Noyes Cut Section 1135 Ecosystem Restoration
Year 1 Post-Construction Monitoring Report
Satilla River Basin, Georgia

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Abstract

The purpose of the 2018 Noyes Cut Section 1135 Integrated Feasibility Report/Environmental Assessment (IFR/EA) was to identify actions to restore aquatic habitat in the Satilla River estuary, with the focus on four primary tributaries: Dover Creek, Umbrella Creek, West Tributary Creek, and East Tributary Creek. Phase I construction was completed for two closures at the manmade cuts, Dynamite Cut and Old River Run (ORR), in March 2023. Phase II, closure of Noyes Cut, has not yet occurred at the date of this report. Post construction monitoring is a requirement of any Section 1135 Continuing Authorities Program (CAP) project. The monitoring plan was developed to measure the degree in which the project met the identified restoration and ecological lift benefits of increased flux throughout the system, restored salinity gradient in West Tributary Creek, and a deepened Umbrella Creek.

This monitoring report will (1) to analyze the pre- and post-construction data to determine the cut closures impacts on the estuary and (2) to determine if the models and predictions from the 2018 report are accurate. Year one post-construction monitoring included (1) discharge monitoring of the creeks using an acoustic doppler current profiler (ADCP), (2) salinity measurement using YSI sondes, and (3) multibeam bathymetry surveys using sonar. In summary, the post-construction discharge data analysis indicates that the current flux is trending well with the predicted flux values from the 2018 report and the post-construction bathymetry data analysis indicates that Umbrella Creek experienced deepening as predicted. Post-construction salinity data analysis indicates that the gradient has not been increased in the West Tributary Creek; however, the gradient is expected to be improved upon the closure of Noyes Cut, which is currently being planning and is pending additional appropriations. The objectives and opportunities identified in the IFR/EA are listed below. Green checks depict that the objective or opportunity has been determined to be achieved during this post-construction year, and the black circle depicts that the objective or opportunity has not been determined to be achieved during this post-construction year.

- ✓ Restore natural circulation to the Satilla River estuary.
- ✓ Increase tidal exchange and restore water depths to Dover and Umbrella Creeks.
- o Restore salinity gradients, which would provide migratory species directional cues to upstream spawning habitat.
- ✓ Restore historic depths and circulation patterns to Umbrella and Dover Creeks.
- ✓ Improve aquatic habitat for resident species (e.g., blue crabs, shrimp);
- o Increase connectivity and salinity gradients for migratory species (e.g., striped bass, American eels, shad, ad river herring, etc.) in the upper reaches of the estuary.

1 Introduction

As described in the 2018 IFR/EA, the purpose of the Noyes Cut Restoration Project is to restore aquatic habitat (wetlands and tidal creeks) degraded by the Atlantic Intracoastal Waterway (AIWW) in the vicinity of Umbrella and Dover Creeks of the Satilla River estuary and improve salinity gradients that provides benefit to the directional cues for migratory fish, shrimp, and crabs. The need to restore salinity gradients originated because of past AIWW actions that allowed a large volume of Satilla River water to enter upriver portions of tidal creeks through pathways such as Old River Run (ORR) and Dynamite Cut, thereby diminishing natural salinity differences along the creeks.

The non-Federal sponsors of the project, Georgia Department of Natural Resources (GADNR) and the Satilla Riverkeeper, in collaboration with Dover Bluff residents, requested that the U.S. Army Corps of Engineers (USACE) investigate the best way to restore the Satilla River estuary system. Under the authority provided by the continuing authorities program (CAP) Section 1135 of the Water Resources Development Act of 1986, USACE may plan, design, and build modifications to existing USACE projects, or areas degraded by USACE projects, to restore aquatic habitats for fish and wildlife. In 1933, USACE widened and deepened Noyes Cut as part of the Inland Waterway. In 1940, USACE constructed the AIWW from Umbrella Creek through the lower reach of Dover Creek. In total, eight man-made cuts account for the degraded ecosystem in the study area. Those cuts changed the water circulation patterns in the estuary, altered patterns of tidal exchange, disrupted gradual salinity gradients from the headwaters to the mouth of the creeks, and limited access to headwaters for estuarine species due to channel sedimentation.

To address these concerns, the study team assessed, evaluated, and compared the following final array of action alternatives: closing Noyes Cut alone (alternative 1); closing Dynamite Cut and ORR (alternative 6), and closing Noyes Cut, Dynamite Cut, and ORR (alternative 7) in the 2018 Noyes Cut Section 1135 IFR/EA. The study team identified Alternative 7 as the Recommended Plan because it would provide the greatest amount of ecosystem restoration benefits and the best habitat for migratory fish spawning habitat. Construction of the Dynamite Cut and ORR stone closures were completed in March 2023 as part of Phase I (**Figure 1**). Construction of the Noyes Cut stone closure has not begun due to phasing of the project; therefore, all predicted and expected environmental responses in the 2018 Noyes Cut Section 1135 IFR/EA may not be realized. Thus, comparison of the year 1 post-construction data was compared with both Alternatives 6 and 7 modeled and predicted benefits, as Alternative 6 best represents the current post construction conditions.

