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Startup Run Data Collection & Modeling Report

Oxygen Injection System Environmental Testing for the Savannah Harbor Expansion Project

U.S. Army Corps of Engineers

March 2022 Revision 1



Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

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PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG^2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

EXECUTIVE SUMMARY

As one of the environmental mitigation projects for the Savannah Harbor Expansion Project (SHEP), two oxygen injection plants were constructed by the United States Army Corps of Engineers (USACE) on the Savannah River (Downriver and Upriver plants) to offset potential decreases in dissolved oxygen (DO) due to navigation channel deepening. The Downriver plant, located on Hutchinson Island in Chatham County, Georgia, discharges super-oxygenated water to the Front River and Back River via two separate diffusers. The Downriver plant is designed to deliver 12,000 pounds of oxygen per day (lbs/day), 8,000 lbs/day to the Front River, and 4,000 lbs/day to the Back River. The Upriver plant is located upstream on the Savannah River in Effingham County, Georgia. The Upriver plant is designed to deliver 28,000 lbs/day via one discharge diffuser. The USACE started operating the Downriver plant in January 2019 and the Upriver plant in July 2020. The system, which includes the generation and injection of high purity oxygen gas into raw river water and subsequent discharge back into the water column, will be operated seasonally during the critical summer months. The SHEP Final Environmental Impact Statement (EIS) and General Re-evaluation Report (GRR), both finalized in 2012, specified the requirement to operate the injection system from June 15 through September 30, during the warmest months of the year when DO concentrations in the river are generally at their lowest.

Two successful test operations of the oxygen injection system, known as the Test Run and Startup Run (SUR), were required to ensure overall SHEP success. The Test Run was completed from March 14 through May 12, 2019. The SUR was a 59-day continuous operation of the combined oxygen injection system, both Upriver and Downriver plants, as specified in the Compromise and Settlement Agreement. The EIS specified a requirement to deliver a daily average equal to or greater than the combined design production oxygen load of 40,000 lbs/day. The SUR occurred from July 25 through September 22, 2020. The USACE was required to extensively monitor the Savannah River and estuary continuously for the duration of the SUR and undertake subsequent modeling and analyses.

The full-scale data collection effort involved monitoring on the Front River, Back River, and Savannah River by collecting data from semi-permanent buoy sondes, profile sondes, and drift sondes. The field team also conducted dye releases before and during the SUR, to track the movement and retention of the dye plumes, and therefore, oxygen injection. In total, the field crew of 15 personnel operated over 84 days and installed 21 buoys, completed 371 profile measurements, sampled 103 drifts, and implemented 10 separate dye releases. Supplementary data were also sourced from the network of publicly available United States Geological Survey (USGS) stations throughout the Savannah River and estuary, and the data collected at both oxygen injection plants. All data were subject to thorough quality assurance/quality control (QA/QC) review prior to analysis.

In 2020, the SHEP model was recalibrated to represent existing conditions more accurately throughout the harbor and predict future outcomes. This included multiple grid and bathymetry updates to the model to better define the cross-sections of the Middle and Back Rivers and the Savannah River upstream of Interstate 95 (I-95) up to the Upriver plant, as well as additional marshes to improve the tidal flow circulation in the system.

Completion of the field monitoring and model updates was the initial step in assessing SUR mitigation impacts. The *Success Criteria* was defined in the Compromise and Settlement Agreement: **"The purpose of the modeling and monitoring is to confirm that the Oxygen Injection System will mitigate for DO impacts of the Project, as shown by comparing actual DO levels in the modeled area, from Station 0+000 upstream to River Mile (RM) 27.8, to DO levels in the without-Project scenario (the "*Success Criteria*")."** In other words, the *Success Criteria* requires evidence the DO impacts across the estuary caused by deepening have been compensated for in time (tidally and seasonally) and space (vertically and horizontally).

It should be explicitly noted that neither the *Success Criteria* nor the EIS or GRR, specify a target concentration of increased DO to appropriately mitigate for channel deepening. The dynamic nature of the Savannah River and estuary vertically, spatially, and temporally, means specifying a target concentration increase was impossible. To address the *Success Criteria*, an alternative approach was needed to prove mitigation was achieved.

A tiered approach was developed whereby the *Success Criteria* was proven by evaluating four *Success Metrics,* each of which captured a complementary portion of the *Success Criteria* and were consistent with the EIS and GRR. Further, the four *Success Metrics* were able to be assessed by a total of 12 *Lines of Evidence*, three for each *Success Metric*. Successfully demonstrating achievement of the *Lines of Evidence* would prove accomplishment of the *Success Metrics* and ultimately the *Success Criteria*, proving the oxygen injection system is successfully able to inject the required oxygen loads into the river. This would also demonstrate that the injected oxygen can be retained and distributed vertically and spatially, thereby mitigating impacts to DO by harbor deepening.

The *Success Metrics* cover four complementary components essential to oxygen mitigation. The 12 *Lines of Evidence*, three for each *Success Metric*, are presented below:

1) **OXYGEN LOAD DELIVERED** – The requirement was a daily average of 40,000 lbs/day of oxygen over a continuous 59-day period to be injected into the water column during the critical summer months. Success Metric #1 was achieved during the SUR by:
   (1.1) injecting a total daily average of more than 40,000 lbs/day for 59 days – **42,412 lbs/day were achieved**.
   (1.2) injecting a daily average of more than 28,000 lbs/day for 59 days from the Upriver plant – **28,838 lbs/day were achieved**.
   (1.3) injecting a daily average of more than 12,000 lbs/day for 59 days from the Downriver plant – **13,574 lbs/day was achieved**.
2) **OXYGEN LOAD RETAINED** – The requirement was for 90 percent of the delivered oxygen load to the water column to remain dissolved and saturated in the water. Success Metric #2 was achieved during the SUR by:
   (2.1) Achieved 99 Percent Water Column Transfer Efficiency (WCTE) – **Significantly greater than the 90 percent goal, indicating almost all injected oxygen stayed within the river and was used for mitigation.**
   (2.2) Oxygen plume retention after injection – **Evidence of oxygen retention was detected up to one month after injection on the Front River and three weeks on the Back River.**
   (2.3) No effervescence or bubbling observed during field data collection – **No evidence on any of the 84 field sampling days.**
3) **DO MITIGATION IN BOTTOM WATERS** – The requirement was for the SHEP model to show oxygen injection mitigated median DO concentrations in 97 percent of the bottom half of the water column across the estuary. Success Metric #3 was achieved during the SUR by:
   (3.1) Mitigation in the bottom half of the water column – **The SHEP Model results demonstrated increased DO concentrations in greater than 97 percent of the total volume in bottom waters. All zones for the SUR Scenario exhibited positive DO deltas.**
   (3.2) Analysis of field data (profile and dye data) – **Successfully demonstrated oxygen retention and vertical distribution of oxygen load.**
   (3.3) USGS test-control analysis (vertical) – **successfully increased DO concentrations at two depths in the upper and bottom halves of the water column.**
4) **SPATIAL EXTENT OF DO MITIGATION THROUGHOUT ESTUARY** – The requirement was to confirm the oxygen injection system would mitigate for SHEP impacts throughout the Savannah Harbor system (from Station 0+000 upstream to RM 27.8), including critical zones identified in the EIS as being most affected by navigational channel deepening.

(4.1) Analysis of field data (buoy, drift, and dye data) – **Successfully demonstrated oxygen retention and spatial distribution of oxygen load.**

(4.2) USGS test-control analysis (spatial) – **successfully increased DO concentrations at 10 different locations across the Savannah River and estuary.**

(4.3) Spatial analysis of the SHEP model – **The SHEP Model results demonstrated increased DO concentrations at all nine critical zones as well as the majority of the Savannah River and estuary. Additional analysis using the 2015 predictive guideline plots and measured USGS data successfully demonstrated compliance by mitigating for impacts during the Startup Run against the *without-project* scenario (*Success Criteria*).**

Based on analyses of both measured data and modeling results, **the conclusion is that the 12 *Lines of Evidence* suitably address the four *Success Metrics*, and therefore the *Success Criteria* was achieved.** During the SUR period, the system operated in accordance with requirements; demonstrating that the system is capable of meeting the DO mitigation requirements of SHEP.

USACE intends to meet post construction monitoring and modeling requirements as outlined in Appendix D of the EIS, in accordance with Section I. A. 15 of the Compromise and Settlement Agreement.

TABLE OF CONTENTS

1.0 INTRODUCTION 13
1.1 Background 13
1.2 The Savannah River and Estuary 14
1.3 Stakeholders 18
1.4 Oxygen Injection System 18
1.5 Test Run 22
1.6 Startup Run 23
2.0 DATA COLLECTION PROCEDURES 25
2.1 Semi-Permanent Buoy Monitoring / Data Collection 26
2.2 Profile Monitoring / Data Collection 29
2.3 Drift Monitoring / Data Collection 30
2.4 Dye Releases and Monitoring 30
2.5 Startup Run Data Summary 33
2.5.1 Upriver Data Summary 33
2.5.1.1 Upriver Buoy Data 33
2.5.1.2 Upriver Drift Data 34
2.5.1.3 Upriver Profile Data 35
2.5.2 Front River Data Summary 36
2.5.2.1 Front River Buoy Data 36
2.5.2.2 Front River Drift Data 36
2.5.2.3 Front River Profile Data 37
2.5.3 Back River Data Summary 39
2.5.3.1 Back River Data Summary 39
2.5.3.2 Back River Drift Data 39
2.5.3.3 Back River Profile Data 40
2.5.4 Middle River Data Summary 41
3.0 DATA QA/QC 42
3.1 Semi-Permanent Buoy Data 42
3.2 Profile and Drift Data 42
3.3 USGS Data 43
3.4 Oxygen Injection Plant Data 43
4.0 SUCCESS EVALUATION APPROACH 45
4.1 Background 45
4.2 The Success Criteria 46

4.3 The Lines of Evidence Approach 46
4.4 Supporting Anecdotal Evidence 53
5.0 OXYGEN INJECTION SYSTEM DATA ANALYSIS 54
5.1 Oxygen Injection System 54
5.2 Startup Run Operations 54
5.3 Summary 59
6.0 WATER COLUMN TRANSFER EFFICIENCY 60
6.1 Summary 62
7.0 USGS DATA ANALYSIS 63
7.1 Test Run 63
7.2 Startup Run 66
7.3 Assessment of Oxygen Retention After Operations Cease 69
7.4 Summary 71
8.0 UPRIVER MONITORING DATA ANALYSIS 72
8.1 Upriver Semi-Permanent Buoys 72
8.2 Upriver Drift and Profile Data 76
8.2.1 Upriver Drift Sampling – July 24, 2020 76
8.2.2 Upriver Drift Sampling – July 28, 2020 78
8.2.3 Upriver Drift Sampling – August 5, 2020 80
8.2.4 Upriver Drift Sampling – September 1, 2020 82
8.2.5 Upriver Drift Sampling – September 16, 2020 84
8.3 Summary 84
9.0 DOWNRIVER MONITORING DATA ANALYSIS 85
9.1 Front River Drift and Profile Data 85
9.1.1 Front River Drift Sampling – August 17, 2020 86
9.1.2 Front River Profile Sampling – August 28, 2020 88
9.1.3 Front River Profile Sampling – September 04 and 17, 2020 89
9.2 Back River Monitoring Data 91
9.2.1 Back River Buoy Data Analysis 91
9.2.2 Back River Drift and Profile Data 93
9.2.3 Back River Drift Sampling – July 23, 2020 94
9.2.4 Back River Drift Sampling – August 17, 2020 95
9.2.5 Back River and Little Back River Drift and Profile Sampling – September 17, 2020 96
9.3 Summary 97
10.0 DYE RELEASES AND ANALYSIS 98
10.1 Upriver Dye Releases 100

10.1.1 July 15, 2020 Dye Release 100
10.1.2 August 24, 2020 Super Dye Release 105
10.1.3 USGS I-95 Gage 109
10.2 Front River Dye Releases 110
10.2.1 July 16 and August 11, 2020 Dye Releases 110
10.2.2 August 25, 2020 Dye Release 111
10.3 Back River Dye Releases 120
10.3.1 July 16 and August 12, 2020 Dye Releases 120
10.3.2 August 25 to September 24, 2020 Dye Sampling Results 121
10.4 Summary 124
11.0 2020 SHEP MODEL 125
11.1 Background 125
11.1.1 The 2020 SHEP Model 125
11.2 Model Setup 126
11.2.1 Modeling Scenarios 131
11.3 Model Evaluation for the Startup Run 132
11.3.1 DO Longitudinal Profiles 132
11.3.2 DO Zonal Analysis 138
11.3.3 DO Cell Analysis 145
11.4 Summary 146
12.0 MODEL GUIDELINE ASSESSMENT 147
12.1 Background 147
12.2 Results 148
12.3 Summary 155
13.0 CONCLUSIONS 156
14.0 BIBLIOGRAPHY 158
APPENDIX A SEMI-PERMANENT BUOY DATA A-1
APPENDIX B PROFILE DATA B-1
APPENDIX C DRIFT DATA C-1
APPENDIX D FIELD NOTE LOGS/CALIBRATION D-1
APPENDIX E DYE RELEASES E-1
APPENDIX F DATA COLLECTION QA/QC F-1
APPENDIX G USGS DATA G-1
APPENDIX H PLANT DATA H-1
APPENDIX I WATER COLUMN TRANSFER EFFICIENCY I-1
APPENDIX J USGS ANALYSIS J-1

APPENDIX K SHEP MODEL ADDITIONAL DETAIL.....K-1

APPENDIX L SHEP MODEL GUIDELINE ASSESSMENT L-1

LIST OF TABLES

Table 1-1 Stakeholders Involved in SHEP, Collectively Known as the Agencies 18
Table 1-2 Test Run (2019) Daily Averages 22
Table 1-3 Test Run (2019) Modeling Results Summary 22
Table 2-1 SUR Dye Releases and Locations 32
Table 2-2 Upriver Buoy Data 34
Table 2-3 Upriver Drift Data Summary 34
Table 2-4 Upriver Background Below Diffuser and Tributary Drift Data Comparison 35
Table 2-5 Upriver Profile Data Summary 35
Table 2-6 Front River Buoy Data Summary 36
Table 2-7 Front River Drift Data Summary 37
Table 2-8 Front River Profile Data Summary 37
Table 2-9 Front River (Upper Half) Data Comparison 38
Table 2-10 Front River (Bottom Half) Data Comparison 38
Table 2-11 Back River Buoy Data Summary 39
Table 2-12 Back River Drift Data Summary 40
Table 2-13 Back River Profile Data Summary 40
Table 2-14 Middle River Data Summary 41
Table 5-1 SUR Daily Averages 54
Table 6-1 Oxygen Load Retained Summary 62
Table 7-1 Test Run DO Differences – Absolute DO Concentration (mg/L) 64
Table 7-2 SUR DO differences – Absolute DO Concentration (mg/L) 67
Table 10-1 SUR Dye Releases Details 98
Table 11-1 Modeling Scenarios 131
Table 11-2 Maximum DO Deltas for Longitudinal Profiles – SUR Scenario (bottom half) 137
Table 11-3 DO Deltas by Zone for SUR Scenario – Bottom Half 142

LIST OF FIGURES

Figure 1-1 The Savannah River and Estuary 16
Figure 1-2 Savannah River and Estuary Average Summertime DO Transect 17
Figure 1-3 Oxygen Injection Plant Locations and Other Important Startup Run Features 19
Figure 1-4 Upriver Oxygen Injection Plant 20
Figure 1-5 Downriver Oxygen Injection Plant 21
Figure 2-1 Summary of Data Collection Program 26
Figure 2-2 Upriver Semi-Permanent Buoys, Looking Toward Injection Plant 27
Figure 2-3 Upriver Semi-Permanent Buoy Monitoring Locations 28
Figure 2-4 Downriver Semi-Permanent Buoy Monitoring Locations 29
Figure 2-5 Dye Plume from Front River Diffuser Near Downriver Plant 32
Figure 3-1 Location of USGS Gages Used for SUR Analysis 44
Figure 4-1 The Four Success Metrics 47
Figure 4-2 Lines of Evidence Approach Summary 48
Figure 4-3 Success Metric #1 – Oxygen Load Delivered 49
Figure 4-4 Success Metric #2 – Oxygen Load Retained 50
Figure 4-5 Success Metric #3 – DO Mitigation in Bottom Waters 51
Figure 4-6 Success Metric #4 – Spatial Extent of DO Mitigation Throughout the Estuary 52

Figure 5-1 Upriver Plant Flow During SUR 55
Figure 5-2 Downriver Plant Flow During SUR (total) 56
Figure 5-3 Downriver Plant Flow During SUR (Front and Back River) 56
Figure 5-4 Upriver Plant Oxygen Loads 57
Figure 5-5 Downriver Plant Oxygen Loads (Total) 58
Figure 5-6 Downriver Plant Net Oxygen Loads (Front and Back River) 58
Figure 6-1 Daily Average WCTE Values for Front River, Back River, and Upriver 61
Figure 7-1 Test Run DO Differences – Absolute DO Concentration (mg/L) 65
Figure 7-2 Startup Run DO Differences – Absolute DO Concentration (mg/L) 68
Figure 7-3 DO Saturation at USGS station 021989715_2 for Test Run 70
Figure 7-4 DO Saturation at USGS station 021989715_2 for SUR 70
Figure 7-5 DO Saturation at USGS station 021989773 for Test Run 70
Figure 7-6 DO Saturation at USGS station 021989773 for SUR 70
Figure 8-1 Upriver Semi-Permanent Buoy Locations 73
Figure 8-2 Box and Whisker Plots of DO Concentrations at the Upriver Buoys During the SUR, Diffuser located near UR_10 74
Figure 8-3 Upriver 16 and 16a Observed DO Concentration 75
Figure 8-4 Upriver Drift Sampling – July 24, 2020 77
Figure 8-5 Savannah River DO transect – July 24, 2020 78
Figure 8-6 Upriver Drift Sampling – July 28, 2020 79
Figure 8-7 Upriver Drift Sampling – August 5, 2020 80
Figure 8-8 Upriver Drift Sampling – August 5, 2020 (inset) 81
Figure 8-9 Savannah River DO Transect – August 05, 2020 82
Figure 8-10 Upriver Drift Sampling – September 1, 2020 83
Figure 8-11 Savannah River DO Transect – September 01, 2020 83
Figure 8-12 Savannah River DO Transect – September 16, 2020 84
Figure 9-1 Front River Drift Sampling – August 17, 2020 (surface) 86
Figure 9-2 Front River Drift Sampling – August 17, 2020 (mid-depth) 87
Figure 9-3 Front River Profile Sampling – August 28, 2020 88
Figure 9-4 Front River DO Profiles – August 28, 2020 89
Figure 9-5 Front River DO Profiles – September 04, 2020 (Neap Tide) 90
Figure 9-6 Front River DO Profiles – September 17, 2020 (Spring Tide) 90
Figure 9-7 Box and Whisker Plots of Back River Buoy Data During Flood and Ebb Tides. The Back River Diffuser is Located Between LBR_5 and LBR_4 92
Figure 9-8 Back River Drift Sampling – July 23, 2020 94
Figure 9-9 Back River Drift Sampling – August 17, 2020 (surface) 95
Figure 9-10 Back River and Little Back River Drift Sampling – September 17, 2020 (surface) 96
Figure 9-11 Back River and Little Back River DO Profile – September 17, 2020 97
Figure 10-1 August 24, 2020 Dye Release Showing Dye Dispersing Below the Upriver Diffuser 99
Figure 10-2 Upriver Dye Sampling – July 15, 2020 101
Figure 10-3 Upriver Dye Sampling – July 15, 2020 (inset) 102
Figure 10-4 Upriver Dye Transect – July 15, 2020 103
Figure 10-5 Upriver USGS Dye Cross-section – July 15, 2020 (Hardeeville) 104
Figure 10-6 Upriver Dye Sampling – August 24, 2020 105
Figure 10-7 Upriver USGS Dye Cross-section – August 24, 2020 (Hardeeville) 106
Figure 10-8 August 25, 2020 Dye sampling 107
Figure 10-9 August 25, 2020 DO sampling 108
Figure 10-10 Dye Measurements at USGS Gage 02198840 (I-95) 109
Figure 10-11 Front River Dye Sampling – July 16, 2020 110
Figure 10-12 Front River Dye Sampling – August 25, 2020 (mid-depth) (100 to 180 µg/L) 111
Figure 10-13 Front River Dye Sampling – August 25, 2020 (mid-depth) (20 to 180 µg/L) 112
Figure 10-14 Front River Dye Sampling – August 25, 2020 (mid-depth) (2 to 180 µg/L) 113
Figure 10-15 Front River Dye Sampling – August 25, 2020 (mid-depth) (100 to 180 µg/L) 114

Figure 10-16 Front River Dye Profile – August 27 through August 31, 2020 116
Figure 10-17 Front River Dye Profile – September 18 through September 23, 2020 117
Figure 10-18 Front River Dye Profile – September 25, 2020 118
Figure 10-19 Front River - Fort Pulaski Dye Concentrations (bottom) 118
Figure 10-20 Front River – Turning Basin Dye Concentrations (bottom) 119
Figure 10-21 Back River Dye Sampling – July 16, 2020 121
Figure 10-22 Back River Dye Profile – August 26 to September 03, 2020 122
Figure 10-23 Back River Dye Profile – September 08, 2020, to September 24, 2020 123
Figure 10-24 Dye concentrations at the Little Back River Mouth 124
Figure 11-1 SHEP 2020 EFDC and WASP Computational Grids 126
Figure 11-2 Raw DO Intake Time Series at Front River 127
Figure 11-3 Raw DO Intake Time Series at Savannah River 127
Figure 11-4 Downriver Plant Flow 128
Figure 11-5 Upriver Plant Flow 128
Figure 11-6 Oxygen Injection Plant Temperature Data 129
Figure 11-7 Downriver Plant DO Concentrations 130
Figure 11-8 Upriver Plant DO Concentrations 130
Figure 11-9 River Mile Markers for the Savannah, Little Back, and Middle Rivers 133
Figure 11-10 Savannah River Longitudinal Profile of DO – SUR Scenario (bottom half) 135
Figure 11-11 Back River Longitudinal Profile of DO – SUR Scenario (bottom half) 136
Figure 11-12 Middle River Longitudinal Profile of DO – SUR Scenario (bottom half) 137
Figure 11-13 Location of DO Spatial Zones from RM 0 to RM 27.8 139
Figure 11-14 Location of DO Spatial Zones in the Front, Middle and Little Back Rivers 140
Figure 11-15 Location of DO Spatial Zones in the Savannah River 141
Figure 11-16 Savannah River Spatial Zone DO Deltas – SUR Scenario (bottom half) 143
Figure 11-17 Middle River and Back River Spatial Zone DO Deltas – SUR Scenario (bottom half) 144
Figure 11-18 Spatial Bottom Layers Delta DO by Model Cells 145
Figure 12-1 2015 SHEP *without-project* model daily average dissolved oxygen confidence intervals at USGS 021989715 relative to freshwater flow at USGS 02198500 150
Figure 12-2 2015 SHEP *with-project* model daily average dissolved oxygen confidence intervals at USGS 021989715 relative to freshwater flow at USGS 02198500 151
Figure 12-3 2015 SHEP *without-project* model daily average dissolved oxygen confidence intervals at USGS 02198950 relative to freshwater flow at USGS 02198500 152
Figure 12-4 2015 SHEP *with-project* model daily average dissolved oxygen confidence intervals at USGS 02198950 relative to freshwater flow at USGS 02198500 153
Figure 12-5 2015 SHEP *without-project* model daily average dissolved oxygen confidence intervals at USGS 021989793 relative to water temperature at USGS 02198840 154
Figure 12-6 2015 SHEP *with-project* model daily average dissolved oxygen confidence intervals at USGS 021989793 relative to water temperature at USGS 02198840 155

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BR	Back River
BGA	Phycoerythrin blue-green algae
CBOD	Carbonaceous Biochemical Oxygen Demand
cfs	cubic feet per second
DO	dissolved oxygen
DOsat	saturated dissolved oxygen
EFDC	Environmental Fluid Dynamic Code
EIS	SHEP Final Environmental Impact Statement
Excel	Microsoft Excel
FR	Front River
GA	Georgia
GA 17	Georgia U.S. Highway 17
GA 25	Georgia U.S. Highway 25
GA DNR	Georgia Department of Natural Resources
GPA	Georgia Ports Authority
gpm	gallons per minute
GPS	geospatial positioning system
GRR	General Re-Evaluation Report
I-95	Interstate 95
lbs	pounds
lbs/day	pounds per day
LBR	Little Back River
mg/L	milligrams per liter
MLLW	mean lower low water
MR	Middle River
NH3	Ammonia
NOAA	National Oceanic and Atmospheric Administration
OneDrive	Microsoft OneDrive
Plant	Oxygen Injection Plant
ppt	parts per trillion
QA/QC	quality assurance/quality control
RM	river mile
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SELC	Southern Environmental Law Review

Acronyms/Abbreviations	Definition
SHEP	Savannah Harbor Expansion Project
SPCOND	specific conductivity
SRMC	Savannah River Maritime Commission
SUR	Startup Run
Settlement Agreement	Compromise and Settlement Agreement
SOD	sediment oxygen demand
Total Algae	Chlorophyll + Blue-green Algae
TMDL	Total Maximum Daily Load
UOD	Ultimate Oxygen Demand
U.S.	United States
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WASP	Water Quality Analysis Simulation Program
WCTE	Water Column Transfer Efficiency
WSE	water surface elevation
µg/L	micrograms per liter

1.0 INTRODUCTION

1.1 BACKGROUND

Shipping traffic within the Savannah Harbor has been an integral part of the area since well before the Revolutionary War. Bathymetric data collected in the Savannah Harbor in 1854 show that the natural depth was approximately 12 to 15 feet Mean Lower Low Water (MLLW). Since this time, it has been deepened over multiple projects to allow access to the Port of Savannah to larger ships. Prior to the Savannah Harbor Expansion Project (SHEP), the authorized depth of the federal navigation channel was 42 feet MLLW. The historical deepening projects depressed dissolved oxygen (DO) in the harbor by an estimated 1.0 milligram per liter (mg/L) due to salinity stratification and lack of vertical mixing, especially during neap tides (USEPA 2006).

The site-specific water quality standard for the Savannah Harbor requires a minimum DO concentration greater than 3.0 mg/L. DO concentrations near the bottom of the water column do not meet this criterion during the *critical period* – the warmest months of the year when DO concentrations in the river are generally at their lowest (USEPA 2006). The Savannah Harbor is unable to achieve this standard year-round, even with the removal of oxygen-demanding substances, such as wastewater discharges and nonpoint sources (USEPA 2006). The United States Environmental Protection Agency (USEPA) issued a “no discharge” DO Total Maximum Daily Load (TMDL) in 2006 (USEPA 2006), which was revised in 2010 to require no more than a 0.10 mg/L deficit from the “natural” DO value and set allowable loads for Ultimate Oxygen Demand (UOD) (USEPA April 2010). Natural UOD background load sources enter the harbor from several points: upstream from the Savannah River, adjacent marshes in the estuary, and downstream at the Atlantic Ocean (USEPA April 2010).

The SHEP Final Environmental Impact Statement (EIS) described the need for the deepening project. At 42 feet MLLW, the Savannah Harbor was too shallow for over 70 percent of vessels to enter at their maximum capacity or design draft. Container vessels needed to be ‘light loaded’, which increased costs to the ocean carrier, freight logistics, and the consumer (USACE 2012a). As part of the Final General Re-evaluation Report (GRR), the United States Army Corps of Engineers (USACE) evaluated a wide range of alternatives to address navigational constraints in the harbor, and the analysis determined that channel deepening was the only way to address navigational issues (USACE 2012b). The SHEP currently being implemented involves deepening the Savannah Harbor federal shipping channel from 42 feet by an additional five feet to its authorized depth of 47 feet MLLW. Once complete, this deepening will produce substantial economic benefits for the nation by enabling larger and more heavily loaded vessels to call on the harbor with fewer tidal delays.

Exhaustive engineering and environmental studies were undertaken in the initial project planning stages through EIS development to identify the environmental impacts that would be expected from the project and ensure those impacts would be offset through mitigation. Environmental mitigation features include installation of an oxygen injection system, constructing a fish bypass upstream at the New Savannah Bluff Lock and Dam, rerouting freshwater flow in the upper harbor, preserving 2,245 acres of freshwater wetlands for the Savannah National Wildlife Refuge, and recovering remnants of the *CSS Georgia* civil war ironclad that rested some 40 feet MLLW below the river's surface.

One of the major environmental impacts from SHEP was the proposed impact on water quality by potentially further decreasing DO concentrations in the Savannah River and estuary during the critical warm summer months (USACE 2012a). The primary mitigation feature designed to offset and mitigate potential decreases in DO caused by navigation channel deepening was the installation of an oxygen injection system. This system contained two oxygen injection plants (Upriver plant and Downriver plant) and three discharge locations (Upriver, Front River, Back River)

with a requirement to inject super-oxygenated water into the Savannah River and estuary during the critical period (Compromise and Settlement Agreement 2013, USACE 2012a, USACE 2012b).

Two successful test operations of the oxygen injection system, known as the Test Run and Startup Run (SUR), were required to demonstrate the success of the DO mitigation for SHEP. A summary of the 2019 Test Run is presented in Section 1.5 and the 2020 SUR is introduced in Section 1.6.

1.2 THE SAVANNAH RIVER AND ESTUARY

The Savannah River and estuary is a complex hydrodynamic and water quality system. To understand the dynamics of the estuary and how oxygen injection impacts the DO regime, an understanding of how the Savannah River and estuary behaves is needed, particularly in the critical summer period when DO concentrations are at their lowest.

During summer months, estuaries in the southeastern United States naturally have low DO concentrations due to higher water temperatures, higher salinity concentrations, and lower freshwater flows. The range of DO values within the Savannah estuary is dependent on three primary driving forces:

- Freshwater flow from upstream sources, measured at the United States Geological Service (USGS) Clyo gage, influences saltwater intrusion. Lower freshwater flows result in saline and brackish water extending farther upriver.
- Semi-diurnal tides move water upstream (flood tide) and downstream (ebb tide) in the harbor approximately twice a day.
- Neap and spring tides are driven by lunar cycles. Neap tides have less tidal amplitude (difference between high and low water levels) and less energy to mix vertically, resulting in harbor stratification with higher salinity and lower DO in the bottom waters. Spring tides have larger tidal amplitude, and due to the increased energy, the harbor tends to destratify and mix well through the entire vertical water column.

The Savannah River and estuary is comprised of six estuarine regions, which influence the DO concentrations throughout the estuary, especially in the critical summer months. These six regions are presented in ***Figure 1-1*** and described below.

1. An upstream riverine portion, which starts upstream at the USGS gage at Clyo (River Mile [RM] 45) and flows down to the Interstate 95 (I-95) bridge (RM 27.8). This zone is almost wholly fresh water as saline tidal waters do not usually extend upstream beyond the I-95 bridge. However, it is tidally impacted as the incoming tide slows down the river's flow, causing water levels to rise and fall, approximately 1.0 foot, with the tides. During summertime low flows (below 10,000 cubic feet per second (cfs)), DO levels on average start at 7.0 mg/L measured at the Clyo gage, and decrease to approximately 6.0 mg/L at the I-95 bridge due to lower reaeration caused by the slower flows and the influxes of low DO water from side tributaries and marsh areas.
2. A transition zone starts around the I-95 bridge (RM 27.8) and ends between United States (U.S.) Highway 25 (Georgia [GA] 25) and the turning basin (RM 19). This zone is mainly fresh water during periods of high flows (above 20,000 cfs) and brackish to saline water during the lower flows. During summer low flows, the average DO concentration decreases from 6.0 mg/L to 3.0 mg/L through this transition zone due to a variety of factors. The river's reaeration rate is lower due to slower velocities, sediment oxygen demand (SOD) rates are higher due to more solids settling to the bottom, and the higher salinity water has a lower capacity to hold DO.

3. The inner harbor navigation channel on the Front River runs from the turning basin (RM 19) downstream to Fort Pulaski (RM 0). Salinities vary from approximately 1.0 to 32.0 parts per trillion (ppt) depending on the magnitude of upstream freshwater flows. The Front River is typically stratified with lower DO and salinity concentrations in the lower half of the water column and higher DO and salinity concentrations in the upper half. However, during spring tides, when the tides are the highest, the system becomes destratified whereby the upper and lower layers mix resulting in uniform DO and salinity values top to bottom. Once the regular tidal regime is returned, so too is the stratification.

4. The outer harbor navigation channel extends from Fort Pulaski (RM 0) to approximately 20 miles offshore. The incoming tidal flows range from 150,000 to 400,000 cfs during flood tides and outgoing flows range from 200,000 to 450,000 cfs during ebb tides. This zone delivers high salinity water into the inner harbor navigation channel, along with average summertime DO concentrations of 5.0 mg/L in the top half of the water column and 3.0 mg/L in the lower half.

5. The Back, Little Back, and Middle Rivers form a complex side river system. The upper portion connects to the main channel of the Savannah River around RM 26. There are two further connections to the Front River at RM 20 and RM 12. High DO fresh water enters the upper portion and then mixes with the lower DO and high salinity water that enters on flood tides, through the lower connections. This mixing typically occurs around the GA 25 bridges but varies dependent on flows and tidal conditions.

6. Large areas of tidally impacted freshwater and saltwater marshes and their associated tributaries deliver lower DO water to the system, as identified above in the upstream riverine portion. The amount of low DO water discharged from these marshes is dependent on the rainfall in the area and the amount of tidal intrusion into the marsh area.

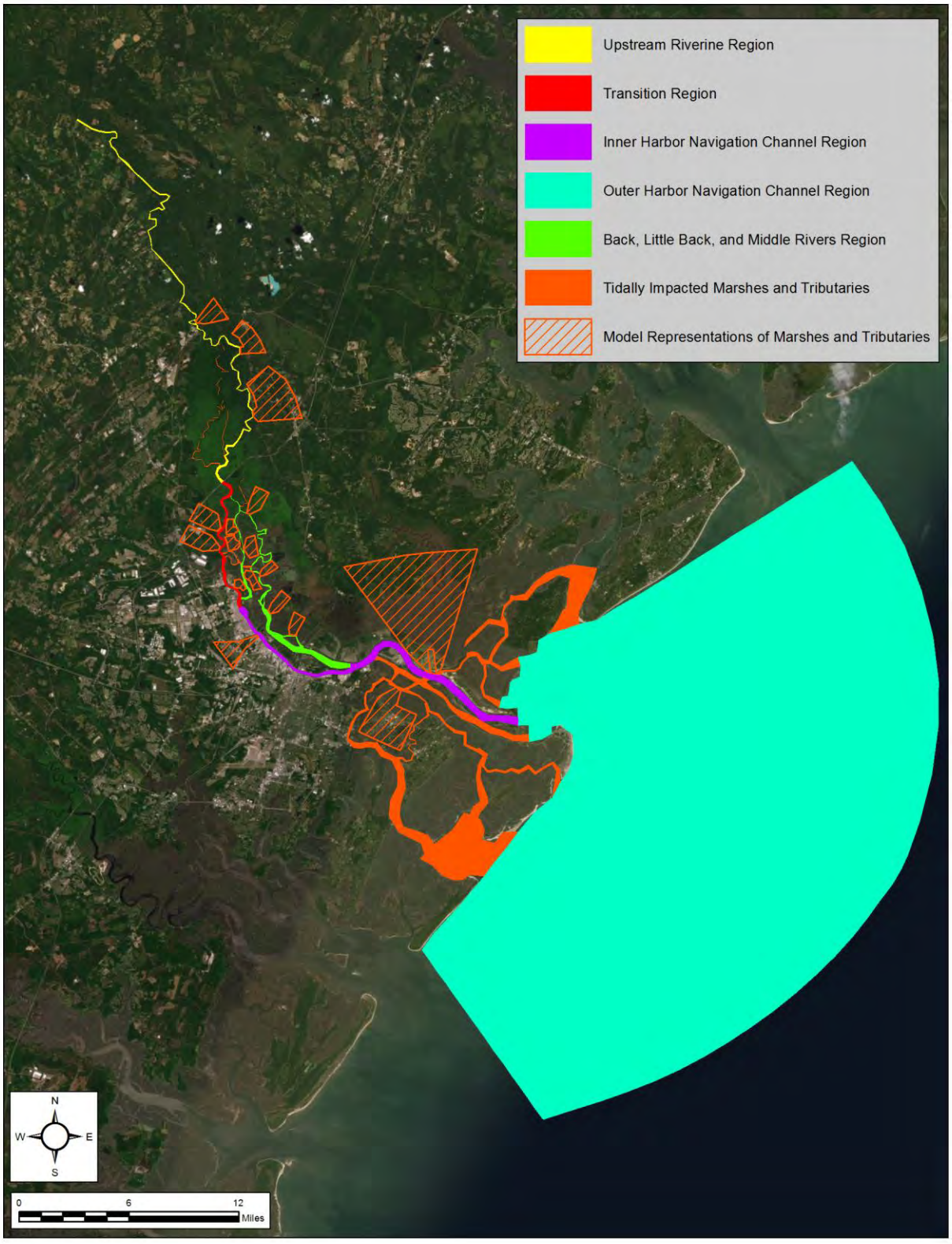

Figure 1-1 The Savannah River and Estuary

To lesser degrees, point source wastewater discharges and water withdrawals also impact the DO of the estuary. The states of Georgia and South Carolina have strict permitting processes to ensure individual and overall compliance.

A typical summertime DO transect of the entire estuary for both the surface waters and bottom waters, without oxygen injection, is presented in ***Figure 1-2***.

The deepening of the navigation channel from 42 to 47 feet MLLW allows for additional lower DO and higher salinity tidal flows to enter the estuary causing the estuaries' DO to be slightly lowered. The Upriver and Downriver plants were designed to mitigate this lowering of the DO during the critical summertime period.

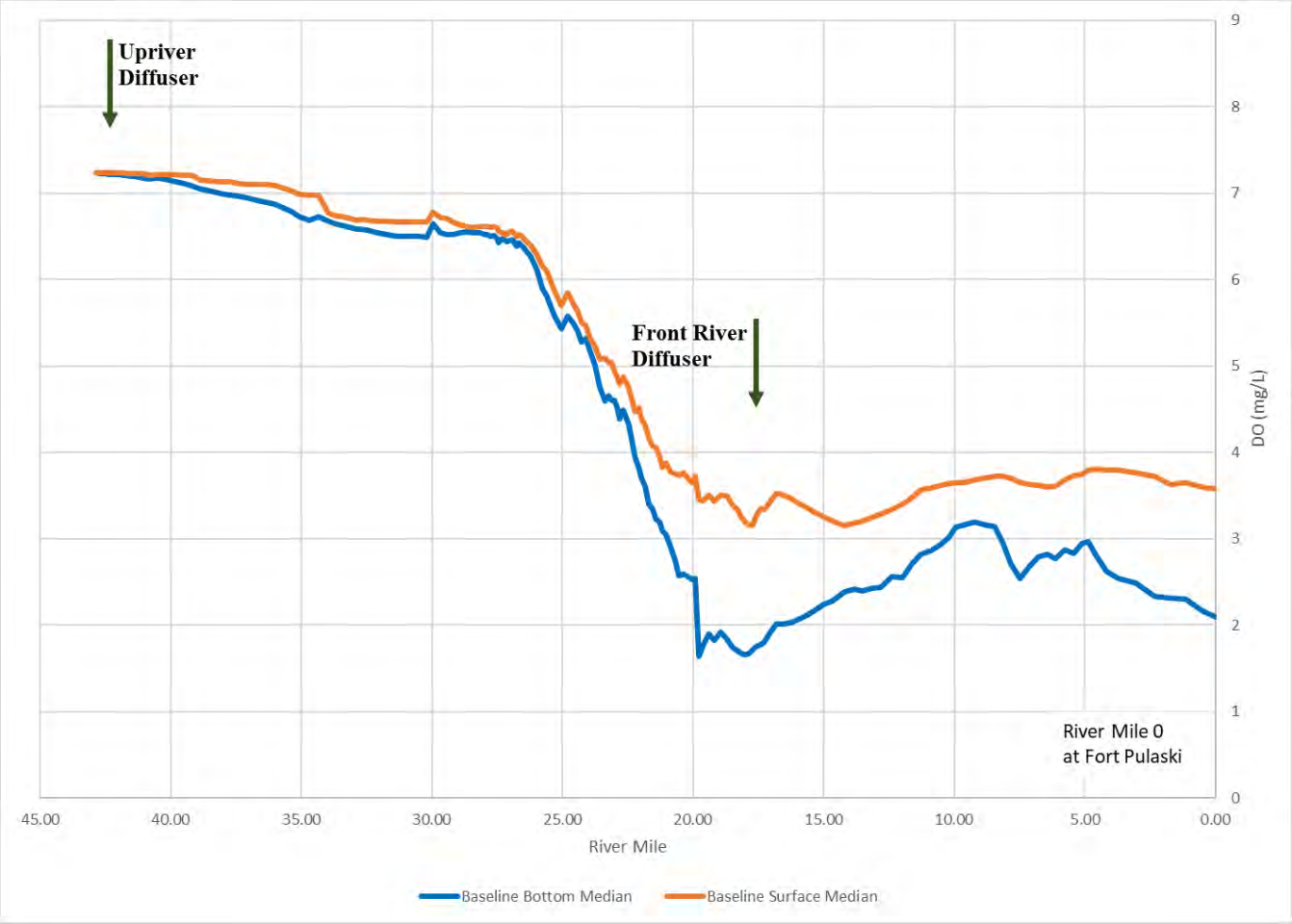

Figure 1-2 Savannah River and Estuary Average Summertime DO Transect

1.3 STAKEHOLDERS

A large group of stakeholders have been involved in the SHEP since its inception and will continue to be involved throughout the project. Collectively, these stakeholders are referred to in this report as *the agencies*. The agencies are made up of the resource agencies and parties of the Compromise and Settlement Agreement (Settlement Agreement) as identified in ***Table 1-1***. The agencies provided input and approval of key stages of the SHEP, including the development of the EIS and the Settlement Agreement (USACE 2012a, Compromise and Settlement Agreement 2013).

Table 1-1 Stakeholders Involved in SHEP, Collectively Known as the Agencies

Resource Agencies	Parties of the Settlement Agreement
U.S. Fish and Wildlife Service (USFWS)	South Carolina Attorney General
National Oceanic and Atmospheric Administration (NOAA)	Southern Environmental Law Center (SELC) - representing the South Carolina Coastal Conservation League, Savannah Riverkeeper, and South Carolina Wildlife Federation
USEPA	SCDHEC
South Carolina Department of Natural Resources (SCDNR)	Savannah River Maritime Commission (SRMC)
South Carolina Department of Health and Environmental Control (SCDHEC)	Georgia Ports Authority (GPA)
Georgia Department of Natural Resources (GA DNR)	USACE
USGS	

1.4 OXYGEN INJECTION SYSTEM

The oxygen injection system is made up of two plants that withdraw raw river water from the Savannah River, super-oxygenate the water, and then discharge the water back to the river. To super-oxygenate the water, high-purity oxygen gas is generated on-site at each plant and injected into water withdrawn from the river water using “Speece” cones, named after the inventor, Dr. Richard Speece. This super-oxygenated water is then returned to the river and mixes with the ambient river water, resulting in elevated DO levels.

The Upriver plant is in Rincon, Georgia (GA), in Effingham County, as presented in ***Figure 1-3*** and ***Figure 1-4***, and has the following characteristics:

- Eight Speece cones (during operation, seven are active and one is on reserve)
- One intake from the Savannah River
- One discharge pipe into the Savannah River
- Target oxygen production of 28,000 pounds per day (lbs/day)
- Target water flow of 70,490 gallons per minute (gpm)

The Upriver plant was designed to increase Upriver DO concentrations as well as in downstream regions. The impact of the Upriver plant is relatively easy to discern due to unidirectional flow, lack of tidal influence, and the confined nature of the upper Savannah River. It can be quantified by comparing background DO concentrations

upstream of the Upriver plant diffuser to the DO concentrations measured downstream of the diffuser.

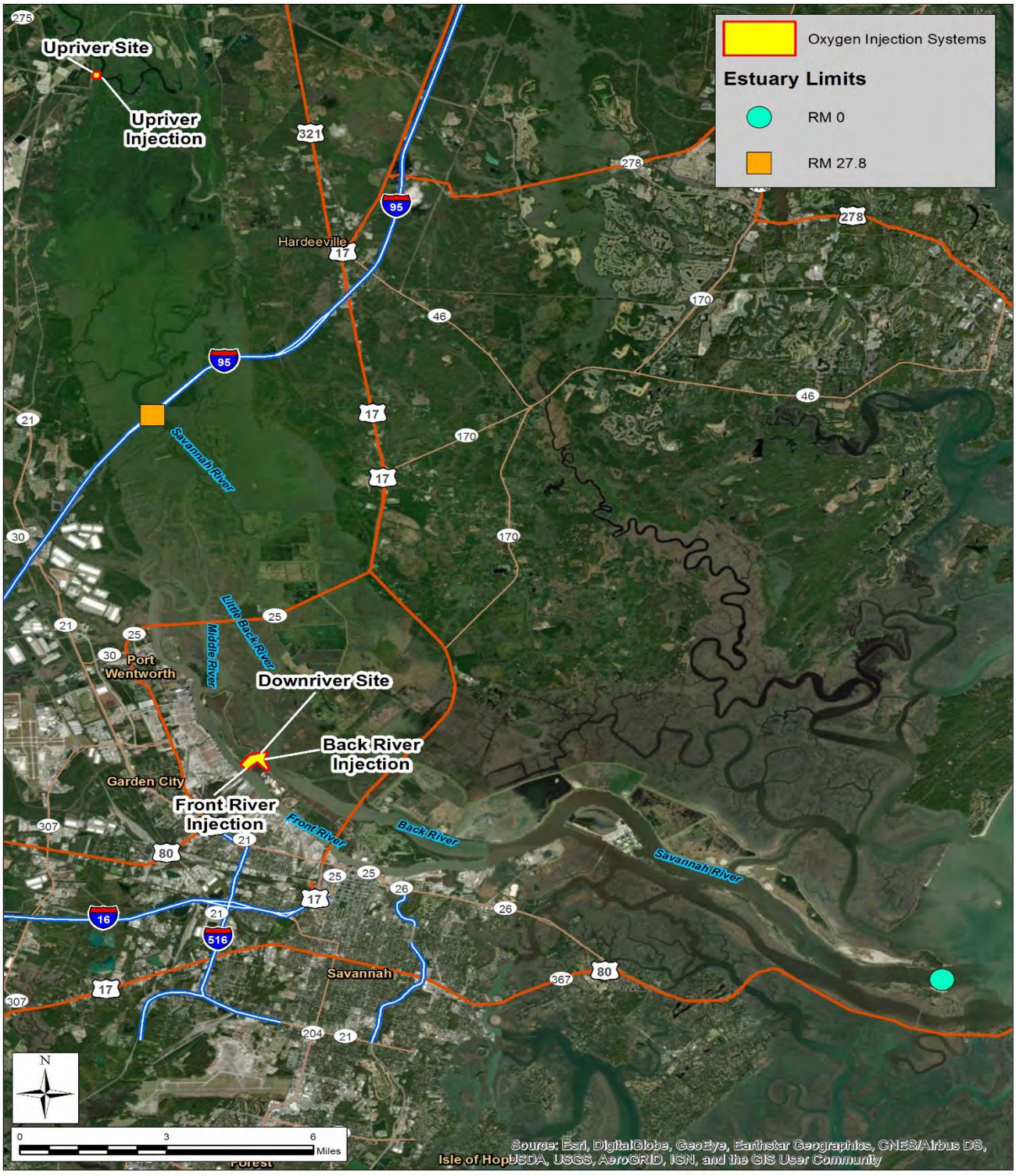

Figure 1-3 Oxygen Injection Plant Locations and Other Important Startup Run Features



Figure 1-4 Upriver Oxygen Injection Plant

The Downriver plant is located on Hutchison Island, GA, in Chatham County, as presented in ***Figure 1-3*** and ***Figure 1-5***, and has the following characteristics:

- Four Speece cones (during operation, three are active and one is on reserve)
- One intake from the Front River
- Two discharge pipes, one to the Front River and one to the Back River
- Target oxygen production of 12,000 lbs/day (8,000 lbs/day to the Front River, 4,000 lbs/day to the Back River)
- Target water flow of 30,210 gpm (20,140 gpm to the Front River, 10,070 gpm to the Back River)



Figure 1-5 Downriver Oxygen Injection Plant

The Downriver plant was designed to increase DO concentrations throughout the inner harbor navigation channel and the Back, Little Back, and Middle Rivers. The impact of the Downriver plant is less easily discernable due to the bidirectional flow, the impact of tides, varying channel widths, complex side river system, and other SHEP mitigation features including the McCoy's Cut freshwater flow rerouting. However, the impact can be quantified using a selection of independent data sources which provide corroborating conclusions.

In addition to the Speece cones and the pipes which transfer water through the plant, important equipment includes the oxygen generators which produce the high-purity oxygen before mixing in the cones, the pumps which generate the pressure to move water through the plant, and the diffusers which are the primary interface between the oxygen generation at the plant and the injection to the river.

Together the oxygen injection system is designed to deliver a daily average of 40,000 pounds (lbs) of DO to the Savannah River and estuary. The USACE started operating the Downriver plant in January 2019 and the Upriver plant in July 2020. The system will be operated seasonally during the critical summer months. The EIS requirement is to operate the injection system from June 15 through September 30, during the warmest months of the year when DO concentrations in the river are generally at their lowest (USACE 2012a).

It should be noted the diffusers at both plants were upgraded to address issues with the original design. Improvements were made at the Downriver plant on both the Front and Back River diffusers in 2019 before the Test Run to address visible localized surface disturbances. Each diffuser has multiple ports, five on the Front River and three on the Back River. Divers inspected both diffusers and noted the rubber check valves had been damaged, due to an inability to handle the high-pressure flows. The issue was addressed by capping ports in shallower water and installing replacement steel components on the deeper ports, which were able to handle the plant flows. These

improvements addressed the surface disturbance issue, allowing the injected oxygen to diffuse properly in the bottom waters and mix horizontally and vertically in the river. The learnings from 2019 were applied to the Upriver plant in 2020 prior to the SUR. None of the 11 ports on the Upriver diffuser were capped; however, new steel components replaced the rubber check valves. After the diffusers were repaired and replaced, there was no visual evidence at any of the three diffusers that oxygen was bubbling to the water surface and transferring to the atmosphere. These upgrades were completed as work in kind for the non-federal sponsor, GPA.

1.5 TEST RUN

The Test Run was a 59-day continuous run of the Downriver plant with a requirement to deliver a daily average oxygen load of 12,000 lbs/day (Compromise and Settlement Agreement 2013). The Test Run occurred from March 14 through May 12, 2019, and a report documenting the monitoring and modeling during this period was delivered (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc. 2019a). The goal of achieving a daily average of 12,000 lbs/day across the Test Run was achieved, as detailed in ***Table 1-2***.

Table 1-2 Test Run (2019) Daily Averages

Plant	Target (lbs/day)	Actual (lbs/day)
Upriver	NA	NA
Downriver	12,000	13,385
TOTAL	**12,000**	**13,385**

During the Test Run, the field team conducted monitoring on the Front River and Back River by collecting data from platform sondes, semi-permanent buoy sondes, profiling sondes, and drift sondes. Seven dye releases were performed and monitored to visually confirm the directions and migrations of the DO plumes, as well as assess the areal extents of the plumes. This information was also used by the field team to fine-tune data collection methodologies throughout the Test Run.

Results from the SHEP model scenarios indicated that during the Test Run period, the oxygen injection system produced an increase in the surface and bottom layer DO concentrations as shown in ***Table 1-3***.

Table 1-3 Test Run (2019) Modeling Results Summary

Location	Average Increase DO Concentration (mg/L)	Maximum 10th Percentile DO Concentration Increase (mg/L)
Front River (Surface Layer)	0.02	0.10
Front River (Bottom Layer)	2.35	0.15
Back River (Surface Layer)	0.14	0.22
Back River (Bottom Layer)	0.75	0.68

The Test Run Report (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc. 2019a) concluded that the analyses of both measured data and model results illustrated the Test Run was a success, for the following reasons:

1. the oxygen injection target was achieved,
2. the injected oxygen was retained within the water column, and
3. mixing of the oxygen occurred vertically and spatially through the lower portion of the Savannah River and estuary.

The Test Run also allowed the monitoring and modeling team to apply lessons learned to the SUR in 2020.

The Test Run did leave several items unanswered. The Test Run did not prove the success of the Upriver plant's operation, nor did it prove the success of both Upriver and Downriver plants operating together. It did not occur in the critical summer period, and it did not occur with the inner harbor dredging underway. The Test Run was always intended to be a precursor to the SUR.

One additional analysis on the Test Run data was undertaken after delivery of the Test Run Report, and therefore has been included in this report. This analysis relied on the independently collected and publicly available USGS dataset and is presented in Section 7.1.

1.6 STARTUP RUN

The SUR was a 59-day continuous run of both the Upriver and Downriver plants with a requirement to deliver a daily average equal to or greater than the combined design production oxygen load of 40,000 lbs/day, as specified in the EIS and GRR Appendix C (USACE 2012a, USACE 2012b). The plants were required to operate for 59 days (approximately two lunar cycles), of which at least one 29.5-day period (one lunar cycle) must have occurred in July, August, or September while the Upriver and Downriver plants were operational (Compromise and Settlement Agreement 2013). The SUR occurred from July 25, 2020, through September 22, 2020.

Similar to the Test Run, a full-scale data collection effort during the SUR was needed to determine how well the injected oxygen delivered into the Savannah River and estuary was retained, and the ability of the injected oxygen to mix vertically and spatially, to mitigate the DO impacts of SHEP. The SUR data collection was performed around the Downriver plant diffusers on the Back River and the Front River and downstream of the Upriver plant on the Savannah River. In addition to the data collected near the diffusers, hydrodynamic and water quality data from USGS stations located in the Savannah River and estuary, and oxygen injection plant data provided by the USACE, were collected, reviewed, and analyzed.

Modeling was also required to evaluate the oxygen injection system performance throughout the estuary and the water column. Specifically, model results could be used at locations where field data were collected to validate the monitoring, and at locations where field data were not collected to fill data gaps. The SHEP models have been a useful tool to predict the future conditions of a completed project. Since outer harbor dredging was completed in March 2018 and inner harbor dredging started in September 2019, there is a need to show a completed SHEP with and without oxygen injection in addition to the actual conditions in the harbor while projects are ongoing.

The purpose of the SUR monitoring and modeling was to confirm that the oxygen injection system could mitigate for the SHEP navigational channel deepening impacts from Station 0+000 upstream to RM 27.8 (Compromise and Settlement Agreement 2013). The station extents from RM 0 to 27.8 are significant because they encompass the main components of the estuary of the Savannah River. RM 0 is adjacent to Fort Pulaski at the mouth of the river and RM 27.8 is the I-95 Bridge. These two demarcations signify the upper and lower extents of the freshwater-

saltwater interface. The extent includes the Front River and South Channel near the mouth (downstream); the Front and Back Rivers near downtown Savannah; and the Front, Middle, and Little Back Rivers (upstream) (***Figure 1-3***).

Information in the EIS was used to develop success metrics that have been used to demonstrate the oxygen injection system can achieve the mitigation requirements identified in the EIS. To achieve the success metrics, a combination of monitoring and modeling efforts was required, and the subsequent analyses led to multiple lines of evidence proving the success of harbor deepening mitigation efforts. Additional detail on what quantifies SUR success and how success was achieved is presented in Section 4.0.

The SUR data collection and monitoring and modeling report were Tasks 9 and 10, respectively, of the contract between LG2 Environmental Solutions, their sub-consultants Tetra Tech and GHD, and the USACE Savannah District. SUR data collection and quality assurance/quality control (QA/QC) followed the methodology documented in Appendix A and Appendix B of the *Work Plan (REV9)* for *Dissolved Oxygen Facility Environmental Testing for the Savannah Harbor Expansion Project* (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc. 2019b). This report discusses the data collection procedures used by the field team for the SUR data collection period, data QA/QC evaluations conducted by the QA/QC team on the SUR data, and analyses of the monitoring and modeling data to demonstrate the success of the SUR.

2.0 DATA COLLECTION PROCEDURES

The SUR data collection efforts consisted of three major data collection methods which provided a comprehensive understanding of how the Front River, Back River, and Upriver areas of the Savannah River responded to the injected oxygen. These three data collection methods were:

- *Semi-permanent buoys* were deployed at targeted locations upstream and downstream of the diffusers in the Front River, Back River, and Upriver areas of the Savannah River to collect continuous water quality data. Details are provided in Section 2.1.
- *Boat collection methods* were used to obtain "Profile" and "Drift" data upstream and downstream of the diffusers to show how the injected oxygen plume mixed in the water column and where and how far it traveled in the harbor. Daily sampling events were conducted and rotated between the Front River, Back River, and Upriver areas. Details are provided in Section 2.2 and Section 2.3.
- *Periodic Rhodamine dye injections* and subsequent monitoring of dye were conducted to better determine how the DO behaved after injection at the two injection plants. Details are provided in Section 2.4.

Data collection procedures for the SUR event followed the data collection procedures that were validated during the background data collection efforts in 2018 and were similar to the procedures used during the WCTE and Test Run studies conducted in 2019. Data collection methods used from the inception of the monitoring project through 2019 included using monitoring instruments deployed by boats for targeted sampling, semi-permanent buoys at selected locations, and permanent mounts via a fixed floating platform. The data collection efforts completed for the SUR in 2020 were conducted by intensive boat sampling (up to three boats at one time) and semi-permanent buoys to allow quick responses and flexibility for tracking the general movement and behavior of the three injected oxygen plumes. Fixed floating platforms were not installed during the SUR to allow the monitoring team more flexibility with buoyed instruments and targeted sampling.

All data sondes and associated sonde sensors used for the various data collection methods were prepared and calibrated following manufacturer's specifications by field team scientists who were trained by the manufacturer's technicians and completed instrument training classes. The data sondes, according to the YSI manufacturer specifications, were capable of accurately collecting DO data to 0.01 mg/L at various intervals (up to one-second intervals). Preparation and maintenance of the data sondes were performed at the laboratory and workspaces provided by the USACE at the Army Corps Depot located on the north bank of the Savannah River on Hutchinson Island.

A visual summary of the SUR data collection effort is illustrated in ***Figure 2-1*** and a statistical summary of the collected data is in Section 2.5.

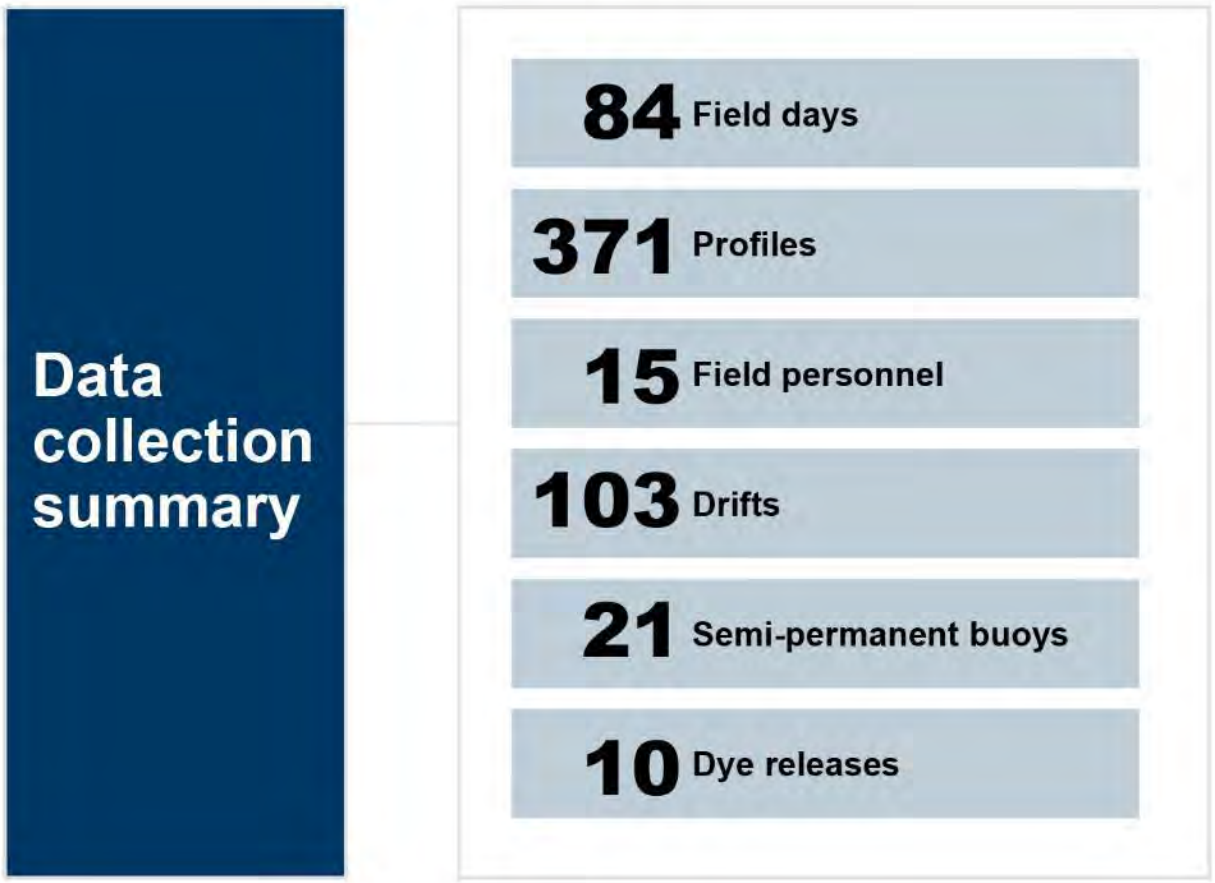

Figure 2-1 Summary of Data Collection Program

2.1 SEMI-PERMANENT BUOY MONITORING / DATA COLLECTION

During the SUR period, water quality data were collected from data sondes deployed at:

- Ten semi-permanent buoys located in the Upriver area with one buoy deployed upstream of the diffuser and nine buoys deployed downstream of the diffuser (photo of installed buoys in ***Figure 2-2*** and map in ***Figure 2-3***). These buoys are labeled UR_9 to UR_18. A sonde was also installed at the discontinued USGS Hardeeville gage (02198760), located approximately two miles downstream of the Upriver diffuser, a few weeks after data collection began to capture DO concentrations downstream and quantify the impact of low DO water entering the Savannah River from tributaries and marshes.
- Three semi-permanent buoys located in the Front River (***Figure 2-4***). These buoys are labeled LFR-A, LFR-N, and LFR-S. All three buoys were removed on July 14, 2020, due to channel dredging activities in this area and were not redeployed for SUR sampling activities. An additional sonde was deployed at USGS station 021989773 at the USACE Depot on Hutchinson Island for the duration of the SUR (***Figure 2-4***).
- Eight semi-permanent buoys located in the Back River with four buoys deployed upstream and four buoys deployed downstream of the diffuser (***Figure 2-4***). These buoys are labeled LBR_8 to LBR_1.

The data sondes and buoys were deployed by July 14, 2020, before the SUR period which began on July 25, 2020. The data sondes were fitted with DO, conductivity, temperature, depth, and salinity sensors. Several of the sondes were also equipped with Phycoerythrin Blue-green Algae (BGA) sensors and/or Rhodamine dye sensors to detect the dye injected periodically during the SUR to mimic the movement of injected oxygen.

The semi-permanent buoy data sondes were designed to be tethered in one location approximately 3.3 feet below the water's surface where they would continuously collect and record data at five-minute intervals. At two of the Upriver buoys downstream of the diffuser, UR_12 and UR_16, additional data sondes were also deployed along the mooring lines at approximately 9.8 feet below the water's surface. The deeper sondes are designated UR_12a and UR_16a, respectively. Data were retrieved from the semi-permanent buoy data sondes weekly.

Additional detail on the semi-permanent buoy data collection is presented in **APPENDIX A** and a statistical summary of the collected data is in Section 2.5. The semi-permanent buoy data is analyzed in Section 8.0 and Section 9.0.



Figure 2-2 Upriver Semi-Permanent Buoys, Looking Toward Injection Plant

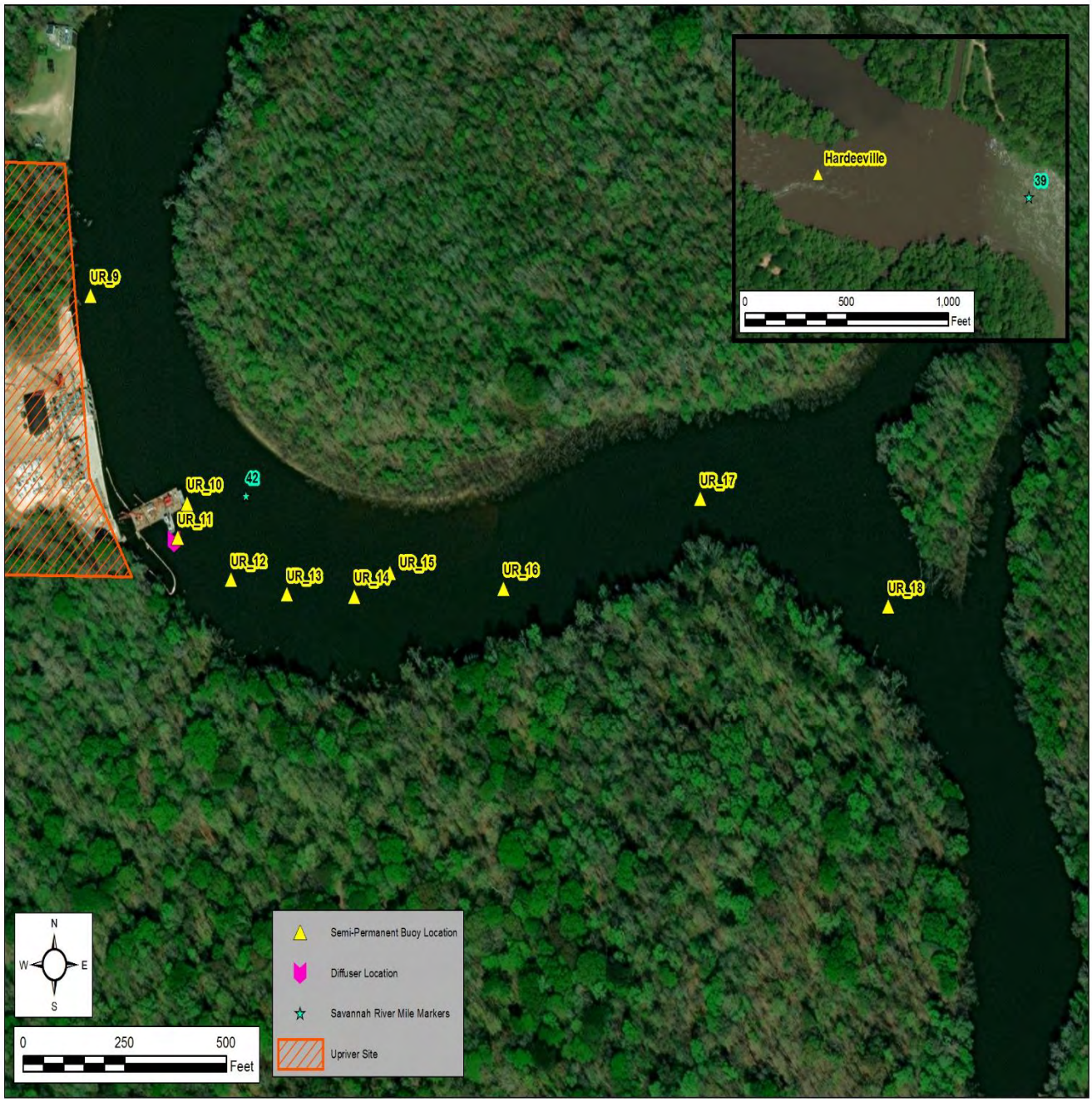

Figure 2-3 Upriver Semi-Permanent Buoy Monitoring Locations

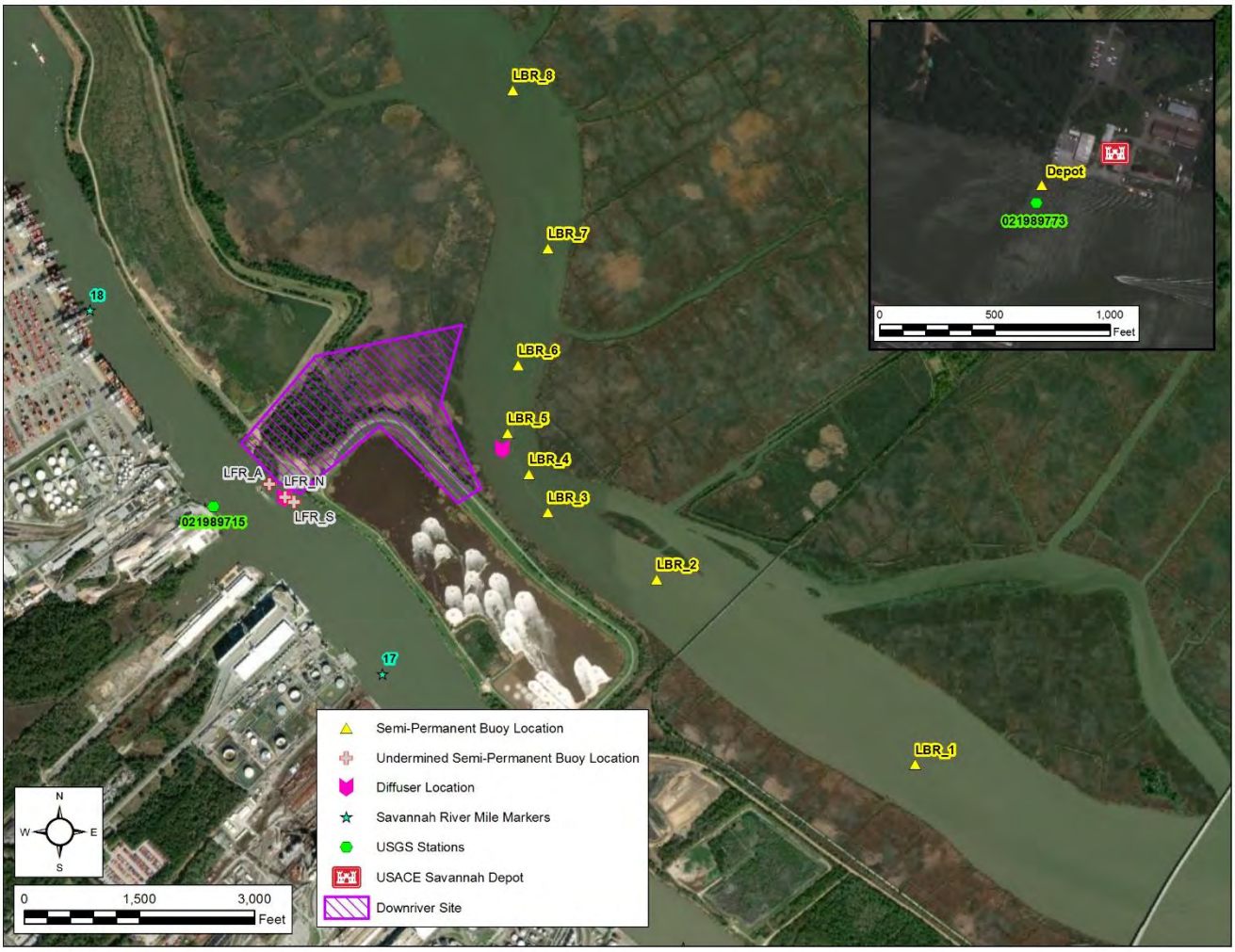

Figure 2-4 Downriver Semi-Permanent Buoy Monitoring Locations

2.2 PROFILE MONITORING / DATA COLLECTION

Profile data collection was conducted by the field team via project boats and consisted of deploying a data sonde over the side of a project boat and lowering and raising it through the water column from the water's surface to the river bottom. The data sonde was suspended 1.0 foot above the river bottom for approximately 30 seconds before raising it to the water's surface. Profile data collection locations were selected by the field team at landmark locations (semi-permanent buoys) or points of interest along the Front River, Back River, and Savannah River areas. These points of interest include various tributaries, physical features (closed channel cuts and diversion structures), and around each of the three diffusers.

Each data sonde recorded DO, DO percent saturation, salinity, specific conductivity (SPCOND), water temperature, date, time, depth, and Geospatial positioning system (GPS) locations of each measurement. Additionally, Chlorophyll and Blue-green Algae (Total Algae) sensors used to detect dye were installed on selected sondes during profiling measurements depending on the timing of dye injection events and/or the locations of the sampling events. When available, Rhodamine dye sensors were installed on several profile sondes per the instruction of the

field team leader. The BGA data was converted to an equivalent Rhodamine dye value using a conversion factor developed from the SUR information, allowing for comparable dye values. Water quality measurements were monitored using a hand-held interface device connected to the data sonde by a communication cable allowing real-time viewing of information logged by the data sondes. Profiling data were recorded at a frequency of two seconds.

A general data collection schedule was prepared before starting the SUR monitoring period that identified the dates, tidal conditions, and types of boat data collection techniques that would occur on each part of the river. However, this schedule was visited and refined weekly depending on variables such as weather conditions, data density, and interpretations of previously collected data to better meet the goals of the SUR study.

Additional detail on the profile monitoring undertaken is provided in **APPENDIX B** and a statistical summary of the collected data is in Section 2.5. The profile data is analyzed in Section 8.0 and Section 9.0.

Field notes and daily logs were prepared to document the data collection times and locations, field crew members, weather conditions, and data collection issues if any (**APPENDIX D**). 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 (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc. 2019b). 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 qualified by the QA/QC team.

2.3 DRIFT MONITORING / DATA COLLECTION

Drift data collection was conducted by the field team via project boats using multiple instruments deployed from a single boat. Typically, one or two data sondes were deployed from a boat, each deployed at different yet constant depth intervals over the side of the sampling boat. The first sonde was deployed at approximately 3.3 feet below the water's surface (shallow) and an additional sonde was deployed between 8.2 and 16.4 feet (deep) if sampling conditions allowed. Drift routes were conducted with the flow of the tide either in zig-zag patterns (roughly bank to bank), or relatively straight routes along the channel parallel to water flows. Data were collected at two-second intervals and monitored in real-time using a hand-held interface device to log the data.

The goal of the drift data collection method was to help determine the spatial and temporal variability inside and outside of detectable oxygen or dye plumes. Each data sonde recorded DO, DO percent saturation, salinity, SPCOND, temperature, date, time, and depths of measurements. Total Algae and Rhodamine dye sensors were installed on various data sondes as needed.

Additional detail on the drift monitoring undertaken is provided in **APPENDIX C** and a statistical summary of the collected data is in Section 2.5. The drift data is analyzed in Section 8.0 and Section 9.0.

2.4 DYE RELEASES AND MONITORING

Rhodamine WT dye injection and tracking were conducted in the Front River, Back River, and Savannah River areas before and during the SUR data collection event. Rhodamine WT dye is a stable, non-toxic, fluorescent, xanthene dye routinely used as a hydrologic tracer in surface water systems and was used to track where the injected flow and the associated oxygen travels. This dye was detected by data sondes equipped with fluorometers and assisted with locating and tracking the DO plumes. This dye has been used in hydrologic studies for decades since the dye has a similar molecular structure to water. The standard procedure in dye fluorometry hydrologic studies is to introduce a quantity of dye into a water body, and subsequently collect water samples over some spatial and temporal regimes. Fluorometer readings show the concentration of the dye that is proportional to its fluorescence. Since this dye mimics the movement of water molecules, a measure of the movement of the dye (i.e.,

Rhodamine WT) will in effect be a measure of the movement of the water and, therefore, substances transported by the water (i.e., dissolved oxygen) into which it is introduced. Typically, dispersion and mixing occur in all dimensions of the water body. For example, in streams, vertical mixing typically occurs first. Subsequently, and depending on current, channel configuration, and stream characteristics, lateral mixing and longitudinal mixing follow. For other bodies, the sequence of the mixing phenomena may vary, but the mixing principle remains.

The dye was injected into discharge pipes at both DO plants at designated ports using a stainless steel drum pump powered by a 120-volt electric motorhead and fitted with an impeller that could completely pump the contents of a container. Dye injection was regulated at the drum pump with a one-inch ball valve and electronic flow meter to deliver the dye into the discharge pipes at approximately 3.0 gpm. ***Table 2-1*** provides the dates, times, injection areas of the river, tide conditions, dye strengths, and dye volumes used for the SUR event dye releases. An aerial photo of the Front River dye release on August 25, 2020, is presented in ***Figure 2-5***.

The dye releases were used to track the behavior of the injected DO plumes, the potential areal and vertical extents of plumes, as well as how quickly the dye and therefore the DO mixed throughout the waterbody during varying flow and tidal conditions. The dye was monitored instream using both Rhodamine dye and BGA sensors. The BGA data was converted to an equivalent Rhodamine dye value by multiplying by a factor of 0.088. This is based on a regression analysis comparing BGA to Rhodamine dye measurements. Both the Rhodamine dye and converted BGA values are referred to as dye for the remainder of the report.

Due to development by the manufacturer and timing of the release to commercial markets, only BGA sensors were available for the July 2020 dye releases. The Rhodamine dye sensors were still in the development stage; however, upon availability, the preferred Rhodamine sensors were used thereafter. Thirty gallons of undiluted (full strength) dye were injected at all three diffusers on July 15 and July 16, 2020, such that it would be detectable at the three USGS gage BGA sensors at Savannah River near I-95 (USGS 02198840), Back River at U.S Highway 17 (GA 17) (USGS 0219897945), Little Back River at Hog Island (USGS 021989793), and the BGA sensor at the USACE Depot (USGS 021989773). Rhodamine dye sensors were available and installed for the August 10 through August 12, 2020, and remaining SUR dye events. Lower dye concentrations, at one-third full strength, were used for the August 10 through August 12 dye events, to examine the near-field dilution of the dye around the diffusers and to help develop a BGA-Rhodamine dye relationship. A super dye event was conducted from August 24 through August 25, 2020. The purpose of this study was to assess how long the dye would remain in the Front and Little Back Rivers. Sixty gallons of full-strength dye were injected at each diffuser so the dye could be measured and tracked for approximately three to four weeks after release. On September 15, 2020, 45 more gallons were injected at the Upriver plant only to see how the Upriver dye (and therefore oxygen) in isolation (without influence from the Downriver plant), mixed into the Front River.

The dye releases are analyzed in Section 10.0.

Table 2-1 SUR Dye Releases and Locations

Date	Time	River	Tide	Dye Strength	Dye Volume (gallons)
15-Jul-20	10:30	Upriver	N/A	Full	30
16-Jul-20	09:50	Back	13:49 L	Full	30
16-Jul-20	11:07	Front	13:49 L	Full	30
10-Aug-20	10:00	Upriver	N/A	1:3	30
11-Aug-20	09:00	Front	08:40 L	1:3	30
12-Aug-20	10:00	Back	09:31 L	1:3	30
24-Aug-20	10:00	Upriver	N/A	Full	60
25-Aug-20	08:45	Front	08:29 L	Full	60
25-Aug-20	09:45	Back	08:29 L	Full	60
15-Sep-20	08:54	Upriver	N/A	Full	45



Figure 2-5 Dye Plume from Front River Diffuser Near Downriver Plant

2.5 STARTUP RUN DATA SUMMARY

Data were collected from July 7 through September 30, 2020, in the Upriver, Front River, Middle River, and Back and Little Back River, with limited data collected in the first two weeks and for the final week of fieldwork given these were outside of the SUR period. As previously mentioned, the three types of data collection procedures were:

- Drift data collection using a surface sonde (~3.3 feet deep) and at times an additional mid-depth sonde,
- Profile depth data collections at set points in the river, and
- Semi-permanent buoys located around the diffusers.

The main parameters that were collected are:

- DO in mg/L
- Dissolved Oxygen Saturation (DOsat) in percent
- Salinity in ppt
- Temperature in degrees Celsius
- Rhodamine dye in micrograms per liter (µg/L)
- BGA (algal) in relative fluorescence units – this is before conversion to dye in µg/L
- SPCOND

During the field data collection, no effervescence or bubbling was observed above or in the vicinity of the three diffusers.

2.5.1 Upriver Data Summary

Upriver data were collected at 13 sondes and during 62 drift and 30 profile sampling events.

2.5.1.1 Upriver Buoy Data

Thirteen sondes were deployed. Of the 10 semi-permanent buoys, eight had one surface sonde and two had an additional mid-depth sonde. One additional sonde was deployed at the discontinued USGS Hardeeville station (02198760), approximately two miles downstream of the diffuser.

The Upriver buoy upstream of the oxygen injection plant was installed on July 7, 2020, the semi-permanent Upriver buoys downstream of the diffuser were installed on July 9 and 10, 2020, and the Hardeeville sonde on July 15, 2020. ***Table 2-2*** provides a summary of the Upriver buoy data.

Table 2-2 Upriver Buoy Data

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	6.1	6.5	6.9	7.3	7.7	8.0	8.1	280,194	5.6	8.6
DO saturation (%)	76	79	86	92	97	102	105	280,194	65	110
Salinity (ppt)	0.02	0.0	0.0	0.0	0.0	0.0	0.0	280,194	0.0	0
Temp_C (°C)	22	22	27	28	28	29	30	280,194	21	30
BGA_R (RFU)	0.1	1.3	1.7	2.0	2.3	2.7	3.3	39,105	0.0	158
Sp_Cond	55	61	71	77	85	92	95	280,194	21	99

Notes: PCTL – percentile, Min – minimum, Max – maximum

2.5.1.2 Upriver Drift Data

Upriver drift data was collected during the SUR. The drift routes ranged from:

- Detailed sampling around the diffuser,
- Drift sampling upstream of diffuser to one to four miles downstream of the diffuser, and
- Two drift routes from the diffuser to the I-95 bridge.

Table 2-3 provides a summary of the Upriver drift data.

Table 2-3 Upriver Drift Data Summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	6.06	6.34	6.69	7.33	7.61	7.84	8.01	97,452	5.90	8.72
DO saturation (%)	76.5	80.6	84.4	92.45	96.09	99.59	101.3	97,452	73.2	107.7
Salinity (ppt)	0.03	0.03	0.03	0.04	0.04	0.04	0.04	97,452	0	0.05
Temp_C (°C)	23.46	25.53	27.36	27.60	27.87	29.15	29.2	97,452	23.43	29.29
BGA_R (RFU)	1.275	1.38	1.61	1.98	2.5	112.77	157.01	87,941	1.22	158.6
Dye (µg/L)	0.02	0.02	0.03	0.04	2.29	16.65	39.16	40,167	0.02	107.07
Sp_Cond	65	72	74	78	86	94	97	97,452	0	111

Notes: PCTL – percentile, Min – minimum, Max - maximum

The Upriver drift DO data sampling can be divided into three areas:

- Background sampling above the diffuser,
- Oxygen injection impact sampling below the diffuser, and
- Tributary sampling.

Comparing the background DO to the DO downstream from the diffuser shows the overall impact of the injected oxygen. The low DO values from tributaries explain why the DO levels decrease as the river flows down to the I-95 bridge. This comparison is presented in Table 2-4.

Table 2-4 Upriver Background Below Diffuser and Tributary Drift Data Comparison

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	6.06	6.34	6.69	7.33	7.61	7.84	8.01	97,452	5.90	8.72
DO (mg/L)	6.38	6.62	7.26	7.54	7.75	8.01	8.17	195,498	5.61	8.59
DO (mg/L)	4.64	4.87	5.51	5.65	5.79	5.88	5.9	648	4.61	5.9

2.5.1.3 Upriver Profile Data

Upriver profile data was collected during the SUR. Profile data sampling was conducted around the diffuser and buoys to evaluate whether the oxygen was mixing throughout the water column. ***Table 2-5*** provides a summary of the Upriver profile data.

Table 2-5 Upriver Profile Data Summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	6.69	7.07	7.86	7.99	8.02	8.19	8.31	5,287	6.66	9.00
DO saturation (%)	83	90.01	99.7	100.3	100.9	103	104.6	5,287	82.6	115.73
Salinity (ppt)	0.03	0.03	0.04	0.04	0.04	0.04	0.05	5,287	0	0.05
Temp_C (°C)	26.34	26.36	27.03	27.05	27.06	28.40	29.31	5,287	24.73	29.34
BGA_R (RFU)	1.61	1.93	2.33	10.61	84.11	156.96	158.28	5,287	0.54	158.42
Dye (µg/L)	0.04	0.04	0.29	1.92	7.50	35.68	53.03	3,979	0.03	70.27
Sp_Cond	74	76	84	97	98	98	99	5,287	2	99

Notes: PCTL – percentile, Min – minimum, Max – maximum

2.5.2 Front River Data Summary

Front River data were collected at one sonde and during 30 drift and 305 profile sampling events.

2.5.2.1 Front River Buoy Data

Three Front River buoys were deployed on July 9, 2020, but had to be removed on July 14, 2020, due to ongoing dredging activities in the area. A sonde was also deployed at the USACE Depot Dock on July 9, 2020, and removed on September 28, 2020. ***Table 2-6*** provides a Front River buoy data summary.

Table 2-6 Front River Buoy Data Summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	2.4	2.8	3.3	3.8	4.4	5.6	6.0	27,390	1.5	6.5
DO saturation (%)	32.7	38.0	45.4	51.6	58.5	71.0	77.5	27,390	20.6	86.8
Salinity (ppt)	1.5	2.7	5.6	7.4	9.9	13.5	16.2	27,390	0.6	20.2
Temp_C (°C)	23.0	23.6	28.2	28.9	29.5	30.2	30.6	27,390	22.7	31.1
BGA_R (RFU)	0.03	0.03	0.04	0.05	0.06	0.10	0.14	15,905	0.02	0.52
Dye (µg/L)	1.0	1.2	1.7	2.1	2.6	3.4	4.8	13,062	0.8	98.1
Sp_Cond	2,823	5,052	10,033	12,961	16,945	22,473	26,612	27,390	1,269	32,540

Notes: PCTL – percentile, Min – minimum, Max - maximum

2.5.2.2 Front River Drift Data

Front River drift data was collected during the SUR. The drift routes ranged from:

- Detailed sampling around the diffuser, and
- Drift sampling ranging from the I-95 bridge (RM 27) to Fort Pulaski (RM 0).

Table 2-7 provides a summary of the Front River drift data.

Table 2-7 Front River Drift Data Summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	1.9	2.4	3.6	4.3	5.2	6.9	7.8	171,770	0.1	8.2
DO saturation (%)	26.0	33.5	48.2	57.9	67.8	86.8	97.3	171,770	1.3	101.9
Salinity (ppt)	0.0	0.1	1.8	3.8	6.1	9.9	15.9	171,770	0.0	30.4
Temp_C (°C)	25.9	26.4	27.5	28.7	29.3	29.8	29.9	171,770	25.6	30.5
BGA_R (RFU)	0.03	0.04	0.05	0.07	0.12	3.55	38.06	117,693	0.02	182.33
Dye (µg/L)	1.5	1.9	2.3	2.8	3.7	24.4	151.6	149,061	0.5	159.0
Sp_Cond	89	102	3,510	6,954	10,844	16,894	26,068	171,770	5	46,934

Notes: PCTL – percentile, Min – minimum, Max - maximum

2.5.2.3 Front River Profile Data

Front River profile data was collected during the SUR. ***Table 2-8*** provides a summary of the Front River profile data.

Table 2-8 Front River Profile Data Summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	1.9	2.4	3.6	4.3	5.1	6.0	6.7	164,281	0.1	9.0
DO saturation (%)	25.4	33.6	47.8	57.1	66.3	77.4	86.0	164,281	1.3	101.5
Salinity (ppt)	0.1	0.6	2.4	4.2	6.5	12.9	25.4	164,281	0.0	33.5
Temp_C (°C)	23.4	26.8	27.7	28.8	29.3	29.8	29.9	164,281	19.5	30.5
BGA_R (RFU)	0.03	0.04	0.05	0.07	0.12	4.63	40.18	110,208	0.02	182.33
Dye (µg/L)	1.5	1.9	2.4	2.9	3.8	26.5	151.9	144,192	-3.8	159.0
Sp_Cond	355	1,293	4,396	7,374	10,995	16,789	26,359	156,122	5	46,934

Notes: PCTL – percentile, Min – minimum, Max - maximum

The Front River is a stratified estuarine system, with lower salinity values in the upper half of the water column and higher salinity values in the bottom half. All Front River profile data were separated into upper half (depth less than 16.4 feet) shown in ***Table 2-9*** and bottom half (depth greater than or equal to 16.4 feet) shown in ***Table 2-10***.

Table 2-9 Front River (Upper Half) Data Comparison

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	2.4	3.1	4.0	4.5	5.2	6.0	6.7	104,066	0.1	8.1
DO saturation (%)	33.5	42.4	53.2	59.8	67.5	77.5	85.8	104,066	1.7	101.0
Salinity (ppt)	0.1	0.5	2.2	3.8	5.8	8.9	14.8	104,066	0.0	22.9
Temp_C (°C)	26.5	27.0	28.3	28.8	29.3	29.7	29.9	104,066	26.1	30.5
BGA_R (RFU)	0.03	0.04	0.05	0.07	0.14	8.07	53.19	75,237	0.02	182.33
Dye (µg/L)	1.4	1.8	2.2	2.8	3.8	56.4	154.8	88,498	0.5	159.0
Sp_Cond	240	1,073	4,216	6,930	10,258	15,275	24,489	104,066	5	36,467

Notes: PCTL – percentile, Min – minimum, Max - maximum

Table 2-10 Front River (Bottom Half) Data Comparison

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	1.2	1.9	2.8	3.3	3.9	5.2	6.6	28,879	0.1	6.8
DO saturation (%)	16.5	26.2	38.1	45.2	51.9	67.2	86.0	28,879	1.3	88.4
Salinity (ppt)	0.2	1.8	3.8	5.7	7.6	10.6	24.1	28,879	0.1	30.4
Temp_C (°C)	27.2	27.7	29.0	29.3	29.6	29.9	30.0	28,879	26.8	30.1
BGA_R (RFU)	0.04	0.04	0.06	0.08	0.10	0.70	18.54	26,812	0.03	76.09
Dye (µg/L)	1.6	2.1	2.7	3.3	4.2	17.5	104.0	28,118	1.3	157.1
Sp_Cond	387	3,396	6,896	10,133	13,209	18,016	38,195	28,879	170	46,934

Notes: PCTL – percentile, Min – minimum, Max – maximum

2.5.3 Back River Data Summary

Back River data were collected at eight sondes and during 32 drift and 36 profile sampling events.

2.5.3.1 Back River Data Summary

Eight buoys were deployed in the Back River, all with surface sondes. Four sondes were located upstream and four were located downstream of the diffuser. The Back River buoy sondes were installed on July 9, 2020. ***Table 2-11*** provides a summary of the Back River buoy data.

Table 2-11 Back River Buoy Data Summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	3.1	3.7	4.6	5.2	5.6	6.4	7.1	174,433	0.7	9.7
DO saturation (%)	41.9	50.3	60.3	66.9	72.8	85.2	95.6	174,433	9.2	132.5
Salinity (ppt)	0.1	0.1	0.8	3.1	5.5	9.7	12.7	174,433	0.0	17.9
Temp_C (°C)	22.0	23.4	27.9	29.0	29.7	30.6	31.0	174,433	20.9	32.1
BGA_R (RFU)	2.0	2.4	3.3	4.4	6.4	9.9	14.0	44,210	1.4	153.9
Sp_Cond	127	227	1,662	5,835	9,821	16,663	21,299	174,433	82	29,089

Notes: PCTL – percentile, Min – minimum, Max - maximum

2.5.3.2 Back River Drift Data

Back River drift data was collected during the SUR. The drift routes ranged from:

- Detailed sampling around the diffuser,
- Drift sampling ranging from GA 25 bridge to downstream confluence with Front River, and
- Drift sampling of all the Back and Little Back Rivers from upstream confluence to downstream confluence with Front River.

Table 2-12 provides a summary of the Back River drift data.

Table 2-12 Back River Drift Data Summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	3.1	3.7	4.6	5.2	5.6	6.4	7.1	174,433	0.7	9.7
DO saturation (%)	41.9	50.3	60.3	66.9	72.8	85.2	95.6	174,433	9.2	132.5
Salinity (ppt)	0.1	0.1	0.8	3.1	5.5	9.7	12.7	174,433	0.0	17.9
Temp_C (°C)	22.0	23.4	27.9	29.0	29.7	30.6	31.0	174,433	20.9	32.1
BGA_R (RFU)	2.0	2.4	3.3	4.4	6.4	9.9	14.0	44,210	1.4	153.9
Sp_Cond	127	227	1,662	5,835	9,821	16,663	21,299	174,433	82	29,089

Notes: PCTL – percentile, Min – minimum, Max - maximum

2.5.3.3 Back River Profile Data

Due to relatively shallow channel depths, limited Back River profile data were collected during the SUR. ***Table 2-13*** provides a summary of the Back River profile data.

Table 2-13 Back River Profile Data Summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	3.5	3.7	4.5	5.1	5.3	5.4	7.3	1,882	3.4	8.2
DO saturation (%)	45.9	51.7	60.4	66.6	69.8	71.1	87.7	1,882	45.7	95.9
Salinity (ppt)	0.1	0.1	1.2	2.6	6.4	11.3	20.6	1,882	0.1	20.6
Temp_C (°C)	24.0	25.5	28.4	28.8	29.2	30.4	30.6	1,882	22.9	30.6
BGA_R (RFU)	3.0	3.2	3.6	4.0	5.3	6.5	7.1	366	2.9	8.2
Sp_Cond	178	180	2,429	4,862	11,348	19,110	32,971	1,882	178	33,081

Notes: PCTL – percentile, Min – minimum, Max – maximum

2.5.4 Middle River Data Summary

Limited drift sampling data were collected in the Middle River given it was not a priority of the field data collection. Three complete Middle River drifts were completed, along with several profiles near the USGS Middle River Fish Hole gage. ***Table 2-14*** provides a summary of the Middle River data.

Table 2-14 Middle River Data Summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	3.6	4.0	5.4	6.2	6.5	7.0	7.2	23,462	3.1	7.3
DO saturation (%)	48.4	52.6	68.1	75.4	79.4	83.9	86.4	23,462	42.2	88.1
Salinity (ppt)	0.0	0.0	0.0	0.1	0.9	3.3	4.3	23,462	0.0	5.7
Temp_C (°C)	21.4	21.6	26.6	26.7	28.1	28.7	29.0	23,462	21.3	29.2
BGA_R (RFU)	1.0	1.2	1.5	1.7	2.1	3.0	5.5	23,462	0.9	7.9
Sp_Cond	70	71	85	118	1,722	6,044	7,771	23,462	31	10,081

Notes: PCTL – percentile, Min – minimum, Max - maximum

3.0 DATA QA/QC

The QA/QC team conducted a review of the data collected during the SUR data collection effort. The team followed the QA/QC procedures outlined in Appendix B of the Work Plan (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc. 2019b) also used during the Test Run (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc. 2019a). The semi-permanent buoy, profile, and drift data collection efforts resulted in a total of approximately 8,317,000 raw data points that were retained after QA/QC evaluations. The sections below provide a summary of the SUR data adjustments and removal during QA/QC. Full documentation including figures and tables is provided in **APPENDIX F**.

3.1 SEMI-PERMANENT BUOY DATA

The semi-permanent buoy data were reviewed in time series plots to identify any sample dates and times which contained measured values which were inconsistent with the observed values. Three types of data that were removed are:

- Periods when the field crew was at a buoy retrieving sonde data since the sonde was out of the water when it logged some data.
- A period when the mid-depth data sonde at Upriver station UR_16a provided inconsistent data because the river flows were very low, most likely due to interaction with the river's bottom.
- A period when the sonde at Upriver station UR_9 initially experienced an upward DO drift. These data were corrected using an approved USGS methodology.

Further details of the QA/QC methods are in **APPENDIX F**. Approximately 3,208,000 buoy data points were retained after QA/QC evaluations. **APPENDIX A** presents plots of the processed and accepted data at each semi-permanent buoy collected during the SUR.

3.2 PROFILE AND DRIFT DATA

The raw profile and drift data were reviewed, and any inadvertent data recorded when the sampling boats were moving location were removed. These data were then QA/QC evaluated in time series plots to identify any sample dates and times which contained values that did not appear correct, such as when the sonde was removed from the water to download data. The main parameters collected were DO, DO saturation, salinity, temperature, specific conductivity, and BGA and Rhodamine dye. For the main parameters, approximately 1,600,000 profile data points and 3,200,000 drift data points were collected and over 95 percent were retained after QA/QC evaluations. **APPENDIX B** presents plots of the processed and accepted data for each profile and **APPENDIX C** presents plots of the processed and accepted data for each drift run collected during the SUR.

Profile sampling typically occurred at landmark locations (semi-permanent buoys) to check if oxygen plume was mixing top to bottom or at various points in the Front River to measure the DO and dye stratification between the top and bottom layers. Drift sampling typically occurred upstream and downstream of the diffusers to track the oxygen plume as it moved through the waterbody.

3.3 USGS DATA

The USGS maintains a network of hydrodynamic and water quality monitoring stations within the Savannah River and estuary. The stations measure multiple parameters in real-time and the data are publicly available. Additionally, the stations have been installed for a significant period such that a rich historical dataset dating back to 2007 exists for some locations (e.g., USGS 021989773 – USACE Dock).

It should be noted that not all stations measure the same suite of parameters. Some stations such as the one above Hardeeville measure water surface elevation (WSE) and a limited number of water quality parameters, whereas the station at the USACE Dock on Hutchison Island (Station 021989773) measures all hydrodynamic and water quality parameters of interest including DO. The location of the stations with the full suite of parameters required for DO analysis is presented in ***Figure 3-1***. Other stations, such as the Hardeeville gage, are not presented but their data have been relied upon elsewhere in this report, such as the hydrodynamic model calibration in **APPENDIX K.**

Another clarification is that while the USGS provides the data real-time via its website, all data are labeled as *provisional* until they have been subject to rigorous internal USGS field calibration and verification procedures by USGS personnel in the South Atlantic Water Science Center. Once the *provisional* data have been reviewed, they update to *approved* status. The SUR data evaluations used only *approved* USGS hydrodynamic and water quality data. **APPENDIX G** presents plots of measurements at each USGS station during the SUR. The USGS data have been analyzed in Section 7.0.

3.4 OXYGEN INJECTION PLANT DATA

After completion of the SUR, an independent QA/QC evaluation was performed on the operational data from both oxygen injection plants including flows, water temperatures, and oxygen loads. A project-specific 'oxygen injection plant QA/QC script' using the modeling program *R* was prepared to automate the QA/QC process. The script was used on the 2020 plant data and will be used to review raw data associated with future plant operations as well.

This QA/QC dataset for the entirety of the SUR is included in **APPENDIX H**. The plant data is analyzed in Section 5.0, with additional detail in **APPENDIX H.**

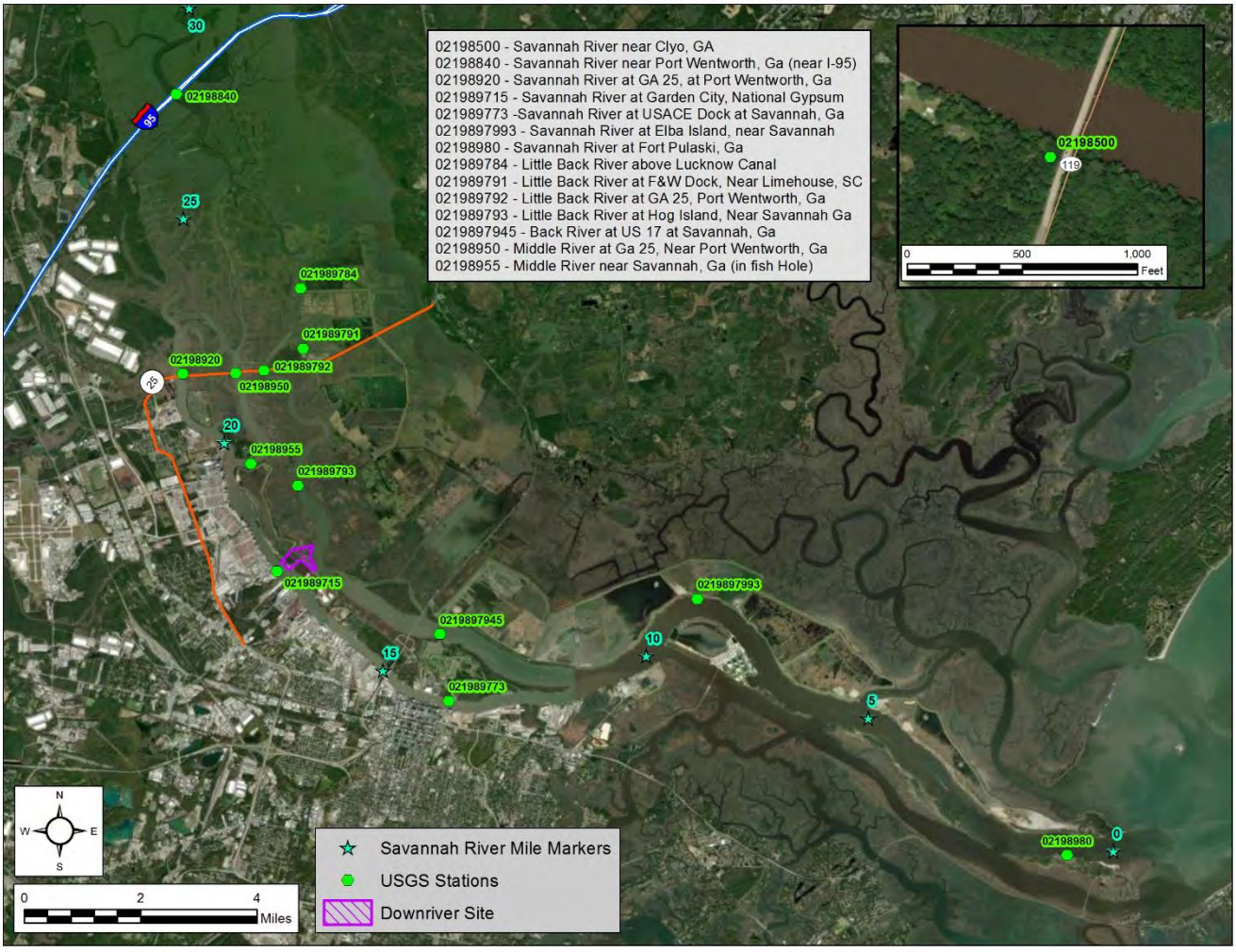

Figure 3-1 Location of USGS Gages Used for SUR Analysis

4.0 SUCCESS EVALUATION APPROACH

4.1 BACKGROUND

To evaluate the impact of the oxygen injection system on the Front River, Back River, and Savannah River, it is necessary to understand how water moves throughout the estuary. There are three primary driving forces:

- Freshwater flow from upstream sources is measured at the USGS Clyo gage (02198500). Lower freshwater flows result in saline and brackish water extending farther upriver (saltwater intrusion).
- Semi-diurnal tides move water upstream (flood tide) and downstream (ebb tide) in the harbor approximately twice a day. The upstream extent of tidal impacts is approximately where I-95 crosses the Savannah River, at RM 27.8.
- Neap and spring tides are driven by lunar cycles. Neap tides have less amplitude (difference between high and low water) and less energy to mix vertically, resulting in harbor stratification with higher salinity and lower DO in the bottom waters. Spring tides have larger tidal amplitude, and due to the increased energy, the harbor tends to destratify and mix well through the entire vertical water column.

Depending on the environmental forces within the harbor, such as tides, flows, and seasonal variation, the injected oxygen will move differently throughout the system. During spring tides, the Downriver oxygen plume moves farther upriver and mixes quicker into the water column (vertically). Conversely, during neap tides, the oxygen plume from the Downriver plant remains stratified and does not spread through the harbor quickly. The Upriver plant oxygen plume travels downstream past I-95 and mixes into the estuary.

The Savannah River and estuary has a natural low DO due to mixing (described above) and the physical slope of the bottom elevation of the river (gradient as the river moves downhill into the estuary). Most estuaries have a stratification of DO and salinity and most have sediment deposition because of the river gradients intersecting the flat estuary and meeting the ocean. According to the EIS, the low DO regime of the estuary has been accentuated by historical deepening projects (USACE 2012a). During the EIS development, several “natural conditions” model scenarios demonstrated a 1.0 mg/L decrease due to manmade channel improvements. The modeling team used an 1854 bathymetric map to characterize the natural bottom elevations of the river and estuary. Compared to the pre-existing 42 feet MLLW channel, the impacts directly related to the SHEP deepening to 47 feet MLLW were predicted to be approximately 0.2 to 0.6 mg/L in the critical areas on the Front River.

The EIS and GRR used modeling to evaluate SHEP impacts and identify the mitigation requirements. The models were used to compute the mitigation required by the following analysis:

1) a 97 percent of volume metric in critical segments (volume approach),
2) examined 5th, 10th, 25th, and 50th percentiles of DO concentrations over time to determine how the mitigation load was offsetting deepening (temporal approach),
3) utilized the bottom three layers of the six-layer model grid with the approval of the agencies to represent “bottom waters” (vertical location approach), and
4) Plan 6A of the EIS calls for an injection of 40,000 lbs/day of oxygen at three discharge locations in the harbor (Upriver, Downriver Front River, and Downriver Back River) (horizontal location approach) (Tetra Tech, Inc. 2010).

The EIS and GRR mitigation requirements were:

- An average of 40,000 lbs/day of DO must be injected and entrained into the water column to mitigate project impacts, with 28,000 lbs/day injected by the Upriver plant and 12,000 lbs/day injected by the Downriver plant, based on modeling performed for the EIS and GRR (USACE 2012a, USACE 2012b). To calculate the number of Speece cones required, 4,000 lbs/day per cone was used based on the 80 percent efficiency resulting from loss estimate during oxygen generation, injection, and retention (5,000 lbs/day per cone by manufacturer, ECO_2). This efficiency percentage was determined from lessons learned after the 2007 demonstration project and required by the federal and state agencies (Tetra Tech, Inc. 2010).
- The oxygen injection system must mitigate for the median (50th percentile) DO concentration reductions in 97 percent of the bottom half of the Savannah River and estuary waters caused by deepening the navigational channel. (Tetra Tech, Inc. 2015a, USACE 2012a, USACE 2012b).
- Out of 27 zones evaluated, water quality in zones Front River (FR) 07, FR08, FR011, Middle River (MR) 01, MR05, Back River (BR)01, BR02, BR03, and Little Back River (LBR)03 will be the most affected by navigational channel deepening. Therefore, impacts to DO concentrations should be mitigated in these zones by the oxygen injection (Tetra Tech, Inc. 2010). These zones are presented in ***Figure 11-13***, ***Figure 11-14***, and ***Figure 11-15***.

While the SUR monitoring data and model output evaluations provide numerous indications that the oxygen injection system is providing the oxygen loads required to offset SHEP impacts, a thorough and comprehensive approach was needed to assess if the SUR was a success.

4.2 THE SUCCESS CRITERIA

The Success Criteria were defined in the Compromise and Settlement Agreement (2013, bullet 11, pg. 3, Exhibit A):

"The purpose of the modeling and monitoring is to confirm that the Oxygen Injection System will mitigate for the DO impacts of the Project, as shown by comparing actual DO levels in the modeled area, from Station 0+000 upstream to RM 27.8, to DO levels in the without-Project scenario (the "Success Criteria")."

Simply stated, the Success Criteria are to prove the DO impacts caused by deepening the Front River have been compensated for in time (tidally and seasonally) and space (vertically in the water column and horizontally in the estuary).

It should be explicitly noted that neither the Success Criteria nor the EIS or GRR specify a target concentration of increased DO to appropriately mitigate for channel deepening. As identified in Section 4.1, the dynamic nature of the Savannah River and estuary vertically, spatially, and temporally, mean specifying a target concentration increase was impossible. To address the Success Criteria, an alternative approach was needed to prove mitigation was achieved.

4.3 THE LINES OF EVIDENCE APPROACH

No single, overarching piece of evidence exists which proves the Success Criteria has been achieved. Instead, a tiered approach needed to be developed whereby the Success Criteria was proven by evaluating four *Success Metrics* which each captured a complementary portion of the Success Criteria and were consistent with the EIS and GRR. A graphic of the four *Success Metrics* is presented in ***Figure 4-1.*** Further, each of the four *Success Metrics* was able to be assessed by a total of 12 *Lines of Evidence*, three for each *Success Metric*. This *Lines of Evidence* approach, visually illustrated in ***Figure 4-2***, proves that the oxygen injection system is successfully able to inject the

required oxygen loads into the river and that the injected oxygen can be retained and distributed vertically and spatially, thereby mitigating impacts to DO by harbor deepening.

Detail on each of the four *Success Metrics* and their *Lines of Evidence* are described further in this section.

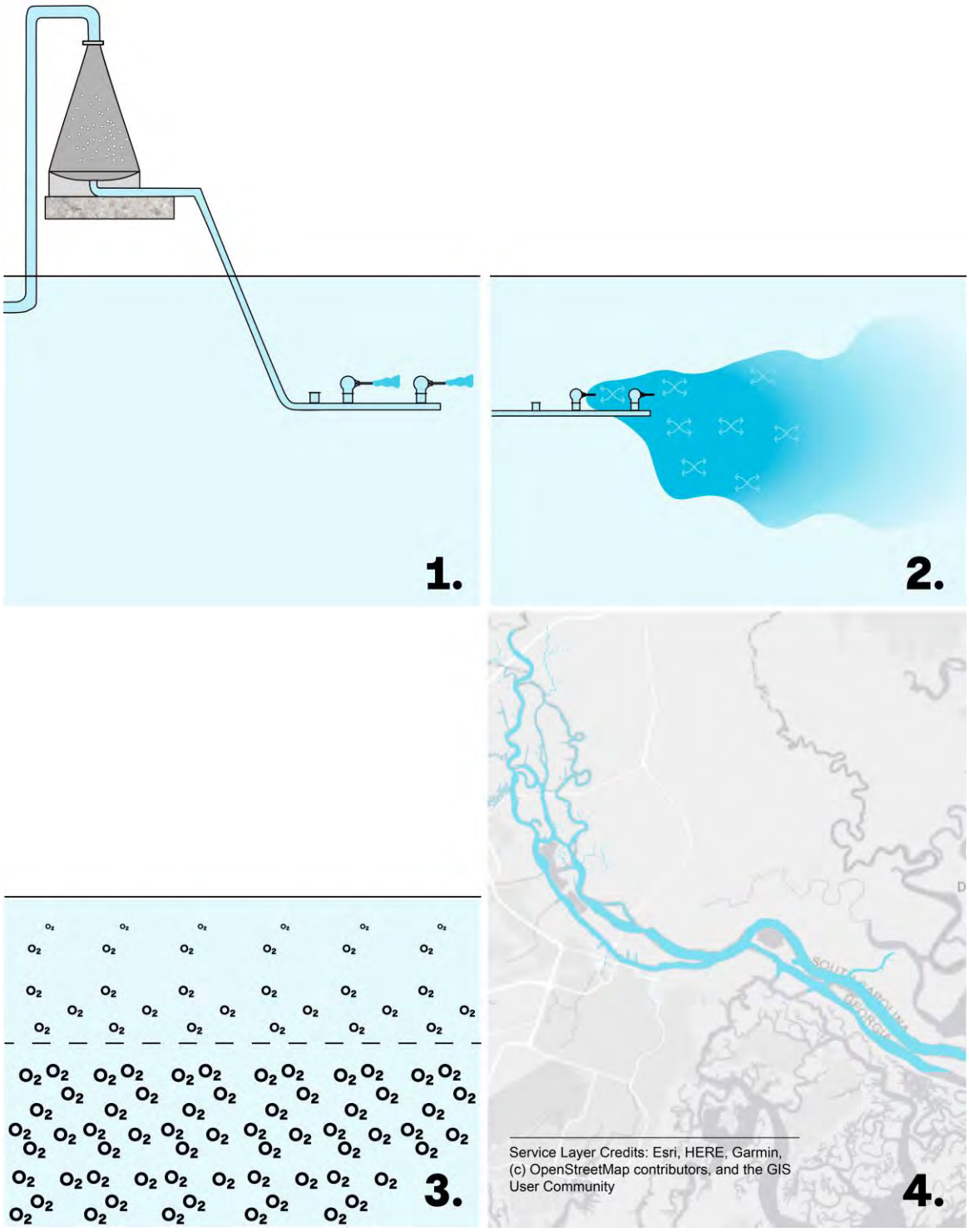

Figure 4-1 The Four Success Metrics

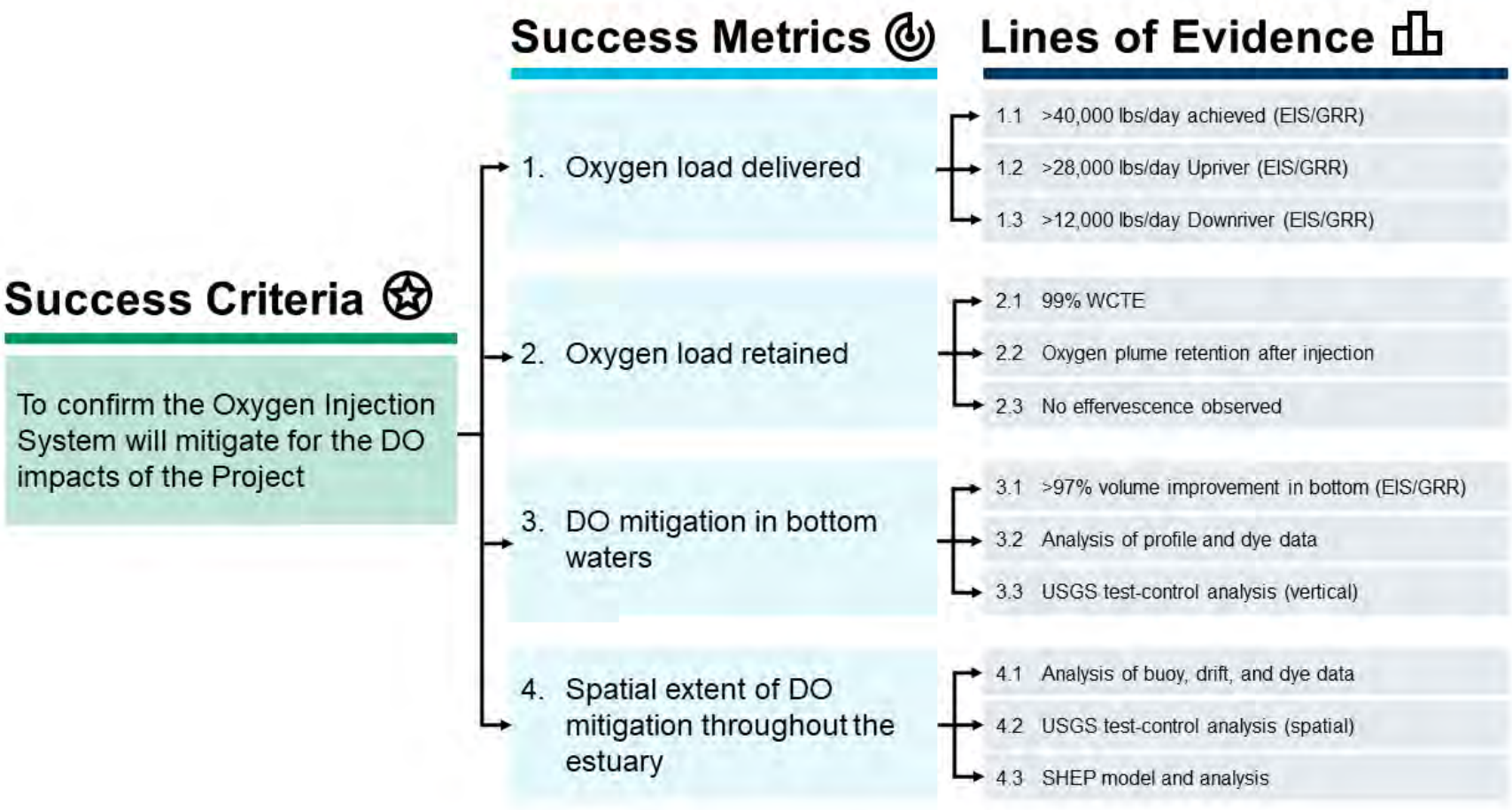

Figure 4-2 Lines of Evidence Approach Summary

Success Metric #1 – Evaluate if the oxygen injection system delivered the required oxygen load

The requirement is a daily average injection and retention of 40,000 lbs/day of oxygen over a continuous 59-day period during the critical summer months. To achieve this, two oxygen injection plants were constructed. One at Georgia Power's Plant McIntosh called the Upriver plant and a second on Hutchinson Island which is called the Downriver plant. 28,000 lbs/day were specified for the Upriver plant and the remaining 12,000 lbs/day from the Downriver plant (8,000 lbs/day via the Front River diffuser and 4,000 lbs/day via the Back River diffuser). These values are specified in the EIS and GRR Appendix C (USACE 2012a, USACE 2012b).

Success Metric #1, illustrated in ***Figure 4-3***, was achieved during the SUR by:

- injecting a total daily average of more than 40,000 lbs/day for 59 days – **Line of Evidence 1.1**.
- injecting a daily average of more than 28,000 lbs/day for 59 days from the Upriver plant – **Line of Evidence 1.2**.
- injecting a daily average of more than 12,000 lbs/day for 59 days from the Downriver plant – **Line of Evidence 1.3**.

Details on the oxygen injection are provided in Section 5.0.

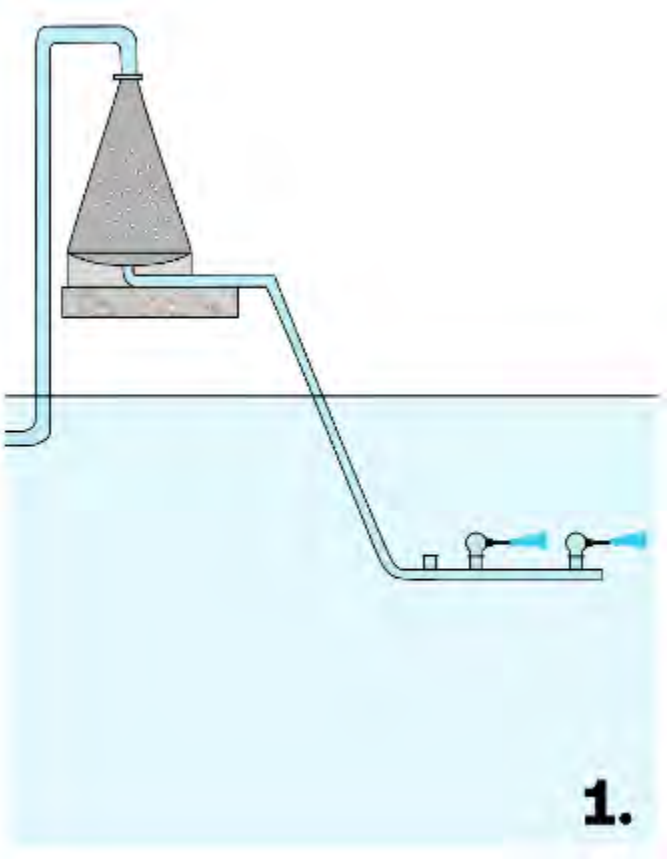

Figure 4-3 Success Metric #1 – Oxygen Load Delivered

Success Metric #2 – Determine if the injected oxygen is being retained in the water column

The requirement is based on agency feedback on the oxygen transfer efficiency. This process involves producing oxygen at the generators, pumping the oxygen through a Speece cone with pumps and pipes, and directing it into the water column to the bottom waters through pipes, bends, and diffusers. The agencies required 80 percent efficiency for the entire oxygen delivery process (from oxygen production to delivery to bottom waters) (Tetra Tech, Inc. 2010). The 80 percent efficiency was applied to the load of each Speece cone of 5,000 lbs/day to produce a design condition of 4,000 lbs/day per cone. From Success Metric #1, 40,000 lbs/day divided by 4,000 lbs/cone equals 10 cones in total for the system. As identified in Section 1.4, The Upriver plant operates with seven active Speece cones and the Downriver plant operates with three. The calculation of WCTE, a method used to estimate the percentage of oxygen retained in the Savannah River and estuary, excludes any potential losses from production, piping, and pumping operations. The WCTE goal was to achieve 90 percent retention. At least 90 percent of the delivered load to the water column needed to remain dissolved and saturated in the water column. Conversely, a maximum allowable transfer of oxygen from the river to the atmosphere would be 10 percent.

Success Metric #2, illustrated in ***Figure 4-4***, was achieved during the SUR by:

- Achieved 99 percent WCTE – **Line of Evidence 2.1**. Details on oxygen retention are provided in Section 6.0.
- Oxygen plume retention after injection – **Line of Evidence 2.2**. Details are provided in Section 7.3 for the retention of oxygen after operations cease, and Section 10.0 whereby dye plumes were tracked and detected weeks after each release.
- No effervescence or bubbling observed during field data collection – **Line of Evidence 2.3**. Details are provided in Section 8.0, Section 9.0, and Section 10.0.

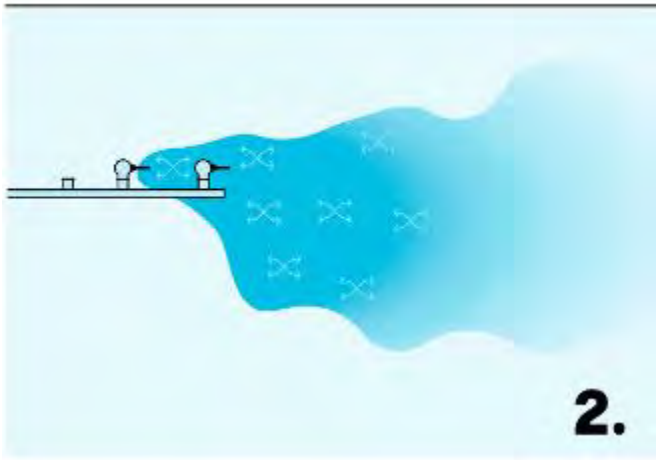

Figure 4-4 Success Metric #2 – Oxygen Load Retained

Success Metric #3 – Evaluate if the retained oxygen is mixing vertically and mitigating the bottom half of the water column

The requirement is for oxygen injection to mitigate median DO concentrations in 97 percent of the bottom half of the water column. This value is specified in the EIS Appendix C (Mitigation Planning) (USACE 2012a).

During the EIS development, the agencies were consulted and provided input on how modeling could be used to demonstrate the requirements of the mitigation. With a dynamic model outputting DO results by cell, by segment, and over time, it was necessary to determine which statistics could be compared when examining a model run with and without oxygen injection. The agencies agreed that the analysis should examine the effects in the lower half of the water column rather than the bottom grid layer. The lower half of the water column includes the bottom three layers of the six-layer model grid at the time of EIS development; the upgraded 2020 SHEP model is 10 layers, so the bottom half is five layers. Generally, DO decreases with channel depth, so analyses of conditions at the river bottom would represent worst-case conditions. Analyses of the bottom half of the water column would be more representative (but still somewhat conservative) of average conditions throughout the vertical profile. Attempts to achieve 100 percent of the total volume were not possible due to the numerical solution technique of the model, such that a surrogate of 97 percent of the total volume was used to compare model runs with and without mitigation. Also, by adding the flow volume of oxygen load to the model in the “with mitigation” scenarios, there was always a small difference in the with and without model scenarios. Therefore, the goal of 97 percent of the bottom half of the water column was determined to be the complete mitigation surrogate for total volume.

The SHEP model was the most encompassing tool to assess this requirement but supporting evidence was provided by the profile and dye data, which measured the impact of the oxygen injection plume across the water column, and by the USGS Front River Garden City gage where data for two separate depths was available for analysis.

Success Metric #3, illustrated in ***Figure 4-5***, was achieved during the SUR by:

- SHEP model showed achievement of 97 percent of the total volume in bottom waters with DO equal or greater when comparing with and without model scenarios – **Line of Evidence 3.1**. Details are provided in **Section 11.0**.
- Analysis of field data collection (profile and dye data) – **Line of Evidence 3.2**. Details on the profile analysis are provided in **Section 8.0** for Upriver and **Section 9.0** for Downriver, with the dye releases documented and analyzed in **Section 10.0**.
- USGS test-control analysis (vertical) – **Line of Evidence 3.3**. Details are provided in **Section 7.2**.

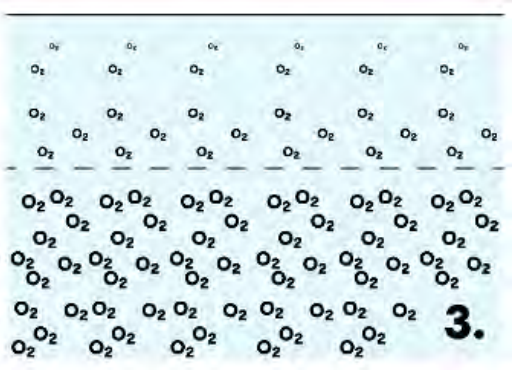

Figure 4-5 Success Metric #3 – DO Mitigation in Bottom Waters

Success Metric #4 – Evaluate if the retained oxygen is mixing spatially to provide the necessary mitigation throughout the Savannah River and estuary

The requirement is to confirm the oxygen injection system will mitigate for SHEP impacts throughout the Savannah River and estuary (from Station 0+000 upstream to RM 27.8), including critical zones identified in the EIS as being most affected by navigational channel deepening (identified in Section 4.1). Field data collected by the monitoring team was analyzed including drift data and measurements from semi-permanent buoys. Drift data helped determine where the oxygen plume was moving and how quickly it mixed with receiving waters, both side to side horizontally and longitudinally through the river. Semi-permanent buoy data provided continuous data and information around the oxygen injection diffusers to show how the oxygen plume was influenced by various freshwater flows and tides.

Additionally, long-term and publicly available data collected by USGS was analyzed to determine the impact of oxygen injection at various locations throughout the harbor. The SHEP model results provided supporting evidence to the findings of field measured data analysis.

Success Metric #4, illustrated in ***Figure 4-6***, was achieved during the SUR by:

- Analysis of field data collection (buoy, drift, and dye data) – **Line of Evidence 4.1**. Details are provided in **Section 8.0** for Upriver and **Section 9.0** for Downriver, with the dye releases documented and analyzed in Section 10.0.
- USGS test-control analysis (spatial) – **Line of Evidence 4.2**. Details are provided in Section 7.2.
- Spatial analysis of the SHEP model – **Line of Evidence 4.3**. Details are provided in Section 11.0.

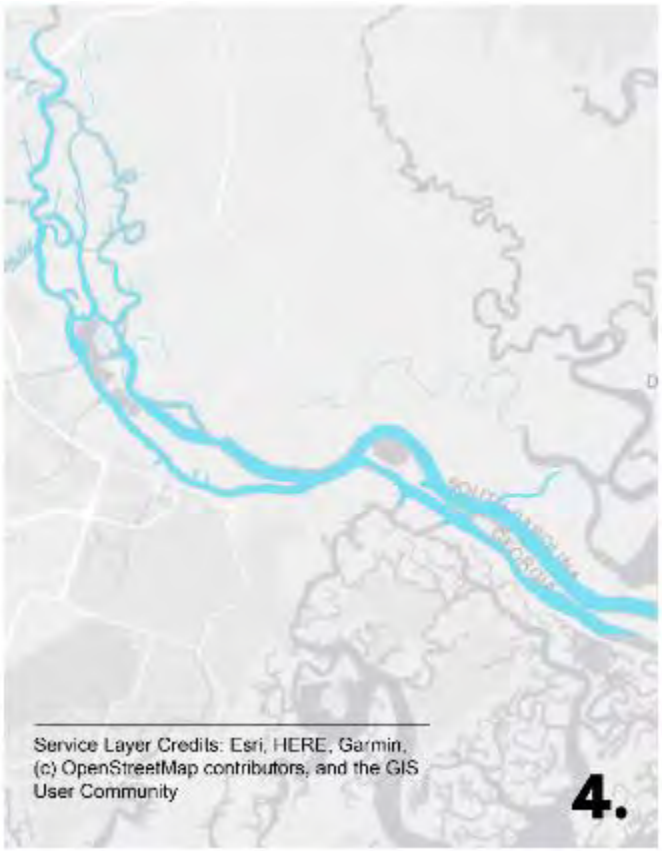

Figure 4-6 Success Metric #4 – Spatial Extent of DO Mitigation Throughout the Estuary

4.4 SUPPORTING ANECDOTAL EVIDENCE

In addition to the four *Success Metrics* and 12 *Lines of Evidence*, there was visual, anecdotal, and other evidence that support the DO mitigation conclusions observed during the SUR. These are listed below:

- Dye injections stayed in the main channels for a longer period than expected.
- No fish kills were documented or observed by the monitoring teams.
- No marine mammals were observed to be attracted to the diffusers.
- No navigation impacts or vessel strikes to the diffusers and equipment.
- No air or noise impacts from the operations of the injection equipment.

5.0 OXYGEN INJECTION SYSTEM DATA ANALYSIS

THIS CHAPTER ADDRESSES SUCCESS METRIC #1 AS IDENTIFIED IN SECTION 4.0

Success Metric #1 – Evaluate if the oxygen injection system delivered the required oxygen load

5.1 OXYGEN INJECTION SYSTEM

Details of the operational procedures of the oxygen injection plants are provided in Section 1.4.

5.2 STARTUP RUN OPERATIONS

Both oxygen injection plants have internal computer programs that measure, record, analyze, display, and store data. These data are analyzed by programmed logic controls built-in to both plants, which automates plant operations and makes real-time adjustments. For example, changing water levels at the intakes, due to upstream flows at the Upriver plant or tidal conditions at the Downriver plant, require slightly different pump operating pressures to maintain a constant rate of water withdrawal. The raw data are stored such that they can be retrieved and analyzed later.

The raw data collected during the SUR were independently reviewed. Further detail on this process can be found in Section 3.4 and **APPENDIX H**.

The SUR occurred from July 25, 2020, to September 22, 2020, during which the plants operated nearly continuously. Like any industrial plant with mechanical parts including pumps, generators, and valves, scheduled and unscheduled maintenance activities were necessary to maintain overall function. The oxygen injection system is no different. There were periods when one or both plants were offline to undertake necessary maintenance. However, the goal of achieving a daily average of 40,000 lbs/day across the SUR was achieved. Additionally, the daily average goal for the Upriver and Downriver plants was also achieved, as detailed in ***Table 5-1***.

Table 5-1 SUR Daily Averages

Plant	Target (lbs/day)	Actual (lbs/day)
Upriver	28,000	28,838
Downriver	12,000	13,574
TOTAL	**40,000**	**42,412**

The daily total oxygen loads are presented in **APPENDIX H**. While the daily averages were achieved over the entire SUR, the daily target was not achieved every single day due to unavoidable plant maintenance. This is considered reasonable, given the goal was to achieve the target loads as an average over the 59-day duration and this goal was achieved for the whole system and at each plant. Also, not achieving the daily target load every single day is acceptable from an environmental and scientific perspective. The high residence time of retained oxygen in the estuary, as identified in Section 7.3 and Section 10.0, means the effectiveness of mitigation is not instantaneous. Instead, the benefits are retained for weeks. Further, the varying conditions throughout the lunar cycle mean the injected oxygen is more critical in some periods (e.g., neap tides) than others (e.g., spring tides).

LINE OF EVIDENCE 1.1 – INJECT AVERAGE 40,000 LBS/DAY

LINE OF EVIDENCE 1.2 – INJECT AVERAGE 28,000 LBS/DAY UPRIVER

LINE OF EVIDENCE 1.3 – INJECT AVERAGE 12,000 LBS/DAY DOWNRIVER

The total flows through the Upriver and Downriver plants are shown in ***Figure 5-1***, ***Figure 5-2***, and ***Figure 5-3***. The occasional drops in flow correspond to the periods when the plant was completely or partially offline for maintenance purposes. Some maintenance works can occur without completely shutting down the plant, rather, by isolating specific parts such as a Speece cone, pump, or oxygen generator. For the SUR, the Upriver and Downriver plants were injecting oxygen 99.8 and 98.3 percent of the time, respectively.

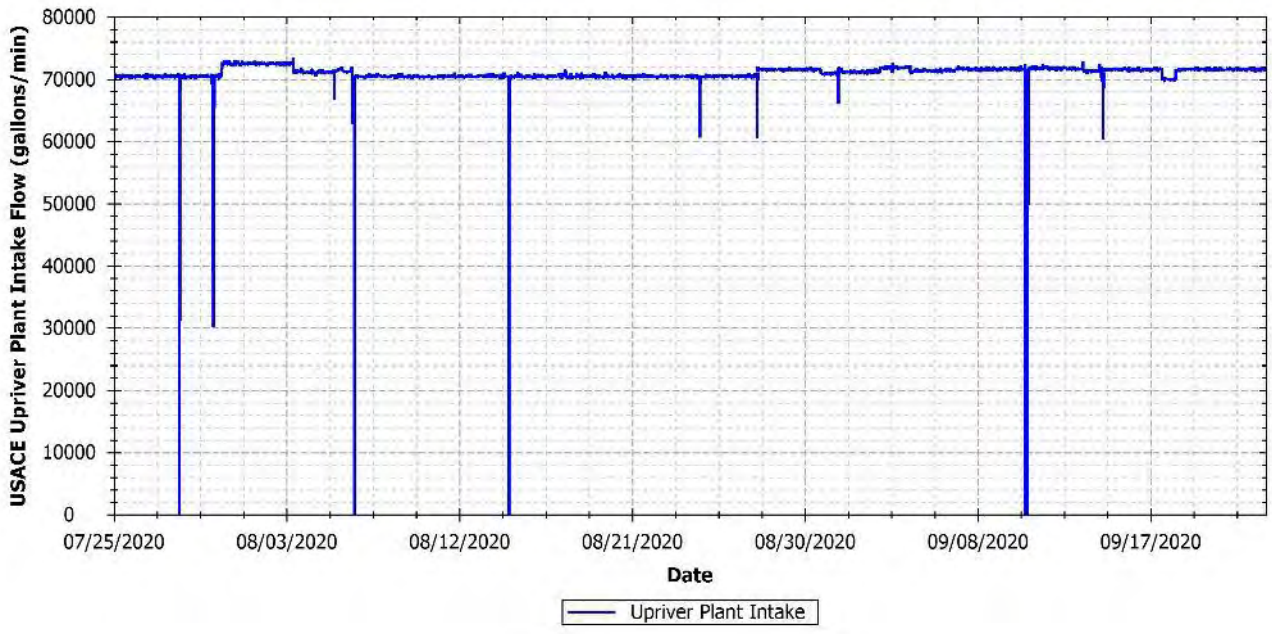

Figure 5-1 Upriver Plant Flow During SUR

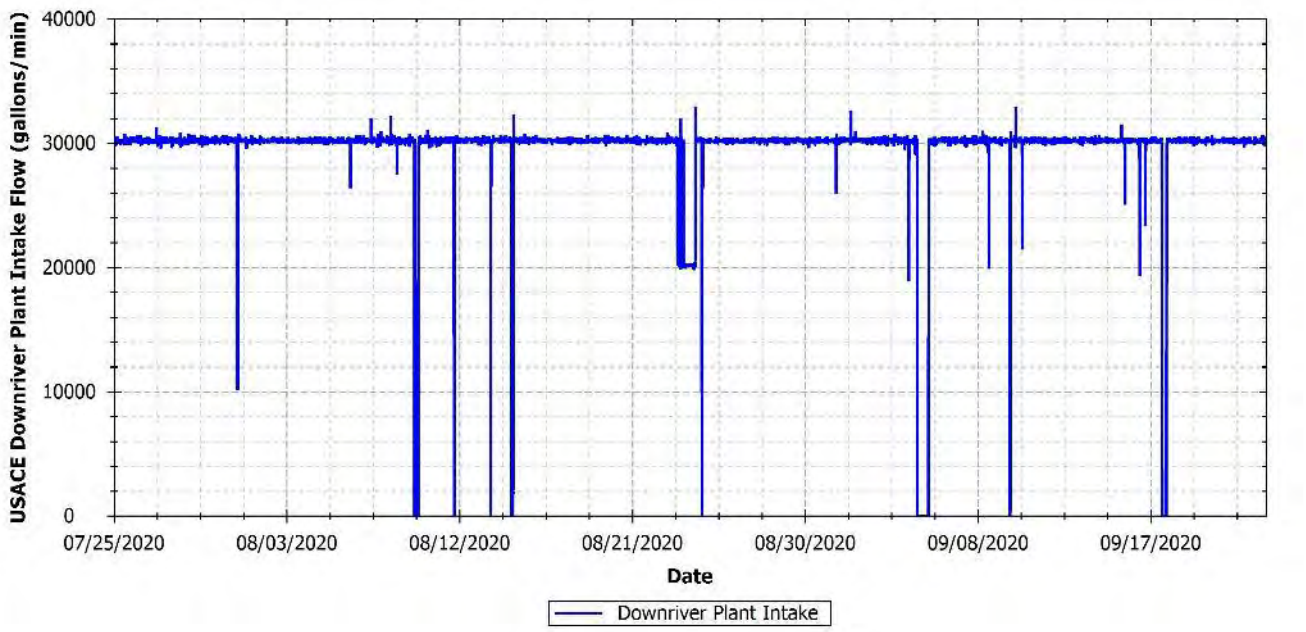

Figure 5-2 Downriver Plant Flow During SUR (total)

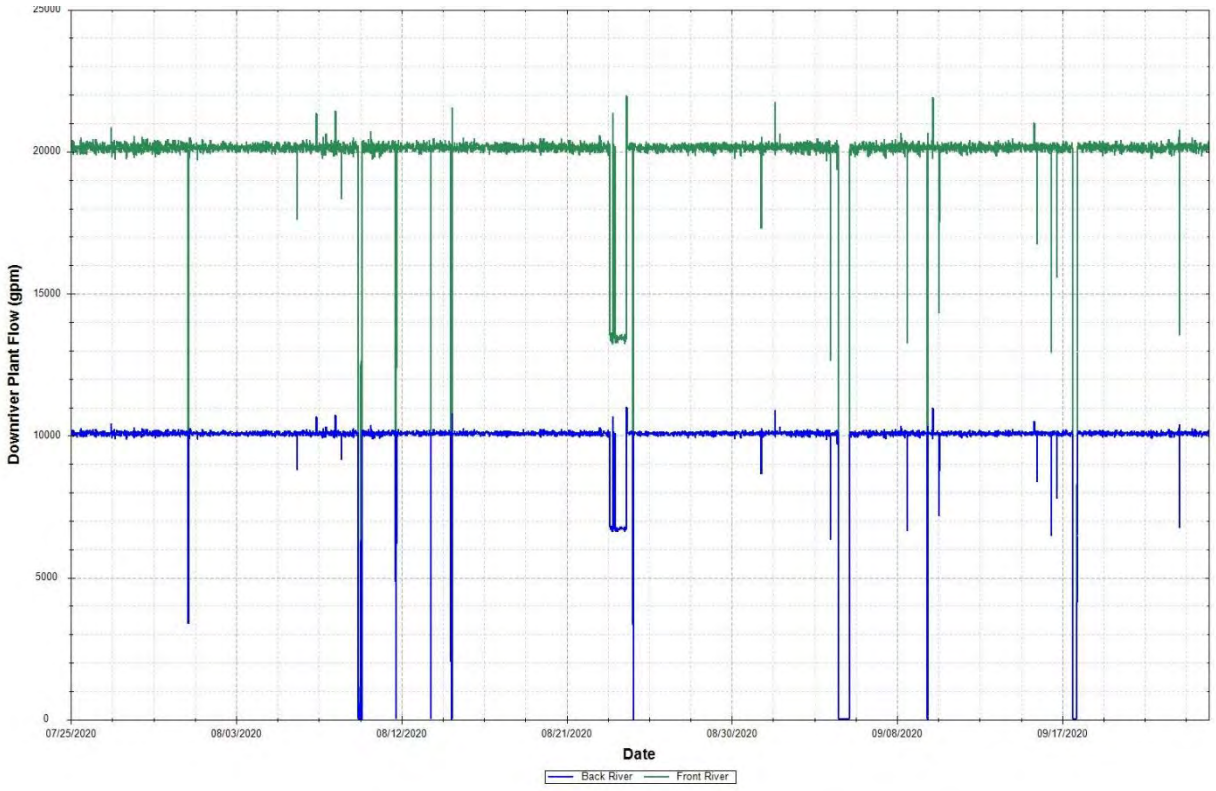

Figure 5-3 Downriver Plant Flow During SUR (Front and Back River)

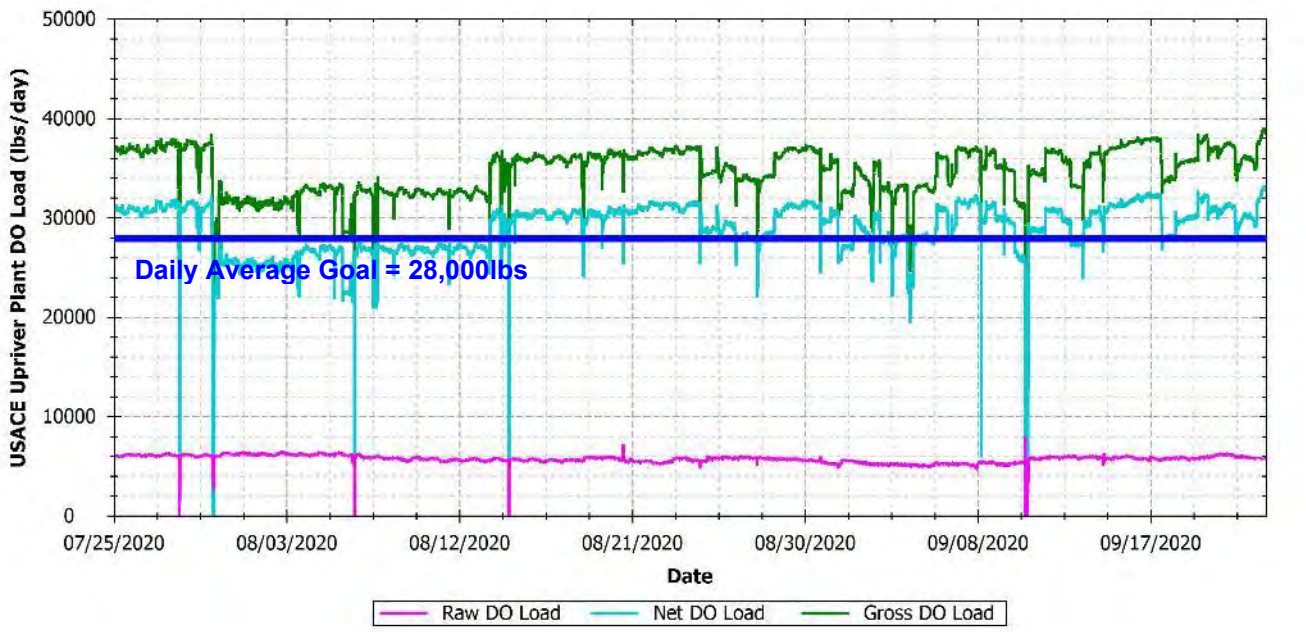

Figure 5-4 Upriver Plant Oxygen Loads

The raw, net, and gross oxygen loads at the Upriver and Downriver plants are presented in ***Figure 5-4*** and ***Figure 5-5***. The total raw oxygen load is the background oxygen load in the water withdrawn from the Savannah River and is determined using the measured DO in the raw intake water and the measured flow. The total gross oxygen load is the total oxygen load in the water prior to discharge and is determined using the measured DO in the water after exiting the Speece cones and the measured flow. The total net oxygen load is the difference between the raw and gross oxygen loads. The net oxygen load is the value of interest given this quantifies how much oxygen was added to the river. ***Figure 5-4*** and ***Figure 5-5*** illustrate that both plants consistently produced more than their target loads, which agrees with the average daily values presented in ***Table 5-1***. Similar to ***Figure 5-3***, ***Figure 5-6*** presents the oxygen loads delivered to the Back River and Front River from the Downriver plant.

It should be noted that the drops in flow correspond with the drops in oxygen load, as this is when the plant pumps were undergoing maintenance. This is intuitive as, without any plant flow, no load can be injected into the river. The opposite is not true, and this accounts for the rare events where there is a drop in oxygen load without a corresponding drop in flow. This is because of one or multiple oxygen generators undergoing maintenance while the plant was still partially operating and pumping water.

Another important point to consider is that despite these drops in injected oxygen load, which were typically in the range of 15 minutes to three hours (excluding one 14-hour outage at the Downriver plant from 8 pm on September 4 to 10 am on September 5, 2020, and one five-hour outage at the Downriver plant on September 17, 2020), they do not necessarily equate to a noticeable drop in DO in the critical areas of the estuary. This is because of the retention time of the DO, which is in the order of days to weeks depending on location in the estuary. Evidence of this retention time is presented in Section 7.3 and Section 10.0.

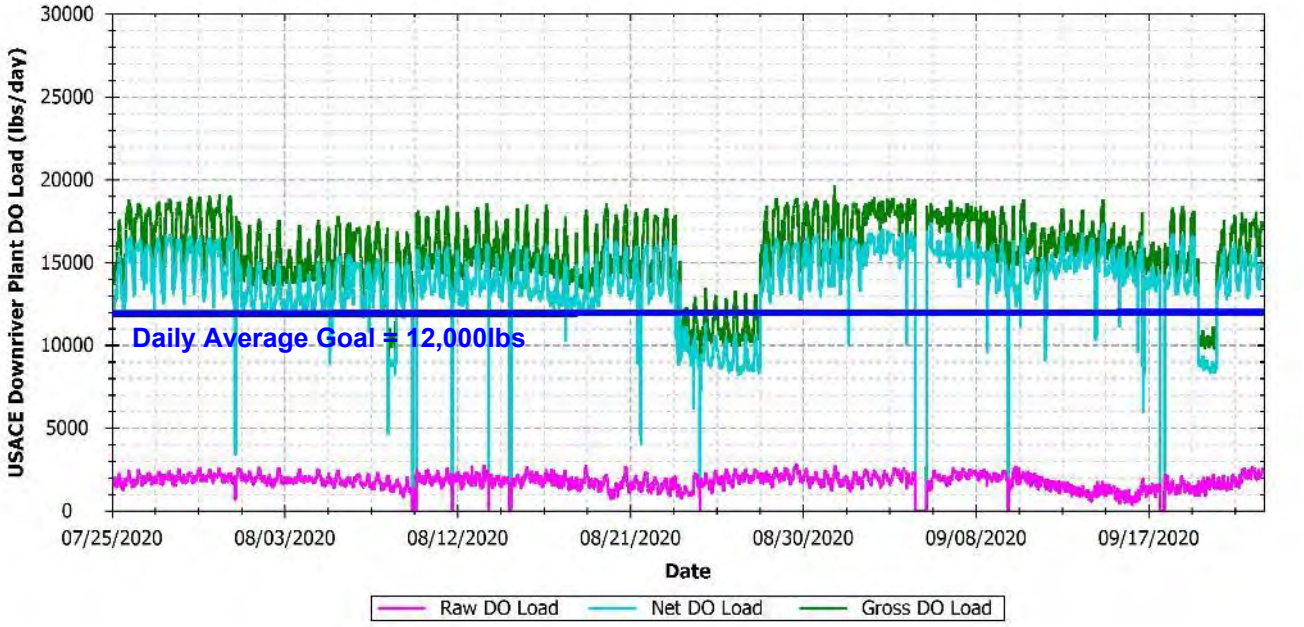

Figure 5-5 Downriver Plant Oxygen Loads (Total)

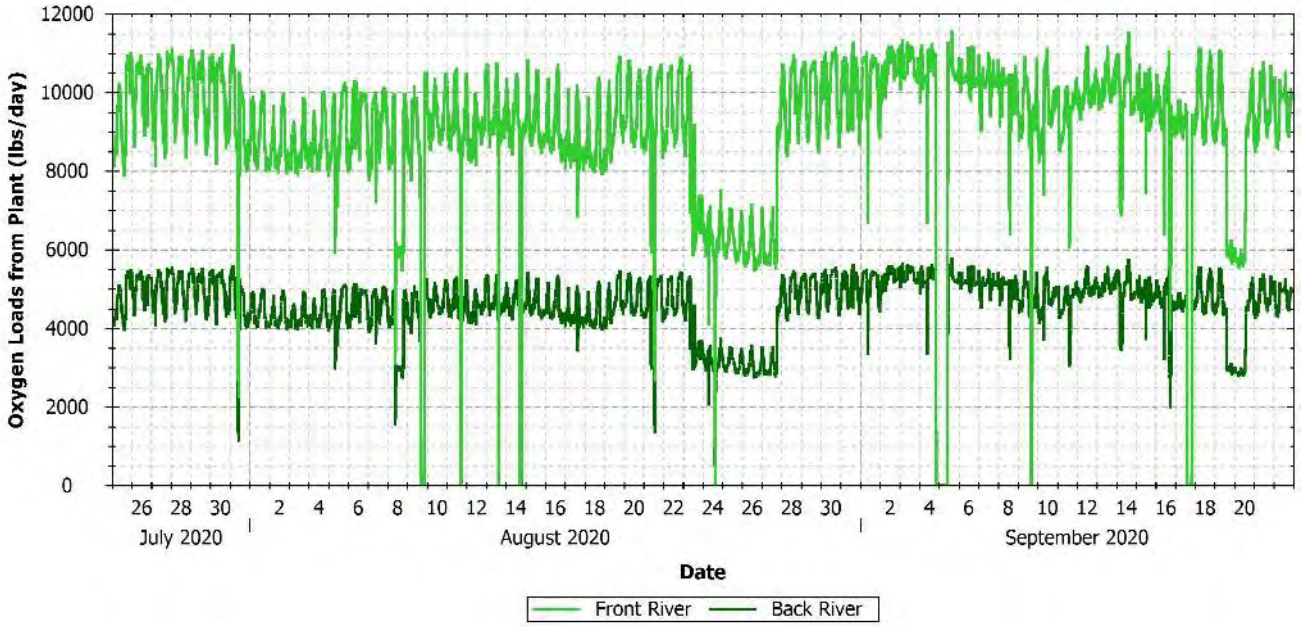

Figure 5-6 Downriver Plant Net Oxygen Loads (Front and Back River)

5.3 SUMMARY

Across the SUR, there was variation in the injected oxygen load. However, the required loads of a daily average of 40,000 lbs/day from the combined system, 28,000 lbs/day from the Upriver plant, and 12,000 lbs/day from the Downriver plant were all exceeded. Therefore, the required oxygen loads were delivered and injection was successfully achieved.

6.0 WATER COLUMN TRANSFER EFFICIENCY

THIS CHAPTER ADDRESSES SUCCESS METRIC #2 AS IDENTIFIED IN SECTION 4.0

Success Metric #2 – Determine if the injected oxygen is being retained in the water column

After successfully producing and injecting oxygen into the river, the injected oxygen should be retained by the receiving waters such that it mixes, both vertically throughout the water column and spatially throughout the Savannah River and estuary. Ideally, the oxygen load delivered by the plants through the diffusers would be completely mixed with the ambient water. However, if the injected plume of super-saturated water reached the surface, oxygen could be transferred from the water column to the atmosphere, resulting in reduced oxygen retention. To evaluate oxygen retention, WCTE (introduced in Section 1.6) is a calculation used to estimate the percentage of oxygen that remained in the Savannah River and estuary. The goal WCTE for the SUR was 90 percent, as described in Section 4.3. To calculate WCTE, the following is needed:

1. the mass of oxygen injected, and
2. the mass of oxygen transferred to the atmosphere if any.

Oxygen loads delivered by each oxygen injection plant were determined by oxygen sensors and flow measuring devices installed on each Speece cone discharge pipe. These sensors provided flow and oxygen concentration measurements of the super-saturated DO water that was discharged into the water columns. Additional details are provided in Section 5.2 and **APPENDIX H.**

The monitoring data collected during the SUR were used to estimate the mass of oxygen transferred 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 transfer to the atmosphere when the DO saturation at the air-water interface was greater than 100 percent, resulting in a WCTE of less than 100 percent. When DO saturation was less than or equal to 100 percent, DO was able to be fully retained in the water column and therefore WCTE was 100 percent. A detailed discussion of the methodologies used to calculate WCTE is provided in the WCTE Report (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc. 2020) and summarized in **APPENDIX I.** The WCTE calculation method identified periods when DO transfer conditions (DO saturation greater than 100 percent in the top 4.9 feet) were present. During these periods, the method calculated: (1) the length of time oxygen could be transferred; (2) the area from which oxygen could be transferred; (3) the amount of oxygen above atmospheric equilibrium (i.e., excess oxygen); and (4) the rate (not instantaneous) at which oxygen is transferred to the atmosphere (i.e., interfacial transfer coefficient).

General DO transfer observations at each of the discharge locations are summarized below and plotted in ***Figure 6-1*** against the 90 percent WCTE goal:

- Upriver: DO Transfer conditions were frequently observed in the continuous dataset (buoys and USGS gages) and were occasionally observed in the intermittent (profile and drift) dataset. Throughout the SUR, the daily WCTE varied from 97.8 percent to 100.0 percent, with an average of 99.9 percent over the SUR period. WCTE values dropped below 100 percent only when river flows were relatively low. These periods were from July 25 through August 8, 2020, and July 12 through July 17, 2020. Low flows, below 7,000 cfs, are expected to contribute to some atmospheric transfer due to the reduced vertical distance between the diffuser and river level, and therefore reduced ability for mixing all the oxygen injected into the water column.
- Front River: DO Transfer conditions were not observed in the continuous and intermittent datasets. Throughout the SUR, the daily WCTE had a constant value of 100 percent over the SUR period. This is

likely due to the high demand for oxygen in the Front River during the critical period, as well as the success of the diffusers in delivering and diluting the oxygen load allowing for strong vertical and horizontal mixing.

- Back River: DO Transfer conditions were occasionally observed in the continuous dataset but were not evident in the intermittent dataset. Throughout the SUR, the daily WCTE varied from 99.7 percent to 100 percent, with an average of 100 percent over the SUR period. The only periods when WCTE dropped below 100 percent was from August 14 through August 16, 2020, when there were a spring tide and high temperatures. As identified in Section 1.2, spring tides result in the oxygen plume residing longer in the water column causing the DO to build up. The increase in water temperature also lowers the saturation point. This build-up led to supersaturation and therefore some transfer of oxygen to the atmosphere. This phenomenon only last for a few days each summer.

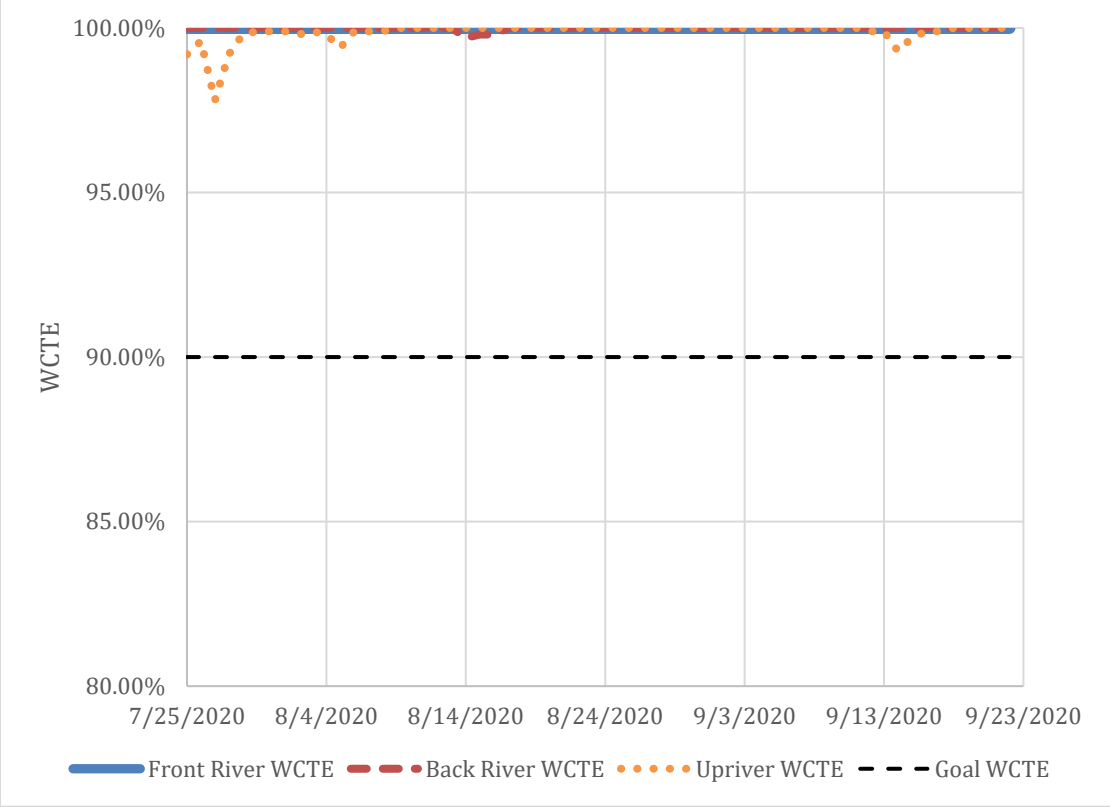

Figure 6-1 Daily Average WCTE Values for Front River, Back River, and Upriver

APPENDIX I includes tables presenting the river-specific plant loads and WCTEs.

The average combined WCTE over the SUR was calculated at 99.9 percent but has been conservatively rounded to 99 percent. In comparison to the Test Run (March 14 to May 12, 2019, WCTE of approximately 98 percent, see Section 1.5 for detail), conditions during the SUR resulted in less oxygen transfer across the air-water interface and therefore higher WCTE values. A key driver was the higher biological activity and higher temperatures given the SUR occurred in the critical summer period. This caused reduced background DO saturation levels, thereby increasing the water's ability to assimilate the injected oxygen.

The SUR had WCTE values significantly greater than the goal of 90 percent. This was consistent when looking at the Savannah River and estuary combined over the 59-day period, as well as looking at each location daily. The high WCTE values validate the design and implementation of the diffusers.

LINE OF EVIDENCE 2.1 – 99 PERCENT WCTE ACHIEVED

The conservative combined WCTE value of 99 percent was applied to the oxygen load injected to determine the oxygen load entrained in the Savannah River and estuary during the SUR. The oxygen loads injected and entrained by the Speece cone systems were greater than the loads required for harbor deepening mitigation. Results are summarized in **Table 6.1**.

Table 6-1 Oxygen Load Retained Summary

Plant	Load Injected* (lbs/day)	Load Retained (with WCTE value of 99 percent) (lbs/day)	Load Required for Mitigation (lbs/day)
Upriver	28,838	28,549	28,000
Downriver (Front River and Back River)	13,574	13,438	12,000
Totals	**42,412**	**41,987**	**40,000**
* Load injected sourced from ***Table 5-1***			

6.1 SUMMARY

A key feature of the oxygen injection system is the ability of the injected oxygen to be retained by the river, such that it can then be mixed and distributed vertically and spatially to the areas that require mitigation. The WCTE goal was 90 percent, and this was exceeded emphatically with an average of 99 percent achieved. This means that almost all of the injected load was able to be retained. High temperatures that occur in the critical period help with the retention. Factors that reduce WCTE are low freshwater flows from Upriver, and neap tides.

7.0 USGS DATA ANALYSIS

THIS CHAPTER ADDRESSES SUCCESS METRIC #2, #3 AND #4 AS IDENTIFIED IN SECTION 4.0

Success Metric #2 – Determine if the injected oxygen is being retained in the water column
Success Metric #3 – Evaluate if the retained oxygen is mixing vertically and mitigating the bottom half of the water column
Success Metric #4 – Evaluate if the retained oxygen is mixing spatially to provide the necessary mitigation throughout the Savannah River and estuary

The network of USGS stations positioned throughout the Savannah River and estuary, and its associated long-term, publicly available, and continuous dataset, provides an excellent opportunity to independently assess the impact of the oxygen injection system. A simple analysis would involve comparing the DO from the SUR against the DO from corresponding periods in previous years. This would be an idealized condition. However, continuous periods of identical conditions do not exist in a dynamic system. The comparison would not account for interannual variation in applicable parameters, such as gage height (otherwise WSE), temperature, salinity, and tidal direction, that can impact DO concentrations. There is also the fact that the Savannah Harbor has changed physically in recent years due to the harbor deepening plus other mitigation projects (McCoy's Cut, closure of Rifle and McCoombs Cut, tide gate removal). Another simple analysis would be to analyze various statistics such as daily minimums. As identified in Section 5.2, the plants do not operate at a constant rate. Rather, their oxygen output varies with factors such as water level or scheduled and unscheduled maintenance. Consequently, the entire operational period should be assessed instead of daily statistics.

A more accurate approach is to develop a dataset where for every individual data point in the test period, there is a corresponding "paired" data point in the control period (i.e., any time without oxygen injection for which the USGS gages have been operational, some of which date back to 2007) with near-identical water quality parameters (gage height, temperature, salinity, and tidal direction). These paired test/control observations were then evaluated for absolute DO concentration and percent saturation. The average difference in DO at each USGS gage was considered attributable to the oxygen injection.

The network of USGS stations is presented in ***Figure 3-1*** with additional details in **APPENDIX G.**

7.1 TEST RUN

This paired test/control analysis was first used to assess the success of the Test Run. It should be disclosed that the analysis was undertaken in May 2020, after the Test Run report was delivered (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc. 2019a). It was developed using independently collected and long-term publicly available data, and therefore it is a valuable line of evidence and warrants inclusion in this report.

The algorithm works by identifying a data point in the Test Run period and comparing it to every other data point from the same station outside the Test Run period, otherwise known as the control period. Specifically, the data are compared for gage height, temperature, salinity, and tidal direction. By using a Euclidean distance approach for each of the four parameters compared, the data point from the control period most similar to the data point from the Test Run period is matched, forming a test/control pair of data points. This approach was applied for every data point in the Test Run, such that there were 5,664 test/control pairs for each USGS station in the overall network. Given the complexity of this algorithm, it is not possible manually and therefore required computer programming. The DO values were not controlled for and therefore the differences between the test and control data points could

be assessed. The median value of all test/control pairs was considered the most appropriate statistic for comparison to negate the potential impact of outliers.

Overall, the algorithm was successful in identifying control points where independent variable values nearly perfectly matched those of the Test Run. Using these points to compare concentrations demonstrates that at all stations' DO were significantly greater during the Test Run than for the control points, except for the I-95 gage. Differences in DO concentration were highly significant (except for the I-95 gage) and consistent with expectations from previous modeling.

A method to evaluate the effect of the oxygen injection was the use of t-tests between the test/control data. Two sets of observations are directly compared and used to determine if differences between observations are random or are statistically significant. The typical accepted scientific standard of a successful t-test is achieving less than five percent chance of a false positive ($p<0.05$, two-tailed test). For the purposes of this analysis, achieving a *p*-value of less than 0.05 indicated the algorithm was successful in identifying suitable test/control pairs.

The results of the t-tests presented in ***Table 7-1*** indicate that nearly all *p*-values exceed the accepted scientific standard of a five percent chance of a false positive. Most values exceeded 10^{-9}, indicating that the likelihood of observing this difference by chance alone is infinitesimal. The one exception was the I-95 gage, which had a near-zero difference and *p*-value much greater than five percent. This was expected given I-95 is typically considered the upper limit of tidal influence, and only the Downriver plant was in operation during the Test Run. As discussed in Section 7.2, the I-95 station was influenced by the oxygen injection from the Upriver plant during the SUR.

Results of the analyses are presented in ***Table 7-1***, arranged in order from upstream at RM 27.8 downstream toward RM 0. They are also presented graphically in

Figure 7-1. Further details on the analyses are presented in **APPENDIX J.**

Table 7-1 Test Run DO Differences – Absolute DO Concentration (mg/L)

Station	Name	Test Run	Control	Difference	*p*-value
02198840	I-95	7.82	7.84	-0.02	0.20
02198920	Savannah River-Port Wentworth	7.18	6.92	0.26	1.25E-09
02198950	Middle River- Port Wentworth	7.40	6.95	0.45	2.83E-43
021989792	Little Back-Port Wentworth	7.60	6.93	0.67	5.60E-185
021989715	Garden City 13.3 feet	6.91	6.35	0.56	1.06E-110
021989715	Garden City 23.3 feet	6.80	6.13	0.68	1.2E-8
021989773	USACE Dock	6.99	6.36	0.64	2.42E-165
0219897993	Elba Island	6.88	6.41	0.47	1.51E-115

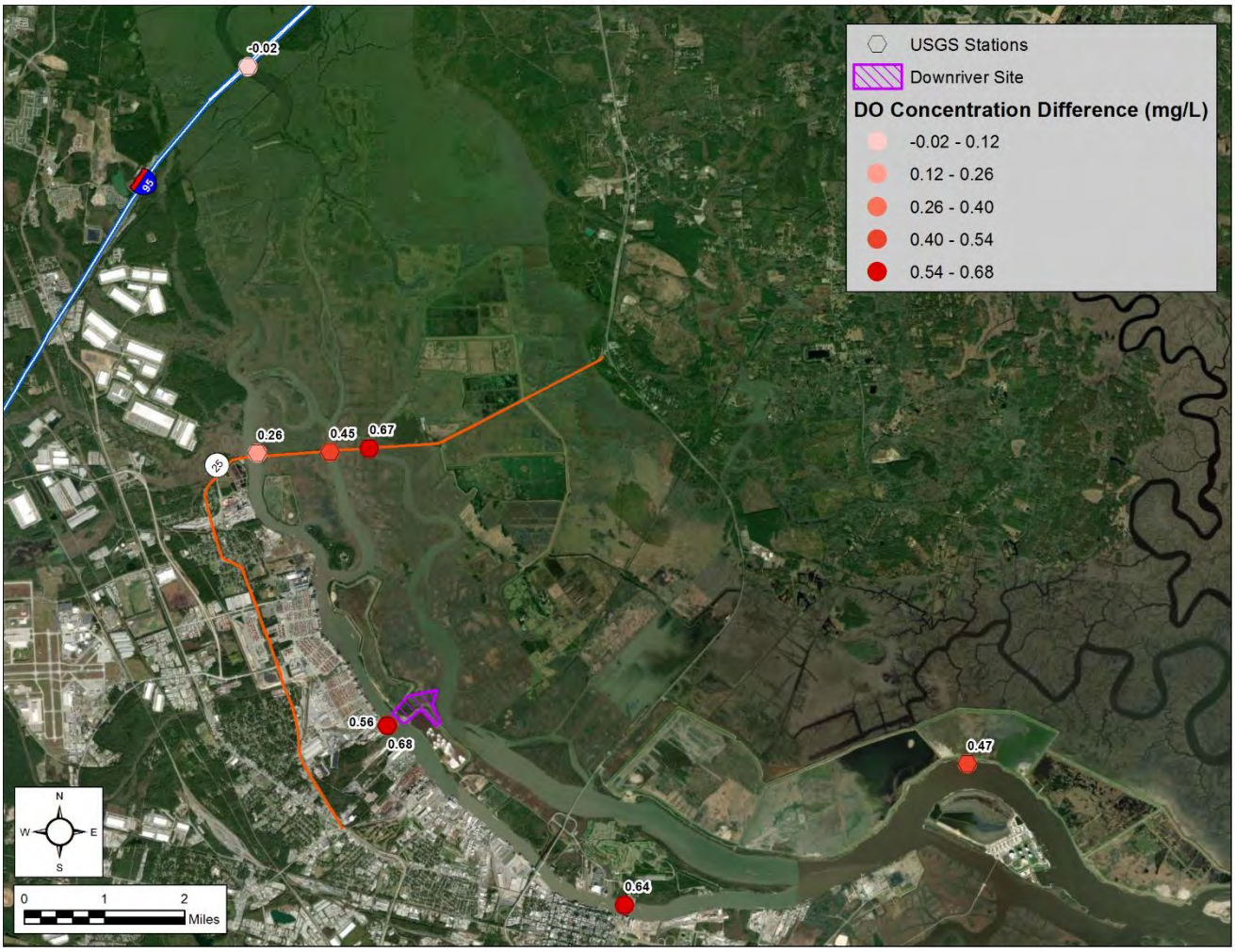

Figure 7-1 Test Run DO Differences – Absolute DO Concentration (mg/L)

7.2 STARTUP RUN

The analysis undertaken for the Test Run was repeated to determine the impact of the SUR, with a few minor additions made to the algorithm. Firstly, the Test Run dates plus approximately three weeks after completion were excluded from consideration for the control dataset given the need for the control data to be free of injected oxygen influence. Similarly, the period from July 1 to July 24, 2020, was excluded because the plants were being tested intermittently in the lead up to the SUR. Also, three additional gages were included (02198955 Middle River Savannah, 02198979 Little Back - Hog Island, 0219897945 Back River at GA 17). These three gages do not measure WSE, but they do measure the other water quality parameters of interest (i.e., salinity, temperature and DO). Therefore, a synthetic WSE was determined by interpolating measured values from the nearest hydrodynamically connected gages. This approach allowed for the full potential for the test/control algorithm to be realized.

Overall, the algorithm was successful in identifying control points where independent variable values nearly perfectly matched those of the SUR. Using these points to compare concentrations demonstrates that at all stations, DO was significantly greater during the SUR than for the control points.

At all USGS stations, the median DO concentrations during the SUR were higher than the control concentrations by 0.12 mg/L to 0.86 mg/L (***Table 7-2***). The one exception to this is the gage on the Little Back River near GA 25 (021989792) where a near-zero change between the SUR and the control dataset was determined. This was an unexpected conclusion and is investigated further below.

The only USGS station assessed that did not achieve such low values was the Little Back River near GA 25 (021989792). The *p*-value for the Little Back River is 5.4 percent, indicating the algorithm at this location was not as successful in identifying control points where independent variable values nearly perfectly matched those of data points in the SUR. Interestingly, the *p*-value for this station was significantly less than 10^{-9} in the Test Run, and a notable increase in DO was determined. This success at identifying suitable control points in 2019 and relative struggle at identifying suitable control points in 2020 suggests something significant changed in the system which affected this individual location. The McCoy's Cut flow rerouting mitigation project, constructed to deliver additional high DO freshwater flow to the Little Back and Middle Rivers and prevent saltwater intrusion, was completed in early 2020. Therefore, despite the dataset at this USGS gage beginning in 2013, only a small period (approximately six months between completion and SUR beginning) existed with increased freshwater flows, the majority of which occurred in winter and spring with low water temperatures. Given the SUR occurred with freshwater flow from upstream, the suitable control dataset was significantly reduced, and the algorithm was not as successful in finding near identical test/control data pairs, particularly due to salinity. Also, the additional freshwater flow reduced the potential for retained oxygen to extend that far upstream, except under spring tide conditions (supporting analysis presented in Section 9.2.5). This is the reason for the near-zero change between the SUR and the control dataset at the Little Back River near GA 25, and therefore the results are considered inconclusive at this singular location. It should be noted that the Middle River near GA 25 USGS station (02198950) was successful in showing a positive delta between the SUR and control dataset and had a *p*-value significantly less than 10^{-9}. Despite additional freshwater flow being diverted down the Middle River in addition to the Little Back River from the McCoy's Cut freshwater flow rerouting project, the connections the Middle River has with the Front River immediately upstream and downstream of the GA 25 bridge meant no discernable impact was observed.

Results of the analysis are presented in ***Table 7-2***, arranged in order from upstream toward the ocean. They are also presented graphically in ***Figure 7-2***. Further details on the analyses are presented in **APPENDIX J.**

Table 7-2 SUR DO differences – Absolute DO Concentration (mg/L)

Station	Name	SUR	Control	Difference	*p*-value
02198840	I-95	6.91	6.67	0.24	4.93E-163
02198920	Savannah River-Port Wentworth	4.77	4.24	0.53	5.66E-312
02198950	Middle River- Port Wentworth	5.28	4.69	0.60	0
021989792[+]	Little Back-Port Wentworth	5.17	5.21	-0.03	0.054
02198955*^	Middle River Savannah in Fish Hole	4.30	3.65	0.65	0
021989793*^	Little Back River at Hog Island	5.22	4.96	0.26	6.76E-71
021989715	Garden City 13.3 feet	3.98	3.12	0.86	0
021989715	Garden City 23.3 feet	3.33	2.77	0.56	0
0219897945*^	Back River at GA 17	4.67	4.22	0.45	5.50E-149
021989773	USACE Dock	3.65	3.25	0.40	2.69E-158
0219897993	Elba Island	4.11	3.99	0.12	3.10E-18

* Interpolated WSE derived based on measured values from the nearest hydrodynamically connected gages

^ New gage used for SUR only, not included in Test Run analysis

[+] Results inconclusive due to limited control dataset

The high differences in DO concentrations of 0.86 mg/L and 0.56 mg/L at USGS station 021989715, located adjacent to the Front River diffuser, show that the DO plume was retained and mixed vertically throughout the water column. The difference in DO concentrations was lower at the deeper 23.3 feet depth, likely due to the higher SOD that occurs at depth in the critical period, but still significantly positive. It should be noted that despite station 021989715 being located immediately across the Front River from the Downriver plant, this positive result is not due to the plume reaching the gage immediately upon injection. Instead, as illustrated by the drift data and dye releases in Section 0 and Section 10.2 respectively, the oxygen plume does not reach the other side of the Front River until fully mixed by successive tidal changes.

LINE OF EVIDENCE 3.3 – USGS TEST-CONTROL ANALYSIS (VERTICAL)

Increases at other USGS stations on the Front River both upstream and downstream of the diffuser validate the improvement caused by the oxygen injection. More than 1.75 miles downstream of the Back River diffuser at USGS station 0219897945, the DO concentration difference was 0.45 mg/L. Approximately 1.5 miles upstream of the diffuser at USGS station 021989793, the DO difference was 0.26 mg/L. The relatively high DO concentration differences upstream and downstream of the Back River diffuser confirm that the injected DO mixed in the water column and was distributed throughout the Back River. Farther upstream in the Little Back River at USGS station 021989792, the DO concentration was near zero, for the reasons described previously, and therefore this individual result is considered inconclusive and not representative of the overall test/control analysis.

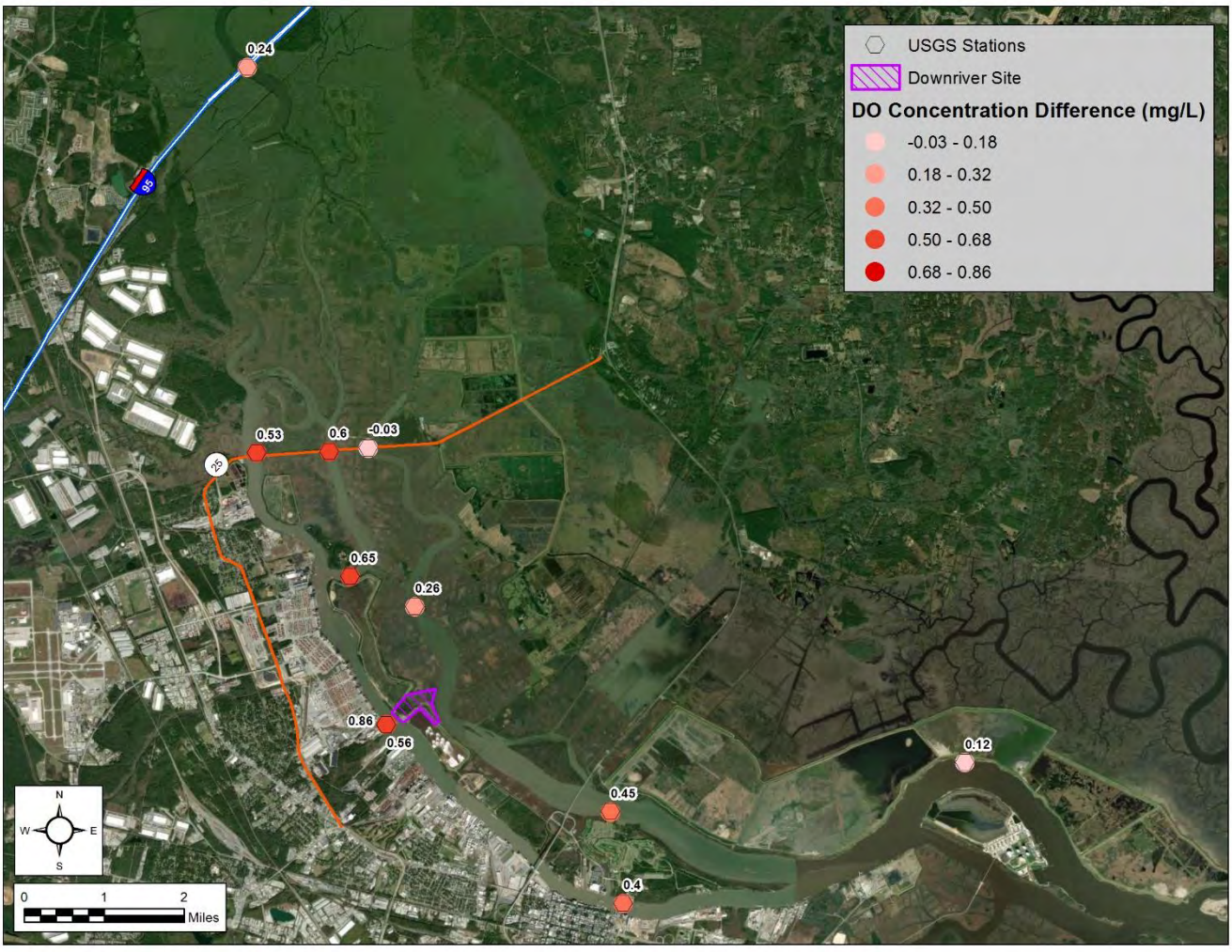

Figure 7-2 Startup Run DO Differences – Absolute DO Concentration (mg/L)

The closest station to the Upriver plant which measures the necessary parameters is the gage located at I-95 (02198840). Despite being located approximately 17 RMs downstream of the plant and subject to numerous influxes of low DO water from the adjacent tributaries, a DO increase of 0.24 mg/L was observed during the SUR. Given no improvement was observed at this station during the Test Run, this increase is considered purely attributable to the oxygen injection from the Upriver plant.

LINE OF EVIDENCE 4.2 – USGS TEST-CONTROL ANALYSIS (SPATIAL)

7.3 ASSESSMENT OF OXYGEN RETENTION AFTER OPERATIONS CEASE

The USGS data have been successfully analyzed to determine the impacts of the oxygen injection when the plants are in operation (Section 7.1 and Section 7.2). The data can also be analyzed to determine the long-term effects of oxygen injection. One item not addressed in the test-control analysis was if the injected oxygen remains in the system after the plants cease operating or if the benefits are only realized when the plants are in operation. There are several factors that cause DO reduction at an individual point, such as a USGS station, when plants cease operating. They are:

- As the DO plume mixes throughout the estuary, the improvement in an individual location will diminish.
- The DO is consumed by the SOD. Further detail on SOD is available in Section K.5 in **APPENDIX K.**
- The plume naturally moves toward the ocean over time, despite tidal cycles, due to the constant flow from Upriver.
- Loss of DO via atmospheric transfer (albeit minimal due to 99 percent WCTE as identified in Section 6.0 and only occur during neap tides or periods of freshwater flow below 7,000 cfs).

Based on this, the expectation is for the injected DO to remain within the Savannah River system after oxygen injection ceases and gradually reduces until returning to typical background concentrations. Additionally, residual effects are likely to be more long-lasting at USGS stations closer to the ocean.

To test the expectation, DO plots for all analyzed USGS gages have been prepared for the years 2013 through 2020. This graphical assessment technique does not account for interannual variations in salinity and gage height, but temperature variations are negated given DO saturation considers the effect of temperature. The DO saturations are presented on the y-axis and the date is on the x-axis. Only the months of May and June are presented for the Test Run, and September to October for the SUR, for ease of comparison. The Test Run ended May 12, 2019, and the SUR ended September 22, 2020. It should be noted that both oxygen injection plants continued operating for a week after the SUR concluded. The periods when the oxygen injection system was operating (Test Run and SUR plus an extra week) are shown in blue while all other data are red, to help distinguish when oxygen injection ceased. The plots for Garden City at 23.28 feet depth (USGS station 021989715_2) and the USACE Dock (USGS station 021989773) for both Test Run and SUR are presented in ***Figure 7-4*** through ***Figure 7-6***. The corresponding plots for all other USGS gages are presented in **APPENDIX J**.

The increases in DO saturation after the Test Run and SUR, compared to corresponding periods from other years, are visually noticeable. Additionally, the SUR retention appears greater than the Test Run, due to the additional load from the Upriver plant. This qualitative assessment indicated oxygen plumes in downstream gages retained the positive impact of the oxygen injection for more than a week after plant operations ceased. Farther upstream, the retention was reduced. The retention at the I-95 gage, the approximate tidal limits of the Savannah River, and the most upstream gage that measures DO were not visually detectable, which was to be expected given the unidirectional flow and the approximate 24-hour travel time from the Upriver plant to this station (See Section 10.1.3).

It is worth recognizing that this assessment technique is more qualitative and less robust than the test/control analysis used in Section 7.1 and 7.2. However, the conclusion is assured and supports the findings on oxygen retention in Section 10.0.

LINE OF EVIDENCE 2.2 – OXYGEN PLUME RETENTION AFTER INJECTION

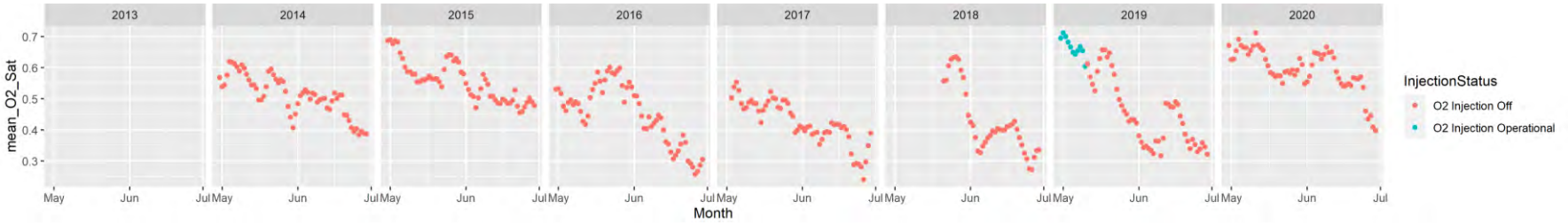

Figure 7-3 DO Saturation at USGS station 021989715_2 for Test Run

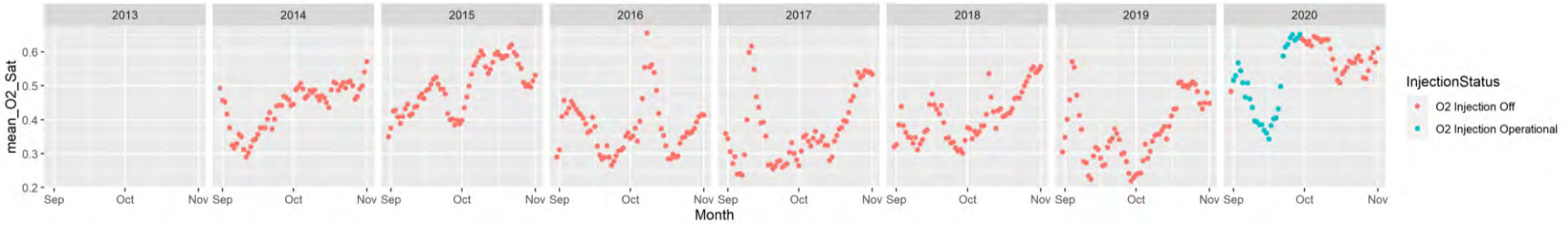

Figure 7-4 DO Saturation at USGS station 021989715_2 for SUR

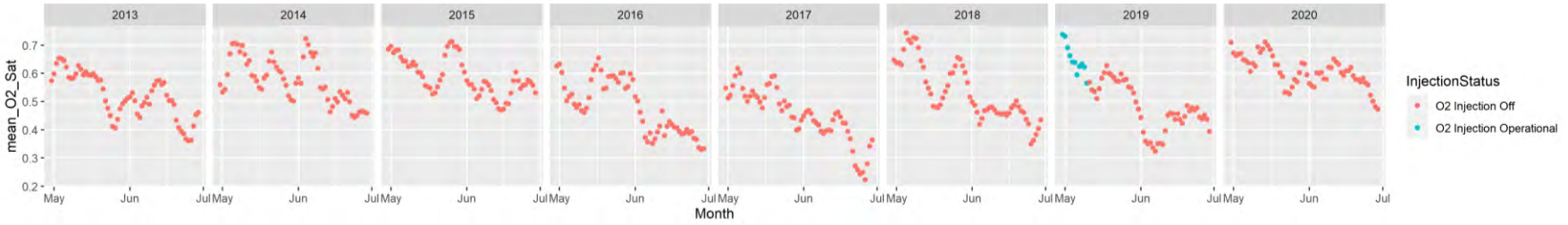

Figure 7-5 DO Saturation at USGS station 021989773 for Test Run

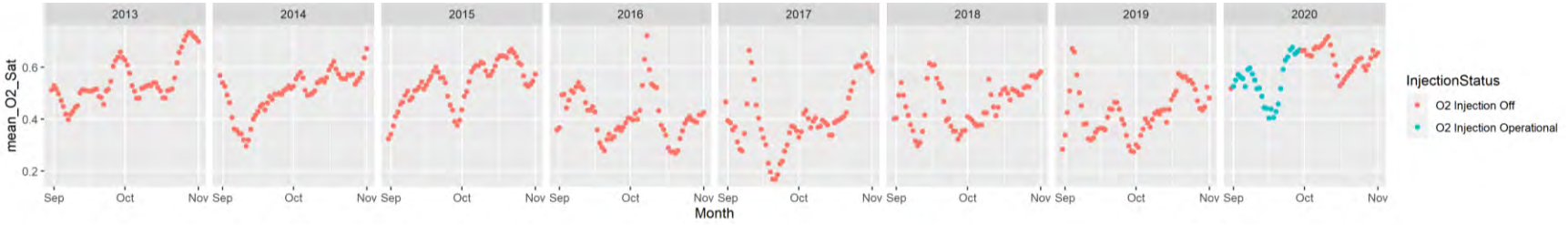

Figure 7-6 DO Saturation at USGS station 021989773 for SUR

7.4 SUMMARY

The long-term, independently collected, and publicly available data record that the network of USGS gages provides was a perfect opportunity to assess the impact of the oxygen injection system. A test/control analysis, whereby the interannual effects of gage height, temperature, salinity, and tidal direction were controlled for, allowed a pure analysis of DO change. The positive results support the assertion that the retained oxygen load is being successfully mixed throughout the estuary, both spatially and vertically.

In addition, a graphical comparative analysis identified significant retention in the lower regions of the estuary after oxygen injection had ceased. This analysis supports long-term retention findings presented in Section 10.0 and supports the assertion that short-term drops in injected oxygen below the 40,000 lbs/day target do not reduce the effectiveness of mitigation, as described in Section 5.0.

8.0 UPRIVER MONITORING DATA ANALYSIS

THIS CHAPTER ADDRESSES SUCCESS METRIC #2, #3 AND #4 AS IDENTIFIED IN SECTION 4.0
Success Metric #2 – Determine if the injected oxygen is being retained in the water column
Success Metric #3 – Evaluate if the retained oxygen is mixing vertically and mitigating the bottom half of the water column
Success Metric #4 – Evaluate if the retained oxygen is mixing spatially to provide the necessary mitigation throughout the Savannah River and estuary

As detailed in Section 2.0 and summarized in Section 2.5.1, Upriver data were collected at 13 sondes and during 62 drift and 30 profile sampling events. This chapter describes the analysis of these data.

LINE OF EVIDENCE 4.1 – ANALYSIS OF BUOY, DRIFT, AND DYE DATA

8.1 UPRIVER SEMI-PERMANENT BUOYS

Ten Upriver semi-permanent buoys collected monitoring data during the SUR period at a depth of approximately 3.3 feet with two buoys, UR_12 and UR_16, each equipped with an additional sonde mounted along the mooring lines at approximately 9.8 feet deep (***Figure 8-1***). All buoys were in the main Savannah River channel, except for UR_15 which was located outside the channel and was used to help determine how quickly the DO was mixing across the channel. The diffuser injected oxygen at a depth near the bottom of the main channel between buoys UR_9 and UR_10. During setup for the SUR, an additional sonde was deployed in an existing standpipe near Hardeeville, located approximately two miles downstream of the diffuser. This sonde at Hardeeville was installed to capture downstream DO concentrations and quantify the impact of low DO water entering the Savannah River from tributaries and marshes. A total of 13 sondes were deployed to evaluate Upriver conditions.



Figure 8-1 Upriver Semi-Permanent Buoy Locations

The surface buoy data are shown in ***Figure 8-2*** via box and whisker plots. The *box* identifies the 25th, 50th, and 75th percentiles (bottom, middle, and top of box) while the whisker and dots identify the upper and lower DO concentrations. The lower DO concentrations occurred during the early September high freshwater flows. The box and whisker plots showed a significant increase in DO concentrations downstream of the diffuser. The following observations were made:

- Buoy UR_9 was located upstream of the oxygen injection diffuser, while Buoys UR_10 and UR_11 were in the vicinity of the diffuser but too close to the diffuser for injected oxygen to mix vertically and reach the surface sondes. The DO measurements here represent background river DO levels.
- Buoy UR_12 was located approximately 200 feet downstream of the diffuser and had two sondes collecting data, one at 3.3 feet below the surface and the second at mid-depth, about 9.8 feet deep. Both sondes had DO concentrations above background concentrations, with the surface sonde's DO concentration lower indicating the oxygen plume has started to reach the surface around this location.

- Buoy UR_15 was intentionally located outside the main river channel to help determine when the oxygen plume was mixed across the river. The DO was not completely mixed across the river at this location as shown by the lower DO concentrations.
- Buoy UR_16 was deployed with two sondes to collect data, one at 3.3 feet below the surface and the second at mid-depth, about 9.8 feet deep. These two sondes had similar DO transects confirming the oxygen was mixed top to bottom (***Figure 8-3***).
- Buoy UR_18 was located and detected where the oxygen plume was mixed across the river channel.
- The Hardeeville sonde was located approximately two miles downstream of the diffuser and showed DO concentrations that were still approximately 0.6 mg/L higher than background concentrations but lower than UR_18 due to low DO water being introduced by the tributaries between the two stations.

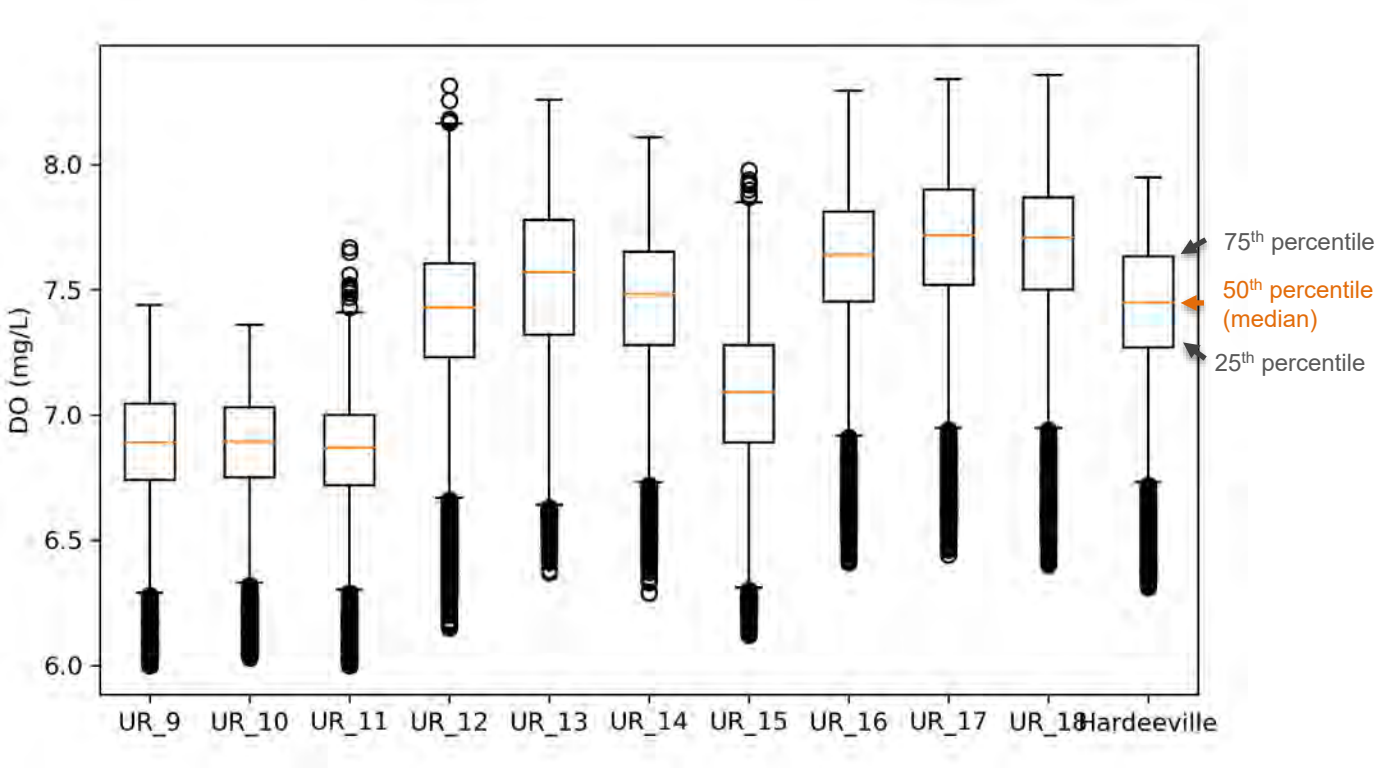

Figure 8-2 Box and Whisker Plots of DO Concentrations at the Upriver Buoys During the SUR, Diffuser located near UR_10

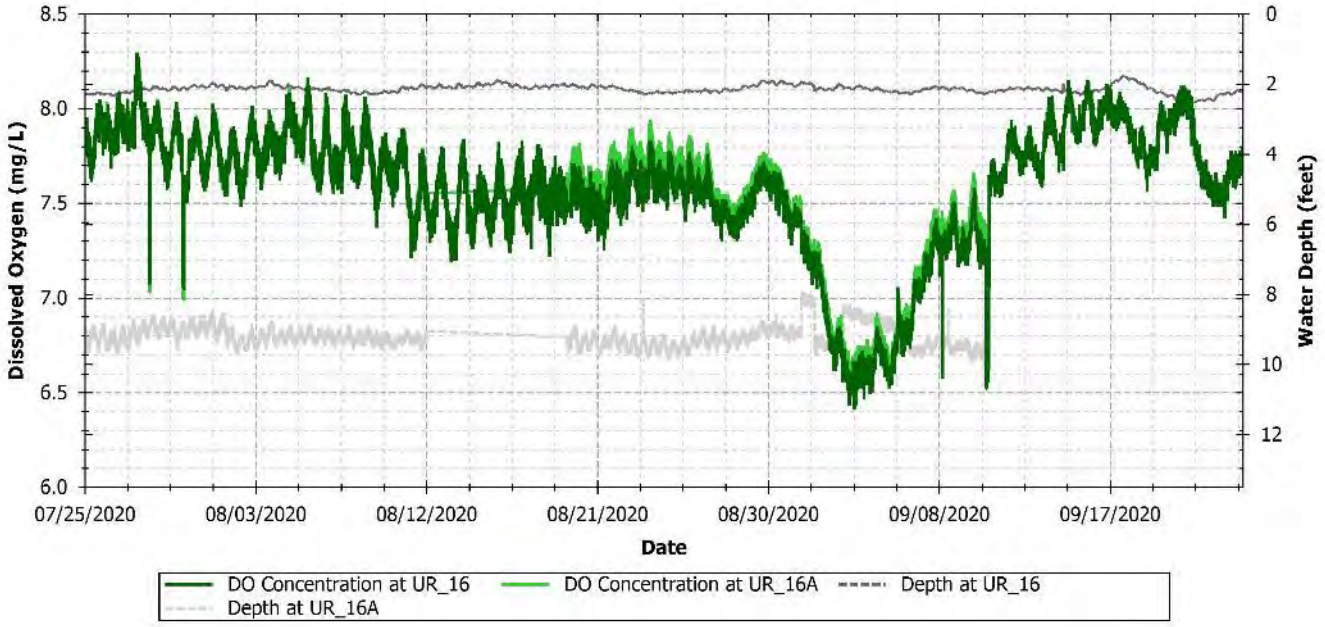

Figure 8-3 Upriver 16 and 16a Observed DO Concentration

All semi-permanent buoy data are presented in **APPENDIX A**.

LINE OF EVIDENCE 4.1 – ANALYSIS OF BUOY, DRIFT, AND DYE DATA

8.2 UPRIVER DRIFT AND PROFILE DATA

Sixty-two drift and 30 profile datasets were collected during boat sampling events throughout the SUR. A summary of the data is presented in Section 2.5.1.2. The sampling varied in time and distance depending on the objective of the event. All drift sampling began upstream of the Upriver plant and moved slowly downstream either by following the channel or taking a zigzag route (bank to bank). Certain sampling events focused on data collection in the vicinity of the diffuser, to help determine the dispersion of the oxygen plume. Other sampling events focused on extending data collection farther downstream and included sampling of the downstream tributaries, to help determine the extent of the oxygen plume and the impact of low DO water entering the river from adjacent tributaries. All Upriver drift sampling events are documented in **APPENDIX C**, including maps of the sampling event extent and drift sampling of the collected data. During dye releases (see Section 2.4 and Section 10.0), the boat sondes were also equipped with Rhodamine dye sensors. In general, the DO plume mixed in the water column quickly resulting in an elevated increase in DO ranging from 0.6 to 0.8 mg/L above background concentrations.

Five drift sampling events were selected to illustrate the impact of the oxygen injection during various river flow conditions, ranging from 6,700 to 12,000 cfs. These five were selected specifically as they encapsulate the following observations:

- The oxygen plume was mixed across the river within one mile downstream of the diffuser (***Figure 8-5***) under low flow conditions, and within 0.4 miles of the diffuser under high flow conditions (***Figure 8-10*** and ***Figure 8-11***).
- DO concentrations downstream of the oxygen injection diffuser ranged from 0.6 to 0.8 mg/L higher than background (upstream) DO concentrations (***Figure 8-5***).
- The tributaries flowing into the Savannah River contributed water with low DO concentrations and gradually lowered the river's DO as they flowed downstream (***Figure 8-11***).
- The extent of tidal influence is approximately RM 27.8, near the I-95 bridge. The benefits of Upriver oxygen injection were detected downstream to RM 21 near the GA 25 bridge (***Figure 8-12***).

8.2.1 Upriver Drift Sampling – July 24, 2020

The July 24, 2020 boat drift conducted a zig-zag pattern route for the first mile downstream of the diffuser, as illustrated in ***Figure 8-4***, then directly down the main channel for a further two miles downstream. The Savannah River flow was approximately 6,700 cfs at the time of this sampling event.

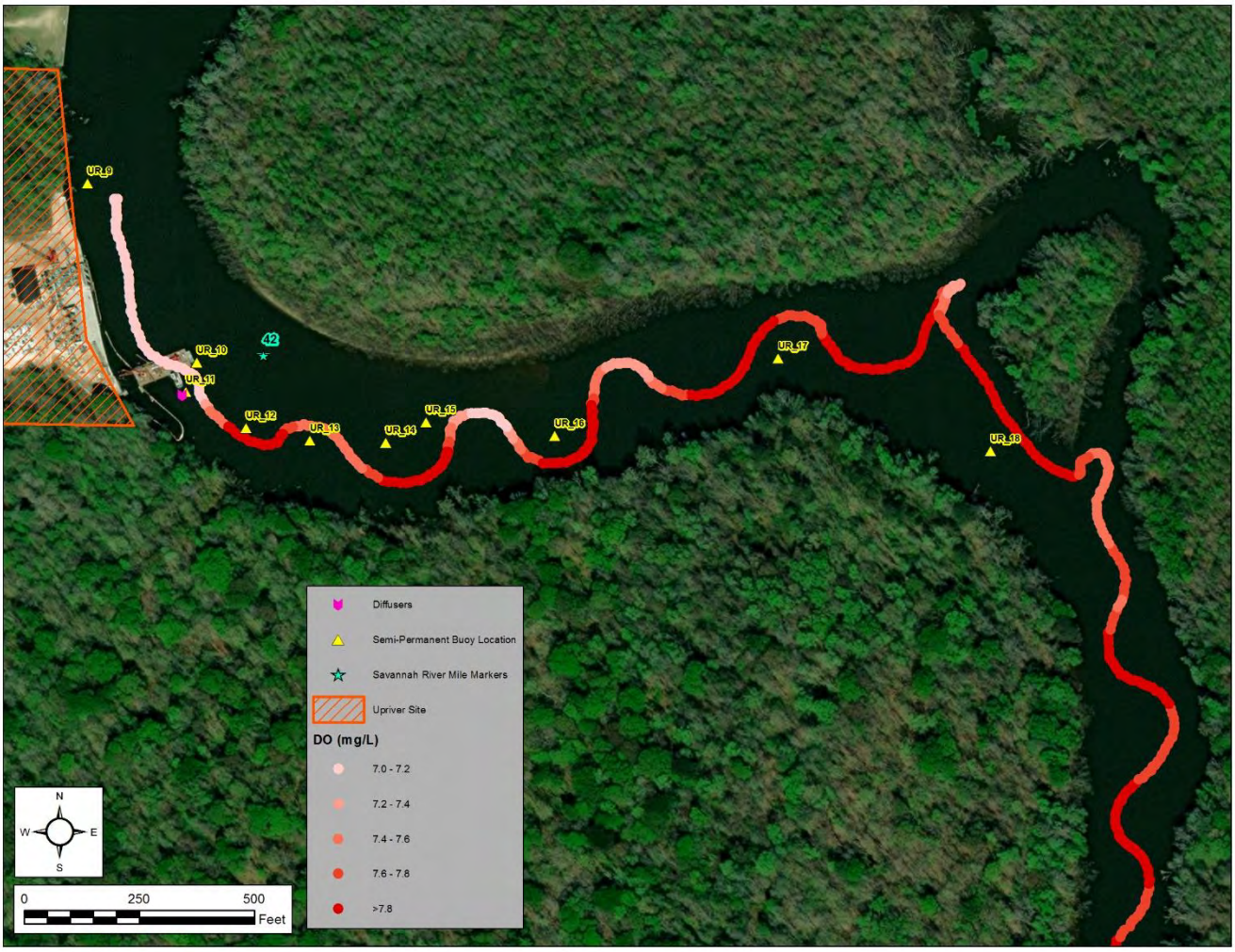

Figure 8-4 Upriver Drift Sampling – July 24, 2020

The following observations were made from the sampling event and the results presented in ***Figure 8-4*** and ***Figure 8-5***:

- The oxygen plume mixed across the river by the time it reached one mile downstream of the diffuser. Due to the low river flows, the oxygen plume took longer to mix into the water column than it would under a high flow condition (see Section 8.2.4 for comparison).
- Upstream DO concentrations were 6.9 mg/L, and at one mile downstream the DO levels were 7.6 mg/L.
- The tributaries flowing into the lower Savannah River had low DO (see RM 40.3) in ***Figure 8-5***.

The DO concentrations in the lower two-mile section remained relatively constant, only decreasing slightly due to incoming tributary flows with low DO concentrations. This indicated that most of the injected oxygen was mixed throughout the water column and was retained in the water, not transferring to the atmosphere, even during low river flows.

LINE OF EVIDENCE 2.3 – NO EFFERVESCENCE OBSERVED

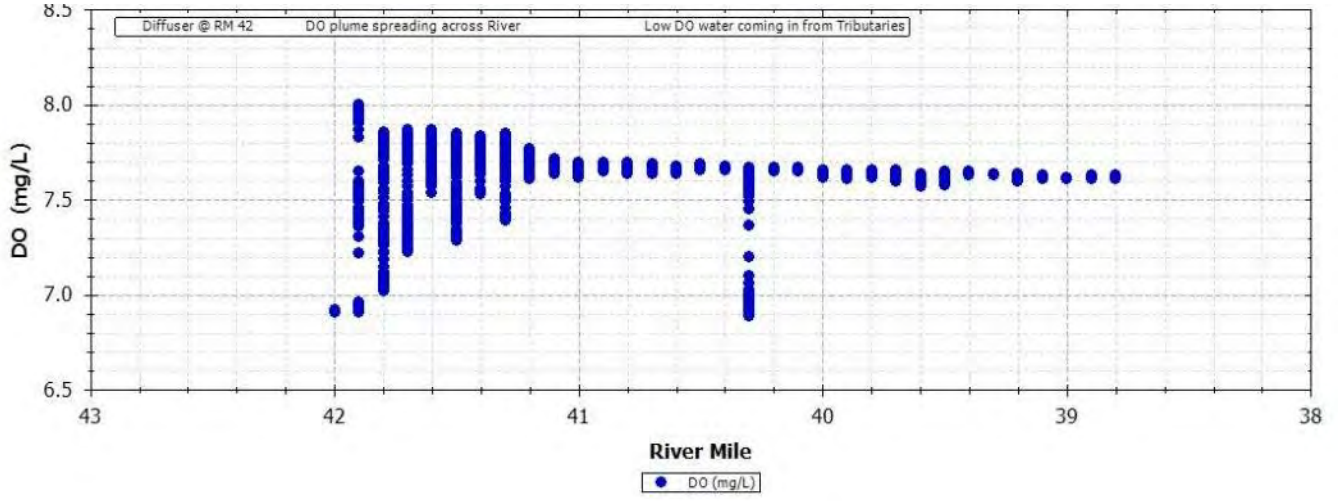

Figure 8-5 Savannah River DO transect – July 24, 2020

8.2.2 Upriver Drift Sampling – July 28, 2020

The July 28, 2020 drift event was conducted at a higher river flow of 8,500 cfs and is illustrated in ***Figure 8-6***. This event provides further evidence of the impact of the injected oxygen system during a period of drift data collection when the plant was not operating (that is, undergoing maintenance). At 9 am, before the start of data collection, the instantaneous plant load was measured at 26,265.6 lbs/day. DO measurements (top of ***Figure 8-6***) were collected upstream and downstream of the diffuser while the plant was operating, with the surface DO concentrations downstream of the diffuser ranged between 0.1 mg/L and 0.8 mg/L higher than the upstream background concentrations.

At approximately 9:30 am, the oxygen load from the plant began to decline and reached a plant load of zero at 9:45 am. DO measurements (bottom of ***Figure 8-6***) were collected upstream and downstream of the diffuser when the oxygen system was not operating. No discernible difference in DO concentrations was detected between upstream and downstream of the diffuser, indicating the increased DO seen in top figure is solely due to the injected oxygen.

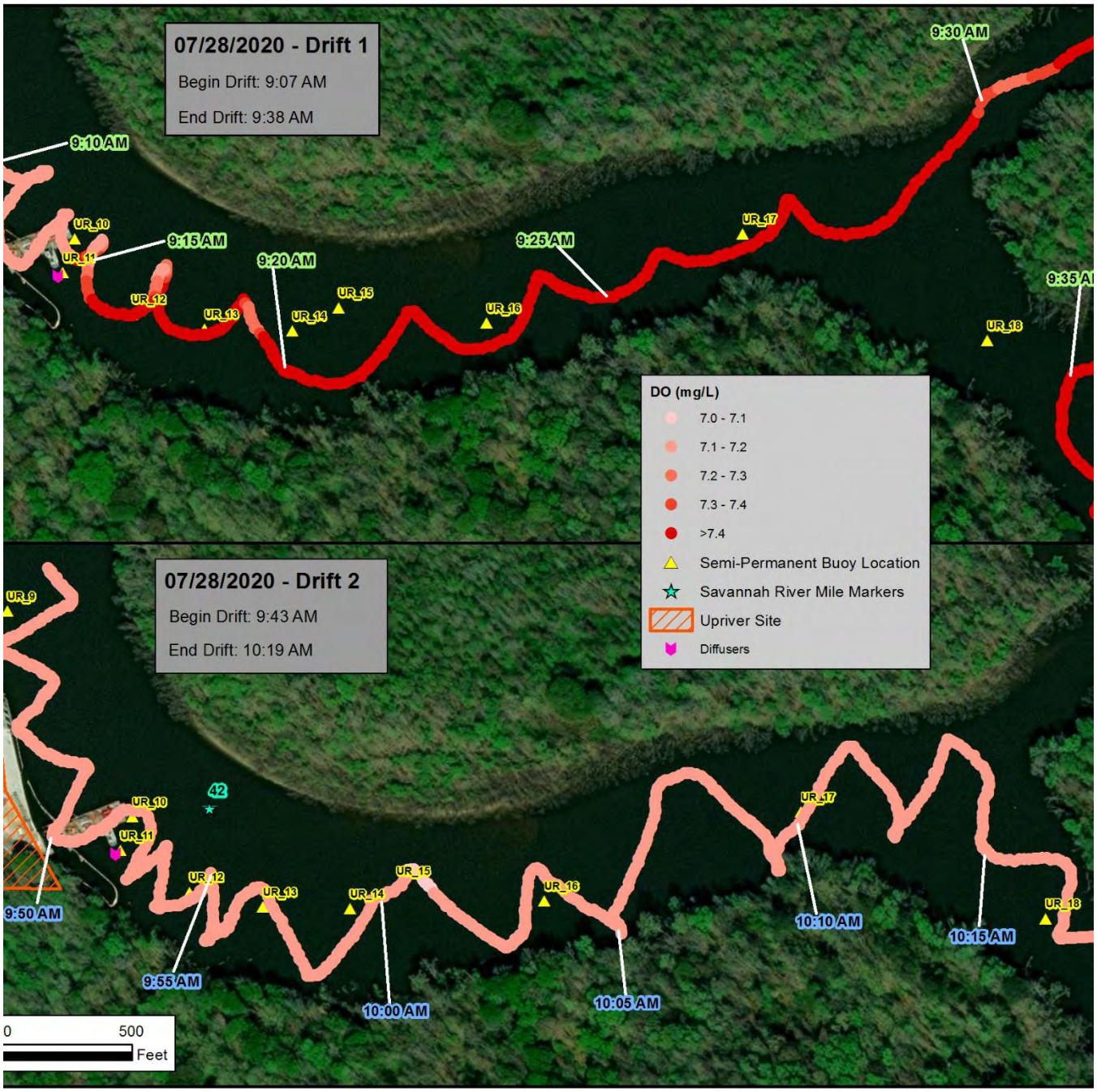

Figure 8-6 Upriver Drift Sampling – July 28, 2020

8.2.3 Upriver Drift Sampling – August 5, 2020

The August 5, 2020 boat drift conducted a zig-zag pattern route from upstream of the diffuser to three miles downstream, as illustrated in ***Figure 8-7*** and ***Figure 8-8***. The Savannah River flow was approximately 8,000 cfs. The DO was completely mixed throughout the water column by UR_18, as indicated by the uniform coverage (red dots) bank to bank. Also, the tributaries flowing into the lower Savannah River contributed water with low DOs in comparison, slightly lowering the river's DO concentrations (see ***Figure 8-8*** immediately downstream of UR_18 where low DO water enters from the oxbow).

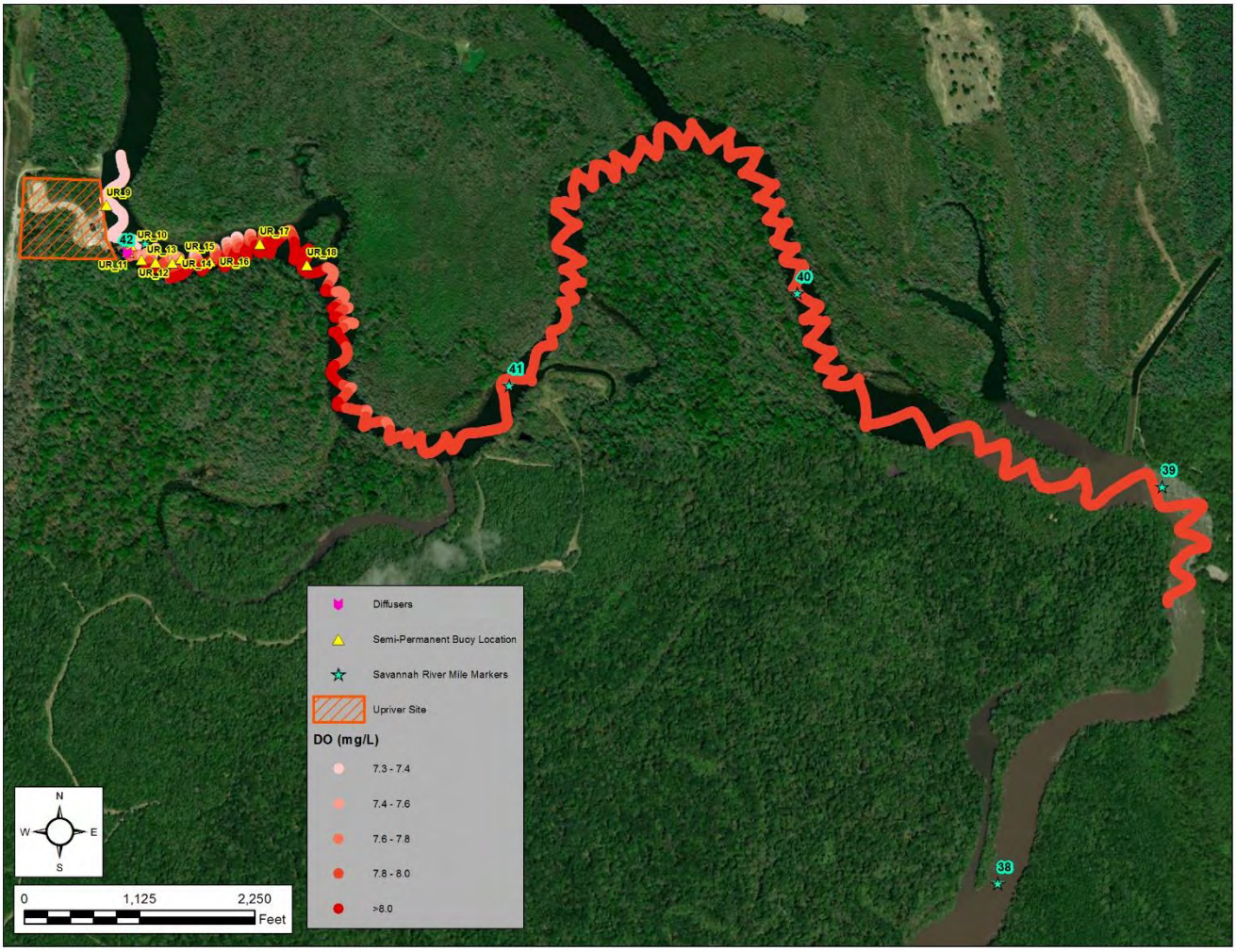

Figure 8-7 Upriver Drift Sampling – August 5, 2020

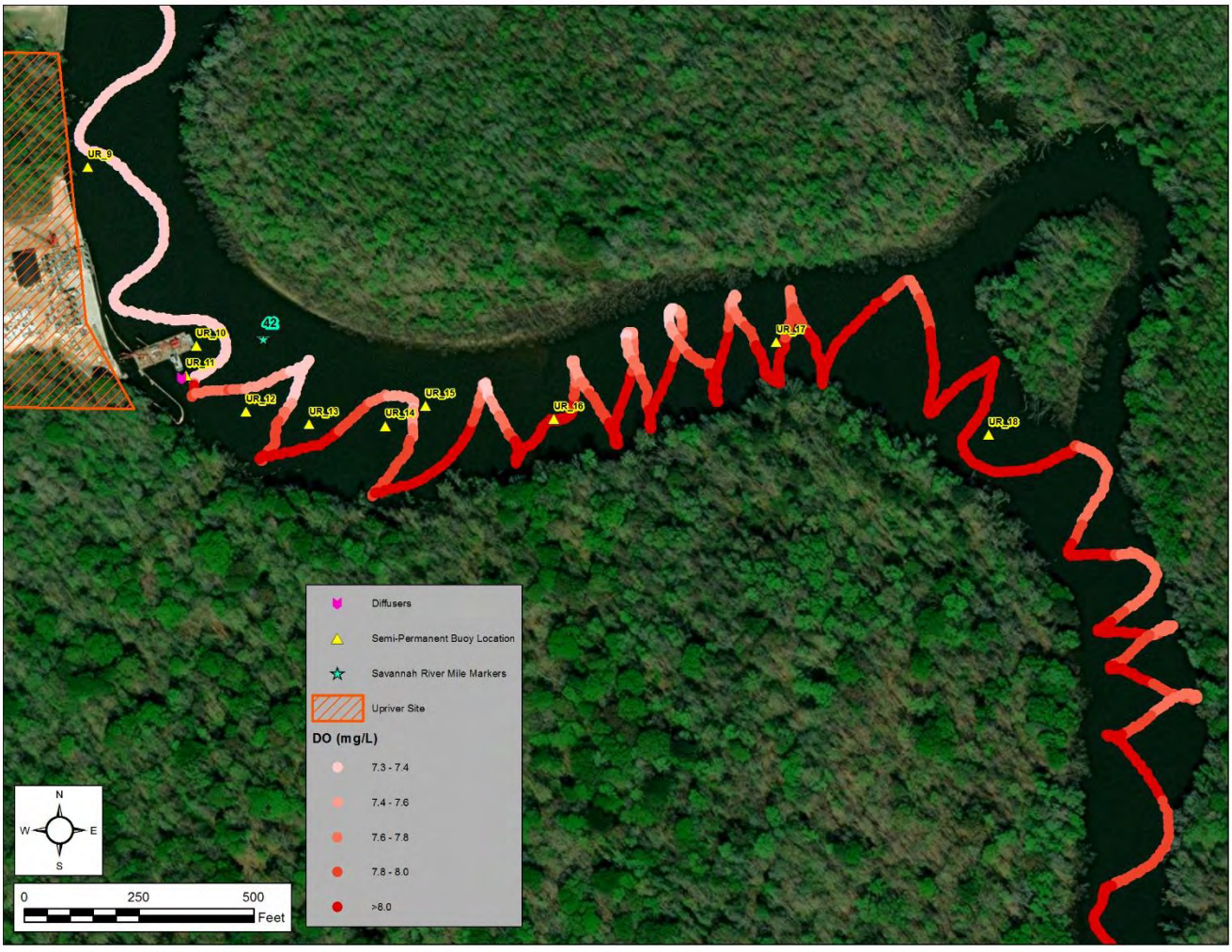

Figure 8-8 Upriver Drift Sampling – August 5, 2020 (inset)

Figure 8-9 shows the DO versus RM cross-section measurements averaged over each 0.1 miles. The injected oxygen load was completely mixed by RM 41.5, indicated by the narrow band in recorded concentrations. Here, injected oxygen raised the Savannah River's DO by 0.6 mg/L (from 6.85 to 7.45 mg/L). At RM 41.4, low DO water flowed in from the oxbow tributary and then was completely mixed again at RM 41 with a resultant river DO of 7.4 mg/L, a small but noticeable reduction of 0.05 mg/L.

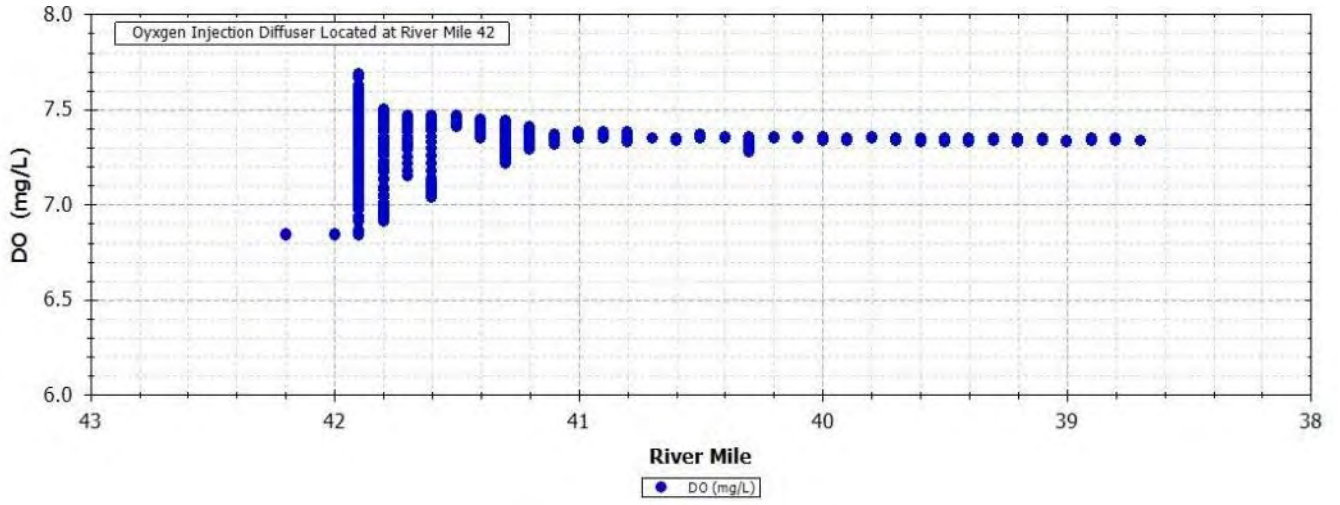

Figure 8-9 Savannah River DO Transect – August 05, 2020

8.2.4 Upriver Drift Sampling – September 1, 2020

The September 1, 2020 boat drift conducted a detailed zig-zag sampling from upstream of the diffuser to three miles downstream, as illustrated in ***Figure 8-10***. The Savannah River flow was high, approximately 12,000 cfs, at the time of this sampling event.

The results were similar to the August 5, 2020 event, but additional emphasis was placed on obtaining more detailed tributary samples and evaluating the effect of high river flows. The following observations were made:

- The oxygen plume mixed across the river by the time it reached buoy UR_18, 0.4 miles downstream of the diffuser. Prior to that, the plume had not mixed bank to bank, as indicated by the white data points near the northern bank. This is significantly less than the one mile it took for complete mixing to occur under a low flow condition, as previously described in Section 8.2.1.
- Upstream DO concentrations were 6.8 mg/L; however, at buoy UR_18 the DO levels had increased 0.6 mg/L to 7.4 mg/L, where the DO was completely mixed throughout the water column.
- The tributaries flowing into the lower Savannah River contributed water with low DOs. These can be seen in ***Figure 8-11*** at RM 41.3, 40.3, and 39.1.

The DO concentrations in the three-mile stretch remained relatively constant, only being lowered slightly by incoming tributary flows with low DO. This indicated the injected oxygen was mixed throughout the water column, was retained in the water, and did not transfer to the atmosphere.

LINE OF EVIDENCE 2.3 – NO EFFERVESCENCE OBSERVED

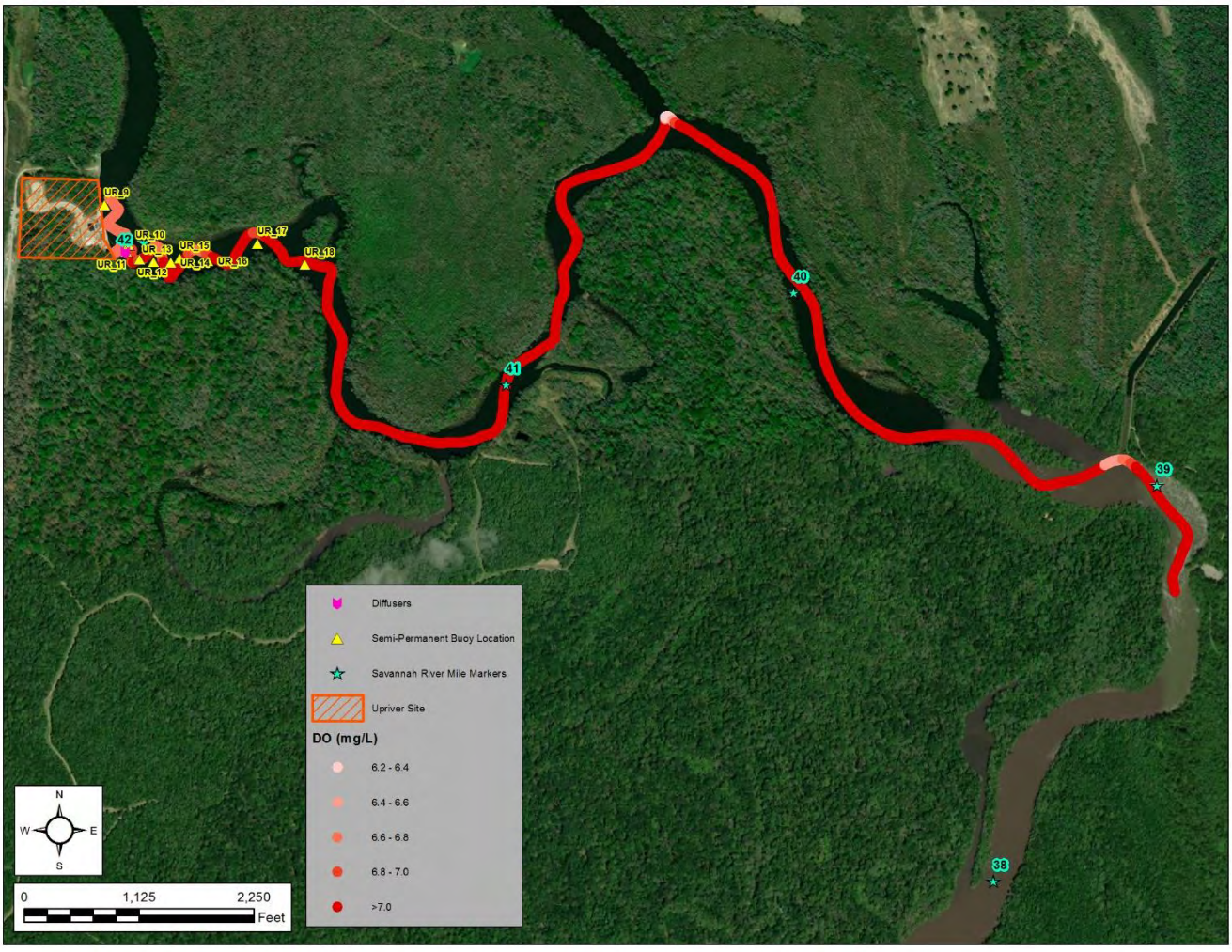

Figure 8-10 Upriver Drift Sampling – September 1, 2020

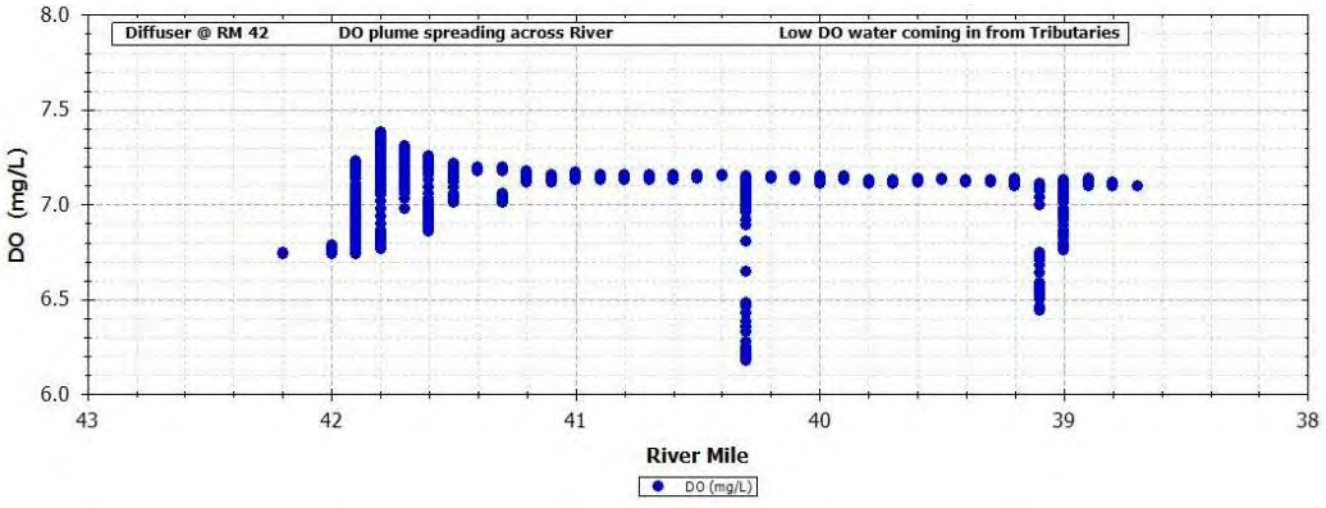

Figure 8-11 Savannah River DO Transect – September 01, 2020

8.2.5 Upriver Drift Sampling – September 16, 2020

The September 16, 2020 boat drift consisted of extensive main channel sampling from upstream of the Upriver diffuser downstream to RM 21, below the I-95 bridge. The longitudinal DO transect per RM is presented in ***Figure 8-12***. The Savannah River flow had reduced since early September 2020 to approximately 7,400 cfs. The Savannah River DO decreased downstream, both due to the low DO from incoming tributaries and the impact of the tides moving lower Harbor DO water upstream. The limit of tidal influence is approximately RM 27.8, as identified in Section 7.1, and this is supported by the results in ***Figure 8-12***, given a noticeable reduction occurs here. Another sizeable reduction is evident at RM 21 near the GA 25 bridge and the extent of harbor deepening.

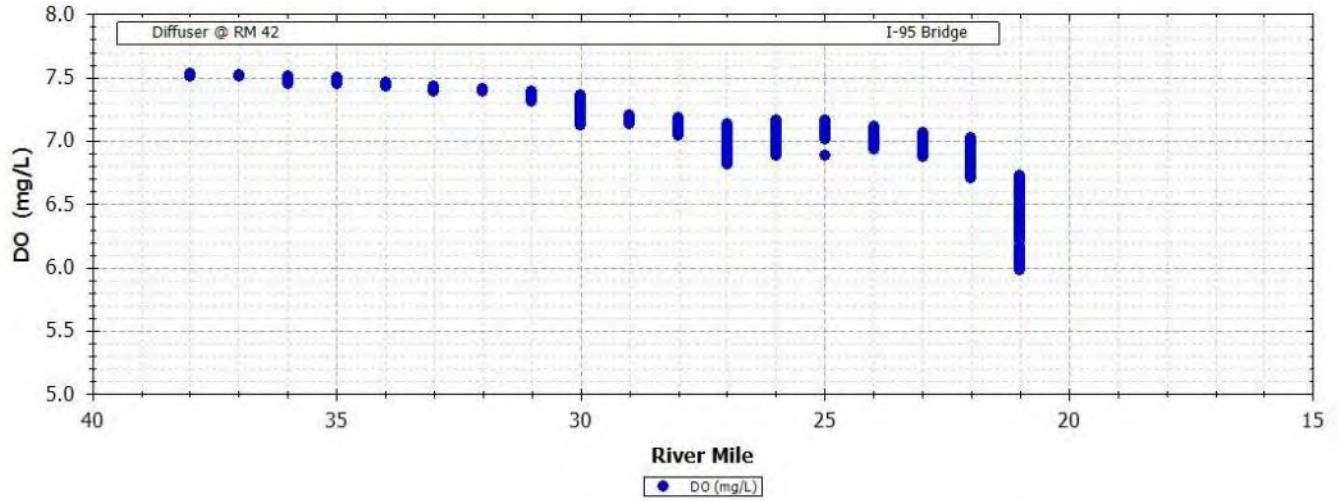

Figure 8-12 Savannah River DO Transect – September 16, 2020

LINE OF EVIDENCE 4.1 – ANALYSIS OF BUOY, DRIFT, AND DYE DATA

8.3 SUMMARY

The impact of the Upriver oxygen injection plant was relatively easy to discern due to unidirectional flow, lack of tidal influence, and the confined nature of the upper Savannah River. It can be quantified by comparing background DO concentrations upstream of the Upriver plant diffuser to the DO concentrations measured downstream of the diffuser.

Upriver semi-permanent buoy, profile, and boat drift data were collected during the SUR period. With the oxygen injection system operating, DO concentrations downstream of the Upriver plant increased between 0.5 and 1.0 mg/L, depending on the flow of the Savannah River and the output of the Upriver plant. The injected oxygen plume expanded as it moved downstream of the Upriver diffuser dispersing from bottom to surface and side to side. By the time the plume traveled 0.4 miles downstream from the diffuser, the oxygen was well mixed throughout the water column. The plume was also well mixed spatially across the river by this location under high flow conditions, but under low flow conditions, full mixing did not occur until one mile downstream of the diffuser.

Along with the injected oxygen plume being well mixed into the receiving water, there was no observed effervescence, bubbling or surface disturbances near the Upriver diffuser.

The benefits of the injected oxygen from the Upriver plant were detected downstream of the I-95 bridge and into the zone of tidal influence.

9.0 DOWNRIVER MONITORING DATA ANALYSIS

THIS CHAPTER ADDRESSES SUCCESS METRIC #2, #3 AND #4 AS IDENTIFIED IN SECTION 4.0

Success Metric #2 – Determine if the injected oxygen is being retained in the water column
Success Metric #3 – Evaluate if the retained oxygen is mixing vertically and mitigating the bottom half of the water column
Success Metric #4 – Evaluate if the retained oxygen is mixing spatially to provide the necessary mitigation throughout the Savannah River and estuary

9.1 FRONT RIVER DRIFT AND PROFILE DATA

As detailed in Section 2.0 and summarized in Section 2.5.2, Front River data were collected at one sonde and during 30 drift and 305 profile sampling events. Three semi-permanent buoys were deployed but removed before the start of the SUR due to channel dredging activities in this area. This chapter describes the analysis of these data.

Similar to approaches employed Upriver, boat sampling drifts either followed the channel or took a zig-zag route going bank to bank. The observed DO increased in the vicinity of the oxygen injection diffuser. The direction of drift sampling was selected depending on the tide. During incoming (flood) tides, the oxygen plume moved upstream and during outgoing (ebb) tides, the oxygen plume moved downstream. The injected oxygen plume was initially concentrated along the west bank and expanded as it moved upstream or downstream of the diffuser, mixing bottom to surface and side to side. Because of the tidal and dynamic nature of the Front River, determining the spatial and vertical DO improvements caused by oxygen injection could not be quantified by boat sampling alone. The Front River field monitoring analysis was augmented by evaluating the USGS station data and the modeling data to provide a more complete assessment approach. The USGS data are in Section 7.0 and the modeling results are in Section 11.0. During the SUR sampling events, there was no observed effervescence, bubbling, or surface disturbances near the Front River diffuser.

Three drift and profile sampling events were selected to illustrate the impact of the oxygen injection in the Front River. These three were selected specifically as they encapsulate the following observations:

- During all the sampling events, there was no observed effervescence, bubbling, or surface disturbances near the diffuser.
- The injected oxygen was more pronounced at mid-depth (***Figure 9-2***) than the surface (***Figure 9-1***).
- Injected oxygen was mixed throughout the water column and dispersed into both the bottom and the top of the water column layers during spring tides (***Figure 9-6***). Stratification was evident during neap tides (***Figure 9-5***). The Front River behaved differently during neap and spring tides.
- Increased DO levels were measured upstream beyond the turning basin (RM 19) and downstream beyond the GA 17 bridge (***Figure 9-3***).
- Analyses of the Front River dye data (Section 10.2), collected during selected boat sampling events, indicated the injected oxygen remained in the Front River system for over a month during summer low flow conditions.

All profile and drift sampling events are documented in **APPENDIX B** and **APPENDIX C**, including maps of the sampling extent and graphs of the collected data. During dye releases, the boat sondes were also equipped with Rhodamine dye sensors (Section 10.2).

9.1.1 Front River Drift Sampling – August 17, 2020

On August 17, 2020, targeted boat sampling was conducted in the vicinity of the Front River oxygen injection diffuser. Sampling consisted of multiple zig-zag patterns around the diffuser over a two-hour high slack tide using two sondes, one at the surface (3.3 feet deep) and the other sonde at mid-depth (13.2 feet deep). ***Figure 9-1*** illustrates results collected using the surface sonde. The white dots represent the background DO levels around 2.6 to 3.0 mg/L and the pink to red dots represent DO values ranging from 3.0 to 5.2 mg/L, demonstrating the positive effects of the injected oxygen. ***Figure 9-2*** illustrates the results collected using the mid-depth sonde, with more red dots evident than in ***Figure 9-1*** as the injected oxygen was well distributed at the lower depth. This outcome agreed with the design intent of the diffuser whereby oxygen is injected into and retained primarily in bottom waters.

LINE OF EVIDENCE 4.1 – ANALYSIS OF BUOY, DRIFT, AND DYE DATA

During this sampling event when a significant portion of time was spent in the vicinity of the Front River diffuser, there was no observed effervescence, bubbling, or surface disturbances.

LINE OF EVIDENCE 2.3 – NO EFFERVESCENCE OBSERVED



Figure 9-1 Front River Drift Sampling – August 17, 2020 (surface)



Figure 9-2 Front River Drift Sampling – August 17, 2020 (mid-depth)

9.1.2 Front River Profile Sampling – August 28, 2020

On August 28, 2020, multiple Front River DO profiles were measured on an ebb tide between the I-95 bridge and Fort Pulaski. High DO concentrations entered the Front River from upstream, aided by the oxygen injection from the Upriver plant (Section 8.2.5), sharply decreased around the turning basin (RM 19), then increased by the Front River diffuser, and then decreased downstream near Fort Pulaski. ***Figure 9-3*** illustrates the change in surface DO values in the Front River, as described. While DO concentrations change, the beneficial effects of both the Upriver and Front River oxygen injection are evident from these profiles. ***Figure 9-4*** shows the stratified upper and lower layer over a longitudinal DO profile.

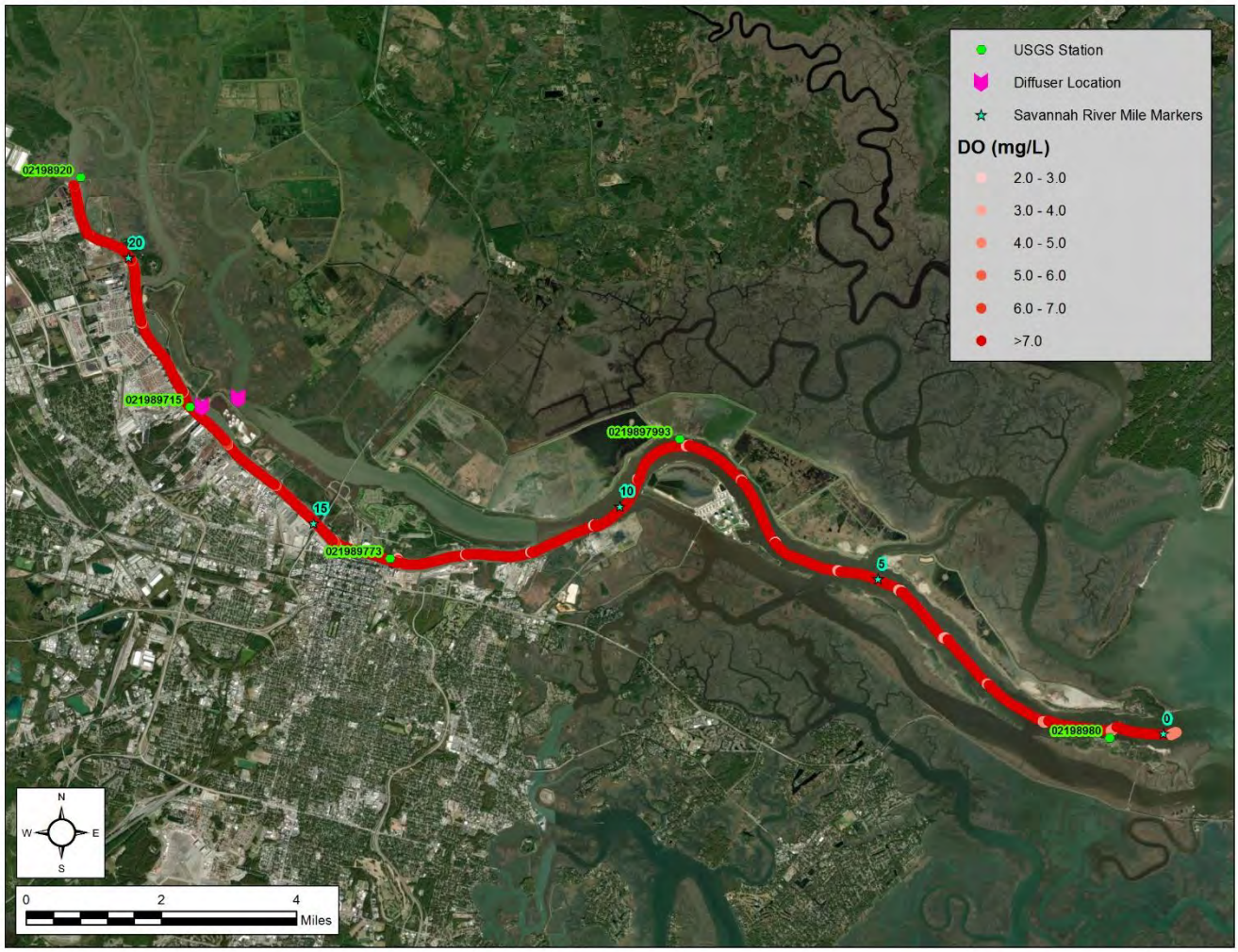

Figure 9-3 Front River Profile Sampling – August 28, 2020

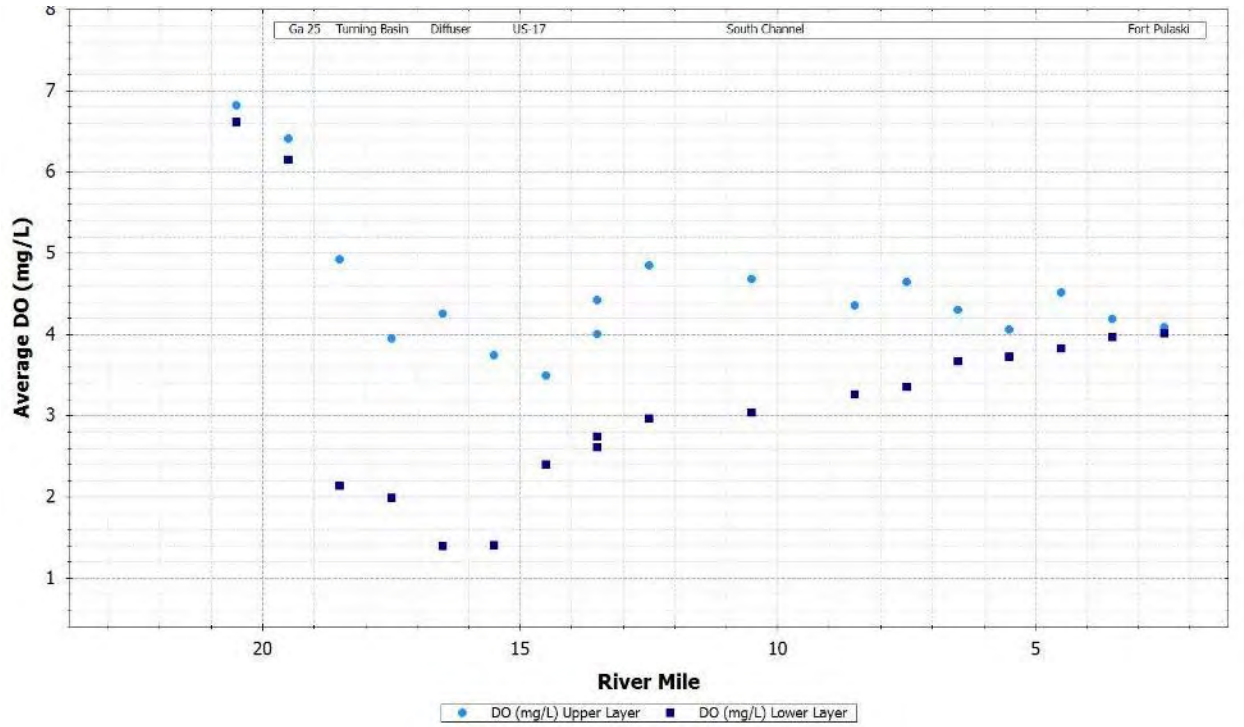

Figure 9-4 Front River DO Profiles – August 28, 2020

9.1.3 Front River Profile Sampling – September 04 and 17, 2020

During a neap tide on September 04, 2020, and a spring tide on September 17, 2020, detailed Front River profile sampling was conducted. The difference between concentrations in the upper and lower layer in ***Figure 9-5*** and the similarities in concentrations in the upper and lower layers in ***Figure 9-6*** illustrate the stratification that occurred during neap tides and the top-to-bottom mixing that occurred during spring tides. During spring tides, the injected DO mixes throughout the water column as the Front River destratified and the impacts of the injected oxygen mixed throughout the system.

LINE OF EVIDENCE 3.2 – ANALYSIS OF PROFILE AND DYE DATA

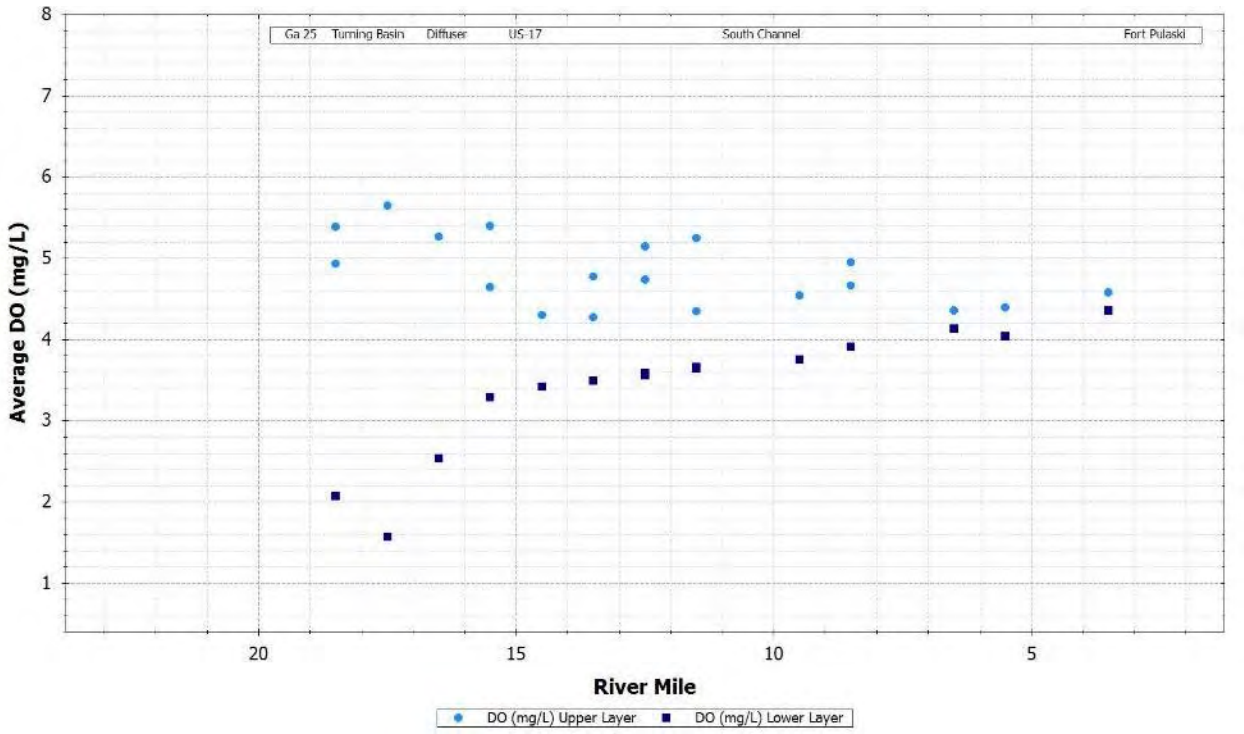

Figure 9-5 Front River DO Profiles – September 04, 2020 (Neap Tide)

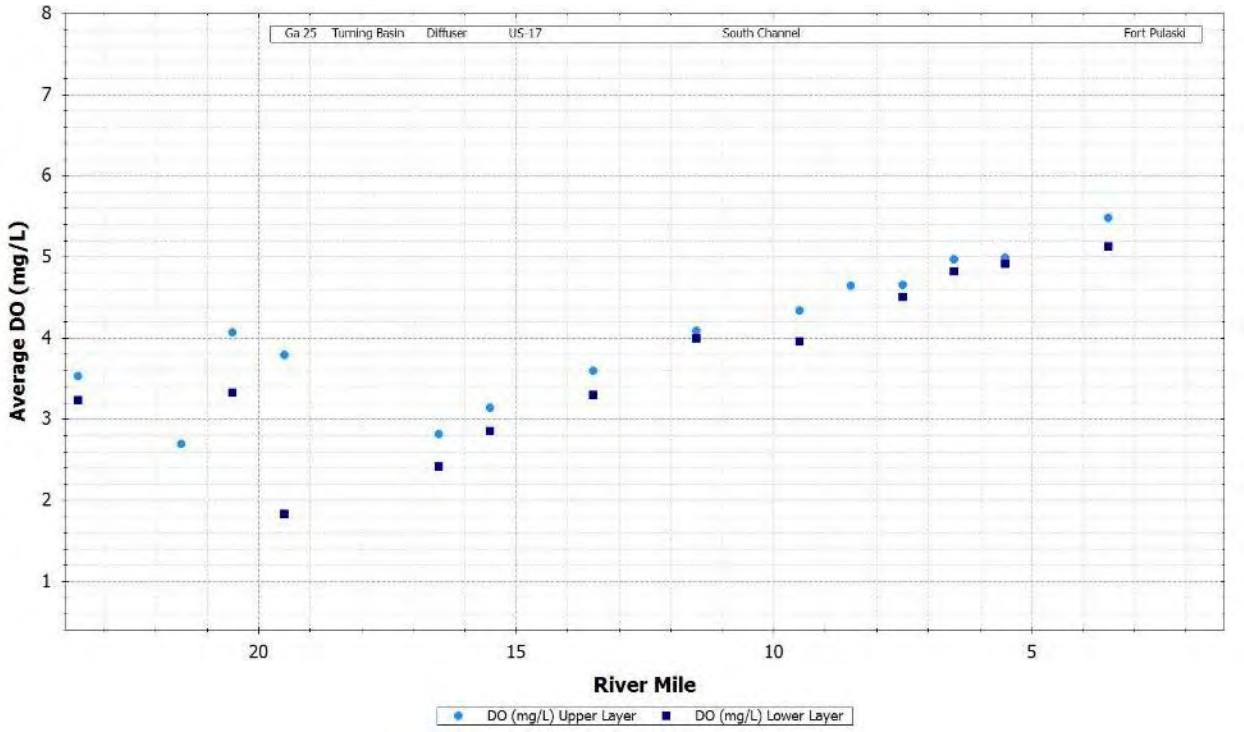

Figure 9-6 Front River DO Profiles – September 17, 2020 (Spring Tide)

9.2 BACK RIVER MONITORING DATA

As detailed in Section 2.0 and summarized in Section 2.5.3, Back River data were collected at eight sondes and during 32 drift and 36 profile sampling events. This chapter describes the analysis of these data.

Because of the tidal and dynamic nature of the Back River and Little Back River, determining the vertical and spatial DO improvements caused by oxygen injection could not be quantified by just the buoy or boat sampling alone. The buoy and drift sampling measured the oxygen plume as the plume mixed into the Back River but could not measure the cumulative impact of the injected oxygen over several weeks. The Back River field monitoring analysis was augmented by evaluating the USGS station data and the modeling data to provide a more complete assessment approach. The USGS data are in Section 7.0 and the modeling results are in Section 11.0. During all the sampling events, there was no observed effervescence, bubbling, or surface disturbances near the Back River diffuser.

LINE OF EVIDENCE 2.3 – NO EFFERVESCENCE OBSERVED

9.2.1 Back River Buoy Data Analysis

Eight semi-permanent buoys were placed in the Back River. Buoys LBR_8 through LBR_5 were located upstream of the Back River diffuser, and buoys LBR_4 through LBR_1 were located downstream of the Back River diffuser (as labeled in ***Figure 9-8***). During ebb tides, the river flows downstream and during flood tides, the river flows upstream. Therefore, the injected oxygen plume would transport downstream of the diffuser during ebb tides and upstream of the diffuser during flood tides. Since the injected oxygen plume was being moved both up and downstream and was being well mixed in the system, the average DO values at all eight buoys were relatively similar. The lack of discernible difference between buoys in ***Figure 9-7*** for both flood and ebb tides supports this statement.

Additional details regarding the Back River buoy data are provided in **APPENDIX A.**

LINE OF EVIDENCE 4.1 – ANALYSIS OF BUOY, DRIFT, AND DYE DATA

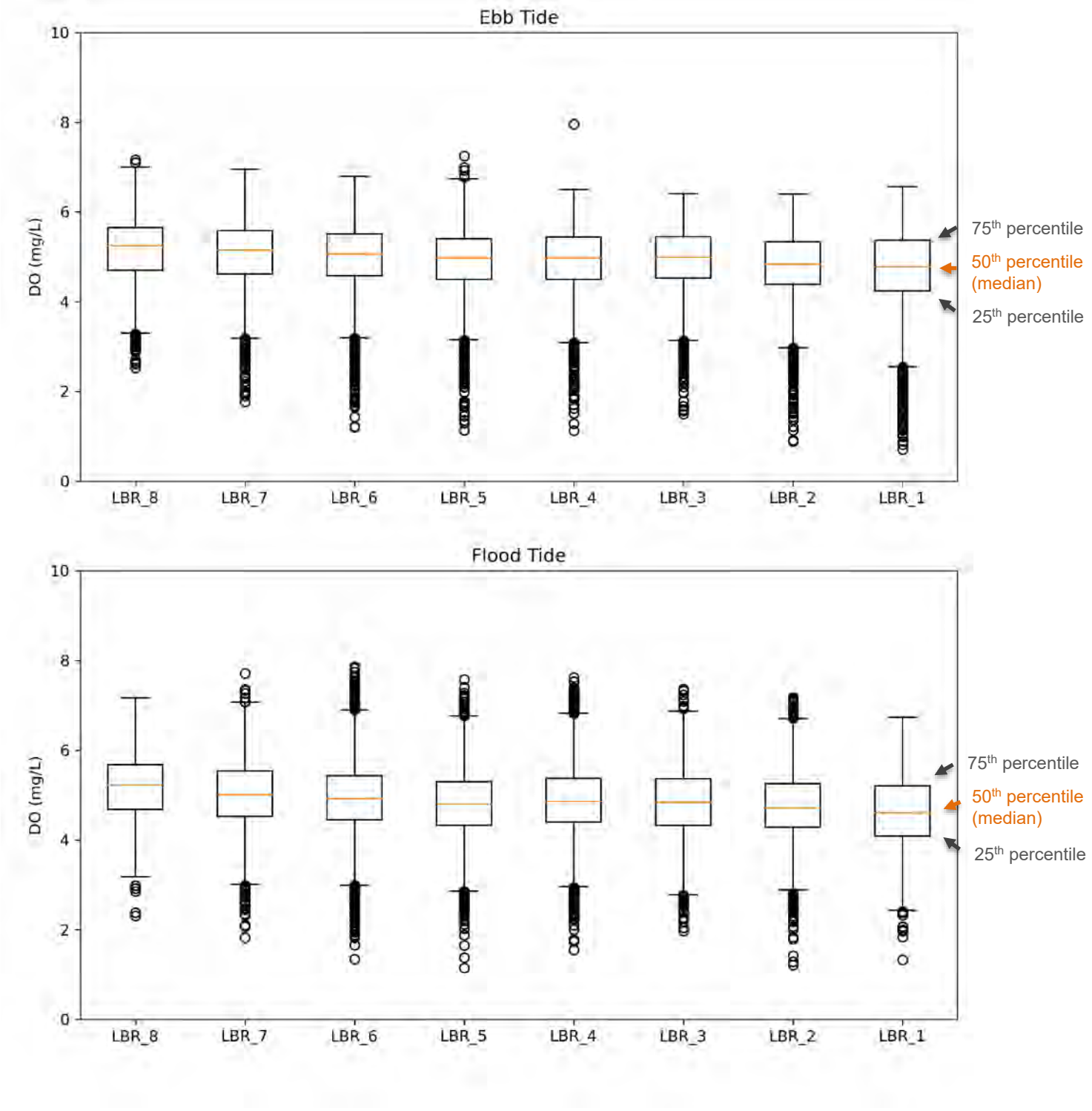

Figure 9-7 Box and Whisker Plots of Back River Buoy Data During Flood and Ebb Tides. The Back River Diffuser is Located Between LBR_5 and LBR_4.

9.2.2 Back River Drift and Profile Data

Data were collected during 32 separate boat drift and 36 profile sampling events during the SUR period. The sampling events varied in time and distance depending on the objectives for sample collection. Certain sampling events focused on data collection in the vicinity of the diffuser, to help determine the dispersion of the oxygen plume, while other sampling events focused on data collection extending farther upstream and downstream to determine the overall DO longitudinal profile of the Little Back River. All profile and drift sampling events are documented in **APPENDIX B** and **APPENDIX C**, including maps of the sampling extent and graphs of the collected data. During dye releases, the boat sondes were also equipped with Rhodamine dye sensors (Section 10.3).

Three drift and profile events were selected to illustrate the various impacts of the oxygen injection in the Back River. These three were selected specifically as they encapsulate the following observations:

- During all the sampling events, there was no observed effervescence, bubbling, or surface disturbances near the diffuser.
- The injected oxygen mixed vertically throughout the water column.
- The injected oxygen plume did not completely mix across the channel until the tide reversed (***Figure 9-9***).
- The injected oxygen stayed in the Back River over several tidal cycles raising the DO.
- The amount of time the DO stayed in the Little Back River depended on upstream flows and tidal conditions. The benefits of the Downriver plant, the Upriver plant, and a separate mitigation project (McCoy's Cut freshwater flow rerouting) were evident (***Figure 9-11***).

LINE OF EVIDENCE 2.3 – NO EFFERVESCENCE OBSERVED

9.2.3 Back River Drift Sampling – July 23, 2020

On July 23, 2020, drift data were collected during a flood tide around the Back River diffuser. Upstream, DO concentrations were approximately 1.0 mg/L higher near the central and west side of the channel than DO concentrations in the water flowing in from the Front River on the downstream side. The higher DO concentrations are shown in red in ***Figure 9-8***. The plume was well mixed vertically but still not mixed side to side.

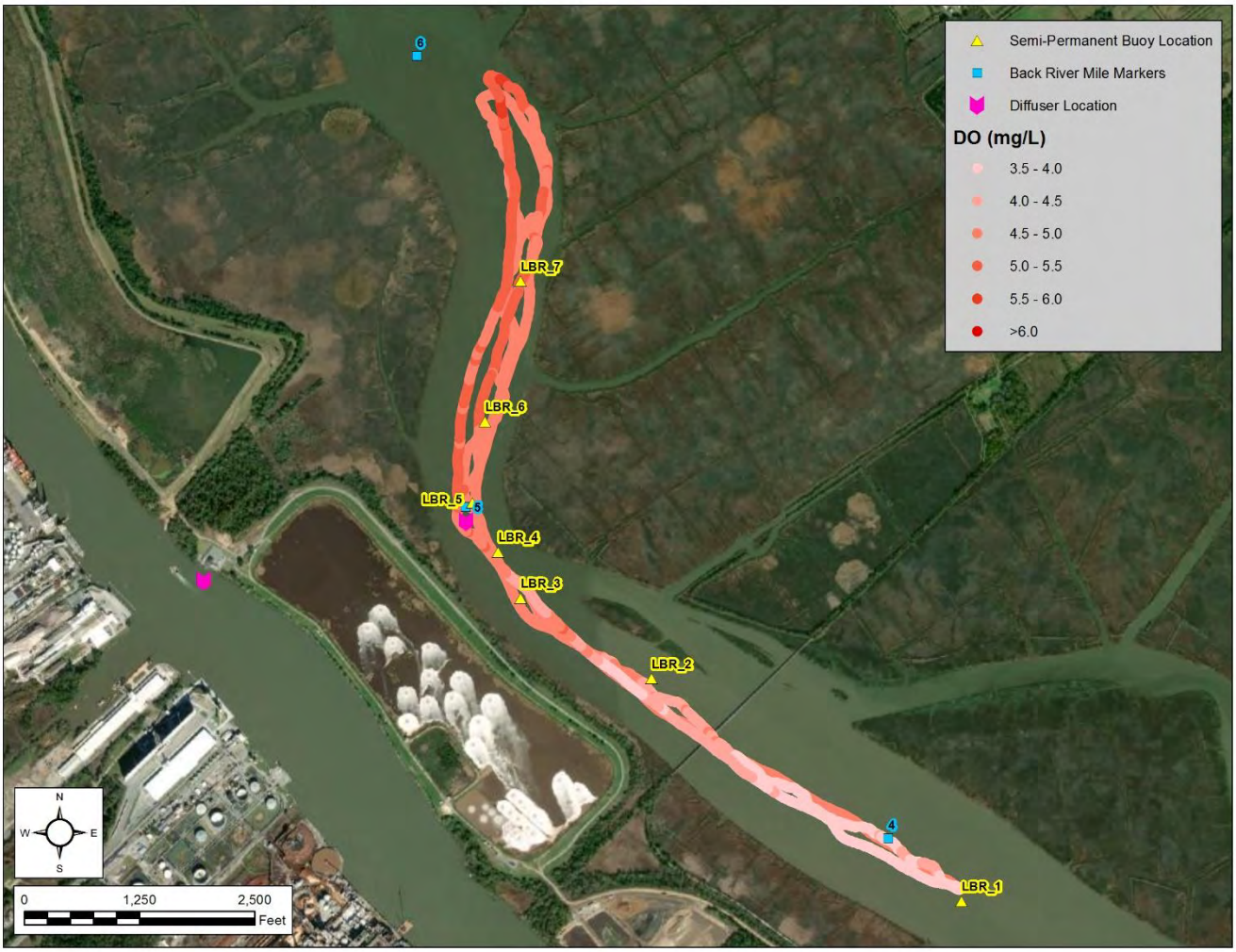

Figure 9-8 Back River Drift Sampling – July 23, 2020

9.2.4 Back River Drift Sampling – August 17, 2020

On August 17, 2020, detailed sampling was taken around the Back River diffuser by both a surface and mid-depth sonde during high tide. The drift data show that the higher DO plume was detectable in the vicinity of and downstream of the Back River diffuser. ***Figure 9-9*** shows the surface oxygen plume (darker red dots) primarily hugging the eastern bank of the channel upstream of the diffuser but completely mixed across the channel downstream of the diffuser. The drift data collected using the mid-depth sonde showed a similar pattern, indicating the oxygen plume was well mixed vertically.

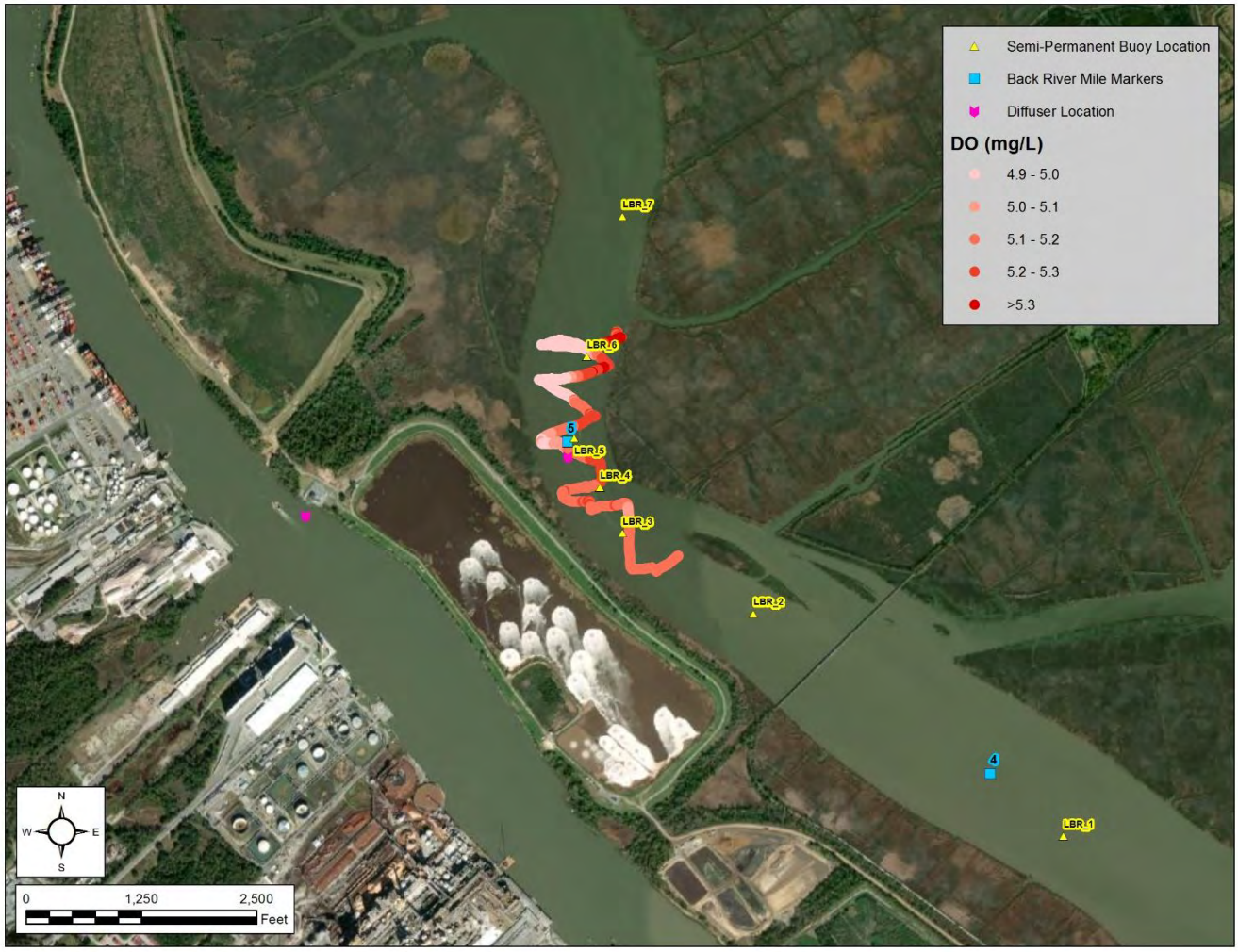

Figure 9-9 Back River Drift Sampling – August 17, 2020 (surface)

9.2.5 Back River and Little Back River Drift and Profile Sampling – September 17, 2020

During the sampling event on September 17, 2020, spring tides moved the oxygen plume further upstream past the GA 25 bridge (RM 9) as seen in ***Figure 9-10*** and illustrated by the depth averaged longitudinal DO profile in ***Figure 9-11***. The injected oxygen is retained within the water column, shifting back and forth with the tides. Without the injected oxygen, it is estimated the DO during this sampling event would peak at 4.2 mg/L. The injected oxygen from the Back River diffuser appears to contribute up to 1.0 mg/L more. The findings from this event agree with the description in Section 7.2, whereby the oxygen plume from the Back River diffuser is only able to reach GA 25 and the USGS station (021989792) during spring tides. The influx of high DO freshwater flow from upstream, aided by the McCoy's Cut freshwater flow rerouting mitigation project, is evident in both ***Figure 9-10*** and ***Figure 9-11*** and prevents the oxygen plume from moving significantly up the Little Back River under other tidal conditions.

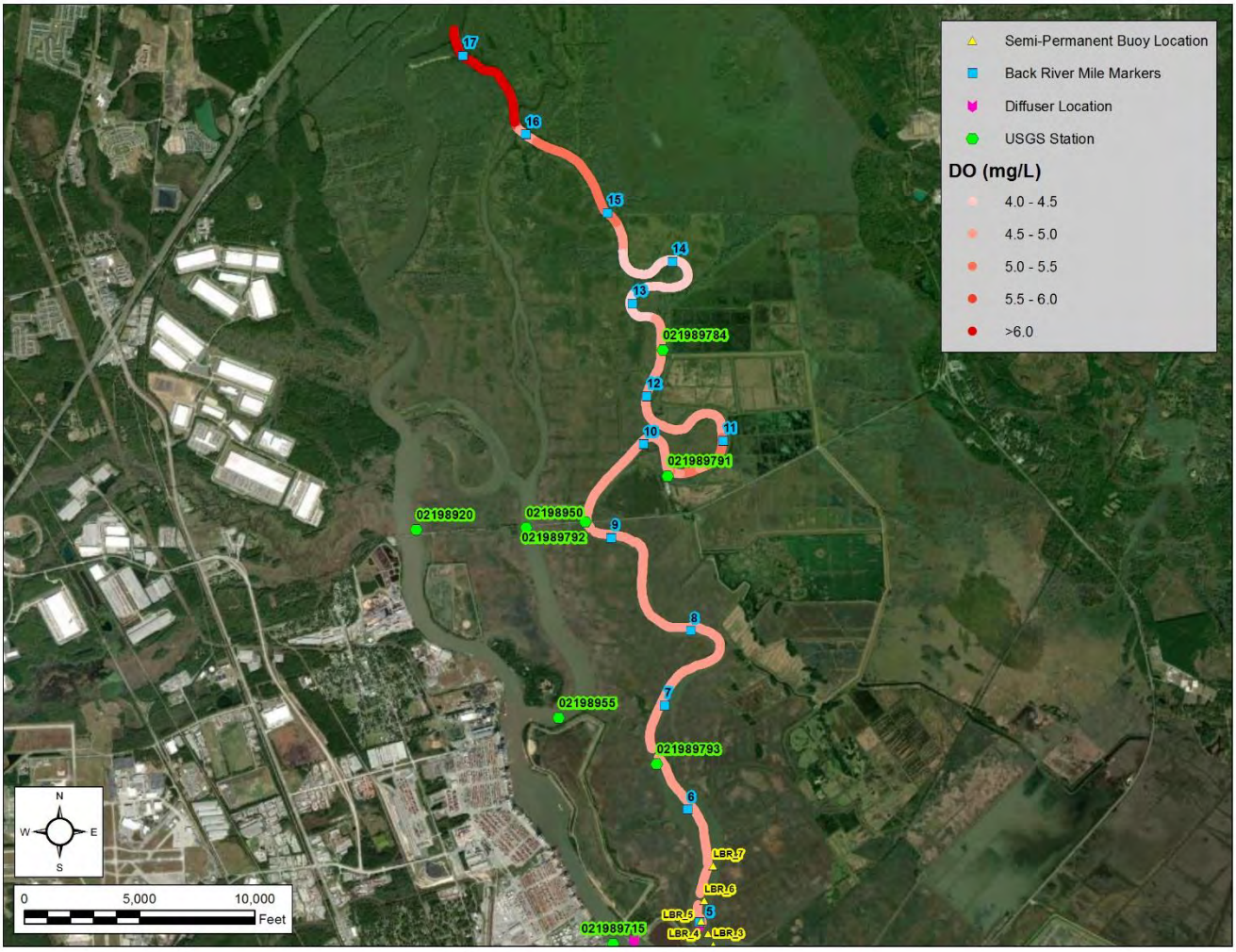

Figure 9-10 Back River and Little Back River Drift Sampling – September 17, 2020 (surface)

LINE OF EVIDENCE 4.1 – ANALYSIS OF BUOY, DRIFT, AND DYE DATA

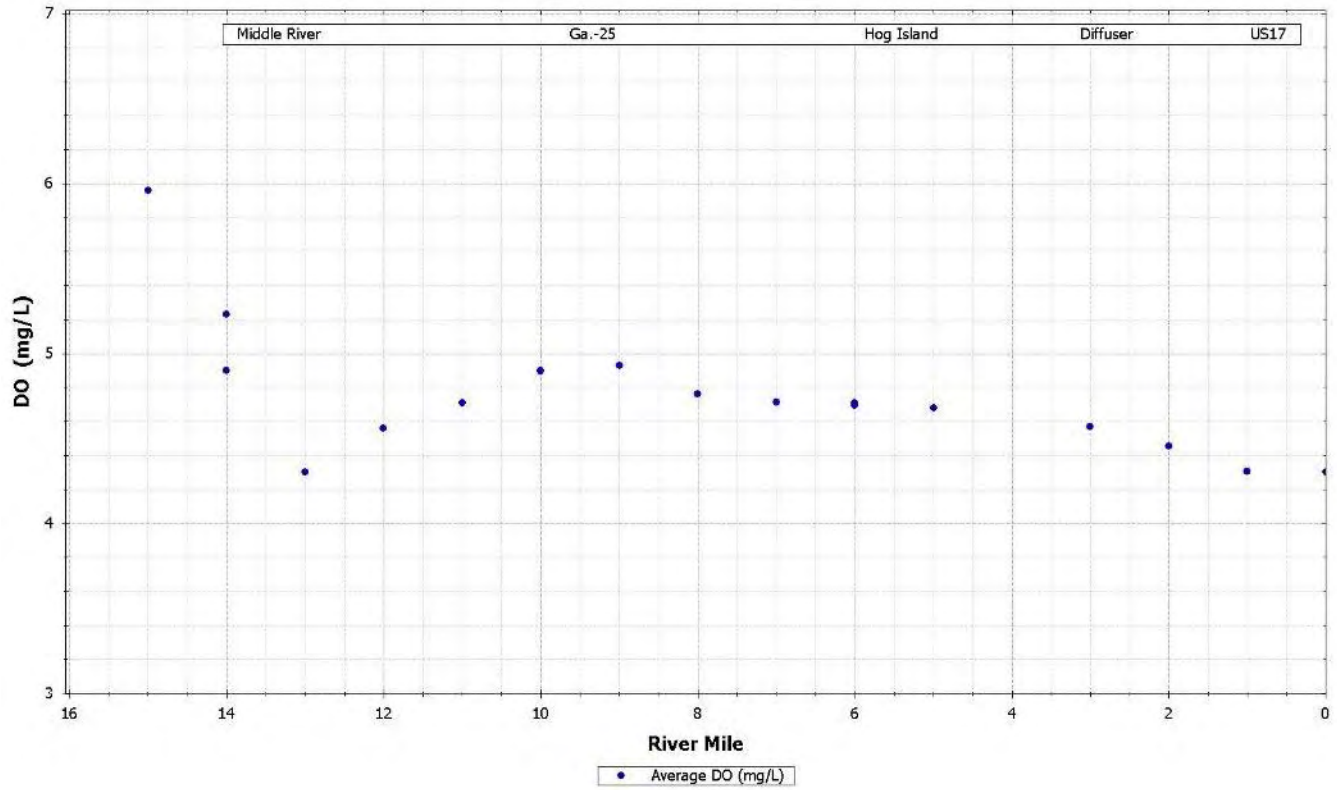

Figure 9-11 Back River and Little Back River DO Profile – September 17, 2020

LINE OF EVIDENCE 3.2 – ANALYSIS OF PROFILE AND DYE DATA

9.3 SUMMARY

The Downriver plant was designed to increase DO concentrations throughout the inner harbor navigation channel and the Back, Little Back, and Middle Rivers. The impact of the Downriver plant is less easily discernable than the Upriver plant, due to the bidirectional flow, the impact of tides, varying channel widths, complex side river system, and other SHEP mitigation features. However, the impact can be quantified by analyzing field data in addition to independent data sources which provide corroborating conclusions.

Along with the injected oxygen plumes being well mixed into the receiving water, there was no observed effervescence, bubbling, or surface disturbances near the Front River or Back River diffusers.

The benefits of the injected oxygen from the Front River diffuser were detected upstream beyond the turning basin (RM 19) and downstream beyond the GA 17 bridge.

The benefits of the injected oxygen from the Back River diffuser were detected throughout the Back River and upstream beyond the GA 25 bridge in the Little Back River.

10.0 DYE RELEASES AND ANALYSIS

THIS CHAPTER ADDRESSES SUCCESS METRIC #2, #3 AND #4 AS IDENTIFIED IN SECTION 4.0

Success Metric #2 – Determine if the injected oxygen is being retained in the water column
Success Metric #3 – Evaluate if the retained oxygen is mixing vertically and mitigating the bottom half of the water column
Success Metric #4 – Evaluate if the retained oxygen is mixing spatially to provide the necessary mitigation throughout the Savannah River and estuary

Details on the dye releases are presented in Section 2.4. This chapter focuses on the analysis of these releases.

Rhodamine dye releases were conducted in the Front River, Back River, and Upriver before and during the SUR data collection. 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 injected oxygen discharge pipe and was dispersed through the diffuser. The dye mimics how the injected oxygen is dispersed and migrates throughout the estuary. The dye releases were used to determine:

- Where the potential areal and vertical extents of dye plumes are and therefore the oxygen plumes.
- How the dye and injected oxygen mixed under varying hydrodynamic conditions.
- Where the dye and oxygen plumes migrated.
- What regions of the Savannah River and estuary are impacted by the dye and injected oxygen.
- How quickly the dye and oxygen mixed into the water column.
- How long the dye and the injected oxygen remained in the waterbody.

Table 2-1 provides the dates, times, injection areas of the river, tide conditions, dye strengths, and dye volumes used for the SUR data collection dye releases. These are presented once again below in ***Table 10-1***. Each release had a specific purpose, as described in Section 2.4 and the remainder of this section.

Table 10-1 SUR Dye Releases Details

Date	Time	River	Tide	Dye Strength	Dye Volume (gallons)
15-Jul-20	10:30	Upriver	N/A	Full	30
16-Jul-20	09:50	Back	13:49 L	Full	30
16-Jul-20	11:07	Front	13:49 L	Full	30
10-Aug-20	10:00	Upriver	N/A	1:3	30
11-Aug-20	09:00	Front	08:40 L	1:3	30
12-Aug-20	10:00	Back	09:31 L	1:3	30
24-Aug-20	10:00	Upriver	N/A	Full	60
25-Aug-20	08:45	Front	08:29 L	Full	60
25-Aug-20	09:45	Back	08:29 L	Full	60
15-Sep-20	08:54	Upriver	N/A	Full	45

Additional detail on each of the dye releases is presented in **APPENDIX E**.

On the day of the dye releases, detailed receiving water sampling was conducted just before dye release to gather background dye values. During and after the dye release, dye concentrations were measured for two to four hours. The dye and other parameters were sampled to track where the dye, and therefore oxygen plume, were moving and how quickly it mixed into the water column. The visible impacts from the dye release on August 24, 2020, are presented in ***Figure 10-1***, taken from one of the sampling boats looking upstream. The Upriver plant can be seen in the background.



Figure 10-1 August 24, 2020 Dye Release Showing Dye Dispersing Below the Upriver Diffuser

10.1 UPRIVER DYE RELEASES

Four Upriver dye releases were completed to help determine how quickly the injected oxygen mixed with the river water and how fast the oxygen moved downstream. The July 15 and August 10, 2020, dye releases were planned to investigate the dye dispersion in the vicinity of the Upriver diffuser and extending two to three miles downstream. The quicker the injected oxygen mixed into the water column, the less likely any of the injected oxygen would be transferred to the atmosphere. The August 24, 2020 super dye release, which included an additional 30 gallons of dye, traced the dye movement initially around the Upriver diffuser and on August 25, 2020, measured the dye in the Savannah Harbor area downstream of the I-95 bridge. The September 15, 2020 dye release further examined the impact of the dye and Upriver oxygen injection on the Front River.

The dye sampling was conducted by boat with a probe located about 3.3 feet below the surface with the boats moving in and out of the dye plume as it traveled downstream. Profile samples were taken at deeper depths to measure the mixing top to bottom.

The USGS Georgia District collected an independent set of data during the July 15 to 16 and August 24 to 25, 2020 dye injection events. The USGS also installed dye monitors at Savannah River near I-95 (USGS 02198840), Back River at GA 17 (USGS 0219897945), and Little Back River at Hog Island (USGS 021989793) to assist in tracking the dye movements in the Savannah River and estuary. USGS used a BGA algal dye sensor at their I-95 gage, which detected the Upriver dye as it moved past the I-95 gage approximately one day after each dye injection. The BGA measurements were converted to Rhodamine dye concentrations by multiplying by a factor of 0.088. This is based on a regression analysis comparing BGA to Rhodamine dye measurements.

The July 15 and August 24, 2020 dye results are presented below and additional detail on each of the four dye releases is presented in **APPENDIX E**.

10.1.1 July 15, 2020 Dye Release

The July 15, 2020 dye sampling event measured how the dye, and therefore the injected oxygen, mixed with the Upriver flow. Thirty gallons of undiluted dye were injected into the Savannah River. The immediate dilution after the diffuser ports was a ratio of three to one. Dilution, when dye reached the surface, was a ratio of 10 to one and the dye had completely mixed throughout the water column within 0.6 miles downstream. ***Figure 10-2*** shows the boats' July 15, 2020 sampling routes with the redder dots indicating higher dye concentrations, while ***Figure 10-3*** illustrates the dye mixing side to side. ***Figure 10-3*** also shows the impact of the oxbow significantly reducing the dye concentration, supporting the finding from Section 8.2 that the tributaries flowing into the Savannah River have low DO, which helps explain why the river's DO gradually lowered as it flowed downstream. High river flows of 12,500 cfs were measured at the upstream USGS Clyo gage (02198500) at the time of this release.

LINE OF EVIDENCE 4.1 – ANALYSIS OF BUOY, DRIFT, AND DYE DATA

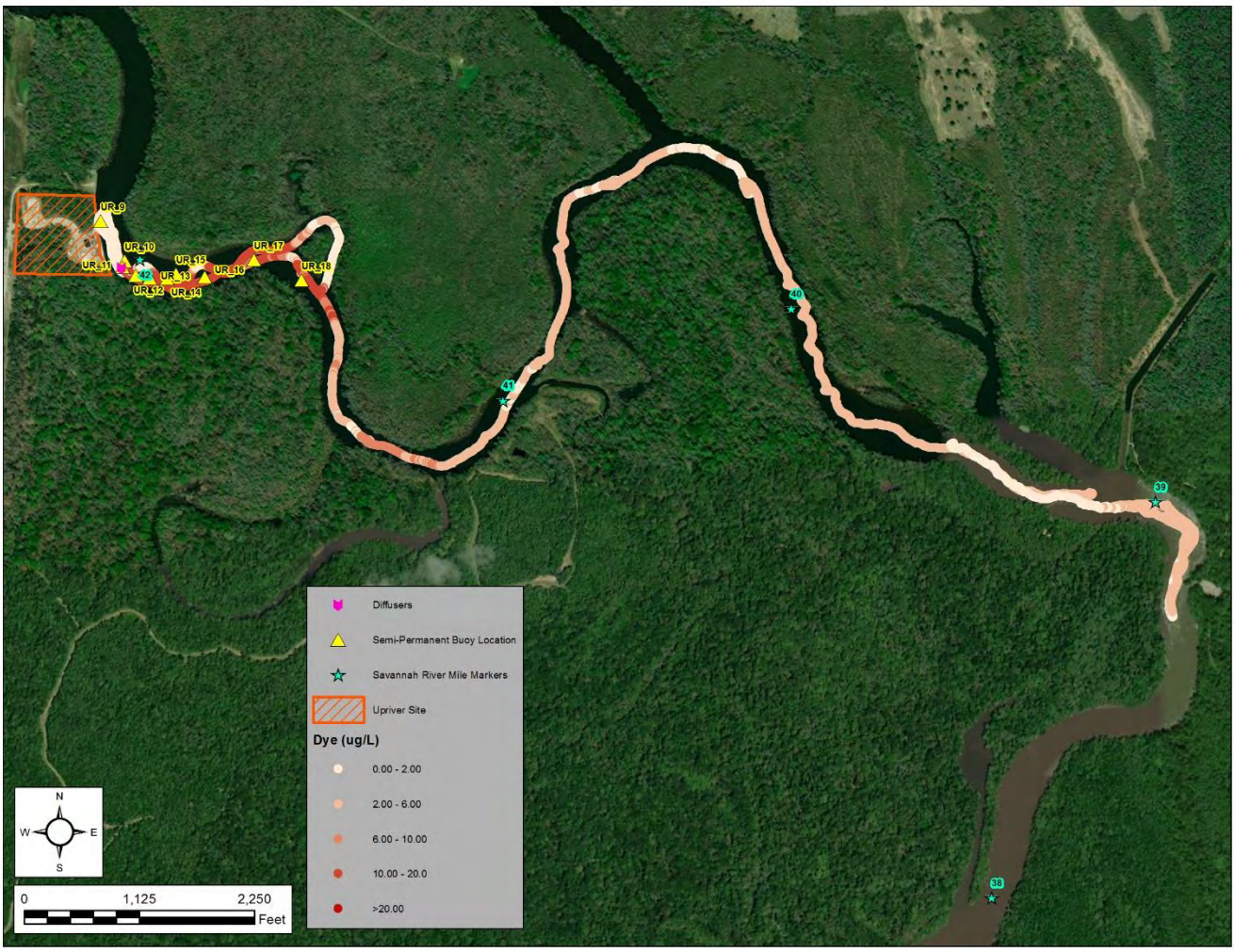

Figure 10-2 Upriver Dye Sampling – July 15, 2020

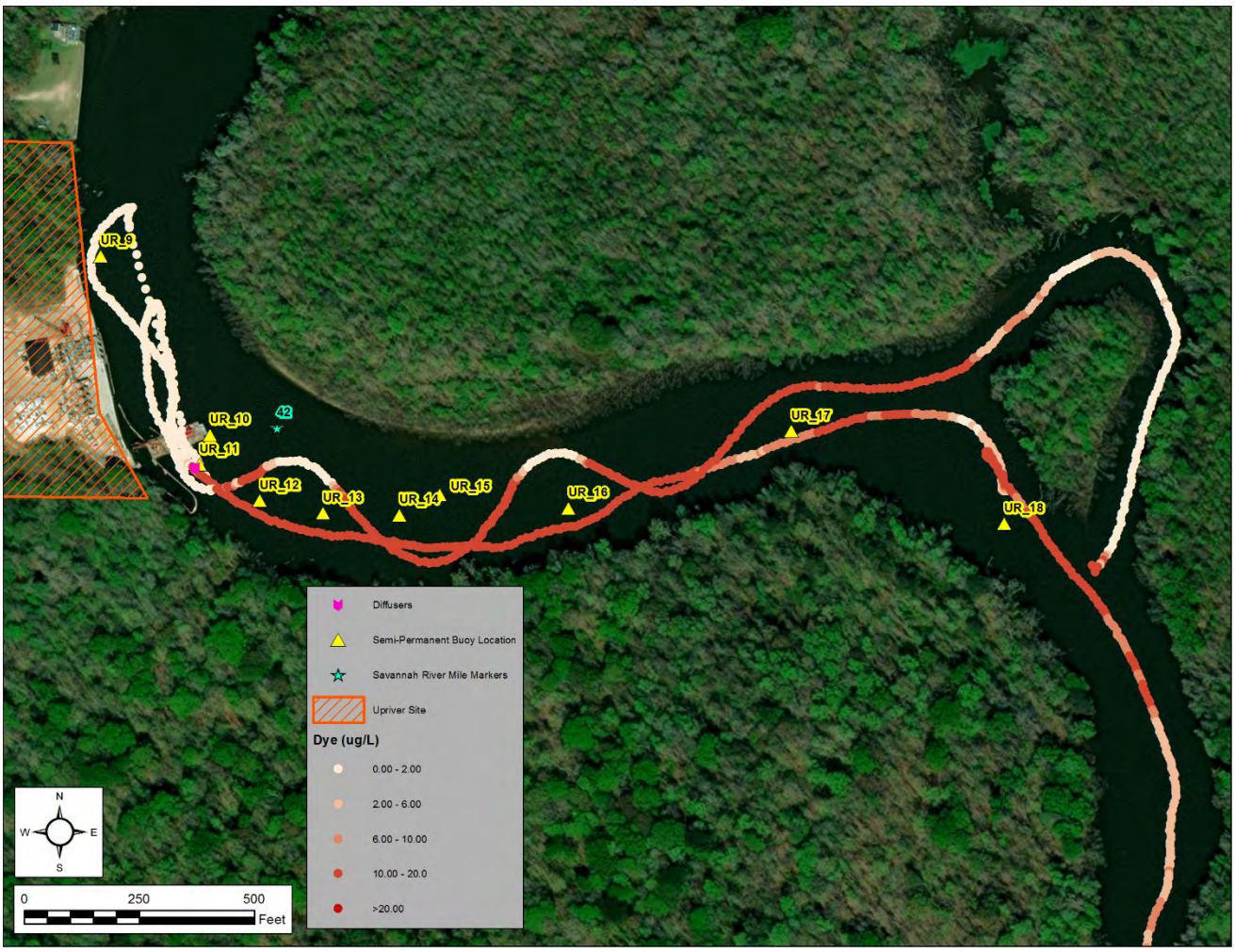

Figure 10-3 Upriver Dye Sampling – July 15, 2020 (inset)

Figure 10-4 shows the concentration of dye, measured in µg/L, versus RM as the dye flows downstream. The dye is mixed side to side around RM 41.4 then decreases going downstream as tributaries flow into the Savannah River. The measured dye concentrations show a similar pattern as the DO values previously presented in Section 8.2, dropping between RM 41.4 and 39 due to the incoming tributary flows.

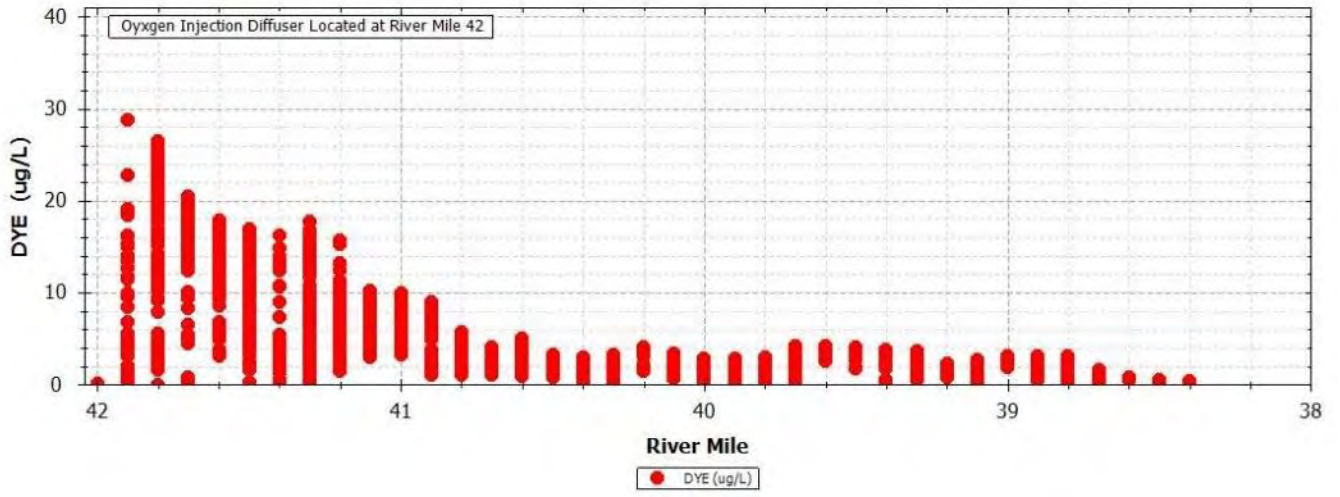

Figure 10-4 Upriver Dye Transect – July 15, 2020

The USGS Georgia District collected independent sampling data during the July 15, 2020 dye release. The dye was injected around 10:00 AM from the Upriver plant. The cross-section location was approximately 220 feet upstream from the Hardeeville gage, and the dye took approximately two hours to travel the approximate two-mile distance to this location. ***Figure 10-5*** shows the cross-section dye concentrations at the top, middle, and bottom depths of the river along with a cross-section profile of the river. The dye was well-mixed top to bottom with the highest concentration in the main channel. Further details are in **Appendix E**.

LINE OF EVIDENCE 3.2 – ANALYSIS OF PROFILE AND DYE DATA

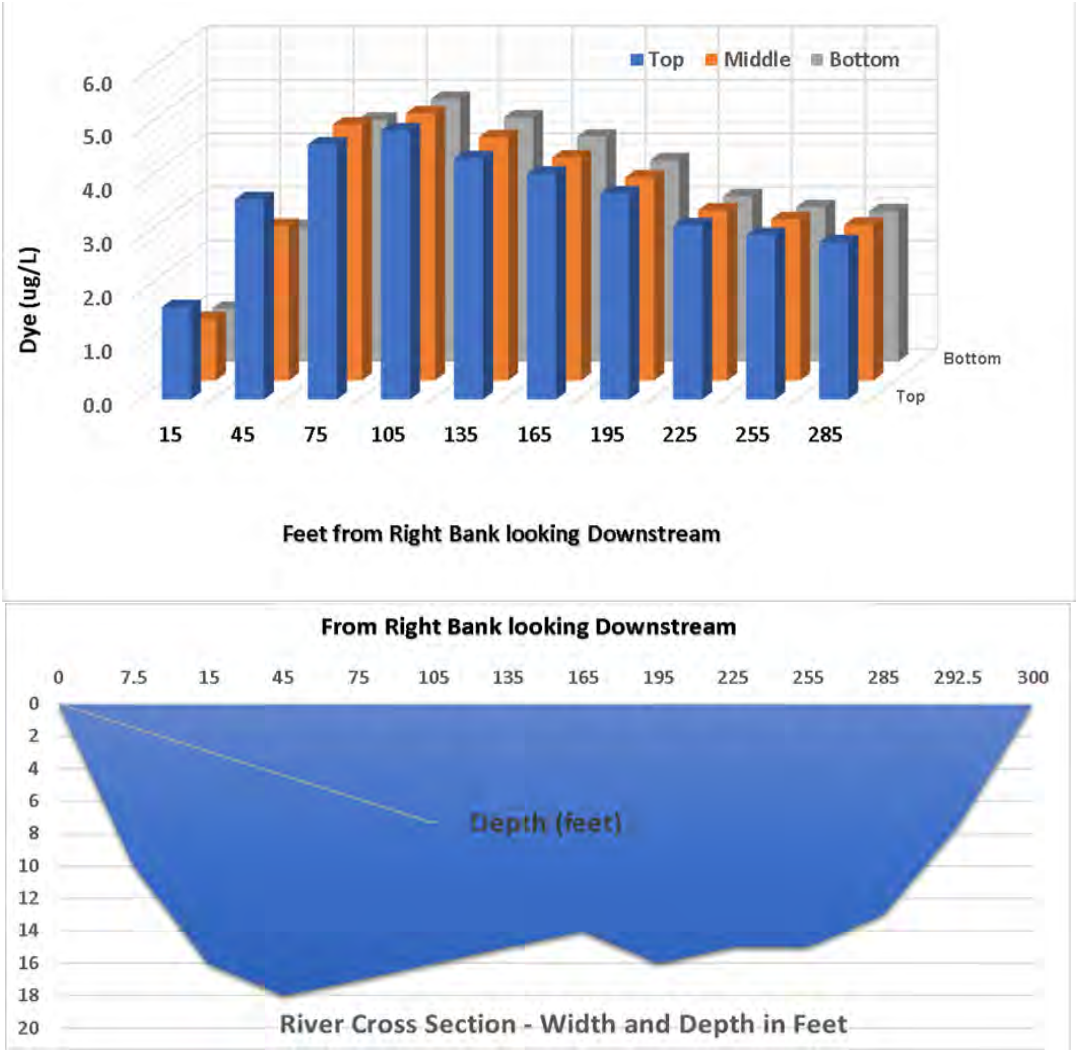

Figure 10-5 Upriver USGS Dye Cross-section – July 15, 2020 (Hardeeville)

10.1.2 August 24, 2020 Super Dye Release

On August 24, 2020, 60 gallons of dye were injected into the Savannah River via the Upriver diffuser. The dye was released at 10:05 AM. The main purpose of this release was to track the dye downstream and into the lower reaches of the Savannah River. Detailed dye sampling around and downstream of the diffuser was also completed during the dye injection. A contour plot of the dye distribution is shown in ***Figure 10-6***. Relatively low river flows of 7,500 cfs were measured at the upstream USGS Clyo gage (02198500) at the time of this release.



Figure 10-6 Upriver Dye Sampling – August 24, 2020

Similarly to the July 15, 2020 dye release, the USGS Georgia District collected independent sampling data during the August 24, 2020 dye release at a cross-section near the discontinued Hardeeville gage (USGS Hardeeville station 02198760). The cross-section sampling was collected from 11:27 to 11:49, given the dye required nearly two hours to cover the distance from the diffuser to the cross-section location. The dye was highly visible during cross-section sampling. ***Figure 10-7*** shows the cross-section dye concentrations at the top, middle, and bottom depths of the river along with a cross-section of the river. The dye was well mixed top to bottom and therefore the injected oxygen will be well mixed in the water column. Additional cross-section data and further details are in **Appendix E.**

LINE OF EVIDENCE 3.2 – ANALYSIS OF PROFILE AND DYE DATA

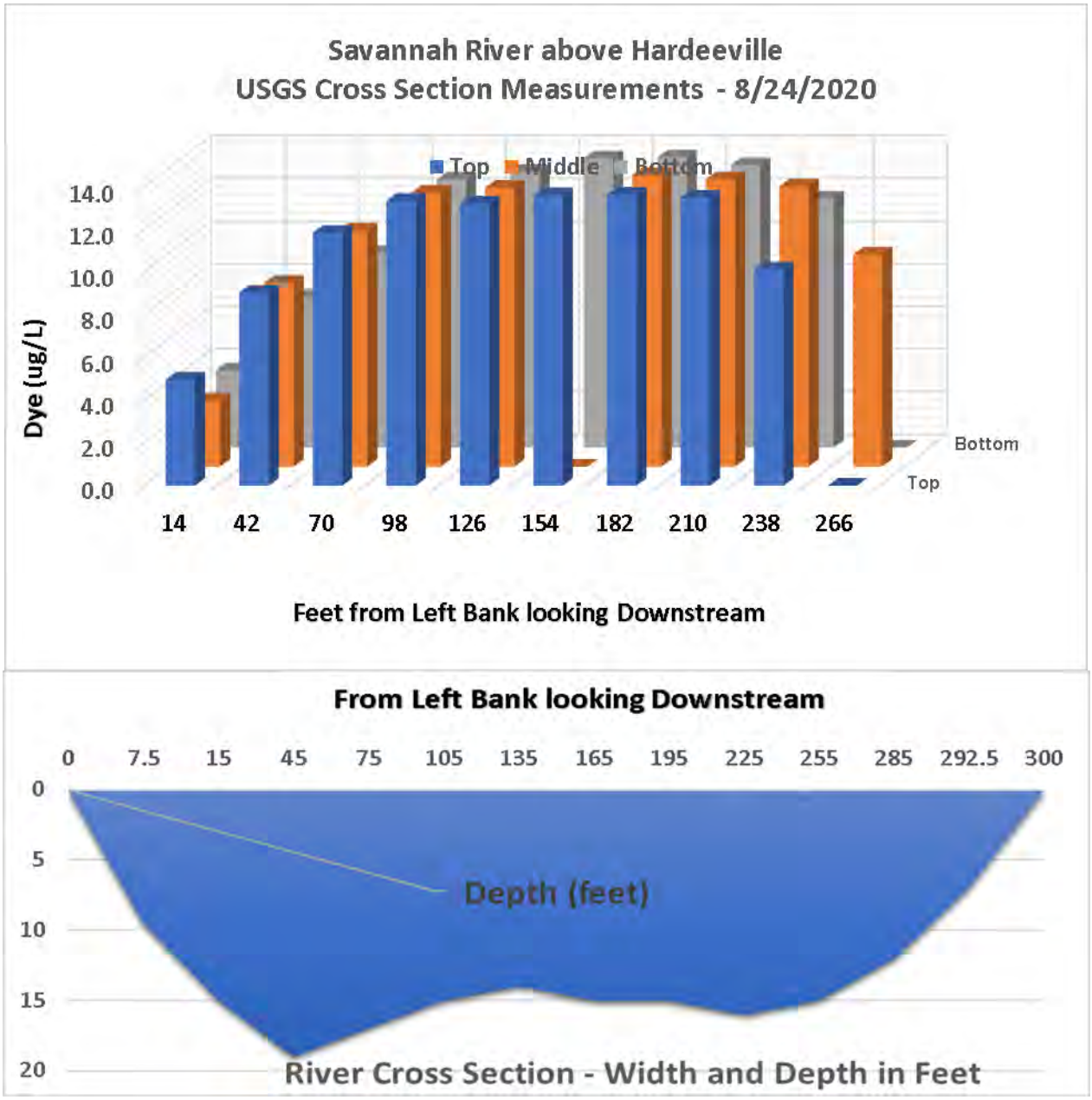

Figure 10-7 Upriver USGS Dye Cross-section – August 24, 2020 (Hardeeville)

After successfully measuring the dye dispersion in the vicinity of the Upriver diffuser and downstream of the August 24, 2020 dye release, additional sampling was undertaken. One day later, on August 25, 2020, extended boat sampling was completed from above the Upriver diffuser downstream past the I-95 bridge. The dual objectives were to locate the dye from the previous days release and identify its movement, and to measure a longitudinal DO transect of the Upriver and Front River. River flow measured at the upstream USGS Clyo gage (02198500) was 7,500 cfs. As shown in ***Figure 10-8***, the dye peak was located four miles downstream of the I-95 bridge, indicating the dye plume had traveled approximately 16 RMs over the 24-hour period. This peak, located near USGS station 0219820 in a pink color, is not to be confused with the dye peak in dark red from the Front River diffuser, a further five miles downstream. The DO transect was successfully captured, as shown in ***Figure 10-9***. DO gradually declined from 7.9 mg/L at the Upriver diffuser to 6.5 mg/L below I-95 Bridge. These results support the assertion that low DO from tributaries joining the Savannah River reduce DO concentrations, but also that the dye plume, and therefore oxygen plume, is well mixed and being retained within the water column over a very significant distance.

LINE OF EVIDENCE 4.1 – ANALYSIS OF BUOY, DRIFT, AND DYE DATA

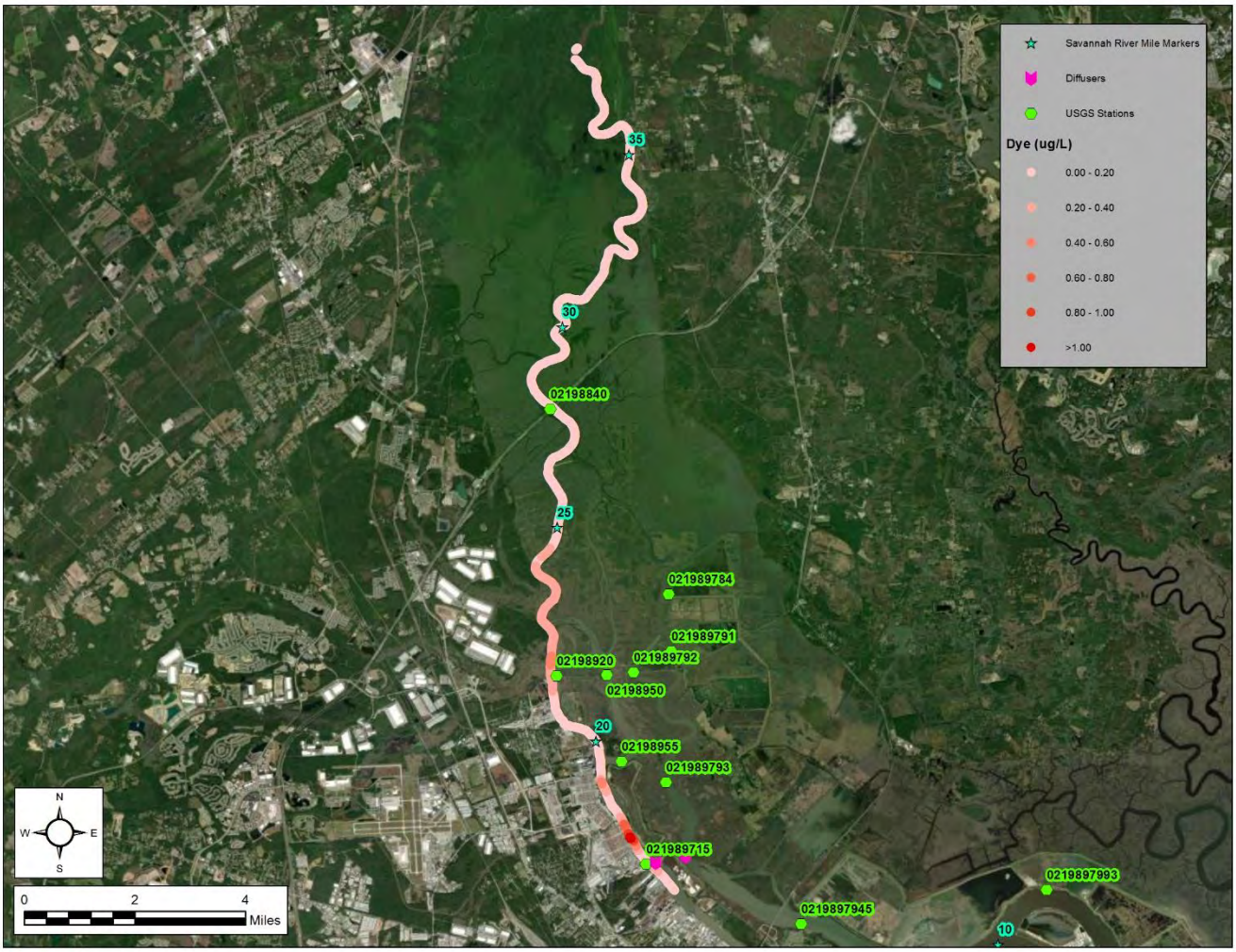

Figure 10-8 August 25, 2020 Dye sampling

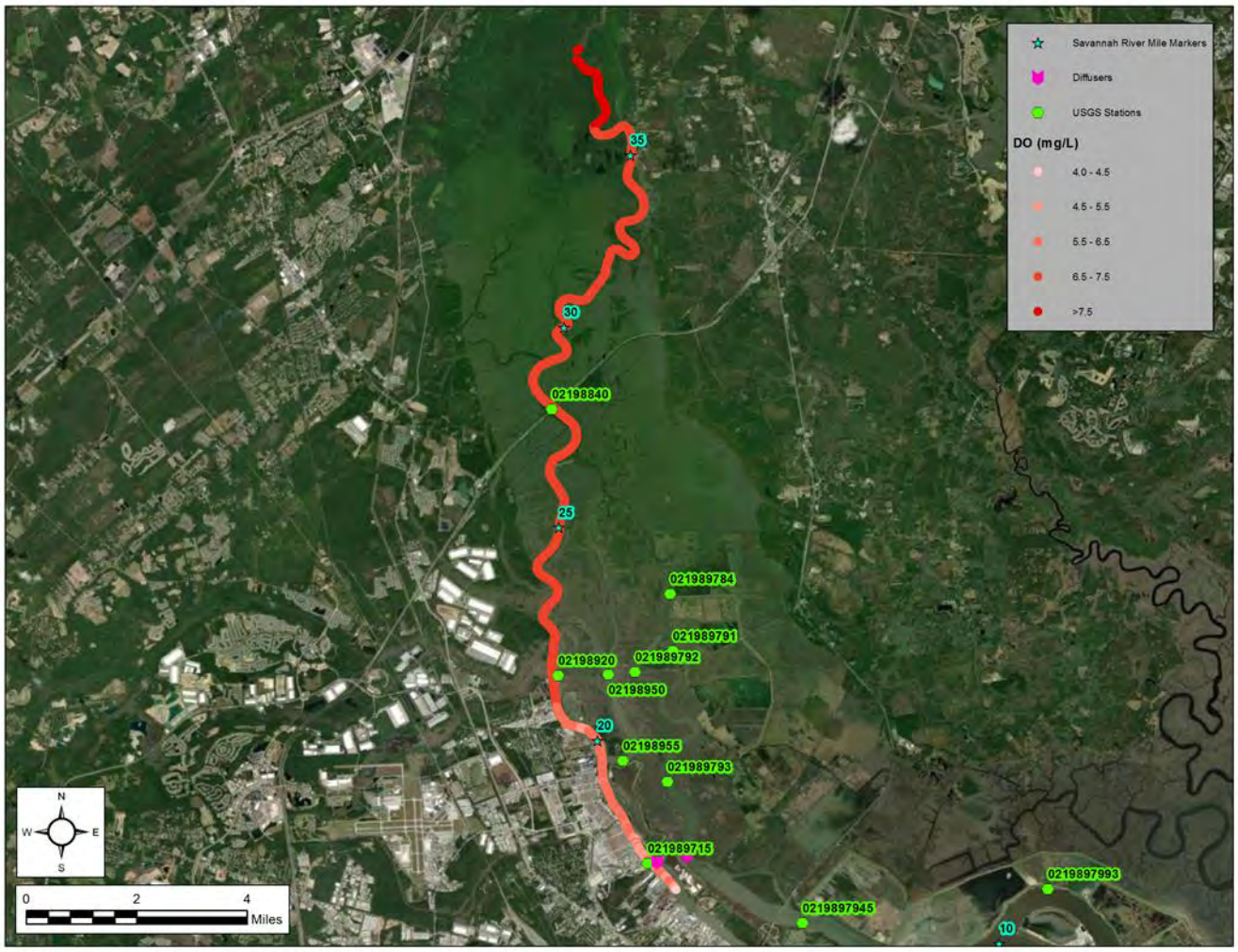

Figure 10-9 August 25, 2020 DO sampling

10.1.3 USGS I-95 Gage

The USGS gage at the I-95 bridge (02198840) included a BGA sensor which detected the Upriver injected dye as it moved past approximately one day after each dye injection (***Figure 10-10***). This is significant because it shows the injected dye, and therefore the injected oxygen, was retained within the water column to I-95 (RM 27.8) and beyond. All four dye releases (July 15, August 10, August 24, and September 15) are evident given the spikes in dye concentrations above background. However, the August 24, 2020 release is most noticeable. This makes sense given it was the largest dye volume and was full strength (undiluted). Conversely, the August 10 had the equal lowest volume and was diluted to one-third full strength. Out of the four releases, this recorded the lowest spike at I-95.

LINE OF EVIDENCE 2.2 – OXYGEN PLUME RETENTION AFTER INJECTION

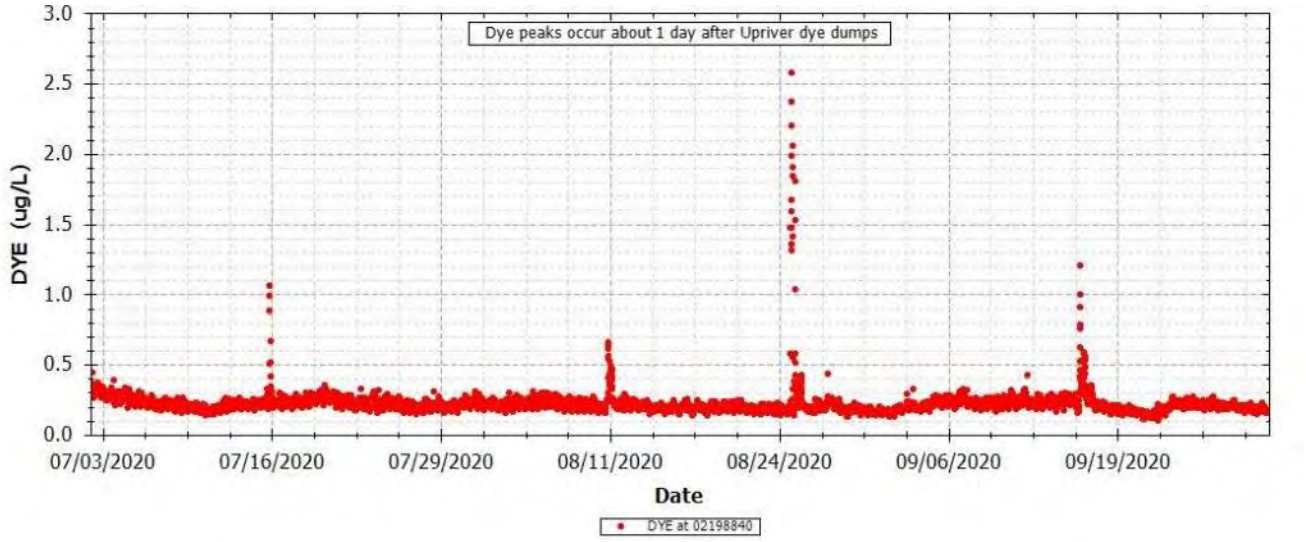

Figure 10-10 Dye Measurements at USGS Gage 02198840 (I-95)

10.2 FRONT RIVER DYE RELEASES

Three Front River dye releases were conducted during the SUR. The primary goal of the Front River dye releases was to determine where the dye and therefore injected oxygen, was distributed and how long the dye and injected oxygen stayed in the Front River. Detailed near-field dye and DO measurements were taken during the 2019 Test Run sampling that detailed the initial mixing and near field distribution of the dye and oxygen plumes, and therefore were not repeated during the SUR sampling (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc. 2019a). The dates and details of the three Front River dye releases are presented in ***Table 2-1*** and again in ***Table 10-1***. Additional detail on each of the dye releases is presented in **APPENDIX E**.

10.2.1 July 16 and August 11, 2020 Dye Releases

The July 16 and August 11, 2020 dye releases occurred at approximately 10:00 AM and both occurred on ebb tides. The dye in both releases headed downstream and hugged the west bank, in accordance with the findings from Section 7.0. ***Figure 10-11*** shows the results for the July 16 dye release. August 11 dye details is presented in **APPENDIX E**.



Figure 10-11 Front River Dye Sampling – July 16, 2020

10.2.2 August 25, 2020 Dye Release

The August 25, 2020 Front River dye release best illustrated where the dye, and therefore injected oxygen, traveled and how long it remained in the Front River. After the 60 gallons of dye was injected, profile sampling of the Front River was conducted almost daily to see how long the dye, and the associated injected oxygen, would remain in the Front River.

The dye was injected on a low slack tide, so the dye initially dispersed around the diffuser, moving slightly downstream, and then moved upstream on the incoming tide. A time-lapse of all sampling from August 25, 2020, is shown in ***Figure 10-12*** through ***Figure 10-15***, where each successive figure shows the mid-depth dye concentrations decreased from 180 µg/L near the diffuser to 0.5 µg/L as the dye entered the turning basin. This illustrates how the dye, and the injected oxygen, mixed spatially as the tide turned from ebb to flood tide.

LINE OF EVIDENCE 4.1 – ANALYSIS OF BUOY, DRIFT, AND DYE DATA



Figure 10-12 Front River Dye Sampling – August 25, 2020 (mid-depth) (100 to 180 µg/L)

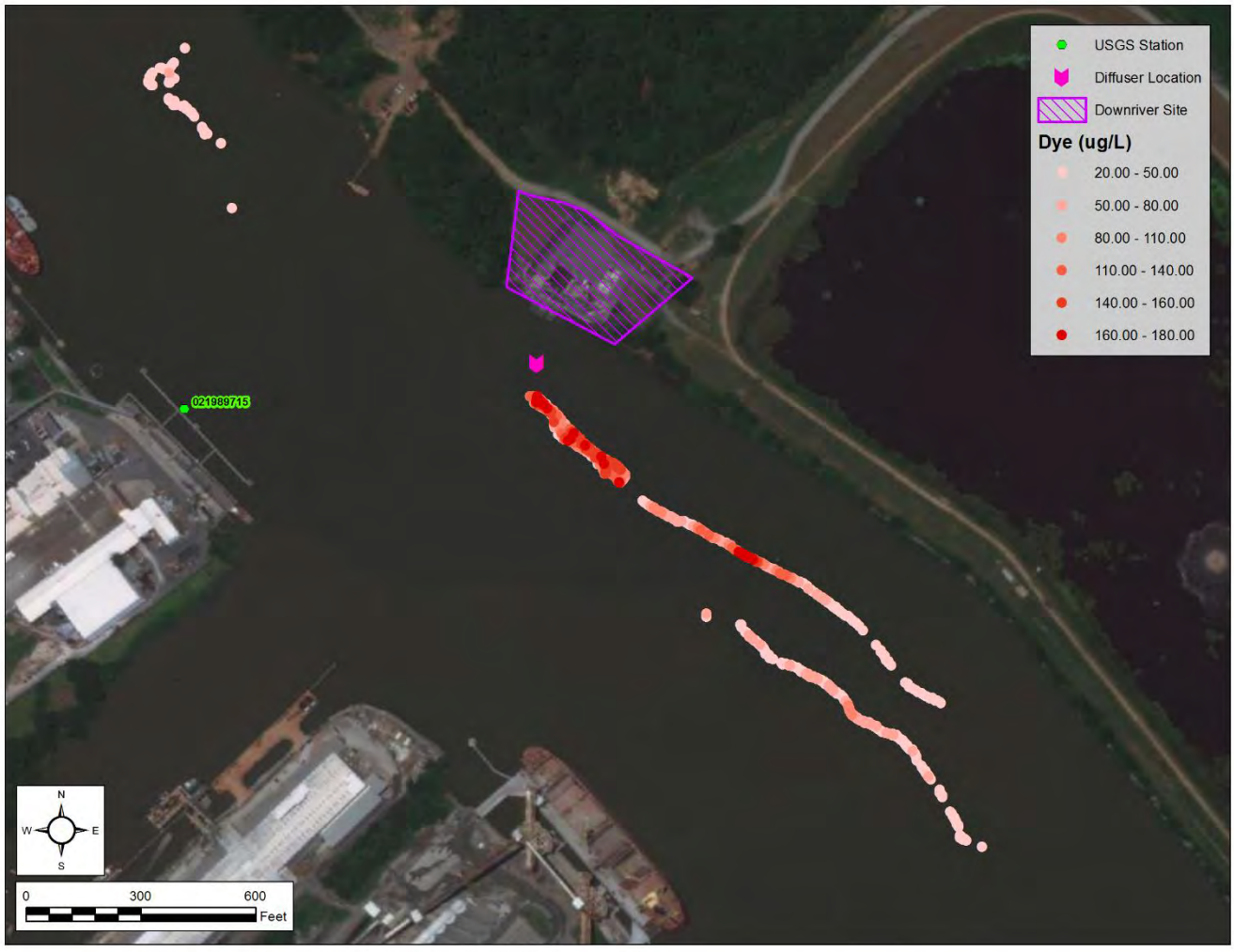

Figure 10-13 Front River Dye Sampling – August 25, 2020 (mid-depth) (20 to 180 µg/L)

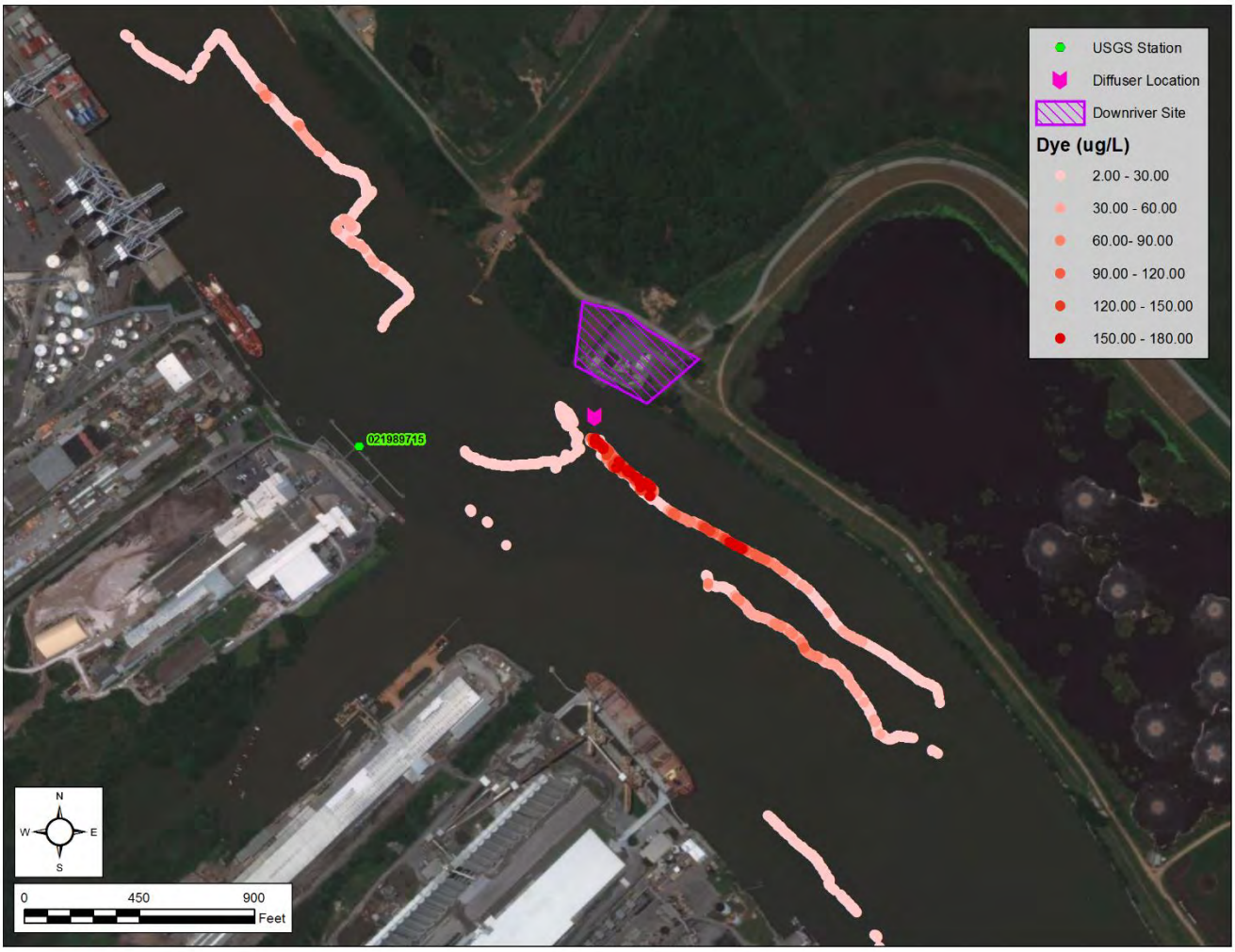

Figure 10-14 Front River Dye Sampling – August 25, 2020 (mid-depth) (2 to 180 µg/L)



Figure 10-15 Front River Dye Sampling – August 25, 2020 (mid-depth) (100 to 180 µg/L)

Detailed Front River profile sampling was conducted from August 26, 2020, to September 15, 2020, to track the movement of the dye in the Front River from the release on August 25, 2020. The sampling locations varied day to day depending on the tidal conditions. To illustrate dye movement, the profile sampling locations were converted to approximate RMs with RM 0 being the mouth of the Savannah River, near Fort Pulaski (refer ***Figure 11-9***). The dye profile samples were averaged between the upper (top 15 feet) and bottom layers and the results, by day, are presented in ***Figure 10-16*** through ***Figure 10-18***.

From August 27, 2020, through August 31, 2020, the dye was well distributed throughout the Front River, with higher dye concentrations in the bottom layers (***Figure 10-16***).

From September 02, 2020, to September 07, 2020, the dye was still well distributed throughout the Front River, with the higher dye concentrations reduced to 0.35 µg/L. Then from September 09, 2020, to September 17, 2020, the dye was still present in the Front River, with the higher dye concentrations reduced to 0.2 µg/L.

From September 18, 2020, to September 23, 2020, the impact of the September 15, 2020 Upriver dye injection is seen with an increase in dye concentrations to 0.3 µg/L. The Upriver dye injection caused an increase of

approximately 0.1 µg/L in the bottom layers and 0.05 µg/L increase in the upper layers throughout the Front River (***Figure 10-17***).

On September 25, 2020, the last day of the SUR sampling, dye concentrations of up to 0.25 µg/L were still present, with the dye plume moving gradually downstream (***Figure 10-18***).

LINE OF EVIDENCE 3.2 – ANALYSIS OF PROFILE AND DYE DATA

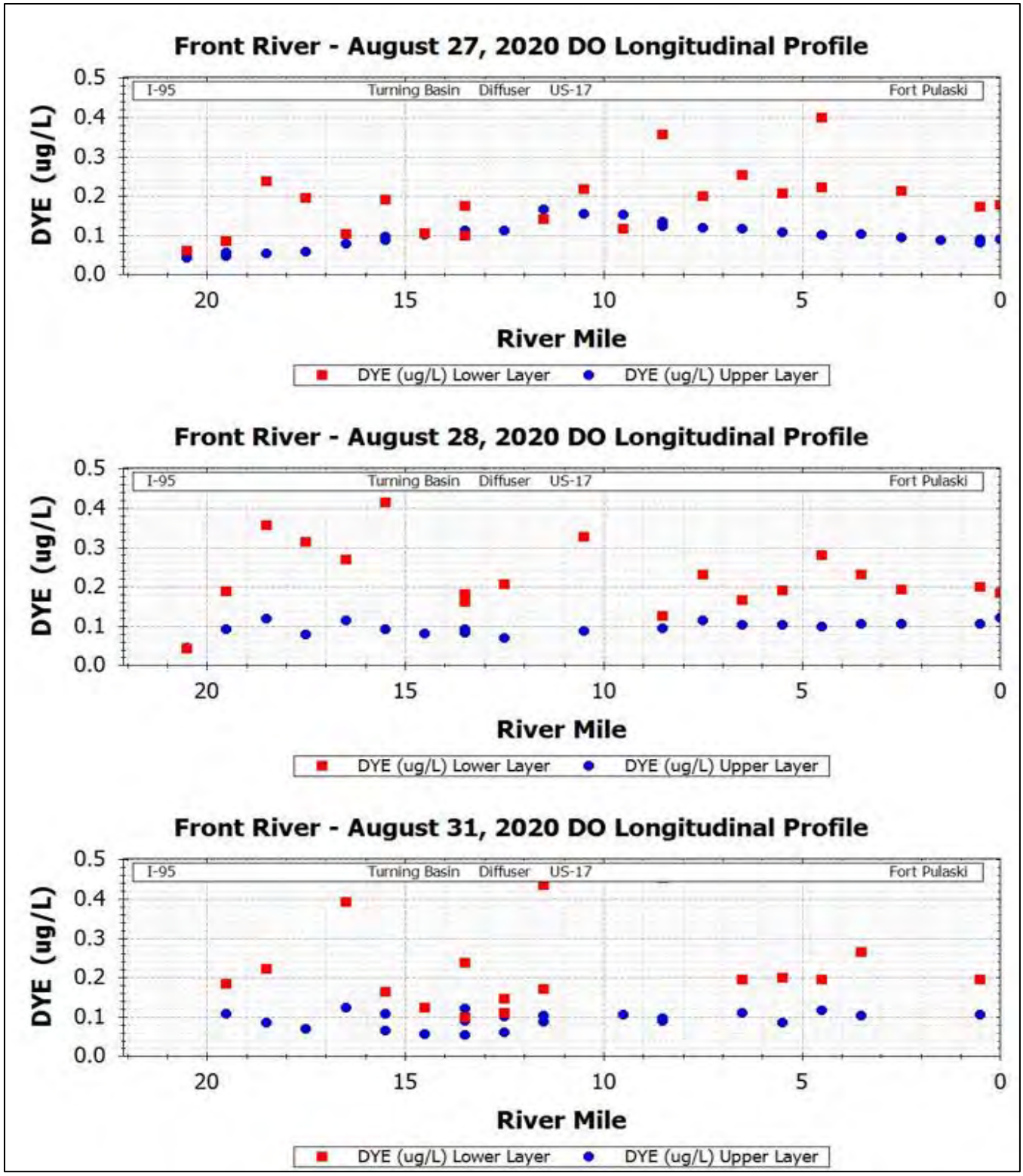

Figure 10-16 Front River Dye Profile – August 27 through August 31, 2020

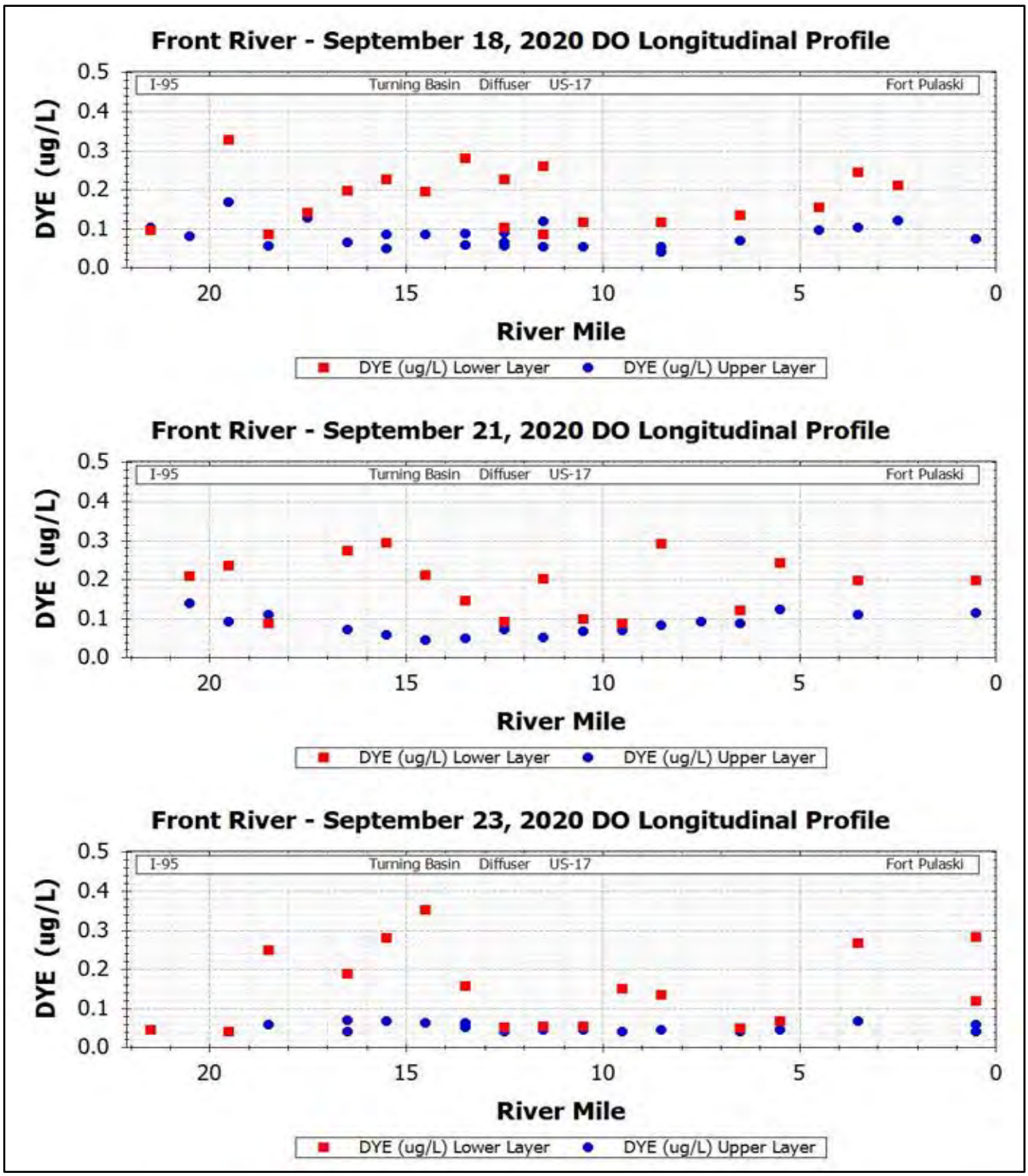

Figure 10-17 Front River Dye Profile – September 18 through September 23, 2020

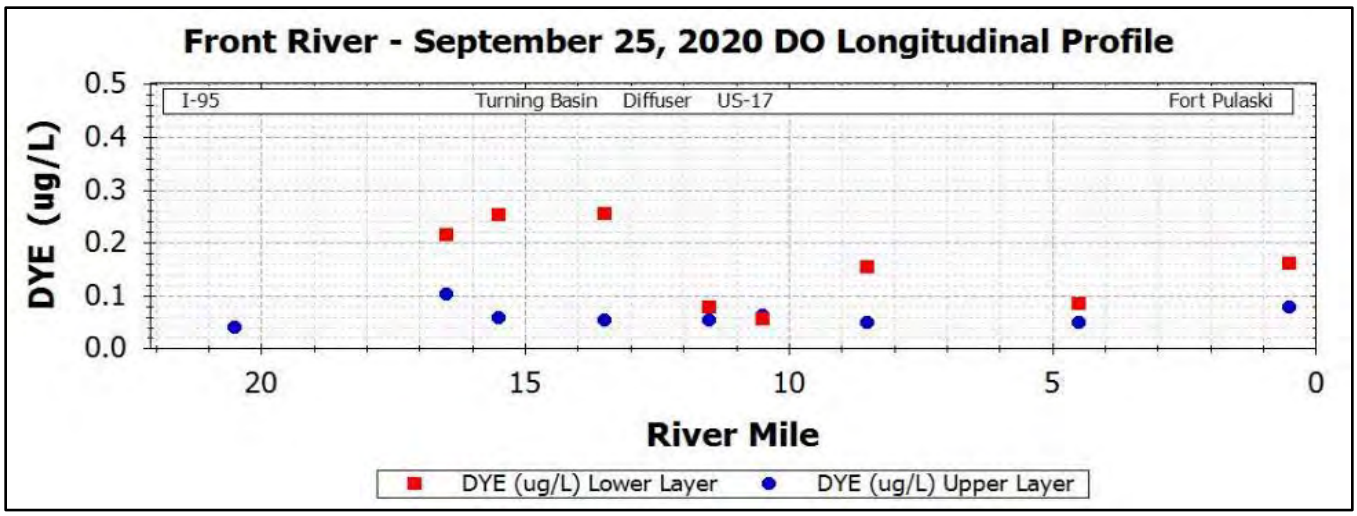

Figure 10-18 Front River Dye Profile – September 25, 2020

The dye concentrations at Fort Pulaski and the turning basin (RM 19) are presented in ***Figure 10-19*** and ***Figure 10-20***. The dye release from Upriver on September 15, 2020, is evident at both locations, as indicated by the increase in late September 2020. Based on these figures, it was roughly estimated the dye and the injected oxygen would stay in the Front River for three weeks to a month, dependent on upstream flows and tidal conditions. This supports the findings from Section 7.3, where DO increases were observed to remain for over a week.

LINE OF EVIDENCE 2.2 – OXYGEN PLUME RETENTION AFTER INJECTION

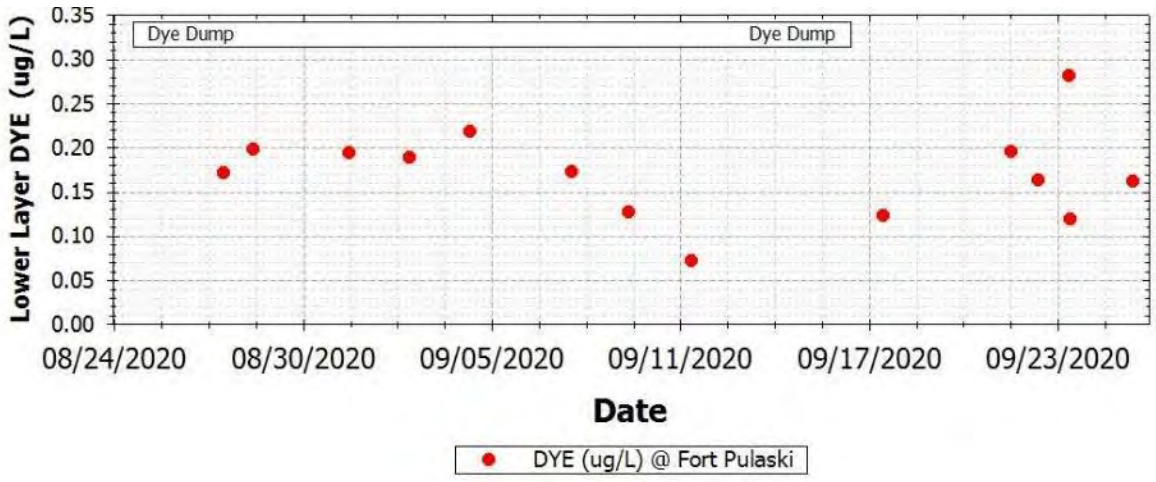

Figure 10-19 Front River - Fort Pulaski Dye Concentrations (bottom)

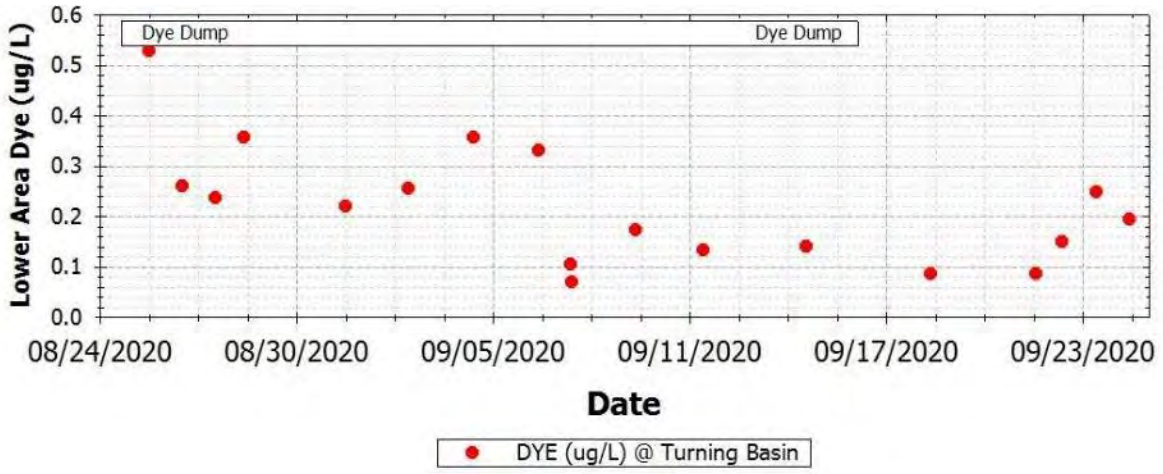

Figure 10-20 Front River – Turning Basin Dye Concentrations (bottom)

10.3 BACK RIVER DYE RELEASES

Three Back River dye releases were conducted during the SUR. The primary goal of the dye releases was to determine where in the river the dye migrated and therefore where injected oxygen was entrained. Detailed near-field dye and DO measurements were collected during the 2019 Test Run sampling that detailed the initial mixing and near field distribution of the dye and oxygen plumes and therefore were not repeated during the SUR sampling (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc. 2019a). The dates and details of the three Back River dye releases are presented in ***Table 10-1***. Additional detail on each dye release is presented in **APPENDIX E**.

10.3.1 July 16 and August 12, 2020 Dye Releases

The July 16, 2020 dye release was conducted during an ebb tide. ***Figure 10-21*** shows the dye plume moving downstream toward the GA 17 bridge and mixing side to side.

LINE OF EVIDENCE 4.1 – ANALYSIS OF BUOY, DRIFT, AND DYE DATA

The August 12, 2020 dye release was conducted on a low slack tide, and detailed depth profiles were taken that showed the dye was mixing vertically by the time it reached LBR_5 buoy, just upstream of the diffuser.

LINE OF EVIDENCE 3.2 – ANALYSIS OF PROFILE AND DYE DATA

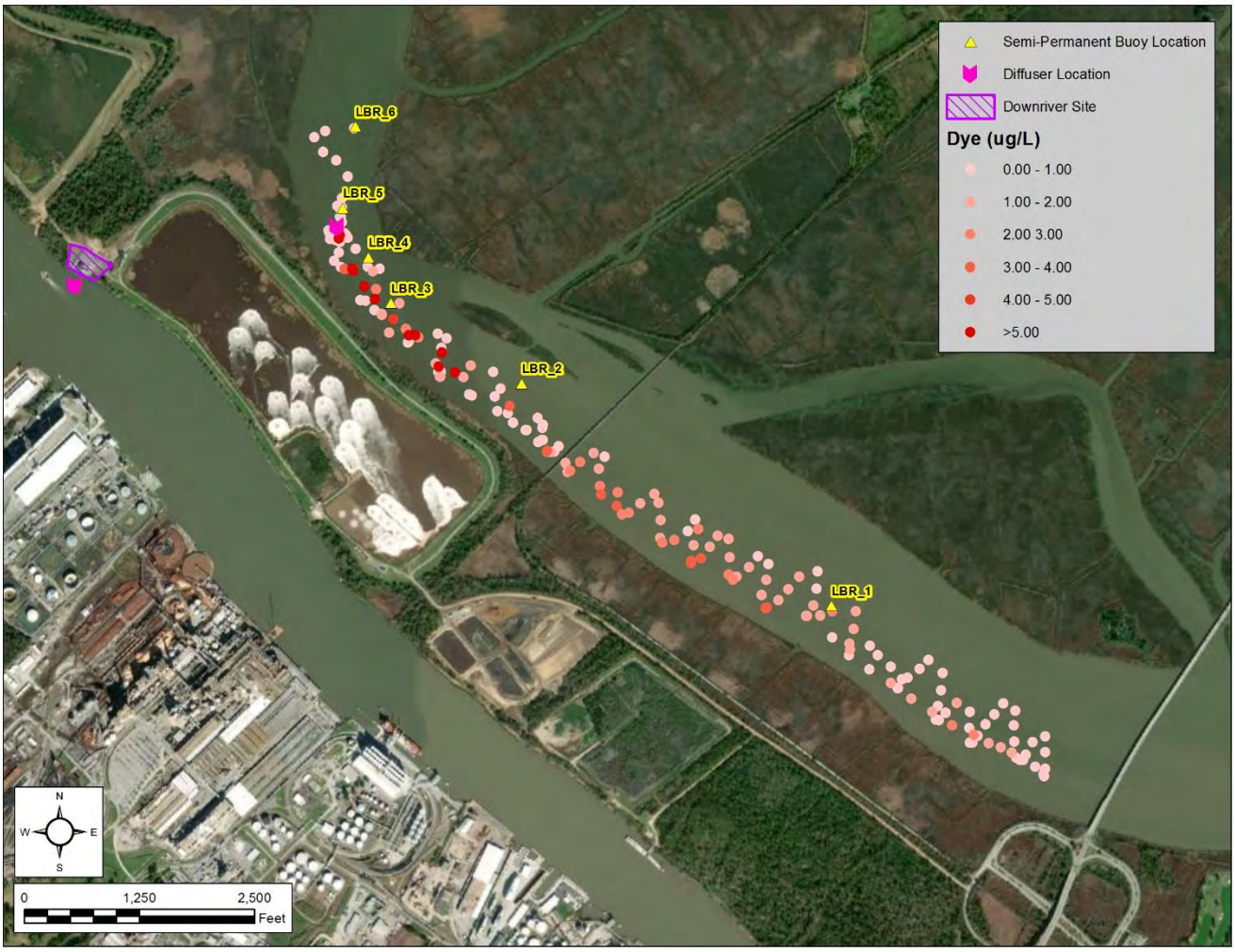

Figure 10-21 Back River Dye Sampling – July 16, 2020

10.3.2 August 25 to September 24, 2020 Dye Sampling Results

Similar to the Front River dye releases, the August 25, 2020 event best illustrates where the dye, and therefore injected oxygen, traveled and how long it remained in the Back River. After the dye was injected, profile sampling of the river was conducted weekly to see how long the dye and the associated injected oxygen would remain in the Back River. The following figures (***Figure 10-22*** and ***Figure 10-23***) show the dye sampling from August 26, 2020, to September 24, 2020. Dye from the August 25, 2020 release was retained in the river for two to three weeks until the dye reached a background concentration of around 0.06 µg/L. Dye from the Upriver dye releases undertaken September 15, 2020, were detected in the Little Back River on September 17 and September 24, 2020, as seen by the small spikes between RM 16 and RM 12 in ***Figure 10-23***.

LINE OF EVIDENCE 2.2 – OXYGEN PLUME RETENTION AFTER INJECTION

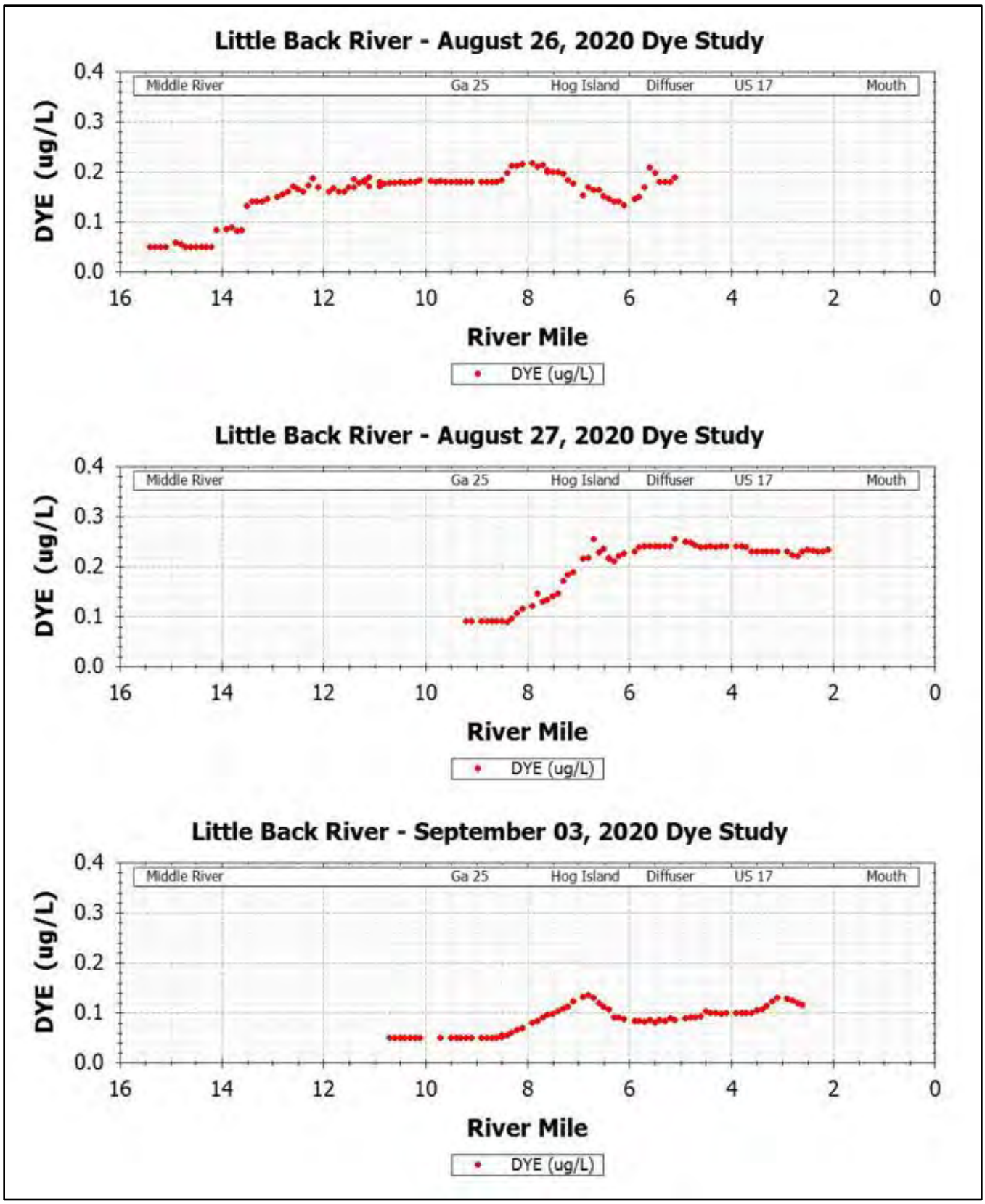

Figure 10-22 Back River Dye Profile – August 26 to September 03, 2020

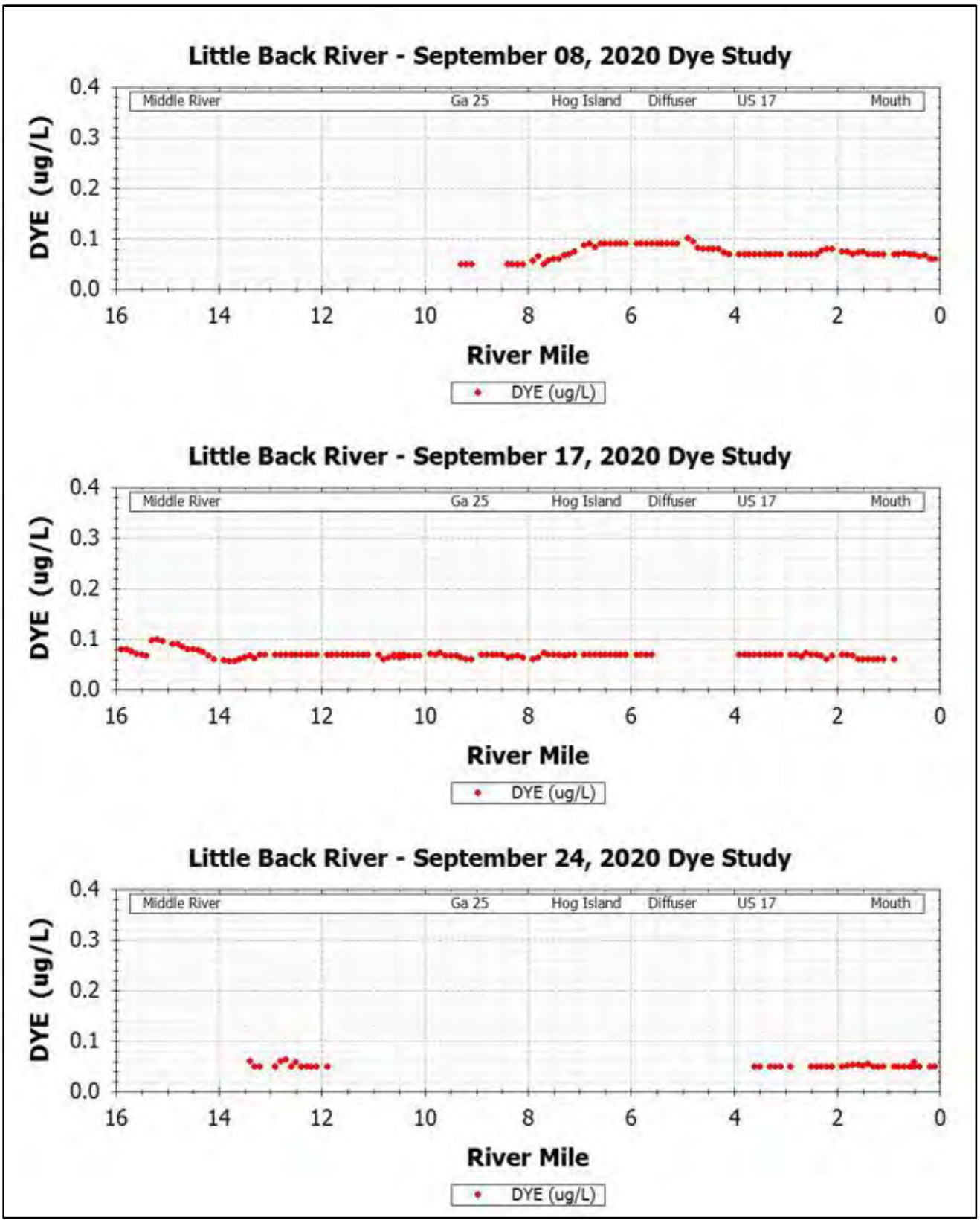

Figure 10-23 Back River Dye Profile – September 08, 2020, to September 24, 2020

In ***Figure 10-24***, time series plots of dye concentrations at the river mouth, Back River diffuser, and GA 25 show how the dye decreased to background levels in two to three weeks. This long retention time supports the assertion that the Savannah River and estuary is successful at retaining injected oxygen, as proposed in Sections 7.3 and 10.2.

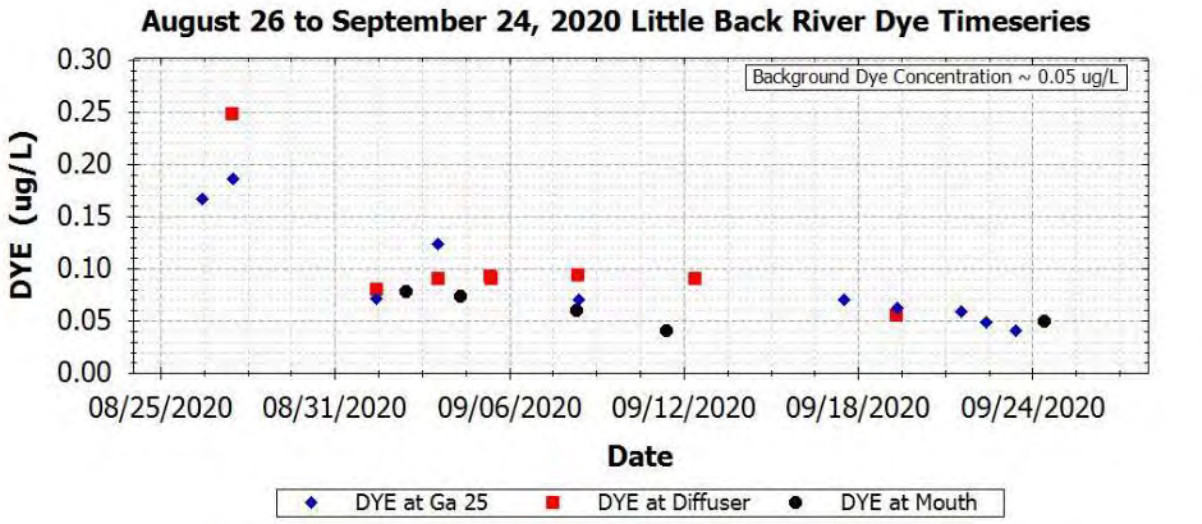

Figure 10-24 Dye concentrations at the Little Back River Mouth

LINE OF EVIDENCE 2.2 – OXYGEN PLUME RETENTION AFTER INJECTION

10.4 SUMMARY

The 10 dye releases and the subsequent field sampling undertaken before and during the SUR were successful.

The Upriver dye releases supported the findings from the buoy, drift, and profile data. Dye, and therefore injected oxygen, mixed well both vertically and spatially. Additionally, evidence of the Upriver releases was detected significantly far downstream on the Front River as far as Fort Pulaski. This confirms the importance of both Upriver and Downriver plants to the overall oxygen injection system.

The Front River dye releases supported the findings from the buoy, drift, and profile data. Dye, and therefore injected oxygen, mixed well both vertically and spatially, particularly on ebb tides. Also, the injected dye, and therefore the injected oxygen, stays in the Back River for about two to three, depending on flow and tidal conditions. This is significant as it proves the benefits of oxygen injection are not instantaneous but instead provide ongoing mitigation. Further, dye from the Upriver plant was present in the upper portion of the Little Back River, indicating another SHEP mitigation project, the McCoy's Cut flow rerouting, has been successful.

11.0 2020 SHEP MODEL

THIS CHAPTER ADDRESSES SUCCESS METRIC #3 AND #4 AS IDENTIFIED IN SECTION 4.0

Success Metric #3 – Evaluate if the retained oxygen is mixing vertically and mitigating the bottom half of the water column

Success Metric #4 – Evaluate if the retained oxygen is mixing spatially to provide the necessary mitigation throughout the Savannah River and estuary

11.1 BACKGROUND

A mechanistic modeling approach using the Environmental Fluid Dynamics Code (EFDC) and Water Quality Analysis Simulation Program (WASP) models has been used to simulate the circulation, transport, and biochemical processes impacting hydrodynamics and water quality in the Savannah River and Harbor. The EFDC model simulates the hydrodynamic transport (velocities and water surface elevation), salinity exchange between the ocean and the river, temperature, and the interaction between those parameters. The WASP model simulates the relevant water quality processes impacting DO in the system (Tetra Tech, Inc. 2015a). The SHEP model was developed in 2006 and has been updated several times over 15 years. The purpose of the model is to evaluate changes to hydrodynamics and water quality in the Savannah River and estuary from a variety of sources, including the SHEP channel deepening and mitigation features.

A history of the model development, beginning in 2006, is presented in **APPENDIX K.**

11.1.1 The 2020 SHEP Model

Due to changes in the harbor and additional data collected since 2015, the 2020 SHEP model updates included significant grid modifications to improve the representation of flows in and out of the estuary. The 2020 SHEP model was calibrated to the January 1 through December 31, 2019 period for WSE, salinity, water temperature, flow, velocity, and DO at 10 USGS stations. Reasons for the latest calibration included the opportunity to capture the full seasonality of the Savannah River system, construction of the majority of SHEP features which included McCoy's Cut and the outer harbor dredging, and bathymetric surveys completed in 2020.

Figure 11-1 presents the 2020 SHEP model computational grids for EFDC and WASP. The EFDC grid extends further offshore since WASP open boundary conditions are generated by EFDC and must be prescribed at an internal region of the EFDC grid. Grid cells vary in size but were approximately 250 feet by 650 feet, 400 feet by 750 feet, and 150 feet by 650 feet at the Front River, Back River, and Upriver diffuser area, respectively. The model contains 10 layers that vary in thickness depending on water depth.

Detailed information about model setup, grid improvements, and calibration for the 2020 SHEP model is provided in **APPENDIX K**

The re-calibrated (updated) 2020 SHEP model was utilized to evaluate the levels of DO in the Savannah River and estuary during the SUR period and to evaluate the performance of the oxygen injection system when operating under EIS conditions. The model was utilized for the evaluation of far-field impacts where the injected oxygen has fully mixed with the receiving waters, and for spatial and temporally averaged conditions. Plume dynamics in the proximity of the diffusers were analyzed and evaluated using analysis of the dye releases as presented in Section 10.0 and monitoring data collected at buoys deployed during the SUR and presented in Section 8.0 and Section 9.0.

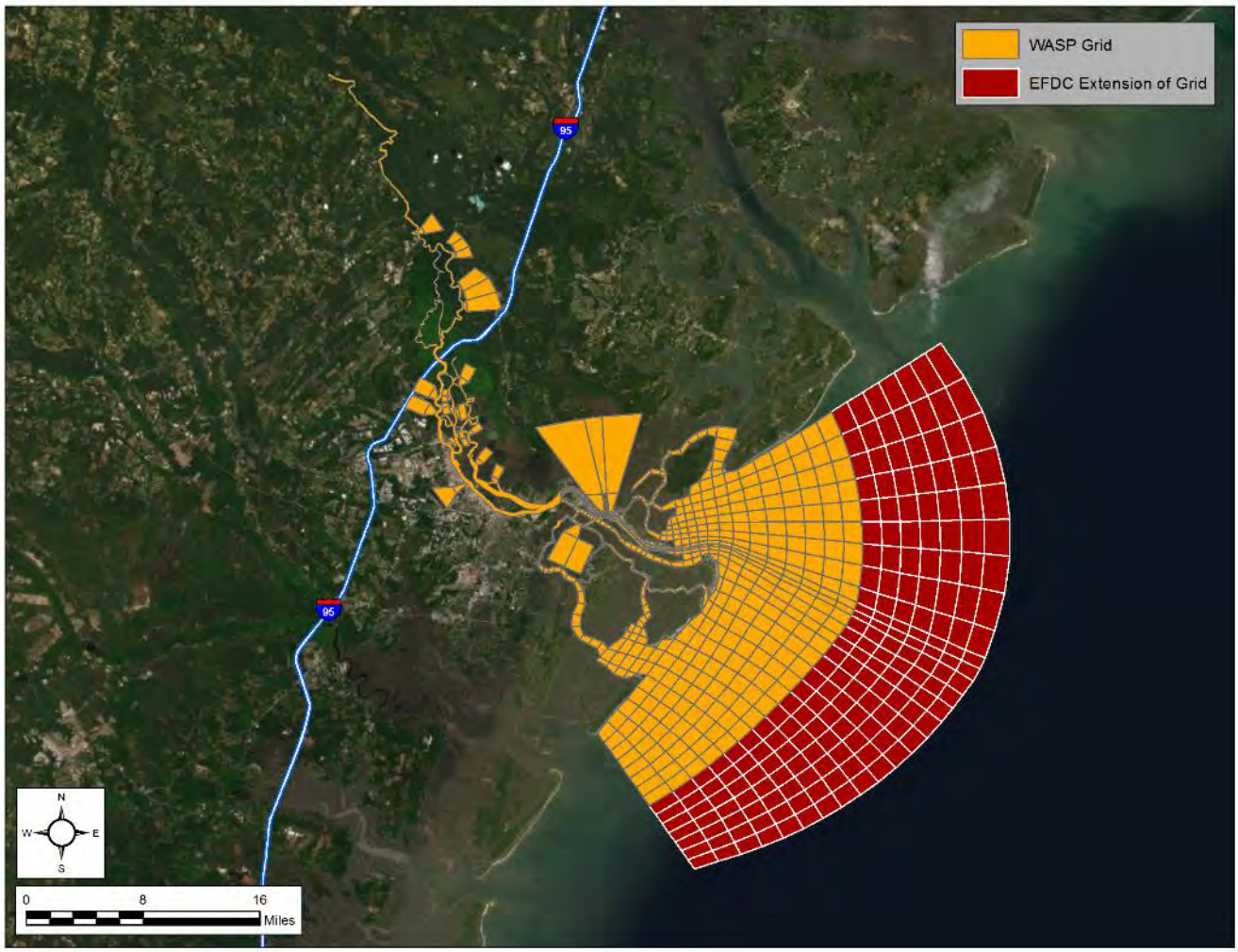

Figure 11-1 SHEP 2020 EFDC and WASP Computational Grids

11.2 MODEL SETUP

The 2020 SHEP model was used as another line of evidence to confirm that the oxygen injection system improved DO concentrations throughout the estuary and mitigated the DO impacts of the project. Simulated DO levels for different scenarios that included impacts from the oxygen injection system were compared to DO levels simulated without oxygen injection.

The model was set up and calibrated for the period January 1, 2019, to December 31, 2019. In November 2020, the model was extended through September 30, 2020, to include SUR conditions in the simulations.

The intake locations of the Downriver and Upriver plants on the Front River and Savannah River, respectively, were represented as flow withdrawals, in addition to other permitted withdrawals, in the EFDC Model. The plant inflows and outflows were determined using the reviewed plant data as described in Section 5.2. A raw water DO concentration time series, measured at the intakes of both plants, was included in the WASP Model at the Downriver and Upriver intake locations (***Figure 11-2*** and ***Figure 11-3***).

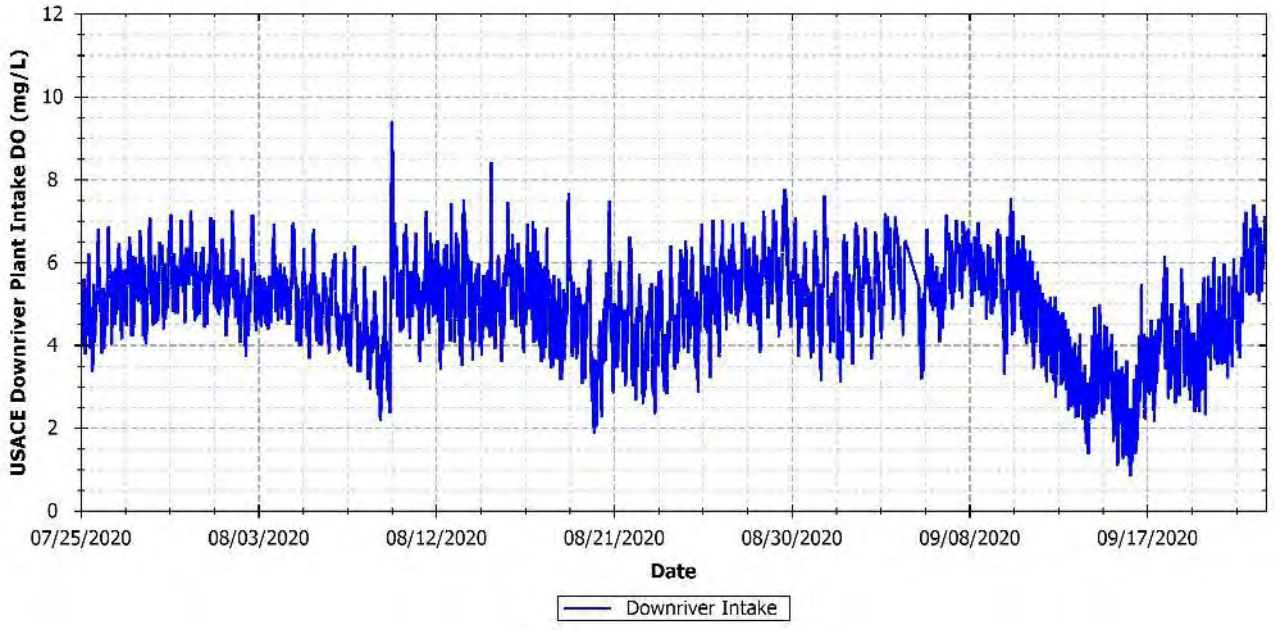

Figure 11-2 Raw DO Intake Time Series at Front River

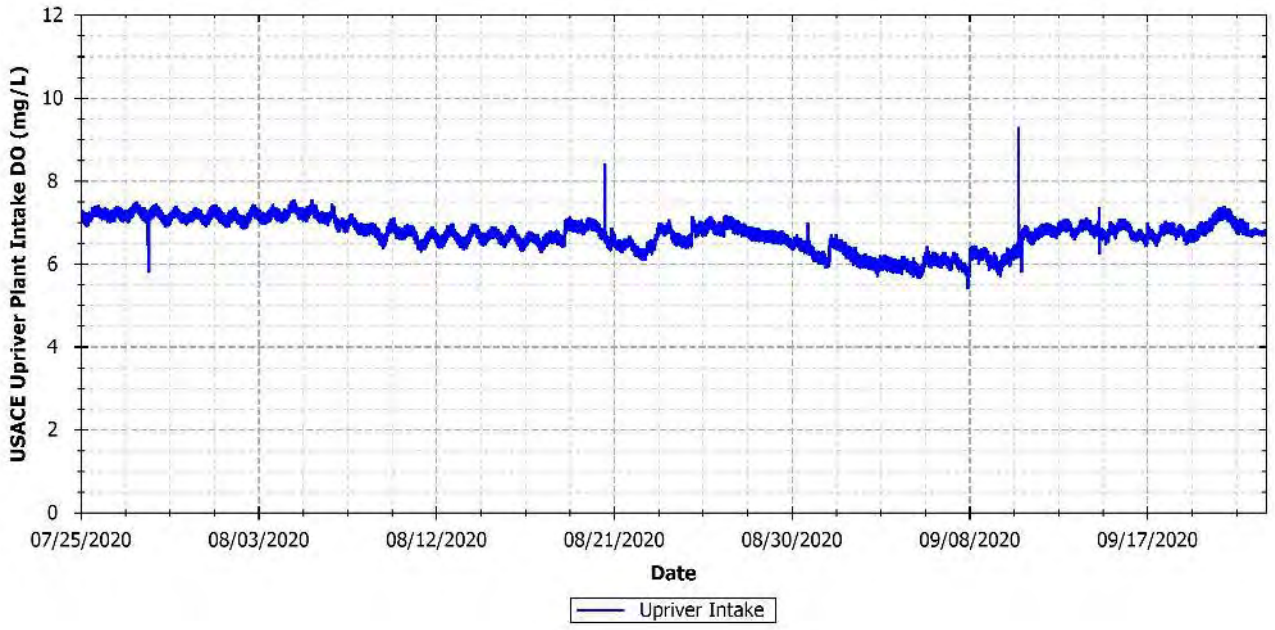

Figure 11-3 Raw DO Intake Time Series at Savannah River

The flows, temperatures, salinity, and DO concentrations from the Front River, Back River, and Upriver diffusers were represented as point sources in the model. The 15-minute plant data for the SUR from July 25, 2020, through September 22, 2020 (Section 3.3 and **APPENDIX H**), consisted of information on the flow distribution of the super-oxygenated water to the Back River, Front River, and Upriver, and the total raw, gross, and net oxygen loads. These

were used to develop the plant discharge representation in the model. The reviewed plant flows were converted from gpm (***Figure 11-4*** and ***Figure 11-5***) to cfs, as required in the model, and included in the EFDC Model at the Back River, Front River, and Upriver diffusers.

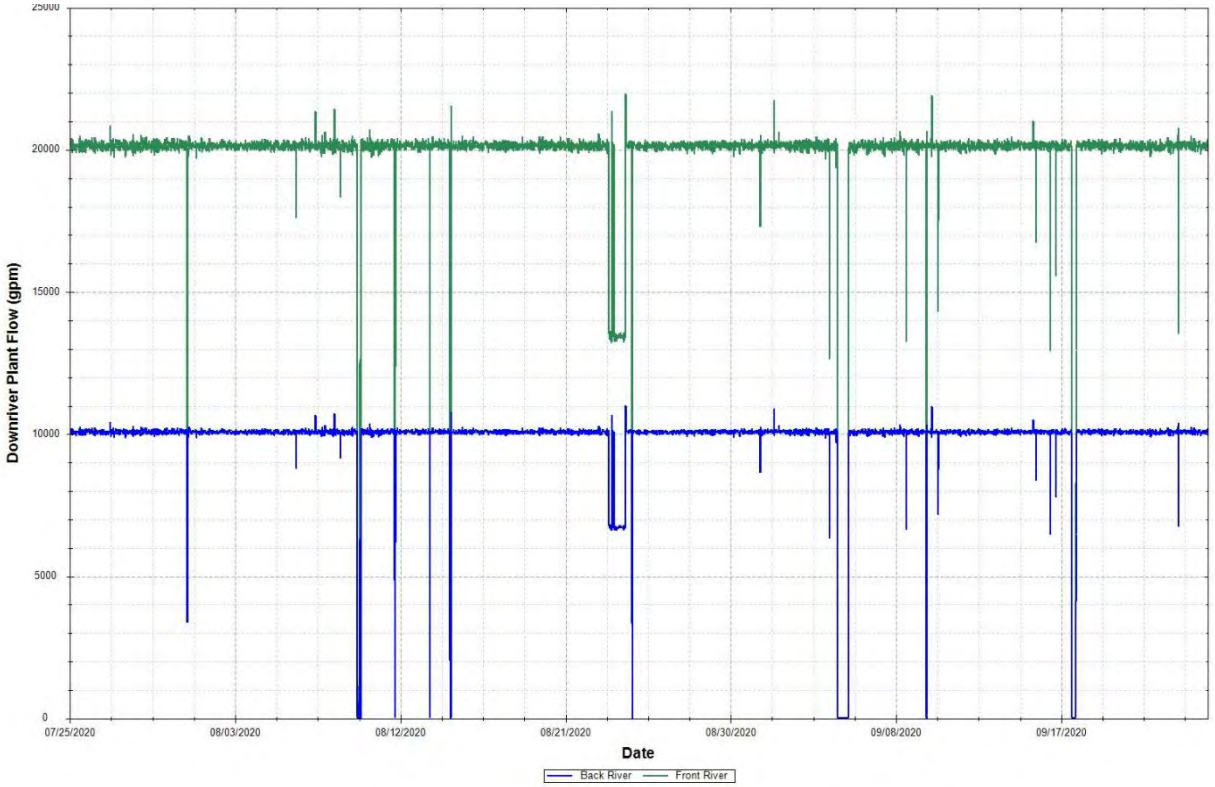

Figure 11-4 Downriver Plant Flow

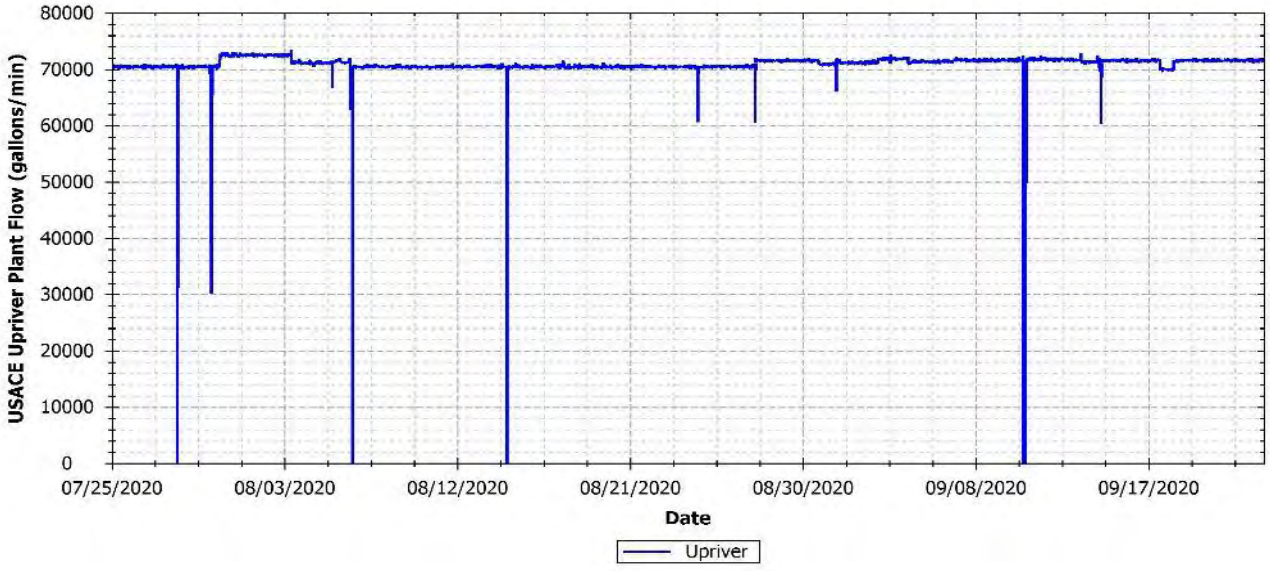

Figure 11-5 Upriver Plant Flow

The 15-minute raw temperature data at the Downriver plant were not available, but they were available at the Upriver plant. Raw plant data consisted of temperatures at each of the eight Upriver Speece cones. These were flow-weighted using each Speece cone flow to calculate a composite water temperature time series for the Upriver plant. To determine the temperature at the Downriver plant, modeled water temperatures at the intake location were applied at the Back River and Front River diffuser locations. The temperatures were converted from Fahrenheit to Celsius, as per the requirements of the model, and included in the EFDC Model at the Back River, Front River, and Upriver diffusers (***Figure 11-6***).

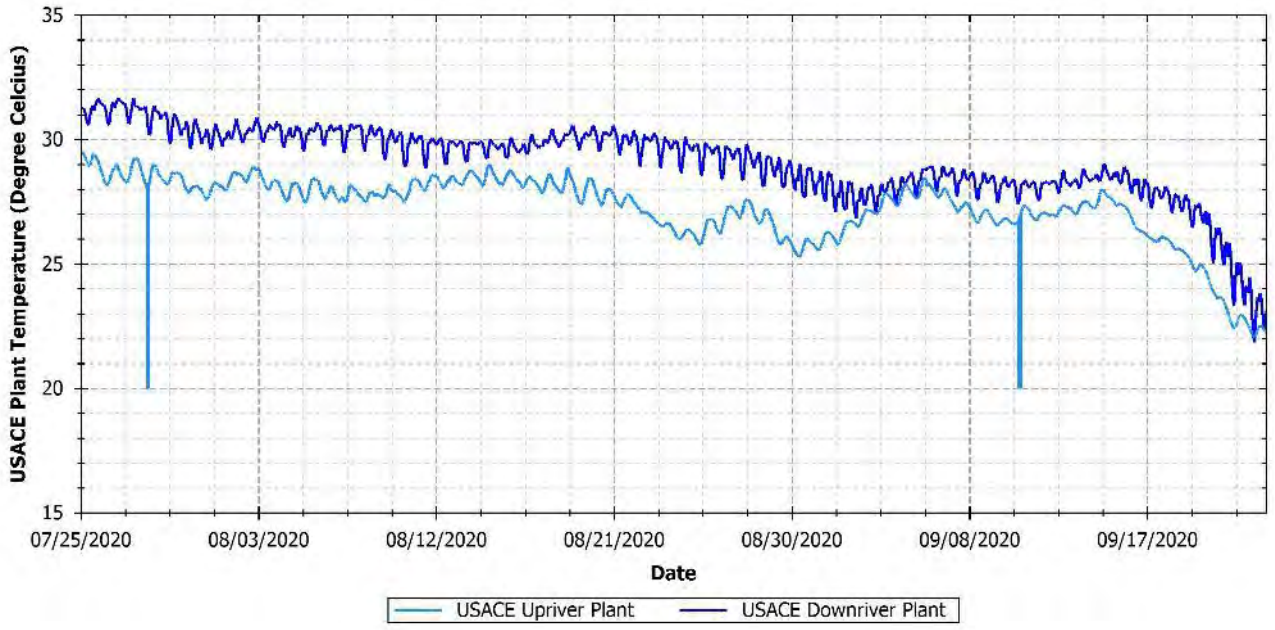

Figure 11-6 Oxygen Injection Plant Temperature Data

Salinity, Carbonaceous Biochemical Oxygen Demand (CBOD), and Ammonia (NH3) were not measured at either plant intake. Therefore, to represent the concentrations from the plant flows, modeled salinity concentrations at the intake location were applied at the Front River, Back River, and Savannah River diffuser locations in the EFDC Model, and modeled CBOD and NH3 concentrations were applied at the diffuser locations in the WASP Model.

The total net DO concentration, calculated from the reviewed plant load and the flow distribution data, was input into the WASP model at the Back River, Front River, and Upriver diffusers (***Figure 11-7*** and ***Figure 11-8***).

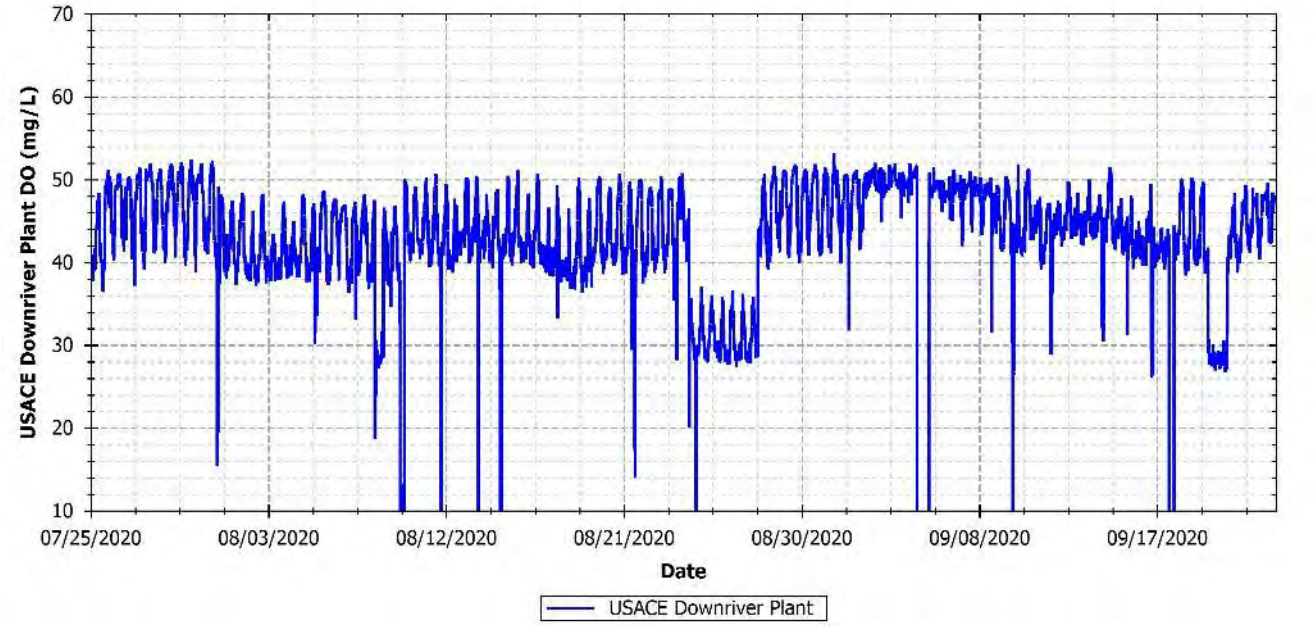

Figure 11-7 Downriver Plant DO Concentrations

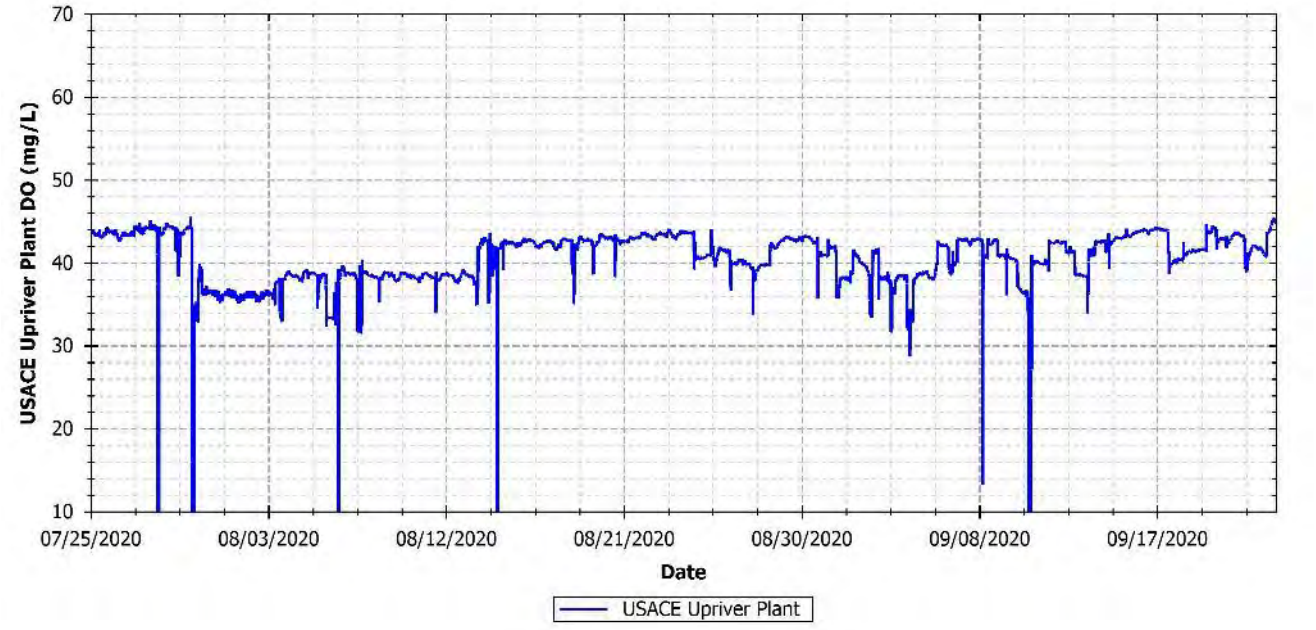

Figure 11-8 Upriver Plant DO Concentrations

11.2.1 Modeling Scenarios

To evaluate the oxygen injection system impacts, two runs were simulated as described in ***Table 11-1***. DO and DO deltas between the SUR and Baseline runs for the entire water column and the bottom half of the water column were evaluated and analyzed to determine the mitigation success of the oxygen injection system.

Table 11-1 Modeling Scenarios

Scenario Name	Model Run Period	Model Assessment Period	Model Bathymetry	Injected oxygen
SUR	May 1, 2019 to September 30, 2020	July 25 to September 22, 2020	Partial SHEP deepening complete, reflective of the channel condition during the Startup Run	Actual flows and oxygen loads injected into Front River, Back River, and Savannah River during the SUR
Baseline				No oxygen injection

DO concentrations and incremental deltas in DO were evaluated for the bottom layers (defined as the model layers at the bottom half of the water column at each model cell, in the case of the 2020 SHEP model, five layers). One of the requirements is for the oxygen injection system to mitigate median DO concentrations in 97 percent of the volume in the bottom half of the water column as specified in the EIS Appendix C (USACE 2012a) and engineering supplemental studies (Tetra Tech, Inc. 2010). DO concentrations and incremental deltas in DO were also calculated for the entire water column given the Savannah River TMDL was evaluated for the entire water column (USEPA 2010). The results for the bottom half of the water column are presented in the following section while the results for the entire water column are presented in **APPENDIX K**.

11.3 MODEL EVALUATION FOR THE STARTUP RUN

To evaluate the mitigation capability of the oxygen injection system during SUR, a comprehensive analysis was undertaken. Changes in DO were evaluated for longitudinal profiles of the rivers, for spatial zones identified in the EIS, and at the individual cell level.

11.3.1 DO Longitudinal Profiles

The changes in DO in the Savannah Harbor due to the oxygen injection system were evaluated throughout the Savannah River, Front River, Middle River, and Back River using longitudinal profiles. The RMs for each river are used as reference points and are presented in ***Figure 11-9*** (Front River and Savannah River in red, Middle River in green, and Back River and Little Back River in yellow).

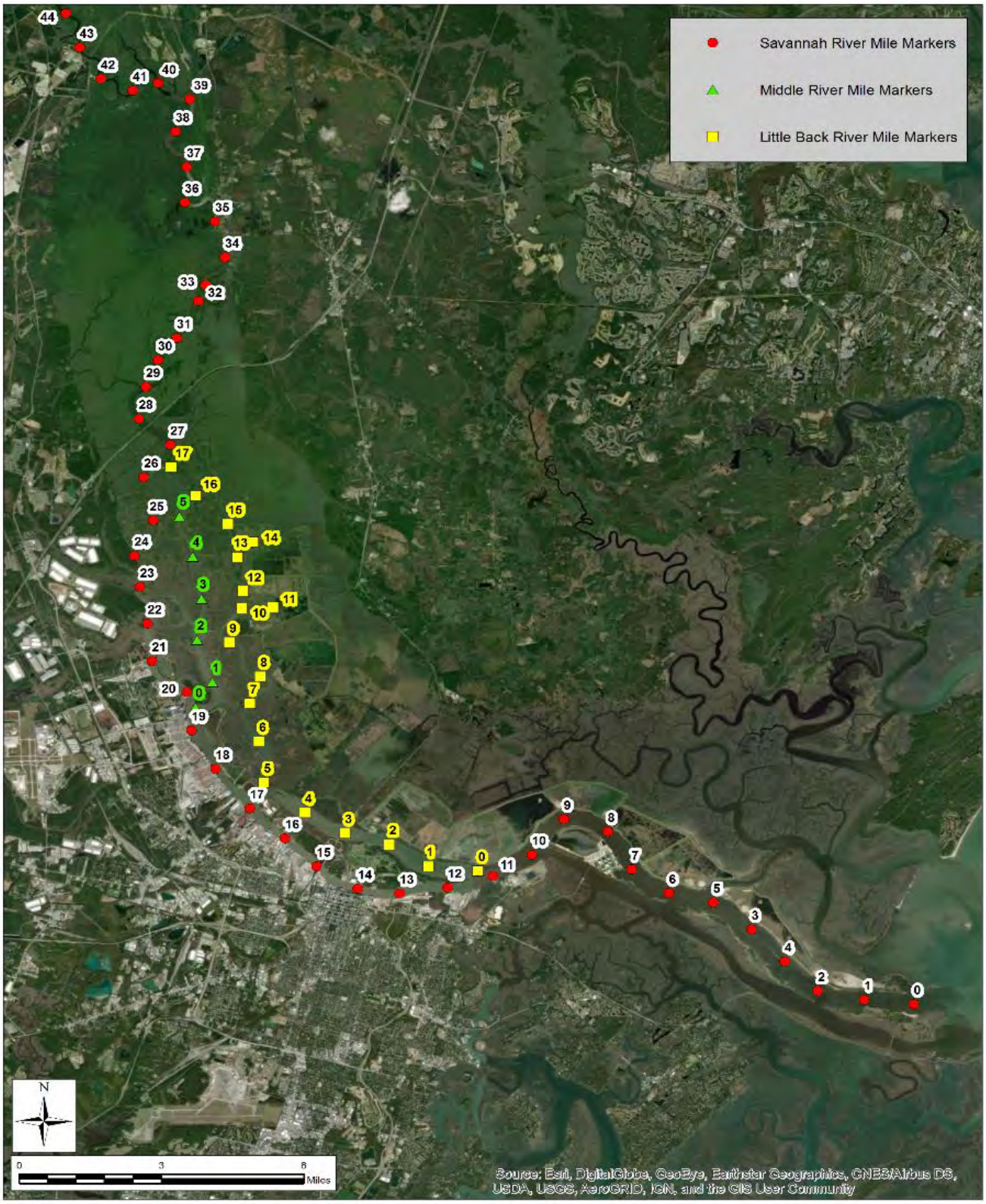

Figure 11-9 River Mile Markers for the Savannah, Little Back, and Middle Rivers

The longitudinal profiles plot DO against RMs and used all modeled outputs from the SUR period. The profiles were created for the 10th, median, and 90th percentiles. The profiles also show the location of the zones, analyzed in Section 11.3.2. Separate profiles were generated for both the bottom half and the entire water column. The profiles for the entire water column are presented in **APPENDIX K**.

The longitudinal profile for the Front and Savannah River were calculated along the navigation channel. The bottom layers results (***Figure 11-10***) showed that there was a positive median DO delta for the entire profile except for the lower five miles of the river to Fort Pulaski, where open ocean conditions dominate, and the effect of the oxygen injection was negligible while not showing deterioration of the previous condition. Along the Savannah River downstream of the Upriver plant, between approximately RM 40 and the I-95 bridge at RM 27.8, the DO delta created by the Upriver plant gradually decreased from 2.0 mg/L to 0.4 mg/L. This agrees with the trends observed in Section 8.0 and Section 10.1. This Upriver area is mostly riverine with no tidal influence that could cause a reversal of flow direction. The residence time in this region is smaller than downstream, allowing the oxygen to move downstream to the areas that require mitigation. The region between RM 27 and RM 10 showed a significant reduction in DO both for the SUR conditions as well as the baseline conditions. In this area, retention times were larger due to the bidirectional tidal flows and the mixing with the river water. Also, the upper extent of the navigation channel is in this region causing a sudden change in depth that contributes to lowering the DO. Sediments are deposited in the deeper waters due to the reduction in velocity and the effect of the tide, thereby increasing the SOD. All these factors contribute to the DO decreases in this region. Despite being the most sensitive part of the estuary for DO, the Upriver and Downriver injection plants contribute to maintaining positive DO deltas throughout with values ranging from 0.1 to 0.4 mg/L. The influence of the tide on the injected oxygen load from the Front River diffuser can be perceived by the slight increase in DO deltas both upstream and downstream of the diffuser. During flood tide, the injected DO was transported upstream while during ebb tides the injected DO was transported downstream.

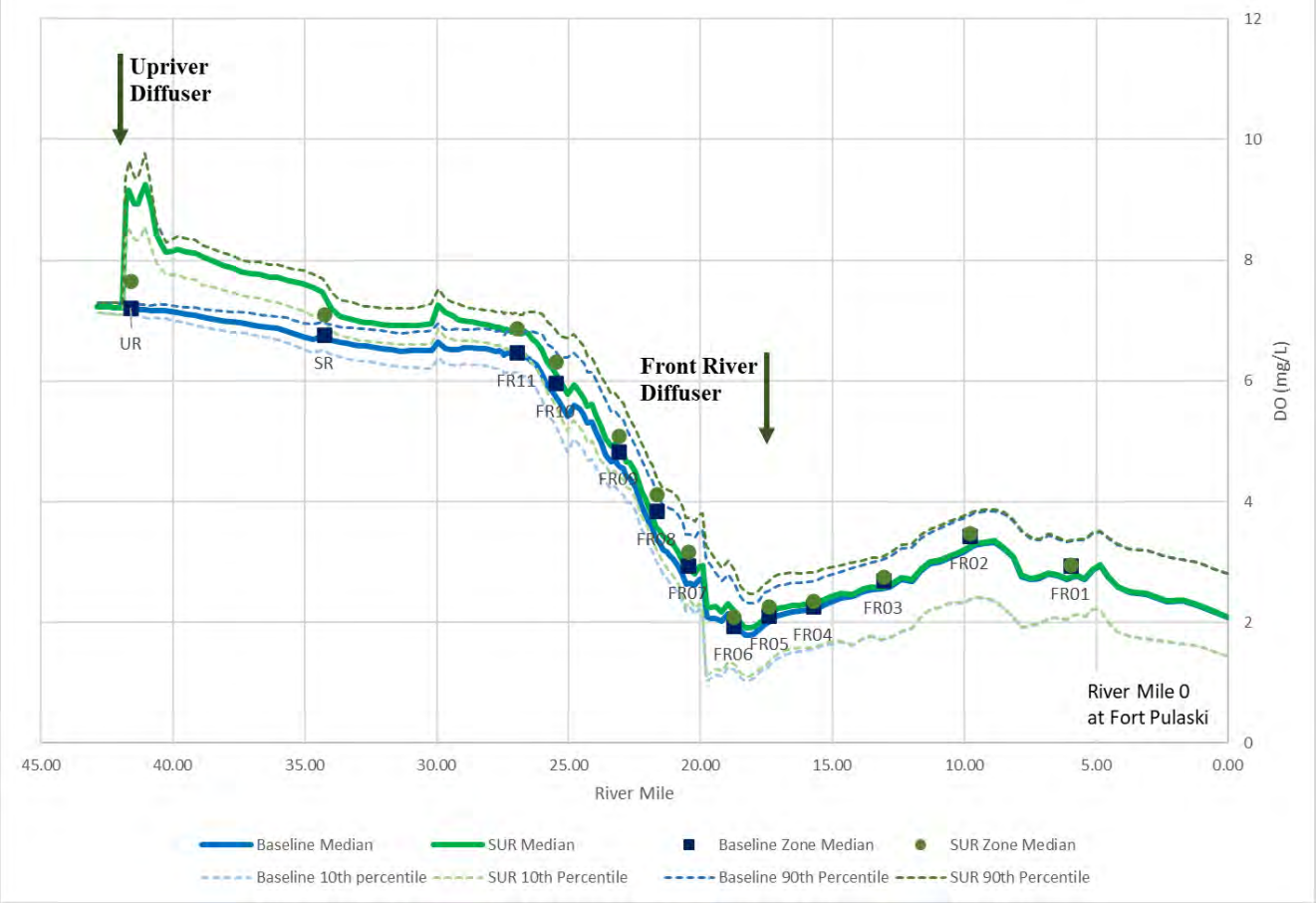

Figure 11-10 Savannah River Longitudinal Profile of DO – SUR Scenario (bottom half)

The longitudinal profile for the bottom half of the Back River and Little Back River showed positive DO deltas along the entire profile confirmed by the zones' values (***Figure 11-11***). The depth and width of the channel were relatively consistent with a widening of the cross-section between RM 2.0 and RM 3.0, where the river enters the sediment basin, causing a sudden decrease in DO. The DO deltas were uniform with a median value of 0.5 mg/L and a minimum of 0.2 mg/L. A maximum median value of 0.6 mg/L was simulated at the location of the Back River diffuser (***Table 11-2***).

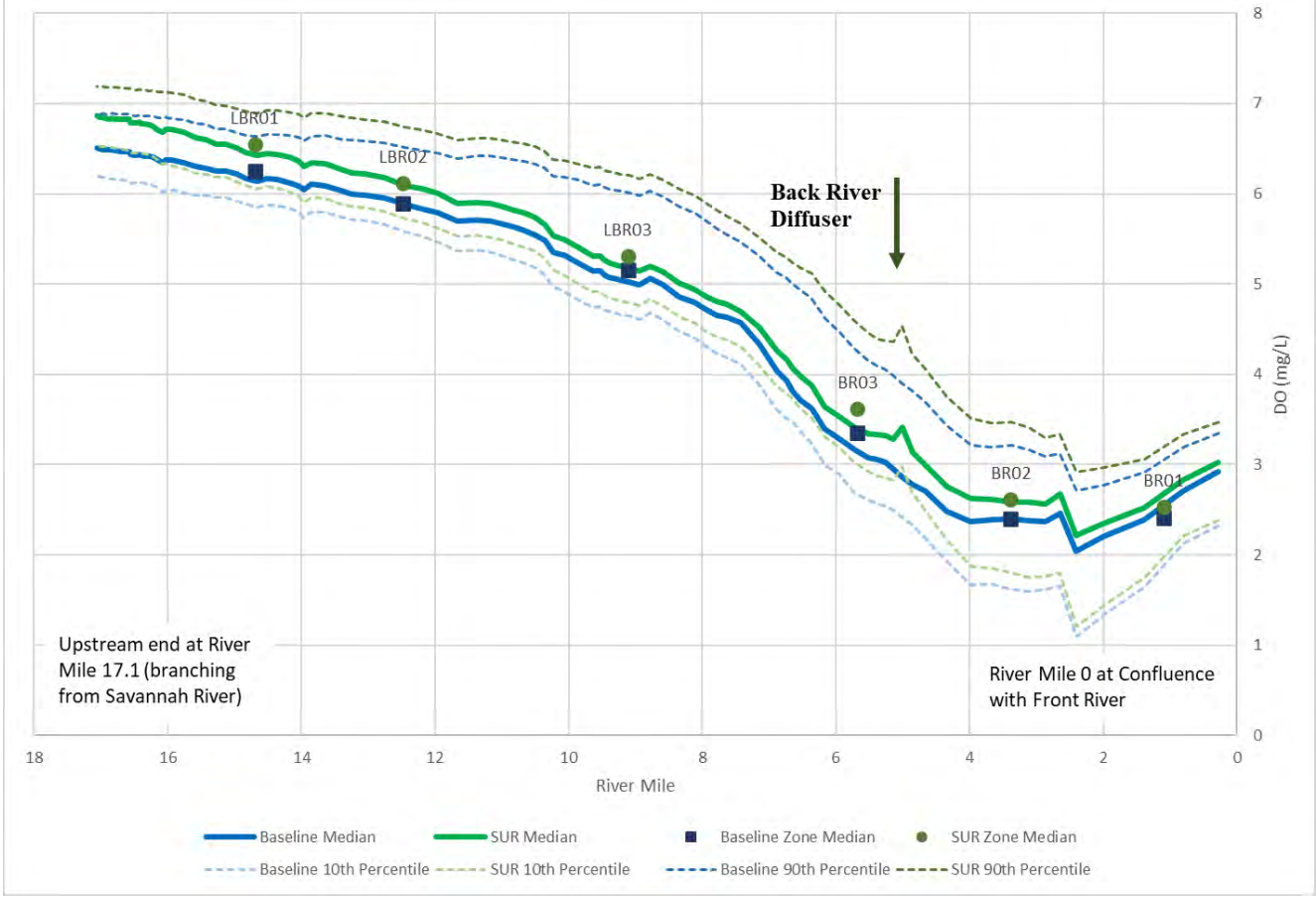

Figure 11-11 Back River Longitudinal Profile of DO – SUR Scenario (bottom half)

Table 11-2 Maximum DO Deltas for Longitudinal Profiles – SUR Scenario (bottom half)

Location	Bottom Layer DO Maximum Delta (mg/L)		
	10th Percentile	Median	90th Percentile
Savannah River	1.37	2.08	2.73
Front River	0.26	0.39	0.45
Middle River	0.21	0.34	0.38
Back River	0.42	0.56	0.68

The Middle River showed the most uniform DO delta with values ranging from 0.2 to 0.4 mg/L with an average of 0.4 mg/L (***Figure 11-12***, ***Table 11-2***). Despite not having an oxygen injection diffuser along the Middle River, the benefits from the Upriver and Downriver plants are evident by the positive deltas at both upper and lower extents.

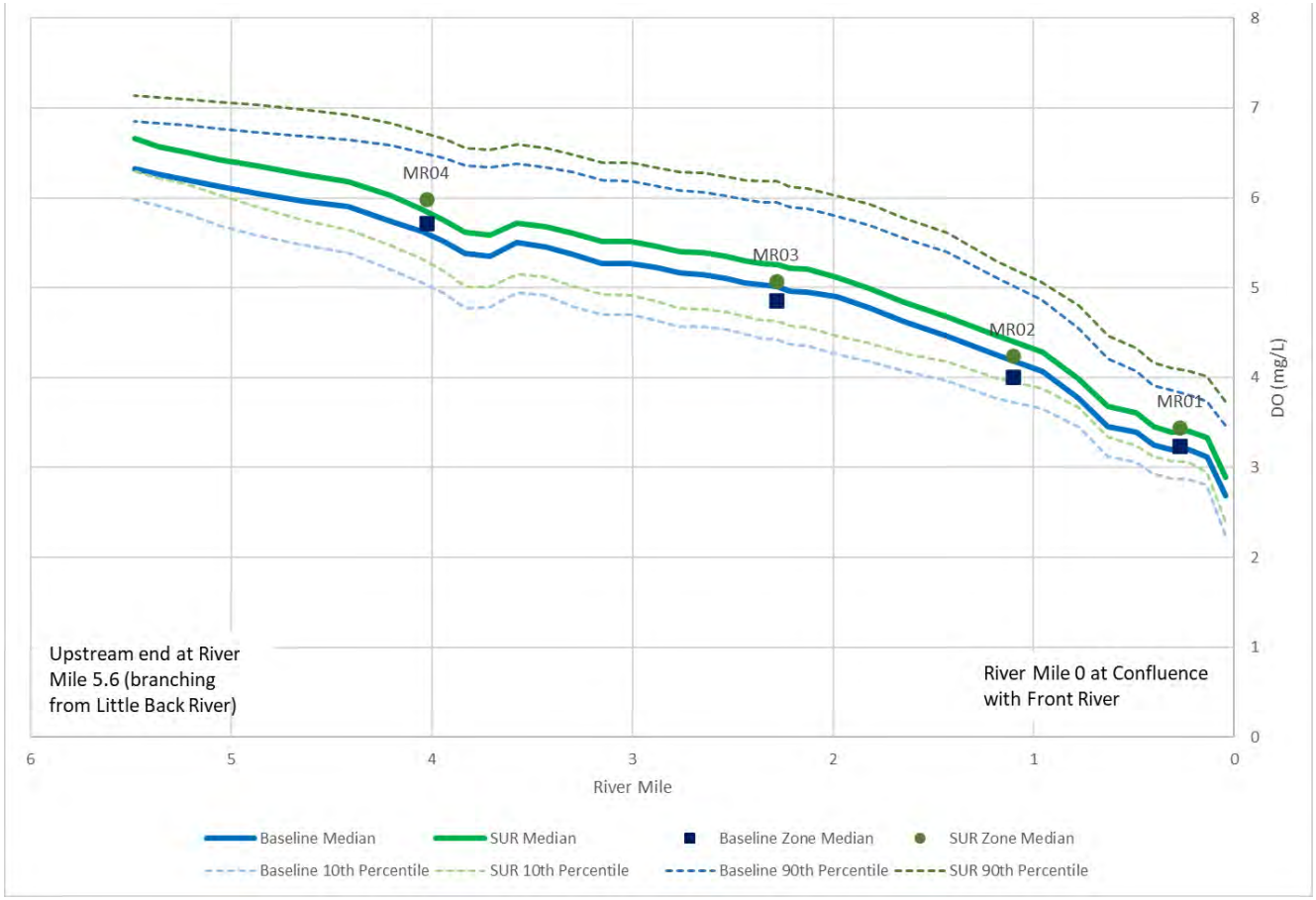

Figure 11-12 Middle River Longitudinal Profile of DO – SUR Scenario (bottom half)

11.3.2 DO Zonal Analysis

DO spatial zones defined by the EIS (USACE 2012a) were delineated to evaluate average conditions over them (***Figure 11-13*** to ***Figure 11-15***). The median values for the zones were added to the profiles in Section 11.3.1 for reference.

During the design phase of the oxygen injection system, the USACE and agencies determined that the design must mitigate 97 percent of the estuary waters, which was computed by comparing zones' volume-weighted DO concentrations for existing and project scenarios (Tetra Tech, Inc. 2010). Twenty-seven zones were delineated which covered the area to be mitigated, from RM 0 to RM 27.8 (***Figure 11-13*** to ***Figure 11-15***). Eleven zones were defined along the Front River, two along the Savannah River, six along the Little Back River, five along the Middle River, two in the South Channel, and one in Steamboat River (the Horseshoe). For both the bottom half and the entire water column, 10th percentile, median, and 90th percentile DO values were calculated for all zones. The results from the DO zonal analysis indicated that the oxygen injection system positively impacted the DO in the bottom half of the water column by increasing the median zonal concentrations by values ranging from 0.01 to 0.45 mg/L (***Figure 11-16*** and ***Figure 11-17***). This results in 100 percent of the zonal volume-weighted DO concentrations being improved by the oxygen injection system during the SUR. Areas that were identified as most affected by the navigational channel deepening were the following nine zones: FR07, FR08, FR11, MR01, MR05, BR01, BR02, BR03, and LBR03 (Tetra Tech, Inc. 2010). The DO zonal analysis showed that the oxygen injection system increased DO concentrations in the bottom half of the most affected zones during the SUR period compared to baseline conditions. The median oxygen levels increased from 0.13 mg/L to 0.40 mg/L in the critical zones, with an average oxygen increase of 0.25 mg/L. Full details for all zones are presented in ***Table 11-3***.

