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**Restoration through Planting,  
Houston Point, TX**

Final Report  
Contract No. 528-13-32998



**Restoration through Planting, Houston Point, TX  
Final Report**

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## **Restoration through Planting, Houston Point, TX Final Report**

### **A. Executive Summary**

Past projects have demonstrated and bathymetry surveying indicates that in some locations *Spartina alterniflora* (*Spartina*) is capable of growing successfully at elevations lower than its current elevation range. Examination of aerial photography of the Jumbile Cove Restoration Project Phase II revealed that the width of the marsh fringe varied greatly amongst the different mounds with some mounds appearing to have “plantable” areas below (lower elevations) the natural existing marsh and some planted marsh.

TPWD utilized aerial imagery to select planting locations that appeared to have an appropriate elevation to support *Spartina alterniflora*. For this project Houston Point was selected. After the location was selected a planting scheme (transects and rows) was developed for the project area. Bathymetric survey was performed along the established planting transects so that plant survival could be correlated with an elevation. Additional survey included a coastal boundary survey (CBS), the CBS was performed and approved as required by the Texas General Land Office (GLO).

In total 53,030 linear feet was planted with 21,428 sprigs of *Spartina alterniflora*. The planting densities along the transects and rows differed and were determined by elevations and the likely hood of the planted sprig surviving.

### **B. Introduction**

Past projects have demonstrated and bathymetry surveying indicates that in some locations *Spartina alterniflora* is capable of growing successfully at elevations lower than its current elevation range. Examination of aerial photography of the Jumbile Cove Restoration Project Phase II revealed that the width of the marsh fringe varied greatly amongst the different mounds with some mounds appearing to have “plantable” areas below (lower elevations) the natural existing marsh and some planted marsh. This observation correlated with the fact that the mounds in this area were planted during very different tide levels (high tide vs. a blowout) giving the appearance that *Spartina alterniflora* that was planted at lower elevations during a blowout survived and even thrived at the lower elevations while it also survived and thrived at the higher elevations that were planted. However, it appeared that when *Spartina alterniflora* was planted at the higher elevations the plants did not grow “down” the mound slope and become established at the lower elevations, they only established at the higher elevations. A subsequent survey at Jumbile Cove in preparation for the engineering and design of the Recovery Act: Restoring Estuarine Habitats in West Galveston Bay did demonstrate that *Spartina alterniflora* was growing at lower elevations on the created mounds than in the nature marsh. Other successful planting projects include a previous project at Houston Point and along the north shore of Christmas Bay however, no elevation data was collect with these projects.

To select potential planting areas Texas Parks and Wildlife Department (TPWD) utilized aerial imagery and locations that appeared to have an appropriate elevation to support *Spartina alterniflora* where selected. For this project Houston Point was selected. After the location was selected a planting scheme (transects and rows) was developed for the project area. A bathymetric survey was performed along the established planting transects so that plant survival could be correlated with an elevation. Additional survey included a coastal boundary survey (CBS); the CBS was performed and approved as required by the GLO.

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Initially it was not known if a Coastal Lease (CL) from the GLO would be required. However, after coordinating the project scope and location with the La Porte Field Office in October 2013, TPWD was notified that the GLO would require a CL for the project. TPWD submitted a CL application on December 23, 2013. On January 3, 2014 TPWD received an email from the La Porte Field Office Upper Coast Regional Manager stating, “The attached application is located within the Chambers - Liberty Counties Navigation District and will not require a lease with the GLO at this time.”

When it was determined that the submerged land was under the management of the CLCND instead of the GLO it was unknown if a CBS would still be required however, the GLO informed TPWD that while the project did not require a CL since the submerged lands in under the jurisdiction of the LCCND the state is still the owner of the underlying minerals which established the project under the Natural Resource Code Section 33.136 statute, that requires CBS. The requirement to conduct a CBS was a cost that had already been incorporated into the project and TPWD had already issued a Purchase Order (December 2013) to High Tide Surveying to perform the CBS (and bathymetric survey) based the GLO’s original determination that the project would require a CL.