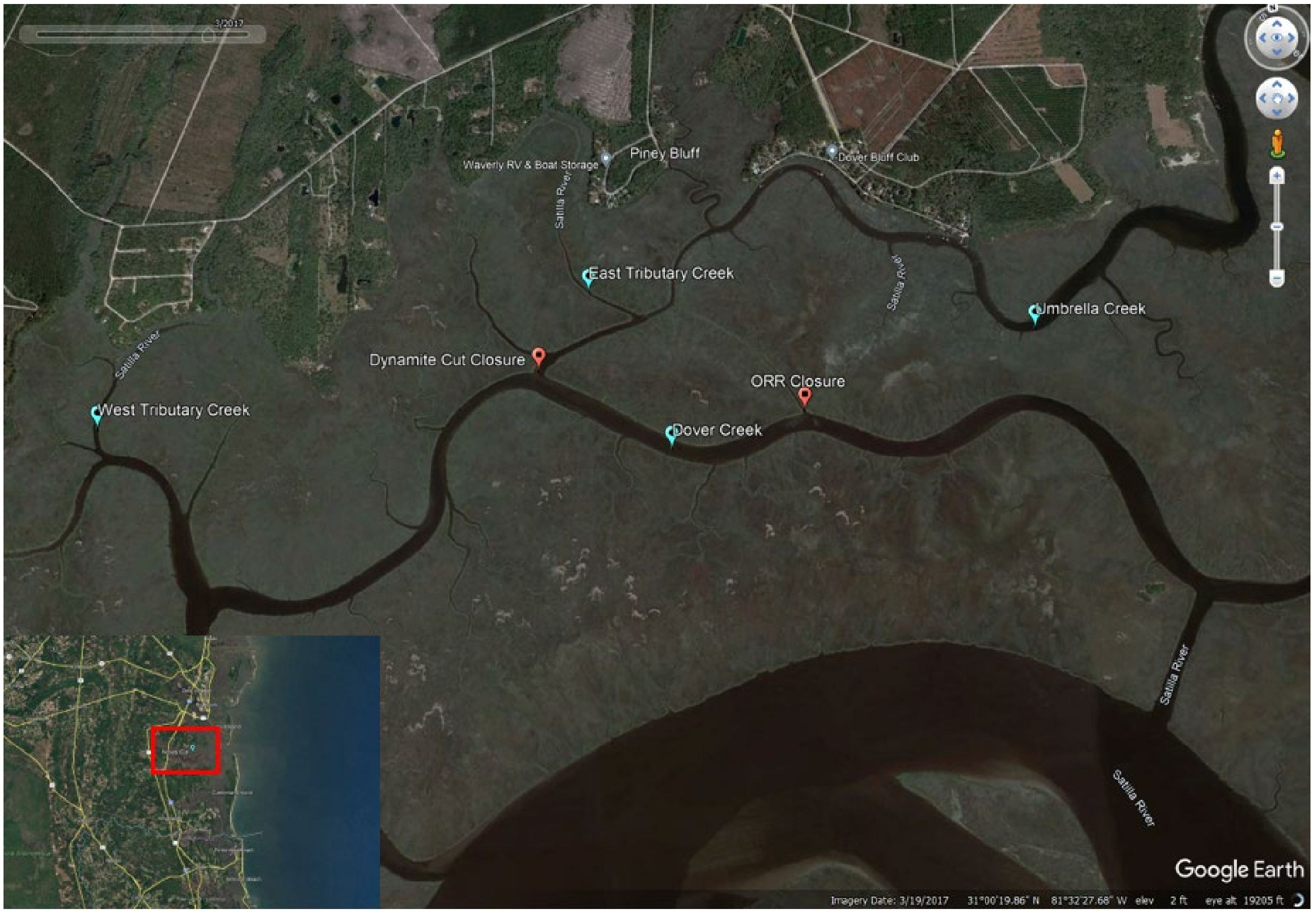


Figure 1. Dynamite Cut and ORR closure locations.

The large volume of brackish water of the Satilla River was believed to have overwhelmed the freshwater that enters the headwater area and caused the salinity to be nearly constant throughout most of Umbrella and Dover Creeks. Additionally, creation of the cuts created a tidal node which increased sediment deposition and reduced natural channel flows. It was hypothesized that closing the cuts should restore water depths in Dover and Umbrella creeks, allowing for more access to portions of the estuary for shrimp, shellfish, and migratory fish. Closing of the cuts should also increase homogeneity of sediment deposition through the system, creating a sandier, deeper creek bottom, and restoring gradual salinity gradients from the headwaters to the mouth. The area that could be benefited by the project consists of approximately 4,518 acres and encompasses the tributaries and associated Spartina marsh above the Noyes Cut closure area, including the East and West Tributary Creeks (**Figure 2**). The estuarine species historically found in Dover and Umbrella Creeks include shrimp (white and brown), river herring, American shad, blue crabs, eastern oyster, and striped bass. All of these species may experience benefits from the restoration of tidal flows, water depths, and salinity gradients in the area. Shad, herring, and striped bass require freshwater for spawning, while blue crabs, oysters, and shrimp require brackish water for successful reproduction.

Figure 2. The estimated acreage of habitat restored (USACE, 2018).

Opportunities and objectives were identified in the 2018 Noyes Cut Section 1135 IFR/EA:

Opportunities:

- Restore natural circulation to the Satilla River estuary;
- Increase tidal exchange and restore water depths to Dover and Umbrella Creeks;
- Restore salinity gradients, which would provide migratory species directional cues to upstream spawning habitat.

Objectives:

- Restore historic depths and circulation patterns to Umbrella and Dover Creeks;
- Improve aquatic habitat for resident species (e.g., blue crabs, shrimp);
- Increase connectivity and salinity gradients for migratory species (e.g., striped bass, American eels, shad, ad river herring, etc.) in the upper reaches of the estuary.

2 Monitoring Plan

As part of the requirements for Section 1135 studies, monitoring to determine the success of achieving the restoration goals is required. In the 2018 Noyes Cut Section 1135 IFR/EA, pre- and post-construction monitoring elements were included to evaluate system changes and to determine the accuracy of the predicted effects from the models. These elements were developed to determine the success of the opportunities and objectives provided above.

The elements are listed below:

1) Monitor post-construction changes in flux at 10 locations and compare to pre-construction flux.
   a) Performed by United States Geological Survey (USGS) using an acoustic doppler current profiler (ADCP).
   b) 1 pre-construction monitoring event (completed).
   c) 3 post-construction monitoring events (years 1, 3, and 5; 2023, 2025, and 2027).
   d) Monitoring of flux will be performed during mid-tide and average tide.
   e) Goal is for the change in flux at 100% of the locations to trend in the same direction as the modeled results by year 2025 and to be within 10% of the values by year 2027.

2) Monitor post-construction changes in the salinity profile along Umbrella and Dover Creeks. The monitoring will extend to the upper end of each of these two major tidal creeks.
   a) Data collection performed by USGS using YSI EXO sondes. Analysis performed by USACE Engineering.
   b) 1 pre-construction monitoring event (completed).
   c) 3 post-construction monitoring events (years 1, 3, and 5; 2023, 2025, and 2027).
   d) Monitoring will be performed during maximum spring tide.
   e) Goal is for the data to measure if a continually decreasing trend from high to low salinity as one progresses up the tidal creeks by year 2025 can be observed.

3) Channel surveys (bathymetry) of domain of the hydraulic model within Dover and Umbrella Creeks, and the Alternate AIWW to measure the amounts of scouring/sedimentation.
   a) Data collection performed by USACE Navigation. Analysis performed by USACE Engineering.
   b) 1 pre-construction monitoring event (completed).
   c) 3 post-construction monitoring events (years 1, 3, and 5; 2023, 2025, and 2027).
   d) Goal is for the bathymetry trends to be in the direction (increasing or decreasing) predicted in the model by year 2027.

3 Monitoring Element 1: Flux

3.1 Model Predictions

A hydrodynamic model output was used to evaluate the Δflux (change in flux or volume of water moving over a certain period of time) between the base conditions and each alternative in the study, at each of the 10 environmental designated locations (**Figure 3** under Section 3.2) for a variety of tidal conditions. The Δflux was calculated by multiplying the scalar dataset of depth and the vector dataset of velocity, over a cross-sectional length under varying 6-hour time periods. This calculation yields an increase or decrease in flux in units of cubic meters per second and percent change. A conditional formatting color scheme was used to visualize the major changes, with dark green representing the largest percent increase and dark red representing the largest percent decrease. **Table 1** provides the flux percent change results for alternative 6, and **Table 2** provides the flux percent change results for alternative 7.

Table 1. Modeled Change in flux during Spring Tide Flood and Ebb at each environmental designated location for Alternative 7.

	Spring Tide Flood	Modeled Spring Flood Percent Change	Spring Tide Ebb	Modeled Spring Ebb Percent Change
ENV1	-14.3	-50%	-17.5	-58%
ENV4	0.0	1%	0.0	-3%
ENV5	0.1	5%	-0.1	-10%
ENV6	7.1	49%	13.6	270%
ENV7	6.4	17%	16.7	66%
ENV8	5.8	6%	19.3	29%
ENV10	-7.1	-3%	-8.3	-4%
ENV12	5.7	7%	6.1	14%
ENV13	-3.5	-1%	-7.8	-3%
ENV14	-1.1	-0.3%	-4.0	-1%

Table 2. Modeled Change in flux during Spring Tide Flood and Ebb at each environmental designated location for Alternative 7.