LINE OF EVIDENCE 3.1 – 97% VOLUME IMPROVEMENT ACHIEVED IN BOTTOM WATERS

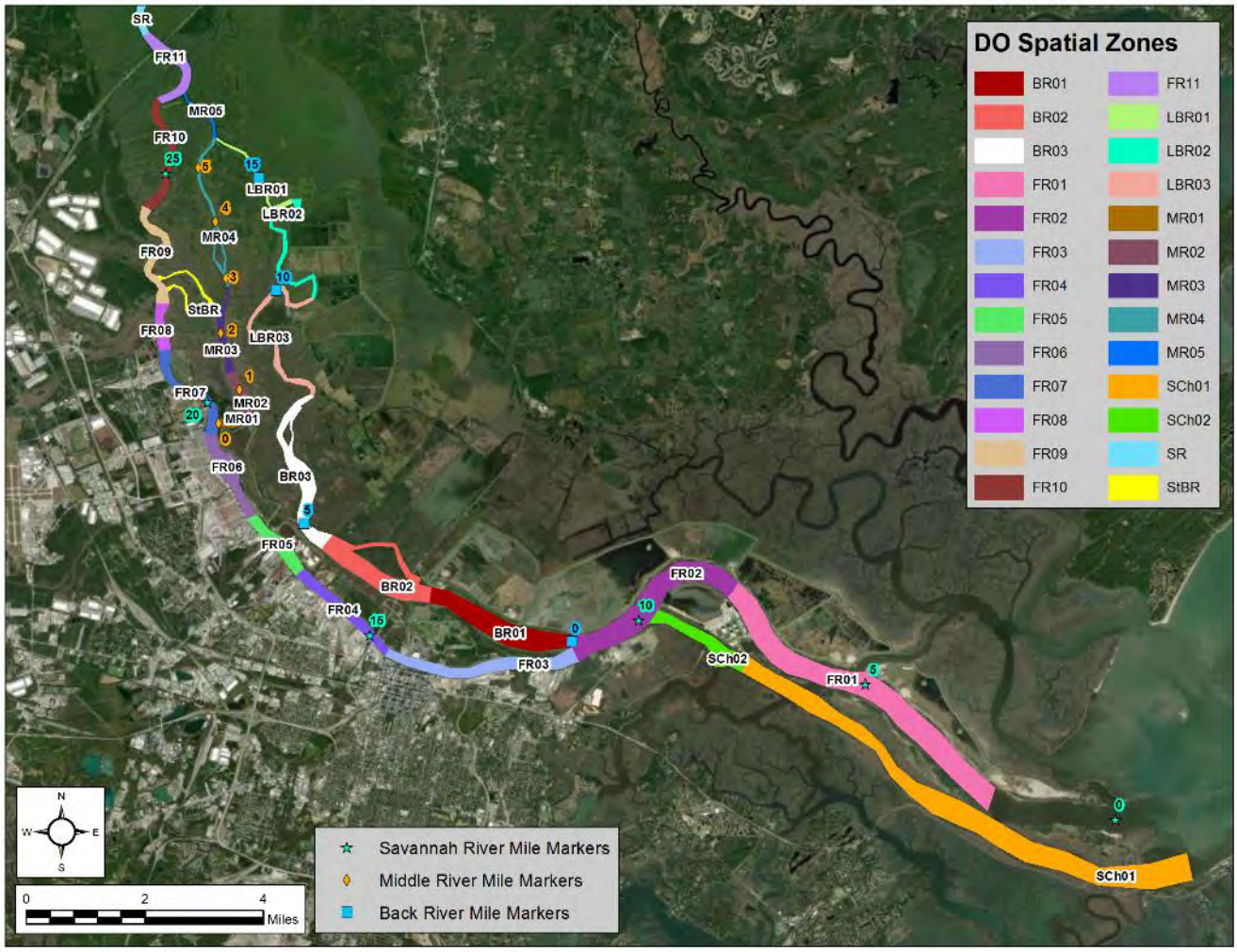

Figure 11-13 Location of DO Spatial Zones from RM 0 to RM 27.8

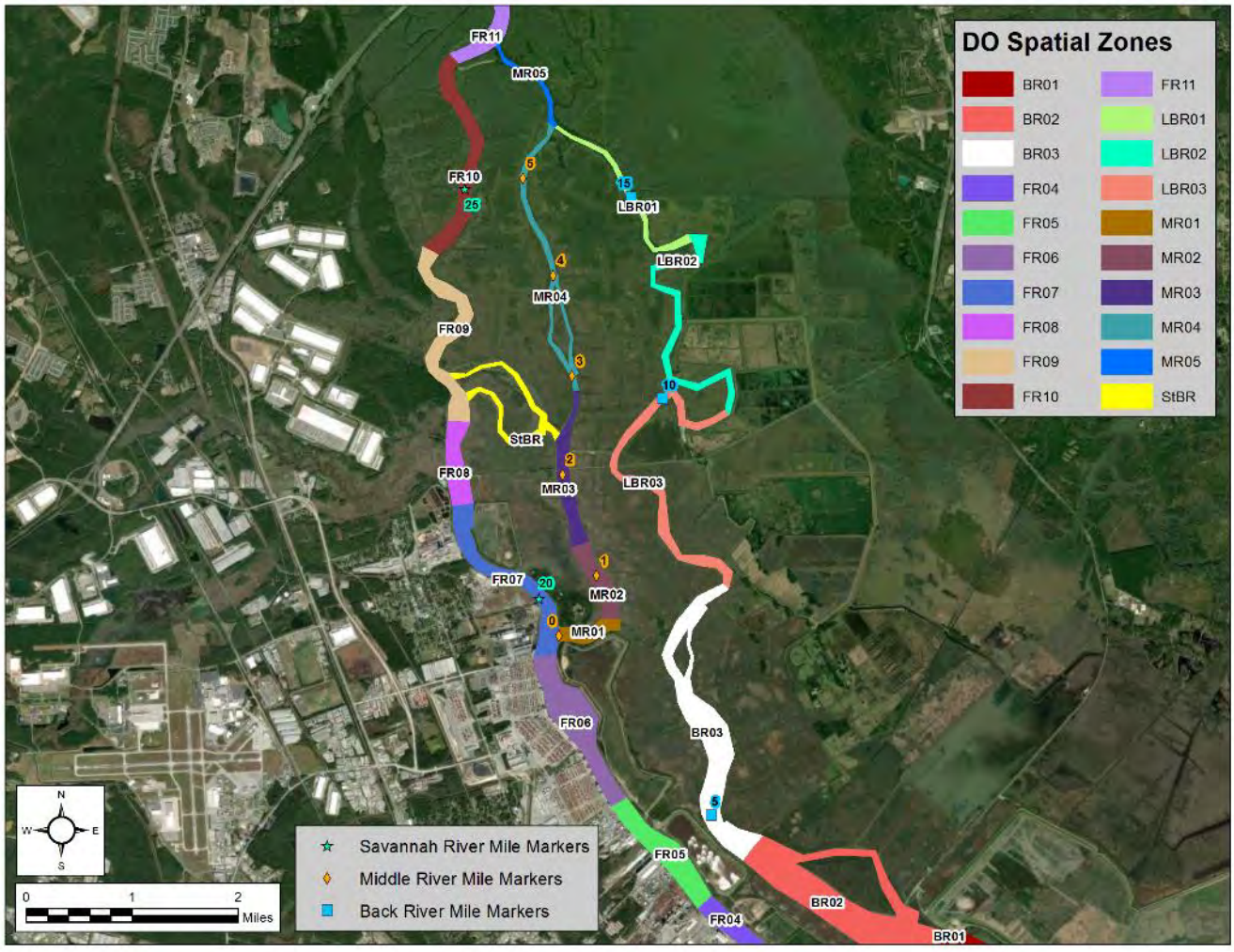

Figure 11-14 Location of DO Spatial Zones in the Front, Middle and Little Back Rivers

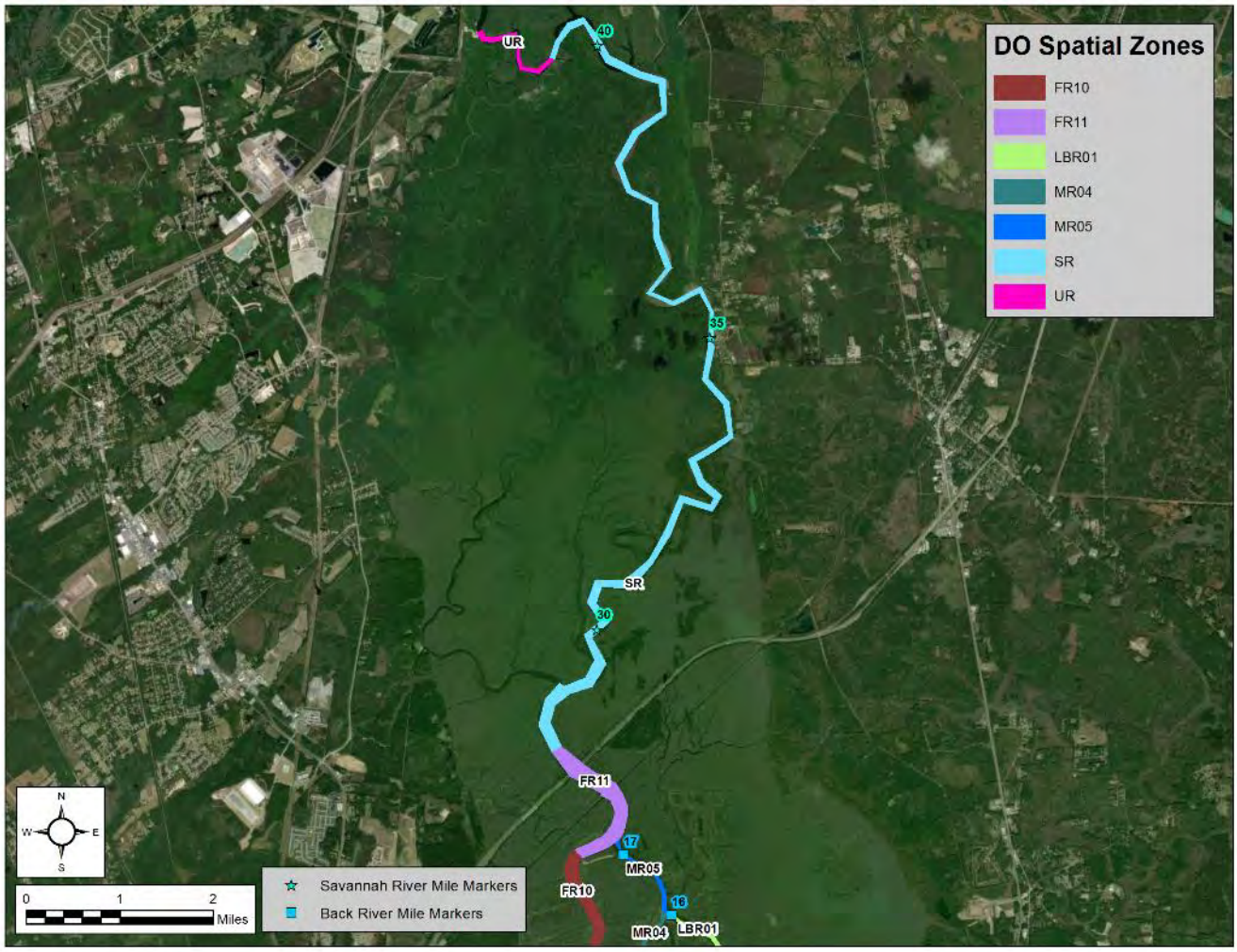

Figure 11-15 Location of DO Spatial Zones in the Savannah River

Table 11-3 DO Deltas by Zone for SUR Scenario – Bottom Half

Bottom Layers Dissolved Oxygen for SUR (mg/L)									
Zone Name	Baseline			SUR			Delta		
	10th Percentile	Median	90th Percentile	10th Percentile	Median	90th Percentile	10th Percentile	Median	90th Percentile
FR01	2.26	2.93	3.52	2.28	2.95	3.53	0.00	0.01	0.02
FR02	2.80	3.44	3.81	2.83	3.48	3.86	0.03	0.05	0.07
FR03	2.01	2.70	3.15	2.03	2.76	3.23	0.02	0.05	0.08
FR04	1.60	2.26	2.72	1.66	2.36	2.87	0.06	0.11	0.15
FR05	1.39	2.10	2.60	1.51	2.27	2.81	0.11	0.17	0.21
FR06	1.05	1.94	2.68	1.13	2.10	2.89	0.09	0.17	0.21
FR07	**2.52**	**2.95**	**3.73**	**2.68**	**3.16**	**4.00**	**0.16**	**0.22**	**0.27**
FR08	**3.50**	**3.84**	**4.62**	**3.73**	**4.12**	**4.90**	**0.18**	**0.25**	**0.30**
FR09	4.36	4.83	5.70	4.64	5.08	5.99	0.19	0.28	0.32
FR10	5.49	5.96	6.61	5.83	6.32	6.97	0.23	0.37	0.41
FR11	**6.18**	**6.47**	**6.81**	**6.57**	**6.87**	**7.14**	**0.27**	**0.40**	**0.48**
SR	6.56	6.77	7.01	6.84	7.11	7.33	0.23	0.34	0.42
UR	7.09	7.21	7.29	7.45	7.66	7.79	0.29	0.45	0.58
BR01	**1.76**	**2.41**	**2.93**	**1.85**	**2.53**	**3.08**	**0.09**	**0.13**	**0.16**
BR02	**1.59**	**2.40**	**3.16**	**1.75**	**2.62**	**3.41**	**0.18**	**0.23**	**0.26**
BR03	**2.98**	**3.35**	**4.49**	**3.28**	**3.61**	**4.80**	**0.23**	**0.29**	**0.34**
LBR03	**4.76**	**5.16**	**6.07**	**4.94**	**5.31**	**6.27**	**0.12**	**0.18**	**0.20**
LBR02	5.59	5.89	6.52	5.74	6.12	6.75	0.14	0.22	0.25
LBR01	5.95	6.25	6.73	6.17	6.54	6.99	0.18	0.30	0.32
MR01	**2.95**	**3.24**	**3.91**	**3.14**	**3.45**	**4.17**	**0.17**	**0.22**	**0.26**
MR02	3.66	4.01	4.81	3.89	4.24	5.07	0.17	0.23	0.27
MR03	4.25	4.86	5.73	4.44	5.07	5.94	0.15	0.22	0.26
MR04	5.21	5.72	6.53	5.49	5.99	6.80	0.18	0.27	0.29
MR05	**6.13**	**6.45**	**6.87**	**6.45**	**6.80**	**7.16**	**0.23**	**0.34**	**0.39**
SCh01	2.35	2.69	3.04	2.38	2.71	3.08	0.02	0.03	0.04
SCh02	3.37	3.70	3.99	3.41	3.76	4.06	0.04	0.06	0.08
StBR	4.13	4.43	5.46	4.30	4.65	5.70	0.16	0.23	0.27

Note – indicates critical DO zone (Tetra Tech, Inc. 2010)

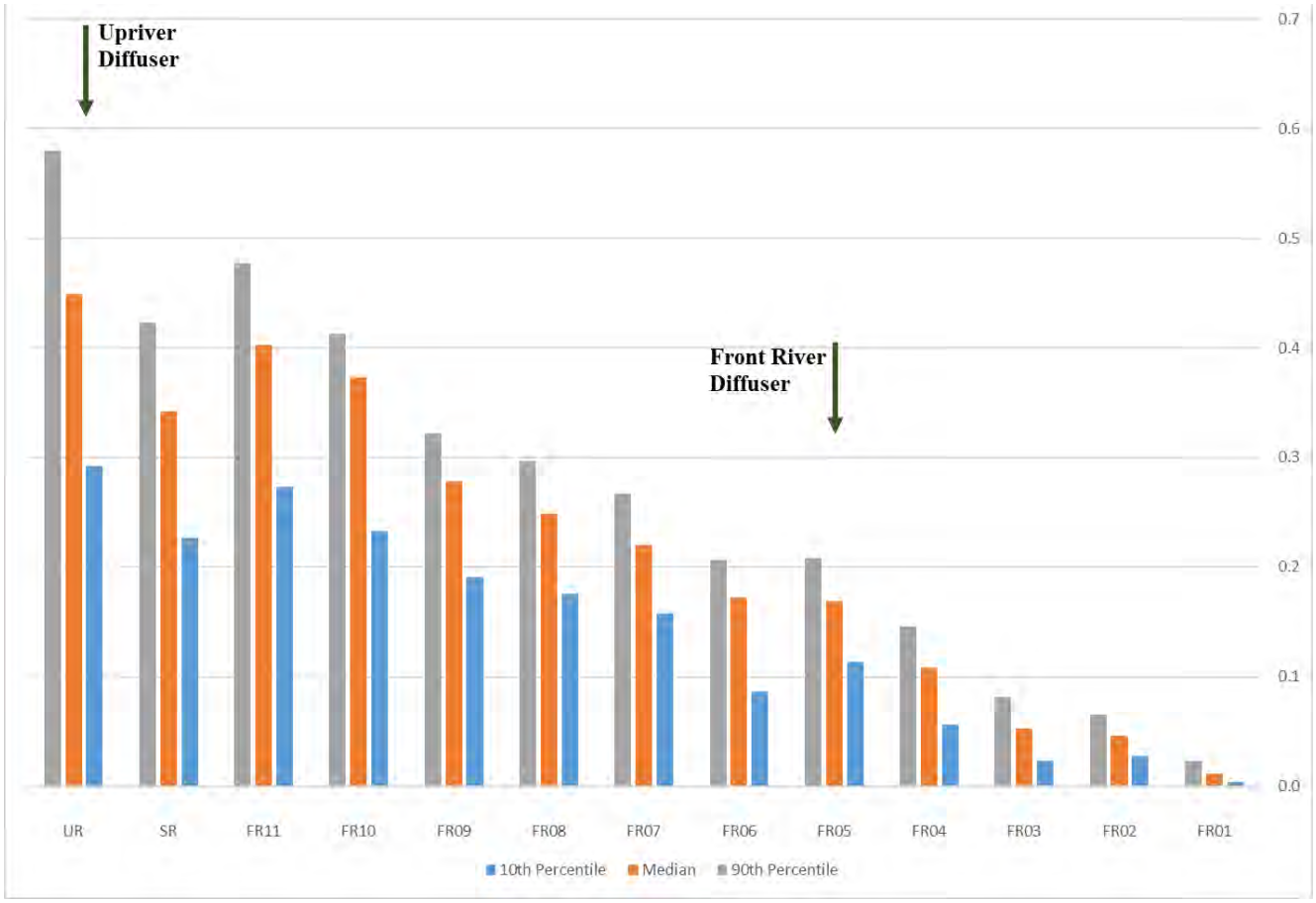

Figure 11-16 Savannah River Spatial Zone DO Deltas – SUR Scenario (bottom half)

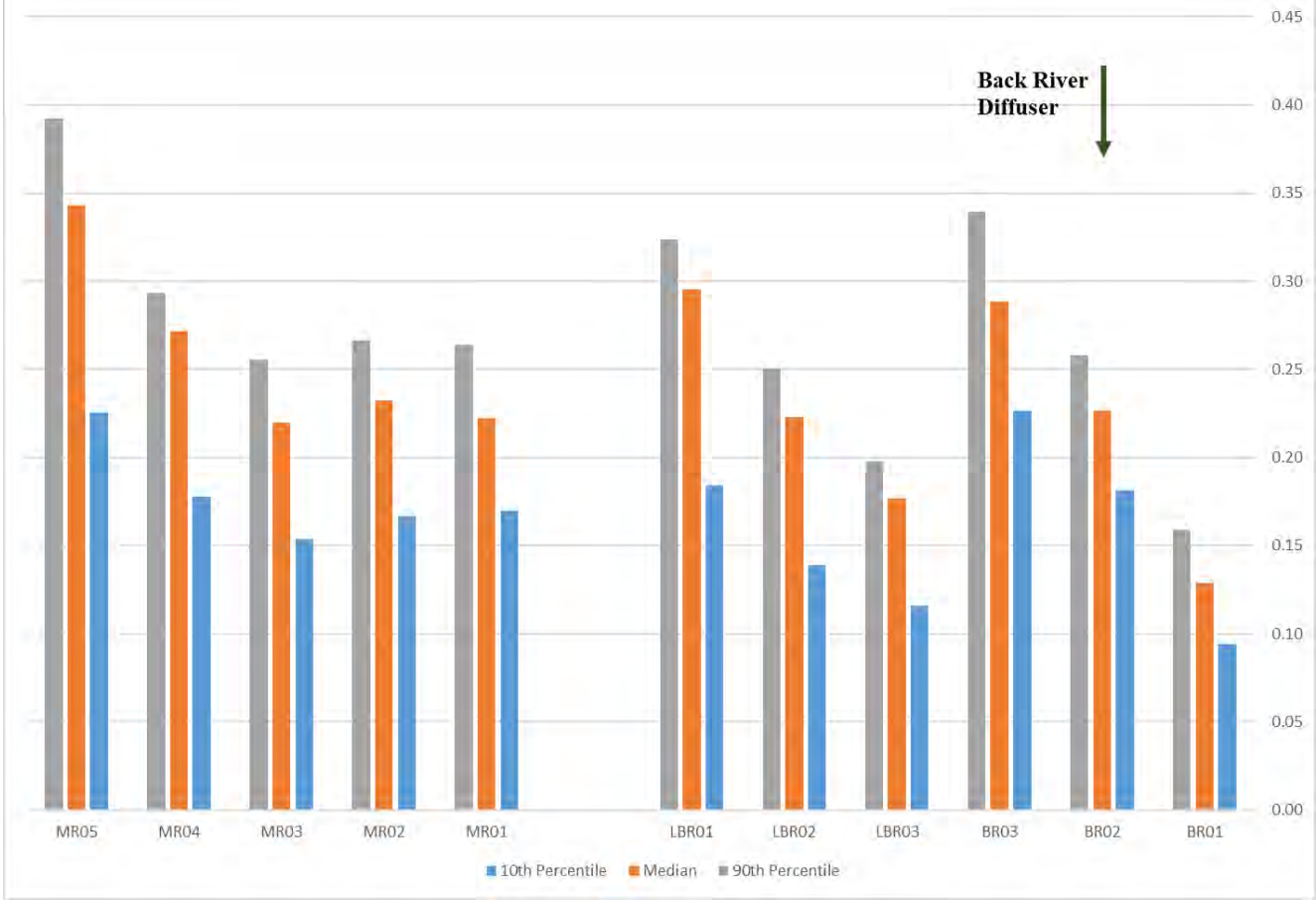

Figure 11-17 Middle River and Back River Spatial Zone DO Deltas – SUR Scenario (bottom half)

The same analysis shown for the bottom layers was completed for the whole water column. Similar results were obtained, particularly in areas that were well mixed vertically and not subject to tidal stratification. In the areas close to the injection diffuser (two to three cells) the delta values for the whole water column tend to be lower than the bottom half since the oxygen load is injected at the bottom and the vertical and spatial mixing does not occur immediately. Results for the water column analysis are shown in **APPENDIX K.**

LINE OF EVIDENCE 4.3 – SPATIAL ANALYSIS OF THE SHEP MODEL

11.3.3 DO Cell Analysis

Changes in DO resulting from the oxygen injection system were also evaluated by calculating the changes in DO in the bottom half for each cell in the Savannah River for the SUR Scenario (***Figure 11-18***). The system was designed to mitigate the incremental effect of navigational channel deepening in 97 percent of the bottom half of the water column volume (USACE 2012a, USACE 2012b).

All zones for the SUR Scenario presented positive DO deltas complying with the criteria. Cells with no or minimal incremental values were mostly in the area between Fort Pulaski and RM 5, due to the dominance of open ocean conditions.

LINE OF EVIDENCE 3.1 – 97 PERCENT VOLUME IMPROVEMENT ACHIEVED IN BOTTOM WATERS

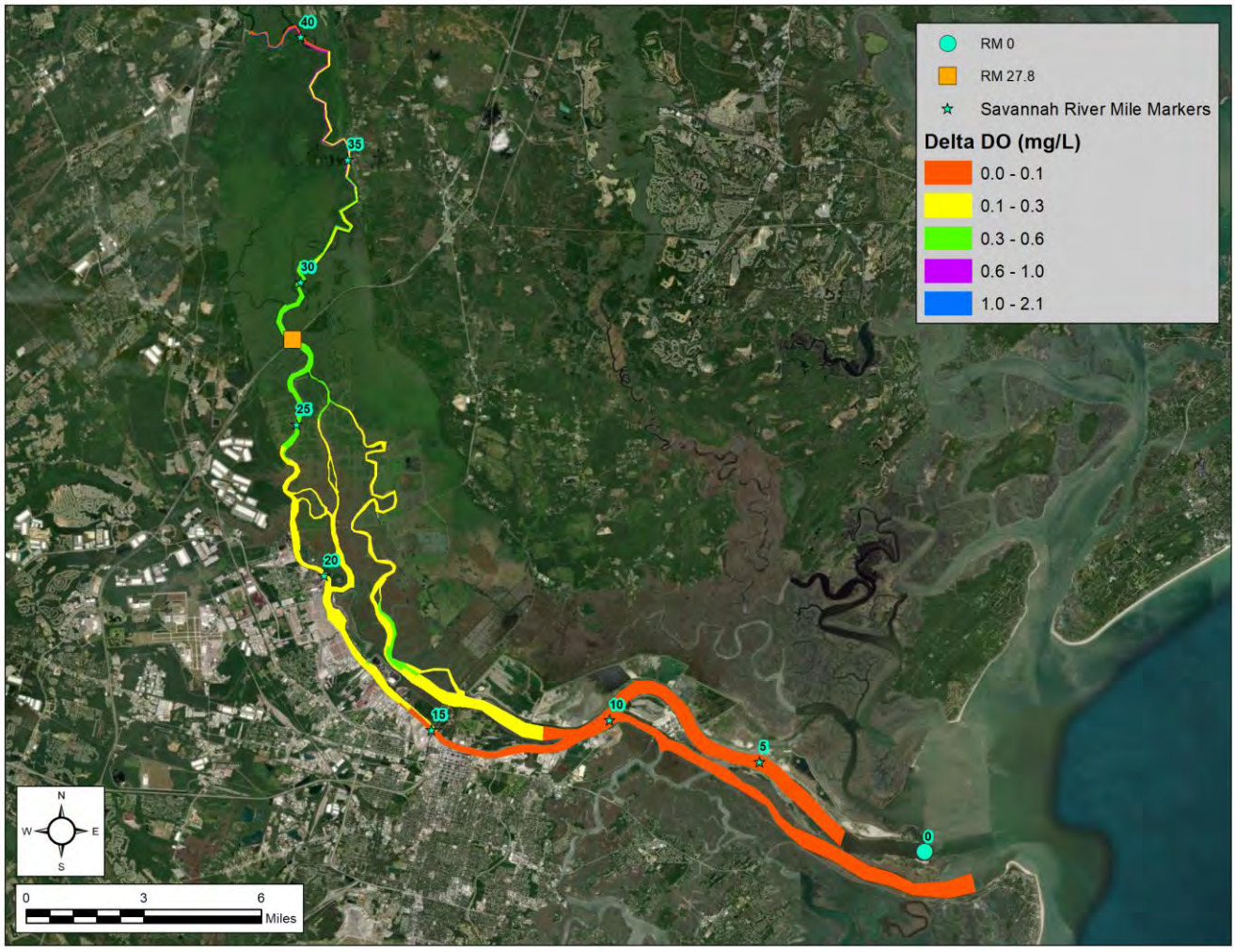

Figure 11-18 Spatial Bottom Layers Delta DO by Model Cells

LINE OF EVIDENCE 4.3 – SPATIAL ANALYSIS OF THE SHEP MODEL

11.4 SUMMARY

The 2020 SHEP model has been used successfully to prove the injected and retained oxygen loads are being distributed both spatially and vertically to the areas that require mitigation. Two scenarios were modeled and analyzed. Significant increases in DO because of oxygen injection were observed across the Savannah River (Upriver), Front River, and Back River. In addition, improvements were evident at all nine critical zones. The only region of the estuary where benefits were negligible was in the lower reaches of the Front River, between Fort Pulaski and RM 5, due to the dominance of the open ocean. Therefore, the SHEP model validates the SUR and the successful mitigation caused by oxygen injection.

12.0 MODEL GUIDELINE ASSESSMENT

THIS CHAPTER ADDRESSES SUCCESS METRIC #4 AS IDENTIFIED IN SECTION 4.0

Success Metric #4 – Evaluate if the retained oxygen is mixing spatially to provide the necessary mitigation throughout the Savannah River and estuary

12.1 BACKGROUND

Section I. A. 7 of the Settlement Agreement, partially provided in Section 4.2, specifically states:

"The Corps will refine and update the SHEP hydrodynamic (EFDC) and water quality (WASP) models specifically for DO. The updated model will take advantage of previous modeling efforts, including U.S. Environmental Protection Agency's TMDL model, and the most current information collected in the Savannah River harbor and estuary. The product will be complete DO model scenarios comparing instream DO concentrations with and without operation of the Oxygen Injection System. The purpose of the modeling and monitoring is to confirm that the Oxygen Injection System will mitigate for the DO impacts of the Project as shown by comparing actual DO levels in the modeled area, from Station 0+000 upstream to River Mile 27.8, to DO levels in the without-Project scenario (the "Success Criteria")."

In 2015, the SHEP EIS model was updated per the requirements of the Settlement Agreement to represent the hydrodynamic and water quality conditions that were present in the Savannah River and estuary during the 2013 and 2014 period. Simulations included *with-project* and *without-project* conditions with the latest available model and revisions conducted by the State and EPA for the TMDL update. The *with-project* scenario included all navigation and mitigation features, while the *without-project* scenario did not. The model was provided to the agencies and parties to the Settlement Agreement.

The 2015 SHEP model output included over 17 years of model results, for the entire modeling period from January 1, 1997 through April 30, 2014, for both the *with-project* and *without-project* scenarios. These results were used to develop predictive modeling guidelines at the 12 USGS continuous monitoring stations located throughout the Savannah River and estuary (which adequately cover "*the modeled area, from Station 0+000 upstream to River Mile 27.8").* The guidelines were developed for the purpose of evaluating system performance during and after construction of SHEP navigation and mitigation features, without the need to recalibrate and rerun the model each time (or as stated in the Settlement Agreement, taking "*advantage of previous modeling efforts*"). Monitoring data falling outside the expected ranges will not be triggers for a specific action, but it could indicate that the system may not be performing as predicted (Tetra Tech, Inc. 2015b).

Therefore, these 2015 guideline plots can be utilized to compare the observed data at the USGS gages ("*actual DO levels in the modeled area*") during the Startup Run to previously modeled data for the *with-* and *without-project* scenarios. The guideline plots illustrating the USGS measured data collected during the Startup Run is the required comparison required via the Settlement Agreement for the *without-Project* scenario. Therefore, compliant results using USGS measured data from the Startup Run and the 2015 guideline plots would fulfill the Success Criteria as defined in that part of the Settlement Agreement.

It should be noted that the conditions of the Savannah River and estuary during the Startup Run did not exactly match either scenario, but rather was somewhere in between with outer harbor dredging complete, inner harbor dredging in progress, some mitigation measures complete (oxygen injection plants, McCoy's Cut, Tidegate removal) and others yet to begin (Sediment Basin, Marsh 1S restoration). For this reason, additional model runs for the *with-project* and *without-project* scenarios were not conducted during the Startup Run.

Each guideline plot included two sets of confidence intervals around the plot trendlines. The confidence intervals were expressed as ± 1,± 2, and ± 3 standard deviations around the fitted curve, which represent the 68%, 95%, and 99.7% confidence intervals.

For each scenario, guideline plots were developed for the full period (all year) and for the critical summer period (July to September). For the purposes of evaluating the success of the Startup Run, comparing measured data in the Startup Run to the July to September guideline plots is most appropriate.

These predictive guideline plots were developed using the 2015 model results at the continuous USGS monitoring stations located throughout the Savannah Harbor for a variety of parameters, including:

- Salinity at each site-specific USGS station versus freshwater flow at the Clyo station (02198500)
- DO at each site-specific USGS station versus freshwater flow at the Clyo station (02198500)
- Current speed at each site-specific USGS station versus flow at the Clyo station (02198500)
- DO at each site-specific USGS station versus temperature at the I-95 station (02198840)

For the purposes of this report, the two relevant guideline plots are DO versus flow and DO versus temperature. For each of these, the guideline plots were prepared for daily average DO concentrations because the 2010 TMDL for the Savannah Harbor requires that changes to daily average DO concentrations be less than 0.1 mg/L. In addition, since the USGS collects DO data at or near the water surface (excluding gages at depth for Garden City Station (021989715)), the guideline plots used model predictions for surface layer concentrations of DO. Statistical analysis has not been undertaken given the incompatibility between individual data points to trend lines. Any statistics in this application would be meaningless and most likely misleading. Therefore, visual comparison is indeed the most appropriate tool.

12.2 RESULTS

The observed data at the USGS gages during the Startup Run has been compared to the 2015 guideline plots. In total, there are 12 USGS stations throughout the Savannah River and estuary, one of which collects data at two separate depths (Garden City (021989715)). However, two of the 12 USGS stations do not measure DO – Fort Pulaski (02198980) and Lucknow Canal (021989784). Therefore, there exists guideline plots for 11 various locations for DO versus flow (Clyo) and DO versus temperature (I-95), and for the *with-project* and *without-project* scenarios resulting in a total of 44 guideline plots. The daily average of the observed data collected at each USGS gage location during the period of the Startup Run has been plotted over the July-September seasonal guideline plots to assess performance of the SHEP mitigation features during the Startup Run.

In general, results demonstrated success with USGS measured data from the Startup Run either outperforming or performing in accordance with the guideline plots, invoking confidence in the system and SHEP mitigation actions. However, a select few locations underperformed suggesting either a deficiency in the mitigation in benefitting these individual locations, or a weakness in the 2015 model used to develop the guidelines. The locations of concern were Garden City surface (021989715), Middle River Fish Hole (02198955), and to lesser extents the Little Back River at GA 25 (021989792) and the Savannah River at Elba Island (0219897993). Plausible explanations of the variances include:

- Data from the Garden City surface gage are considered to be model misrepresentations with how the surface guidelines were created given the success of mitigating at depth at the same location. There is potential this guideline plot was developed using surface salinity from the 2015 model, whereas the surface gage for this location is located at a depth of 13.3 feet.
- Variances between measured data and the guidelines for the other three gages are suspected to be relics of some limitations in the 2015 model, which were addressed via the 2020 model update via flow improvements.

It should be noted that neither the *with-project* nor *without-project* scenarios were an exact representation of the Savannah River and estuary during the Startup Run. However, a significant amount of navigation and mitigation features had been constructed so the *with-project* scenario is more applicable for purposes of comparison.

The results of the DO versus flow are consistent with the results of DO versus temperature at each USGS station. This trend is to be expected, given both parameters influence DO.

In general, the results for gages on the Front River outperformed the guidelines, exceeding expectations, while results for gages on the Middle and Little Back Rivers were in accordance with or slightly underperformed against the guidelines. The 2015 model, used to develop the guidelines, slightly misrepresented flows through the Savannah River and estuary. The 2020 model update addressed this, with increased flows being directed down the Middle and Little Back Rivers to better replicate actual conditions, with less flow being directed down the Front River (refer **Table K-5** in **APPENDIX K)**. In addition, the grid covering the lower portion of the Savannah River was extended, improving tidal flows from offshore upstream (refer **Section K.3** in **APPENDIX K**). It is well known that models improve in accuracy with relevant data. Therefore, it is suspected that if the guidelines were developed using the updated 2020 model, more balanced results would be observed with measured data performing in accordance with the model guideline plots at gages across the Front, Middle and Little Back Rivers.

Consistent with the rest of the report, a subset of the most informational guidelines plots is presented below. Two locations have been selected for the DO versus flow guidelines, while an additional location has been presented for the DO versus temperature guidelines. The DO versus temperature and DO versus flow results display similar outcomes at each location in terms of alignment between the guidelines and the measured USGS data. In addition, this subset has been selected to cover one location each across the Front, Middle and Little Back Rivers. The complete set of all 44 guideline plots are presented in **APPENDIX L**. Each plot contains a brief description and interpretation of the data.

LINE OF EVIDENCE 4.3 – SPATIAL ANALYSIS OF THE SHEP MODEL

The measured data at depth for the Garden City station outperformed the guideline curves for both the *without-project* (***Figure 12-1***) and *with-project* scenarios (***Figure 12-2***) with measured data typically within one standard deviation but also above the fitted daily average. Not all harbor deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable. These results indicate the SHEP mitigation features are appropriately mitigating for harbor deepening at this location on the Front River.

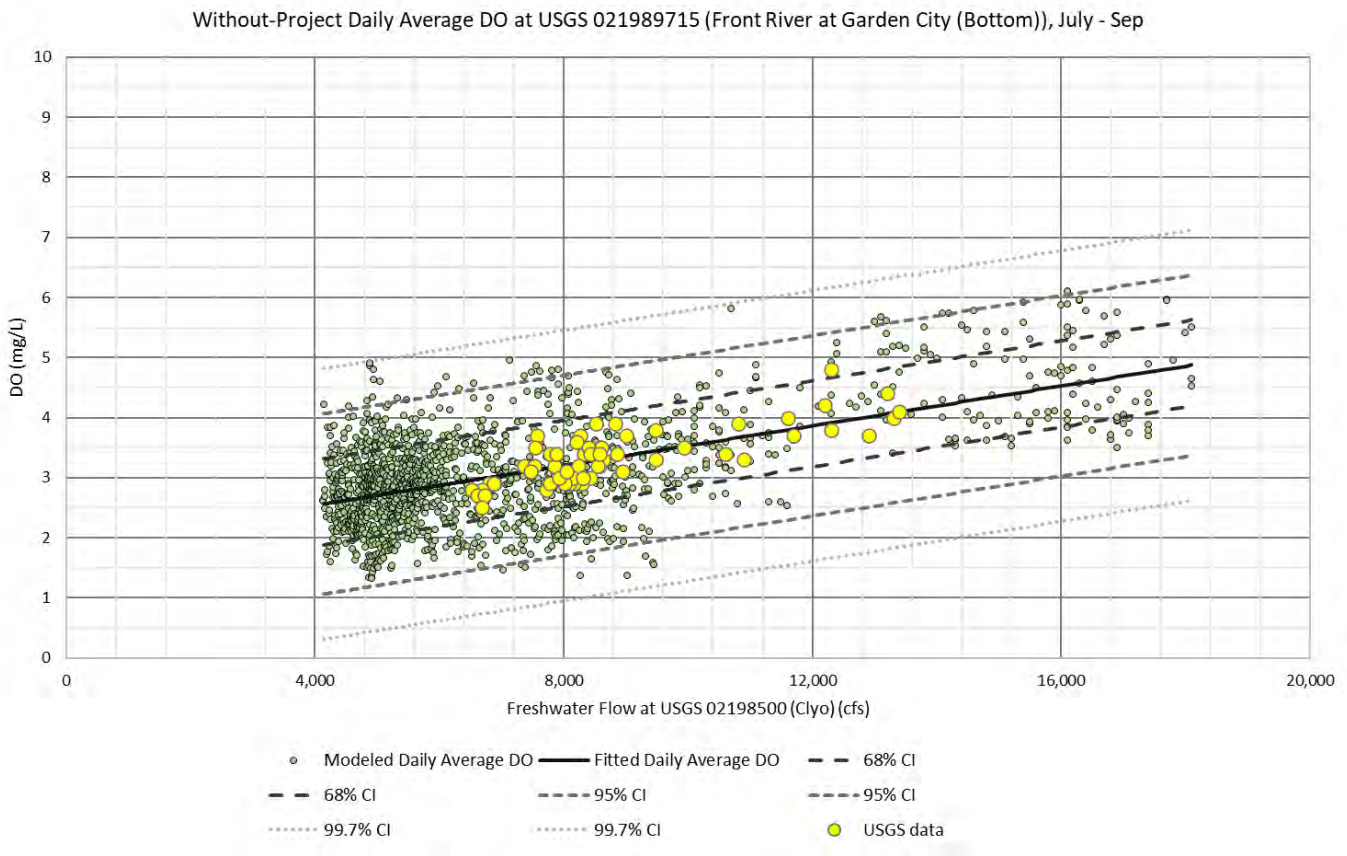

Figure 12-1 2015 SHEP *without-project* model daily average dissolved oxygen confidence intervals at USGS 021989715 relative to freshwater flow at USGS 02198500

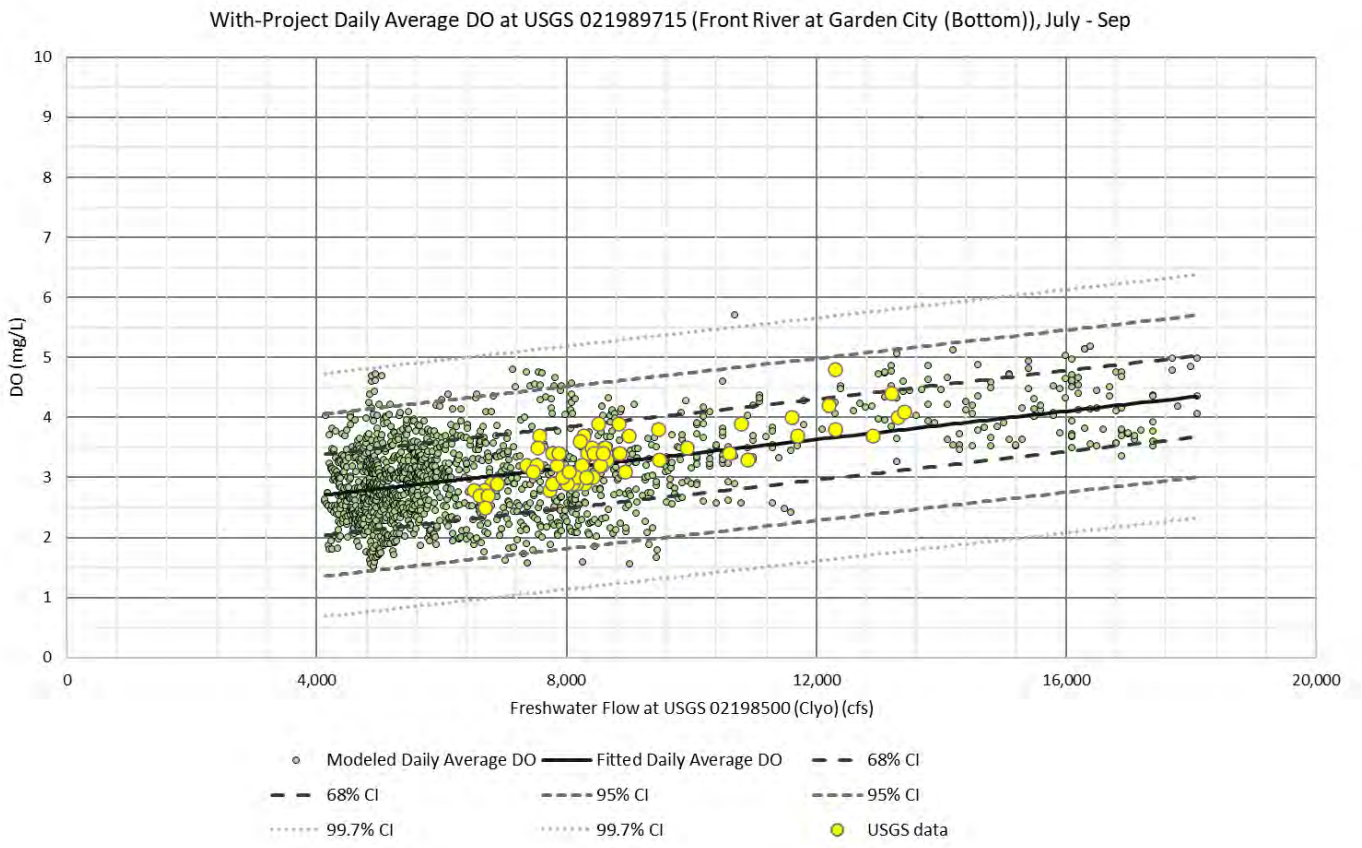

Figure 12-2 2015 SHEP *with-project* model daily average dissolved oxygen confidence intervals at USGS 021989715 relative to freshwater flow at USGS 02198500

The measured data at the Middle River GA 25 station performed in accordance with the guideline curves for both the *without-project* (***Figure 12-3***) and *with-project* scenarios (***Figure 12-4***) with measured data balanced around the fitted daily average and the majority within one standard deviation. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guideline plots are relevant but a scenario in between *with-project* and *without-project* is most applicable.

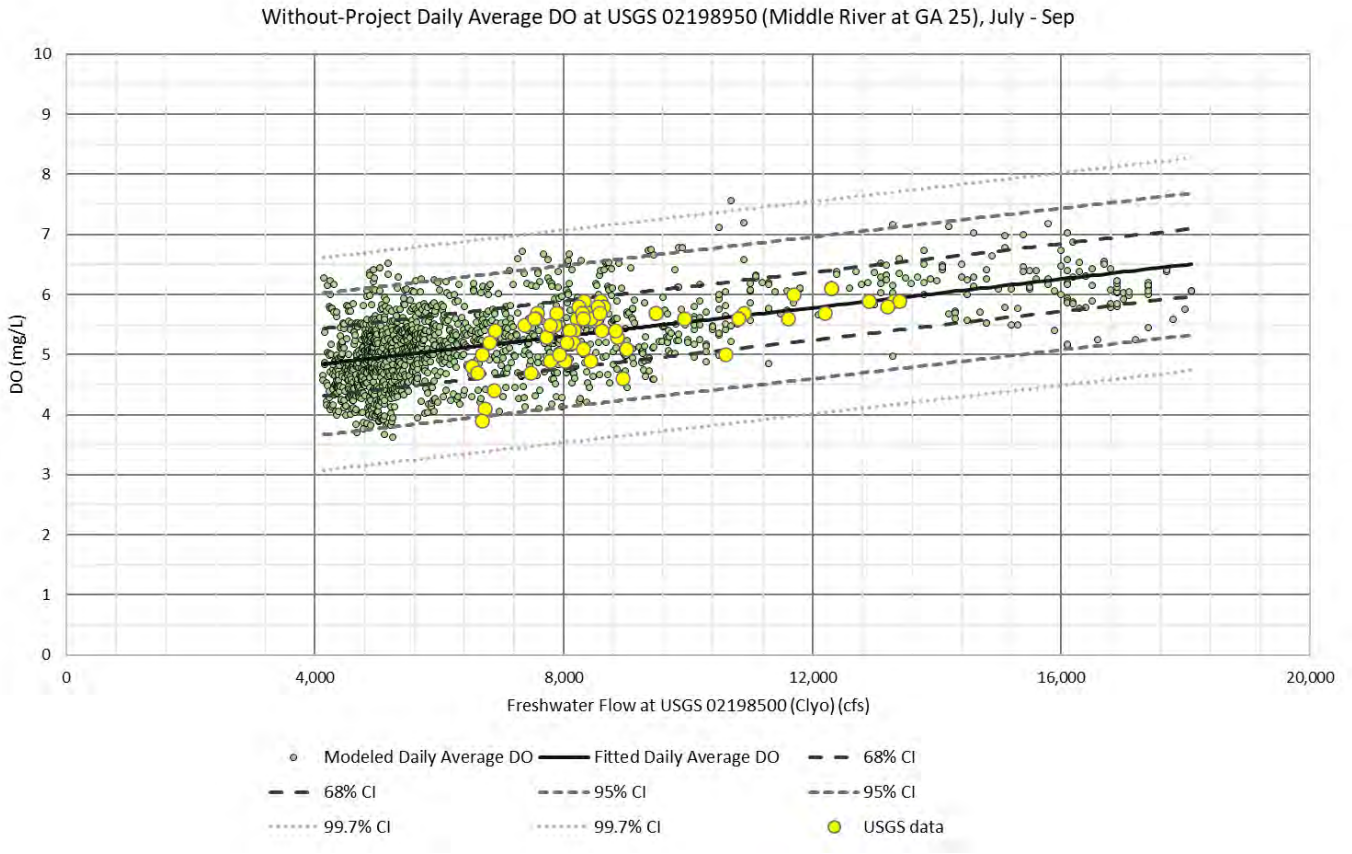

Figure 12-3 2015 SHEP *without-project* model daily average dissolved oxygen confidence intervals at USGS 02198950 relative to freshwater flow at USGS 02198500

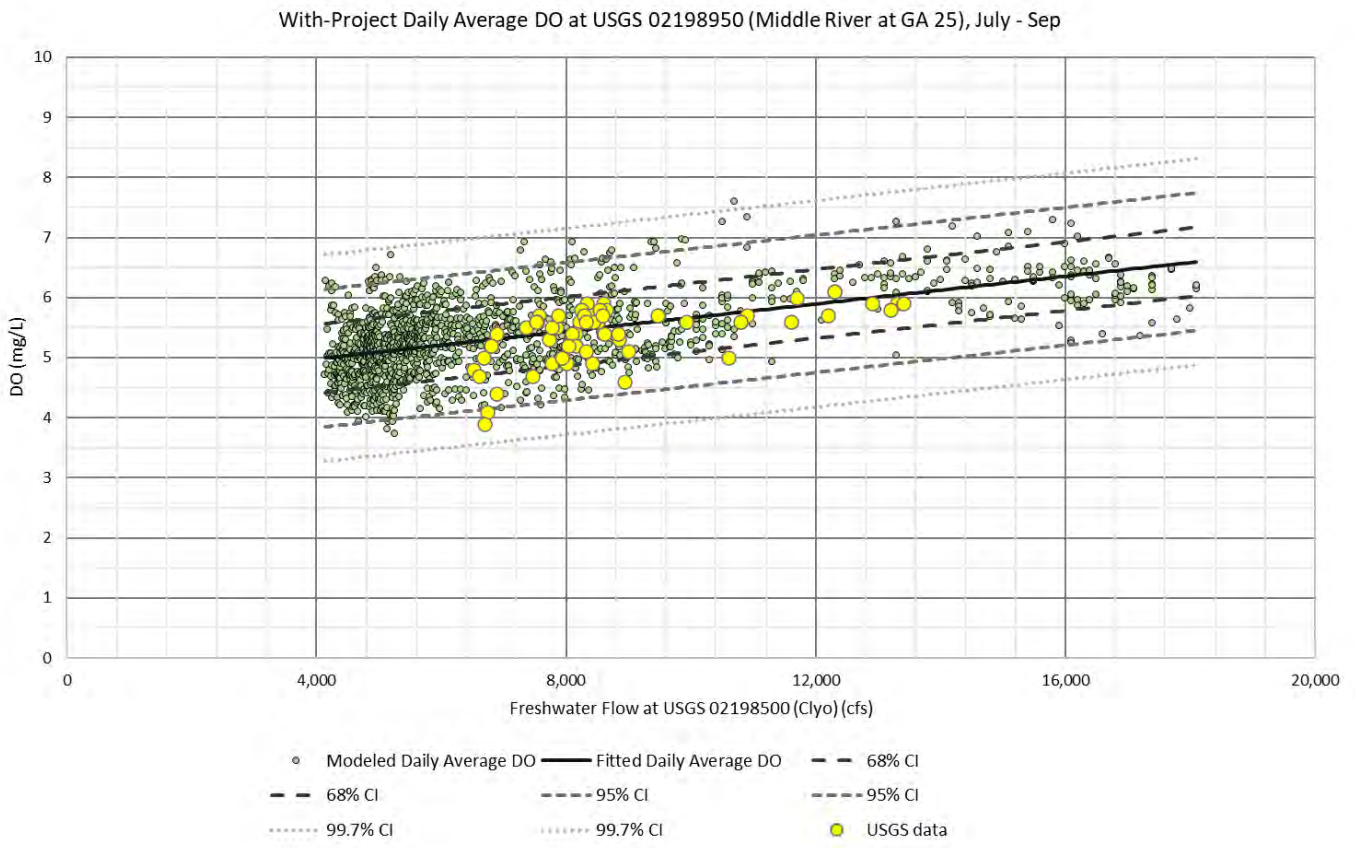

Figure 12-4 2015 SHEP *with-project* model daily average dissolved oxygen confidence intervals at USGS 02198950 relative to freshwater flow at USGS 02198500

The measured data at the Little Back River Hog Island station slightly outperformed the guideline curves for the *without-project* scenario (***Figure 12-5***) and slightly underperformed the guideline curves for the *with-project* scenario (***Figure 12-6***). Most data were within the 95% confidence intervals. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

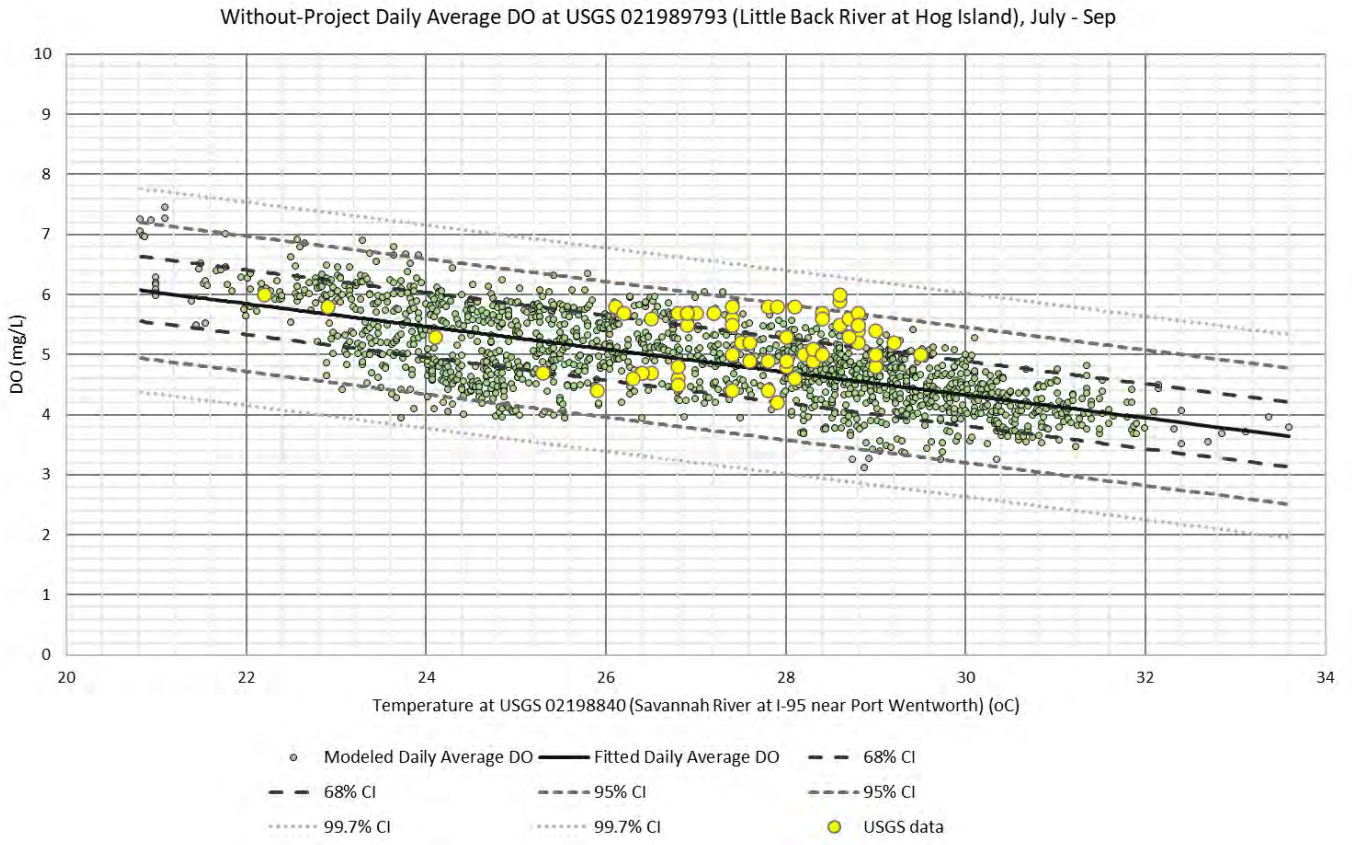

Figure 12-5 2015 SHEP *without-project* model daily average dissolved oxygen confidence intervals at USGS 021989793 relative to water temperature at USGS 02198840

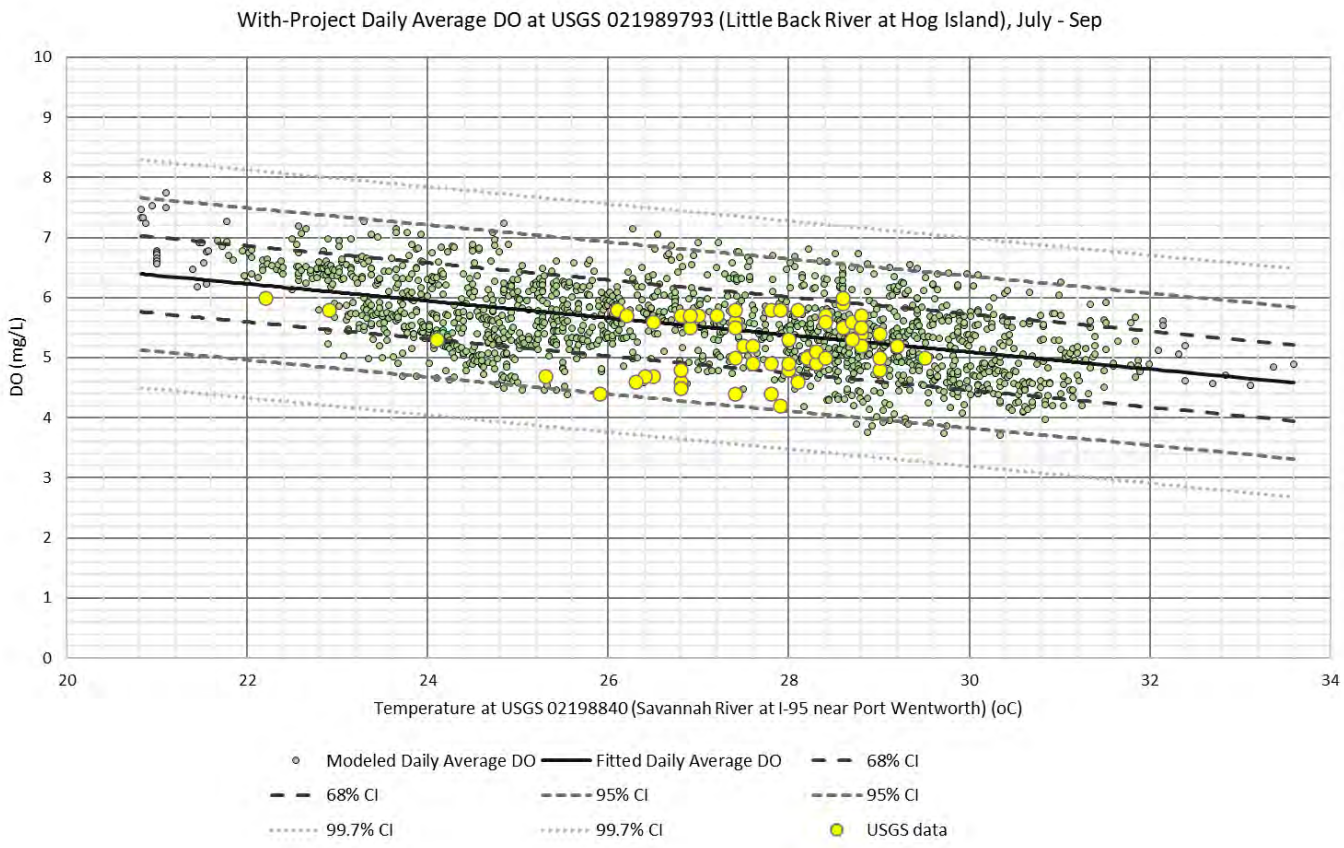

Figure 12-6 2015 SHEP *with-project* model daily average dissolved oxygen confidence intervals at USGS 021989793 relative to water temperature at USGS 02198840

12.3 SUMMARY

The exercise to plot measured USGS data collected during the Startup Run (July 25, 2020 to September 22, 2020) on top of the 2015 predictive modeling guideline plots has successfully proven that the mitigation features are at least performing in accordance with expectations and in most cases are outperforming expectations to offset predicted impacts associated with the deepening activities. There were a few isolated locations which did not perform in accordance with the guideline plots, however this is suspected to be a result of limitations with the 2015 model, which have since been addressed via the 2020 SHEP model.

In general, the measured data aligns well with the guideline plots for both the *with-project* and *without-project* scenarios. It should be noted that neither scenario were an exact representation of the Savannah River and estuary during the Startup Run, but rather was somewhere in between with all deepening and mitigation features yet to be complete. Therefore, this exercise adequately satisfies the requirements of the Settlement Agreement.

Further model improvements will be made during the post-construction monitoring phase of SHEP (refer Appendix D of the EIS) using data collected following completion of all navigation and mitigation features. This post-construction data collection and modeling will provide further verification of the mitigation features in offsetting deepening impacts.

13.0 CONCLUSIONS

The SUR was a continuous operation of both Upriver and Downriver oxygen injection plants with a requirement to deliver a daily average equal to or greater than the combined design production oxygen load of 40,000 lbs/day. The plants were required to operate for 59 days (two lunar cycles), of which at least one 29.5-day testing (one lunar cycle) must occur in July, August, or September, while the Upriver and Downriver plants are operational. The SUR occurred from July 25, 2020, through September 22, 2020. The USACE was required to extensively monitor the Savannah River and estuary continuously for the duration of the SUR and undertake subsequent modeling and analysis.

During the SUR data collection period, the field team successfully conducted monitoring on the Front River, Back River, and Savannah River by collecting data from semi-permanent buoy sondes, profile sondes, and drift sondes. The field data were subject to thorough QA/QC. After reviews, raw data quality was observed to be good and acceptance rates were greater than 90 percent. The field team also conducted dye releases, to track the movement and retention of the dye plumes, and therefore, oxygen injection. In total, the field crew of 15 personnel operated over 84 days and installed 21 buoys, completed 371 profile measurements, sampled 103 drifts, and implemented 10 separate dye releases. Supplementary data were also sourced from the network of publicly available USGS gages throughout the Savannah River and estuary, and the data collected at both oxygen injection plants.

The SHEP model was recalibrated to represent existing conditions more accurately throughout the Savannah River and estuary and predict future outcomes. This included multiple grid and bathymetry updates to the model to better define the cross-sections of the Middle and Back Rivers and the Savannah River upstream of I-95 up to the Upriver oxygen injection plant, as well as additional marshes to improve the tidal flow circulation in the system.

Completion of the field monitoring and model updates was the initial step in assessing SUR mitigation impacts. The *Success Criteria* were defined in the Compromise and Settlement Agreement (2013, bullet 11, pg. 3, Exhibit A), "**The purpose of the modeling and monitoring is to confirm that the Oxygen Injection System will mitigate for the DO impacts of the Project, as shown by comparing actual DO levels in the modeled area, from Station 0+000 upstream to RM 27.8, to DO levels in the without-Project scenario (the "*Success Criteria*").**" Simply stated, the *Success Criteria* requires evidence that DO impacts across the estuary caused by deepening the Front River have been compensated for in time (tidally and seasonally) and space (vertically and horizontally).

Neither the *Success Criteria* nor the EIS or GRR specify a target concentration of increased DO to appropriately mitigate for channel deepening. The dynamic nature of the Savannah River and estuary vertically, spatially, and temporally, mean specifying a target concentration increase was impossible. To address the *Success Criteria*, an alternative approach was needed to prove mitigation was achieved.

A tiered approach was developed whereby the *Success Criteria* was proven by evaluating four *Success Metrics*, each of which captured a complementary portion of the *Success Criteria* and were consistent with the EIS and GRR. Further, the four *Success Metrics* were able to be assessed by a total of 12 *Lines of Evidence*, three for each *Success Metric*. Successfully demonstrating the *Lines of Evidence* were achieved would prove accomplishment of the *Success Metrics* and ultimately the *Success Criteria*, proving the oxygen injection system is successfully able to inject the required oxygen loads into the river and that the injected oxygen can be retained and distributed vertically and spatially, thereby mitigating impacts to DO by harbor deepening.

The *Success Metrics* cover four complementary components essential to oxygen mitigation. The 12 *Lines of Evidence*, three for each *Success Metric*, are presented below:

1) **OXYGEN LOAD DELIVERED** – The requirement was a daily average of 40,000 lbs/day of oxygen over a continuous 59-day period to be injected into the water column during the critical summer months. Success Metric #1 was achieved during the SUR by:
   (1.1) injecting a total daily average of more than 40,000 lbs/day for 59 days – **42,412 lbs/day were achieved**.
   (1.2) injecting a daily average of more than 28,000 lbs/day for 59 days from the Upriver plant – **28,838 lbs/day were achieved**.
   (1.3) injecting a daily average of more than 12,000 lbs/day for 59 days from the Downriver plant – **13,574 lbs/day were achieved**.
2) **OXYGEN LOAD RETAINED** – The requirement was for 90 percent of the delivered oxygen load to the water column to remain dissolved and saturated in the water. Success Metric #2 was achieved during the SUR by:
   (2.1) Achieved 99 Percent Water Column Transfer Efficiency (WCTE) – **Significantly greater than the 90 percent goal, indicating almost all injected oxygen stayed within the river and was used for mitigation.**
   (2.2) Oxygen plume retention after injection – **Evidence of oxygen retention was detected up to one month after injection on the Front River and three weeks on the Back River.**
   (2.3) No effervescence or bubbling observed during field data collection – **No evidence on any of the 84 field sampling days.**
3) **DO MITIGATION IN BOTTOM WATERS** – The requirement was for the SHEP model to show oxygen injection mitigated median DO concentrations in 97 percent of the bottom half of the water column across the estuary. Success Metric #3 was achieved during the SUR by:
   (3.1) Mitigation in the bottom half of the water column – **The SHEP model results demonstrated increased DO concentrations in greater than 97 percent of the total volume in bottom waters. All zones for the SUR Scenario presented positive DO deltas.**
   (3.2) Analysis of field data (profile and dye data) – **Successfully demonstrated oxygen retention and vertical distribution of oxygen load.**
   (3.3) USGS test-control analysis (vertical) – **successfully increased DO concentrations at two depths in the upper and bottom halves of the water column.**
4) **SPATIAL EXTENT OF DO MITIGATION THROUGHOUT ESTUARY** – The requirement was to confirm the oxygen injection system would mitigate for SHEP impacts throughout the Savannah Harbor system (from Station 0+000 upstream to RM 27.8), including critical zones identified in the EIS as being most affected by navigational channel deepening.
   (4.1) Analysis of field data (buoy, drift, and dye data) – **Successfully demonstrated oxygen retention and spatial distribution of oxygen load.**
   (4.2) USGS test-control analysis (spatial) – **successfully increased DO concentrations at 10 different locations across the Savannah River and estuary.**
   (4.3) Spatial analysis of the SHEP model – **The SHEP model results demonstrated increased DO concentrations at all nine critical zones as well as the majority of the Savannah River and estuary. Additional analysis using the 2015 predictive guideline plots and measured USGS data successfully demonstrated compliance by mitigating for impacts during the Startup Run against the *without-project* scenario (*Success Criteria*).**

Based on analyses of both measured data and modeling results, **the conclusion is that the 12 *Lines of Evidence* suitably address the four *Success Metrics*, and therefore the *Success Criteria* was achieved.** During the SUR period, the system operated in accordance with requirements; demonstrating that the system is capable of meeting the DO mitigation requirements of SHEP.

USACE intends to meet post construction monitoring and modeling requirements as outlined in Appendix D of the EIS, in accordance with Section I. A. 15 of the Compromise and Settlement Agreement.

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APPENDIX A SEMI-PERMANENT BUOY DATA

APPENDIX A SEMI-PERMANENT BUOY DATA

Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Task:10
March 2021

PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG^2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX A BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document forms Appendix A of the SUR Report. It is referred to in the main body in Sections 2.1, 3.1, 8.2.1, 9.2.1.

APPENDIX A TABLE OF CONTENTS

APPENDIX A SEMI-PERMANENT BUOY DATA A-1

A.1 Back River Buoy Information and Data A-7
A.2 Back River Data Summary A-9
A.3 Back River 1 (LBR_1) A-10
A.4 Back River 2 (LBR_2) A-13
A.5 Back River 3 (LBR_3) A-15
A.6 Back River 4 (LBR_4) A-18
A.7 Back River 5 (LBR_5) A-21
A.8 Back River 6 (LBR_6) A-23
A.9 Back River 7 (LBR_7) A-26
A.10 Back River 8 (LBR_8) A-28
A.11 Front Buoy Information and Data A-31
A.12 Front River Depot A-33
A.13 Upriver Information A-36
A.14 Upriver Data Summary A-38
A.15 Upriver 9 (UR_9) A-39
A.16 Upriver 10 (UR_10) A-42
A.17 Upriver 11 (UR_11) A-43
A.18 Upriver 12 (UR_12) and Upriver 12a (UR_12a) A-45
A.19 Upriver 13 (UR_13) A-47
A.20 Upriver 14 (UR_14) A-49
A.21 Upriver 15 (UR_15) A-50
A.22 Upriver 16 (UR_16) and Upriver 16a (UR_16a) A-53
A.23 Upriver 17 (UR_17) A-54
A.24 Upriver 18 (UR_18) A-56
A.25 Upriver Hardeeville (UR_Hardeeville) A-59
A.26 Upriver Tributaries A-62

APPENDIX A LIST OF FIGURES

Figure A-1 Location of Back River semi-permanent buoys A-9
Figure A-2 LBR_1 observed BGA A-11
Figure A-3 LBR_1 observed DO concentration A-11
Figure A-4 LBR_1 observed DO saturation A-12
Figure A-5 LBR_1 observed salinity A-12
Figure A-6 LBR_1 observed water temperature A-13
Figure A-7 LBR_2 observed DO concentration A-14
Figure A-8 LBR_2 observed DO saturation A-14
Figure A-9 LBR_2 observed salinity A-14
Figure A-10 LBR_2 observed water temperature A-15
Figure A-11 LBR_3 observed BGA A-16
Figure A-12 LBR_3 observed DO concentration A-16
Figure A-13 LBR_3 observed DO saturation A-17
Figure A-14 LBR_3 observed salinity A-17
Figure A-15 LBR_3 observed water temperature A-18
Figure A-16 LBR_4 observed DO concentration A-19
Figure A-17 LBR_4 observed DO saturation A-19
Figure A-18 LBR_4 observed salinity A-20
Figure A-19 LBR_4 observed water temperature A-20
Figure A-20 LBR_5 observed DO concentration A-21
Figure A-21 LBR_5 observed DO saturation A-22
Figure A-22 LBR_5 observed salinity A-22
Figure A-23 LBR_5 observed water temperature A-22
Figure A-24 LBR_6 observed BGA A-23
Figure A-25 LBR_6 observed DO concentration A-24
Figure A-26 LBR_6 observed DO saturation A-24
Figure A-27 LBR_6 observed salinity A-25
Figure A-28 LBR_6 observed water temperature A-25
Figure A-29 LBR_7 observed DO concentration A-26
Figure A-30 LBR_7 observed DO saturation A-27
Figure A-31 LBR_7 observed salinity A-27
Figure A-32 LBR_7 observed water temperature A-28
Figure A-33 LBR_8 observed BGA A-29
Figure A-34 LBR_8 observed DO concentration A-29
Figure A-35 LBR_8 observed DO saturation A-30
Figure A-36 LBR_8 observed salinity A-30
Figure A-37 LBR_8 observed water temperature A-31
Figure A-38 Location of Front River semi-permanent buoys A-32
Figure A-39 Front River Depot observed BGA A-33
Figure A-40 Front River Depot observed Rhodamine A-34
Figure A-41 Front River Depot observed DO concentration A-34
Figure A-42 Front River Depot observed DO saturation A-35
Figure A-43 Front River Depot observed salinity A-35
Figure A-44 Front River Depot observed water temperature A-36
Figure A-45 Location of Upriver semi-permanent buoys A-38
Figure A-46 UR_9 observed BGA A-40
Figure A-47 UR_9 observed DO concentration A-40

Figure A-48 UR_9 observed DO saturation A-41
Figure A-49 UR_9 observed water temperature A-41
Figure A-50 UR_10 observed DO concentration A-42
Figure A-51 UR_10 observed DO saturation A-42
Figure A-52 UR_10 observed water temperature A-43
Figure A-53 UR_11 observed DO concentration A-44
Figure A-54 UR_11 observed DO saturation A-44
Figure A-55 UR_11 observed water temperature A-45
Figure A-56 UR_12 and UR_12a observed DO concentration A-46
Figure A-57 UR_12 and UR_12a observed DO saturation A-46
Figure A-58 UR_12 and UR_12a observed water temperature A-47
Figure A-59 UR_13 observed DO concentration A-48
Figure A-60 UR_13 observed DO saturation A-48
Figure A-61 UR_13 observed water temperature A-48
Figure A-62 UP_14 observed DO concentration A-49
Figure A-63 UP_14 observed DO saturation A-50
Figure A-64 UP_14 observed water temperature A-50
Figure A-65 UR_15 observed BGA A-51
Figure A-66 UR_15 observed DO concentration A-51
Figure A-67 UR_15 observed DO saturation A-52
Figure A-68 UR_15 observed water temperature A-52
Figure A-69 UR_16 and UR_16a observed DO concentration A-53
Figure A-70 UR_16 and UR_16a observed DO saturation A-54
Figure A-71 UR_16 and UR_16a observed water temperature A-54
Figure A-72 UR_17 observed DO concentration A-55
Figure A-73 UR_17 observed DO saturation A-55
Figure A-74 UR_17 observed water temperature A-56
Figure A-75 UR_18 observed BGA A-57
Figure A-76 UR_18 observed DO concentration A-58
Figure A-77 UR_18 observed DO saturation A-58
Figure A-78 UR_18 observed water temperature A-59
Figure A-79 UR_Hardeeville observed BGA A-60
Figure A-80 UR_Hardeeville observed DO concentration A-61
Figure A-81 UR_Hardeeville observed DO saturation A-61
Figure A-82 UR_Hardeeville observed water temperature A-62

APPENDIX A LIST OF TABLES

Table A-1 Attributes of Back River semi-permanent buoys used for data collection A-8
Table A-2 River data summary for the four downstream buoy sondes A-9
Table A-3 Back River data summary for the four downstream buoy sondes A-10
Table A-4 Summary of the Depot data A-33
Table A-5 Attributes of Upriver semi-permanent buoys used for data collection A-37
Table A-6 Data summary for the Upriver sondes A-39
Table A-7 UR_9 Background Surface Data Summary A-39
Table A-8 Data summary for UR_18 ..... A-56
Table A-9 Hardeeville sonde data summary A-59
Table A-10 Data summary of tributaries A-62

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BGA	Phycoerythin blue-green algae
DO	dissolved oxygen
Lat	latitude
BR	Back River
LFR	Front River
Lon	longitude
mg/L	milligrams per liter
PPT	parts per thousand
RFU	relative fluorescence units
UR	Upriver

A.1 BACK RIVER BUOY INFORMATION AND DATA

During the Startup Run (SUR), eight buoy sondes were located in the main Back River channel to monitor the impacts of the injected oxygen. The Back River diffuser injects the super-saturated water into the lower portion of the Back River. The resulting oxygen plume initially mixes with the water around the diffuser and then moves up or downstream depending on the tide and gradually rises to the surface. The buoy sondes were located to measure the movement and mixing of the oxygen plume and to measure the Dissolved Oxygen (DO) saturation to check if the saturation exceeds 100 percent.

The buoy sondes measure parameters at 15-minute intervals. These parameters are:

- *DO*. Evaluate the impact of the injected oxygen on the Upriver DO regime.
- *Dissolved Oxygen saturation (DOsat*). Check if DO saturation exceeded 100 percent and if DO saturation exceeded 100 percent for any significant time, this would indicate that DO could be transferred to the atmosphere.
- *Salinity.* At higher salinities there is less capacity for the water to hold oxygen resulting in lower DO values and is used to determine the tidal STATUS.
- *Temperature Centigrade (Temp_C)*. At higher temperatures, there is less capacity for the water to hold oxygen and may result in lower DO values and DO saturation to exceed 100 percent.
- *Blue Green Algae (BGA).* Used to measure dye during dye release events. Also used to determine the background levels of BGA.
- *Rhodamine dye*. Used to track the injected dye as it moved past the Depot sonde.
- *Specific conductance*. Can be used to detect lower salinity water that may impact the water intakes. Please note, this parameterwas not included in the time-series, but is available in the SUR database.

Four buoys were located upstream of the diffuser and four sondes located downstream of the diffuser. The Back River buoys were situated to determine how the oxygen plume moved during ebb and flood tides and during spring and neap tidal conditions. Two important functions of these buoys were:

- Track how the DO plume was moving up or down the Back River.
- Measure the DO saturation and check if DO saturation was above or below 100 percent. If DO saturation exceed 100 percent, then the some of the injected oxygen may be transferred to the atmosphere.

During ebb tides the oxygen plume is mostly mixed across the stream, but during flood tides the oxygen plume tends to stay in the channel and hug the west bank. The oxygen plume is not completely mixed until the tide reverses. Based on DO profiles, the oxygen plume reaches the surface within 300 feet of the diffuser and is quickly mixed top to bottom. At three of the eight buoys, the DO saturation was above 100 percent for a few hours during the sixty-day SUR sampling event. Since this occurrence was only for a short length of time, it was not significant enough to allow any measurable oxygen to be transferred to the atmosphere and impact the Water Column Transfer Efficiency (WCTE).

Buoys LBR_5 through LBR_8 were located upstream of the Back River diffuser and are referred to in this appendix as Little Back River buoys. Buoys LBR_1 through LBR_4 were located downstream of the Back River diffuser (***Table A-1Figure A-1***). During ebb tides the river flows downstream and during flood tides the river flows upstream. Therefore, the injected oxygen plume would move downstream of the diffuser during ebb tides when the river pushes the plume downstream, and higher upstream of the diffuser during flood tide when the tide pushes the DO plume upstream. This would be expected to cause higher DO concentration downstream of the Back River diffuser during ebb tides and higher DO concentrations upstream of the diffuser during flood tides. However, the DO concentrations between the buoys were similar during both ebb and flood tides (***Figure A-1***). This likely occurred because DO injected into the Back River becomes 'trapped' for days to weeks and is continually moved upstream and downstream with the tides, resulting in consistently elevated DO concentrations around the Back River diffuser.

Buoys LBR_4 through LBR_7 had very minor exceedances of 100 percent saturation; however, 99.9 percent of the time, the DO saturation did not exceed 100 percent. For an insignificant amount of time during a tidal cycle, the DO saturation was above 100 percent. However, this amount of time did not impact the WCTE. The remaining sondes did not exceed 100 percent saturation during the SUR.

Table A-1 Attributes of Back River semi-permanent buoys used for data collection

Station ID	Location	Relationship to Diffuser	Latitude	Longitude
LBR_1	Back River	Downstream of diffuser ~1.2 miles	32.105099	-81.100601
LBR_2	Back River	Downstream of diffuser ~0.5 miles	32.112202	-81.111000
LBR_3	Back River	Downstream of diffuser ~0.2 miles	32.114799	-81.115402
LBR_4	Back River	Downstream of diffuser ~300 feet	32.116199	-81.116096
LBR_5	Back River	Upstream of diffuser ~300 feet	32.117699	-81.116898
LBR_6	Back River	Upstream of diffuser ~0.2 miles	32.120098	-81.116302
LBR_7	Back River	Upstream of diffuser ~0.5 miles	32.124199	-81.114799
LBR_8	Back River	Upstream of diffuser ~0.9 miles	32.129902	-81.115898

Note: All sondes, except for 12a and 16a were deployed at a depth of approximately 3.3 feet (1 meter)

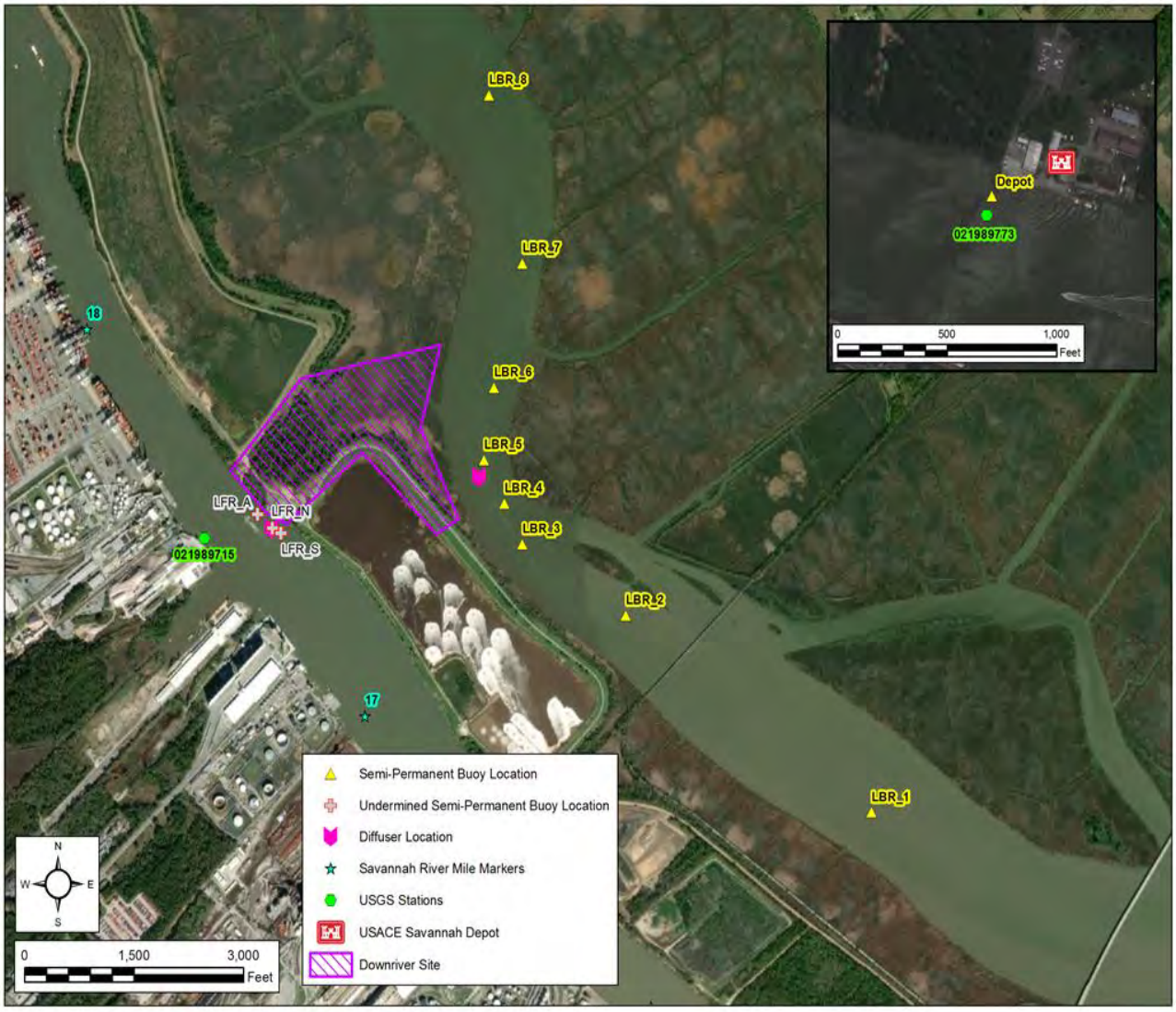


Figure A-1 Location of Back River semi-permanent buoys

A.2 BACK RIVER DATA SUMMARY

Table A-2 provides a data summary of the four downstream buoys and ***Table A-3*** provides the data for the four upstream buoys Back River buoys.

Table A-2 River data summary for the four downstream buoy sondes

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	3.0	3.6	4.5	5.1	5.6	6.3	7.0	85,396	0.7	9.5
DO Saturation (%)	40	48	59	66	72	84	94	85,396	9	131

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
Salinity (ppt)	0.11	0.2	1.5	3.9	6.3	10.6	13.6	85,396	0.1	18
Temp_C (°C)	22	23	28	29	30	31	31	85,396	21	32
BGA_R (RFU)	2.1	2.5	3.5	4.3	6.0	9.7	14.2	21,533	1.8	154

Abbreviations: PCTL – percentile, Min – minimum, Max - maximum

Table A-3 Back River data summary for the four downstream buoy sondes

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	3.3	3.9	4.7	5.2	5.7	6.4	7.2	89,037	1.1	9.7
DO Saturation (%)	44	52	61	68	73	86	97	89,037	16	133
Salinity (ppt)	0.05	0.1	0.4	2.5	4.7	8.8	11.5	89,037	0.0	16
Temp_C (°C)	22	23	28	29	30	31	31	89,037	21	32
BGA_R (RFU)	2.0	2.3	3.2	4.5	6.6	10.0	13.8	22,677	1.4	149

Abbreviations: PCTL – percentile, Min – minimum, Max – maximum

Time-series graphs of the individual Back River sondes parameters are provided in the following sections for each sonde.

A.3 BACK RIVER 1 (LBR_1)

The LBR_1 sonde, 1.2 miles downstream of the diffuser, was in the main channel and where the oxygen plume was about completely mixed side to side. DO saturation at this location did not exceed 100 percent.. LBR_1 algal sensor detected the August 25, 2020 LBR dye injection during neap tide. The algal (BGA) sensor also registered a high reading during the September 17, 2020 spring tide; however, this is most likely due to the interference from the high salinity water being pushed upstream.

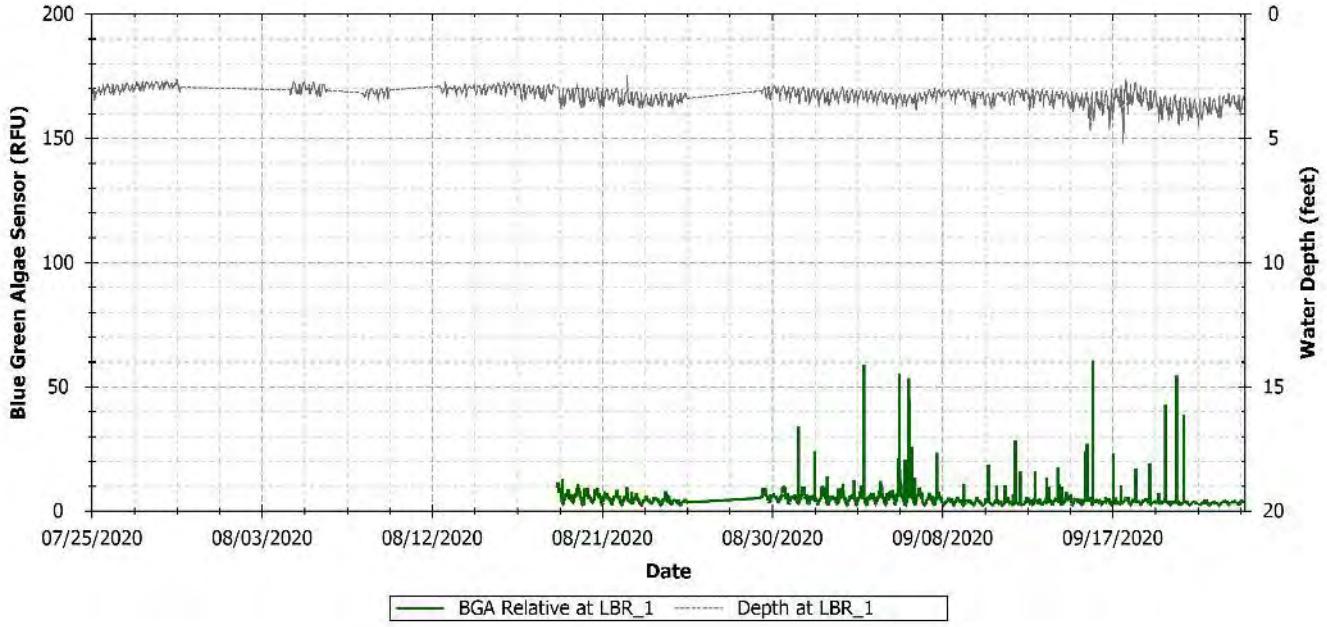


Figure A-2 LBR_1 observed BGA

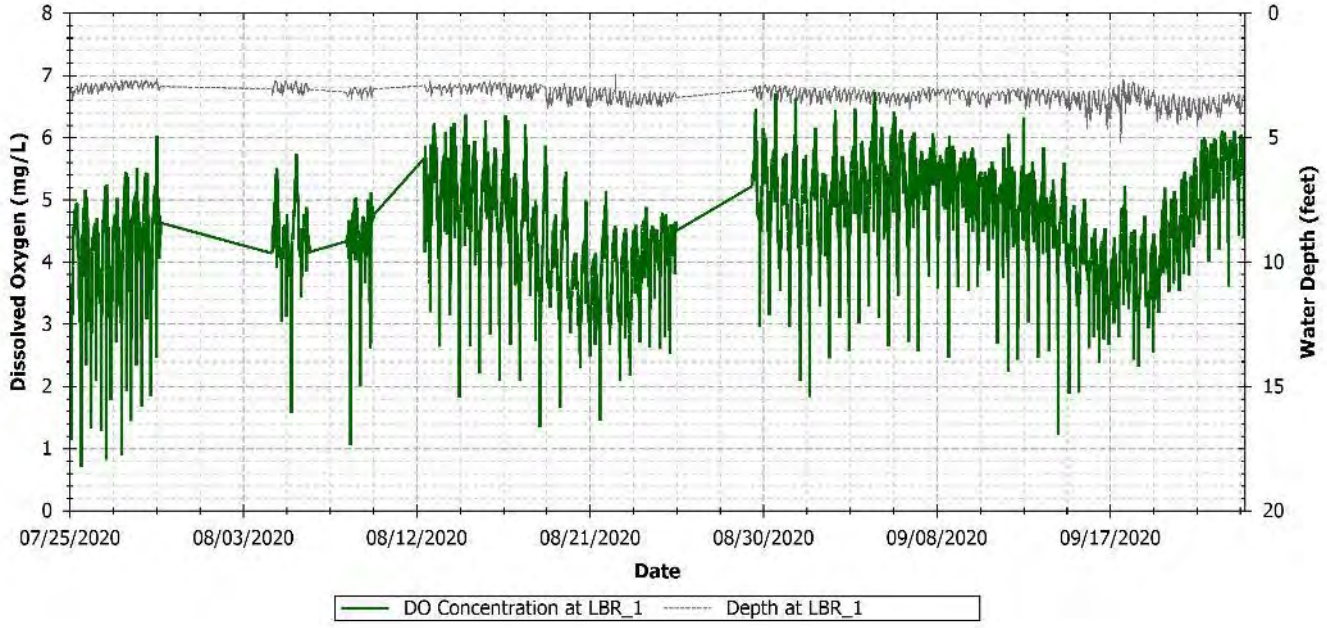


Figure A-3 LBR_1 observed DO concentration

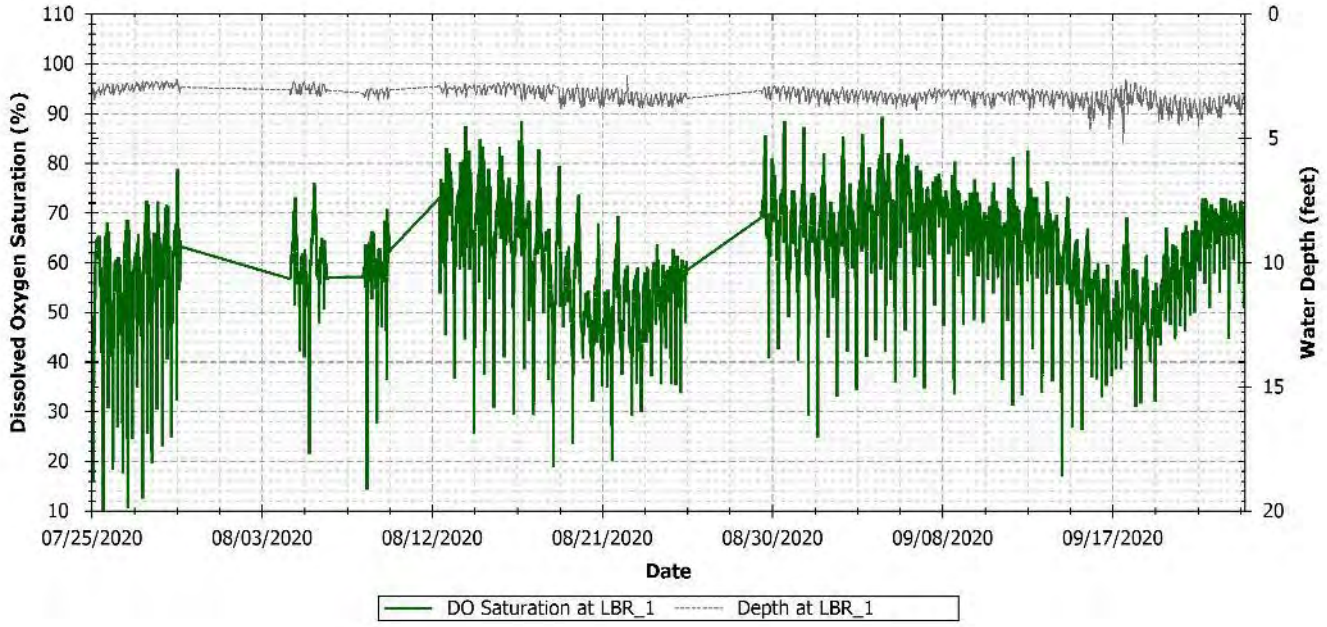


Figure A-4 LBR_1 observed DO saturation

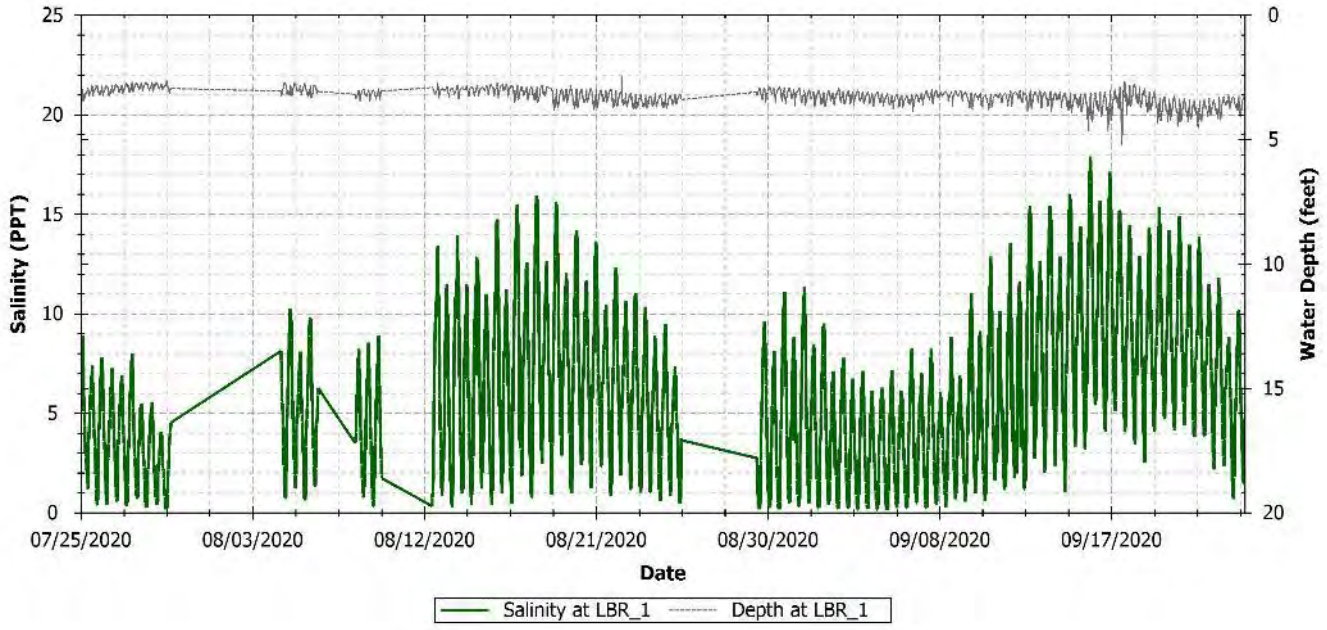


Figure A-5 LBR_1 observed salinity

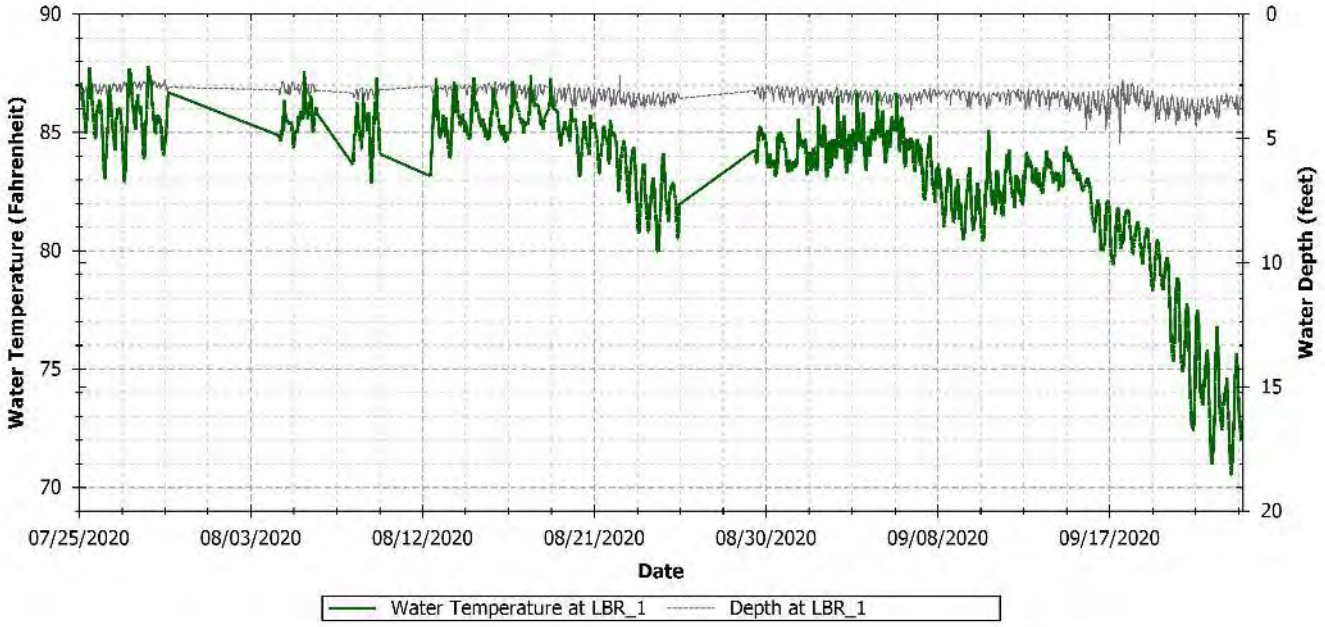


Figure A-6 LBR_1 observed water temperature

A.4 BACK RIVER 2 (LBR_2)

The LBR_2 sonde, 0.5 miles downstream of the diffuser, was located in the main channel; however, the oxygen plume was not always completely mixed at this location. The DO saturation was below 100 percent.

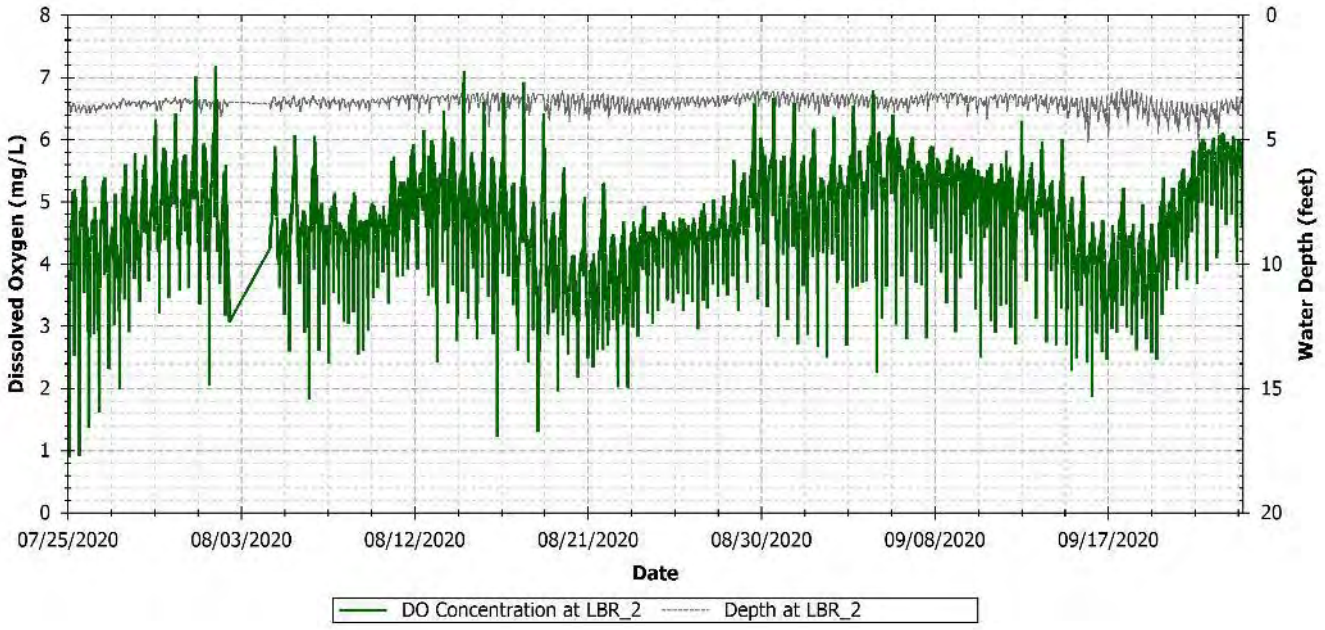


Figure A-7 LBR_2 observed DO concentration

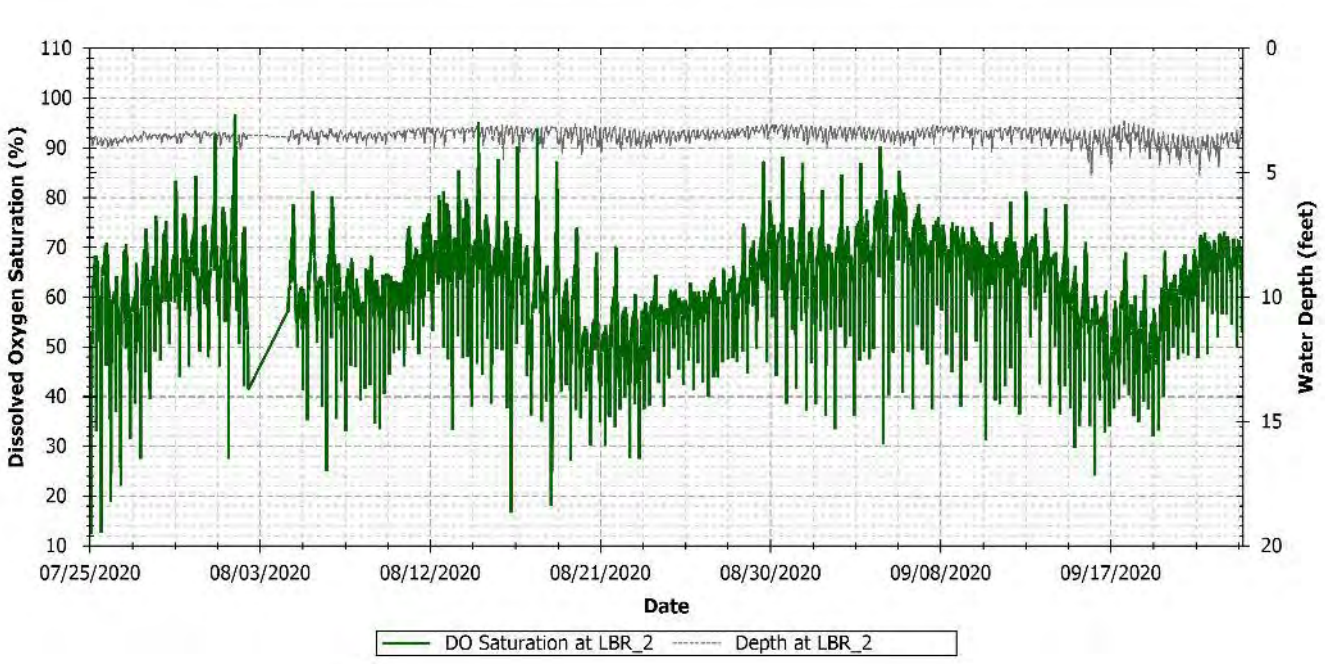


Figure A-8 LBR_2 observed DO saturation

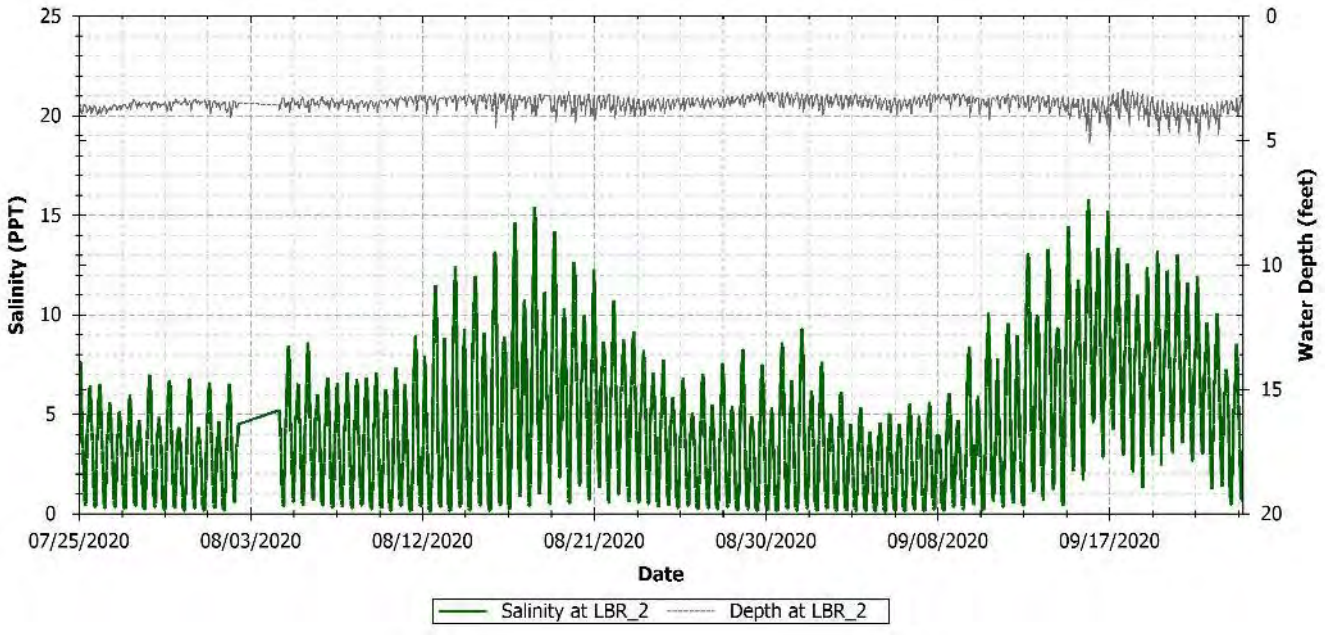


Figure A-9 LBR_2 observed salinity

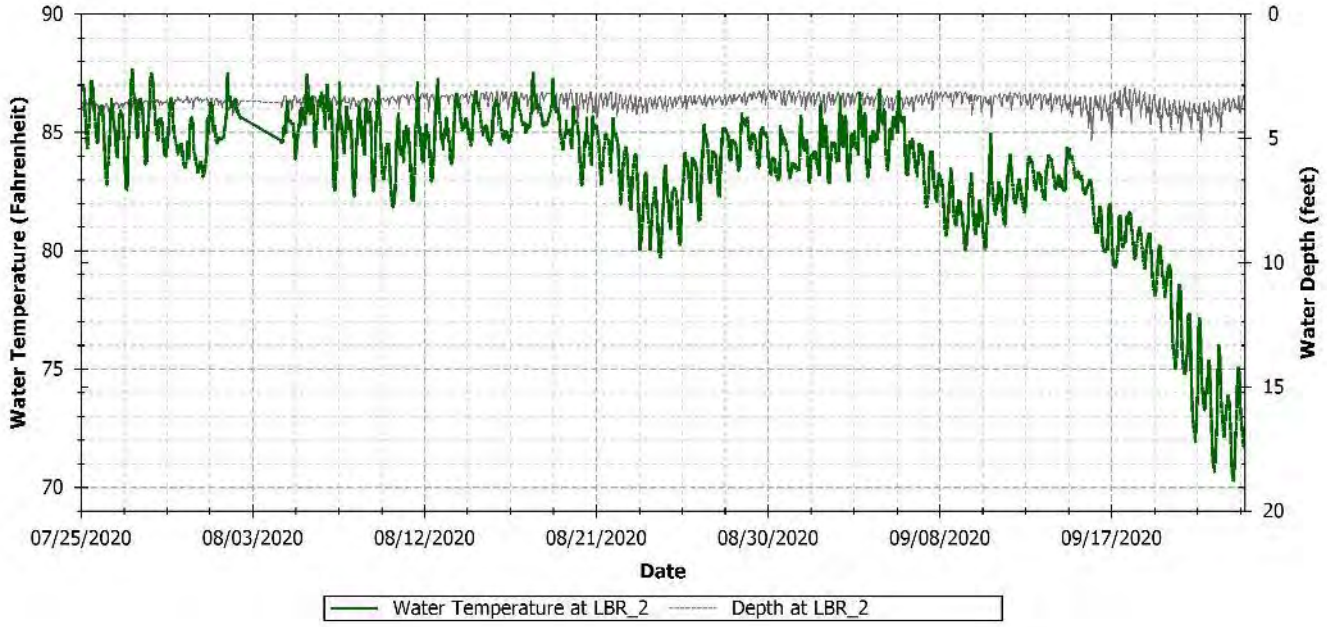


Figure A-10 LBR_2 observed water temperature

A.5 BACK RIVER 3 (LBR_3)

The LBR_3 sonde, 0.2 miles downstream of diffuser, was located in the main channel; however, the oxygen plume was not always completely mixed. The DO saturation was below 100 percent. The LBR_3 algal sensor detected the August 10, 2020 Back River dye injection during spring tide. The algal (BGA) sensor also registered a high reading during this time however, this is most likely due to the interference from the high salinity water being pushed upstream.

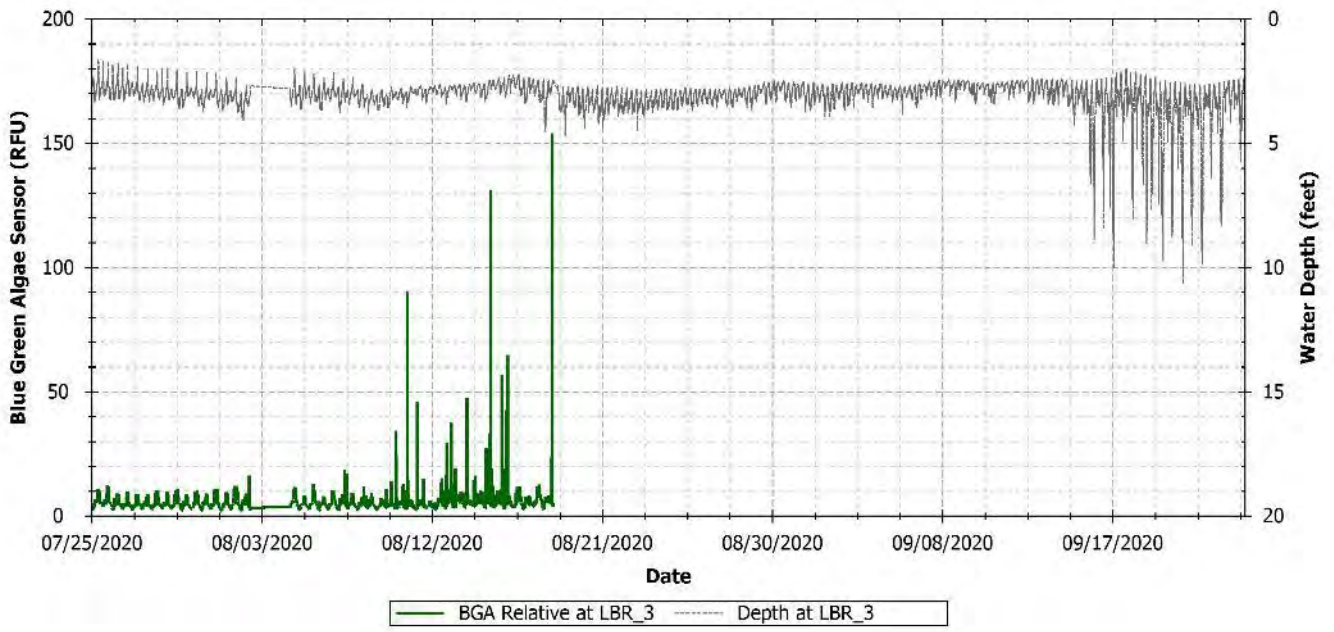


Figure A-11 LBR_3 observed BGA

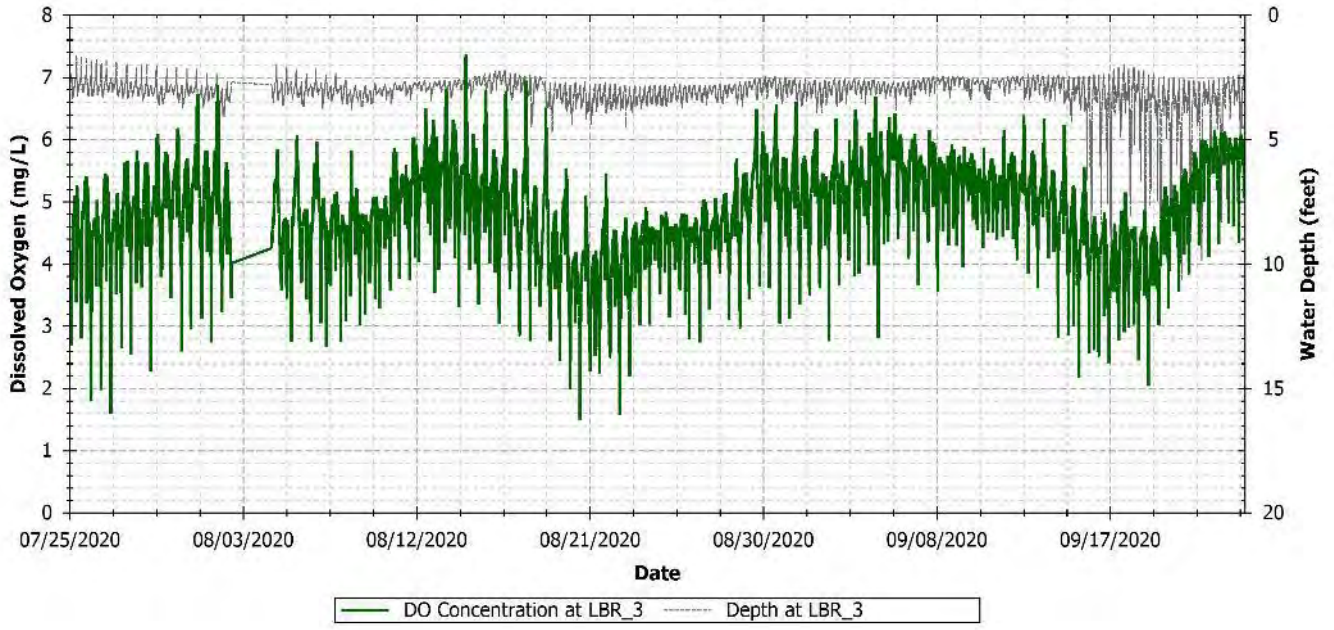


Figure A-12 LBR_3 observed DO concentration

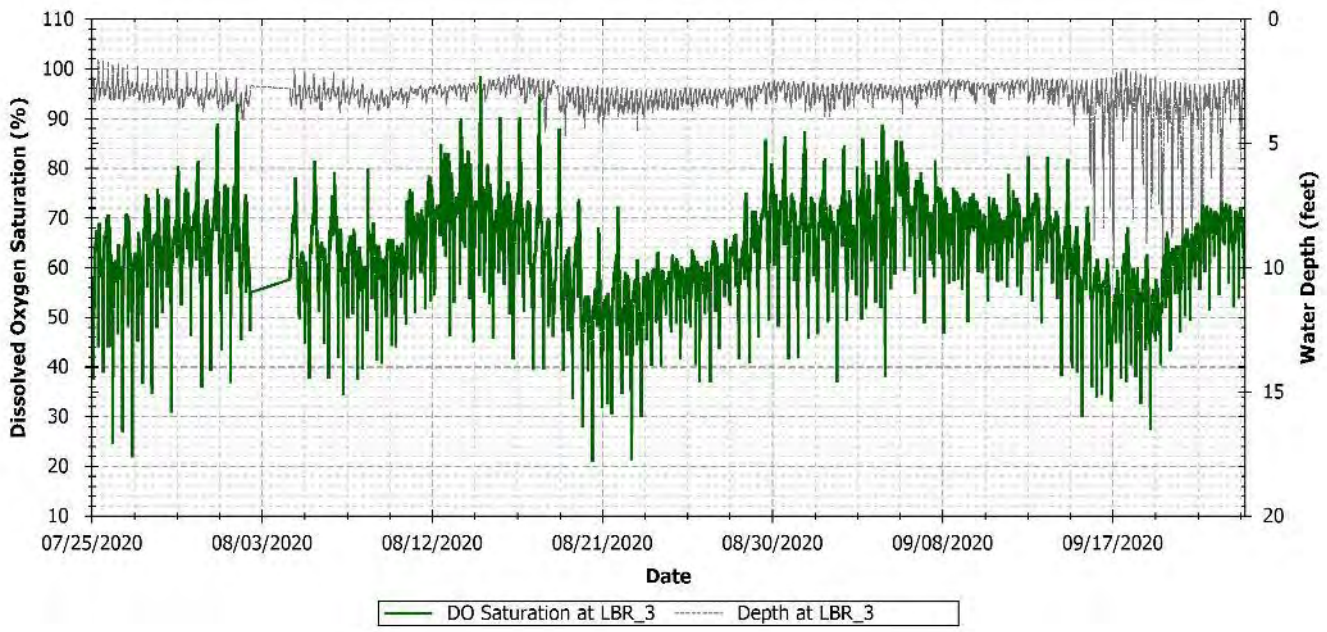


Figure A-13 LBR_3 observed DO saturation

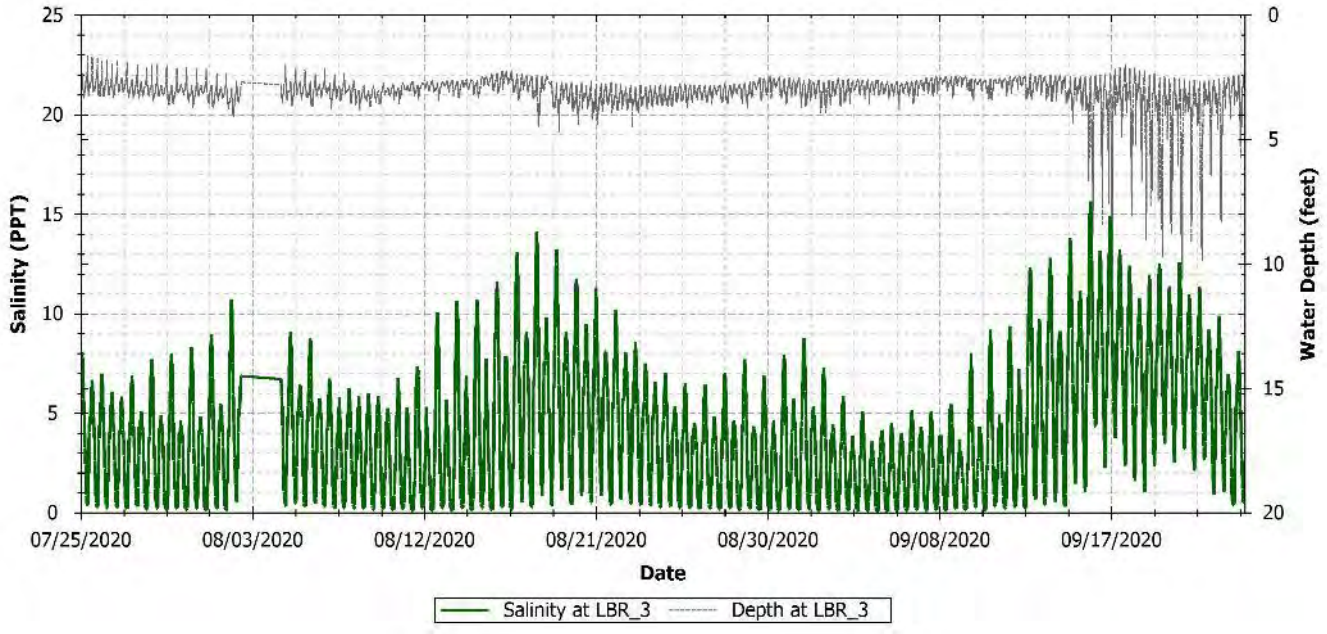


Figure A-14 LBR_3 observed salinity

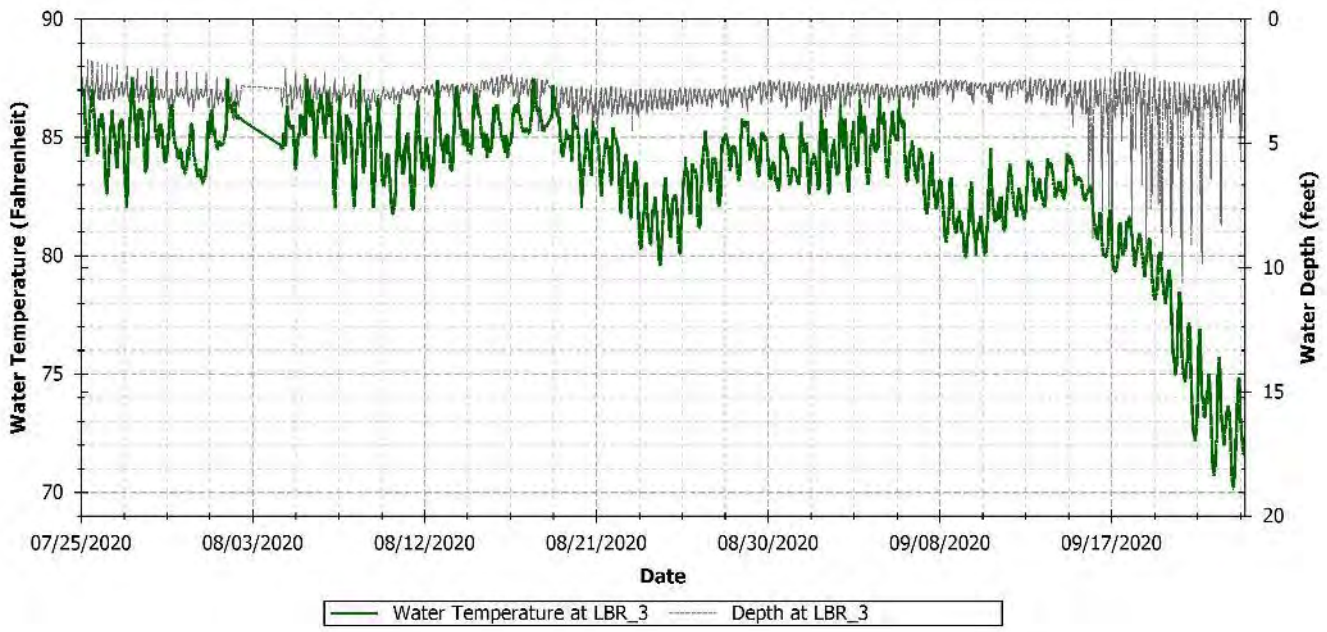


Figure A-15 LBR_3 observed water temperature

A.6 BACK RIVER 4 (LBR_4)

The LBR_4 sonde, 0.06 miles downstream of the diffuser, was located near the diffuser and where the oxygen plume was reaching the surface. During the SUR, 99.9 percent of the time, the DO saturation was below 100 percent. For an insignificant amount of time during a tidal cycle, the DO saturation was above 100 percent. However, this amount of time did not impact the WCTE

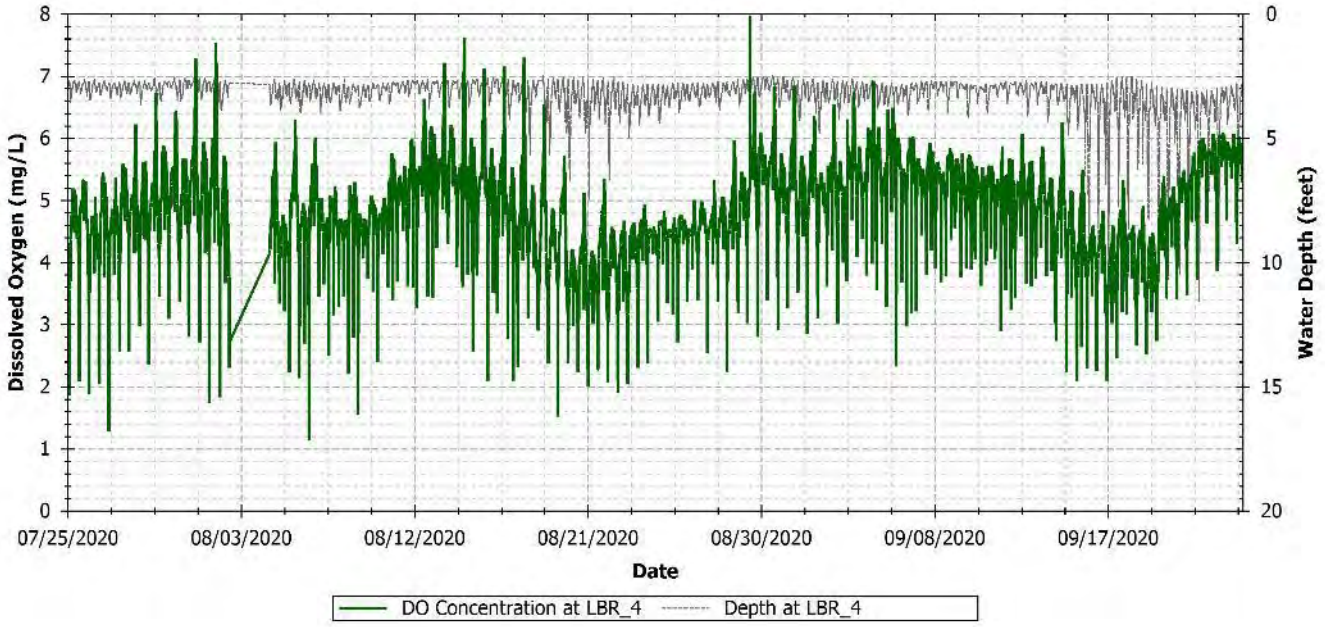


Figure A-16 LBR_4 observed DO concentration

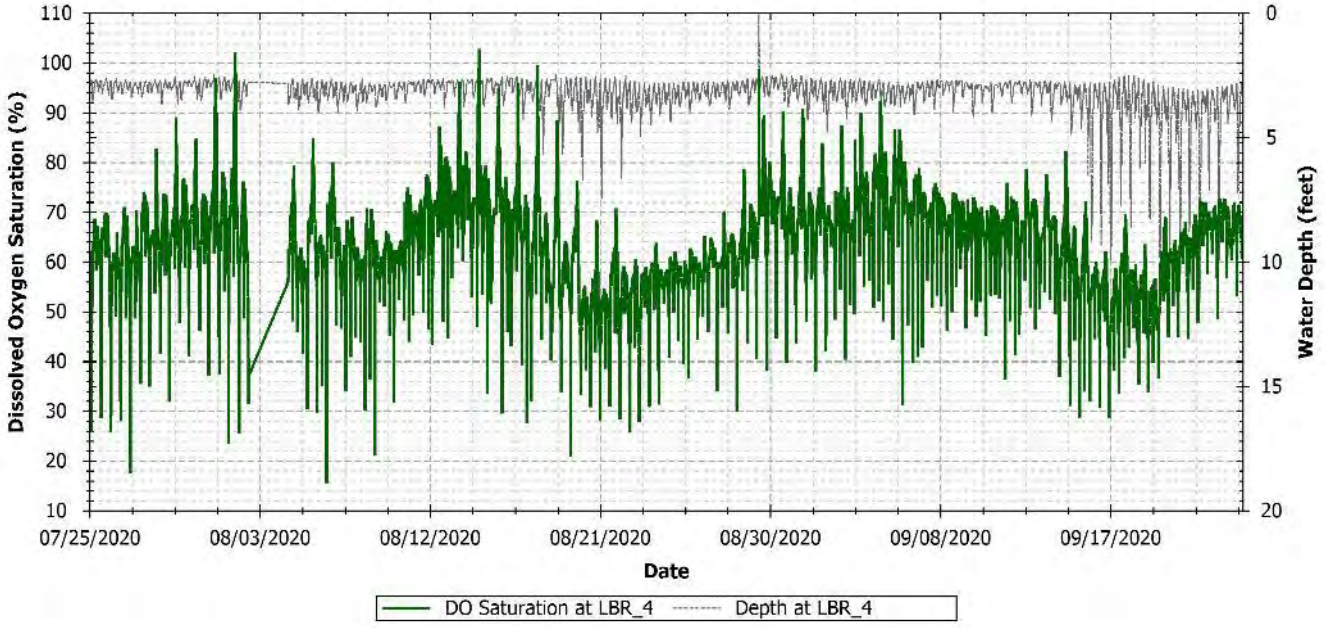


Figure A-17 LBR_4 observed DO saturation

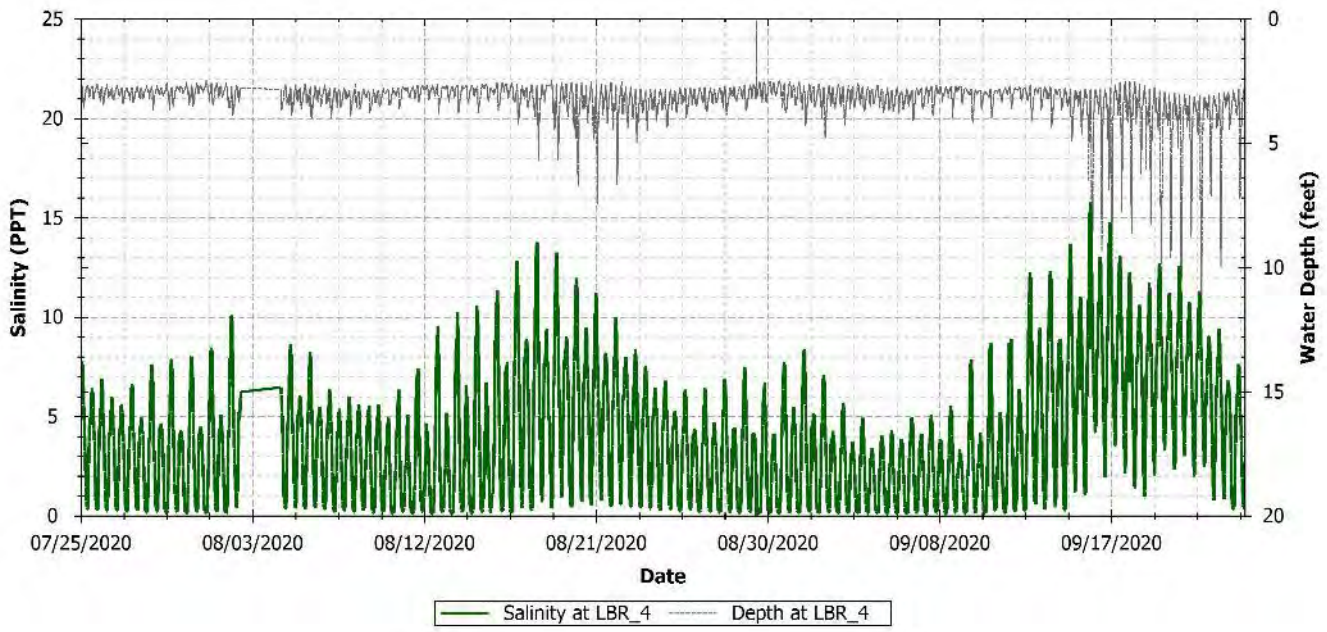


Figure A-18 LBR_4 observed salinity

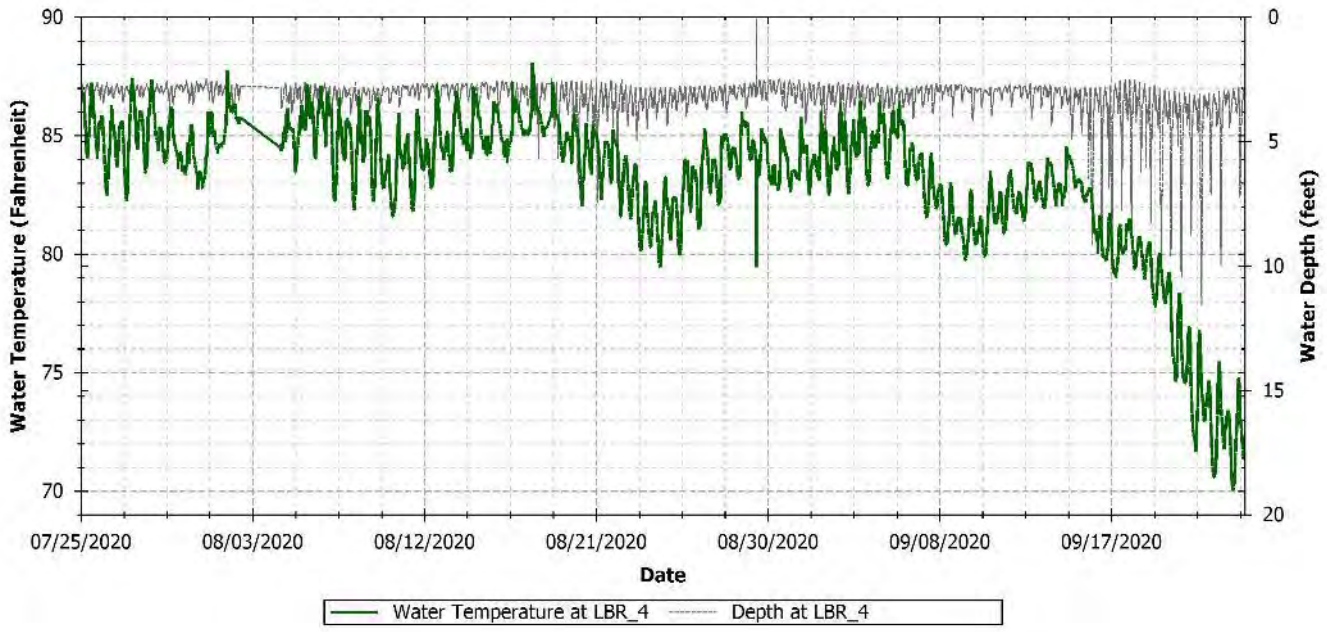


Figure A-19 LBR_4 observed water temperature

A.7 BACK RIVER 5 (LBR_5)

The LBR_5 sonde, 0.06 miles upstream of diffuser, was located near the diffuser and where the oxygen plume was reaching the surface. During the SUR, 99.9 percent of the time, the DO saturation was below 100 percent. For an insignificant amount of time during a tidal cycle, the DO saturation was above 100 percent. However, this amount of time did not impact the WCTE.

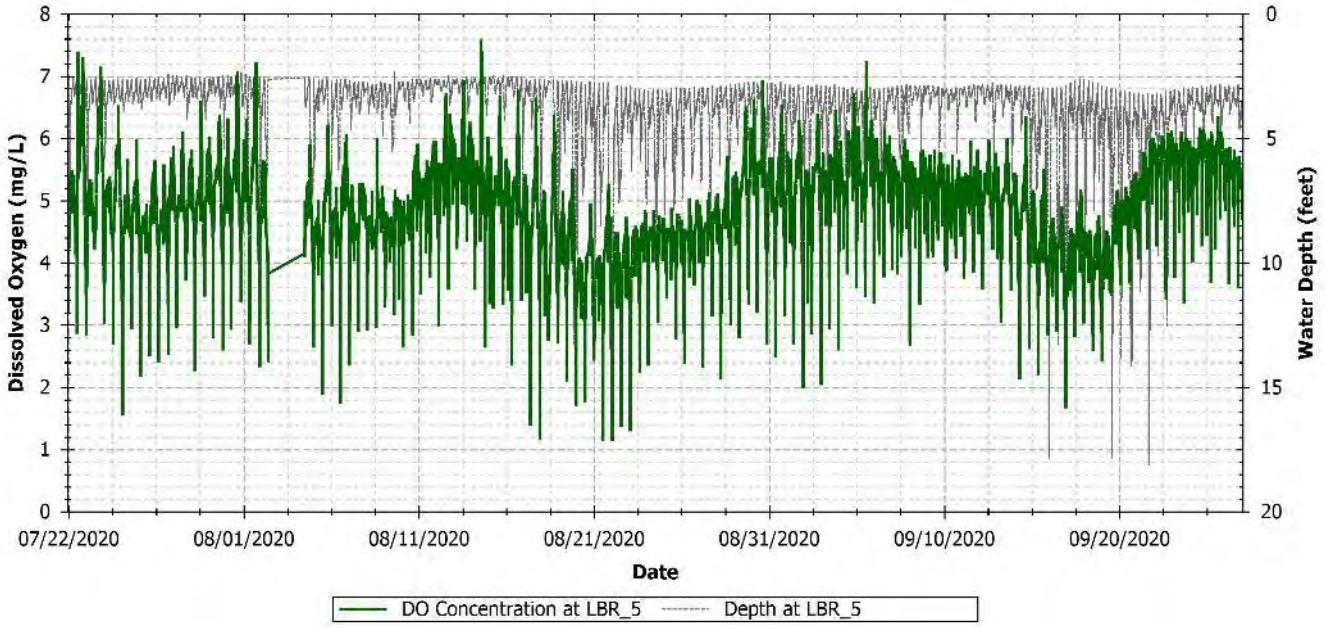


Figure A-20 LBR_5 observed DO concentration

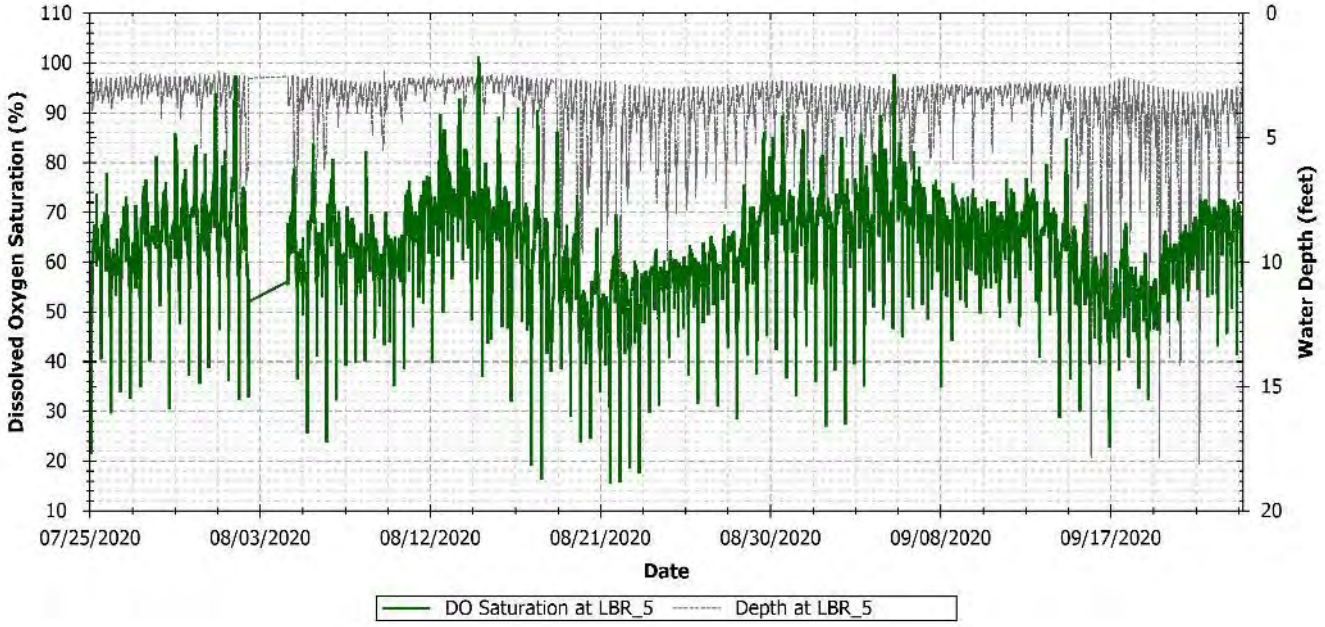


Figure A-21 LBR_5 observed DO saturation

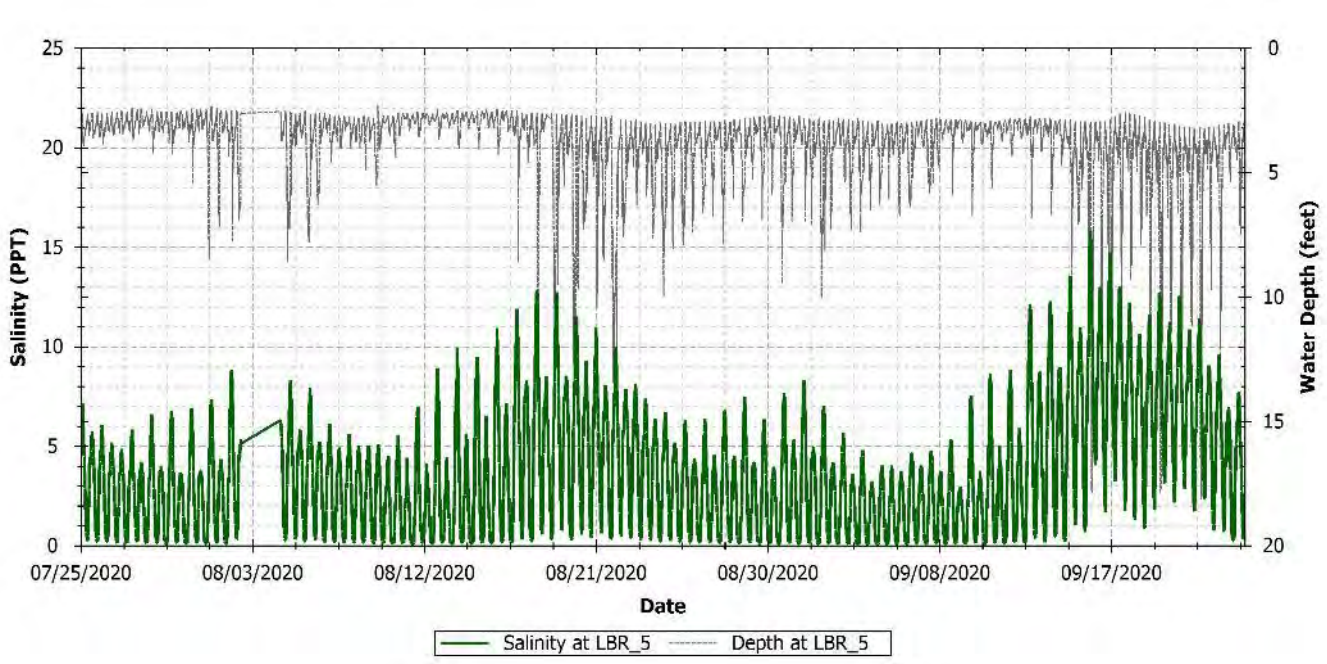


Figure A-22 LBR_5 observed salinity

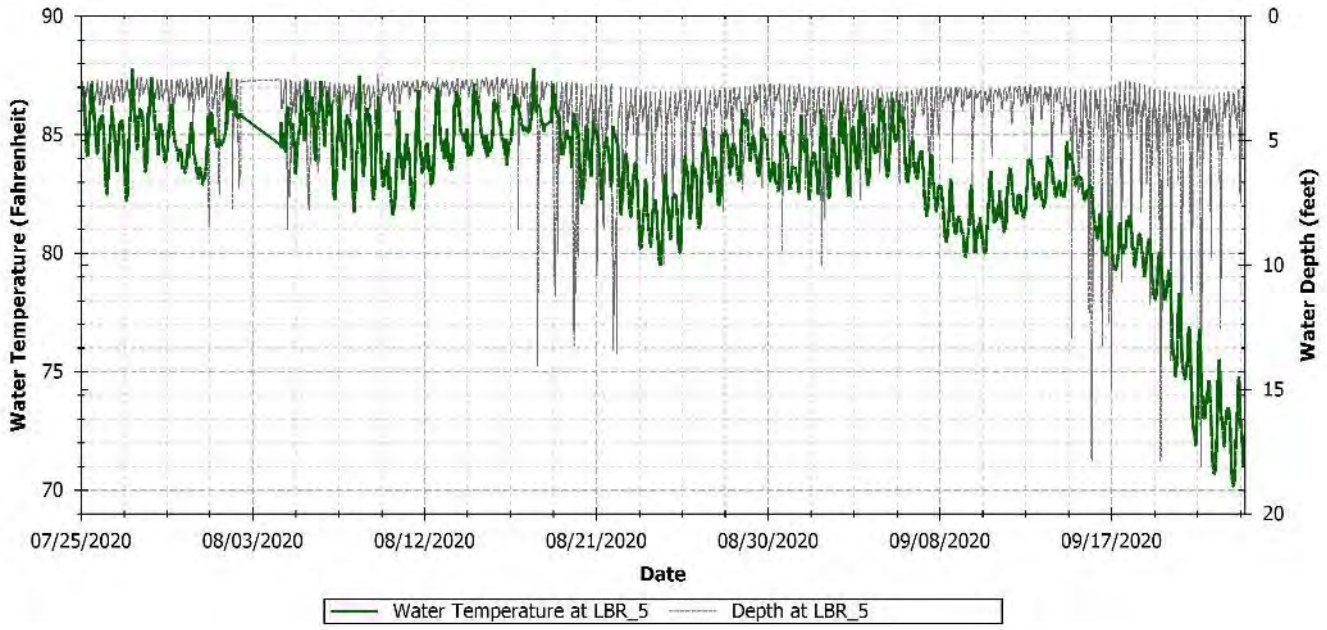


Figure A-23 LBR_5 observed water temperature

A.8 BACK RIVER 6 (LBR_6)

The LBR_6 sonde, 0.2 miles upstream of diffuser, was located just upstream of the in the oxygen plume, but where the oxygen plume was not mixed side to side. The oxygen plume, on flood tides, is pushed toward the west bank and hugs the bank as it moves upstream. During the SUR, 99.9 percent of the time, the DO saturation was below 100 percent. For an insignificant amount of time during a tidal cycle, the DO saturation was above 100 percent. However, this amount of time did not impact the WCTE.

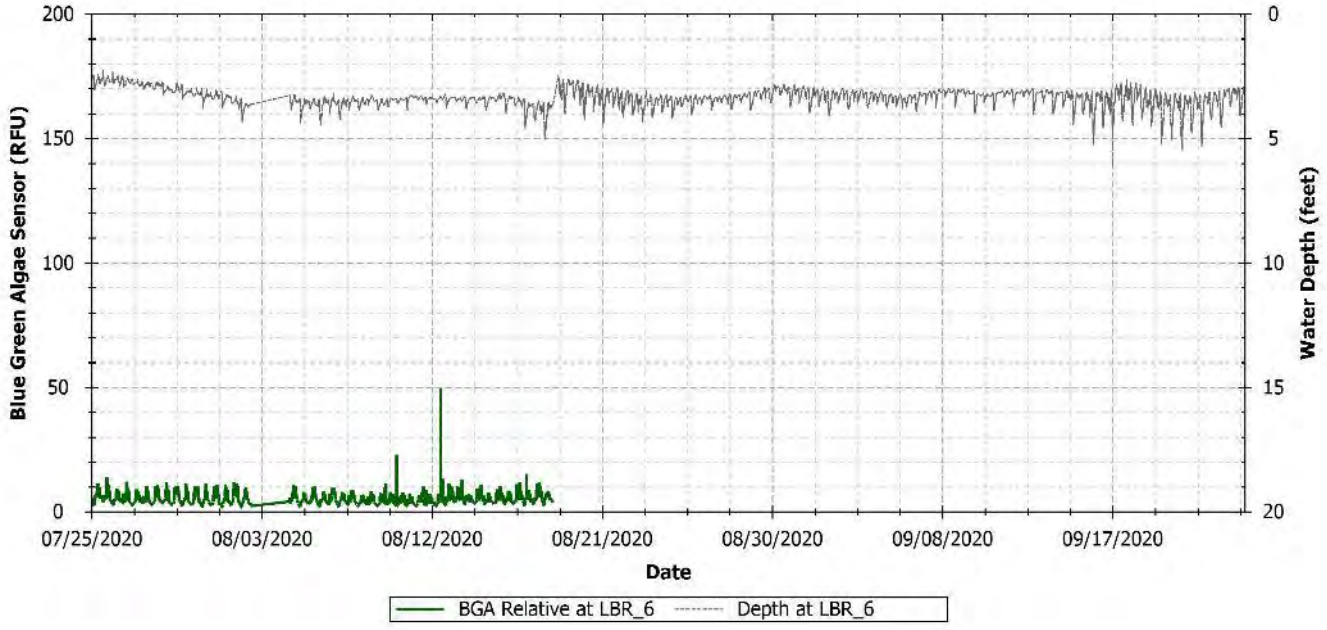


Figure A-24 LBR_6 observed BGA

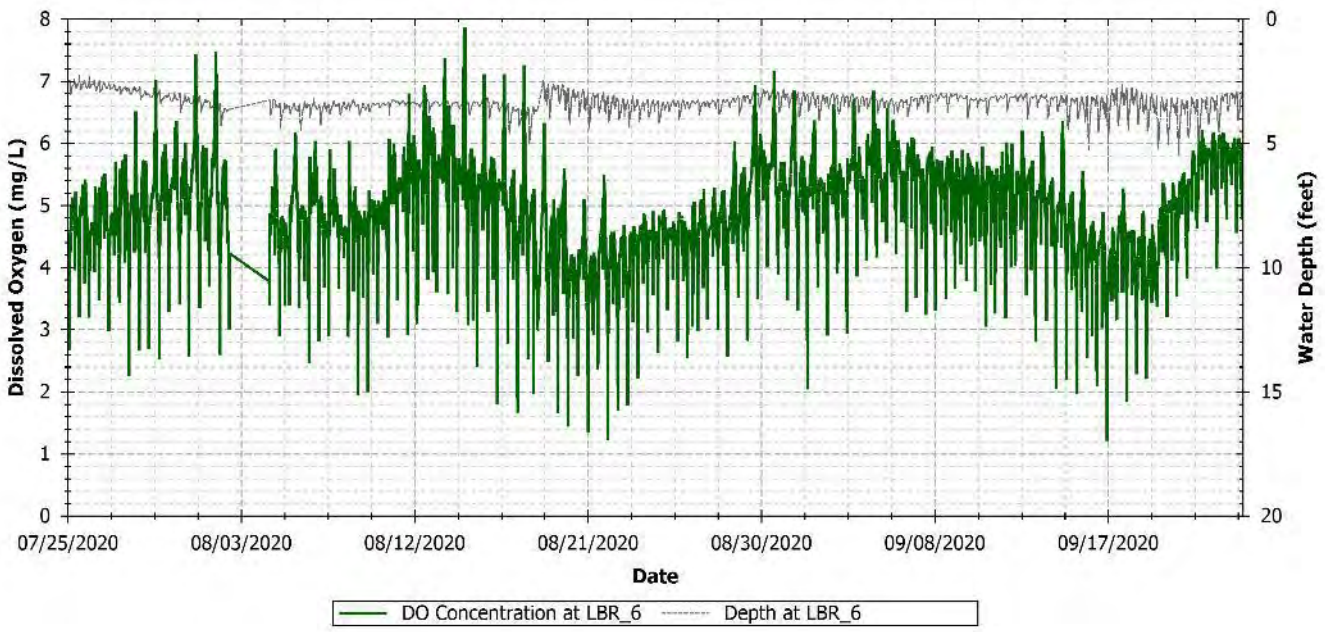


Figure A-25 LBR_6 observed DO concentration

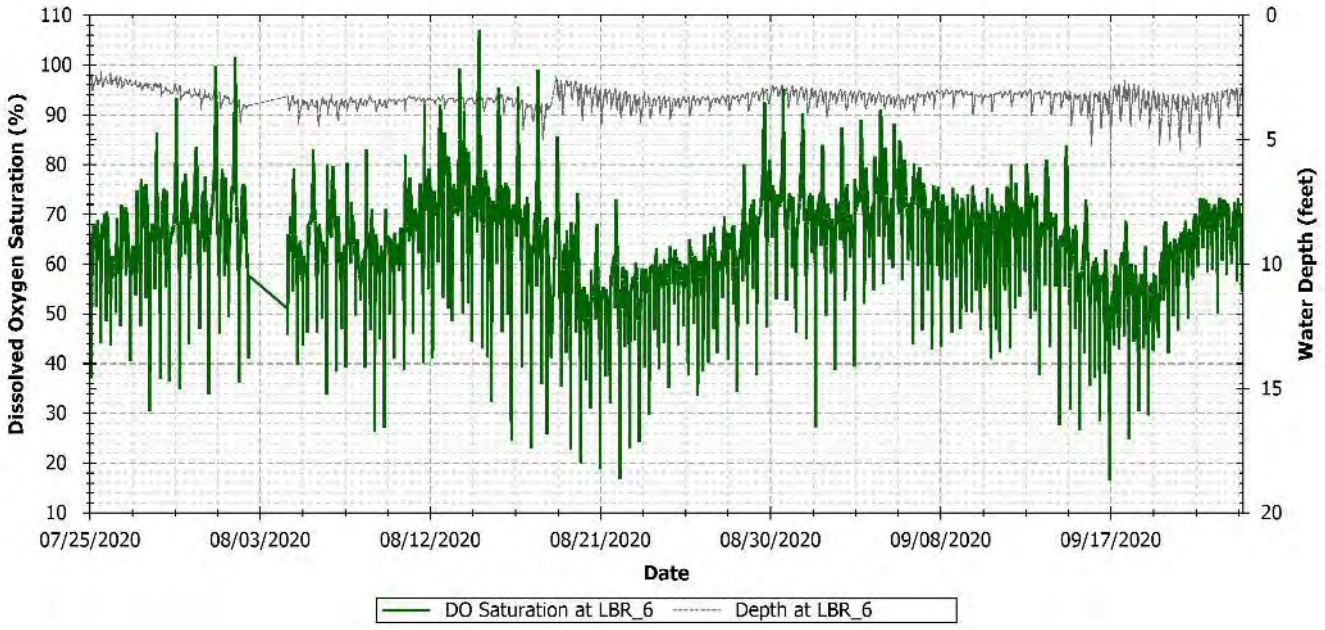


Figure A-26 LBR_6 observed DO saturation

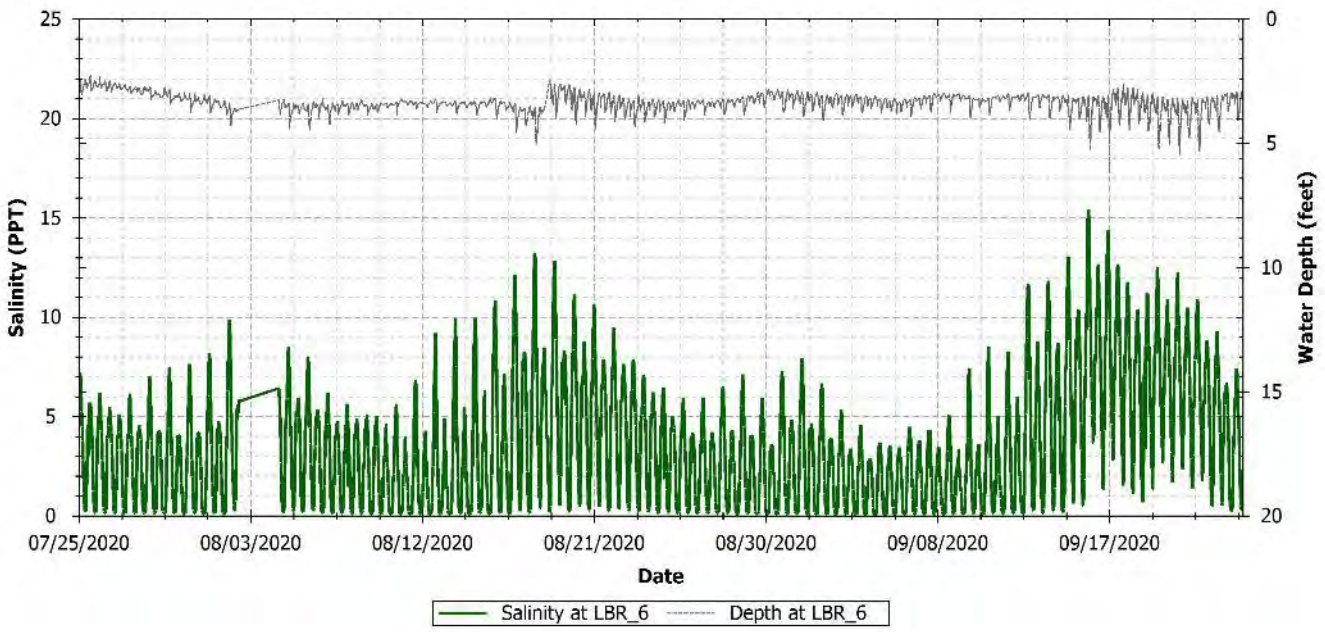


Figure A-27 LBR_6 observed salinity

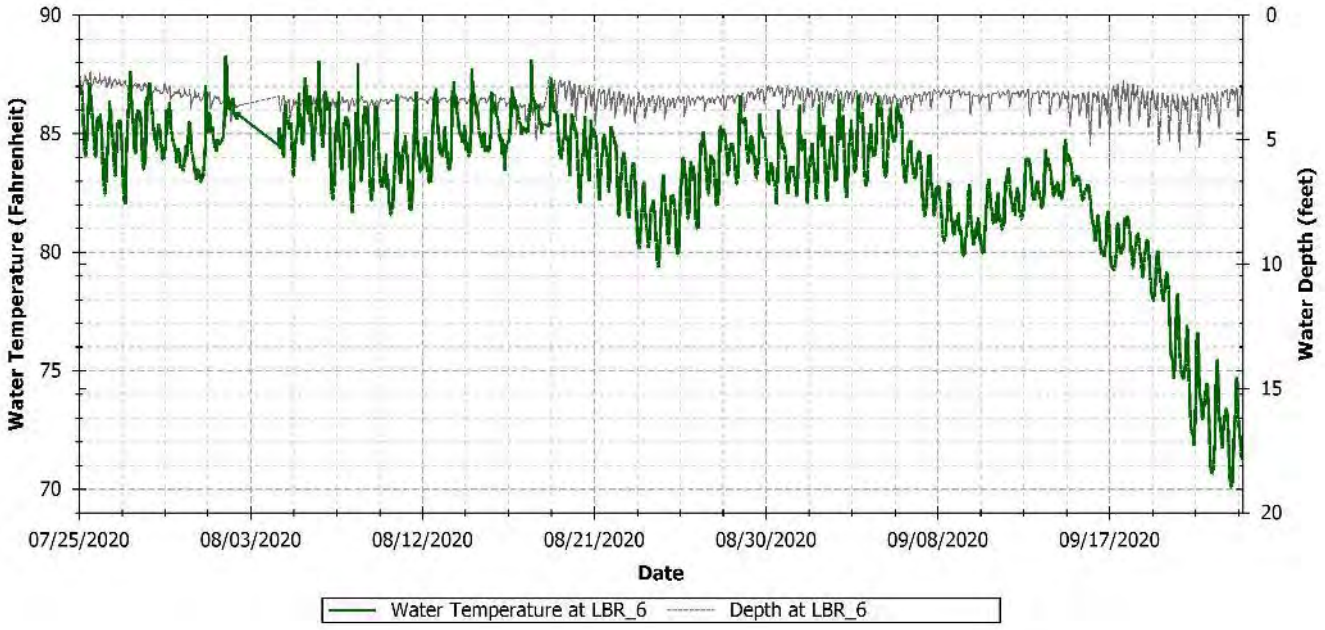


Figure A-28 LBR_6 observed water temperature

A.9 BACK RIVER 7 (LBR_7)

The LBR_7 sonde, 0.5 miles upstream of diffuser, was located upstream of the diffuser in the oxygen plume, but where the oxygen plume was not mixed side to side. During flood tides, the oxygen plume is pushed toward the west bank and hugs the bank as it moves upstream. During the SUR, 99.9 percent of the time, the DO saturation was below 100 percent. For an insignificant amount of time during a tidal cycle, the DO saturation was above 100 percent. However, this amount of time did not impact the WCTE.

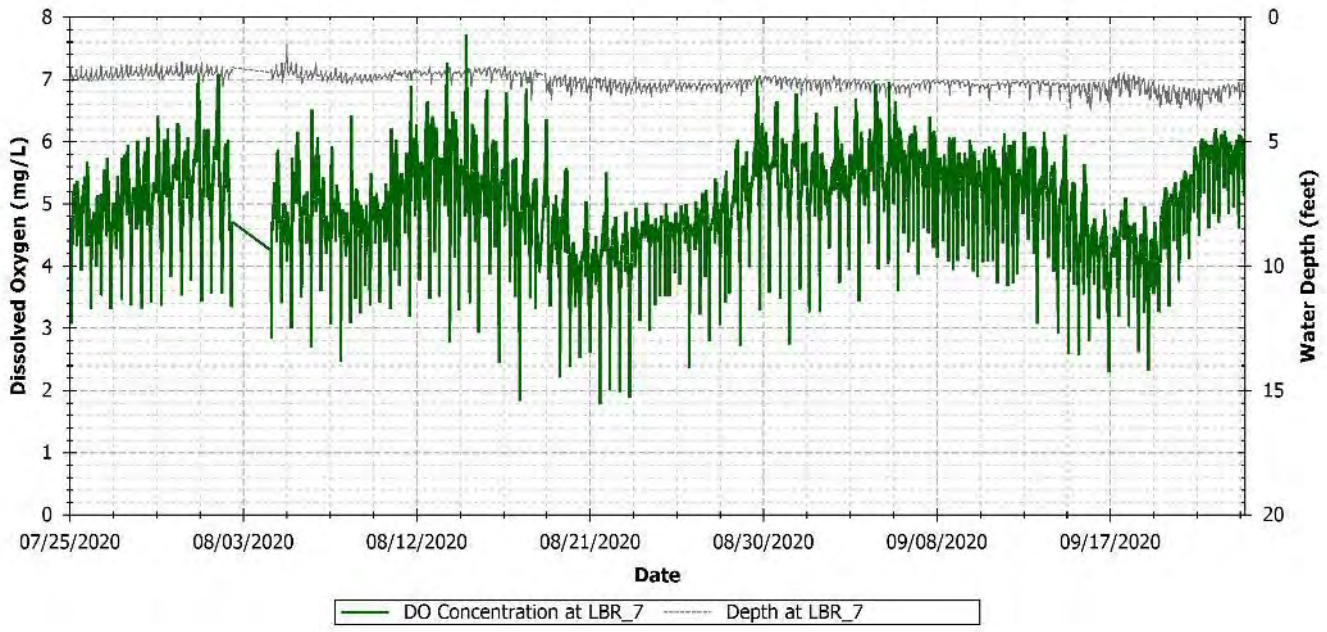


Figure A-29 LBR_7 observed DO concentration

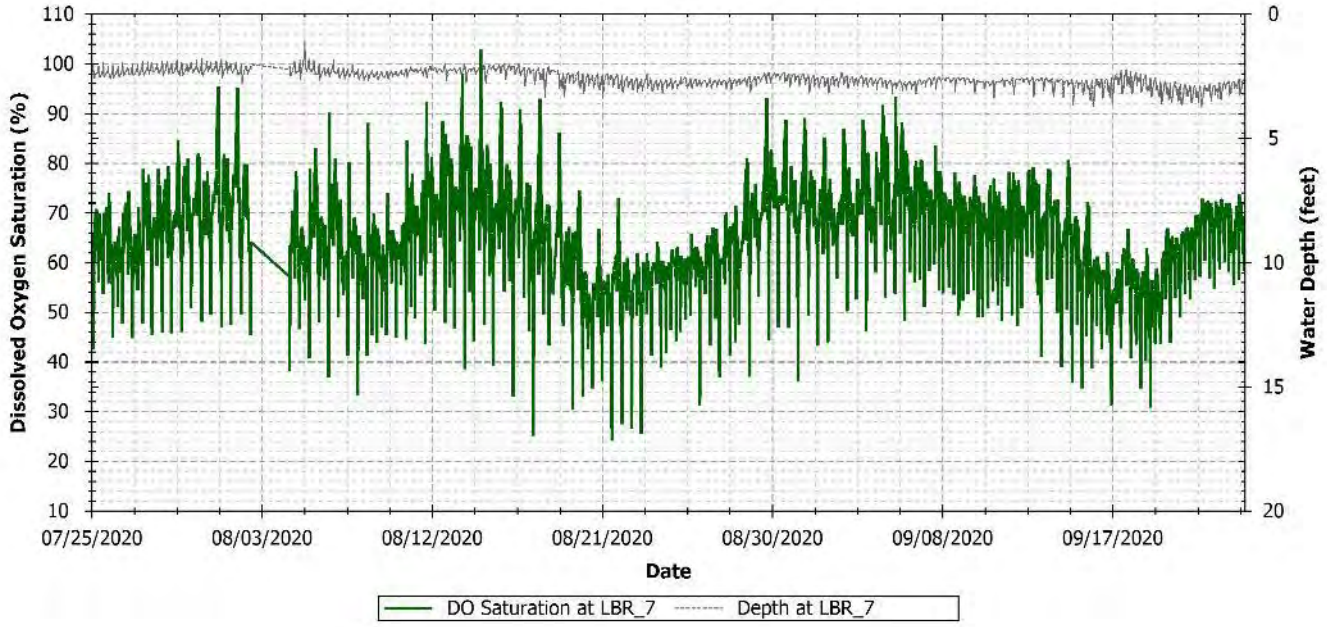


Figure A-30 LBR_7 observed DO saturation

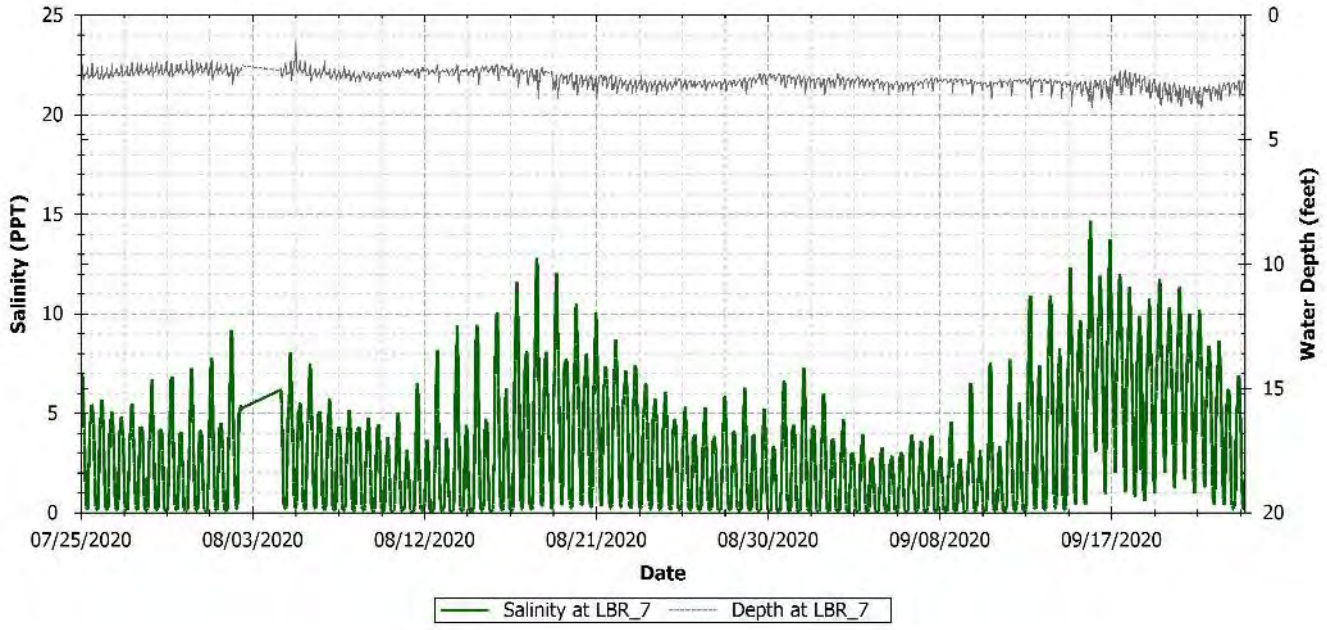


Figure A-31 LBR_7 observed salinity

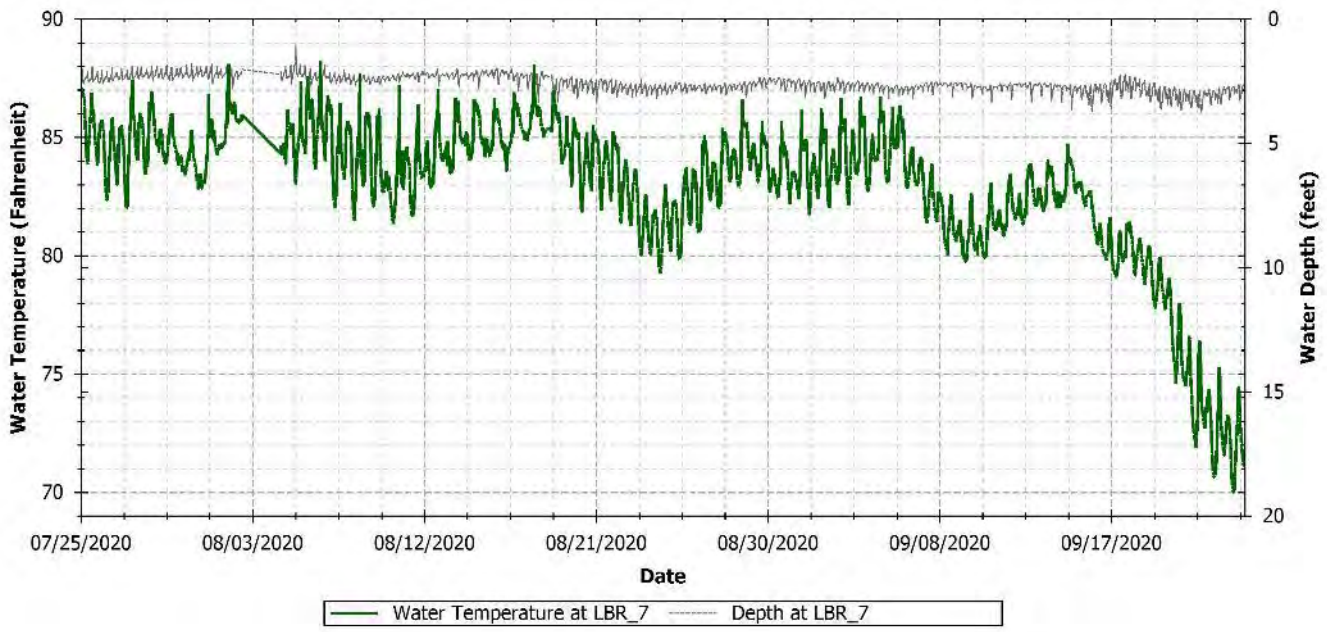


Figure A-32 LBR_7 observed water temperature

A.10 BACK RIVER 8 (LBR_8)

The LBR_8 sonde, 1.2 miles upstream of diffuser, was located upstream of the diffuser in the oxygen plume, but where the oxygen plume is just beginning to mix side to side. During flood tides, the oxygen plume is pushed toward the west bank and hugs the bank as it moves upstream. The DO saturation was below 100 percent.

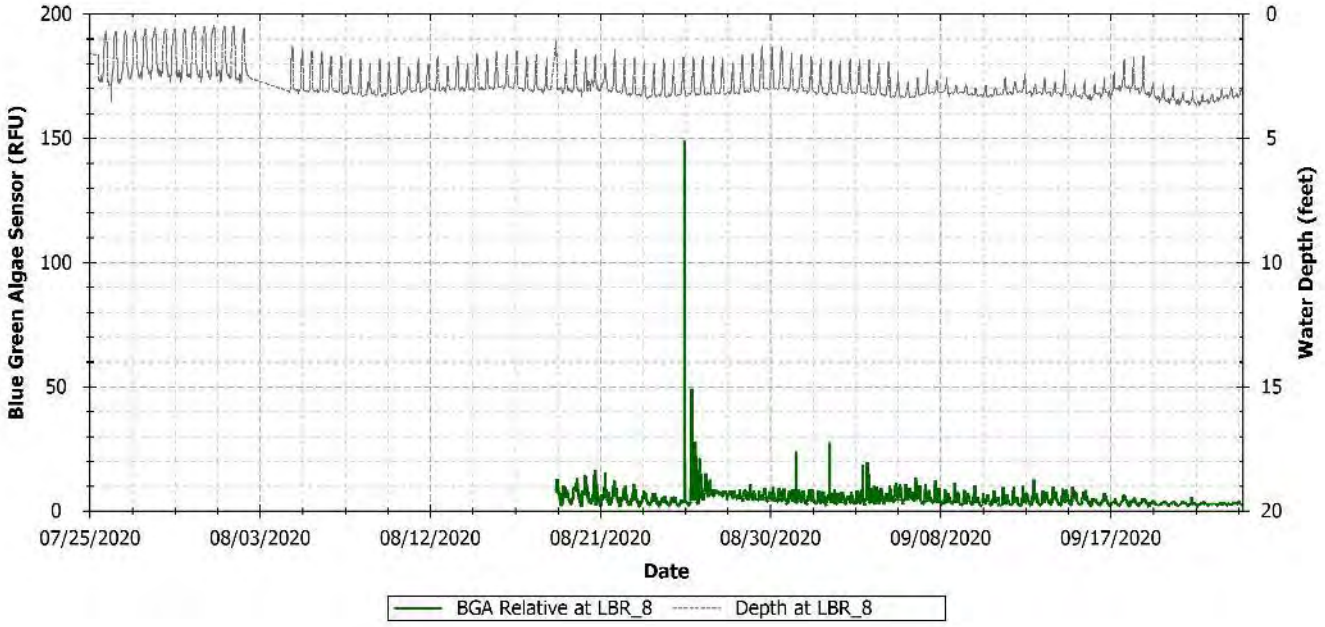


Figure A-33 LBR_8 observed BGA

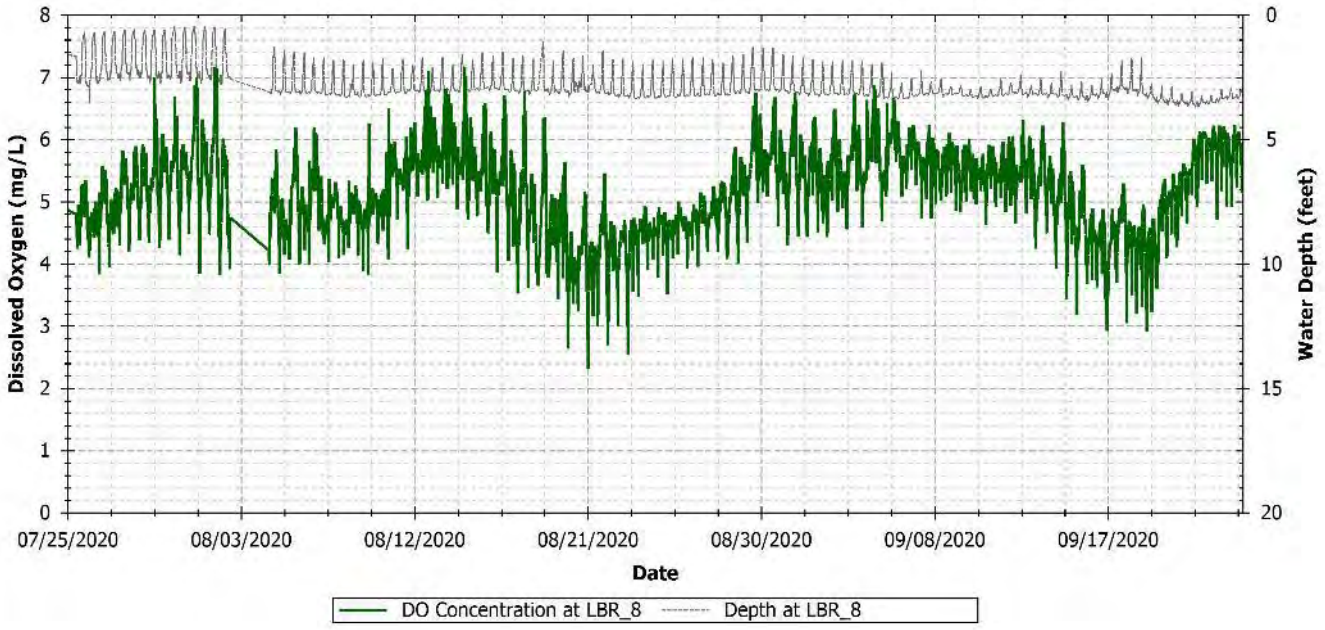


Figure A-34 LBR_8 observed DO concentration

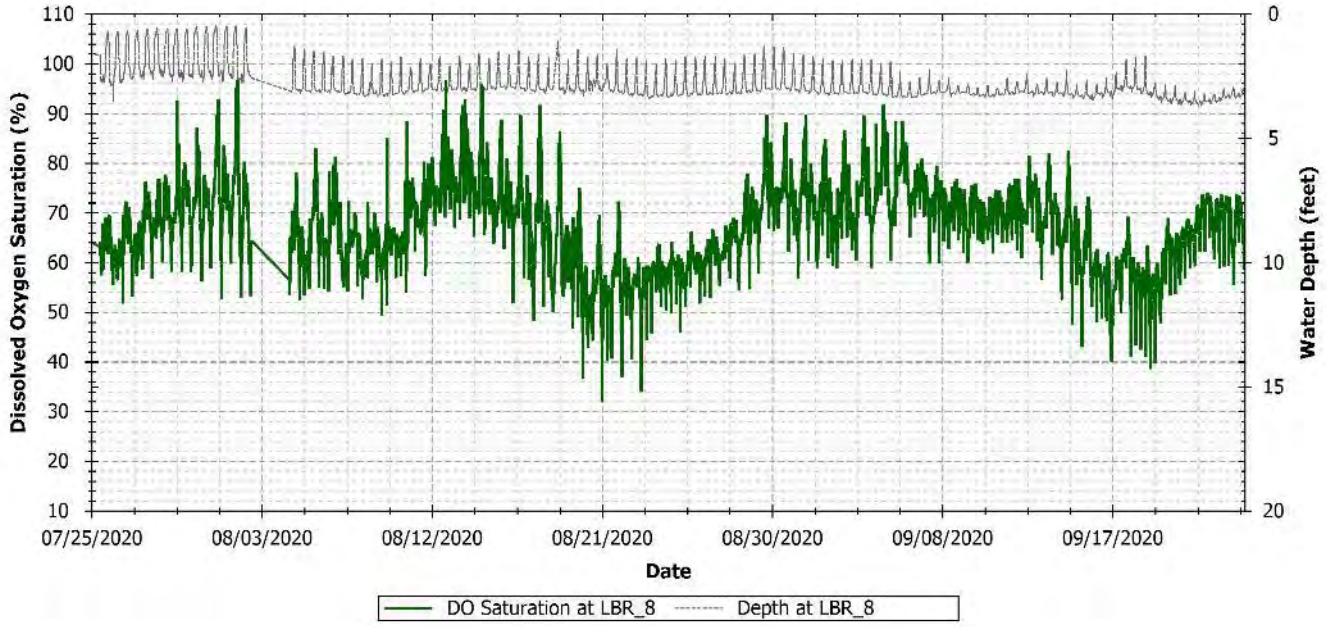


Figure A-35 LBR_8 observed DO saturation

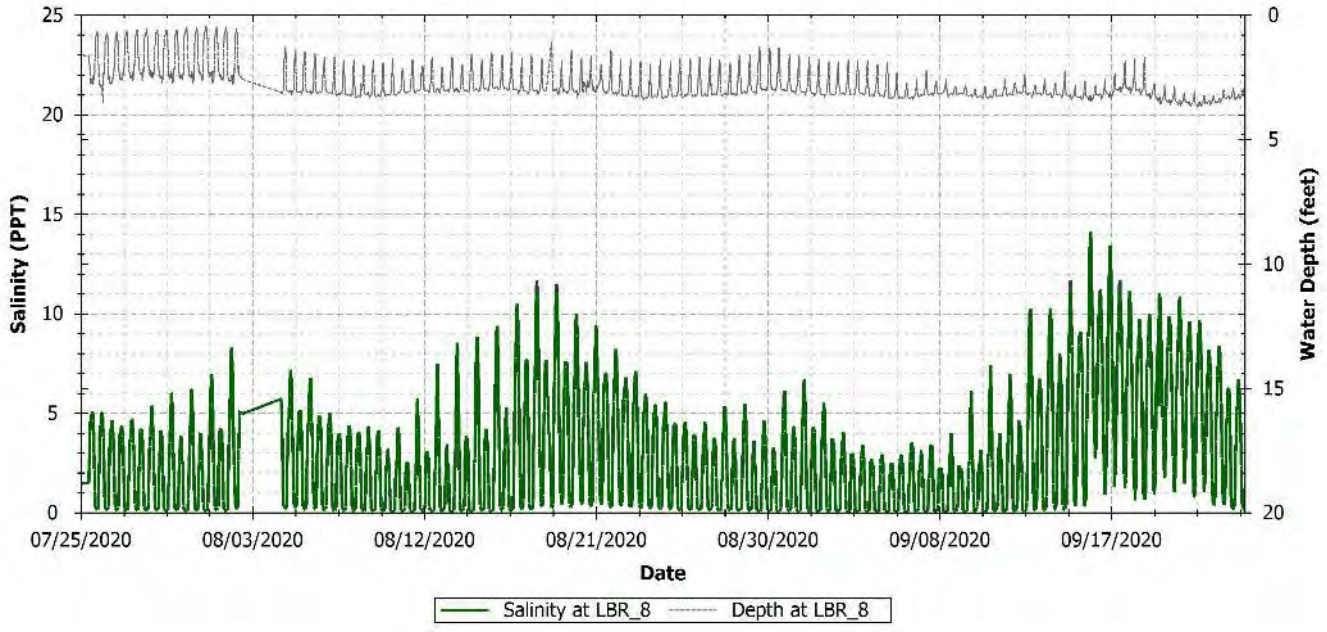


Figure A-36 LBR_8 observed salinity

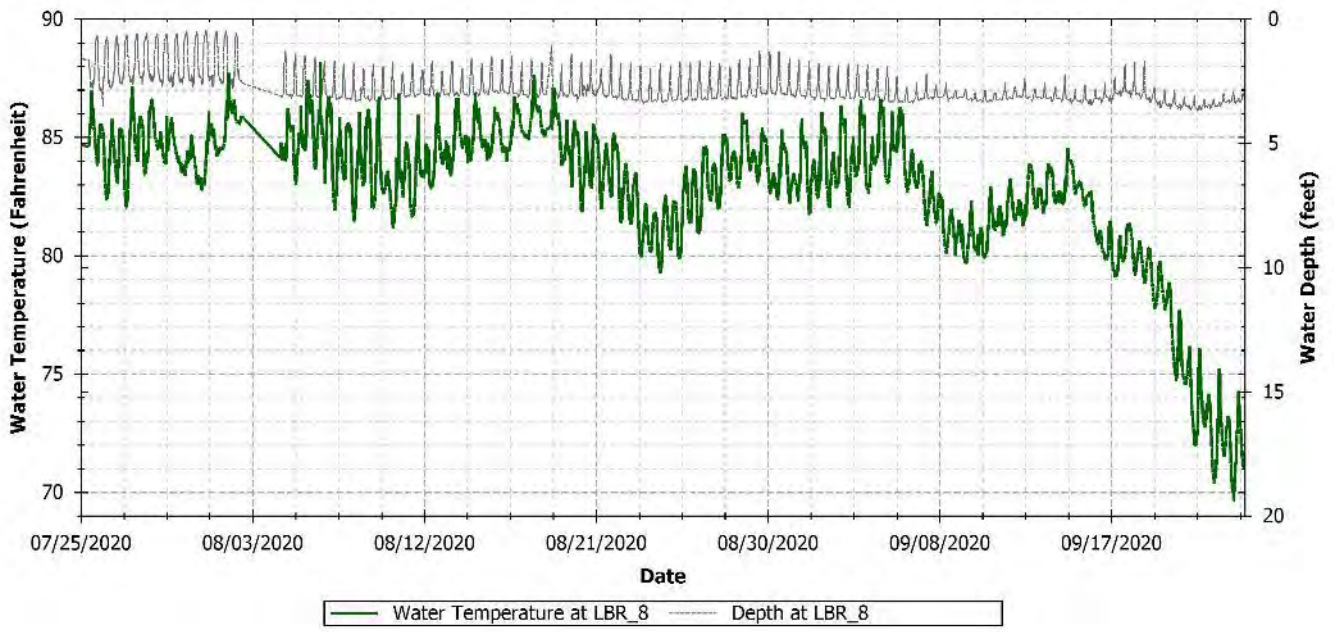


Figure A-37 LBR_8 observed water temperature

A.11 FRONT BUOY INFORMATION AND DATA

Three Front River buoys were initially located near the diffuser; however, they had to be removed before the start of the SUR due to dredging in the area. The sondes were to measure the surface DO and DO saturation above and immediately around the Front River diffuser to check if the oxygen plume was reaching the surface with DO saturation values above 100 percent. Because of the dredging in the immediate area these sondes had to be removed before the SUR. Additional attention was focused on around the diffuser during drift and profile boat sampling and during the dye events. No exceedance of the 100 percent DO saturation were noted.

A single sonde was placed at the USACE Depot Dock (***Figure A-38***) near the USGS gage to assist in tracking the Front River dye injections. The USACE Depot Dock sondes measure parameters at 15-minute intervals. These parameters are:

- DO to evaluate the impact of the injected oxygen on the Upriver DO regime.
- DOsat to check if DO saturation exceeded 100 percent. If DO saturation exceeds 100 percent for any significant time, this would indicate that DO could be transferred to the atmosphere.
- Salinity, at higher salinities there is less capacity for the water to hold oxygen resulting in lower DO values and is used to determine the tidal STATUS.
- Temp_C, at higher temperatures, there is less capacity for the water to hold oxygen and may result in lower DO values and DO saturation to exceed 100 percent.
- BGA used to measure dye during dye release events. Also used to determine the background levels of BGA
- Rhodamine dye used to track the injected dye as it moves past the Depot sonde.

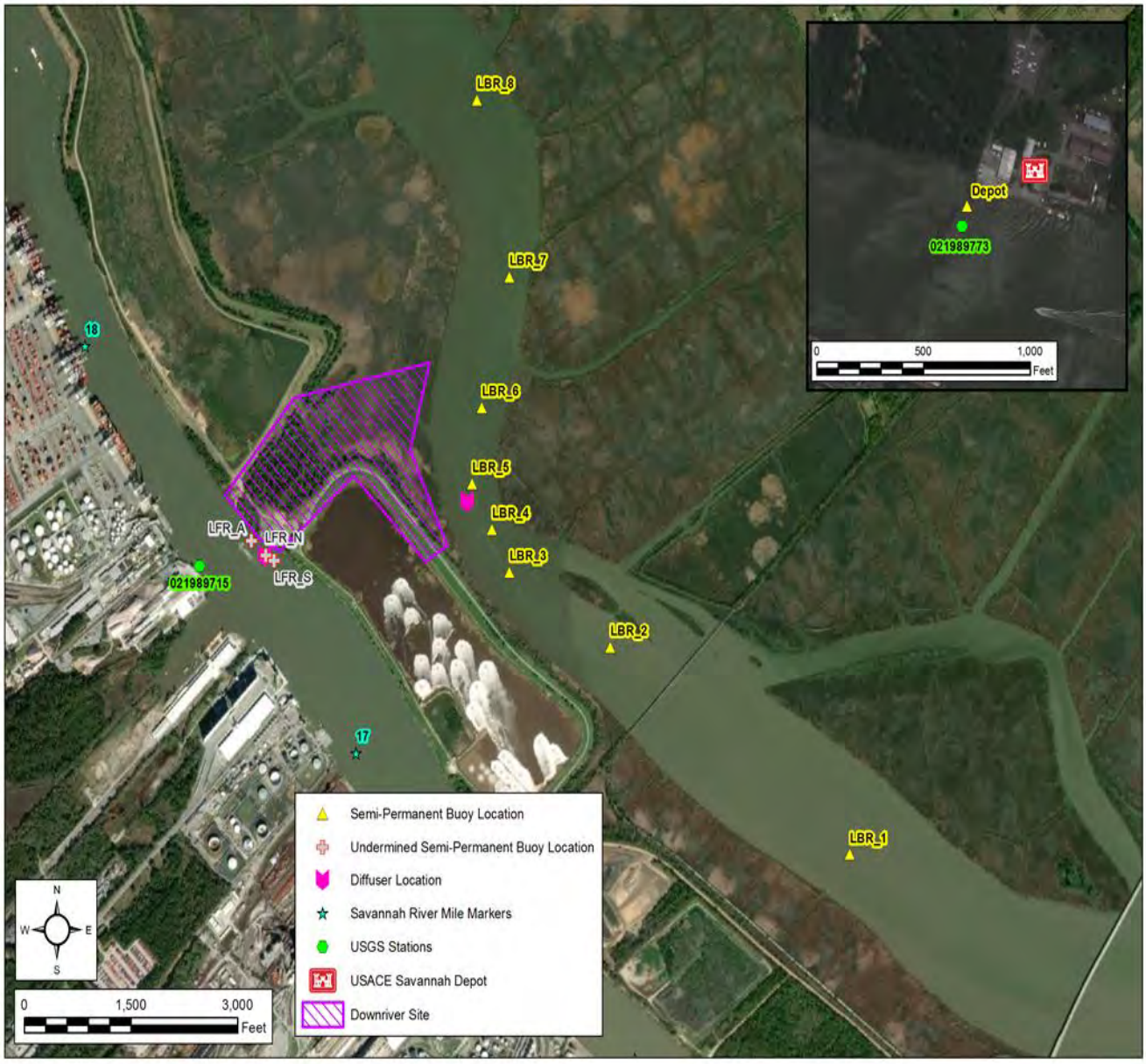


Figure A-38 Location of Front River semi-permanent buoys

The main purpose of the sonde was to collect surface dye data after the SUR Front River dye injections to determine:

- When the dye reached the Depot sonde location
- Track how it moved past the sonde as the tides reversed.
- Determine how long the dye remained in the Front River.

Table A-4 provides a summary of the Depot Data

Table A-4 Summary of the Depot data

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	2.3	2.7	3.3	3.7	4.2	5.2	5.7	23,097	1.5	6.1
DO Saturation (%)	32	37	45	50	56	65	68	23,097	21	75
Salinity (ppt)	3.86	4.8	6.5	8.0	10.4	13.8	16.4	23,097	1.0	20
Temp_C (°C)	23	23	28	29	30	30	31	23,097	23	31
Dye (µg/L)	0.03	0.03	0.04	0.05	0.06	0.1	0.1	15,905	0.02	1
BGA_R (RFU)	1.0	1.2	1.7	2.0	2.4	3.3	4.7	11,630	0.8	98

Abbreviations: PCTL – percentile, Min – minimum, Max - maximum

The following figures show the dye time-series along with other parameters. Further detail of the distribution of the dye and the retention time is found in the main report and Appendix E.

A.12 FRONT RIVER DEPOT

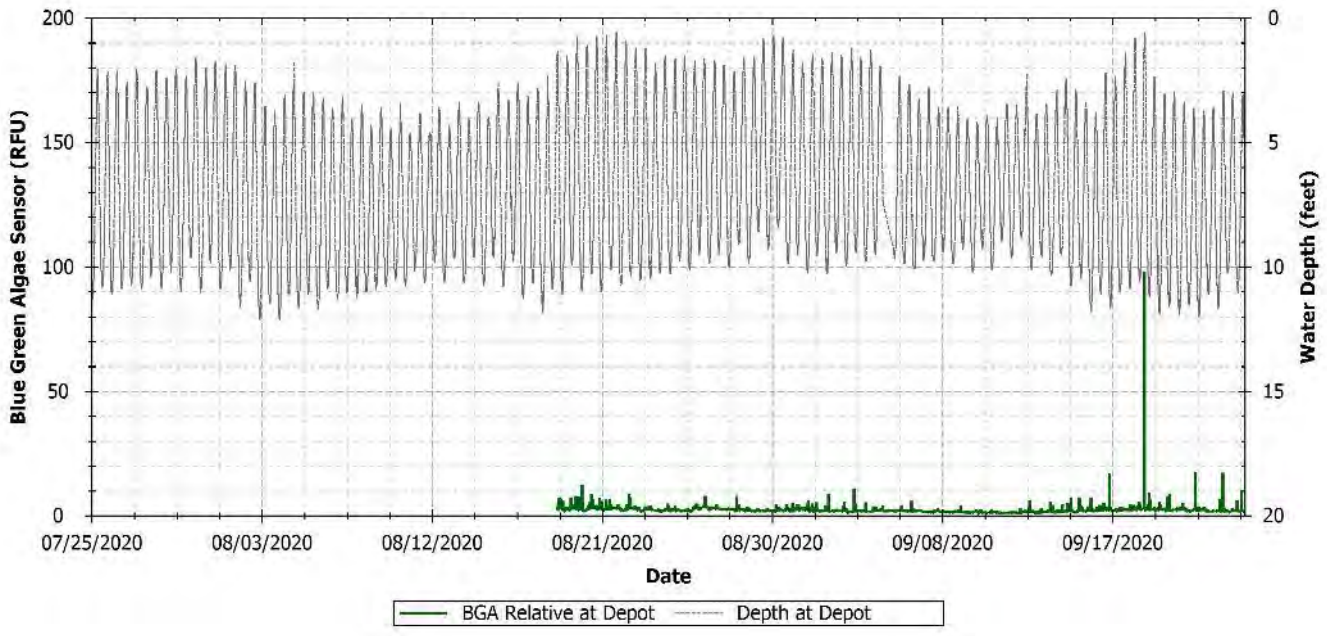


Figure A-39 Front River Depot observed BGA

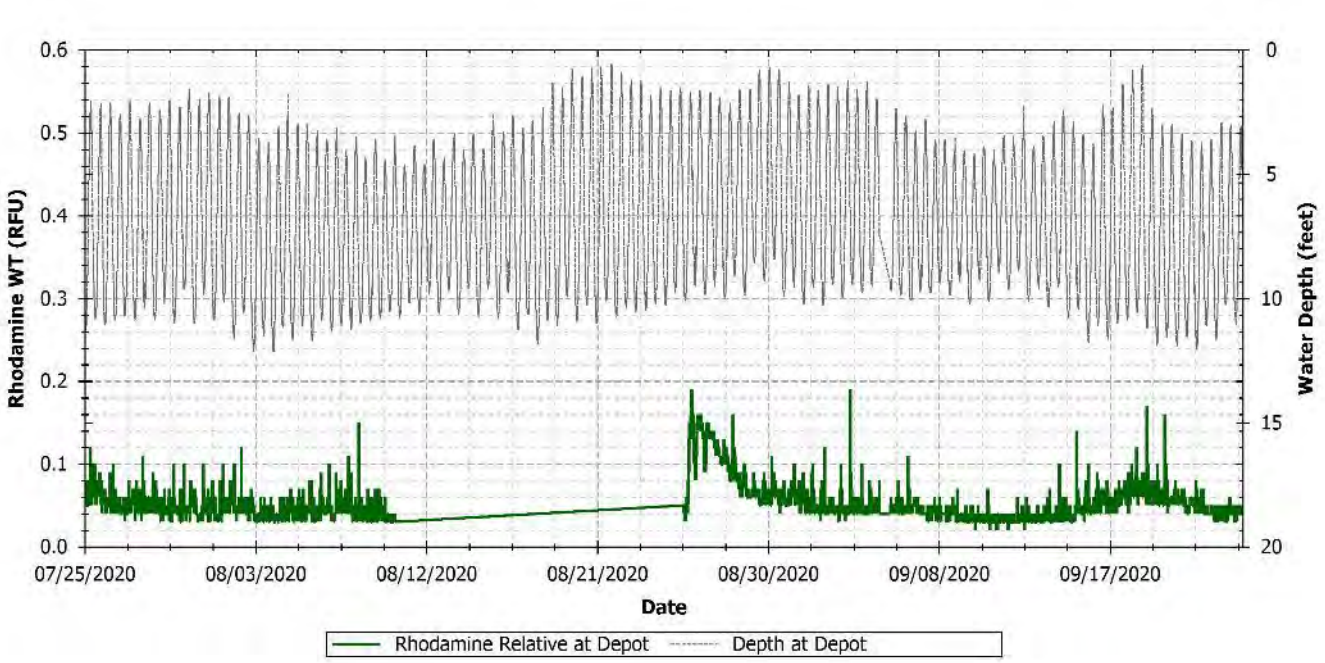


Figure A-40 Front River Depot observed Rhodamine

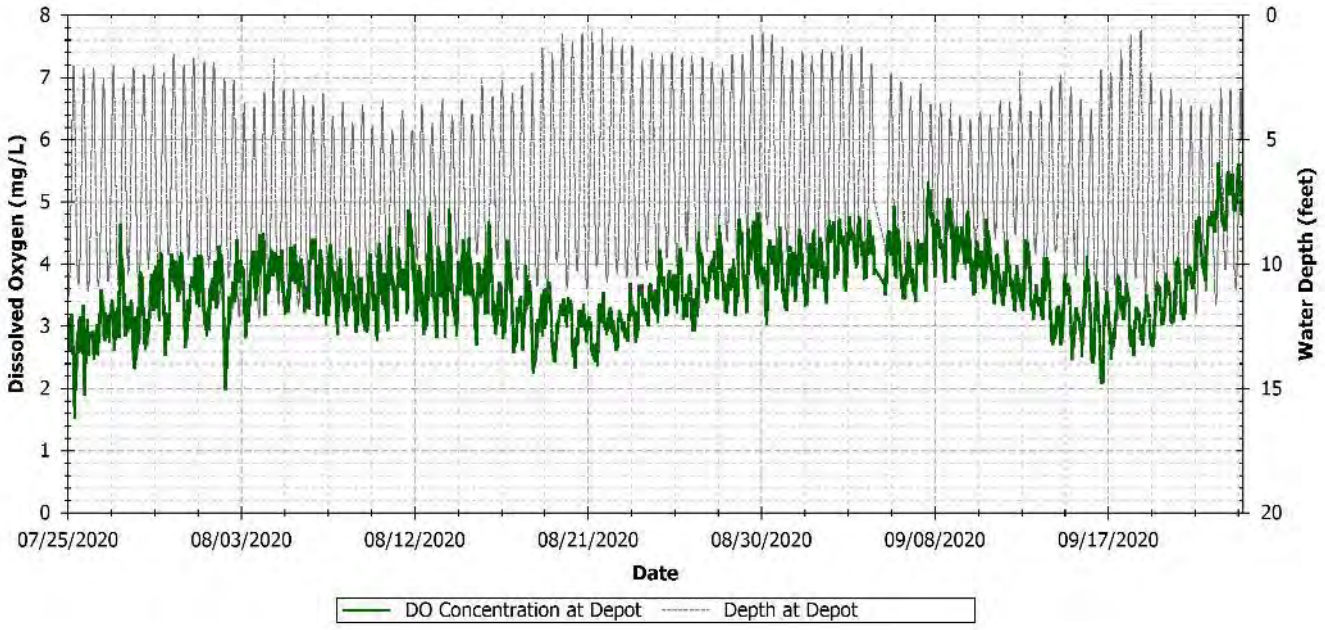


Figure A-41 Front River Depot observed DO concentration

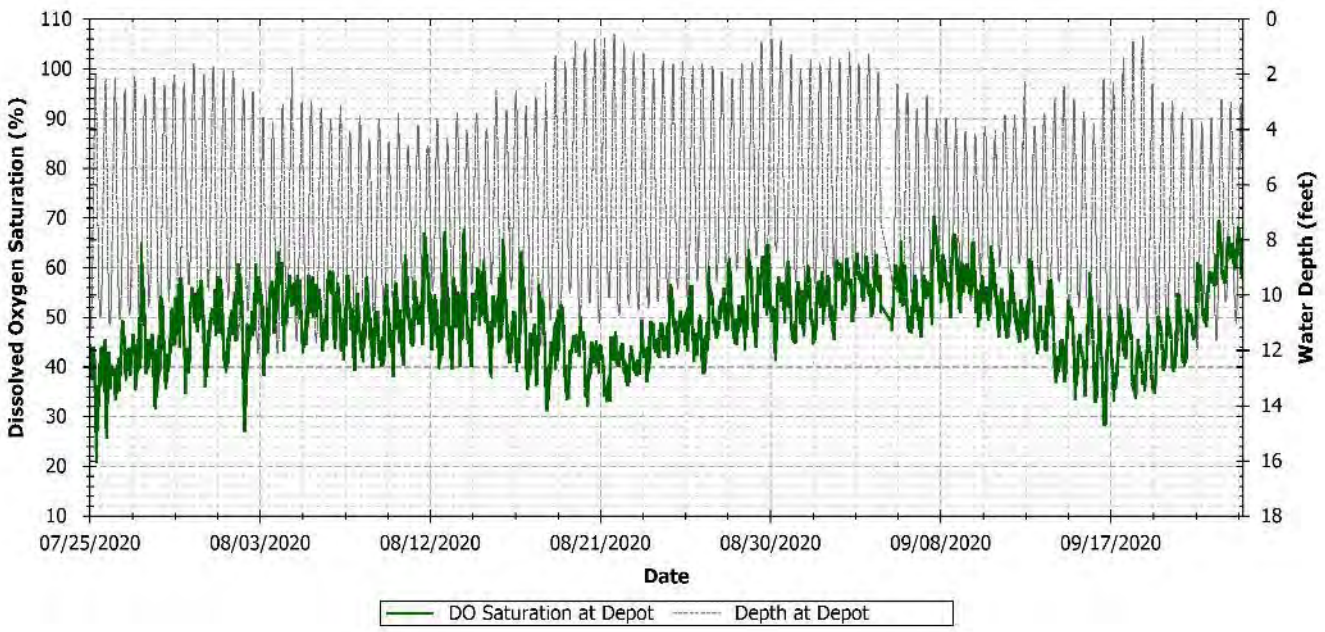


Figure A-42 Front River Depot observed DO saturation

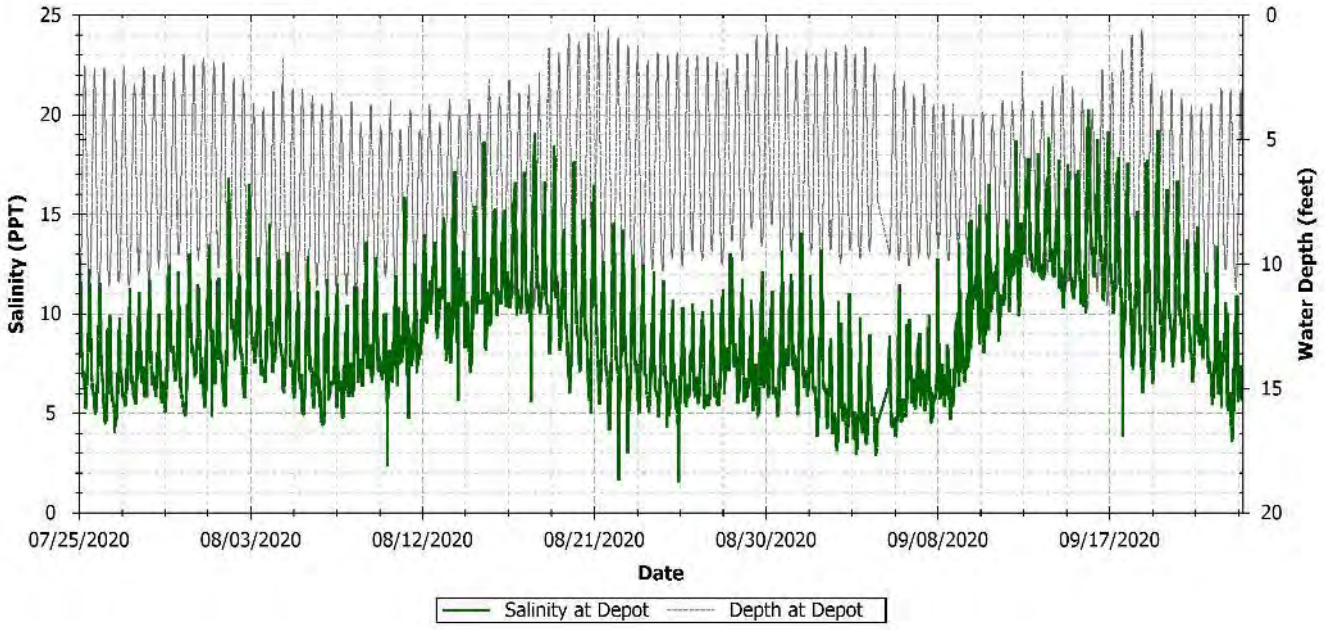


Figure A-43 Front River Depot observed salinity

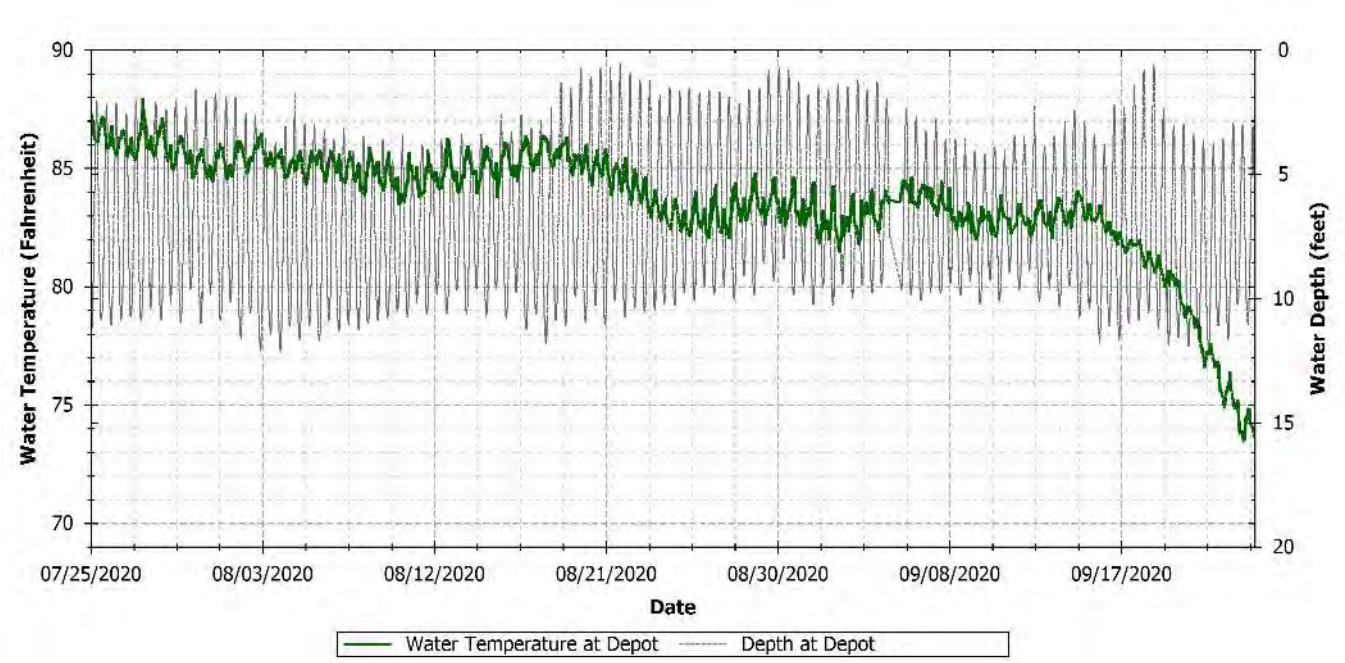


Figure A-44 Front River Depot observed water temperature

A.13 UPRIVER INFORMATION

During the SUR, thirteen sondes were located in the Upriver to monitor the impacts of the injected oxygen. The Upriver diffuser injects the super-saturated water into the lower portion of Upriver. The resulting oxygen plume initially mixes with the water around the diffuser and then moves downstream and gradually rises to the surface. The buoy sondes were located to measure the movement and mixing of the oxygen plume and to measure the DO saturation to check if the saturation exceeds 100 percent.

Thirteen Upriver sondes were deployed to measure parameters at 15 minute intervals. These parameters are:

- DO to evaluate the impact of the injected oxygen on the Upriver DO regime.
- DOsat to check if DO saturation exceeded 100 percent. If DO saturation exceeds 100 percent for any significant time, this would indicate that DO could be transferred to the atmosphere.
- Salinity, at higher salinities there is less capacity for the water to hold oxygen resulting in lower DO values and is used to determine the tidal STATUS.
- Temp_C, at higher temperatures, there is less capacity for the water to hold oxygen and may result in lower DO values and DO saturation to exceed 100 percent.
- BGA used to measure dye during dye release events. Also used to determine the background levels of BGA

The sondes were located up and downstream of the diffuser with the purpose of :

- Determining how quickly and where the oxygen plume reaches the surface
- Determining how fast the oxygen plume is mixed top to bottom
- Determining where the oxygen plume is mix side to side

Table A-5 and ***Figure A-45*** provide the attributes and location of the Upriver buoys

Table A-5 Attributes of Upriver semi-permanent buoys used for data collection

Station ID	Location	Relationship to Diffuser	Latitude	Longitude
UR_9	Upriver	Upstream of diffuser ~400 feet	32.350484	-81.161906
UR_10	Upriver	Downstream of diffuser ~50 feet	32.349359	-81.161236
UR_11	Upriver	Downstream of diffuser ~50 feet	32.349227	-81.161302
UR_12	Upriver	Downstream of diffuser ~200 feet	32.348973	-81.160899
UR_12a	Upriver	At UR_12 at mid-depth	32.348973	-81.160899
UR_13	Upriver	Downstream of diffuser ~300 feet	32.348847	-81.160467
UR_14	Upriver	Downstream of diffuser ~500 feet	32.348813	-81.159929
UR_15	Upriver	Downstream of diffuser ~600 feet	32.348939	-81.159633
UR_16	Upriver	Downstream of diffuser ~900 feet	32.348842	-81.158747
UR_16a	Upriver	At UR_16 at mid-depth	32.348842	-81.158747
UR_17	Upriver	Downstream of diffuser ~0.25 miles	32.349198	-81.157143
UR_18	Upriver	Downstream of diffuser ~0.4 miles	32.348559	-81.155690
UR_Hardeeville	Upriver	Downstream of diffuser ~2.5 miles	32.341633	-81.132021

Note: All sondes, except for 12a and 16a were deployed at a depth of approximately 3.3 feet (1 meter)

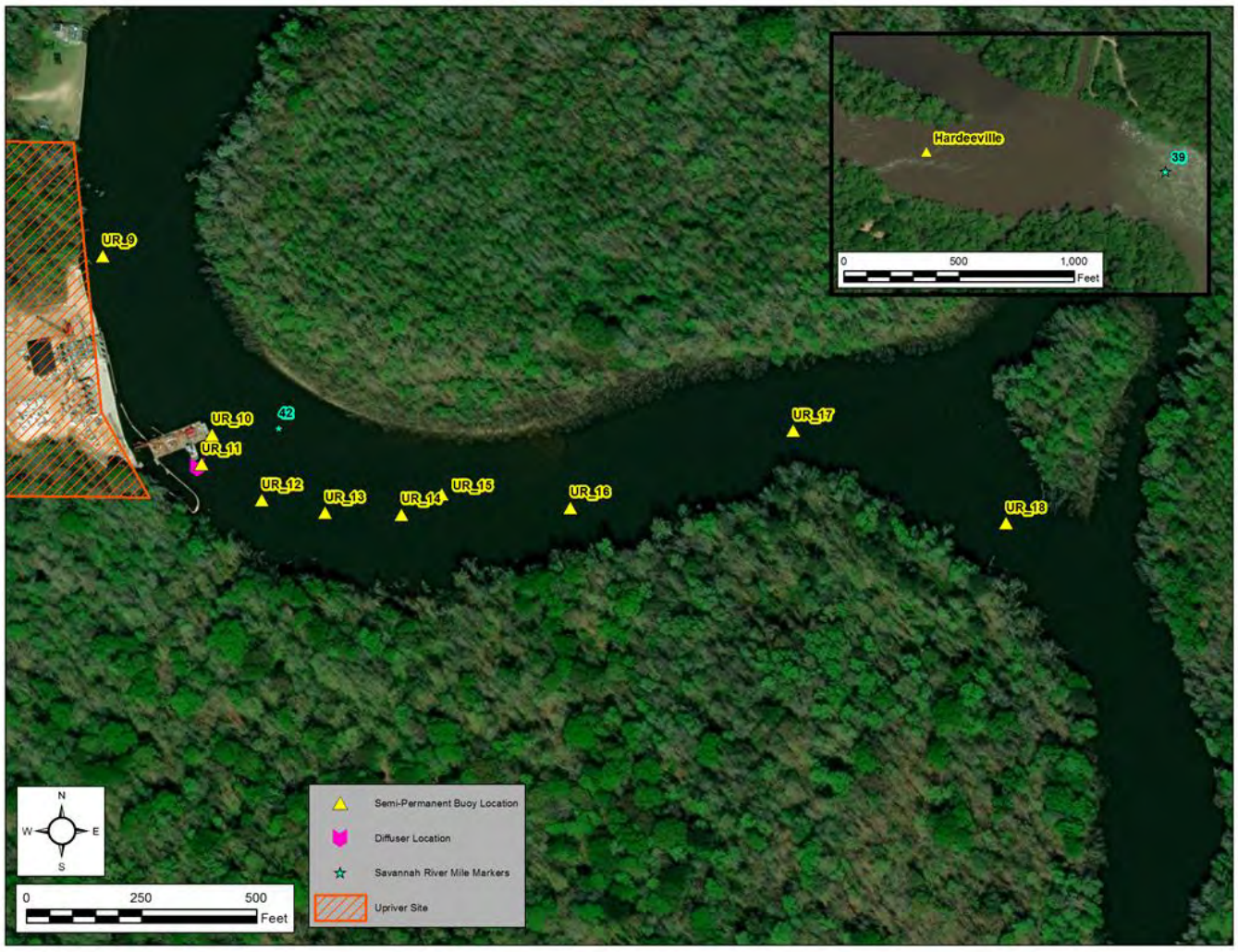


Figure A-45 Location of Upriver semi-permanent buoys

A.14 UPRIVER DATA SUMMARY

The Upriver oxygen injection increased the river DO from 0.6 mg/L to 1 mg/L. The amount of DO increase is dependent on the Upriver flows, which ranged from 6,500 to 12,500 cubic feet per second (cfs) for the SUR. In comparison, the average DO at upstream UR_9 to downstream UR_18, an average increase of 0.8 mg/L was observed.

As the injected oxygen plume moved downstream, the plume:

- Reached the surface at 200 feet downstream (UR_12);
- Mixed top to bottom at 900 feet downstream (UR_16); and
- Mixed side to side at 2,000 feet downstream (UR_18).

The Front River DO saturation was observed to exceed 100 percent saturation for short periods of time. This occurred during periods of lower river flow (less than 7,500 cfs) and higher water temperatures. This low flow and high temperature event coupled with the oxygen injected by the diffuser increased the DO saturation slightly above 100 percent and lowered the overall WCTE about 1 percent.

Table A-6 provides a summary of the data collected at all Upriver sondes and the following sections provide time-series graphs for all thirteen sondes. Data tables are provided for background sonde UR_9 and downstream, after mixing, sonde UR_18.

Table A-6 Data summary for the Upriver sondes

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	6.1	6.5	6.9	7.3	7.7	8.0	8.1	280,194	5.6	8.6
DO saturation (%)	76	79	86	92	97	102	105	280,194	65	110
Salinity (ppt)	0.02	0.0	0.0	0.0	0.0	0.0	0.0	280,194	0.0	0
Temp_C (°C)	22	22	27	28	28	29	30	280,194	21	30
BGA_R (RFU)	0.1	1.3	1.7	2.0	2.3	2.7	3.3	39,105	0.0	158
Sp_Cond	55	61	71	77	85	92	95	280,194	21	99

Abbreviations: PCTL – percentile, Min – minimum, Max - maximum

A.15 UPRIVER 9 (UR_9)

The UR_9 sonde is located upstream of the diffuser and measures background conditions as shown in ***Table A-7***. Normal Upriver summertime DO concentrations range from 6.0 to 7.4 mg/L, averages approximately 7.0 mg/L and DO saturation averages approximately 90 percent saturation during low flow periods. As the flow increased in early September, the Upriver DO concentration decreased to between 6.0 and 6.5 mg/L. This decrease is primarily due to the influx of water with low DO concentrations from adjacent marshes.

Table A-7 UR_9 Background Surface Data Summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	6.1	6.1	6.6	6.9	7.0	7.2	7.3	23,817	6.0	7.4
DO saturation (%)	75	77	81	86	89	93	95	23,817	74	96
Salinity (ppt)	0.02	0.0	0.0	0.0	0.0	0.0	0.0	23,817	0.0	0
Temp_C (°C)	22	22	26	28	28	29	30	23,817	21	30
BGA_R (RFU)	1.4	1.5	1.7	1.9	2.1	2.4	2.6	11,791	1.3	4

Abbreviations: PCTL – percentile, Min – minimum, Max - maximum

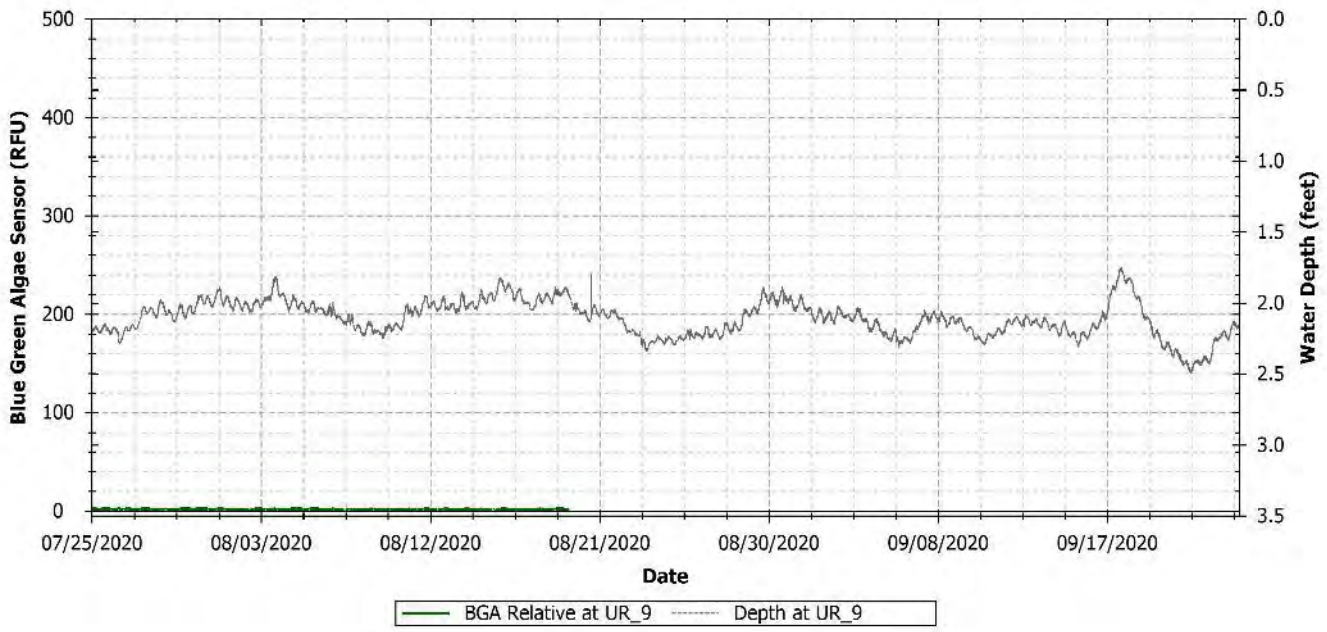


Figure A-46 UR_9 observed BGA

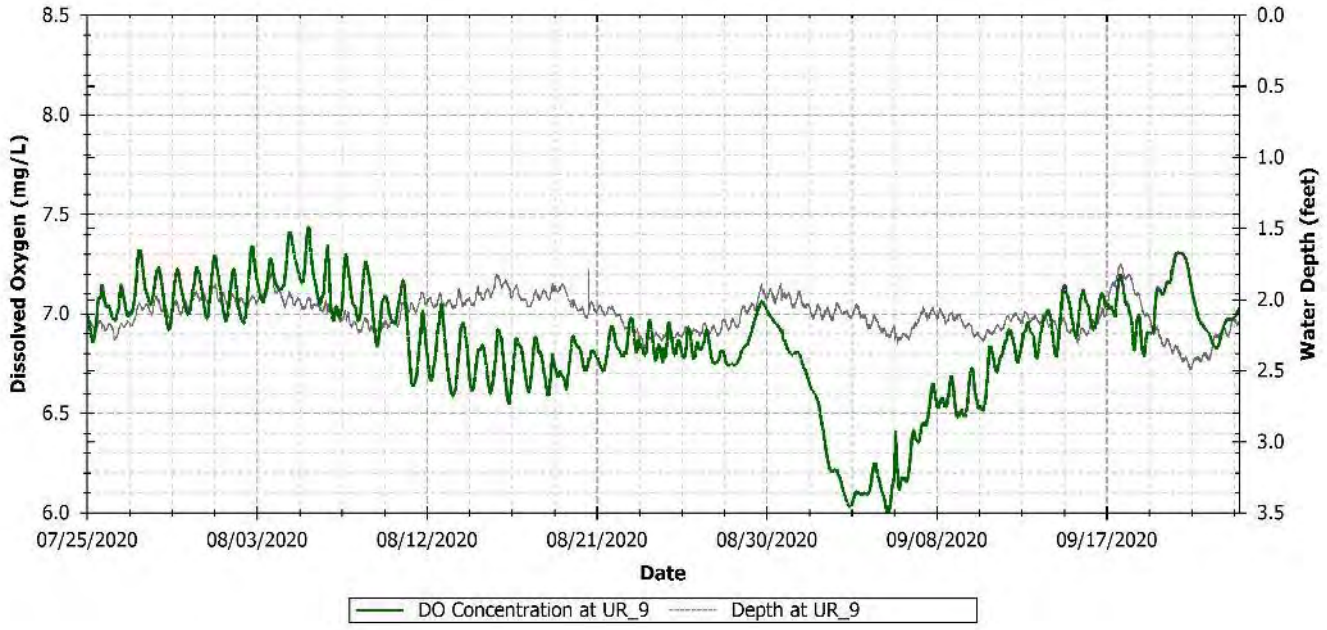


Figure A-47 UR_9 observed DO concentration

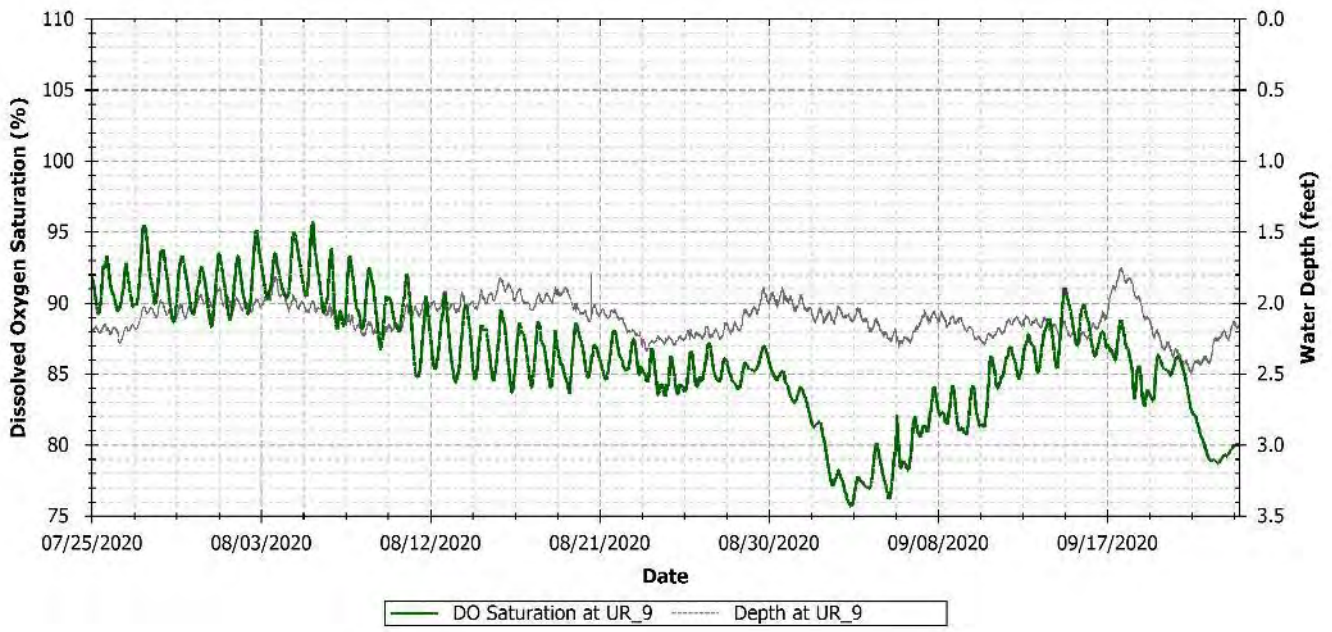


Figure A-48 UR_9 observed DO saturation

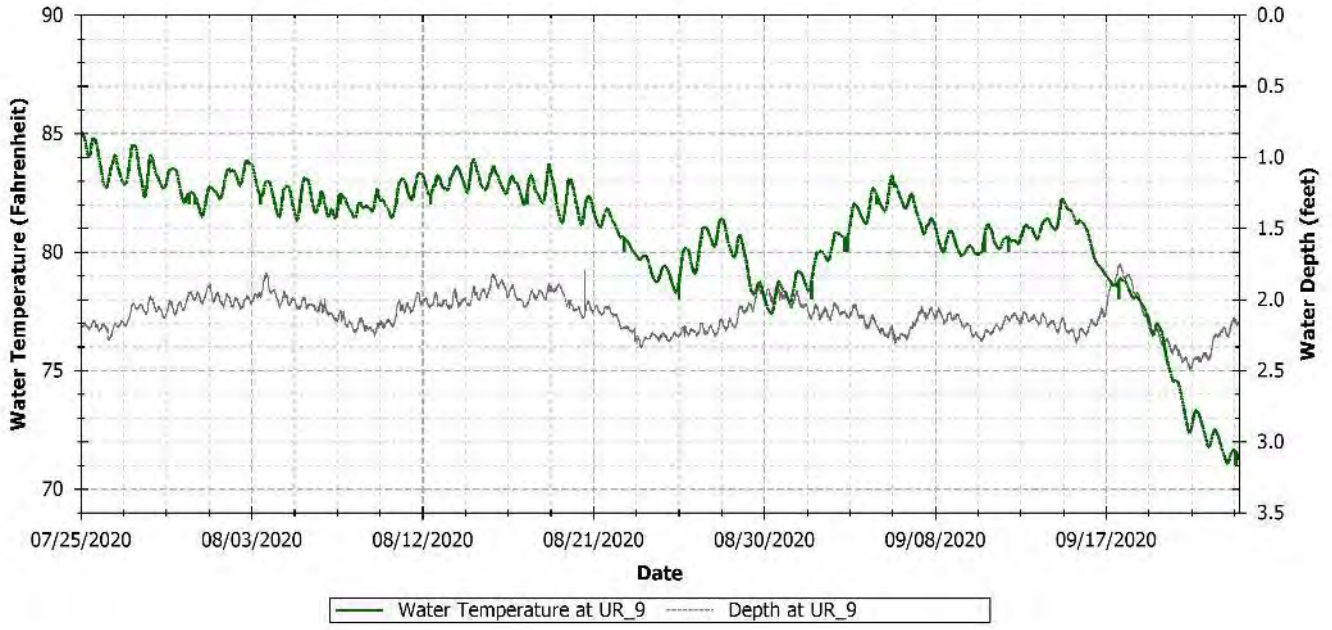


Figure A-49 UR_9 observed water temperature

A.16 UPRIVER 10 (UR_10)

The UR_10 sonde was located 50 feet downstream of the diffuser and did not see any of the impacts of the oxygen injection. UR_10 observed similar DO values as the background UR_9 measurements.

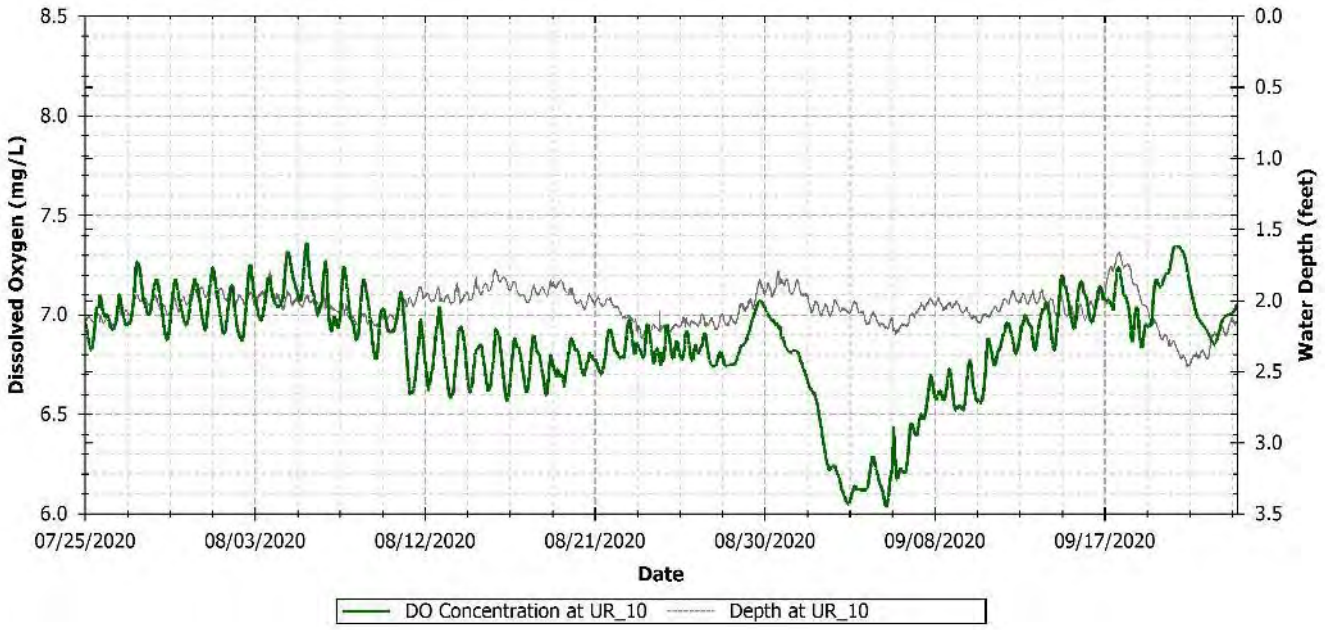


Figure A-50 UR_10 observed DO concentration

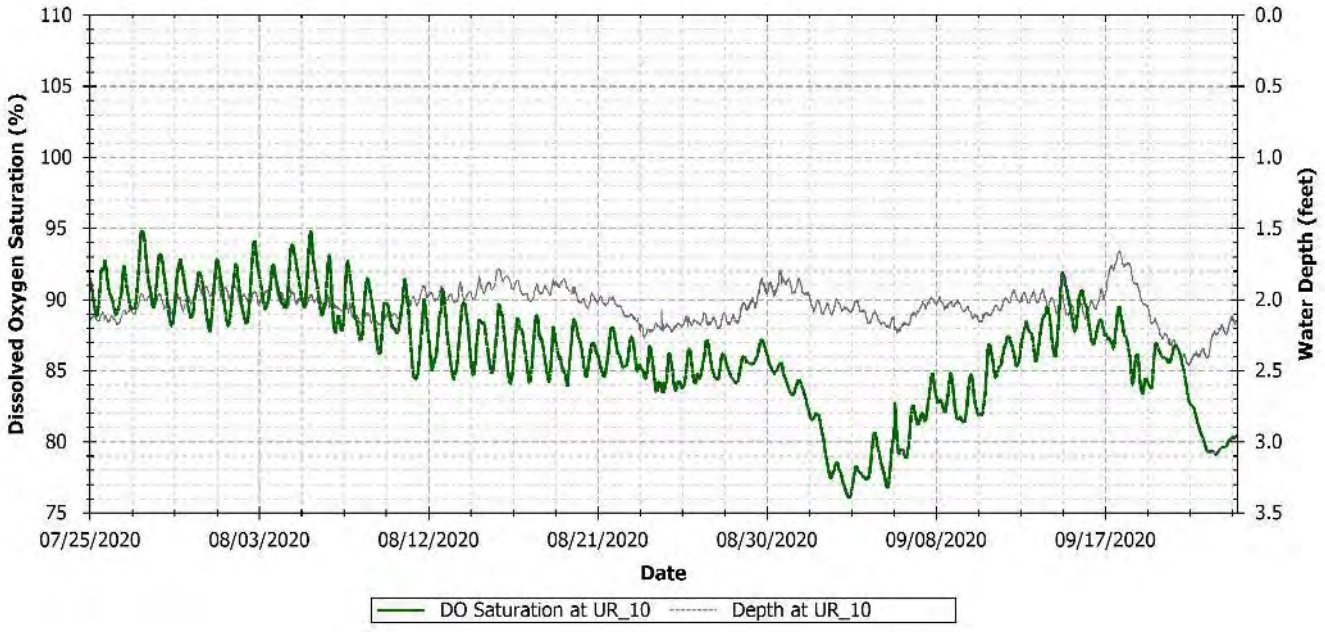


Figure A-51 UR_10 observed DO saturation

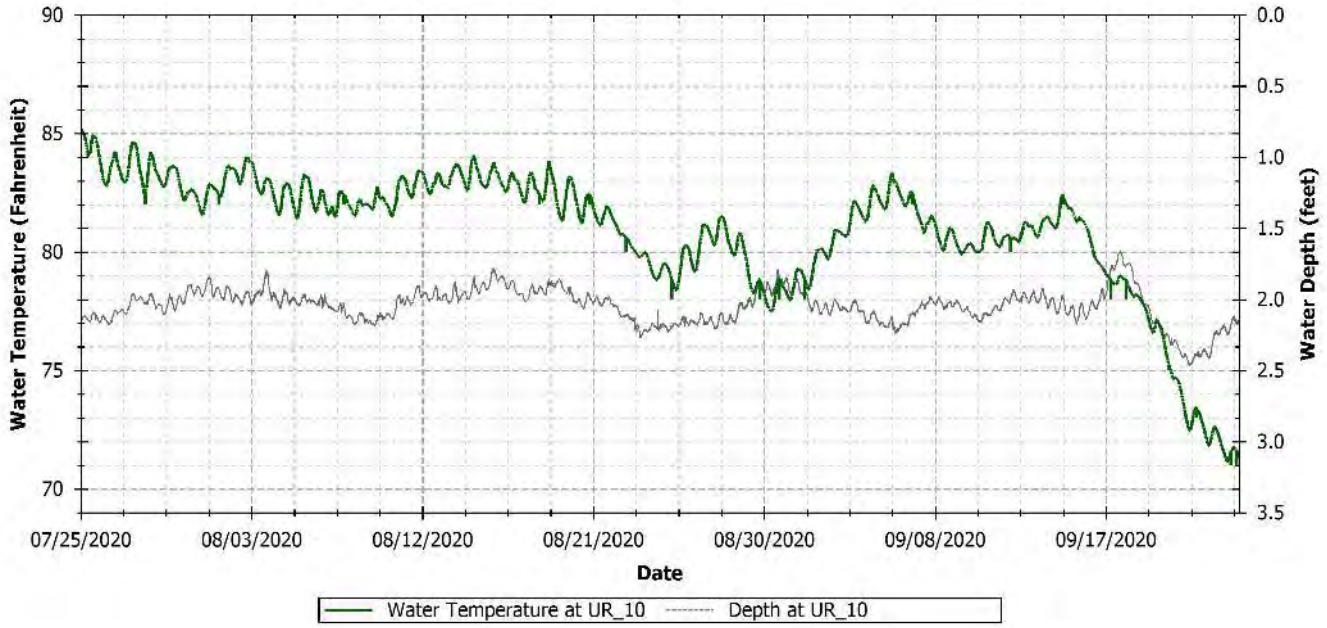


Figure A-52 UR_10 observed water temperature

A.17 UPRIVER 11 (UR_11)

The UR_11 sonde was located 50 feet downstream of the diffuser and did not see any of the impacts of the oxygen injection. Similar DO values were observed as the background UR_9 measurements.

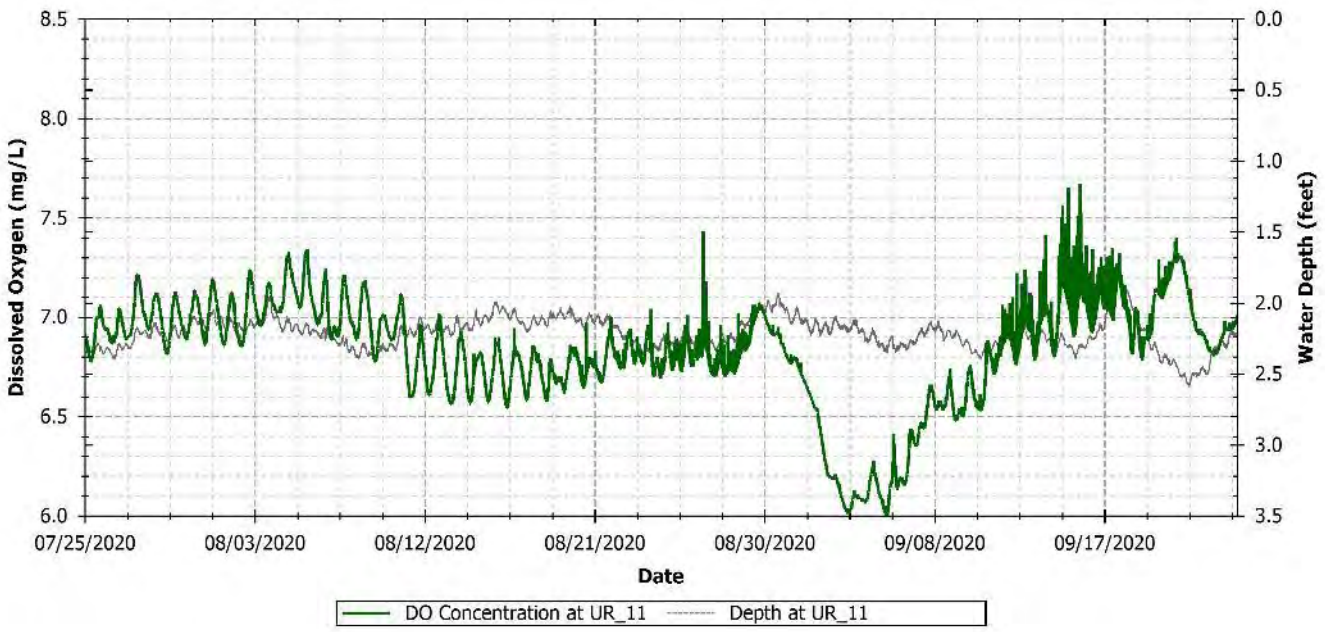


Figure A-53 UR_11 observed DO concentration

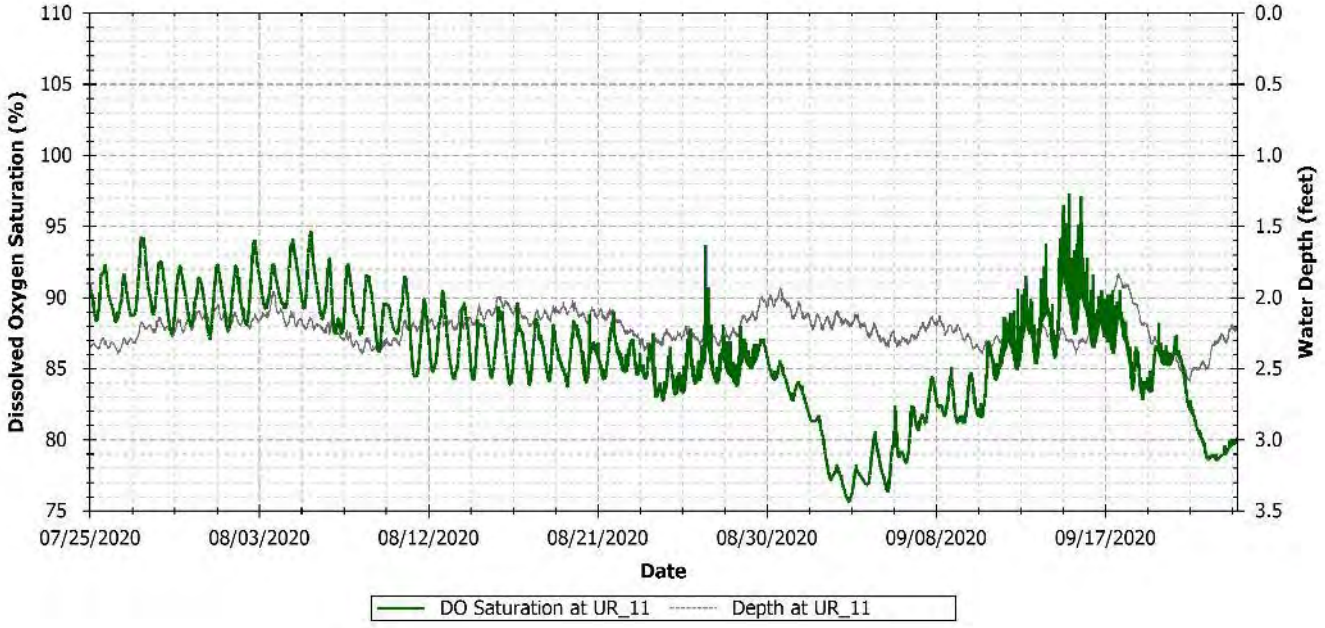


Figure A-54 UR_11 observed DO saturation

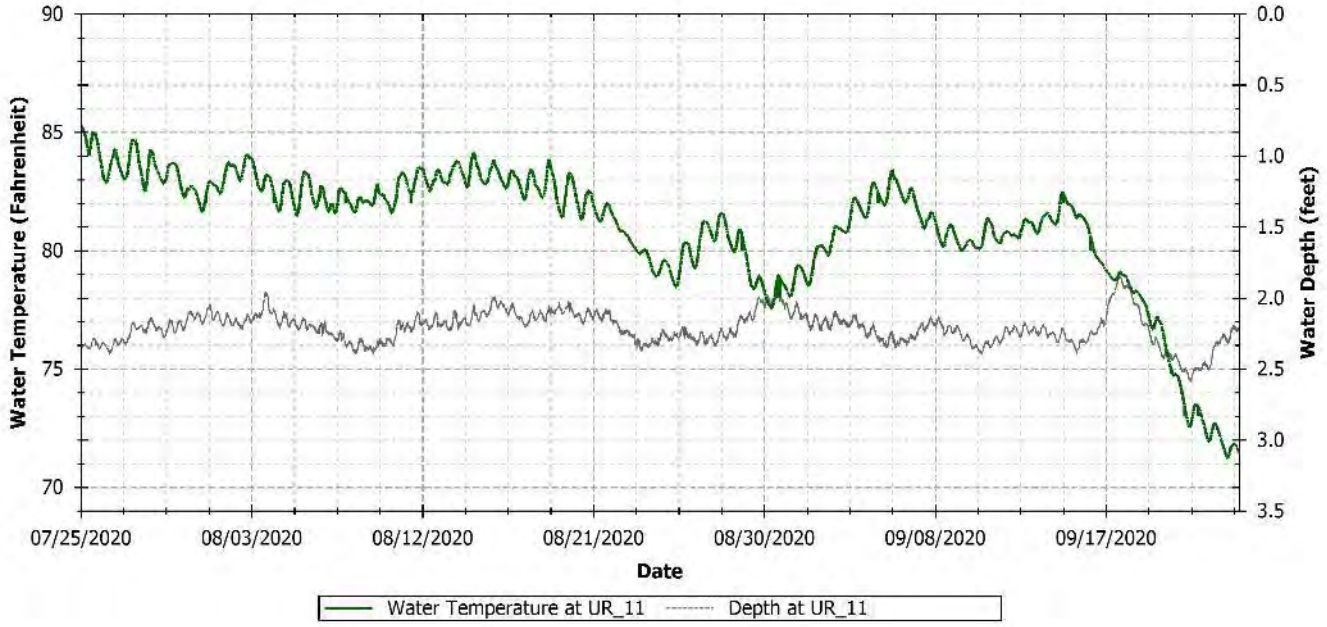


Figure A-55 UR_11 observed water temperature

A.18 UPRIVER 12 (UR_12) AND UPRIVER 12A (UR_12A)

The UR_12 and UR_12A sondes were located 200 feet downstream, with UR_12A located 3 meters deep below the surface. Increased DO concentrations at UR_12A indicate it was located in the oxygen plume, while the surface UR_12 sonde DO concentration were lower, indicating the oxygen plume had not yet reached the surface.

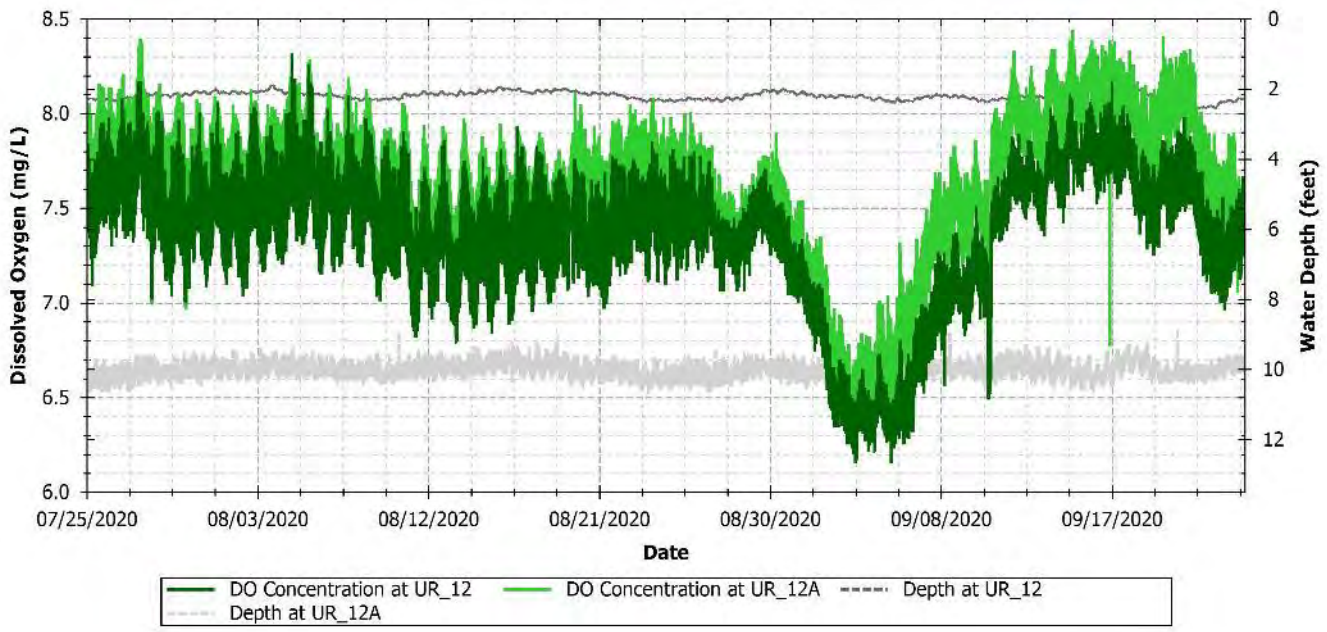


Figure A-56 UR_12 and UR_12a observed DO concentration

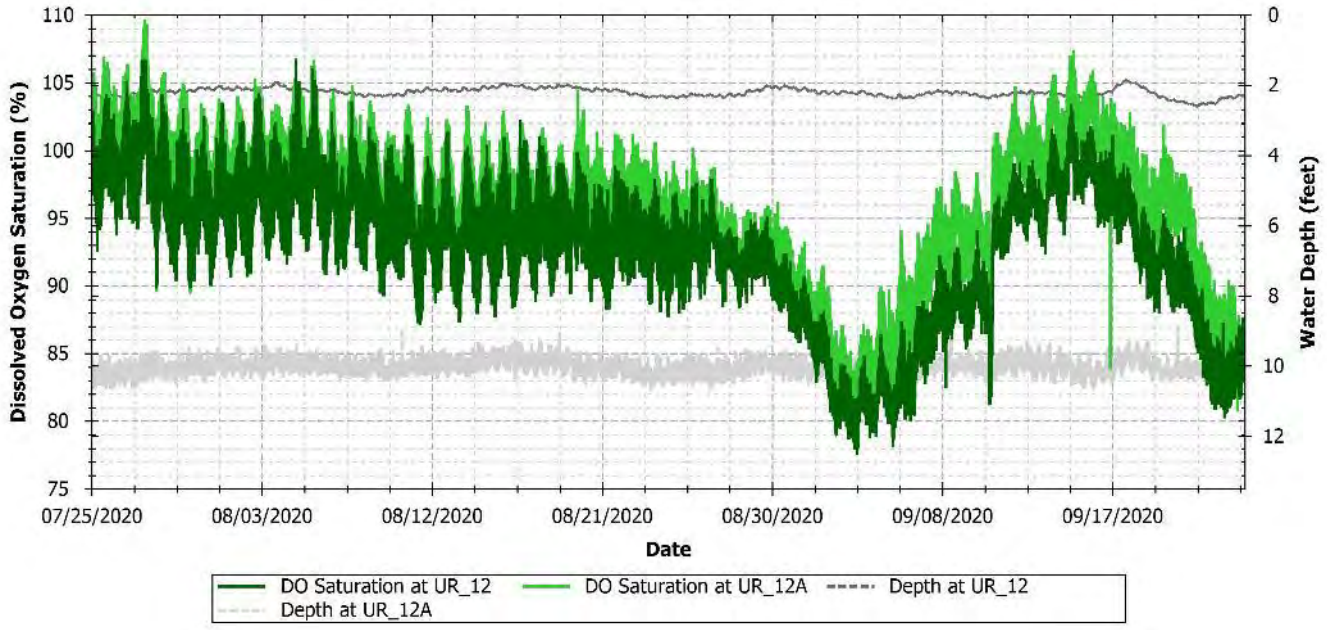


Figure A-57 UR_12 and UR_12a observed DO saturation

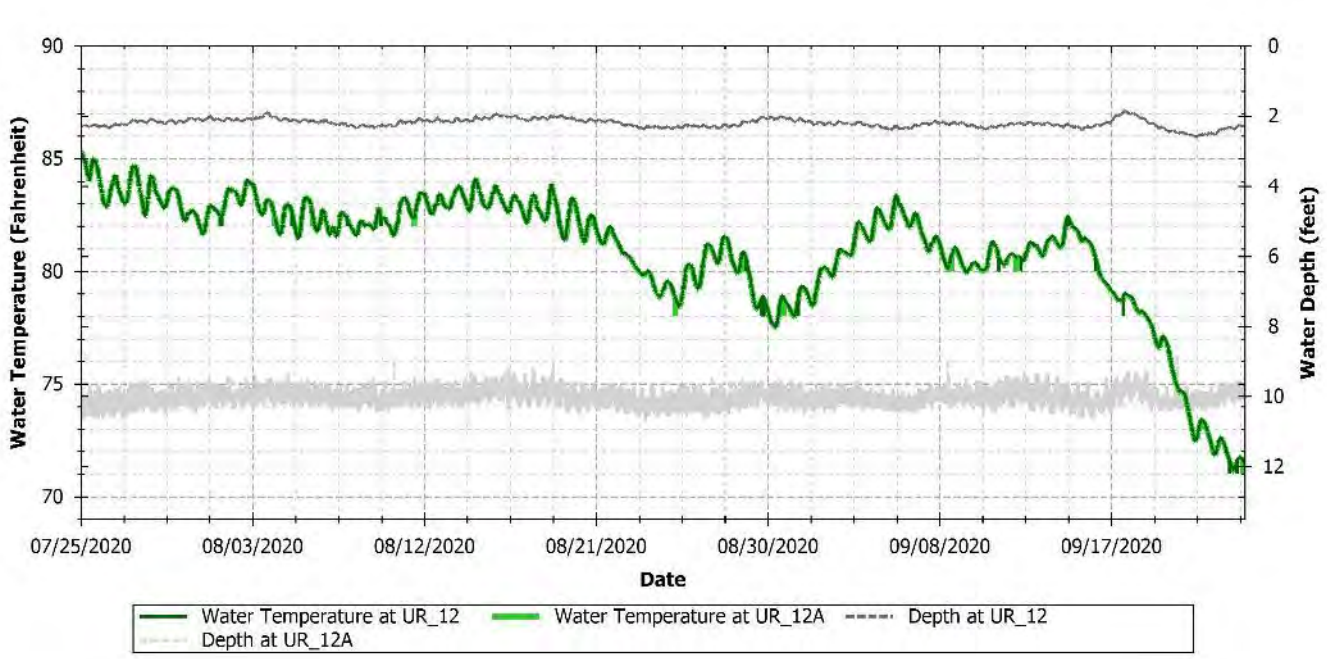


Figure A-58 UR_12 and UR_12a observed water temperature

A.19 UPRIVER 13 (UR_13)

The UR_13 sonde, located 300 feet downstream, observed high DO values indicating the oxygen plume was not well mixed in the river.

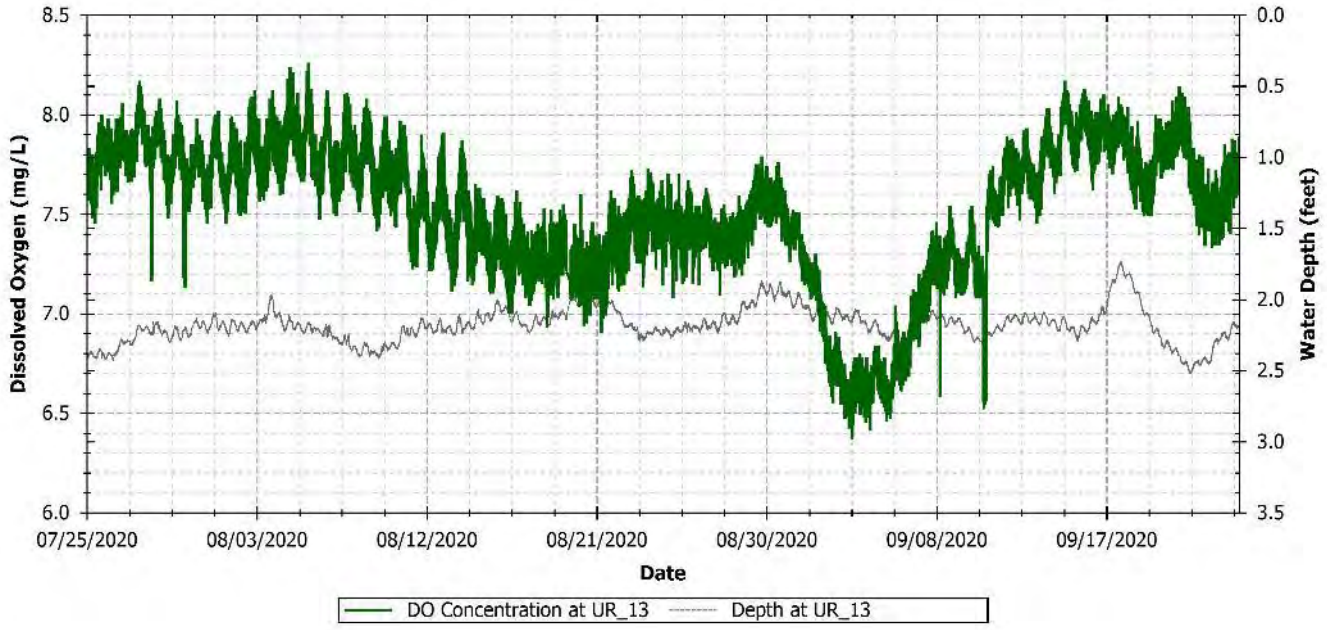


Figure A-59 UR_13 observed DO concentration

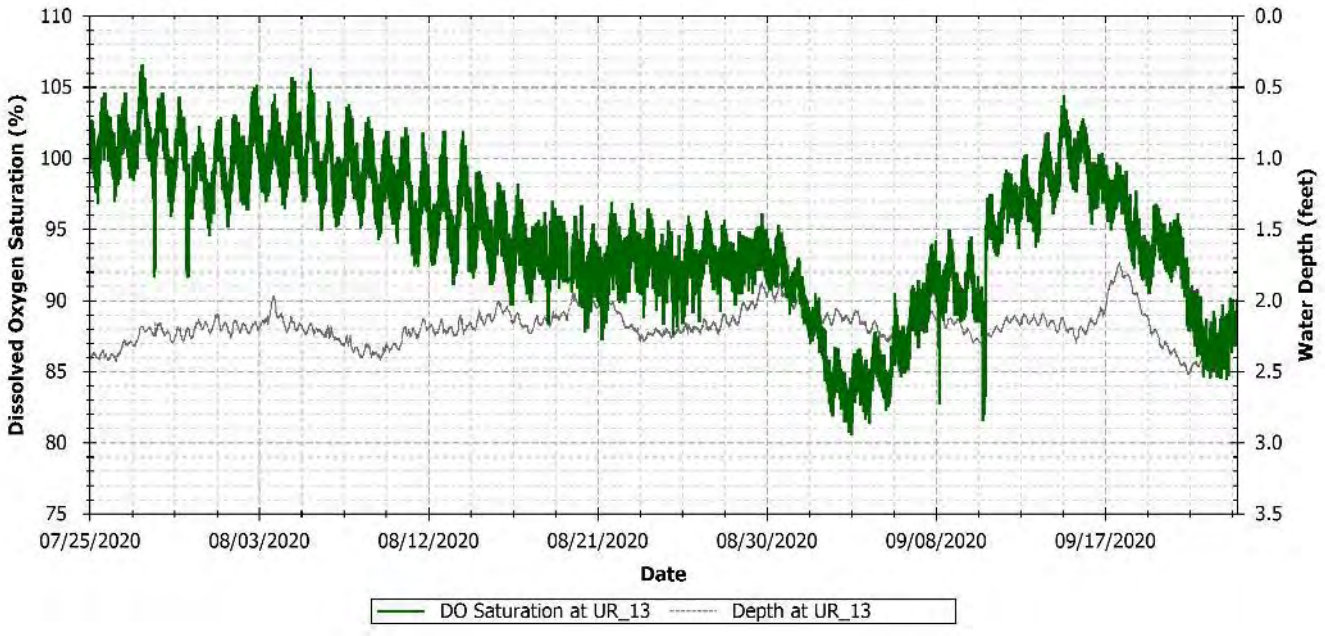


Figure A-60 UR_13 observed DO saturation

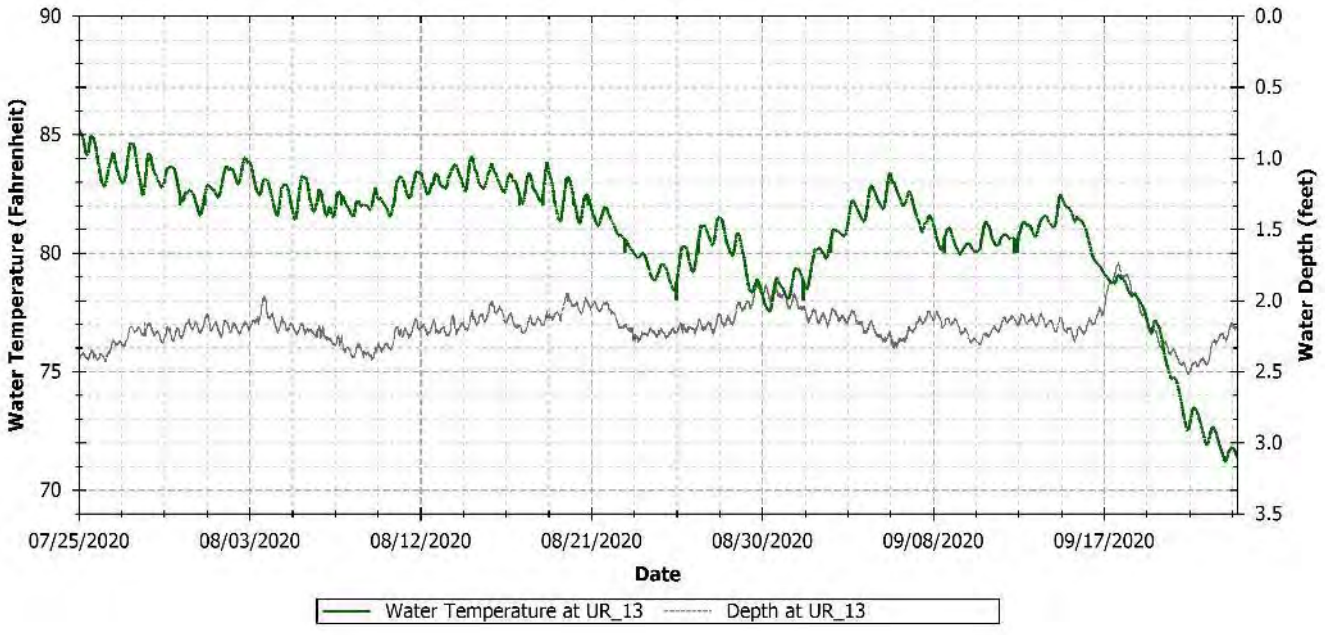


Figure A-61 UR_13 observed water temperature

A.20 UPRIVER 14 (UR_14)

The UR_14 sonde, located 500 feet downstream, observed high DO values indicating the oxygen plume was not well mixed in the river.

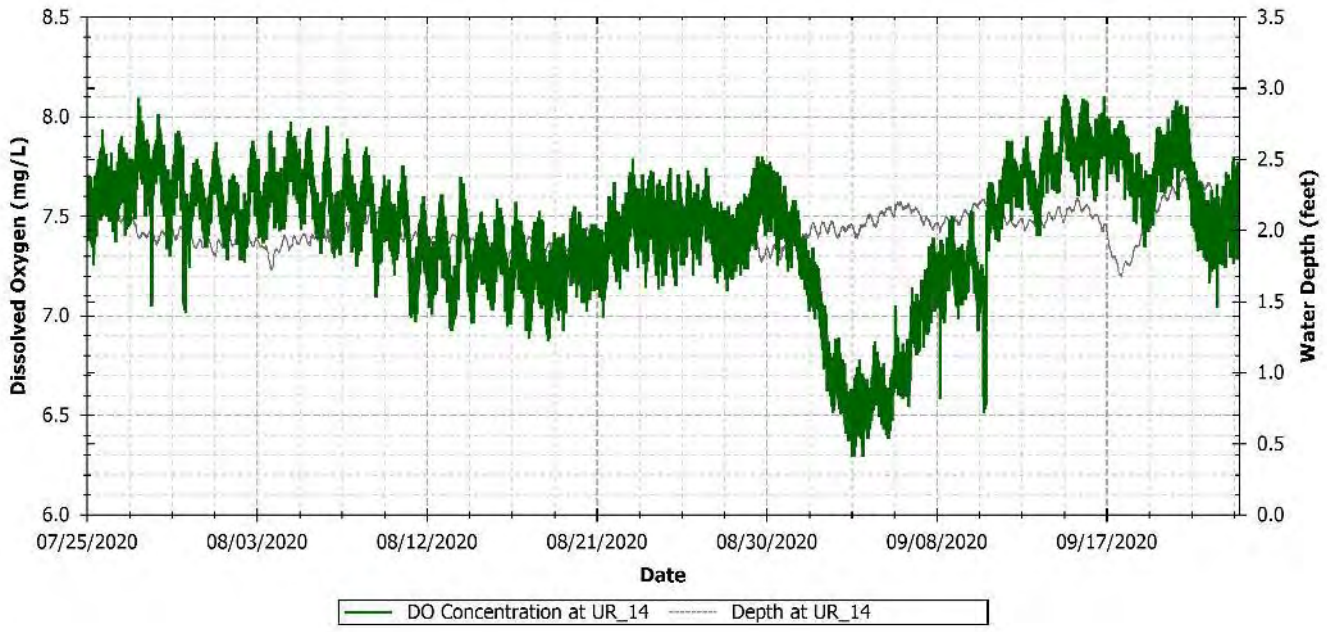


Figure A-62 UP_14 observed DO concentration

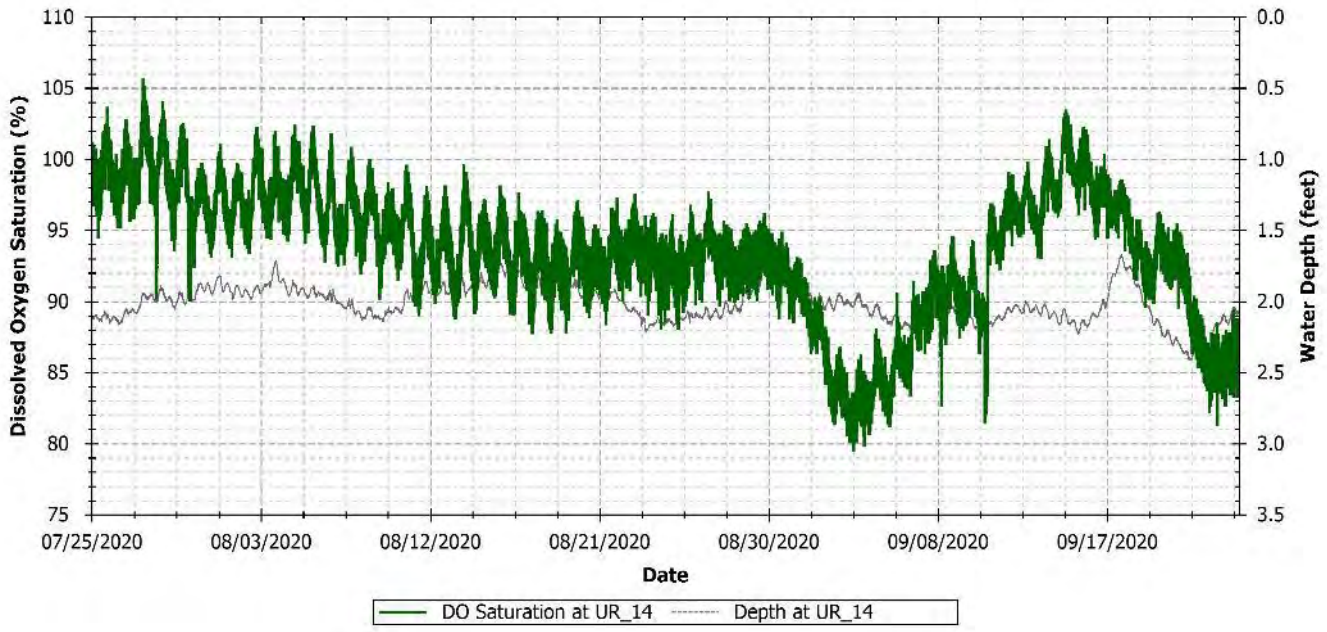


Figure A-63 UP_14 observed DO saturation

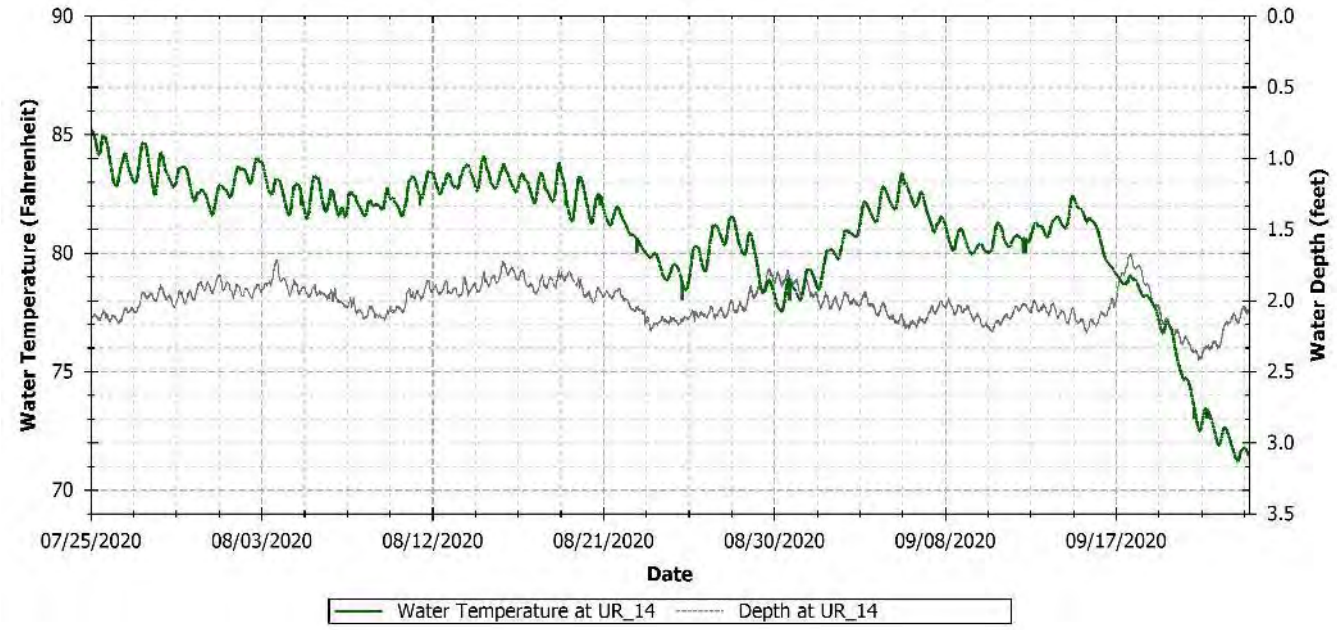


Figure A-64 UP_14 observed water temperature

A.21 UPRIVER 15 (UR_15)

The UR_15 sonde was located 600 feet downstream outside the channel near the South Carolina bank. The sonde observed DO values similar to background DO values, indicating the oxygen plume was not mixed side to side.

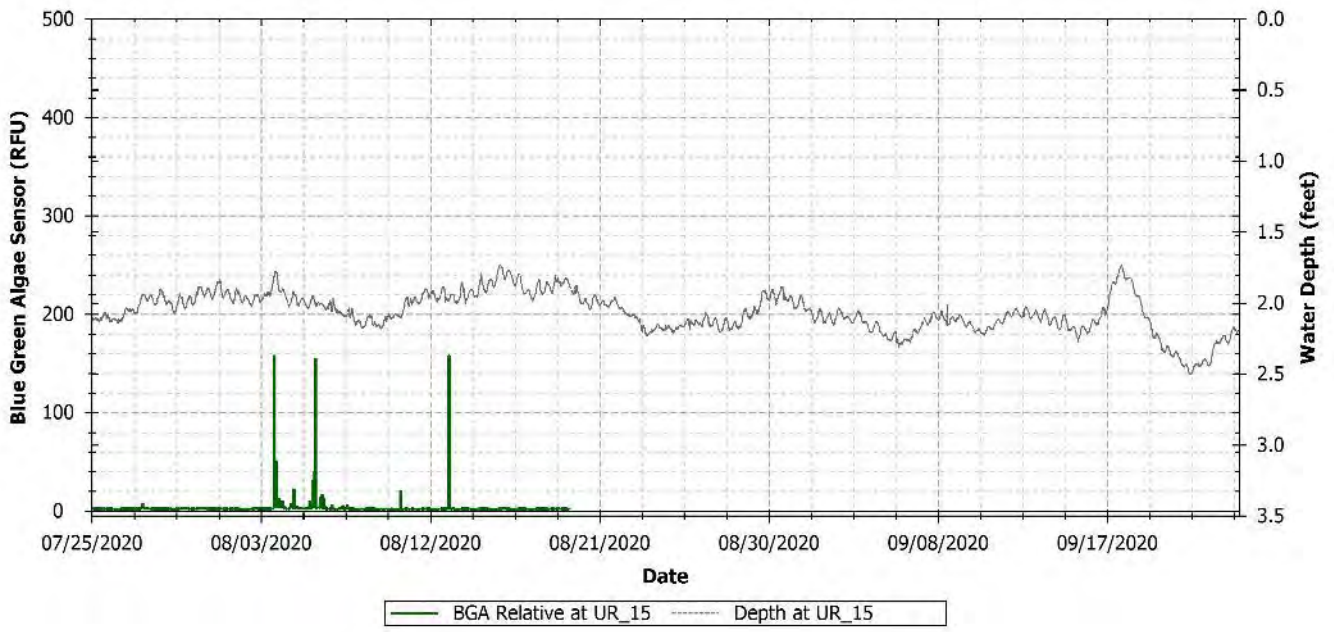


Figure A-65 UR_15 observed BGA

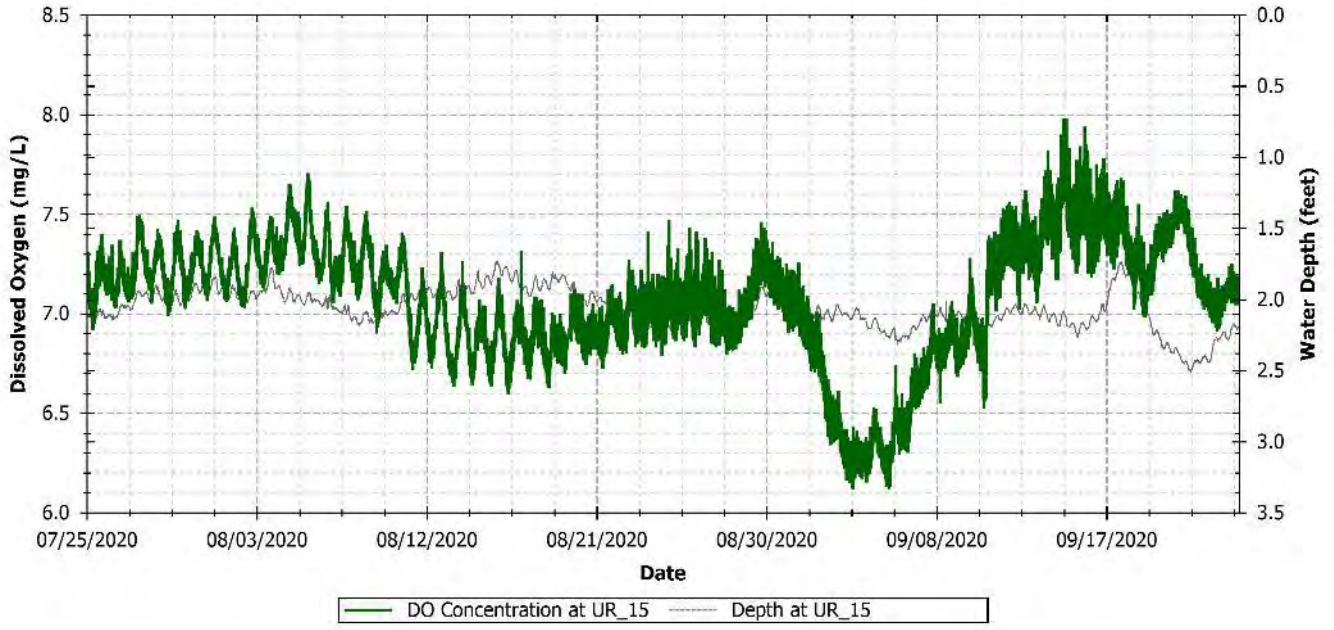


Figure A-66 UR_15 observed DO concentration

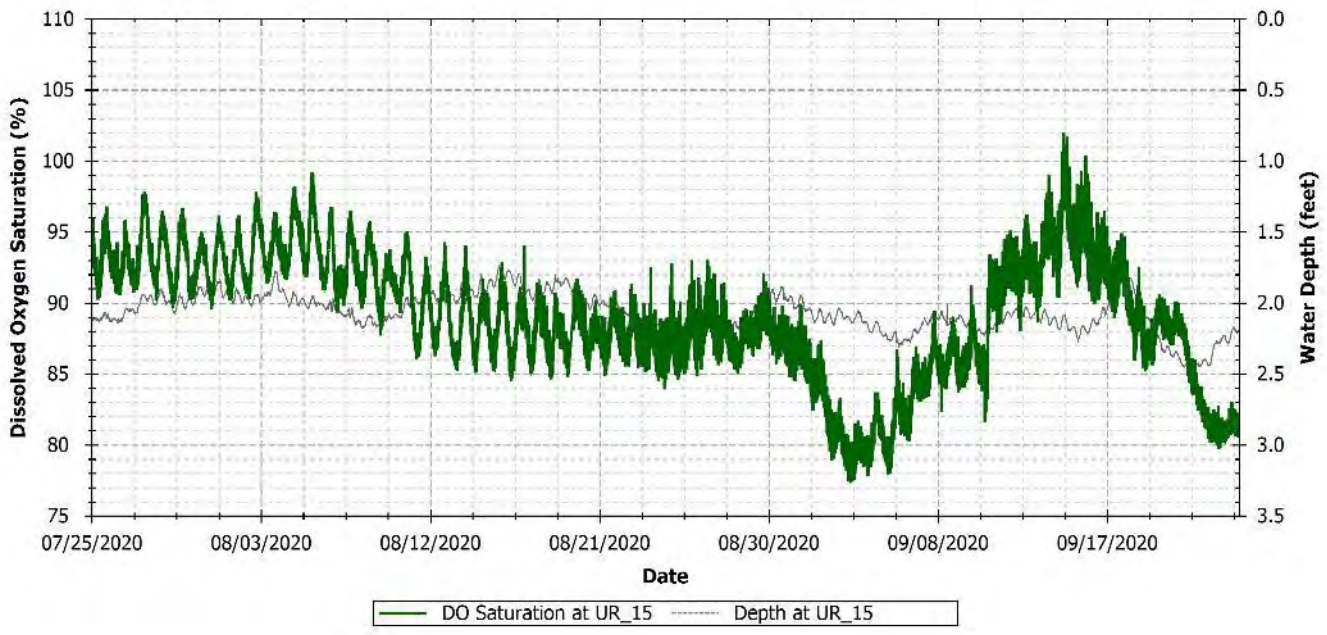


Figure A-67 UR_15 observed DO saturation

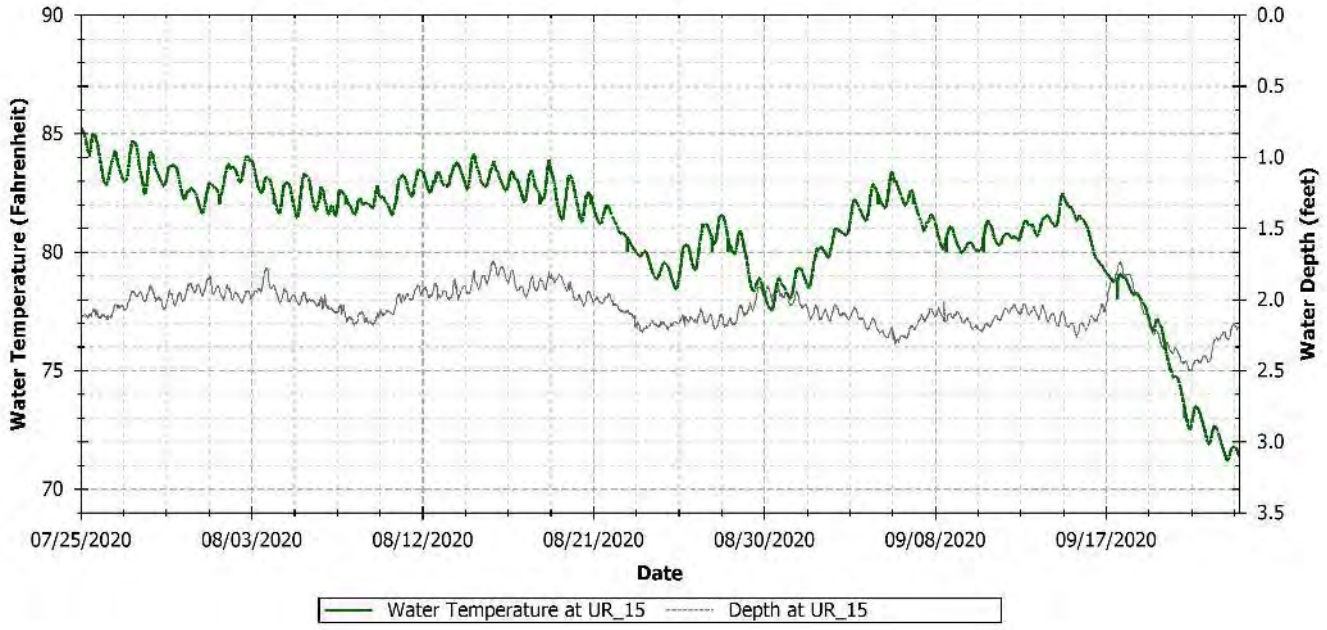


Figure A-68 UR_15 observed water temperature

A.22 UPRIVER 16 (UR_16) AND UPRIVER 16A (UR_16A)

The UR_16 and UR_16A sondes were located 900 feet downstream, with UR_16A located 3 meters deep. UR_16A DO values were approximately the same as UR_16 - 1 meter deep, indicating the oxygen plume was mostly mixed top to bottom.

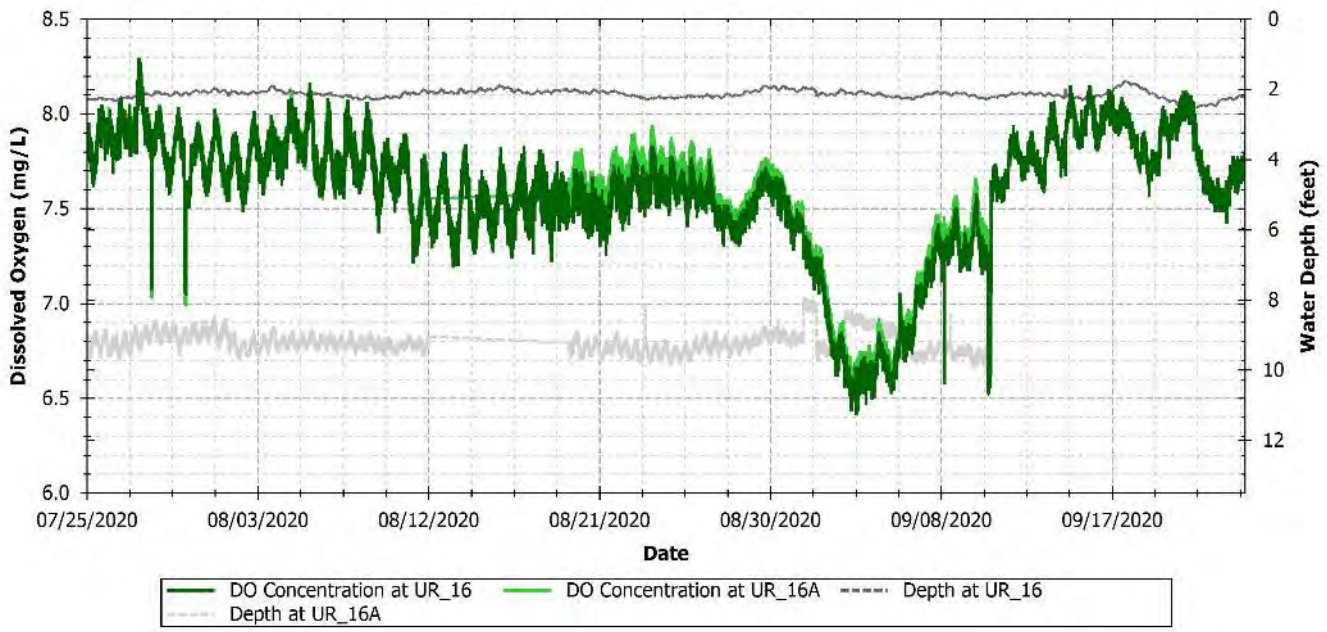


Figure A-69 UR_16 and UR_16a observed DO concentration

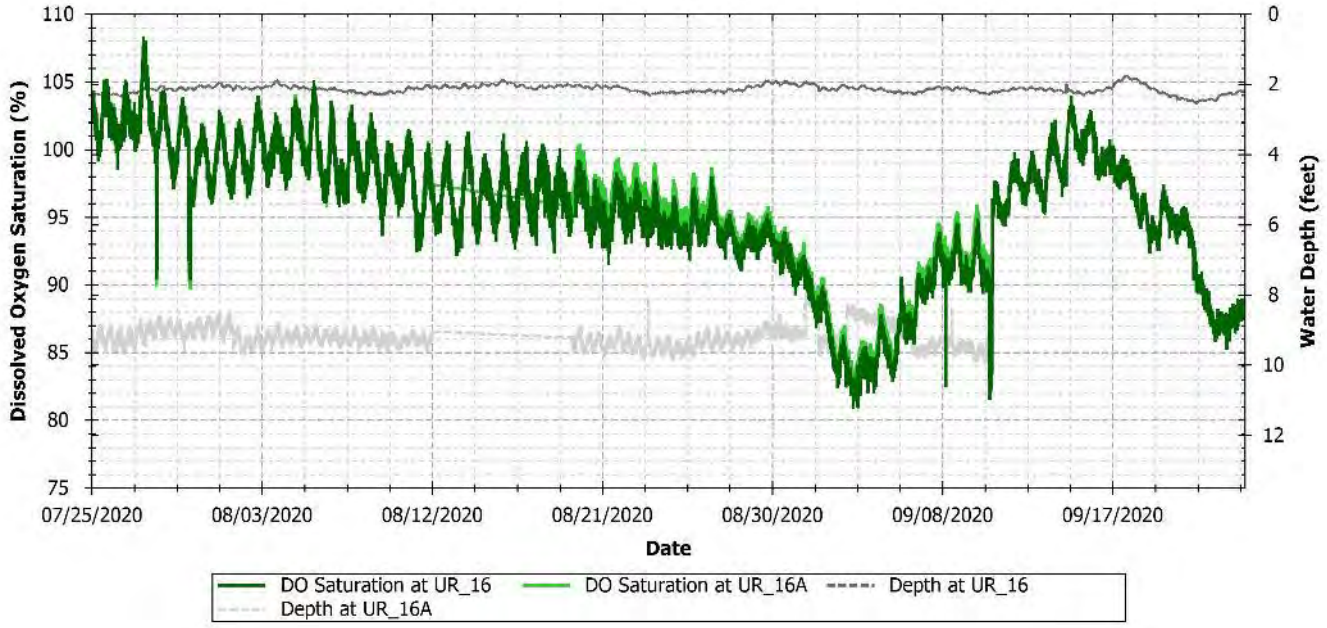


Figure A-70 UR_16 and UR_16a observed DO saturation

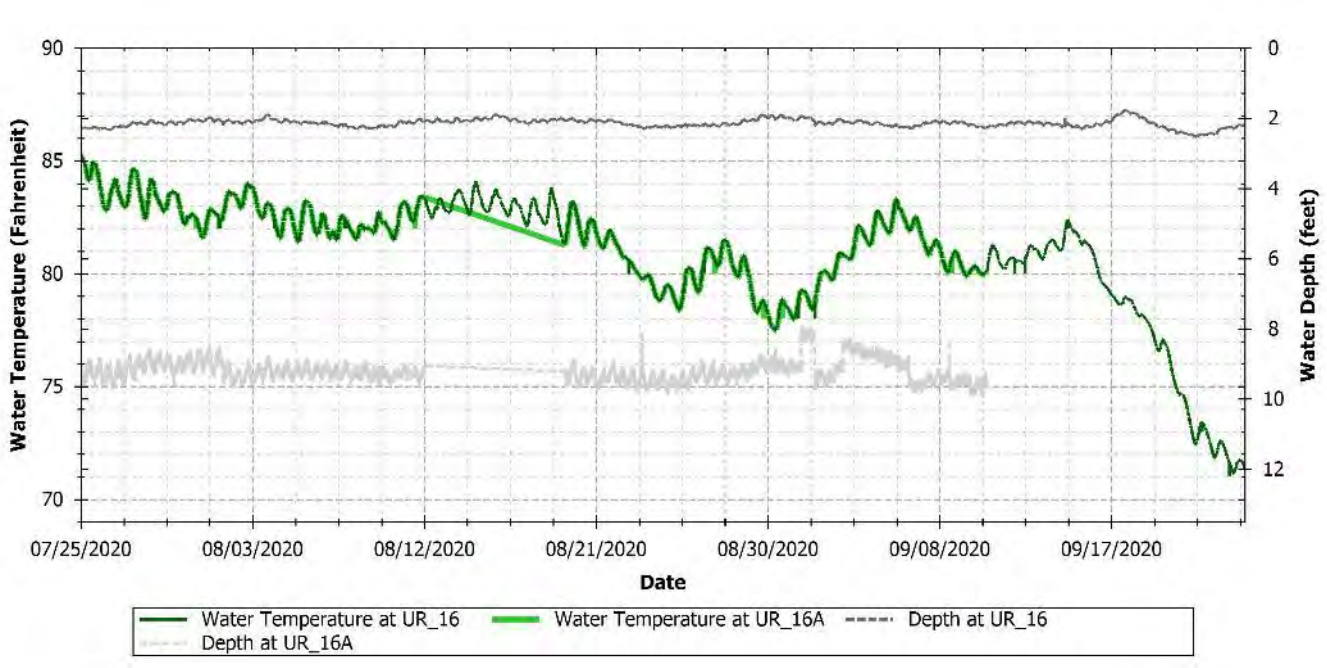


Figure A-71 UR_16 and UR_16a observed water temperature

A.23 UPRIVER 17 (UR_17)

The UR_17 sonde, located 1400 feet downstream, observed DO values slightly lower than the UR_16 DO values. This decrease indicated the oxygen plume gradually dispersed across the river.

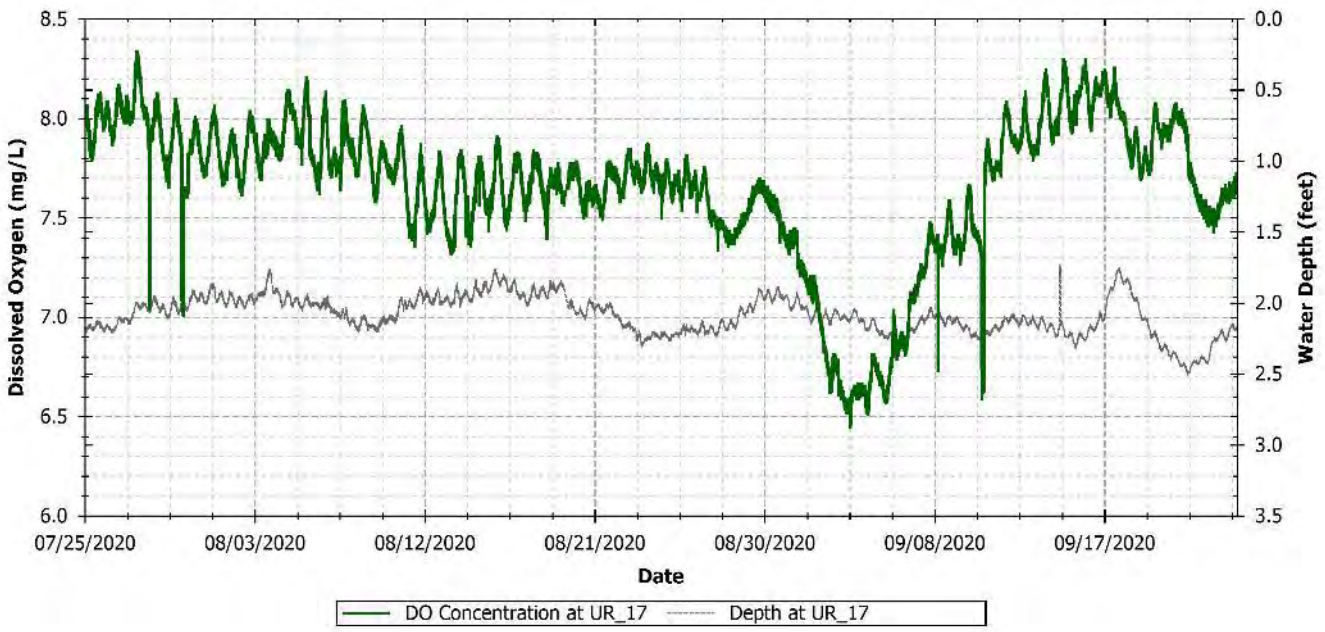


Figure A-72 UR_17 observed DO concentration

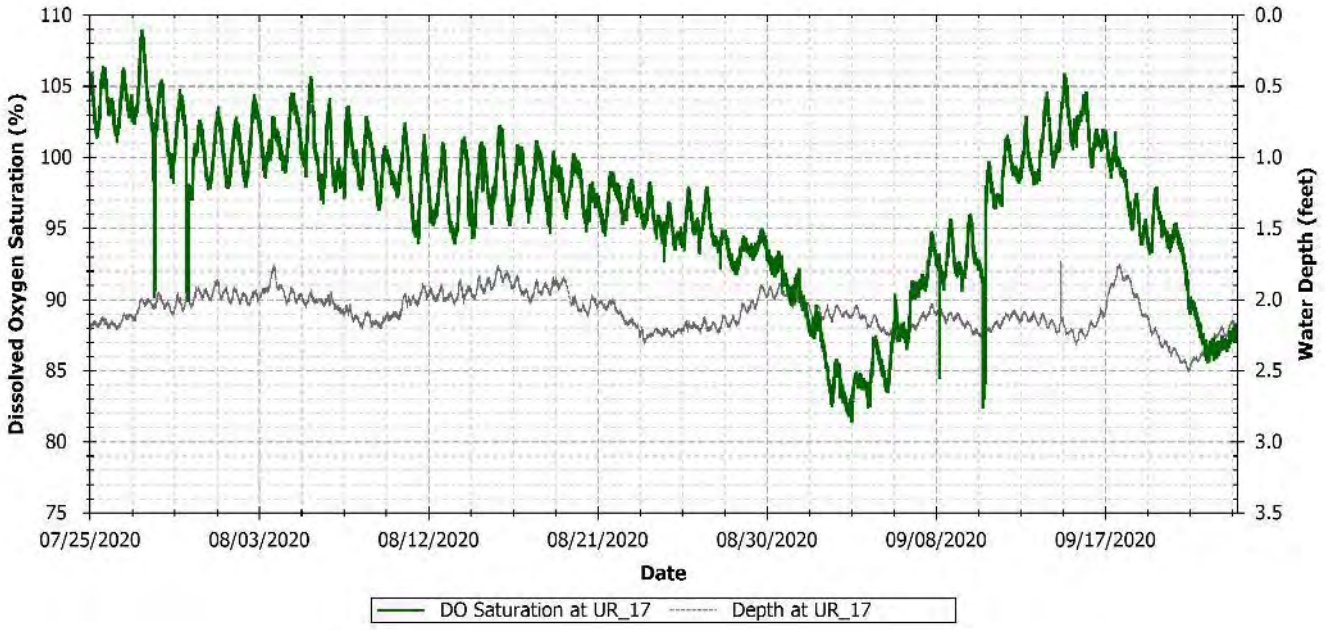


Figure A-73 UR_17 observed DO saturation

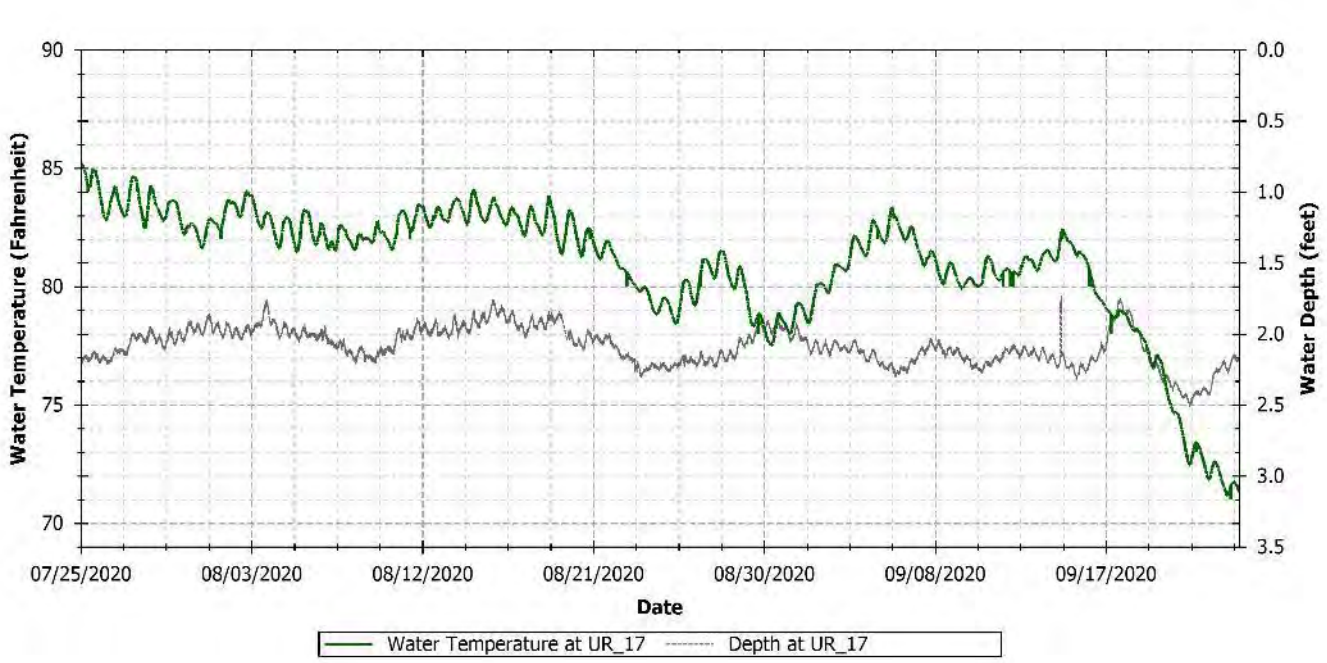


Figure A-74 UR_17 observed water temperature

A.24 UPRIVER 18 (UR_18)

The UR_18 sonde, located approximately 2,300 feet downstream, was located where the oxygen plume was mostly mixed side to side, as shown by the four dye studies and DO drift completed during the SUR. The DO values were 0.6 to 1 mg/L higher than background, dependent on the river flow conditions. DO saturation was observed above 100 percent saturation during periods of lower river flow (less than 7,000 cfs) and higher water temperatures. The BGA sensor measured the dye during the August 24 and September 15, 2020 dye injection events.

Table A-8 provides a summary of the UR_18 data.

Table A-8 Data summary for UR_18

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	6.5	6.6	7.4	7.7	7.8	8.1	8.3	23,843	6.1	8.4
DO saturation (%)	79	83	89	97	100	104	106	23,843	77	108
Salinity (ppt)	0.03	0.0	0.0	0.0	0.0	0.0	0.0	23,843	0.0	0

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
Temp_C (°C)	22	22	26	28	28	29	30	23,843	21	30
BGA_R (RFU)	1.2	1.3	1.5	1.8	2.2	2.7	3.0	12,062	1.1	157

Abbreviations: PCTL – percentile, Min – minimum, Max - maximum

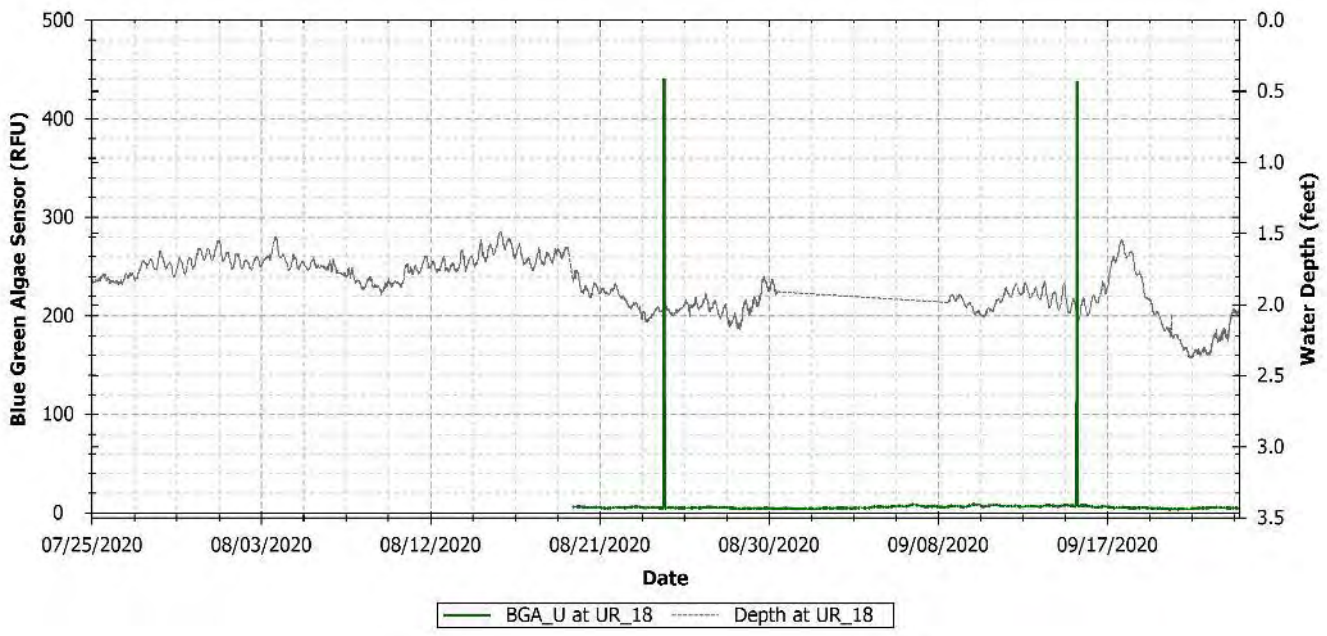


Figure A-75 UR_18 observed BGA

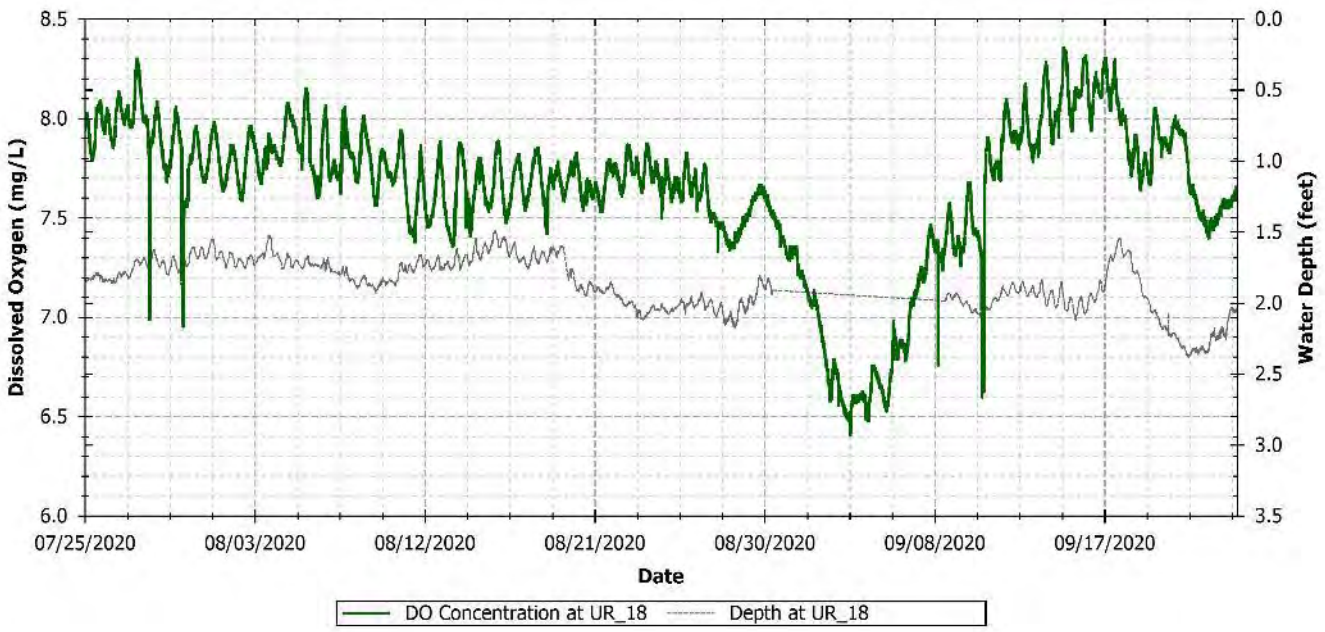


Figure A-76 UR_18 observed DO concentration

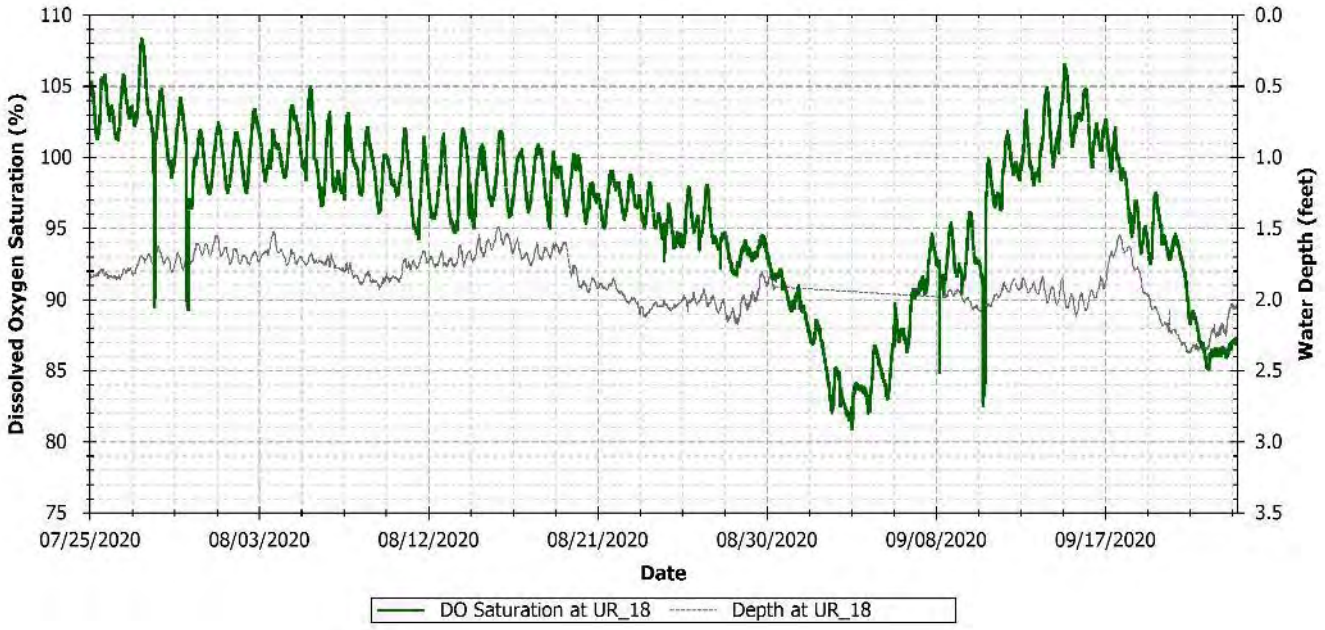


Figure A-77 UR_18 observed DO saturation

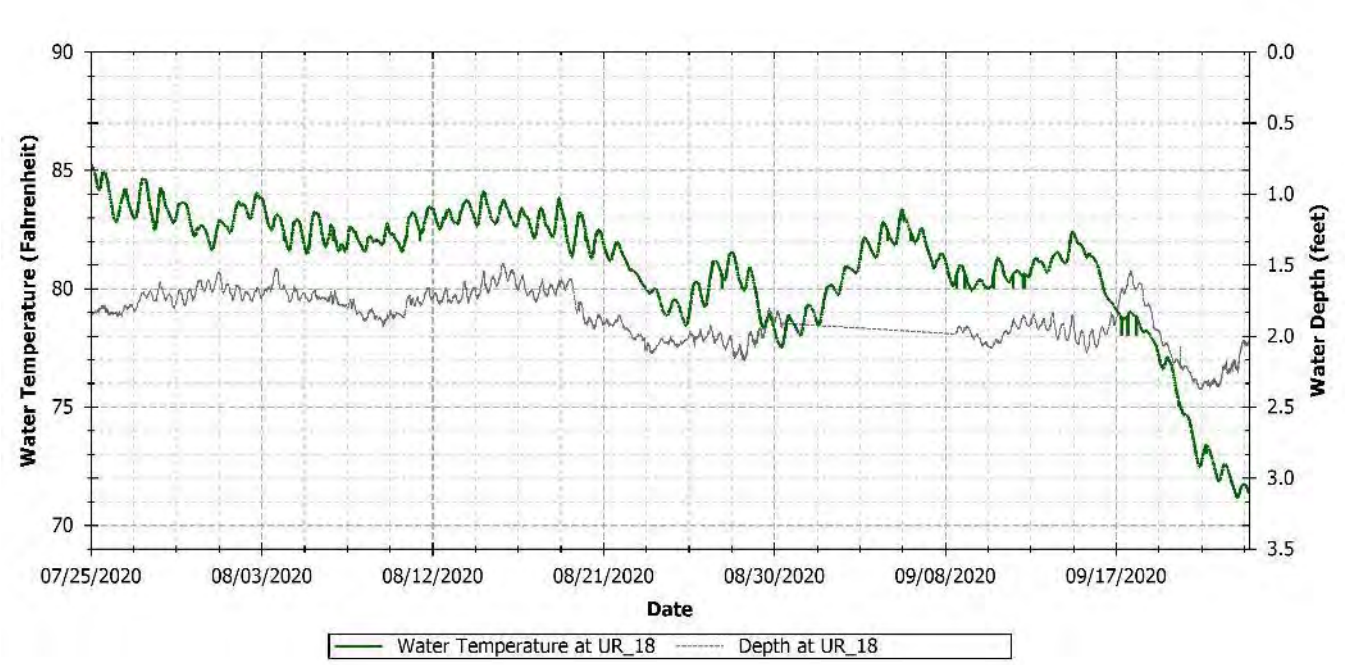


Figure A-78 UR_18 observed water temperature

A.25 UPRIVER HARDEEVILLE (UR_HARDEEVILLE)

The UR_Hardeeville sonde was located 2.5 miles downstream where oxygen plume was completely mixed across the river. The DO concentration values were 0.5 mg/L higher than background, dependent on the river flow conditions. During increased river flow, the DO values were lowered by the inflowing tributary and its low DO values. During periods of lower river flow (less than 7,500 cfs) and higher water temperatures, DO saturation was observed above 100 percent saturation. However, the maximum DO saturation measured was 103 percent and no measurable transfer of oxygen to the atmosphere is known to occur at these low values. The BGA sensor measured the dye during the August 24, 2020 and September 15, 2020 dye injection events.

Table A-9 Hardeeville sonde data summary

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	6.3	6.5	7.2	7.4	7.6	7.8	7.9	11,512	6.2	8.0
DO saturation (%)	81	83	91	96	98	101	102	11,512	79	103
Salinity (ppt)	0.03	0.0	0.0	0.0	0.0	0.0	0.0	11,512	0.0	0

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
Temp_C (°C)	22	27	28	28	29	30	30	11,512	22	30
BGA_R (RFU)	0.0	0.0	0.2	2.4	2.6	2.9	22.2	3,455	0.0	138

Abbreviations: PCTL – percentile, Min – minimum, Max - maximum

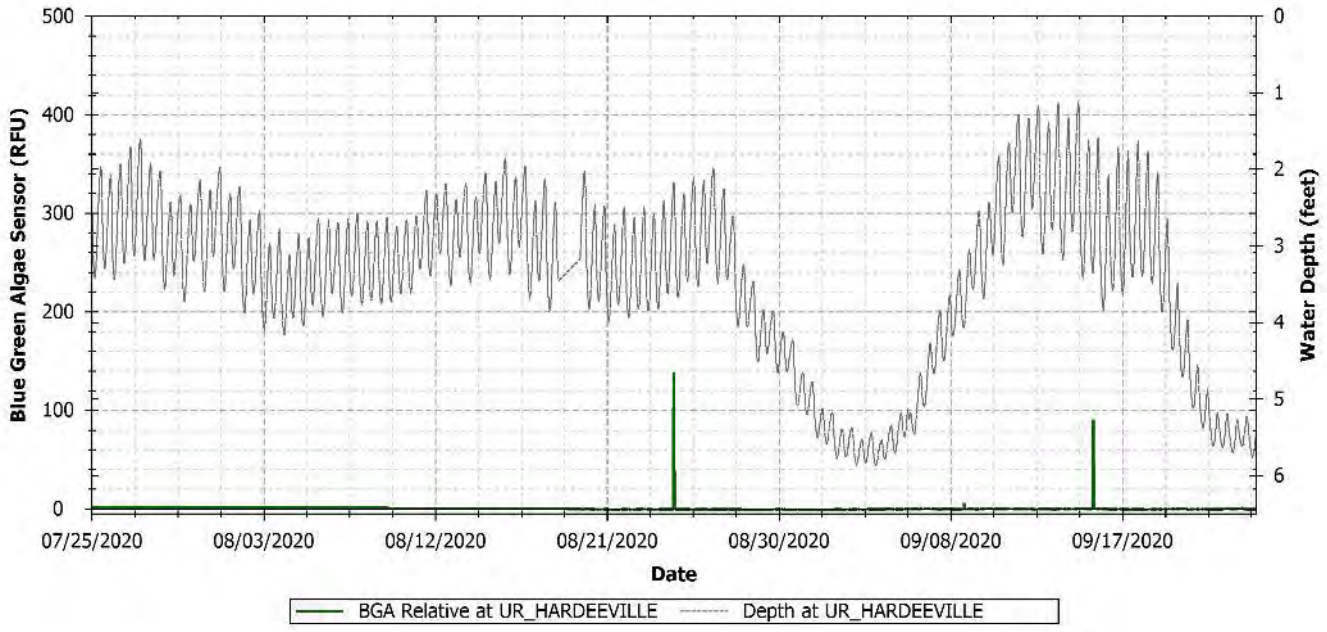


Figure A-79 UR_Hardeeville observed BGA

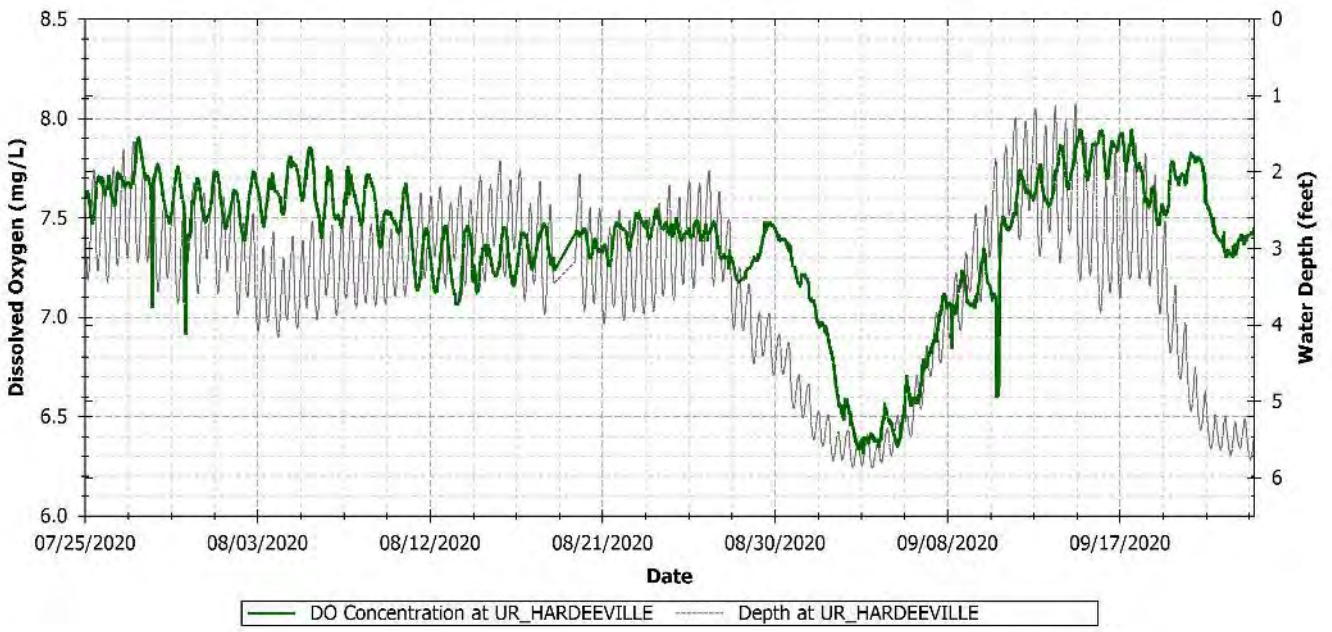


Figure A-80 UR_Hardeeville observed DO concentration

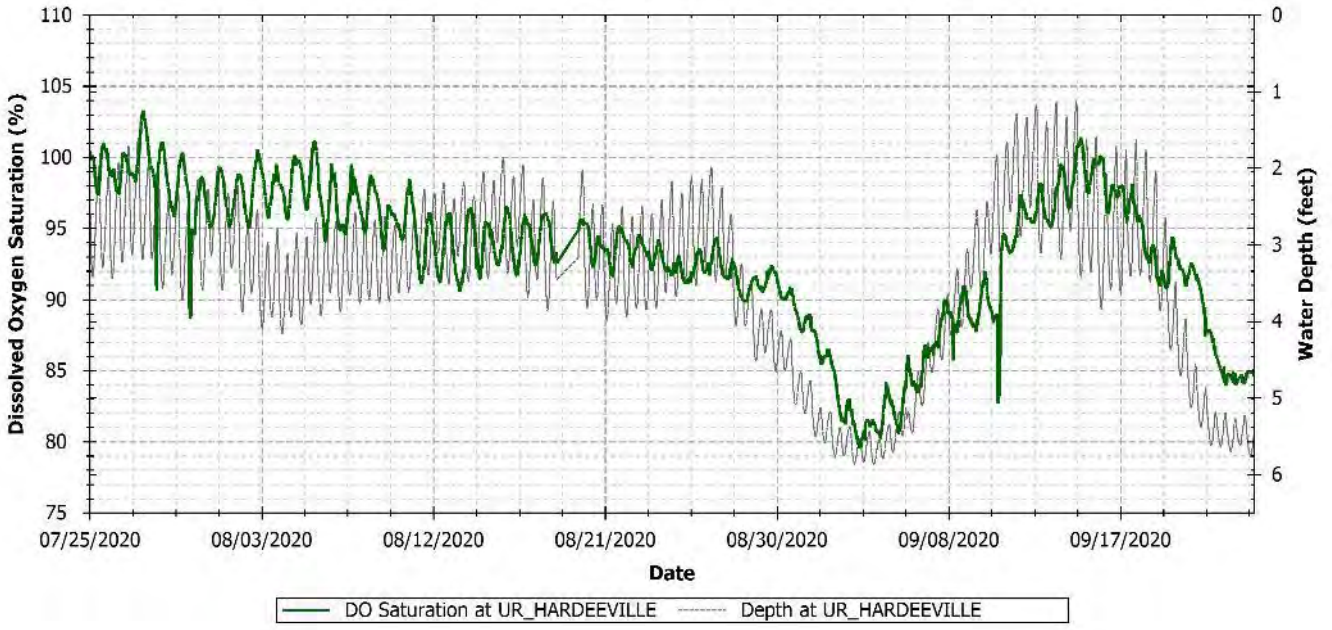


Figure A-81 UR_Hardeeville observed DO saturation

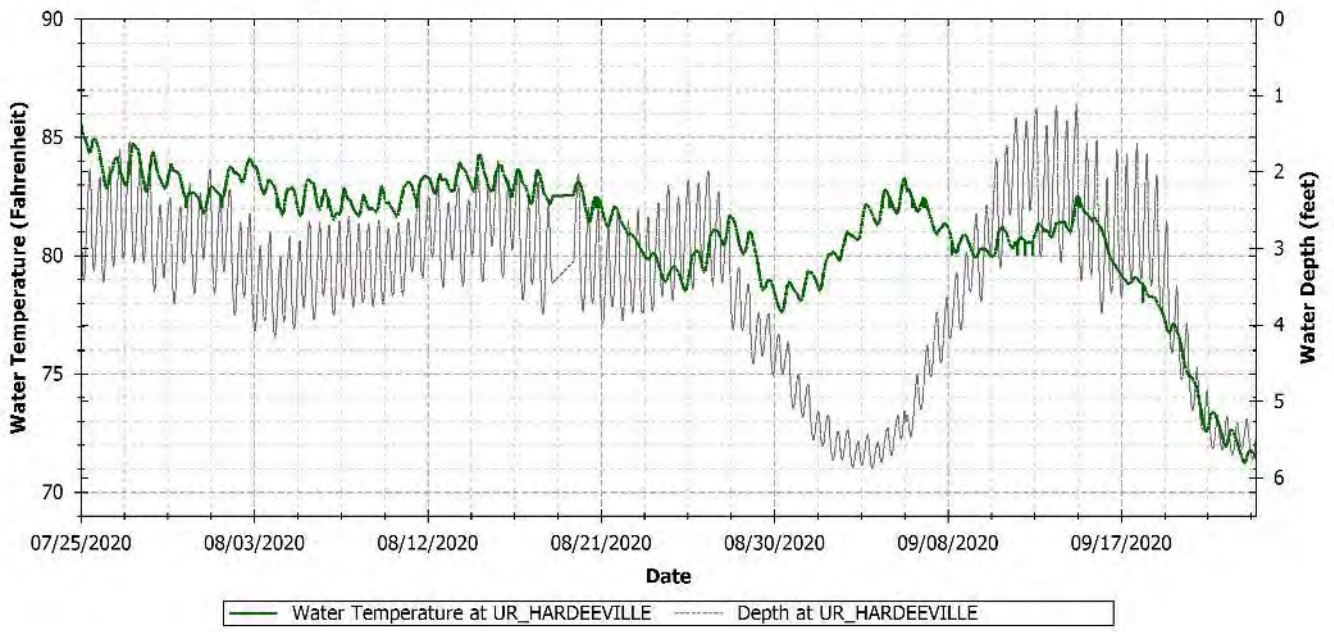


Figure A-82 UR_Hardeeville observed water temperature

A.26 UPRIVER TRIBUTARIES

The DO between UR_18 and the Hardeeville decreased slightly due to the inflow of low DO water from the Upriver tributaries and adjacent marshes. The tributaries average DO is about 2 mg/L less the Upriver DO measured at UR_18. ***Table A-10*** provides a data summary for the tributaries.

Table A-10 Data summary of tributaries

Parameter	1st PCTL	5th PCTL	25th PCTL	50th PCTL	75th PCTL	95th PCTL	99th PCTL	Total Observations	Min	Max
DO (mg/L)	4.6	4.9	5.5	5.7	5.8	5.9	5.9	648	4.6	5.9
DO saturation (%)	58	61	68	70	72	73	74	648	58	75
Salinity (ppt)	0.03	0.0	0.0	0.0	0.0	0.0	0.0	648	0.0	0
Temp_C (°C)	26	26	26	26	27	28	28	648	26	28

Abbreviations: PCTL – percentile, Min – minimum, Max - maximum

APPENDIX B PROFILE DATA

APPENDIX B PROFILE FIGURES

Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Task: 10
March 2021

PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG^2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX B BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document forms Appendix B of the SUR Report. It is referred to in the main body in Sections 2.2, 3.2, 9.1, and 9.2.2.

APPENDIX B TABLE OF CONTENTS

APPENDIX B 0BPROFILE FIGURES B-1

B.1 Front River and Back River Salinity, DO and Dye Profiles B-7
B.2 August 28, 2020 Profiling B-9
B.3 August 29, 2020 Profiling B-11
B.4 August 31, 2020 Profiling B-12
B.5 September 2, 2020 Profiling B-14
B.6 September 4, 2020 Profiling B-16
B.7 September 5, 2020 Profiling B-18
B.8 September 6, 2020 Profiling B-20
B.9 September 7, 2020 Profiling B-21
B.10 September 9, 2020 Profiling B-23
B.11 September 11, 2020 Profiling B-25
B.12 September 14, 2020 Profiling B-27
B.13 September 17, 2020 Profiling B-29
B.14 September 18, 2020 Profiling B-32
B.15 September 19, 2020 Profiling B-34
B.16 September 21, 2020 Profiling B-35
B.17 September 22, 2020 Profiling B-37
B.18 Upriver July 28, 2020 Salinity and DO Profiles B-39
B.19 Upriver September 8, 2020 Salinity and DO Profiles B-40

APPENDIX B LIST OF FIGURES

Figure B-1 Vertical monitoring profiles Front River and Back River August 28, 2020 [LFR_082820_OT_001] B-9
Figure B-2 Vertical monitoring profiles Front River and Back River August 28, 2020 [LFR_082820_OT_002] B-10
Figure B-3 Vertical monitoring profiles Front River and Back River August 29, 2020 [LFR_082920_OT_001] B-11
Figure B-4 Vertical monitoring profiles Front River and Back River August 31, 2020 [LFR_083120_OT_001] B-12
Figure B-5 Vertical monitoring profiles Front River and Back River August 31, 2020 [LFR_083120_OT_002] B-13
Figure B-6 Vertical monitoring profiles Front River and Back River September 2, 2020 [LFR_090220_OT_001] B-14
Figure B-7 Vertical monitoring profiles Front River and Back River September 2, 2020 [LFR_090220_OT_002] B-15
Figure B-8 Vertical monitoring profiles Front River and Back River September 4, 2020 [LFR_090420_IT_001 to LFR_090420_IT_005] B-16
Figure B-9 Vertical monitoring profiles Front River and Back River September 4, 2020 [LFR_090420_IT_006, LFR_090420_IT_007 and MR_090420_IT_001] B-17
Figure B-10 Vertical monitoring profiles Front River and Back River September 5, 2020 [LFR_090520_IT_001 and LFR_090520_IT_002] B-18
Figure B-11 Vertical monitoring profiles Front River and Back River September 5, 2020 [LBR_090520_IT_001 to LBR_090520_IT_008] B-19
Figure B-12 Vertical monitoring profiles Front River and Back River September 6, 2020 [LFR_090620_IT_001 to LFR_090620_IT_008] B-20
Figure B-13 Vertical monitoring profiles Front River and Back River September 7, 2020 [LFR_090720_OT_001] B-21
Figure B-14 Vertical monitoring profiles Front River and Back River September 7, 2020 [LFR_090720_OT_002] B-22
Figure B-15 Vertical monitoring profiles Front River and Back River September 9, 2020 [LFR_090920_OT_001] B-23
Figure B-16 Vertical monitoring profiles Front River and Back River September 9, 2020 [LFR_090920_OT_002] B-24
Figure B-17 Vertical monitoring profiles Front River and Back River September 11, 2020 [LFR_091120_IT_001] B-25
Figure B-18 Vertical monitoring profiles Front River and Back River September 11, 2020 [LFR_091120_IT_002] B-26
Figure B-19 Vertical monitoring profiles Front River and Back River September 14, 2020 [LFR_091420_IT_001] B-27
Figure B-20 Vertical monitoring profiles Front River and Back River September 14, 2020 [LFR_091420_OT_002] B-28
Figure B-21 Vertical monitoring profiles Front River and Back River September 17, 2020 [LFR_091720_OT_001] B-29
Figure B-22 Vertical monitoring profiles Front River and Back River September 17, 2020 [LFR_091720_OT_002] B-30
Figure B-23 Vertical monitoring profiles Front River and Back River September 17, 2020 [LFR_091720_OT_003] B-31
Figure B-24 Vertical monitoring profiles Front River and Back River September 18, 2020 [LFR_091820_IT_001] B-32
Figure B-25 Vertical monitoring profiles Front River and Back River September 18, 2020 [LFR_091820_OT_002] B-33

Figure B-26 Vertical monitoring profiles Front River and Back River September 19, 2020 [LBR_091920_IT_001 and LBR_091920_IT_002_1] B-34
Figure B-27 Vertical monitoring profiles Front River and Back River September 21, 2020 [LFR_092120_IT_001] B-35
Figure B-28 Vertical monitoring profiles Front River and Back River September 21, 2020 [LFR_092120_IT_002] B-36
Figure B-29 Vertical monitoring profiles Front River and Back River September 22, 2020 [LFR_092220_LT_001] B-37
Figure B-30 Vertical monitoring profiles Front River and Back River September 22, 2020 [LFR_092220_OT_002] B-38
Figure B-31 Vertical monitoring profiles Upriver July 28, 2020 [UR_072820_001 to UR_072820_005] B-39
Figure B-32 Vertical monitoring profiles Upriver September 8, 2020 [UR_090820_001 to UR_090820_010] .. B-40

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BGA	Phycoerythin blue-green algae
DO	dissolved oxygen
Lat	latitude
Lon	longitude
mg/L	milligrams per liter
PPT	parts per thousand
RFU	relative fluorescence units
RWT	Rhodamine WT Dye
Sal	salinity

B.1 FRONT RIVER AND BACK RIVER SALINITY, DO AND DYE PROFILES

Detailed depth profiling was conducted on the Front and Back River from August 28, 2020 to September 25, 2020, after the August 25, 2020 super dye study. The main report provides average DO and dye concentrations by river mile (RM) for selected days to provide an overall assessment of how Dissolved Oxygen (DO) changes over time and how much of the dye is retained in the water column, and therefore the injected oxygen is retained in the system.

The profile sondes measure parameters at 2-second intervals These parameters are:

- Dissolved Oxygen (DO) to evaluate the impact of the injected oxygen on the Upriver DO regime.
- Dissolved Oxygen saturation (DOsat) to check if DO saturation exceeded 100 percent. If DO saturation exceeds 100 percent for any significant time, this would indicate that DO could be transferred to the atmosphere.
- Salinity, at higher salinities there is less capacity for the water to hold oxygen resulting in lower DO values and is used to determine the tidal STATUS.
- Temperature Centigrade (Temp_C), at higher temperatures, there is less capacity for the water to hold oxygen and may result in lower DO values and DO saturation to exceed 100 percent.
- Blue Green Algae (BGA) used to measure dye during dye release events. Also used to determine the background levels of BGA
- Rhodamine dye used to track the injected dye as it moves through the Front River.

A summary of the Front River upper and lower layer data are shown in ***Table B-1*** and ***Table B-2***. The upper layer DO is about 1 milligram per liter (mg/L) higher than the lower layer. The dye is well distributed between the upper and lower layer, with the lower layer dye being slightly higher.

Table B-1 Front River upper layer data summary

Parameter	1st Percentile	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile	99th Percentile	Total Observations	Minimum	Maximum
DO (mg/L)	2.4	3.1	4.0	4.5	5.2	6.0	6.7	104,066	0.1	8.1
DO Saturation (%)	33	42	53	60	68	78	86	104,066	2	101
Salinity (ppt)	0.11	0.5	2.2	3.8	5.8	8.9	14.8	104,066	0.0	23
Temp_C (°C)	26	27	28	29	29	30	30	104,066	26	31
Dye (µg/L)	0.03	0.04	0.05	0.07	0.14	8.1	53.2	75,237	0.02	182
BGA_R (RFU)	1.4	1.8	2.2	2.8	3.8	56.4	154.8	88,498	0.5	159

Table B-2 Front River lower layer data summary

Parameter	1st Percentile	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile	99th Percentile	Total Observations	Minimum	Maximum
DO (mg/L)	1.2	1.9	2.8	3.3	3.9	5.2	6.6	28,879	0.1	6.8
DO Saturation (%)	16	26	38	45	52	67	86	28,879	1	88
Salinity (ppt)	0.18	1.8	3.8	5.7	7.6	10.6	24.1	28,879	0.1	30
Temp_C (°C)	27	28	29	29	30	30	30	28,879	27	30
Dye (µg/L)	0.04	0.04	0.06	0.08	0.10	0.7	18.5	26,812	0.03	76
BGA_R (RFU)	1.6	2.1	2.7	3.3	4.2	17.5	104.0	28,118	1.3	157

The following figures provide the detailed graphs on how DO, salinity, and dye vary with depth. This provides a picture of how the Front and Back River change during flood and ebb tides and especially during spring and neap tides. But most importantly to this project, it demonstrates how the dye and oxygen plumes are distributed in the system and remain in the system for three to four weeks. Please note that dye is represented Rhodamine WT (RWT) on all of the dye graphs.

B.2 AUGUST 28, 2020 PROFILING

August 28, 2020 detailed ebb tide profiling conducted from Fort Pulaski to GA 25 bridge on the Front River. Profile locations and results are shown below in ***Figure B-1*** and ***Figure B-2*** .

- There was a strong salinity stratification from Fort Pulaski to above the turning basin.
- The DO stratified in the upper Front River and became less stratified in the lower Front River due to the offshore higher salinity water entering the Front River on an ebb tide.
- The dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.

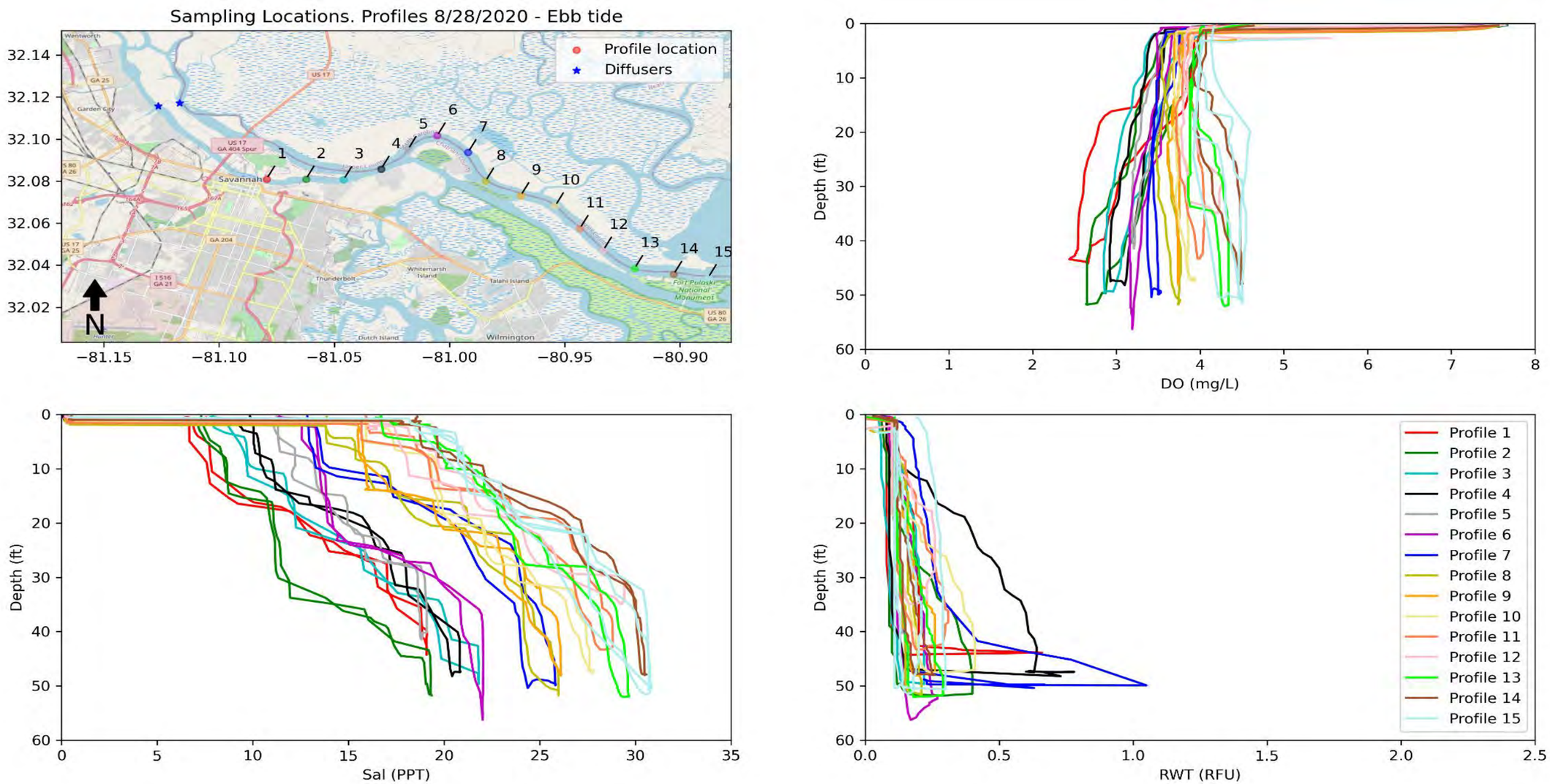


Figure B-1 Vertical monitoring profiles Front River and Back River August 28, 2020 [LFR_082820_OT_001]

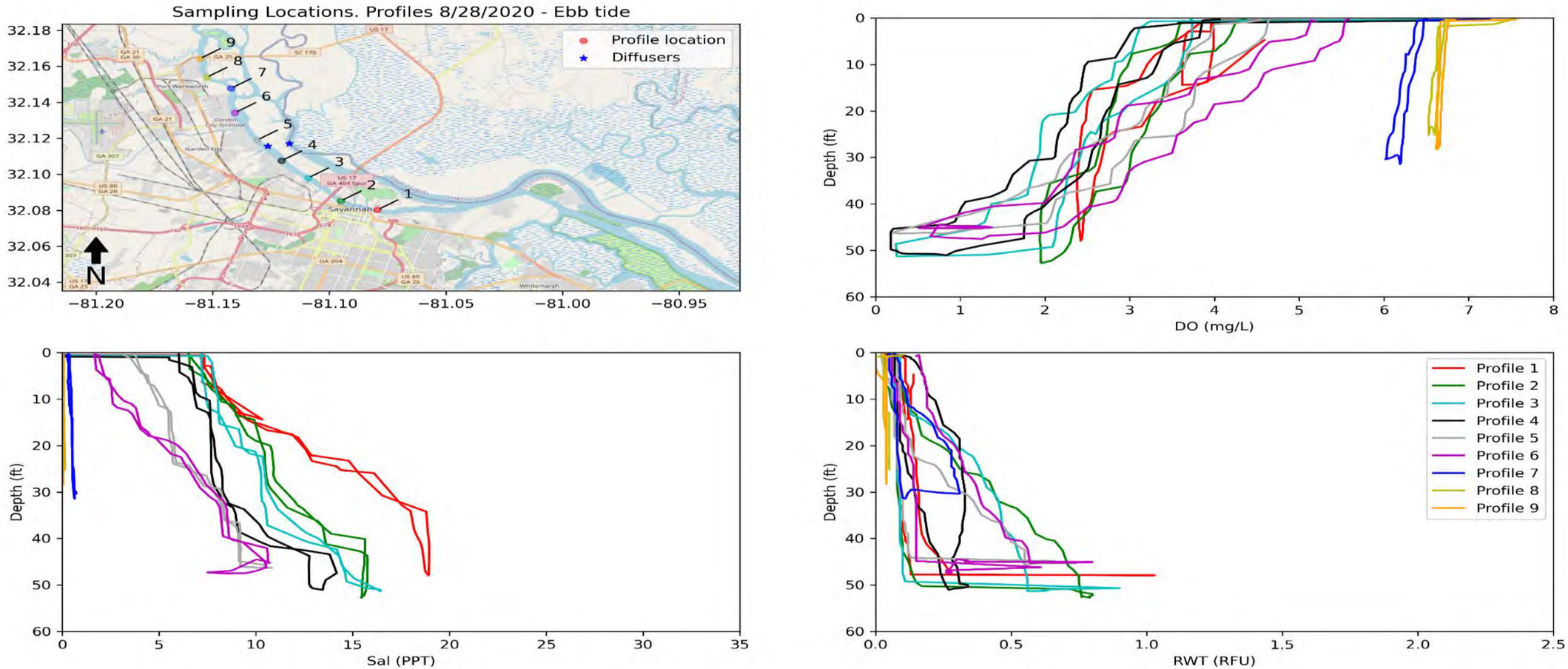


Figure B-2 Vertical monitoring profiles Front River and Back River August 28, 2020 [LFR_082820_OT_002]

B.3 AUGUST 29, 2020 PROFILING

August 29, 2020 detailed ebb tide profiling was conducted from the diffusers to confluence of Front and Back Rivers.

- There was salinity and DO stratification except in the Back River near diffuser.
- The dye concentration remained present in both Front and Back Rivers with highest concentration on the bottom of the Front River.

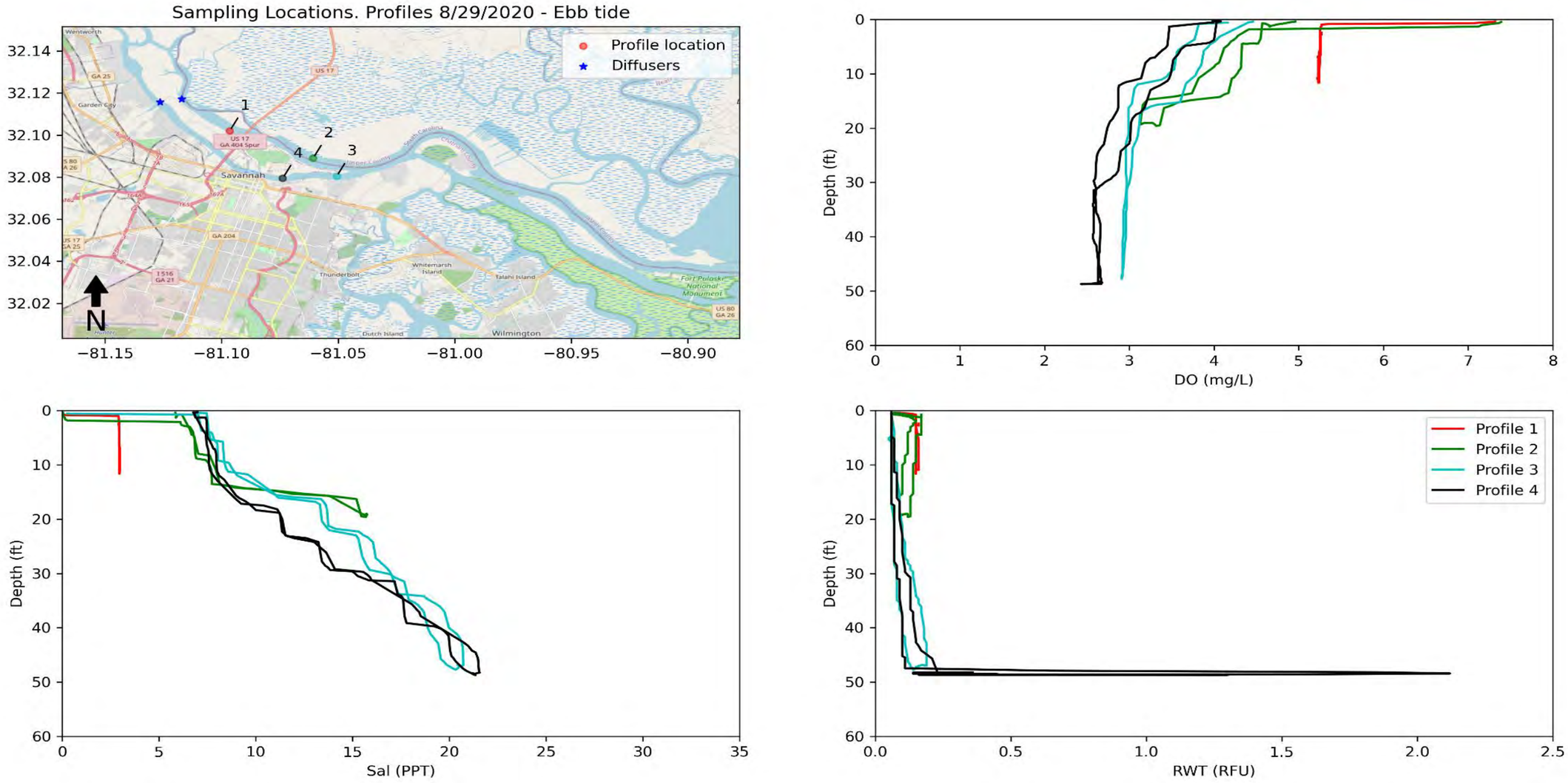


Figure B-3 Vertical monitoring profiles Front River and Back River August 29, 2020 [LFR_082920_OT_001]

B.4 AUGUST 31, 2020 PROFILING

August 31, 2020 detailed ebb tide profiling was conducted from Fort Pulaski to above the turning basin on the Front River and in the Back River downstream of the diffuser. Profile locations and results are shown below in ***Figure B-4*** and ***Figure B-5***.

- There was a strong salinity stratification from Fort Pulaski to above the turning basin
- The DO stratified in the upper Front River and became less stratified in the lower Front River due to the offshore higher salinity water entering the Front River on an ebb tide.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye remained present in the Back River.

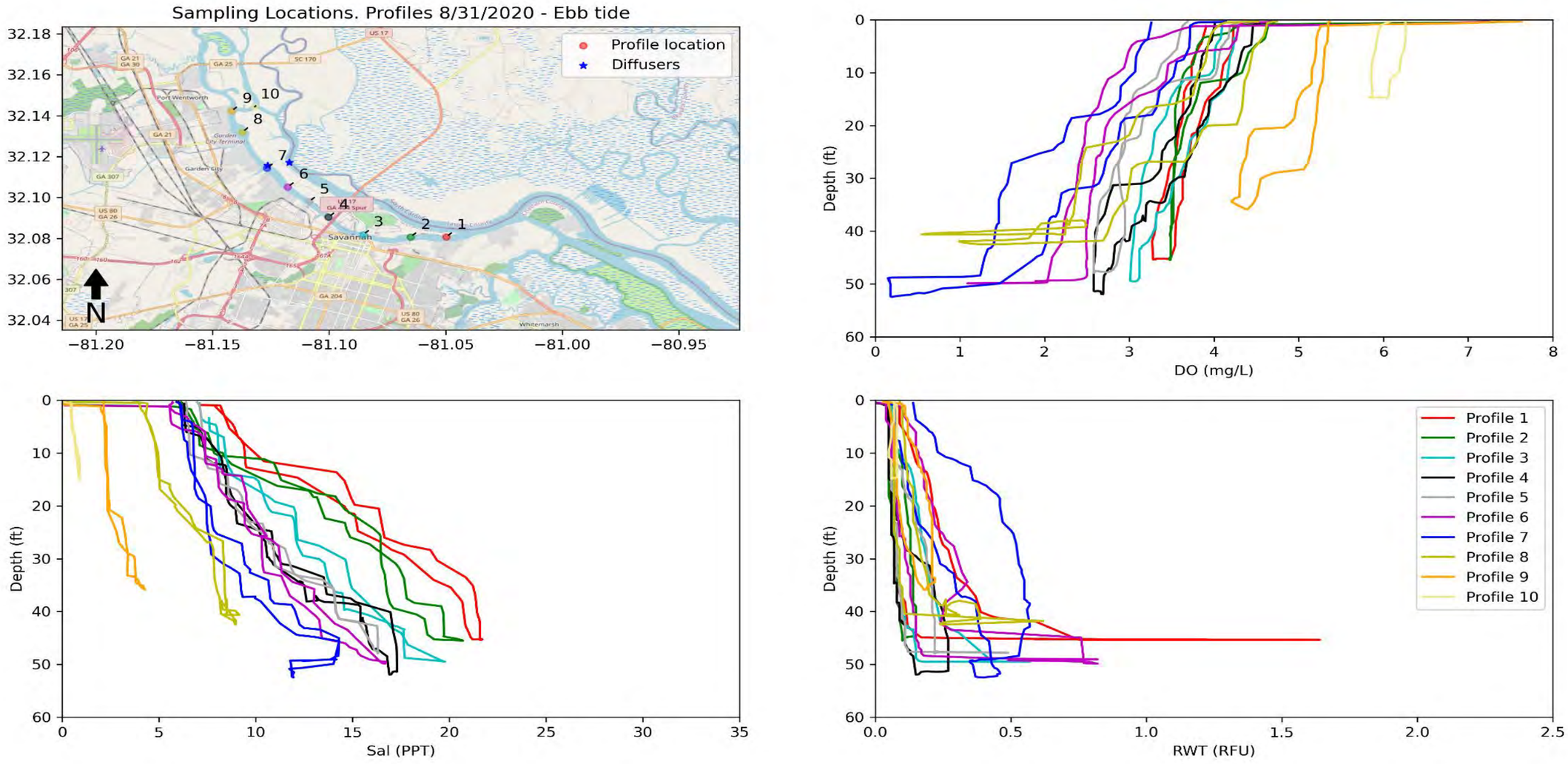


Figure B-4 Vertical monitoring profiles Front River and Back River August 31, 2020 [LFR_083120_OT_001]

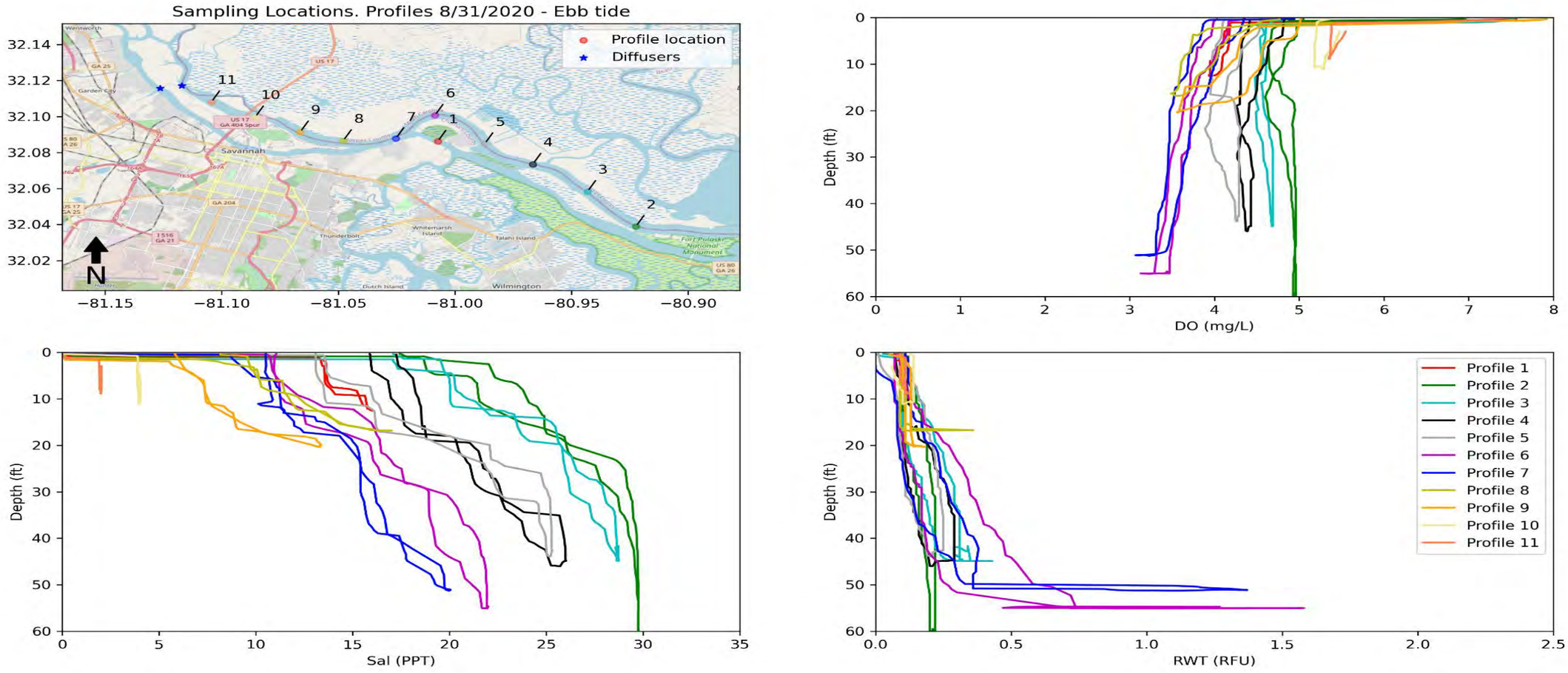


Figure B-5 Vertical monitoring profiles Front River and Back River August 31, 2020 [LFR_083120_OT_002]

B.5 SEPTEMBER 2, 2020 PROFILING

September 2, 2020 detailed ebb tide profiling was conducted from Fort Pulaski to above the turning basin on the Front River and in the Back River downstream of the diffuser. Profile locations and results are shown below in ***Figure B-6*** and ***Figure B-7***.

- There was a strong salinity stratification from Fort Pulaski to above the turning basin.
- The DO stratified in the upper Front River and became less stratified in the lower Front River due to the offshore higher salinity water entering the Front River on an ebb tide.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye remained present in the Back River.
- The dye concentration peaks began to be more distributed in the system.

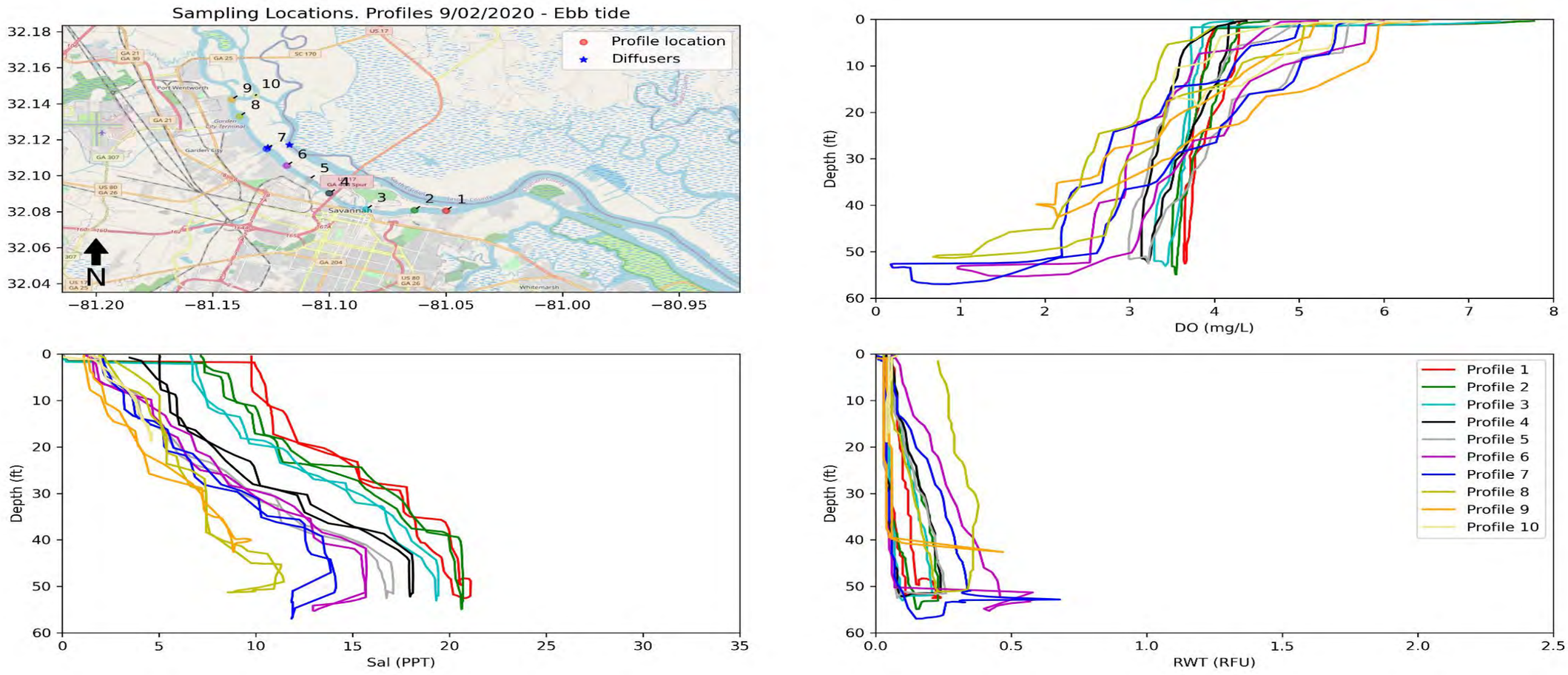


Figure B-6 Vertical monitoring profiles Front River and Back River September 2, 2020 [LFR_090220_OT_001]

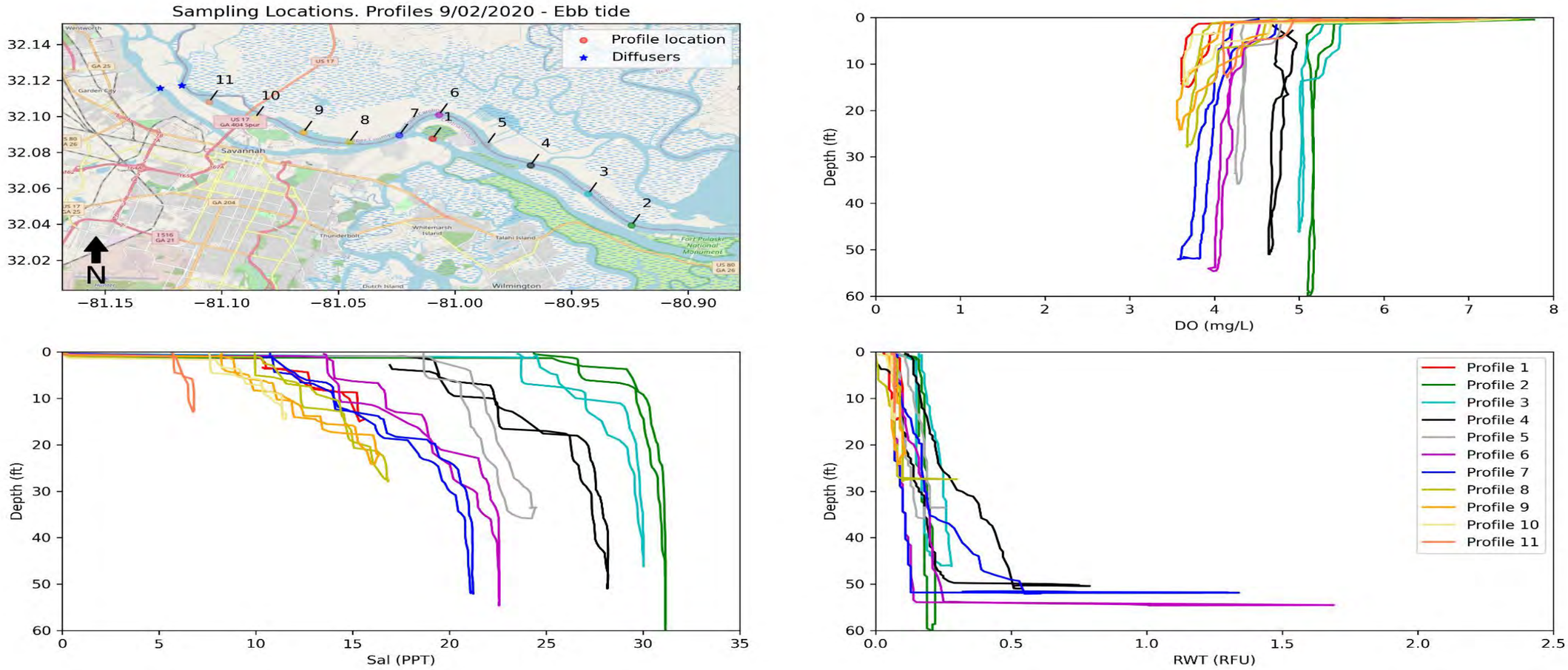


Figure B-7 Vertical monitoring profiles Front River and Back River September 2, 2020 [LFR_090220_OT_002]

B.6 SEPTEMBER 4, 2020 PROFILING

September 4, 2020 detailed flood tide profiling was conducted from Fort Pulaski to above the turning basin in the Front River and below the diffuser on the Back River. One additional profile was conducted in the upper Little Back River. Profile locations and results are shown below in ***Figure B-8*** and ***Figure B-9***.

- There was a strong salinity stratification from Fort Pulaski to above the turning basin.
- The DO stratified in the upper and lower Front River except around Fort Pulaski.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye remained present in the Back River.
- The dye concentration peaks began to be more distributed in the system.

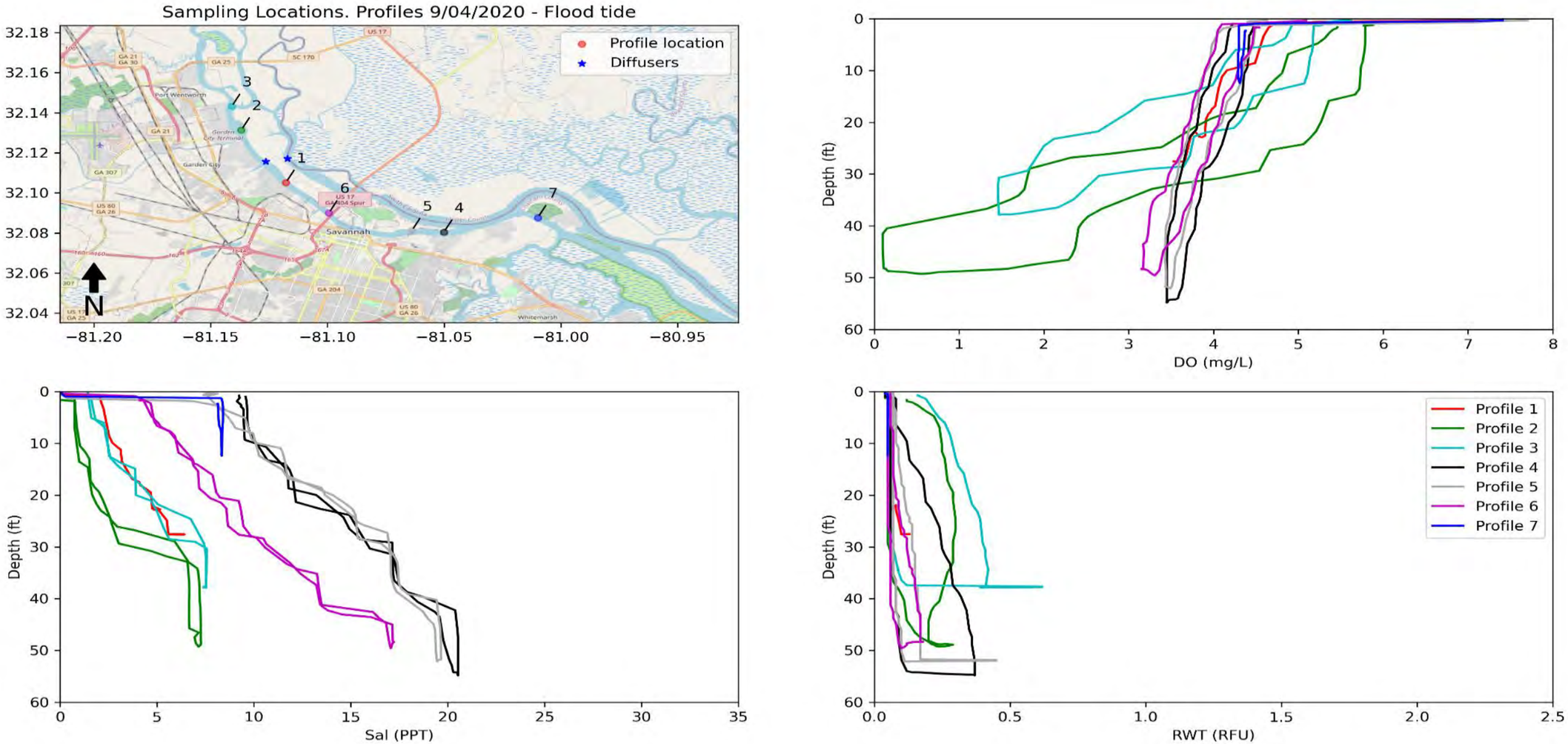


Figure B-8 Vertical monitoring profiles Front River and Back River September 4, 2020 [LFR_090420_IT_001 to LFR_090420_IT_005]

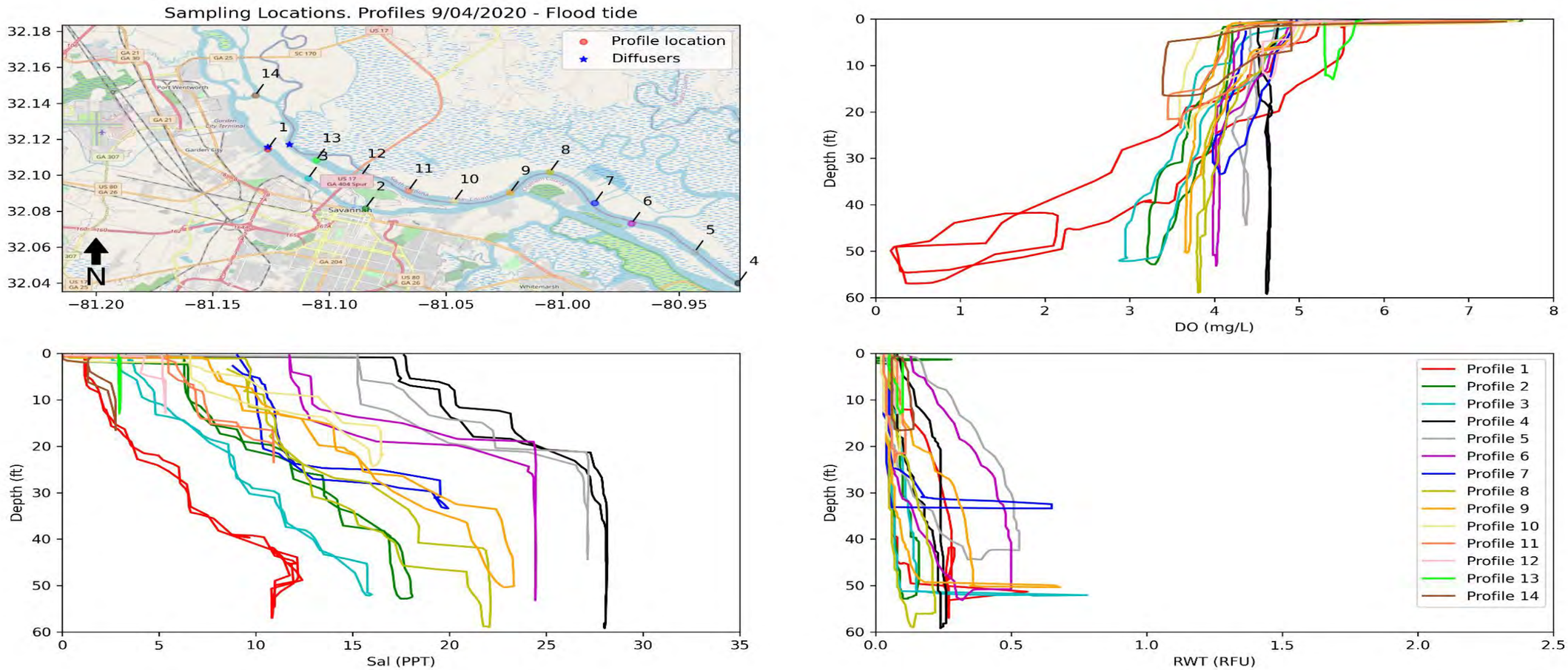


Figure B-9 Vertical monitoring profiles Front River and Back River September 4, 2020 [LFR_090420_IT_006, LFR_090420_IT_007 and MR_090420_IT_001]

B.7 SEPTEMBER 5, 2020 PROFILING

September 5, 2020 limited flood tide profiling was conducted around the Back River diffuser and two locations in the Front River. Profile locations and results are shown below in ***Figure B-10*** and ***Figure B-11***.

- The dye remained present in the Back River.

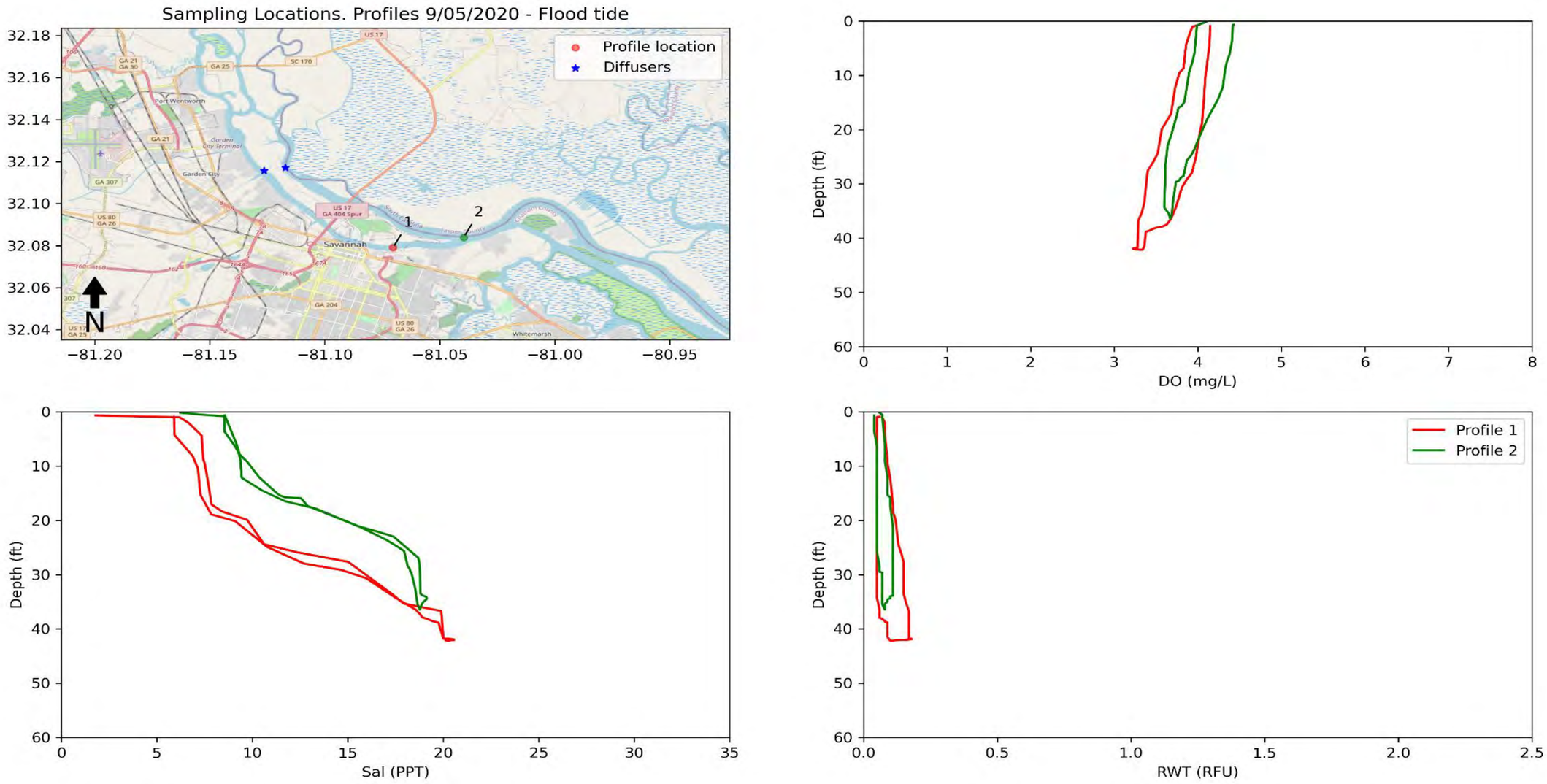


Figure B-10 Vertical monitoring profiles Front River and Back River September 5, 2020 [LFR_090520_IT_001 and LFR_090520_IT_002]

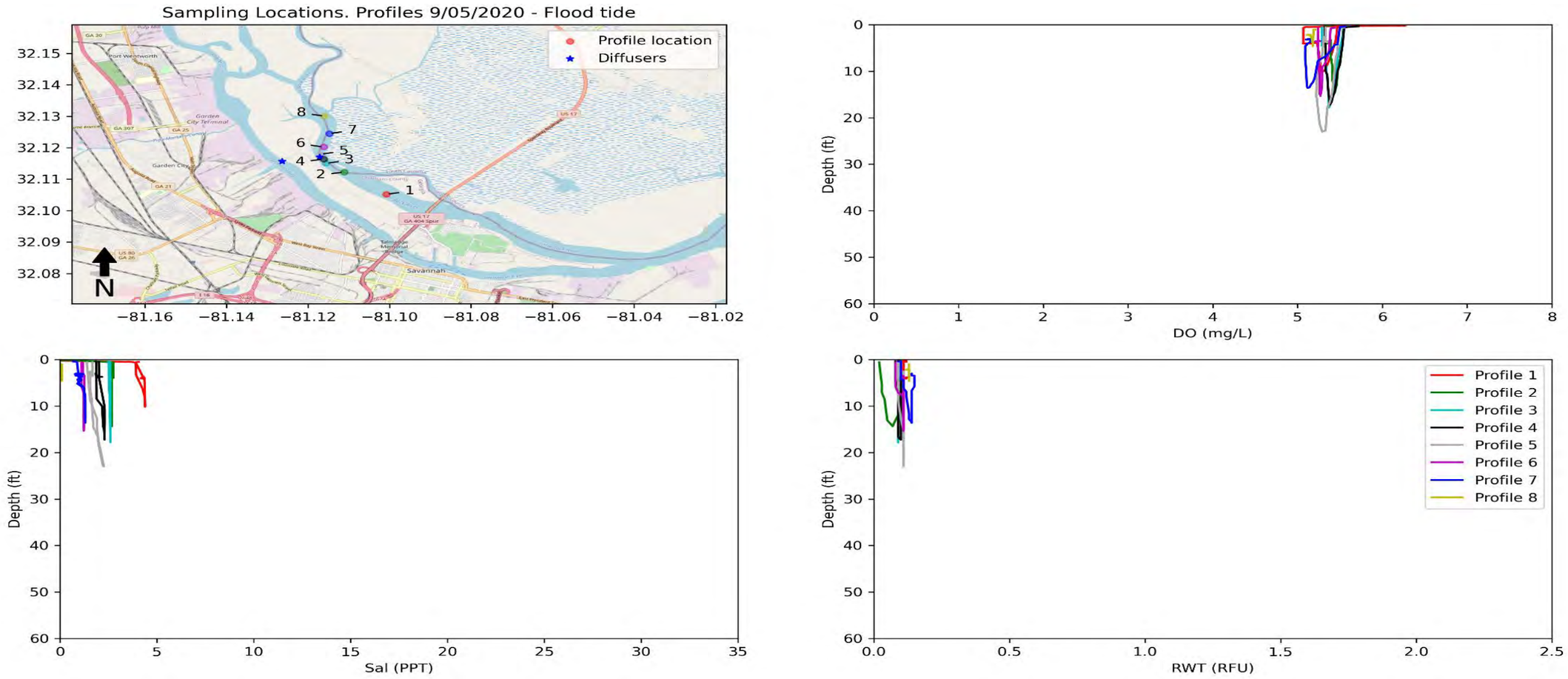


Figure B-11 Vertical monitoring profiles Front River and Back River September 5, 2020 [LBR_090520_IT_001 to LBR_090520_IT_008]

B.8 SEPTEMBER 6, 2020 PROFILING

September 6, 2020 detailed flood tide profiling was conducted from Fort Pulaski to above the turning basin in the Front River. Profile locations and results are shown below in ***Figure B-12***.

- The upper Front River salinity stratification weakened due to high incoming river flows.
- The DO stratified more in the upper Front River than in the lower Front River.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye concentration began to be more distributed in the Front River.

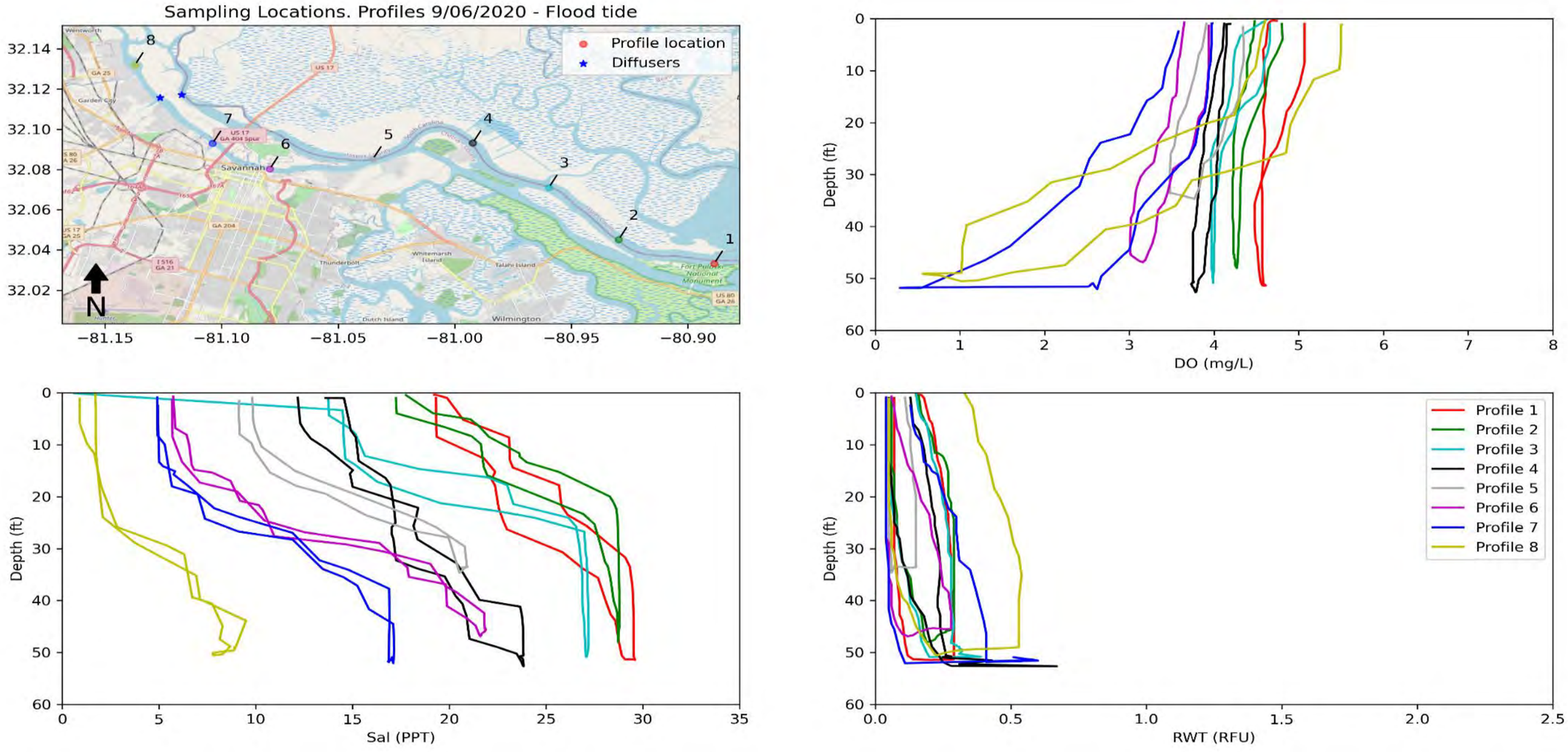


Figure B-12 Vertical monitoring profiles Front River and Back River September 6, 2020 [LFR_090620_IT_001 to LFR_090620_IT_008]

B.9 SEPTEMBER 7, 2020 PROFILING

September 7, 2020 detailed flood tide profiling was conducted from Fort Pulaski to above the turning basin in the Front River and below the diffuser on the Back River. One additional profile was completed in the upper Little Back River. Profile locations and results are shown below in ***Figure B-13*** and ***Figure B-14***.

- There was salinity stratification from Fort Pulaski to above the turning basin; however, the stratification began to weaken around the turning basin as higher river flows (12,000 cfs at Clyo) entered the harbor.
- The DO stratified in the upper Front River and with less stratification in the lower Front River as the offshore water was pushed on up the river.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye remained present in the Back River, but declining.
- The dye concentration peaks began to be more distributed in the Front River and as a result, dye concentrations began to decline.

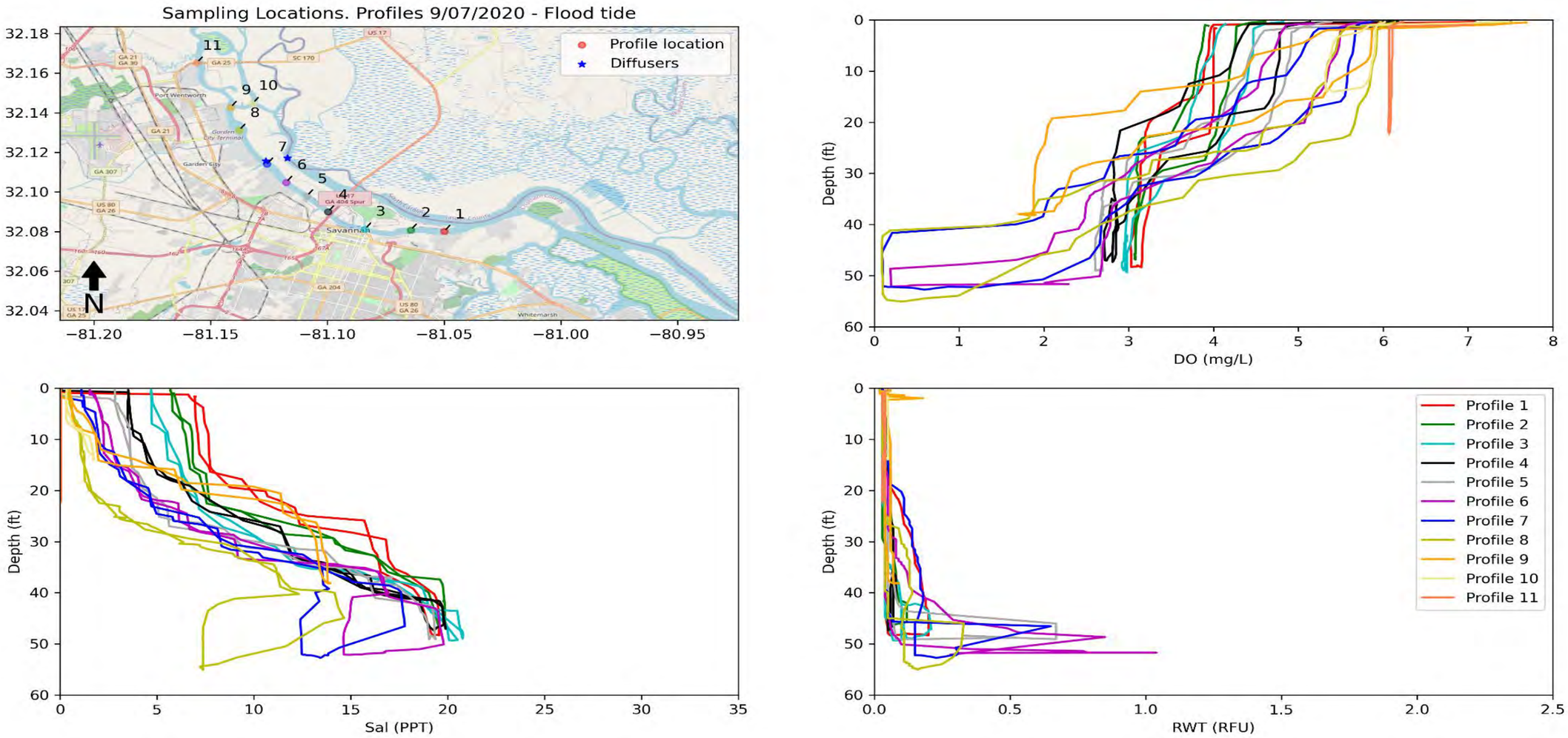
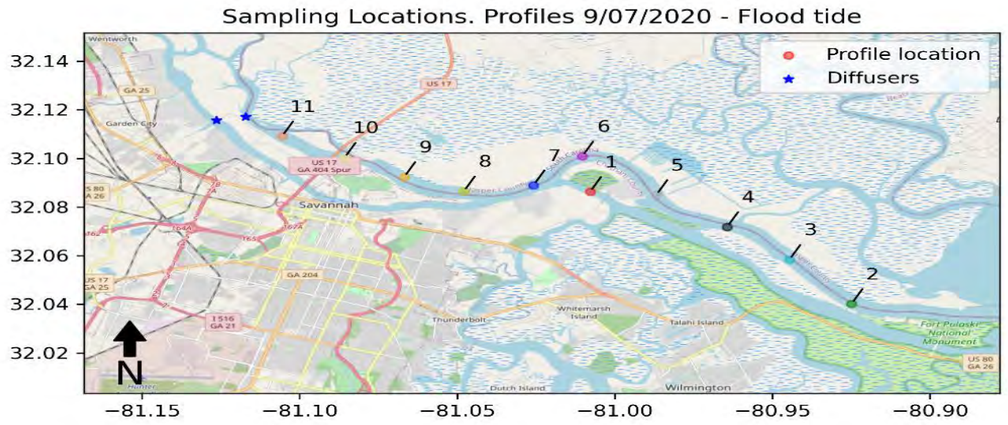
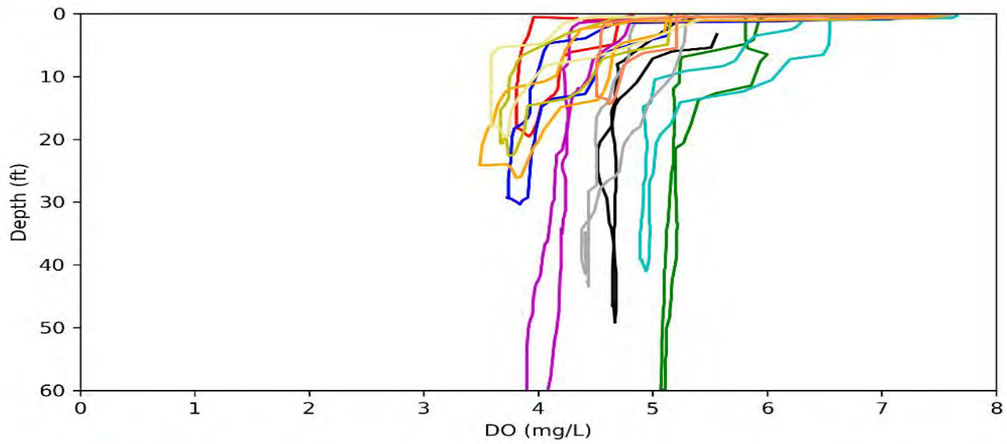
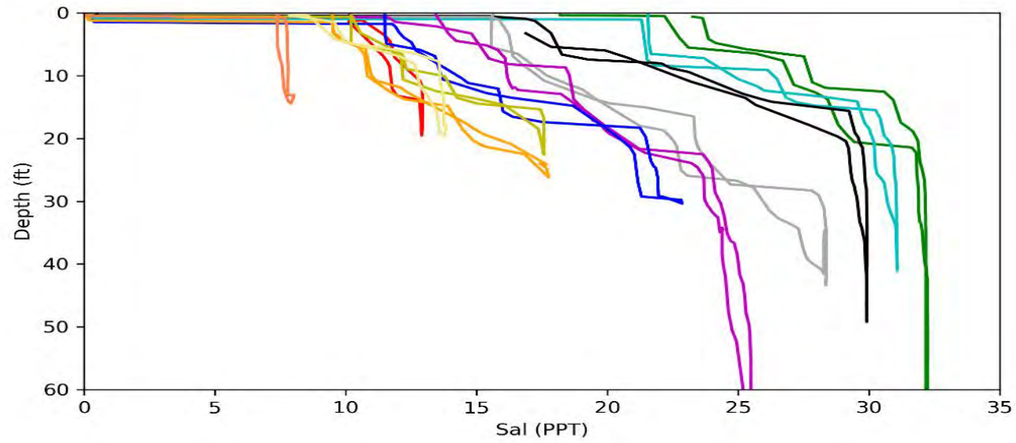


Figure B-13 Vertical monitoring profiles Front River and Back River September 7, 2020 [LFR_090720_OT_001]







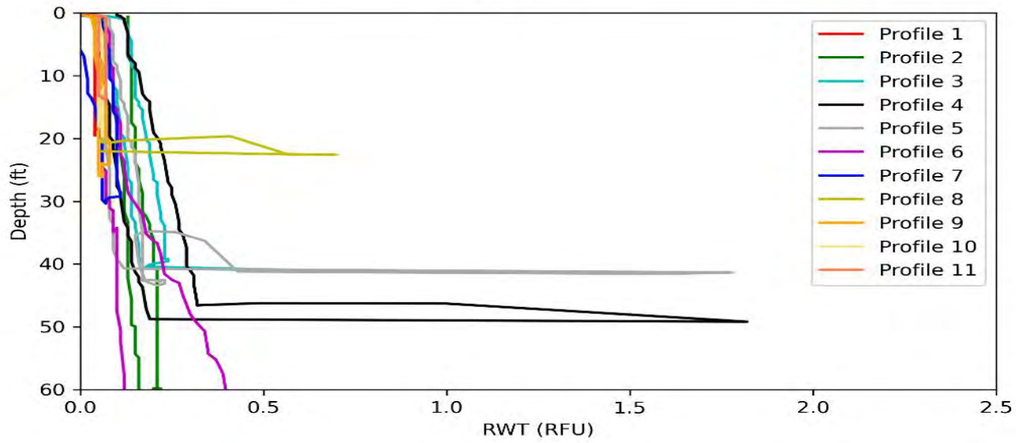


Figure B-14 Vertical monitoring profiles Front River and Back River September 7, 2020 [LFR_090720_OT_002]

B.10 SEPTEMBER 9, 2020 PROFILING

September 9, 2020 detailed flood tide profiling was conducted from Fort Pulaski to above the turning basin in the Front River and below the diffuser on the Back River. One additional profile was completed in the upper Little Back River. Profile locations and results are shown below in ***Figure B-15*** and ***Figure B-16***.

- There was salinity stratification from Fort Pulaski to above the turning basin; however, the stratification began to weaken around the turning basin as higher river flows (12,000 cfs at Clyo) entered the harbor.
- The DO stratified in the upper Front River with less stratification in the lower Front River as the offshore water was pushed up the river.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye remained present in the Back River, but declining.
- The dye concentration peaks began to be more distributed in the Front River and as a result, dye concentration began to decline.

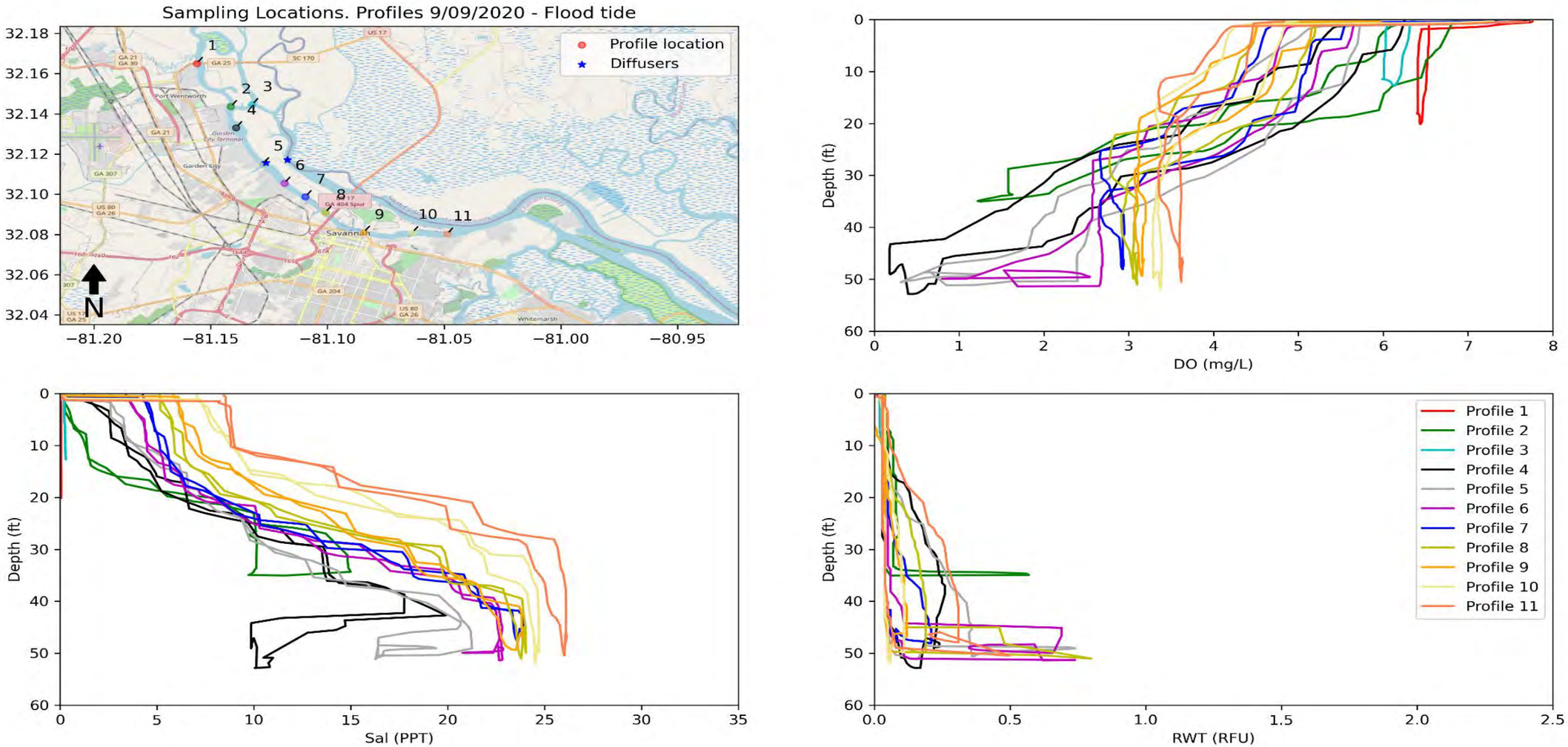
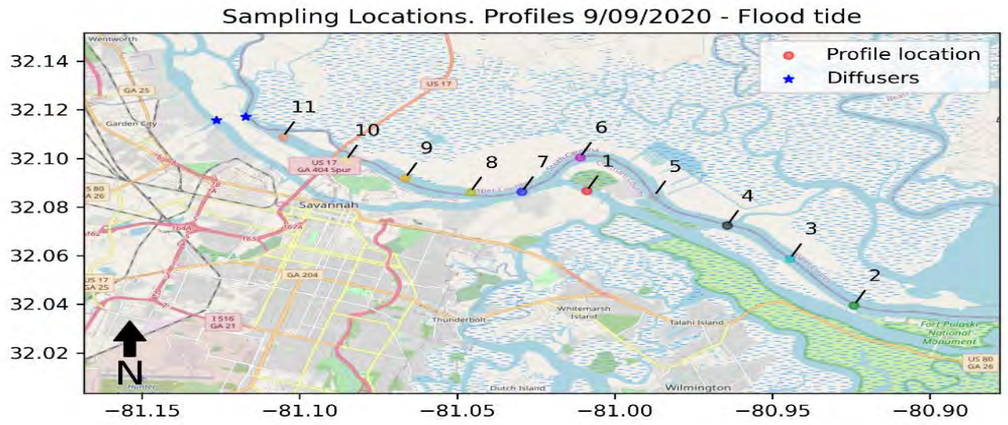
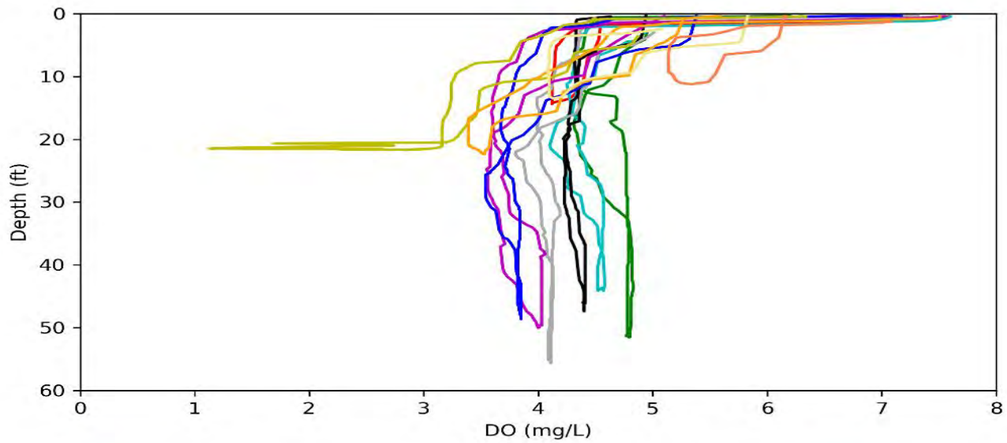
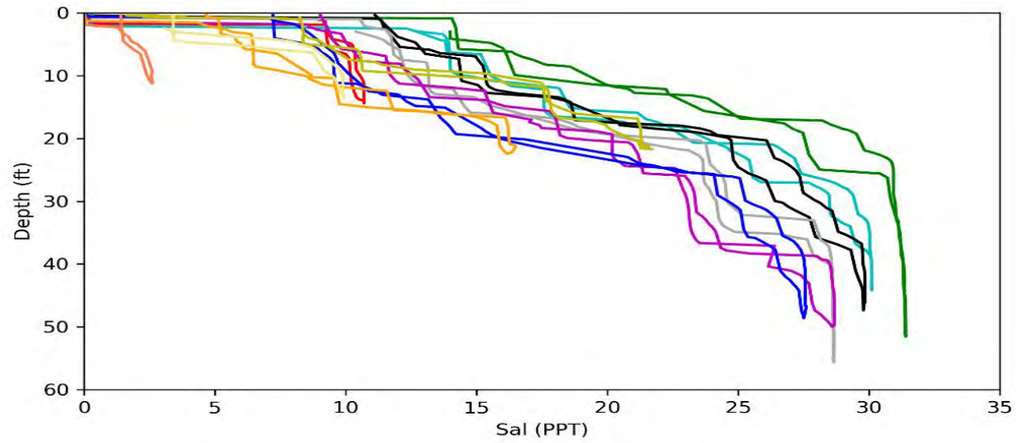


Figure B-15 Vertical monitoring profiles Front River and Back River September 9, 2020 [LFR_090920_OT_001]







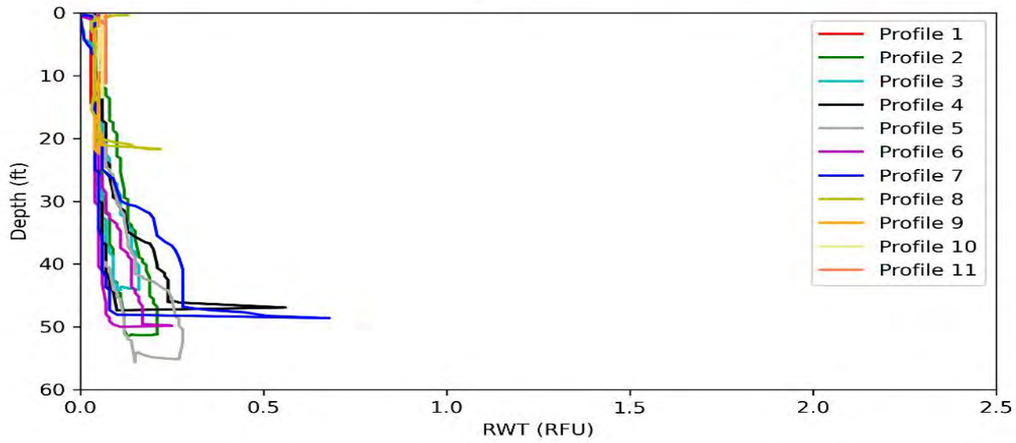


Figure B-16 Vertical monitoring profiles Front River and Back River September 9, 2020 [LFR_090920_OT_002]

B.11 SEPTEMBER 11, 2020 PROFILING

September 11, 2020 detailed flood tide profiling was conducted from Fort Pulaski to above the turning basin in the Front River and below the diffuser on the Back River. One additional profile was conducted in the upper Little Back River. Profile locations and results are shown below in ***Figure B-17*** and ***Figure B-18***.

- There was salinity stratification from Fort Pulaski to above the turning basin, the upstream flows began to decrease, and the stratification was present around the turning basin.
- The DO stratified in the upper Front River and less stratification in the lower Front River as the offshore water was pushed up the river.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye was still present in the Back River, but declining. The dye concentration peaks began to be more distributed in the Front River and as a result, dye concentration began to decline.
- A single strong dye peak was measured at the bottom above Fort Pulaski.

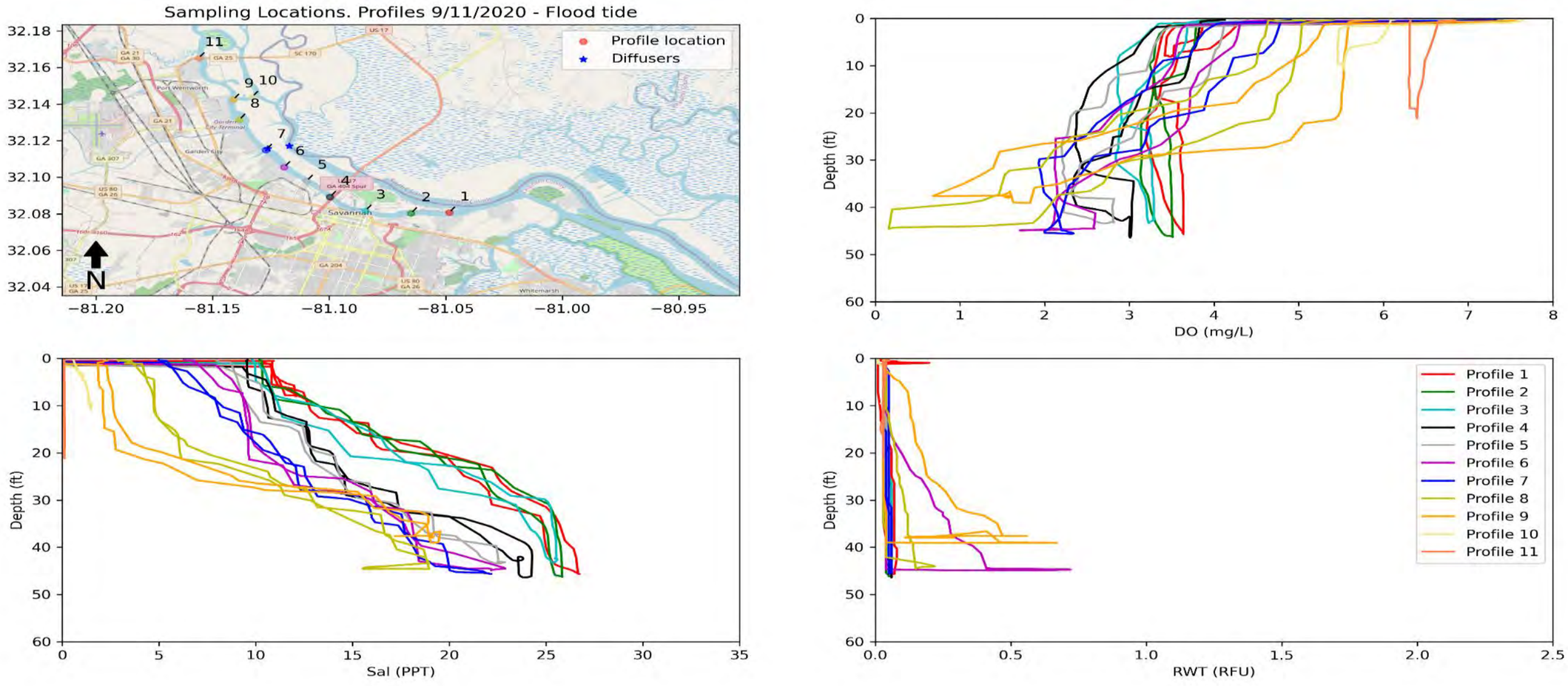
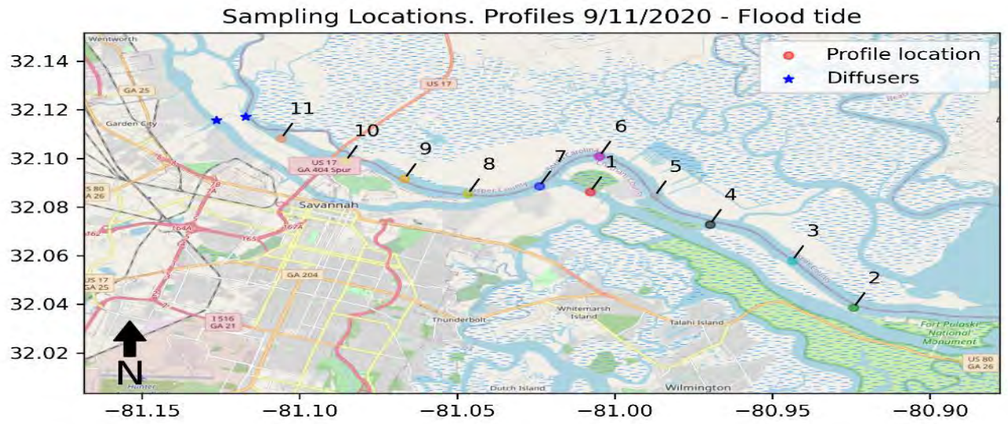
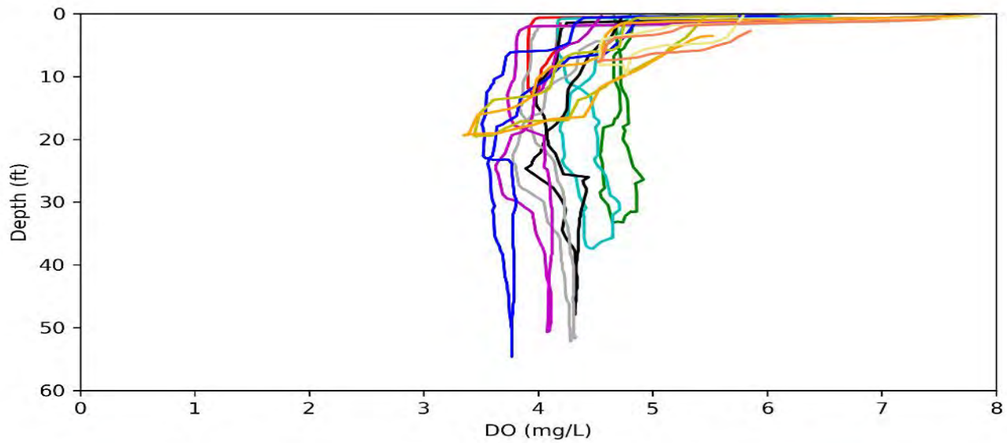
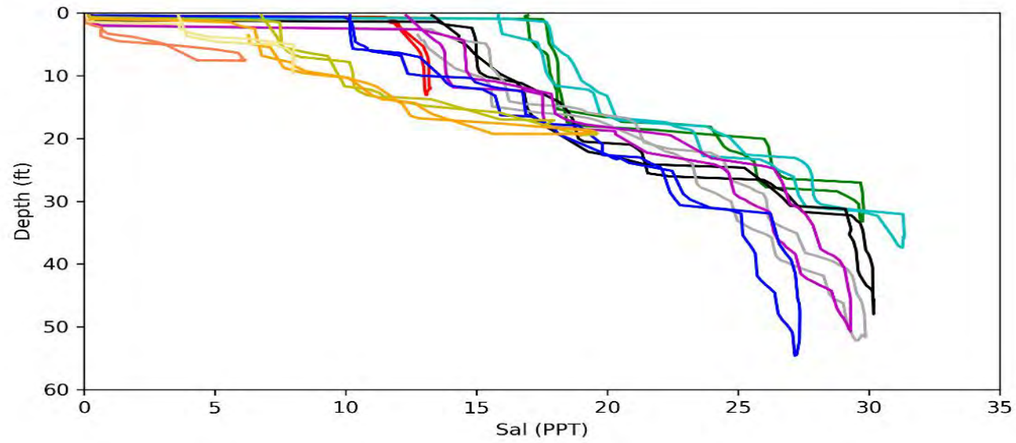


Figure B-17 Vertical monitoring profiles Front River and Back River September 11, 2020 [LFR_091120_IT_001]







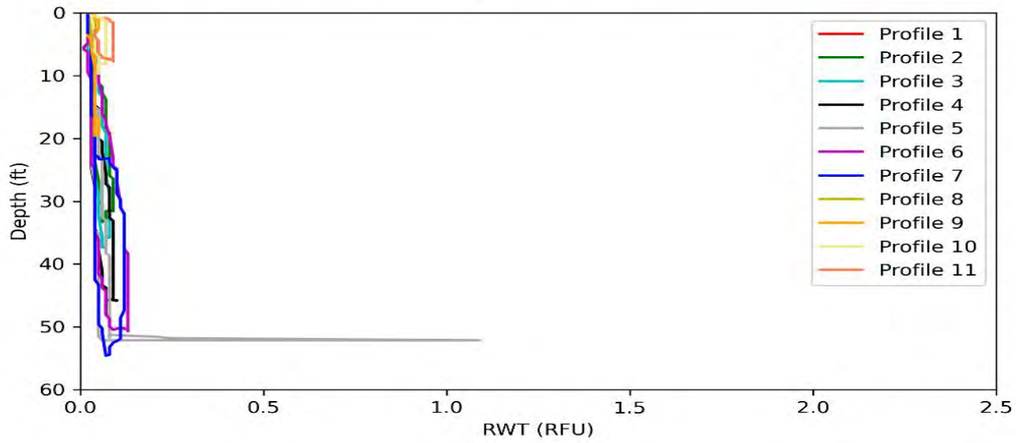


Figure B-18 Vertical monitoring profiles Front River and Back River September 11, 2020 [LFR_091120_IT_002]

B.12 SEPTEMBER 14, 2020 PROFILING

September 14, 2020 detailed flood tide profiling was conducted from Fort Pulaski to above the turning basin in the Front River and below the diffuser on the Back River. One additional profile was completed in the upper Little Back River. Profile locations and results are shown below in ***Figure B-19*** and ***Figure B-20***.

- There was salinity stratification from Fort Pulaski to above the turning basin; however, the stratification began to weaken as spring tide conditions approached.
- The DO stratified in the upper Front river with less stratification in the lower Front River as the offshore water was pushed up the river.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye remained in the Back River, but began to decline.
- The dye concentration peaks were more distributed in the Front River and began to decline.

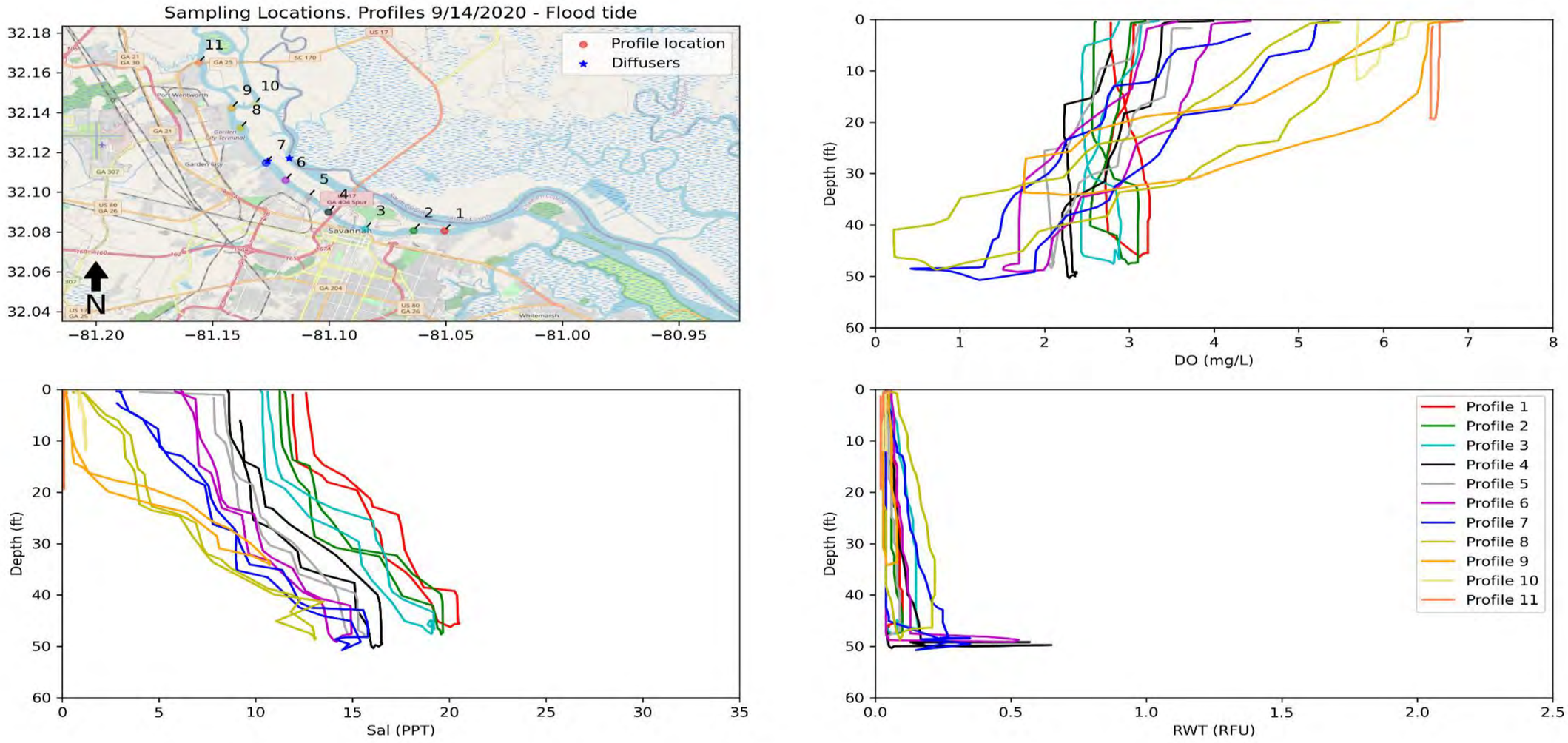
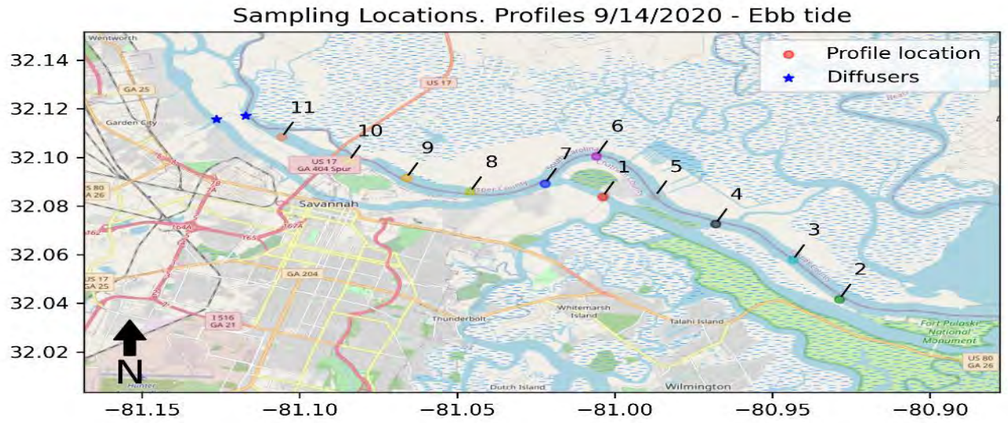
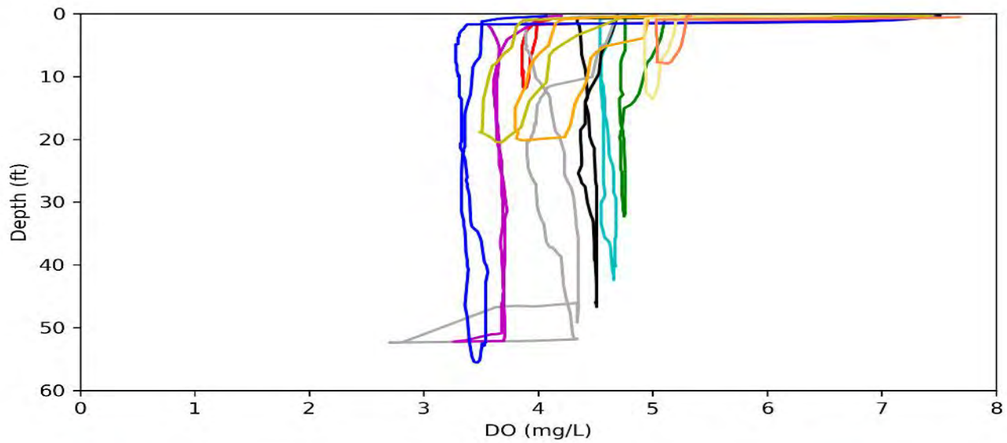
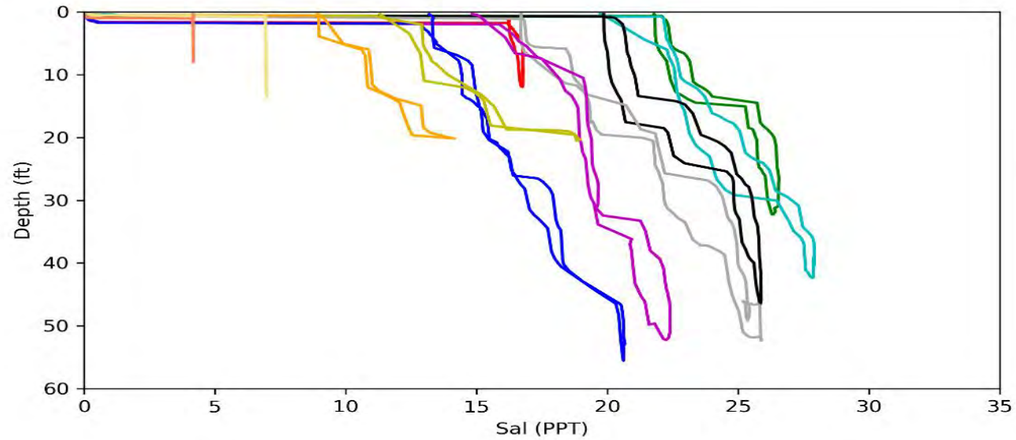


Figure B-19 Vertical monitoring profiles Front River and Back River September 14, 2020 [LFR_091420_IT_001]







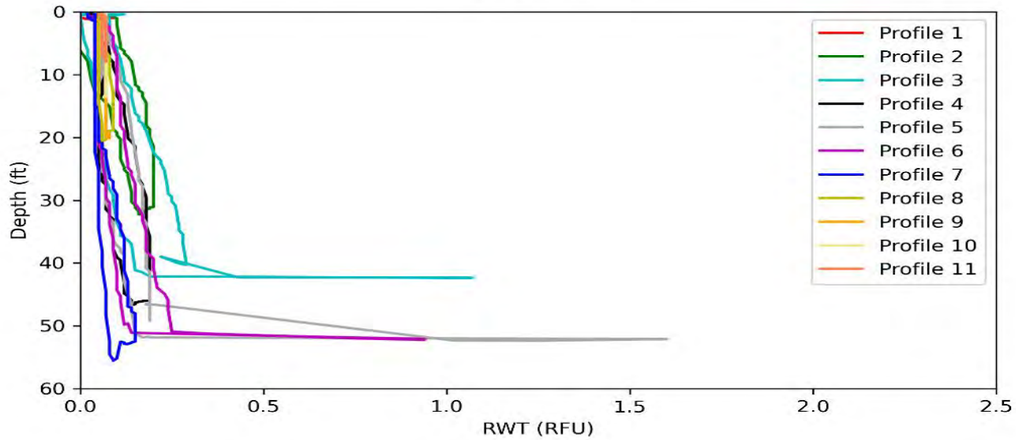


Figure B-20 Vertical monitoring profiles Front River and Back River September 14, 2020 [LFR_091420_OT_002]

B.13 SEPTEMBER 17, 2020 PROFILING

September 17, 2020 detailed ebb tide profiling was conducted from I-95 to above turning basin and below in the lower Front River. Profile locations and results are shown below in ***Figure B-21***, ***Figure B-22***, and ***Figure B-23***. Please note, there was a September 15, 2020 Upriver dye injection.