After being notified that the submerged land was within CLCND’s jurisdiction TPWD contacted General Manager of CLCND with a description of the project. The CLCND provided a coastal easement application on January 9, 2014. The completed application was returned to the CLCND on January 15<sup>th</sup>, the coastal easement returned to TPWD for signature on January 30<sup>th</sup>, and on April 24<sup>th</sup>, the coastal easement was executed.

In June 2014 the completed CBS was approved by the GLO. On June 6<sup>th</sup> a Request for Proposals (RFP) for Aquatic Harvesting and Planting of Smooth Cordgrass within Galveston Bay at Houston Point, Chambers County, Texas was advertised. The RFP was advertised for 14 days. Three vendors submitted proposal, with total projects cost ranging from \$37,485 to \$89,250, the most qualified low bidder was Apache Ecological Services, Inc. (Apache) A Purchase Order (PO) was issued to Apache on July 21, 2014. The issued PO increased the number of planted *Spartina alterniflora* sprigs to be planted from 17,850 to 21,428 which increased to overall cost of the PO to \$44,998.80. Increasing number of planted *Spartina alterniflora* sprigs to be planted was done to utilize the entire remaining funds allocated to the project and to expand the planting areas on the ground.

In total 53,030 linear feet was planted with 21,428 sprigs of *Spartina alterniflora*. The planting densities along the transects and rows differed and were determined by existing elevations and the likely hood of the planted sprig surviving.

### **C. Project Methodology**

To select potential planting areas Texas Parks and Wildlife Department (TPWD) utilized aerial imagery and locations that appeared to have an appropriate elevation to support *Spartina alterniflora*. Once the planting location (Houston Point) was selected a planting scheme (transects and rows) was developed for the project area. The planting densities along the transects and rows differed and were determined by existing elevations and the likely hood of the planted sprig surviving. The transects were planted in replicates (rows) to help determine if non-

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survival of a planted sprig was due to the water depth or the planted sprig not surviving due to transplant shock. A bathymetric survey was performed along the established planting transects so that plant survival could be correlated with an elevation.

Apache was required to harvest 21,248 planting units of *Spartina alterniflora* from the NRG Energy Eco-Center (NRG) transport them and plant them at Houston Point, in accordance with the following specifications (Appendix A: Figure 1-Planting Transects Overview). The surveyed planting transects were delineated in the field with PVC pipe approximately every one-hundred (100) feet. A plant unit was defined as a healthy, well-rooted live plant with a minimum of three (3) live stems.

- Planting transect #'s 1, 2, 3, 5, 6 and 7 were planted with three (3) rows on three (3)-foot-centers five (5) feet apart paralleling the transect (Appendix A: Figure 2-Planting Details).
- Planting transects #4 and #4A were be planted with twenty (20) rows on two (2)-foot-centers, five (5) feet apart paralleling the transect (Appendix A: Figure 3-Planting Details). Planting transects #4A have no water depth data.
- Planting transect #'s 8, 9 and 10 were be planted with three (3) rows on three (3)-foot-centers, five (5) feet apart paralleling the transect (Appendix A: Figure 4-Planting Details). These planting rows have no water depth data.
- Planting rows #'s 1, 2, 3, 5, 6, 8, and 9 were planted (5) feet apart paralleling the one another on three (3)-foot-centers (Appendix A: Figure 5-Planting Details). These planting rows have no water depth data.

Apache submitted reports tracking daily activities on a weekly basis via email to the TPWD Project Manager. The report provides the day/date and number of plants harvested; the day/date and number of plants transported; the day/date and number of plants planted; the day/date and number of plants each planting transect was planted (Appendix B-Daily Planting Reports).