	Spring Tide Flood	Modeled Spring Flood Percent Change	Spring Tide Ebb	Modeled Spring Ebb Percent Change
ENV1	-16.4	-57%	-20.6	-69%
ENV4	-0.1	-6%	0.0	-1%
ENV5	0.0	4%	-0.1	-11%
ENV6	8.8	60%	15.8	314%
ENV7	8.4	22%	19.8	79%
ENV8	9.2	10%	23.8	36%
ENV10	1.7	1%	29.0	14%
ENV12	34.8	45%	52.9	118%
ENV13	-2.6	-1%	32.5	11%
ENV14	0.5	0%	4.6	1%

3.2 Data Collection Methodology

As discussed in the 2018 Noyes Cut Section 1135 IFR/EA, the change in flushing volume will be evaluated within the system, with increases in flux (discharge) viewed as being overall beneficial to the system. The USGS obtained tidal cycle discharges at the 10 designated locations in the Noyes Cut area during spring tide (**Figure 3**). The discharge measurements documented the tidal flux of discharge during the spring tidal cycle on the days of data collection to provide a basis of comparison to what was predicted in the model. Positive discharge is calculated as flows toward the Atlantic Ocean, and negative discharge is calculated as flows inland. Measurements were obtained at a single cross-sectional area at each of the 10 designated locations using an ADCP over the entirety of the tidal cycle.

Initial discharge measurements were taken at all cross-sections during the tidal cycles of April 20-21, 2021 for pre-construction, and during the tidal cycles of June 21-22, 2023 for post-construction. Single cross-sections were attempted at each location for both pre- and post-construction events; however, there were several locations that were too difficult to measure during small periods due to shallow water depth. Therefore, those locations were changed slightly to areas that were more accessible (within 50 feet of original location). Upon post-processing, it was necessary to obtain additional measurements at a few locations to encapsulate the complete tidal cycle.

Figure 3. USGS flux monitoring locations.

3.3 Data Analysis Methodology

The pre- and post-construction flow measurements collected by USGS were used to compare Δflux at the monitoring locations. The Δflux was obtained by multiplying the scalar dataset of depth and the vector dataset of velocity, over a cross sectional length under varying 6-hour time periods. The Δflux from pre-construction 2021 flows and post-construction 2023 flows were compared at each monitoring location. This yields an increase or decrease in flux, in units of CMS (cubic meters per second), and percent change. As defined in the Monitoring Plan of the 2018 Noyes Cut Section 1135 IFR/EA, year 1 post-construction monitoring includes determining if the change in flux at each environmental location is trending in the same direction. Year 3 post-construction monitoring evaluation will consist of determining if the change in flux at 100% of the locations is trending in the same direction as the modeled results. Year 5 post-construction monitoring evaluation will consist of determining if the change in flux at 100% of the locations is trending in the same direction as the modeled results and if the change in flux is within 10% of the modeled values. For this monitoring report, evaluation consisted of determining if the flux at each of the environmental locations was trending in the same direction as predicted by the models for Alternatives 6 and 7.

3.4 Results

Post-construction Δflux was compared with what was modeled in Alternatives 6 and 7 (**Tables 1 and 2**). Overall, post-construction Δflux during spring flood tide and spring ebb tide trended moderately well in regards of the flow direction predicted in what was modeled for Alternative 6 (**Table 3**). Five out of the ten (50%) designated environmental locations trended in the direction predicted for both spring flood and ebb tides. For example, at the monitoring location, ENV1, the model predicted a Spring Tide Flood change in flux of -14.3 or decrease of 50% from the modeled existing conditions to modeled Alternative 6. When comparing the actual pre-construction flux to the post-construction flux at the Spring Tide Flood, the change was a decrease of -42%, so the physical data collection for 1-year post construction is on trend at this monitoring location.

Overall, post-construction Δflux during spring flood and spring ebb tides trended moderately well with what was modeled for Alternative 7 (**Table 4**). Comparing post-construction Δflux with Alternative 7 predictions, four out of the ten (40%) designated environmental locations trended in the direction predicted for both spring flood and ebb tides.

Table 3. Determination if the post-construction Δflux is trending in the same direction as the Δflux direction modeled for Alternative 6 during Spring flood and ebb tides.

	Spring Tide Flood					Spring Tide Ebb				
	Modeled (Base vs. Alt 6.)		1-yr Post-Construction (Pre (2021) vs. Post (2023)		Trending in same direction	Modeled (Base vs. Alt 6.)		1-yr Post-Construction (Pre (2021) vs. Post (2023)		Trending in same direction
	D Flux	**% Change**	**D Flux**	**% Change**	**(Yes or No)**	**D Flux**	**% Change**	**D Flux**	**% Change**	**(Yes or No)**
ENV1	-14.3	-50%	-5.9	-42%	YES	-17.5	-58%	-5.0	-57%	YES
ENV4	0.0	1%	-55.4	-75%	NO	0.0	-3%	-1.1	-7%	YES
ENV5	0.1	5%	3.4	2571%	YES	-0.1	-10%	0.5	21%	NO
ENV6	7.1	49%	7.0	334%	YES	13.6	270%	5.7	248%	YES
ENV7	6.4	17%	16.5	239%	YES	16.7	66%	12.4	71%	YES
ENV8	5.8	6%	-42.5	-52%	NO	19.3	29%	6.4	22%	YES
ENV10	-7.1	-3%	-5.6	-6%	YES	-8.3	-4%	-10.4	-10%	YES
ENV12	5.7	7%	-3.9	-6%	NO	6.1	14%	-3.7	-7%	NO
ENV13	-3.5	-1%	-61.9	-32%	YES	-7.8	-3%	-12.7	-11%	YES
ENV14	-1.1	-0.3%	-85.7	-31%	YES	-4.0	-1%	19.8	11%	NO
	Percent Change for modeled conditions is compared to existing conditions modeling results.									
	Percent Change for Pre vs. Post Spring Tide Flood (compares the 2021 measure pre-construction condition to the 2023 measured post-construction condition).									

Table 4. Determination if the post-construction Δflux is trending in the same direction as the Δflux direction modeled for Alternative 7 during Spring flood and ebb tides.

	Spring Tide Flood					Spring Tide Ebb				
	Modeled (Base vs. Alt 6.)		1-yr Post-Construction (Pre (2021) vs. Post (2023)		Trending in same direction	Modeled (Base vs. Alt 6.)		1-yr Post-Construction (Pre (2021) vs. Post (2023)		Trending in same direction
	D Flux	**% Change**	**D Flux**	**% Change**	**(Yes or No)**	**D Flux**	**% Change**	**D Flux**	**% Change**	**(Yes or No)**
ENV1	-16.4	-57%	-5.9	-42%	YES	-20.6	-69%	-5.0	-57%	YES
ENV4	-0.1	-6%	-55.4	-75%	YES	0.0	-1%	-1.1	-7%	YES
ENV5	0.0	4%	3.4	2571%	YES	-0.1	-11%	0.5	21%	NO
ENV6	8.8	60%	7.0	334%	YES	15.8	314%	5.7	248%	YES
ENV7	8.4	22%	16.5	239%	YES	19.8	79%	12.4	71%	YES
ENV8	9.2	10%	-42.5	-52%	NO	23.8	36%	6.4	22%	YES
ENV10	1.7	1%	-5.6	-6%	NO	29.0	14%	-10.4	-10%	NO
ENV12	34.8	45%	-3.9	-6%	NO	52.9	118%	-3.7	-7%	NO
ENV13	-2.6	-1%	-61.9	-32%	YES	32.5	11%	-12.7	-11%	NO
ENV14	0.5	0.0%	-85.7	-31%	NO	4.6	1%	19.8	11%	YES
	Percent Change for modeled conditions is compared to existing conditions modeling results.									
	Percent Change for Pre vs. Post Spring Tide Flood (compares the 2021 measure pre-construction condition to the 2023 measured post-construction condition).									