- There was some salinity stratification from Fort Pulaski to GA 25 bridge; however, the stratification began to weaken as spring tide conditions approached.
- The DO stratification area began to shrink.
- Upriver September 15, 2020 dye injection peaks were evident around US-17 bridge.

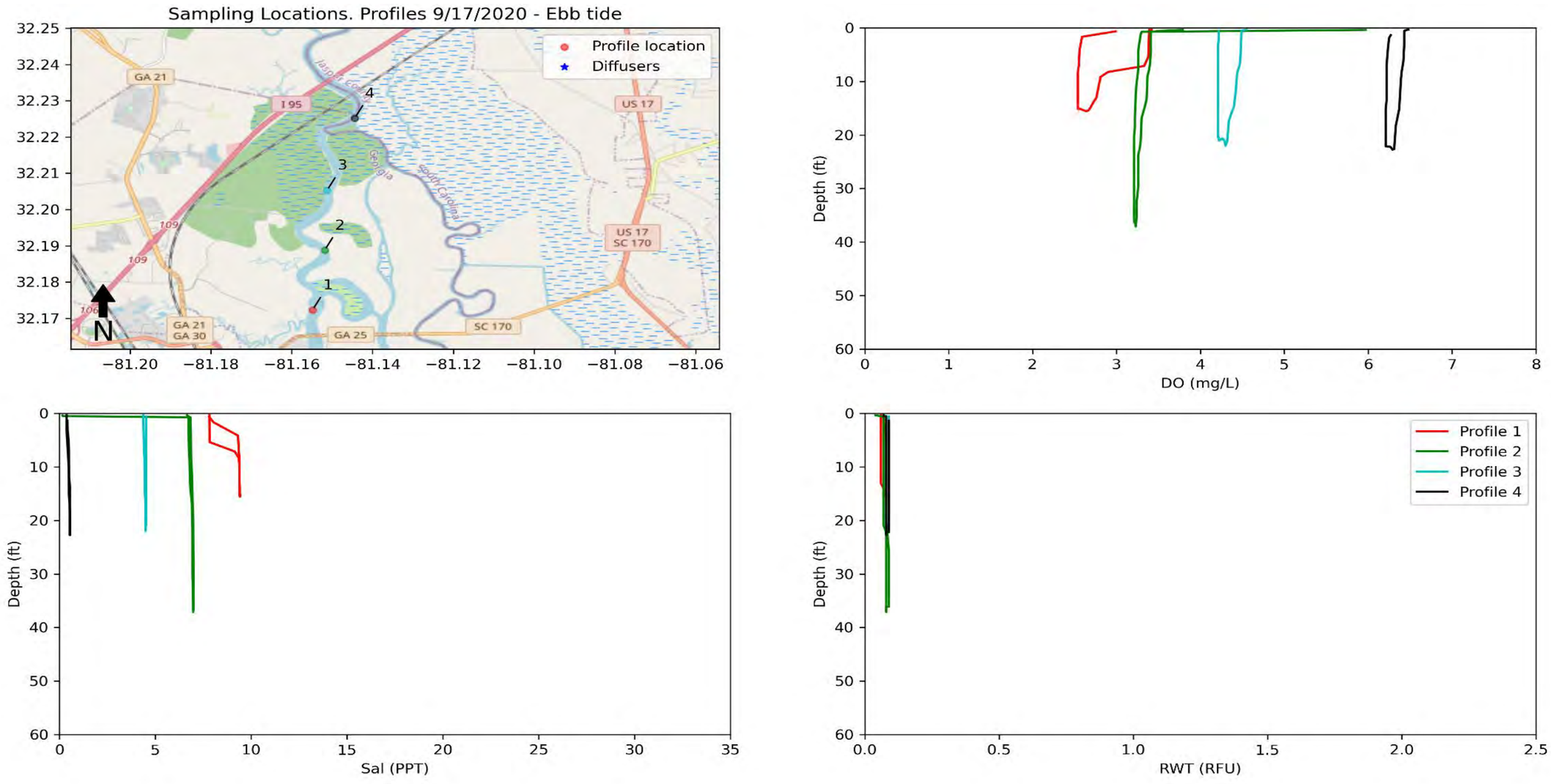


Figure B-21 Vertical monitoring profiles Front River and Back River September 17, 2020 [LFR_091720_OT_001]

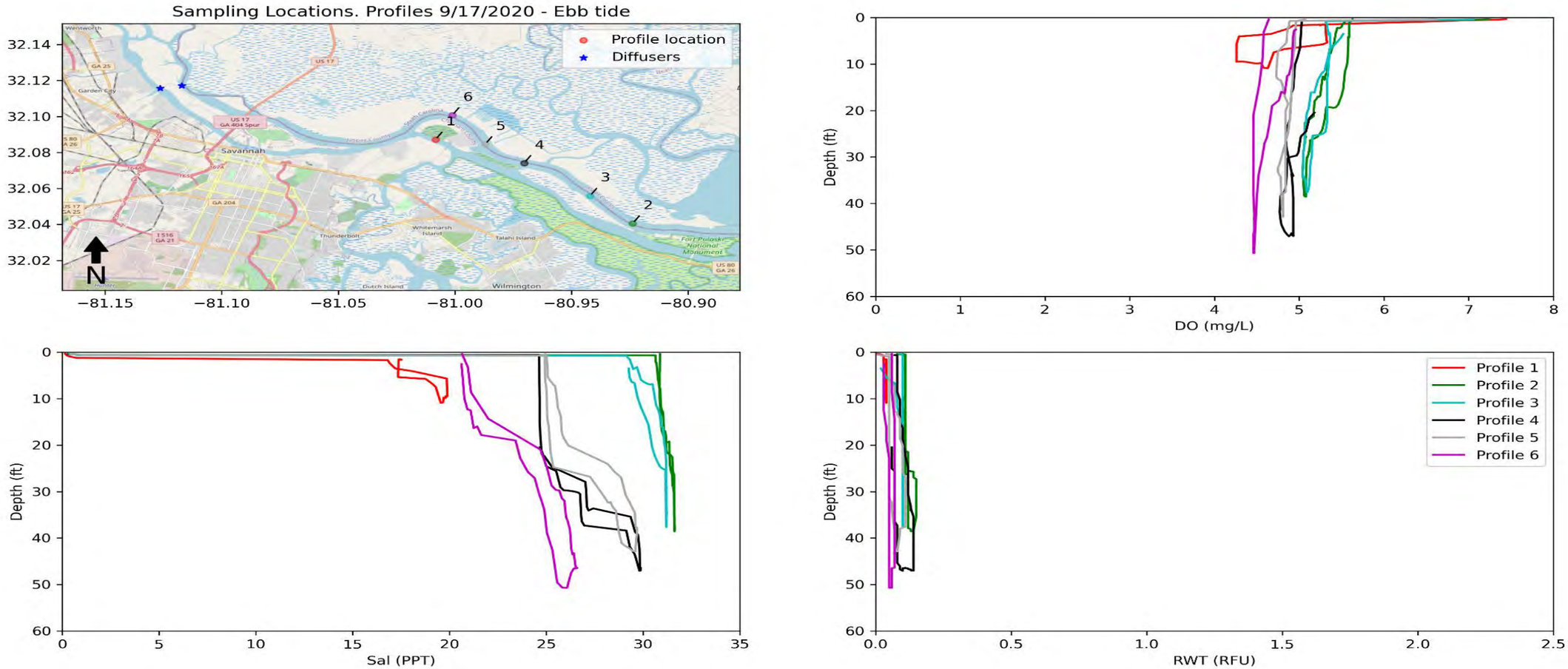


Figure B-22 Vertical monitoring profiles Front River and Back River September 17, 2020 [LFR_091720_OT_002]

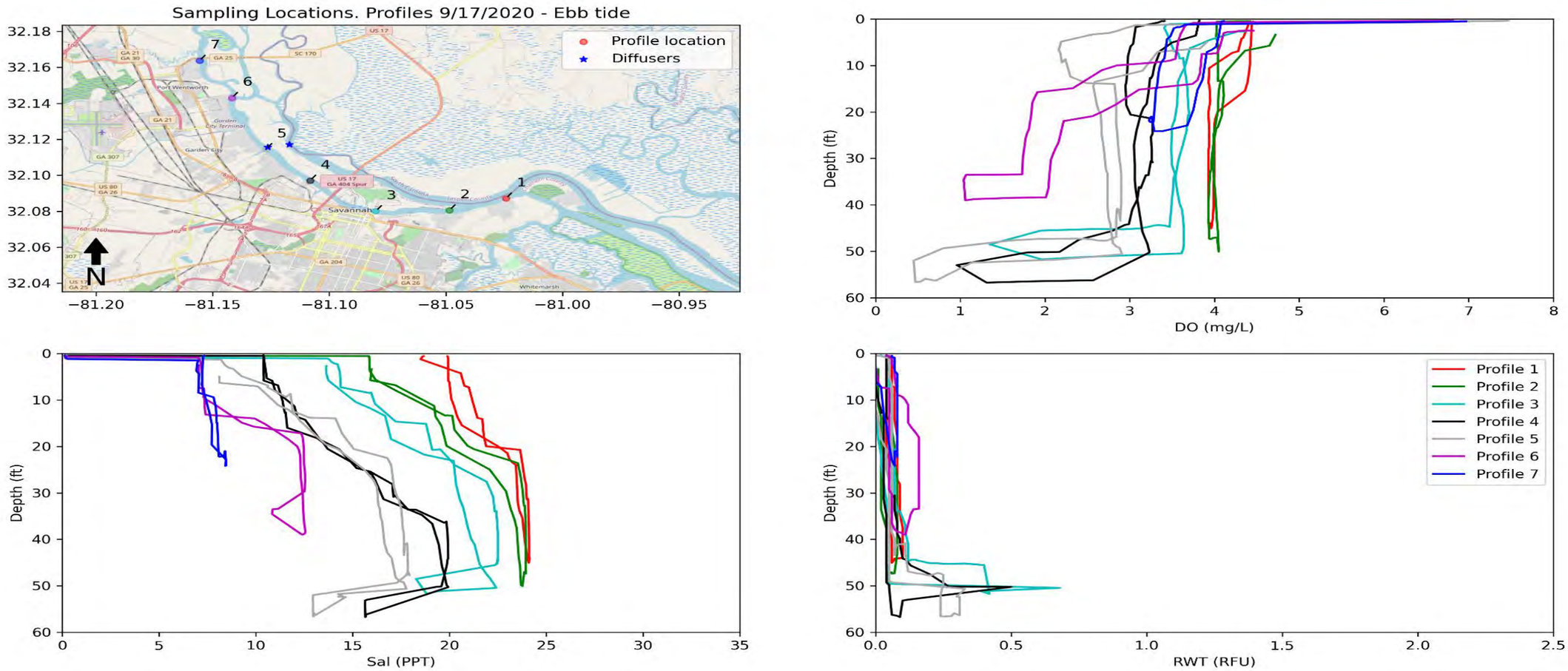


Figure B-23 Vertical monitoring profiles Front River and Back River September 17, 2020 [LFR_091720_OT_003]

B.14 SEPTEMBER 18, 2020 PROFILING

September 18, 2020 detailed ebb tide profiling was conducted from Fort Pulaski to above the turning basin in the Front River and below the diffuser on the Back River. One additional profile was completed in the upper Little Back River. Profile locations and results are shown below in ***Figure B-24*** and ***Figure B-25***.

- There was salinity stratification from Fort Pulaski to above the turning basin; however, the stratification weakened due to spring tide conditions.
- The DO stratified in the upper Front River with less stratification in the lower Front River as the offshore water was pushed up the river.
- The September 15 Upriver dye injection is present in the Front River and the dye concentration were being distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye remained in the Back River but was close to background levels.
- The dye concentration peaks were more distributed in the Front River.

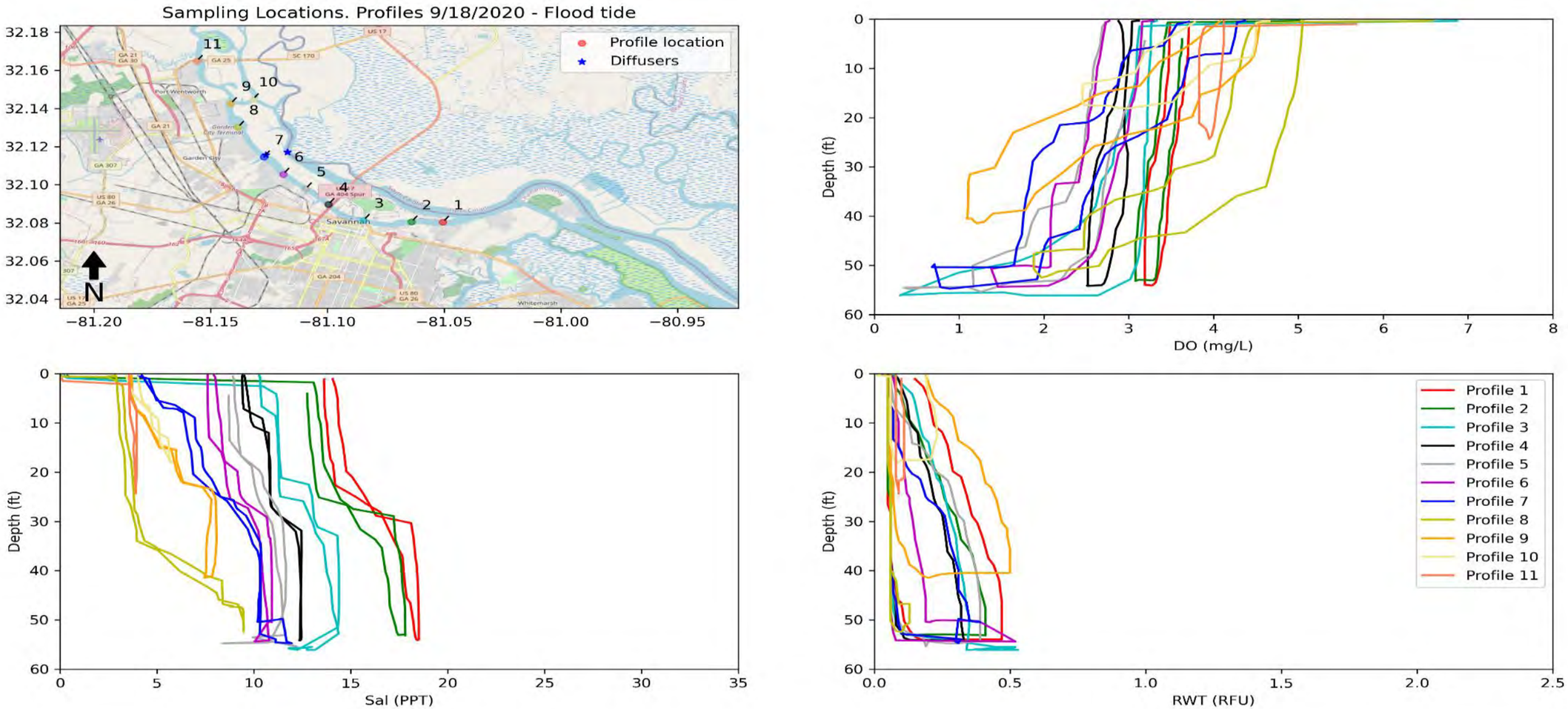


Figure B-24 Vertical monitoring profiles Front River and Back River September 18, 2020 [LFR_091820_IT_001]

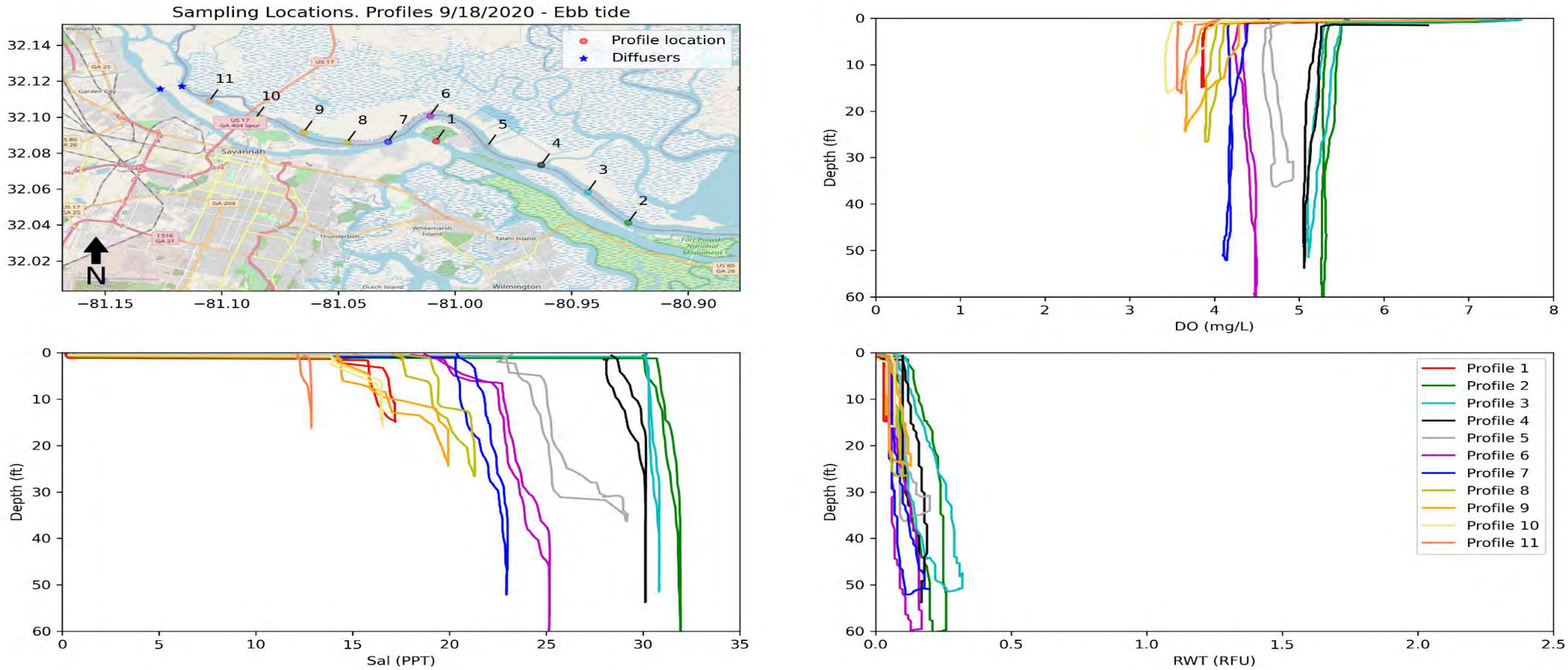


Figure B-25 Vertical monitoring profiles Front River and Back River September 18, 2020 [LFR_091820_OT_002]

B.15 SEPTEMBER 19, 2020 PROFILING

September 19, 2020 detailed flood tide profiling was conducted from Fort Pulaski to above the turning basin in the Front River and below the diffuser on the Back River. One additional profile was completed in the upper Little Back River. Profile locations and results are shown below in ***Figure B-26***.

- There was salinity stratification from Fort Pulaski to above the turning basin; however, the stratification began to weaken as spring tide conditions approached.
- The DO stratified in the upper Front River with less stratification in the lower Front River as the offshore water is pushed up the river.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye was still present in the Back River, but declining.
- The dye concentration peaks were more distributed in the Front River and began to decline.

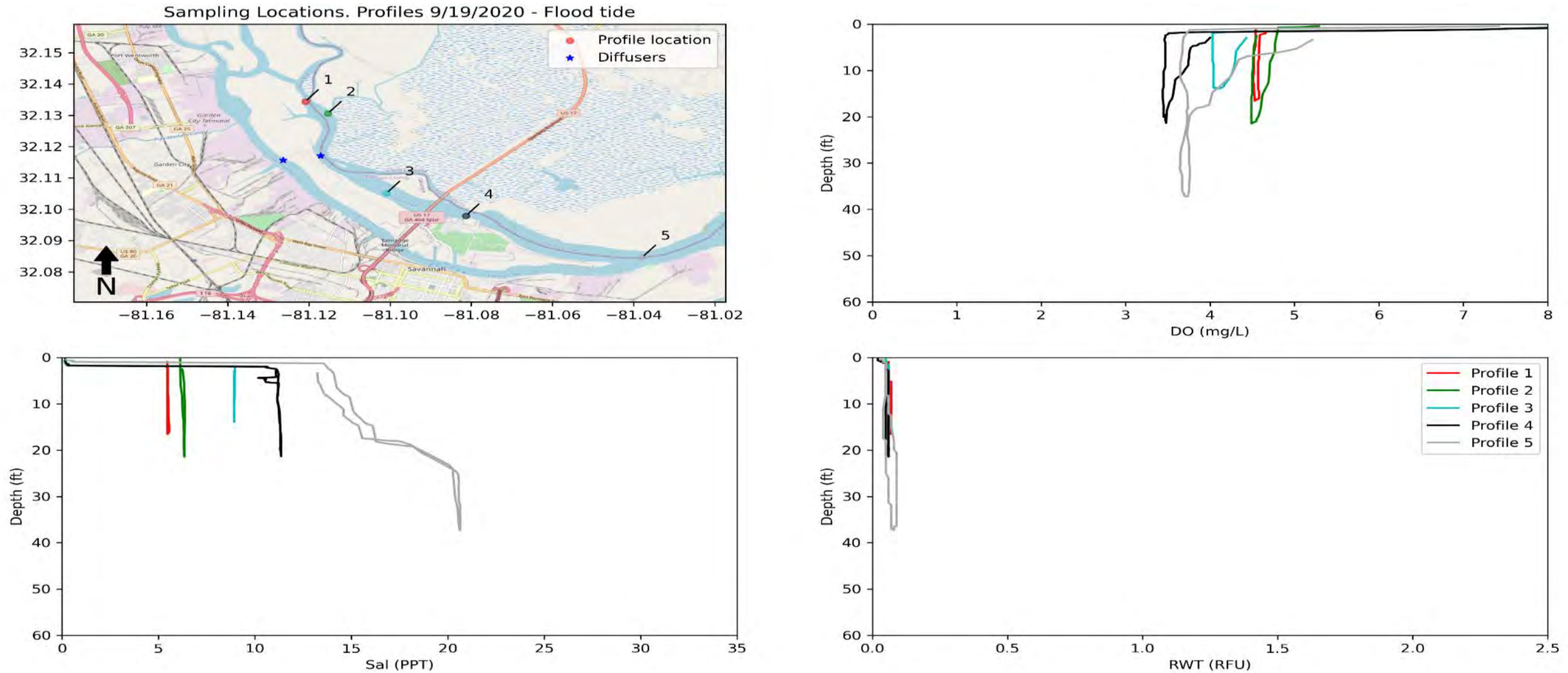


Figure B-26 Vertical monitoring profiles Front River and Back River September 19, 2020 [LBR_091920_IT_001 and LBR_091920_IT_002_1]

B.16 SEPTEMBER 21, 2020 PROFILING

September 21, 2020 detailed flood tide profiling was conducted from Fort Pulaski to above the turning basin in the Front River and below the diffuser on the Back River. One additional profile was completed in the upper Little Back River. Profile locations and results are shown in ***Figure B-27*** and ***Figure B-28***.

- There was salinity stratification from Fort Pulaski to above the turning basin. Stratification began to strengthen as spring tide conditions receded
- The DO stratified in the upper Front river with less stratification in the lower Front River as the offshore water was pushed up the river.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye was at background in Back River.
  The dye concentration peaks were slightly more distributed in the Front River

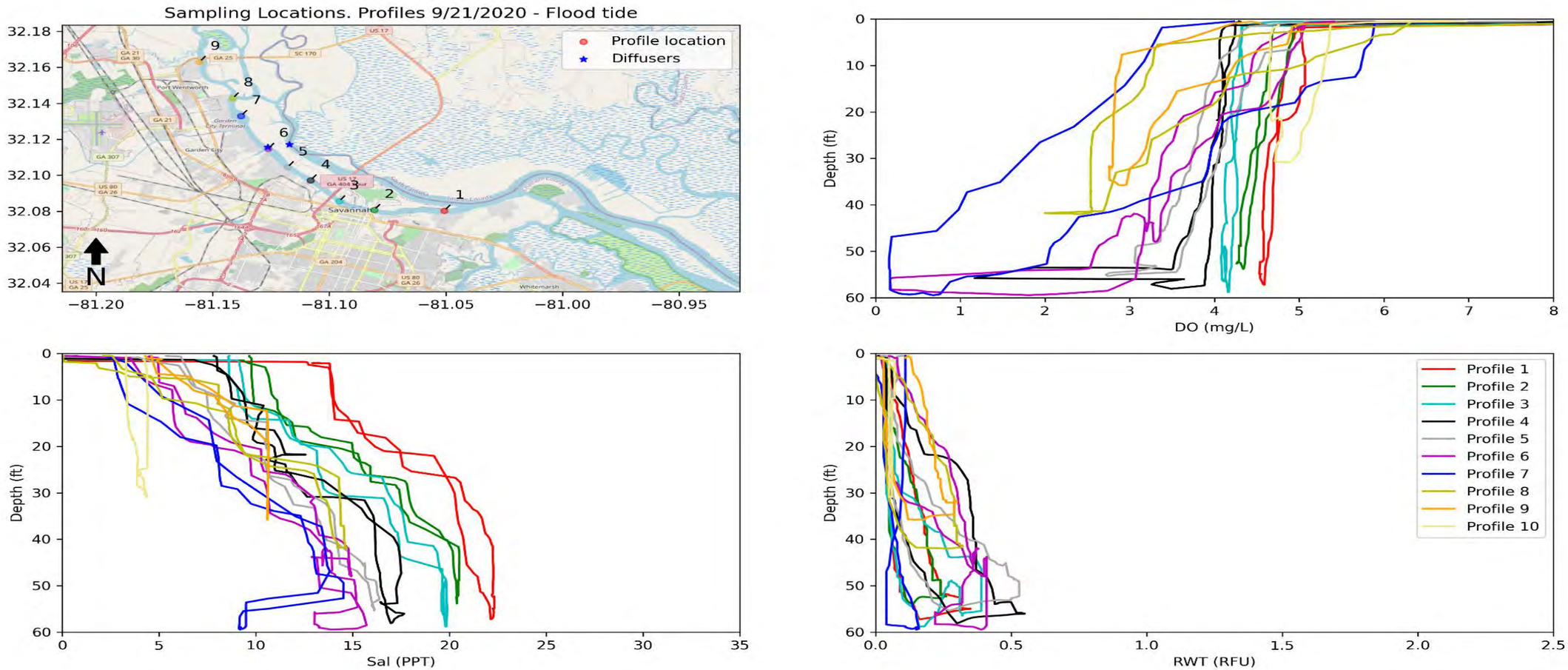


Figure B-27 Vertical monitoring profiles Front River and Back River September 21, 2020 [LFR_092120_IT_001]

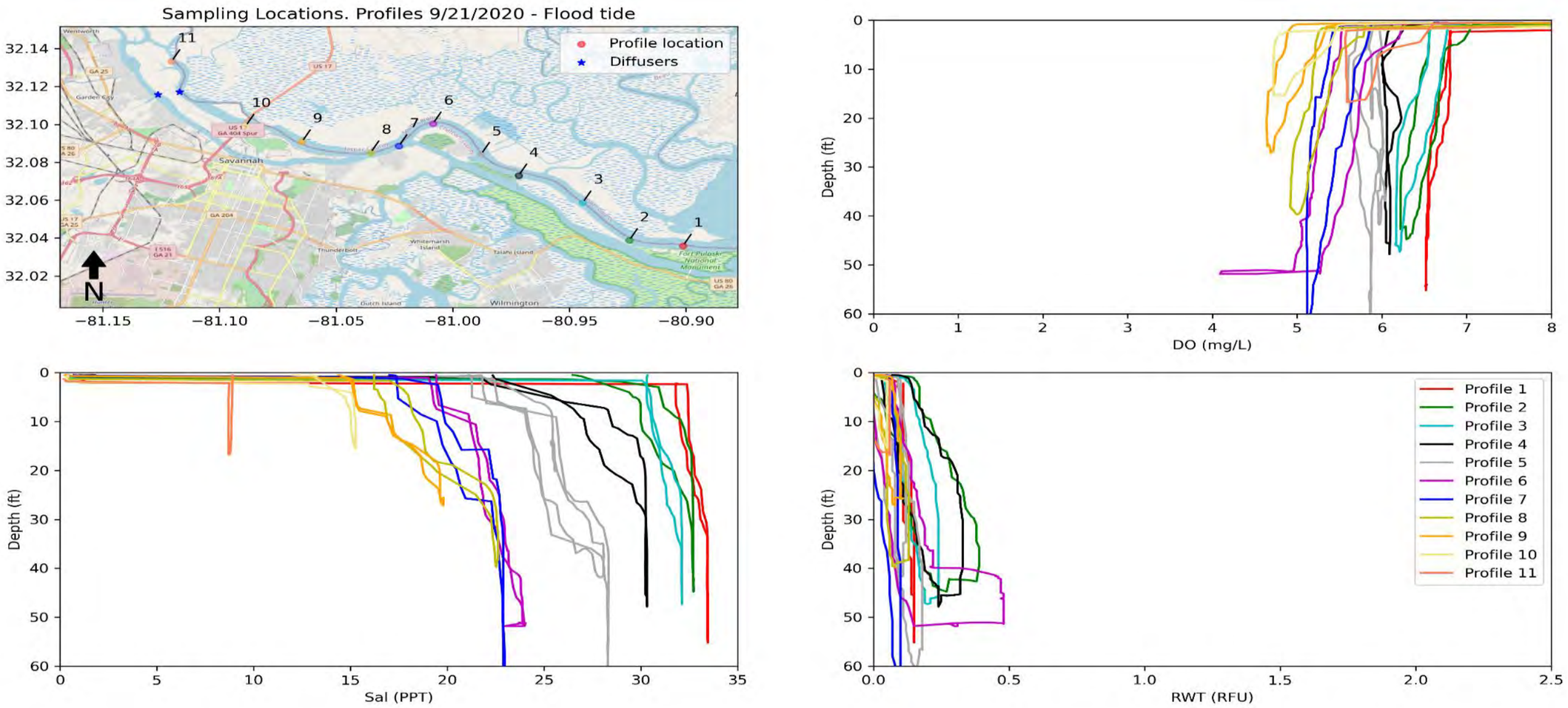


Figure B-28 Vertical monitoring profiles Front River and Back River September 21, 2020 [LFR_092120_IT_002]

B.17 SEPTEMBER 22, 2020 PROFILING

September 22, 2020 detailed flood tide profiling was conducted from Fort Pulaski to above the turning basin in the Front River and below the diffuser on the Back River. One additional profile was completed in the upper Little Back River. Profile locations and results are shown below in ***Figure B-29*** and ***Figure B-30***.

- There was salinity stratification from Fort Pulaski to above the turning basin. Stratification began to strengthen as spring tide conditions receded.
- The DO stratified in the upper Front River with less stratification in the lower Front River as the offshore water was pushed up the river.
- The Front River dye concentration was distributed between the turning basin and the confluence with the Back River, with the higher concentration at the lower depths.
- The dye was at background in Back River.
- The dye concentration peaks were slightly more distributed in the Front River.

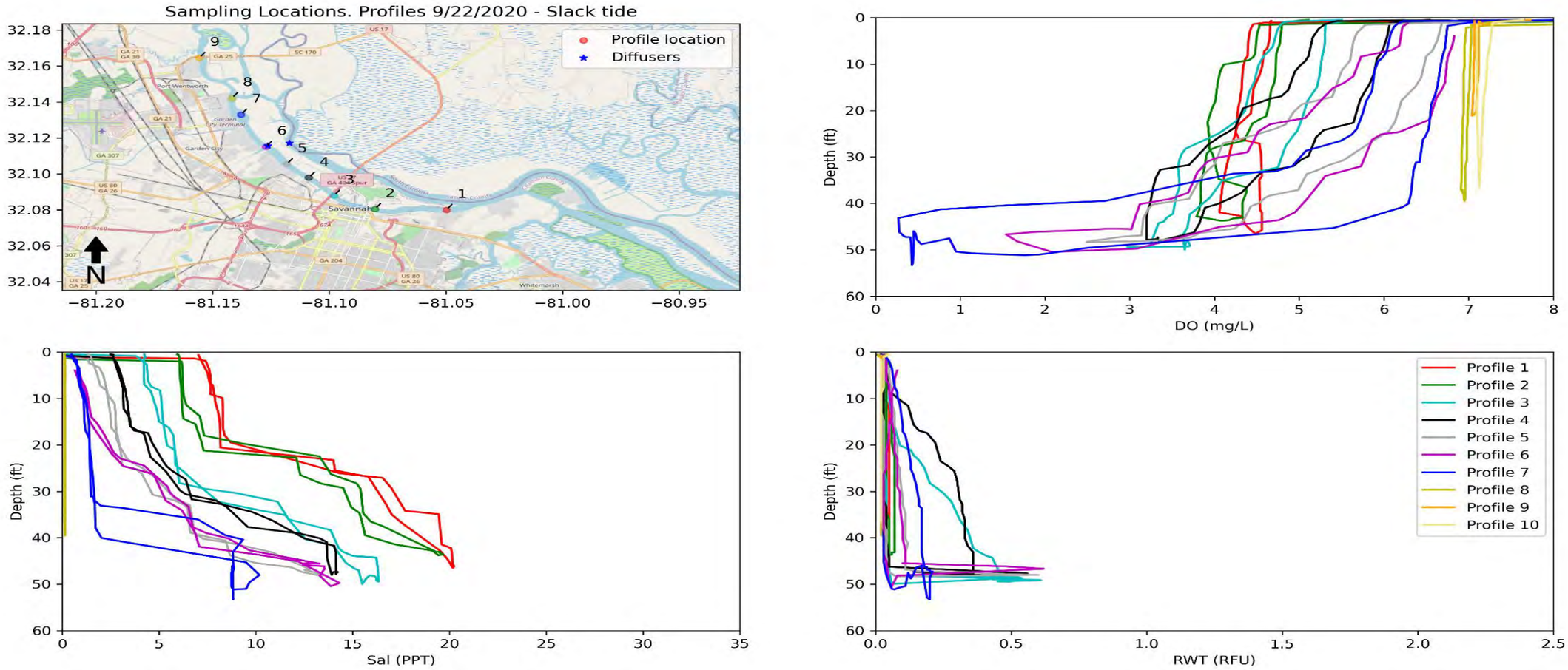


Figure B-29 Vertical monitoring profiles Front River and Back River September 22, 2020 [LFR_092220_LT_001]

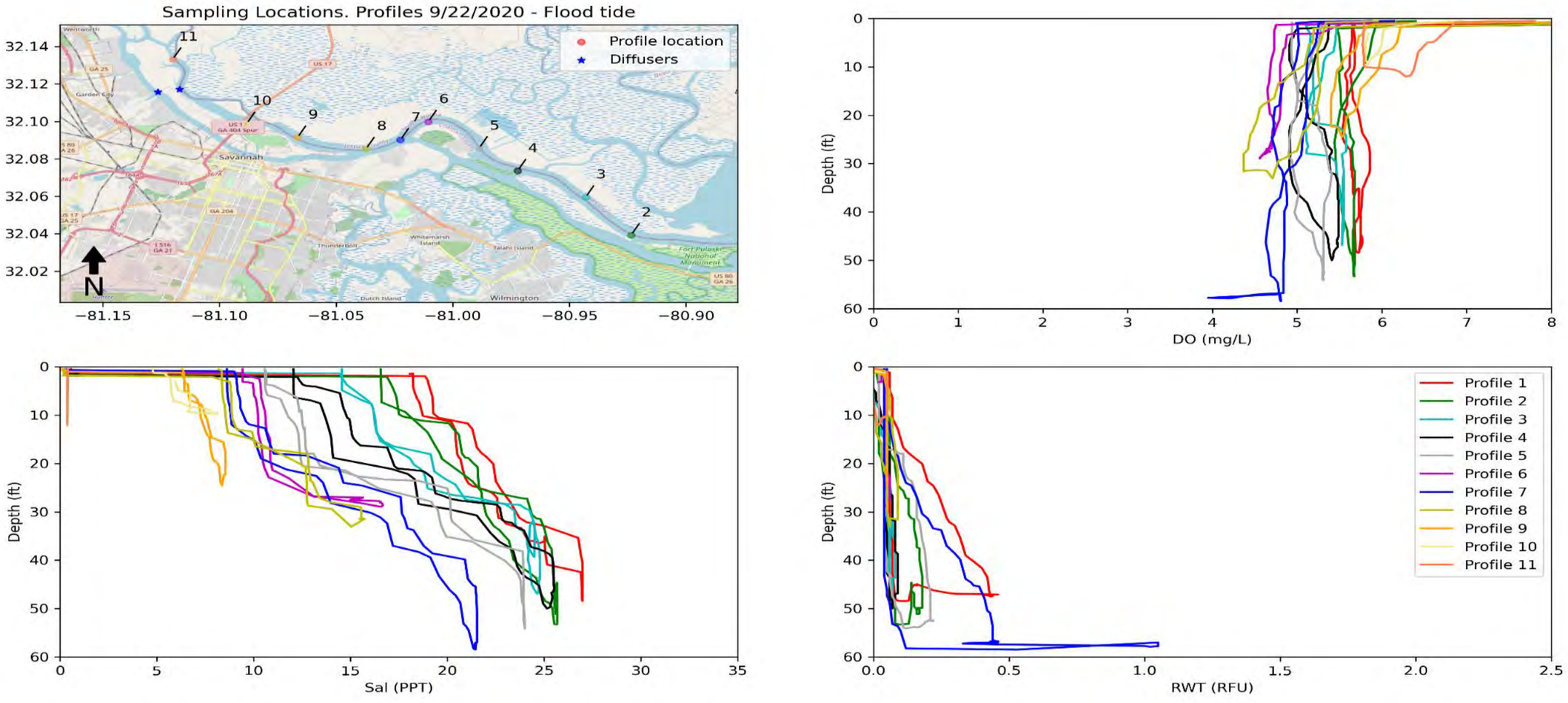


Figure B-30 Vertical monitoring profiles Front River and Back River September 22, 2020 [LFR_092220_OT_002]

B.18 UPRIVER JULY 28, 2020 SALINITY AND DO PROFILES

DO profiles shown below in ***Figure B-31*** detail how the injected oxygen plume was being distributed bottom to surface as the plume moves downstream of the diffuser.

- The Background, profile #1 (red), shows DO the same top to bottom.
- 200 feet downstream of the diffuser, profiles #2 (green) and #3 (aqua), shows background DO at the top and then DO increased from 7 mg/L to 8.5 or 9 mg/L as the sonde descended into the oxygen plume.
- 300 feet downstream of the diffuser, profile #4 (black), shows the DO as it began to mix top to bottom.
- 1200 feet downstream, profile #5 (gray), shows the DO mixed top to bottom, with a change in DO of 0.8 mg/L from background.
- At profile #10 the injected oxygen is well mixed in the river and the DO is increased by 0.8 mg/L over background.

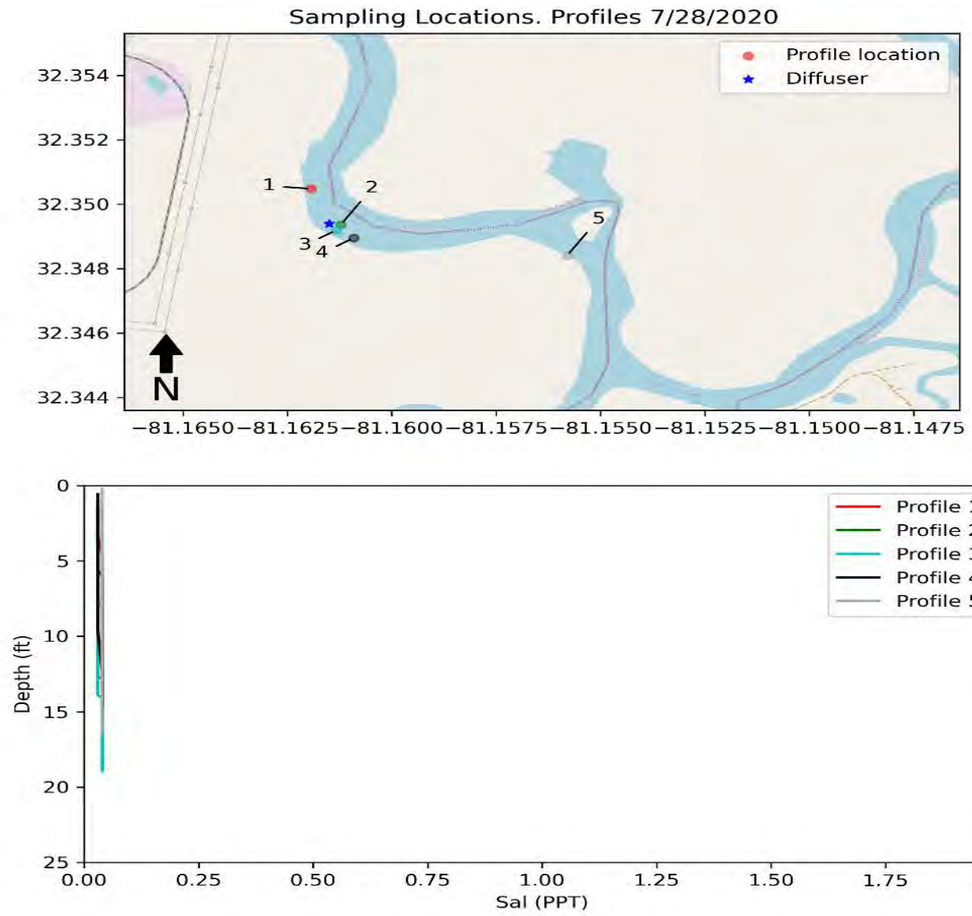


Figure B-31 Vertical monitoring profiles Upriver July 28, 2020 [UR_072820_001 to UR_072820_005]

B.19 UPRIVER SEPTEMBER 8, 2020 SALINITY AND DO PROFILES

These DO profiles show in Figure 31detail how the injected oxygen plume was being distributed bottom to surface.as the plume moves downstream of the diffuser.

- The Background, profile #1 (red), shows DO the same top to bottom.
- 200 feet downstream of the diffuser, profiles #2 (green) and #3 (aqua), shows background DO at the top and then DO increased from 7 mg/L to 8.5 or 9 mg/L as the sonde descended into the oxygen plume.
- 300 feet downstream of the diffuser, profile #4 (black), shows the DO as it began to mix top to bottom.
- 500 to 800 feet downstream, profiles #5 (gray), #6 (purple), #7 (blue), #8 (gold) and #9 (orange) show the DO mostly mixed top to bottom.
- 1200 feet downstream, profile #10 (yellow) show DO mixed top to bottom.
- At profile #10 the injected oxygen is well mixed in the river and the DO is increased by 0.8 mg/L over background.

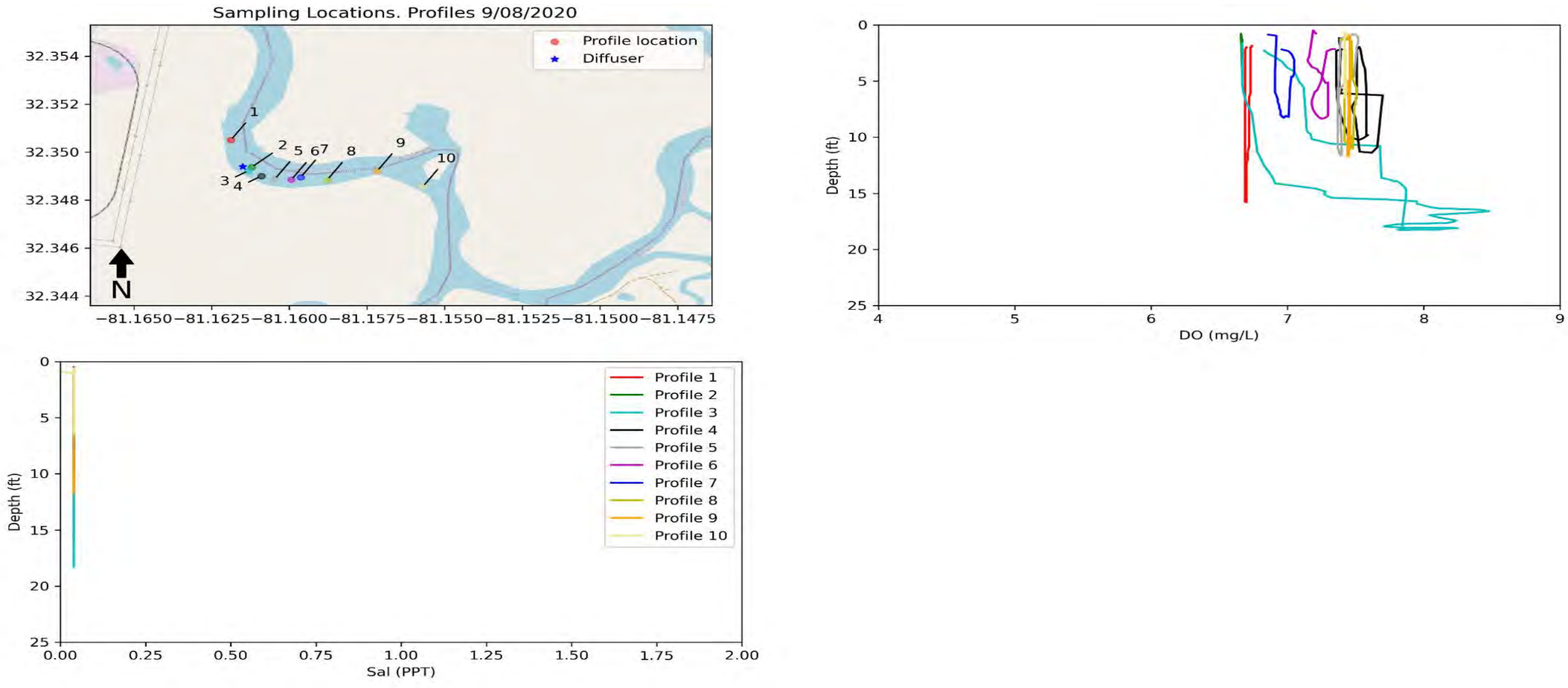


Figure B-32 Vertical monitoring profiles Upriver September 8, 2020 [UR_090820_001 to UR_090820_010]

APPENDIX C DRIFT DATA

APPENDIX C DRIFT DATA

Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Task: 10
March 2021

PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG^2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX C BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document forms Appendix C of the SUR Report. It is referred to in the main body in Sections 2.3, 3.2, 8.2, 9.1, and 9.2.2.

APPENDIX C TABLE OF CONTENTS

APPENDIX C DRIFT DATA C-1

C.1 Drift Data C-11
C.2 Drift Data Summary C-11
C.3 Back River C-13
C.4 July 27, 2020 Drift Back River C-14
C.5 July 28, 2020 Drift Back River C-16
C.6 July 29, 2020 drift Back River C-19
C.7 July 30, 2020 Drift Back River C-21
C.8 July 31, 2020 Drift Back River C-22
C.9 August 4, 2020 Drift Back River C-24
C.10 August 5, 2020 Drift Back RIver C-25
C.11 August 7, 2020 Drift Back River C-26
C.12 August 12, 2020 Dye Injection Drift Back River C-27
C.13 August 13, 2020 Drift Back River C-31
C.14 August 14, 2020 Drift Back River C-34
C.15 August 15, 2020 Drift Back River C-36
C.16 August 17, 2020 Drift Back River C-38
C.18 August 19, 2020 Drift Back River C-44
C.19 August 21, 2020 Drift Back River C-46
C.20 August 22, 2020 Drift Back River C-48
C.21 August 25, 2020 Dye Injection Drift Back River C-50
C.22 August 26, 2020 Drift Back River C-53
C.23 August 27, 2020 Drift Back River C-56
C.24 September 1, 2020 Drift Back River C-58
C.25 September 3, 2020 Drift Back River C-60
C.26 September 8, 2020 Drift Back River C-62
C.27 September 12, 2020 Drift Back River C-64
C.28 September 16, 2020 Drift Back River C-66
C.29 September 17, 2020 Little Back River C-68
C.30 September 19, 2020 Drift Back River C-71
C.31 Front River C-73
C.32 July 27, 2020 Drift Front River C-73

C.33 July 29, 2020 Drift Front River C-76
C.34 July 31, 2020 Drift Front River C-78
C.35 August 4, 2020 Drift Front River C-80
C.36 August 6, 2020 Drift Front RIver C-82
C.37 August 7, 2020 Drift Front River C-84
C.38 August 8, 2020 Drift Front RIver C-86
C.39 August 11, 2020 Dye Injection Drift Front River C-88
C.40 August 14, 2020 Drift Front RIver C-91
C.41 August 17, 2020 Drift Front RIver C-93
C.42 August 21, 2020 Drift Front River C-95
C.43 August 24, 2020 Drift Front RIver C-97
C.44 August 25, 2020 Dye Injection Drift Front River C-99
C.45 August 26, 2020 Drift Front River C-101
C.46 August 27, 2020 Drift Front River C-103
C.47 August 20, 2020 Drift Middle River C-106
C.48 August 26, 2020 Drift Middle River C-108
C.49 September 10, 2020 Drift Middle River C-110
C.50 Upriver C-112
C.51 July 28, 2020 Drift Upriver C-113
C.52 July 30, 2020 Drift Upriver C-118
C.53 August 1, 2020 Drift Upriver C-120
C.54 August 5, 2020 Drift Upriver C-122
C.55 August 6, 2020 Drift Upriver C-125
C.56 August 10, 2020 Dye Injection Drift Upriver C-128
C.57 August 13, 2020 Drift Upriver C-131
C.58 August 16, 2020 Drift Upriver C-133
C.59 August 18, 2020 Drift Upriver C-135
C.60 August 20, 2020 Drift Upriver C-137
C.61 August 23, 2020 Drift Upriver C-139
C.62 August 24, 2020 Dye Injection Drift Upriver C-141
C.63 August 25, 2020 Drift Upriver C-147
C.64 August 28, 2020 Drift Upriver C-149
C.65 September 1, 2020 Drift Upriver C-151
C.66 September 3, 2020 Drift Upriver C-153

C.67 September 10, 2020 Drift Upriver C-155
C.68 September 13, 2020 Drift Upriver C-157
C.69 September 15, 2020 Dye Injection Drift Upriver C-159
C.70 September 16, 2020 Drift Upriver C-161
C.71 September 20, 2020 Drift Upriver C-163

APPENDIX C LIST OF FIGURES

Figure C-1 USGS Gage at Clyo – Flow (cfs) C-12
Figure C-2 July 13, 2020 Pre-SUR DO Profile C-13
Figure C-3 July 16, 2020 Pre-SUR DO profile C-13
Figure C-4 Back River July 27, 2020 drift [LBR_Drift_072720_IT_D1] location map C-14
Figure C-5 Back River July 27, 2020 drift [LBR_Drift_072720_IT_D1] observations C-15
Figure C-6 Back River July 28, 2020 drift 1 [LBR_Drift_072820_D1] location map C-16
Figure C-7 Back River July 28, 2020 DO Profile C-16
Figure C-8 Back River July 28, 2020 drift 1 [LBR_Drift_072820_D1] observations. C-17
Figure C-9 Back River July 28, 2020 drift 2 [LBR_Drift_072820_D2] location map C-18
Figure C-10 Back River July 28, 2020 drift 2 [LBR_Drift_072820_D2] observations. Drift occurred during incoming tide; low tide occurred at approximately 0957. ..... C-18
Figure C-11 Back River July 29, 2020 drift [LBR_Drift_072920_OT_D1] location map C-19
Figure C-12 Back River July 29, 2020 drift [LBR_Drift_072920_OT_D1] observations C-20
Figure C-13 Back River July 30, 2020 drift [LBR_Drift_073020_OT_D1] location map C-21
Figure C-14 Back River July 30, 2020 drift [LBR_Drift_073020_OT_D1] observations. C-21
Figure C-15 Back River July 31, 2020 drift [LBR_Drift_073120_OT_D1] location map C-22
Figure C-16 Back River July 31, 2020 drift [LBR_Drift_073120_OT_D1] observations. C-23
Figure C-17 Back River August 4, 2020 drift [LBR_Drift_080420_HT_D1] location map C-24
Figure C-18 Back River August 4, 2020 drift [LBR_Drift_080420_HT_D1] observations. C-24
Figure C-19 Back River August 5, 2020 drift [LBR_Drift_080520_IT_D1] location map C-25
Figure C-20 Back River August 5, 2020 drift [LBR_Drift_080520_IT_D1] observations. C-25
Figure C-21 Back River August 7, 2020 drift [LBR_Drift_080720_IT_D1] location map C-26
Figure C-22 Back River August 7, 2020 drift [LBR_Drift_080720_IT_D1] observations C-26
Figure C-23 Back River August 12, 2020 dye injection drift 1 [LBR_Drift_081220_DYE_D1] location map . C-27
Figure C-24 Back River August 12, 2020 dye injection drift 1 [LBR_Drift_081220_DYE_D1] observations. C-28
Figure C-25 Back River August 12, 2020 dye injection drift 2 [LBR_Drift_081220_DYE_D2] location map . C-29
Figure C-26 Back River August 12, 2020 dye injection drift 2 [LBR_Drift_081220_DYE_D2] observations. C-29
Figure C-27 Back River August 12, 2020 dye injection drift 3 [LBR_Drift_081220_DYE_D3] location map . C-30
Figure C-28 Back River August 12, 2020 dye injection drift 3 [LBR_Drift_081220_DYE_D3] observations.. C-30
Figure C-29 Back River August 13, 2020 Dye Profile C-31
Figure C-30 Back River August 13, 2020 DO profile C-31
Figure C-31 Back River August 13, 2020 drift [LBR_Drift_081320_OT_D1] location map C-32
Figure C-32 Back River August 13, 2020 drift [LBR_Drift_081320_OT_D1] observations. C-33
Figure C-33 Back River August 14, 2020 drift [LBR_Drift_081420_D1] location map C-34
Figure C-34 Back River August 14, 2020 drift [LBR_Drift_081420_D1] observations. C-35
Figure C-35 Back River August 15, 2020 drift [LBR_Drift_081520_OT_D1] location map C-36
Figure C-36 Back River August 15, 2020 drift [LBR_Drift_081520_OT_D1] observations. C-37
Figure C-37 Back River August 17, 2020 drift 1 [LBR_Drift_081720_OT_D1] location map C-38
Figure C-38 Back River August 17, 2020 drift 1 [LBR_Drift_081720_OT_D1] observations. C-39
Figure C-39 Back River August 17, 2020 drift 2 [LBR_Drift_081720_OT_D2] location map C-40
Figure C-40 Back River August 17, 2020 drift 2 [LBR_Drift_081720_OT_D2] observations. C-41
Figure C-41 Back River August 18, 2020 drift [LBR_Drift_081820_OT_D1] location map C-42
Figure C-42 Back River August 18, 2020 drift [LBR_Drift_081820_OT_D1] observations. C-43
Figure C-43 Back River August 19, 2020 drift [LBR_Drift_081920_IT_D1] location map C-44
Figure C-44 Back River August 19, 2020 drift [LBR_Drift_081920_IT_D1] observations C-45
Figure C-45 Back River August 21, 2020 drift [LBR_Drift_082120_IT_D1] location map C-46
Figure C-46 Back River August 21, 2020 drift [LBR_Drift_082120_IT_D1] observations C-47

Figure C-47 Back River August 22, 2020 drift [LBR_Drift_082220_OT_D1] location map.....C-48
Figure C-48 Back River August 22, 2020 drift [LBR_Drift_082220_OT_D1] observations.....C-49
Figure C-49 Back River August 25, 2020 DO profile.....C-50
Figure C-50 Back River August 25, 2020 Dye Profile.....C-50
Figure C-51 Back River August 25, 2020 dye injection drift [LBR_Drift_082520_DYE_D1] location map.....C-51
Figure C-52 Back River August 25, 2020 dye injection drift [LBR_Drift_082520_DYE_D1] observations.....C-52
Figure C-53 Back River August 26, 2020 Dye Profile.....C-53
Figure C-54 Back River August 26, 2020 DO profile.....C-53
Figure C-55 Back River August 26, 2020 drift [LBR_Drift_082620_IT_D1] location map.....C-54
Figure C-56 Back River August 26, 2020 drift [LBR_Drift_082620_IT_D1] observations.....C-55
Figure C-57 Back River August 27, 2020 drift [LBR_Drift_082720_IT_D1] location map.....C-56
Figure C-58 Back River August 27, 2020 drift [LBR_Drift_082720_IT_D1] observations.....C-57
Figure C-59 Back River September 1, 2020 drift [LBR_Drift_090120_OT_D1] location map.....C-58
Figure C-60 Back River September 1, 2020 drift [LBR_Drift_090120_OT_D1] observations.....C-59
Figure C-61 Back River September 3, 2020 drift [LBR_Drift_090320_OT_D1] location map.....C-60
Figure C-62 Back River September 3, 2020 drift [LBR_Drift_090320_OT_D1] observations.....C-61
Figure C-63 Back River September 8, 2020 drift [LBR_Drift_090820_IT_D1] location map.....C-62
Figure C-64 Back River September 8, 2020 drift [LBR_Drift_090820_IT_D1] observations.....C-63
Figure C-65 Back River September 12, 2020 drift [LBR_Drift_091220_OT_D1] location map.....C-64
Figure C-66 Back River September 12, 2020 drift [LBR_Drift_091220_OT_D1] observations.....C-65
Figure C-67 Back River September 16, 2020 drift [LFR_Drift_091620_D1] location map.....C-66
Figure C-68 Back River September 16, 2020 drift [LFR_Drift_091620_D1] observations.....C-67
Figure C-69 Back River September 17, 2020 drift 1 [LBR_Drift_091720_OT_D1] location map.....C-68
Figure C-70 Back River September 17, 2020 drift 1 [LBR_Drift_091720_OT_D1] observations.....C-69
Figure C-71 Back River September 17, 2020 drift 2 [LBR_Drift_091720_OT_D2] location map.....C-69
Figure C-72 Back River September 17, 2020 drift 2 [LBR_Drift_091720_OT_D2] observations.....C-70
Figure C-73 Back River September 19, 2020 drift [LBR_Drift_091920_IT_D1] location map.....C-71
Figure C-74 Back River September 19, 2020 drift [LBR_Drift_091920_IT_D1] observations.....C-72
Figure C-75 Front River July 27, 2020 DO profile.....C-73
Figure C-76 Front River July 27, 2020 drift [LFR_Drift_072720_IT_D1] location map.....C-74
Figure C-77 Front River July 27, 2020 drift [LFR_Drift_072720_IT_D1] observations.....C-75
Figure C-78 Front River July 29, 2020 DO profile.....C-76
Figure C-79 Front River July 29, 2020 drift [LFR_Drift_072920_OT_D1] location map.....C-76
Figure C-80 Front River July 29, 2020 drift [LFR_Drift_072920_OT_D1] observations.....C-77
Figure C-81 Front River July 31, 2020 drift [LFR_Drift_073120_OT_D1] location map.....C-78
Figure C-82 Front River July 31, 2020 drift [LFR_Drift_073120_OT_D1] observations.....C-79
Figure C-83 Front River August 4, 2020 drift [LFR_Drift_080420_HT_D1] location map.....C-80
Figure C-84 Front River August 4, 2020 drift [LFR_Drift_080420_HT_D1] observations.....C-81
Figure C-85 Front River August 6, 2020 drift [LFR_Drift_080620_IT_D1] location map.....C-82
Figure C-86 Front River August 6, 2020 drift [LFR_Drift_080620_IT_D1] observations.....C-83
Figure C-87 Front River August 7, 2020 drift [LFR_Drift_080720_IT_D1] location map.....C-84
Figure C-88 Front River August 7, 2020 drift [LFR_Drift_080720_IT_D1] observations.....C-85
Figure C-89 Front River August 8, 2020 drift [LFR_Drift_080820_IT_D1] location map.....C-86
Figure C-90 Front River August 8, 2020 drift [LFR_Drift_080820_IT_D1] observations.....C-87
Figure C-91 Front River August 11, 2020 dye injection drift 1 [LFR_Drift_081120_DYE_D1] location map.....C-88
Figure C-92 Front River August 11, 2020 dye injection drift 1 [LFR_Drift_081120_DYE_D1] observations.....C-89
Figure C-93 Front River August 11, 2020 dye injection drift 2 [LFR_Drift_081120_DYE_D2] location map.....C-90
Figure C-94 Front River August 11, 2020 dye injection drift 2 [LFR_Drift_081120_DYE_D2] observations.....C-90
Figure C-95 Front River August 14, 2020 drift [LFR_Drift_081420_OT_D1] location map.....C-91

Figure C-96 Front River August 14, 2020 drift [LFR_Drift_081420_OT_D1] observations.....C-92
Figure C-97 Front River August 17, 2020 drift [LFR_Drift_081720_OT_D1] location map.....C-93
Figure C-98 Front River August 17, 2020 drift [LFR_Drift_081720_OT_D1] observations.....C-94
Figure C-99 Front River August 21, 2020 drift [LFR_Drift_082120_IT_D1] location map C-95
Figure C-100 Front River August 21, 2020 drift [LFR_Drift_082120_IT_D1] observations. C-96
Figure C-101 Front River August 24, 2020 drift [LFR_Drift_082420_IT_D1] location map C-97
Figure C-102 Front River August 24, 2020 drift [LFR_Drift_082420_IT_D1] observations. C-98
Figure C-103 Front River August 25, 2020 Dye Profile.....C-99
Figure C-104 Front River August 25, 2020 dye injection drift [LFR_Drift_082520_DYE_D1] location map C-99
Figure C-105 Front River August 25, 2020 dye injection drift [LFR_Drift_082520_DYE_D1] observations. .C-100
Figure C-106 Front River August 26, 2020 drift [LFR_Drift_082620_IT_D1] location map C-101
Figure C-107 Front River August 26, 2020 drift [LFR_Drift_082620_IT_D1] observations. C-102
Figure C-108 Front River August 27, 2020 drift 1 [LFR_Drift_082720_IT_D1] location map C-103
Figure C-109 Front River August 27, 2020 drift 1 [LFR_Drift_082720_IT_D1] observations. C-104
Figure C-110 Front River August 27, 2020 drift 2 [LFR_Drift_082720_IT_D2] location map C-104
Figure C-111 Front River August 27, 2020 drift 2 [LFR_Drift_082720_IT_D2] observations. C-105
Figure C-112 Middle River August 20, 2020 drift [MR_Drift_082020_OT_D1] location map.....C-106
Figure C-113 Middle River August 20, 2020 drift [MR_Drift_082020_OT_D1] observations.....C-107
Figure C-114 Middle River August 26, 2020 drift [MR_Drift_082620_IT_D1] location map C-108
Figure C-115 Middle River August 26, 2020 drift [MR_Drift_082620_IT_D1] observations. C-109
Figure C-116 Middle River September 10, 2020 drift [MR_Drift_091020_D1] location map C-110
Figure C-117 Middle River September 10, 2020 drift [MR_Drift_091020_D1] observations. C-111
Figure C-118 Upriver July 21, 2020 Upriver Profile.....C-112
Figure C-119 Upriver July 28, 2020 drift 1 [UR_Drift_072820_D1] location map C-113
Figure C-120 Upriver July 28, 2020 drift 1 [UR_Drift_072820_D1] observations. C-114
Figure C-121 Upriver July 28, 2020 drift 2 [UR_Drift_072820_D2] location map C-114
Figure C-122 Upriver July 28, 2020 drift 2 [UR_Drift_072820_D2] observations. C-115
Figure C-123 Upriver July 28, 2020 drift 3 [UR_Drift_072820_D3] location map C-116
Figure C-124 Upriver July 28, 2020 drift 3 [UR_Drift_072820_D3] observations. C-117
Figure C-125 Upriver July 30, 2020 drift [UR_Drift_073020_D1] location map C-118
Figure C-126 Upriver July 30, 2020 drift [UR_Drift_073020_D1] observations. C-119
Figure C-127 Upriver August 1, 2020 drift [UR_Drift_080120_D1] location map.....C-120
Figure C-128 Upriver August 1, 2020 drift [UR_Drift_080120_D1] observations.....C-121
Figure C-129 Upriver August 05, 2020 DO profile below Diffuser C-122
Figure C-130 Upriver August 05, 2020 DO profile C-122
Figure C-131 Upriver August 5, 2020 drift [UR_Drift_080520_D1] location map.....C-123
Figure C-132 Upriver August 5, 2020 drift [UR_Drift_080520_D1] observations.....C-124
Figure C-133 Upriver August 6, 2020 drift 1 [UR_Drift_080620_D1] location map.....C-125
Figure C-134 Upriver August 6, 2020 drift 1 [UR_Drift_080620_D1] observations.....C-126
Figure C-135 Upriver August 6, 2020 drift 2 [UR_Drift_080620_D2] location map.....C-126
Figure C-136 Upriver August 6, 2020 drift 2 [UR_Drift_080620_D2] observations.....C-127
Figure C-137 Upriver August 10, 2020 dye injection drift 1 [UR_Drift_081020_DYE_D1] location map.....C-128
Figure C-138 Upriver August 10, 2020 dye injection drift 1 [UR_Drift_081020_DYE_D1] observations.....C-129
Figure C-139 Upriver August 10, 2020 dye injection drift 2 [UR_Drift_081020_DYE_D2] location map.....C-129
Figure C-140 Upriver August 10, 2020 dye injection drift 2 [UR_Drift_081020_DYE_D2] observations.....C-130
Figure C-141 Upriver August 13, 2020 drift [UR_Drift_081320_D1] location map.....C-131
Figure C-142 Upriver August 13, 2020 drift [UR_Drift_081320_D1] observations.....C-132
Figure C-143 Upriver August 16, 2020 drift [UR_Drift_081620_D1] location map.....C-133
Figure C-144 Upriver August 16, 2020 drift [UR_Drift_081620_D1] observations.....C-134

Figure C-145 Upriver [UR_Drift_081820_D1] location map C-135
Figure C-146 Upriver August 18, 2020 drift [UR_Drift_081820_D1] observations.....C-136
Figure C-147 Upriver August 20, 2020 drift [UR_Drift_082020_D1] location map.....C-137
Figure C-148 Upriver August 20, 2020 drift [UR_Drift_082020_D1] observations.....C-138
Figure C-149 Upriver August 23, 2020 drift [UR_Drift_082320_D1] location map.....C-139
Figure C-150 Upriver August 23, 2020 drift [UR_Drift_082320_D1] observations.....C-140
Figure C-151 Upriver August 24, 2020 dye injection drift 1 [UR_Drift_082420_DYE_D1] location map C-141
Figure C-152 Upriver August 24, 2020 dye injection drift 1 [UR_Drift_082420_DYE_D1] observations. C-142
Figure C-153 Upriver August 24, 2020 dye injection drift 2 [UR_Drift_082420_DYE_D2] location map C-142
Figure C-154 Upriver August 24, 2020 dye injection drift 2 [UR_Drift_082420_DYE_D2] observations. C-143
Figure C-155 Upriver August 24, 2020 dye injection drift 3 [UR_Drift_082420_DYE_D3] location map C-144
Figure C-156 Upriver August 24, 2020 dye injection drift 3 [UR_Drift_082420_DYE_D3] observations. C-145
Figure C-157 Upriver August 24, 2020 dye injection drift 4 [UR_Drift_082420_DYE_D4] location map C-146
Figure C-158 Upriver August 24, 2020 dye injection drift 4 [UR_Drift_082420_DYE_D4] observations. C-147
Figure C-159 Upriver August 25, 2020 drift [UR_Drift_082520_D1] location map.....C-147
Figure C-160 Upriver August 25, 2020 drift [UR_Drift_082520_D1] observations.....C-148
Figure C-161 Upriver August 28, 2020 drift [UR_Drift_082820_D1] location map.....C-149
Figure C-162 Upriver August 28, 2020 drift [UR_Drift_082820_D1] observations.....C-150
Figure C-163 Upriver September 1, 2020 drift [UR_Drift_090120_D1] location map C-151
Figure C-164 Upriver September 1, 2020 drift [UR_Drift_090120_D1] observations C-152
Figure C-165 Upriver September 3, 2020 drift [UR_Drift_090320_D1] location map C-153
Figure C-166 Upriver September 3, 2020 drift [UR_Drift_090320_D1] observations. C-154
Figure C-167 Upriver September 10, 2020 drift [UR_Drift_091020_D1] location map C-155
Figure C-168 Upriver September 10, 2020 drift [UR_Drift_091020_D1] observations. C-156
Figure C-169 Upriver September 13, 2020 drift [UR_Drift_091320_D1] location map C-157
Figure C-170 Upriver September 13, 2020 drift [UR_Drift_091320_D1] observations. C-158
Figure C-171 Upriver September 15, 2020 dye injection drift [UR_Drift_091520_DYE_D1] location map ...C-159
Figure C-172 Upriver September 15, 2020 dye injection drift [UR_Drift_091520_DYE_D1] observations. ..C-160
Figure C-173 Upriver September 16, 2020 drift [UR_Drift_091620_D1] location map C-161
Figure C-174 Upriver September 16, 2020 drift [UR_Drift_091620_D1] observations C-162
Figure C-175 Upriver September 20, 2020 drift [UR_Drift_092020_D1] location map C-163
Figure C-176 Upriver September 20, 2020 drift [UR_Drift_092020_D1] observations.. .....C-164

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BGA	Phycoerythin blue-green algae
Conc.	concentration
DO	dissolved oxygen
LBR	Back River
LFR	Front River
mg/L	milligrams per liter
PPT	parts per thousand
RFU	relative fluorescence units
SHAL	shallow
UR	Upriver

C.1 DRIFT DATA

Drift data was collected on the Back River, Front River, and Upriver waterbodies for the duration of the Startup Run (SUR). Boat drift sampling consist of a surface (1 meter deep) and sometimes a mid-depth (3 to 4 meters deep) sonde collecting data at a reading every two seconds as the boat slowly traverses the waterbody, usually passing by one of the diffusers. The number of drifts per waterbody are:

- Back River - 42
- Front River - 30
- Upriver - 35

The drift data in this appendix are presented mostly as parameter per timestep. Location maps show the route of the boat, with green being the start and red being the end of the route The location maps include timestamps which correspond to the time the samples were taken. For specific drift events, figures with the dissolved oxygen (DO) concentrations were included to illustrate how the oxygen plume moves through the rivers.

The sampling drift events ranged from:

- Detailed sampling around the diffuser and nearby buoys
- Far field sampling upstream and/or downstream of the diffusers
- Sampling the entire waterbody

The purpose of the drift sampling was:

- Determine how fast the oxygen plumes dispersed in the waterbody;
- Determine where the oxygen plumes traveled; and
- Determine how quickly the oxygen plumes mixed across the waterbody.

C.2 DRIFT DATA SUMMARY

The boat drift sampling events may include the results from one or two boats. Sampling events during the SUR:

- 27 times on the Back and Little Back Rivers
- 18 times on the Front River
- 23 times on the Upriver

The boat drifts always had a surface sonde and included a mid-depth or deep sonde deployed at 3 to 5 meters below the surface. The sondes measure parameters at 2-second intervals. The main parameters are:

- *DO*. Evaluate the impact of the injected oxygen on the Upriver DO regime.
- *Dissolved Oxygen saturation (DOsat*). Check if DO saturation exceeded 100 percent and if DO saturation exceeded 100 percent for any significant time, this would indicate that DO could be transferred to the atmosphere.
- *Salinity*. At higher salinities there is less capacity for the water to hold oxygen resulting in lower DO values and is used to determine the tidal STATUS.
- *Temperature Centigrade (Temp_C)*. At higher temperatures, there is less capacity for the water to hold oxygen and may result in lower DO values and DO saturation to exceed 100 percent.
- *Blue Green Algae (BGA)*. Used to measure dye during dye release events. Also used to determine the background levels of BGA.
- *Rhodamine dye*. Used to track the injected dye as it moved past the Depot sonde.
- *Specific conductance*. Can be used to detect lower salinity water that may impact the water intakes. Please note, this parameterwas not included in the time-series, but is available in the SUR database.

The following tables provide a data summary for the Back River, Front River, and Upriver.

Table C-1 Back River Drift Data Summary

Parameter	1st Percentile	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile	99th Percentile	Total Observations	Minimum	Maximum
DO (mg/L)	3.7	4.1	4.6	5.2	5.6	6.2	6.8	183,203	3.3	9.4
DO Saturation (%)	51	55	60	67	73	81	90	183,203	45	124
Salinity (ppt)	0.03	0.0	0.2	1.3	5.3	7.9	10.0	183,203	0.0	12
Temp_C (°C)	22	26	28	29	30	30	31	183,203	21	31
Dye (µg/L)	0.03	0.04	0.08	0.11	0.15	2.8	21.2	123,317	0.02	176
BGA_R (RFU)	1.3	2.3	4.0	5.9	8.3	67.6	149.7	158,106	0.3	159
Sp_Cond	76	96	386	2,506	9,485	13,740	17,139	183,203	4	20,200

Table C-2 Front River Drift Data Summary

Parameter	1st Percentile	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile	99th Percentile	Total Observations	Minimum	Maximum
DO (mg/L)	1.9	2.4	3.6	4.3	5.2	6.9	7.8	171,770	0.1	8.2
DO Saturation (%)	26	34	48	58	68	87	97	171,770	1	102
Salinity (ppt)	0.04	0.1	1.8	3.8	6.1	9.9	15.9	171,770	0.0	30
Temp_C (°C)	26	26	27	29	29	30	30	171,770	26	31
Dye (µg/L)	0.03	0.04	0.05	0.07	0.12	3.6	38.1	117,693	0.02	182
BGA_R (RFU)	1.5	1.9	2.3	2.8	3.7	24.4	151.6	149,061	0.5	159
Sp_Cond	89	102	3,510	6,954	10,844	16,894	26,068	171,770	5	46,934

Table C-3 Upriver Drift Data Summary

Parameter	1st Percentile	5th Percentile	25th Percentile	50th Percentile	75th Percentile	95th Percentile	99th Percentile	Total Observations	Minimum	Maximum
DO (mg/L)	6.1	6.3	6.7	7.3	7.6	7.8	8.0	97,452	5.9	8.7
Dosat (%)	77	81	84	92	96	100	101	97,452	73	108
Salinity (ppt)	0.03	0.0	0.0	0.0	0.0	0.0	0.0	97,452	0.0	0
Temp_C (°C)	23	26	27	28	28	29	29	97,452	23	29
Dye (µg/L)	1.3	1.4	1.6	2.0	2.5	112.8	157.0	87,941	-1.2	159
BGA_R (RFU)	0.02	0.02	0.03	0.04	2.29	16.7	39.2	40,167	0.02	107
Sp_Cond	65	72	74	78	86	94	97	97,452	0	111

During the SUR, river flows ranged between 6,500 to 12,500 cubic feet per second (cfs) as measured at the Clyo USGS Gage (***Figure C-1***). These flows impact how quickly the Upriver oxygen plume mixes in to the river and how fast the Upriver injected oxygen reaches the Front River.

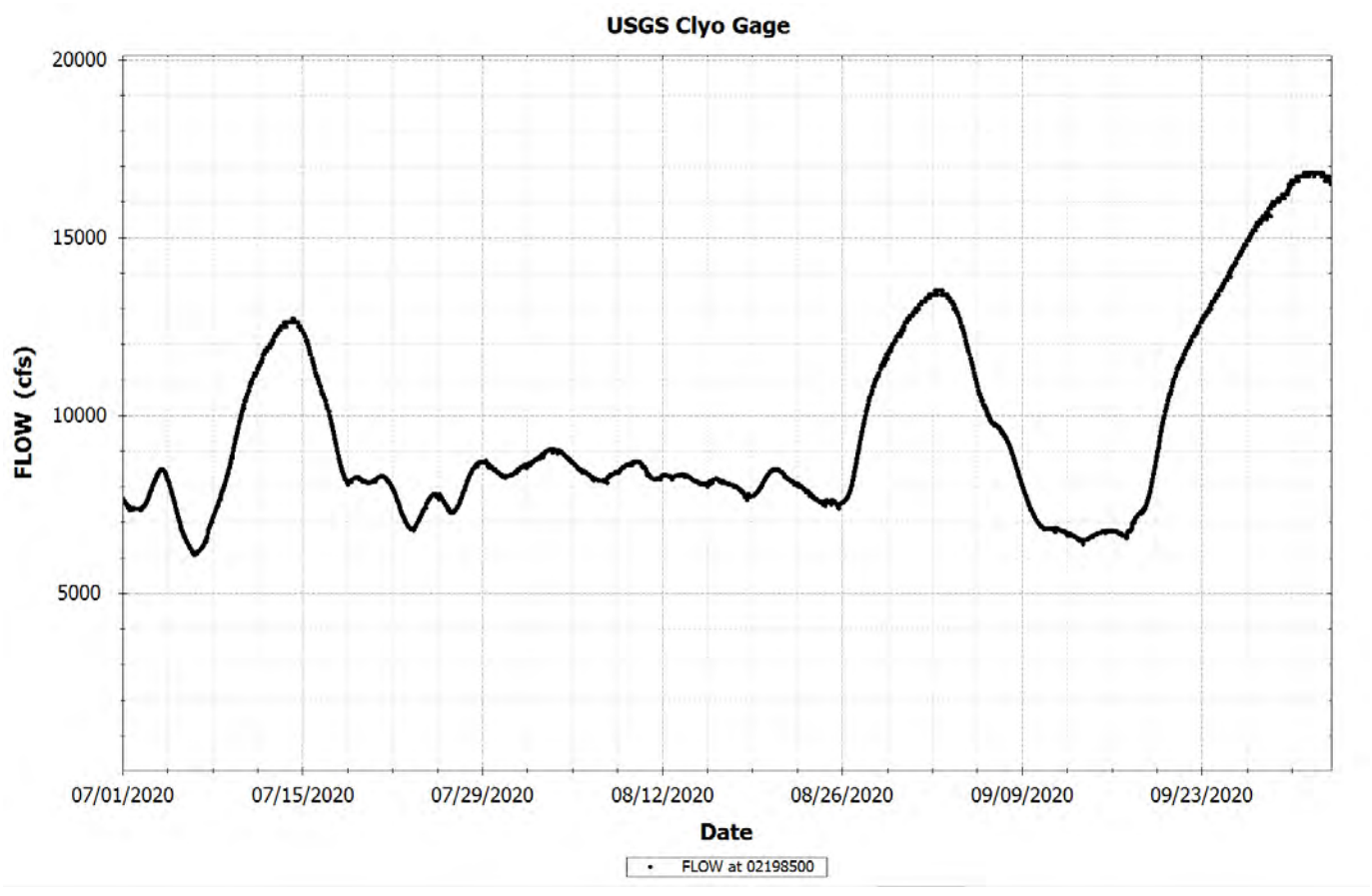


Figure C-1 USGS Gage at Clyo – Flow (cfs)

C.3 BACK RIVER

SUR drift sampling began July 27, 2020. Pre-SUR sampling was completed in the previous two weeks while the oxygen system was in startup mode. The below ***Figure C-2*** and ***Figure C-3*** provide visuals of how the oxygen plume moved during ebb and flood tides, along with the location of diffuser and Back River buoys.

The following are observations about how the injected oxygen dispersed into the Back River:

- Dispersed quickly bottom to top.
- Followed the deep channel on ebb and flood tides then mixed across the river when tides reversed.
- Moved up to GA 25 bridge on flood tide and past US-17 on ebb tides, depending on if it was a spring or neap tidal condition.
- Based on the dye studies, the oxygen plume stayed in the Back River for one to two weeks.

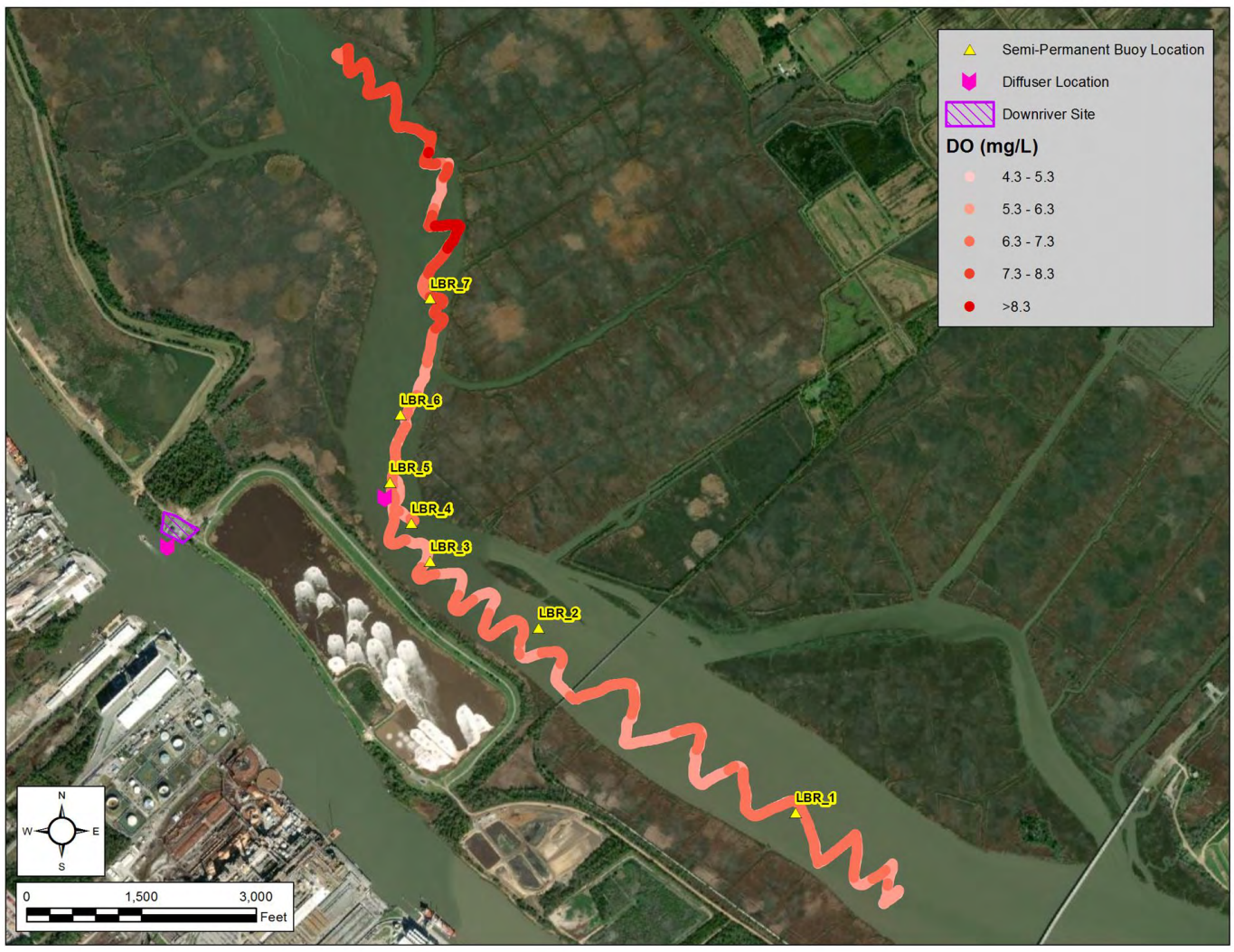


Figure C-2 July 13, 2020 Pre-SUR DO Profile

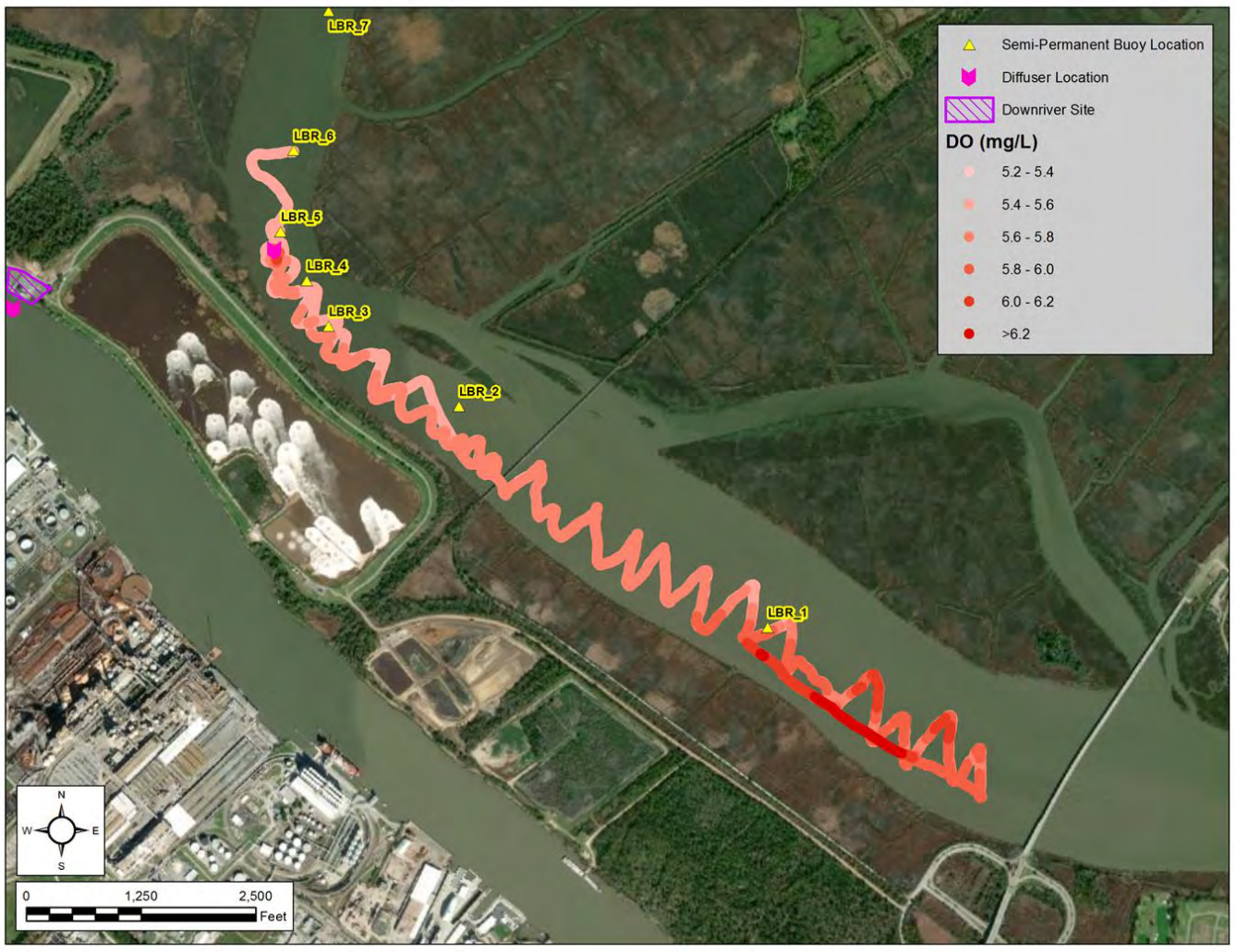


Figure C-3 July 16, 2020 Pre-SUR DO profile

C.4 JULY 27, 2020 DRIFT BACK RIVER

Drift occurred during incoming tide; low tide occurred at approximately 0900 (24-hour clock). The drift approached the diffuser around 1020 and appeared to intersect the near-field plume several times between 1023 and 1037 and the DO concentrations spiked by approximately 0.5 milligrams per liter (mg/L). The DO concentration decreased at 1005 as the sonde dragged the bottom

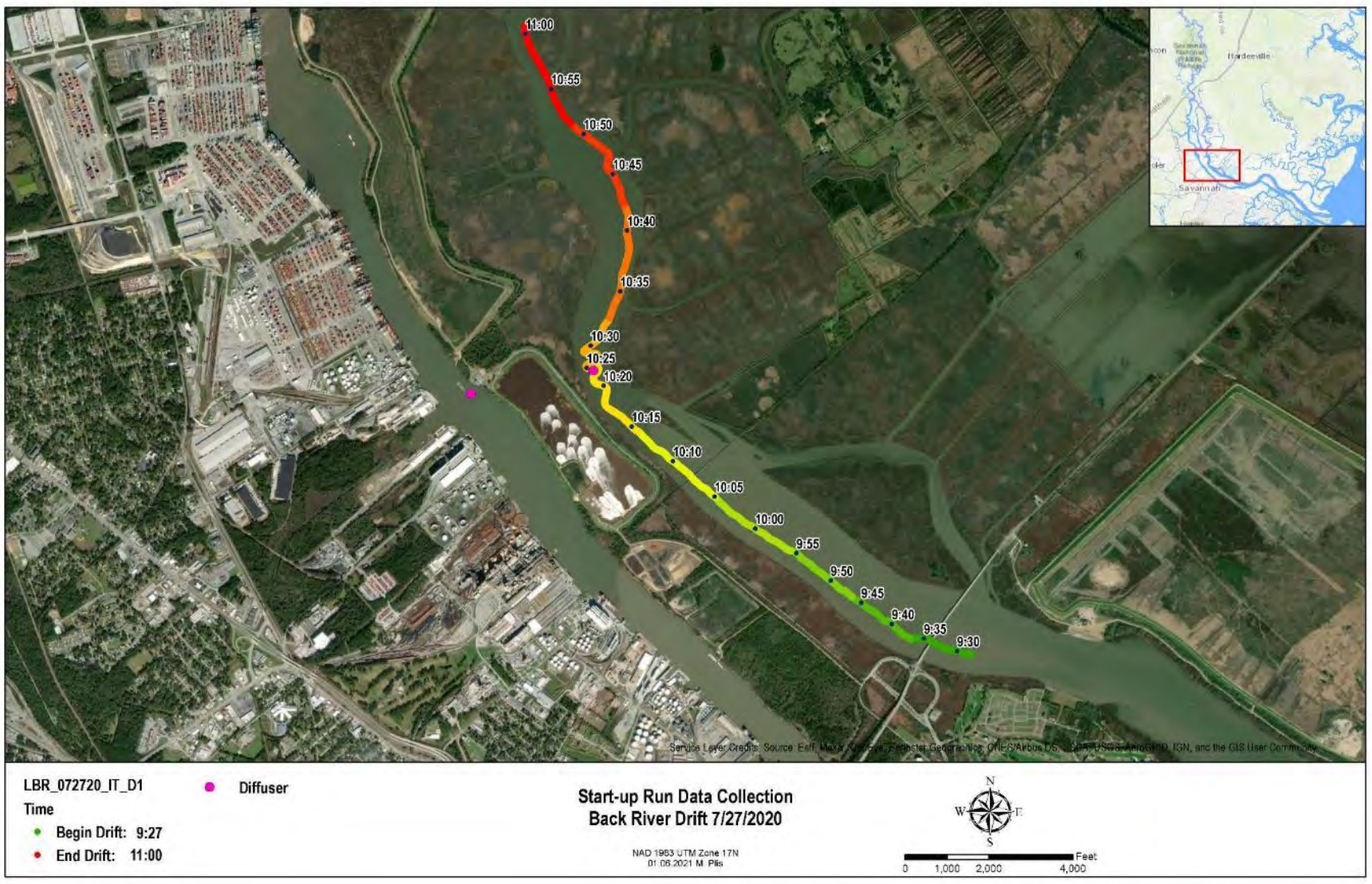
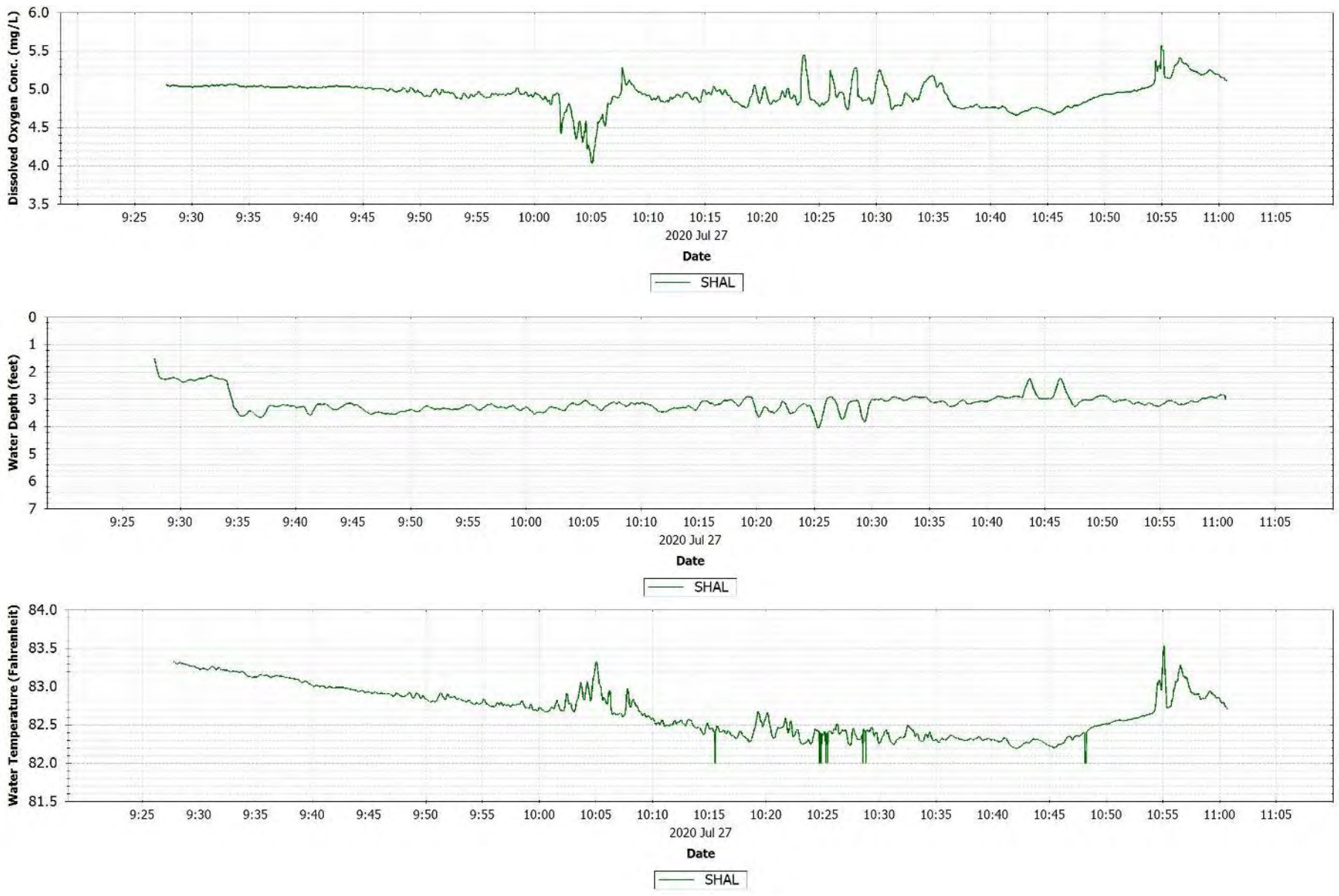


Figure C-4 Back River July 27, 2020 drift [LBR_Drift_072720_IT_D1] location map



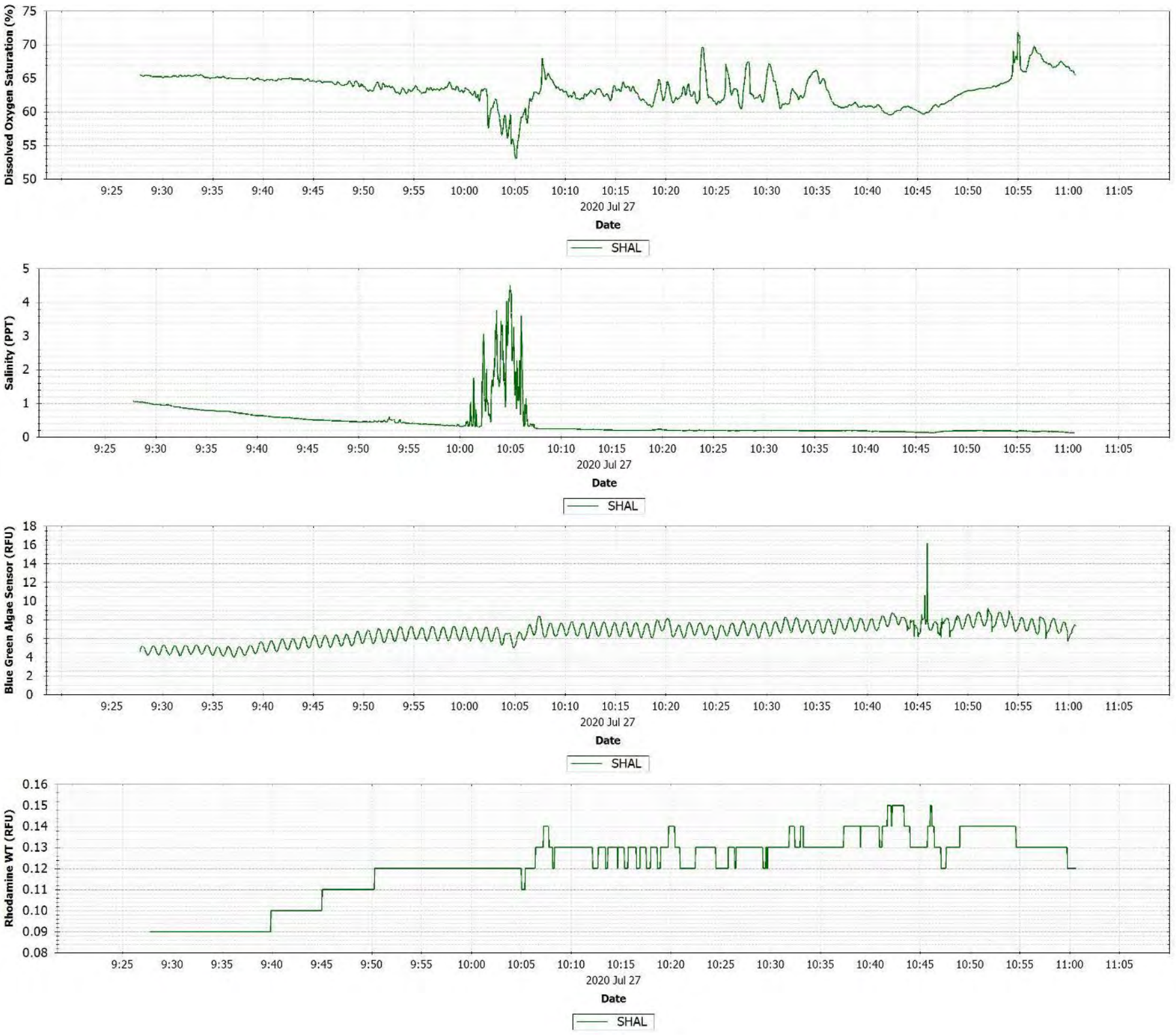


Figure C-5 Back River July 27, 2020 drift [LBR_Drift_072720_IT_D1] observations

C.5 JULY 28, 2020 DRIFT BACK RIVER

Drift occurred during slack tide; low tide occurred at approximately 0957. The drift sonde appeared to initially intersect the near-field plume during upstream travel at 1108 and DO concentrations spiked 1 mg/L above downstream background DO concentrations. Around 1120 several depth profiles were taken and higher DO concentrations were measured at deeper depths indicating the oxygen plume was still not mixed top to bottom. At the downstream samples, the salt wedge from the Front River was measured. ***Figure C-6*** and ***Figure C-7*** show the surface DO variation around the diffuser.

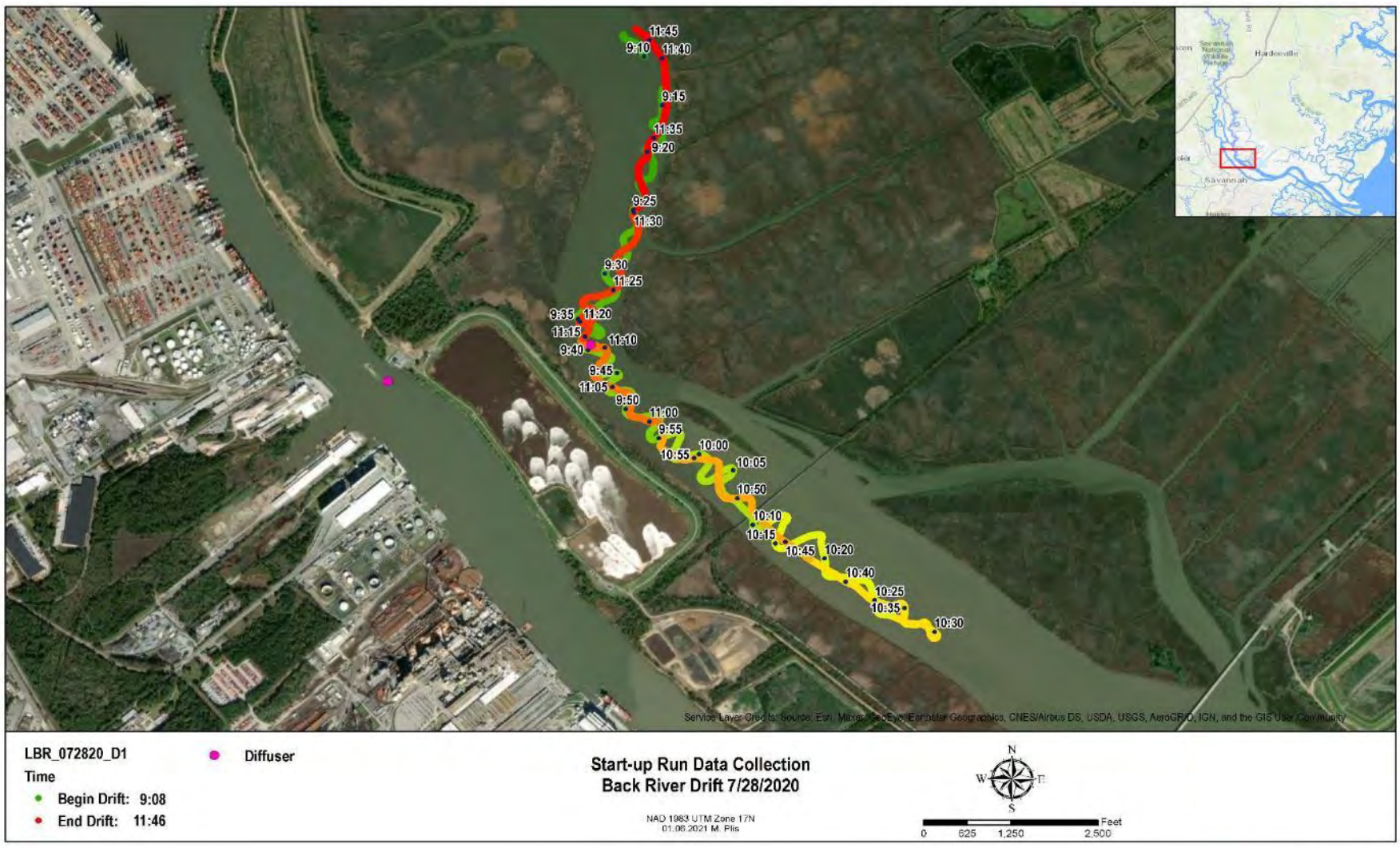


Figure C-6 Back River July 28, 2020 drift 1 [LBR_Drift_072820_D1] location map

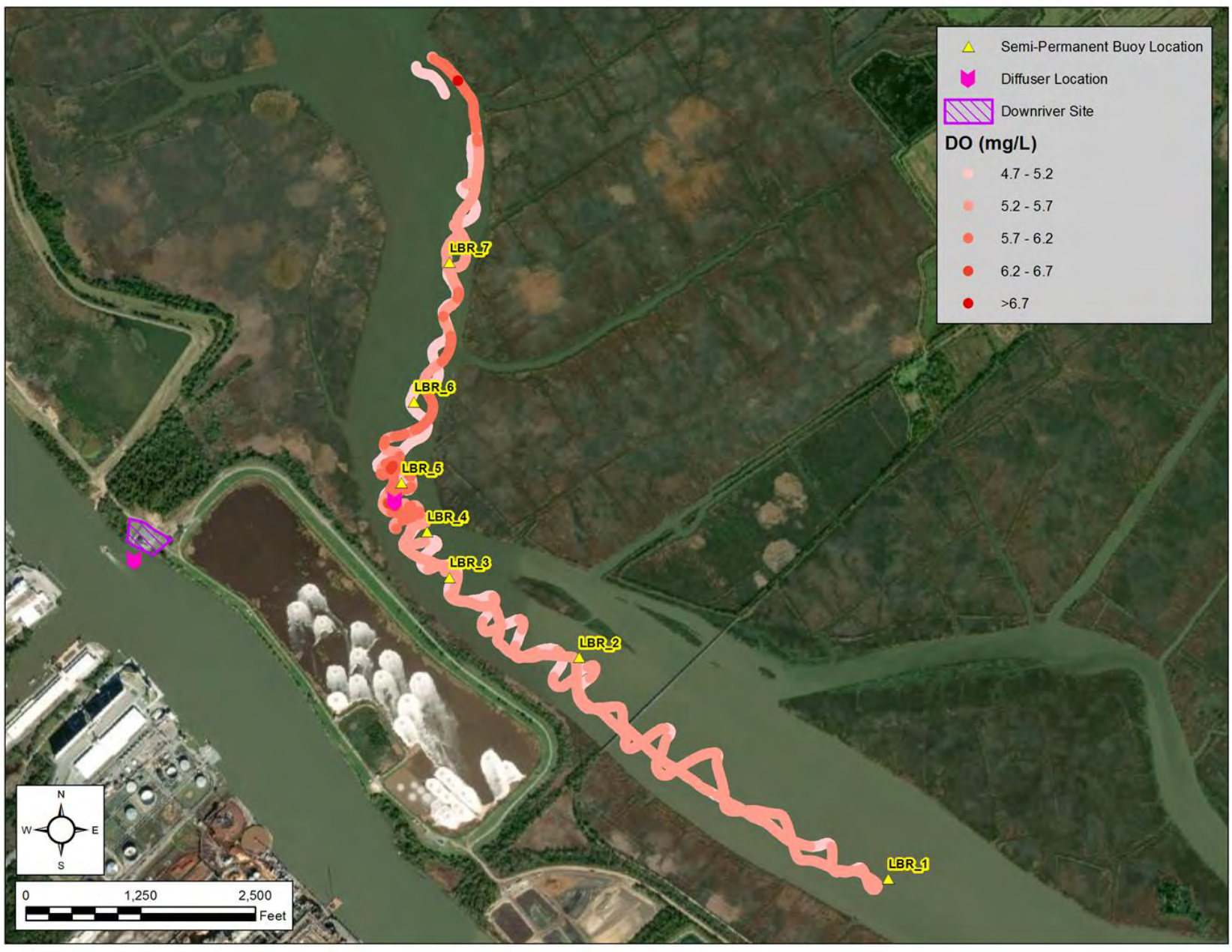


Figure C-7 Back River July 28, 2020 DO Profile

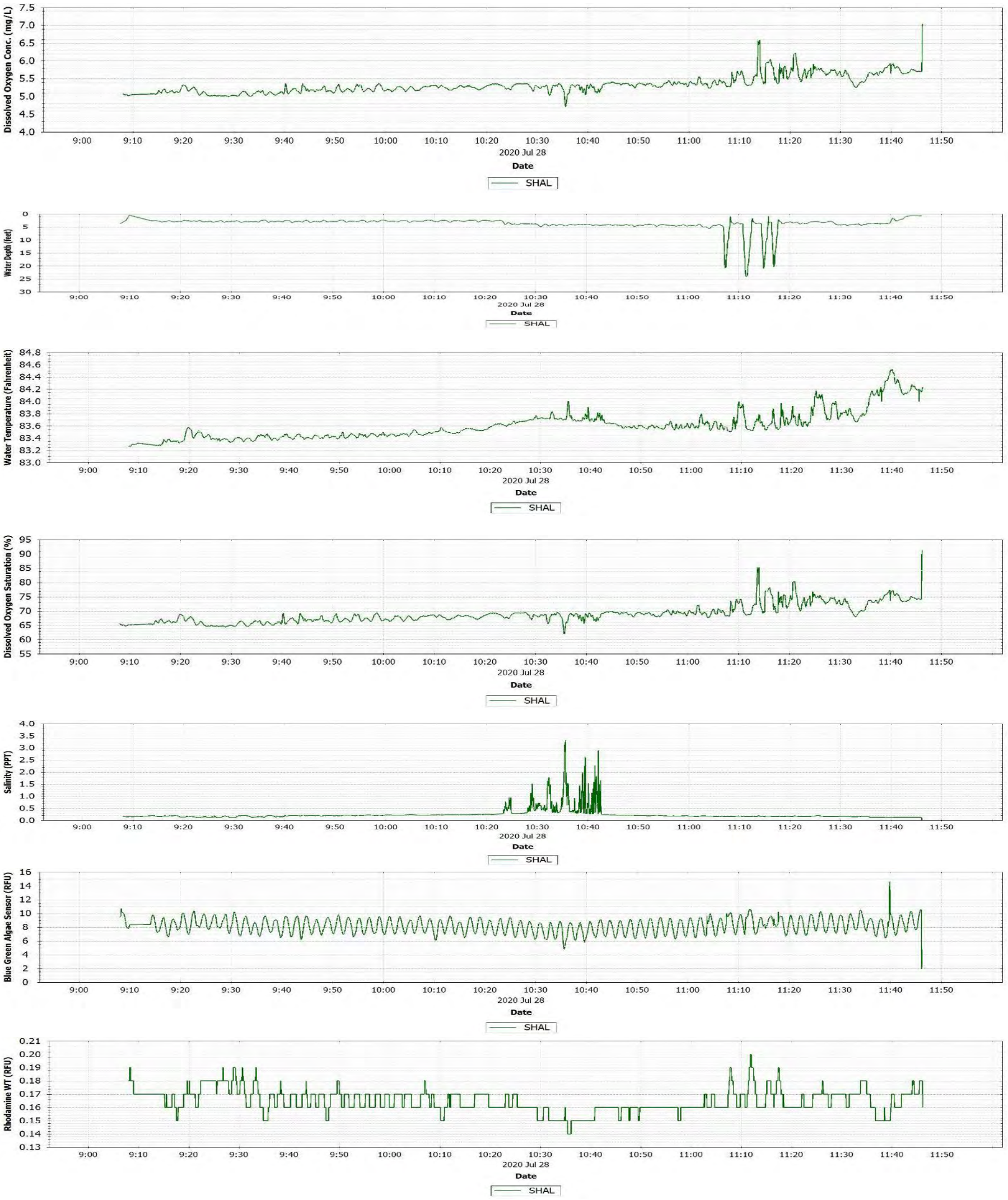


Figure C-8 Back River July 28, 2020 drift 1 [LBR_Drift_072820_D1] observations..

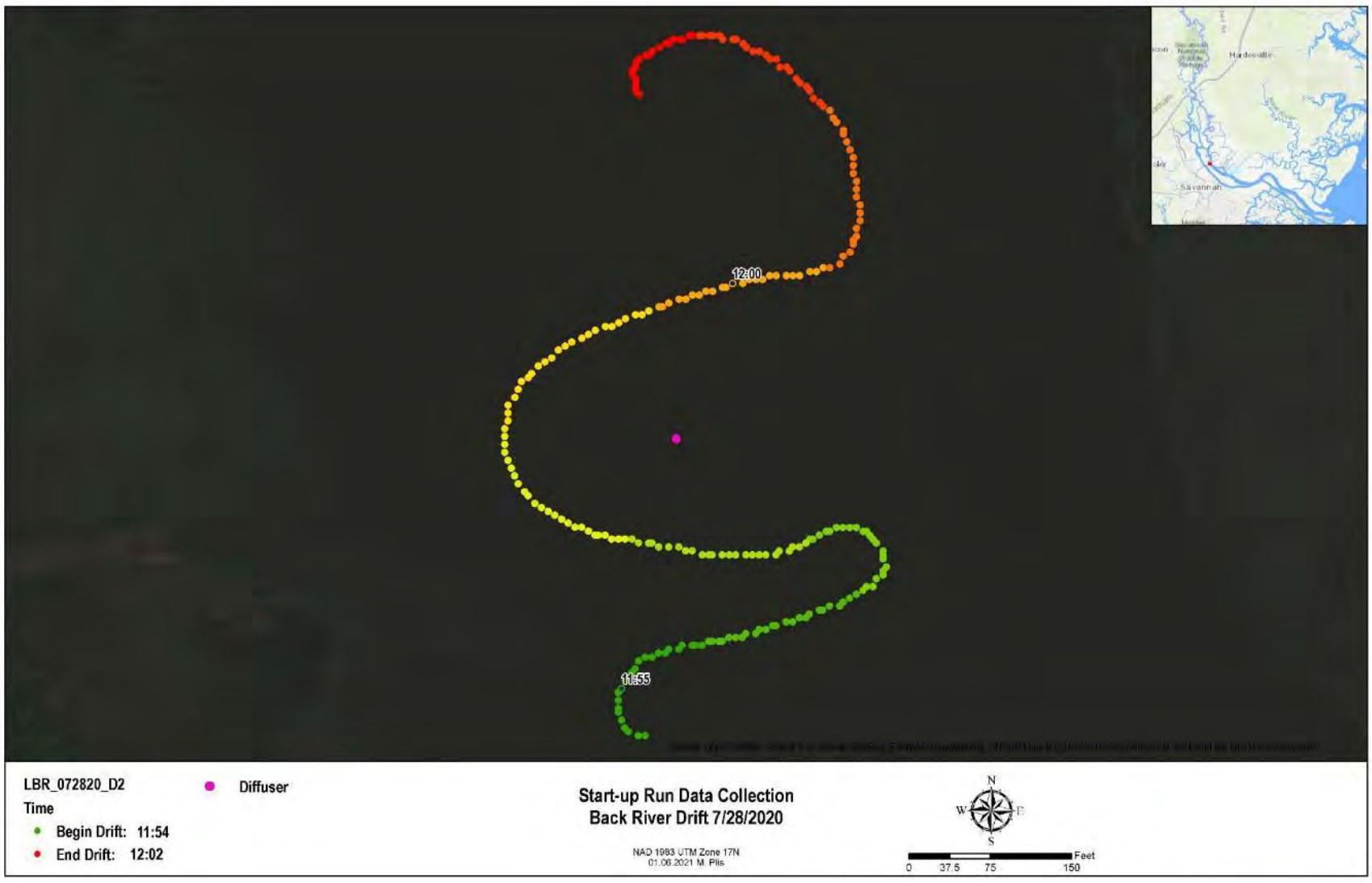


Figure C-9 Back River July 28, 2020 drift 2 [LBR_Drift_072820_D2] location map

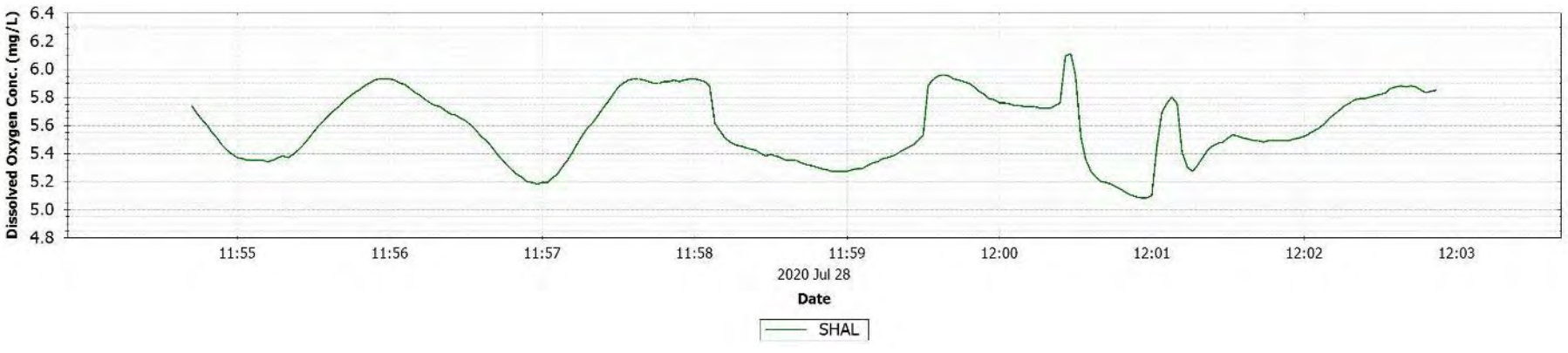


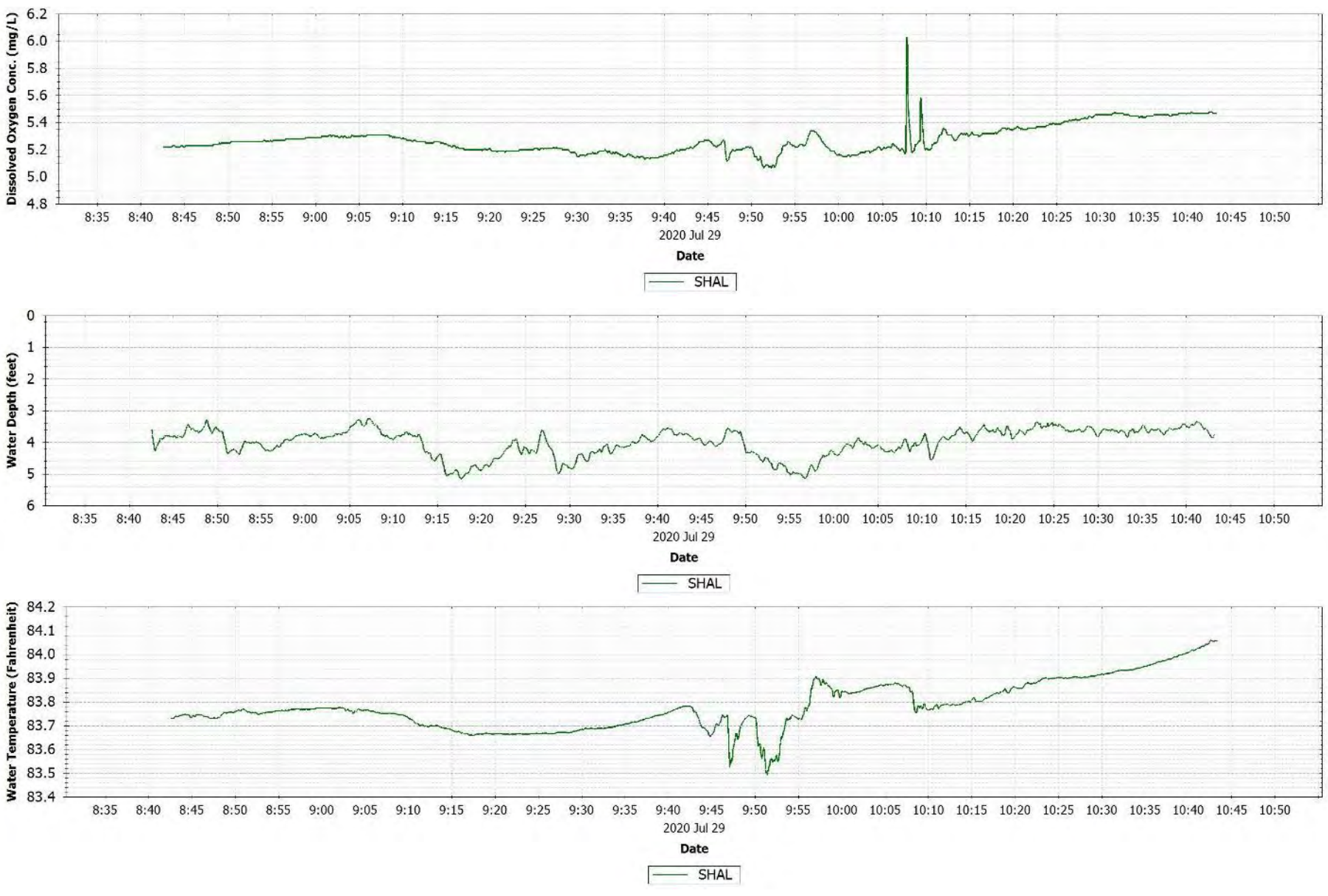
Figure C-10 Back River July 28, 2020 drift 2 [LBR_Drift_072820_D2] observations. Drift occurred during incoming tide; low tide occurred at approximately 0957.

C.6 JULY 29, 2020 DRIFT BACK RIVER

Drift occurred during outgoing tide; low tide occurred at approximately 1055. The near-field oxygen plume was intersected twice between 1005 and 1010 and DO concentrations were elevated downstream of the diffuser compared to concentrations upstream of the diffuser. Salinity and temperature were also elevated downstream as the boat intersected the Front River water being pushed downstream.



Figure C-11 Back River July 29, 2020 drift [LBR_Drift_072920_OT_D1] location map



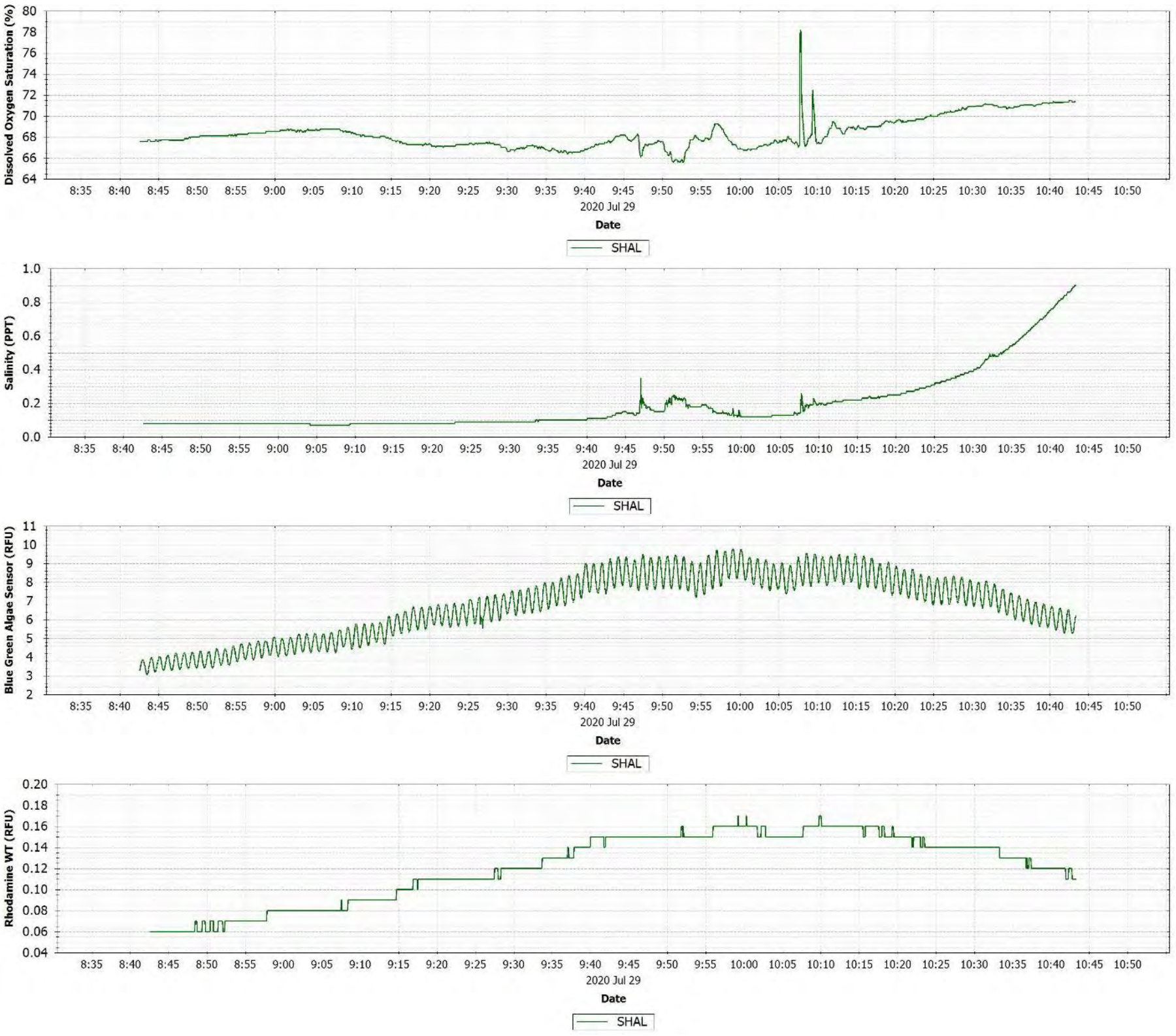


Figure C-12 Back River July 29, 2020 drift [LBR_Drift_072920_OT_D1] observations

C.7 JULY 30, 2020 DRIFT BACK RIVER

Drift occurred during outgoing tide; low tide occurred at approximately 1153. The near-field plume was intersected when the drift sonde reached the diffuser at 1052. DO concentrations were elevated downstream of the diffuser compared to concentrations upstream of the diffuser indicating that the DO injection increased in-situ DO.



Figure C-13 Back River July 30, 2020 drift [LBR_Drift_073020_OT_D1] location map

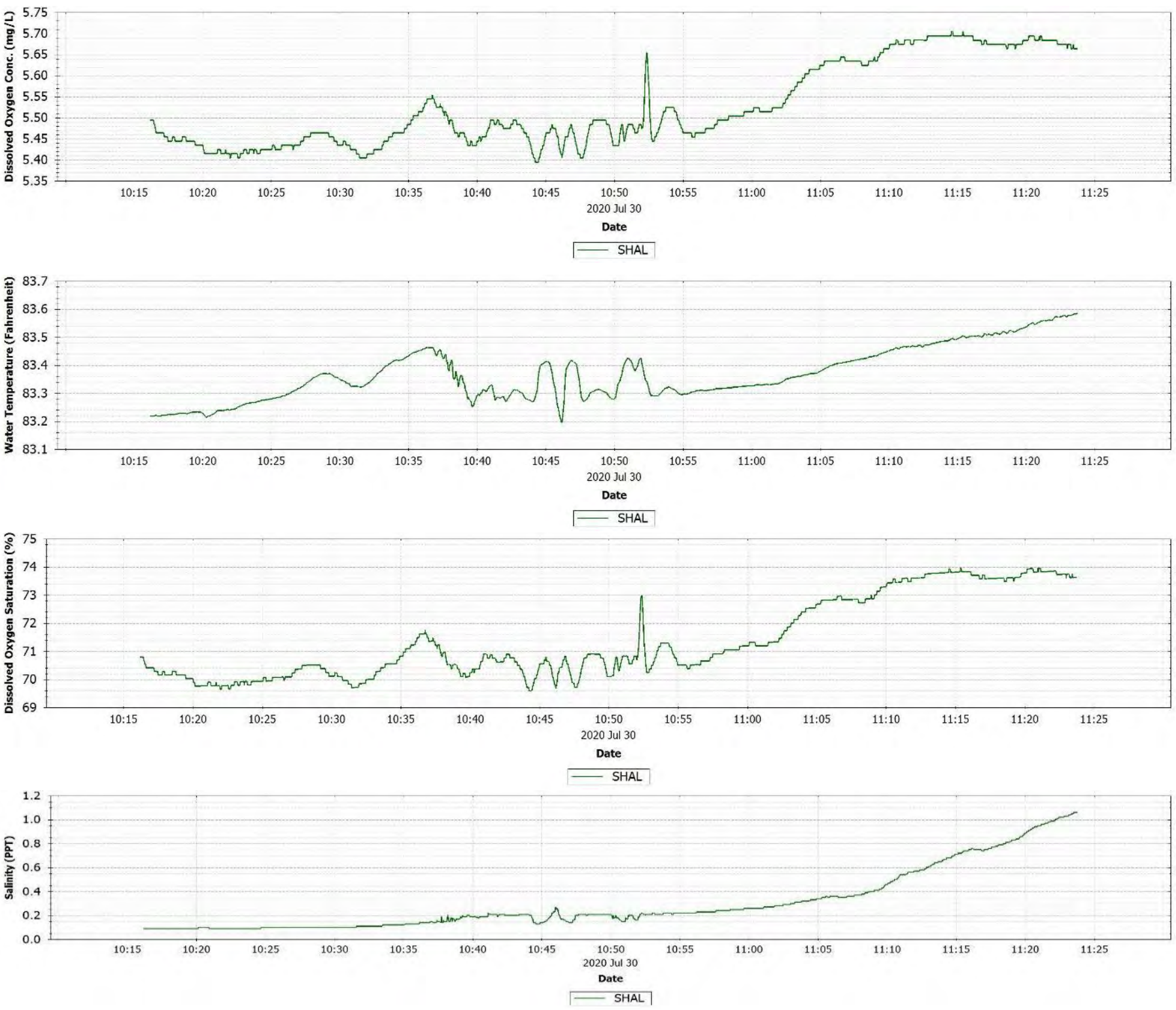


Figure C-14 Back River July 30, 2020 drift [LBR_Drift_073020_OT_D1] observations.

C.8 JULY 31, 2020 DRIFT BACK RIVER

Drift occurred during outgoing tide; high tide occurred at approximately 0647. The near-field plume appeared to be near the bottom of the channel. The drift sondes did not detect the near-field plume at depths of 4 feet and 10 feet during the first pass by the diffuser at 0935, but did detect the plume on the second pass at 1016 when the middle sonde was lowered to 25 feet.

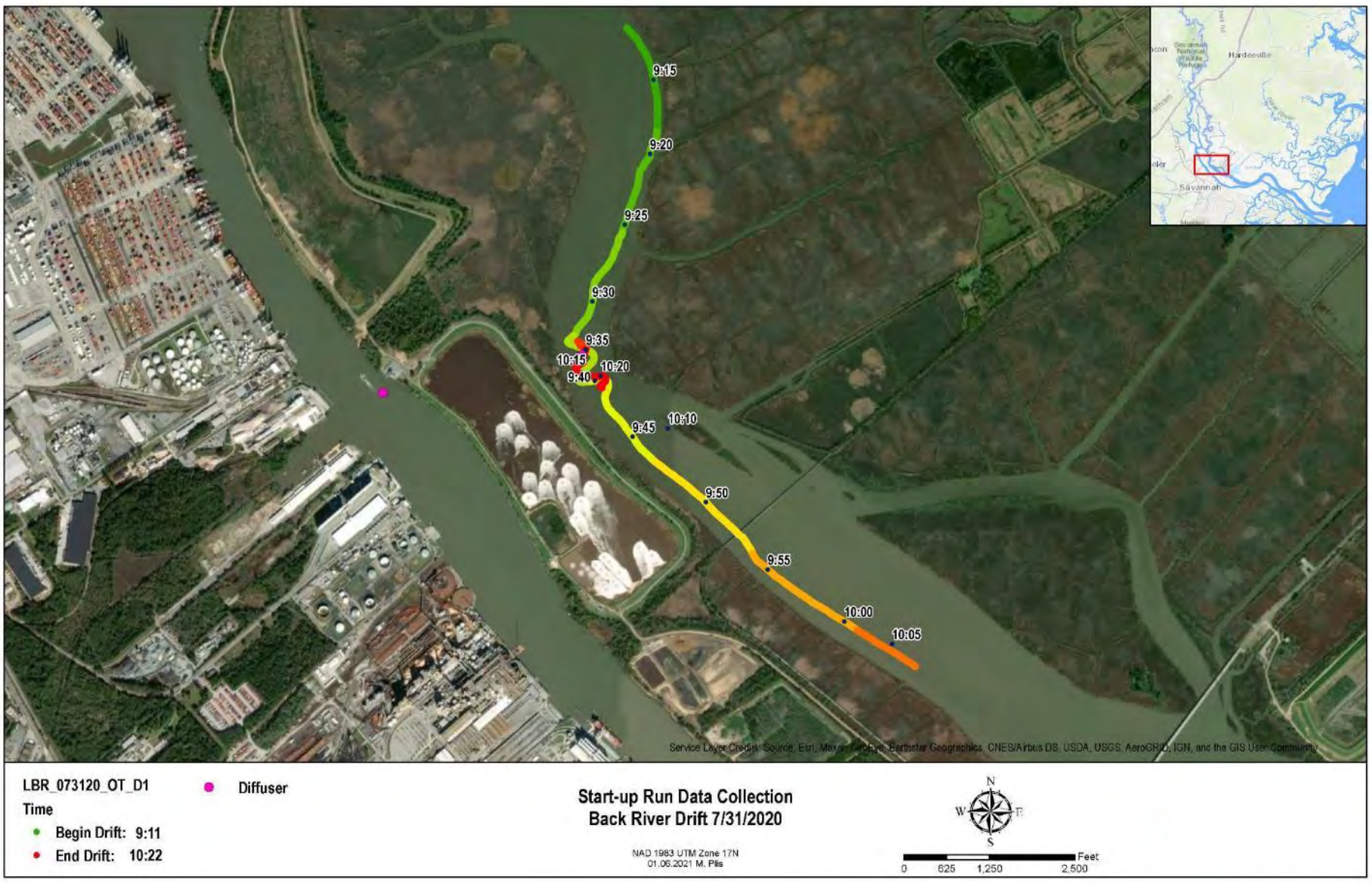
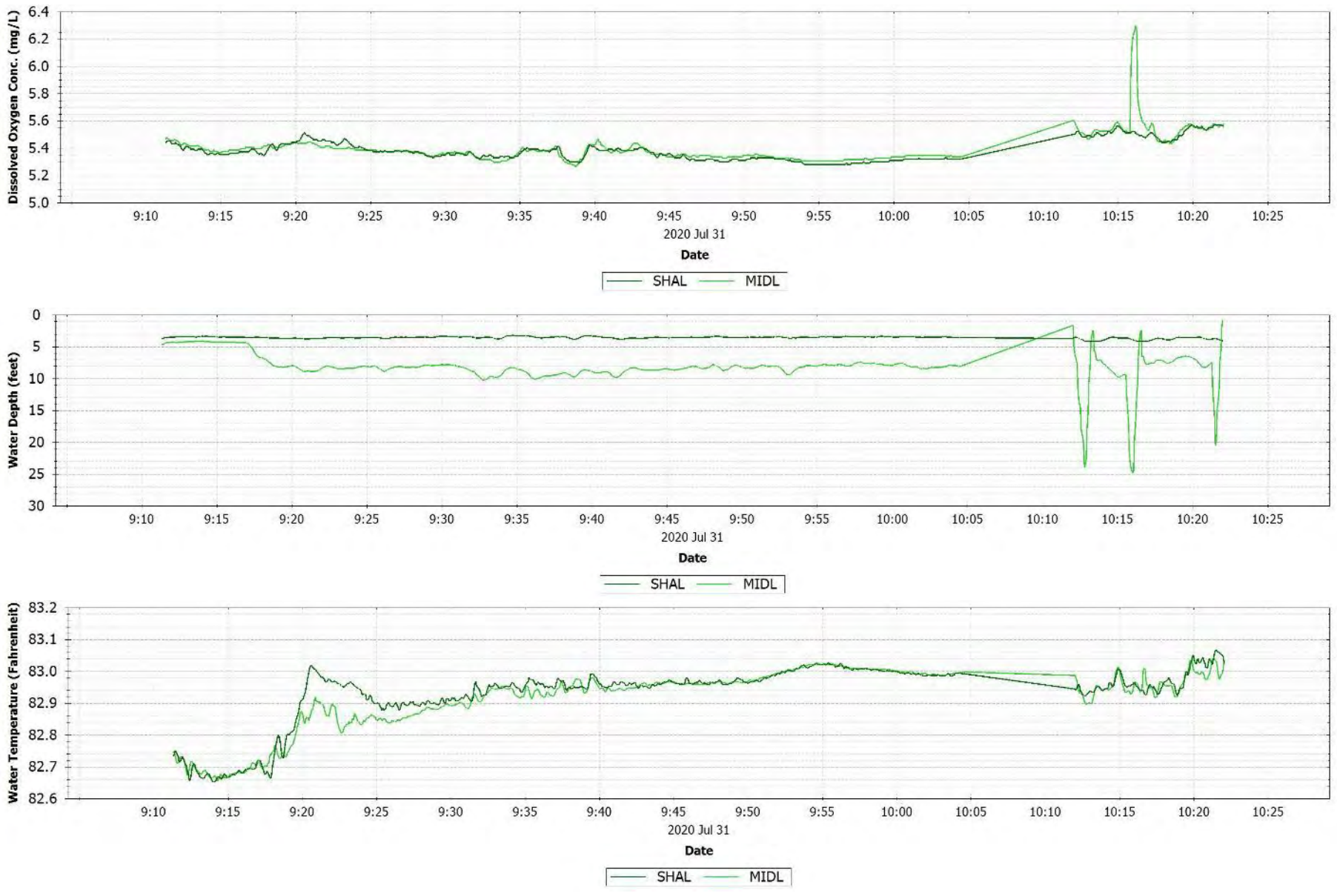


Figure C-15 Back River July 31, 2020 drift [LBR_Drift_073120_OT_D1] location map



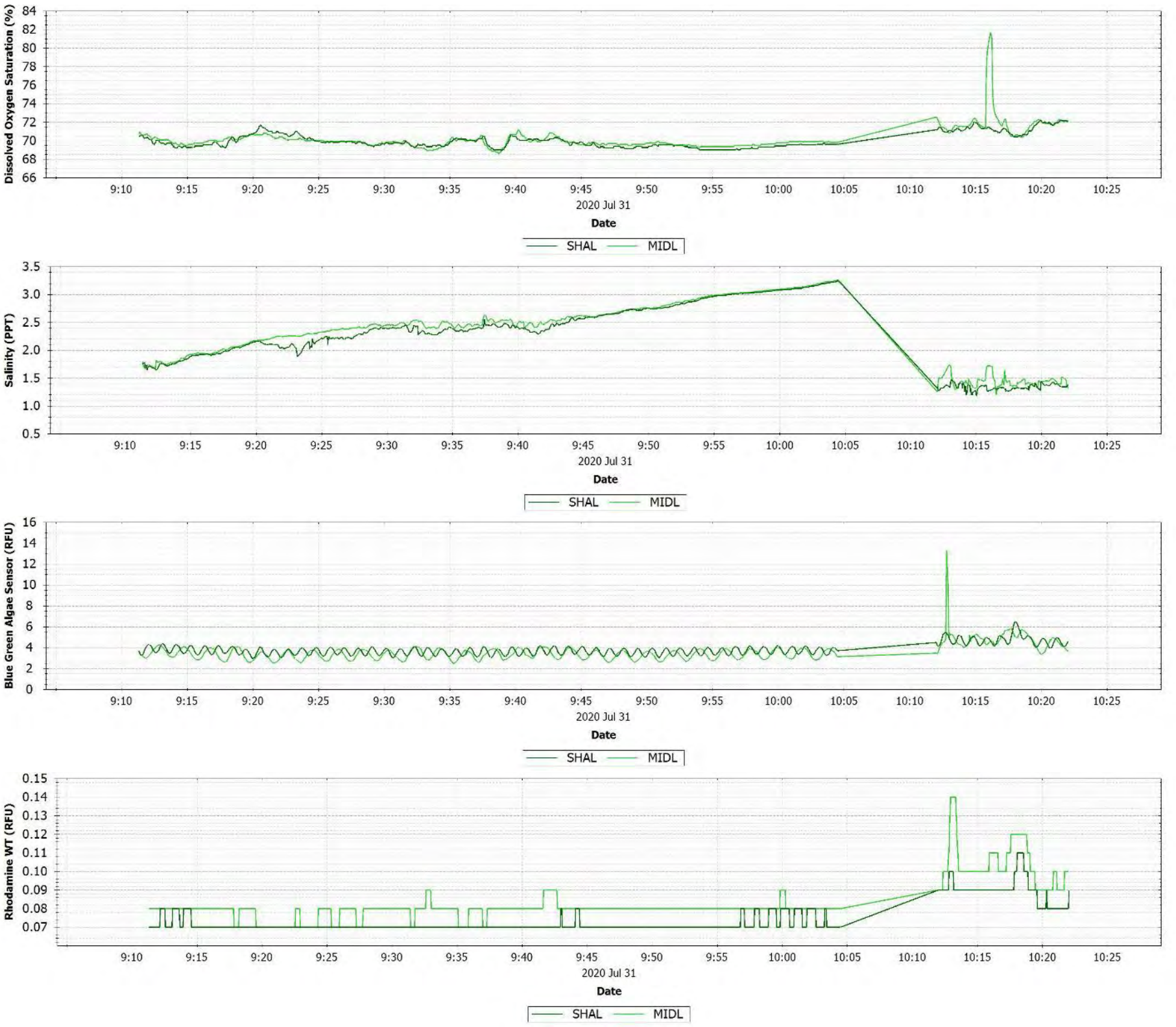


Figure C-16 Back River July 31, 2020 drift [LBR_Drift_073120_OT_D1] observations.

C.9 AUGUST 4, 2020 DRIFT BACK RIVER

Drift occurred during a high slack tide; high tide occurred at approximately 1007 with surface and mid-depth sondes. The drift sonde moved from bank to bank several times near the diffuser during the high tide. The near-field plume was detected several times during the maneuvers. The surface and mid-depth sondes DO were similar indicating good mixing top to bottom.



Figure C-17 Back River August 4, 2020 drift [LBR_Drift_080420_HT_D1] location map

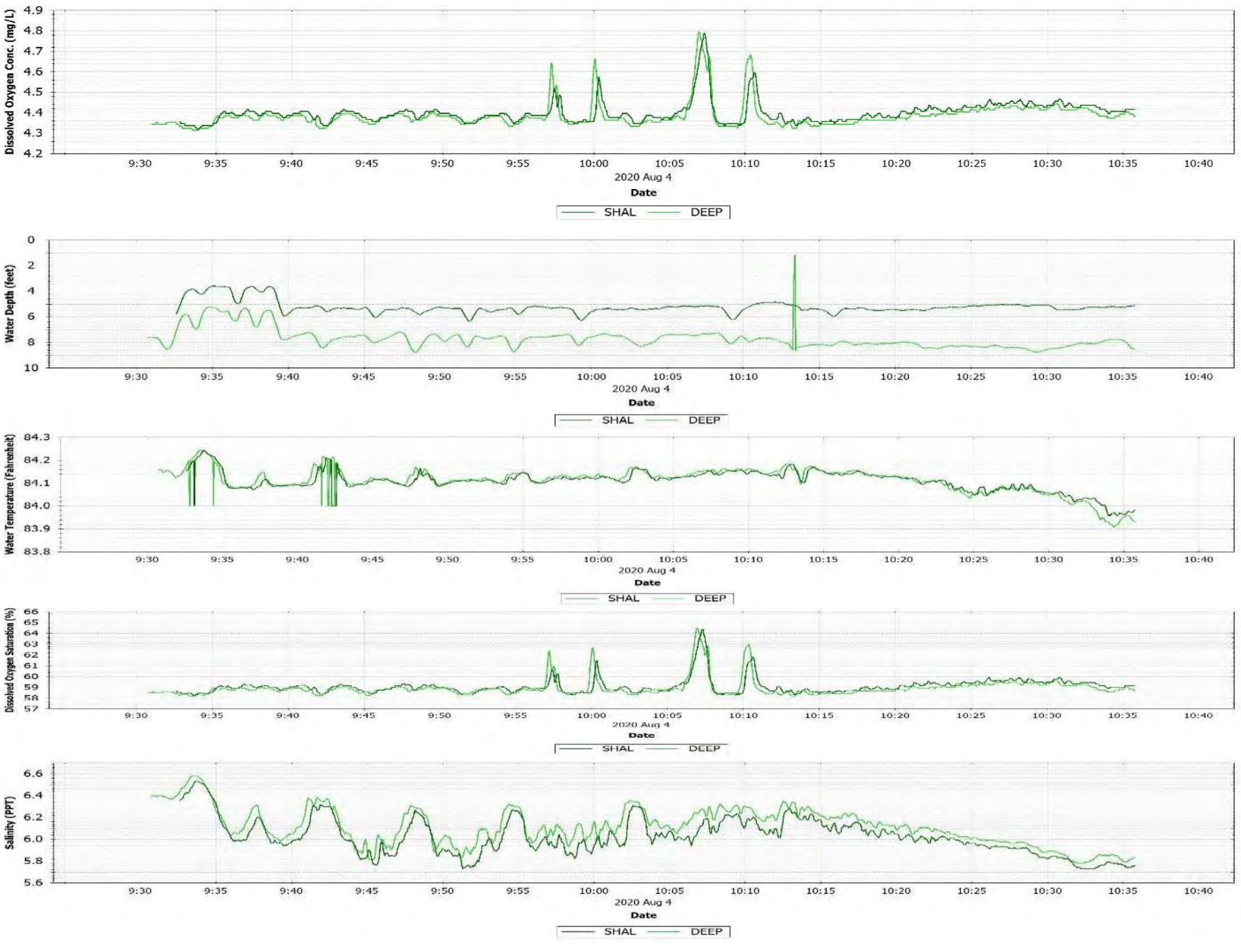


Figure C-18 Back River August 4, 2020 drift [LBR_Drift_080420_HT_D1] observations.

C.10 AUGUST 5, 2020 DRIFT BACK RIVER

Drift occurred during incoming tide and slack tide; high tide occurred at approximately 1049. DO increased as sampling occurred upstream of diffuser and then decreased as oxygen plume became mixed into the waterbody.



Figure C-19 Back River August 5, 2020 drift [LBR_Drift_080520_IT_D1] location map

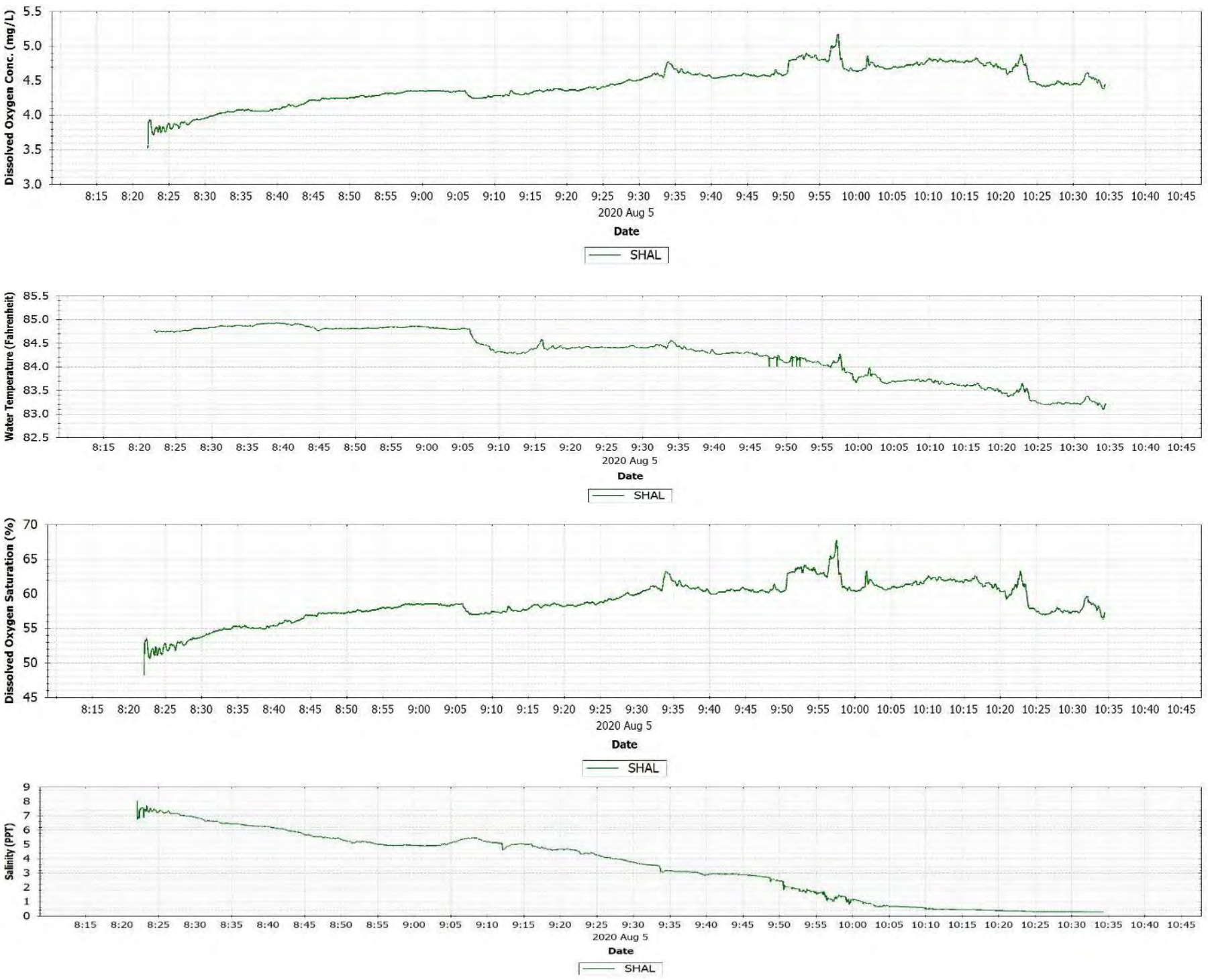


Figure C-20 Back River August 5, 2020 drift [LBR_Drift_080520_IT_D1] observations.

C.11 AUGUST 7, 2020 DRIFT BACK RIVER

Drift occurred during incoming tide; low tide occurred at approximately 0647. The sondes measured an increase in DO concentration in the vicinity of the diffuser between 0909 and 0919. The mid-depth DO was lower than the surface DO as the boat proceeded upstream of the diffuser indicating the oxygen plume was not yet fully mixed.

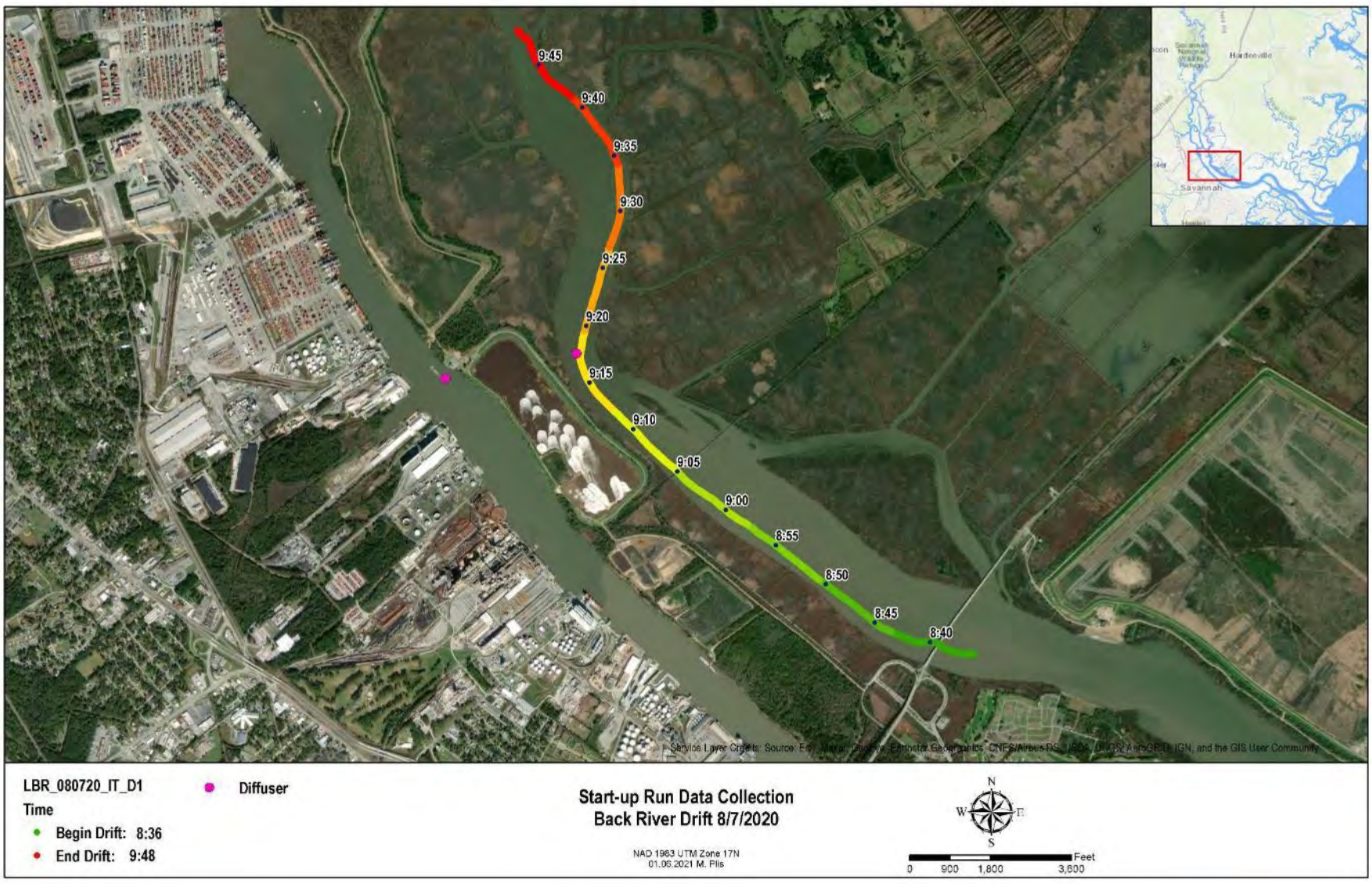


Figure C-21 Back River August 7, 2020 drift [LBR_Drift_080720_IT_D1] location map

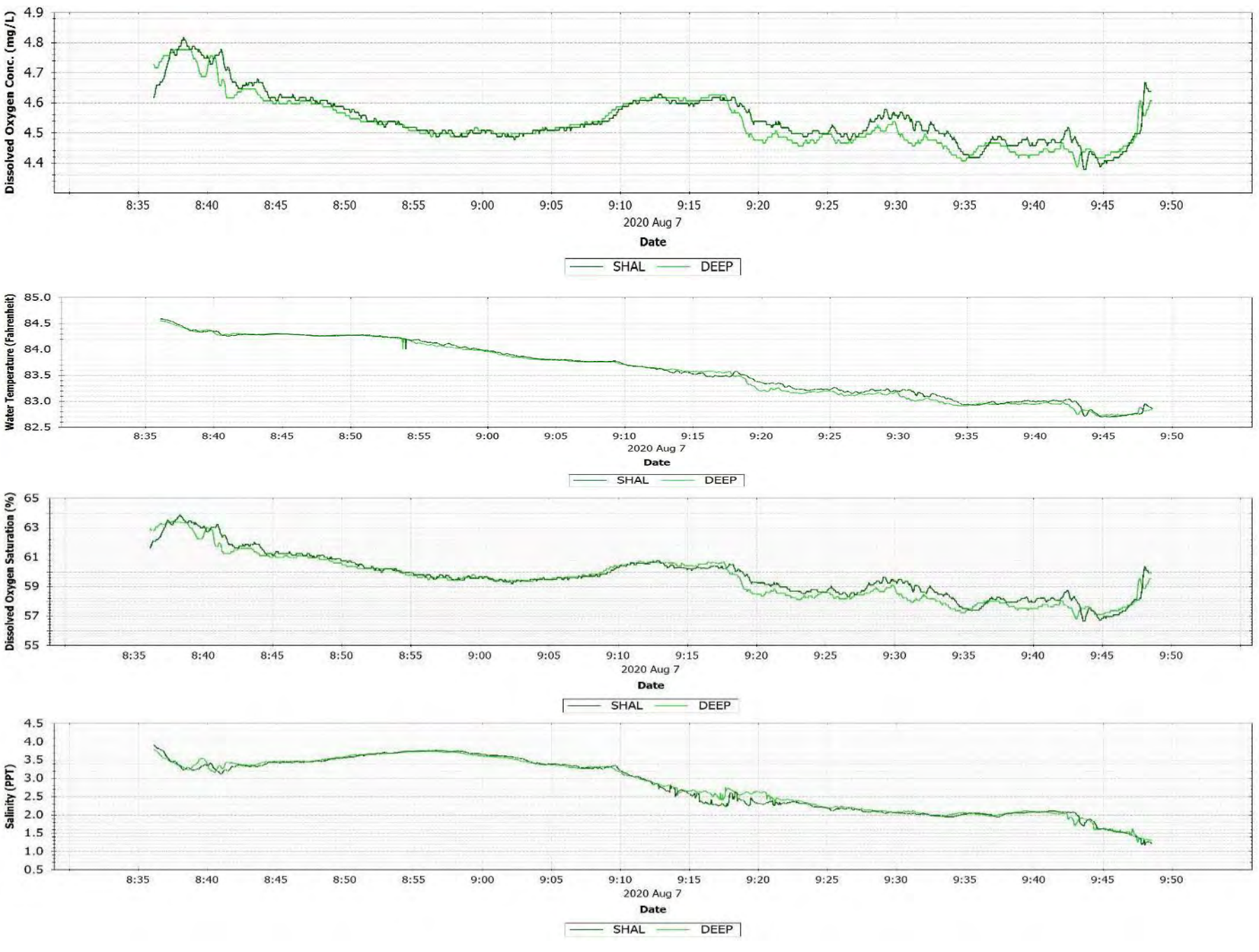


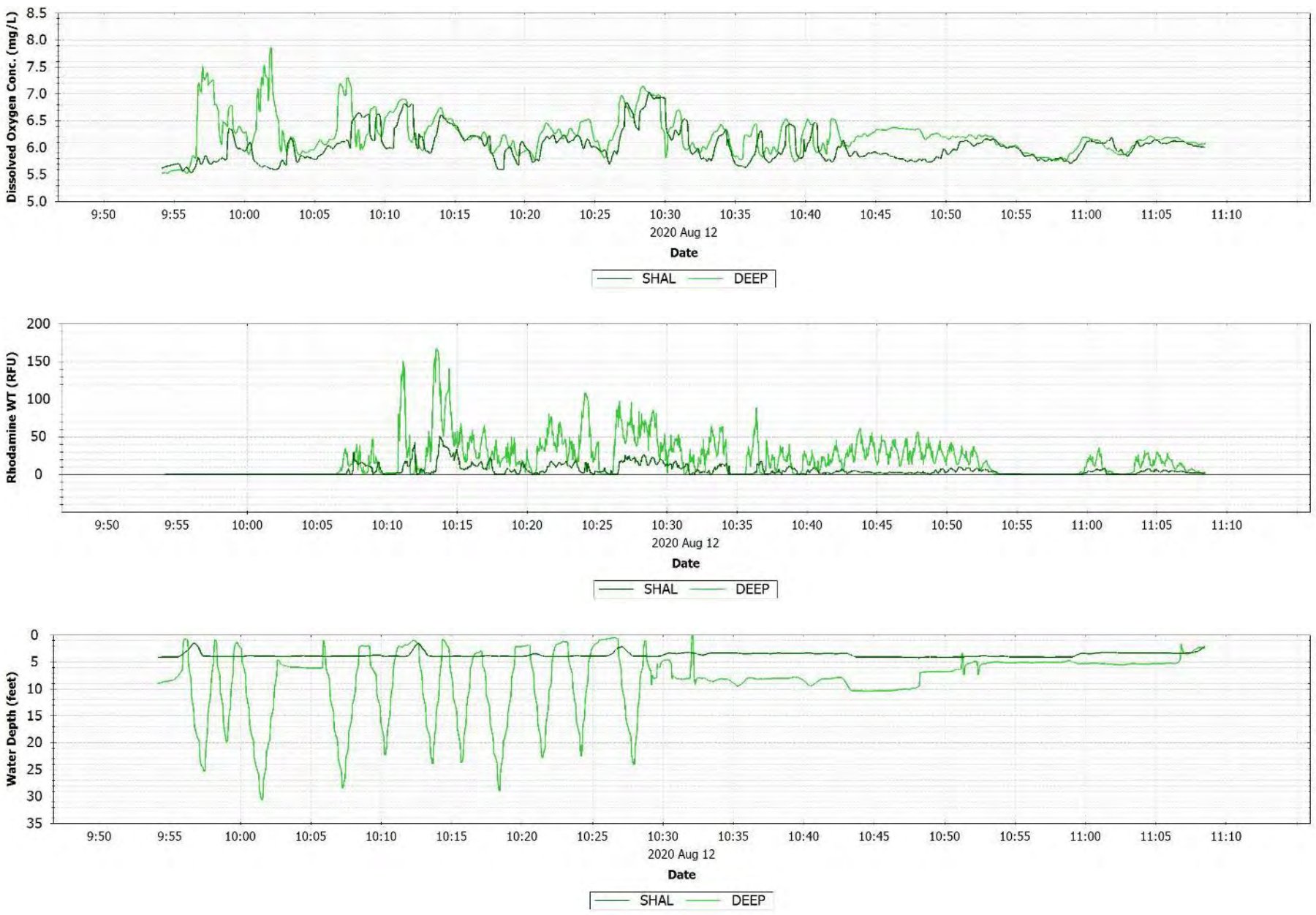
Figure C-22 Back River August 7, 2020 drift [LBR_Drift_080720_IT_D1] observations

C.12 AUGUST 12, 2020 DYE INJECTION DRIFT BACK RIVER

Three boat drift sampling occurred during the dye injection sampling. Drift occurred during low slack tide to incoming tide; low tide occurred at approximately 0942. When the middle sonde was lowered to a depth of 25 feet or more near the diffuser, the concentrations in DO increased more than 1 mg/L, indicating that the DO near-field plume was near the bottom of the channel. Increases in BGA and Rhodamine concentrations appear to be directly correlated to increases in DO concentrations, confirming that dye can be used to track the DO plume. More detail provided in main report.



Figure C-23 Back River August 12, 2020 dye injection drift 1 [LBR_Drift_081220_DYE_D1] location map



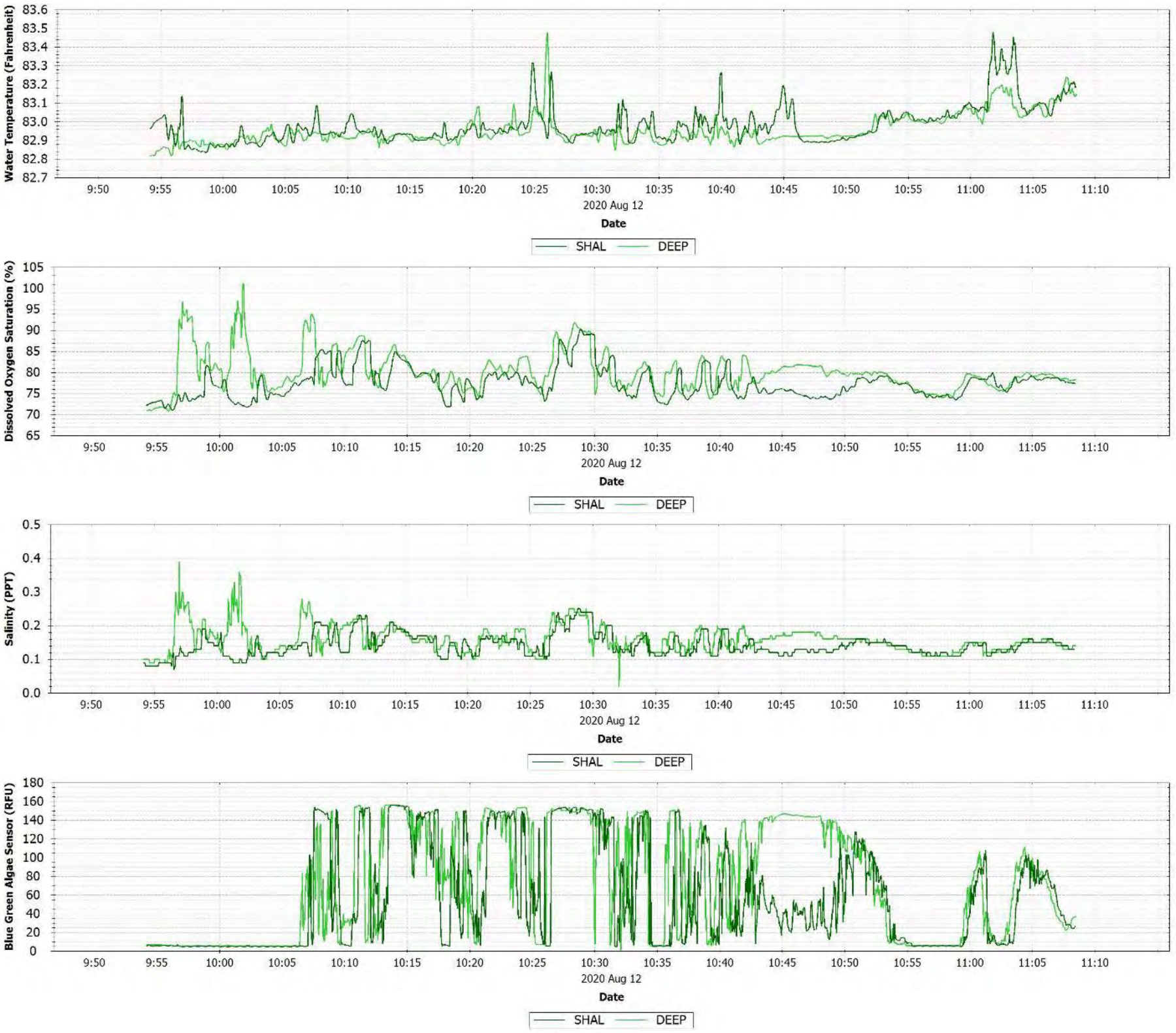


Figure C-24 Back River August 12, 2020 dye injection drift 1 [LBR_Drift_081220_DYE_D1] observations.



Figure C-25 Back River August 12, 2020 dye injection drift 2 [LBR_Drift_081220_DYE_D2] location map



Figure C-26 Back River August 12, 2020 dye injection drift 2 [LBR_Drift_081220_DYE_D2] observations.

The third drift occurred during incoming tide; low tide occurred at approximately 0942. Upstream of the diffuser, DO concentrations were higher when BGA and Rhodamine were detected. DO concentrations were highest between 1120 and 1123 when the sonde was close to the diffuser.



Figure C-27 Back River August 12, 2020 dye injection drift 3 [LBR_Drift_081220_DYE_D3] location map

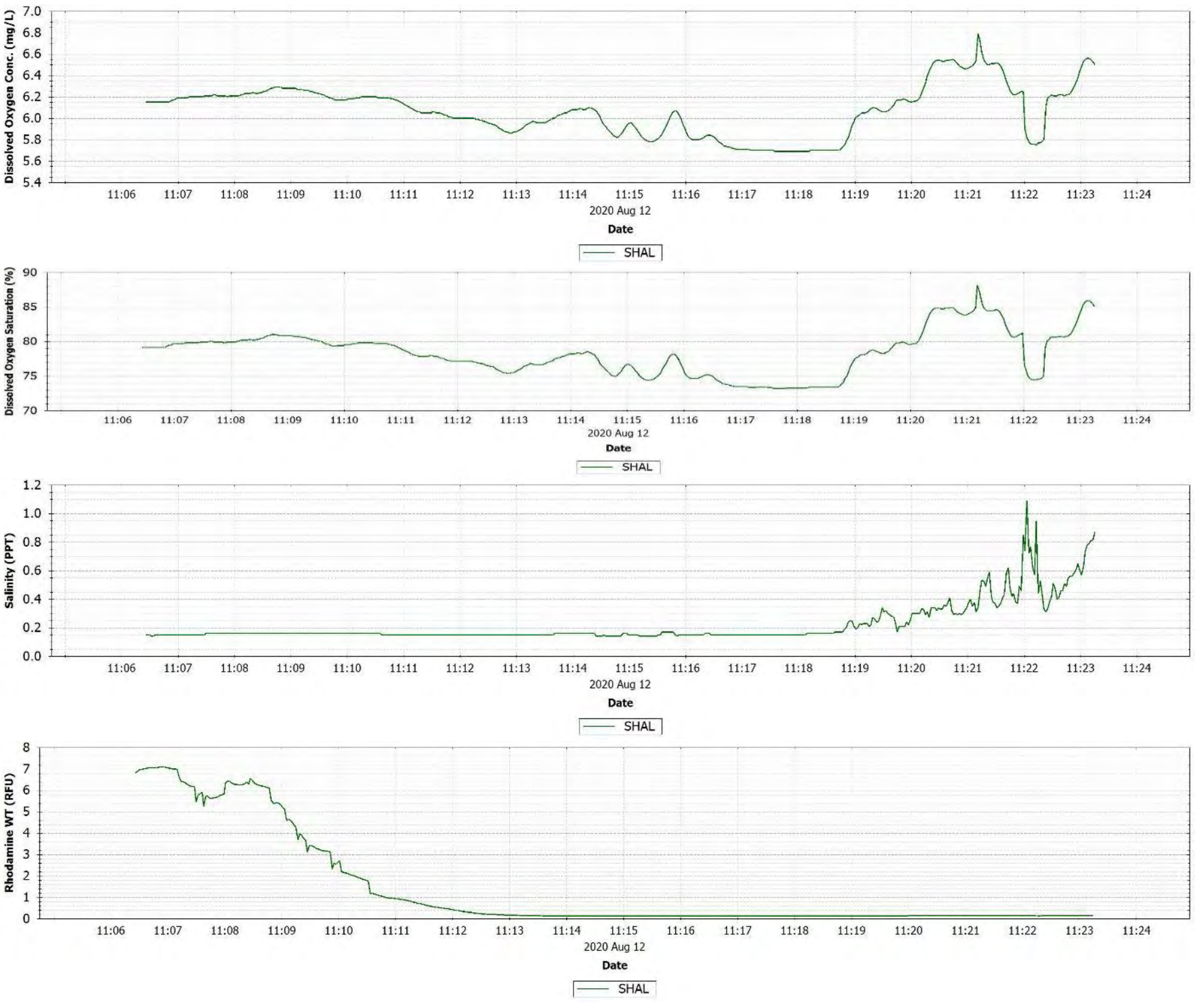


Figure C-28 Back River August 12, 2020 dye injection drift 3 [LBR_Drift_081220_DYE_D3] observations..

C.13 AUGUST 13, 2020 DRIFT BACK RIVER

Drift occurred during outgoing tide to low slack tide; low tide occurred at approximately 1036. The August 12, 2020 injected dye spread out in the Back River, with the dye peak downstream of discharge on ebb tide. The DO was fairly constant, with the lower DO levels near the confluence of the Front River. The drift sonde did appear to intersect the near-field DO plume around 945. The low DO spikes most likely occurred when sonde had to be raised as boat approached shallow side areas.

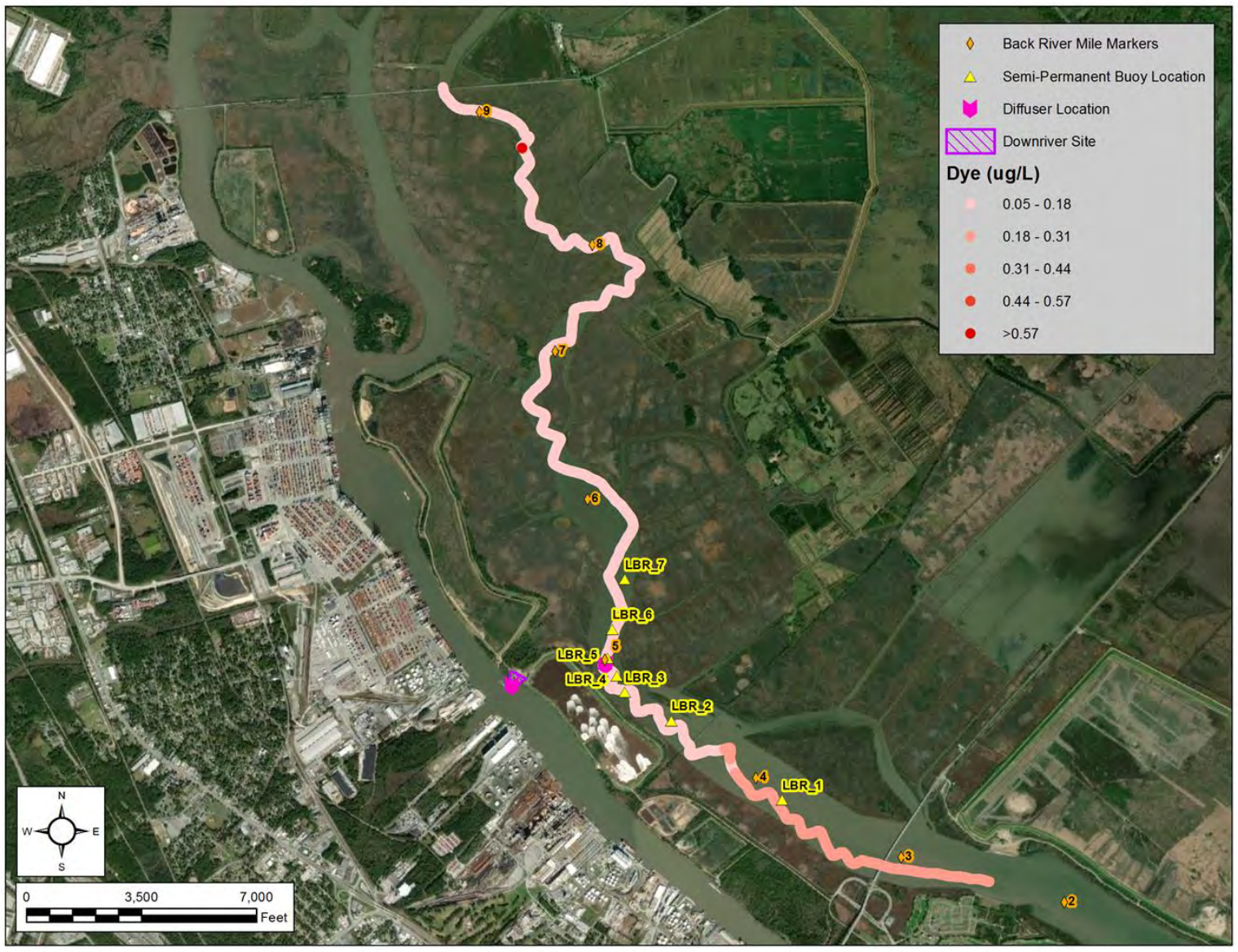


Figure C-29 Back River August 13, 2020 Dye Profile

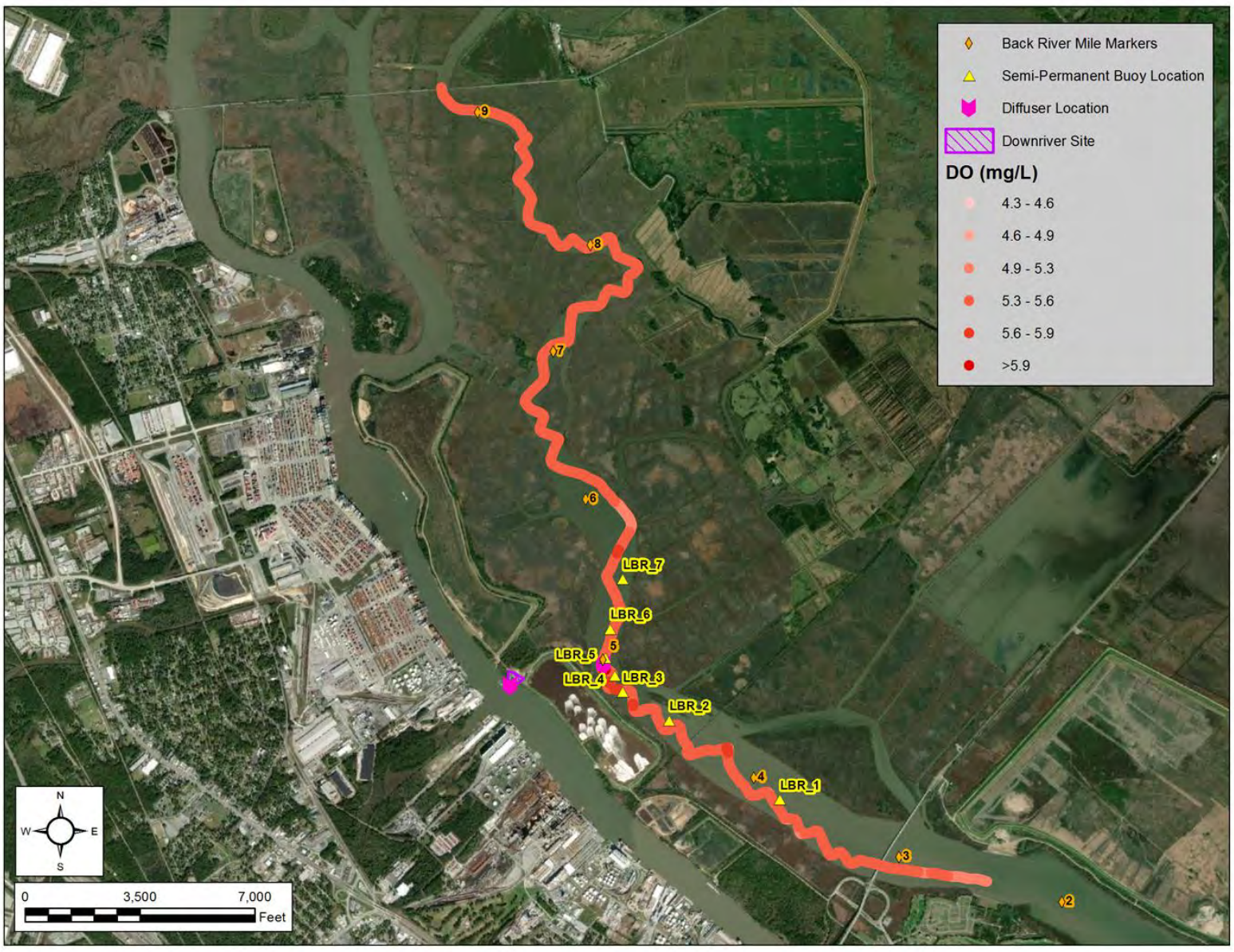


Figure C-30 Back River August 13, 2020 DO profile

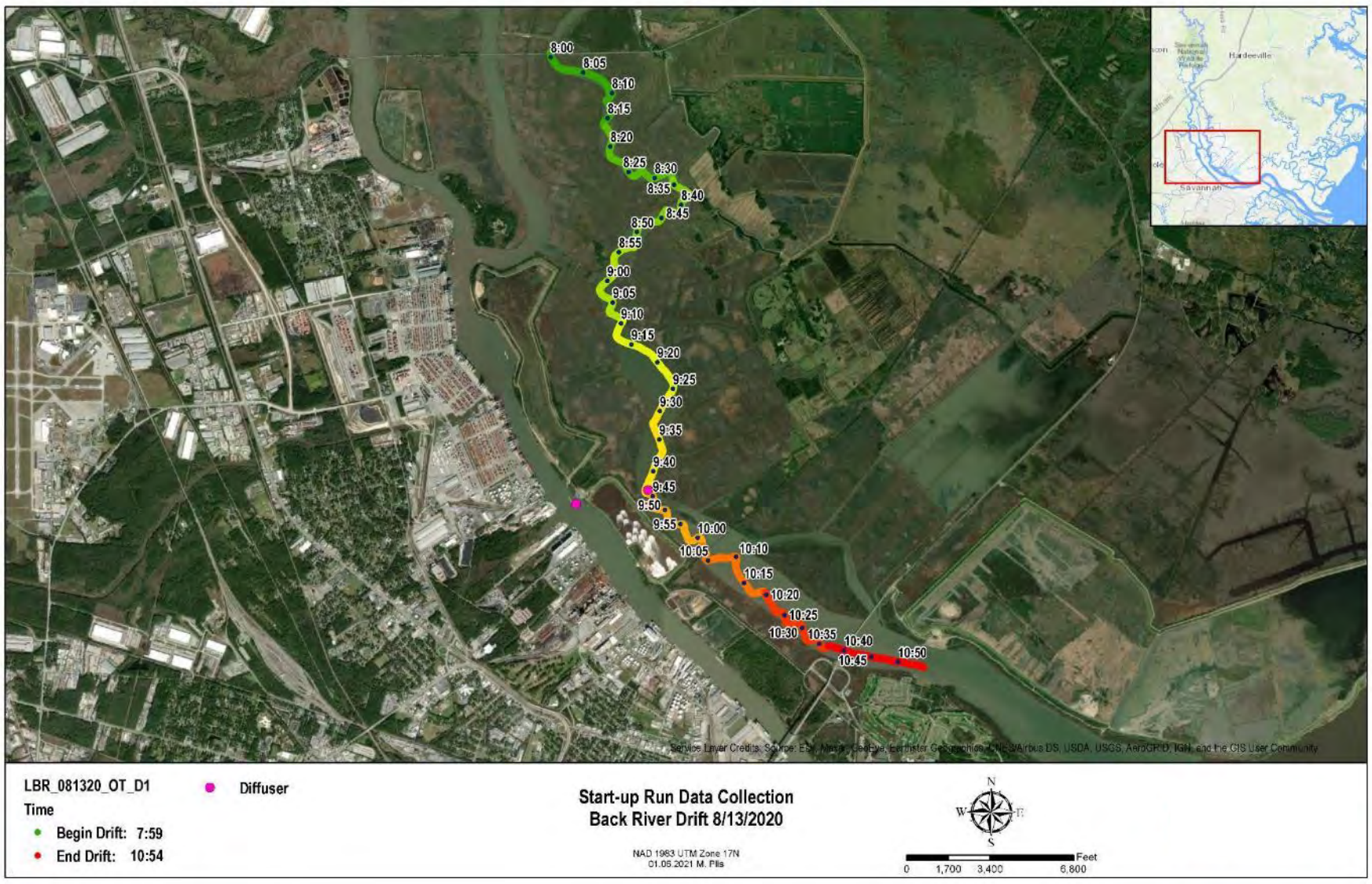
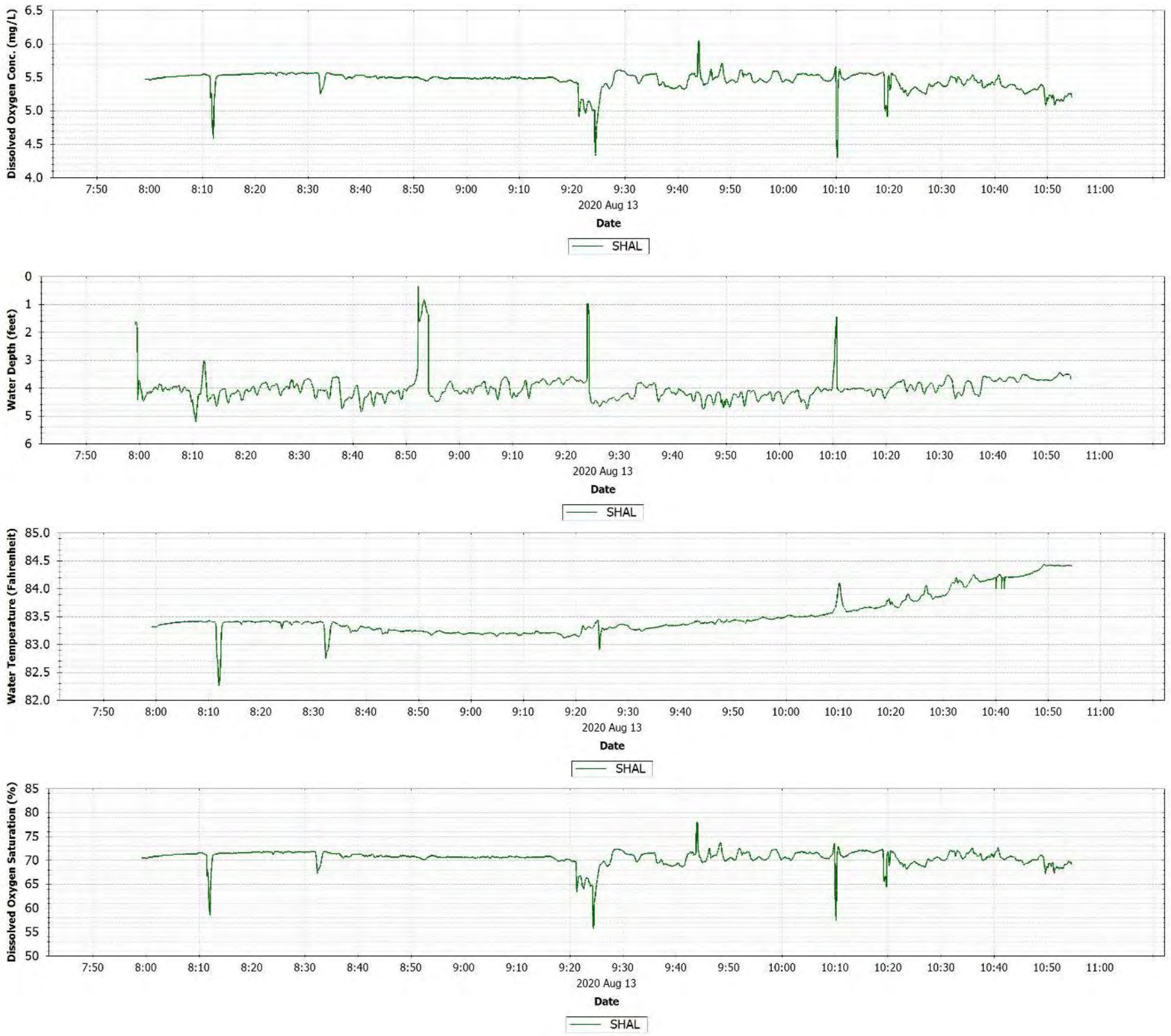


Figure C-31 Back River August 13, 2020 drift [LBR_Drift_081320_OT_D1] location map



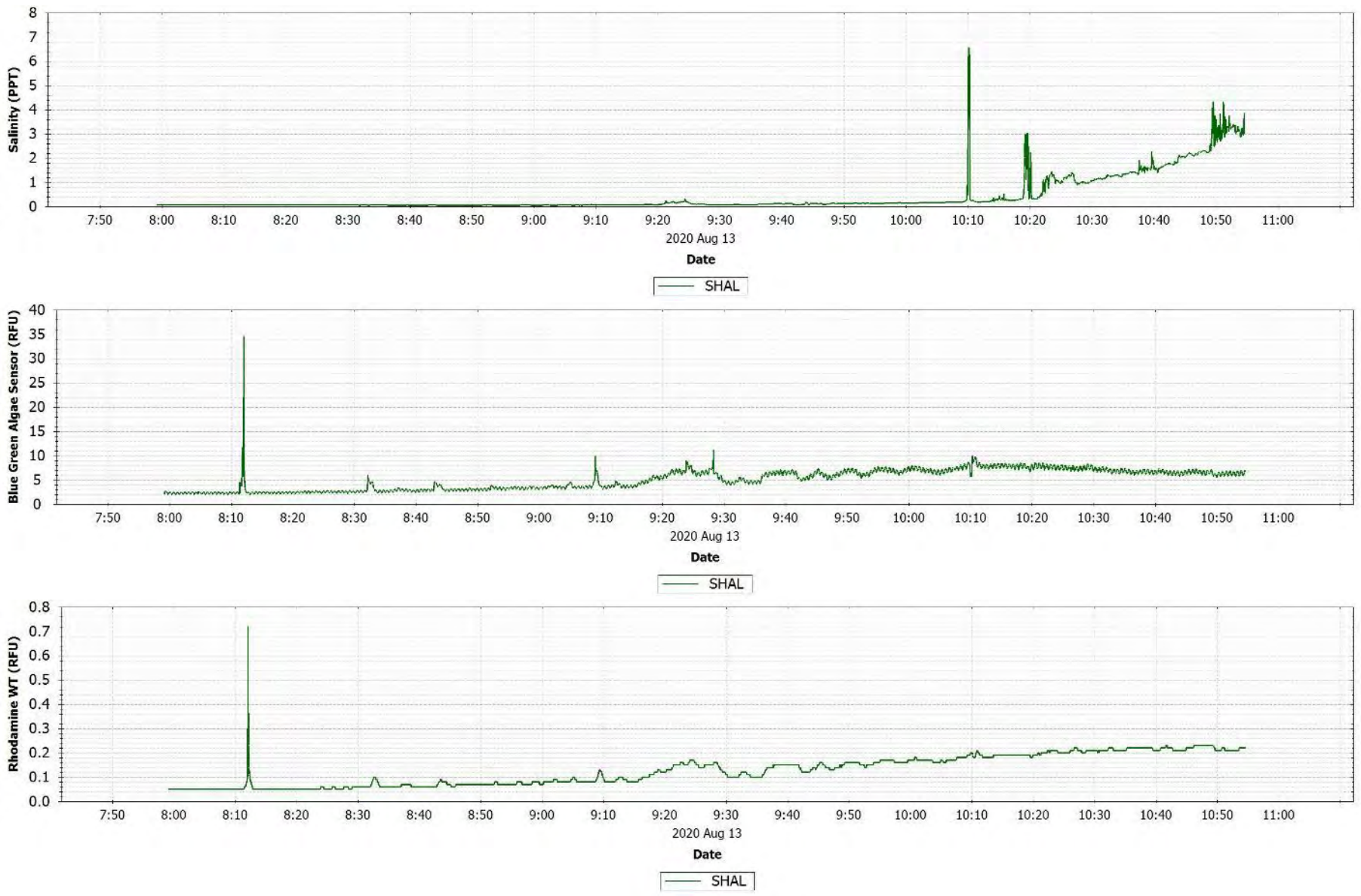


Figure C-32 Back River August 13, 2020 drift [LBR_Drift_081320_OT_D1] observations.

C.14 AUGUST 14, 2020 DRIFT BACK RIVER

Drift occurred during outgoing tide; low tide occurred at approximately 1131. The sonde was lowered to depths of 17 feet to 26 feet in the vicinity of the diffuser. DO concentrations increased more than 0.5 mg/L at deeper depths, indicating that the injected DO near-field plume was staying at the bottom of the water column.

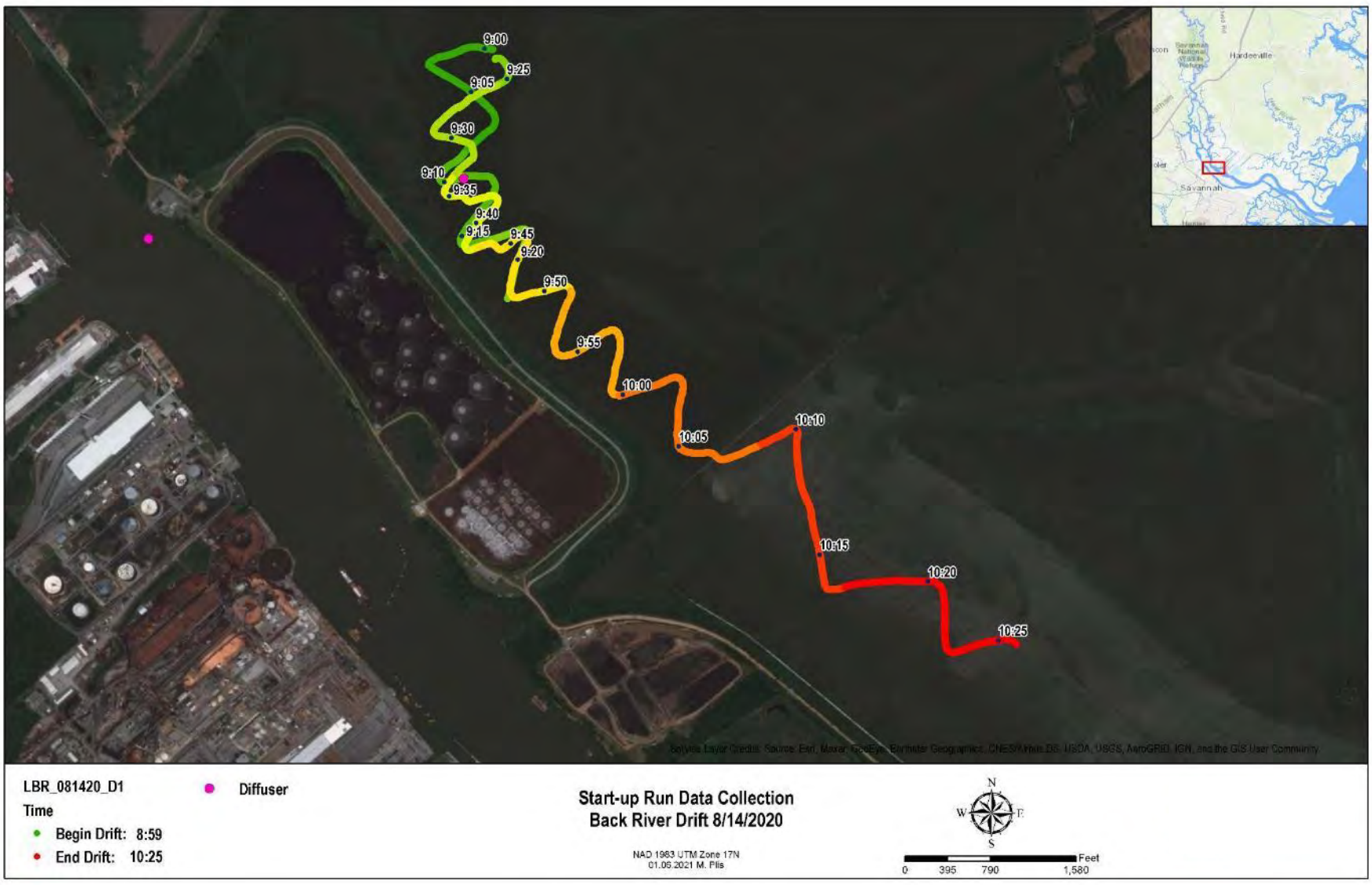
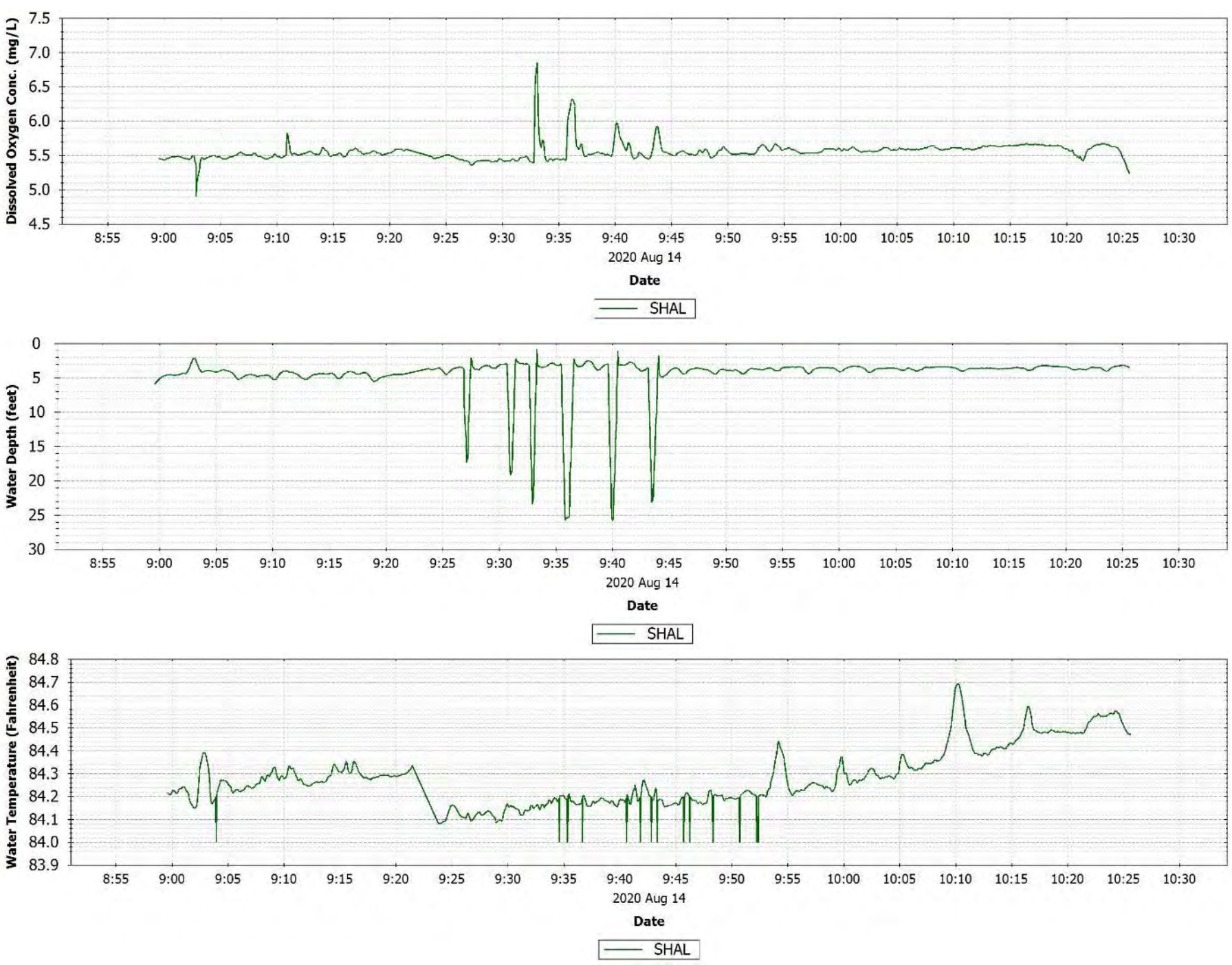


Figure C-33 Back River August 14, 2020 drift [LBR_Drift_081420_D1] location map



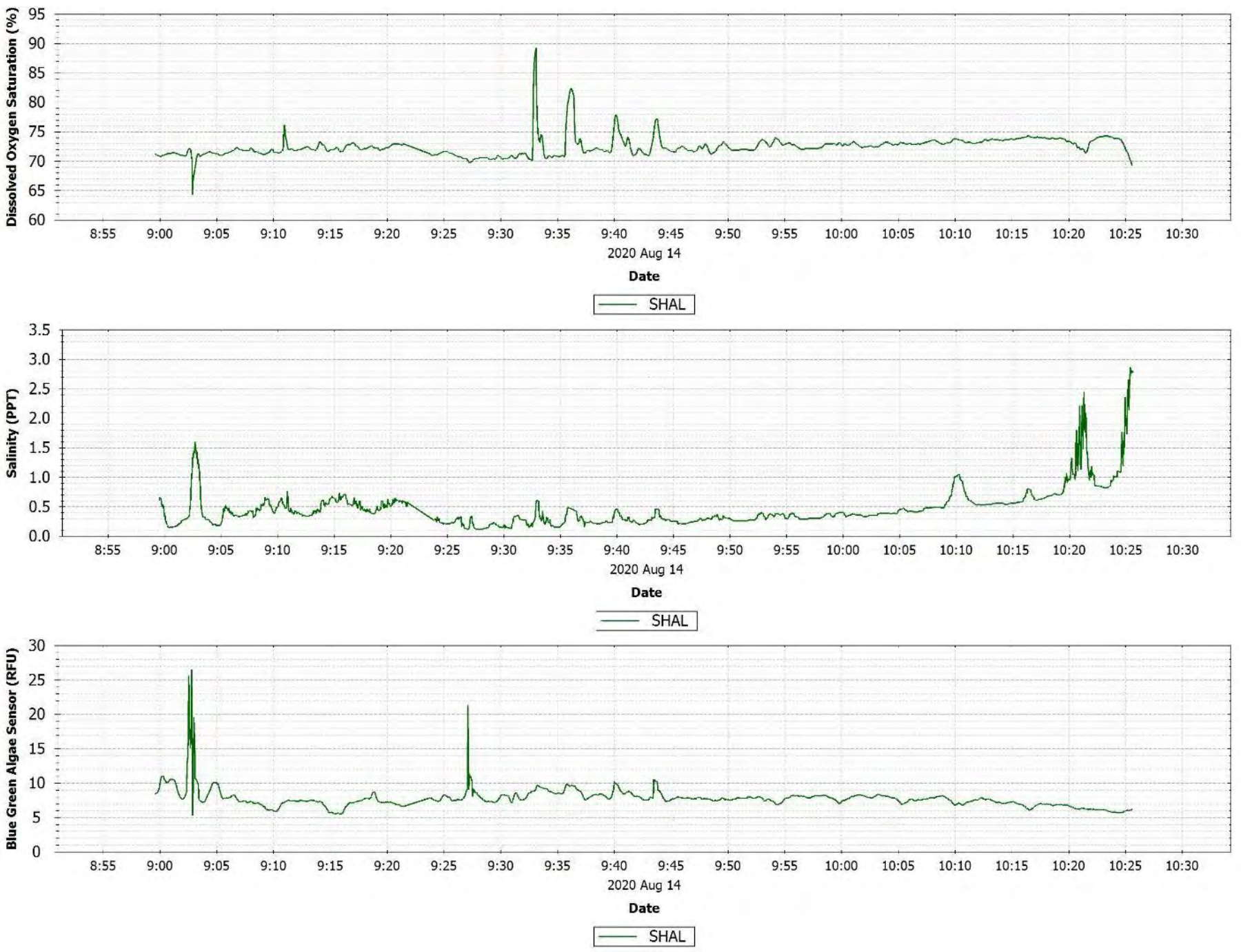


Figure C-34 Back River August 14, 2020 drift [LBR_Drift_081420_D1] observations.

C.15 AUGUST 15, 2020 DRIFT BACK RIVER

Drift occurred during outgoing tide; low tide occurred at approximately 1226. The DO concentrations increased approximately 0.2 mg/L near the diffuser at approximately 1122 and remained elevated downstream, indicating the sonde intersected the DO plume. Dye was still measured upstream of diffuser indicating the dye peak and therefore, the injected oxygen is remained in the Back River.

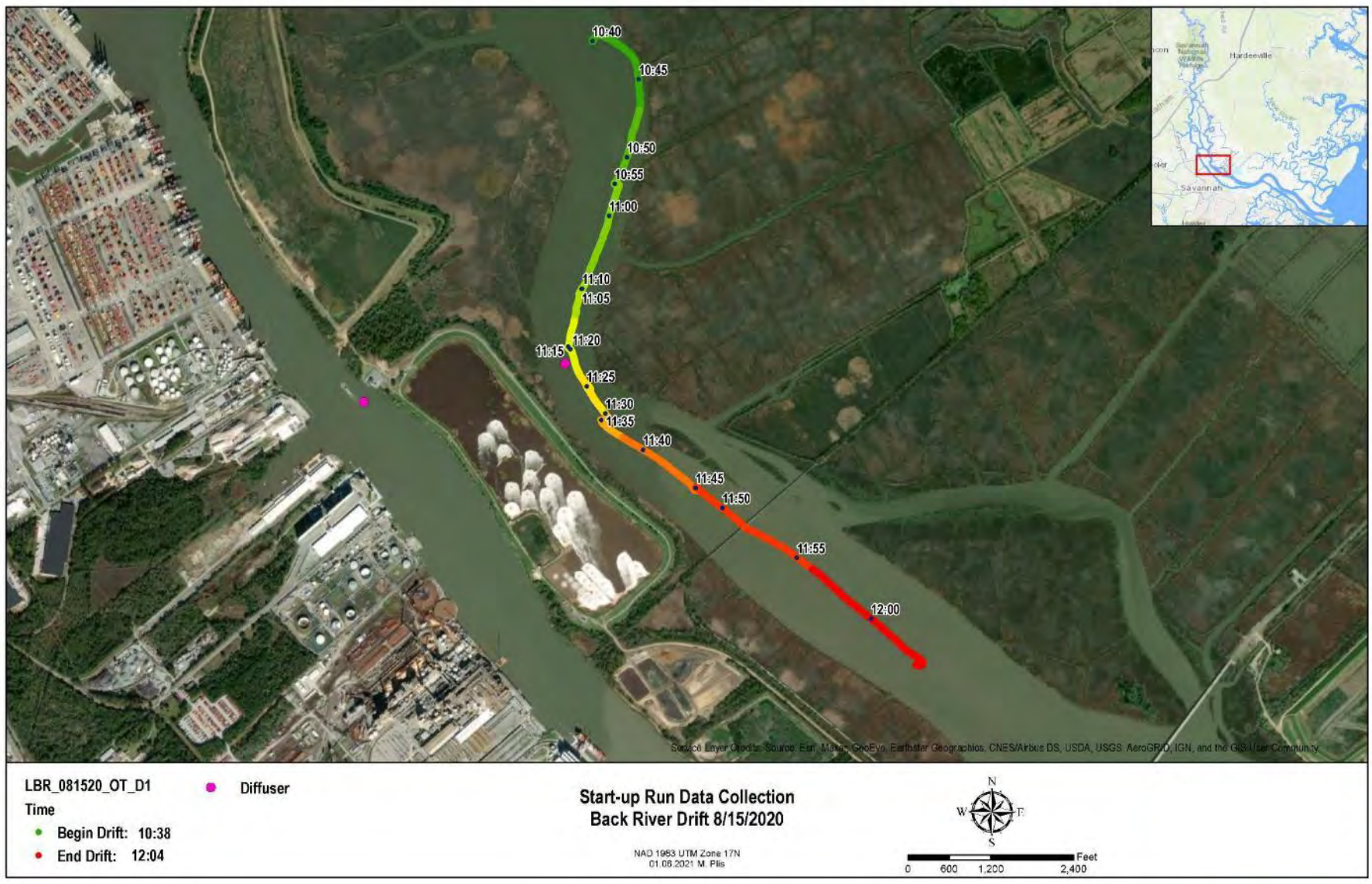
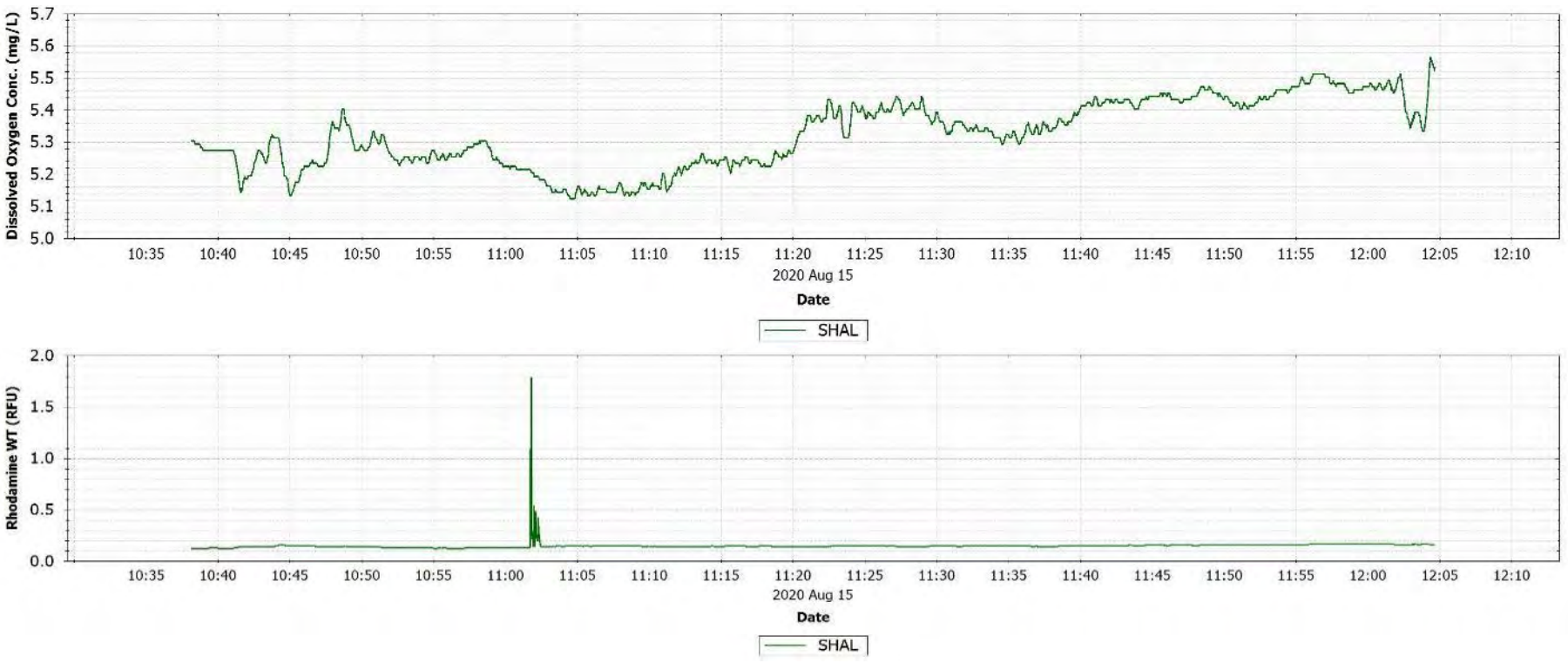


Figure C-35 Back River August 15, 2020 drift [LBR_Drift_081520_OT_D1] location map



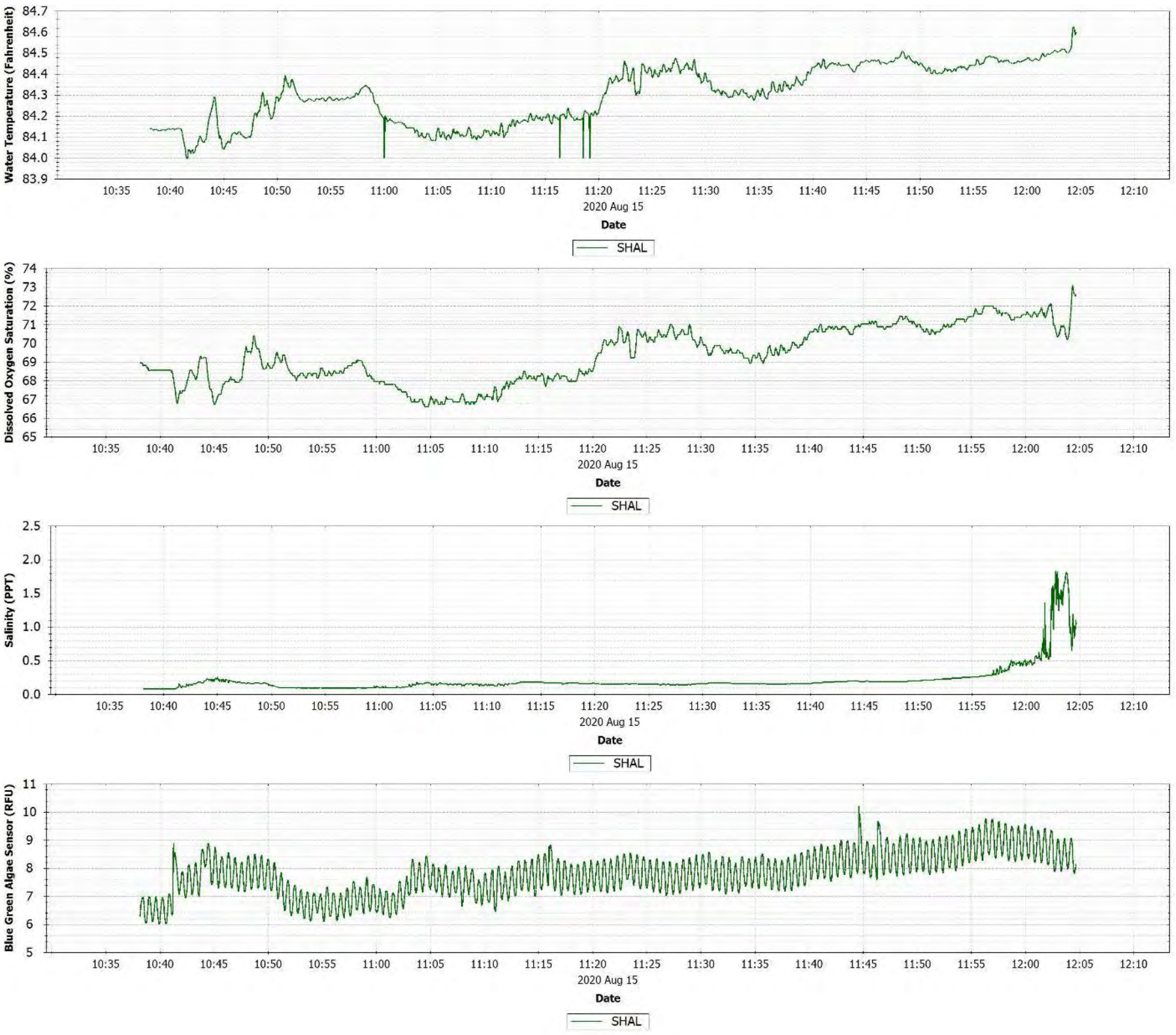


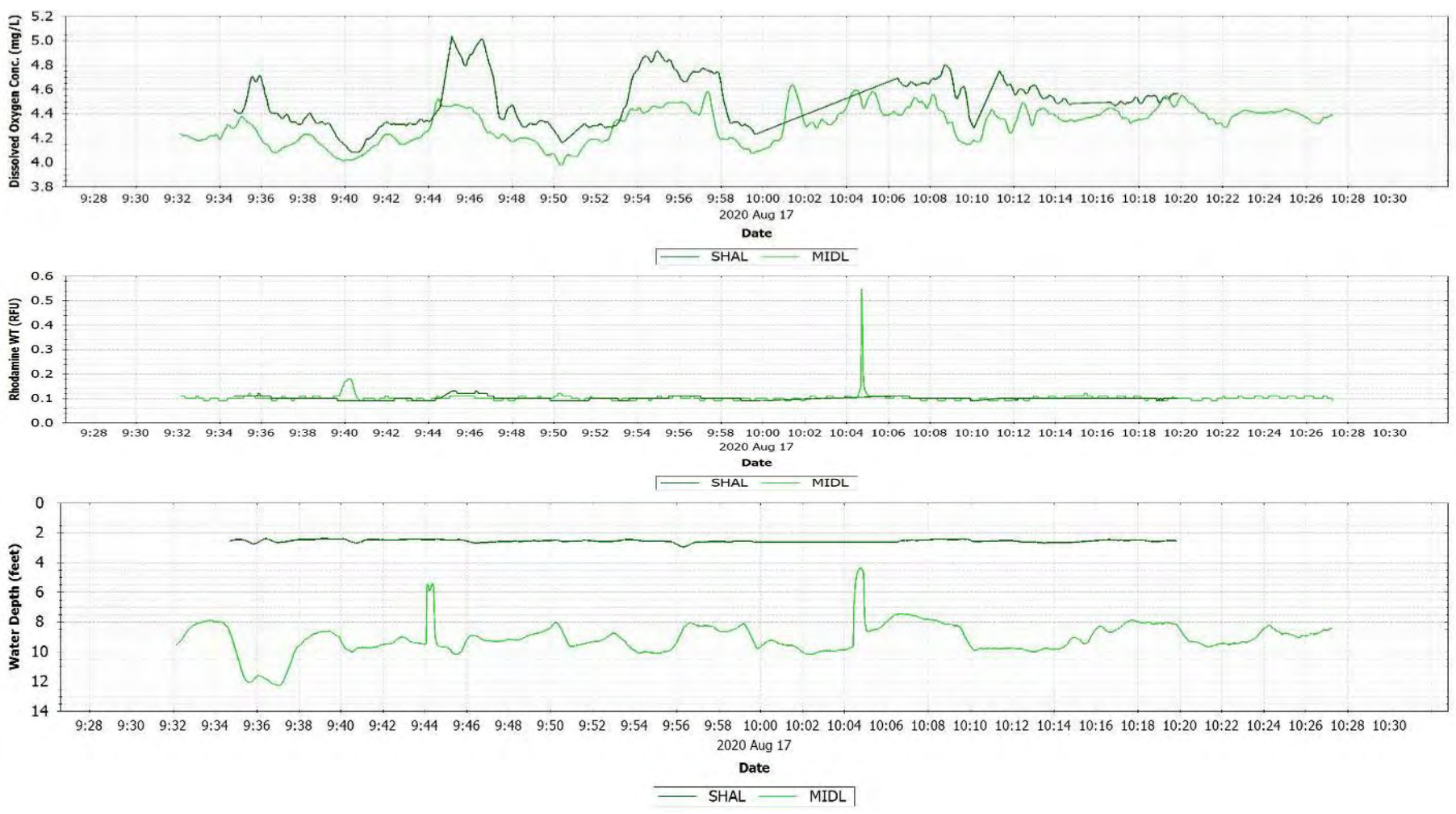
Figure C-36 Back River August 15, 2020 drift [LBR_Drift_081520_OT_D1] observations.

C.16 AUGUST 17, 2020 DRIFT BACK RIVER

Two boat drifts occurred during outgoing tide; high tide occurred at approximately 0754. The drift maneuvered from bank to bank near the diffuser and appeared to intersect the near-field plume multiple times when DO increased more than 0.5 mg/L. The near-field DO concentrations were higher near the surface where previous drifts showed that the near-field DO concentrations were higher near the bottom. This is most likely due to salinity stratification causing the oxygen plume to rise to the surface. Dye was still measured upstream of diffuser indicating the dye peak and therefore, the injected oxygen is remaining in the Back River.



Figure C-37 Back River August 17, 2020 drift 1 [LBR_Drift_081720_OT_D1] location map



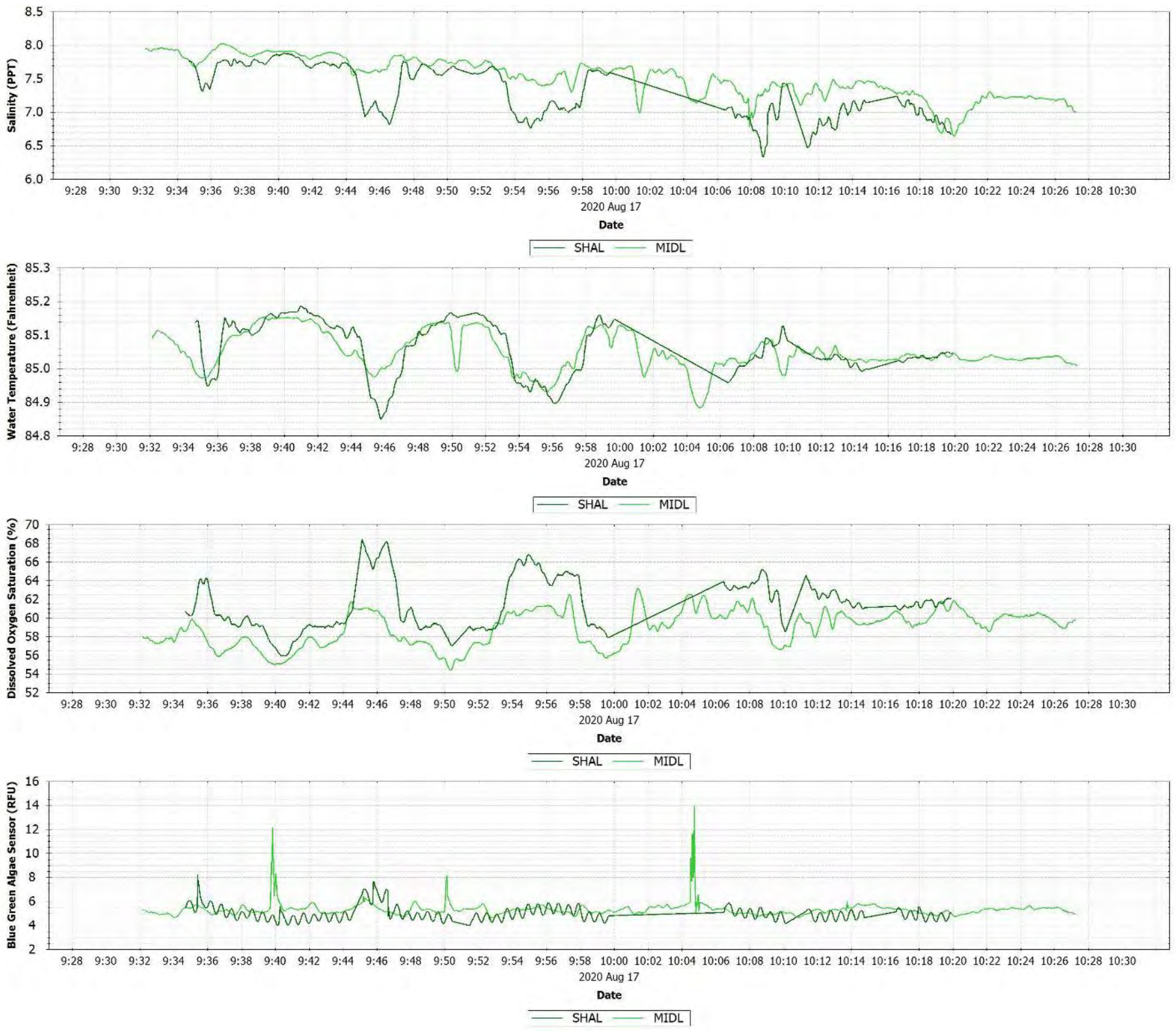
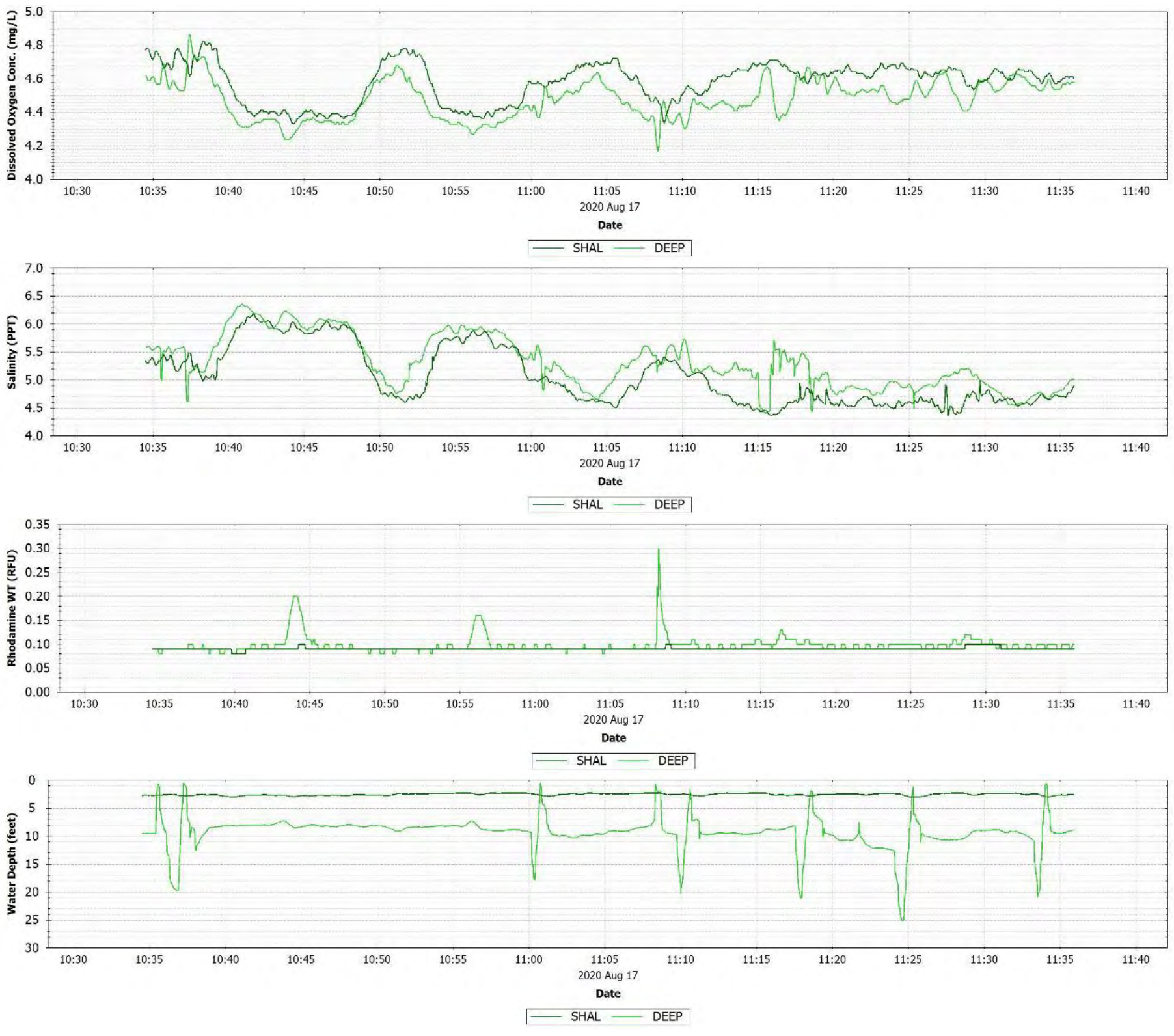


Figure C-38 Back River August 17, 2020 drift 1 [LBR_Drift_081720_OT_D1] observations.



Figure C-39 Back River August 17, 2020 drift 2 [LBR_Drift_081720_OT_D2] location map



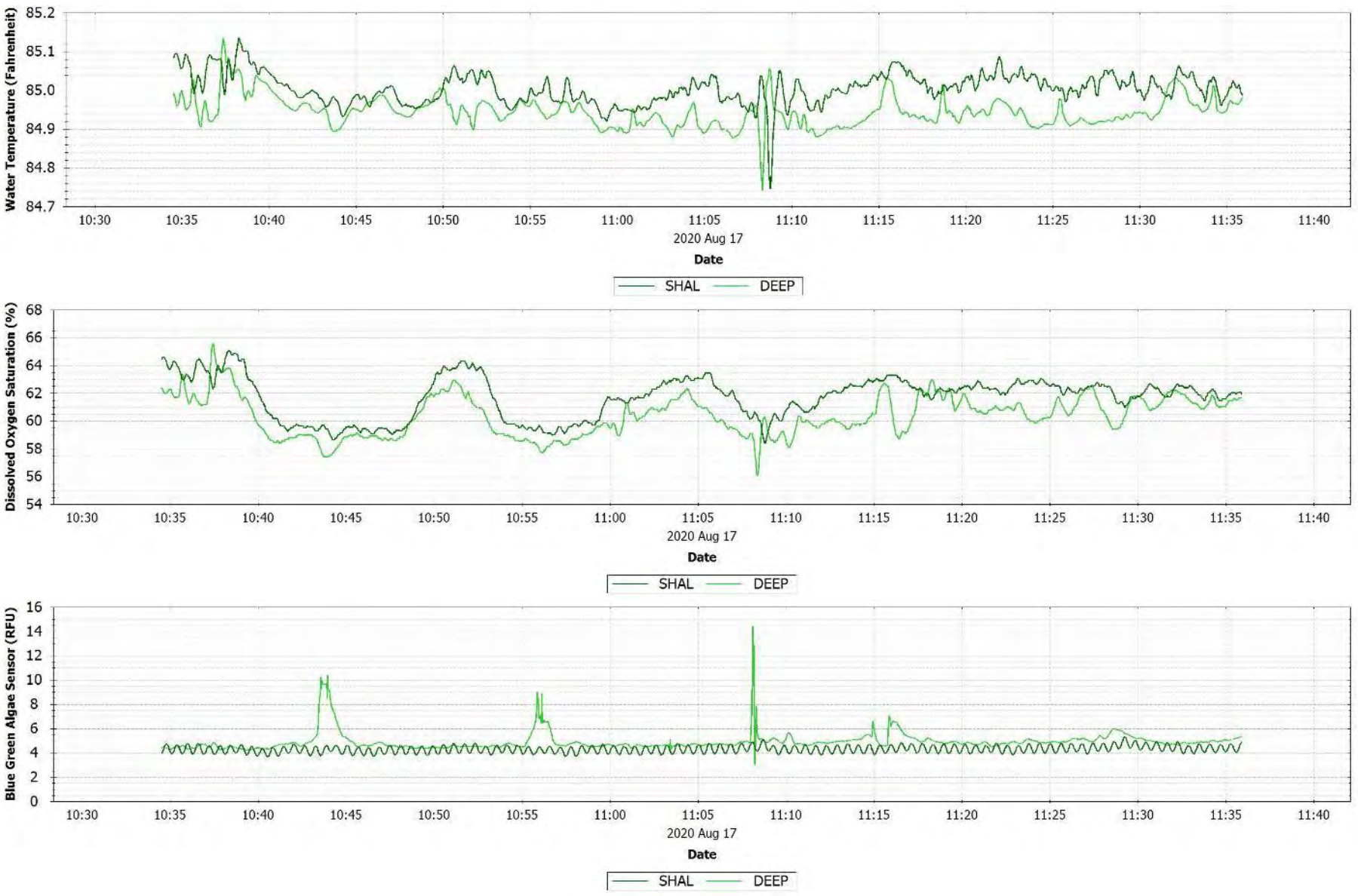


Figure C-40 Back River August 17, 2020 drift 2 [LBR_Drift_081720_OT_D2] observations.

C.17 AUGUST 18, 2020 DRIFT BACK RIVER

Drift occurred during high slack tide to outgoing tide; high tide occurred at approximately 0845. The sonde likely intersected the DO plume around 0900. The higher DO concentrations were measured upstream and near the diffuser

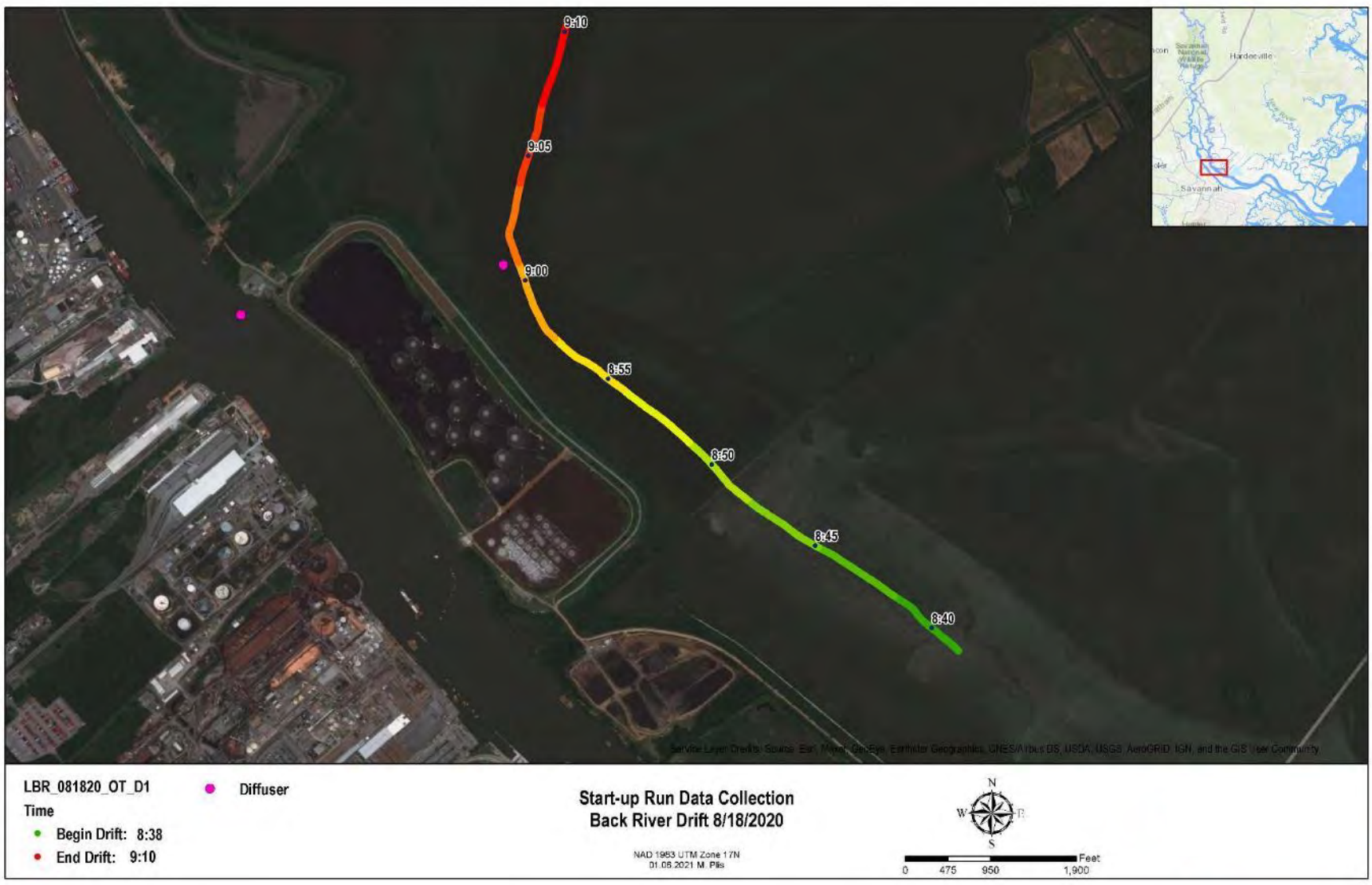
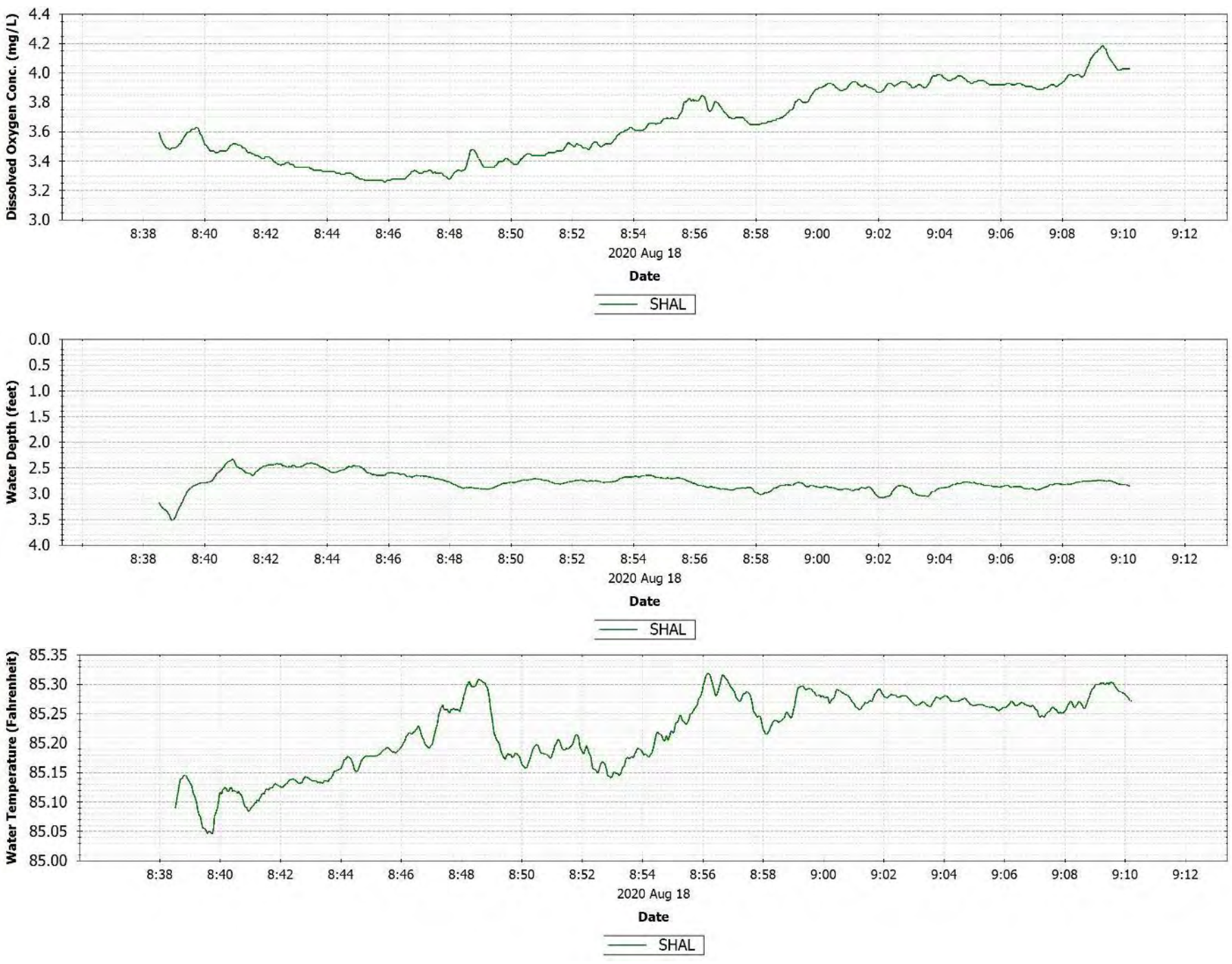


Figure C-41 Back River August 18, 2020 drift [LBR_Drift_081820_OT_D1] location map



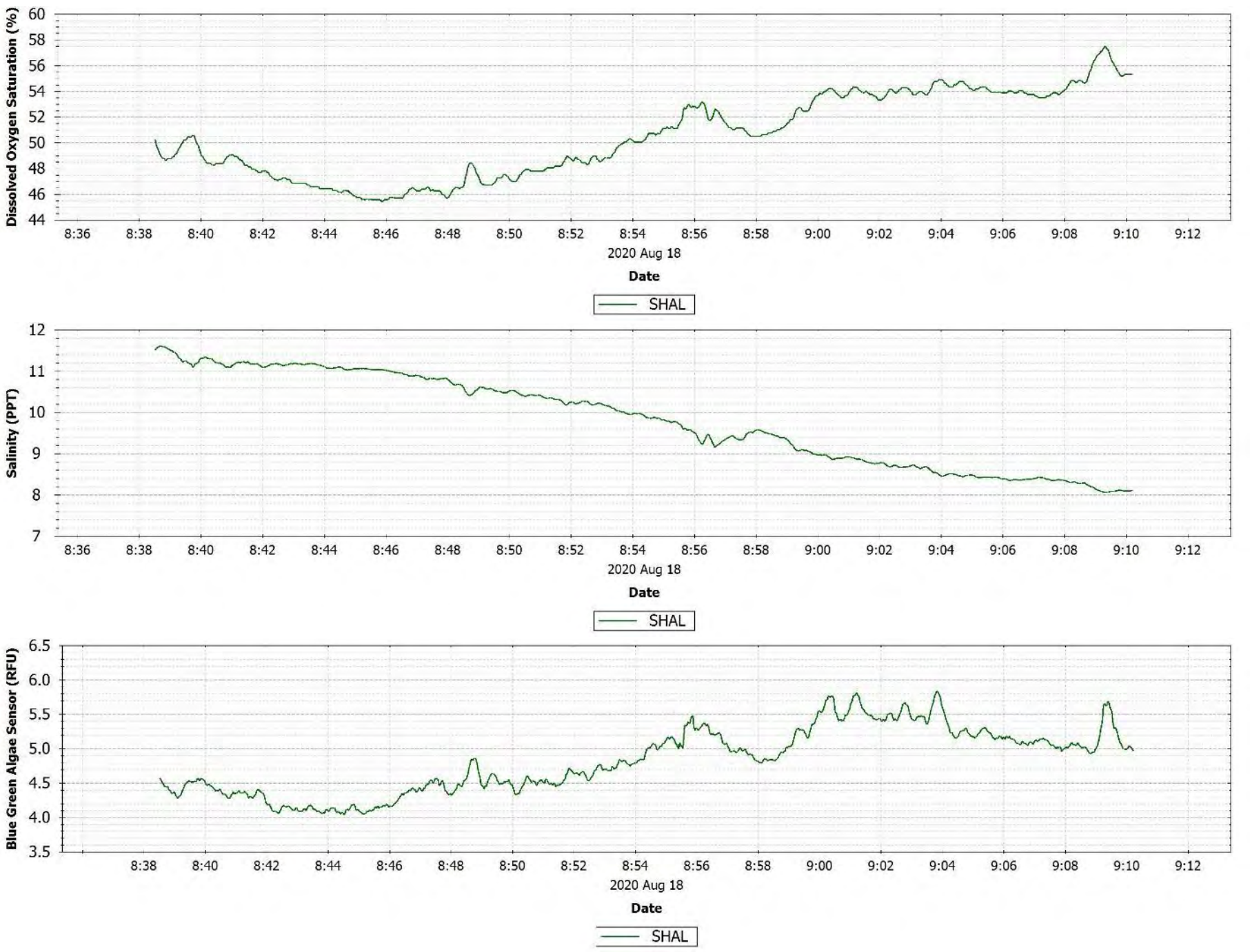


Figure C-42 Back River August 18, 2020 drift [LBR_Drift_081820_OT_D1] observations.

C.18 AUGUST 19, 2020 DRIFT BACK RIVER

Drift occurred during outgoing tide; high tide occurred at approximately 0935. The sonde was in the vicinity of the diffuser at approximately 1145, and there was a small increase in DO concentration at that time. Higher DO concentrations upstream of the diffuser may have been due to previously oxygenated water pushed upstream during the incoming tide. Surface and mid-depth DOs were similar except around the diffuser indicating good mixing top to bottom and no salinity stratification occurring.

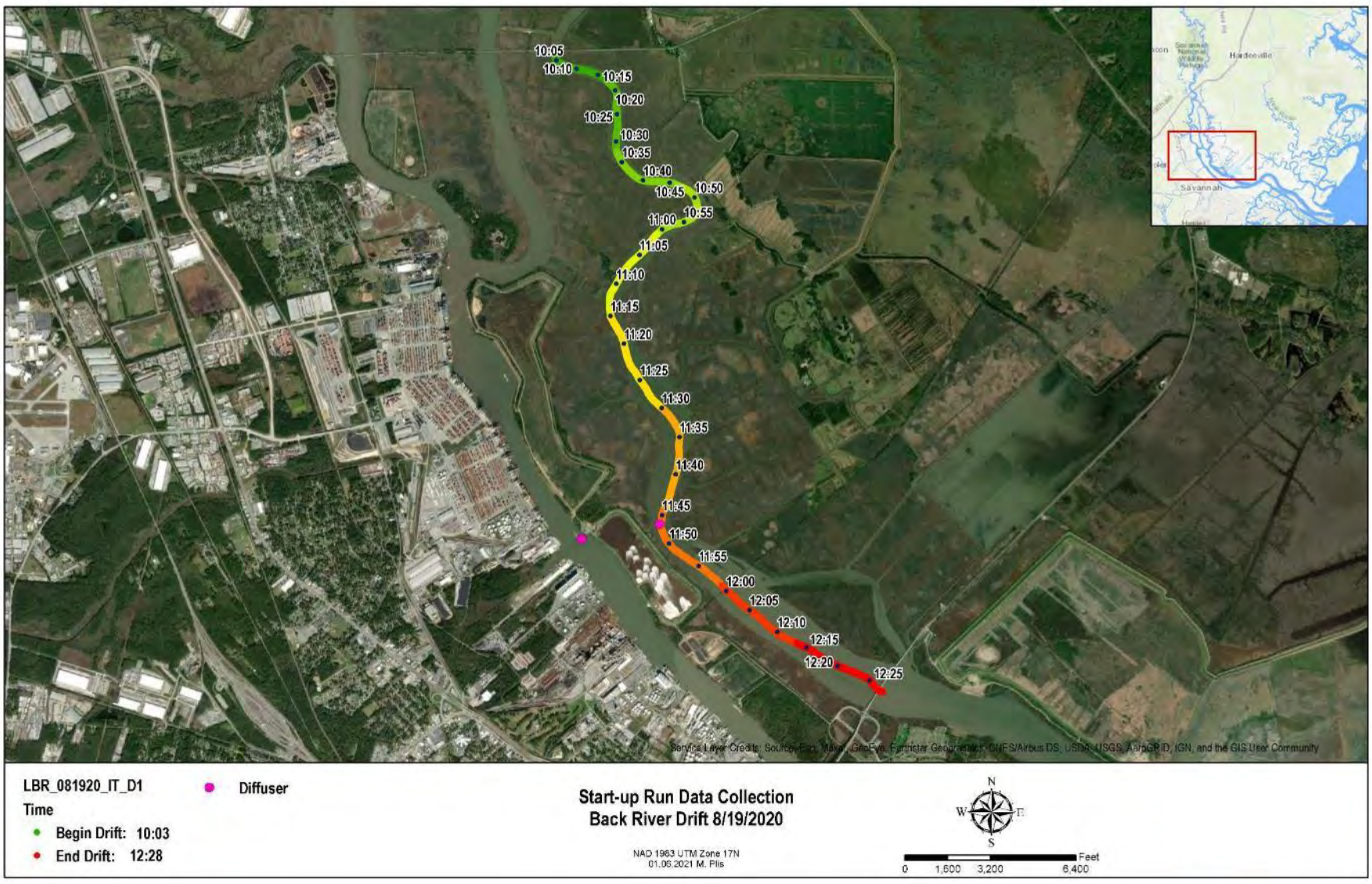


Figure C-43 Back River August 19, 2020 drift [LBR_Drift_081920_IT_D1] location map

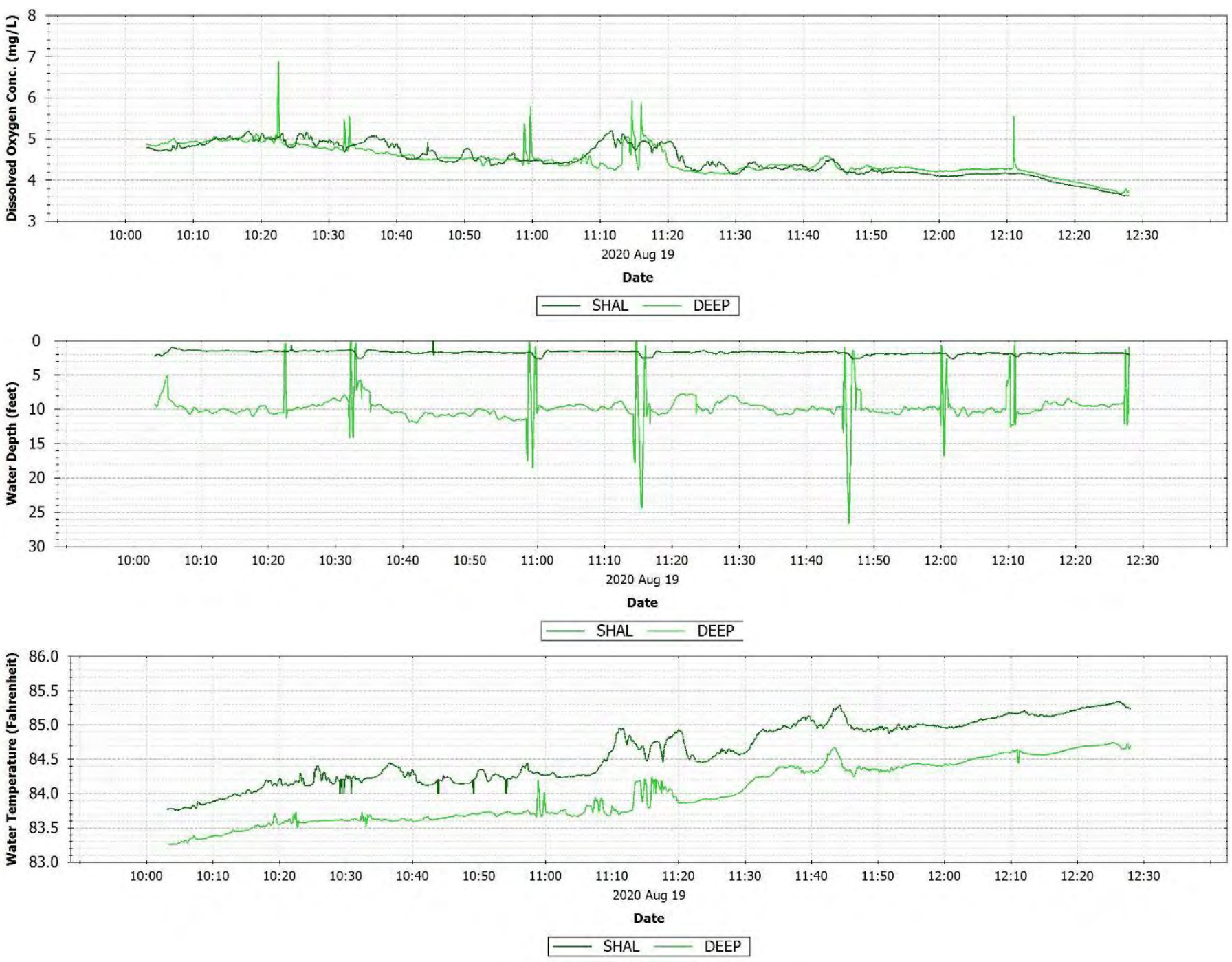




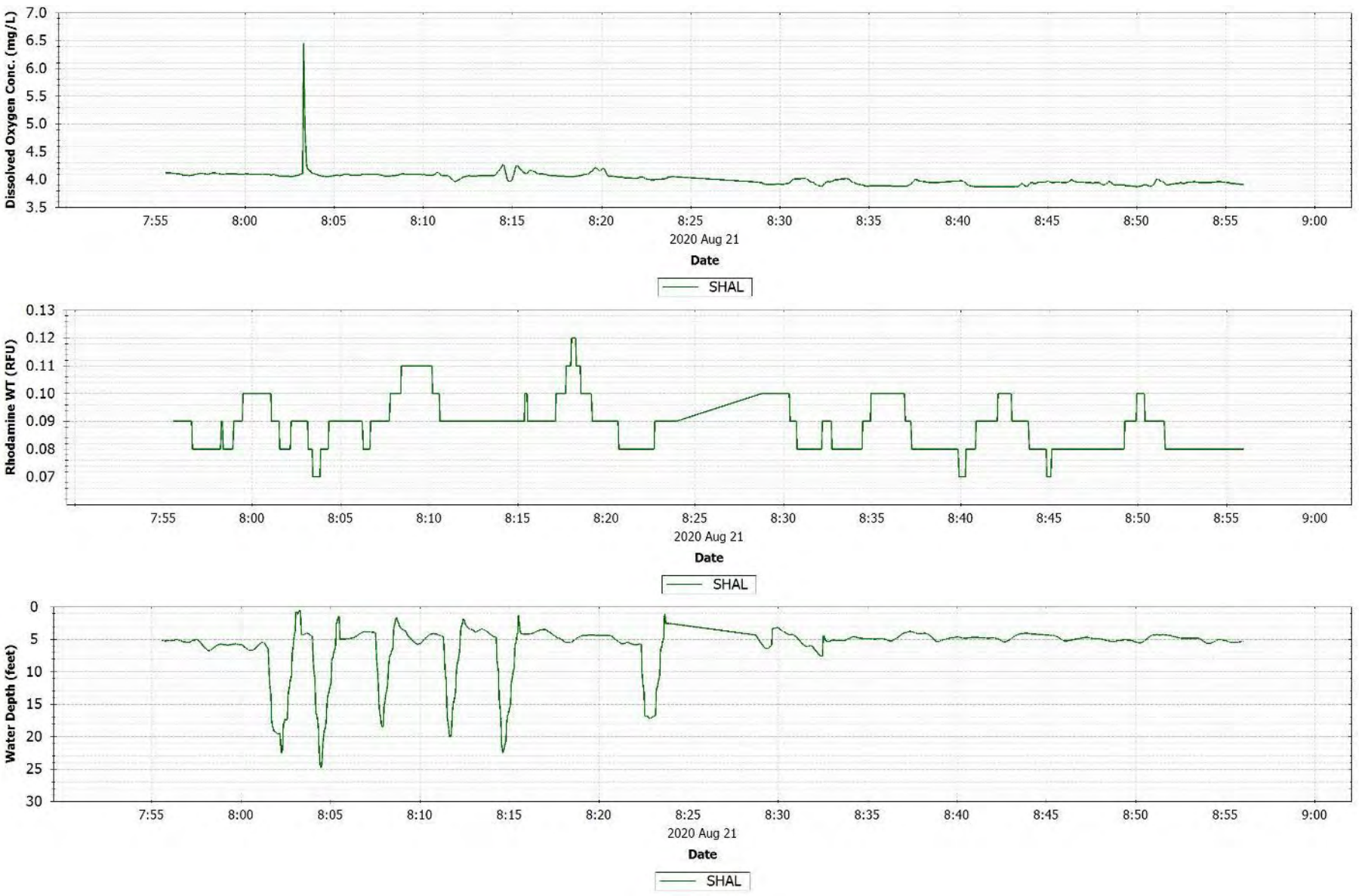
Figure C-44 Back River August 19, 2020 drift [LBR_Drift_081920_IT_D1] observations.

C.19 AUGUST 21, 2020 DRIFT BACK RIVER

Drift with depth profiling, occurred during incoming tide; low tide occurred at approximately 0813. The sonde appears to intersect the near-field DO plume at 0803, but the plume was not detected any other time during the drift.



Figure C-45 Back River August 21, 2020 drift [LBR_Drift_082120_IT_D1] location map



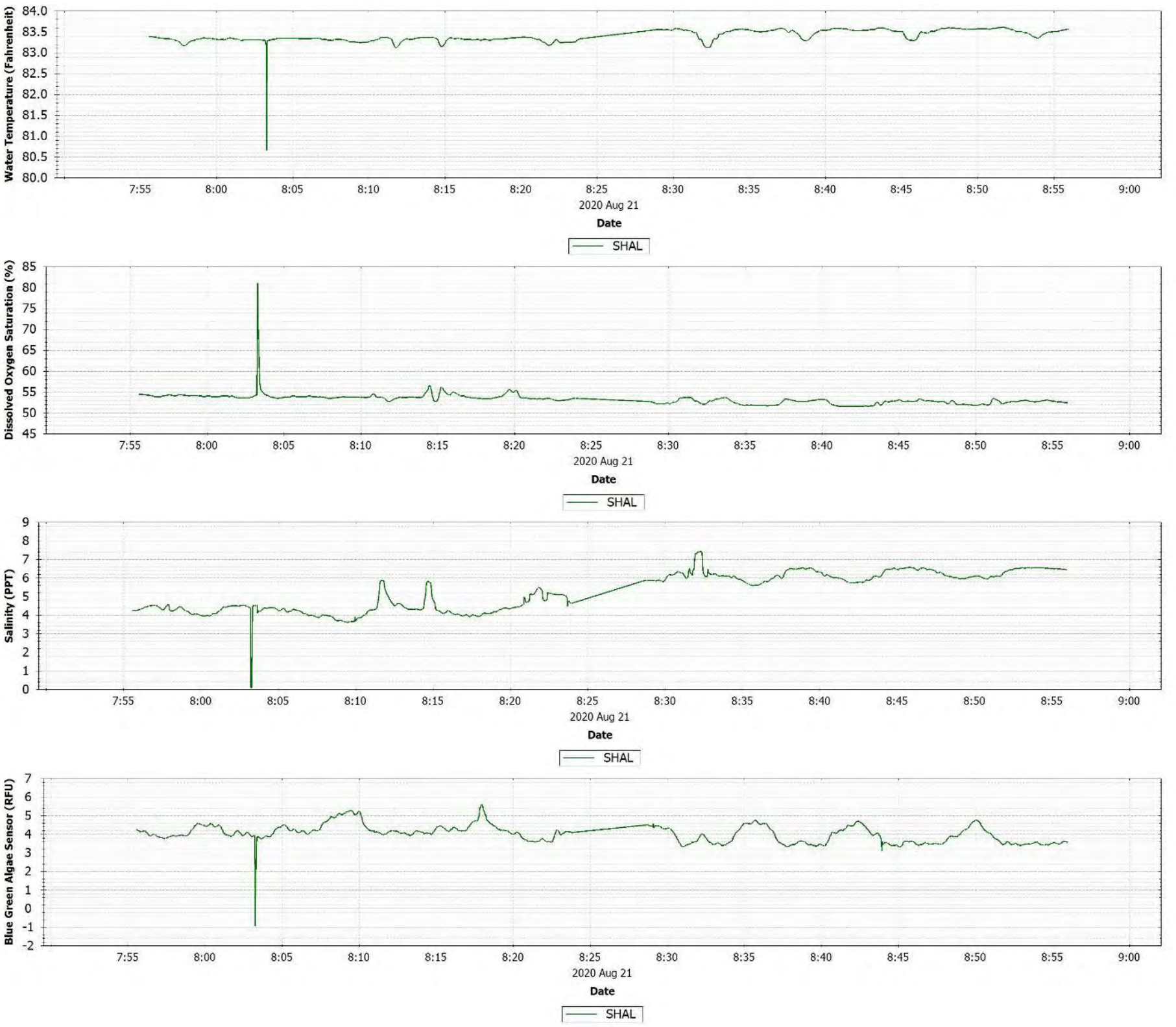


Figure C-46 Back River August 21, 2020 drift [LBR_Drift_082120_IT_D1] observations.

C.20 AUGUST 22, 2020 DRIFT BACK RIVER

Drift occurred during incoming tide; low tide occurred at approximately 0600. The sonde did not appear to intersect the near-field plume. Traces of dye remained in the Back River.

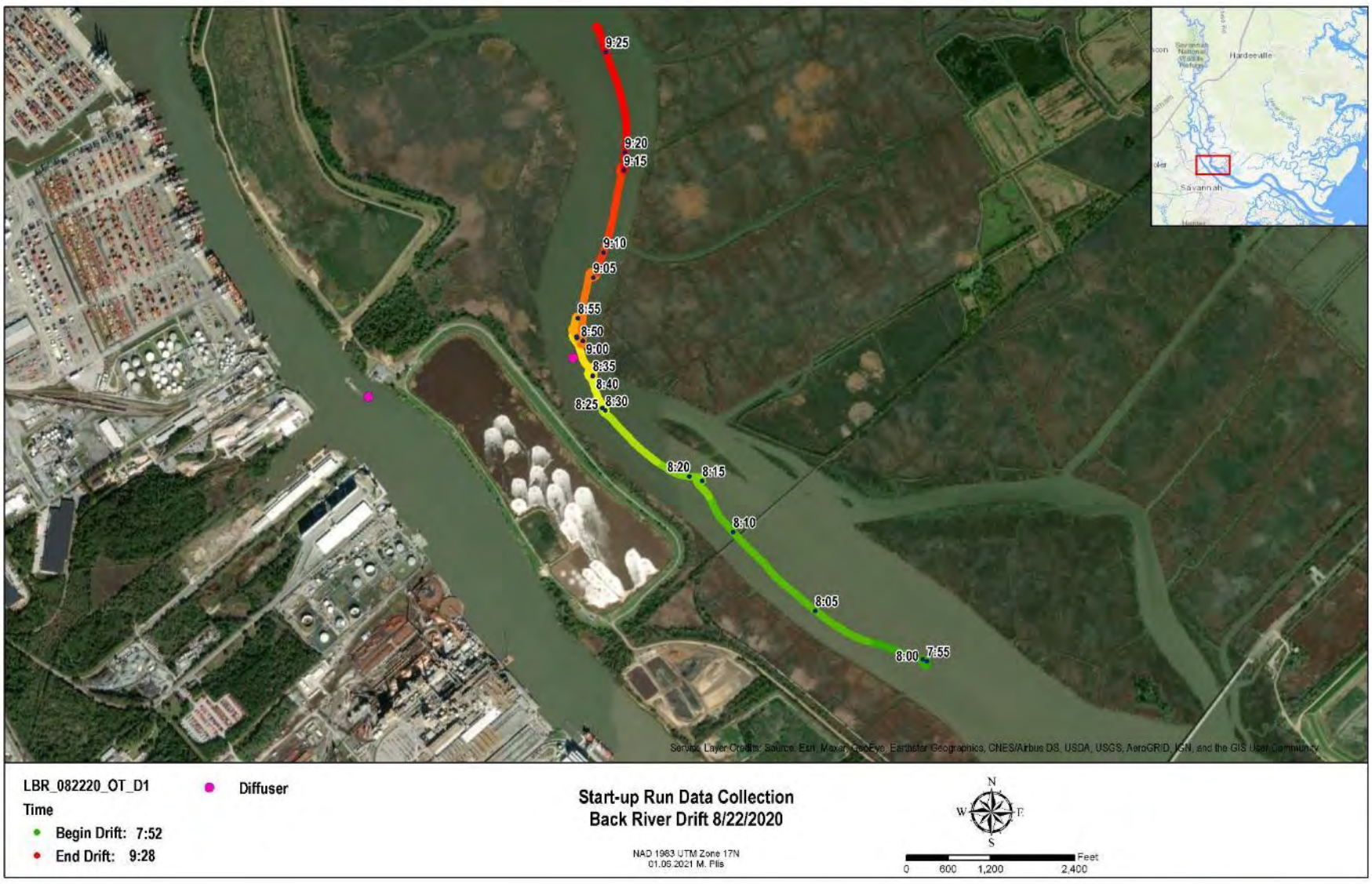


Figure C-47 Back River August 22, 2020 drift [LBR_Drift_082220_OT_D1] location map

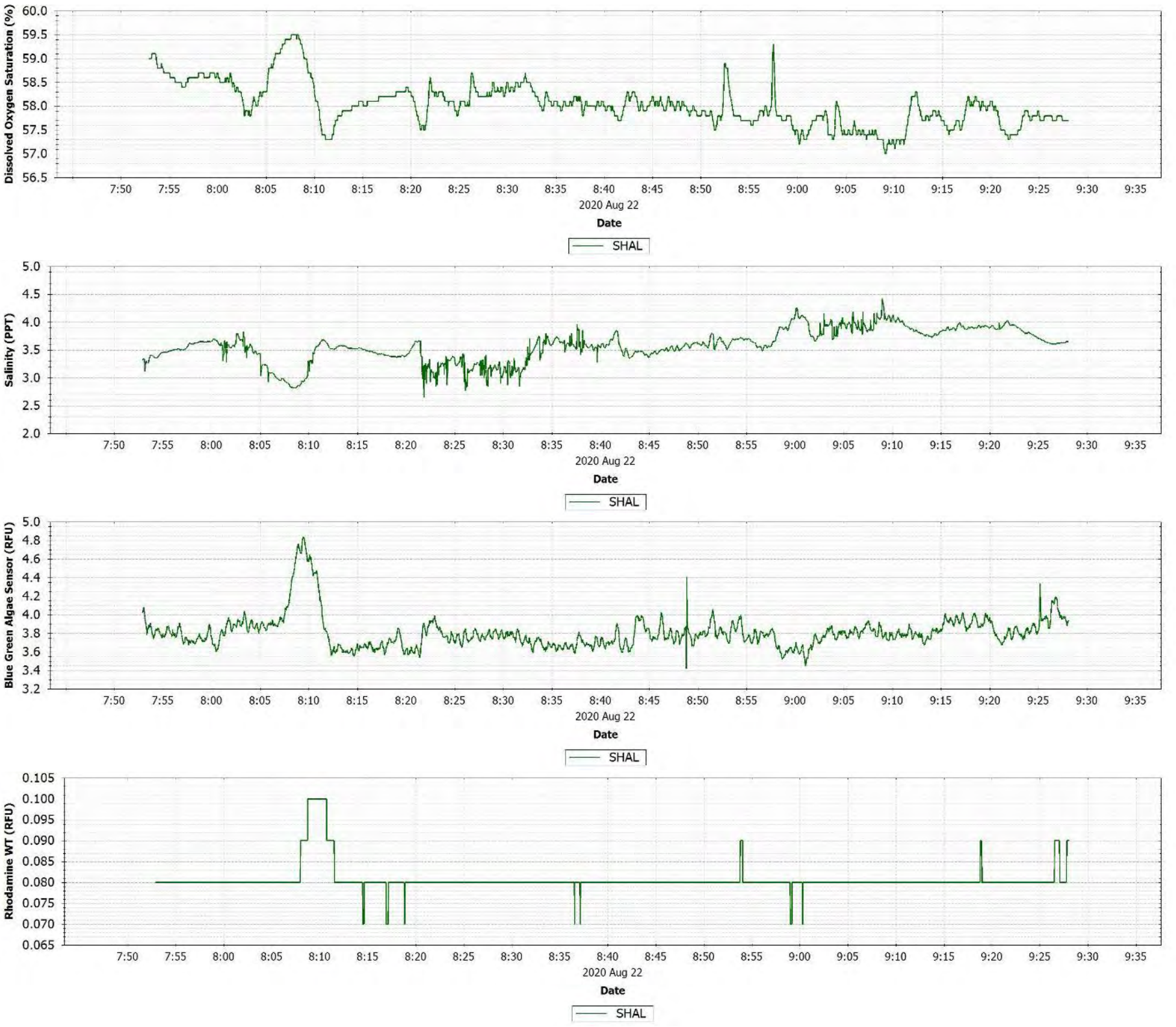


Figure C-48 Back River August 22, 2020 drift [LBR_Drift_082220_OT_D1] observations.

C.21 AUGUST 25, 2020 DYE INJECTION DRIFT BACK RIVER

Dye was injected on a slack going to ebb tide. Drift occurred during ebb tide; low slack tide occurred at approximately 0836. The drift maneuvered bank to bank near the diffuser, and Rhodamine dye, and DO increased when the sondes intersected the near-field plume. Between 1040 and 1050 the sondes did not detect Rhodamine dye and the DO concentration was 4.6 mg/L (background concentration). The DO concentrations increased to 5 mg/L when the sondes detected Rhodamine dye peak. The plume appeared well mixed in the water column comparing the surface and mid-depth DO readings.

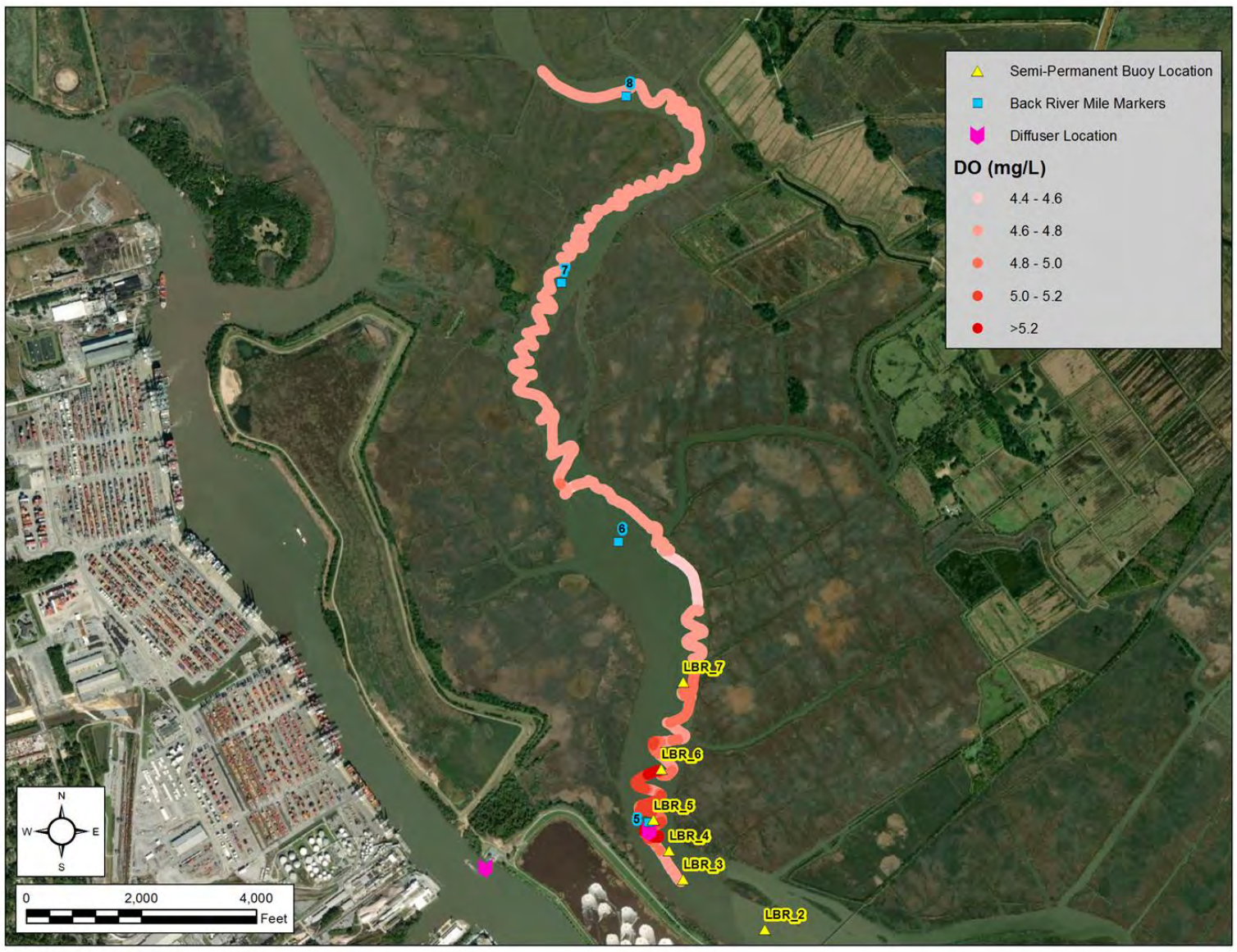


Figure C-49 Back River August 25, 2020 DO profile

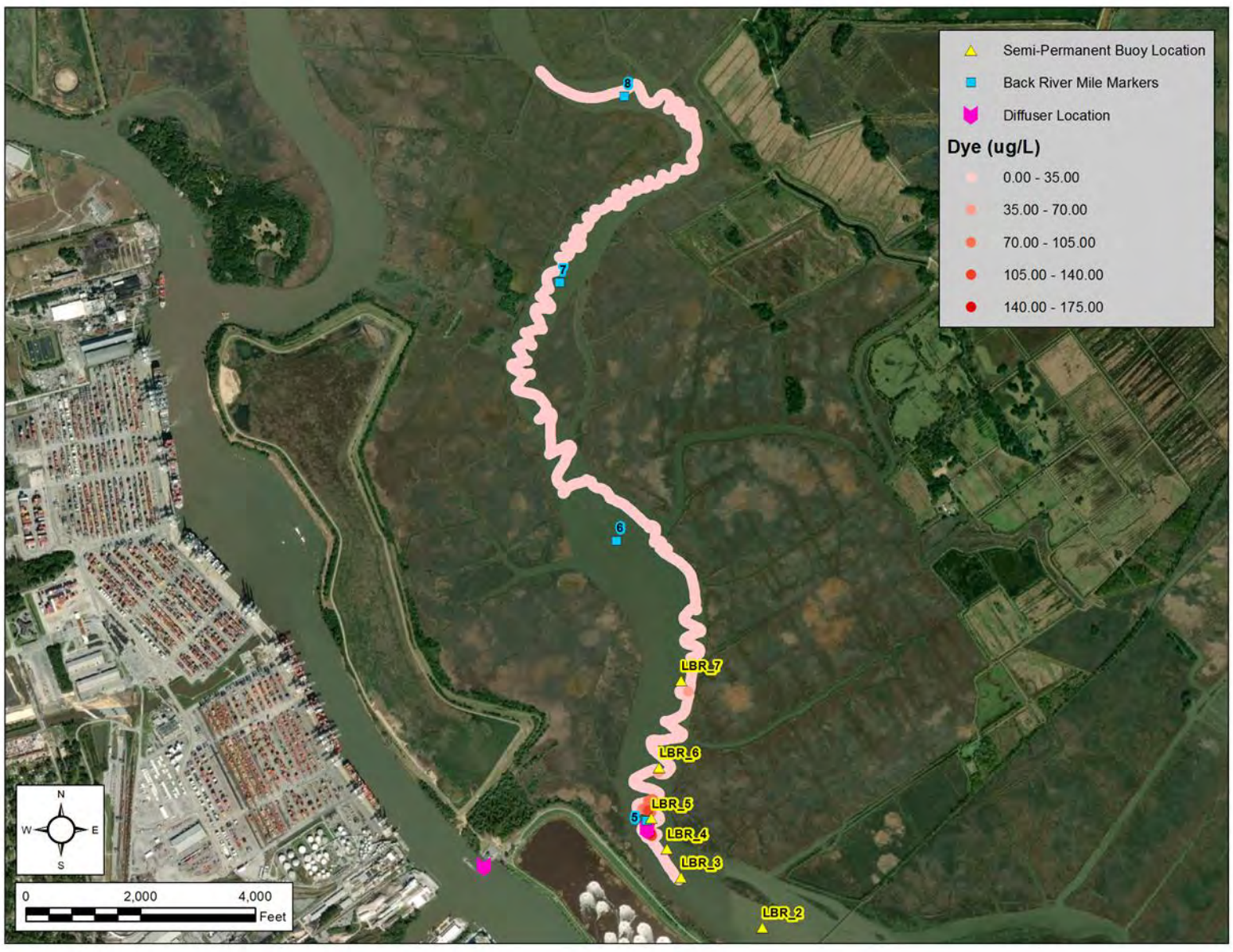
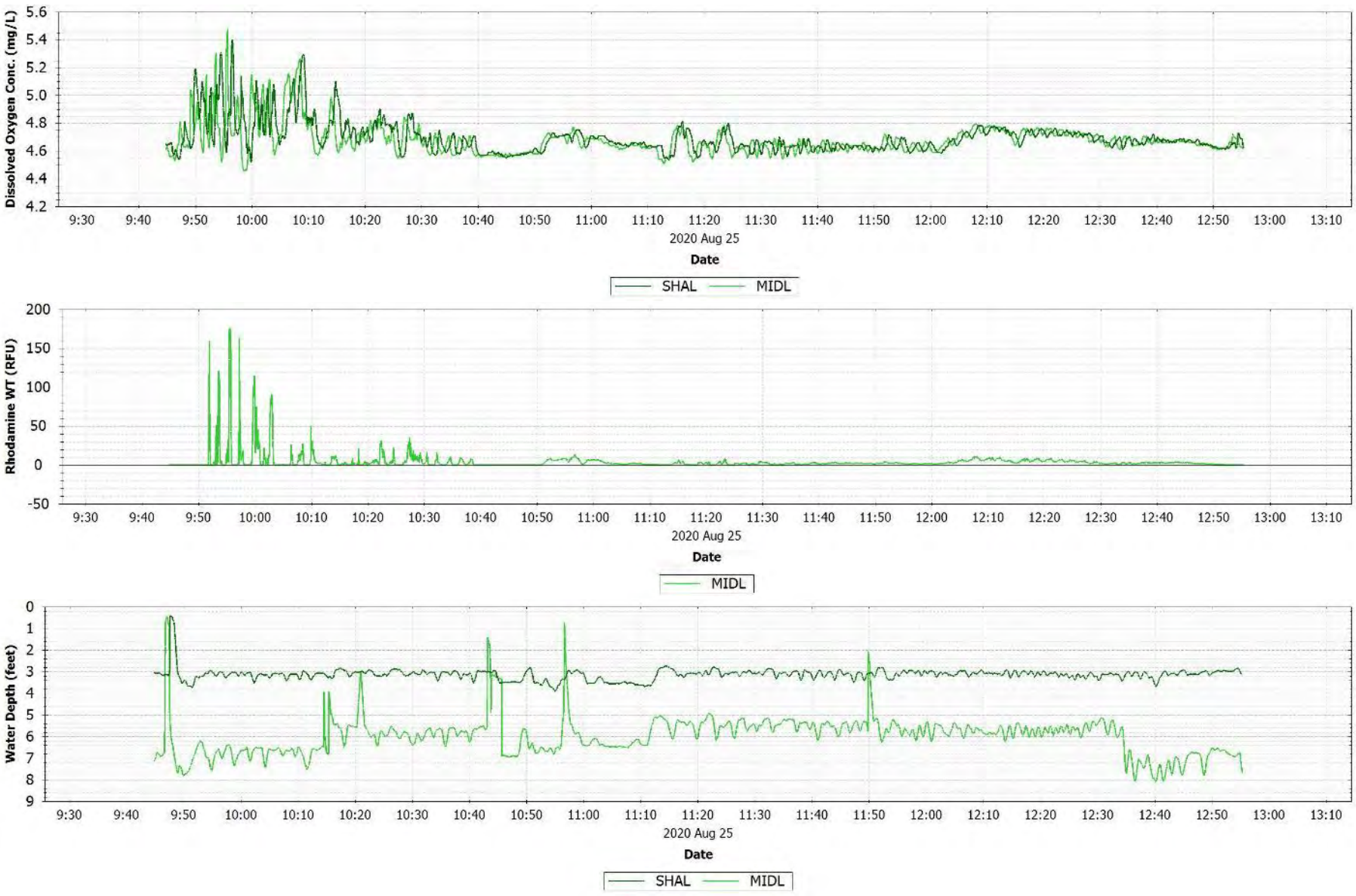


Figure C-50 Back River August 25, 2020 Dye Profile



Figure C-51 Back River August 25, 2020 dye injection drift [LBR_Drift_082520_DYE_D1] location map



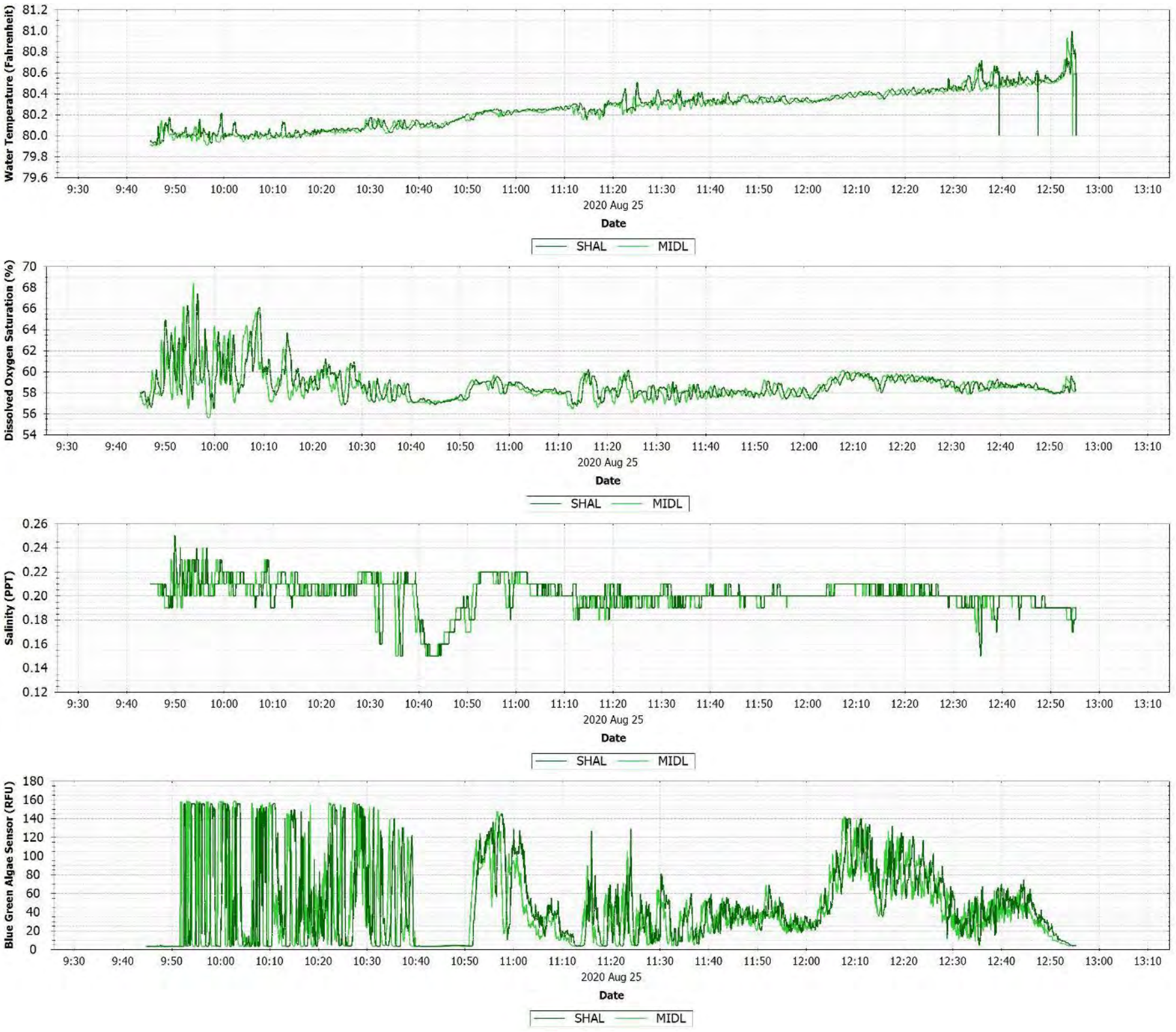


Figure C-52 Back River August 25, 2020 dye injection drift [LBR_Drift_082520_DYE_D1] observations.

C.22 AUGUST 26, 2020 DRIFT BACK RIVER

Drift occurred during incoming tide; low tide occurred at approximately 0935. The drift sonde measured a general increasing trend in DO concentrations from the diffuser upstream, indicating the injected oxygen was mixed in the water column and moving upstream. Two DO sags occurred immediately upstream of both channel horseshoe bends, maybe indicating low DO marsh water coming into the system. The higher DO values at the upstream sampling shows the higher DO water coming down the Back River.

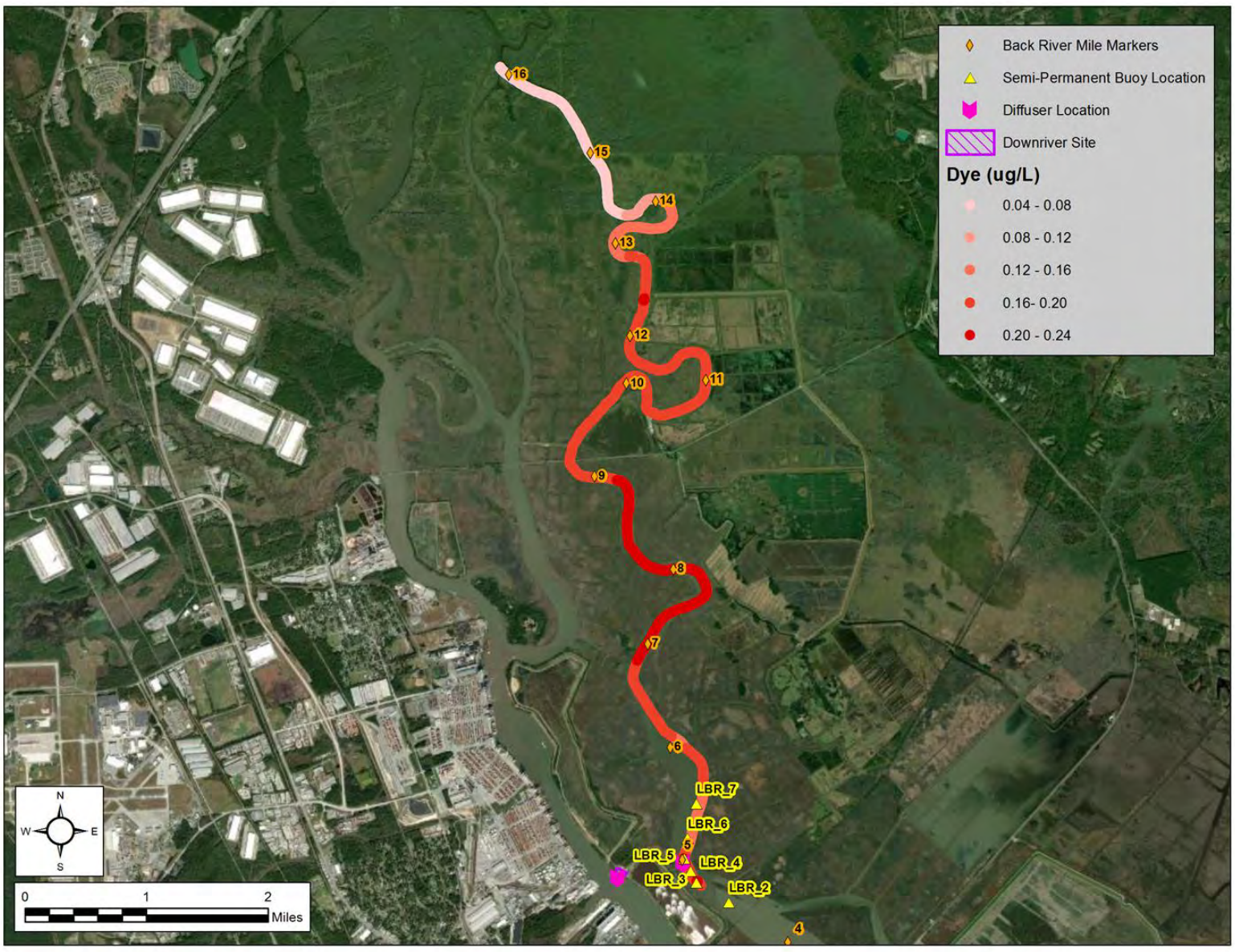


Figure C-53 Back River August 26, 2020 Dye Profile

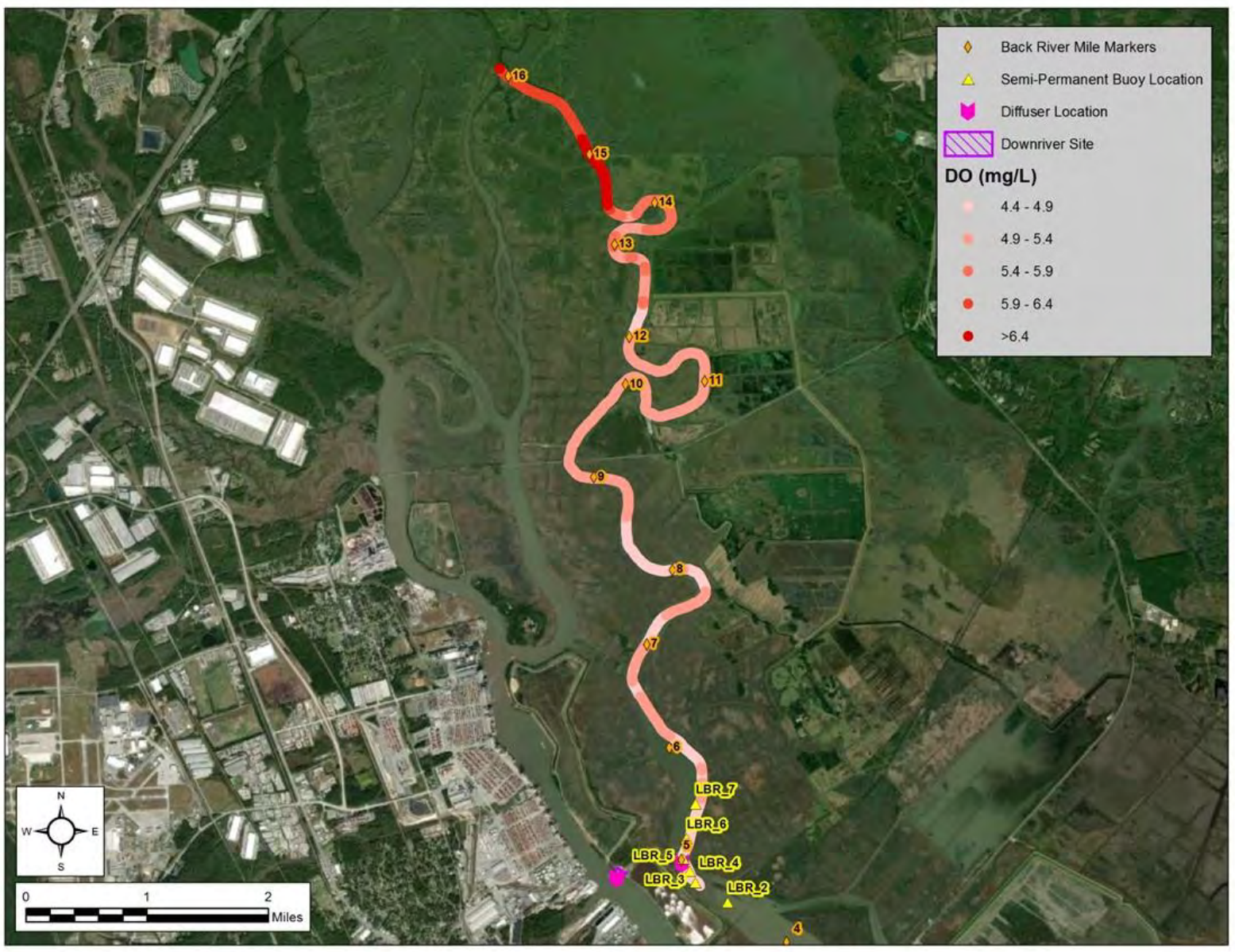


Figure C-54 Back River August 26, 2020 DO profile

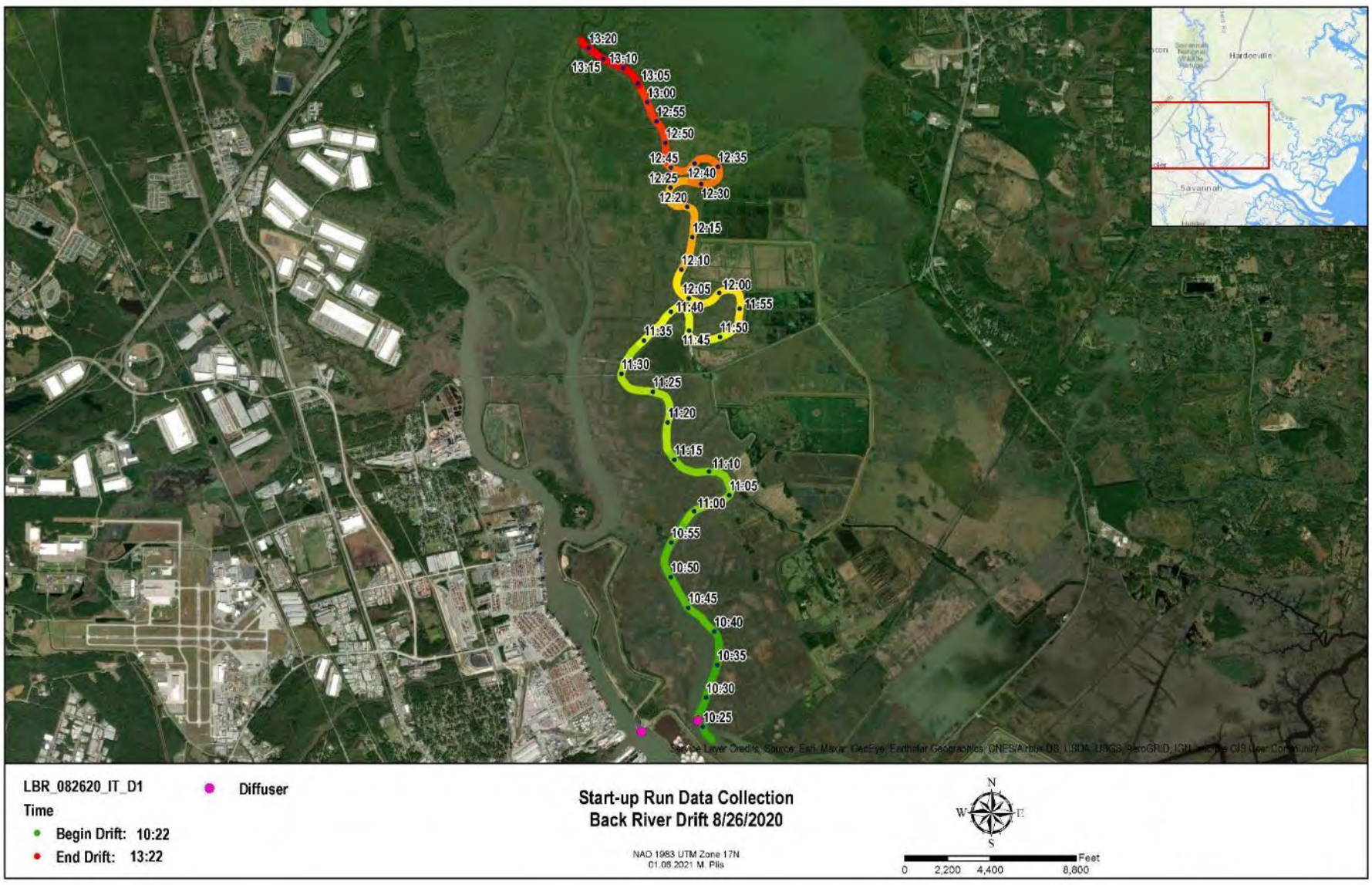
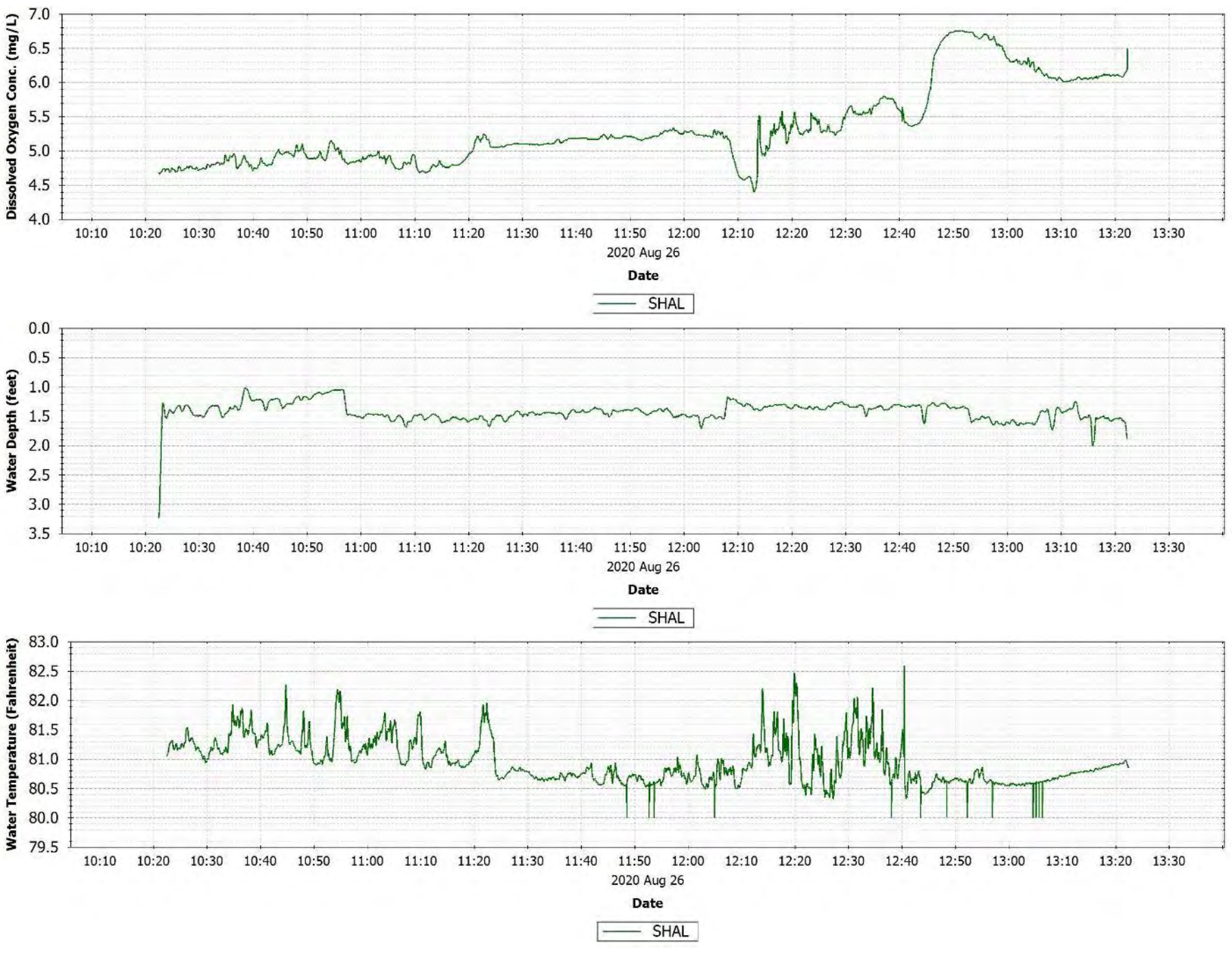


Figure C-55 Back River August 26, 2020 drift [LBR_Drift_082620_IT_D1] location map



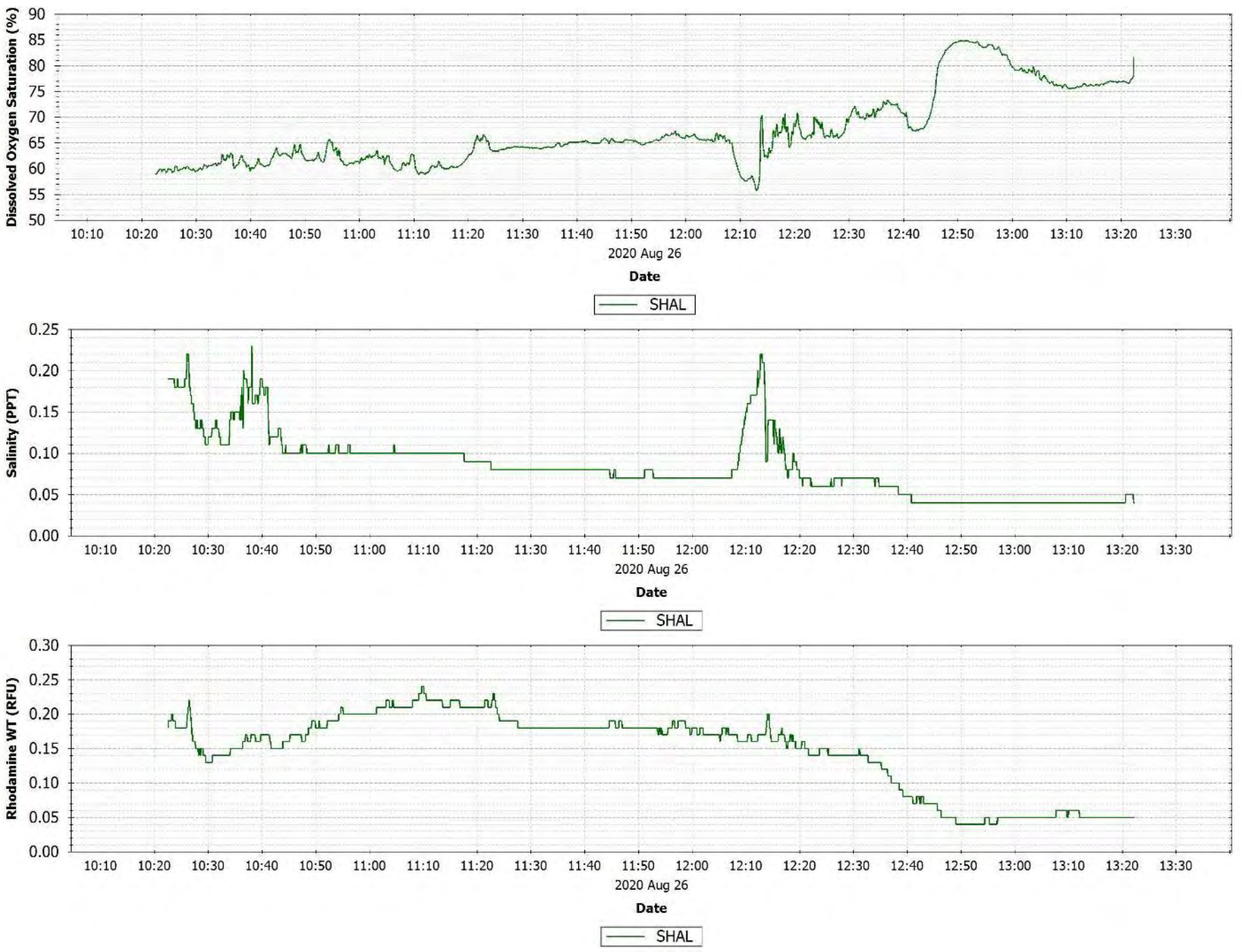


Figure C-56 Back River August 26, 2020 drift [LBR_Drift_082620_IT_D1] observations.

C.23 AUGUST 27, 2020 DRIFT BACK RIVER

Drift occurred during incoming tide; low tide occurred at approximately 1035. DO concentrations were variable near the diffuser and up to 1 mg/L higher compared to downstream background concentrations, indicating that the sonde intersected the near-field plume several times at the water surface. The dye is still in the system and well distributed.

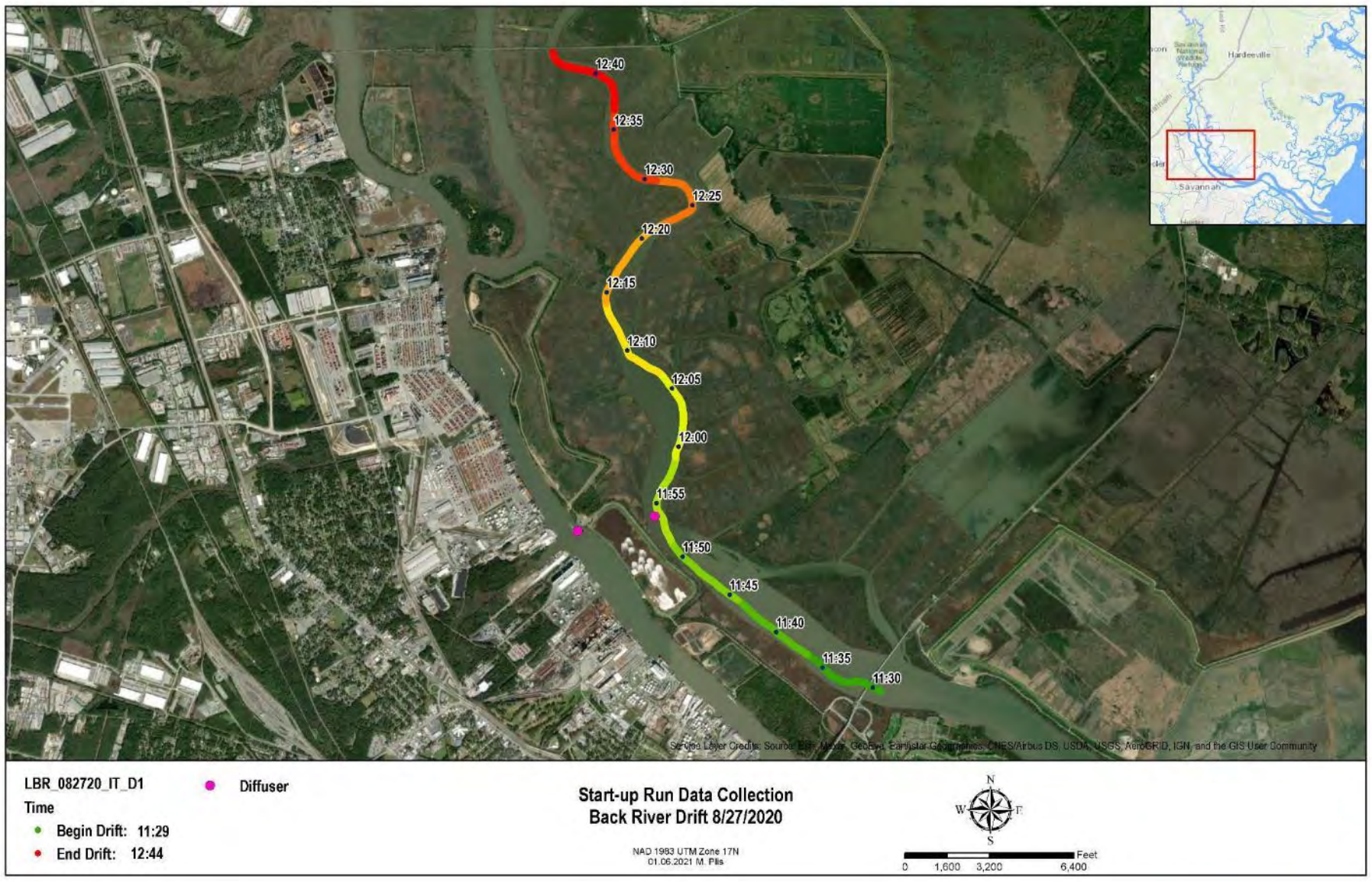
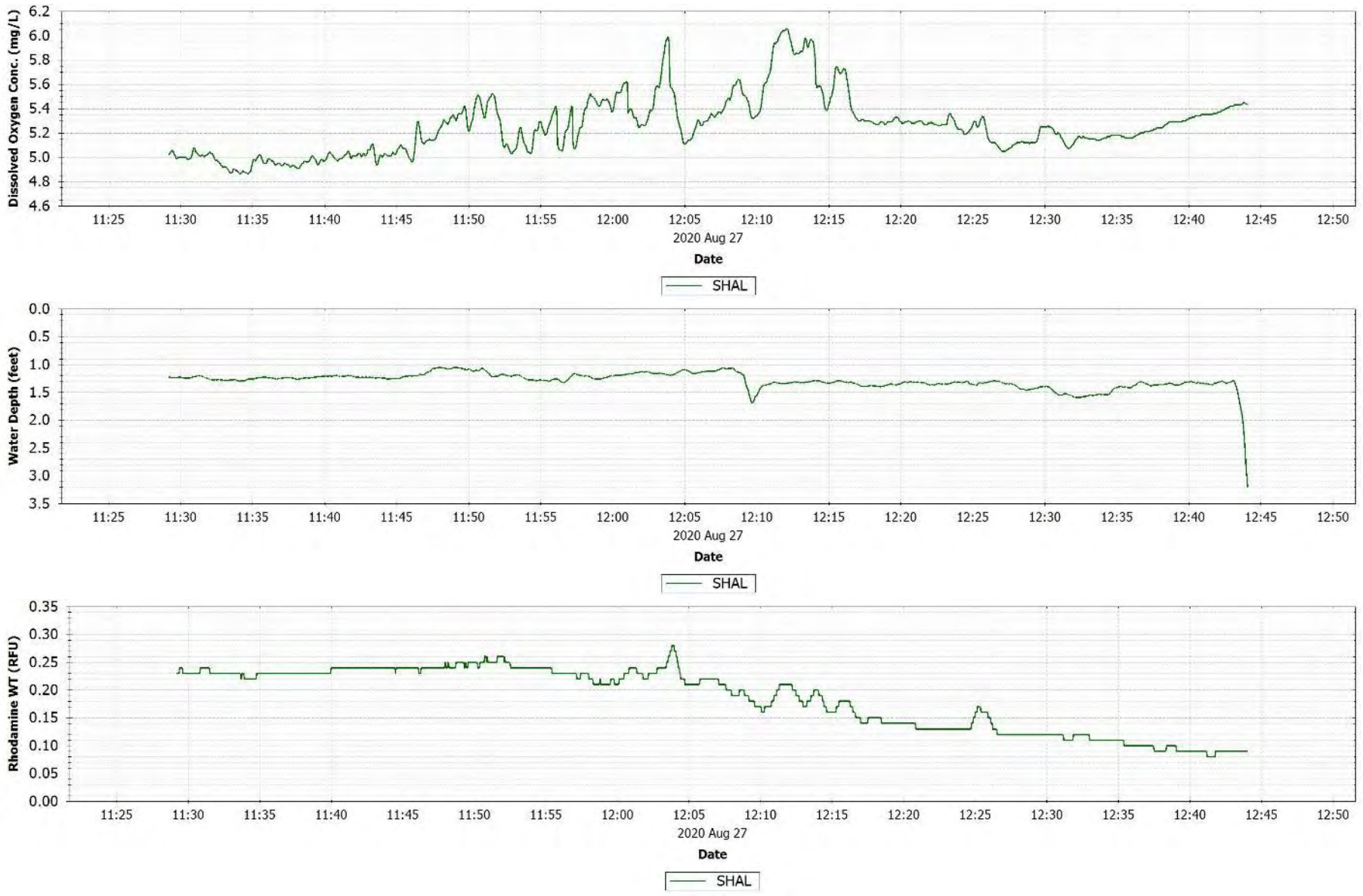


Figure C-57 Back River August 27, 2020 drift [LBR_Drift_082720_IT_D1] location map



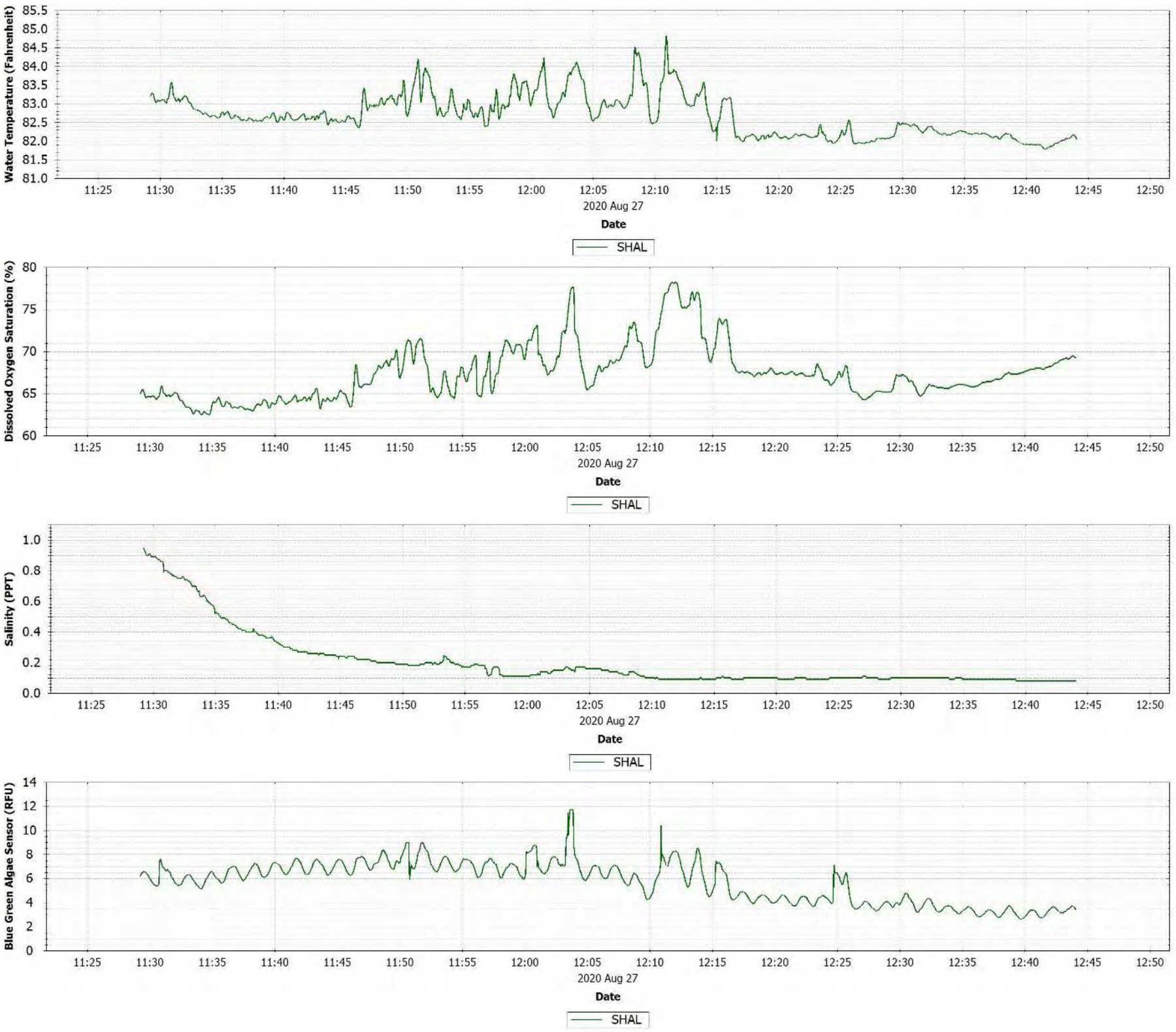


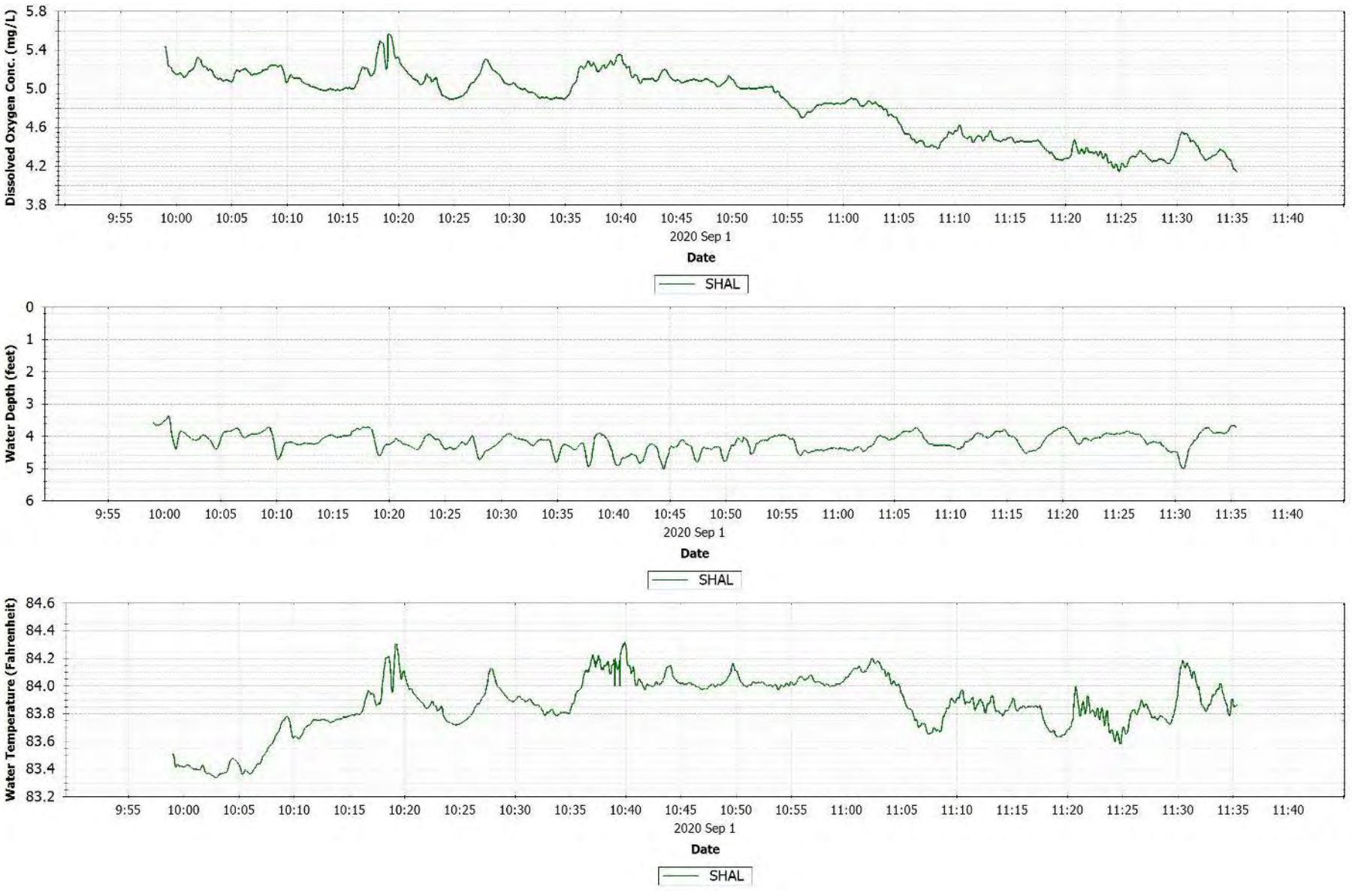
Figure C-58 Back River August 27, 2020 drift [LBR_Drift_082720_IT_D1] observations.

C.24 SEPTEMBER 1, 2020 DRIFT BACK RIVER

Drift occurred during outgoing tide; high tide occurred at approximately 0903. The drift sonde appeared to detect the near-field plume near the diffuser at 1035. Higher DO concentrations were measured upstream of the diffuser potentially due to oxygenated water pushed upstream during incoming tide.



Figure C-59 Back River September 1, 2020 drift [LBR_Drift_090120_OT_D1] location map



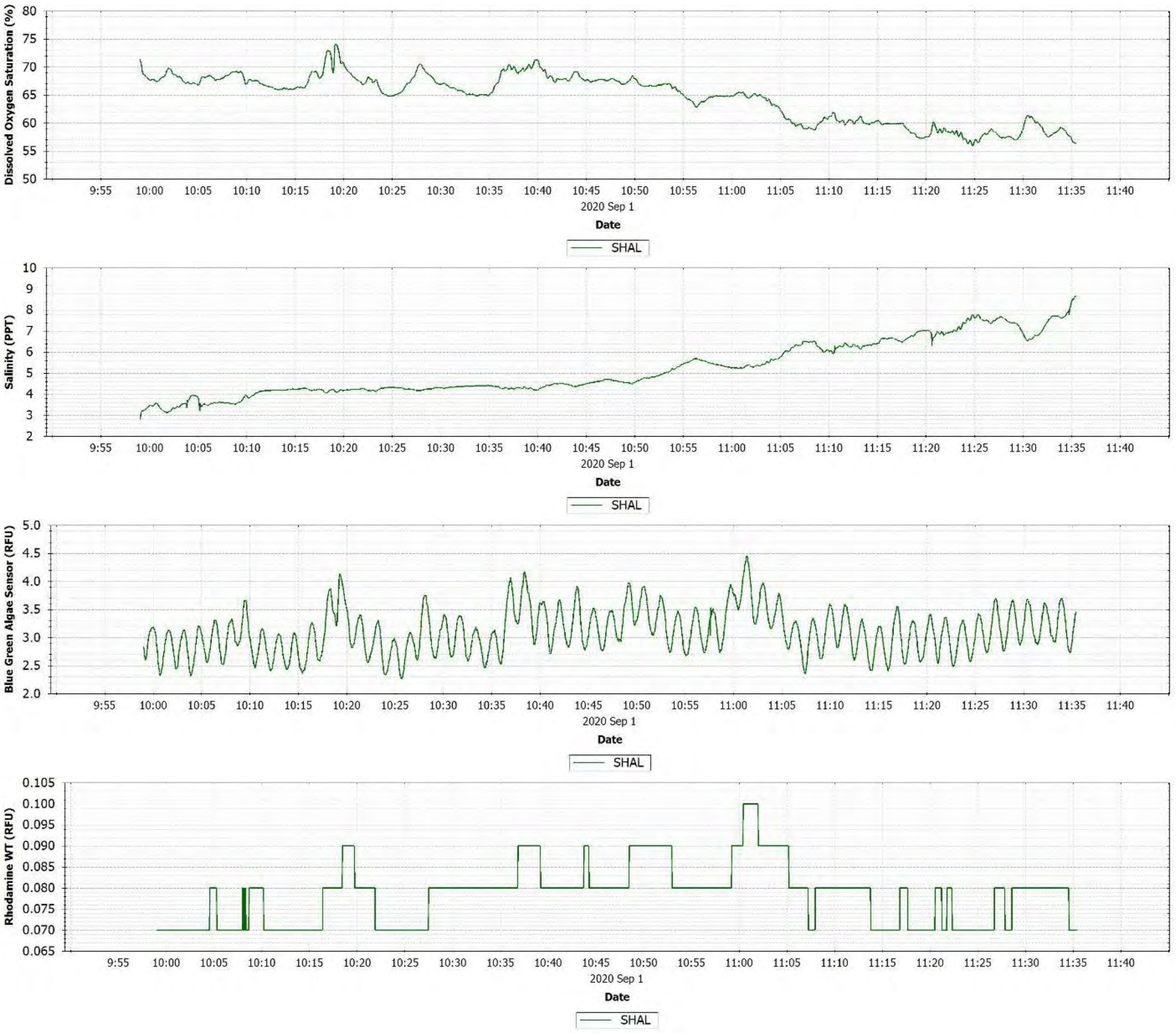


Figure C-60 Back River September 1, 2020 drift [LBR_Drift_090120_OT_D1] observations.

C.25 SEPTEMBER 3, 2020 DRIFT BACK RIVER

Drift occurred during outgoing tide; high tide occurred at approximately 1021. DO decreased around the large horseshoe bend on Back River. Dye was present in the downstream area 9 days after dye injection. The dye being gradually pushed out of the system.

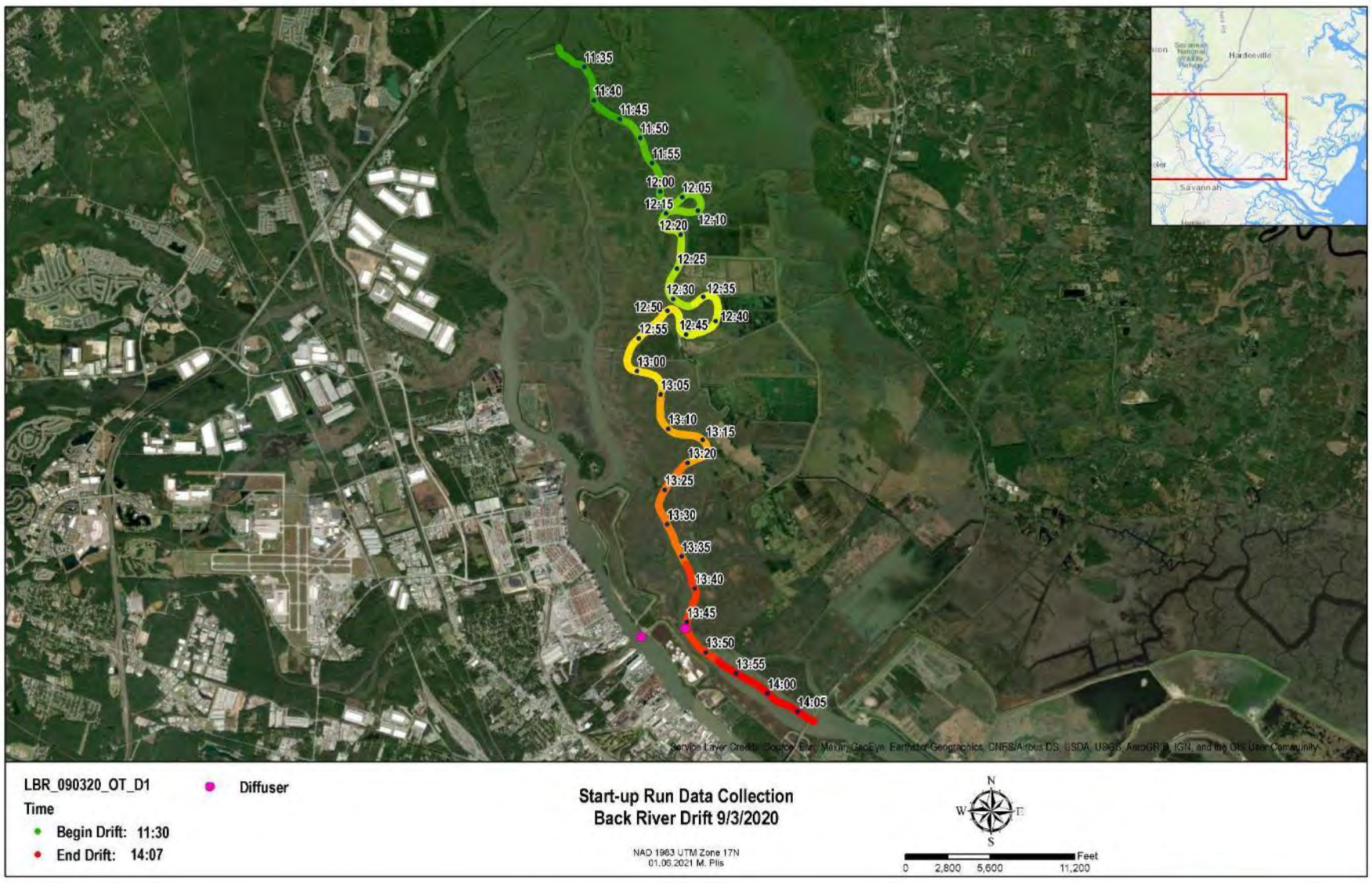
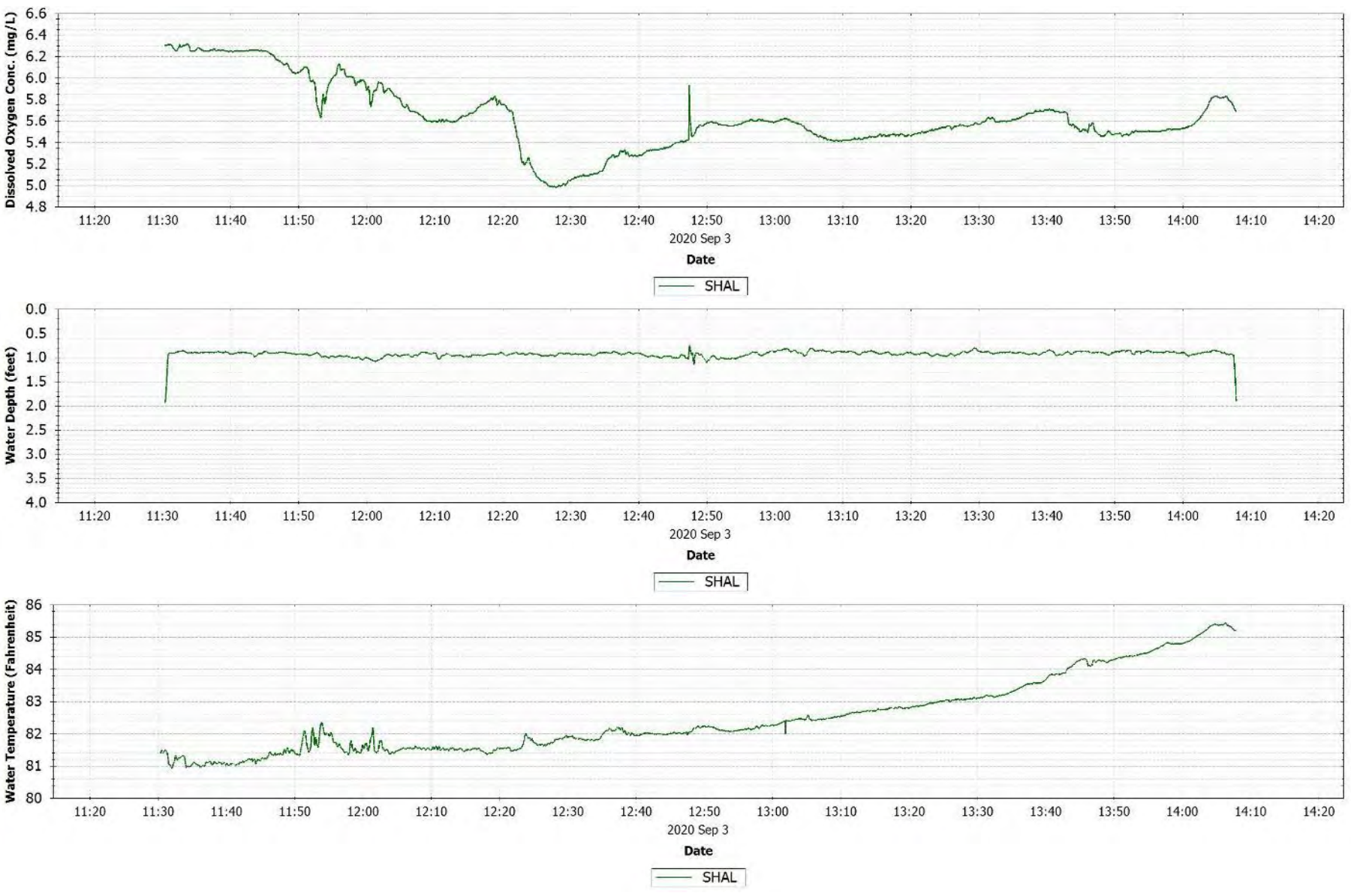


Figure C-61 Back River September 3, 2020 drift [LBR_Drift_090320_OT_D1] location map



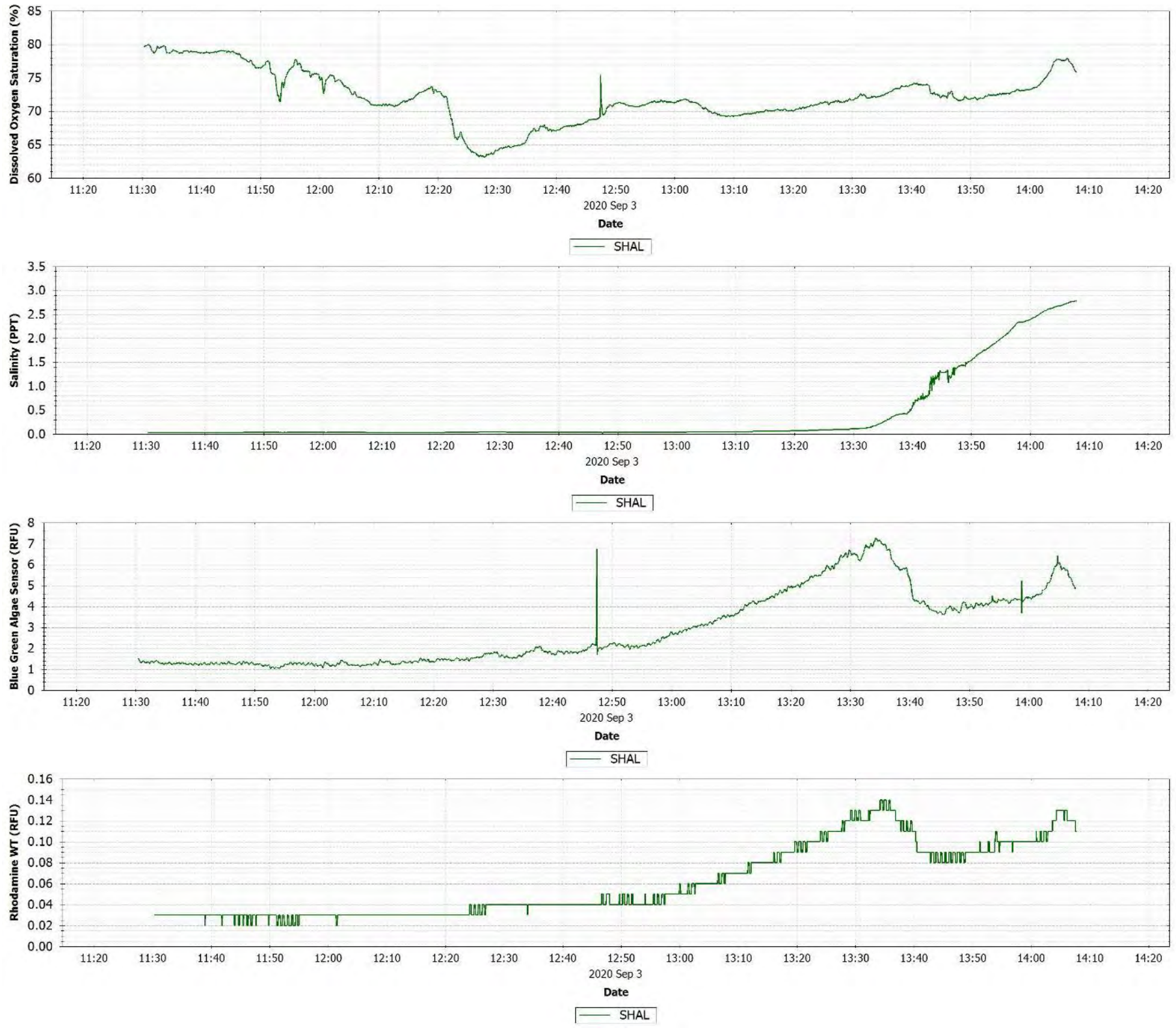


Figure C-62 Back River September 3, 2020 drift [LBR_Drift_090320_OT_D1] observations.

C.26 SEPTEMBER 8, 2020 DRIFT BACK RIVER

Drift occurred during incoming tide starting at the mouth of the Back River; low tide occurred at approximately 0724. Drift sonde appears to intersect near-field plume at 0905 after intersecting a portion of the river with low DO. DO concentrations were elevated downstream of diffuser, which may be due to previously oxygenated water in the area from the outgoing tide.

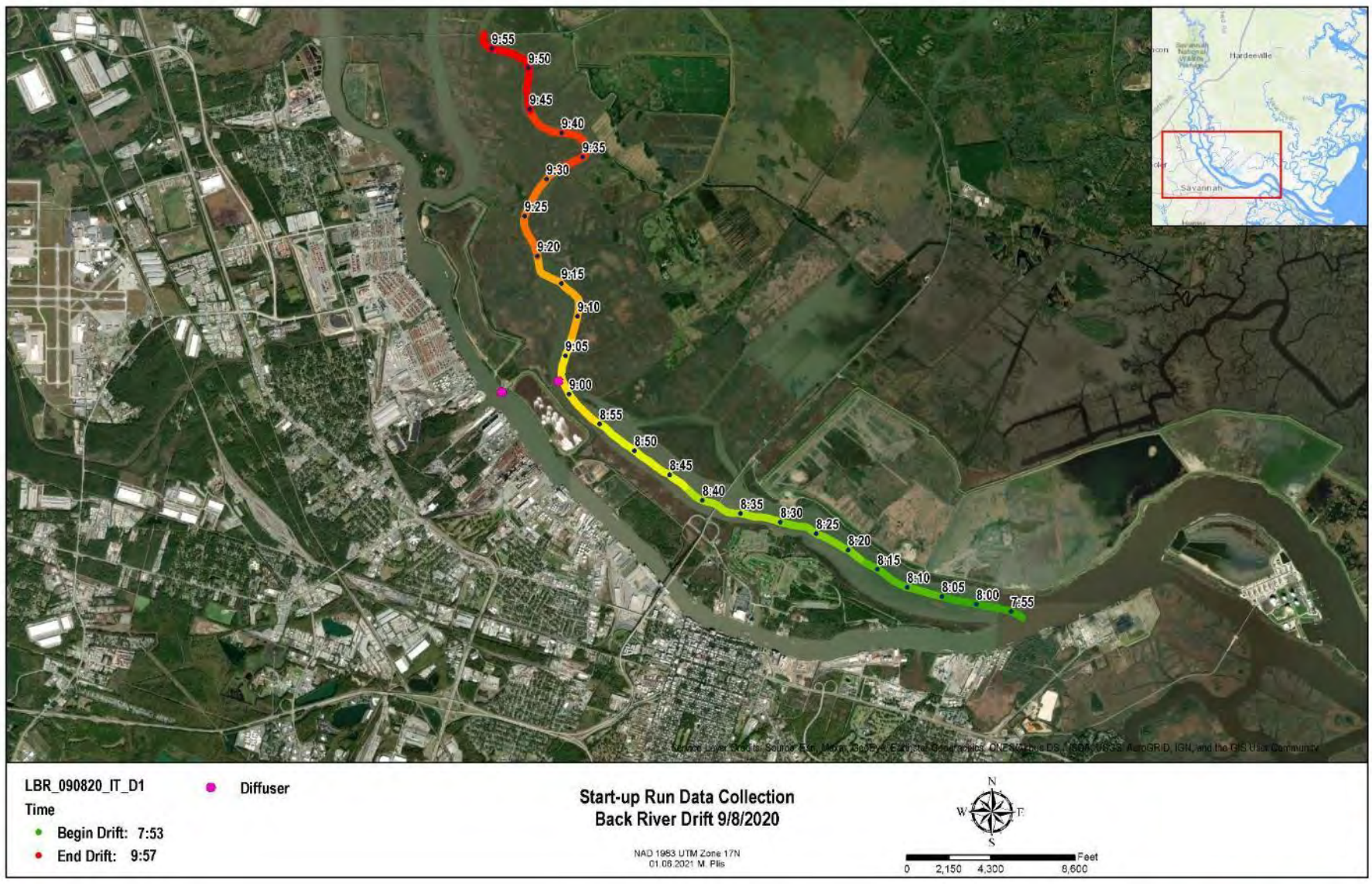
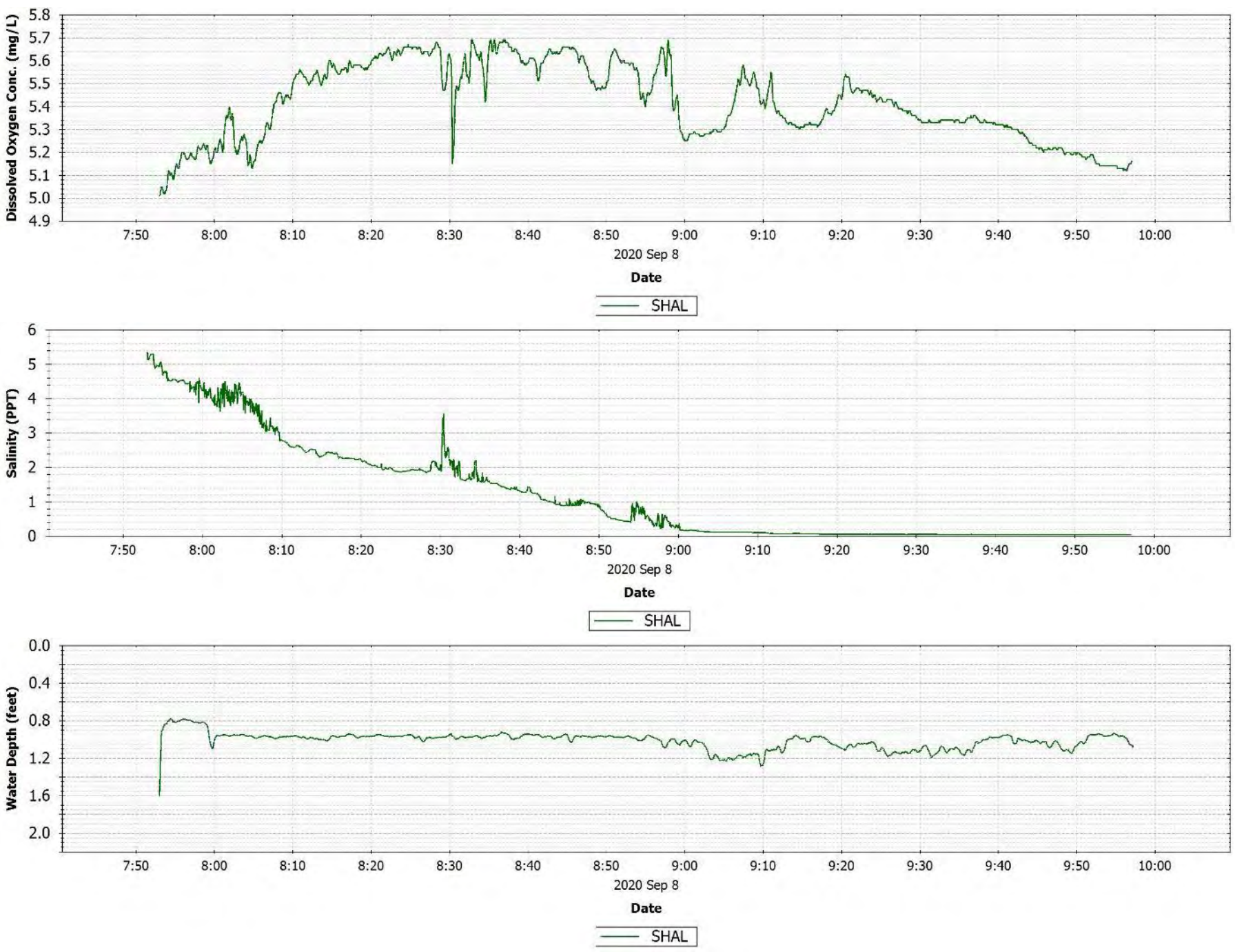


Figure C-63 Back River September 8, 2020 drift [LBR_Drift_090820_IT_D1] location map



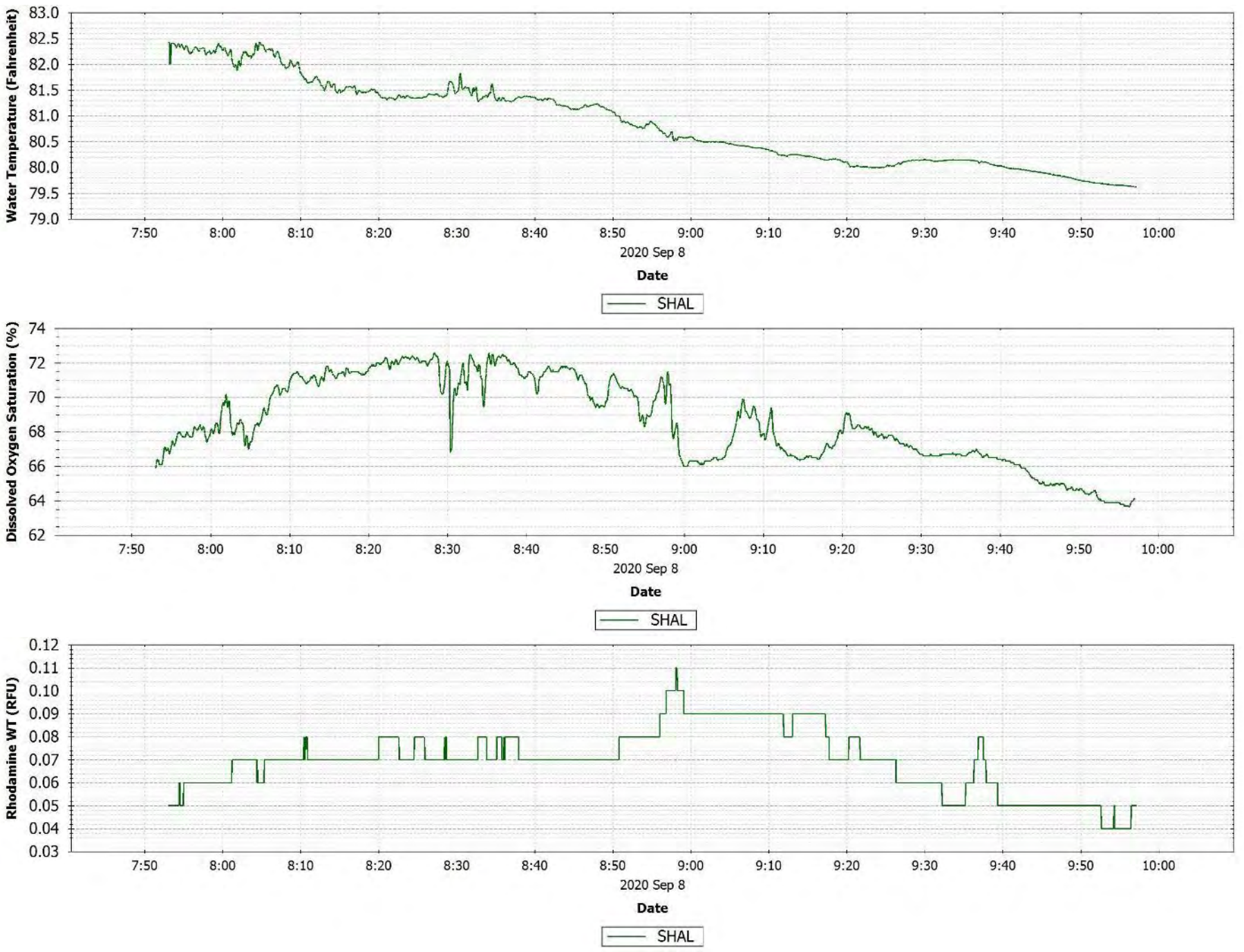


Figure C-64 Back River September 8, 2020 drift [LBR_Drift_090820_IT_D1] observations.

C.27 SEPTEMBER 12, 2020 DRIFT BACK RIVER

Drift occurred during outgoing tide to slack tide; low tide occurred at approximately 1058. The drift sonde encountered low DO concentration immediately downstream of the diffuser, indicating the oxygen plume not yet mixed top to bottom.

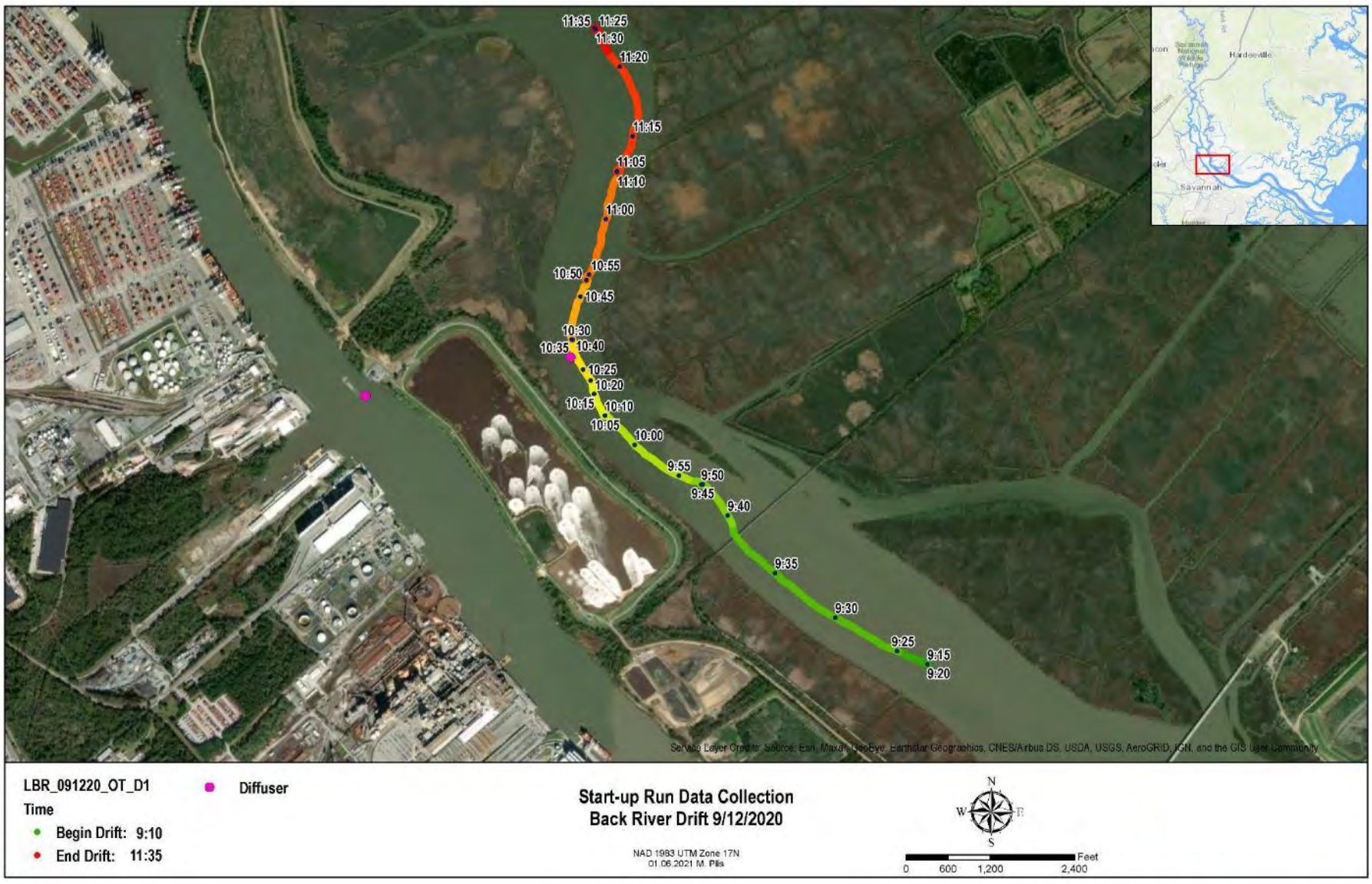
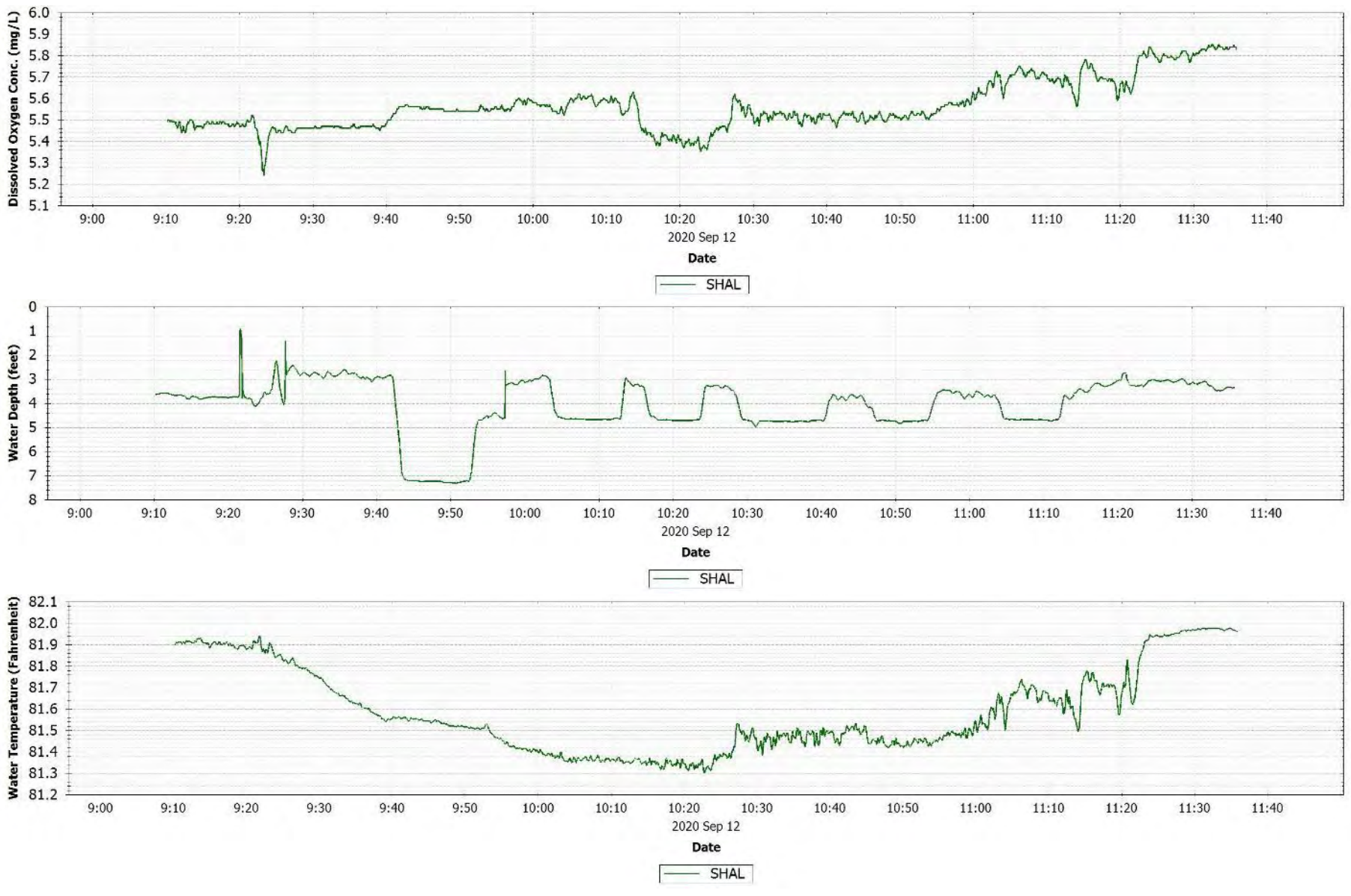


Figure C-65 Back River September 12, 2020 drift [LBR_Drift_091220_OT_D1] location map



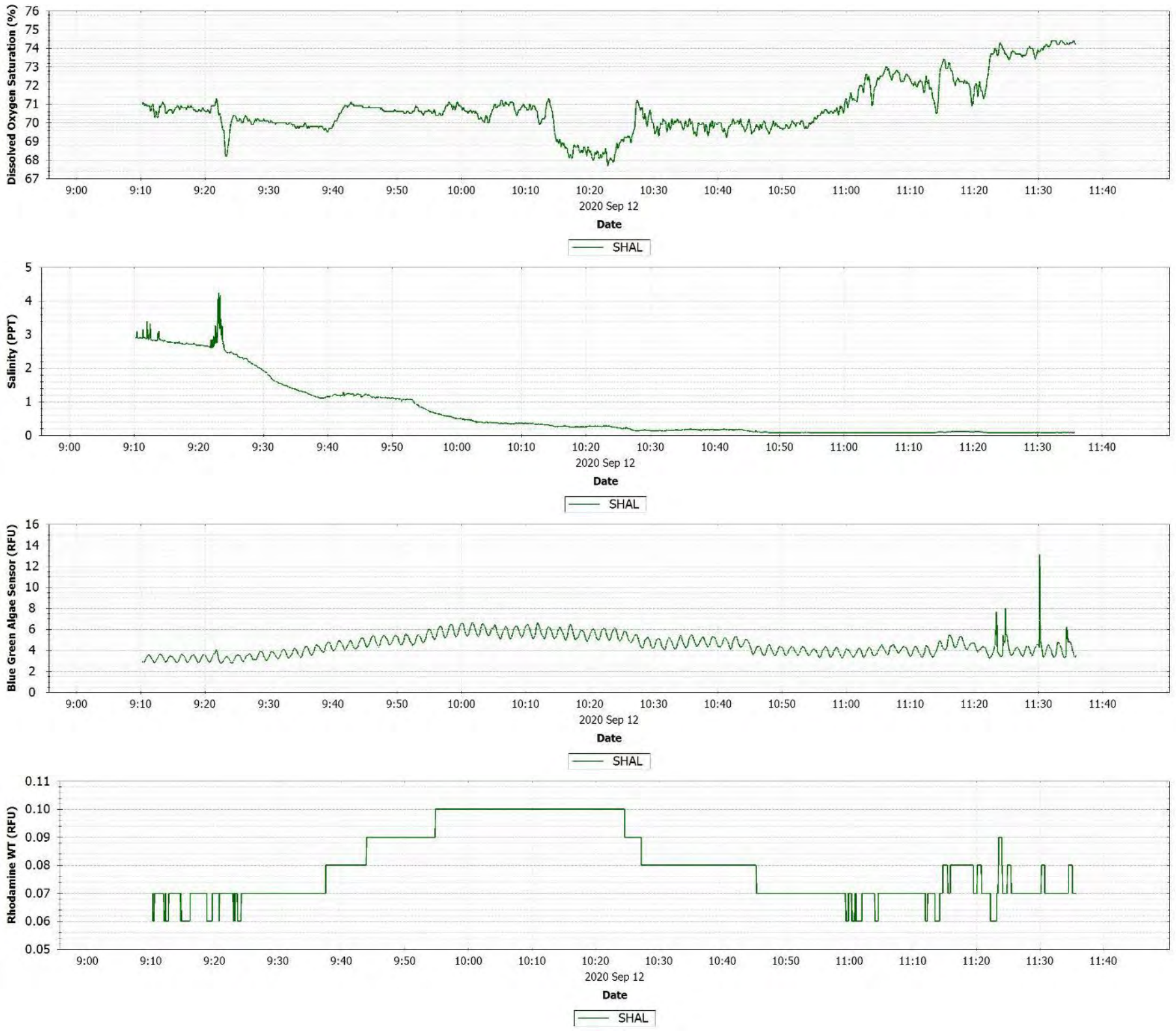


Figure C-66 Back River September 12, 2020 drift [LBR_Drift_091220_OT_D1] observations.

C.28 SEPTEMBER 16, 2020 DRIFT BACK RIVER

Upstream Back River drift occurred during incoming tide; low tide occurred at approximately 0724. Rhodamine dye, from the September 15 Upriver dye injection, was measured in the upper section of Back River

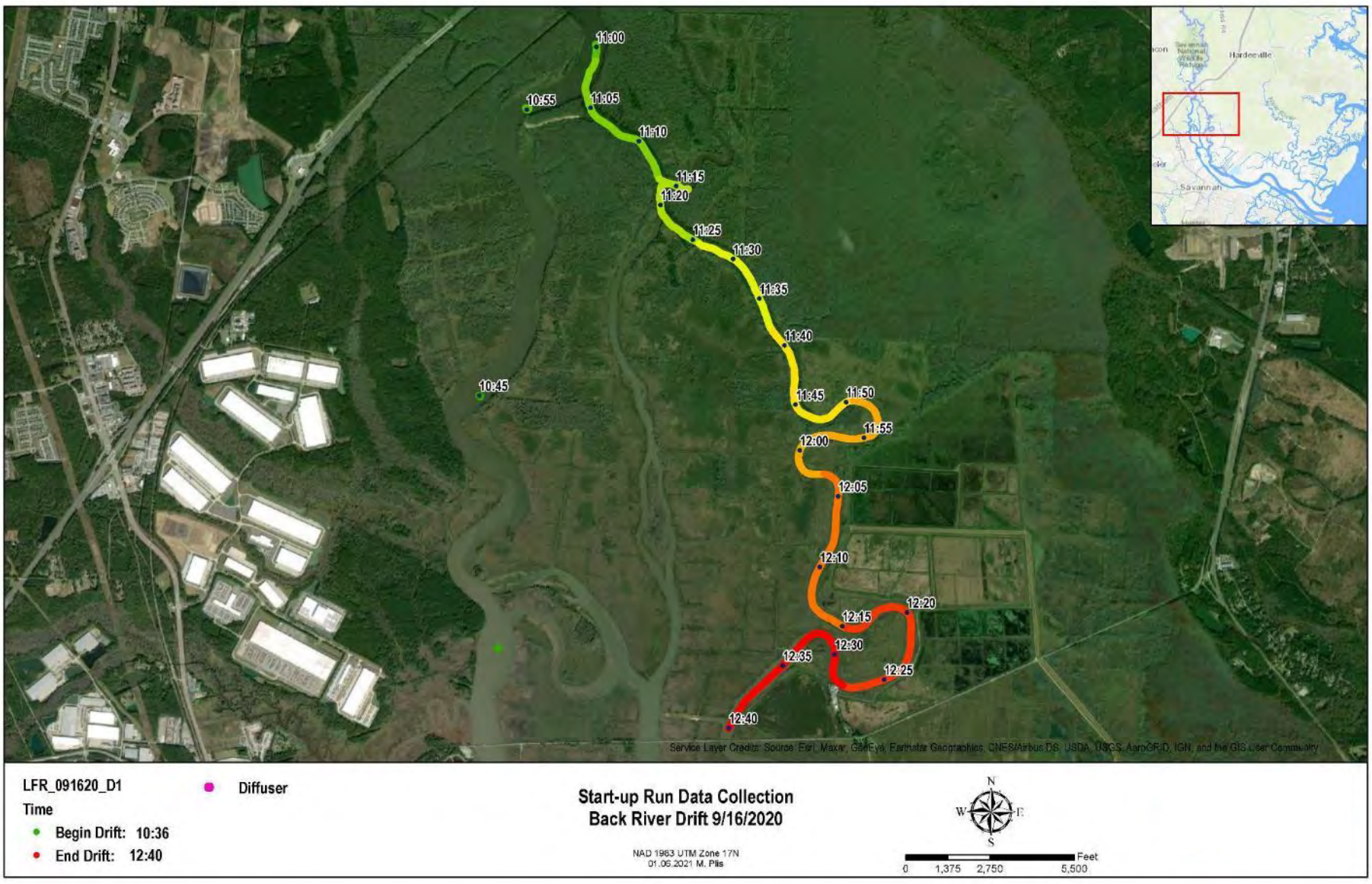
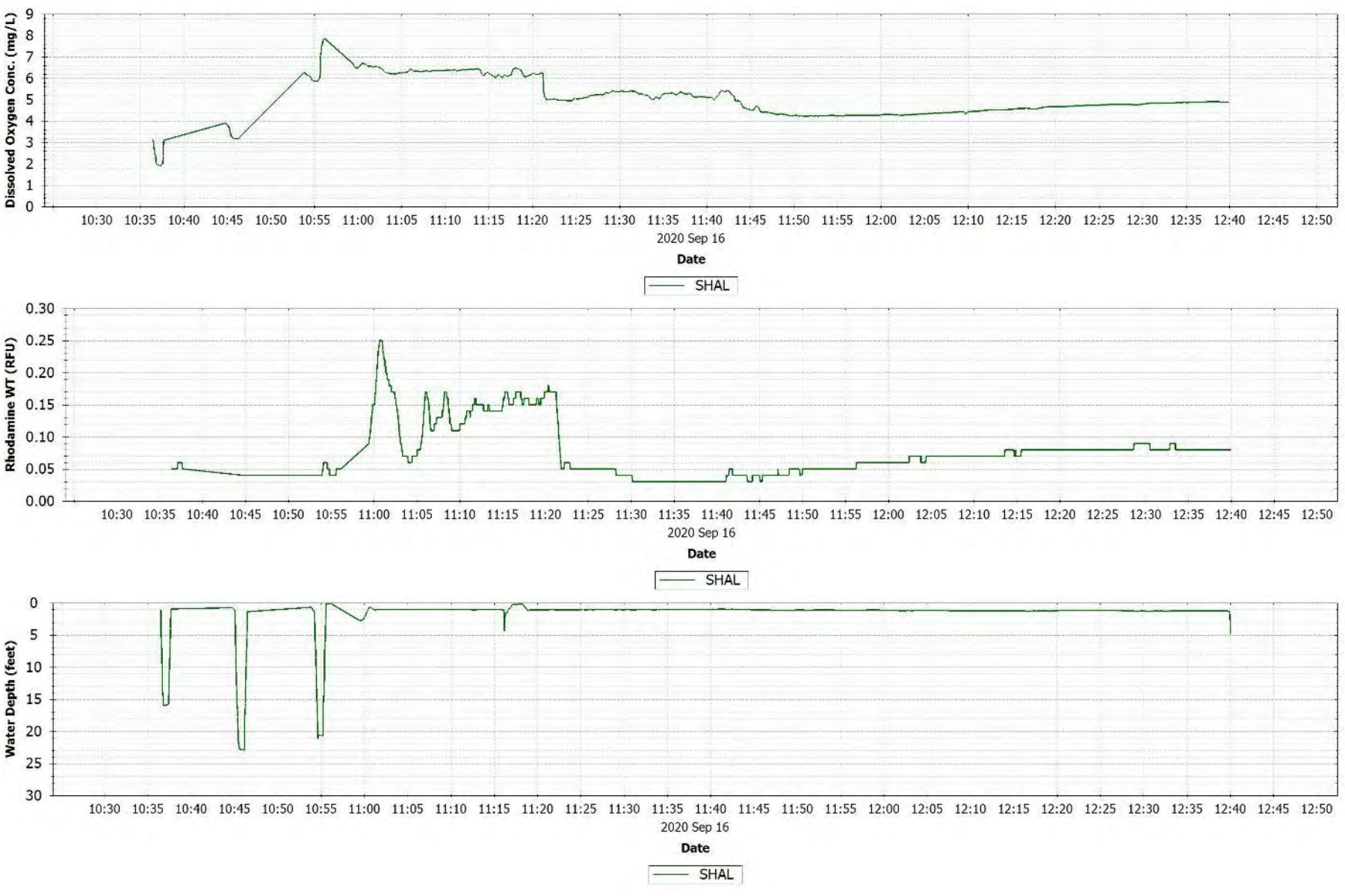


Figure C-67 Back River September 16, 2020 drift [LFR_Drift_091620_D1] location map



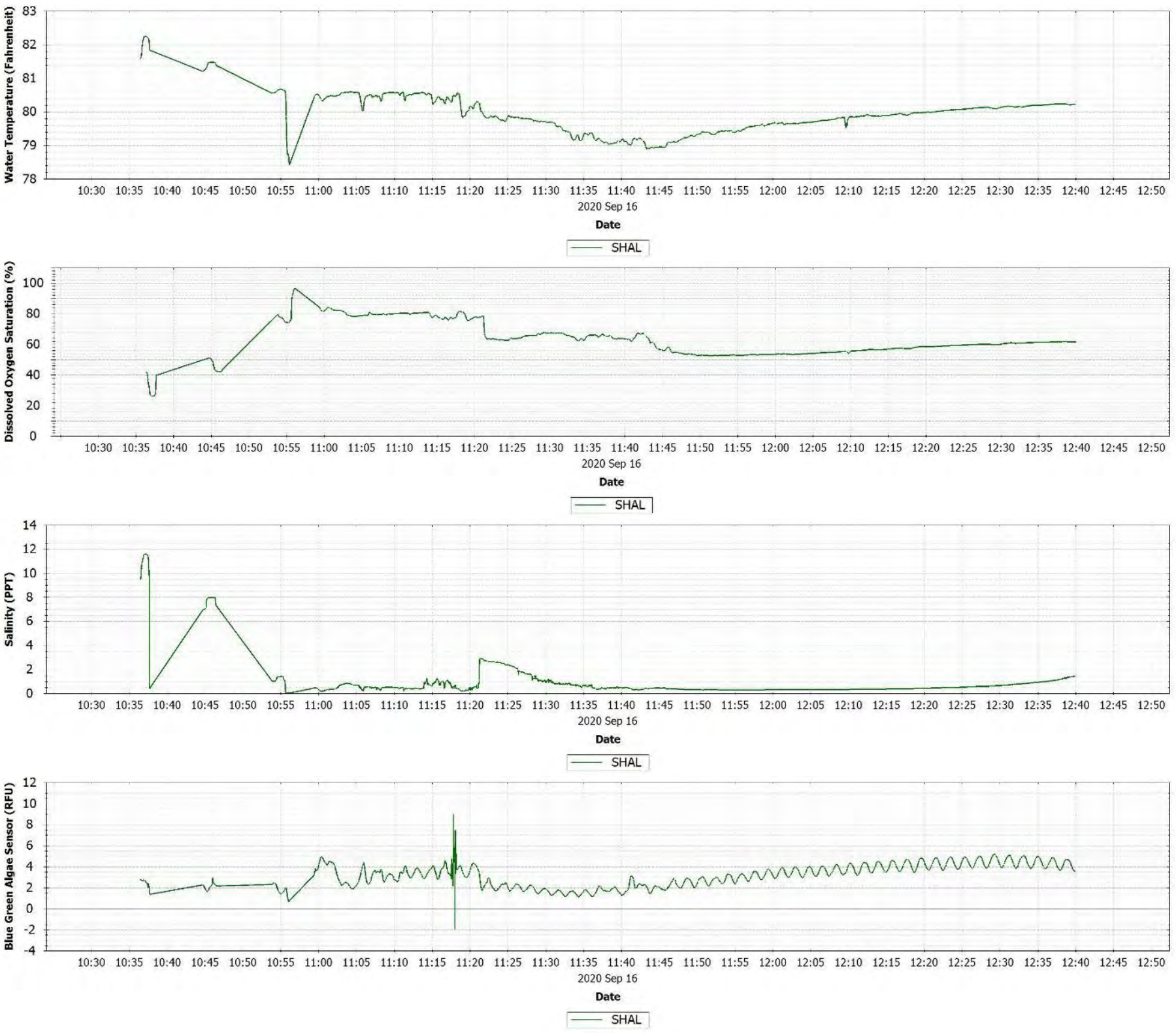


Figure C-68 Back River September 16, 2020 drift [LFR_Drift_091620_D1] observations.

C.29 SEPTEMBER 17, 2020 LITTLE BACK RIVER

One upper Little Back River drift and one lower Back RIver drift occurred during outgoing tide; high tide occurred at approximately 0916. The upper drift appeared to intersect a pocket of high salinity and low DO near the Middle River confluence and a DO sag occurred immediately upstream of a horseshoe bend. The sonde was lowered to 4 feet near the diffuser and DO concentrations increased sharply, indicating that the DO near-field plume was not at the surface of the water column. A lower drift spike of dye was measured, indicating the dye was being pushed up from the Front River.

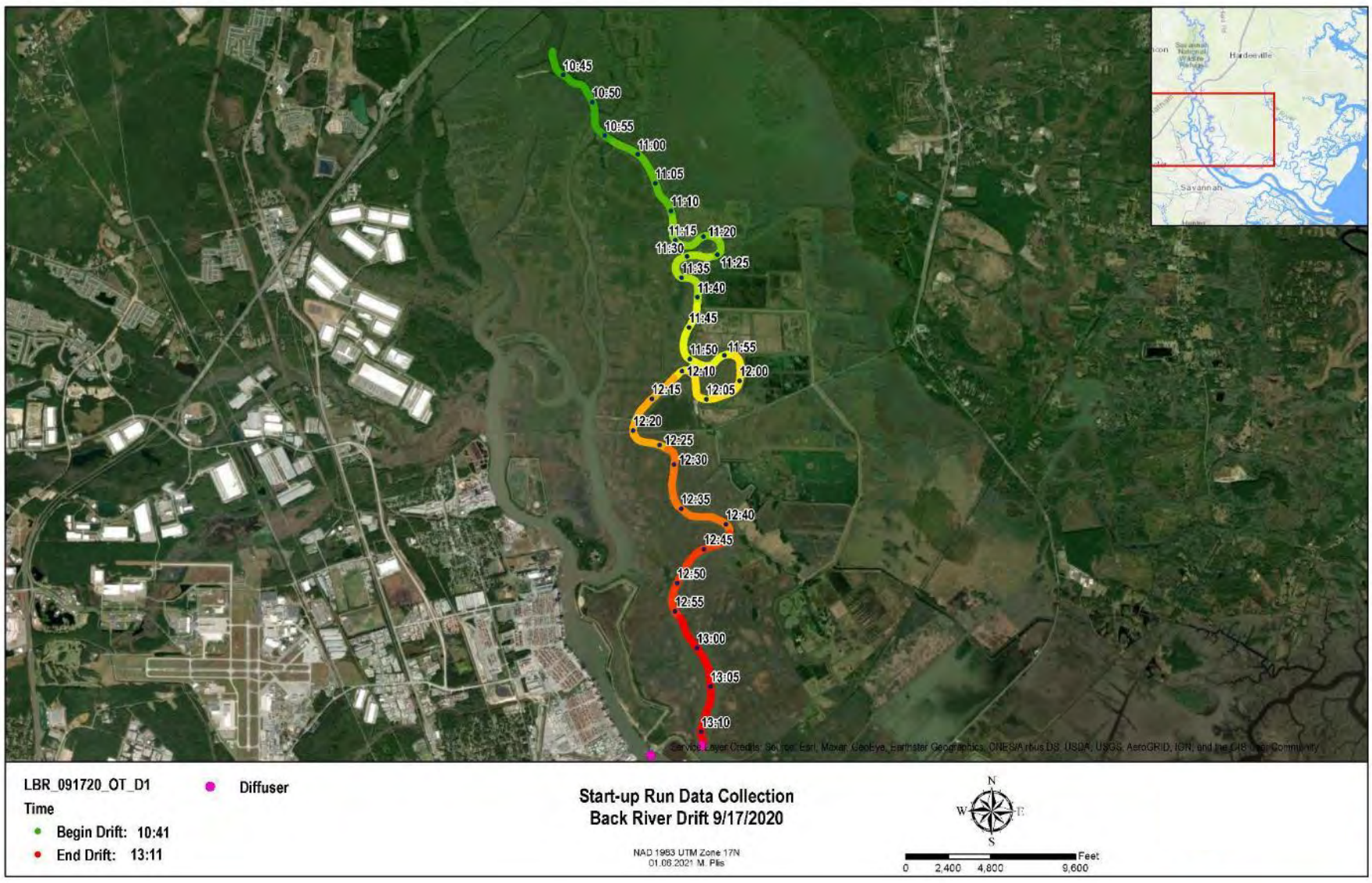
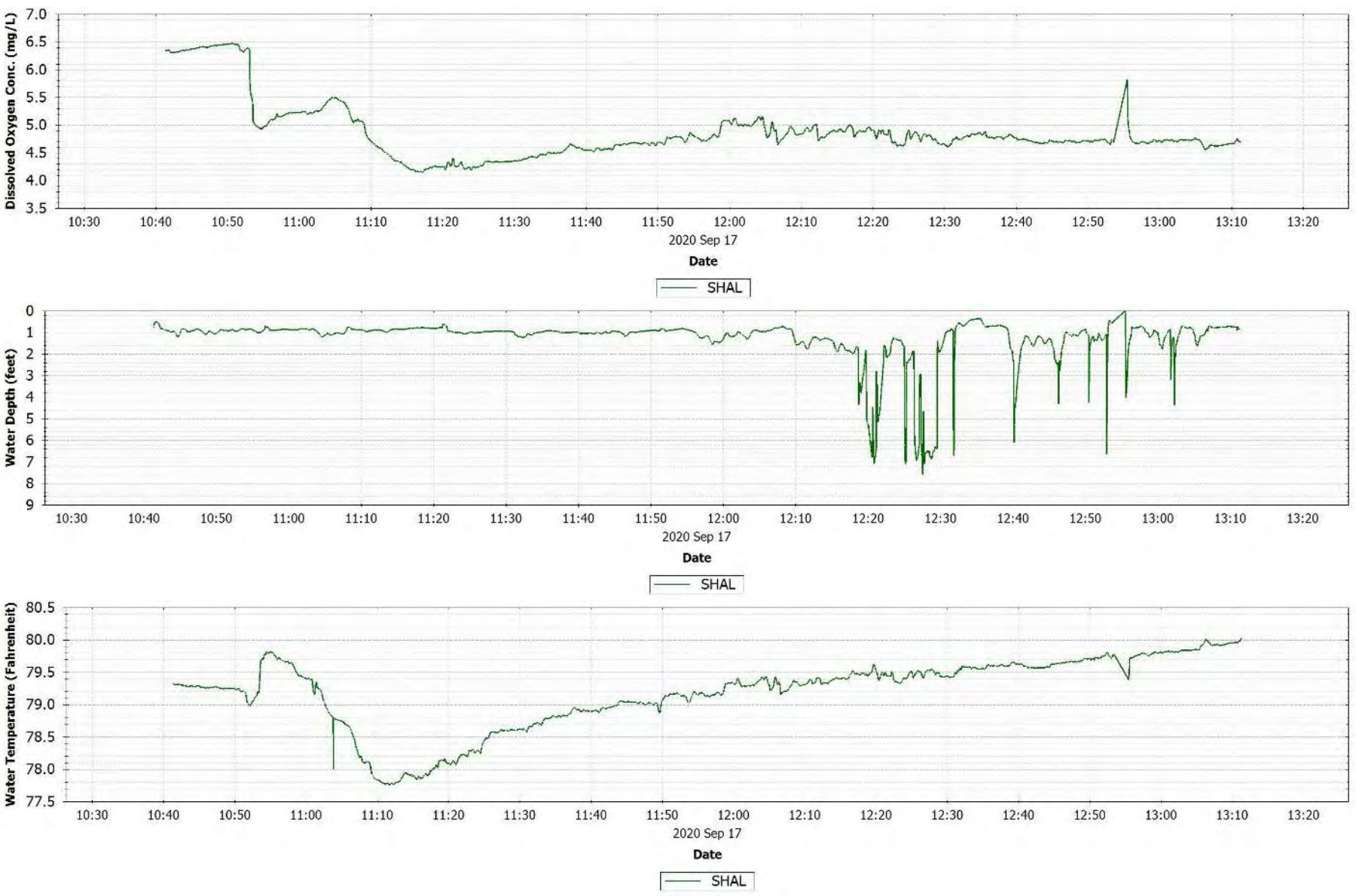


Figure C-69 Back River September 17, 2020 drift 1 [LBR_Drift_091720_OT_D1] location map



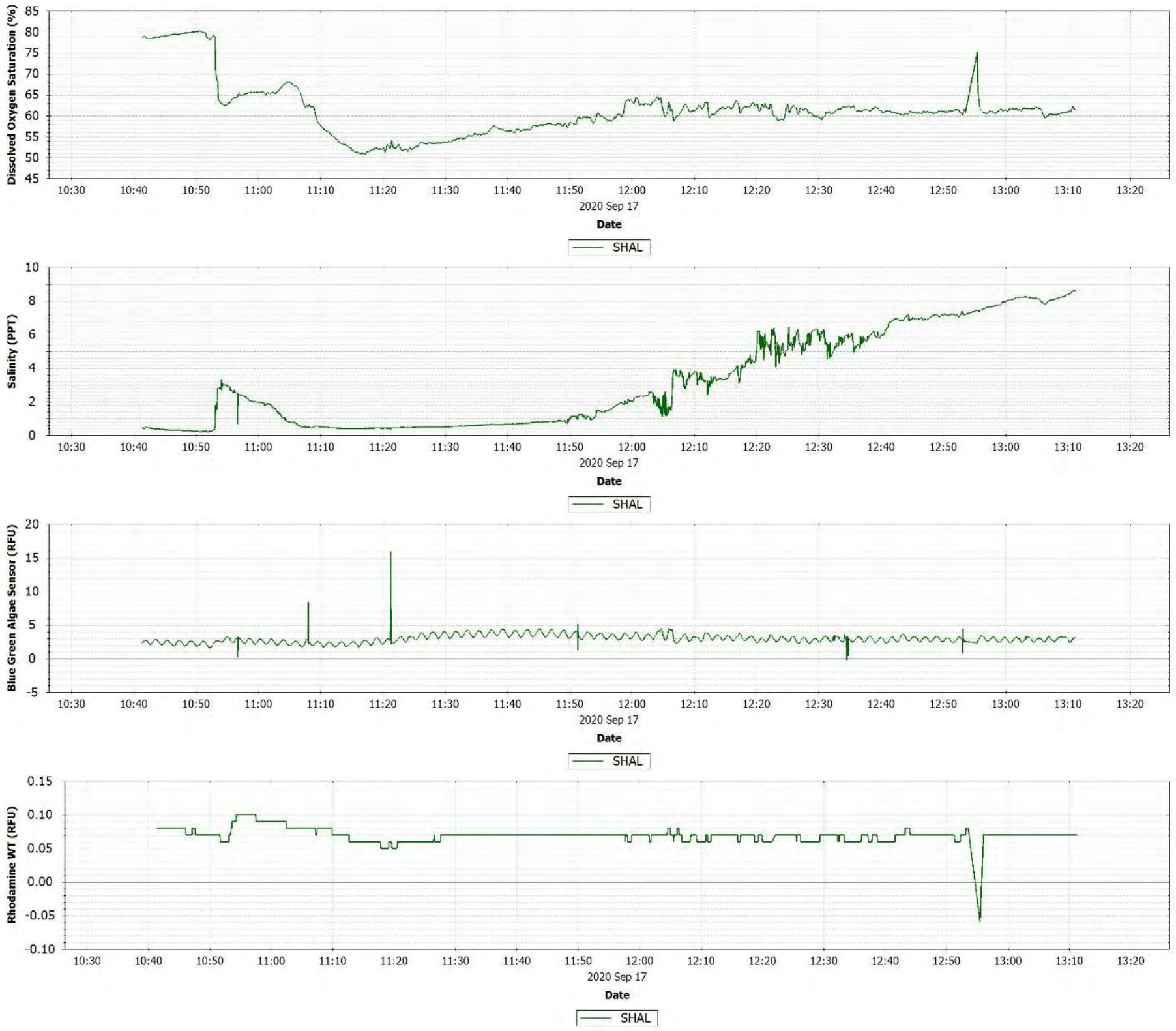


Figure C-70 Back River September 17, 2020 drift 1 [LBR_Drift_091720_OT_D1] observations.

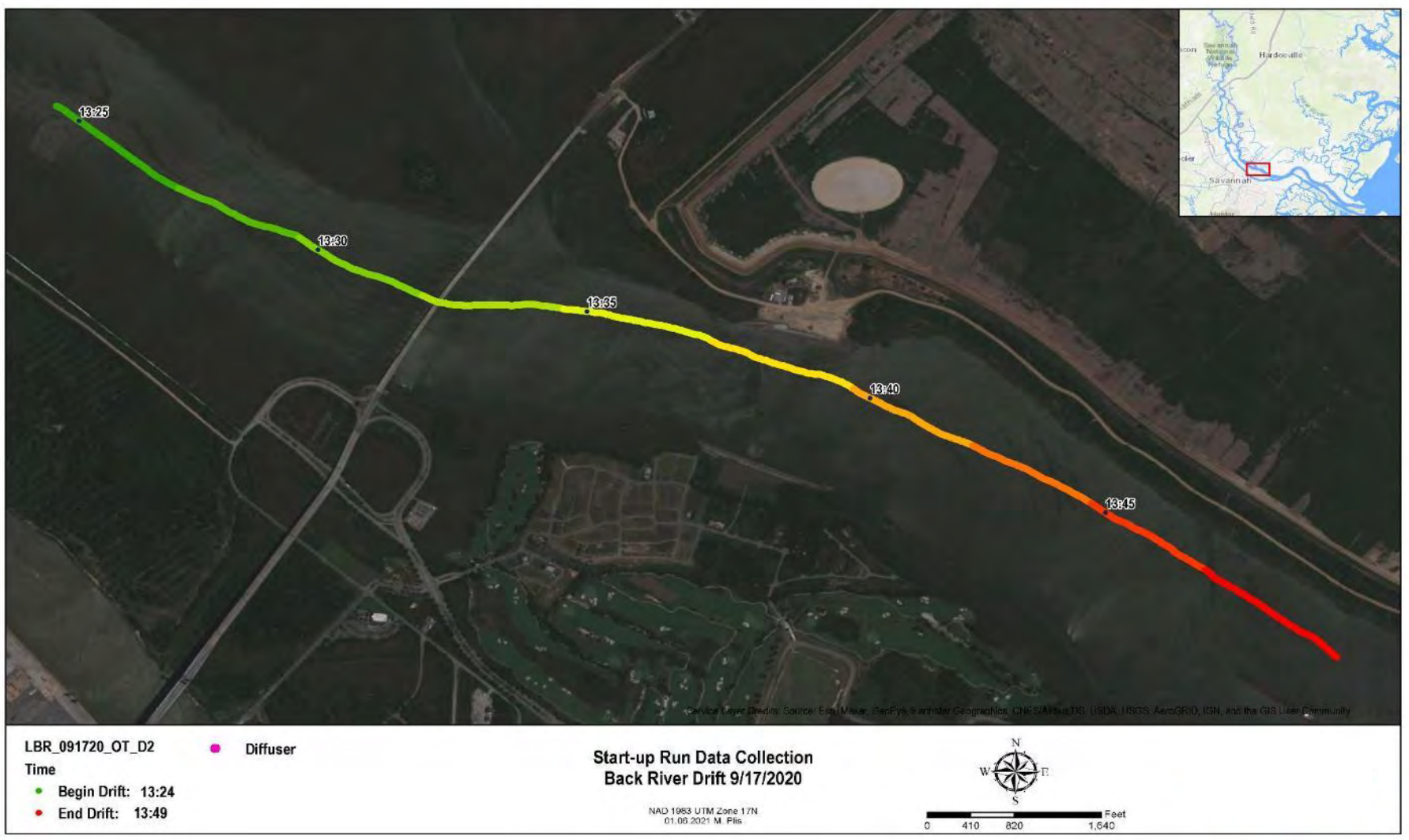


Figure C-71 Back River September 17, 2020 drift 2 [LBR_Drift_091720_OT_D2] location map

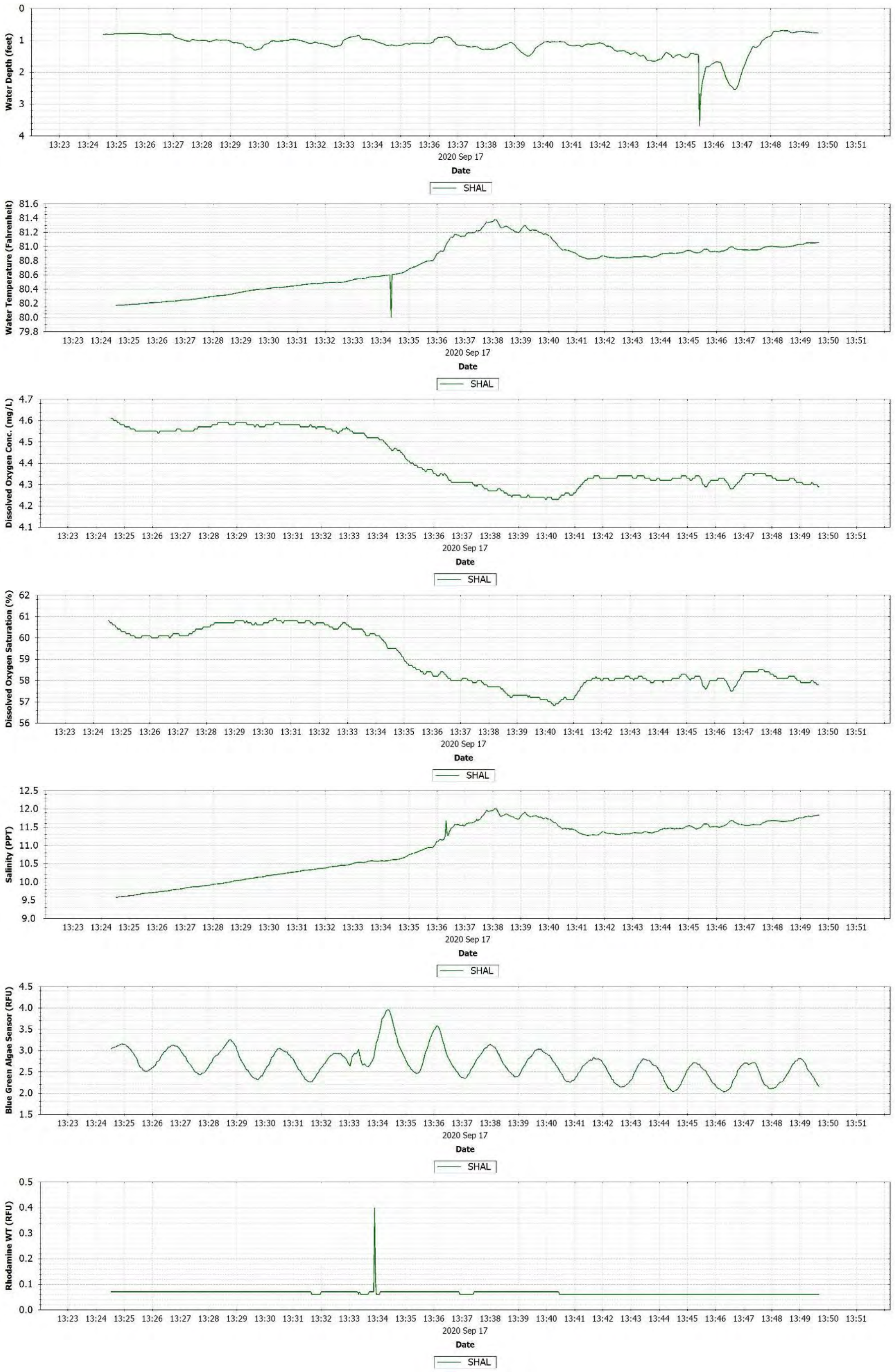


Figure C-72 Back River September 17, 2020 drift 2 [LBR_Drift_091720_OT_D2] observations.

C.30 SEPTEMBER 19, 2020 DRIFT BACK RIVER

A quick Back River drift, around the diffuser, occurred during incoming tide; low tide occurred at approximately 0447. DO concentrations were higher near the surface of the water column. No dye was measured.

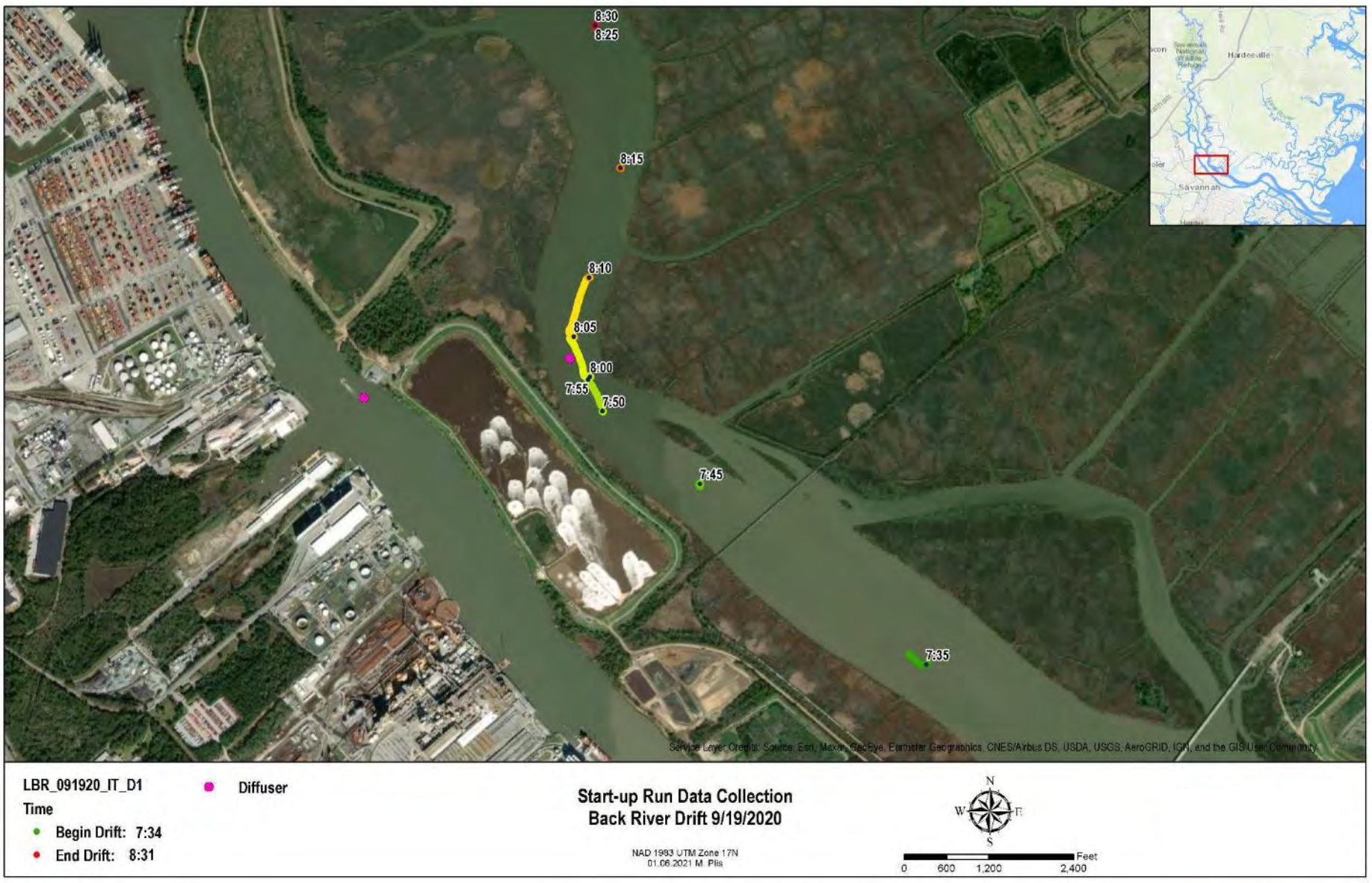
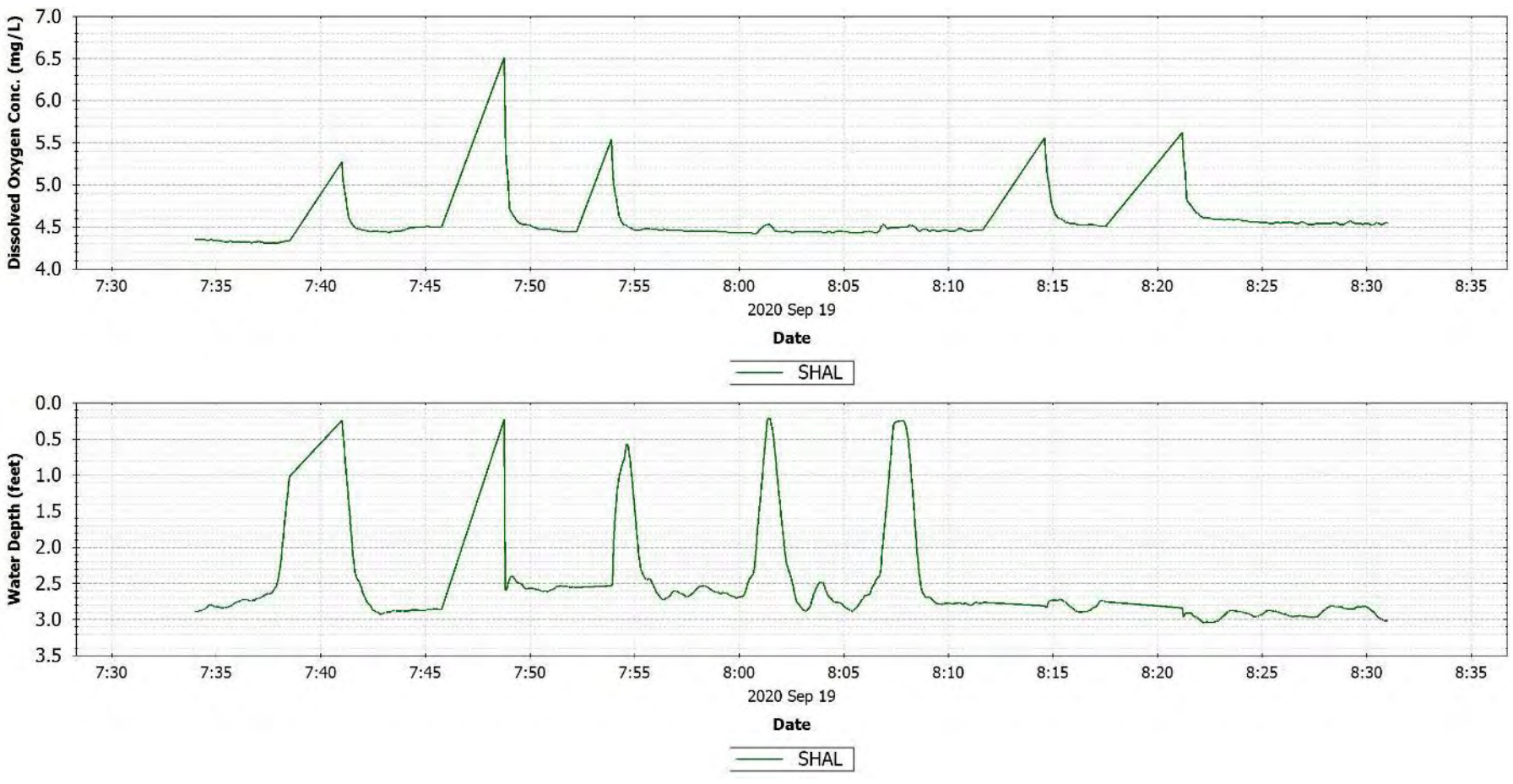


Figure C-73 Back River September 19, 2020 drift [LBR_Drift_091920_IT_D1] location map



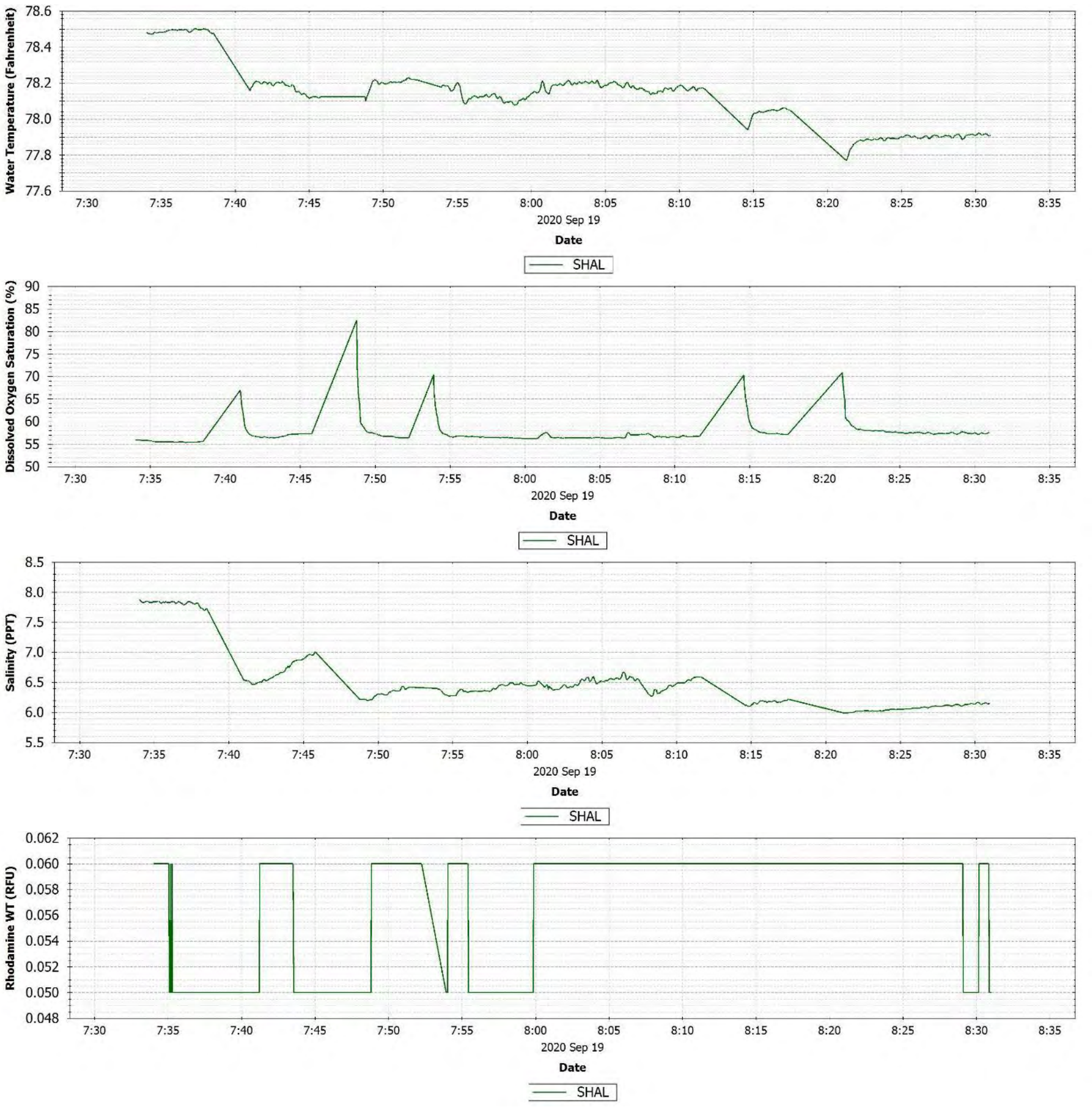


Figure C-74 Back River September 19, 2020 drift [LBR_Drift_091920_IT_D1] observations.

C.31 FRONT RIVER

SUR drift sampling started on July 27, 2020. The following are observations about how the injected oxygen dispersed into the Front River The inject oxygen

- Disperses both to upper and lower layers of the stratified Front River.
- Hugs the west bank, in the upper layer and moves into the channel in the lower layer..
- Can moves up to up past the turning basin on flood tide and past US-17 on Ebb tides, depending on if it a Spring or Neap tidal condition.
- Based on the dye studies, the oxygen plume stays in the Back River for three to four weeks or more.

C.32 JULY 27, 2020 DRIFT FRONT RIVER

Drift began at slack tide and continued during incoming tide; low tide occurred at approximately 0900. DO concentrations spiked in the middle sonde by 1.5 mg/L at 1105 indicating that the near-field oxygen plume was intersected next to the west bank. DO concentrations generally increase upstream of the diffuser. The two low DO spikes are most likely due to the deeper sonde entering the fluffy bottom silt layer in the channel.



Figure C-75 Front River July 27, 2020 DO profile

The drift data in this Front River section, is presented mostly as parameter per timestep. The location maps show the route of the boat with green being the start and red the end of the route, included on the location maps are the times the data was measured in 5 minute increments, so the sampling location can be associated with the parameters in the figures below each location map.

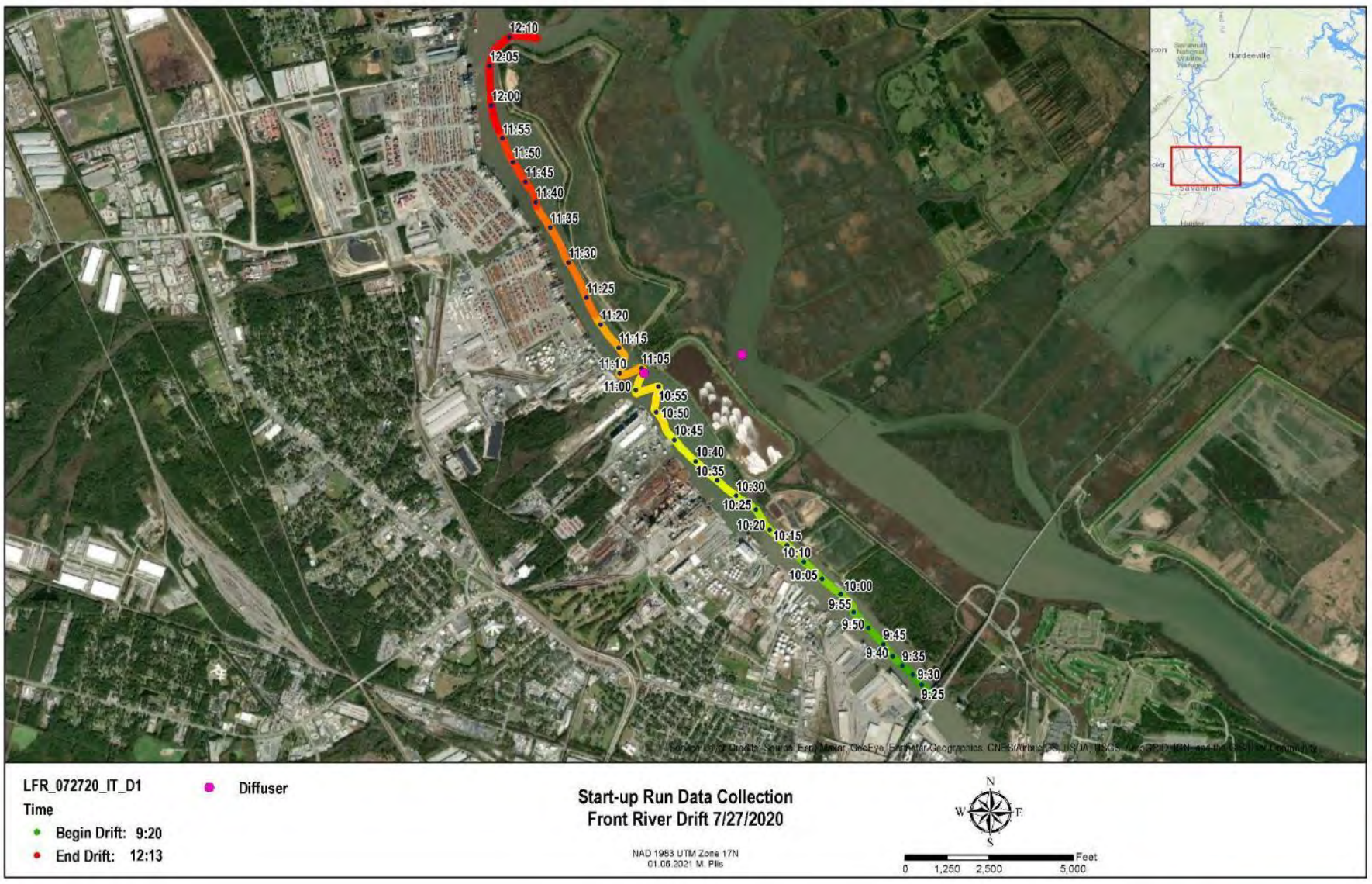
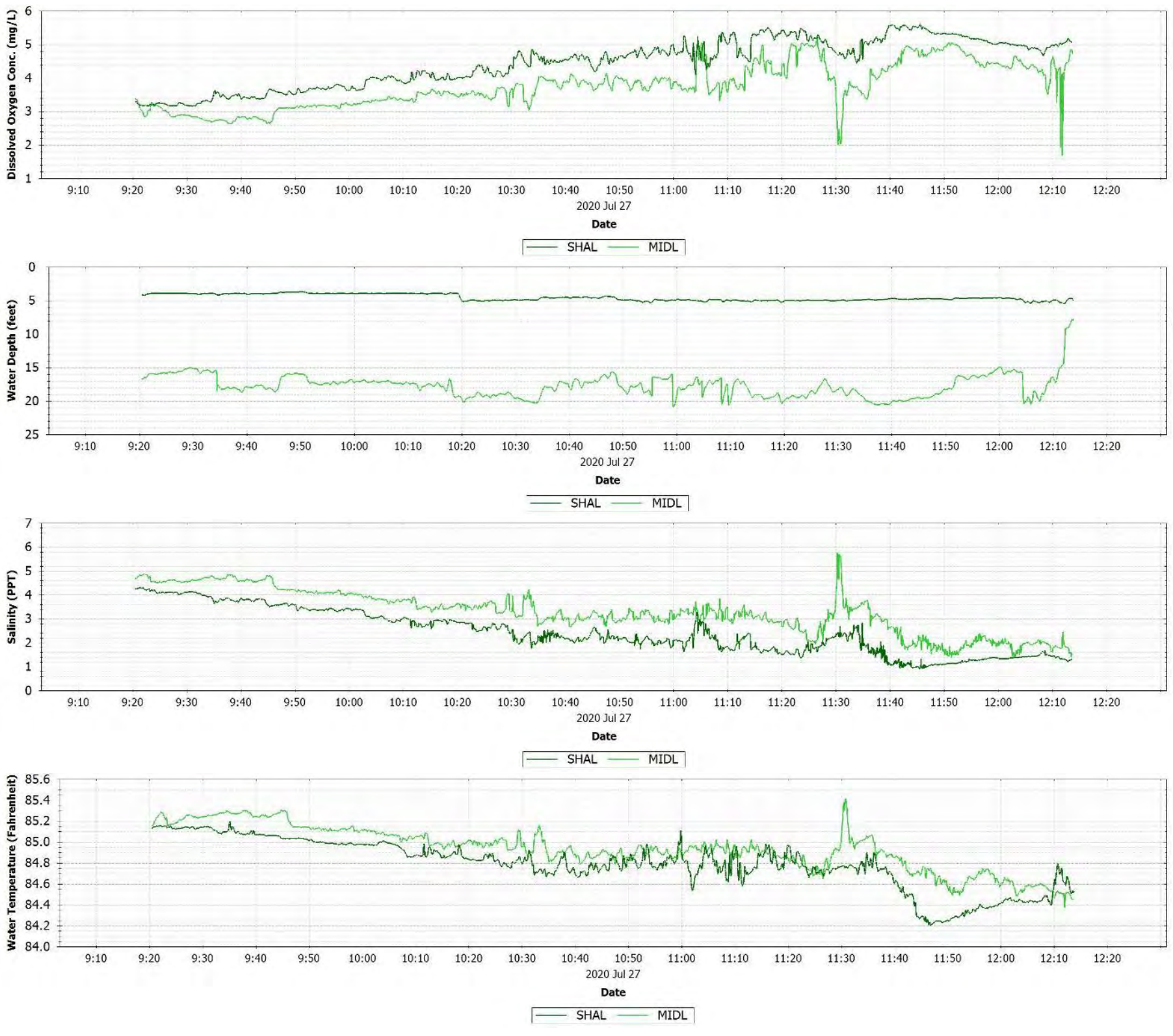


Figure C-76 Front River July 27, 2020 drift [LFR_Drift_072720_IT_D1] location map



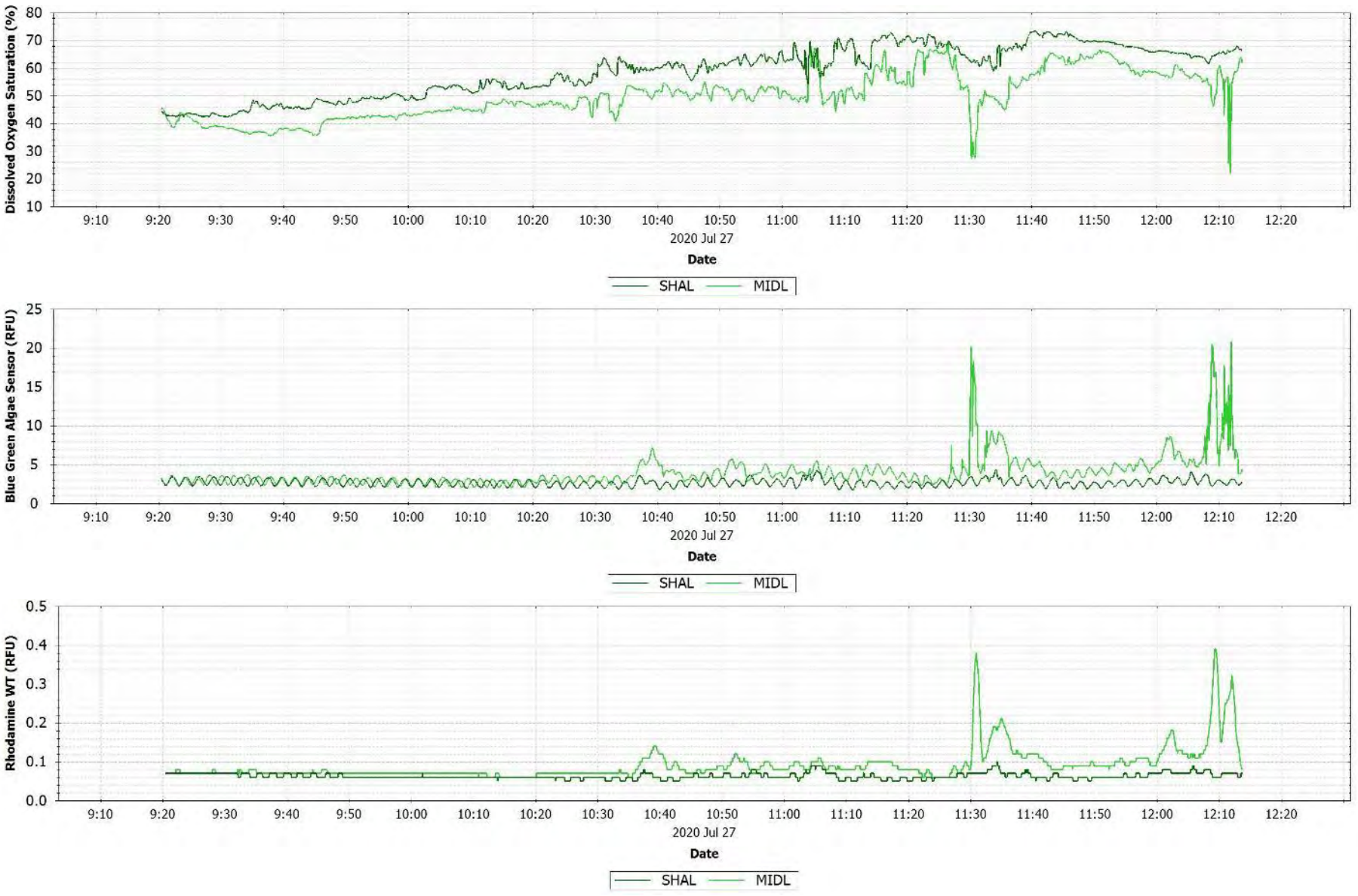


Figure C-77 Front River July 27, 2020 drift [LFR_Drift_072720_IT_D1] observations.

C.33 JULY 29, 2020 DRIFT FRONT RIVER

Drift started upstream in fresh water and proceeded downstream into salt water. Drift occurred during outgoing tide to slack tide; low tide occurred at approximately 1055. DO concentrations generally decreased moving downstream until the drift passed the diffuser. After 1002, the DO concentrations in the middle diffuser no longer had a decreasing trend and appeared to stabilize.



