101640
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F102814
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.07 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.993 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 10:51:18 AM

Calibration Start Time: 2/4/2019 3:47:40 PM

Calibration End Time: 2/4/2019 3:51:06 PM

Parameter: Phycoerythrin (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101640
- **Serial Number:** 17G101640
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105655
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.15 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.996 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 10:51:18 AM

Calibration Start Time: 2/4/2019 3:47:40 PM

Calibration End Time: 2/4/2019 3:51:06 PM

Parameter: Phycoerythrin (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101640
- **Serial Number:** 17G101640
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105663
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.03 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.998 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: 10/12/2018 8:30:50 AM

Calibration Start Time: 2/4/2019 2:42:25 PM

Calibration End Time: 2/4/2019 2:51:56 PM

Parameter: Phycoerythrin (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105657
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.11 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 21.987 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: 10/15/2018 1:28:24 PM

Calibration Start Time: 2/4/2019 2:42:25 PM

Calibration End Time: 2/4/2019 2:51:56 PM

Parameter: Phycoerythrin (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105658
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.10 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.013 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: 10/12/2018 8:20:52 AM

Calibration Start Time: 2/4/2019 2:42:25 PM

Calibration End Time: 2/4/2019 2:51:56 PM

Parameter: Phycoerythrin (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F102813
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.09 RFU

Post Calibration Value: 0.01 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.053 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 10:51:18 AM

Calibration Start Time: 2/4/2019 2:42:25 PM

Calibration End Time: 2/4/2019 2:51:56 PM

Parameter: Phycoerythrin (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105653
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.28 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.069 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: 1/30/2019 10:51:18 AM

Calibration Start Time: 2/4/2019 2:42:25 PM

Calibration End Time: 2/4/2019 2:51:56 PM

Parameter: Phycoerythrin (RFU)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F102815
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.27 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.087 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:50:10 PM

Calibration End Time: 2/4/2019 2:56:00 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 2.62 µg/L

Post Calibration Value: -0.02 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 21.727 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:50:10 PM

Calibration End Time: 2/4/2019 2:56:00 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101639

Serial Number: 17G101639

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105656

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1.50 µg/L

Post Calibration Value: -0.02 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 21.739 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:50:10 PM

Calibration End Time: 2/4/2019 2:56:00 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105654
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.67 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 21.747 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 2:50:10 PM

Calibration End Time: 2/4/2019 2:56:00 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101639
- **Serial Number:** 17G101639
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105664
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.94 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 21.755 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 4:00:53 PM

Calibration End Time: 2/4/2019 4:05:08 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101640
- **Serial Number:** 17G101640
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F102814
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1.07 µg/L

Post Calibration Value: 0.02 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.011 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 4:00:53 PM

Calibration End Time: 2/4/2019 4:05:08 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105655

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1.78 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.016 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 4:00:53 PM

Calibration End Time: 2/4/2019 4:05:08 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17G101640
- **Serial Number:** 17G101640
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F105663
- **Firmware Version:** 3.0.5

Status: Completed

Technician: Hayley DiGiano

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 2.38 µg/L

Post Calibration Value: 0.01 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.021 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: M0R5241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 3:17:33 PM

Calibration End Time: 2/4/2019 3:38:31 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105657

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1.48 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.376 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 3:17:33 PM

Calibration End Time: 2/4/2019 3:38:31 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105658

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1.89 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.391 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 3:17:33 PM

Calibration End Time: 2/4/2019 3:38:31 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

- **Type:** EXO2
- **Name:** Sonde 17H100435
- **Serial Number:** 17H100435
- **Firmware Version:** 1.0.73

Sensor:

- **Type:** TAL-PE
- **Serial Number:** 17F102813
- **Firmware Version:** 3.0.5

Status: Completed With Warnings

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 3.63 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.567 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 3:17:33 PM

Calibration End Time: 2/4/2019 3:38:31 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F105653

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1.69 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.504 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 2/4/2019 3:17:33 PM

Calibration End Time: 2/4/2019 3:38:31 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.73

Sensor:

Type: TAL-PE

Serial Number: 17F102815

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 6.24 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.517 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Kroger

Lot Number: MOR5 241218

Is Stable: True