3.5 Summary

Overall, post-construction flux conditions are trending moderately with what was predicted in both Alternatives 6 and 7. 50% of the environmental designated locations are trending towards what was predicted in the Alternative 6 model for spring flood and ebb tides, and 40% of the locations are trending towards what was predicted in the Alternative 7 model for spring flood and ebb tide. The goal established in the 2018 Noyes Cut Section 1135 IFR/EA was for 100% of the locations to be trending in the same direction as predicted by the year 2025 and to be within 10% of the modeled Δflux values predicted in the Alternative 7 model. However, a major component of Alternative 7, closure of Noyes Cut, has not yet been completed and will likely significantly affect hydrodynamics within the study area. The closure of Noyes Cut within the next two years will fully complete the measures that formulated Alternative 7; therefore, it is predicted that year 5 (2027) post-construction monitoring will provide a more comprehensive determination regarding the comparison of the post-construction and modeled Δflux directions. Year 1 post-construction Δflux monitoring indicates ORR and Dynamite closures are functioning as intended to increase flushing volume within the estuary system and should improve with the upcoming closure of Noyes Cut.

4 Monitoring Element 2: Salinity

4.1 Model Predictions

As discussed in the 2018 Noyes Cut Section 1135 IFR/EA, it is hypothesized that the salinity gradient has flattened within Dover Creek, impeding estuarine species ability to identify suitable habitat through natural directional cues. Models were generated during the study to predict how the alternatives would alter the existing salinity gradients in the creeks during average spring high tide. The full expectations and modeled predictions in the report may not be realized without the closing of Noyes Cut, which will occur as Phase II in the near future. According to the models in the 2018 Noyes Cut Section 1135 IFR/EA Appendix B Engineering report, only Alternative 7 would restore the salinity gradient within West Tributary Creek (tributary of Dover Creek) during maximum spring tide (**Figure 4**). This increase in salinity levels as migratory fish start to swim upstream toward freshwater discourages fish seeking freshwater from continuing upstream towards spawning habitat. With Alternative 7, there would be a steady reduction in salinity as migratory fish progress upstream towards spawning habitat.

None of the other alternatives were expected to alter the existing salinity gradient in Dover or East Tributary Creeks from the base conditions; therefore, they were not used as basis for comparison. Umbrella Creek was not included in the modeling due to the creek being connected and open both downstream at the mouth and at the Dover Creek confluence. The connectivity causes the salinity to be homogenous throughout the creek. The pre- and post-construction conditions were compared with each other and the modeled base conditions for Dover, Umbrella, and East Tributary Creek to evaluate how the conditions have changed, however.

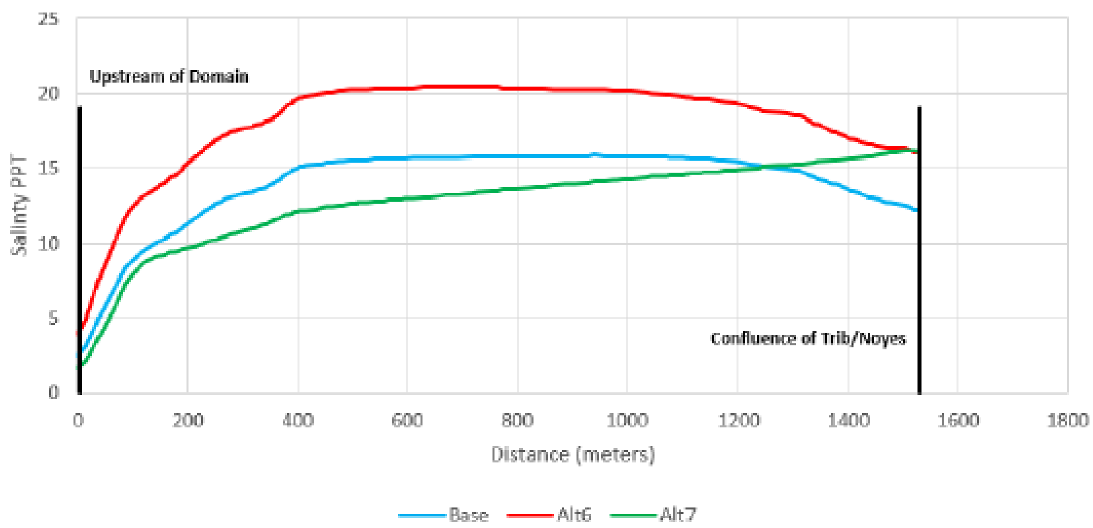


Figure 4. Modeled salinity conditions for West Tributary Creek.

4.2 Data Collection Methodology

For both pre-construction and post-construction monitoring events, the USGS obtained discrete water-quality data at longitudinal cross sections at four different stream segments: Dover Creek, East Tributary Creek, West Tributary Creek, and Umbrella Creek. **Figure 5** shows the generalized points where water quality data was collected in each creek. The parameters that were documented include water temperature, specific conductance, salinity, dissolved oxygen, and pH. The points were taken in the middle of the channel and at mid-depth, except for points that were deeper than 12 feet. Water quality readings were collected using the following units:

Water Temperature	°C
Specific Conductance	µS/cm
Salinity	PPT
pH	Standard Units
Dissolved Oxygen	mg/L

Figure 5. Point locations of USGS water quality data collection.

Pre-construction readings were collected using a YSI-6950 5-paramater sonde, and post-construction readings were collected using a YSI EXO-3 5-parameter sonde. Standard USGS reporting precision was observed for all parameters except for salinity. USGS reporting precision is usually no greater than 0.1. The higher precision recorded for salinity was left in place as a direct observation only. Depth was recorded to the nearest 0.5 ft due to limitations of the meter used. For the purpose of monitoring element 2, salinity will be the focus of evaluation for this report. Some points had two salinity readings at different depths; these readings were averaged for analyzation purposes. Averaging is appropriate for this analysis because the salinity models did not account for depth.

Pre-construction water quality data was collected on April 20-21, 2021. Post-construction water quality data was collected on June 22, 2023. The tide charts for the Todd Creek Entrance along the Satilla River near the project area is provided in **Tables 5 and 6** below for the dates of data collection. Overall, high and low tide levels were similar for the pre- and post-construction monitoring dates. It is important to note that the pre- and post-construction monitoring occurred during different seasons, potentially contributing to the discrepant salinity conditions seen in the results due to differing freshwater input and water temperatures.

Table 5. Tidal levels for April 20-21, 2021 at Station 8678412 (NOAA).

Date		High Tide				Low Tide				Sun	
		AM	ft	PM	ft	AM	ft	PM	ft	Rise	Set
20	Tue	3:00	6.4	3:31	5.6	10:12	1.1	10:20	1.0	6:51	7:58
21	Wed	4:00	6.4	4:33	5.8	11:08	0.9	11:24	0.7	6:49	7:59

Table 6. Tidal levels for June 22, 2023 at Station 8678412 (NOAA).