Figure C-78 Front River July 29, 2020 DO profile

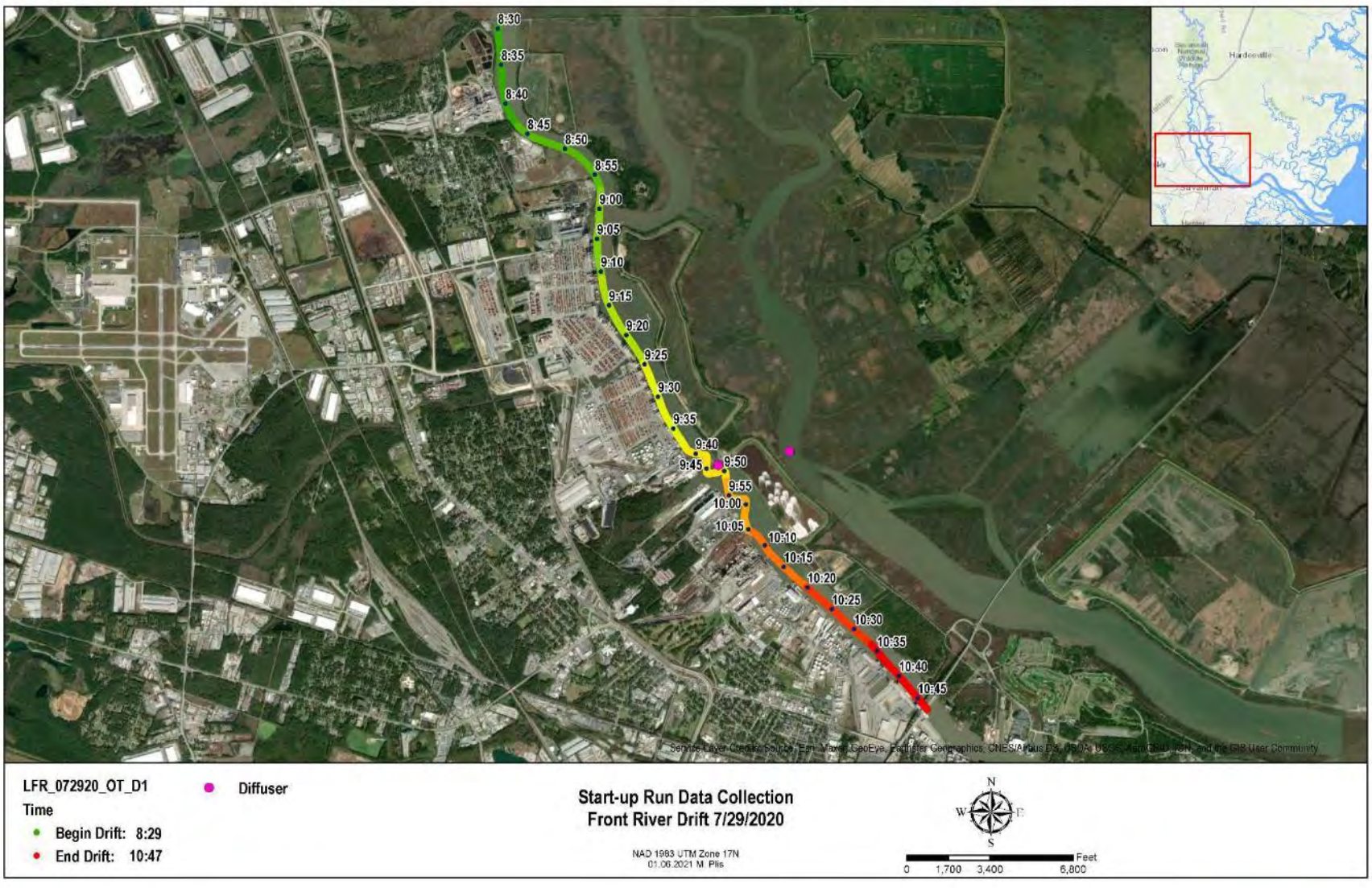


Figure C-79 Front River July 29, 2020 drift [LFR_Drift_072920_OT_D1] location map

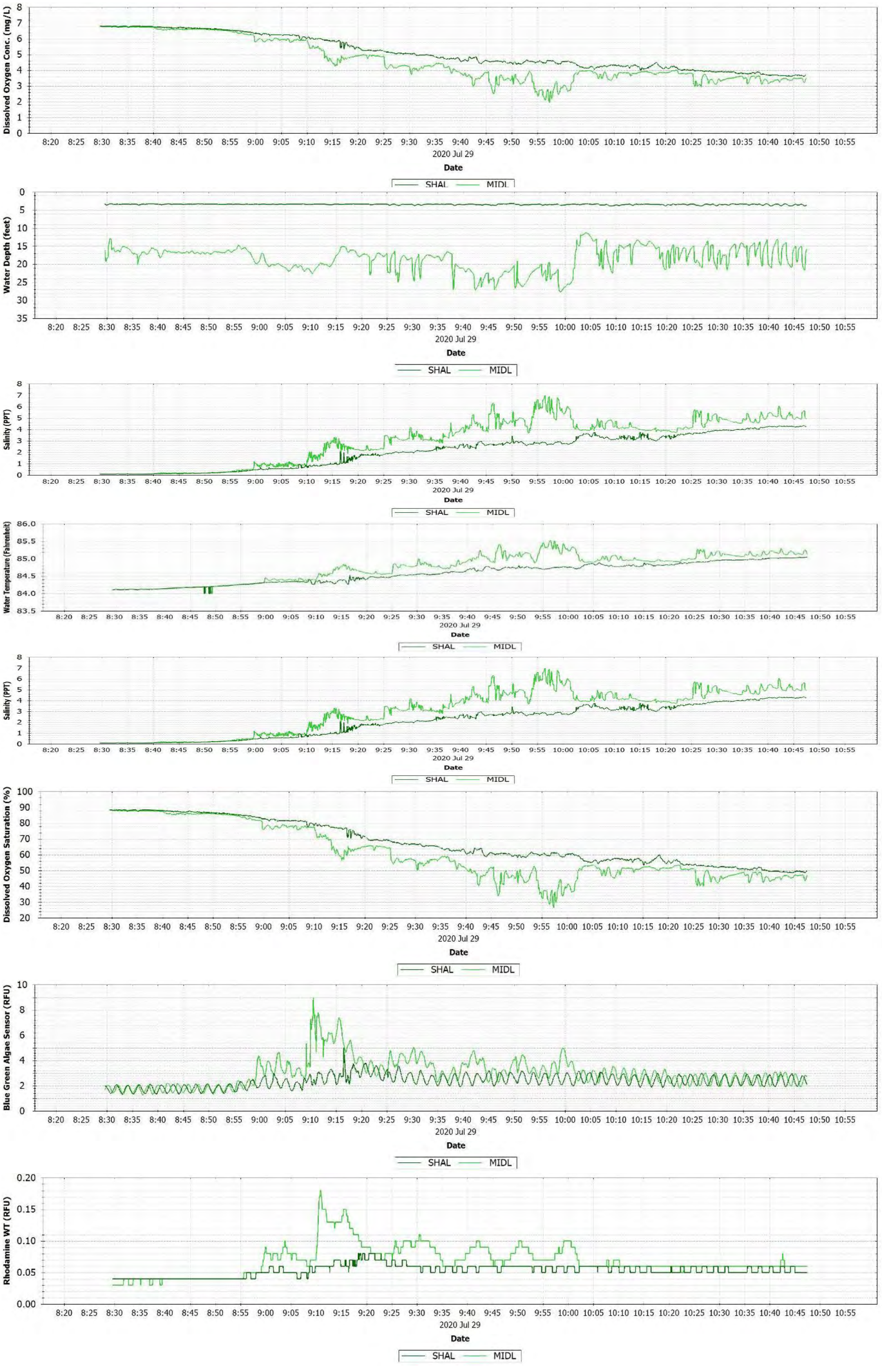


Figure C-80 Front River July 29, 2020 drift [LFR_Drift_072920_OT_D1] observations.

C.34 JULY 31, 2020 DRIFT FRONT RIVER

Drift occurred during outgoing tide; high tide occurred at approximately 0647. The middle sonde appeared to intersect the DO near-field plume at 0849. The plume was not detected immediately before or after the spike but DO concentrations overall increased moving downstream.

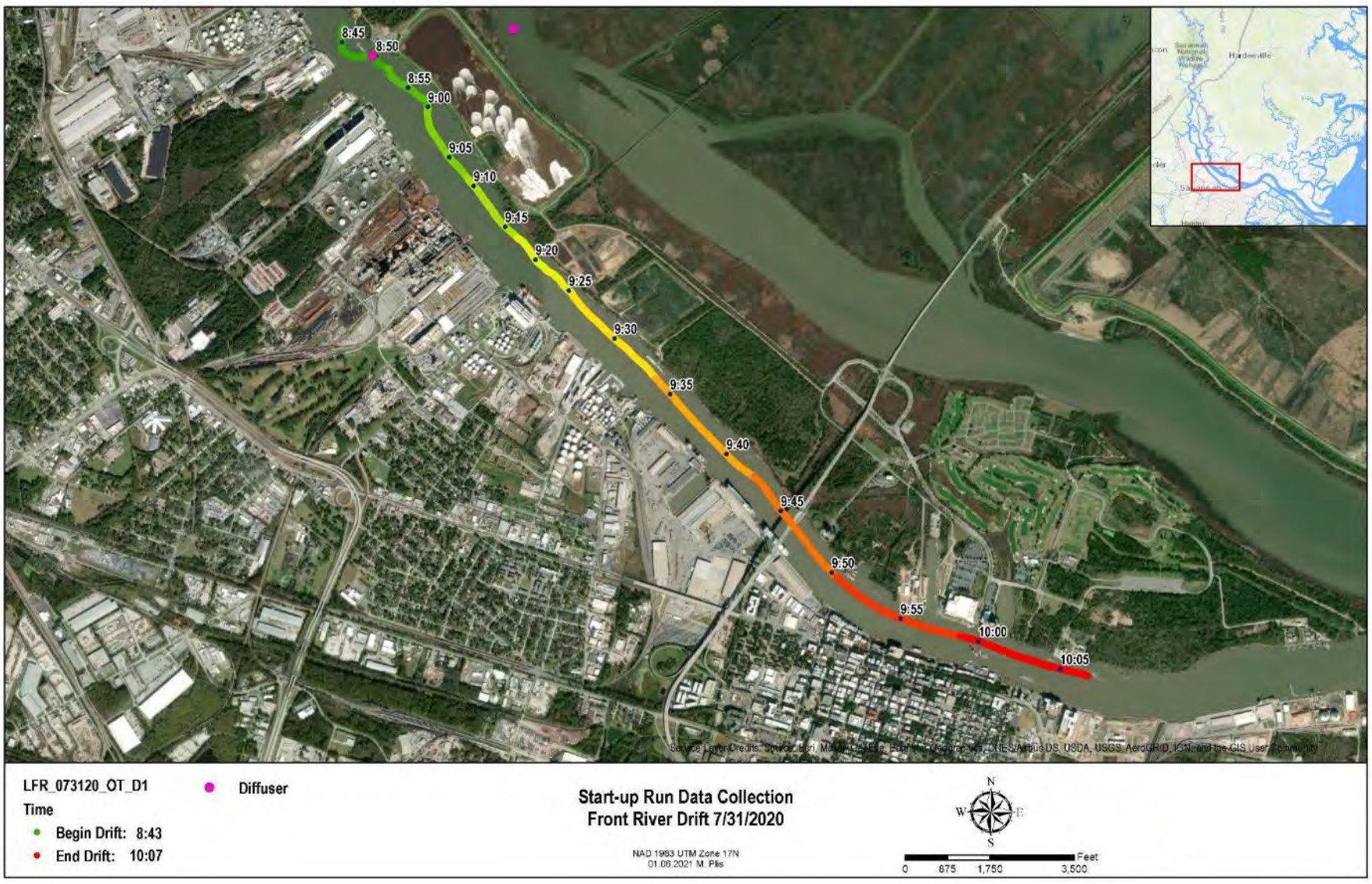
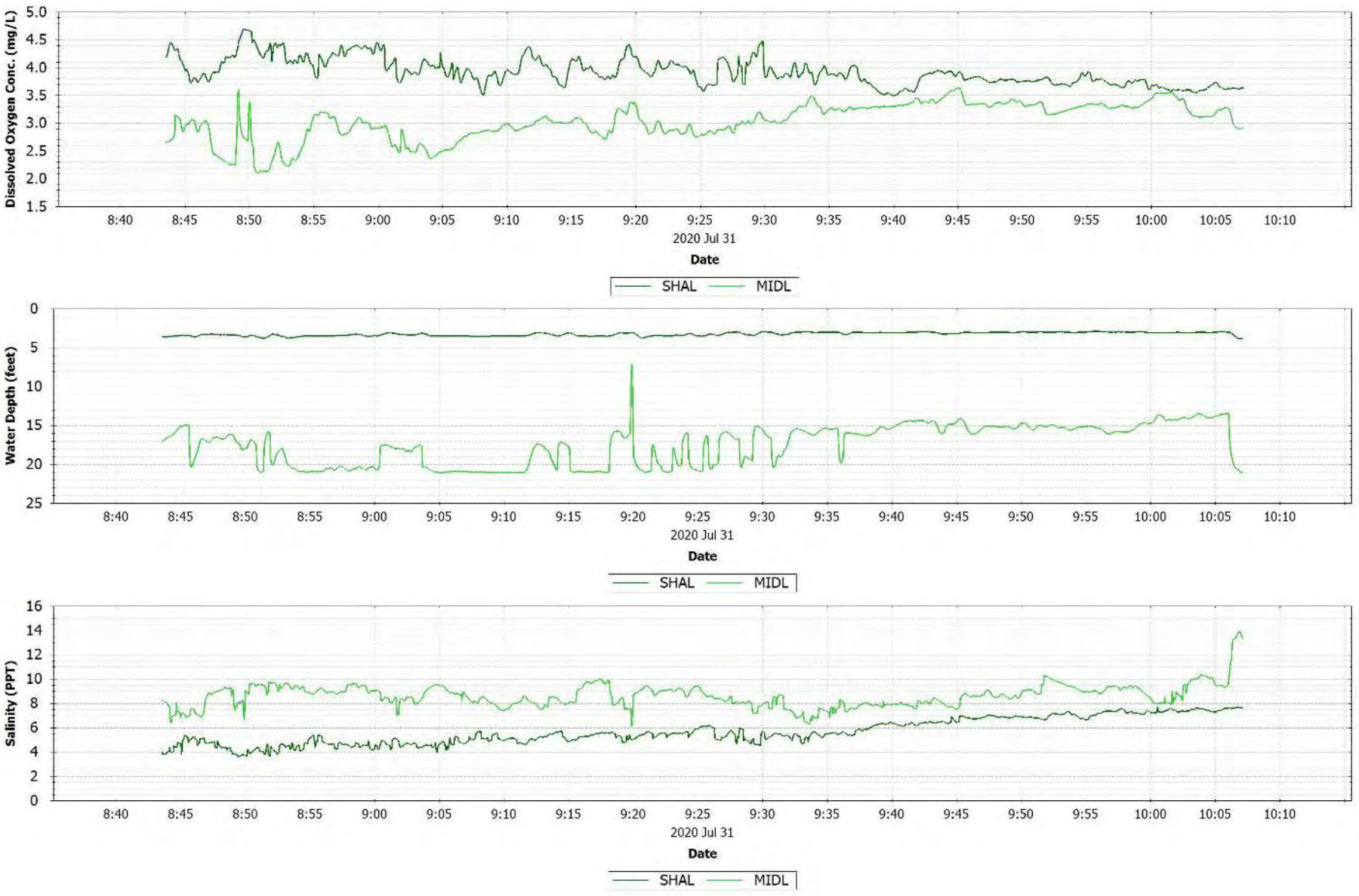


Figure C-81 Front River July 31, 2020 drift [LFR_Drift_073120_OT_D1] location map



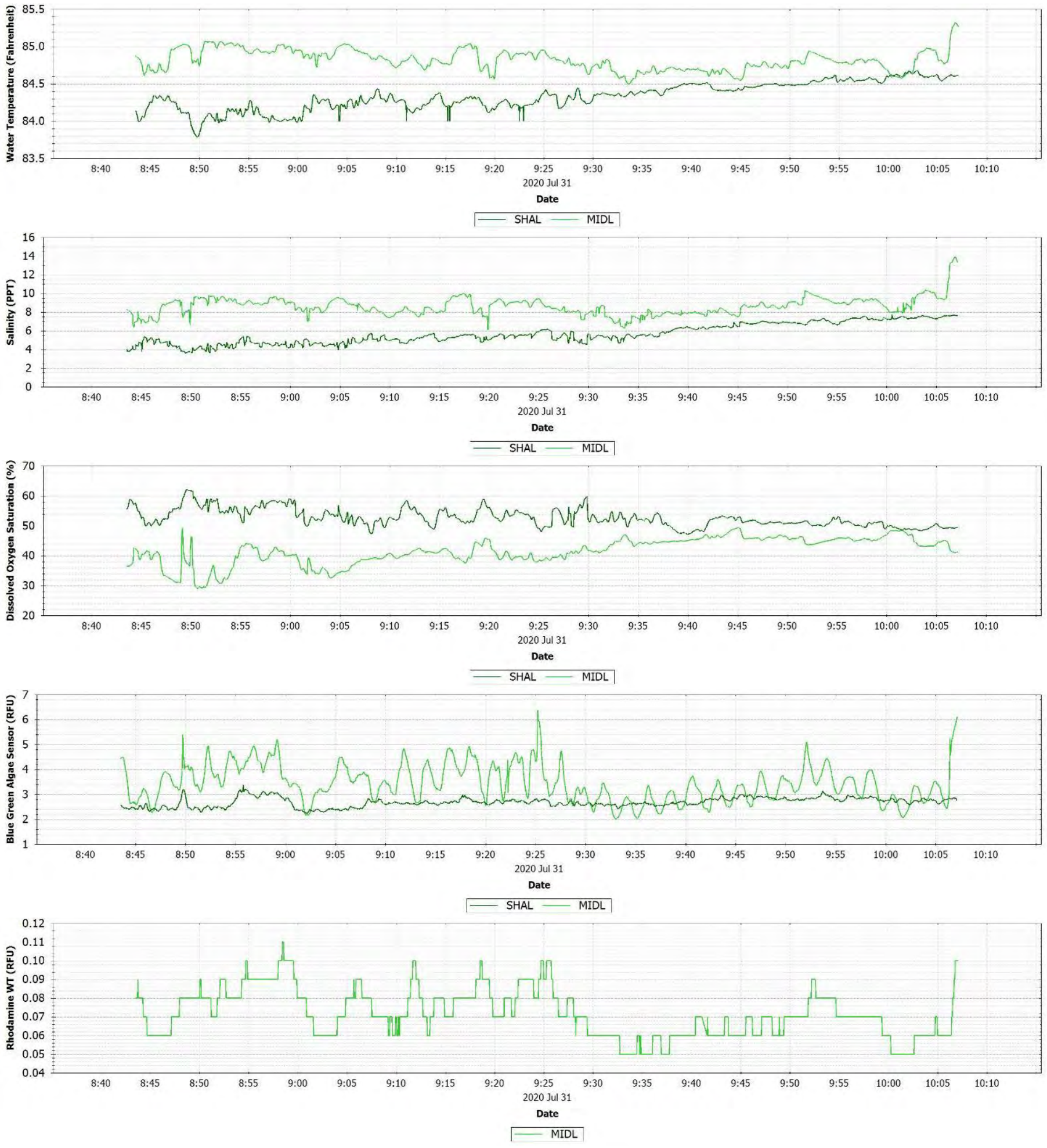


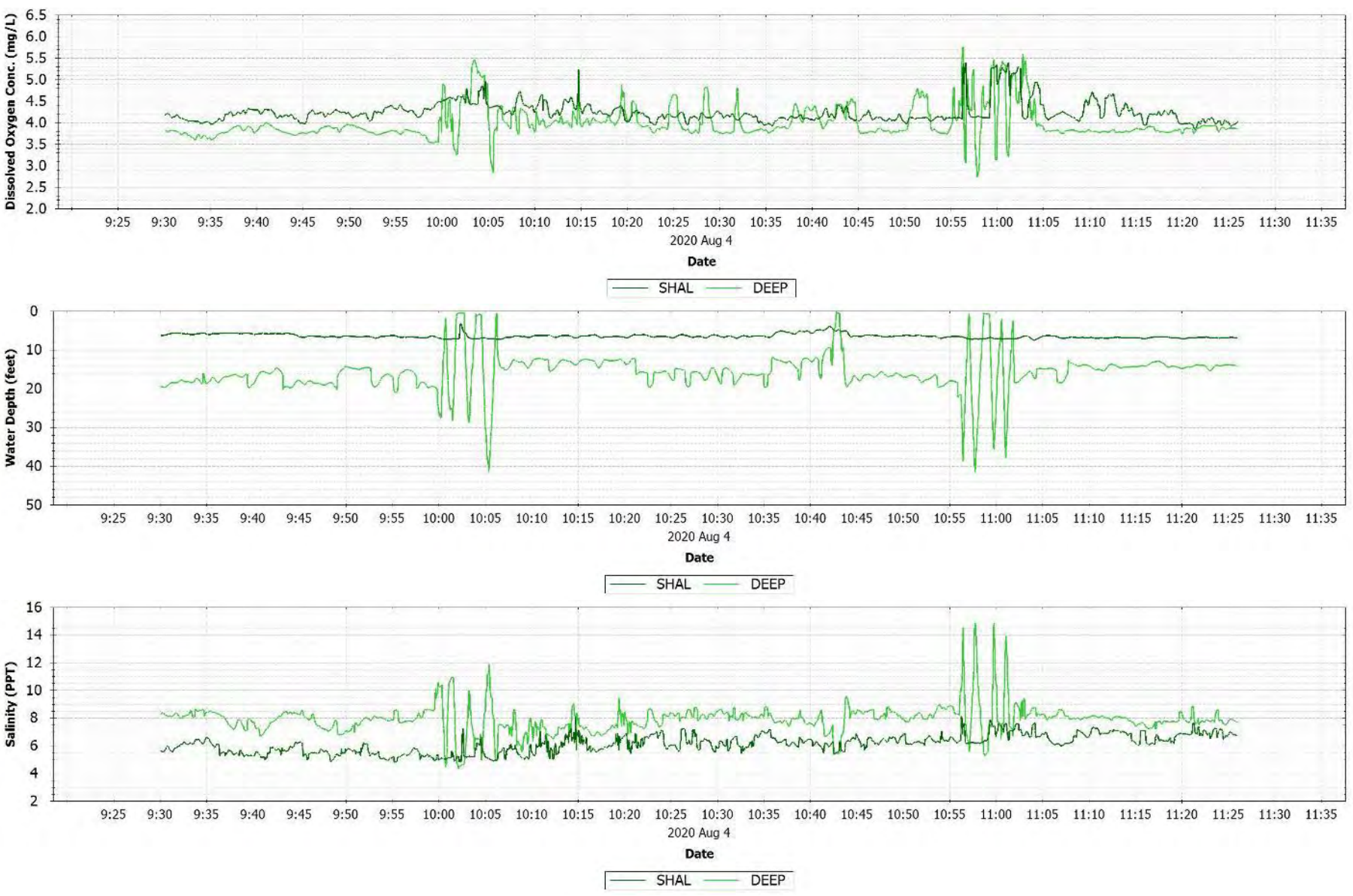
Figure C-82 Front River July 31, 2020 drift [LFR_Drift_073120_OT_D1] observations.

C.35 AUGUST 4, 2020 DRIFT FRONT RIVER

A detailed drift around the diffuser occurred during slack high tide; high tide occurred at approximately 1007. The drift may have intersected the near-field several times when it was in close proximity to the diffuser between 1010 and 1045; the deep sonde DO increased 1 mg/L during this period several times. Other changes in DO concentrations were likely due to profiling that occurred during the drift.



Figure C-83 Front River August 4, 2020 drift [LFR_Drift_080420_HT_D1] location map



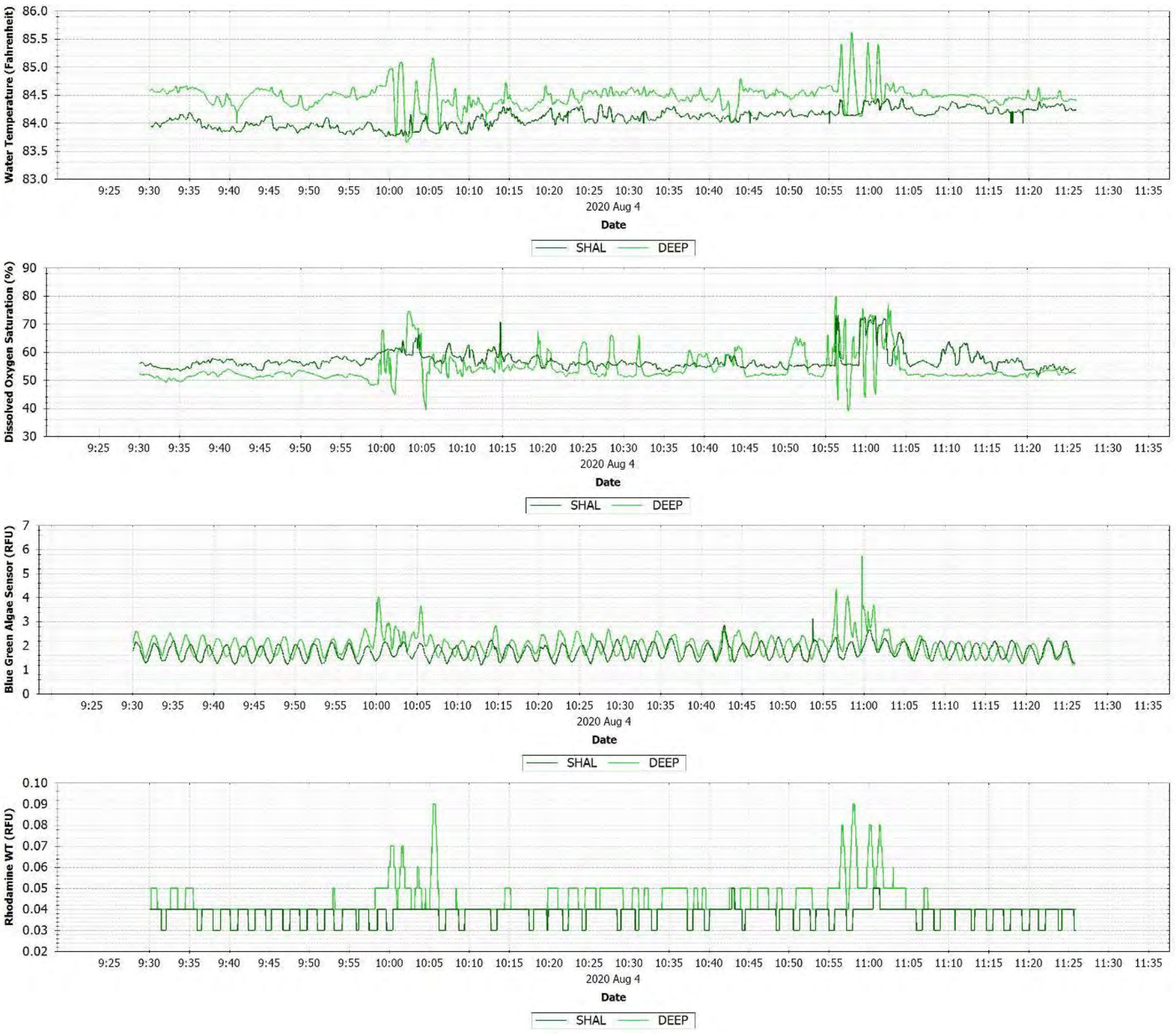


Figure C-84 Front River August 4, 2020 drift [LFR_Drift_080420_HT_D1] observations.

C.36 AUGUST 6, 2020 DRIFT FRONT RIVER

Drift occurred during incoming tide to slack high tide; high tide occurred at approximately 1129. The DO increase upstream of the diffuser.

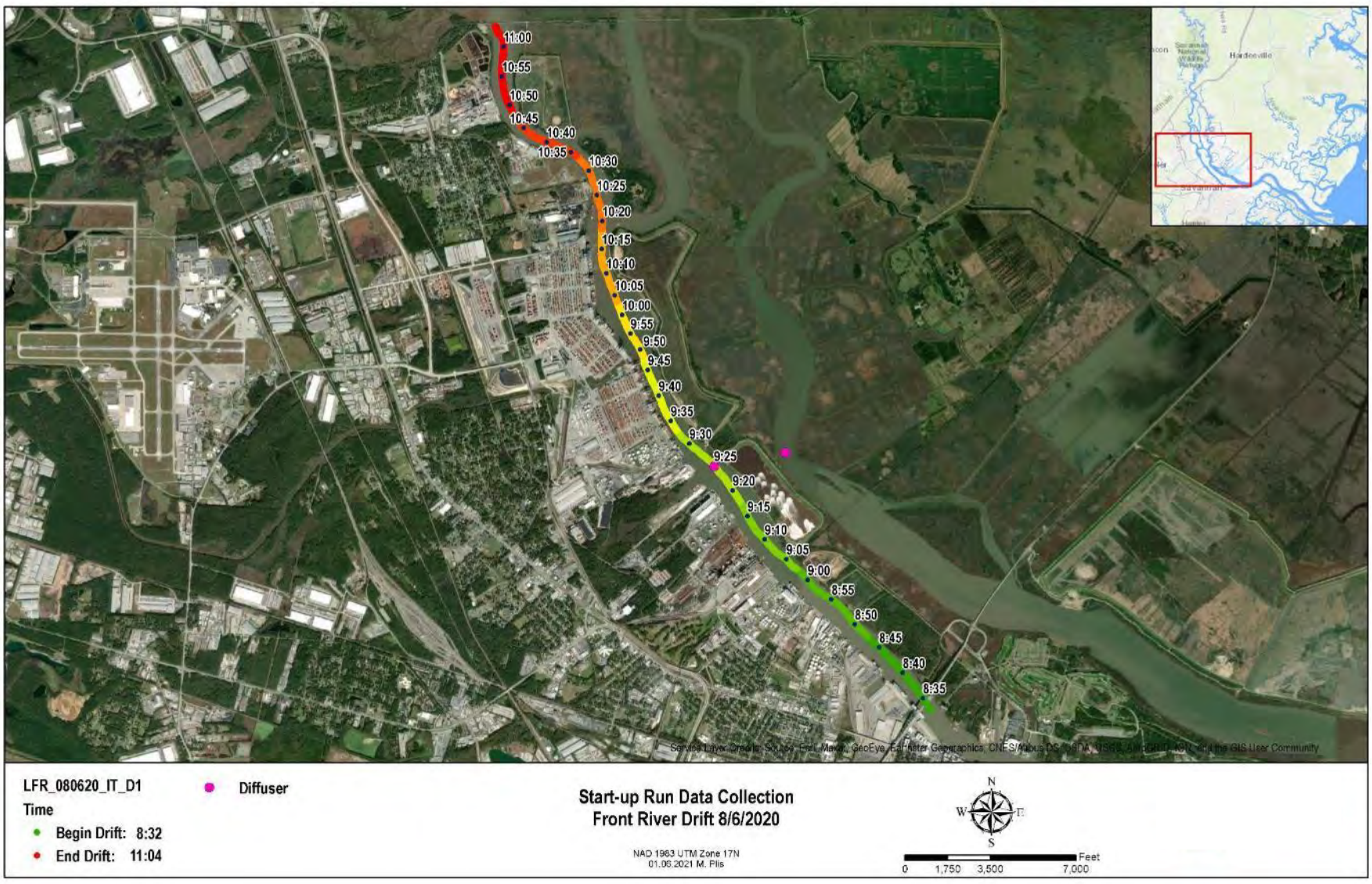
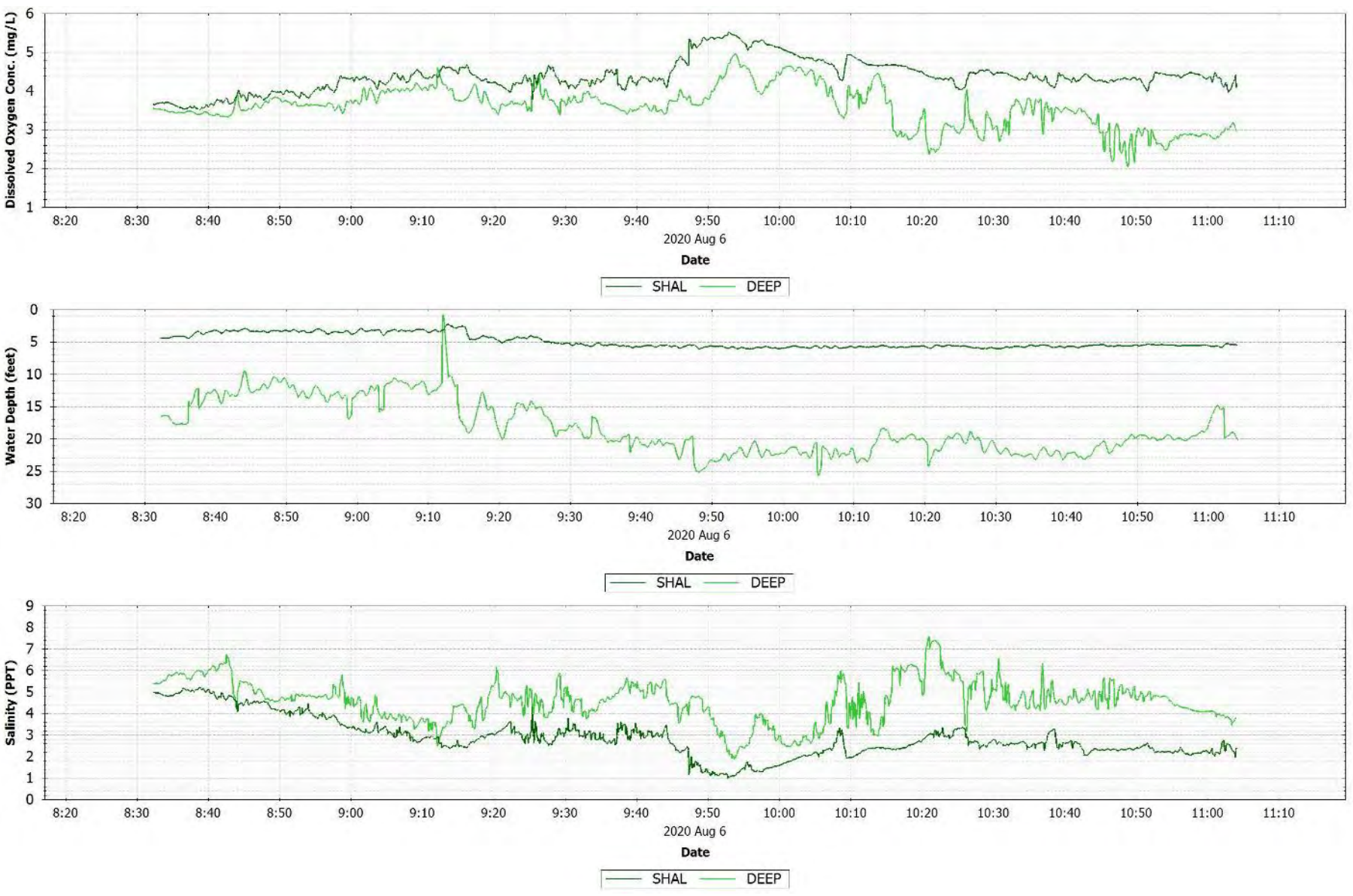


Figure C-85 Front River August 6, 2020 drift [LFR_Drift_080620_IT_D1] location map



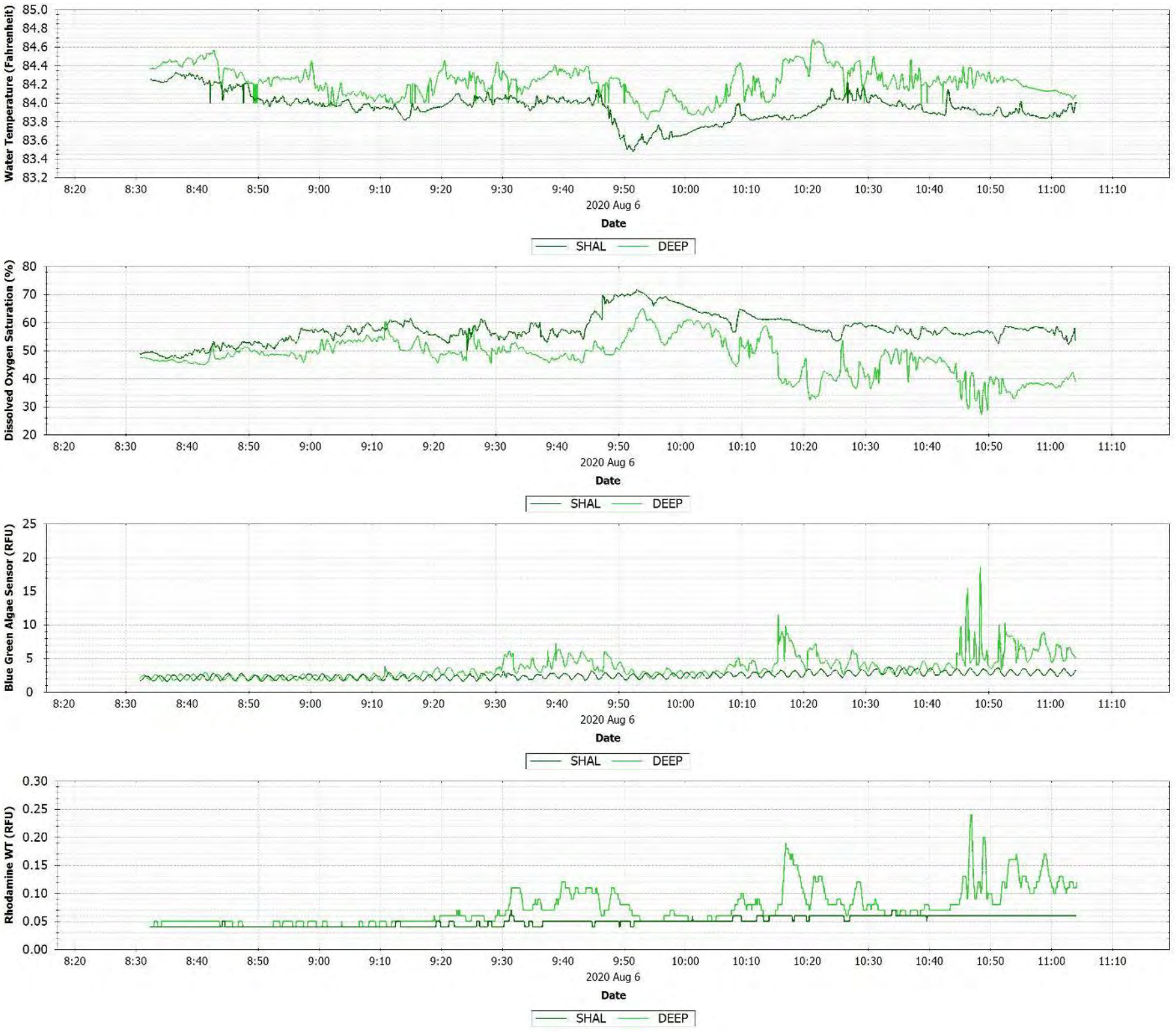


Figure C-86 Front River August 6, 2020 drift [LFR_Drift_080620_IT_D1] observations.

C.37 AUGUST 7, 2020 DRIFT FRONT RIVER

Drift occurred during incoming tide; high tide occurred at approximately 1207. DO concentrations increased slightly moving upstream.

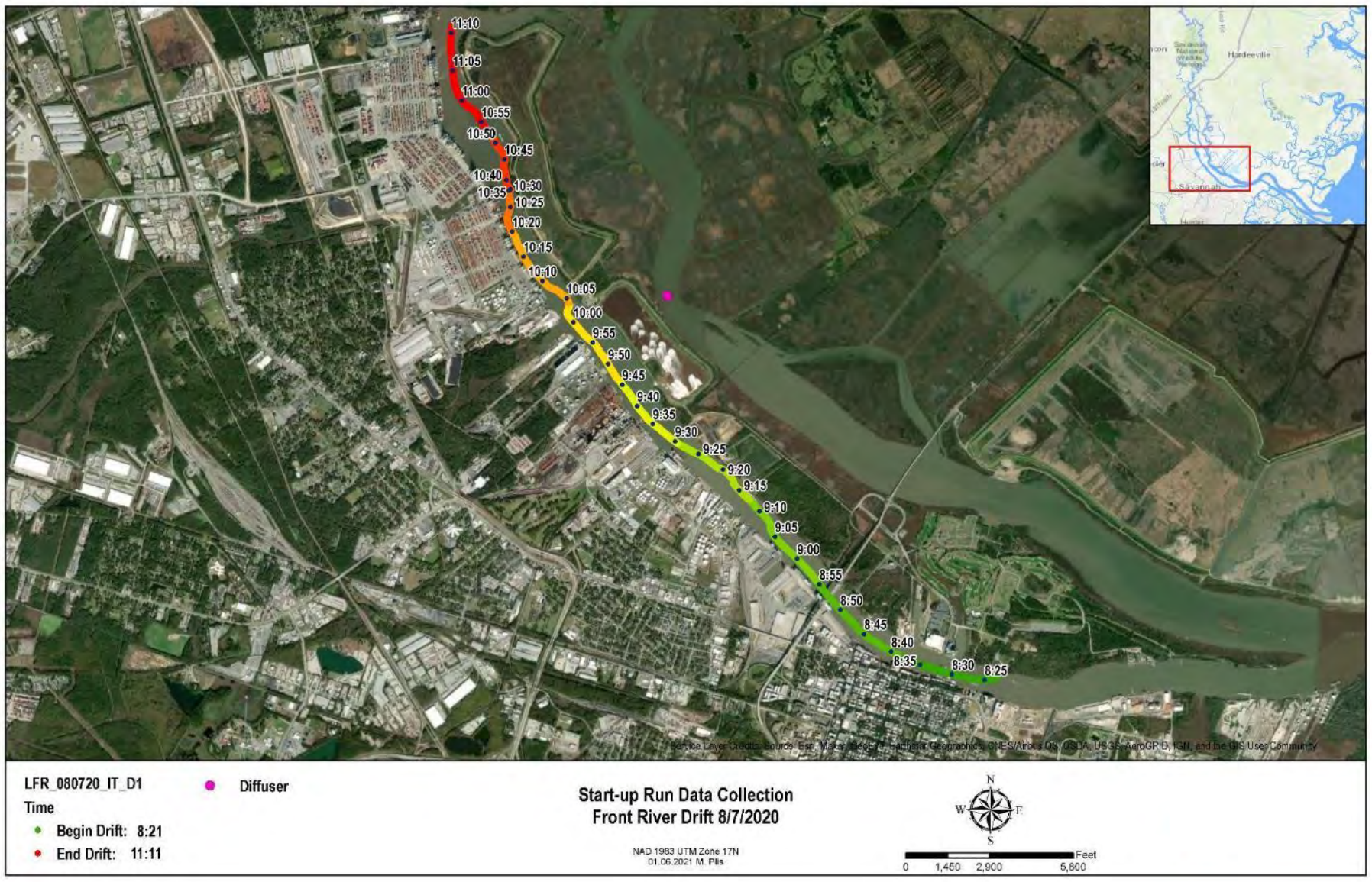
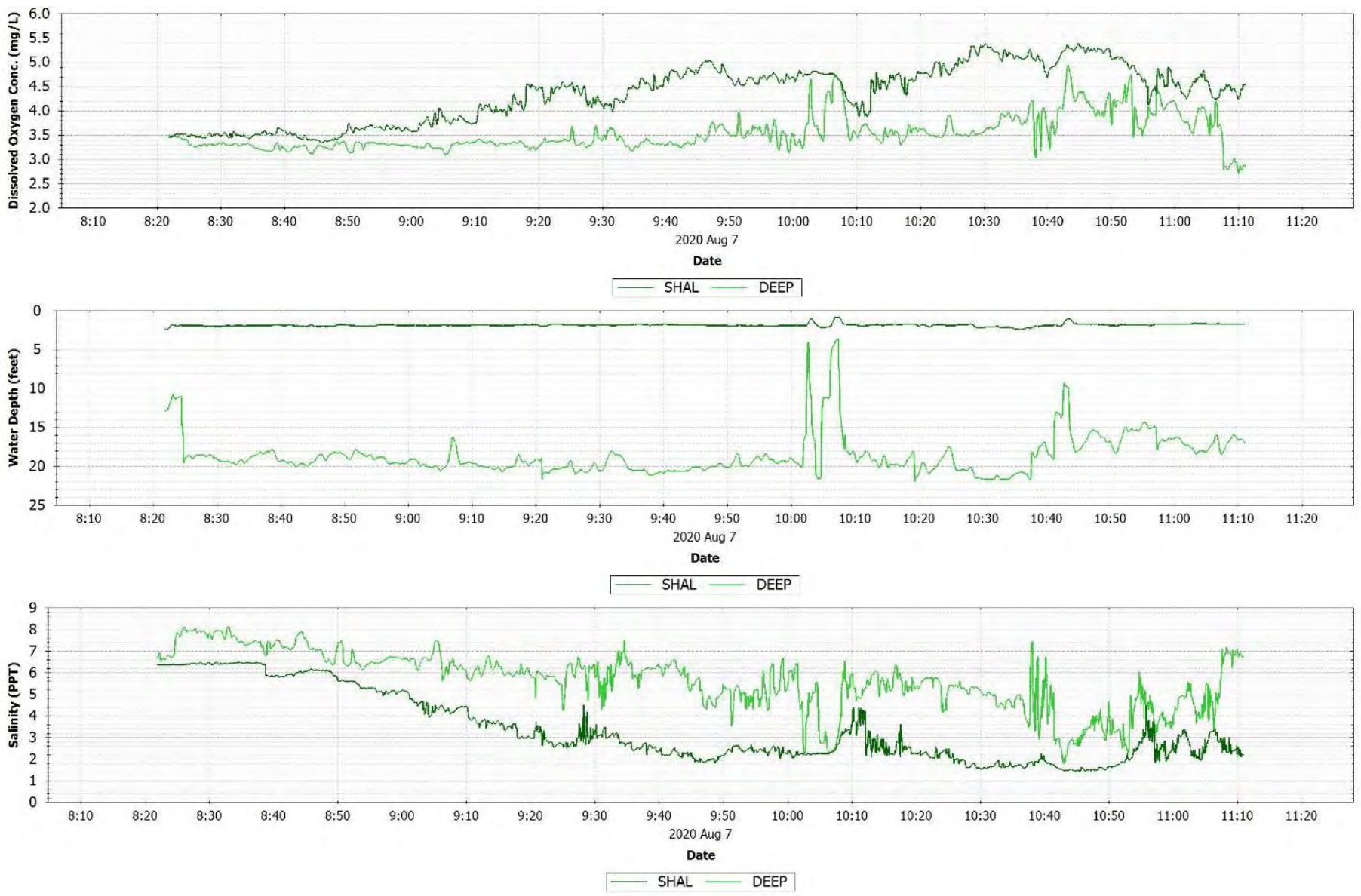


Figure C-87 Front River August 7, 2020 drift [LFR_Drift_080720_IT_D1] location map



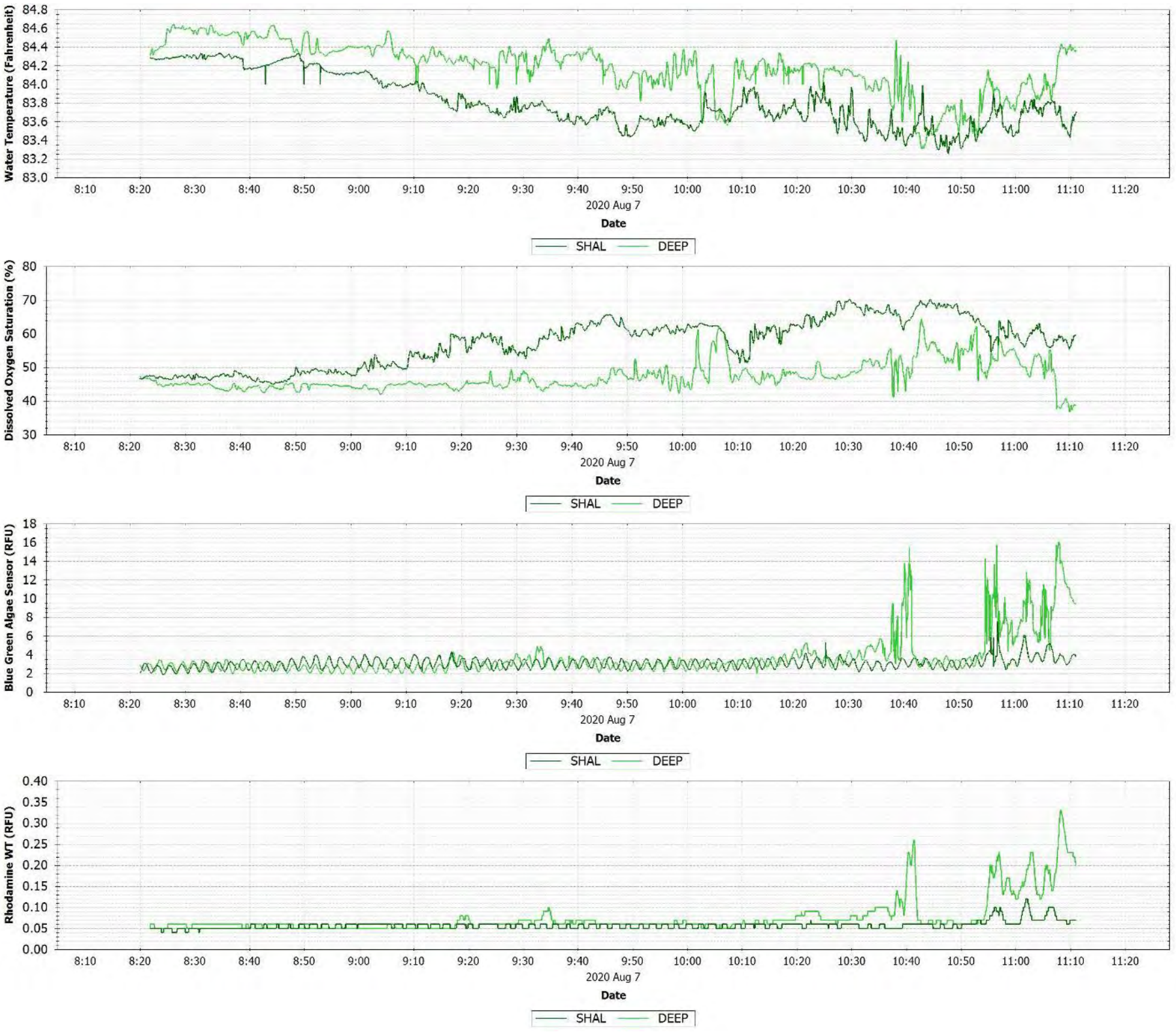


Figure C-88 Front River August 7, 2020 drift [LFR_Drift_080720_IT_D1] observations.

C.38 AUGUST 8, 2020 DRIFT FRONT RIVER

Detailed surface drift, around the diffuser, occurred during incoming tide, high tide occurred at approximately 1245.



Figure C-89 Front River August 8, 2020 drift [LFR_Drift_080820_IT_D1] location map



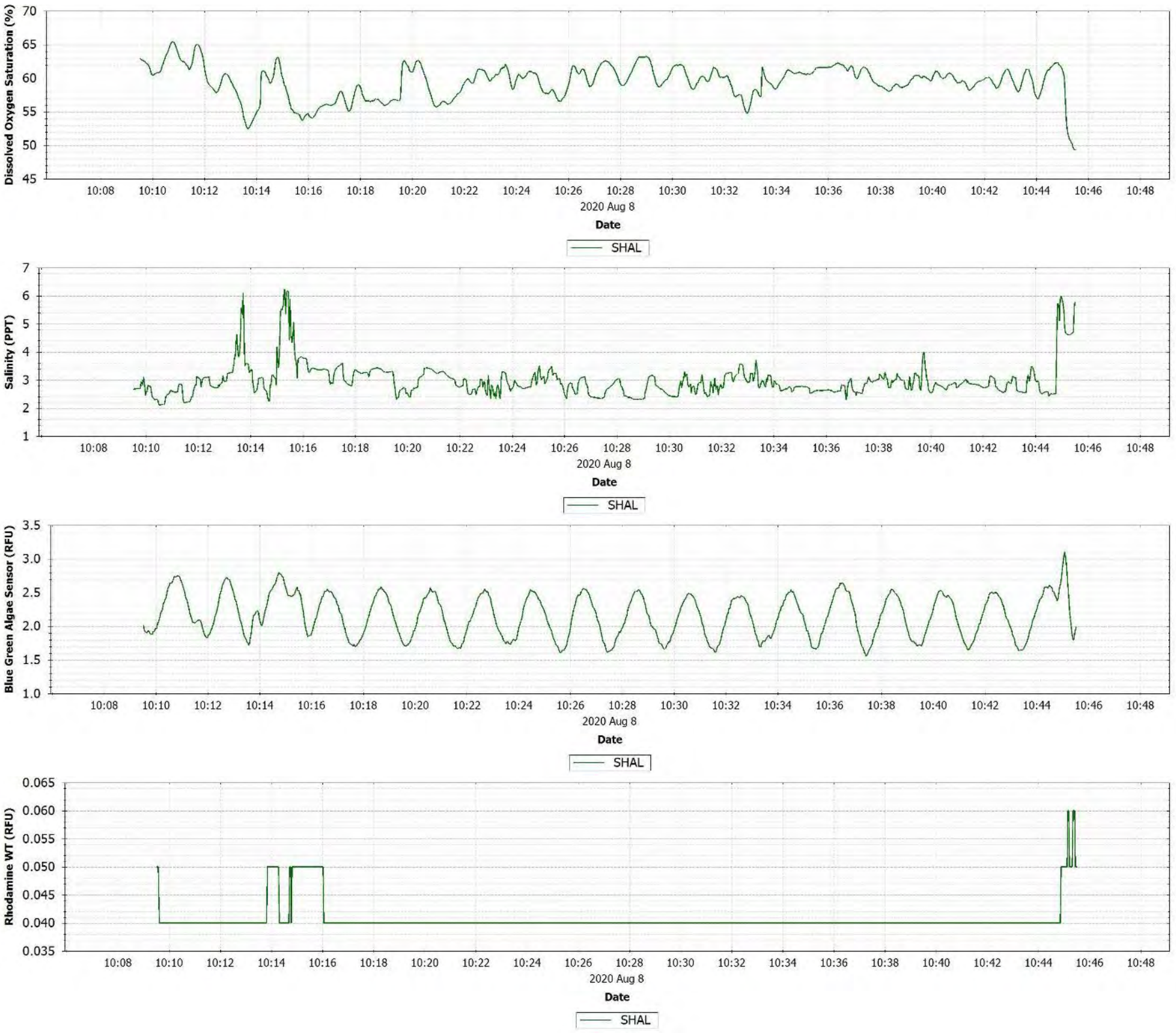


Figure C-90 Front River August 8, 2020 drift [LFR_Drift_080820_IT_D1] observations.

C.39 AUGUST 11, 2020 DYE INJECTION DRIFT FRONT RIVER

Two surface drift occurred during low slack tide transitioning to incoming tide, low tide occurred at approximately 0852. Dye was measured around the diffuser and then downstream near the west bank. More description available in main report.

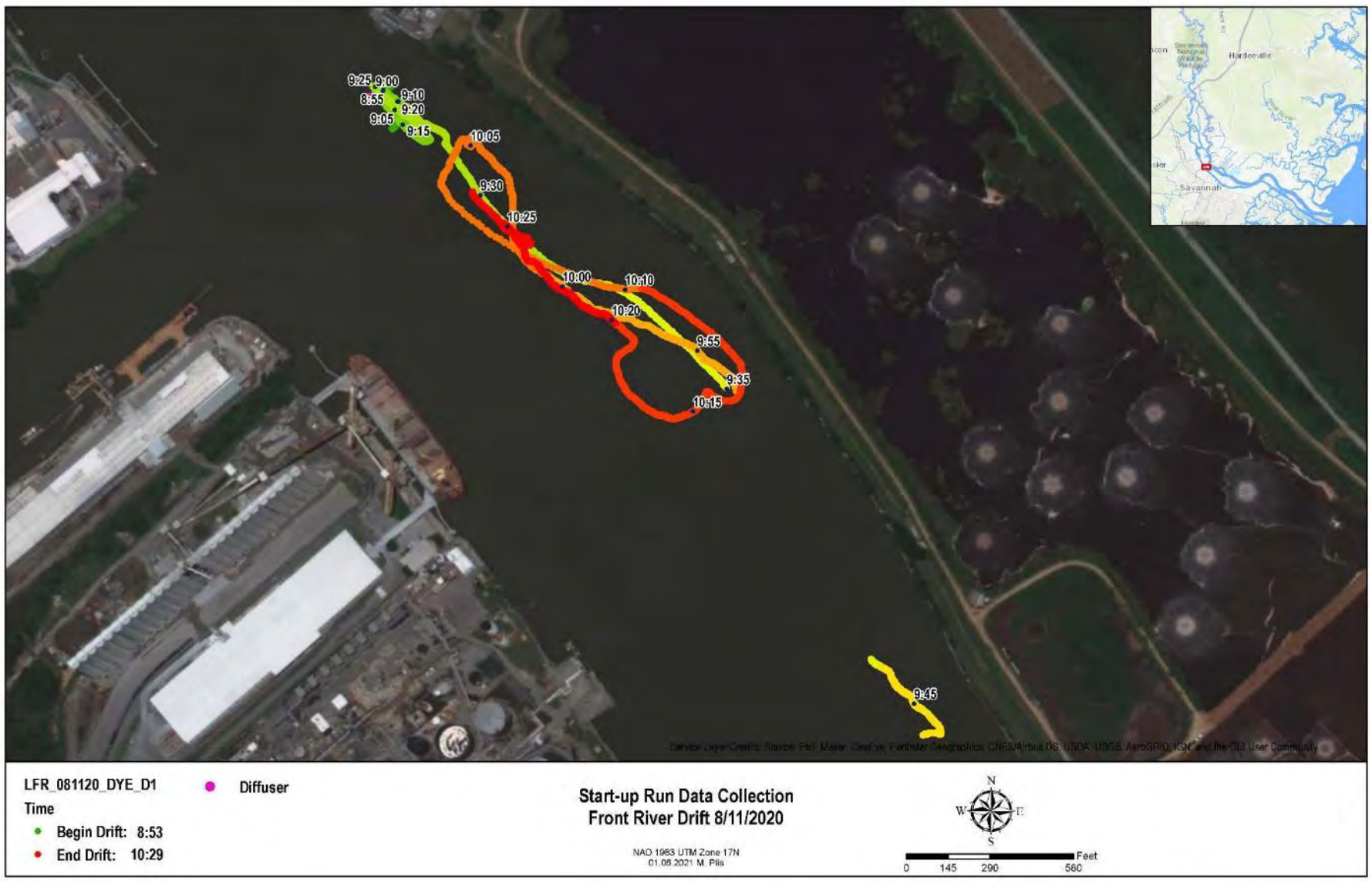
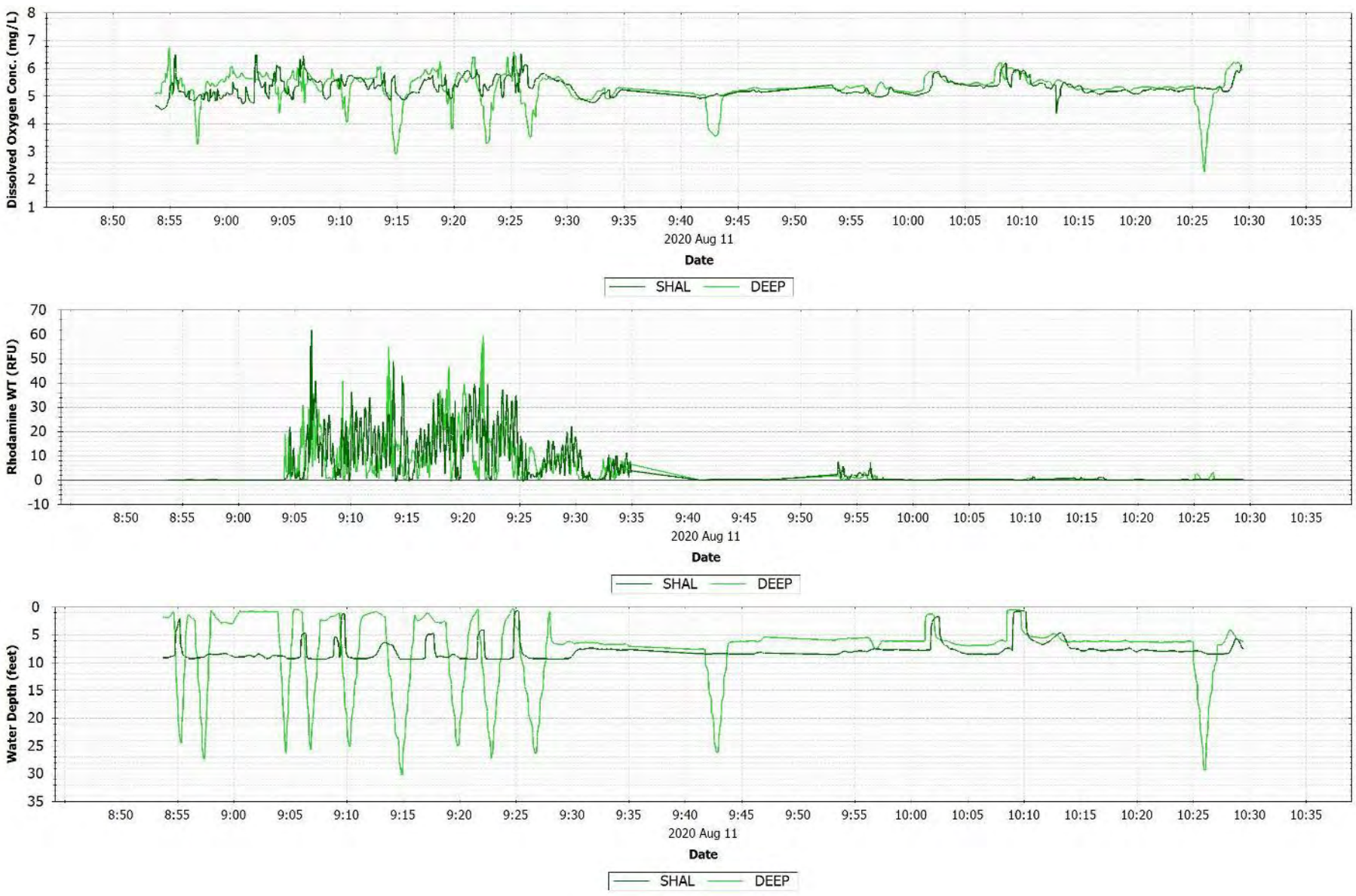


Figure C-91 Front River August 11, 2020 dye injection drift 1 [LFR_Drift_081120_DYE_D1] location map



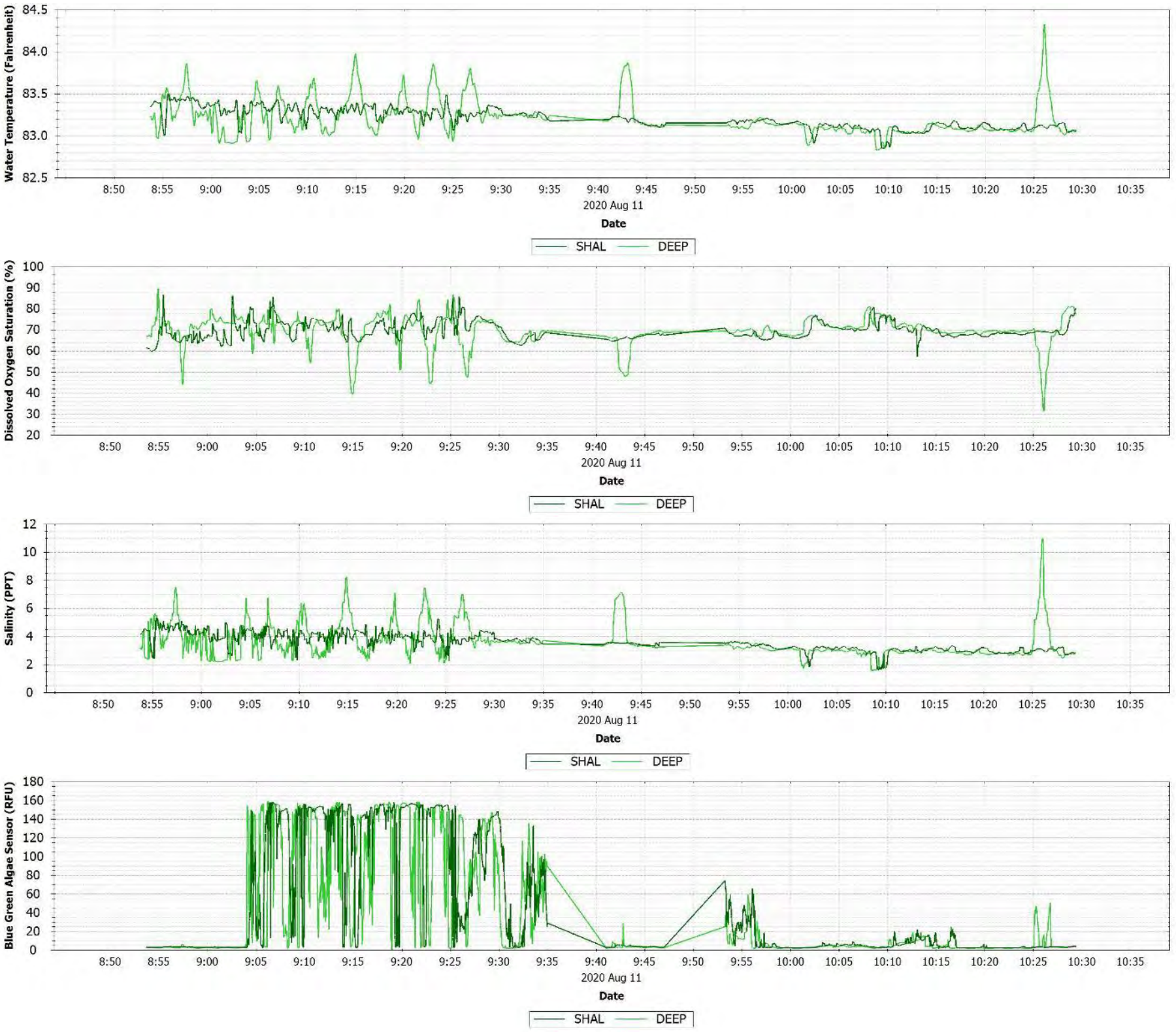


Figure C-92 Front River August 11, 2020 dye injection drift 1 [LFR_Drift_081120_DYE_D1] observations.

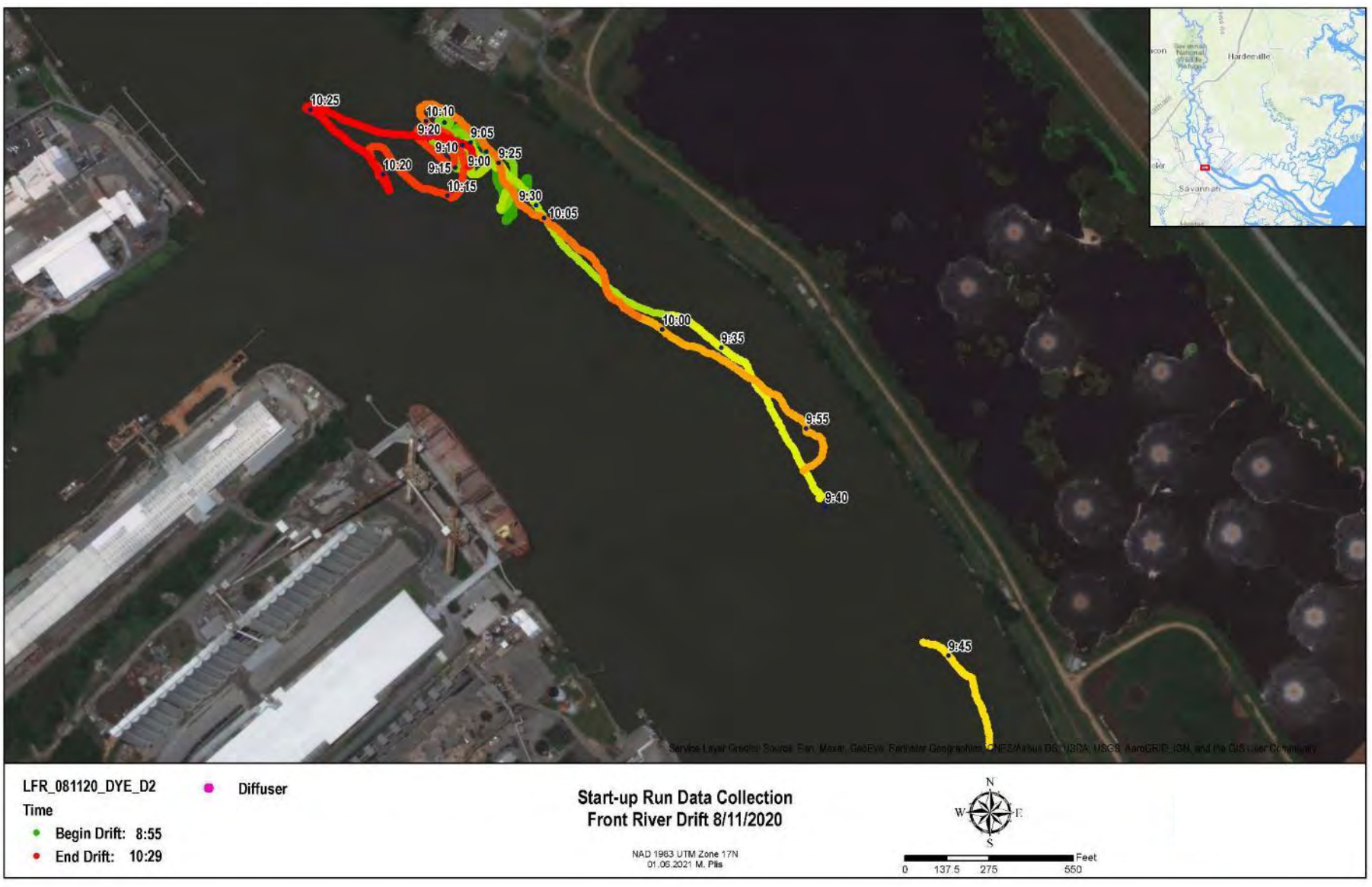


Figure C-93 Front River August 11, 2020 dye injection drift 2 [LFR_Drift_081120_DYE_D2] location map

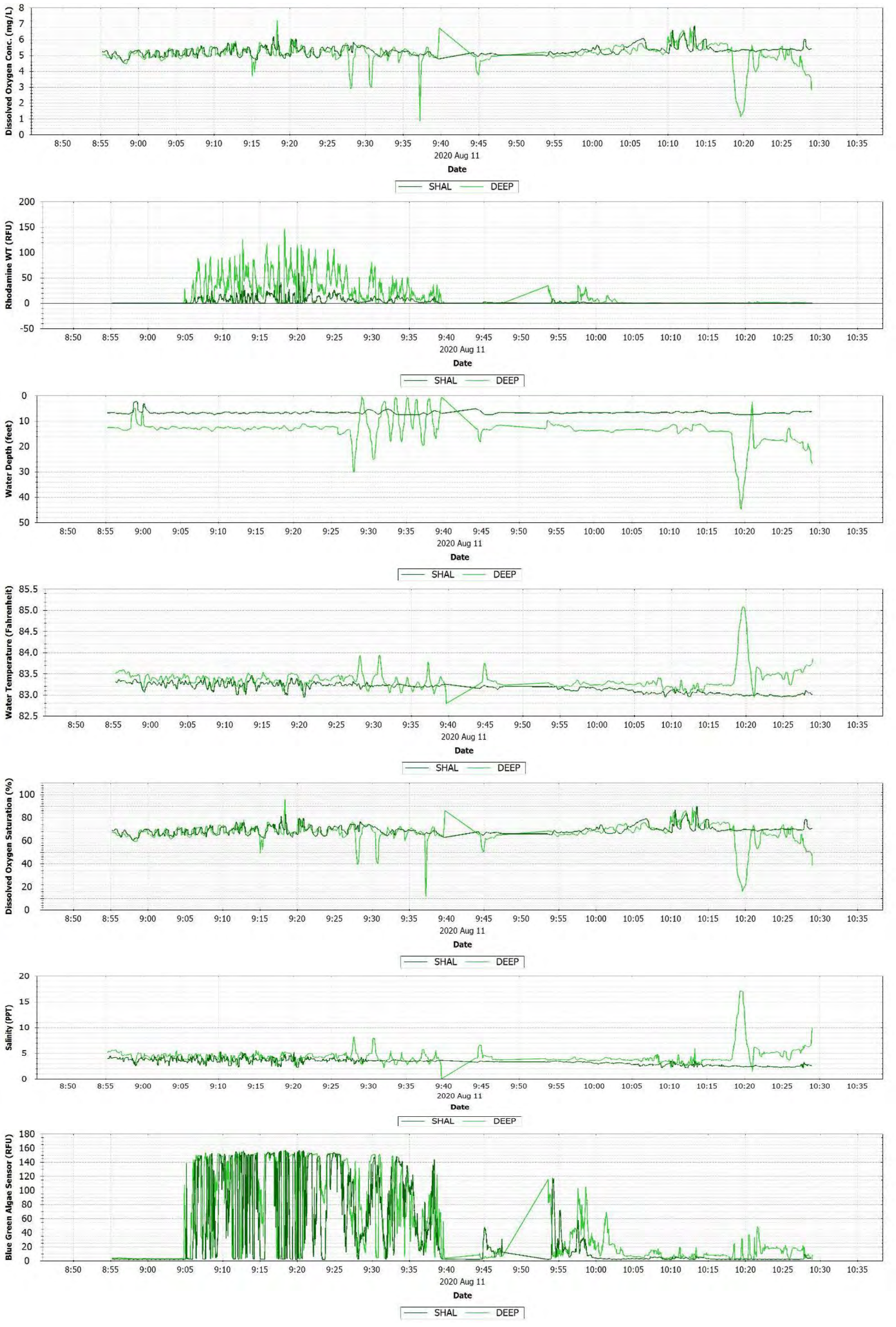


Figure C-94 Front River August 11, 2020 dye injection drift 2 [LFR_Drift_081120_DYE_D2] observations.

C.40 AUGUST 14, 2020 DRIFT FRONT RIVER

Detailed surface diffuser profiling drift occurred during outgoing tide, low tide occurred at approximately 1131.

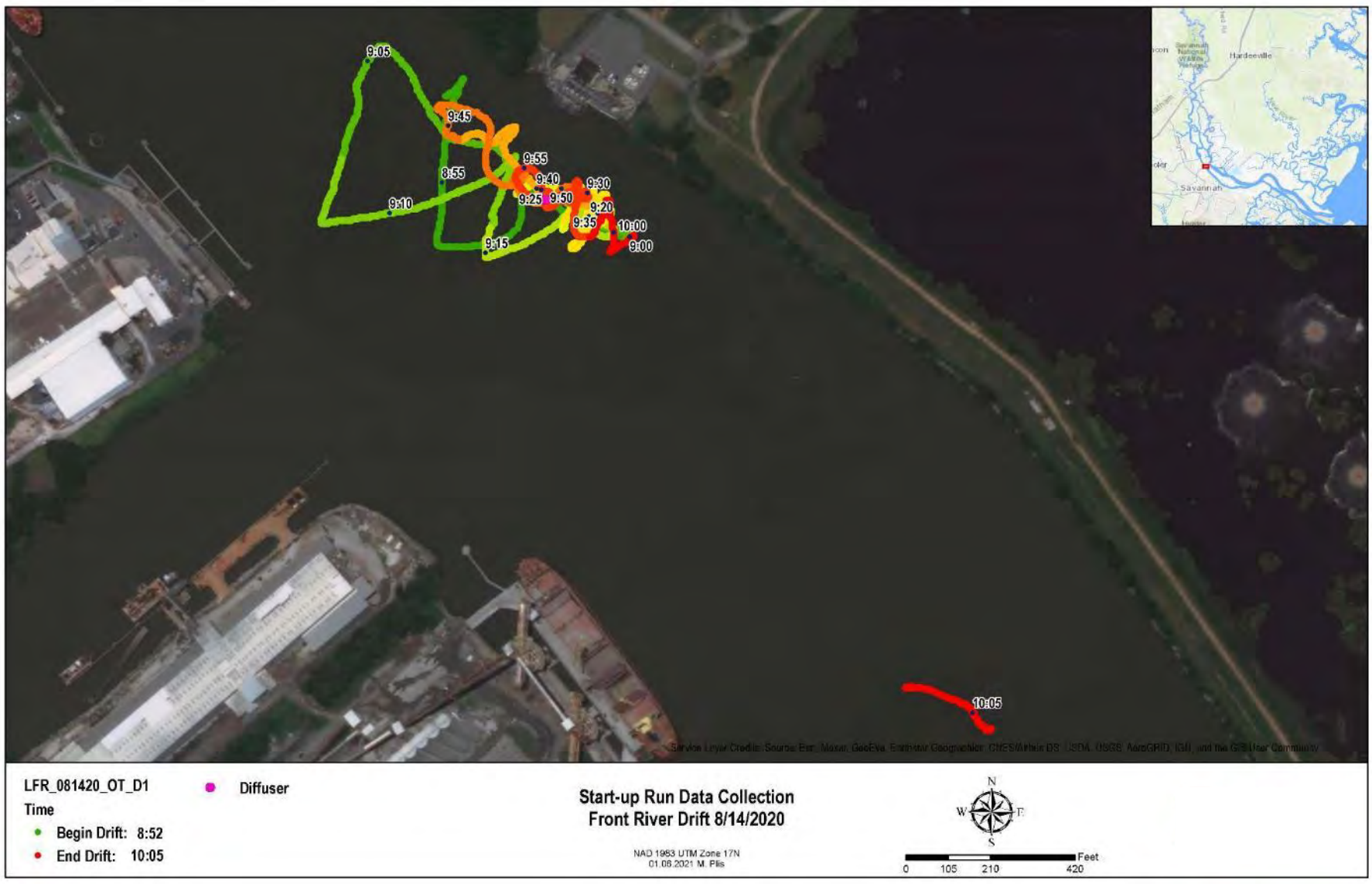


Figure C-95 Front River August 14, 2020 drift [LFR_Drift_081420_OT_D1] location map

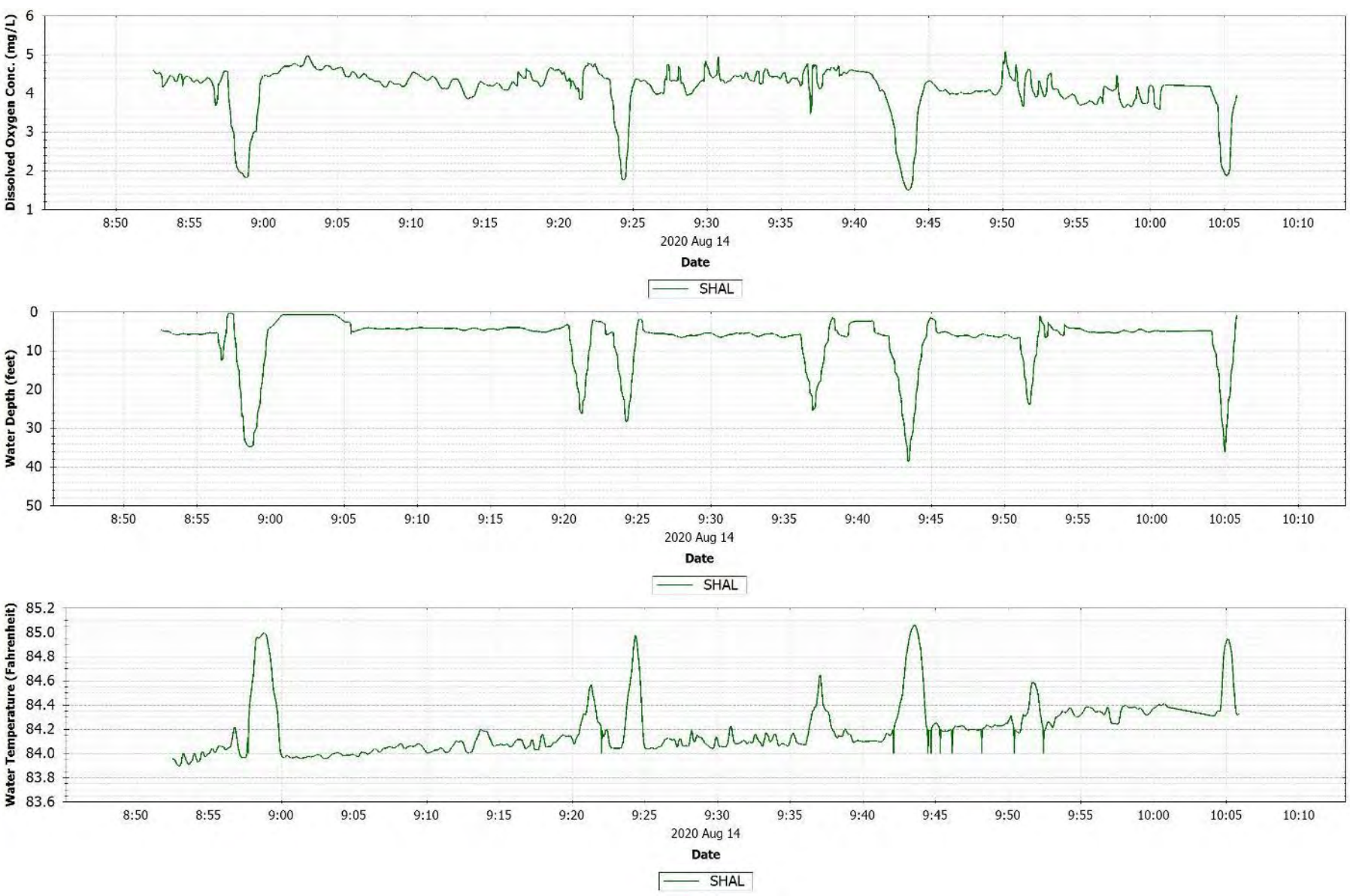




Figure C-96 Front River August 14, 2020 drift [LFR_Drift_081420_OT_D1] observations.

C.41 AUGUST 17, 2020 DRIFT FRONT RIVER

Two sonde detailed diffuser drift occurred during outgoing tide, high tide occurred at approximately 0754. The sonde appears to intersect the plume several times during the data collection and at 1008 the deep sonde entered the fluffy silt bottom layer.

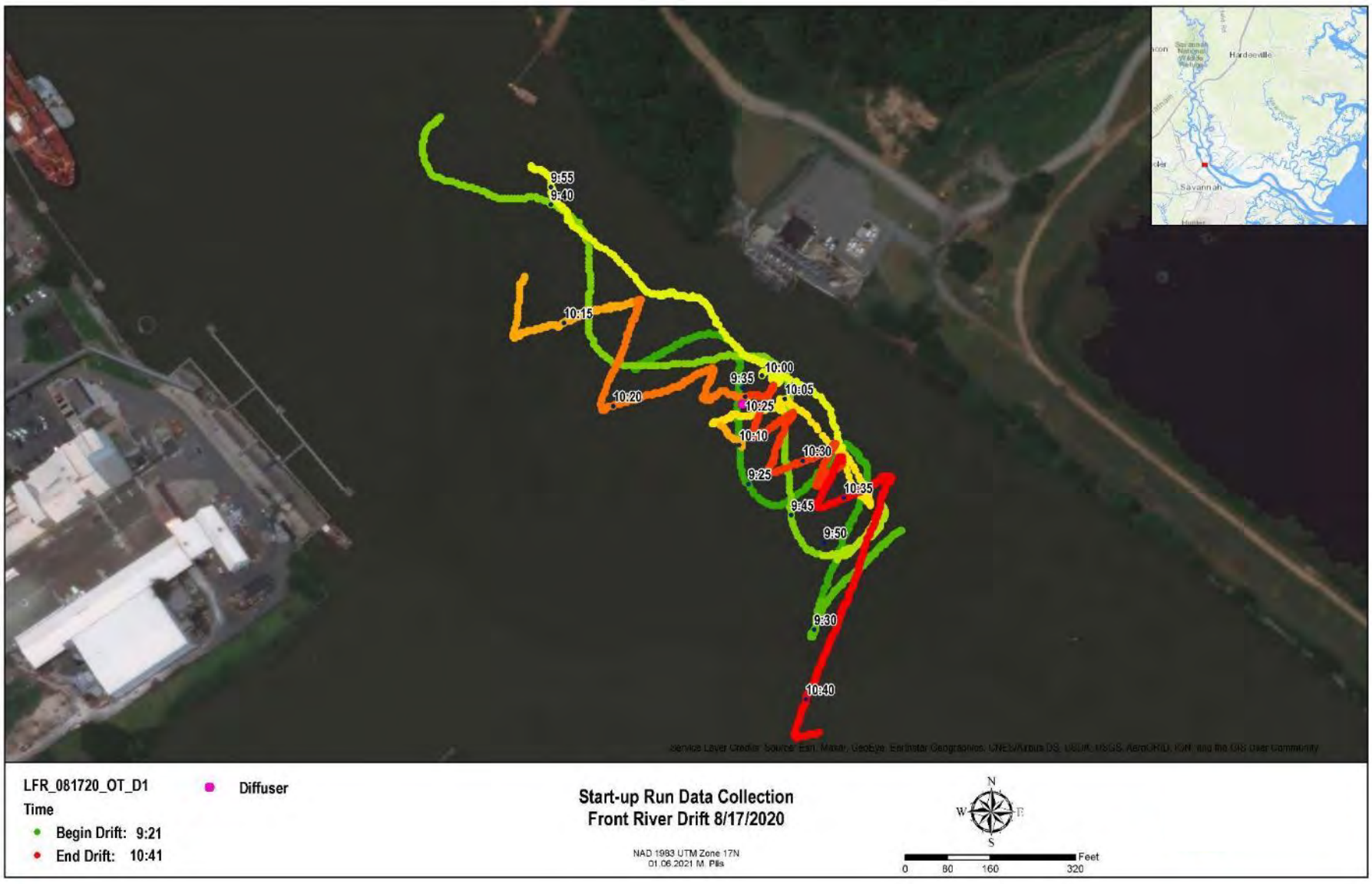
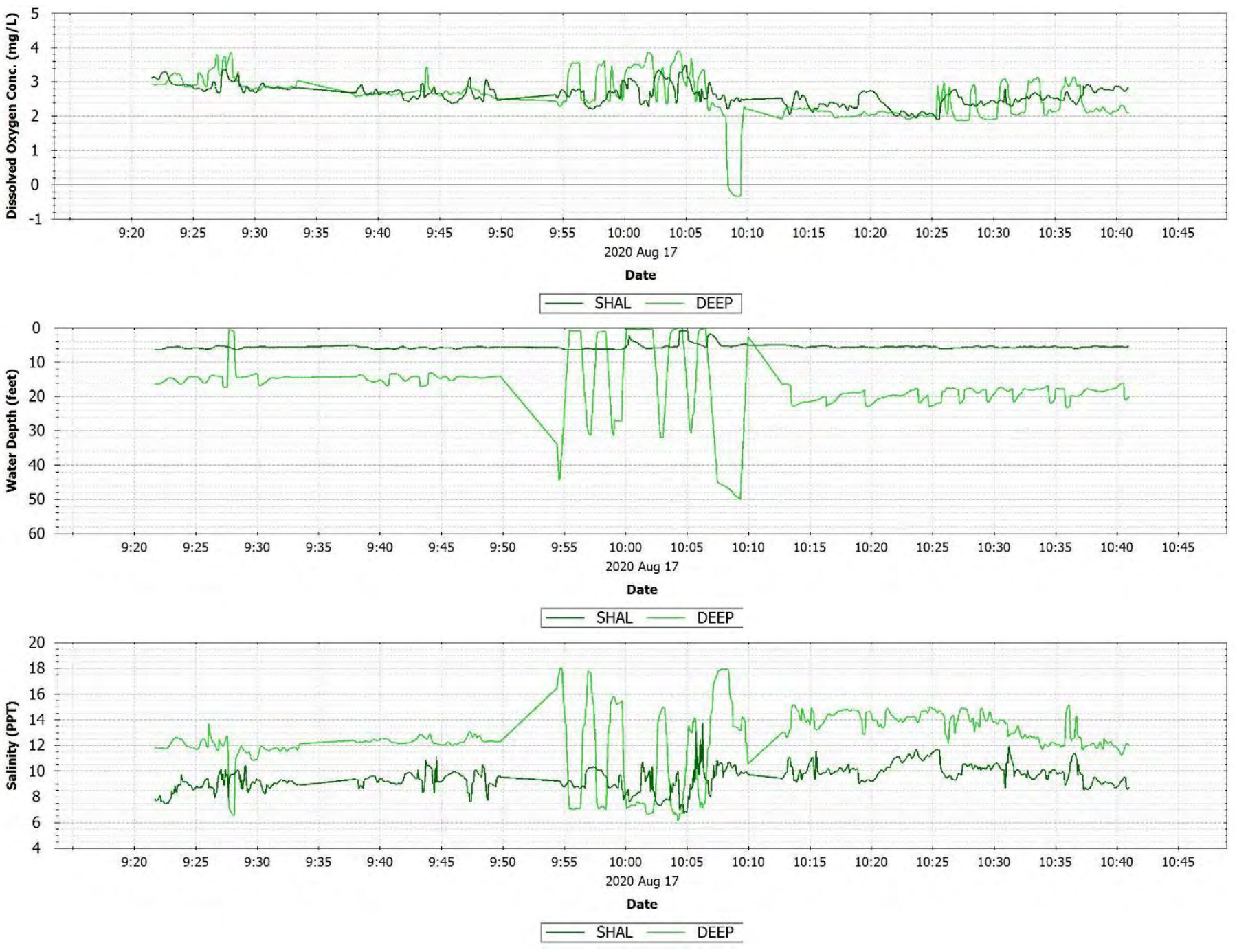


Figure C-97 Front River August 17, 2020 drift [LFR_Drift_081720_OT_D1] location map



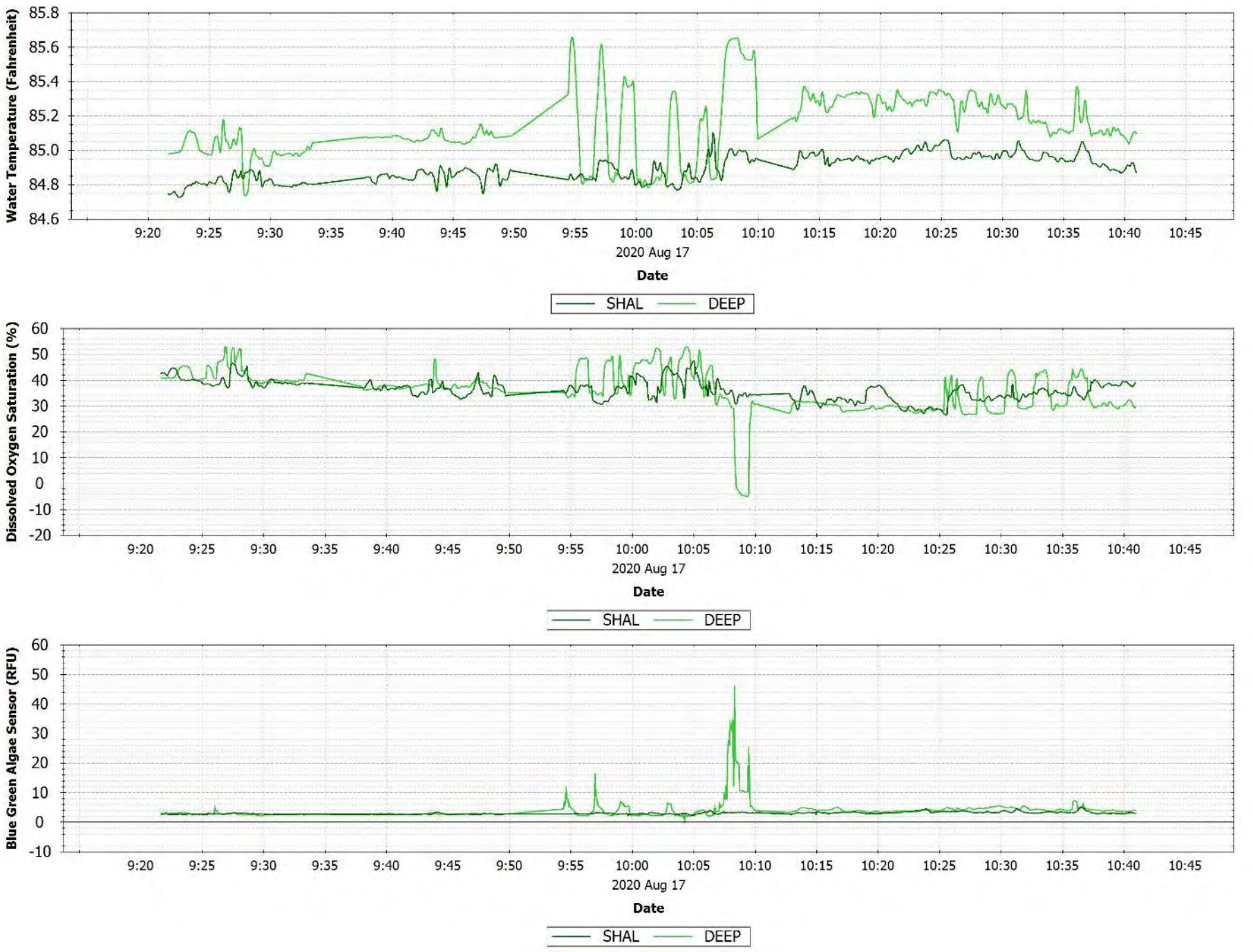


Figure C-98 Front River August 17, 2020 drift [LFR_Drift_081720_OT_D1] observations.

C.42 AUGUST 21, 2020 DRIFT FRONT RIVER

Detailed diffuser drift, with profiling, occurred during incoming tide, low tide occurred at approximately 0513.

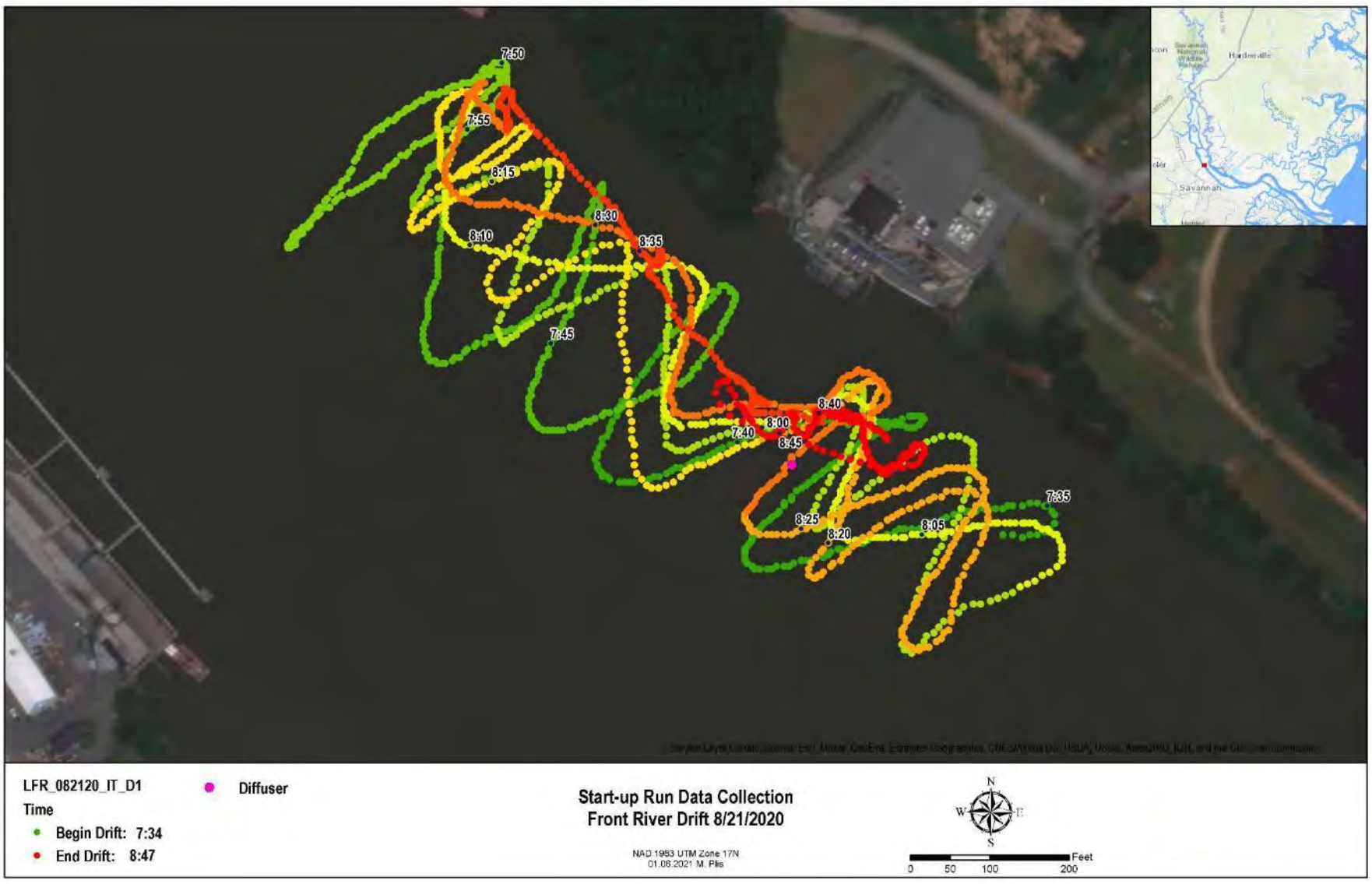
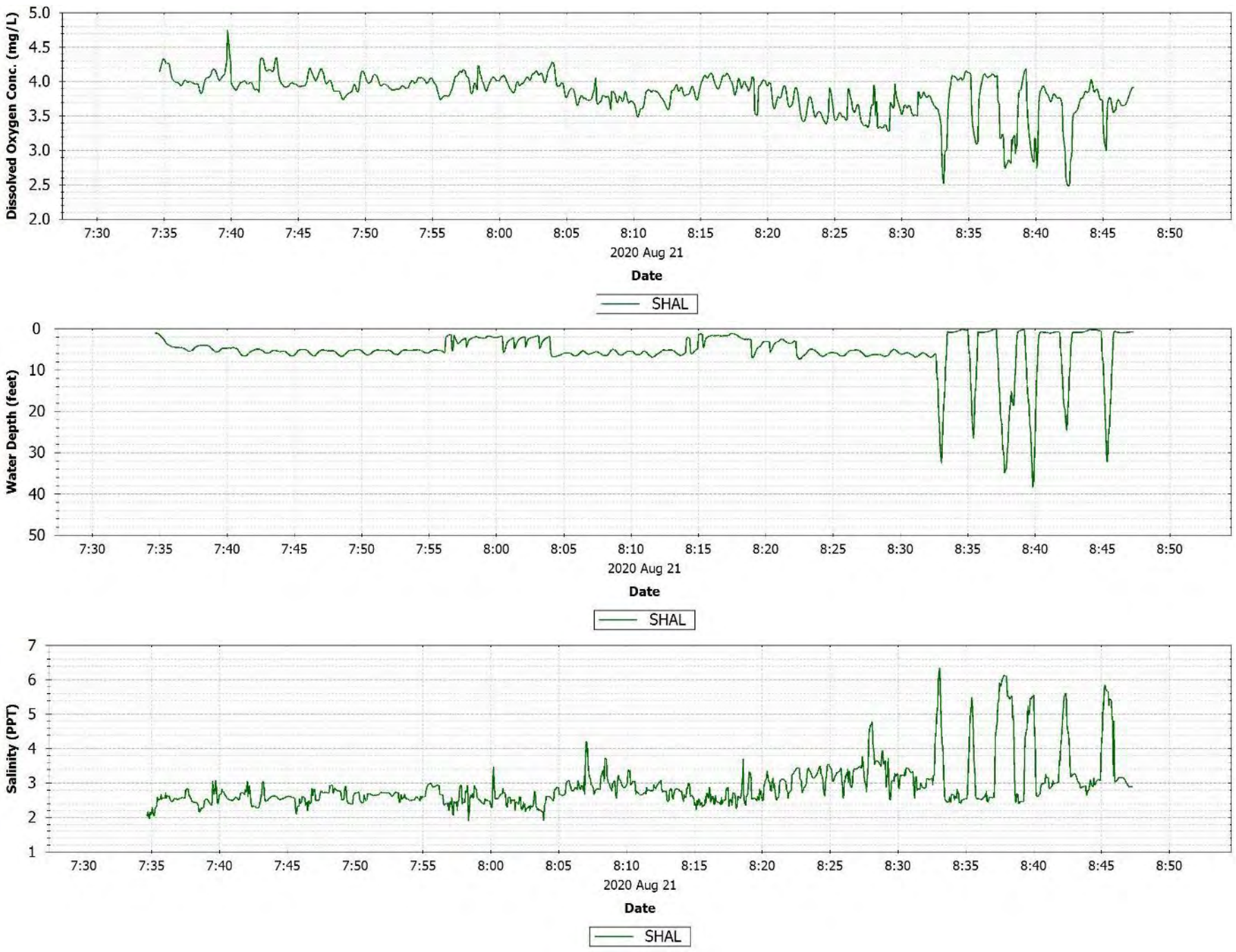


Figure C-99 Front River August 21, 2020 drift [LFR_Drift_082120_IT_D1] location map



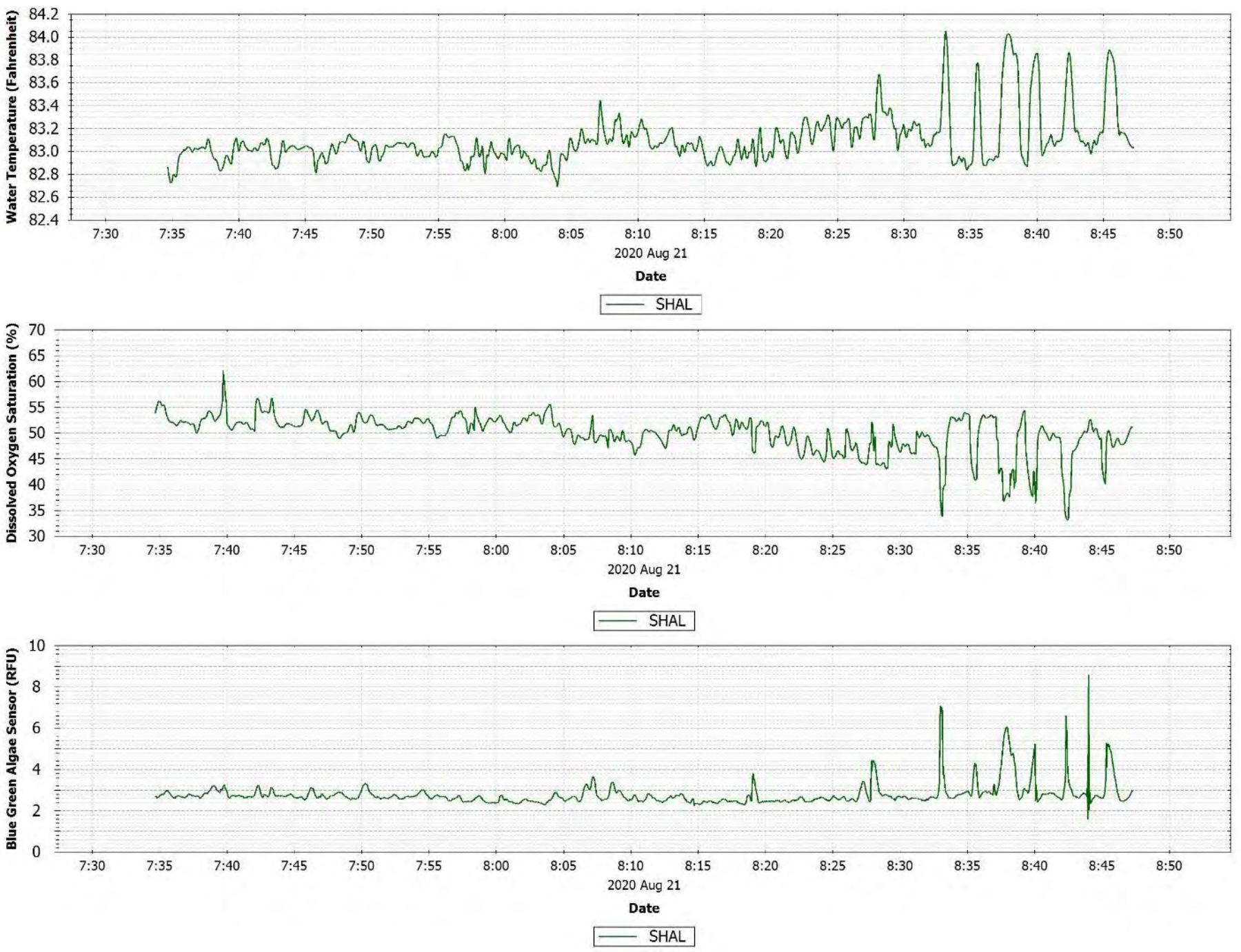


Figure C-100 Front River August 21, 2020 drift [LFR_Drift_082120_IT_D1] observations.

C.43 AUGUST 24, 2020 DRIFT FRONT RIVER

Drift, with channel profiling, occurred during incoming tide, low tide occurred at approximately 0741.

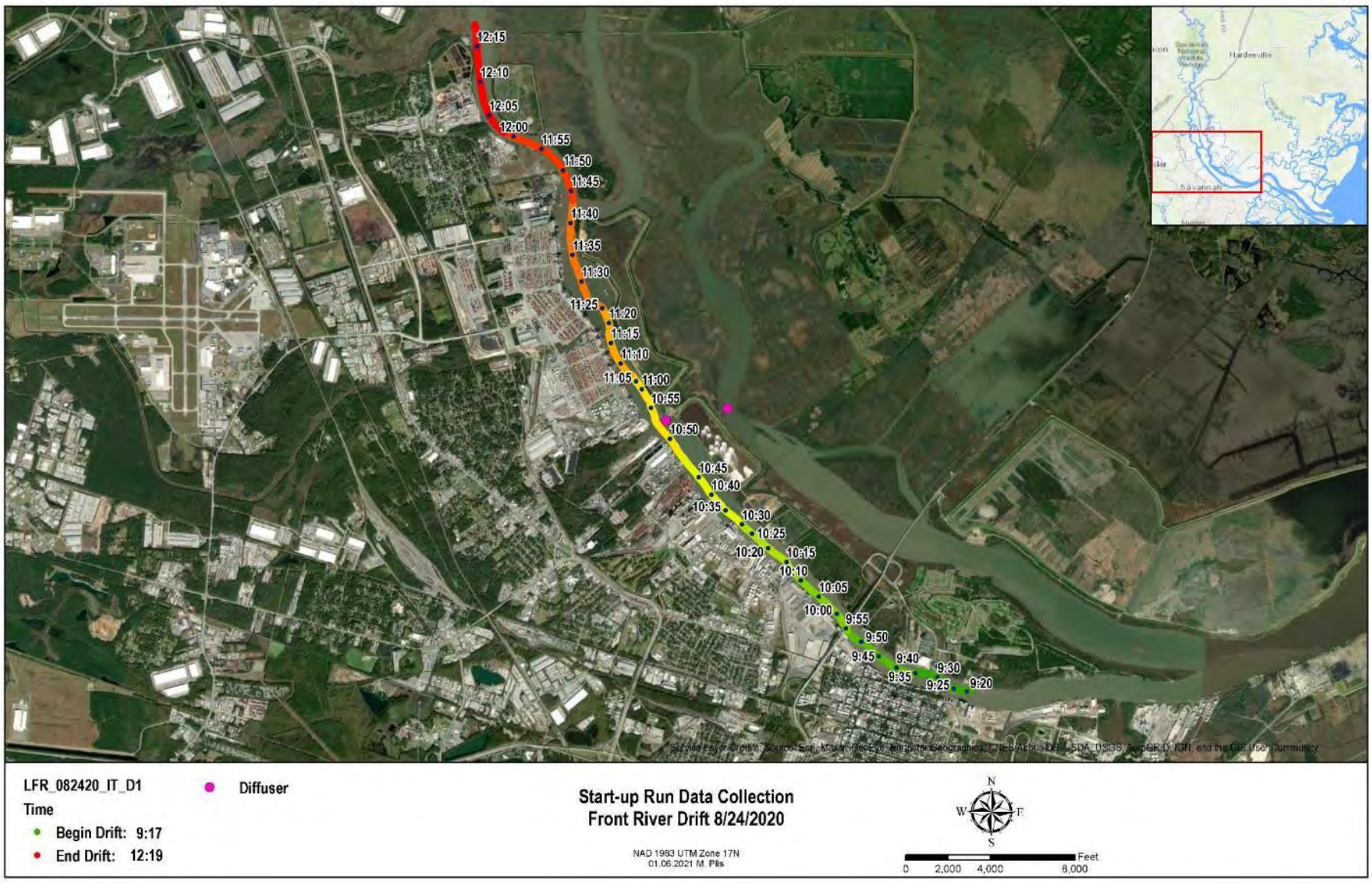
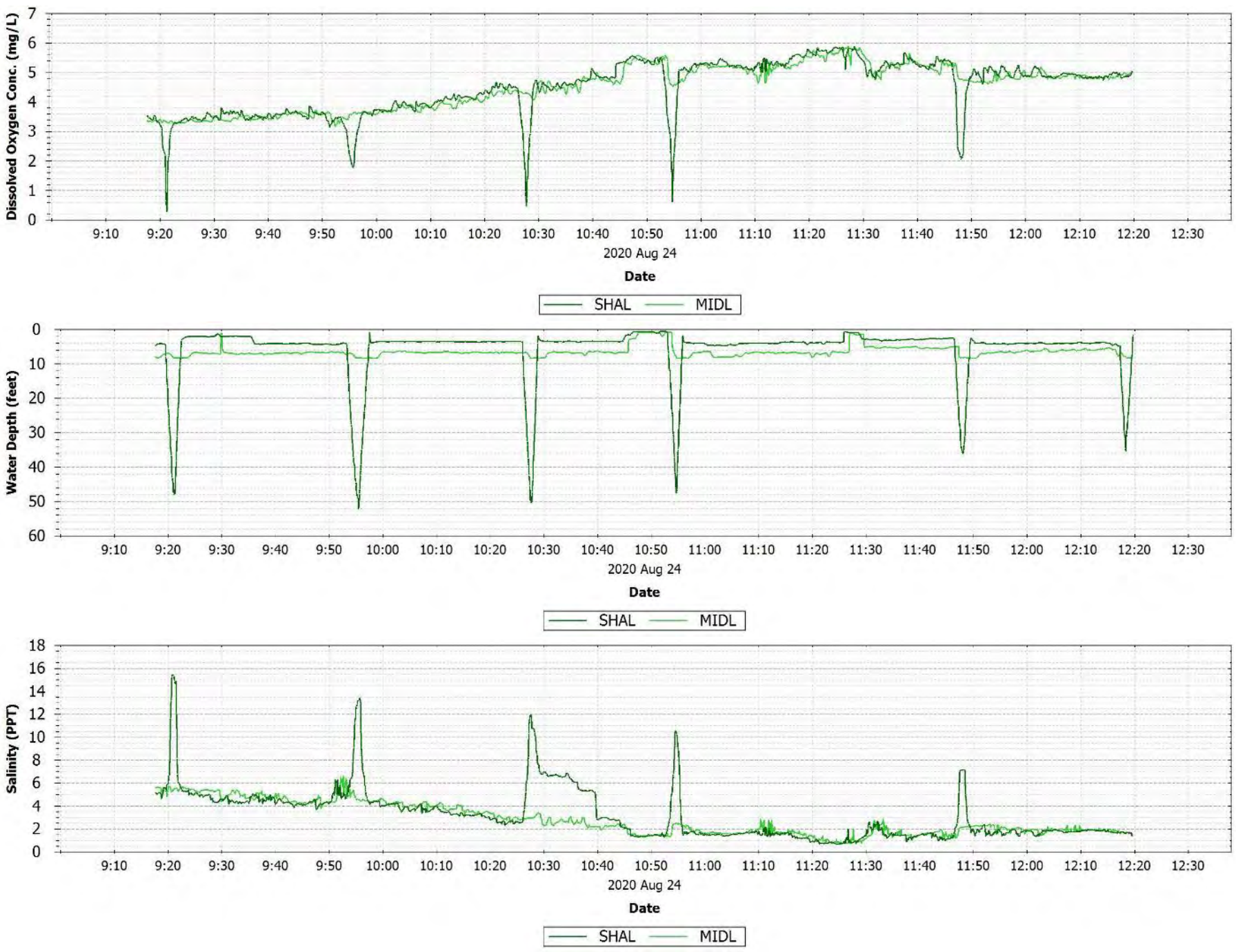


Figure C-101 Front River August 24, 2020 drift [LFR_Drift_082420_IT_D1] location map



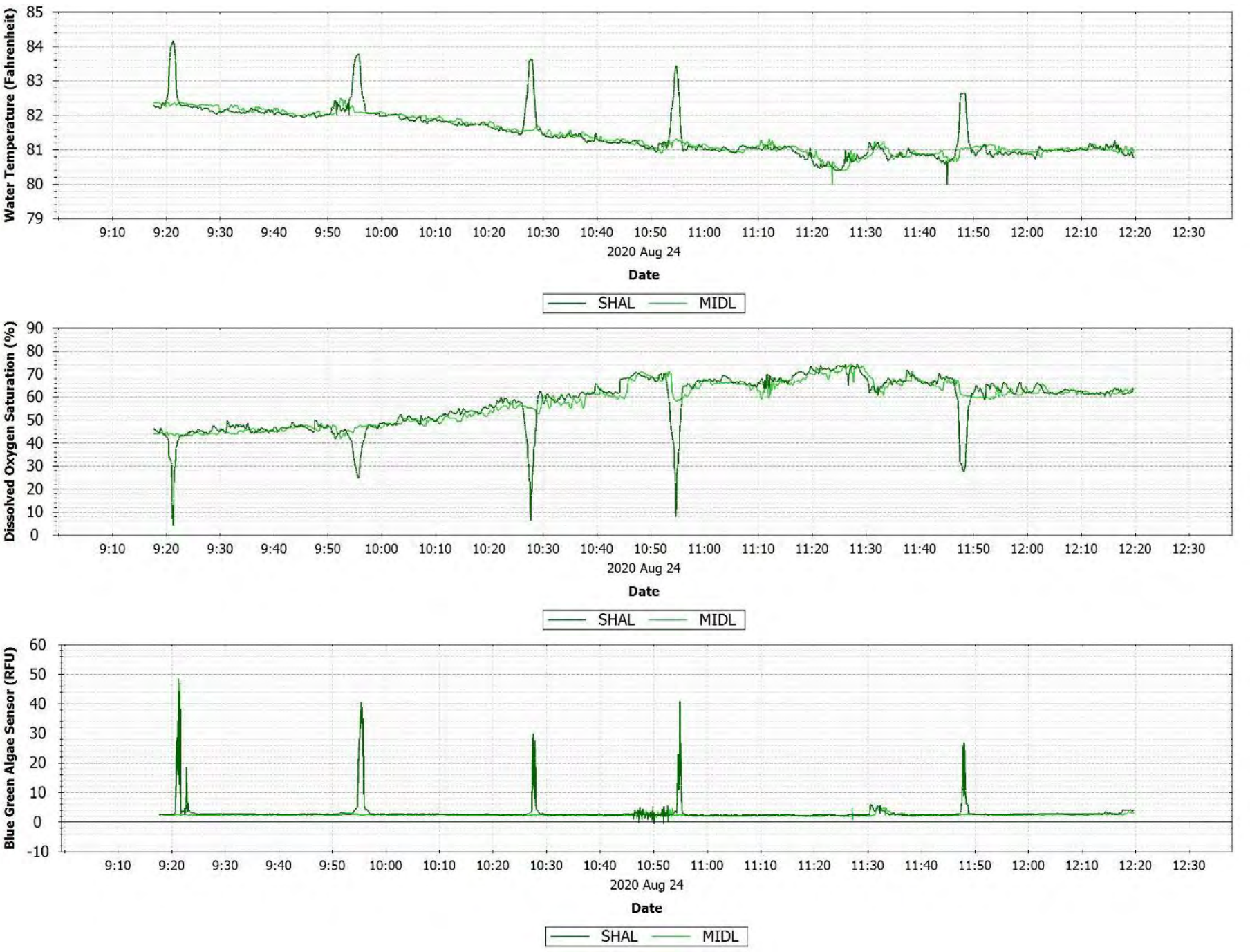


Figure C-102 Front River August 24, 2020 drift [LFR_Drift_082420_IT_D1] observations.

C.44 AUGUST 25, 2020 DYE INJECTION DRIFT FRONT RIVER

Dye drift with profiling occurred during low slack tide transitioning to incoming tide, low tide occurred at approximately 0836. Dye and therefore the oxygen plum, stayed mostly at the lower depths. The intense depth profiling was done to locate the dye in the lower layer. The dye seemed to hug the west bank.



Figure C-103 Front River August 25, 2020 Dye Profile



Figure C-104 Front River August 25, 2020 dye injection drift [LFR_Drift_082520_DYE_D1] location map

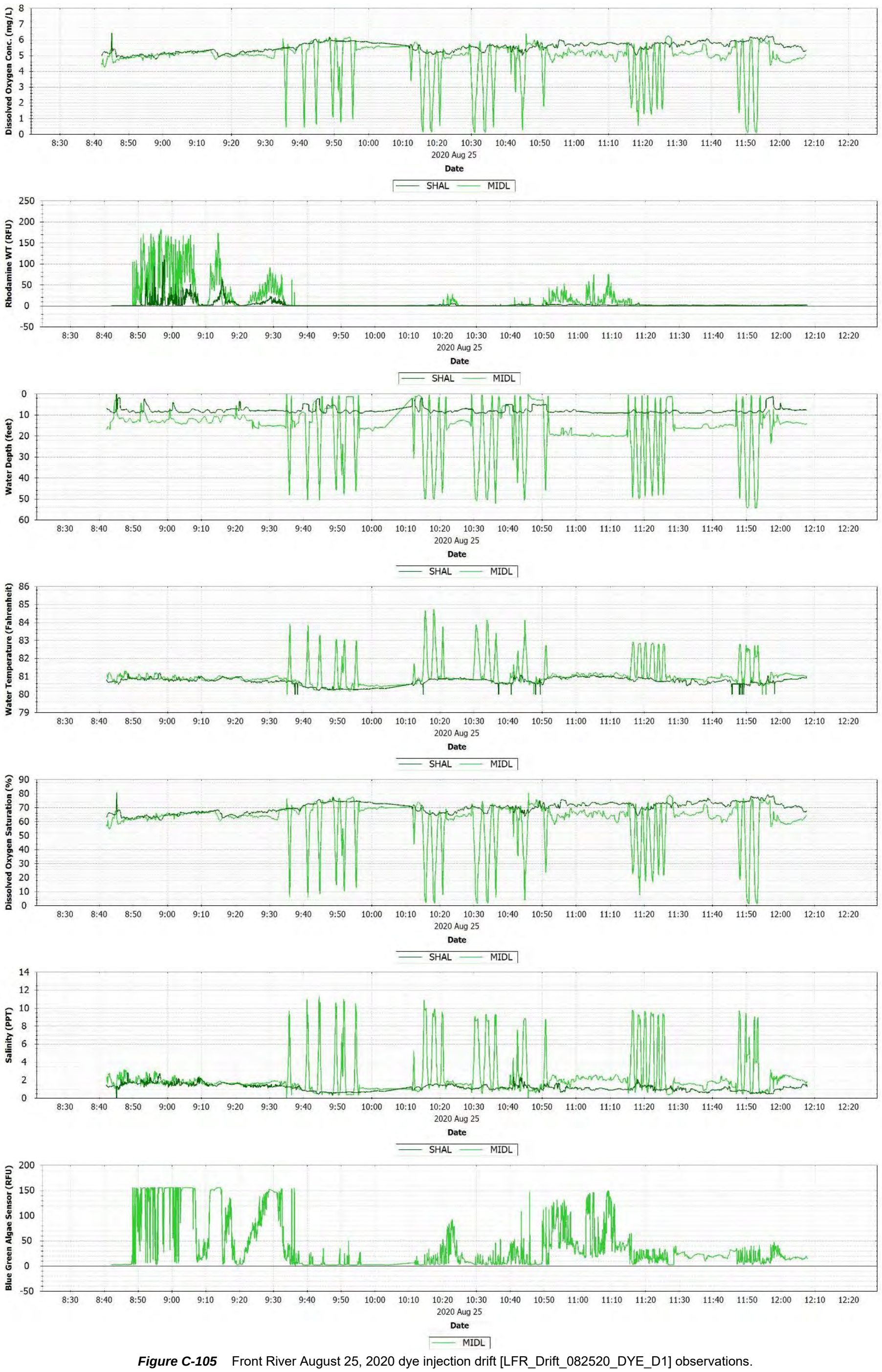


Figure C-105 Front River August 25, 2020 dye injection drift [LFR_Drift_082520_DYE_D1] observations.

C.45 AUGUST 26, 2020 DRIFT FRONT RIVER

Drift occurred during incoming tide, low tide occurred at approximately 0935. Dye was present all through the water column, with the high concentrations in the lower layers.

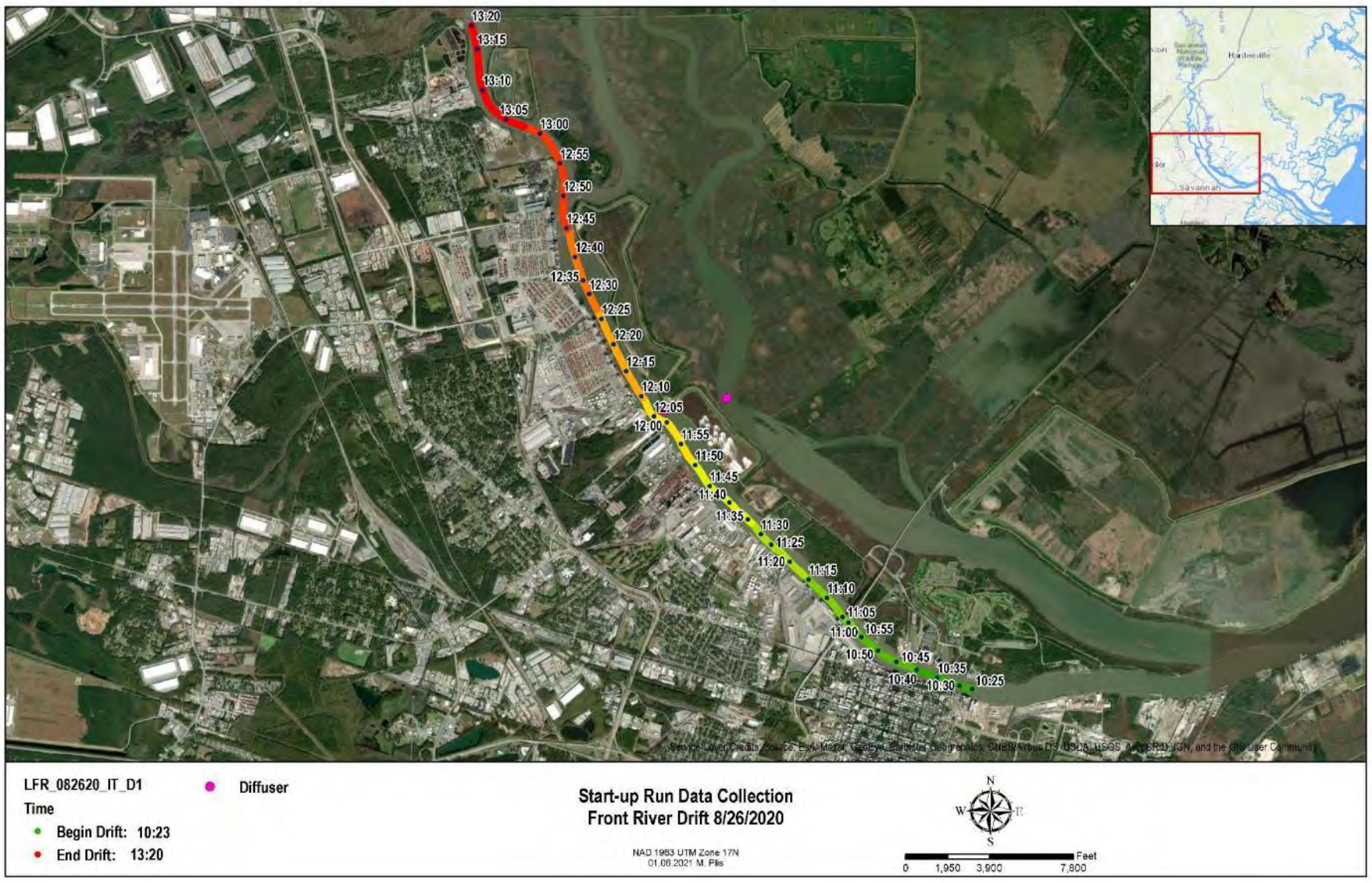
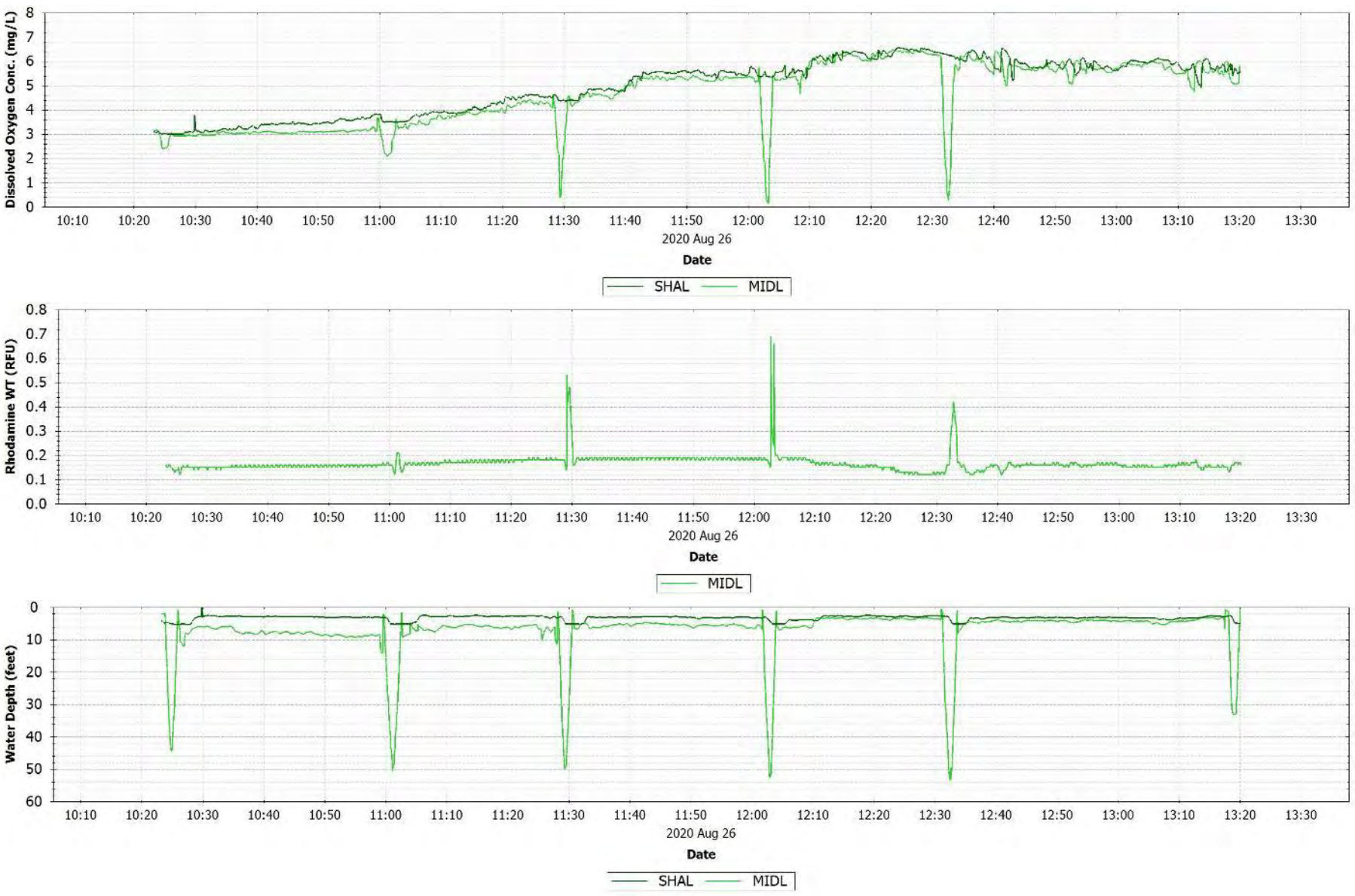


Figure C-106 Front River August 26, 2020 drift [LFR_Drift_082620_IT_D1] location map



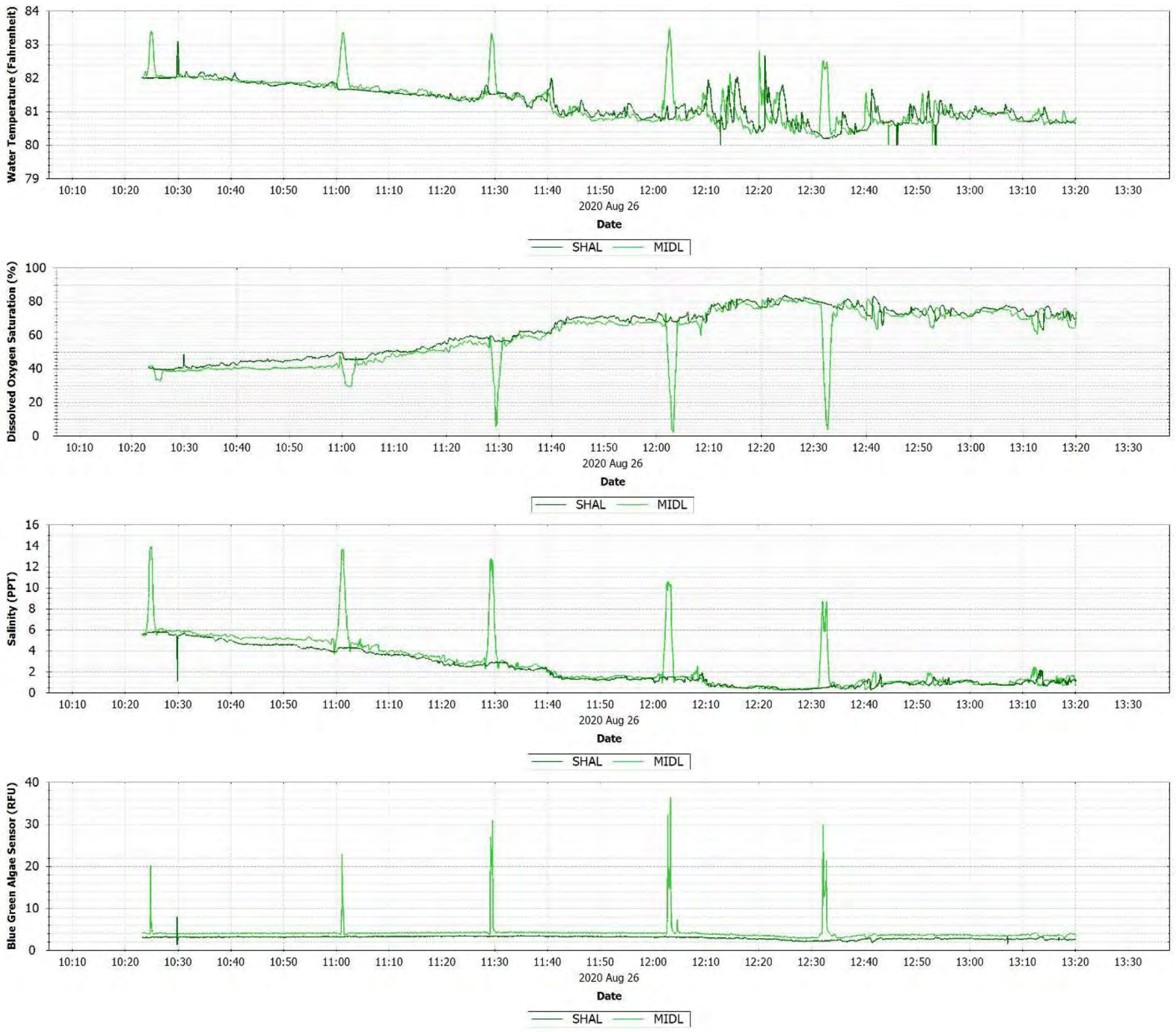


Figure C-107 Front River August 26, 2020 drift [LFR_Drift_082620_IT_D1] observations.

C.46 AUGUST 27, 2020 DRIFT FRONT RIVER

Two drifts occurred during low slack tide transitioning to incoming tide, low tide occurred at approximately 1035. Dye was present all through the water column, with the high concentrations in the lower layers. Note continue monitoring of the Front River continued through September 25, 2020. This is detailed in the profiling appendix.

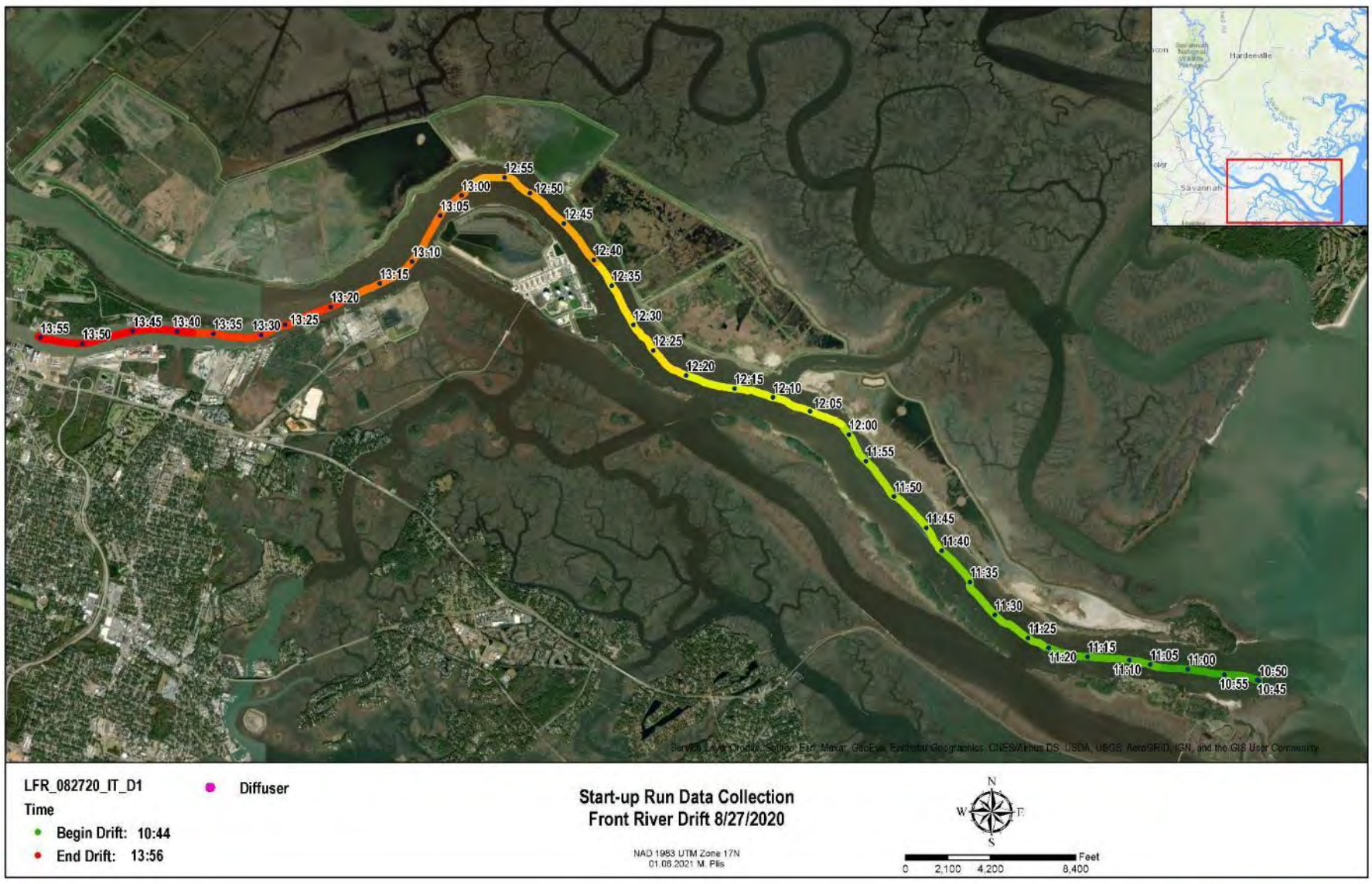
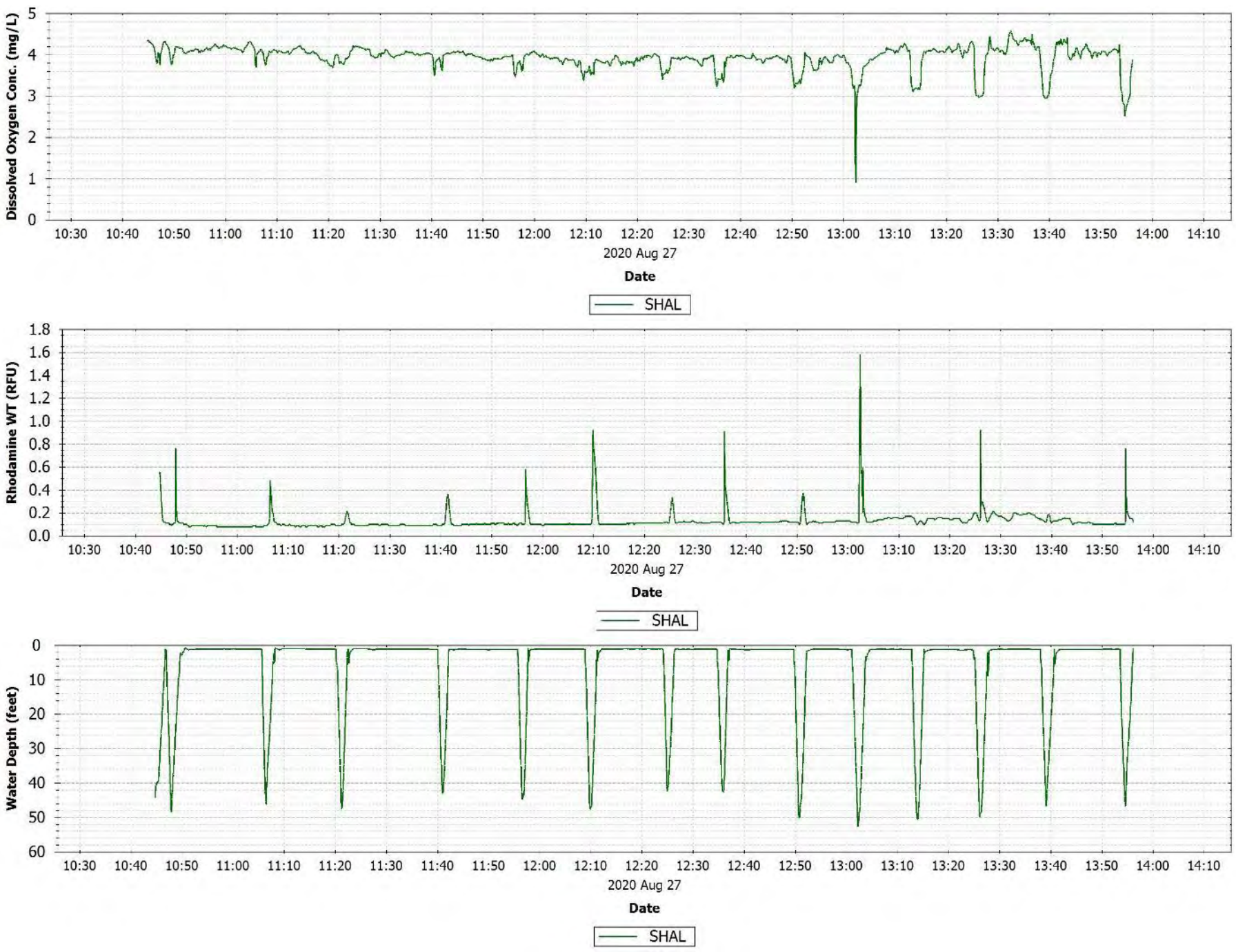


Figure C-108 Front River August 27, 2020 drift 1 [LFR_Drift_082720_IT_D1] location map



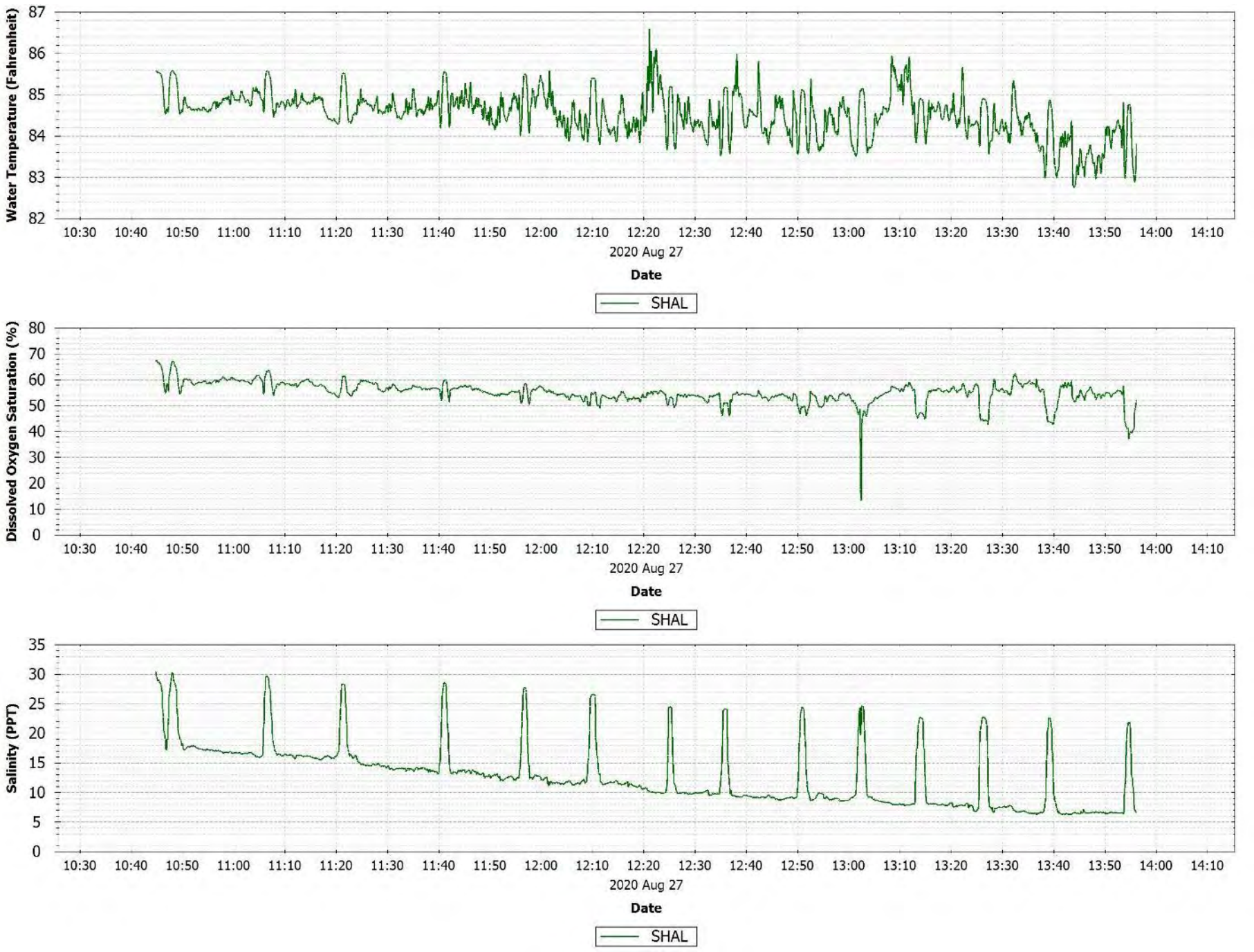


Figure C-109 Front River August 27, 2020 drift 1 [LFR_Drift_082720_IT_D1] observations.

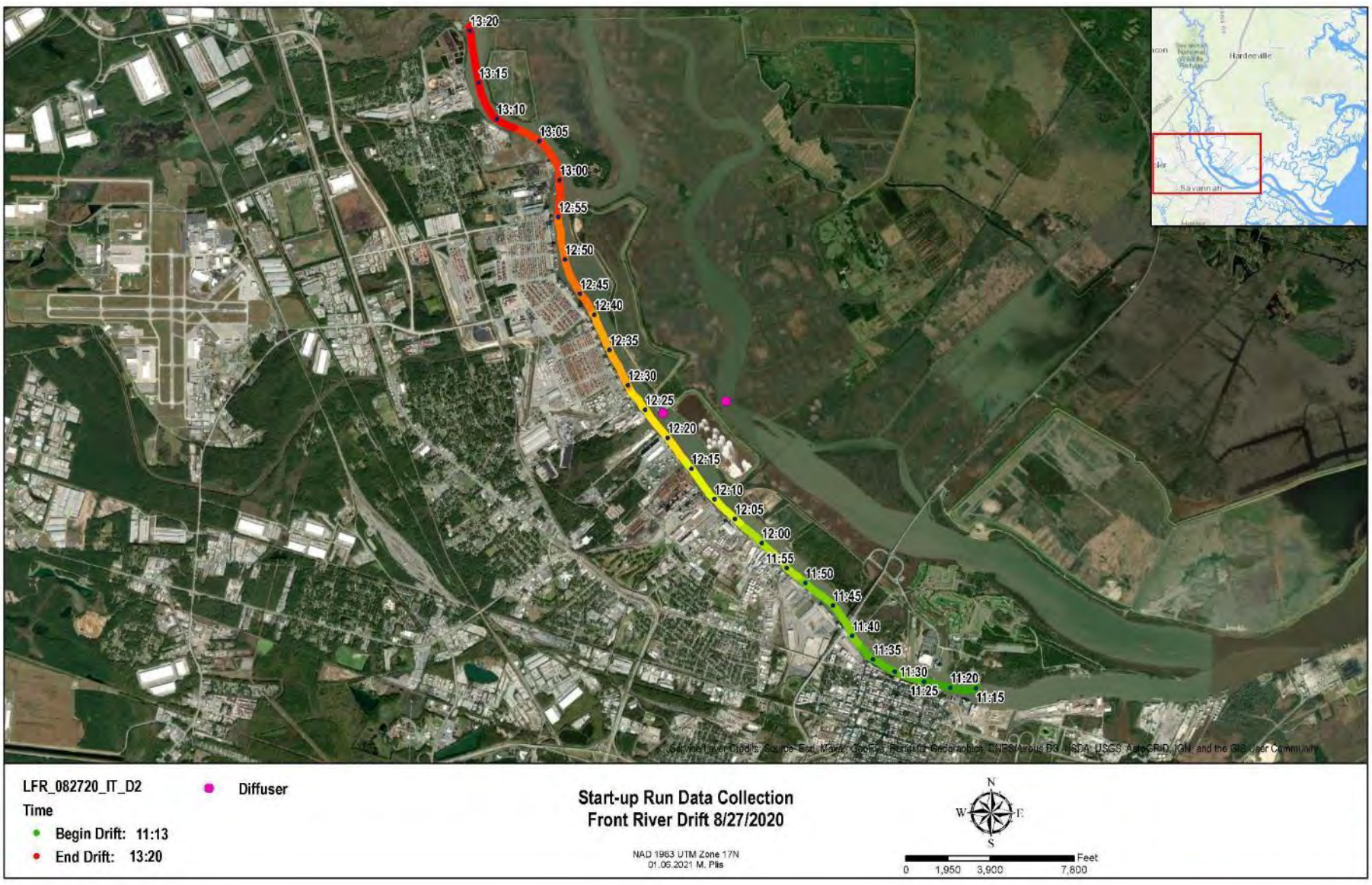


Figure C-110 Front River August 27, 2020 drift 2 [LFR_Drift_082720_IT_D2] location map

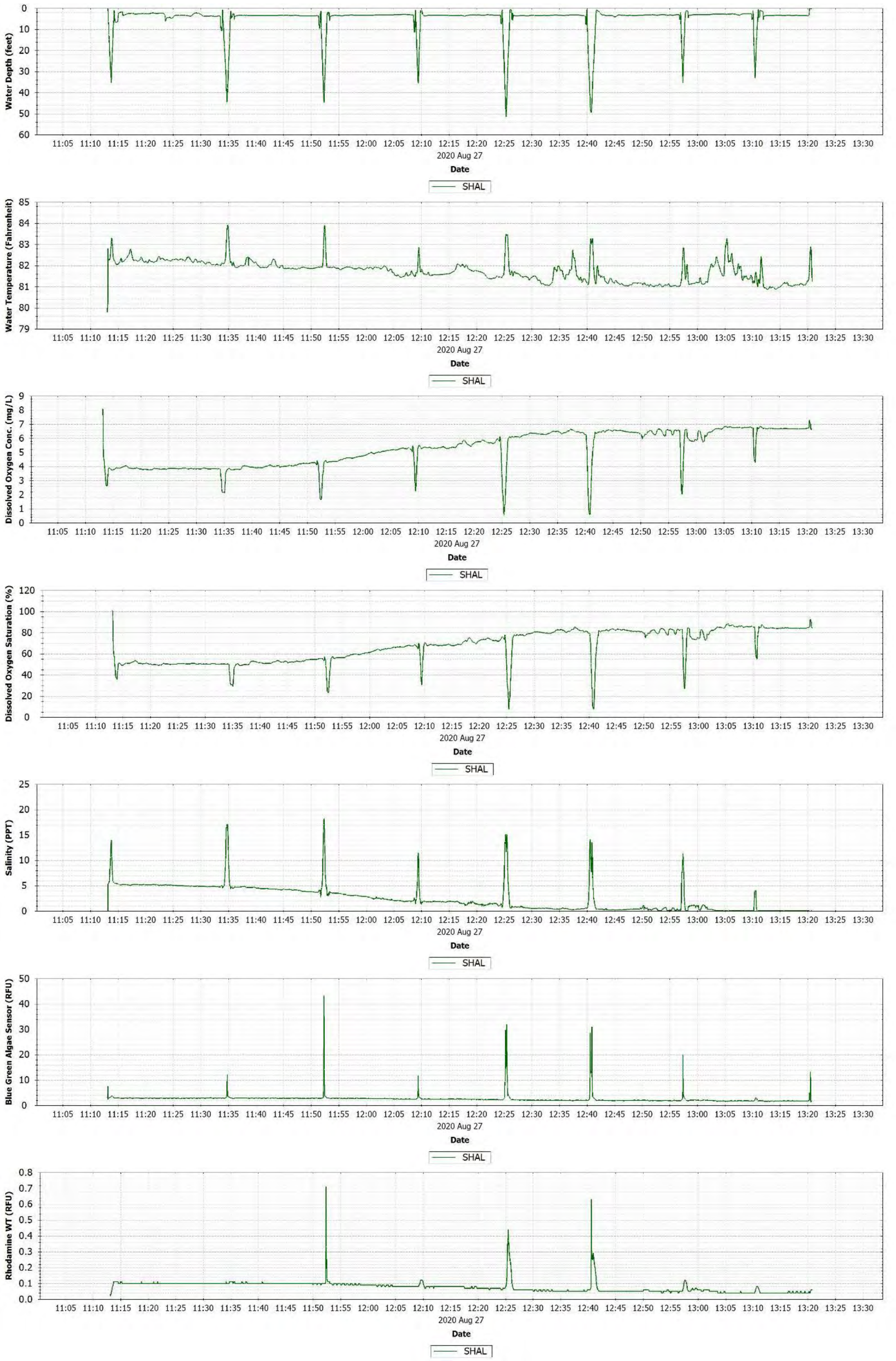


Figure C-111 Front River August 27, 2020 drift 2 [LFR_Drift_082720_IT_D2] observations.

C.47 AUGUST 20, 2020 DRIFT MIDDLE RIVER

Drift occurred during outgoing tide; high tide occurred at approximately 1024. DO concentrations were highest upstream, likely due to inputs from the Savannah River. DO concentrations decreased and salinity increased after the Back River and Middle River diverge. Dye from the August 25, 2020 dye injection was measured in the lower section.

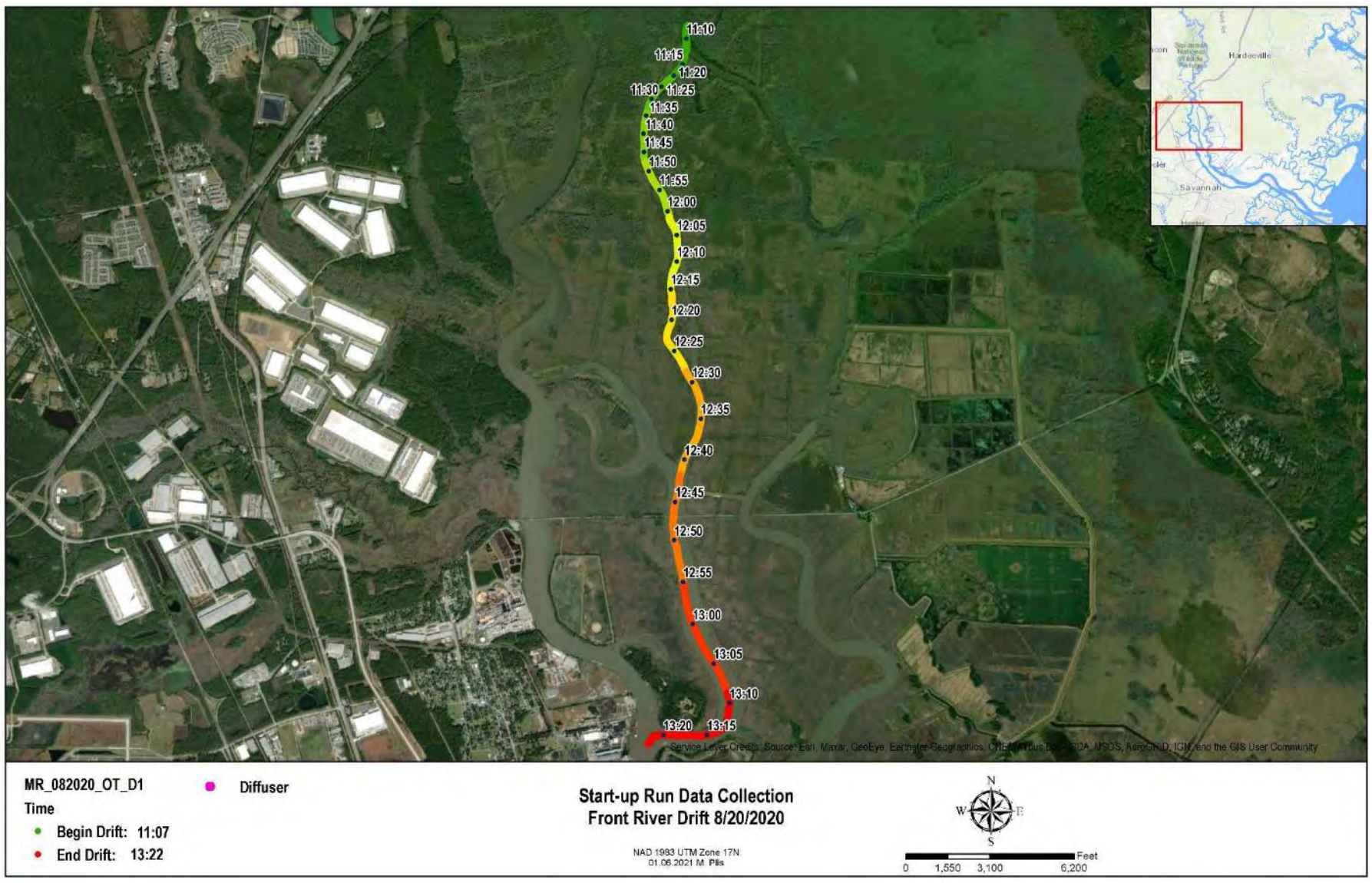
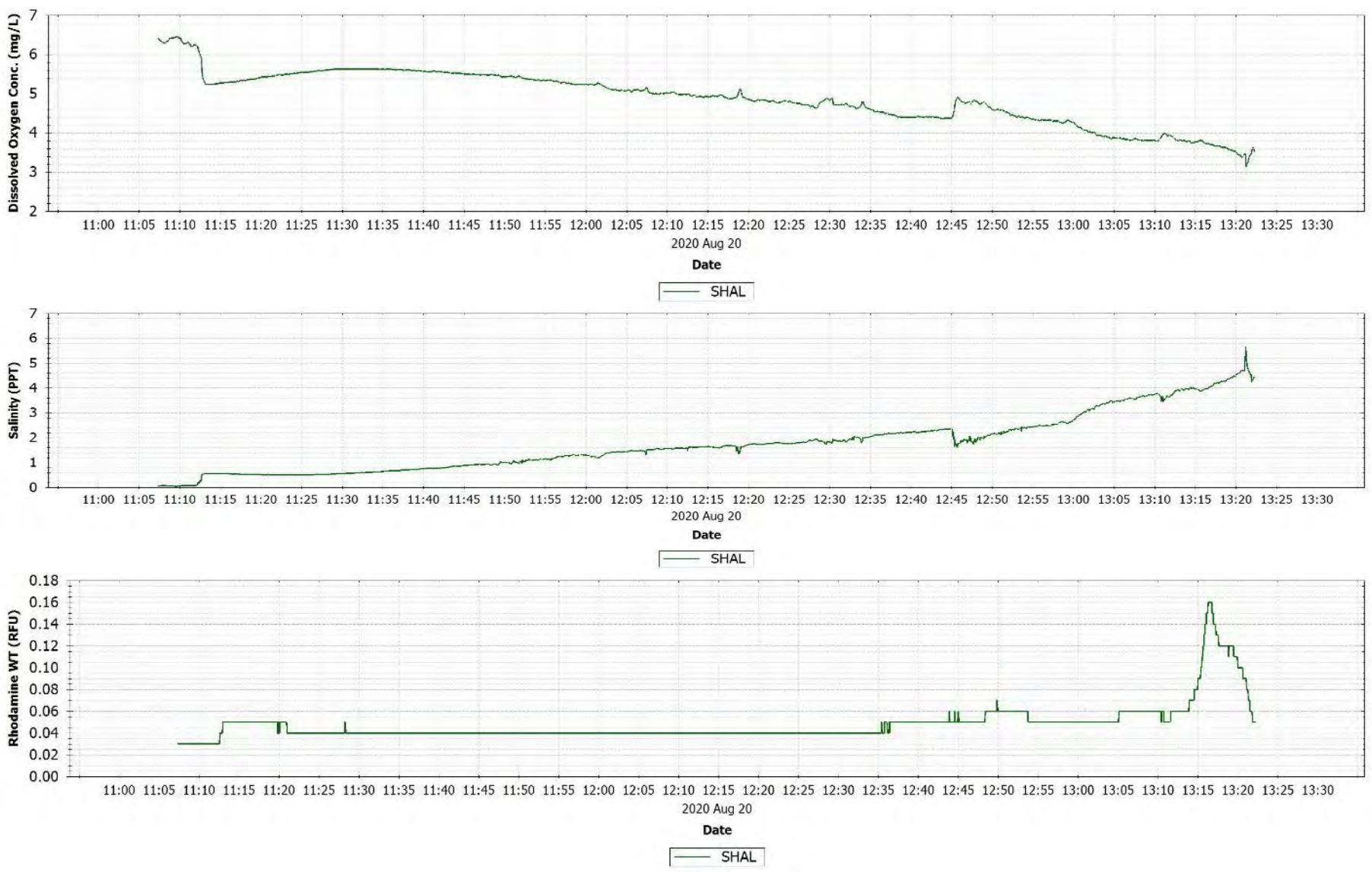


Figure C-112 Middle River August 20, 2020 drift [MR_Drift_082020_OT_D1] location map



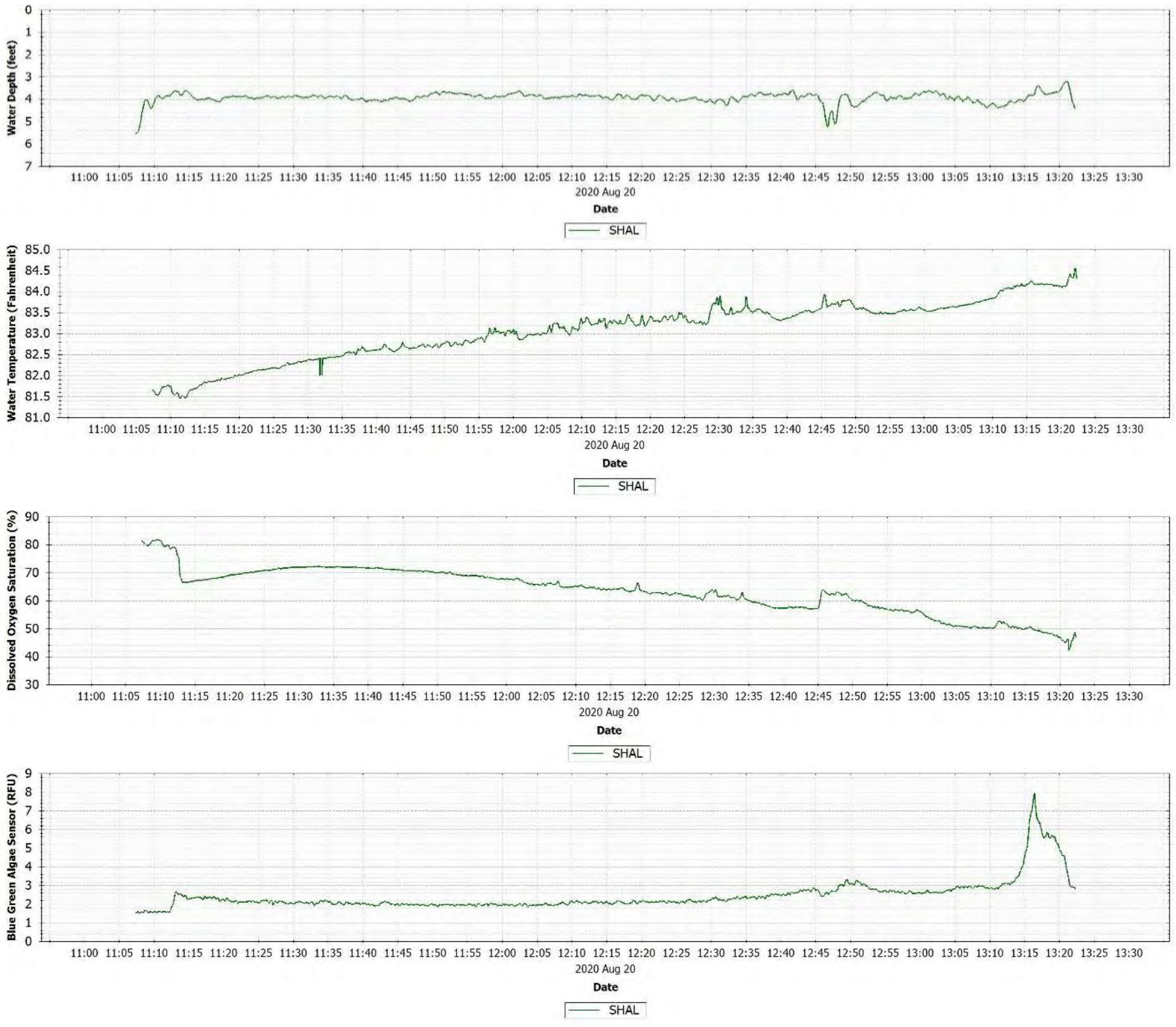


Figure C-113 Middle River August 20, 2020 drift [MR_Drift_082020_OT_D1] observations.

C.48 AUGUST 26, 2020 DRIFT MIDDLE RIVER

Drift occurred during incoming tide; low tide occurred at approximately 0940. Higher DO concentrations downstream may be due to oxygenated water entering the Middle River from the Front River. DO concentrations were lowest immediately downstream of the Back River and Middle River divergence, which is likely due to shallower depths, slower velocities, and marsh inputs. Dye from the August 25, 2020 dye injection was measured in the lower section.

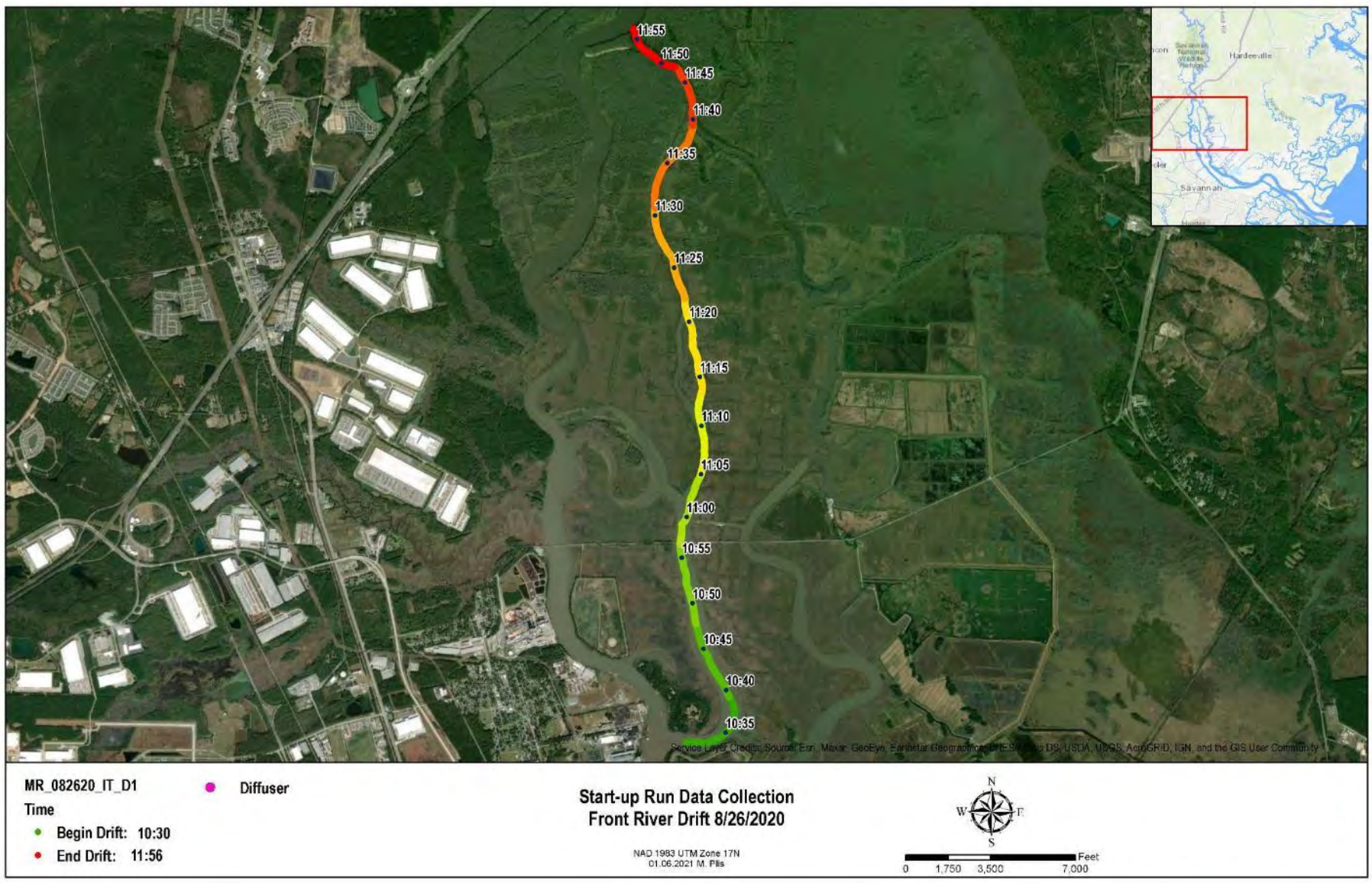
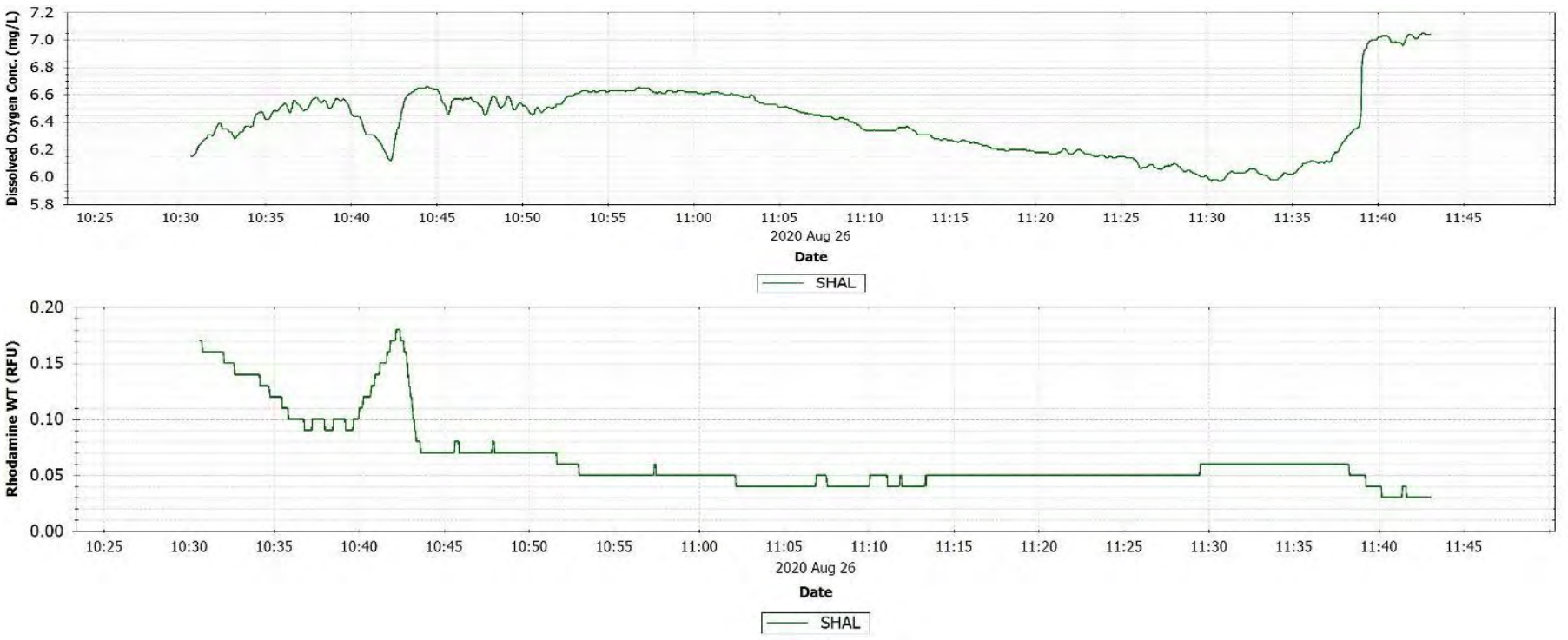


Figure C-114 Middle River August 26, 2020 drift [MR_Drift_082620_IT_D1] location map



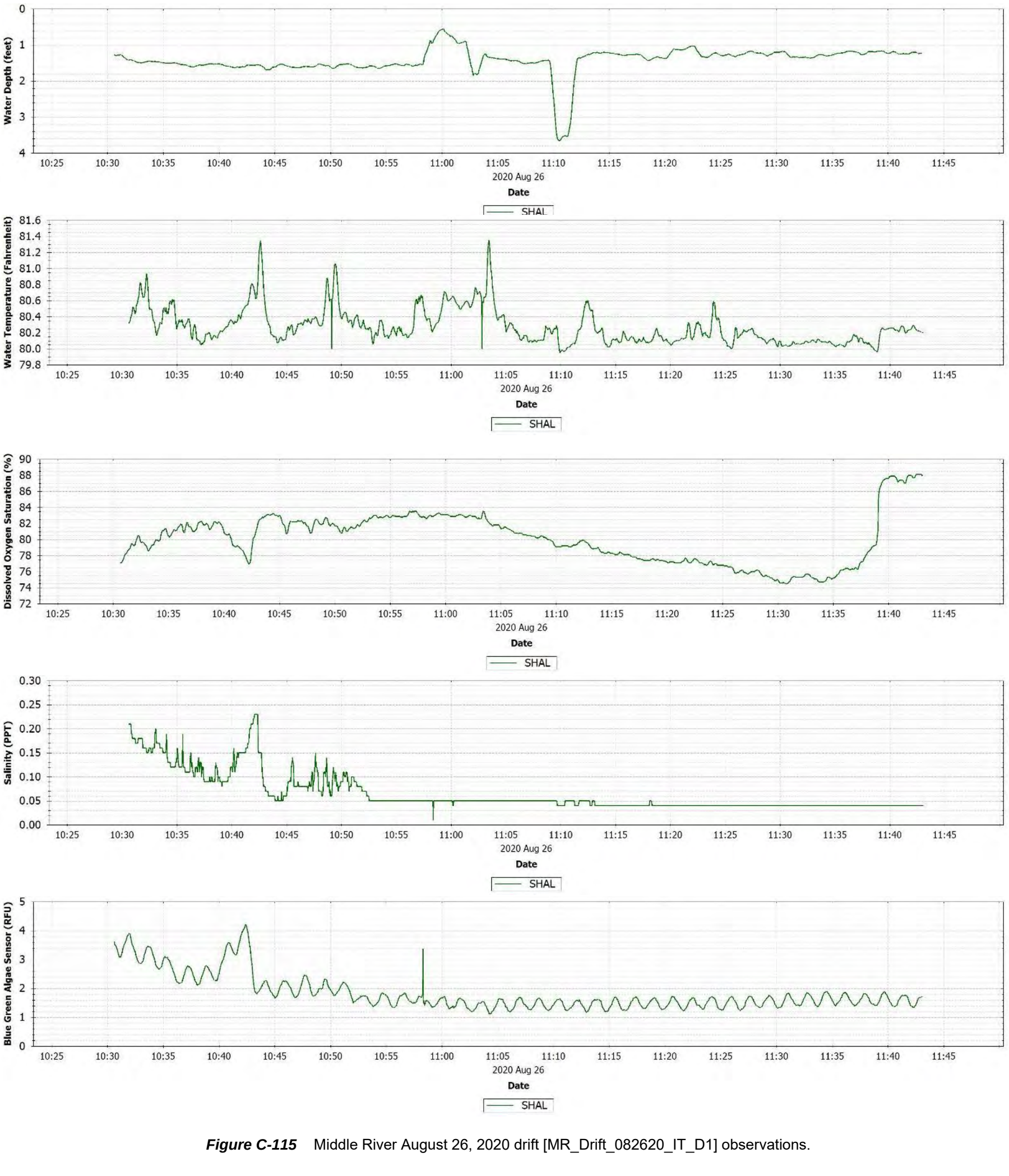


Figure C-115 Middle River August 26, 2020 drift [MR_Drift_082620_IT_D1] observations.

C.49 SEPTEMBER 10, 2020 DRIFT MIDDLE RIVER

Drift occurred during incoming tide; low tide occurred at approximately 0914. DO concentrations were highest upstream, likely due to inputs from the Savannah River. DO concentrations decreased after the Back River and Middle River diverge. No dye was measured in the Middle River.

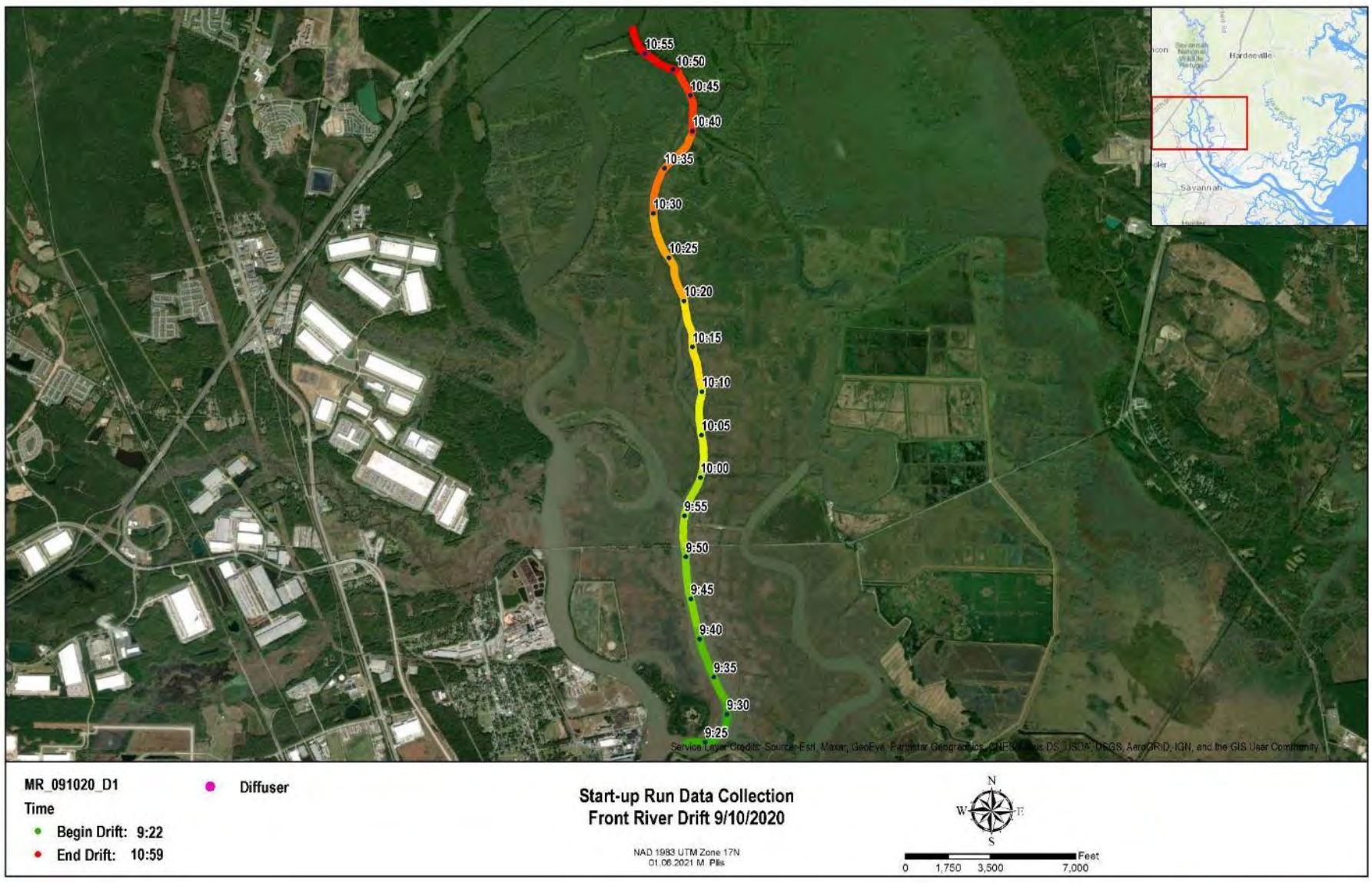
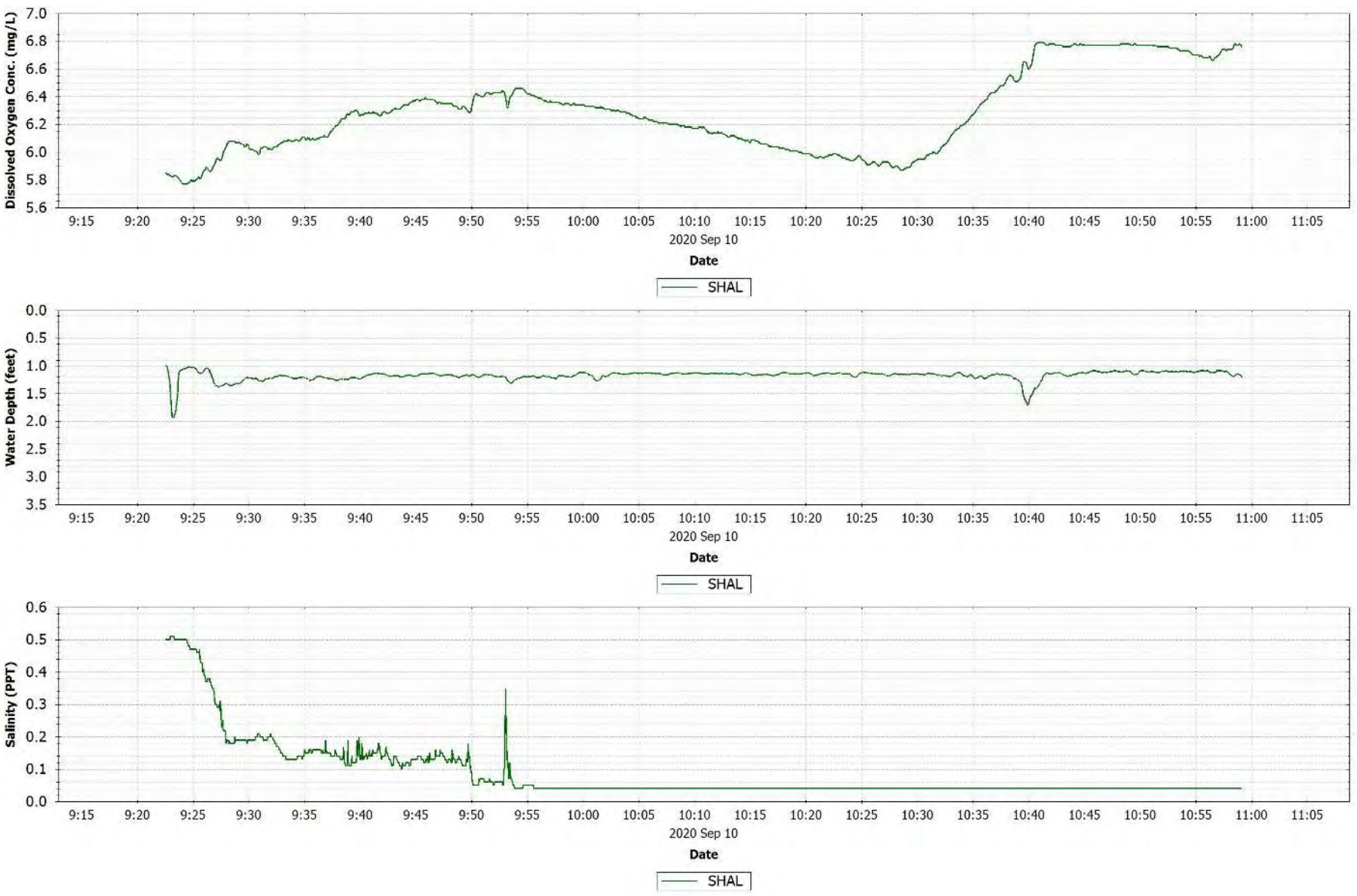


Figure C-116 Middle River September 10, 2020 drift [MR_Drift_091020_D1] location map



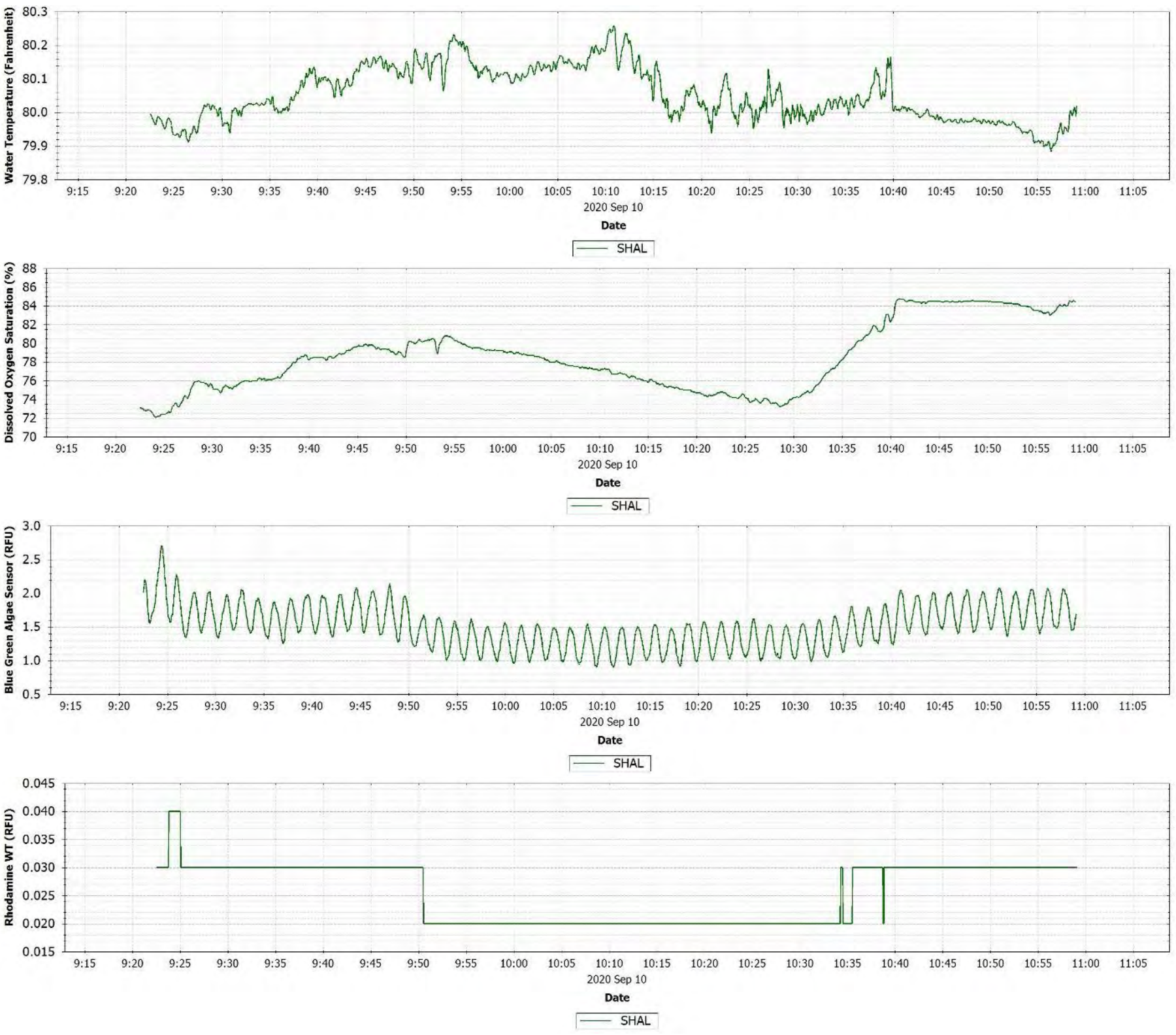


Figure C-117 Middle River September 10, 2020 drift [MR_Drift_091020_D1] observations.

C.50 UPRIVER

SUR drift sampling started on July 28, 2020. Pre-SUR sampling was completed in the previous two weeks while the oxygen system was in startup mode. The below figure provides a visual of how the oxygen plume moves, along with location of diffuser and Upriver buoys.

The following are observations about how the injected oxygen dispersed into the Front River. The inject oxygen:

- Dispersed quickly bottom to top, within 300 feet downstream of diffuser.
- Mixed quickly across the channel and was usually mixed across by UR_18 buoy.
- The downstream tributaries, fed by marsh areas, contributed low DO water slightly lowering the river's DO as it moved down to the harbor.
- Based on the dye studies, it takes the injected oxygen about 1 day to reach the start of the harbor around I-95 bridge.

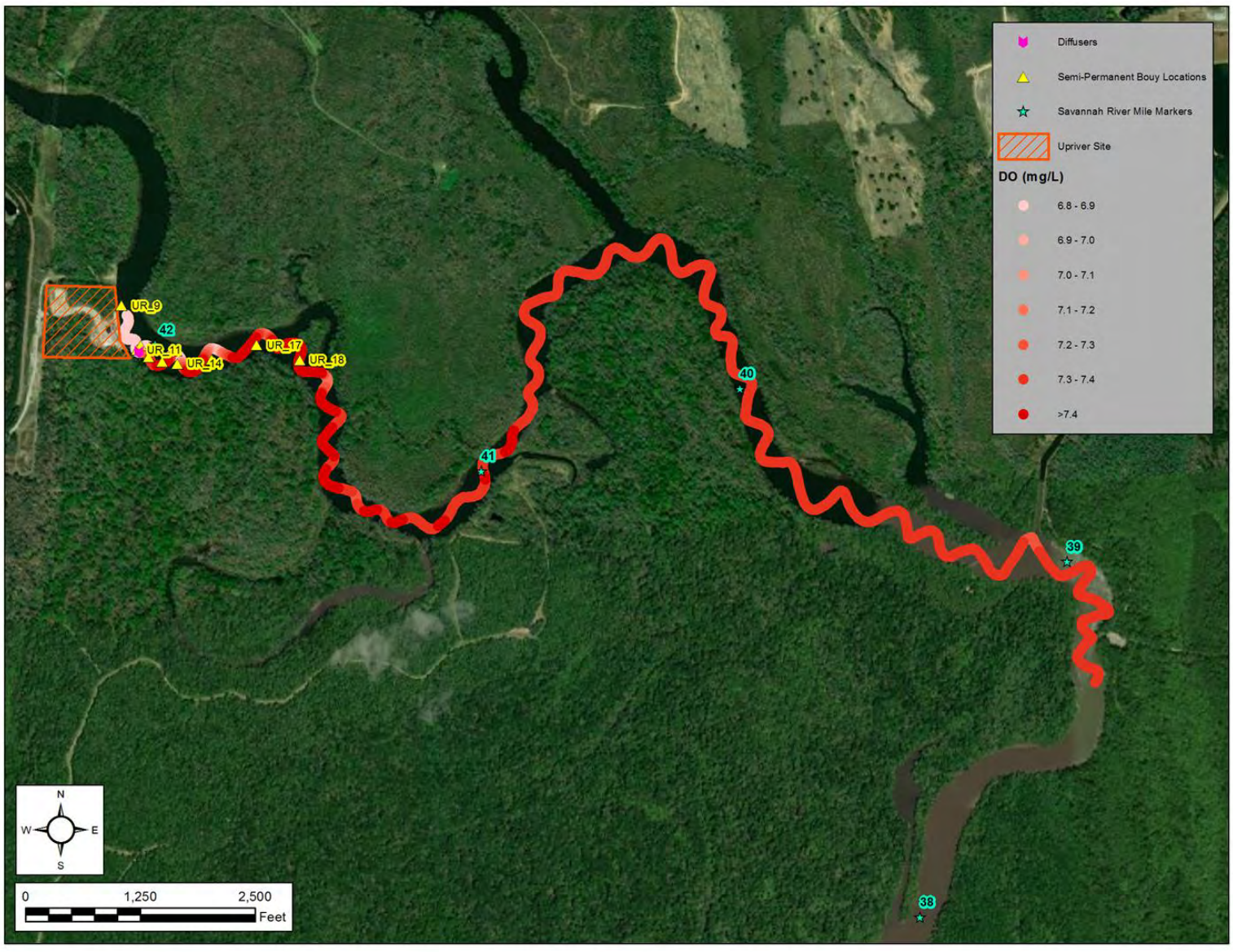


Figure C-118 Upriver July 21, 2020 Upriver Profile

The drift data in this Upriver section is presented mostly as parameter per timestep. The location maps show the route of the boat with green being the start and red the end of the route. Included on the location maps are the times the data was measured in 5 minute increments so the sampling location can be associated with the parameters in the figures below each location map.

C.51 JULY 28, 2020 DRIFT UPRIVER

Three similar drift routes were run below the diffuser. The first drift was with the oxygen system operating and the second drift was without the oxygen system operating. The oxygen plume measured during the first drift traveled downstream, initially staying in the channel and gradually spread across the river as it approached the oxbow. Better description is in the main report. The oxygen was mixed top to bottom a few hundred feet downstream.

The second drift with no oxygen being injected, showed the top and bottom DO values constant throughout the river with the bottom DO being about 0.06 mg/L lower.

The third drift was after the oxygen system was started up again and the shallow data sonde intersected the plume when it began to vertically mix approximately 1,000 feet downstream of the diffuser.

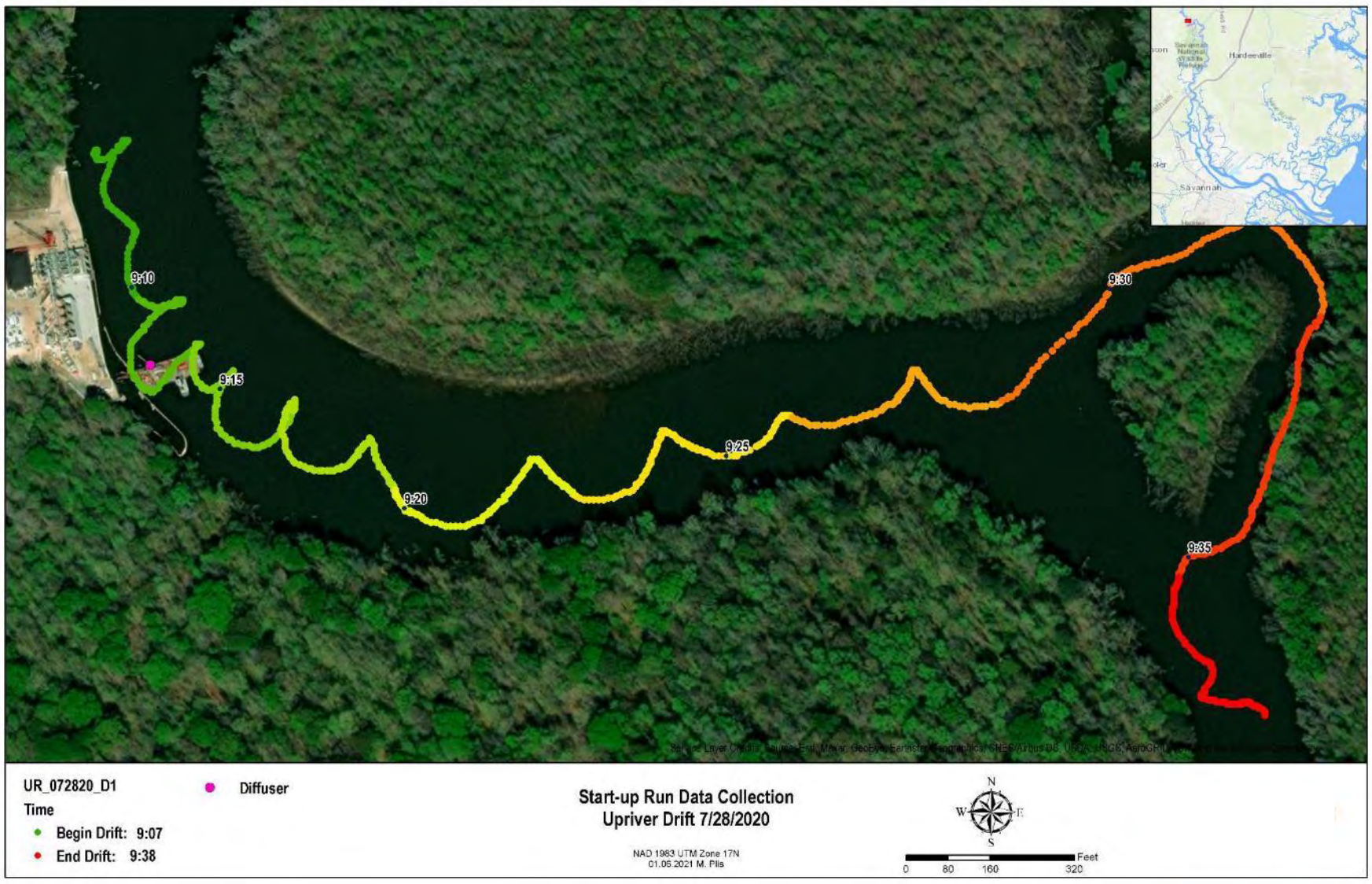
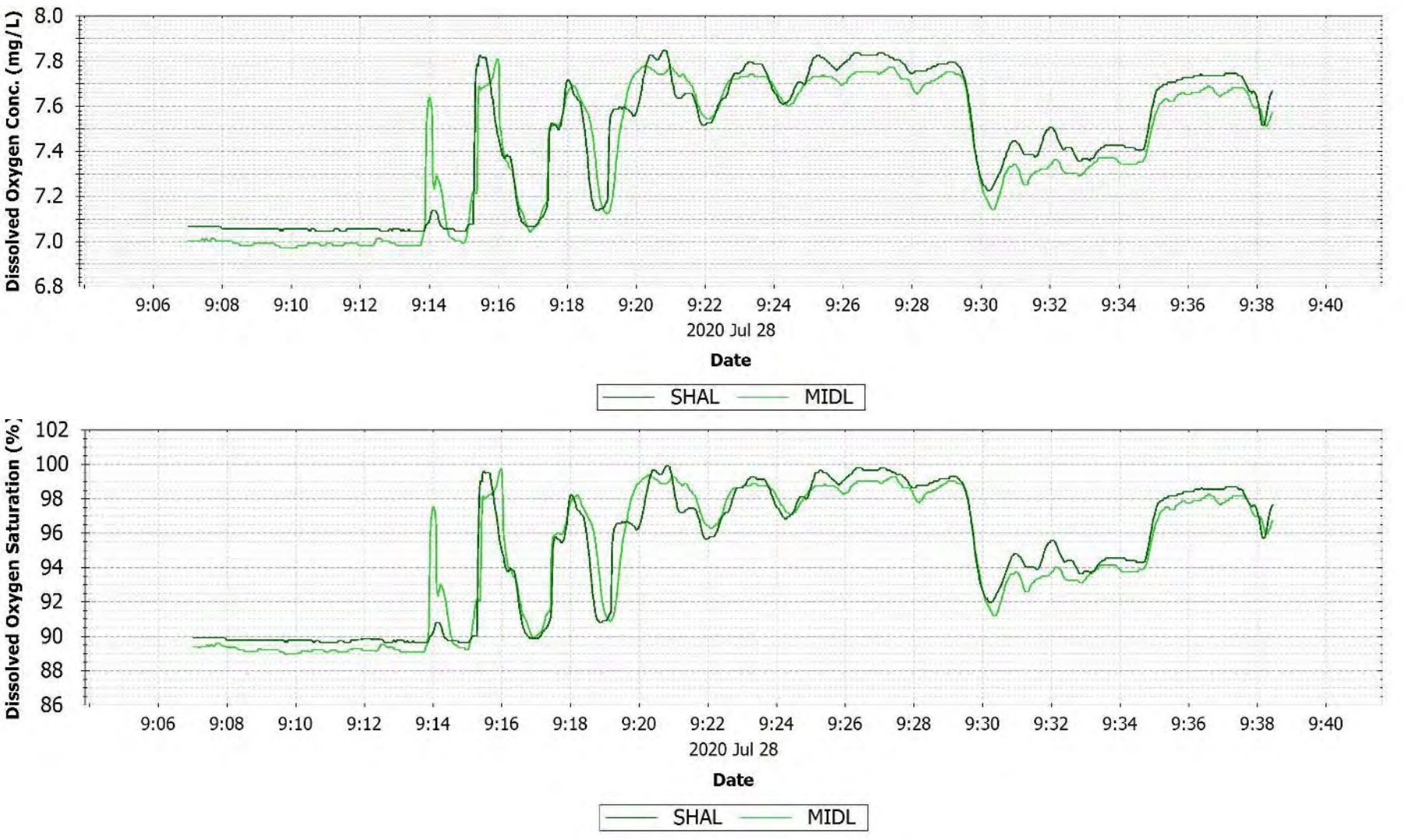


Figure C-119 Upriver July 28, 2020 drift 1 [UR_Drift_072820_D1] location map



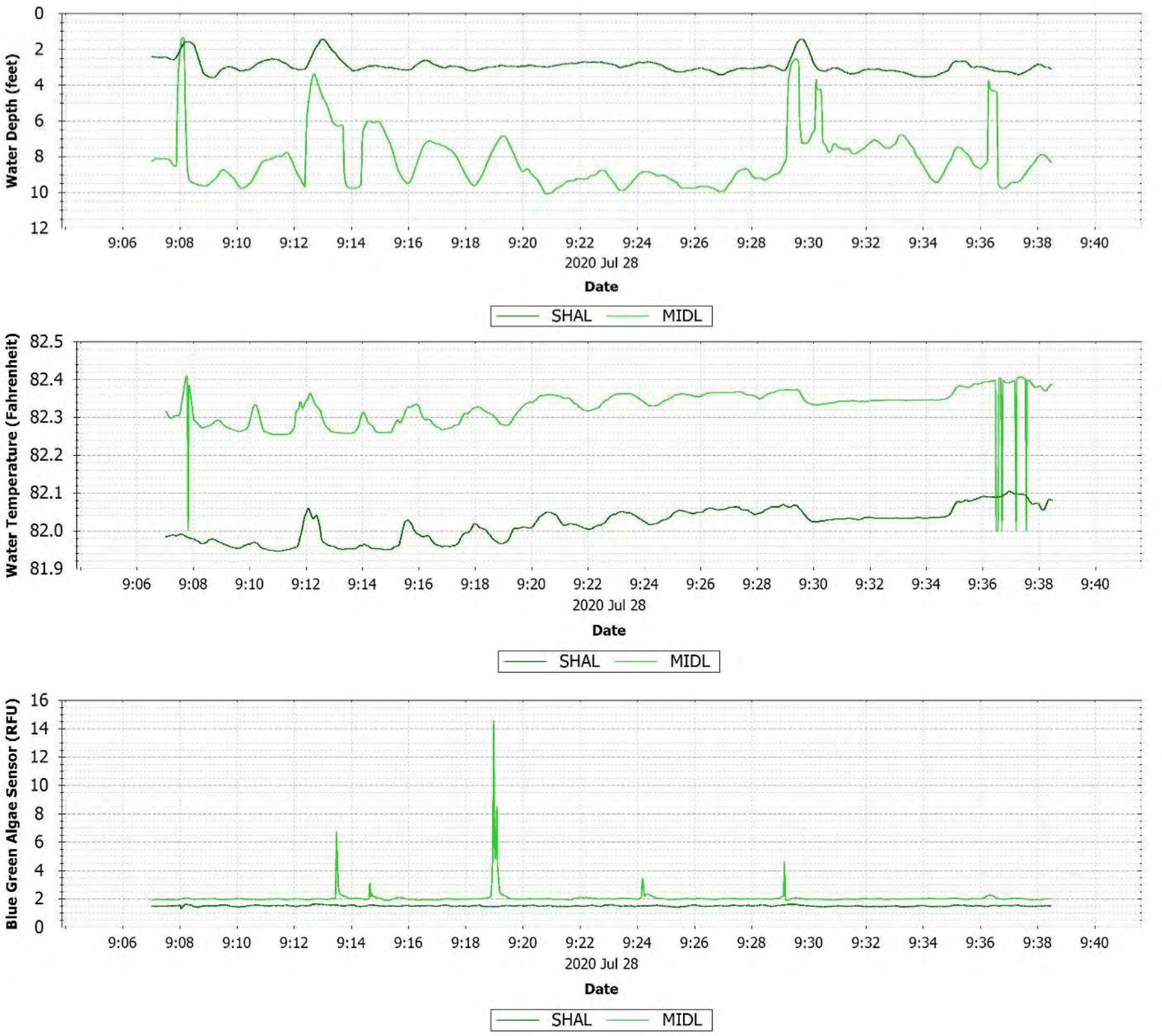


Figure C-120 Upriver July 28, 2020 drift 1 [UR_Drift_072820_D1] observations.

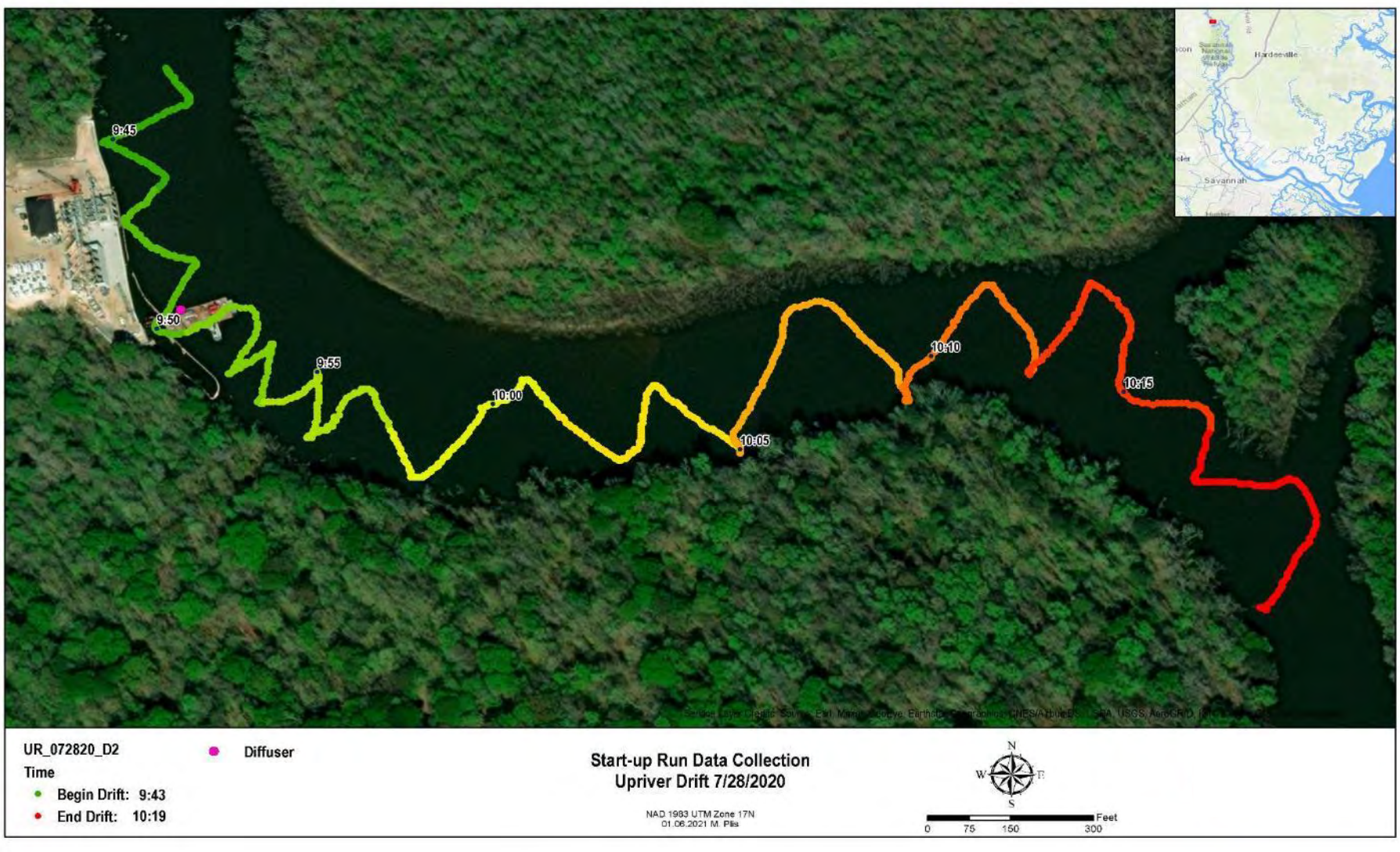


Figure C-121 Upriver July 28, 2020 drift 2 [UR_Drift_072820_D2] location map

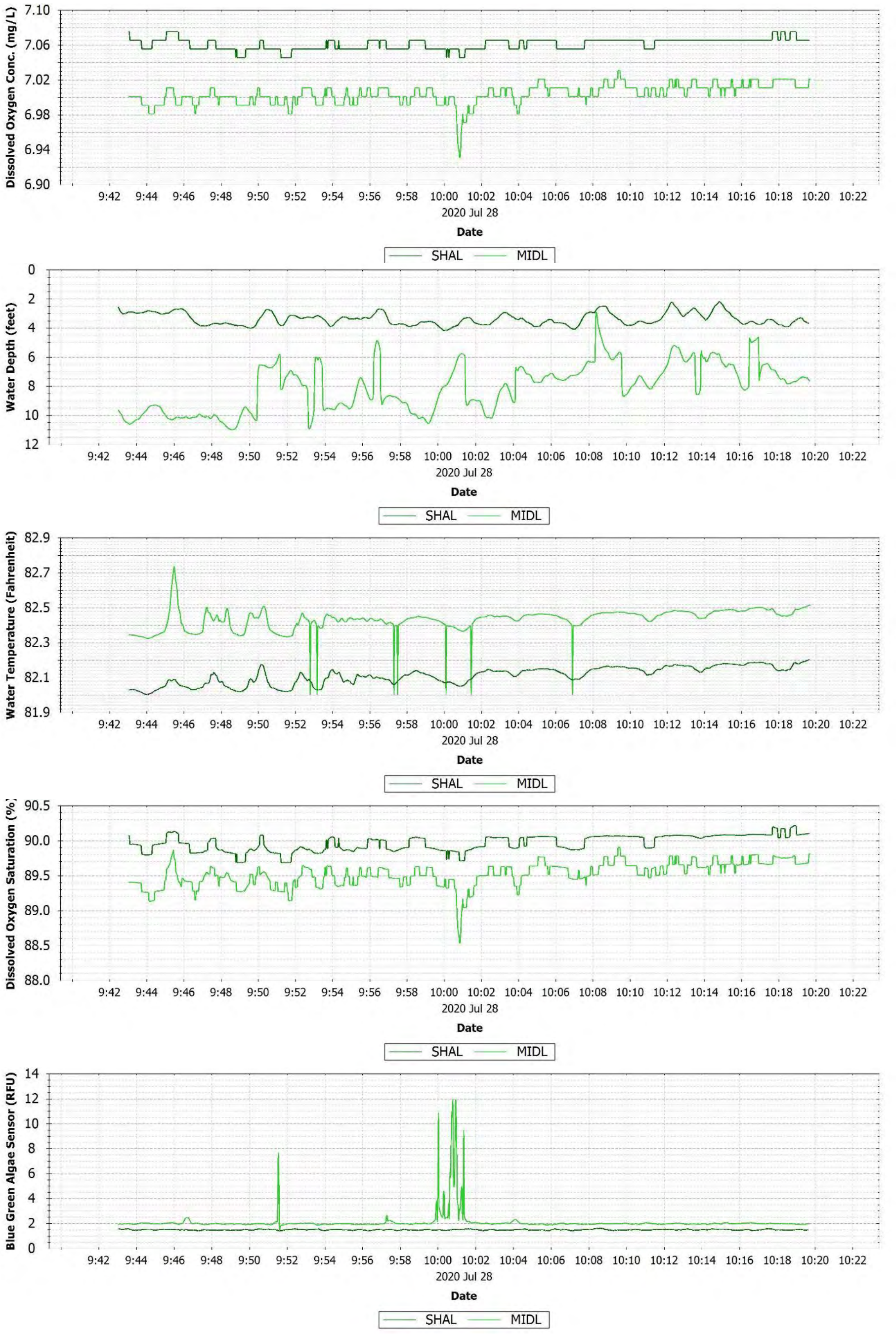


Figure C-122 Upriver July 28, 2020 drift 2 [UR_Drift_072820_D2] observations.

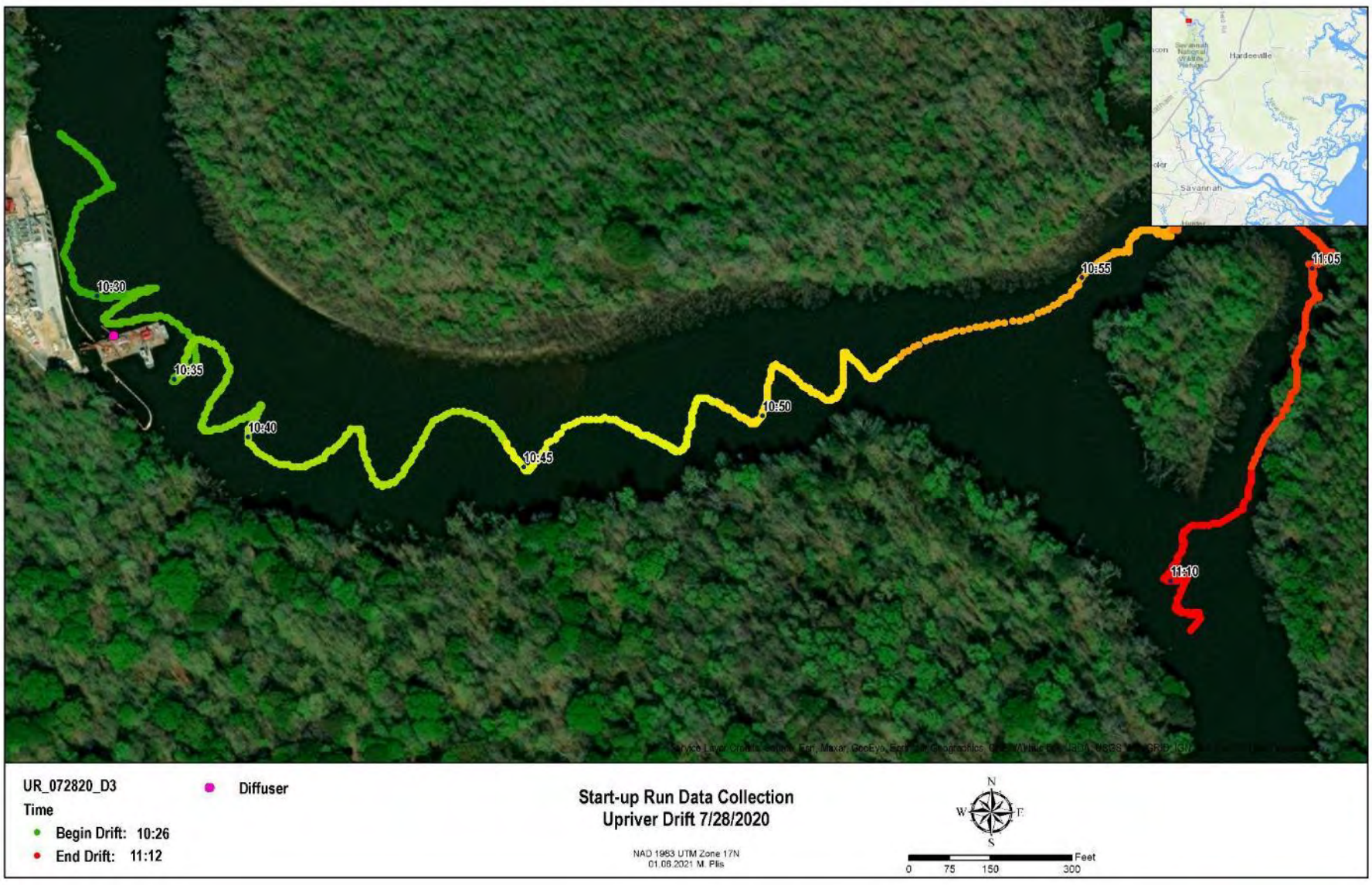


Figure C-123 Upriver July 28, 2020 drift 3 [UR_Drift_072820_D3] location map

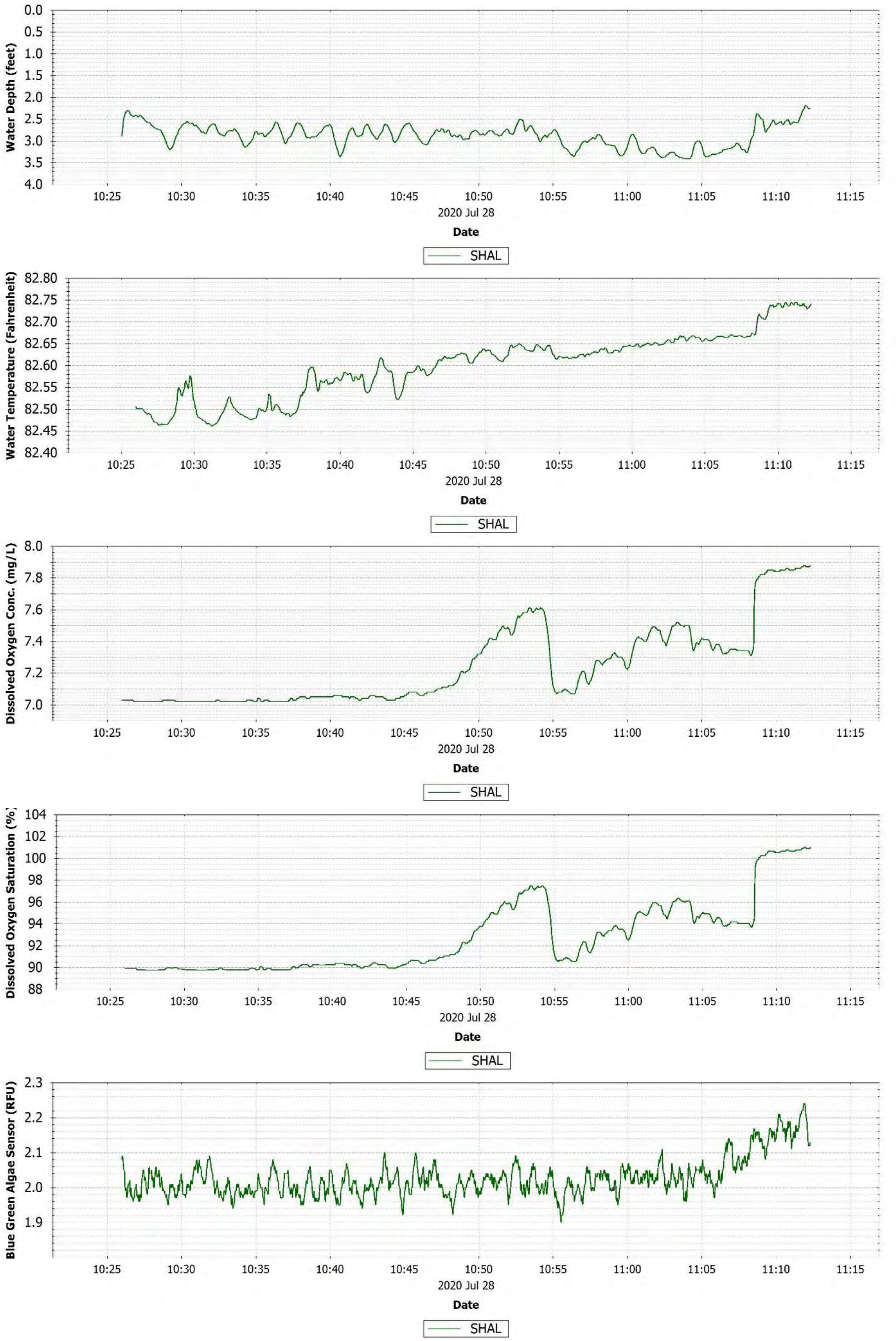


Figure C-124 Upriver July 28, 2020 drift 3 [UR_Drift_072820_D3] observations.

C.52 JULY 30, 2020 DRIFT UPRIVER

The oxygen plume traveled downstream and initially stayed in the channel and gradually spread across the river as it approached the oxbow. A more thorough description is in the main report. The oxygen was mixed top to bottom a few hundred feet downstream.

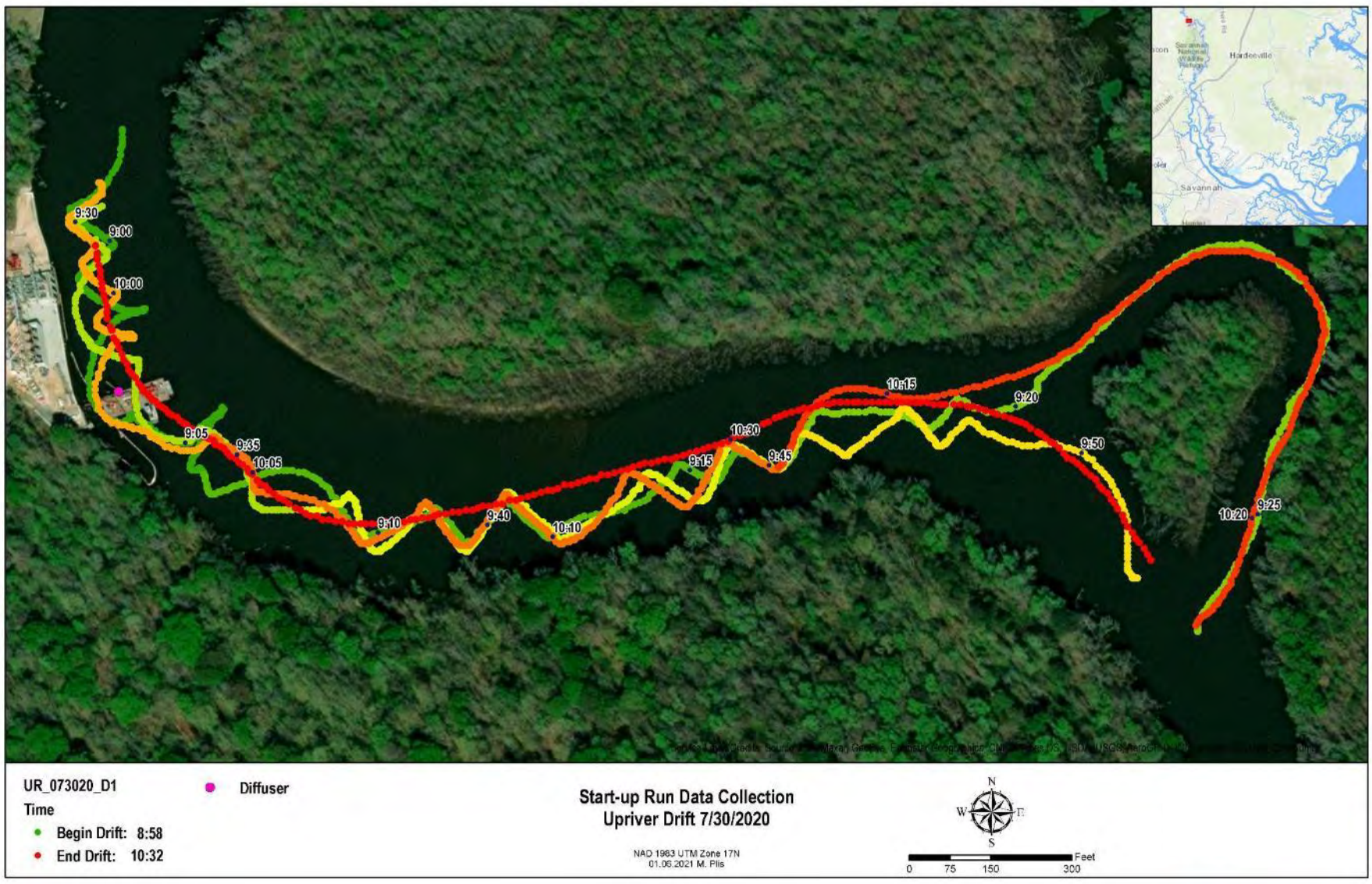
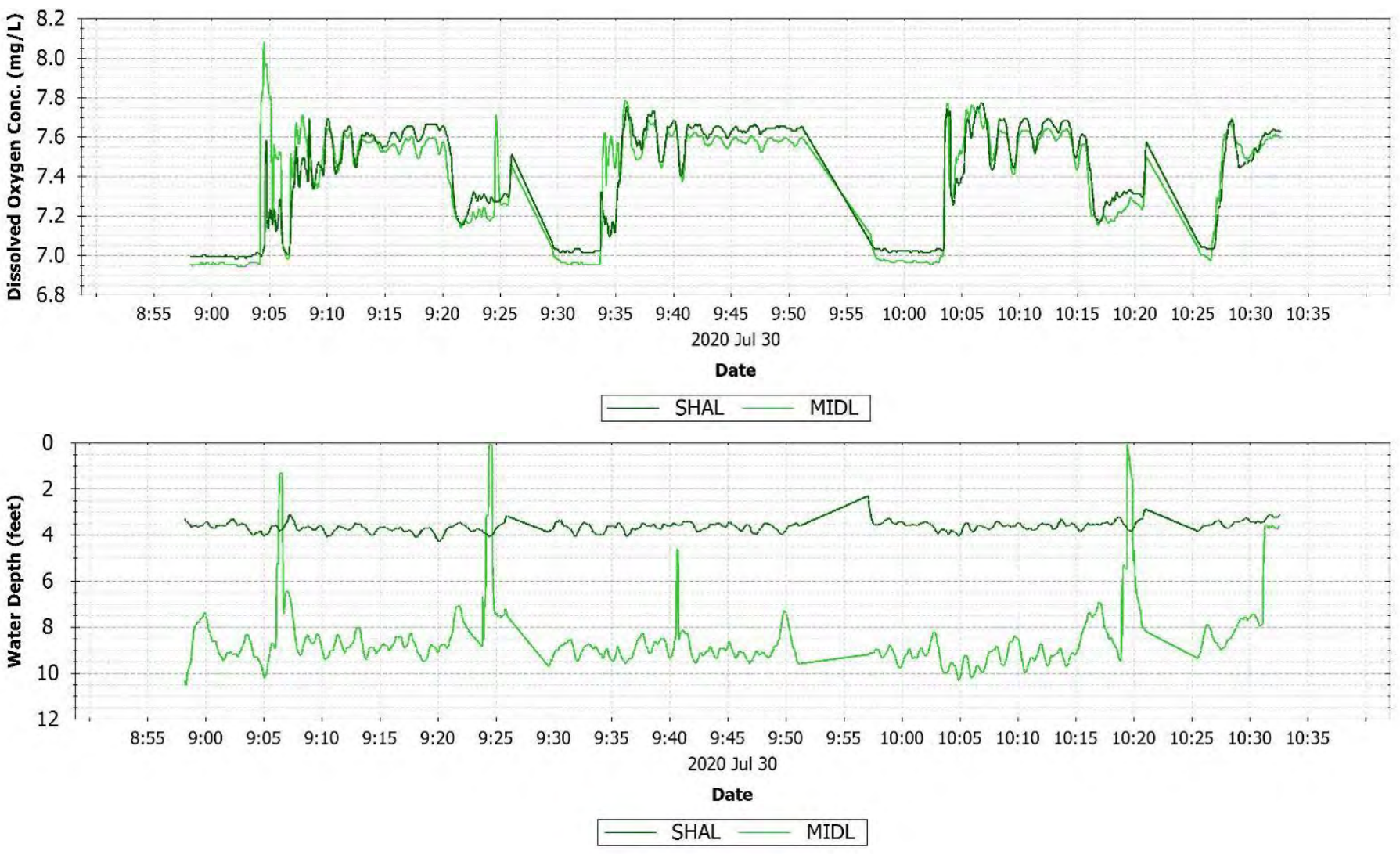


Figure C-125 Upriver July 30, 2020 drift [UR_Drift_073020_D1] location map



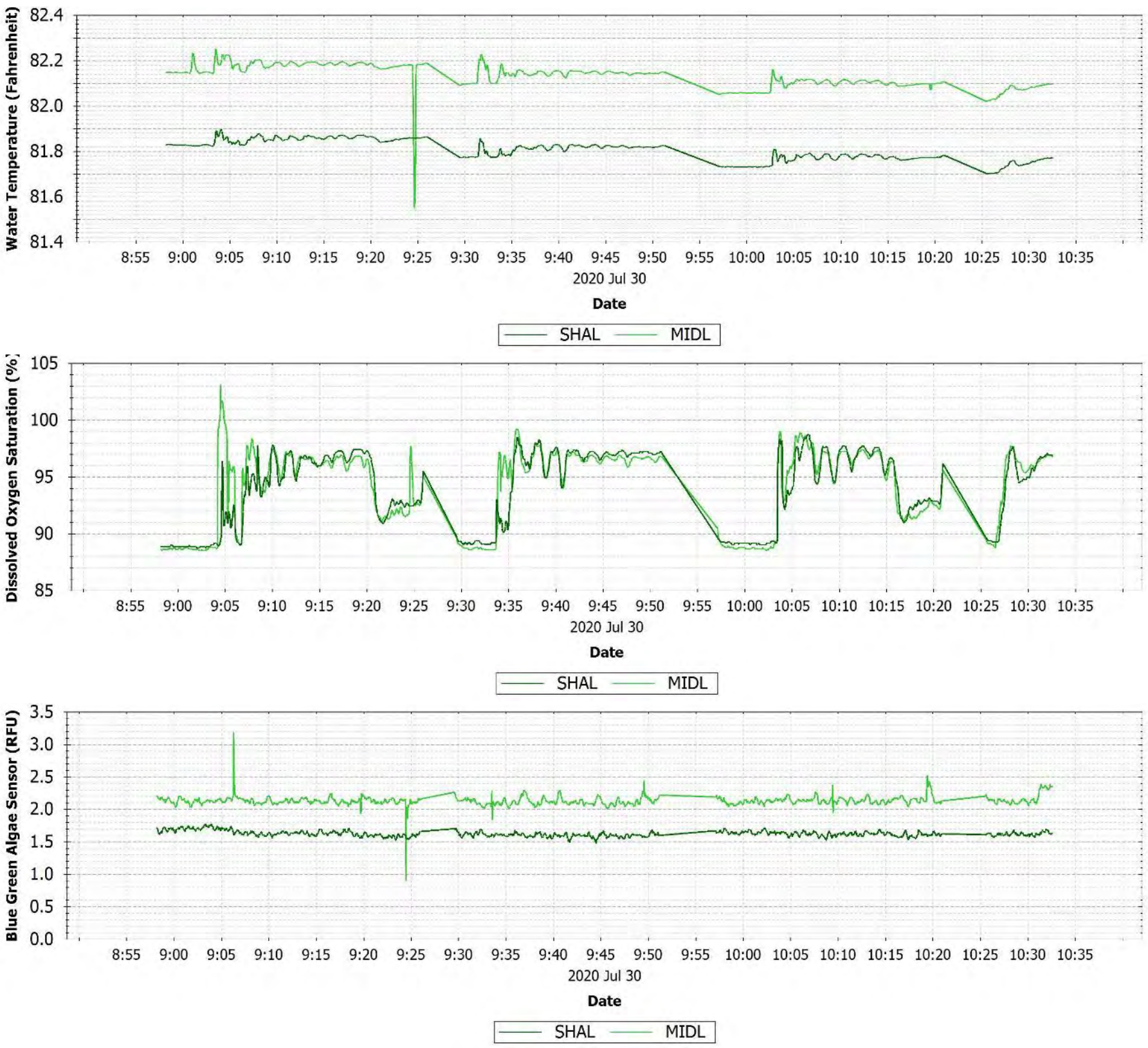


Figure C-126 Upriver July 30, 2020 drift [UR_Drift_073020_D1] observations.

C.53 AUGUST 1, 2020 DRIFT UPRIVER

The DO plume fully mixed in the water column quickly. There was a decrease in DO where the oxbow lake/horseshoe bend discharges to the Savannah River. Downstream of the oxbow lake, DO began to decrease gradually moving downstream.

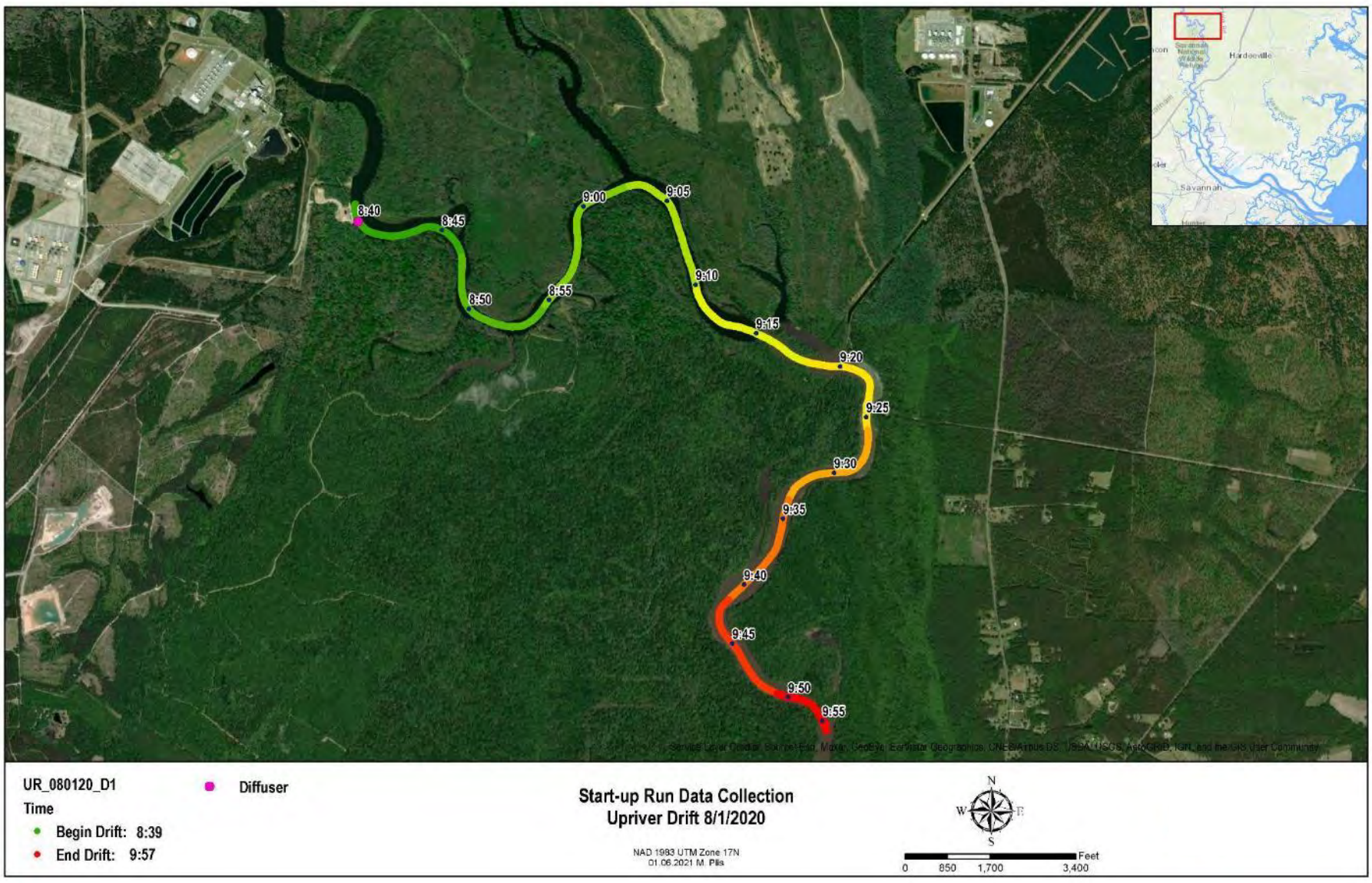
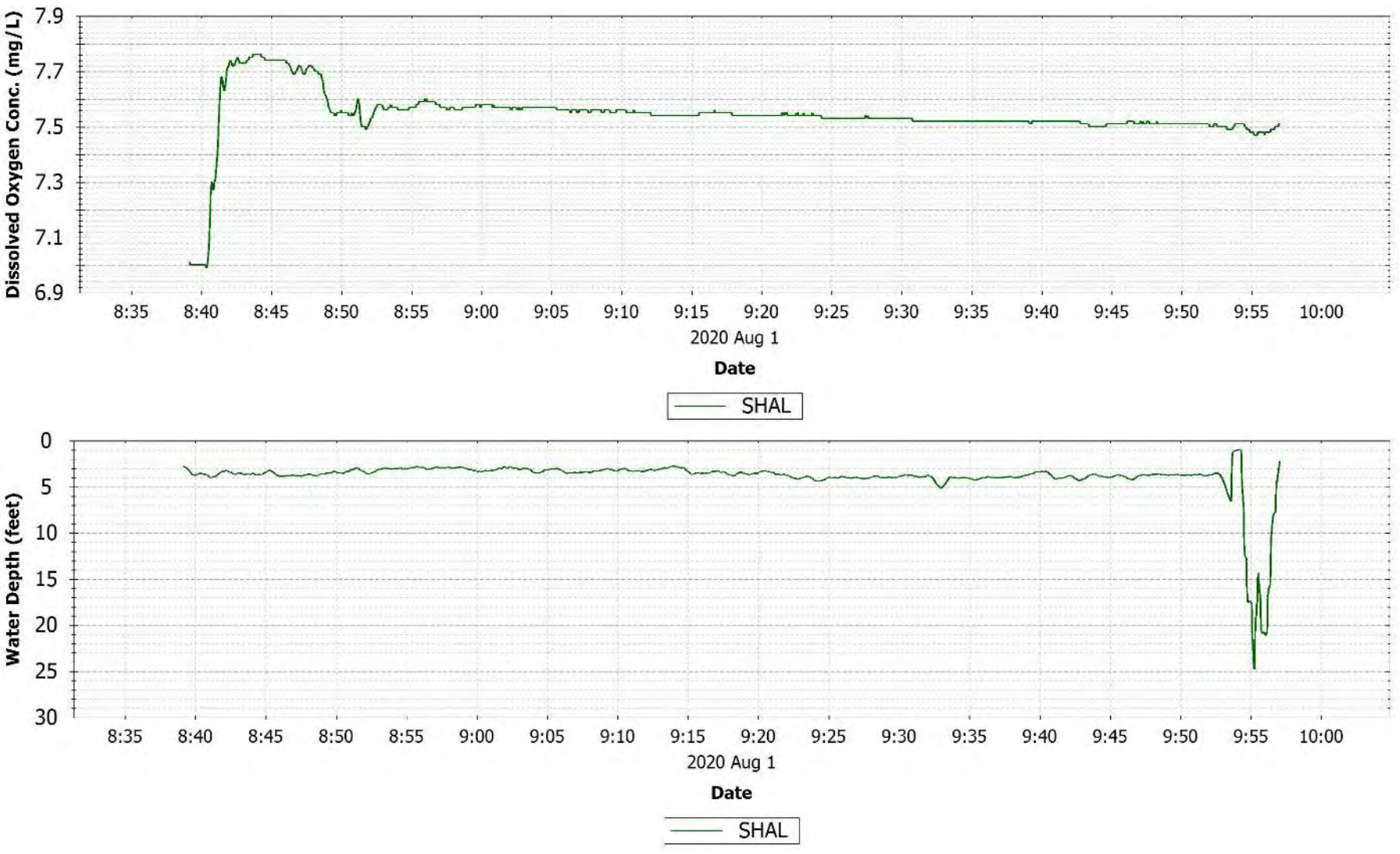


Figure C-127 Upriver August 1, 2020 drift [UR_Drift_080120_D1] location map



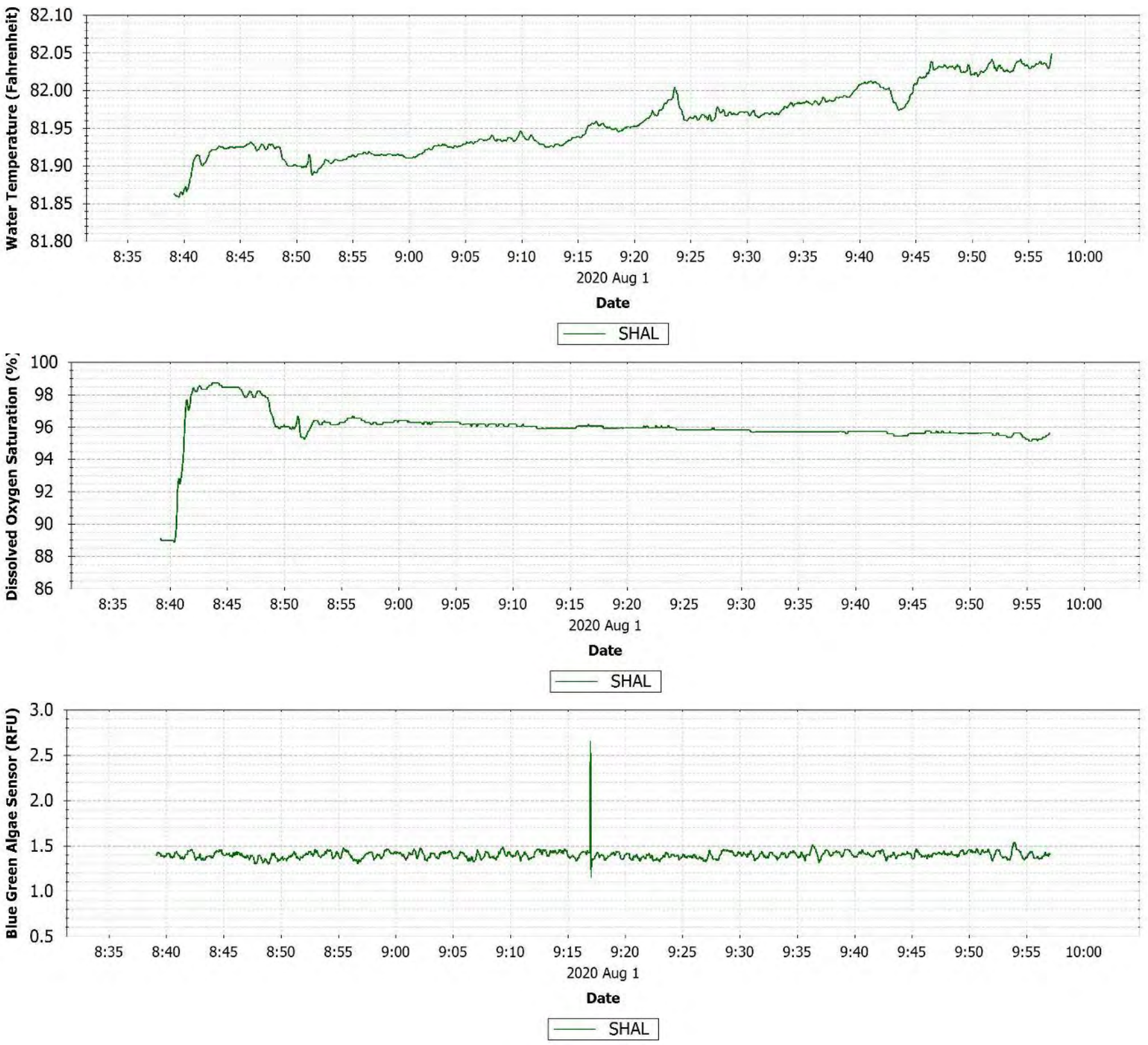


Figure C-128 Upriver August 1, 2020 drift [UR_Drift_080120_D1] observations.

C.54 AUGUST 5, 2020 DRIFT UPRIVER

The drift was conducted in a zig zag pattern and the DO concentrations were higher near the south bank until the plume became fully mixed laterally near the oxbow and Buoy UR_18. The low DO from the oxbow tributary enters below oxbow and then took another 1000 feet to mix across the river.

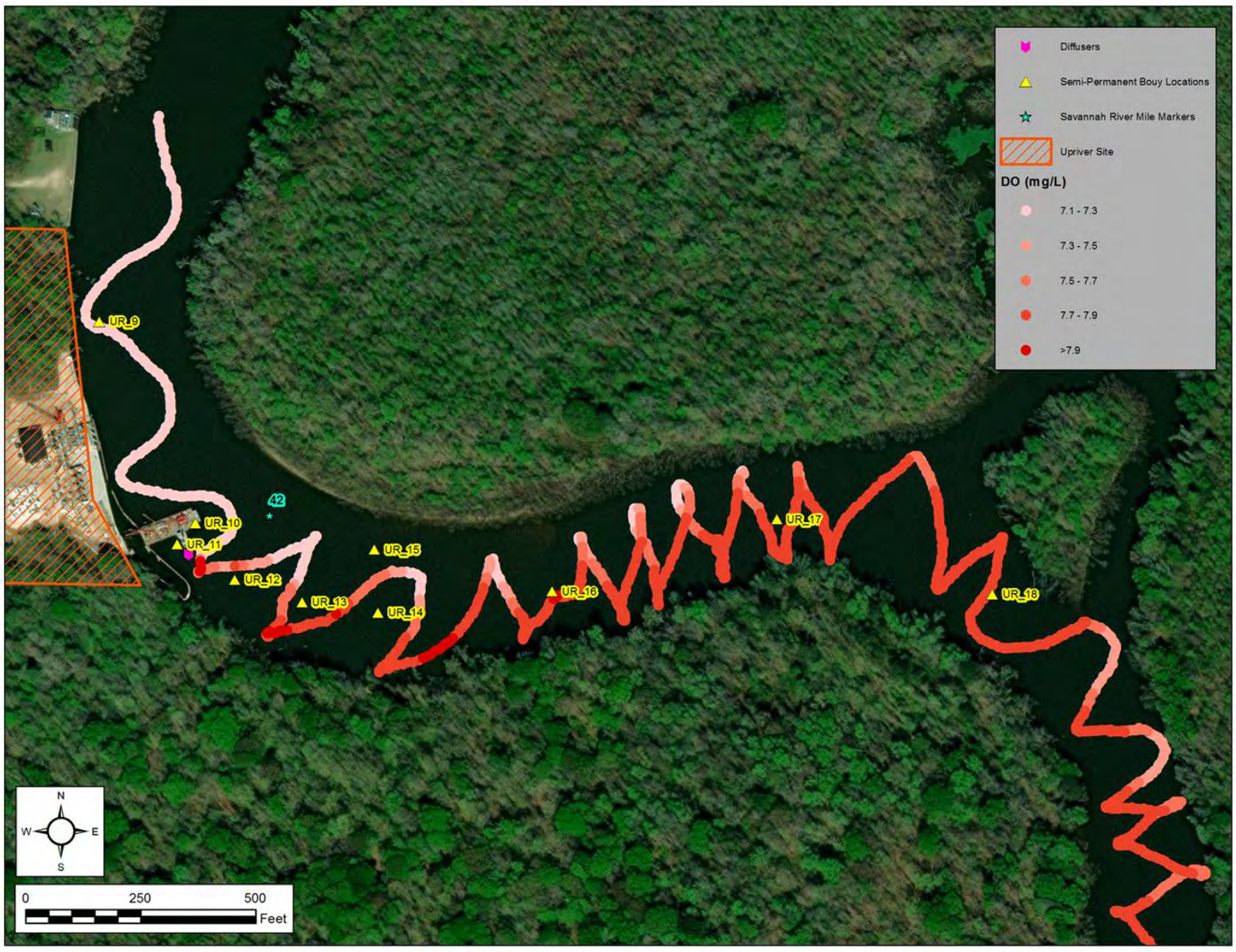


Figure C-129 Upriver August 05, 2020 DO profile below Diffuser

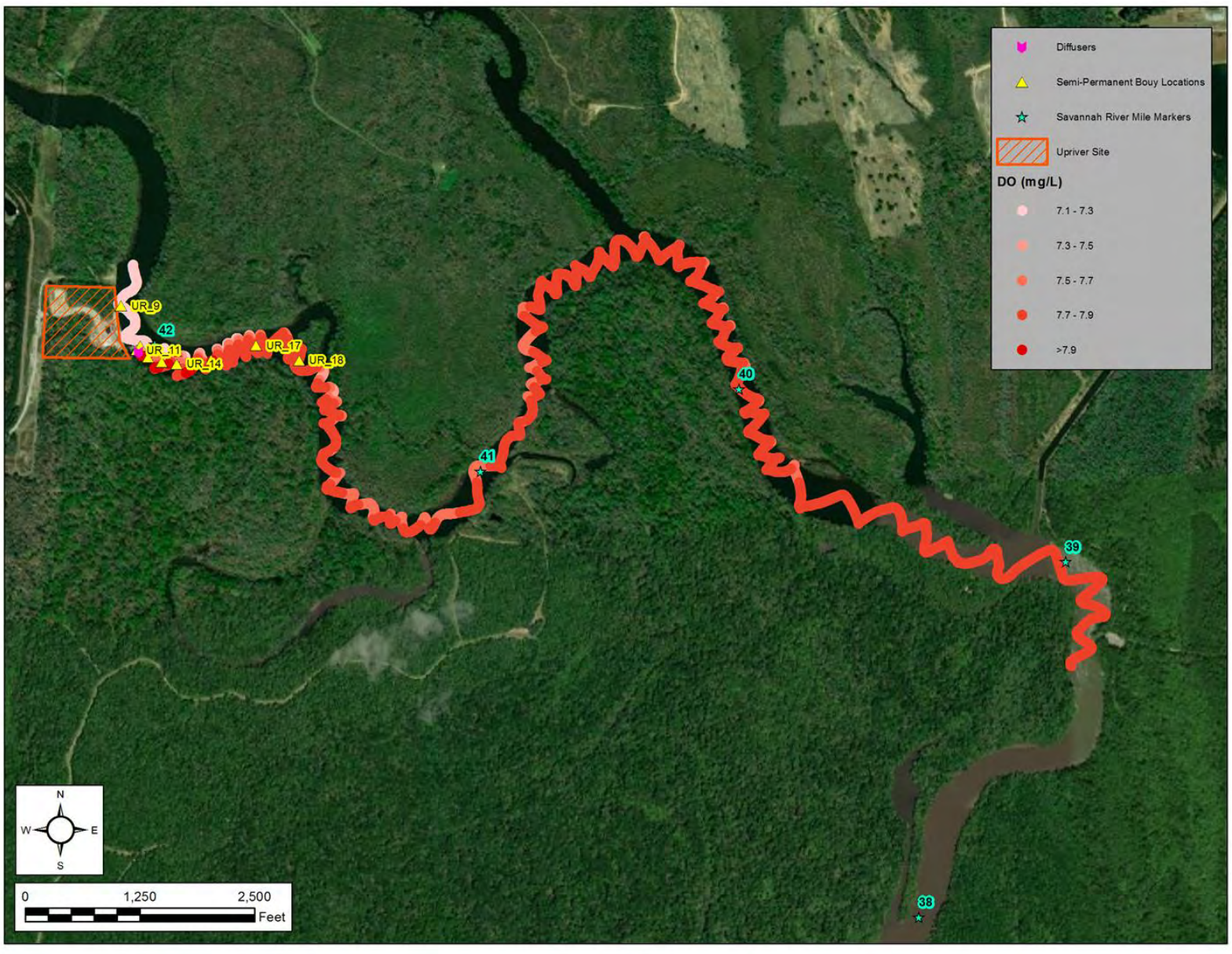


Figure C-130 Upriver August 05, 2020 DO profile

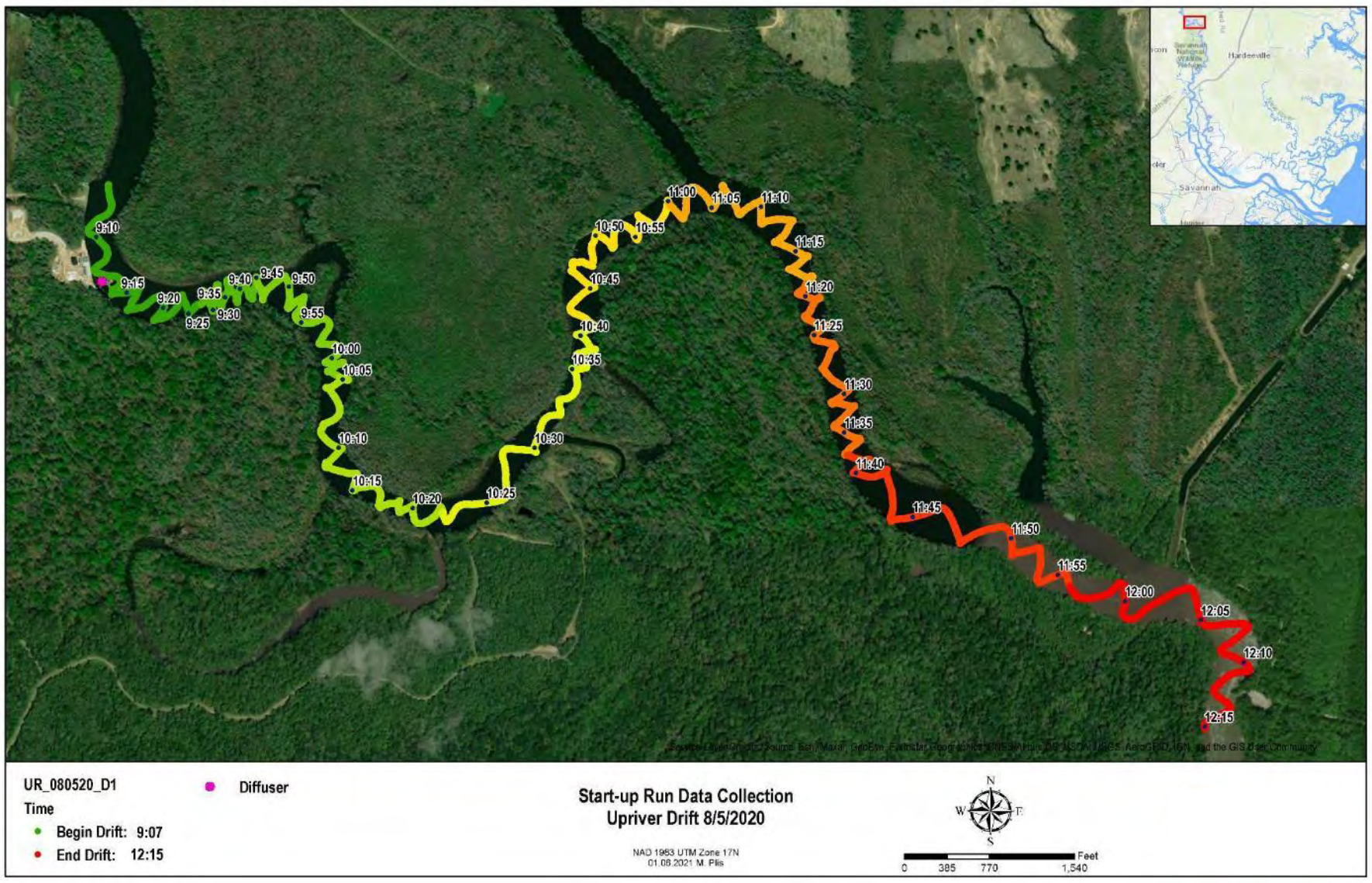
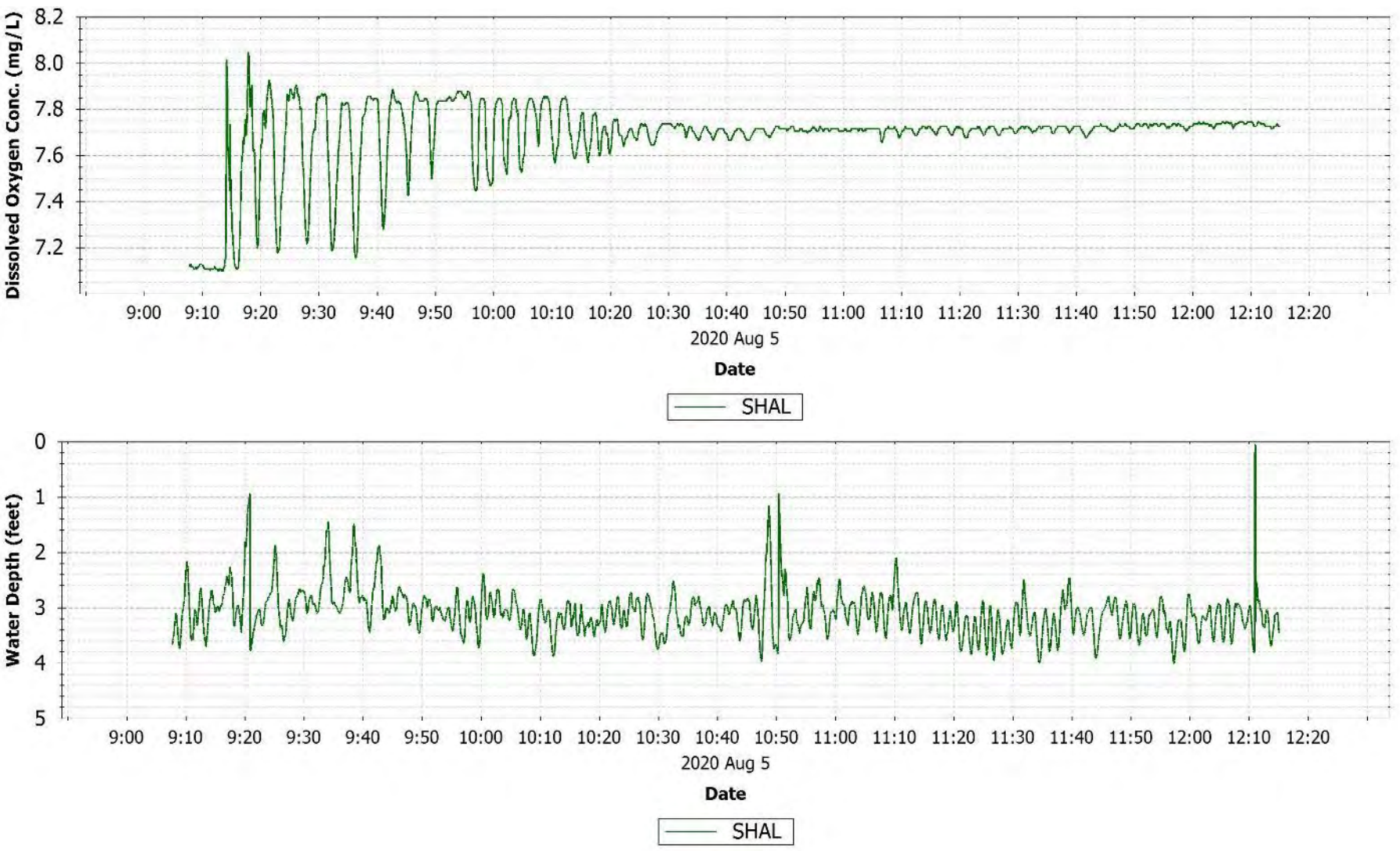


Figure C-131 Upriver August 5, 2020 drift [UR_Drift_080520_D1] location map



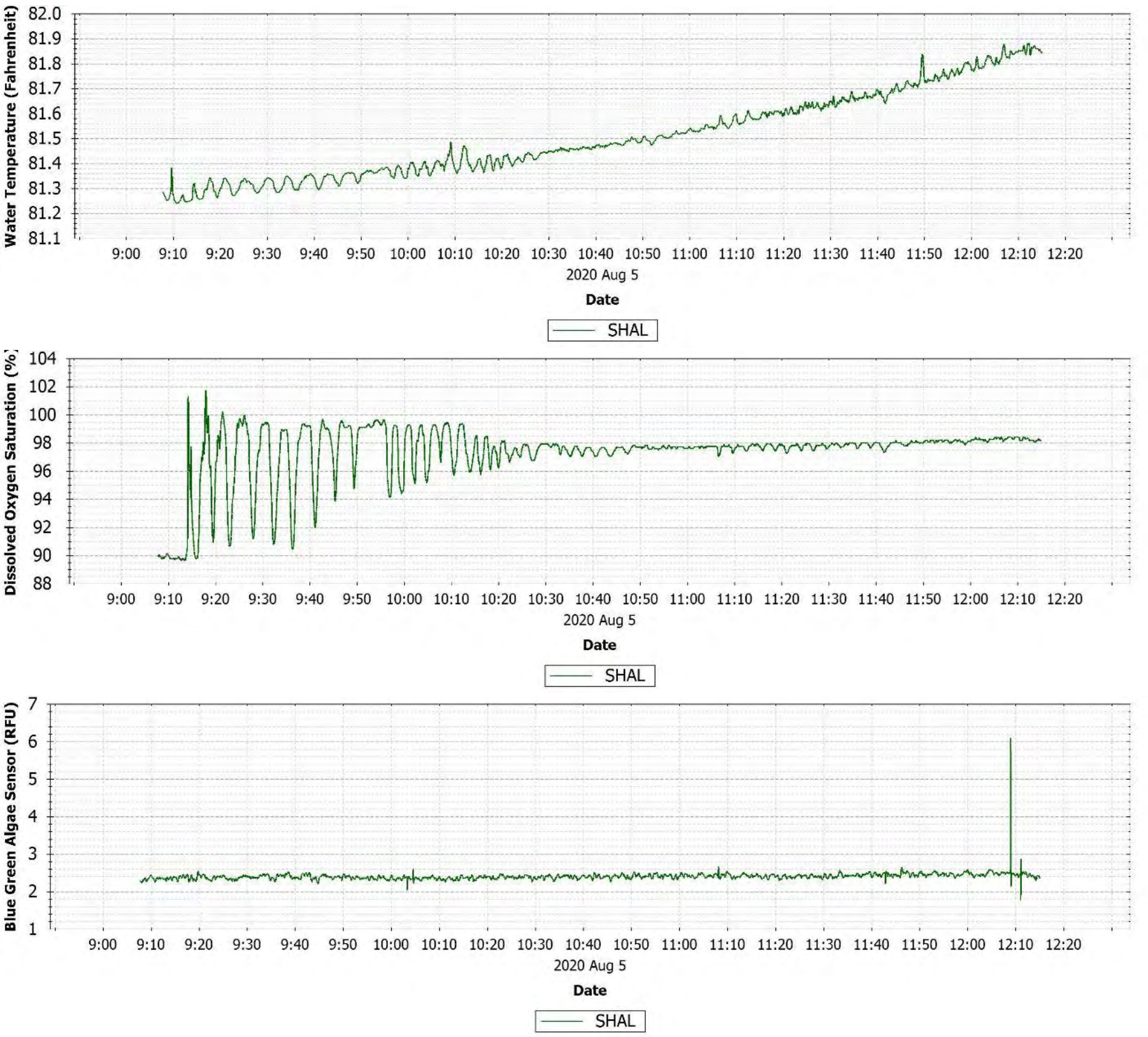


Figure C-132 Upriver August 5, 2020 drift [UR_Drift_080520_D1] observations.

C.55 AUGUST 6, 2020 DRIFT UPRIVER

Sampling reported in two drifts and the second was a continuation of the first drift. The DO plume fully mixed in the water column quickly. There was a small decrease in DO where the oxbow lake/horseshoe bend discharges to the Savannah River. Downstream of the oxbow lake, DO began to decrease gradually moving downstream.

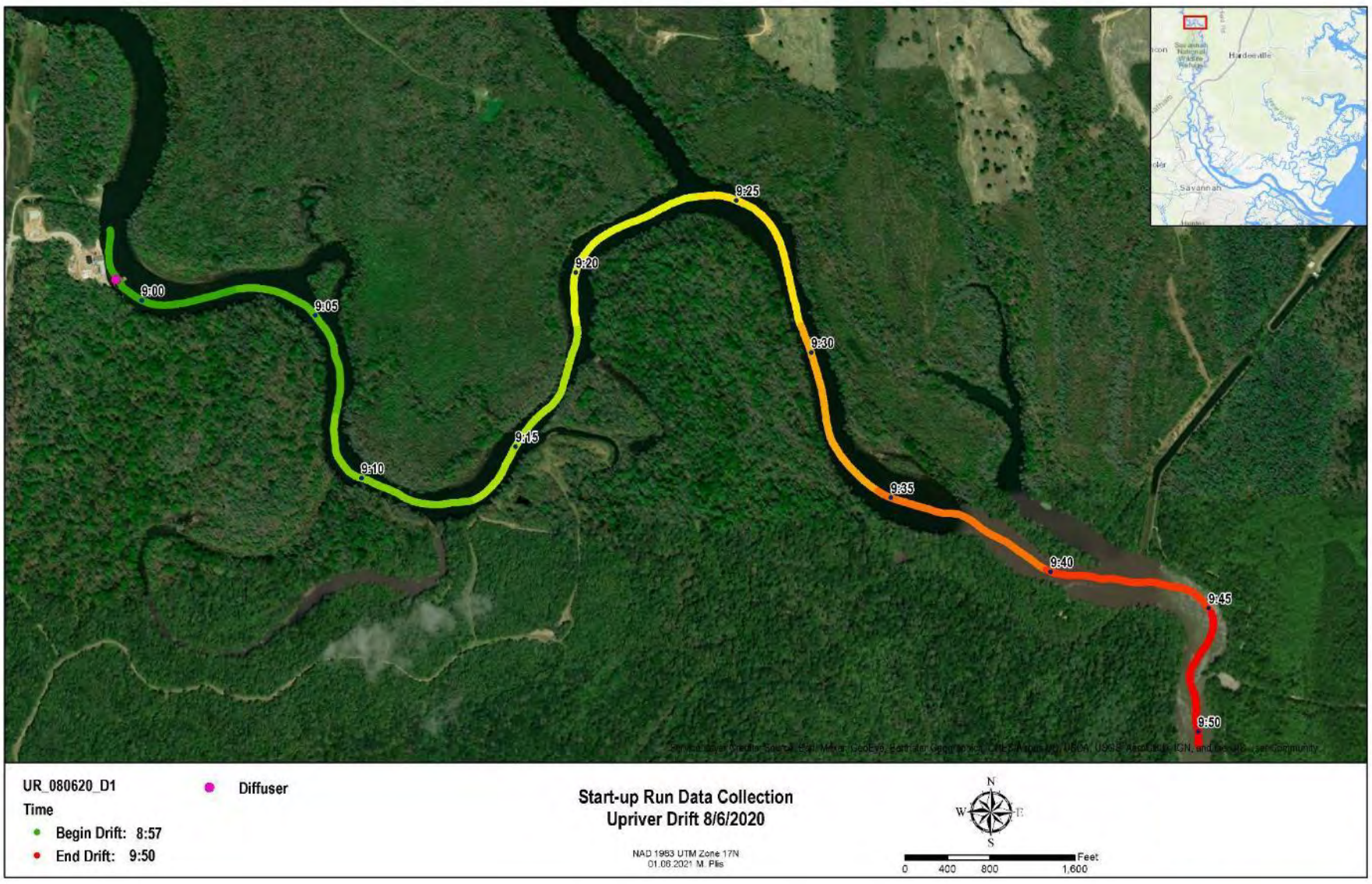
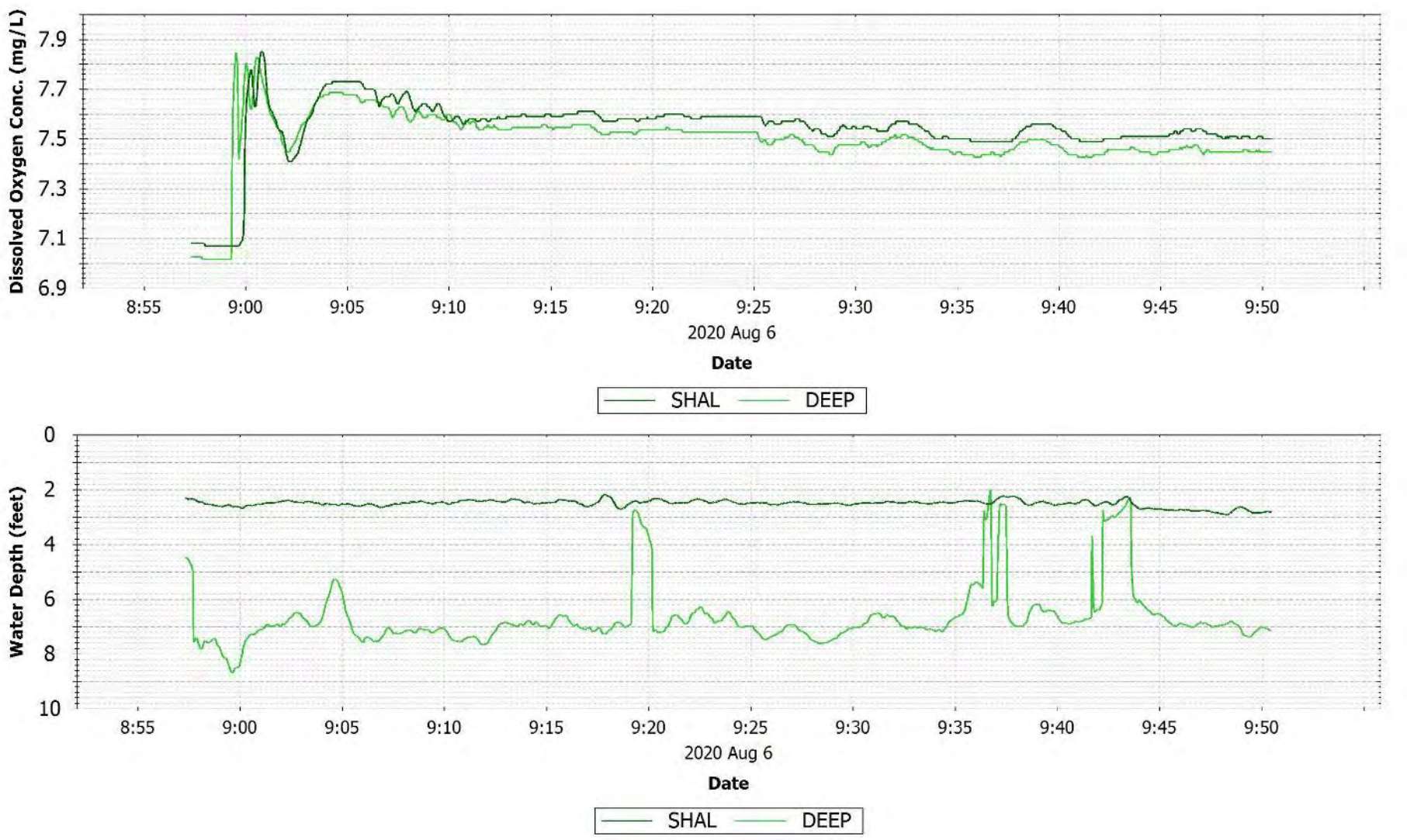


Figure C-133 Upriver August 6, 2020 drift 1 [UR_Drift_080620_D1] location map



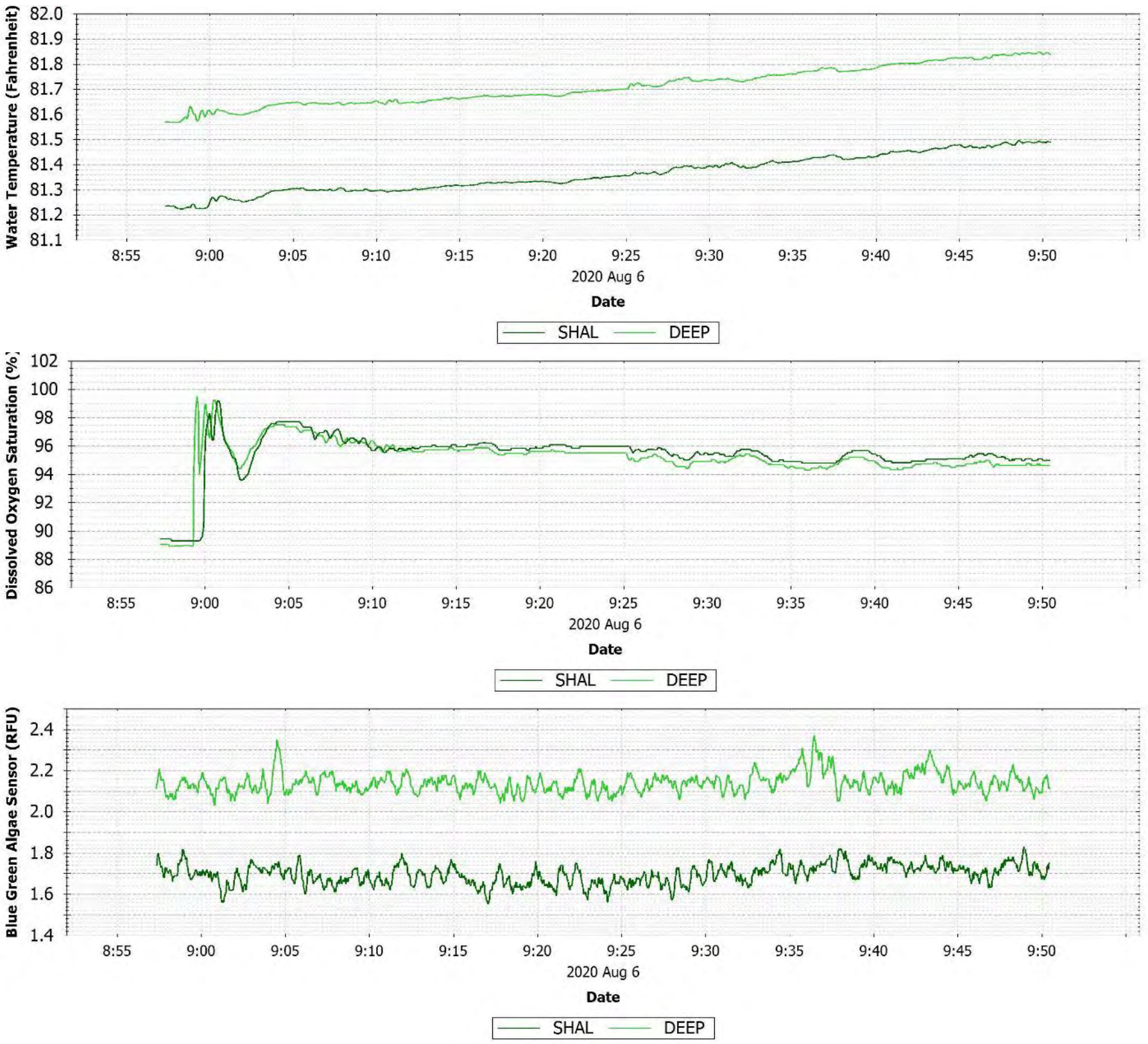


Figure C-134 Upriver August 6, 2020 drift 1 [UR_Drift_080620_D1] observations.

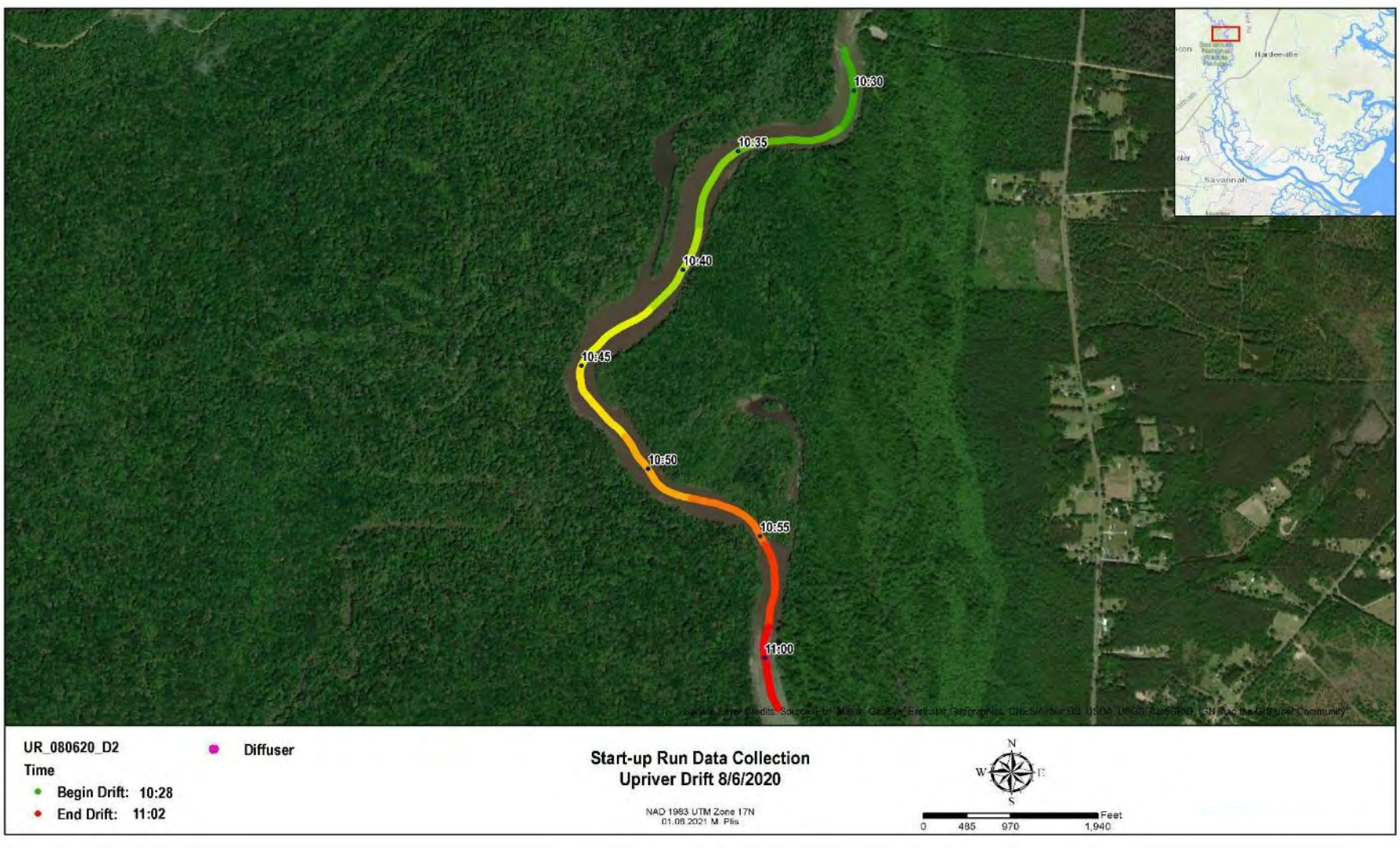


Figure C-135 Upriver August 6, 2020 drift 2 [UR_Drift_080620_D2] location map

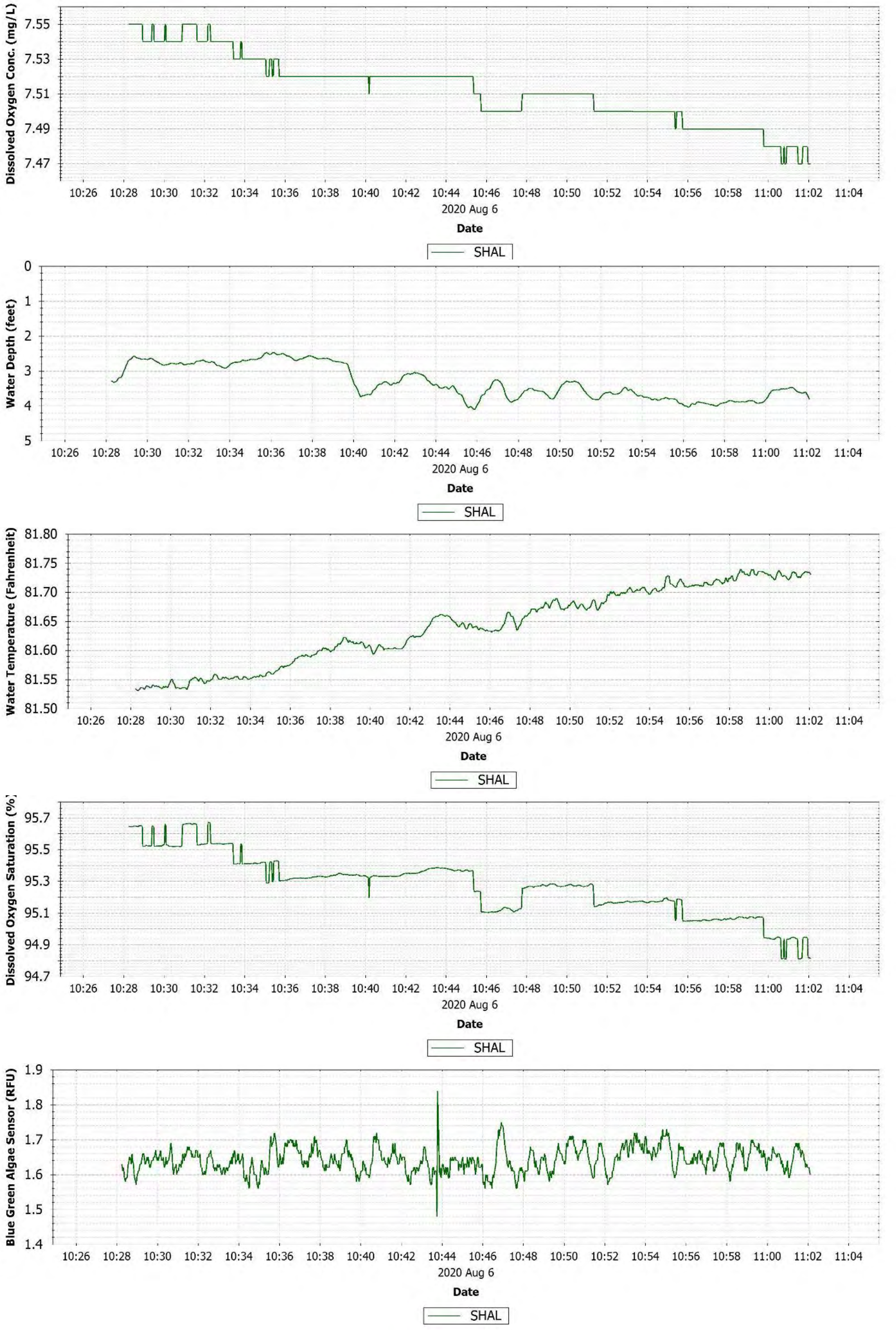


Figure C-136 Upriver August 6, 2020 drift 2 [UR_Drift_080620_D2] observations.

C.56 AUGUST 10, 2020 DYE INJECTION DRIFT UPRIVER

Two boats sampled the dye injection. Near the diffuser, the DO and dye concentrations were higher near the bottom of the water column. DO appeared to become vertically mixed in the water column 500 feet downstream of the diffuser. The dye was measured at the diffuser around 1000 and then the dye peak was located 2000 feet downstream 30 minutes later. The main report provides a detailed analysis of these measurements.

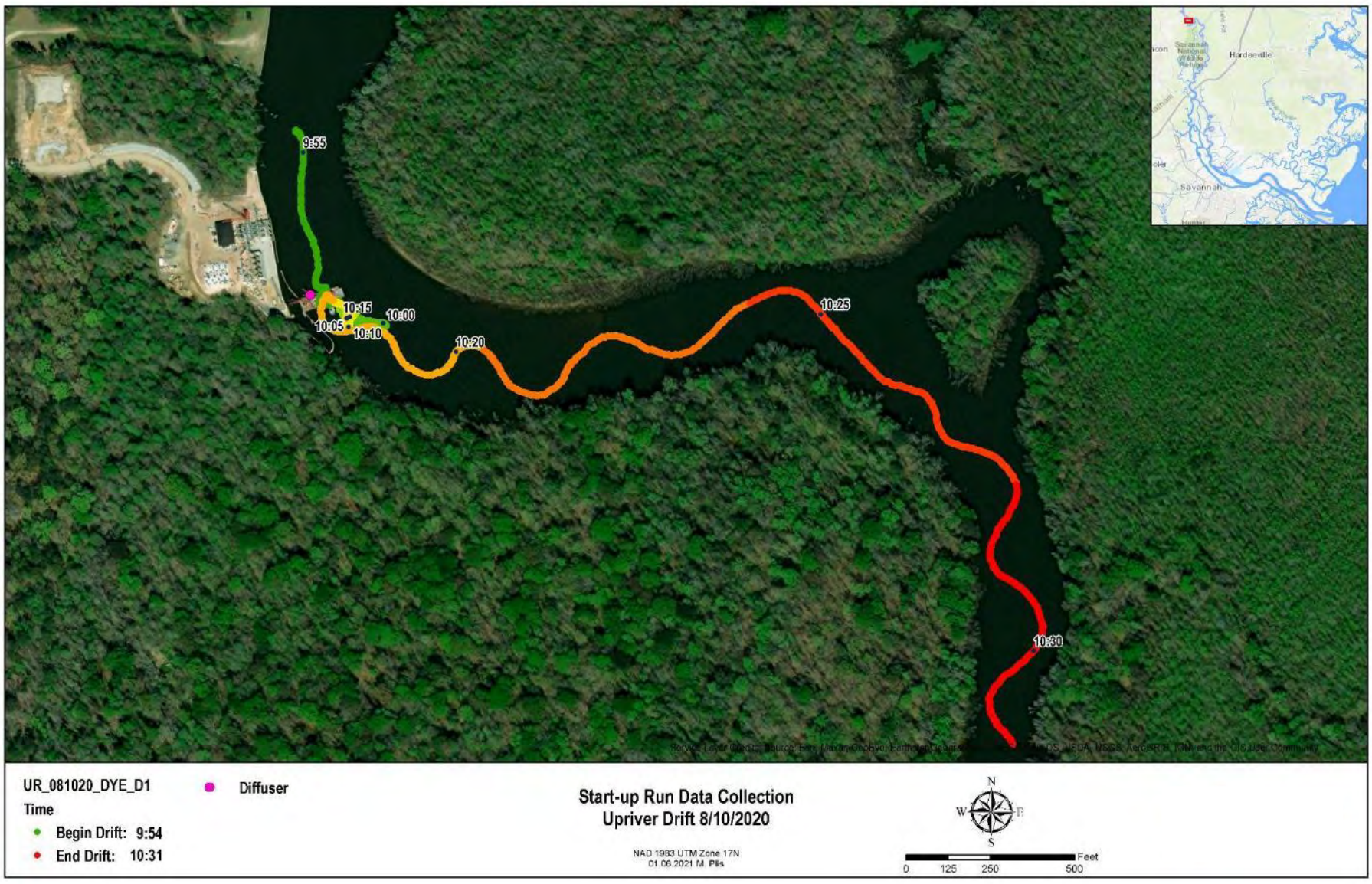
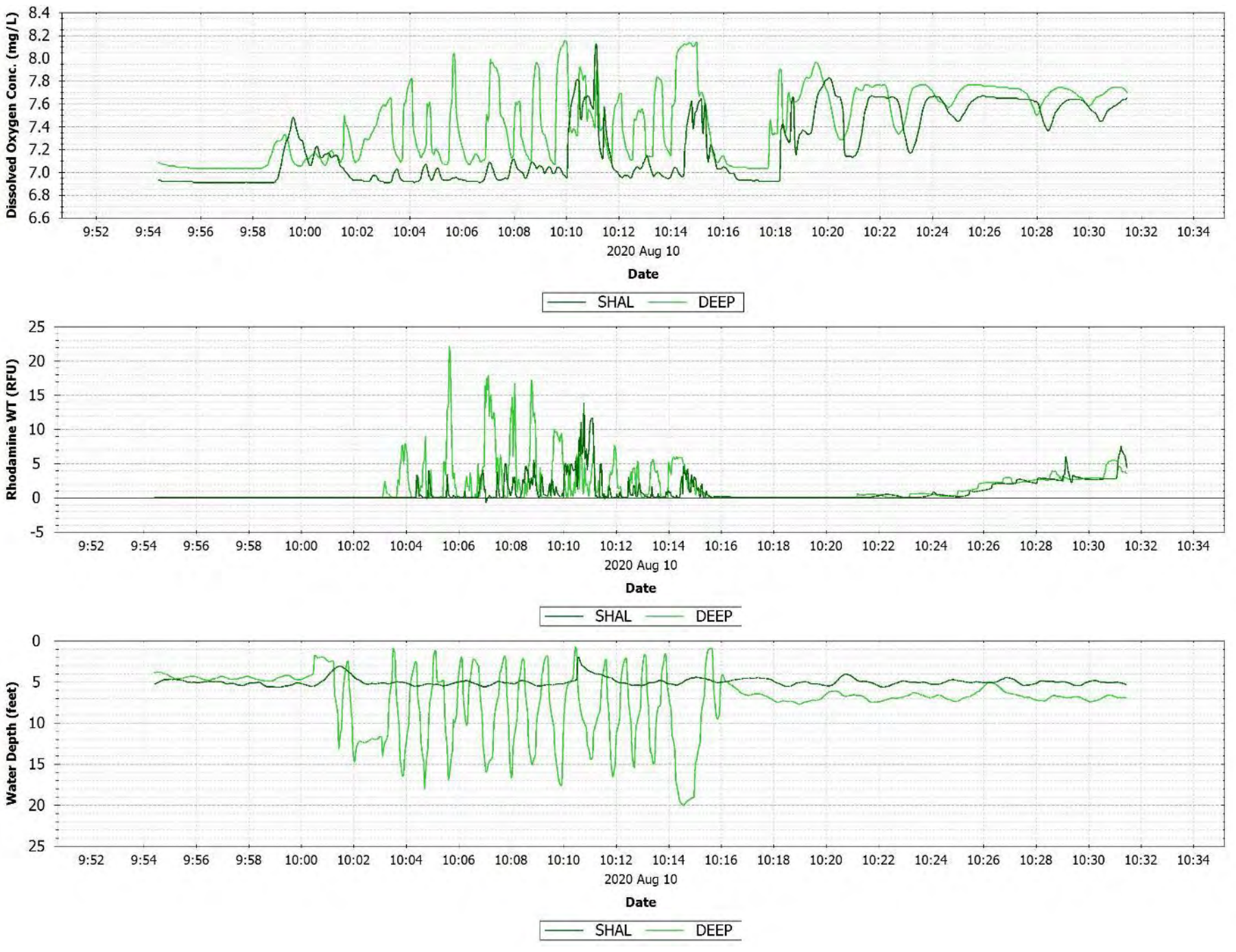


Figure C-137 Upriver August 10, 2020 dye injection drift 1 [UR_Drift_081020_DYE_D1] location map



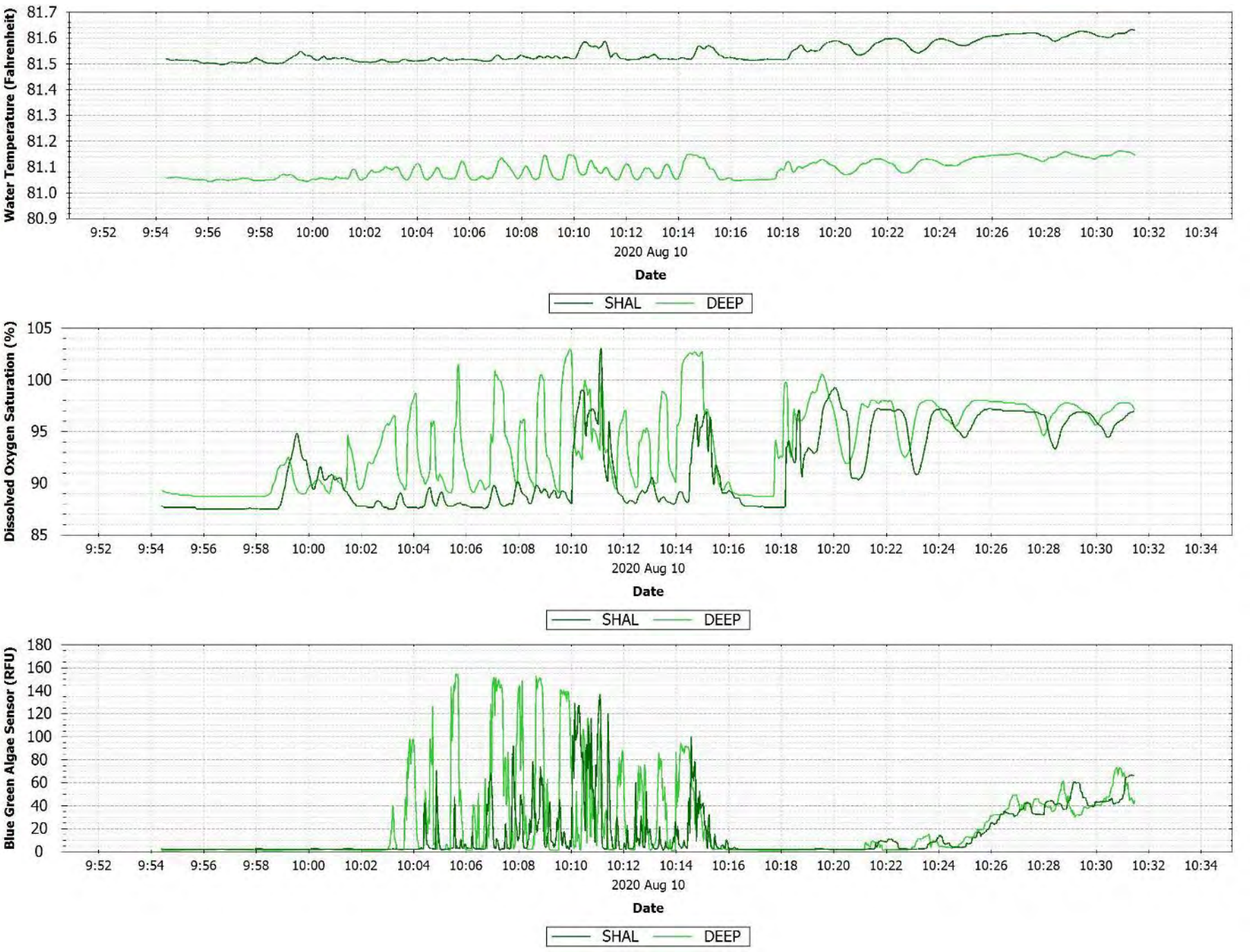


Figure C-138 Upriver August 10, 2020 dye injection drift 1 [UR_Drift_081020_DYE_D1] observations.



Figure C-139 Upriver August 10, 2020 dye injection drift 2 [UR_Drift_081020_DYE_D2] location map

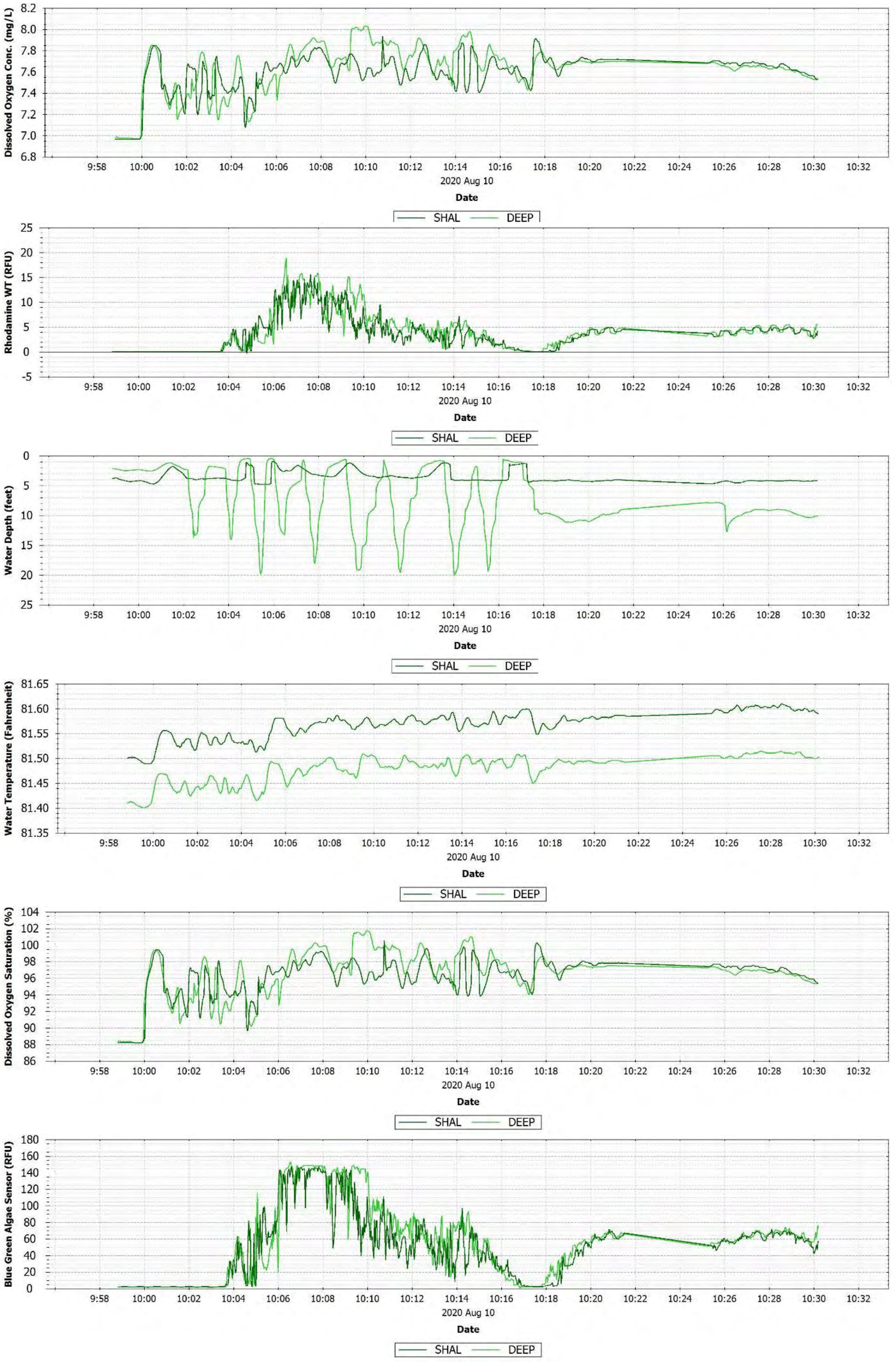


Figure C-140 Upriver August 10, 2020 dye injection drift 2 [UR_Drift_081020_DYE_D2] observations.

C.57 AUGUST 13, 2020 DRIFT UPRIVER

The drift was conducted in a zig zag pattern and the DO concentrations were higher near the south bank until the plume became fully mixed laterally approximately near the oxbow where low DO tributary water flowed in and gradually mixed laterally across the river.

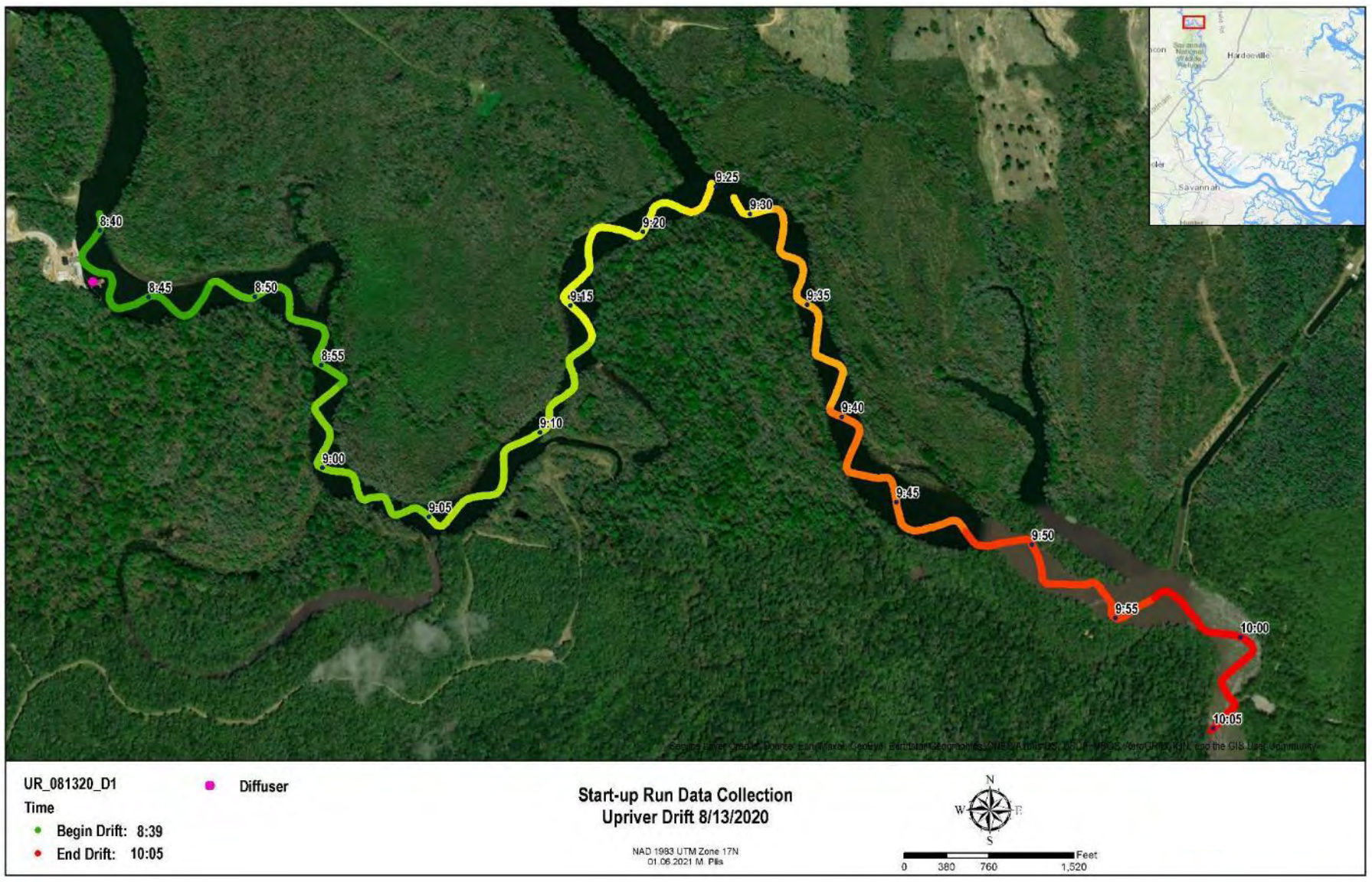
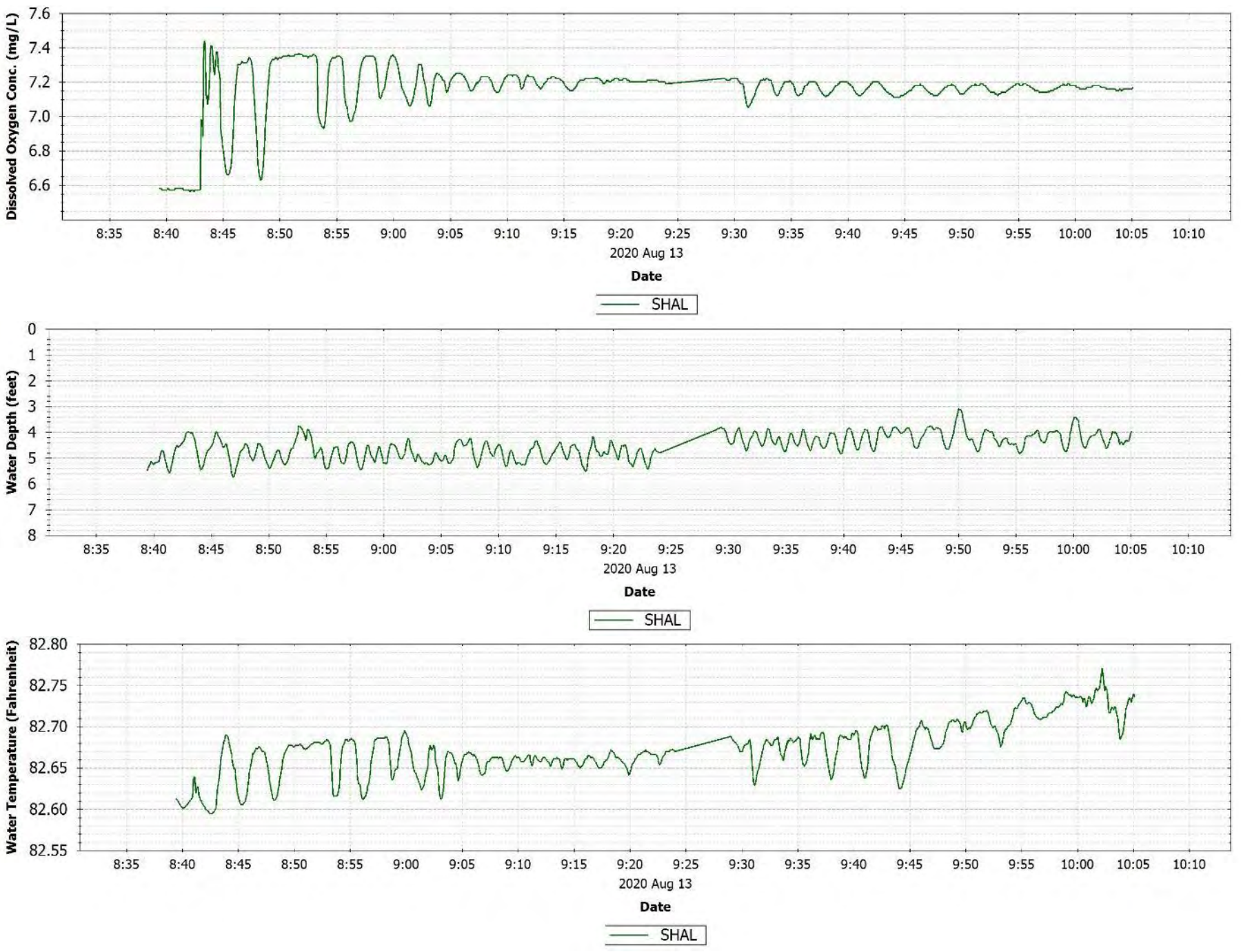


Figure C-141 Upriver August 13, 2020 drift [UR_Drift_081320_D1] location map



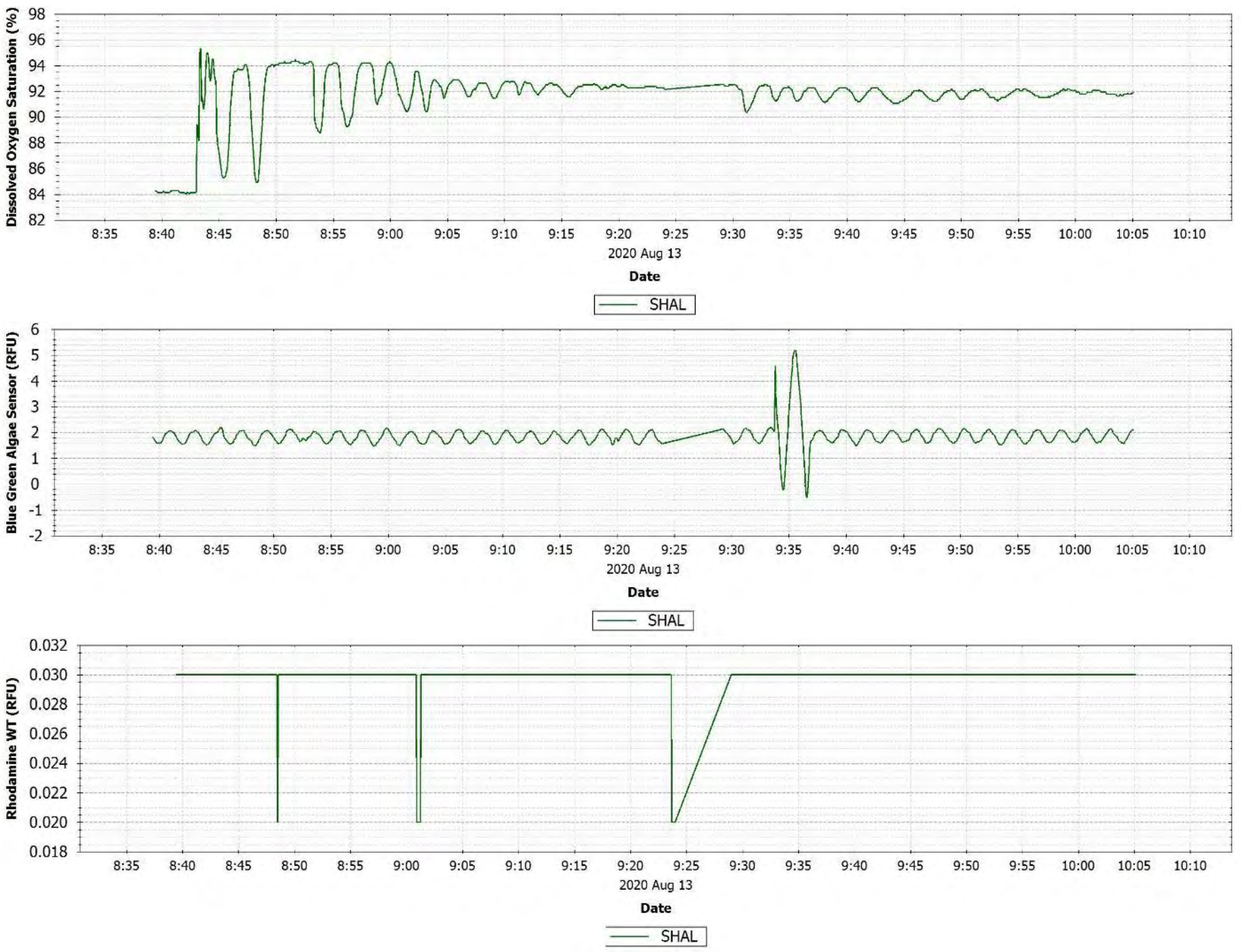


Figure C-142 Upriver August 13, 2020 drift [UR_Drift_081320_D1] observations.

C.58 AUGUST 16, 2020 DRIFT UPRIVER

Sampling was discontinued due to inclement weather; however, observations showed during the short drift that the DO increased below the diffuser.

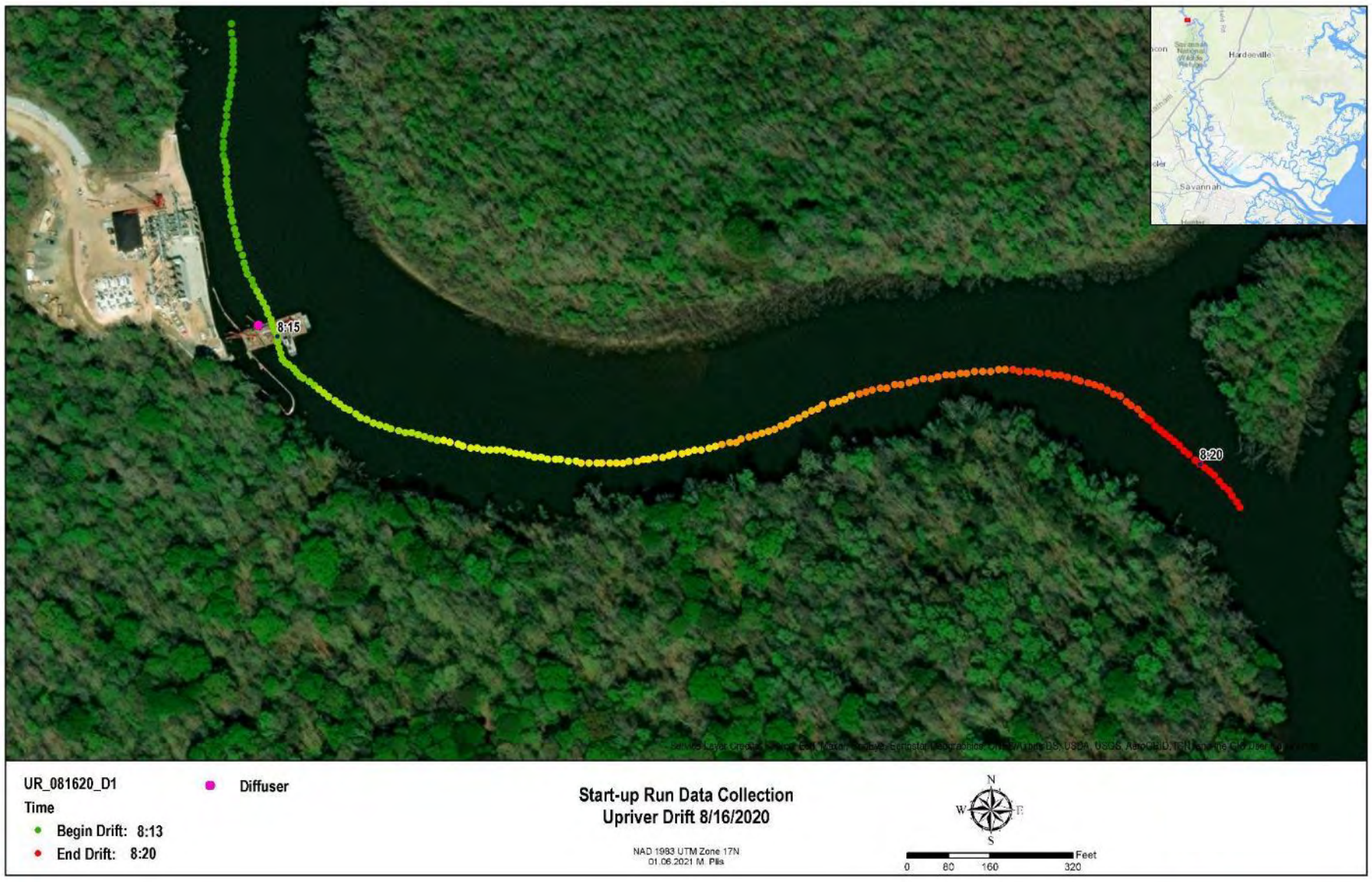
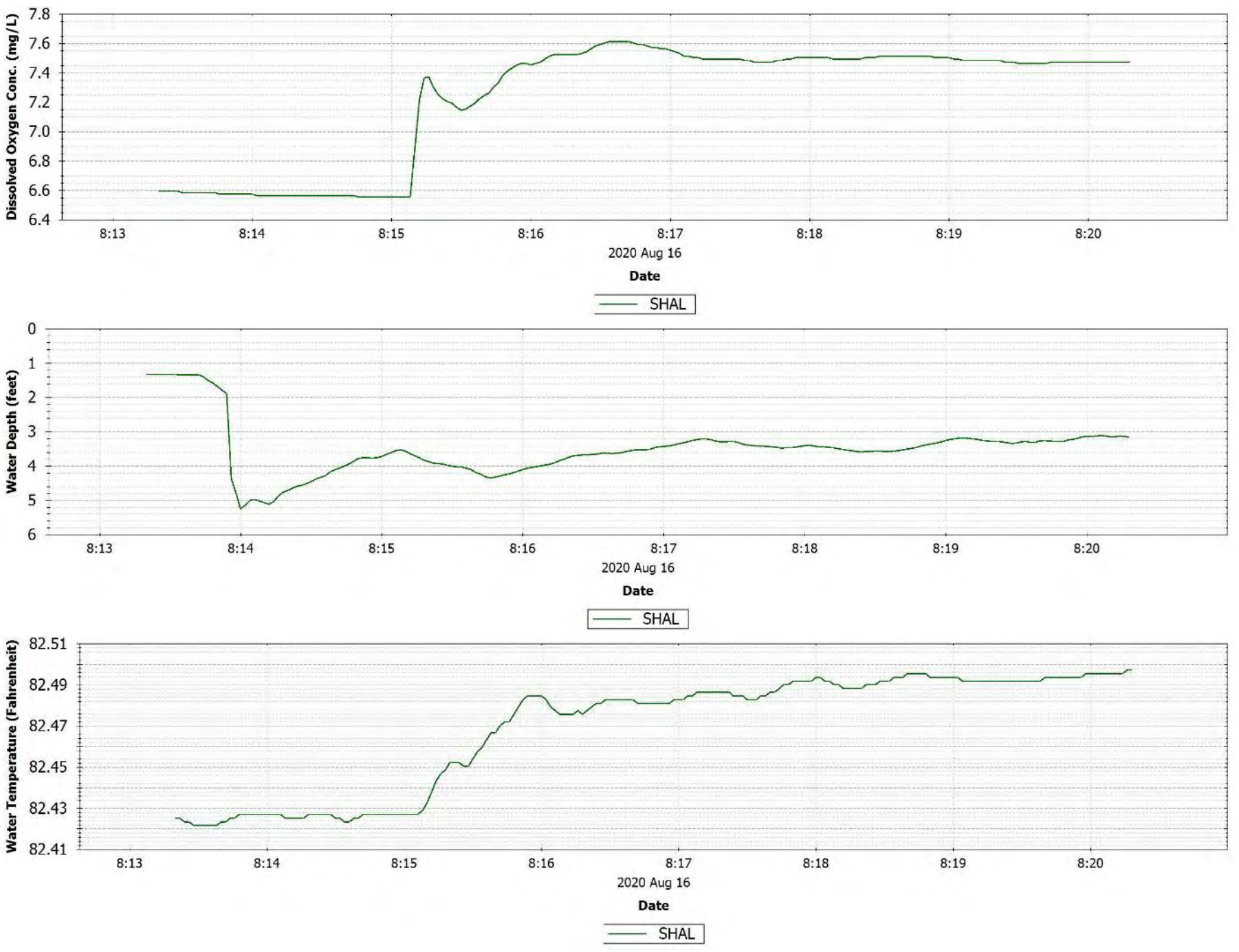


Figure C-143 Upriver August 16, 2020 drift [UR_Drift_081620_D1] location map



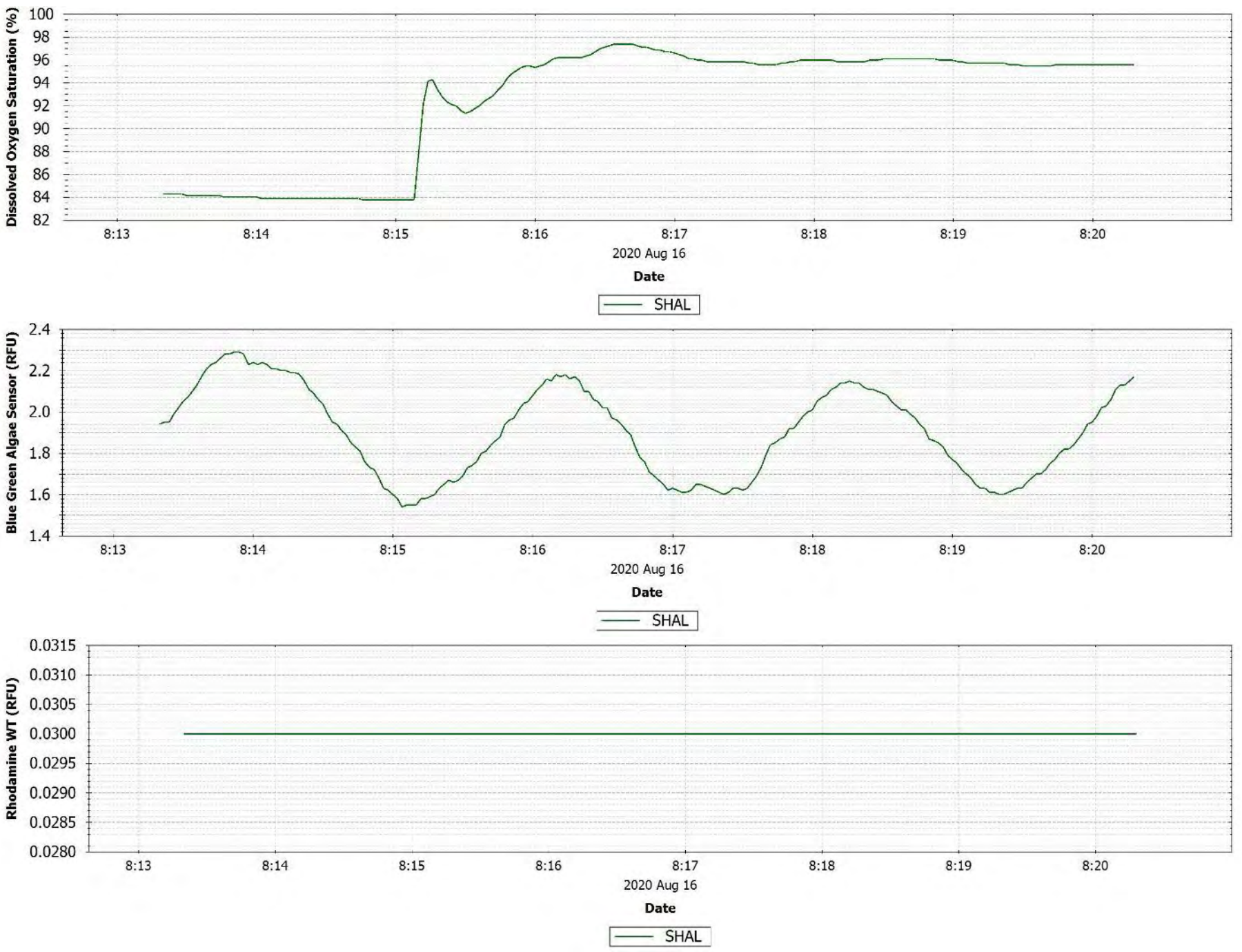


Figure C-144 Upriver August 16, 2020 drift [UR_Drift_081620_D1] observations.

C.59 AUGUST 18, 2020 DRIFT UPRIVER

The drift was conducted in a zig-zag pattern and the DO concentrations were higher near the south bank until the plume became fully mixed laterally, approximately 2,600 feet downstream of the diffuser and below the oxbow.

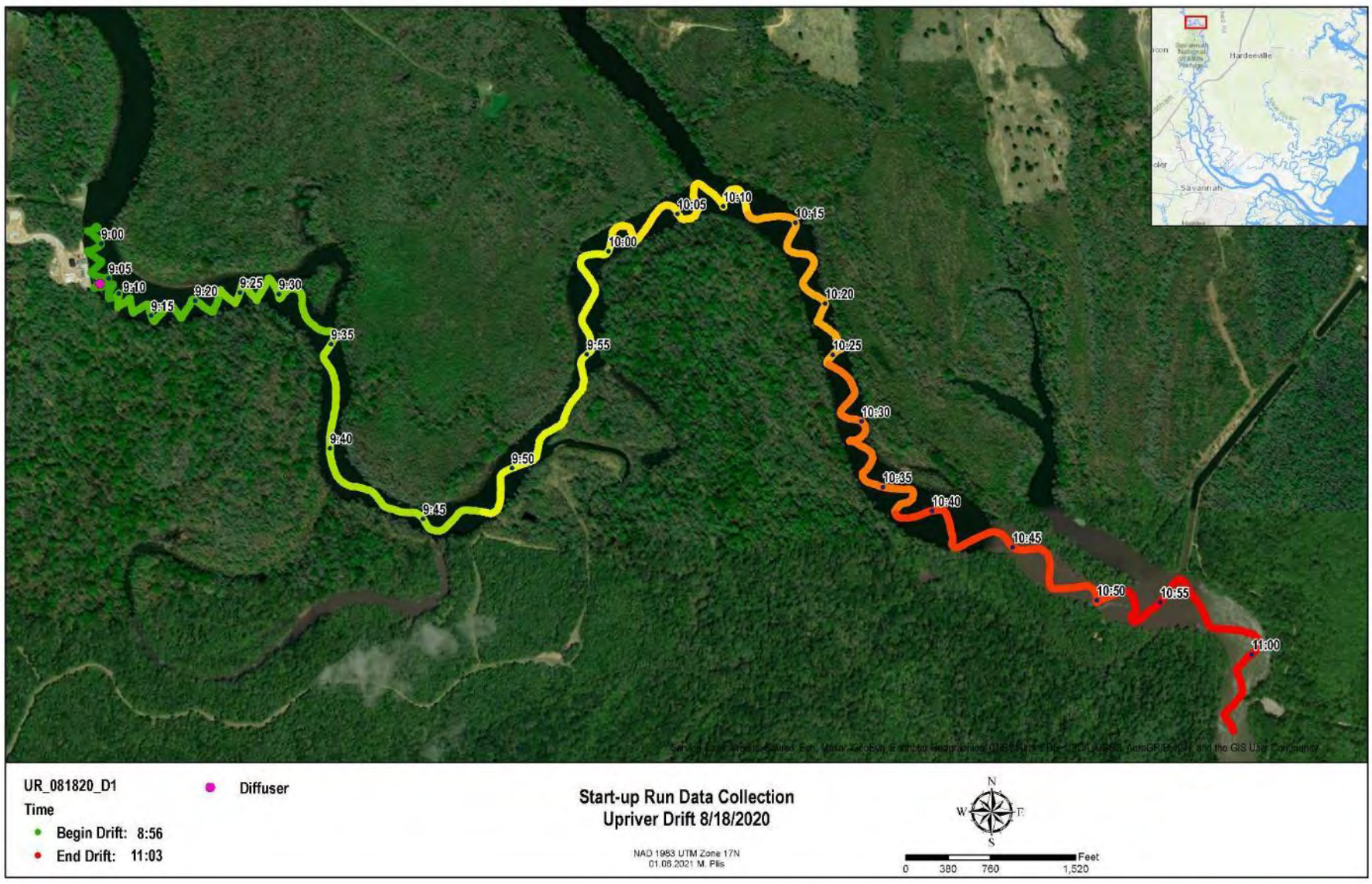
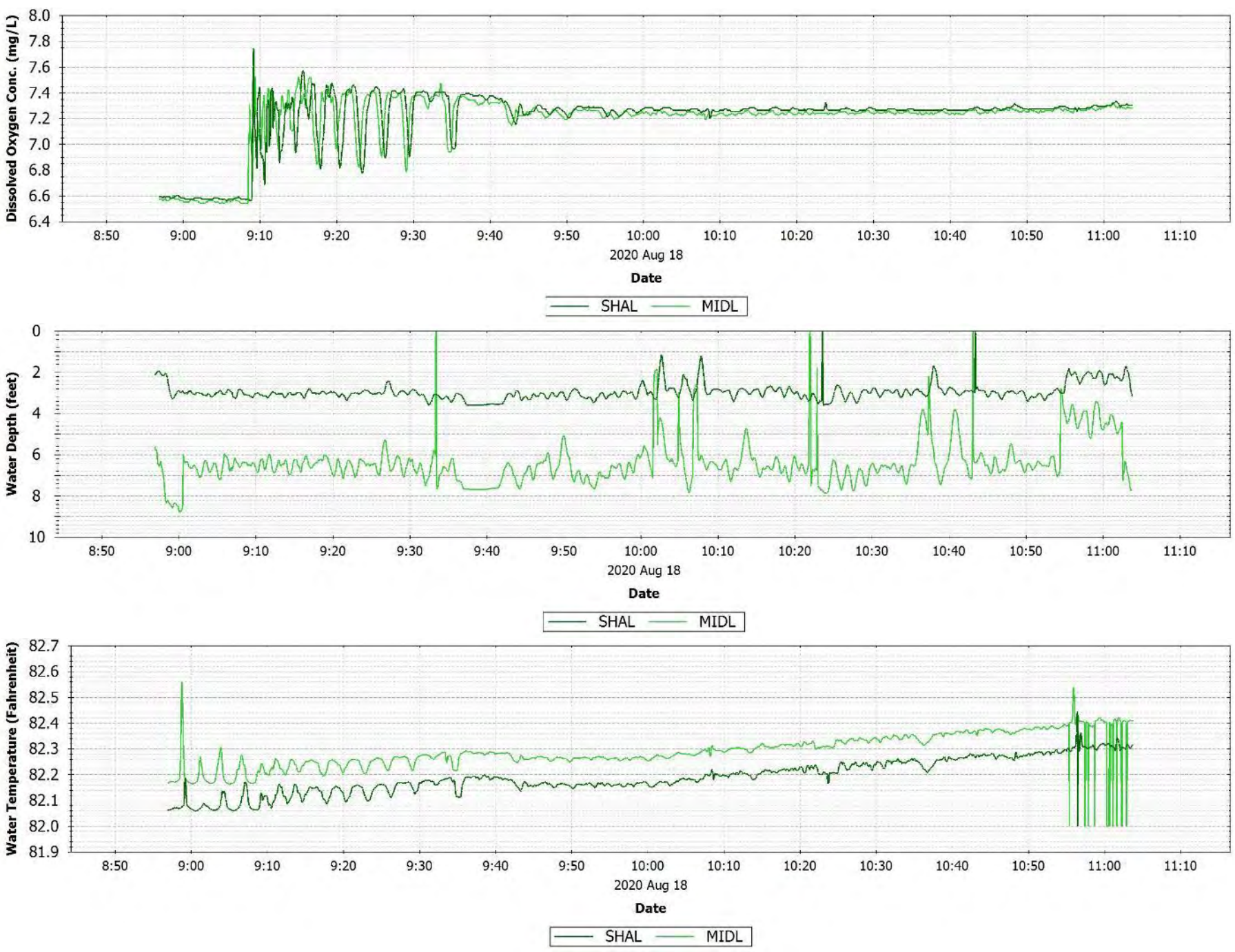


Figure C-145 Upriver [UR_Drift_081820_D1] location map



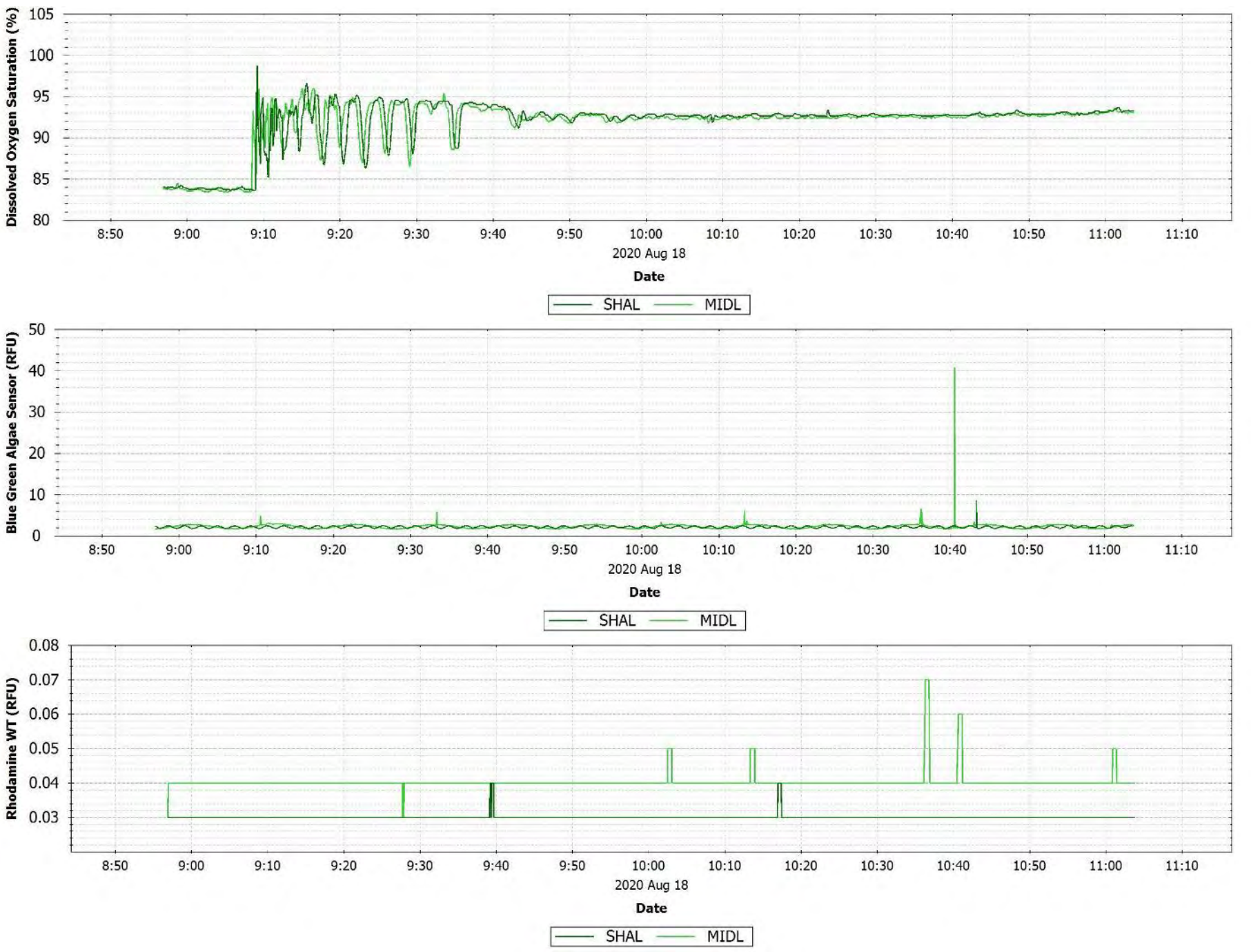


Figure C-146 Upriver August 18, 2020 drift [UR_Drift_081820_D1] observations.

C.60 AUGUST 20, 2020 DRIFT UPRIVER

The DO plume fully mixed in the water column quickly. There was a decrease in DO where the oxbow lake/horseshoe bend discharges to the Savannah River. Downstream of the oxbow lake, DO began to decrease gradually moving downstream.

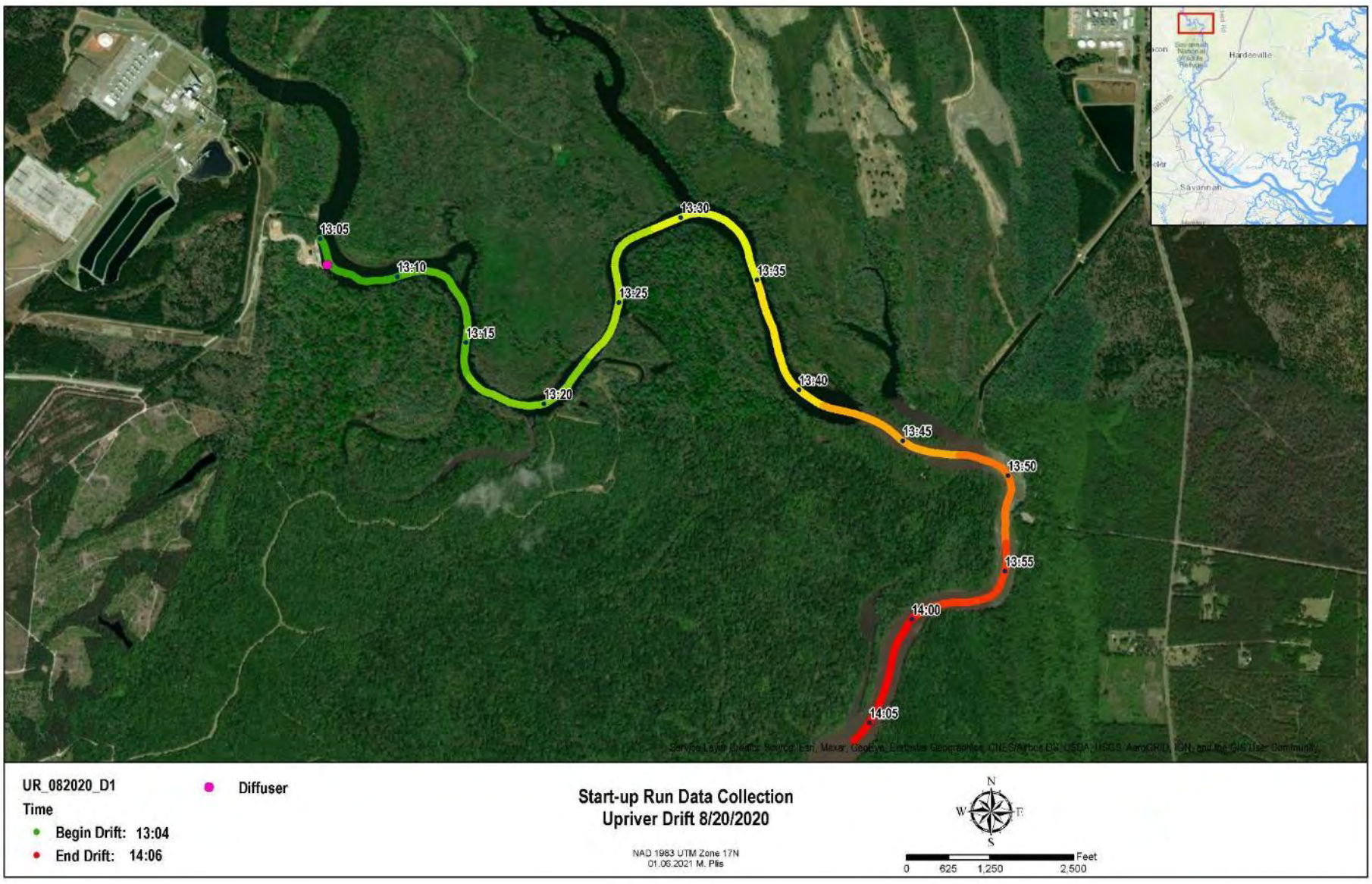
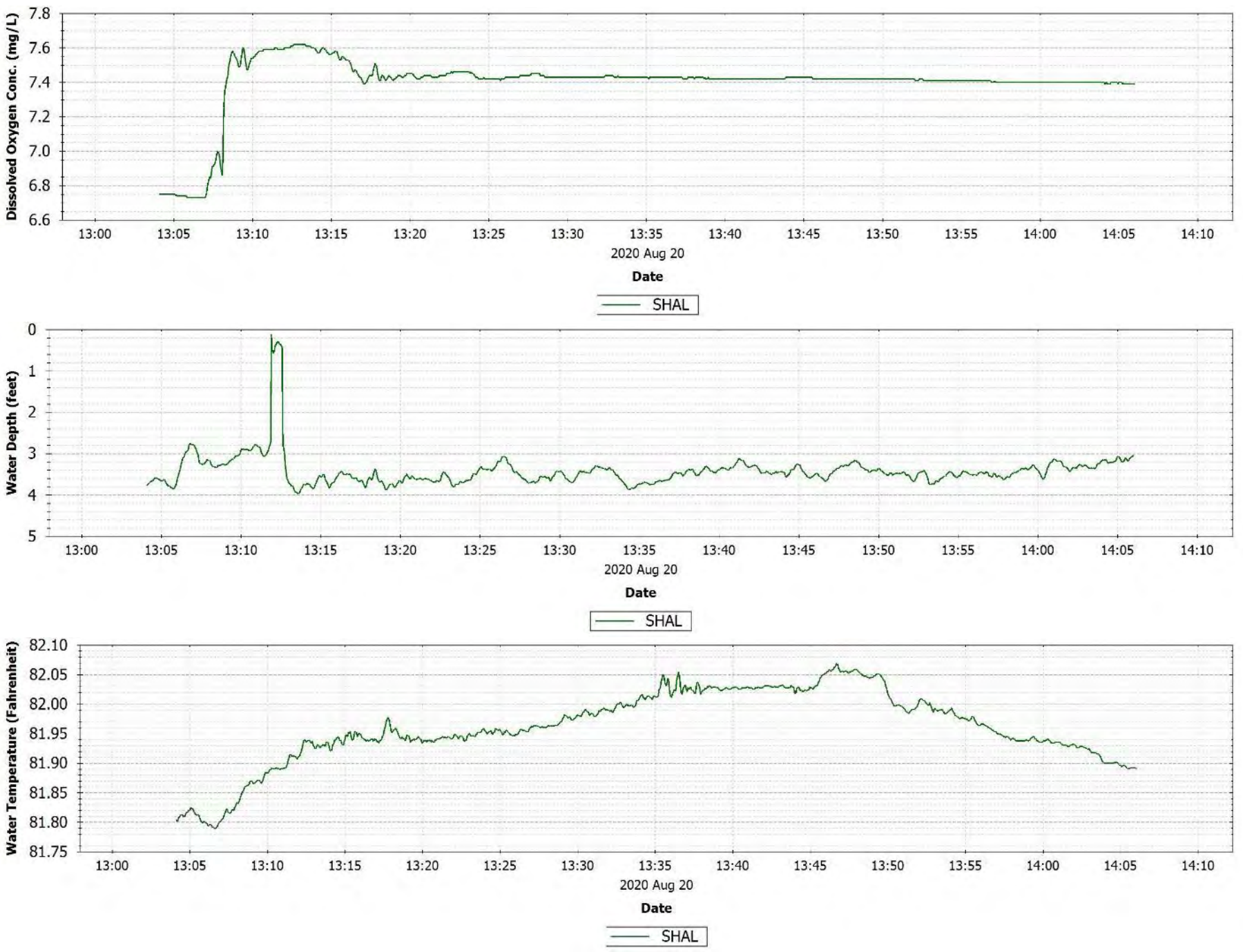


Figure C-147 Upriver August 20, 2020 drift [UR_Drift_082020_D1] location map



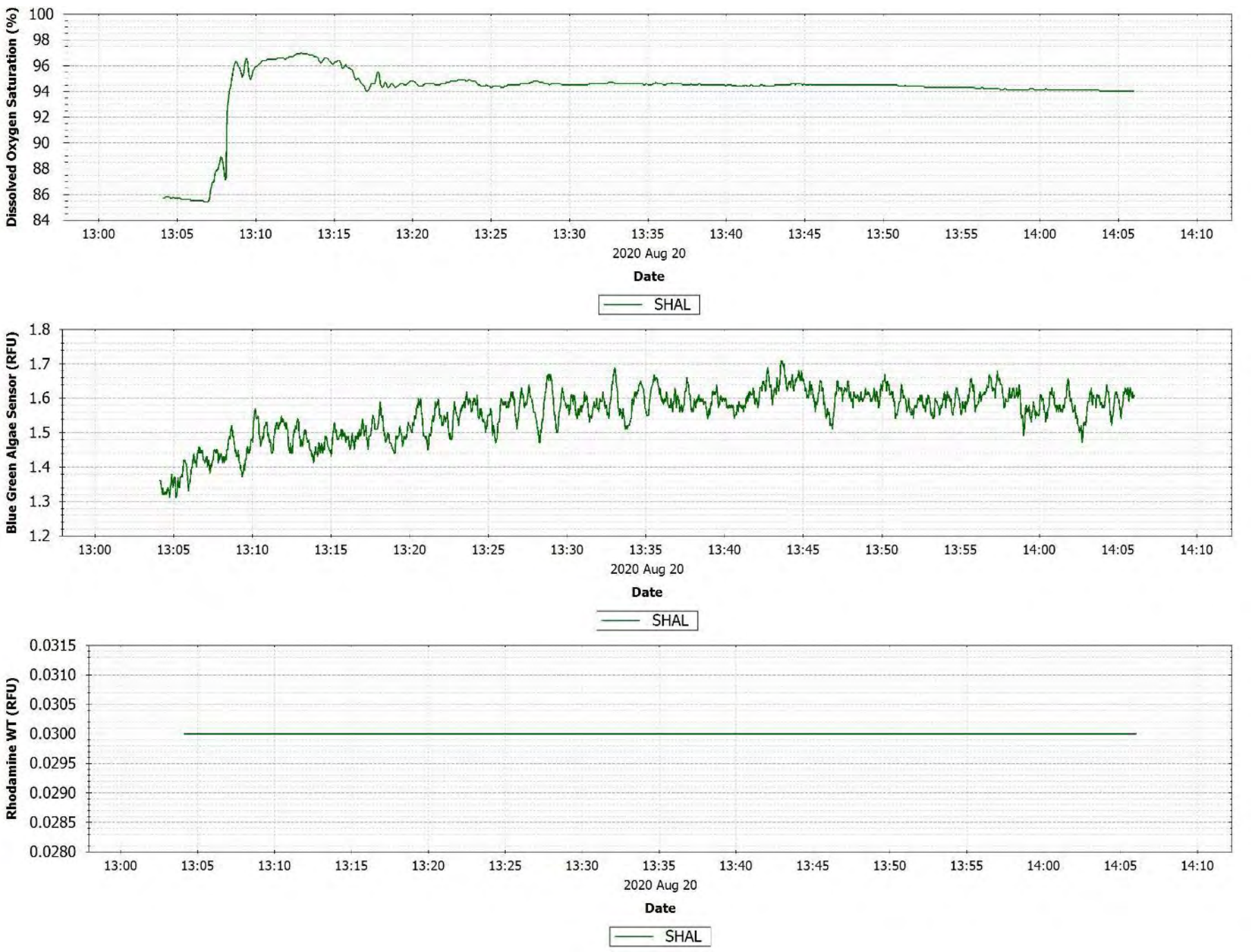


Figure C-148 Upriver August 20, 2020 drift [UR_Drift_082020_D1] observations.

C.61 AUGUST 23, 2020 DRIFT UPRIVER

The DO plume was detected downstream of the diffuser.

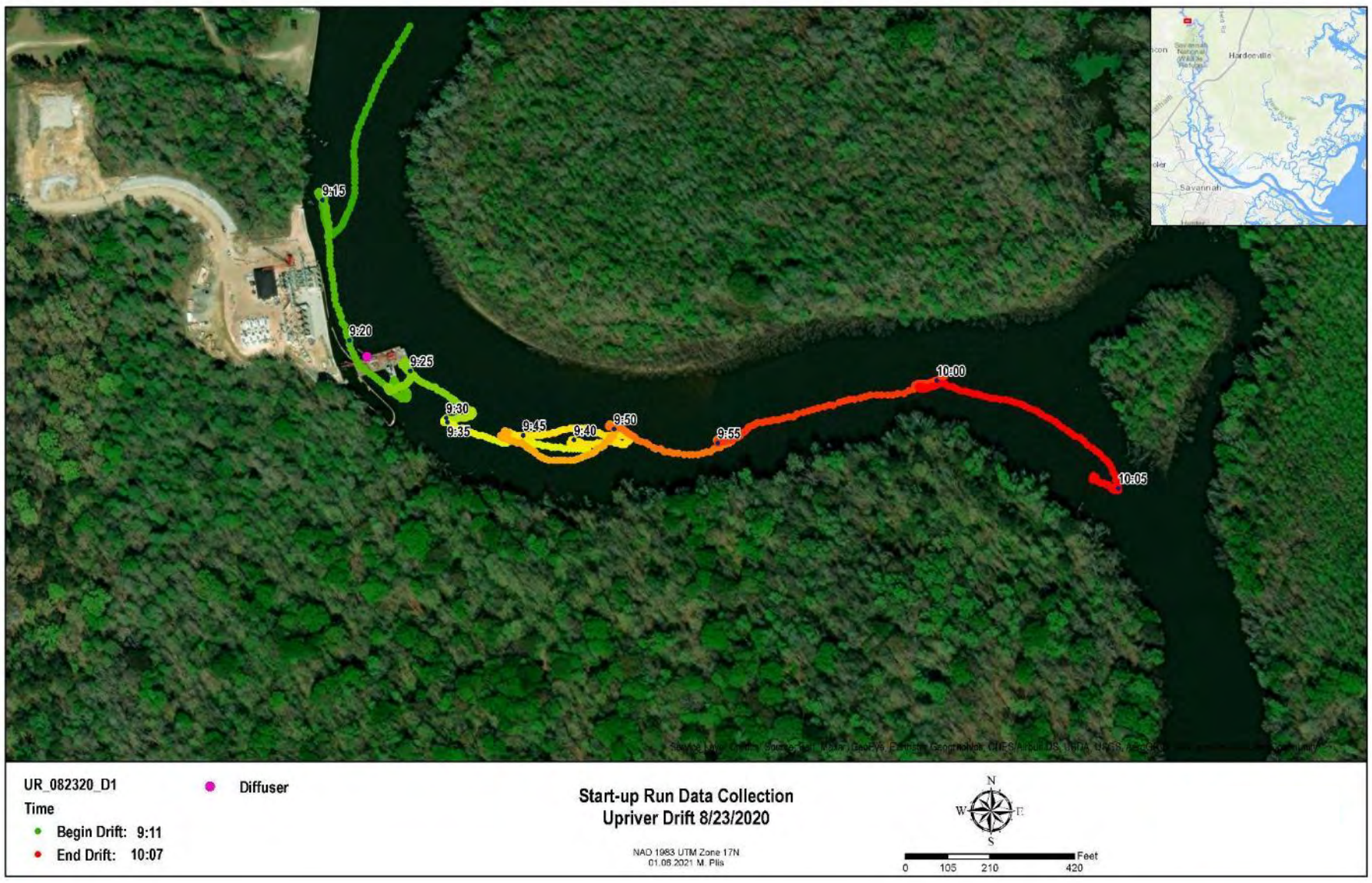
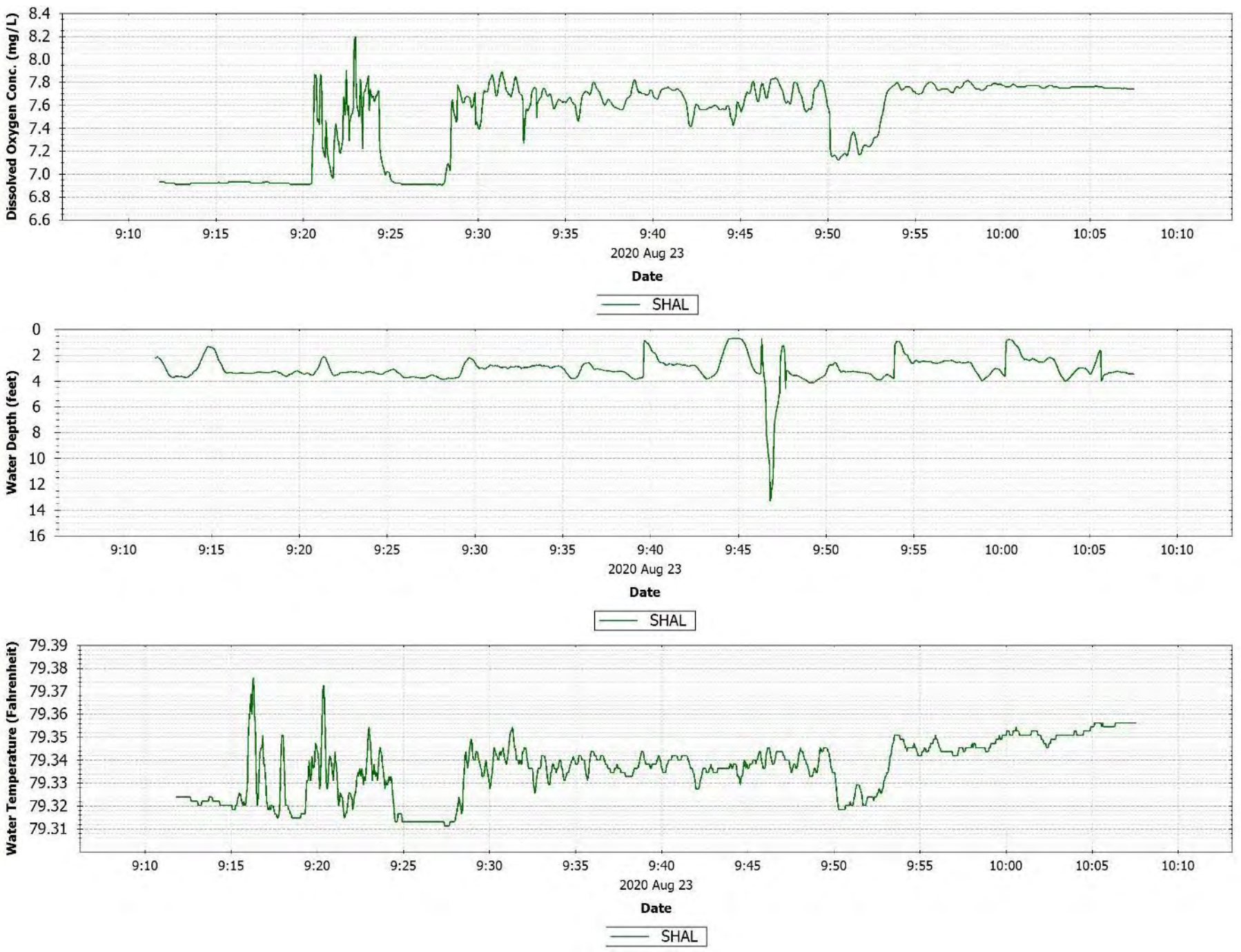


Figure C-149 Upriver August 23, 2020 drift [UR_Drift_082320_D1] location map



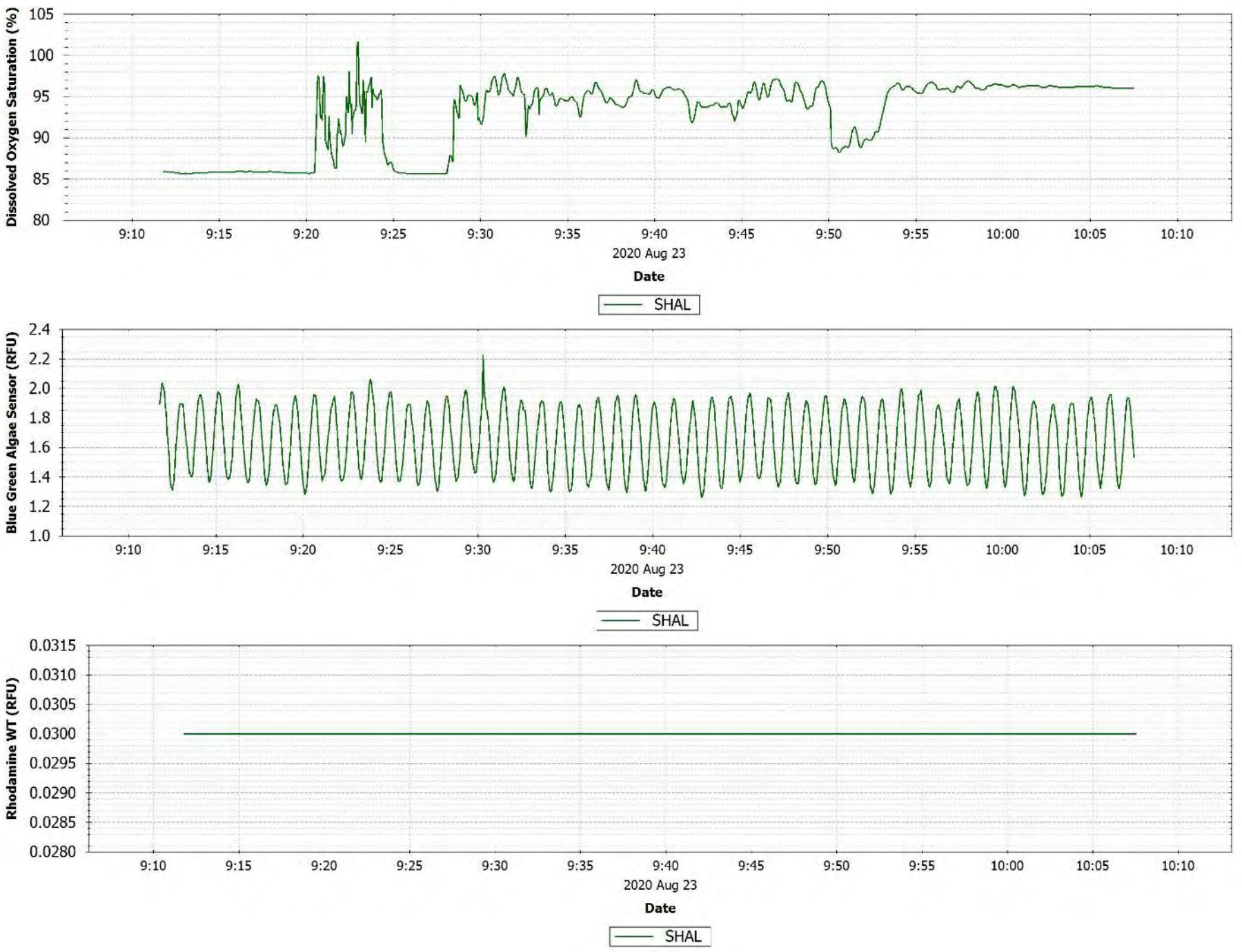


Figure C-150 Upriver August 23, 2020 drift [UR_Drift_082320_D1] observations.

C.62 AUGUST 24, 2020 DYE INJECTION DRIFT UPRIVER

Three separate drifts were sampled. First drift looked at the dye dispersion around the diffuser. Near the diffuser, DO and dye concentrations were higher near the bottom of the water column and the DO and dye plumes were detected downstream of the diffuser. The second drift followed the channel downstream to locate the dye peaks. The second drift also included measurements taken in the tributaries, which had DO values of around 5 mg/L. These tributaries caused the river DO to be slightly lowered. The third drift examined DO values in a downstream tributary.

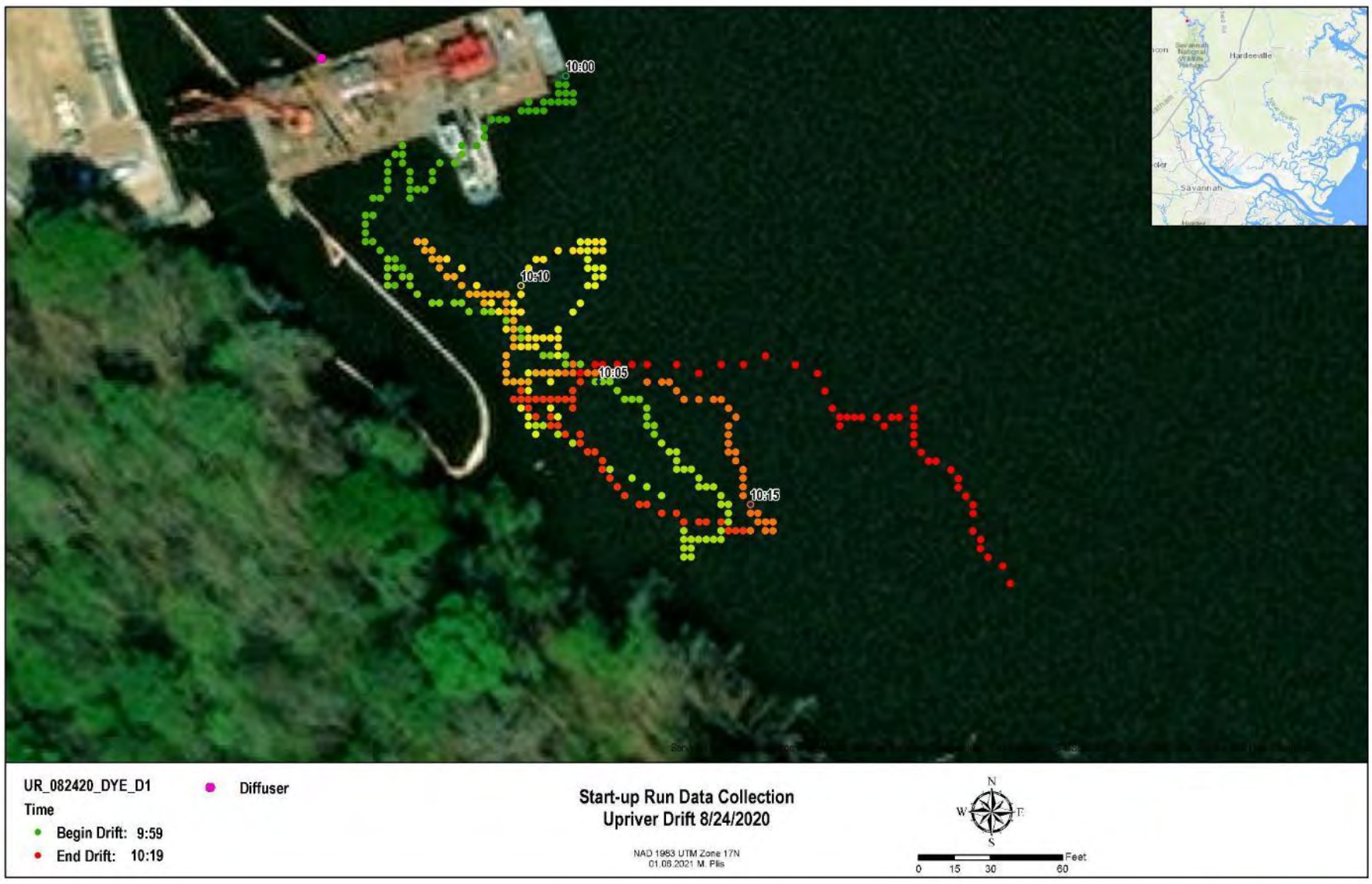
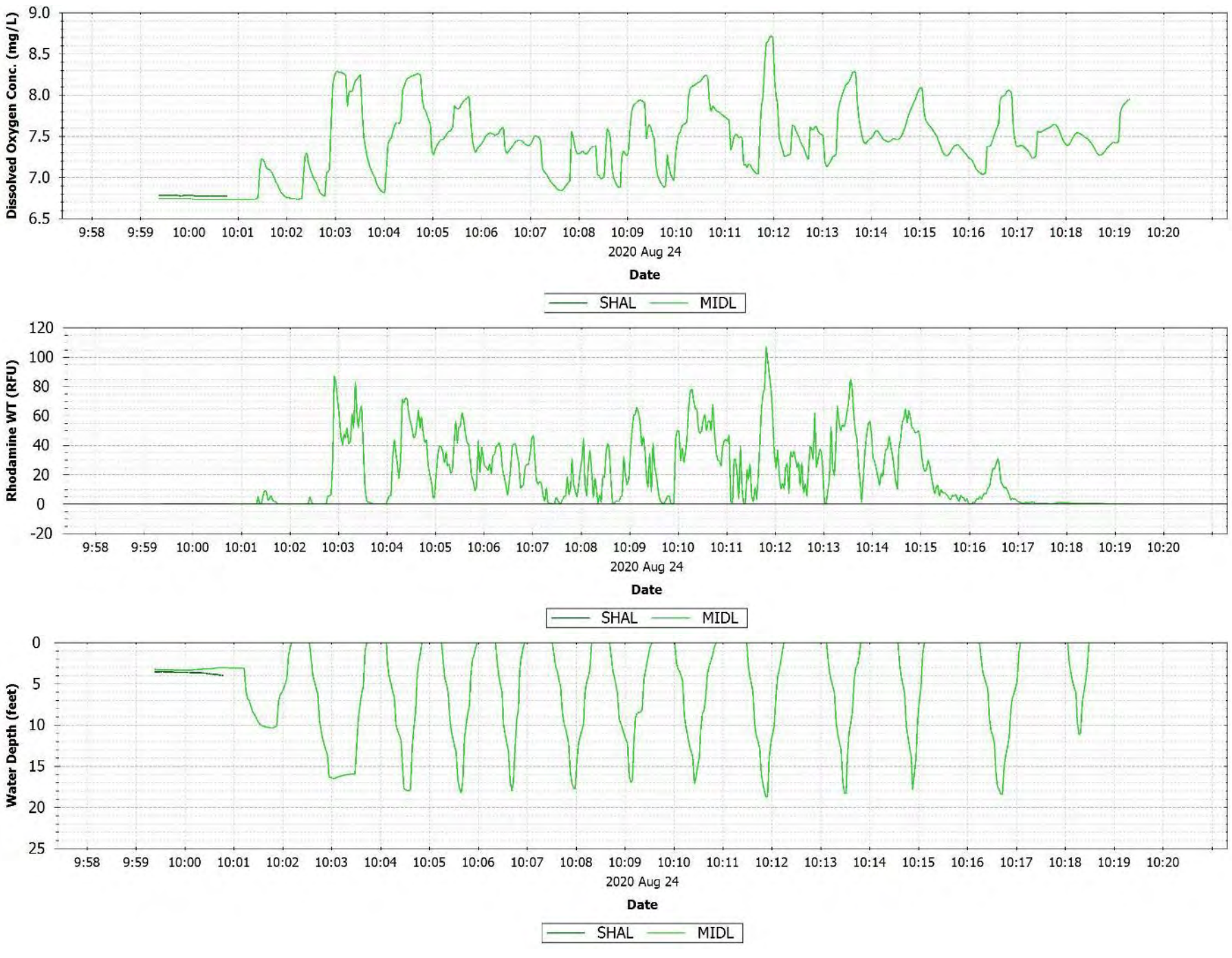


Figure C-151 Upriver August 24, 2020 dye injection drift 1 [UR_Drift_082420_DYE_D1] location map



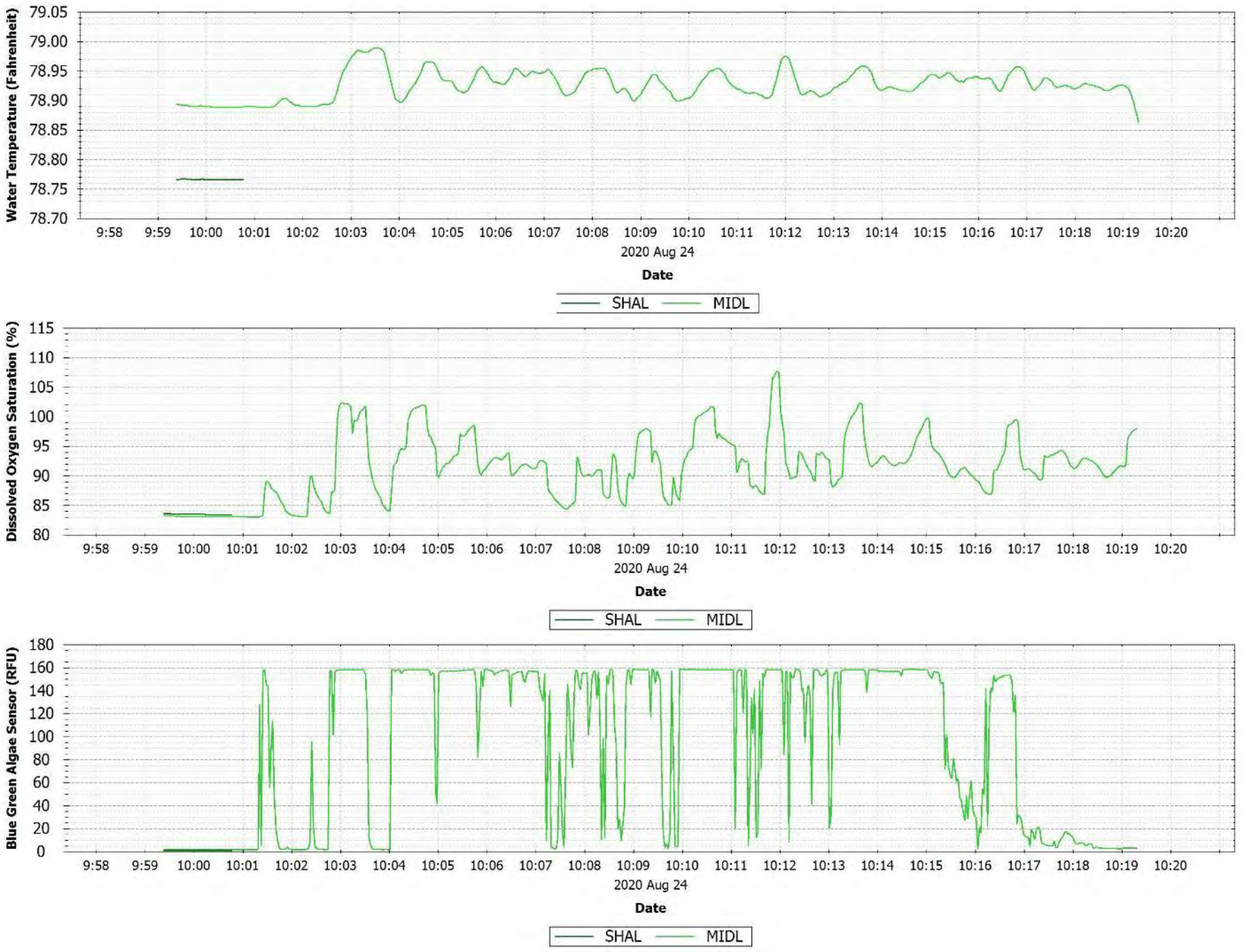


Figure C-152 Upriver August 24, 2020 dye injection drift 1 [UR_Drift_082420_DYE_D1] observations.

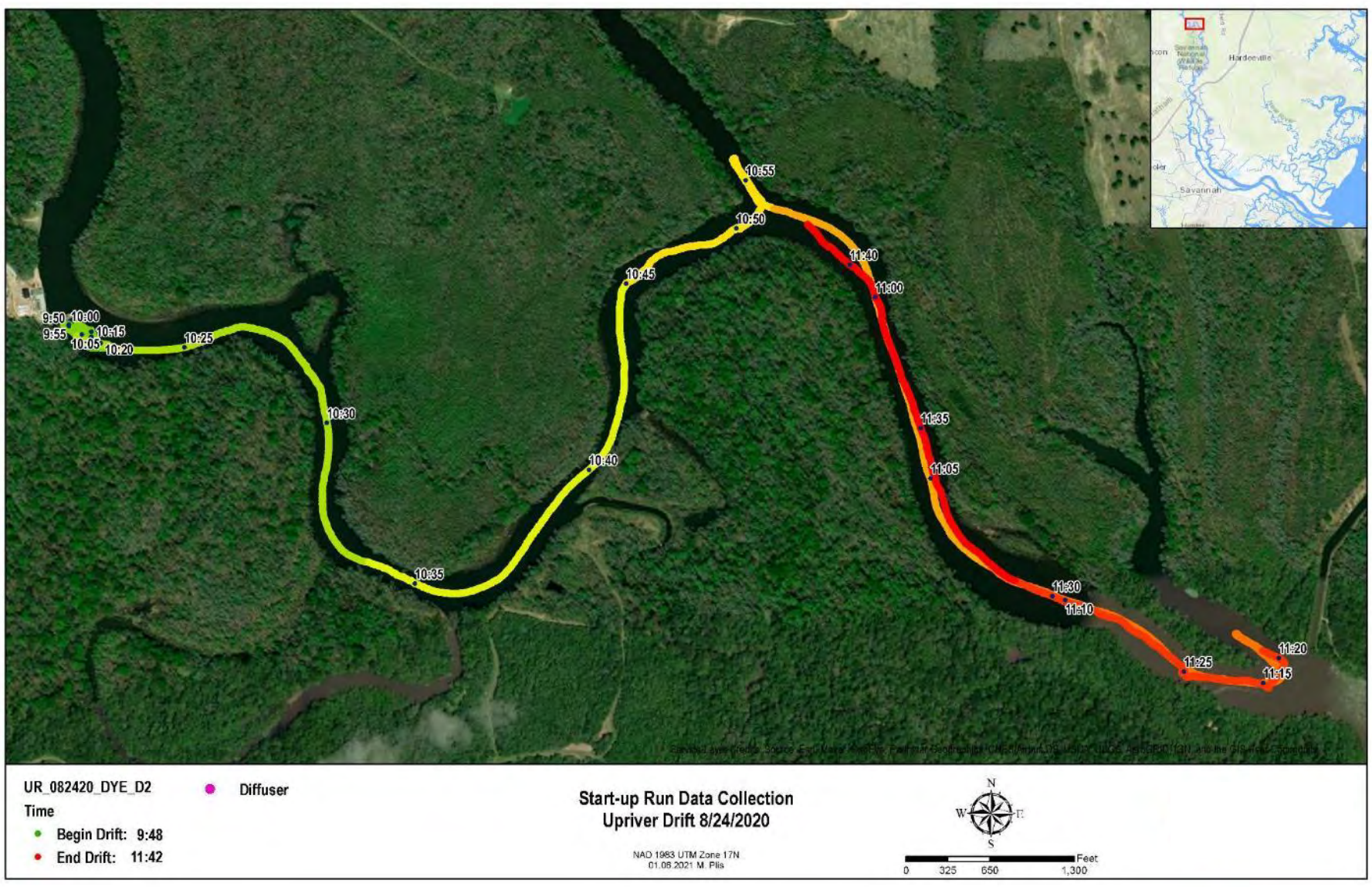


Figure C-153 Upriver August 24, 2020 dye injection drift 2 [UR_Drift_082420_DYE_D2] location map

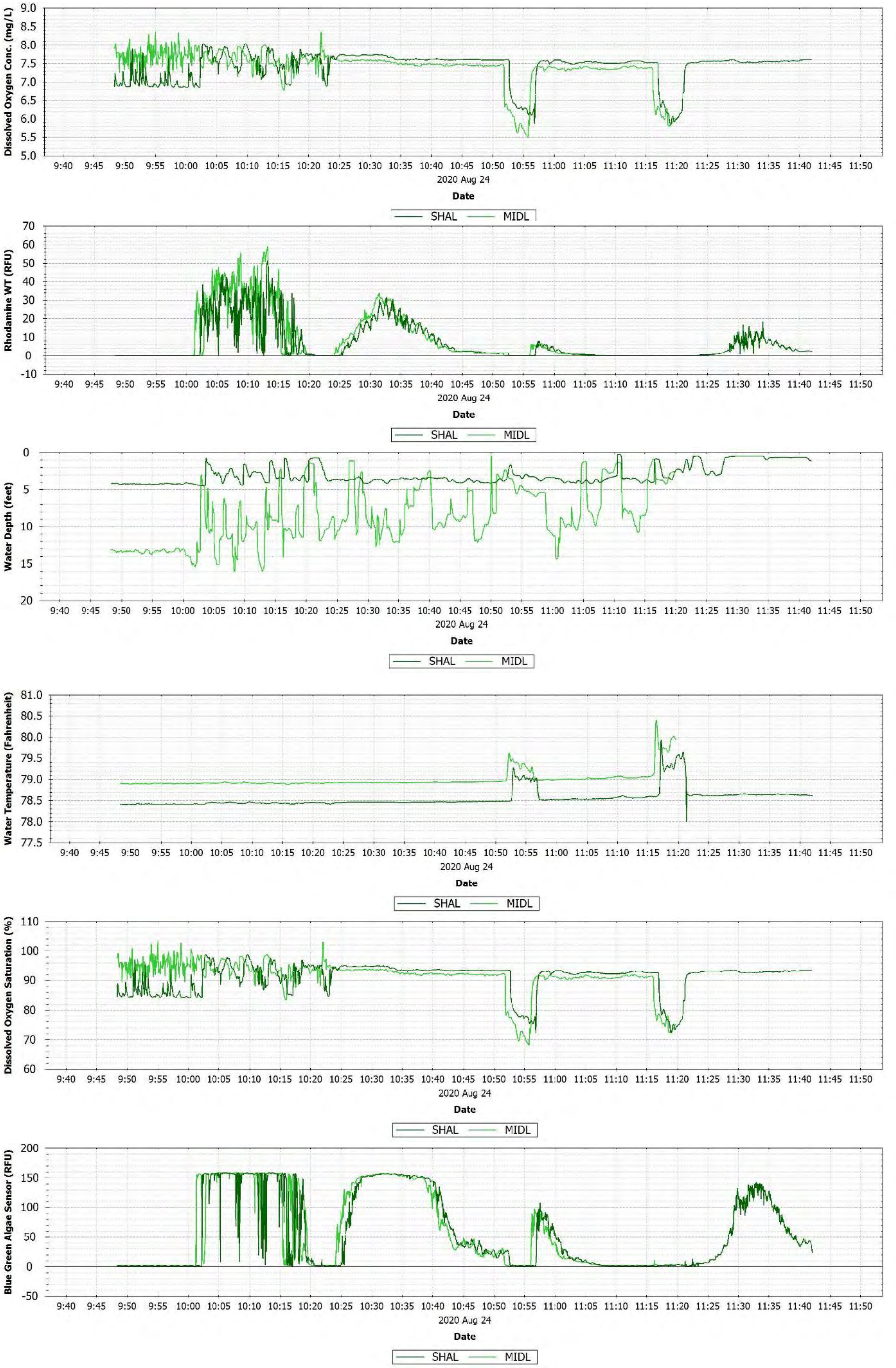


Figure C-154 Upriver August 24, 2020 dye injection drift 2 [UR_Drift_082420_DYE_D2] observations.

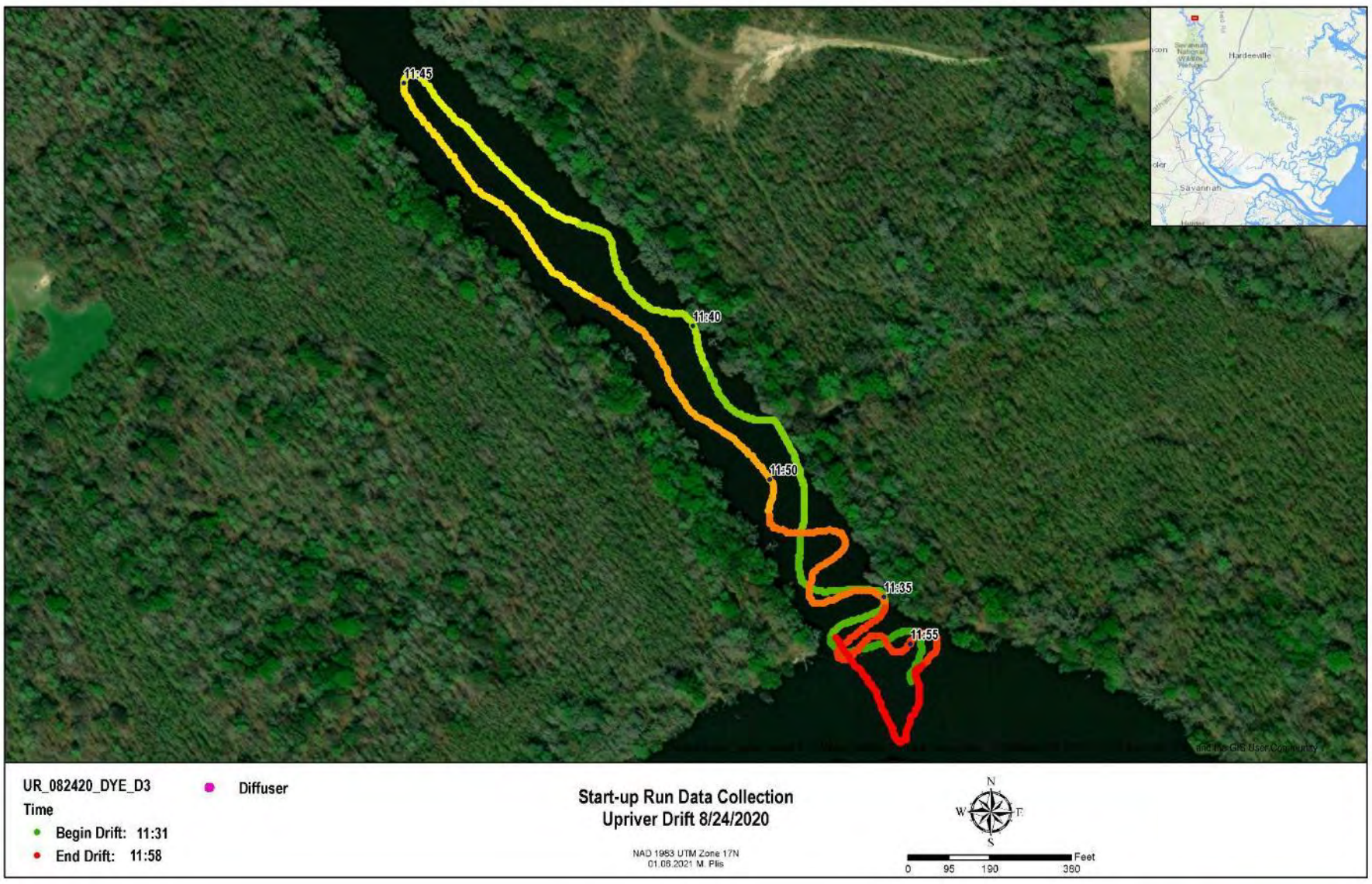


Figure C-155 Upriver August 24, 2020 dye injection drift 3 [UR_Drift_082420_DYE_D3] location map

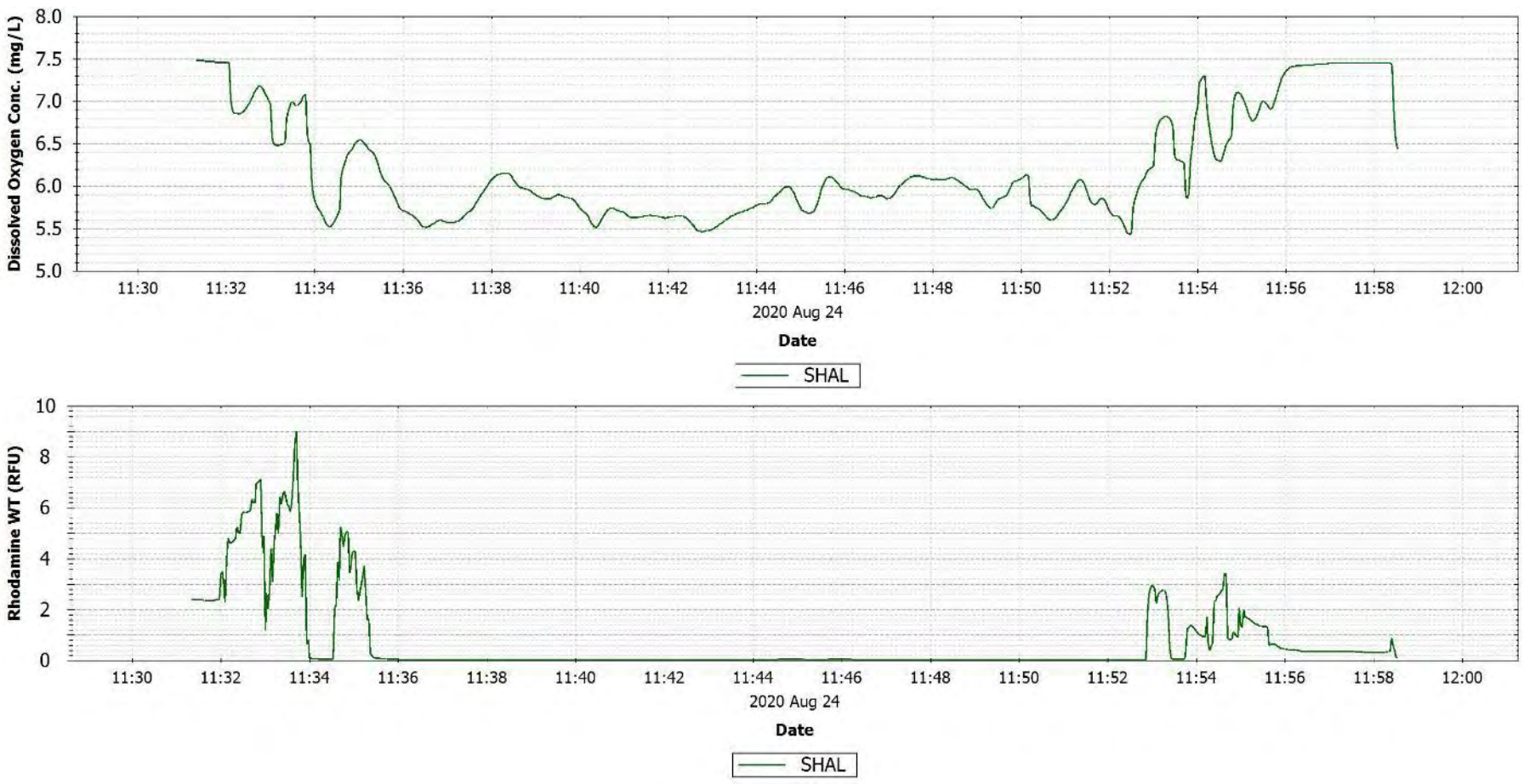




Figure C-156 Upriver August 24, 2020 dye injection drift 3 [UR_Drift_082420_DYE_D3] observations.

The DO plume stayed in the main channel of the Savannah River.

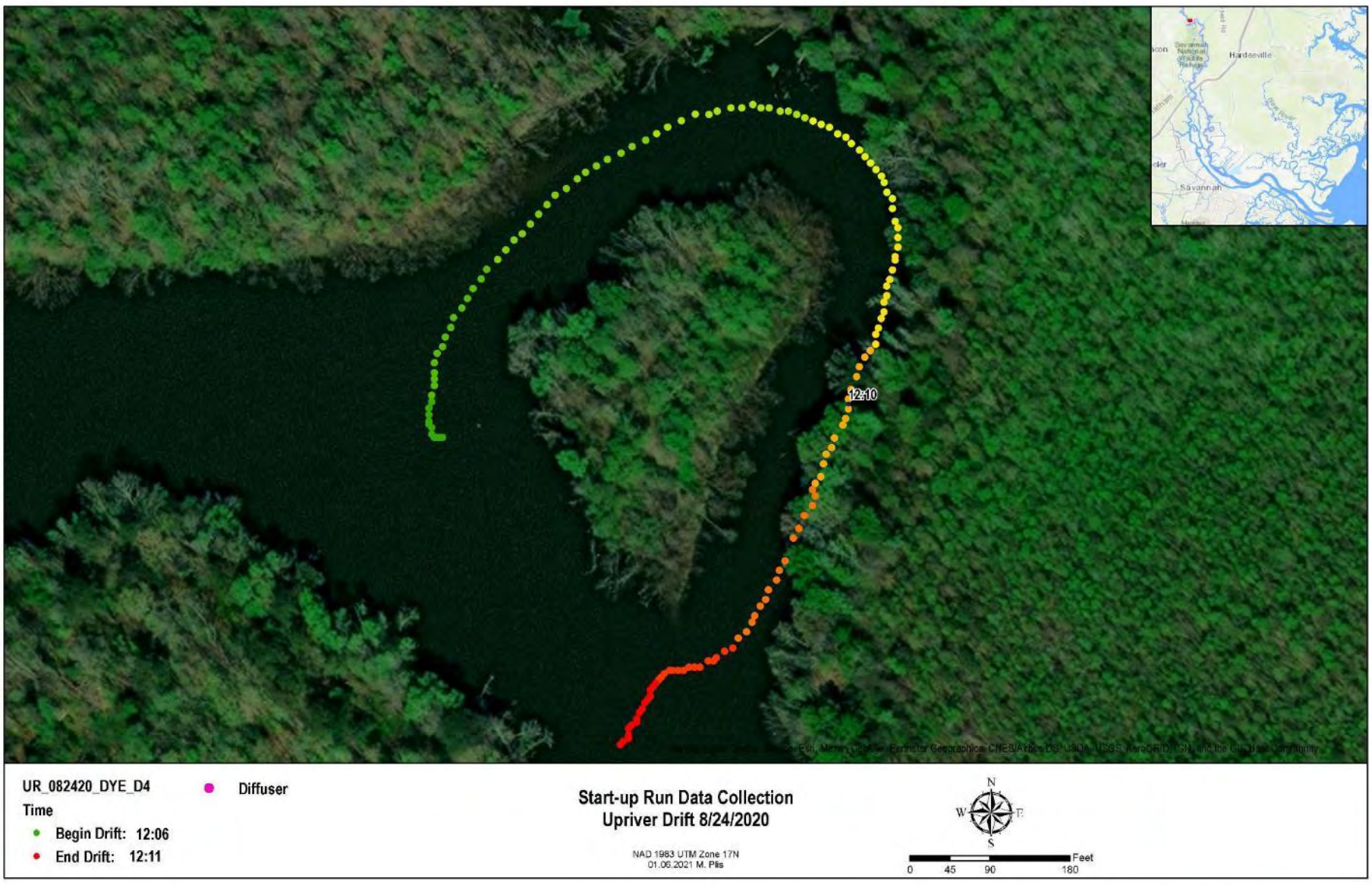
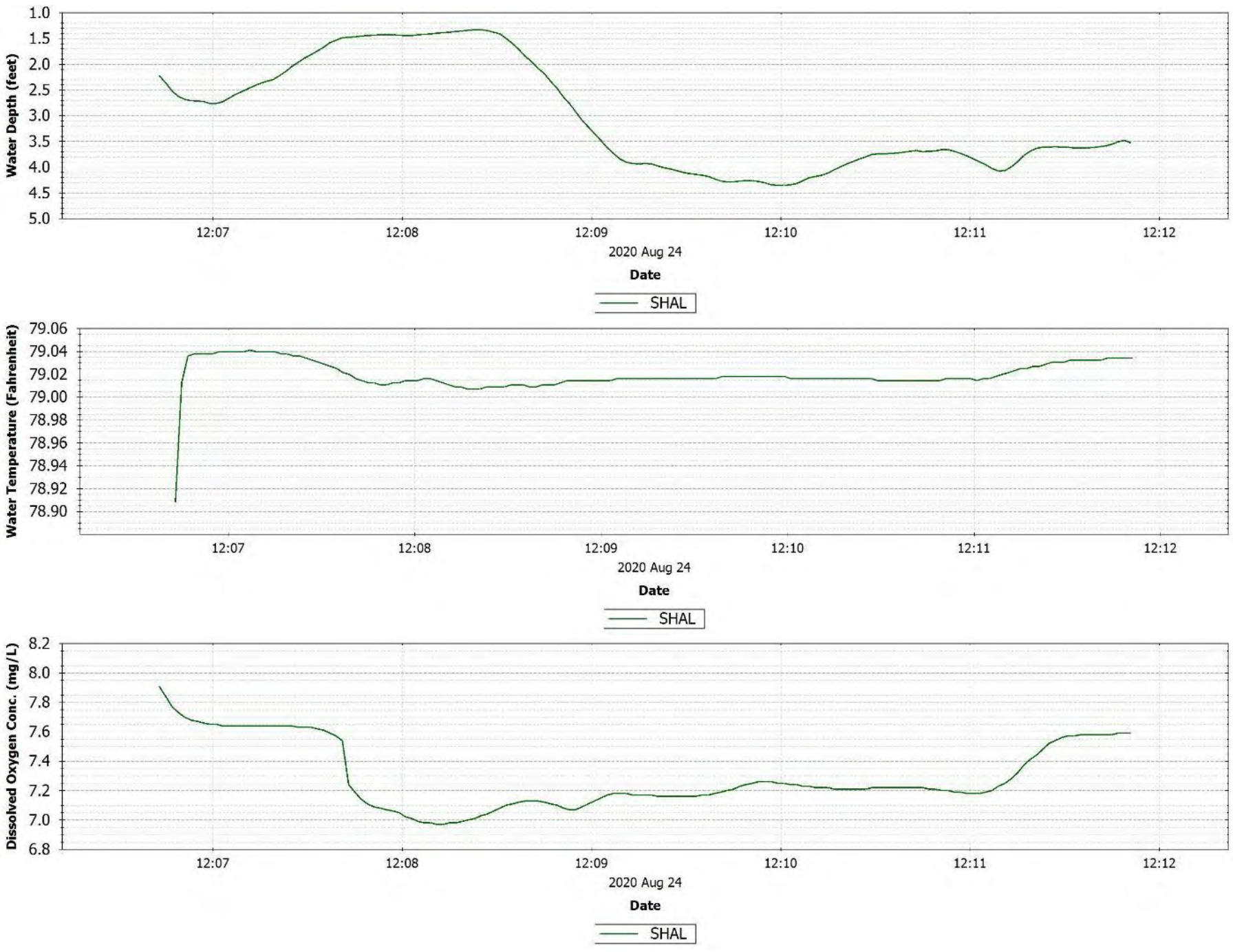


Figure C-157 Upriver August 24, 2020 dye injection drift 4 [UR_Drift_082420_DYE_D4] location map



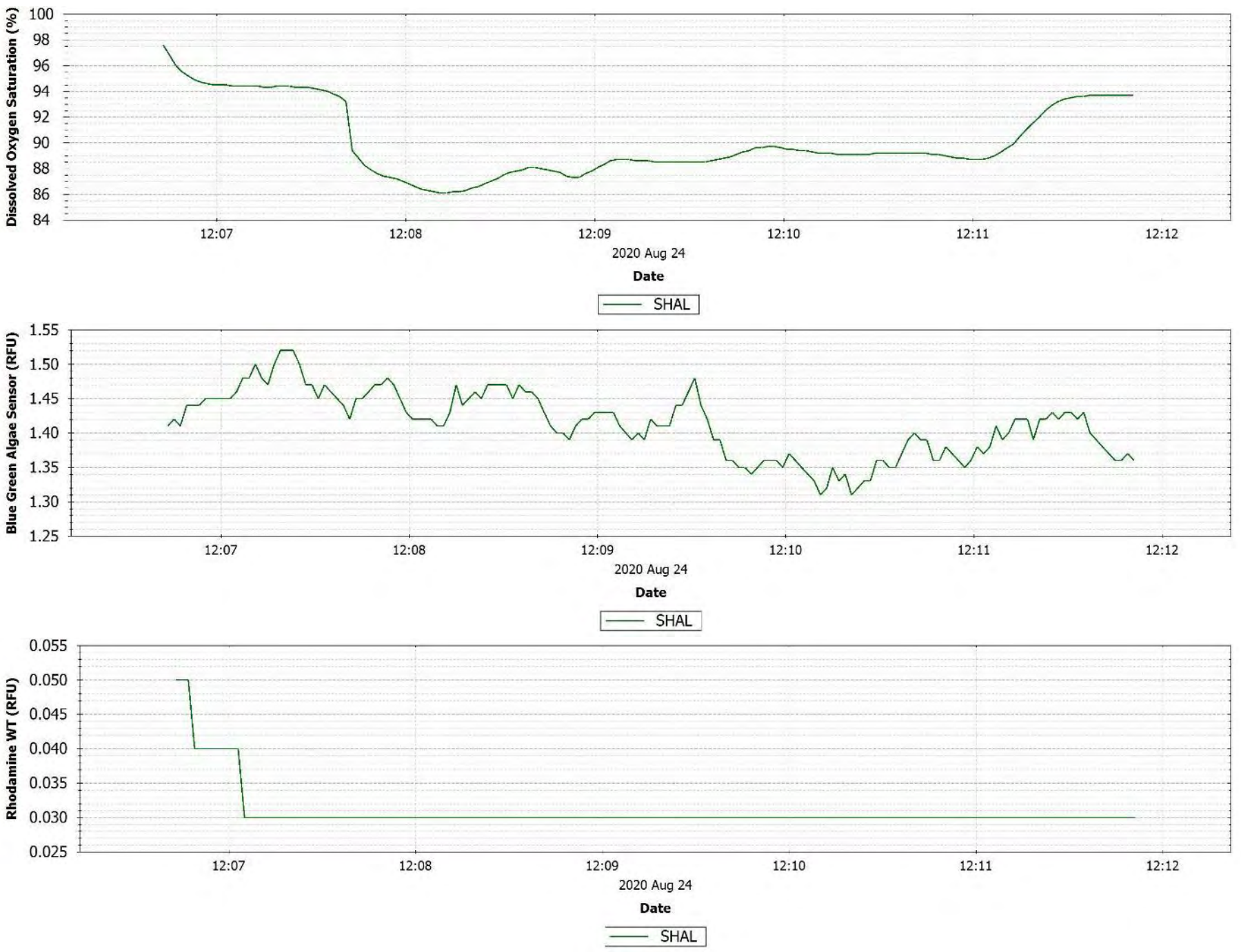


Figure C-158 Upriver August 24, 2020 dye injection drift 4 [UR_Drift_082420_DYE_D4] observations.

C.63 AUGUST 25, 2020 DRIFT UPRIVER

The August 25, 2020 drift went from the Upriver diffuser to the turning basin. The DO plume mixed quickly downstream of the diffuser. Overall, the DO concentrations gradually decreased moving downstream with noticeable decreases in DO concentrations that occurred where some tributaries entered the Savannah River. DO concentrations began decreasing quickly when the saltwater wedge from incoming tide was intersected upstream of the Kings Island Turning Basin. Dye peaks were located downstream around i-95 and then around the turning basin. A more detailed analysis is provided in the main report.

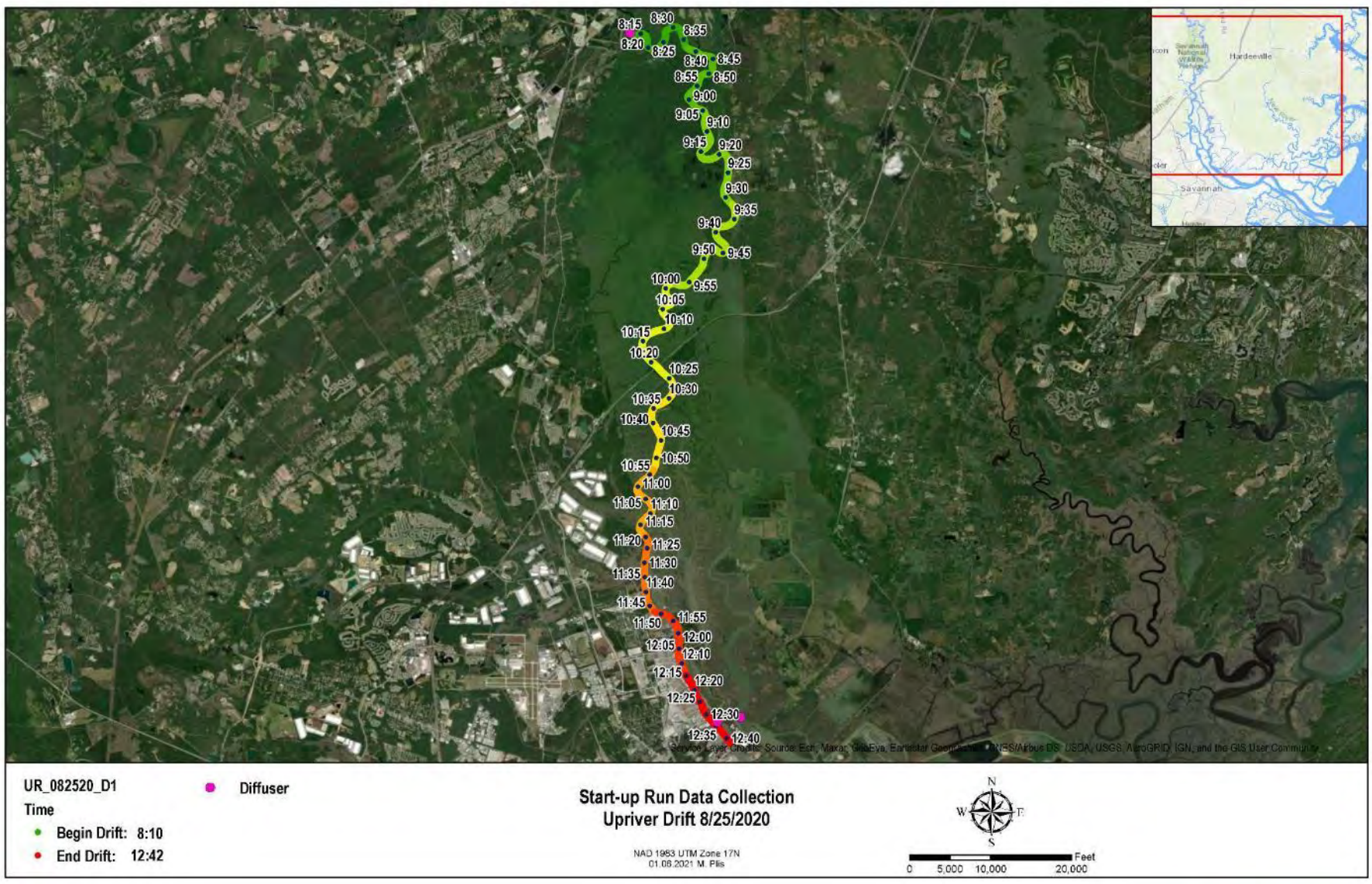


Figure C-159 Upriver August 25, 2020 drift [UR_Drift_082520_D1] location map

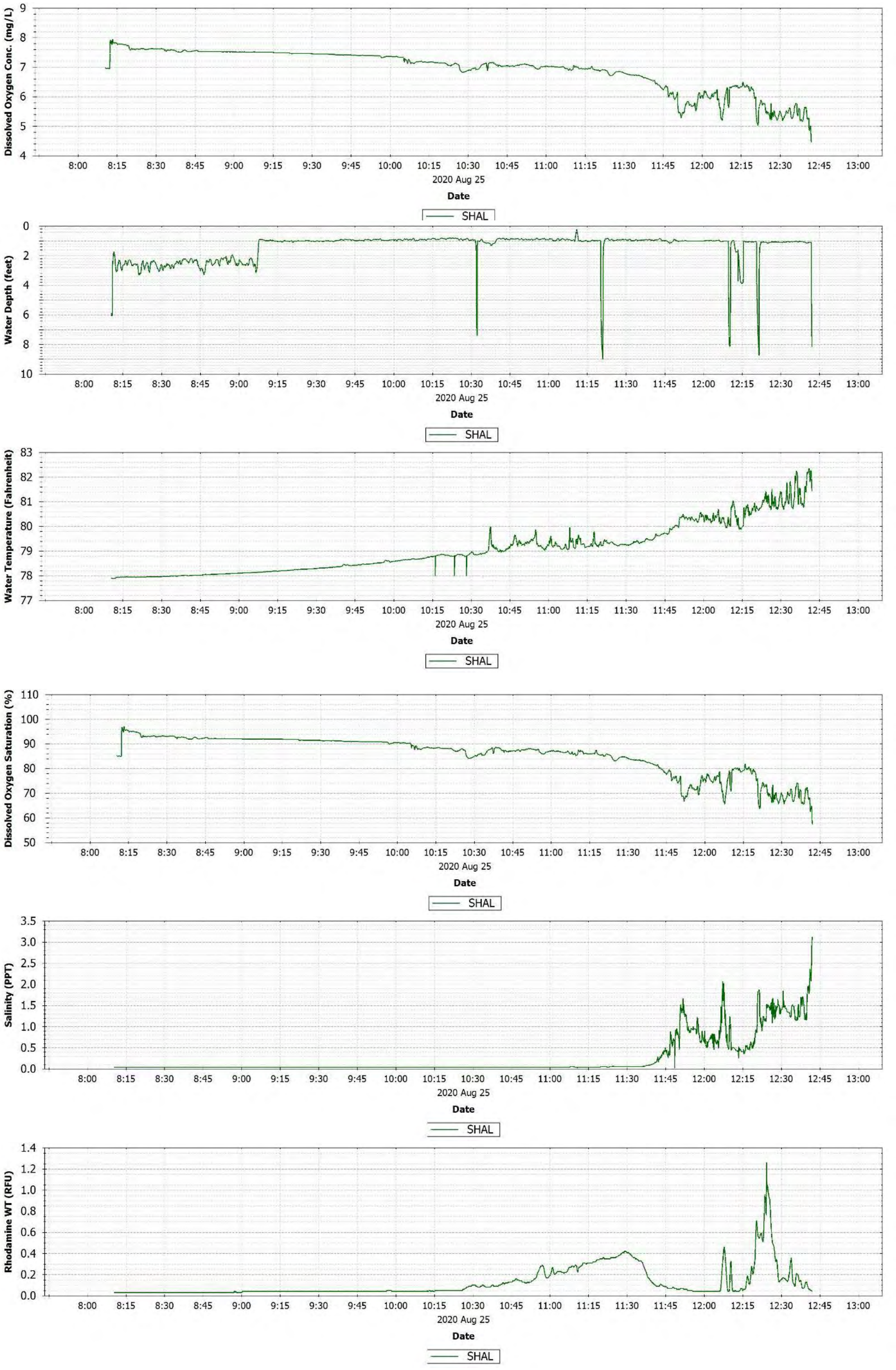


Figure C-160 Upriver August 25, 2020 drift [UR_Drift_082520_D1] observations.

C.64 AUGUST 28, 2020 DRIFT UPRIVER

DO concentrations increased immediately downstream of the diffuser and DO was higher near the south bank until the plume became fully mixed in the water column around the oxbow. River flows were starting to increase, so the oxygen injection did not raise the river's DO as much as during lower flows. This was the same pattern of DO decreasing as the river flowed downstream.

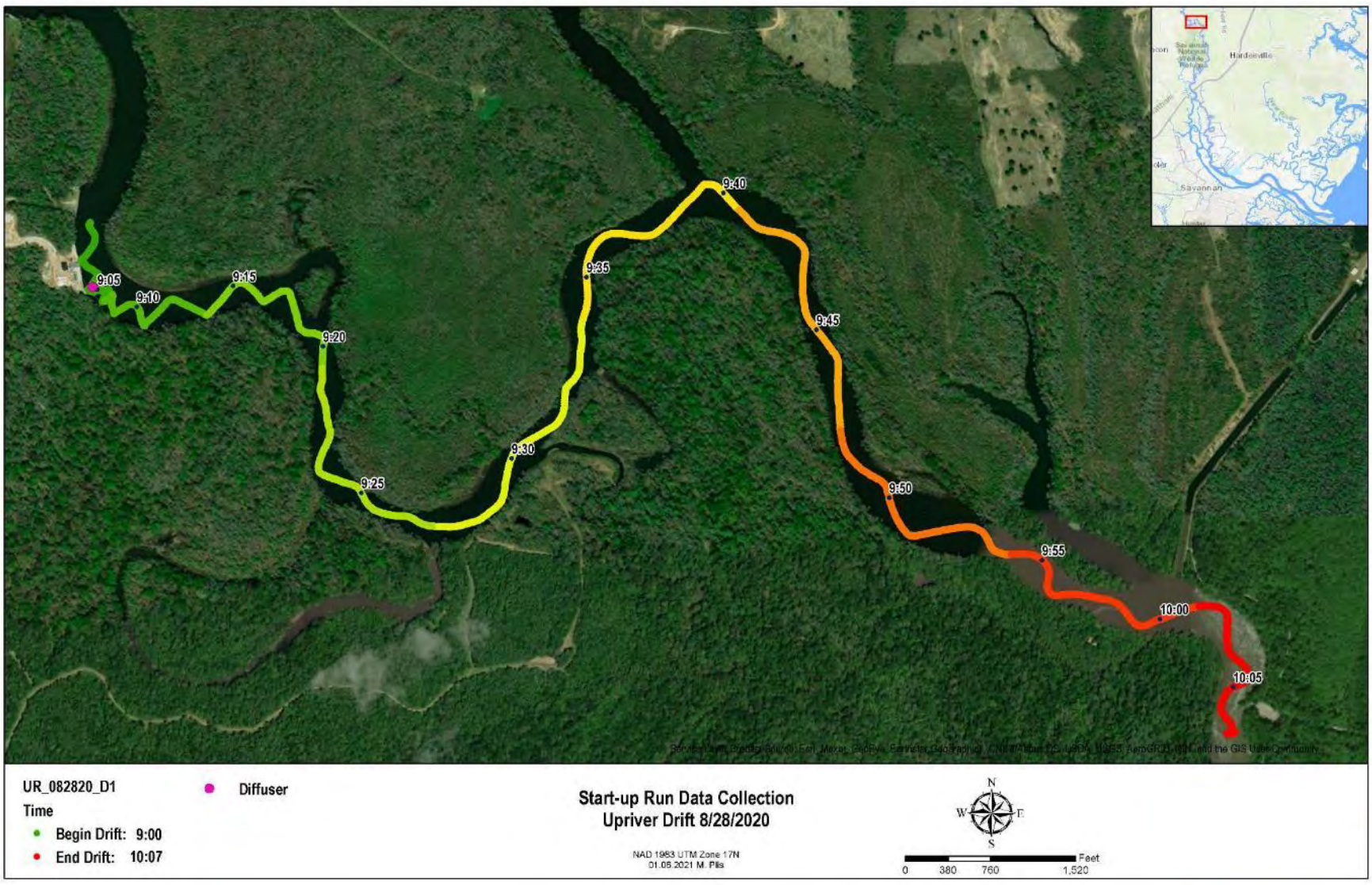
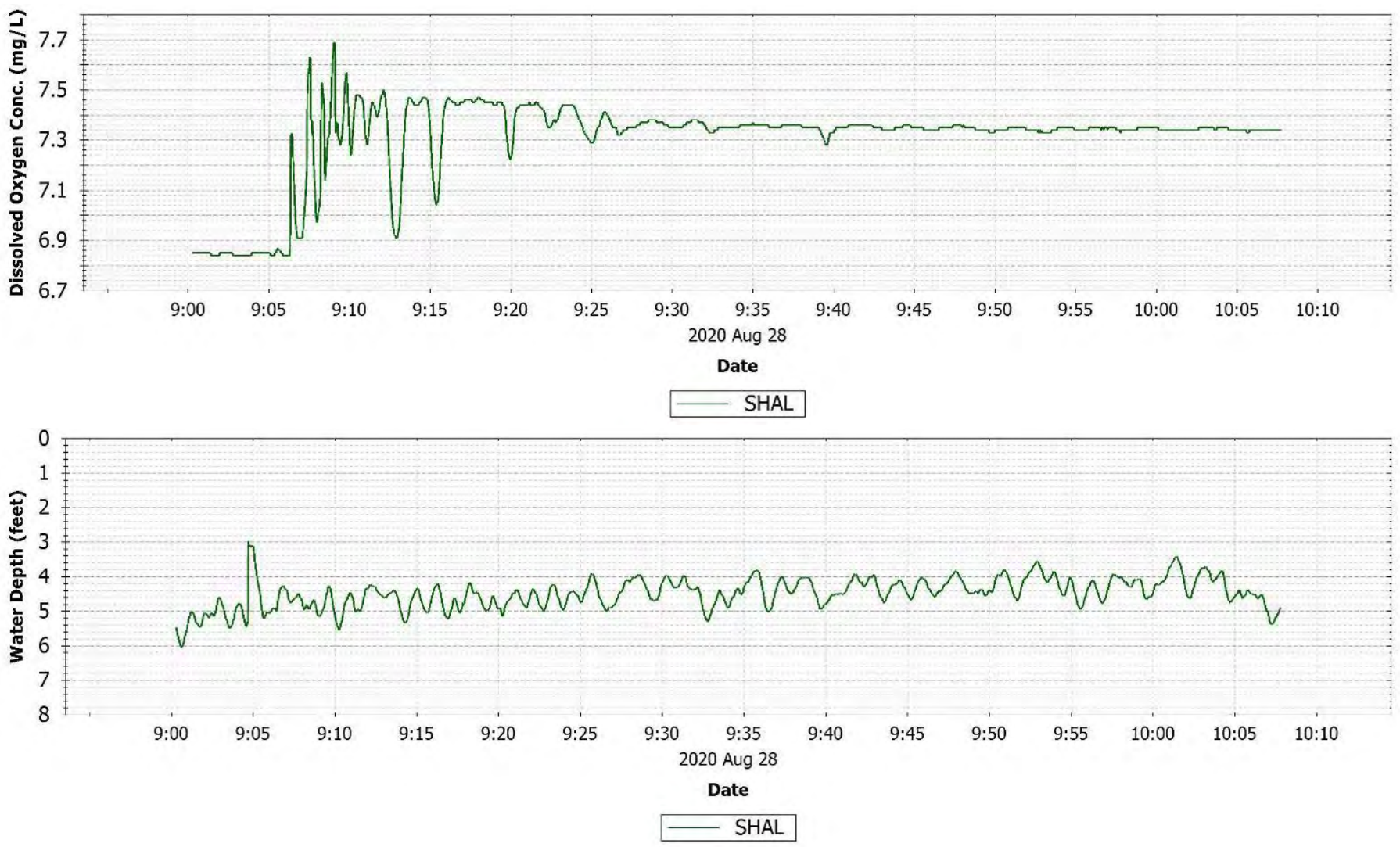


Figure C-161 Upriver August 28, 2020 drift [UR_Drift_082820_D1] location map



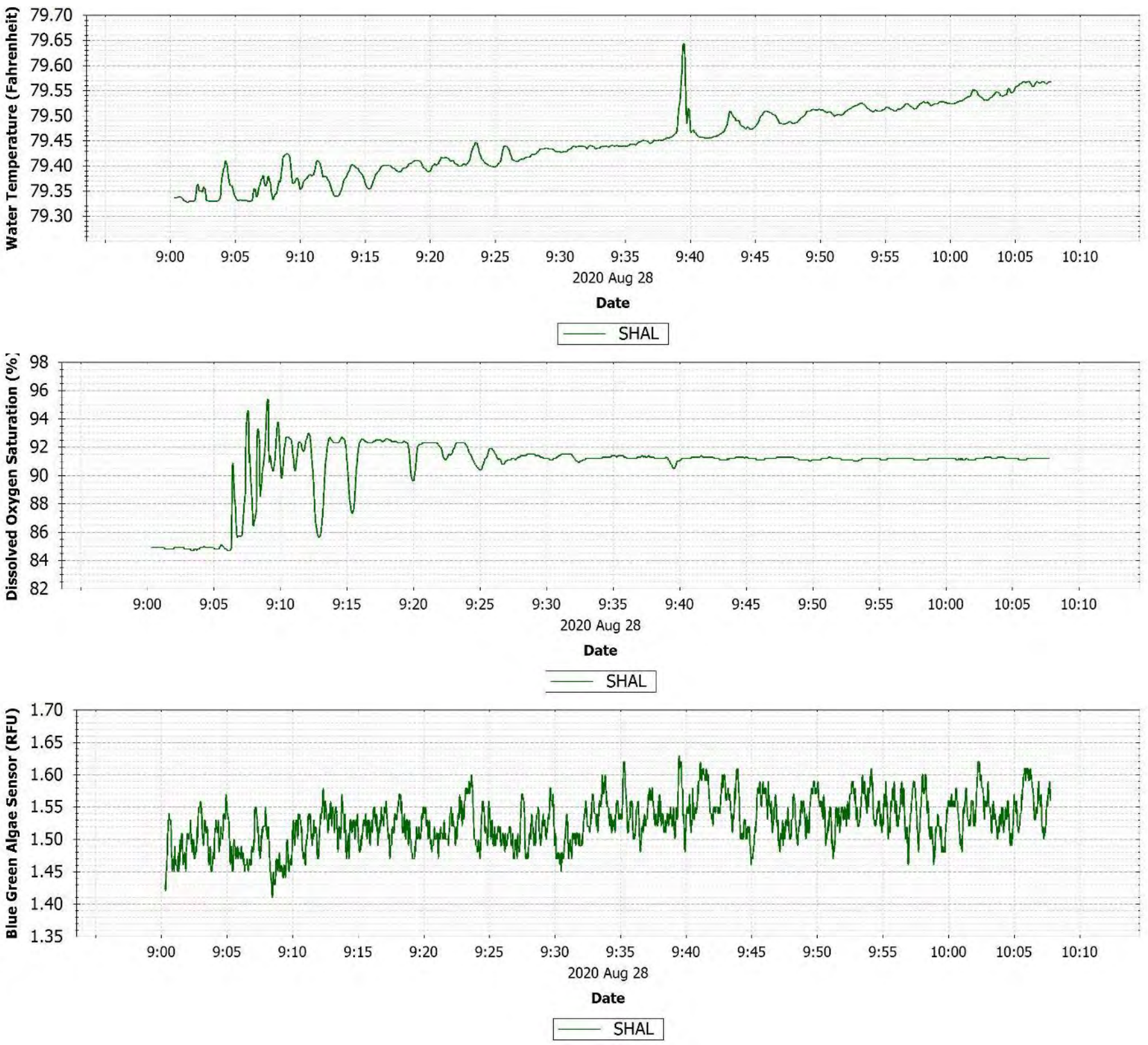


Figure C-162 Upriver August 28, 2020 drift [UR_Drift_082820_D1] observations.