TPWD conducted a site visit to the project area on August 25, 2014 to verify that all of the planting was performed in accordance with the specifications of the issued PO. Pictures are providing in Appendix C.

### **D. Project Results**

In total 53,030 linear feet, eleven (11) transects with multiple rows and nine (9) rows) were planted with 21,428 sprigs of *Spartina alterniflora*.

A site visit to assess survival and growth in comparison to elevation was conducted on April 30, 2015. Pictures comparing the transects from the initial site visit conducted on August 25, 2014 and a follow-up site visit conducted on April 30, 2015 are provided in Appendix C. Provided below is a table summarizing of the outcome of the planted transects and rows.

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**Table 1. Summary of Transect and Row Success**

Transect #/Row #	Elevations with plant survival /growth (NAVD88)	~Distance of vegetation from shoreline (feet)	Overall condition of plants
Transect 1	-0.14	35	Fair, plants increased their stem density. Only a small portion of the transect has successful plant growth.
Transect 2	-0.07	35	Poor, plants have only minimally increased their stem density. Only a small portion of the transect has successful plant growth.
Transect 3	No elevation reference in close proximity to surviving plants	5	Extremely poor, only one surviving plant unit.
Transect 4	1.41, 1.27, 0.66, 3.35, 0.46, 0.12	485	Extremely good, all surviving plants have significantly increased their stem density along the entire transect. In some areas it is impossible to differentiate the planted rows. The row has been impacted by heavy equipment that created a 30-foot gap in the vegetation.
Transect 4a	no elevation data along this transect	40	Good, plants have significantly increased their stem density. However, only a small portion of the transect has successful plant growth
Transect 5	No elevation reference in close proximity to surviving plant	10	Extremely poor, only one surviving plant unit
Transect 6	0.31	100	Fair, plants increased their stem density. However, only a small portion of the transect has successful plant growth.
Transect 7	-0.3	40	Poor, only three surviving plant units. Plants have only minimally increased their stem density. Only a small portion of the transect has successful plant growth.
Transect 8	no elevation data along this transect	55	Good, plants have significantly increased their stem density. However, only a small portion of the transect has successful plant growth.
Transect 9	no elevation data along this transect	260	Good, plants have significantly increased their stem density. However, less than half of the transect has successful plant growth. Two isolated clumps are surviving along the transect, each clump is very healthy.

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Transect 10	no elevation data along this transect	350	Good, plants have significantly increased their stem density. However, less than half of the transect has successful plant growth. In some areas it is impossible to differentiate the planted rows. The row has been impacted by heavy equipment that crated a 40-foot gap in the vegetation.
Rows 1-9	no elevation data	NA	Extremely poor, only 8 surviving plant units. Each plant unit sparse in stem density, plants do not seem to have increased in stem density.

**E. Project Conclusions and Lessons Learned**

Overall the project was successful and did demonstrate that *Spartina alterniflora* is capable of growing successfully at elevations lower than its current elevation range at Houston Point. The most successful transect was Transect 4 supporting successful *Spartina* growth at elevations 1.41, 1.27, 0.66, 3.35, 0.46, 0.12 NAVD88. However, there were some transects and rows that where expected to successfully support *Spartina* that did not, particularly Transects 5, 6, and 7 and Rows 1-9. Evaluating their location within the project area (protected from ship wake) and utilizing the elevation data and successful plant growth at other projects (Jumbile Cove) it was expected that the elevations along these transects and rows should have supported *Spartina*, at minimum a higher success than what was experienced was expected.

One possible explanation for the lack of success of *Spartina* growth at Transects 5, 6, and 7 and Rows 1-9 was a crude oil spill that occurred within the project area in October of 2014. Transect 7 was initially boomed inside the product spill until the TPWD Spills and Kills Region 4 Response Biologist conducted a site assessment and had the responsible party relocate the boom so that Transect 7 was not located with the spill boundary. The crude oil was successfully contained within a small area of Houston Point however; the exact boundary and potential impacts from the spill are not known. The eastern shoreline along Transects 5, 6 and 7 does appear to have experienced a vegetation die-off (Appendix C, Figures 48 and 49) however the cause is unknown.