Date		High Tide				Low Tide				Sun	
		AM	ft	PM	ft	AM	ft	PM	ft	Rise	Set
22	Thu			12:25	5.4	6:55	0.6	6:53	0.8	6:22	8:33

4.3 Data Analysis Methodology

None of the models from the 2018 Noyes Cut Section 1135 IFR/EA demonstrated restoration of salinity gradients in Dover Creek, East Tributary Creek, and Umbrella Creek. However, the modeled base salinity gradients were included as reference for a comparison with the post-construction salinity gradients. Alternatives 6 and 7 modeled salinity gradients were included for West Tributary Creek to determine if the salinity gradient has been restored with the construction of the Dynamite and ORR closures. It is important to note that the salinity gradient was restored in West Tributary Creek only with the implementation of Alternative 7. However, both alternatives were included to demonstrate the comparisons between the current conditions that exist from the Dynamite Cut and ORR closures (Alternative 6), as well as the modeled predictions if Dynamite Cut, ORR, and Noyes Cut were all closed (Alternative 7).

In order to compare the collected pre-construction and post-construction data with the modeled salinity gradient predictions, the distance of each data point was measured with respect to the described starting point for each model graph (i.e., upstream of domain for Dover Creek). For example, the first Dover Creek post-construction point (P1) was 32 ft from the upstream domain location described for the Dover Creek model graph.

4.4 Results

4.4.1 Dover Creek

4.4.1.1 Pre-Construction

Dover Creek pre-construction readings were collected on April 20, 2021 (**Figure 6**). The first observation (P1) is the most upstream and was collected at the confluence with Noyes Cut and West Tributary Creek. The final reading was taken inside of Dover (P24, most downstream point).

Figure 6. Dover Creek pre-construction water quality points.

4.4.1.2 Post-Construction

Dover Creek post-construction salinity readings were collected June 22, 2023 (**Figure 7**). The first point is located furthest upstream at the confluence with Noyes Cut and West Tributary Creek, and the last point (P29) is the most downstream point.

Figure 7. Dover Creek post-construction water quality points.

4.4.1.3 Data Analysis

Measured pre-construction and post-construction salinity data were compared with each other, as well as to the modeled base condition from the 2018 IFR/EA Appendix B Engineering Report (**Figure 8**). None of the modeled alternatives predicted changes to the gradient from the base or existing salinity gradient within Dover Creek; therefore, they were not included in this analysis. The post-construction salinity does not demonstrate improvement when compared to the modeled base condition. The pre-construction salinity gradient demonstrates a higher salinity gradient than the base condition and the post-construction gradient. This finding may be attributed to the fact that post-construction salinity readings were collected while the tide was already in transition from high tide to low tide, potentially attributing to a small gradient, while pre-construction salinity readings were collected at peak high tide to peak low tide.

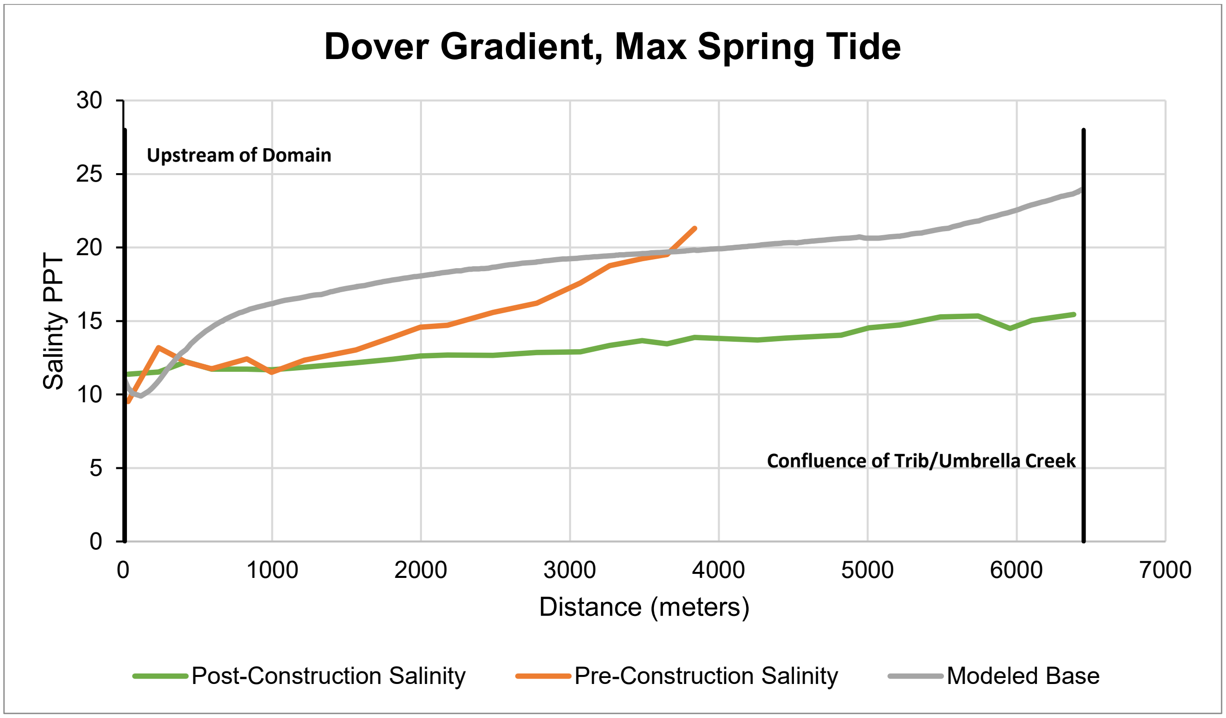


Figure 8. Dover Creek salinity gradient comparisons moving downstream.

4.4.2 Umbrella Creek

4.4.2.1 Pre-Construction

Readings were collected at Umbrella Creek on April 21, 2021 (**Figure 9**). The first reading was collected approximately 2,600 feet from the confluence with Dover Creek. The final reading was collected at P18.

Figure 9. Umbrella Creek pre-construction water quality points.

4.4.2.2 Post-Construction

Readings were collected at Umbrella Creek June 22, 2023 (**Figure 10**). The first reading was collected near the constructed closure. The last reading was collected at the furthest downstream point.

Figure 10. Umbrella Creek post-construction water quality points.

4.4.2.3 Data Analysis

The pre-construction salinity gradient was compared with the post-construction salinity gradient and the modeled base condition (**Figure 11**). None of the modeled alternatives predicted changes to the gradient from the base or existing salinity gradient within Umbrella Creek; therefore, they were not included in this analysis. According to the graph, the pre-construction salinity gradient is slightly larger than the post-construction salinity gradient. Both the pre- and post-construction salinity gradients demonstrate slight increases when compared to the base condition from the model.