C.65 SEPTEMBER 1, 2020 DRIFT UPRIVER

River flows had increased to 13,000 cfs and the DO concentrations increased less than at lower flows, immediately downstream of the diffuser and DO was higher near the south bank until the plume became fully mixed in the water column around the oxbow. DO concentrations were lower at the mouths of the tributaries.

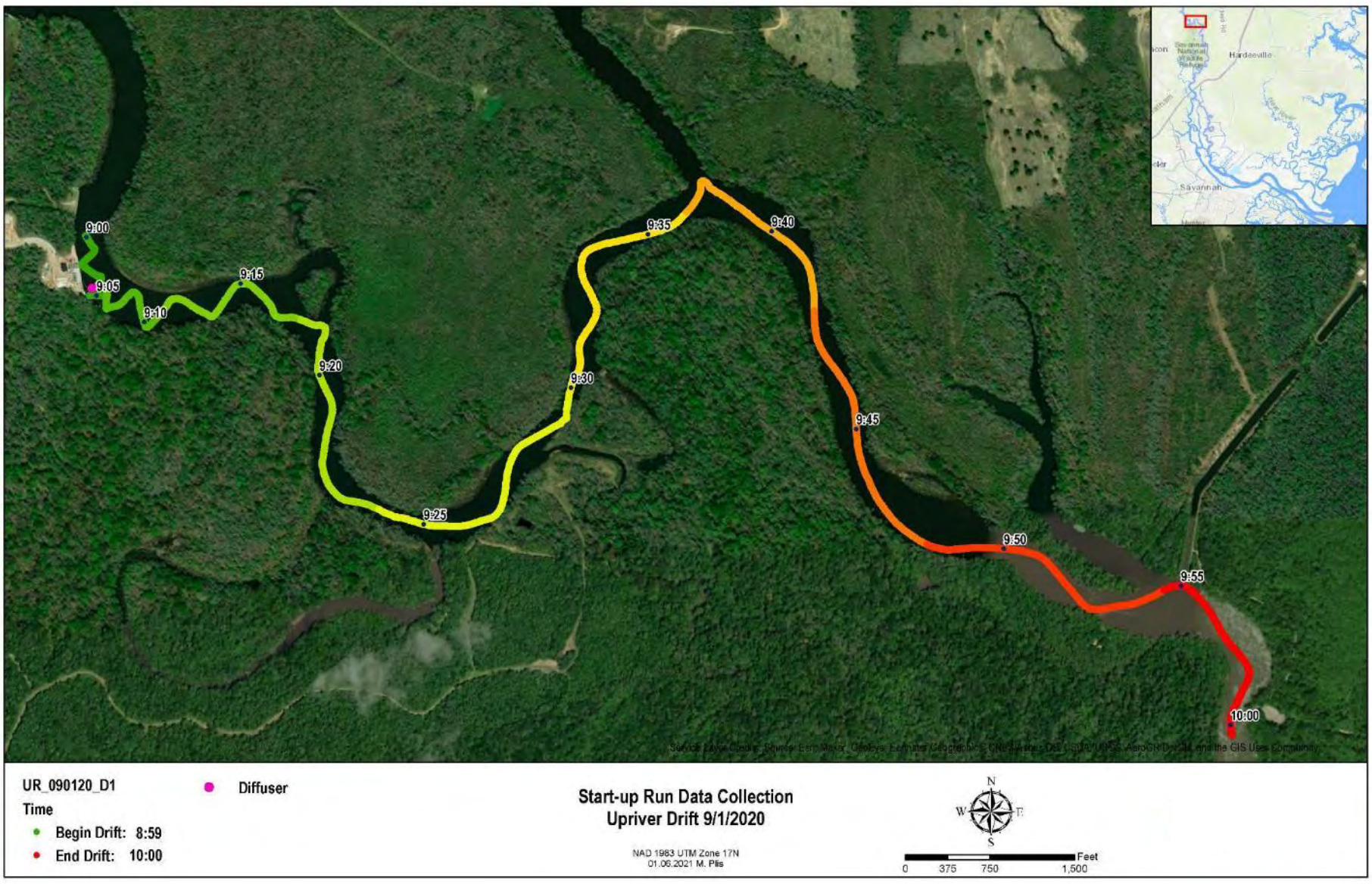
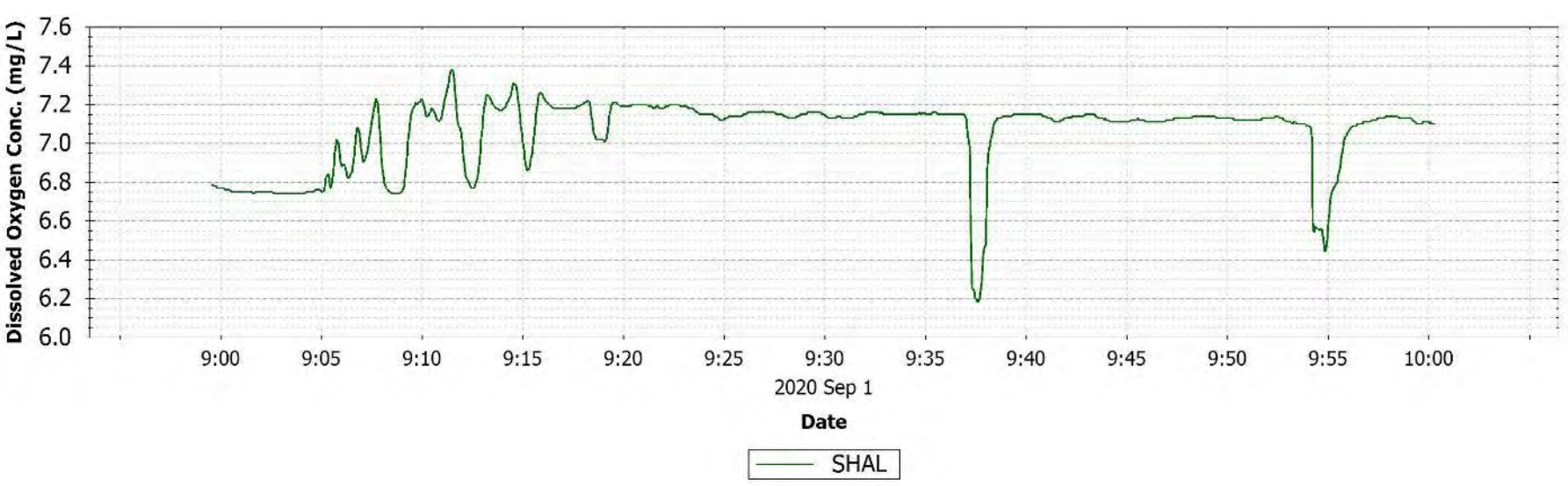


Figure C-163 Upriver September 1, 2020 drift [UR_Drift_090120_D1] location map



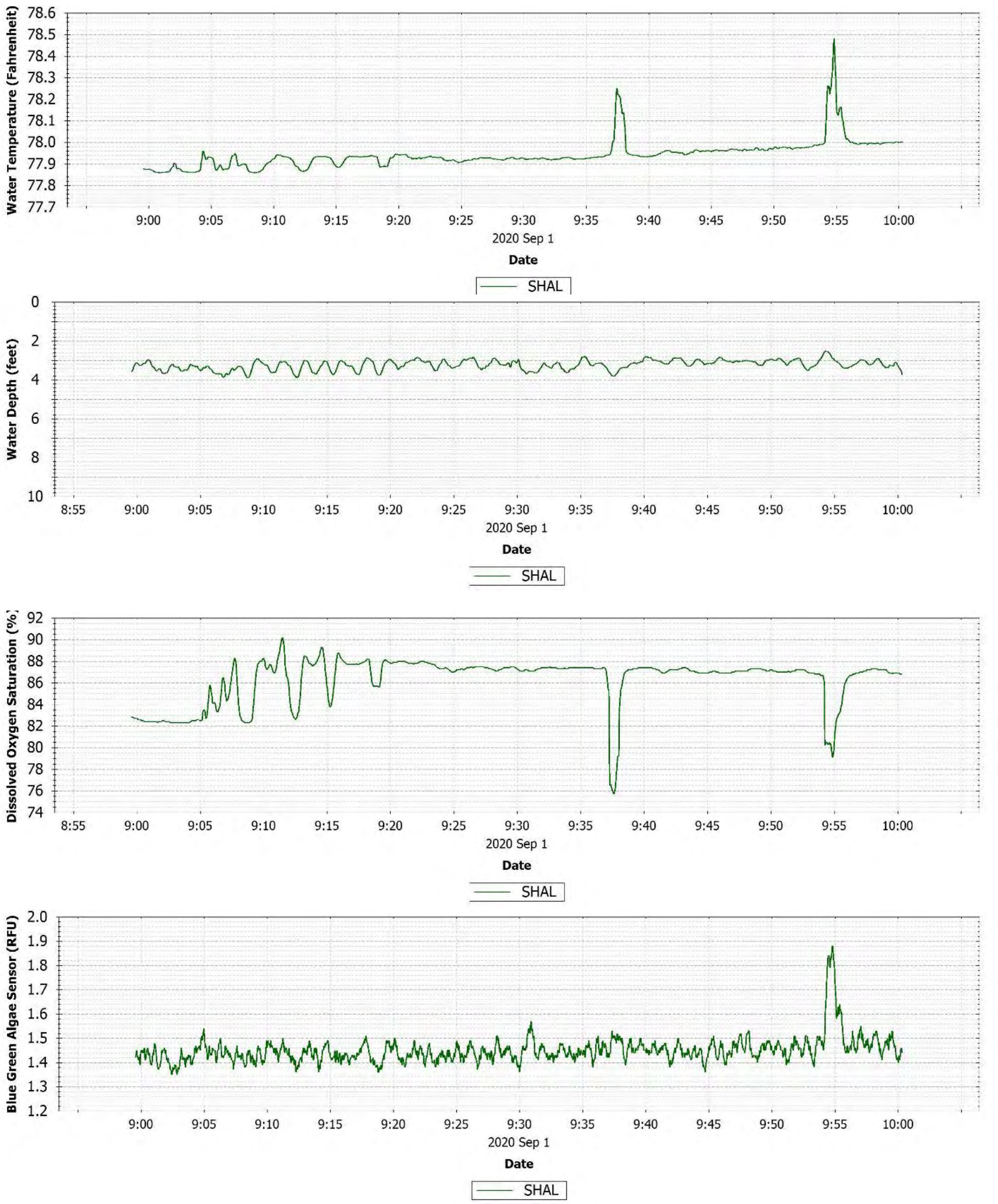


Figure C-164 Upriver September 1, 2020 drift [UR_Drift_090120_D1] observations

C.66 SEPTEMBER 3, 2020 DRIFT UPRIVER

River flows were still high, at 12,500 cfs. The DO plume mixed in the water column quickly. There was a decrease in DO where the oxbow lake/horseshoe bend discharges to the Savannah River. Noticeable decreases in DO occurred downstream of tributaries. Because of the rainfall in the area, more flow and low DO concentrations flowed into the river, which caused the DO to decrease at a faster rate than at low flows.

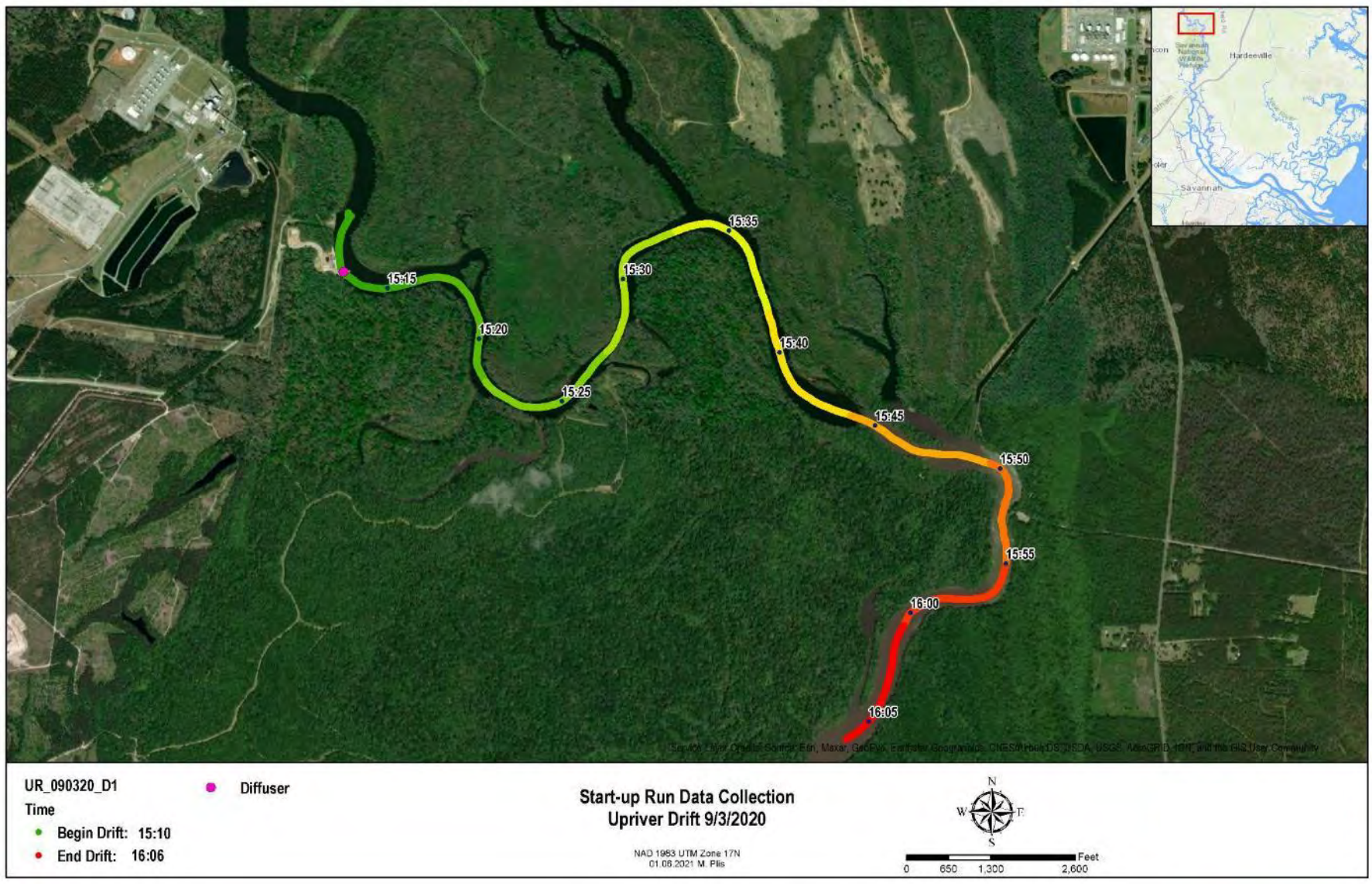


Figure C-165 Upriver September 3, 2020 drift [UR_Drift_090320_D1] location map

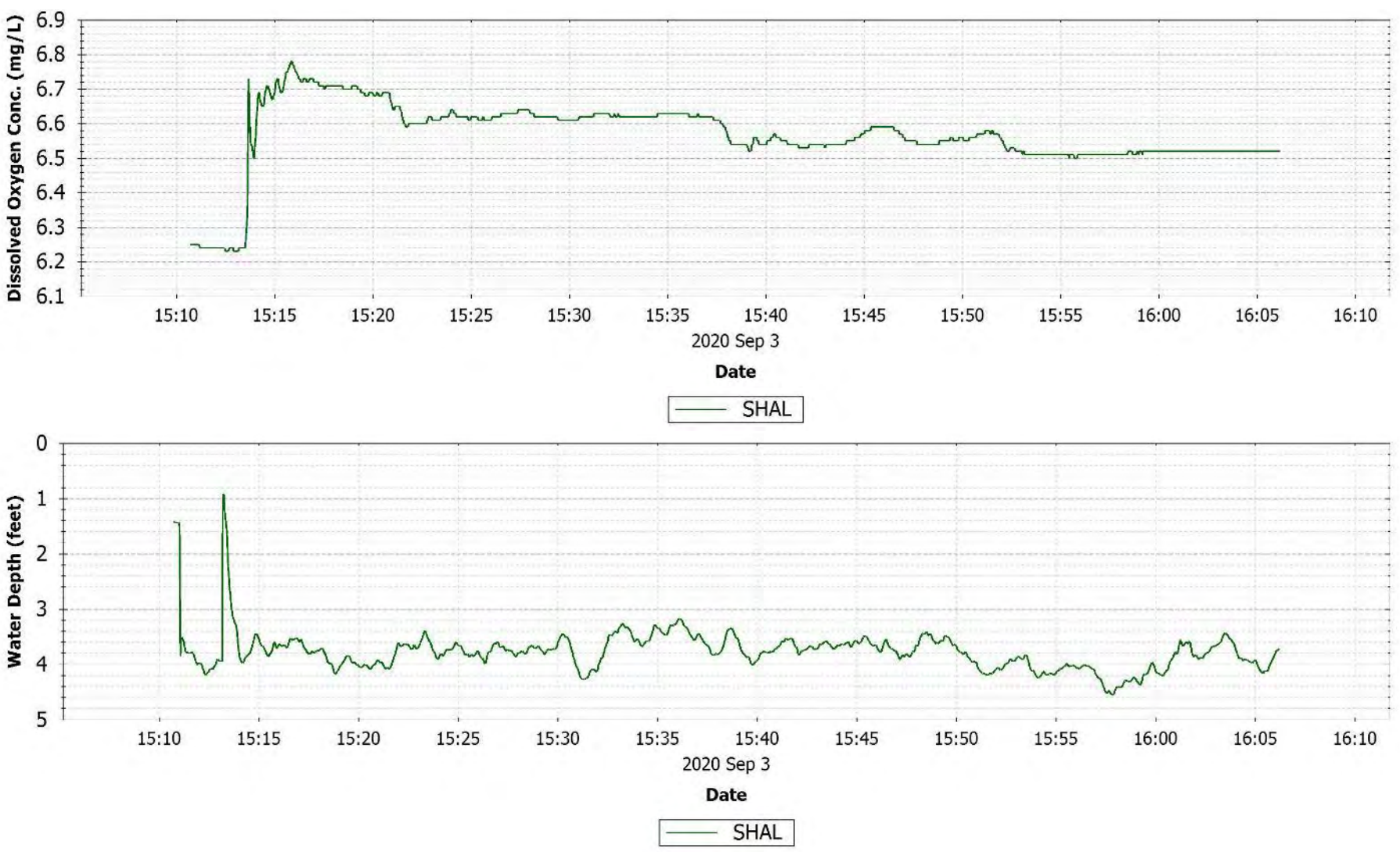




Figure C-166 Upriver September 3, 2020 drift [UR_Drift_090320_D1] observations.

C.67 SEPTEMBER 10, 2020 DRIFT UPRIVER

Flows were back to low flow of 7,000 cfs. The DO plume mixed in water column quickly. There was a decrease in DO where the oxbow lake/horseshoe bend discharges to the Savannah River. Noticeable decreases in DO occurred downstream of tributaries.

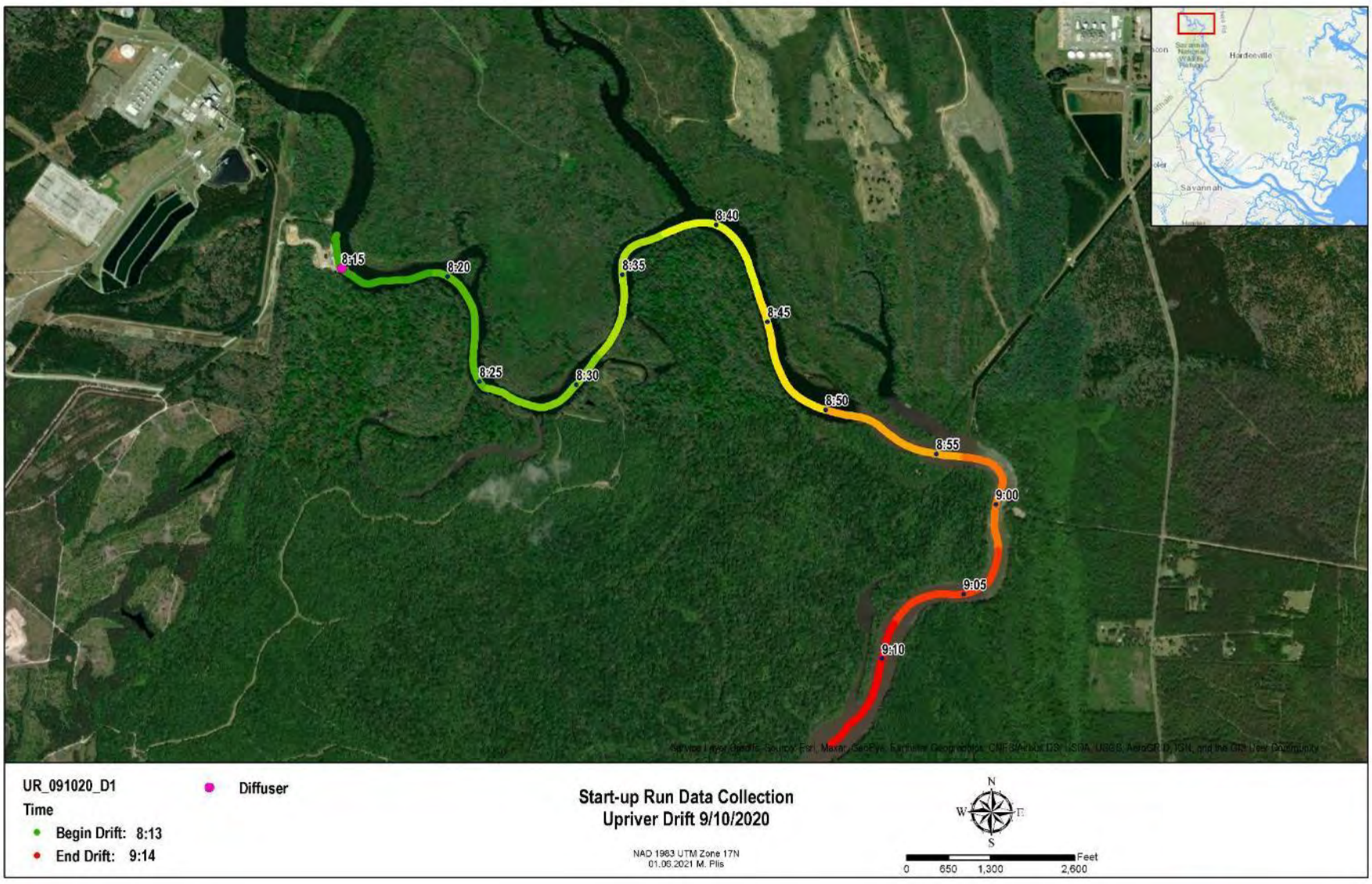
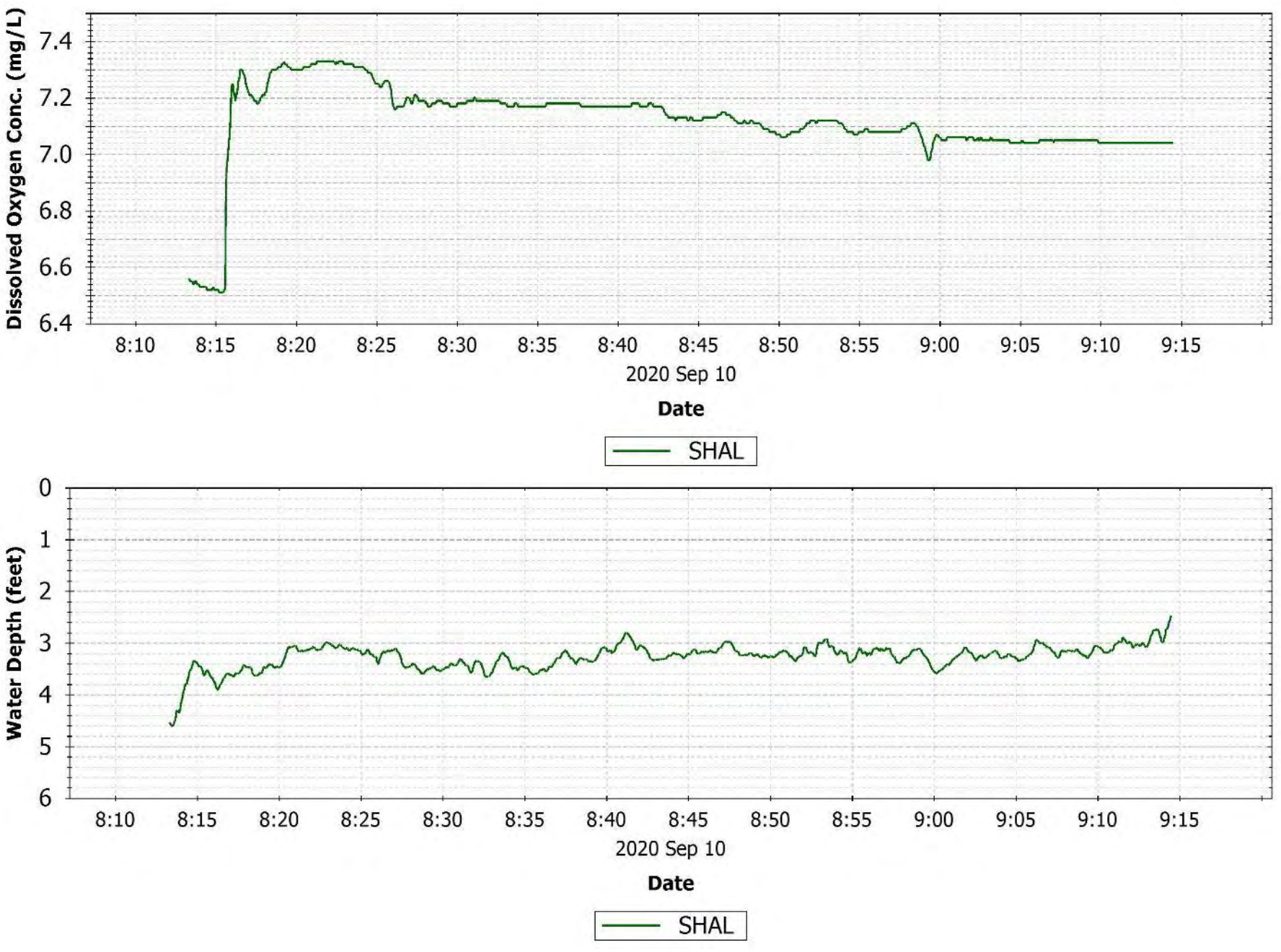


Figure C-167 Upriver September 10, 2020 drift [UR_Drift_091020_D1] location map



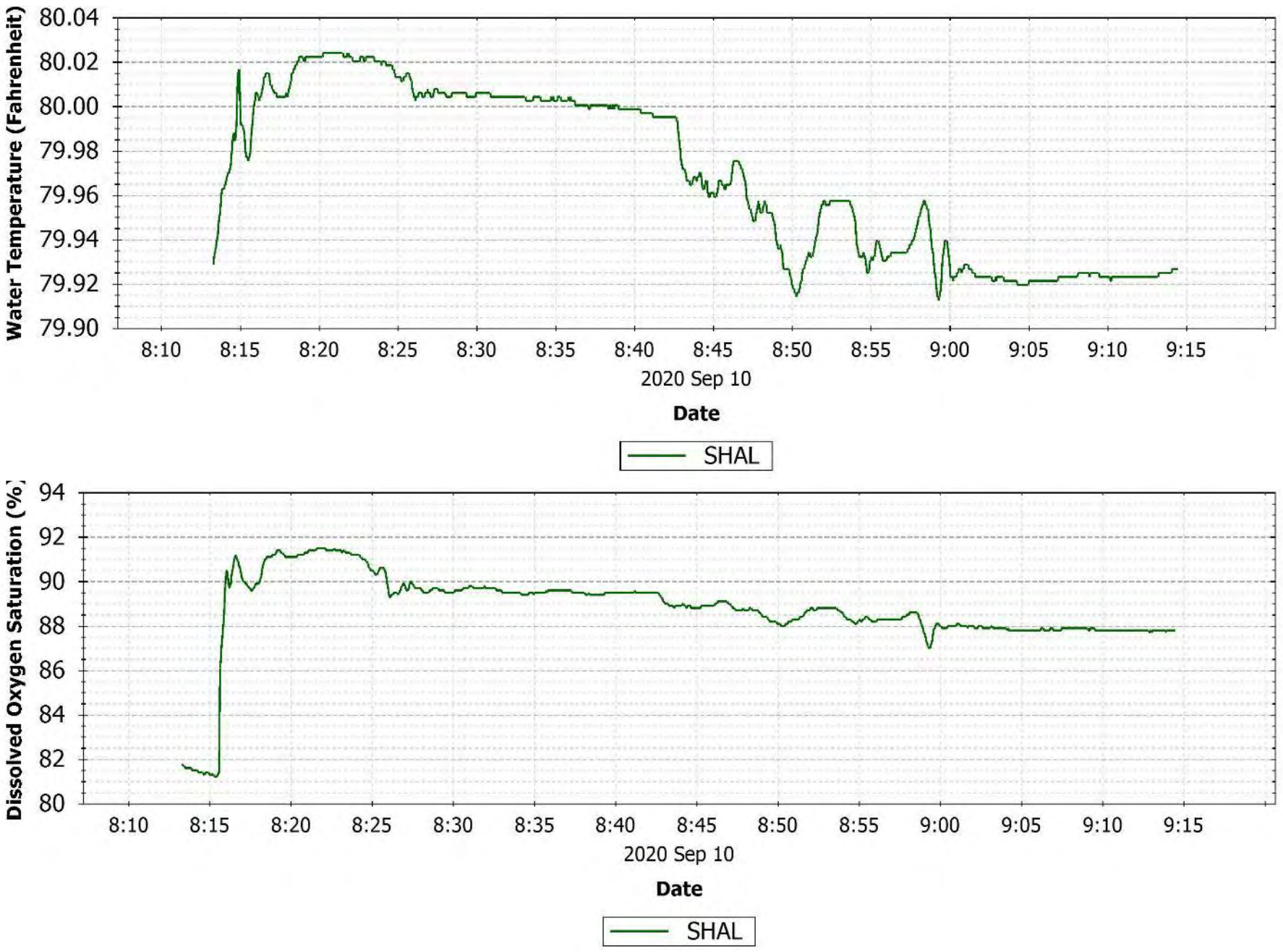


Figure C-168 Upriver September 10, 2020 drift [UR_Drift_091020_D1] observations.

C.68 SEPTEMBER 13, 2020 DRIFT UPRIVER

This drift took depth profiles at the buoy locations. Other than the buoys around the diffuser the DO was similar top to bottom at the buoy locations.

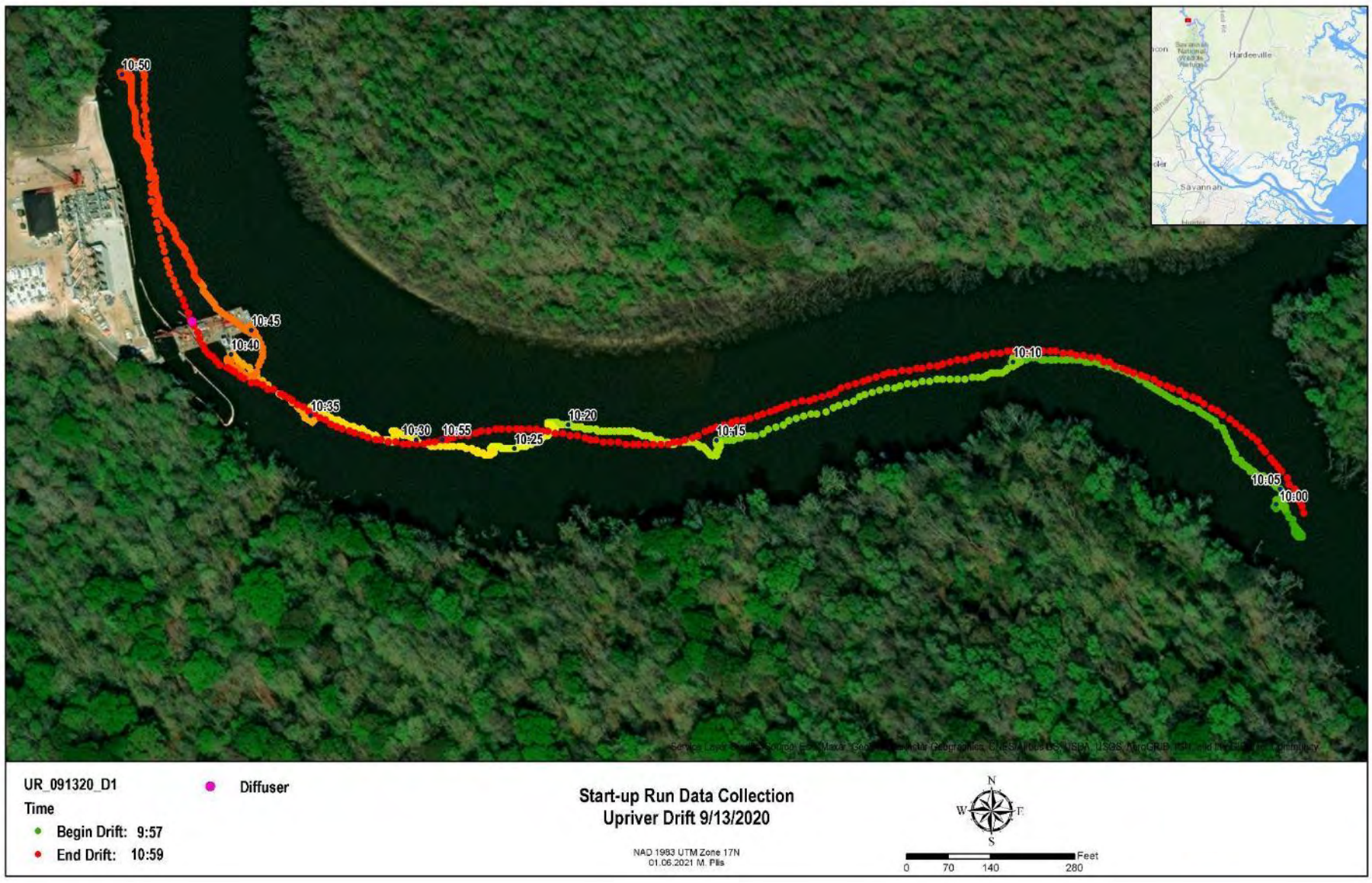
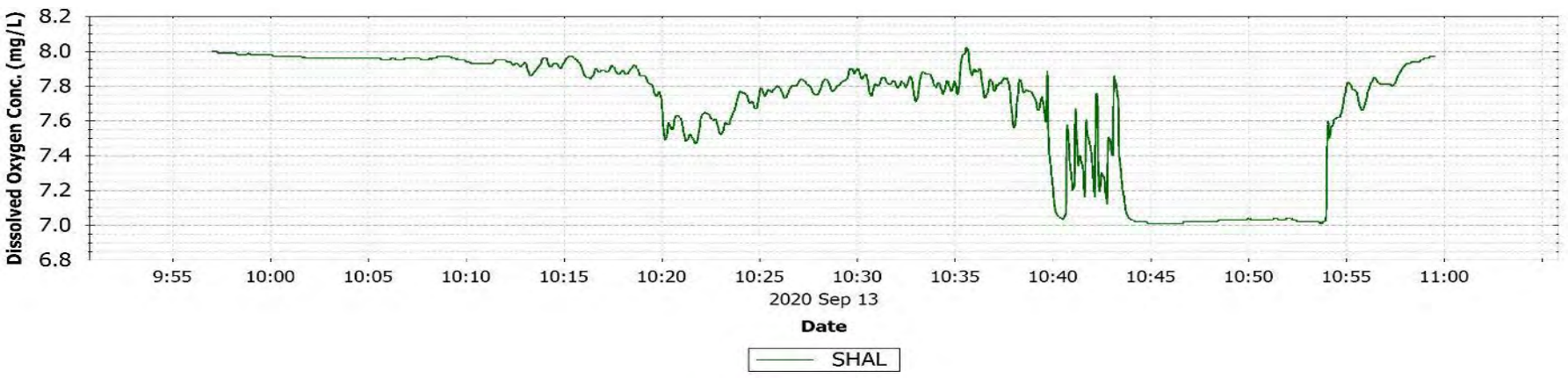
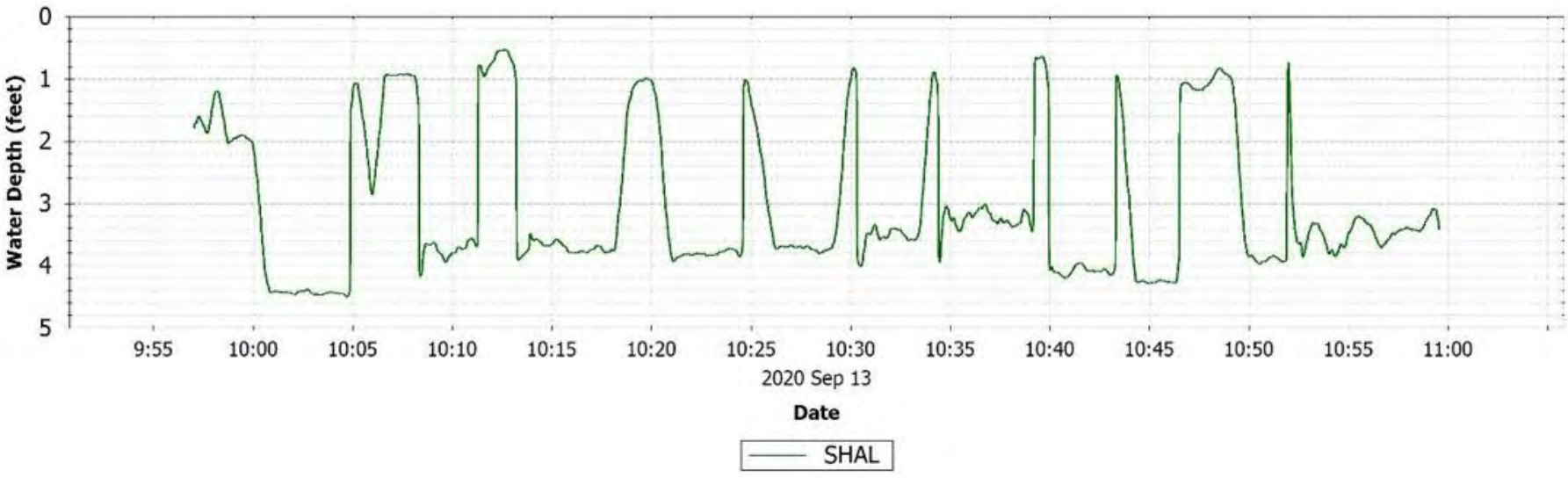


Figure C-169 Upriver September 13, 2020 drift [UR_Drift_091320_D1] location map





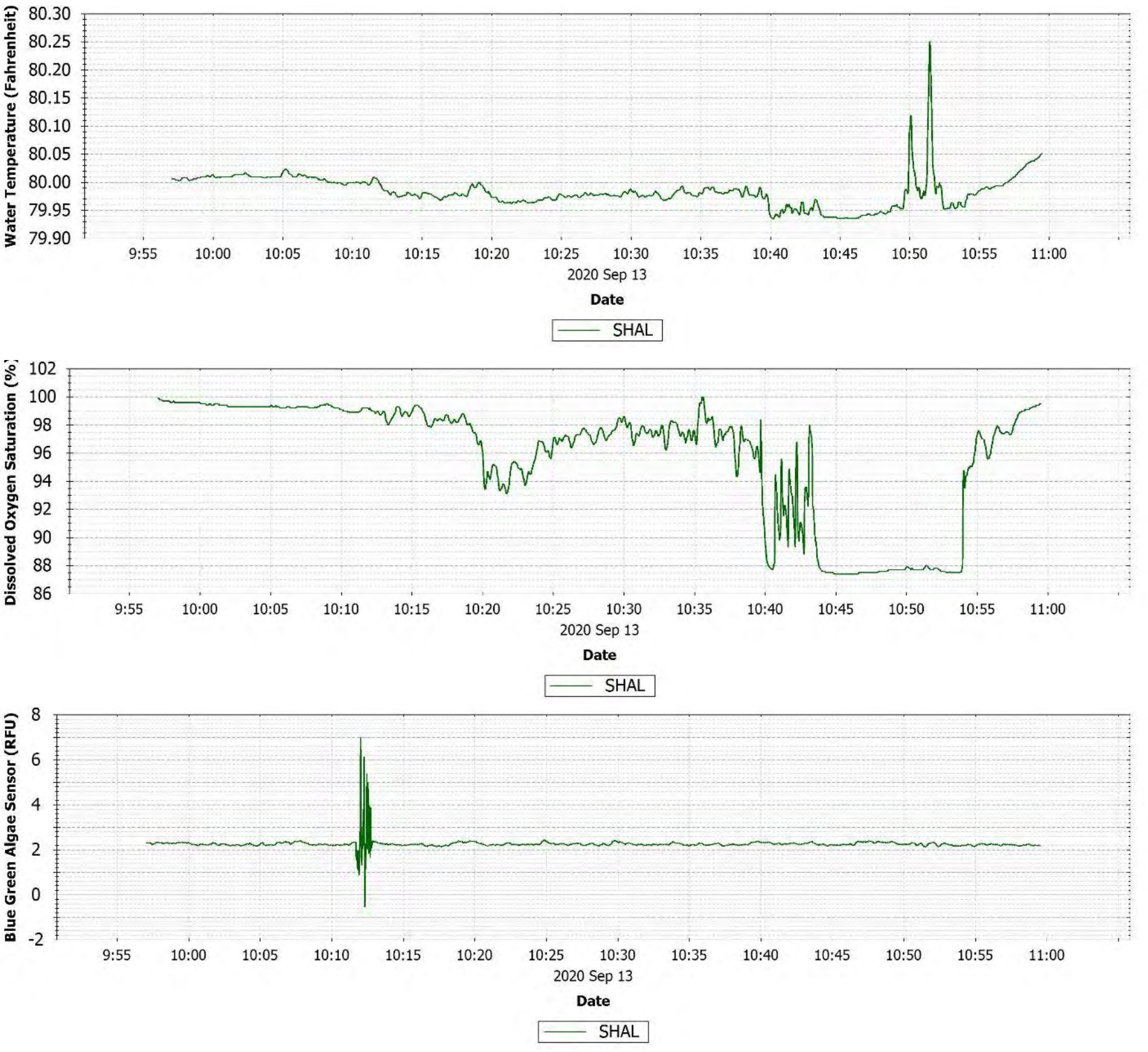


Figure C-170 Upriver September 13, 2020 drift [UR_Drift_091320_D1] observations.

C.69 SEPTEMBER 15, 2020 DYE INJECTION DRIFT UPRIVER

This drift traveled up and down the river locating the dye peaks as the dye traveled downstream. A more detailed analysis is provided in the main report.

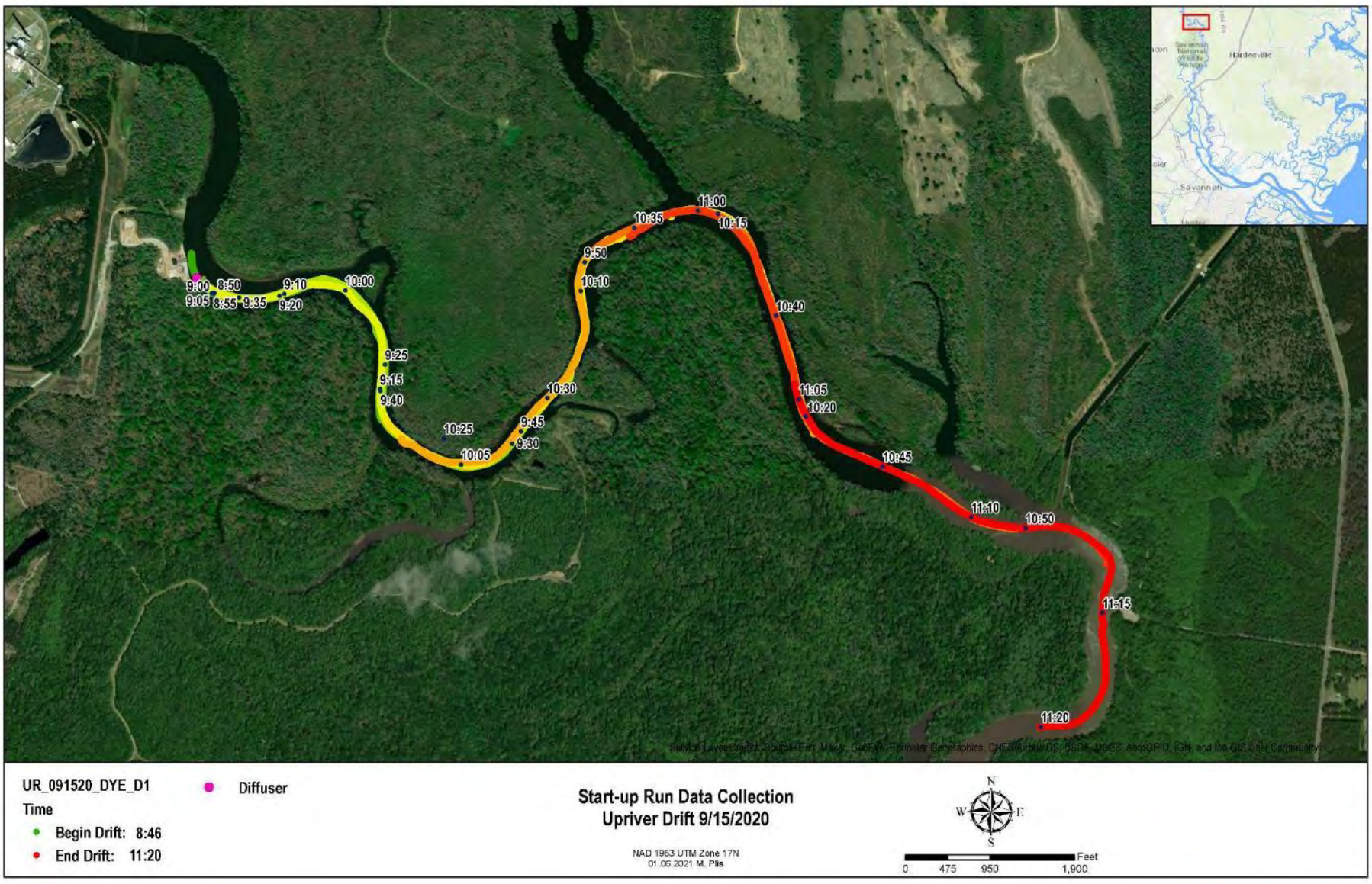
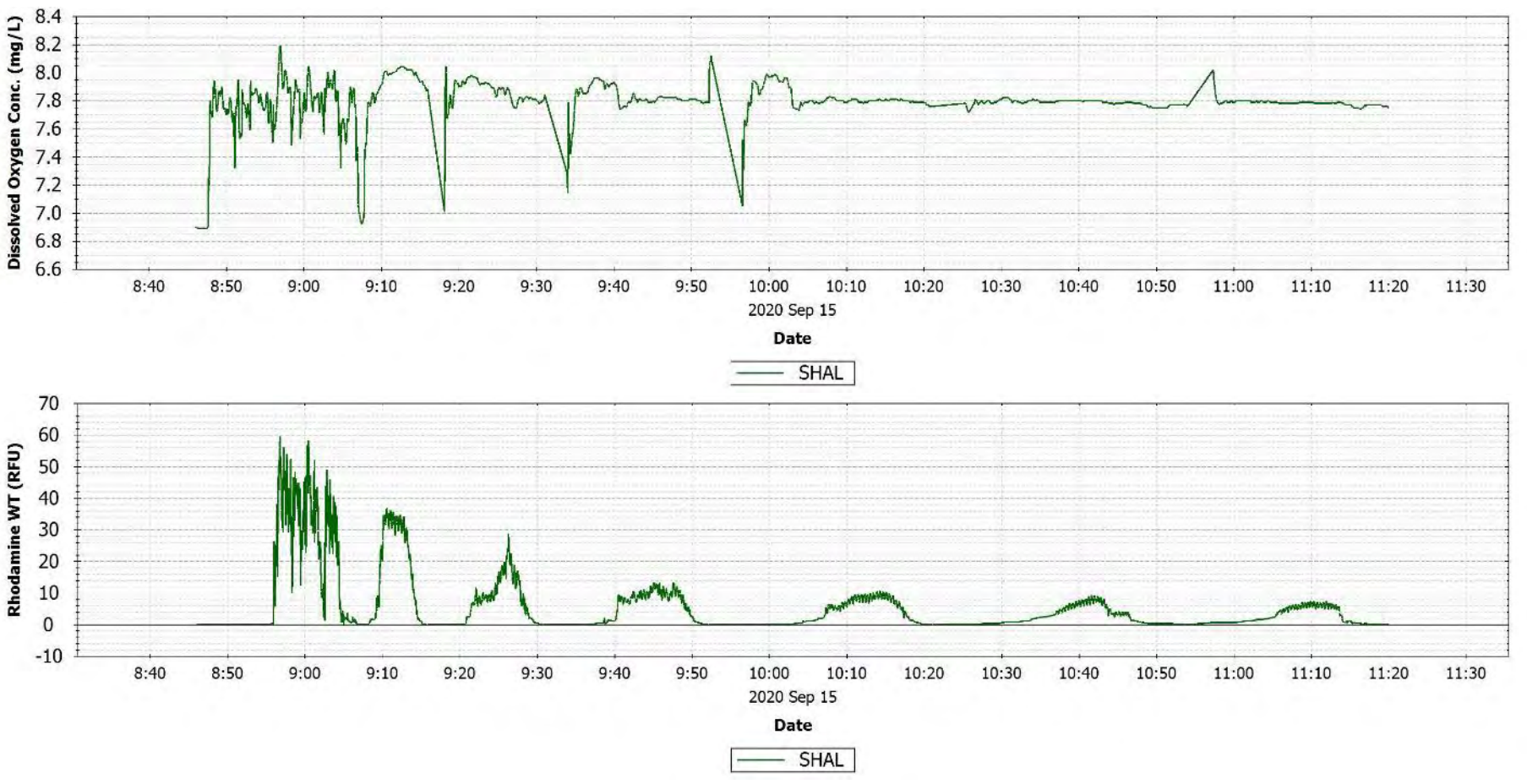


Figure C-171 Upriver September 15, 2020 dye injection drift [UR_Drift_091520_DYE_D1] location map



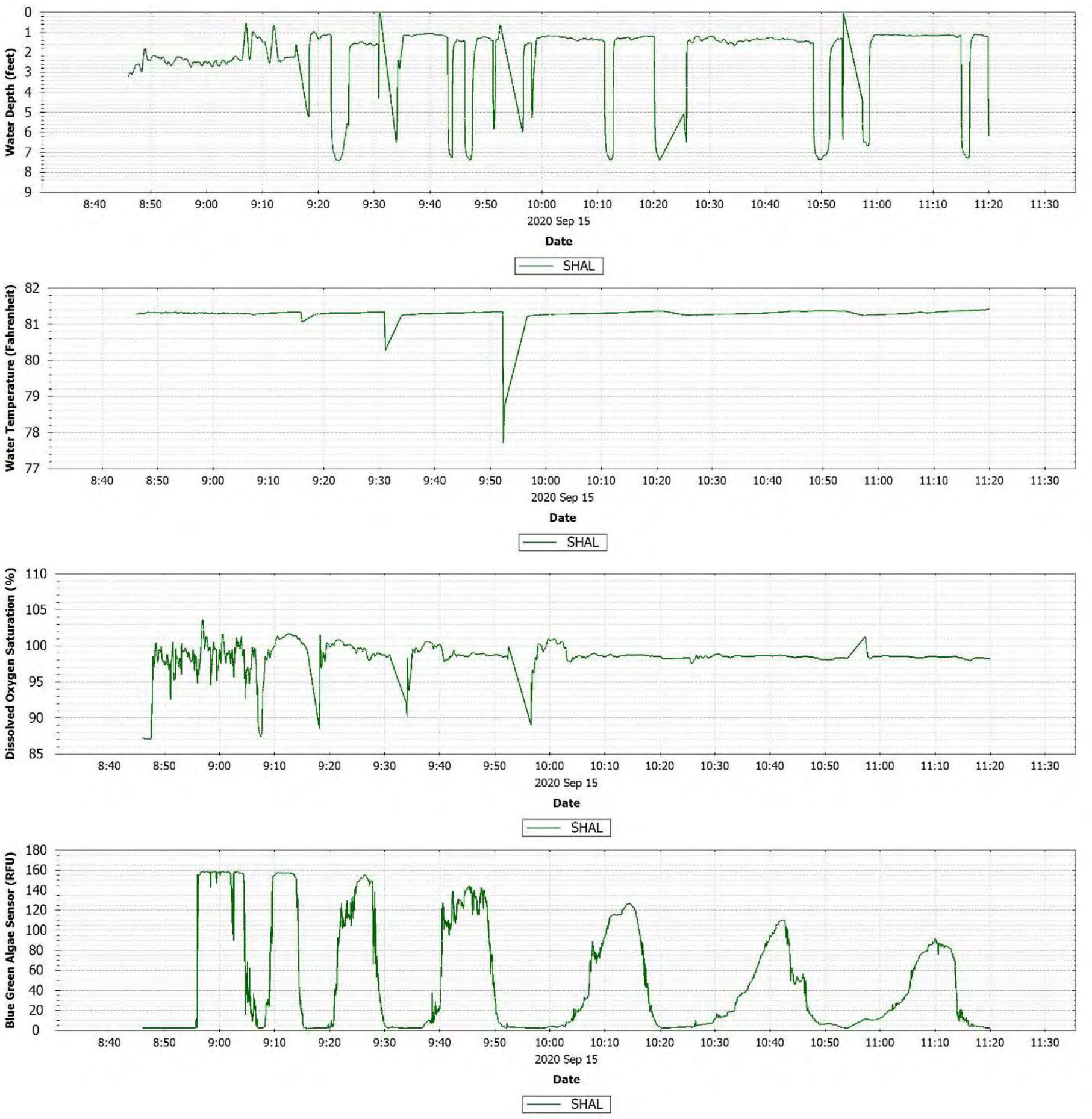


Figure C-172 Upriver September 15, 2020 dye injection drift [UR_Drift_091520_DYE_D1] observations.

C.70 SEPTEMBER 16, 2020 DRIFT UPRIVER

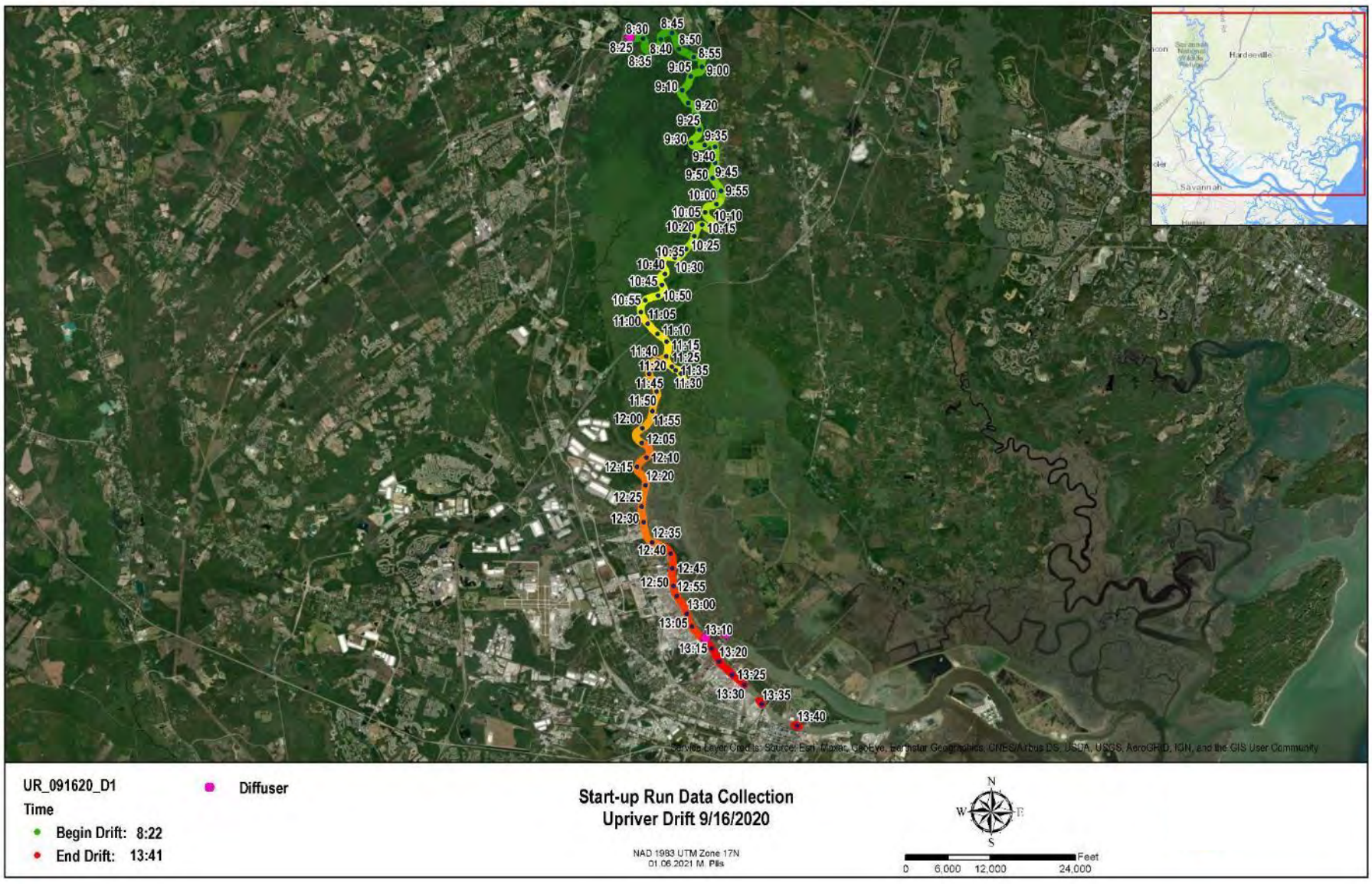
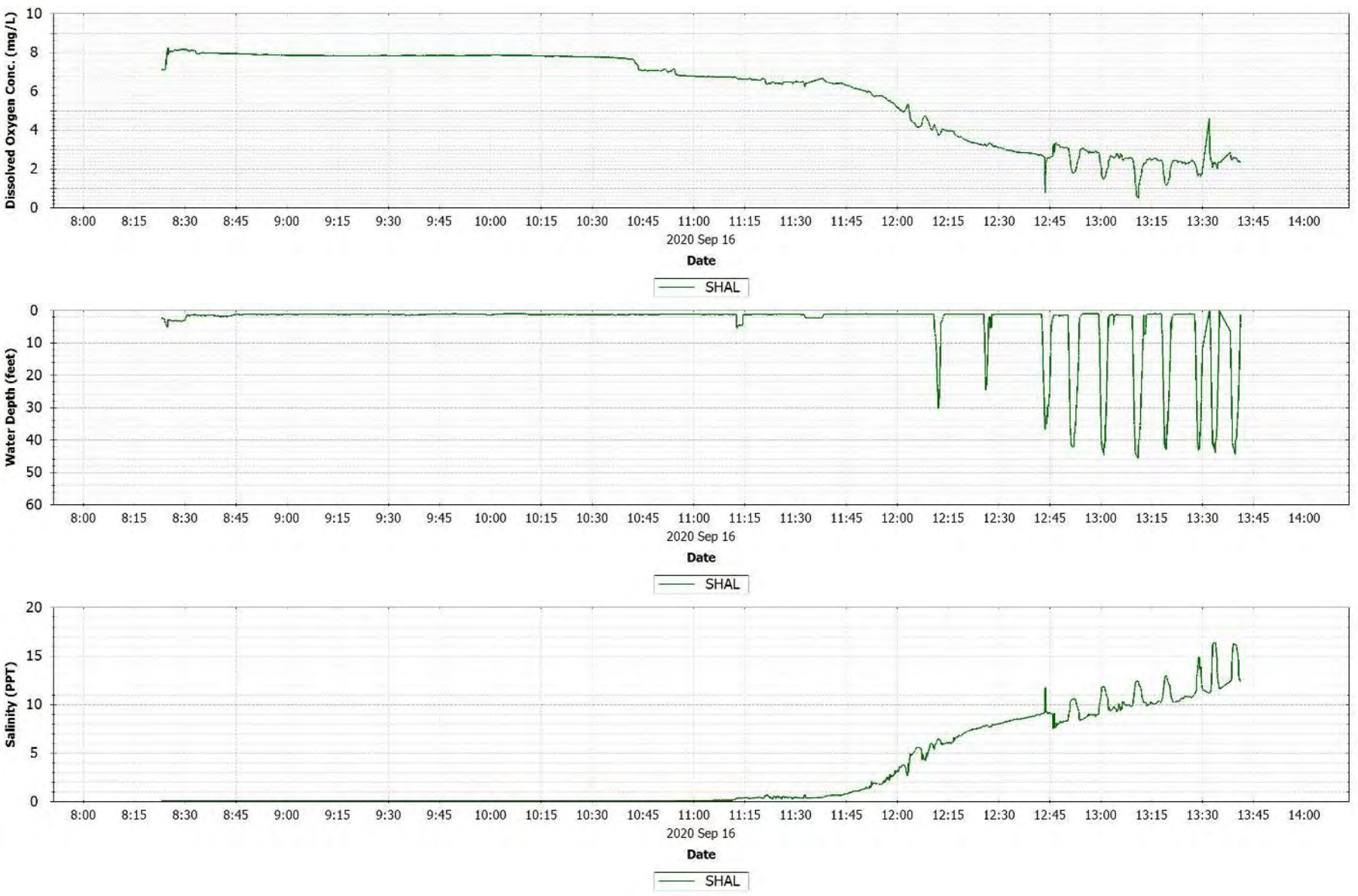


Figure C-173 Upriver September 16, 2020 drift [UR_Drift_091620_D1] location map



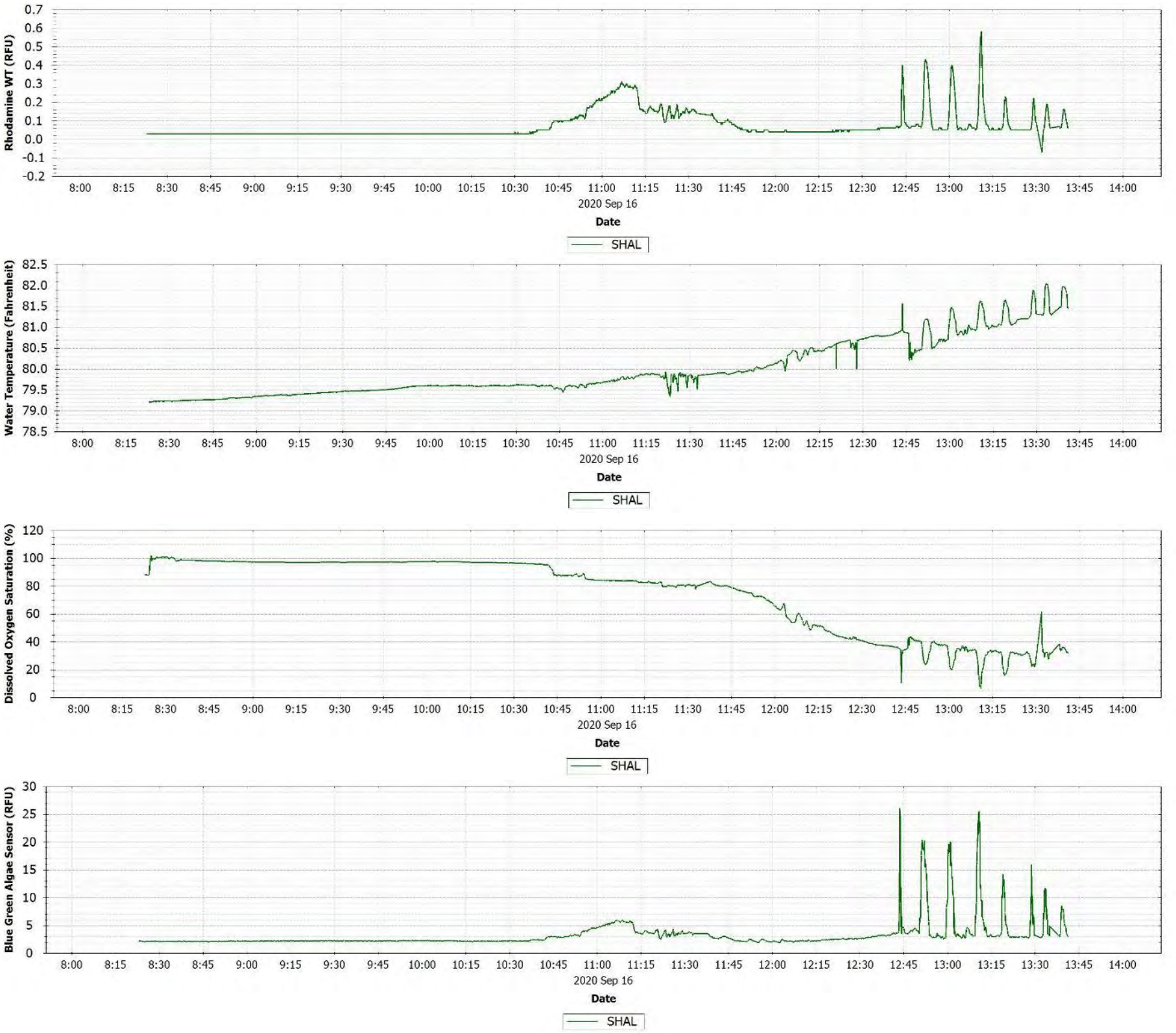


Figure C-174 Upriver September 16, 2020 drift [UR_Drift_091620_D1] observations

C.71 SEPTEMBER 20, 2020 DRIFT UPRIVER

DO concentrations were higher downstream of the diffuser



Figure C-175 Upriver September 20, 2020 drift [UR_Drift_092020_D1] location map

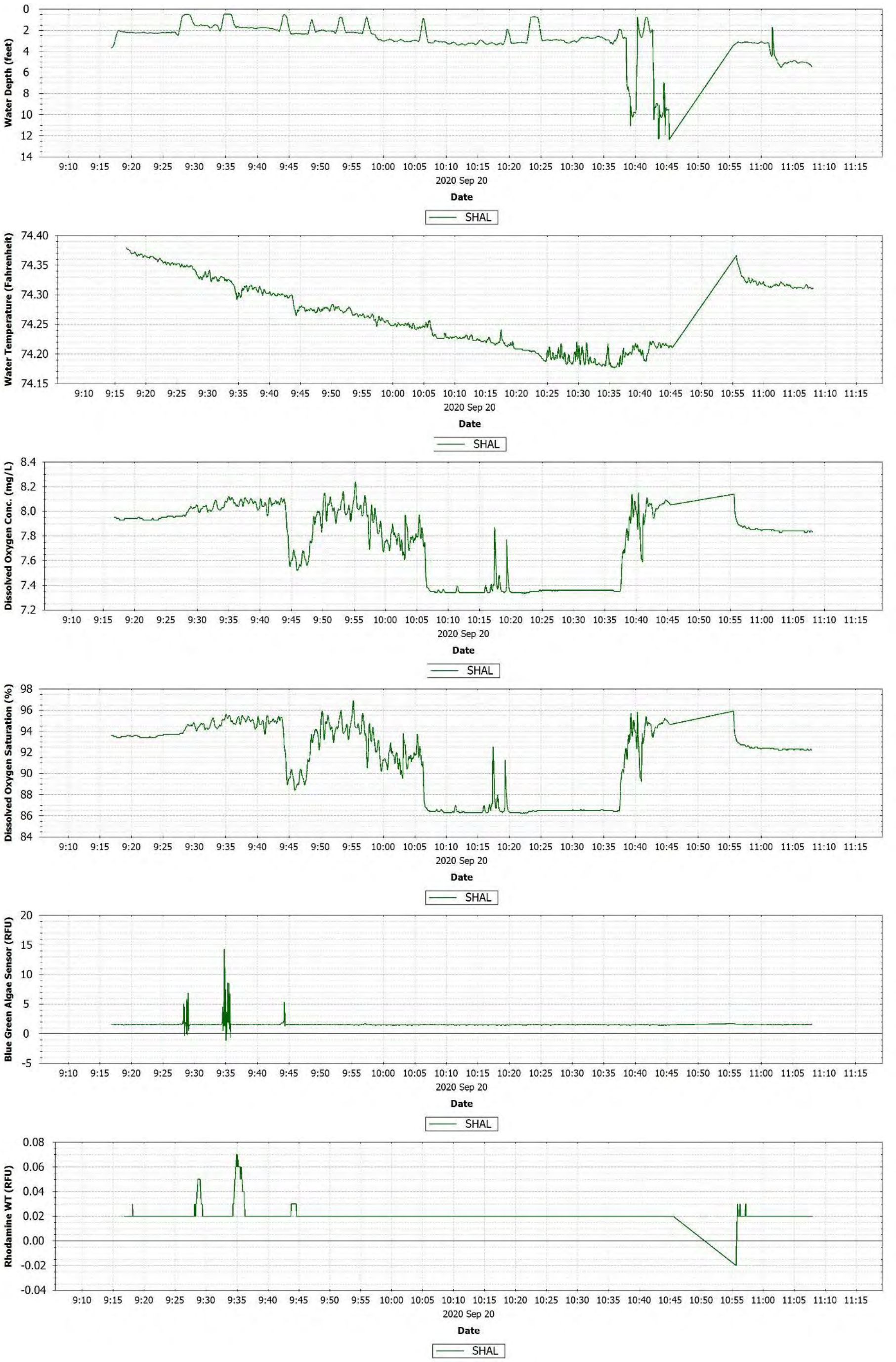


Figure C-176 Upriver September 20, 2020 drift [UR_Drift_092020_D1] observations..

APPENDIX D FIELD NOTE LOGS/CALIBRATION

APPENDIX D FIELD NOTE LOGS AND CALIBRATION REPORTS

Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Task: 10
March 2021

PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX D BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document is provided as Appendix D of the SUR Report and is referred to in the main body of the report in Sections 2.2..

APPENDIX D TABLE OF CONTENTS

APPENDIX D FIELD NOTE LOGS AND CALIBRATION REPORTS D-1

D.1 Number of Sondes Used per Drift Event D-4

D.2 Field Notes and Daily Logs D-7

APPENDIX D LIST OF TABLES

Table D-1 Number of Sondes Used per Drift Event D-4

D.1 NUMBER OF SONDES USED PER DRIFT EVENT

Data was collected during drift events by the field team via project boats using multiple instruments deployed from a single boat. Up to three data sondes were deployed from a boat with each deployed at three different depth intervals. The monitoring zones were relative to each sonde due to the variable river depths encountered during data collection, but when monitored were designated as *surface, shallow, middle (mid-depth),* and *deep sondes*. They were generally deployed at 0.5 meters below the water's surface (surface) and at variable depths to monitor the remaining zones. Data were collected simultaneously from all sondes in use for the duration of the drift event. The exact number of sondes used for each drift monitoring event is presented in ***Table D-1***.

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 to each part of the river based on rapid interpretation of monitoring data with procedures quickly modified to optimize data collection efforts. During dye injection monitoring events, drift data was collected within and around the dye plumes. Each data sonde recorded dissolved oxygen (DO), DO saturation, salinity, conductivity, temperature, Rhodamine WT, 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 of the data sondes by a communication cable (i.e. like stationary and traveling profiles); 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.

Section D.2 contains the field notes, daily logs, and calibration logs prepared to document monitoring efforts such as data collection times and locations, the field crews, weather conditions, and pertinent data collection issues, if any.

Table D-1 Number of Sondes Used per Drift Event

Week	Lower River		Upper River	
	Drift	Sondes	Drift	Sondes
1	1	2	1	3
	1	4	1	2
	1	1	1	2
	1	3	1	2
	1	2	1	2
	1	1	1	1
	-	-	1	1
2	1	2	1	1
	1	1	1	1
	1	1	1	2
	1	2	1	1

Week	Lower River		Upper River	
	Drift	Sondes	Drift	Sondes
	1	1	-	-
	1	2	-	-
	1	2	-	-
3	1	1	1	2
	1	1	1	2
	1	1	1	1
	1	1	1	2
	1	2	1	1
	1	2	-	-
	1	2	-	-
	1	2	-	-
4	1	2	1	1
	1	1	1	2
	1	2	1	1
	1	2	-	-
	1	2	-	-
	1	2	-	-
	1	1	-	-
5	1	2	1	2
	1	2	1	2
	1	1	1	1
	1	1	-	-
	1	1	-	-
	1	2	-	-
	1	2	-	-
	1	1	-	-
6	1	3	1	1
	1	1	1	2
	1	2	1	1
	1	1	-	-
	1	1	-	-
	1	2	-	-
	1	1	-	-

Week	Lower River		Upper River	
	Drift	Sondes	Drift	Sondes
	1	1	-	-
7	1	2	1	1
	1	1	1	2
	1	1	1	1
	1	2	1	1
	1	2	1	1
	1	2	1	1
	1	2	1	1
	1	1	1	1
8	1	1	1	1
	1	1	1	1
9	1	1	1	1
	1	1	1	1
10	1	1	1	1
	1	1	1	1
	1	1	1	1
11	1	1	1	1
	1	1	-	-

D.2 FIELD NOTES AND DAILY LOGS

Calibration Report

Last Calibration Time: 5/21/2019 2:52:42 PM

Calibration Start Time: 6/23/2020 2:23:22 PM

Calibration End Time: 6/23/2020 2:28:57 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105664

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.673 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 12:25:00 PM

Calibration Start Time: 6/23/2020 2:23:22 PM

Calibration End Time: 6/23/2020 2:28:57 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105653

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.679 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 2:52:42 PM

Calibration Start Time: 6/23/2020 2:23:22 PM

Calibration End Time: 6/23/2020 2:28:57 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105656

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.680 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 12:25:00 PM

Calibration Start Time: 6/23/2020 2:23:22 PM

Calibration End Time: 6/23/2020 2:28:57 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102814

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.678 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 2:52:42 PM

Calibration Start Time: 6/23/2020 2:48:33 PM

Calibration End Time: 6/23/2020 3:09:52 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.08 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.634 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 2:52:42 PM

Calibration Start Time: 6/23/2020 2:48:33 PM

Calibration End Time: 6/23/2020 3:09:52 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102813

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.14 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.555 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: False

Calibration Report

Last Calibration Time: 4/16/2019 1:38:16 PM

Calibration Start Time: 6/23/2020 2:48:33 PM

Calibration End Time: 6/23/2020 3:09:52 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105658

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.600 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 12:25:00 PM

Calibration Start Time: 6/23/2020 1:40:19 PM

Calibration End Time: 6/23/2020 1:50:25 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105663

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.648 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 12:25:00 PM

Calibration Start Time: 6/23/2020 1:40:19 PM

Calibration End Time: 6/23/2020 1:50:25 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105655

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.652 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 12:25:00 PM

Calibration Start Time: 6/23/2020 1:40:19 PM

Calibration End Time: 6/23/2020 1:50:25 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102815

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.652 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 2:52:42 PM

Calibration Start Time: 6/23/2020 1:40:19 PM

Calibration End Time: 6/23/2020 1:50:25 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105657

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.650 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 2:52:42 PM

Calibration Start Time: 6/23/2020 1:40:19 PM

Calibration End Time: 6/23/2020 1:50:25 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105654

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.647 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 3:08:16 PM

Calibration Start Time: 6/23/2020 2:29:31 PM

Calibration End Time: 6/23/2020 2:33:48 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105664

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.34 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.674 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:09:45 PM

Calibration Start Time: 6/23/2020 2:29:31 PM

Calibration End Time: 6/23/2020 2:33:48 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105653

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.02 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.670 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 3:08:16 PM

Calibration Start Time: 6/23/2020 2:29:31 PM

Calibration End Time: 6/23/2020 2:33:48 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105656

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.06 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.667 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:09:45 PM

Calibration Start Time: 6/23/2020 2:29:31 PM

Calibration End Time: 6/23/2020 2:33:48 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102814

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.58 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.666 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 3:08:16 PM

Calibration Start Time: 6/23/2020 3:10:44 PM

Calibration End Time: 6/23/2020 3:19:13 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.54 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.564 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 3:08:16 PM

Calibration Start Time: 6/23/2020 3:10:44 PM

Calibration End Time: 6/23/2020 3:19:13 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102813

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.60 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.579 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: False

Calibration Report

Last Calibration Time: 4/16/2019 1:40:22 PM

Calibration Start Time: 6/23/2020 3:10:44 PM

Calibration End Time: 6/23/2020 3:19:13 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105658

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.21 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.580 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:09:45 PM

Calibration Start Time: 6/23/2020 1:52:14 PM

Calibration End Time: 6/23/2020 2:00:24 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105663

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.05 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.634 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:09:45 PM

Calibration Start Time: 6/23/2020 1:52:14 PM

Calibration End Time: 6/23/2020 2:00:24 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105655

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.20 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.631 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:09:45 PM

Calibration Start Time: 6/23/2020 1:52:14 PM

Calibration End Time: 6/23/2020 2:00:24 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102815

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.10 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.626 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 3:08:16 PM

Calibration Start Time: 6/23/2020 1:52:14 PM

Calibration End Time: 6/23/2020 2:00:24 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105657

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.01 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.626 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 3:08:16 PM

Calibration Start Time: 6/23/2020 1:52:14 PM

Calibration End Time: 6/23/2020 2:00:24 PM

Parameter: Chlorophyll (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105654

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.11 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.629 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:40:49 PM

Calibration Start Time: 6/23/2020 2:34:19 PM

Calibration End Time: 6/23/2020 2:38:06 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105664

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.05 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.667 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 11:38:57 AM

Calibration Start Time: 6/23/2020 2:34:19 PM

Calibration End Time: 6/23/2020 2:38:06 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105653

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.669 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:40:49 PM

Calibration Start Time: 6/23/2020 2:34:19 PM

Calibration End Time: 6/23/2020 2:38:06 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105656

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.674 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 11:38:57 AM

Calibration Start Time: 6/23/2020 2:34:19 PM

Calibration End Time: 6/23/2020 2:38:06 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102814

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.38 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.686 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:40:49 PM

Calibration Start Time: 6/23/2020 3:19:49 PM

Calibration End Time: 6/23/2020 3:22:29 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.31 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.579 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:40:49 PM

Calibration Start Time: 6/23/2020 3:19:49 PM

Calibration End Time: 6/23/2020 3:22:29 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102813

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.53 RFU

Post Calibration Value: 0.01 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.579 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: False

Calibration Report

Last Calibration Time: 4/16/2019 1:32:24 PM

Calibration Start Time: 6/23/2020 3:19:49 PM

Calibration End Time: 6/23/2020 3:22:29 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105658

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.578 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 11:38:57 AM

Calibration Start Time: 6/23/2020 2:01:24 PM

Calibration End Time: 6/23/2020 2:07:51 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105663

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.31 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.640 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 11:38:57 AM

Calibration Start Time: 6/23/2020 2:01:24 PM

Calibration End Time: 6/23/2020 2:07:51 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105655

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.21 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.653 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 11:38:57 AM

Calibration Start Time: 6/23/2020 2:01:24 PM

Calibration End Time: 6/23/2020 2:07:51 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102815

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -2.01 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.678 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:40:49 PM

Calibration Start Time: 6/23/2020 2:01:24 PM

Calibration End Time: 6/23/2020 2:07:51 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105657

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.29 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.700 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:40:49 PM

Calibration Start Time: 6/23/2020 2:01:24 PM

Calibration End Time: 6/23/2020 2:07:51 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105654

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.716 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:51:47 PM

Calibration Start Time: 6/23/2020 2:38:44 PM

Calibration End Time: 6/23/2020 2:42:56 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105664

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.35 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.694 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 11:49:53 AM

Calibration Start Time: 6/23/2020 2:38:44 PM

Calibration End Time: 6/23/2020 2:42:56 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105653

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.32 µg/L

Post Calibration Value: -0.02 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.703 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:51:47 PM

Calibration Start Time: 6/23/2020 2:38:44 PM

Calibration End Time: 6/23/2020 2:42:56 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105656

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.56 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.711 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 11:49:53 AM

Calibration Start Time: 6/23/2020 2:38:44 PM

Calibration End Time: 6/23/2020 2:42:56 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102814

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -1.17 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.716 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:51:47 PM

Calibration Start Time: 6/23/2020 3:23:11 PM

Calibration End Time: 6/23/2020 3:26:24 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.52 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.577 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:51:47 PM

Calibration Start Time: 6/23/2020 3:23:11 PM

Calibration End Time: 6/23/2020 3:26:24 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102813

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1.39 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.573 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 4/16/2019 1:34:30 PM

Calibration Start Time: 6/23/2020 3:23:11 PM

Calibration End Time: 6/23/2020 3:26:24 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105658

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -1.00 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.571 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 11:49:53 AM

Calibration Start Time: 6/23/2020 2:08:26 PM

Calibration End Time: 6/23/2020 2:17:20 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105663

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.98 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.758 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 11:49:53 AM

Calibration Start Time: 6/23/2020 2:08:26 PM

Calibration End Time: 6/23/2020 2:17:20 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105655

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.48 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.773 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 11:52:27 AM

Calibration Start Time: 6/23/2020 2:08:26 PM

Calibration End Time: 6/23/2020 2:17:20 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102815

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -2.57 µg/L

Post Calibration Value: 0.01 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.785 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:51:47 PM

Calibration Start Time: 6/23/2020 2:08:26 PM

Calibration End Time: 6/23/2020 2:17:20 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105657

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.78 µg/L

Post Calibration Value: 0.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.792 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:51:47 PM

Calibration Start Time: 6/23/2020 2:08:26 PM

Calibration End Time: 6/23/2020 2:17:20 PM

Parameter: Phycoerythrin (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105654

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.22 µg/L

Post Calibration Value: 0.01 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.795 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 8:54:50 AM

Calibration Start Time: 6/23/2020 2:32:28 PM

Calibration End Time: 6/23/2020 2:35:38 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103295

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 5.12

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10049.8 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.527 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 4/7/2019 3:09:10 PM

Calibration Start Time: 6/23/2020 2:32:28 PM

Calibration End Time: 6/23/2020 2:35:38 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100179

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: 9905.2 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.525 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 4/16/2019 12:15:38 PM

Calibration Start Time: 6/23/2020 2:32:28 PM

Calibration End Time: 6/23/2020 2:35:38 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104023

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: 9950.0 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.523 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:13:58 AM

Calibration Start Time: 6/23/2020 1:20:32 PM

Calibration End Time: 6/23/2020 1:46:56 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100176

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: 9976.5 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.603 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 4/16/2019 12:52:59 PM

Calibration Start Time: 6/23/2020 1:20:32 PM

Calibration End Time: 6/23/2020 1:46:56 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100173

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: 9967.8 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.601 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 4/16/2019 12:52:59 PM

Calibration Start Time: 6/23/2020 1:20:32 PM

Calibration End Time: 6/23/2020 1:46:56 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100172

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: 9966.0 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.594 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:13:58 AM

Calibration Start Time: 6/23/2020 1:20:32 PM

Calibration End Time: 6/23/2020 1:46:56 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

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: 9983.6 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.588 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 4/16/2019 12:15:38 PM

Calibration Start Time: 6/23/2020 1:20:32 PM

Calibration End Time: 6/23/2020 1:46:56 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100164

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: 9990.7 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.583 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 4/16/2019 12:52:59 PM

Calibration Start Time: 6/23/2020 2:04:20 PM

Calibration End Time: 6/23/2020 2:13:51 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100169

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: 9979.8 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.568 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 4/7/2019 3:09:10 PM

Calibration Start Time: 6/23/2020 2:04:20 PM

Calibration End Time: 6/23/2020 2:13:51 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104024

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: 9973.4 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.561 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:13:58 AM

Calibration Start Time: 6/23/2020 2:04:20 PM

Calibration End Time: 6/23/2020 2:13:51 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101758

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: 9987.8 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.558 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:13:58 AM

Calibration Start Time: 6/23/2020 2:04:20 PM

Calibration End Time: 6/23/2020 2:13:51 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

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: 9996.0 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.551 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:37:27 AM

Calibration Start Time: 6/23/2020 2:04:20 PM

Calibration End Time: 6/23/2020 2:13:51 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101761

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: 9975.1 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.547 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:24:50 AM

Calibration Start Time: 6/23/2020 2:04:20 PM

Calibration End Time: 6/23/2020 2:13:51 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

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: 22.545 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 8:54:50 AM

Calibration Start Time: 6/23/2020 2:22:43 PM

Calibration End Time: 6/23/2020 2:26:17 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104076

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 5.11

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10023.0 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.473 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 8:54:50 AM

Calibration Start Time: 6/23/2020 2:22:43 PM

Calibration End Time: 6/23/2020 2:26:17 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104073

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 5.15

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10004.3 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.470 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:49:55 AM

Calibration Start Time: 6/23/2020 2:22:43 PM

Calibration End Time: 6/23/2020 2:26:17 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103298

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 5.19

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9977.7 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.465 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:49:55 AM

Calibration Start Time: 6/23/2020 2:22:43 PM

Calibration End Time: 6/23/2020 2:26:17 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104074

Firmware Version: 3.0.5

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

Cell Constant: 5.12

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10007.6 µS/cm

Post Calibration Value: 9999.9 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.460 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:24:50 AM

Calibration Start Time: 6/23/2020 10:20:40 AM

Calibration End Time: 6/23/2020 10:29:30 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104022

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 994.5 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.421 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D10332

Is Stable: True

Calibration Report

Last Calibration Time: 4/16/2019 12:15:38 PM

Calibration Start Time: 6/23/2020 10:20:40 AM

Calibration End Time: 6/23/2020 10:29:30 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100183

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 996.3 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.422 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 4/7/2019 3:09:10 PM

Calibration Start Time: 6/23/2020 10:20:40 AM

Calibration End Time: 6/23/2020 10:29:30 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100175

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 996.8 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.421 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:37:27 AM

Calibration Start Time: 6/23/2020 10:20:40 AM

Calibration End Time: 6/23/2020 10:29:30 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100178

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.3 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.418 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:37:27 AM

Calibration Start Time: 6/23/2020 10:20:40 AM

Calibration End Time: 6/23/2020 10:29:30 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100180

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 997.1 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.411 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 4/9/2019 4:09:30 PM

Calibration Start Time: 6/23/2020 10:20:40 AM

Calibration End Time: 6/23/2020 10:29:30 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100167

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.1 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.406 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:49:55 AM

Calibration Start Time: 6/23/2020 11:03:37 AM

Calibration End Time: 6/23/2020 11:12:09 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104021

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 991.8 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.485 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:24:50 AM

Calibration Start Time: 6/23/2020 11:03:37 AM

Calibration End Time: 6/23/2020 11:12:09 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104075

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.18

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.9 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.487 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:37:27 AM

Calibration Start Time: 6/23/2020 11:03:37 AM

Calibration End Time: 6/23/2020 11:12:09 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100182

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.1 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.487 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:24:50 AM

Calibration Start Time: 6/23/2020 11:03:37 AM

Calibration End Time: 6/23/2020 11:12:09 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104031

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 993.1 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.490 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 8:54:50 AM

Calibration Start Time: 6/23/2020 10:45:36 AM

Calibration End Time: 6/23/2020 10:53:03 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103297

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.18

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1000.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.429 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:37:27 AM

Calibration Start Time: 6/23/2020 10:45:36 AM

Calibration End Time: 6/23/2020 10:53:03 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100168

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1000.1 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.435 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:13:58 AM

Calibration Start Time: 6/23/2020 10:45:36 AM

Calibration End Time: 6/23/2020 10:53:03 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100166

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.5 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.438 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:49:55 AM

Calibration Start Time: 6/23/2020 10:45:36 AM

Calibration End Time: 6/23/2020 10:53:03 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100170

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 996.3 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.442 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 8:54:50 AM

Calibration Start Time: 6/23/2020 10:45:36 AM

Calibration End Time: 6/23/2020 10:53:03 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103296

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.17

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 986.3 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.446 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 9:24:50 AM

Calibration Start Time: 6/23/2020 10:45:36 AM

Calibration End Time: 6/23/2020 10:53:03 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100177

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 995.0 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.447 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/9/2020 12:48:14 PM

Calibration End Time: 7/9/2020 12:51:59 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104025

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1000.0 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.454 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/9/2020 12:48:14 PM

Calibration End Time: 7/9/2020 12:51:59 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101753

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1001.8 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.456 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/9/2020 12:48:14 PM

Calibration End Time: 7/9/2020 12:51:59 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101752

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1004.0 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.454 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 4/16/2019 1:12:02 PM

Calibration Start Time: 6/23/2020 12:48:41 PM

Calibration End Time: 6/23/2020 1:10:16 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101846

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100596

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.09

DO (mg/L): 8.65 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 97.8 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.516 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 4/16/2019 1:12:02 PM

Calibration Start Time: 6/23/2020 12:48:41 PM

Calibration End Time: 6/23/2020 1:10:16 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100743

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100557

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.13

DO (mg/L): 8.66 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 95.5 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.561 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 11:03:43 AM

Calibration Start Time: 6/23/2020 12:48:41 PM

Calibration End Time: 6/23/2020 1:10:16 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101858

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100627

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.14

DO (mg/L): 8.67 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 95.1 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.593 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 4/16/2019 1:21:14 PM

Calibration Start Time: 6/23/2020 12:48:41 PM

Calibration End Time: 6/23/2020 1:10:16 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101848

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100600

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.10

DO (mg/L): 8.65 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.5 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.618 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 11:03:43 AM

Calibration Start Time: 6/23/2020 12:48:41 PM

Calibration End Time: 6/23/2020 1:10:16 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101458

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102877

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.20

DO (mg/L): 8.65 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 89.0 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.646 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 4/16/2019 1:21:14 PM

Calibration Start Time: 6/23/2020 1:11:26 PM

Calibration End Time: 6/23/2020 1:30:11 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101472

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102903

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.21

DO (mg/L): 8.68 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 90.2 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.181 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 4/9/2019 4:47:33 PM

Calibration Start Time: 6/23/2020 1:11:26 PM

Calibration End Time: 6/23/2020 1:30:11 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101457

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102888

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.20

DO (mg/L): 8.69 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 91.5 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.267 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 4/7/2019 3:43:39 PM

Calibration Start Time: 6/23/2020 1:11:26 PM

Calibration End Time: 6/23/2020 1:30:11 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100750

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100562

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.11

DO (mg/L): 8.69 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 97.6 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.319 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 11:03:43 AM

Calibration Start Time: 6/23/2020 1:11:26 PM

Calibration End Time: 6/23/2020 1:30:11 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100737

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100559

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.12

DO (mg/L): 8.69 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 97.8 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.385 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 11:03:43 AM

Calibration Start Time: 6/23/2020 1:11:26 PM

Calibration End Time: 6/23/2020 1:30:11 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100752

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100588

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.19

DO (mg/L): 8.33 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 90.8 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.444 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 6/23/2020 12:40:20 PM

Calibration End Time: 6/23/2020 1:01:03 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101467

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102893

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.11

DO (mg/L): 8.55 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 90.1 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.328 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 6/23/2020 12:40:20 PM

Calibration End Time: 6/23/2020 1:01:03 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101470

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102901

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.13

DO (mg/L): 8.54 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 88.6 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.318 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 6/23/2020 12:40:20 PM

Calibration End Time: 6/23/2020 1:01:03 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101464

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102889

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.14

DO (mg/L): 8.56 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 87.7 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.200 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 6/23/2020 12:40:20 PM

Calibration End Time: 6/23/2020 1:01:03 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101459

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102872

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.12

DO (mg/L): 8.56 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 89.4 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.161 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:10:15 AM

Calibration Start Time: 6/23/2020 12:02:02 PM

Calibration End Time: 6/23/2020 12:23:48 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101462

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K101898

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.09

DO (mg/L): 8.77 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.7 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.913 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 6/23/2020 12:02:02 PM

Calibration End Time: 6/23/2020 12:23:48 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101466

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102892

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.12

DO (mg/L): 8.77 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 89.0 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.927 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 6/23/2020 12:02:02 PM

Calibration End Time: 6/23/2020 12:23:48 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101455

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102874

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.09

DO (mg/L): 8.76 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 91.5 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.945 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 6/23/2020 12:02:02 PM

Calibration End Time: 6/23/2020 12:23:48 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101468

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102894

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.11

DO (mg/L): 8.76 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 90.0 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.955 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 6/23/2020 12:02:02 PM

Calibration End Time: 6/23/2020 12:23:48 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101474

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102906

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.10

DO (mg/L): 8.76 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 90.7 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.962 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 4/7/2019 3:43:39 PM

Calibration Start Time: 6/23/2020 11:14:02 AM

Calibration End Time: 6/23/2020 11:21:42 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100747

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104236

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.07

DO (mg/L): 8.61 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.8 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.842 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 11:20:28 AM

Calibration Start Time: 6/23/2020 11:14:02 AM

Calibration End Time: 6/23/2020 11:21:42 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101853

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100607

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.10

DO (mg/L): 8.61 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.9 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.858 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 11:20:28 AM

Calibration Start Time: 6/23/2020 11:14:02 AM

Calibration End Time: 6/23/2020 11:21:42 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101456

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102884

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.09

DO (mg/L): 8.61 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.2 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.863 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:27:38 AM

Calibration Start Time: 6/23/2020 11:14:02 AM

Calibration End Time: 6/23/2020 11:21:42 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101854

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100608

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.10

DO (mg/L): 8.61 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.7 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.861 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:10:15 AM

Calibration Start Time: 6/23/2020 11:14:02 AM

Calibration End Time: 6/23/2020 11:21:42 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

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: 1.10

DO (mg/L): 8.53 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 96.7 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.856 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 11:20:28 AM

Calibration Start Time: 6/23/2020 11:41:28 AM

Calibration End Time: 6/23/2020 11:53:22 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101461

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102909

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.08

DO (mg/L): 8.80 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.2 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.404 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:27:38 AM

Calibration Start Time: 6/23/2020 11:41:28 AM

Calibration End Time: 6/23/2020 11:53:22 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101471

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102902

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.08

DO (mg/L): 8.81 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.3 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.474 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:43:56 AM

Calibration Start Time: 6/23/2020 11:41:28 AM

Calibration End Time: 6/23/2020 11:53:22 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100748

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104238

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.04

DO (mg/L): 8.81 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.4 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.575 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:43:56 AM

Calibration Start Time: 6/23/2020 11:41:28 AM

Calibration End Time: 6/23/2020 11:53:22 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101862

Firmware Version: 3.0.0

Status: Completed

Technician: Lisa Heise

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100631

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.12

DO (mg/L): 8.81 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 96.7 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.643 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:43:56 AM

Calibration Start Time: 6/23/2020 11:41:28 AM

Calibration End Time: 6/23/2020 11:53:22 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

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): 8.80 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 97.2 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.711 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 12:17:08 PM

Calibration Start Time: 6/23/2020 12:20:43 PM

Calibration End Time: 6/23/2020 12:22:54 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100738

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100553

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.13

DO (mg/L): 8.64 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.2 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.683 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 12:17:08 PM

Calibration Start Time: 6/23/2020 12:20:43 PM

Calibration End Time: 6/23/2020 12:22:54 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101851

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100606

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.08

DO (mg/L): 8.64 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.3 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.683 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 12:17:08 PM

Calibration Start Time: 6/23/2020 12:20:43 PM

Calibration End Time: 6/23/2020 12:22:54 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100746

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104235

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.00

DO (mg/L): 8.64 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.2 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.683 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 12:20:20 PM

Calibration Start Time: 6/23/2020 12:20:43 PM

Calibration End Time: 6/23/2020 12:22:54 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100751

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100563

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.11

DO (mg/L): 8.65 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.1 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.683 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:43:56 AM

Calibration Start Time: 6/23/2020 11:22:35 AM

Calibration End Time: 6/23/2020 11:40:09 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100745

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104234

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.03

DO (mg/L): 8.69 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 97.5 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.317 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.5 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:27:38 AM

Calibration Start Time: 6/23/2020 11:22:35 AM

Calibration End Time: 6/23/2020 11:40:09 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101849

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100601

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.08

DO (mg/L): 8.71 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.8 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.333 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.5 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:10:15 AM

Calibration Start Time: 6/23/2020 11:22:35 AM

Calibration End Time: 6/23/2020 11:40:09 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100744

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104233

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.05

DO (mg/L): 8.70 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 97.8 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.333 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:27:38 AM

Calibration Start Time: 6/23/2020 11:22:35 AM

Calibration End Time: 6/23/2020 11:40:09 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101860

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100629

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.09

DO (mg/L): 8.70 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.2 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.326 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 10:10:15 AM

Calibration Start Time: 6/23/2020 11:22:35 AM

Calibration End Time: 6/23/2020 11:40:09 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100736

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104237

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.09

DO (mg/L): 8.69 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.5 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.316 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.6 mmHg

Calibration Report

Last Calibration Time: 6/24/2020 10:29:49 AM

Calibration Start Time: 6/24/2020 2:20:38 PM

Calibration End Time: 6/24/2020 2:21:33 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101989

Serial Number: 17G101989

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104624

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 21.743 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 10:38:53 AM

Calibration Start Time: 6/24/2020 2:22:53 PM

Calibration End Time: 6/24/2020 2:23:24 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101992

Serial Number: 17G101992

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104628

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.020 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.639 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 10:55:16 AM

Calibration Start Time: 6/24/2020 2:40:30 PM

Calibration End Time: 6/24/2020 2:40:41 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102930

Serial Number: 17L102930

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104910

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.020 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.841 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:01:27 AM

Calibration Start Time: 6/24/2020 2:34:09 PM

Calibration End Time: 6/24/2020 2:34:16 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102013

Serial Number: 17G102013

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104614

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 21.535 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:11:24 AM

Calibration Start Time: 6/24/2020 2:17:12 PM

Calibration End Time: 6/24/2020 2:17:23 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102004

Serial Number: 17G102004

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104608

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 21.840 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:17:05 AM

Calibration Start Time: 6/24/2020 2:18:44 PM

Calibration End Time: 6/24/2020 2:19:15 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101996

Serial Number: 17G101996

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104630

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.003 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.673 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:21:29 AM

Calibration Start Time: 6/24/2020 2:27:46 PM

Calibration End Time: 6/24/2020 2:29:35 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102009

Serial Number: 17G102009

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104611

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.002 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.428 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:28:45 AM

Calibration Start Time: 6/24/2020 2:25:46 PM

Calibration End Time: 6/24/2020 2:26:19 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101997

Serial Number: 17G101997

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104631

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.034 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.436 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:34:55 AM

Calibration Start Time: 6/24/2020 2:36:24 PM

Calibration End Time: 6/24/2020 2:37:03 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101993

Serial Number: 17G101993

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104632

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.003 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.920 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:39:46 AM

Calibration Start Time: 7/6/2020 12:03:03 PM

Calibration End Time: 7/6/2020 12:03:22 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102940

Serial Number: 17L102940

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104915

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.041 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.584 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:46:01 AM

Calibration Start Time: 6/25/2020 7:45:49 AM

Calibration End Time: 6/25/2020 7:46:23 AM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102942

Serial Number: 17L102942

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104904

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.023 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.376 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 12:14:51 PM

Calibration Start Time: 7/6/2020 12:44:45 PM

Calibration End Time: 7/6/2020 12:45:01 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102010

Serial Number: 17G102010

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104610

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.035 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.154 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 10:58:06 AM

Calibration Start Time: 7/6/2020 1:18:29 PM

Calibration End Time: 7/6/2020 1:18:50 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102003

Serial Number: 17G102003

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104601

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.019 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.660 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:07:16 AM

Calibration Start Time: 7/6/2020 1:32:59 PM

Calibration End Time: 7/6/2020 1:33:07 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102000

Serial Number: 17G102000

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104605

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 23.163 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:33:33 AM

Calibration Start Time: 7/6/2020 1:21:03 PM

Calibration End Time: 7/6/2020 1:21:26 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102939

Serial Number: 17L102939

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104905

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.022 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.591 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:44:13 AM

Calibration Start Time: 7/6/2020 1:25:28 PM

Calibration End Time: 7/6/2020 1:26:01 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102938

Serial Number: 17L102938

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104906

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.020 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.223 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:49:41 AM

Calibration Start Time: 7/6/2020 1:36:32 PM

Calibration End Time: 7/6/2020 1:36:40 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101988

Serial Number: 17G101988

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104623

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.018 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.037 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:57:11 AM

Calibration Start Time: 7/6/2020 1:29:17 PM

Calibration End Time: 7/6/2020 1:29:26 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102935

Serial Number: 17L102935

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104900

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.017 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.304 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 12:07:57 PM

Calibration Start Time: 7/6/2020 1:39:07 PM

Calibration End Time: 7/6/2020 1:39:41 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102946

Serial Number: 17L102946

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104917

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.016 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.991 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 12:12:37 PM

Calibration Start Time: 7/6/2020 1:15:48 PM

Calibration End Time: 7/6/2020 1:15:54 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102932

Serial Number: 17L102932

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104903

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.001 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.674 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 12:17:40 PM

Calibration Start Time: 7/6/2020 1:11:20 PM

Calibration End Time: 7/6/2020 1:11:25 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102931

Serial Number: 17L102931

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104912

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.021 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.992 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 1:52:05 PM

Calibration Start Time: 7/9/2020 1:56:01 PM

Calibration End Time: 7/9/2020 1:56:10 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102945

Serial Number: 17L102945

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104909

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.297 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.835 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 5/21/2019 1:09:41 PM

Calibration Start Time: 7/9/2020 11:59:30 AM

Calibration End Time: 7/9/2020 11:59:50 AM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102005

Serial Number: 17G102005

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104606

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.047 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.866 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 1:56:20 PM

Calibration Start Time: 7/9/2020 12:09:07 PM

Calibration End Time: 7/9/2020 12:10:16 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102933

Serial Number: 17L102933

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104913

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 22.375 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/24/2017 2:29:48 PM

Calibration Start Time: 7/6/2020 2:23:40 PM

Calibration End Time: 7/6/2020 2:24:01 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101999

Serial Number: 17G101999

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104607

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.031 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.431 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 1:59:24 PM

Calibration Start Time: 7/9/2020 12:21:52 PM

Calibration End Time: 7/9/2020 12:23:29 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101990

Serial Number: 17G101990

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104625

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.032 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.848 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 12:34:36 PM

Calibration Start Time: 7/6/2020 1:52:57 PM

Calibration End Time: 7/6/2020 1:53:02 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G102021

Serial Number: 17G102021

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100273

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.023 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.306 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 12:49:15 PM

Calibration Start Time: 7/6/2020 1:45:59 PM

Calibration End Time: 7/6/2020 1:46:26 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100250

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.016 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.669 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 1:05:42 PM

Calibration Start Time: 7/6/2020 1:49:30 PM

Calibration End Time: 7/6/2020 1:49:53 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100277

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.021 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.153 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 11:56:59 AM

Calibration Start Time: 7/6/2020 11:39:48 AM

Calibration End Time: 7/6/2020 11:40:13 AM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100292

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.011 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.241 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 11:10:33 AM

Calibration Start Time: 7/6/2020 11:41:52 AM

Calibration End Time: 7/6/2020 11:42:25 AM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100276

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.082 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.217 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 12:02:52 PM

Calibration Start Time: 7/6/2020 11:43:27 AM

Calibration End Time: 7/6/2020 11:44:00 AM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100252

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 23.183 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/22/2017 3:30:47 PM

Calibration Start Time: 7/9/2020 12:56:50 PM

Calibration End Time: 7/9/2020 12:58:44 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100255

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.043 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.337 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/24/2017 2:24:58 PM

Calibration Start Time: 7/9/2020 1:18:26 PM

Calibration End Time: 7/9/2020 1:18:37 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102011

Serial Number: 17G102011

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104615

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.014 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 20.811 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/9/2020 1:40:54 PM

Calibration End Time: 7/9/2020 1:41:23 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102934

Serial Number: 17L102934

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104921

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10.324 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.438 °C

Standard Value: 0.000 m

Is Stable: True

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/09/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 79°F Cloudy WNW 4mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Ethan Bright, Lisa Heise, Sam Booth, 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: 2.5 hours (SB & HT)
- ☐ White Boat – Duration:
- ☐ Yellow Boat – Duration:

Other Equipment Used:

Work Completed:

- See field notes.

Notes:

Daily Log Completed by: Sam Booth

Signature: Samuel Booth

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

7/9/2020

Sam Booth Hayley Torkos
79°F mostly cloudy WNW 4

0800 SB & HT arrive at depot
0853 Leave for LBR (black)
0920 arrive at LBR 8
0927 Deploy sonde 24 @ LBR-8
LBL-5, too horizontal in water
will need additional weight
0934 Deploy sonde 23 @ LBR_7
LBR 7 needs longer lanyard
0940 Deploy sonde 22 @ LBR_6
0947 Deploy sonde 21 @ LBR_5
0952 Deploy sonde 20 @ LBR-4
0959 Deploy Sonde 19 @ LBR_3
1005 Deploy Sonde 18 @ LBR_2
~~1008~~ LBR_2 needs collar + lanyard
1014 Deploy Sonde 17 @ LBR_1
LBR_1 needs Lanyard
1015 Depart LBR
1040 Arrive @ LFR
1044 Deploy Sonde 16 @ LFR_5
-need D-rings-used from cord
1050 Deploy Sonde 15 @ LFR_1
1057 Deploy sonde 14 @ LFR_A

1100 Depart LFR
1111 arrive at depot
1120 Calibrate and assemble
Sondes 28, 29, 32, H, I, J
for additional profile sondes
Prep for SOR kick-off on
monday
RM Completed capsules for
Mid Sonde deployment
1427 LH + EB arrive at depot
from up River
1515 deploy Sonde 25 at depot
1524 Upload UR TE data
1537 RM leave depot
1600 SB LH EB HT leave
for Jacksonville

Rite in the Rain.

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/13/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 92°F Partly Cloudy SW 10 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Lisa Heise, Sam Booth, Eric Huss		
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:	5.0 hours	
☒ White Boat – Duration:	4.0 hours	
☐ Yellow Boat – Duration:		

Work Completed:

- See field notes.

Notes:

Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise
	Photos Attached? ☐ **# of Photos** ____

7/13/20

SB, LH, EB
91°F sunny, 6 mph WSW

~~OH~~ EH
1130 SB, LH, EB arrive @ Depot
1200 EH arrive @ Depot
1350 SB + LH1 departed depot
1415 arrived @ Buoy LBR8 to install weight + transfer data
- could not get shackle pin loose did not install weight Sonde out of water
1422 LBR8 - Stopped deployment
LBR8 - transferred data
1424 LBR8 - Started deployment
1427 LBR7 - stopped deployment
1432 Started deployment
1438 LBR6 stopped deployment
1439 LBR6 transferred sonde data + started deployment
1444 LBR5 stopped deploy + transferred data
1445 Started deploy LBR5
1450 Started deploy LBR4 transferred data + deployed
screw holding lanyard to buoy ~~was~~ and to sonde were both disconnected

used another screw to put lanyard back in place, screw not all the way in so need to fix next time
used new lanyard for connection to sonde.
1512 Start setup for 2 sonde drift
Sonde 28 H4 1m
Sonde B H1 2.5m ~~started 1505~~
1517 Sonde B started logging
1518 Sonde 28 started logging
Drifted w/ hightide North (floodtide)
1618 Slack pulled up sondes to travel to diffuser for south drift and ebb tide
1626 drift south during ebb tide from diffuser towards LBR1
1745 stopped logging

1801 Started ~~deployment~~ LBR1
1818 Started deployment LBR2
stop bolt only had one bolt + was loose. found other bolt attached to D-ring by sonde ???
~~1823~~ 1825 stopped deploy + transferred data + started deploy on LBR3

Rite in the Rain

1846 arrived @ depot & took black boat out of water
1914 uploaded data
2000 departed depot

Rite in the Rain

7/13/20 92° wind S13 Sunny

1400 leave depot for LFR

1415 arrive, GPS 3 FR buoys
take pictures
retrieve buoy data from Sten N then A

1444 prep for drift
sonde 32 o/m
" A ~3m
" C ~5m (cable length of boat)

1500 start logging
ship came by about 1545, had to
stop zig zag

1600 start heading down river

1715 ship passed stopped zig zag
also had to wait for dredge to move

1738 stop logging

1750 arrive at depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/14/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 95°F Partly Cloudy, light wind	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Lisa Heise, Sam Booth, Eric Huss, 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:
- ☒ White Boat – Duration: 2.0 hours
- ☐ Yellow Boat – Duration:

Other Equipment Used:

Work Completed:

- See field notes.
- See photos on One Drive

Notes:

Daily Log Completed by: Ethan Bright | **Signature:** Ethan Bright

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

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 4:12:12 PM

Calibration End Time: 7/14/2020 4:20:36 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101859

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100628

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.05

DO (mg/L): 8.68 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 95.5 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.517 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 4:12:12 PM

Calibration End Time: 7/14/2020 4:20:36 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101852

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100603

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.11

DO (mg/L): 8.68 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 89.9 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.502 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 11:53:22 AM

Calibration Start Time: 7/14/2020 4:12:12 PM

Calibration End Time: 7/14/2020 4:20:36 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101461

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102909

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.05

DO (mg/L): 8.67 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.1 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.492 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 11:21:42 AM

Calibration Start Time: 7/14/2020 4:12:12 PM

Calibration End Time: 7/14/2020 4:20:36 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101456

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102884

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.06

DO (mg/L): 8.76 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.5 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.479 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:30:11 PM

Calibration Start Time: 7/14/2020 4:12:12 PM

Calibration End Time: 7/14/2020 4:20:36 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100737

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100559

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.12

DO (mg/L): 8.69 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.3 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.465 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 4:26:13 PM

Calibration End Time: 7/14/2020 4:40:50 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101465

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102890

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.04

DO (mg/L): 8.60 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 95.9 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.736 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:01:03 PM

Calibration Start Time: 7/14/2020 4:26:13 PM

Calibration End Time: 7/14/2020 4:40:50 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101459

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102872

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.06

DO (mg/L): 8.64 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 105.8 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.742 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 12:23:48 PM

Calibration Start Time: 7/14/2020 4:26:13 PM

Calibration End Time: 7/14/2020 4:40:50 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101455

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102874

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.06

DO (mg/L): 8.63 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.6 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.734 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 4:26:13 PM

Calibration End Time: 7/14/2020 4:40:50 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101856

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100625

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.14

DO (mg/L): 8.64 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 88.0 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.714 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:01:03 PM

Calibration Start Time: 7/14/2020 4:26:13 PM

Calibration End Time: 7/14/2020 4:40:50 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101464

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102889

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.09

DO (mg/L): 8.64 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.7 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.686 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 3:37:31 PM

Calibration End Time: 7/14/2020 3:51:42 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101475

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102908

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.04

DO (mg/L): 8.61 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 96.0 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.935 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 3:37:31 PM

Calibration End Time: 7/14/2020 3:51:42 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101855

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100624

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.14

DO (mg/L): 8.62 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 87.6 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.875 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 11:53:22 AM

Calibration Start Time: 7/14/2020 3:37:31 PM

Calibration End Time: 7/14/2020 3:51:42 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101862

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100631

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.14

DO (mg/L): 8.63 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.3 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.807 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 3:37:31 PM

Calibration End Time: 7/14/2020 3:51:42 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101847

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100599

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.10

DO (mg/L): 8.63 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 90.6 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.739 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 11:40:09 AM

Calibration Start Time: 7/14/2020 3:37:31 PM

Calibration End Time: 7/14/2020 3:51:42 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100744

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104233

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.08

DO (mg/L): 8.61 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 97.4 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.704 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.4 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 11:40:09 AM

Calibration Start Time: 7/14/2020 2:45:31 PM

Calibration End Time: 7/14/2020 2:57:15 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101860

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100629

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.21

DO (mg/L): 8.68 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 90.0 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.079 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.8 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 12:22:54 PM

Calibration Start Time: 7/14/2020 2:45:31 PM

Calibration End Time: 7/14/2020 2:57:15 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101851

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100606

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.13

DO (mg/L): 8.68 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 96.2 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.115 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.8 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 12:23:48 PM

Calibration Start Time: 7/14/2020 2:45:31 PM

Calibration End Time: 7/14/2020 2:57:15 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101468

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102894

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.21

DO (mg/L): 8.67 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 92.1 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.183 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.8 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 11:40:09 AM

Calibration Start Time: 7/14/2020 2:45:31 PM

Calibration End Time: 7/14/2020 2:57:15 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101849

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100601

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.09

DO (mg/L): 8.68 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.1 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.288 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.8 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 11:53:22 AM

Calibration Start Time: 7/14/2020 2:45:31 PM

Calibration End Time: 7/14/2020 2:57:15 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101463

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K101906

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.17

DO (mg/L): 8.59 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 92.6 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.365 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:10:16 PM

Calibration Start Time: 7/19/2020 8:46:24 AM

Calibration End Time: 7/19/2020 8:57:07 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101858

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100627

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.10

DO (mg/L): 8.50 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.1 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.636 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 763.6 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:10:16 PM

Calibration Start Time: 7/19/2020 8:46:24 AM

Calibration End Time: 7/19/2020 8:57:07 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101458

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102877

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.11

DO (mg/L): 8.48 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 108.6 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.671 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 763.6 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:30:11 PM

Calibration Start Time: 7/19/2020 8:46:24 AM

Calibration End Time: 7/19/2020 8:57:07 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100752

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100588

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.18

DO (mg/L): 8.51 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.4 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.688 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 763.5 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:30:11 PM

Calibration Start Time: 7/19/2020 8:46:24 AM

Calibration End Time: 7/19/2020 8:57:07 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100750

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100562

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.07

DO (mg/L): 8.51 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.7 % Sat

Post Calibration Value: 100.6 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.675 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 763.7 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 12:23:48 PM

Calibration Start Time: 7/19/2020 8:46:24 AM

Calibration End Time: 7/19/2020 8:57:07 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101466

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102892

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.07

DO (mg/L): 8.51 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 105.5 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.678 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 763.6 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:10:16 PM

Calibration Start Time: 7/19/2020 9:12:25 AM

Calibration End Time: 7/19/2020 9:20:39 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101846

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100596

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.10

DO (mg/L): 8.50 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.6 % Sat

Post Calibration Value: 100.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.468 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 763.7 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:30:11 PM

Calibration Start Time: 7/19/2020 9:12:25 AM

Calibration End Time: 7/19/2020 9:20:39 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101472

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102903

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.06

DO (mg/L): 8.49 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 114.9 % Sat

Post Calibration Value: 100.4 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.540 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 763.7 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:10:16 PM

Calibration Start Time: 7/19/2020 9:12:25 AM

Calibration End Time: 7/19/2020 9:20:39 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101848

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100600

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.11

DO (mg/L): 8.49 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.3 % Sat

Post Calibration Value: 100.5 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.672 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 763.7 mmHg

Calibration Report

Last Calibration Time: 4/7/2019 3:58:45 PM

Calibration Start Time: 7/19/2020 9:12:25 AM

Calibration End Time: 7/19/2020 9:20:39 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100742

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100556

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.08

DO (mg/L): 8.51 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.0 % Sat

Post Calibration Value: 100.5 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.710 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 763.7 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:10:16 PM

Calibration Start Time: 7/19/2020 9:12:25 AM

Calibration End Time: 7/19/2020 9:20:39 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100743

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Warning

Sensor Specific

DO Cap Serial Number: 17G100557

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.50

DO (mg/L): 8.50 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 75.7 % Sat

Post Calibration Value: 100.5 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.737 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 763.8 mmHg

Calibration Report

Last Calibration Time: 5/21/2019 11:03:43 AM

Calibration Start Time: 7/14/2020 1:59:40 PM

Calibration End Time: 7/14/2020 2:09:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101469

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102897

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.06

DO (mg/L): 8.52 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.9 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.170 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 761.0 mmHg

Calibration Report

Last Calibration Time: 4/16/2019 1:21:14 PM

Calibration Start Time: 7/14/2020 1:59:40 PM

Calibration End Time: 7/14/2020 2:09:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101857

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100626

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.12

DO (mg/L): 8.52 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 95.5 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.228 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 761.0 mmHg

Calibration Report

Last Calibration Time: 4/16/2019 1:12:02 PM

Calibration Start Time: 7/14/2020 1:59:40 PM

Calibration End Time: 7/14/2020 2:09:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100749

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100560

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.15

DO (mg/L): 8.53 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 93.9 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.256 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 761.0 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 12:22:54 PM

Calibration Start Time: 7/14/2020 1:59:40 PM

Calibration End Time: 7/14/2020 2:09:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100751

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100563

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.05

DO (mg/L): 8.54 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 105.7 % Sat

Post Calibration Value: 100.3 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.279 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 761.0 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 11:40:09 AM

Calibration Start Time: 7/14/2020 1:59:40 PM

Calibration End Time: 7/14/2020 2:09:51 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100736

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104237

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.09

DO (mg/L): 8.54 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.0 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.285 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 761.0 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 11:53:22 AM

Calibration Start Time: 7/14/2020 3:14:53 PM

Calibration End Time: 7/14/2020 3:27:55 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100748

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104238

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.00

DO (mg/L): 8.76 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.8 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.592 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.5 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:30:11 PM

Calibration Start Time: 7/14/2020 3:14:53 PM

Calibration End Time: 7/14/2020 3:27:55 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101457

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102888

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.07

DO (mg/L): 8.76 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 111.4 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.677 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.5 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 3:14:53 PM

Calibration End Time: 7/14/2020 3:27:55 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101850

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100602

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.06

DO (mg/L): 8.76 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 94.0 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.798 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.5 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 11:21:42 AM

Calibration Start Time: 7/14/2020 3:14:53 PM

Calibration End Time: 7/14/2020 3:27:55 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101854

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100608

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.11

DO (mg/L): 8.76 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.5 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.838 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 760.5 mmHg

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 3:14:53 PM

Calibration End Time: 7/14/2020 3:27:55 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100739

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100552

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.14

DO (mg/L): 8.46 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 87.8 % Sat

Post Calibration Value: 100.0 % 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: 760.5 mmHg

Upriver Sampling 7/14/20

S. Booth, L. Heise
92°F 7 mph WNW Sunny

1045 arrived @ GA Power boat Ramp
1115 arrived @ diffuser and set up 2 sondes
Sonde G (H4) 2.5m
Sonde D (H2) 1.0m
1121 started zigzag drift according to "Standard upriver procedure"
Very high flow, arrived @ buoy 18 by 1132
1133 stopped logging ~~on~~ on mid depth sonde + went around island w/ shallow sonde still logging
1139 Stopped logging on shallow sonde + traveled up to diffuser for 3 sonde drift
1148 arrived @ GA Power boat ramp to retreive forgotten weight from ~~yellow~~ boat
1156 deployed Sonde D w/ (H2) (1m)
1158 started logging Sonde F (H2) (2.7m)
1159 started logging Sonde G (H4) (2.0m)
1204 ran up to before diffuser to get background reading (forgot)

7.66 %. 6.05 mg/L DO background
1314 Stopped logging G (H4)
1315 stopped logging F (H2)
1316 stopped deployment on D w/ (H2)
Broke down equipment
1320 traveled back to diffuser
1338 transfered UR-18 sonde data
1344 transferred UR-17 sonde data
1349 transferred UR-16 sonde data
1352 transfered UR-15 sonde data
1356 transefered UR-14 sonde data
1401 transferred UR-13 sonde data
1409 transfered UR-12 "
1415 transfered UR-11 " "
1418 transfered UR-10 " "
1423 transferred Plant Sonde data
1429 transferred UR-9 sonde data
1443 take out float boat
1456 H2 + H4 data transferred to USB drives
1458 depart GA Power for Depot
1550 arrive @ depot
1558 downloaded data

Rite in the Rain

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 12:51:23 PM

Calibration End Time: 7/14/2020 1:13:12 PM

Parameter: Rhodamine WT (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Rhodamine WT

Serial Number: 20F162670

Firmware Version: 3.1.10

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.14 µg/L

Post Calibration Value: 0.14 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.817 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: None

Is Stable: True

Calibration Point #2:

Pre Calibration Value: 25.58 µg/L

Post Calibration Value: 25.58 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.290 °C

Standard Value: 25.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Calibration Report

Calibration Point #3:

Pre Calibration Value: 26.66 µg/L

Post Calibration Value: 26.66 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.322 °C

Standard Value: 25.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Calibration Point #4:

Pre Calibration Value: 233.15 µg/L

Post Calibration Value: 250.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.457 °C

Standard Value: 250.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 12:51:23 PM

Calibration End Time: 7/14/2020 1:13:12 PM

Parameter: Rhodamine WT (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Rhodamine WT

Serial Number: 20F162671

Firmware Version: 3.1.10

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Report

Calibration Point #1:

Pre Calibration Value: 0.15 µg/L

Post Calibration Value: 0.15 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.852 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: None

Is Stable: True

Calibration Point #2:

Pre Calibration Value: 25.57 µg/L

Post Calibration Value: 25.56 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.303 °C

Standard Value: 25.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Calibration Point #3:

Pre Calibration Value: 25.60 µg/L

Post Calibration Value: 25.60 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.324 °C

Standard Value: 25.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Calibration Point #4:

Pre Calibration Value: 226.77 µg/L

Post Calibration Value: 250.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.465 °C

Standard Value: 250.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 12:51:23 PM

Calibration End Time: 7/14/2020 1:13:12 PM

Parameter: Rhodamine WT (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Rhodamine WT

Serial Number: 20F161143

Firmware Version: 3.1.10

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.24 µg/L

Post Calibration Value: 0.24 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.890 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: None

Is Stable: True

Calibration Point #2:

Pre Calibration Value: 23.97 µg/L

Post Calibration Value: 23.97 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.313 °C

Standard Value: 25.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Calibration Report

Calibration Point #3:

Pre Calibration Value: 24.01 µg/L

Post Calibration Value: 24.01 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.327 °C

Standard Value: 25.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Calibration Point #4:

Pre Calibration Value: 231.45 µg/L

Post Calibration Value: 250.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.466 °C

Standard Value: 250.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Last Calibration Time: <Unknown>

Calibration Start Time: 7/14/2020 12:51:23 PM

Calibration End Time: 7/14/2020 1:13:12 PM

Parameter: Rhodamine WT (µg/L)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Rhodamine WT

Serial Number: 20F161144

Firmware Version: 3.1.10

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Report

Calibration Point #1:

Pre Calibration Value: 0.22 µg/L

Post Calibration Value: 0.22 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.924 °C

Standard Value: 0.00 µg/L

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: None

Is Stable: True

Calibration Point #2:

Pre Calibration Value: 25.81 µg/L

Post Calibration Value: 25.81 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.318 °C

Standard Value: 25.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Calibration Point #3:

Pre Calibration Value: 25.83 µg/L

Post Calibration Value: 25.83 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.332 °C

Standard Value: 25.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

Calibration Point #4:

Pre Calibration Value: 236.50 µg/L

Post Calibration Value: 250.00 µg/L

Raw Calibration Value: 0.00 µg/L

Temperature: 22.468 °C

Standard Value: 250.00 µg/L

Type: FWT Red 25

Manufacturer: Kingscote Chemicals

Lot Number: None

Is Stable: True

6 1846 arrived @ depot + took black boat out of water
1914 uploaded data
2000 departed depot

7/14/2020

RM, EB, EH, HT, SB LH
Forecast Sunny High 98°F light winds
0815 EB LH, SB RM arrive onsite
0845 EH onsite conference call w. Jim
0920 SB + LH depart for up river with Black boat on trailer.
EB + EH Load up while bouys to replace current LFR bouys because dredging was getting close to area.
RM - Starts pulling together Die test supply
1000 EB + EH arrive at LFR and pull sondes from bouys stopping logging + downloading the data from each
After pulling sonde, exchange a white bouy for existing yellow or orange.
Dredging was on far side of river across for bouys / O_2 Plant.
1035 HT arrives onsite + set up for calibration rhodamine sensors + start calibration of all sensors.
1045 EB + EH complete pulling sondes + replacing bouys + start back to COE dock to unload bouys. Upon return unload bouys + place in warehouse clean boat.

Rite in the Rain

7/14/20

HT - completes Rhodamin Sensor Calibrations & starts installing D.O. Sensors
EB - installs new caps in D.O. Sensors
~~HH~~ - assembly parts for dye test @ all three locations. puts fuel in new generator & confirms operational.
RM offsite to procure gaskets for dye pump & additional parts for dye testing
EB. completes putting new D.O. caps on. & proceeds to cut cord for bouys (LFR)

1550 LH & SB return to depot from UR
~~first~~ work on dye pump
continue replacing and calibrating ~~DO caps~~ new DO caps

1715 leave depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log Up-River

Date: 07/14/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 92°F Sunny WNW 7 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Sam Booth, Lisa Heise		
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:	4.0 hours	
☐ White Boat – Duration:		
☐ Yellow Boat – Duration:		

Work Completed:

- See field notes.

Notes:

Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise
Photos Attached? ☒	**# of Photos** 2

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 1: View of apparent bubbles from diffuser



Photograph 2: View of apparent bubbles toward diffuser

Upriver Sampling 7/14/20

S. Booth, L. Heise
92°F 7 mph WNW Sunny

1045 arrived @ GA Power boat Ramp
1115 arrived @ diffuser and set up 2 sondes
Sonde G (H4) 2.5m
Sonde D (H2) 1.0m
1121 started zigzag drift according to "Standard upriver procedure"
Very high flow, arrived @ buoy 18 by 1132
1133 stopped logging ~~on~~ on mid depth sonde + went around island w/ shallow sonde still logging
1139 Stopped logging on shallow sonde + traveled up to diffuser for 3 sonde drift
1148 arrived @ GA Power boat ramp to retreive forgotten weight from ~~yellow~~ boat
1156 deployed Sonde D w/ (H2) (1m)
1158 started logging Sonde F (H2) (2.7m)
1159 started logging Sonde G (H4) (2.0m)
1204 ran up to before diffuser to get background reading (forgot)

7.66 %. 6.05 mg/L DO background
1314 Stopped logging G (H4)
1315 stopped logging F (H2)
1316 stopped deployment on D w/ (H2)
Broke down equipment
1320 traveled back to diffuser
1338 transfered UR-18 sonde data
1344 transferred UR-17 sonde data
1349 transferred UR-16 sonde data
1352 transfered UR-15 sonde data
1356 transefered UR-14 sonde data
1401 transferred UR-13 sonde data
1409 transfered UR-12 "
1415 transfered UR-11 " "
1418 transfered UR-10 " "
1423 transferred Plant Sonde data
1429 transferred UR-9 sonde data
1443 take out float boat
1456 H2 + H4 data transferred to USB drives
1458 depart GA Power for Depot
1550 arrive @ depot
1558 downloaded data

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log Up-River

Date: 07/15/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 92°F Mostly Sunny ESE 3 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Sam Booth, Lisa Heise, Hayley Torkos, 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:	3.0 hrs	
☐ White Boat – Duration:		
☒ Yellow Boat – Duration:	3.0 hrs	

Work Completed:

- Dye Test. See field notes.

Notes:

Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise
Photos Attached? ☒	**# of Photos** 6

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 1: Beginning of dye test



Photograph 2: Beginning of dye test facing south

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 3: View of dye facing DO plant



Photograph 4: View of dye facing Buoy UR-13



Photograph 5: View of dye facing south and Buoys UR-14 and UR-15



Photograph 6: View of dye facing northeast around island at Bay Bush Point

Up River Dye test Boat 2 7/15/20
S. Booth, L Heise Mostly sunny
92°F ESE 3 mph Partly cloudy
0730 departed hotel
0820 Arrive @ GA Power boat ramp
1000 Put yellow boat in water
1025 started deployment sonde D w/ H3 (1.0m)
1031 started logging Sonde G (H3) (2.7m)
1031 Dye dump, we continued downstream behind their boat (black) in zigzag pattern
1040 went around island
1204 stopped logging Sonde G (H3)
1205 stopped deployment Sonde D
1206 started logging Sonde G
* traveled in straightish line
1230 back to GA Power Boat Ramp
1249 arrive @ GA Power Boat Ramp
1330 depart GA Power Boat ramp
1430 arrive @ depot

Rite in the Rain.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log Up-River

Date: 07/15/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 92°F Mostly Sunny ESE 3 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Sam Booth, Lisa Heise, Hayley Torkos, 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:	3.0 hrs	
☐ White Boat – Duration:		
☒ Yellow Boat – Duration:	3.0 hrs	

Work Completed:

- Dye Test. See field notes.

Notes:

Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise
Photos Attached? ☒	**# of Photos** 6

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 1: Beginning of dye test



Photograph 2: Beginning of dye test facing south

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 3: View of dye facing DO plant



Photograph 4: View of dye facing Buoy UR-13



Photograph 5: View of dye facing south and Buoys UR-14 and UR-15



Photograph 6: View of dye facing northeast around island at Bay Bush Point

Up River Dye test Boat 2 7/15/20
S. Booth, L Heise Mostly sunny
92°F ESE 3 mph Partly cloudy
0730 departed hotel
0820 Arrive @ GA Power boat ramp
1000 Put yellow boat in water
1025 started deployment sonde D w/ H3 (1.0m)
1031 started logging Sonde G (H3) (2.7m)
1031 Dye dump, we continued downstream behind their boat (black) in zigzag pattern
1040 went around island
1204 stopped logging Sonde G (H3)
1205 stopped deployment Sonde D
1206 started logging Sonde G
* traveled in straightish line
1230 back to GA Power Boat Ramp
1249 arrive @ GA Power Boat Ramp
1330 depart GA Power Boat ramp
1430 arrive @ depot

Rite in the Rain.

7/15/20

EB, LH, HT, SB
79° Partly cloudy
0820 arrive at UR Site
0906 HT, EB leave for Hardeeville ramp @ Black boat
0919 arrive at ramp, talk to USGS crew, decide to deploy Sonde at their old site.
0928 deploy Sonde 30
0935 head back to UR boat ramp
0951 arrive back
0956 J. Greenfield on site
1010 JG, EB, HT leave on black boat
1028 deploy sondes for dye test
$J \approx 1m$
$H \approx 2.5\text{-}3m$ on Hz
1030 dye injected
1033 dye visible
1202 arrive at Hardeeville boat ramp
keep sondes in the water and head back towards OZ plant
1230 end deployment
1254 return to boat ramp

1336 depart for depot
1426 arrive at depot
1446 put in black boat
1500 upload data
1540 EH leave depot
1630 leave depot for the day

Rite in the Rain

7/15/20

EB, LH, HT, SB
79° Partly cloudy
0820 arrive at UR Site
0906 HT, EB leave for Hardeeville ramp @ Black boat
0919 arrive at ramp, talk to USGS crew, decide to deploy Sonde at their old site.
0928 deploy Sonde 30
0935 head back to UR boat ramp
0951 arrive back
0956 J. Greenfield on site
1010 JG, EB, HT leave on black boat
1028 deploy sondes for dye test
$J \approx 1m$
$H \approx 2.5\text{-}3m$ on Hz
1030 dye injected
1033 dye visible
1202 arrive at Hardeeville boat ramp
keep sondes in the water and head back towards OZ plant
1230 end deployment
1254 return to boat ramp

1336 depart for depot
1426 arrive at depot
1446 put in black boat
1500 upload data
1540 EH leave depot
1630 leave depot for the day

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/16/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 87°F Partly Cloudy, E 6 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Lisa Heise, Sam Booth, Hayley Torkos, Eric Huss, Rick McCann, Jim Greenfield		
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:	3.5 hours	
☒ White Boat – Duration:	3.5 hours	
☐ Yellow Boat – Duration:		

Work Completed:

- Dye Test – LBR, LFR. See field notes.

Notes:

Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise
Photos Attached? ☒	**# of Photos** 4

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 1: Beginning of dye dump, dye visible at diffuser



Photograph 2: View of dye facing north

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 3: View of dispersed dye facing north near train bridge



Photograph 4: View of dispersed dye and train bridge facing north

7/14/20

HT- complete Rhodamin Sensor Calibrations + starts installs D.O. Sensors
EB- installs new caps in D.O. Sensors
EH - assembly parts for dye test @ all three locations. puts fuel in new generator & Confirms operational
RM office to procure gaskets for dye pump & additional parts for dye testing
EB complete putting new D.O. caps on & proceeds to cut cord for buoys (LFR)

1550 LH & SB return to depot from UR
~~float~~ work on dye pump
continue replacing and calibrating ~~D.O. caps~~ new DO caps

1715 leave depot

RM, EB, EH, JG, LH, HT
81°F Clear NNE 7mph

0800 SB, LH, HT, EB, JG, EH at depot
0810 Meeting to plan Dye test + extended Sampling Friday
0827 RM at depot
0845 RM, EH leave for LBR plant
0913 EB, JG, HT leave for LBR (white)
0934 arrive at LBR
0943 deploy for dye test
A ≈ 1m H_3
C ≈ 3m H_2
0950 EH notify team that dye dump has started
0954 dye visible
0958 dye dump completed
1028 stop logging - head to LFR for dye test
1100 arrive at LFR
1104 begin logging
A ≈ 1m H_3
C ≈ 4.4m H_2
1107 dye dump started
1108 dye visible
1116 EH notify dye dump complete

Rite in the Rain

7/14/20

Active dredging in Front River
Surrounding LFR diffuser
1202 Stop logging A
1217 Stop logging C
1332 arrive at depot
1251 upload dye test data
1301 stop deployment at depot
sonde
1307 install Rhodamine sensor
and re-deploy
1345 upload dye test photos/video
1445 all leave depot for day

Rite in the Rain

Backriver Dye test 7/16/20

S. Booth, L. Herse

87°F, Partly cloudy E 6 mph

#910

0940 depart depot

0933 arrive @ backriver diffuser to set up for drift

0936 Sonde 28 (H1) 1m 6.9 RFU 72.8%

Sonde B (H4) 2.5m 7.1 RFU 72.9%

0945 started logging Sonde B

0945 started logging Sonde 28

1002 Moved sonde B to 2.9m

1054 moved sonde B to 2.0m

1216 stopped logging on sonde B

1217 stopped logging on Sonde 28

broke down equipment

1222 departed LBR for depot

1245 arrived @ depot

Rite in the Rain.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/17/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 81°F Sunny, NE 3 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Lisa Heise, Sam Booth, Hayley Torkos, Rick McCann		
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:	5.5 hours	
☒ White Boat – Duration:	4.5 hours	
☐ Yellow Boat – Duration:		

Work Completed:

- Lower River Extended Drift, Outgoing tide. See field notes.

Notes:

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

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

7/16/20

Active dredging in Front River
Surrounding LFR diffuser
1202 Stop logging A
1217 Stop logging C
1232 arrive at depot
1251 upload dye test data
1301 stop deployment at depot
sonde
1307 install Rhodamine sensor
and re-deploy
1345 upload dye test photos/video
1445 all leave depot for day

7/17/20

EB, HT, LH, SB
78°F Sunny NE 2mph
0730 EB HT at depot
0737 SB LH at depot
0753 EB HT leave for 95
bridge Extended sampling
0834 begin ex drift
C on H_2 at ≈2m
1300 end drift
1320 return to depot
1330 upload data
1400 SB LH EB RM leave
for Jacksonville

Rite in the Rain

Down River Middle Extended 7/17/20

Litterise, S. Booth

81°F NE 3 mph sunny

0817 depart depot for fork north of Houlihan boat ramp

0845 arrived @ Northern cut entrance

0850 started logging Sonde A(H3) 3m

0858 changed depth to 1.5m due to shallowness. Depth finder on boat not working (white boat)

0915 changed depth to 1.0, depth of water is 1.4m

0925 changed depthe to surface because depth of water is <1m

1000 Stopped logging finished route around island

1035 started logging for mid river to FR drift

1256 Stopped logging

1300 arrive @ depot

Rite in the Rain

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log Up-River

Date: 07/18/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Mostly Sunny Calm	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Hayley Torkos, Emily Camargo		
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: ☒ Yellow Boat – Duration: 3.0 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

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

Photos Attached? ☒	**# of Photos** 1

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 1: Large tree stuck on UR_10

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log Up-River

Date: 07/18/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Mostly Sunny Calm	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Hayley Torkos, Emily Camargo		
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: ☒ Yellow Boat – Duration: 3.0 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

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

Photos Attached? ☒	**# of Photos** 1

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 1: Large tree stuck on UR_10

7/18/20

HT + Emily Camargo (EC)
78° Clear Calm
0809 arrive at GP security for EC's badge
0855 depart for UR in yellow boat
0905 Stop deployment UR_9
transfer data
install DO 17L1014610
0909 redeploy Sonde 1
0916 Stop deployment UR_11
transfer data
install DO 17L101455
0918 redeploy Sonde 3
0922 Stop deployment UR_10
transfer data
install DO 17G101859
0925 redeploy Sonde 2
0929 Stop deployment UR_12
transfer data
install DO 17L101465
0932 redeploy Sonde 4
0935 Stop deployment UR_13
transfer data
install DO 17G101862
0939 redeploy Sonde 5

0943 Stop deployment UR_14
transfer data
install DO 17G100737
0946 redeploy Sonde
0949 Stop deployment UR_15
transfer data
install DO 17L101475
0952 redeploy Sonde 8
0956 Stop deployment UR_16
transfer data
install DO 17G101847
1000 redeploy Sonde 9
1005 Stop deployment UR_17
transfer data
install DO 17L101459
1007 redeploy Sonde 10
1013 Stop deployment UR_18
transfer data
install DO
1016 redeploy Sonde 11
1026 Stop deployment Plant
transfer data
1027 redeploy plant Sonde
1028 large tree hit
attached to UR10

Rite in the Rain

7/18/20

1033 begin UR Drift
G≈1m on 44
1042 end drift
1055 stop deployment Sonde30
at Hardeeville
1106 attempt to move true
at buoy- could not move
alerted KM
1137 return to boat ramp
1200 head to Security for EC
badge return - NO official
~~to~~ badge today
1229 leave Georgia power
1522 update serial tracker,
deployments
walk through data upload,
onedrive & daily checklist with
EC

7/18/20

HT + Emily Camargo (EC)
78° Clear Calm
0809 arrive at GP security for EC's badge
0855 depart for UR in yellow boat
0905 Stop deployment UR_9
transfer data
install DO 17L1014610
0909 redeploy Sonde 1
0916 Stop deployment UR_11
transfer data
install DO 17L101455
0918 redeploy Sonde 3
0922 Stop deployment UR_10
transfer data
install DO 17G101859
0925 redeploy Sonde 2
0929 Stop deployment UR_12
transfer data
install DO 17L101465
0932 redeploy Sonde 4
0935 Stop deployment UR_13
transfer data
install DO 17G101862
0939 redeploy Sonde 5

0943 Stop deployment UR_14
transfer data
install DO 17G100737
0946 redeploy Sonde
0949 Stop deployment UR_15
transfer data
install DO 17L101475
0952 redeploy Sonde 8
0956 Stop deployment UR_16
transfer data
install DO 17G101847
1000 redeploy Sonde 9
1005 Stop deployment UR_17
transfer data
install DO 17L101459
1007 redeploy Sonde 10
1013 Stop deployment UR_18
transfer data
install DO
1016 redeploy Sonde 11
1026 Stop deployment Plant
transfer data
1027 redeploy plant Sonde
1028 large tree hit
attached to UR10

Rite in the Rain

7/18/20

1033 begin UR Drift
G≈1m on 44
1042 end drift
1055 stop deployment Sonde30
at Hardeeville
1106 attempt to move true
at buoy- could not move
alerted KM
1137 return to boat ramp
1200 head to Security for EC
badge return - NO official
~~to~~ badge today
1229 leave Georgia power
1522 update serial tracker,
deployments
walk through data upload,
onedrive & daily checklist with
EC

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/19/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 90°F Sunny, SW 5 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Emily Camargo		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 2 hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Set aside sonde 30, cable and Handheld for Lon at USACE

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

7/19/20

HT, EC
0806 arrived at depot
0827 replace DO caps, calibrate, update schedule, prep sonde for Lon, install New DO on 14, 15, 16
0929 Sensor 17G100743 Calibrated w/ QC Warning, will NOT deploy
90°F Clear SW 5mph
1005 EC, HT leave for LBR (black)
1021 arrive at LBR_1
1025 transfer data, GPS Point install new DO 17G101855 Sonde covered in barnacles will need new batteries on 7/20/20, cannot re-deploy
1040 Stop deployment LBR_2 transfer data, GPS, install New Do 17G100742
1042 redeploy Sonde 18
1049 Stop deployment LBR_3 transfer data, GPS, install New DO 17G101848
1051 redeploy Sonde 19

1055 Stop deployment LBR_4 transfer data, GPS, install NEW DO 17L101472
1057 redeploy Sonde 20
1102 Stop deployment LBR_5 transfer data, GPS, install NEW DO 17G101856
1105 redeploy Sonde 21
1111 Stop deployment LBR_6 transfer data, GPS, install New DO 17G100750
1113 redeploy Sonde 22
1119 Stop deployment LBR_7 transfer data, GPS, install NEW DO 17G101846
1121 redeploy Sonde 23
1129 Stop deployment LBR_8 transfer data GPS, install NEW DO 17G100752
- battery voltage at 0.0V cannot redeploy - Replace 7/20
- Needs more cable in buoy found unattached, might cause need more weight on buoy laying horizontal

Rite in the Rain

07/19/20

24

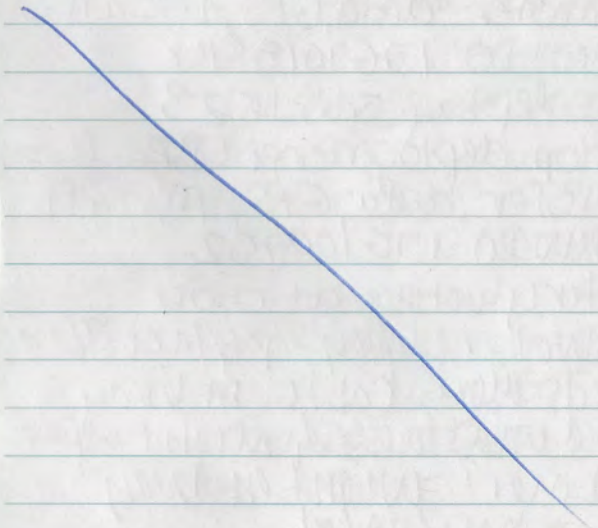
1134 redeployed sonde ^After reattaching cable battery VOLT at 2.8V

1200 return to depot
Update Serial tracker, upload data, daily log

1240 install New DO on depot Sonde 25 : 17G100744 + transfer data #

1245 redeploy Sonde 25

1300 leave depot
Hayley return to Sax



Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/20/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 85°F Mostly Sunny Calm	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Ethan Bright, Lisa Heise, Emily Camargo, 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: 4 hours ☒ White Boat – Duration: 4 hours ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Handheld firmware updated; rhodamine readings visible on handheld
- Batteries replaced at LBR_1

Notes:

Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise
	Photos Attached? ☐ **# of Photos** ____

07/20/2015

LH, EB, EH, EC

0800 EC, LH, EH, EB arrive at depot

0836 EB, EH leave depot for front river

0848 start logging at 17 bridge shallow A 43 deep C 44

0920 ship passed

0945 wait for tugs to move in order to pass dredge

1025 passing OZ plant
Hampton Roads is <100 ft ~~from~~ from plant
LFR A and LFR 5 are not visible

1045 had to keep deep sonde at 6m as tide states moving

1157 stop logging at MR

1210 check status of FR buoys, still only see LFR N

1230 arrive at depot

1240 upload data to Onedrive

1323 attemp to download rhodamine data directly from sondes
Sonde J successful
sonde D successful

1410 updated handheld firmware
rhodamine now visible

1500 depart depot EC, EH, EB, LH

Rite in the Rain.

07/20/20

83°F, 5mph WSW, Sunny

0833 EC, LH depart for LBR in BB

0853 start logging @ 17 bridge
Sonde 28 at 1m (H1)
Sonde B at 2.5m (H2)

1134 Stopped logging sonde B

1135 Stopped logging sonde 28

1144 checked batteries at LBR-8
2.4V, did not replace

1155 replaced batteries at LBR-1

1159 start deployment LBR-1 (17)

1201 depart LBR for depot

1225 arrive @ depot

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Lower River

Date: 07/21/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 84°F Mostly Sunny SW 1 mph	**Tides:** High 10:08	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: 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: 4 hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

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

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

16 LBR Drift Diff → Hwy 25 7/21/20

E. Huss, L. Heise

84°F SW 1 mph Mostly Sunny

0800 arrive @ depot

0815 depart depot for LBR

0830 arrived @ train bridge to setup
Sonde B (H3) 1.3 m - 1.7 m

0840 started logging, zig zag around
diffuser then continued
to Hwy 25 bridge

0900 heard O_2 Generator start

1045 turned around @ 25 bridge
& drifted back to ~~diffuser~~ LBR-8 w/ tide

1156 stopped logging

1201 departed for depot

1223 arrived @ depot → downloaded data

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Lower River

Date: 07/21/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 90°F Mostly Sunny S 5 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Ethan Bright, Emily Camargo		
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: ☒ Yellow Boat – Duration: 3.5 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Attached is picture of Hardeeville sonde installation

Notes:

Daily Log Completed by: Ethan Bright	**Signature:** Ethan Bright

Photos Attached? ☒	**# of Photos** 1

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



7/21/2020

81°F, clear, calm
0830 EB, EC arrive at UR ramp
0900 depart ramp to UR system
0910 removed log from buoy 11
0927 removed sonde 12 from plant
0934 start logging drift
(H2) sonde D @ 1M
1105 stop logging sonde D
1110 transfer sonde 12 data
1115 replace DO sensor on sonde 12
1123 arrive at Hardeeville to deploy
sonde 12 on USGS pillar
1146 start deployment sonde 12
@ Hardeeville
1221 arrive back at GP ramp
1227 depart GP ramp
1630 download data to one drive

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Lower River

Date: 07/22/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 91°F Mostly Sunny SE 5 mph	**Tides:** High 10:32 Ft. Jackson	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Lisa Heise, Eric Huss, Emily Camargo, 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:	3.5 hours	
☒ White Boat – Duration:	4 hours	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Ethan Bright	**Signature:** Ethan Bright

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

7/22/20

90°F, 0mph NNW, Mostly clear

EC, EB, EH, LH

0802 arrive at depot

0838 depart depot for LFR (EC+LH)

0850 started logging Sonde C (H4) 6m

0852 started deployment Sonde A (H1) 1m

0939 pulled up sondes to get past dredges + large cargo ships & lots of traffic

1005 dredge nose went in water to dredge

1027 pulled up sondes due to tugs & boats parking, wanted to get past them

1217 stop logging/deployment due to thunder & lightning

1221 return to depot

1245 arrived @ depot + uploaded data EH + EB prepped UR mid depth capsules

1323 depart depot

Rite in the Rain.

07/22/20 EB EH

Sunny 85° wind <5 mph

0800 arrive at depot

0835 leave depot for LBR

0857 start logging H2 sonde B (1-2m)

~~08~~ N0940 passing near diffuser

~~[illegible]~~

1124 stop logging

1130 return to depot

1205 arrive at depot

Rite in the Rain.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Lower River

Date: 07/23/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 90°F Partly Cloudy N 2 mph	**Tides:** High 11:22 Ft. Jackson	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Lisa Heise, Emily Camargo		
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:	5.5 hours	
☐ White Boat – Duration:		
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes.
- It appears the LBR_2 buoy moved. Emily is getting the shp file from Brian Watson to check the location on her computer to see if it moved compared to new coordinates. Photos on the OneDrive.

Notes:

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

Photos Attached? ☒	**# of Photos** 2

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 1: Debris at Buoy LBR_7



Photograph 2: Buoy LBR_2 location in relation to train bridge and island north

90°, 2 MPH N, partly cloudy 7/23/20

"Zig Zag around diffuser" EC, LH

0804 EC & LH arrive at depot

0

0830 depart depot for LBR

0850 arrive @ LBR_1 buoy - set up, Lots of debris

0857 started deployment Sonde A (H2) 1 m

0900 started logging Sonde B (H1) ~2m

1230 Depth finder on boat stopped working

1245 stopped logging sonde B.
started zig zagging shore to shore between buoys, depth finder working

1250 profile @ LBR_5

1252 continued zig zagging

1311 profile @ LBR_4

* LBR2 appears to have moved closer to train bridge (photos) & dropped a pin for unofficial GPS point to compare to flint point

1314 stop deployment sonde A
LBR_2 Lat ~~32.112128~~
32.112135
-81.110931

1325 depart LBR

1345 arrive @ depot & uploaded data

1440 Put gas in boats

1500 depart depot for hotel

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 07/23/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 90°F Mostly Sunny E5 mph	**Tides:** Not Applicable	

Client/Stakeholder Interaction (if any): None

Personnel/Visitors on site:

Ethan Bright, Eric Huss

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:	
☐ White Boat – Duration:	
☒ Yellow Boat – Duration: 4.5 hrs	

Work Completed:

- 0830 arrive at plant McIntosh.
- 0840 leave plant McIntosh.
- 0849 arrive at 02 plant.
- Work on 12 mid depth sonde until 0937 and deploy.
- Work on 16 mid depth sonde until 1012 and deploy.
- 1030 Stop at buoy 11 to check DO reading. Hook to buoy sonde and drop one of the sampling sondes next to it. Took pictures of the readings
- 1040 start logging D shallow (1m) G deep (2m)
- USGS and DHEC showed up to sample
- 1140ish stop logging.
- 1150 start with 1sonde D (1m), stop at 1244.
- 1246 profile 18.
- 1248 profile 17.
- 1251 profile 16.
- 1252 profile 15.
- 1254 profile 14.
- 1256 profile 13.
- 1258 profile 12.
- 1300 profile 11.
- 1303 profile 10.
- 1304 profile 9.
- 1307 profile between 11 and bank (O2 plant side).
- 1310 profile between 12 and bank (O2 plant side).
- 1325 arrive at plant, load boat, download data and leave by 1425.

Photos on one drive

Photos on OneDrive

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

Notes:	
Daily Log Completed by: Ethan Bright	**Signature:** 

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

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07//2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 83°F Sunny, ENE 1 mph	**Tides:** L – 0653 H – 1235	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, 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 hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	
Work Completed: - See Field Notes		
Notes:		
Daily Log Completed by: Hayley Torkos	**Signature:** Hayley Torkos	
	Photos Attached? ☐	**# of Photos** ____

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

90°, 2 MPH N, partly cloudy 7/23/20

"ZigZag around diffuser" EC, LH

0804 EC & LH arrive at depot

0

0830 depart depot for LBR

0850 arrive @ LBR_1 buoy & set up, Lots of debris

0857 started deployment Sonde A (H2) 1 m

0900 started logging Sonde B (H1) ~2M

1230 Depth Finder on boat stopped working

1245 stopped logging sonde B.
started zig zagging shore to shore between buoys, depth finder working

1250 profile @ LBR_5

1252 continued zig zagging

1311 profile @ LBR_4

* LBR2 appears to have moved closer to train bridge (photos) & dropped a pin for unofficial GPS point to compare to flint point

1314 Stop deployment sonde A
LBR_2 Lat ~~32.112128~~
32.112135
-81.110931

1325 depart LBR

1345 arrive @ depot & uploaded data

1440 Put gas in boats

1500 depart depot for hotel

HT, EH

83°F fair ENE 1mph

0854 HT arrive at depot

0927 EH at depot

0943 EH, HT leave for Hog Island black boat

1009 arrive at LBR2

1012 begin drift B on H2

1204 @ diffuse do not hear O2 Quenching
D.O. = 64.9 over diffusers

1300 end drift

1320 return to depot

1334 upload data, daily log
prep for buoy retrieval LBR Saturday

1400 leave depot for day

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Up River

Date: 07/24/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 90°F Partly Cloudy N 2 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Lisa Heise, Emily Camargo		
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:	
☐ White Boat – Duration:	
☒ Yellow Boat – Duration: 2 hrs	

Work Completed:

- See Field Notes

Notes:

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

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

Zig to h-ramp 7/24/20

EC, 2H

90°F N 2 mph Partly Cloudy

~~CAST TIME~~

0850 arrived @ GA Power ramp

0925 depart GA Power ramp

0932 start logging

sonde D (H3) 1 m

1056 stop logging

1100 depart for GA Power ramp

1115 arrive at ramp

hose down boat

1148 offload data

1200 depart GA power boat ramp

for JAX

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/25/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Partly Cloudy NNW 1 mph	**Tides:** L – 0739 H – 1336	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, 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: 2.5 hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Check Buoy Sonde Batteries at retrieval next weekend
- Install new cable system in LBR buoys, metal cables are corroding
- Check on Sonde 17 (LBR_1)
- Added weight to LBR_8, still leaning, might need new weight system. Not in channel, approximately 1.3m deep.

Notes:

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

Photos Attached? ☒	**# of Photos** 2

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 1. LBR_8 leaning with addition of 5lb weight

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 2. LBR_1 Sonde with barnacle growth

7/25/2020

78°F partly cloudy NNW 1
0750 HT arrive at depot
buoy retrieval LBR_1 7/20, depot
+LBR2-8 7/19
0756 EH arrive at depot
0818 leave for LBR (black)
0840 Stop LBR_1 deployment
transfer data sonde 17
10 only registering w/ sonde
powered via HH, change
batteries
0845 redeploy - if same issue
next retrieval, replace sonde 17
0853 stop deployment LBR_2
transfer data, missing wiper
increased barnacle growth
0855 redeploy - will need new central
wiper brush
0906 Stop LBR_3 deployment
metal cable broken, will
need to replace, transfer data
0908 redeploy, will need new
pin
0914 Stop deploy LBR_4 transfer data
0917 redeploy

0924 stop deployment LBR_5
cable broken, transfer data
0927 redeploy
0935 Stop deployment LBR_6
transfer data, Cable broken
Replace ALL LBR buoy cables
next time in LBR
0939 redeploy
0945 Stop deployment LBR_7
transfer data
0947 redeploy
0950 stop deployment LBR_8
NO → ~~Stop~~ transfer data, add 5 lb
weight to buoy, Change
batteries
0958 redeploy, additional
weight did not help
1026 return to depot
1030 stop deployment, transfer
data
1031 redeploy
1047 upload data, daily log
LBR_8 has no data, unsure
Why? Putgas in black boat
1130 Leave for day

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 07/26/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Partly Cloudy	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Hayley Torkos, 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: _____ ☐ White Boat – Duration: _____ ☒ Yellow Boat – Duration: 1.5 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Data downloaded from HH and Uploaded to OneDrive from the Hotel (H3)
- Batteries will most likely need to be replaced at next buoy data retrieval
- Replace metal cables with Paracord

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

7/26/20

EH, HT
0759 pick up boat ramp key
0809 meet EH & boat ramp
0827 leave for UR buoy
0845 stop deployment transfer data
0847 redeploy
0851 begin profile across River at Hardeeville
H3 + D, conducted 5 profiles
0854 end profiles
0905 Stop deployment UR_18 -2.43V
0906 redeploy after data download
cables need to be replaced
0910 Stop deployment UR_17 - 2.44V
0912 redeployment after data download
0915 Stop deployment UR_16A -2.43V
0918 redeploy ~~after~~ data download
0919 Stop deployment UR_16 - 2.50V
0921 redeploy after data download
0925 Stop deploying UR_15 - 2.44V
0926 redeploy after data download
0930 Stop Deployment UR_14 2.57V
0931 redeploy after data downloa

Rate in the Ri

9/26/20

0935 Stop deployment UR_13 - 2.33V
0937 redeploy, after data download
0940 Stop deployment UR_12A - 2.76V
0942 redeployed, after data downloaded
0943 Stop deployment UR_12 - 2.55V
0944 redeploy after data download
0948 Stop deployment UR_11 - 2.53V
0950 redeploy after data download
0953 Stop deployment UR_10 - 2.61V
0955 redeploy after data download
0959 Stop deployment UR_09 - 2.40V
1001 redeploy after data download
return to ramp pull out boat
clean boat, fuel at ⅔
1018 return to boat ramp
Yellow Boat gas at ½ 1/3
1030 leave for the day

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/27/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 81°F Mostly Cloudy W 4 mph	**Tides:** L – 0923 H – 1538	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Ethan Bright, Samuel Booth, Lisa Heise Lon		
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:	2.5 hours	
☒ White Boat – Duration:	3.5 hours	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- Supplied EXO2 (F) for Lon at USACE with HH and Cord, serial numbers of all inventory recorded on OneDrive
- Confirmed only 1 buoy left in LFR

Notes:

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

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

7/27/20

HT, LH, EB, SB
76°F mostly cloudy WNW 3

0724 HT at depot
0752 EB, LH, SB at depot from Tat
0904 EB, HT leave for 17 with 1
0908 arrive at 17
0918 deploy A at 1m
0920 start logging C at ~5m H_2
drift from 17 to MR (HT)
1025 alter path for passing of two ships w/ tugs
1213 end drift, stop deployment & logging
1238 return to depot remove with 1 boat to wash
1300 upload data
update personnel schedule, prep for next day sampling
1423 combined Sonde of w/ 5 DO sensors, 1 wiper & 1 CT for LON at USACE, will give with cord, HH1
1500 LON got Sonde from depot
1532 install new depth finder-white
1600 leave depot

~~Hog 21~~ (1) 17 → hog 7/27/20

SB LH L: 0923

81°F W 4 mph Mostly Cloudy

0850 depart depot for LBR

0904 arrive before 17 bridge to setup

0930 started logging

Sonde B (H1) 1m

1100 stopped logging & broke down equipment

1105 departed LBR for depot

1135 arrived @ depot & uploaded data

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/28/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Mostly Sunny WSW 6 mph	**Tides:** L – 1022 H – 1635	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Samuel Booth, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 4 hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

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

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

Zig around diffuser (2) 7/28/2023
SB, LH
78°F Mostly sunny WSW 6 mph

0840 arrived @ depot
0825 departed depot for LBR
0850 arrived @ LBR-8 for zig
0853 called Jim because super low tide, only need 1 sonde @ 1m
0901 Sonde A (H2) 1m started logging
0903 sonde ~~dr~~ bad connection changing sonde
0908 started logging Sonde C (H2) 1m
0909 went straight too shallow depth finder isn't working in shallow area
0910 beached boat, took sonde out sand bar
0912 put sonde back in
1105 replaced pin in LBR_3
1107 profile even w/ LBR_4
1110 profile @ diffuser
1112 profile north of diffuser
1116 profile @ LBR_5
1146 stopped logging
1154 started logging zig around diffuser
1202 stopped logging + broke down equip
1210 departed fort depot, first ~~change~~ replaced wipes on LBR2
1230 arrived @ depot
1330 Put white boat in + departed depot for hotel

Hate in the rain.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 07/28/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 82°F Partly Cloudy W 7mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Hayley Torkos, 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: _____ ☒ Yellow Boat – Duration: 4 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Replaced cables with Paracord on 9/10 buoys UR

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

7/28/2021

82°F partly cloudy w 7mph
0825 EB, HT at boat ramp
0845 leave for OR System (yellow)
0857 arrive OR
0907 begin drift 1 (Zig-Zag) ox bow
D - 1m (H_3) deployed
G - 2.5m (H_4) logging
0938 end drift 1
0942 begin drift 2 (Zig Zag)
0947 No longer near system running
0956 system appears to be running
1019 end drift 2
1024 G at 1m on H_4 drift
1112 end drift
1114 Profile (4) across River at UR-18 (G, H_4)
1121 remove UR-18 from buoy to swap cord
1126 UR-18 back in Water
1129 UR-17 out of water, swap cord
1130 UR-17 back in water
1135 UR-16 out of water, swap cord
1138 UR-16 back in water
1141 UR-15 out of water, swap cord
1142 UR-15 back in water

Rite in the Rain

7/28/20

1144 UR_14 out of water, swap card
1145 UR_14 back in water
1147 UR_13 out of water, swap card
1148 UR_13 back in water
1151 UR_12 out of water, swap card
1153 UR_12 back in water
1155 profile UR_12 (G, H4)
1157 end profile UR_12
1158 UR_11 out of water to check card, fine (out under 1mm)
1159 profile UR_11
1202 end profile UR_11
1204 UR_10 out of water, swap card
1206 UR_10 back in water
1206 profile UR_10
1208 end profile UR_10
1210 UR_9 out of water, swap card
1212 UR_9 back in water
1212 Profile UR_9
1215 end profile UR_9
1225 return to boat ramp
1300 leave GA Power
will upload data at home

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/29/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 80°F Mostly Cloudy WSW 6 mph	**Tides:** L – 1122 H – 1734	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Ethan Bright, Lisa Heise, Sam Booth		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 3.0 hours; ☒ White Boat – Duration: 3.0 Hours; ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

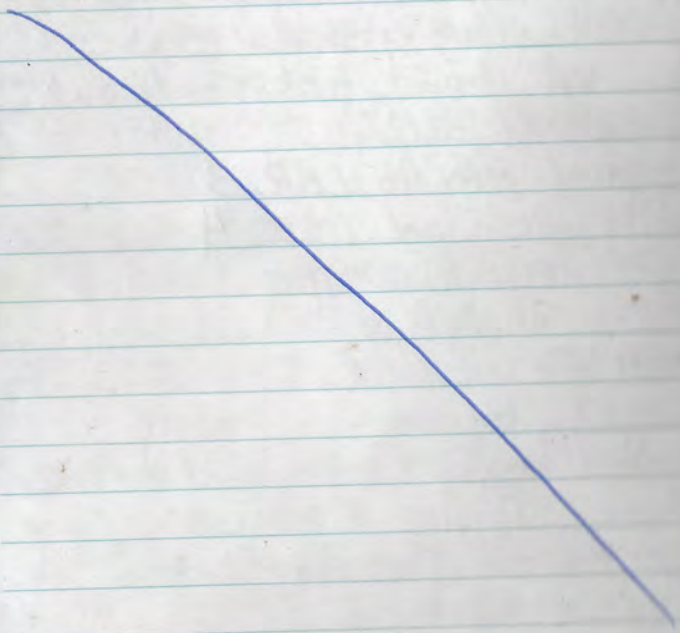
Notes:

Daily Log Completed by: Hayley Torkos	**Signature:** Hayley Torkos
Photos Attached? ☐	**# of Photos** ____

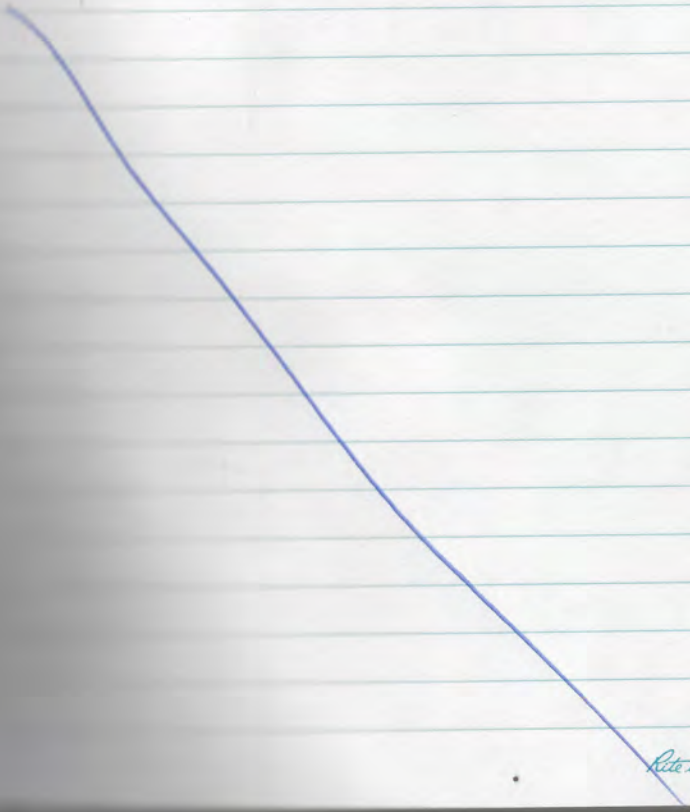
Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

7/29/20

77°F Mostly Cloudy WSW 6mph
0730 SB, EB, LH, HT at depot
0805 EB, HT depart for LFR in White Boat
0808 SB, LH depart for LBR in Black Boat
0842 Start logging @ Hwy 21 bridge
Sonde B on #4 @ 1 meter
1043 stopped logging @ Hwy 17 bridge
1045 depart LBR
1103 arrived @ depot
1115 upload data
1200 leave depot



(2) 25 → 17 7/29/20
80°F mostly cloudy WSW 4mph
0759 EB, HT leave for 25 LFR
white boat (boat 2)
0824 arrive at 25
0826 deploy A at ~1m
0829 ~~start~~ logging C ≈ 5m (H_2)
+ begin drift 25 → 17
1047 end drift
1057 return to depot +
upload data



Rite in the Rain

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/30/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Light Rain,Cloudy SW 8 mph	**Tides:** L – 1222 H – N/A	

Client/Stakeholder Interaction (if any):

Lon, Tom

Personnel/Visitors on site:

Hayley Torkos, 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:		
☒ White Boat – Duration:	2.0 Hours	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
-

Notes:

Daily Log Completed by: Hayley Torkos

Signature: Hayley Torkos

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 1. Flow-through Cell

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 2. General Readout

Hog → 17 (1) 7/30/25
78°F light rain, cloudy SW 8 mph
0755 EB. HT at depot
0813 Raining, decision to wait to leave depot until it has passed
0944 leave for hog island (white)
1013 arrive at hog island
1014 begin drift Hog → 17 (1)
B ≈ 1m on H2
1123 end drift
1147 arrive at depot
1204 upload data, put gas in white boat
1245 leave depot for down river system to meet Lon
1254 arrive at system to meet Lon + Tom
look at YSI DO sensors, conclude sensors for flow through cell do not need re-cal (leave w/ Lon) offer insight on how to improve testing method. photos in daily log.
1424 leave ~~depot~~ River system

Rite in the Rain

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 07/30/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 80°F Cloudy SW 7mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Samuel Booth, Lisa Heise		
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: _____ ☒ Yellow Boat – Duration: 2.5 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Lisa Heise

Signature: Lisa Heise

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

Zig around diffuser 7/30/2023
SB, LH
Cloudy, 80°F, wind; SW 7mph

0815 arrive @ GA Power boat ramp
depart boat ramp for UR-9
to set up for drift
0830 SB found missing bilge
plug in the gravel by pavilion
0845 depart boat ramp
0850 arrive upstream of UR 9 to setup
Sonde D 1m deployment
Sonde G 2.5m (H3) logger
0857 started deployment on Sonde D
0858 started logging on Sonde G
0926 ran back to UR9
0928 began rez zig zag
0952 pulled up sondes to run back to UR9
0956 started new zig zag
1021 pulled up sondes to run back to UR9
1024 started straight to UR 18
1032 stopped logging & deployment
1053 arrived @ GA Power boat ramp
rinsed boat
1115 Depart GA Power

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 07/31/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Light Rain,Cloudy SW 8 mph	**Tides:** L – 0637 H – 1319	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Ethan Bright, Sam Booth, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 2.0 Hours ☒ White Boat – Duration: 2.0 Hours ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Black boat out of water for service at Hale

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

26 diffuser → depot 7/31/20
79°F fair WSW 8 mph
0757 EB, SB, LH, HT at depot
0834 EB, HT leave for LFK (black)
0837 arrive at diffusers
0840 deploy 28 ≈ 1m
0843 start drift A ≈ 5m Hz
1007 end drift
1014 return to depot
1024 upload data
1112 black boat out of water for service, wash, replace black trailer lights
1200 EB, LH, HT leave for Jax
SB leave w/ black boat

60 LBR Diffuser Zig-Zags 7/31/20
LBR-8 → LBR-1
82°F, mostly sunny, wind: WSW 9 mph
0835 LH + SB depart Depot in White
0900 arrive at LBR-8
0908 Deploy Sonde B @ 1m w/ H4
0911 start logging on Sonde C @ 1.5m w/ H4
0918 reset Sonde C to 2.5 meters due to deeper portion of river
1004 pulled in sondes ran back to diffuser
1012 profile upriver of diffuser
1015 profile near diffuser
1021 profile downriver of diffuser
1022 stop logging on Sonde C
1023 stop deployment on Sonde B
1025 depart LBR
1045 arrive @ depot + download data

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/01/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 81°F Sunny SW 5mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Samuel Booth, 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: _____ ☐ White Boat – Duration: _____ ☒ Yellow Boat – Duration: 4 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Sam Booth	**Signature:** 

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

EH + SB
Diffuser to Hardeeville 8/1/20
+ buoy data collection
81°F, sunny, wind: 5 mph SW
0755 - SB arrive @ boat ramp
0800 - EH arrive @ boat ramp
0825 - depart boat ramp
0838 - start logging Sonde on 43
set at 1 meter
1000 performed profile & stopped
logging
1008 downloaded Hardeeville Sonde
data (2.45 volts on batt.)
1020 download UR_18 aft stop deploy
replace batteries 3.07V redeploy
Apply "18" decals to buoy
1030 download UR_17 aft stop deploy
replace batteries 3.07V redeploy
Apply "17" decals to buoy
1038 download UR_16A aft stop deploy
1046 download UR_16 aft stop deploy
replace batteries UR_16 3.07V redeploy
Upgrade to open Cage sonde UR_16A Apply "16" decals
1111 download UR 15 aft stop deploy
replace batteries 3.01V redeploy
Apply "15" decals to buoy

1117 download UR_14 aft stop deploy
replace batteries 3.05V redeploy
apply "14" decals to buoy
1124 download UR_13 aft stop deploy
replace batteries 3.06V redeploy
~~1131~~ apply "13" decals to buoy
1131 download UR_12A aft stop deploy
Batteries 3.64V redeploy
1133 download UR_12 aft stop deploy
replace batteries 3.02V redeploy
apply "12" decals to buoy
1141 download UR_11 aft stop deploy
replace battery 3.09V redeploy
apply "11" decals to buoy
1147 download UR_10 aft stop deploy
replace batteries 3.05V redeploy
apply "10" decals to buoy
1155 download UR_09 aft stop deploy
replace batteries 3.00V redeploy
apply "09" decals to buoy
1201 depart plant area for boat Ramp
1215 pull out boat
1224 EH + SB depart boat ramp
SB towed Yellow boat to Depot
1225 SB called RM; discussed potential
hurricane prep.

Rite in the Rain

per discussion w/ RM; SB returned to boat ramp and took photos and double checked trailer wheel blocks
1247 SB depart Boat ramp
1343 SB arrive @ Depot
~1420 uploaded all data from UR
1430 unload; pressure wash, clean Yellow boat; parked in warehouse for possible hurricane
1630 - SB depart Depot

SB

Rite in the Rain

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/02/2020	**Task:** 9B – Start-Up Run (Hurricane Prep)	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 81°F Sunny; no wind	**Tides:** N/A	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, 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: ☒ White Boat – Duration: 2.25 Hours ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- All LBR buoy sondes stored in warehouse at Depot for hurricane/tropical storm Isaias

Notes:

Daily Log Completed by: Sam Booth	**Signature:** Sam Booth

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

LBR Buoy Sonde Retrieval 8/2/20

81°F sunny, no wind

0745 SB arrive @ Depot

0755 EH arrive @ Depot

0825 depart Depot in white boat

0843 arrive @ LBR_1; removed Sonde, stop deployment, transfer data; install ring on LBR_1

0906 arrive at LBR_2 - same procedures as LBR_1

0918 arrive at LBR_3 - same as above

0925 arrive @ LBR_4 - same as above

0933 arrive @ LBR_5 - same as above

0951 arrive @ LBR_6 - same as above

1000 arrive @ LBR_7 - same as above

arrive @ LBR_8 - same as above

(all sondes taken out for safe keeping due to hurricane)

1020 depart LBR

1045 arrive @ Depot + remove white boat; put new batteries in LBR sondes

Clean white boat and sondes

Sondes + boat stored in warehouse for potential hurricane

1325 EH depart Depot

1345 all data uploaded

1400 SB depart to Jax

Rite in the Rain

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/04/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 74°F Overcast, NNW 4mph	**Tides:** L – 1644 H – 1007	

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Hayley Torkos, Lisa Heise, Katie Smith, Emily Camargo, Eric Huss

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:		
☒ White Boat – Duration:	2.0 Hours	
☒ Yellow Boat – Duration:	2.5 Hours	

Work Completed:

- See Field Notes
- Black boat out of water for service at Hale

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

8/4/20

Katie Smith, Eric Huss, Lisa Heise, Hayley Torres, Emily Camargo
74°F mostly cloudy NNW 4mph
0747 KS, EH, HT, LH at depot
0758 EC at Depot
0830 Launched YB + WB
0915 EC + HT depart in WB to LFR
0926 Arrive at LFR
0928 Sonde A deployed - 2M
0930 (HZ) Sonde C start logging - 5.5M
0934 adjust Zig-Zag pattern for USACE Boat
0000 profile around diffuser Sonde C - cargo ship inbound
1006 end profile, resume drift
1043 switch drift direction
1055 additional profiles at diffuser
1102 end profile, continue drift
1124 end drift
1144 return to depot - upload
1205 pull yellow boat out to bring upriver
1235 prep for tommorrow sampling
1300 leave depot

60 LBR Diffuser Zig-Zags 7/31/20

LBR-8 → LBR-1

82°F, mostly sunny, wind: WSW 9 mph

0835 LH + SB depart Depot in White Bay

0900 arrive at LBR-8

0908 Deploy Sonde B @ 1m w/ H4

0911 start logging on Sonde C @ 1.5m w/ H4

0918 reset Sonde C to 2.5 meters due to deeper portion of river

1004 pulled in sondes ran back to diffuser

1017 profile upriver of diffuser

1015 profile near diffuser

1021 profile downriver of diffuser

1022 stop logging on Sonde C

1023 stop deployment on Sonde B

1025 depart LBR

1045 arrive @ depot + download data

Zig around diffuser + profiles 8/4/20 61

EH, LH, KS

78°F Cloudy N 3 mph

0858 departed depot for LBR

0920 arrive @ LBR near LBR-2

Sonde B shallow 1m (H4)

Sonde 28 2.5m (H3)

0929 started deployment of Sonde B

0930 started logging Sonde 28

1035 stopped logging

1036 stopped deployment

1042 started deployment on sonde 24 @ LBR-8

1048 started deployment on Sonde 23 @ LBR-7

1058 started deployment on Sonde 22 @ LBR-6

1104 started deployment on sonde 21 @ LBR-5 + profile x 2 1107+1111

1117 started dployment and Sonde 20 @ LBR-4 + profile @ 1115 stopped logging 1116

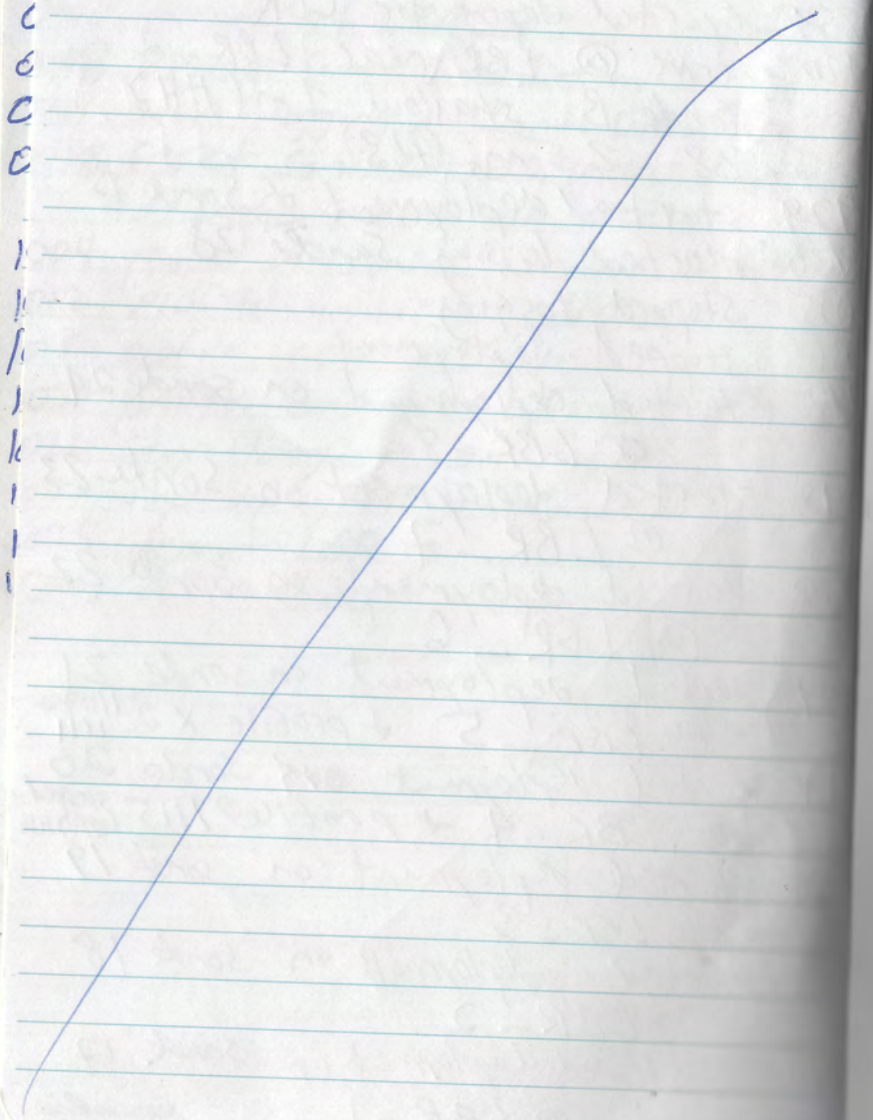
1126 started deployment on sonde 19 @ LBR-3

1133 started deployment on Sonde 18 @ LBR-2

1140 started deployment on Sonde 17 @ LBR-1

Rite in the Rain

1145 depart LBR for depot
1205 arrive @ depot + pulled yellow boat out for YR + download data
~~1205 ar~~ PH



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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/05/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 87°F Sunny, S 3mph	**Tides:** L – 1726 H – 1048	

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Lisa Heise, Emily Camargo, Sam Booth

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:		
☒ White Boat – Duration:	3.5 Hours (LH, EC)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- SB picked up Black Boat from Hale Marine and returned it to Depot (SB arrive at Depot at 1000).

Notes:

Daily Log Completed by: Samuel Booth	**Signature:** Saml Booth

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

17 gage → 25 Incoming tide 6/5/20

Emily Camargo, Lisa Heise

80°F, Clear, SSW 1mph

0745 arrive @ depot

0758 depart depot in WB to LBR

0815 arrive @ LBR (uses gage @ 17)

0822 start logging
sonde Σ @ 1m (H4)

1034 stopped logging

1045 depart from Hwy 25 to depot

1130 arrive at depot
upload data

1200 Filled WB gas tank

1230 depart depot

Rite in the Rain.

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/05/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 79°F Sunny WSW 1mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Hayley Torkos, Katie Smith, 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: _____ ☐ White Boat – Duration: _____ ☒ Yellow Boat – Duration: 4 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Brought Yellow Boat back

Notes:

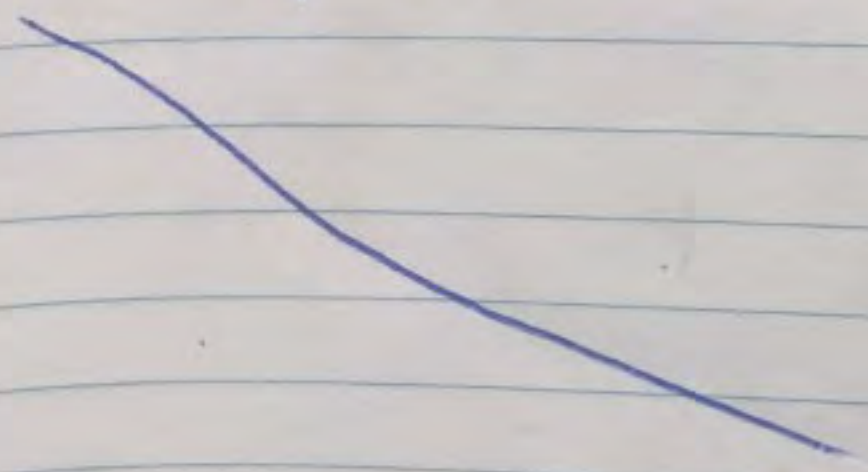
Daily Log Completed by: Hayley Torkos	**Signature:**

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

8/5/20 27

AF sunny WSW 1
0815 EH, KS, #7 at Georgia
Power, KS to get badge
0839 at boat ramp
0859 leave OR ramp (yellow)
0907 arrive at OR buoy begin
zig-zag drift to Hardeeville
G ≈ 1.5m on Hz
1215 Stop Logging below Hardeeville
1224 Check Sonde UR_10A Batt 3.2v
1232 Sonde UR U21 Batt 2.6V
1245 return to boat ramp
1250 leave for Security office
to get KS badge then
return to hotel to
Upload data



Rain in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/06/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 80°F Sunny, SSW 3mph	**Tides:** L – 1804 H – 1128	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Eric Huss, Katie Smith		
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: 3.5 Hours
- ☐ Yellow Boat – Duration:

Other Equipment Used:

Work Completed:

- See Field Notes

Notes:

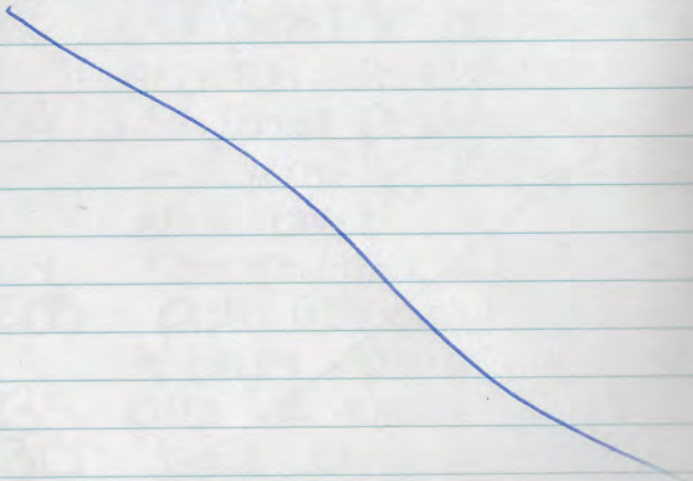
Daily Log Completed by: Katie Smith

Signature: 

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

8/6/20

17 → 25 incoming
80°F Sunny SSW 3mph
0745 KS, HT, EH at depot
0814 leave on white for 17 bridge
0831 deploy for drift
C ≈ 5m on HT
A ≈ 1m
1104 end drift
1145 return to depot
1223 train KS on daily log, data upload
1250 launch black boat
1300 leave depot for the day



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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/06/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 85°F Sunny SSW 4mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Lisa Heise, Sam Booth, Emily Camargo		
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: ☒ Yellow Boat – Duration: 3 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Sam Booth	**Signature:** Samuel Booth

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/07/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Sunny, NW 1 mph	**Tides:** L – 0634 H – 1208	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Katie Smith, Emily Camargo, Sam Booth, Lisa Heise		
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:	2.0 hours	
☒ White Boat – Duration:	3.0 hours	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes

Notes:

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

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

depot → MR incoming 8/7/20
74°F Sunny Calm
0722 EC, HT, KS at depot
0737 SB, LH at depot (boat gas)
0821 begin drift EC, HT, KS, white
A ≈ 1m
C ≈ 5m on Hz

0917 Alter course for barge, tug boat, and ship
1004 Alter course for ship & barge
1028 hold spot while barge turns around in port
1111 stop logging
1120 return to depot
1138 arrive at depot
1145 upload data
1200 leave depot

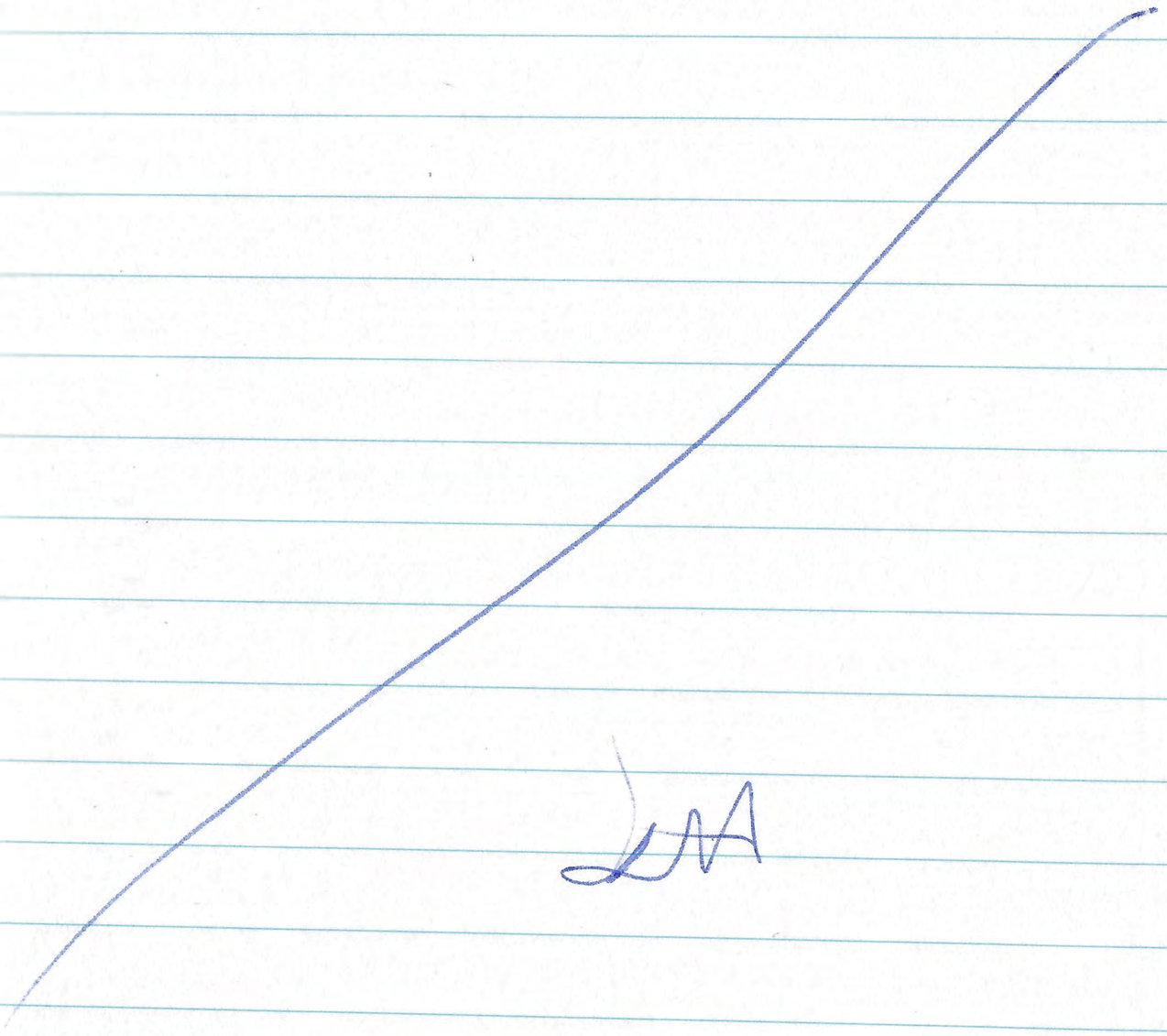
Rite in the Rain

17 → hog 8/7/20

SB, CH

78°F NW 1 mph Sunny

0820 depart depot for LBR
0833 arrive before 17 + setup
0834 Sonde 28 1m (H4) deployment
0836 Sonde B 2.5m (H4) started logging
0948 stopped logging and deployment
transferred sonde data +
broke down equipment
0955 departed LBR for depot
1020 arrived @ depot + uploaded data



LA

Rite in the Rain.

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/08/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Mostly Cloudy W 3mph	**Tides:** L – 0708 H – 1251	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, 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: 3.0 Hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Take white boat out to bring UR for Monday dye test

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

Buoy, FR Zigzag IT 8/8/20
78°F Mostly Cloudy w 3mph
0755 EB, HT at depot
0815 Leave for LBR (black)
0839 Stop deployment, transfer data: LBR-1
Sonde out of water 0835-0839
Not registering on HH, changed card battery 2.12 V.. ~~Cannot re-deploy~~ HT
Will switch out sonde. replaced batteries. Covered in barnacles.
0849 redeploy sonde.
0856 end deployment LBR_2 transfer data, Barnacle growth
0857 redeploy
0902 stop deployment LBR_3 transfer data, barnacles
0903 redeploy
0908 stop deployment LBR_4 transfer data, barnacles
0909 redeploy
0913 stop deployment LBR_5, transfer data, No sondom, barnacle growth
0914 redeploy
0920 stop deployment LBR_6, transfer data, sondom torn up

8/8/20
0921 redeploy
0925 stop deployment LBR_7 transfer data, barnacle growth
0926 redeploy
0932 stop deployment LBR_8 transfer data, barnacles
0933 redeploy
0937 leave LBR for LFR
1006 arrive at LFR
1009 begin diffuser sampling Zigzag
C = bn on H_2
1045 end sampling
1100 return to depot
1104 stop deployment, depot transfer data
1103 redeploy
1120 upload data
1122 put new batteries in Sonde C
1130 Pull White boat out to bring UR
1200 leave depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/09/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 74°F Sunny S 1mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Hayley Torkos, 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: 2.0 hours ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
-

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

Buoys 8/9/20
HT, EB
74°F Sunny S 1mph
0827 arrive at UR
0847 launch White + leave for Hardeeville
0859 Stop deployment Hardeeville transfer data, battery at 2.34v - Hornets in tube w/ Sonde, will need to figure out way to extinguish to retrieve Sonde
0905 redeployed
0915 stop deployment, transfer data UR_18
0916 redeploy Sonde
0920 UR_17 Stop deployment transfer data
0921 redeploy
0926 UR_16A stop deployment transfer data
0928 UR_16 stop deployment, transfer data
0937 change UR_16A batteries No bottom to Sonde guard
0943 redeploy UR_16 + UR_16A

8/9/20

0948 UR_15 stop deployment
transfer data
0949 redeploy
0952 UR_14 stop deployment,
transfer data
0953 redeploy
0955 UR_13 stop deploy, transfer
0956 redeploy
1000 UR_12a stop deploy, transfer
1002 redeploy 2.58U
1003 UR_12 stop deploy, transfer
1005 redeploy
1009 UR_11 stop deploy, transfer
1010 redeploy
1013 UR_10 stop deploy, transfer
1014 redeploy
1018 UR_9 stop deploy, transfer
1019 redeploy
1032 return to boat ramp
1100 leave GA Power, HT to upload
data from hotel

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/10/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 73°F Partly Cloudy SE 2mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Hayley Torkos, Ethan Bright, Emily Camargo, Lisa Heise, Sam Booth, 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: _____

☒ White Boat – Duration: 1.0 hours

☒ Yellow Boat – Duration: 1.0 hours

Other Equipment Used:

Generator, Dye Trailer

Work Completed:

- See Field Notes
- Diluted Dye Test

Notes:

Daily Log Completed by: Hayley Torkos

Signature: Hayley Torkos

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



UR diluted dye test 8/10/20

73°F Partly cloudy SE 2mph
0725 EC, EB, EH, HT at depot to collect dye test
0731 pull depot sonde for Rhodamine
0753 put back in H_2O
0756 transfer Rhodamine + algae from DR sondes to UR sondes
0815 EC, EB, EH, HT leave depot for UR
0900 arrive at UR, meet SB, LH
0940 launch yellow boat
0942 EC, HT leave for UR
0951 Sat ≈ 1m deployed
0954 D logging on H_4 (profile)
1000 Dye started (EH, EB)
~~1000~~ profile around UR 10 + UR 11
1003 Dye visible
1014 Dye dump complete
approx 10gal dye 30gal diluted
1015 Dye no longer visible from diffuser
1017 begin Zig-Zag through buoys
move D ≈ 2m
1031 end profile / drift
1042 return to boat ramp

Rite in the Rain

8/10/20

0952 pull yellow boat out
1102 pull white boat out
to take back down River
1120 leave GA power EC, LH, EB, HT
For depot
1207 arrive at depot
1215 launch White boat
1222 upload data, transfer
Rhodamine + Algae back to LBR
1300 leave depot

Dye Dilution 8/10/20 3

86°F, Sunny, Calm
0830 SB, LH arrive
0845 put white boat in
0900 hooked up yellow boat to put in once EB, HT, EH get here
0940 put yellow boat in
0950 departed GA Power boat ramp
0953 arrive to setup
H 1m H3
G profiler H3
0955 started deployment on Sonde H
0000 started logging on Sonde G
1000 dye dump stayed around buoy 12
1014 ~~dye st~~ dye stopped; began going in channel toward YR-18, SB @ 3m
1020-1025 sonde G out of water due to striking underwater debris guard tightened & sonde reset at 3 meters
1030 stopped logging
1043 arrive at boat ramp

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/11/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 73°F Mostly Cloudy ESE 1 mph	**Tides:** L – 0902 H – 1514	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Ethan Bright, Eric Huss, Emily Camargo, Sam Booth, Lisa Heise		
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:	2.5 Hours	
☒ White Boat – Duration:	2.5 hours	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- Diluted Dye Test LFR

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 1: Boat 1 profiling during dye pumping at LFR on 08/11/2020.



Photo 2: View from LFR O2 system of sampling during dye test on 08/11/2020.

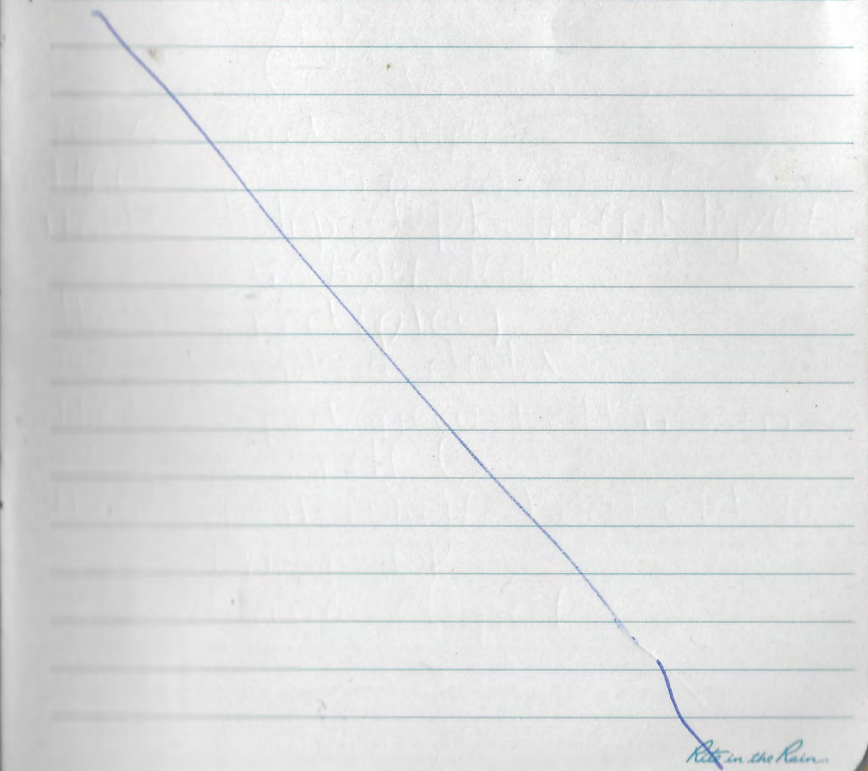
Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 3: Dredge and pipes crossing majority of channel both upstream and downstream of LFR O2 diffuser, view facing upstream toward system.

diluted dye FR 0902 slack low 8/11/20
73F mostly cloudy ESE 1mph
0745 EC, EH, LH, EB, SB, HT at depot
0830 depart depot for ~~LFR~~
0840 arrive at LFR diffuser area
Sonde C - profiler w/ HH
Sonde 2E - deployed @ 3 m w/ HH
0852 start deployment on Sonde 2E
0853 start logging on Sonde C
0900 EB texted dye pump started
0914 dye pump end
0928 set Sonde C @ 2 m
0931 due to stationary barge, had to go around out of dye until passed, trawling South
0934 Pulled up sondes b/c of dredge & pipe to go around
0938 put sondes back in, dye not visible not apparent on HH.
Completed profile - slight jumps in RWT + PE. Current seems to have slowed down. Appears to be slack.
0946 pulled sondes to go back by dredge to follow dye.
0947 dredge started moving so had to stop and wait w/ sondes on
0950 started to go by dredge

0952 Put sondes back in, see dye visually & on HH. Started drifting North to follow dye
1029 stopped logging
1030 stopped deployment & transferred Sonde data
1044 departed LFR for depot
1051 arrived @ depot
1111 upload data
1125 departed depot for hotel
~~H2S~~



8/11/20

Diluted dye LFR Boat 2
77°F mostly cloudy WSW 4mph
0830 EC, HT leave for LFR (blacle
0840 arrive at LFR
0854 deploy for drift LT
A ≈ 2m
B ≈ 4m on H_2
0900 Dye pumping
0903 Dye visible in LFR
0924 Dye pump end
0927 begin profile B/H_2
0931 cannot stay w/ plume - headed directly under barge on plant side of River,
0933 went around to catch plume, headed toward land side of dredge pipes will follow + have to change course
0940 end profile, remove Sondes from H_2O to move around dredge
0943 continue drift
0947 pull Sondes to go back around dredge - tidal shift
0949 wait for dredge to move
0952 sondes back in water

8/11/20

1019 Profile in channel in line with diffuser (Sonde B)
1022 set deep sonde (B) at ~5.5m to drift thru diffuser
1029 stop logging Sonde B
1030 stop deployment Sonde A transfer sonde data
1041 depart LFR to depot
1100 arrive at depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/12/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 7°F Partly Cloudy WSW 1 mph	**Tides:** L – 0931 H – 1603	

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Hayley Torkos, Ethan Bright, Eric Huss, Emily Camargo, Sam Booth, Lisa Heise

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:	2.0 Hours	
☒ White Boat – Duration:	2.5 hours	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- Diluted Dye Test LBR

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 1: Boat 1 profiling during dye pumping at LBR on 08/12/2020.

Diluted Dye LBR 8/12/20

78°F Partly Cloudy WSW 5mph

0825 EC, EH, EB, SB, LH, HT @ depot

0924 depart depot for LBR

0945 arrive @ LBR ~~near 1~~

Sonde A @ 1m deploy w/ H2

Sonde B @ 2.5m / profiling w/ H3

0952 tide appears slack or close

0953 deployed Sonde A

0954 started logging 5.28 PERFs 0.24 RWT

1001 EB texted that dye is pumping

1005 dye visible

1021 EB texted that pumping is done

1028 set Sonde B @ 2.5 m + began ~~data~~

1108 stopped deployment on Sonde A + stopped logging on Sonde B

1113 depart LBR

1134 arrive @ depot + upload data

1215 swap Rhodamine, algae, clean Sonde, 17

1245 LH, ~~EB~~, EH, SB, SB leave depot EB, HT leave depot for Jax

 Diluted dye LBR_Boat2 08/12/20

81°F fair SSW 4mph

0921 EC, HT leave for LBR (white)

0939 arrive at LBR_1, stop deploy
transfer data
replace w/ Sonde 16 -
will need new buoy template
to update site ID

0953 Deploy ~~28~~ C ≈ 1m

0954 log ~~28~~ C ≈ 3.5m on H_4

1001 begin dye dump

1006 dye visible LBR

1021 end dye dump

1030 begin profile on 28/H_4

1045 set 28 ≈ 2.5 drift

1103 end drift

1109 log on C ≈ 1m return trip
to/through diffuser

1123 end drift

1151 return to depot

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/13/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 82°F Partly Cloudy NNE 0 mph	**Tides:** L – 1026 H – 1654	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Emily Camargo, Sam Booth		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 4.0 Hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Sam Booth	**Signature:** Sam Booth

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

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/13/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 75°F Sunny Calm	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Eric Huss, Lisa Heise		
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: ☒ Yellow Boat – Duration: 2.0 hours	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

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

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

Diluted Dye LBR 8/12/20

78°F Partly Cloudy WSW 5mph

0825 EC, EH, EB, SB, LH, HT at depot

0924 depart depot for LBR

0945 arrive @ LBR ~~next~~ 1

Sonde A @ 1m deploy w/ H2

Sonde B @ 2.5m / profiling w/ H3

0952 tide appears slack or close

0953 deployed Sonde A

0954 started logging 5.28 PERFS 0.09 RWT

1001 EB texted that dye is pumping

1005 dye visible

1021 EB texted that pumping is done

1028 set Sonde B @ 2.5 m + began ~~drift~~

1108 stopped ~~deploy~~ on Sonde A + stopped logging on Sonde B

1113 depart LBR

1134 arrive @ depot + upload data

1215 swap Rhodamine, algae, clean Sonde, 17

1245 LH, ~~EB~~ HT, EH, SB, SB leave depot EB, HT leave depot for Jax

LBR 25→17 zig 8/13/20

84°F, partly cloudy, SSE 2 mph

0645 EC + SB arrive @ Depot

0725 depart depot to 25 bridge

0755 arrive @ HWY 25 bridge

0759 started logging Sonde A @ 1m on H2

0852 shallow spot - raised temporarily

0918 - temporarily stopped zig zagging due to shallow portion of river

0925 resume zig zags

1040 ended zig zags due to changing tide

1054 stopped logging

1055 ~~left~~ depart LBR

1100 slow for EC to take photo call

1125 arrive @ Depot

1155 depart depot

Rite in the Rain

8/13/20

ZZ to H-ramp
75°f sunny calm
EH, LH
0800 arrive @ GA Power boat ramp
0830 depart boat ramp
0837 set up
0839 Sonde G (H3) 1.5 m
Started logging
0923 hit something pulled up sonde
seems crooked trying to fix
0926 put sonde back in water
1005 stopped logging & brokedown equip
1009 departed boat ramp to spray
hornets nest
1030 arrive @ GA Power & rinse boat
~~1100 departed~~ & uploaded data
1110 departed GA Power

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/14/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 80°F Sunny WSW 6 mph	**Tides:** L – 1123 H – 1747	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Emily Camargo, Sam Booth, Eric Huss, Lisa Heise		
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:	2.5 hours	
☒ White Boat – Duration:	2.0 hours	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes

Notes:

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

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

Diffuser zigzag + profiles 8/14/20

79°F Partly cloudy WSW 7 mph

0800 EC, EH, LH, SB arrive at depot

0835 EC + LH depart to LFR in WB

0852 start logging
Sonde B @ ~1.5 m (HZ)

0858 profile

* dredge very close to O2 system, photos taken, navigating to maintain safe distance with strong outgoing current

0921 profile

0923 profile

0938 profile

0943 profile

0953 profile

1002 lift sonde to move downstream of dredge & O2 system, profile

1005 stop logging

1012 depart LFR

1027 arrive @ depot & upload data

1045 SB & EH arrive @ depot & upload data

1115 depart depot

66 Diluted dye LBR_Boat2 08/12/20

81°F fair SSW 4mph

0921 EC, HT leave for LBR (white)

0939 arrive at LBR_1, stop deploy transfer data replace w/ Sonde 16 - will need new loggy template to update Site ID

0953 Deploy ~~28~~ ≈ 1m

0954 log ~~28C~~ ≈ 3.5m on H4

1001 begin dye dump

1006 dye visible LBR

1021 end dye dump

1030 begin profile on 28/H4

1045 set 28 ≈ 2.5 drift

1103 end drift

1109 log on C ≈ 1m return trip to/through diffuser

1123 end drift

1151 return to depot

Diffuser Drift LBR SB, E4 8/14/20 67

0835 depart depot in Black truck

0856 arrive @ LBR

Sonde C @ ~2m on H4

0858 start logging

0927 profile 1

0930 profile 2

0932 profile 3

0935 profile 4

0939 profile 5

0945 profile 6

1025 stopped logging near LBR_1

1030 depart LBR

1045 arrive @ Depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/15/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 82°F Light Rain WSW 8 mph	**Tides:** L – 1218 H – 0612	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Lisa Heise		
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 hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	
Work Completed: - See Field Notes		
Notes:		
Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise	
	Photos Attached? ☐	**# of Photos** ____

Buoys SB, LH 8/15/20

82°F Light rain WSW 8 mph

0930 arrive @ depot

1000 pulled data from depot sonde (H4) 2945

1007 depart depot for LBK

1034 arrive @ LBR-8; download data

Set sonde A @ 1 meter w/ H2

1038 started logging

1052 arrive @ LBR-7; download data

1105 arrive @ LBR-6; download data

1115 arrive @ LBR-5; download data

1123 arrive @ LBR-4; download data

1131 arrive @ LBR-3; download data

1144 arrive @ LBR-2; download data

1203 arrive @ LBR-1; download data

1204 stopped logging on Sonde A

1210 Depart LBR

1224 arrive @ Depot + uploaded data

1315 depart depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/16/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 75°F Sunny Calm	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Sam Booth, Lisa Heise		
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: _____ ☒ Yellow Boat – Duration: 2.5 hours	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Sam Booth	**Signature:** Samuel Booth

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

34 Buoys & 1 sonde drift 8/16/20

SB, LH

76°F Sunny NE 3 mph

0730 arrive @ GA Power boat ramp

0800 depart boat ramp

0813 start logging for buoy area drift

0820 stopped logging

0830 transferred sonde data on hardeeville sonde & charged batteries

0850 UR 18 transferred sonde data

0856 UR 17 transferred sonde data

0901 UR 16 + Mid depth transferred sonde data

0907 UR 15 transferred sonde data

0911 UR 14 transferred sonde data

0917 UR 13 transferred sonde data

0922 UR 12 ~~trans~~ + Mid transferred sonde data

0930 UR 10 transferred sonde data

0936 UR 11 transferred sonde data

0941 UR 10 tranferred sonde data

0945 depart UK for GA Power boat ramp

0955 pulled boat out & downloaded data

1030 Departed GA Power

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/17/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 72°F Partially Cloudy NE 7 mph	**Tides:** L –1406 H – 0758	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Eric Huss, Ethan Bright, Katie Smith		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 3.0 Hours ☒ White Boat – Duration: 2.0 Hours ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Pulled black boat from water to clean
- Calibration of LBR sondes to take place 8/18/20

Notes:

Daily Log Completed by: Hayley Torkos	**Signature:** Hayley Torkos
	Photos Attached? ☐ **# of Photos** ____

Diffuser ZigZag & Profiles FR+LBR 8/17/20
74°F partly cloudy Wind NE 7mph
0757 E.H arrives at depot starts Setup Faraday
0815 HT KS at depot from Jax
0828 EB at depot
0900 EH, HT leave for LFR white
0912 arrive at LFR
0921 begin zig-zag diffuser drift (OT)
28 ≈ 1m
C ≈ 5m on H_2
0933 pull sondes to travel upstream
0937 sondes in, resume
0950 pull sonde, go upstream
0953 begin profile (not zigzag)
0958-1002 alter course for ship
1010 end profile, pull to go upstream
1012 begin final zig-zag drift
1041 end drift
1100 return to depot, upload data
1230 Pulled black boat from water and cleaned / preped for calibration of LBR sondes

8/17/20 LBR – ZZ Drift w/ Profiles
EB, KS
79°f ENE 8 clear

0900 Depart from Depot for back river on Black boat

0930 Deploy Sonde A @ 1 m Depth

0932 start Logging on Sonde B @ 3 m Depth

1028 pull Sonde from water
-Transfer Deployed data to hand held
Sonde may have died - unsure

1032 Deploy Sonde A @ 1 m Depth
Past Diffuser
*covered same area as when Sonde died

1033 start Logging Sonde B @ 3m

1037 Profile 1 – 6

1140 stop logging

1205 arrive at the depot

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/18/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Partly Cloudy Calm	**Tides:** N/A	

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Hayley Torkos, Eric Huss, Ethan Bright, Katie Smith

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:		
☒ White Boat – Duration:	2.0 hours (HT/EH), 1.5 hours (EH/EB)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- Pulled LBR Buoy sondes to calibrate.
    - Calibrated sonde 17 (original LBR_1) but decided to not re-deploy. Officially replaced with 16.
- Cleaned sondes
- Calibrate LBR Profiling sondes
- Calibrate sondes D, I, J, 14, and 15 for UR
- Ethan Bright pulled Hardeeville sonde on 8.18.20 to assist with UR calibration on 8.19.20

Notes:

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

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

Calibration Report

Last Calibration Time: 7/14/2020 4:20:36 PM

Calibration Start Time: 8/19/2020 12:51:21 PM

Calibration End Time: 8/19/2020 12:58:41 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101859

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100628

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.01

DO (mg/L): 7.81 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.0 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 27.745 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.1 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 3:51:42 PM

Calibration Start Time: 8/19/2020 12:51:21 PM

Calibration End Time: 8/19/2020 12:58:41 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101475

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102908

DO Cap Replacement Date: 11/21/2017

DO Gain: 0.99

DO (mg/L): 7.80 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 105.3 % Sat

Post Calibration Value: 99.6 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 27.799 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.1 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 3:51:42 PM

Calibration Start Time: 8/19/2020 12:51:21 PM

Calibration End Time: 8/19/2020 12:58:41 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101847

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100599

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.05

DO (mg/L): 7.80 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.5 % Sat

Post Calibration Value: 99.8 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 27.877 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.1 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 4:40:50 PM

Calibration Start Time: 8/19/2020 12:51:21 PM

Calibration End Time: 8/19/2020 12:58:41 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101459

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102872

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.01

DO (mg/L): 7.79 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.7 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 27.985 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.1 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 3:27:55 PM

Calibration Start Time: 8/19/2020 12:51:21 PM

Calibration End Time: 8/19/2020 12:58:41 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101457

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102888

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.04

DO (mg/L): 7.80 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.8 % Sat

Post Calibration Value: 99.8 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 28.103 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.1 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 4:40:50 PM

Calibration Start Time: 8/19/2020 12:07:18 PM

Calibration End Time: 8/19/2020 12:13:19 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101455

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102874

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.03

DO (mg/L): 7.90 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.1 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 26.855 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.4 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 2:57:15 PM

Calibration Start Time: 8/19/2020 12:07:18 PM

Calibration End Time: 8/19/2020 12:13:19 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101860

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100629

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.15

DO (mg/L): 7.89 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 105.6 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 26.970 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.4 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 2:57:15 PM

Calibration Start Time: 8/19/2020 12:07:18 PM

Calibration End Time: 8/19/2020 12:13:19 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101849

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100601

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.02

DO (mg/L): 7.90 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 106.9 % Sat

Post Calibration Value: 99.8 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 27.110 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.4 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 4:40:50 PM

Calibration Start Time: 8/19/2020 12:07:18 PM

Calibration End Time: 8/19/2020 12:13:19 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101465

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102890

DO Cap Replacement Date: 11/21/2017

DO Gain: 0.99

DO (mg/L): 7.90 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.7 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 27.198 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.4 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 4:20:36 PM

Calibration Start Time: 8/19/2020 12:07:18 PM

Calibration End Time: 8/19/2020 12:13:19 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101461

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102909

DO Cap Replacement Date: 11/21/2017

DO Gain: 0.99

DO (mg/L): 8.05 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 105.9 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 27.318 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.4 mmHg

Calibration Report

Last Calibration Time: 7/19/2020 8:57:07 AM

Calibration Start Time: 8/18/2020 1:42:37 PM

Calibration End Time: 8/18/2020 1:50:15 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101858

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100627

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.10

DO (mg/L): 8.40 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.9 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 24.070 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 759.2 mmHg

Calibration Report

Last Calibration Time: 7/19/2020 9:20:39 AM

Calibration Start Time: 8/18/2020 1:42:37 PM

Calibration End Time: 8/18/2020 1:50:15 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101472

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102903

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.03

DO (mg/L): 8.38 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.4 % Sat

Post Calibration Value: 99.8 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 24.093 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 759.2 mmHg

Calibration Report

Last Calibration Time: 7/19/2020 8:57:07 AM

Calibration Start Time: 8/18/2020 1:42:37 PM

Calibration End Time: 8/18/2020 1:50:15 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100750

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100562

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.05

DO (mg/L): 8.37 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.8 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 24.104 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 759.2 mmHg

Calibration Report

Last Calibration Time: 7/19/2020 8:57:07 AM

Calibration Start Time: 8/18/2020 1:42:37 PM

Calibration End Time: 8/18/2020 1:50:15 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100752

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100588

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.15

DO (mg/L): 8.38 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.1 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 24.111 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 759.2 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 3:51:42 PM

Calibration Start Time: 8/18/2020 1:42:37 PM

Calibration End Time: 8/18/2020 1:50:15 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100744

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104233

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.03

DO (mg/L): 8.39 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.8 % Sat

Post Calibration Value: 99.8 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 24.131 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 759.2 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 3:51:42 PM

Calibration Start Time: 8/18/2020 12:21:34 PM

Calibration End Time: 8/18/2020 12:29:25 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101855

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100624

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.10

DO (mg/L): 8.54 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.9 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.924 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/19/2020 9:20:39 AM

Calibration Start Time: 8/18/2020 12:21:34 PM

Calibration End Time: 8/18/2020 12:29:25 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100742

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100556

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.02

DO (mg/L): 8.52 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 106.1 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.001 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/19/2020 9:20:39 AM

Calibration Start Time: 8/18/2020 12:21:34 PM

Calibration End Time: 8/18/2020 12:29:25 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101848

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100600

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.09

DO (mg/L): 8.53 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.3 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.067 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 4:40:50 PM

Calibration Start Time: 8/18/2020 12:21:34 PM

Calibration End Time: 8/18/2020 12:29:25 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101856

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100625

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.08

DO (mg/L): 8.54 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 105.0 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.126 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/19/2020 9:20:39 AM

Calibration Start Time: 8/18/2020 12:21:34 PM

Calibration End Time: 8/18/2020 12:29:25 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101846

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100596

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.05

DO (mg/L): 8.54 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.2 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.236 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 2:09:51 PM

Calibration Start Time: 8/18/2020 11:10:29 AM

Calibration End Time: 8/18/2020 11:19:41 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100736

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104237

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.02

DO (mg/L): 8.63 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 106.4 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.422 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 2:57:15 PM

Calibration Start Time: 8/18/2020 11:10:29 AM

Calibration End Time: 8/18/2020 11:19:41 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101851

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100606

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.07

DO (mg/L): 8.63 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 105.5 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.526 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 2:09:51 PM

Calibration Start Time: 8/18/2020 11:10:29 AM

Calibration End Time: 8/18/2020 11:19:41 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101857

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100626

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.06

DO (mg/L): 8.64 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.9 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.576 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 2:57:15 PM

Calibration Start Time: 8/18/2020 11:10:29 AM

Calibration End Time: 8/18/2020 11:19:41 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101468

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102894

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.12

DO (mg/L): 8.64 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 107.8 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.612 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 2:57:15 PM

Calibration Start Time: 8/18/2020 11:10:29 AM

Calibration End Time: 8/18/2020 11:19:41 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101463

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K101906

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.12

DO (mg/L): 8.64 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.5 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.623 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 3:27:55 PM

Calibration Start Time: 8/18/2020 3:10:09 PM

Calibration End Time: 8/18/2020 3:13:04 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100739

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100552

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.11

DO (mg/L): 8.62 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.5 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.760 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 2:09:51 PM

Calibration Start Time: 8/18/2020 3:10:09 PM

Calibration End Time: 8/18/2020 3:13:04 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101469

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102897

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.02

DO (mg/L): 8.62 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.3 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.764 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 2:09:51 PM

Calibration Start Time: 8/18/2020 3:10:09 PM

Calibration End Time: 8/18/2020 3:13:04 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100749

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100560

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.11

DO (mg/L): 8.90 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.8 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.769 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: None

Lot Number: None

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 3:27:55 PM

Calibration Start Time: 8/19/2020 10:46:30 AM

Calibration End Time: 8/19/2020 10:52:41 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101854

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100608

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.07

DO (mg/L): 8.14 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 104.0 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 25.402 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.8 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 3:27:55 PM

Calibration Start Time: 8/19/2020 10:46:30 AM

Calibration End Time: 8/19/2020 10:52:41 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101850

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100602

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.03

DO (mg/L): 8.14 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.4 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 25.442 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.8 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 3:51:42 PM

Calibration Start Time: 8/19/2020 10:46:30 AM

Calibration End Time: 8/19/2020 10:52:41 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101862

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100631

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.17

DO (mg/L): 8.08 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 96.6 % Sat

Post Calibration Value: 99.8 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 25.557 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.8 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 4:20:36 PM

Calibration Start Time: 8/19/2020 10:46:30 AM

Calibration End Time: 8/19/2020 10:52:41 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100737

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100559

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.06

DO (mg/L): 8.14 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 105.1 % Sat

Post Calibration Value: 99.8 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 25.625 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.8 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 4:20:36 PM

Calibration Start Time: 8/19/2020 10:46:30 AM

Calibration End Time: 8/19/2020 10:52:41 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101852

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100603

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.07

DO (mg/L): 8.19 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 103.9 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 25.689 °C

Standard Value: 100.0 % Sat

Type: Tap Water

Manufacturer: N/A

Lot Number: N/A

Is Stable: True

Barometer: 758.8 mmHg

Calibration Report

Last Calibration Time: 6/23/2020 1:50:25 PM

Calibration Start Time: 8/18/2020 1:57:52 PM

Calibration End Time: 8/18/2020 2:01:41 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105654

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.914 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 1:50:25 PM

Calibration Start Time: 8/18/2020 1:57:52 PM

Calibration End Time: 8/18/2020 2:01:41 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105663

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.02 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.858 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 3:09:52 PM

Calibration Start Time: 8/18/2020 1:57:52 PM

Calibration End Time: 8/18/2020 2:01:41 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.02 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.870 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:28:57 PM

Calibration Start Time: 8/19/2020 11:14:04 AM

Calibration End Time: 8/19/2020 11:36:45 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105653

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 25.734 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number:

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:28:57 PM

Calibration Start Time: 8/19/2020 11:14:04 AM

Calibration End Time: 8/19/2020 11:36:45 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102814

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.12 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 26.026 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number:

Is Stable: False

Calibration Report

Last Calibration Time: 6/23/2020 1:50:25 PM

Calibration Start Time: 8/19/2020 11:14:04 AM

Calibration End Time: 8/19/2020 11:36:45 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102815

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 25.928 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number:

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:28:57 PM

Calibration Start Time: 8/19/2020 11:14:04 AM

Calibration End Time: 8/19/2020 11:36:45 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105664

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.02 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 25.973 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number:

Is Stable: False

Calibration Report

Last Calibration Time: 6/23/2020 3:09:52 PM

Calibration Start Time: 8/18/2020 11:25:41 AM

Calibration End Time: 8/18/2020 11:33:05 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105658

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.08 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.657 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 1:50:25 PM

Calibration Start Time: 8/18/2020 11:25:41 AM

Calibration End Time: 8/18/2020 11:33:05 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105657

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.644 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:28:57 PM

Calibration Start Time: 8/18/2020 11:25:41 AM

Calibration End Time: 8/18/2020 11:33:05 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105656

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.02 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.640 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 1:50:25 PM

Calibration Start Time: 8/18/2020 11:25:41 AM

Calibration End Time: 8/18/2020 11:33:05 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105655

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.659 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 11:12:09 AM

Calibration Start Time: 8/19/2020 12:21:41 PM

Calibration End Time: 8/19/2020 12:27:12 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104031

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1001.0 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 27.773 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:29:30 AM

Calibration Start Time: 8/19/2020 12:21:41 PM

Calibration End Time: 8/19/2020 12:27:12 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100178

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 27.761 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:29:30 AM

Calibration Start Time: 8/19/2020 12:21:41 PM

Calibration End Time: 8/19/2020 12:27:12 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100183

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1000.1 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 27.751 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 11:12:09 AM

Calibration Start Time: 8/19/2020 12:21:41 PM

Calibration End Time: 8/19/2020 12:27:12 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104021

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1003.0 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 27.756 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:53:03 AM

Calibration Start Time: 8/19/2020 12:21:41 PM

Calibration End Time: 8/19/2020 12:27:12 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100168

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 997.6 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 27.768 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 11:12:09 AM

Calibration Start Time: 8/19/2020 11:01:18 AM

Calibration End Time: 8/19/2020 11:07:45 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100182

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 995.6 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 25.398 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:53:03 AM

Calibration Start Time: 8/19/2020 11:01:18 AM

Calibration End Time: 8/19/2020 11:07:45 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100170

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 25.399 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:53:03 AM

Calibration Start Time: 8/19/2020 11:01:18 AM

Calibration End Time: 8/19/2020 11:07:45 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100177

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 997.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 25.403 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:29:30 AM

Calibration Start Time: 8/19/2020 11:01:18 AM

Calibration End Time: 8/19/2020 11:07:45 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100167

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 997.8 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 25.418 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:29:30 AM

Calibration Start Time: 8/19/2020 11:01:18 AM

Calibration End Time: 8/19/2020 11:07:45 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100175

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 997.9 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 25.430 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:53:03 AM

Calibration Start Time: 8/18/2020 2:44:14 PM

Calibration End Time: 8/18/2020 2:48:55 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103296

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.18

Notes:

- 17F
- Ignore note 1

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 997.8 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.851 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 7/9/2020 12:51:59 PM

Calibration Start Time: 8/18/2020 2:44:14 PM

Calibration End Time: 8/18/2020 2:48:55 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101753

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

- 17F
- Ignore note 1

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1005.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.863 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 7/9/2020 12:51:59 PM

Calibration Start Time: 8/18/2020 2:44:14 PM

Calibration End Time: 8/18/2020 2:48:55 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101752

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.46

Notes:

- 17F
- Ignore note 1

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1005.4 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.860 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:35:38 PM

Calibration Start Time: 8/18/2020 2:44:14 PM

Calibration End Time: 8/18/2020 2:48:55 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104023

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

- 17F
- Recalibrated from 10,000 microsiemens to 1,000 microsiemens

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.843 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:35:38 PM

Calibration Start Time: 8/18/2020 2:44:14 PM

Calibration End Time: 8/18/2020 2:48:55 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100179

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

- 17F
- Recalibrated from 10,000 microsiemens to 1,000 microsiemens

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1004.6 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.832 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 11:12:09 AM

Calibration Start Time: 8/19/2020 10:20:07 AM

Calibration End Time: 8/19/2020 10:26:49 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104075

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.19

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 24.633 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 7/9/2020 12:51:59 PM

Calibration Start Time: 8/19/2020 10:20:07 AM

Calibration End Time: 8/19/2020 10:26:49 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104025

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.4 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 24.661 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:29:30 AM

Calibration Start Time: 8/19/2020 10:20:07 AM

Calibration End Time: 8/19/2020 10:26:49 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104022

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.8 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 24.680 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:29:30 AM

Calibration Start Time: 8/19/2020 10:20:07 AM

Calibration End Time: 8/19/2020 10:26:49 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100180

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 24.693 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:53:03 AM

Calibration Start Time: 8/19/2020 10:20:07 AM

Calibration End Time: 8/19/2020 10:26:49 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100166

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 997.0 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 24.716 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 1:46:56 PM

Calibration Start Time: 8/18/2020 1:15:37 PM

Calibration End Time: 8/18/2020 1:22:38 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100173

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.48

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9824.6 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.330 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:13:51 PM

Calibration Start Time: 8/18/2020 1:15:37 PM

Calibration End Time: 8/18/2020 1:22:38 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101758

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9889.2 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.285 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 1:46:56 PM

Calibration Start Time: 8/18/2020 1:15:37 PM

Calibration End Time: 8/18/2020 1:22:38 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100181

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.48

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9814.8 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.269 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:13:51 PM

Calibration Start Time: 8/18/2020 1:15:37 PM

Calibration End Time: 8/18/2020 1:22:38 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101761

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9858.7 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.277 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:13:51 PM

Calibration Start Time: 8/18/2020 1:15:37 PM

Calibration End Time: 8/18/2020 1:22:38 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104024

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.48

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9811.1 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.269 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:13:51 PM

Calibration Start Time: 8/18/2020 11:57:09 AM

Calibration End Time: 8/18/2020 12:03:07 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100174

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Hayley Torkos

QC Score: Bad

Sensor Specific

Cell Constant: 1.26

Notes:

- Barnacle growth on sensor head/membrane. Attempted to clean but concerned that too much scrubbing would compromise the sensor. V

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 3713.9 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.049 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Will retire this sensor.

Calibration Report

Last Calibration Time: 6/23/2020 1:46:56 PM

Calibration Start Time: 8/18/2020 11:57:09 AM

Calibration End Time: 8/18/2020 12:03:07 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100172

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.46

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10252.5 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.057 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 1:46:56 PM

Calibration Start Time: 8/18/2020 11:57:09 AM

Calibration End Time: 8/18/2020 12:03:07 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100176

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9998.8 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.082 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 1:46:56 PM

Calibration Start Time: 8/18/2020 11:57:09 AM

Calibration End Time: 8/18/2020 12:03:07 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100164

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.49

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9631.1 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.102 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:13:51 PM

Calibration Start Time: 8/18/2020 11:57:09 AM

Calibration End Time: 8/18/2020 12:03:07 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100169

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10039.2 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.121 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:26:17 PM

Calibration Start Time: 8/18/2020 10:46:24 AM

Calibration End Time: 8/18/2020 10:54:42 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104073

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.28

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9750.9 µS/cm

Post Calibration Value: 10000.1 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.063 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:35:38 PM

Calibration Start Time: 8/18/2020 10:46:24 AM

Calibration End Time: 8/18/2020 10:54:42 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103295

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.26

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9733.9 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.059 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:26:17 PM

Calibration Start Time: 8/18/2020 10:46:24 AM

Calibration End Time: 8/18/2020 10:54:42 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104076

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.23

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9761.3 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.062 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:26:17 PM

Calibration Start Time: 8/18/2020 10:46:24 AM

Calibration End Time: 8/18/2020 10:54:42 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103298

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.29

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9821.3 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.063 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:26:17 PM

Calibration Start Time: 8/18/2020 10:46:24 AM

Calibration End Time: 8/18/2020 10:54:42 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104074

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.23

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9790.6 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.067 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:07:51 PM

Calibration Start Time: 8/18/2020 2:03:02 PM

Calibration End Time: 8/18/2020 2:07:17 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105654

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.13 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.938 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:07:51 PM

Calibration Start Time: 8/18/2020 2:03:02 PM

Calibration End Time: 8/18/2020 2:07:17 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105663

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.961 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 3:22:29 PM

Calibration Start Time: 8/18/2020 2:03:02 PM

Calibration End Time: 8/18/2020 2:07:17 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.12 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.973 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:38:06 PM

Calibration Start Time: 8/19/2020 11:38:18 AM

Calibration End Time: 8/19/2020 11:51:16 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105653

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.30 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 26.060 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number:

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:38:06 PM

Calibration Start Time: 8/19/2020 11:38:18 AM

Calibration End Time: 8/19/2020 11:51:16 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102814

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.76 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 26.152 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number:

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:07:51 PM

Calibration Start Time: 8/19/2020 11:38:18 AM

Calibration End Time: 8/19/2020 11:51:16 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102815

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 2.21 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 26.213 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number:

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:38:06 PM

Calibration Start Time: 8/19/2020 11:38:18 AM

Calibration End Time: 8/19/2020 11:51:16 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105664

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 26.231 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number:

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 3:22:29 PM

Calibration Start Time: 8/18/2020 11:33:56 AM

Calibration End Time: 8/18/2020 11:39:10 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105658

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.02 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.681 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:07:51 PM

Calibration Start Time: 8/18/2020 11:33:56 AM

Calibration End Time: 8/18/2020 11:39:10 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105657

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.700 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:38:06 PM

Calibration Start Time: 8/18/2020 11:33:56 AM

Calibration End Time: 8/18/2020 11:39:10 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105656

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.03 RFU

Post Calibration Value: 0.01 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.715 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 2:07:51 PM

Calibration Start Time: 8/18/2020 11:33:56 AM

Calibration End Time: 8/18/2020 11:39:10 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105655

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.729 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 2:21:33 PM

Calibration Start Time: 8/19/2020 1:12:07 PM

Calibration End Time: 8/19/2020 1:12:22 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101989

Serial Number: 17G101989

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104624

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.032 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.970 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 2:23:24 PM

Calibration Start Time: 8/19/2020 1:10:03 PM

Calibration End Time: 8/19/2020 1:10:39 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101992

Serial Number: 17G101992

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104628

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.026 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.797 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 2:40:41 PM

Calibration Start Time: 8/19/2020 1:07:19 PM

Calibration End Time: 8/19/2020 1:07:44 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102930

Serial Number: 17L102930

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104910

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 25.854 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 2:34:16 PM

Calibration Start Time: 8/19/2020 12:37:11 PM

Calibration End Time: 8/19/2020 12:37:43 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102013

Serial Number: 17G102013

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104614

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.027 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.738 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 2:17:23 PM

Calibration Start Time: 8/19/2020 12:49:43 PM

Calibration End Time: 8/19/2020 12:49:51 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102004

Serial Number: 17G102004

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104608

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.028 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.951 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 2:19:15 PM

Calibration Start Time: 8/19/2020 12:39:37 PM

Calibration End Time: 8/19/2020 12:39:51 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101996

Serial Number: 17G101996

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104630

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.031 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.614 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 2:29:35 PM

Calibration Start Time: 8/19/2020 1:24:20 PM

Calibration End Time: 8/19/2020 1:24:31 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102009

Serial Number: 17G102009

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104611

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.029 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.350 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 2:26:19 PM

Calibration Start Time: 8/19/2020 1:17:34 PM

Calibration End Time: 8/19/2020 1:17:45 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101997

Serial Number: 17G101997

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104631

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.001 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.583 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 2:37:03 PM

Calibration Start Time: 8/19/2020 1:19:35 PM

Calibration End Time: 8/19/2020 1:19:46 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101993

Serial Number: 17G101993

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104632

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.036 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.203 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 12:03:22 PM

Calibration Start Time: 8/19/2020 1:15:04 PM

Calibration End Time: 8/19/2020 1:15:34 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102940

Serial Number: 17L102940

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104915

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.074 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.944 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/25/2020 7:46:23 AM

Calibration Start Time: 8/19/2020 1:05:08 PM

Calibration End Time: 8/19/2020 1:05:27 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102942

Serial Number: 17L102942

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104904

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.052 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.822 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 12:45:01 PM

Calibration Start Time: 8/19/2020 1:29:37 PM

Calibration End Time: 8/19/2020 1:29:50 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102010

Serial Number: 17G102010

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104610

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.067 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 28.773 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 10:38:06 AM

Calibration Start Time: 8/18/2020 3:41:05 PM

Calibration End Time: 8/18/2020 3:41:26 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102008

Serial Number: 17G102008

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104613

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 24.257 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:18:50 PM

Calibration Start Time: 8/18/2020 3:37:02 PM

Calibration End Time: 8/18/2020 3:37:36 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102003

Serial Number: 17G102003

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104601

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.040 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.260 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:33:07 PM

Calibration Start Time: 8/18/2020 2:31:22 PM

Calibration End Time: 8/18/2020 2:31:53 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102000

Serial Number: 17G102000

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104605

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.036 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 19.533 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:21:26 PM

Calibration Start Time: 8/18/2020 1:33:20 PM

Calibration End Time: 8/18/2020 1:33:53 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102939

Serial Number: 17L102939

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104905

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.083 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.713 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:26:01 PM

Calibration Start Time: 8/18/2020 2:14:12 PM

Calibration End Time: 8/18/2020 2:14:32 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102938

Serial Number: 17L102938

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104906

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.033 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.111 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:36:40 PM

Calibration Start Time: 8/18/2020 2:18:09 PM

Calibration End Time: 8/18/2020 2:18:17 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101988

Serial Number: 17G101988

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104623

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.019 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 20.514 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:29:26 PM

Calibration Start Time: 8/18/2020 2:29:37 PM

Calibration End Time: 8/18/2020 2:30:07 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102935

Serial Number: 17L102935

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104900

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 20.053 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:39:41 PM

Calibration Start Time: 8/18/2020 2:12:14 PM

Calibration End Time: 8/18/2020 2:12:24 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102946

Serial Number: 17L102946

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104917

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.023 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.371 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:15:54 PM

Calibration Start Time: 8/18/2020 2:28:00 PM

Calibration End Time: 8/18/2020 2:28:09 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102932

Serial Number: 17L102932

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104903

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.223 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.373 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:11:25 PM

Calibration Start Time: 8/18/2020 2:20:12 PM

Calibration End Time: 8/18/2020 2:20:46 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102931

Serial Number: 17L102931

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104912

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.063 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 18.493 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 6/24/2020 12:24:38 PM

Calibration Start Time: 8/18/2020 2:25:45 PM

Calibration End Time: 8/18/2020 2:26:07 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102941

Serial Number: 17L102941

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104914

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.021 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.717 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/9/2020 1:56:10 PM

Calibration Start Time: 8/18/2020 2:23:08 PM

Calibration End Time: 8/18/2020 2:23:28 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102945

Serial Number: 17L102945

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104909

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.294 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.209 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/9/2020 11:59:50 AM

Calibration Start Time: 8/18/2020 12:48:48 PM

Calibration End Time: 8/18/2020 12:51:07 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102005

Serial Number: 17G102005

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104606

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.034 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.763 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 7/9/2020 12:10:16 PM

Calibration Start Time: 8/18/2020 12:52:26 PM

Calibration End Time: 8/18/2020 12:52:49 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102933

Serial Number: 17L102933

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104913

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 23.840 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 2:24:01 PM

Calibration Start Time: 8/19/2020 1:27:35 PM

Calibration End Time: 8/19/2020 1:27:51 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101999

Serial Number: 17G101999

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104607

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.047 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 28.117 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:53:02 PM

Calibration Start Time: 8/18/2020 12:37:47 PM

Calibration End Time: 8/18/2020 12:39:19 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G102021

Serial Number: 17G102021

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100273

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.034 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.643 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:46:26 PM

Calibration Start Time: 8/18/2020 12:41:22 PM

Calibration End Time: 8/18/2020 12:42:23 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100250

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 23.817 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 1:49:53 PM

Calibration Start Time: 8/18/2020 12:31:02 PM

Calibration End Time: 8/18/2020 12:31:17 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100277

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.029 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.290 °C

Standard Value: 0.000 m

Type: None

Manufacturer: None

Lot Number: None

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 11:40:13 AM

Calibration Start Time: 8/18/2020 3:33:37 PM

Calibration End Time: 8/18/2020 3:34:33 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100292

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.051 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.491 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 11:44:00 AM

Calibration Start Time: 8/19/2020 10:15:49 AM

Calibration End Time: 8/19/2020 10:16:49 AM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100252

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.043 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.611 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/9/2020 12:58:44 PM

Calibration Start Time: 8/19/2020 12:34:50 PM

Calibration End Time: 8/19/2020 12:35:50 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100255

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.014 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.440 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/9/2020 1:18:37 PM

Calibration Start Time: 8/18/2020 3:44:48 PM

Calibration End Time: 8/18/2020 3:45:39 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102011

Serial Number: 17G102011

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104615

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.509 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.619 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/9/2020 1:41:23 PM

Calibration Start Time: 8/18/2020 3:31:55 PM

Calibration End Time: 8/18/2020 3:32:04 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102934

Serial Number: 17L102934

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104921

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.058 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.847 °C

Standard Value: 0.000 m

Is Stable: True

Buoy Sonde Cal/Check 8/18/20
74°F Cloudy Calm
0750 EH arrive at depot.
0754 HT at depot
0819 EH, HT leave for LBR (white)
0837 arrive at LBR_1
0838 begin Channel drift (IT)
LBR 1 to LBR ~~7~~
28 ≈ 1m on H_2
0910 end drift
0914 Stop, transfer + remove LBR-~~7~~
0919 Stop, transfer, remove LBR-10
0924 Stop, transfer, remove LBR_5
0930 Stop, transfer, remove LBR_8
0936 Stop, transfer, remove LBR_4
0940 stop, transfer, remove LBR_3
0944 Stop, transfer, remove LBR_2
0950 Stop, transfer, remove LBR_1
1010 return to depot for Calibration, upload data
1112 Stop deployment, transfer, remove Depot
1129 No option to re-cal ug/L for Phyco/Chloro, RFU only
1200 EH finish cleaning LBR sondes
1203 Sonde 17 CT recal w/ bad

Rite in the Rain

8/18/20

QC - barnacle growth on sensor head, will retire. concerned cleaning will compromise, retired sonde 17
Change batteries - A, 18

1348 EB, KS at depot from UR
1427 Redeploy, Depot Sonde
1446 Depart dock to LBR
1505 Deploy LBR 1
1511 " 2
1515 " 3
1521 " 4 (had to turn bluetooth off again)
1525 " 5
1529 " 6
1533 " 7
1538 " 8 Low tide. bottom of buoy might be sitting on the bottom.
1545 leave LBR
1613 arrive at depot
1620 finish calibration of LBR buoys, Depot
Dawn river profile sondes, UR DO, pH, T
1630 leave depot

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/18/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 77°F Sunny Calm	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Ethan Bright, Katie Smith		
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: ☒ Yellow Boat – Duration: 3 hours	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Pulled Hardeeville sonde for calibration and uploaded data (8/16/20-8/18/20)

Notes:

Daily Log Completed by: Katie Smith	**Signature:** 

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

EB, KS

77°f sunny NE 2 mph

0800 Arrive @ GA power boat ramp

0846 Launch boat

0855 start Deployment of Sonde G shallow (1m)

0857 start logging of Sonde H (2m)

0858 start route @ buoy 09 to Hardeeville

1103 Stop logging
Stop Deployments

~1130 stop deployment on Hardeeville sonde and pulled from USGS station for calibration
* Transfer data to ~~sonde~~ handheld

1150 Pull Boat from water and rinse sondes

Rite in the Rain

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/19/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 72°F Partly Cloudy NE 2mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Hayley Torkos, 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: _____ ☐ White Boat – Duration: _____ ☒ Yellow Boat – Duration: 2.5 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Calibration of UR Buoy and Profiling sondes
- Replace sonde 30 and 13 for 15 and 14 (middle buoy sondes)

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

Buoy Collection / Calibration 8/19/20
72°F Partly Cloudy NE 2mph
807 EH, HT at Boat Ramp
0825 Depart Boat Ramp
0837 Stop, transfer + remove UR_18
0841 Stop, transfer, remove UR_17
0845 Stop, transfer, remove UR_16
0847 Stop, transfer, remove UR_16a
0900 deploy sonde 15 at UR_16a - replacing sonde 30
0904 Stop, transfer, remove UR_15
0907 Stop, transfer, remove UR_14
0910 Stop, transfer, remove UR_13
0913 Stop, transfer, remove UR_12
0915 Stop, transfer, remove UR_12a
0925 deploy Sonde 14 at UR_12a replacing Sonde 13
0930 Stop, transfer, remove UR_11
0933 Stop, transfer, remove UR_10
0936 Stop, transfer, remove UR_9
0945 return to boat ramp to ~~0945~~ calibrate + clean, will 1000 HI upload data later when in wifi - uploading at 1045
1120 Chlorophyll sensors offered

1204
Good
Best
rep
Can
U
133
134
140
141
142
143

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/19/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 77°F Clear WNW 2mph	**Tides:** L –1549 H – 0937	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Katie Smith		
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: 4.0 Hours ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Katie Smith	**Signature:** 

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

Hwy 25 → 17 gage w/ DP 8/19/20 43

77°F WNW 2 mph Sunny

0900 Arrive @ Depot

0922 Depart from Dock for LBR

1000 Deploy Sonde I @ 1m

1003 Start logging Sonde D @ 3m

1033 Depth profile 1 on Sonde D

1059 Depth profile 2 " "

1114 Depth profile 3 " "

1146 Depth profile 4 by Diffuser

1200 Depth Profile 5 by railroad Bridge

1228 Depth profile 6 by 17

1228 pull Sonde D and stop logging

1229 pull Sonde I and stop Deployment

1258 Dock boat

1305 Filled up Gas tank for white boat

1305 Data Entry

1330 leave depot

Rite in the Rain

8/19/20

cal point for RFU 4 ug/L
unlike previous sensors from
down River, did NOT recal ug/L for
consistency.
1204 replaced wiper brush on Sondes
To deer: 12 3 4 10 2 8, 6
To-H → C J → 11, G → 9
Good Condition: 5
Best of old brushes placed on: 1, G, H, J
replace central wiper unit on 5!
Cannibalize 30 to make 7 backup
UR profiling Sonde
1330 finish Calibration of ALL UR
Sondes
1347 leave for hardeeville
1402 re-deploy Sonde 12 at hardeeville
1410 deploy UR-18
1413 deploy UR-17
1416 deploy UR-16
1420 deploy UR-15
1422 deploy UR-14
1425 deploy UR-13
1427 deploy UR-12
1430 deploy UR-11
1432 deploy UR-10

Rite in the Rain

8/19/20

1438 deploy UR-9
1451 return to boat ramp + pullout yellow boat
1515 level GA power

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/20/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 83°F Sunny NNE 1 mph	**Tides:** L –1640 H – 1026	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Lisa Heise		
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: 3.5 Hours ☐ Yellow Boat – Duration:	**Other Equipment Used:**	
Work Completed: - See Field Notes		
Notes:		
Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise	
	Photos Attached? ☐	**# of Photos** ____

44 MR: LBR → LFR 8/20/20

83°F sunny, winds ENE 1mph

0945: SB arrive @ Depot

1000: L4 arrive @ Depot

1027 depart depot for MR connect on LBR near I-95

1100 arrive @ confluence of MR & LBR Sonde A @ near on H4

1107 start logging

1322 stopped logging in LFR

1345 arrived @ Depot

1430 depart depot

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/20/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 83°F Partly Cloudy E 5mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Hayley Torkos, Katie Smith		
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:	
☐ White Boat – Duration:	
☒ Yellow Boat – Duration: 1.5 hrs	

Work Completed:

- See Field Notes
- Afternoon sampling – conducted prior to 1500 due to radar showing storms around 1600 when checked at 1000

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

8/19/20

9.
ramp +
boat

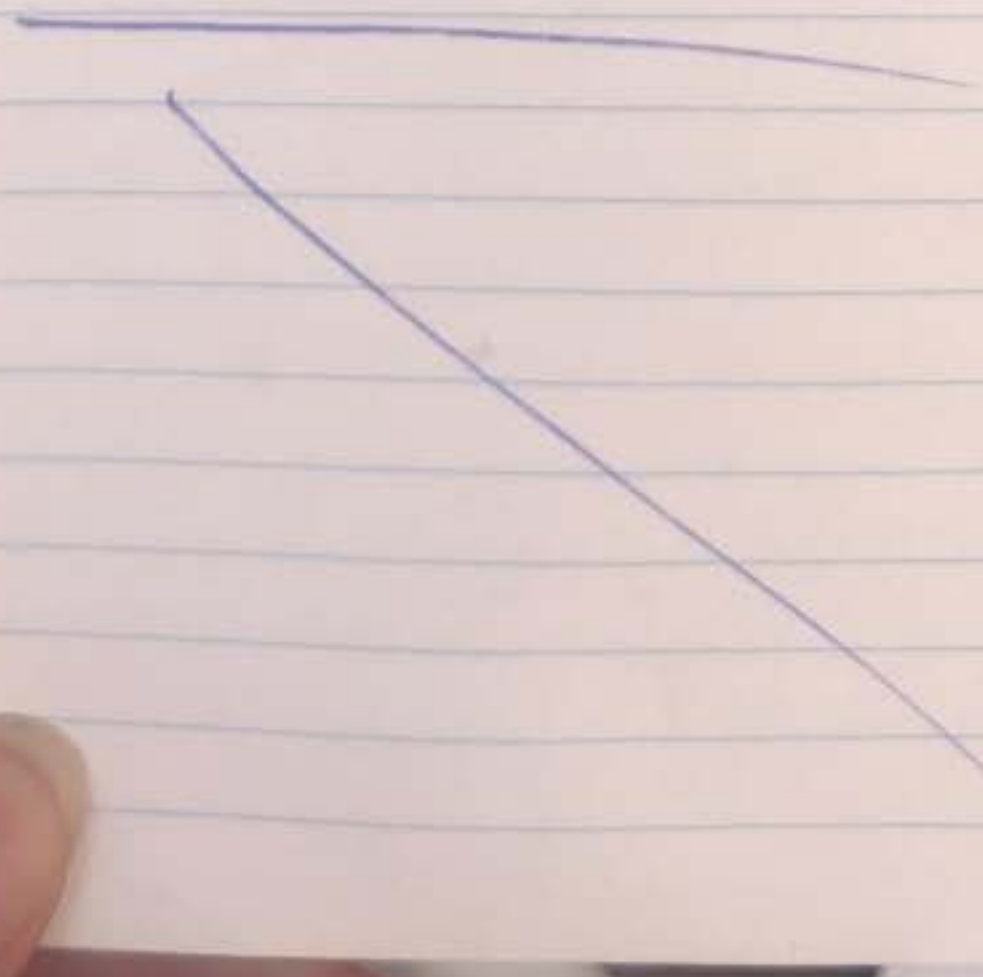
8/20/20

87f mostly Claudy E5 mph
1238 KS, AT at Boat ramp
1255 leave for UR plant
1304 begin 4mile drift from diffuser
G on H3 Logging ≈ 1m

1406 Stop time
Stopped logging on H3

1435 pull yellow boat
from water

1445 leave site



Rite in the Rain

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/21/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Partly Cloud SW 1mph	**Tides: H –** 1118 **L -** 1731	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Sam Booth, Lisa Heise, Katie Smith		
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:	2.0 hours	
☒ White Boat – Duration:	2.0 hours	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- Put in black boat, pulled out white boat for UR dye test Monday

Notes:

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

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

diffuser ZZ+ Profile (IT) 8/21/2045
78°F Partly Cloudy SW 1mpH
0658 KS, LH, HT, SB at depot
0714 launch black boat
0718 KS, HT leave for LFR
0728 arrive at LFR
0734 begin zig-zag diffuser C ≈ 2m only
0810 manatee in sampling area, heading upstream
0832 begin profiles 1-6
0847 end drift
0910 return to depot, upload LFR data
0930 KS, HT leave for Jax
1030 LH, SB depart depot

Rite in the Rain.

~~8/21/20~~ LBR 22 drift & profile 8/21/20

0735 SB & CH depart for LBR lighthouse
0750 arrived @ LBR
0755 started logging
Sonde A (H2) 1.5m
0801 profile 1
0804 profile 2
0807 profile 3
0812 profile 4
0814 profile 5
0822 Profile 6
0823 pulled up sonde to go upstream of buoy 3 to start zig again
0856 stopped logging & broke down equipment
0858 departed LBR
0930 arrived @ depot & pulled out white boat to clean
1015 uploaded data

Rite in the Rain.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/22/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 76°F Cloudy Calm	**Tides: H –** 1212 **L -** 1823	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 3.0 hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- LBR_5 fully submerged underwater. Tried to retrieve but could not find it again.

Notes:

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

Photos Attached? ☒	**# of Photos** 2

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photograph 1: Ripples of submerged LBR_5



Photograph 2: LBR_5 not visible

46 Buoys + drift 8/22/20

SB, LH 76°F Cloudy Calm

0700 arrive @ depot

0734 depart depot in Black boat

0748 arrive @ LBR South of LBR-1

Sonde A @ 1 mctrs on M4

H2 used to collect buoy data

0752 start logging

0754 arrive @ LBR-1; download data

0815 arrive @ LBR-2; download data

0827 arrive @ LBR-3; download data

0836 arrive @ LBR-4; download data

LBR-5 totally submerged

attempted to retrieve but unable

not visible under water

0904 arrive @ LBR-6; download data

0914 arrive @ LBR-7; download data

0927 arrive @ LBR-8; download data

0928 stopped logging on Sonde A

0940 tried finding LBR-5 but did not

0950 departed LBR

1015 arrive @ depot

1018 download depot buoy data

1030 uploaded all data

1100 departed depot

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/23/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 74°F Cloudy Calm	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Sam Booth, Lisa Heise		
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: 2.0 hours ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Sam Booth	**Signature:** Samuel Booth

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

UR Buoys + Drift 8/23/20
SB, LH 74°F Cloudy Calm
0835 SB + LH arrive @ boat ramp
0900 depart in whole boat
0908 arrive @ UR to set up
Sonde B (H3) 1 m
0911 started logging
0917 transferred UR 9 sonde data
0922 transferred UR 11 sonde data
0926 transferred UR 10 sonde data
0932 transferred UR 12 both sondes data
0937 transferred UR 13 sonde data
0942 transferred UR 14 sonde data
0945 profile @ ~~sonde~~ UR 13
0952 transferred UR 15 sonde data
0956 transferred UR 16 both sondes data
1001 transferred UR 17 sonde data
1006 transferred UR 18 sonde data
1010 depart UR 18 for H ramp, stopped logging
1020 transferred Hardee sonde data
1022 departed Hville for GA power boat ramp
1035 arrive @ GA power boat ramp
remove + rinse boat + upload data
1145 depart GA Power

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/24/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 83°F Mostly Sunny NE 4 mph	**Tides: H –** 1408 **L -** 0734	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 3.0 hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	
Work Completed: - See Field Notes		
Notes:		
Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise	
	Photos Attached? ☐	**# of Photos** ____

LFR Depot → 25 w/profiles 8/24/20
83°F, mostly sunny wind: NE 4 mph
SB+LH with Black Boat
0800 - arrive @ Depot
0850 - turned on bilge to empty water from rain + set up equipment. Bilge drained for 10 mins.
0911 departed depot
0916 Started deployment Sonde A (H4) 2m
0917 Started logging Sonde B (H4) 1m
0919 Depot profile
0927 adjusted course slightly east of channel due to passing ship
0953 US17 profile
1026 profile between US17 + diffuser
1045 increase speed to pass dredge barge before incoming ship arrives
Unable to profile @ diffuser due to location of dredgers
1054 profile just North of diffuser
1146 profile between diffuser + Hwy 25
1217 profile @ Hwy 25
1219 stopped logging on Sonde B
1220 stopped deployment of Sonde A
1222 depart towards depot
1250 arrive @ Depot + uploaded data
1400 depart depot

Rite in the Rain

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/24/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 77°F Partly Cloudy (Rain)	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Katie Smith, Emily Camargo, Ethan Bright, Eric Huss, Rick McCann, Jim Greenfield		
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:		
☒ White Boat – Duration:	3.0 hrs	
☒ Yellow Boat – Duration:	2.5 hrs	

Work Completed:

- See Field Notes
- Super Dye Test

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

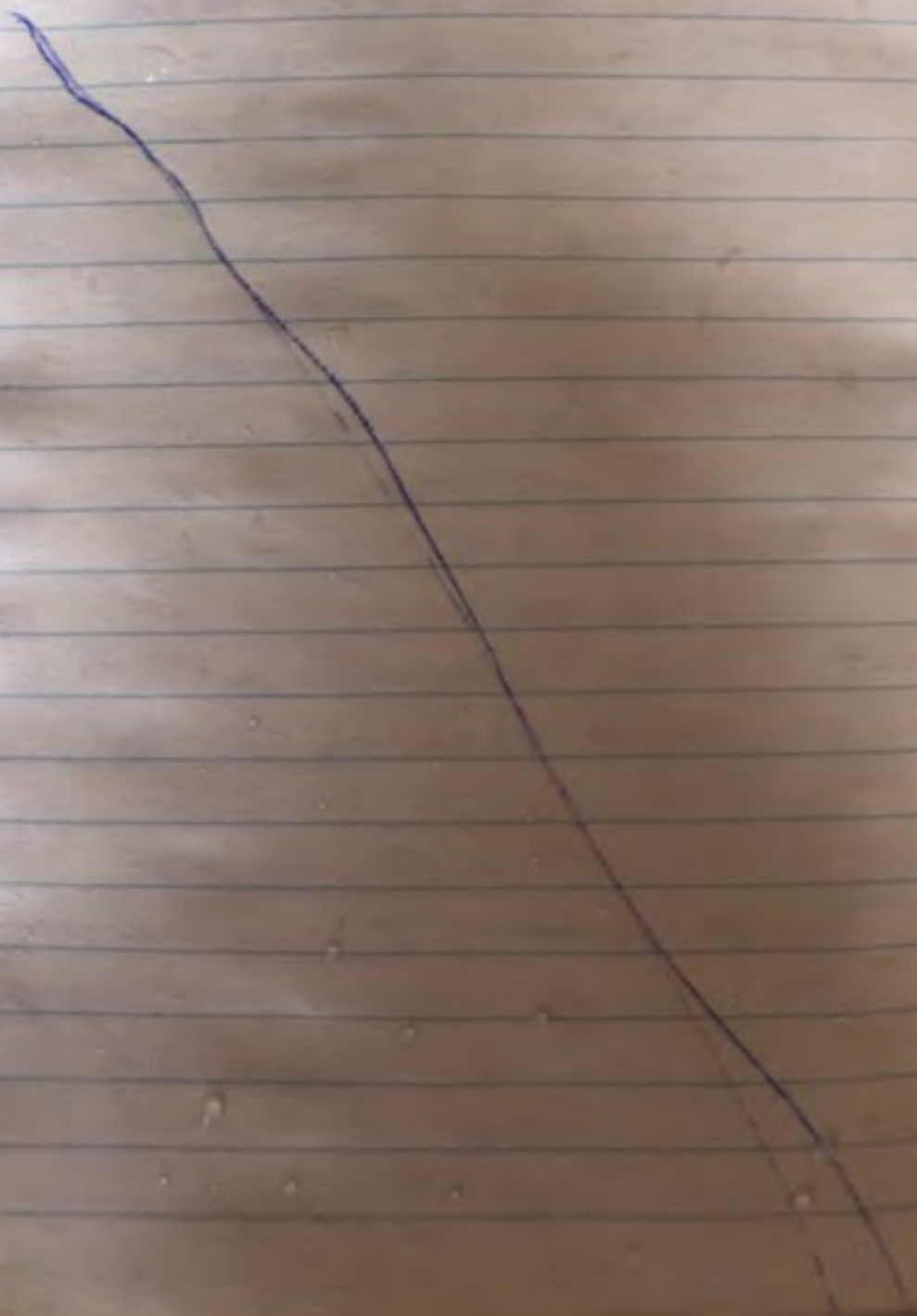
Dye Test UR
EC, JG, RM, EH, HT, EB, KS
77°F, cloudy, foggy
0825 EC, Jim + RM arrive at ramp
0869 EB, HT at ramp
~~0959~~ Depart from Dock
0957 Deploy sonde G ~~I~~ @ 1 m
0959 start logging sonde I
* tried to Deploy - says
sonde was out of memory
storage (0% free)
↳ logs fine on handheld
1022 stop profiling around
O2 Diffuser, pull sonde
I and stop logging.
1023 start zig zag to
Hardeeville
1124 Stop Deployment on Sonde G
due to incoming storm

1131 start logging on sonde G
@ ~~ox bow~~ and coleman lake
on way back to boat ramp
1136 stop logging @ coleman
1206 start logging @ OXbow
1211 stop logging

Rite in the Rain

8/24

1230 return to boat ramp, JG leave
1240 pull white & yellow boats out
1300 EC, EB, HT, KS leave UK ramp for depot



4 Super dye - Boat 1 8/24/20

0932 EC, JG, HT leave for UR
0937 arrive UR (yellow)
D ≅ 1m deployed
H ≅ 4m on H_2
0946 begin drift
1000 dye injection begins
1001 dye visible
1009 Rain
1018 dye dump complete
1120 thunder & lightning within 8 miles, pulled sonde H but continue logging for GPS, heading back to UR
1125 stop to talk to USGS boat
1142 end drift
1157 return to boat ramp, pouring rain

4 Super dye - Boat 1 8/24/20

0932 EC, JG, HT leave for UR
0937 arrive UR (yellow)
D ≈ 1m deployed
H ≈ 4m on H2
0946 begin drift
1000 dye injection begins
1001 dye visible
1009 RDIN
1018 dye dump complete
1120 thunder & lightning within 8 miles, pulled sonde H but continue logging for GPS, heading back to UR
1125 stop to talk to USGS boat
1142 end drift
1157 return to boat ramp, pouring rain

Dye Test UR 8/24/20 41

EC, JG, RM, EH, HT, EB, KS

77°F, cloudy, foggy

0825 EC, Jim + RM arrive at ramp

0869 EB, HT at ramp

~~[illegible]~~ Depart from Dock

0957 Deploy sonde G @ 1 m

0959 Start logging sonde I

* tried to Deploy - Says sonde was out of memory storage (0% free)

↳ logs fine on handheld

1022 stop profiling around O2 Diffuser, pull sonde I and stop logging

1023 Start Zig Zag to Hardeeville

1124 Stop Deployment on Sonde G due to incoming storm

1131 Start logging on sonde G @ ~~ox bow and~~ Coleman lake on way back to boat ramp

1156 stop logging @ coleman

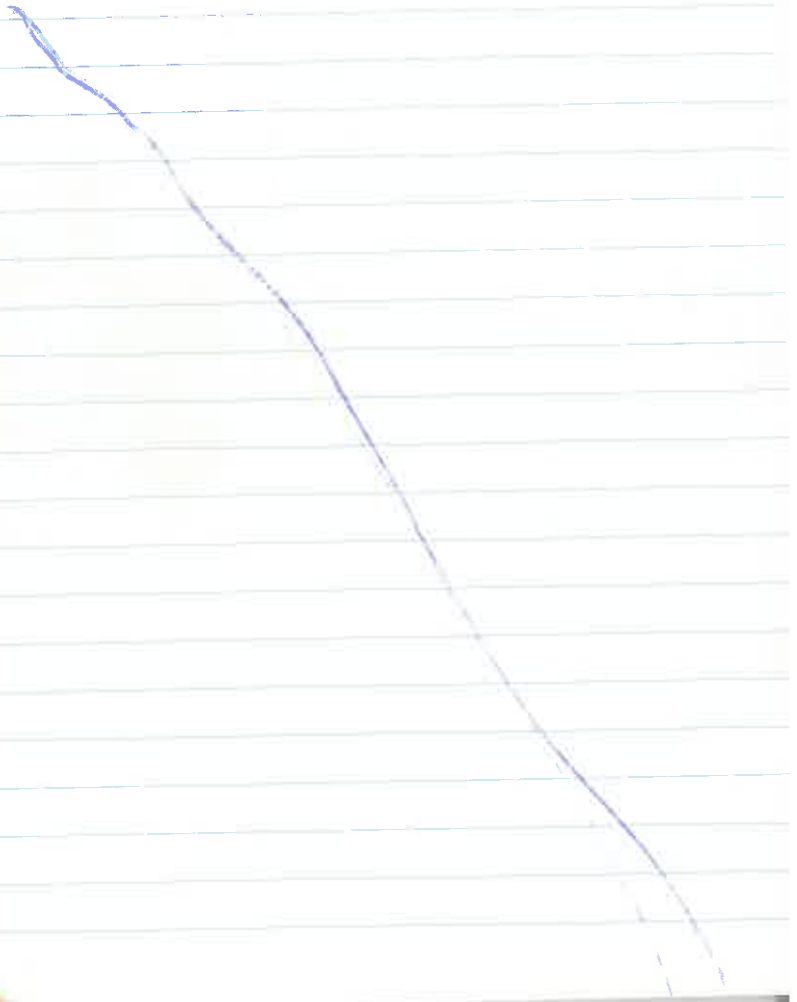
1206 start logging @ OXbow

1211 stop logging

Rite in the Rain

8/24

1230 return to boat ramp, JG leave boots on
1240 pull white & yellow boats out
1300 EC, EB, HZ, KS leave UK ramp for depot



Dye Test UR 8/24/20 41

EC, JG, RM, EH, HT, EB, KS

77°F, cloudy, foggy

0825 EC, Jim & RM arrive at ramp

0869 EB, HT at ramp

0957 Depart from Dock

Deploy sonde G Z @ 1 m

0959 Starts logging Sonde I

* tried to Deploy - Says sonde was out of memory storage (0% free)

4 logs fine on handheld

1022 Stop profiling around O2 Diffuser, pull Sonde I and stop logging.

1023 Start zig zag to Hardeeville

1129 Stop Deployment on Sonde G due to incoming storm

1131 Start logging on Sonde G @ ~~Oxbow~~ and Coleman lake on way back to boat ramp

1156 stop logging @ coleman

1206 start logging @ Oxbow

1211 stop logging

Rite in the Rain.

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/25/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Mostly Cloudy E 2 mph	**Tides: H –** 1508 **L -** 0829	
Client/Stakeholder Interaction (if any): Jeremy Buddemeier (USACE PR)		
Personnel/Visitors on site: Hayley Torkos, Katie Smith, Rick McCann, Lisa Heise, Emily Camargo, Eric Huss, Ethan Bright, Sam booth, Jim Greenfield		
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:	4.0 hours (HT, KS)	
☒ White Boat – Duration:	5 hours (SB, EB, JG)	
☒ Yellow Boat – Duration:	4 hours (LH, EC)	

Work Completed:

- See Field Notes
- Super Dye Test

Notes:

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

Photos Attached? ☒	**# of Photos 5**

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Figure 1: Example of dye concentrating around dredge pipes.



Figure 2: Dye concentrated around dredge pipes and not dispersing towards the channel and bank.



Figure 3: Example of dye concentrating around dredge pipes after discharge.



Figure 4: View of LBR_5 and dye during Dye Test



Figure 5: View facing south at dye near USGS station

LBR Dye Test 8/25/20

0900 LH arrives at depot with WB trailor
0920 EC + LH depart depot to LBR in YB
0936 arrive at LBR + setup
0940 deployed Sonde A 1m (H2)
0944 started logging Sonde 29 2m (H2)
0946 LBR dye release start
0951 Dye visible
1002 Dye release complete
Begin following dye
1041 Navigated away from dye briefly to avoid shallow spot
1255 Stopped logging
1256 Stopped deployment + transferred sonde data
1303 depart LBR
1335 arrive @ depot

Super Dye LFR 8/25/203

78°F fog / PHy cloudy E 2mph

0726 EC, KS, HT at depot

0741 Launch yellow boat

0753 EH, RM leave for LFR Dye test

0821 leave dock for LFR black Boat HT, KS, JSB

0830 arrive at LFR. dredge Floating pipe on top of diffuser, Vessel 50 yards N

0839 deploy C ≈ 2m

0841 B ≈ 4m on Hy

0845 started pumping Dye

0846 saw dye in river

↳ dye hugging plant side of bank heading downstream and sticking in between dredge pipe and bank * boat cannot access ~90% of dye due to active dredge work in front of plant

0906 dye dump completed

0921 Captain Jack spoke to us and said they are

Rite in the Rain

beginning work on the dredge pipe and that we need to stay clear and distance ourselves

~0950 profile around channel in an attempt to follow Dye. Not seeing elevated levels of Dye upstream. Highest reading @ 2.8 RWT RFU @ ~8-9m.

0958 checked with Jim - told to continue plan of going upstream (dye appears to be going downstream)

1005 pulled Sonde from water

1010 put Sonde back in water by plant then started upstream again per Jim's request

1045 dye visible @ upstream of front river plant @ dredge pipe - visible upstream of dredge both visually and on handheld

1109-1112 Stay in place for passing cargo ship

1117 dye visible at surface after shiptag went by

1208 end drift

1234 return to depot

1248 pull depot Sonde to add Rhodamine

1251 put depot Sonde back in water

1259 upload LFR data

1320 Jeremy Buddemeier left

1411 upload UR, LBR data

1445 all leave depot

Rite in the Rain

UR ⇒ Depot 8/25/20

76° Foggy wind 1 NE

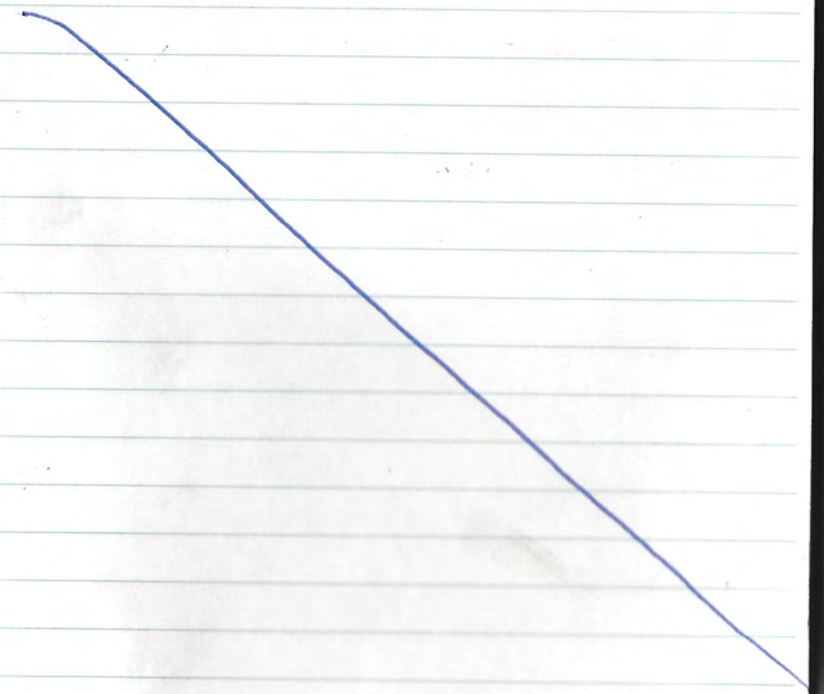
0745 SB, JG, EB, LH arrive at Plant Mac Boat Ramp

0805 SB, JG, EB depart in white boat; LH depart in truck w/ white boat trailer

0810 start logging on H3 w/ Sonde @ ~1 meter

1242 stop logging

1257 arrive @ Depot



Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/26/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Partly Cloudy Calm	**Tides: L** – 0930 **H -** 1607	

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Hayley Torkos, Eric Huss, Ethan Bright, Katie Smith, Lisa Heise, Sam Booth, Emily Camargo

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:	2.5 hrs (HT, RM, EC)	
☒ White Boat – Duration:	3.5 hrs (EB, EH)	
☒ Yellow Boat – Duration:	4.0 hrs (KS, LH, SB)	

Work Completed:

- See Field Notes

Notes:

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

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

6 MR to FR 8/26/20
76°F Partly cloudy calm
0759 KS, HT at depot
0801 EC, EB, SB, LH at depot
0807 EH at depot
0917 print mid cal records
0945 RM at depot
1008 RM, EC, HT leave Depot for MR (Black)
1030 start logging Sonde A (HZ)
1156 stop logging + return to depot
1238 arrive at depot
1247 Upload data - Note HZ stopped logging data from approx 1145 until end
1417 RM, EH leave depot
1430 all leave depot for day

diff → MR (LBR) 8/26/20

84°F NW 2 mph Partly cloudy

SB, LH, KS

1002 depart depot for LBK

1021 arrive @ LBR diffuser

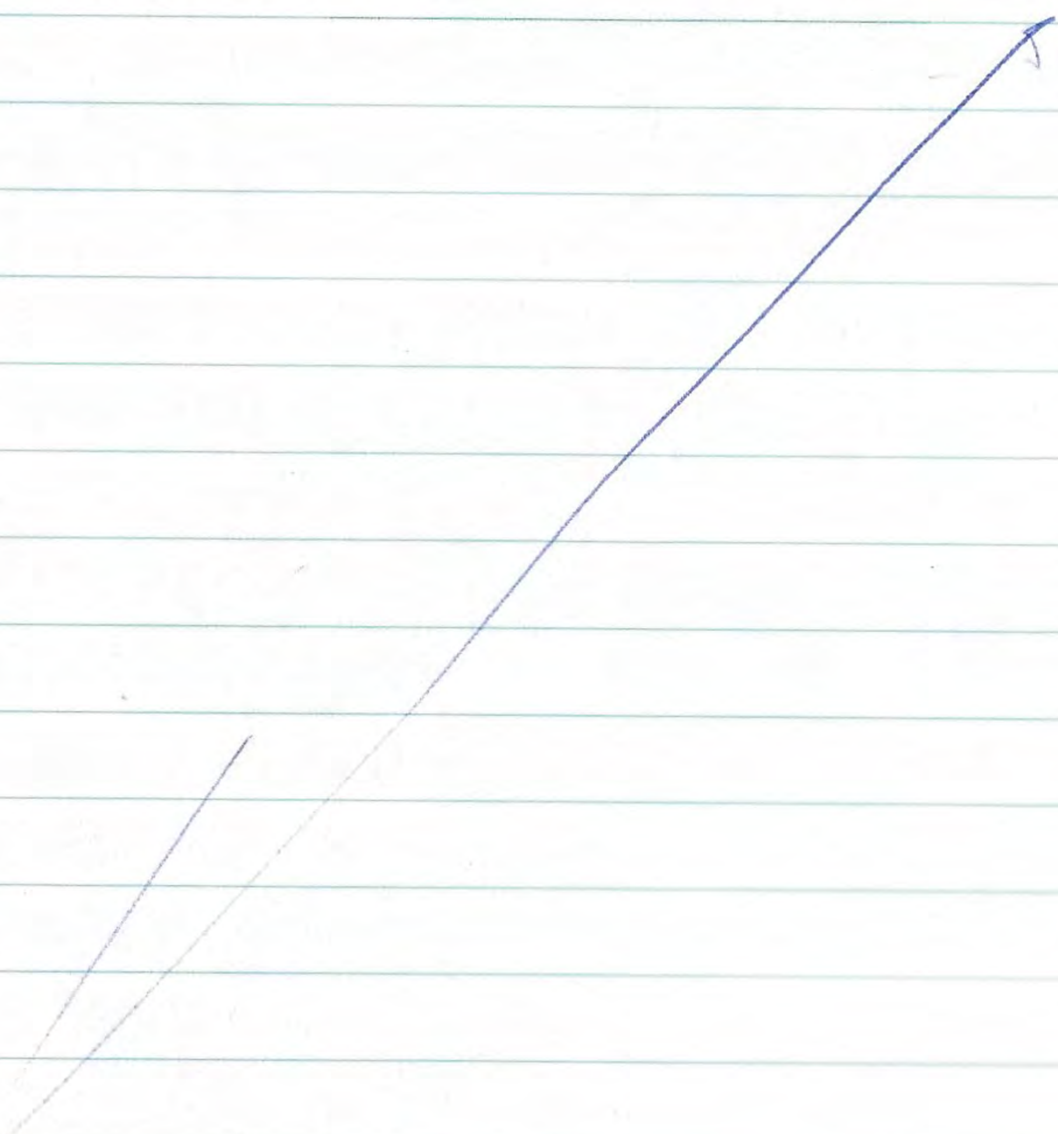
Sonde C at meters on #3

1022 started logging

~~1122~~ 1322 stopped logging

1324 departed LBR

1354 arrive @ Depot + uploaded data



Rite in the Rain

EB EH	Sunny 85° wind ~5mph	8/26/20
1015	leave depot	handheld #4
1022	deploy sonde ~1m	#28
1024	start logging sonde ~3m	B
1026	profile at depot	
~1100	profile at 17	
~1130	" b/w 17 and diffuser	
1202	" in the channel in front of O_2 plant	
	dredge right in front of O_2 plant	
1233	profile in turning basin	
1318	" at Houlihan bridge	
1320	stop logging	
1349	arrive at depot	

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/27/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 82°F Sunny WSW 2 mph	**Tides: L** – 1033 **H -** 1707	

Client/Stakeholder Interaction (if any): HT met Lon (USACE) to swap out handheld H2 for H1.

Personnel/Visitors on site:

Sam Booth, Ethan Bright, Hayley Torkos, Katie Smith, Lisa Heise, Emily Camargo

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:	3.0 hrs (HT, KS)	
☒ White Boat – Duration:	2.5 hrs (EC, LH)	
☒ Yellow Boat – Duration:	4.0 hrs (SB, EB)	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Samuel Booth

Signature: Samuel Booth

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

LFR depot to 25 (profile) 8/27/20 7

82°F Sunny wind WSW 2 mph

0930 EB, SB arrive @ Depot

1000 EB, SB depart in Yellow Boat

1006 HT at depot after meeting
Lon to swap HH

1040 EC, LH, KS at depot

1113 Drift B ≈2m on H4 (+profile)
(KS, HT on Black) (IT)
profile approx. every 1mile

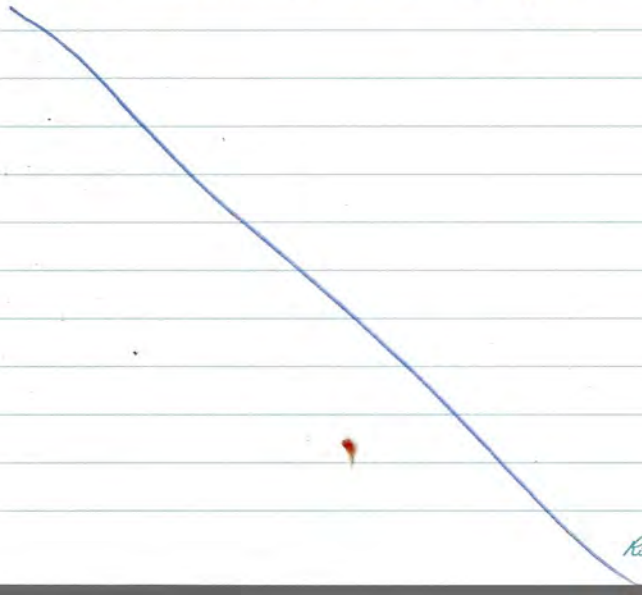
1320 end drift at 25 did Not do final profile - lost weight

1353 return to depot

~~1353 r HT~~

1400 upload data

1500 all leave Depot



Rite in the Rain

LBR Channel Drift 8/27/20

1110 Depart depot to LBR
EC & LH in WB
1125 arrive at 17 bridge & setup
1129 start logging
Sonde A (HH) @ 0.3m
1244 stop logging
1254 return to depot
* Two boats at diffuser during
& after our sampling, apparently
collecting data
1325 arrive at depot & uploaded data

SB, FB

Fort Pulaski to Depot 8/27/20

82°F Sunny wind: 2 mph WSW

1000 depart depot in Yellow boat

1041 arrive at Ft. Pulaski

1045 start logging sonde C #3

1045 profile at Ft. Pulaski

1105 " #2

1121 " #3

1140 " #4

1209 " #5

1224 " #6

1237 " #7

1250 " #8

1301 " #9

1313 " #10

1325 " #11

1342 " #12

1354 " #13

1358 stop logging at depot.

1400 put boat on trailer for upriver.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/28/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 79°F Partly Cloudy WNW 1 mph	**Tides: L** – 1135 **H -** 1806	

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Sam Booth, Hayley Torkos, Katie Smith, Lisa Heise

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:	2.0 hrs (HT, SB)	
☒ White Boat – Duration:	1.5 hrs (KS, LH)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- Prepped Sonde 13 for deployment this weekend at UR13 to replace Sonde 5

Notes:

Daily Log Completed by: Samuel Booth	**Signature:** Samuel Booth

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

8/28/2073

Depot → 25 profiles

84°F SW 2mph Cloudy

KS, LH

0853 depart depot

0854 started logging

0855 profile 1 @ depot

0902 profile 2

0909 profile 3

0915 profile 4

0923 profile 5

0931 profile 6

0937 profile 7

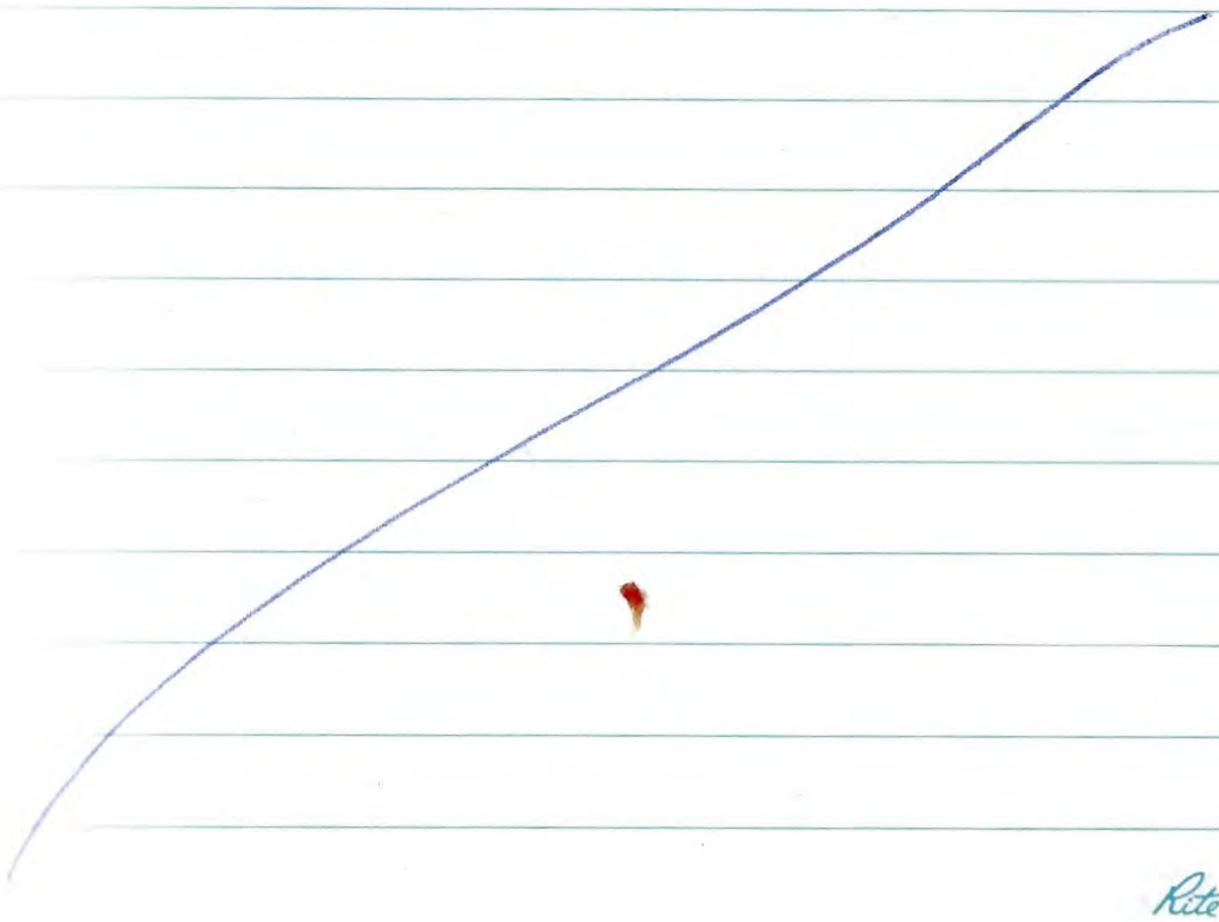
0942 profile 8

0949 profile 9 @ bridge

0954 stopped logging

1000 depart ~~25~~ bridge for depot

1022 arrive @ depot + uploaded data



Rite in the Rain

8 Profile depot to Ft Pulaski (OT) 8/28/2
79°F partly cloudy WNW 1mph
0726 SB HT at depot
0752 leave depot (black) SB, HT
0755 begin profiles (profile #1)
B on H3
0800 profile #2
0805 profile #3
0810 profile #4
0816 profile #5
0822 profile #6
0827 profile #7
0834 profile #8
0841 profile #9
0848 profile #10
0856 profile #11
0902 profile #12
0908 profile #13
0916 profile #14
0923 profile #15
0926 end profiles
0930 depart Ft. Pulaski area
1007 return to depot
1014 upload data
1045 SB, HT leave for JAX

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/28/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 81°F Partly Cloudy, Calm	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Ethan Bright, Emily Camargo		
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: _____ ☒ Yellow Boat – Duration: 2.0 hours	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Ethan Bright	**Signature:** Ethan Bright

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

6

Zig Diffuser → Hville 8/28/20

81°F Partly Cloudy @ramp

0880 EC & EB arrive [redacted] & launch YB

0850 depart ramp to diffuser UR

0900 start logging

Sonde D @ [redacted] ~1M (H1)

1009 stop logging

1027 arrive at ramp

1050 depart

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/29/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 81°F Partly Cloudy	**Tides**: H – 0616 L - 1230	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Emily Camargo		
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 hours ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	
Work Completed: - See Field Notes		
Notes:		
Daily Log Completed by: Ethan Bright	**Signature:** Ethan Bright	
	Photos Attached? ☐	**# of Photos** ____

LBR buoys + profiles 8/29/20

81°F Partly Cloudy, 11 mph SSW
0810 EB + EC arrive at depot
0837 Depart in BB to LBR
0900 arrive at buoy #8
collect data
0910 " " from #7
0915 " " from #6
0922 " " from #5
0927 " " from #4
0932 " " from #3
0938 " " from #2
0945 " " from #1
0948 Switch batteries from LBR-1
sonde 16, was at 1.9V
1005 conduct profile 1 of 4 blw
buoy #1 and 17 bridge
1014 conduct profile 2 of 4 blw 17
and Ft Jackson (back river)
1026 conduct profile 3 of 4
~~1040~~ by front river powe line crossing
1036 profile 4 of 4 near depot
1040 stop logging
1047 arrive at depot
1055 download data
1140 base depot

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 08/30/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 82°F Overcast, Calm	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Ethan Bright, Emily Camargo		
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: _____ ☒ Yellow Boat – Duration: 2.0 hours	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Replaced batteries at UR_18 and Hardeeville
- Replace sonde 5 with sonde 13 at UR_13 buoy

Notes:

Daily Log Completed by: Ethan Bright	**Signature:** Ethan Bright

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

Buoys

82°F overcast

0845 EB & EC arrive at ramp

0900 Depart ramp in YB to UR

0911 Collect Buoy data @ UR-18

0920 " " UR-17

0925 " " UR-16

0928 " " UR-16-A

0934 " " UR-15

0938 " " UR-14

0942 Replace sonde #5 @ UR-13 buoy with Sonde #13, collect #5 data

0947 collect buoy data @ UR-12

" " UR-12A

0955 " " UR-11

1000 " " UR-10

1005 " " UR-9

1025 " " Hardeeville

*Replaced batteries @ UR-18, Sonde #11 voltage was 2.29v

*1046 Replaced batteries @ Hville Sonde #12, sprayed hornets voltage was 2.29v

1055 Return to ramp

1108 Arrive at ramp

1125 Depart

Rite in the Rain.

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 08/31/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Partly Cloudy Calm	**Tides: L** – 1417 **H -** 0830	

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Hayley Torkos, Ethan Bright, Lisa Heise, Sam Booth

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:	2.0 hrs (HT, EB)	
☒ White Boat – Duration:	2.5 hrs (SB, LH)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes

Notes:

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

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

10 Profile LFR to MR (OT) 8/31/20
82°F partly cloudy w 6 mph
0945 SB, HT at depot
1000 EB, LH at depot
1034 EB, HT leave depot for LFR/LBR confluence (black)
1043 profile #1 by powerline crossing
1050 " #2 by tug boat dock
1058 " #3 by Westin
1105 " #4 by 17 bridge
1114 " #5 by the yacht yard
1122 " #6 by paper plant
1129 " #7 by O2 plant
dredge ~100 yds away
1139 profile #8 in turning basin
1145 " #9 MR + FR intersection
1152 " #10 in MR
1153 stop logging
1200 drive back to depot
1220 arrive
1245 upload data
1330 leave depot

74 LBR → LFR Profiles 8/31/20

SB, LH

1030 Depart Depot in white Boat
Sonde B with #4

1047 Profile # 1 (behind island)

1110 Profile #2

1121 Profile # 3

1134 Profile #4

1142 Profile #5

1151 Profile #6

1202 Profile #7

1211 Profile #8 (LBR)

1217 Profile #9

1223 Profile #10

1227 Profile #11

1230 Stop logging

1233 Depart LBR

1251 arrive @ Depot + uploaded data

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/01/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 87°F Sunny W 4 mph	**Tides: L** – 1546 **H -** 0933	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Lisa Heise, Sam Booth		
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: 2.5 hrs (SB, LH) ☐ Yellow Boat – Duration:	**Other Equipment Used:**	
Work Completed: - See Field Notes		
Notes:		
Daily Log Completed by: Sam Booth	**Signature:** Sam Booth	
	Photos Attached? ☐	**# of Photos** ____

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 09/01/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 76°F Sunny NW 3mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Hayley Torkos, 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: _____ ☒ Yellow Boat – Duration: 2.5 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Replace batters in UR_16a and UR_12a

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

22 Hog to 17 LBR 9/1/2011

87°F, Sunny, W 4 mph

0830 SB, LH arrive @ Depot
waited for tide to change

0930 depart depot

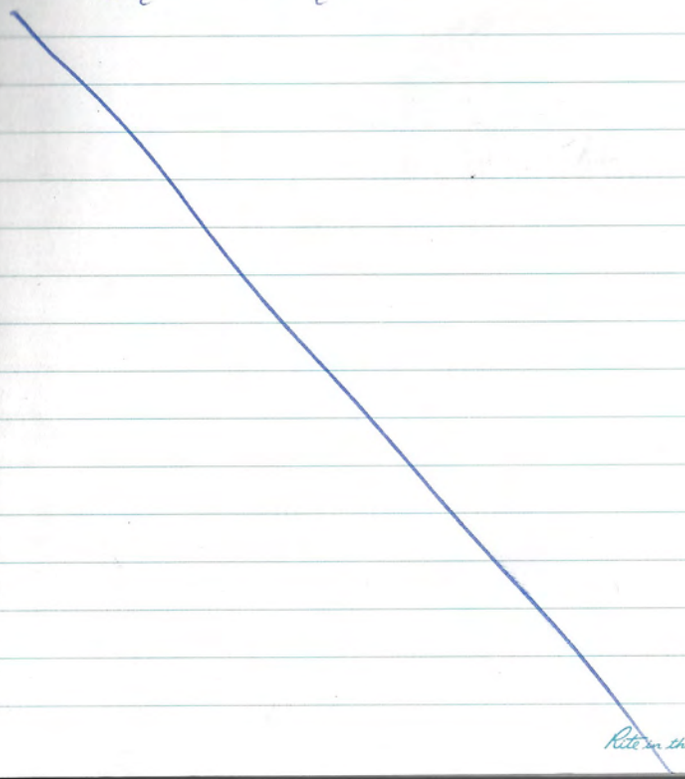
0959 started logging
Sonde A (H4)

1135 stopped logging

1139 depart LBR

1155 arrive @ Depot + upload data

1230 depart Depot



Rite in the Rain

8 Zig-Zag hardeeville 9/1/20
76°F Sunny NW 3mph
0834 EB, H7 at Boat Ramp
0852 leave for UR Site (yellow)
0859 begin Zig-Zag
D on H1 ≈ 1m
1000 end drift
1007 check bluetooth on Sonde
at hardeeville - OK
*wasps still present - spray
1009 update wipe interval to
every 8 samples
1021 large "stick" on UR16,
Removed
1031 pull 16A to replace
batteries - update wipe
interval to 8
1047 pull 12A to replace
batteries - update wipe
interval to 8
1104 Remove large branch UR10
1112 return to boat ramp
1122 pull yellow boat out
1145 leave for day

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/02/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 80°F Sunny SW 2 mph	**Tides: L** – 1546 **H -** 0933	

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Lisa Heise, Sam Booth, Hayley Torkos, 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:	3.0 hrs (SB, LH)	
☒ White Boat – Duration:	2.0 hrs (HT, EB)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Sam Booth	**Signature:** Saml Booth

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

12 Profile LFR → MR 9/2/20

80°F Sunny SW 2mph

0803 EB, LH, H7, SB at depot

0848 EB, H7 leave for LFR (Black)
profile A on H3

0857 profile #1 at powerline crossing

0904 " #2 at fwg boat depot

0911 " #3 by Westin

0919 " #4 by I7 bridge

0925 " #5 by ship yard

0931 " #6 by paper mill

0937 " #7 by O2 plant
~200 yrds downstream of dredge Chatham

0948 profile #8 in turning basin
~~dog~~ dredge Hampton Roads in basin
ship recently arrived and docked

0957 profile #9 by ~~St~~ Dixie Crystal

1003 " #10 in MR

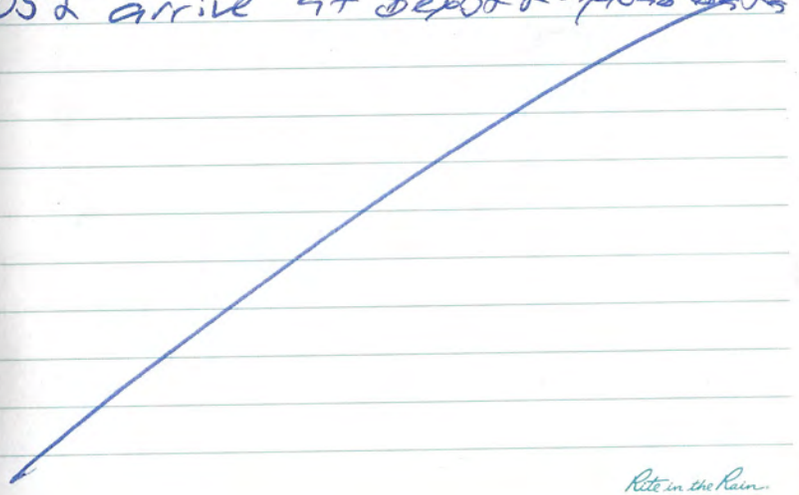
1004 stop logging

1010 ~~return to~~ leave for depot

1037 return to depot, upload data

1115 depart depot

Profiles ft. Pulaski 9/2/20
81°F W 3 mph Sunny LH, SB
0848 depart depot
Sonde B w/ #4
0902 profile #1 (behind Island)
0920 profile #2
0929 profile #3
0938 Profile #4
0946 " #5
0953 " #6
1002 " #7
1010 " #8
1016 " #9
1023 " #10
1029 " #11
1030 Stopped logging
1033 depart LBR
1052 arrive at depot & upload data



Rite in the Rain

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/03/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 93°F Sunny NW 6mph	**Tides: L** – 1626 **H -** 1030	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, 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 (HT, EH) ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

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

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

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 09/03/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 97°F Sunny W 7 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Sam Booth, Lisa Heise		
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: ☒ Yellow Boat – Duration: 1.5 hrs (SB, LH)	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Sam Booth

Signature: Samuel Booth

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

9/3/20

FR to 17 (LBR) OT
89°F Sunny NW 6mph
0933 HT at depot
0958 EH at depot
1049 leave for LFR confluence
EH, HT blade
1126 arrive at N confluence
1130 Start drift B on H3
1407 end drift
1409 recal for depot
1427 return to depot
1436 upload data
1500 leave for day

Rite in the Rain

Drift - Differ ⇒ 4 miles
97°F, Sunny, wind: W 7 mph
1450 LH, SB arrive @ Boat Ramp
1500 depart boat ramp
1508 arrive UR to set up sonde, very high flow
1510 started logging Sonde D (HI)
1606 Stopped logging
1610 departed for GA Power boat ramp
1625 arrived @ boat ramp + pulled out boat
1700 depart Plant Mac

Rite in the Rain.

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/04/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 80°F Partly cloudy W 4 mph	**Tides: L** – 1720 **H -** 1110	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Lisa Heise, Sam Booth, Hayley Torkos, Eric Huss		
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:	2.0 hrs (SB, LH)	
☒ White Boat – Duration:	3.0 hrs (HT, EH)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Sam Booth	**Signature:** Saml Booth

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

14 Profiles 9/4/20

80°F, partly cloudy, W 4 mph
0630 SB, LH arrive @ Depot
0644 depart depot
Sonde A w/ H4
0657 Start logging + Profile #1
0715 Profile #2
0723 " #3
0730 " #4
0736 " #5
0742 " #6
0748 " #7
0754 " #8
0800 " #9
0805 " #10
0809 " #11
0810 stopped logging
0812 depart LBR
0830 arrive @ Depot + upload data
0835 Put gas in black boat
0850 LH, SB depart depot

Profile LFR (IT) → MR 9/4/20

75°F Clear SW 2mph

0700 HT at depot
0730 EH at depot
0740 leave for LFR (white)
*alter profile locations for multiple ships heading out
0747 arrive at LFR (H_3)
0749 profile power line
0758 profile at tug dock
0806 profile the Westin
0813 profile at IT
0820 profile yacht dock
0828 profile industrial park
0832 profiles might not have been logged. EH noticed HH was not logging.
0836 profile LFR plant, down stream of dredge (Active)
0841 H_3 not logging correctly stopped logging.
0849 profile turning basin down river of active dredge
0853 stop logging - cord error Kry Fox cord connection
0900 Profile at LFR/MR
0903 stop logging - connection error

0908 profile MR
0910 end profile
0912 try to find where HH stopped logging between 0747 - 0832 via view data on HH, unable to ID in field - HH not showing data from 9/4/20, will need to check via laptop at depot
0914 leave for depot
0938 return to depot
0948 upload data - profiles from 0749 - 0830 not collected as HH logging wasn't started
0952 retire 33m cable from white boat
1010 leave depot to repeat missing profiles
1014 arrive at LFR
1015 profile (B, H_3) power line
1018 end log; connection issue w/ 33m cord from blackboat maybe connection problem w/ Sonde B
1022 profile tug dock
1029 profile the Westin

Rite in the Rain

9/4/12

HT

~~1036 profile 17 bridge~~

1036 lost connection, stop logging

1039 profile 17 bridge

1046 profile yacht dock

1049 stop logging

1050 leave for depot

1100 arrive at depot

1105 upload data

1125 EH, HT leave depot

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/05/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F Sunny SSE 1mph	**Tides: L** – 1741 **H -** 1132	

Client/Stakeholder Interaction (if any):

Personnel/Visitors on site:

Hayley Torkos, Eric Huss

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:	2.5 hrs (HT, EH)	
☐ White Boat – Duration:		
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- Buoy deployment was not stopped on 8/29/20, buoy data was collected from 8/22/20 to 9/5/20
- LBR_5 was under water upon getting to back river, we were successful in freeing it to bring up to the surface and retrieve data.

Notes:

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

Photos Attached? ☒	**# of Photos** 1

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 1. LBR_5 after first attempt to “Rescue”

8/29/20

Buoy data / Profile LBR 9/15/2015

78°F Clear SSE 1mph

0702 HT at Depot

0710 EH at depot

0730 leave for LBR (Black)

0753 Arrive at LBR-8 Setup for profile + data downloc Start profile hang @ 1m while collecting buoy data

0755 Stop deploy LBR-8 + download

0759 redeploy to place note data had to be transfered from 8/22/20 as Sonde Deployment was not stopped Stop Profile at LBR-8

0801 Start Profile @ LBR-7 hang @ 1m

0806 Stop deploy LBR-7 + download data

0808 redeploy LBR-7

0809 Stop logging @ LBR-7

0813 Start profile @ LBR-6 hang @ 1m

0814 Stop deploy of LBR-6 + download data

0816 redeploy LBR-6

0817 Stop logging @ LBR-6

0821 LBR-5 under water

0827 LBR-5 surfaced ≈ 6 inch Something very heavy is latched onto it, attempt to remove

Rite in the Rain

9/5/20

0832 Freed LBR5 + brought to surface
0833 Start Profile @ LBR-5
0835 Stop deploy of LBR-5 + download download in data from 8/15 →
0838 Redeploy LBR-5
0839 Complet Profile @ LBR-5
0842 Start Profile @ LBR-4 hold @ 1m
0844 Stop deploy of LBR-4 + download
0846 Redeploy LBR-4
0847 Complet Profile @ LBR-4
0850 Start Profile @ LBR-3 + hold @ 1m
0852 Stop deployment of LBR-3 + download
0853 Redeploy LBR-3
0854 Complete Profile @ LBR-3
0858 Start Profile @ LBR-2 + hold @ 1m
0859 Stop deployment of LBR-2 + download
0901 Redeploy LBR-2
0902 complet Profile @ LBR-2
0804 Start Profile @ LBR-1 + hold at 1m
0910 Stop deployment of LBR-1 + download
0911 Redeploy LBR-1
0912 Complet Profile @ LBR-1
Bony data collected on LBR-4
0917 Start Profile at LBR-LFR Continue

9/5/20

Complete Profiles
0937 Start Profile LFR-Between Tug docks + Depot
Complet Profile
0947 Return to depot
0948 Stop deployment, transfer data from 8/22/20 of depot battery dead, will replace
1003 change depot batteries + redeploy
1013 upload data
Change Sonde C batteries
1030 Leave depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/06/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 71°F Cloudy N 7mph	**Tides: L** – 0559 **H -** 1212	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, 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: 2.0 hrs (HT, EH) ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

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

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

18 LFR → Pulaski profile (IT) 9/6/20
71°F Cloudy N 7mph
0703 HT at depot
0715 EH at depot
0741 leave for Ft. Pulaski (black)
0819 arrive at Ft. Pulaski
0823 profile #1
Con Hy Approx every 2.5miles
0834 profile #2
0843 profile #3
0853 profile #4
0907 profile #5
0913 profile #6
0920 profile #7
0932 profile #8 (turning basin)
0933 Raining, leave for airport
0951 return to depot
Gas in boats
1004 upload data
1030 leave depot

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/07/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 73°F Partly Cloudy E 4mph	**Tides: L** – 0635 **H -** 1254	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Eric Huss, Lisa Heise, Katie Smith		
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:	2.5 hrs (KS, LH)	
☒ White Boat – Duration:	2.0 hrs (EH, HT)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes

Notes:

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

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

LFR-MR profile (IT) 9/7/2019
73°F partly cloudy E 4mph
0710 HT at depot
0722 EH at depot
0750 leave depot (white)
0755 arrive at LFR
0756 profile #1
0803 profile #2
0810 profile #3
0817 profile #4
0824 profile #5
0831 profile #6
0840 profile #7
0853 profile #8
*near active dredge
0901 Profile #9
0906 profile #10
0922 profile #11 at USGS at 25
0925 stop logging
0926 leave for depot
0953 arrive at depot
1000 upload data, gas boat
1030 leave depot

Rite in the Rain

9/4/20

HT

~~1036 profile 17 bridge~~

1036 lost connection, stop logging

1039 profile 17 bridge

1046 profile yacht dock

1049 stop logging

1050 leave for depot

1100 arrive at depot

1105 upload data

1125 EH, HT leave depot

KS, LH Profiles 9/7/20

84°F Partly cloudy NE 9 mph

1130 Depart Depot on black Boat

1147 arrive @ Profile 1 Sonde A (H4)

1150 started logging Profile 1

1210 profile 2

1220 profile 3

1228 profile 4 * high boat traffic due to Labor Day

1236 profile 5

1246 profile 6

1258 profile 7

1304 profile 8

1309 profile 9

1315 profile 10

1324 profile 11 + stopped logging

1330 depart LBK for depot

1352 arrived @ depot + uploaded data

1420 leave Depot

Rite in the Rain

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/08/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 72°F Partly Cloudy NNE 5mph	**Tides: L** – 0713 **H –** 1339	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Emily Camargo		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 3.0 hrs (HT, EC) ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

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

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

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 09/08/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 75°F Cloudy SSE 1 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Katie Smith, Lisa Heise		
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:	
☐ White Boat – Duration:	
☒ Yellow Boat – Duration: 4 hrs (KS, LH)	

Work Completed:

- See Field Notes
- Pulled hanging pipe down from diffuser plant due to attachment failure.

Notes:

Daily Log Completed by: Katie Smith	**Signature:** Kathryn Smith

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

Profile and Buoy data 9/8/20

75°F cloudy SSE 1mph

0850 Arrive onsite LH, KS

0915 Launch boat

0925 Retrieve phone from truck for safety -Phone Dead

0930 relaunch and head towards site

0952 Arrive @ Buoy 9 UR_09

-0954 Profile Buoy 9

* batteries = 2.32V - changed

10:00 - stopped deployment

10:04 - Transfer Data (8/30/20)

1007 - start deployment

1012 collect UR_10 data

1012 profile

1014 Transfer data

* changed batteries (2.34V)

1020 start deployment

1023 collect UR_11 data

1023 profile

1028 Transfer data

* change batteries (2.4V)

1034 start deployment

1038 collect buoy data UR_012

1038 profile

1042 transfer UR_12A

↳ batteries @ 2.7V - did not change

1043 start deployment UR_12A

1046 transfer UR_12

↳ changed batteries (2.3V)

1051 start deployment UR_12

1056 collect buoy data UR_13

1056 profile

1103 transfer data

* changed batteries (2.48V)

1108 start deployment

1113 collect Buoy data UR14

1113 profile

1117 Transfer data

* changed batteries (2.33V)

1121 start deployment

1125 collect Buoy data UR_15

1126 profile

1132 transfer data

* changed batteries (2.27V)

1138 start deployment

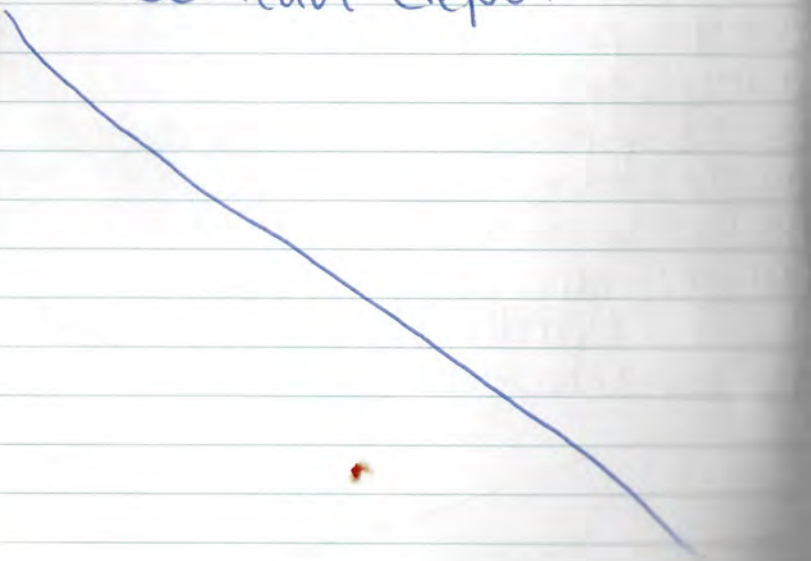
1145 collect Buoy data UR-16

1145 profile

1151 transfer Data UR_16A

1155 start deployment UR-16A
battery @ 2.7 - Did not change
1156 transfer data UR-16
*changed batteries (2.41 V)
1200 start deployment UR-16
1208 collect Buoy data UR-17
1208 protile
1212 transfer Sonde data
* changed batteries (2.3)
1217 Start deployment
1222 collect Buoy data UR-18
1223 protile
1228 Transfer Data
1231 start Deployment
1244 Collect Hardeville Sonde data
1244 transfer data
*Did not change battery (2.48)
1246 start deployment
* sprayed for Wasps / hornets
1248 head back to ramp
1305 pull pipe off Diffuser plant
due to attachment failure
1314 arrive @ ramp and pull boat
1327 upload data + wash boat
1415 Depart

20 lower confluence FR, LBR → 25 9/8/20
72°F partly cloudy NNE 5mph
0653 HT at depot
0711 EC at depot
0730 gas white + black boats
0742 Leave for LFR/LBR confluence
0750 Arrive at confluence + setup
0758 Start logging
Sonde C @ ~0.3m (H3)
0957 stop logging
1001 ~~return~~ leave for depot
1030 return to depot
1038 upload data
1100 HT leave for Sat
EC leave depot



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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/09/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 75°F, Cloudy, N 7 mph	**Tides: L** – 0757 **H –** 1447	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Lisa Heise, Katie Smith, Emily Camargo, Sam Booth		
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:	2.5 (EC, LH)	
☒ White Boat – Duration:	2 (SB, KS)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- Pulled white boat out and cleaned, taken to Hale for engine service

Notes:

Daily Log Completed by: Samuel Booth	**Signature:** Samuel Booth
	Photos Attached? ☐ **# of Photos** ____

Profiles

9/9/2021

75°F, cloudy, NW 7 mph
0710 SB arrive @ Depot
0730 KS, EC arrive @ Depot
0740 LH arrive @ Depot
0810 EC + LH depart to Ft. P
in BB
0825 Profile 1 & started logging
* slowed down for several dolphins
0854 profile 2
0904 profile 3
0913 profile 4
0922 profile 5
0932 profile 6
0940 profile 7 moved pt. to avoid dredge
0948 profile 8
0957 profile 9
1003 profile 10
1009 profile 11
1011 Stopped logging
1015 depart LBK
1035 arrive @ depot + uploaded data
1115 depart depot

Rite in the Rain

LFR Profiles

9/9/20

Rain, 75, ~~W~~ 7 mph
0807 - SB, KS Depart Depot
Sonde A ~/ H4
0835 Profile # 1 (at 25)
0843 Profile # 2
0848 " # 3 (in MR)
0853 " # 4
0900 " # 5
0907 " # 6
0913 " # 7
0919 " # 8
0926 " # 9
0932 " # 10
0938 " # 11
0942 depart to depot
0950 arrive at depot / uploaded data

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/10/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F, Cloudy, NE 2 mph	**Tides: L** – 0848 **H –** 1519	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Katie Smith, Emily Camargo		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 3 hrs ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Dredge pipe located directly above the diffuser blocking access during profiles.

Notes:

Daily Log Completed by: Katie Smith	**Signature:** 

Photos Attached? ☐	**# of Photos** 1

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 1: Dredge pipe located directly above the diffuser, blocking access during profiles.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 09/10/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 77°F; Foggy; N 5 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Sam Booth, Eric Huss		
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:	
☐ White Boat – Duration:	
☒ Yellow Boat – Duration: 2.0 hrs	

Work Completed:

- See Field Notes
- SB hauled Yellow boat to USACE Depot

Notes:

Daily Log Completed by: Sam Booth	**Signature:** 

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

22 MR + Profiles @ Diffuser 9/10/20

78°F NE 2 mph Cloudy

0844 EC, KS arrive @ Depot

0854 Depart Depot in black boat for MR

0922 start logging on sonde A and handheld 4 @ 0.3 m

1059 stop logging

1132 start logging

1133 Profile 1

* Note: Dredge pipe located directly above the diffuser blocking Access

1138 Profile 2

1144 Profile 3

1148 stop logging and return to depot

1210 upload data

1230 Depart Depot

Drift to 4 miles 9/10/20

77°F, fog; NW 5 mph

0740 EH + SB arrive @ Boat ramp

0813 start logging

Sonde H on HH @ 1 meter

sonde 6 would not connect; battery?

0914 stop logging & head back to boat ramp

1000 EH + SB depart

(-18)

Rite in the Rain.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/11/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F, Cloudy, NNE 6 mph	**Tides: L** – 1000 **H –** 1610	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Katie Smith, Emily Camargo, Sam Booth, Eric Huss		
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:	2 hrs (SB, EC)	
☐ White Boat – Duration:	2 hrs (EH, KS)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- Removed yellow boat to take UR during weekend.

Notes:

Daily Log Completed by: Katie Smith	**Signature:** 

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

LFR, LFR/LBR Profiles 9/11/20

79°F NNE 6 MPH

0730 [redacted] arrive at depot

0815 EC & SB depart to LFR/Ft. P
Sonde A w/ H4

0830 start logging

0831 Profile #1

0849 Profile #2

0858 " #3

0906 " #4

0914 " #5

0923 " #6

0930 " #7

0937 " #8

0942 " #9

0947 " #10

0952 " #11; stop logging 0954

0956 depart LBR

1015 arrive @ depot
pulled yellow boat out

1030 conference Teams call w/ Rick M.

1100 rinse yellow boat

1130 leave Depot

Rite in the Rain.

LFR Profile 9/11/20

Foggy 78°F NW 1 mph

0755 KS EH depart Dept

Sonde C H3 Yellow Boat

0805 Profile #1 (Power lines)

0811 Profile #2

0818 Profile #3

0829 Profile #4 (@17)

0835 Profile #5

0842 Profile #6

0855 Profile #7 (LFR D.O. Plant)

0904 Profile #8 (Turney Basin)

0909 Profile #9 (confl w/MK)

0915 Profile #10 (MK)

0944 Profile #11 USGS @25

0950 Stop logging + Depart for depot

1015 arrive @ depot Load

Yellow Boat data Trailer

1030 upload data and participate

in teams meeting

Rite in the Rain.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/12/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 78°F, Sunny, NNE 5 mph	**Tides: L** – 1049 **H –** 1711	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Katie Smith, Sam Booth		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 3 hrs (SB, KS) ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Collected buoy data from LBR and re-deployed

Notes:

Daily Log Completed by: Katie Smith	**Signature:** 

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

LBR Bouys ; KS, SB 9/12/20

78° F Sunny NNES mph

0826 KS, SB arrive @ Depot

0849 depart depot by Blackboat

0906 arrive @ LBR-1

Setup Sonde A @ 1 meter w/ H43 SB

0910 start logging

0913 collect LBR-1 data

0945 collect LBR-2 data

1025 collect LBR-3 data

1018 collect LBR-4 data

1030 " " 5 "

1049 " " 6 "

1105 " " 7 "

1125 " " 8 "

Replaced all sonde batteries

1135 stop logging on Sonde A

1140 depart LBR

1205 arrive @ Depot

1210 upload data and fill black boat with gas

1245 Trailer yellow boat for Driver Site tomorrow

1256 Depart Depot

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 09/13/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 80°F; Mostly Cloudy; NE 7 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any): None		
Personnel/Visitors on site: Sam Booth, Katie Smith		
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: _____ ☒ Yellow Boat – Duration: 1.5 hrs	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Replaced batteries in Hardeeville sonde
- Returned Yellow Boat to UR site from USACE Depot

Notes:

Daily Log Completed by: Sam Booth	**Signature:** Sam Booth

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

UR Buoys 9/13/20

80°F, mostly cloudy, NE 7 mph

0856 SB. KS arrive onsite

0927 launch boat and head to UR Buoys

0940 arrive at Hasbeville sonde + collect data; replace batteries

0957 start logging sonde ~/ 1 @ <1 meter

1000 collect data from UR_18 Cleaned ports on sonde to fix depth reading issue

1008 collect UR_17 data

1013 collect UR_16a & UR16 data

1020 collect UR_15 data

1025 collect UR_14 data

1030 collect UR_13 data

1035 collect UR_12a & UR_12 data

1041 collect UR_11 data

1045 collect UR_10 data

1051 collect UR_9 data

1052 start drift from UR_9 → UR18

1059 stop logging

1100 depart back to Boat Ramp

1117 pull and wash boat

1130 Depart Dan for hotel

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/14/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 76°F, Sunny, NNE 7 mph	**Tides: L** – 1300 **H –** 0650	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Katie Smith, Sam Booth, Ethan Bright, Hayley Torkos		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 2 hrs (SB, KS) 1.5 hrs (EB, HT) ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

Daily Log Completed by: Katie Smith	**Signature:** 

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

LFR LBR Profiles 9/14/2025

~~0~~ 76°F Sunny NNE 7 mph

0755 KS SB arrive onsite, prep ops

Full gas tanks, prep dye for tomorrow

0800 Transfer all remaining dye into one drum and loaded dye trailer for tomorrow cleans up

0945 KS, SB depart for Flaglerm back Sonde A on ff 4

0955 start logging

~~0956 Profile #1~~ issues w/ cond

1002 Profile #1

1017 Profile #2

1025 " #3

1033 " #4

1040 " #5

1048 " #6

1055 " #7

1103 " #8

1108 " #9

1112 " #10

1117 " #11

1119 stop logging

1120 depart LBR

1137 KS, SB arrive @ dept / upload data

1145 EB, HT Arrive onsite

Rite in the Rain

9/14/20

1250 EB, HT leave for LFR
1257 arrive at LFR
Profile Con H_3 (IT)
1302 profile #1 at power line
1307 profile #2 at tug depot
1313 " #3 by westin
1322 " #4 by 17 bridge
1328 " #5 by yacht dry docks
1335 " #6 by paper plant
1340 " #6 by O_2 plant
1347 " #7 in turning basin
1353 " #8 by Dixie Crystals
1357 " #9 in MR
1407 " #10 at USGS gauge Hohlihan bridge
1408 stop logging, return to depot
1435 return to depot
1442 upload data
1500 EB, HT leave

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 09/15/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 77°F Cloudy NE 9mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Hayley Torkos, Sam Booth, Katie Smith, Ethan Bright, 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: _____ ☐ White Boat – Duration: _____ ☒ Yellow Boat – Duration: 3.0 hrs (SB, HT, KS)	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Dye Test:
  - one full ~30-gallon drum and one ~half drum of pure dye (about 45 gallons total) and the remaining half drum of last year's dilution

Notes:

Daily Log Completed by: Hayley Torkos	**Signature:** Hayley Torkos	
	Photos Attached? ☐	**# of Photos** ____

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

Dye Dump upriver

77°F Cloudy NE 9mph

0800 SB, HT, KS arrive onsite

0815 add rhodamine sensors on sonde and prep boat (B+G)

0838 Launch boat

0847 D on H, - profile

0846 G on Hy - drift

*RM & EB at UR plant to input dye

0854 begin dye pump

0855 dye visible

0904 stop pumping dye

0923 profile #1

0943 profile #2

0946 profile #3

~~1~~012 profile #4

1020 profile #5

1049 profile #6

1058 profile #7

1115 profile #8

1116 stop logging profile sonde (D)

1120 stop logging Drift sonde (G)

1123 leave for UR boat ramp

1141 pull yellow boat out

1200 SB, HT leave for Hotel, KS to Jax

Rite in the Rain.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/16/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 72°F, Cloudy, NNE 8 mph	**Tides: L** – 1438 **H –** 0824	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Ethan Bright, Hayley Torkos, Lisa Heise, Rick McCann		
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:	5.5 hrs (SB, EB, RM)	
☒ White Boat – Duration:	3.5 hrs (HT, LH)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes

Notes:

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

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

3 profiles LFR, fast drift LBR 95→25 9/16/2087
72°F Cloudy NNE 8 mph
0916 HT at depot after dropping
RM, EB, SB off UR
0925 LH arrive @ depot from Jax
0950 Put white boat in
0959 LH, HT leave for 25 LFR (wrote)
begin profiles A on #3
1036 Profile 1
1045 Profile 2
1054 Profile 3
1101 started drift
1240 stopped logging
1247 depart LBR for depot
1320 arrive @ depot
1334 upload data
1430 RM leave for Jax
HT, SB, LH, EB leave for hotel

Rite in the Rain.

9/16/20

Long Run Upriver to LFR
EB SB RM 72° NE 7mph rain

0815 leave UR boat ramp
0823 start logging at UR O2 plant
0825 begin motoring ~~to~~ dam river.
1133 pulled Sonde into boat to cruise back to FR, from ~0.5 miles into LBR
1135 Sonde back in water @ LFR
1212 profile
1226 profile @ 25 bridge
1243 profile @ MR
1253 Profile
1300 profile
1310 profile
1330 Profile
1333 Profile
1338 Profile
1341 stopped logging
1346 arrive @ Depot & upload data

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/17/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 82°F, Mostly Cloudy, S 13 mph	**Tides: L** – 1546 **H –** 0930	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Ethan Bright, Hayley Torkos, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 4.0 hrs (HT, EB) ☒ White Boat – Duration: 3.5 hrs (LH, SB) ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes

Notes:

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

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

28 ~~FR 25~~ → LBR profile, LBR - FR drift 9/17/20

82°F mostly cloudy 5 13 mph

0853 EB, HT at depot

0917 SB, CH at depot

0950 EB HT leave for FR 25 (black)

1013 arrive at 25

* A on H4

1019 profile #1

1025 profile #2

1032 profile #3

1039 profile #4

1040 end profile

1041 begin LBR Drift

1254 - 1256 pull sonde out

1323 battery died, stop log, power via the continue logging

1349 stop logging

1410 arrive at depot - pouring rain

1414 upload data, replace batteries in sonde A.

1430 leave depot

Profiles, LFR Ft Pulaski → 25
83°F S 13 mph Cloudy

1000 depart depot
1013 arrive South Channel + setup Sonde C on H3
1018 start logging
1019 Profile #1
1045 Profile #2
1055 " #3
1104 " #4
1112 " #5
1119 " #6
1132 ~~#7~~ stopped logging
1133 restart logging / Profile #7
1140 Profile #8
1147 " #9
1156 " #10
1204 " #11
1213 " #12
1222 ~~#14~~ #13
1223 stop logging
1225 depart Alwyzs for Depot
1320 arrive @ depot + uploaded data

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/18/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 75°F, Cloudy, W 6 mph	**Tides: L** – 1638 **H –** 1020	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Ethan Bright, Hayley Torkos, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 1.5 hrs (HT, SB) ☒ White Boat – Duration: 2.5 hrs (LH, EB) ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- LFR_N not visible in Front River, uncertain if this is due to extreme high tide or if dredge took it out, will investigate further next week.

Notes:

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

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

LFR Profile (IT) 9/18/20

75°F Cloudy W 6mph

0734 HT SB at depot

Gas in both boats, bilged boats

0806 SB, HT depart Depot

0810 start logging; Sonde A ✓ 43

0811 Profile #1

0816 " #2

0823 " #3

0829 " #4

0833 " #5

0838 " #6

0843 " #7

0849 " #8

0854 " #9

0858 " #10

0907 ~~#13~~ #11

0929 Depart Hwy 25 bridge and stop logging

0934 arrive @ Depot

0941 Upload data

1000 SB, HT leave for Jax

Rite in the Rain

Ft Pulaski → LBR Profiles 9/18/20 83
75°F WNW 7 mph Cloudy
EB, LH

0905 departed depot
0920 Arrive @ South Channel profile 1 to set up
0925 started logging
0926 Profile 1
0942 Profile 2
0956 profile 3
1010 Profile 4
1019 Profile 5
1022 Profile 6
1043 Profile 7 moved due to dredge
1052 Profile 8
1059 profile 9
1106 Profile 10
1114 Profile 11 & stopped logging
1120 depart LBR
1145 Arrive @ depot & uploaded data
1205 departed depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/19/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 71°F, Cloudy, NNE 10 mph	**Tides: L** – 1730 **H –** 1110	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Lisa Heise		
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 (EB, LH) ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	
Work Completed: - See Field Notes		
Notes:		
Daily Log Completed by: Lisa Heise	**Signature:** Lisa Heise	
	Photos Attached? ☐	**# of Photos** ____

30 LBR buoys + profiles 9/19/20
71°F cloudy NNE 10
EB, LH

0700 arrive @ depot
0720 depart depot
0730 arrive at LBR 1
0734 start logging drift sonde
0735 collect buoy data from LBR 1
0742 " " LBR 2
0749 " " LBR 3
0757 " " LBR 4
0804 " " LBR 5
0810 " " LBR 6
0816 " " LBR 7
0821 " " LBR 8
change batteries, it was 2.3 v
0831 stop logging drift sonde
0839 start logging profile
0840 profile at USGS platform at Hog Island
0843 " near LBR 8
0854 " " LBR 1
0900 " near USI7 USGS platform
0910 " ~~near~~ FR near LBR mouth
0913 stop logging return to depot
0925 arrive @ depot + uploaded data
collected depot datasonde
1015 depart depot

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log – Upper River

Date: 09/20/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 65°F Cloudy NNE 15 mph	**Tides:** Not Applicable	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Lisa Heise		
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:	
☐ White Boat – Duration:	
☒ Yellow Boat – Duration: 2.5 hrs (EB, LH)	

Work Completed:

- See Field Notes

Notes:

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

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

20

Buoys + drift EB, LH - 9/20/20 27

65°F Cloudy NNE 15 mph

0845 arrive @ GA Power boat ramp

0858 put yellow boat in

0905 depart boat ramp for UR 18

0915 arrive @ UR 18 to collect buoy data + set up drift sonde - Sonde D (H4) 1 m

0916 Started logging drift sonde

0917 collected UR-18 buoy data 090620-092120 2 files

0931 " UR-17 090820-092120 1 file

0938 " UR-16 + 16a 1043 profile

~~0939~~ 090820-092120 1 file

0946 " UR-15 090820-092120 1 file

0950 " UR-14

~~0955~~ 090820-092120 1 file

0956 " UR 13 090820-092120

0959 " UR 12 + 12a 1040 Profile 0908

1008 " UR 11 tied new rope to replace Metal wire

1020 " UR 10 090820-092120

1025 " UR 9 changed batteries (2.27) 090820-092120

1102 " Hardeeville 091320-092120 Stopped logging

1125 arrive @ GA Power boat ramp + upload data

1215 depart GA Power

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/21/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 69°F, Sunny, NE 14 mph	**Tides: L** – 0635 **H –** 1302	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Ethan Bright, Hayley Torkos, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 2.0 hrs (HT, EB) ☒ White Boat – Duration: 2.5 hrs (LH, SB) ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- LFR_N Visible – very high tide, maybe 6 inches below the surface

Notes:

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

Photos Attached? ☒	**# of Photos** 1

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 1. LFR_N barely visible in LFR

LFR profile (IT) 9/21/20 31
69 Sunny NE 14 mph
1113 SB, #T at depot from Jax
1130 EB, LH at depot
1236 EB, #7 leave for LFR/Beach
1241 arrive at LFR
1245 profile #1
1254 profile #2
1300 profile #3
1309 profile #4
1317 profile #5
* profiles behind tug + cargo ship kicking up a lot
1324 profile #6
LFR_N still not visible - very high tide right now
1331 saw LFR_N = 6in below water
1338 profile #7
1342 profile #8
1353 profile #9
1403 profile #10
1406 stop logging, C on H3
1408 leave for depot
1441 arrive at depot
1451 upload data
1500 leave depot

Rite in the Rain

84 Profiles 9/21/

1200 depart Depot; SB & LH; while boat
1231 start logging Profile #1
1239 Profile #2
1247 " #3
1255 " #4
1302 " #5
1312 " #6
1318 " #7
1327 " #8
1329 " #9
1335 " #10
1347 " #11
1349 stop logging
1350 depart LBR
1410 arrive @ Depot & upload data

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/22/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 58°F, Sunny, NNE 6 mph	**Tides: L** – 0730 **H –** 1400	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Ethan Bright, Hayley Torkos, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 2.0 hrs (HT, EB) ☒ White Boat – Duration: 2.5 hrs (LH, SB) ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- LFR_N not visible at low tide – could not find

Notes:

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

Photos Attached? ☒	**# of Photos** 1

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 1. LFR_N Not visible

32 LFR Profile 9/22/20

58°F Sunny NNE 6 mph

0726 SB, LH, HT, EB at depot

0754 leave depot

0805 start logging C on H3

0806 profile #1 by power line

0813 " #2 by depot

0820 " #3 by rr bridge

0826 " #4 by yacht basin

0831 " #5 by paper plant

0839 " #6 by O2 plant

0845 investigate LFR_N at low tide, not visible today, unable to locate buoy

0850 profile #7 by turning basin dredge moving ~100 yds S

0856 profile #8 by dixie crystals

0905 " #9 by USGS 25

0917 " #10

0918 stop logging, return to depot

0947 return to depot

1000 upload data

1015 call w/ RM for planning

1205 leave depot (ALL)

Profiles Ft. Pulaski 9/22/20

SB, LH 66°F Sunny NE 10 mph

0755 depart Depot

0832 start logging Sonde A 44

0853 Profile #1

0840 Profile #2

0848 " #3

0858 " #4

0906 " #5

0915 " #6

0920 " #7

0925 " #8

0952 " #9

0939 " #10

0950 " #11

0953 stop logging / depart CBR

1020 arrive @ Depot + upload data

Rite in the Rain.

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/23/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 61°F, Partly Cloudy, SSW 1 mph	**Tides: L** – 0822 **H –** 1505	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Ethan Bright, Hayley Torkos, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 2.0 hrs (HT, EB) ☒ White Boat – Duration: 2.5 hrs (LH, SB) ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- No sign of LFR_N at low tide

Notes:

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

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

LFR Profile (LT) 9/23/88

61°F Light fog SSW 1mph

0758 SB, HT at depot

0808 EB, LH at depot

0823 EB, HT leave FOR LFR (White)

0835 start logging A on H3

0836 profile #1 at powerline

0844 " #2 at depot

0850 " #3 at I7 bridge

0856 " #4 by yacht basin

0902 " #5 by paper plant

0907 " #6 by OZ plant - NO LFR N

SB profile #7, ship in turning basin

0917 profile #8 by Dixie Crystals

0926 " #9 by USGS

0934 " #10

0951 " #7 in turning basin

0953 stop logging return to depot

1012 arrive at depot

1018 upload data, put gas in white boat

1100 EB leave for Jax

SB, HT, LH leave depot

Rite in the Rain

Ft. Pulaski Profiles 9/23/20

SB + LH Sonde C w/ H4

0810 depart depot in Blue's Boat

0857 Start logging

0858 Profile #1

0906 " #2

0914 " #3

0923 " #4

0931 " #5

0939 " #6

0945 " #7

0951 " #8

0958 " #9

1004 " #10

1013 " #11

1016 Stop logging / depart LBR

1042 arrive @ Depot + upload data

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/24/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 70°F, Partly Cloudy, NNE 3 mph	**Tides: L** – 0923 **H –** 1605	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Sam Booth, Katie Smith, Hayley Torkos, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 4.0 hrs (LH, SB) ☒ White Boat – Duration: 3.0 hrs (KS, HT) ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- LFR_N barely visible at low tide

Notes:

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

Photos Attached? ☒	**# of Photos** 1

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 1. LFR_N barely at the surface (LT)

(54) MR fast drift, LFR Profile 9/24/20
70°F Partly Cloudy NNE 3mph
0900 SB, LH, HT at depot
0941 KS at depot
0951 KS, HT leave for LFR (white)
0955 start logging A on H_3
0956 profile #1
1006 profile #2
1016 LFR_N barely visible at LT water surface.
1017 profile #3
1023 profile #4
1027 stop logging
1032 start MR drift ≈ .3m
1158 end drift
1200 leave for depot
1243 arrive at depot
1252 upload data
1400 SB leave for Jax with dye trailor
1405 LH, KS, HT leave depot

LBR Drift 9/24/20

SB + LH Sonde C w/ H4 Black Boat

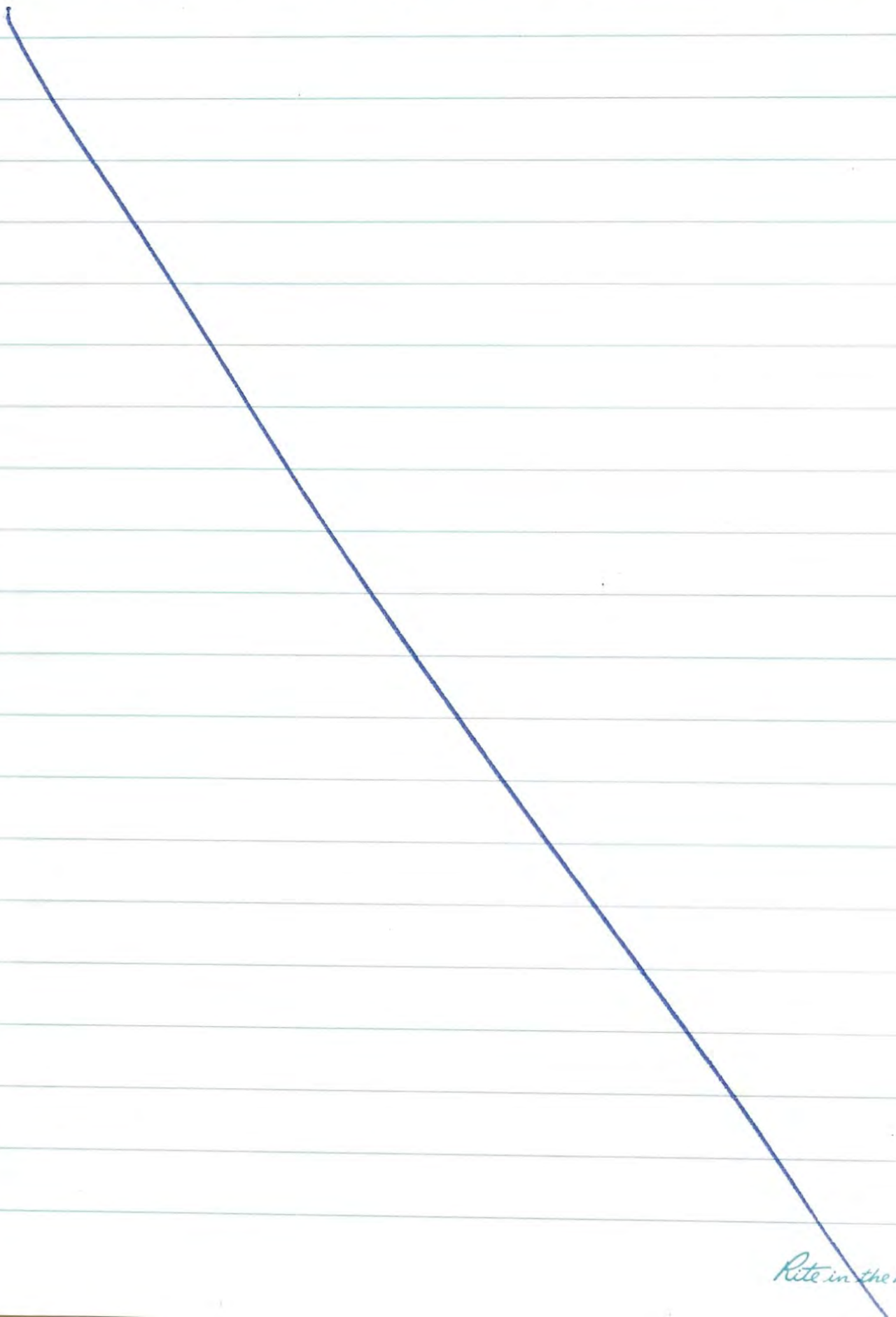
0935 depart Depot

0949 start logging

1312 stop logging

1315 depart LBR

1349 arrive @ Depot + upload data



Rite in the Rain

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/25/2020	**Task:** 9B – Start-Up Run	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 76°F, Mostly Cloudy, SSE 4 mph	**Tides: L** – 1030 **H –** 1705	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Katie Smith, Hayley Torkos, Lisa Heise		
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 (LH, KS, HT) ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- LFR_N not visible at mid-low tide

Notes:

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

Photos Attached? ☒ **# of Photos** 1

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log



Photo 1. LFR_N not visible at mid-low tide

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/28/2020	**Task:** 11a/b – Equipment Decommission and Closeout	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 74°F, Rainy, SE 4 mph	**Tides: L** – 0653 **H –** 1309	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Sam Booth, Hayley Torkos, Lisa Heise		
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:	3.5 hrs (LH, EB)	
☒ White Boat – Duration:	1.5 hrs (SB, HT)	
☐ Yellow Boat – Duration:		

Work Completed:

- See Field Notes
- All LBR Buoys removed from river
- Final week of LBR buoy data uploaded

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

9/28/20

Break Down

74°F, Rainy, SE 4mph

1000 SB + LH arrive @ Depot

1010 EB + HT arrive @ Depot

1115 EB LH leave for LBR (black)

1137 SB HT leave for LBR (white)

1161 arrive at LBR to retrieve Sondes & buoys

1203 retrieve Sonde 18 from LBR-2

1206 retrieve Sonde 19 from LBR-3

1211 " 20 from LBR-4

1216 " 21 from LBR-5

1221 " 22 from LBR-6

1226 " 23 from LBR-7

1230 " 24 from LBR-8

1307 arrive @ Depot

1314 retrieve Sonde from depot (2

1353 upload data

1412 Calibrate depth LBR buoy Sond

1625 leave depot

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Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log - Lower River

Date: 09/29/2020	**Task:** 11a/b – Equipment Decommission and Closeout	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 74°F, Cloudy, W 4 mph	**Tides: L** – 0653 **H –** 1309	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Sam Booth, Hayley Torkos, Lisa Heise		
Have all on-site personnel and all visitors reviewed and signed the Health and Safety Plan today? ☒		
Boat(s) Used: ☒ Black Boat – Duration: 4.0 hrs (LH, EB, SB) ☐ White Boat – Duration: ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Calibration of LBR Sondes

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

Calibration Report

Last Calibration Time: 8/18/2020 3:13:04 PM

Calibration Start Time: 9/30/2020 4:55:37 PM

Calibration End Time: 9/30/2020 4:56:17 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100749

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100560

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.10

DO (mg/L): 9.07 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.5 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.273 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 12:13:19 PM

Calibration Start Time: 9/30/2020 4:55:37 PM

Calibration End Time: 9/30/2020 4:56:17 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101461

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102909

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.00

DO (mg/L): 9.05 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.3 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.273 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 10:52:41 AM

Calibration Start Time: 9/30/2020 4:55:37 PM

Calibration End Time: 9/30/2020 4:56:17 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100737

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100559

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.07

DO (mg/L): 9.06 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.3 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.273 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 12:58:41 PM

Calibration Start Time: 9/30/2020 4:49:28 PM

Calibration End Time: 9/30/2020 4:54:33 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101475

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102908

DO Cap Replacement Date: 11/21/2017

DO Gain: 0.98

DO (mg/L): 9.05 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.8 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.111 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 12:58:41 PM

Calibration Start Time: 9/30/2020 4:49:28 PM

Calibration End Time: 9/30/2020 4:54:33 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101847

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100599

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.05

DO (mg/L): 9.06 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.3 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.185 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 12:13:19 PM

Calibration Start Time: 9/30/2020 4:49:28 PM

Calibration End Time: 9/30/2020 4:54:33 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101455

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102874

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.02

DO (mg/L): 9.07 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.9 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 20.227 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 12:13:19 PM

Calibration Start Time: 9/30/2020 4:21:07 PM

Calibration End Time: 9/30/2020 4:28:28 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101849

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100601

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.03

DO (mg/L): 8.77 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.7 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.302 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 12:29:25 PM

Calibration Start Time: 9/30/2020 4:21:07 PM

Calibration End Time: 9/30/2020 4:28:28 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101855

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100624

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.09

DO (mg/L): 8.80 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.1 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.402 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 12:13:19 PM

Calibration Start Time: 9/30/2020 4:21:07 PM

Calibration End Time: 9/30/2020 4:28:28 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101860

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100629

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.16

DO (mg/L): 8.79 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.7 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.425 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 12:58:41 PM

Calibration Start Time: 9/30/2020 4:21:07 PM

Calibration End Time: 9/30/2020 4:28:28 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101859

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100628

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.01

DO (mg/L): 8.81 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.0 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.545 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 12:13:19 PM

Calibration Start Time: 9/30/2020 4:21:07 PM

Calibration End Time: 9/30/2020 4:28:28 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101465

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102890

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.00

DO (mg/L): 8.81 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.1 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.610 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 1:50:15 PM

Calibration Start Time: 9/29/2020 12:01:34 PM

Calibration End Time: 9/29/2020 12:01:59 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101472

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102903

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.04

DO (mg/L): 8.58 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.4 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.009 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 12:29:25 PM

Calibration Start Time: 9/29/2020 12:01:34 PM

Calibration End Time: 9/29/2020 12:01:59 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100742

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100556

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.03

DO (mg/L): 8.58 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.2 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.010 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 12:29:25 PM

Calibration Start Time: 9/29/2020 12:01:34 PM

Calibration End Time: 9/29/2020 12:01:59 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101848

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100600

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.10

DO (mg/L): 8.58 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.8 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.012 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 1:50:15 PM

Calibration Start Time: 9/29/2020 12:01:34 PM

Calibration End Time: 9/29/2020 12:01:59 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100744

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104233

DO Cap Replacement Date: 7/21/2017

DO Gain: 1.04

DO (mg/L): 8.58 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.3 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.014 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 12:29:25 PM

Calibration Start Time: 9/29/2020 12:01:34 PM

Calibration End Time: 9/29/2020 12:01:59 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101846

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100596

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.06

DO (mg/L): 8.57 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.8 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 23.015 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 760.0 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 1:50:15 PM

Calibration Start Time: 9/29/2020 12:19:14 PM

Calibration End Time: 9/29/2020 12:24:16 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100750

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100562

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.05

DO (mg/L): 8.58 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.5 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.550 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.0 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 1:50:15 PM

Calibration Start Time: 9/29/2020 12:19:14 PM

Calibration End Time: 9/29/2020 12:24:16 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101858

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100627

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.09

DO (mg/L): 8.57 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.5 % Sat

Post Calibration Value: 99.6 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.555 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.0 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 1:50:15 PM

Calibration Start Time: 9/29/2020 12:19:14 PM

Calibration End Time: 9/29/2020 12:24:16 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100752

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100588

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.14

DO (mg/L): 8.57 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.5 % Sat

Post Calibration Value: 99.6 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.655 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.0 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 12:29:25 PM

Calibration Start Time: 9/29/2020 12:19:14 PM

Calibration End Time: 9/29/2020 12:24:16 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101856

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100625

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.09

DO (mg/L): 8.59 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.1 % Sat

Post Calibration Value: 99.6 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.736 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.0 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 11:19:41 AM

Calibration Start Time: 9/29/2020 10:46:41 AM

Calibration End Time: 9/29/2020 10:53:37 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101851

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100606

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.08

DO (mg/L): 8.60 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.1 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.681 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.5 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 11:19:41 AM

Calibration Start Time: 9/29/2020 10:46:41 AM

Calibration End Time: 9/29/2020 10:53:37 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101857

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100626

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.07

DO (mg/L): 8.59 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.8 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.690 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.5 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 11:19:41 AM

Calibration Start Time: 9/29/2020 10:46:41 AM

Calibration End Time: 9/29/2020 10:53:37 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101463

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K101906

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.12

DO (mg/L): 8.59 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.1 % Sat

Post Calibration Value: 99.5 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.692 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.5 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 11:19:41 AM

Calibration Start Time: 9/29/2020 10:46:41 AM

Calibration End Time: 9/29/2020 10:53:37 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101468

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102894

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.12

DO (mg/L): 8.59 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.6 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.691 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.5 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 11:19:41 AM

Calibration Start Time: 9/29/2020 10:46:41 AM

Calibration End Time: 9/29/2020 10:53:37 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100736

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104237

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.02

DO (mg/L): 8.59 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.4 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.691 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.5 mmHg

Calibration Report

Last Calibration Time: 7/19/2020 8:57:07 AM

Calibration Start Time: 9/29/2020 10:03:28 AM

Calibration End Time: 9/29/2020 10:11:02 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101466

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102892

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.07

DO (mg/L): 8.53 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 100.1 % Sat

Post Calibration Value: 99.6 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.777 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.7 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 3:27:55 PM

Calibration Start Time: 9/29/2020 10:03:28 AM

Calibration End Time: 9/29/2020 10:11:02 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100748

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17F104238

DO Cap Replacement Date: 7/21/2017

DO Gain: 0.99

DO (mg/L): 8.54 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.2 % Sat

Post Calibration Value: 99.8 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.832 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.7 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 4:40:50 PM

Calibration Start Time: 9/29/2020 10:03:28 AM

Calibration End Time: 9/29/2020 10:11:02 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101464

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102889

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.07

DO (mg/L): 8.54 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 101.2 % Sat

Post Calibration Value: 99.6 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.925 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.7 mmHg

Calibration Report

Last Calibration Time: 7/19/2020 8:57:07 AM

Calibration Start Time: 9/29/2020 10:03:28 AM

Calibration End Time: 9/29/2020 10:11:02 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101458

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102877

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.12

DO (mg/L): 8.55 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.3 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.992 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.7 mmHg

Calibration Report

Last Calibration Time: 7/14/2020 2:09:51 PM

Calibration Start Time: 9/29/2020 10:03:28 AM

Calibration End Time: 9/29/2020 10:11:02 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100751

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100563

DO Cap Replacement Date: 7/23/2017

DO Gain: 1.03

DO (mg/L): 8.54 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 102.2 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.997 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.7 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 10:52:41 AM

Calibration Start Time: 9/30/2020 4:03:07 PM

Calibration End Time: 9/30/2020 4:08:31 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101850

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100602

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.04

DO (mg/L): 8.79 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.1 % Sat

Post Calibration Value: 100.0 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.927 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 10:52:41 AM

Calibration Start Time: 9/30/2020 4:03:07 PM

Calibration End Time: 9/30/2020 4:08:31 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101854

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100608

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.08

DO (mg/L): 8.78 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.0 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.930 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 12:58:41 PM

Calibration Start Time: 9/30/2020 4:03:07 PM

Calibration End Time: 9/30/2020 4:08:31 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101457

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102888

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.05

DO (mg/L): 8.78 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.8 % Sat

Post Calibration Value: 100.1 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.933 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 12:58:41 PM

Calibration Start Time: 9/30/2020 4:03:07 PM

Calibration End Time: 9/30/2020 4:08:31 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101459

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102872

DO Cap Replacement Date: 11/16/2017

DO Gain: 1.01

DO (mg/L): 8.78 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.9 % Sat

Post Calibration Value: 99.9 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.939 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 10:52:41 AM

Calibration Start Time: 9/30/2020 4:03:07 PM

Calibration End Time: 9/30/2020 4:08:31 PM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101852

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100603

DO Cap Replacement Date: 7/24/2017

DO Gain: 1.08

DO (mg/L): 8.77 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.6 % Sat

Post Calibration Value: 100.2 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 21.938 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 761.1 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 3:13:04 PM

Calibration Start Time: 9/29/2020 10:13:50 AM

Calibration End Time: 9/29/2020 10:17:44 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17L101469

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17K102897

DO Cap Replacement Date: 11/21/2017

DO Gain: 1.03

DO (mg/L): 8.60 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 98.4 % Sat

Post Calibration Value: 99.6 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.748 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.8 mmHg

Calibration Report

Last Calibration Time: 8/19/2020 10:52:41 AM

Calibration Start Time: 9/29/2020 10:13:50 AM

Calibration End Time: 9/29/2020 10:17:44 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G101862

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100631

DO Cap Replacement Date: 7/26/2017

DO Gain: 1.09

DO (mg/L): 8.59 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 107.1 % Sat

Post Calibration Value: 99.6 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.766 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.7 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 3:13:04 PM

Calibration Start Time: 9/29/2020 10:13:50 AM

Calibration End Time: 9/29/2020 10:17:44 AM

Parameter: DO (% Sat)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: DO

Serial Number: 17G100739

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

DO Cap Serial Number: 17G100552

DO Cap Replacement Date: 7/20/2017

DO Gain: 1.11

DO (mg/L): 8.59 mg/L

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 99.5 % Sat

Post Calibration Value: 99.7 % Sat

Raw Calibration Value: 0.0 % Sat

Temperature: 22.791 °C

Standard Value: 100.0 % Sat

Is Stable: True

Barometer: 757.7 mmHg

Calibration Report

Last Calibration Time: 8/18/2020 1:22:38 PM

Calibration Start Time: 9/29/2020 11:45:31 AM

Calibration End Time: 9/29/2020 11:46:10 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101758

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10040.7 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.840 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 12:03:07 PM

Calibration Start Time: 9/29/2020 11:45:31 AM

Calibration End Time: 9/29/2020 11:46:10 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100172

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9782.5 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.839 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 12:03:07 PM

Calibration Start Time: 9/29/2020 11:45:31 AM

Calibration End Time: 9/29/2020 11:46:10 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100176

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10014.0 µS/cm

Post Calibration Value: 9999.8 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.837 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 1:22:38 PM

Calibration Start Time: 9/29/2020 11:45:31 AM

Calibration End Time: 9/29/2020 11:46:10 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101761

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10146.1 µS/cm

Post Calibration Value: 9999.9 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.836 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 12:03:07 PM

Calibration Start Time: 9/29/2020 11:45:31 AM

Calibration End Time: 9/29/2020 11:46:10 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100169

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 9976.6 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.835 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 1:22:38 PM

Calibration Start Time: 9/29/2020 12:04:27 PM

Calibration End Time: 9/29/2020 12:04:50 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104024

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10189.7 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.924 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 1:22:38 PM

Calibration Start Time: 9/29/2020 12:04:27 PM

Calibration End Time: 9/29/2020 12:04:50 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100173

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10128.3 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.924 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 1:22:38 PM

Calibration Start Time: 9/29/2020 12:04:27 PM

Calibration End Time: 9/29/2020 12:04:50 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100181

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10174.4 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.925 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 12:03:07 PM

Calibration Start Time: 9/29/2020 12:04:27 PM

Calibration End Time: 9/29/2020 12:04:50 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100164

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10335.5 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.925 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 10:54:42 AM

Calibration Start Time: 9/29/2020 10:25:03 AM

Calibration End Time: 9/29/2020 10:30:20 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103295

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.14

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10233.7 µS/cm

Post Calibration Value: 9999.9 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.990 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 10:54:42 AM

Calibration Start Time: 9/29/2020 10:25:03 AM

Calibration End Time: 9/29/2020 10:30:20 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104073

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.17

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10209.1 µS/cm

Post Calibration Value: 10000.1 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.982 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 10:54:42 AM

Calibration Start Time: 9/29/2020 10:25:03 AM

Calibration End Time: 9/29/2020 10:30:20 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104076

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.13

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10197.8 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.979 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 10:54:42 AM

Calibration Start Time: 9/29/2020 10:25:03 AM

Calibration End Time: 9/29/2020 10:30:20 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103298

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.19

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10193.1 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.974 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 10:54:42 AM

Calibration Start Time: 9/29/2020 10:25:03 AM

Calibration End Time: 9/29/2020 10:30:20 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104074

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.14

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 10181.7 µS/cm

Post Calibration Value: 10000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 22.974 °C

Standard Value: 10000.0 µS/cm

Type: YSI 3168 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20C100477

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 10:26:49 AM

Calibration Start Time: 9/30/2020 4:36:06 PM

Calibration End Time: 9/30/2020 4:38:30 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100180

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.4 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.183 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:07:45 AM

Calibration Start Time: 9/30/2020 4:36:06 PM

Calibration End Time: 9/30/2020 4:38:30 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100175

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.5 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.183 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:48:55 PM

Calibration Start Time: 9/30/2020 4:36:06 PM

Calibration End Time: 9/30/2020 4:38:30 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100179

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1000.0 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.184 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:07:45 AM

Calibration Start Time: 9/30/2020 4:31:28 PM

Calibration End Time: 9/30/2020 4:33:49 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100182

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1000.9 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.311 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 12:27:12 PM

Calibration Start Time: 9/30/2020 4:31:28 PM

Calibration End Time: 9/30/2020 4:33:49 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100178

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.311 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 12:27:12 PM

Calibration Start Time: 9/30/2020 4:31:28 PM

Calibration End Time: 9/30/2020 4:33:49 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100183

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.308 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:07:45 AM

Calibration Start Time: 9/30/2020 3:56:58 PM

Calibration End Time: 9/30/2020 4:01:42 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100177

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.5 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.343 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:48:55 PM

Calibration Start Time: 9/30/2020 3:56:58 PM

Calibration End Time: 9/30/2020 4:01:42 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104023

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.7 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.345 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:48:55 PM

Calibration Start Time: 9/30/2020 3:56:58 PM

Calibration End Time: 9/30/2020 4:01:42 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101752

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 993.8 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.349 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 12:27:12 PM

Calibration Start Time: 9/30/2020 3:56:58 PM

Calibration End Time: 9/30/2020 4:01:42 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104031

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.1 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.353 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:07:45 AM

Calibration Start Time: 9/30/2020 3:56:58 PM

Calibration End Time: 9/30/2020 4:01:42 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100167

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.4 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.359 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 10:26:49 AM

Calibration Start Time: 9/29/2020 9:45:06 AM

Calibration End Time: 9/29/2020 9:50:26 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104022

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.4 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.179 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:48:55 PM

Calibration Start Time: 9/29/2020 9:45:06 AM

Calibration End Time: 9/29/2020 9:50:26 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103296

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.16

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1003.5 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.203 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:48:55 PM

Calibration Start Time: 9/29/2020 9:45:06 AM

Calibration End Time: 9/29/2020 9:50:26 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17G101753

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 997.5 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.215 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:07:45 AM

Calibration Start Time: 9/29/2020 9:45:06 AM

Calibration End Time: 9/29/2020 9:50:26 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100170

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 1000.4 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.222 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 6/23/2020 10:53:03 AM

Calibration Start Time: 9/29/2020 9:45:06 AM

Calibration End Time: 9/29/2020 9:50:26 AM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F103297

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.19

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 997.8 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 23.225 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 10:26:49 AM

Calibration Start Time: 9/30/2020 3:37:33 PM

Calibration End Time: 9/30/2020 3:43:03 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104025

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.3 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.922 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 10:26:49 AM

Calibration Start Time: 9/30/2020 3:37:33 PM

Calibration End Time: 9/30/2020 3:43:03 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Conductivity

Serial Number: 17F104075

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 5.19

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.5 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.922 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 12:27:12 PM

Calibration Start Time: 9/30/2020 3:37:33 PM

Calibration End Time: 9/30/2020 3:43:03 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17F104021

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.0 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.914 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 10:26:49 AM

Calibration Start Time: 9/30/2020 3:37:33 PM

Calibration End Time: 9/30/2020 3:43:03 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100166

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 999.2 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.920 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 12:27:12 PM

Calibration Start Time: 9/30/2020 3:37:33 PM

Calibration End Time: 9/30/2020 3:43:03 PM

Parameter: Sp Cond (µS/cm)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Wiped Conductivity And Temperature

Serial Number: 17L100168

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Sensor Specific

Cell Constant: 0.47

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 998.1 µS/cm

Post Calibration Value: 1000.0 µS/cm

Raw Calibration Value: 0.0 µS/cm

Temperature: 20.923 °C

Standard Value: 1000.0 µS/cm

Type: YSI 3167 Conductivity Calibrator

Manufacturer: YSI

Lot Number: 20D100332

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:01:41 PM

Calibration Start Time: 9/29/2020 12:31:30 PM

Calibration End Time: 9/29/2020 12:38:45 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105663

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.02 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.748 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 11:33:05 AM

Calibration Start Time: 9/29/2020 12:31:30 PM

Calibration End Time: 9/29/2020 12:38:45 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105657

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.02 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.750 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 11:33:05 AM

Calibration Start Time: 9/29/2020 12:31:30 PM

Calibration End Time: 9/29/2020 12:38:45 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105658

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.759 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:01:41 PM

Calibration Start Time: 9/29/2020 12:31:30 PM

Calibration End Time: 9/29/2020 12:38:45 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105654

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.770 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:36:45 AM

Calibration Start Time: 9/30/2020 5:04:07 PM

Calibration End Time: 9/30/2020 5:10:10 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105664

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.08 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 20.722 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:36:45 AM

Calibration Start Time: 9/30/2020 5:04:07 PM

Calibration End Time: 9/30/2020 5:10:10 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102815

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 20.716 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:36:45 AM

Calibration Start Time: 9/30/2020 5:04:07 PM

Calibration End Time: 9/30/2020 5:10:10 PM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105653

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 20.728 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:36:45 AM

Calibration Start Time: 9/29/2020 11:18:05 AM

Calibration End Time: 9/29/2020 11:37:07 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102814

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.13 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 22.908 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:01:41 PM

Calibration Start Time: 9/29/2020 11:18:05 AM

Calibration End Time: 9/29/2020 11:37:07 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed With Warnings

Technician: Hayley Torkos

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: 23.035 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: False

Calibration Report

Last Calibration Time: 8/18/2020 11:33:05 AM

Calibration Start Time: 9/29/2020 11:18:05 AM

Calibration End Time: 9/29/2020 11:37:07 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105656

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.976 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 11:33:05 AM

Calibration Start Time: 9/29/2020 11:18:05 AM

Calibration End Time: 9/29/2020 11:37:07 AM

Parameter: Chlorophyll (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105655

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.984 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:07:17 PM

Calibration Start Time: 9/29/2020 12:39:30 PM

Calibration End Time: 9/29/2020 12:43:23 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105663

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.772 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 11:39:10 AM

Calibration Start Time: 9/29/2020 12:39:30 PM

Calibration End Time: 9/29/2020 12:43:23 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105657

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.775 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 11:39:10 AM

Calibration Start Time: 9/29/2020 12:39:30 PM

Calibration End Time: 9/29/2020 12:43:23 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105658

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.779 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:07:17 PM

Calibration Start Time: 9/29/2020 12:39:30 PM

Calibration End Time: 9/29/2020 12:43:23 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105654

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 22.783 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:51:16 AM

Calibration Start Time: 9/30/2020 5:10:50 PM

Calibration End Time: 9/30/2020 5:12:37 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105664

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 20.739 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:51:16 AM

Calibration Start Time: 9/30/2020 5:10:50 PM

Calibration End Time: 9/30/2020 5:12:37 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102815

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -1.69 RFU

Post Calibration Value: 0.01 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 20.742 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:51:16 AM

Calibration Start Time: 9/30/2020 5:10:50 PM

Calibration End Time: 9/30/2020 5:12:37 PM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105653

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 20.757 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 11:51:16 AM

Calibration Start Time: 9/29/2020 11:37:59 AM

Calibration End Time: 9/29/2020 11:43:56 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F102814

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.36 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 23.050 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:07:17 PM

Calibration Start Time: 9/29/2020 11:37:59 AM

Calibration End Time: 9/29/2020 11:43:56 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105662

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.75 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 23.070 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 11:39:10 AM

Calibration Start Time: 9/29/2020 11:37:59 AM

Calibration End Time: 9/29/2020 11:43:56 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105656

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

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: 23.081 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 11:39:10 AM

Calibration Start Time: 9/29/2020 11:37:59 AM

Calibration End Time: 9/29/2020 11:43:56 AM

Parameter: Phycoerythrin (RFU)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: TAL-PE

Serial Number: 17F105655

Firmware Version: 3.0.5

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.26 RFU

Post Calibration Value: 0.00 RFU

Raw Calibration Value: 0.00 RFU

Temperature: 23.092 °C

Standard Value: 0.00 RFU

Type: Distilled Water

Manufacturer: Crystal Springs

Lot Number: 14920

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 1:12:22 PM

Calibration Start Time: 9/30/2020 3:11:12 PM

Calibration End Time: 9/30/2020 3:12:11 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101989

Serial Number: 17G101989

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104624

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.014 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.490 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 1:10:39 PM

Calibration Start Time: 9/30/2020 3:10:00 PM

Calibration End Time: 9/30/2020 3:10:15 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101992

Serial Number: 17G101992

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104628

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.147 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.676 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 1:07:44 PM

Calibration Start Time: 9/30/2020 3:13:28 PM

Calibration End Time: 9/30/2020 3:13:41 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102930

Serial Number: 17L102930

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104910

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.032 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.952 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 12:37:43 PM

Calibration Start Time: 9/30/2020 2:55:49 PM

Calibration End Time: 9/30/2020 2:56:23 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102013

Serial Number: 17G102013

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104614

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.049 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.209 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 12:49:51 PM

Calibration Start Time: 9/28/2020 3:07:25 PM

Calibration End Time: 9/28/2020 3:07:36 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102004

Serial Number: 17G102004

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104608

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.016 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.599 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 12:39:51 PM

Calibration Start Time: 9/30/2020 3:14:52 PM

Calibration End Time: 9/30/2020 3:15:26 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101996

Serial Number: 17G101996

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104630

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.027 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 21.022 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 1:24:31 PM

Calibration Start Time: 9/30/2020 3:08:00 PM

Calibration End Time: 9/30/2020 3:08:20 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102009

Serial Number: 17G102009

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104611

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.025 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.462 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 1:17:45 PM

Calibration Start Time: 9/30/2020 2:51:16 PM

Calibration End Time: 9/30/2020 2:51:32 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101997

Serial Number: 17G101997

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104631

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.039 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.406 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 1:19:46 PM

Calibration Start Time: 9/30/2020 2:59:40 PM

Calibration End Time: 9/30/2020 3:00:02 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101993

Serial Number: 17G101993

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104632

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.041 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 19.292 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 1:15:34 PM

Calibration Start Time: 9/30/2020 2:58:09 PM

Calibration End Time: 9/30/2020 2:58:39 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102940

Serial Number: 17L102940

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104915

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 19.238 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 1:05:27 PM

Calibration Start Time: 9/30/2020 2:54:33 PM

Calibration End Time: 9/30/2020 2:54:58 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102942

Serial Number: 17L102942

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104904

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.019 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.732 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 1:29:50 PM

Calibration Start Time: 9/30/2020 3:05:37 PM

Calibration End Time: 9/30/2020 3:05:59 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102010

Serial Number: 17G102010

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104610

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.048 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.107 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 3:41:26 PM

Calibration Start Time: 9/30/2020 2:49:03 PM

Calibration End Time: 9/30/2020 2:49:22 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102008

Serial Number: 17G102008

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104613

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.091 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.868 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 3:37:36 PM

Calibration Start Time: 9/30/2020 2:52:35 PM

Calibration End Time: 9/30/2020 2:53:10 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102003

Serial Number: 17G102003

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104601

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.094 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.002 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:31:53 PM

Calibration Start Time: 9/28/2020 2:10:37 PM

Calibration End Time: 9/28/2020 2:11:01 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102000

Serial Number: 17G102000

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104605

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.011 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 23.918 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:14:32 PM

Calibration Start Time: 9/28/2020 2:05:35 PM

Calibration End Time: 9/28/2020 2:05:54 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102938

Serial Number: 17L102938

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104906

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.024 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 30.028 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:18:17 PM

Calibration Start Time: 9/28/2020 2:03:52 PM

Calibration End Time: 9/28/2020 2:04:13 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101988

Serial Number: 17G101988

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104623

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.079 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 30.147 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:30:07 PM

Calibration Start Time: 9/28/2020 2:07:04 PM

Calibration End Time: 9/28/2020 2:08:01 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102935

Serial Number: 17L102935

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104900

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.014 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 29.854 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:12:24 PM

Calibration Start Time: 9/28/2020 2:01:15 PM

Calibration End Time: 9/28/2020 2:01:42 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102946

Serial Number: 17L102946

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104917

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.003 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 30.256 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:28:09 PM

Calibration Start Time: 9/28/2020 1:59:55 PM

Calibration End Time: 9/28/2020 2:00:17 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102932

Serial Number: 17L102932

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104903

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.122 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 30.251 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:20:46 PM

Calibration Start Time: 9/28/2020 1:58:07 PM

Calibration End Time: 9/28/2020 1:58:39 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102931

Serial Number: 17L102931

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104912

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 30.266 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:26:07 PM

Calibration Start Time: 9/28/2020 2:09:15 PM

Calibration End Time: 9/28/2020 2:09:35 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102941

Serial Number: 17L102941

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104914

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.012 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 29.852 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 2:23:28 PM

Calibration Start Time: 9/28/2020 1:56:05 PM

Calibration End Time: 9/28/2020 1:56:31 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102945

Serial Number: 17L102945

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104909

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.018 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 30.330 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 12:51:07 PM

Calibration Start Time: 9/28/2020 2:30:25 PM

Calibration End Time: 9/28/2020 2:31:28 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102005

Serial Number: 17G102005

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104606

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.701 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.818 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 12:52:49 PM

Calibration Start Time: 9/28/2020 2:28:39 PM

Calibration End Time: 9/28/2020 2:29:18 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102933

Serial Number: 17L102933

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104913

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.041 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.842 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 1:27:51 PM

Calibration Start Time: 9/28/2020 3:08:58 PM

Calibration End Time: 9/28/2020 3:09:18 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G101999

Serial Number: 17G101999

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104607

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 22.416 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 12:39:19 PM

Calibration Start Time: 9/28/2020 2:27:01 PM

Calibration End Time: 9/28/2020 2:27:27 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G102021

Serial Number: 17G102021

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100273

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 22.960 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 12:42:23 PM

Calibration Start Time: 9/28/2020 2:33:39 PM

Calibration End Time: 9/28/2020 2:33:49 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G101640

Serial Number: 17G101640

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100250

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.013 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.954 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 12:31:17 PM

Calibration Start Time: 9/28/2020 2:25:23 PM

Calibration End Time: 9/28/2020 2:25:42 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G102336

Serial Number: 17G102336

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100277

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.020 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.798 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 3:34:33 PM

Calibration Start Time: 9/28/2020 3:05:34 PM

Calibration End Time: 9/28/2020 3:05:48 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17H100435

Serial Number: 17H100435

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100292

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

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: 22.542 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 7/6/2020 11:42:25 AM

Calibration Start Time: 9/29/2020 9:59:24 AM

Calibration End Time: 9/29/2020 10:01:14 AM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G102335

Serial Number: 17G102335

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100276

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: 0.012 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.558 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 10:16:49 AM

Calibration Start Time: 9/30/2020 3:02:19 PM

Calibration End Time: 9/30/2020 3:02:38 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G101641

Serial Number: 17G101641

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100252

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.283 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.829 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/19/2020 12:35:50 PM

Calibration Start Time: 9/30/2020 3:03:53 PM

Calibration End Time: 9/30/2020 3:04:10 PM

Parameter: Depth (m)

Instrument:

Type: EXO2

Name: Sonde 17G101642

Serial Number: 17G101642

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17G100255

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.163 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 24.385 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 3:45:39 PM

Calibration Start Time: 9/28/2020 3:03:38 PM

Calibration End Time: 9/28/2020 3:03:44 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17G102011

Serial Number: 17G102011

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17E104615

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.498 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 22.945 °C

Standard Value: 0.000 m

Is Stable: True

Calibration Report

Last Calibration Time: 8/18/2020 3:32:04 PM

Calibration Start Time: 9/30/2020 3:00:53 PM

Calibration End Time: 9/30/2020 3:01:17 PM

Parameter: Depth (m)

Instrument:

Type: EXO3

Name: Sonde 17L102934

Serial Number: 17L102934

Firmware Version: 1.0.83

Sensor:

Type: Depth

Serial Number: 17K104921

Firmware Version: 3.0.0

Status: Completed

Technician: Hayley Torkos

QC Score: Good

Notes:

Calibration Points:

Calibration Point #1:

Pre Calibration Value: -0.945 m

Post Calibration Value: 0.000 m

Raw Calibration Value: 0.000 m

Temperature: 25.360 °C

Standard Value: 0.000 m

Is Stable: True

Break down 9/29/20

74°F Cloudy W4mph

0820 SB, LH, EB at depot

0830 HT at depot From picking up sonde, HH + cord from LON

1230 Calibrate DO, CT, Chlorophyll Clean sondes,

1250 SB, LH, EB leave for LBR (black)

1520 return from LBR w/ lights put new white buoys on the 2 remaining platform anchors. added extra floatation underneath to float the chain

1630 leave depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log

Date: 09/30/2020	**Task:** 11a/b – Equipment Decommission and Closeout	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 57°F, Sunny, WNW 4 mph	**Tides: L** – N/a **H –** N/a	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Sam Booth, Hayley Torkos, Lisa Heise		
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: _____ ☒ Yellow Boat – Duration: 4.0 hrs (LH, EB, SB)	**Other Equipment Used:** White trailer	

Work Completed:

- See Field Notes
- Collect UR buoys
- Calibrate UR sondes
- Remove all gear from UR site

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

Break down

9/30/20

1426 SB, LH, EB, HT arrived at depot From UR

1447 upload UR data

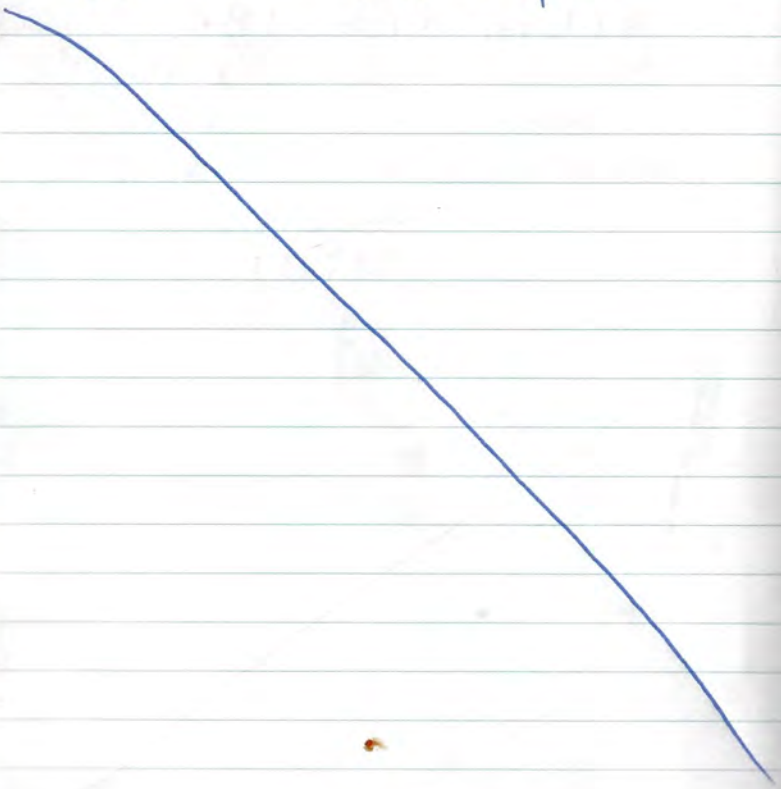
1515 Calibrate depth (UR)

1530 Store buoys

1656 Calibrate DO, CT for UR

1713 Calibrate Chlorophyll

1730 all leave depot



57°F sunny WNW 4mph 9/30/23

Break Down

0850 SB, LH arrive

0855 EB, HT arrive

0919 SB, EB, LH leave (yellow) to retrieve sondes/buoys

1027 return w/ buoys 12, 16 + sondes 14, 15, 4, 9, 12

1051 return w/ buoys 9, 11 + sondes 1+3

1125 return w/ buoys 10, 14 + sondes 6, 2

1154 return w/ buoys 13, 15 + sondes 13,

1217 return w/ buoys 17, 18 + sondes #5

1227 pull out yellow boat load trailor, buoys, sondes

1331 All leave for depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log

Date: 10/01/2020	**Task:** 11a/b – Equipment Decommission and Closeout	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 57°F, Sunny, ESE 1 mph	**Tides: L** – N/a **H –** N/a	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Sam Booth, Hayley Torkos, Lisa Heise		
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: _____ ☐ Yellow Boat – Duration:	**Other Equipment Used:**	
Work Completed: - See Field Notes -		
Notes:		
Daily Log Completed by: Hayley Torkos	**Signature:** Hayley Torkos	
	Photos Attached? ☐	**# of Photos** ____

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

Break down 10/1/20

57°F Sunny ESE 1mph

0828 SB, LH, HT, EB at depot

1338 inventory lab, garage
pack lab + garage
pull out black boat -
to park for P. Maggioni
get permission from Cone to
leave additional boat for
pick up next week

1412 hand over Sondes to
corps for storage
print inventory Lists

1428 all instrumentation handed
over to Cone for storage
in Corps warehouse in
labeled containers on pallets

1445 All leave depot

Rite in the Rain

LG² ENVIRONMENTAL SOLUTIONS, INC.

Savannah Harbor Expansion Project - O_2 Injection Monitoring

Daily Log

Date: 10/02/2020	**Task:** 11a/b – Equipment Decommission and Closeout	**All Daily Items Completed?** ☒ (see below)
Daily Items for SUR: 1) Download data from sondes & upload to OneDrive 2) Upload field notes		
Weather: 62°F, Partly Cloudy, NNW 7 mph	**Tides: L** – N/a **H –** N/a	
Client/Stakeholder Interaction (if any):		
Personnel/Visitors on site: Ethan Bright, Sam Booth, Hayley Torkos, Lisa Heise		
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: _____ ☐ Yellow Boat – Duration:	**Other Equipment Used:**	

Work Completed:

- See Field Notes
- Final Day of Clean-up / Breakdown
- Will return next week to retrieve a boat from depot

Notes:

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

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

Savannah Harbor Expansion Project - O2 Injection Monitoring
Task 9 – Start Up Run
Daily Log

10/21/20

Break down
62° F Partly Cloudy NNW 7
0818 EB, HT at depot
0835 SB, LH at depot
0912 empty trailer of ALL LGZES Supplies + warehouse
0918 final walk thru w/ "depot" Jim, handover keys + inventory list
0945 leave for Jax with white trailer + yellow boat
White boat will be picked up next week, + black boat will stay for P. Maggioni

APPENDIX E DYE RELEASES

APPENDIX E DYE RELEASE DATA

Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Task: 10
March 2021

PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG^2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX E BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document is provided as Appendix E of the SUR Report and is referred to in the main body of the report in Sections 2.4, 10.0, 10.1, 10.1.1, 10.1.2,10.2.1, and 10.3. .

APPENDIX E TABLE OF CONTENTS

APPENDIX E DYE RELEASE DATA E-1

E.1 Dye Release Analysis E-7

E.2 Upriver E-8

E.3 Front River E-25

E.4 Back and Little Back River E-41

APPENDIX E LIST OF FIGURES

Figure E-1 July 15, 2020 dye release E-10
Figure E-2 July 15, 2020 USGS Dye Cross-section #1 Savannah River at Hardeeville E-11
Figure E-3 July 15, 2020 USGS cross-section Savannah River at Hardeeville E-11
Figure E-4 July 15, 2020 USGS Dye Cross-section #2 Savannah River at Hardeeville E-12
Figure E-5 July 15, 2020 USGS dye cross-section #3 Savannah River at Hardeeville E-12
Figure E-6 August 10, 2020 dye release E-13
Figure E-7 Detailed view of dye around the Upriver diffuser E-14
Figure E-8 August 24, 2020 dye release E-15
Figure E-9 Upriver August 24, 2020 dye contours E-16
Figure E-10 August 24, 2020 USGS dye cross-section #1 Savannah River at Hardeeville E-17
Figure E-11 August 24, 2020 USGS cross-section Savannah River at Hardeeville E-18
Figure E-12 August 24, 2020 USGS dye cross-section #2 Savannah River at Hardeeville E-18
Figure E-13 USGS August 24, 2020 Upriver dye sampling #1 ..... E-19
Figure E-14 USGS August 24, 2020 Upriver dye sampling #2 ..... E-19
Figure E-15 August 25, 2020 dye sampling E-20
Figure E-16 September 15, 2020 dye contours below diffuser E-21
Figure E-17 September 15, 2020 dye concentration vs river mile E-22
Figure E-18 September 16, 2020 dye profile downstream of Upriver diffuser E-23
Figure E-19 Timeseries dye measurements at the USGS Gage I-95 bridge E-24
Figure E-20 July 16, 2020 Front River ebb tide dye release E-26
Figure E-21 USACE Depot Dock dye from July 16 Front River dye injection E-27
Figure E-22 Front River August 11, 2020 dye injection drift 1 [LFR_Drift_081120_DYE_D1] BGA relative points. E-28
Figure E-23 August 25, 2020 dye moving as tide switches from ebb slack to flood tide E-29
Figure E-24 August 25, 2020 dye contours showing dye moving Upstream on flood tide E-30
Figure E-25 August 25, 2020 USGS background dye sampling Savannah River at I-95 ..... E-31
Figure E-26 August 25, 2020 USGS background dye sampling Savannah River at GA 25 ..... E-32
Figure E-27 August 27, 2020 through August 31, 2020 dye profile sampling E-34
Figure E-28 September 02 to 07, 2020 dye profile sampling E-35
Figure E-29 September 09, 2020 through September 17, 2020 dye profile sampling E-36
Figure E-30 September 18, 2020 through September 23, 2020 dye profile sampling E-37
Figure E-31 September 25, 2020 dye profile sampling E-38
Figure E-32 Front River - lower layer dye at Fort Pulaski E-39
Figure E-33 Front River - lower layer dye timeseries at Turning Basin E-39
Figure E-34 Dye timeseries at USACE Depot Dock E-40
Figure E-35 July 16, 2020 Little Back River dye release during ebb tide – Diffuser to US-17 bridge E-42
Figure E-36 July 16, 2020 USGS dye cross-section #1 Back River downstream US-17 ..... E-43
Figure E-37 July 16, 2020 USGS Cross-section Back River downstream US-17 ..... E-44
Figure E-38 July 16, 2020 USGS dye cross-section #2 Back River downstream US-17 ..... E-44
Figure E-39 July 16, 2020 USGS dye cross-section #1 Back River near Railroad Bridge E-45
Figure E-40 July 16, 2020 USGS cross-section Back River near Railroad Bridge E-46
Figure E-41 July 16, 2020 USGS dye cross-section #2 Back River near Railroad Bridge E-46
Figure E-42 July 16, 2020 USGS dye cross-section #1 Back River near Hog Island E-47
Figure E-43 July 16, 2020 USGS cross-section Back River near Hog Island E-48
Figure E-44 July 16, 2020 USGS dye cross-section #1 Back River near Hog Island E-48
Figure E-45 Back River dye sampling E-49
Figure E-46 August 25, 2020 dye contour plot E-50

Figure E-47 First USGS Event - Little Back River at GA 25 ..... E-52
Figure E-48 Second USGS event - Little Back River at GA 25 ..... E-52
Figure E-49 August 26 to September 03, 2020 Little Back River dye sampling E-53
Figure E-50 September 08, 2020 to September 24, 2020 Little Back River dye sampling E-54
Figure E-51 August 26 to September 24, 2020 timeseries at Little Back River mouth E-55

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BGA	blue-green algae
cfs	Cubic feet per second
LBR	Back River
LFR	Front River
mg/L	Milligrams per liter
RFU	relative fluorescence units
RM	River Mile
SUR	Startup Run
UR	Upriver

E.1 DYE RELEASE ANALYSIS

Rhodamine WT dye releases were conducted in the Front River, Back River, and Upriver before and during the Startup Run (SUR) data collection. 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 injected oxygen discharge pipe and was dispersed through the diffuser. The dye sampling was conducted by boat with a probe located about 1 meter below the surface with the boats moving in and out of the dye plume as it traveled downstream. A subset of drift samples were taken at deeper depths to measure the mixing from top to bottom. ***Table 1*** includes the number of dye measurements observed, as well as the minimum and maximum dye concentration values.

Table 1 Dye measurements

River	Min Results	Max Results	# of observations	First Date	Last Date
Upriver	0.03 µg/L	107 µg/L	39,568	7/15/2020	9/20/2020
Front River	0.03 µg/L	182 µg/L	112,476	7/22/2020	9/25/2020
Back River	0.03 µg/L	182 µg/L	152,044	7/15/2020	9/25/2020

The U.S. Geological Survey (USGS) Georgia District collected an independent data during the July 15 – 16 and August 24 – 25, 2020 dye injection events. The USGS also installed dye monitors on three USGS gages to assist in tracking the dye movements in the Savannah Harbor system. The USGS used YSI algal sensors to gather the data in relative fluorescence units (RFU). These data were converted to an equivalent Rhodamine WT dye value, referred to as 'dye', by a conversion factor of 0.088 for Upriver freshwater. Due to variability in the algal data caused by the salt water, a factor of 0.01 was used for background algal levels less than 10 RFU and a factor of 0.035 for algal levels greater than 10 RFU.

The USGS data provided additional information on how the dye was mixing side to side and top to bottom and how quickly the dye was moving through the waterbody. Detailed cross-section widths and depths at specific points were also included in the USGS data.

The dye releases were used to determine:

- The potential areal and vertical extents of dye plumes and therefore the oxygen plumes
- How the injected oxygen mixed under varying hydrodynamic conditions.
- Where the dye and oxygen plumes travelled.
- What sections of the harbor were impacted by the dye and injected oxygen.
- How quickly the dye and oxygen mixed into the water column.
- How long the dye and the injected oxygen remained in the waterbody.

On the day of the dye releases, detailed receiving water sampling was conducted just before dye release to gather background dye values. During and after the dye release, dye concentrations were measured for two to four hours. The dye and other parameters were sampled to track where the dye and the oxygen plume were moving and how quickly it mixed into the water column.

E.2 UPRIVER

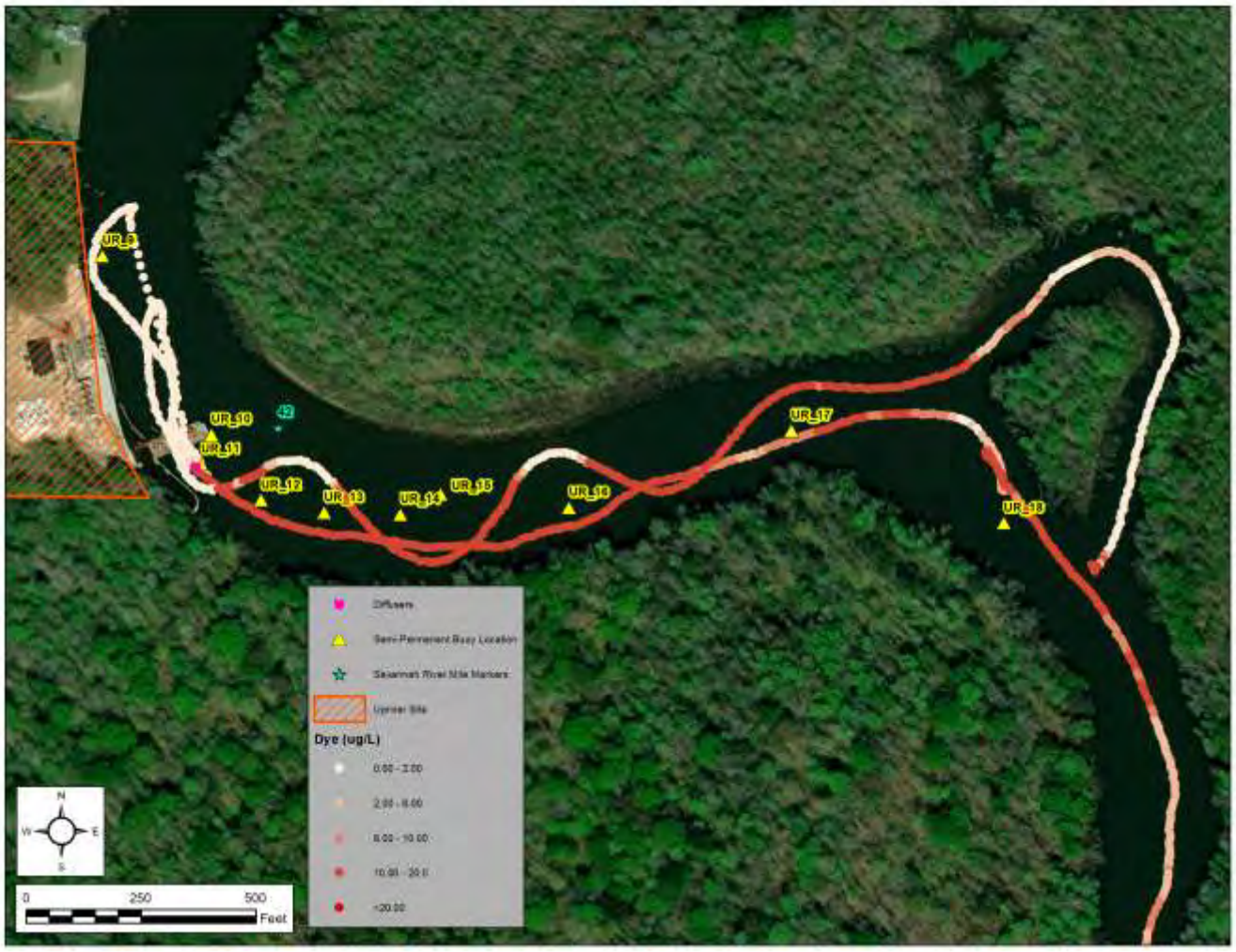
Four Upriver dye releases were completed to help determine how quickly the injected oxygen mixed with the river water and how fast the oxygen moved downstream. The July 15 and August 10, 2020 dye releases were planned to investigate the dye dispersion in the vicinity of the injection site extending two to three miles downstream. The quicker the injected oxygen mixed into the water column the less likely any of the injected oxygen would be released to the atmosphere. The August 2, 2020 4 super dye release, which included an additional 30 gallons of dye, traced the dye movement initially around the diffuser and on August 25, 2020 measured the dye in the harbor area below the I-95 bridge. The September 15, 2020 dye release further examined the impact of the dye and Upriver oxygen injection on the Front River.

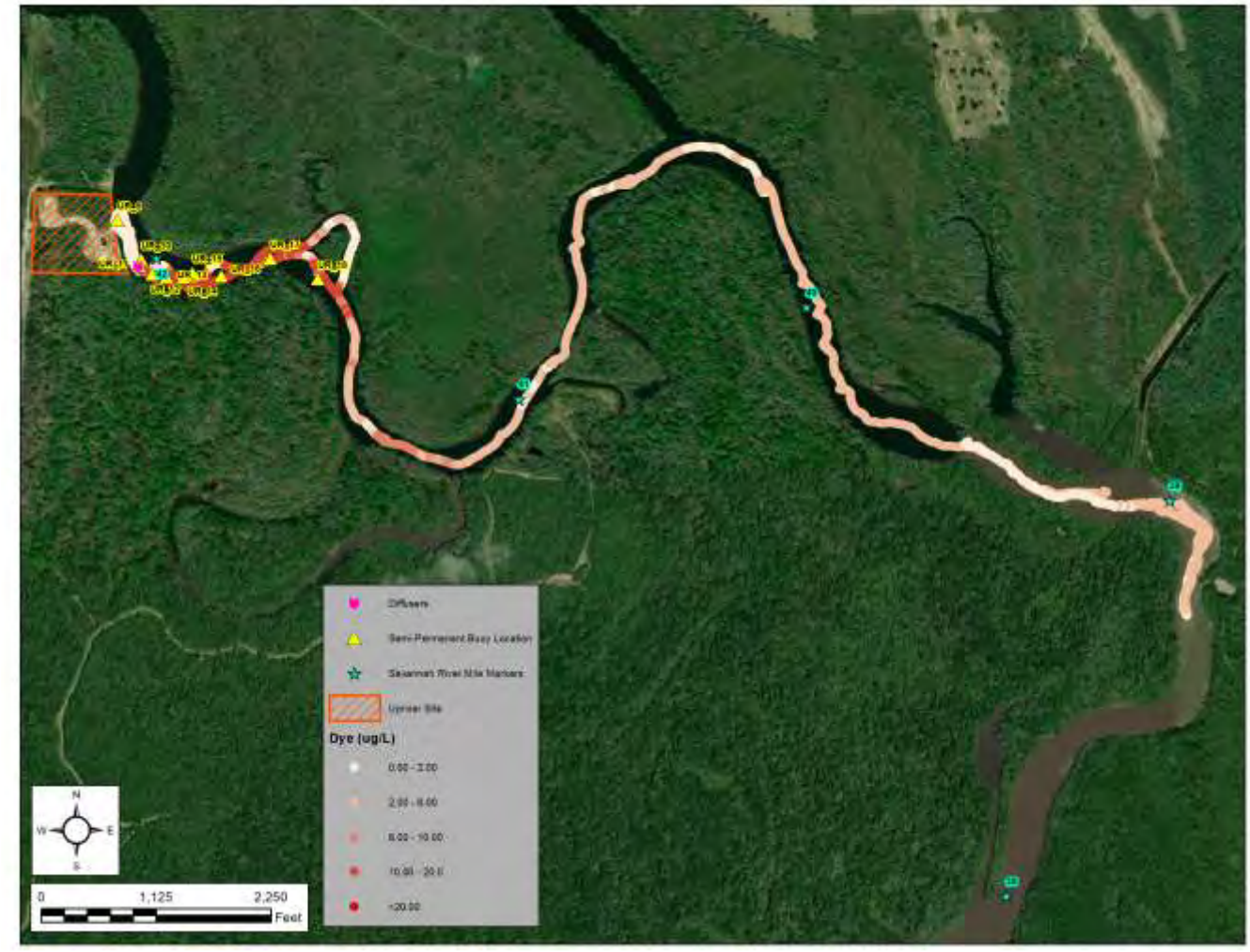
The dye sampling was conducted by boat with a probe located about 1 m below the surface with the boats moving in and out of the dye plume as it traveled downstream. A subset of drift samples was taken at deeper depths to measure the mixing top to bottom.

The USGS Georgia District collected an independent set of data during the July 15 – 16 and August 24 – 25, 2020 dye injection events. The USGS also installed dye monitors on three USGS gages to assist in tracking the dye movements in the Savannah Harbor system. USGS used a BGA algal dye sensor which detected the Upriver dye as it moved past approximately one day after each dye injection. The BGA measurements were converted to rhodamine Dye concentrations by multiplying by a factor of 0.088. This is based on a regression analysis comparing BGA to rhodamine dye measurements.

July 15, 2020 Dye Release

The July 15, 2020 dye sampling event measured how the dye, and therefore the injected oxygen, mixed with the Upriver water column. The dye was released around 1000 (24-hour clock) from the Upstream facility. Thirty gallons of undiluted dye were injected into river. The dilution when dye reached the surface was 10:1 and the dye had completely mixed into the water column within 0.6 miles downstream. The dye release also shows how the oxbow in the river significantly reduced the dye concentration and supports the finding from Section 8.2 of the main report that the tributaries flowing into the Savannah River have low dissolved oxygen (DO). This low DO then gradually lowered the river's DO as it flowed downstream. ***Figure E-1*** shows the concentration of dye verses river mile (RM) as the dye flows downstream. The dye is mixed side to side around RM 41.4 then decreases going downstream as tributaries flow into the Savannah River. The DO measured at the same time shows a similar pattern as the DO values previously shown in Section 8.2 of the main report, dropping between RM 41.4 and 39 due to the incoming tributary flows. River flow measured at the upstream USGS Clyo Gage were 12,500 cfs.





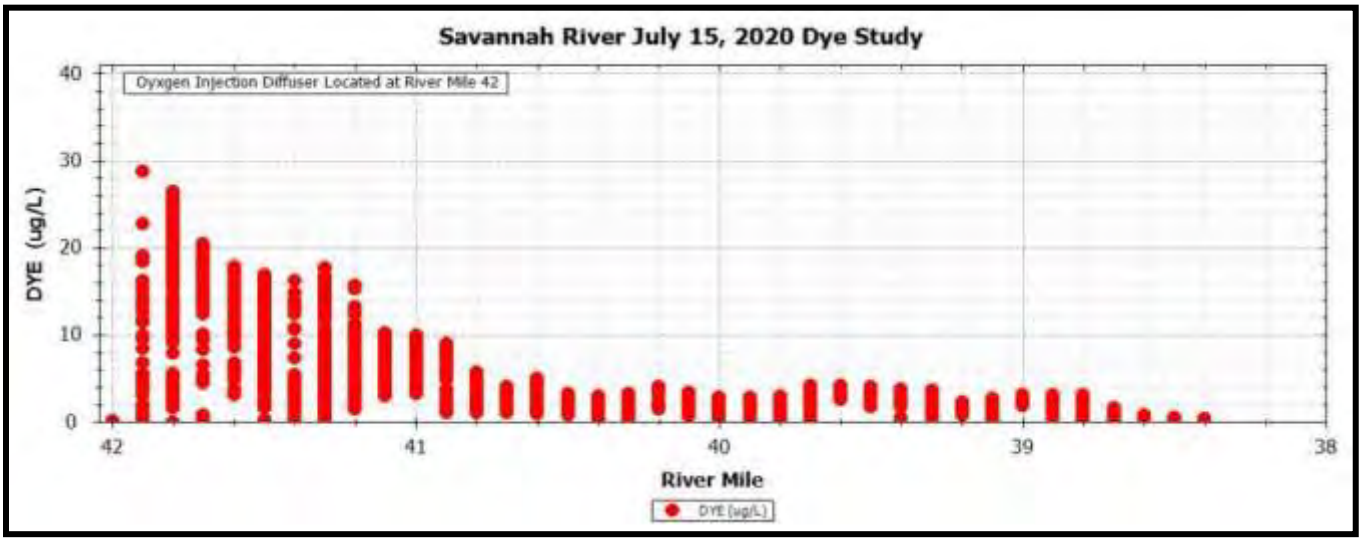


Figure E-1 July 15, 2020 dye release

July 15, 2020 USGS Upper Savannah River Dye Event Summary

The USGS Georgia District collected an independent data during the July 15, 2020 dye injection event. The dye was released around 1000 from the upstream facility. The sampling location was approximately 220 feet upstream of the old Hardeeville gage (02198760).

The dye took approximately 2 hours to reach the Hardeeville cross-section, which was sampled three times. The first event cross-section was sampled around. The dye was highly visible during this cross-section. ***Figure E-2*** through ***Figure E-5*** below show the cross-section dye concentrations at the top, middle, and bottom portions of the river, along with a cross-section profile of the river. The dye was well mixed top to bottom with the highest concentration in the main channel, located 75 to 195 feet from the right bank, during the dye peak measured in event #1. The 2nd and 3rd cross-section events, taken between 1200 and 1300 shows the dye moving quickly out of the channel but hanging on along the banks, most likely due to downed trees holding up the dye.

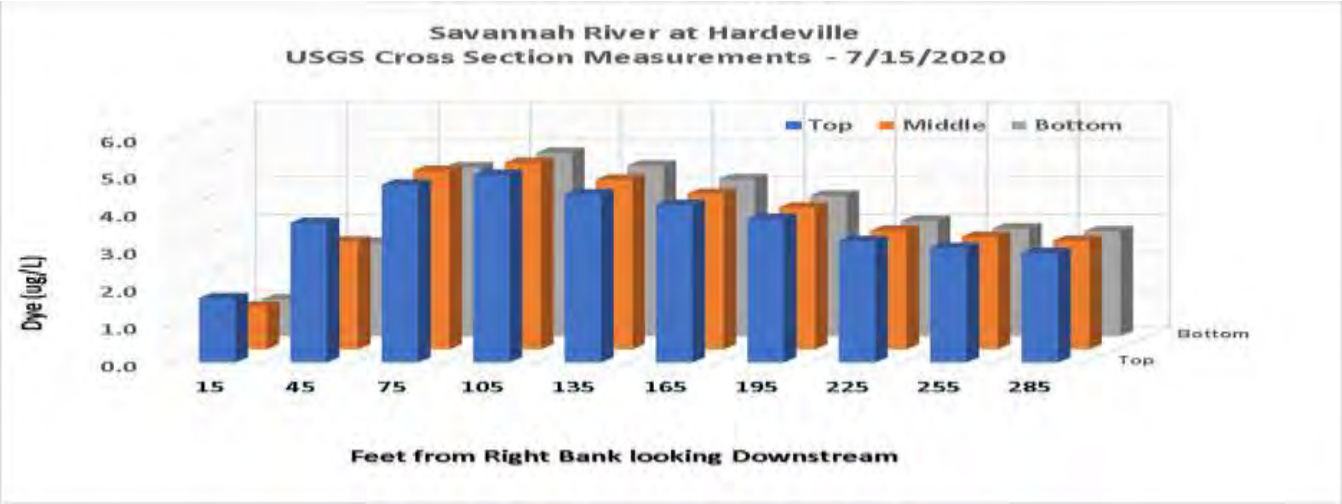


Figure E-2 July 15, 2020 USGS Dye Cross-section #1 Savannah River at Hardeeville

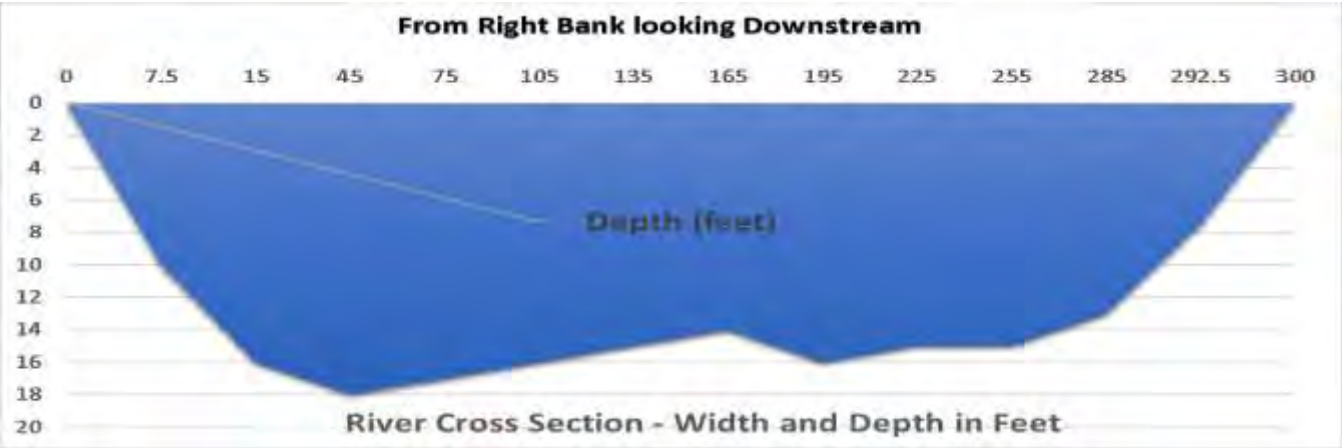


Figure E-3 July 15, 2020 USGS cross-section Savannah River at Hardeeville

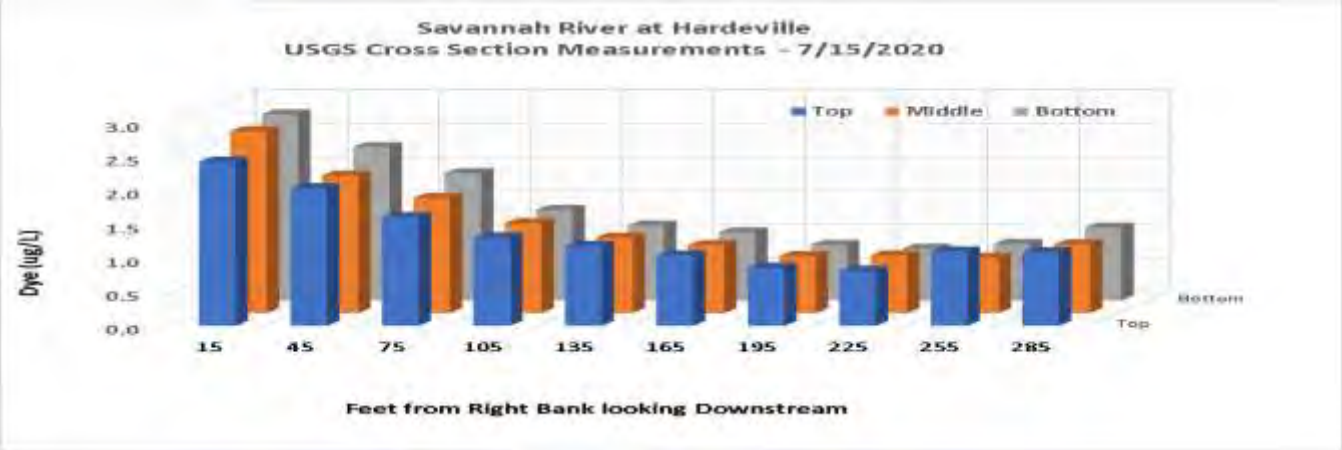


Figure E-4 July 15, 2020 USGS Dye Cross-section #2 Savannah River at Hardeeville

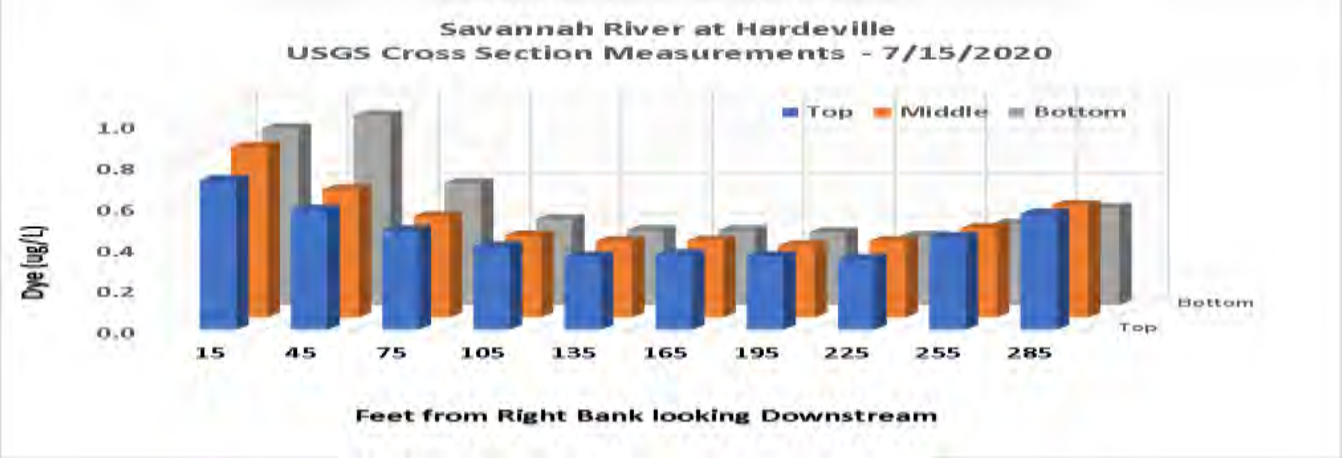


Figure E-5 July 15, 2020 USGS dye cross-section #3 Savannah River at Hardeeville

August 10, 2020 Dye Release

The August 10, 2020 release was designed to measure how fast the dye moved downstream and across the channel. The dye was released around 1000 with sampling going from at 0950 to 1030. River flow measured at the upstream USGS Clyo Gage at the time of this release was 8,500 cubic feet per second (cfs). The sampling boats first collected dye around the diffuser, then proceed downstream to find the dye peaks***. Figure E-6 and Figure E-7*** show some of the dye reaching the surface above the diffuser.



Figure E-6 August 10, 2020 dye release



Figure E-7 Detailed view of dye around the Upriver diffuser

August 24, 2020 Super Dye Release

On August 24, 2020, 60 gallons of dye was pumped into the Upriver plant oxygen injection pipe and diffused into the river. The dye was released at 1005 from the upstream diffuser. The main purpose was to track this dye as it reached the Savannah Harbor area. Detailed dye sampling around the diffuser was completed during the dye injection to get a more complete near-field distribution of the dye, as shown in ***Figure E-8*** and ***Figure E-9***. River flow measured at the upstream USGS Clyo Gage was 7,500 cfs.



Figure E-8 August 24, 2020 dye release

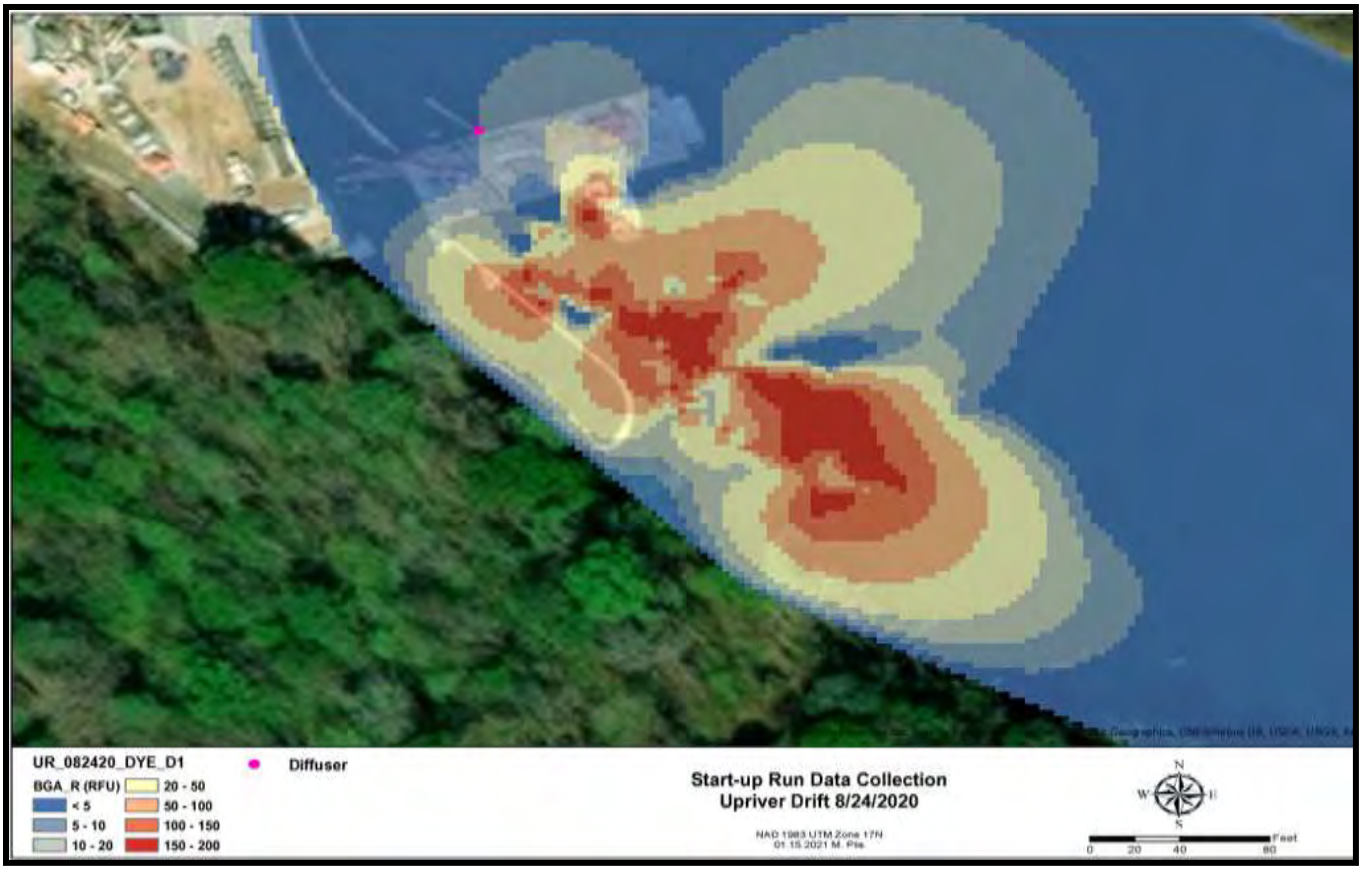


Figure E-9 Upriver August 24, 2020 dye contours

August 24, 2020 USGS Upper Savannah River Dye Event

The USGS Georgia District collected an independent set of data during the August 24, 2020 dye injection event. The dye was released at 1005 from the upstream diffuser. Cross-sections were conducted at two locations in the upper reaches of the Savannah River. One cross-section was in the vicinity of the July 15, 2020 event, approximately 370 feet upstream of the discontinued Hardeeville USGS gage (02198760). A second sample cross-section and the baseline cross-section was collected approximately two miles downstream of the old Hardeeville gage. The baseline cross-section was conducted between 0910-0940 and results showed that dye values were low, given the injected dye from the Upriver diffuser had not reached this location. USGS collected a baseline cross-section at the old Hardeeville gage at 0953-1019. Dye values were also low in this location.

The first event cross-section at this location was collected from 1127-1149 and a second event cross-section was collected at this location from 1151-1210. The dye was highly visible during both cross-sections. There was moderate to heavy rain during portions of these two event cross-sections. The below Figures show the cross-section dye concentrations at the top, middle, and bottom portions of the river, along with a width depth profile of the river. As shown in ***Figure E-10*** the dye is well mixed top to bottom for most of the width, except at the edges where fallen trees and branches are slowing down the river flow.

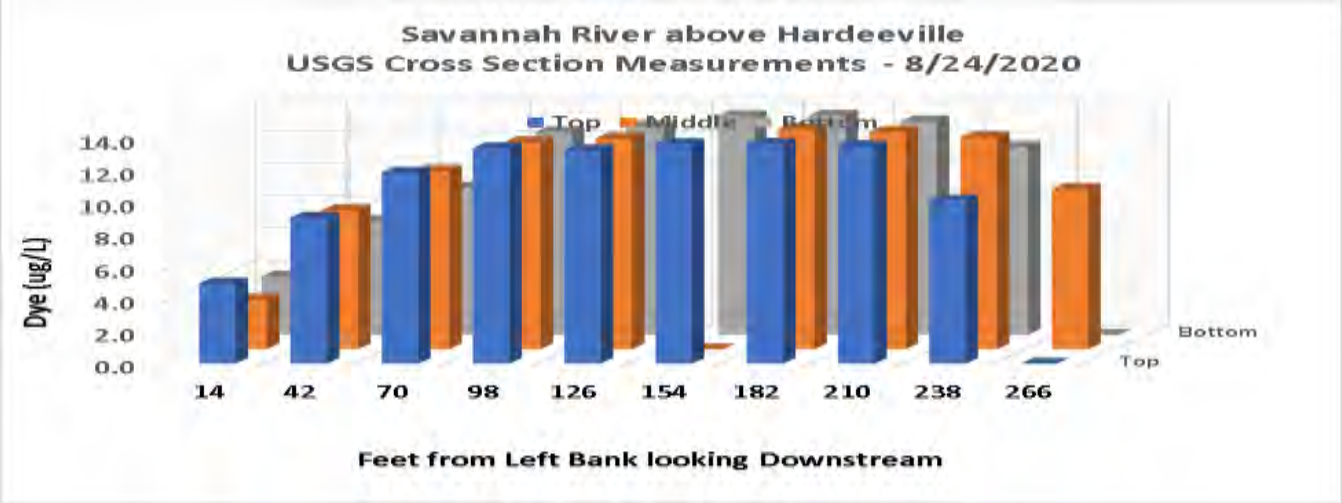


Figure E-10 August 24, 2020 USGS dye cross-section #1 Savannah River at Hardeeville

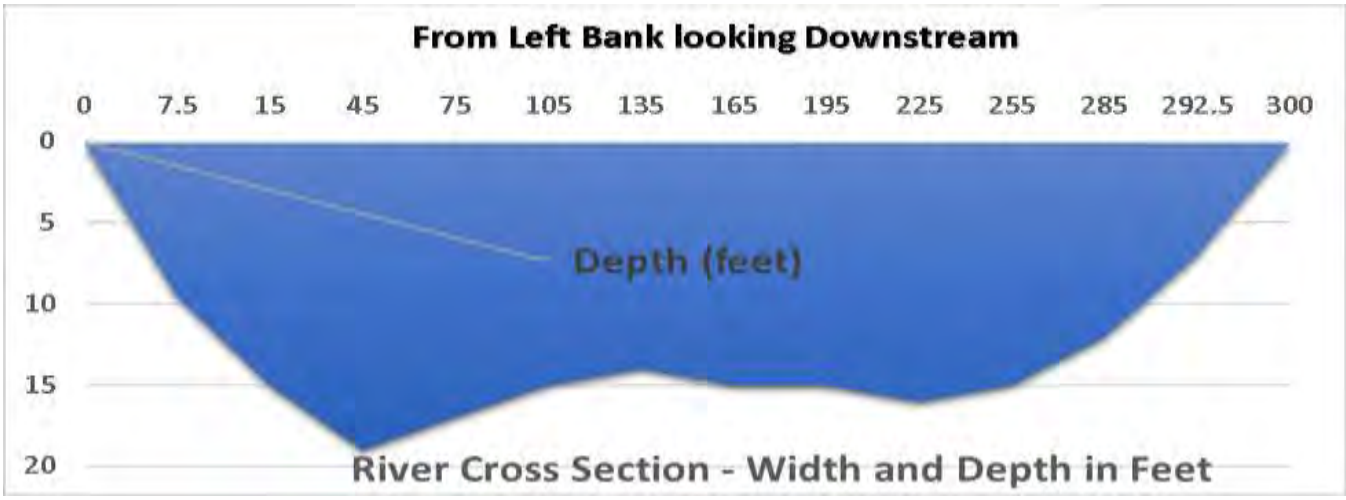


Figure E-11 August 24, 2020 USGS cross-section Savannah River at Hardeeville

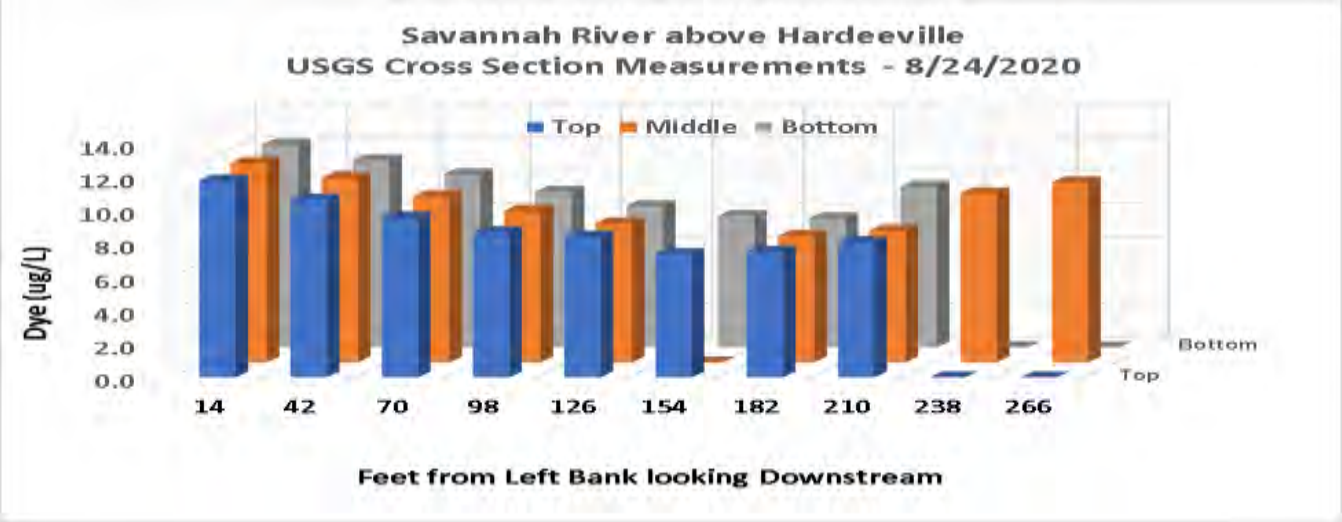


Figure E-12 August 24, 2020 USGS dye cross-section #2 Savannah River at Hardeeville

Following the Hardeeville event cross-sections, measurements were taken at a site located two miles downstream of the discontinued Hardeeville USGS gage.

The dye reached this downstream location around 1310. Data were collected for the first event cross-section at this location from 1312-1338. The dye was highly visible during both event cross-sections. As shown in the below ***Figure E-14***, the cross-section dye concentrations at the top, middle, and bottom for the full width of the river is well mixed top to bottom.