Transects 4a, 8, 9, and 10 are the other transects that where expected to successfully support *Spartina* that did support *Spartina* but not as successfully as expected. The plants along these transects did significantly increase their stem density however, only small portions of the transect had successful plant growth. Comparing the elevation of theses portions of the transects that did not support *Spartina* to Transect 4 (a transect that supported *Spartina* along its entire length) it does not seem that the lack of successful *Spartina* growth is due to elevation, deeper elevations along Transect 4 are supporting *Spartina*. One potential explanation for the lack of success along Transect 4a and 8 are their exposure to ship wake however, Transects 9 and 10 are not exposed to ship wake. A potential explanation for the lack of success along Transects 9 and 10 is the large quantity of bird roosting that occurs in this area, potentially trampling the transplanted *Spartina*.

The minimal success of Transects 1, 2 and 3 is likely due to the constant ship wake that hits this shoreline (Appendix C, Figure 9 and 9) and the water depths being too deep to successfully

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support *Spartina* along the three transects. The ship wake likely contributes to the deeper depths in this area.

Other impacts that did occur to transects was damage to the vegetation along Transects 4 and 9 from wide tracked equipment. The equipment very likely directly damaged the vegetation affecting its successful growth along that portion of the transect. The equipment also altered the elevation within in its track, lowering the elevation approximately six inches. The equipment tracts also created a focus point for tidal ingress and egress that also likely affected the vegetation's ability to successfully survive in this area.

The transects to be surveyed and planted where selected utilizing aerial imagery and its color signatures prior to any on-the-ground activities. The number of transect selected to be surveyed and planted were based on estimating project cost and project budget. In future projects it would be beneficial to identify and survey a multitude of transects in order to ensure that each transect that is planted has elevation data associated with it. In this project four (4) transects and nine (9) rows did not have any elevation data, in fact these transects and rows where added to the project after the initial planting cost proposal was received. The issued PO increased the number of planted *Spartina alterniflora* sprigs to be planted from 17,850 to 21,428 to utilize the entire remaining funds allocated to the project and to expand the planting areas on the ground. Adding additional transects to be surveyed would have likely added very little additional cost to the overall surveying cost of the project and would allow for selectively choosing transects (i.e. elevations) to be planted in order to optimize success.