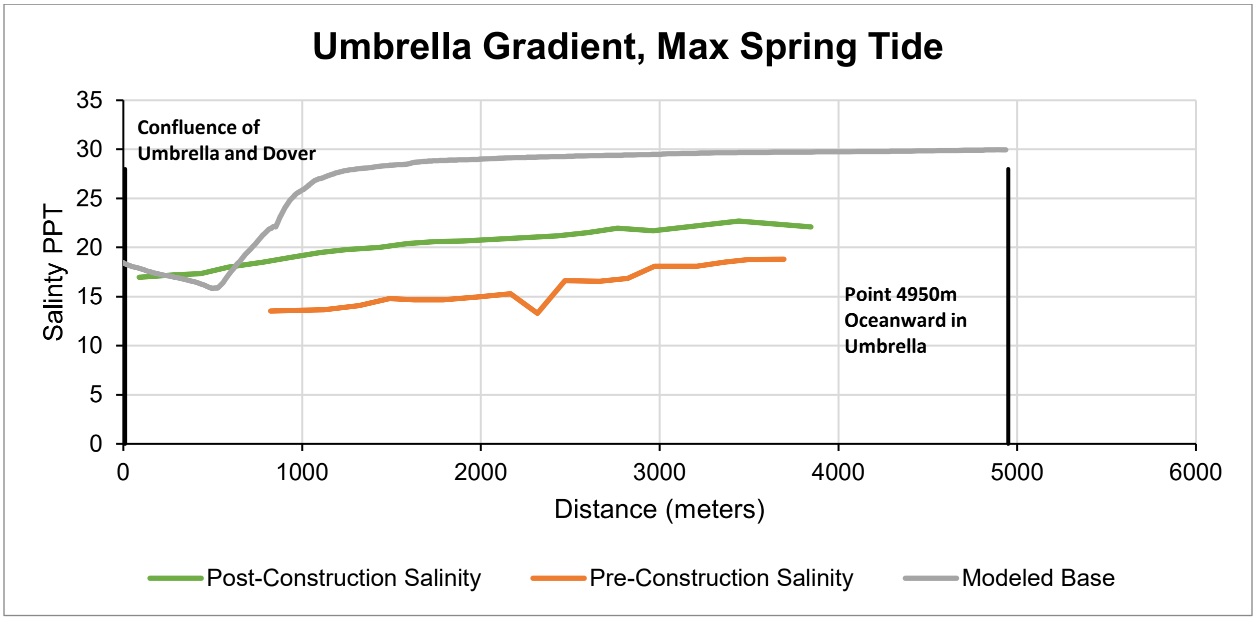


Figure 11. Umbrella Creek salinity gradient comparisons moving downstream.

4.4.3 West Tributary Creek

4.4.3.1 Pre-Construction

Readings were collected in the West Tributary Creek on April 20, 2021, beginning at the confluence with Noyes Cut and Dover Creek (**Figure 12**). P1 is the most downstream point and P9 is the most upstream point.

Figure 12. West Tributary Creek pre-construction water quality points.

4.4.3.2 Post-Construction

Readings were collected in the West Tributary Creek on June 22, 2023, beginning at the confluence with Noyes Cut and Dover Creek (**Figure 13**). Data points were collected on both days of June 21-22, 2023; however, the data points from June 22 were used due to similar tide levels as the pre-construction conditions.

Figure 13. West Tributary Creek post-construction water quality points.

4.4.3.3 Data Analysis

Pre-construction salinity gradient was compared with the post-construction salinity gradient and the base condition (**Figure 14**). According to the modeling, Alternative 7 is the only alternative to significantly restore a salinity gradient in West Tributary Creek. Pre- and post-construction salinity do not demonstrate similarity to the Alternative 7 modeled gradient. There is no change between the salinity gradient of the pre-construction and post-construction conditions. It is expected based on the modeling that the salinity gradient will experience restoration and improvement with the closure of Noyes Cut as part of Phase II within the next two years.

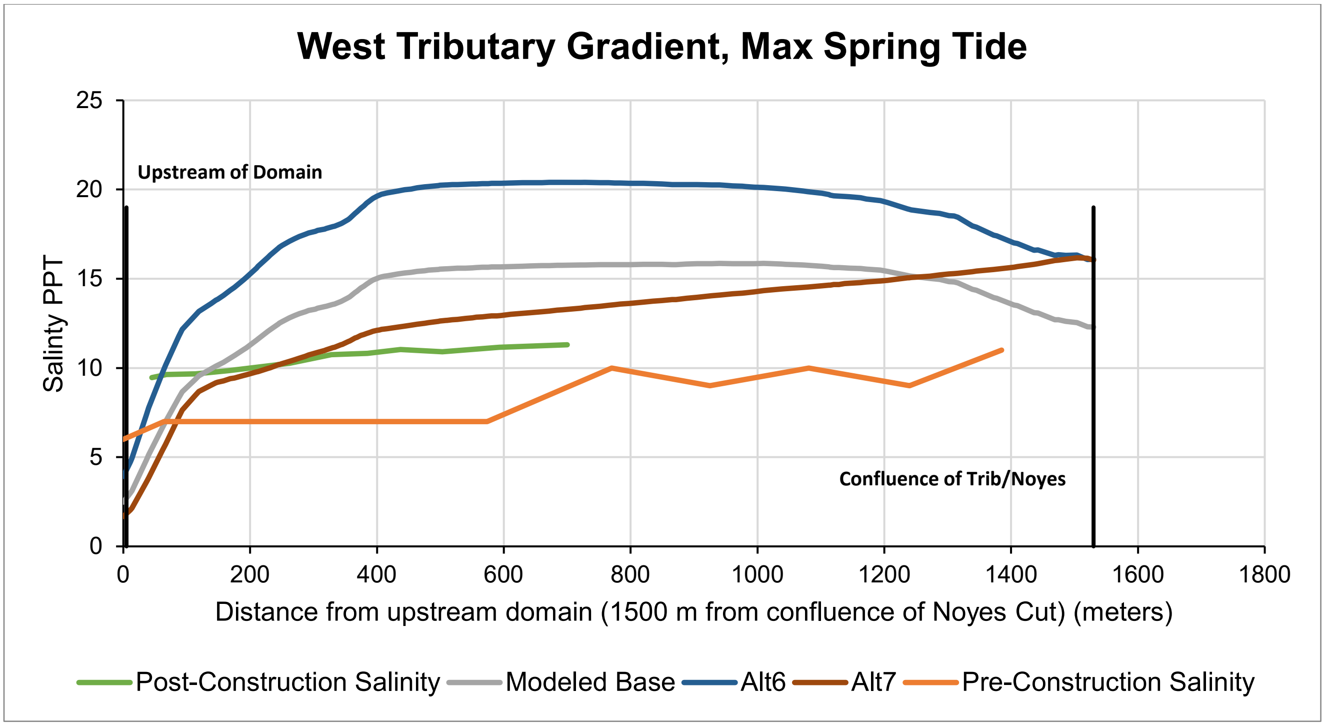


Figure 14. West Tributary Creek salinity gradient comparisons moving downstream.

4.4.4 East Tributary Creek

4.4.4.1 Pre-Construction

Readings were collected on April 21, 2021, starting at the mouth of East Tributary Creek at the confluence with Umbrella Creek to the furthest upstream point (P17) (**Figure 15**).

Figure 15. East Tributary Creek pre-construction water quality points.

4.4.4.2 Post-Construction

Readings were collected on June 21-22, 2023 at the mouth of East Tributary Creek at the confluence with Umbrella Creek to the furthest upstream point (**Figure 16**).