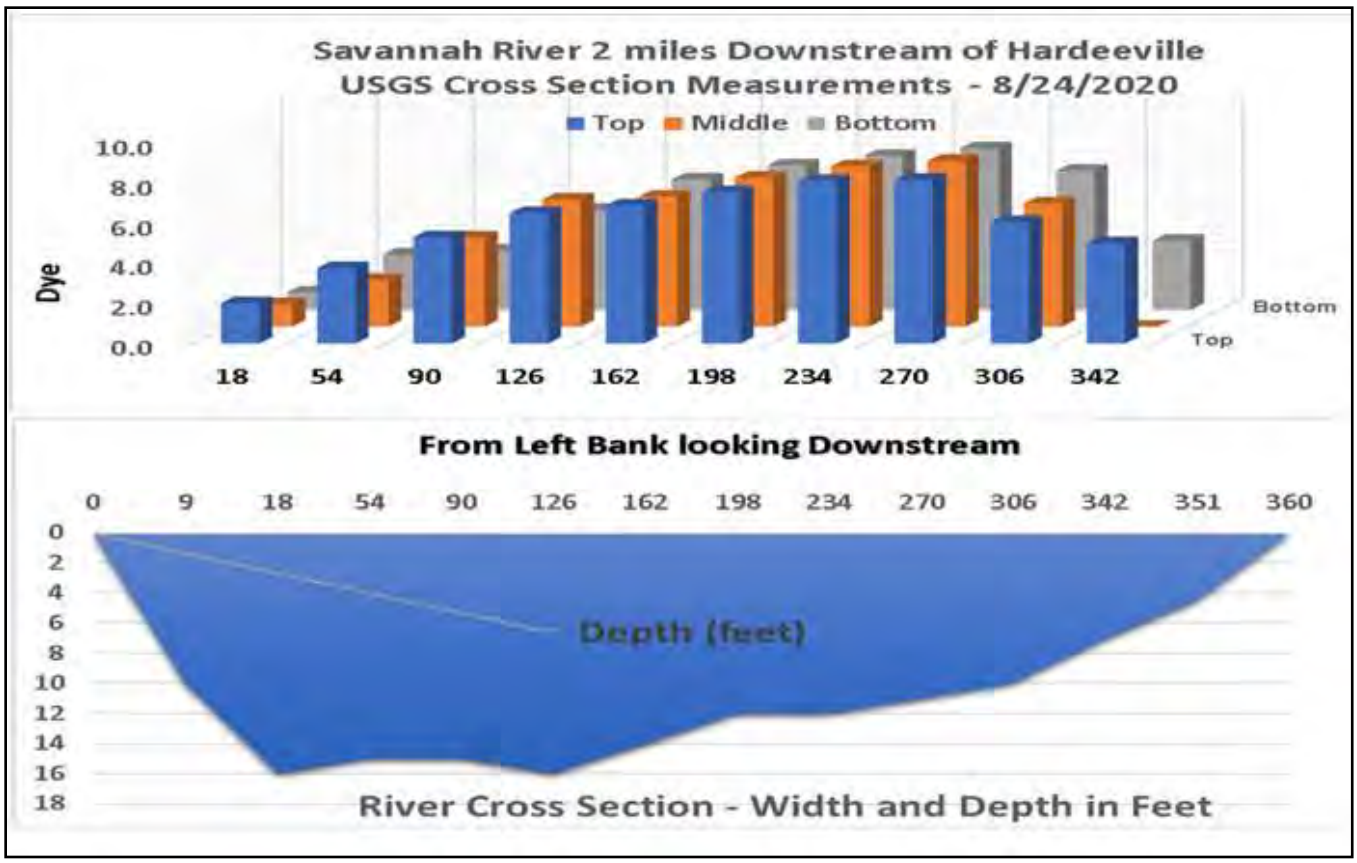


Figure E-13 USGS August 24, 2020 Upriver dye sampling #1

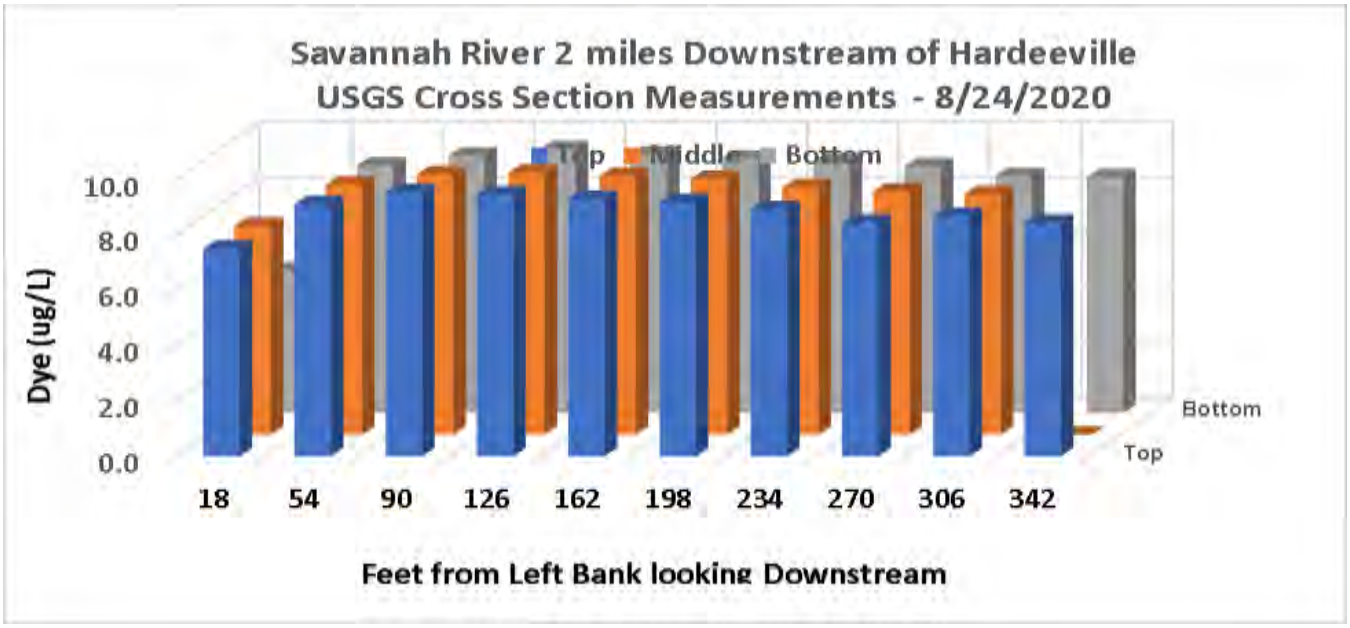


Figure E-14 USGS August 24, 2020 Upriver dye sampling #2

August 25, 2020 Dye and DO Monitoring from Diffuser to I-95 Bridge

On August 25, 2020, extended boat sampling was completed from above the Upriver diffuser to downstream past the I-95 bridge. The objectives were to locate the dye from the previous days release, to see how far it traveled, and to measure a longitudinal DO profile of the Upriver. River flow measured at the upstream USGS Clyo Gage was 7,500 cfs. As shown in ***Figure E-15***, the dye peak was located four miles downstream of the I-95 Bridge. DO gradually declined from 7.9 mg/L at the diffuser to 6.5 mg/L below I-95 Bridge. These results support the notion that low DO from tributaries joining the Savannah River reduce DO concentrations, but also that the dye plume, and therefore oxygen plume, is well mixed and being retained within the water column over a very significant distance.

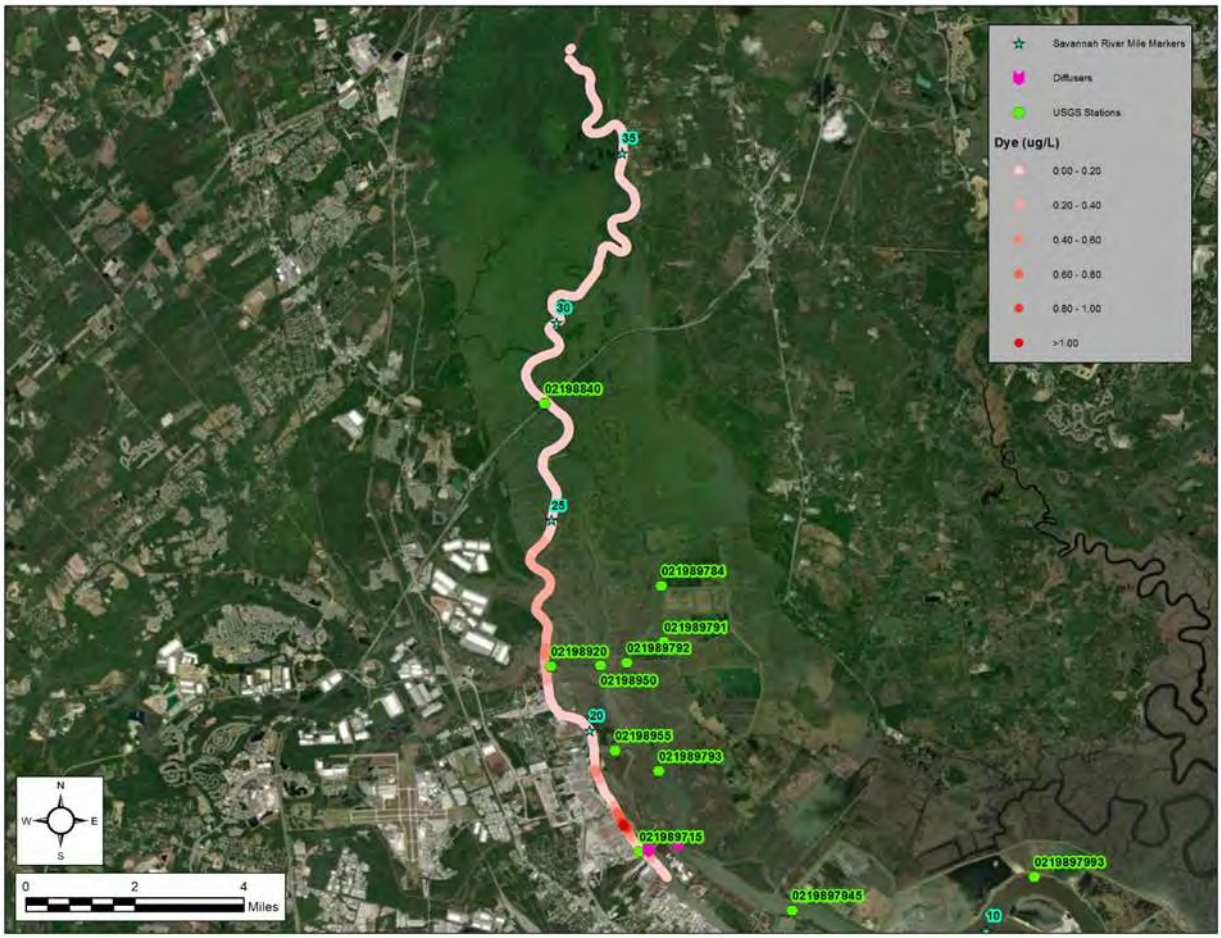


Figure E-15 August 25, 2020 dye sampling

September 15, 2020 Dye Sampling

The September 15, 2020 dye release was conducted to confirm the dye mixed at a lower river flow (6,500 cfs) and to see how the dye was retained downstream. ***Figure E-16*** and ***Figure E-17*** show the dye concentrations contours downstream of the diffuser and a graph of the dye verses RM. The dye profile had a similar pattern as measured during the previous release.

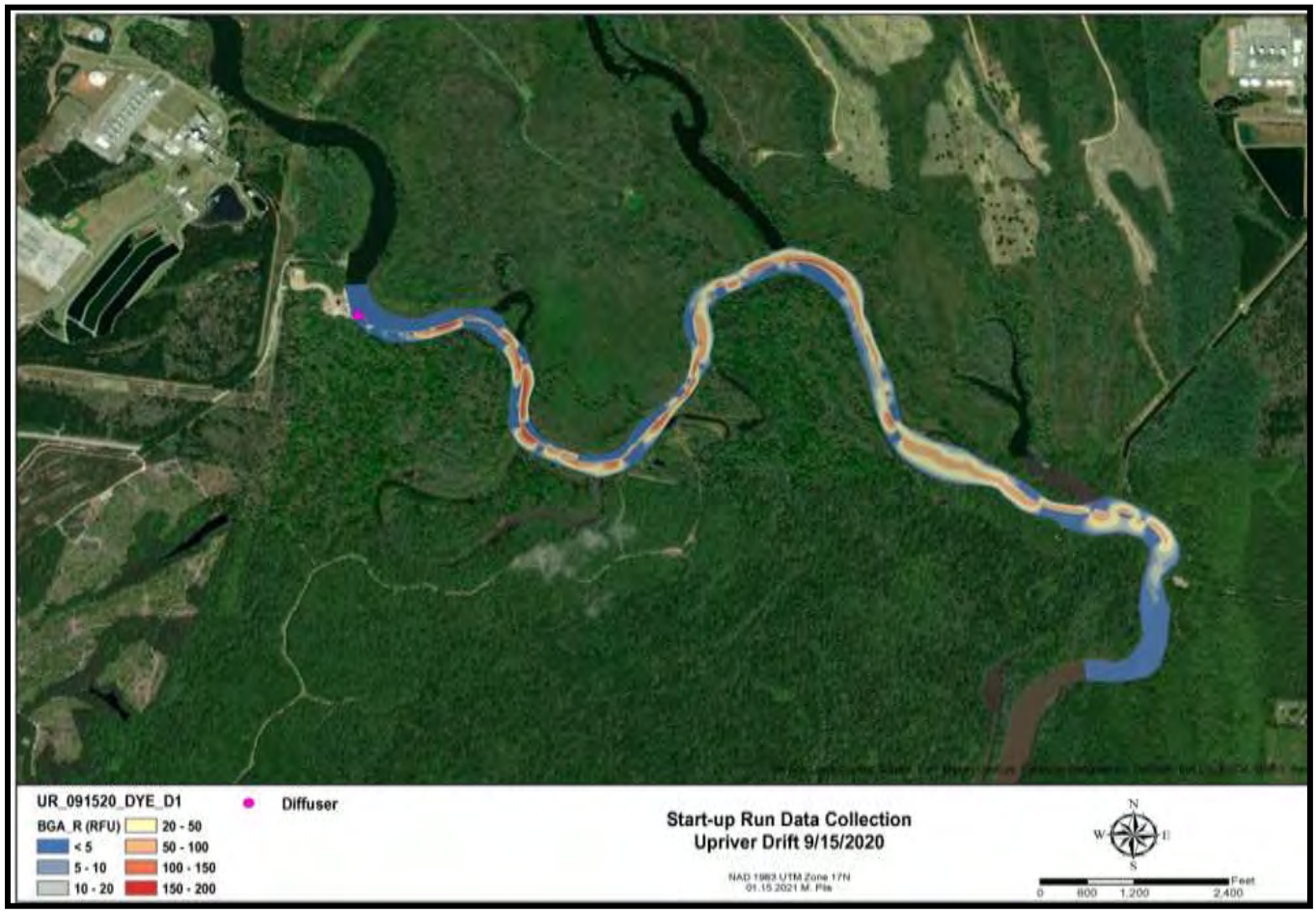


Figure E-16 September 15, 2020 dye contours below diffuser

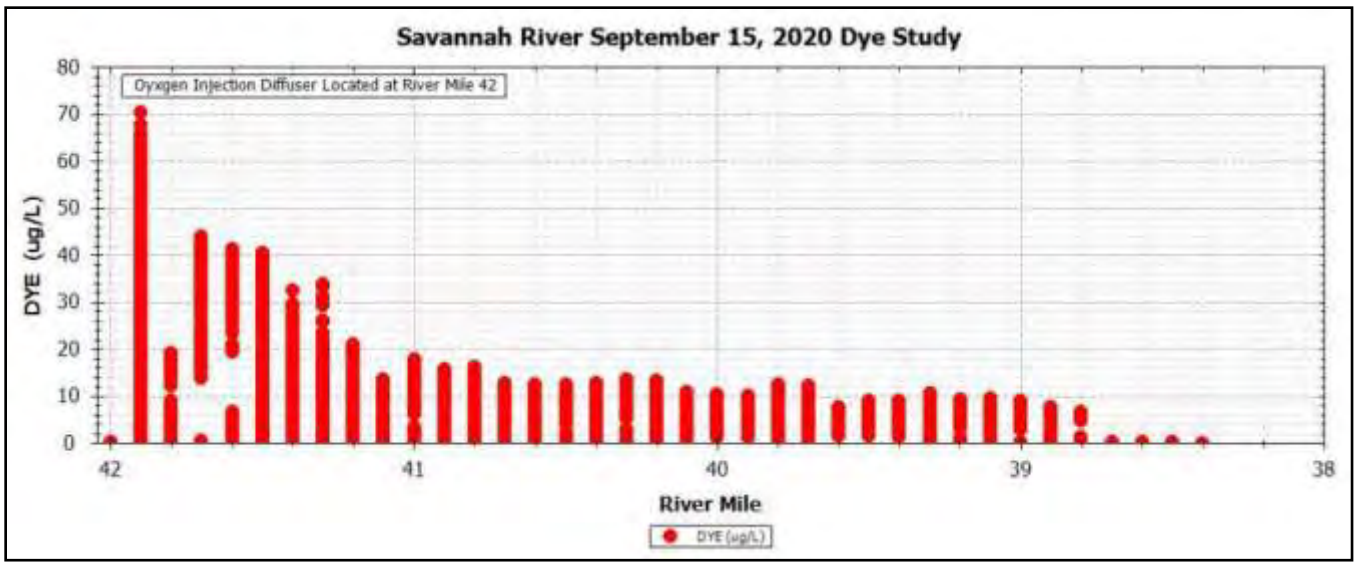


Figure E-17 September 15, 2020 dye concentration vs river mile

September 16, 2020 Sampling from Diffuser to USACE Dock

One day after dye injection at the Upriver plant, boat sampling located the dye peak at RM 28, near I-95, after approximately 24 hours.

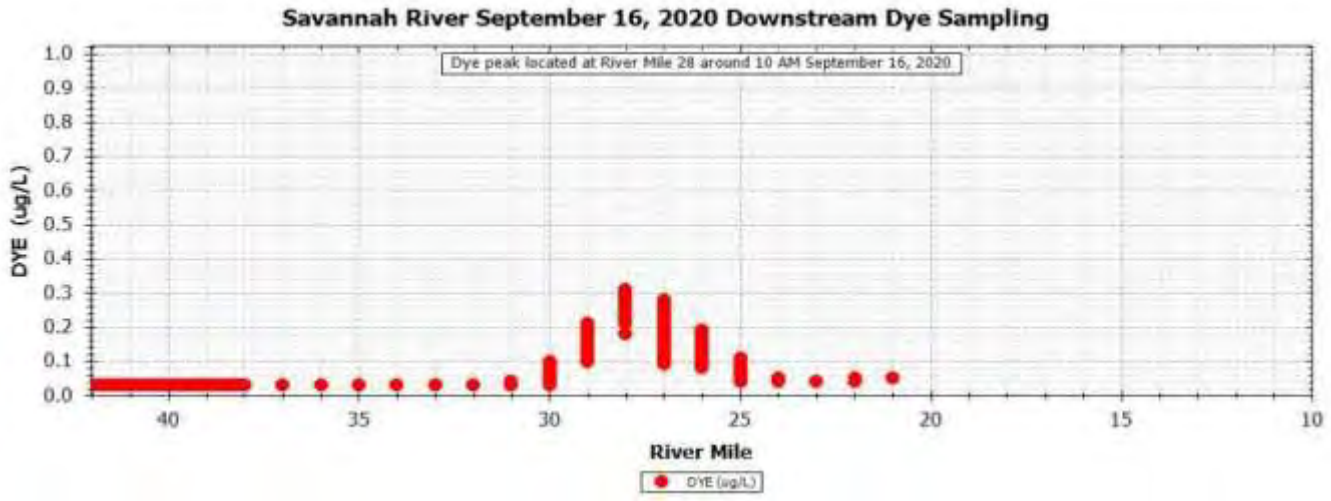


Figure E-18 September 16, 2020 dye profile downstream of Upriver diffuser

USGS I-95 Bridge Dye Monitoring

The USGS gage at I-95 bridge included a blue-green algae (BGA) dye sensor which detected the Upriver dye as it moved past approximately one day after each dye injection. The BGA measurements were converted to rhodamine Dye concentrations by multiplying by a factor of 0.088. This is significant because it represents the injected dye and therefore the injected oxygen staying entrained within the water column to I-95 and beyond. The four spikes in data ***Figure E-19*** are evident and are attributable to each of the four Upriver dye releases.

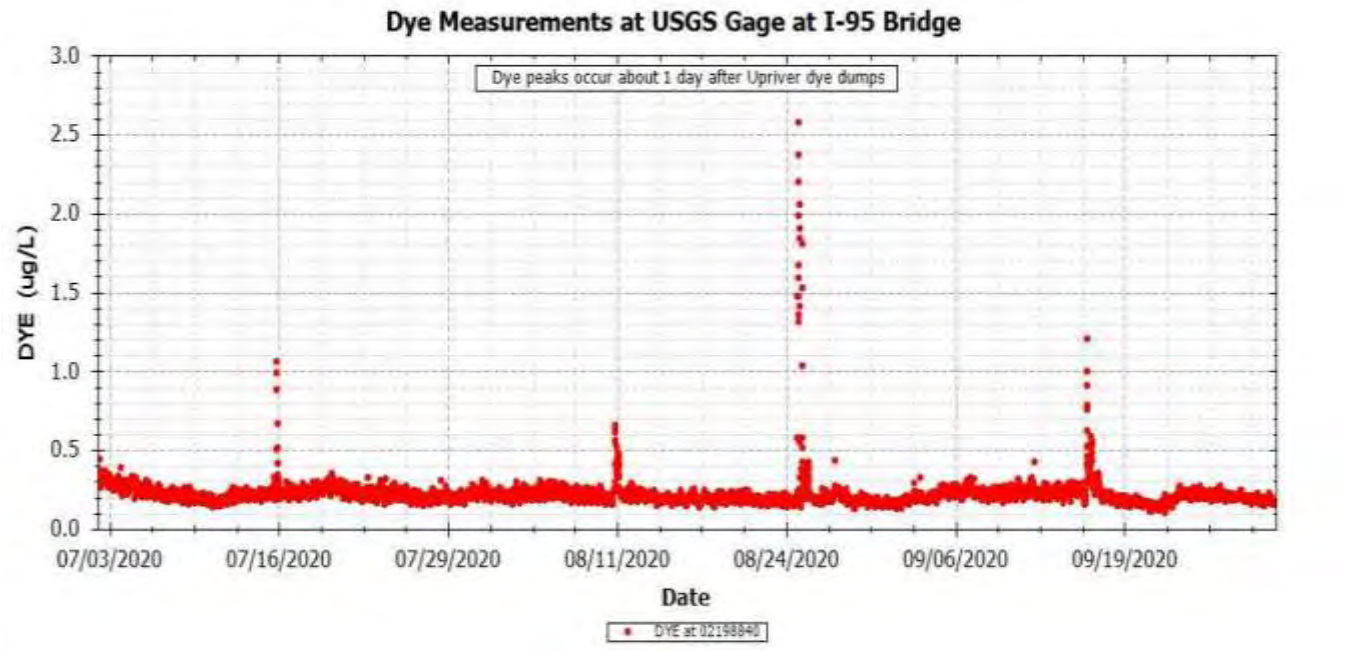


Figure E-19 Timeseries dye measurements at the USGS Gage I-95 bridge

E.3 FRONT RIVER

Three Front River dye releases were conducted during the SUR. The primary goal of the Front River dye releases was to determine where in the harbor the dye and therefore injected oxygen, was distributed and how long the dye and injected oxygen stayed in the harbor. Detailed near field dye and DO measurements were taken during the previous years' Test Run sampling that detailed the initial mixing and near field distribution of the dye and oxygen plumes and were not repeated during the SUR sampling. The dates and details of the three Front River dye releases are presented in the main report.

A summary of the Front River dye sampling results is listed below:

- Initially the dye injection hugs the west bank, on both ebb and flood tides and slowly spreads across the river, dispersing in to the upper and lower layers.
- About 2/3 of the injected dye ends up in the bottom layer.
- The injected dye, and therefore the injected oxygen, stays in the Front River for about three weeks, depending on flow and tidal conditions.
- The injected Upriver dye raises the Front River dye concentration with most of the dye going to the bottom layer.

July 16, 2020 Dye Release

The July 16, 2020 dye releases occurred on ebb tide. The dye in both releases headed downstream and hugged the west bank as shown in ***Figure E-20***.



Figure E-20 July 16, 2020 Front River ebb tide dye release

A dye sensor was located at the USACE Depot Dock to measure the dye concentration and retention time. The dye was still above background levels of 0.03 ug/L on August 10, almost four weeks after the release. The results are presented in ***Figure E-21***.

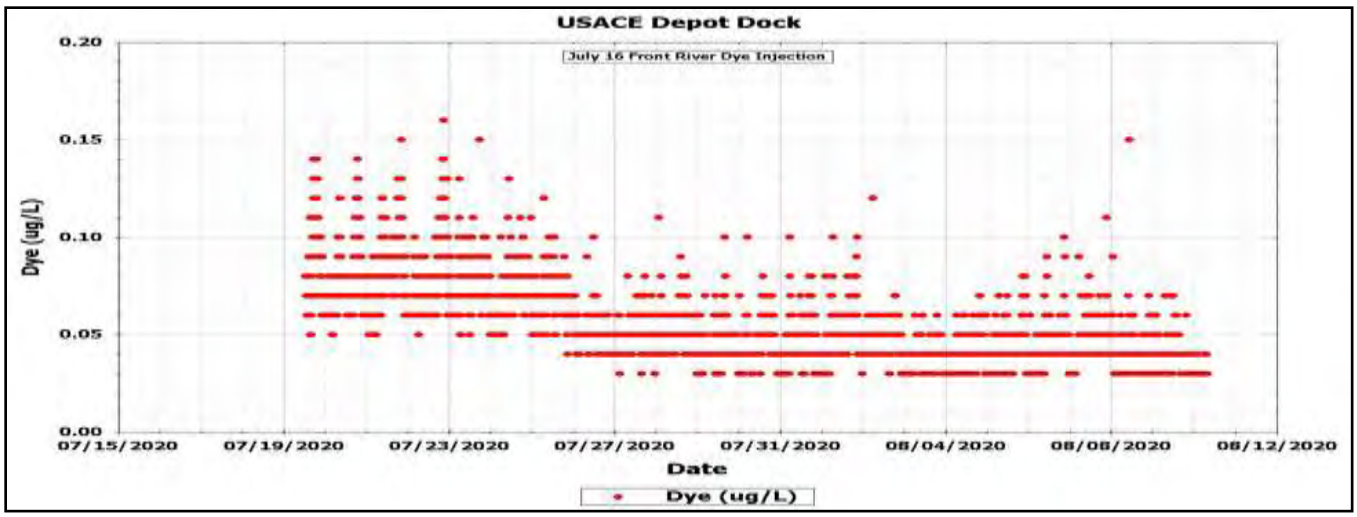


Figure E-21 USACE Depot Dock dye from July 16 Front River dye injection

August 11, 2020 Dye Releases

The August 11, 2020 dye release occurred on ebb tide. The dye in both releases headed downstream and hugged the west bank as shown in the following figure. Drift occurred during low slack tide transitioning to incoming tide. Results are presented in ***Figure E-22***.



Figure E-22 Front River August 11, 2020 dye injection drift 1 [LFR_Drift_081120_DYE_D1] BGA relative points.

August 25, 2020 Super Dye Release

The August 25, 2020 Front River dye release best illustrated where the dye and injected oxygen traveled to and how long the dye and injected oxygen remained in the Front River. After 60 gallons of dye was injected, profile sampling of the Front River was conducted almost daily to see how long the dye, and the associated injected oxygen, would remain in the Front River.

The dye was injected on a low slack tide, so the dye initially dispersed around the diffuser (***Figure E-23***), moving slightly downstream, and then moved upstream on the incoming tide as shown below in contour map, ***Figure E-24***.

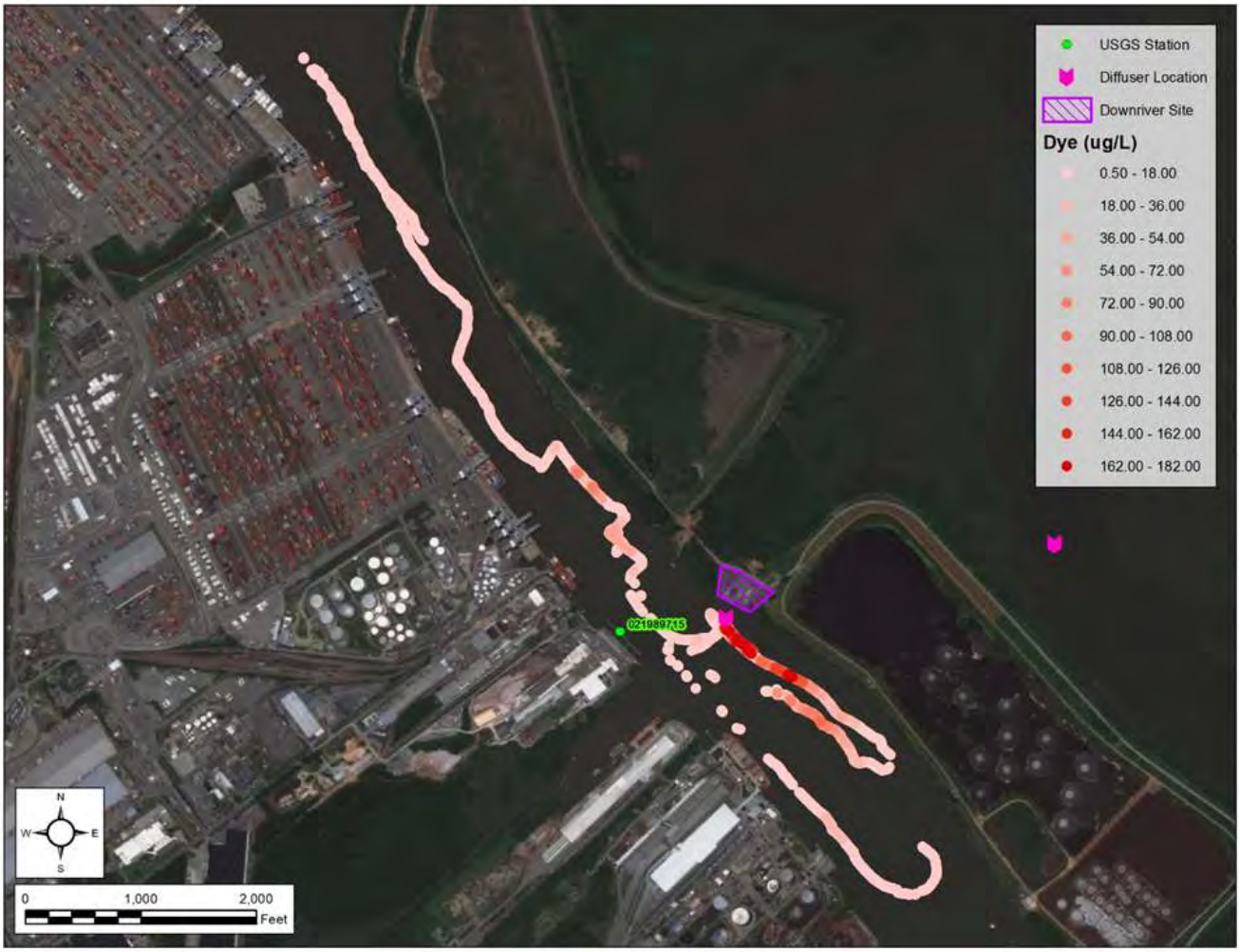


Figure E-23 August 25, 2020 dye moving as tide switches from ebb slack to flood tide



Figure E-24 August 25, 2020 dye contours showing dye moving Upstream on flood tide

August 25, 2020 USGS Dye Event Sampling - Savannah River at I-95 near Port Wentworth, GA

USGS was to sample, at the I-95 bridge, the dye plume that was released the previous day, August 24, 2020. However, the dye had already moved past this location, so they collected a baseline cross-section from 1153-1222, shown in ***Figure E-25***. After this cross-section, it seemed likely that there would be little to no return of dye in this area for a considerable amount of time, if at all and no other cross-sections were made at this site.

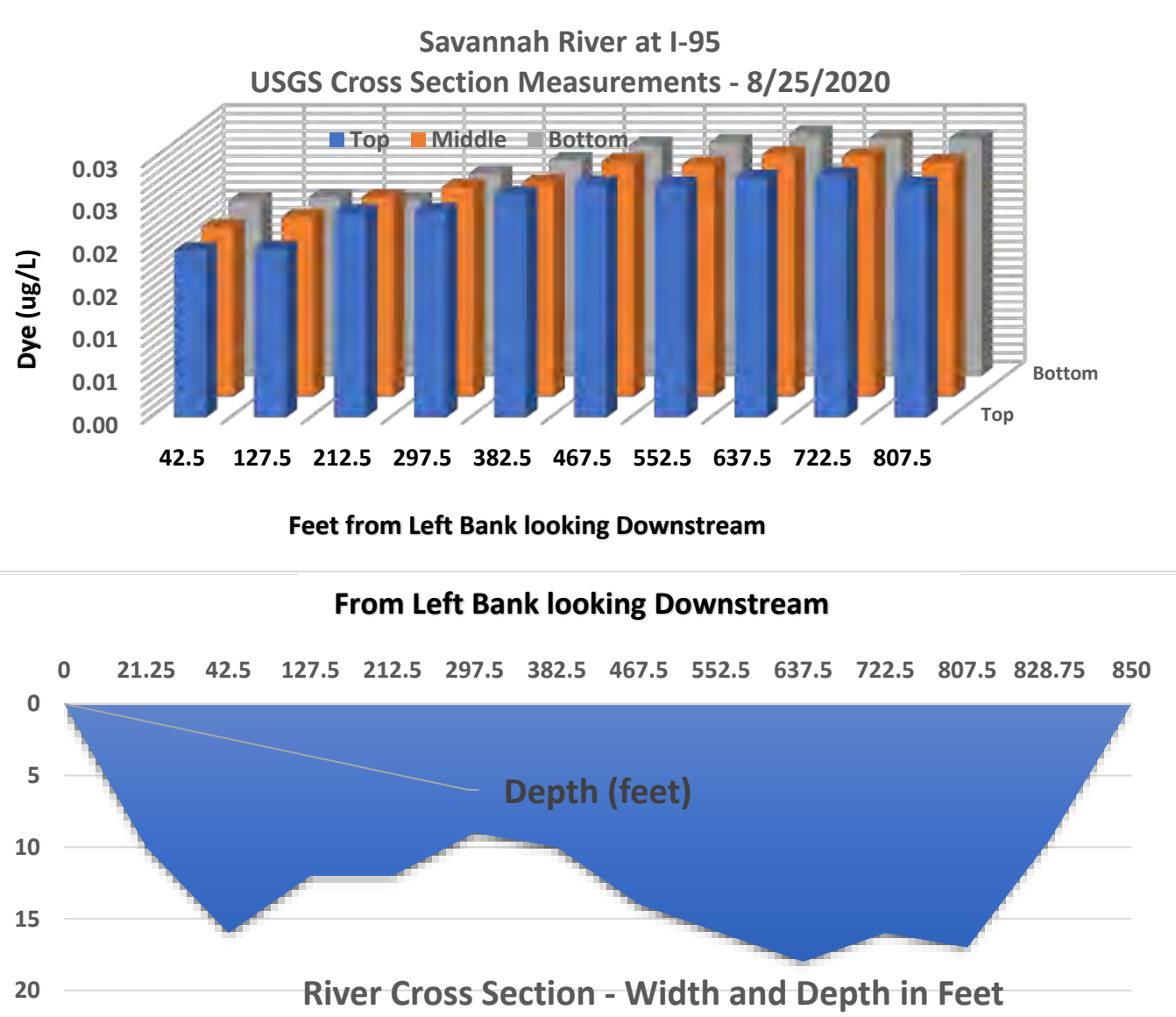


Figure E-25 August 25, 2020 USGS background dye sampling Savannah River at I-95

August 25, 2020 USGS Dye Event Sampling - Savannah River at GA 25 near Port Wentworth, GA

USGS was to sample, at the GA 25 bridge, the dye plume that was released the previous day, August 24, 2020. However, the dye had not arrived at this site, so a baseline cross-section was collected from 1027-1105, shown in ***Figure E-26***. After this cross-section, it seemed likely that there would be little to no return of dye in this area for a considerable amount of time, if at all and no other cross-sections were made at this site and USGS moved on to the Little Back River where dye was present.

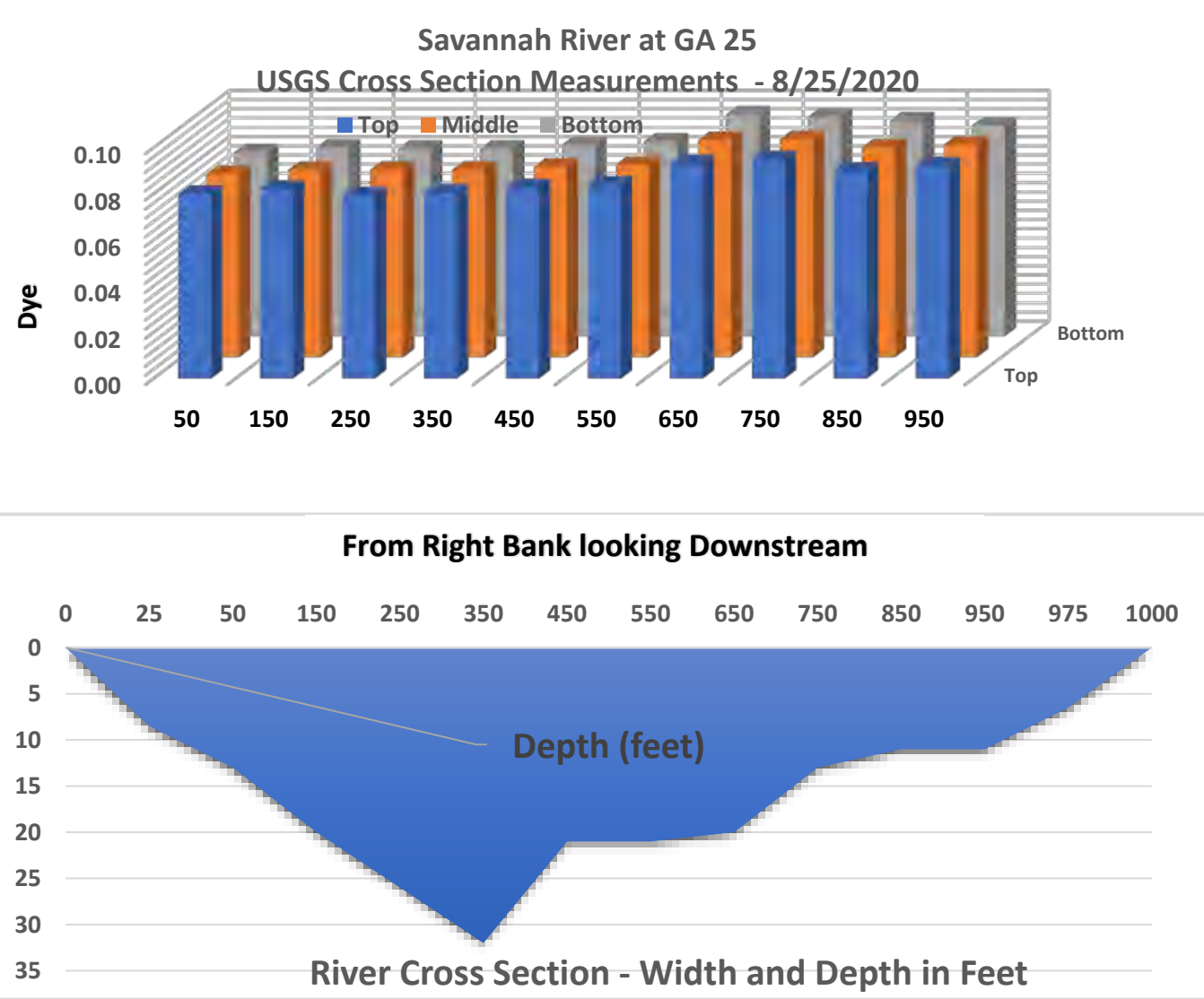


Figure E-26 August 25, 2020 USGS background dye sampling Savannah River at GA 25

Detailed Front River Dye Profiling

Detailed Front River profile sampling was conducted from August 26, 2020 to September 15, 2020 to track the movement of the dye in the Front River from the release on August 25 ,2020. The sampling locations varied day to day depending on slack, incoming, or outgoing tide. To illustrate dye movement, the profile sampling locations were converted to approximate RMs with RM 0 being at the mouth of the Savannah River, near Fort Pulaski. The dye profile samples were averaged between the upper (top 15 feet) and lower layers and the results, by day, are presented below in the following figures.

From August 27, 2020 through August 31, 2020, the dye was well distributed throughout the Front River, with the higher dye concentrations in the lower layers as shown in ***Figure E-27***.

From September 02, 2020 to September 07, 2020, the dye was still well distributed throughout the Front River, with the higher dye concentrations reduced to 0.35 µg/L, slightly above background value of 0.03 ug/L. See ***Figure E-28***.

From September 09, 2020 to September 17, 2020, the dye was still present in the Front River, with the peak dye concentrations reduced to 0.2 µg/L. See ***Figure E-29***.

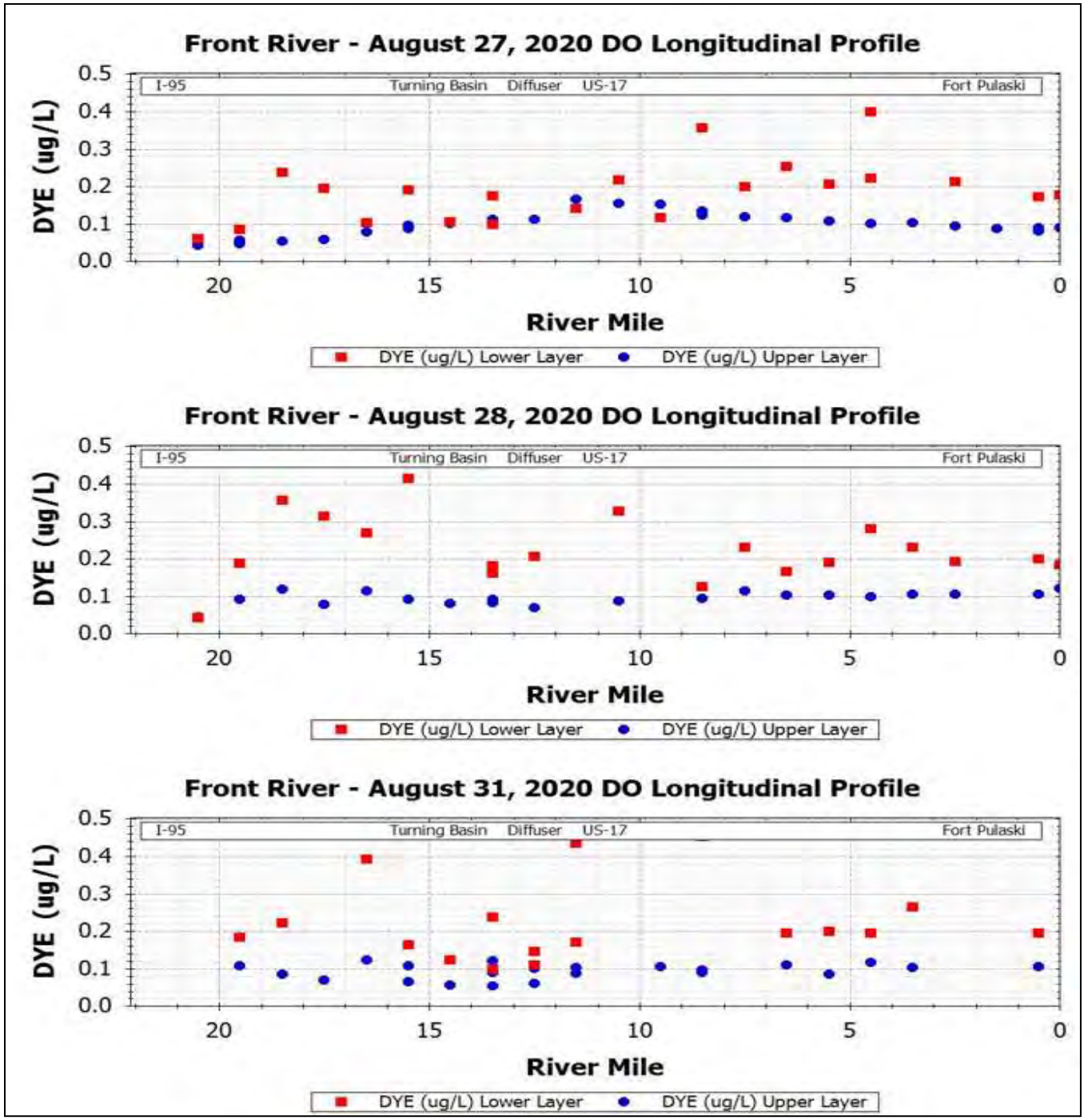


Figure E-27 August 27, 2020 through August 31, 2020 dye profile sampling

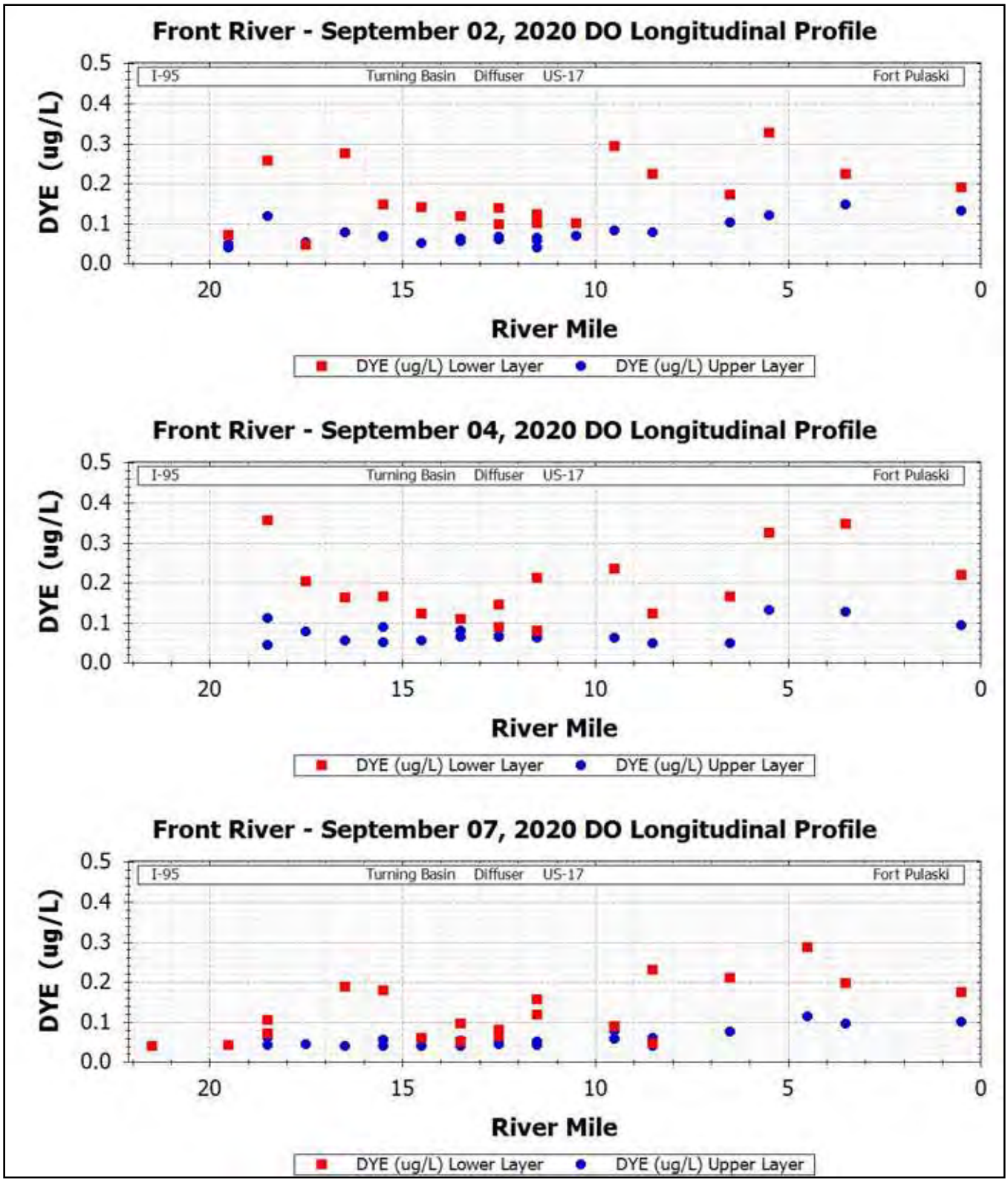


Figure E-28 September 02 to 07, 2020 dye profile sampling

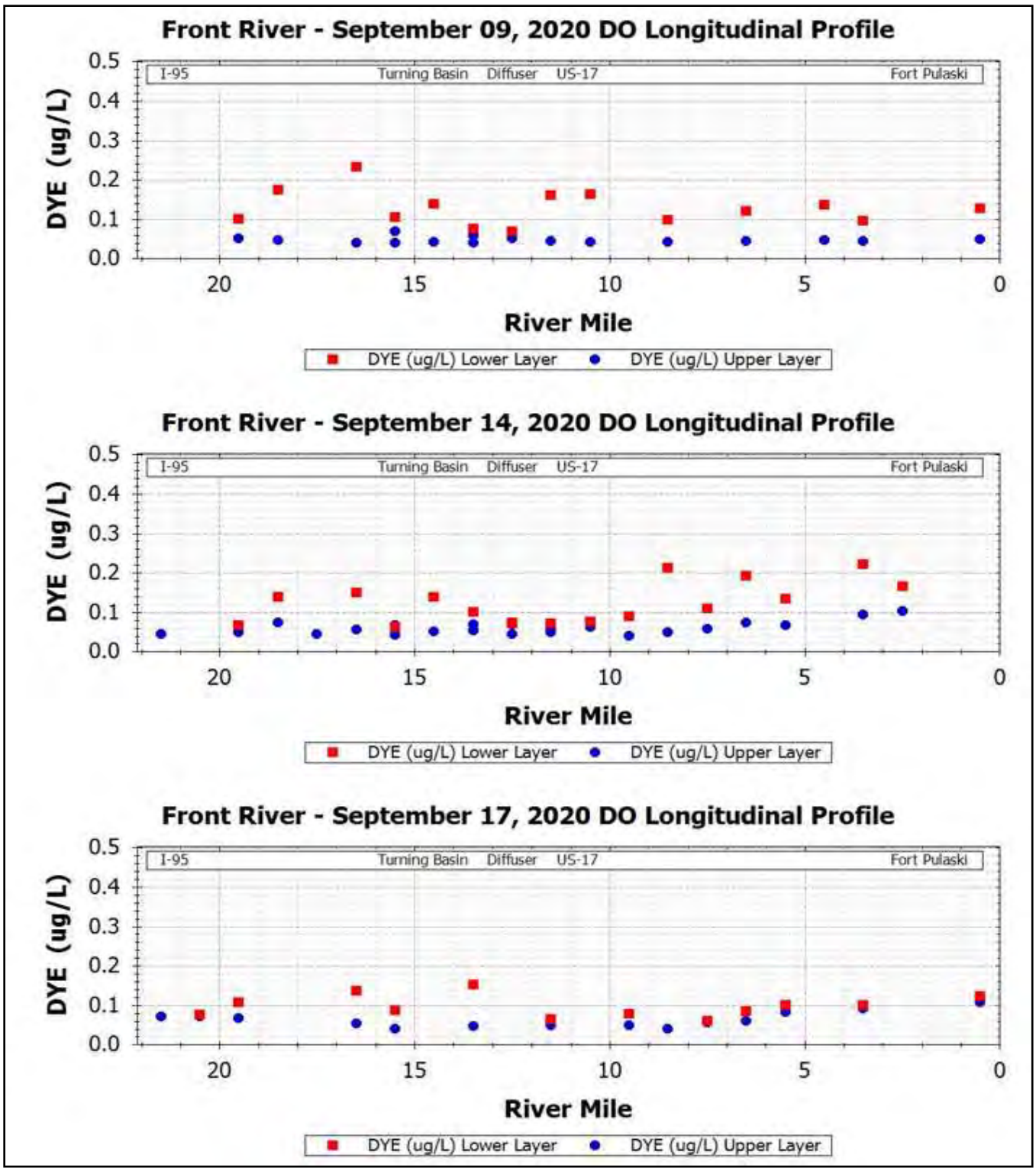


Figure E-29 September 09, 2020 through September 17, 2020 dye profile sampling

From September 18, 2020 to September 23, 2020, the impact of the September 15, 2020 Upriver dye injection is seen with an increase in dye concentrations to 0.3 µg/L. The Upriver dye injection caused an increase of approximately 0.1 µg/L in the lower layer and 0.05 µg/L increase in the upper layer throughout the Front River. See ***Figure E-30***.

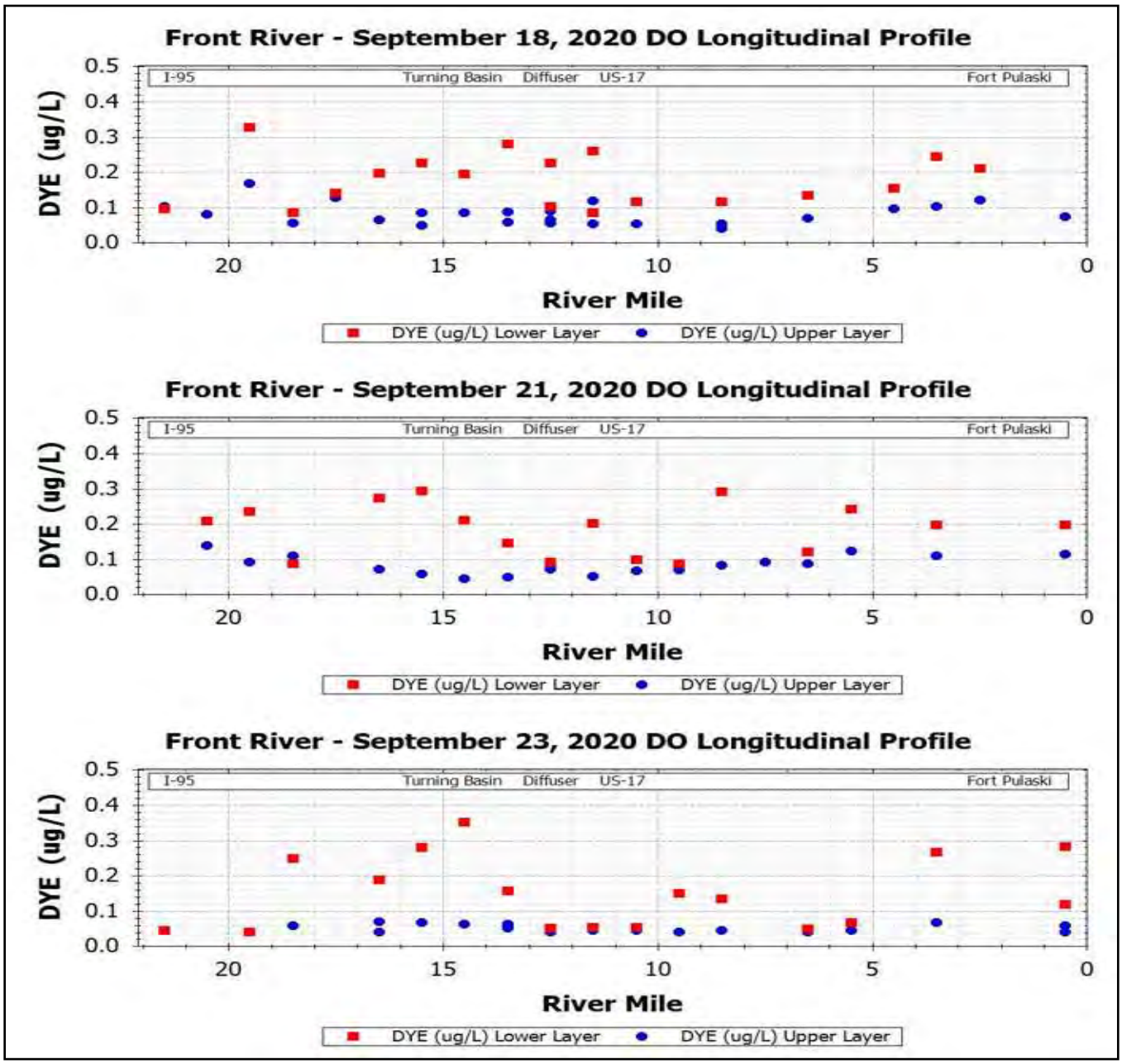


Figure E-30 September 18, 2020 through September 23, 2020 dye profile sampling

On September 25, 2020, the last day of the SUR sampling, dye concentrations of up to 0.25 µg/L were still present, with the dye plume moving gradually downstream. Results are presented in ***Figure E-31***.

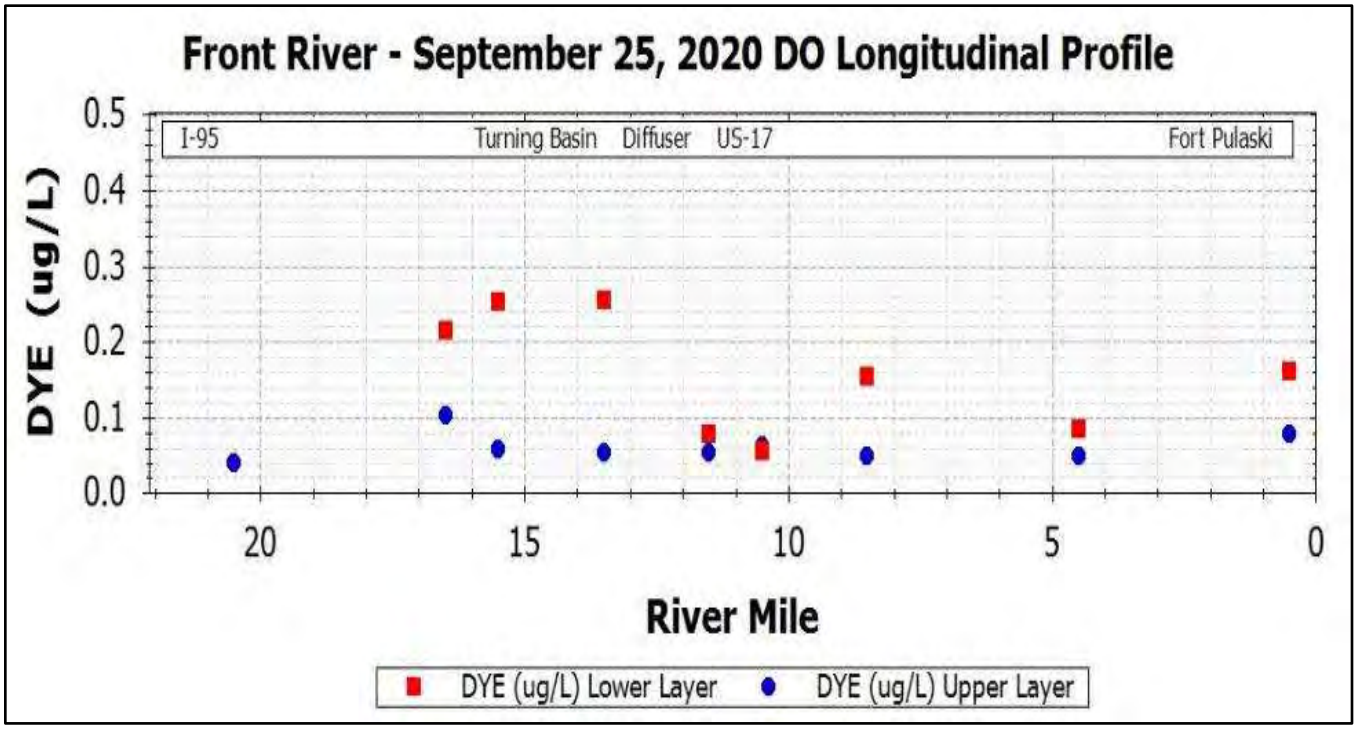


Figure E-31 September 25, 2020 dye profile sampling

Figure E-32, ***Figure E-33*** and ***Figure E-34*** show timeseries' of the dye concentrations at Fort Pulaski, the Turning Basin (RM 18.5) and the USACE Depot. Based on these figures, it was roughly estimated the dye and the injected oxygen would stay in the Front River for three weeks to a month, dependent on upstream flows and tidal conditions. This supports the findings from Section 7.3 of the main report, where DO increases were observed to remain for more than a week.

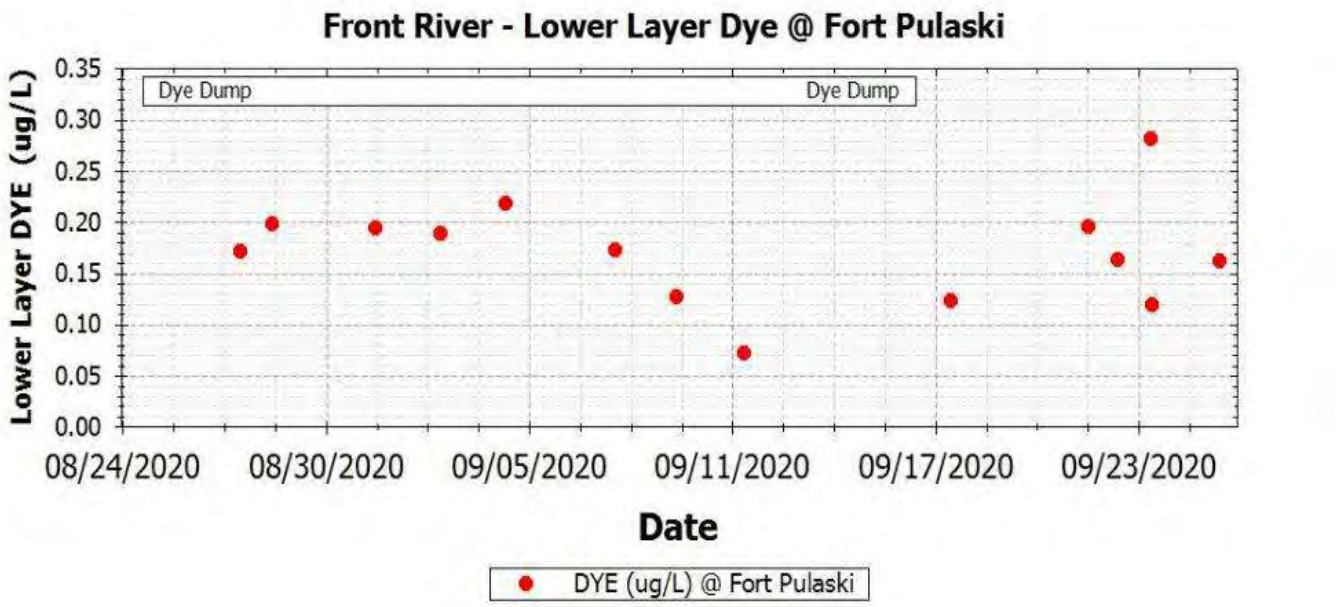


Figure E-32 Front River - lower layer dye at Fort Pulaski

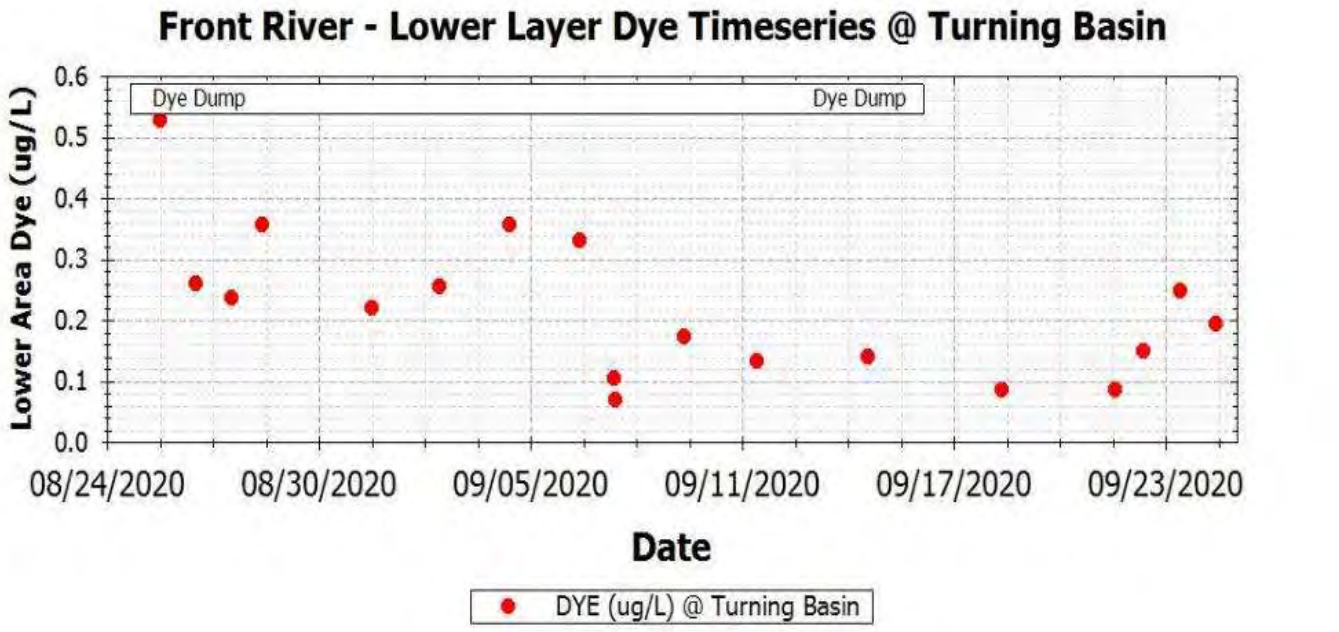


Figure E-33 Front River - lower layer dye timeseries at Turning Basin

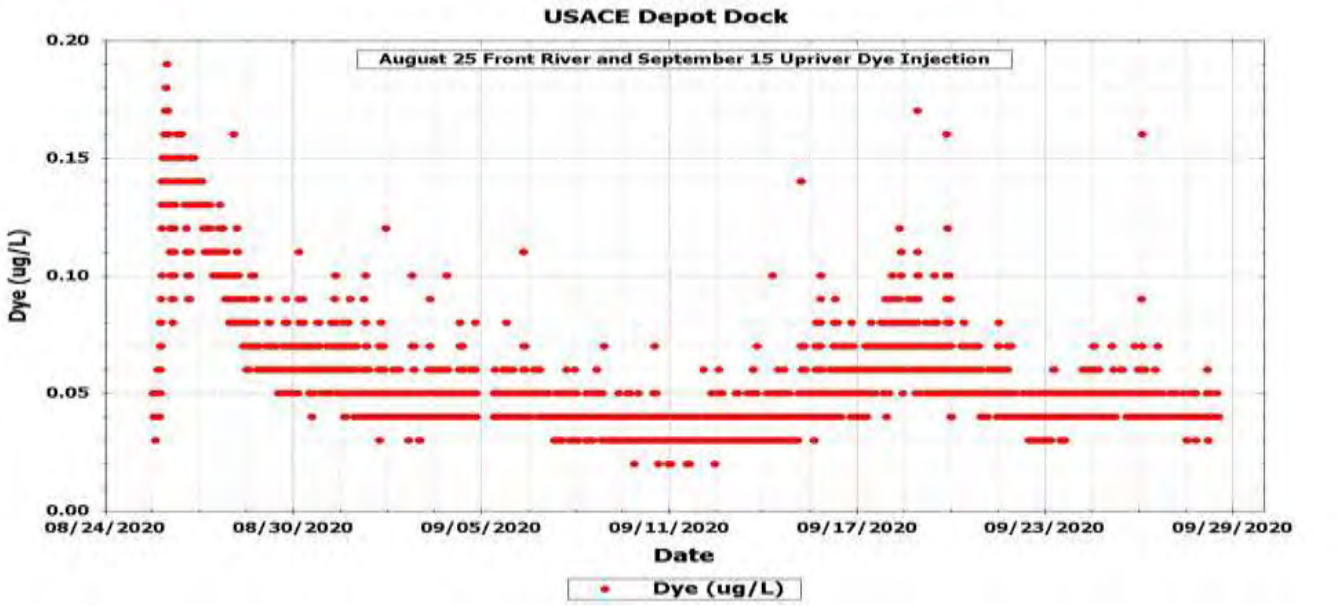


Figure E-34 Dye timeseries at USACE Depot Dock

E.4 BACK AND LITTLE BACK RIVER

Three Back and Little Back River dye releases were conducted during the SUR. The primary goal of the dye releases was to determine where in the river the dye was located and therefore where injected oxygen was entrained. Detailed near field dye and DO measurements were taken during the previous years' Test Run sampling that detailed the initial mixing and near field distribution of the dye and oxygen plumes and were not repeated, in detail, during the SUR sampling. The dates and details of the three Little Back River dye releases are presented in main report.

A summary of the Back and Little Back River dye sampling results is listed below:

- The injected dye stays in the main channel on ebb tides.
- The injected dye concentrated along the west bank on flood tides.
- When tides reverse the dye mixes across the channel.
- The injected dye remained in the Little Back River system around two to three weeks.
- Dye from the upriver dye injection was present in the upper portion of the Little Back River.

July 16, 2020 Dye Release

The July 16, 2020 dye release was conducted during an ebb tide. The following figure shows the dye plume moving downstream and mixing side to side. Results are presented in ***Figure E-35***.

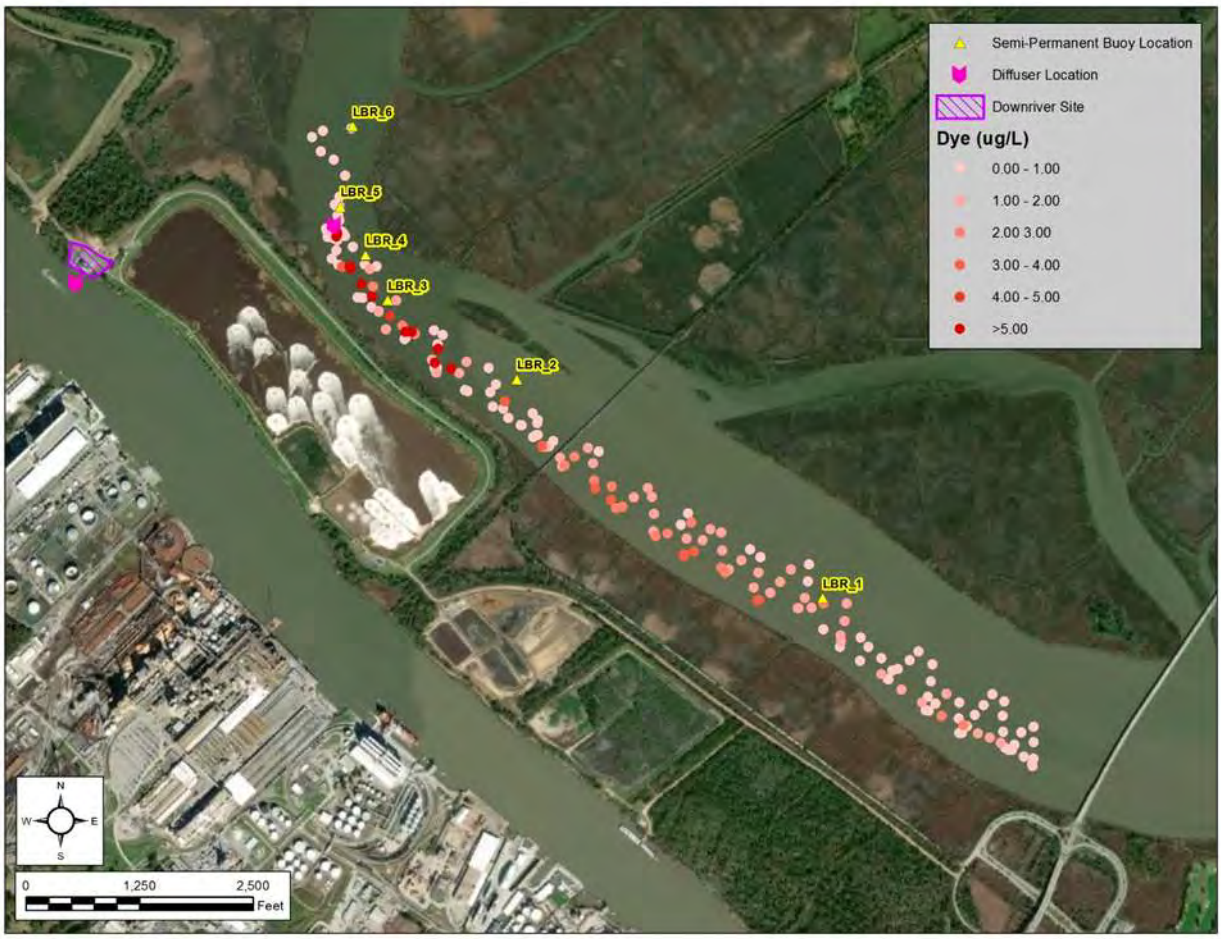


Figure E-35 July 16, 2020 Little Back River dye release during ebb tide – Diffuser to US-17 bridge

July 16, 2020 USGS Back River Dye Sampling

The USGS Georgia District collected an independent set of data during the July 16, 2020 dye injection event. The dye was released around 1000 from the Back River diffuser on a low, outgoing tide. Sampling started at the Highway 17 (US-17) Bridge, in the vicinity of the USGS gage (0219897945) Back River 0.4 miles downstream of US-17. The first baseline transect was collected approximately 60 feet upstream of the floating platform at 0930. As expected, dye values were low.

The first dye cross-section was collected between the Highway 17 bridge and the abandoned railroad bridge. Two event cross-sections were collected approximately 1.2 miles upstream of 0219897945, in between the two bridges. The dye was highly visible during these cross-sections. ***Figure E-36*** through ***Figure E-38*** show the cross-section dye concentrations at the top, middle, and bottom portions of the river, along with a width depth profile of the river. The dye is well mixed top to bottom, but not across the river. The dye tends to stay in the main river channel located 80 to 700 feet from the right bank.

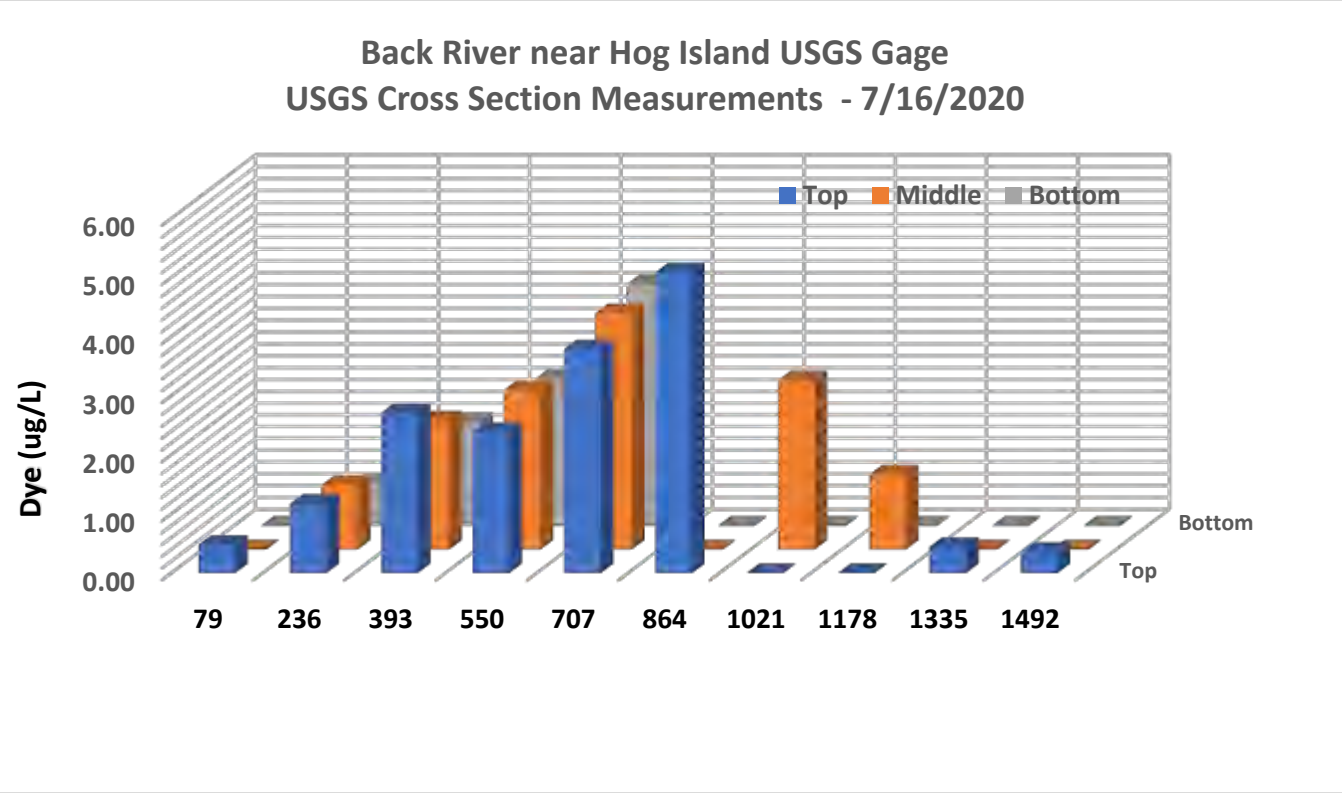


Figure E-36 July 16, 2020 USGS dye cross-section #1 Back River downstream US-17

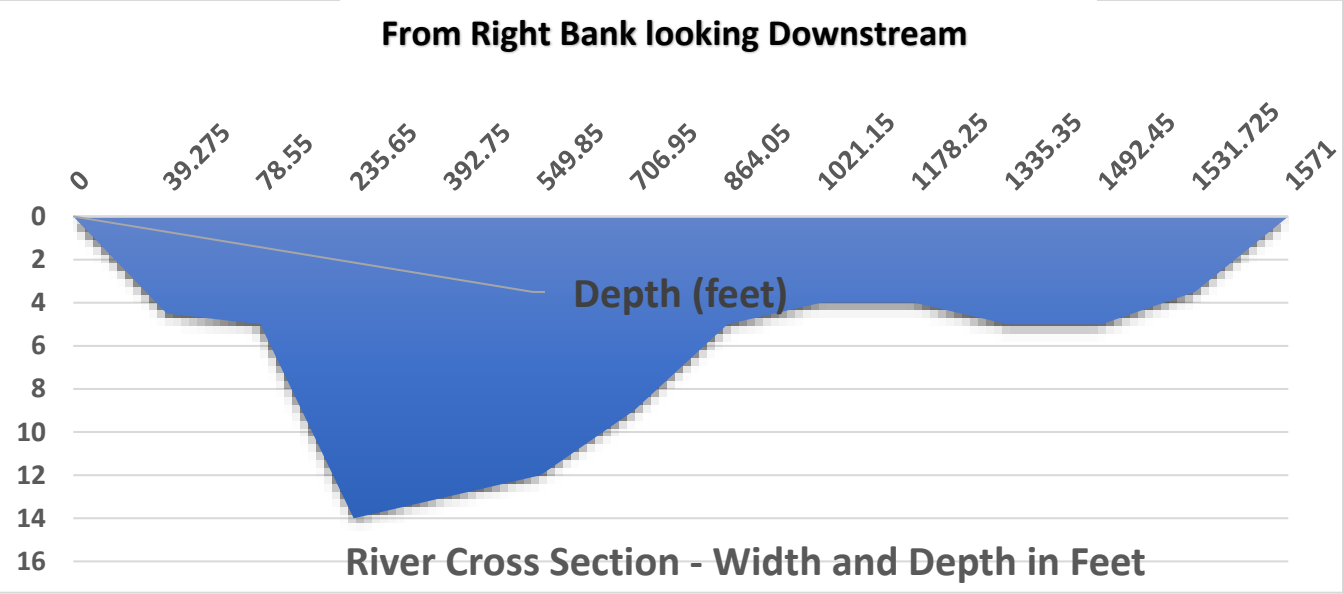


Figure E-37 July 16, 2020 USGS Cross-section Back River downstream US-17

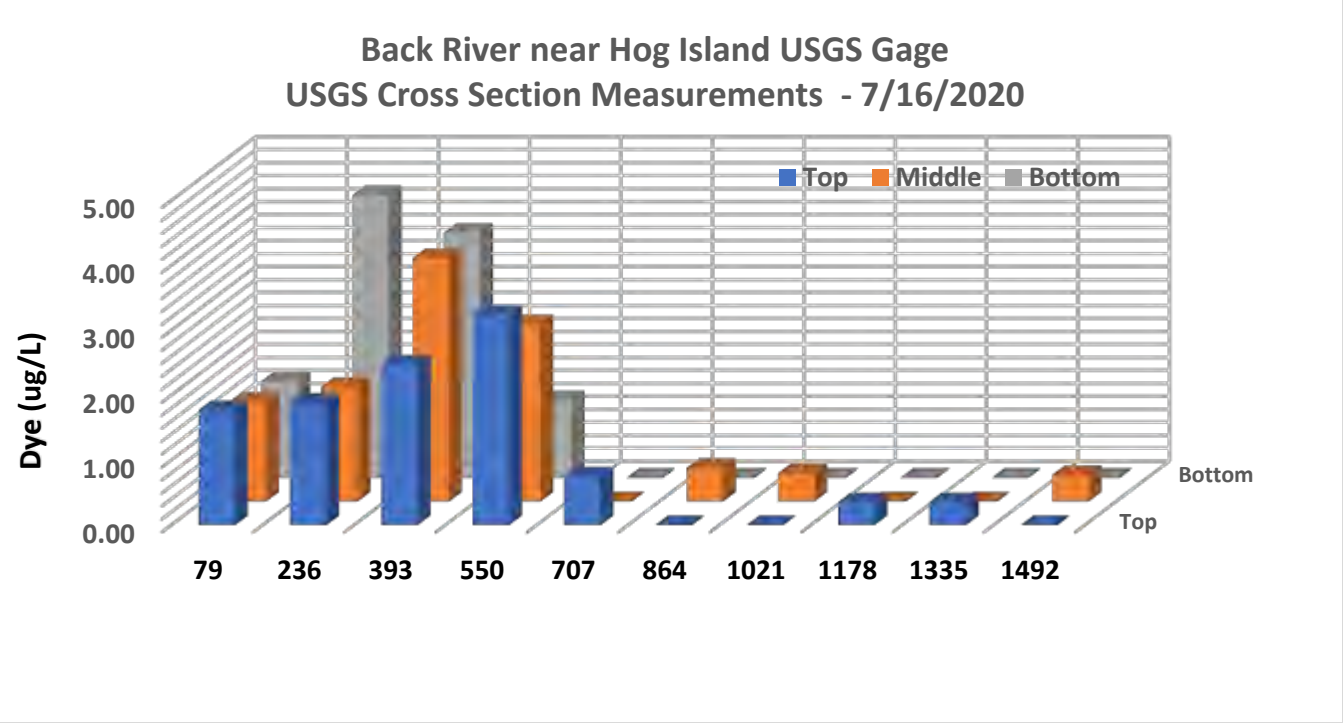


Figure E-38 July 16, 2020 USGS dye cross-section #2 Back River downstream US-17

The dye traveled upstream and reached approximately 950 feet upstream of the old railroad bridge around 1340. Two event cross-sections were collected. ***Figure E-39*** through ***Figure E-41*** show the cross-section dye concentrations at the top, middle, and bottom portions of the river, along with a width depth profile of the river. The dye is well mixed top to bottom and across the river once the tide had reversed as seen during event #1, ***Figure E-39***. Event #2, ***Figure E-40***, shows the dye clearing out of the main channel, but still hugging the right side.

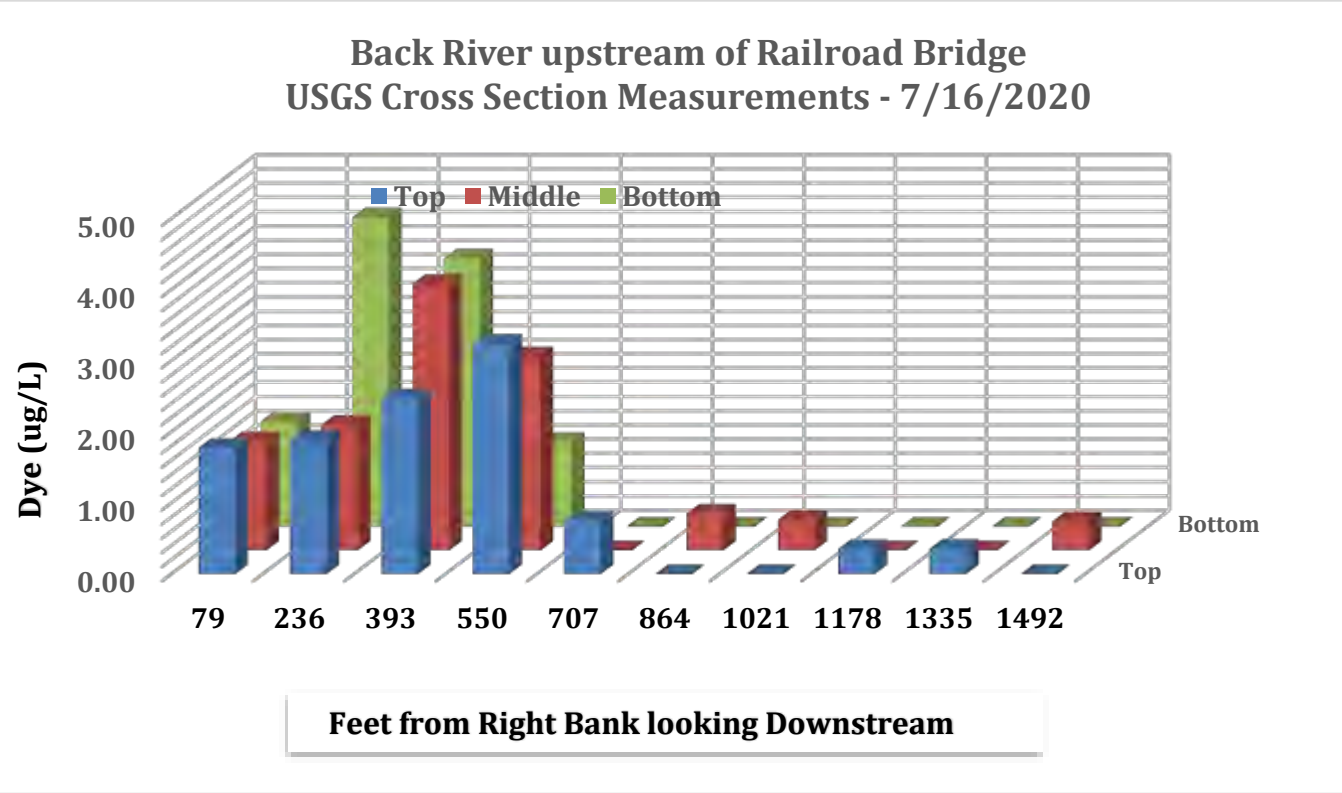


Figure E-39 July 16, 2020 USGS dye cross-section #1 Back River near Railroad Bridge

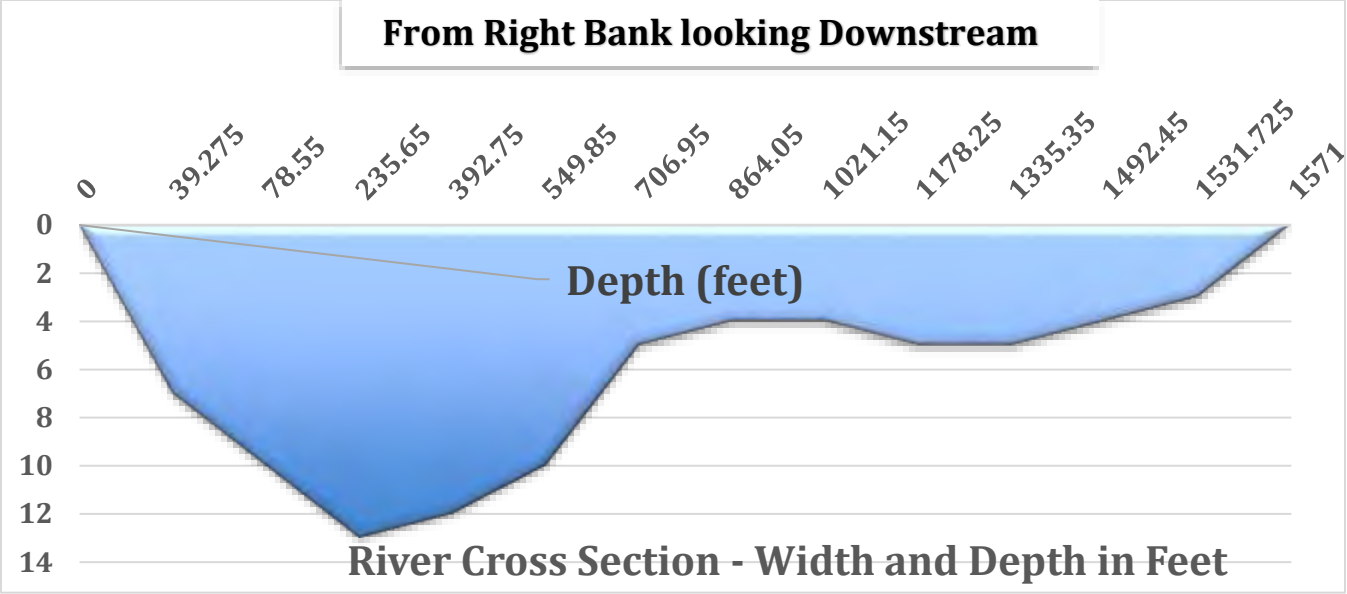


Figure E-40 July 16, 2020 USGS cross-section Back River near Railroad Bridge

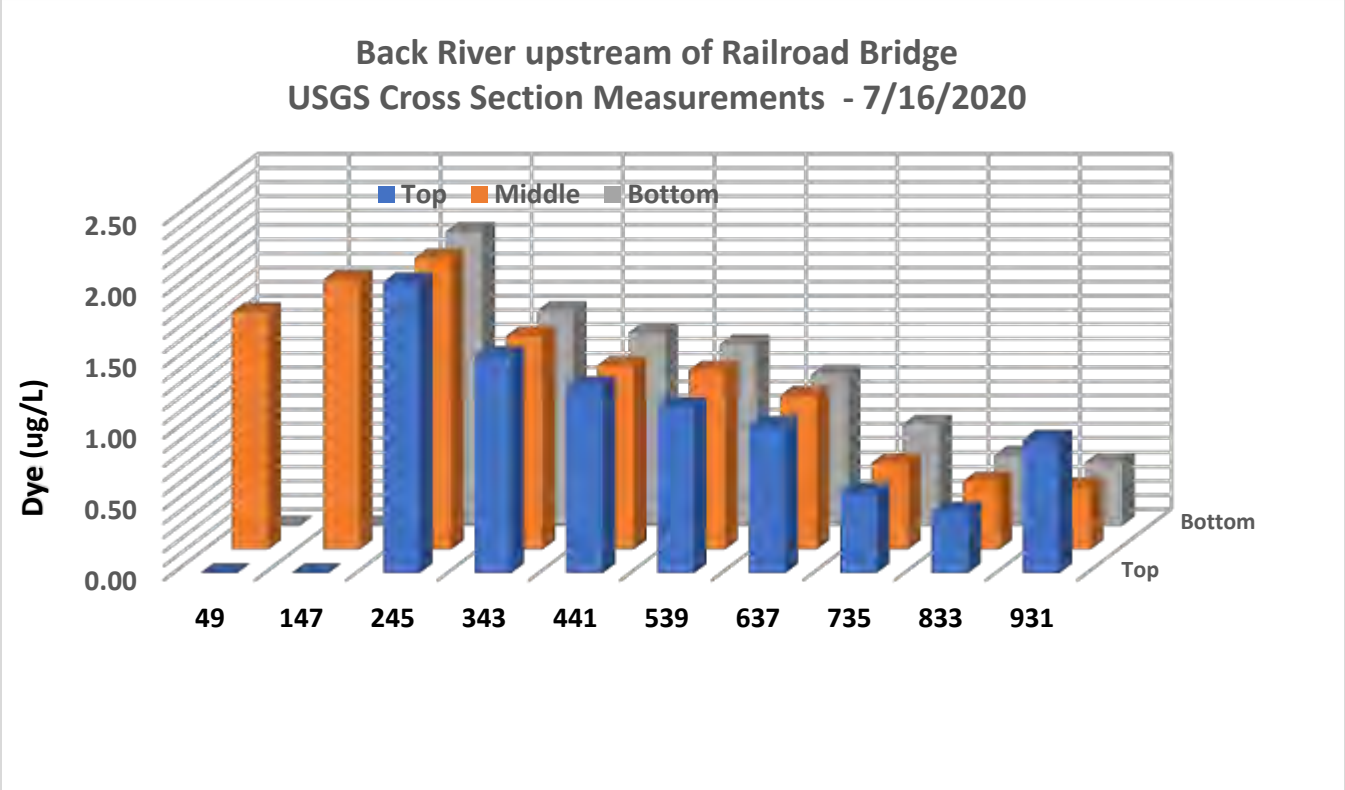


Figure E-41 July 16, 2020 USGS dye cross-section #2 Back River near Railroad Bridge

The USGS final sampling cross-section was upstream close to Hog Island USGS gage (021989793). When sampling started at this location, the visible dye plume covered approximately half of the first cross-section. There was more visible dye along the east edge of water (facing downstream) than on the west By the end of the first cross-section, and beginning of the second cross-section, the dye seemed to stretch across the entire transect, and around the YSI buoy. ***Figure E-42*** through ***Figure E-44*** show the cross-section dye concentrations at the top, middle, and bottom portions of the river, along with a width depth profile of the river. The dye is well mixed top to bottom and across the river as the tide moved upstream during event #1, ***Figure E-42***. Event #2, ***Figure E-44***, shows the dye clearing out of the main channel but still hugging the right side.

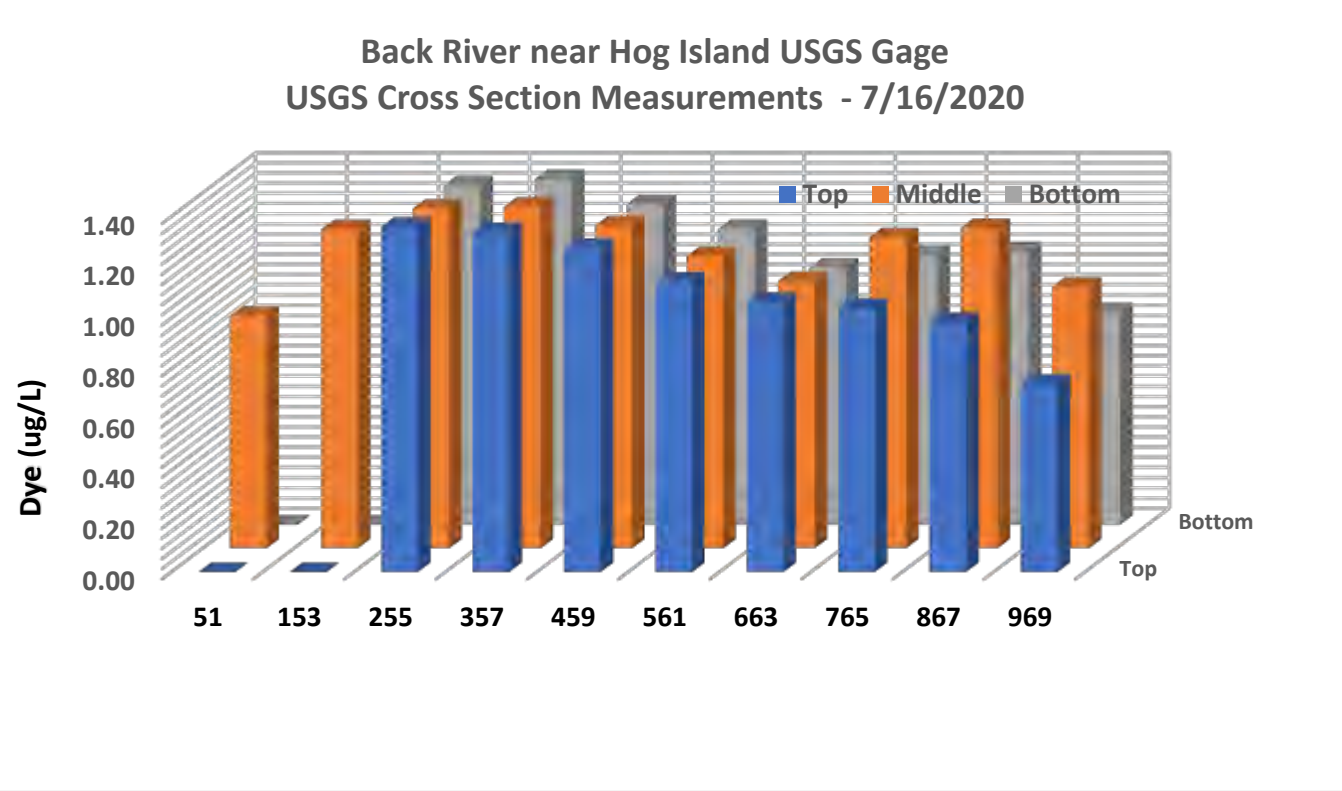


Figure E-42 July 16, 2020 USGS dye cross-section #1 Back River near Hog Island

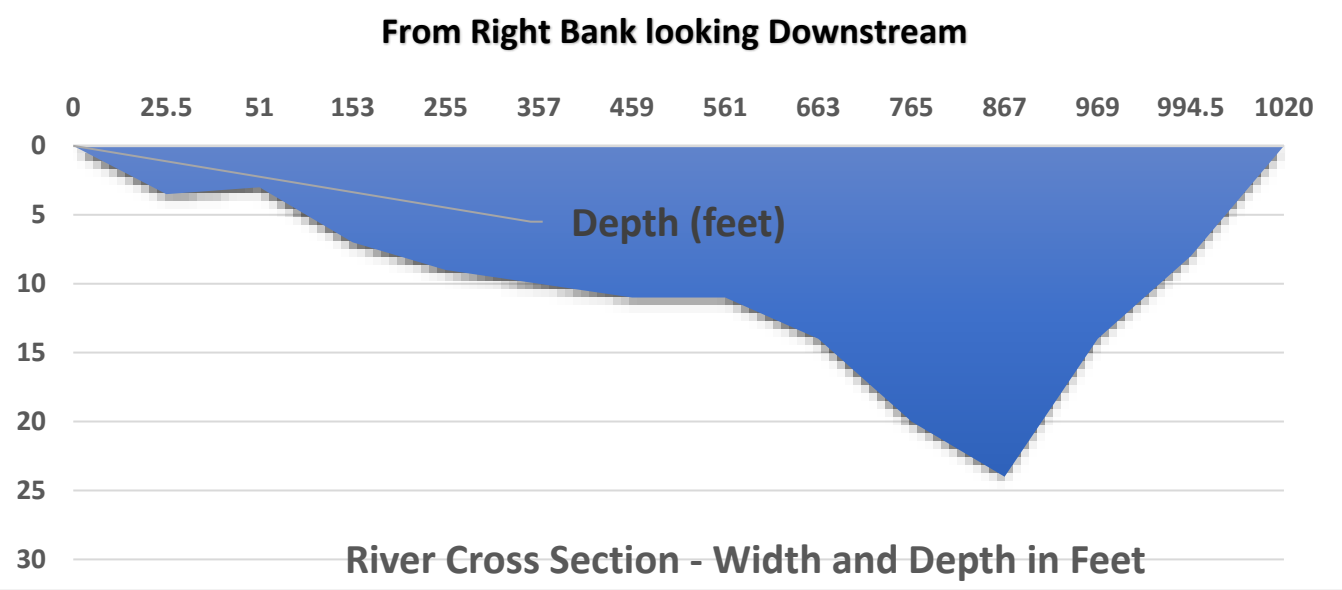


Figure E-43 July 16, 2020 USGS cross-section Back River near Hog Island

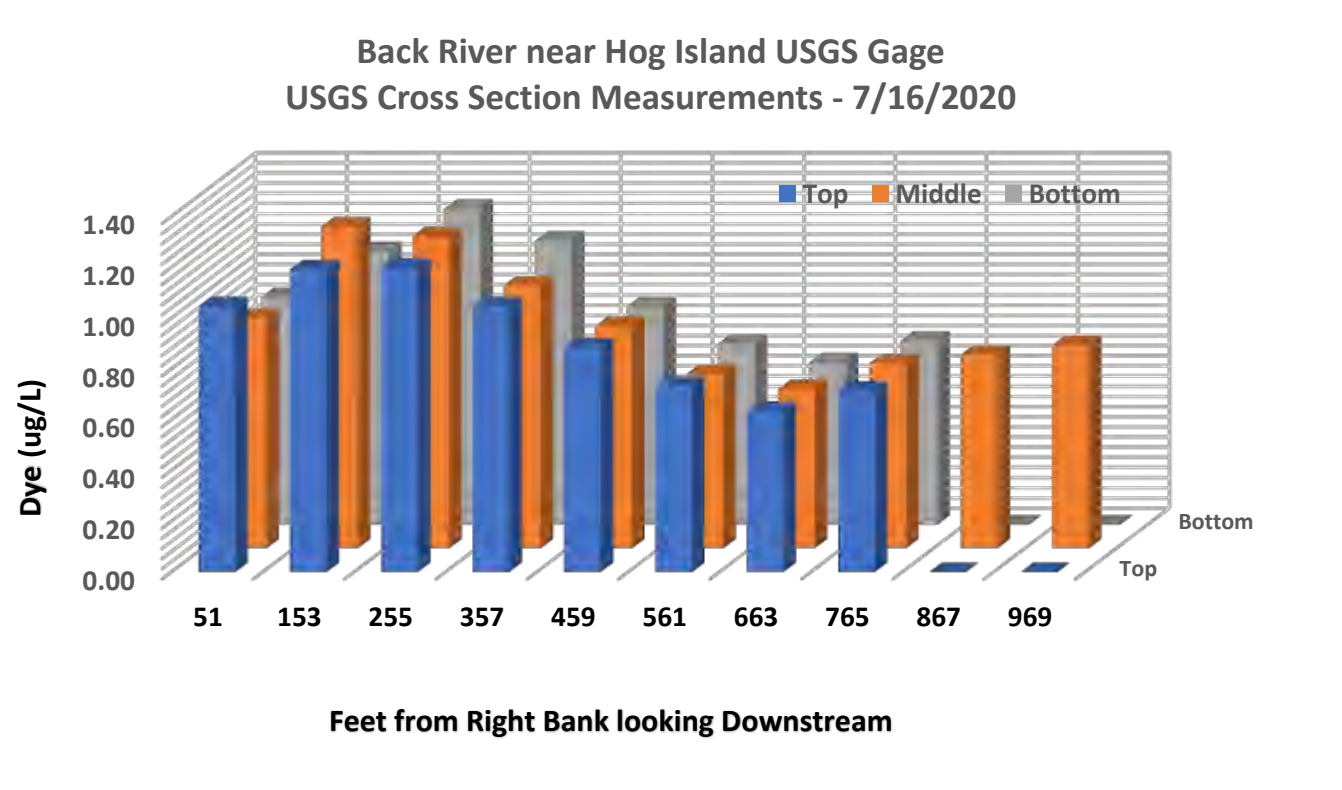


Figure E-44 July 16, 2020 USGS dye cross-section #1 Back River near Hog Island

August 12, 2020 Dye Release

The August 12, 2020 dye release was conducted on low slack tide and detailed depth profiles were taken that showed the dye was mixing bottom to top by the time it reached LBR_5 buoy, just upstream of the diffuser, as evident in ***Figure E-45***.



Figure E-45 Back River dye sampling

August 25, 2020 Dye Sampling

Similarly, to the Front River dye releases, the August 25, 2020 event best illustrates where the dye and injected DO travel to and how long the dye and injected oxygen remained in the Back River. After the 30 gallons of dye was injected, profile sampling of the river was conducted weekly to see how long the dye and the associated injected oxygen would remain in the Back River. ***Figure E-47*** through ***Figure E-51*** show the dye sampling from August 26, 2020 to September 24, 2020. Dye from the August 25, 2020 injection event stayed in the river for two to three weeks until the dye reached a background concentration of around 0.06 µg/L.

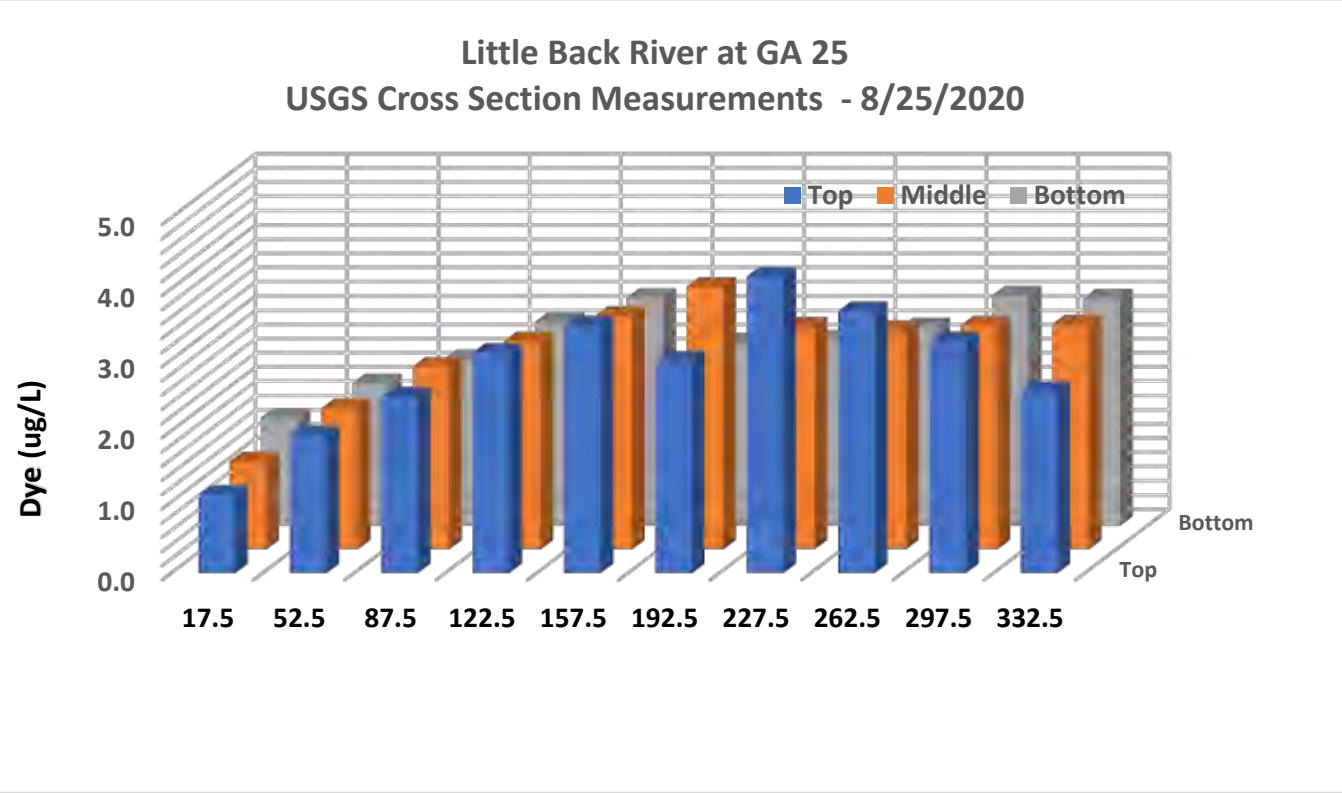
The dye was injected on a low slack tide, so the dye initially dispersed around the diffuser, moving slightly downstream, and then moved upstream on the tide as shown in Figure E-46.



Figure E-46 August 25, 2020 dye contour plot

August 25, 2020 USGS Dye Event Sampling

The USGS Georgia District collected an independent set of data at Little Back River at GA 25, near Port Wentworth, GA, near USGS Gage 021989792 during the August 25, 2020 dye injection event. A baseline cross-section was collected from 1310-1339. The first event cross-section was collected from 1431-1457. The Second event cross-section was collected from 1503-1531. The dye arrived first in the main channel and was somewhat mixed top to bottom and side to side, which is characteristic of the Little Back River. Complete mixing did not occur until the tide reverses.



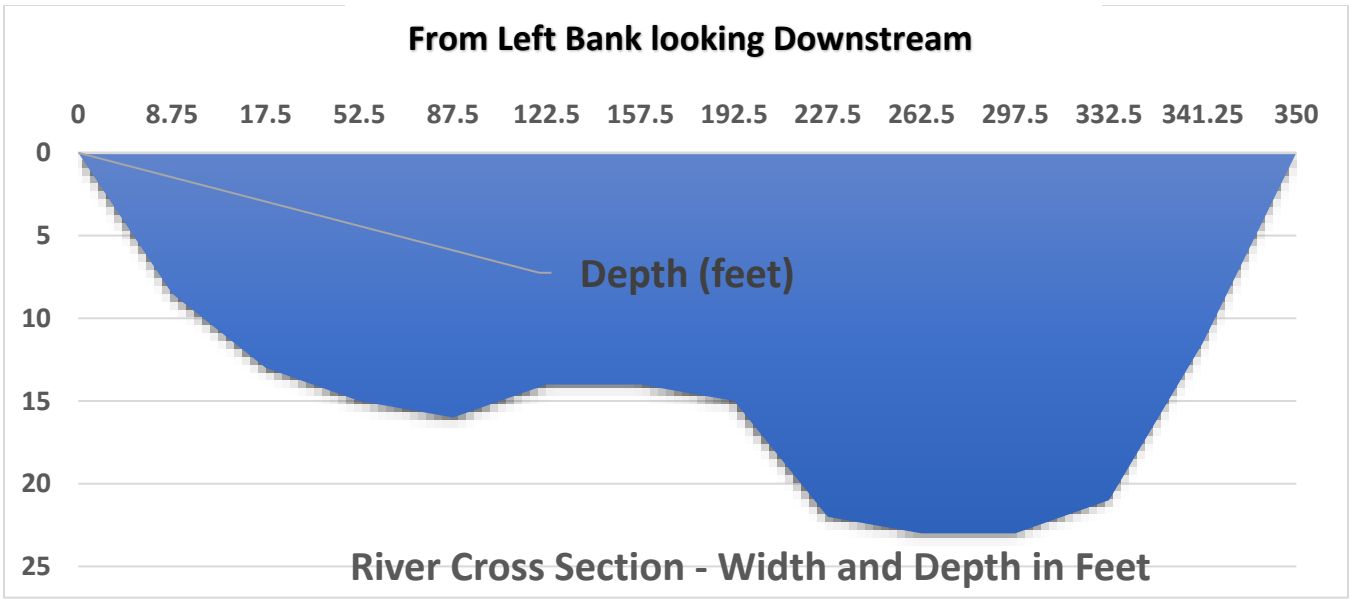


Figure E-47 First USGS Event - Little Back River at GA 25

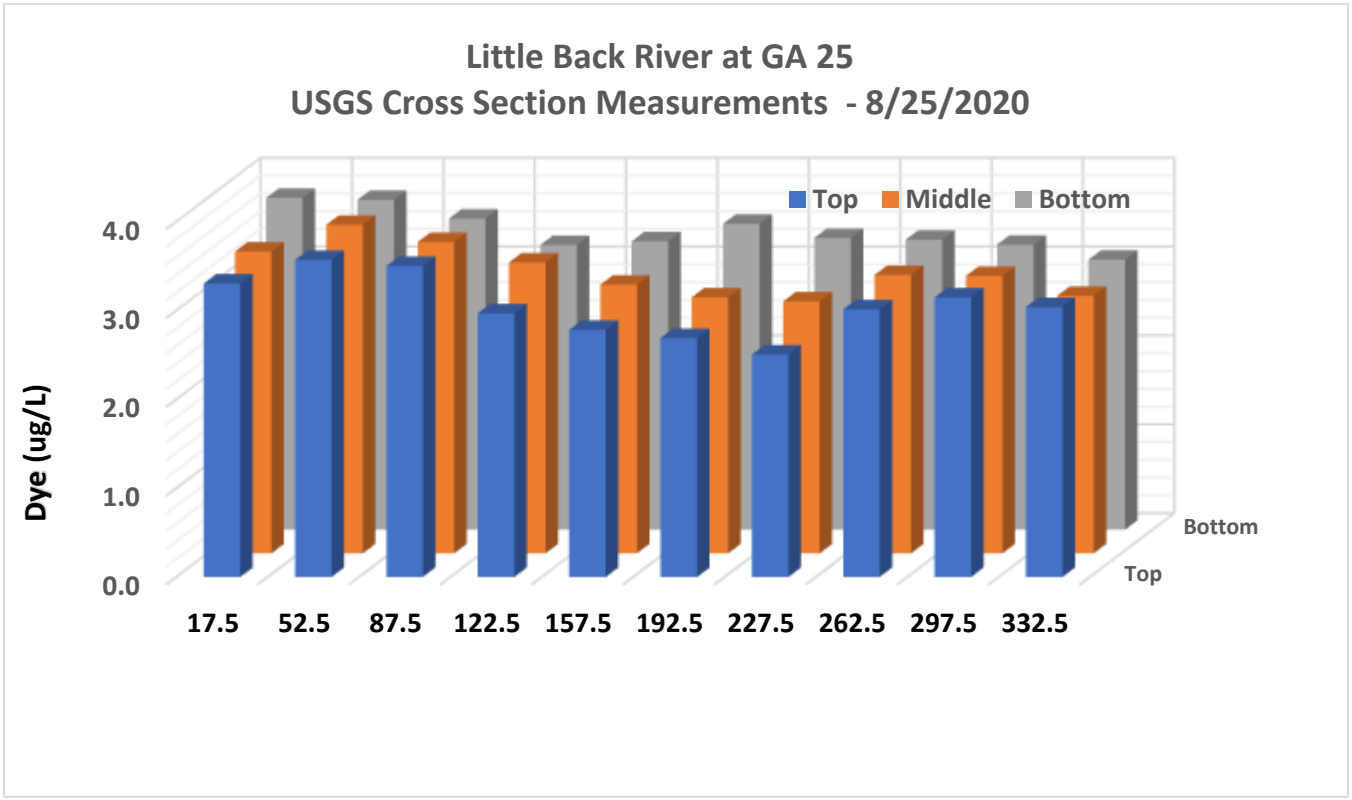


Figure E-48 Second USGS event - Little Back River at GA 25

August 25 to September 24, 2020 Dye Sampling Results

From August 26, 2020 through September 02, 2020, the dye was well distributed throughout the Little Back River, with the higher dye concentrations moving toward the mouth into the Front River. See ***Figure E-49***.

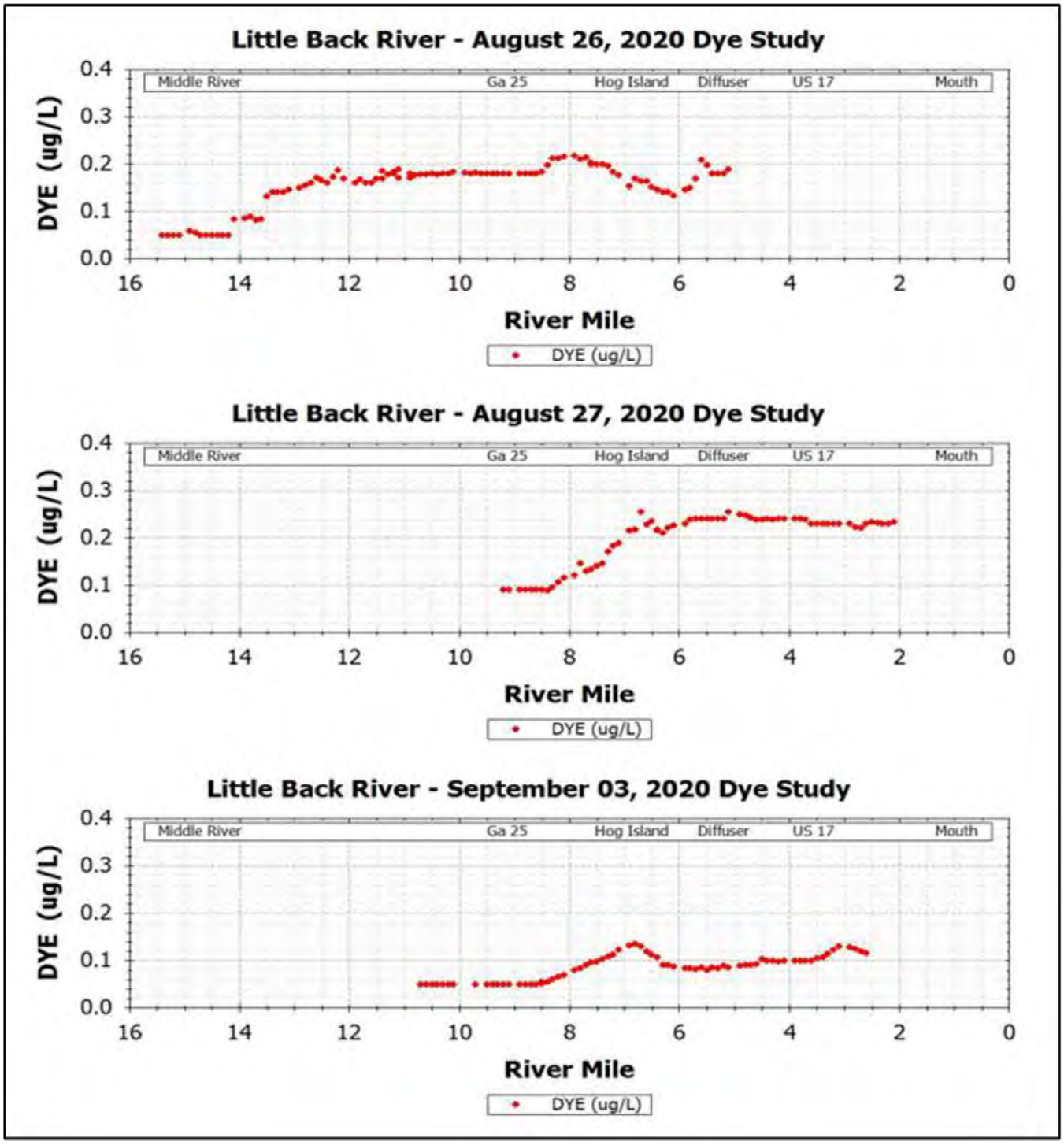


Figure E-49 August 26 to September 03, 2020 Little Back River dye sampling

From August 27, 2020 through August 31, 2020, the dye was moving out of the Little Back River. Dye from the Upriver dye releases undertaken September 15, 2020 were detected in the Little Back River on September 17 and September 24, 2020, as seen by the small spikes between RM 16 and RM 12. See ***Figure E-50***.

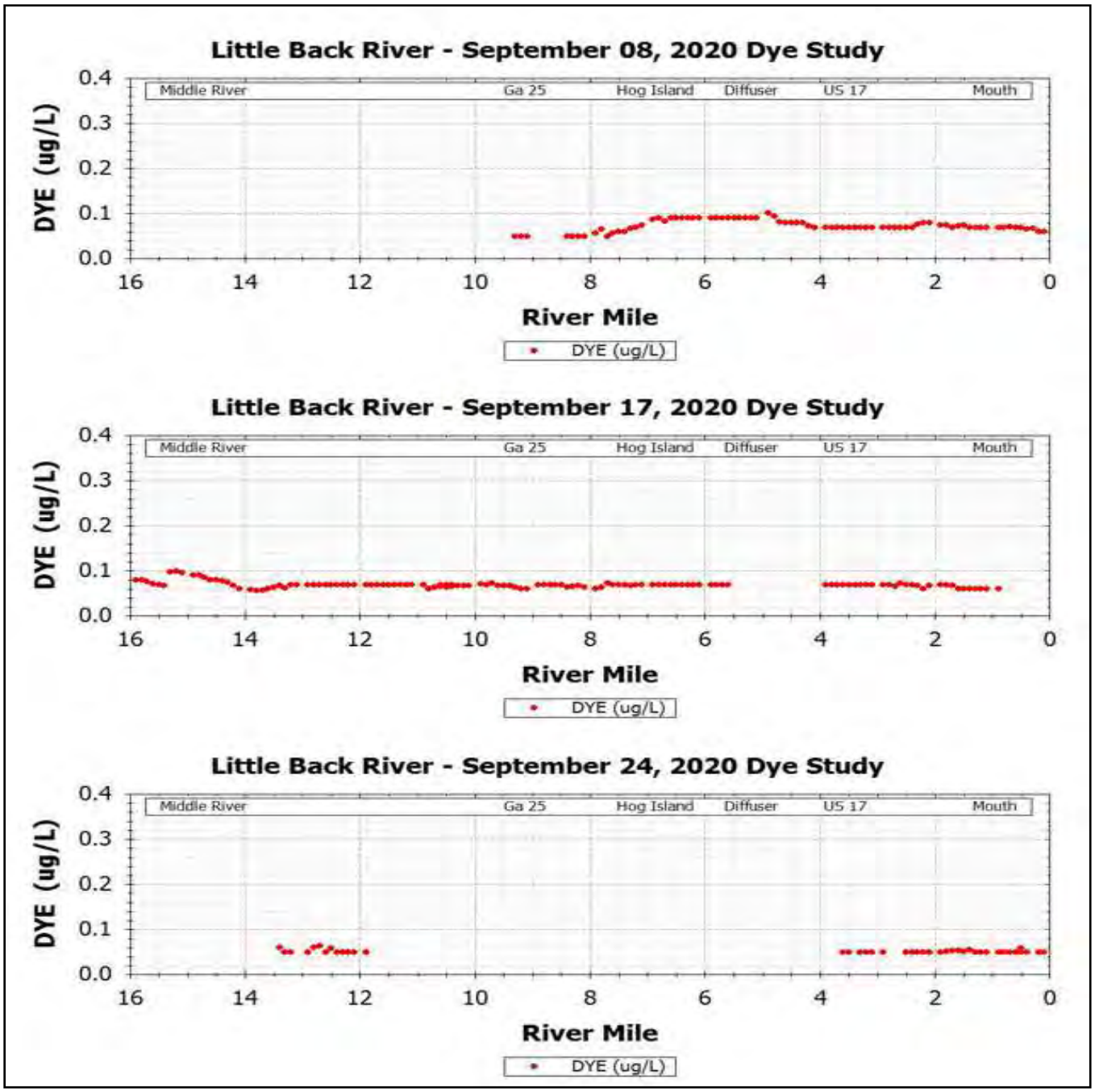


Figure E-50 September 08, 2020 to September 24, 2020 Little Back River dye sampling

Timeseries plots of dye concentrations at the Little Back River mouth, presented in ***Figure E-51***, show how the dye decreased to background levels in two to three weeks. This long retention time supports the notion that the river is successful at retaining injected oxygen, as proposed in Section 7.3 and Section 10.0 of the main report..

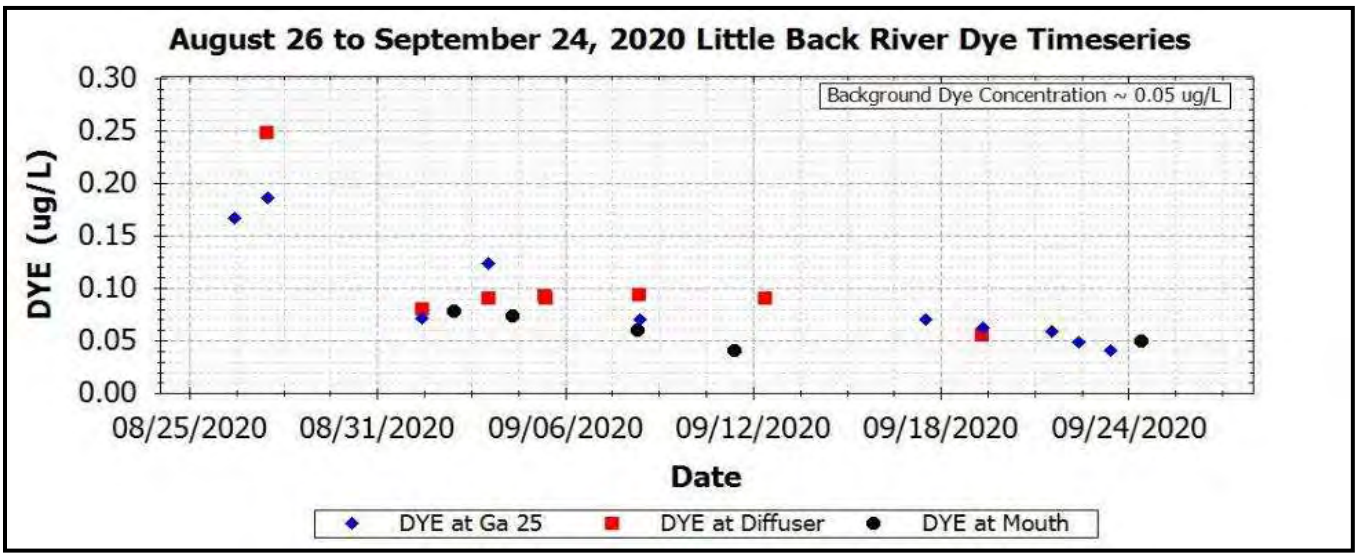


Figure E-51 August 26 to September 24, 2020 timeseries at Little Back River mouth

APPENDIX F DATA COLLECTION QA/QC

APPENDIX F DATA COLLECTION QA/QC

Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Task: 10
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PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG^2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX F BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document is provided as Appendix F of the SUR Report and is referred to in the main body of the report in Section 3.0 and 3.1.

APPENDIX F TABLE OF CONTENTS

APPENDIX F DATA COLLECTION QA/QC F-1

F.1 Semi-permanent Buoy Data F-7

F.2 Profile Data F-12

F.3 Drift Data F-19

F.4 Semi-Permanent, Profile, Drift DO Calibration Drift Correction F-30

F.5 USGS Data F-45

APPENDIX F LIST OF FIGURES

Figure F-1 Upriver UR_10 buoy depth QA/QC example F-9
Figure F-2 Upriver UR_10 buoy DO QA/QC example F-9
Figure F-3 Upriver UR_16a buoy QA/QC data DO and specific conductivity F-10
Figure F-4 September 22, 2020 profile QA/QC depth and DO F-15
Figure F-5 September 22, 2020 profile location map QA/QC F-16
Figure F-6 LBR_073120_OT_D1 drift location map QA/QC F-25
Figure F-7 LBR_073120_OT_D1 drift depth QA/QC timeseries F-26
Figure F-8 LBR_073120_OT_D1 drift DO QA/QC timeseries F-26
Figure F-9 Upriver buoy diffuser near-field observed DO concentration discontinuities F-30
Figure F-10 Back River buoy 1 uncorrected and corrected observed DO concentration F-31
Figure F-11 Back River buoy 2 uncorrected and corrected observed DO concentration F-32
Figure F-12 Back River buoy 3 uncorrected and corrected observed DO concentration F-32
Figure F-13 Back River buoy 4 uncorrected and corrected observed DO concentration F-33
Figure F-14 Back River buoy 5 uncorrected and corrected observed DO concentration F-33
Figure F-15 Back River buoy 6 uncorrected and corrected observed DO concentration F-34
Figure F-16 Back River buoy 7 uncorrected and corrected observed DO concentration F-34
Figure F-17 Back River buoy 8 uncorrected and corrected observed DO concentration F-35
Figure F-18 Front River Depot sonde uncorrected and corrected observed DO concentration F-35
Figure F-19 Upriver buoy 9 uncorrected and corrected observed DO concentration F-36
Figure F-20 Upriver buoy 10 uncorrected and corrected observed DO concentration F-36
Figure F-21 Upriver 11 uncorrected and corrected observed DO concentration F-37
Figure F-22 Upriver buoy 12 uncorrected and corrected observed DO concentration F-37
Figure F-23 Upriver 12a sonde uncorrected and corrected observed DO concentration F-38
Figure F-24 Upriver buoy 13 uncorrected and corrected observed DO concentration F-38
Figure F-25 Upriver buoy 14 uncorrected and corrected observed DO concentration F-39
Figure F-26 Upriver buoy 15 uncorrected and corrected observed DO concentration F-39
Figure F-27 Upriver buoy 16 uncorrected and corrected observed DO concentration F-40
Figure F-28 Upriver 16a sonde uncorrected and corrected observed DO concentration F-40
Figure F-29 Upriver buoy 17 uncorrected and corrected observed DO concentration F-41
Figure F-30 Upriver buoy 18 uncorrected and corrected observed DO concentration F-41
Figure F-31 Upriver Hardeeville sonde uncorrected and corrected observed DO concentration F-42
Figure F-32 Back River profile uncorrected and corrected observed DO concentration F-42
Figure F-33 Back River drift uncorrected and corrected observed DO concentration F-43
Figure F-34 Front River drift uncorrected and corrected observed DO concentration F-43
Figure F-35 Upriver profile uncorrected and corrected observed DO concentration F-44
Figure F-36 Upriver drift uncorrected and corrected observed DO concentration F-44
Figure F-37 Location of USGS gages used for the SUR sampling F-46

APPENDIX F LIST OF TABLES

Table F-1 Attributes of semi-permanent buoys used for the SUR study data collection F-7
Table F-2 Data counts for monitoring constituents collected using semi-permanent buoys in the Front River, Back River, and Upriver F-8
Table F-3 Percentage of inconsistent values for semi-permanent buoys F-11
Table F-4 Attributes of depth profiles collected on the Back River F-12
Table F-5 Attributes of depth profiles collected on the Front River F-13
Table F-6 Attributes of depth profiles collected Upriver F-14

Table F-7 Data counts for profile constituents collected on the Back River, Front River, and Upriver..... F-14
Table F-8 Percentage of boat repositioning values for profile data F-17
Table F-9 Attributes of drift data collected in the Back River..... F-20
Table F-10 Attributes of drift data collected in the Front River F-21
Table F-11 Attributes of drift data collected Upriver F-22
Table F-12 Data counts for drift constituents collected on the Back River, Front River, and Upriver F-23
Table F-13 Percentage of inconsistent values for drift data F-27
Table F-14 USGS gages data compiled for the SUR sampling..... F-45

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
°C	degrees Celsius
BGA	blue-green algae
DO	dissolved oxygen
EDT	Eastern Daylight Time
EST	Eastern Standard Time
ID	identification
Lat	latitude
LBR	Back River
LFR	Front River
Lon	longitude
mg/L	milligrams per liter
µg/L	micrograms per liter
MIDL	middle
mm Hg	millimeters of mercury
µS/cm	microsiemens per centimeter
PPT	parts per thousand
PSI	pound per square inch
Sal	salinity
UR	Upriver
QA/QC	quality assurance/quality control
RFU	relative fluorescence units
RWT	Rhodamine WT
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey

F.1 SEMI-PERMANENT BUOY DATA

A total of 252 sonde data files were collected from instruments deployed from semi-permanent buoys during Startup Run (SUR) sampling event. Eighty-eight files were collected in the Back River, 20 files were collected in the Front River, and 144 files collected Upriver. Data collection was logged at five-minute intervals and spanned the period from July 14, 2020 (instrument deployment date) to September 25, 2020. The SUR period began July 25, 2020 and ended September 22, 2020. Data were retrieved from the semi-permanent buoy sondes and uploaded by the field team a shared drive protected by authorized access (OneDrive). Each semi-permanent buoy data file was given a consistent file name using naming conventions as follows:

River_Location_BeginDate_EndDate, where:

- River = LBR (Back River), LFR (Front River), or UR (Upriver)
- Location = Buoy number (e.g. 1, 5, 12, 16a, etc), Depot, or Hardeeville
- BeginDate = beginning date of data within the file
- EndDate = ending date of data within the file

The Quality Assurance/Quality Control (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 Water Resources Database (WRDB) database, and plotted the data in timeseries format. ***Table F-1*** provides attribute information for each semi-permanent buoy used for SUR data collection, including the River, station ID, latitude, longitude, and the number of raw data records collected at each location. ***Table F-2*** provides a list of constituents obtained for semi-permanent buoys and the number of raw records in the WRDB database for each constituent.

Table F-1 Attributes of semi-permanent buoys used for the SUR study data collection

River	Station ID	Latitude	Longitude	Raw Data Count
Back River	LBR_1	32.105099	-81.100601	140,760
Back River	LBR_2	32.112202	-81.111000	132,888
Back River	LBR_3	32.114799	-81.115402	158,636
Back River	LBR_4	32.116199	-81.116096	132,640
Back River	LBR_5	32.117699	-81.116898	132,920
Back River	LBR_6	32.120098	-81.116302	158,696
Back River	LBR_7	32.124199	-81.114799	132,976
Back River	LBR_8	32.129902	-81.115898	172,716
Front River	LFR_Depot	32.081250	-81.081140	189,497
Upriver	UR_9	32.350484	-81.161906	137,784
Upriver	UR_10	32.349359	-81.161236	137,784
Upriver	UR_11	32.349227	-81.161302	137,760
Upriver	UR_12	32.348973	-81.160899	138,240
Upriver	UR_12a	32.348973	-81.160899	137,744
Upriver	UR_13	32.348847	-81.160467	137,752
Upriver	UR_14	32.348813	-81.159929	166,992
Upriver	UR_15	32.348939	-81.159633	137,704

River	Station ID	Latitude	Longitude	Raw Data Count
Upriver	UR_16	32.348842	-81.158747	138,176
Upriver	UR_16a	32.348842	-81.158747	137,728
Upriver	UR_17	32.349198	-81.157143	172,100
Upriver	UR_18	32.348559	-81.155690	167,016
Upriver	UR_Hardeeville	32.341633	-81.132021	175,252
Total				**3,273,761**

Table F-2 Data counts for monitoring constituents collected using semi-permanent buoys in the Front River, Back River, and Upriver

PCode	Parameter Name	Units	Raw Data Count
BATTERY	battery voltage	volts	370,001
BGA_R	phycoerythin BGA	RFU	76,565
BGA_U	phycoerythin BGA	µg/L	76,565
CHLA_R	chlorophyll a	RFU	76,565
CHLA_U	chlorophyll a	µg/L	76,565
DEP_PSIA	water depth (pressure)	PSI	313,558
DEPTH	water depth	meters	367,381
DO	dissolved oxygen	mg/L	370,001
DO_SAT	dissolved oxygen saturation	%	370,001
RWT_R	Rhodamine WT	RFU	12,733
SALPPT	salinity	ppt	370,001
SPCOND	specific conductance	µS/cm	370,001
TDS	total dissolved solids	mg/L	53,823
WTEMP	water temperature	°C	370,001
Total			**3,273,761**

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 F-1*** and ***Figure F-2*** present the depth and dissolved oxygen (DO) timeseries, respectively at the Upriver 10 (UR_10) buoy. The data points in red were identified as being inconsistent and were associated with beginning and ending times of the approximately weekly data retrievals.

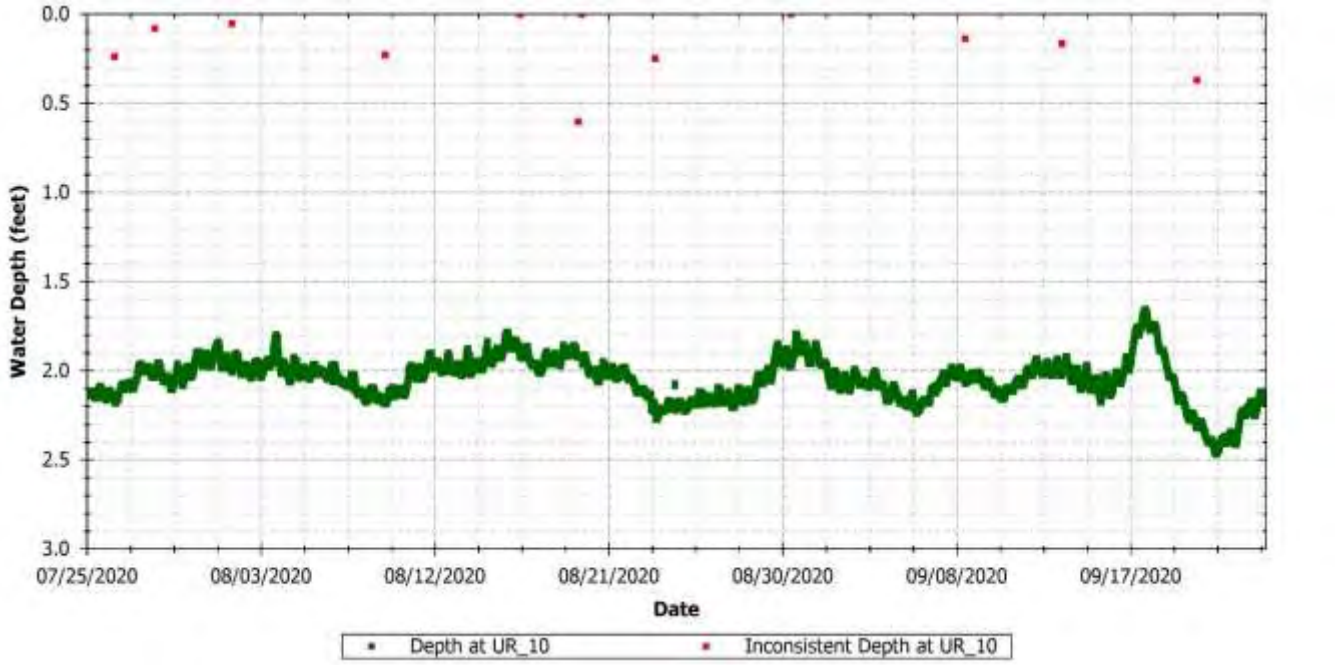


Figure F-1 Upriver UR_10 buoy depth QA/QC example

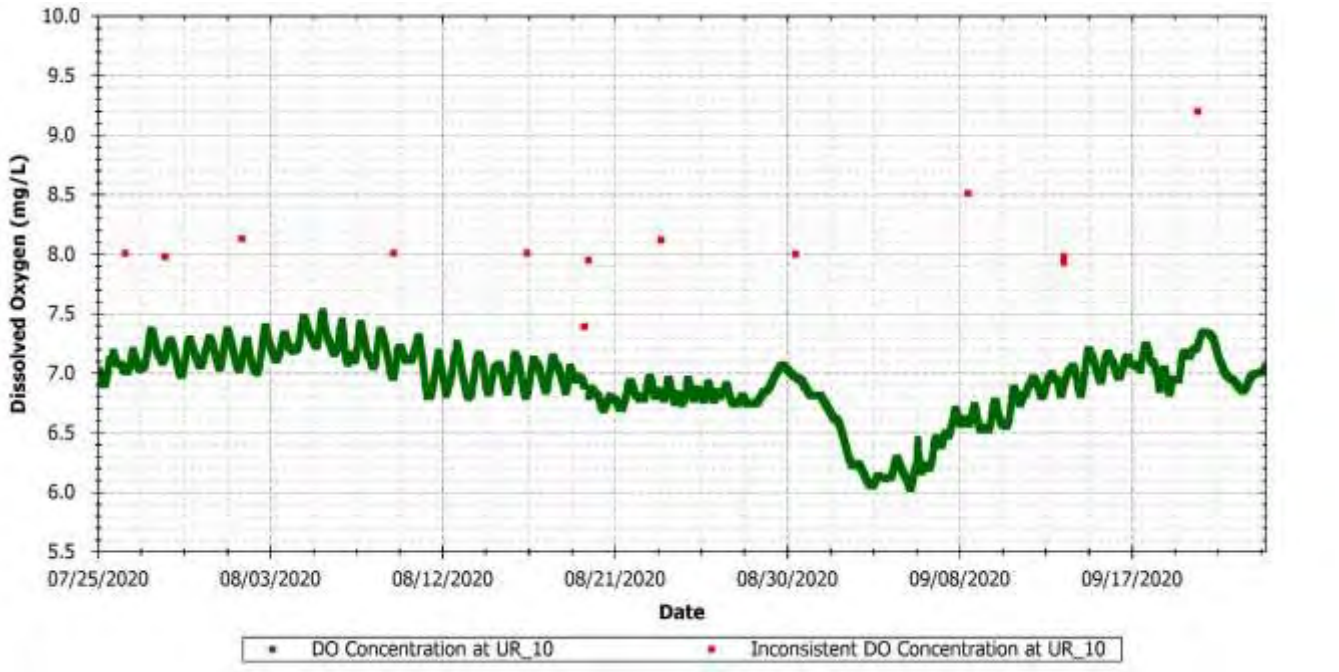


Figure F-2 Upriver UR_10 buoy DO QA/QC example

The data for buoy Upriver 16 mid-depth (UR_16a) (***Figure F-3***) contained two periods of inconsistent data. The red DO concentration points and rose colored specific conductivity points identify data that was inconsistent for buoy UR_16a. Between August 12 and August 19, 2020, it was unknown why the sonde was producing inconsistent DO and specific conductivity data. On August 19, 2020 the sonde was recalibrated and the data inconsistency was rectified. Between September 10 and September 17, 2020, based on reported DO and specific conductivity, it was theorized that the sonde was likely laying on the muddy bottom due to reduced flow. Flows increased on September 18, 2020 which lifted the sonde off the muddy bottom; however, the subsequent erratic behavior of specific conductivity and DO resulted in identifying all data after September 10, 2020 UR_16a as inconsistent.

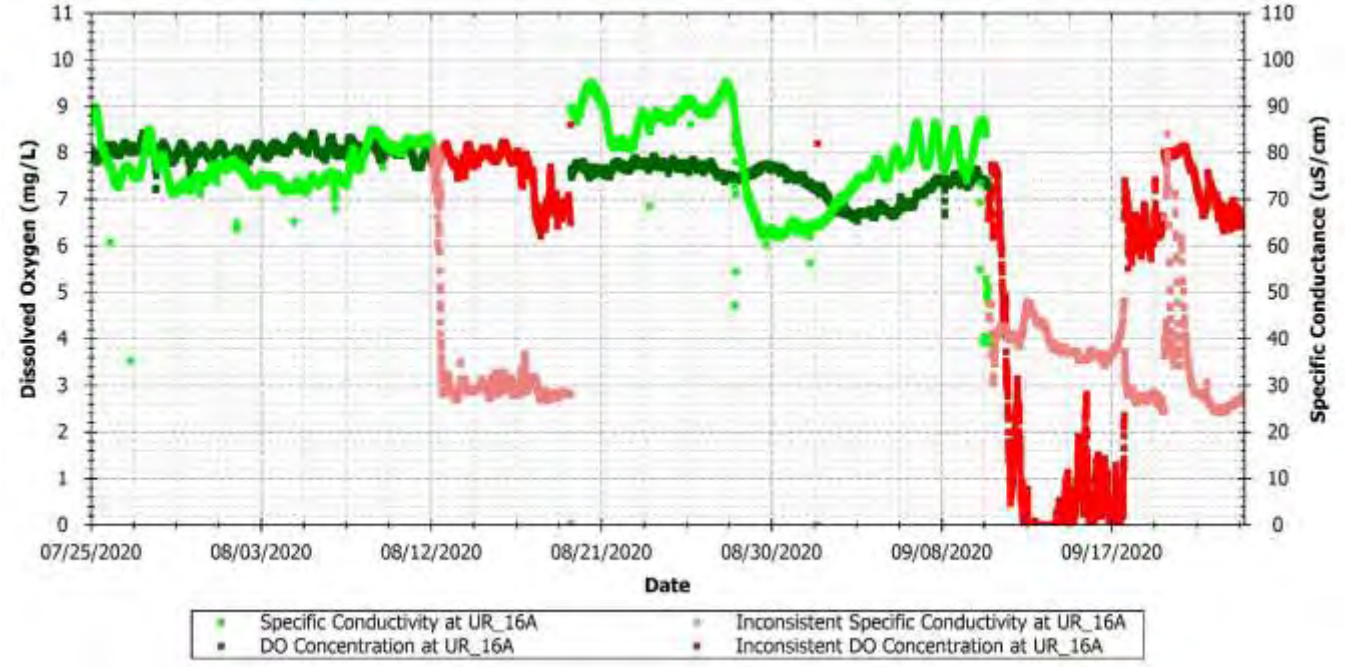


Figure F-3 Upriver UR_16a buoy QA/QC data DO and specific conductivity

The buoy data for UR_18 contained no depth observations between August 30 and September 8, 2020. The field team investigated, but could not determine the reason for the missing depth observations. The QA/QC team retained the data since it was known that the sampled depth was near the surface. Additionally, even though depth measurements were missing, the other sampled constituents were in range and trending with the constituent observations when depths were being recorded.

At each semi-permanent buoy, all dates and times identified as inconsistent were separated from the consistent data in the processed data files and project database. The percentage of inconsistent data for each semi-permanent buoy is provided in ***Table F-3***.

Table F-3 Percentage of inconsistent values for semi-permanent buoys

Station ID	Inconsistent values (%)
LBR_1	0.09
LBR_2	0.08
LBR_3	0.08
LBR_4	0.08
LBR_5	0.05
LBR_6	0.08
LBR_7	0.07
LBR_8	0.09
LFR_Depot	0.01
UR_9	0.10
UR_10	0.08
UR_11	0.12
UR_12	0.12
UR_12a	0.07
UR_13	0.08
UR_14	0.07
UR_15	0.08
UR_16	0.15
UR_16a	33.23
UR_17	0.07
UR_18	0.09
UR_Hardeeville	0.01
Total	**1.48**

F.2 PROFILE DATA

A total of 75 data files were collected by vertical profiling from boats during the SUR collection period. Eleven files were collected in the Back River, 47 files collected in the Front River, and 17 collected in the Upriver. The vertical profile data typically collected near project landmarks such as instruments buoys, USGS gaging stations, specific project mitigation features, or impactful estuary features (sometimes point sources) to augment data sets. The profile data files were uploaded by the field team to the project OneDrive were structured in two ways: (1) a single vertical profile was contained within its own *.csv or Excel workbook, or (2) multiple vertical profiles were contained within a *.csv or Excel workbook. The vertical profile data files were generally named with a consistent file naming convention as follows:

Location_Profile_Date_Sub-location_TT, where:

- Location = LBR (Back River), LFR (Front River), or UR (Upriver)
- Date = Sample Date
- Sub-location = location within river (e.g. the buoy ID number, Front River to Middle River [LFRtoMR], Fort Pulaski to Back River [PulaskitoLBR])
- 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, 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 profile data file was assigned a unique station ID for the WRDB database 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 data files for each day.

Table F-4, ***Table F-5*** and ***Table F-6*** provide identifying attribute information for each profile collected on the Back River, Front River, and Upriver respectively. 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 number of unique profiles contained in each file. ***Table F-7*** provides a list of constituents obtained for depth profiles and the number of raw records in the WRDB database for each constituent.

Table F-4 Attributes of depth profiles collected on the Back River

Station ID	Station Name	Begin DateTime	End DateTime	Count of Profiles
LBR_080420_HT_001	LBR_Profile_080420_HT	8/4/2020 11:07:53	8/4/2020 11:15:53	3
LBR_090520_IT_001	LBR1_Profile_090520_IT	9/5/2020 9:08:37	9/5/2020 9:12:39	1
LBR_090520_IT_002	LBR2_Profile_090520_IT	9/5/2020 8:58:00	9/5/2020 9:02:10	1
LBR_090520_IT_003	LBR3_Profile_090520_IT	9/5/2020 8:50:30	9/5/2020 8:54:24	1
LBR_090520_IT_004	LBR4_Profile_090520_IT	9/5/2020 8:42:29	9/5/2020 8:46:59	1
LBR_090520_IT_005	LBR5_Profile_090520_IT	9/5/2020 8:33:01	9/5/2020 8:39:25	1
LBR_090520_IT_006	LBR6_Profile_090520_IT	9/5/2020 8:13:02	9/5/2020 8:17:04	1
LBR_090520_IT_007	LBR7_Profile_090520_IT	9/5/2020 8:04:29	9/5/2020 8:09:27	1
LBR_090520_IT_008	LBR8_Profile_090520_IT	9/5/2020 7:53:14	9/5/2020 7:59:50	1
LBR_091920_IT_001	LBR_Profile1_091920_HogGage_IT	9/19/2020 8:39:24	9/19/2020 8:41:24	1
LBR_091920_IT_002	LBR_Profiles2345_091920_IT	9/19/2020 8:43:54	9/19/2020 9:12:14	4

Table F-5 Attributes of depth profiles collected on the Front River

Station ID	Station Name	Begin DateTime	End DateTime	Count of Profiles
LFR_082820_OT_001	LFR_FtPulaski_Profile_082820_OT	8/28/2020 7:54:01	8/28/2020 9:26:56	15
LFR_082820_OT_002	LFR_Profile_082820_OT	8/28/2020 8:54:11	8/28/2020 9:54:22	9
LFR_082920_OT_001	LFR_LBR_Profile_082920_OT	8/29/2020 10:04:29	8/29/2020 10:40:49	4
LFR_083120_OT_001	LFR_Profile_083120_OT_LFRtoMR	8/31/2020 10:44:02	8/31/2020 11:53:57	10
LFR_083120_OT_002	LFR_Profile_083120_OT_PulaskitoLBR	8/31/2020 10:47:49	8/31/2020 12:30:27	11
LFR_090220_OT_001	LFR_Profile_090220_LFRtoMR	9/2/2020 8:57:30	9/2/2020 10:04:46	10
LFR_090220_OT_002	LFR_Profile_090220_OT_PulaskitoLBR	9/2/2020 9:02:51	9/2/2020 10:30:55	11
LFR_090420_IT_001	LFR_Profile_090420_IT	9/4/2020 8:30:45	9/4/2020 8:40:35	2
LFR_090420_IT_002	LFR_Profile_090420_IT(2)	9/4/2020 8:48:27	9/4/2020 8:52:53	1
LFR_090420_IT_003	LFR_Profile_090420_IT(3)	9/4/2020 8:59:26	9/4/2020 9:02:40	1
LFR_090420_IT_004	LFR_Profile_090420_IT(4)	9/4/2020 10:14:38	9/4/2020 10:17:50	1
LFR_090420_IT_005	LFR_Profile_090420_IT(5)	9/4/2020 10:21:09	9/4/2020 10:35:59	2
LFR_090420_IT_006	LFR_Profile_090420_IT(6)	9/4/2020 10:39:03	9/4/2020 10:49:07	2
LFR_090420_IT_007	LFR_Profile_090420_IT_PulaskitoLBR	9/4/2020 6:57:15	9/4/2020 8:10:54	11
LFR_090520_IT_001	LFR_Profile_090520_IT	9/5/2020 9:32:30	9/5/2020 9:34:24	1
LFR_090520_IT_002	LFRLBR_Profile_090520_IT	9/5/2020 9:24:43	9/5/2020 9:26:23	1
LFR_090620_IT_001	LFR_Profile_090620_IT(1)	9/6/2020 8:23:02	9/6/2020 8:25:12	1
LFR_090620_IT_002	LFR_Profile_090620_IT(2)	9/6/2020 8:34:01	9/6/2020 8:36:05	1
LFR_090620_IT_003	LFR_Profile_090620_IT(3)	9/6/2020 8:43:00	9/6/2020 8:44:52	1
LFR_090620_IT_004	LFR_Profile_090620_IT(4)	9/6/2020 8:53:00	9/6/2020 8:55:08	1
LFR_090620_IT_005	LFR_Profile_090620_IT(5)	9/6/2020 9:04:41	9/6/2020 9:06:19	1
LFR_090620_IT_006	LFR_Profile_090620_IT(6)	9/6/2020 9:13:03	9/6/2020 9:14:55	1
LFR_090620_IT_007	LFR_Profile_090620_IT(7)	9/6/2020 9:20:14	9/6/2020 9:22:08	1
LFR_090620_IT_008	LFR_Profile_090620_IT(8)	9/6/2020 9:32:21	9/6/2020 9:33:49	1
LFR_090720_OT_001	LFR_Profile_090720_IT	9/7/2020 7:56:21	9/7/2020 9:24:48	11
LFR_090720_OT_002	LFR_PROFILE_090720_IT_PulaskitoLBR	9/7/2020 11:48:15	9/7/2020 13:26:19	11
LFR_090920_OT_001	LFR_Profile_090920_IT	9/9/2020 8:36:07	9/9/2020 9:42:09	11
LFR_090920_OT_002	LFR_Profile_090920_IT_PulaskitoLBR	9/9/2020 8:24:31	9/9/2020 10:11:39	11
LFR_091120_IT_001	LFR_Profile_091120_IT	9/11/2020 8:02:46	9/11/2020 9:50:08	11
LFR_091120_IT_002	LFR_Profile_091120_OT_PulaskitoLBR	9/11/2020 8:30:57	9/11/2020 9:53:30	11
LFR_091420_IT_001	LFR_Profile_091420_IT	9/14/2020 13:02:25	9/14/2020 14:08:09	11
LFR_091420_OT_002	LFR_Profile_091420_OT_PulaskitoLBR	9/14/2020 10:02:05	9/14/2020 11:19:11	11
LFR_091720_OT_001	LFR_Profile_091720_OT	9/17/2020 10:19:15	9/17/2020 10:40:51	4
LFR_091720_OT_002	LFR_Profile_091720_OT_1	9/17/2020 10:18:34	9/17/2020 11:32:28	6
LFR_091720_OT_003	LFR_Profile_091720_OT_2	9/17/2020 11:33:06	9/17/2020 12:23:38	7
LFR_091820_IT_001	LFR_Profile_091820_IT	9/18/2020 8:11:32	9/18/2020 9:08:20	11
LFR_091820_OT_002	LFR_Profile_091820_OT_PulaskitoLBR	9/18/2020 9:25:11	9/18/2020 11:15:30	11

Station ID	Station Name	Begin DateTime	End DateTime	Count of Profiles
LFR_092120_IT_001	LFR_Profile_092120_IT	9/21/2020 12:45:20	9/21/2020 14:06:03	10
LFR_092120_IT_002	LFR_Profile_092120_IT_PulaskitoLBR	9/21/2020 12:31:51	9/21/2020 13:49:13	11
LFR_092220_LT_001	LFR_Pofile_092220_LT	9/22/2020 8:05:05	9/22/2020 9:18:47	10
LFR_092220_OT_002	LFR_Profile_092220_OT_PulaskitoLBR	9/22/2020 8:32:27	9/22/2020 9:53:04	11
MR_090420_IT_001	MR_Profile_090420_IT	9/4/2020 9:06:47	9/4/2020 9:09:43	1

Table F-6 Attributes of depth profiles collected Upriver

Station ID	Station Name	Begin DateTime	End DateTime	Count of Profiles
UR_072620_001	UR_Hardeeville_Profile_07262020	7/26/2020 8:51:19	7/26/2020 8:54:55	5
UR_072820_001	UR9_Profile_07282020	7/28/2020 12:12:49	7/28/2020 12:15:01	1
UR_072820_002	UR10_Profile_07282020	7/28/2020 12:06:41	7/28/2020 12:08:03	1
UR_072820_003	UR11_Profile_07282020	7/28/2020 11:59:40	7/28/2020 12:02:18	1
UR_072820_004	UR12_Profile_07282020	7/28/2020 11:55:02	7/28/2020 11:57:14	1
UR_072820_005	UR18_Profile_07282020	7/28/2020 11:14:29	7/28/2020 11:19:17	1
UR_090820_001	UR09_Profile_090820	9/8/2020 9:54:20	9/8/2020 9:56:18	1
UR_090820_002	UR10_Profile_090820	9/8/2020 10:12:23	9/8/2020 10:13:05	1
UR_090820_003	UR11_Profile_090820	9/8/2020 10:23:20	9/8/2020 10:26:14	1
UR_090820_004	UR12_Profile_090820	9/8/2020 10:38:28	9/8/2020 10:40:18	2
UR_090820_005	UR13_Profile_090820	9/8/2020 10:56:24	9/8/2020 10:57:32	1
UR_090820_006	UR14_Profile_090820	9/8/2020 11:13:33	9/8/2020 11:14:43	1
UR_090820_007	UR15_Profile_090820	9/8/2020 11:26:26	9/8/2020 11:27:54	1
UR_090820_008	UR16_Profile_090820	9/8/2020 11:45:33	9/8/2020 11:48:59	1
UR_090820_009	UR17_Profile_090820	9/8/2020 12:08:04	9/8/2020 12:10:02	1
UR_090820_010	UR18_Profile_090820	9/8/2020 12:23:01	9/8/2020 12:24:03	2
UR_091020_001	UR_Profile_091020_Diffuser	9/10/2020 11:32:10	9/10/2020 11:48:44	3
UR_091520_DYETEST	UR_Profile_091520_DyeTest	9/15/2020 8:47:18	9/15/2020 11:16:38	multiple

Table F-7 Data counts for profile constituents collected on the Back River, Front River, and Upriver

PCode	Parameter Name	Units	Raw Data Count
BARO	barometric pressure	mm Hg	67,730
BATTERY	battery voltage	volts	67,525
BGA_R	phycoerythin BGA	RFU	42,235
BGA_U	phycoerythin BGA	µg/L	42,235
CHLA_R	chlorophyll a	RFU	42,235

PCode	Parameter Name	Units	Raw Data Count
CHLA_U	chlorophyll a	µg/L	42,235
DEP_PSIA	water depth (pressure)	PSI	35,178
DEPTH	water depth	meters	67,525
DO	dissolved oxygen	mg/L	67,525
DO_SAT	dissolved oxygen saturation	%	67,525
LAT	latitude	degrees	67,730
LON	longitude	degrees	67,730
RWT_R	Rhodamine WT	RFU	66,477
SALPPT	salinity	PPT	67,525
SPCOND	specific conductance	µS/cm	67,525
WTEMP	water temperature	°C	67,525
Total			**946,460**

The profile data were reviewed in timeseries plots to identify any sample dates and times which contained observed values that did not appear to be part of the profile datasets. Profile sampling typically occurred at landmark locations (semi-permanent buoys) or points of interest (tributaries) along the river. Over approximately two-hour sampling periods, the sondes continued to log data while the boats moved to profile sampling locations. These data were flagged as '*boat repositioning*' and removed from the raw data set (***Figure F-4*** and ***Figure F-5***). No data collected during the actual profile sampling were removed.

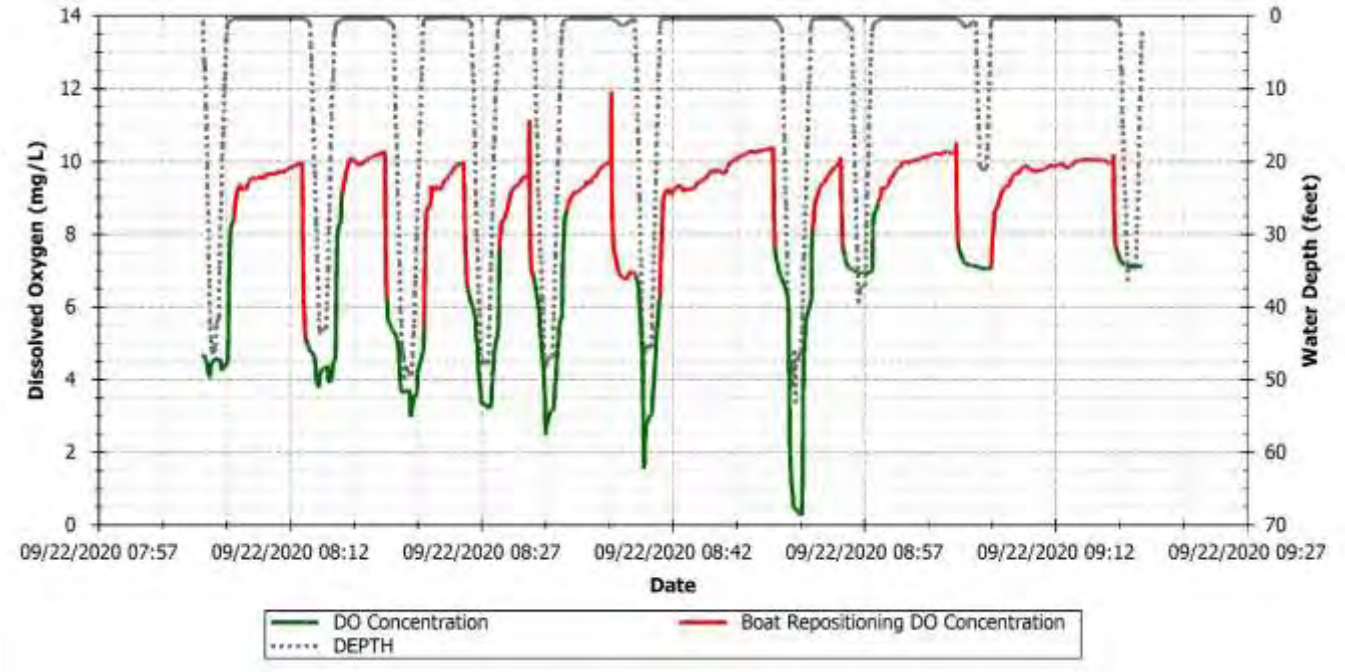


Figure F-4 September 22, 2020 profile QA/QC depth and DO



Figure F-5 September 22, 2020 profile location map QA/QC

For each profile, all dates and times identified as *boat repositioning* were separated from the consistent data in the processed data files and project database. The percentage of *boat repositioning* data for each profile is provided in ***Table F-8***.

Table F-8 Percentage of boat repositioning values for profile data

Station ID	Station Name	Boat Repositioning Values (%)
LBR_080420_HT_001	LBR_Profile_080420_HT	0.00
LBR_090520_IT_001	LBR1_Profile_090520_IT	0.00
LBR_090520_IT_002	LBR2_Profile_090520_IT	0.00
LBR_090520_IT_003	LBR3_Profile_090520_IT	0.00
LBR_090520_IT_004	LBR4_Profile_090520_IT	0.00
LBR_090520_IT_005	LBR5_Profile_090520_IT	0.00
LBR_090520_IT_006	LBR6_Profile_090520_IT	0.00
LBR_090520_IT_007	LBR7_Profile_090520_IT	0.00
LBR_090520_IT_008	LBR8_Profile_090520_IT	0.00
LBR_091920_IT_001	LBR_Profile1_091920_HogGage_IT	0.00
LBR_091920_IT_002	LBR_Profiles2345_091920_IT	65.92
LFR_082820_OT_001	LFR_FtPulaski_Profile_082820_OT	34.21
LFR_082820_OT_002	LFR_Profile_082820_OT	55.06
LFR_082920_OT_001	LFR_LBR_Profile_082920_OT	57.01
LFR_083120_OT_001	LFR_Profile_083120_OT_LFRtoMR	55.36
LFR_083120_OT_002	LFR_Profile_083120_OT_PulaskitoLBR	61.98
LFR_090220_OT_001	LFR_Profile_090220_LFRtoMR	53.79
LFR_090220_OT_002	LFR_Profile_090220_OT_PulaskitoLBR	57.09
LFR_090420_IT_001	LFR_Profile_090420_IT	43.27
LFR_090420_IT_002	LFR_Profile_090420_IT(2)	4.96
LFR_090420_IT_003	LFR_Profile_090420_IT(3)	1.32
LFR_090420_IT_004	LFR_Profile_090420_IT(4)	2.08
LFR_090420_IT_005	LFR_Profile_090420_IT(5)	45.77
LFR_090420_IT_006	LFR_Profile_090420_IT(6)	29.37
LFR_090420_IT_007	LFR_Profile_090420_IT_PulaskitoLBR	64.36
LFR_090520_IT_001	LFR_Profile_090520_IT	0.00
LFR_090520_IT_002	LFRLBR_Profile_090520_IT	0.00
LFR_090620_IT_001	LFR_Profile_090620_IT(1)	0.00
LFR_090620_IT_002	LFR_Profile_090620_IT(2)	0.00
LFR_090620_IT_003	LFR_Profile_090620_IT(3)	0.00
LFR_090620_IT_004	LFR_Profile_090620_IT(4)	0.00
LFR_090620_IT_005	LFR_Profile_090620_IT(5)	0.00
LFR_090620_IT_006	LFR_Profile_090620_IT(6)	0.00
LFR_090620_IT_007	LFR_Profile_090620_IT(7)	0.00
LFR_090620_IT_008	LFR_Profile_090620_IT(8)	0.00
LFR_090720_OT_001	LFR_Profile_090720_IT	52.54

Station ID	Station Name	Boat Repositioning Values (%)
LFR_090720_OT_002	LFR_Profile_090720_IT_PulaskitoLBR	68.40
LFR_090920_OT_001	LFR_Profile_090920_IT	48.19
LFR_090920_OT_002	LFR_Profile_090920_IT_PulaskitoLBR	59.97
LFR_091120_IT_001	LFR_Profile_091120_IT	68.53
LFR_091120_IT_002	LFR_Profile_091120_OT_PulaskitoLBR	61.50
LFR_091420_IT_001	LFR_Profile_091420_IT	66.61
LFR_091420_OT_002	LFR_Profile_091420_OT_PulaskitoLBR	62.45
LFR_091720_OT_001	LFR_Profile_091720_OT	71.03
LFR_091720_OT_002	LFR_Profile_091720_OT_1	81.22
LFR_091720_OT_003	LFR_Profile_091720_OT_2	70.07
LFR_091820_IT_001	LFR_Profile_091820_IT	61.70
LFR_091820_OT_002	LFR_Profile_091820_OT_PulaskitoLBR	65.78
LFR_092120_IT_001	LFR_Profile_092120_IT	51.67
LFR_092120_IT_002	LFR_Profile_092120_IT_PulaskitoLBR	54.05
LFR_092220_LT_001	LFR_Pofile_092220_LT	64.60
LFR_092220_OT_002	LFR_Profile_092220_OT_PulaskitoLBR	57.19
MR_090420_IT_001	MR_Profile_090420_IT	0.00
UR_072620_001	UR_Hardeeville_Profile_07262020	0.00
UR_072820_001	UR9_Profile_07282020	0.00
UR_072820_002	UR10_Profile_07282020	0.00
UR_072820_003	UR11_Profile_07282020	0.00
UR_072820_004	UR12_Profile_07282020	0.00
UR_072820_005	UR18_Profile_07282020	0.00
UR_090820_001	UR09_Profile_090820	0.00
UR_090820_002	UR10_Profile_090820	0.00
UR_090820_003	UR11_Profile_090820	0.00
UR_090820_004	UR12_Profile_090820	0.00
UR_090820_005	UR13_Profile_090820	0.00
UR_090820_006	UR14_Profile_090820	0.00
UR_090820_007	UR15_Profile_090820	0.00
UR_090820_008	UR16_Profile_090820	0.00
UR_090820_009	UR17_Profile_090820	0.00
UR_090820_010	UR18_Profile_090820	0.00
UR_091020_001	UR_Profile_091020_Diffuser	0.00
UR_091520_DYETEST	UR_Profile_091520_DyeTest	11.18
Total		**52.1**

F.3 DRIFT DATA

A total of 110 data files were collected from instruments while drifting from boats in collection areas during the SUR sampling even. Forty drift data files were collected in the Back River, 33 drift data files were collected in the Front River and Middle River, and 37 were collected Upriver. The drift data files were uploaded by the field team to the OneDrive and named with a consistent file naming convention as follows:

Location_Drift_Date_X _TT, where:

- Location = LBR (Back River), LFR (Front River), or UR (Upriver)
- Date = Sample Date
- X = qualitative depth (deep, middle, shallow, surface, or profile)
- 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. The recording of measurements was performed either in real-time mode by using a hand-held device connected to one of the data sondes by a communication cable, or in deployment mode by setting the sonde to log data internally. Each drift event had the potential of having up to four files that were collected simultaneously at different depths, with one of the files attributed with latitude and longitude information. The QA/QC team grouped the multi-depth drift data file(s) in an Excel data file with each “depth” copied into its own individual tab. The Excel file was then named as follows:

Location_Drift_Date_TT _Drift#, where:

- Location = LBR (Back River), LFR (Front River), or UR (Upriver)
- Date = Sample Date
- XT = OT (outgoing tide), IT (incoming tide), LT (ebb tide), or HT (flood tide)
- Drift# = drift number (D1, D2, D3, 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. During the SUR data collection, 31 drifts occurred in the Back River, 21 occurred in the Front River and Middle River, and 28 occurred Upriver.

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 data files) based on time. Additionally, the data within each tab was assigned a unique station ID for the WRDB database that consisted of an 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 (i.e. setting the sonde to log data internally), data logging was started and stopped before and after logging was started and stopped with the sonde connected to 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 F-9, ***Table F-10***, and ***Table F-11*** provide attribute information for drift data collected on the Back River, Front River, and Upriver, respectively, including the drift ID, station ID, time of the beginning and ending of the collection period, and the average depth. ***Table F-12*** provides a list of constituents obtained for drift data and the number of raw records in the WRDB database for each constituent.

Table F-9 Attributes of drift data collected in the Back River

Drift ID	Station ID	Begin DateTime	End DateTime	Average Depth (feet)
LBR_Drift_072720_IT_D1	LBR_072720_IT_D1_SHAL	7/27/2020 9:27:46	7/27/2020 11:00:43	3.3
LBR_Drift_072820_D1	LBR_072820_D1_SHAL	7/28/2020 9:08:02	7/28/2020 11:46:13	3.6
LBR_Drift_072820_D2	LBR_072820_D2_SHAL	7/28/2020 11:54:42	7/28/2020 12:02:52	4.6
LBR_Drift_072920_OT_D1	LBR_072920_OT_D1_SHAL	7/29/2020 8:42:35	7/29/2020 10:43:21	3.6
LBR_Drift_073020_OT_D1	LBR_073020_OT_D1_SHAL	7/30/2020 10:16:11	7/30/2020 11:23:46	3.3
LBR_Drift_073120_OT_D1	LBR_073120_OT_D1_MIDL	7/31/2020 9:11:19	7/31/2020 10:22:03	7.5
	LBR_073120_OT_D1_SHAL	7/31/2020 9:11:19	7/31/2020 10:22:03	3.3
LBR_Drift_080420_HT_D1	LBR_080420_HT_D1_DEEP	8/4/2020 9:30:44	8/4/2020 10:35:50	7.9
	LBR_080420_HT_D1_SHAL	8/4/2020 9:32:37	8/4/2020 10:35:49	5.2
LBR_Drift_080520_IT_D1	LBR_080520_IT_D1_SHAL	8/5/2020 8:22:01	8/5/2020 10:34:29	3.6
LBR_Drift_080720_IT_D1	LBR_080720_IT_D1_DEEP	8/7/2020 8:36:08	8/7/2020 9:48:34	8.5
	LBR_080720_IT_D1_SHAL	8/7/2020 8:36:07	8/7/2020 9:48:33	4.6
LBR_Drift_081220_DYE_D1	LBR_081220_DYE_D1_DEEP	8/12/2020 9:54:10	8/12/2020 11:08:31	8.5
	LBR_081220_DYE_D1_SHAL	8/12/2020 9:54:09	8/12/2020 11:08:27	3.6
LBR_Drift_081220_DYE_D2	LBR_081220_DYE_D2_DEEP	8/12/2020 9:54:44	8/12/2020 11:03:00	9.2
	LBR_081220_DYE_D2_SHAL	8/12/2020 9:54:43	8/12/2020 11:02:59	3.9
LBR_Drift_081220_DYE_D3	LBR_081220_DYE_D3_SHAL	8/12/2020 11:06:24	8/12/2020 11:23:15	4.3
LBR_Drift_081320_OT_D1	LBR_081320_OT_D1_SHAL	8/13/2020 7:59:09	8/13/2020 10:54:37	3.9
LBR_Drift_081420_D1	LBR_081420_D1_SHAL	8/14/2020 8:59:35	8/14/2020 10:25:39	4.3
LBR_Drift_081520_OT_D1	LBR_081520_OT_D1_SHAL	8/15/2020 10:38:09	8/15/2020 12:04:39	3.0
LBR_Drift_081720_OT_D1	LBR_081720_OT_D1_MIDL	8/17/2020 9:32:08	8/17/2020 10:27:16	9.2
	LBR_081720_OT_D1_SHAL	8/17/2020 9:34:42	8/17/2020 10:19:53	2.6
LBR_Drift_081720_OT_D2	LBR_081720_OT_D2_DEEP	8/17/2020 10:34:32	8/17/2020 11:35:56	9.2
	LBR_081720_OT_D2_SHAL	8/17/2020 10:34:31	8/17/2020 11:35:55	2.6
LBR_Drift_081820_OT_D1	LBR_081820_OT_D1_SHAL	8/18/2020 8:38:31	8/18/2020 9:10:13	3.0
LBR_Drift_081920_IT_D1	LBR_081920_IT_D1_DEEP	8/19/2020 10:03:08	8/19/2020 12:28:02	1.6
	LBR_081920_IT_D1_SHAL	8/19/2020 10:03:07	8/19/2020 12:28:01	9.8
LBR_Drift_082120_IT_D1	LBR_082120_IT_D1_SHAL	8/21/2020 7:55:34	8/21/2020 8:56:00	5.6
LBR_Drift_082220_OT_D1	LBR_082220_OT_D1_SHAL	8/22/2020 7:52:54	8/22/2020 9:28:05	3.6
LBR_Drift_082520_DYE_D1	LBR_082520_DYE_D1_MIDL	8/25/2020 9:44:47	8/25/2020 12:55:22	5.9
	LBR_082520_DYE_D1_SHAL	8/25/2020 9:44:48	8/25/2020 12:55:22	3.3
LBR_Drift_082620_IT_D1	LBR_082620_IT_D1_SHAL	8/26/2020 10:22:30	8/26/2020 13:22:21	1.3
LBR_Drift_082720_IT_D1	LBR_082720_IT_D1_SHAL	8/27/2020 11:29:12	8/27/2020 12:44:04	1.3

Drift ID	Station ID	Begin DateTime	End DateTime	Average Depth (feet)
LBR_Drift_090120_OT_D1	LBR_090120_OT_D1_SHAL	9/1/2020 9:59:00	9/1/2020 11:35:26	4.3
LBR_Drift_090320_OT_D1	LBR_090320_OT_D1_SHAL	9/3/2020 11:30:21	9/3/2020 14:07:50	1.0
LBR_Drift_090820_IT_D1	LBR_090820_IT_D1_SHAL	9/8/2020 7:53:01	9/8/2020 9:57:10	1.0
LBR_Drift_091220_OT_D1	LBR_091220_OT_D1_SHAL	9/12/2020 9:10:12	9/12/2020 11:35:52	3.9
LBR_Drift_091720_OT_D1	LBR_091720_OT_D1_SHAL	9/17/2020 10:41:21	9/17/2020 13:23:28	1.3
LBR_Drift_091720_OT_D2	LBR_091720_OT_D2_SHAL	9/17/2020 13:23:46	9/17/2020 13:49:41	1.3
LBR_Drift_091920_IT_D1	LBR_091920_IT_D1_SHAL	9/19/2020 7:34:01	9/19/2020 8:31:01	2.0
Unknown	NONE	7/31/2020 9:08:43	8/25/2020 12:57:24	N/A

Table F-10 Attributes of drift data collected in the Front River

Drift ID	Station ID	Begin DateTime	End DateTime	Average Depth (feet)
LFR_Drift_072720_IT_D1	LFR_072720_IT_D1_MIDL	7/27/2020 9:20:28	7/27/2020 12:13:45	17.7
	LFR_072720_IT_D1_SHAL	7/27/2020 9:20:28	7/27/2020 12:13:46	4.6
LFR_Drift_072920_OT_D1	LFR_072920_OT_D1_MIDL	7/29/2020 8:29:35	7/29/2020 10:47:29	18.4
	LFR_072920_OT_D1_SHAL	7/29/2020 8:29:35	7/29/2020 10:47:29	3.3
LFR_Drift_073120_OT_D1	LFR_073120_OT_D1_MIDL	7/31/2020 8:43:32	7/31/2020 10:07:10	3.3
	LFR_073120_OT_D1_SHAL	7/31/2020 8:43:31	7/31/2020 10:07:09	17.4
LFR_Drift_080420_HT_D1	LFR_080420_HT_D1_DEEP	8/4/2020 9:30:05	8/4/2020 11:26:01	15.7
	LFR_080420_HT_D1_SHAL	8/4/2020 9:30:05	8/4/2020 11:26:01	6.6
LFR_Drift_080620_IT_D1	LFR_080620_IT_D1_DEEP	8/6/2020 8:32:17	8/6/2020 11:04:08	18.4
	LFR_080620_IT_D1_SHAL	8/6/2020 8:32:17	8/6/2020 11:04:07	4.9
LFR_Drift_080720_IT_D1	LFR_080720_IT_D1_DEEP	8/7/2020 8:21:49	8/7/2020 11:11:08	18.7
	LFR_080720_IT_D1_SHAL	8/7/2020 8:21:50	8/7/2020 11:11:08	2.0
LFR_Drift_080820_IT_D1	LFR_080820_IT_D1_SHAL	8/8/2020 10:09:31	8/8/2020 10:45:31	3.9
LFR_Drift_081120_DYE_D1	LFR_081120_DYE_D1_DEEP	8/11/2020 8:53:44	8/11/2020 10:29:26	6.9
	LFR_081120_DYE_D1_SHAL	8/11/2020 8:53:43	8/11/2020 10:29:25	7.2
LFR_Drift_081120_DYE_D2	LFR_081120_DYE_D2_DEEP	8/11/2020 8:55:13	8/11/2020 10:29:00	12.1
	LFR_081120_DYE_D2_SHAL	8/11/2020 8:55:13	8/11/2020 10:28:59	6.2
LFR_Drift_081420_OT_D1	LFR_081420_OT_D1_SHAL	8/14/2020 8:52:32	8/14/2020 10:05:52	6.9
LFR_Drift_081720_OT_D1	LFR_081720_OT_D1_DEEP	8/17/2020 9:21:40	8/17/2020 10:41:00	15.1
	LFR_081720_OT_D1_SHAL	8/17/2020 9:21:39	8/17/2020 10:40:59	4.9
LFR_Drift_082120_IT_D1	LFR_082120_IT_D1_SHAL	8/21/2020 7:34:40	8/21/2020 8:47:18	5.2
LFR_Drift_082420_IT_D1	LFR_082420_IT_D1_MIDL	8/24/2020 9:17:37	8/24/2020 12:19:47	6.6

Drift ID	Station ID	Begin DateTime	End DateTime	Average Depth (feet)
	LFR_082420_IT_D1_SHAL	8/24/2020 9:17:37	8/24/2020 12:19:48	5.6
LFR_Drift_082520_DYE_D1	LFR_082520_DYE_D1_MIDL	8/25/2020 8:42:09	8/25/2020 12:07:49	16.1
	LFR_082520_DYE_D1_SHAL	8/25/2020 8:42:09	8/25/2020 12:07:49	7.9
LFR_Drift_082620_IT_D1	LFR_082620_IT_D1_MIDL	8/26/2020 10:23:13	8/26/2020 13:20:08	7.5
	LFR_082620_IT_D1_SHAL	8/26/2020 10:23:13	8/26/2020 13:20:07	3.3
LFR_Drift_082720_IT_D1	LFR_082720_IT_D1_SHAL	8/27/2020 10:44:46	8/27/2020 13:56:11	5.9
LFR_Drift_082720_IT_D2	LFR_082720_IT_D2_SHAL	8/27/2020 11:13:04	8/27/2020 13:20:48	4.6
LFR_Drift_091620_D1	LFR_091620_D1_SHAL	9/16/2020 10:36:24	9/16/2020 12:40:01	1.3
MR_Drift_082020_OT_D1	MR_082020_OT_D1_SHAL	8/20/2020 11:07:21	8/20/2020 13:22:18	3.9
MR_Drift_082620_IT_D1	MR_082620_IT_D1_SHAL	8/26/2020 10:30:37	8/26/2020 11:43:06	1.3
MR_Drift_091020_D1	MR_091020_D1_SHAL	9/10/2020 9:22:31	9/10/2020 10:59:07	1.3
Unknown	NONE	7/27/2020 9:18:02	8/26/2020 13:23:01	N/A

Table F-11 Attributes of drift data collected Upriver

Drift ID	Station ID	Begin DateTime	End DateTime	Average Depth (feet)
UR_Drift_072820_D1	UR_072820_D1_MIDL	7/28/2020 9:07:01	7/28/2020 9:38:29	8.2
	UR_072820_D1_SHAL	7/28/2020 9:07:01	7/28/2020 9:38:29	3.0
UR_Drift_072820_D2	UR_072820_D2_MIDL	7/28/2020 9:43:02	7/28/2020 10:19:44	8.2
	UR_072820_D2_SHAL	7/28/2020 9:43:02	7/28/2020 10:19:40	3.3
UR_Drift_072820_D3	UR_072820_D3_SHAL	7/28/2020 10:26:00	7/28/2020 11:12:18	3.0
UR_Drift_073020_D1	UR_073020_D1_MIDL	7/30/2020 8:58:11	7/30/2020 10:32:37	7.5
	UR_073020_D1_SHAL	7/30/2020 8:58:11	7/30/2020 10:32:37	3.3
UR_Drift_080120_D1	UR_080120_D1_SHAL	8/1/2020 8:39:08	8/1/2020 9:57:04	3.9
UR_Drift_080520_D1	UR_080520_D1_SHAL	8/5/2020 9:07:46	8/5/2020 12:15:06	3.0
UR_Drift_080620_D1	UR_080620_D1_DEEP	8/6/2020 8:57:20	8/6/2020 9:50:29	6.6
	UR_080620_D1_SHAL	8/6/2020 8:57:20	8/6/2020 9:50:30	2.6
UR_Drift_080620_D2	UR_080620_D2_SHAL	8/6/2020 10:28:15	8/6/2020 11:02:07	3.3
UR_Drift_081020_DYE_D1	UR_081020_DYE_D1_DEEP	8/10/2020 9:54:24	8/10/2020 10:31:28	7.2
	UR_081020_DYE_D1_SHAL	8/10/2020 9:54:24	8/10/2020 10:31:28	4.9
UR_Drift_081020_DYE_D2	UR_081020_DYE_D2_DEEP	8/10/2020 9:58:50	8/10/2020 10:30:12	6.6
	UR_081020_DYE_D2_SHAL	8/10/2020 9:58:49	8/10/2020 10:30:11	3.3
UR_Drift_081320_D1	UR_081320_D1_SHAL	8/13/2020 8:39:25	8/13/2020 10:05:07	4.3
UR_Drift_081620_D1	UR_081620_D1_SHAL	8/16/2020 8:13:20	8/16/2020 8:20:18	3.6

Drift ID	Station ID	Begin DateTime	End DateTime	Average Depth (feet)
UR_Drift_081820_D1	UR_081820_D1_MIDL	8/18/2020 8:56:55	8/18/2020 11:03:49	3.0
	UR_081820_D1_SHAL	8/18/2020 8:56:55	8/18/2020 11:03:49	6.6
UR_Drift_082020_D1	UR_082020_D1_SHAL	8/20/2020 13:04:07	8/20/2020 14:06:02	3.3
UR_Drift_082320_D1	UR_082320_D1_SHAL	8/23/2020 9:11:48	8/23/2020 10:07:33	3.0
UR_Drift_082420_DYE_D1	UR_082420_DYE_D1_MIDL	8/24/2020 9:59:23	8/24/2020 10:19:19	4.6
	UR_082420_DYE_D1_SHAL	8/24/2020 9:59:23	8/24/2020 10:00:47	3.6
UR_Drift_082420_DYE_D2	UR_082420_DYE_D2_MIDL	8/24/2020 9:48:20	8/24/2020 11:42:08	3.0
	UR_082420_DYE_D2_SHAL	8/24/2020 9:48:20	8/24/2020 11:42:08	7.2
UR_Drift_082420_DYE_D3	UR_082420_DYE_D3_SHAL	8/24/2020 11:31:20	8/24/2020 11:58:32	3.6
UR_Drift_082420_DYE_D4	UR_082420_DYE_D4_SHAL	8/24/2020 12:06:43	8/24/2020 12:11:51	3.0
UR_Drift_082520_D1	UR_082520_D1_SHAL	8/25/2020 8:10:31	8/25/2020 12:42:06	1.3
UR_Drift_082820_D1	UR_082820_D1_SHAL	8/28/2020 9:00:18	8/28/2020 10:07:49	4.6
UR_Drift_090120_D1	UR_090120_D1_SHAL	9/1/2020 8:59:35	9/1/2020 10:00:21	3.3
UR_Drift_090320_D1	UR_090320_D1_SHAL	9/3/2020 15:10:44	9/3/2020 16:06:12	3.9
UR_Drift_091020_D1	UR_091020_D1_SHAL	9/10/2020 8:13:19	9/10/2020 9:14:30	3.3
UR_Drift_091320_D1	UR_091320_D1_SHAL	9/13/2020 9:57:02	9/13/2020 10:59:34	3.0
UR_Drift_091520_DYE_D1	UR_091520_DYE_D1_SHAL	9/15/2020 8:46:02	9/15/2020 11:20:03	2.0
UR_Drift_091620_D1	UR_091620_D1_SHAL	9/16/2020 8:22:56	9/16/2020 13:41:19	3.6
UR_Drift_092020_D1	UR_092020_D1_SHAL	9/20/2020 9:16:48	9/20/2020 11:08:05	2.6
Unknown	NONE	7/28/2020 9:38:31	8/24/2020 11:43:32	N/A

Table F-12 Data counts for drift constituents collected on the Back River, Front River, and Upriver

PCode	Parameter Name	Units	Raw Data Count
BARO	barometric pressure	mm Hg	235,954
BATTERY	battery voltage	volts	328,963
BGA_R	phycoerythin BGA sensor	RFU	291,644
BGA_U	phycoerythin BGA sensor	µg/L	291,644
CHLA_R	chlorophyll a	RFU	291,644
CHLA_U	chlorophyll a	µg/L	291,644
DEP_PSIA	water depth	psia	217,640
DEPTH	water depth	meters	328,957
DO	dissolved oxygen	mg/L	328,957
DO_SAT	dissolved oxygen saturation	%	328,957

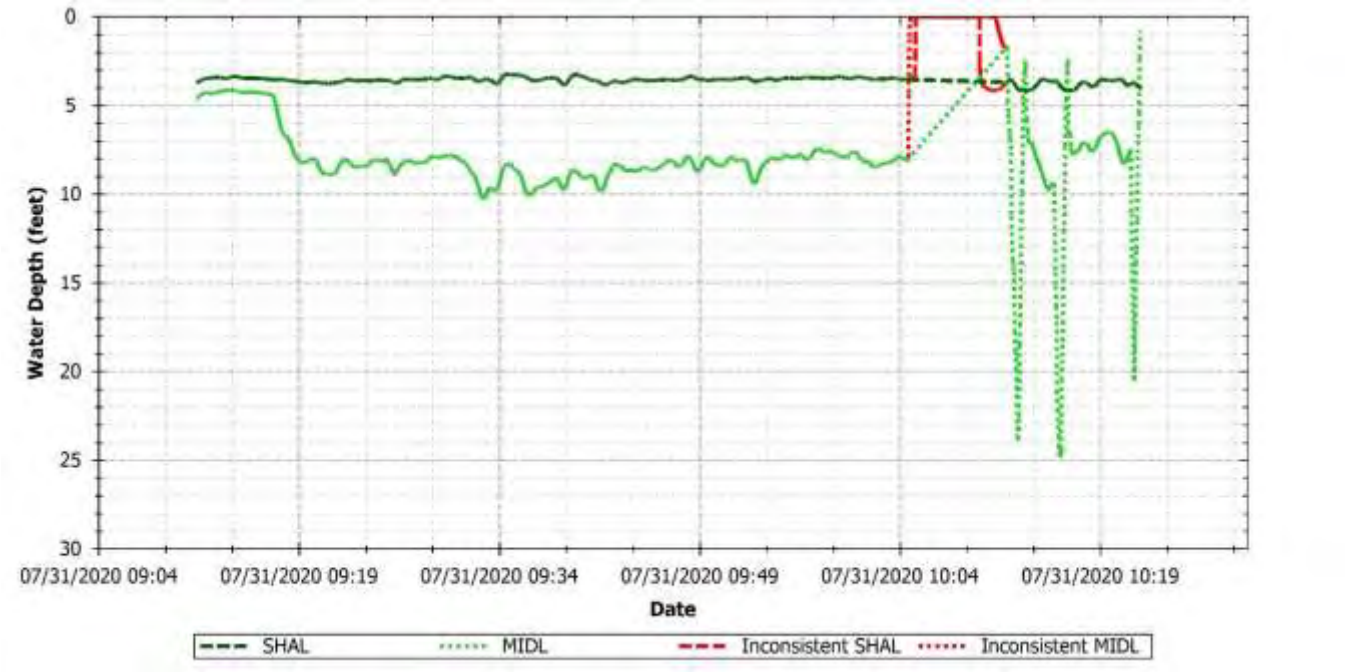
PCode	Parameter Name	Units	Raw Data Count
LAT	latitude	degrees	325,102
LON	longitude	degrees	325,102
RWT_R	Rhodamine WT	RFU	246,896
SALPPT	salinity	PPT	328,957
SPCOND	specific conductance	µS/cm	328,957
WTEMP	water temperature	°C	328,957
Total			**4,819,975**

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 when the sondes were likely out of the water, as frequently confirmed by the field notes. As an example, the red dots in ***Figure F-6*** and red dots in ***Figure F-7*** and ***Figure F-8*** identify a period of time where all of the sondes were confirmed out of the water and the boat was traveling at a speed greater than 20 miles per hour and the field notes indicated “ran back to the diffuser” for the LBR_073120_OT_D1 drift.

For each drift, 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 inconsistent data for each drift is provided in ***Table F-13***.

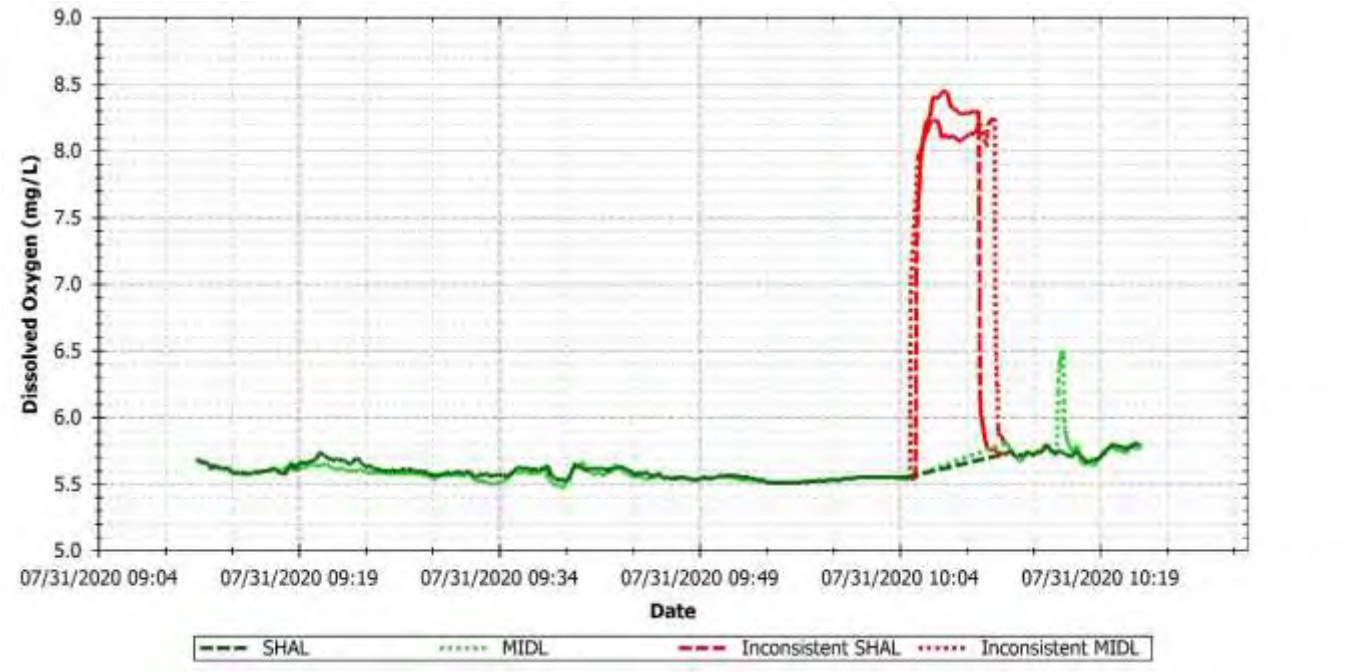


Figure F-6 LBR_073120_OT_D1 drift location map QA/QC



Note: straight dark green and lime green lines are an artifact of the graphing program connecting the before and after points for the section of data that was removed

Figure F-7 LBR_073120_OT_D1 drift depth QA/QC timeseries



Note: straight dark green and lime green lines are an artifact of the graphing program connecting the before and after points for the section of data that was removed

Figure F-8 LBR_073120_OT_D1 drift DO QA/QC timeseries

Table F-13 Percentage of inconsistent values for drift data

Drift ID	Station ID	Inconsistent values (%)
LBR_Drift_072720_IT_D1	LBR_072720_IT_D1_SHAL	0.00
LBR_Drift_072820_D1	LBR_072820_D1_SHAL	2.55
LBR_Drift_072820_D2	LBR_072820_D2_SHAL	0.00
LBR_Drift_072920_OT_D1	LBR_072920_OT_D1_SHAL	0.00
LBR_Drift_073020_OT_D1	LBR_073020_OT_D1_SHAL	0.00
LBR_Drift_073120_OT_D1	LBR_073120_OT_D1_MIDL	9.58
	LBR_073120_OT_D1_SHAL	10.60
LBR_Drift_080420_HT_D1	LBR_080420_HT_D1_DEEP	0.00
	LBR_080420_HT_D1_SHAL	0.00
LBR_Drift_080520_IT_D1	LBR_080520_IT_D1_SHAL	0.00
LBR_Drift_080720_IT_D1	LBR_080720_IT_D1_DEEP	0.00
	LBR_080720_IT_D1_SHAL	0.00
LBR_Drift_081220_DYE_D1	LBR_081220_DYE_D1_DEEP	0.00
	LBR_081220_DYE_D1_SHAL	0.00
LBR_Drift_081220_DYE_D2	LBR_081220_DYE_D2_DEEP	0.00
	LBR_081220_DYE_D2_SHAL	0.00
LBR_Drift_081220_DYE_D3	LBR_081220_DYE_D3_SHAL	0.20
LBR_Drift_081320_OT_D1	LBR_081320_OT_D1_SHAL	0.00
LBR_Drift_081420_D1	LBR_081420_D1_SHAL	2.63
LBR_Drift_081520_OT_D1	LBR_081520_OT_D1_SHAL	0.00
LBR_Drift_081720_OT_D1	LBR_081720_OT_D1_MIDL	0.00
	LBR_081720_OT_D1_SHAL	0.00
LBR_Drift_081720_OT_D2	LBR_081720_OT_D2_DEEP	0.00
	LBR_081720_OT_D2_SHAL	0.00
LBR_Drift_081820_OT_D1	LBR_081820_OT_D1_SHAL	0.00
LBR_Drift_081920_IT_D1	LBR_081920_IT_D1_DEEP	0.00
	LBR_081920_IT_D1_SHAL	0.00
LBR_Drift_082120_IT_D1	LBR_082120_IT_D1_SHAL	7.88
LBR_Drift_082220_OT_D1	LBR_082220_OT_D1_SHAL	0.00
LBR_Drift_082520_DYE_D1	LBR_082520_DYE_D1_MIDL	0.00
	LBR_082520_DYE_D1_SHAL	0.00
LBR_Drift_082620_IT_D1	LBR_082620_IT_D1_SHAL	0.00
LBR_Drift_082720_IT_D1	LBR_082720_IT_D1_SHAL	0.00
LBR_Drift_090120_OT_D1	LBR_090120_OT_D1_SHAL	0.00
LBR_Drift_090320_OT_D1	LBR_090320_OT_D1_SHAL	0.00
LBR_Drift_090820_IT_D1	LBR_090820_IT_D1_SHAL	0.00
LBR_Drift_091220_OT_D1	LBR_091220_OT_D1_SHAL	0.00

Drift ID	Station ID	Inconsistent values (%)
LBR_Drift_091720_OT_D1	LBR_091720_OT_D1_SHAL	3.07
LBR_Drift_091720_OT_D2	LBR_091720_OT_D2_SHAL	2.95
LBR_Drift_091920_IT_D1	LBR_091920_IT_D1_SHAL	23.85
LFR_Drift_072720_IT_D1	LFR_072720_IT_D1_MIDL	0.00
	LFR_072720_IT_D1_SHAL	0.00
LFR_Drift_072920_OT_D1	LFR_072920_OT_D1_MIDL	0.00
	LFR_072920_OT_D1_SHAL	0.00
LFR_Drift_073120_OT_D1	LFR_073120_OT_D1_MIDL	0.00
	LFR_073120_OT_D1_SHAL	0.00
LFR_Drift_080420_HT_D1	LFR_080420_HT_D1_DEEP	0.00
	LFR_080420_HT_D1_SHAL	0.00
LFR_Drift_080620_IT_D1	LFR_080620_IT_D1_DEEP	0.00
	LFR_080620_IT_D1_SHAL	0.00
LFR_Drift_080720_IT_D1	LFR_080720_IT_D1_DEEP	0.00
	LFR_080720_IT_D1_SHAL	0.00
LFR_Drift_080820_IT_D1	LFR_080820_IT_D1_SHAL	0.00
LFR_Drift_081120_DYE_D1	LFR_081120_DYE_D1_DEEP	12.85
	LFR_081120_DYE_D1_SHAL	12.81
LFR_Drift_081120_DYE_D2	LFR_081120_DYE_D2_DEEP	11.23
	LFR_081120_DYE_D2_SHAL	10.47
LFR_Drift_081420_OT_D1	LFR_081420_OT_D1_SHAL	4.13
LFR_Drift_081720_OT_D1	LFR_081720_OT_D1_DEEP	14.83
	LFR_081720_OT_D1_SHAL	14.78
LFR_Drift_082120_IT_D1	LFR_082120_IT_D1_SHAL	0.00
LFR_Drift_082420_IT_D1	LFR_082420_IT_D1_MIDL	0.00
	LFR_082420_IT_D1_SHAL	0.00
LFR_Drift_082520_DYE_D1	LFR_082520_DYE_D1_MIDL	3.91
	LFR_082520_DYE_D1_SHAL	3.91
LFR_Drift_082620_IT_D1	LFR_082620_IT_D1_MIDL	0.00
	LFR_082620_IT_D1_SHAL	0.00
LFR_Drift_082720_IT_D1	LFR_082720_IT_D1_SHAL	0.00
LFR_Drift_082720_IT_D2	LFR_082720_IT_D2_SHAL	0.00
LFR_Drift_091620_D1	LFR_091620_D1_SHAL	14.26
MR_Drift_082020_OT_D1	MR_082020_OT_D1_SHAL	0.00
MR_Drift_082620_IT_D1	MR_082620_IT_D1_SHAL	0.00
MR_Drift_091020_D1	MR_091020_D1_SHAL	0.00
UR_Drift_072820_D1	UR_072820_D1_MIDL	0.00
	UR_072820_D1_SHAL	0.00

Drift ID	Station ID	Inconsistent values (%)
UR_Drift_072820_D2	UR_072820_D2_MIDL	0.00
	UR_072820_D2_SHAL	0.00
UR_Drift_072820_D3	UR_072820_D3_SHAL	0.00
UR_Drift_073020_D1	UR_073020_D1_MIDL	14.68
	UR_073020_D1_SHAL	14.68
UR_Drift_080120_D1	UR_080120_D1_SHAL	0.00
UR_Drift_080520_D1	UR_080520_D1_SHAL	0.00
UR_Drift_080620_D1	UR_080620_D1_DEEP	0.00
	UR_080620_D1_SHAL	0.00
UR_Drift_080620_D2	UR_080620_D2_SHAL	0.00
UR_Drift_081020_DYE_D1	UR_081020_DYE_D1_DEEP	0.00
	UR_081020_DYE_D1_SHAL	0.00
UR_Drift_081020_DYE_D2	UR_081020_DYE_D2_DEEP	12.00
	UR_081020_DYE_D2_SHAL	12.00
UR_Drift_081320_D1	UR_081320_D1_SHAL	5.83
UR_Drift_081620_D1	UR_081620_D1_SHAL	0.00
UR_Drift_081820_D1	UR_081820_D1_MIDL	0.00
	UR_081820_D1_SHAL	0.00
UR_Drift_082020_D1	UR_082020_D1_SHAL	0.00
UR_Drift_082320_D1	UR_082320_D1_SHAL	0.00
UR_Drift_082420_DYE_D1	UR_082420_DYE_D1_MIDL	0.00
	UR_082420_DYE_D1_SHAL	0.00
UR_Drift_082420_DYE_D2	UR_082420_DYE_D2_MIDL	0.00
	UR_082420_DYE_D2_SHAL	19.71
UR_Drift_082420_DYE_D3	UR_082420_DYE_D3_SHAL	0.00
UR_Drift_082420_DYE_D4	UR_082420_DYE_D4_SHAL	0.00
UR_Drift_082520_D1	UR_082520_D1_SHAL	0.00
UR_Drift_082820_D1	UR_082820_D1_SHAL	0.00
UR_Drift_090120_D1	UR_090120_D1_SHAL	0.00
UR_Drift_090320_D1	UR_090320_D1_SHAL	0.00
UR_Drift_091020_D1	UR_091020_D1_SHAL	0.00
UR_Drift_091320_D1	UR_091320_D1_SHAL	0.00
UR_Drift_091520_DYE_D1	UR_091520_DYE_D1_SHAL	10.75
UR_Drift_091620_D1	UR_091620_D1_SHAL	3.11
UR_Drift_092020_D1	UR_092020_D1_SHAL	9.10
Unknown	NONE	100.00
Total		**3.5**

F.4 SEMI-PERMANENT, PROFILE, DRIFT DO CALIBRATION DRIFT CORRECTION

DO concentration calibration drift was initially identified by the QA/QC team during routine weekly visual data checks. The QA/QC team noticed DO discontinuities between pre- and post- calibration DO readings at Upriver buoy locations (***Figure F-9***). Review of the DO sensor calibration records indicated that all semi-permanent buoy, profile, and drift DO sensors used by the field team between July 14 and August 18, 2020 experienced calibration drift. Each sensor experienced a unique amount of drift which generally ranged between +0.2 milligram per liter (mg/L)/L and +0.6 mg/L at the SUR mid-point sensor recalibration effort (August 18, 2020).

The USGS publication *Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting* indicates that a DO calibration difference of ±0.3 mg/L is within acceptable limits when determining if a sensor ought to be recalibrated. The QA/QC team used a threshold of ±0.15 mg/L because of the required precision of the SUR study and did not correct for DO calibration drift if the amount of drift was below the chosen threshold.

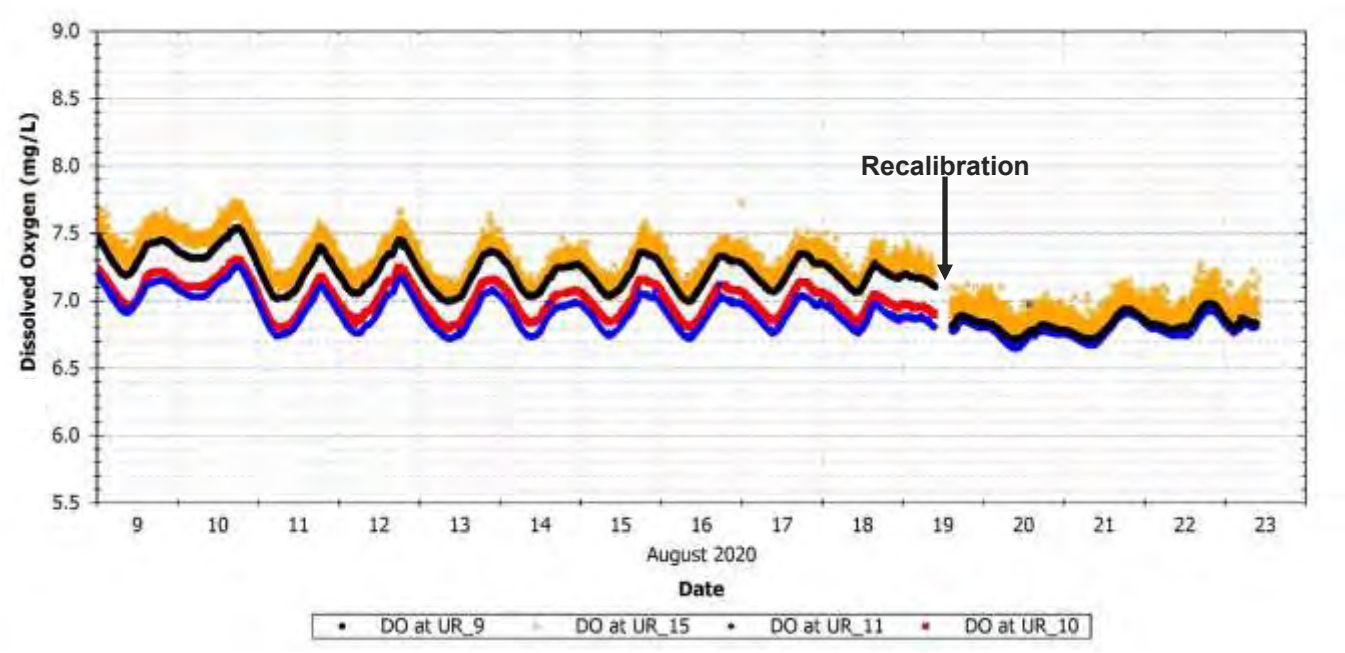


Figure F-9 Upriver buoy diffuser near-field observed DO concentration discontinuities

Most semi-permanent buoy, profile, and drift DO sensors used by the field team between July 14 and August 18, 2020 experienced calibration drift greater than the 0.15 mg/L threshold. Between August 18 and September 25, 2020, the DO sensors used by the field team also experienced drift, ranging between -0.12 and +0.08 mg/L, below the 0.15 mg/L threshold. The raw DO readings between July 14 and August 18, 2020 were corrected for DO sensor calibration drift. The USGS routinely completes sensor calibration drift corrections for provisional data sets before they are classified as accepted data. The DO calibration drift correction followed a procedure that is widely accepted and replicated, and the corrections were in the downward direction (decreasing raw DO concentration to corrected concentrations). The DO drift corrections were calculated for each sensor using the August 18, 2020 pre- and post-calibration DO percent saturation observations and used the following methodology:

1) Calculated the pre- and post-calibration DO concentrations using the percent saturation and air temperature measurements and calculated the Δ DO concentrations;
2) Calculated the Δ DO concentration per second correction factor for each sensor by assuming the calibration drift was linear between the July 14, 2020 calibration and August 18, 2020 recalibration dates;
3) Applied the sensor specific correction factors to the sensor specific measured DO concentration raw data time series and calculated the DO drift correction concentration values; and
4) Calculated the DO drift corrected percent saturation from the DO drift corrected concentration values.

The DO sensor used at UR_13 did not experience DO calibration drift outside of the 0.15 mg/L threshold; however after the August 18, 2020 recalibration this sensor began reporting values approximately 0.5 mg/L higher then neighboring buoys, indicating it was no longer functioning properly. The field team replaced the sonde deployed at UR_13 on August 30, 2020 and the raw data from the malfunctioning DO sensor was corrected by supplying a Δ correction factor calculated from pre- and post-sonde change out observed values.

The figures below present uncorrected (raw) and corrected DO concentration timeseries for all the semi-permanent buoy, profile, and drift data collected for the SUR. The data points in orange show the uncorrected (raw) data and the data points in green show the calibration drift corrected data.

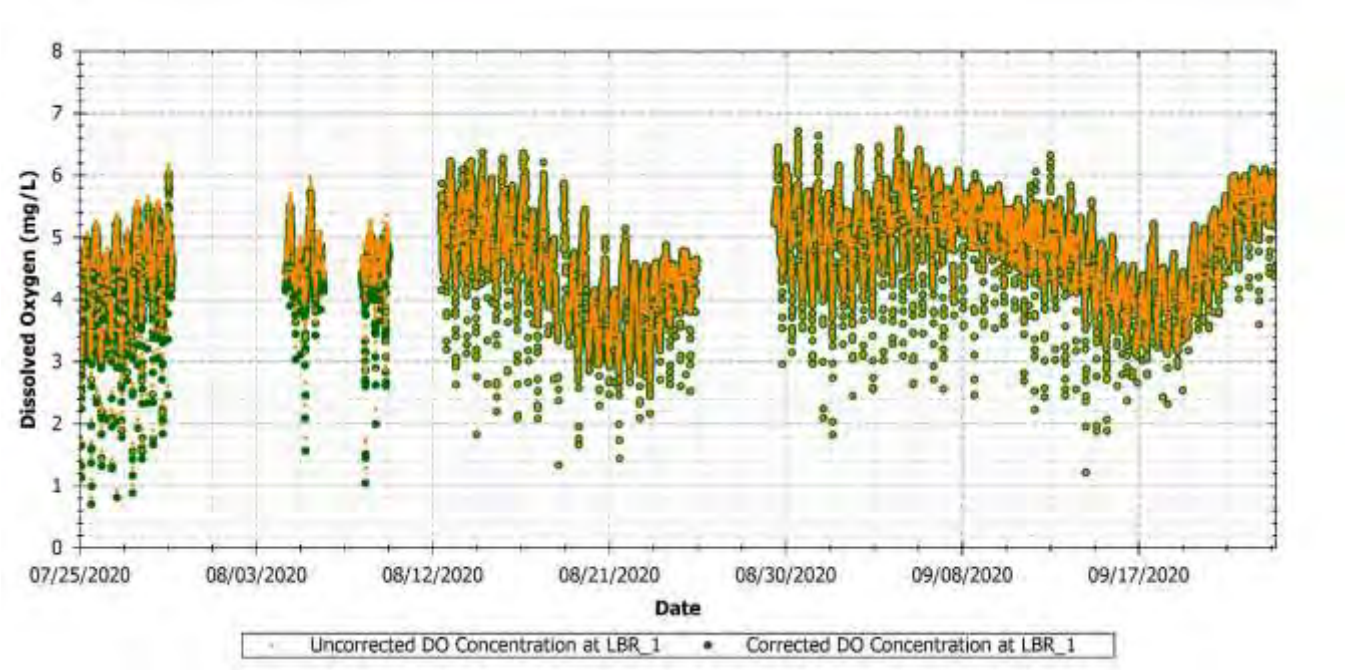


Figure F-10 Back River buoy 1 uncorrected and corrected observed DO concentration

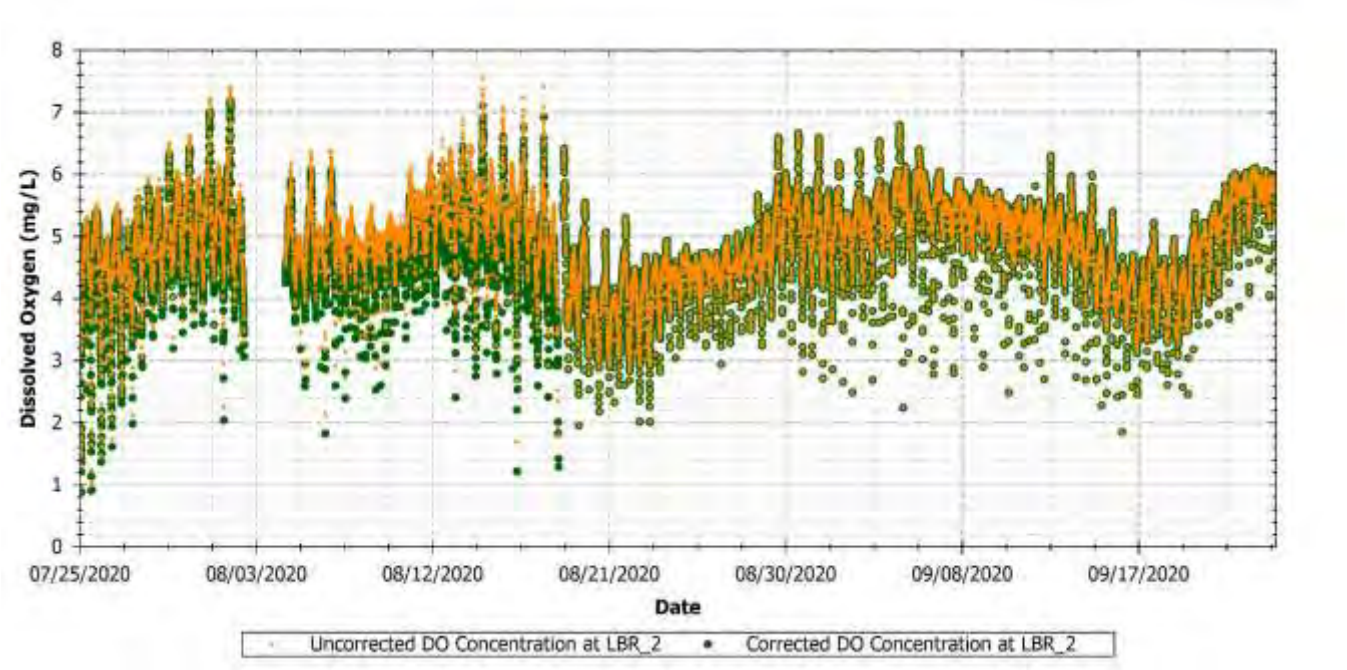


Figure F-11 Back River buoy 2 uncorrected and corrected observed DO concentration

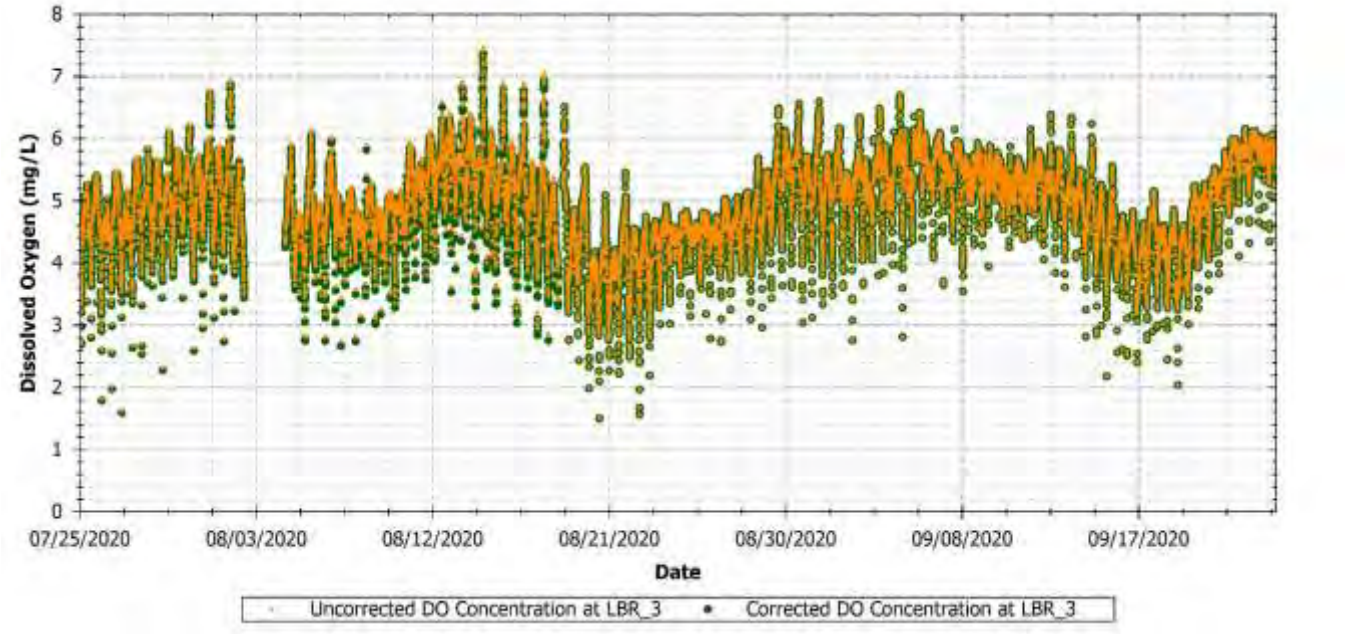


Figure F-12 Back River buoy 3 uncorrected and corrected observed DO concentration

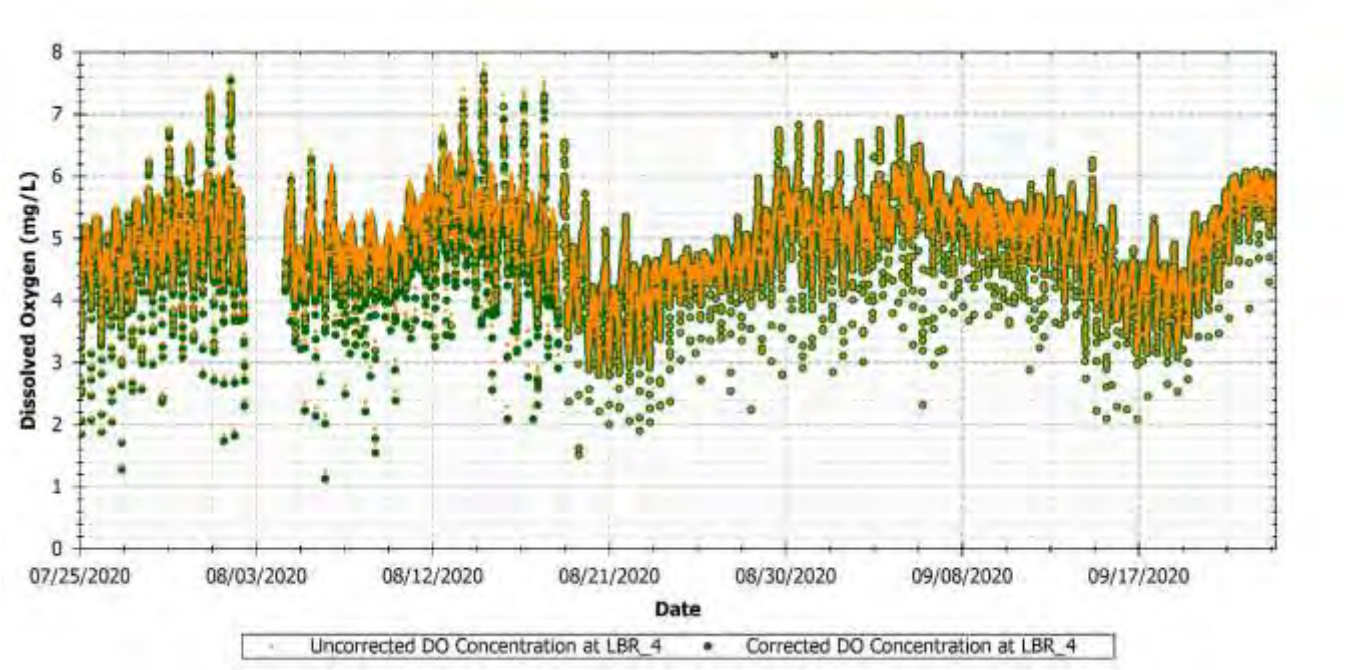


Figure F-13 Back River buoy 4 uncorrected and corrected observed DO concentration

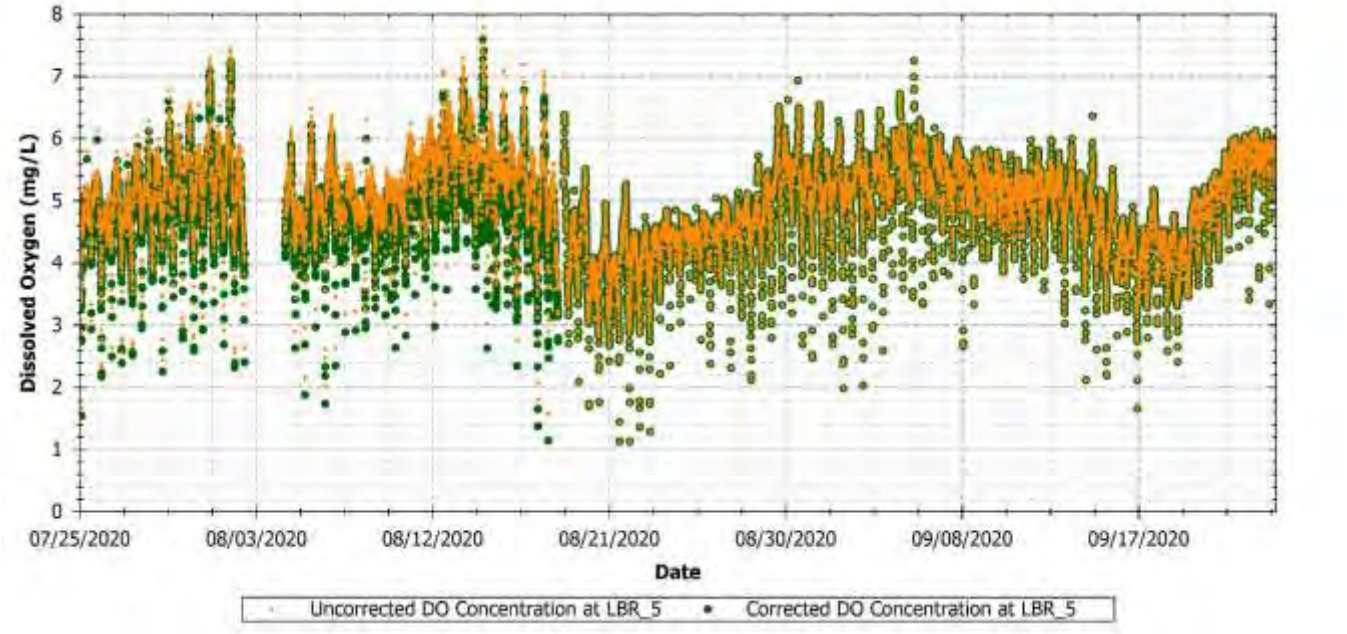


Figure F-14 Back River buoy 5 uncorrected and corrected observed DO concentration

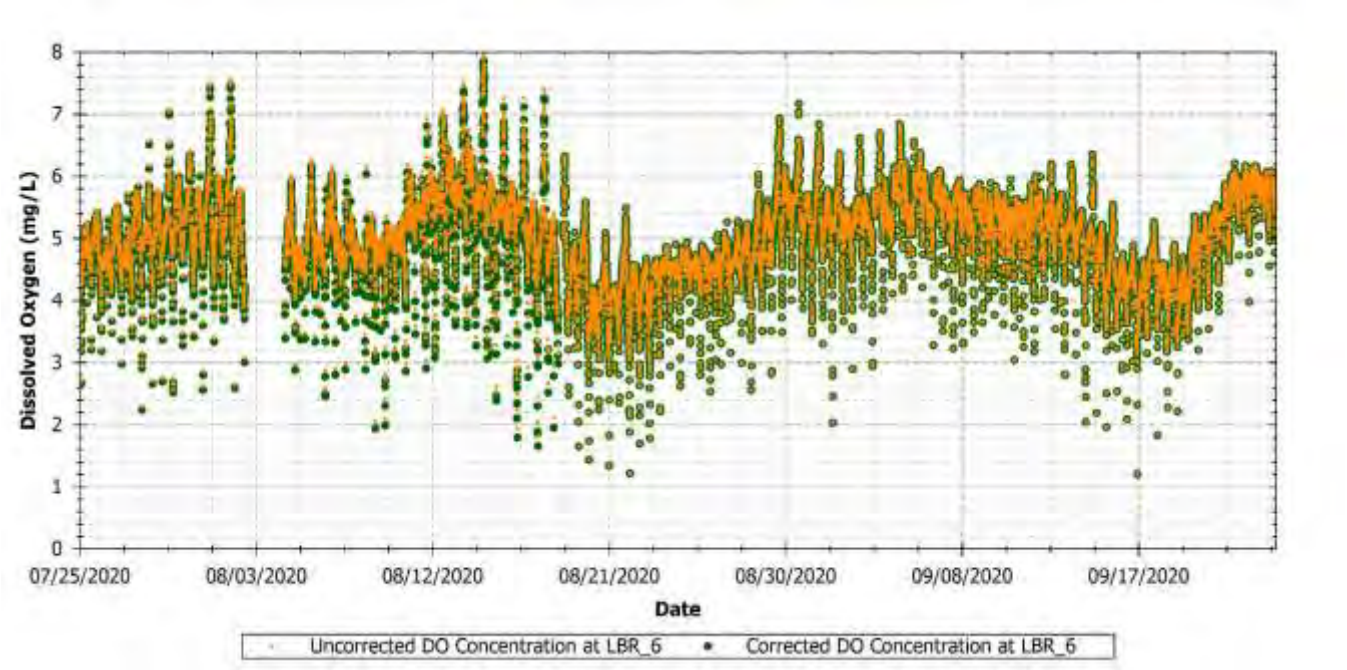


Figure F-15 Back River buoy 6 uncorrected and corrected observed DO concentration

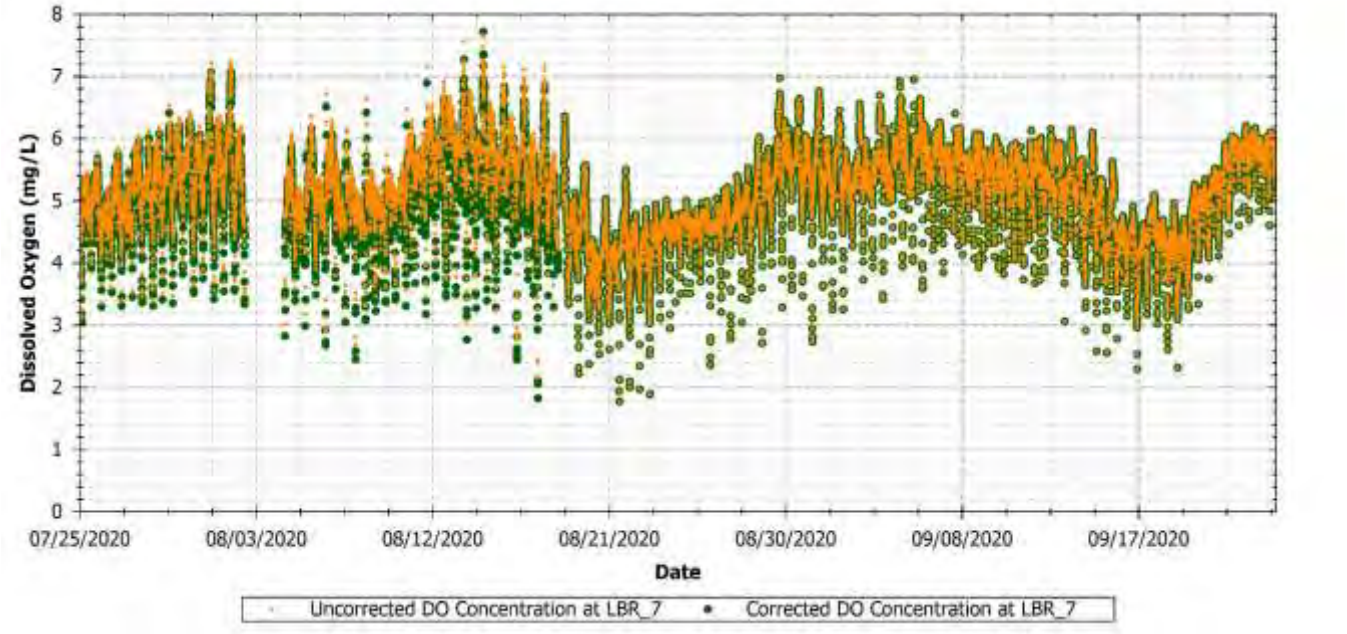


Figure F-16 Back River buoy 7 uncorrected and corrected observed DO concentration

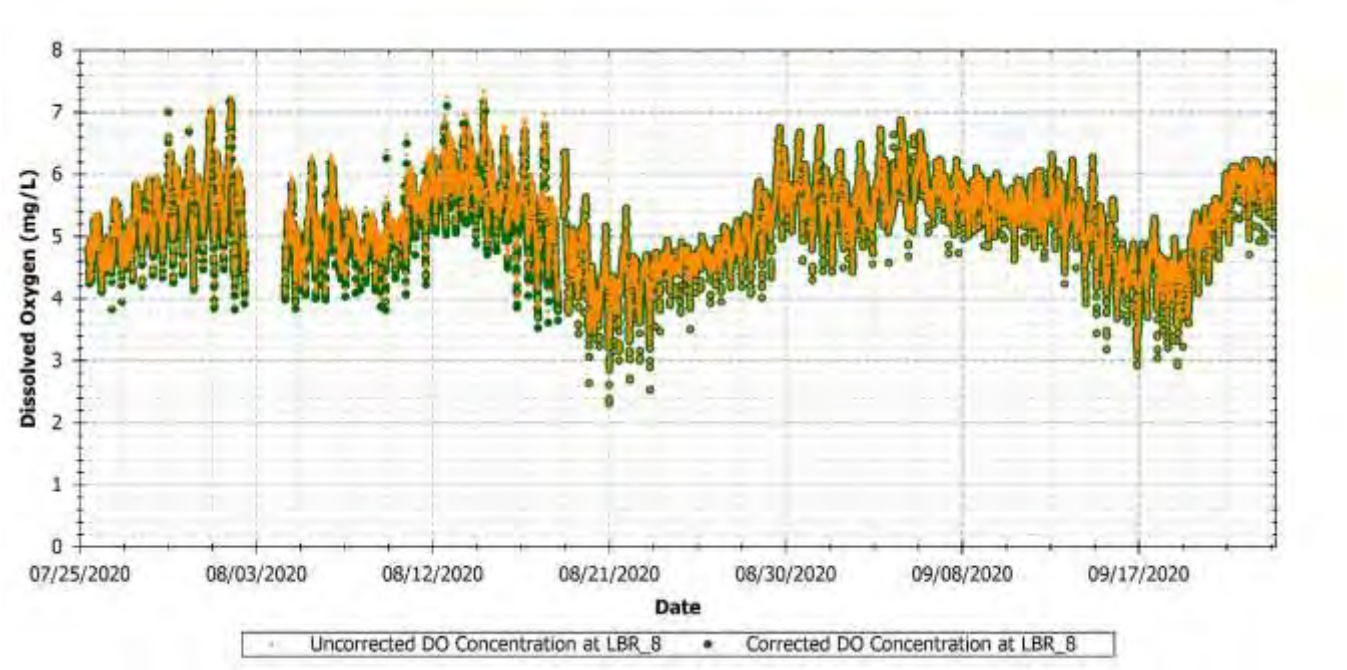


Figure F-17 Back River buoy 8 uncorrected and corrected observed DO concentration

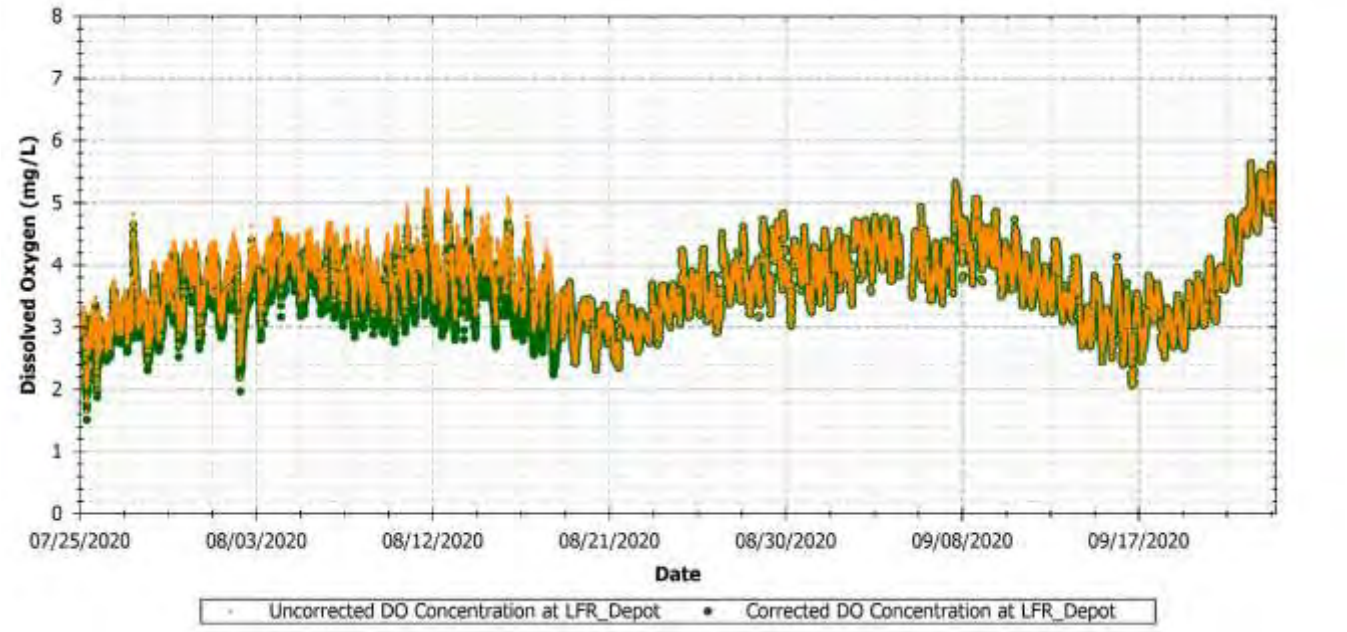


Figure F-18 Front River Depot sonde uncorrected and corrected observed DO concentration

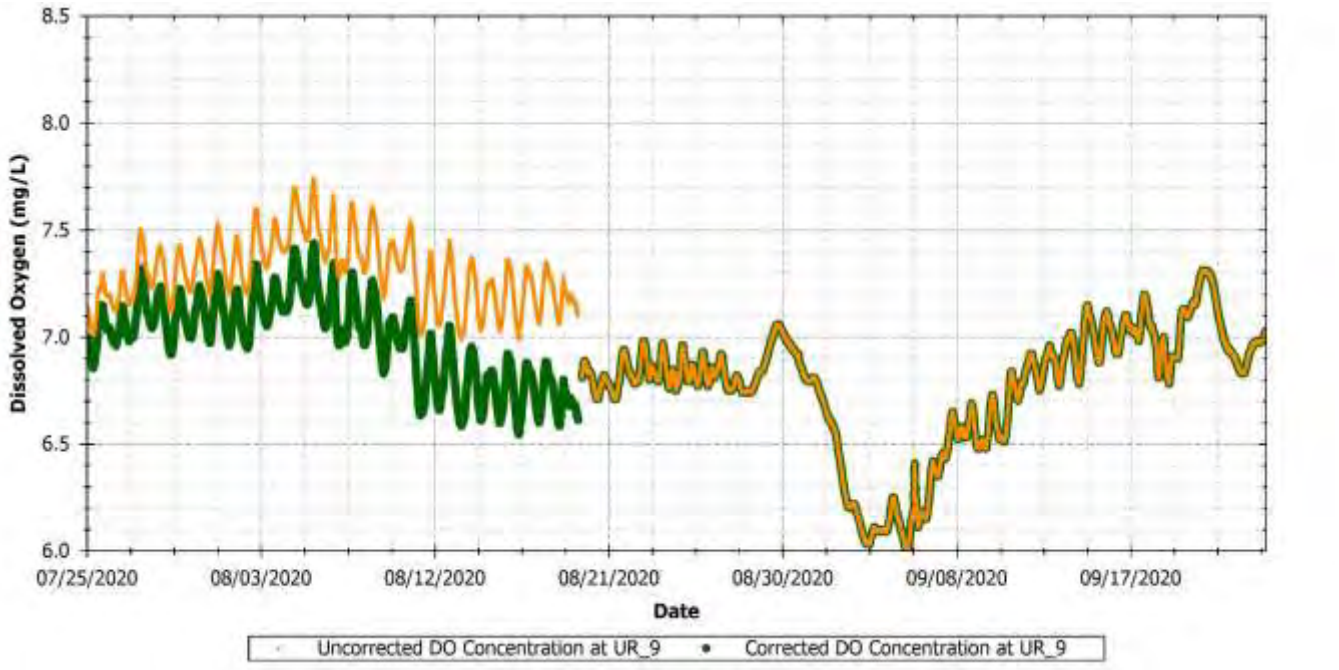


Figure F-19 Upriver buoy 9 uncorrected and corrected observed DO concentration

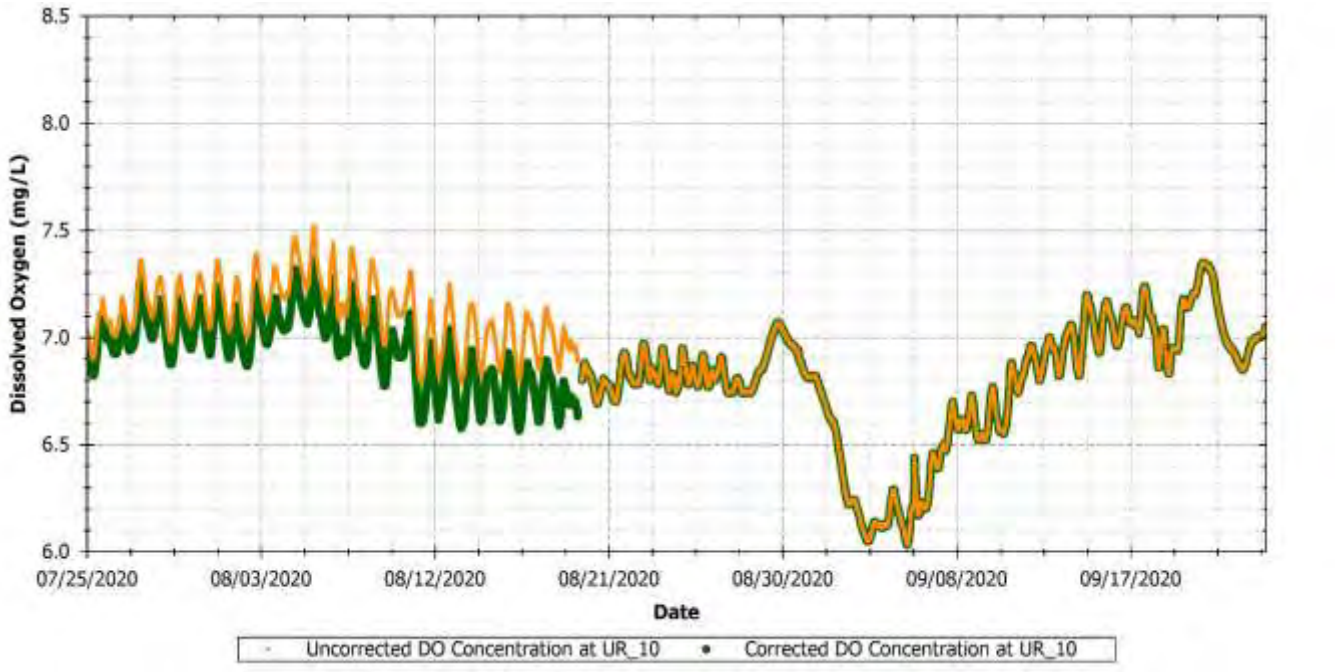


Figure F-20 Upriver buoy 10 uncorrected and corrected observed DO concentration

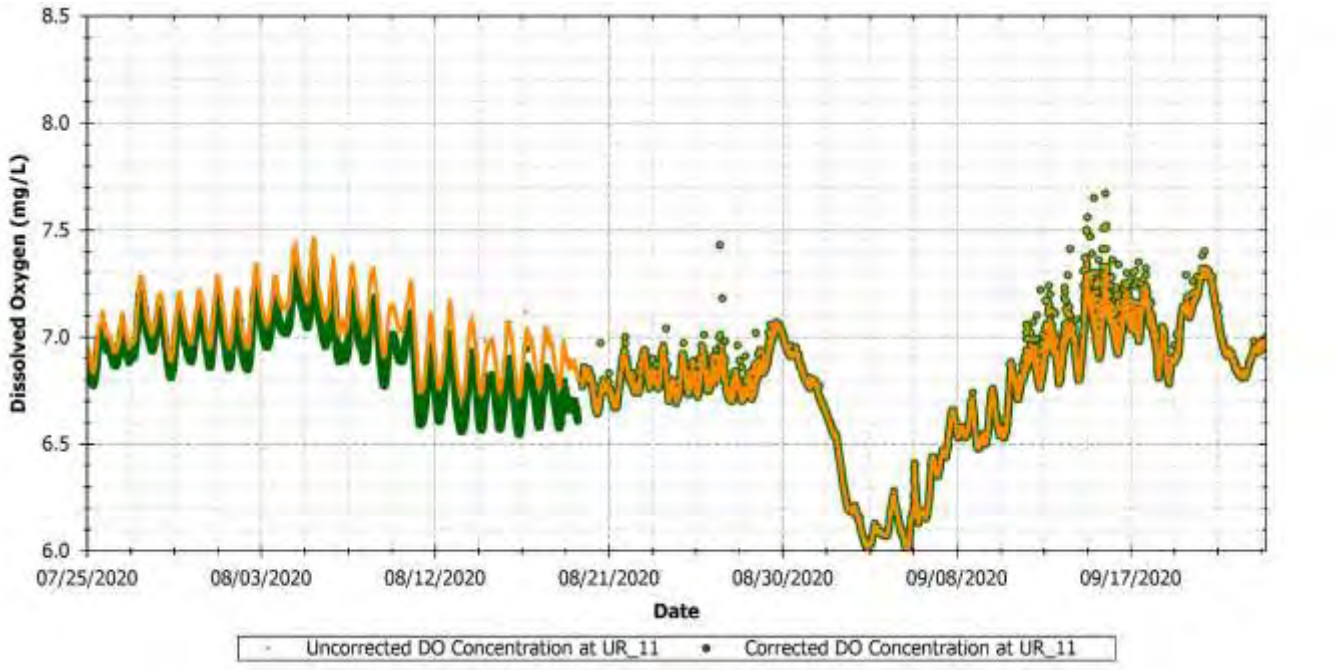


Figure F-21 Upriver 11 uncorrected and corrected observed DO concentration

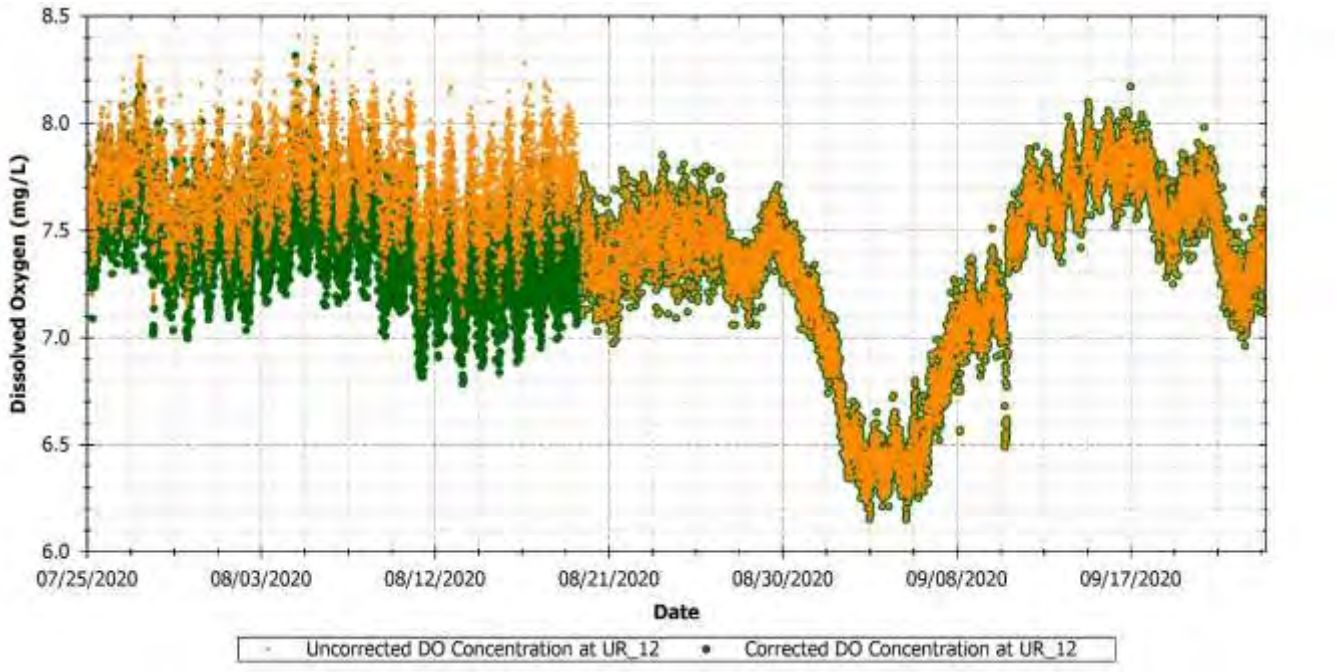


Figure F-22 Upriver buoy 12 uncorrected and corrected observed DO concentration

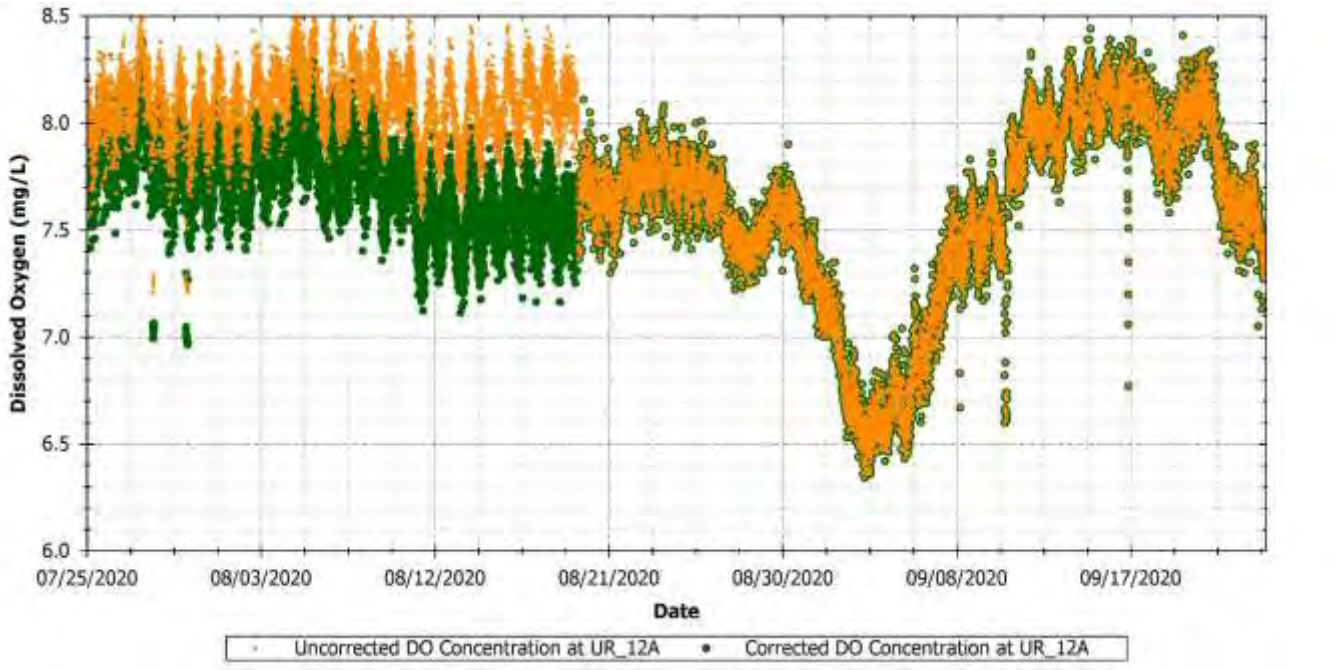


Figure F-23 Upriver 12a sonde uncorrected and corrected observed DO concentration

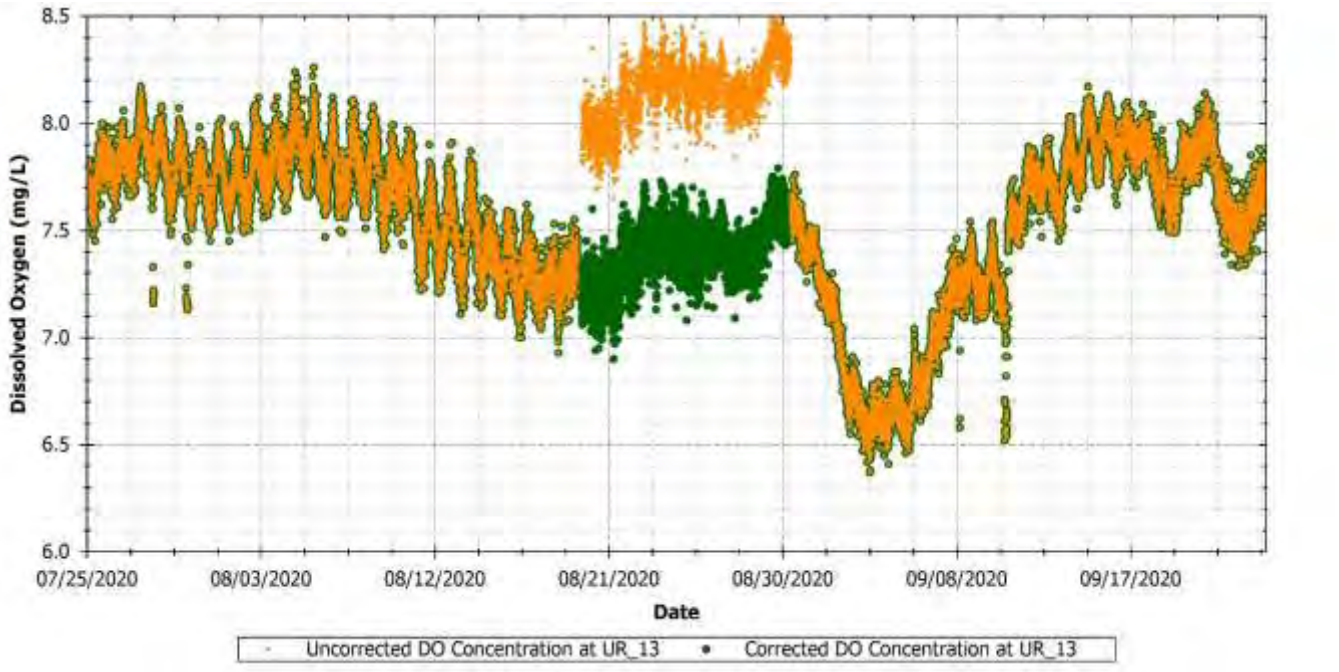


Figure F-24 Upriver buoy 13 uncorrected and corrected observed DO concentration

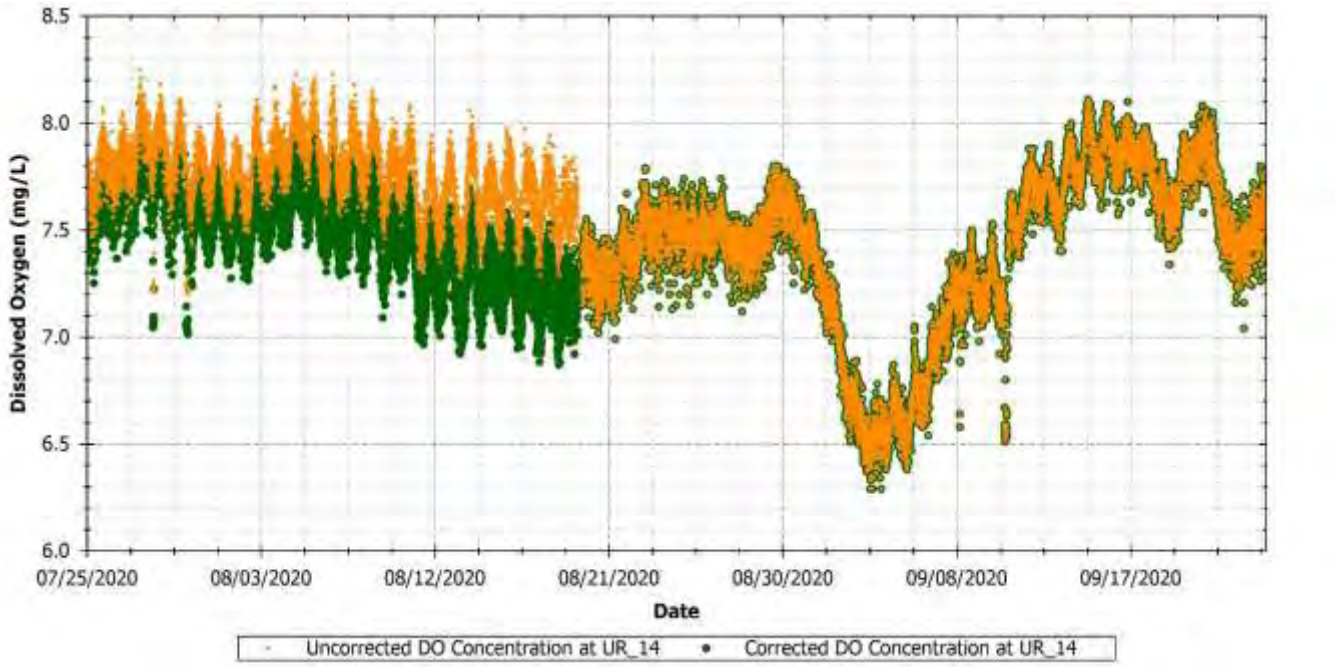


Figure F-25 Upriver buoy 14 uncorrected and corrected observed DO concentration

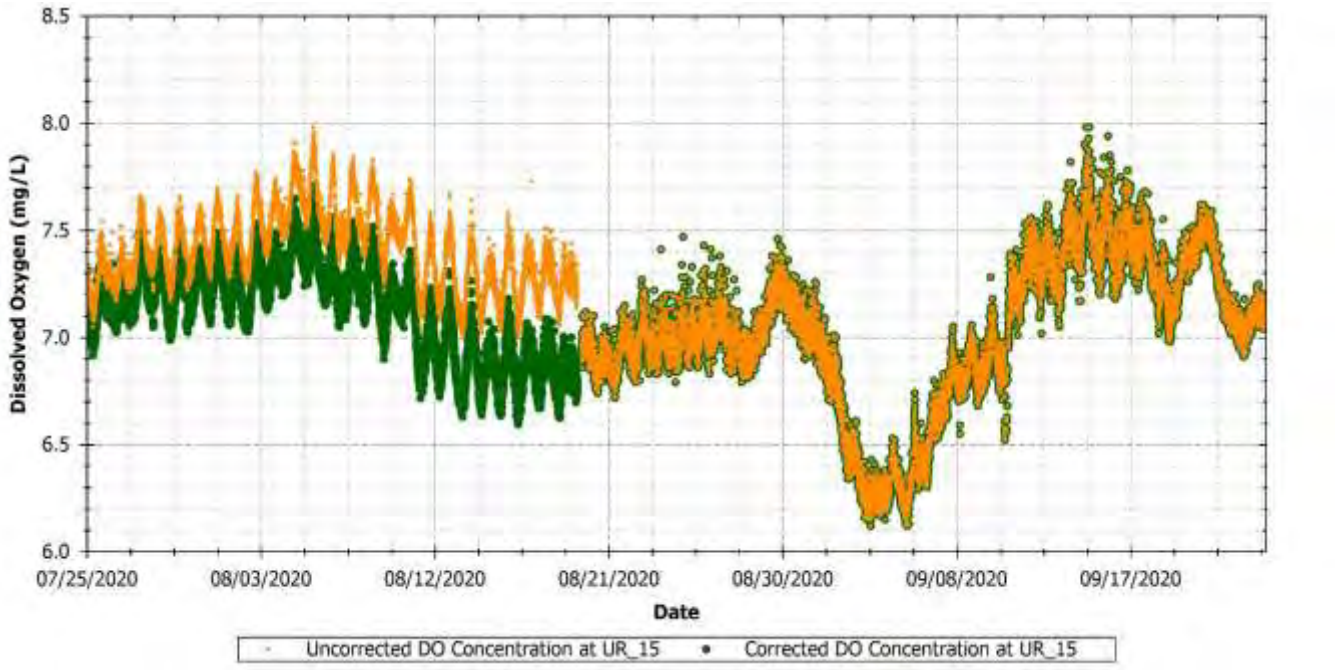


Figure F-26 Upriver buoy 15 uncorrected and corrected observed DO concentration

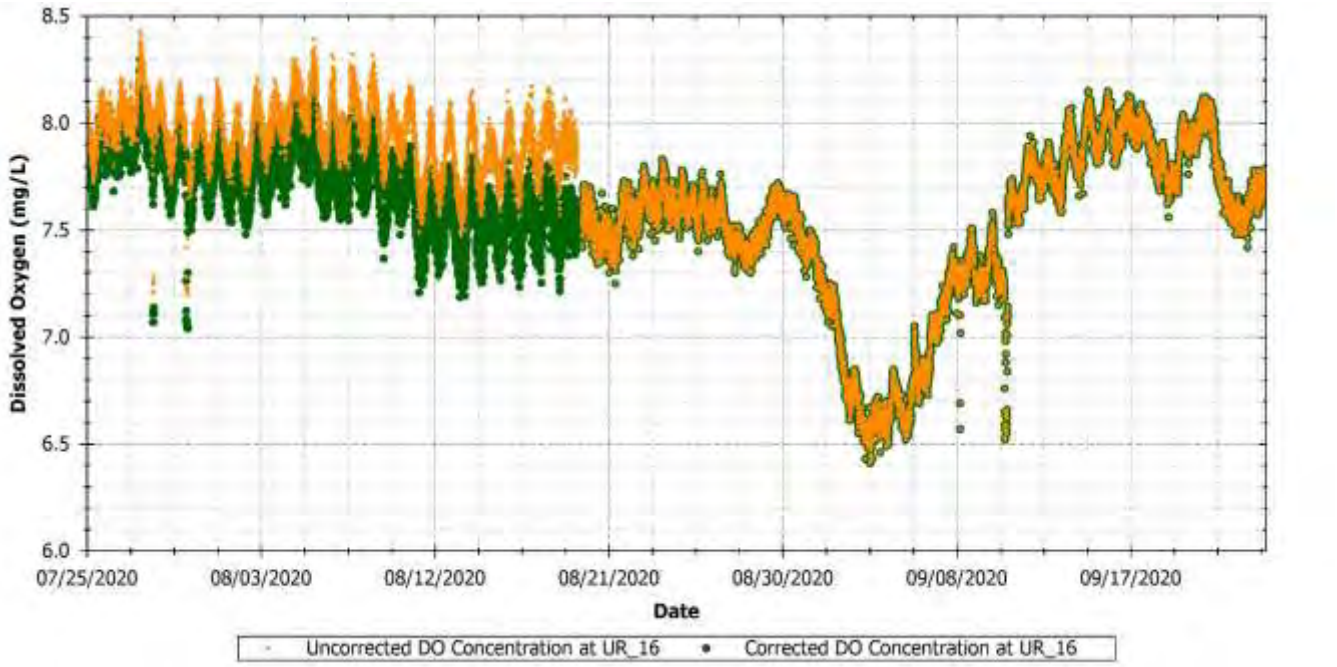


Figure F-27 Upriver buoy 16 uncorrected and corrected observed DO concentration

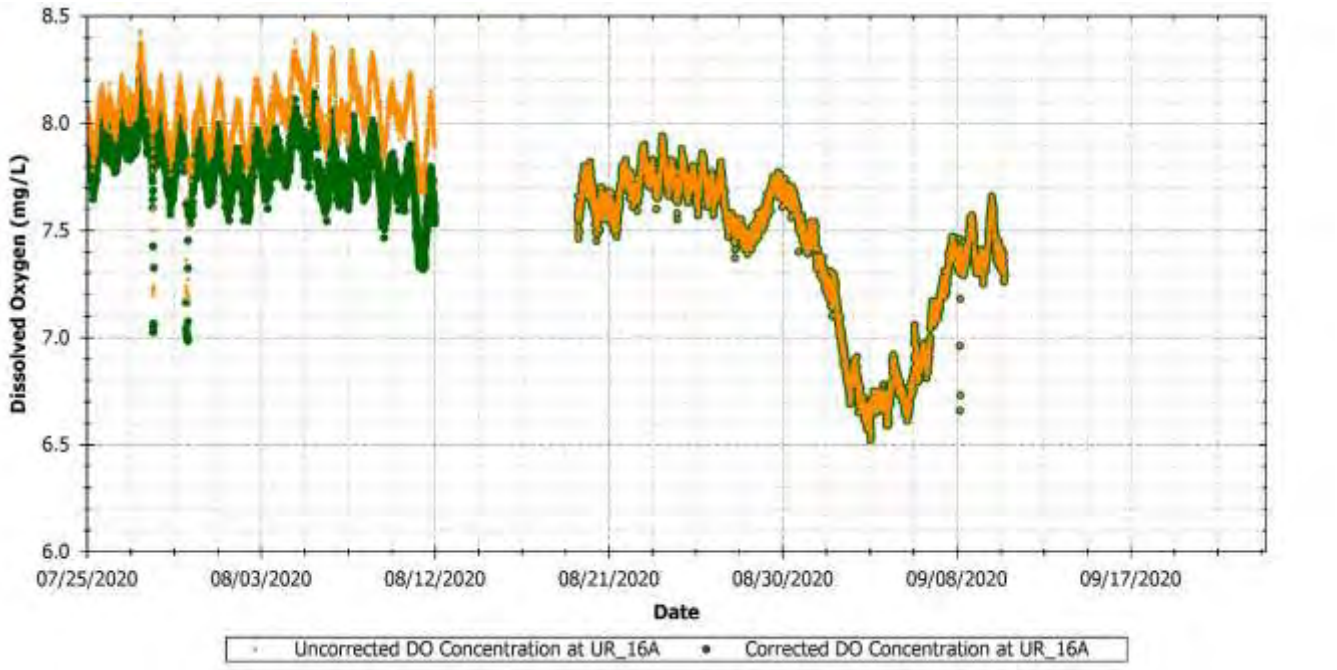


Figure F-28 Upriver 16a sonde uncorrected and corrected observed DO concentration

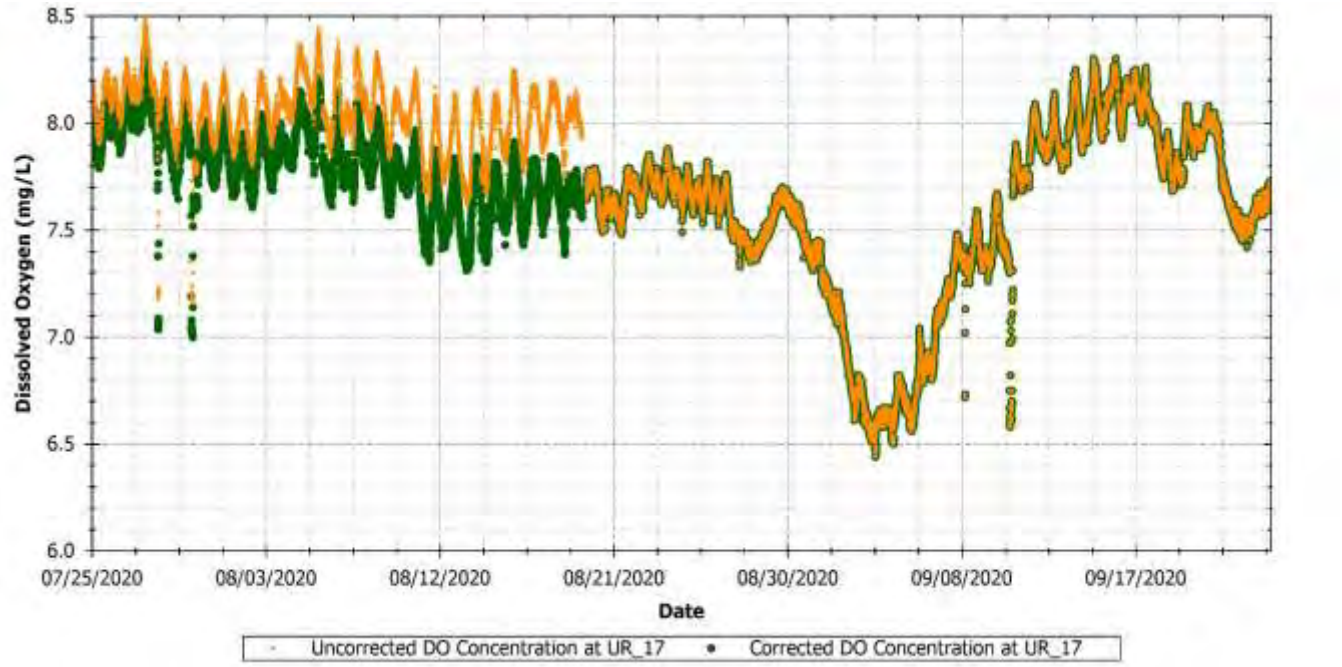


Figure F-29 Upriver buoy 17 uncorrected and corrected observed DO concentration

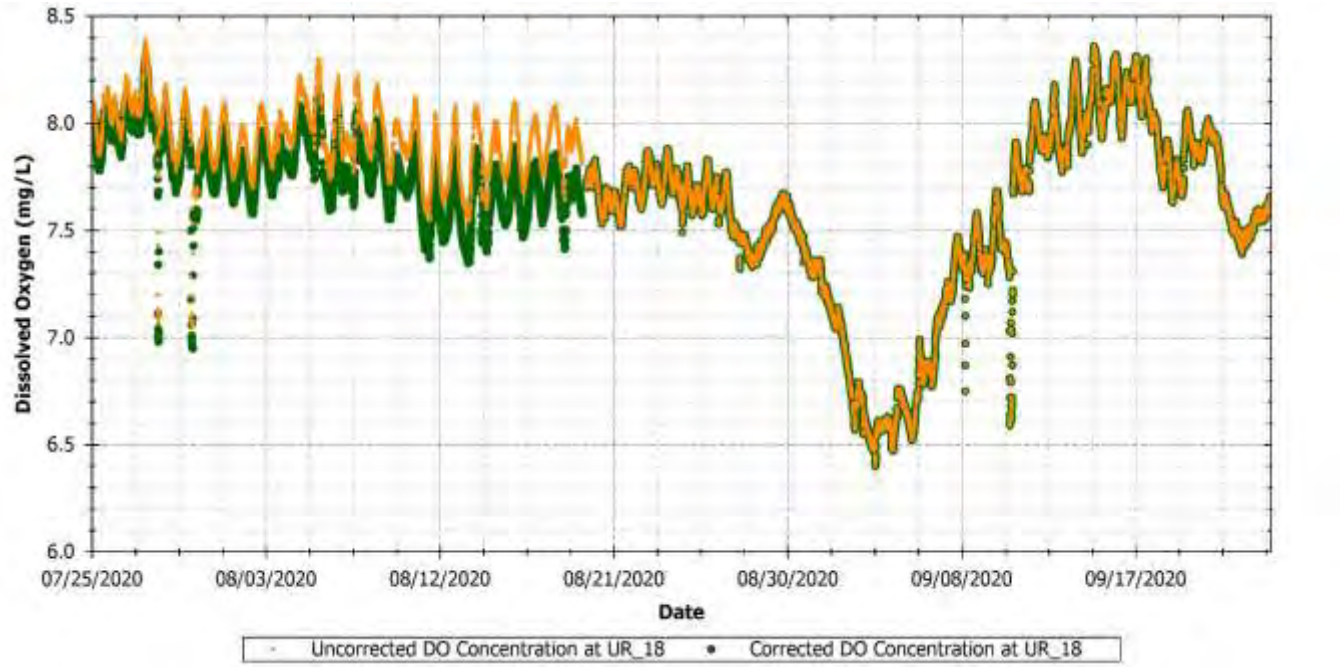


Figure F-30 Upriver buoy 18 uncorrected and corrected observed DO concentration

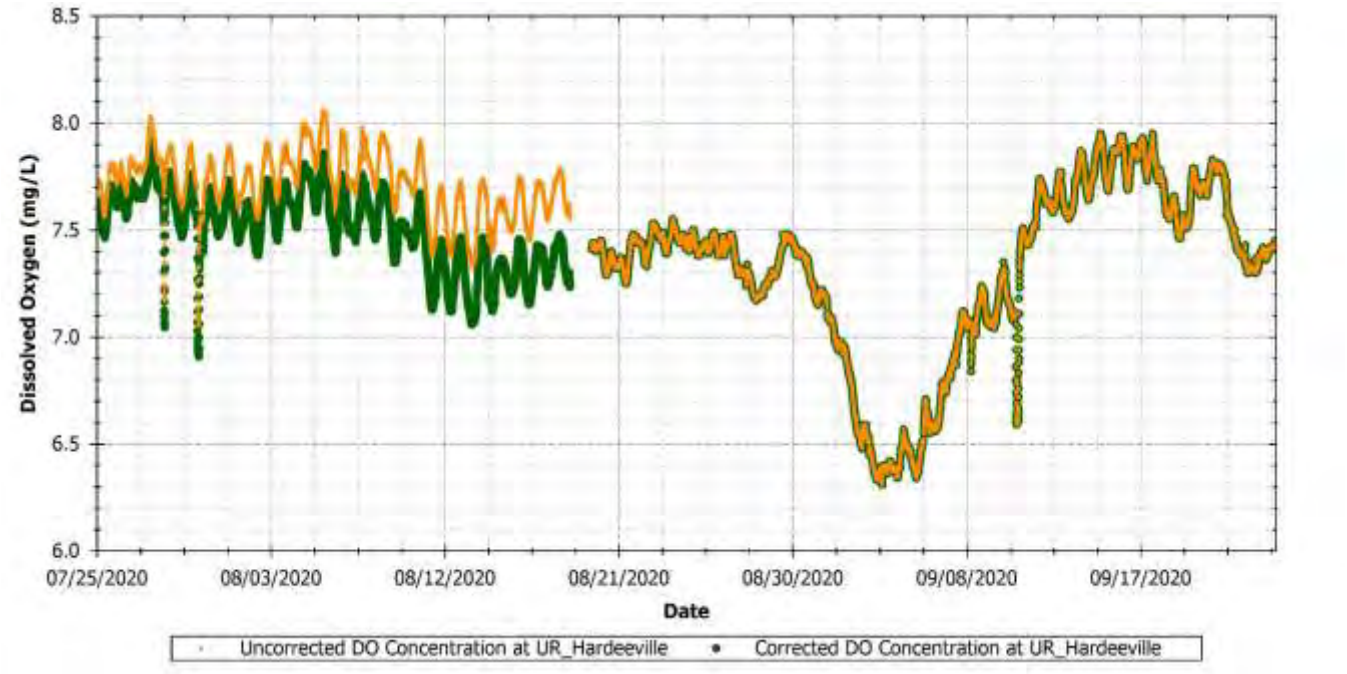


Figure F-31 Upriver Hardeeville sonde uncorrected and corrected observed DO concentration

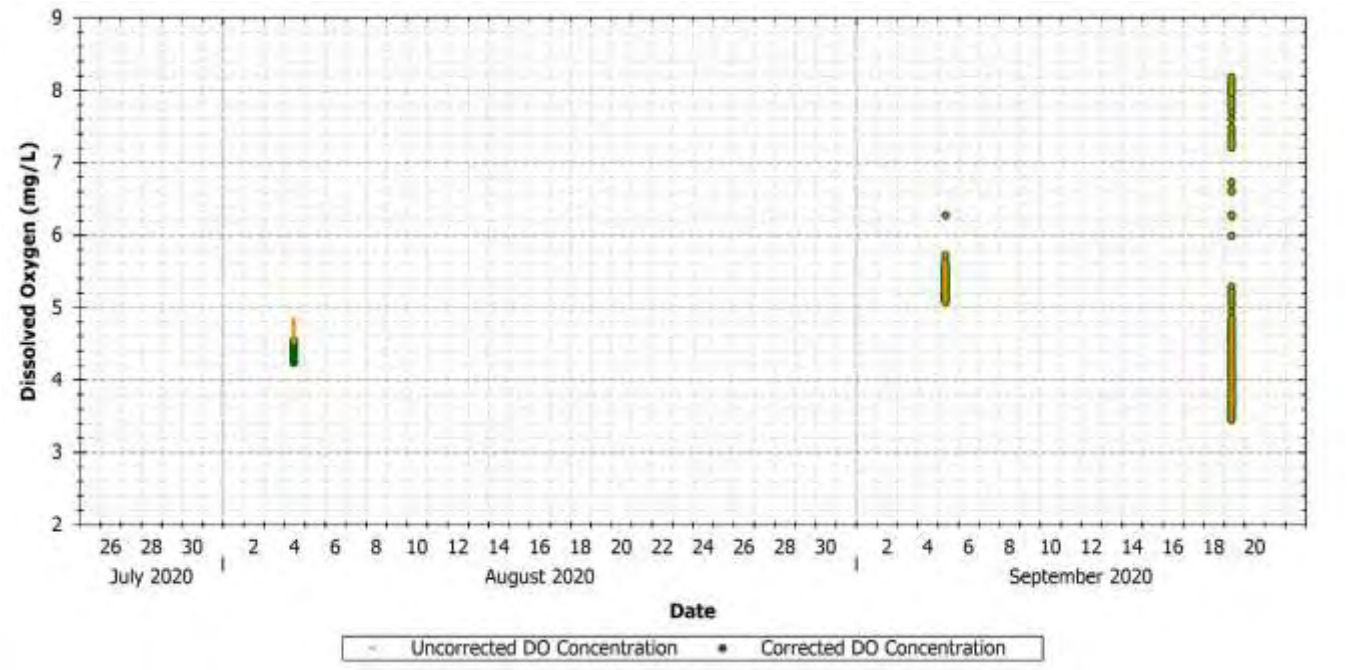


Figure F-32 Back River profile uncorrected and corrected observed DO concentration

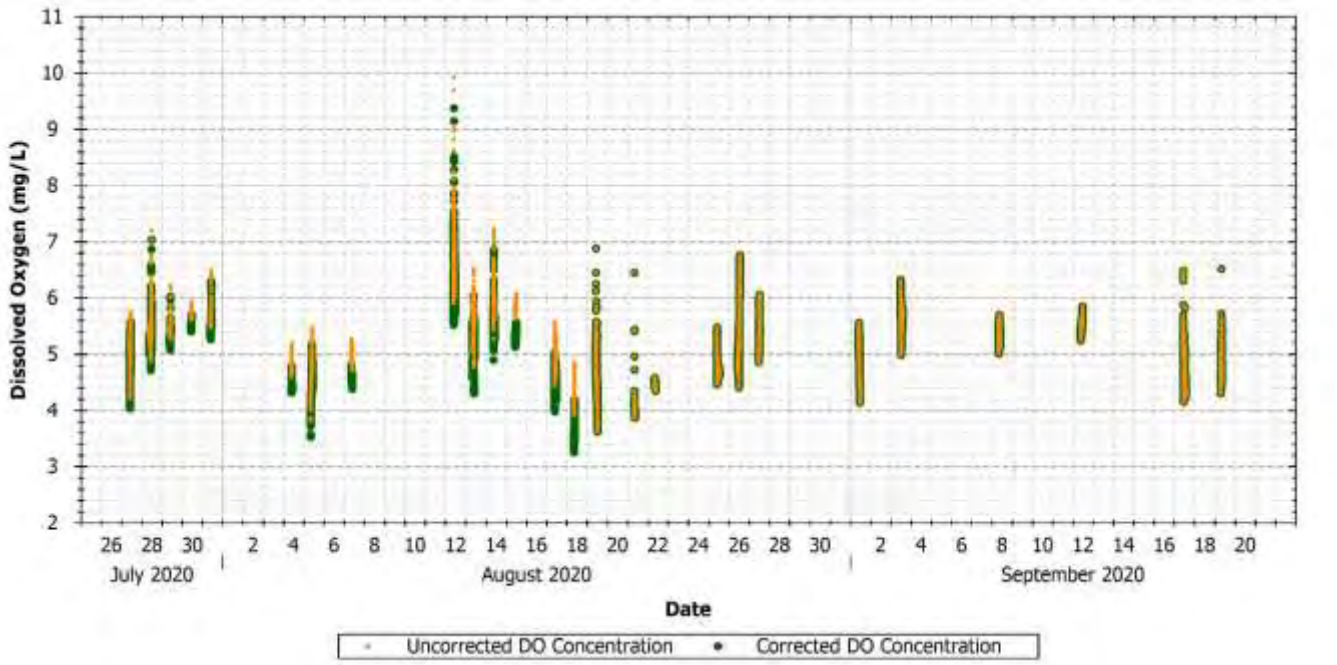


Figure F-33 Back River drift uncorrected and corrected observed DO concentration

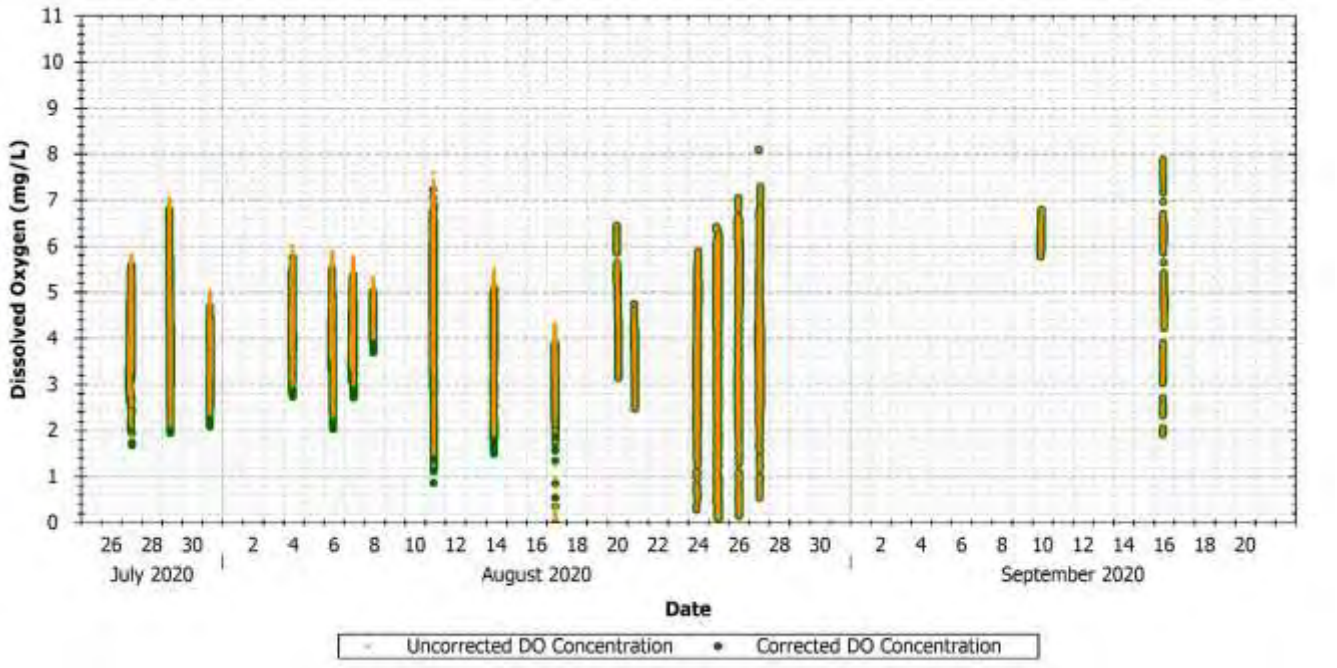


Figure F-34 Front River drift uncorrected and corrected observed DO concentration

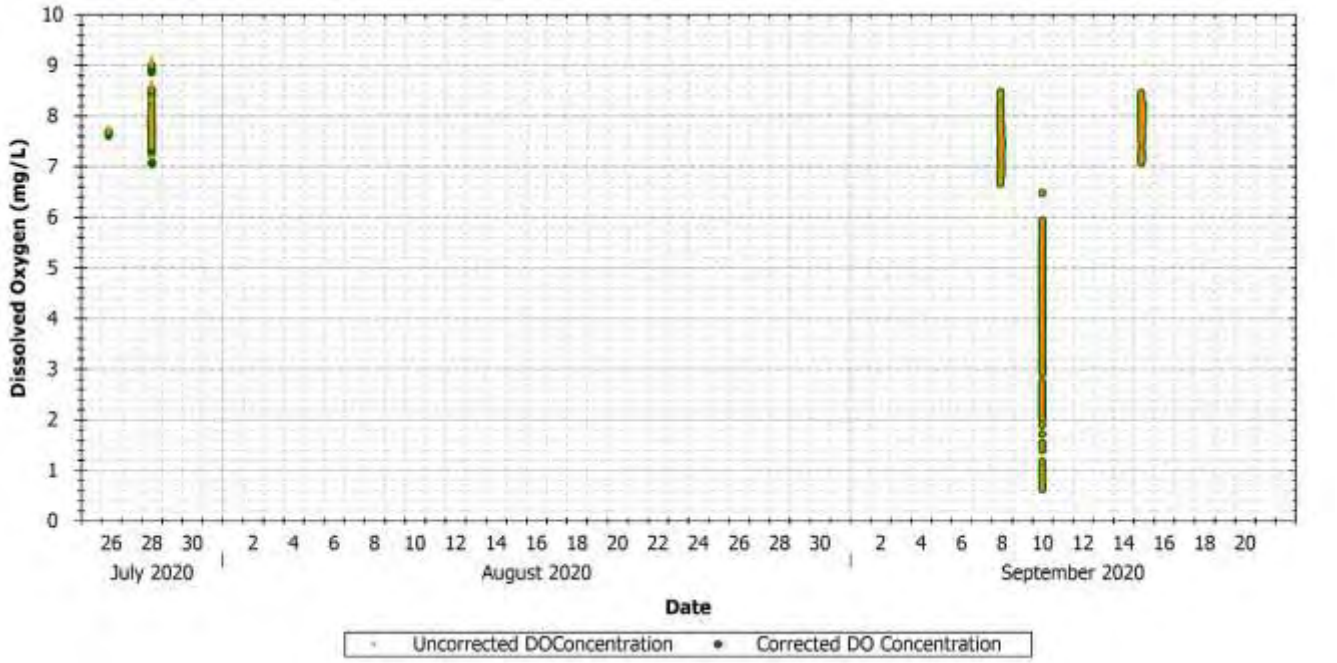


Figure F-35 Upriver profile uncorrected and corrected observed DO concentration

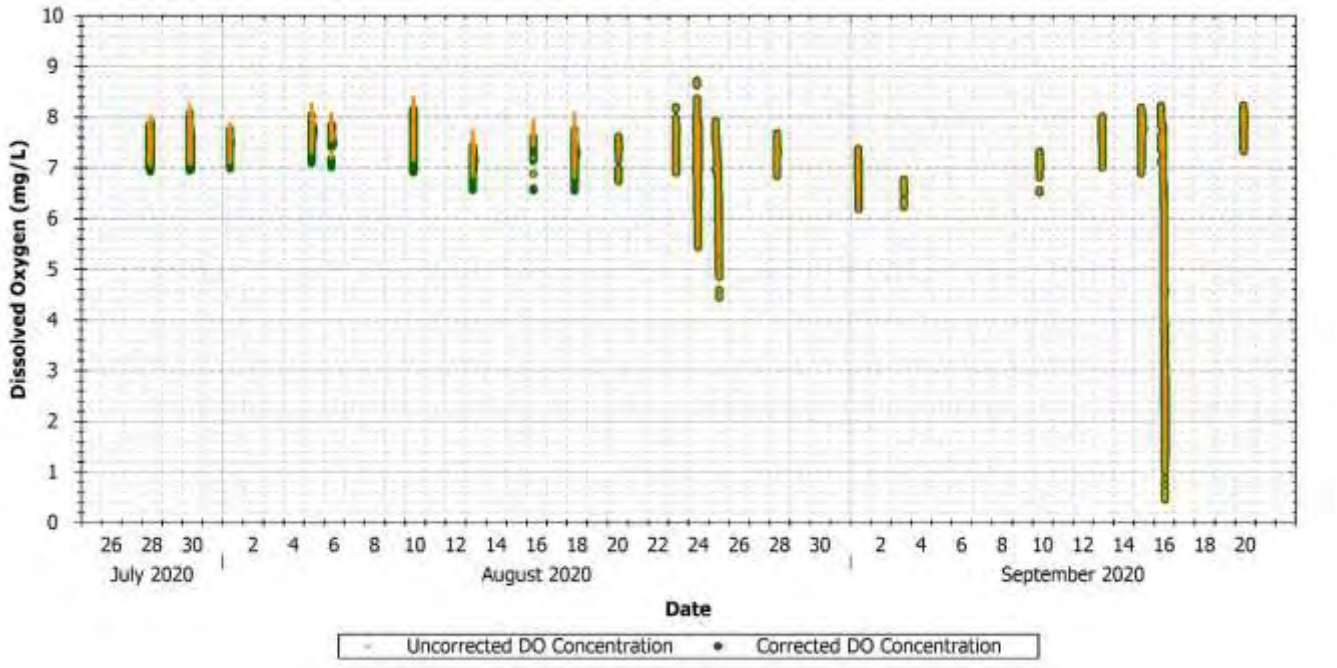


Figure F-36 Upriver drift uncorrected and corrected observed DO concentration

F.5 USGS DATA

The USGS data used in the SUR evaluation were all approved by the USGS and were accepted by the project team without alterations. This is due to the rigorous QAQC methods USGS employ on their data. All data is labelled as *provisional* until it has undergone internal USGS field calibration and verification. Once the *provisional* data has been reviewed, it moves to *approved* status. The SUR data evaluations used only *approved* USGS hydrodynamic and water quality data.

Data were downloaded from the National Water Information System Web Interface (https://waterdata.usgs.gov/ga/nwis/) with a sampling interval of 15 minutes and spanned the period from July 25, 2020 to September 23, 2020.

Table F-14 USGS gages data compiled for the SUR sampling

Station ID	Description
02198840	Savannah River (I-95) near Port Wentworth, GA
02198920	Savannah River at GA 25 at Port Wentworth, GA
02198950	Middle River at GA 25 at Port Wentworth, GA
02198955	Middle River at Fish Hole at Port Wentworth, GA
021989715	Savannah River at Garden City, GA
021989773	Savannah River at USACE Dock, at Savannah, GA
021989792	Little Back River at GA 25 at Port Wentworth, GA
021989793	Little Back River at Hog Island, near Savannah, GA
0219897945	Back River 0.4 miles downstream US17, near Savannah, GA
0219897993	Savannah River at Elba Island near Savannah, GA

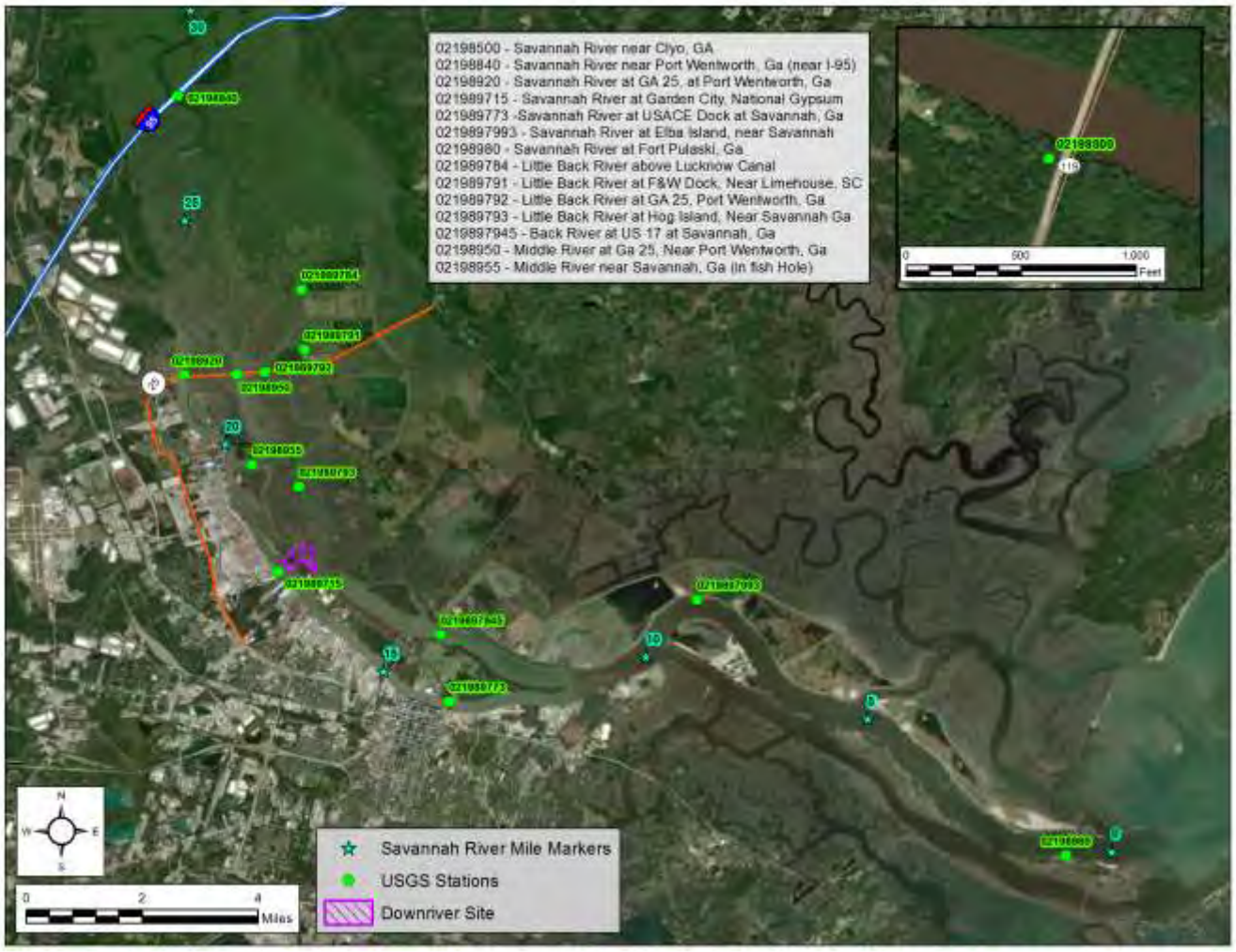


Figure F-37 Location of USGS gages used for the SUR sampling

The downloaded USGS data were attributed with a time zone code (i.e. Eastern Daylight Time [EDT] and Eastern Standard Time [EST]). During data processing, the sample times were brought to a consistent time basis by subtracting one hour from the EDT time zone codes. Therefore, the USGS data in the processing workbooks and the project WRDB database have a time code of EST.

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):

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

where,

C_{sf}	=	freshwater DO concentration at 100% saturation at 1 atm in mg/L
ln	=	natural logarithm
T	=	temperature in Kelvin

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

where,

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

S = salinity in ppt

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

where,

DOSAT = DO percent saturation

APPENDIX G USGS DATA

APPENDIX G USGS DATA

Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Tasks: 10
March 2021

PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX G BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document is provided as Appendix G of the SUR Report and is referred to in the main body of the report in Section 3.3 and Section 7.0.

APPENDIX G TABLE OF CONTENTS

APPENDIX G USGS DATA G-1

G.1 Definitions and Location Map G-7

G.2 USGS 02198840 – I-95 – Savannah River G-9

G.3 USGS 02198920 – Port Wentworth – Savannah River G-13

G.4 USGS 02198950 – Port Wentworth – Middle River G-17

G.5 USGS 021989792 – Port Wentworth – Back River G-21

G.6 USGS 02198955 – Fish Hole – Middle River G-25

G.7 USGS 021989793 – Hog Island – Back River G-28

G.8 USGS 021989715 – Garden City – Front River G-31

G.9 USGS 0219897945 – US17 – Back River G-35

G.10 USGS 021989773 – USACE Dock – Front River G-38

G.11 USGS 0219897993 – Elba Island – Savannah River G-42

APPENDIX G LIST OF FIGURES

Figure G-1 Location of USGS gages used for Startup Run sampling G-7
Figure G-2 USGS 02198840 (Savannah River) observed blue-green algae G-9
Figure G-3 USGS 02198840 (Savannah River) observed DO concentration G-9
Figure G-4 USGS 02198840 (Savannah River) calculated DO saturation G-10
Figure G-5 USGS 02198840 (Savannah River) observed discharge G-10
Figure G-6 USGS 02198840 (Savannah River) observed gage height G-11
Figure G-7 USGS 02198840 (Savannah River) observed pH G-11
Figure G-8 USGS 02198840 (Savannah River) observed salinity G-12
Figure G-9 USGS 02198840 (Savannah River) observed water temperature G-12
Figure G-10 USGS 02198920 (Savannah River) observed blue-green algae G-13
Figure G-11 USGS 02198920 (Savannah River) observed DO concentration G-13
Figure G-12 USGS 02198920 (Savannah River) calculated DO saturation G-14
Figure G-13 USGS 02198920 (Savannah River) observed discharge G-14
Figure G-14 USGS 02198920 (Savannah River) observed gage height G-15
Figure G-15 USGS 02198920 (Savannah River) observed pH G-15
Figure G-16 USGS 02198920 (Savannah River) observed salinity G-16
Figure G-17 USGS 02198920 (Savannah River) observed water temperature G-16
Figure G-18 USGS 02198950 (Middle River) observed blue-green algae G-17
Figure G-19 USGS 02198950 (Middle River) observed DO concentration G-17
Figure G-20 USGS 02198950 (Middle River) calculated DO saturation G-18
Figure G-21 USGS 02198950 (Middle River) observed discharge G-18
Figure G-22 USGS 02198950 (Middle River) observed gage height G-19
Figure G-23 USGS 02198950 (Middle River) observed pH G-19
Figure G-24 USGS 02198950 (Middle River) observed salinity G-20
Figure G-25 USGS 02198950 (Middle River) observed water temperature G-20
Figure G-26 USGS 021989792 (Back River) observed blue-green algae G-21
Figure G-27 USGS 021989792 (Back River) observed DO concentration G-21
Figure G-28 USGS 021989792 (Back River) calculated DO saturation G-22
Figure G-29 USGS 021989792 (Back River) observed discharge G-22
Figure G-30 USGS 021989792 (Back River) observed gage height G-23
Figure G-31 USGS 021989792 (Back River) observed pH G-23
Figure G-32 USGS 021989792 (Back River) observed salinity G-24
Figure G-33 USGS 021989792 (Back River) observed water temperature G-24
Figure G-34 USGS 02198955 (Middle River) observed DO concentration G-25
Figure G-35 USGS 02198955 (Middle River) calculated DO saturation G-25
Figure G-36 USGS 02198955 (Middle River) observed pH G-26
Figure G-37 USGS 02198955 (Middle River) observed salinity G-26
Figure G-38 USGS 02198955 (Middle River) observed water temperature G-27
Figure G-39 USGS 021989793 (Back River) observed DO concentration G-28
Figure G-40 USGS 021989793 (Back River) calculated DO saturation G-28
Figure G-41 USGS 021989793 (Back River) observed pH G-29
Figure G-42 USGS 021989793 (Back River) observed salinity G-29
Figure G-43 USGS 021989793 (Back River) observed water temperature G-30
Figure G-44 USGS 021989715 (Front River) observed depth G-31
Figure G-45 USGS 021989715 (Front River) observed DO concentration G-31
Figure G-46 USGS 021989715 (Front River) calculated DO saturation G-32
Figure G-47 USGS 021989715 (Front River) observed gage height G-32

Figure G-48 USGS 021989715 (Front River) observed pH G-33
Figure G-49 USGS 021989715 (Front River) observed salinity G-33
Figure G-50 USGS 021989715 (Front River) observed water temperature G-34
Figure G-51 USGS 0219897945 (Back River) observed blue-green algae G-35
Figure G-52 USGS 0219897945 (Back River) observed DO concentration G-35
Figure G-53 USGS 0219897945 (Back River) calculated DO saturation G-36
Figure G-54 USGS 0219897945 (Back River) observed pH G-36
Figure G-55 USGS 0219897945 (Back River) observed salinity G-37
Figure G-56 USGS 0219897945 (Back River) observed water temperature G-37
Figure G-57 USGS 021989773 (Front River) observed DO concentration G-38
Figure G-58 USGS 021989773 (Front River) calculated DO saturation G-38
Figure G-59 USGS 021989773 (Front River) observed discharge G-39
Figure G-60 USGS 021989773 (Front River) observed gage height G-39
Figure G-61 USGS 021989773 (Front River) observed pH G-40
Figure G-62 USGS 021989773 (Front River) observed salinity G-40
Figure G-63 USGS 021989773 (Front River) observed water temperature G-41
Figure G-64 USGS 0219897993 (Savannah River) observed DO concentration G-42
Figure G-65 USGS 0219897993 (Savannah River) calculated DO saturation G-42
Figure G-66 USGS 0219897993 (Savannah River) observed gage height G-43
Figure G-67 USGS 0219897993 (Savannah River) observed pH G-43
Figure G-68 USGS 0219897993 (Savannah River) observed salinity G-44
Figure G-69 USGS 0219897993 (Savannah River) observed water temperature G-44

APPENDIX G LIST OF TABLES

Table G-1 Attributes of USGS stations used for the Startup Run data collection G-8

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BGA	Phycoerythin blue-green algae
cfs	cubic feet per second
DO	dissolved oxygen
F	Fahrenheit
mg/L	milligrams per liter
NAVD88	North American Vertical Datum 1988
RFU	relative fluorescence units
Std	standard
USGS	United States Geological Survey

G.1 DEFINITIONS AND LOCATION MAP

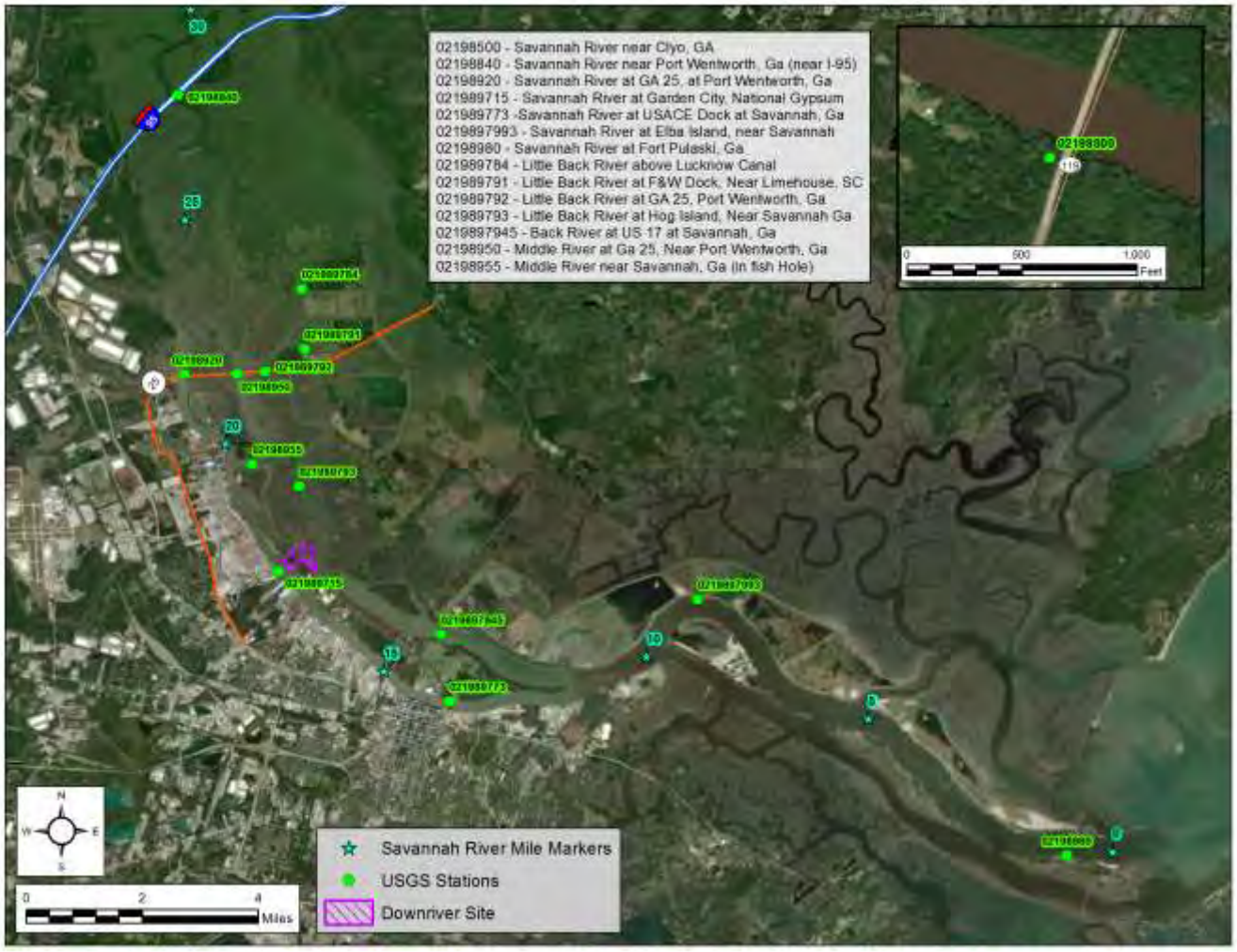


Figure G-1 Location of USGS gages used for Startup Run sampling

The USGS stations have been arranged in order from Upriver towards the ocean in ***Table G-1*** and in Sections G.2 through to G.11.

Table G-1 Attributes of USGS stations used for the Startup Run data collection

Station ID	Description	Available Data Used[1]
02198840	Savannah River (I-95) near Port Wentworth, GA	Blue-green algae sensor; dissolved oxygen; dissolved oxygen saturation; discharge; gage height; pH; salinity; water temperature
02198920	Savannah River at GA 25 at Port Wentworth, GA	Blue-green algae sensor; dissolved oxygen; dissolved oxygen saturation; discharge; gage height; pH; salinity; water temperature
02198950	Middle River at GA 25 at Port Wentworth, GA	Blue-green algae sensor; dissolved oxygen; dissolved oxygen saturation; discharge; gage height; pH; salinity; water temperature
021989792	Little Back River at GA 25 at Port Wentworth, GA	Blue-green algae sensor; dissolved oxygen; dissolved oxygen saturation; discharge; gage height; pH; salinity; water temperature
02198955	Middle River at Fish Hole at Port Wentworth, GA	Dissolved oxygen; dissolved oxygen saturation; pH; salinity; water temperature
021989793	Little Back River at Hog Island, near Savannah, GA	Dissolved oxygen; dissolved oxygen saturation; pH; salinity; water temperature
021989715	Savannah River at Garden City, GA	Depth of sensor below the water surface; dissolved oxygen[2]; dissolved oxygen saturation[2]; gage height; pH; salinity[2]; water temperature[2]
0219897945	Back River 0.4 miles downstream US17, near Savannah, GA	Blue-green algae sensor; dissolved oxygen; dissolved oxygen saturation; pH; salinity; water temperature
021989773	Savannah River at USACE Dock, at Savannah, GA	Dissolved oxygen; dissolved oxygen saturation; discharge; gage height; pH; salinity; water temperature
0219897993	Savannah River at Elba Island near Savannah, GA	Dissolved oxygen; dissolved oxygen saturation; gage height; pH; salinity; water temperature

[1]Dissolved oxygen saturation is calculated at all USGS stations and all other parameters are measured. Depth of water quality parameter measurements are unknown except where noted.
[2]Parameters measured at two elevations: -23.28 feet NAVD88 and -13.25 feet NAVD88.

G.2 USGS 02198840 – I-95 – SAVANNAH RIVER

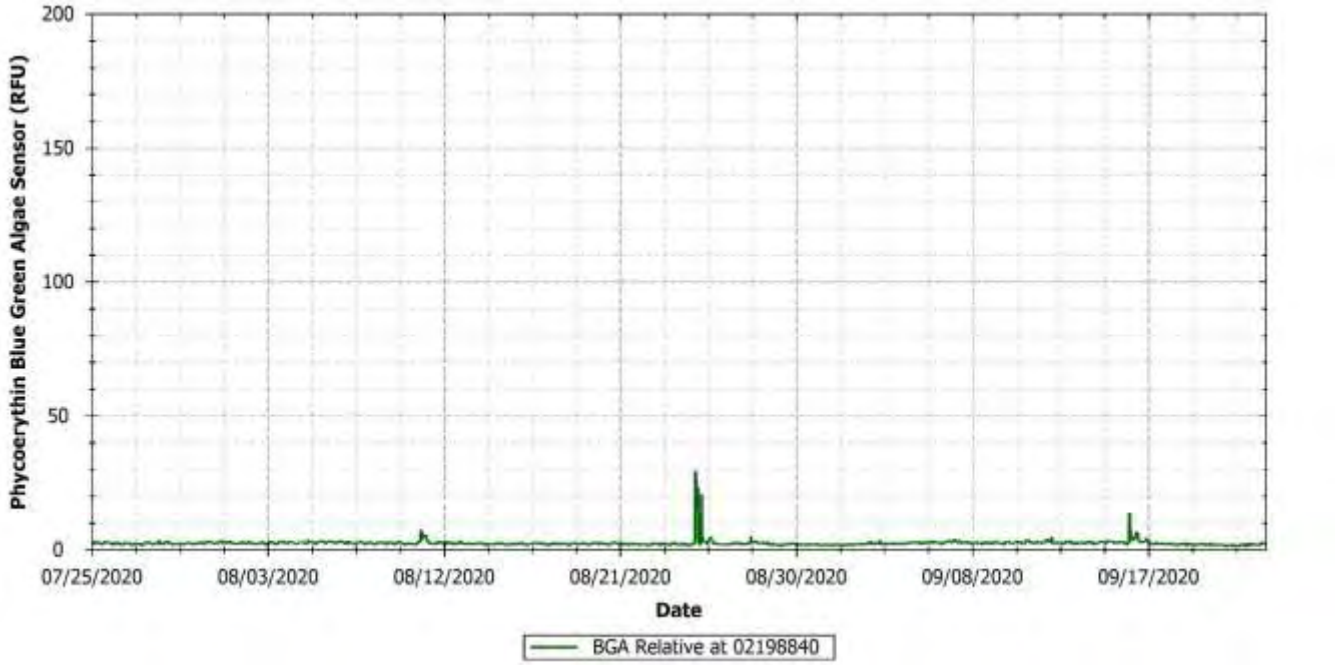


Figure G-2 USGS 02198840 (Savannah River) observed blue-green algae

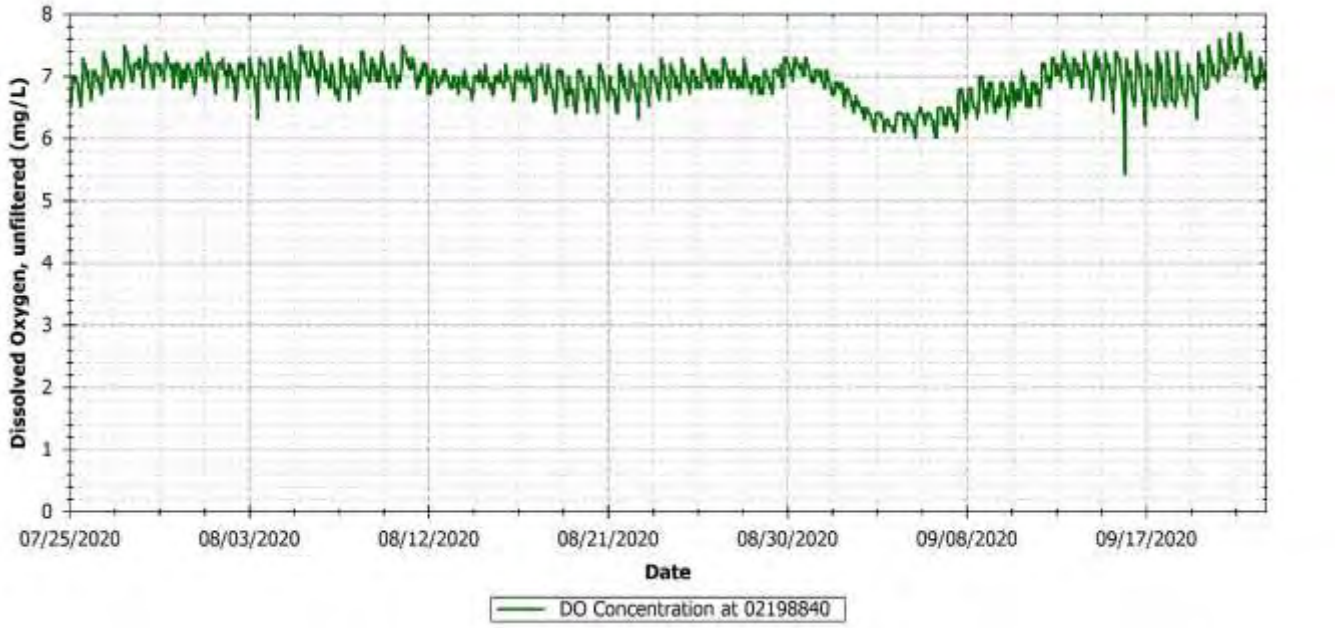


Figure G-3 USGS 02198840 (Savannah River) observed DO concentration

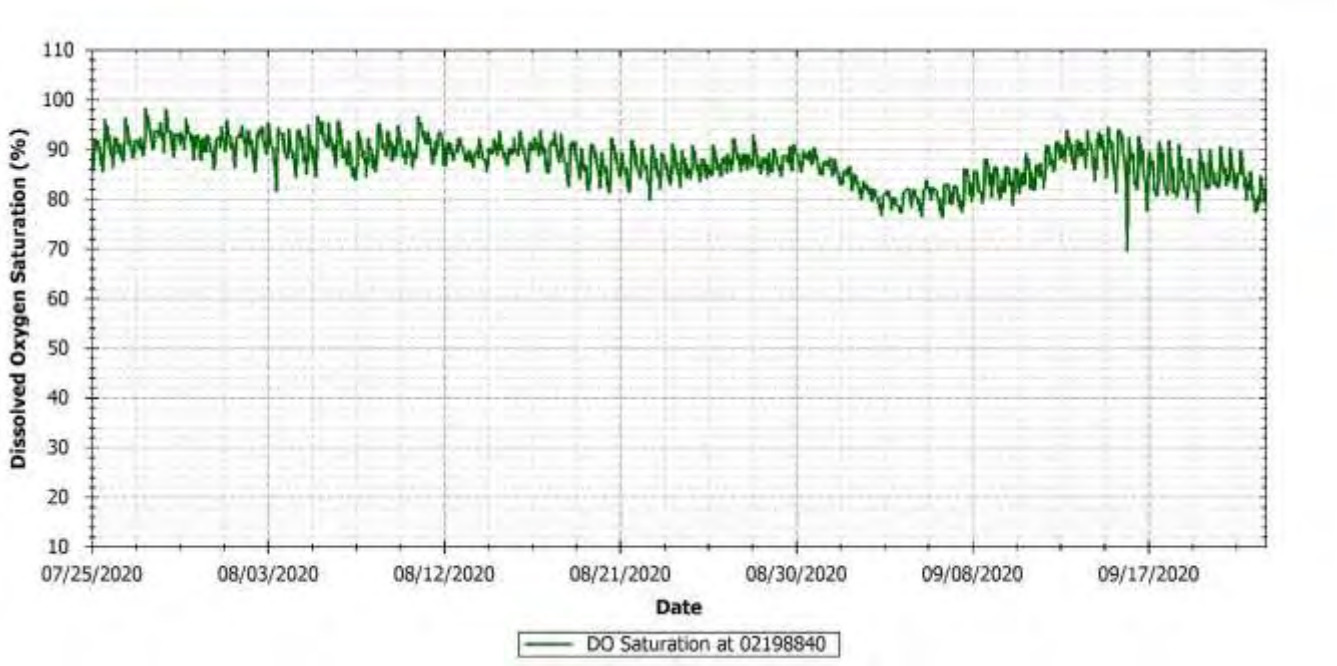


Figure G-4 USGS 02198840 (Savannah River) calculated DO saturation

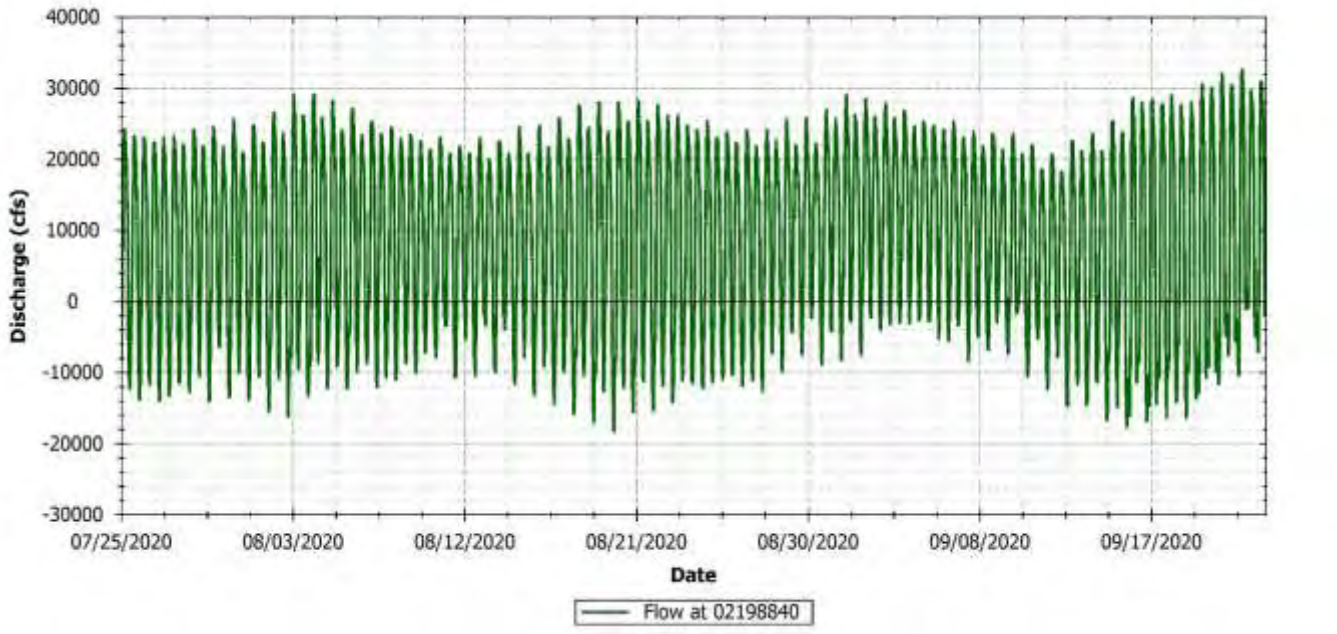


Figure G-5 USGS 02198840 (Savannah River) observed discharge

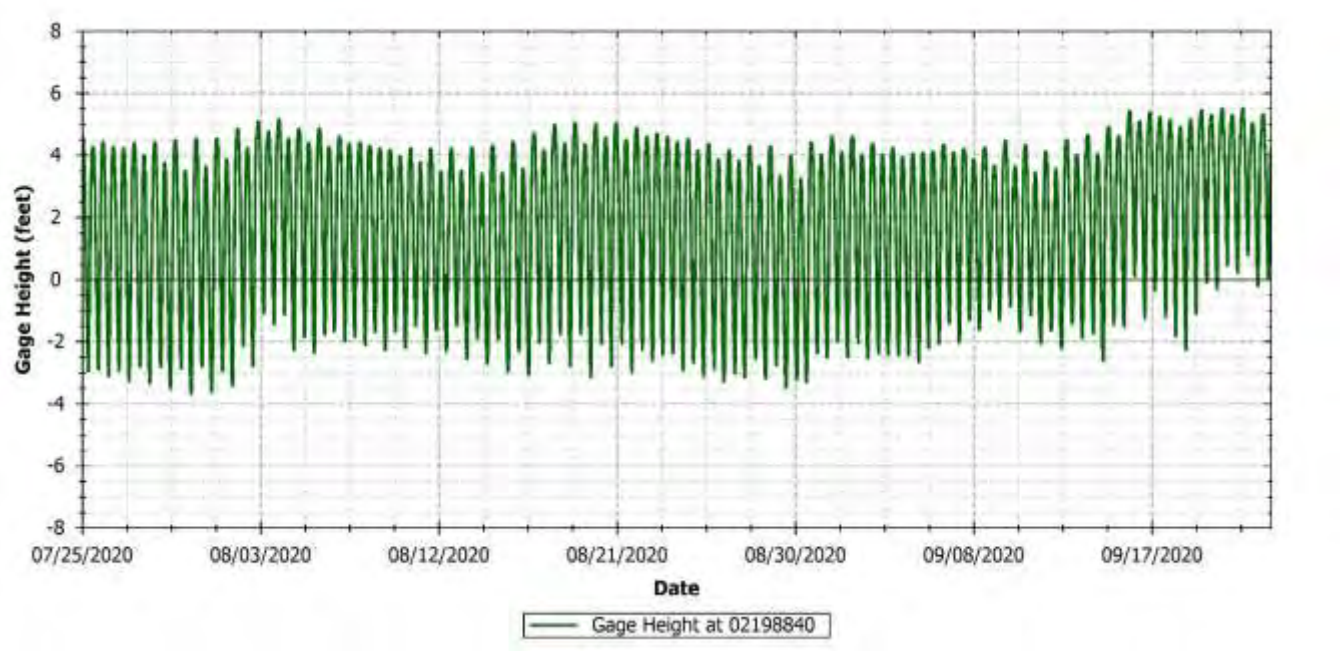


Figure G-6 USGS 02198840 (Savannah River) observed gage height

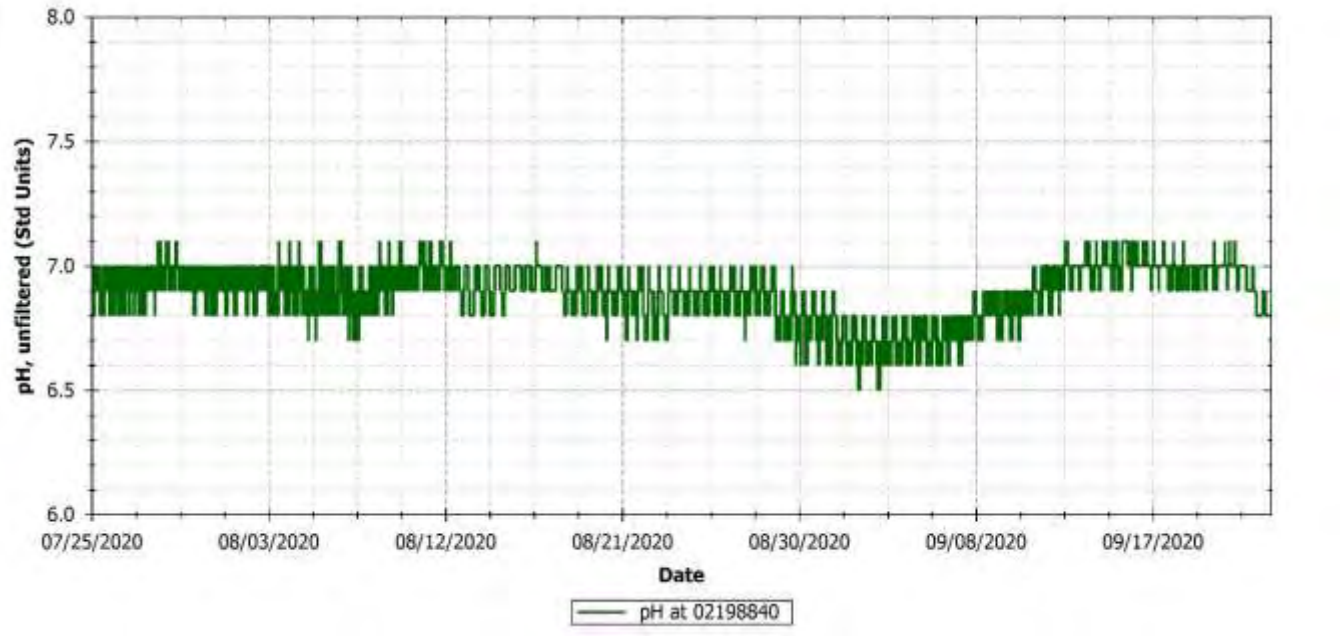


Figure G-7 USGS 02198840 (Savannah River) observed pH

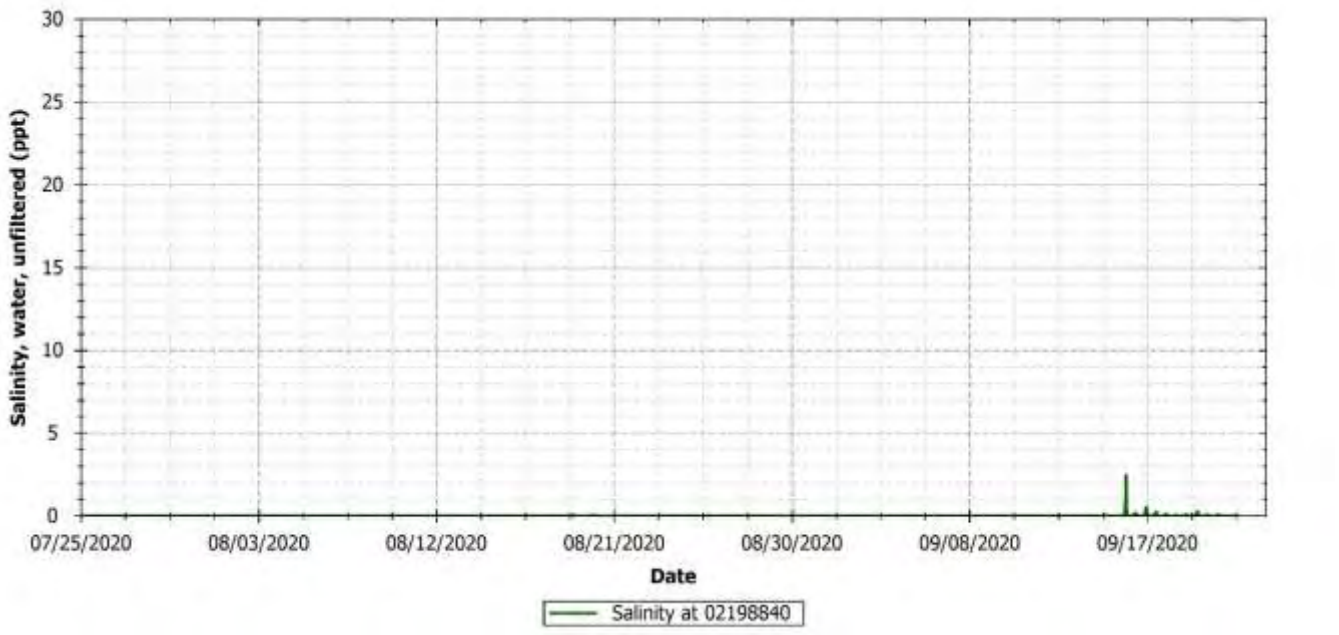


Figure G-8 USGS 02198840 (Savannah River) observed salinity

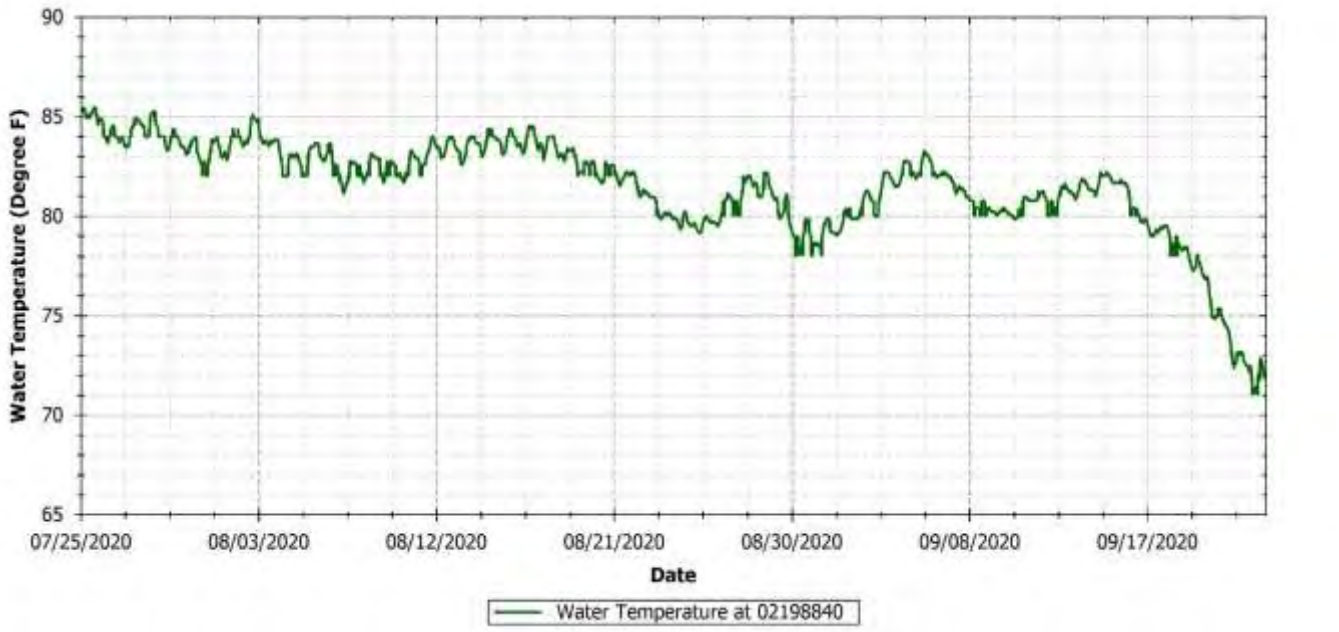


Figure G-9 USGS 02198840 (Savannah River) observed water temperature

G.3 USGS 02198920 – PORT WENTWORTH – SAVANNAH RIVER

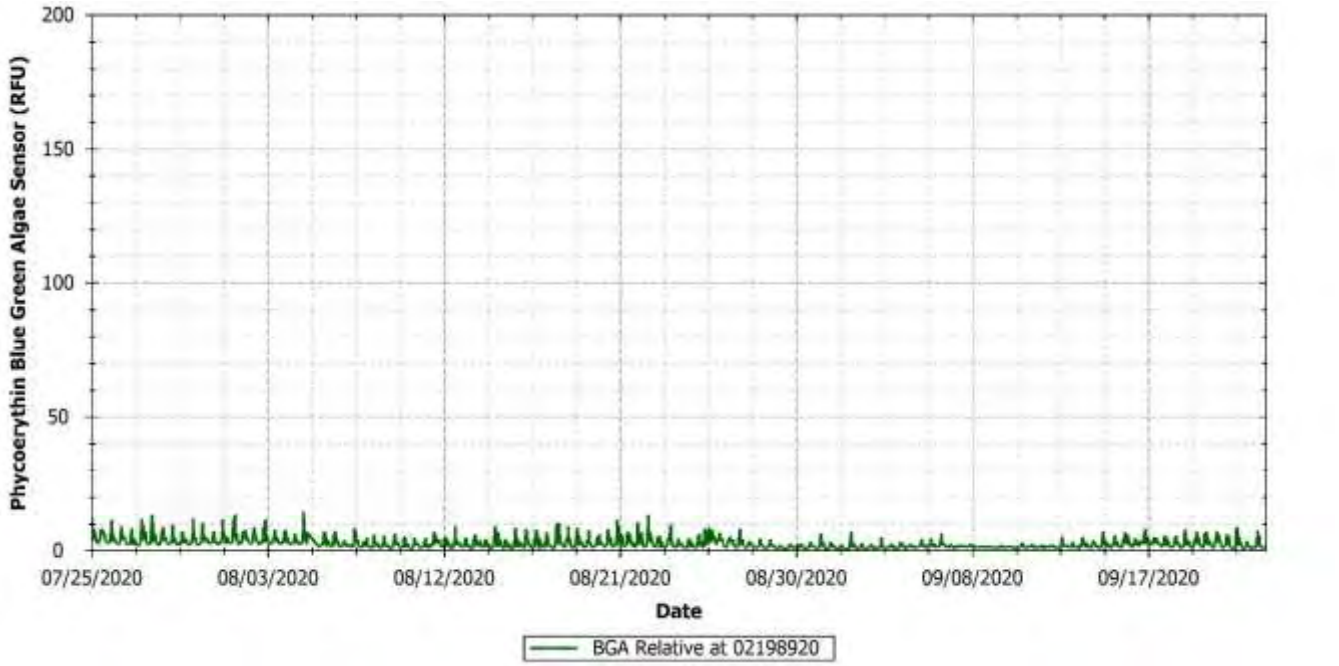


Figure G-10 USGS 02198920 (Savannah River) observed blue-green algae

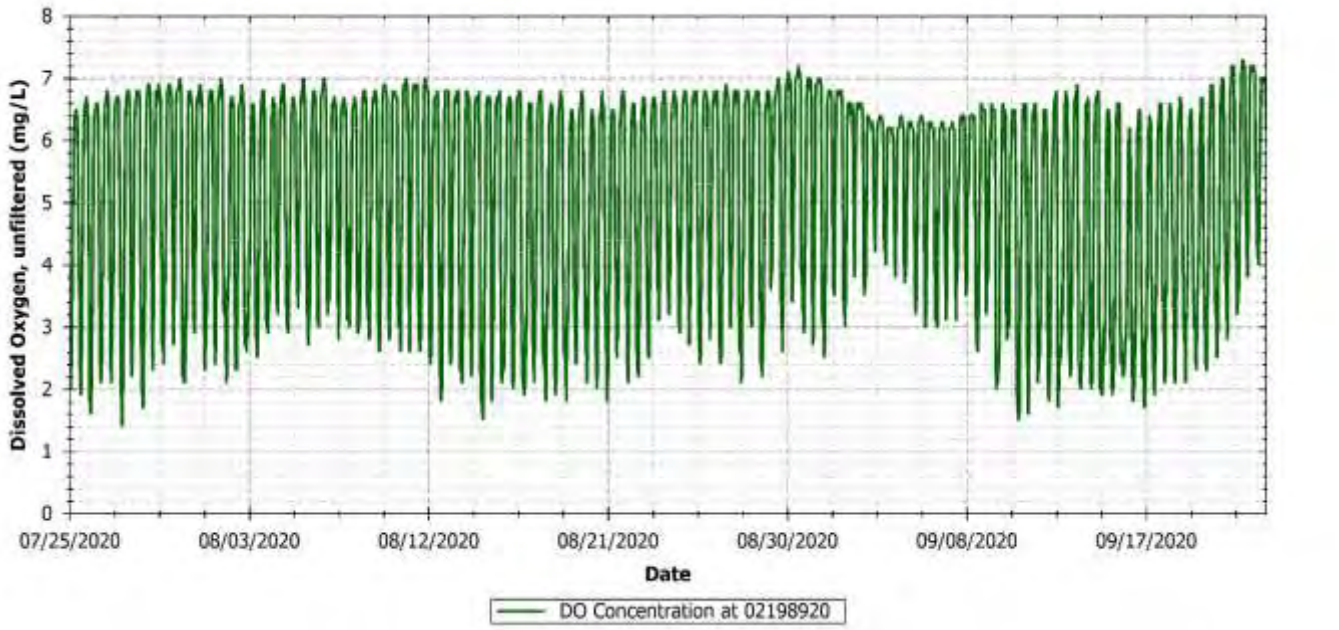


Figure G-11 USGS 02198920 (Savannah River) observed DO concentration

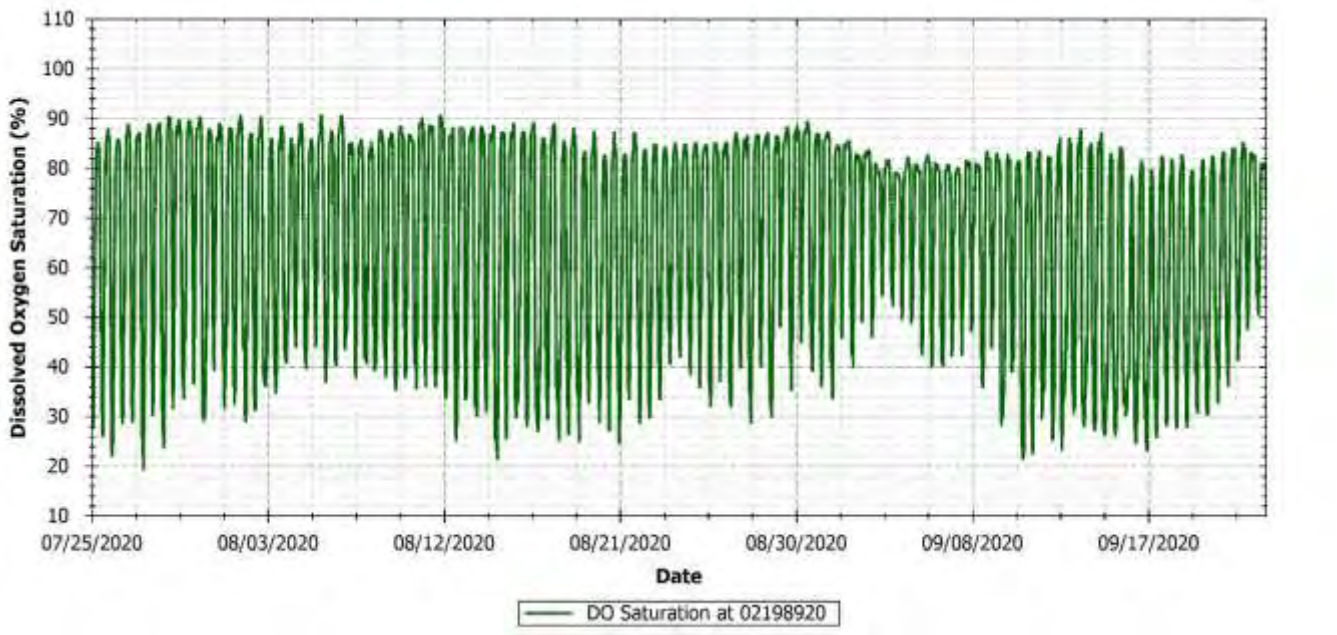


Figure G-12 USGS 02198920 (Savannah River) calculated DO saturation

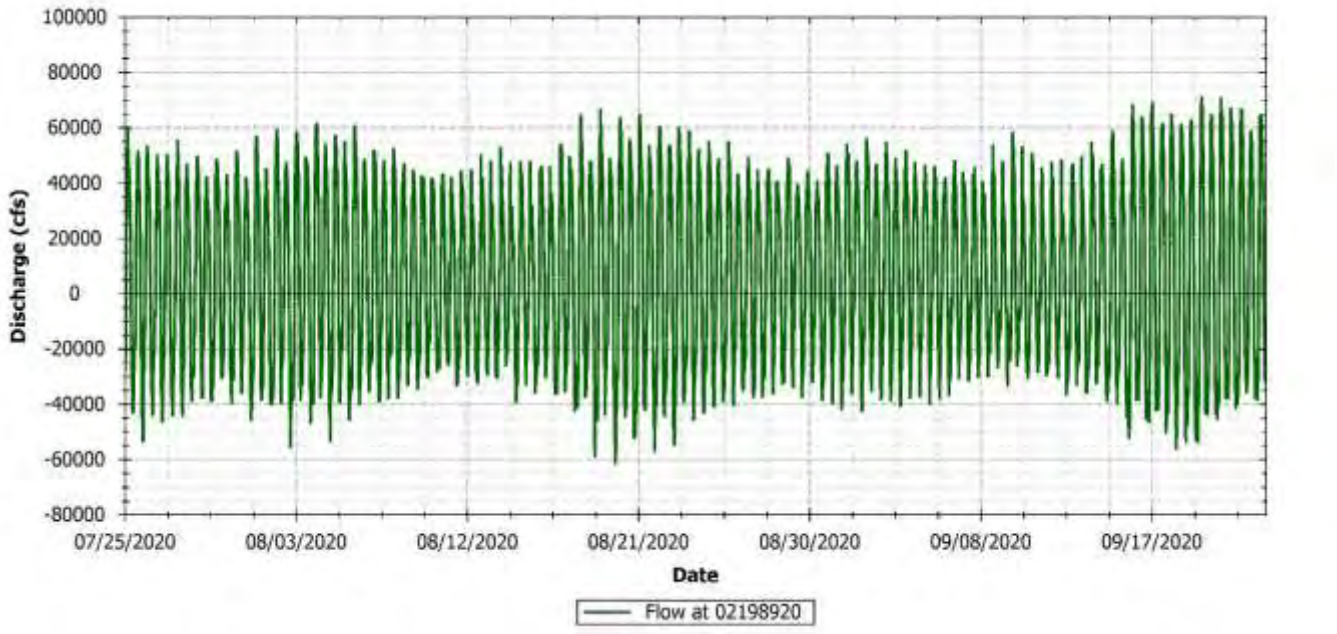


Figure G-13 USGS 02198920 (Savannah River) observed discharge

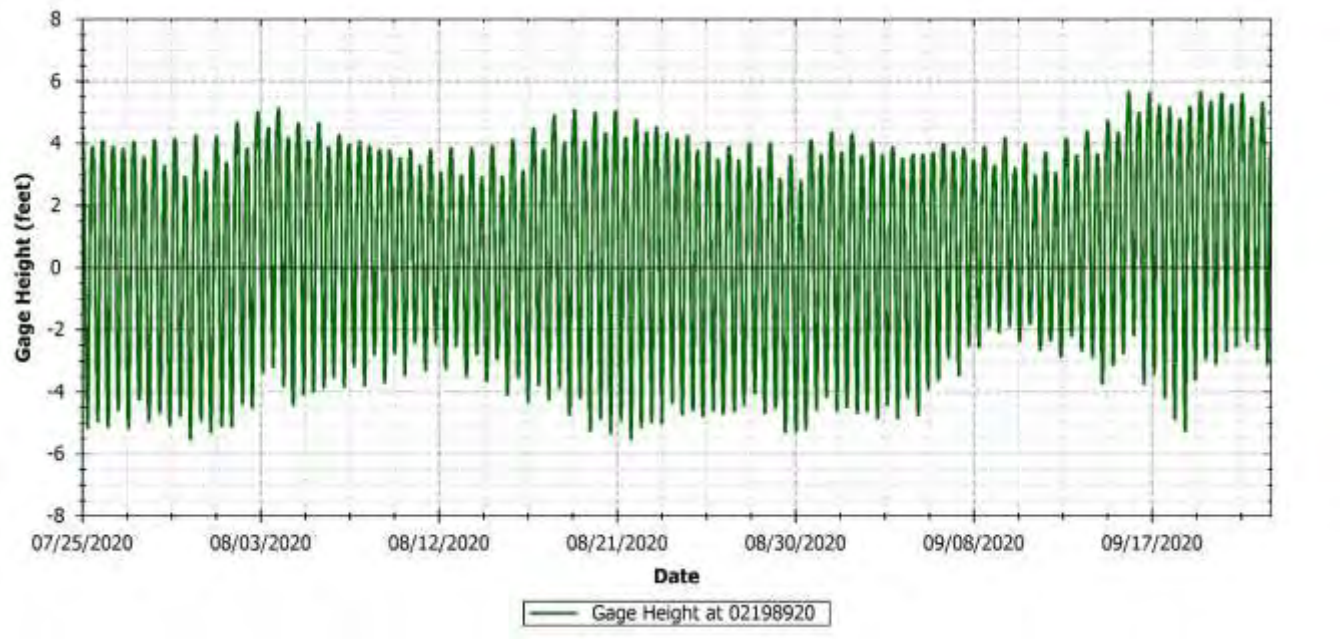


Figure G-14 USGS 02198920 (Savannah River) observed gage height

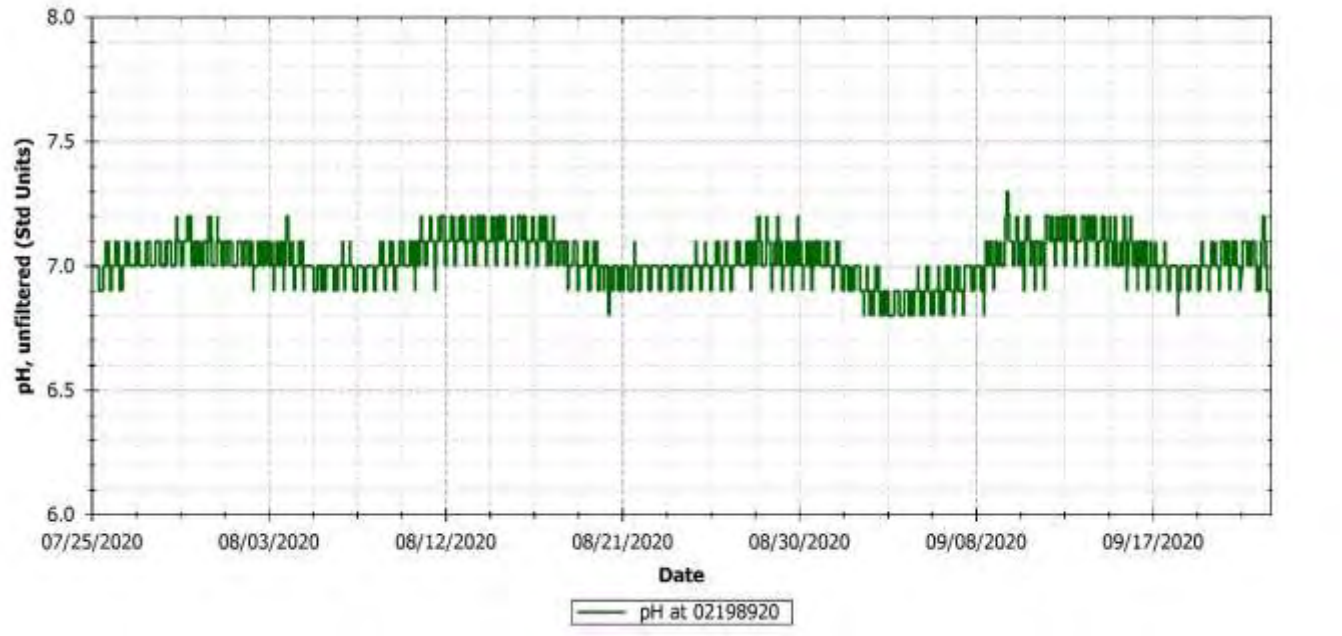


Figure G-15 USGS 02198920 (Savannah River) observed pH

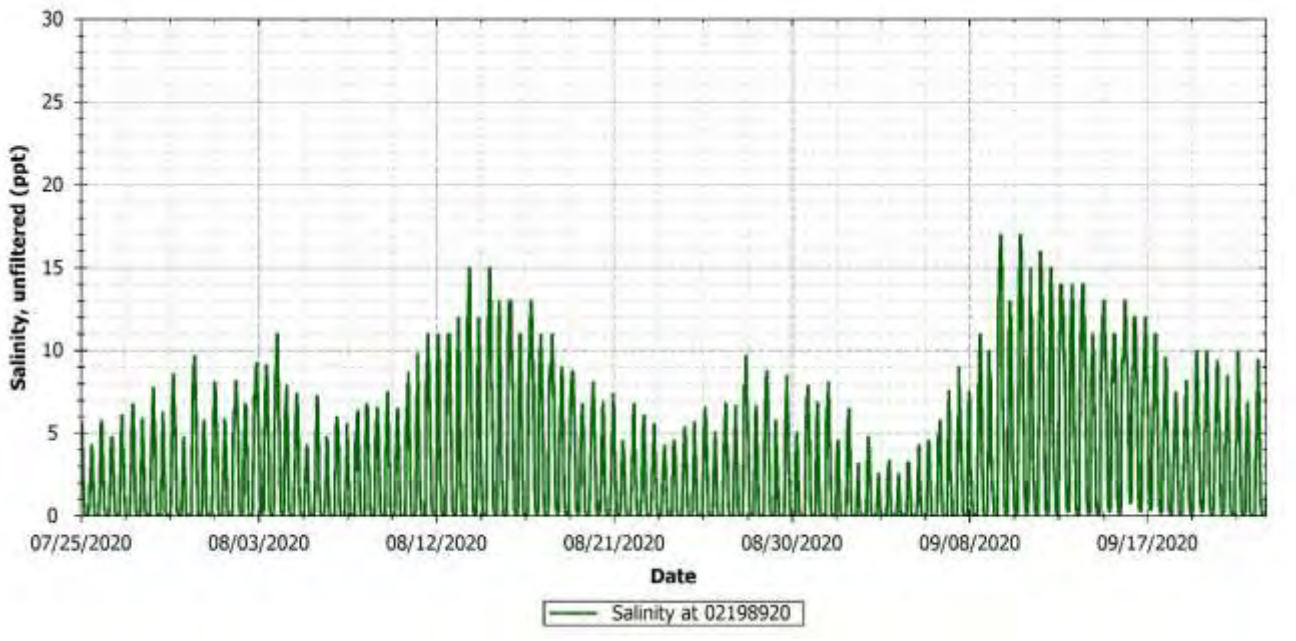


Figure G-16 USGS 02198920 (Savannah River) observed salinity

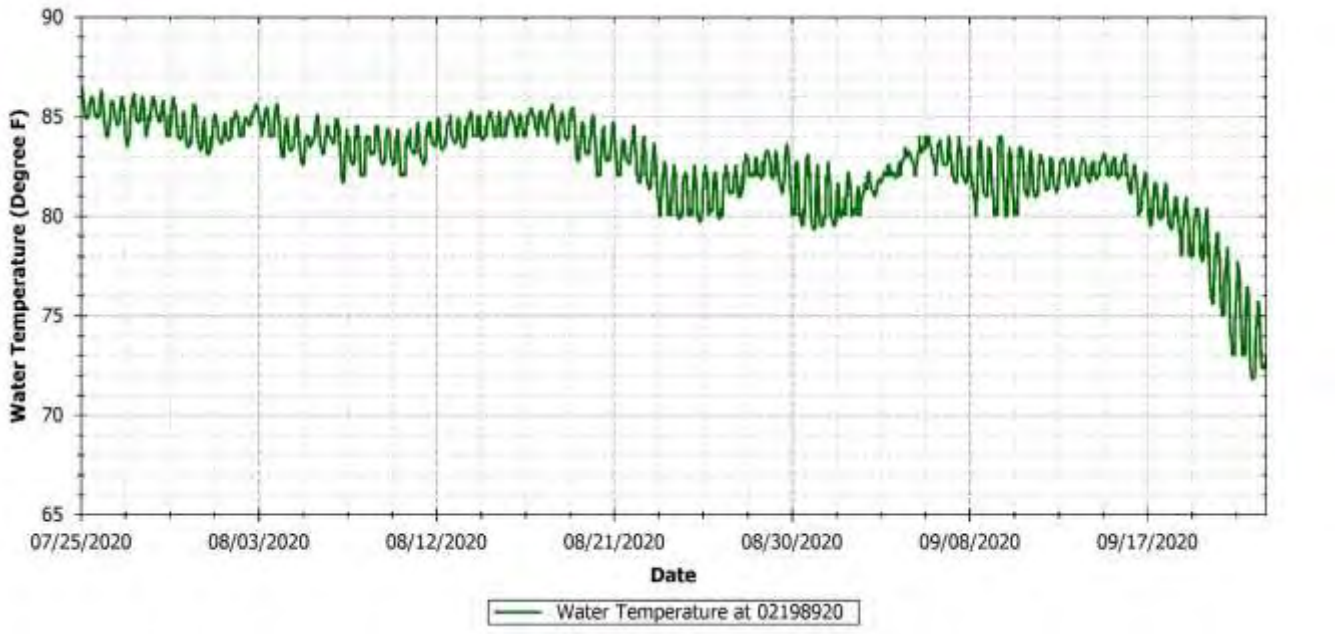


Figure G-17 USGS 02198920 (Savannah River) observed water temperature

G.4 USGS 02198950 – PORT WENTWORTH – MIDDLE RIVER

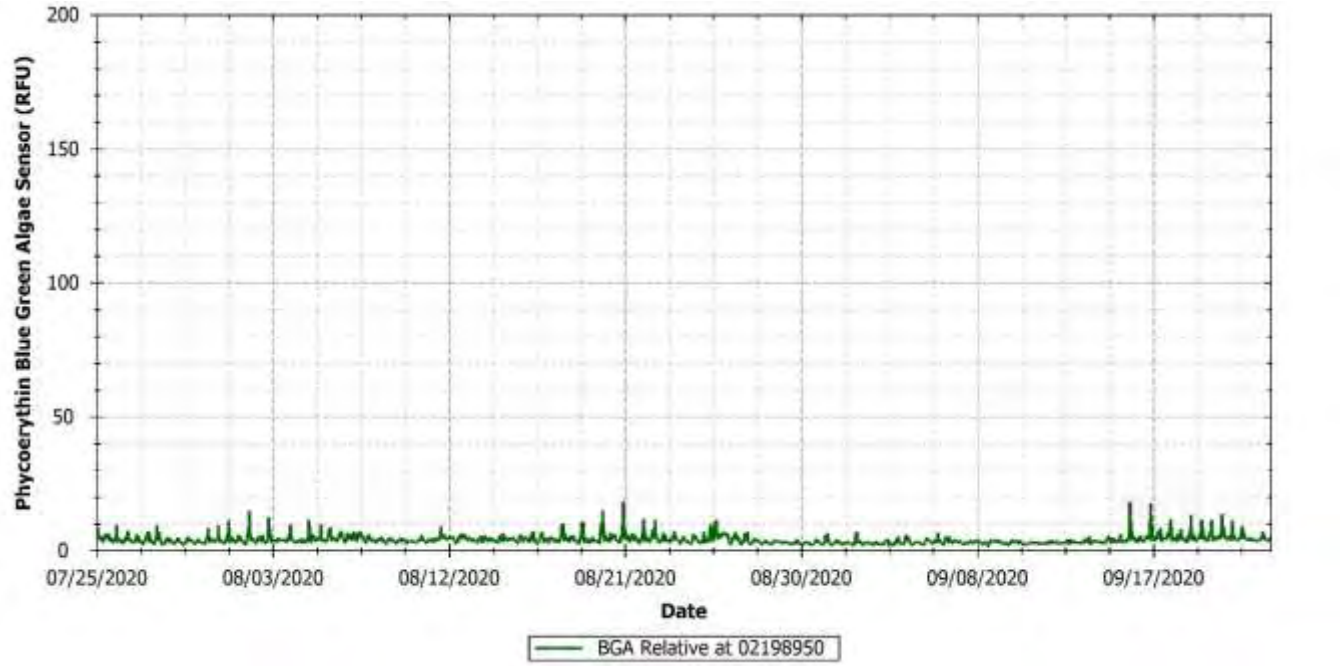


Figure G-18 USGS 02198950 (Middle River) observed blue-green algae

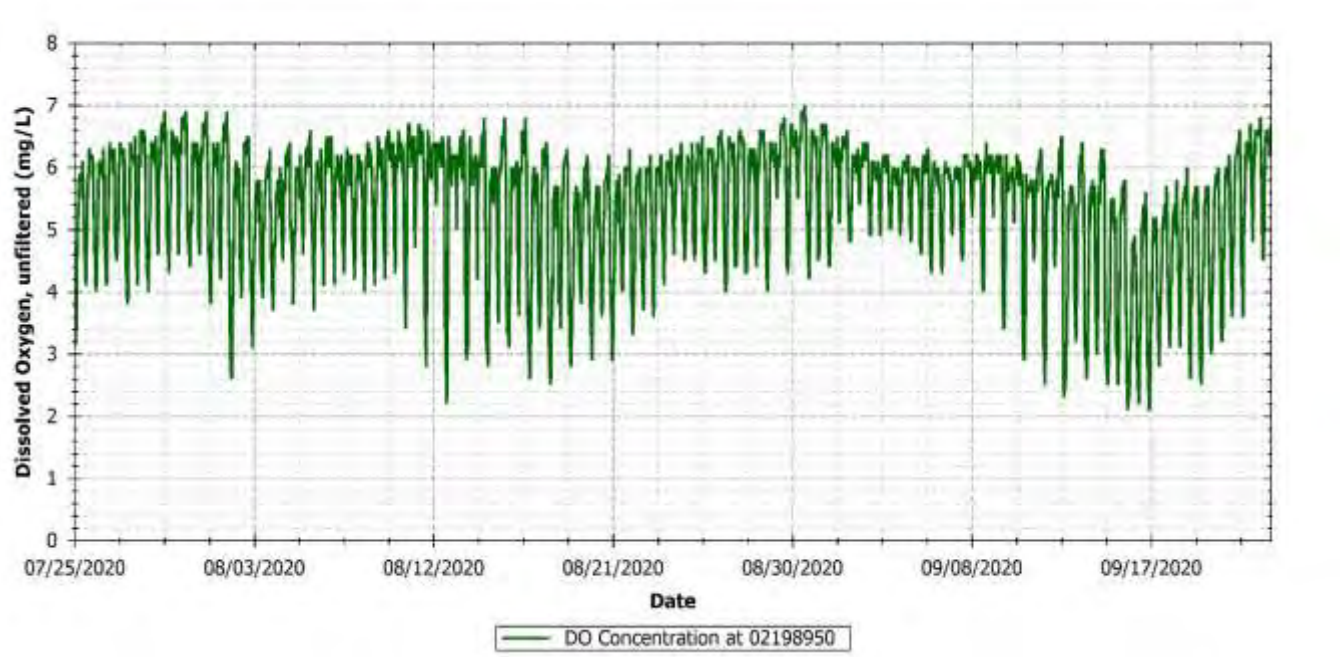


Figure G-19 USGS 02198950 (Middle River) observed DO concentration

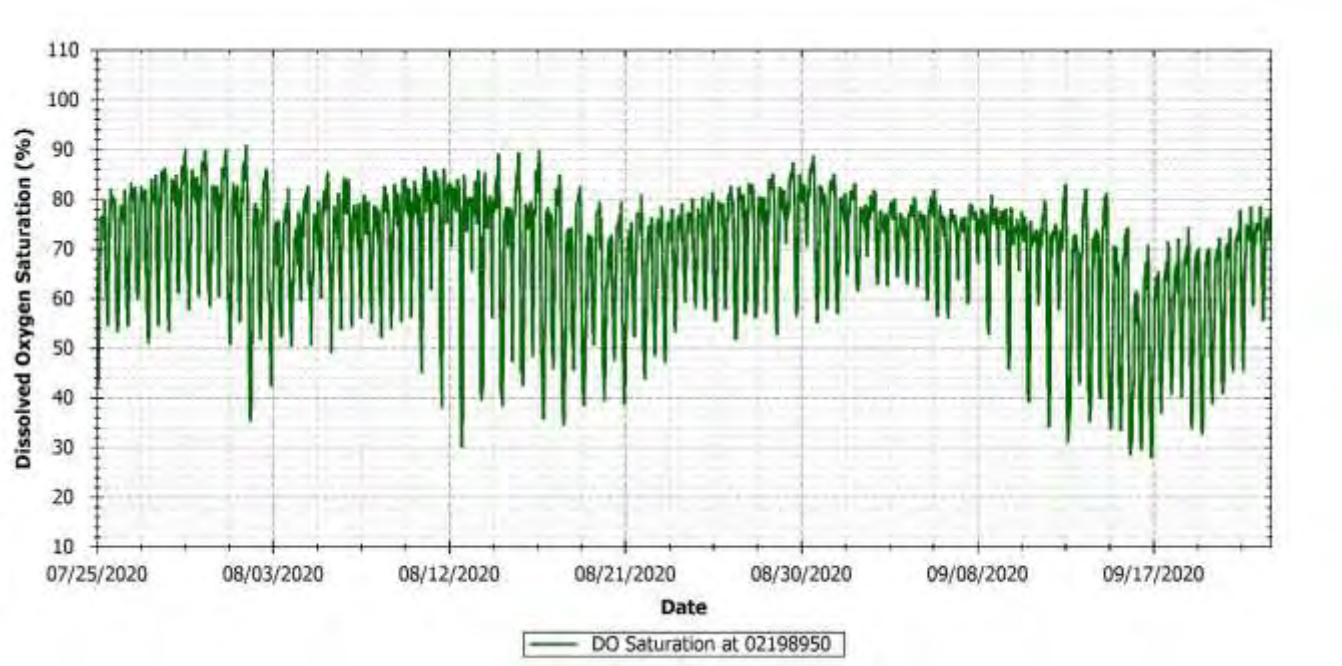


Figure G-20 USGS 02198950 (Middle River) calculated DO saturation

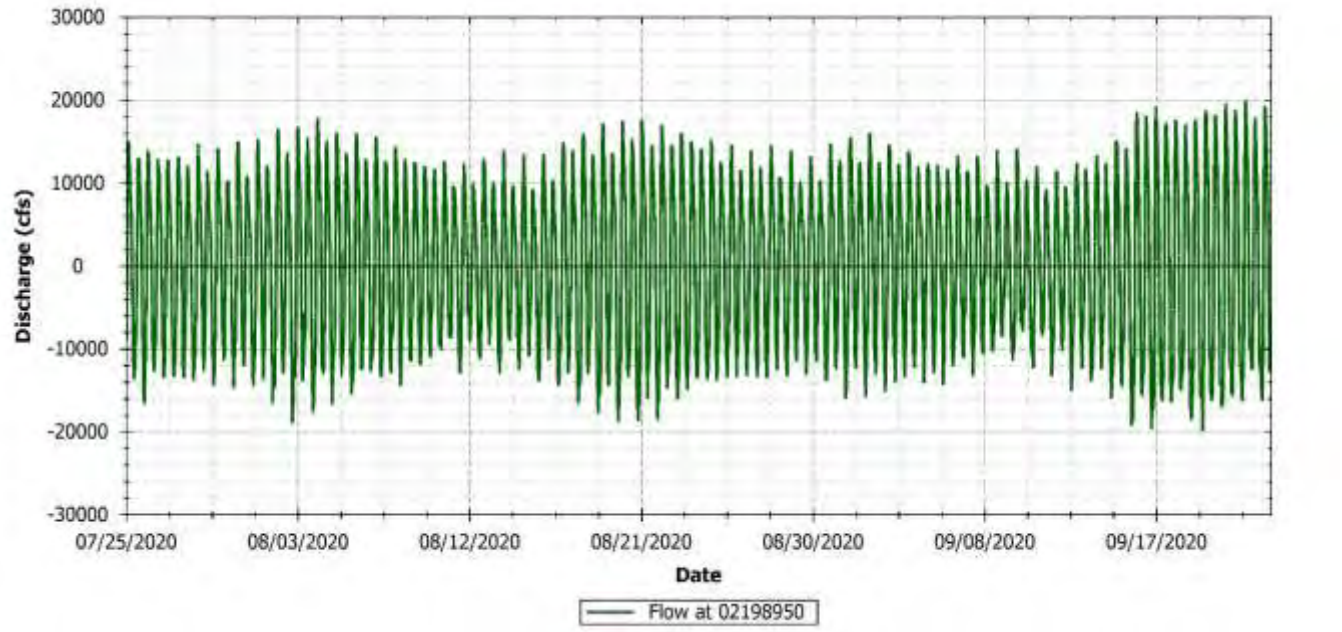


Figure G-21 USGS 02198950 (Middle River) observed discharge

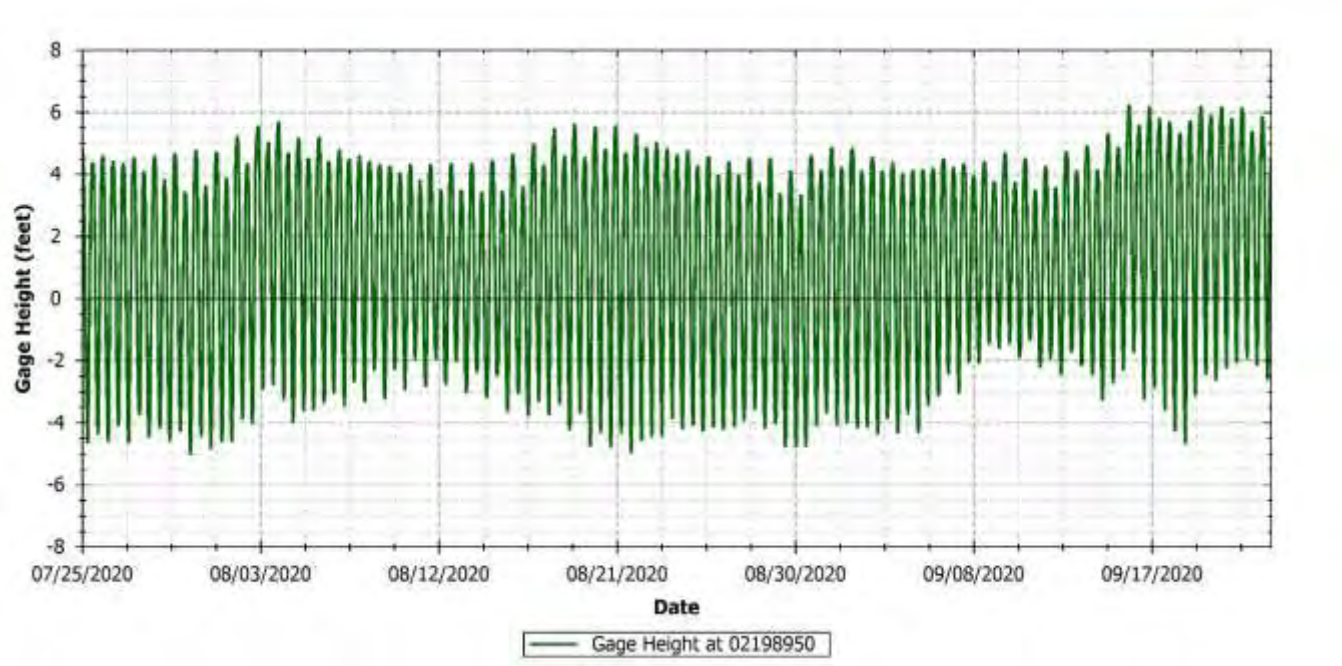


Figure G-22 USGS 02198950 (Middle River) observed gage height

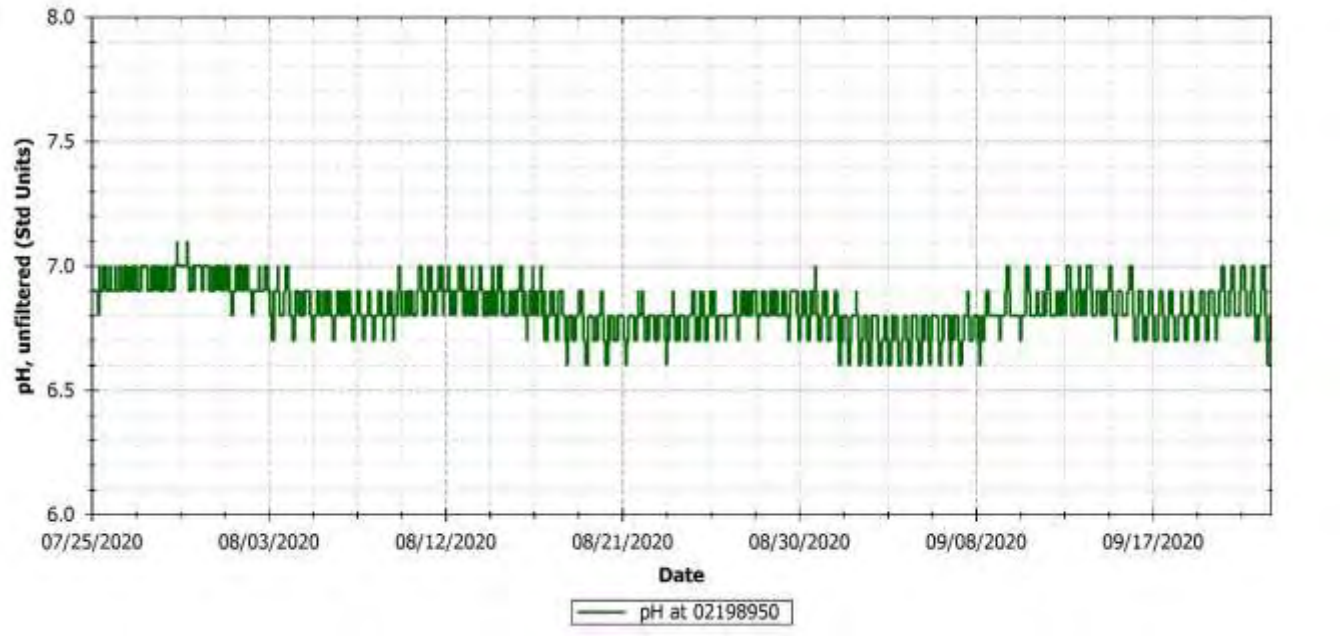


Figure G-23 USGS 02198950 (Middle River) observed pH

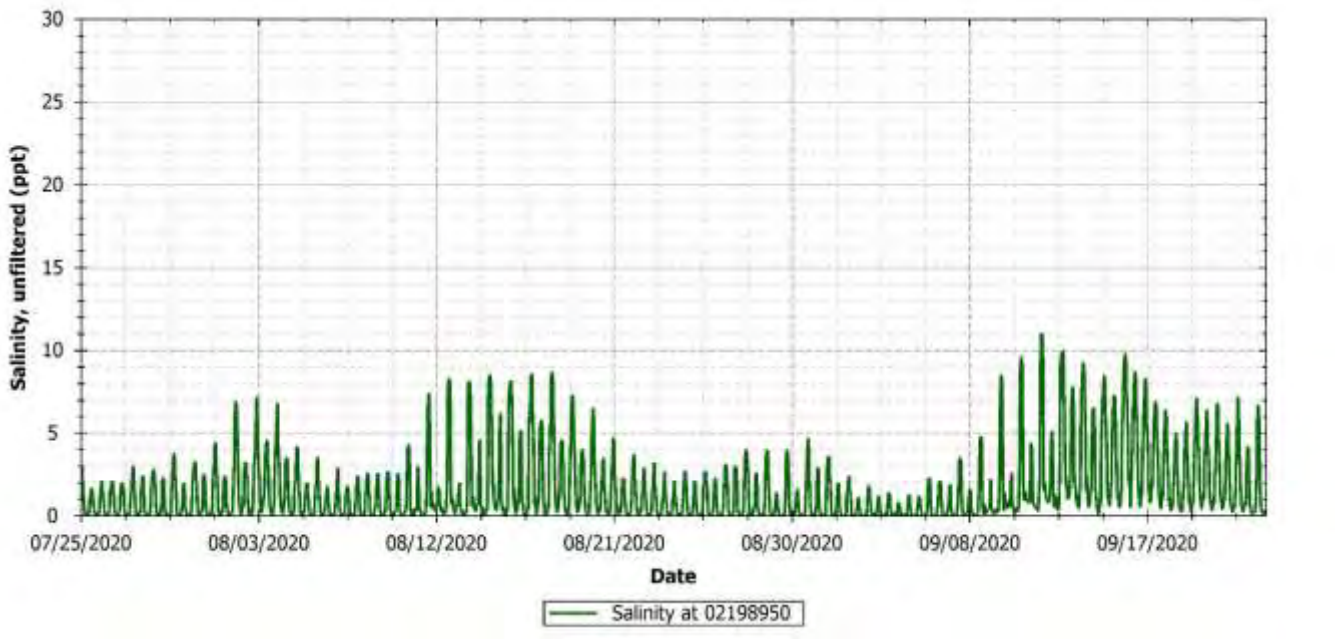


Figure G-24 USGS 02198950 (Middle River) observed salinity

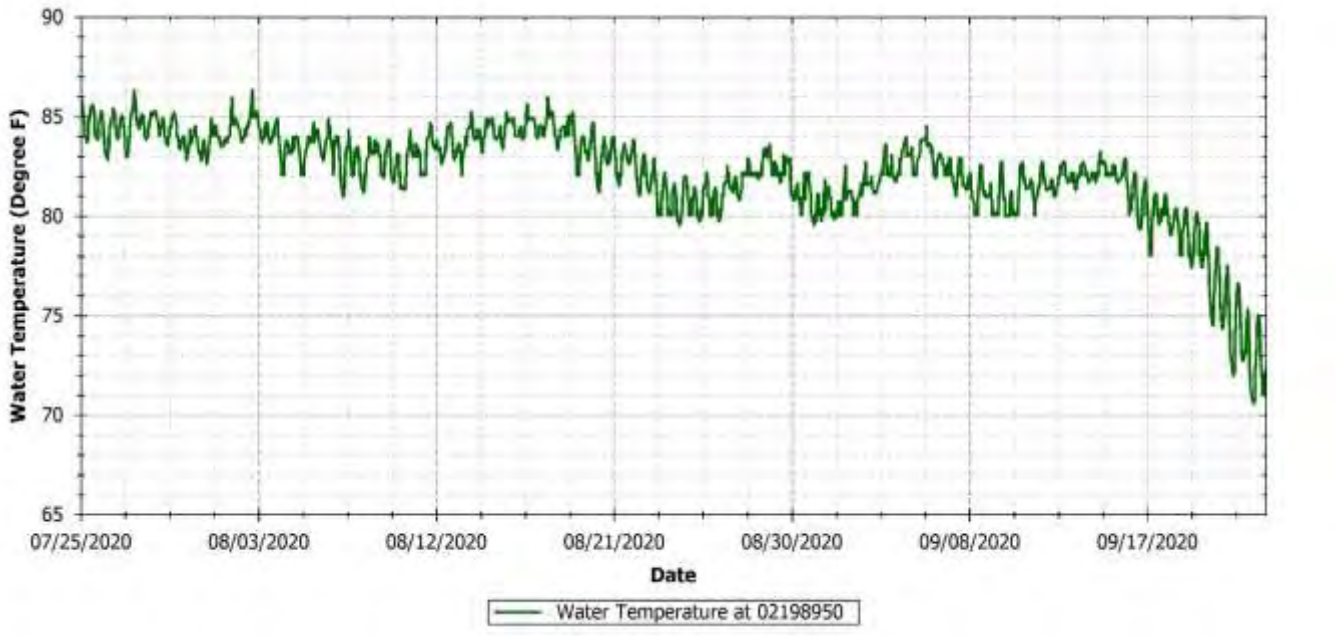


Figure G-25 USGS 02198950 (Middle River) observed water temperature

G.5 USGS 021989792 – PORT WENTWORTH – BACK RIVER

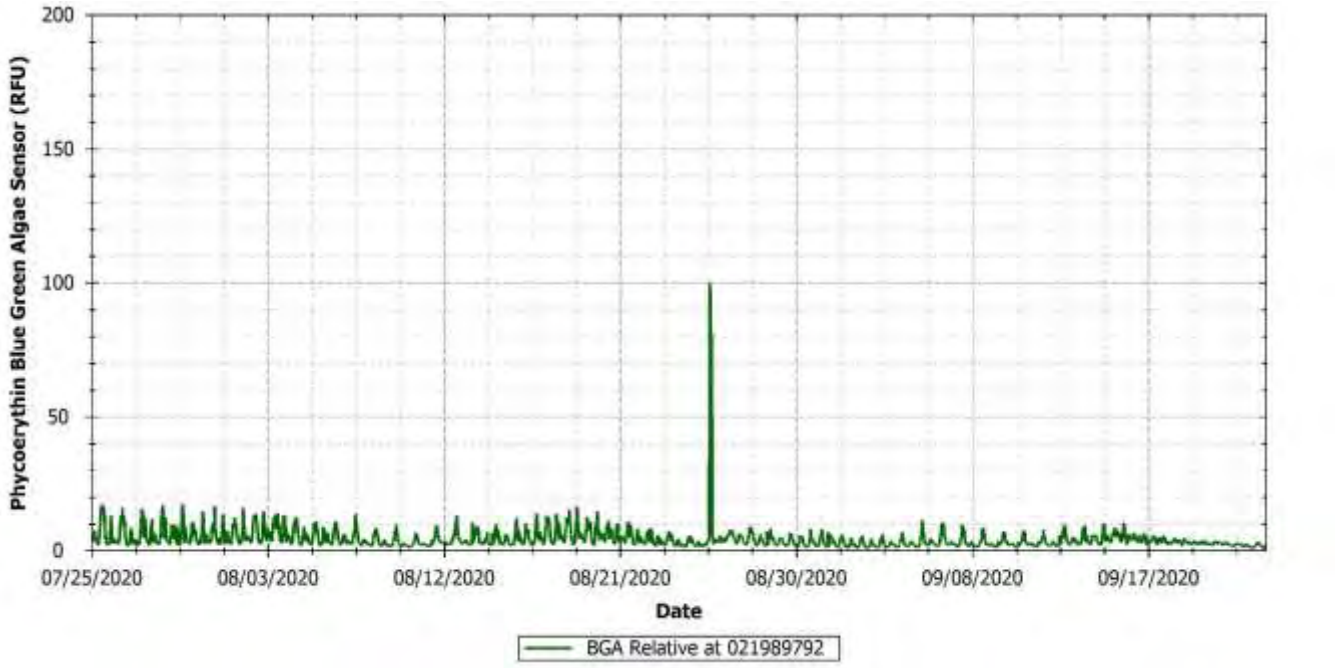


Figure G-26 USGS 021989792 (Back River) observed blue-green algae

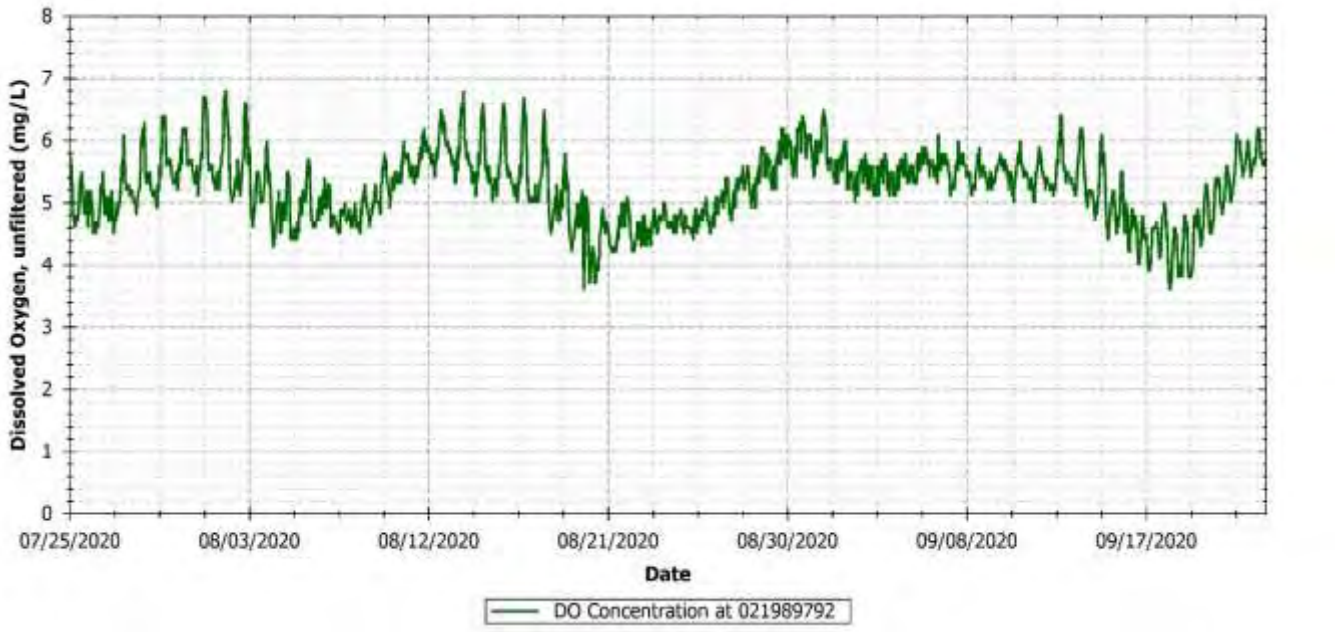


Figure G-27 USGS 021989792 (Back River) observed DO concentration

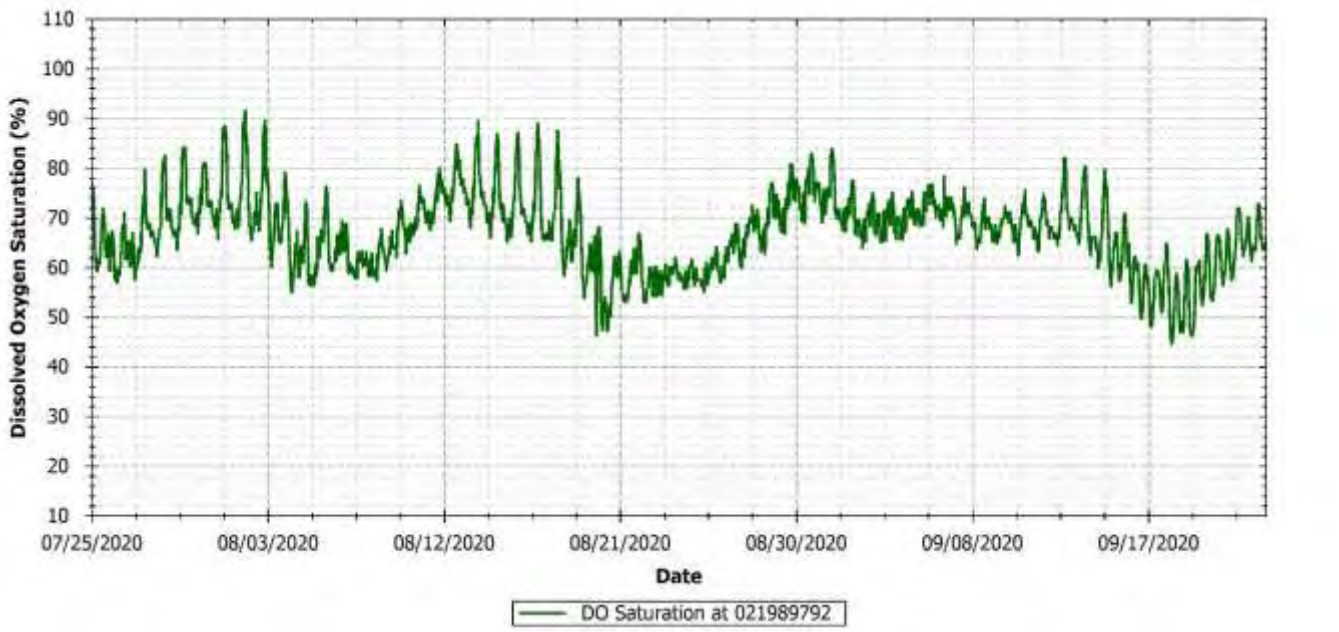


Figure G-28 USGS 021989792 (Back River) calculated DO saturation

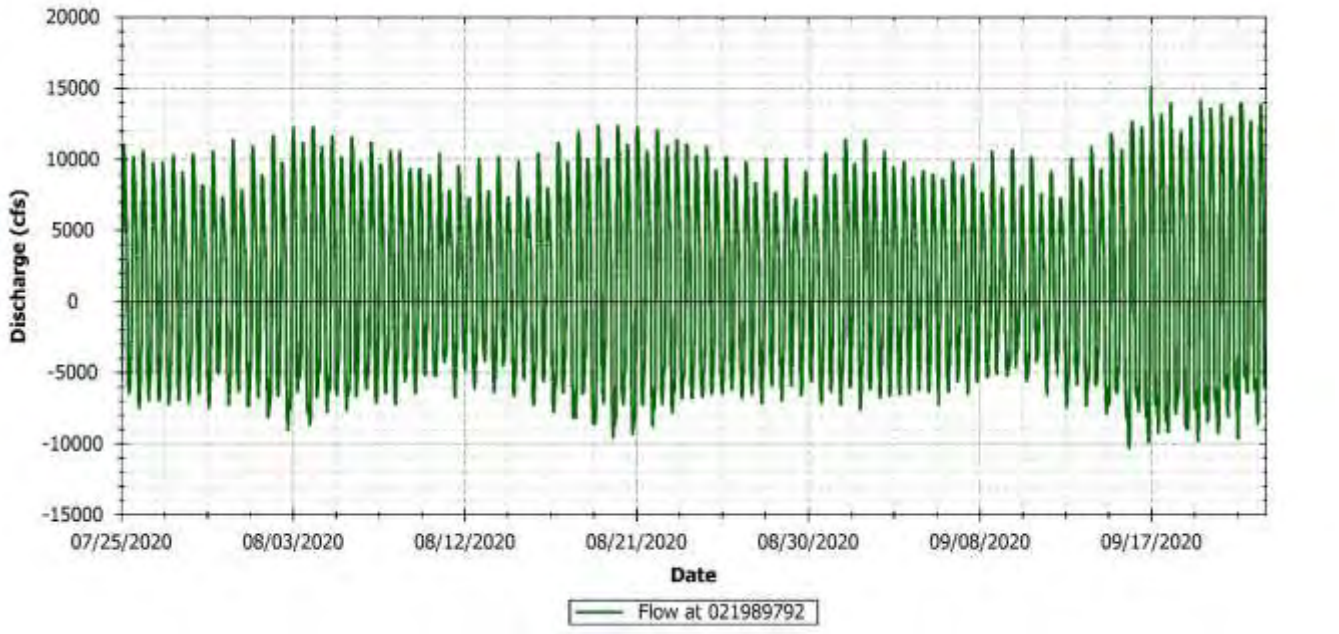


Figure G-29 USGS 021989792 (Back River) observed discharge

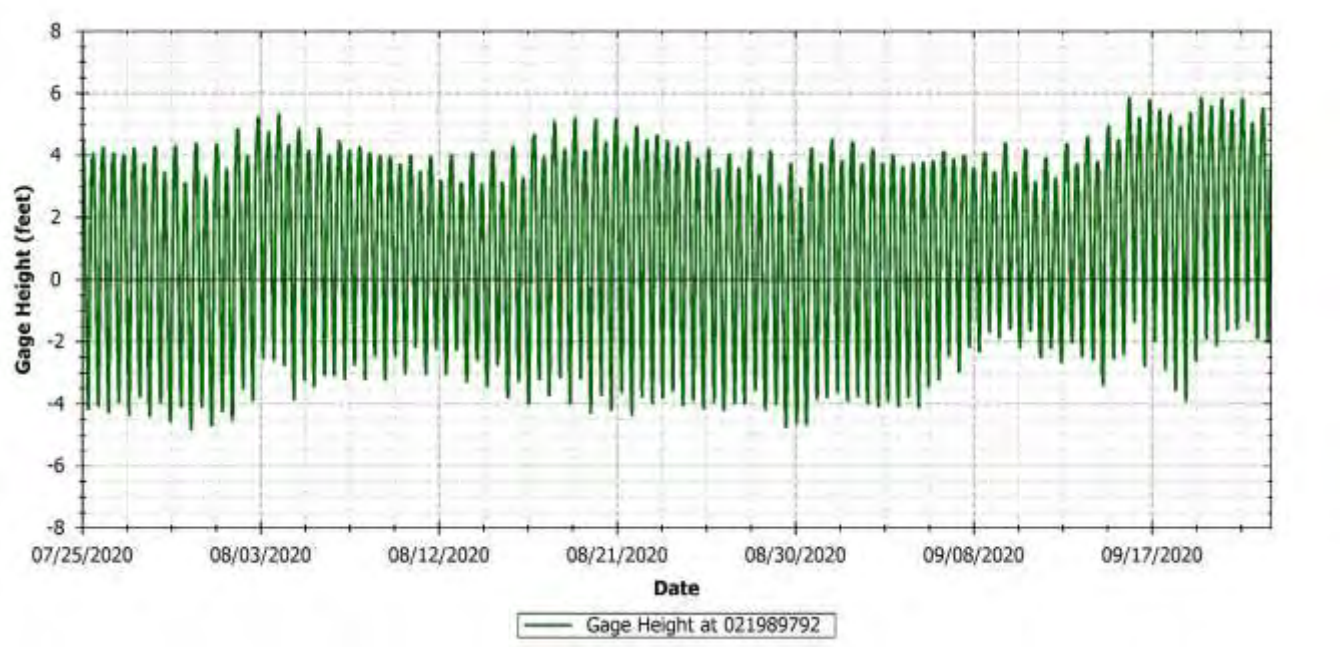


Figure G-30 USGS 021989792 (Back River) observed gage height

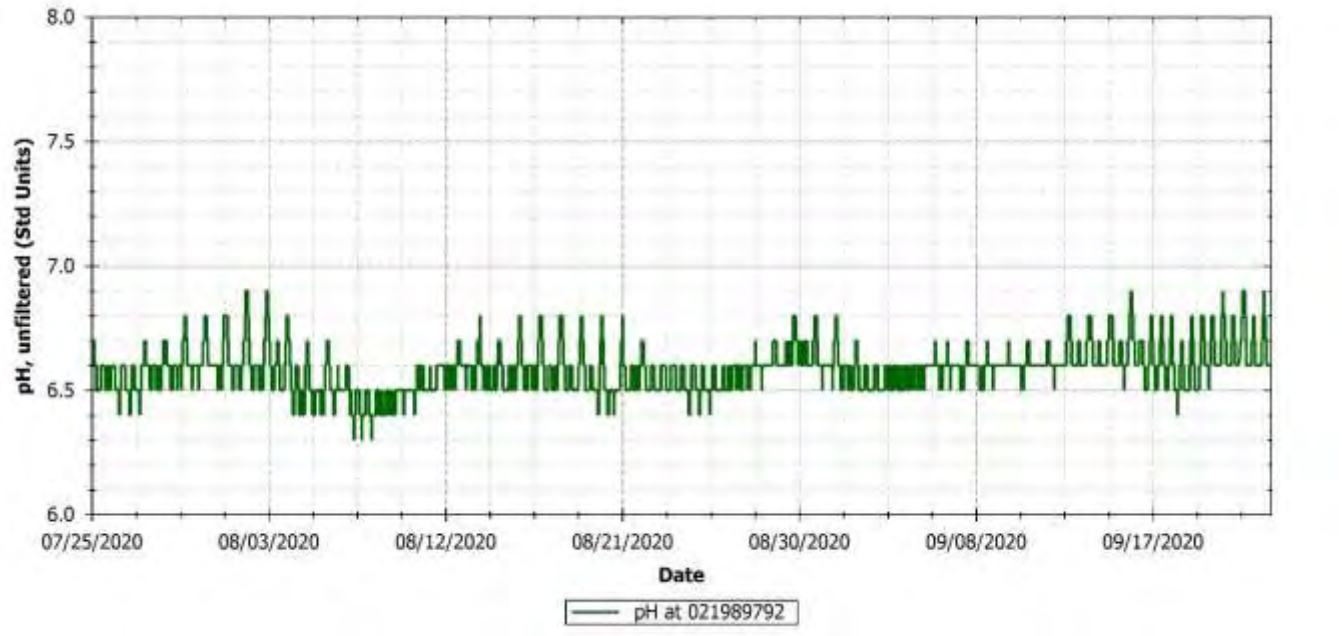


Figure G-31 USGS 021989792 (Back River) observed pH

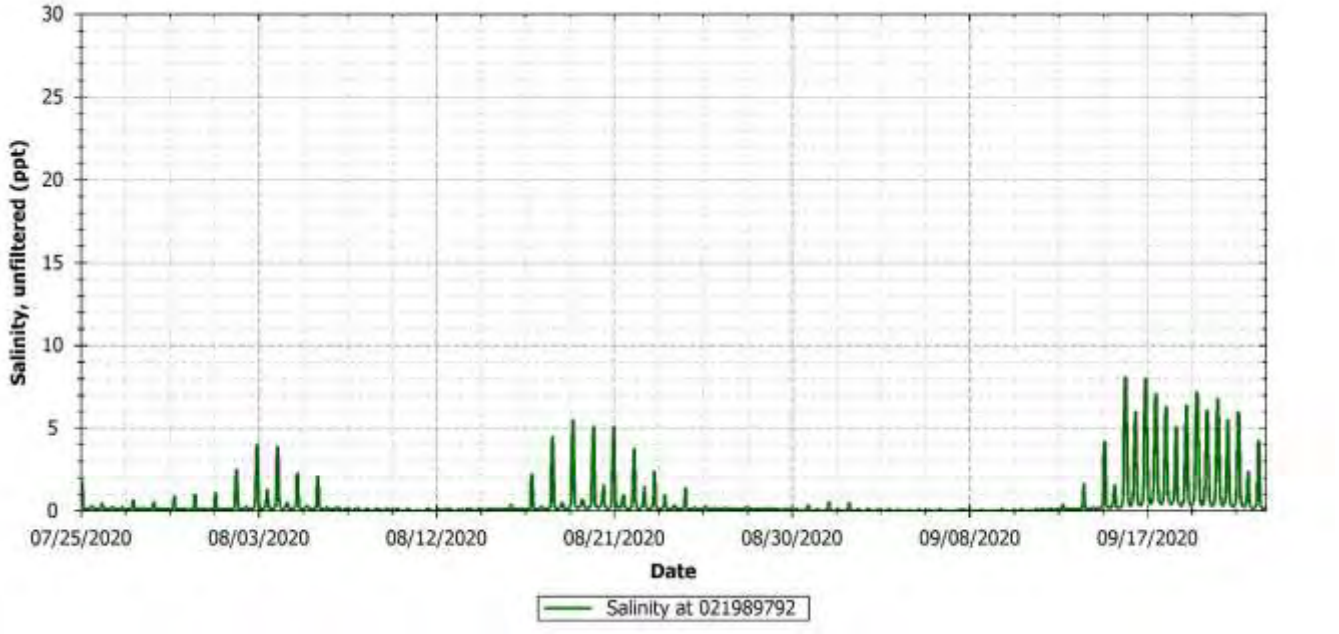


Figure G-32 USGS 021989792 (Back River) observed salinity

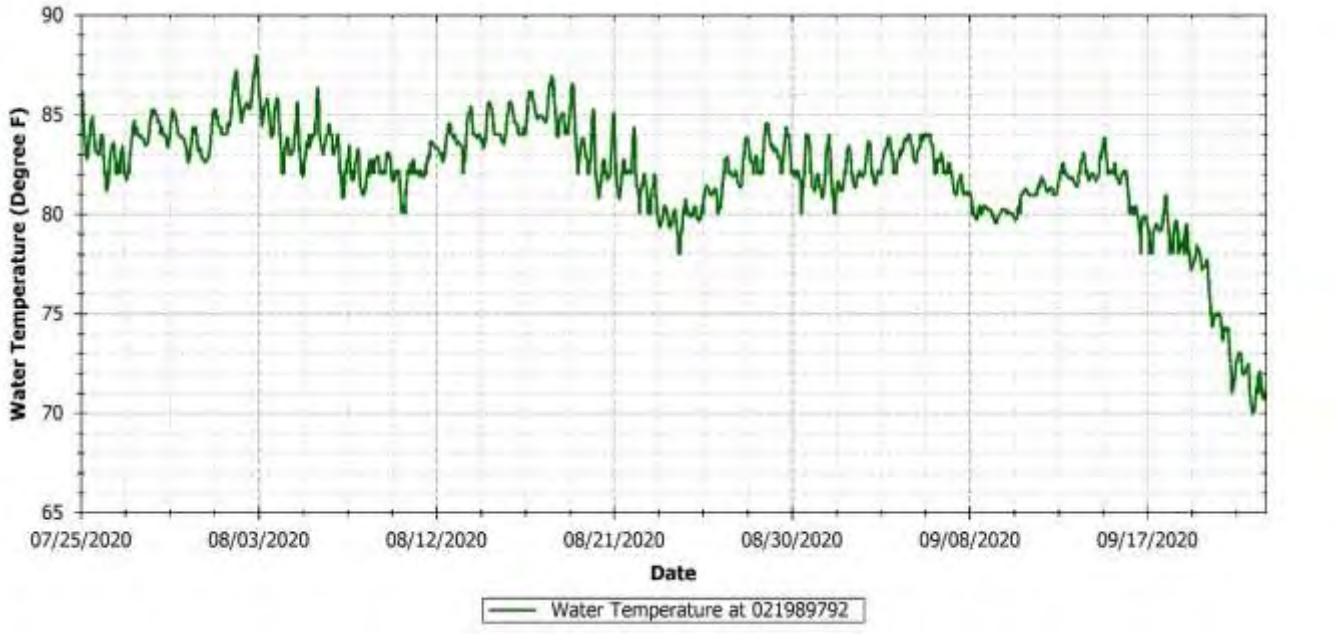


Figure G-33 USGS 021989792 (Back River) observed water temperature

G.6 USGS 02198955 – FISH HOLE – MIDDLE RIVER

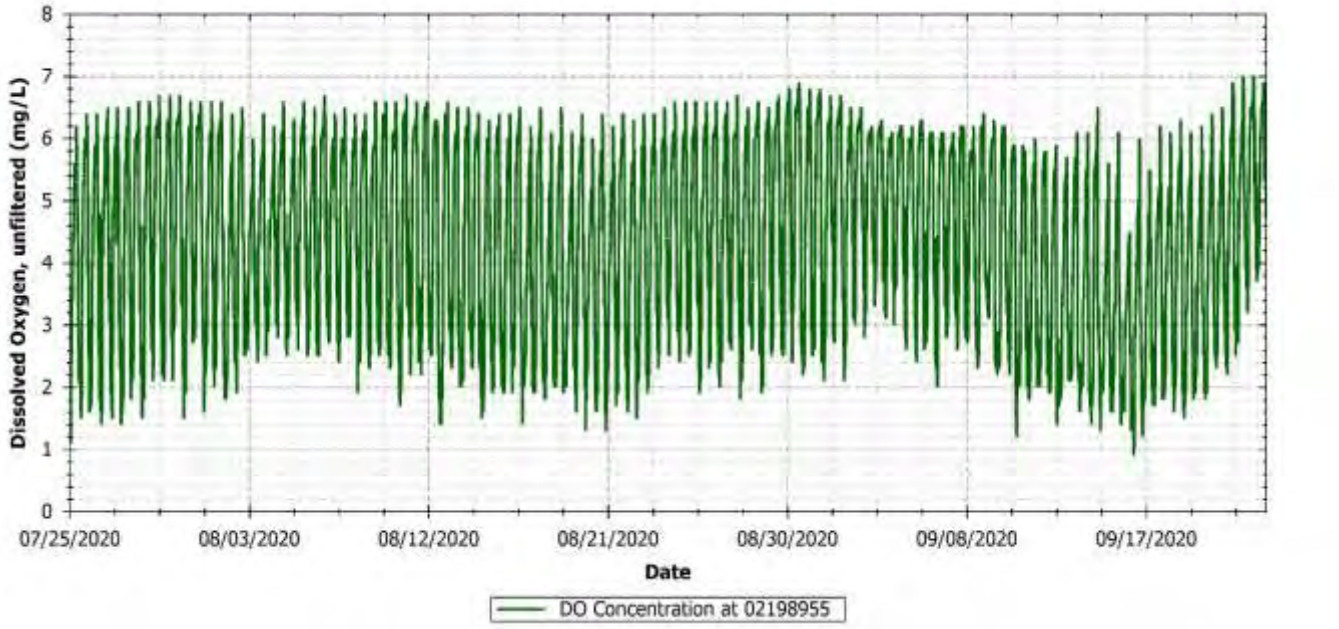


Figure G-34 USGS 02198955 (Middle River) observed DO concentration

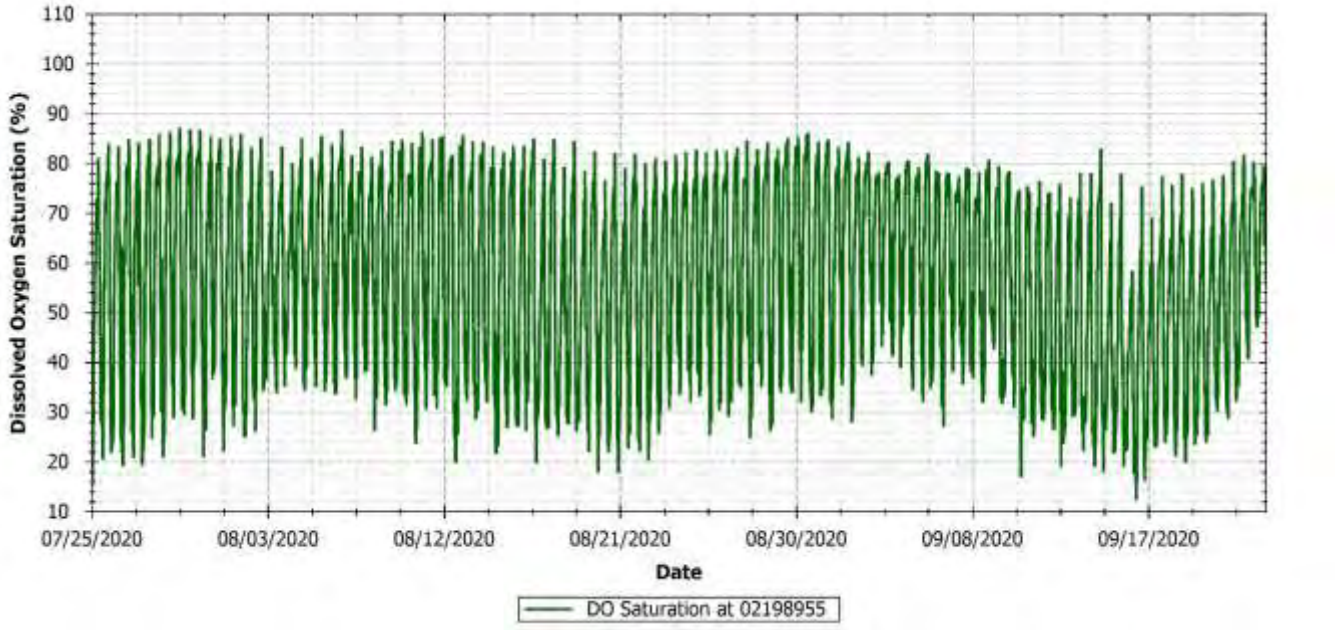


Figure G-35 USGS 02198955 (Middle River) calculated DO saturation

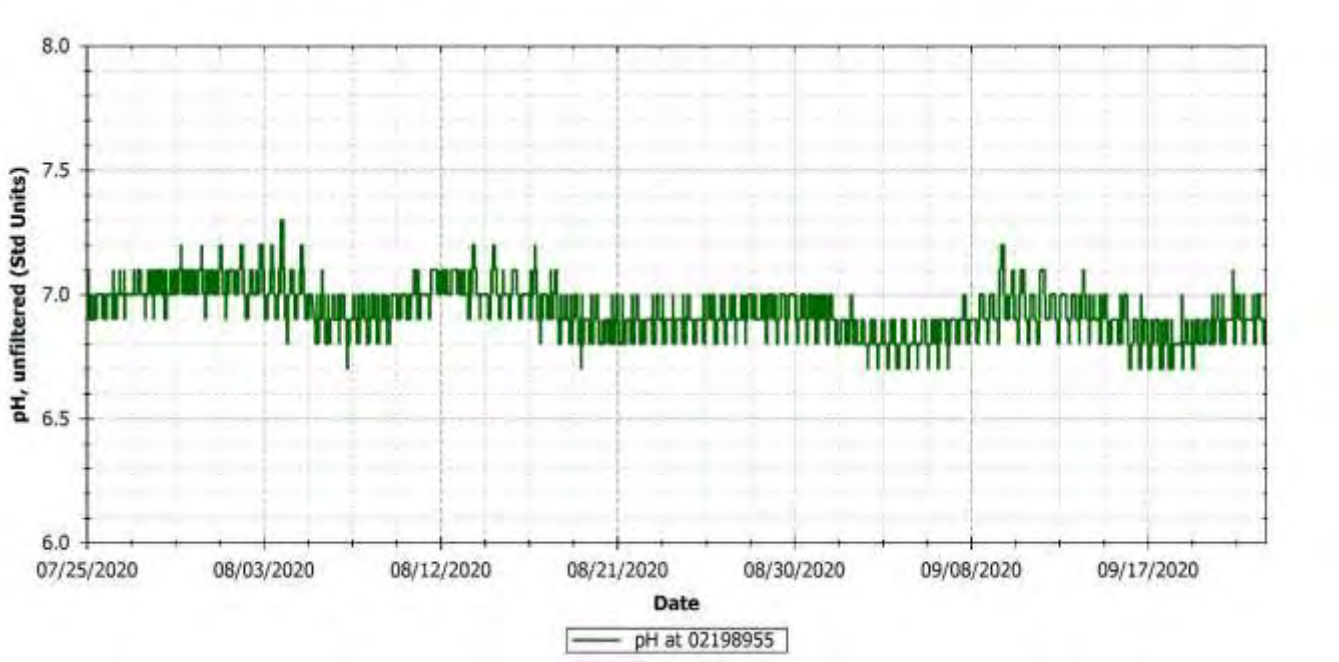


Figure G-36 USGS 02198955 (Middle River) observed pH

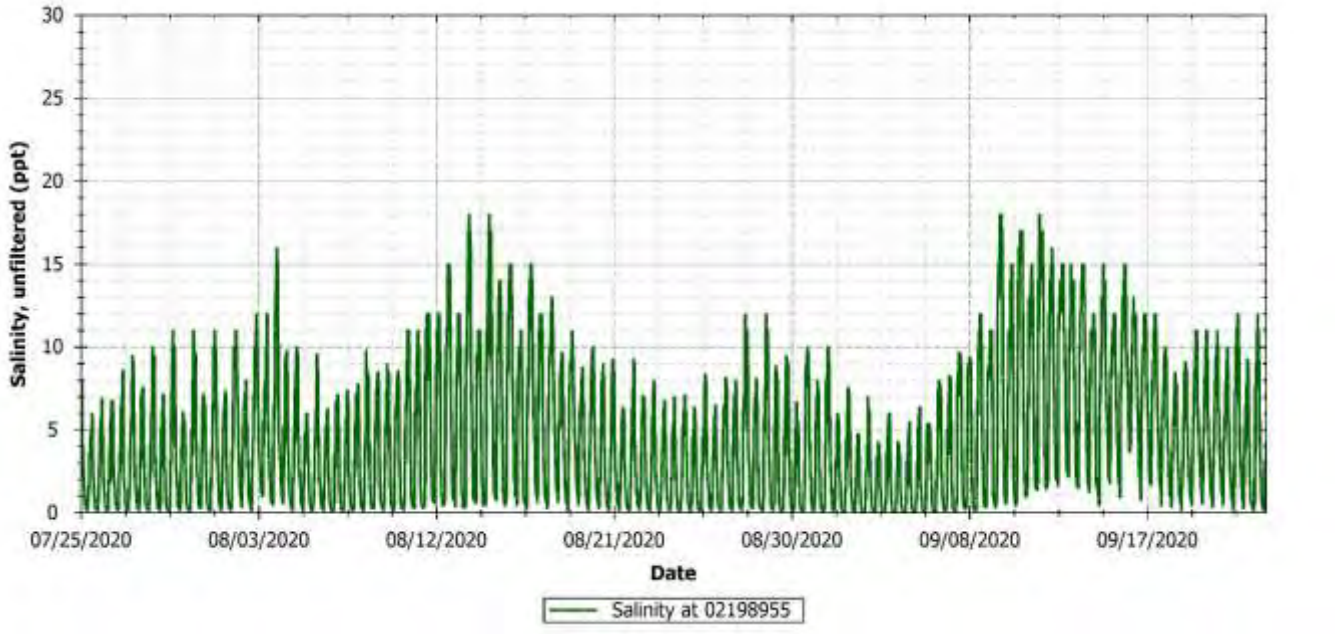


Figure G-37 USGS 02198955 (Middle River) observed salinity

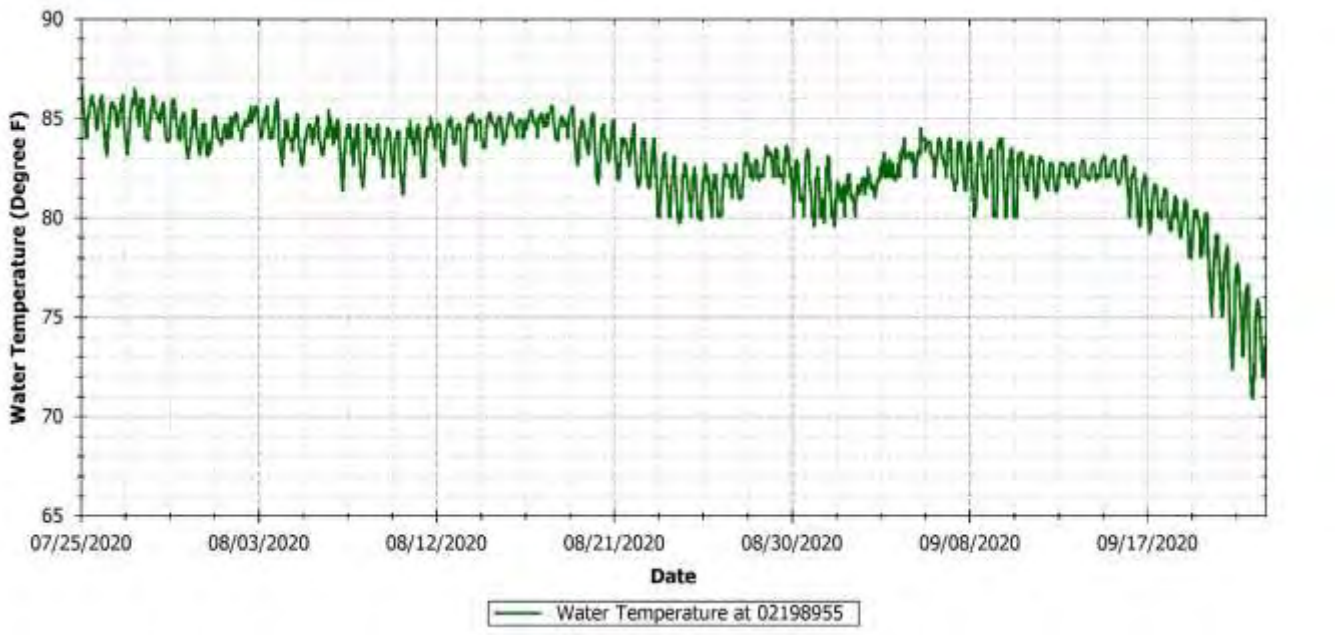


Figure G-38 USGS 02198955 (Middle River) observed water temperature

G.7 USGS 021989793 – HOG ISLAND – BACK RIVER

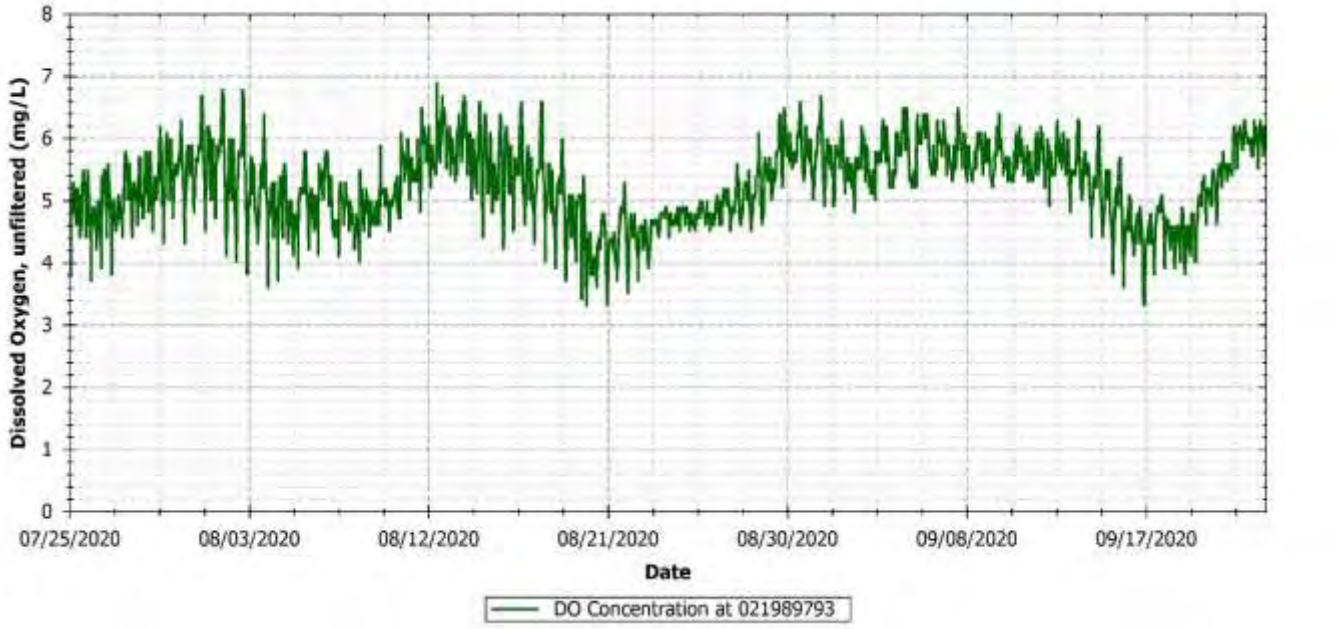


Figure G-39 USGS 021989793 (Back River) observed DO concentration

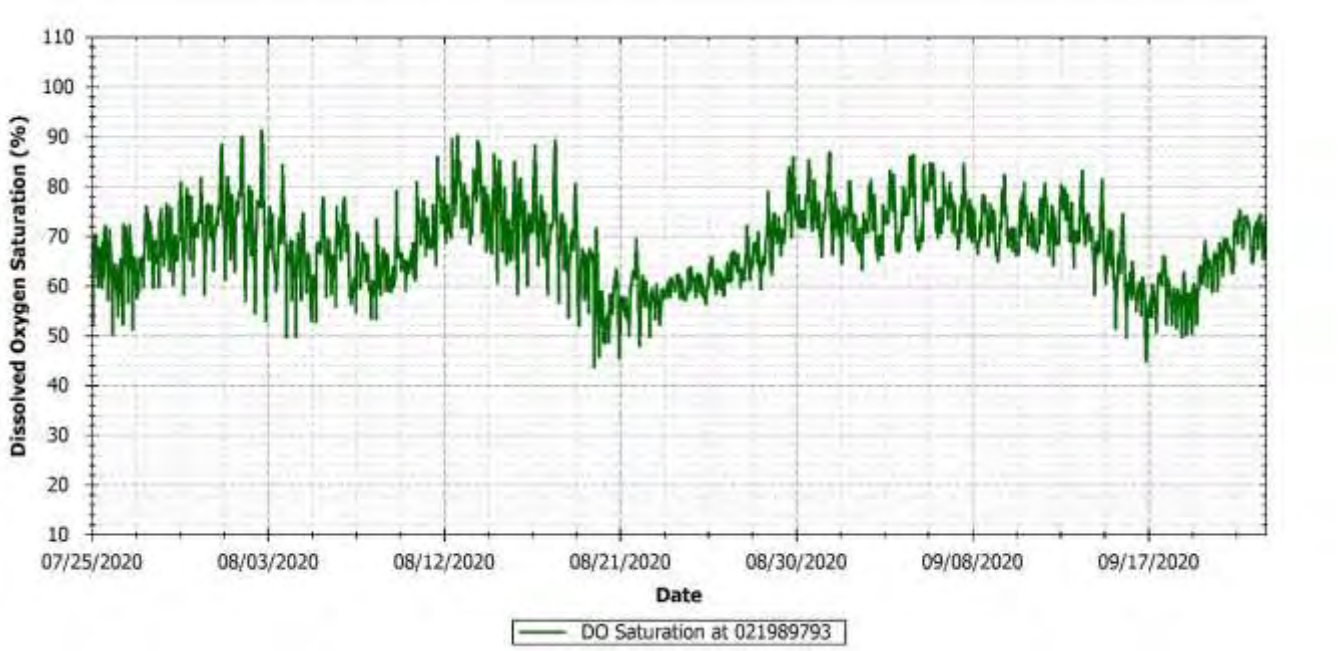


Figure G-40 USGS 021989793 (Back River) calculated DO saturation

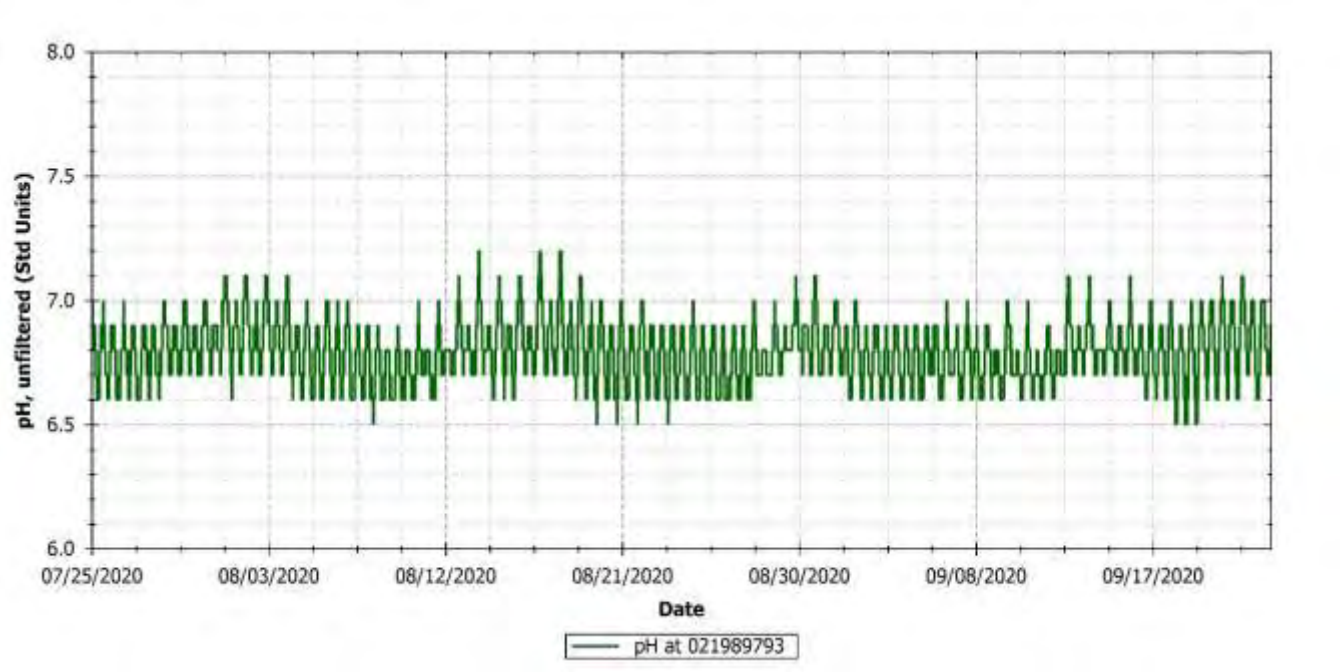
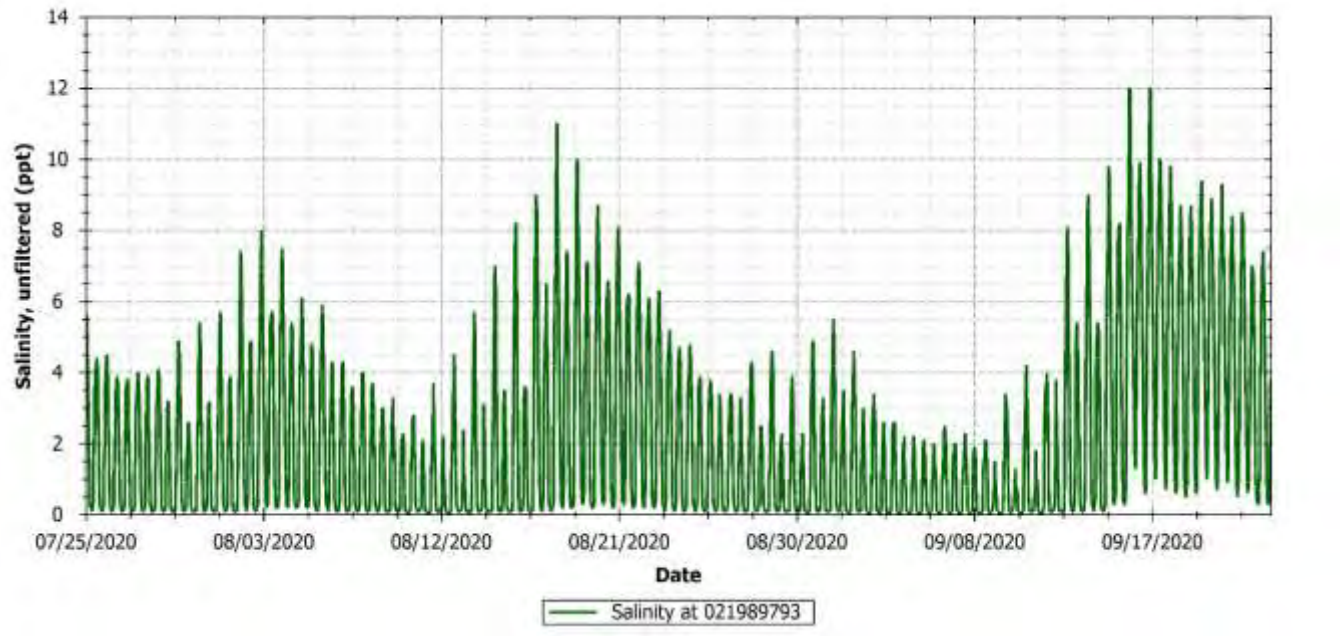