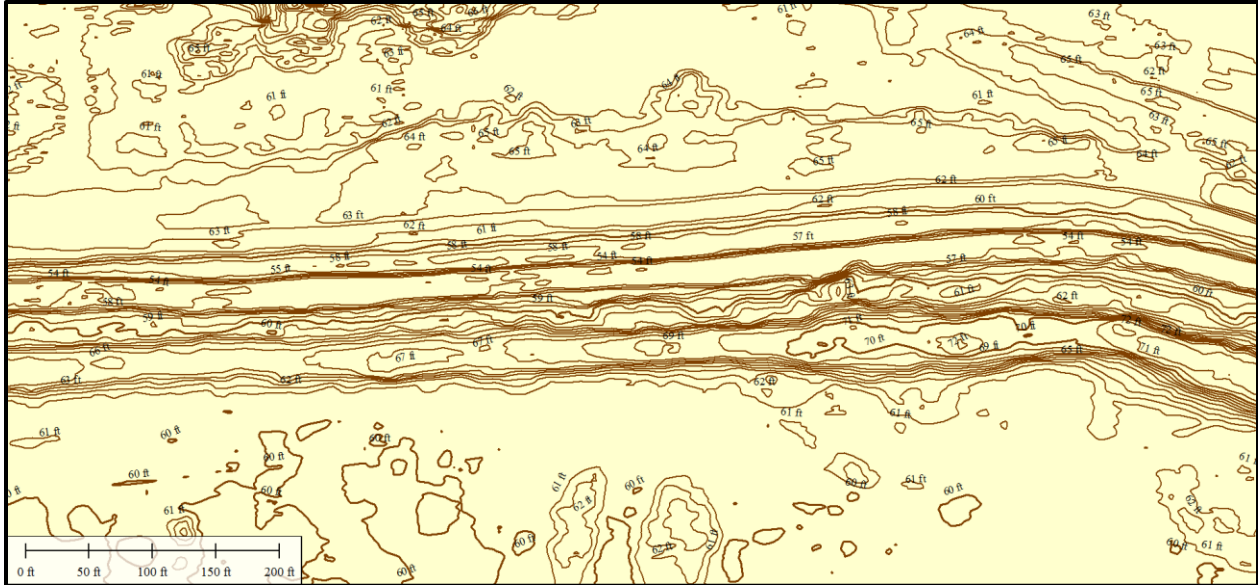
A new surveying technique, Low Altitude Aerial Scanning (LAAS) is a surveying technique that performs and creates a highly detailed topographic survey. A project surveyed using this technique in Brazoria County surveyed 12.5 Miles of canal, acquiring data at a rate of 1/2 acre per second, taking approximately 22 minutes, and collecting approximately 47 million survey points, utilizing only one ground survey control point and completing the data collection in one day. Approximately two weeks after the field work was completed, a ground classified data point file, 3-dimensional digital terrain model, contour map in .dwg format (Figure 1), and GIS grid file where created and transmitted to the client via email as well as on a flash drive.

The LAAS data collecting equipment has the ability to penetrate vegetative cover and is survey grade with horizontal and vertical accuracies on the order of 0.2 feet. Low altitude aerial scanning technology can also be utilized for the mapping of railroads, highways, utility corridors, large acreage tracts, and levee systems. Compared to traditional surveying techniques, this method provides a greatly increased amount of survey data at a fraction of the time and is significantly more cost effective.

Future planting projects could utilize this technique to create detailed contour maps and create planting zones that would optimize the success of a project. One potential drawback is that this technique cannot collect data through a water column however, appropriately timed projects could take advantage of winter fronts that cause "blow-outs", removing the water from an area so that the area can be successfully surveyed utilizing the LAAS technique.



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**Figure 1. Contour Map Created Utilizing Low Altitude Aerial Scanning.**

The LAAS technique utilized for the Brazoria County project described above was performed by High Tide Land Surveying, LLC (HTS). HTS is one of very few Texas Licensed State Land Surveyor (LSLS), which is a Registered Professional Land Surveyor additionally licensed to determine the location or relocation of original land grant boundaries and corners, and to prepare field note descriptions of land in which the state or permanent school fund has an interest, also known as Coastal Boundary Surveys.

The GLO's survey division has stated that they are receptive to the use of the new technologies available. Therefore CBS and topographic/bathymetric surveying data collection could be performed in a single data collection effort.

The Restoration Through Planting at Houston Point, TX Project and other planting projects have demonstrated that the saying "if the plant wanted to be there it would be there" is not an accurate statement about *Spartina alterniflora*. Utilizing this technique (i.e. planting) is an extremely cost effective and successful restoration technique. This technique eliminates the need and cost of engineering and design work, U.S. Army Corps of Engineers Section 404 and Section 10 permit requirements, and construction activities (e.g. hydraulic dredges). In most areas Coastal Boundary Surveying (CBS) and Coastal Leasing from the GLO or the local submerged bottom landowner/manager would still be required.