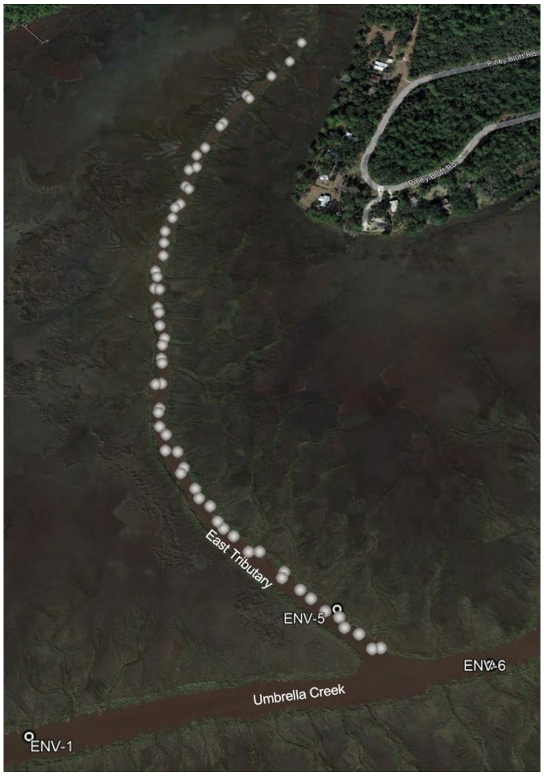


Figure 16. East Tributary Creek post-construction water quality points.

4.4.4.3 Data Analysis

Pre-construction salinity gradient was compared with the post-construction salinity gradient and the base condition (**Figure 17**). None of the modeled alternatives predicted changes to the gradient from the base or existing salinity gradient within East Tributary Creek; therefore, they were not included in this analysis. The base condition salinity gradient is higher than the pre- and post-construction salinity gradients, indicating that there was no improvement to the salinity gradient in the East Tributary Creek.

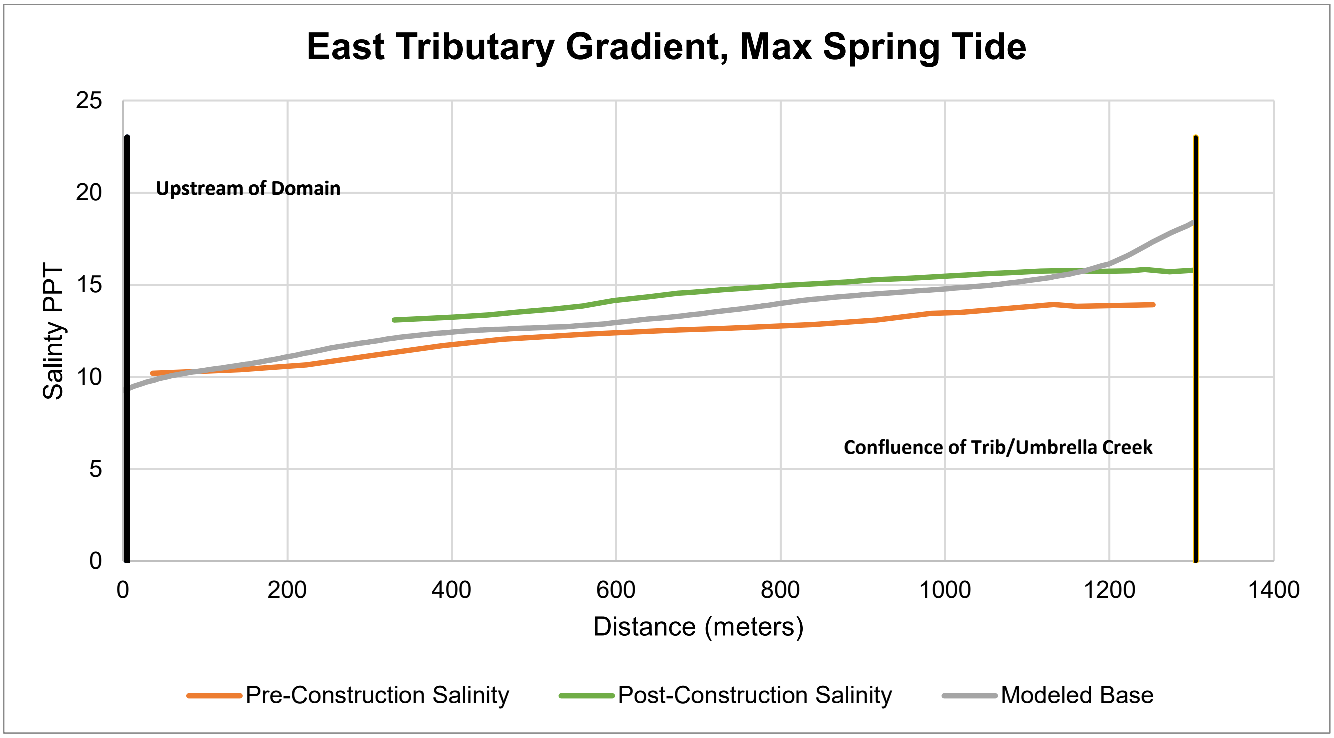


Figure 17. East Tributary Creek salinity gradient comparisons moving downstream.

4.5 Summary

Overall, all four creeks demonstrated minimal salinity trends that were higher downstream and decreased moving upstream. The salinity gradient in West Tributary Creek is not similar to what was modeled for Alternatives 6 and 7 but tracks well with what the monitoring goal was as described in the 2018 Noyes Cut Section 1135 IFR/EA: “Goal is for the data to show a continually decreasing trend from high to low salinity as one progresses up the tidal creeks by year 2025.” It is important to note that all alternatives previously modeled for the 2018 Noyes Cut Section 1135 IFR/EA that showed a salinity gradient restoration included the closure of Noyes Cut. Therefore, it is expected that closure of Noyes Cut within the next two years should show more favorable results for the salinity gradient of the West Tributary Creek.

5 Monitoring Element 3: Bathymetry

5.1 Model Predictions

Umbrella Creek was the area of primary concern for increased shoaling due to concern from Dover Bluff residents’ accessibility to the water way and the inability for migratory species to access this area during low tide. Based on bed shear stress models generated for the study (Appendix B of 2018 Noyes Cut Section 1135 IFR/EA), Alternative 7 was predicted to cause the largest increase in bed shear (most reduction in shoaling), though not substantially more than Alternative 6.

5.2 Data Collection Methodology

Post-construction bathymetric surveys were completed for Noyes Cut, Dover Creek, Umbrella Creek, and the East and West Tributary Creeks the week of July 17, 2023. A heat map was generated to provide visual comparison for analysis between the pre-construction 2021 data and the post-construction 2023 data (Attachment 1). Elevation and volumes changes were used to depict the differences. The four shades of blue, or negative elevation changes, indicate deepening within the creeks. The green to red shades, or positive elevation changes, indicate shallowing or shoaling within the creeks.

5.3 Results

Umbrella Creek near the Dover Bluff docks has deepened from 0 to 9 ft since the cut closure structures were completed when comparing the pre- and post-construction bathymetry in the heat map. Dover Creek, upstream of the ORR cut closure, has shallowed/shoaled from 0-6 ft above where the creek bottom was prior to the cut closure construction. The entire extent of Dover Creek has shoaled from 0-3 ft above pre-construction conditions. Noyes Cut and Dover Creek near Noyes Cut have remained relatively unchanged compared to pre- and year 1 post-construction.

5.4 Summary

Umbrella Creek has experienced significant deepening as a result of the completion of the ORR and Dynamite cut closures. This is beneficial for increased tidal exchange and establishment of a salinity gradient of high to low moving upstream in the creek. Dover Creek has experienced minor shallowing since pre-construction conditions. These results are indicative that the expected, modeled results are being realized without the closure of Noyes Cut. Further deepening is expected as a result of the closure of Noyes Cut in the near future.