Figure G-41 USGS 021989793 (Back River) observed pH



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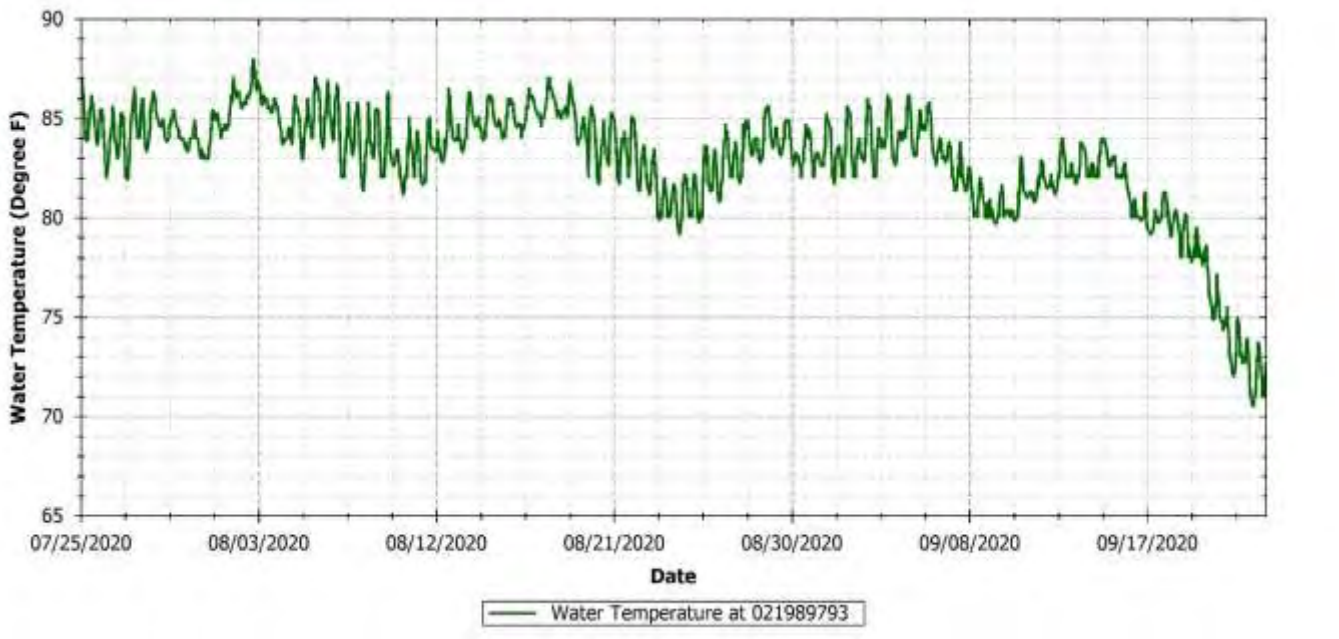

Figure G-43 USGS 021989793 (Back River) observed water temperature

G.8 USGS 021989715 – GARDEN CITY – FRONT RIVER

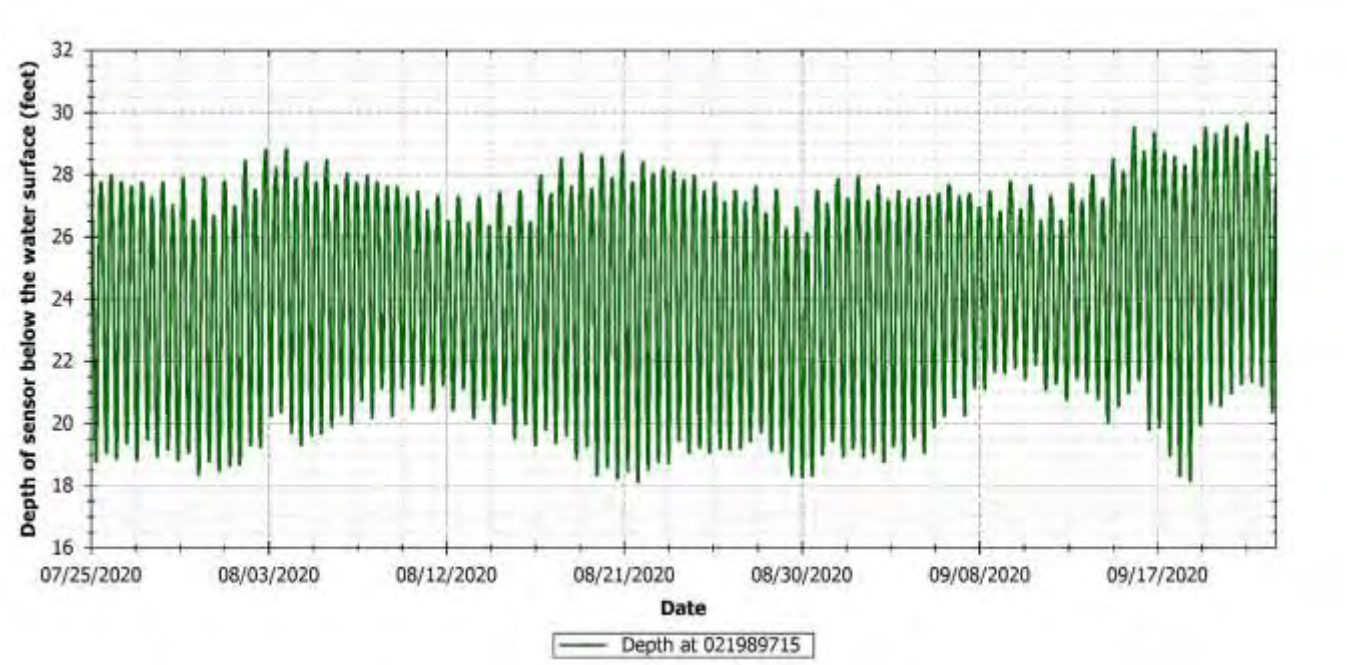

Figure G-44 USGS 021989715 (Front River) observed depth

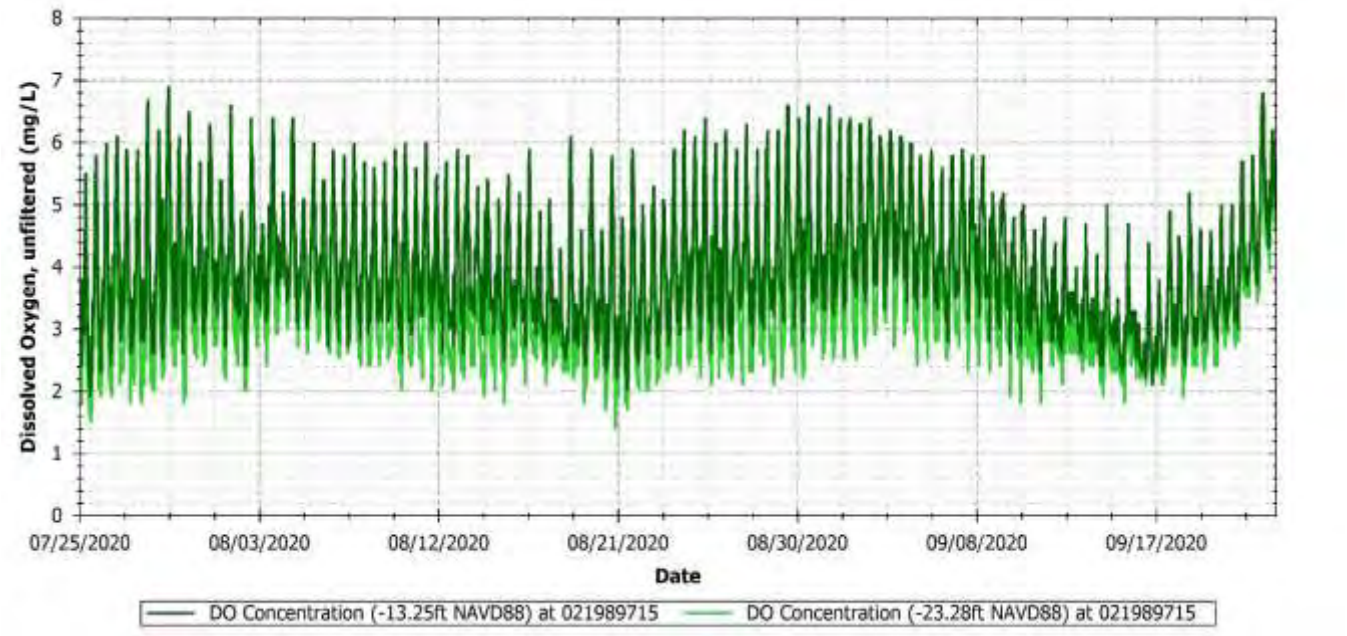

Figure G-45 USGS 021989715 (Front River) observed DO concentration

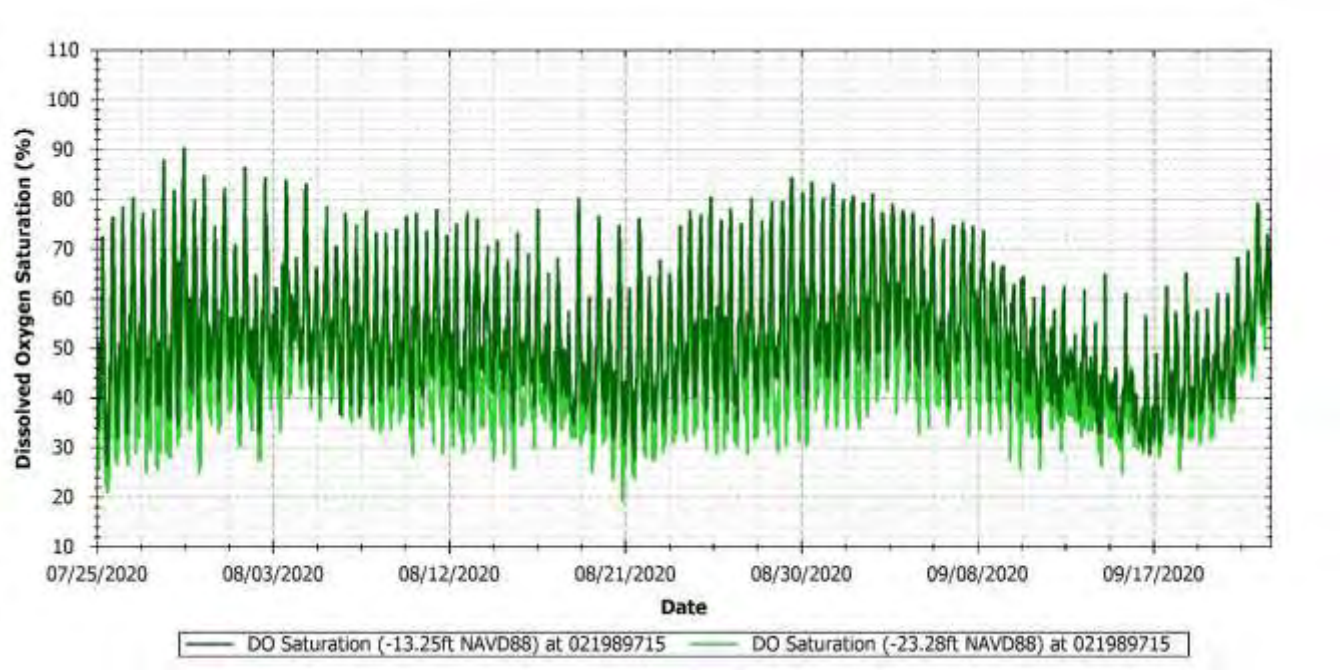

Figure G-46 USGS 021989715 (Front River) calculated DO saturation

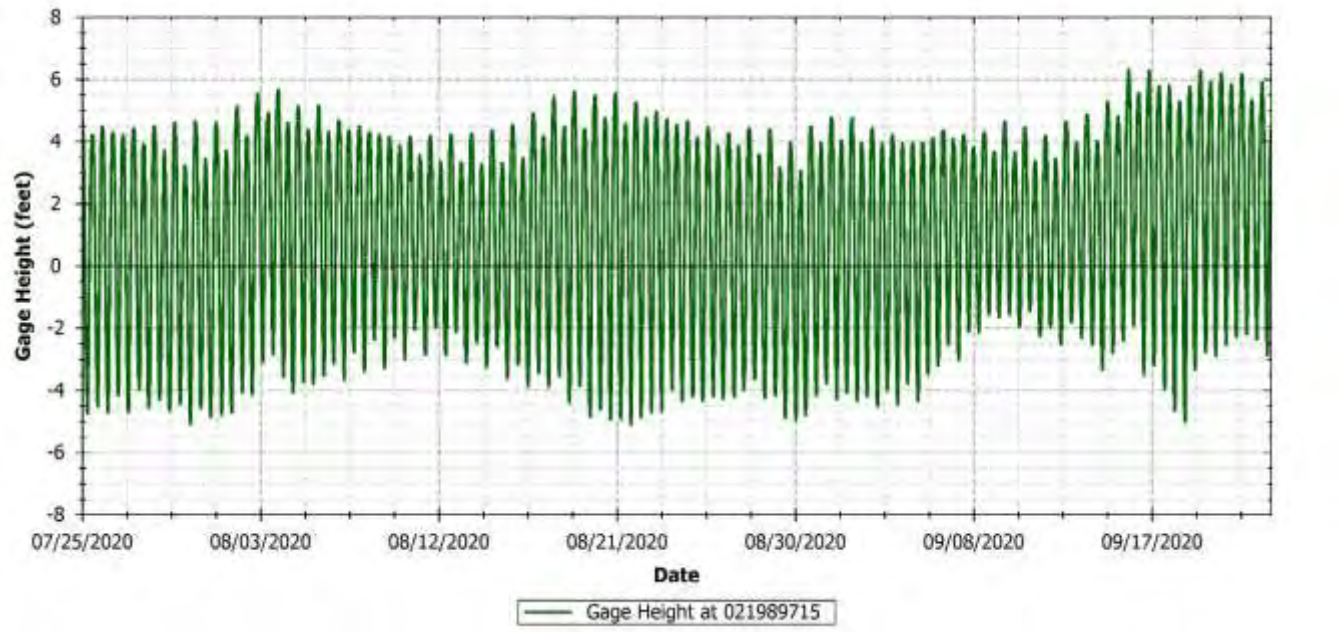

Figure G-47 USGS 021989715 (Front River) observed gage height

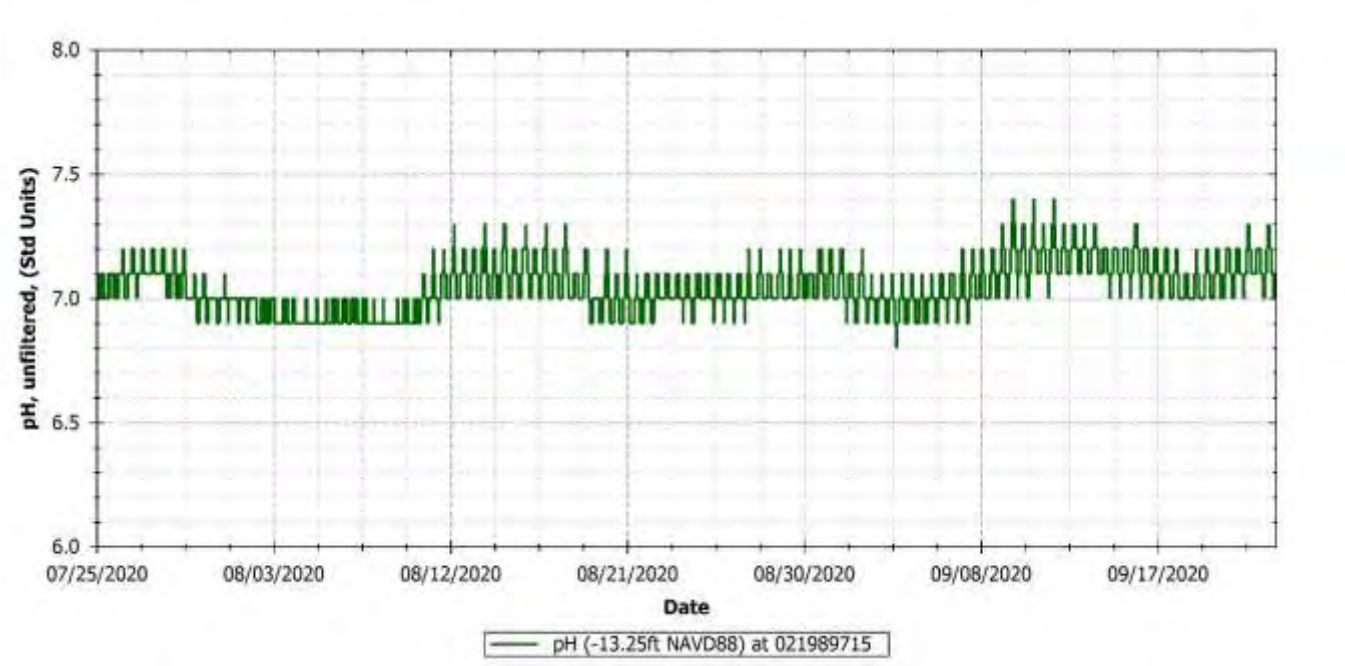

Figure G-48 USGS 021989715 (Front River) observed pH

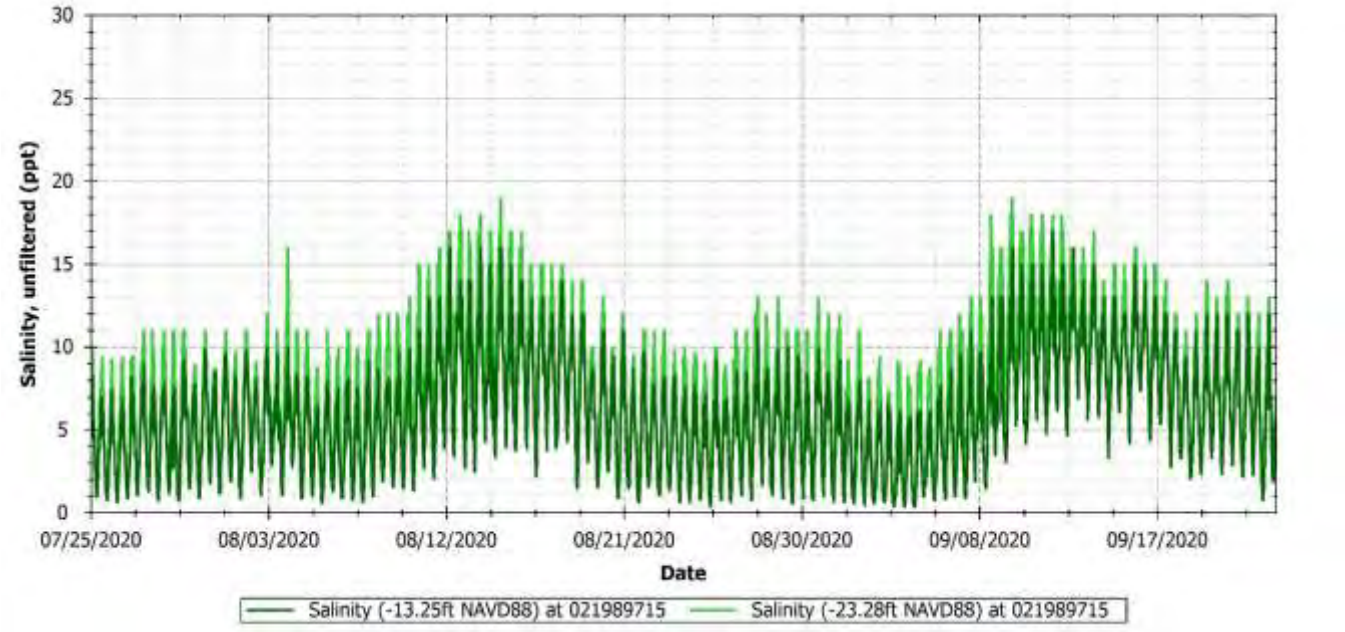

Figure G-49 USGS 021989715 (Front River) observed salinity

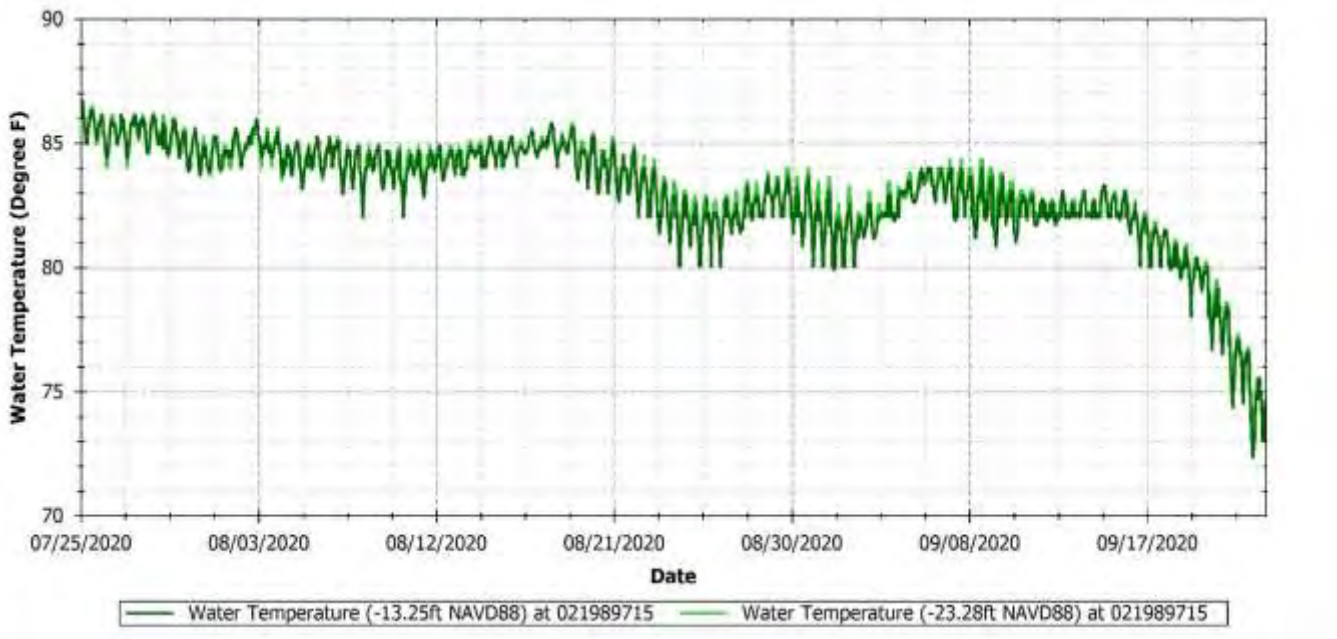

Figure G-50 USGS 021989715 (Front River) observed water temperature

G.9 USGS 0219897945 – US17 – BACK RIVER

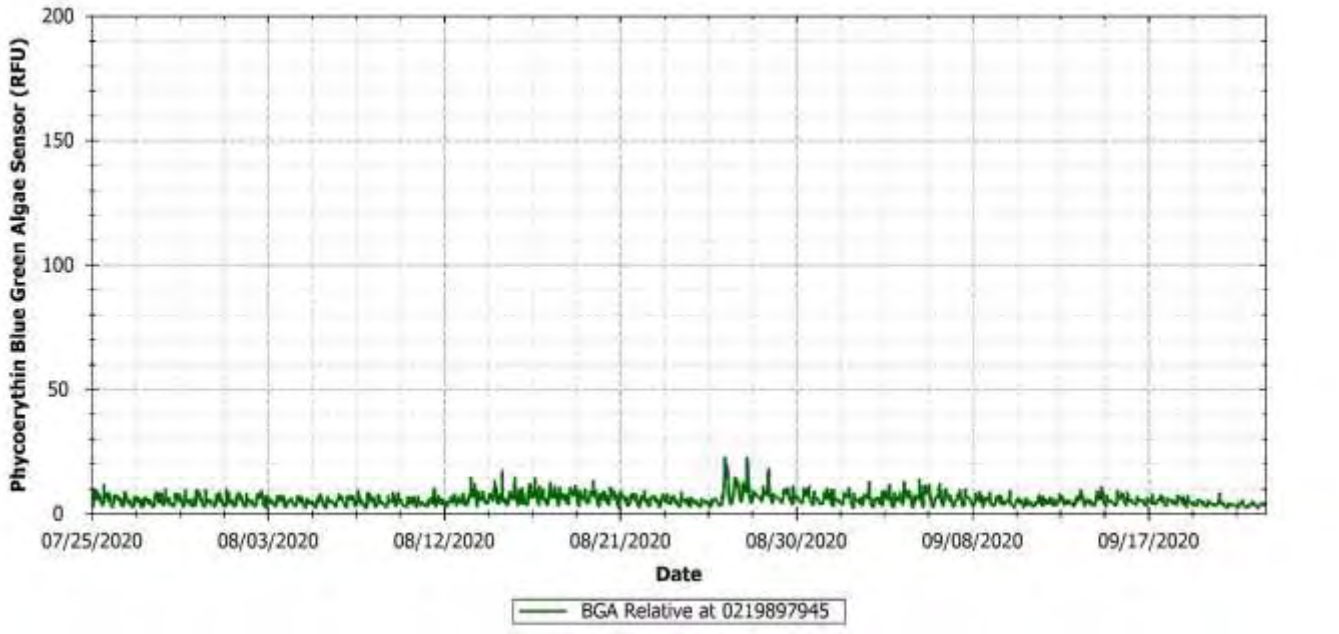

Figure G-51 USGS 0219897945 (Back River) observed blue-green algae

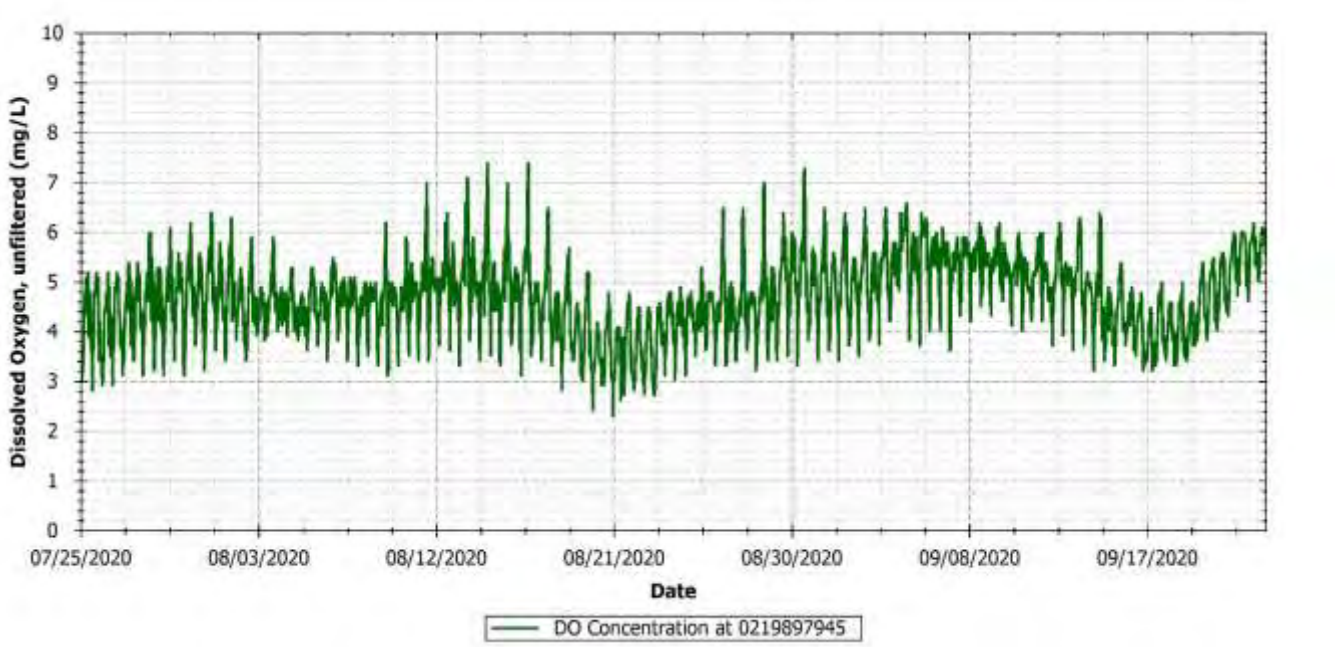

Figure G-52 USGS 0219897945 (Back River) observed DO concentration

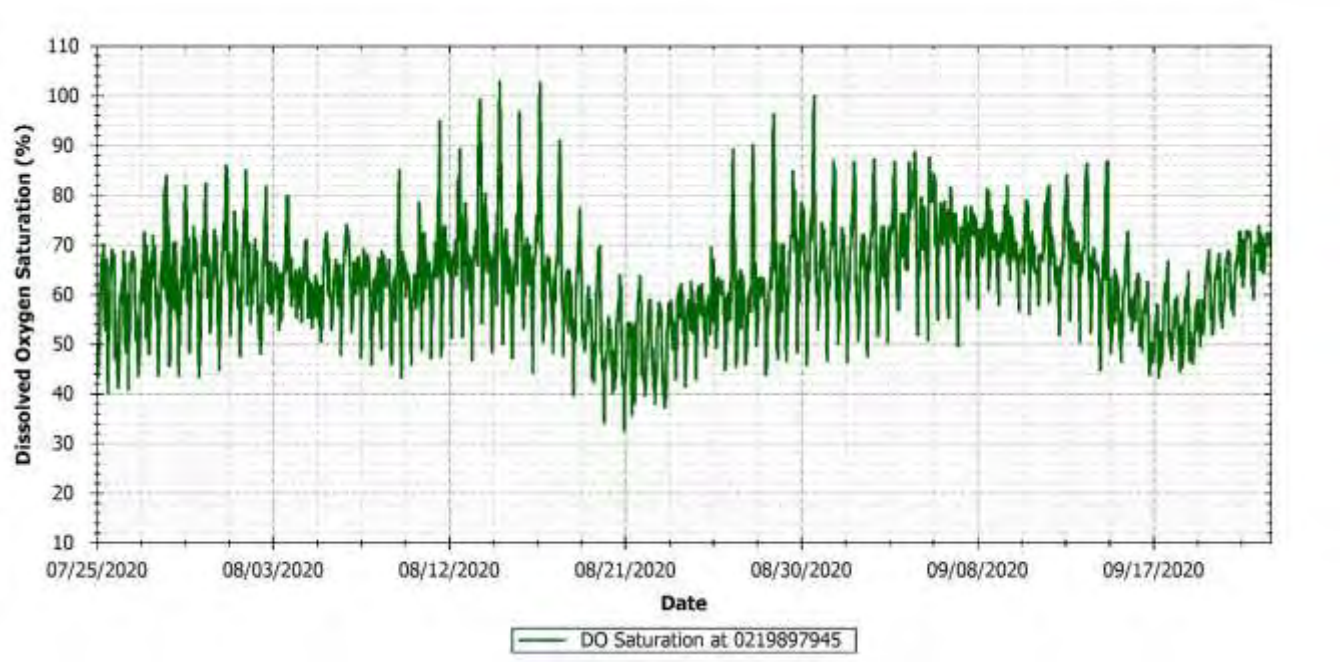

Figure G-53 USGS 0219897945 (Back River) calculated DO saturation

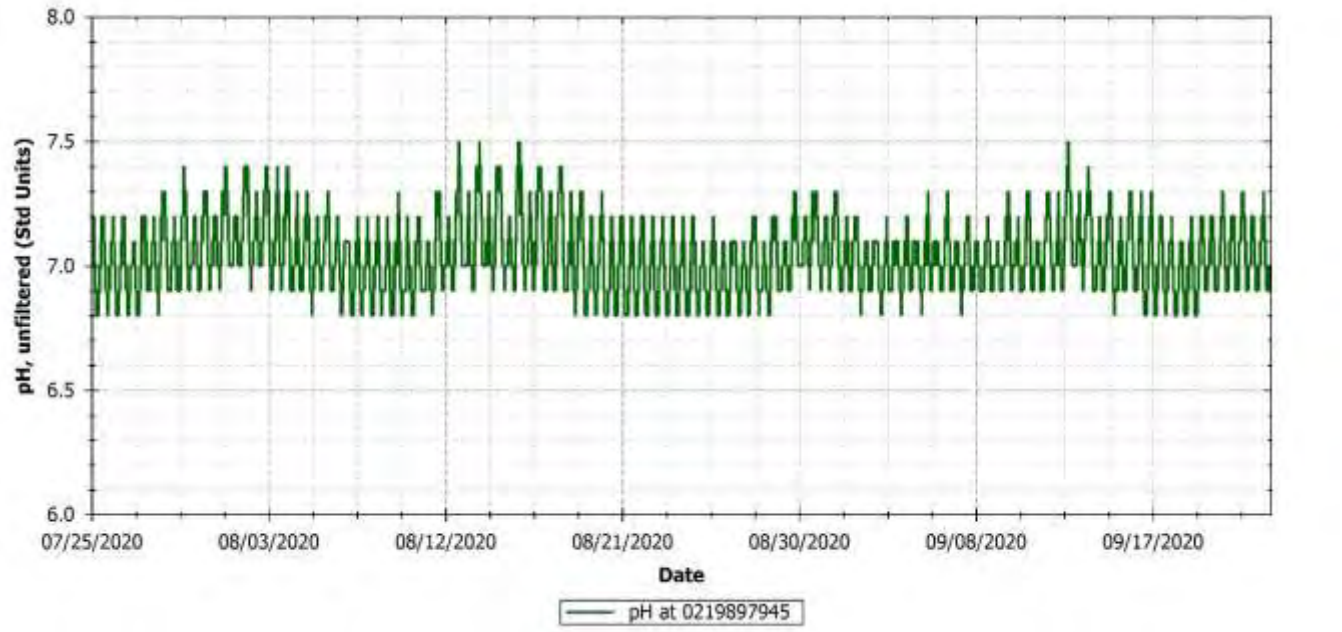

Figure G-54 USGS 0219897945 (Back River) observed pH

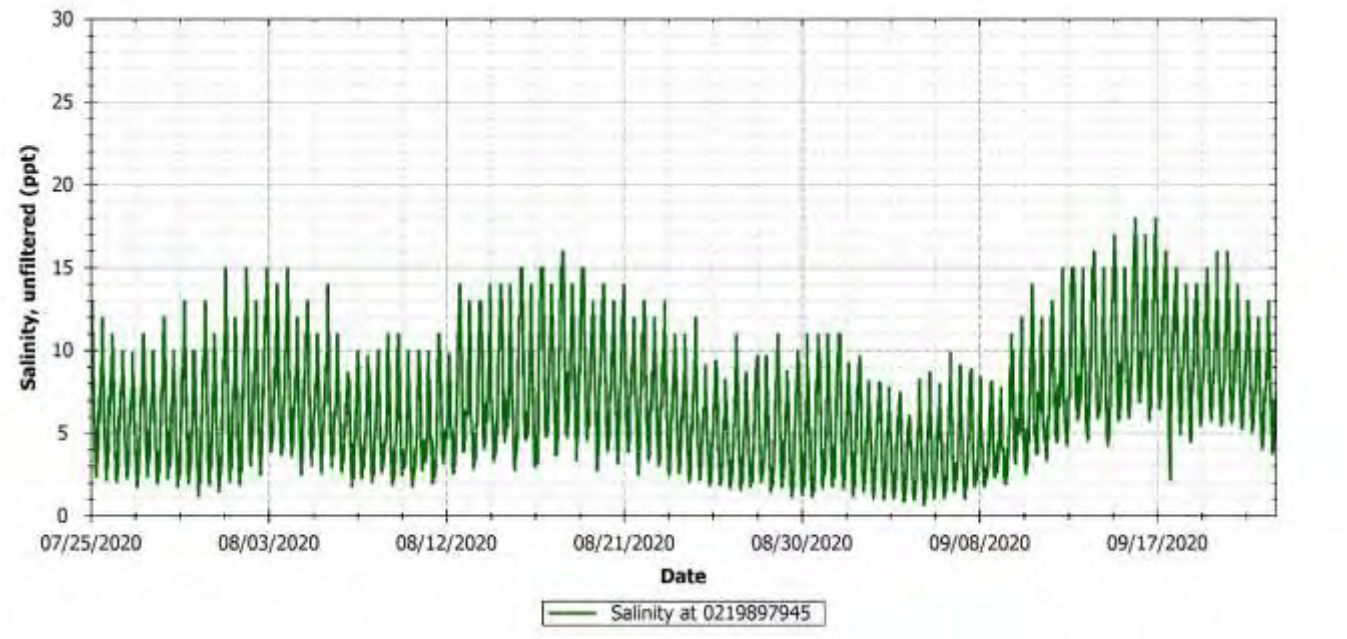

Figure G-55 USGS 0219897945 (Back River) observed salinity

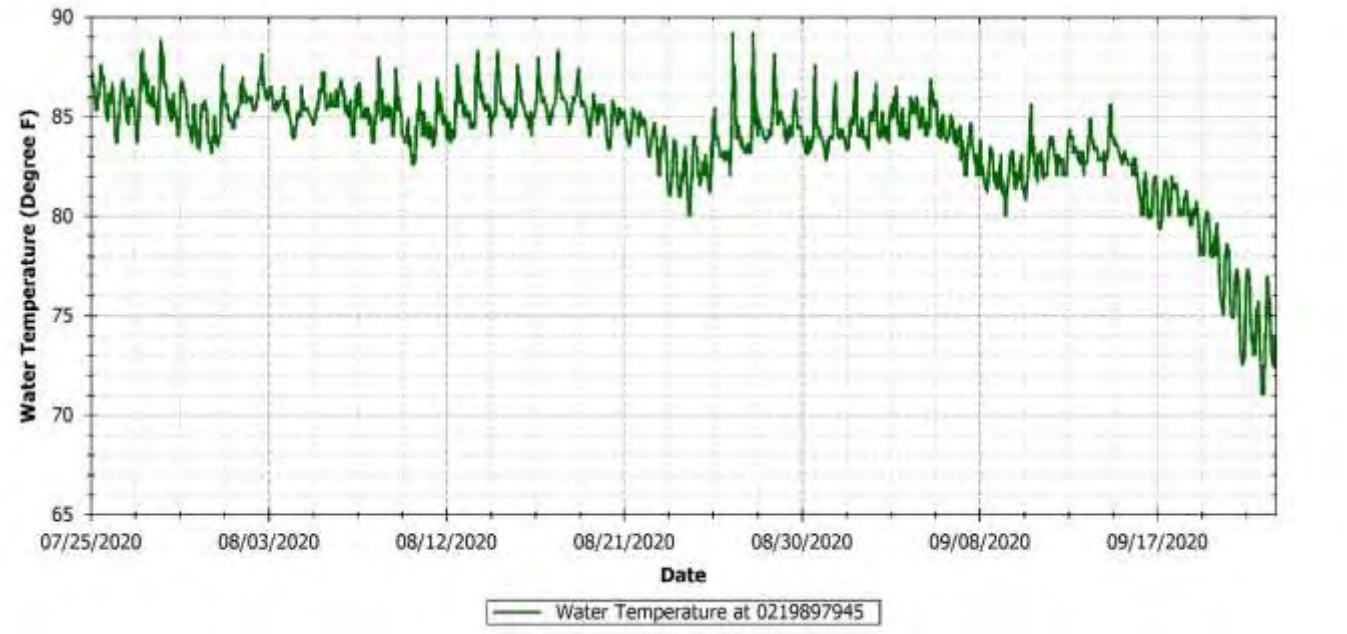

Figure G-56 USGS 0219897945 (Back River) observed water temperature

G.10 USGS 021989773 – USACE DOCK – FRONT RIVER

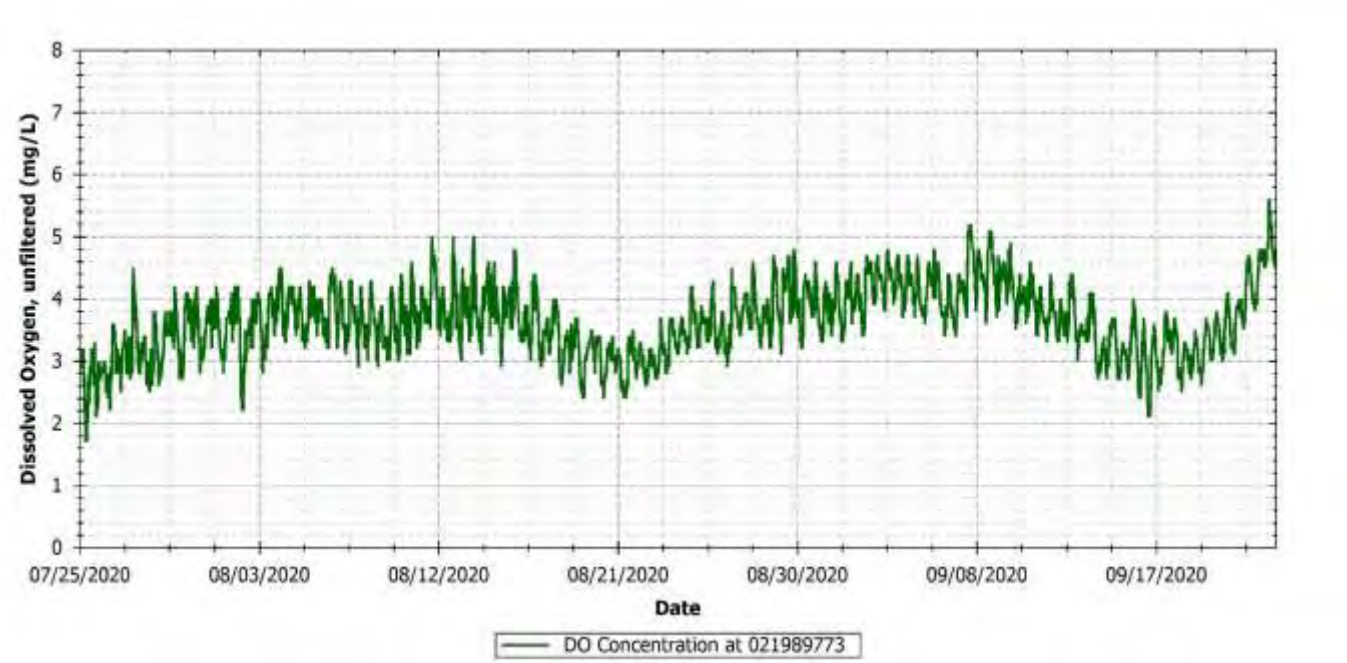

Figure G-57 USGS 021989773 (Front River) observed DO concentration

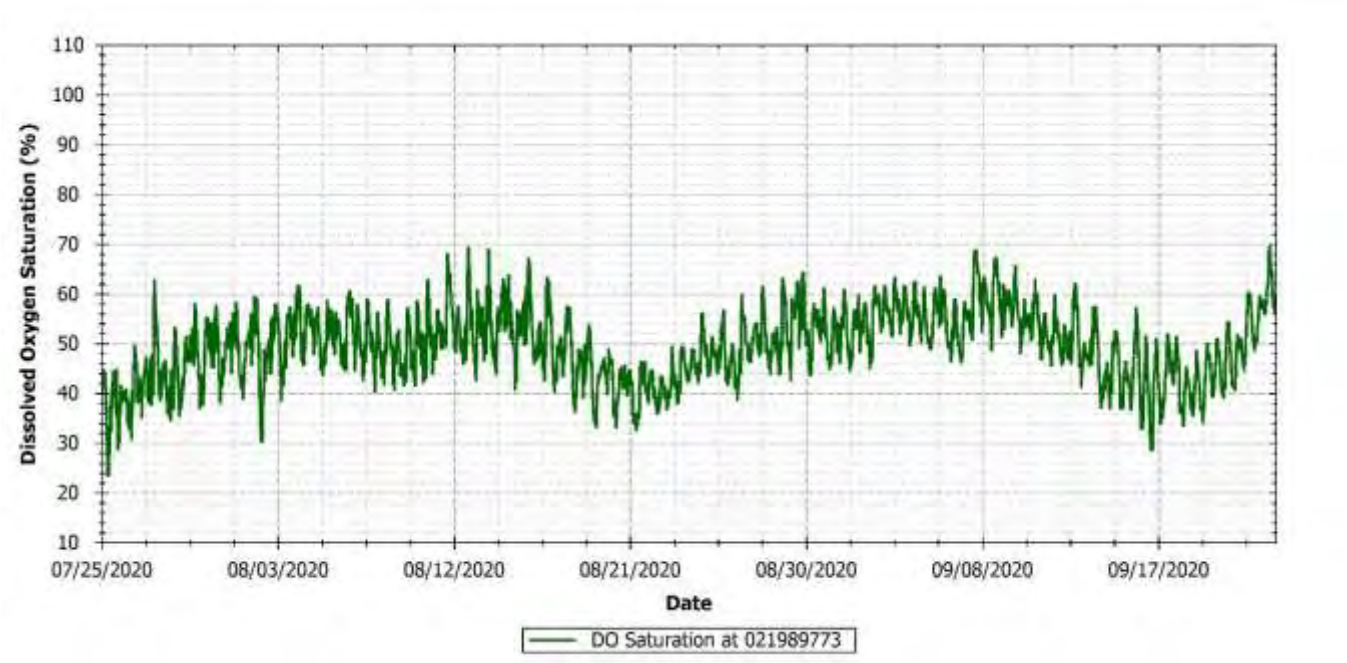

Figure G-58 USGS 021989773 (Front River) calculated DO saturation

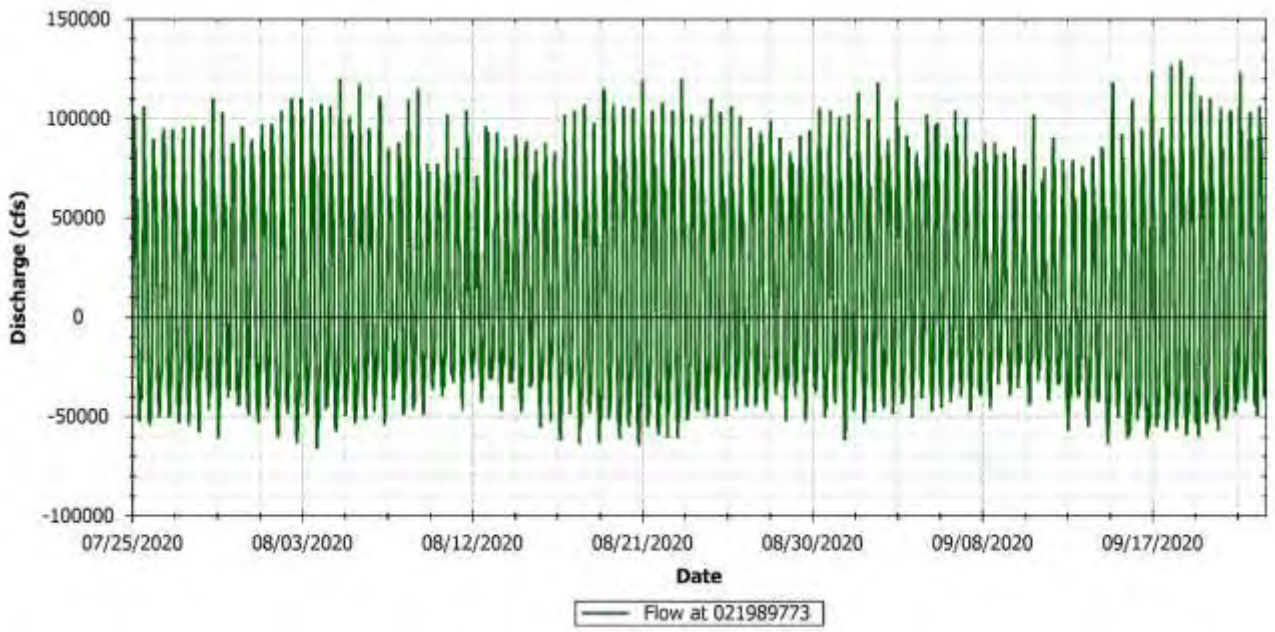

Figure G-59 USGS 021989773 (Front River) observed discharge

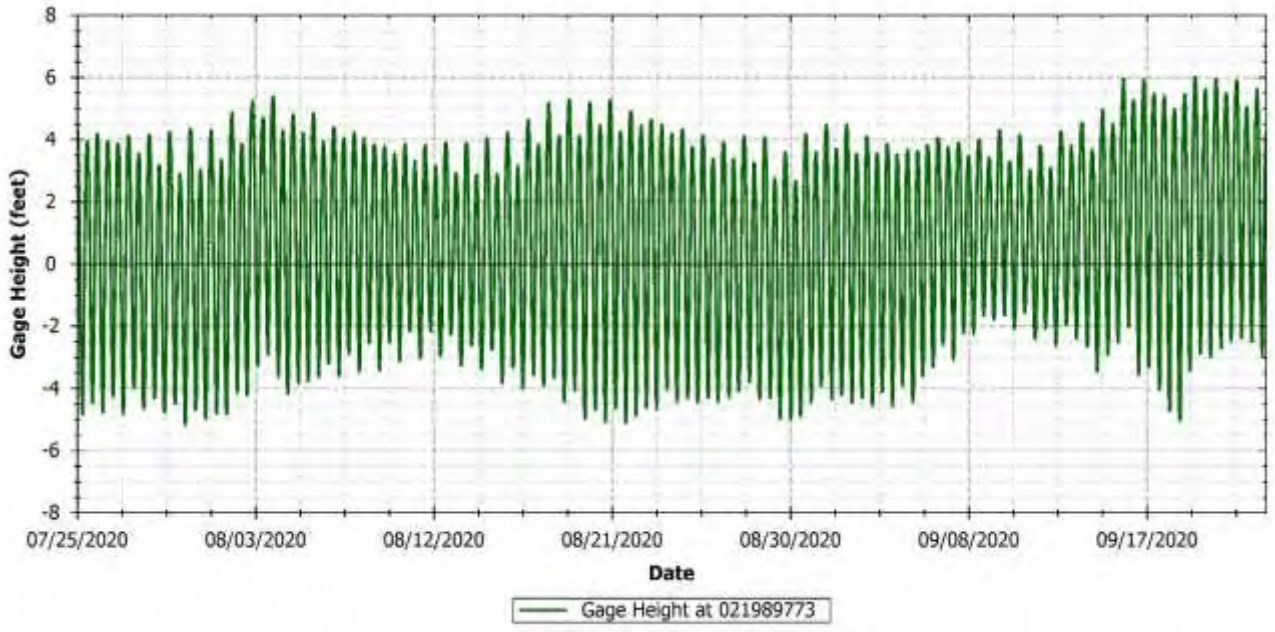

Figure G-60 USGS 021989773 (Front River) observed gage height

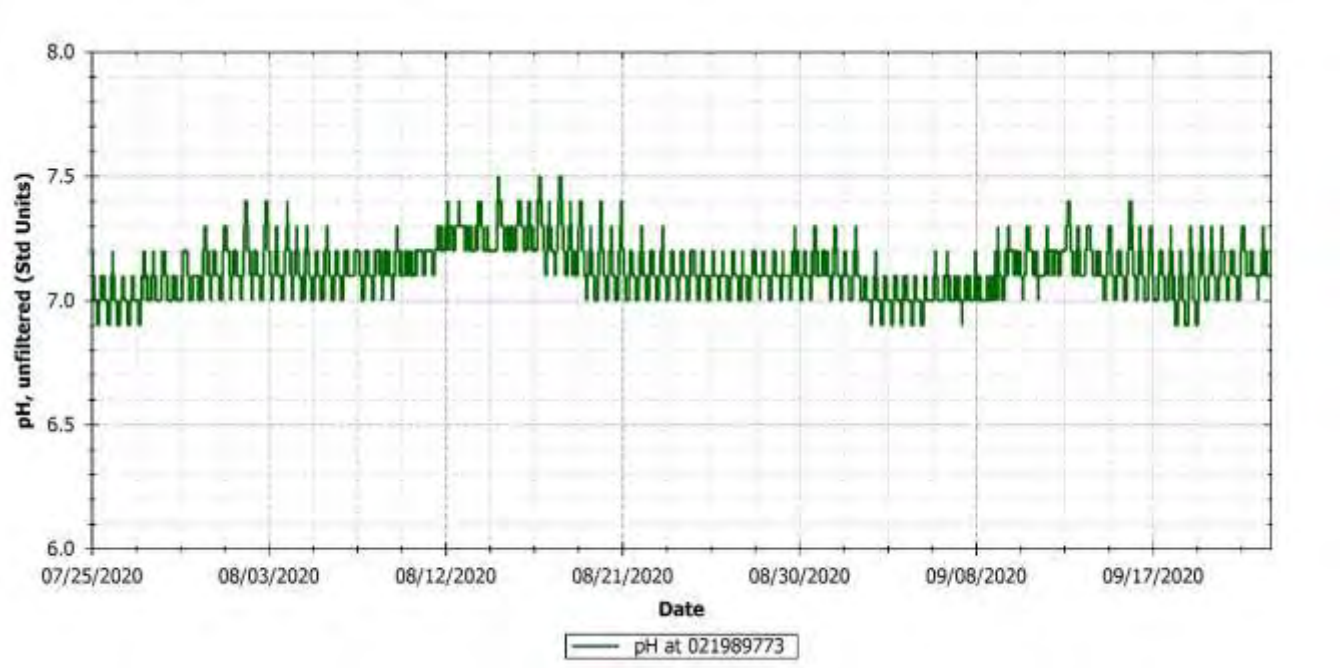

Figure G-61 USGS 021989773 (Front River) observed pH

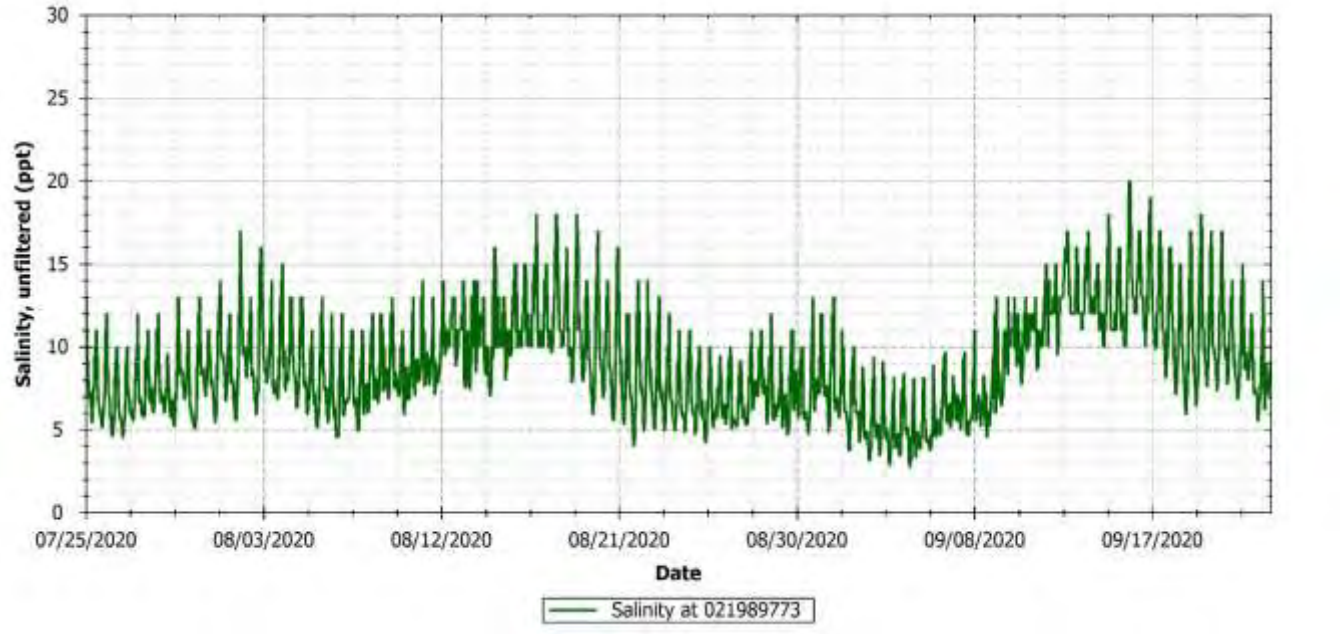

Figure G-62 USGS 021989773 (Front River) observed salinity

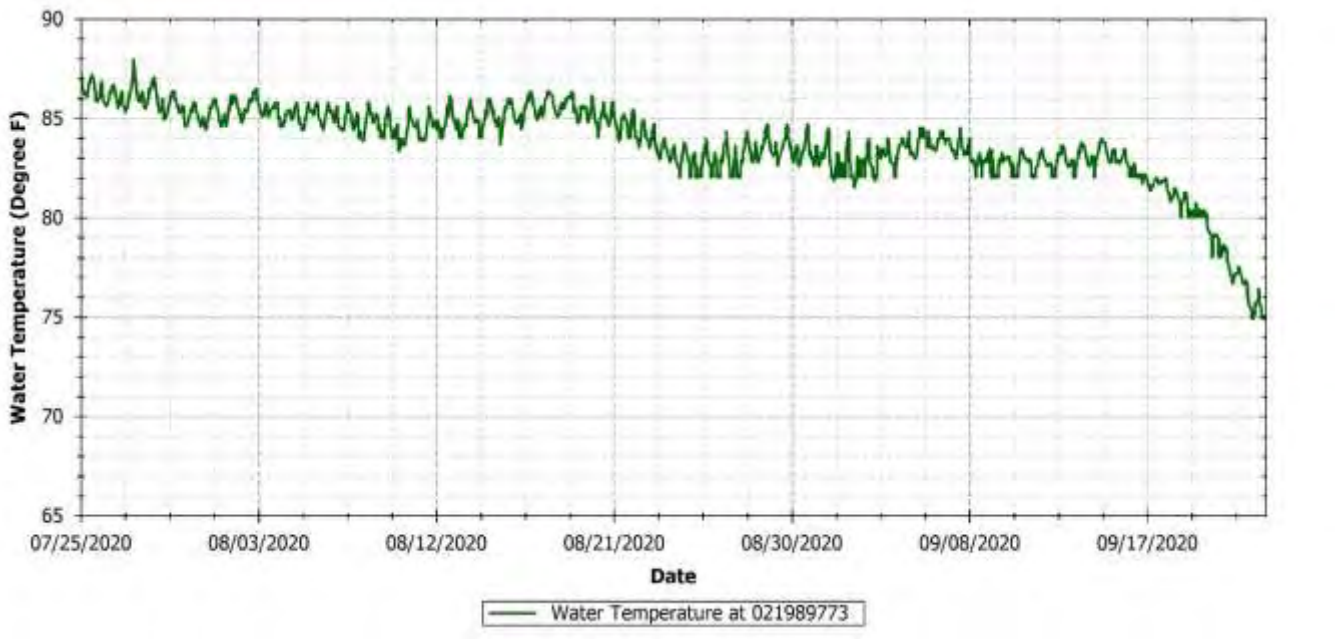

Figure G-63 USGS 021989773 (Front River) observed water temperature

G.11 USGS 0219897993 – ELBA ISLAND – SAVANNAH RIVER

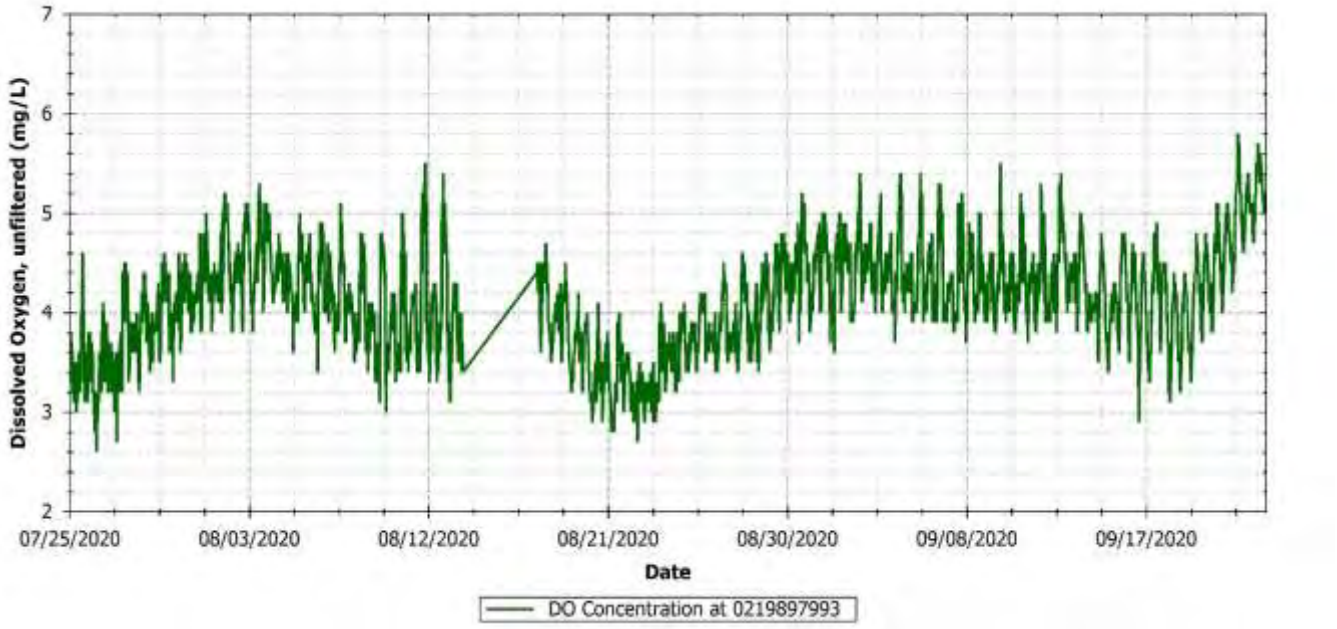

Figure G-64 USGS 0219897993 (Savannah River) observed DO concentration

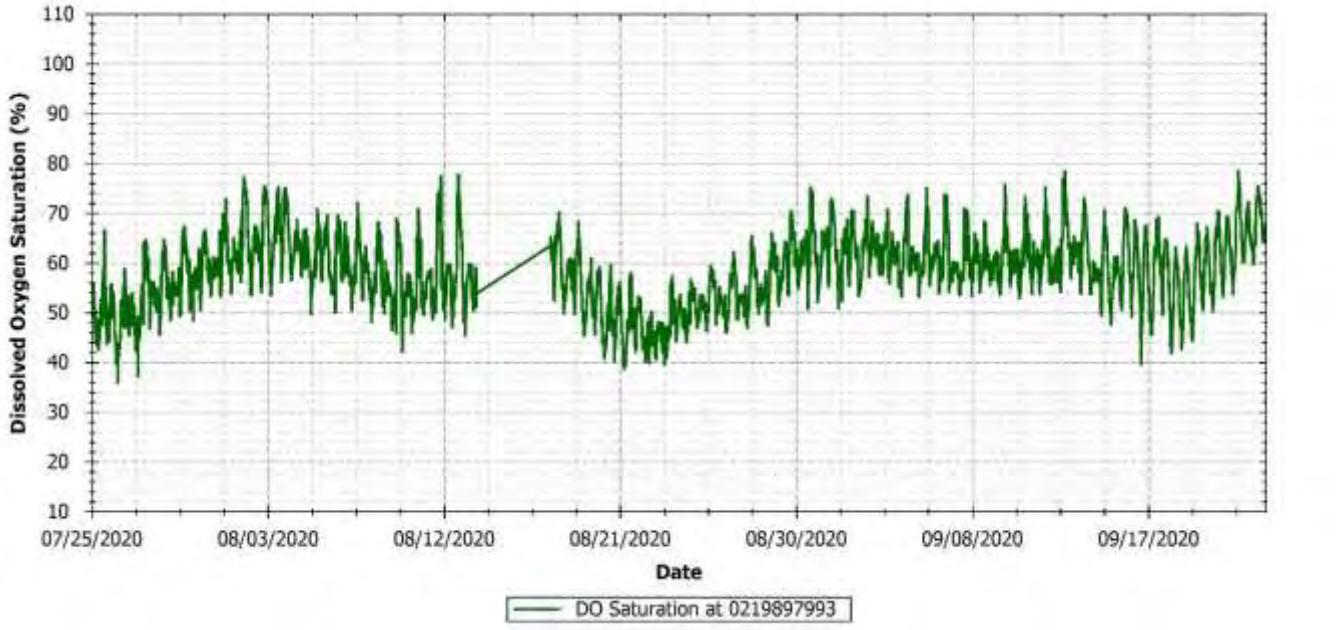

Figure G-65 USGS 0219897993 (Savannah River) calculated DO saturation

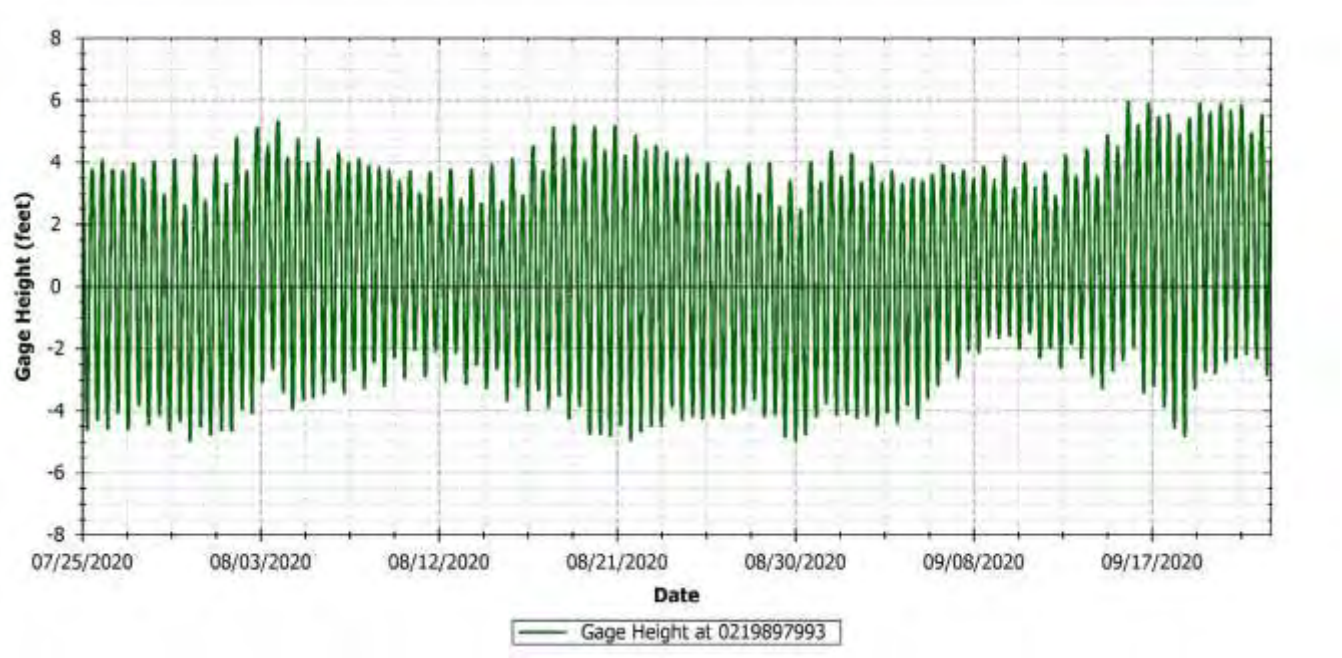

Figure G-66 USGS 0219897993 (Savannah River) observed gage height

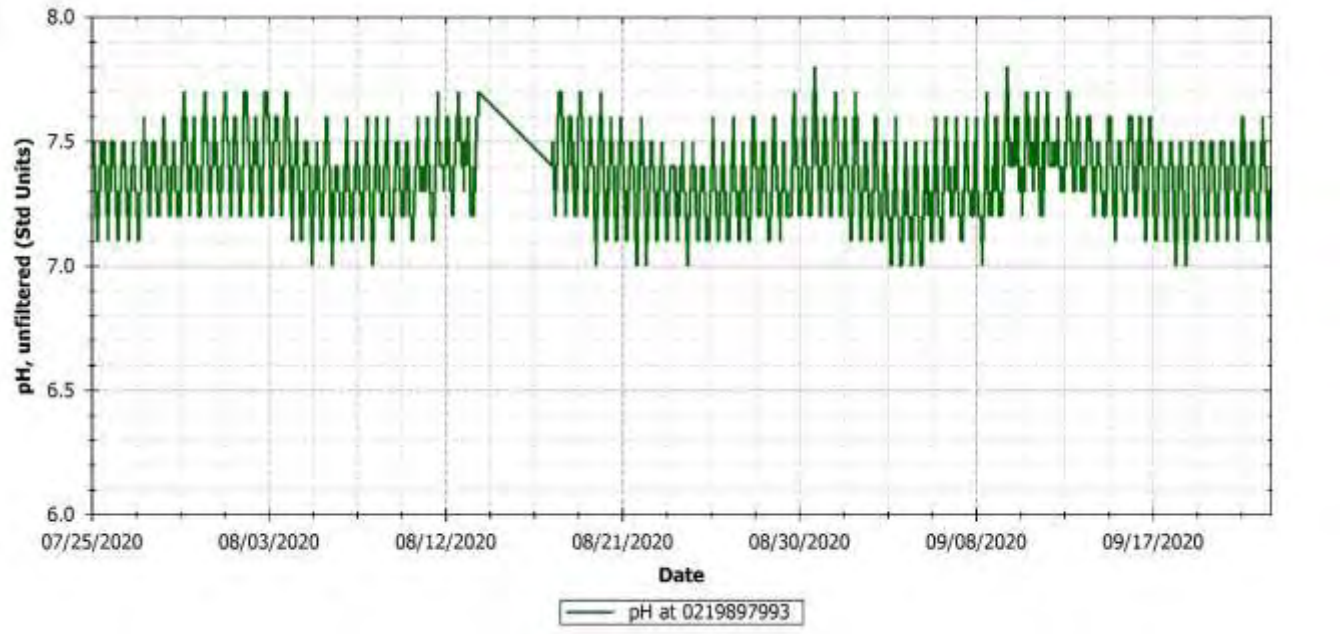

Figure G-67 USGS 0219897993 (Savannah River) observed pH

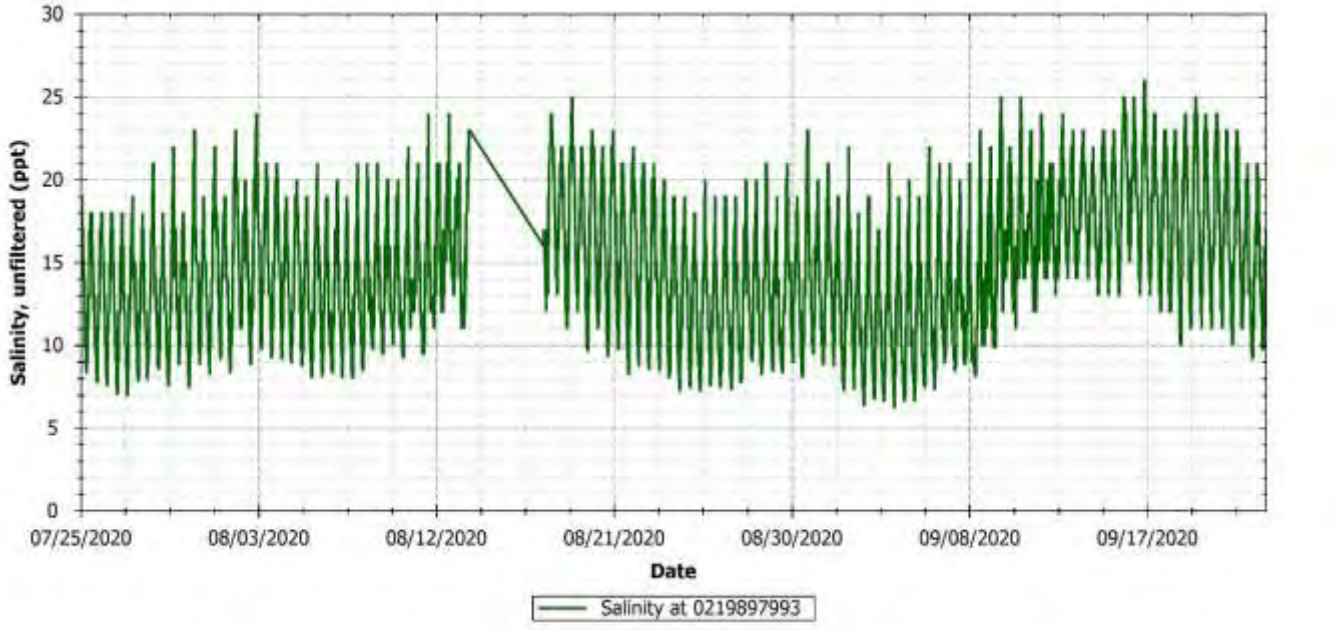

Figure G-68 USGS 0219897993 (Savannah River) observed salinity

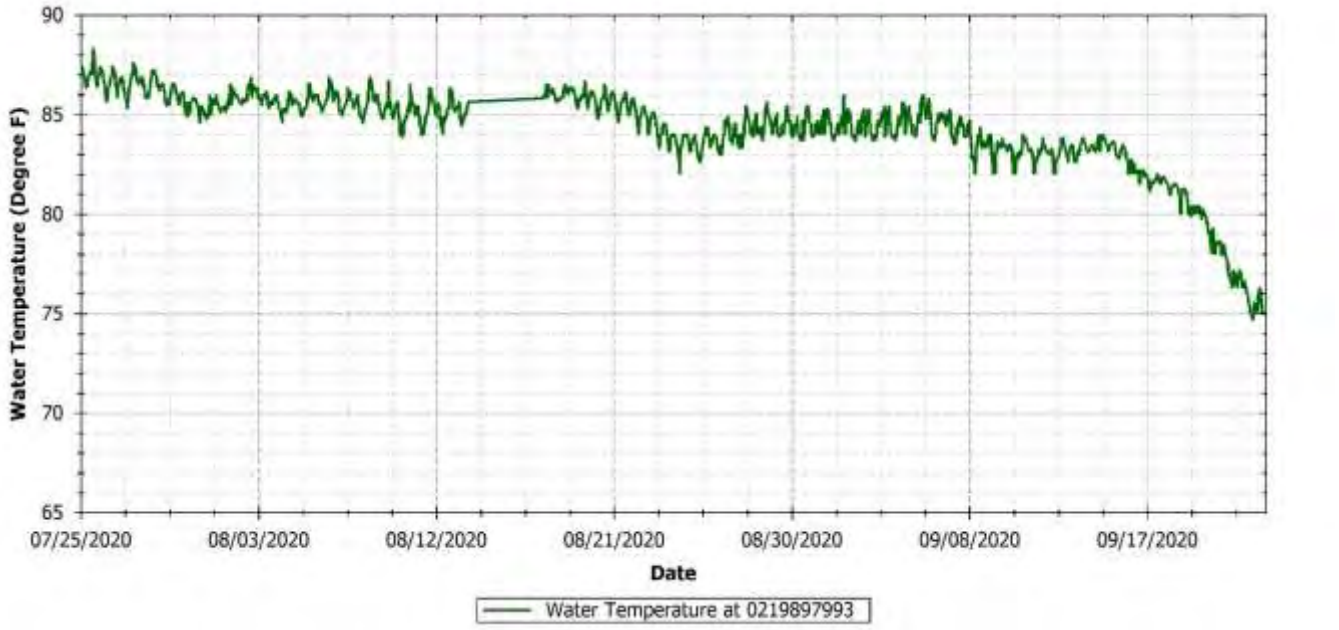

Figure G-69 USGS 0219897993 (Savannah River) observed water temperature

APPENDIX H PLANT DATA

APPENDIX H USACE PLANT DATA

Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Tasks: 10
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PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX H BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document is provided as Appendix H of the SUR Report and is referred to in the main body of the report in Sections 3.4, 5.2, 6.0, and 11.2.

APPENDIX H TABLE OF CONTENTS

APPENDIX H USACE PLANT DATA H-1

H.1 Plant Data H-5

H.2 SHEP Start Up Run –Plant Data QA/QC –Technical Memorandum H-10

APPENDIX H LIST OF TABLES

Table H-1 Startup Run total daily flows and loads from the Upriver diffuser H-6

Table H-2 Startup Run total daily flows and loads from the Front River and Back River diffusers H-8

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
GPM	gallons per minute
lbs/day	pounds per day
min	minute(s)
USACE	United States Army Corps of Engineers

H.1 PLANT DATA

This section presents the data for the total daily flow and oxygen loads discharged from the Upriver and the Downriver plants (Oxygen Injection System) during the Startup Run (SUR).

At the Upriver plant, the average operating daily load under normal conditions injected by the Upriver plant was 28,838 lbs/day, which was greater than the required 28,000 lbs/day. Daily plant oxygen loads varied due to scheduled and unscheduled downtime for maintenance on the oxygen generators. However, downtimes were typically short, and plant was able to over-produce the required oxygen load when it was operating.

At the Downriver plant, the average operating daily load under normal conditions was 13,574 lbs/day, which was greater than the required 12,000 lbs/day. Similar to the Downriver plant, the Upriver plant daily oxygen loads varied due to scheduled and unscheduled plant downtime.

Figures showing the plant flows and oxygen loads for each plant are presented in Section 5.2 in the main body of the report. Supporting tables with plant flows and injected oxygen loads per day throughout the SUR are presented in ***Table H-1*** and ***Table H-2***.

Table H-1 Startup Run total daily flows and loads from the Upriver diffuser

Date	Plant Time on (min)	Upriver	
		Flow (gallons/day)	Oxygen Load (pounds/day)
7/25/2020	1,440	101,461,350	30,773
7/26/2020	1,440	101,471,865	30,609
7/27/2020	1,440	101,470,125	31,101
7/28/2020	1,410	98,501,580	29,616
7/29/2020	1,440	101,485,875	30,841
7/30/2020	1,440	99,195,000	23,597
7/31/2020	1,440	104,408,715	25,366
8/1/2020	1,440	104,429,100	25,218
8/2/2020	1,440	104,429,925	25,236
8/3/2020	1,440	103,188,840	25,567
8/4/2020	1,440	102,357,615	26,707
8/5/2020	1,440	102,584,160	26,291
8/6/2020	1,410	99,327,945	24,305
8/7/2020	1,440	101,480,970	26,144
8/8/2020	1,440	101,455,500	26,698
8/9/2020	1,440	101,407,755	26,821
8/10/2020	1,440	101,367,315	26,742
8/11/2020	1,440	101,500,575	26,755
8/12/2020	1,440	101,465,145	26,845
8/13/2020	1,440	101,559,960	28,087
8/14/2020	1,395	98,313,195	28,441
8/15/2020	1,440	101,454,330	30,253
8/16/2020	1,440	101,463,975	30,332
8/17/2020	1,440	101,514,765	30,295
8/18/2020	1,440	101,510,445	29,868
8/19/2020	1,440	101,425,005	30,205
8/20/2020	1,440	101,452,305	30,529
8/21/2020	1,440	101,491,470	30,923
8/22/2020	1,440	101,441,520	31,309
8/23/2020	1,440	101,457,675	31,054
8/24/2020	1,440	101,278,905	30,139
8/25/2020	1,440	101,474,010	28,947

Date	Plant Time on (min)	Upriver	
		Flow (gallons/day)	Oxygen Load (pounds/day)
8/26/2020	1,440	101,471,745	28,403
8/27/2020	1,440	102,065,580	27,728
8/28/2020	1,440	103,017,525	29,703
8/29/2020	1,440	103,026,420	31,193
8/30/2020	1,440	102,872,910	30,930
8/31/2020	1,440	102,221,655	29,062
9/1/2020	1,440	102,455,025	28,135
9/2/2020	1,440	102,598,560	28,342
9/3/2020	1,440	103,369,470	27,188
9/4/2020	1,440	103,026,855	26,358
9/5/2020	1,440	102,746,415	28,404
9/6/2020	1,440	102,840,915	29,975
9/7/2020	1,440	103,135,605	31,633
9/8/2020	1,440	103,056,090	30,461
9/9/2020	1,440	103,082,865	29,456
9/10/2020	1,365	94,172,730	23,578
9/11/2020	1,440	103,354,605	29,700
9/12/2020	1,440	103,291,575	29,678
9/13/2020	1,440	102,967,080	28,432
9/14/2020	1,440	102,444,960	30,544
9/15/2020	1,440	103,030,200	31,316
9/16/2020	1,440	103,031,385	31,999
9/17/2020	1,440	102,152,160	30,301
9/18/2020	1,440	102,314,970	29,218
9/19/2020	1,440	103,113,855	31,022
9/20/2020	1,440	103,033,950	30,782
9/21/2020	1,440	103,056,795	30,117
9/22/2020	1,440	103,061,190	31,020

Table H-2 Startup Run total daily flows and loads from the Front River and Back River diffusers

Date	Plant Time on (min)	Front River		Back River	
		Flow (gallons/day)	Oxygen Load (pounds/day)	Flow (gallons/day)	Oxygen Load (pounds/day)
7/25/2020	1,440	28,993,200	9,374	14,496,660	4,687
7/26/2020	1,440	29,011,815	10,190	14,505,900	5,095
7/27/2020	1,440	28,995,480	9,972	14,497,770	4,986
7/28/2020	1,440	28,977,165	10,048	14,488,620	5,024
7/29/2020	1,440	29,003,715	10,037	14,501,910	5,019
7/30/2020	1,440	29,007,465	10,007	14,503,635	5,003
7/31/2020	1,440	28,420,875	9,060	14,210,385	4,530
8/1/2020	1,440	28,983,690	8,903	14,491,875	4,451
8/2/2020	1,440	28,999,590	8,656	14,499,810	4,328
8/3/2020	1,440	28,981,065	8,569	14,490,480	4,284
8/4/2020	1,440	28,993,335	8,731	14,496,630	4,365
8/5/2020	1,440	28,978,770	8,882	14,489,310	4,441
8/6/2020	1,440	28,975,305	9,399	14,487,765	4,699
8/7/2020	1,440	28,998,375	9,102	14,499,285	4,551
8/8/2020	1,440	28,982,865	7,526	14,491,410	3,763
8/9/2020	1,275	23,870,415	7,384	11,931,510	3,692
8/10/2020	1,440	28,981,275	9,369	14,490,615	4,684
8/11/2020	1,425	28,107,135	8,809	14,053,635	4,404
8/12/2020	1,440	28,999,860	9,111	14,500,020	4,555
8/13/2020	1,425	28,695,525	9,366	14,347,755	4,683
8/14/2020	1,365	26,870,835	8,505	13,435,485	4,253
8/15/2020	1,440	29,010,720	9,266	14,505,345	4,633
8/16/2020	1,440	29,011,650	9,110	14,505,855	4,555
8/17/2020	1,440	29,014,845	8,710	14,507,460	4,355
8/18/2020	1,440	28,994,835	8,654	14,497,395	4,327
8/19/2020	1,440	29,007,015	9,338	14,503,530	4,669
8/20/2020	1,440	29,017,575	9,536	14,508,750	4,768
8/21/2020	1,440	28,986,615	9,315	14,493,225	4,658
8/22/2020	1,440	29,008,095	9,689	14,504,055	4,845
8/23/2020	1,440	23,698,080	7,884	11,849,010	3,942
8/24/2020	1,425	25,616,865	6,164	12,808,500	3,082
8/25/2020	1,440	28,975,890	6,254	14,487,915	3,127

Date	Plant Time on (min)	Front River		Back River	
		Flow (gallons/day)	Oxygen Load (pounds/day)	Flow (gallons/day)	Oxygen Load (pounds/day)
8/26/2020	1,440	28,973,115	6,010	14,486,520	3,005
8/27/2020	1,440	29,013,675	6,780	14,506,815	3,390
8/28/2020	1,440	29,009,415	9,810	14,504,655	4,905
8/29/2020	1,440	28,992,825	9,930	14,496,390	4,965
8/30/2020	1,440	28,995,510	10,175	14,497,725	5,088
8/31/2020	1,440	28,943,490	10,125	14,471,775	5,062
9/1/2020	1,440	29,059,020	10,241	14,529,465	5,120
9/2/2020	1,440	28,988,355	10,640	14,494,200	5,320
9/3/2020	1,440	29,014,905	10,694	14,507,430	5,347
9/4/2020	1,215	24,236,400	8,928	12,118,170	4,464
9/5/2020	825	16,401,990	5,956	8,201,025	2,978
9/6/2020	1,440	28,984,980	10,387	14,492,565	5,194
9/7/2020	1,440	28,987,365	10,204	14,493,735	5,102
9/8/2020	1,440	28,811,670	9,897	14,405,760	4,948
9/9/2020	1,425	28,290,690	9,143	14,145,345	4,572
9/10/2020	1,440	28,875,225	9,538	14,437,650	4,769
9/11/2020	1,440	28,995,030	9,296	14,497,515	4,648
9/12/2020	1,440	28,982,325	9,999	14,491,140	5,000
9/13/2020	1,440	28,996,395	10,141	14,498,130	5,070
9/14/2020	1,440	29,027,400	9,860	14,513,700	4,930
9/15/2020	1,440	28,966,140	9,759	14,483,010	4,879
9/16/2020	1,440	28,810,665	9,224	14,405,340	4,612
9/17/2020	1,110	22,077,675	6,921	11,038,845	3,461
9/18/2020	1,440	29,008,275	9,801	14,504,100	4,900
9/19/2020	1,440	28,992,810	8,057	14,496,495	4,029
9/20/2020	1,440	28,988,115	7,412	14,494,020	3,706
9/21/2020	1,440	28,977,225	9,540	14,488,650	4,770
9/22/2020	1,440	28,954,950	9,570	14,477,535	4,785

H.2 SHEP START UP RUN –PLANT DATA QA/QC –TECHNICAL MEMORANDUM

Technical Memorandum

Final Issue

04 November 2020

To:	Hope Moorer (GPA), Bryan Robinson (USACE), Spencer Davis (USACE)	Ref. No.:	11189380
From:	Tom Gillespie (GHD)	Tel:	225-236-6959
cc:	Steven Davie (GHD), Jason Curole (GHD), Hugo Rodriguez (GHD), Lon Lyford (USACE), Craig Clarke (USACE)		
Subject:	**SHEP Start Up Run – Plant Data QA/QC – Technical Memorandum**		

1. Background

An independent QA/QC review of the 2019 Test Run was needed to ensure the requirements of the Settlement Agreement were correctly adhered to; specifically, injecting an average of at least 12,000 lb/day of oxygen from the Down River plant over a continuous 59-day period. The 2020 Start-Up Run has an associated goal of 40,000 lb/day over a continuous 59-day period (28,000 Up River and 12,000 Down River). Given the importance of the Start-Up Run to overall SHEP success, a similar independent QA/QC review was required to ensure this goal is achieved.

The three main factors that influence the oxygen injection load are:

1. water flows though the plant,
2. oxygen levels in the water, prior to and after oxygen injection, and
3. the transfer efficiency of the effluent flow into the receiving waters.

GHD undertook a QA/QC review on the first two items for the 2019 Test Run. The third item was reviewed by LG2 Environmental Solutions, Inc. (LG2ES).

For continuity and to maintain independence, GHD was again tasked with undertaking the flow and oxygen load QA/QC review for the 2020 Start-Up Run.

2. Approach

The QA/QC approach for the 2019 Test Run was a manual process in that all works were completed using Microsoft Excel and there was no coding or in-built logic. In addition, there were some challenges associated with the raw oxygen and flow data. Confidence in the raw data for the 2020 Start-Up Run increased significantly due to the new dissolved oxygen (DO) sensors which are more appropriate for the oxygen-rich

effluent, as well as plant calibration and operational improvements (further details on these will be available in a report documenting Start-Up Run improvement works, to be furnished by GHD in late 2020). Coupling the raw data improvement with GHD's added experience and knowledge of the oxygen injection plants derived from another 15 months of involvement, there was an opportunity to automate the QA/QC process for the 2020 Start-Up Run. This process can be re-applied by USACE operational staff into perpetuity, following annual plant operations.

GHD have prepared an 'oxygen injection plant QA/QC script' using the modeling program R. The program's strengths lie in its ability to handle and process large quantities of data in rapid time. In addition, users of a prepared R script do not require experience with coding. Consequently, USACE staff will not be limited in their ability to use the script for 2021 operations and beyond.

3. QA/QC Process

Please refer to Appendix A for a detailed description on the logic imposed by the R script on the raw plant data.

3.1 Manual Corrections

There are unique occasions when manual modifications are needed to correct the raw plant data, in addition to subjecting the raw data to the automated QA/QC process. During the Start-Up Run, there was one such occurrence at the Down River plant. On 30 July 2020, USACE operational staff were investigating why the DO readings were noticeably lower for speece cone 3 relative to the others. After looking at a number of possible causes, the error was determined. The transmitter for the DO sensor had an incorrect setting which was reducing the reported DO by 25%. The setting was corrected at 3:00pm. Review of the other three cones and their associated transmitters confirmed the incorrect setting had only been applied to speece cone 3.

Accordingly, the raw DO data was retrospectively and manually adjusted for speece cone 3 from the beginning of plant operations on July 13 through to July 30 at 3:00pm. Because this change was a one-off manual correction, it is not documented in Appendix A.

3.2 Changes from 2019 QA/QC Format

The primary QA/QC data file was prepared to replicate the format of the corresponding file prepared for the 2019 Test Run (dated 24 May 2019). However, some minor improvements have been made to the format to allow for better interpretation. These include:

- Reporting oxygen load in "lb" instead of "lb/day." Given the data is reported in 15-minute intervals, it makes more sense to report the data for the load generated in that interval, rather than reporting an equivalent daily amount per interval.
- Given the change above, one column with total net oxygen load in lb/day has been added to allow direct comparison with Test Run data. There are 96 15-minute intervals per day, so to transform the load per 15-minute interval into a daily equivalent, multiply the reported interval load by 96.

4. Outputs

The automated script produces the following outputs:

- Results (.csv file)
    - Final QA/QC dataset in naming format “O2_calcs_YYYY-MM-DD_XX.csv” where XX represents which plant, Down River or Up River. This contains all pertinent data for plant flow and oxygen load in 15 minute intervals.
    - Final QA/QC dataset titled “Daily_totals.csv” which contains the total injected oxygen per day, measured in pounds.
    - Supplemental data detailing any modifications made to the raw data by the QA/QC script. That is, individual time steps for certain columns where the raw data was found to be needing correction.
- Plots (.pdf file)
    - Plots of all columns in the final QA/QC dataset for the duration of the data record. Both columns are plotted twice, once with the full dataset and another with the bottom 5% of values filtered out, to allow better interpretation of data.
- QA/QC processing report in .html file. These reports for both plants have been provided in Appendix A.

Appendix A – QA/QC processing report

Savannah Harbor Expansion Project - Down River Plant Quality Control Processing

Jason P. Curole

11/4/2020

This documentation serves as a record of the quality control review of the raw data produced by the Up River (UR) and Down River (DR) O_2 injection plants and documents the equations used to calculate total dissolved oxygen load for the Savannah Harbor Expansion Project. This document is automatically produced during execution of the quality control processing script for each plant's data.

1 Constants and set-up

The following constants are set for the quality control processing:

- Time Zone: US/Eastern
- Time Interval: 15 minutes.

2 Data Review and Quality Control

Prior to calculating O_2 load for each cone and for the plant, the 60-second interval raw data are reviewed and values that exceed quality control parameters are adjusted.

2.1 Raw data

Identify the number of speece cones in the data set and use this to determine which plant's data is being processed.

The following speece cones were found: 1, 2, 3, 4, indicating that this is the DR plant.

2.2 Flow adjustment

Each speece cone is designed to handle a flow of 10,070 gpm. There is potential for this flow to vary above and below this design value, however, any flow in excess of 11,500 gpm is deemed to be erroneous. For any individual time step where an exceedance is contained within the raw data, the flow is corrected to the upper limiting value of 11,500 gpm.

2.3 Raw water adjustment

Infrequently raw water values exceed those expected from an analysis of the historical record of nearby USGS gages. For the purposes of this analysis any raw water value above 10 mg/L is replaced with a value estimated by linear interpolation of adjacent values. Additionally, any raw water values less than 0 are set to NULL.

The table below shows the dates and total minutes of values replaced with interpolation. If a continuous time period in excess of 30 minutes is replaced, it is recommended that a manual review be conducted by the user via comparison to the nearest USGS gage (DR at 021989715, Garden City; UR at 02198840, I-95).

- https://waterdata.usgs.gov/ga/nwis/uv/?site_no=021989715&PARAmeter_cd=00400,00095,00010 (https://waterdata.usgs.gov/ga/nwis/uv/?site_no=021989715&PARAmeter_cd=00400,00095,00010)
- https://waterdata.usgs.gov/ga/nwis/uv/?site_no=02198840&PARAmeter_cd=00400,00095,00010 (https://waterdata.usgs.gov/ga/nwis/uv/?site_no=02198840&PARAmeter_cd=00400,00095,00010)

The original raw water values can be found in the file Results/Supplemental/RW_exceedences_2020-11-05.csv.

Dates and total minutes of raw water dissolved oxygen values that have been replaced by interpolation.

Date	Minutes
2020-07-13	1
2020-07-24	2
2020-08-09	1
2020-09-17	1

2.4 Inactive Speece Cone

Each speece cone in the plant is assigned a position, which is documented in the SPEECE_X_POSITION column of the data. In the DR plant the speece cone in position 4 is inactive. All data for the inactive cone is set to a NULL value. In addition, position 0 is a maintenance position and all data for any cone in this position is set to NULL. A record of inactive speece cones is provided in the file Results/Supplemental/Inactive_speece_cones_2020-11-05.csv.

2.5 Dissolved oxygen exceedance values

Infrequently, the dissolved oxygen measurement at the speece cone will either show an error value (>77) or a value that exceeds a theoretical maximum. These values are identified and adjusted using the following approach.

The dissolved oxygen exceedance threshold is set at:

- Dissolved Oxygen Exceedance Threshold: 55 mg/L

2.5.1 Exceedance adjustment

Any value exceeding the Dissolved Oxygen Exceedance Threshold is replaced with the following mass balance estimate. This is done on a cone specific basis.

Given the following:

- OXYGEN_FLOW w^f is in $\frac{lbs}{day}$ and is unique to each cone c. This is the quanity of gas supplied from the oxygen generators for each cone.
- WATER_FLOW_ACTUAL f is in $\frac{gal}{min}$ and is unique to each cone c. This is the flow through each cone.
- RAW_WATER_DISSOLVED_OXYGEN o^{rw} is in $\frac{mg}{L}$ and is the same for all cones. This is the measured dissolved O_2 in the water prior to oxygen injection.

2.5.1.1 The retention time in seconds r_y for a given cycle y assuming a maximum speece cone capacity of 5700 gallons is:

$$r_y = \frac{5700gal}{f_c \frac{gal}{min}} \times 60 \frac{sec}{min}$$

2.5.1.2 The volume per cycle in liters v_y is then calculated as:

$$v_y = 3.78541 \frac{L}{gal} \times \frac{f \frac{gal}{min}}{r_y \, s} \times 60 \frac{s}{min}$$

2.5.1.3 Cycles per day y_d is calculated as:

$$y_d = 24 \frac{hr}{day} \times 60 \frac{min}{hr} \times \frac{60 \frac{s}{min}}{r_y \, s}$$

2.5.1.4 Milligrams O_2 injected w_y for a given cycle y is then calculated as:

$$w_y = 453592 \frac{mg}{lb} \times \frac{w_y^f \frac{lbs}{day}}{y_d}$$

2.5.1.5 The estimated total milligrams per liter O_2 w_{calc} for each cycle y is then equal to:

$$o_y^{calc} = e^f \times \frac{w_y \, mg}{v_y \, L} + o_y^{rw} \frac{mg}{L}$$

Where e_f is an efficiency adjustment due to losses in the system attributable to oxygen purity, cone efficiency, and other losses. This factor is based on a linear regression analysis of observed data and the associated theoretical maximum for all values less than 55 mg/L. For the Up River plant, $e_f = 0.82$, and for the Down River plant $e_f = 0.85$.

Values adjusted for each speece cone x are recorded in csv files in the Supplemental results folder with the name “SPEECEX_EXCEEDENCE_ADJUSTMENTS.”

2.6 Filter to 15 minute intervals

The ~60 second data are now filtered to 15 minute intervals. This is done as follows:

1. Establish 15 minute bins (e.g. 00:00:00, 00:15:00, 00:30:00).
2. Assign data to a bin based on the actual time stamp.
3. Choose the observation from the 60 second data set closest to the bin boundary as the 15 minute observation.

3 Calculation of Gross and Net O_2 load

Given the following:

- WATER_FLOW_ACTUAL f is in $\frac{gal}{min}$ and is unique to each cone c. This is the flow of water through each cone.
- DISSOLVED_O2 o^d is in $\frac{mg}{L}$ or ppm and is unique to each cone c. This is the measured dissolved oxygen in the water after oxygen injection for each cone.

- RAW_WATER_DISSOLVED_OXYGEN o^{rw} is in $\frac{mg}{L}$ and is the same for all cones. This is the measured dissolved oxygen in the water prior to oxygen injection.

3.1 Raw Water Load per cycle

The raw water O_2 load in lbs, w_y^{rw} per 15 minute cycle y is equal to:

$$w_{c,y}^{rw} = o_y^{rw}\frac{mg}{L} \times q\frac{\frac{lbs}{gal}}{\frac{mg}{L}} \times f_{c,y}\frac{gal}{min} \times t_y\, min$$

where q is a unit conversion factor, $f_{c,y}$ is the flow for cone c during cycle y, and t_y is the time interval for cycle y.

3.2 Gross O_2 load per cycle

The gross O_2 load in lbs, $w_{c,y}^{g}$, for cone c per 15 minute cycle y is equal to:

$$w_{c,y}^{g} = o_{c,y}^{d}\frac{mg}{L} \times q\frac{\frac{lbs}{gal}}{\frac{mg}{L}} \times f_{c,y}\frac{gal}{min} \times t_y\, min$$

where q is a unit conversion factor, $o_{c,y}^{d}$ is the dissolved oxygen concentration measured at cone c during cycle y, and t_y is the time interval for cycle y.

3.3 Net O_2 load per cycle

Finally, the net O_2 load in lbs, $w_{c,y}^{n}$, for cone c during 15 minute cycle y is equal to:

$$w_{c,y}^{n} = w_{c,y}^{g} - w_{c,y}^{rw}$$

3.4 Total DO Gross Load Out

The **Total DO Gross Load Out** w_y^g for all cones per cycle y is:

$$w_y^g = \sum_{c=1}^{no.ofcones} w_{c,y}^g$$

3.5 Total DO Net Load Out

The **Total DO Net Load Out** w_y^n for all cones per cycle y is:

$$w_y^n = \sum_{c=1}^{no.ofcones} w_{c,y}^n$$

3.6 Total DO Raw Water Load Out

The **Total DO RW Load Out** w_y^{rw} for all cones per cycle y is:

$$w_y^n = \sum_{c=1}^{no.ofcones} w_{c,y}^{rw}$$

3.7 Total Water Flow

The **Total Water Flow** f_y for all cones per cycle y is:

$$f_y = \sum_{c=1}^{no.ofcones} f_{c,y}$$

3.8 Total DO Net Load Out - Daily Equivalent

To allow for direct comparison with the QA dataset from the 2019 Test Run, an additional column has been added. This column shows the total DO net load out from the plant in a daily equivalent value, for every 15 minute interval.

The **Total DO Net Load Out - Daily Equivlent** w_y^d for all cones per cycle y is:

$$w_y^d = w_y^n \times N^d$$

where N^d is the number of cycles per day d and is equal to:

$$N^d = \frac{24\frac{hours}{day} \times 60\frac{mins}{hour}}{t_y mins/cycle}$$

For this analysis, $N^d = 96$.

3.9 Down River split

Note – not applied to UR plant given only one discharge location.

The DR plant splits flow between the front and back rivers. Flow is calculated via differential pressure at the front river, back river and on each of the four cones. The front river pipe has a greater diameter than that of the cones and the back river, inducing greater error potential with flow calculation on the front river. As a result, the front river flow is determined as the difference of the sum of the flow through all active cones and the back river flow.

Thus, flow for the Back River and Front River is calculated as follows.

Assume the following:

- BACK_RIVER_FLOW_GPM f_y^b is in $\frac{gal}{min}$.
- Total water flow f_y is calculated as above.
- Front River Flow f_y^f is calculated as below.

In addition, there may be unique periods where back river flow needs to be adjusted, such as:

- In the event of a plant shutdown or cone transfer, given the pressure-calculated flow to the back river has not yet responded to the change and exceeds the total water flow.
- Back River flow is in excess of 11,500 gpm

For these rare events, Back River Flow is calculated as below.

$$if(f_y > f_y^b) \begin{bmatrix} f_y^b = f_y^b \\ f_y^f = f_y - f_y^b \end{bmatrix}$$

$$if(f_y = 0) \begin{bmatrix} f_y^f = NULL \\ f_y^b = NULL \end{bmatrix}$$

$$if(f_y < f_y^b) \begin{bmatrix} f_y^f = \frac{1}{3} f_y \\ f_y^b = \frac{2}{3} f_y \end{bmatrix}$$

Flow values set to NULL are recorded in the file “Supplemental/Total_WF_0.csv.” Flow values adjusted to a $\frac{1}{3} : \frac{2}{3}$ split are recorded in “Supplemental/Flow_2_FR_o.csv.”

4 Final Data Set

For the final data set, all values have been reduced to a specific number of decimal places:

- 0 decimal places for flow (gpm)
- 2 decimal places for O_2 concentration (mg/L)
- 2 decimal places for load (lbs)

The final data set is output to the file Results/O2_calcs_2020-11-05_DR.csv for review.

5 Plots

Quality control time-series plots are produced for each variable in the final data set and output to Plots/Final_QC_plots DR .pdf. Two plots are created for each variable:

- The first plot (titled “All Values”) is all observations at that particular variable
- The second plot (titled “Bottom 5% of Observations Filtered”) filters out the bottom 5% of observations to allow for expanding the y-axis.

6 Daily Net Total

Finally, produce a table with the daily sums for Net DO Load. This table is output to Results/Daily_totals.csv.

Savannah Harbor Expansion Project - Up River Plant Quality Control Processing

Jason P. Curole

11/4/2020

This documentation serves as a record of the quality control review of the raw data produced by the Up River (UR) and Down River (DR) O_2 injection plants and documents the equations used to calculate total dissolved oxygen load for the Savannah Harbor Expansion Project. This document is automatically produced during execution of the quality control processing script for each plant's data.

1 Constants and set-up

The following constants are set for the quality control processing:

- Time Zone: US/Eastern
- Time Interval: 15 minutes.

2 Data Review and Quality Control

Prior to calculating O_2 load for each cone and for the plant, the 60-second interval raw data are reviewed and values that exceed quality control parameters are adjusted.

2.1 Raw data

Identify the number of speece cones in the data set and use this to determine which plant's data is being processed.

The following speece cones were found: 1, 2, 3, 4, 5, 6, 7, 8, indicating that this is the UR plant.

2.2 Flow adjustment

Each speece cone is designed to handle a flow of 10,070 gpm. There is potential for this flow to vary above and below this design value, however, any flow in excess of 11,500 gpm is deemed to be erroneous. For any individual time step where an exceedance is contained within the raw data, the flow is corrected to the upper limiting value of 11,500 gpm.

2.3 Raw water adjustment

Infrequently raw water values exceed those expected from an analysis of the historical record of nearby USGS gages. For the purposes of this analysis any raw water value above 10 mg/L is replaced with a value estimated by linear interpolation of adjacent values. Additionally, any raw water values less than 0 are set to NULL.

The table below shows the dates and total minutes of values replaced with interpolation. If a continuous time period in excess of 30 minutes is replaced, it is recommended that a manual review be conducted by the user via comparison to the nearest USGS gage (DR at 021989715, Garden City; UR at 02198840, I-95).

- https://waterdata.usgs.gov/ga/nwis/uv/?site_no=021989715&PARAmeter_cd=00400,00095,00010 (https://waterdata.usgs.gov/ga/nwis/uv/?site_no=021989715&PARAmeter_cd=00400,00095,00010)
- https://waterdata.usgs.gov/ga/nwis/uv/?site_no=02198840&PARAmeter_cd=00400,00095,00010 (https://waterdata.usgs.gov/ga/nwis/uv/?site_no=02198840&PARAmeter_cd=00400,00095,00010)

The original raw water values can be found in the file Results/Supplemental/RW_exceedences_2020-11-05.csv.

Dates and total minutes of raw water dissolved oxygen values that have been replaced by interpolation.

Date	Minutes
2020-07-28	4
2020-08-20	5
2020-08-30	7
2020-09-10	10
2020-09-14	8

2.4 Inactive Speece Cone

Each speece cone in the plant is assigned a position, which is documented in the SPEECE_X_POSITION column of the data. In the UR plant the speece cone in position 8 is inactive. All data for the inactive cone is set to a NULL value. In addition, position 0 is a maintenance position and all data for any cone in this position is set to NULL. A record of inactive speece cones is provided in the file Results/Supplemental/Inactive_speece_cones_2020-11-05.csv.

2.5 Dissolved oxygen exceedance values

Infrequently, the dissolved oxygen measurement at the speece cone will either show an error value (>77) or a value that exceeds a theoretical maximum. These values are identified and adjusted using the following approach.

The dissolved oxygen exceedance threshold is set at:

- Dissolved Oxygen Exceedance Threshold: 55 mg/L

2.5.1 Exceedance adjustment

Any value exceeding the Dissolved Oxygen Exceedance Threshold is replaced with the following mass balance estimate. This is done on a cone specific basis.

Given the following:

- OXYGEN_FLOW w^f is in $\frac{lbs}{day}$ and is unique to each cone c. This is the quanity of gas supplied from the oxygen generators for each cone.
- WATER_FLOW_ACTUAL f is in $\frac{gal}{min}$ and is unique to each cone c. This is the flow through each cone.

- RAW_WATER_DISSOLVED_OXYGEN o^{rw} is in $\frac{mg}{L}$ and is the same for all cones. This is the measured dissolved O_2 in the water prior to oxygen injection.

2.5.1.1 The retention time in seconds r_y for a given cycle y assuming a maximum speece cone capacity of 5700 gallons is:

$$r_y = \frac{5700gal}{f_c \frac{gal}{min}} \times 60\frac{sec}{min}$$

2.5.1.2 The volume per cycle in liters v_y is then calculated as:

$$v_y = 3.78541\frac{L}{gal} \times \frac{f\frac{gal}{min}}{r_y\, s} \times 60\frac{s}{min}$$

2.5.1.3 Cycles per day y_d is calculated as:

$$y_d = 24\frac{hr}{day} \times 60\frac{min}{hr} \times \frac{60\frac{s}{min}}{r_y\, s}$$

2.5.1.4 Milligrams O_2 injected w_y for a given cycle y is then calculated as:

$$w_y = 453592\frac{mg}{lb} \times \frac{w_y^f \frac{lbs}{day}}{y_d}$$

2.5.1.5 The estimated total milligrams per liter O_2 w_{calc} for each cycle y is then equal to:

$$o_y^{calc} = e^f \times \frac{w_y\, mg}{v_y\, L} + o_y^{rw}\frac{mg}{L}$$

Where e_f is an efficiency adjustment due to losses in the system attributable to oxygen purity, cone efficiency, and other losses. This factor is based on a linear regression analysis of observed data and the associated theoretical maximum for all values less than 55 mg/L. For the Up River plant, $e_f = 0.82$, and for the Down River plant $e_f = 0.85$.

Values adjusted for each speece cone x are recorded in csv files in the Supplemental results folder with the name “SPEECEX_EXCEEDENCE_ADJUSTMENTS.”

2.6 Filter to 15 minute intervals

The ~60 second data are now filtered to 15 minute intervals. This is done as follows:

1. Establish 15 minute bins (e.g. 00:00:00, 00:15:00, 00:30:00).
2. Assign data to a bin based on the actual time stamp.
3. Choose the observation from the 60 second data set closest to the bin boundary as the 15 minute observation.

3 Calculation of Gross and Net O_2 load

Given the following:

- WATER_FLOW_ACTUAL f is in $\frac{gal}{min}$ and is unique to each cone c. This is the flow of water through each cone.

- DISSOLVED_O2 o^d is in $\frac{mg}{L}$ or ppm and is unique to each cone c. This is the measured dissolved oxygen in the water after oxygen injection for each cone.
- RAW_WATER_DISSOLVED_OXYGEN o^{rw} is in $\frac{mg}{L}$ and is the same for all cones. This is the measured dissolved oxygen in the water prior to oxygen injection.

3.1 Raw Water Load per cycle

The raw water O_2 load in lbs, w_y^{rw} per 15 minute cycle y is equal to:

$$w_{c,y}^{rw} = o_y^{rw}\frac{mg}{L} \times q\frac{\frac{lbs}{gal}}{\frac{mg}{L}} \times f_{c,y}\frac{gal}{min} \times t_y\, min$$

where q is a unit conversion factor, $f_{c,y}$ is the flow for cone c during cycle y, and t_y is the time interval for cycle y.

3.2 Gross O_2 load per cycle

The gross O_2 load in lbs, $w_{c,y}^{g}$, for cone c per 15 minute cycle y is equal to:

$$w_{c,y}^{g} = o_{c,y}^{d}\frac{mg}{L} \times q\frac{\frac{lbs}{gal}}{\frac{mg}{L}} \times f_{c,y}\frac{gal}{min} \times t_y\, min$$

where q is a unit conversion factor, $o_{c,y}^{d}$ is the dissolved oxygen concentration measured at cone c during cycle y, and t_y is the time interval for cycle y.

3.3 Net O_2 load per cycle

Finally, the net O_2 load in lbs, $w_{c,y}^{n}$, for cone c during 15 minute cycle y is equal to:

$$w_{c,y}^{n} = w_{c,y}^{g} - w_{c,y}^{rw}$$

3.4 Total DO Gross Load Out

The **Total DO Gross Load Out** w_y^g for all cones per cycle y is:

$$w_y^g = \sum_{c=1}^{no.ofcones} w_{c,y}^g$$

3.5 Total DO Net Load Out

The **Total DO Net Load Out** w_y^n for all cones per cycle y is:

$$w_y^n = \sum_{c=1}^{no.ofcones} w_{c,y}^n$$

3.6 Total DO Raw Water Load Out

The **Total DO RW Load Out** w_y^{rw} for all cones per cycle y is:

$$w_y^n = \sum_{c=1}^{no.ofcones} w_{c,y}^{rw}$$

3.7 Total Water Flow

The **Total Water Flow** f_y for all cones per cycle y is:

$$f_y = \sum_{c=1}^{no.ofcones} f_{c,y}$$

3.8 Total DO Net Load Out - Daily Equivalent

To allow for direct comparison with the QA dataset from the 2019 Test Run, an additional column has been added. This column shows the total DO net load out from the plant in a daily equivalent value, for every 15 minute interval.

The **Total DO Net Load Out - Daily Equivlent** w_y^d for all cones per cycle y is:

$$w_y^d = w_y^n \times N^d$$

where N^d is the number of cycles per day d and is equal to:

$$N^d = \frac{24\frac{hours}{day} \times 60\frac{mins}{hour}}{t_y mins/cycle}$$

For this analysis, $N^d = 96$.

3.9 Down River split

Note – not applied to UR plant given only one discharge location.

The DR plant splits flow between the front and back rivers. Flow is calculated via differential pressure at the front river, back river and on each of the four cones. The front river pipe has a greater diameter than that of the cones and the back river, inducing greater error potential with flow calculation on the front river. As a result, the front river flow is determined as the difference of the sum of the flow through all active cones and the back river flow.

Thus, flow for the Back River and Front River is calculated as follows.

Assume the following:

- BACK_RIVER_FLOW_GPM f_y^b is in $\frac{gal}{min}$.
- Total water flow f_y is calculated as above.
- Front River Flow f_y^f is calculated as below.

In addition, there may be unique periods where back river flow needs to be adjusted, such as:

- In the event of a plant shutdown or cone transfer, given the pressure-calculated flow to the back river has not yet responded to the change and exceeds the total water flow.
- Back River flow is in excess of 11,500 gpm

For these rare events, Back River Flow is calculated as below.

$$if(f_y > f_y^b) \begin{bmatrix} f_y^b = f_y^b \\ f_y^f = f_y - f_y^b \end{bmatrix}$$

$$if(f_y = 0) \begin{bmatrix} f_y^f = NULL \\ f_y^b = NULL \end{bmatrix}$$

$$if(f_y < f_y^b) \begin{bmatrix} f_y^f = \frac{1}{3} f_y \\ f_y^b = \frac{2}{3} f_y \end{bmatrix}$$

Flow values set to NULL are recorded in the file “Supplemental/Total_WF_0.csv.” Flow values adjusted to a $\frac{1}{3} : \frac{2}{3}$ split are recorded in “Supplemental/Flow_2_FR_o.csv.”

4 Final Data Set

For the final data set, all values have been reduced to a specific number of decimal places:

- 0 decimal places for flow (gpm)
- 2 decimal places for O_2 concentration (mg/L)
- 2 decimal places for load (lbs)

The final data set is output to the file Results/O2_calcs_2020-11-05_UR.csv for review.

5 Plots

Quality control time-series plots are produced for each variable in the final data set and output to Plots/Final_QC_plots UR .pdf. Two plots are created for each variable:

- The first plot (titled “All Values”) is all observations at that particular variable
- The second plot (titled “Bottom 5% of Observations Filtered”) filters out the bottom 5% of observations to allow for expanding the y-axis.

6 Daily Net Total

Finally, produce a table with the daily sums for Net DO Load. This table is output to Results/Daily_totals.csv.

APPENDIX I WATER COLUMN TRANSFER EFFICIENCY

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Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Task: 10
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PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG^2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX I BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document is provided as Appendix I of the SUR Report and is referred to in the main body of the report in Section 6.0.

APPENDIX I TABLE OF CONTENTS

APPENDIX I WATER COLUMN TRANSFER EFFICIENCY I-1

I.1 WCTE Calculation Procedure Updates I-6

I.2 Continuous Site Super-saturated Surface Water Area Calculation I-10

I.3 WCTE Oxygen Transfer Time I-15

I.4 WCTE Oxygen Transfer Area I-21

I.5 WCTE Excess Oxygen Concentration I-27

I.6 WCTE Volumetric Reaeration Coefficient I-33

I.7 WCTE Mass of Oxygen Transfer I-39

I.8 Startup Run WCTE Results I-45

APPENDIX I LIST OF FIGURES

Figure I-1 Front River DO saturation in the intermittent (profile and drift) surface dataset..... I-7
Figure I-2 Front River DO saturation in the continuous (buoy and USGS) surface dataset..... I-7
Figure I-3 Back River DO saturation in the intermittent (profile and drift) surface dataset..... I-8
Figure I-4 Back River DO saturation in the continuous (buoy and USGS) surface dataset..... I-8
Figure I-5 Upriver DO saturation in the intermittent (profile and drift) surface dataset..... I-9
Figure I-6 Upriver DO saturation in the continuous (buoy) surface dataset..... I-9
Figure I-7 Back River continuous site zones..... I-11
Figure I-8 Upriver continuous site zones..... I-12
Figure I-9 Abercorn Creek DO Transfer segment..... I-14

APPENDIX I LIST OF TABLES

Table I-1 Back River daily oxygen transfer time (minutes) by intermittent area and continuous site zone I-15
Table I-2 Upriver daily oxygen transfer time (minutes) by intermittent area and continuous site zone..... I-18
Table I-3 Back River daily oxygen transfer area (square meters) by intermittent area and continuous site zone..... I-21
Table I-4 Upriver daily oxygen transfer area (square meters) by intermittent area and continuous site zoneI-24
Table I-5 Back River daily oxygen transfer excess concentration (mg/L) by intermittent area and continuous site zone..... I-27
Table I-6 Upriver daily oxygen transfer excess concentration (mg/L) by intermittent area and continuous site zone..... I-30
Table I-7 Back River daily oxygen transfer K_a by intermittent area and continuous site zone..... I-33
Table I-8 Upriver daily oxygen transfer K_a by intermittent area and continuous site zone..... I-36
Table I-9 Back River daily oxygen transfer load (pounds) by intermittent area and continuous site zone. I-39
Table I-10 Upriver daily oxygen transfer load (pounds) by intermittent area and continuous site zone..... I-42
Table I-11 Startup Run WCTE results..... I-45

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
DO	dissolved oxygen
K_a	volumetric reaeration coefficient
SHEP	Savannah Harbor Expansion Project
USGS	United States Geological Survey
WASP	Water Quality Analysis Simulation Program
WCTE	Water Column Transfer Efficiency

I.1 WCTE CALCULATION PROCEDURE UPDATES

The water column transfer efficiency (WCTE) calculation estimated the percentage of oxygen delivered by the Speece Cone Systems that remained in the Savannah River and estuary water columns. Ideally, the flow and oxygen discharged by the Upriver and Downriver Plants 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. Therefore, the WCTE calculation was based on two pieces of information: (1) the mass of oxygen injected and (2) the mass of oxygen transferred to the atmosphere.

In this scenario, dissolved oxygen (DO) was available for release, or transfer, to the atmosphere when the DO saturation at the air-water interface was greater than 100 percent. The monitoring data collected during the Startup Run (SUR) 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. A detailed discussion of the methodologies used to calculate WCTE is contained in the Water Column Transfer Efficiency Report (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2020).

The WCTE calculation method identified periods when DO transfer conditions (DO saturation greater than 100 percent in the top 5 feet were present. During these periods, the method calculated: (1) the length of time oxygen could be transferred; (2) the area from which oxygen could be transferred; (3) the amount of oxygen above atmospheric equilibrium (i.e. excess oxygen); and (4) the rate at which oxygen is transferred to the atmosphere (i.e. Interfacial Transfer Coefficient).

For the SUR, the WCTE calculation method was slightly modified to account for the updated data collection procedures following the Test Run. The modifications to the Test Run procedure is discussed in more detail in the sections below, and the calculations and results are provided in Section I.3 through Section I.7.

- Front River: DO Transfer conditions were not observed in the intermittent (profile and drift) and continuous (buoy and USGS) datasets (***Figure I-1***and ***Figure I-2***)
- Back River: DO Transfer conditions were not evident in the intermittent dataset, but were occasionally observed in the continuous dataset but (***Figure I-3*** and ***Figure I-4***).
- Upriver: DO Transfer conditions were occasionally observed in the intermittent dataset and were frequently observed in the continuous dataset (***Figure I-5*** and ***Figure G-6***).

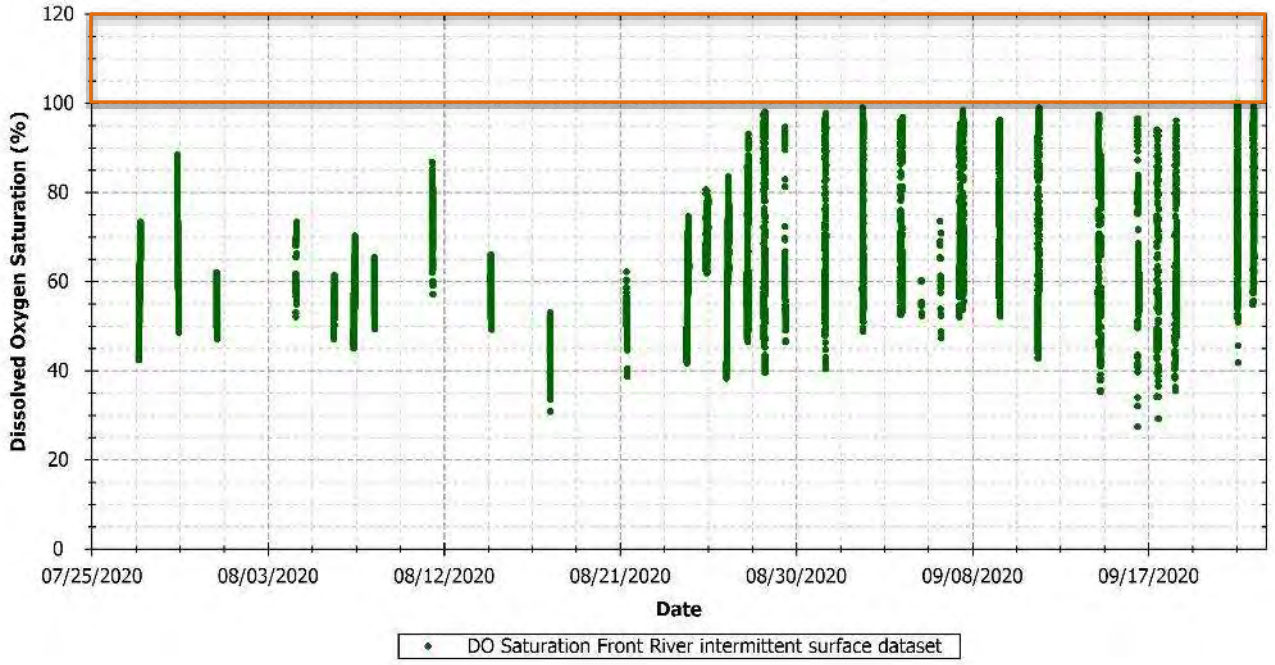

Figure I-1 Front River DO saturation in the intermittent (profile and drift) surface dataset

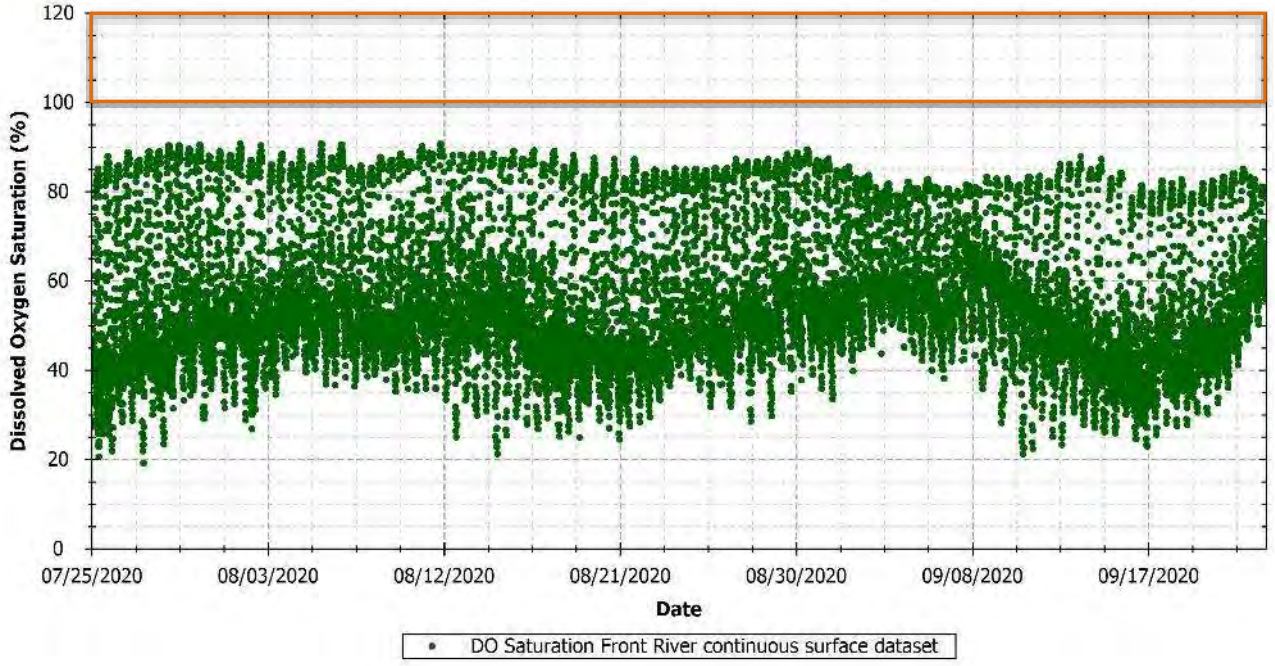

Figure I-2 Front River DO saturation in the continuous (buoy and USGS) surface dataset

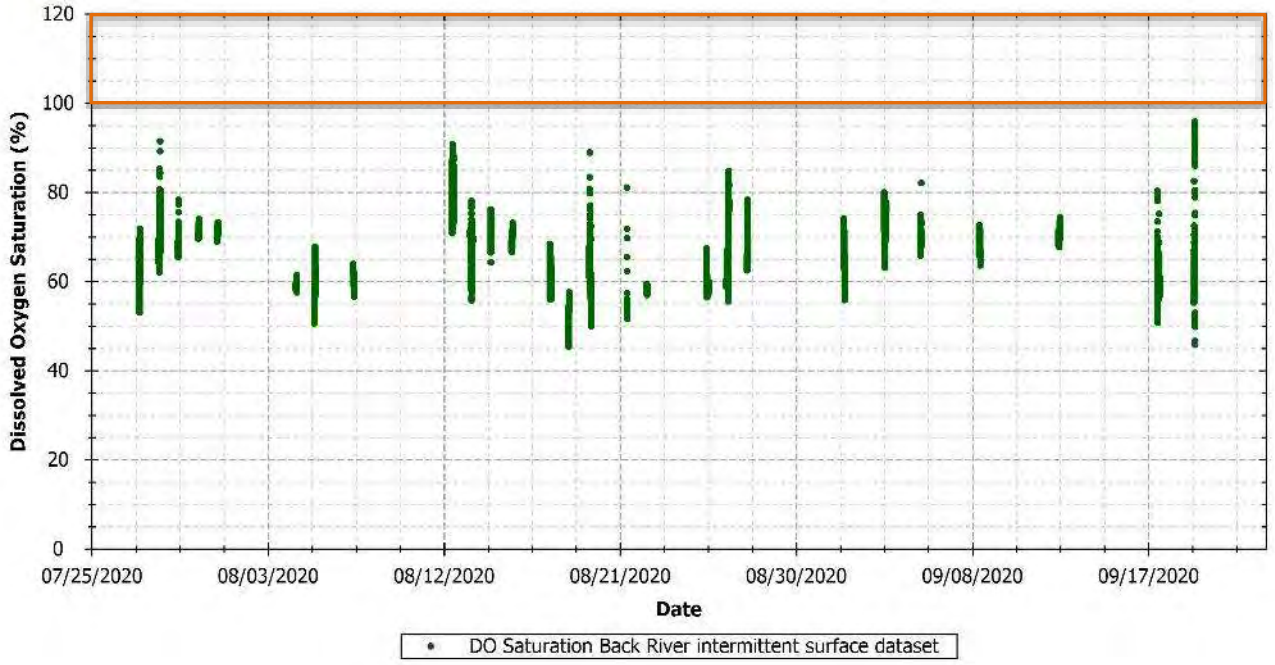

Figure I-3 Back River DO saturation in the intermittent (profile and drift) surface dataset

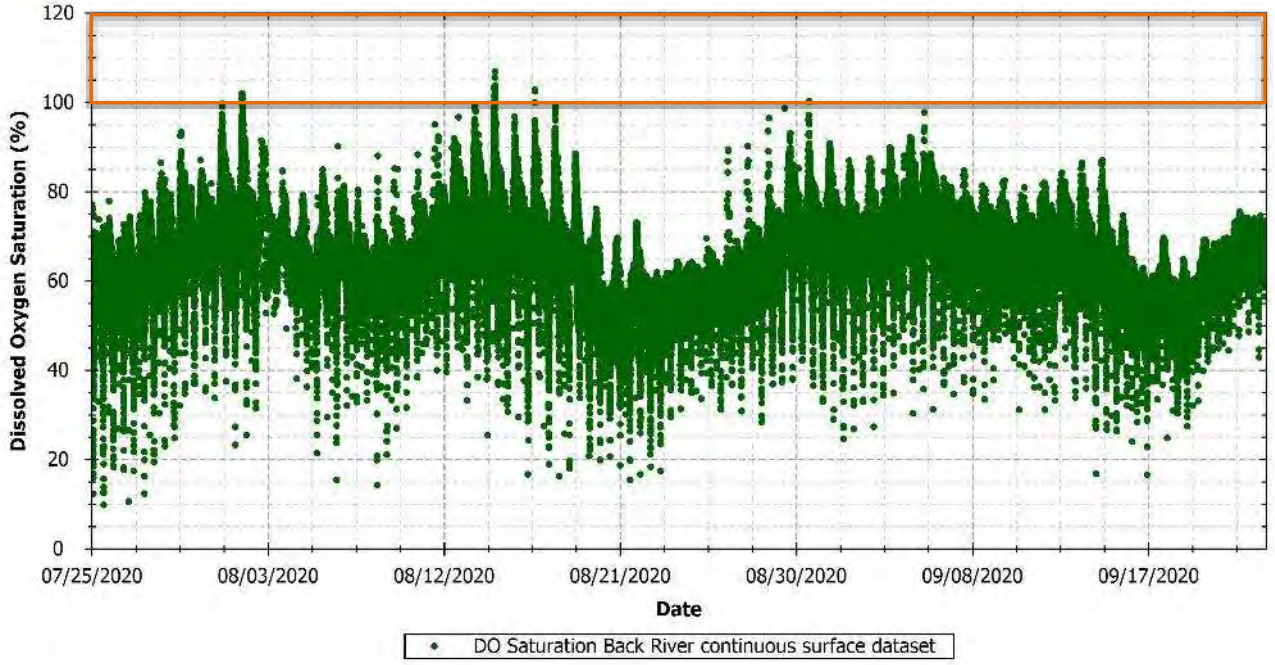

Figure I-4 Back River DO saturation in the continuous (buoy and USGS) surface dataset

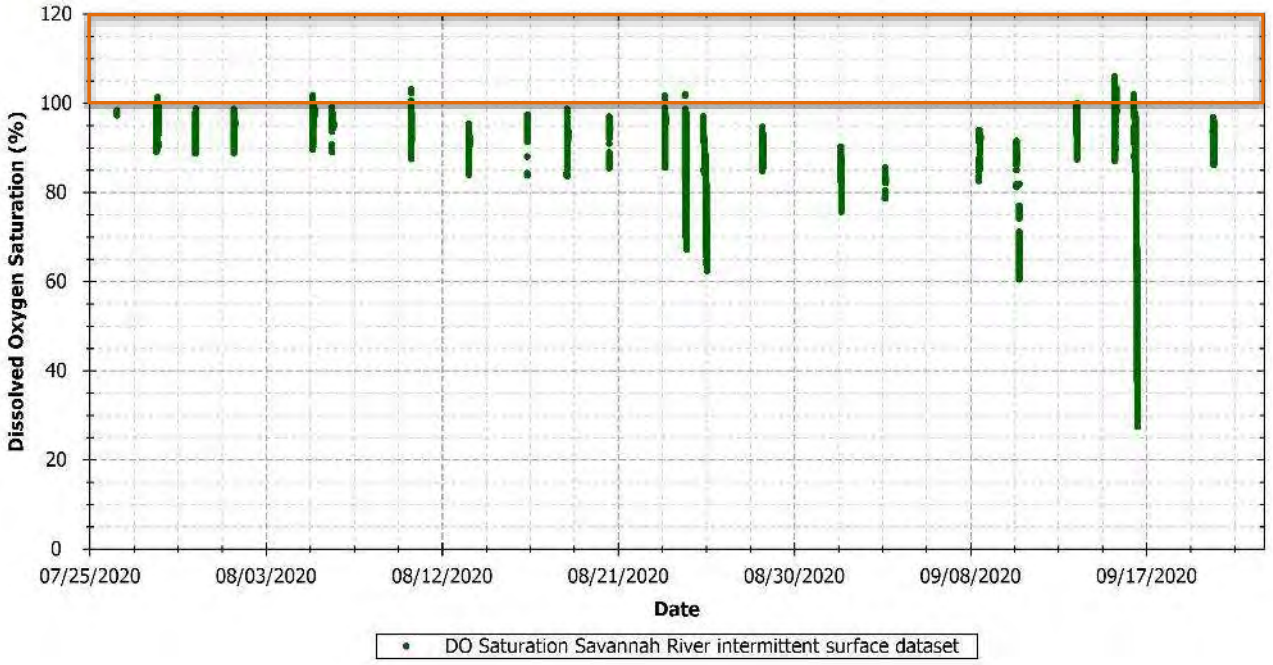

Figure I-5 Upriver DO saturation in the intermittent (profile and drift) surface dataset

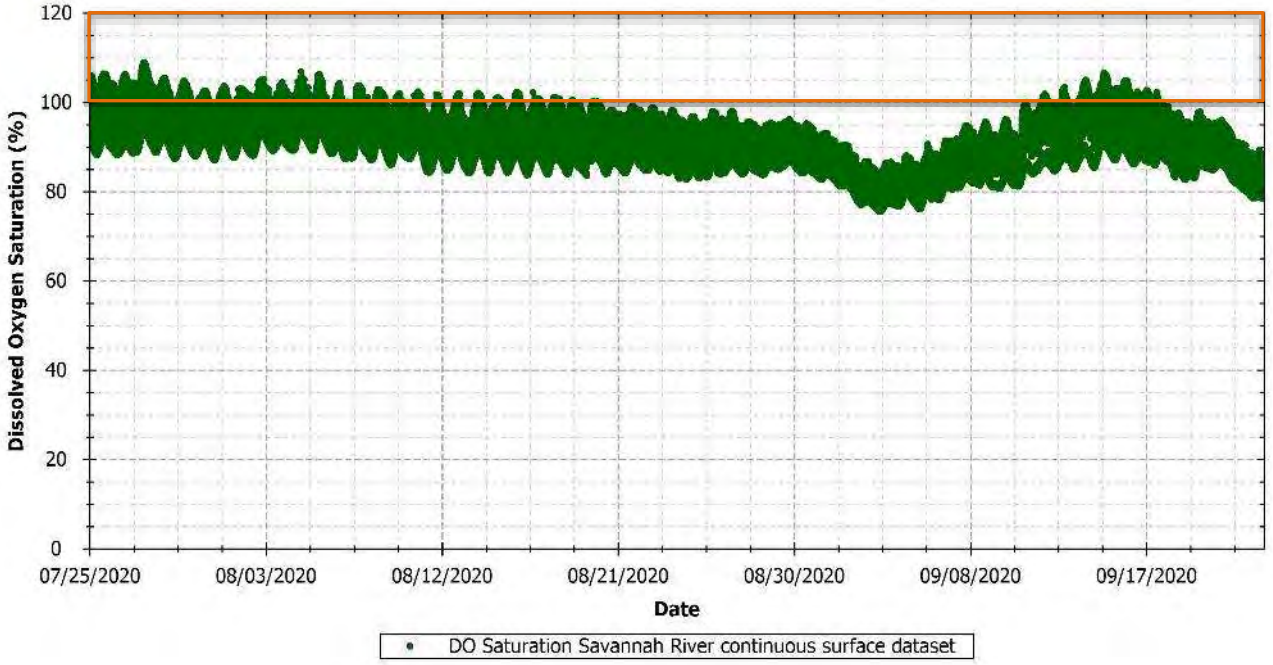

Figure I-6 Upriver DO saturation in the continuous (buoy) surface dataset

I.2 CONTINUOUS SITE SUPER-SATURATED SURFACE WATER AREA CALCULATION

The methodology discussed in the Water Column Transfer Efficiency Report (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2020) states *each continuous site (semi-permanent buoys and USGS gaging stations) represented an individual area of twenty-one (21) square meters which was established by a eight and a half (8.5) foot radius [two and sixth tenths (2.6) meter radius] around each continuous point.* The deployment locations of the SUR semi-permanent buoys allowed for the Back River and Upriver to be segmented into continuous site zones, which better represented expected conditions in the estuary. The upstream and downstream extents of the continuous site zones were established by bisecting the river at the mid-point between each continuous data site location. For the Back River, the lateral extents for each continuous site zone were set to the river banks (***Figure I-7***). For the Upriver, the lateral extents for each continuous site zone were set to the assumed width of the DO injection plume (***Figure I-8***). Computational fluid dynamic modeling conducted during the Test Run and zig-zag drift monitoring data collected during the SUR indicated that the DO injection plume was between the middle of the Savannah River and the south bank near buoys UR_12 and UR_13, and the DO injection plume expanded to a bank-to-bank extent between buoys UR_16 and UR_17. It was assumed that the observed conditions at each continuous site were representative for the zone established around that site.



Figure I-7 Back River continuous site zones



Figure I-8 Upriver continuous site zones

I.2.1 Interfacial Transfer Coefficient Calculation

The methodology discussed in the 2019 Water Column Transfer Efficiency Report states '*daily volumetric reaeration coefficient (K_a) values were determined by averaging the 2019 Savannah Harbor Expansion Project (SHEP) Water Quality Analysis Simulation Program (WASP) model daily K_a output for the model cells located around the diffusers'.* With the update to the continuous site zones, one value for each day and section of the river was no longer applicable. For the 2020 SUR WCTE calculations, volumetric reaeration coefficient K_a values were determined for each intermittent area [the area of DO Transfer derived from the intermittent profile and drift datasets with the method described in (LG2 Environmental Solutions, Inc. and Tetra Tech, Inc., 2020)] and continuous site zone by finding the area weighted daily average K_a from the 2020 SHEP WASP model for the model cells intersecting each area. This resulted in a unique daily K_a value for each intermittent area and continuous site zone based on the spatial relationship between the areas and the computational grid.

I.2.2 General Calculation

The methodology discussed in the 2019 Water Column Transfer Efficiency Report used Final Daily River Time and applied that time to each continuous and intermittent area in the Mass of Transfer Calculation. With the update to continuous site zones, the 2020 WCTE calculations were performed based on Site Time for each continuous site zone and intermittent area. The Site Time component for the continuous site zones were precisely known (±5 minutes for semi-permanent buoy data site zones and ±15 minutes for United States Geologic Survey (USGS) data site zones) however the Site Time for intermittent areas was estimated at one hour since the boats moved quickly through those areas. When intermittent areas and continuous site zones overlapped the time of day of DO Transfer within each was examined in detail and if the time overlapped, the WCTE calculations were performed with the continuous site data. This ensured that areas of the river experiencing DO Transfer were only counted one time. To determine the Daily River DO Transfer, the amount of transfer to the atmosphere from each continuous site zone and intermittent area were summed for each river for each day.

For 11 days during the SUR, portions of the river flowing past the Hardeeville data sonde deployment location was above 100 percent DO saturation. The Hardeeville data sonde deployment location was the last sonde Upriver until the USGS gage downstream of the Savannah River and Abercorn Creek confluence at US I-95 [approximately ten miles downstream]. The USGS gage at US I-95 located in relation to the Hardeeville location did not measure river conditions above 100 percent DO saturation. The location where DO saturation decreased below 100 percent is unknown so the length of time oxygen could be transferred to the atmosphere, the area from which oxygen could be transferred to the atmosphere, and the amount of oxygen above atmospheric equilibrium were all unknown. To overcome this, on the days when water flowing past the Hardeeville data sonde deployment location was above 100 percent DO saturation, the length of time was set equal to the length of time from the Hardeeville segment, the area was from the end of the Hardeeville segment downstream to the Abercorn Creek confluence and from bank to bank (***Figure I-9***), the amount of oxygen above atmospheric equilibrium was set equal to the amount of oxygen above atmospheric equilibrium from the Hardeeville segment, and K_a was calculated as discussed above.

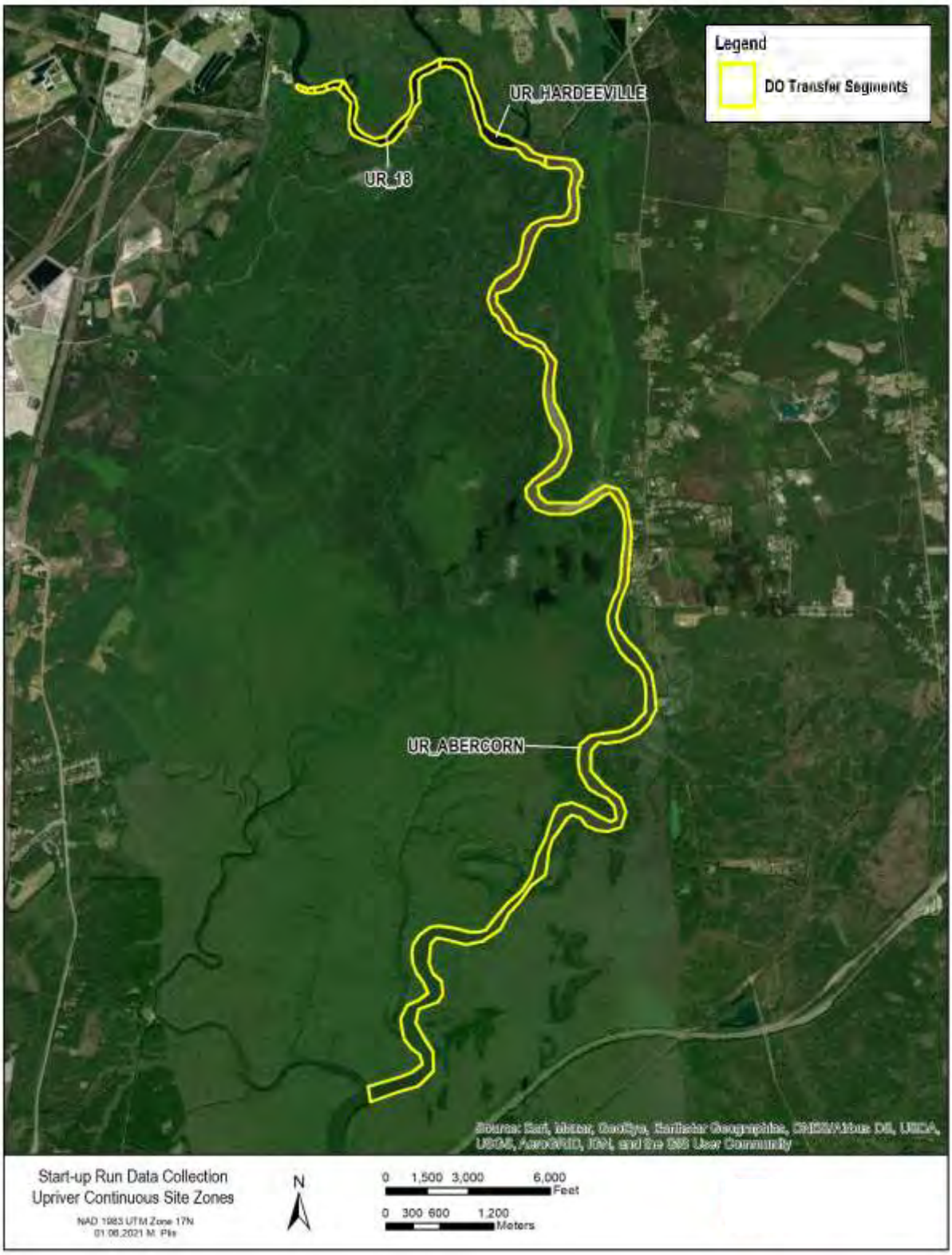

Figure I-9 Abercorn Creek DO Transfer segment

I.3 WCTE OXYGEN TRANSFER TIME

Tables are not provided for the Front River, because DO transfer conditions were never observed.

Table I-1 Back River daily oxygen transfer time (minutes) by intermittent area and continuous site zone

Date	Oxygen Transfer Time (minutes)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
7/25/2020	0	0	0	0	0	0	0	0	0	0	0
7/26/2020	0	0	0	0	0	0	0	0	0	0	0
7/27/2020	0	0	0	0	0	0	0	0	0	0	0
7/28/2020	0	0	0	0	0	0	0	0	0	0	0
7/29/2020	0	0	0	0	0	0	0	0	0	0	0
7/30/2020	0	0	0	0	0	0	0	0	0	0	0
7/31/2020	0	0	0	0	0	0	0	0	0	0	0
8/1/2020	0	0	0	0	5	0	10	0	0	0	0
8/2/2020	0	0	0	0	0	0	0	0	0	0	0
8/3/2020	0	0	0	0	0	0	0	0	0	0	0
8/4/2020	0	0	0	0	0	0	0	0	0	0	0
8/5/2020	0	0	0	0	0	0	0	0	0	0	0
8/6/2020	0	0	0	0	0	0	0	0	0	0	0
8/7/2020	0	0	0	0	0	0	0	0	0	0	0
8/8/2020	0	0	0	0	0	0	0	0	0	0	0
8/9/2020	0	0	0	0	0	0	0	0	0	0	0
8/10/2020	0	0	0	0	0	0	0	0	0	0	0
8/11/2020	0	0	0	0	0	0	0	0	0	0	0
8/12/2020	0	0	0	0	0	0	0	0	0	0	0
8/13/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer Time (minutes)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
8/14/2020	30	0	0	0	10	10	50	5	0	0	0
8/15/2020	0	0	0	0	0	0	0	0	0	0	0
8/16/2020	30	0	0	0	0	0	0	0	0	0	0
8/17/2020	0	0	0	0	0	0	0	0	0	0	0
8/18/2020	0	0	0	0	0	0	0	0	0	0	0
8/19/2020	0	0	0	0	0	0	0	0	0	0	0
8/20/2020	0	0	0	0	0	0	0	0	0	0	0
8/21/2020	0	0	0	0	0	0	0	0	0	0	0
8/22/2020	0	0	0	0	0	0	0	0	0	0	0
8/23/2020	0	0	0	0	0	0	0	0	0	0	0
8/24/2020	0	0	0	0	0	0	0	0	0	0	0
8/25/2020	0	0	0	0	0	0	0	0	0	0	0
8/26/2020	0	0	0	0	0	0	0	0	0	0	0
8/27/2020	0	0	0	0	0	0	0	0	0	0	0
8/28/2020	0	0	0	0	0	0	0	0	0	0	0
8/29/2020	0	0	0	0	0	0	0	0	0	0	0
8/30/2020	15	0	0	0	0	0	0	0	0	0	0
8/31/2020	0	0	0	0	0	0	0	0	0	0	0
9/1/2020	0	0	0	0	0	0	0	0	0	0	0
9/2/2020	0	0	0	0	0	0	0	0	0	0	0
9/3/2020	0	0	0	0	0	0	0	0	0	0	0
9/4/2020	0	0	0	0	0	0	0	0	0	0	0
9/5/2020	0	0	0	0	0	0	0	0	0	0	0
9/6/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer Time (minutes)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
9/7/2020	0	0	0	0	0	0	0	0	0	0	0
9/8/2020	0	0	0	0	0	0	0	0	0	0	0
9/9/2020	0	0	0	0	0	0	0	0	0	0	0
9/10/2020	0	0	0	0	0	0	0	0	0	0	0
9/11/2020	0	0	0	0	0	0	0	0	0	0	0
9/12/2020	0	0	0	0	0	0	0	0	0	0	0
9/13/2020	0	0	0	0	0	0	0	0	0	0	0
9/14/2020	0	0	0	0	0	0	0	0	0	0	0
9/15/2020	0	0	0	0	0	0	0	0	0	0	0
9/16/2020	0	0	0	0	0	0	0	0	0	0	0
9/17/2020	0	0	0	0	0	0	0	0	0	0	0
9/18/2020	0	0	0	0	0	0	0	0	0	0	0
9/19/2020	0	0	0	0	0	0	0	0	0	0	0
9/20/2020	0	0	0	0	0	0	0	0	0	0	0
9/21/2020	0	0	0	0	0	0	0	0	0	0	0
9/22/2020	0	0	0	0	0	0	0	0	0	0	0

Table I-2 Upriver daily oxygen transfer time (minutes) by intermittent area and continuous site zone

Date	Oxygen Transfer Time (minutes)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
7/25/2020	395	1,120	620	0	1,350	1,440	1,440	575	575	0	0
7/26/2020	435	1,070	265	0	1,400	1,435	1,435	270	270	0	0
7/27/2020	665	1,250	640	0	1,425	1,440	1,440	640	640	0	0
7/28/2020	275	1,180	750	0	1,275	1,350	1,305	530	530	0	0
7/29/2020	75	805	405	0	840	1,090	915	170	170	0	0
7/30/2020	40	380	20	0	560	825	640	0	0	0	0
7/31/2020	110	460	50	0	575	770	670	0	0	0	0
8/1/2020	45	515	0	0	485	820	725	0	0	0	0
8/2/2020	230	725	210	0	675	880	775	195	195	0	0
8/3/2020	110	835	70	0	690	1,060	755	0	0	0	0
8/4/2020	200	860	220	0	750	1,055	885	40	40	0	0
8/5/2020	265	945	315	0	900	1,245	965	395	395	60	0
8/6/2020	80	515	50	0	380	550	435	0	0	0	0
8/7/2020	70	510	10	0	505	585	540	0	0	0	0
8/8/2020	35	505	0	0	470	760	550	0	0	0	0
8/9/2020	15	215	0	0	40	415	210	0	0	0	0
8/10/2020	35	230	0	0	250	485	375	0	0	60	60
8/11/2020	0	45	0	0	30	190	190	0	0	0	0
8/12/2020	15	70	0	0	35	205	270	0	0	0	0
8/13/2020	5	125	0	0	130	355	405	0	0	0	0
8/14/2020	5	0	0	0	0	280	460	0	0	0	0
8/15/2020	5	0	0	0	10	435	460	0	0	0	0
8/16/2020	30	0	0	0	5	400	295	0	0	0	0

Date	Oxygen Transfer Time (minutes)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
8/17/2020	20	0	0	0	30	370	455	0	0	0	0
8/18/2020	0	0	0	0	5	45	125	0	0	0	0
8/19/2020	0	0	0	0	0	45	65	0	0	0	0
8/20/2020	0	0	0	0	0	0	10	0	0	0	0
8/21/2020	0	0	0	0	0	0	0	0	0	0	0
8/22/2020	0	0	0	0	0	0	0	0	0	0	0
8/23/2020	0	0	0	0	0	0	0	0	0	60	0
8/24/2020	0	0	0	0	0	0	0	0	0	60	0
8/25/2020	0	0	0	0	0	0	0	0	0	0	0
8/26/2020	0	0	0	0	0	0	0	0	0	0	0
8/27/2020	0	0	0	0	0	0	0	0	0	0	0
8/28/2020	0	0	0	0	0	0	0	0	0	0	0
8/29/2020	0	0	0	0	0	0	0	0	0	0	0
8/30/2020	0	0	0	0	0	0	0	0	0	0	0
8/31/2020	0	0	0	0	0	0	0	0	0	0	0
9/1/2020	0	0	0	0	0	0	0	0	0	0	0
9/2/2020	0	0	0	0	0	0	0	0	0	0	0
9/3/2020	0	0	0	0	0	0	0	0	0	0	0
9/4/2020	0	0	0	0	0	0	0	0	0	0	0
9/5/2020	0	0	0	0	0	0	0	0	0	0	0
9/6/2020	0	0	0	0	0	0	0	0	0	0	0
9/7/2020	0	0	0	0	0	0	0	0	0	0	0
9/8/2020	0	0	0	0	0	0	0	0	0	0	0
9/9/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer Time (minutes)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
9/10/2020	0	0	0	0	0	0	5	0	0	0	0
9/11/2020	0	0	0	0	0	460	460	0	0	0	0
9/12/2020	0	10	0	0	0	465	505	0	0	0	0
9/13/2020	115	240	140	0	445	700	695	0	0	60	0
9/14/2020	430	665	605	55	675	1,255	1,295	500	500	0	0
9/15/2020	375	990	680	5	1,080	1,440	1,440	180	180	0	0
9/16/2020	25	95	25	0	225	1,295	1,285	35	35	0	0
9/17/2020	0	0	0	0	10	535	760	0	0	0	0
9/18/2020	0	0	0	0	0	0	0	0	0	0	0
9/19/2020	0	0	0	0	0	0	0	0	0	0	0
9/20/2020	0	0	0	0	0	0	0	0	0	0	0
9/21/2020	0	0	0	0	0	0	0	0	0	0	0
9/22/2020	0	0	0	0	0	0	0	0	0	0	0

I.4 WCTE OXYGEN TRANSFER AREA

Tables are not provided for the Front River, because DO transfer conditions were never observed.

Table I-3 Back River daily oxygen transfer area (square meters) by intermittent area and continuous site zone

Date	Oxygen Transfer Area (square meters)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
7/25/2020	0	0	0	0	0	0	0	0	0	0	0
7/26/2020	0	0	0	0	0	0	0	0	0	0	0
7/27/2020	0	0	0	0	0	0	0	0	0	0	0
7/28/2020	0	0	0	0	0	0	0	0	0	0	0
7/29/2020	0	0	0	0	0	0	0	0	0	0	0
7/30/2020	0	0	0	0	0	0	0	0	0	0	0
7/31/2020	0	0	0	0	0	0	0	0	0	0	0
8/1/2020	0	0	0	0	49,498	0	122,497	0	0	0	0
8/2/2020	0	0	0	0	0	0	0	0	0	0	0
8/3/2020	0	0	0	0	0	0	0	0	0	0	0
8/4/2020	0	0	0	0	0	0	0	0	0	0	0
8/5/2020	0	0	0	0	0	0	0	0	0	0	0
8/6/2020	0	0	0	0	0	0	0	0	0	0	0
8/7/2020	0	0	0	0	0	0	0	0	0	0	0
8/8/2020	0	0	0	0	0	0	0	0	0	0	0
8/9/2020	0	0	0	0	0	0	0	0	0	0	0
8/10/2020	0	0	0	0	0	0	0	0	0	0	0
8/11/2020	0	0	0	0	0	0	0	0	0	0	0
8/12/2020	0	0	0	0	0	0	0	0	0	0	0
8/13/2020	0	0	0	0	0	0	0	0	0	0	0
8/14/2020	743,288	0	0	0	48,948	71,686	122,497	179,077	0	0	0

Date	Oxygen Transfer Area (square meters)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
8/15/2020	0	0	0	0	0	0	0	0	0	0	0
8/16/2020	743,288	0	0	0	0	0	0	0	0	0	0
8/17/2020	0	0	0	0	0	0	0	0	0	0	0
8/18/2020	0	0	0	0	0	0	0	0	0	0	0
8/19/2020	0	0	0	0	0	0	0	0	0	0	0
8/20/2020	0	0	0	0	0	0	0	0	0	0	0
8/21/2020	0	0	0	0	0	0	0	0	0	0	0
8/22/2020	0	0	0	0	0	0	0	0	0	0	0
8/23/2020	0	0	0	0	0	0	0	0	0	0	0
8/24/2020	0	0	0	0	0	0	0	0	0	0	0
8/25/2020	0	0	0	0	0	0	0	0	0	0	0
8/26/2020	0	0	0	0	0	0	0	0	0	0	0
8/27/2020	0	0	0	0	0	0	0	0	0	0	0
8/28/2020	0	0	0	0	0	0	0	0	0	0	0
8/29/2020	0	0	0	0	0	0	0	0	0	0	0
8/30/2020	743,288	0	0	0	0	0	0	0	0	0	0
8/31/2020	0	0	0	0	0	0	0	0	0	0	0
9/1/2020	0	0	0	0	0	0	0	0	0	0	0
9/2/2020	0	0	0	0	0	0	0	0	0	0	0
9/3/2020	0	0	0	0	0	0	0	0	0	0	0
9/4/2020	0	0	0	0	0	0	0	0	0	0	0
9/5/2020	0	0	0	0	0	0	0	0	0	0	0
9/6/2020	0	0	0	0	0	0	0	0	0	0	0
9/7/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer Area (square meters)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
9/8/2020	0	0	0	0	0	0	0	0	0	0	0
9/9/2020	0	0	0	0	0	0	0	0	0	0	0
9/10/2020	0	0	0	0	0	0	0	0	0	0	0
9/11/2020	0	0	0	0	0	0	0	0	0	0	0
9/12/2020	0	0	0	0	0	0	0	0	0	0	0
9/13/2020	0	0	0	0	0	0	0	0	0	0	0
9/14/2020	0	0	0	0	0	0	0	0	0	0	0
9/15/2020	0	0	0	0	0	0	0	0	0	0	0
9/16/2020	0	0	0	0	0	0	0	0	0	0	0
9/17/2020	0	0	0	0	0	0	0	0	0	0	0
9/18/2020	0	0	0	0	0	0	0	0	0	0	0
9/19/2020	0	0	0	0	0	0	0	0	0	0	0
9/20/2020	0	0	0	0	0	0	0	0	0	0	0
9/21/2020	0	0	0	0	0	0	0	0	0	0	0
9/22/2020	0	0	0	0	0	0	0	0	0	0	0

Table I-4 Upriver daily oxygen transfer area (square meters) by intermittent area and continuous site zone

Date	Oxygen Transfer Area (square meters)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
7/25/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	169,920	1,838,363	0	0
7/26/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	169,920	1,838,363	0	0
7/27/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	169,920	1,838,363	0	0
7/28/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	169,920	1,838,363	0	0
7/29/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	169,920	1,838,363	0	0
7/30/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	0	0	0	0
7/31/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	0	0	0	0
8/1/2020	3,958	4,883	0	0	10,620	14,298	162,081	0	0	0	0
8/2/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	169,920	1,838,363	0	0
8/3/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	0	0	0	0
8/4/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	169,920	1,838,363	0	0
8/5/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	169,920	1,838,363	75	0
8/6/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	0	0	0	0
8/7/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	0	0	0	0
8/8/2020	3,958	4,883	0	0	10,620	14,298	162,081	0	0	0	0
8/9/2020	3,958	4,883	0	0	10,620	14,298	162,081	0	0	0	0
8/10/2020	3,958	4,883	0	0	10,620	14,298	162,081	0	0	3	38
8/11/2020	0	4,883	0	0	10,620	14,298	162,081	0	0	0	0
8/12/2020	3,958	4,883	0	0	10,620	14,298	162,081	0	0	0	0
8/13/2020	3,958	4,883	0	0	10,620	14,298	162,081	0	0	0	0
8/14/2020	3,958	0	0	0	0	14,298	162,081	0	0	0	0
8/15/2020	3,958	0	0	0	10,620	14,298	162,081	0	0	0	0
8/16/2020	3,958	0	0	0	10,620	14,298	162,081	0	0	0	0

Date	Oxygen Transfer Area (square meters)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
8/17/2020	3,958	0	0	0	10,620	14,298	162,081	0	0	0	0
8/18/2020	0	0	0	0	10,620	14,298	162,081	0	0	0	0
8/19/2020	0	0	0	0	0	14,298	162,081	0	0	0	0
8/20/2020	0	0	0	0	0	0	162,081	0	0	0	0
8/21/2020	0	0	0	0	0	0	0	0	0	0	0
8/22/2020	0	0	0	0	0	0	0	0	0	0	0
8/23/2020	0	0	0	0	0	0	0	0	0	3	0
8/24/2020	0	0	0	0	0	0	0	0	0	6	0
8/25/2020	0	0	0	0	0	0	0	0	0	0	0
8/26/2020	0	0	0	0	0	0	0	0	0	0	0
8/27/2020	0	0	0	0	0	0	0	0	0	0	0
8/28/2020	0	0	0	0	0	0	0	0	0	0	0
8/29/2020	0	0	0	0	0	0	0	0	0	0	0
8/30/2020	0	0	0	0	0	0	0	0	0	0	0
8/31/2020	0	0	0	0	0	0	0	0	0	0	0
9/1/2020	0	0	0	0	0	0	0	0	0	0	0
9/2/2020	0	0	0	0	0	0	0	0	0	0	0
9/3/2020	0	0	0	0	0	0	0	0	0	0	0
9/4/2020	0	0	0	0	0	0	0	0	0	0	0
9/5/2020	0	0	0	0	0	0	0	0	0	0	0
9/6/2020	0	0	0	0	0	0	0	0	0	0	0
9/7/2020	0	0	0	0	0	0	0	0	0	0	0
9/8/2020	0	0	0	0	0	0	0	0	0	0	0
9/9/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer Area (square meters)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
9/10/2020	0	0	0	0	0	0	162,081	0	0	0	0
9/11/2020	0	0	0	0	0	14,298	162,081	0	0	0	0
9/12/2020	0	4,883	0	0	0	14,298	162,081	0	0	0	0
9/13/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	0	0	3	0
9/14/2020	3,958	4,883	4,414	5,288	10,620	14,298	162,081	169,920	1,838,363	0	0
9/15/2020	3,958	4,883	4,414	5,288	10,620	14,298	162,081	169,920	1,838,363	0	0
9/16/2020	3,958	4,883	4,414	0	10,620	14,298	162,081	169,920	1,838,363	0	0
9/17/2020	0	0	0	0	10,620	14,298	162,081	0	0	0	0
9/18/2020	0	0	0	0	0	0	0	0	0	0	0
9/19/2020	0	0	0	0	0	0	0	0	0	0	0
9/20/2020	0	0	0	0	0	0	0	0	0	0	0
9/21/2020	0	0	0	0	0	0	0	0	0	0	0
9/22/2020	0	0	0	0	0	0	0	0	0	0	0

I.5 WCTE EXCESS OXYGEN CONCENTRATION

Tables are not provided for the Front River, because DO transfer conditions were never observed.

Table I-5 Back River daily oxygen transfer excess concentration (mg/L) by intermittent area and continuous site zone

Date	Oxygen Transfer Excess Concentration (mg/L)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
7/25/2020	0	0	0	0	0	0	0	0	0	0	0
7/26/2020	0	0	0	0	0	0	0	0	0	0	0
7/27/2020	0	0	0	0	0	0	0	0	0	0	0
7/28/2020	0	0	0	0	0	0	0	0	0	0	0
7/29/2020	0	0	0	0	0	0	0	0	0	0	0
7/30/2020	0	0	0	0	0	0	0	0	0	0	0
7/31/2020	0	0	0	0	0	0	0	0	0	0	0
8/1/2020	0	0	0	0	0.149	0	0.083	0	0	0	0
8/2/2020	0	0	0	0	0	0	0	0	0	0	0
8/3/2020	0	0	0	0	0	0	0	0	0	0	0
8/4/2020	0	0	0	0	0	0	0	0	0	0	0
8/5/2020	0	0	0	0	0	0	0	0	0	0	0
8/6/2020	0	0	0	0	0	0	0	0	0	0	0
8/7/2020	0	0	0	0	0	0	0	0	0	0	0
8/8/2020	0	0	0	0	0	0	0	0	0	0	0
8/9/2020	0	0	0	0	0	0	0	0	0	0	0
8/10/2020	0	0	0	0	0	0	0	0	0	0	0
8/11/2020	0	0	0	0	0	0	0	0	0	0	0
8/12/2020	0	0	0	0	0	0	0	0	0	0	0
8/13/2020	0	0	0	0	0	0	0	0	0	0	0
8/14/2020	0.143	0	0	0	0.153	0.052	0.248	0.221	0	0	0

Date	Oxygen Transfer Excess Concentration (mg/L)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
8/15/2020	0	0	0	0	0	0	0	0	0	0	0
8/16/2020	0.192	0	0	0	0	0	0	0	0	0	0
8/17/2020	0	0	0	0	0	0	0	0	0	0	0
8/18/2020	0	0	0	0	0	0	0	0	0	0	0
8/19/2020	0	0	0	0	0	0	0	0	0	0	0
8/20/2020	0	0	0	0	0	0	0	0	0	0	0
8/21/2020	0	0	0	0	0	0	0	0	0	0	0
8/22/2020	0	0	0	0	0	0	0	0	0	0	0
8/23/2020	0	0	0	0	0	0	0	0	0	0	0
8/24/2020	0	0	0	0	0	0	0	0	0	0	0
8/25/2020	0	0	0	0	0	0	0	0	0	0	0
8/26/2020	0	0	0	0	0	0	0	0	0	0	0
8/27/2020	0	0	0	0	0	0	0	0	0	0	0
8/28/2020	0	0	0	0	0	0	0	0	0	0	0
8/29/2020	0	0	0	0	0	0	0	0	0	0	0
8/30/2020	0.010	0	0	0	0	0	0	0	0	0	0
8/31/2020	0	0	0	0	0	0	0	0	0	0	0
9/1/2020	0	0	0	0	0	0	0	0	0	0	0
9/2/2020	0	0	0	0	0	0	0	0	0	0	0
9/3/2020	0	0	0	0	0	0	0	0	0	0	0
9/4/2020	0	0	0	0	0	0	0	0	0	0	0
9/5/2020	0	0	0	0	0	0	0	0	0	0	0
9/6/2020	0	0	0	0	0	0	0	0	0	0	0
9/7/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer Excess Concentration (mg/L)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
9/8/2020	0	0	0	0	0	0	0	0	0	0	0
9/9/2020	0	0	0	0	0	0	0	0	0	0	0
9/10/2020	0	0	0	0	0	0	0	0	0	0	0
9/11/2020	0	0	0	0	0	0	0	0	0	0	0
9/12/2020	0	0	0	0	0	0	0	0	0	0	0
9/13/2020	0	0	0	0	0	0	0	0	0	0	0
9/14/2020	0	0	0	0	0	0	0	0	0	0	0
9/15/2020	0	0	0	0	0	0	0	0	0	0	0
9/16/2020	0	0	0	0	0	0	0	0	0	0	0
9/17/2020	0	0	0	0	0	0	0	0	0	0	0
9/18/2020	0	0	0	0	0	0	0	0	0	0	0
9/19/2020	0	0	0	0	0	0	0	0	0	0	0
9/20/2020	0	0	0	0	0	0	0	0	0	0	0
9/21/2020	0	0	0	0	0	0	0	0	0	0	0
9/22/2020	0	0	0	0	0	0	0	0	0	0	0

Table I-6 Upriver daily oxygen transfer excess concentration (mg/L) by intermittent area and continuous site zone

Date	Oxygen Transfer Excess Concentration (mg/L)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
7/25/2020	0.102	0.137	0.076	0	0.201	0.313	0.295	0.038	0.038	0	0
7/26/2020	0.095	0.113	0.076	0	0.161	0.276	0.252	0.014	0.014	0	0
7/27/2020	0.193	0.198	0.176	0	0.253	0.380	0.354	0.165	0.165	0	0
7/28/2020	0.101	0.154	0.105	0	0.168	0.259	0.236	0.052	0.052	0	0
7/29/2020	0.068	0.112	0.075	0	0.129	0.173	0.171	0.014	0.014	0	0
7/30/2020	0.057	0.048	0.062	0	0.060	0.111	0.104	0	0	0	0
7/31/2020	0.054	0.073	0.025	0	0.095	0.140	0.108	0	0	0	0
8/1/2020	0.066	0.083	0	0	0.067	0.108	0.075	0	0	0	0
8/2/2020	0.107	0.158	0.060	0	0.148	0.187	0.164	0.019	0.019	0	0
8/3/2020	0.057	0.103	0.054	0	0.080	0.103	0.081	0	0	0	0
8/4/2020	0.120	0.149	0.051	0	0.144	0.181	0.163	0.006	0.006	0	0
8/5/2020	0.126	0.153	0.052	0	0.152	0.183	0.189	0.053	0.053	0.066	0
8/6/2020	0.063	0.111	0.049	0	0.104	0.152	0.149	0	0	0	0
8/7/2020	0.060	0.109	0.041	0	0.083	0.146	0.119	0	0	0	0
8/8/2020	0.052	0.072	0	0	0.060	0.099	0.091	0	0	0	0
8/9/2020	0.019	0.047	0	0	0.019	0.024	0.007	0	0	0	0
8/10/2020	0.047	0.055	0	0	0.051	0.082	0.096	0	0	0.210	0.013
8/11/2020	0	0.044	0	0	0.016	0.046	0.052	0	0	0	0
8/12/2020	0.095	0.040	0	0	0.022	0.041	0.074	0	0	0	0
8/13/2020	0.025	0.048	0	0	0.036	0.058	0.108	0	0	0	0
8/14/2020	0.033	0	0	0	0	0.032	0.034	0	0	0	0
8/15/2020	0.076	0	0	0	0.071	0.104	0.097	0	0	0	0
8/16/2020	0.056	0	0	0	0.014	0.031	0.019	0	0	0	0

Date	Oxygen Transfer Excess Concentration (mg/L)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
8/17/2020	0.042	0	0	0	0.028	0.031	0.029	0	0	0	0
8/18/2020	0	0	0	0	0.003	0.020	0.021	0	0	0	0
8/19/2020	0	0	0	0	0	0.008	0.007	0	0	0	0
8/20/2020	0	0	0	0	0	0	0.001	0	0	0	0
8/21/2020	0	0	0	0	0	0	0	0	0	0	0
8/22/2020	0	0	0	0	0	0	0	0	0	0	0
8/23/2020	0	0	0	0	0	0	0	0	0	0.116	0
8/24/2020	0	0	0	0	0	0	0	0	0	0.156	0
8/25/2020	0	0	0	0	0	0	0	0	0	0	0
8/26/2020	0	0	0	0	0	0	0	0	0	0	0
8/27/2020	0	0	0	0	0	0	0	0	0	0	0
8/28/2020	0	0	0	0	0	0	0	0	0	0	0
8/29/2020	0	0	0	0	0	0	0	0	0	0	0
8/30/2020	0	0	0	0	0	0	0	0	0	0	0
8/31/2020	0	0	0	0	0	0	0	0	0	0	0
9/1/2020	0	0	0	0	0	0	0	0	0	0	0
9/2/2020	0	0	0	0	0	0	0	0	0	0	0
9/3/2020	0	0	0	0	0	0	0	0	0	0	0
9/4/2020	0	0	0	0	0	0	0	0	0	0	0
9/5/2020	0	0	0	0	0	0	0	0	0	0	0
9/6/2020	0	0	0	0	0	0	0	0	0	0	0
9/7/2020	0	0	0	0	0	0	0	0	0	0	0
9/8/2020	0	0	0	0	0	0	0	0	0	0	0
9/9/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer Excess Concentration (mg/L)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
9/10/2020	0	0	0	0	0	0	0	0	0	0	0
9/11/2020	0	0	0	0	0	0.059	0.082	0	0	0	0
9/12/2020	0	0.020	0	0	0	0.087	0.119	0	0	0	0
9/13/2020	0.042	0.050	0.028	0	0.067	0.184	0.217	0	0	0.005	0
9/14/2020	0.084	0.159	0.128	0.058	0.166	0.196	0.229	0.067	0.067	0	0
9/15/2020	0.044	0.087	0.064	0.031	0.095	0.201	0.228	0.019	0.019	0	0
9/16/2020	0.025	0.049	0.016	0	0.043	0.105	0.131	0	0	0	0
9/17/2020	0	0	0	0	0.017	0.059	0.092	0	0	0	0
9/18/2020	0	0	0	0	0	0	0	0	0	0	0
9/19/2020	0	0	0	0	0	0	0	0	0	0	0
9/20/2020	0	0	0	0	0	0	0	0	0	0	0
9/21/2020	0	0	0	0	0	0	0	0	0	0	0
9/22/2020	0	0	0	0	0	0	0	0	0	0	0

I.6 WCTE VOLUMETRIC REAERATION COEFFICIENT

Tables are not presented for the Front River, because DO transfer conditions were never observed.

Table I-7 Back River daily oxygen transfer K_a by intermittent area and continuous site zone

Date	Oxygen Transfer K_a										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
7/25/2020	0	0	0	0	0	0	0	0	0	0	0
7/26/2020	0	0	0	0	0	0	0	0	0	0	0
7/27/2020	0	0	0	0	0	0	0	0	0	0	0
7/28/2020	0	0	0	0	0	0	0	0	0	0	0
7/29/2020	0	0	0	0	0	0	0	0	0	0	0
7/30/2020	0	0	0	0	0	0	0	0	0	0	0
7/31/2020	0	0	0	0	0	0	0	0	0	0	0
8/1/2020	0	0	0	0	1.298	0	1.361	0	0	0	0
8/2/2020	0	0	0	0	0	0	0	0	0	0	0
8/3/2020	0	0	0	0	0	0	0	0	0	0	0
8/4/2020	0	0	0	0	0	0	0	0	0	0	0
8/5/2020	0	0	0	0	0	0	0	0	0	0	0
8/6/2020	0	0	0	0	0	0	0	0	0	0	0
8/7/2020	0	0	0	0	0	0	0	0	0	0	0
8/8/2020	0	0	0	0	0	0	0	0	0	0	0
8/9/2020	0	0	0	0	0	0	0	0	0	0	0
8/10/2020	0	0	0	0	0	0	0	0	0	0	0
8/11/2020	0	0	0	0	0	0	0	0	0	0	0
8/12/2020	0	0	0	0	0	0	0	0	0	0	0
8/13/2020	0	0	0	0	0	0	0	0	0	0	0
8/14/2020	0.939	0	0	0	1.055	0.841	1.115	1.079	0	0	0

Date	Oxygen Transfer K_a										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
8/15/2020	0	0	0	0	0	0	0	0	0	0	0
8/16/2020	0.963	0	0	0	0	0	0	0	0	0	0
8/17/2020	0	0	0	0	0	0	0	0	0	0	0
8/18/2020	0	0	0	0	0	0	0	0	0	0	0
8/19/2020	0	0	0	0	0	0	0	0	0	0	0
8/20/2020	0	0	0	0	0	0	0	0	0	0	0
8/21/2020	0	0	0	0	0	0	0	0	0	0	0
8/22/2020	0	0	0	0	0	0	0	0	0	0	0
8/23/2020	0	0	0	0	0	0	0	0	0	0	0
8/24/2020	0	0	0	0	0	0	0	0	0	0	0
8/25/2020	0	0	0	0	0	0	0	0	0	0	0
8/26/2020	0	0	0	0	0	0	0	0	0	0	0
8/27/2020	0	0	0	0	0	0	0	0	0	0	0
8/28/2020	0	0	0	0	0	0	0	0	0	0	0
8/29/2020	0	0	0	0	0	0	0	0	0	0	0
8/30/2020	1.094	0	0	0	0	0	0	0	0	0	0
8/31/2020	0	0	0	0	0	0	0	0	0	0	0
9/1/2020	0	0	0	0	0	0	0	0	0	0	0
9/2/2020	0	0	0	0	0	0	0	0	0	0	0
9/3/2020	0	0	0	0	0	0	0	0	0	0	0
9/4/2020	0	0	0	0	0	0	0	0	0	0	0
9/5/2020	0	0	0	0	0	0	0	0	0	0	0
9/6/2020	0	0	0	0	0	0	0	0	0	0	0
9/7/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer K_a										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
9/8/2020	0	0	0	0	0	0	0	0	0	0	0
9/9/2020	0	0	0	0	0	0	0	0	0	0	0
9/10/2020	0	0	0	0	0	0	0	0	0	0	0
9/11/2020	0	0	0	0	0	0	0	0	0	0	0
9/12/2020	0	0	0	0	0	0	0	0	0	0	0
9/13/2020	0	0	0	0	0	0	0	0	0	0	0
9/14/2020	0	0	0	0	0	0	0	0	0	0	0
9/15/2020	0	0	0	0	0	0	0	0	0	0	0
9/16/2020	0	0	0	0	0	0	0	0	0	0	0
9/17/2020	0	0	0	0	0	0	0	0	0	0	0
9/18/2020	0	0	0	0	0	0	0	0	0	0	0
9/19/2020	0	0	0	0	0	0	0	0	0	0	0
9/20/2020	0	0	0	0	0	0	0	0	0	0	0
9/21/2020	0	0	0	0	0	0	0	0	0	0	0
9/22/2020	0	0	0	0	0	0	0	0	0	0	0

Table I-8 Upriver daily oxygen transfer K_a by intermittent area and continuous site zone

Date	Oxygen Transfer K_a										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
7/25/2020	0.889	0.889	0.889	0	0.618	0.689	0.720	0.642	1.062	0	0
7/26/2020	0.889	0.889	0.889	0	0.606	0.678	0.710	0.636	1.051	0	0
7/27/2020	0.913	0.913	0.913	0	0.650	0.722	0.767	0.708	1.103	0	0
7/28/2020	0.921	0.921	0.921	0	0.634	0.709	0.751	0.677	1.035	0	0
7/29/2020	0.952	0.952	0.952	0	0.660	0.739	0.799	0.753	1.102	0	0
7/30/2020	0.951	0.951	0.951	0	0.641	0.719	0.770	0	0	0	0
7/31/2020	0.942	0.942	0.942	0	0.637	0.715	0.763	0	0	0	0
8/1/2020	0.916	0.916	0	0	0.631	0.705	0.759	0	0	0	0
8/2/2020	0.866	0.866	0.866	0	0.633	0.700	0.762	0.724	1.035	0	0
8/3/2020	0.815	0.815	0.815	0	0.622	0.683	0.736	0	0	0	0
8/4/2020	0.799	0.799	0.799	0	0.590	0.650	0.687	0.613	0.963	0	0
8/5/2020	0.819	0.819	0.819	0	0.587	0.650	0.685	0.612	0.964	0.819	0
8/6/2020	0.866	0.866	0.866	0	0.631	0.698	0.746	0	0	0	0
8/7/2020	0.823	0.823	0.823	0	0.588	0.653	0.685	0	0	0	0
8/8/2020	0.822	0.822	0	0	0.585	0.649	0.682	0	0	0	0
8/9/2020	0.853	0.853	0	0	0.603	0.670	0.706	0	0	0	0
8/10/2020	0.878	0.878	0	0	0.619	0.688	0.729	0	0	0.878	0.878
8/11/2020	0	0.918	0	0	0.642	0.715	0.759	0	0	0	0
8/12/2020	0.936	0.936	0	0	0.649	0.724	0.769	0	0	0	0
8/13/2020	0.929	0.929	0	0	0.632	0.708	0.753	0	0	0	0
8/14/2020	0.937	0	0	0	0	0.710	0.754	0	0	0	0
8/15/2020	0.930	0	0	0	0.630	0.706	0.756	0	0	0	0
8/16/2020	0.912	0	0	0	0.622	0.696	0.741	0	0	0	0

Date	Oxygen Transfer K_a										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
8/17/2020	0.857	0	0	0	0.597	0.665	0.707	0	0	0	0
8/18/2020	0	0	0	0	0.602	0.666	0.712	0	0	0	0
8/19/2020	0	0	0	0	0	0.644	0.674	0	0	0	0
8/20/2020	0	0	0	0	0	0	0.679	0	0	0	0
8/21/2020	0	0	0	0	0	0	0	0	0	0	0
8/22/2020	0	0	0	0	0	0	0	0	0	0	0
8/23/2020	0	0	0	0	0	0	0	0	0	0.784	0
8/24/2020	0	0	0	0	0	0	0	0	0	0.803	0
8/25/2020	0	0	0	0	0	0	0	0	0	0	0
8/26/2020	0	0	0	0	0	0	0	0	0	0	0
8/27/2020	0	0	0	0	0	0	0	0	0	0	0
8/28/2020	0	0	0	0	0	0	0	0	0	0	0
8/29/2020	0	0	0	0	0	0	0	0	0	0	0
8/30/2020	0	0	0	0	0	0	0	0	0	0	0
8/31/2020	0	0	0	0	0	0	0	0	0	0	0
9/1/2020	0	0	0	0	0	0	0	0	0	0	0
9/2/2020	0	0	0	0	0	0	0	0	0	0	0
9/3/2020	0	0	0	0	0	0	0	0	0	0	0
9/4/2020	0	0	0	0	0	0	0	0	0	0	0
9/5/2020	0	0	0	0	0	0	0	0	0	0	0
9/6/2020	0	0	0	0	0	0	0	0	0	0	0
9/7/2020	0	0	0	0	0	0	0	0	0	0	0
9/8/2020	0	0	0	0	0	0	0	0	0	0	0
9/9/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer K_a										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
9/10/2020	0	0	0	0	0	0	0.647	0	0	0	0
9/11/2020	0	0	0	0	0	0.647	0.677	0	0	0	0
9/12/2020	0	0.944	0	0	0	0.751	0.818	0	0	0	0
9/13/2020	0.811	0.811	0.811	0	0.560	0.626	0.680	0	0	0.811	0
9/14/2020	0.794	0.794	0.794	0.871	0.541	0.605	0.635	0.571	0.903	0	0
9/15/2020	0.743	0.743	0.743	0.848	0.534	0.592	0.655	0.633	0.932	0	0
9/16/2020	0.665	0.665	0.665	0	0.486	0.535	0.568	0.511	0.821	0	0
9/17/2020	0	0	0	0	0.699	0.758	0.825	0	0	0	0
9/18/2020	0	0	0	0	0	0	0	0	0	0	0
9/19/2020	0	0	0	0	0	0	0	0	0	0	0
9/20/2020	0	0	0	0	0	0	0	0	0	0	0
9/21/2020	0	0	0	0	0	0	0	0	0	0	0
9/22/2020	0	0	0	0	0	0	0	0	0	0	0

I.7 WCTE MASS OF OXYGEN TRANSFER

Tables are not provided for the Front River, because DO transfer conditions were never observed.

Table I-9 Back River daily oxygen transfer load (pounds) by intermittent area and continuous site zone

Date	Oxygen Transfer Load (pounds)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
7/25/2020	0	0	0	0	0	0	0	0	0	0	0
7/26/2020	0	0	0	0	0	0	0	0	0	0	0
7/27/2020	0	0	0	0	0	0	0	0	0	0	0
7/28/2020	0	0	0	0	0	0	0	0	0	0	0
7/29/2020	0	0	0	0	0	0	0	0	0	0	0
7/30/2020	0	0	0	0	0	0	0	0	0	0	0
7/31/2020	0	0	0	0	0	0	0	0	0	0	0
8/1/2020	0	0	0	0	0.109	0	0.319	0	0	0	0
8/2/2020	0	0	0	0	0	0	0	0	0	0	0
8/3/2020	0	0	0	0	0	0	0	0	0	0	0
8/4/2020	0	0	0	0	0	0	0	0	0	0	0
8/5/2020	0	0	0	0	0	0	0	0	0	0	0
8/6/2020	0	0	0	0	0	0	0	0	0	0	0
8/7/2020	0	0	0	0	0	0	0	0	0	0	0
8/8/2020	0	0	0	0	0	0	0	0	0	0	0
8/9/2020	0	0	0	0	0	0	0	0	0	0	0
8/10/2020	0	0	0	0	0	0	0	0	0	0	0
8/11/2020	0	0	0	0	0	0	0	0	0	0	0
8/12/2020	0	0	0	0	0	0	0	0	0	0	0
8/13/2020	0	0	0	0	0	0	0	0	0	0	0
8/14/2020	6.895	0	0	0	0.182	0.071	3.889	0.490	0	0	0

Date	Oxygen Transfer Load (pounds)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
8/15/2020	0	0	0	0	0	0	0	0	0	0	0
8/16/2020	9.452	0	0	0	0	0	0	0	0	0	0
8/17/2020	0	0	0	0	0	0	0	0	0	0	0
8/18/2020	0	0	0	0	0	0	0	0	0	0	0
8/19/2020	0	0	0	0	0	0	0	0	0	0	0
8/20/2020	0	0	0	0	0	0	0	0	0	0	0
8/21/2020	0	0	0	0	0	0	0	0	0	0	0
8/22/2020	0	0	0	0	0	0	0	0	0	0	0
8/23/2020	0	0	0	0	0	0	0	0	0	0	0
8/24/2020	0	0	0	0	0	0	0	0	0	0	0
8/25/2020	0	0	0	0	0	0	0	0	0	0	0
8/26/2020	0	0	0	0	0	0	0	0	0	0	0
8/27/2020	0	0	0	0	0	0	0	0	0	0	0
8/28/2020	0	0	0	0	0	0	0	0	0	0	0
8/29/2020	0	0	0	0	0	0	0	0	0	0	0
8/30/2020	0.294	0	0	0	0	0	0	0	0	0	0
8/31/2020	0	0	0	0	0	0	0	0	0	0	0
9/1/2020	0	0	0	0	0	0	0	0	0	0	0
9/2/2020	0	0	0	0	0	0	0	0	0	0	0
9/3/2020	0	0	0	0	0	0	0	0	0	0	0
9/4/2020	0	0	0	0	0	0	0	0	0	0	0
9/5/2020	0	0	0	0	0	0	0	0	0	0	0
9/6/2020	0	0	0	0	0	0	0	0	0	0	0
9/7/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer Load (pounds)										
	0219897945	LBR_1	LBR_2	LBR_3	LBR_4	LBR_5	LBR_6	LBR_7	LBR_8	021989793	Intermittent Area
9/8/2020	0	0	0	0	0	0	0	0	0	0	0
9/9/2020	0	0	0	0	0	0	0	0	0	0	0
9/10/2020	0	0	0	0	0	0	0	0	0	0	0
9/11/2020	0	0	0	0	0	0	0	0	0	0	0
9/12/2020	0	0	0	0	0	0	0	0	0	0	0
9/13/2020	0	0	0	0	0	0	0	0	0	0	0
9/14/2020	0	0	0	0	0	0	0	0	0	0	0
9/15/2020	0	0	0	0	0	0	0	0	0	0	0
9/16/2020	0	0	0	0	0	0	0	0	0	0	0
9/17/2020	0	0	0	0	0	0	0	0	0	0	0
9/18/2020	0	0	0	0	0	0	0	0	0	0	0
9/19/2020	0	0	0	0	0	0	0	0	0	0	0
9/20/2020	0	0	0	0	0	0	0	0	0	0	0
9/21/2020	0	0	0	0	0	0	0	0	0	0	0
9/22/2020	0	0	0	0	0	0	0	0	0	0	0

Table I-10 Upriver daily oxygen transfer load (pounds) by intermittent area and continuous site zone

Date	Oxygen Transfer Load (pounds)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
7/25/2020	0.325	1.529	0.426	0	4.077	10.194	113.852	5.451	97.636	0	0
7/26/2020	0.334	1.205	0.181	0	3.321	8.818	95.708	0.909	16.256	0	0
7/27/2020	1.065	2.536	1.043	0	5.711	12.988	145.585	29.261	493.011	0	0
7/28/2020	0.233	1.880	0.734	0	3.312	8.140	85.950	7.318	121.042	0	0
7/29/2020	0.044	0.960	0.293	0	1.738	4.579	46.539	0.722	11.440	0	0
7/30/2020	0.020	0.194	0.012	0	0.529	2.161	19.094	0	0	0	0
7/31/2020	0.050	0.353	0.012	0	0.853	2.533	20.478	0	0	0	0
8/1/2020	0.025	0.437	0	0	0.503	2.056	15.393	0	0	0	0
8/2/2020	0.194	1.115	0.111	0	1.542	3.782	36.104	1.056	16.330	0	0
8/3/2020	0.047	0.786	0.031	0	0.835	2.443	16.692	0	0	0	0
8/4/2020	0.174	1.144	0.091	0	1.555	4.078	36.855	0.057	0.969	0	0
8/5/2020	0.249	1.324	0.135	0	1.959	4.858	46.406	4.984	84.879	0.001	0
8/6/2020	0.040	0.553	0.022	0	0.608	1.921	17.976	0	0	0	0
8/7/2020	0.031	0.514	0.003	0	0.599	1.836	16.342	0	0	0	0
8/8/2020	0.014	0.335	0	0	0.401	1.604	12.694	0	0	<0.001	<0.001
8/9/2020	0.002	0.096	0	0	0.011	0.215	0.410	0	0	0	0
8/10/2020	0.013	0.123	0	0	0.192	0.899	9.776	0	0	0	0
8/11/2020	0	0.020	0	0	0.007	0.206	2.766	0	0	0	0
8/12/2020	0.012	0.029	0	0	0.012	0.199	5.698	0	0	0	0
8/13/2020	0.001	0.063	0	0	0.072	0.479	12.255	0	0	0	0
8/14/2020	0.001	0	0	0	0	0.211	4.411	0	0	0	0
8/15/2020	0.003	0	0	0	0.011	1.045	12.539	0	0	0	0
8/16/2020	0.014	0	0	0	0.001	0.285	1.575	0	0	0	0

Date	Oxygen Transfer Load (pounds)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
8/17/2020	0.007	0	0	0	0.012	0.251	3.534	0	0	0	0
8/18/2020	0	0	0	0	<0.001	0.019	0.707	0	0	0	0
8/19/2020	0	0	0	0	0	0.007	0.119	0	0	0	0
8/20/2020	0	0	0	0	0	0	0.004	0	0	0	0
8/21/2020	0	0	0	0	0	0	0	0	0	0	0
8/22/2020	0	0	0	0	0	0	0	0	0	0	0
8/23/2020	0	0	0	0	0	0	0	0	0	<0.001	0
8/24/2020	0	0	0	0	0	0	0	0	0	<0.001	0
8/25/2020	0	0	0	0	0	0	0	0	0	0	0
8/26/2020	0	0	0	0	0	0	0	0	0	0	0
8/27/2020	0	0	0	0	0	0	0	0	0	0	0
8/28/2020	0	0	0	0	0	0	0	0	0	0	0
8/29/2020	0	0	0	0	0	0	0	0	0	0	0
8/30/2020	0	0	0	0	0	0	0	0	0	0	0
8/31/2020	0	0	0	0	0	0	0	0	0	0	0
9/1/2020	0	0	0	0	0	0	0	0	0	0	0
9/2/2020	0	0	0	0	0	0	0	0	0	0	0
9/3/2020	0	0	0	0	0	0	0	0	0	0	0
9/4/2020	0	0	0	0	0	0	0	0	0	0	0
9/5/2020	0	0	0	0	0	0	0	0	0	0	0
9/6/2020	0	0	0	0	0	0	0	0	0	0	0
9/7/2020	0	0	0	0	0	0	0	0	0	0	0
9/8/2020	0	0	0	0	0	0	0	0	0	0	0
9/9/2020	0	0	0	0	0	0	0	0	0	0	0

Date	Oxygen Transfer Load (pounds)										
	UR_12	UR_13	UR_14	UR_15	UR_16	UR_17	UR_18	Hardeeville	Abercorn	Intermittent Area 1	Intermittent Area 2
9/10/2020	0	0	0	0	0	0	0	0	0	0	0
9/11/2020	0	0	0	0	0	0.580	9.516	0	0	0	0
9/12/2020	0	0.002	0	0	0	1.002	18.371	0	0	0	0
9/13/2020	0.036	0.109	0.032	0	0.404	2.647	38.151	0	0	<0.001	0
9/14/2020	0.260	0.942	0.623	0.034	1.481	4.889	70.169	7.425	127.037	0	0
9/15/2020	0.111	0.717	0.327	0.002	1.342	5.634	79.862	0.864	13.768	0	0
9/16/2020	0.004	0.035	0.003	0	0.114	2.385	35.686	0	0	0	0
9/17/2020	0	0	0	0	0.003	0.780	21.512	0	0	0	0
9/18/2020	0	0	0	0	0	0	0	0	0	0	0
9/19/2020	0	0	0	0	0	0	0	0	0	0	0
9/20/2020	0	0	0	0	0	0	0	0	0	0	0
9/21/2020	0	0	0	0	0	0	0	0	0	0	0
9/22/2020	0	0	0	0	0	0	0	0	0	0	0

I.8 STARTUP RUN WCTE RESULTS

Daily average WCTE values for each discharge location have been presented below. The daily averages have been combined to determine an average over the entire Startup Run. In addition, the three discharges have been combined to determine an average for the entire estuary.

Table I-11 Startup Run 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	Upriver Daily Plant DO Load (pounds/day)	Upriver WCTE	River Combination WCTE
7/25/2020	9,374	100.0%	4,687	100.0%	30,773	99.2%	99.5%
7/26/2020	10,190	100.0%	5,095	100.0%	30,609	99.6%	99.7%
7/27/2020	9,972	100.0%	4,986	100.0%	31,101	97.8%	98.5%
7/28/2020	10,048	100.0%	5,024	100.0%	29,616	99.2%	99.5%
7/29/2020	10,037	100.0%	5,019	100.0%	30,841	99.8%	99.9%
7/30/2020	10,007	100.0%	5,003	100.0%	23,597	99.9%	99.9%
7/31/2020	9,060	100.0%	4,530	100.0%	25,366	99.9%	99.9%
8/1/2020	8,903	100.0%	4,451	100.0%	25,218	99.9%	100.0%
8/2/2020	8,656	100.0%	4,328	100.0%	25,236	99.8%	99.8%
8/3/2020	8,569	100.0%	4,284	100.0%	25,567	99.9%	99.9%
8/4/2020	8,731	100.0%	4,365	100.0%	26,707	99.8%	99.9%
8/5/2020	8,882	100.0%	4,441	100.0%	26,291	99.4%	99.6%
8/6/2020	9,399	100.0%	4,699	100.0%	24,305	99.9%	99.9%
8/7/2020	9,102	100.0%	4,551	100.0%	26,144	99.9%	100.0%
8/8/2020	7,526	100.0%	3,763	100.0%	26,698	99.9%	100.0%
8/9/2020	7,384	100.0%	3,692	100.0%	26,821	100.0%	100.0%
8/10/2020	9,369	100.0%	4,684	100.0%	26,742	100.0%	100.0%
8/11/2020	8,809	100.0%	4,404	100.0%	26,755	100.0%	100.0%
8/12/2020	9,111	100.0%	4,555	100.0%	26,845	100.0%	100.0%
8/13/2020	9,366	100.0%	4,683	100.0%	28,087	100.0%	100.0%
8/14/2020	8,505	100.0%	4,253	99.7%	28,441	100.0%	100.0%
8/15/2020	9,266	100.0%	4,633	99.8%	30,253	100.0%	99.9%
8/16/2020	9,110	100.0%	4,555	99.8%	30,332	100.0%	100.0%
8/17/2020	8,710	100.0%	4,355	100.0%	30,295	100.0%	100.0%
8/18/2020	8,654	100.0%	4,327	100.0%	29,868	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	Upriver Daily Plant DO Load (pounds/day)	Upriver WCTE	River Combination WCTE
8/19/2020	9,338	100.0%	4,669	100.0%	30,205	100.0%	100.0%
8/20/2020	9,536	100.0%	4,768	100.0%	30,529	100.0%	100.0%
8/21/2020	9,315	100.0%	4,658	100.0%	30,923	100.0%	100.0%
8/22/2020	9,689	100.0%	4,845	100.0%	31,309	100.0%	100.0%
8/23/2020	7,884	100.0%	3,942	100.0%	31,054	100.0%	100.0%
8/24/2020	6,164	100.0%	3,082	100.0%	30,139	100.0%	100.0%
8/25/2020	6,254	100.0%	3,127	100.0%	28,947	100.0%	100.0%
8/26/2020	6,010	100.0%	3,005	100.0%	28,403	100.0%	100.0%
8/27/2020	6,780	100.0%	3,390	100.0%	27,728	100.0%	100.0%
8/28/2020	9,810	100.0%	4,905	100.0%	29,703	100.0%	100.0%
8/29/2020	9,930	100.0%	4,965	100.0%	31,193	100.0%	100.0%
8/30/2020	10,175	100.0%	5,088	100.0%	30,930	100.0%	100.0%
8/31/2020	10,125	100.0%	5,062	100.0%	29,062	100.0%	100.0%
9/1/2020	10,241	100.0%	5,120	100.0%	28,135	100.0%	100.0%
9/2/2020	10,640	100.0%	5,320	100.0%	28,342	100.0%	100.0%
9/3/2020	10,694	100.0%	5,347	100.0%	27,188	100.0%	100.0%
9/4/2020	8,928	100.0%	4,464	100.0%	26,358	100.0%	100.0%
9/5/2020	5,956	100.0%	2,978	100.0%	28,404	100.0%	100.0%
9/6/2020	10,387	100.0%	5,194	100.0%	29,975	100.0%	100.0%
9/7/2020	10,204	100.0%	5,102	100.0%	31,633	100.0%	100.0%
9/8/2020	9,897	100.0%	4,948	100.0%	30,461	100.0%	100.0%
9/9/2020	9,143	100.0%	4,572	100.0%	29,456	100.0%	100.0%
9/10/2020	9,538	100.0%	4,769	100.0%	23,578	100.0%	100.0%
9/11/2020	9,296	100.0%	4,648	100.0%	29,700	100.0%	100.0%
9/12/2020	9,999	100.0%	5,000	100.0%	29,678	99.9%	100.0%
9/13/2020	10,141	100.0%	5,070	100.0%	28,432	99.9%	99.9%
9/14/2020	9,860	100.0%	4,930	100.0%	30,544	99.3%	99.5%
9/15/2020	9,759	100.0%	4,879	100.0%	31,316	99.7%	99.8%
9/16/2020	9,224	100.0%	4,612	100.0%	31,999	99.9%	99.9%
9/17/2020	6,921	100.0%	3,461	100.0%	30,301	99.9%	99.9%

Date	Front River Daily Plant DO Load (pounds/day)	Front River WCTE	Back River Daily Plant DO Load (pounds/day)	Back River WCTE	Upriver Daily Plant DO Load (pounds/day)	Upriver WCTE	River Combination WCTE
9/18/2020	9,801	100.0%	4,900	100.0%	29,218	100.0%	100.0%
9/19/2020	8,057	100.0%	4,029	100.0%	31,022	100.0%	100.0%
9/20/2020	7,412	100.0%	3,706	100.0%	30,782	100.0%	100.0%
9/21/2020	9,540	100.0%	4,770	100.0%	30,117	100.0%	100.0%
9/22/2020	9,570	100.0%	4,785	100.0%	31,020	100.0%	100.0%
Average	9,049	100.0%	4,525	100.0%	28,838	99.9%	99.9%

APPENDIX J USGS ANALYSIS

APPENDIX J USGS DATA ANALYSIS

Start-up Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Tasks: 10
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PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX J BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document is provided as Appendix J of the SUR Report and is referred to in the main body of the report in Section 7.1, 7.2, and 7.3.

ATTACHMENT A – TEST RUN ANALYSIS

SHEP Test Run

Evaluation of Impact - Final

October 2020

Objective – Evaluate whether the Test Run worked using available data?

- USACE constructed and now operates two oxygen (O_2) injection system for the Savannah River
  - Upriver (Plant McIntosh) and Downriver (Hutchinson Island) facilities
  - Test Run was March 14 through May 12, 2019
  - Goal is to inject O_2 into water as a form for mitigation for harbor deepening – End goal is an increase in O_2 levels in the river/harbor
  - During the Test Run, USACE injected 13,385 lb/day of O_2 over 59 days
- There are numerous USGS gages along the river which measure several physiochemical parameters, including dissolved oxygen
- Can we detect a change in O_2 at these various gages during the Test Run, or---did the Test Run work?

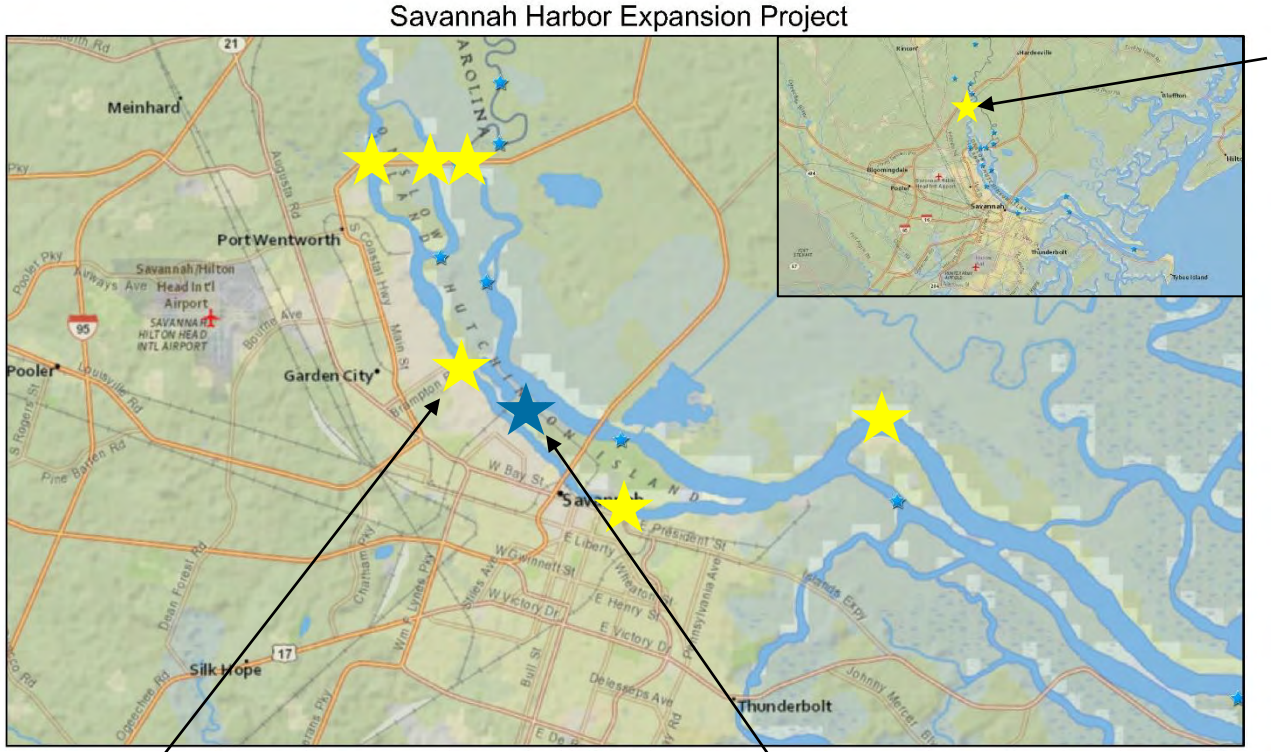
Analysis Platform -



- Use R for analysis
- R is an open-source, free, statistical computing platform (www.r-project.org)
- Why R?
  - R can be downloaded and used by anyone
  - R is a scripting language – code written for analysis can be run on any computer with R installed
  - R is extremely powerful – R can easily handle large data sets
  - R is used extensively by the academic community, so cutting edge statistical techniques are often implemented in R
  - R has powerful graphing and web-based capabilities

GHD

Data – Numerous USGS gages on River

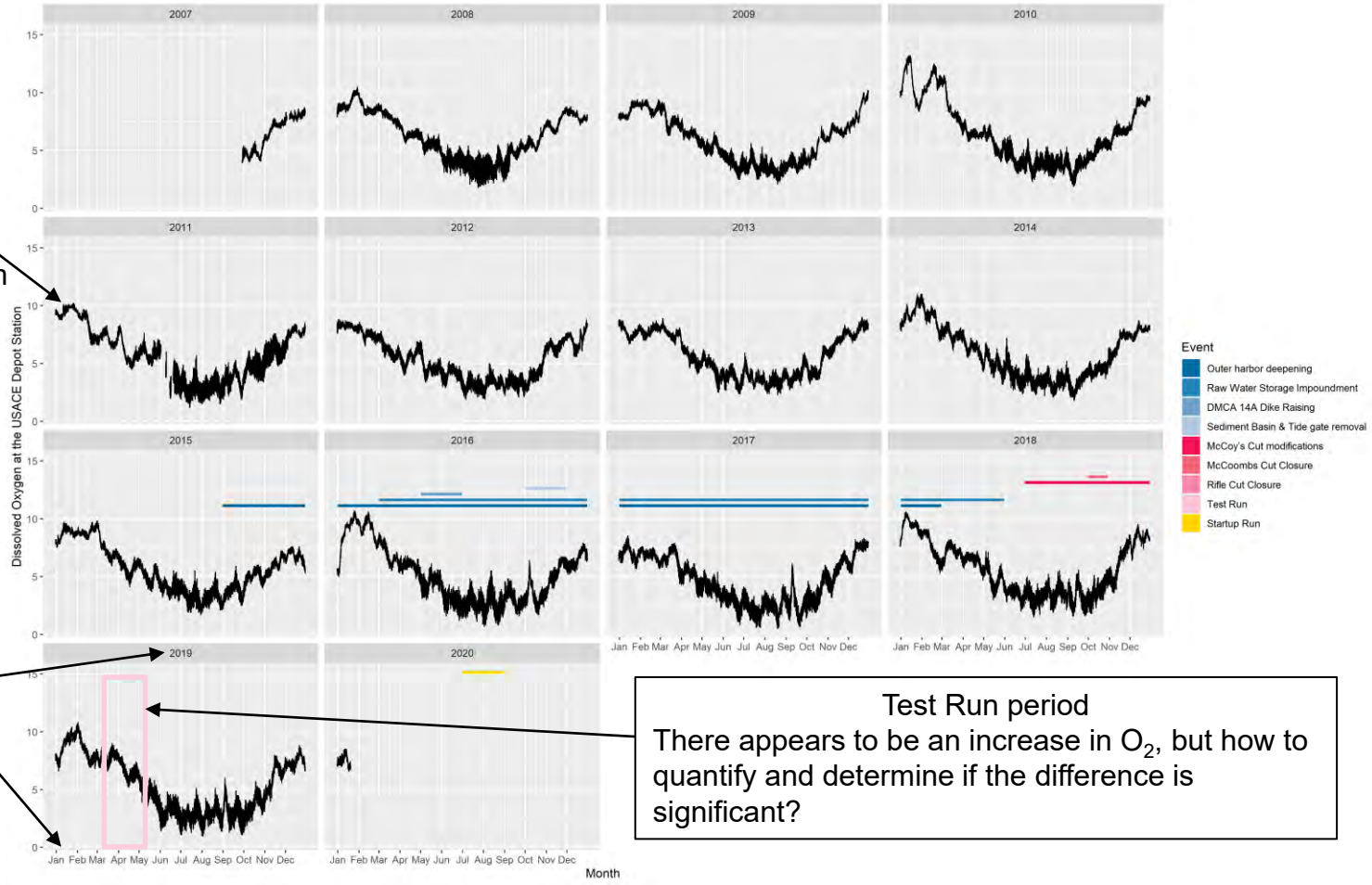


Savannah Harbor Expansion Project

Start with USACE Depot station (USGS gage 021989773)



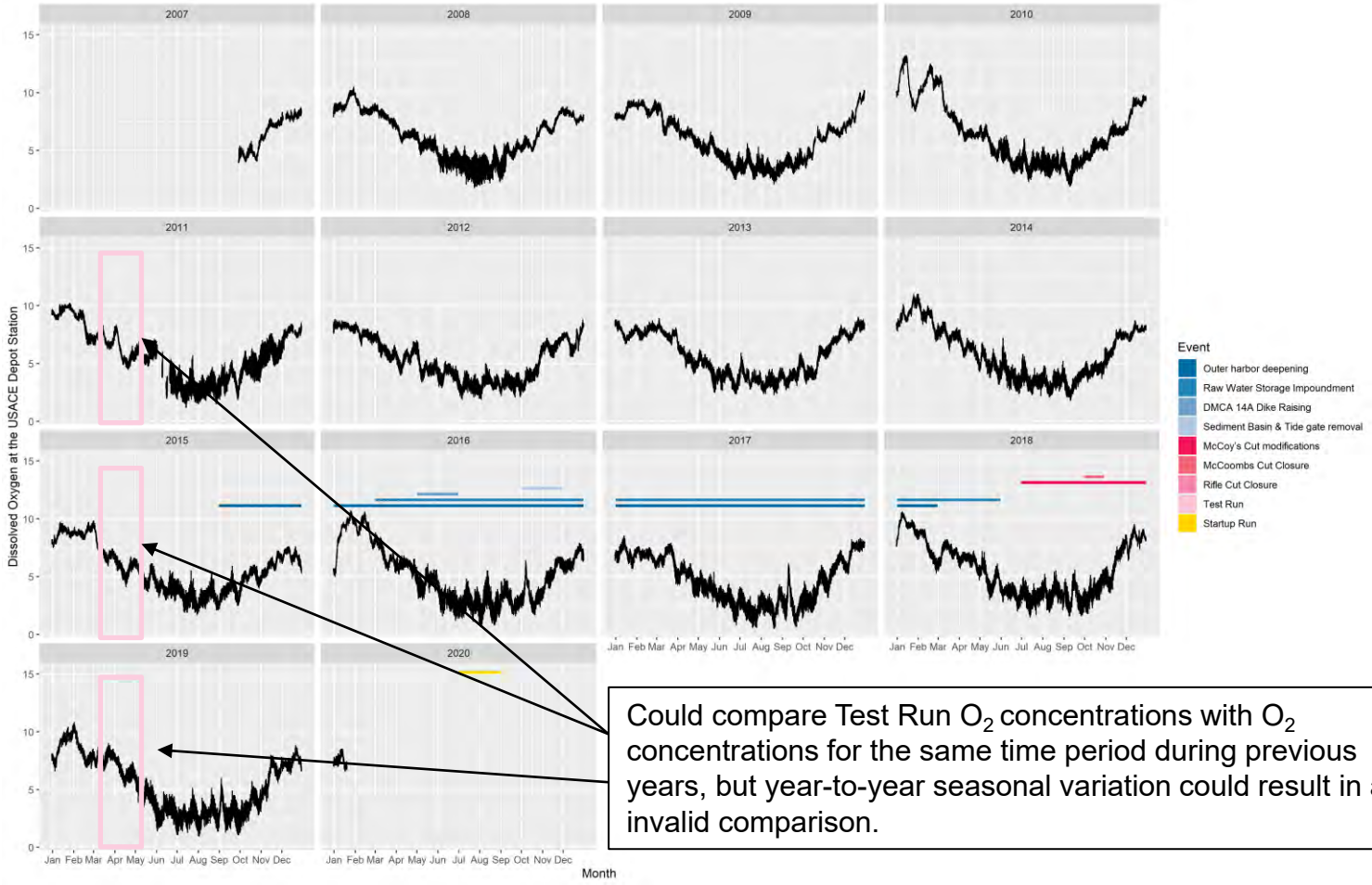
Dissolved oxygen at the USACE Depot Station from 2007-2020



Year by Month

Test Run period

There appears to be an increase in O_2, but how to quantify and determine if the difference is significant?



Could compare Test Run O_2 concentrations with O_2 concentrations for the same time period during previous years, but year-to-year seasonal variation could result in an invalid comparison.

Create a control?

- Ideally we want a control period that matches closely with the Test Run period---compare apples to apples
  - But not just any apple to any apple, we want to compare Granny Smith apples grown in New Hampshire to Granny Smith apples grown in NH
- Data include salinity, gage height, temperature.
- Can we use these variables to match test run data with non-test run data?
  - For each Test Run timepoint choose a timepoint outside the Test Run that matches
- Depot station has 434,331 time-point observations
- 5,668 of these are during the Test Run

Create a control?

- Approach: use Euclidean distance to identify “control” point most similar to test run point
- Result: Data set of paired test-control observations selected from the full time series.

Test-Control Data Set – Depot Station

Test Run Timepoint Values

Pair	Time Period	Gage Height (ft)	Water Temp (C)	Salinity	Date-Time	Dissolved O_2	% Saturation
1	Test	2.91	16.6	1.5	3/14/2019 17:45	7.3	75.6
1	Control	2.94	16.6	1.5	3/11/2016 17:15	7.5	77.7
3	Test	3.21	16.6	1.6	3/14/2019 18:15	7.3	75.6
3	Control	3.14	16.6	1.7	4/3/2014 16:45	7.3	75.7
5	Test	3.86	16.4	2.5	3/14/2019 5:30	7.1	73.7
5	Control	3.89	16.4	2.6	12/19/2015 20:00	6.6	68.5

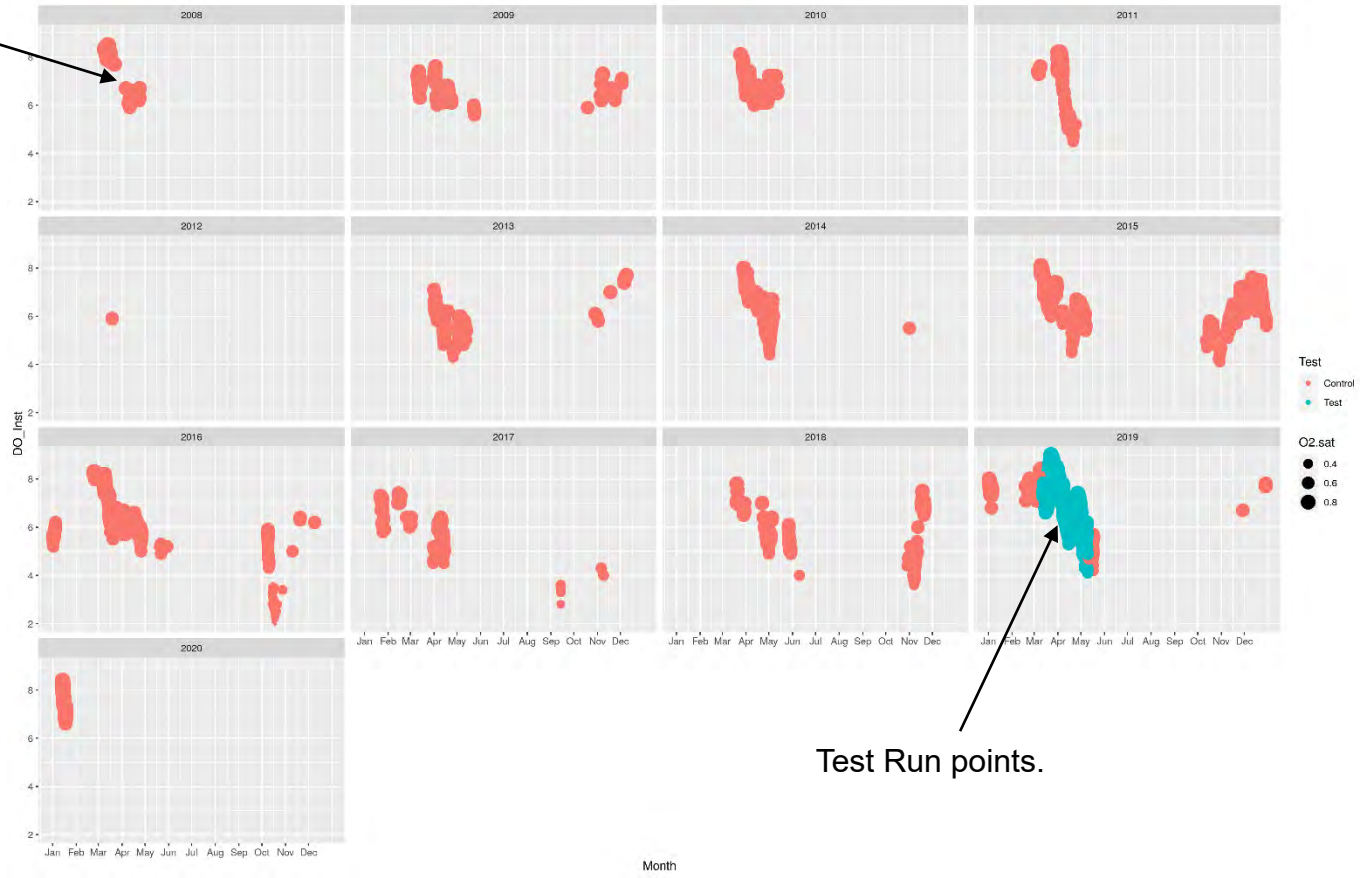
Matching Control Point Values

Algorithm matches all three variables simultaneously

021989773 – USACE Dock

Selected control points.

This plot shows the control points that were selected to match the Test Run points.

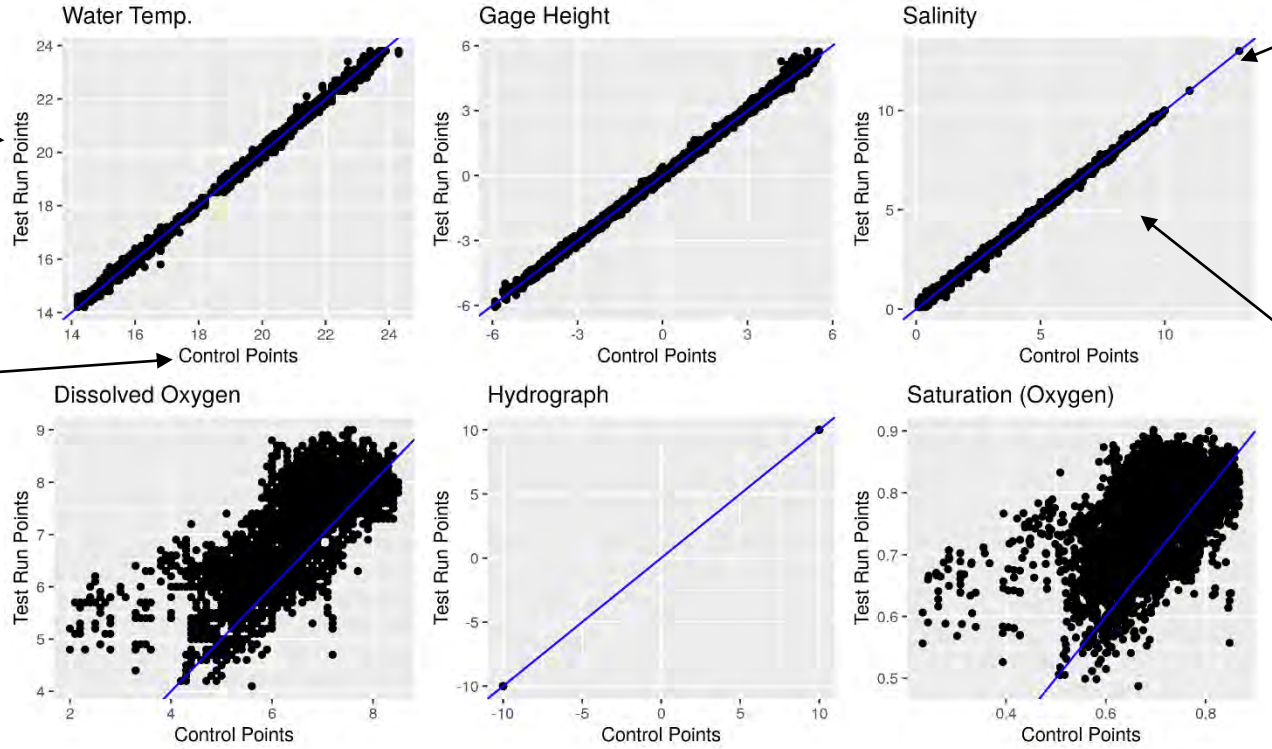


Test Run points.

021989773 – USACE Dock/Depot gage

Value for Test Run point

Matching value for control point

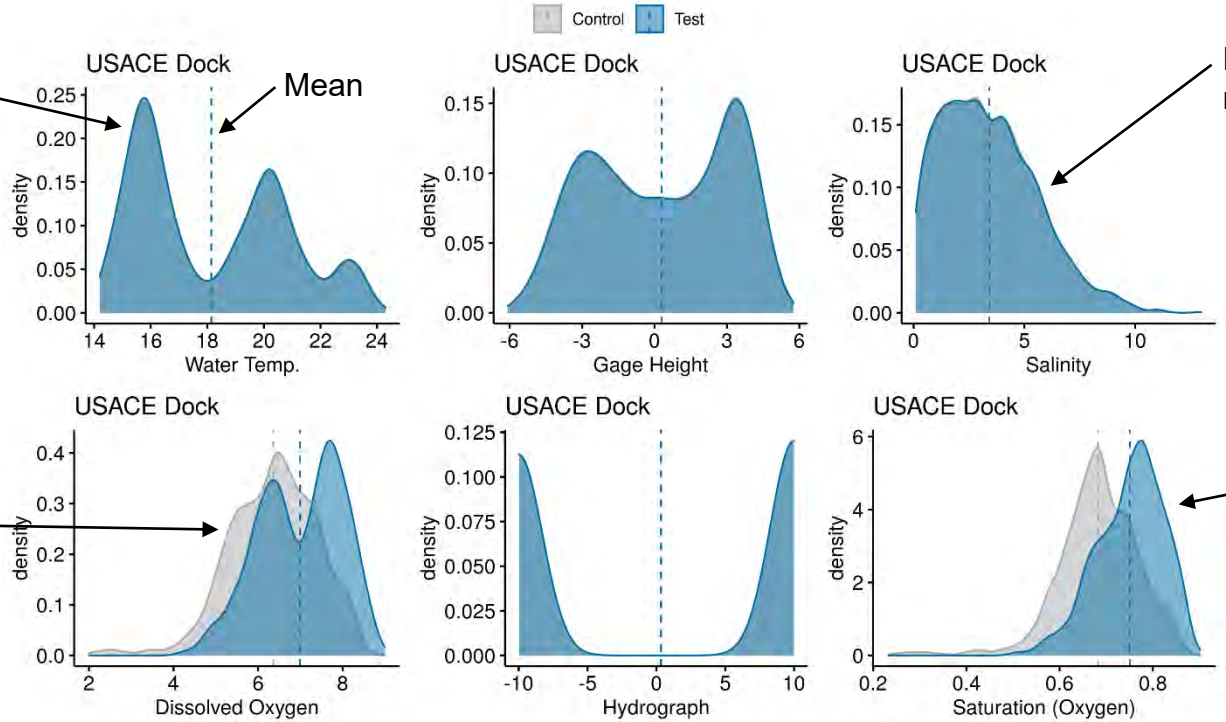


Blue line is 1:1. Points on this line mean the Test Run value and control value are equal.

Tight clustering around these lines means Test Run values and control point values are very similar.

021989773 – USACE Dock/Depot gage

Distribution of points for Test Run (blue) and control (silver)

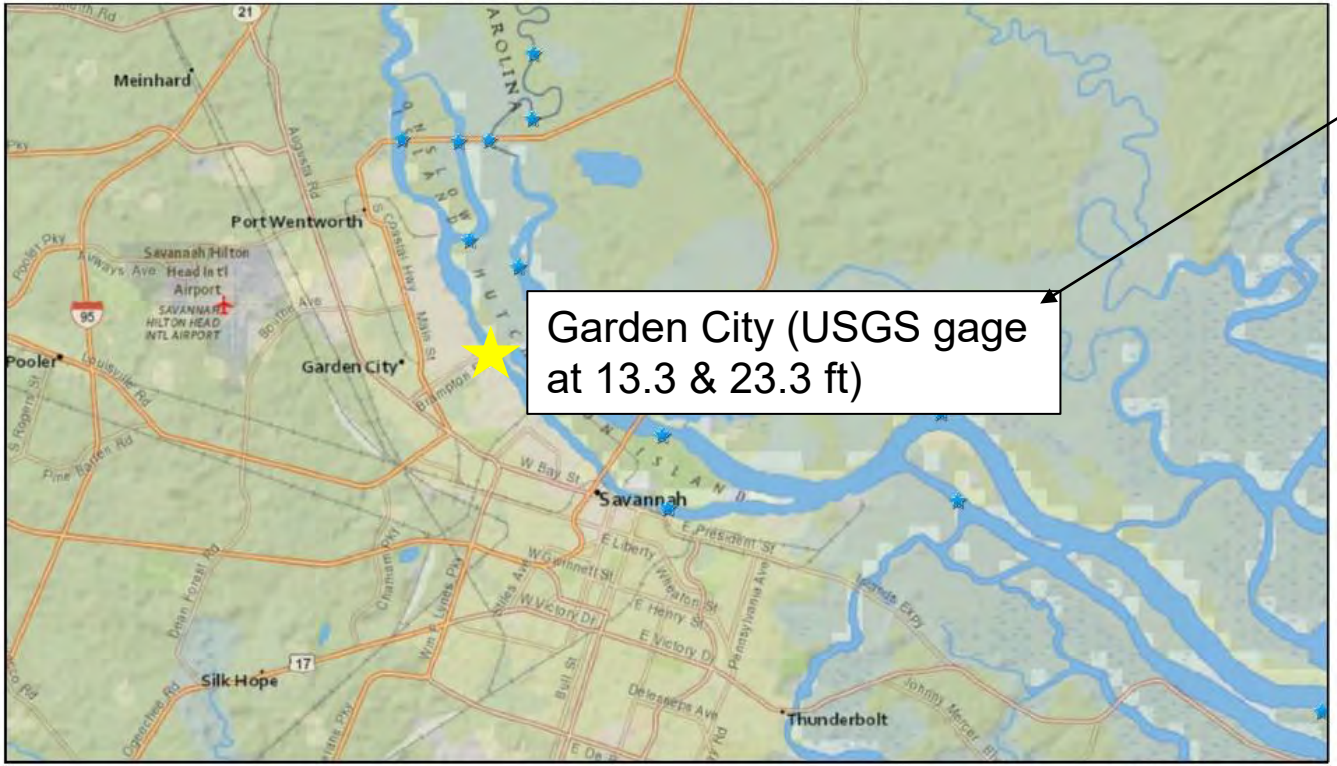


Distributions are nearly identical.

However, there are significant differences in O_2 concentration (Δ=0.64mg/L $P=2\times10^{-165}$ by t-test)

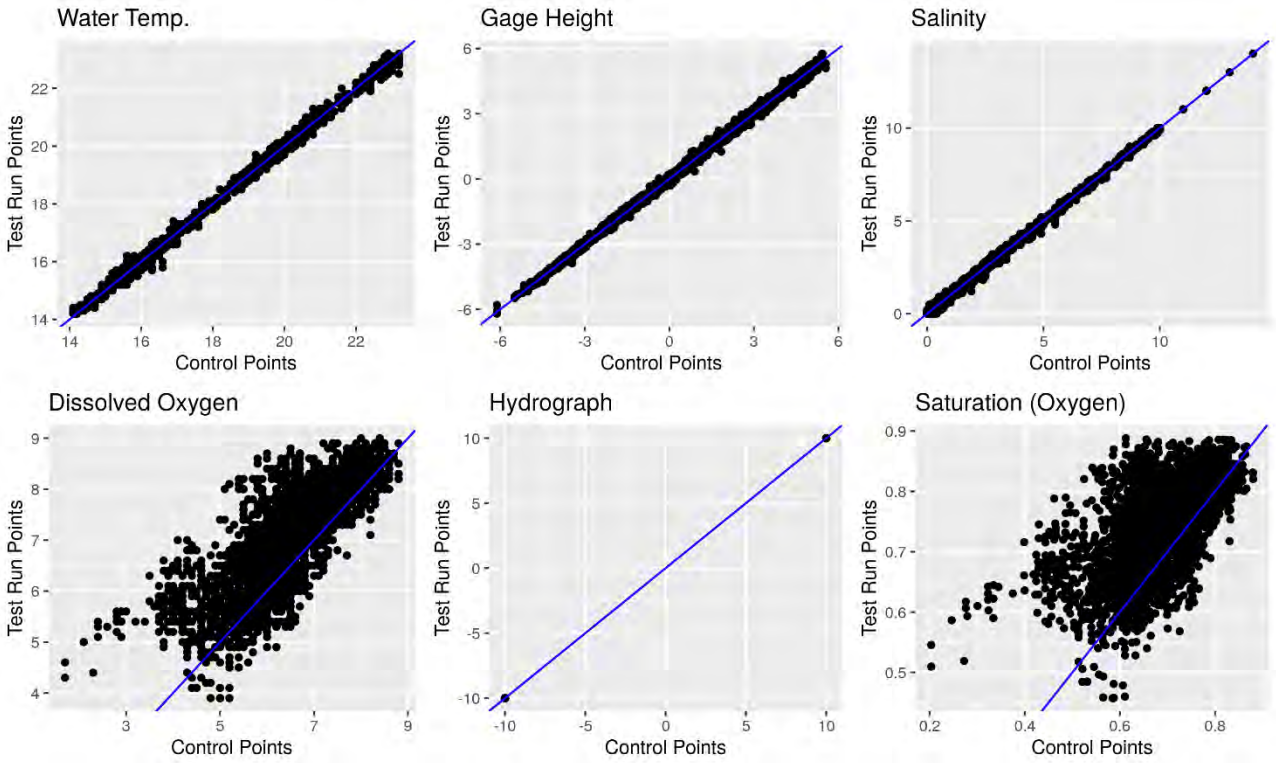
Test Run has shifted O_2 saturation substantially

Savannah Harbor Expansion Project

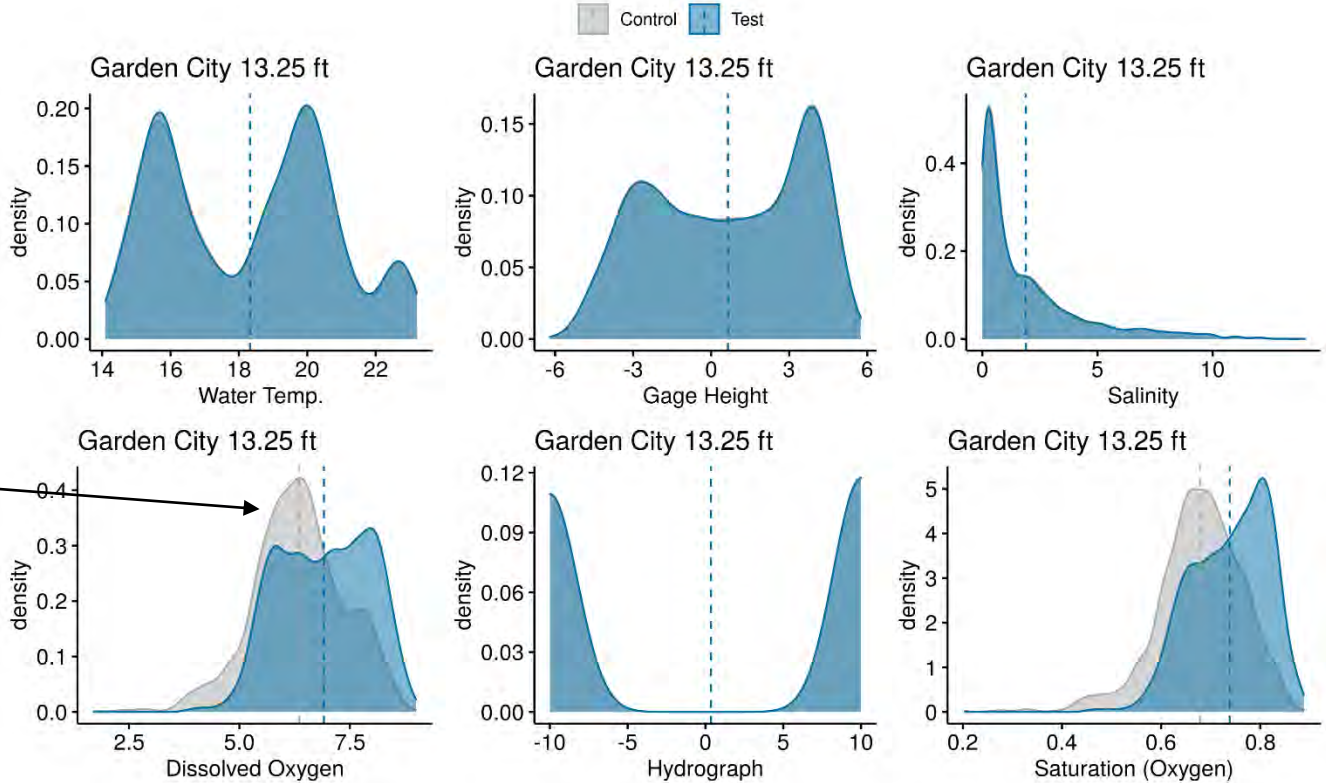


Moving upstream from Depot

021989715 – Garden City (13.25 ft)

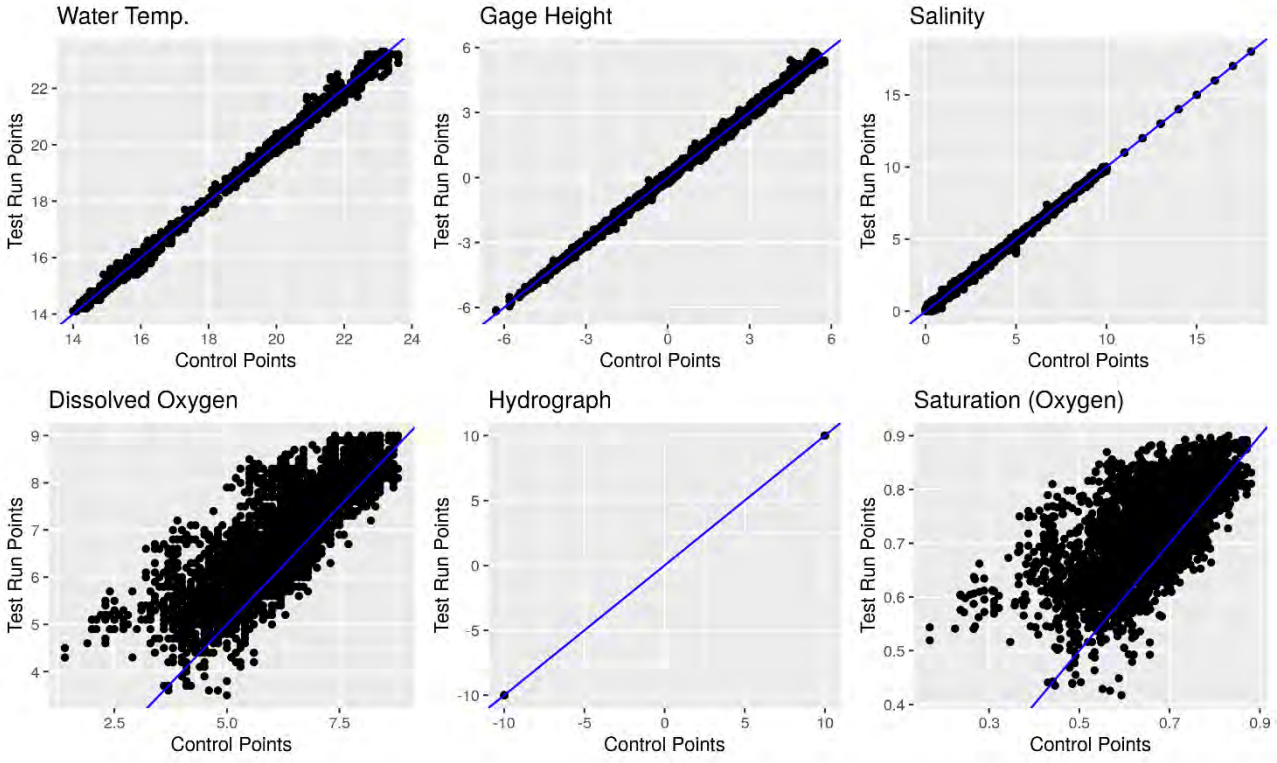


021989715 – Garden City (13.25 ft)

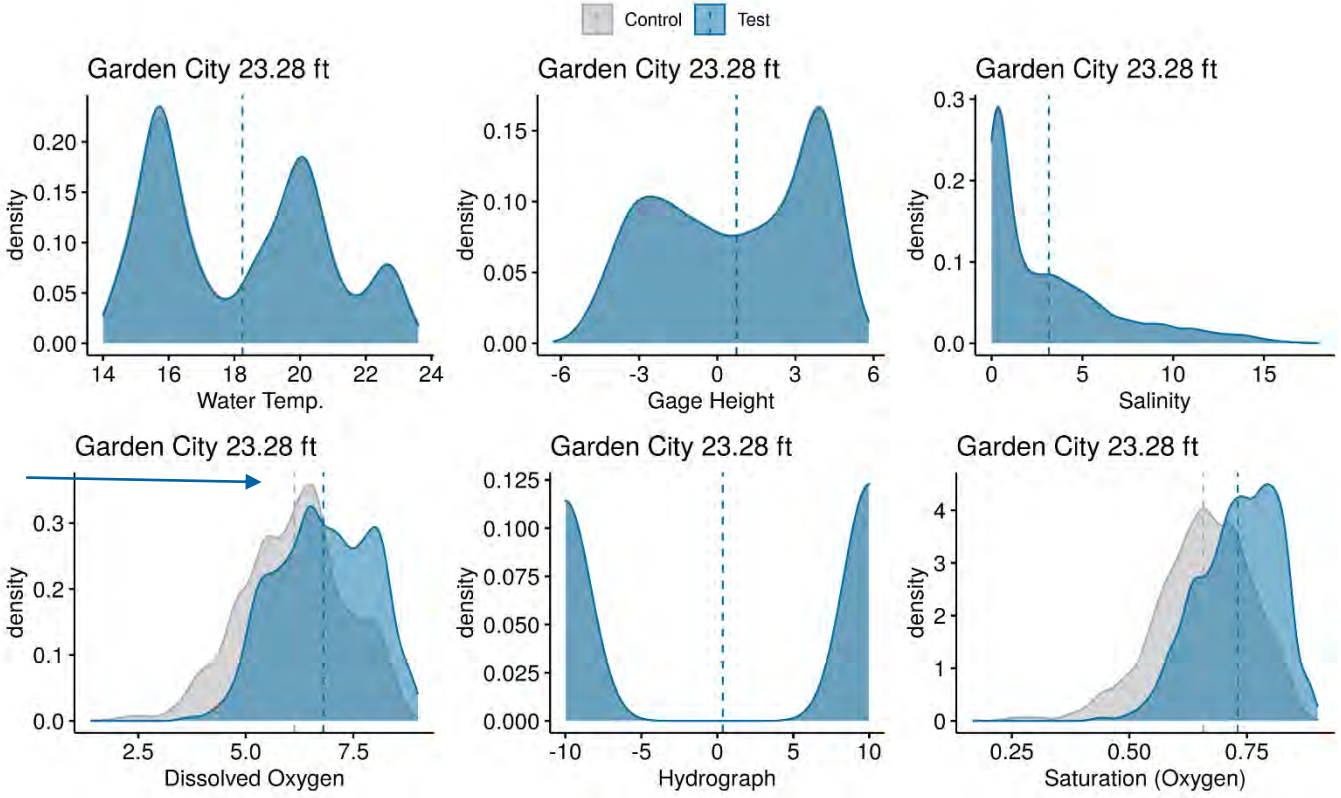


O_2 difference decreases as we move upstream, but is still significant (Δ=0.56mg/L $P=2\times10^{-110}$)

021989715 – Garden City (23.28 ft)



021989715 – Garden City (23.28 ft)



Slightly greater O_2 difference with depth (Δ=0.68 mg/L $P=7\times10^{-159}$)

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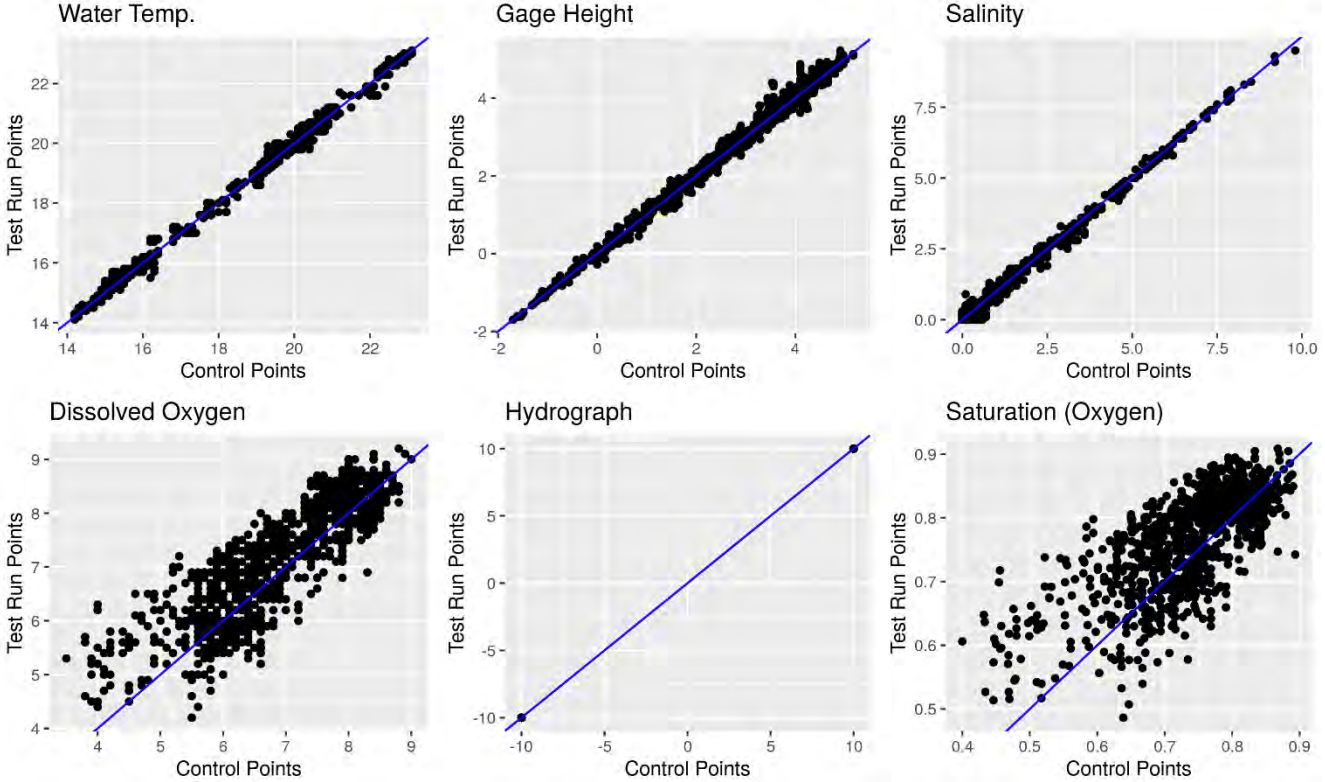
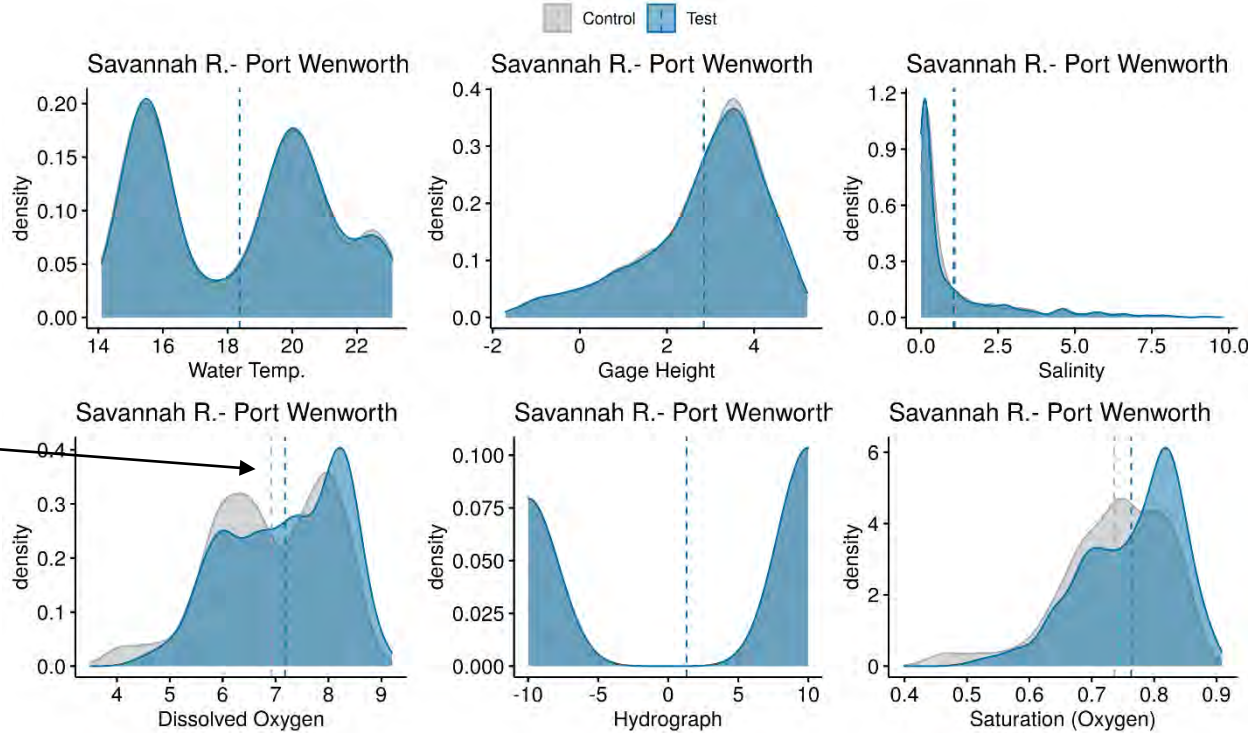
02198920 – Savannah R. at Port Wentworth

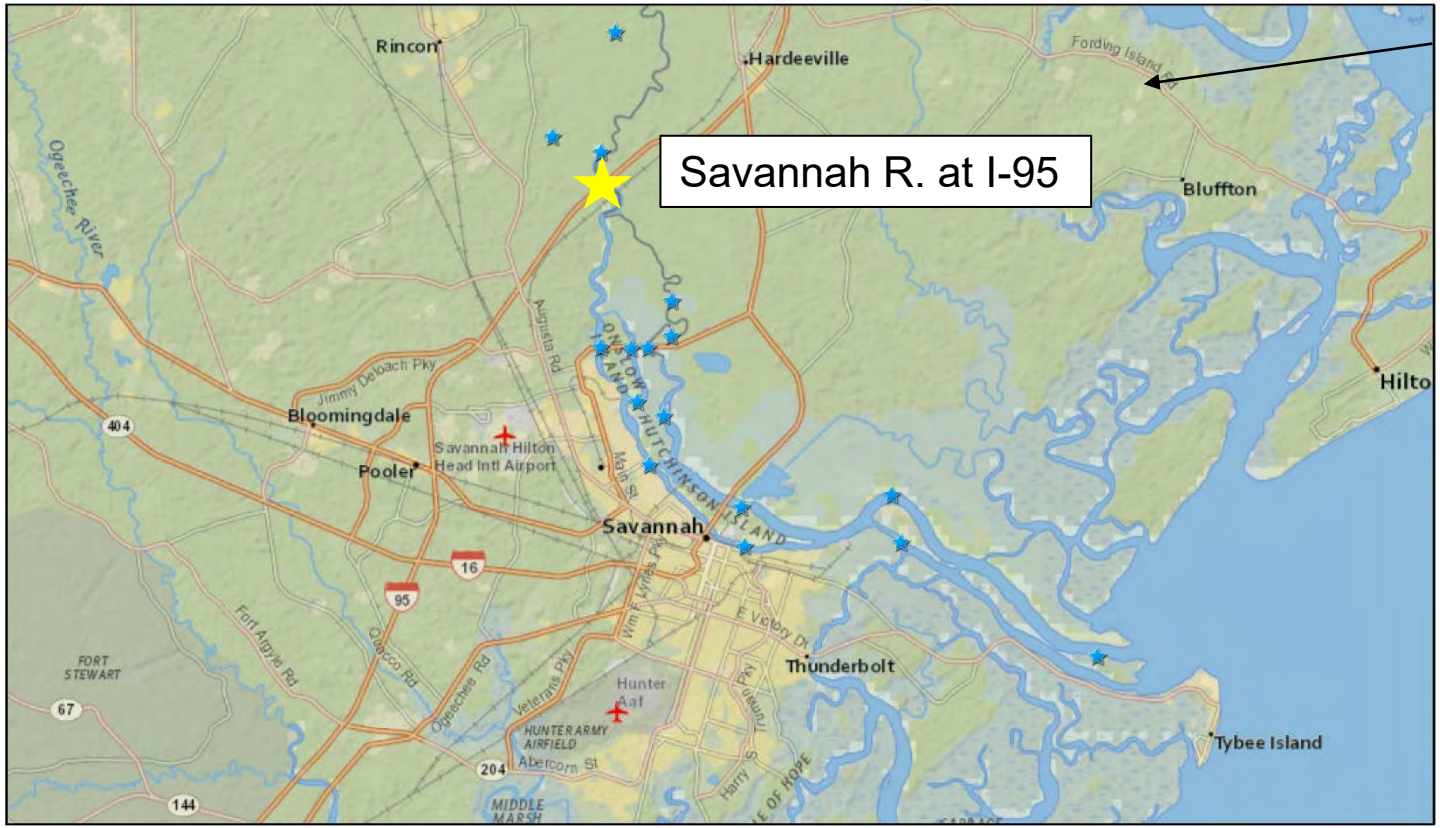


02198920 – Savannah R. at Port Wentworth



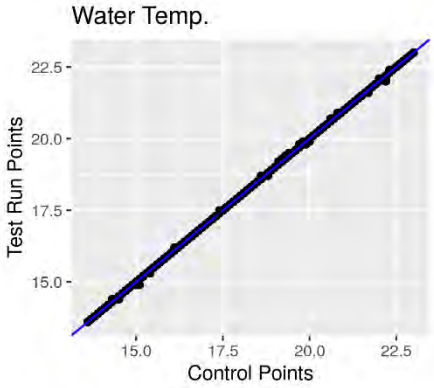
O_2 difference continues to decrease as we move upstream (Δ=0.26mg/L $P=1.2\times10^{-8}$)

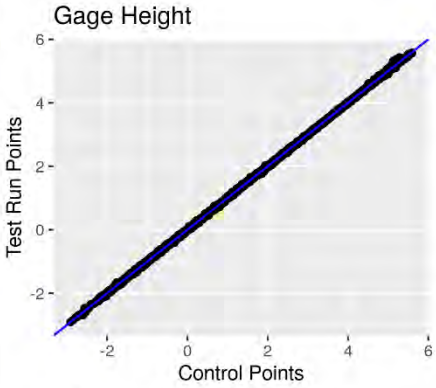
Savannah Harbor Expansion Project

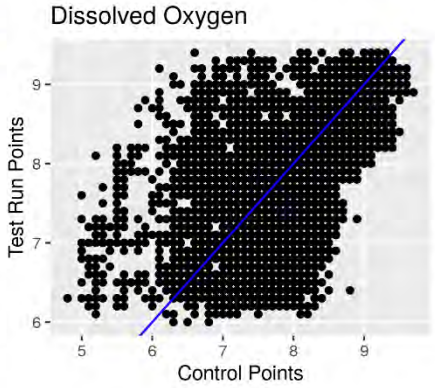


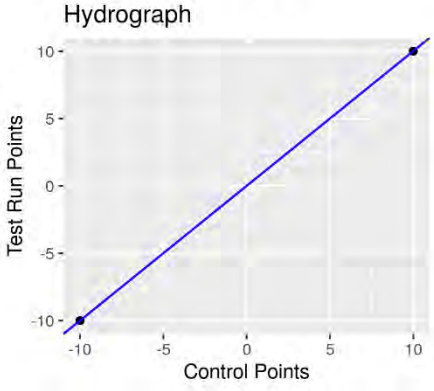
Continue moving upstream

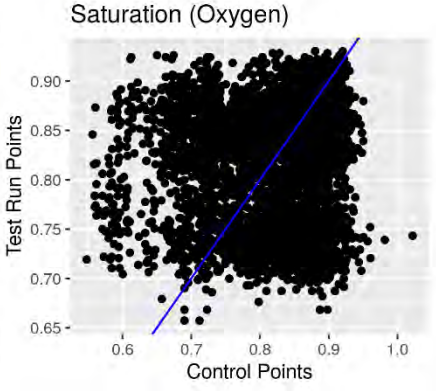
02198840 – I-95



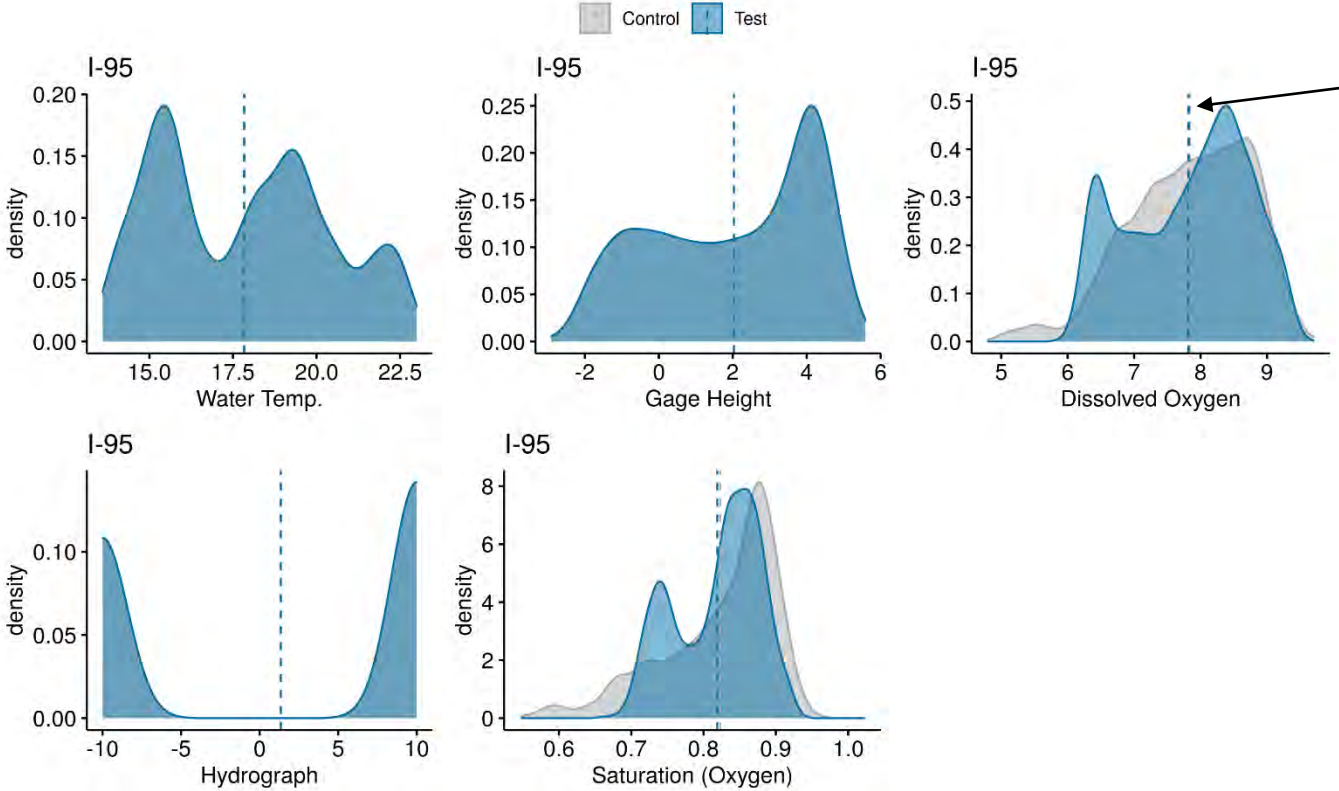








02198840 – I-95



No detectable O_2 difference at I-95, furthest upstream gage examined (Δ= -0.02 mg/ml *P=0.20*)

Savannah Harbor Expansion Project



5/18/2020 11:15:08 AM

★ USGS Gages

1:144,448

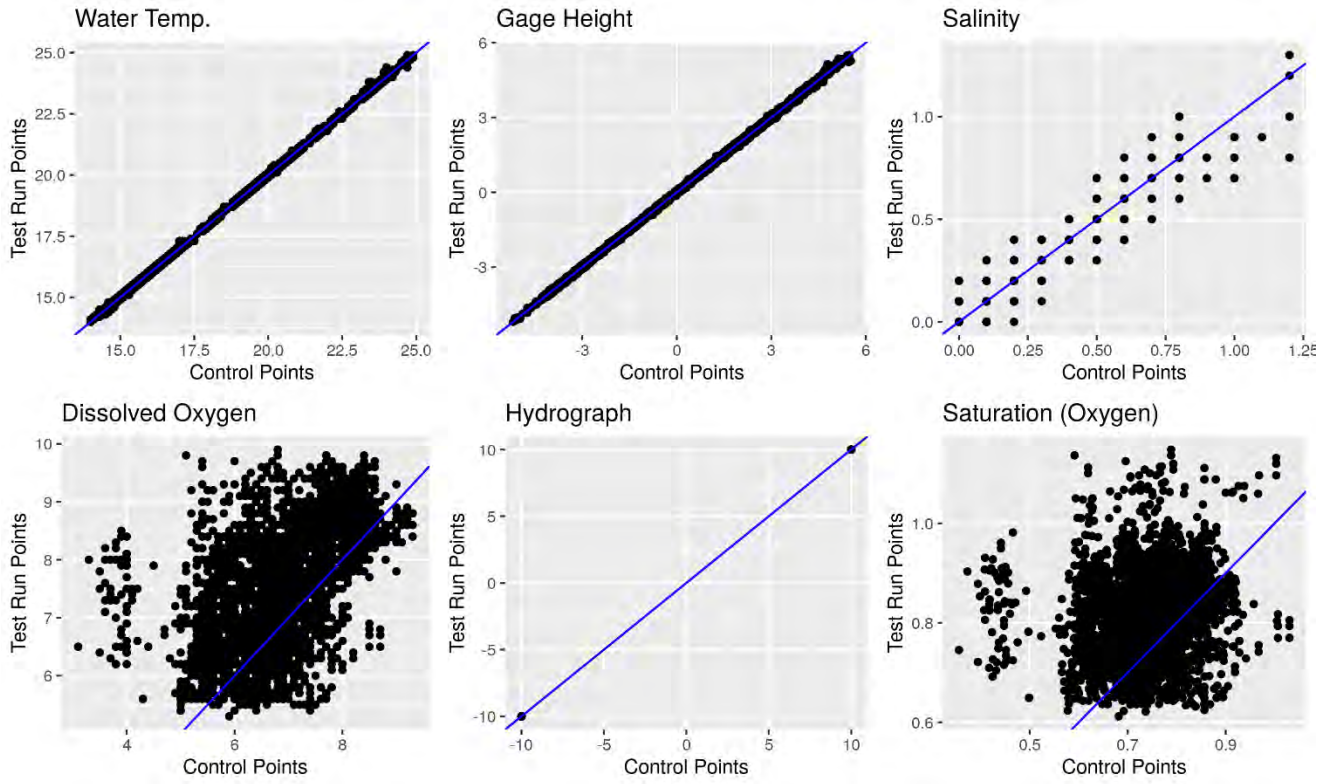
0 1 2 4 mi

0 1.5 3 6 km

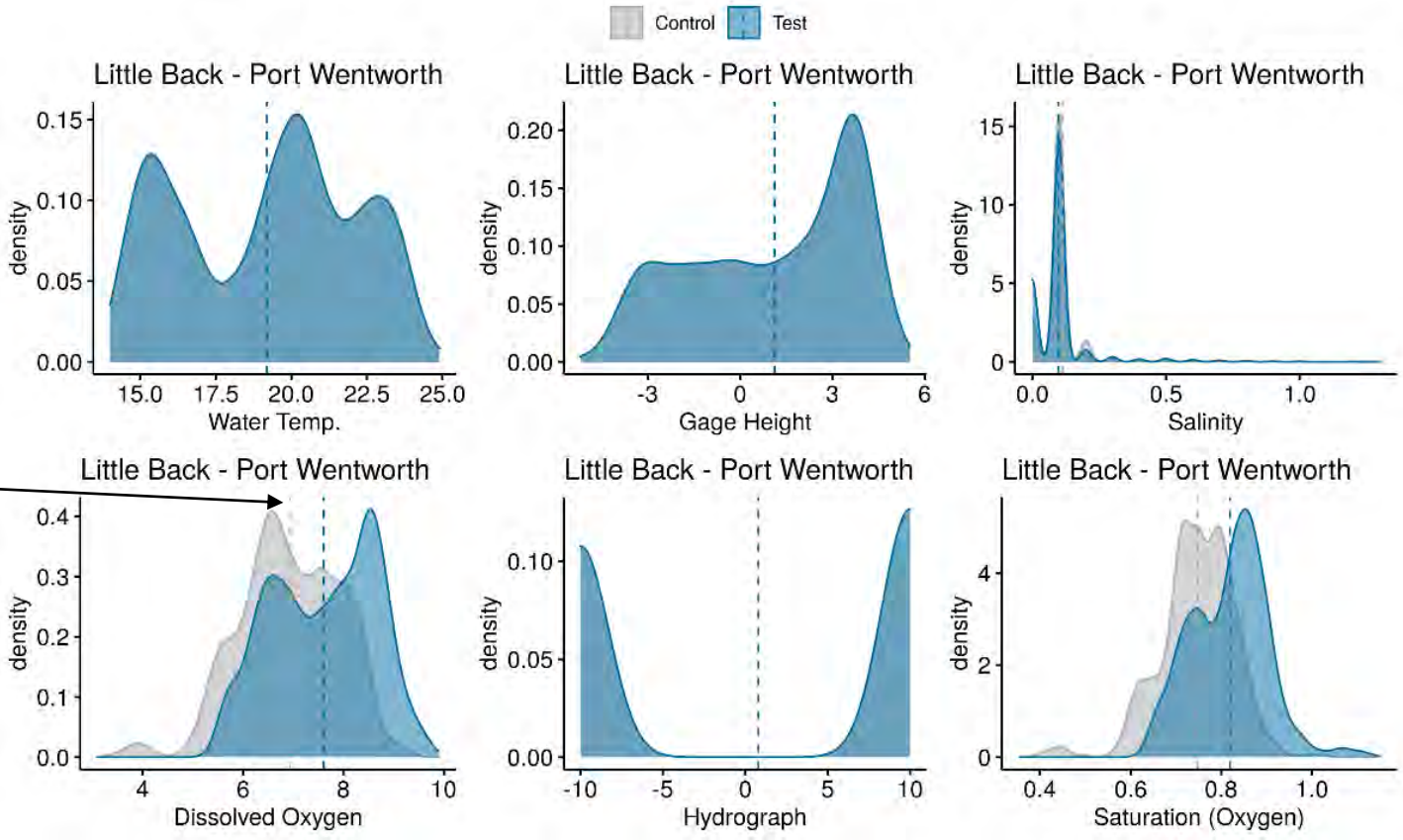
National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

US Army Corps of Engineers

021989792 – Little Back at Port Wentworth



021989792 – Little Back at Port Wentworth



As with Front River, O_2 difference decreases as we move upstream (Δ=0.67mg/ml $P=5.6\times10^{-185}$)

Savannah Harbor Expansion Project



5/18/2020 11:15:08 AM

USGS Gages

1:144,448

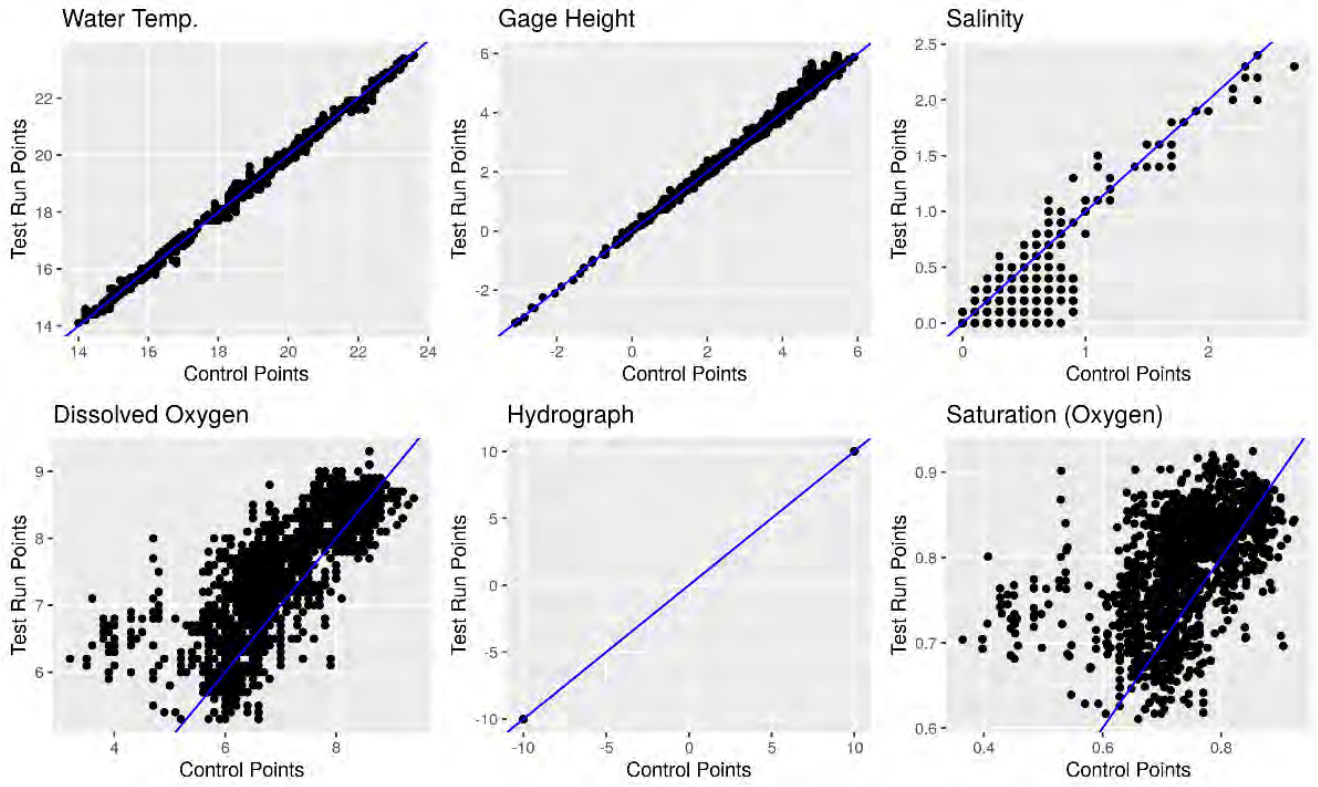
0 1 2 4 mi

0 1.5 3 6 km

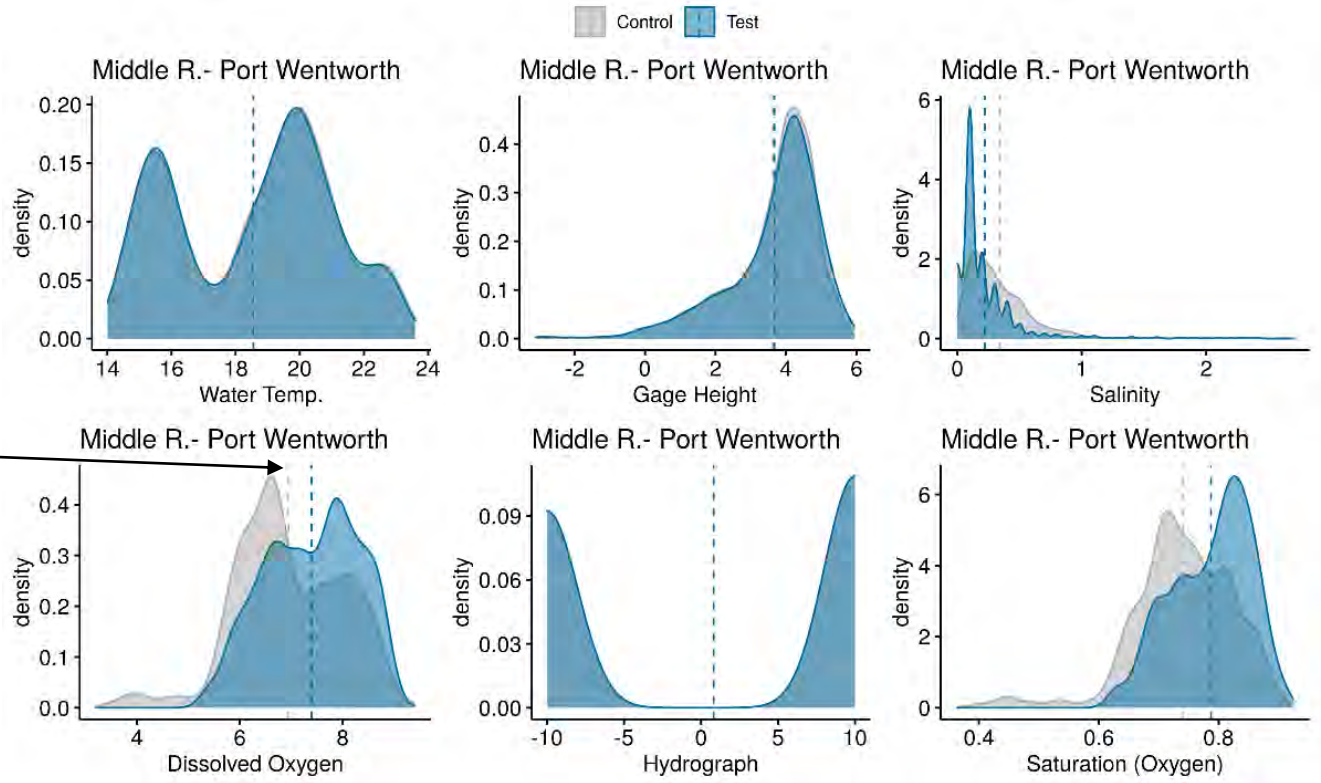
National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

US Army Corps of Engineers

02198950 – Middle River at Port Wentworth



02198950 – Middle River at Port Wentworth

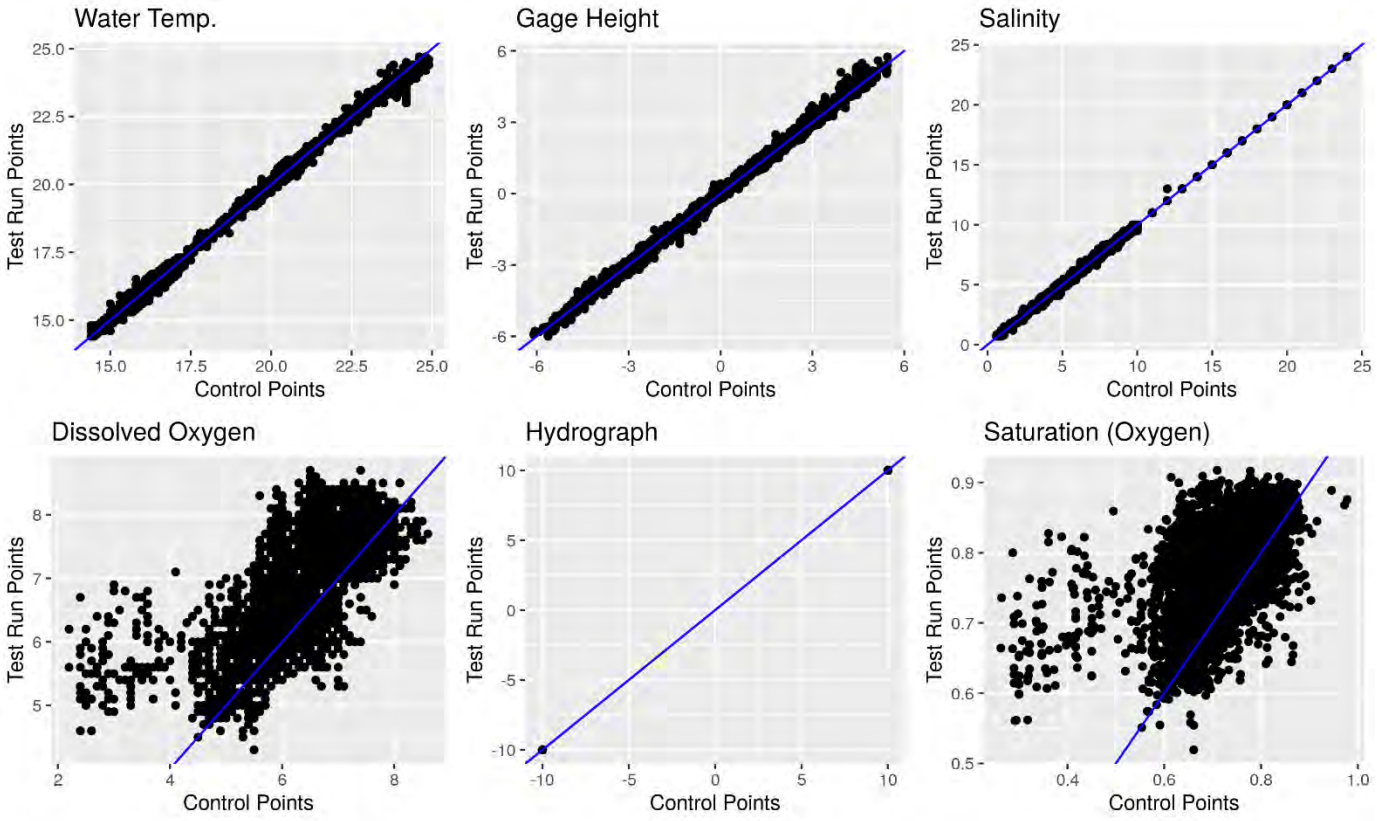


As with Front River, O_2 difference decreases as we move upstream (Δ=0.45mg/ml $P=2.8\times10^{-43}$)

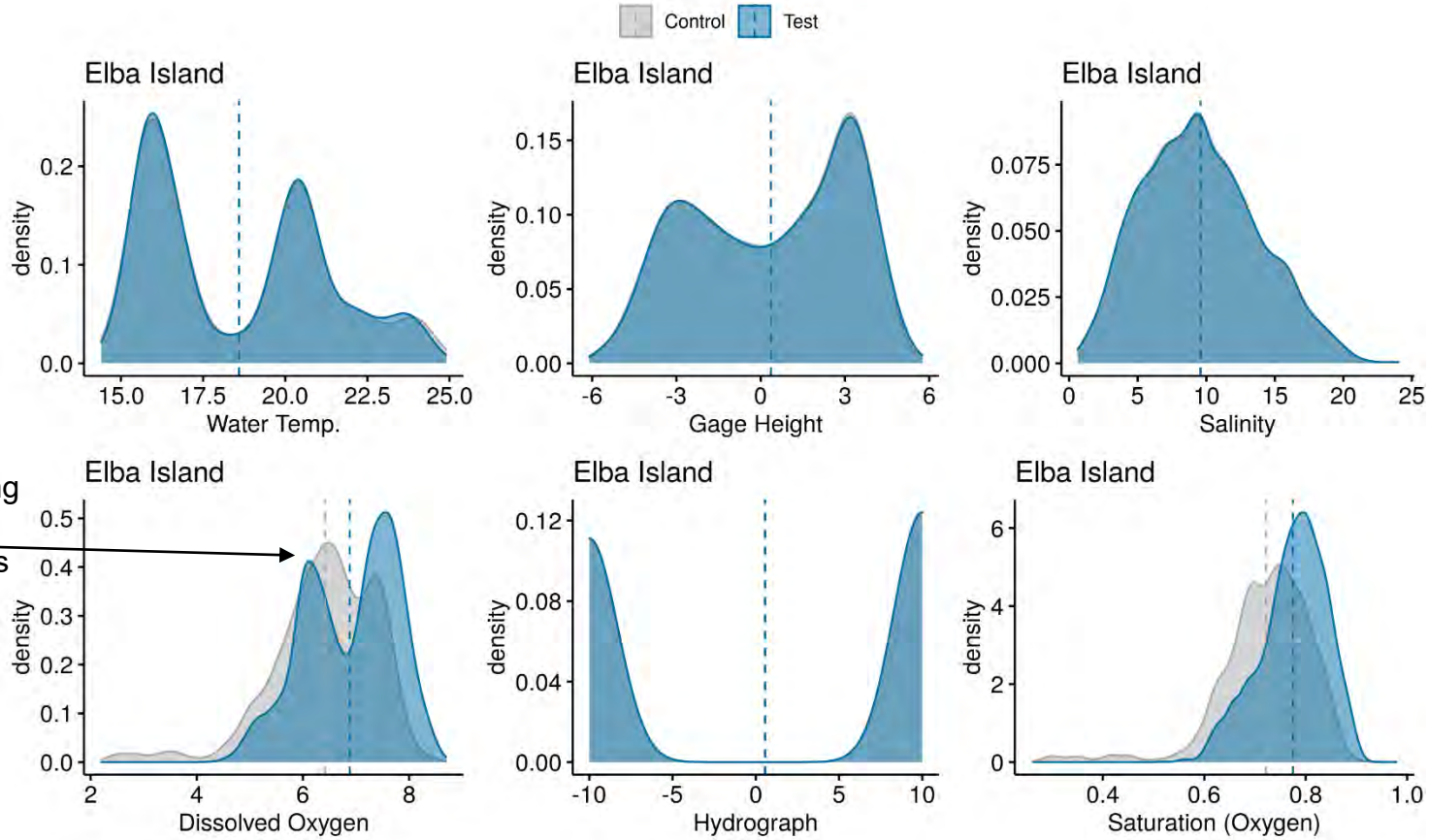
Savannah Harbor Expansion Project



0219897993 – Elba Island



021989773 – Elba Island



Similar to moving upstream, the effect decreases as we move downstream (Δ=0.47 mg/ml $P=1.5\times10^{-115}$)

Table of differences and significance for O_2 concentration (mg/L)

Station	Station Name	Test	Control	Difference	p-value
02198840	I-95	7.82	7.84	-0.02	0.20
02198920	Savannah R.-Port Wenworth	7.18	6.92	0.26	1.25E-09
02198950	Middle R.- Port Wentworth	7.40	6.95	0.45	2.83E-43
021989792	Little Back-Port Wentworth	7.60	6.93	0.67	5.60E-185
021989715_1	Garden City 13.25 ft	6.91	6.35	0.56	1.06E-110
021989715_2	Garden City 23.28 ft	6.80	6.13	0.68	1.2E-8
021989773	USACE Dock	6.99	6.36	0.64	2.42E-165
0219897993	Elba Island	6.88	6.41	0.47	1.51E-115

Table of differences and significance for O_2 Saturation (percent saturation)

Station	Station Name	Test	Control	Difference
02198840[1]	I-95	81.9	82.3	-0.4
02198920	Savannah R.-Port Wenworth	76.3	73.6	2.7
02198950	Middle R.- Port Wentworth	78.7	73.9	4.8
021989792	Little Back-Port Wentworth	81.9	74.7	7.2
021989715_1	Garden City 13.25 ft	73.8	67.9	5.9
021989715_2	Garden City 23.28 ft	73.0	65.7	7.3
021989773	USACE Dock	75.1	68.2	6.8
0219897993	Elba Island	77.5	72.2	5.3

[1]Assumes missing salinity values are 0.

Conclusions

- Analysis of USGS gage data conclusively show that the Test Run worked.
- Differences in O_2 concentration show that near the injection plant O_2 levels were 0.56-0.68 mg/ml higher during the Test Run
- This effect diminishes both upstream and downstream of the plant.
- At I-95, the gage furthest from the plant that was examined, there is no discernable difference.

ATTACHMENT B – STARTUP RUN ANALYSIS

SHEP Startup Run

Evaluation of Impact

February 2020

Objective – Evaluate whether the Startup Run worked using available data?

- USACE constructed and now operates two oxygen (O_2) injection system for the Savannah River
  - Upriver (Plant McIntosh) and Downriver (Hutchinson Island) facilities
  - Test Run was March 14 through May 12, 2019 and Startup Run was 25 July through September 22, 2020
  - Goal is to inject O_2 into water as a form for mitigation for harbor deepening – End goal is an increase in O_2 levels in the river/harbor
  - During the Startup Run, USACE injected 13,574 lbs/day DR and 28,838 lbs/day UR
  - There are numerous USGS gages along the river which measure several physiochemical parameters, including dissolved oxygen
- Can we detect a change in O2 at these various gages during the Startup Run, or---did the Startup Run work?

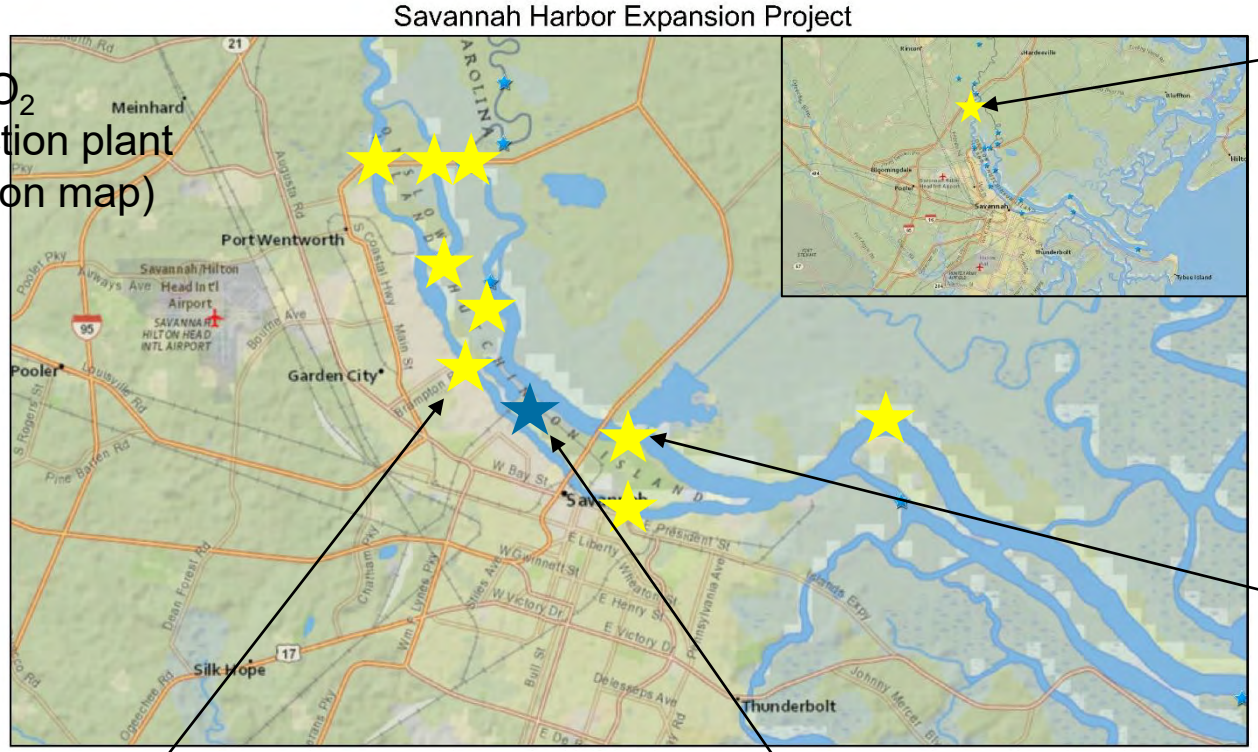
Analysis Platform -



- Use R for analysis
- R is an open-source, free, statistical computing platform (www.r-project.org)
- Why R?
  - R can be downloaded and used by anyone
  - R is a scripting language – code written for analysis can be run on any computer with R installed
  - R is extremely powerful – R can easily handle large data sets
  - R is used extensively by the academic community, so cutting edge statistical techniques are often implemented in R
  - R has powerful graphing and web-based capabilities

GHD

Data – Numerous USGS gages on River



UR O_2 injection plant (not on map)

I-95 gage (upstream)

★ USGS gages with:
- Dissolved oxygen
- Water level
- Temperature
- Salinity

Except for Back River, Hog Island and Middle River – no Water Level

Two gage elevations at Garden City

DR O_2 injection plant

Savannah Harbor Expansion Project

Start with USACE Depot station (USGS gage 021989773)



Create a control?

- Ideally we want a control period that matches closely with the Startup Run period---compare apples to apples
  - But not just any apple to any apple, we want to compare Granny Smith apples grown in New Hampshire to Granny Smith apples grown in NH
- Data include salinity, gage height, temperature.
- Can we use these variables to match Startup Run data with non-Startup Run data?
  - For each Startup Run timepoint choose a timepoint outside the Startup Run that matches
- Depot station has 456,232 time-point observations
- 5,663 of these are during the Startup Run

Create a control?

- Approach: use Euclidean distance to identify “control” point most similar to Startup Run point
- Result: Data set of paired test-control observations selected from the full time series.

Start Up Run-Control Data Set – Depot Station

Startup Run Timepoint Values

Pair	Time Period	Gage Height (ft)	Water Temp (C)	Salinity	Date-Time	Dissolved O_2	% Saturation
1	Start Up Run	-0.41	30.2	5.5	7/25/2020 1:00	2.8	38.3
1	Control	-0.27	30.2	5.3	7/27/2016 16:15	2.1	28.7
3	Start Up Run	-0.28	29.9	5.1	7/26/2020 14:30	2.4	32.6
3	Control	-0.41	29.9	5.1	7/25/2016 14:15	2.2	29.9
5	Start Up Run	0.97	30.2	6.1	7/25/2020 1:30	2.8	38.4
5	Control	0.92	30.3	6.1	7/27/2016 16:45	2.2	30.3

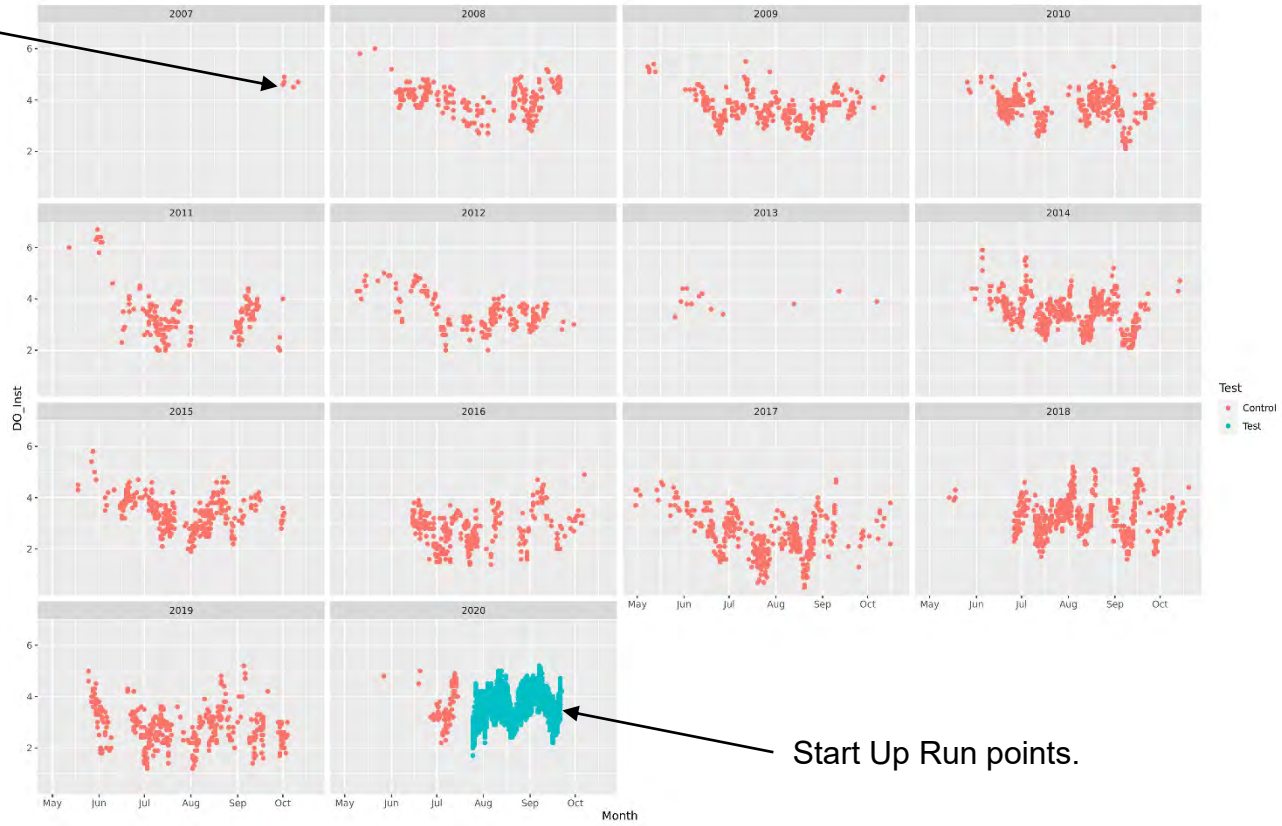
Matching Control Point Values

Algorithm matches all three variables simultaneously

021989773 – USACE Dock

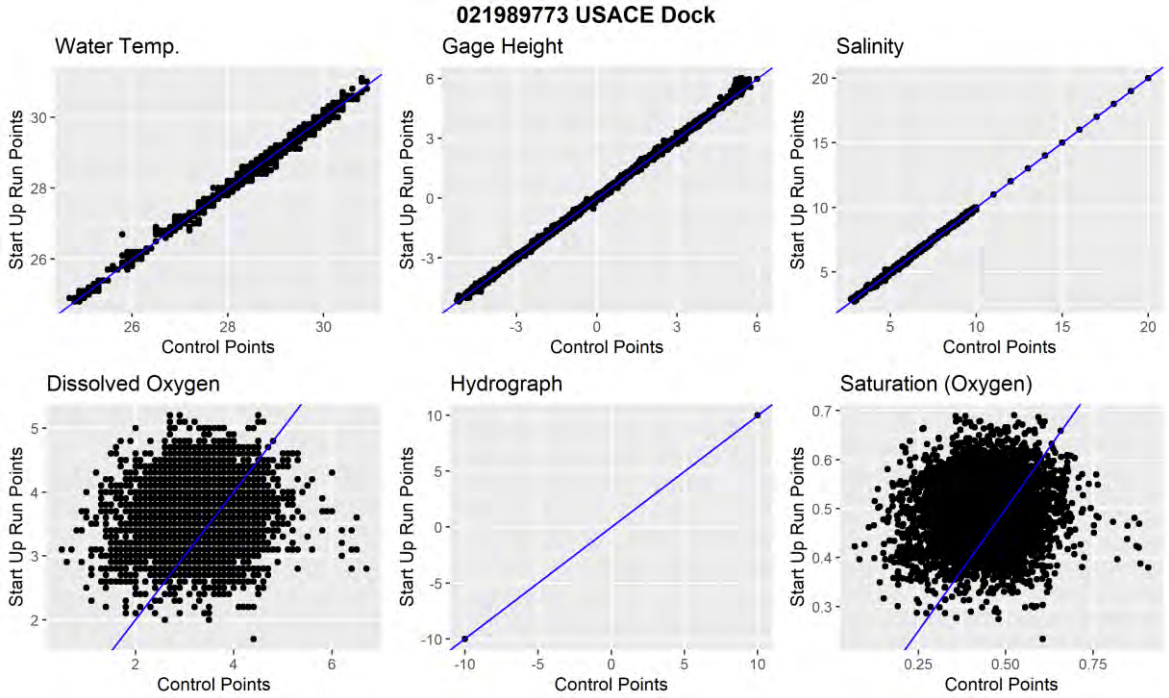
Selected control points.

This plot shows the control points that were selected to match the Start Up Run points.

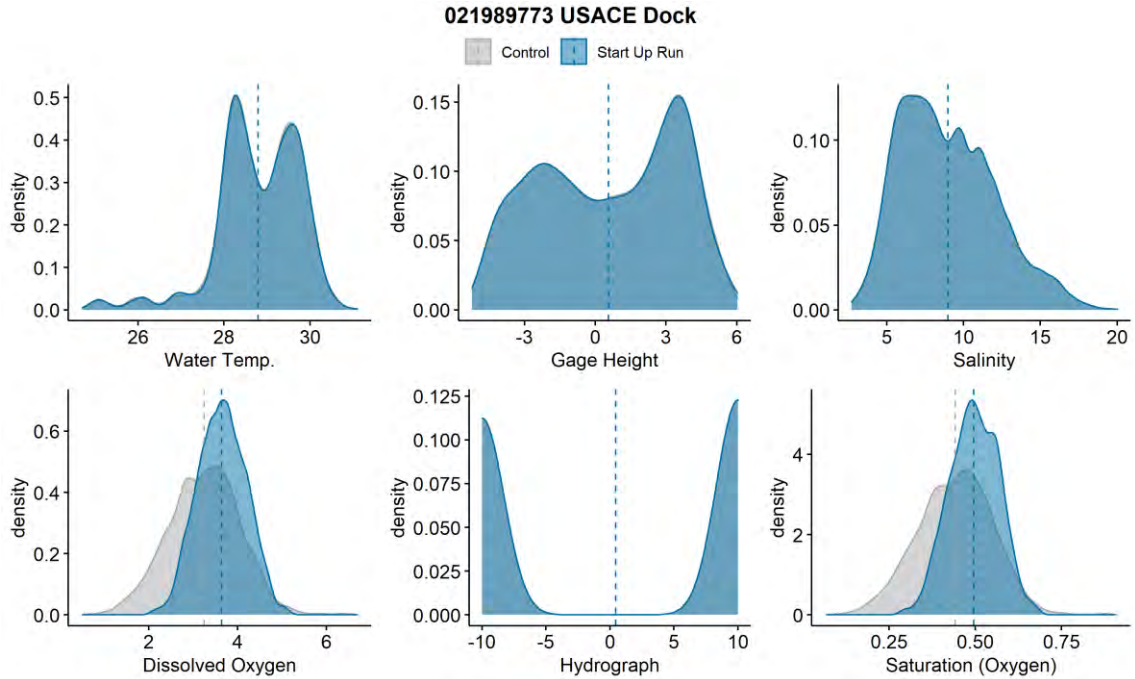


Start Up Run points.

021989773 – USACE Dock/Depot gage



021989773 – USACE Dock/Depot gage



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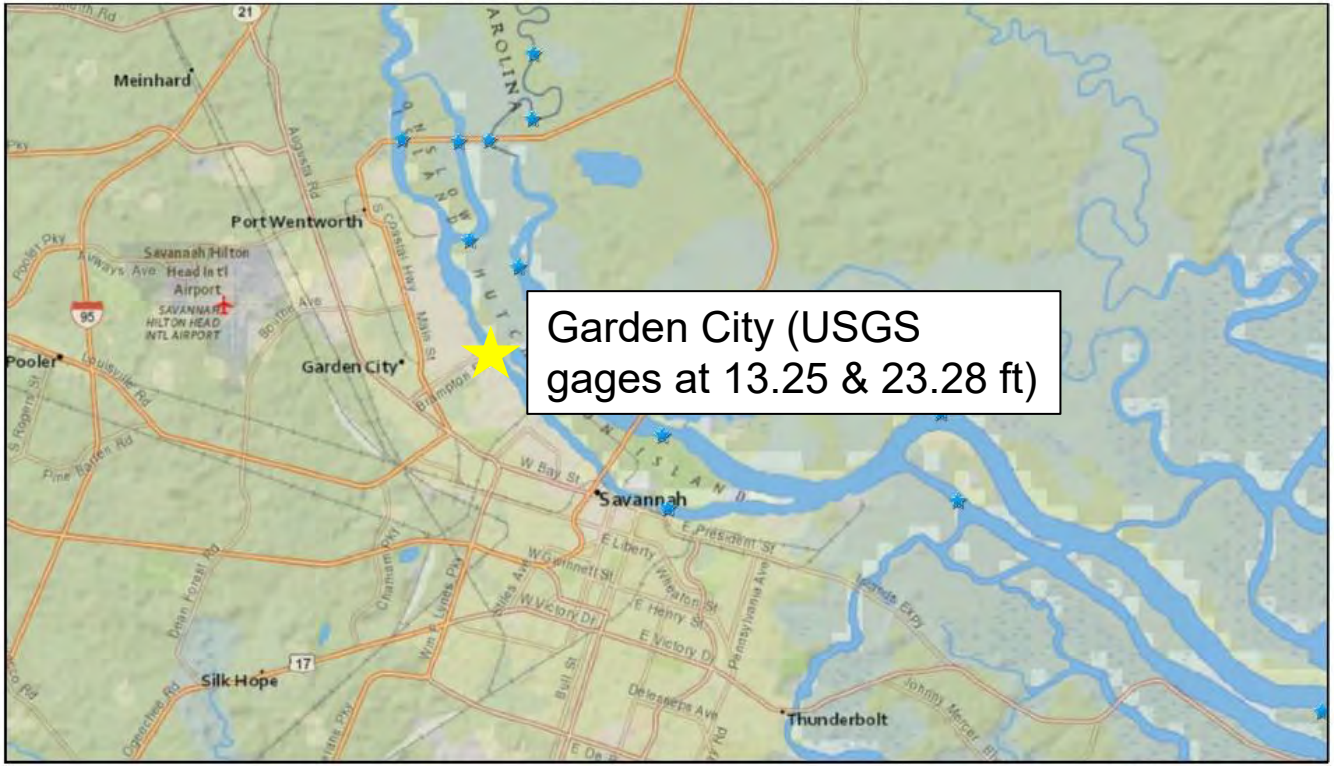

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USGS Gages

1:144,448

0 1 2 4 mi

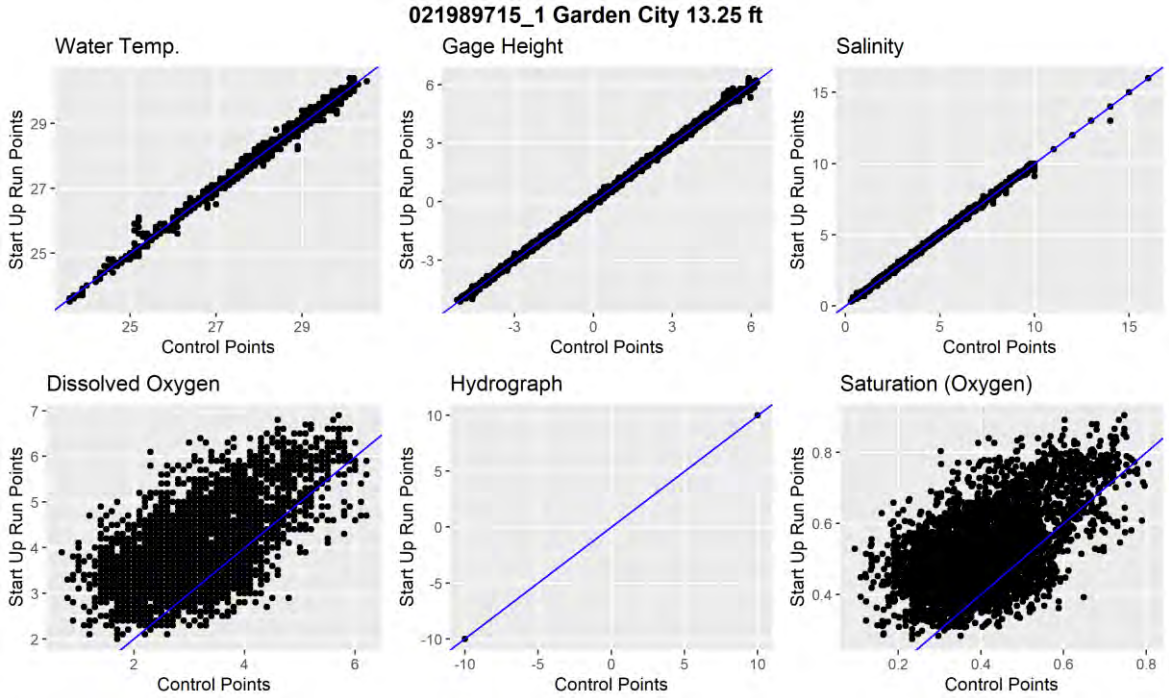
0 1.5 3 6 km

National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC

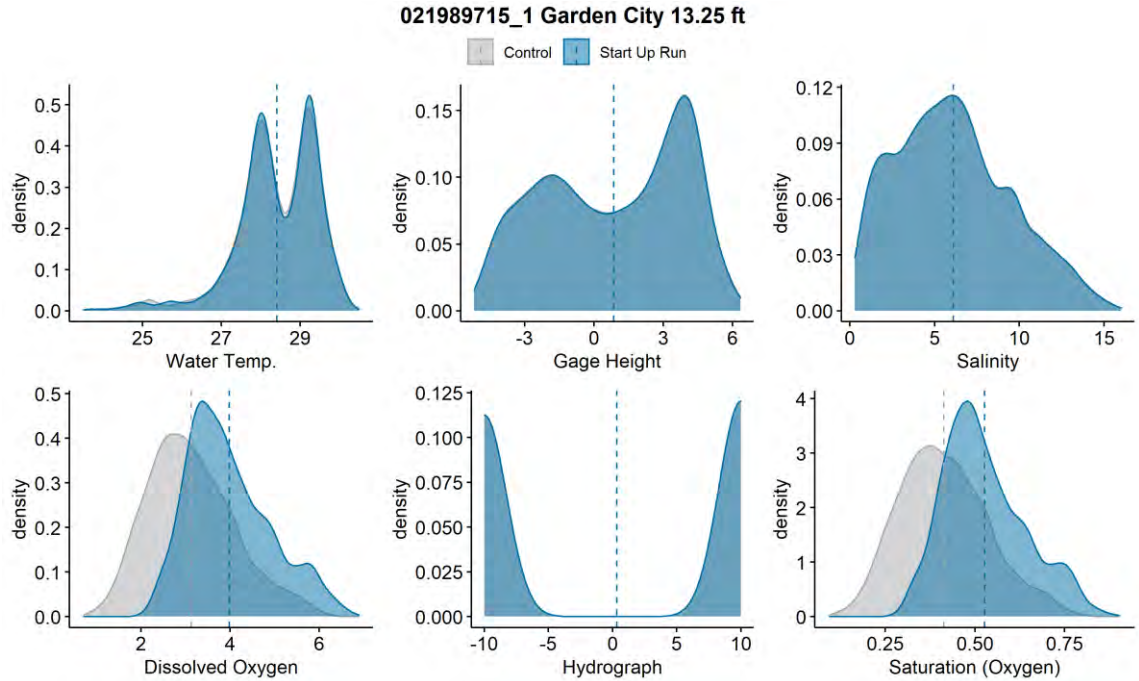
US Army Corps of Engineers

GHD

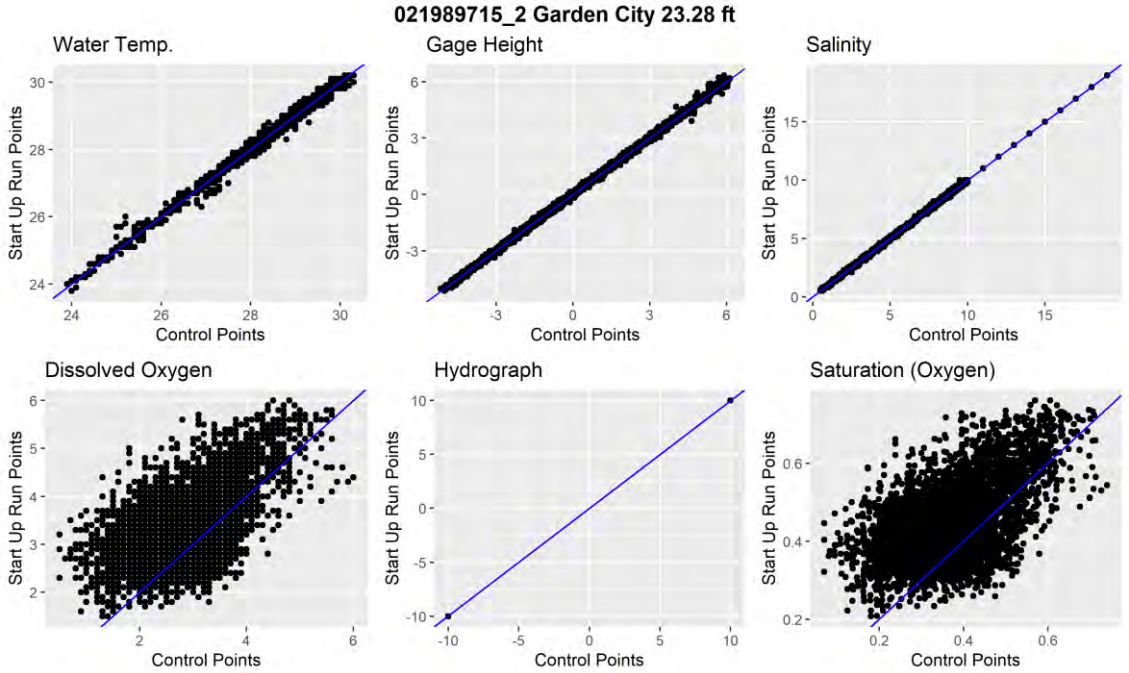
021989715 – Garden City (13.25 ft)



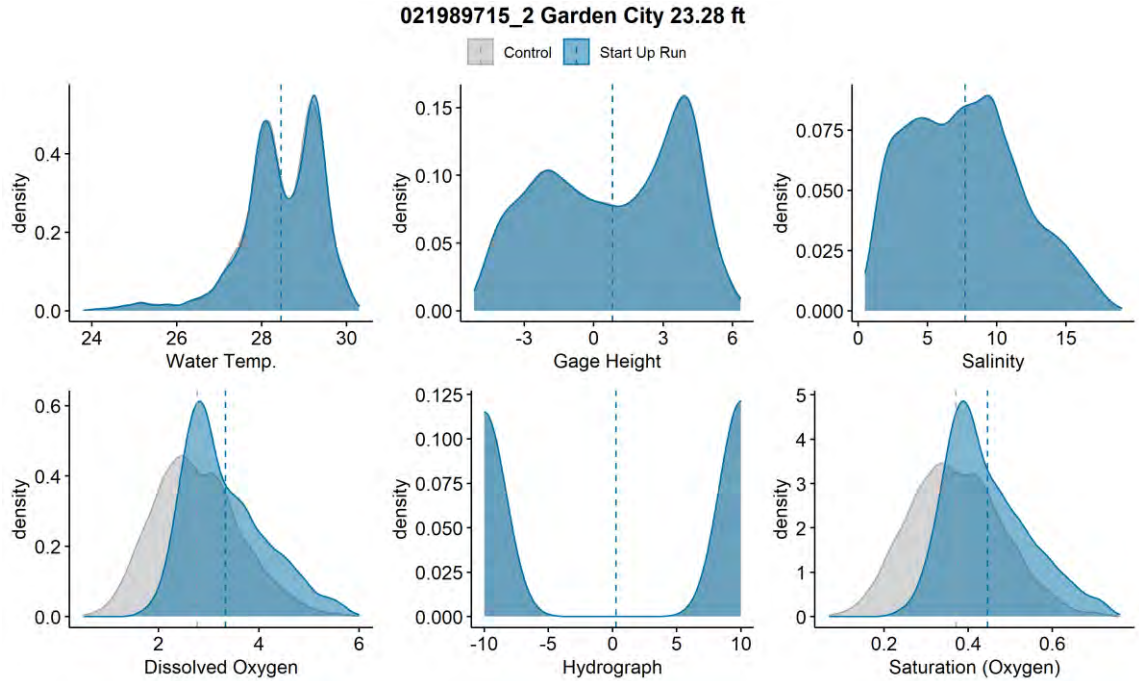
021989715 – Garden City (13.25 ft)



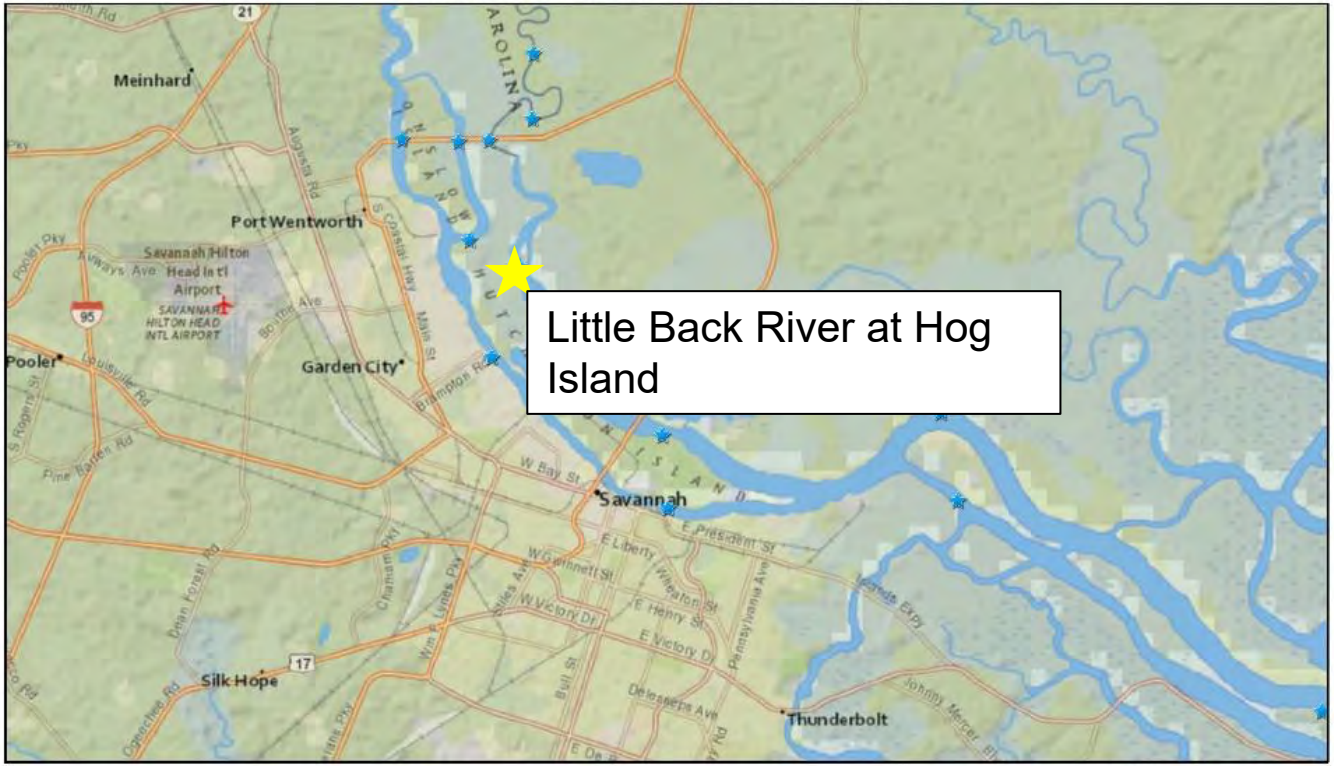
021989715 – Garden City (23.28 ft)



021989715 – Garden City (23.28 ft)

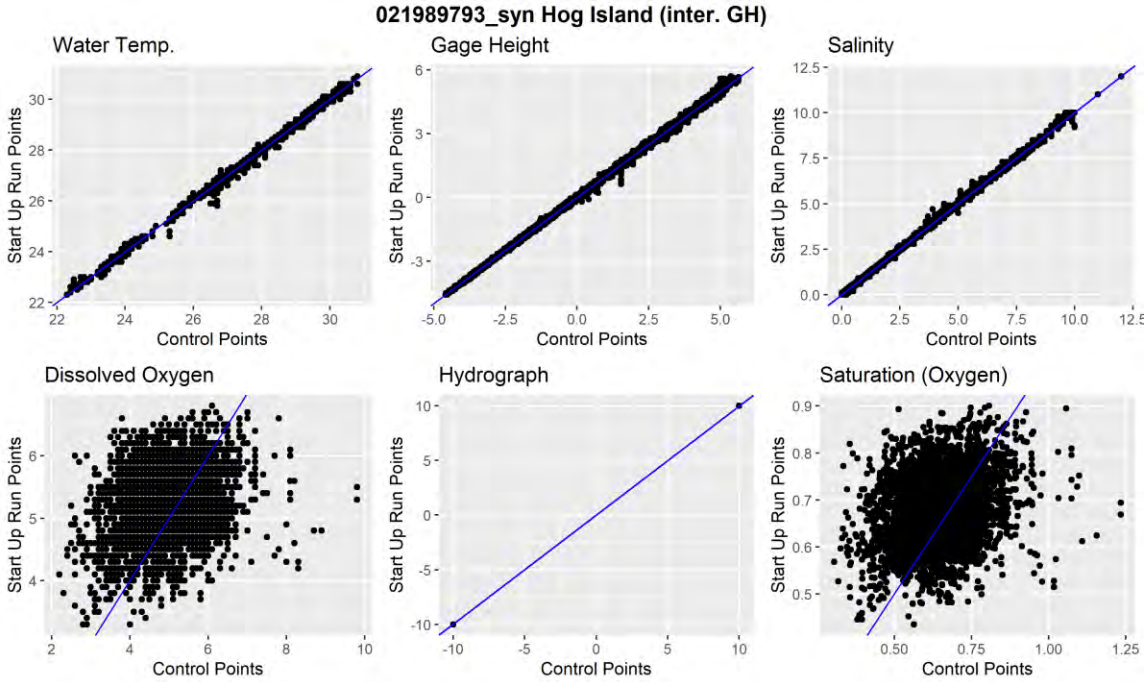


Savannah Harbor Expansion Project

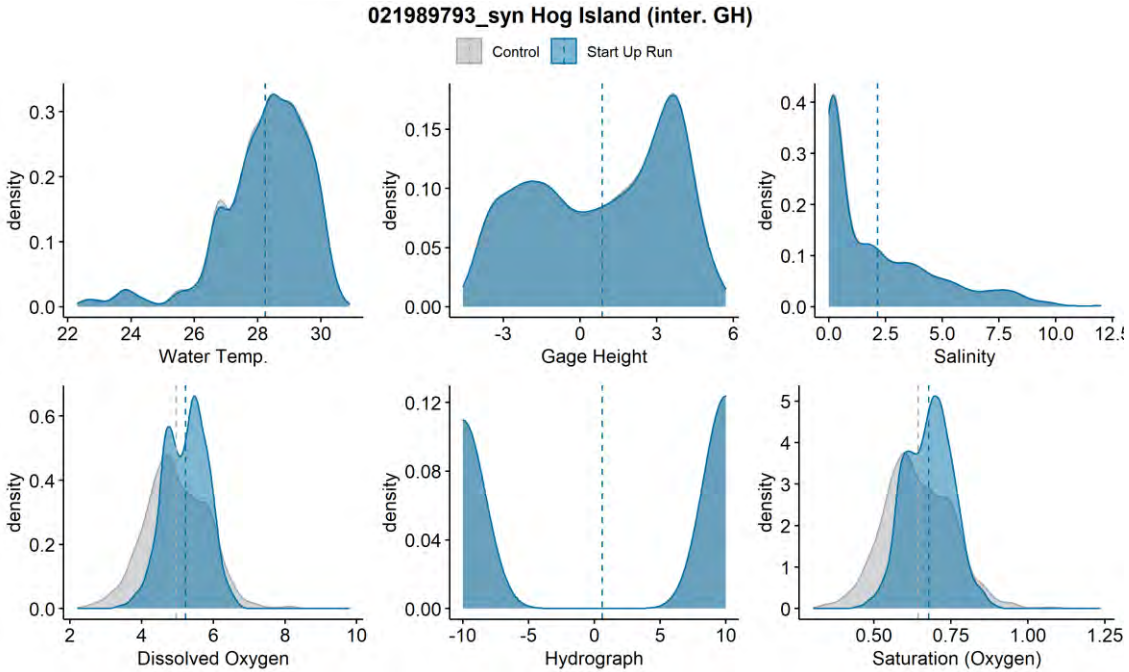


Gage Height not available here, interpolation undertaken

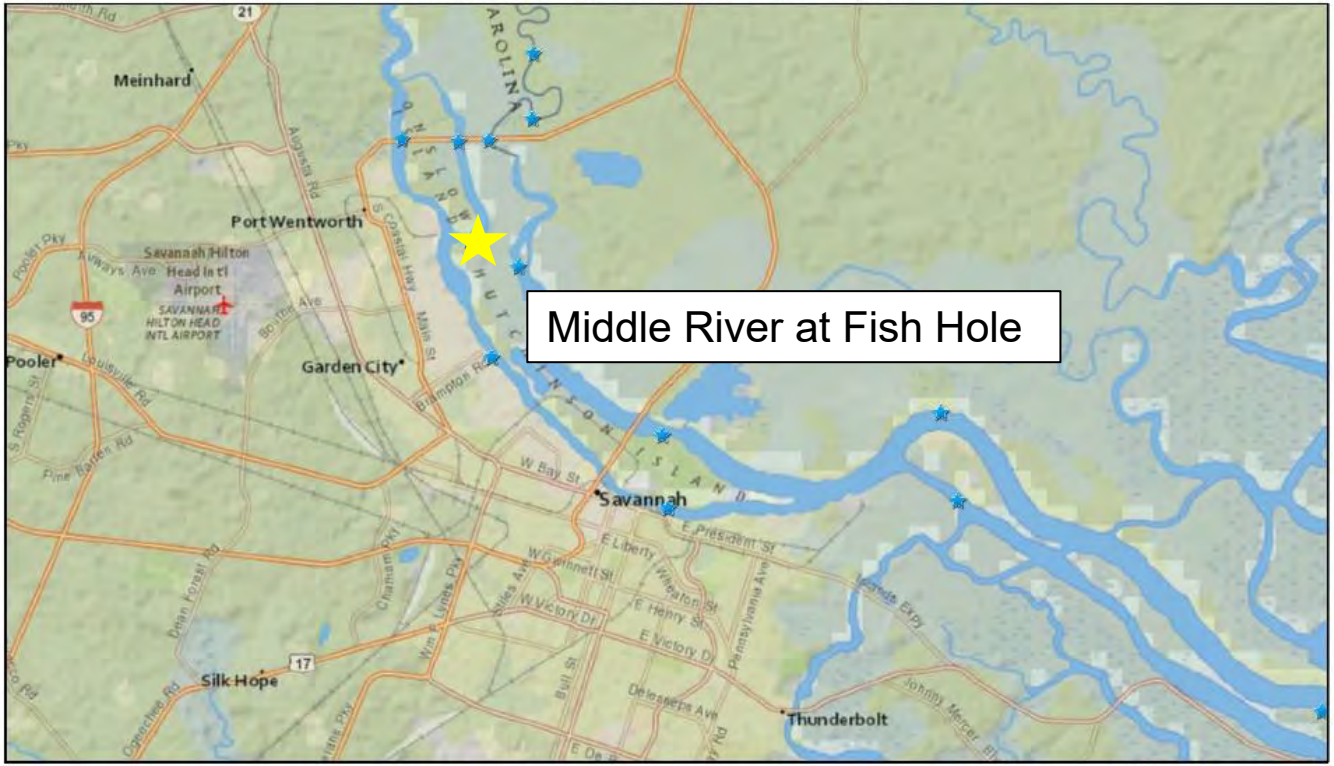
021989793 – Little Back River at Hog Island Interpolated Gage Height



021989793 – Little Back River at Hog Island Interpolated Gage Height



Savannah Harbor Expansion Project



5/18/2020 11:15:08 AM

USGS Gages

1:144,448

0 1 2 4 mi

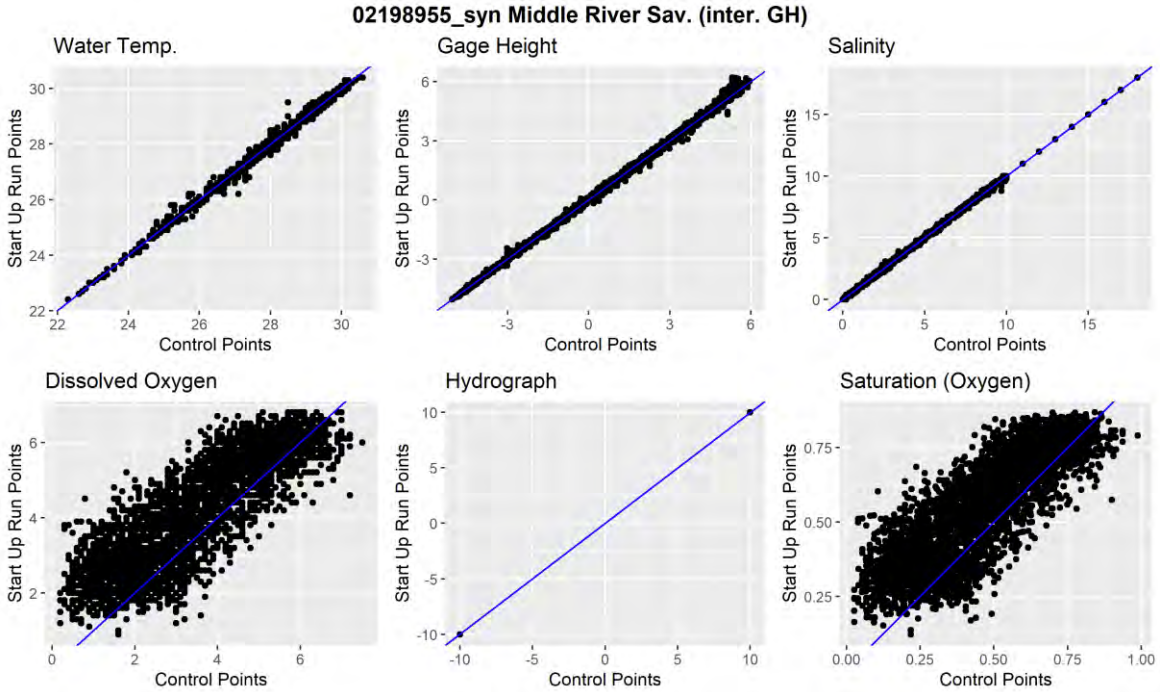
0 1.5 3 6 km

National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC

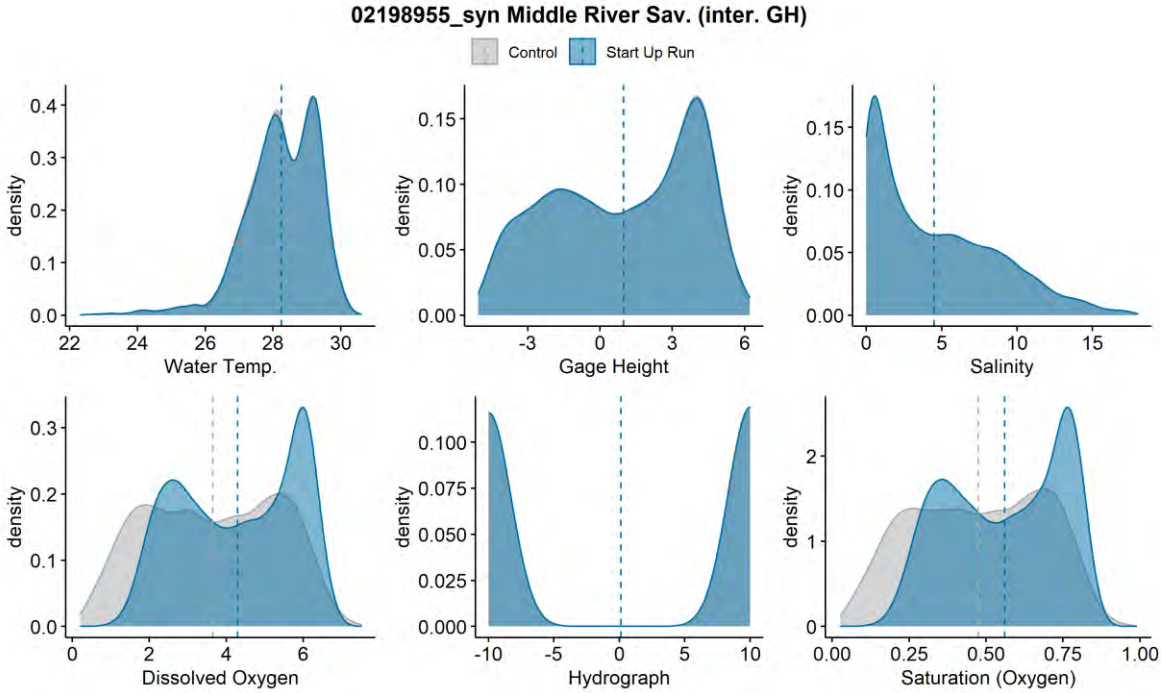
US Army Corps of Engineers

Gage Height not available here, interpolation undertaken

02198955 – Middle River at Fish Hole Interpolated Gage Height



02198955 – Middle River at Fish Hole Interpolated Gage Height



Savannah Harbor Expansion Project



5/18/2020 11:15:08 AM

USGS Gages

1:144,448

0 1 2 4 mi

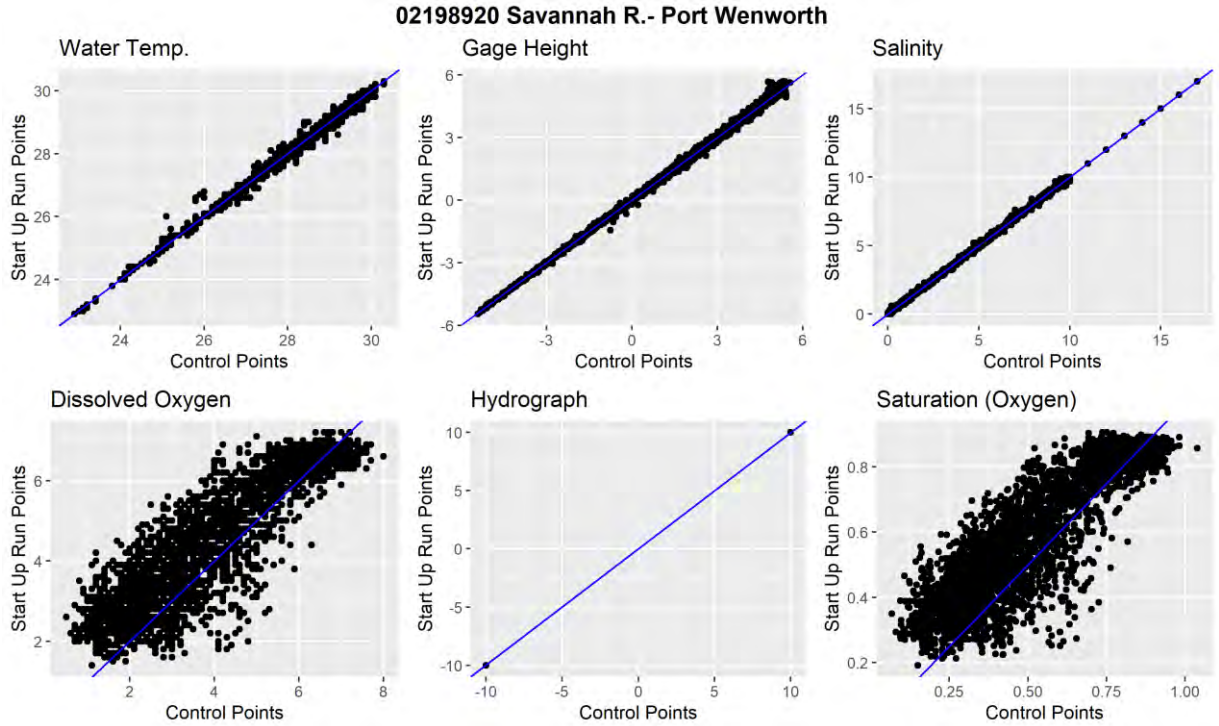
0 1.5 3 6 km

National Geographic, Esri, Garmin, HERE, DeLorme, MapmyIndia, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

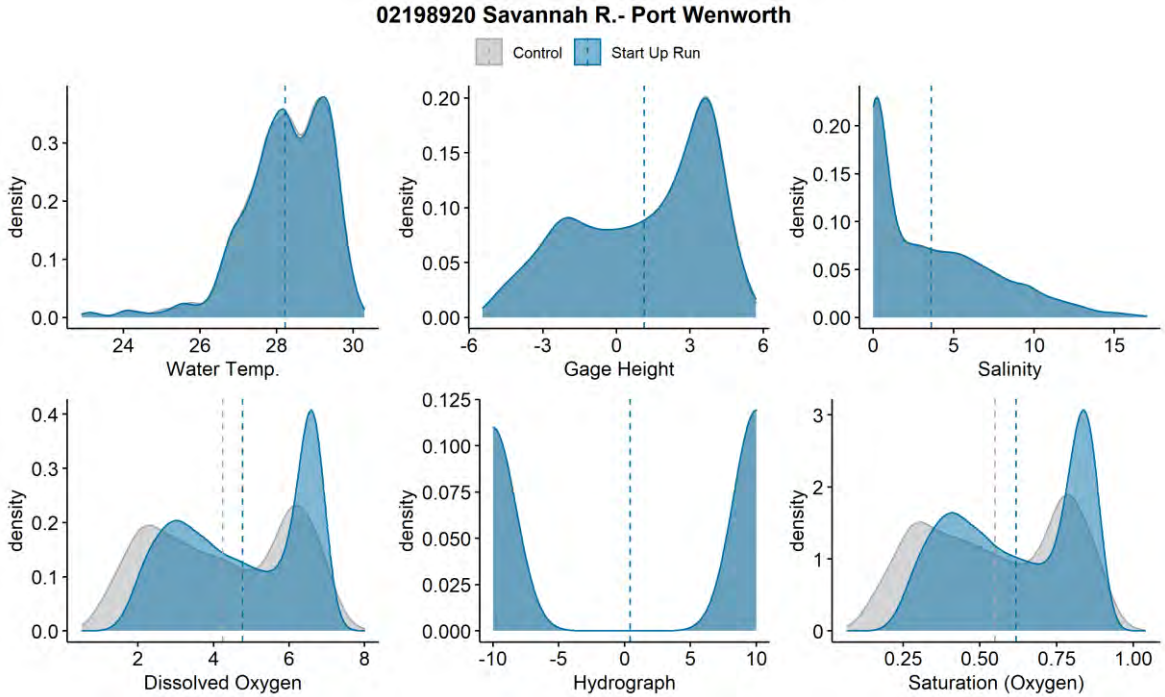
US Army Corps of Engineers

GHD

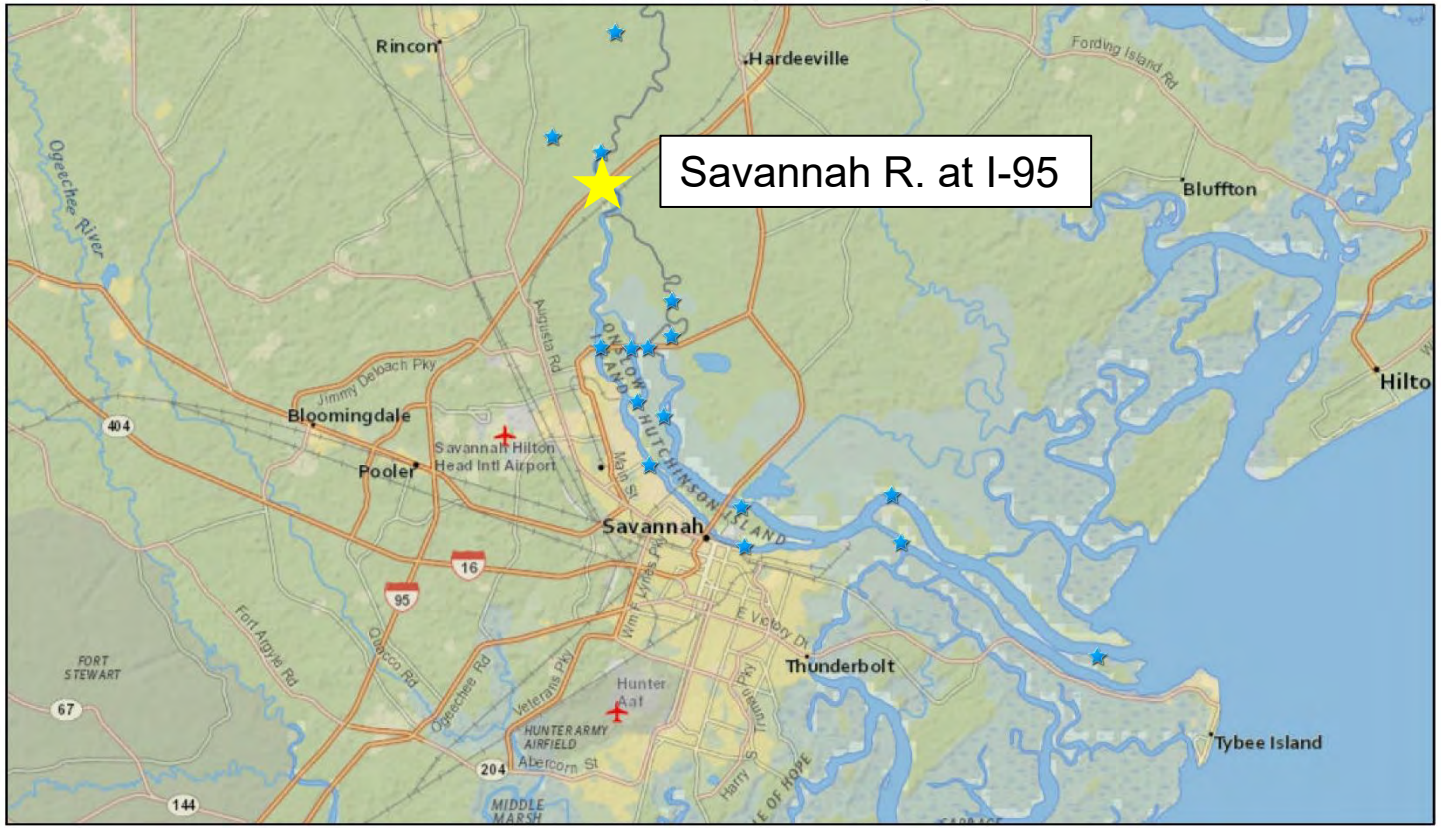
02198920 – Savannah R. at Port Wentworth



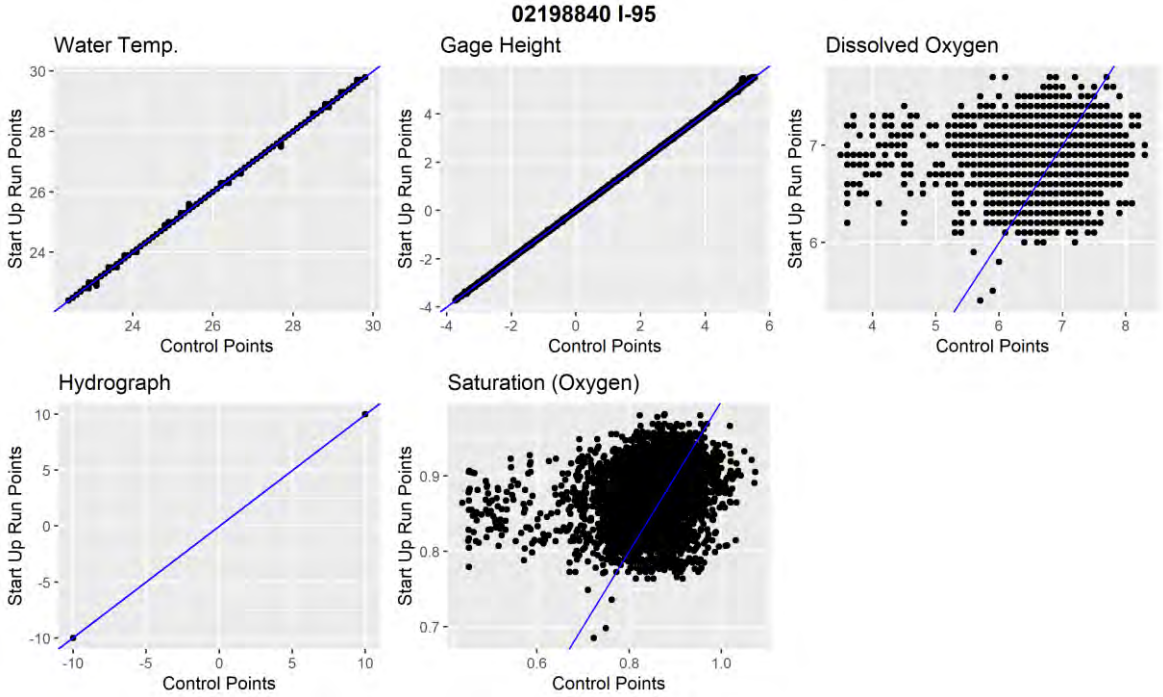
02198920 – Savannah R. at Port Wentworth



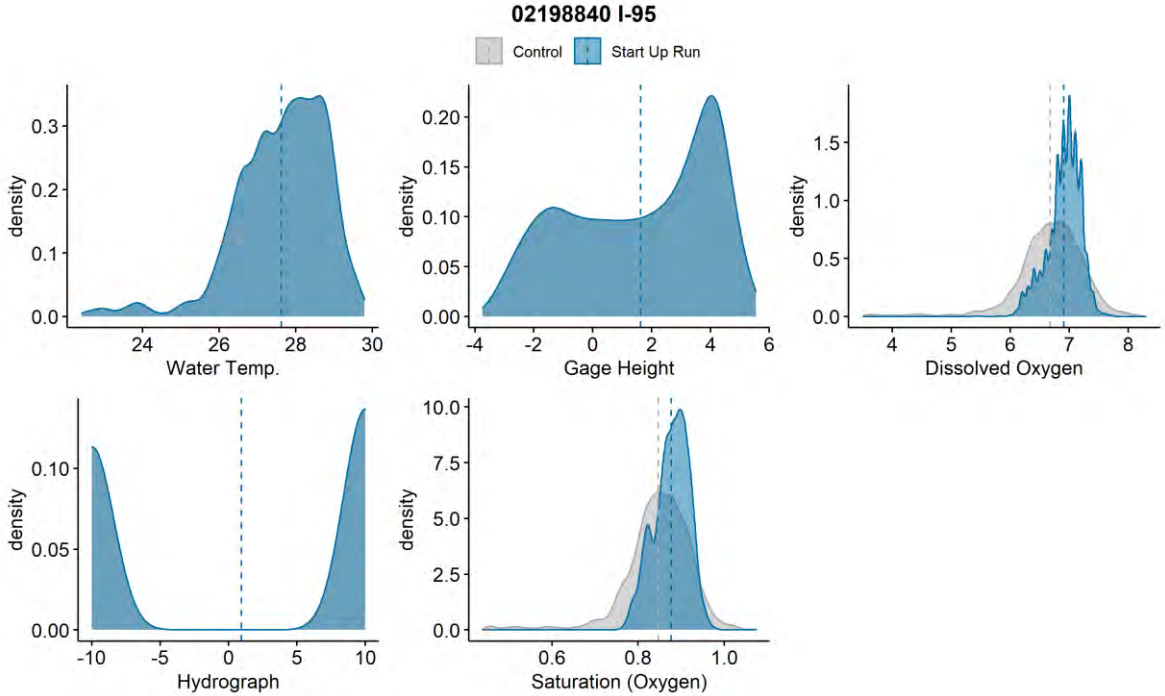
Savannah Harbor Expansion Project



02198840 – I-95



02198840 – I-95

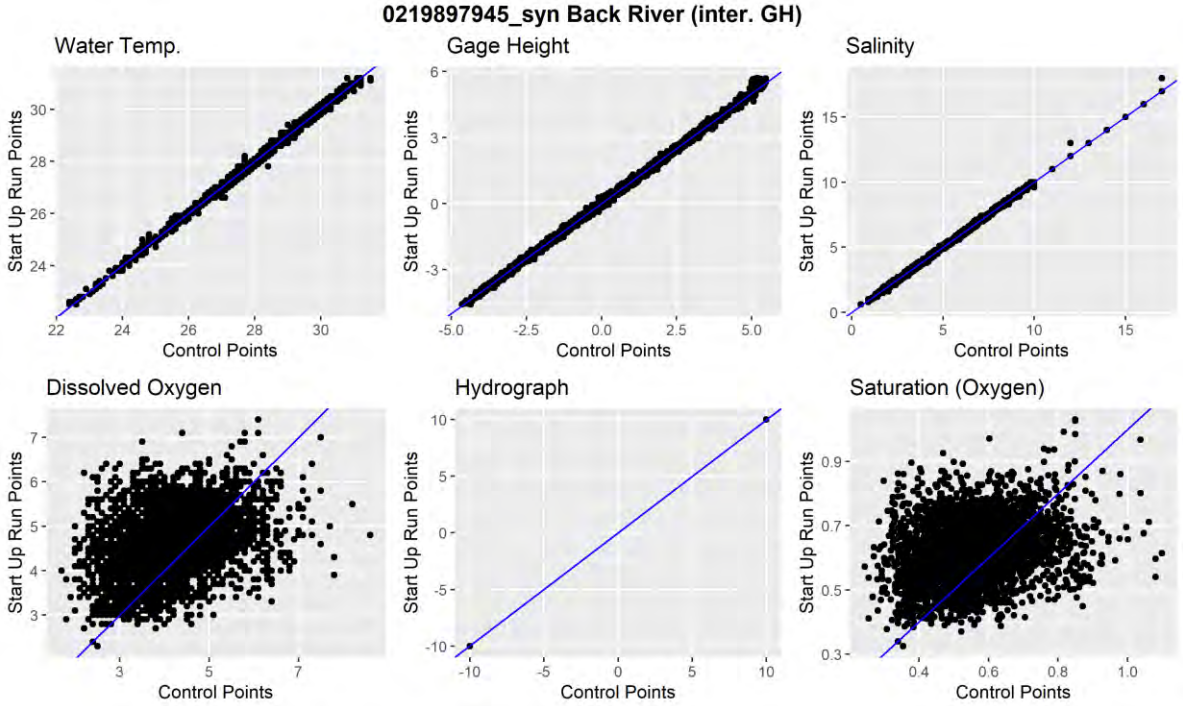


Savannah Harbor Expansion Project

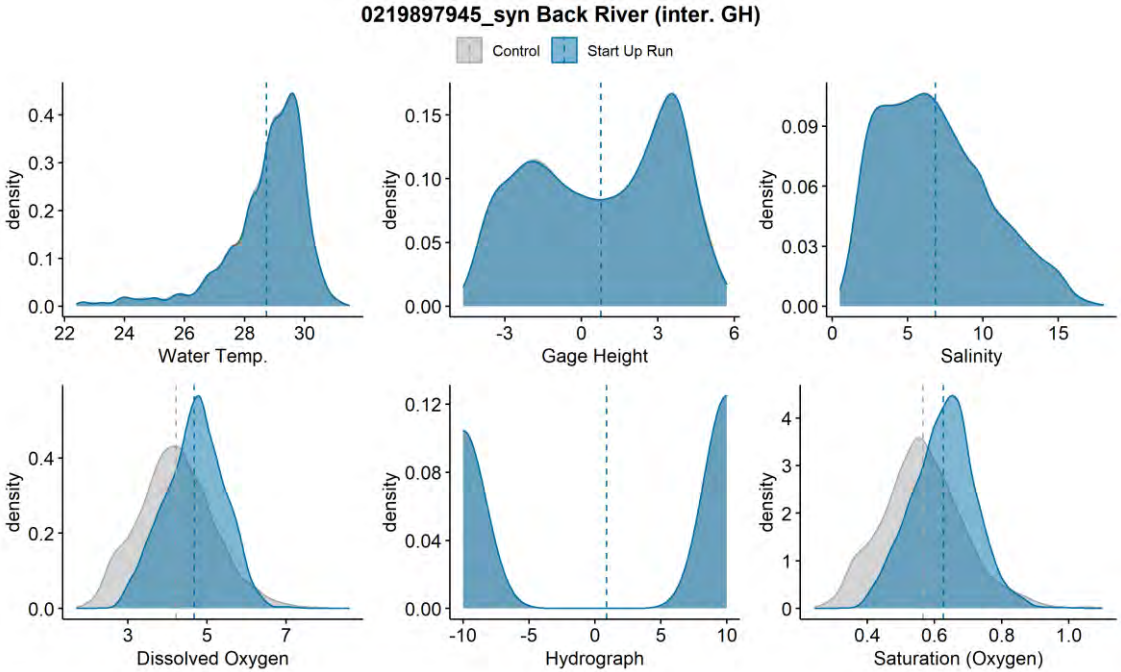


Gage Height not available here, interpolation undertaken

0219897945 – Back River Interpolated Gage Height



0219897945 – Back River Interpolated Gage Height



Savannah Harbor Expansion Project



5/18/2020 11:15:08 AM

★ USGS Gages

1:144,448

0 1 2 4 mi

0 1.5 3 6 km

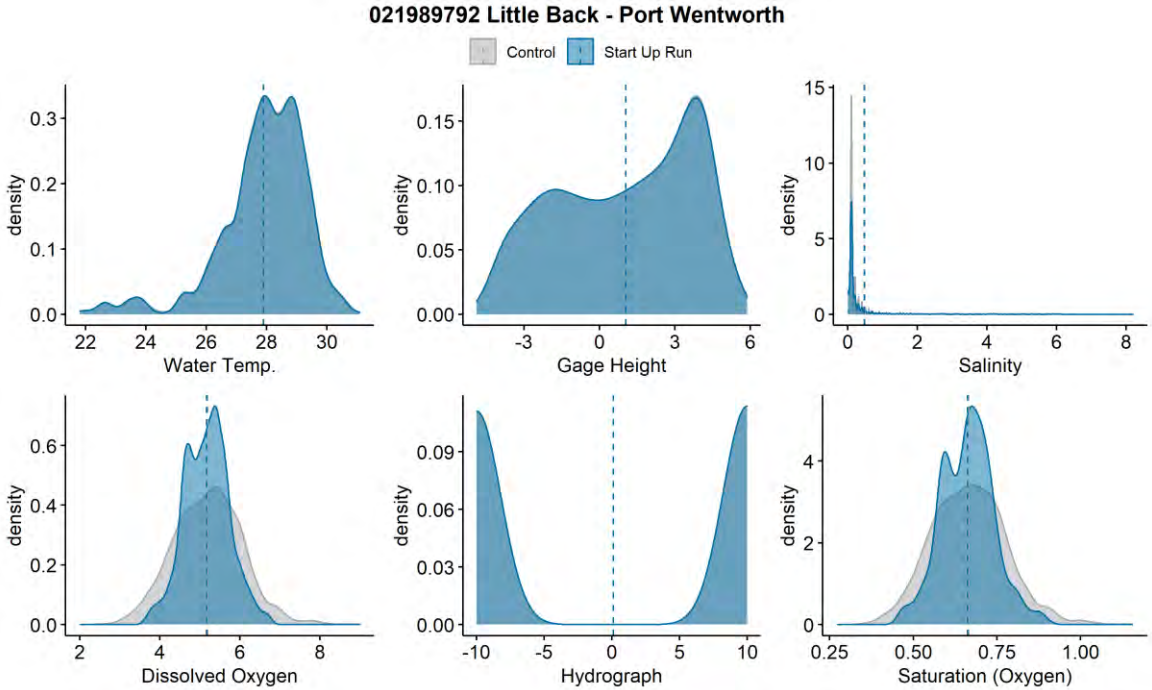
National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

US Army Corps of Engineers

021989792 – Little Back at Port Wentworth



021989792 – Little Back at Port Wentworth



Savannah Harbor Expansion Project



5/18/2020 11:15:08 AM

USGS Gages

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0 1 2 4 mi

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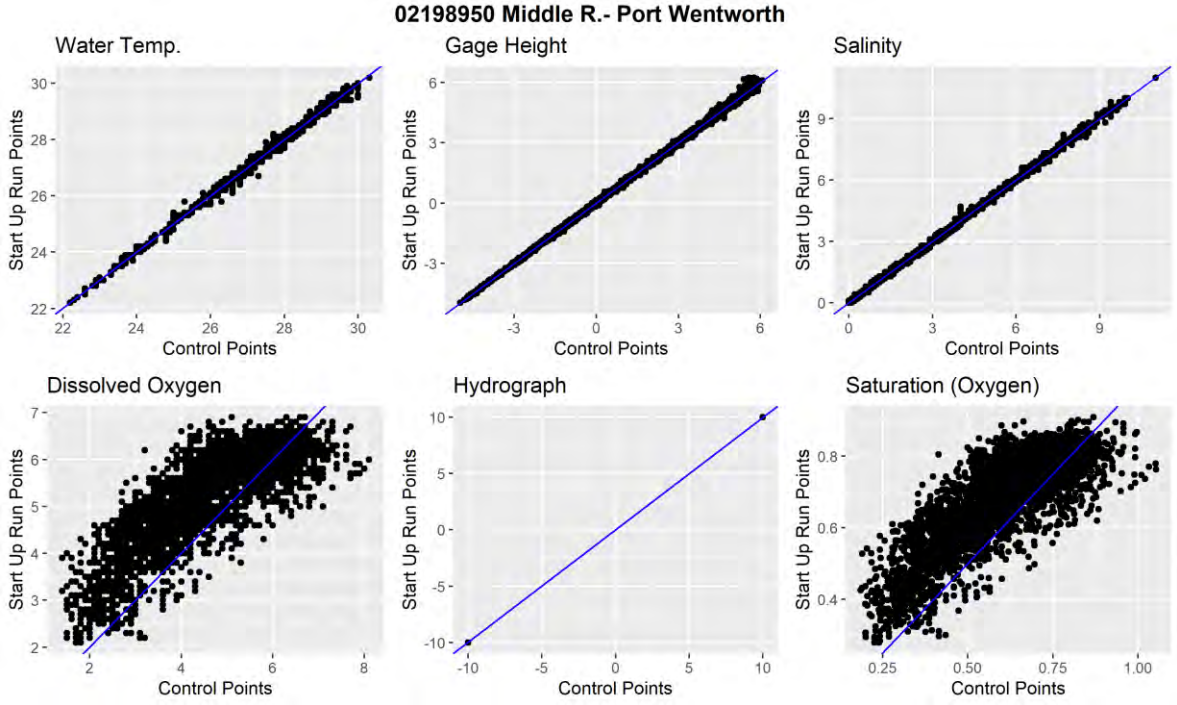
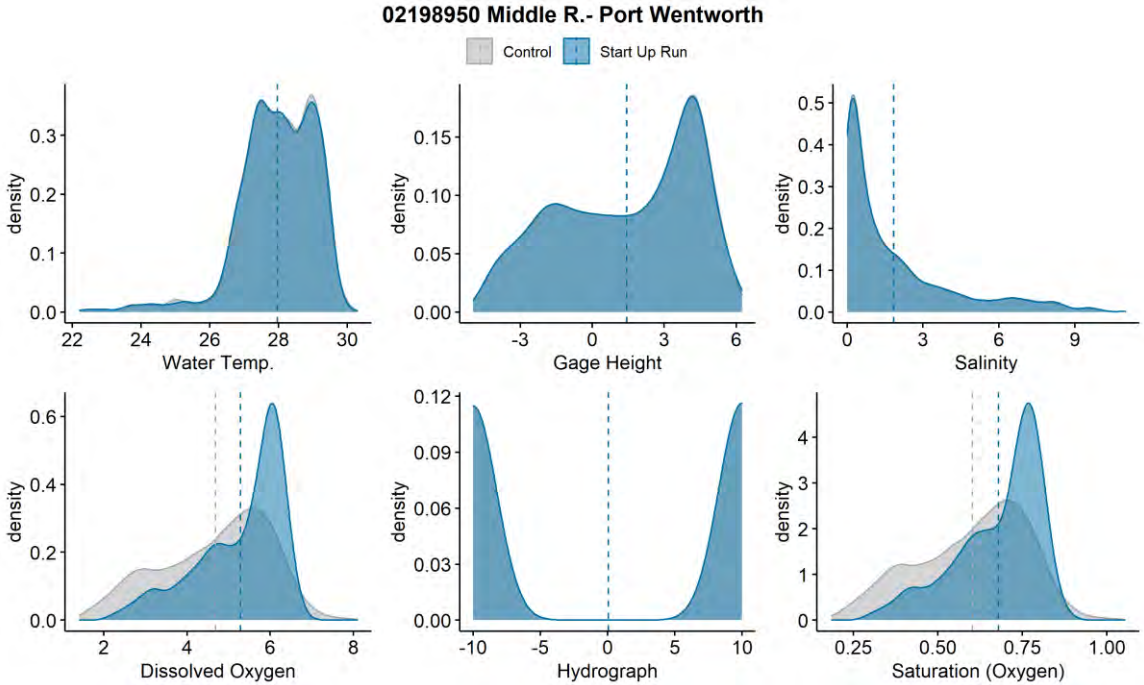
US Army Corps of Engineers

02198950 – Middle River at Port Wentworth



02198950 – Middle River at Port Wentworth



Savannah Harbor Expansion Project



5/18/2020 11:15:08 AM

★ USGS Gages

1:144,448

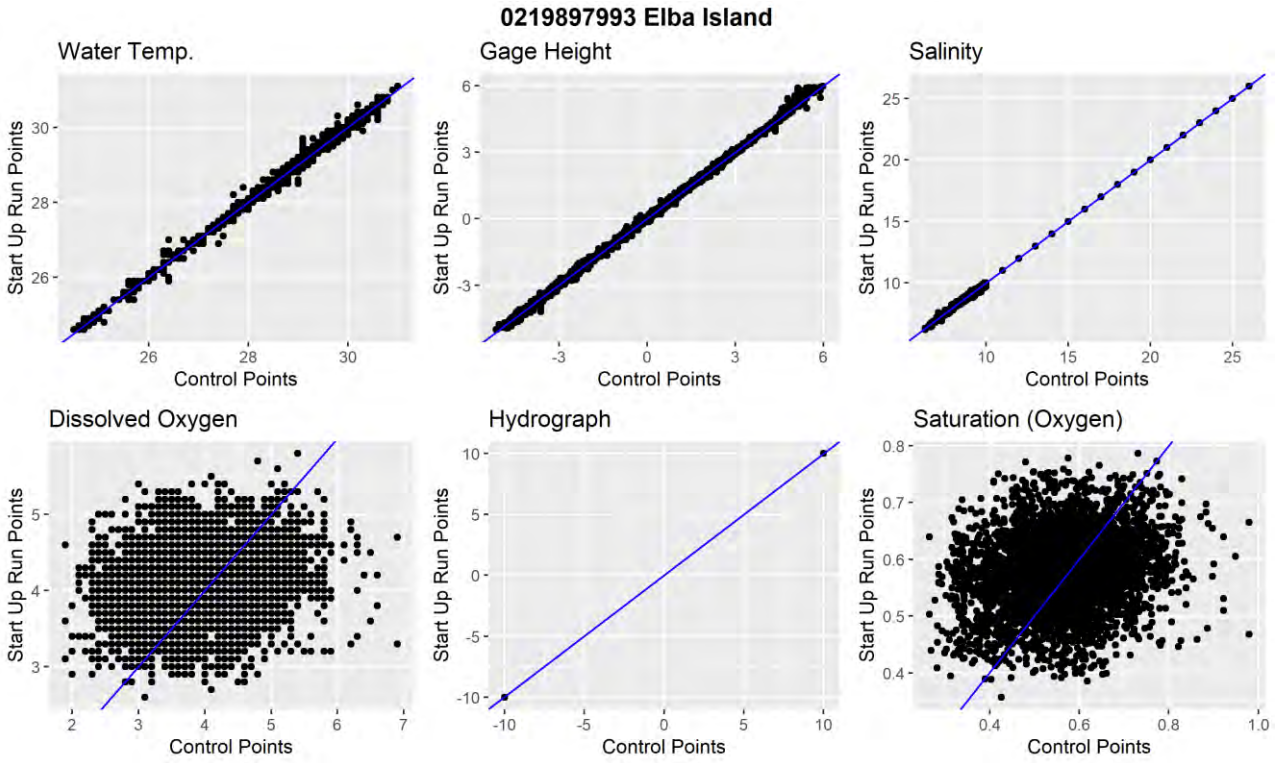
0 1 2 4 mi

0 1.5 3 6 km

National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

US Army Corps of Engineers

0219897993 – Elba Island



0219897993 – Elba Island

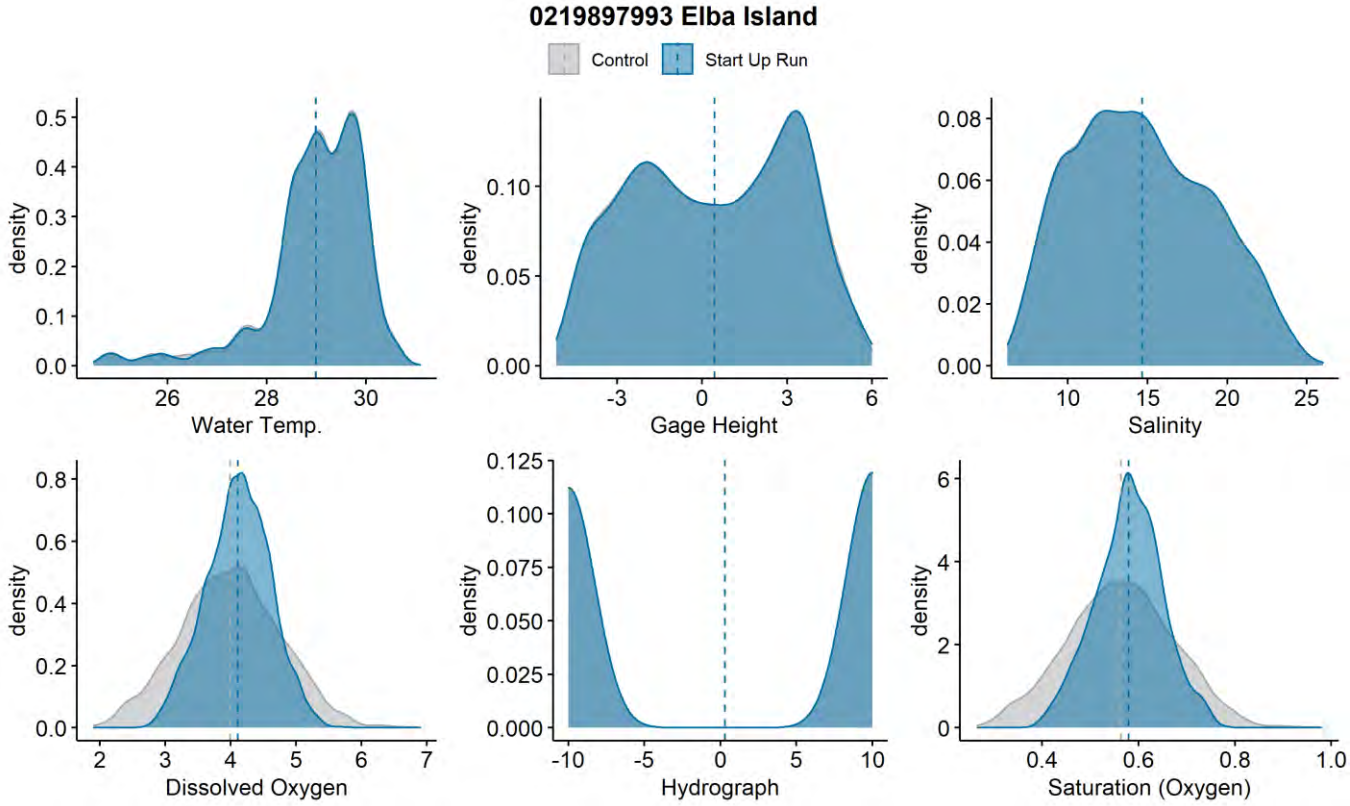


Table of differences and significance for O_2 concentration (mg/L)

Station	Station Name	Startup Run	Control	Difference	p-value
02198840	I-95	6.91	6.67	0.24	4.93E-163
02198920	Savannah R.-Port Wentworth	4.77	4.24	0.53	5.66E-312
02198950	Middle R.- Port Wentworth	5.28	4.69	0.60	0
021989792	Little Back-Port Wentworth	5.17	5.21	-0.03	0.054
02198955*^	Middle River Savannah in Fish Hole	4.30	3.65	0.65	0
021989793*^	Little Back River at Hog Island	5.22	4.96	0.26	6.76E-71
021989715	Garden City 13.25 ft	3.98	3.12	0.86	0
021989715	Garden City 23.28 ft	3.33	2.77	0.56	0
0219897945*^	Back River at US 17	4.67	4.22	0.45	5.50E-149
021989773	USACE Dock	3.65	3.25	0.40	2.69E-158
0219897993	Elba Island	4.11	3.99	0.12	3.10E-18

* Interpolated WSE derived based on measured values from the nearest hydrodynamically connected gages

^ New gage used for Startup Run only, not included in Test Run analysis

Table of differences and significance for O_2 Saturation (percent saturation)

Station	Station Name	Test	Control	Difference
02198840[1]	I-95	87.7	84.7	3.0
02198920	Savannah R.-Port Wentworth	61.9	54.9	6.9
02198950	Middle R.- Port Wentworth	68.0	60.2	7.7
021989792	Little Back-Port Wentworth	66.2	66.6	-0.3
02198955*^	Middle River Savannah in Fish Hole	56.0	47.4	8.6
021989793*^	Little Back River at Hog Island	67.8	64.4	3.4
021989715	Garden City 13.25 ft	52.7	41.4	11.4
021989715	Garden City 23.28 ft	44.6	37.1	7.4
0219897945*^	Back River at US 17	62.7	56.6	6.1
021989773	USACE Dock	49.6	44.2	5.4
0219897993	Elba Island	58.0	56.3	1.6

[1]Assumes missing salinity values are 0.

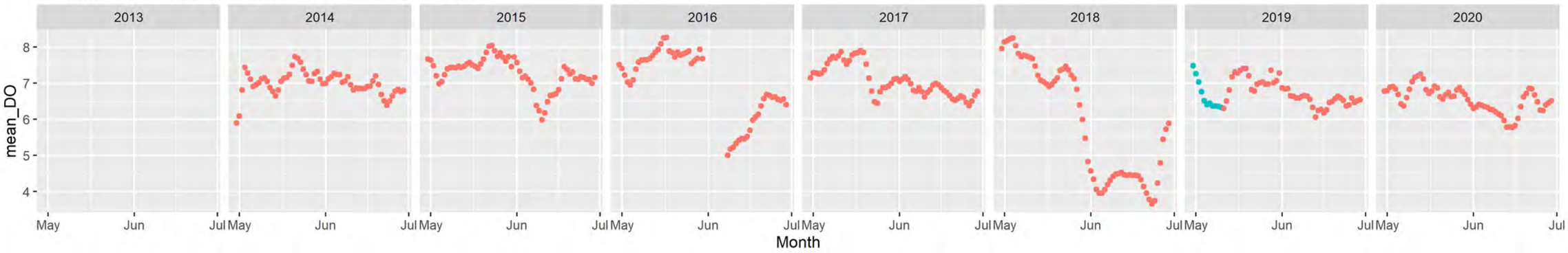
Conclusions

- Analysis of USGS gage data conclusively show that the Startup Run worked.
- Differences in O_2 concentration vary throughout the system spatially and at depth
- Differences are influenced by distance from injection plants

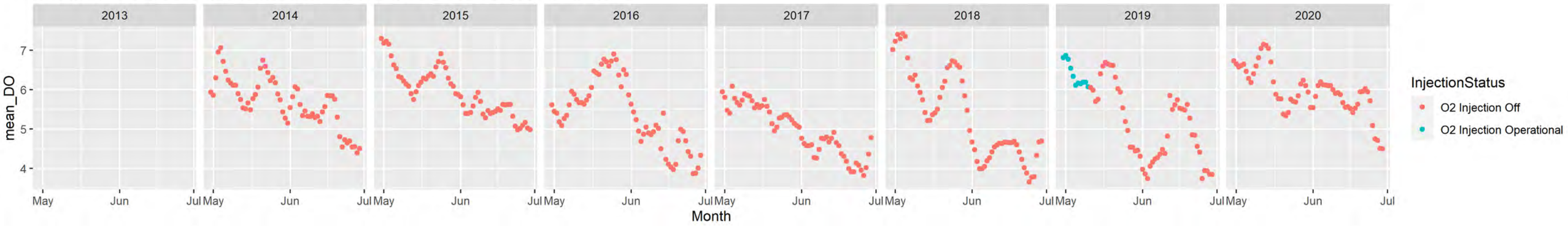
ATTACHMENT C – OXYGEN RETENTION AFTER OPERATIONS CEASE

Dissolved Oxygen Concentrations - Test Run

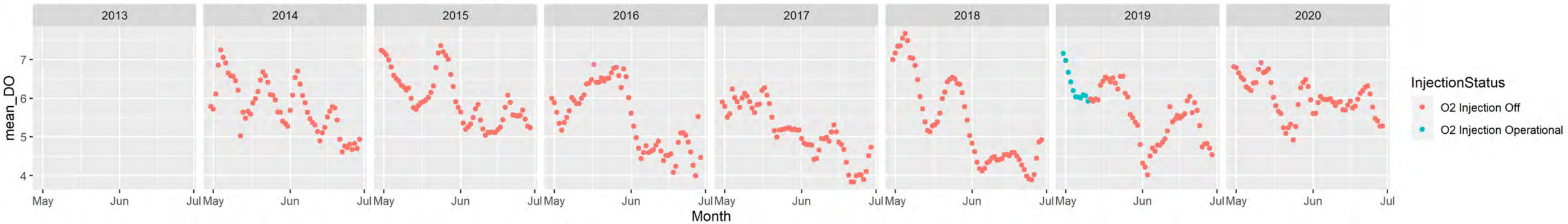
02198840 - I-95 Injection Status - Test Run - 24-Hour



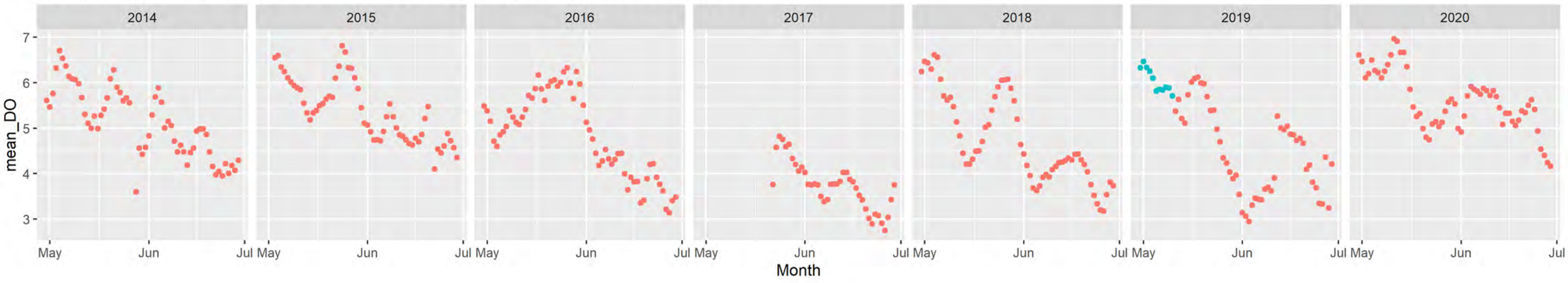
02198920 - Savannah R.-Port Wentworth Injection Status - Test Run - 24-Hour



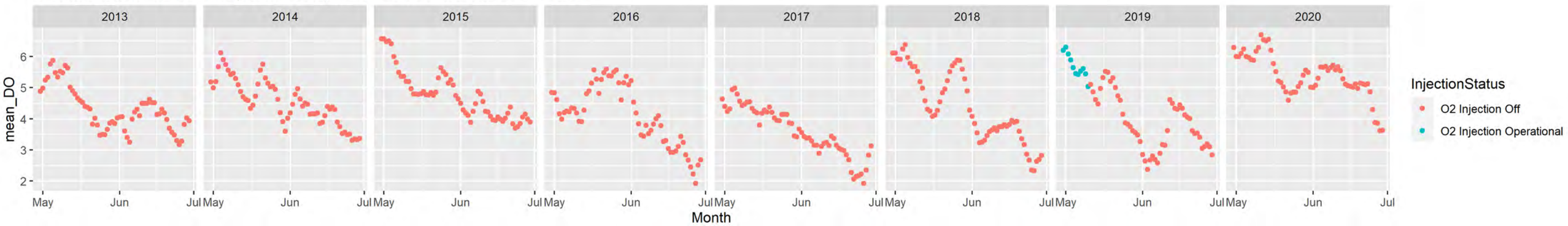
02198950 - Middle R.- Port Wentworth Injection Status - Test Run - 24-Hour



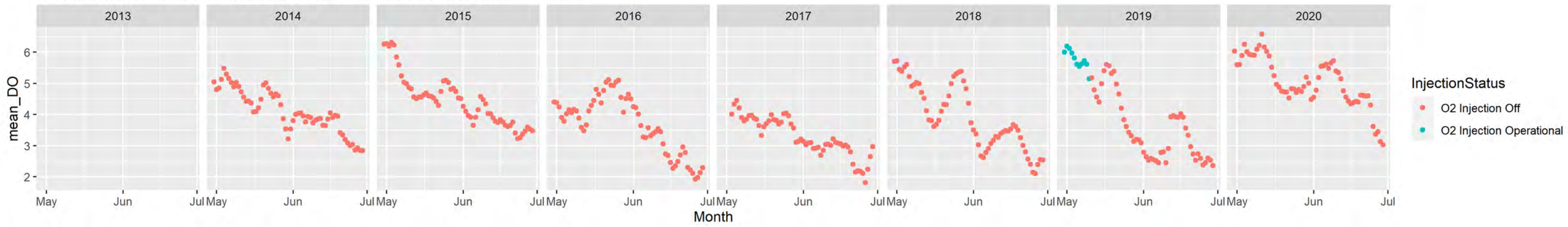
02198955_syn - Middle River Savannah in Fish Hole Injection Status - Test Run - 24-Hour



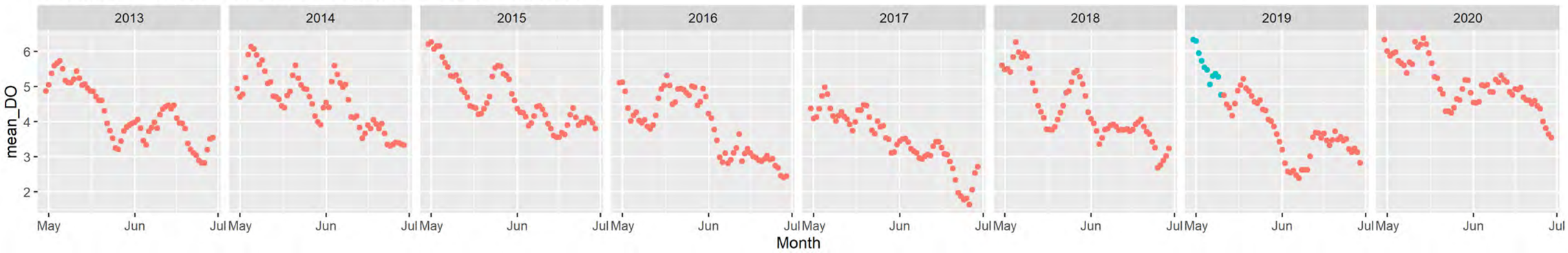
021989715_1 - Garden City 13.25 ft Injection Status - Test Run - 24-Hour



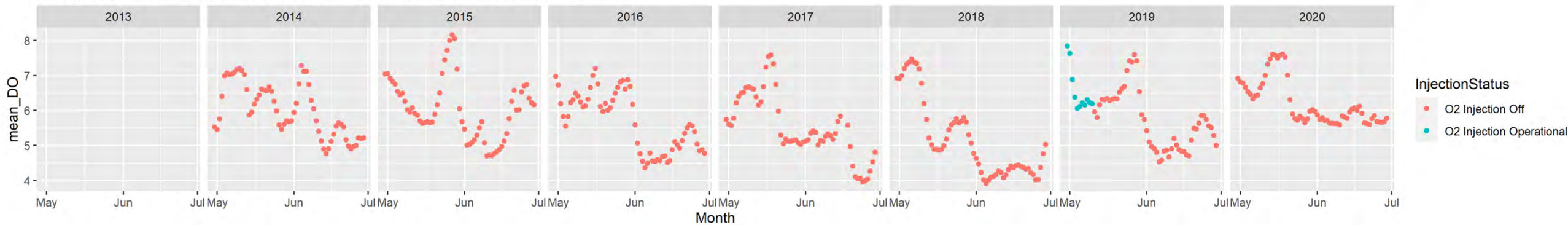
021989715_2 - Garden City 23.28 ft Injection Status - Test Run - 24-Hour



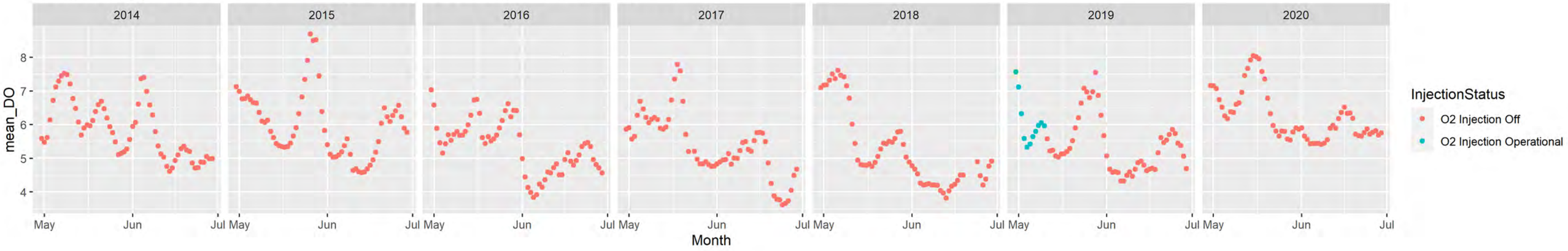
021989773 - USACE Dock Injection Status - Test Run - 24-Hour



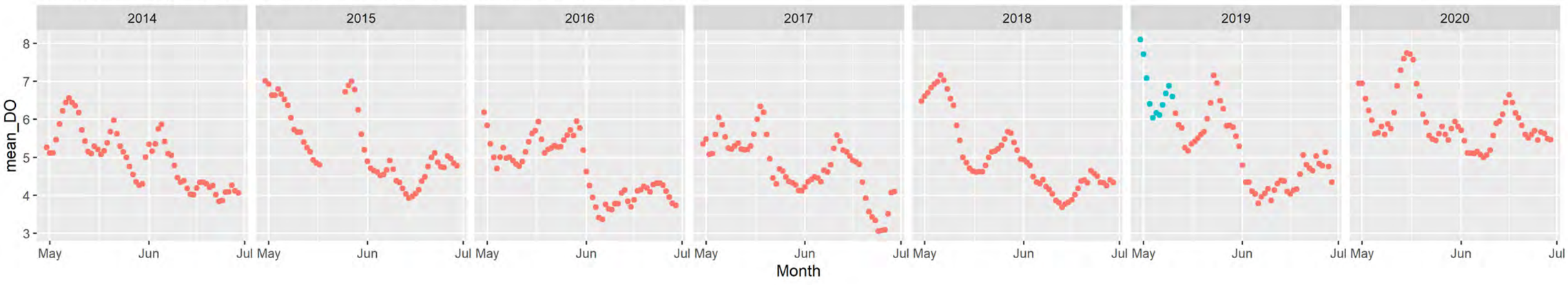
021989792 - Little Back-Port Wentworth Injection Status - Test Run - 24-Hour



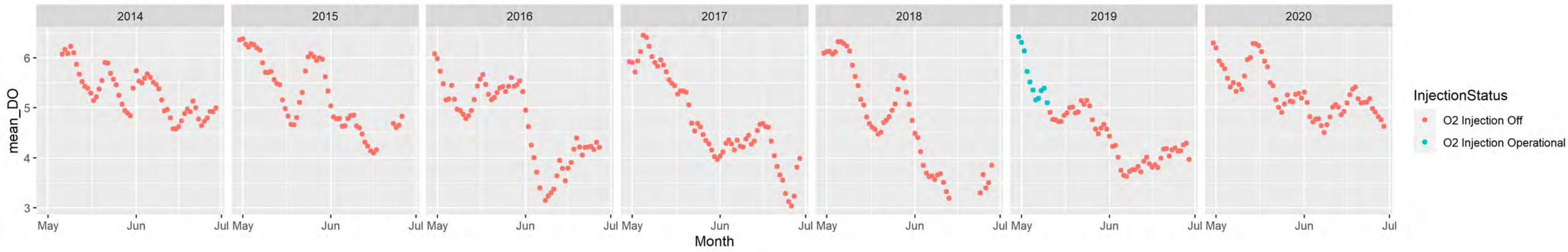
021989793_syn - Little Back River at Hog Island Injection Status - Test Run - 24-Hour



0219897945_syn - Back River at US 17 Injection Status - Test Run - 24-Hour

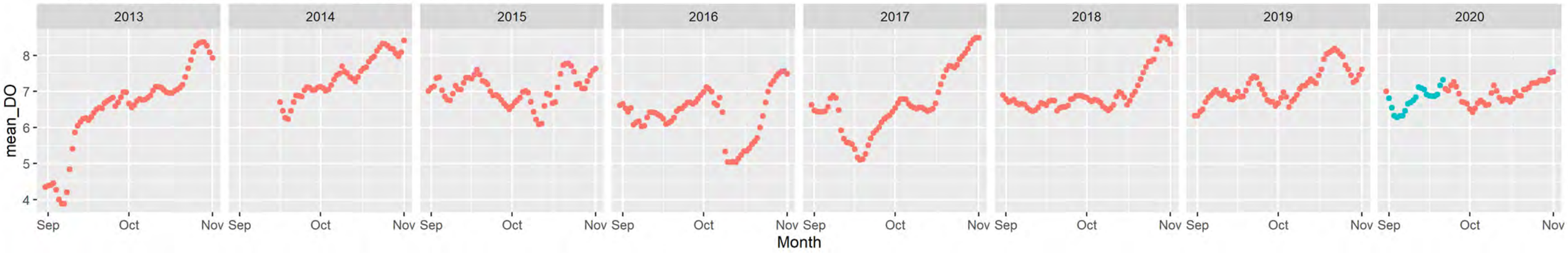


0219897993 - Elba Island Injection Status - Test Run - 24-Hour

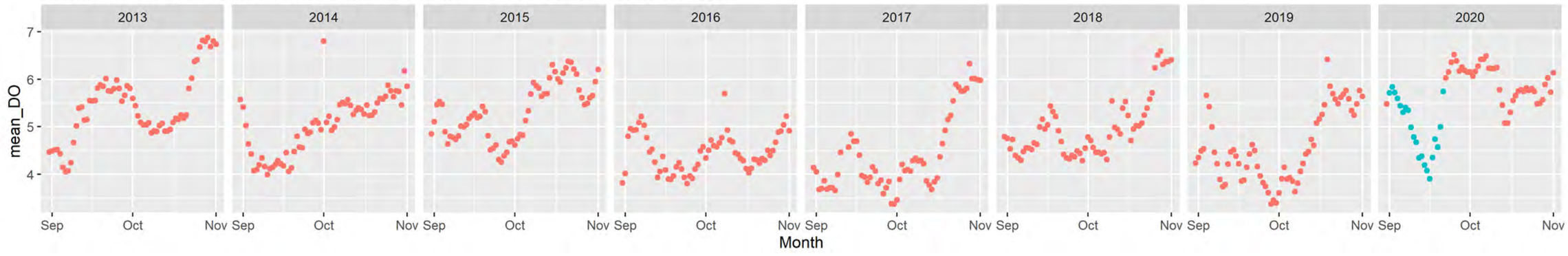


Dissolved Oxygen Concentrations - Startup Run

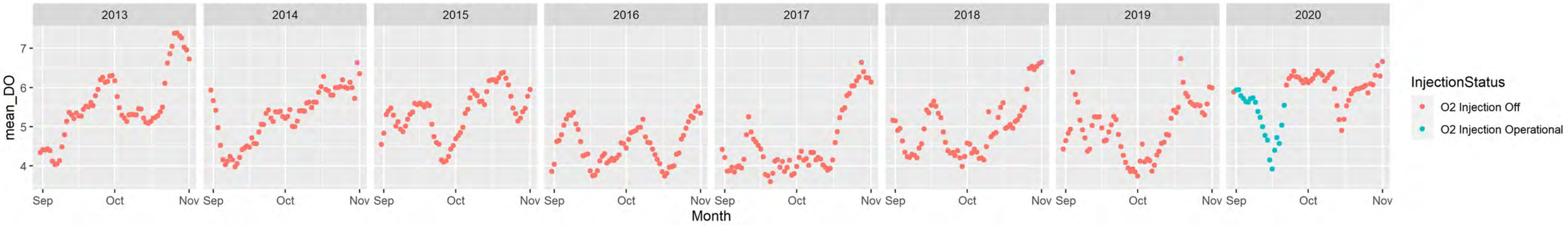
02198840 - I-95 Injection Status - Startup Run - 24-Hour



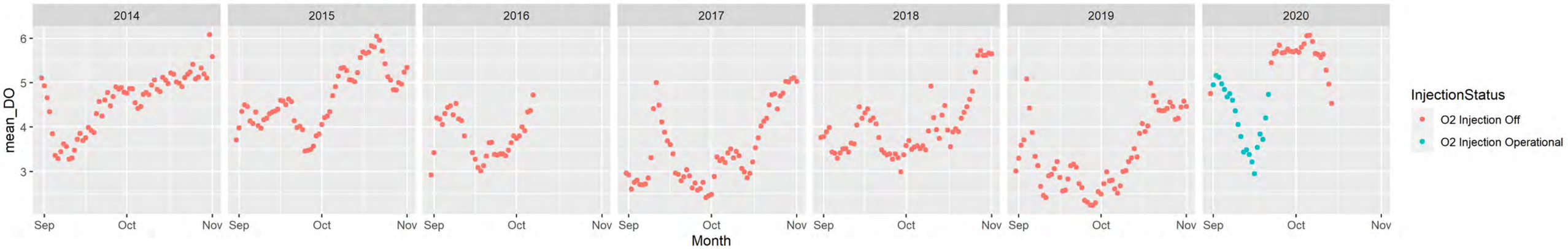
02198920 - Savannah R.-Port Wentworth Injection Status - Startup Run - 24-Hour



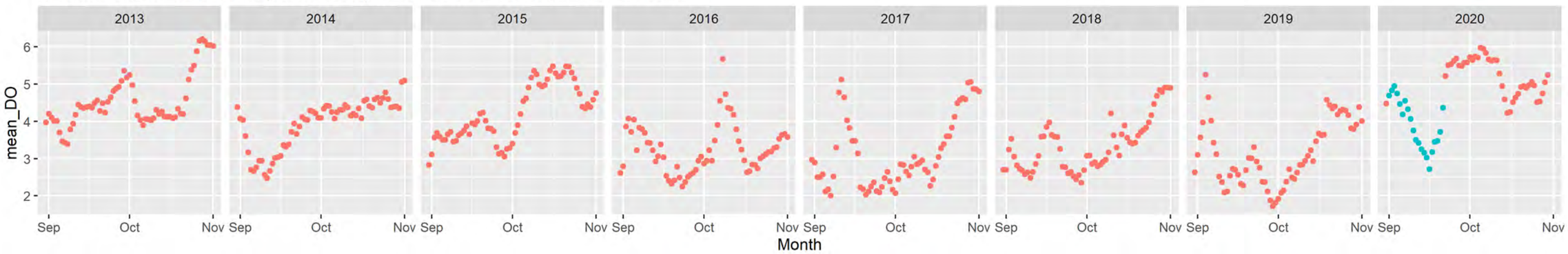
02198950 - Middle R.- Port Wentworth Injection Status - Startup Run - 24-Hour



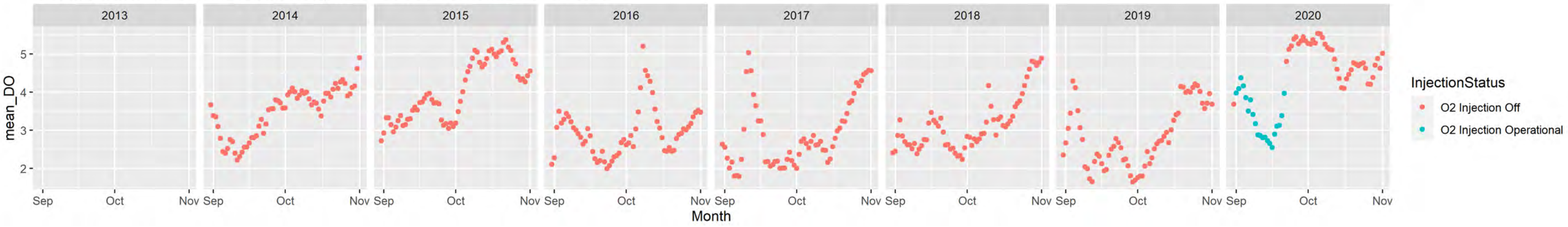
02198955_syn - Middle River Savannah in Fish Hole Injection Status - Startup Run - 24-Hour



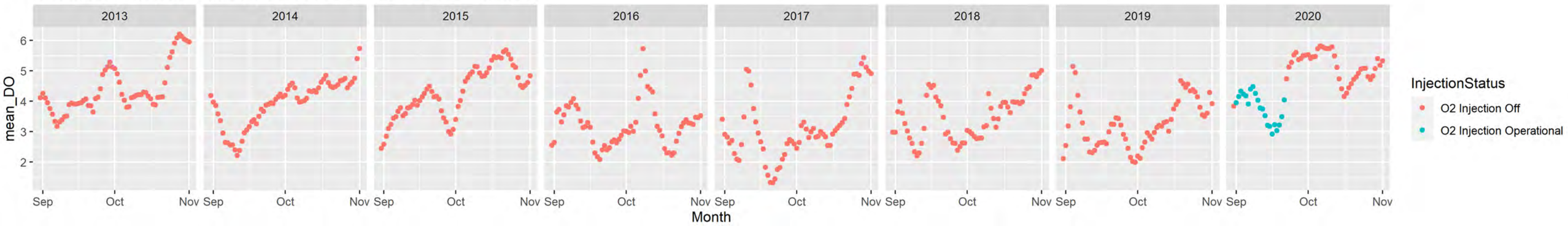
021989715_1 - Garden City 13.25 ft Injection Status - Startup Run - 24-Hour



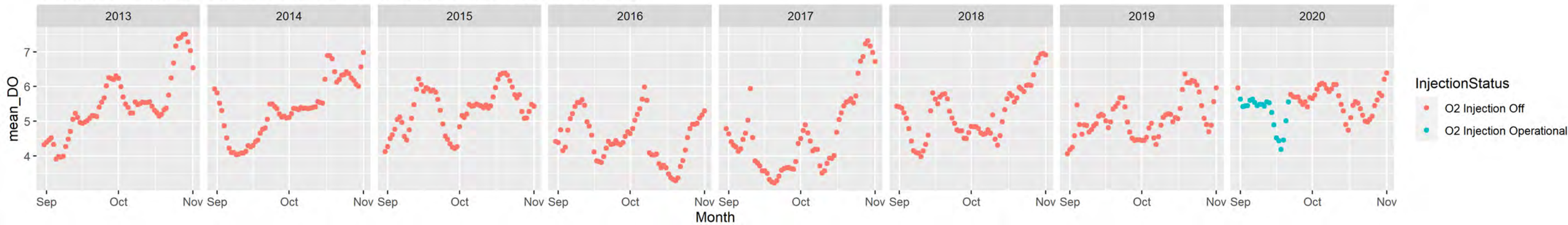
021989715_2 - Garden City 23.28 ft Injection Status - Startup Run - 24-Hour



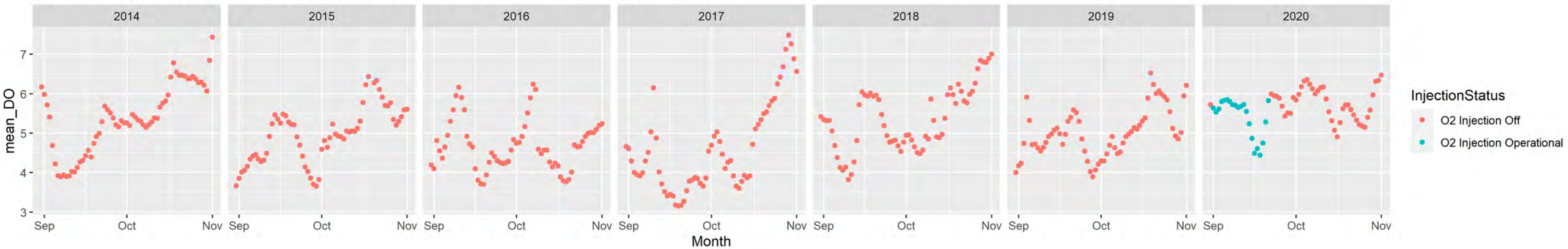
021989773 - USACE Dock Injection Status - Startup Run - 24-Hour



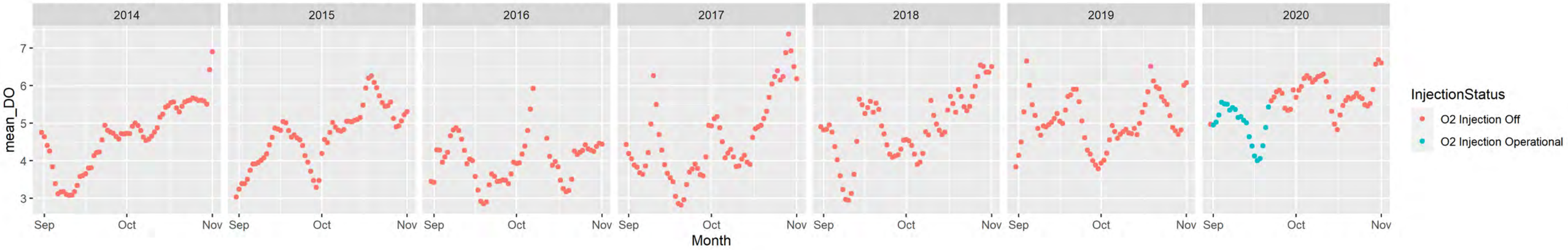
021989792 - Little Back-Port Wentworth Injection Status - Startup Run - 24-Hour



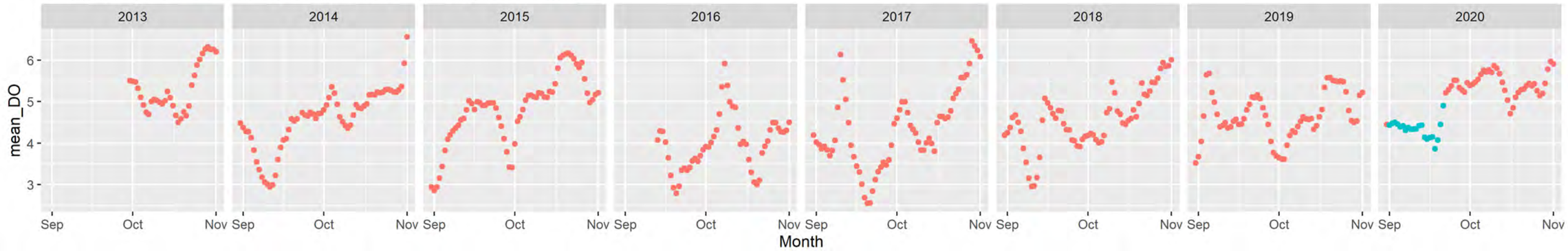
021989793_syn - Little Back River at Hog Island Injection Status - Startup Run - 24-Hour



0219897945_syn - Back River at US 17 Injection Status - Startup Run - 24-Hour

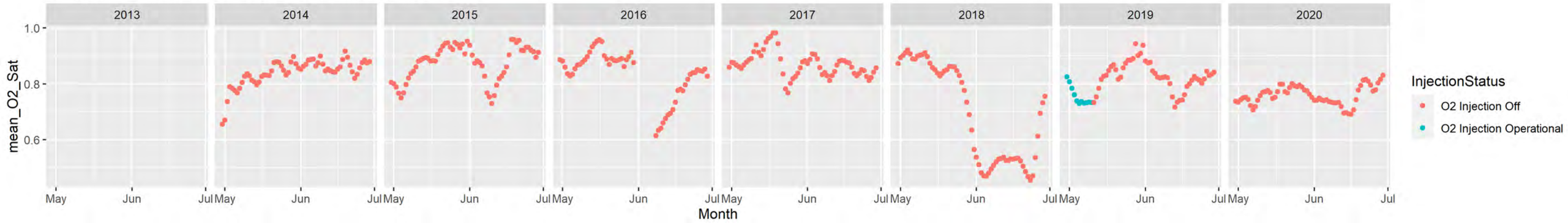


0219897993 - Elba Island Injection Status - Startup Run - 24-Hour

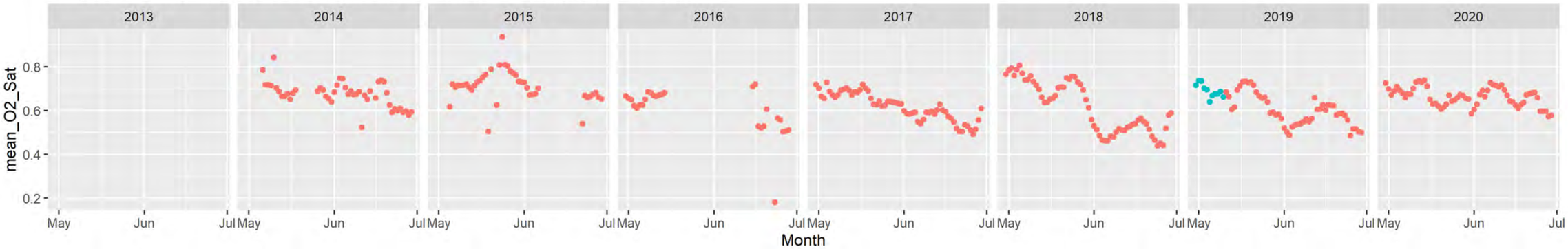


Oxygen Saturation - Test Run

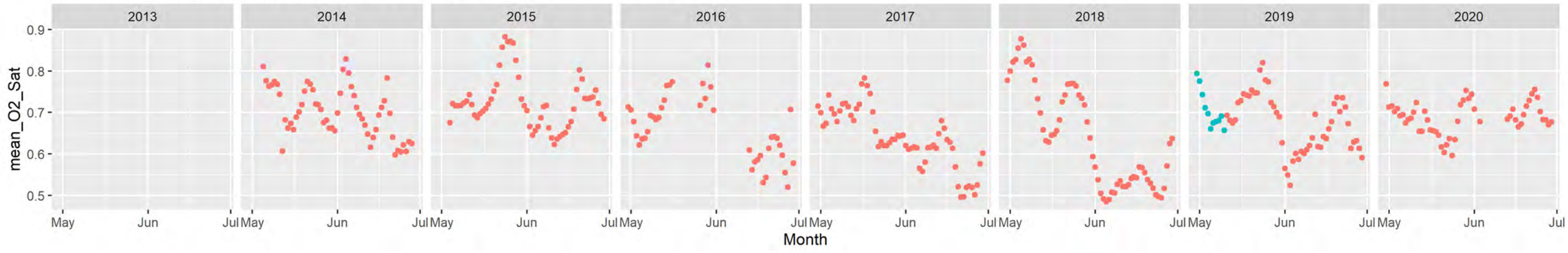
02198840 - I-95 O2 Saturation - Test Run - 24-Hour



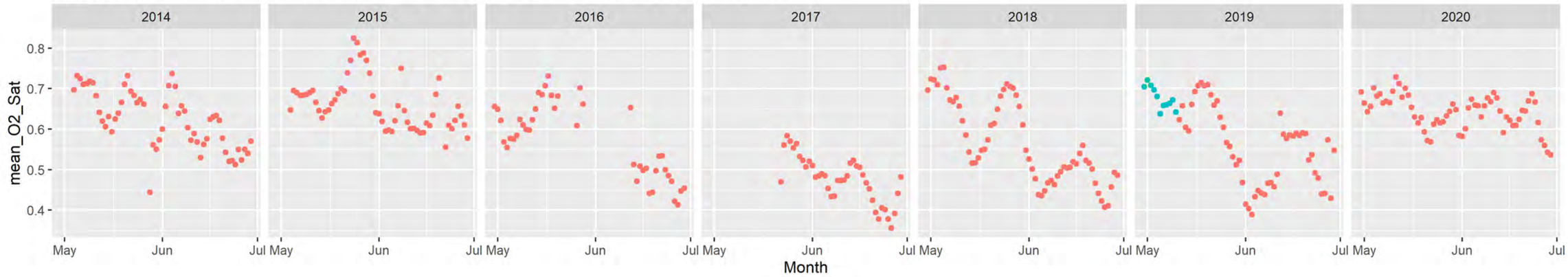
02198920 - Savannah R.-Port Wentworth O2 Saturation - Test Run - 24-Hour



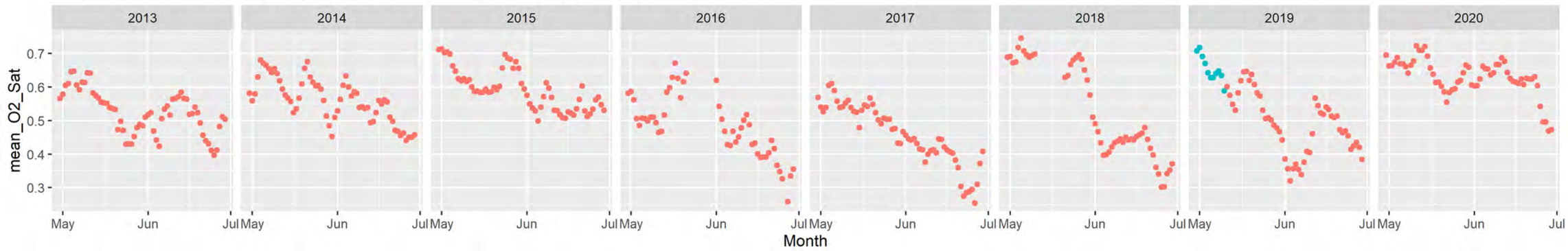
02198950 - Middle R.- Port Wentworth O2 Saturation - Test Run - 24-Hour



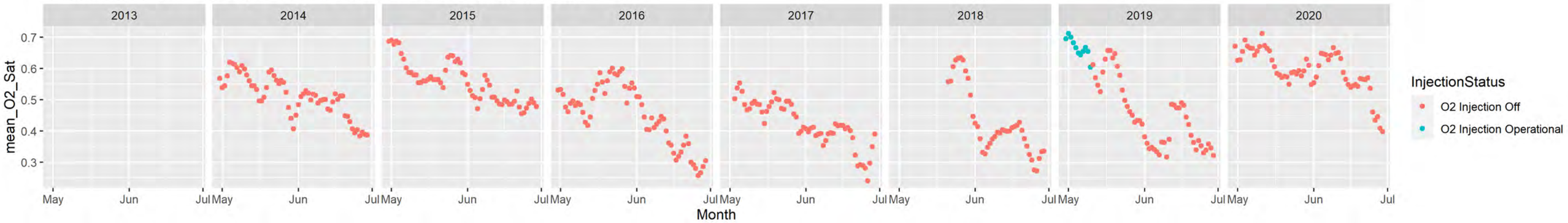
02198955_syn - Middle River Savannah in Fish Hole O2 Saturation - Test Run - 24-Hour



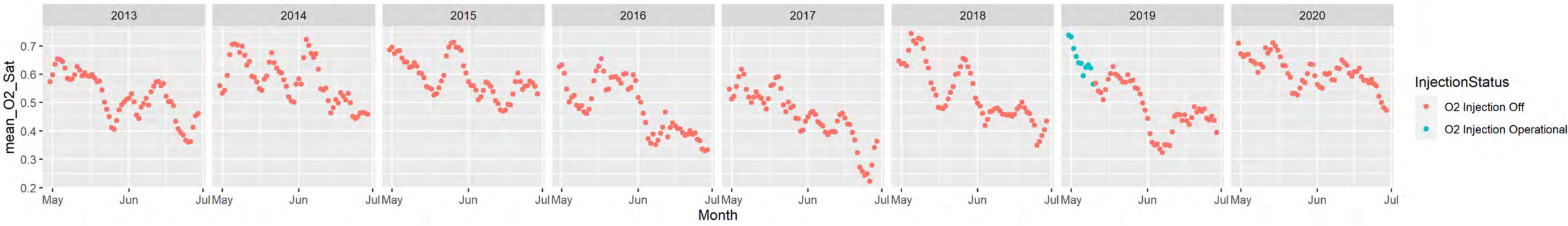
021989715_1 - Garden City 13.25 ft O2 Saturation - Test Run - 24-Hour



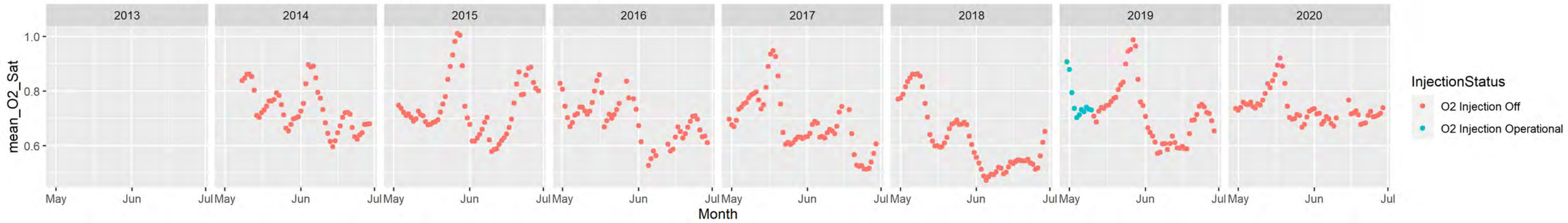
021989715_2 - Garden City 23.28 ft O2 Saturation - Test Run - 24-Hour



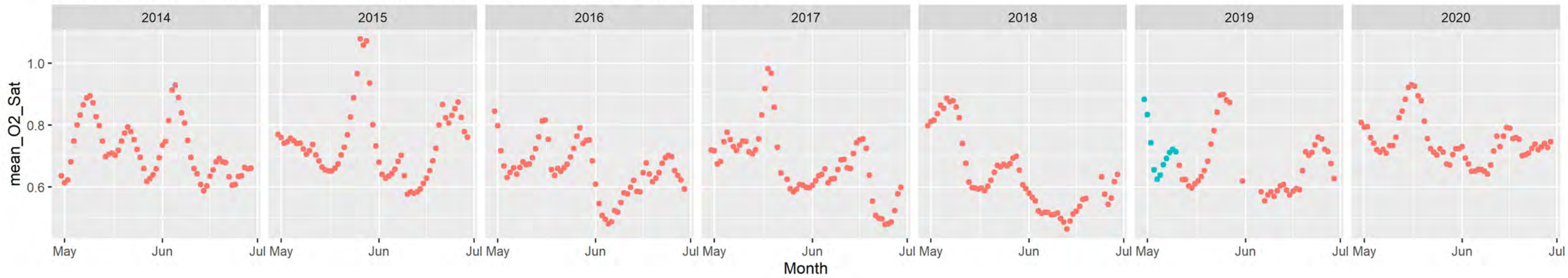
021989773 - USACE Dock O2 Saturation - Test Run - 24-Hour



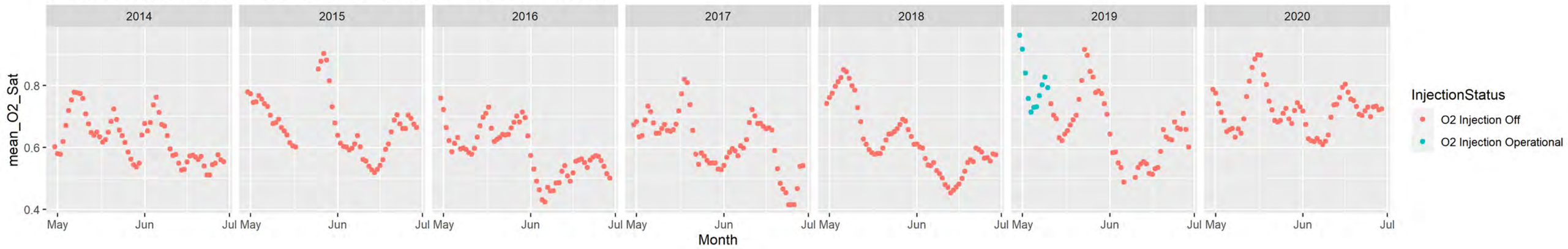
021989792 - Little Back-Port Wentworth O2 Saturation - Test Run - 24-Hour



021989793_syn - Little Back River at Hog Island O2 Saturation - Test Run - 24-Hour



0219897945_syn - Back River at US 17 O2 Saturation - Test Run - 24-Hour



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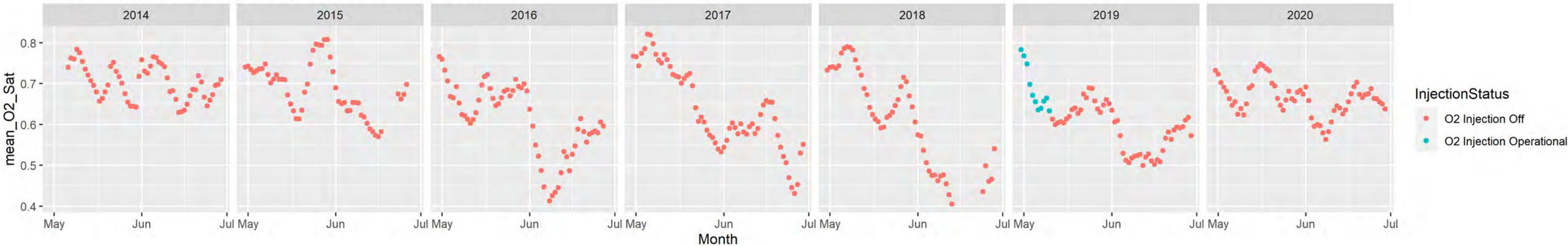
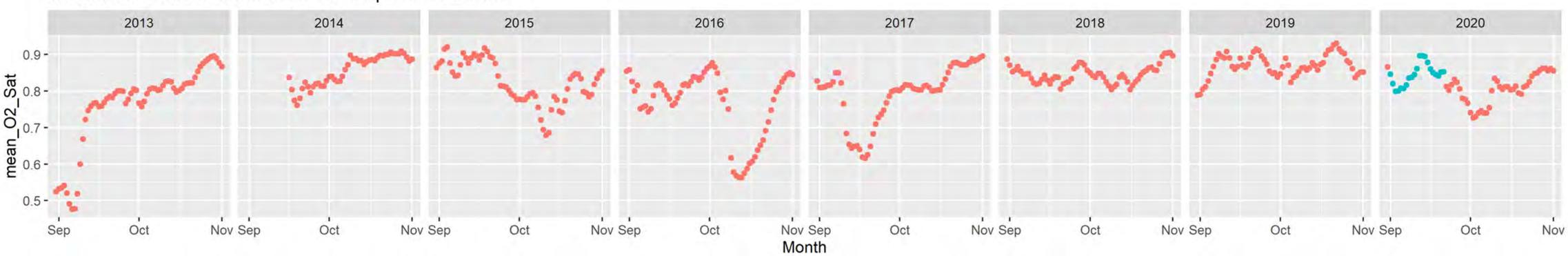
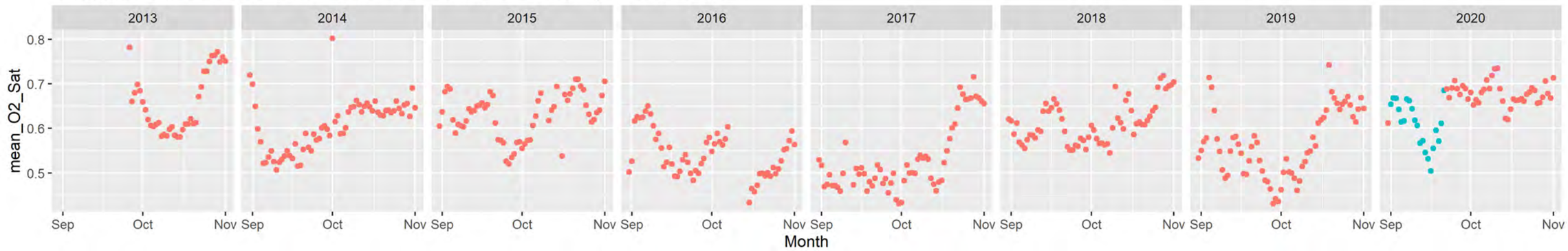


Oxygen Saturation - Startup Run

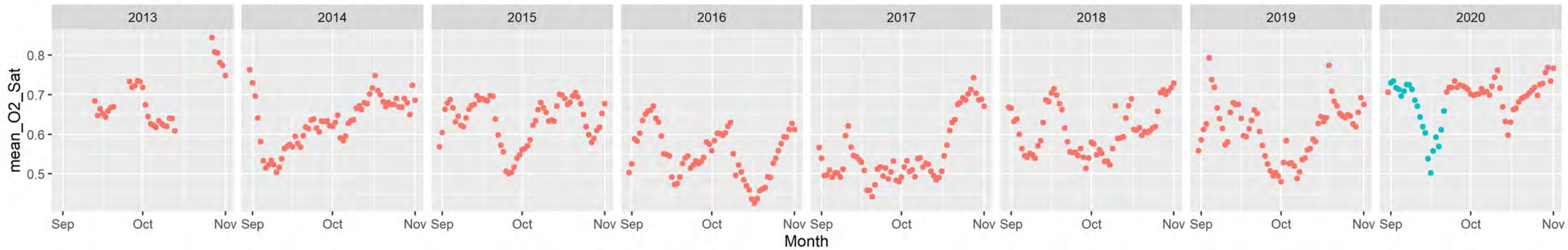
02198840 - I-95 O2 Saturation - Startup Run- 24-Hour



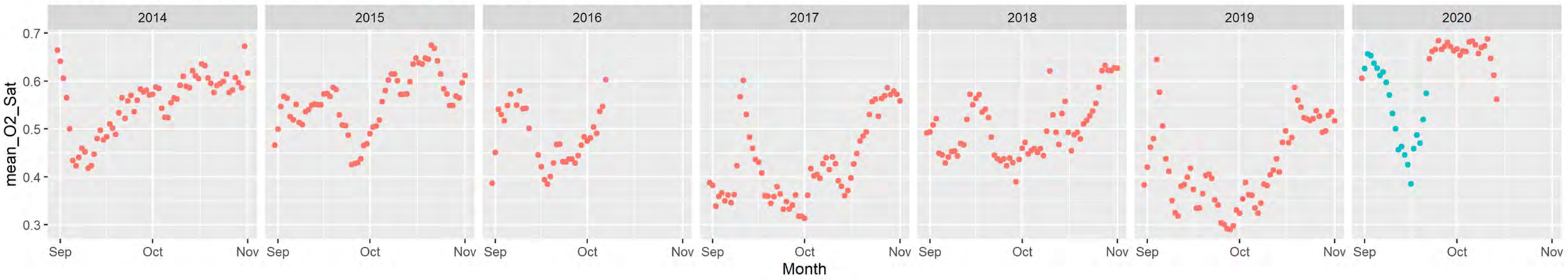
02198920 - Savannah R.-Port Wentworth O2 Saturation - Startup Run- 24-Hour



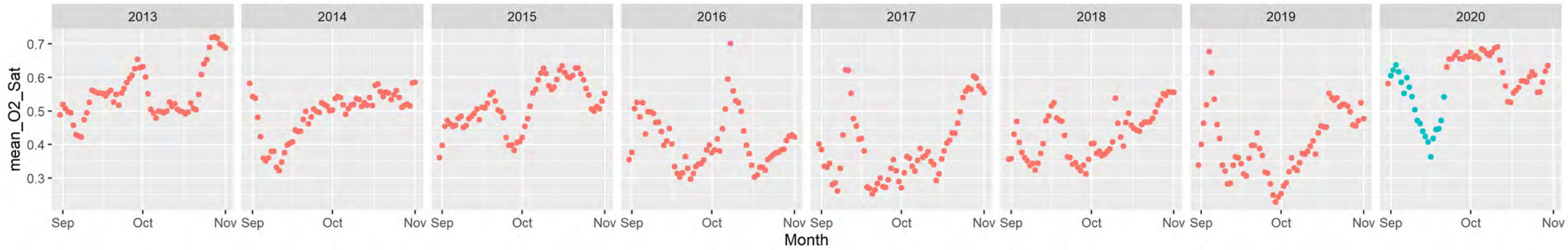
02198950 - Middle R.- Port Wentworth O2 Saturation - Startup Run- 24-Hour



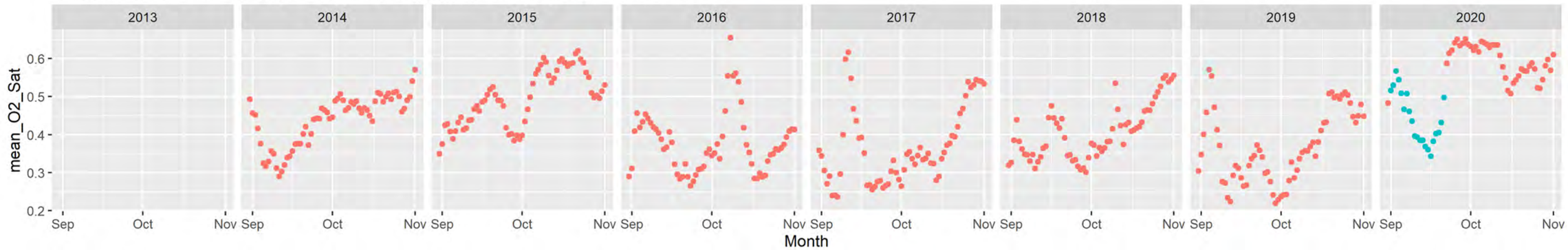
02198955_syn - Middle River Savannah in Fish Hole O2 Saturation - Startup Run- 24-Hour



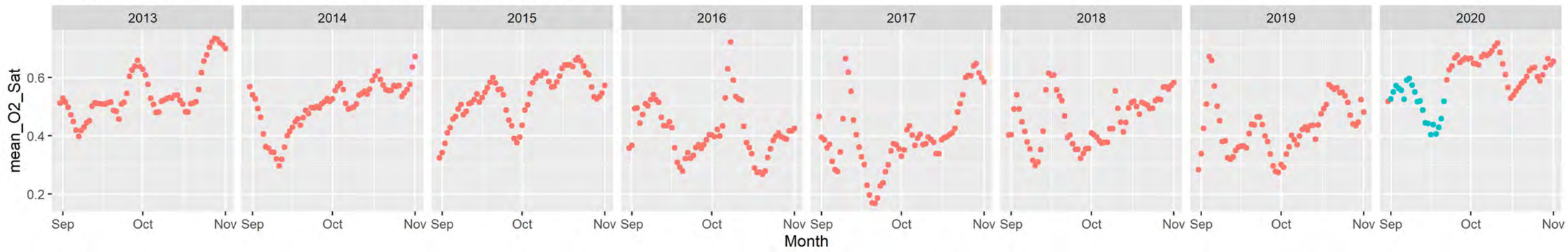
021989715_1 - Garden City 13.25 ft O2 Saturation - Startup Run- 24-Hour



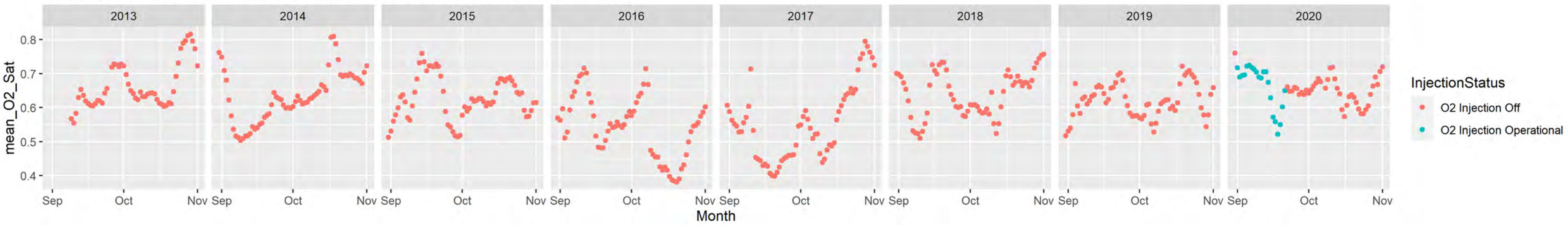
021989715_2 - Garden City 23.28 ft O2 Saturation - Startup Run- 24-Hour



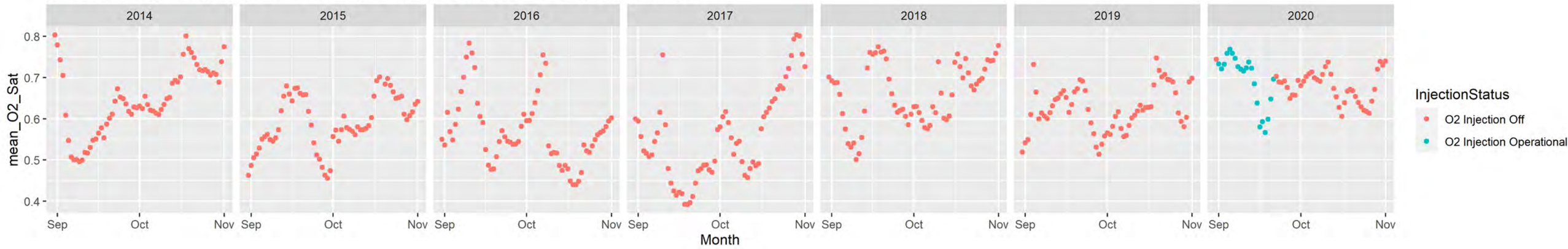
021989773 - USACE Dock O2 Saturation - Startup Run- 24-Hour



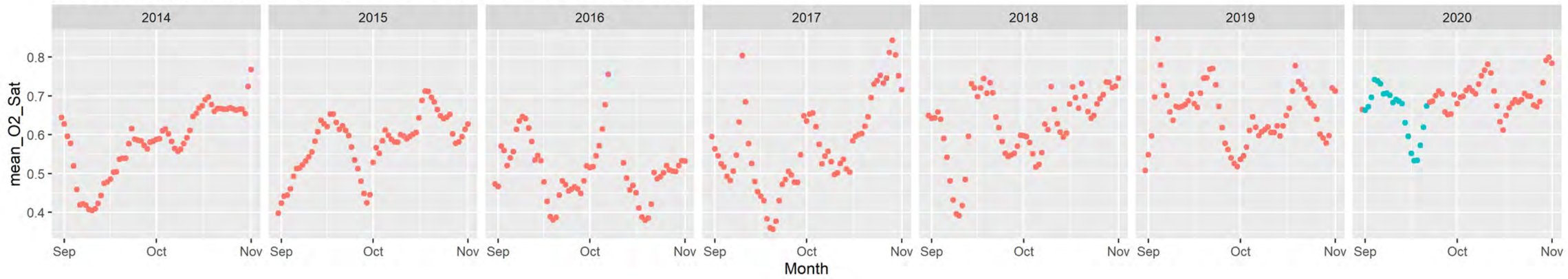
021989792 - Little Back-Port Wentworth O2 Saturation - Startup Run- 24-Hour



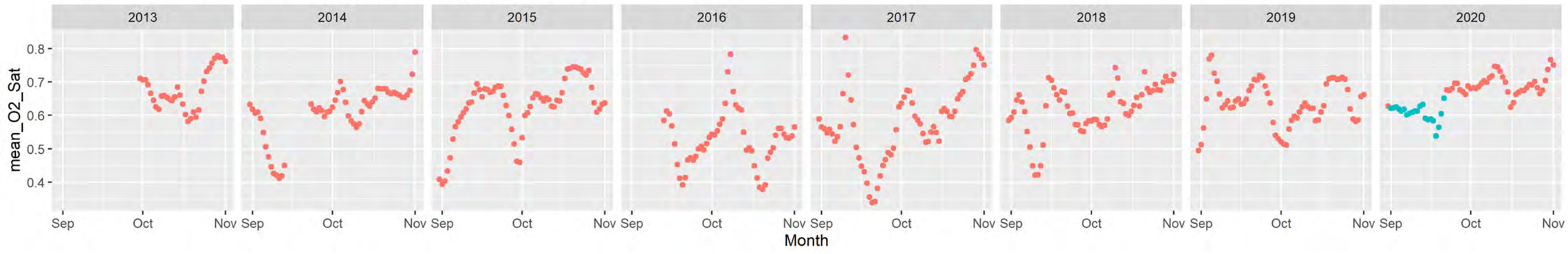
021989793_syn - Little Back River at Hog Island O2 Saturation - Startup Run- 24-Hour



0219897945_syn - Back River at US 17 O2 Saturation - Startup Run- 24-Hour



0219897993 - Elba Island O2 Saturation - Startup Run- 24-Hour



APPENDIX K SHEP MODEL ADDITIONAL DETAIL

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Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Tasks: 10
March 2022 Revision 1

PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX K BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two Plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both Plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the Plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document is provided as Appendix K of the SUR Report and is referred to in the main body of the report in Sections 3.3, 7.3, 11.1, 11.1.1, 11.2.1, 11.3.1, 11.3.2, and 12.2.