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**APPENDIX A – Planting Scheme**

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Figure 2. Planting transects Overview

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**Figure 3. Planting Details of Planting Transects 1, 2, 3, 5, 6, and 7.**

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**Figure 4. Planting Details of Planting Transects 4 and 4A.**

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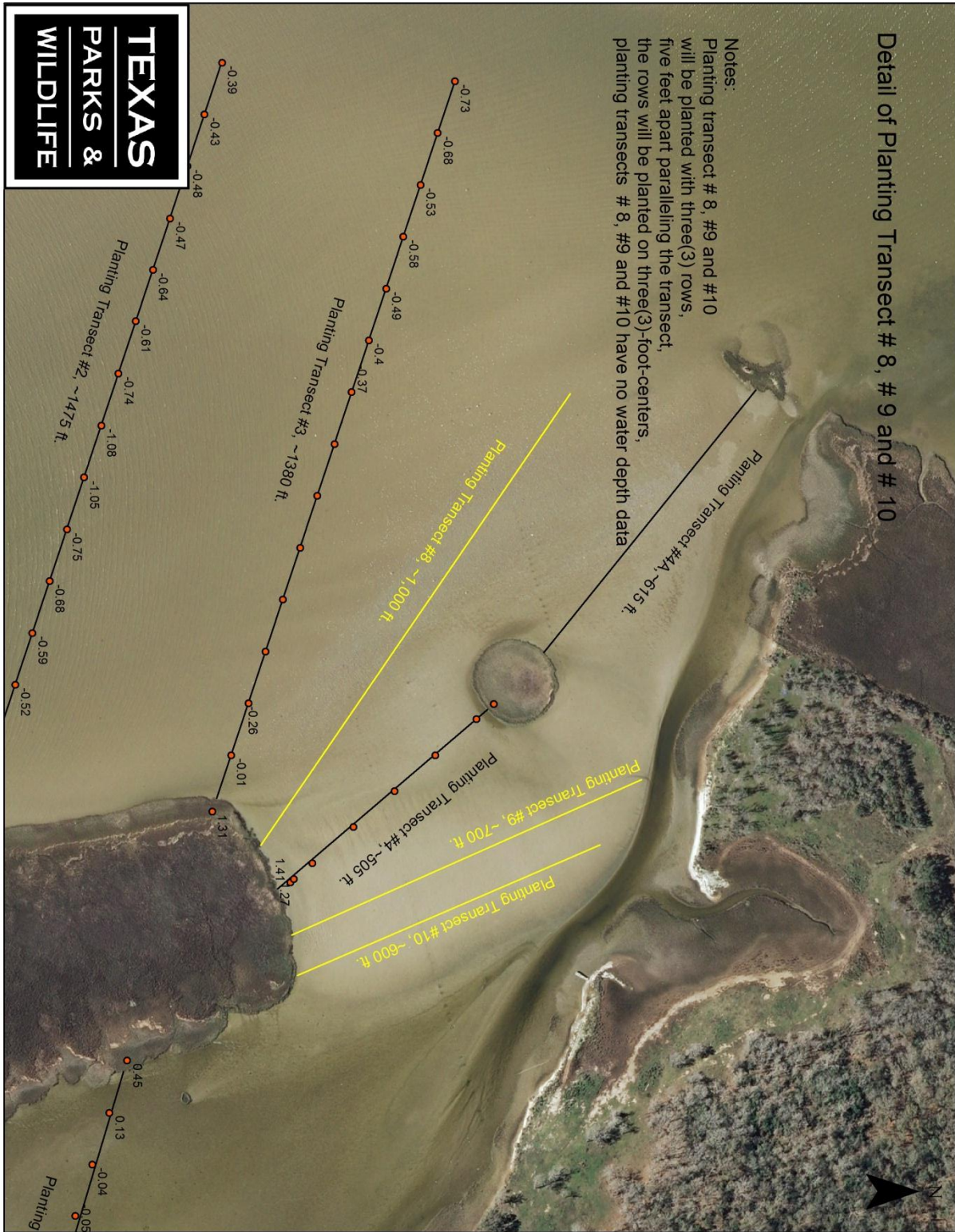


Figure 5. Planting Details of Planting Transects 8, 9, and 10.