6 Conclusion

Comparing the results of the post-construction data with the modeled predictions of Alternative 6, the flux and bathymetry monitoring elements are trending as predicted in the Monitoring Plan goals as described in Section 2.0 of this report. This indicates that the Dynamite Cut and ORR closures are having the predicted effects in terms of natural hydrologic circulation and sediment movement in the Satilla River estuary system without the closure of Noyes Cut. Comparing the results of the post-construction data with the modeled prediction of Alternative 7, the flux and bathymetry monitoring elements are trending as predicted in the Monitoring Plan goals, though not as well as the trends observed when compared with Alternative 6. This indicates that although Noyes Cut has not yet been closed, there may prematurely be beneficial effects in the Satilla River estuary system similar to what was modeled in Alternative 7 regarding hydrologic circulation and sediment movement. However, these benefits observed are not to the predicted and modeled degree of Alternative 7 most likely because Noyes Cut has not yet been closed.

Salinity gradients have not demonstrated improvements when comparing the pre- and post-construction data, nor does the West Tributary Creek post-construction salinity data demonstrate similarity to the Alternative 7 modeled prediction. This may be due to numerous factors, including changes in elevation within the channels due to sedimentation changes and differing data collection times during different tidal cycles, but is determined to primarily be due to the lack of the Noyes Cut closure. Noyes Cut Phase II, closure of Noyes Cut, will be occurring before the final year of post-construction. Year 5 post-construction monitoring will be used to determine the effectiveness of the Noyes Cut closure on the salinity gradient improvement.

Future actions include the potential implementation of Phase II of the project, which involves the closing of Noyes Cut. The next post-construction monitoring event will be occurring in 2025.

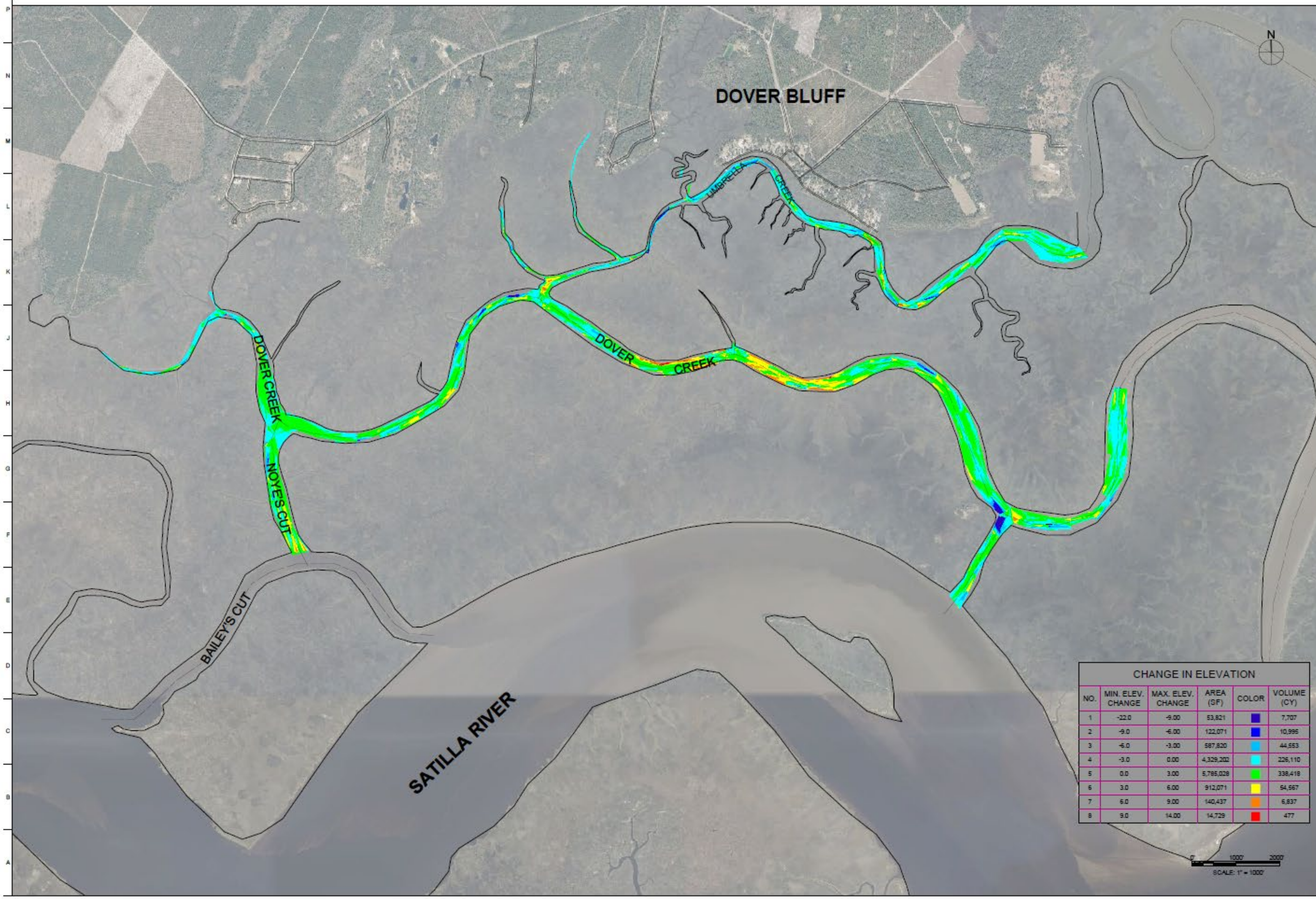
7 Acknowledgments

The Corps would like to acknowledge and thank the USGS for their discharge and water quality data collection efforts completed in 2021 and 2023.

8 References

USACE. 2018. Noyes Cut Section 1135 Modifications for the Improvement of the Environment, Satilla River Basin, Camden County, Georgia Integrated Feasibility Report & Environmental Assessment.

Attachment 1



CHANGE IN ELEVATION					
NO.	MIN. ELEV. CHANGE	MAX. ELEV. CHANGE	AREA (SF)	COLOR	VOLUME (CY)
1	-22.0	-9.00	53,821		7,707
2	-9.0	-6.00	122,071		10,996
3	-6.0	-3.00	587,820		44,553
4	-3.0	0.00	4,329,202		226,110
5	0.0	3.00	5,785,028		338,418
6	3.0	6.00	912,071		54,567
7	6.0	9.00	140,437		6,837
8	9.0	14.00	14,729		477

US Army Corps of Engineers

MARK	DESCRIPTION	DATE

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT
100 W. OGLETHORPE AVE
SAVANNAH, GA 31401

DESIGNED BY: E. WORTMAN	ISSUE DATE: AUGUST 2023
DRAWN BY: E. WORTMAN	SOLICITATION NO.: -
CHECKED BY: L. WILLIAMS	CONTRACT NO.: -
SUBMITTED BY: L. WILLIAMS	CATEGORY CODE: CW0002
SIZE: ANSI D	.

GLYNN COUNTY, GEORGIA
NOYES CUT ECOSYSTEM RESTORATION
FY23

Pre (2020.09) Vs. Post-Construction Survey (2023.07)

SHEET ID

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POST CONSTRUCTION MONITORING