APPENDIX K TABLE OF CONTENTS

APPENDIX K SHEP MODEL ADDITIONAL DETAIL K-1

K.1 Model History K-6

K.2 2020 SHEP Model Re-Calibration K-8

K.3 Model Refinements K-8

K.4 Model Code Updates K-11

K.5 Model Re-Calibration K-11

K.6 2020 SHEP Model Outputs K-26

K.7 References K-27

Attachment A – Visuals on Model Grid Refinements K-28

Attachment B – Hydrodynamics Calibration – Figures and Statistic Tables K-29

Attachment C – Water Quality Calibration – Figures and Statistic Tables K-30

Attachment D – Startup Run Modeling Outputs K-31

APPENDIX K LIST OF FIGURES

Figure K-1 EFDC Computational Grids for the 2015 Model and the 2020 Model K-9
Figure K-2 EFDC Computational Grids for the 2015 Model and the 2020 Model at the Mid-River Area K-10
Figure K-3 EFDC Computational Grids for the 2015 Model and the 2020 Model near the Upriver Plant ... K-10
Figure K-4 Location of USGS verification stations K-12

APPENDIX K LIST OF TABLES

Table K-1 Point source discharges and withdrawals K-13
Table K-2 Area weighting factor for tributary flows K-14
Table K-3 Grading criteria for R^2 and IOA K-16
Table K-4 Summary and grading of statistics for WSE K-16
Table K-5 Summary and grading of statistics for flow K-17
Table K-6 Summary and grading of statistics for residual flow K-17
Table K-7 Summary and grading of statistics for salinity K-18
Table K-8 Summary and grading of statistics for temperature K-18
Table K-9 USGS stations used for model calibration K-21
Table K-10 Marsh load distribution K-22
Table K-11 Marsh load seasonal variation K-23
Table K-12 Water quality kinetic rates K-24
Table K-13 Summary and grading of statistics for DO K-25

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
°C	degrees Celsius
CBOD	Carbonaceous biochemical oxygen demand
CBODU	Ultimate carbonaceous biochemical oxygen demand
DO	Dissolved oxygen
DMR	Discharge Monitoring Reports
EFDC	Environmental Fluid Dynamic Code
EIS	Environmental Impact Statement
$g/m^2/day$	grams per square meters per day
GUI	graphical user interface
IA	Index of agreement
I-95	Interstate 95
kg/day	kilograms per day
lbs/day	pounds per day
mg/L	milligrams per liter
MAE	Mean absolute errors
NH3	Ammonia
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
Plant	DO Injection System
SHEP	Savannah Harbor Expansion Project
SUR	Startup Run
RMSE	Root mean square error
SOD	Sediment oxygen demand
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WASP	Water Quality Analysis Simulation Program
WRDB	Water Resources Database
WSE	water surface elevation

K.1 MODEL HISTORY

The Savannah Harbor Expansion Project (SHEP) model was first developed in 2006 and has been updated several times over a nearly 15-year period to evaluate impacts to water quality from a variety of sources, including the proposed SHEP navigational and mitigation features. The updates have been made for several reasons, including improvements in the model code, changes to Savannah River system, incorporating new data such as bathymetric surveys, and general improvements to the modeling approach. A summary of each model and its use is presented below.

- **2006 SHEP Model**
    - Used to develop the SHEP Environmental Impact Statement (EIS)
    - Simulated hydrodynamic and water quality conditions from January 1, 1997 through December 31, 2003
    - Evaluated and approved by agencies and stakeholders
- **2010 SHEP Model**
    - Developed by U.S. Environmental Protection Agency (USEPA) and used to develop the 2010 Dissolved Oxygen (DO) Total Maximum Daily Load
    - Used 2006 SHEP Model as baseline
    - Revised model grid to better represent DO in Savannah River and Harbor
    - Evaluated and approved by agencies and stakeholders
- **2015 SHEP Model**
    - Simulated hydrodynamic and water quality conditions from January 1, 1997 to April 30, 2014
    - Calibrated baseline model
    - Evaluated and approved by agencies and stakeholders
- **2015 SHEP Without-Project**
    - Used 2015 SHEP model as baseline
    - Bathymetry modified to meet authorized depth throughout navigation channel
- **2015 SHEP With-Project (WP)**
    - Used 2015 SHEP WP model as baseline
    - Included all proposed SHEP navigational and mitigation features
- **2018 SHEP Model**
    - Used 2015 SHEP model as baseline
    - Simulated hydrodynamic and water quality conditions from January 1, 2014 through December 31, 2017
    - Updated the navigational channel bathymetry using the May 2018 bathymetric survey performed by the U.S. Army Corps of Engineers (USACE) Savannah District
    - Updated the Downriver and Upriver site bathymetry using the bathymetric survey conducted by Bottom Line Echo Company during 2017 to support development of the Computational Fluid Dynamics near-field models

- **2019 SHEP Model**
  - Used 2018 SHEP model as baseline
  - Simulated hydrodynamic and water quality conditions from January 1, 2018 through June 30, 2019
  - Updated the navigational channel bathymetry using the March 2019 bathymetric survey performed by the USACE Savannah District
  - Updated the McCoy's Cut area and Rifle Cut bathymetry using the September 2018 bathymetric survey performed by the USACE Savannah District
  - Removed tidal gate representation from the model
  - Closed Rifle and McCoombs Cuts in the model
  - Added the DO injection system to assist with the Test Run data collection evaluations
  - Developed three scenario models to assist in evaluating DO injection system
    - **2019 SHEP Model Baseline**: No DO loads injected
    - **2019 SHEP Model Actual**: Actual 15-min DO loads injected into Front River and Back River
    - **2019 SHEP Model EIS**: DO loads injected at loads identified in EIS - 8,000 pounds per day (lbs/day) into Front River and 4,000 lbs/day into Back River
- **2020 SHEP Model**
  - Used 2019 SHEP Model Actual as baseline
  - Significantly modified grid by extending the offshore boundary, adding cells to represent the Intracoastal Waterway and lower Calibogue Sound, refining grid cells in the Middle and Back Rivers, and modifying the size and locations of marshes
  - Updated the navigational channel bathymetry using the July and August 2020 bathymetric surveys performed by the USACE Savannah District
  - Updated Water Quality Analysis Simulation Program (WASP) model to latest version, WASP8.4.
  - Added the Upriver DO injection system to assist with the Startup Run (SUR) data collection evaluations
  - Developed three scenario models to assist in evaluating DO injection system
    - **2020 SHEP Model Baseline**: No DO loads injected
    - **2020 SHEP Model Actual**: Actual 15-min DO loads injected into Front River, Back River, and Savannah River
    - **2020 SHEP Model EIS**: DO loads injected at loads identified in EIS; 8,000 lbs/day into Front River, 4,000 lbs/day into Back River, and 28,000 lbs/day into Upriver

K.2 2020 SHEP MODEL RE-CALIBRATION

Due to changes in the Savannah Harbor because of SHEP deepening and mitigation projects plus a significant amount of monitoring data, there was a need to upgrade the model to represent existing conditions more accurately throughout the harbor and predict future outcomes. The tasks required to accomplish the necessary 2020 SHEP Model re-calibration were:

- Model Refinements
- Model Code Updates
- Model Re-Calibration.

The Model upgrades were undertaken in 2020 prior to completion of the SUR and are detailed in the sections below.

K.3 MODEL REFINEMENTS

The purpose of this task was to refine the Environmental Fluid Dynamic Code (EFDC) model grid to capture marsh, creeks, and rivers for inclusion in the 2020 SHEP Model. Refinements were needed to better capture flows in and out of the system.

Grid refinements included:

- Addition of lower marsh between USACE Depot dock and Fort Pulaski
- Offshore grid extended south of the Savannah River including Wassaw Sound, Wilmington and Bull Rivers, and the Intracoastal Waterway
- Grid extended north of the lower Savannah River including the Intracoastal Waterway and lower Calibogue Sound
- Additional cells added to channels to better represent the deep water and adjacent shallow side areas. The Middle and Back Rivers were updated from one grid cell wide to two. Same for Upper Savannah River to Upriver DO Injection System (Plant)
- Modification of the marsh areas throughout river system, modifying the sizes and locations of the existing 16 marshes from the 2015 SHEP Model and adding new marshes for a total of 18 marsh areas.

The grid refinements were implemented to better define the cross sections of the Middle and Back Rivers and the Savannah River upstream of Interstate 95 (I-95) up to the Upriver DO Plant, and marshes were added to improve the simulation of the tidal prism of the Savannah River and thus improving the tidal flow circulation in the system. The new marsh cells were initially estimated based on analysis of measured flows and model performance using previous marsh area distribution. During calibration the number and area of marsh cells were adjusted as needed to better represent the tidal prism and general circulation in the Savannah Harbor area (see ***Figure K-1***, ***Figure K-2***,and **Attachment A**). In 2014, U.S. Geological Survey (USGS) started collecting continuous flow data at six locations on the Front, Middle, and Back Rivers. Marsh areas included in the 2010 Total Maximum Daily Load (TMDL) Model and the 2015 SHEP Model were determined based on limited flow data collected in 1999 for a single tidal cycle. Comparing these to the USGS data, it was apparent that peak flows and the spring-neap variability in the system were previously underpredicted. Marshes act as storage areas and as such play a relevant role in the determination of the tidal prism and contribution to the fluxes in the system. Using the USGS flow data, the area and location of marsh storage areas were updated to improve the flow circulation.

Bathymetry updates included:

- Data for upper estuary around McCoy's Cut and the sediment basin collected from April 6, 2020 through April 8, 2020 by USACE
- New bathymetry data collected for an 18-mile segment between Upriver DO Plant and McCoy's Cut – transects at 500-foot intervals. Data was provided on May 21, 2020 by USACE
- Federal navigation channel - latest survey data from USACE Hydrographic Survey (eHydro) website.

These bathymetry updates were implemented to include new data not previously available on the upper Savannah River up to the Upriver DO Plant, to adjust the bathymetry for the river segments where cross sections were increased from one cell to two cells, and to define the bathymetry of the new areas added to the model mesh.

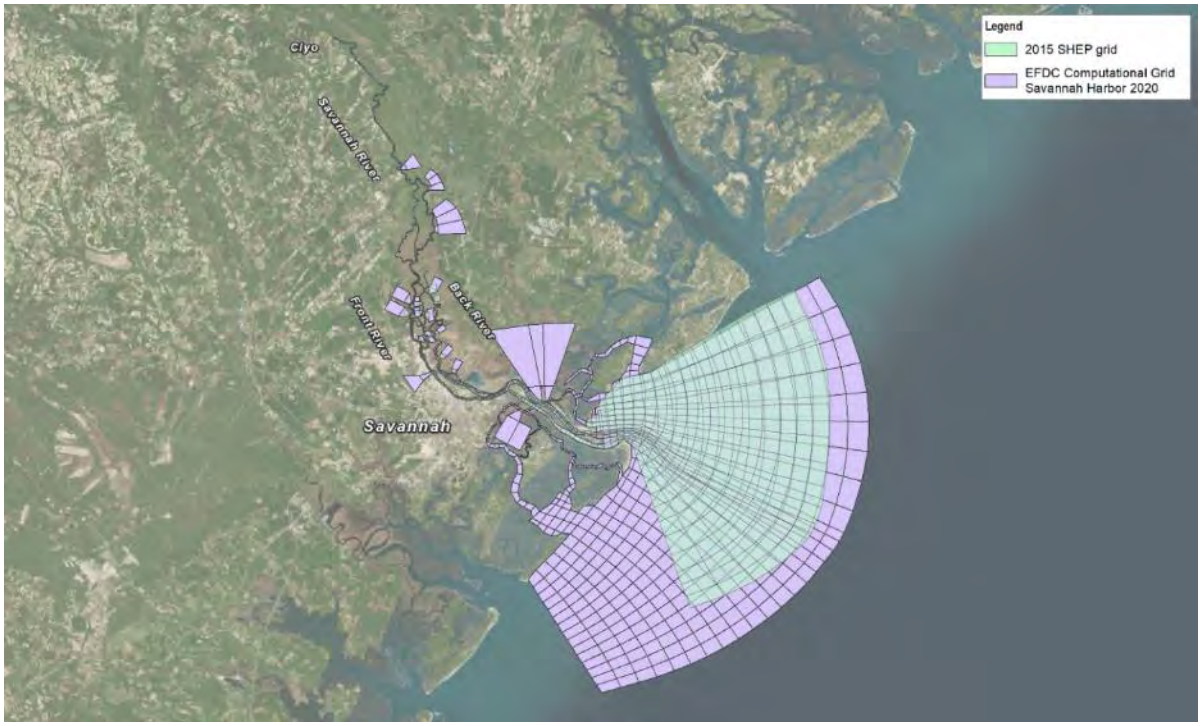

Figure K-1 EFDC Computational Grids for the 2015 Model and the 2020 Model

Figure K-1 shows a plan view of the 2020 SHEP Model grid with the 2015 SHEP Model to highlight the updates made. ***Figure K-2*** is a close up view of the two grids in the mid-river area showing the updates to the marsh areas, and the Middle and Back River update to three lateral cells. ***Figure K-3*** illustrate the changes in the area around the Upriver DO Plant. A detailed visual summary of the changes is presented in **Attachment A**.

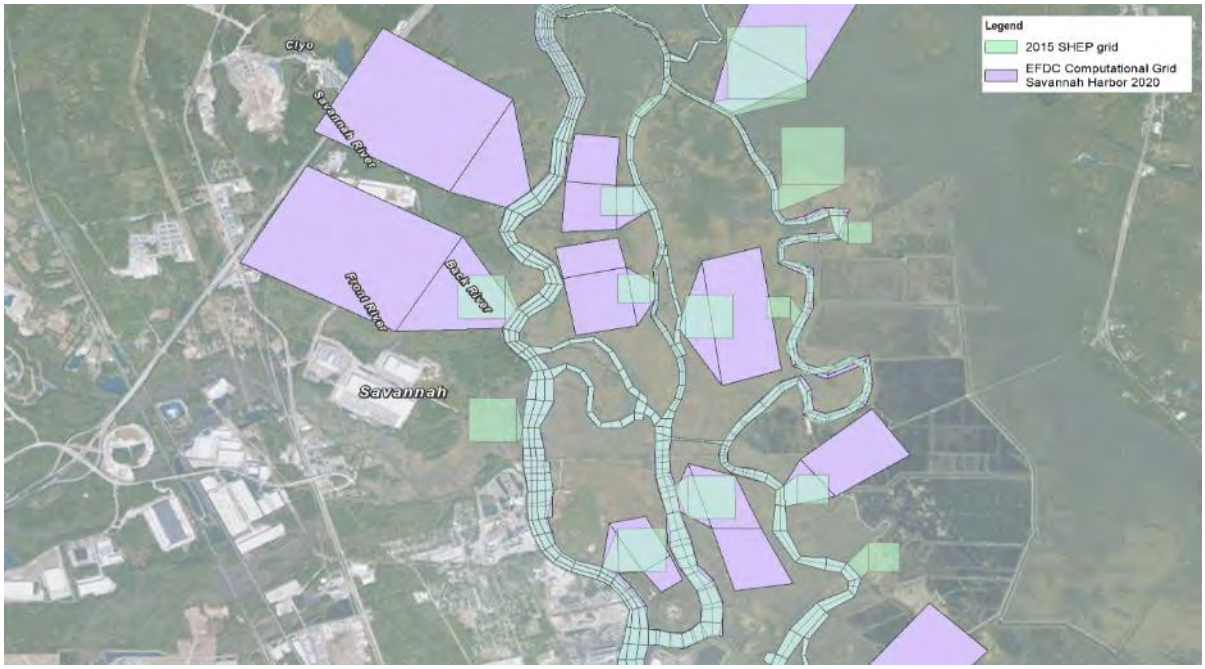

Figure K-2 EFDC Computational Grids for the 2015 Model and the 2020 Model at the Mid-River Area



Figure K-3 EFDC Computational Grids for the 2015 Model and the 2020 Model near the Upriver Plant

K.4 MODEL CODE UPDATES

The purpose of this task was to re-evaluate the model code to ensure it was appropriately simulating the complex hydrodynamic conditions within the Savannah River, as well as updating, if necessary, the connection between EFDC and the latest version of the USEPA WASP8 water quality model. The latest version of the water quality code, WASP8.4, was received from the developers of the model on August 28, 2020. This version was deemed appropriate to use for the update of the model, since previous versions of the WASP code are no longer being supported. The improvements introduced to this version (WASP8.4) are primarily related to the graphical user interface (GUI) for a more user-friendly interface environment. No changes were made to the computational part of the code.

In May 2020, a linkage file that transfers the full hydrodynamics from the EFDC model to WASP8 was created using a two-month period for November 2019 through December 2019. The file was successfully loaded into WASP8 creating a workable WASP file, with the right segments and flow connections. The file was tested for mass balance using a conservative substance as implemented in WASP to verify the correct transfer of flows and volumes of segments from the hydrodynamics to the water quality models. The test proved that the flows and volumes transferred through the linkage files were consistent and correctly interpreted by WASP8. During the water quality model re-calibration task, the hydrodynamic linkage file was tested for the new WASP8.4 code. The linkage file worked correctly, without any changes needed in the EFDC code.

K.5 MODEL RE-CALIBRATION

Overview

The hydrodynamic (EFDC) and water quality (WASP) model of the Savannah River has a long history of continuous development as new data has become available. Initial EFDC and WASP models were developed in 2004 by Tetra Tech and USEPA Region 4 for the DO TMDL in the Savannah Harbor. In 2004, the model was updated by Tetra Tech for the USACE Savannah District to inform the SHEP EIS. The work was finalized in 2006 with major updates including a finer resolution model grid, bathymetry updates using new data, and using an alternate approach for model calculation of the river-marsh interactions (Tetra Tech 2006).

In 2009, the USEPA Region 4 converted the EFDC sigma grid in the 2006 SHEP Model to a generalized vertical coordinate option (Z-grid). This 2010 TMDL Model revised the 2006 SHEP Model marsh areas to include areas downstream of Fort Jackson, an additional marsh area upstream near the I-95 Bridge and included marsh load seasonality. The reaeration approach and carbonaceous biological oxygen demand (CBOD) decay rates were modified, and the model was subject to an extensive peer review process which recommended kinetic rates for the water quality model.

In 2014, Tetra Tech updated the 2006 SHEP EFDC Model and 2010 TMDL WASP Model to meet project requirements outlined in Appendix D of the SHEP EIS (USACE 2012). The models were extended through 30 April 2014 and recalibrated to data collected in 2013 and 2014. Updates included refining the 2006 SHEP Model grid to increase grid resolution at mitigation project locations, incorporating the Z-grid from the 2010 TMDL Model, increasing the number of vertical layers to a maximum of 10 layers for the channel and deep areas, and updating bathymetry with 2014 survey data. The 2015 SHEP Model uses the same marsh implementation as the 2010 TMDL Model.

The 2015 SHEP Model flow was calibrated to limited flow data which USGS started collecting in 2014. In 2019, Tetra Tech extended the simulation period to 2019 and compared all model parameters for the extended period. With this extended period of comparison, it became apparent that the model was underestimating flows in the system compared to the flows reported by USGS. Due to changes in the harbor, additional data, and team consensus to upgrade the model, it was agreed that an update and recalibration of the model was needed.

The 2020 SHEP Model is an updated version of the 2015 SHEP Model which has been re-calibrated to better align with measured USGS gage data throughout the Savannah River system. The grid, bathymetry and code updates have been described previously. The 2020 SHEP Model uses the same WASP water quality kinetics and oxygen demanding matter (biochemical oxygen demand [BOD]) partitioning that were established for the 2010 TMDL Model and used in the 2015 SHEP Model. The 2020 SHEP Model also uses the same point source and tributary flows used for the 2015 SHEP Model.

The location of the USGS stations used for calibration of the hydrodynamic and water quality models are shown in ***Figure K-4***.

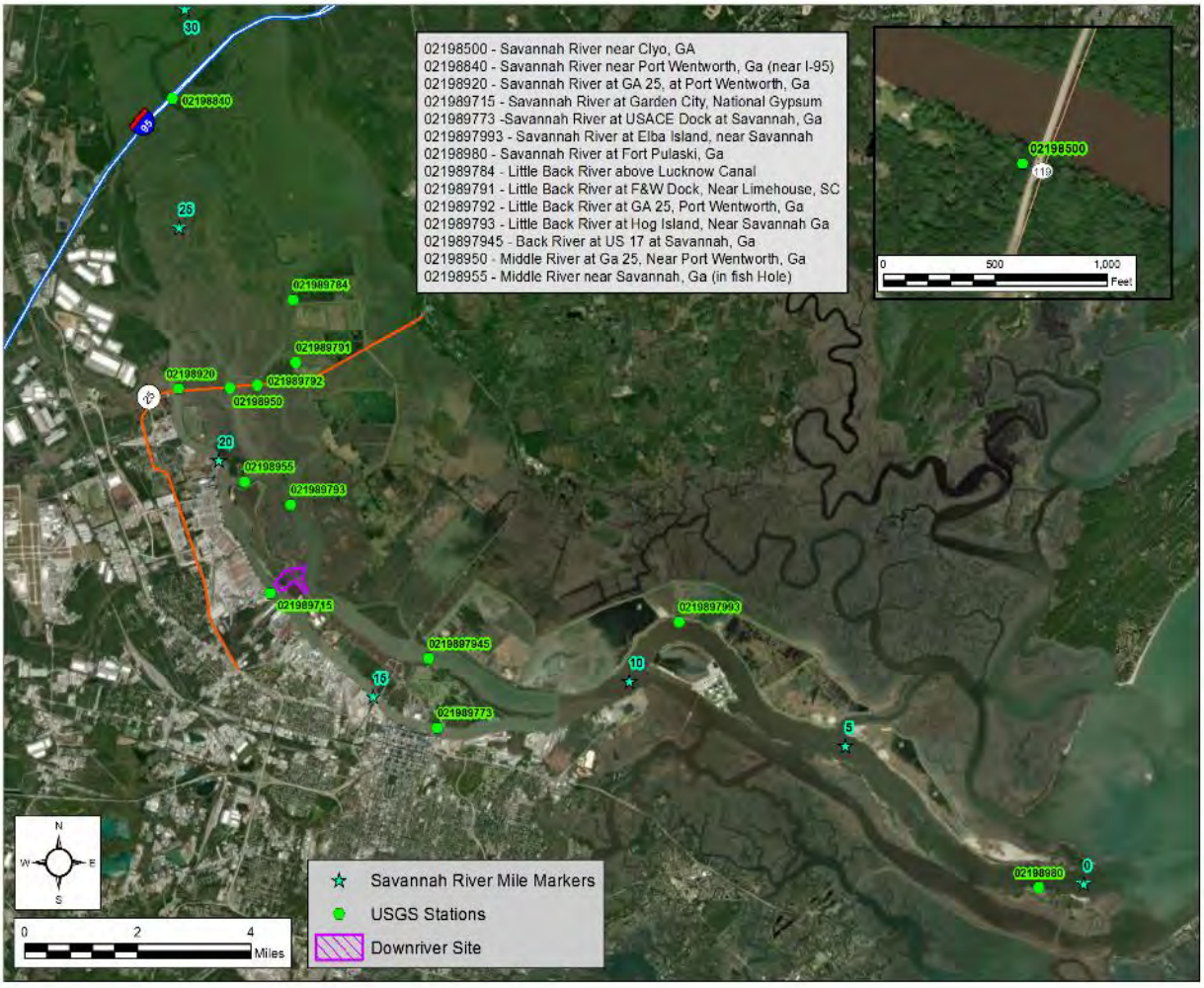

Figure K-4 Location of USGS verification stations

Hydrodynamics

The updated grid described in Section 3 was used to re-calibrate the hydrodynamic and water quality models using EFDC and WASP8.4, respectively. The hydrodynamic grid has 1,720 horizontal cells with a maximum of 10 vertical layers (**below Attachment A** – Visuals on Model Grid Refinements).

Precipitation, atmospheric pressure, air temperature, relative humidity, solar radiation, cloud cover and wind speed and direction were the meteorological parameters used for atmospheric interactions. Precipitation was taken from the USGS gage at the USACE Depot dock on Hutchison Island (021989773) and the Weather Bureau, Air Force, and Navy (WBAN) 03822 at Savannah was used for the remaining parameters.

Table K-1 lists the 14 point source discharges and four water withdrawals that were included in the simulation. Flows discharged or withdrawn by these facilities were provided by Tetra Tech based on National Pollutant Discharge Elimination System (NPDES) permits.

Table K-1 Point source discharges and withdrawals

NPDES Number	Facility	Type
GA0001988	International Paper - Savannah Mill	discharge
GA0002356	PCS Nitrogen Fertilizer	discharge
GA0002798	Weyerhaeuser - Port Wentworth Mill	discharge
GA0020427	Savannah - Travis Field WP	discharge
GA0020443	Savannah - Wilshire WPCP	discharge
GA0025348	Savannah President St. WPCP	discharge
GA0027588	U.S. Army Hunter Airfield WPCP	discharge
GA0031038	Garden City WPCP	discharge
GA0046973	Georgia Pacific-Savannah Mill	discharge
GA0048330	BASF Corp-Savannah Operations Engelhard	discharge
SC0034584	Hardeeville WPCP	discharge
GA0003611	Savannah Sugar Refinery	discharge
GA0038326	City of Savannah - Crossroads	discharge
GA0038814	Port Wentworth WPCP	discharge
051-0115-01	Savannah Industrial & Domestic Water System	withdrawal
07WS005	Beaufort Jasper W&SA	withdrawal
051-0114-01	Georgia-Pacific Consumer Products LP	withdrawal
025-0192-06	Savannah Acid Plant LLC	withdrawal

Flows measured at USGS station 02198500 (Savannah River near Clyo, GA) were used for the upstream boundary conditions for the Savannah River. Downstream from Clyo, several tributaries flow into the modeling domain. These tributaries are not gaged except for Ebenezer Creek (USGS station 02198690 at Springfield, GA). The standard

method for determining flows in small, ungaged tributaries is to calculate the ratio between the ungaged watershed area and the area of contribution for a gaged watershed of similar characteristics. Flows for all ungaged tributaries were calculated by area weighting the flows at Ebenezer Creek. In addition, there is drainage area in the modeling domain that is not considered by the tributary flows or the flow at Clyo. A 1.1 flow factor was included to account for these flows necessary to match fresh water flows at the most upstream USGS stations at I-95 and GA-25.

Table K-2 presents the location in the model domain and the area weighted factor applied to the flows at USGS station 02198690, for each individual ungaged tributary considered in the hydrodynamic model. These factors are the same used in the 2015 SHEP Model.

Table K-2 Area weighting factor for tributary flows

Tributary	Model cell		Factor applied to Ebenezer Flow
	I	J	
Union Creek	49	141	0.28
Unnamed Tributaries	23	61	0.07
Dandee Canal	22	71	0.04
Pipe Makers Canal	23	79	0.37
St. Augustine Creek	22	99	0.08
Black Creek	22	107	0.17
Ebenezer Creek	23	210	2.11
Mill Creek	16	152	0.41

Upstream temperature measurements were not available for either the Savannah River or tributaries. Data from the most upstream USGS station available, station 02198840 Savannah River at I-95, was used as the boundary condition and these values were adjusted during Model re-calibration.

The offshore boundary conditions were analyzed for potential refinements in the forcing for water surface elevation (WSE). The offshore boundary in 2015 SHEP Model and previous versions was made up of one time series with no spatial variation along the boundary. This time series is generated using National Oceanic and Atmospheric Administration (NOAA) tidal station 8670870 at Fort Pulaski and adjusted in phase and amplitude. Using the DHI global tide model, GHD obtained time series water level data at each boundary cell and compared it against the time series generated from NOAA data. The comparison showed that there were no significant phase or amplitude differences along the open boundary and a boundary condition based on NOAA station 8670870 was deemed appropriate. Therefore, the boundary condition at the offshore boundary of the modeling domain was forced by prescribing the WSE using 6-minute tidal data from NOAA station 8670870 at Fort Pulaski. The amplitude and phase of the tidal signal prescribed at the boundary were adjusted during calibration by comparing the model outputs at Fort Pulaski.

Temperature data measured from NOAA station 8670870 at Fort Pulaski was also used for the open ocean boundary condition.

The salinity boundary in the 2015 SHEP Model was set constant at 35.12 Practical Salinity Units (PSU) based on SABSOON data measured at the now-decommissioned offshore R2 station between 1999 and 2001. An analysis

on this SABSOON data, plus salinity data at the Fort Pulaski USGS gage, was undertaken to gain a better understanding of seasonal cycles. The analysis found small fluctuations and no significant seasonal variations. Based on this analysis, it was logical to keep the original, constant value of 35.12 PSU for the open ocean boundary condition in the 2020 SHEP Model.

The hydrodynamic model calibration period was from January 1, 2019 through December 31, 2019 and the parameters used for calibration were WSE, flow, residual flow at GA-25, salinity, and temperature. Graphical and statistical comparisons during the calibration were undertaken using measured data at the 13 stations, one of which measures data at two depths, as described in. as well as Figure B-8 in **Attachment A** – Visuals on Model Grid Refinements shows the location of the USGS stations.

Model calibration is typically a multi-step process of model adjustments and comparison of modeled parameters versus measurements. For this exercise, model calibration was evaluated using the following quantitative indices:

- **Mean Absolute Error (MAE).** This is a quantitative measurement of the differences between the simulated and measured data at a particular location. Specifically, it represents the average of the absolute differences between the simulated predictions and the measured observations. As such, lower values of MAE represent better model performance. The MAE is calculated as follows:

$$\boldsymbol{MAE} = \frac{\sum_{i=1}^{n}|P_i - O_i|}{n}$$

  Where:

  – P_i = Predicted value at comparison time i;

  – O_i = Observed value at comparison time i; and

  – n = number of comparison measurements.

- **Index of Agreement (IOA).** The IOA is a measure of the average differences between predicted and observed values relative to the range of values in the observation dataset. It is bounded between the values of 0 and 1, with values close to 0 describing models with large relative differences (i.e., poor calibration) and values close to 1 describing models with small relative differences (i.e., good calibration). The IOA is calculated as follows:

$$\boldsymbol{IOA} = 1 - \frac{\sum_{i=1}^{n}(P_i - O_i)^2}{\sum_{i=1}^{n}(|P_i - \bar{O}| + |O_i - \bar{O}|)^2}$$

  Where, further to the definitions for MAE:

  – $\bar{O}$ = The mean of the observations during the comparison period.

- **Coefficient of determination (R^2).** The R^2 is a measure of how well predicted and observed values are related. It is bounded between the values of 0 and 1, with values closer to 1 meaning that they are correlated, and values close to 0 that the two are poorly related. The R^2 is calculated as follows:

$$\mathbf{R^2} = \frac{(n\sum_{i=1}^{n}(P_i \times O_i) - \sum_{i=1}^{n}P_i \times \sum_{i=1}^{n}O_i)^2}{[n\sum_{i=1}^{n}P_i^2 - (\sum_{i=1}^{n}P_i)^2][n\sum_{i=1}^{n}O_i^2 - (\sum_{i=1}^{n}O_i)^2]}$$

The graphs and statistics for R^2, MAE, root mean square error (RMSE), normalized root mean square error (NRMSE), and IOA, as well as the mean, median, and 5th and 95th percentiles of the simulations and measurements were generated with the post-processor Water Resources Database (WRDB) Graph.

To facilitate the interpretation of calibration results, qualitative grading of the coefficient of determination and the IOA are provided. The grading for these two parameters were based on research studies completed for watershed model applications. Ahmadisharaf et al. (2019) present a thorough analysis and compiled a vast review of qualitative grading for different parameters including the R^2. Although it did not include the IOA, it included other bounded parameters with similar interpretation to the IOA. The range of grading qualifiers for these parameters is uniform for a large range of parameters and conditions modeled. Based on those values, grading criteria for R^2 and the IOA were selected for all parameters simulated in this model. The grading criteria are presented in ***Table K-3***

Table K-3 Grading criteria for R^2 and IOA

Grade	Index value
very good	>0.85
good	0.75 – 0.85
satisfactory	0.60 – 0.75
unsatisfactory	<0.60

A summary of the results for R^2 and the IOA are presented in ***Table K-4*** through ***Table K-8***. All parameters present good to very good correlation except salinity at station 02198840, Savannah River at I-95, which present unsatisfactory correlation. Salinity at this location is very low, below 2 milligram per liter (mg/L), with simulated salinities reaching 2.5 mg/L, making the simulation sensitive to small variations. Station 021989791 Back River at F&W Dock present a similar yet slightly improved behavior.

Table K-4 Summary and grading of statistics for WSE

Station ID	Station Name	R^2	R^2 grade	IOA	IOA grade
02198840	Savannah River at I-95	0.94	very good	0.96	very good
02198920	Front River at GA 25	0.99	very good	0.99	very good
02198950	Middle River at GA 25	0.99	very good	1.00	very good
021989715	Savannah River at Garden City	1.00	very good	1.00	very good
021989773	Savannah River at USACE Dock	0.98	very good	0.99	very good
021989784	Back River at Lucknow Canal	0.96	very good	0.99	very good

Station ID	Station Name	R^2	R^2 grade	IOA	IOA grade
021989791	Back River at F&W Dock	0.97	very good	0.99	very good
021989792	Back River at GA 25	0.98	very good	0.99	very good
0219897993	Savannah River at Elba Island	0.99	very good	1.00	very good
02198980	Savannah River at Pulaski	1.00	very good	1.00	very good

Table K-5 Summary and grading of statistics for flow

Station ID	Station Name	R^2	R^2 grade	IOA	IOA grade
02198840	Savannah River at I-95	0.80	Good	0.86	very good
02198920	Front River at GA 25	0.93	very good	0.98	very good
02198950	Middle River at GA 25	0.90	very good	0.97	very good
021989773	Savannah River at USACE Dock	0.88	very good	0.96	very good
021989792	Back River at GA 25	0.90	very good	0.97	very good
02198980	Savannah River at Pulaski	0.81	Good	0.93	very good

Table K-6 Summary and grading of statistics for residual flow

Station ID	Station Name	R^2	R^2 grade	IOA	IOA grade
02198920	Front River at GA 25	0.97	very good	0.99	very good
02198950	Middle River at GA 25	0.84	good	0.84	good
021989792	Back River at GA 25	0.85	good	0.76	good

Table K-7 Summary and grading of statistics for salinity

Station ID	Station Name	R^2	R^2 grade	IOA	IOA grade
02198840	Savannah River at I-95	0.40	unsatisfactory	0.57	unsatisfactory
02198920	Front River at GA 25	0.79	very good	0.86	very good
02198950	Middle River at GA 25	0.72	satisfactory	0.81	good
02198955	Middle River at Fish Hole	0.76	good	0.88	very good
021989715	Savannah River at Garden City (Surface)	0.81	good	0.91	very good
021989715	Savannah River at Garden City (Bottom)	0.82	good	0.78	good
021989773	Savannah River at USACE Dock	0.87	very good	0.89	very good
021989784	Back River at Lucknow Canal	0.60	satisfactory	0.66	satisfactory
021989791	Back River at F&W Dock	0.57	unsatisfactory	0.63	satisfactory
021989792	Back River at GA 25	0.64	satisfactory	0.79	very good
021989793	Back River at Hog Island	0.85	very good	0.90	very good
0219897945	Back River at US17	0.83	good	0.86	very good
0219897993	Savannah River at Elba Island	0.87	very good	0.94	very good
02198980	Savannah River at Pulaski	0.82	good	0.80	good

Table K-8 Summary and grading of statistics for temperature

Station ID	Station Name	R^2	R^2 grade	IOA	IOA grade
02198840	Savannah River at I-95	0.99	very good	0.99	very good
02198920	Front River at GA 25	0.99	very good	0.99	very good
02198950	Middle River at GA 25	0.99	very good	0.99	very good
02198955	Middle River at Fish Hole	0.99	very good	0.99	very good
021989715	Savannah River at Garden City (Surface)	0.99	very good	0.99	very good
021989715	Savannah River at Garden City (Bottom)	0.99	very good	0.99	very good

Station ID	Station Name	R^2	R^2 grade	IOA	IOA grade
021989773	Savannah River at USACE Dock	0.99	very good	0.99	very good
021989784	Back River at Lucknow Canal	0.98	very good	0.99	very good
021989791	Back River at F&W Dock	0.98	very good	0.99	very good
021989792	Back River at GA 25	0.98	very good	0.99	very good
021989793	Back River at Hog Island	0.98	very good	0.99	very good
0219897945	Back River at US17	0.98	very good	0.99	very good
0219897993	Savannah River at Elba Island	1.00	very good	0.99	very good
02198980	Savannah River at Pulaski	1.00	very good	0.99	very good

A detailed visual and statistical comparison for all parameters of the hydrodynamic calibration is presented in **Attachment B** – Hydrodynamics Calibration – Figures and Statistic Tables and is divided into the following five sections:

- B-1. Water Surface Elevation
- B-2. Flows
- B-3. Residual Flows
- B-4. Salinity
- B-5. Water Temperature

Each section has a table summarizing the statistical parameters calculated for the corresponding parameter for all USGS stations with measurement for such parameter: mean, median, standard deviation, minimum, maximum, 5 percentile, 10 percentile, 90 percentile, 95 percentile, R^2, MAE, RMSE, Norm RMSE, IOA. Following the statistics, figures of measured vs simulated plots for the corresponding parameters are presented. ***Table K-9*** and Figure B-8 in **Attachment A** – Visuals on Model Grid Refinements shows all 13 USGS stations (one station with surface and bottom measurements) used for calibration. All 13 stations have measurements of salinity and temperature, 10 have measurements of WSE, and six have flow measurements. Residual flows were calculated and statistics computed for the three stations near GA-25 at the Front, Middle, and Back Rivers.

Water Quality

Water quality simulation was performed using the WASP8.4 model code. The EFDC hydrodynamic model was dynamically linked to the WASP8.4 water quality model using an external hydrodynamic linkage file which transfers flows and volumes of model segments as well as salinity and temperature. The model rates used for this calibration were the same as previously used in the 2010 TMDL Model and the 2015 SHEP Model. Those rates were determined during the TMDL development based on tests and measurement and were subject to extensive peer review and stakeholder consent. As such, they are considered the most appropriate for the conditions and discharges in the 2020 SHEP Model.

Figure B-5 in **Attachment A** – Visuals on Model Grid Refinements shows the domain used for the water quality simulation. The WASP model only uses flow boundary conditions. Since the hydrodynamic model uses a WSE condition at the open boundary, the effective boundary for WASP must be moved inshore where a flow condition calculated in the hydrodynamic model can be prescribed. The eutrophication module of WASP was used for the simulation with the following water quality variables simulated: DO, ultimate carbonaceous biological oxygen demand ($CBOD_U$), and ammonia (NH_3). Three classes of $CBOD_U$ (fast, medium, and slow component) were considered in the simulation $CBOD_{U1}$, $CBOD_{U2}$, and $CBOD_{U3}$.

The calibration period for the water quality model was from January 1, 2019 to December 31, 2019. The model was calibrated using available observations of DO at the USGS stations presented in ***Table K-9***. The same time series discussed previously for the EFDC model for air temperature, cloud cover, and wind speed from station WBAN 03822 were used for the water quality simulation in WASP. Solar radiation was calculated internally by the WASP model based on the latitude.

Water quality data for DO, $CBOD_U$, and NH_3 for the 14 point source discharges listed in ***Table K-1*** were provided by Tetra Tech from Discharge Monitoring Reports (DMR). A default value of NH_3 = 2 mg/L and DO = 6 mg/L were used for facilities not reporting those parameters. All point sources $CBOD_U$ were discharged as medium ($CBOD_{U2}$), except paper mill facilities that where partitioned between the fast and slow components $CBOD_{U1}$ and $CBOD_{U3}$.

The upstream boundary condition for DO used data from USGS station 02198840 Savannah River at I-95, which is the most upstream station available with DO measurements, with a minimum value of 7.5 mg/L prescribed. Since no measured data of CBOD or NH_3 were available, default values were used. For NH_3 a seasonal variation between 0.03 mg/L in the winter to 0.07 mg/L in the summer was used. For the carbonaceous demand, default values of $CBOD_1$ = 2 mg/L and $CBOD_3$ = 2 mg/L were used.

For the tributaries, the DO boundary condition was calculated as 85 percent saturation based on temperatures from USGS station 02198840 Savannah River at I-95. Ammonia and fast and slow carbonaceous demand used seasonal varying default values ranging from NH_3 = 0.03 to 0.07 mg/L, $CBOD_1$ = 0.5 to 1.35 mg/L, and $CBOD_3$ = 2.4 to 3.5 mg/L. The seasonal range was the same used for marsh load seasonal distribution detailed below in ***Table K-10***.

Table K-9 USGS stations used for model calibration

USGS ID	Name	Model cell			Gage	Flow	Salinity	Temp	DO
		I	J	Layer					
02198840	SAVANNAH RIVER (I-95) NEAR PORT WENTWORTH, GA	23	143	9	WSE	✓	✓	✓	✓
02198920	SAVANNAH RIVER AT GA 25, AT PORT WENTWORTH, GA	23	98	9	WSE	✓	✓	✓	✓
02198950	MIDDLE RIVER AT GA 25 AT PORT WENTWORTH, GA	36	100	9	WSE	✓	✓	✓	✓
02198955	MIDDLE RIVER AT FISH HOLE AT PORT WENTWORTH, GA	28	84	10	-	-	✓	✓	✓
021989715	SAVANNAH RIVER AT GARDEN CITY, GA (Surface)	22	72	9	WSE	-	✓	✓	✓
021989715	SAVANNAH RIVER AT GARDEN CITY, GA (Bottom)	22	72	5	-	-	✓	✓	✓
021989773	SAVANNAH RIVER AT USACE DOCK, AT SAVANNAH, GA	24	57	6	WSE	✓	✓	✓	✓
021989784	L BACK RIVER ABOVE LUCKNOW CANAL, NR LIMEHOUSE, SC	42	117	10	WSE	-	✓	✓	-
021989791	LITTLE BACK RIVER AT F&W DOCK, NEAR LIMEHOUSE, SC	42	107	10	WSE	-	✓	✓	-
021989792	LITTLE BACK RIVER AT GA 25 AT PORT WENTWORTH, GA	41	100	9	WSE	✓	✓	✓	✓
021989793	LITTLE BACK RIVER AT HOG ISLAND, NEAR SAVANNAH, GA	41	82	10	-	-	✓	✓	✓
0219897945	BACK RIVER 0.4 MI DOWNSTREAM US17, NR SAVANNAH, GA	41	63	10	-	-	✓	✓	✓
0219897993	SAVANNAH RIVER AT ELBA ISLAND, NEAR SAVANNAH, GA	24	43	9	WSE	-	✓	✓	✓
02198980	SAVANNAH RIVER AT FORT PULASKI, GA	22	22	9	WSE	✓	✓	✓	✓

Table K-10 Marsh load distribution

Station_ID	Q-Zones	Marsh cell		July/August $CBOD_u$ (kg/day)
		I	J	
Marsh32	Q11+Q12 A	25	32	51,208
Marsh34	Q11+Q12 B	25	34	115,486
Marsh36	Q13	16	36	69,822
Marsh68	Q2	48	68	44,606
Marsh70	Q16	22	70	3,000
Marsh79	Q3	44	79	10,089
Marsh88	Q7	24	88	4,384
Marsh94	Q4 and Q5	42	94	4,398
Marsh97	Q10	37	97	6,140
Marsh107	Q1	22	107	4,454
Marsh111	Q6	33	111	2,000
Marsh113	Q9	35	113	1,456
Marsh115	Q15 A	22	115	2,449
Marsh119	Q15 B	36	119	2,449
Marsh128	Q8	40	128	5,070
Marsh163	-	25	163	15,000
Marsh177	-	25	177	15,000
Marsh202	-	24	202	15,000

For the ocean open boundary, DO was calculated as 90 percent saturation based on temperatures and salinity from USGS station 02198980 at Fort Pulaski for the top six layers (K=5 to 10), and 90 percent saturation minus 5.4 mg/L for the four bottom layers. Constant default values were used for NH_3 = 0.05 mg/L, $CBOD_1$ = 2 mg/L, and $CBOD_3$ = 2 mg/L. The high productivity and complex ecological interaction in the marsh areas could not be simulated in full by the model. To account for the large amount of carbonaceous material that marshes discharge into surrounding open waters, the CBOD marsh loadings calculated for the 2010 TMDL Model and used in the 2015 SHEP Model were once again applied. Since the locations and sizes of marsh areas were modified with respect to the previous models and new marshes were added as identified previously, especially upstream of I-95, the distribution and point of discharge into open waters was updated as specified in ***Table K-10***. The total values of marsh loadings calculated for the 2010 TMDL Model using Q-zones in the Front, Middle, and Back Rivers and used in the 2015 SHEP Model were maintained and assigned to the new marsh layout. The marshes added upstream of I-95 were each assigned a load of 15,000 kilograms per day (kg/day). The seasonal variation of the marsh loading is the same used for both the 2010 TMDL and the 2015 Models and is specified in ***Table K-11***.

Table K-11 Marsh load seasonal variation

Month	Percent of Total Load (%)
January	20
February	20
March	40
April	40
May	60
June	80
July	100
August	100
September	80
October	60
November	40
December	40

As stated before, the same kinetic rates set forth for the 2010 TMDL Model and used in the 2015 SHEP Model were applied and are presented in ***Table K-12***. These rates are based on tests and measurements conducted during the TMDL development and are considered the most suitable for the Savannah River system.

The only parameter adjusted during calibration was sediment oxygen demand (SOD). SOD was spatially adjusted with final values shown in Figure B-9 in **Attachment A** – Visuals on Model Grid Refinements. The values vary between 0.3 grams per square meters per day ($g/m^2/day$) at 20 degrees Celsius (^oC) in the offshore area to 5 $g/m^2/day$ at 20^oC in the turning basin, with values of 1.2 $g/m^2/day$ for the Savannah River from the estuary mouth up to the confluence of the Back River, 2.8 $g/m^2/day$ for the Front River from the Back River confluence to GA-25, 2.0 $g/m^2/day$ for the sediment basin area from the Back River confluence up to Hwy 17, 2 and 1 $g/m^2/day$ for the Back and Middle Rivers, 1.5 $g/m^2/day$ for the Front River from GA-25 up to I-95, 0.5 $g/m^2/day$ from I-95 up to upstream model boundary, and 0.5 $g/m^2/day$ for the marshes. The SOD values were adjusted based on calibration results considering ranges of SOD values measured by USEPA in the area (USEPA, 1999).

Table K-12 Water quality kinetic rates

Kinetic rates	Value
Reaeration model	O'Connor-Dobbins Formulation
$CBOD_1$ Decay Rate Constant at 20 °C (per day)	0.06
$CBOD_2$ Decay Rate Constant at 20 °C (per day)	0.04
$CBOD_3$ Decay Rate Constant at 20 °C (per day)	0.02
Dissolved organic Nitrogen mineralization rate at 20 °C	0.05

Similar to the hydrodynamic model, water quality model calibration was undertaken using graphical and statistical comparisons between the model predictions and measurements. Comparison for the period January 1 to December 31, 2019 for the USGS stations with DO measurements listed in ***Table K-9*** were performed. WRDB GRAPH was used to calculate the statistics for R^2, MAE, RMSE, NRMSE, and IOA, and mean, median, 5th, and 95th percentiles of measurements and simulations.

A summary of the results for R^2 and the IOA for DO are presented in ***Table K-13***, using the grading criteria in ***Table K-3***. The results indicated very good correlation for the IOA for all stations, and good to very good correlation for R^2.

A detailed visual and statistical comparison of the water quality calibration is presented in **Attachment C** – Water Quality Calibration – Figures and Statistic Tables. The attachment presents a table with all the statistical parameters calculated for DO for all 10 USGS stations with DO measurement: mean, median, standard deviation, minimum, maximum, 5 percentile, 10 percentile, 90 percentile, 95 percentile, R^2, MAE, RMSE, Norm RMSE, IOA. Following the statistics, figures of measured vs simulated plots for the DO are presented. ***Table K-13*** below presents the USGS stations with DO measurement used for calibration.

Table K-13 Summary and grading of statistics for DO

Station ID	Station Name	R^2	R^2 grade	IOA	IOA grade
02198840	Savannah River at I-95	0.86	very good	0.96	very good
02198920	Front River at GA 25	0.86	very good	0.96	very good
02198950	Middle River at GA 25	0.85	very good	0.96	very good
02198955	Middle River at Fish Hole	0.89	very good	0.96	very good
021989715	Savannah River at Garden City (Surface)	0.9	very good	0.92	very good
021989715	Savannah River at Garden City (Bottom)	0.84	good	0.95	very good
021989773	Savannah River at USACE Dock	0.84	good	0.95	very good
021989792	Back River at GA 25	0.81	good	0.97	very good
021989793	Back River at Hog Island	0.77	good	0.92	very good
0219897945	Back River at US17	0.79	good	0.92	very good
0219897993	Savannah River at Elba Island	0.89	very good	0.93	very good

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K.6 2020 SHEP MODEL OUTPUTS

The goal of the 2020 SHEP Model was to update and re-calibrate the 2015 SHEP Model with continuous USGS data such that it could be used to represent existing conditions more accurately throughout the Savannah River system and predict future outcomes. The updates to marsh areas significantly improved flow exchanges by increasing the tidal prism volume. Updates to the model grid in the Middle and Back River improved distribution of flows. Further updates in the vicinity of the Upriver DO Plant improved the capability of the model and its ability to predict outcomes with both DO Plants in operation. The statistics and grading for each parameter analyzed for hydrodynamic and water quality performance certifies this improvement.

The 2020 SHEP Model was therefore deemed suitable for modeling of the 2020 SUR and associated scenarios. The results of these model runs are presented in Section 11.0 of the main report and Attachment D.

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K.7 REFERENCES

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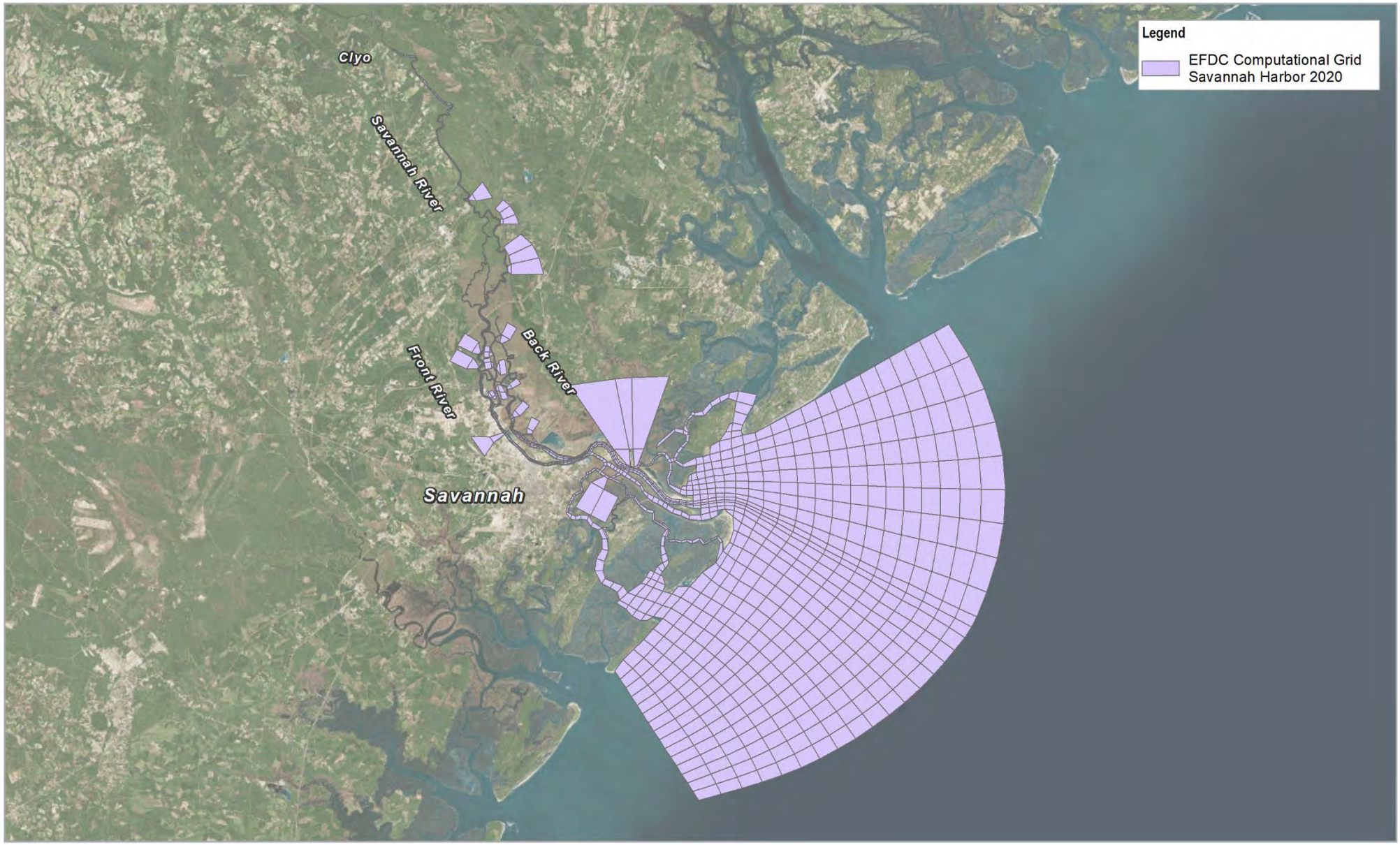
ATTACHMENT A – VISUALS ON MODEL GRID REFINEMENTS



Paper Size ANSI A

0 2 4 6 8

Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Georgia East FIPS 1001 Feet

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GHD

LG2
SHEP Model
Recalibration and Update

Project No. **11212177**
Revision No. **1 (final)**
Date **September 2020**

EFDC Computational Mesh

FIGURE B-1

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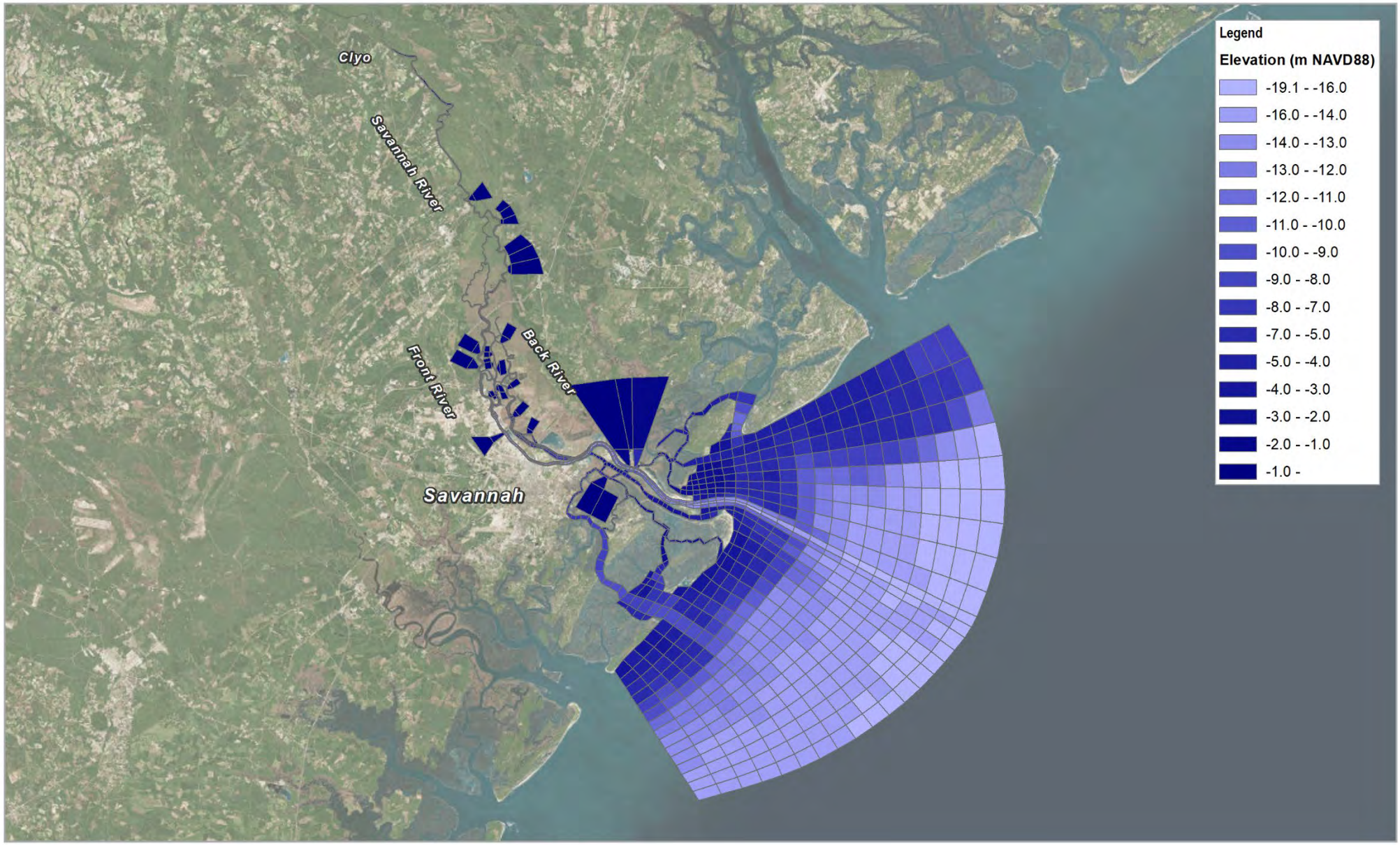

Paper Size ANSI A

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Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Georgia East FIPS 1001 Feet

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GHD

LG2
SHEP Model
Recalibration and Update

EFDC Computational Mesh Bathymetry

Project No. **11212177**
Revision No. **1 (final)**
Date **September 2020**

FIGURE B-2

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Print date: 02 Oct 2020 - 15:20

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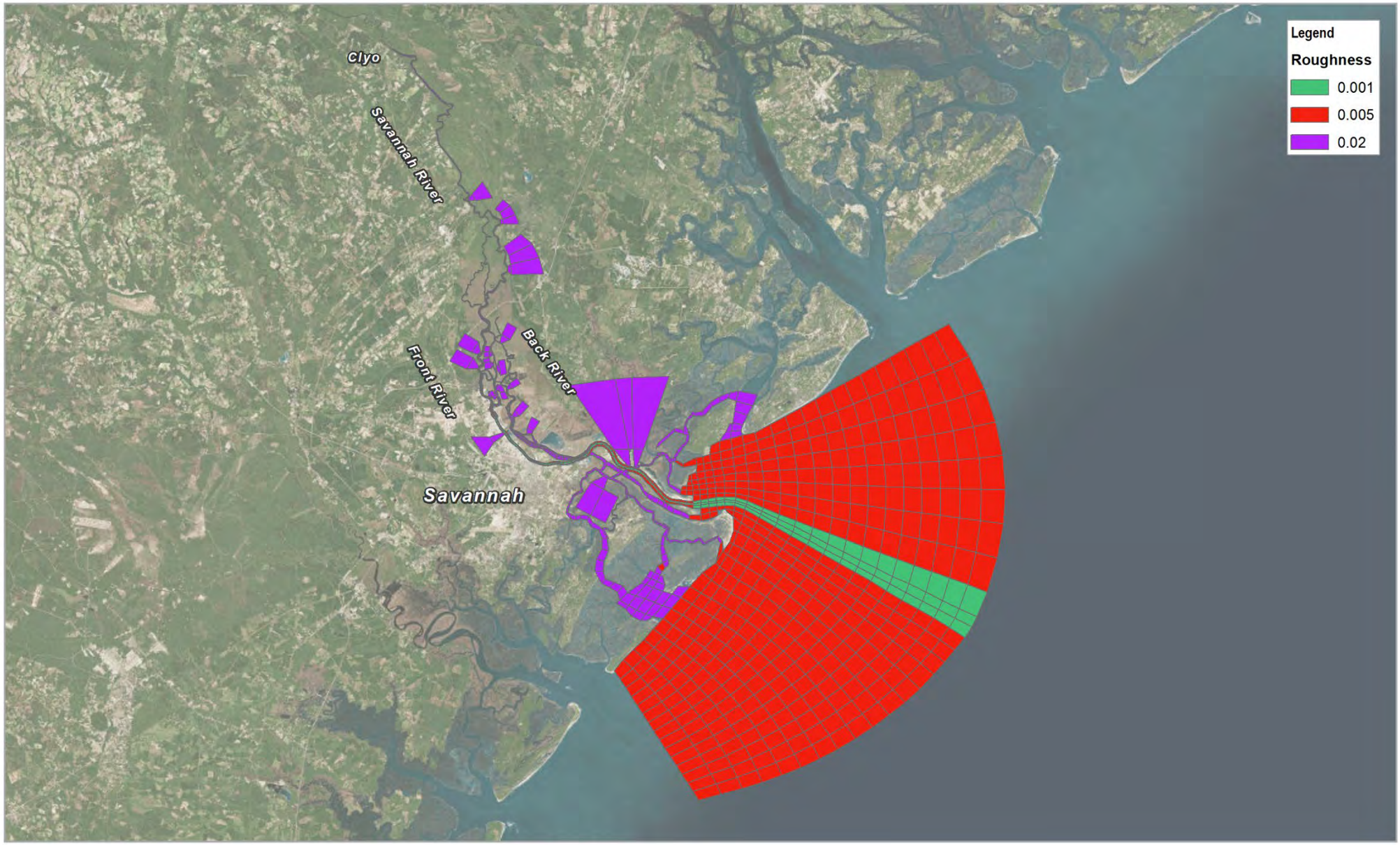


Paper Size ANSI A

0 2 4 6 8

Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Georgia East FIPS 1001 Feet

LG2
SHEP Model
Recalibration and Update

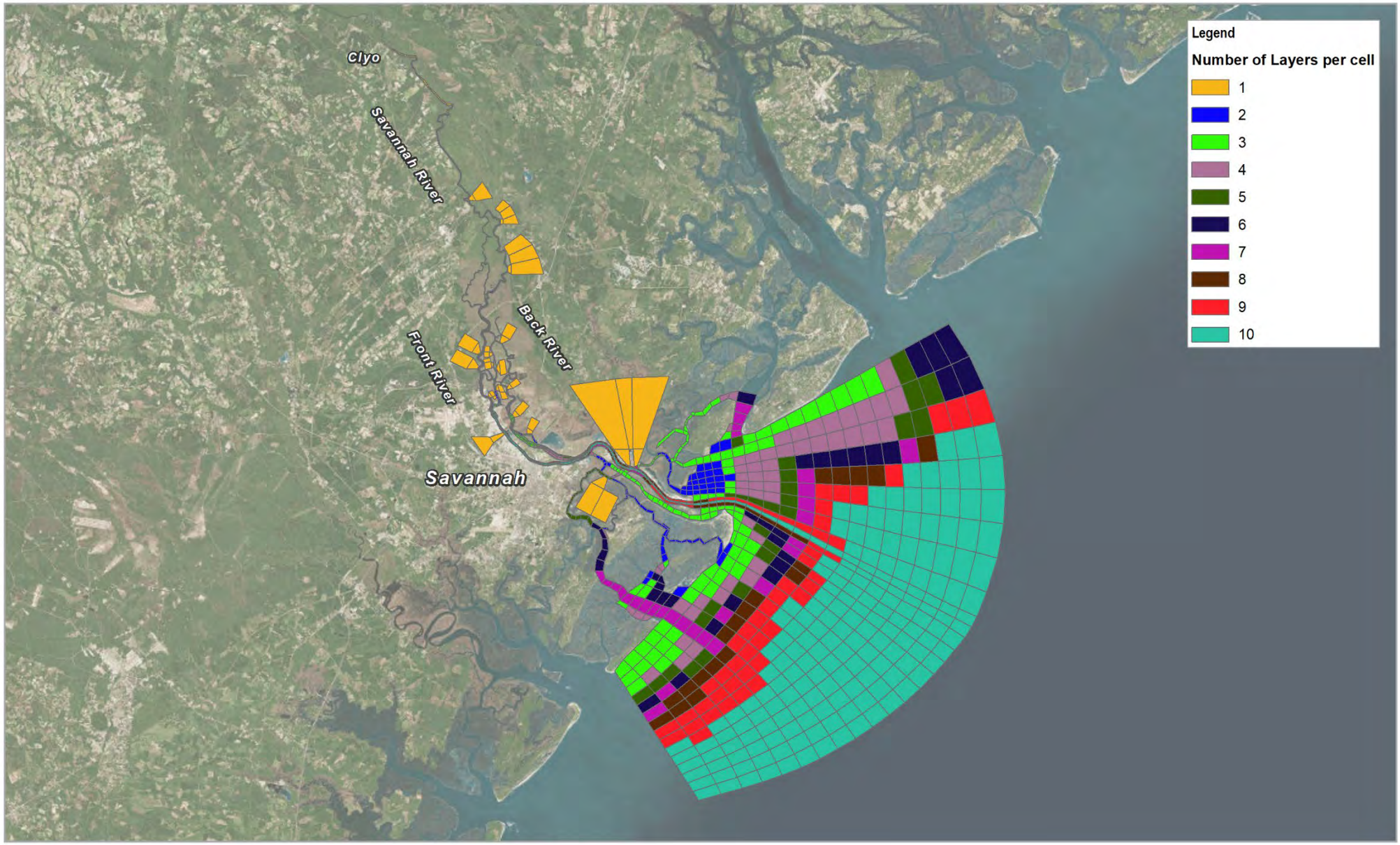
EFDC Computational Mesh Roughness

Project No. **11212177**
Revision No. **1 (final)**
Date **September 2020**

FIGURE B-3

\\ghdnet\ghd\US\Hilton Head\Projects\56\11212177\GIS\Maps\Deliverables\11212177_0B3_EFDC_grid.mxd
Print date: 02 Oct 2020 - 16:16

Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: hrodriguez



Paper Size ANSI A

0 2 4 6 8

Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Georgia East FIPS 1001 Feet

N

GHD

LG2
SHEP Model
Recalibration and Update

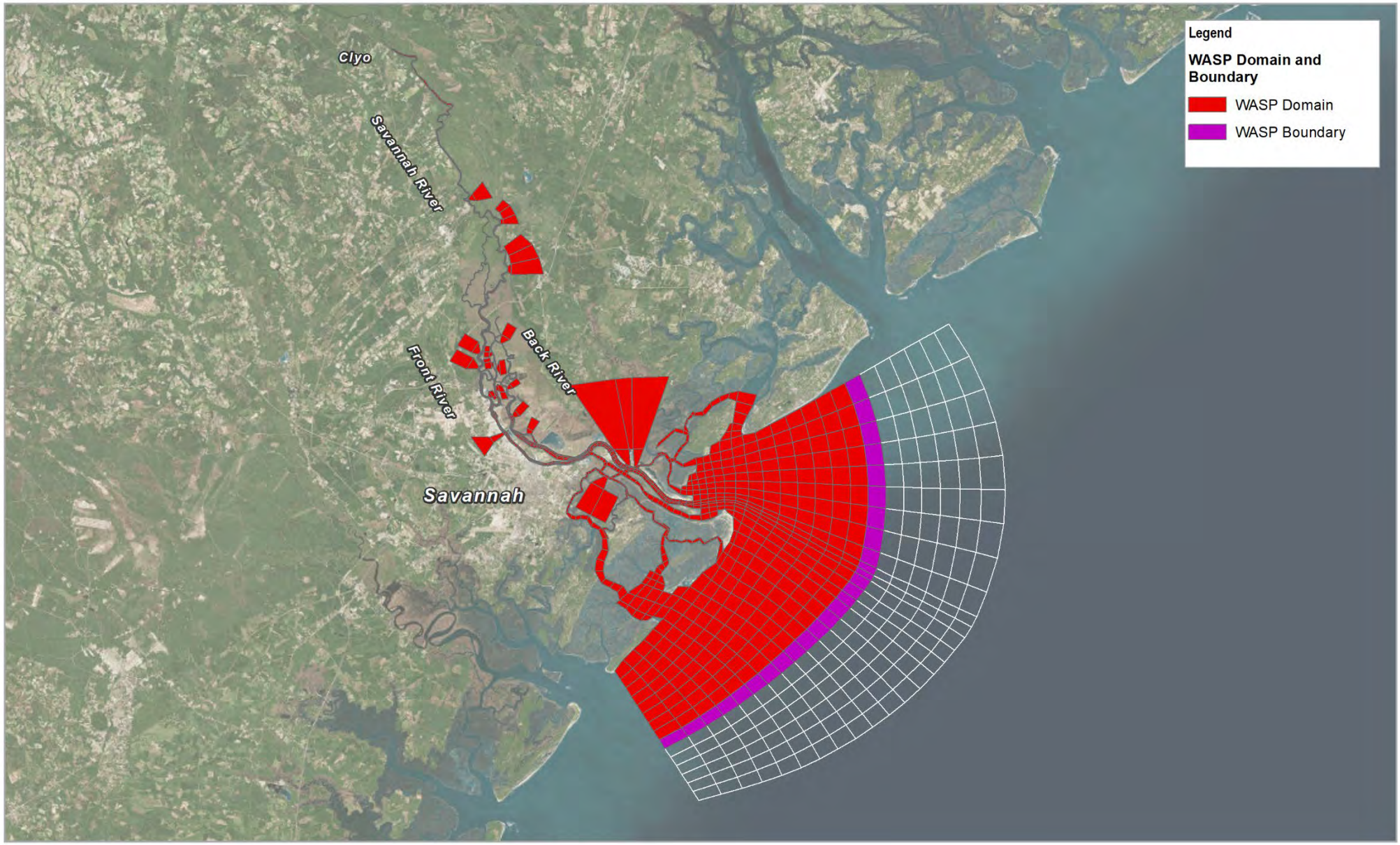
EFDC Computational Mesh
Vertical Layers per cell

Project No. **11212177**
Revision No. **1 (final)**
Date **September 2020**

FIGURE B-4

\\ghdnet\ghd\US\Hilton Head\Projects\565\11212177\GIS\Maps\Deliverables\11212177_0B4_EFDC_grid.mxd
Print date: 15 Oct 2020 - 20:47

Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: hrodriguez



Paper Size ANSI A

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Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Georgia East FIPS 1001 Feet

N

GHD

LG2
SHEP Model
Recalibration and Update

EFDC Computational Mesh
WASP Domain and Boundary

Project No. **11212177**
Revision No. **1 (final)**
Date **September 2020**

FIGURE B-5

\\ghdnet\ghd\US\Hilton Head\Projects\565\11212177\GIS\Maps\Deliverables\11212177_0B5_EFDC_grid.mxd
Print date: 02 Oct 2020 - 21:45

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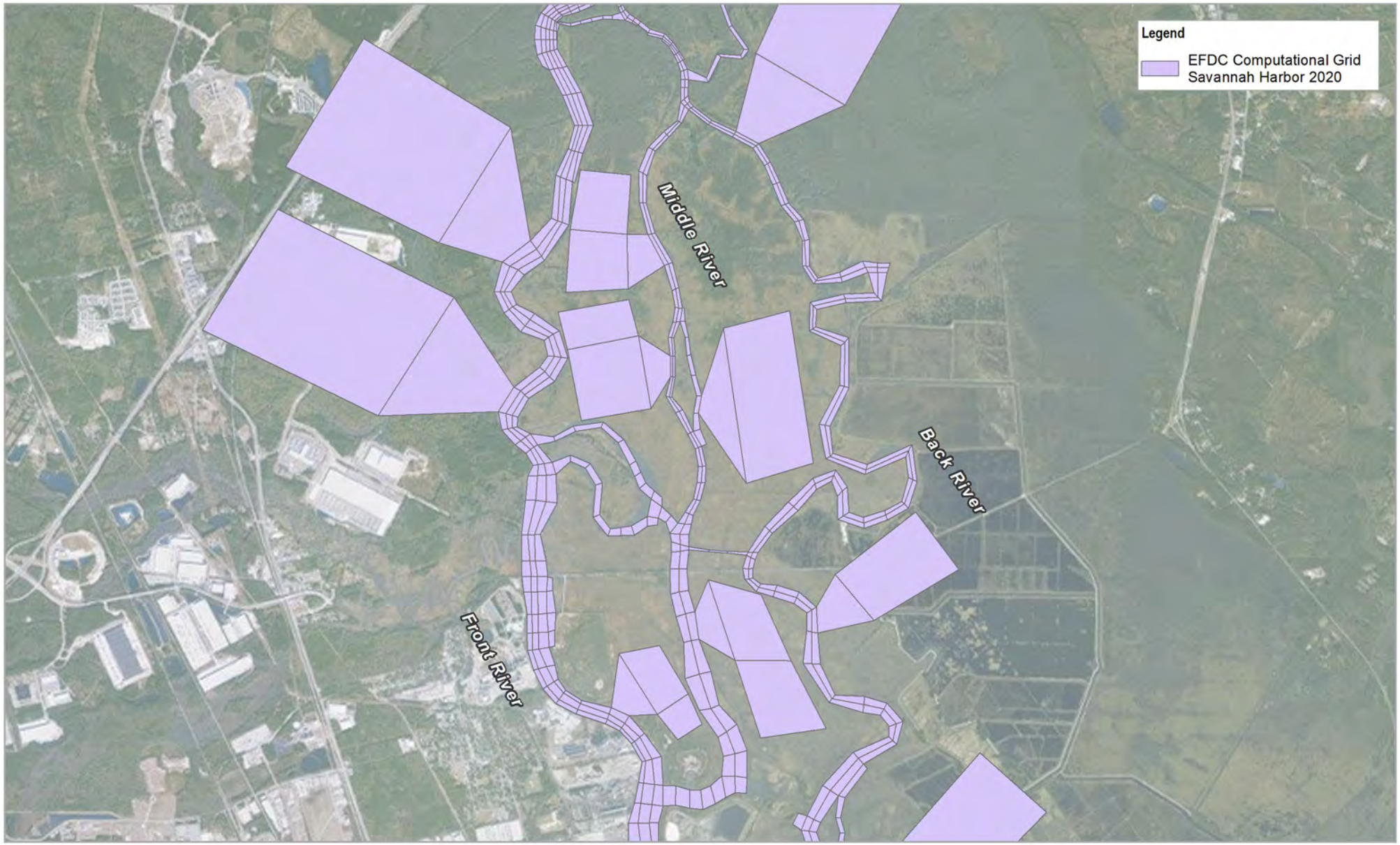

Paper Size ANSI A

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Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Georgia East FIPS 1001 Feet

N

GHD

LG2
SHEP Model
Recalibration and Update

EFDC Computational Mesh two-cell channels and new marshes in Middle and Back Rivers

Project No. **11212177**
Revision No. **1 (final)**
Date **September 2020**

FIGURE B-6

\\ghdnet\ghd\US\Hilton Head\Projects\565\11212177\GIS\Maps\Deliverables\11212177_0B6_EFDC_grid.mxd
Print date: 02 Oct 2020 - 20:44

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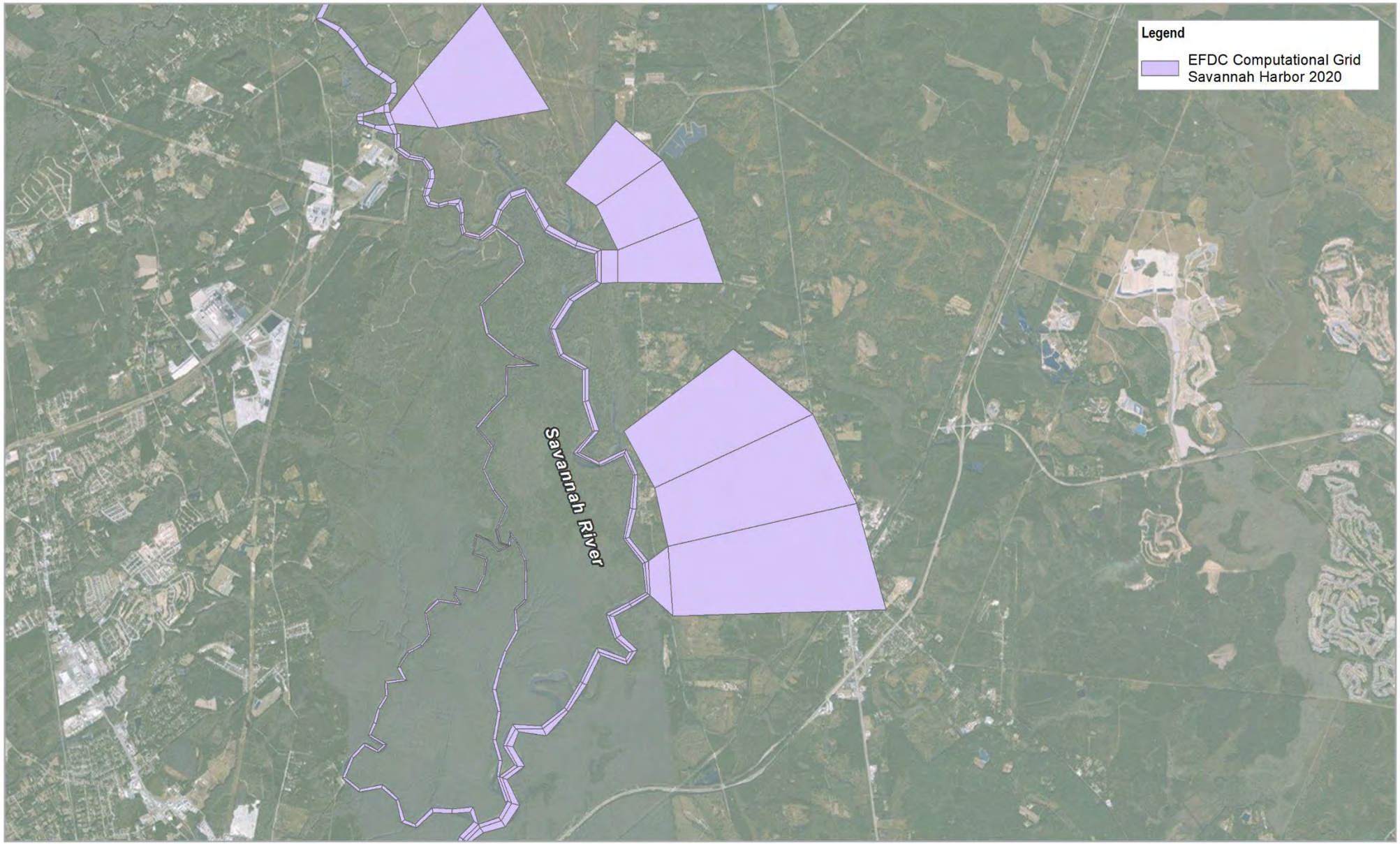

Paper Size ANSI A

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Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Georgia East FIPS 1001 Feet

N

LG2
SHEP Model
Recalibration and Update

EFDC Computational Mesh two-cell channel in Savannah River and new marshes

Project No. **11212177**
Revision No. **1 (final)**
Date **September 2020**

FIGURE B-7

\\ghdnet\ghd\US\Hilton Head\Projects\565\11212177\GIS\Maps\Deliverables\11212177_0B7_EFDC_grid.mxd
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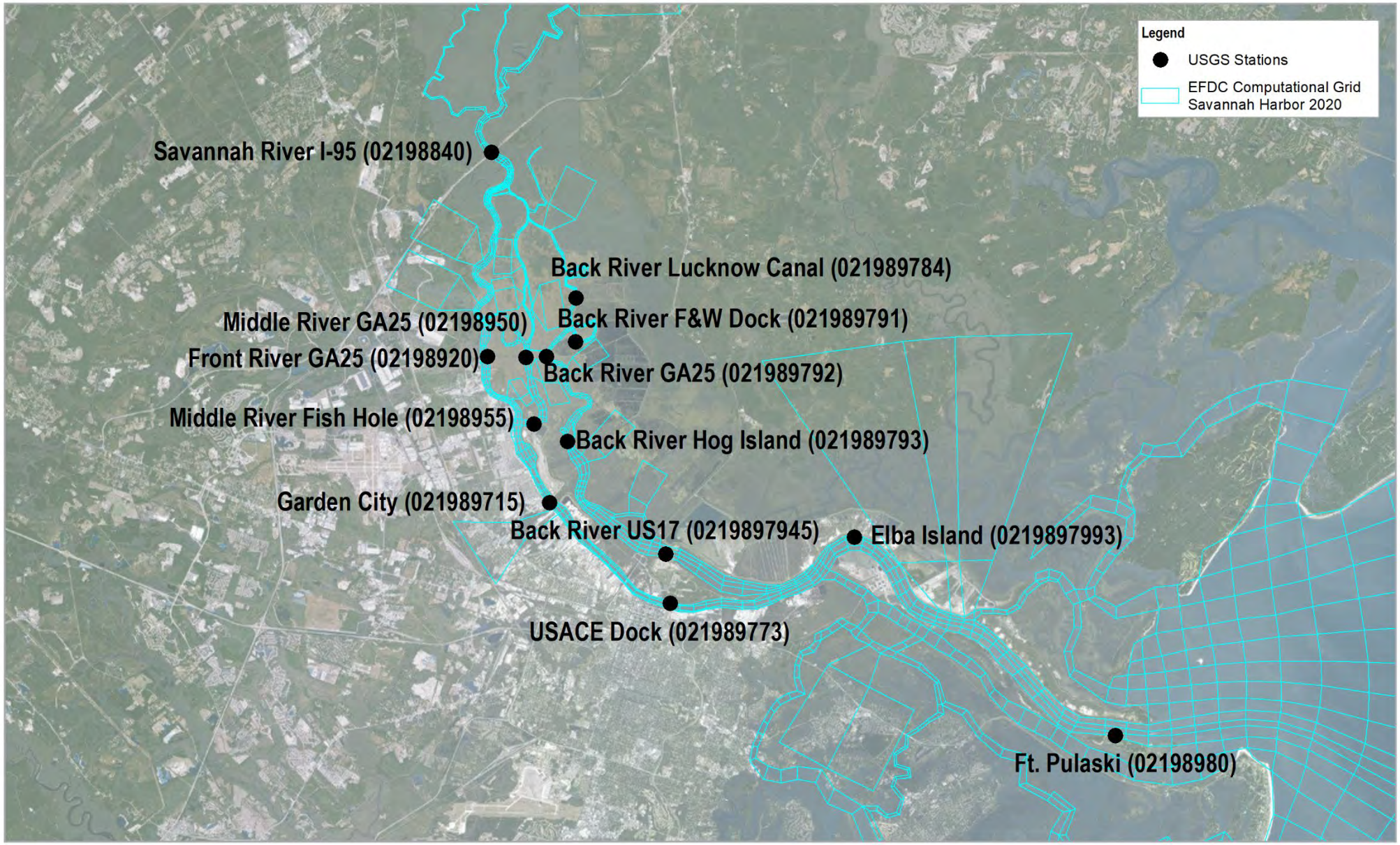

Paper Size ANSI A

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Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Georgia East FIPS 1001 Feet

N

GHD

LG2
SHEP Model
Recalibration and Update

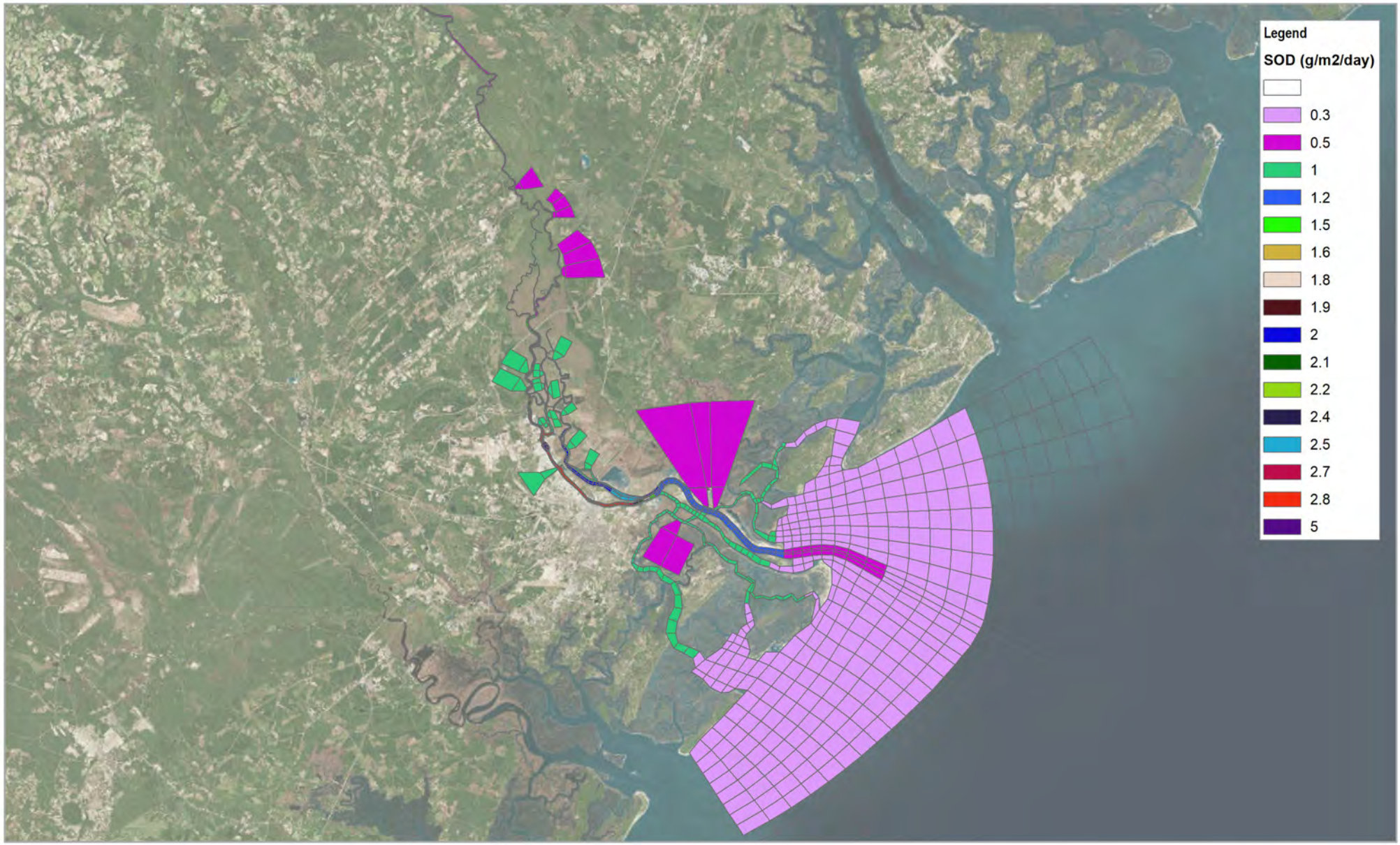
Project No. **11212177**
Revision No. **1 (final)**
Date **September 2020**

Location of USGS Stations

FIGURE B-8

N:\US\Hilton Head\Projects\565\11212177\GIS\Maps\Deliverables\11212177_0B8_EFDC_grid.mxd
Print date: 02 Oct 2020 - 22:47

Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: hrodriguez



Paper Size ANSI A

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Miles

Map Projection: Transverse Mercator
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Georgia East FIPS 1001 Feet

N

GHD

LG2
SHEP Model
Recalibration and Update

SOD spatial distribution in the WASP model

Project No. **11212177**
Revision No. **1 (final)**
Date **September 2020**

FIGURE B-9

\\ghdnet\ghd\US\Hilton Head\Projects\565\11212177\GIS\Maps\Deliverables\11212177_0B9_EFDC_grid.mxd
Print date: 13 Oct 2020 - 14:59

Data source: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Created by: hrodriguez

ATTACHMENT B – HYDRODYNAMICS CALIBRATION – FIGURES AND STATISTIC TABLES

C-1. Water Surface Elevation

Table C-1. Water Surface Elevation Statistics (01/01/2019 – 01/01/2020) (feet)

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 02198980; Fort Pulaski		Station: 0219897993; Sav River Elba Is.		Station: 021989773; USACE Dock		Station: 021989715; Sav River Garden City		Station: 02198920; Front River GA25	
Mean:	0.31	0.32	0.42	0.63	0.53	0.62	0.88	0.71	0.48	0.88
Median:	0.94	1.02	1.26	1.34	1.43	1.48	1.86	1.70	1.49	1.84
Std Dev:	2.52	2.52	2.76	2.58	2.88	2.76	2.99	2.84	2.97	2.78
Min:	-5.98	-5.88	-6.80	-6.05	-7.13	-6.59	-6.91	-6.68	-7.04	-6.07
Max:	5.78	5.66	6.14	6.00	6.15	6.83	6.49	5.93	5.89	6.13
5 %tile:	-3.62	-3.65	-3.97	-3.50	-4.06	-3.85	-3.90	-3.90	-4.29	-3.65
10 %tile:	-3.14	-3.18	-3.44	-2.98	-3.51	-3.33	-3.32	-3.36	-3.73	-3.10
90 %tile:	3.52	3.49	3.85	3.86	4.05	3.99	4.50	4.12	4.06	4.22
95 %tile:	3.99	3.93	4.30	4.30	4.47	4.39	4.89	4.50	4.41	4.61
Coef of Det (R^2):	1.00		0.99		0.98		1.00		0.99	
Mean Abs Error:	0.11		0.33		0.28		0.25		0.42	
RMS Error:	0.14		0.37		0.40		0.30		0.53	
Norm RMS Error:	0.05		0.13		0.14		0.10		0.18	
Index of Agreement:	1.00		1.00		0.99		1.00		0.99	

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 02198950; Middle River GA25		Station: 021989792; Back River GA25		Station: 021989784; Back River Lucknow		Station: 021989791; Back River F&W Dock		Station: 02198840; Savannah River I95	
Mean:	1.00	0.90	0.95	0.95	1.29	1.29	1.07	1.09	1.85	2.14
Median:	1.99	1.84	1.87	1.71	2.31	2.03	2.03	1.84	2.73	2.62
Std Dev:	2.97	2.74	2.70	2.59	2.61	2.37	2.64	2.51	2.31	1.71
Min:	-6.29	-5.39	-5.28	-4.78	-5.01	-3.90	-5.10	-4.40	-3.94	-1.80
Max:	6.38	6.11	6.01	5.85	5.74	5.86	5.79	5.80	5.75	6.23
5 %tile:	-3.78	-3.54	-3.45	-3.19	-3.12	-2.50	-3.30	-2.92	-2.20	-0.72
10 %tile:	-3.20	-3.02	-2.92	-2.74	-2.57	-2.07	-2.76	-2.49	-1.60	-0.30
90 %tile:	4.56	4.22	4.16	4.13	4.30	4.17	4.17	4.16	4.50	4.28
95 %tile:	4.92	4.61	4.51	4.50	4.59	4.51	4.49	4.52	4.76	4.66
Coef of Det (R^2):	0.99		0.98		0.96		0.97		0.94	
Mean Abs Error:	0.35		0.31		0.41		0.39		0.59	
RMS Error:	0.40		0.40		0.54		0.48		0.77	
Norm RMS Error:	0.13		0.15		0.21		0.18		0.33	
Index of Agreement:	1.00		0.99		0.99		0.99		0.96	

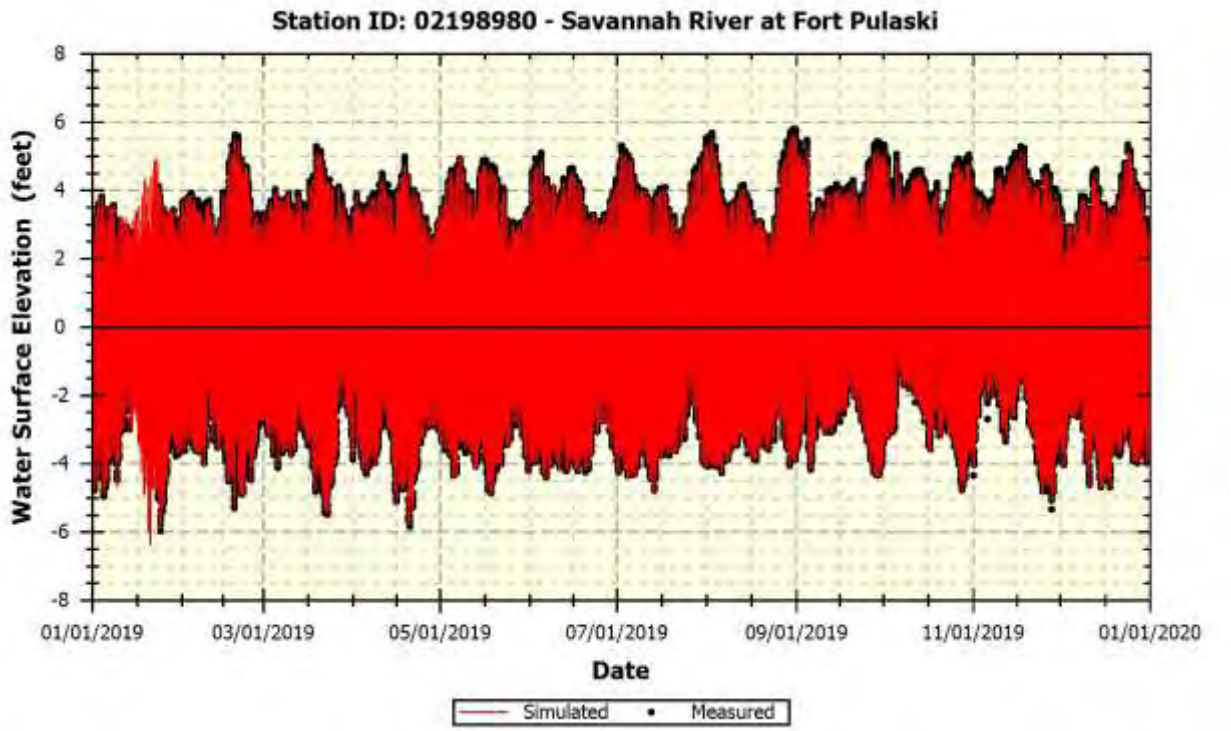

Figure C-1. Simulated vs measured water surface elevation at station 02198980 – Savannah River at Fort Pulaski.

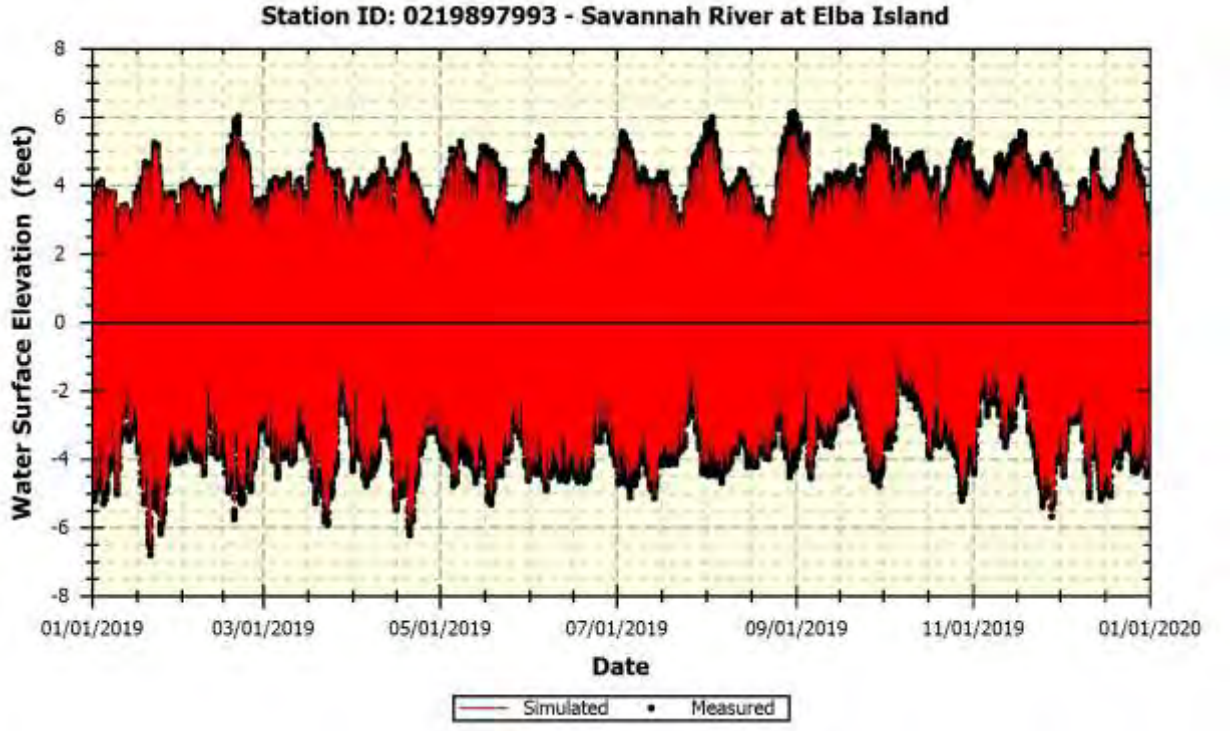

Figure C-2. Simulated vs measured water surface elevation at station 0219897993 – Savannah River at Elba Island.

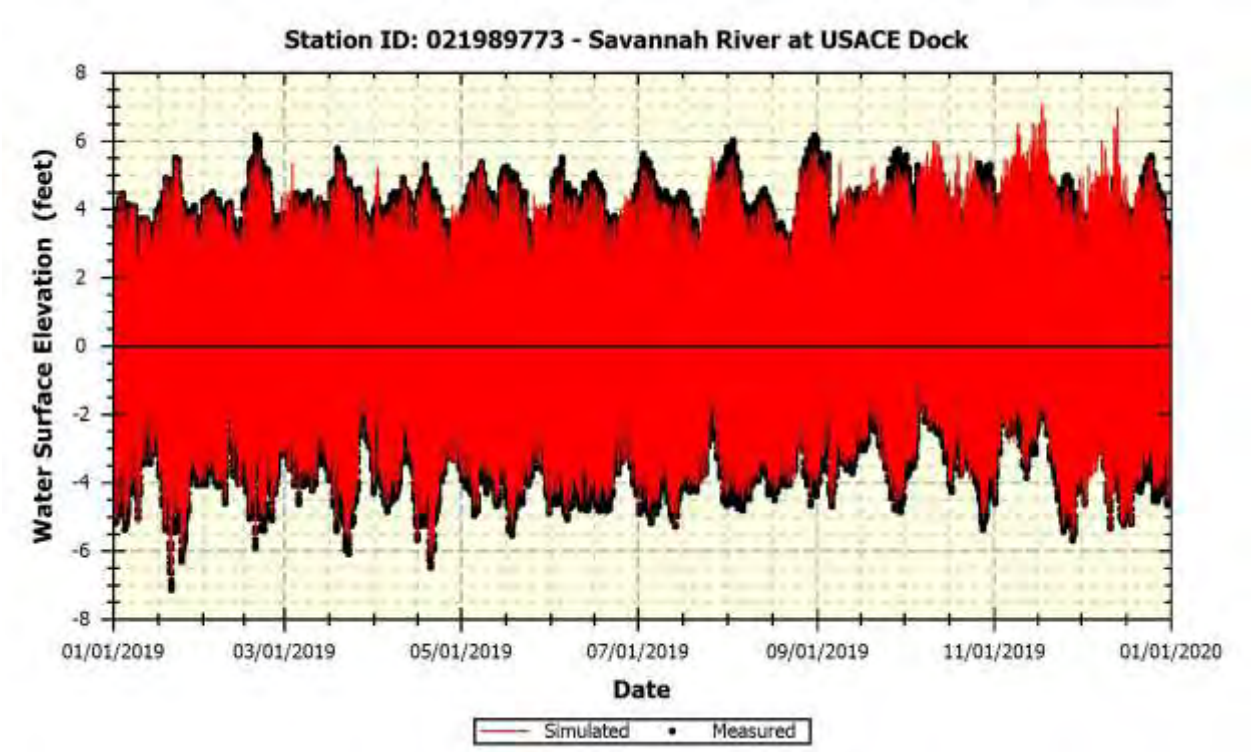

Figure C-3. Simulated vs measured water surface elevation at station 021989773 – Savannah River at USACE Dock.

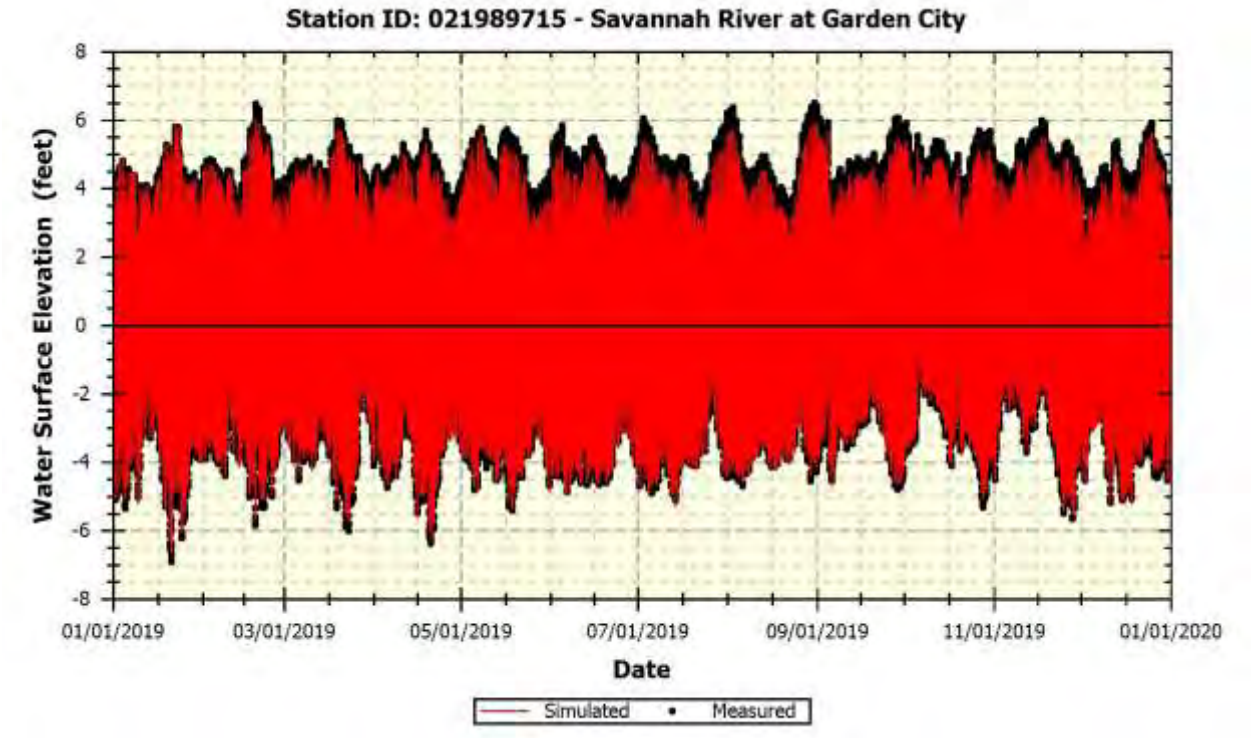

Figure C-4. Simulated vs measured water surface elevation at station 021989715 – Front River at Garden City.

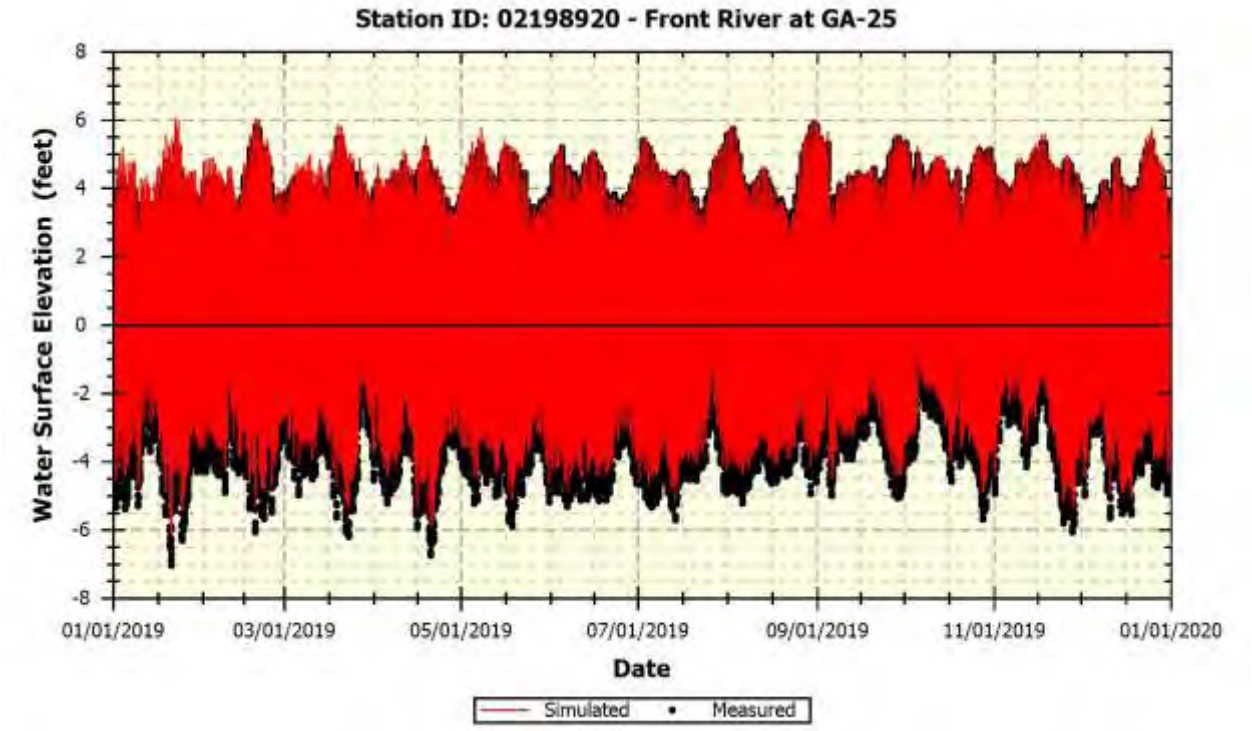

Figure C-5. Simulated vs measured water surface elevation at station 02198920 – Front River at GA-25.

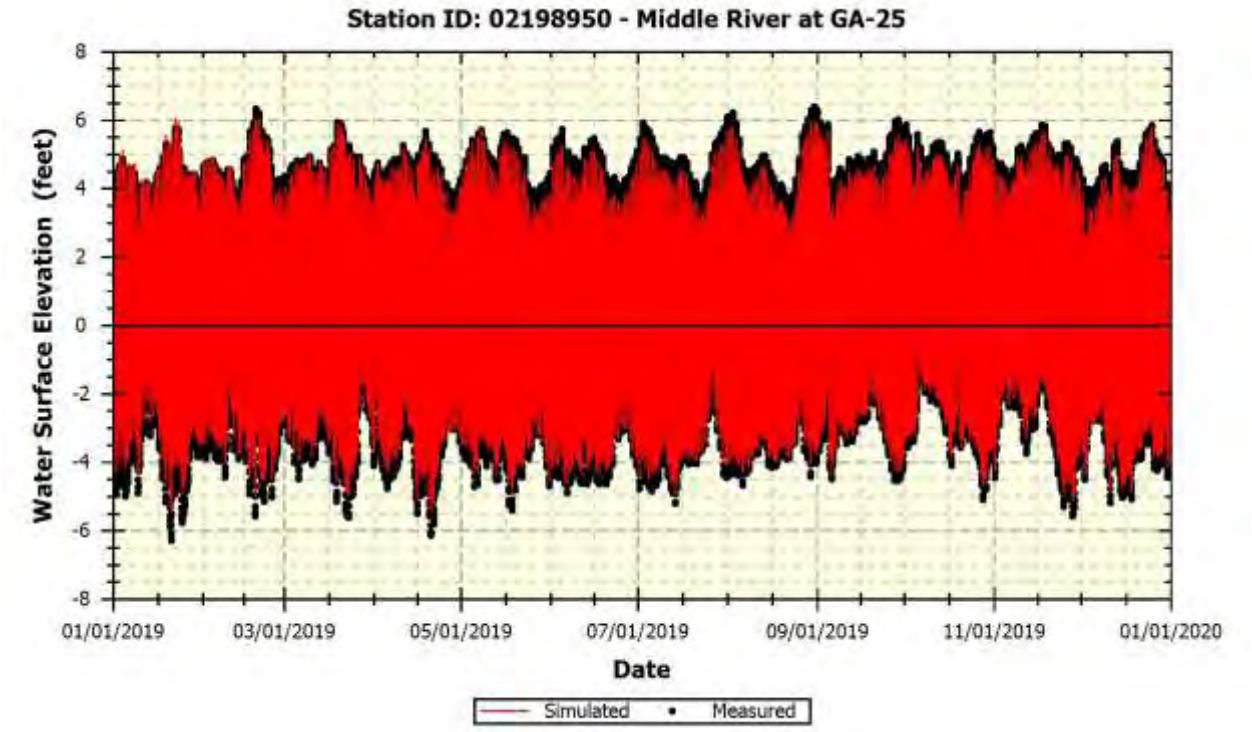

Figure C-6. Simulated vs measured water surface elevation at station 02198950 – Middle River at GA-25.

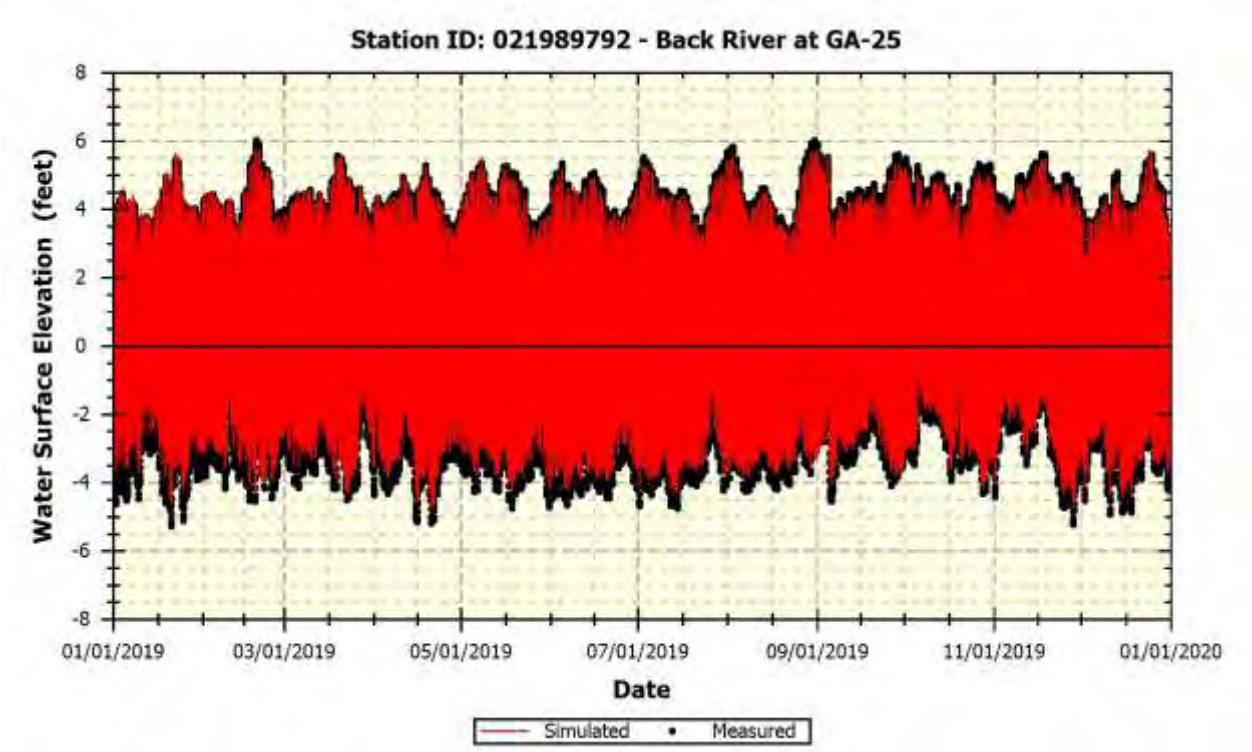

Figure C-7. Simulated vs measured water surface elevation at station 021989792 – Back River at GA-25.

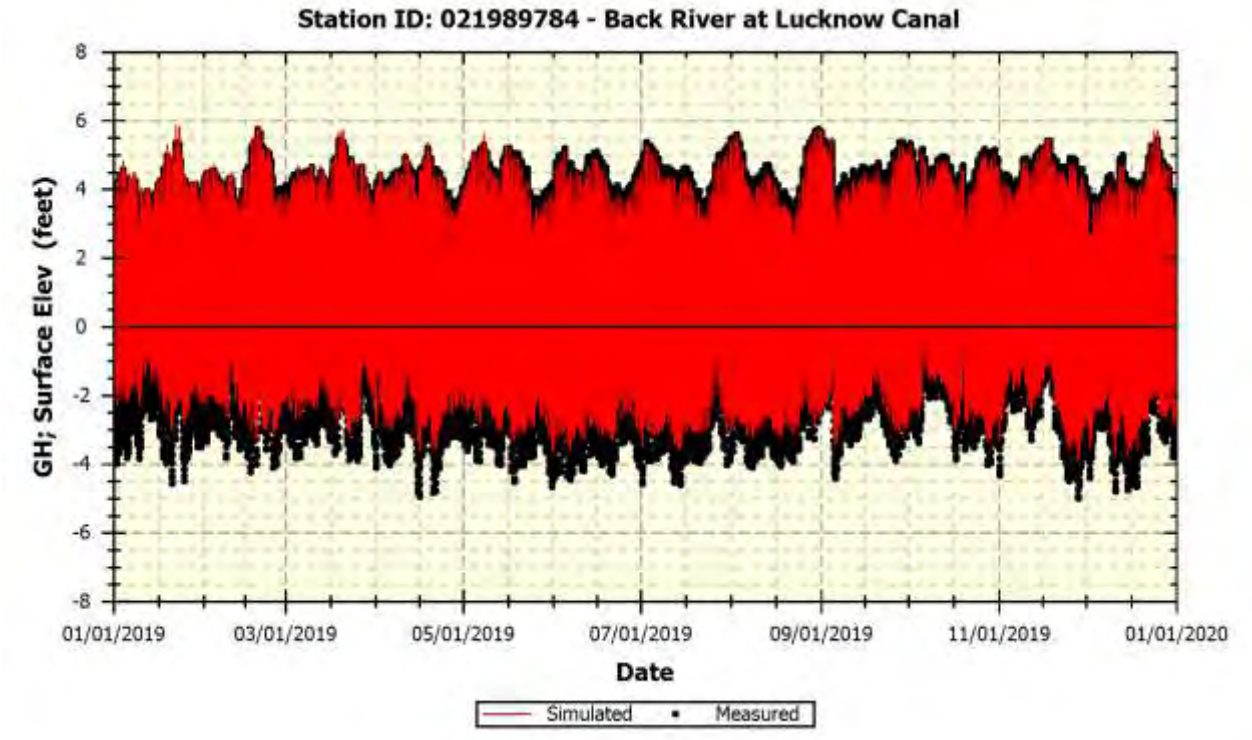

Figure C-8. Simulated vs measured water surface elevation at station 021989784 – Back River at Lucknow Canal.

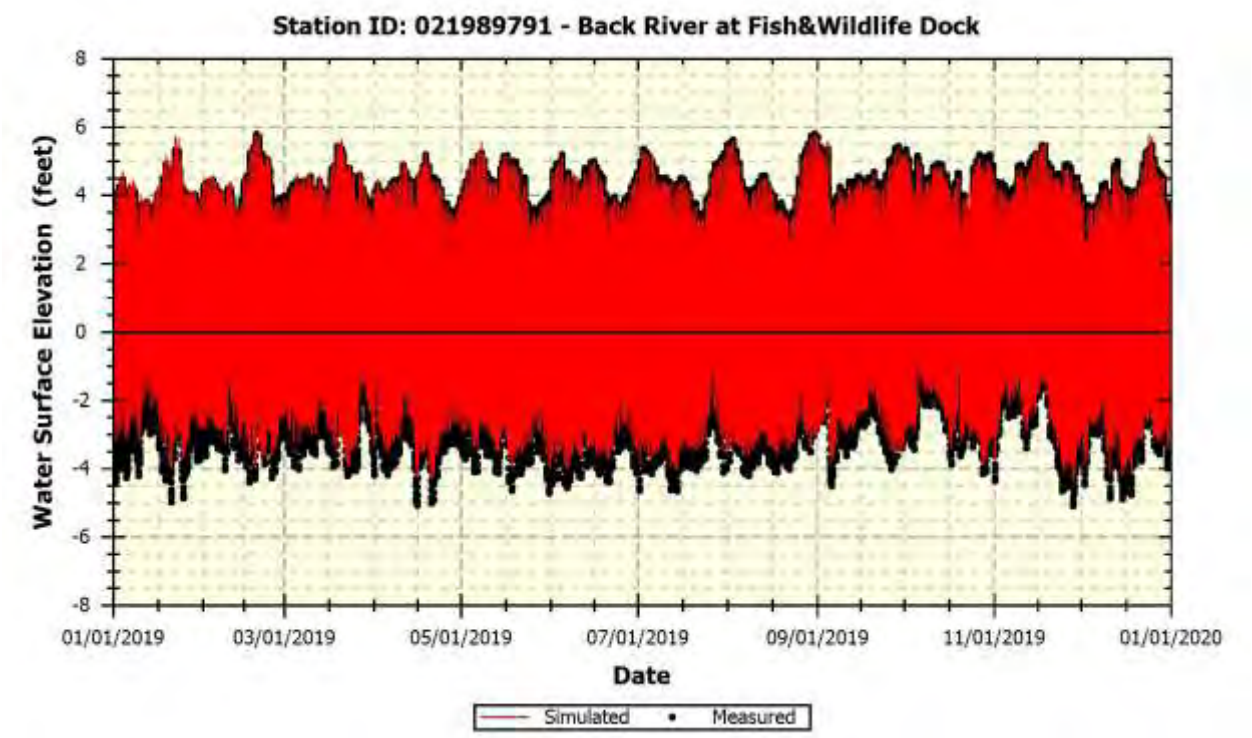

Figure C-9. Simulated vs measured water surface elevation at station 021989791 – Back River at Fish&Wildlife Dock.

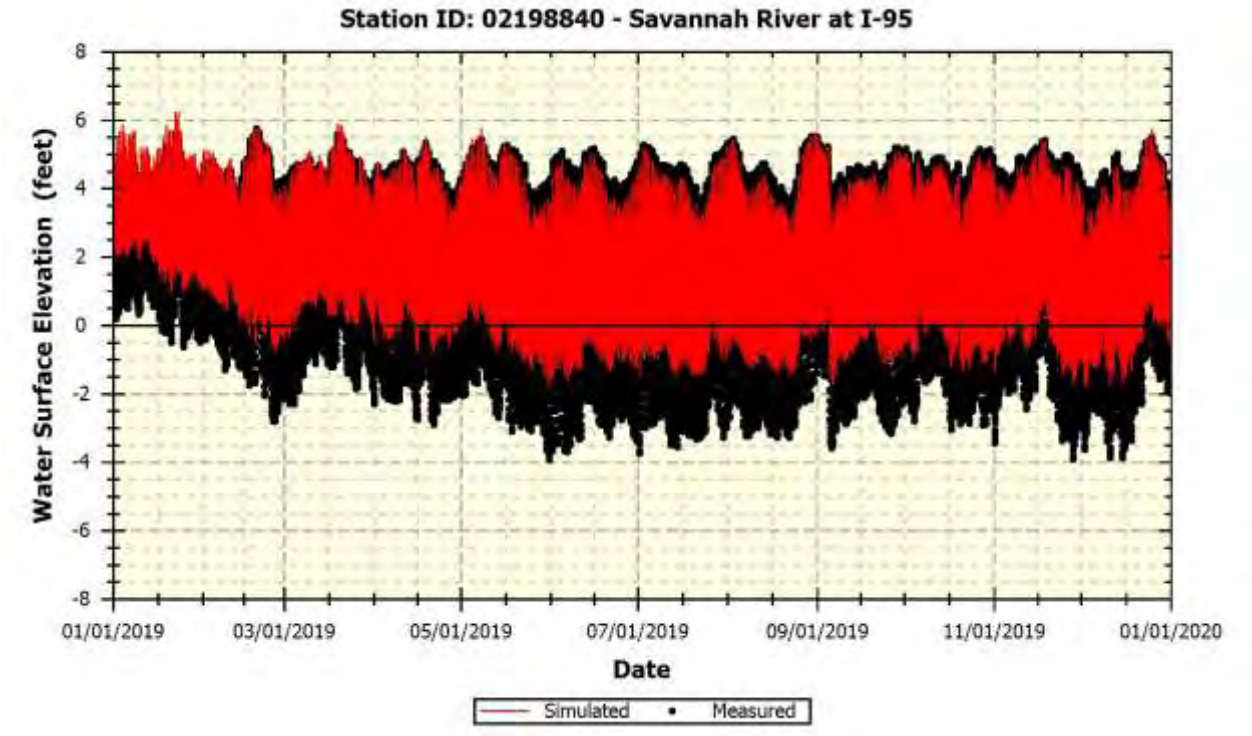

Figure C-10. Simulated vs measured water surface elevation at station 02198840 – Savannah River at I-95.

C-2. Flows

Table C-2. Flow Statistics (01/01/2019 – 01/01/2020) (cfs)

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 02198980; Fort Pulaski		Station: 021989773; USACE Dock		Station: 02198840; Savannah River I95	
Mean:	-15,354	-12,718	-16,847	-11,741	-10,575	-12,911
Median:	N/A	71,433	-3,415	4,798	-10,900	-13,094
Std Dev:	165,120	209,411	59,232	70,086	12,790	15,762
Min:	-468,000	-429,080	-164,000	-136,294	-40,600	-48,243
Max:	424,000	385,360	120,000	135,947	21,500	22,686
5 %tile:	-254,000	-339,640	-105,000	-109,309	-27,700	-35,176
10 %tile:	-221,000	-312,117	-93,100	-101,025	-25,300	-31,301
90 %tile:	207,000	234,992	60,900	79,083	8,550	10,074
95 %tile:	242,000	260,962	71,700	89,132	11,500	13,465
Coef of Det (R^2):	0.81		0.88		0.80	
Mean Abs Error:	77,914		21,259		9,052	
RMS Error:	94,762		26,047		10,442	
Norm RMS Error:	0.57		0.44		0.82	
Index of Agreement:	0.93		0.96		0.86	

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 02198920; Front River GA25		Station: 02198950; Middle River GA25		Station: 021989792; Back River GA25	
Mean:	-9,967	-10,155	-1,007	-1,554	-1,445	-1,988
Median:	-5,820	-4,958	1,100	-808	-1,590	-4,196
Std Dev:	31,103	34,533	8,391	9,221	6,618	7,110
Min:	-76,800	-70,610	-22,600	-20,374	-15,500	-15,092
Max:	65,400	63,801	19,300	21,372	11,400	14,612
5 %tile:	-54,600	-56,405	-14,605	-14,038	-11,100	-10,768
10 %tile:	-49,500	-52,006	-12,500	-12,404	-10,100	-9,869
90 %tile:	32,700	36,120	9,570	10,997	6,780	7,914
95 %tile:	38,100	41,362	11,200	12,786	7,520	9,112
Coef of Det (R^2):	0.93		0.90		0.90	
Mean Abs Error:	7,511		2,428		1,780	
RMS Error:	9,194		2,938		2,225	
Norm RMS Error:	0.30		0.35		0.34	
Index of Agreement:	0.98		0.97		0.97	

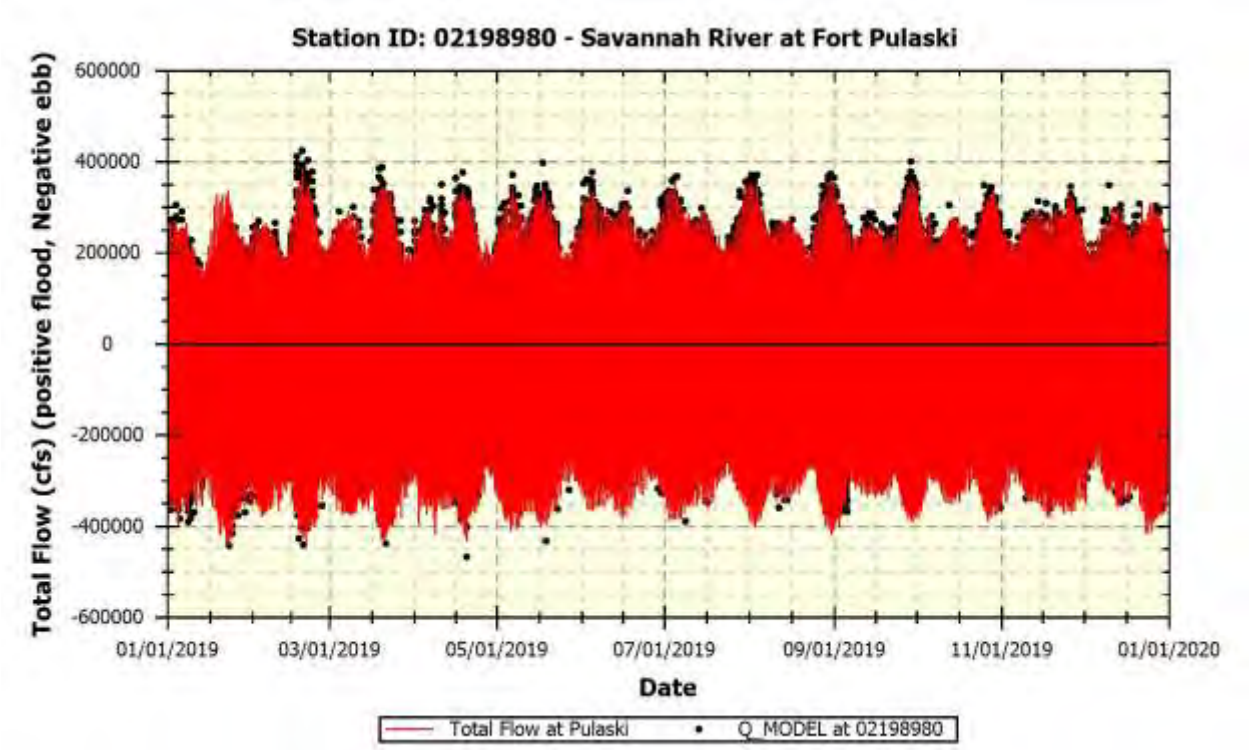

Figure C-11. Simulated vs measured flow at station 02198980 – Savannah River at Fort Pulaski.

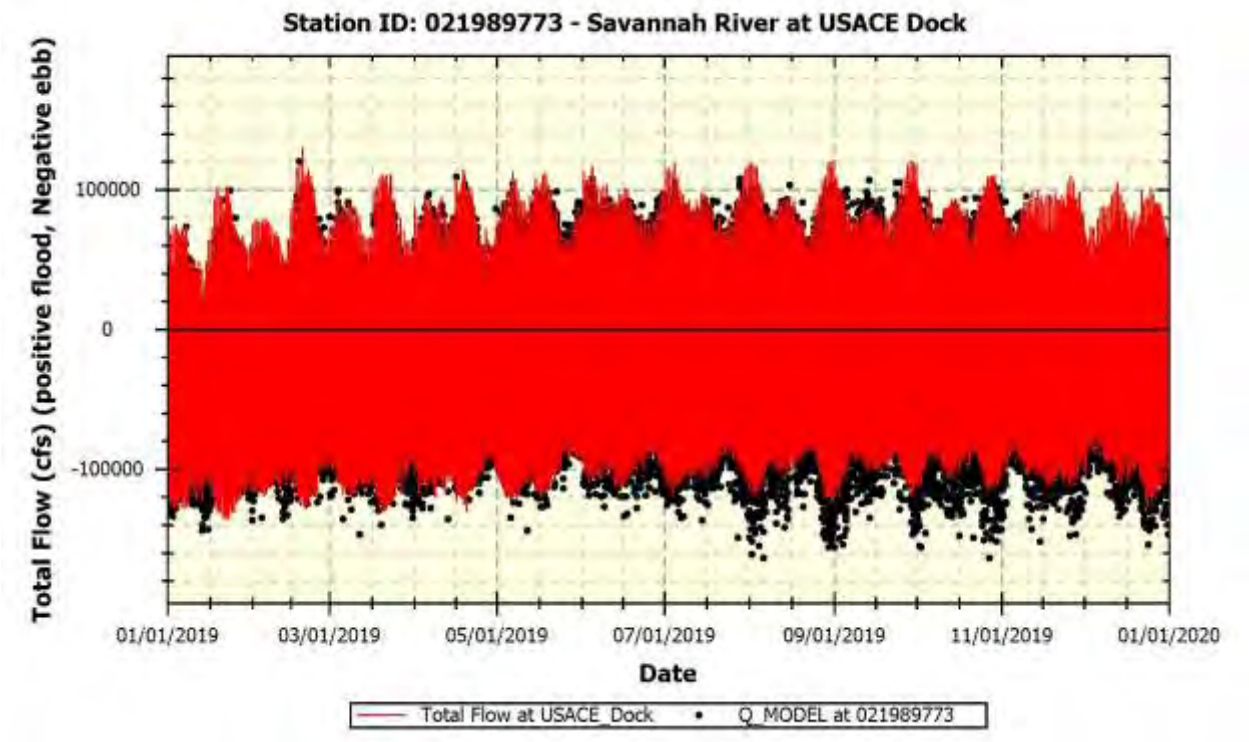

Figure C-12. Simulated vs measured flow at station 021989773 – Savannah River at USACE Dock.

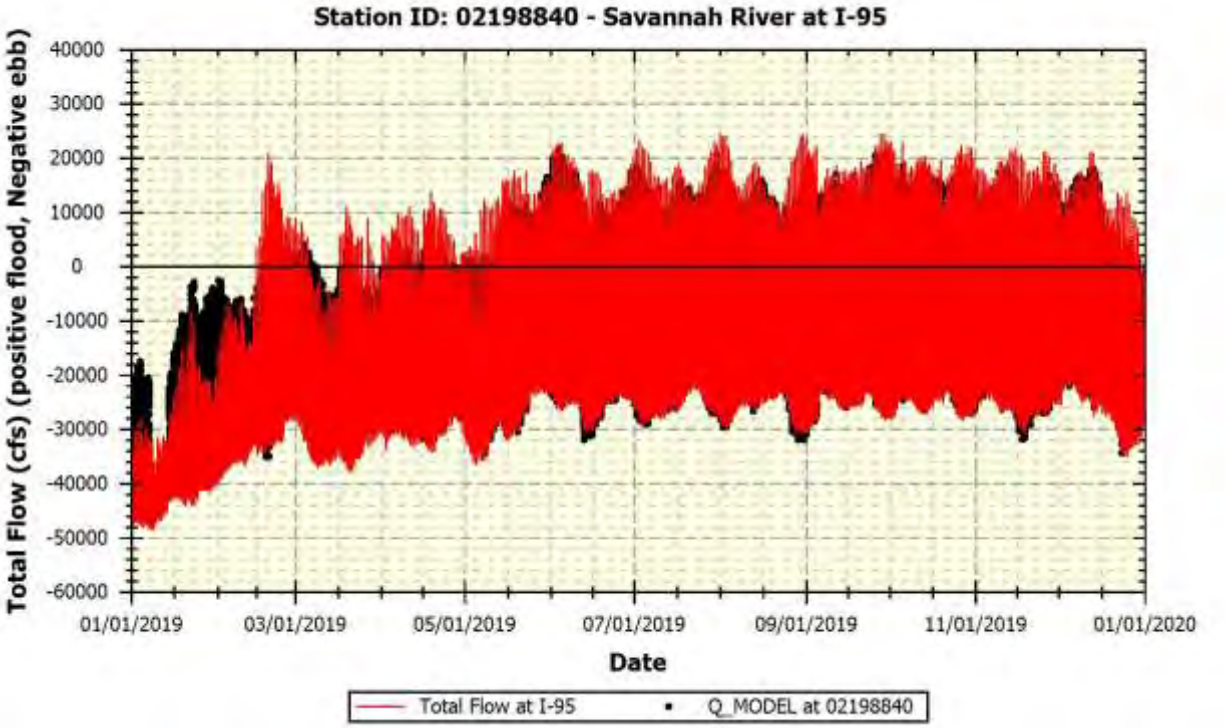

Figure C-13. Simulated vs measured flow at station 02198840 – Savannah River at I-95.

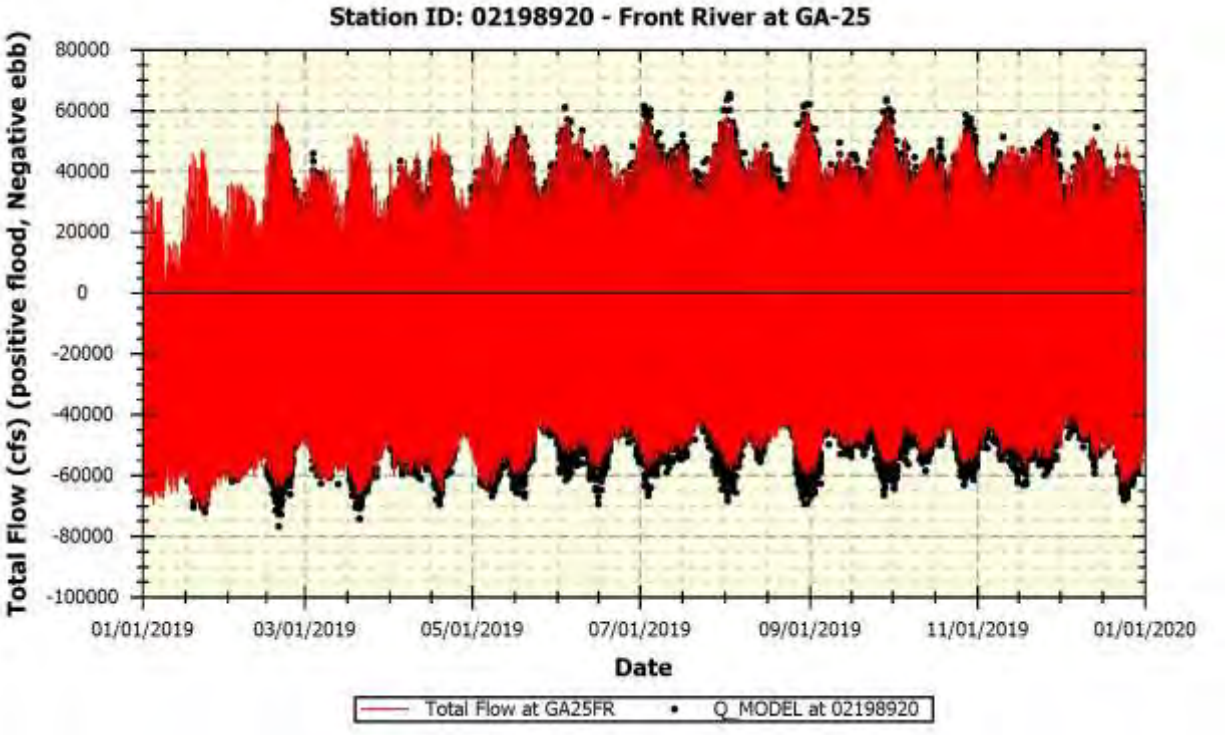

Figure C-14. Simulated vs measured flow at station 02198920 – Front River at GA-25.

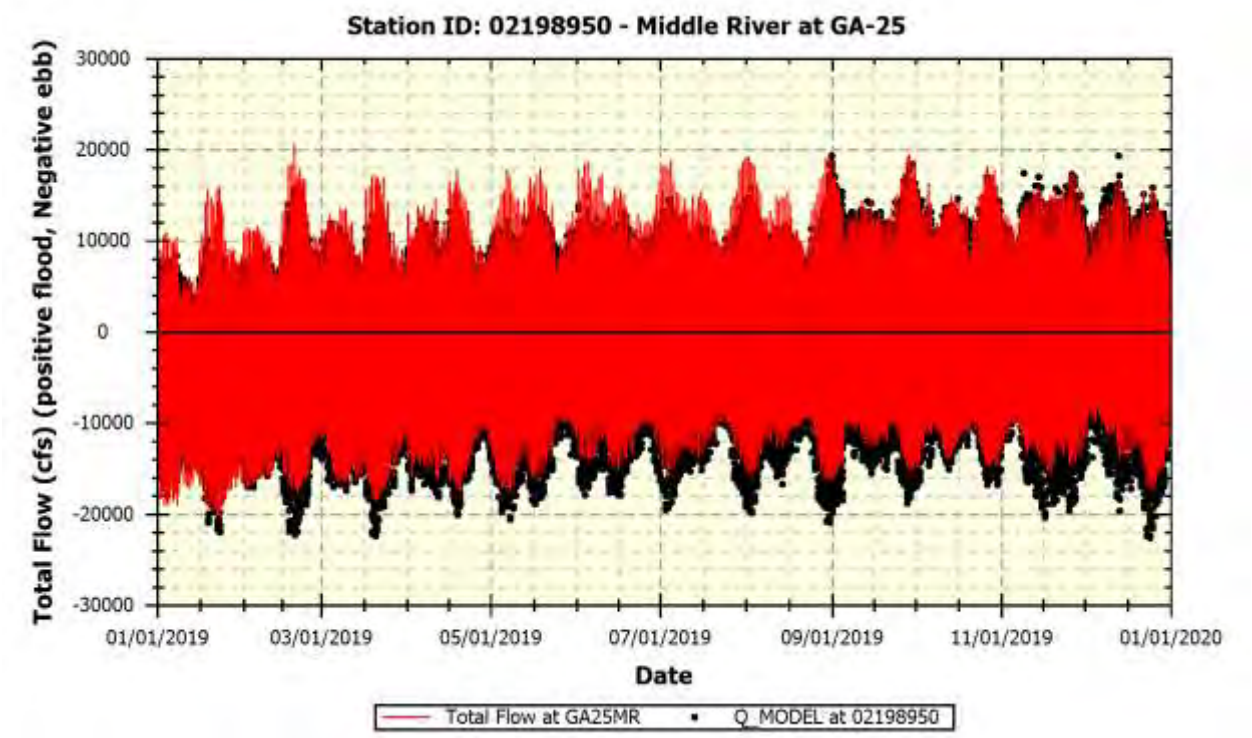

Figure C-15. Simulated vs measured flow at station 02198950 – Middle River at GA-25.

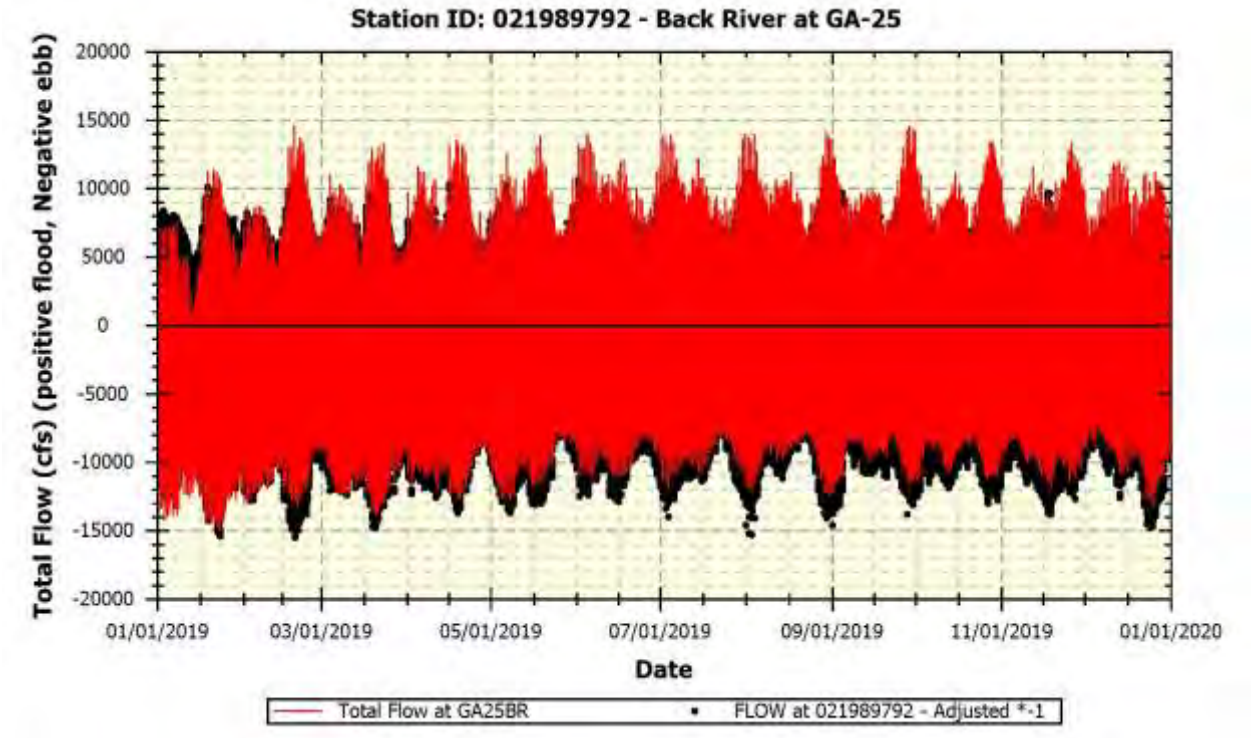

Figure C-16. Simulated vs measured flow at station 021989792 – Back River at GA-25.

C-3. Residual Flows

Table C-3. Residual Flow Statistics (01/01/2019 – 01/01/2020) (cfs)

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 02198920; Front River GA25		Station: 02198950; Middle River GA25		Station: 021989792; Back River GA25	
Mean:	-9,937	-10,121	-1,008	-1,550	-1,446	-1,984
Median:	-6,859	-7,431	-867	-938	-1,291	-1,539
Std Dev:	7,184	6,515	1,209	1,664	630	1,325
Min:	-32,695	-32,206	-4,270	-7,031	-3,689	-6,549
Max:	403	-1,383	1,399	888	-216	-94
5 %tile:	-26,092	-24,954	-3,176	-5,289	-2,595	-4,975
10 %tile:	-20,905	-19,150	-2,675	-4,040	-2,347	-3,824
90 %tile:	-3,323	-4,374	555	17	-750	-756
95 %tile:	-2,653	-3,867	776	201	-645	-626
Coef of Det (R^2):	0.97		0.84		0.85	
Mean Abs Error:	1,063		690		583	
RMS Error:	1,365		913		963	
Norm RMS Error:	0.19		0.75		1.53	
Index of Agreement:	0.99		0.84		0.76	

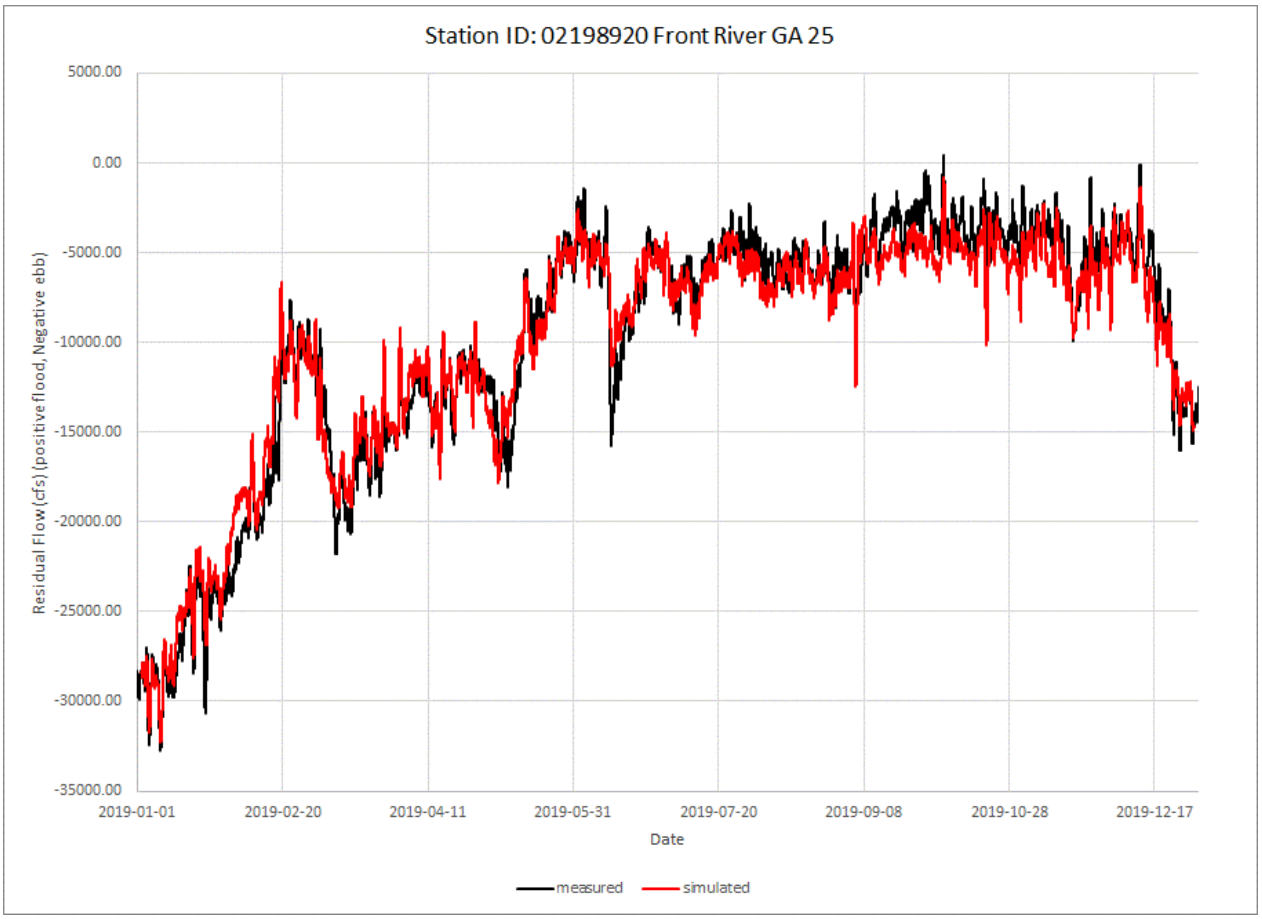

Figure C-17. Simulated vs measured residual flow at station 02198920 – Front River at GA-25.

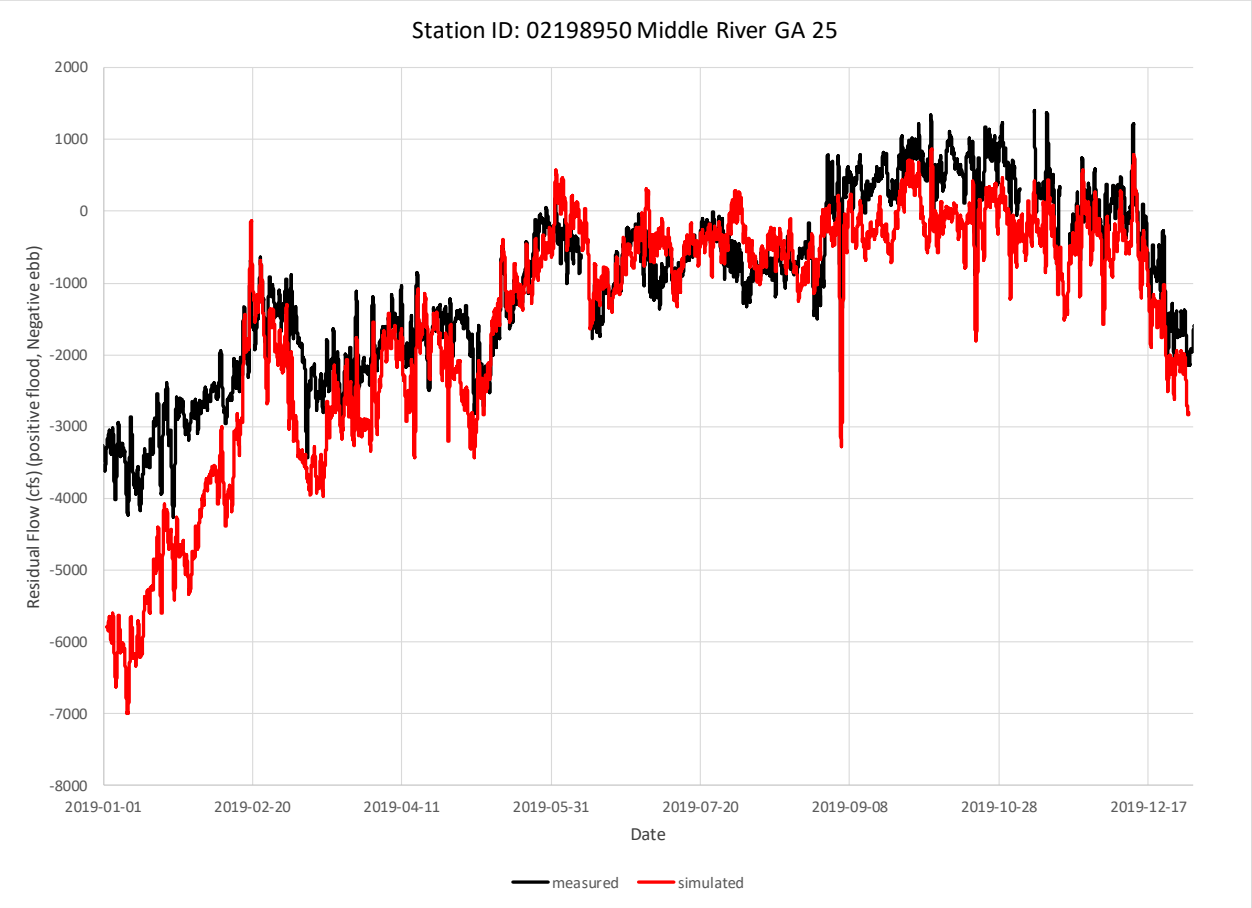

Figure C-18. Simulated vs measured residual flow at station 02198950 – Middle River at GA-25.

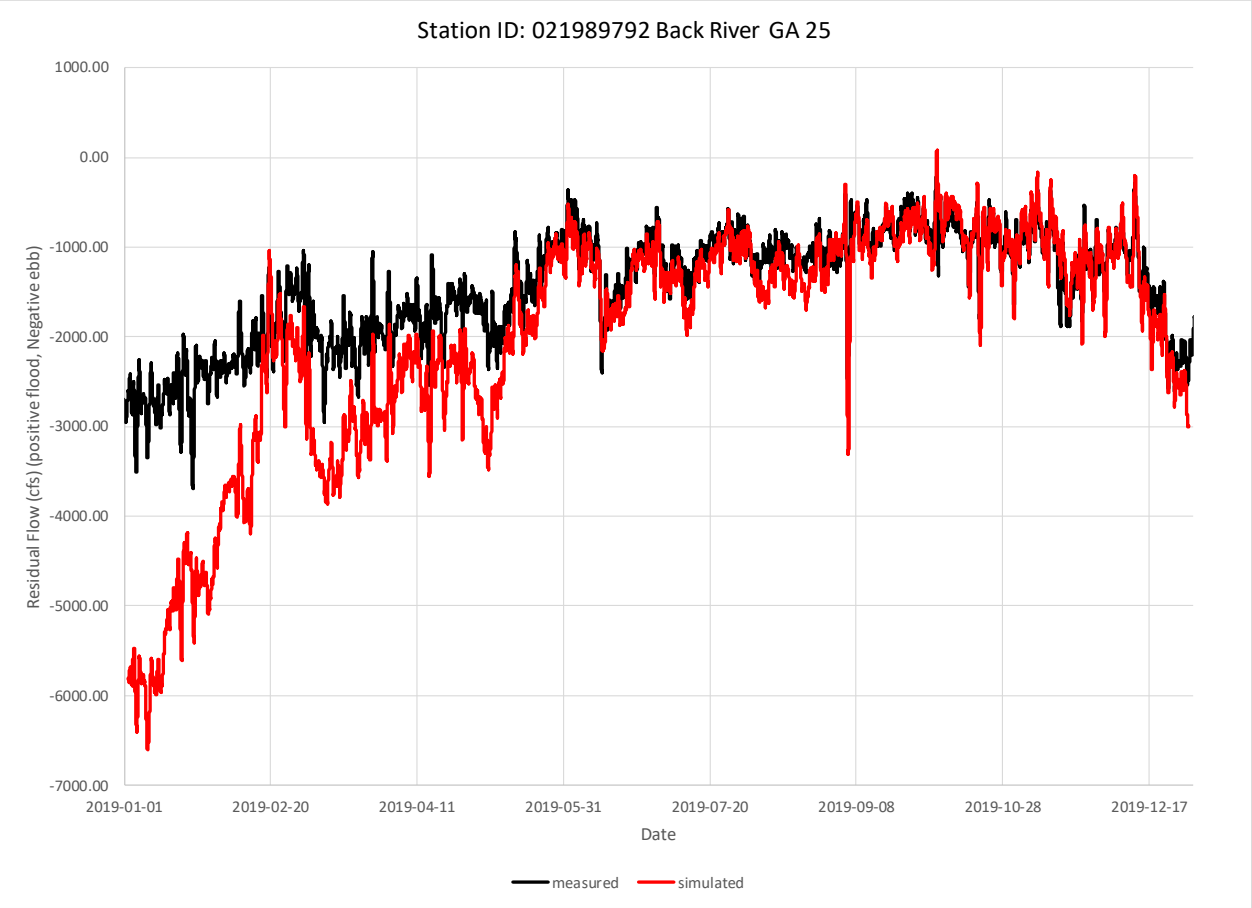

Figure C-19. Simulated vs measured residual flow at station 021989792 – Back River at GA-25.

C-4. Salinity

Table C-4. Salinity Statistics (01/01/2019 – 01/01/2020) (PSU)

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 02198980; Fort Pulaski		Station: 0219897993; Sav River Elba Is.		Station: 021989773; USACE Dock		Station: 02198920; Front River GA25	
Mean:	22.6	26.2	13.1	14.9	7.1	9.9	3.1	5.4
Median:	24.0	27.3	14.0	16.1	7.6	11.2	2.0	5.3
Std Dev:	6.2	3.9	5.7	5.8	4.7	5.0	3.7	3.6
Min:	5.8	13.2	0.2	0.6	0.0	0.0	0.0	0.0
Max:	36.0	32.2	27.0	26.8	21.0	22.7	16.0	14.3
5 %tile:	11.0	18.7	3.7	4.9	0.6	2.0	N/A	0.8
10 %tile:	13.0	20.4	5.1	6.4	1.1	2.9	0.1	1.2
90 %tile:	30.0	30.8	21.0	22.3	14.0	16.1	8.9	10.7
95 %tile:	31.0	31.3	22.0	23.7	15.0	17.5	11.0	11.7
Coef of Det (R^2):	0.82		0.87		0.87		0.79	
Mean Abs Error:	3.94		2.25		2.92		2.48	
RMS Error:	4.81		2.76		3.37		2.84	
Norm RMS Error:	0.78		0.49		0.71		0.77	
Index of Agreement:	0.80		0.94		0.89		0.86	

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 021989715; Garden City (surface)		Station: 021989715; Garden City (bottom)		Station: 02198840; Savannah River I95		Station: 02198950; Middle River GA25	
Mean:	4.80	6.52	6.3	11.2	0.0	0.1	1.9	3.9
Median:	4.80	7.03	6.6	12.5	N/A	0.0	1.0	4.0
Std Dev:	4.15	4.42	5.0	5.1	0.1	0.2	2.5	2.7
Min:	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0
Max:	17.00	18.50	21.0	21.2	1.1	1.8	13.0	12.2
5 %tile:	0.10	0.24	0.1	1.7	N/A	0.0	N/A	0.4
10 %tile:	0.20	0.57	0.3	3.2	N/A	0.0	0.1	0.7
90 %tile:	11.00	12.73	14.0	17.7	0.1	0.3	6.0	7.9
95 %tile:	12.00	13.73	15.0	18.5	0.1	0.5	7.9	9.0
Coef of Det (R^2):	0.81		0.82		0.40		0.72	
Mean Abs Error:	2.06		4.90		0.08		2.09	
RMS Error:	2.60		5.36		0.19		2.46	
Norm RMS Error:	0.63		1.06		2.41		0.97	
Index of Agreement:	0.91		0.78		0.57		0.81	

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 02198955; Middle River Fish Hole		Station: 021989792; Back River GA25		Station: 021989784; Back River Lucknow	
Mean:	4.0	5.7	0.5	1.1	0.2	0.5
Median:	2.7	6.0	0.2	0.7	0.2	0.4
Std Dev:	4.3	3.7	0.9	1.5	0.2	0.6
Min:	0.0	0.0	0.0	0.0	0.0	0.0
Max:	20.0	15.0	9.1	9.0	2.2	4.2
5 %tile:	0.1	0.5	N/A	0.0	N/A	0.0
10 %tile:	0.1	0.9	0.1	0.0	N/A	0.0
90 %tile:	11.0	11.1	1.0	3.3	0.5	1.3
95 %tile:	13.0	12.2	1.9	4.5	0.7	1.6
Coef of Det (R^2):	0.76		0.64		0.60	
Mean Abs Error:	2.34		0.70		0.33	
RMS Error:	2.79		1.16		0.50	
Norm RMS Error:	0.64		1.27		2.23	
Index of Agreement:	0.88		0.79		0.66	

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 021989791; Back River F&W Dock		Station: 021989793; Back River Hog Island		Station: 0219897945; Back River US-17	
Mean:	0.3	0.9	1.8	3.1	5.2	8.1
Median:	0.2	0.6	0.9	2.5	5.4	9.3
Std Dev:	0.4	1.1	2.4	3.1	3.9	4.6
Min:	0.0	0.0	0.0	0.0	0.0	0.0
Max:	6.2	7.8	13.0	12.7	20.0	17.4
5 %tile:	N/A	0.0	0.1	0.0	0.3	0.7
10 %tile:	N/A	0.0	0.1	0.0	0.6	1.5
90 %tile:	0.6	2.3	5.6	8.1	11.0	14.0
95 %tile:	0.9	3.3	7.3	9.4	13.0	14.9
Coef of Det (R^2):	0.57		0.85		0.83	
Mean Abs Error:	0.61		1.34		2.88	
RMS Error:	1.04		1.84		3.41	
Norm RMS Error:	2.45		0.77		0.87	
Index of Agreement:	0.63		0.90		0.86	

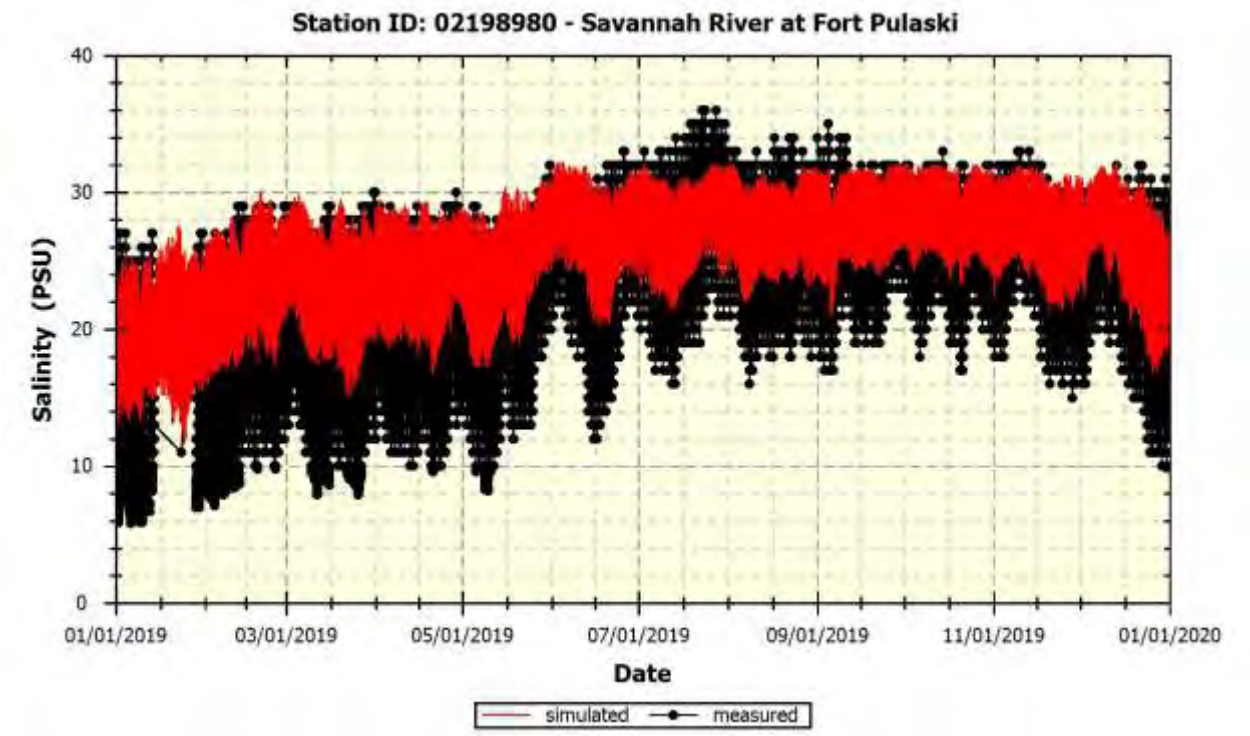

Figure C-20. Simulated vs measured salinity at station 02198980 – Savannah River at Fort Pulaski.

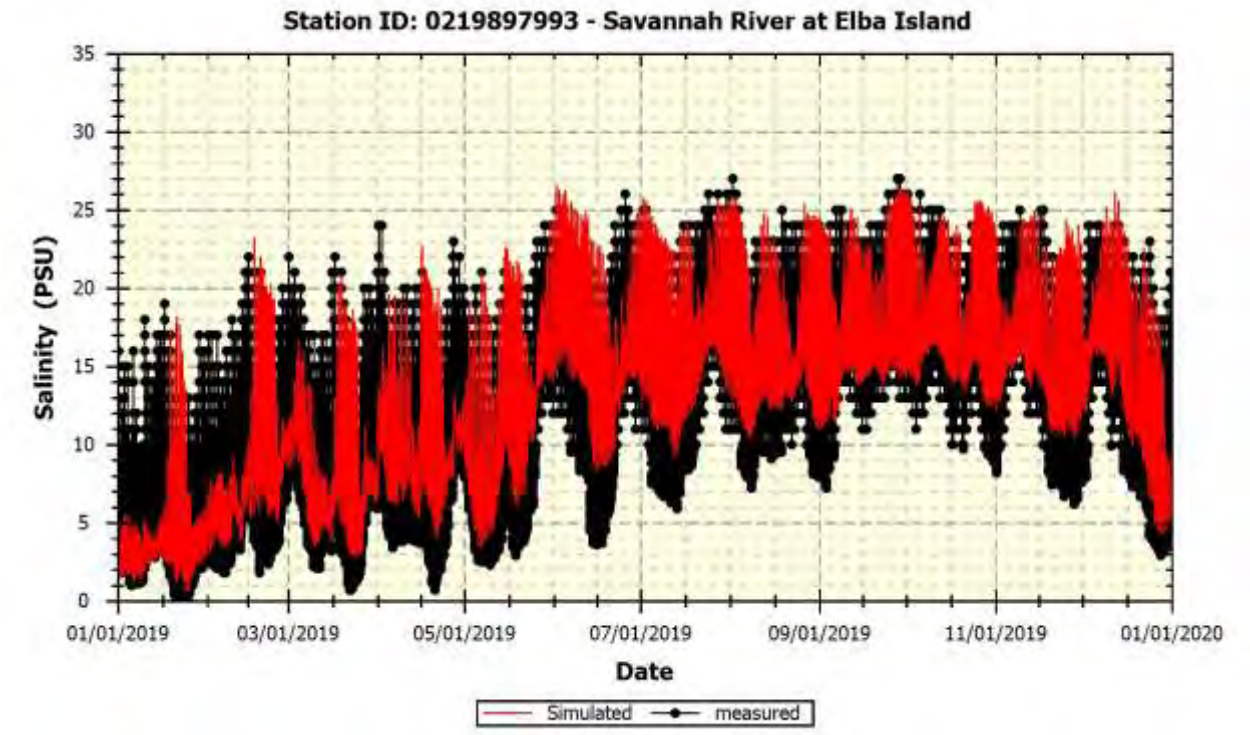

Figure C-21. Simulated vs measured salinity at station 0219897993 – Savannah River at Elba Island.

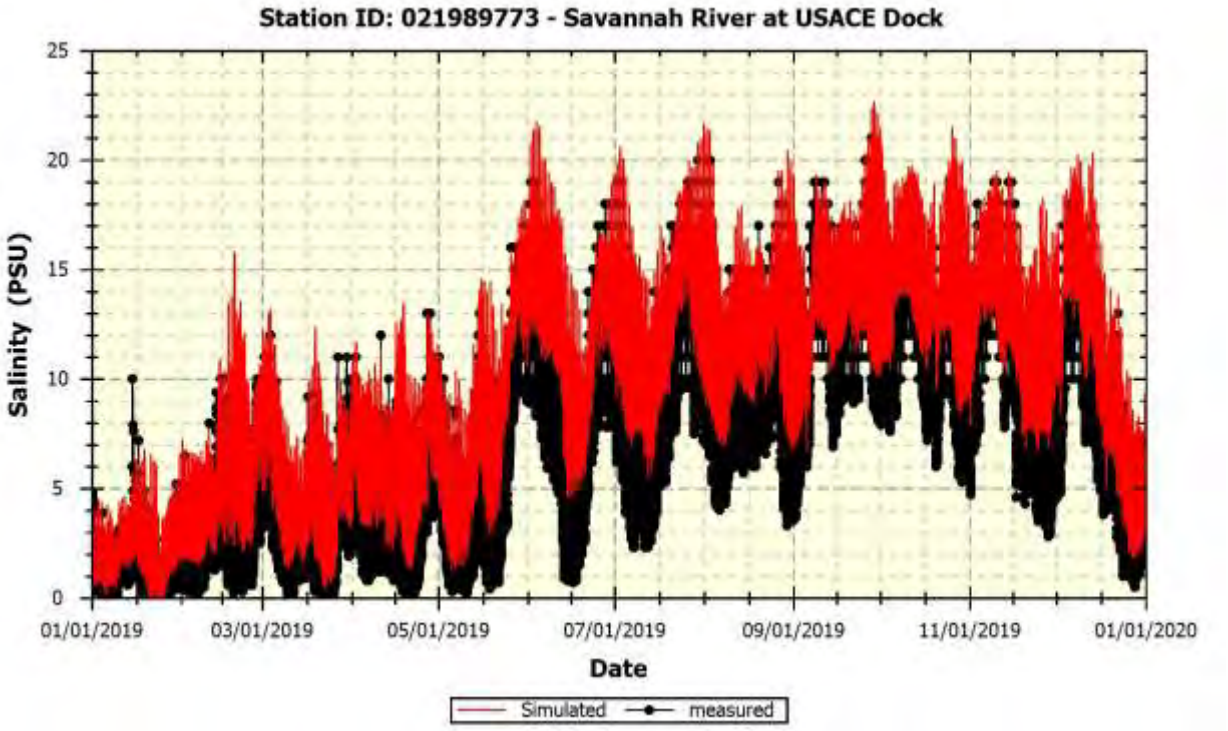

Figure C-22. Simulated vs measured salinity at station 021989773 – Savannah River at USACE Dock.

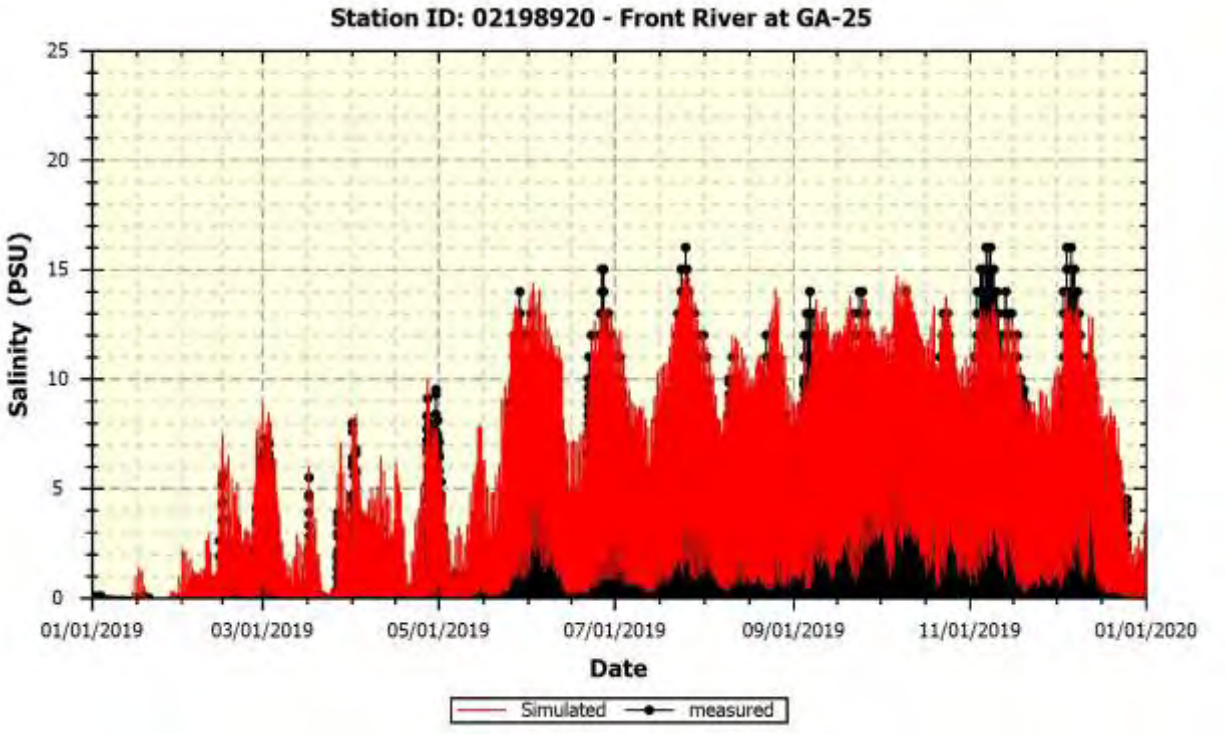

Figure C-23. Simulated vs measured salinity at station 02198920 – Front River at GA-25.

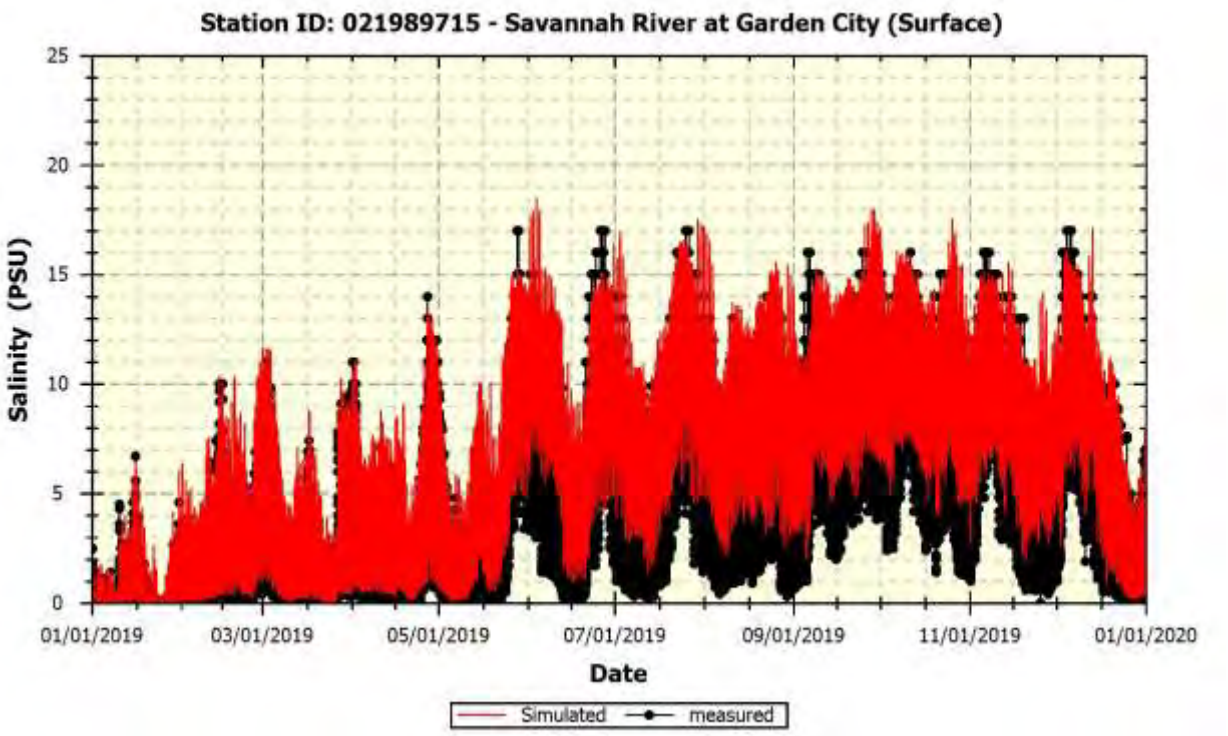

Figure C-24. Simulated vs measured surface salinity at station 021989715 – Savannah River at Garden City.

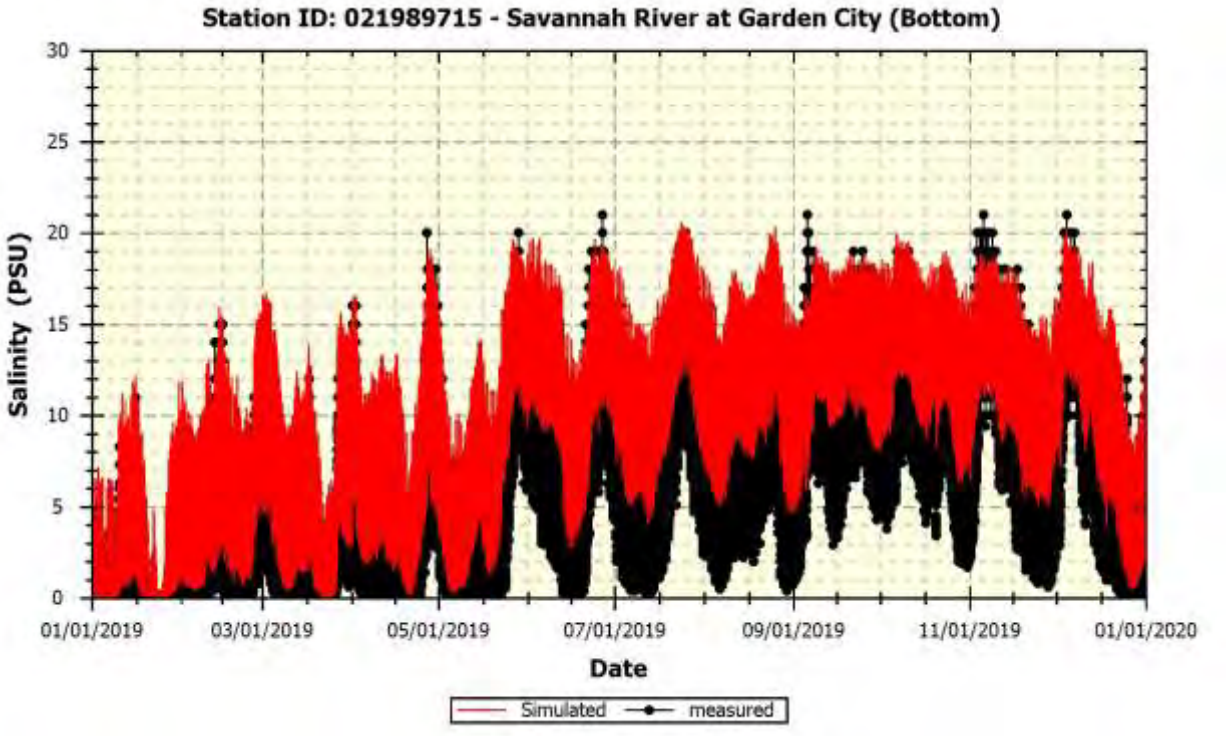

Figure C-25. Simulated vs measured bottom salinity at station 021989715 – Savannah River at Garden City.

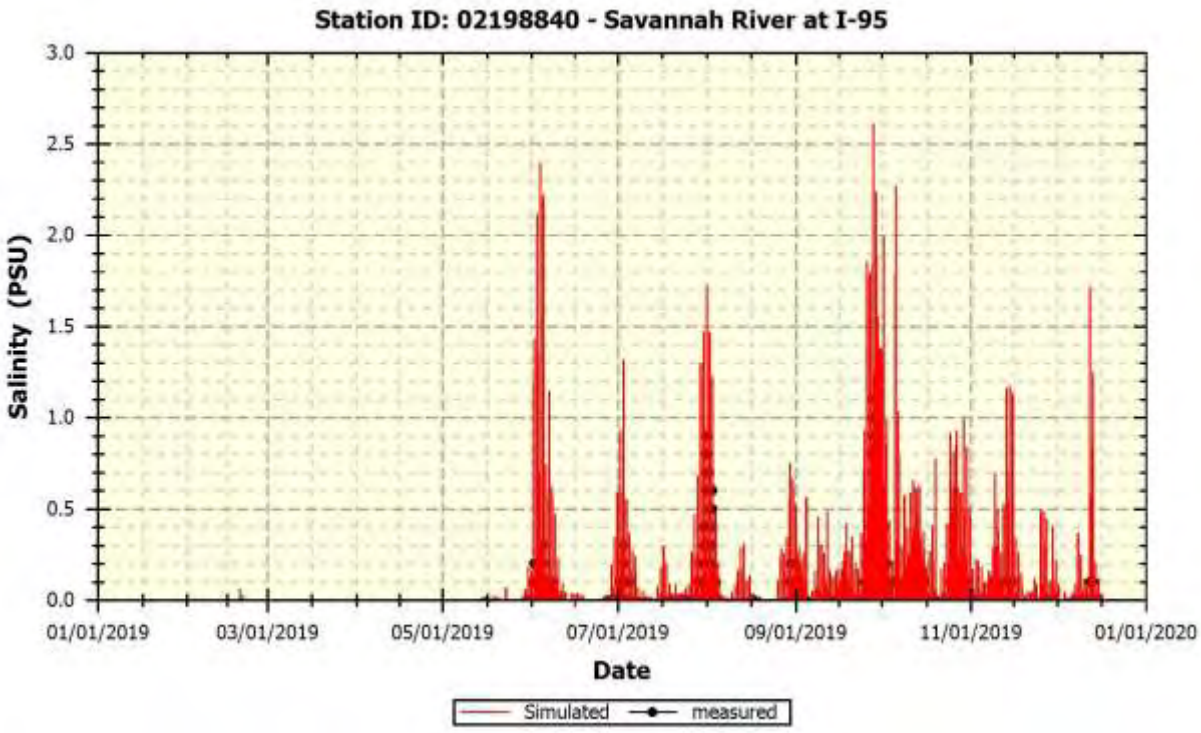

Figure C-26. Simulated vs measured salinity at station 02198840 – Savannah River at I-95.

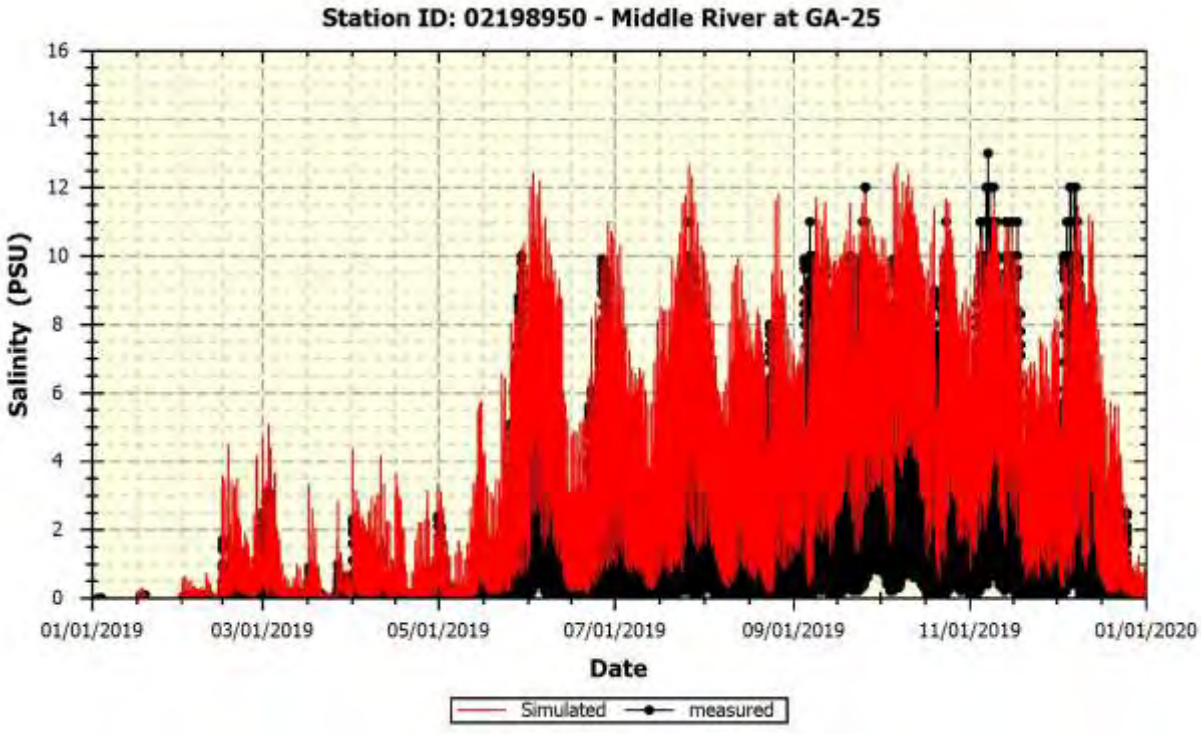

Figure C-27. Simulated vs measured salinity at station 02198950 – Middle River at GA-25.

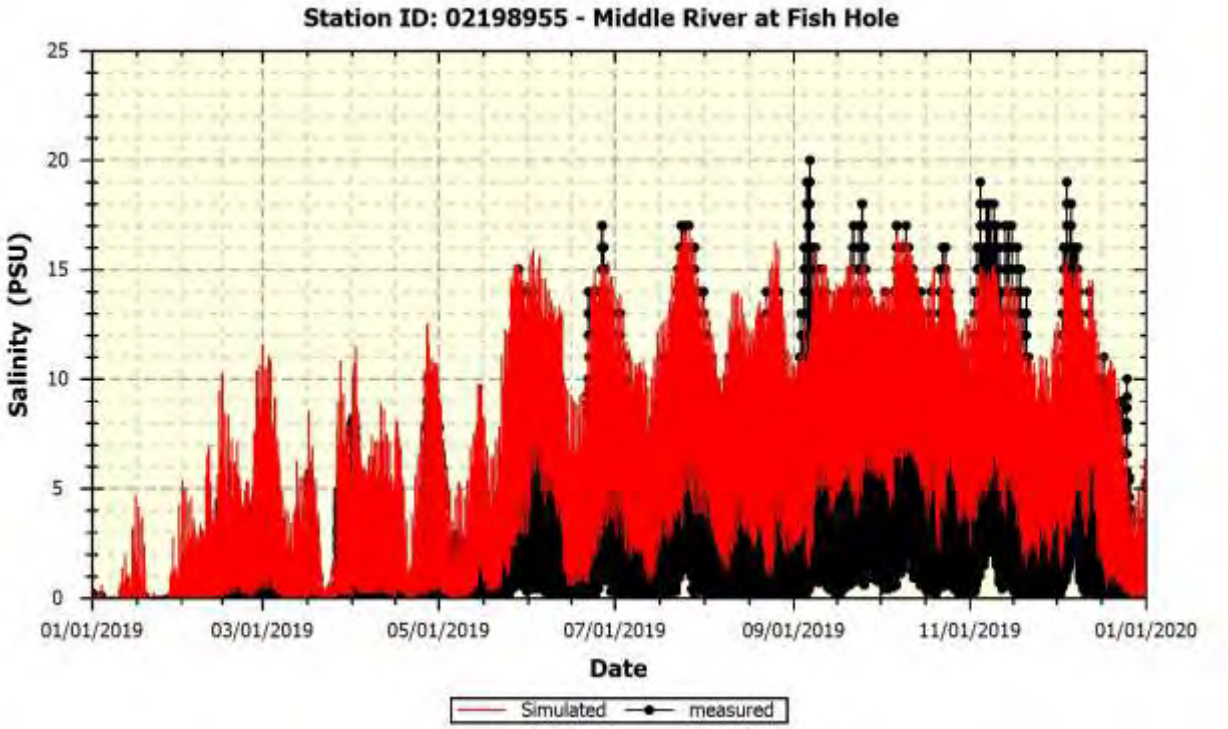

Figure C-28. Simulated vs measured salinity at station 02198955 – Middle River at Fish Hole.

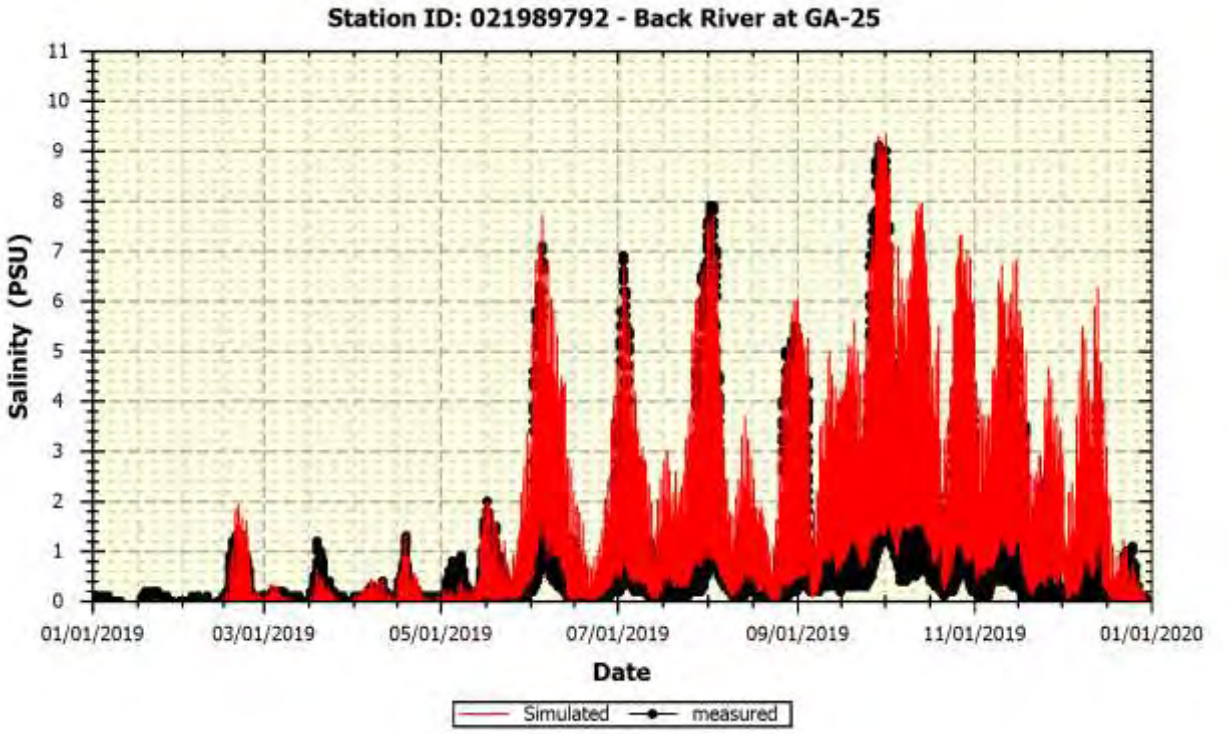

Figure C-29. Simulated vs measured salinity at station 021989792 – Back River at GA-25.

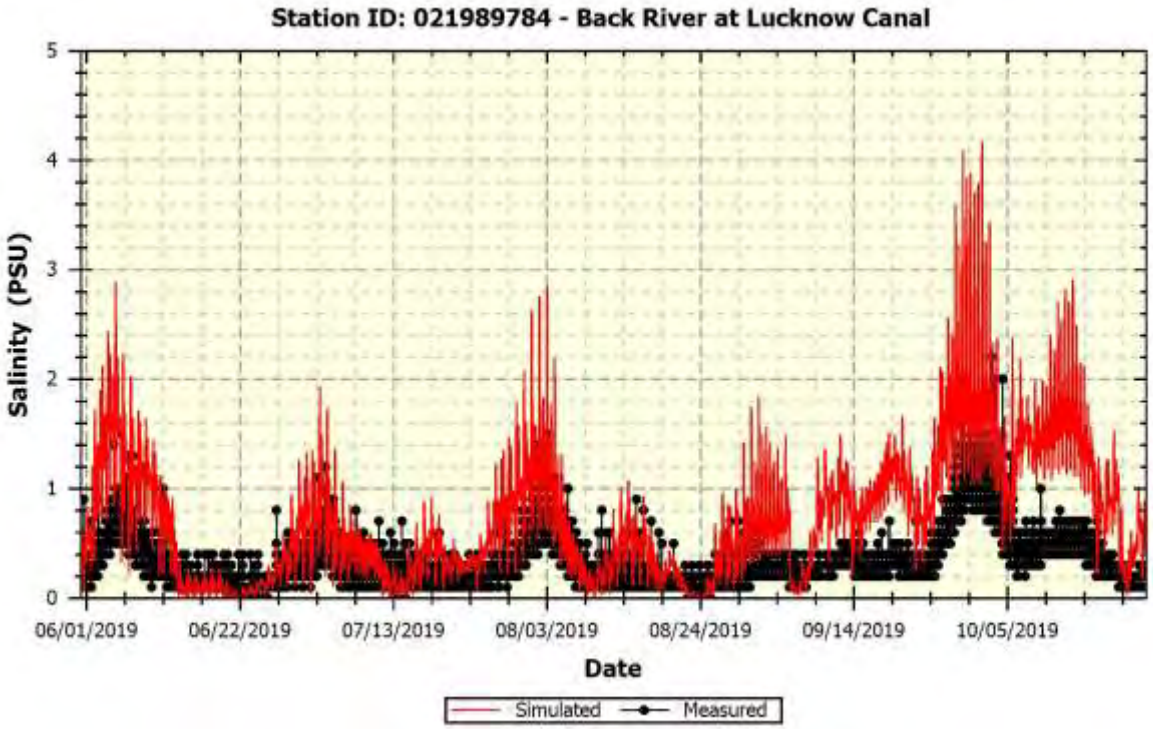

Figure C-30. Simulated vs measured salinity at station 02198979784 – Back River at Lucknow Canal.

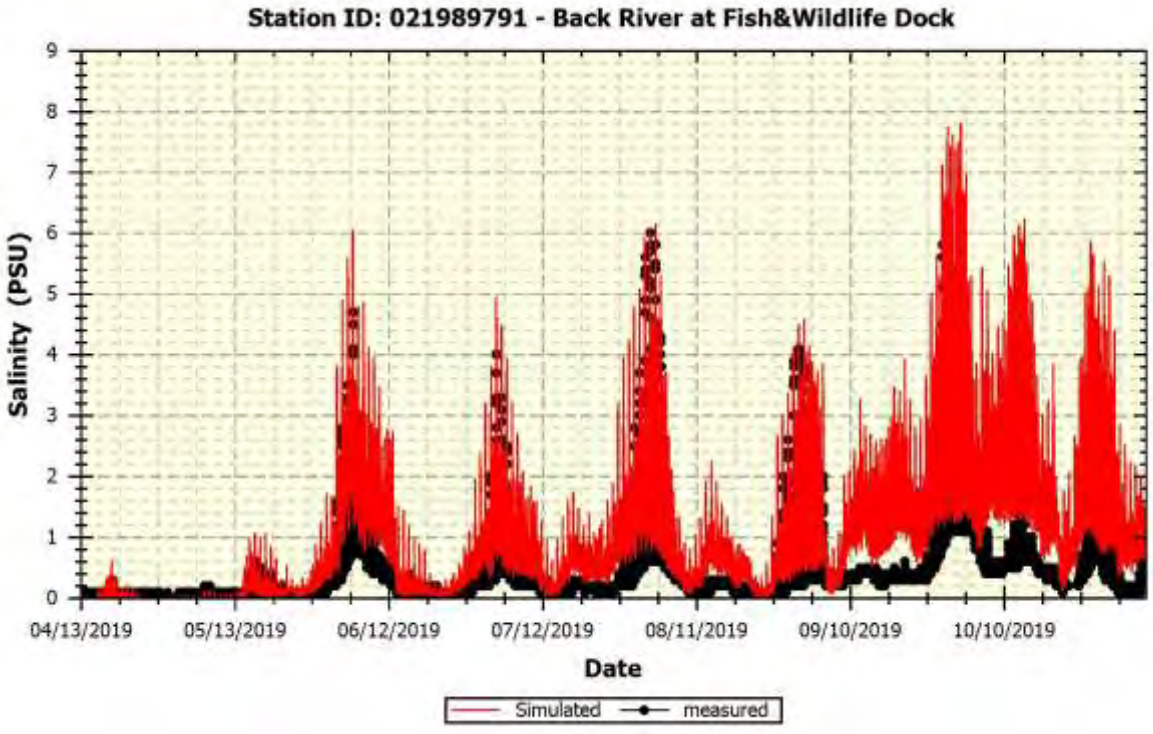

Figure C-31. Simulated vs measured salinity at station 021989791 – Back River at Fish&Wildlife Dock.

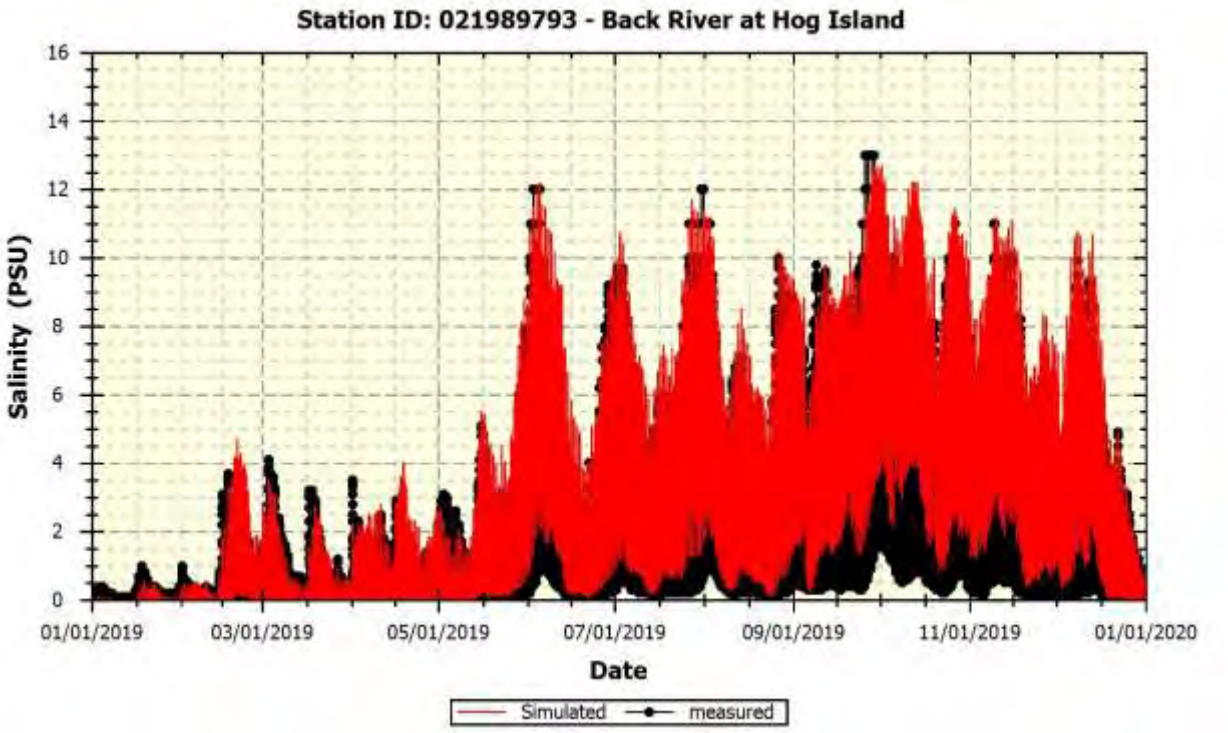

Figure C-32. Simulated vs measured salinity at station 021989793 – Back River at Hog Island.

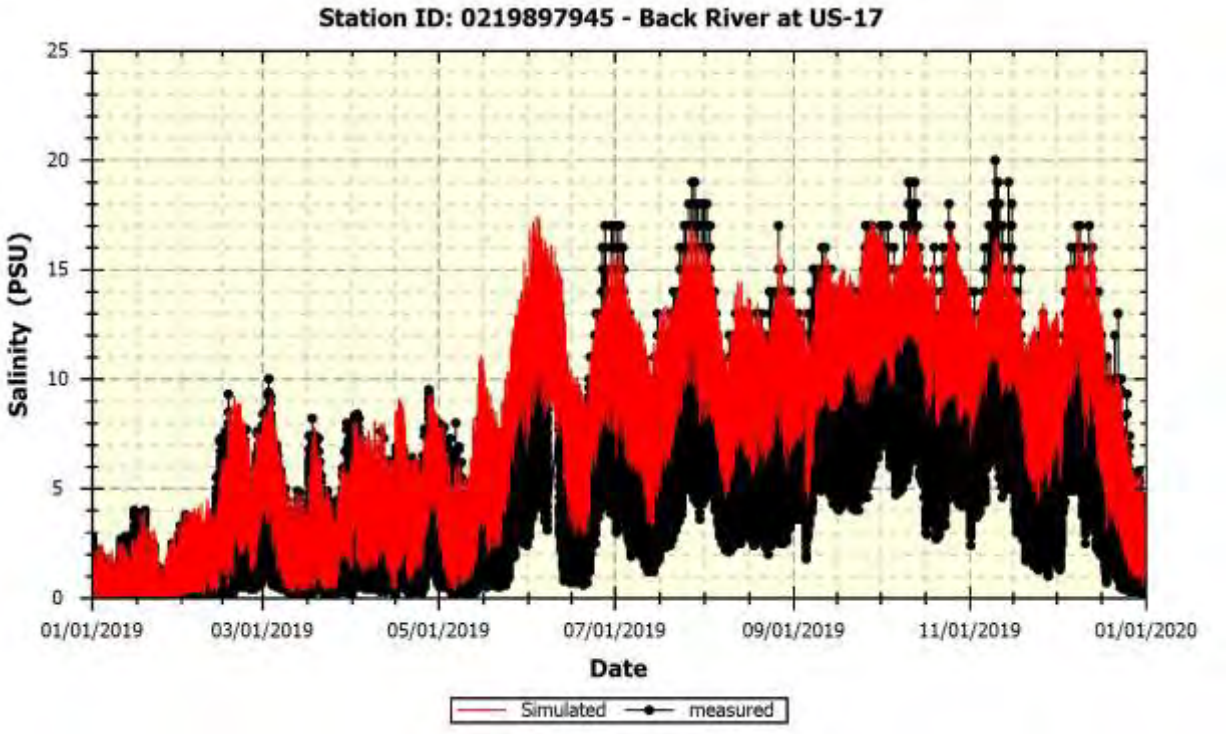

Figure C-33. Simulated vs measured salinity at station 0219897945 – Back River at US-17.

C-5. Water Temperature

Table C-5. Temperature Statistics (01/01/2019 – 01/01/2020) (degree F)

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 02198980; Fort Pulaski		Station: 0219897993; Sav River Elba Is.		Station: 021989773; USACE Dock		Station: 02198920; Front River GA25	
Mean:	71.5	71.2	70.5	70.7	70.0	70.4	69.0	69.0
Median:	75.9	75.5	74.8	75.4	73.8	75.0	72.7	73.5
Std Dev:	11.7	12.6	12.0	13.4	12.0	13.4	11.8	13.4
Min:	49.5	48.2	48.0	46.2	47.3	45.8	46.8	43.8
Max:	88.2	89.4	88.2	90.1	88.2	89.7	87.1	89.3
5 %tile:	55.0	53.2	52.5	50.2	51.6	50.0	50.9	48.7
10 %tile:	56.7	54.6	55.8	53.9	55.2	53.4	54.3	52.3
90 %tile:	85.3	86.3	84.9	87.2	84.4	86.8	83.1	85.2
95 %tile:	86.4	87.0	85.8	88.1	85.5	87.8	84.0	86.3
Coef of Det (R^2):	0.99		0.99		0.99		0.99	
Mean Abs Error:	1.32		1.42		1.52		1.52	
RMS Error:	1.60		1.72		1.87		1.88	
Norm RMS Error:	0.14		0.14		0.16		0.16	
Index of Agreement:	1.00		1.00		0.99		0.99	

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 021989715; Garden City (surface)		Station: 021989715; Garden City (bottom)		Station: 02198840; Savannah River I95		Station: 02198950; Middle River GA25	
Mean:	69.6	69.5	69.6	70.0	68.6	67.7	69.1	69.3
Median:	73.0	74.0	73.2	74.5	72.0	71.8	72.7	73.7
Std Dev:	11.9	13.4	11.9	13.4	11.8	13.0	11.8	13.4
Min:	47.1	44.2	47.1	44.6	46.0	43.5	46.6	44.1
Max:	87.3	89.0	87.1	88.7	86.7	87.0	87.3	89.3
5 %tile:	51.1	49.2	51.3	49.6	50.7	48.0	51.0	48.9
10 %tile:	55.0	52.8	55.0	53.2	54.1	51.6	54.5	52.5
90 %tile:	83.7	85.9	83.7	86.4	82.8	83.3	83.1	85.3
95 %tile:	84.7	86.9	84.7	87.3	83.7	84.4	84.0	86.4
Coef of Det (R^2):	0.99		0.99		0.99		0.99	
Mean Abs Error:	1.50		1.53		1.49		1.63	
RMS Error:	1.83		1.90		1.84		1.98	
Norm RMS Error:	0.15		0.16		0.16		0.17	
Index of Agreement:	0.99		0.99		0.99		0.99	

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 02198955; Middle River Fish Hole		Station: 021989792; Back River GA25		Station: 021989784; Back River Lucknow	
Mean:	69.8	69.9	69.4	69.4	69.1	68.7
Median:	73.2	74.5	73.2	73.9	72.9	73.0
Std Dev:	11.8	13.3	11.9	13.6	11.7	13.3
Min:	46.0	44.3	46.6	44.1	46.0	43.8
Max:	87.4	89.4	88.3	89.1	88.0	88.2
5 %tile:	50.9	48.9	51.0	48.9	51.0	48.6
10 %tile:	55.0	53.4	54.3	52.7	54.0	52.2
90 %tile:	83.5	85.7	83.8	85.7	83.5	84.8
95 %tile:	84.6	86.7	84.9	86.9	84.4	85.8
Coef of Det (R^2):	0.99		0.98		0.98	
Mean Abs Error:	1.55		2.06		2.04	
RMS Error:	1.881		2.41		2.44	
Norm RMS Error:	0.16		0.20		0.21	
Index of Agreement:	0.99		0.99		0.99	

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 021989791; Back River F&W Dock		Station: 021989793; Back River Hog Island		Station: 0219897945; Back River US-17	
Mean:	69.3	69.2	69.95	70.14	70.3	70.7
Median:	73.0	73.7	74.30	74.69	74.5	75.3
Std Dev:	11.9	13.5	12.07	13.69	12.1	13.6
Min:	46.8	44.0	46.76	44.51	47.5	45.4
Max:	88.0	88.9	88.52	89.54	90.1	90.7
5 %tile:	51.0	48.8	51.26	49.37	51.6	49.8
10 %tile:	54.1	52.4	54.50	53.28	55.0	53.6
90 %tile:	83.7	85.4	84.38	86.79	84.9	87.4
95 %tile:	84.7	86.5	85.46	87.78	85.8	88.2
Coef of Det (R^2):	0.98		0.98		0.98	
Mean Abs Error:	2.01		2.16		1.888	
RMS Error:	2.36		2.508		2.251	
Norm RMS Error:	0.20		0.21		0.19	
Index of Agreement:	0.99		0.99		0.99	

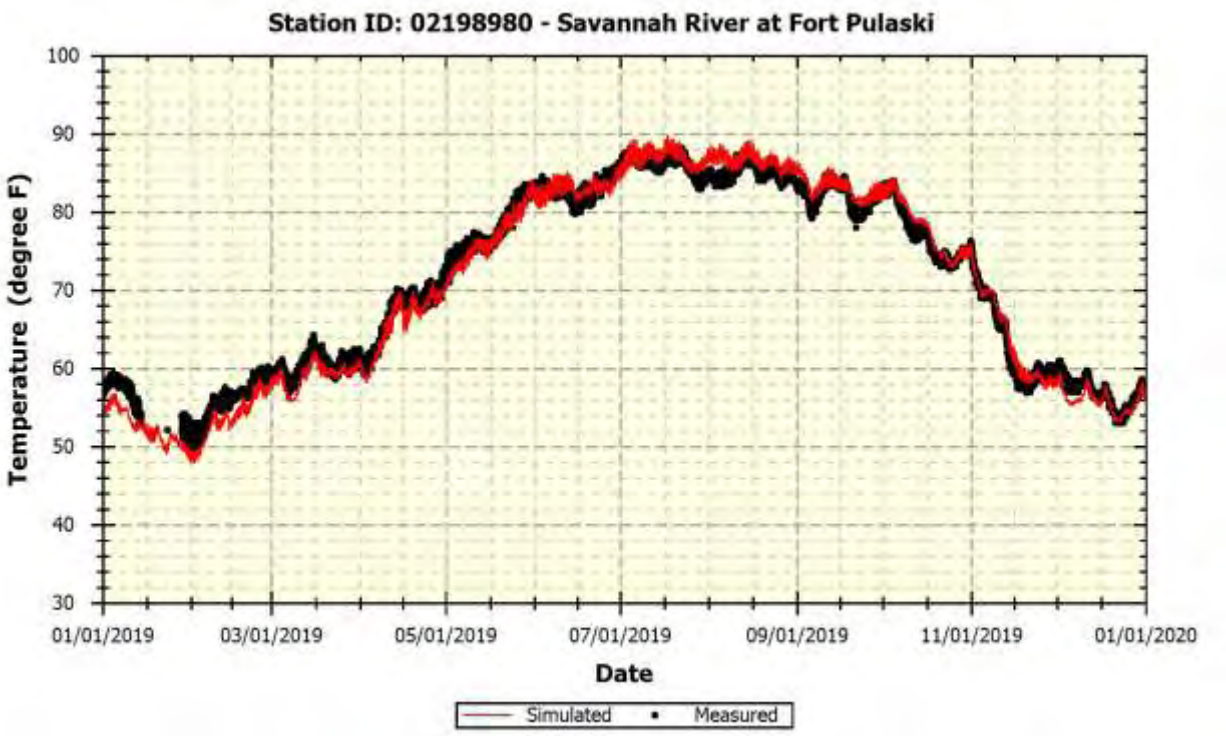

Figure C-34. Simulated vs measured temperature at station 02198980 – Savannah River at Fort Pulaski.

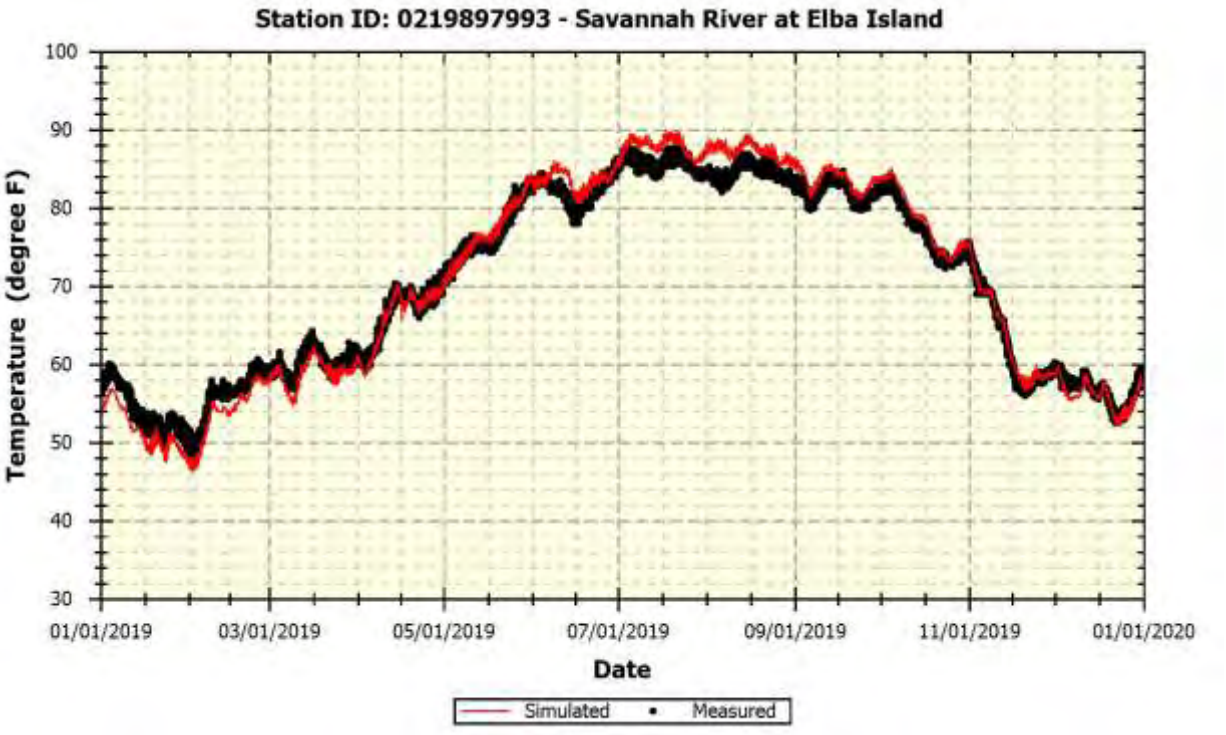

Figure C-35. Simulated vs measured temperature at station 0219897993 – Savannah River at Elba Island.

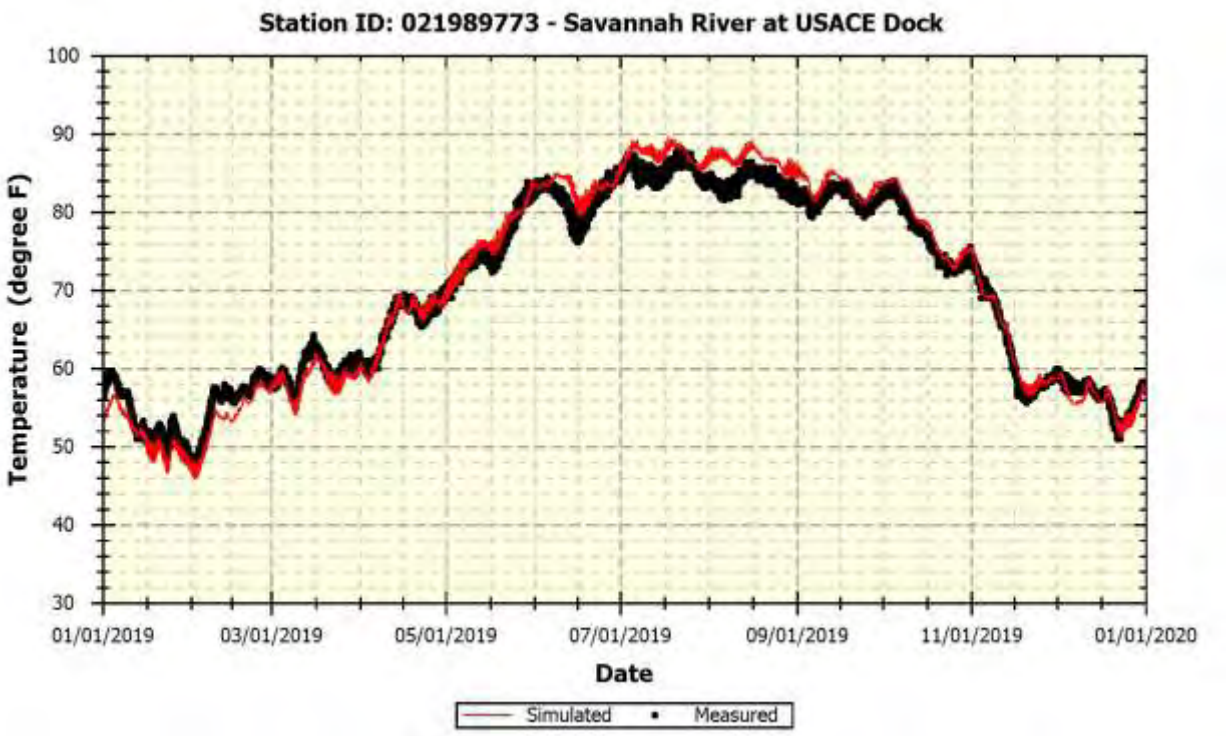

Figure C-36. Simulated vs measured temperature at station 021989773 – Savannah River at USACE Dock.

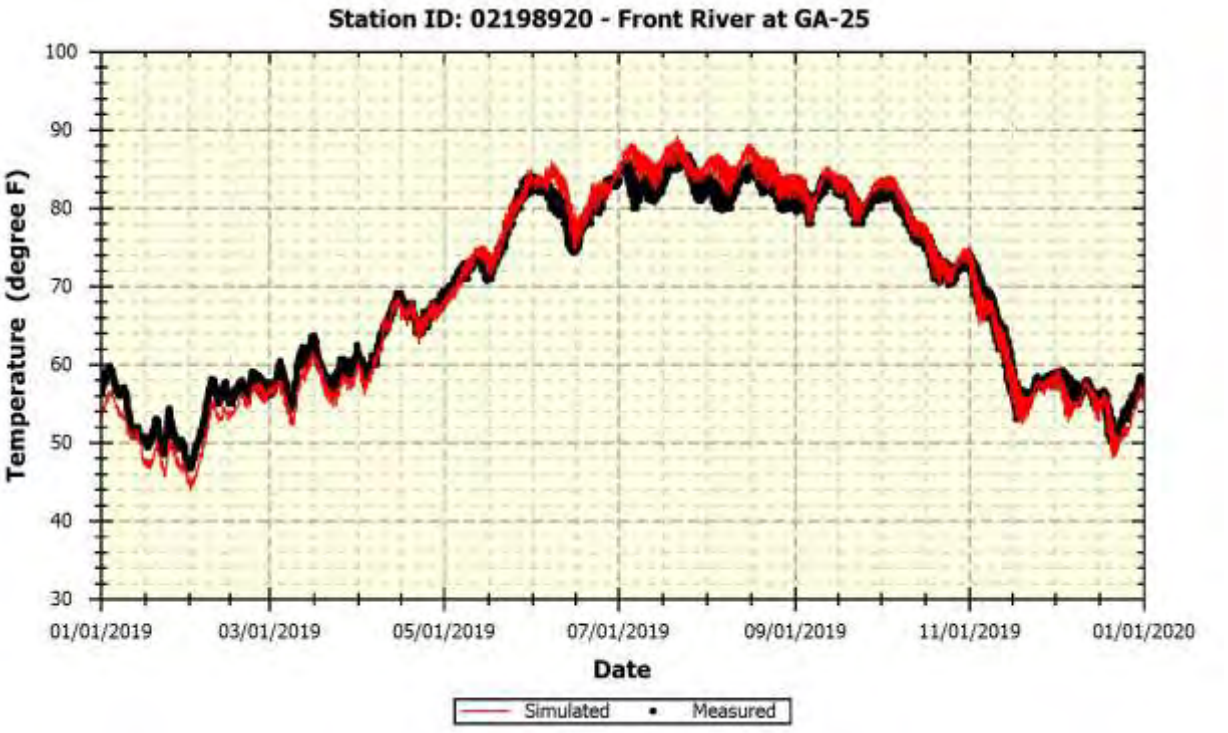

Figure C-37. Simulated vs measured temperature at station 02198920 – Front River at GA-25.

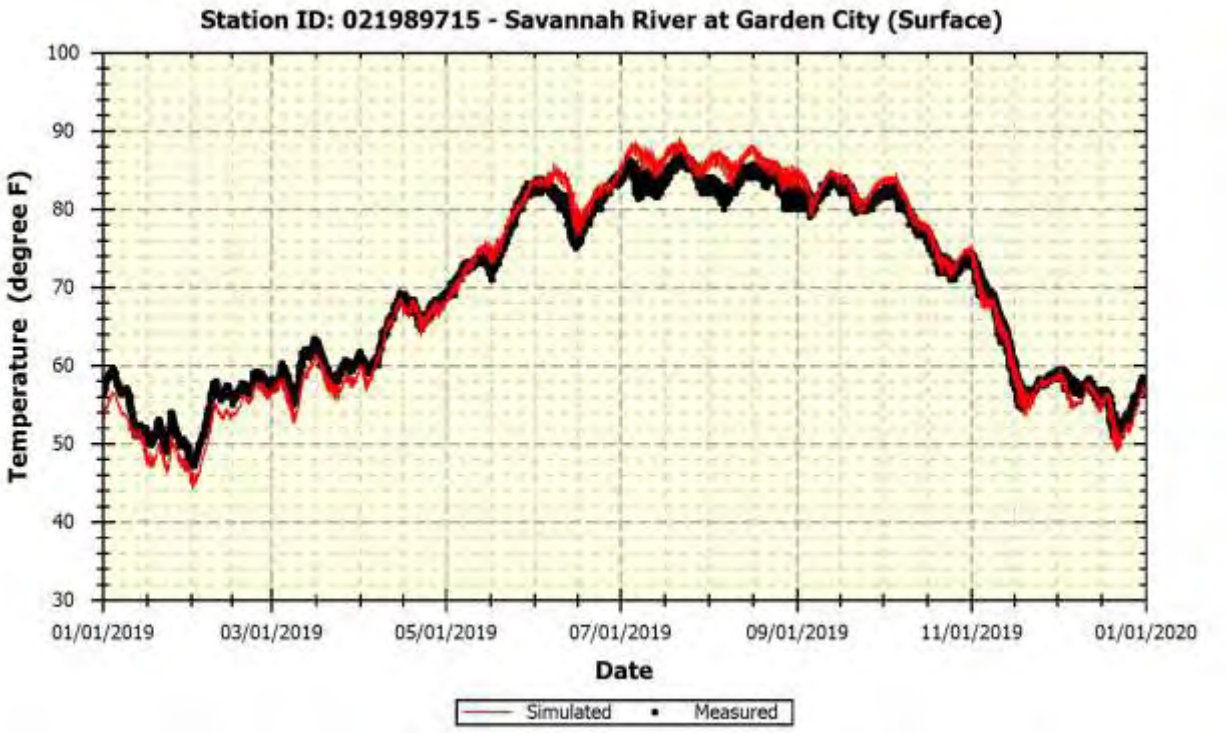

Figure C-38. Simulated vs measured surface temperature at station 021989715 – Savannah River at Garden City.

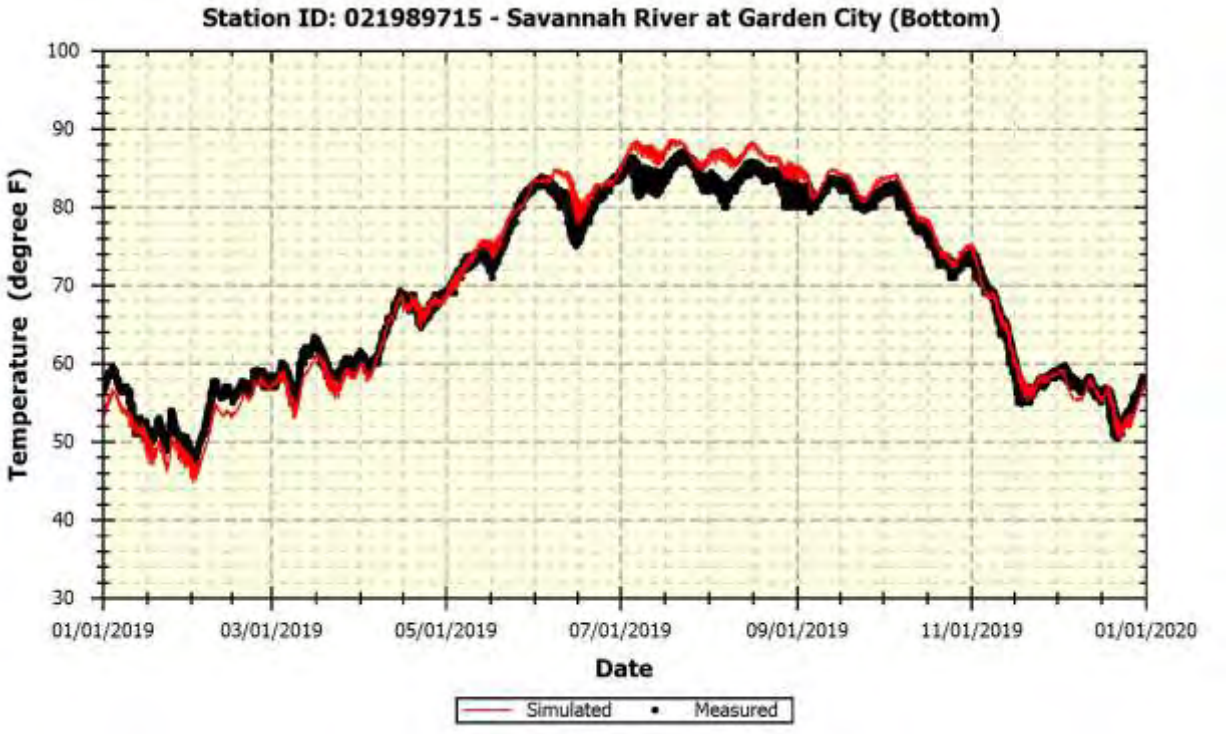

Figure C-39. Simulated vs measured bottom temperature at station 021989715 – Savannah River at Garden City.

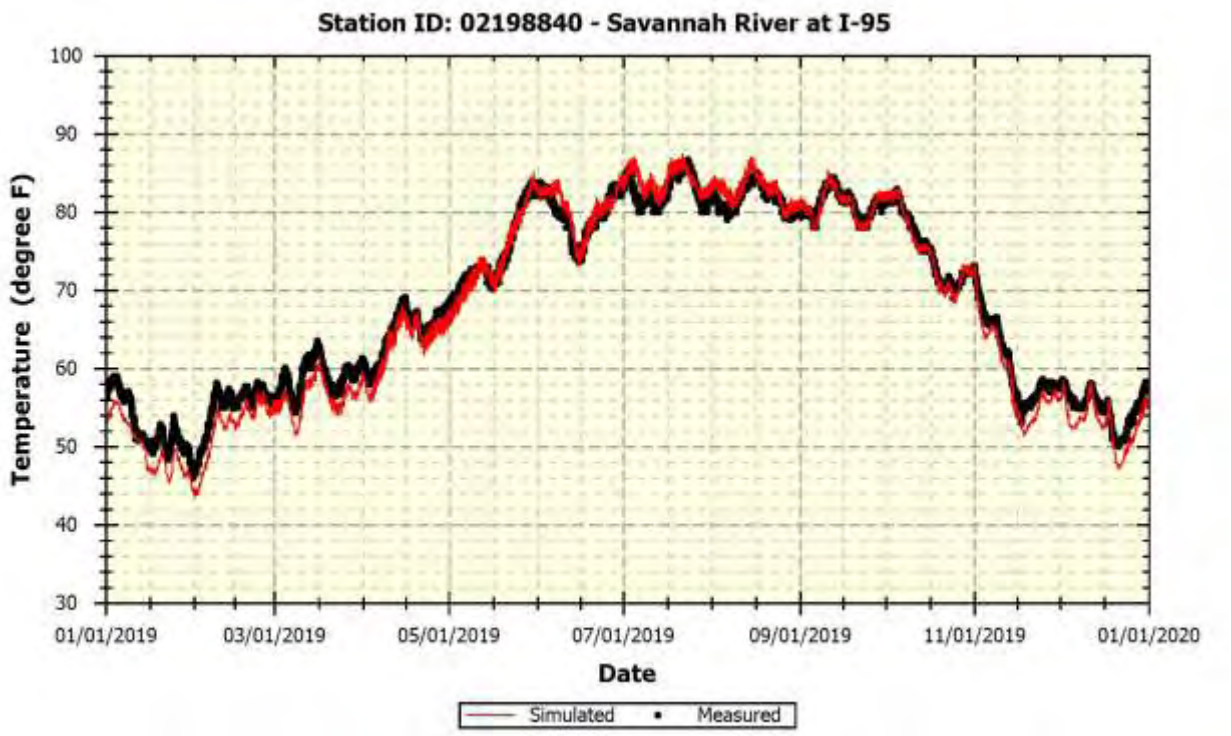

Figure C-40. Simulated vs measured temperature at station 02198840 – Savannah River at I-95.

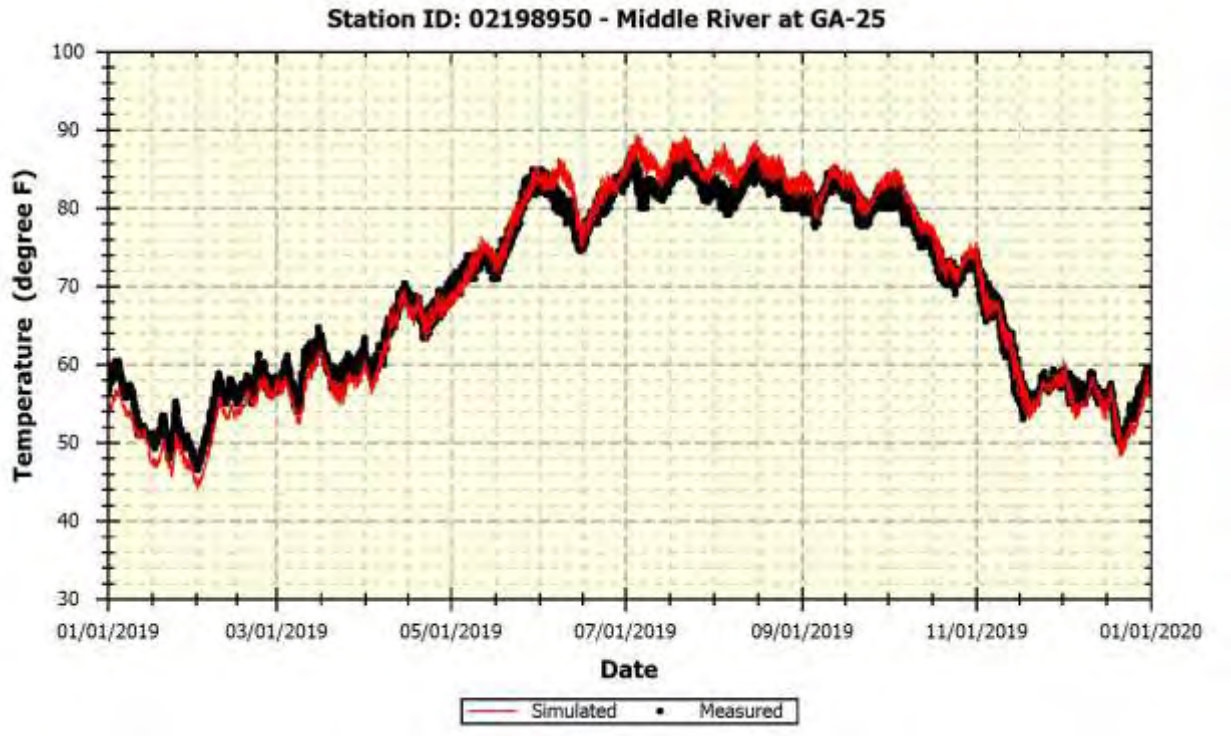

Figure C-41. Simulated vs measured temperature at station 02198950 – Middle River at GA-25.

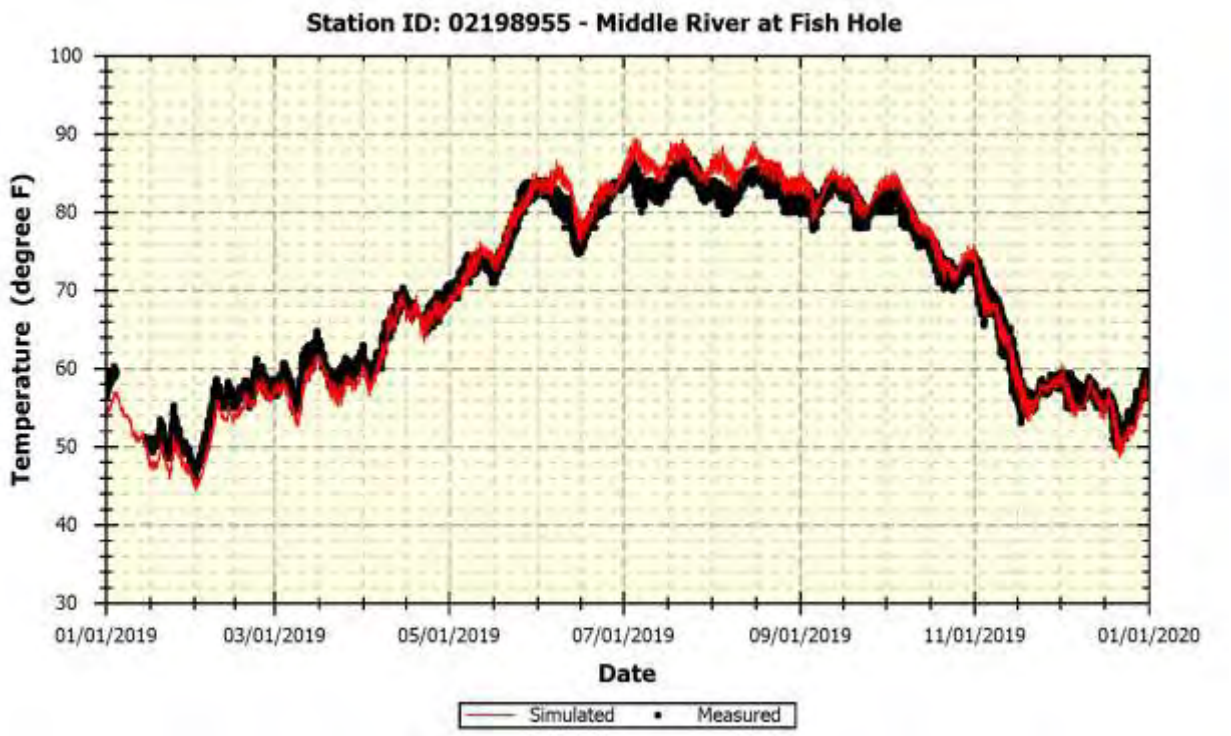

Figure C-42. Simulated vs measured temperature at station 02198955 – Middle River at Fish Hole.

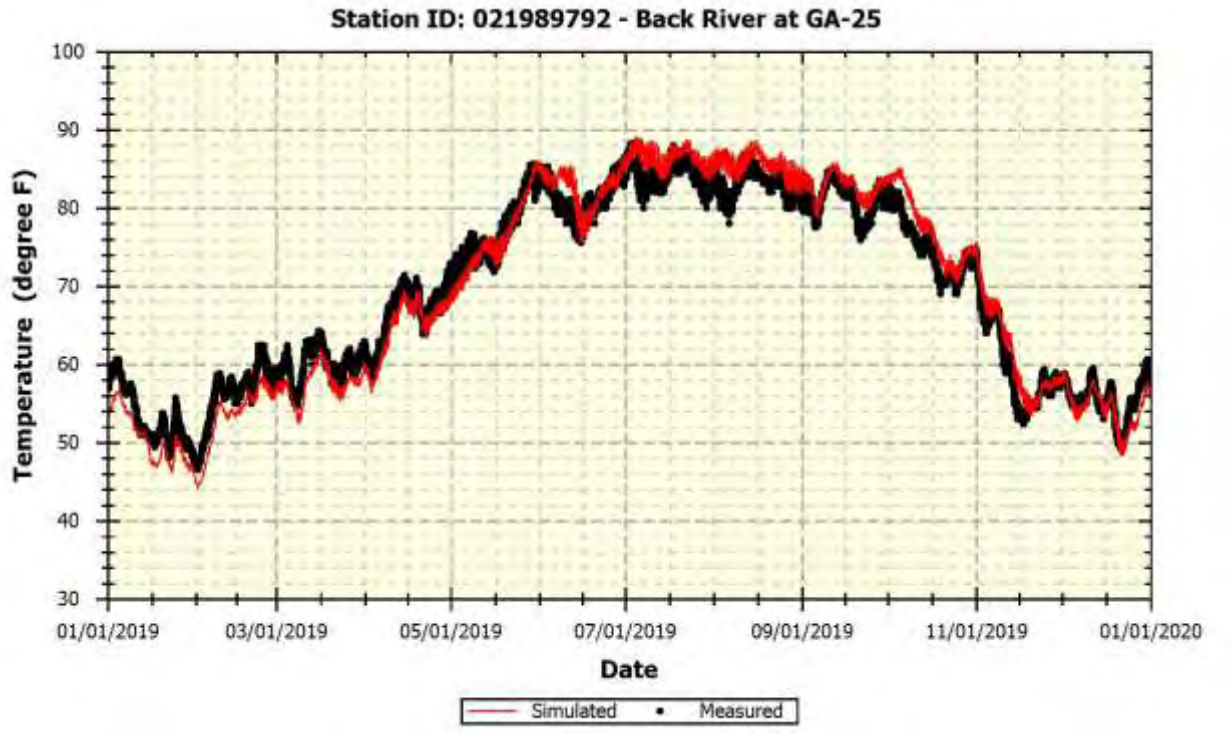

Figure C-43. Simulated vs measured temperature at station 021989792 – Back River at GA-25.

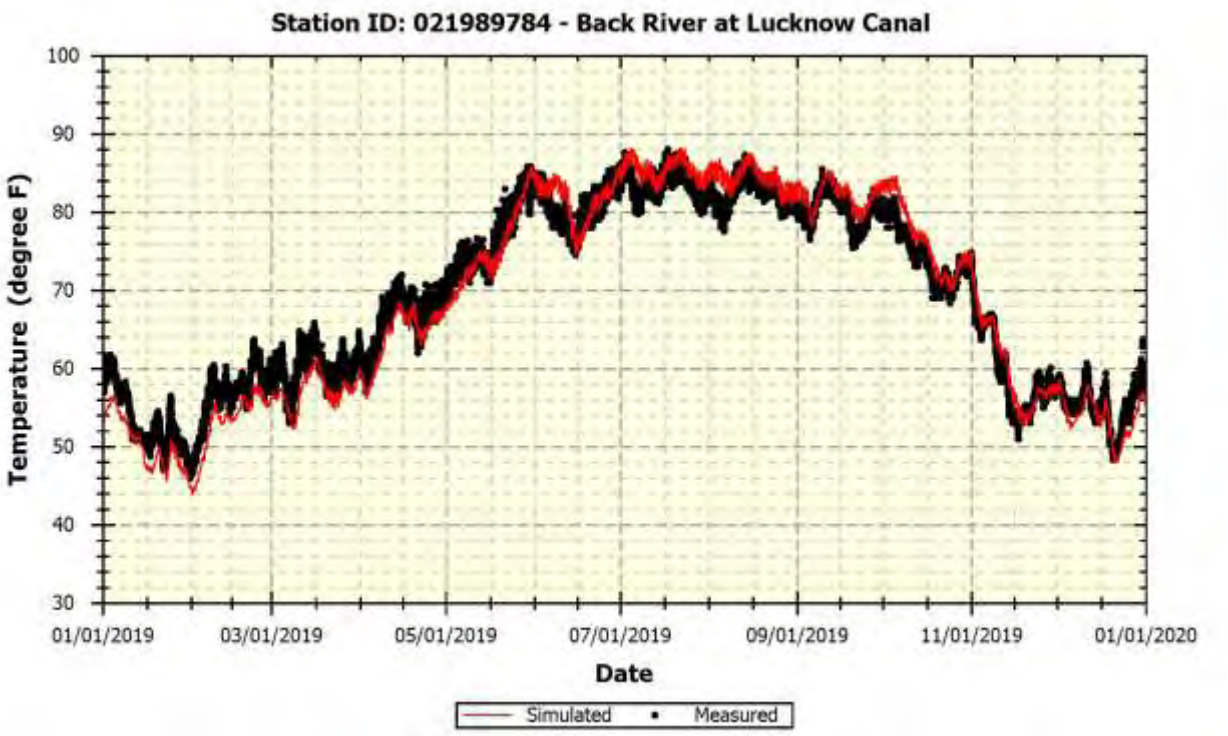

Figure C-44. Simulated vs measured temperature at station 02198979784 – Back River at Lucknow Canal.

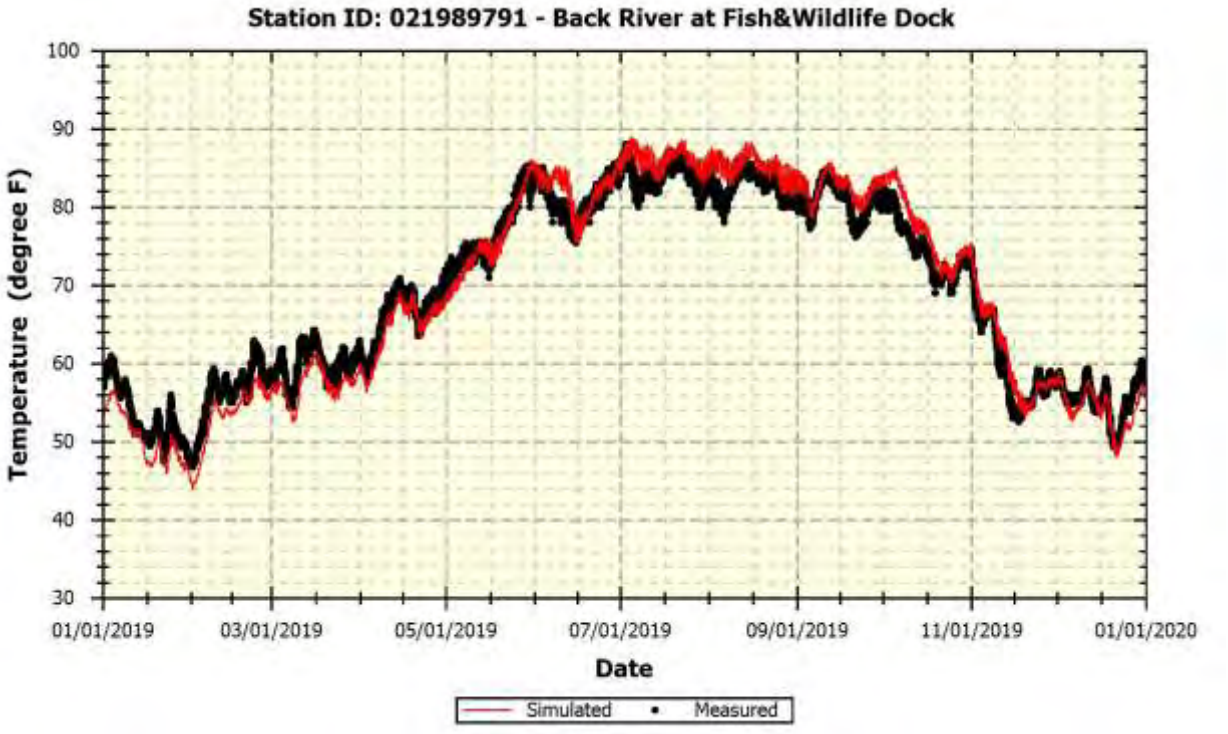

Figure C-45. Simulated vs measured temperature at station 021989791 – Back River at Fish&Wildlife Dock.

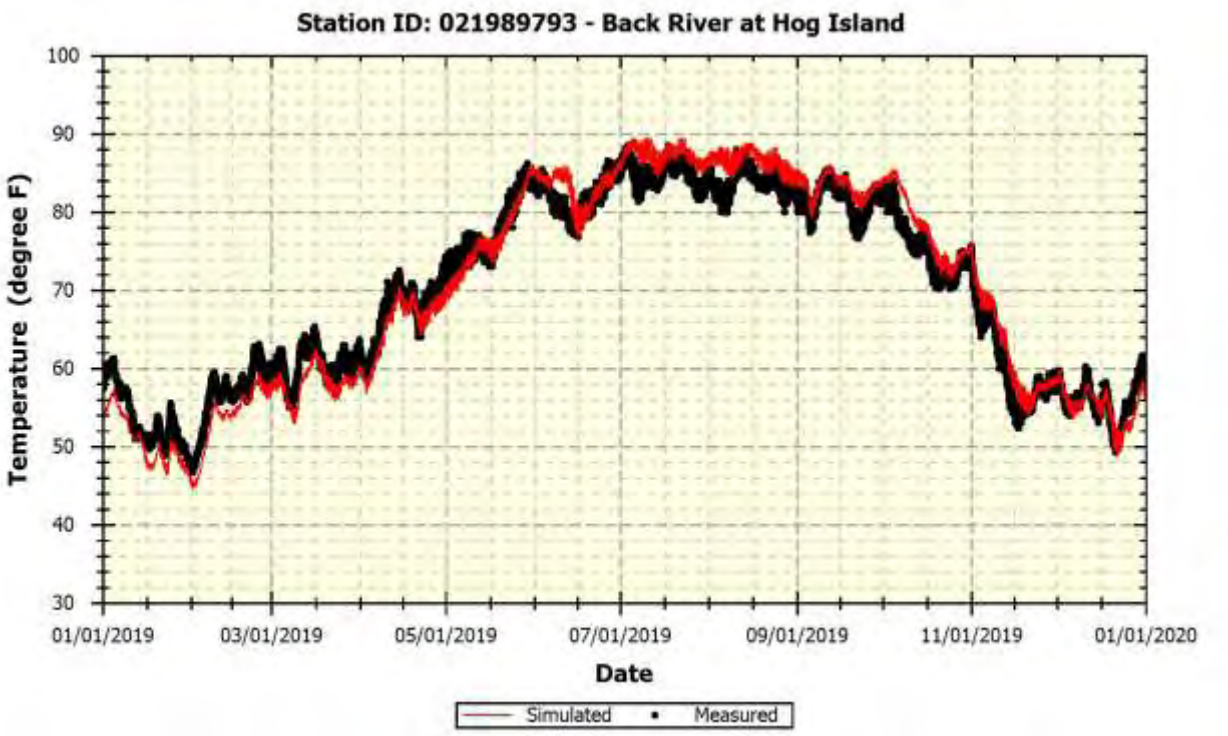

Figure C-46. Simulated vs measured temperature at station 021989793 – Back River at Hog Island.

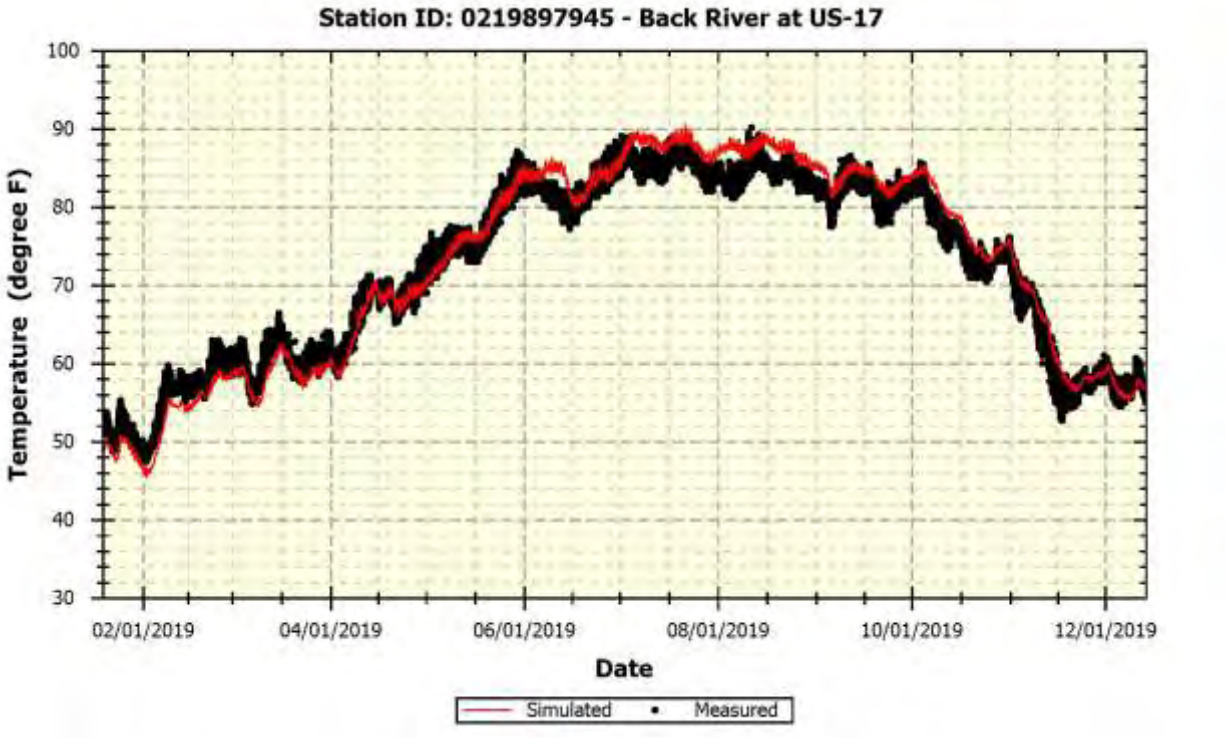

Figure C-47. Simulated vs measured temperature at station 0219897945 – Back River at US-17.

ATTACHMENT C – WATER QUALITY CALIBRATION – FIGURES AND STATISTIC TABLES

D-1. Dissolved Oxygen

Table D-1. Dissolved Oxygen Statistics (01/01/2019 – 01/01/2020) (mg/L)

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 0219897993; Sav River Elba Is.		Station: 021989773; USACE Dock		Station: 021989715; Garden City (surf)		Station: 021989715; Garden City (bottom)	
Mean:	5.9	6.1	5.4	5.5	5.5	6.6	5.2	5.2
Median:	6.2	6.5	6.0	6.1	6.0	7.2	6.0	5.8
Std Dev:	1.8	2.0	2.4	2.0	2.4	2.2	2.5	2.3
Min:	1.9	2.2	1.0	1.4	0.8	1.0	0.4	0.9
Max:	9.9	10.6	10.8	10.7	11.0	11.1	10.8	10.6
5 %tile:	3.4	3.3	2.1	2.5	2.0	3.3	1.7	2.0
10 %tile:	3.7	3.6	2.5	3.0	2.4	3.7	2.0	2.4
90 %tile:	8.2	8.7	8.5	8.0	8.7	9.3	8.4	8.2
95 %tile:	8.9	9.2	9.4	8.5	9.6	10.0	9.3	8.9
Coef of Det (R^2):	0.89		0.84		0.90		0.84	
Mean Abs Error:	0.55		0.80		1.12		0.82	
RMS Error:	0.69		0.99		1.31		1.02	
Norm RMS Error:	0.11		0.17		0.20		0.18	
Index of Agreement:	0.97		0.95		0.92		0.95	

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 02198920; Front River GA25		Station: 02198840; Savannah River I95		Station: 02198955; Middle River Fish Hole		Station: 02198950; Middle River GA25	
Mean:	6.5	6.9	7.8	8.0	5.8	6.2	6.8	7.1
Median:	7.0	7.5	7.9	8.1	6.3	6.9	7.0	7.7
Std Dev:	2.4	2.2	1.2	1.3	2.7	2.5	2.0	2.1
Min:	0.0	1.4	5.4	5.8	0.2	0.7	1.4	1.9
Max:	11.6	11.0	11.4	11.0	12.0	11.0	11.2	11.0
5 %tile:	1.9	3.2	6.3	6.4	1.2	2.2	3.1	3.8
10 %tile:	2.7	3.6	6.5	6.5	1.7	2.8	3.9	4.3
90 %tile:	9.2	9.5	9.4	9.7	9.0	9.3	9.2	9.5
95 %tile:	9.9	10.1	9.9	10.1	10.3	10.1	9.7	10.2
Coef of Det (R^2):	0.86		0.86		0.89		0.85	
Mean Abs Error:	0.73		0.39		0.76		0.68	
RMS Error:	0.94		0.50		0.98		0.85	
Norm RMS Error:	0.13		0.06		0.15		0.12	
Index of Agreement:	0.96		0.96		0.96		0.96	

Statistic	Measured	Simulated	Measured	Simulated	Measured	Simulated
	Station: 0219897945; Back River US-17		Station: 021989793; Back River Hog Island		Station: 021989792; Back River GA25	
Mean:	6.5	6.4	6.6	6.9	6.8	7.4
Median:	7.0	7.1	7.1	7.7	7.2	7.9
Std Dev:	2.0	2.4	1.8	2.3	1.7	1.9
Min:	1.2	1.6	1.2	1.7	3.3	3.0
Max:	11.4	11.2	11.4	11.1	10.7	11.1
5 %tile:	3.4	3.0	4.0	3.3	4.4	4.4
10 %tile:	3.9	3.3	4.4	3.7	4.6	4.7
90 %tile:	9.2	9.4	9.0	9.6	9.0	9.7
95 %tile:	9.6	10.0	9.5	10.3	9.6	10.2
Coef of Det (R^2):	0.79		0.77		0.81	
Mean Abs Error:	0.87		0.94		0.84	
RMS Error:	1.12		1.152		1.02	
Norm RMS Error:	0.17		0.164		0.14	
Index of Agreement:	0.93		0.92		0.92	

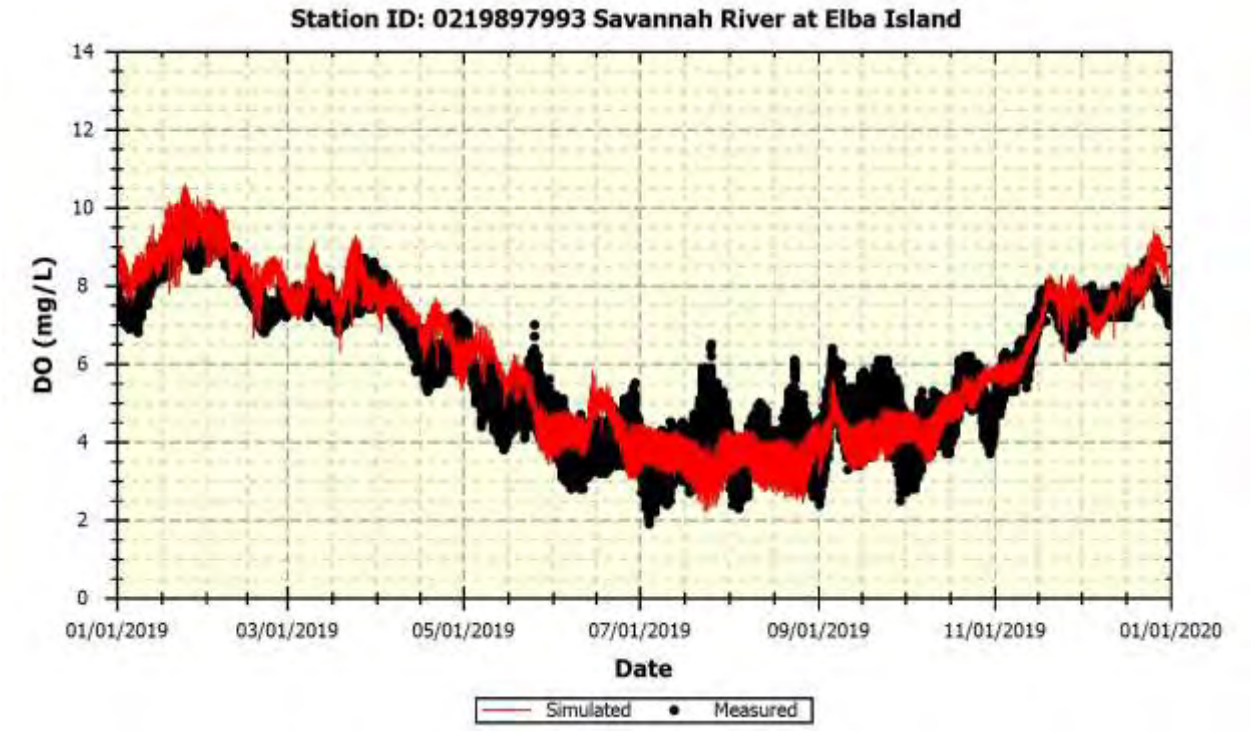

Figure D-1. Simulated vs measured dissolved oxygen at station 0219897993 – Savannah River at Elba Island.

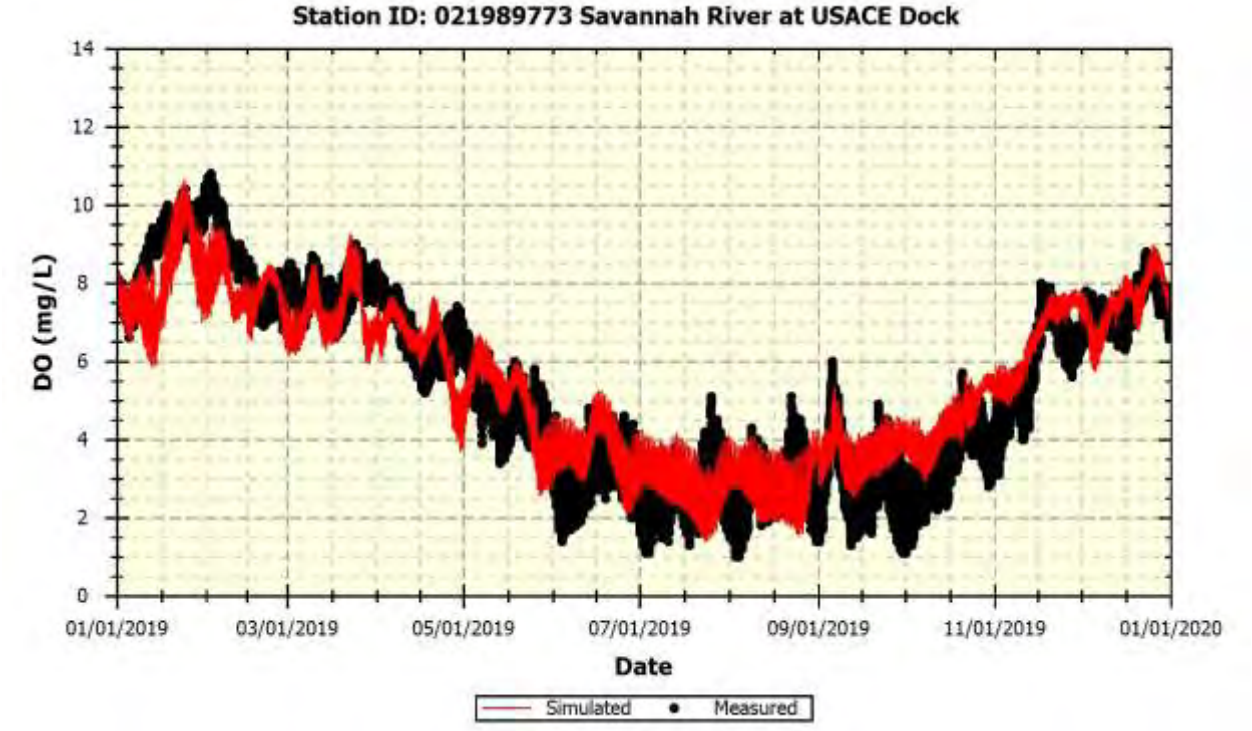

Figure D-2. Simulated vs measured dissolved oxygen at station 021989773 – Savannah River at USACE Dock.

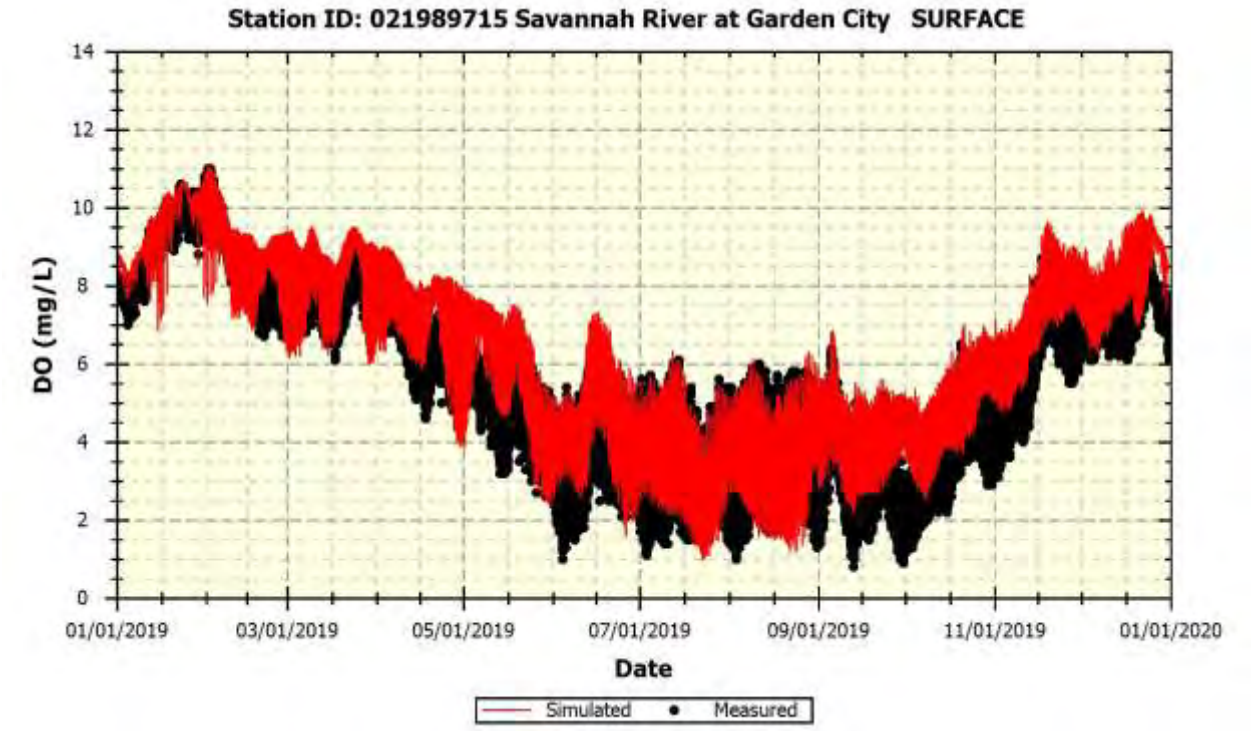

Figure D-3. Simulated vs measured surface dissolved oxygen at station 021989715 – Front River at Garden City.

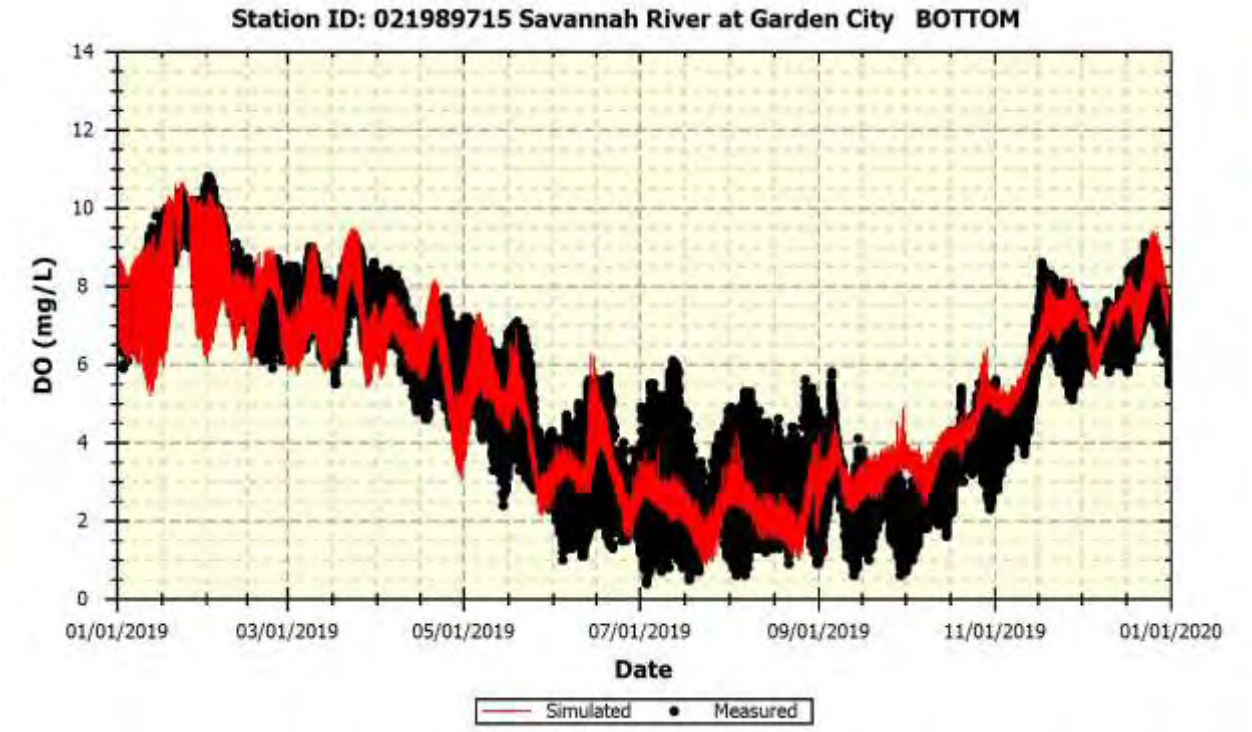

Figure D-4. Simulated vs measured bottom dissolved oxygen at station 021989715 – Front River at Garden City.

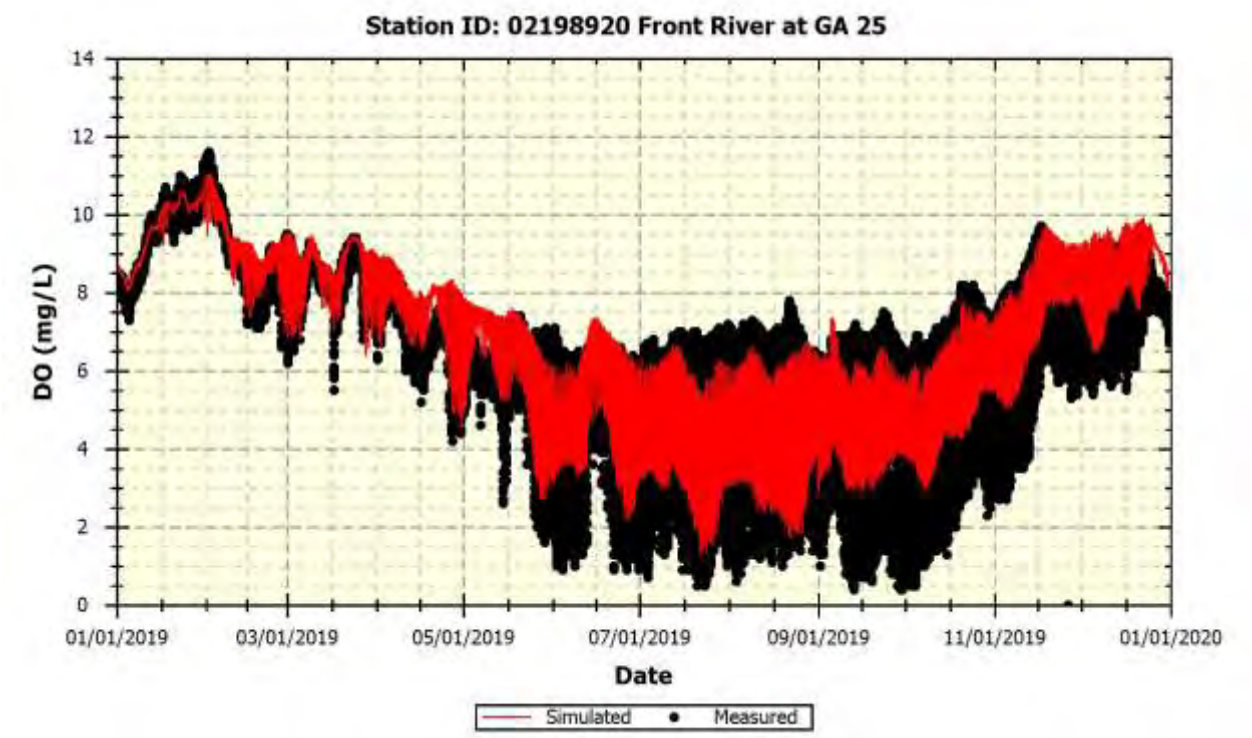

Figure D-5. Simulated vs measured dissolved oxygen at station 02198920 – Front River at GA-25.

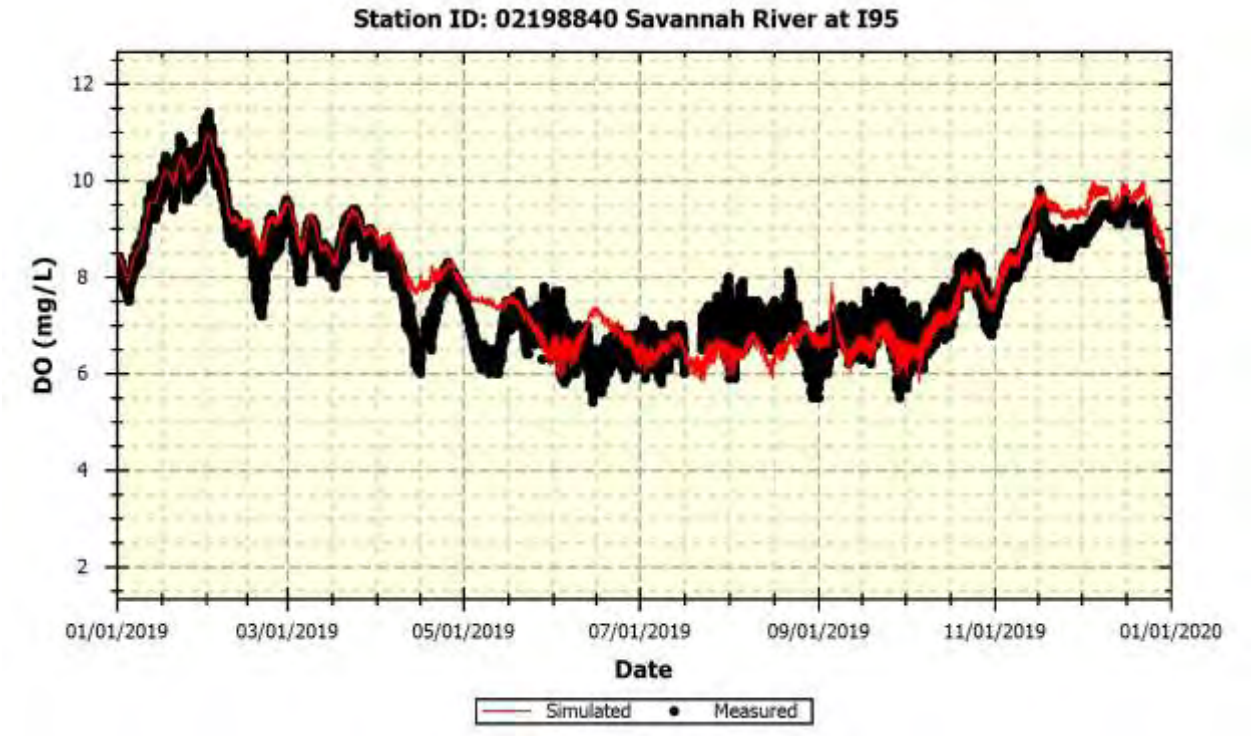

Figure D-6. Simulated vs measured dissolved oxygen at station 02198840 – Savannah River at I-95.

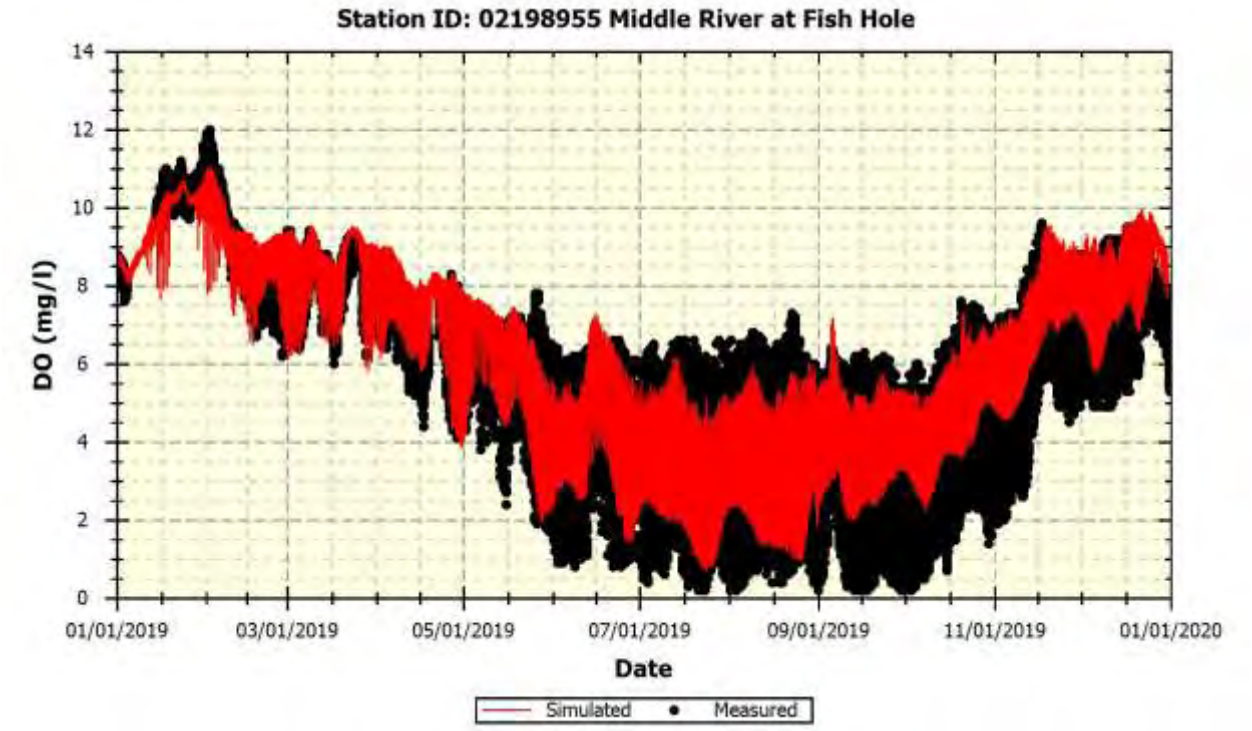

Figure D-7. Simulated vs measured dissolved oxygen at station 02198955 – Middle River at Fish Hole.

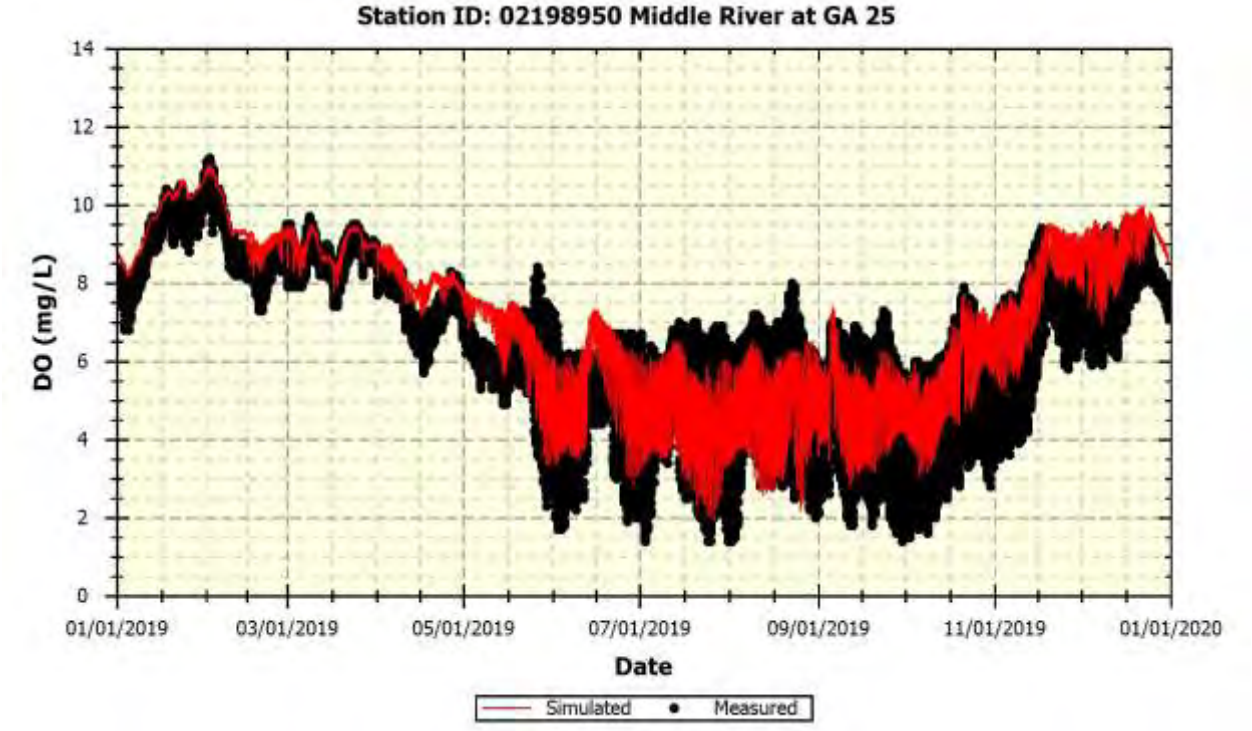

Figure D-8. Simulated vs measured dissolved oxygen at station 02198950 – Middle River at GA-25.

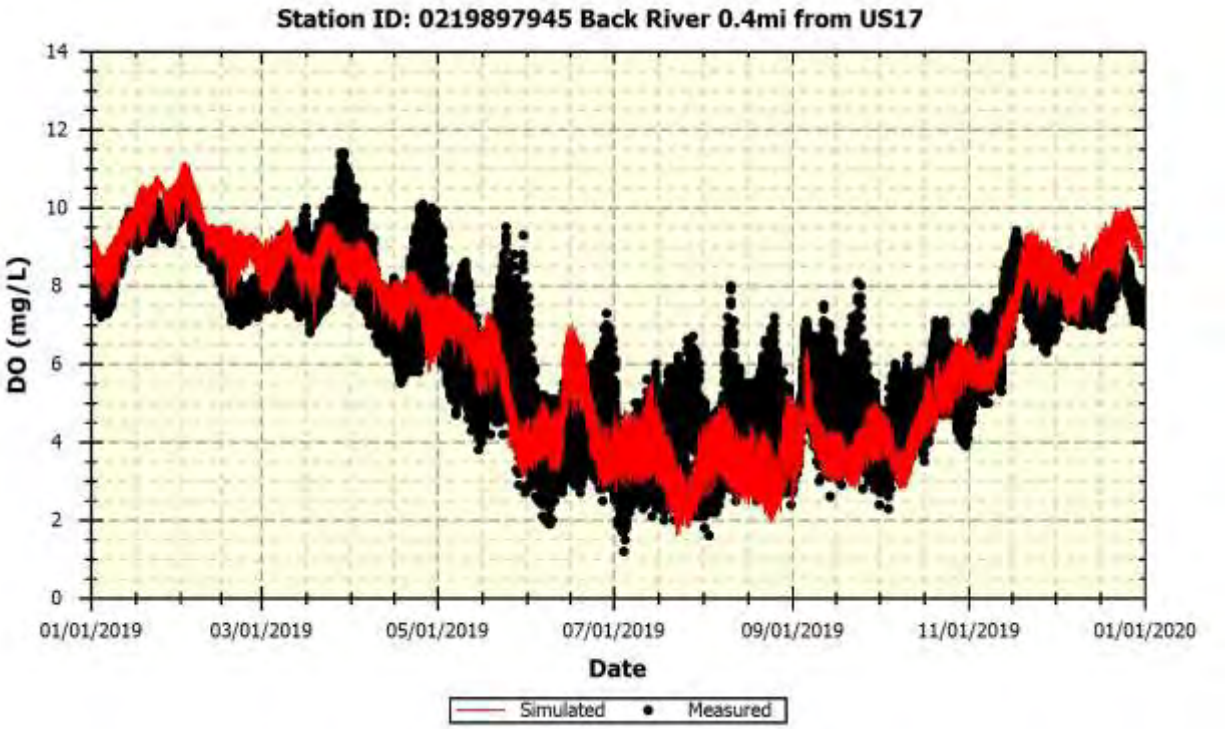

Figure D-9. Simulated vs measured dissolved oxygen at station 0219897945 – Back River at US-17.

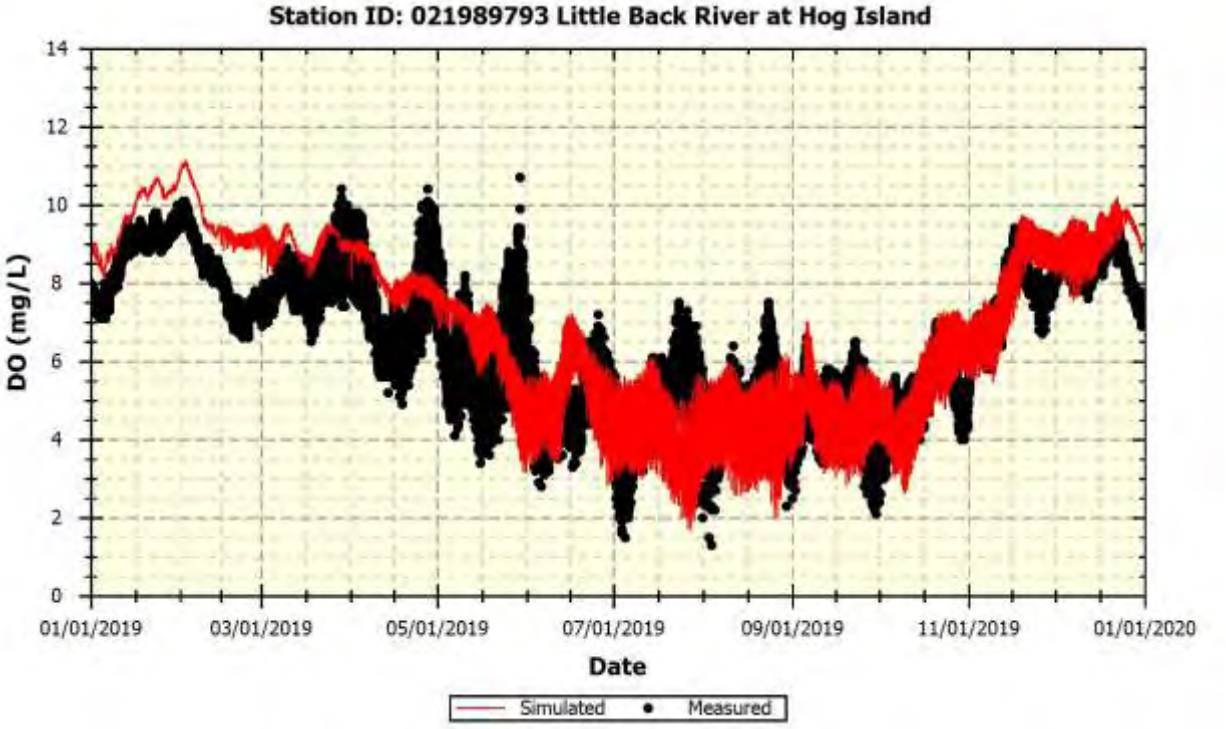

Figure D-10. Simulated vs measured dissolved oxygen at station 021989793 – Back River at Hog Island.

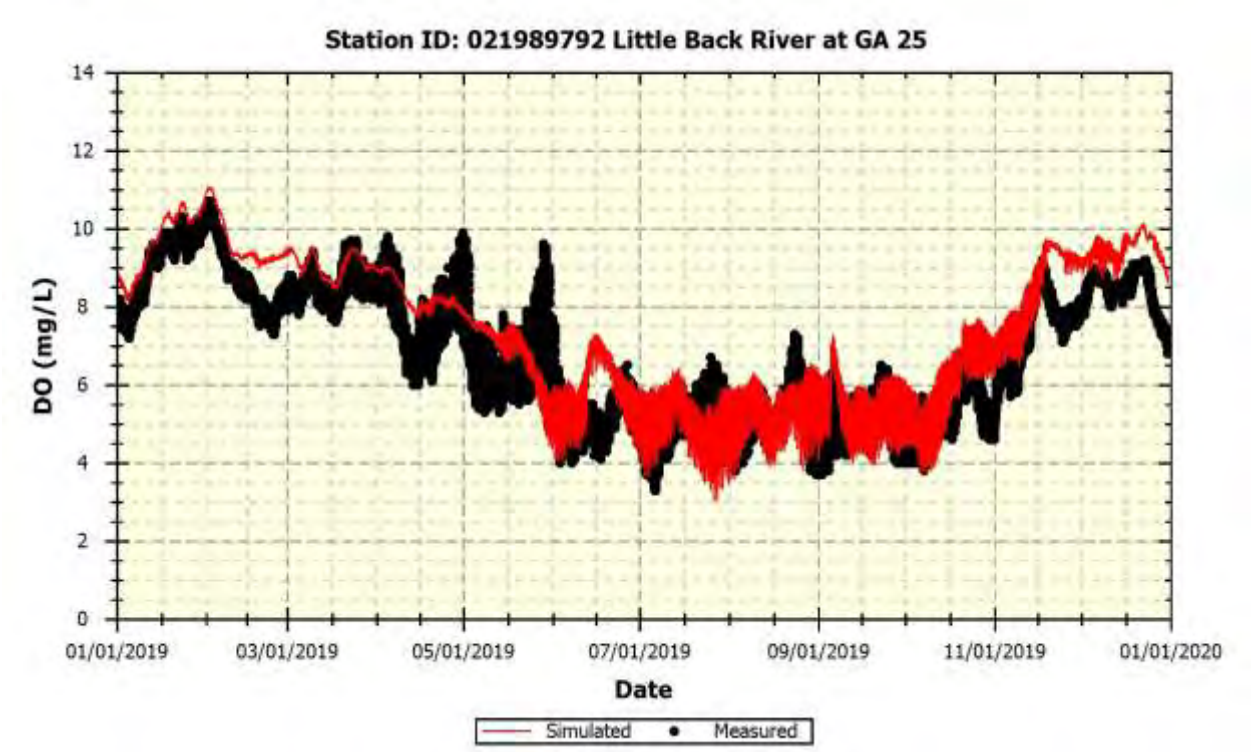

Figure D-11. Simulated vs measured dissolved oxygen at station 021989792 – Back River at GA-25.

ATTACHMENT D – STARTUP RUN MODELING OUTPUTS

The two model scenarios investigated are described in Section 11.2.1 of the main body of this report. The changes in DO in the Savannah Harbor due to the oxygen injection system were evaluated throughout the Savannah River, Front River, Middle River, and Back River by comparing these two model scenarios. This comparison was undertaken for the bottom half of the water column, presented in Section 11.3 of the main report, to verify the success metric that the DO mitigation has to be effective in 97 percent of the volume in the bottom half of the water column. The comparison was also undertaken for the whole water column, presented below, to evaluate the global improvements to the system generated by the oxygen injection system.

For the Savannah and Front Rivers, the water column DO deltas are higher than the bottom half of the water column except in the immediate area to the Upriver diffusers, where the values are higher at the bottom (zone UR), due to the diffuser injection being at the bottom, and the fact that vertical mixing does not occur immediately. For the Back and Middle Rivers, the DO delta values are comparable since they are well mixed and generally do not stratify as is the case for the Front River. All three scenarios for the entire water column show this same trend. Similar to the analysis for the bottom half of the water column, the lowest deltas are at zones FR01 and Sch01 due to influence of the open ocean, although all values are always positive indicating the injected oxygen is dispersed throughout the system.

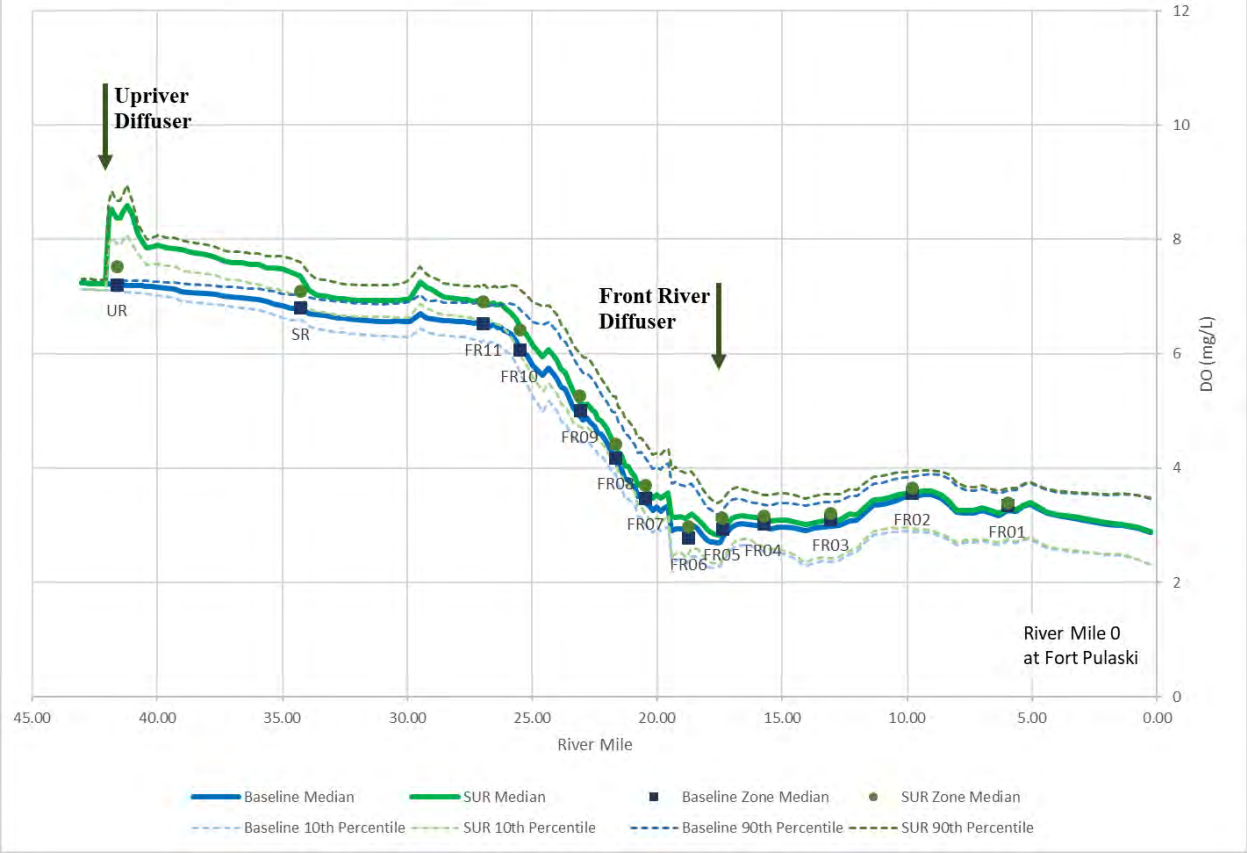

Figure 1 Savannah River Longitudinal Profile of DO – SUR Scenario (whole water column)

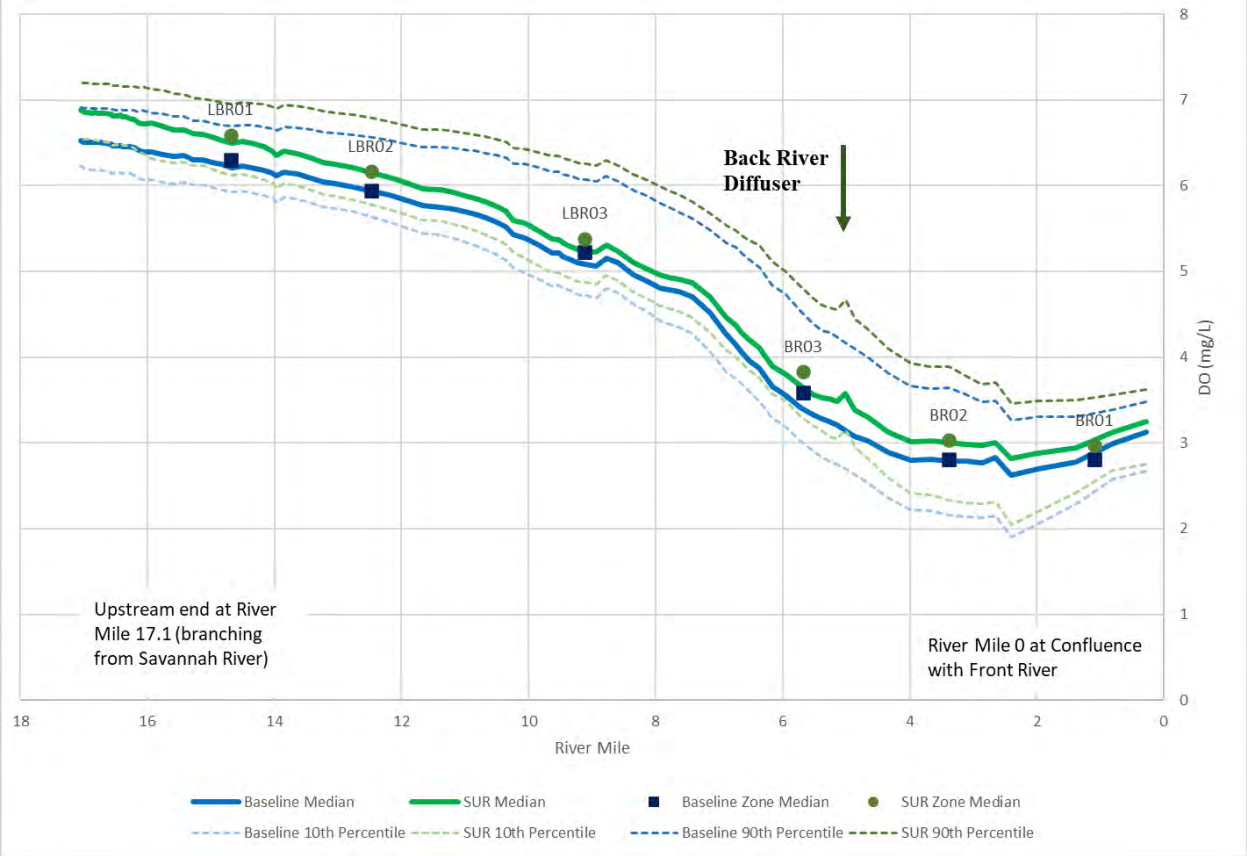

Figure 2 Back River Longitudinal Profile of DO – SUR Scenario (whole water column)

Table 1 Maximum DO Deltas for Longitudinal Profiles – SUR Scenario (whole water column)

Location	Bottom Layer DO Maximum Delta (mg/L)		
	10th Percentile	Median	90th Percentile
Savannah River	0.92	1.40	1.85
Front River	0.25	0.38	0.45
Middle River	0.21	0.33	0.38
Back River	0.34	0.45	0.55

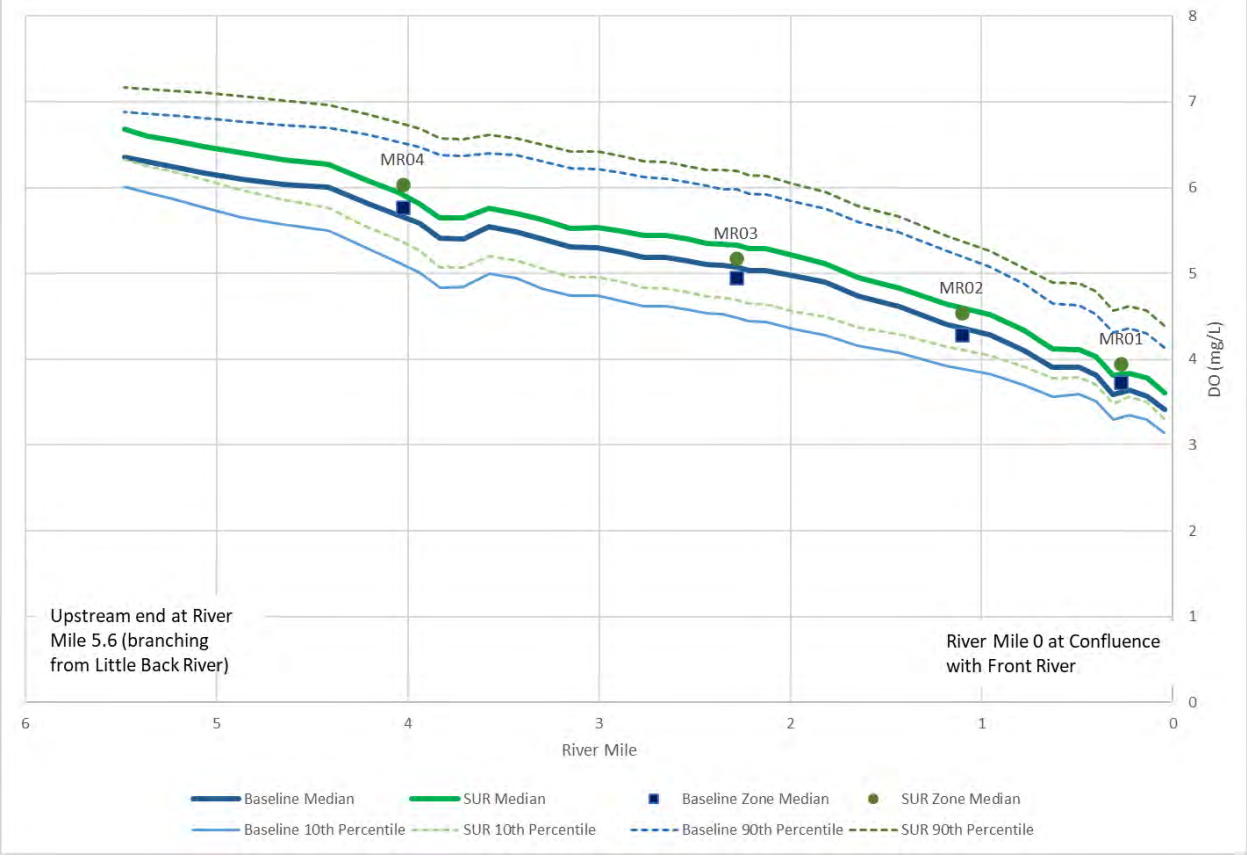

Figure 3 Middle River Longitudinal Profile of DO – SUR Scenario (whole water column)

Table 2 DO Deltas by Zone for SUR Scenario – Whole Water Column

Water Column Dissolved Oxygen for 2020 (mg/L)									
Zone Name	Baseline			SUR			Delta		
	10th Percentile	Median	90th Percentile	10th Percentile	Median	90th Percentile	10th Percentile	Median	90th Percentile
FR01	2.80	3.35	3.73	2.82	3.39	3.76	0.02	0.03	0.04
FR02	3.08	3.57	3.90	3.15	3.65	4.00	0.06	0.08	0.10
FR03	2.56	3.11	3.52	2.63	3.21	3.65	0.08	0.10	0.13
FR04	2.61	3.03	3.42	2.71	3.16	3.59	0.11	0.14	0.17
FR05	2.57	2.94	3.44	2.69	3.13	3.66	0.14	0.18	0.21
FR06	2.31	2.79	3.52	2.42	2.98	3.76	0.14	0.19	0.23
FR07	**3.14**	**3.48**	**4.22**	**3.32**	**3.70**	**4.47**	**0.16**	**0.23**	**0.27**
FR08	**3.84**	**4.19**	**4.91**	**4.05**	**4.41**	**5.18**	**0.17**	**0.25**	**0.29**
FR09	4.53	5.01	5.82	4.81	5.27	6.10	0.19	0.28	0.32
FR10	5.61	6.07	6.70	5.94	6.41	7.06	0.23	0.36	0.40
FR11	**6.25**	**6.53**	**6.88**	**6.62**	**6.91**	**7.18**	**0.26**	**0.38**	**0.46**
SR	6.60	6.81	7.04	6.84	7.09	7.31	0.19	0.29	0.37
UR	7.09	7.21	7.29	7.34	7.52	7.63	0.20	0.30	0.40
BR01	**2.32**	**2.80**	**3.29**	**2.42**	**2.97**	**3.47**	**0.11**	**0.15**	**0.18**
BR02	**2.11**	**2.81**	**3.58**	**2.28**	**3.03**	**3.81**	**0.17**	**0.22**	**0.25**
BR03	**3.25**	**3.58**	**4.71**	**3.54**	**3.83**	**4.99**	**0.21**	**0.26**	**0.31**
LBR03	**4.84**	**5.22**	**6.13**	**5.01**	**5.38**	**6.33**	**0.11**	**0.17**	**0.19**
LBR02	5.65	5.95	6.56	5.79	6.17	6.79	0.14	0.22	0.25
LBR01	6.01	6.30	6.77	6.21	6.59	7.03	0.18	0.29	0.32
MR01	**3.45**	**3.73**	**4.47**	**3.64**	**3.95**	**4.73**	**0.16**	**0.23**	**0.26**
MR02	3.87	4.28	5.05	4.08	4.54	5.26	0.16	0.23	0.26
MR03	4.34	4.95	5.79	4.54	5.17	5.97	0.15	0.22	0.25
MR04	5.27	5.77	6.56	5.55	6.03	6.83	0.18	0.27	0.29
MR05	**6.15**	**6.47**	**6.88**	**6.48**	**6.82**	**7.17**	**0.22**	**0.34**	**0.39**
SCh01	2.91	3.23	3.52	2.94	3.27	3.55	0.02	0.03	0.04
SCh02	3.67	3.93	4.25	3.74	4.00	4.34	0.05	0.08	0.09
StBR	4.47	4.84	5.76	4.65	5.05	5.99	0.16	0.23	0.27

Note – indicates critical DO zone

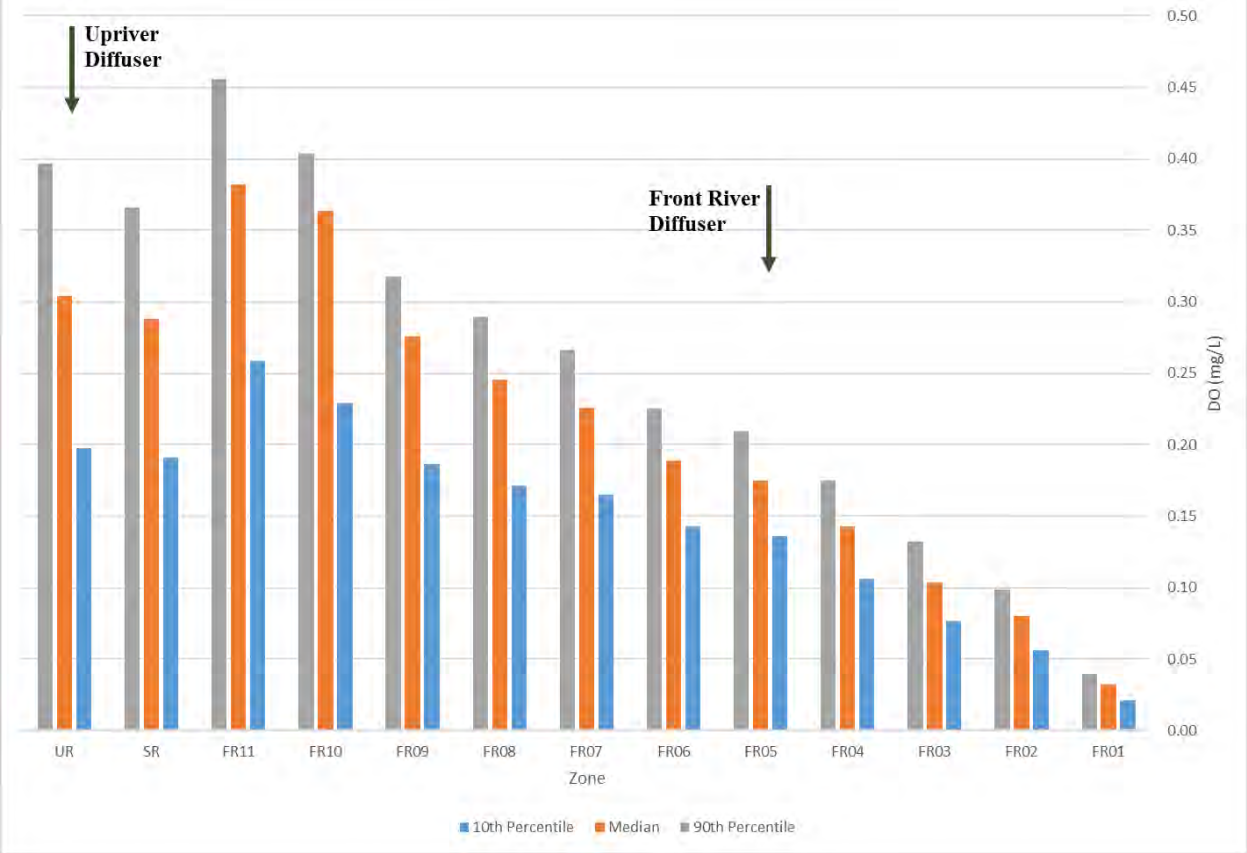

Figure 4 Savannah River Spatial Zone DO Deltas – SUR Scenario (whole water column)

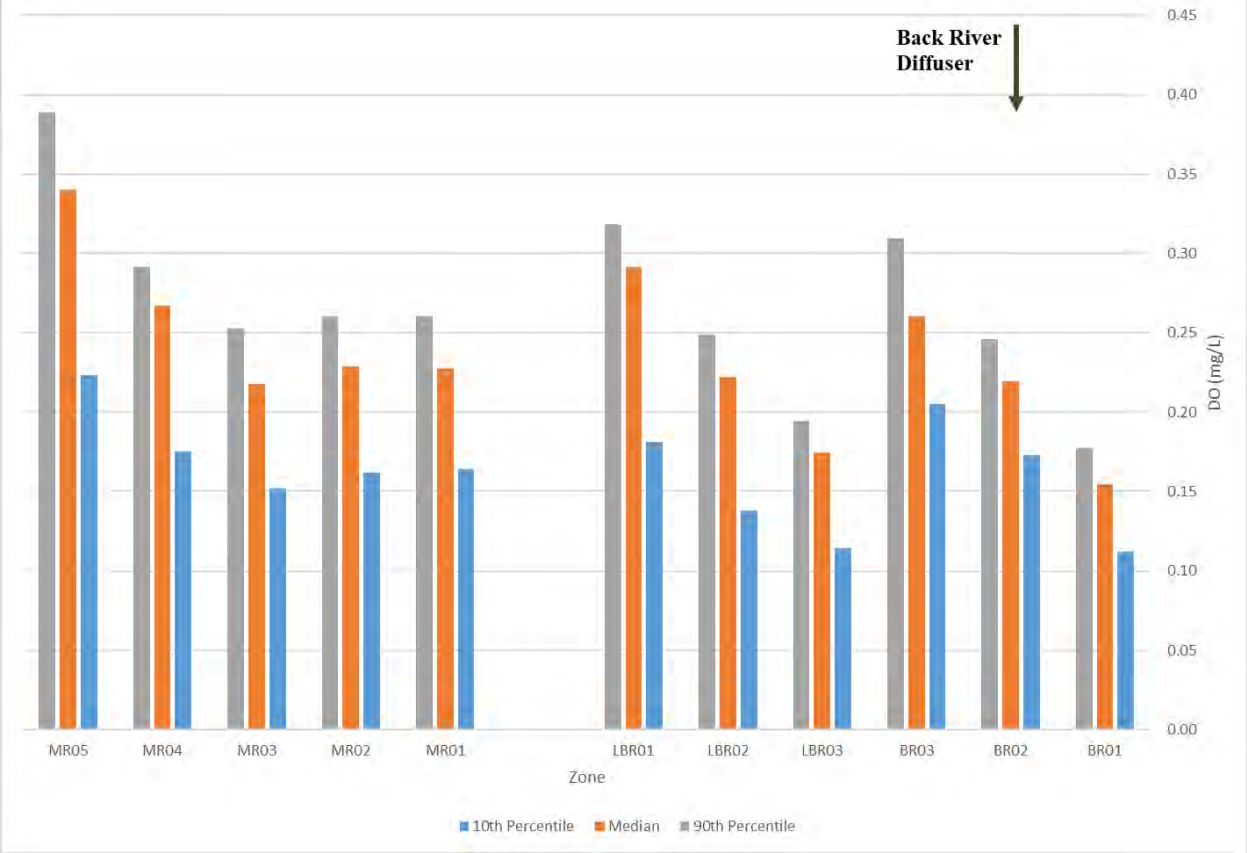

Figure 5 Middle River and Back River Spatial Zone DO Deltas – SUR Scenario (whole water column)

APPENDIX L SHEP MODEL GUIDELINE ASSESSMENT

APPENDIX L SHEP MODEL GUIDELINE ASSESSMENT

Startup Run Data Collection and Modeling Report

for the

Oxygen Injection System Environmental Testing

for the

Savannah Harbor Expansion Project

Contract# W912HN-15-D-0023
Tasks: 10
March 2022 Revision 1

PREPARED FOR

Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

PREPARED BY

LG2 Environmental Solutions, Inc.
10475 Fortune Parkway, Suite 201
Jacksonville, Florida 32256
Tel (904) 288-8631

Tetra Tech, Inc.
1899 Powers Ferry Rd SE, Suite 400
Atlanta, Georgia 30339
Tel (770) 738-6030

GHD
3075 Breckinridge Blvd, Suite 470
Duluth, Georgia 30096
Tel (770) 441-0027

APPENDIX L BACKGROUND

As part of the Savannah Harbor Expansion Project (SHEP), two dissolved oxygen (DO) injection systems were constructed on the Savannah River to offset potential decreases in DO due to navigation channel deepening. The systems, which include the two Plants generating and injecting the DO into the water column, are intended to be operated seasonally during the warmest months of the year when DO concentrations in the river are generally at their lowest. This is known as the critical period. A key requirement of the 2013 Compromise and Settlement Agreement was for a continuous 59-day test during the critical period where both Plants were operating as designed and injecting an average of 40,000 pounds per day of oxygen into the Savannah River. This test is referred to as the Startup Run (SUR). Success during the SUR was essential to ensuring permit conditions of the Compromise and Settlement Agreement were met and the SHEP proceeds as planned.

The SUR took place July 25 through September 22, 2020. In addition to the operation of the Plants, a comprehensive field monitoring effort was undertaken to measure the impact of the oxygen injection. After completion of the SUR, thorough data analysis, modeling, and interpretation was undertaken and has been documented in the SUR Report.

This document is provided as Appendix L of the SUR Report and is referred to in the main body of the report in Section 12.2.

APPENDIX L TABLE OF CONTENTS

APPENDIX L SHEP MODEL GUIDELINE ASSESSMENT L-1

L.1 Dissolved Oxygen versus Temperature Guideline Plots L-5

L.2 Dissolved Oxygen versus Flow Guideline Plots L-17

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
°C	degrees Celsius
cfs	cubic feet per second
CI	Confidence interval
DO	Dissolved oxygen
EIS	Environmental Impact Statement
GRR	General Re-Evaluation Report
GA 25	Georgia U.S. Highway 25
I-95	Interstate 95
lbs/day	pounds per day
mg/L	milligrams per liter
Plant	DO Injection System
SHEP	Savannah Harbor Expansion Project
SUR	Startup Run
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

L.1 DISSOLVED OXYGEN VERSUS TEMPERATURE GUIDELINE PLOTS

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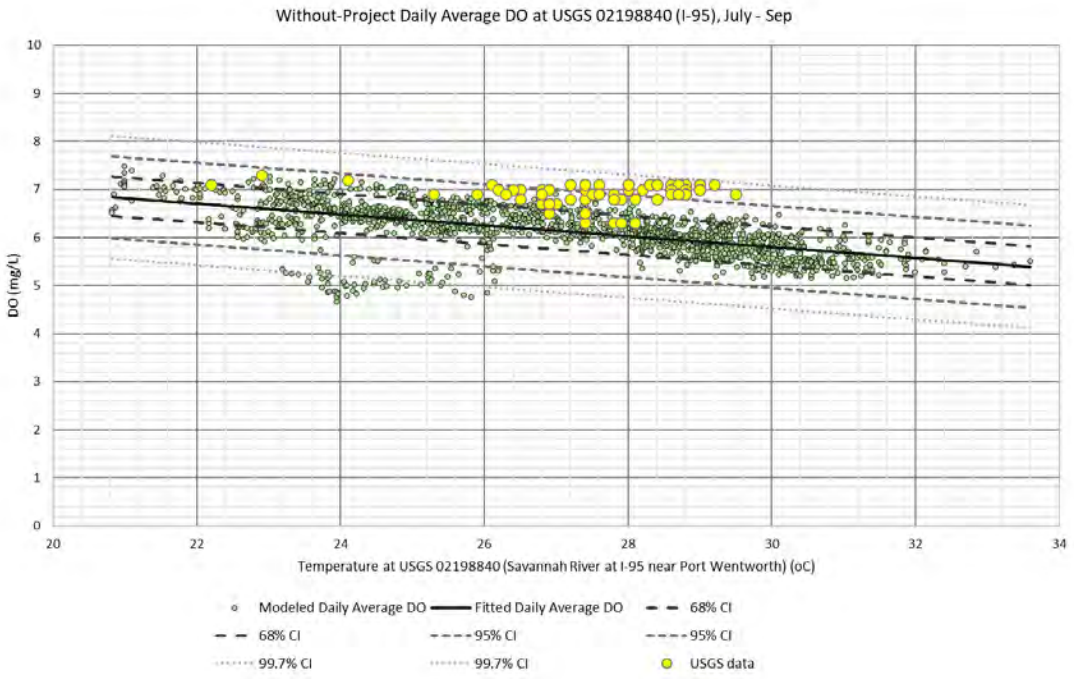
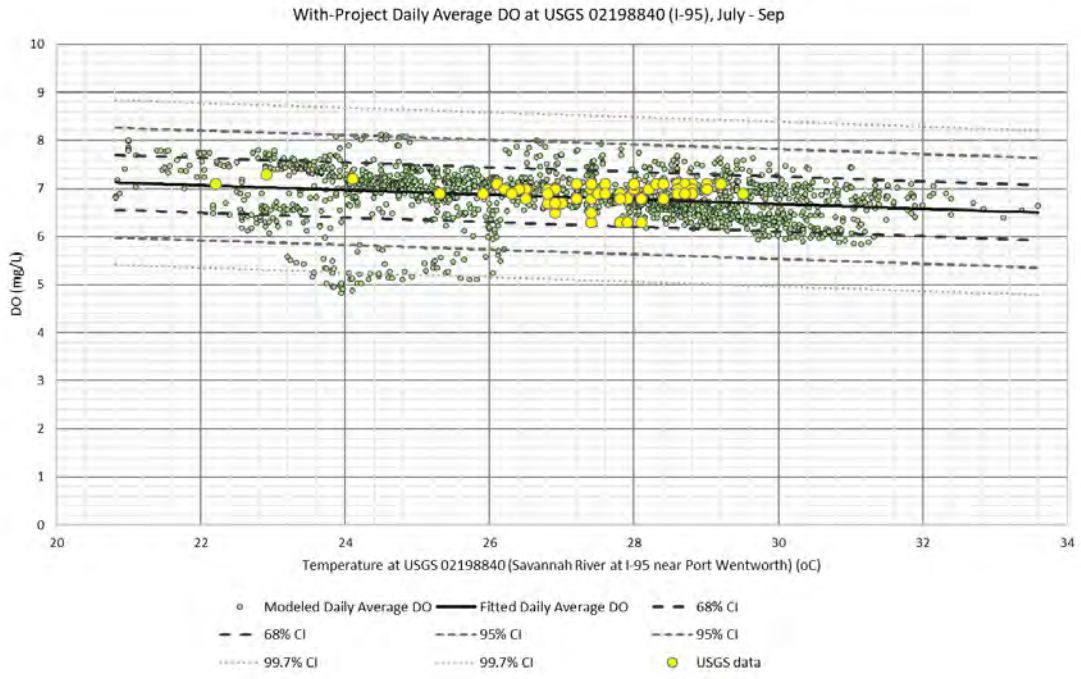
USGS 02198840 – I-95

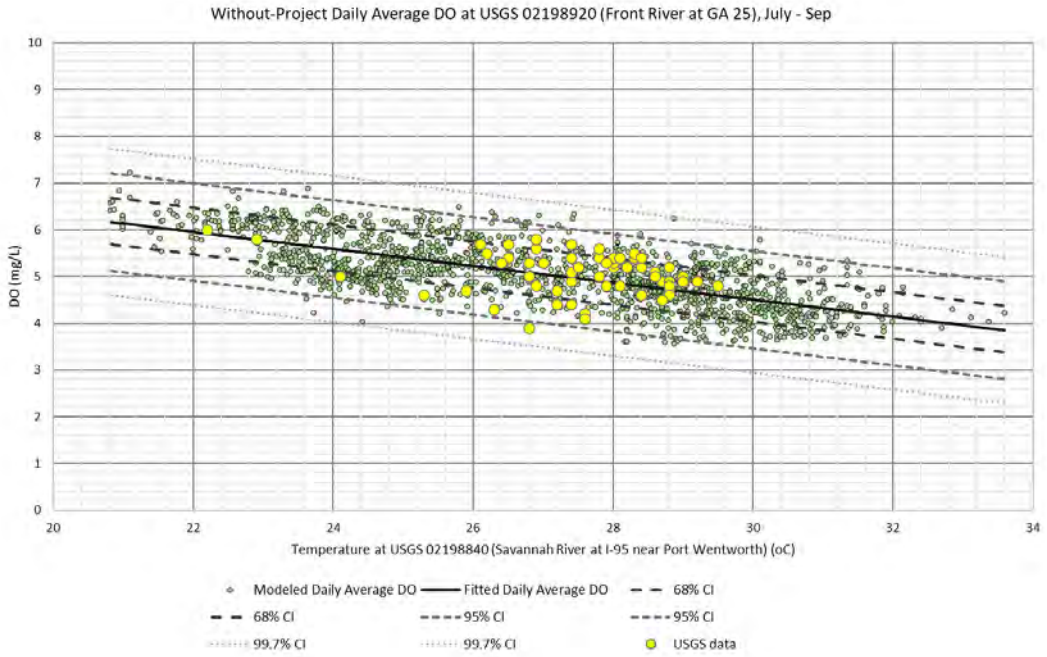
The measured USGS data outperformed the fitted average for the *without-project* scenario. This aligns with expectations given the significant oxygen load injected upstream at the Upriver oxygen plant. For the *with-project* scenario, the measured data aligns well with the guidelines with all data fitting inside one standard deviation. While not all deepening and mitigation features had been completed at time of the Startup Run, the major features that could impact DO at this station were complete and therefore the *with-project* guidelines are the most applicable for this station at the time of the Startup Run.

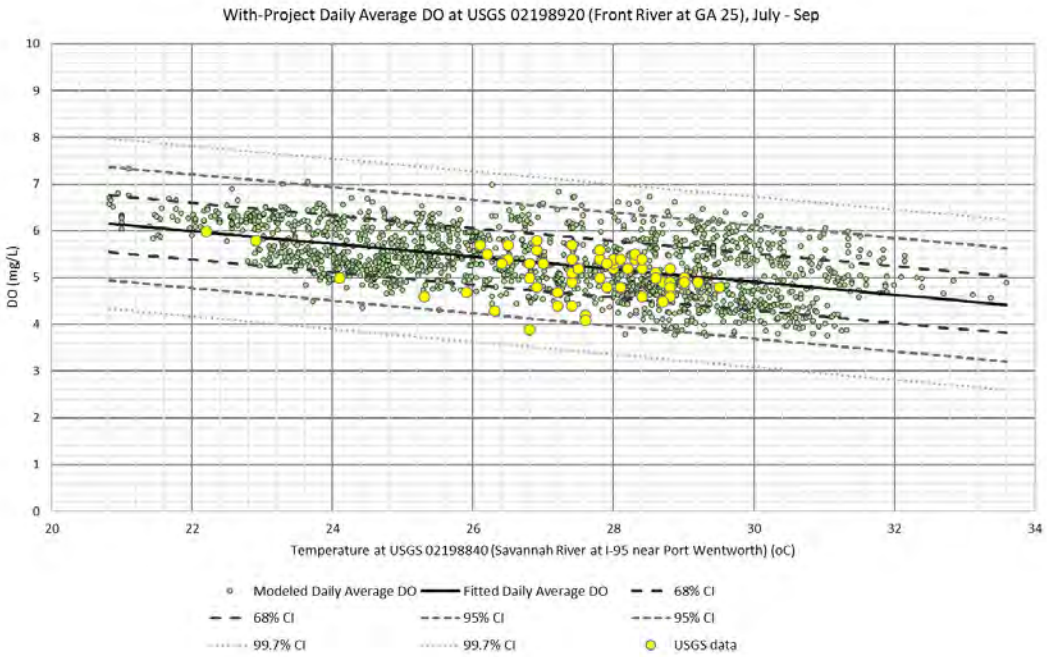




USGS 02198920 – Front River at GA 25

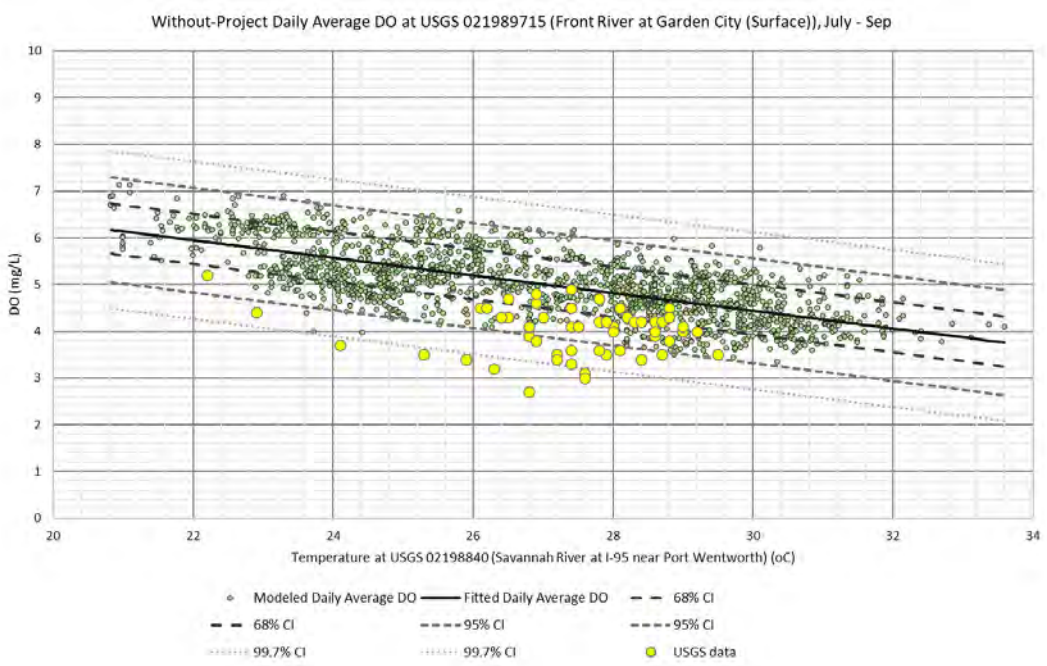
The measured data is slightly above the fitted daily average for the *without-project* scenario but still sits within the 95% confidence interval. For the *with-project* scenario, the measured data is slightly below the fitted daily average but still sits within the 95% confidence interval. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

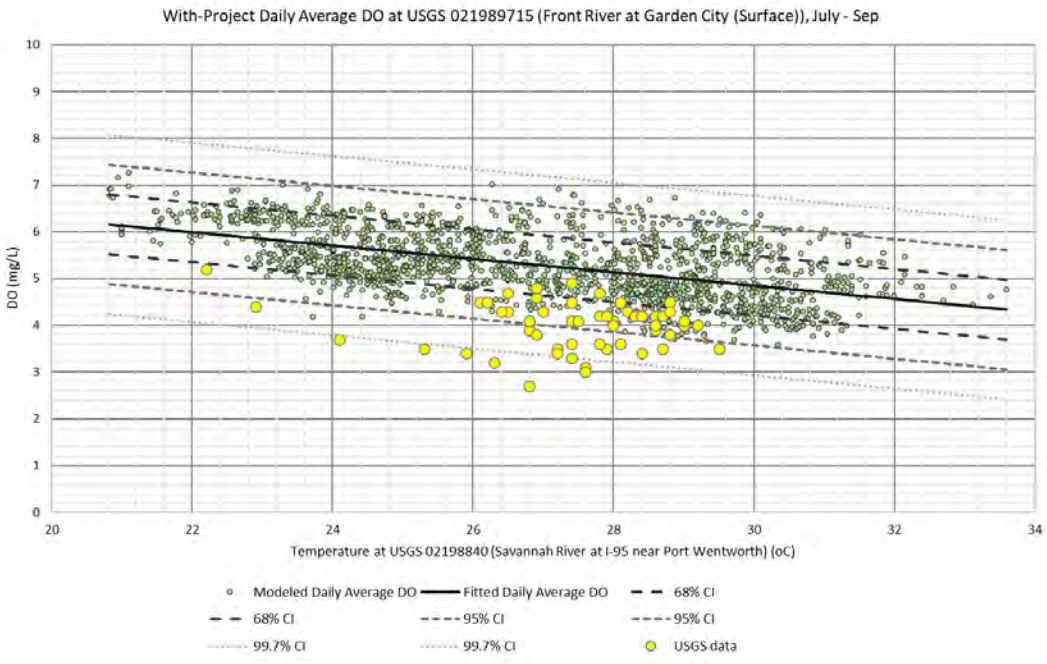




USGS 021989715 – Front River at Garden City (Surface)

The measured data underperformed the guideline curves for both the *with-project* and *without-project* scenarios. Given the success of mitigating at depth at this same location (see next page), it is expected this is a model misrepresentation with how the surface guidelines were created, rather than a cause for concern. The same result was observed for the DO vs flow guidelines at this location.

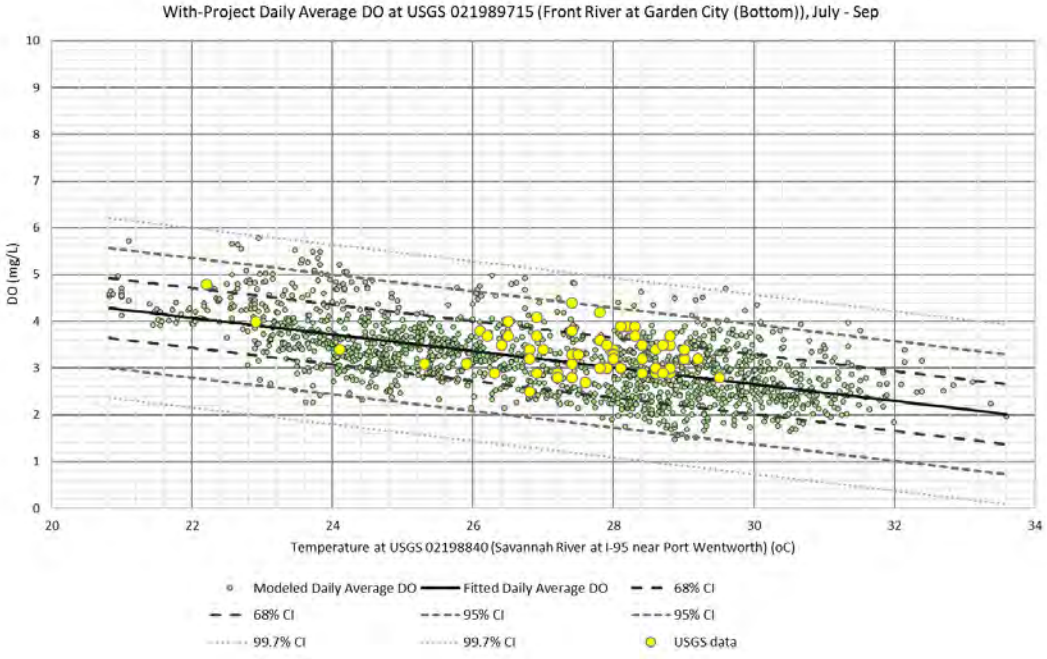




USGS 021989715 – Front River at Garden City (Bottom)

The measured data outperformed the guideline curves for both the *with-project* and *without-project* scenarios with measured data typically within one standard deviation but also above the fitted daily average. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

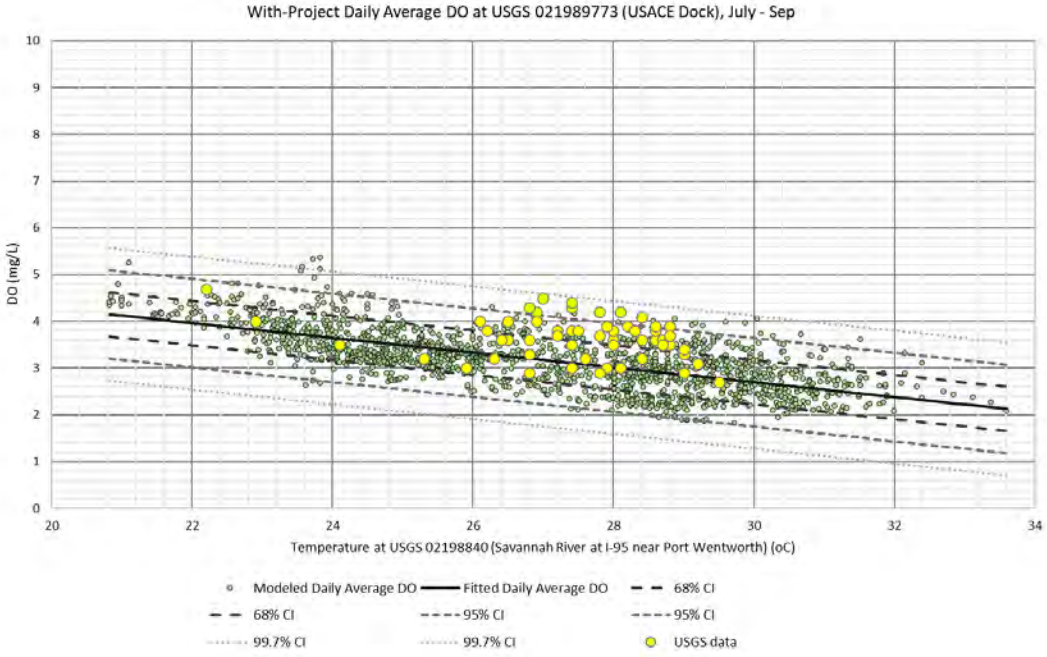




USGS 021989773 – Savannah River at USACE Dock

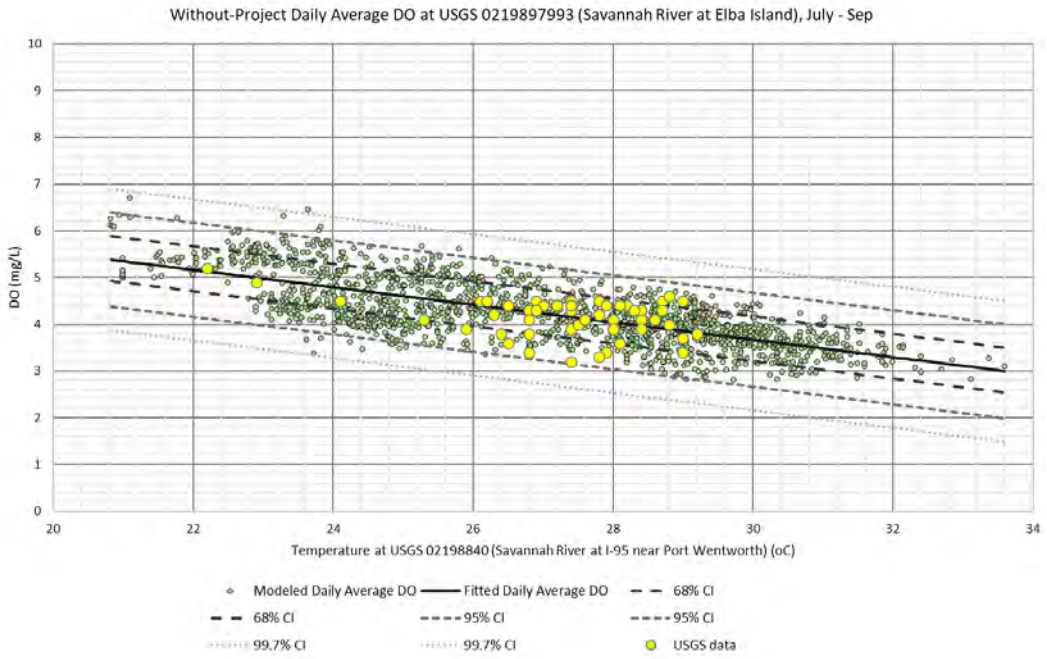
The measured data outperformed the guideline curves for both the *with-project* and *without-project* scenarios with measured data typically above the fitted daily average. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

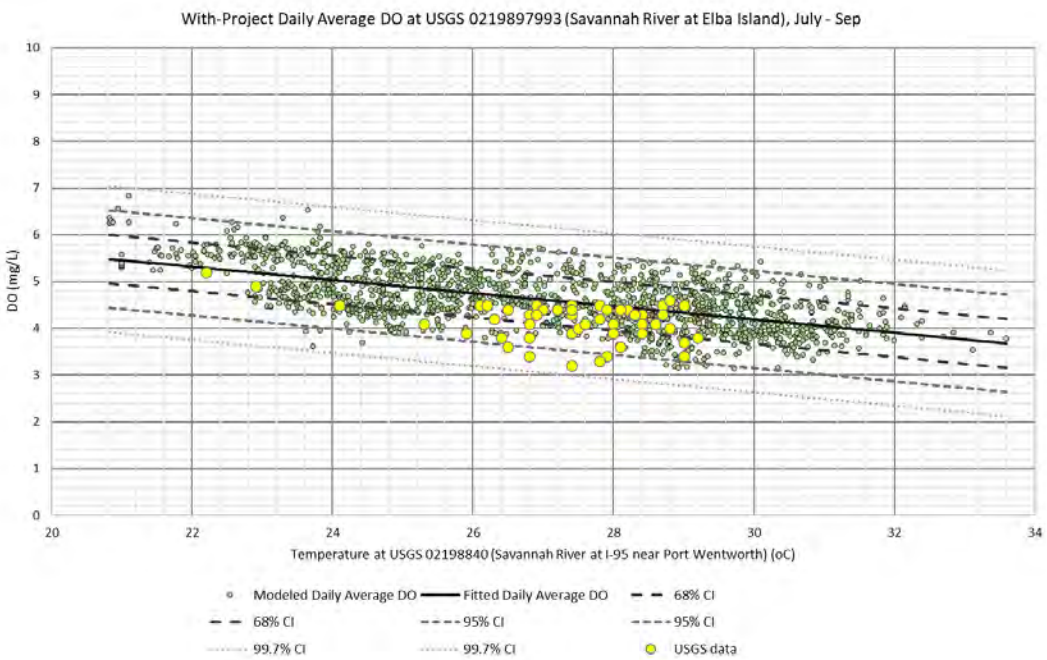




USGS 0219897993 – Savannah River at Elba Island

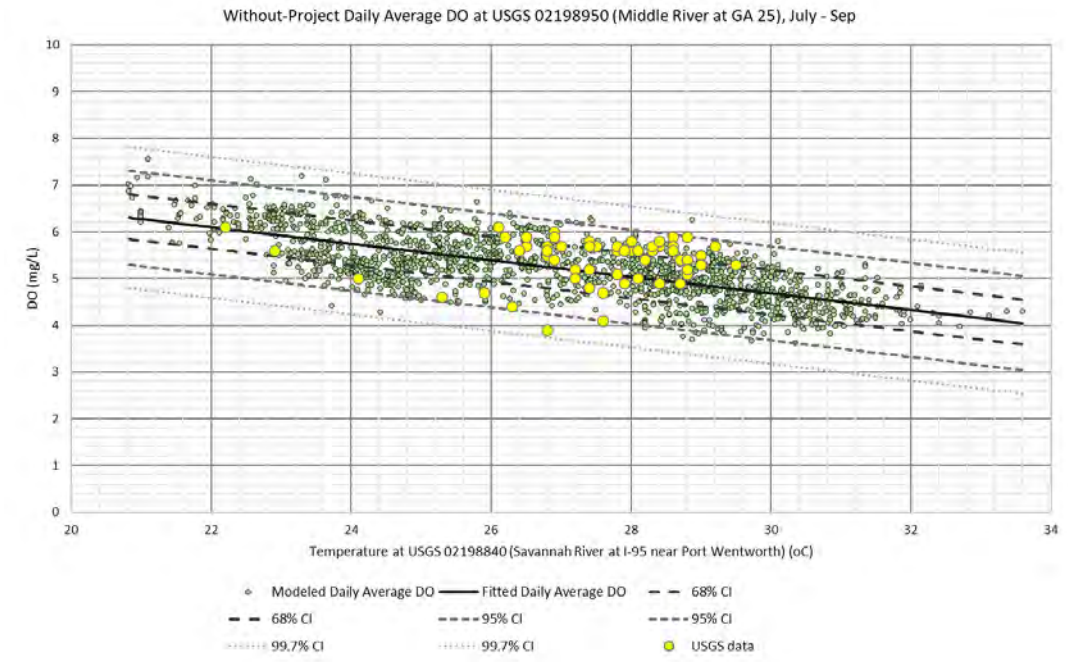
The measured data underperformed the guideline curves for both the *with-project* and *without-project* scenarios with measured data typically below the fitted daily average but also within the 95% confidence interval. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

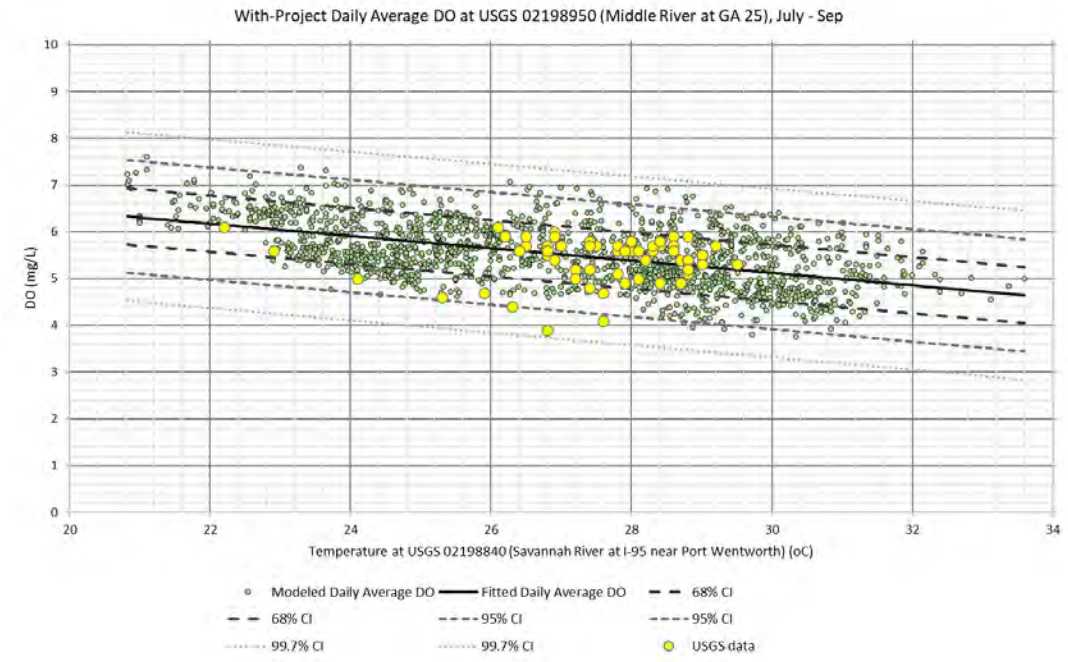




USGS 02198950 - Middle River at GA 25

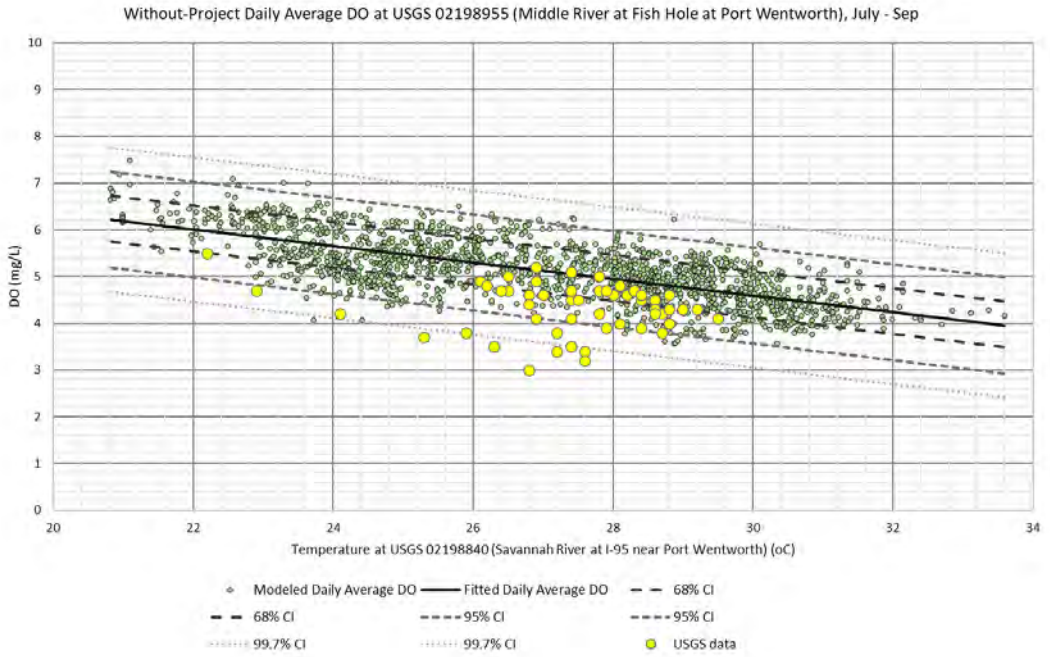
The measured data performed in accordance with the guideline curves for both the *with-project* and *without-project* scenarios with measured data balanced around the fitted daily average and typically within one standard deviation. Each scenario did have underperforming outliers, typically associated with lower temperatures. However all outlier data remained within the 99% confidence intervals. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

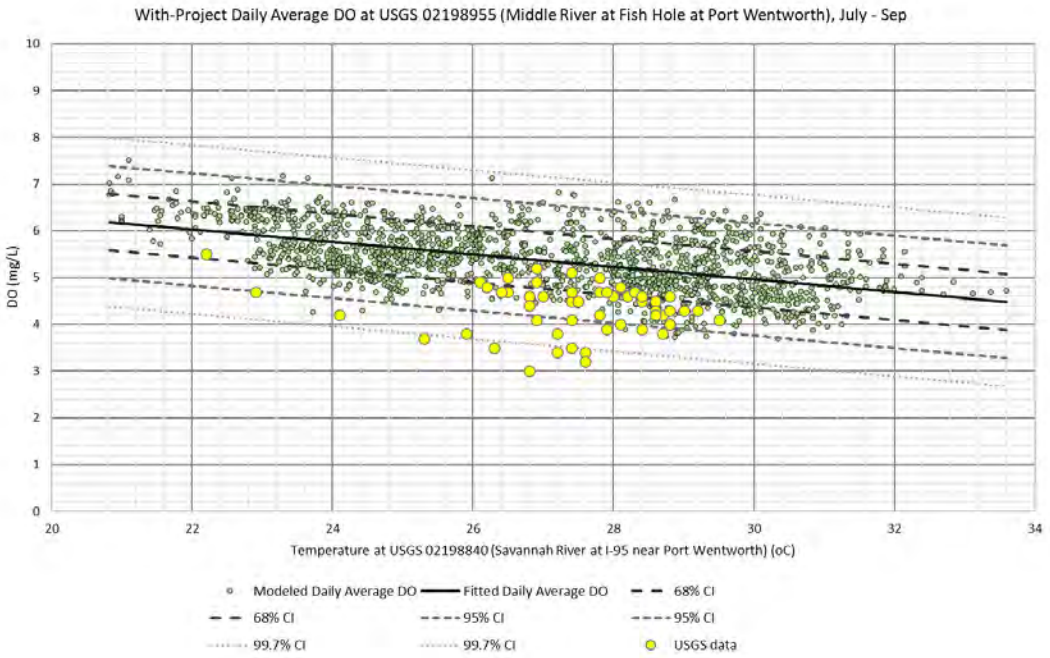




USGS 02198955 - Middle River at Fish Hole

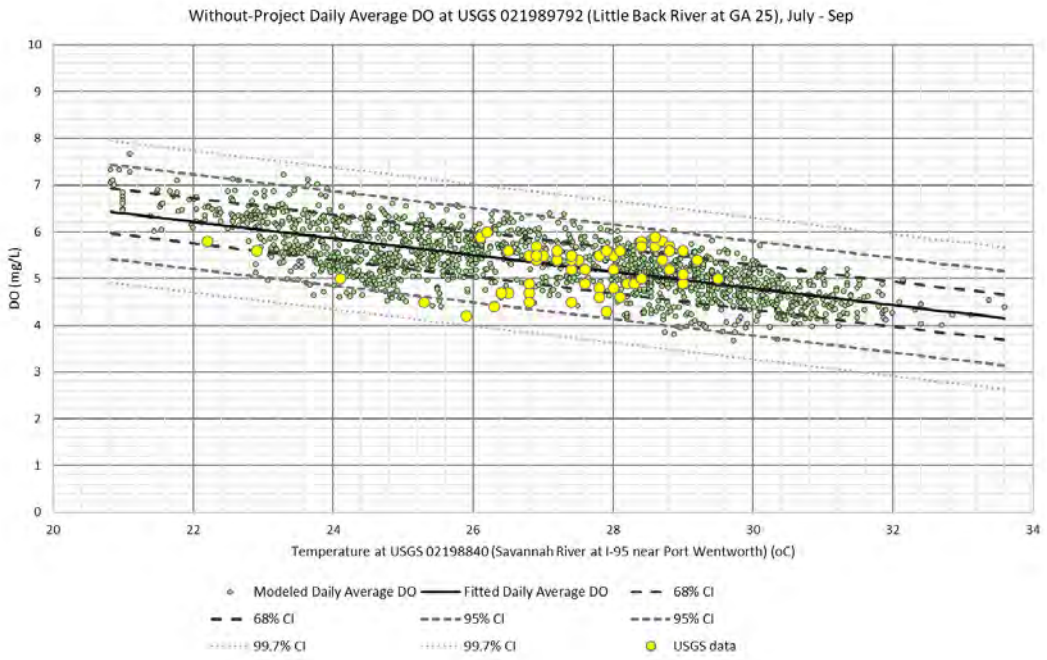
The measured data underperformed the guideline curves for both the *with-project* and *without-project* scenarios. Measured data was below the fitted daily average but also typically within one to two standard deviations. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable. It should be noted that the guidelines were developed using the 2015 SHEP. The 2020 SHEP model was updated to improve various items as referenced in the main report, including representation of freshwater flows down the Middle and Little Back Rivers.

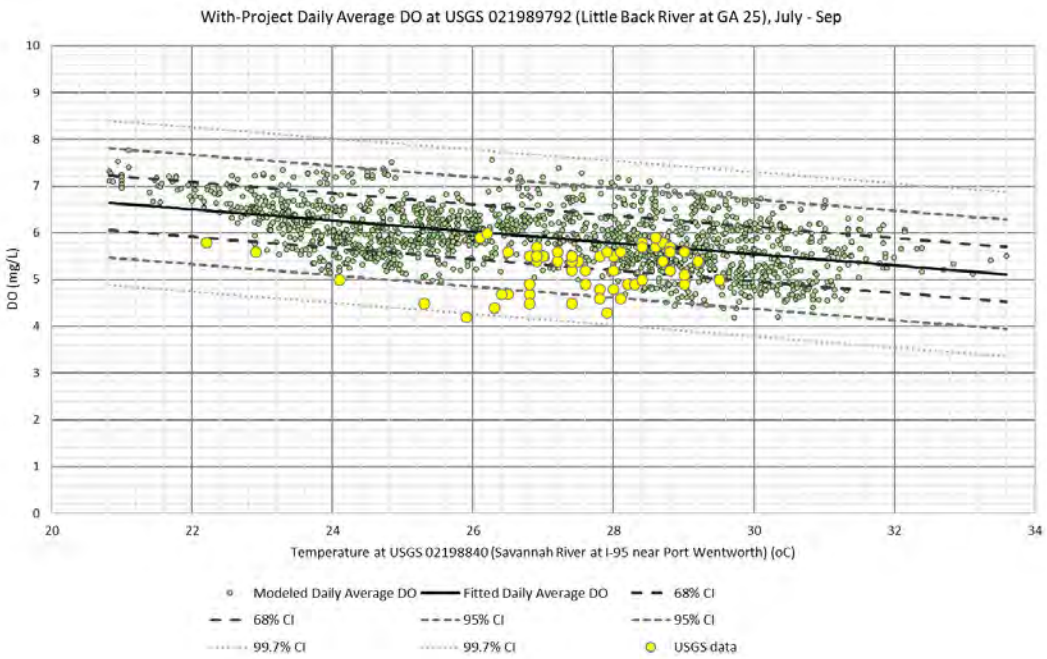




USGS 021989792 - Little Back River at GA 25

The measured data slightly outperformed the guideline curves for the *without-project* scenario and slightly underperformed the guideline curves for the *with-project* scenario. Most data were within the 95% confidence intervals. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

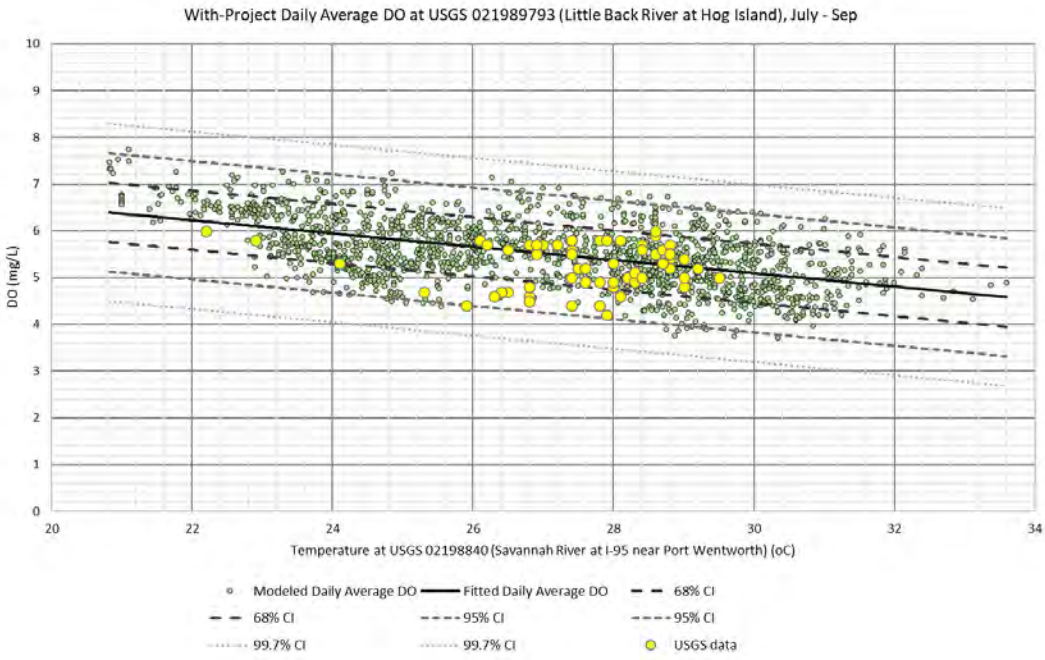




USGS 021989793 - Little Back River at Hog Island

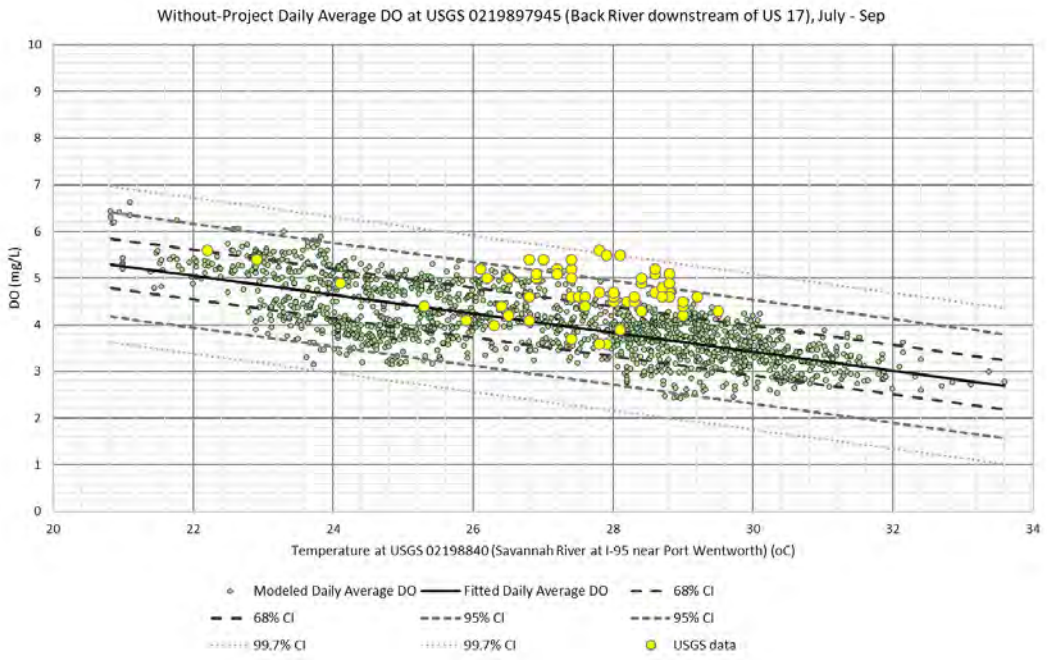
The measured data slightly outperformed the guideline curves for the *without-project* scenario and slightly underperformed the guideline curves for the *with-project* scenario. Most data were within the 95% confidence intervals. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

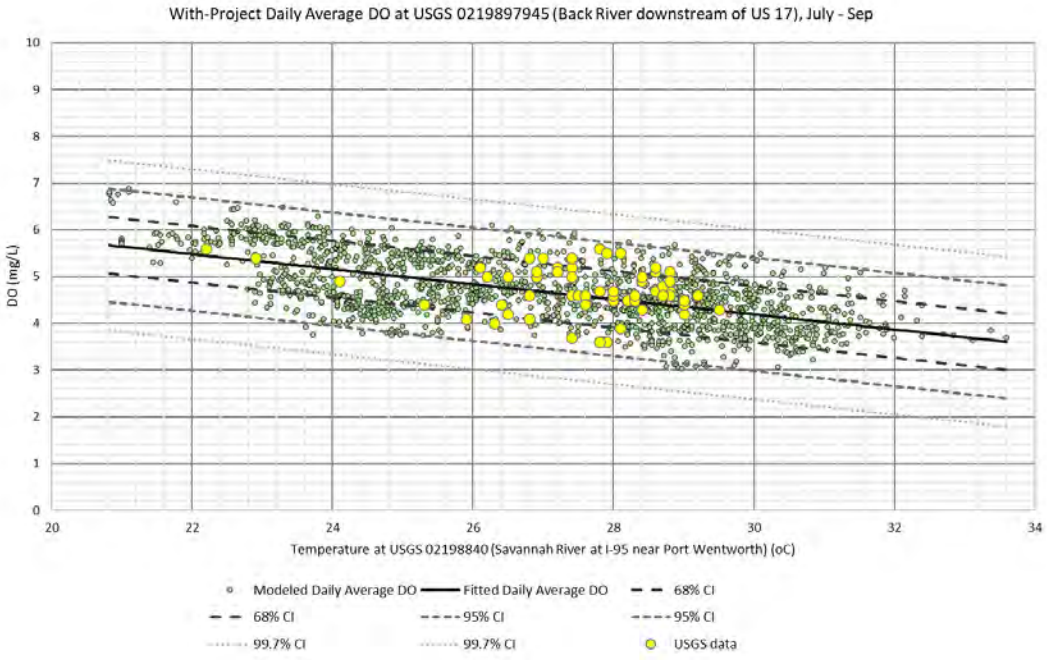




USGS 0219897945 - Back River downstream of US 17

The measured USGS data outperformed the *without-project* guidelines with almost all data above the fitted daily average. For the *with-project* scenario, the measured data performed in accordance with the guidelines with data split around the fitted daily average and well within the 95% confidence interval. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.





L.2 DISSOLVED OXYGEN VERSUS FLOW GUIDELINE PLOTS

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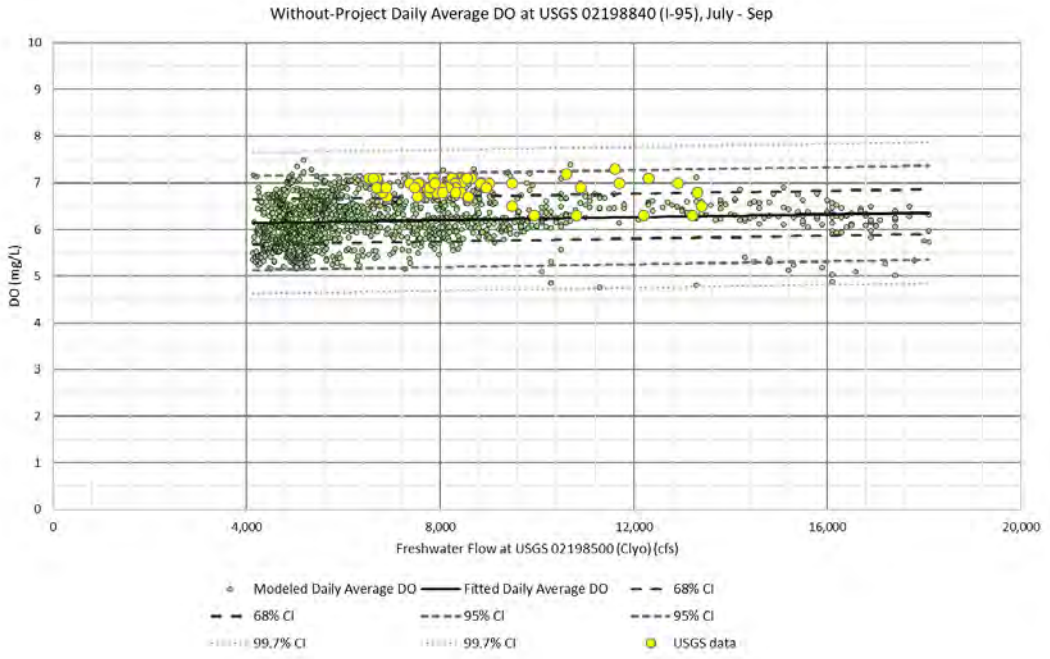
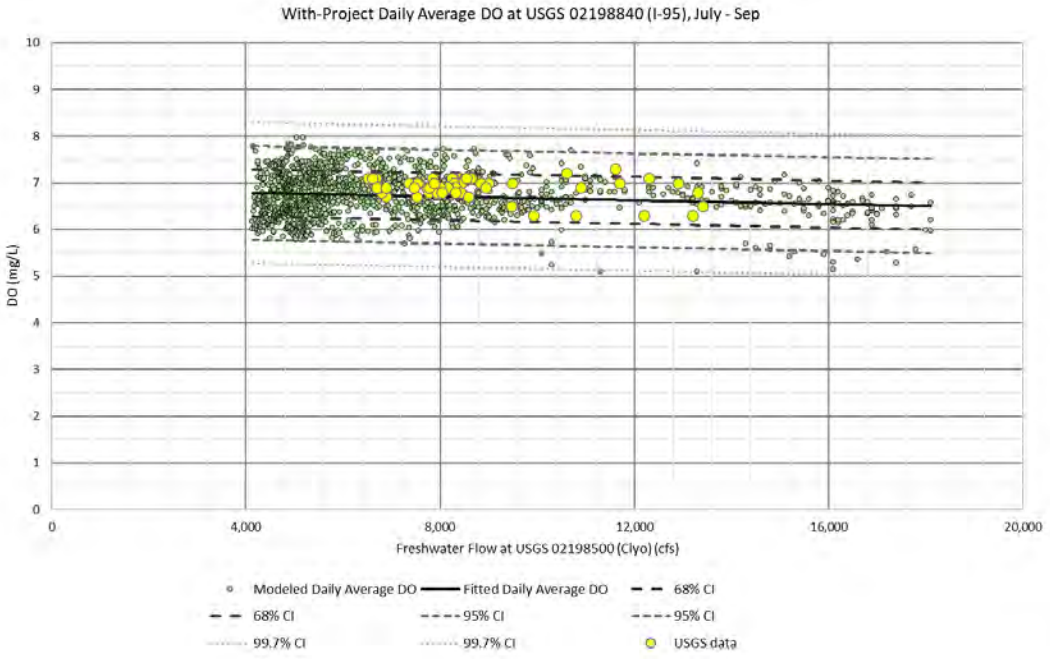
USGS 02198840 – I-95

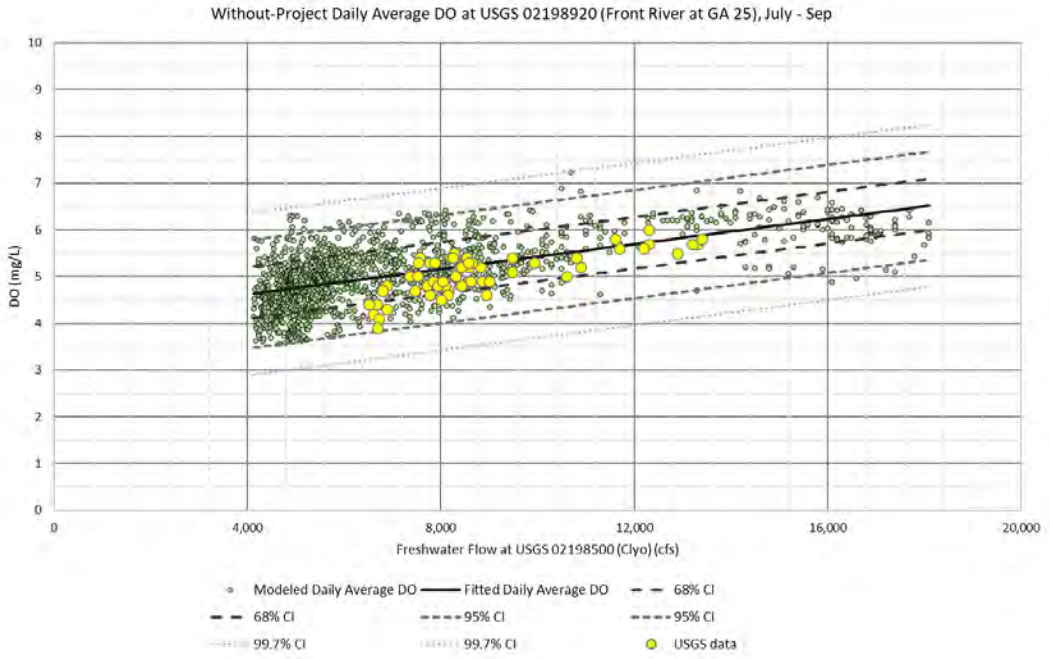
The measured USGS data outperformed the fitted average for the *without-project* scenario. This aligns with expectations given the significant oxygen load injected upstream at the Upriver oxygen plant. For the *with-project* scenario, the measured data aligns well with the guidelines with almost all data fitting inside one standard deviation. While not all deepening and mitigation features had been completed at time of the Startup Run, the major features that could impact DO at this station were complete and therefore the *with-project* guidelines are the most applicable for this station at time of the Startup Run. Interestingly, this is the only station that has an inverse relationship between DO and flow. This is likely due to high flows moving DO-rich water from the Upriver plant faster downriver and extending distances for mixing to occur.

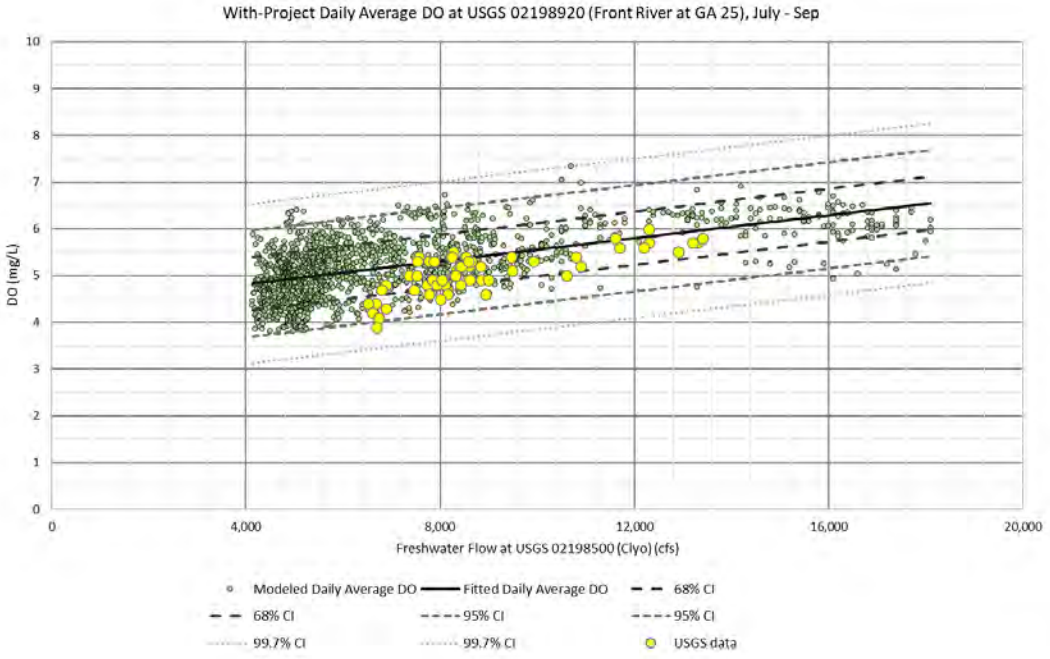




USGS 02198920 – Front River at GA 25

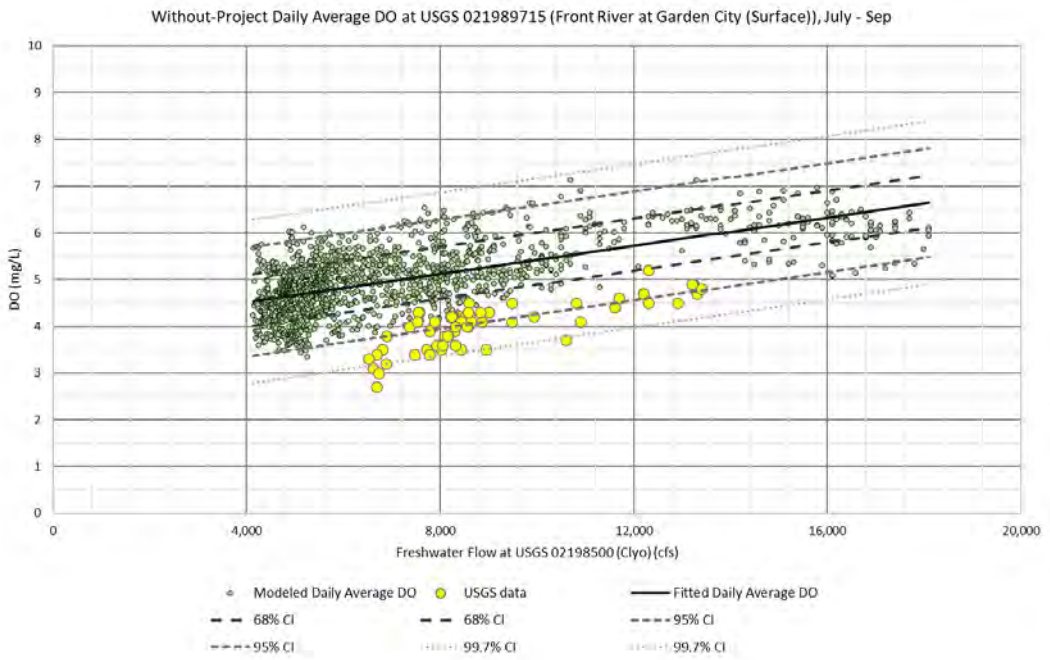
The measured USGS data typically is within one standard deviation of the *without-project* guidelines. For the *with-project* scenario, the measured data is slightly below the fitted daily average but still sits within the 95% confidence interval. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

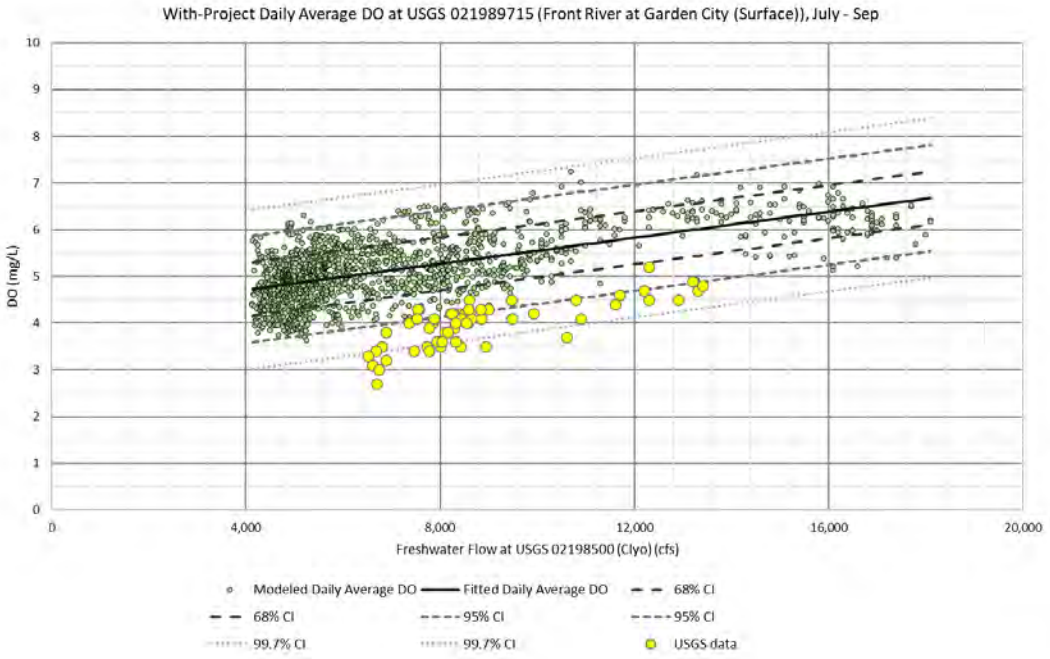




USGS 021989715 – Front River at Garden City (Surface)

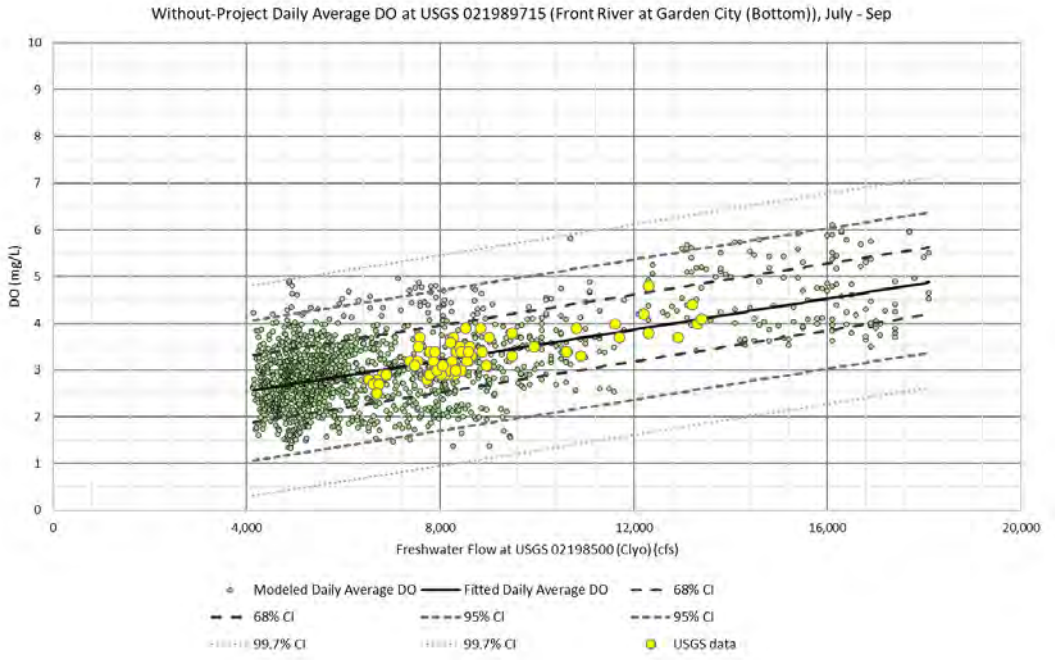
The measured data underperformed the guideline curves for both the *with-project* and *without-project* scenarios. Given the success of mitigating at depth at this same location (see next page), it is expected this is a model misrepresentation with how the surface guidelines were created, rather than a cause for concern. The same result was observed for the DO vs temperature guidelines at this location.

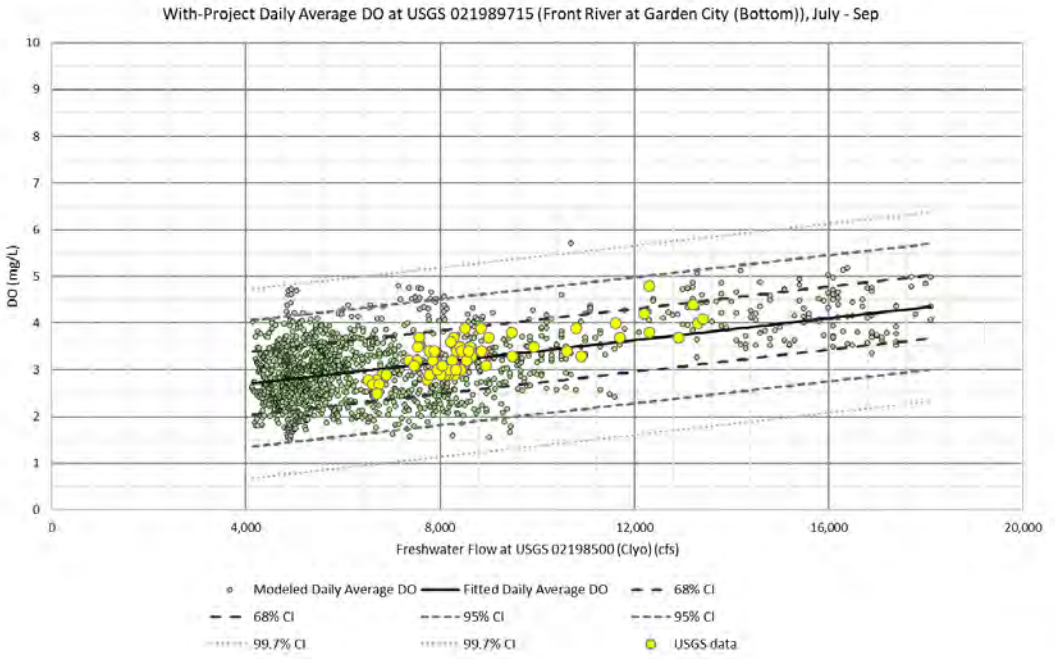




USGS 021989715 – Front River at Garden City (Bottom)

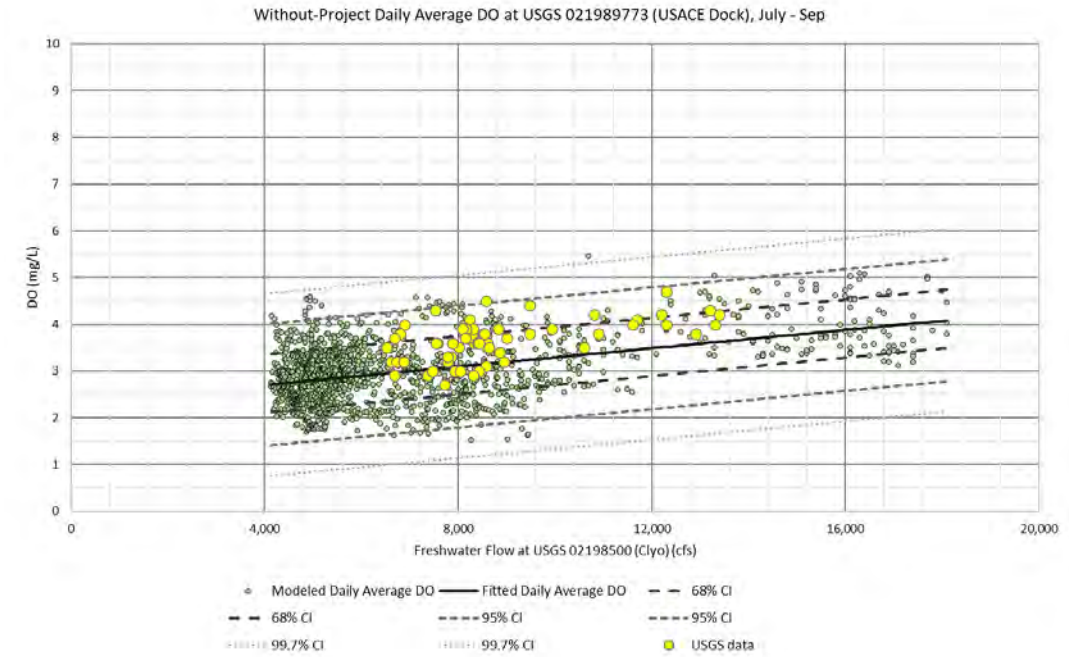
The measured data outperformed the guideline curves for both the *with-project* and *without-project* scenarios with measured data typically within one standard deviation but also above the fitted daily average. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

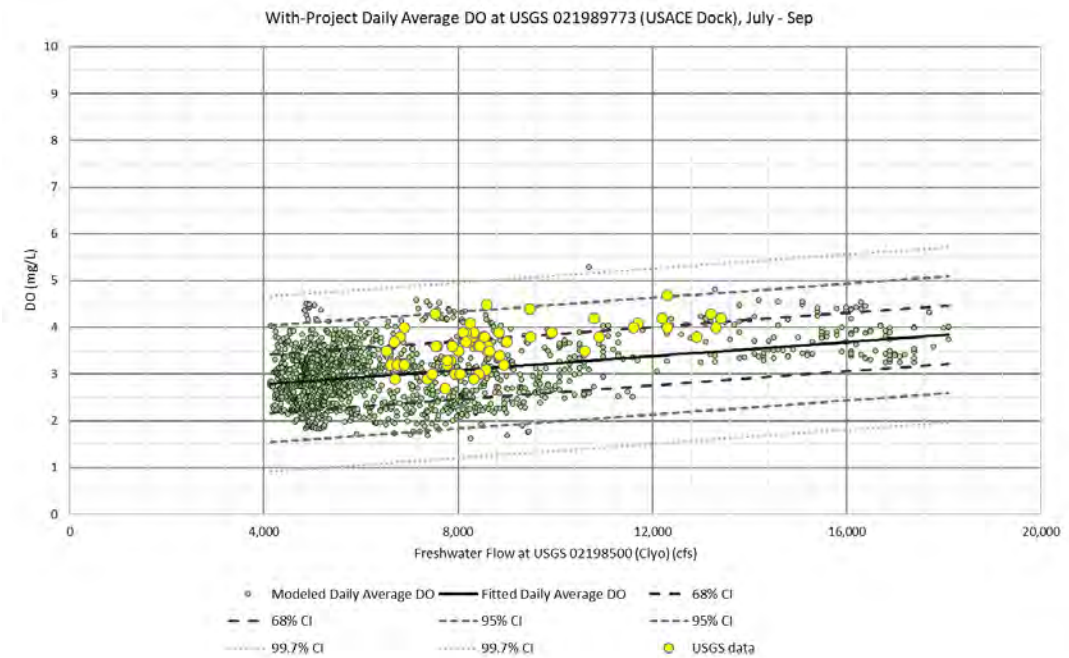




USGS 021989773 – Savannah River at USACE Dock

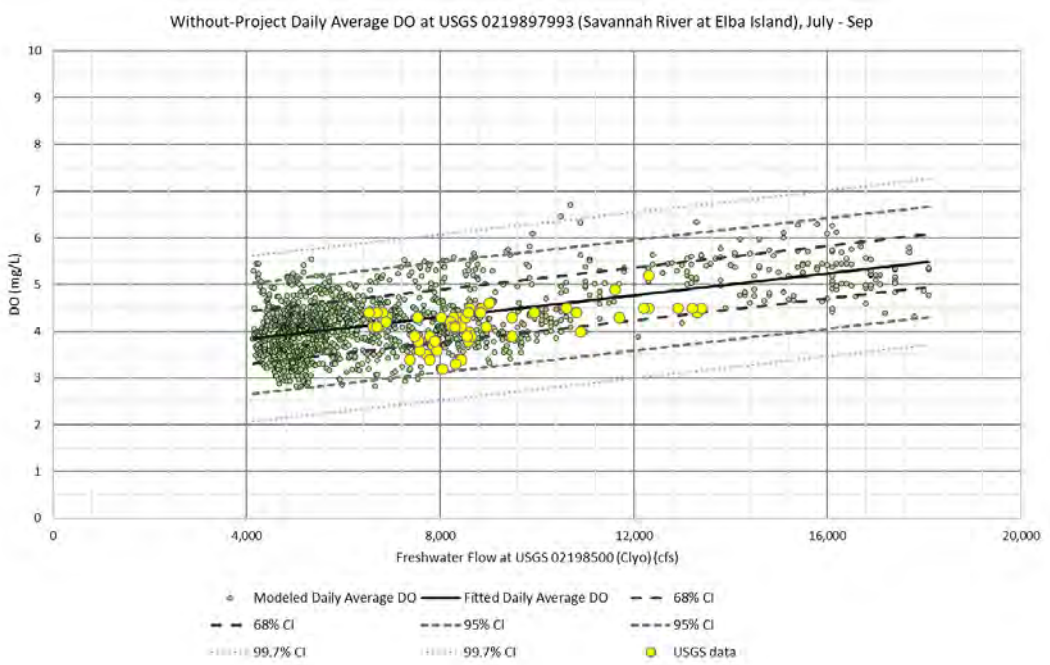
The measured data outperformed the guideline curves for both the *with-project* and *without-project* scenarios with measured data typically above the fitted daily average. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

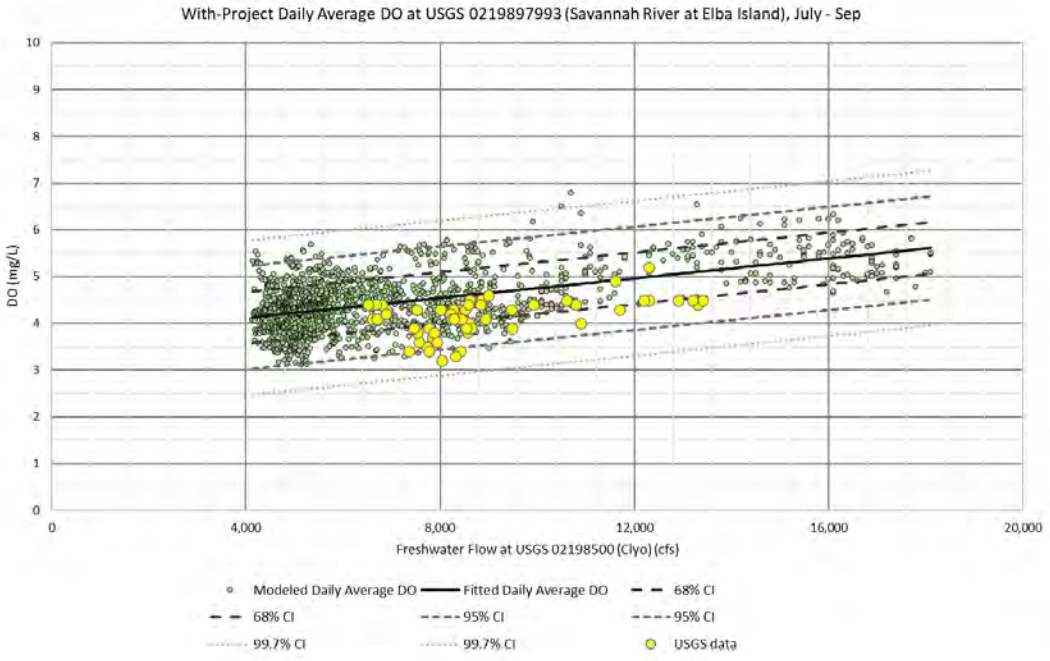




USGS 0219897993 – Savannah River at Elba Island

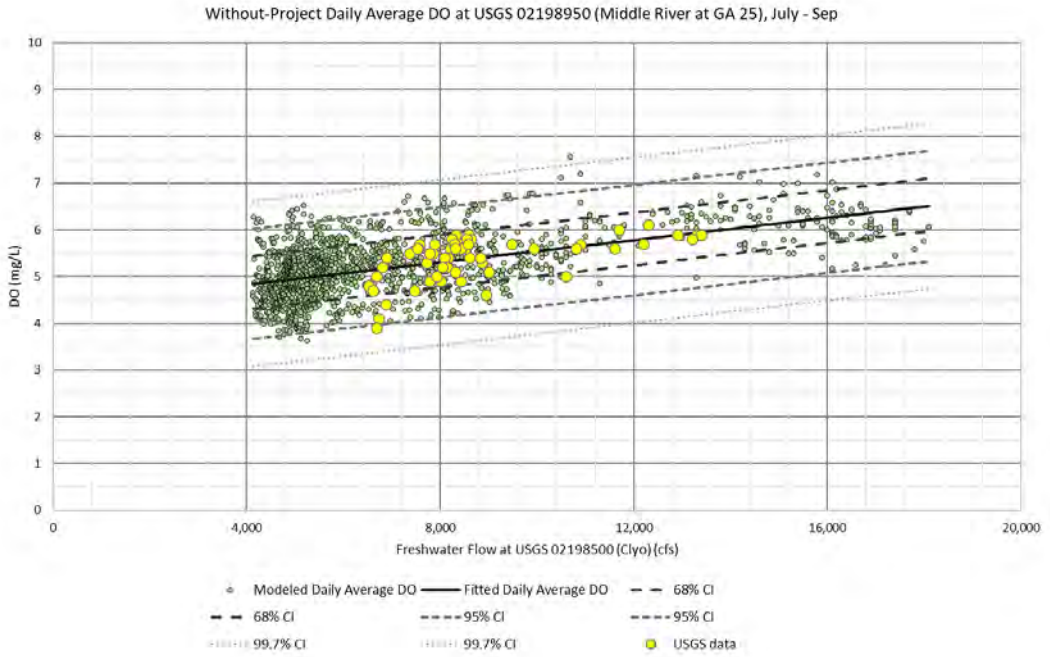
The measured data underperformed the guideline curves for both the *with-project* and *without-project* scenarios with measured data typically below the fitted daily average but also within the 95% confidence interval. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

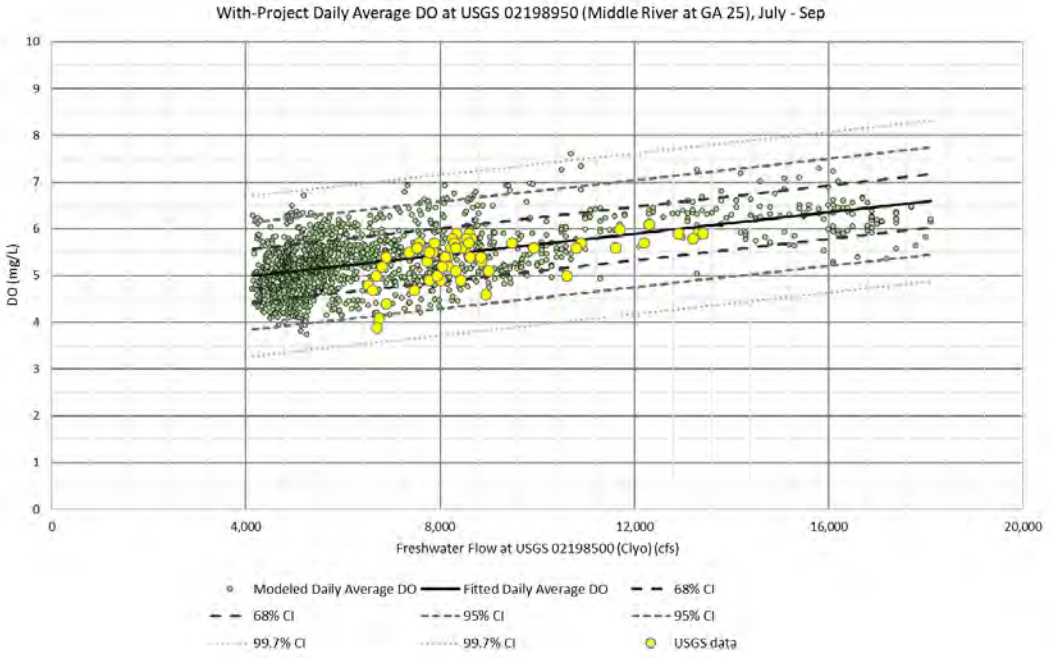




USGS 02198950 - Middle River at GA 25

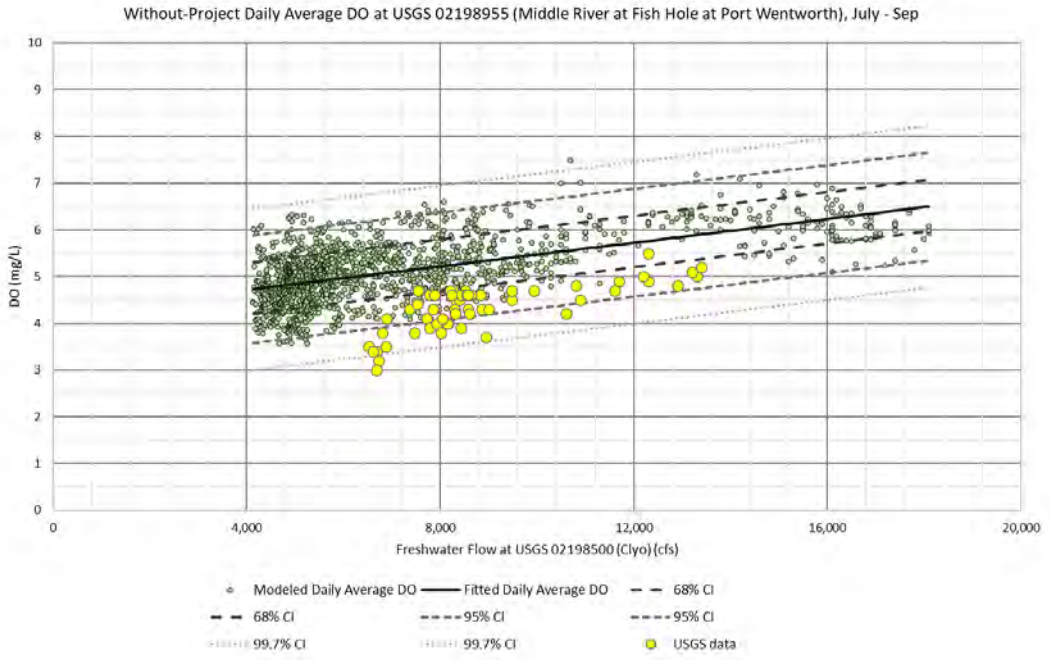
The measured data performed in accordance with the guideline curves for both the *with-project* and *without-project* scenarios with measured data balanced around the fitted daily average and within one standard deviation. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

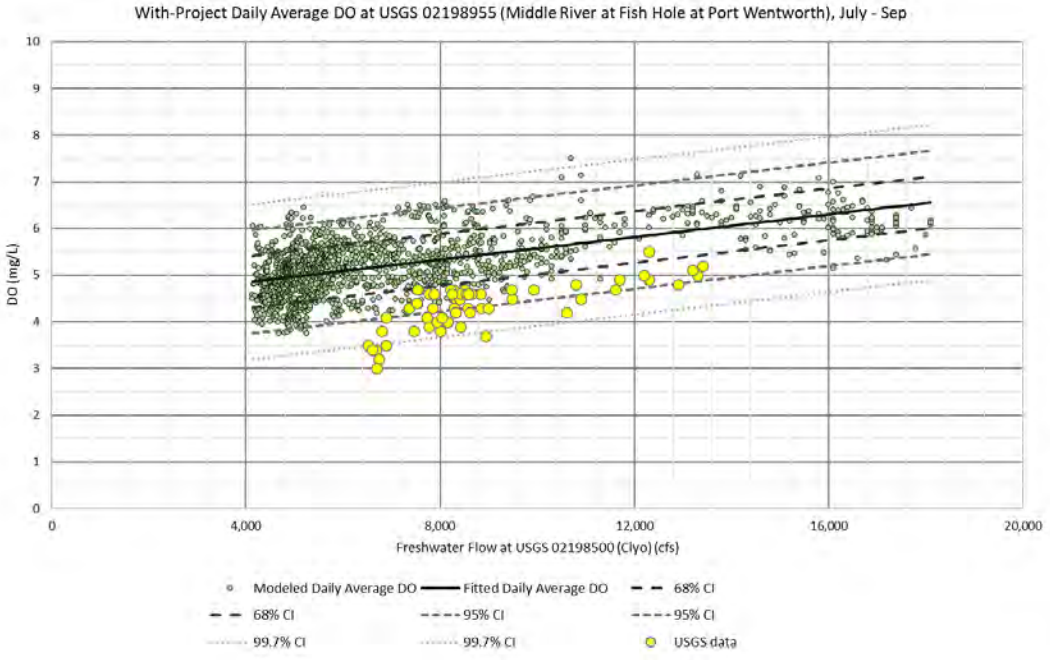




USGS 02198955 - Middle River at Fish Hole

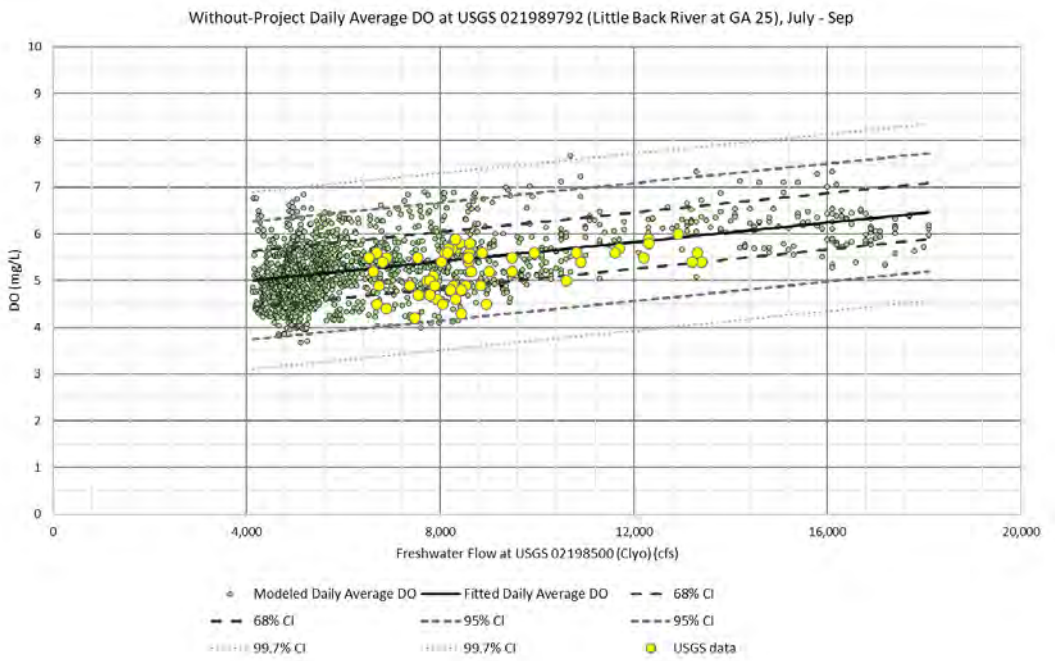
The measured data underperformed the guideline curves for both the *with-project* and *without-project* scenarios. Measured data was below the fitted daily average but also typically within one to two standard deviations. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable. It should be noted that the guidelines were developed using the 2015 SHEP. The 2020 SHEP model was updated to improve various items as referenced in the main report, including representation of freshwater flows down the Middle and Little Back Rivers.

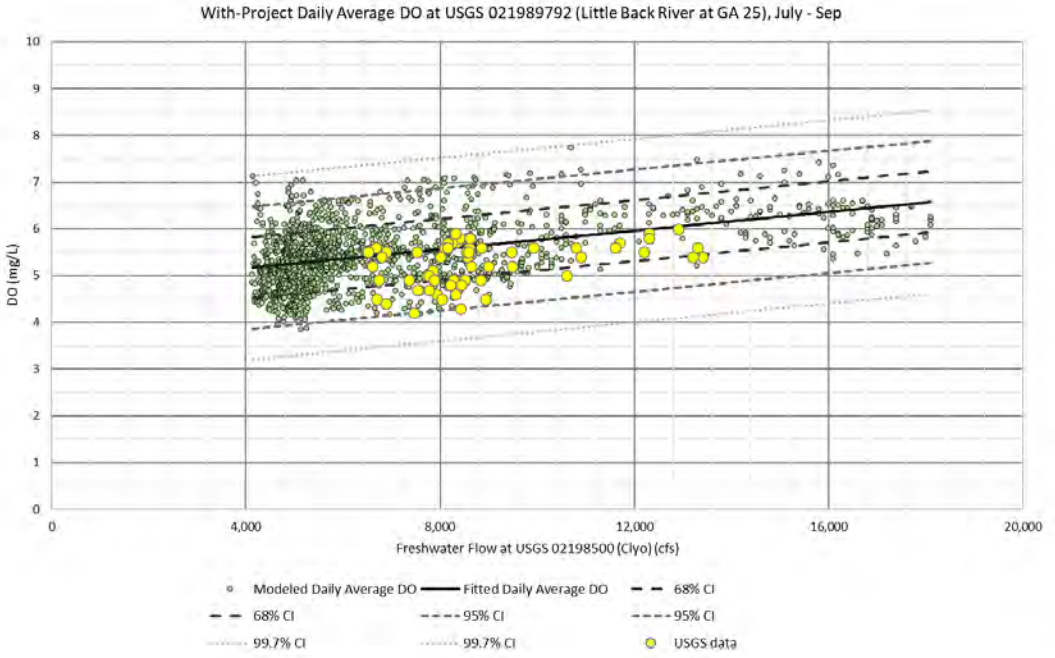




USGS 021989792 - Little Back River at GA 25

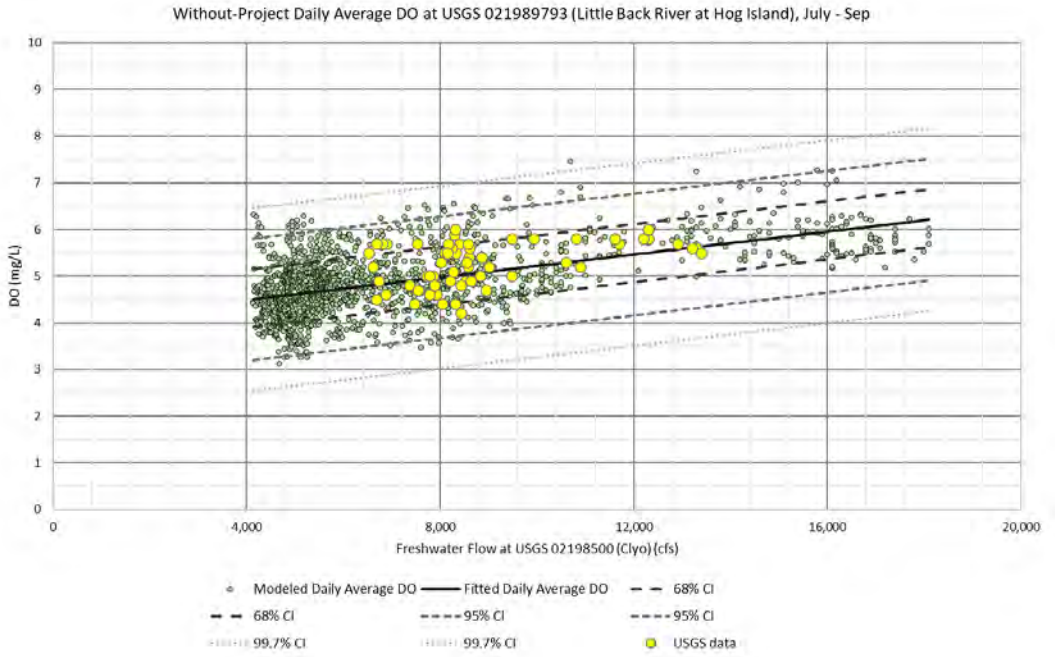
The measured data slightly underperformed the guideline curves for both the *with-project* and *without-project* scenarios with measured data above and below the fitted daily average but with a greater concentration below. All data was within the 95% confidence interval. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

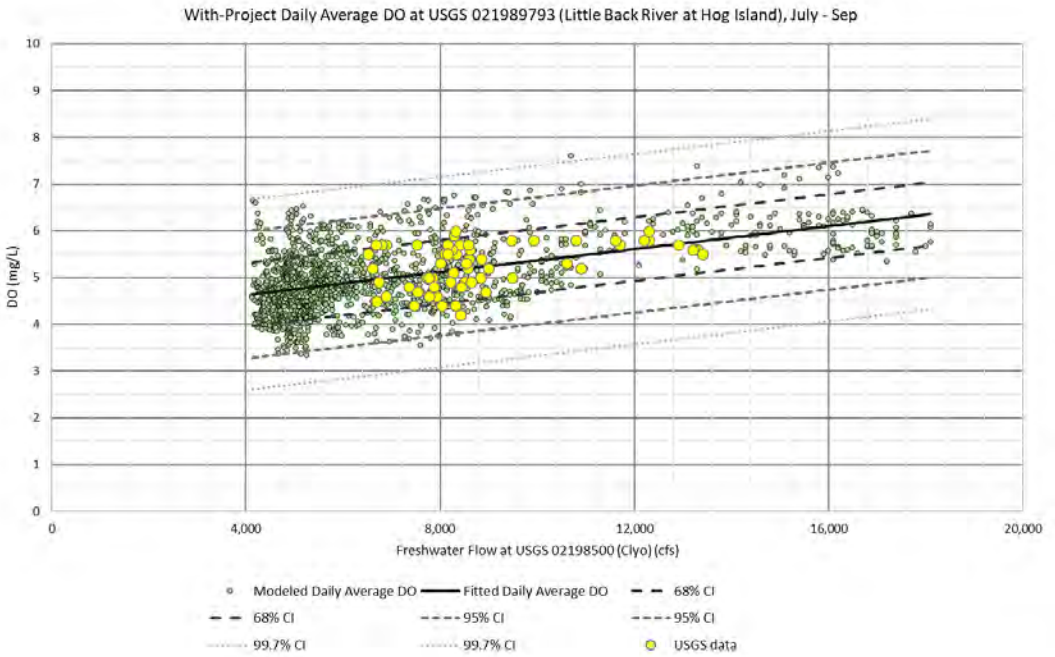




USGS 021989793 - Little Back River at Hog Island

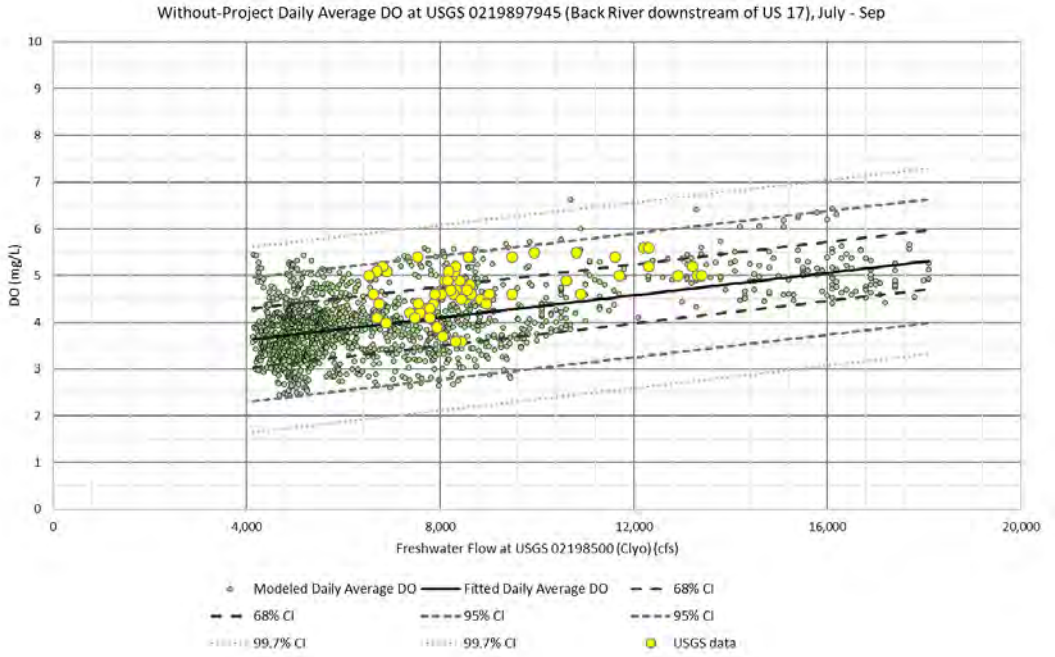
The measured data performed in accordance with the guideline curves for both the *with-project* and *without-project* scenarios with measured data balanced around the fitted daily average and within one standard deviation. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.

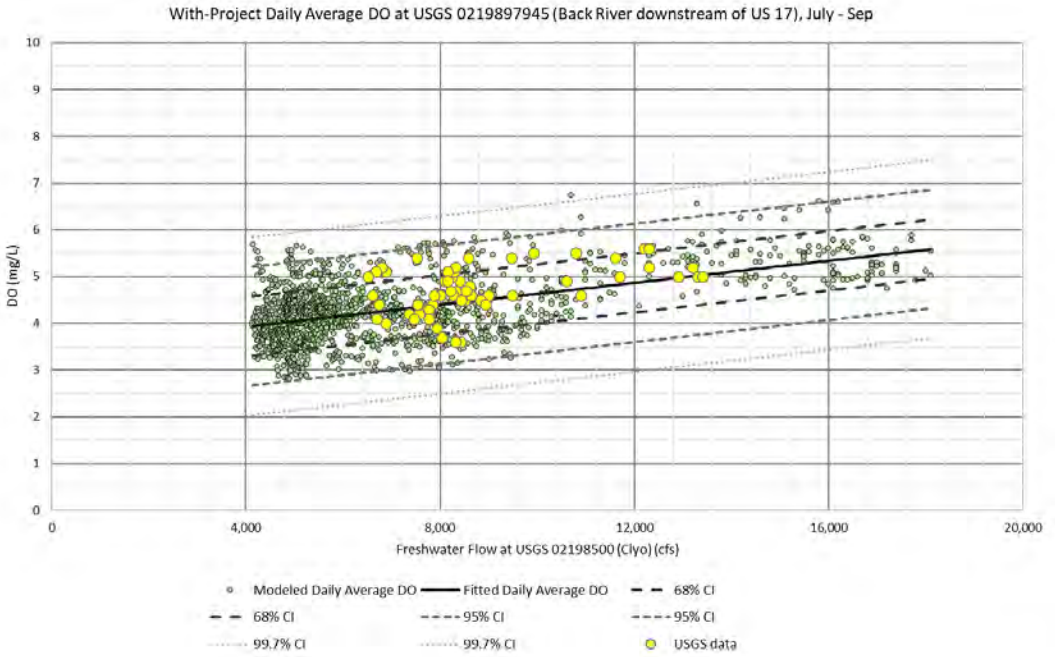




USGS 0219897945 - Back River downstream of US 17

The measured USGS data outperformed the *without-project* guidelines with almost all data above the fitted daily average. For the *with-project* scenario, the measured data performed in accordance with the guidelines with data split around the fitted daily average and well within the 95% confidence interval. Not all deepening and mitigation features had been completed at time of the Startup Run, so both guidelines are relevant but a scenario in between *with-project* and *without-project* is most applicable.





PREPARED FOR
United States Army Corps of Engineers
Savannah District
100 W Oglethorpe Avenue
Savannah, Georgia 31401-3640
Tel (912) 652-5026