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**Figure 5a. Planting Details of Planting Rows 1, 2, 3, 5, 6, 7, 8, and 9.**

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**APPENDIX B – Daily Planting Reports**



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Texas Parks and Wildlife Department  
Harvest and Planting at Houston Point, Chambers County  
RFP 802-14-26504

Wetland Planting Daily Report

Date: 8-4-14

Report Number: 01

Number of Plants Harvested and Transported: HARVESTED 24 BUCKETS  
FROM NRG

Number of Plants Planted: 0

Location of Plants Planted: N/A

Total Plants Planted to Date: 0

Percent Project Complete: 0

Weather: WARM

Comments:

Submitted By: Apache Ecological Service, Inc.

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Texas Parks and Wildlife Department  
Harvest and Planting at Houston Point, Chambers County  
RFP 802-14-26504

Wetland Planting Daily Report

Date: 8-5-14

Report Number: 02

Number of Plants Harvested and Transported: 0

Number of Plants Planted: 4355

Location of Plants Planted: TRANSECTS 1, 2+3 COMPLETED

Total Plants Planted to Date: 4355

Percent Project Complete: 20.3%

Weather: WARM LIGHT WIND

Comments:

Submitted By: Apache Ecological Service, Inc.

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Texas Parks and Wildlife Department  
Harvest and Planting at Houston Point, Chambers County  
RFP 802-14-26504

Wetland Planting Daily Report

Date: 8-6-14

Report Number: 03

Number of Plants Harvested and Transported: 37 BUCKETS

Number of Plants Planted: 0

Location of Plants Planted: N/A

Total Plants Planted to Date: 4355

Percent Project Complete: 20-390

Weather: HOT

Comments:

Submitted By: Apache Ecological Service, Inc.

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Texas Parks and Wildlife Department  
Harvest and Planting at Houston Point, Chambers County  
RFP 802-14-26504

Wetland Planting Daily Report

Date: 8-7-14

Report Number: 04

Number of Plants Harvested and Transported: 0

Number of Plants Planted: 5050

Location of Plants Planted: TRANSECT 4 COMPLETED

Total Plants Planted to Date: 9405

Percent Project Complete: 43.8%

Weather: WARM LIGHT WIND

Comments:

Submitted By: Apache Ecological Service, Inc.

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Texas Parks and Wildlife Department  
Harvest and Planting at Houston Point, Chambers County  
RFP 802-14-26504

Wetland Planting Daily Report

Date: 8-11-14

Report Number: 05

Number of Plants Harvested and Transported: 0

Number of Plants Planted: 4305

Location of Plants Planted: TRANSECT 4A

Total Plants Planted to Date: 13710

Percent Project Complete: 6490

Weather: WARM, WINDY

Comments:

Submitted By: Apache Ecological Service, Inc.

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Texas Parks and Wildlife Department  
Harvest and Planting at Houston Point, Chambers County  
RFP 802-14-26504

Wetland Planting Daily Report

Date: 8-12-14

Report Number: 06

Number of Plants Harvested and Transported: 35 Buckets

Number of Plants Planted: 0

Location of Plants Planted: N/A

Total Plants Planted to Date: 13710

Percent Project Complete: 64.90

Weather: HOT, AFTERNOON STORM

Comments:

Submitted By: Apache Ecological Service, Inc.

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Texas Parks and Wildlife Department  
Harvest and Planting at Houston Point, Chambers County  
RFP 802-14-26504

Wetland Planting Daily Report

Date: 8-13-14

Report Number: 07

Number of Plants Harvested and Transported: 12 BUCKETS

Number of Plants Planted: 3930

Location of Plants Planted: TRANSECTS 4A, 8, 9+10  
STARTED 5

Total Plants Planted to Date:

Percent Project Complete: 17,640

Weather: HOT, SUNNY LIGHT WIND

Comments: TRANSECT 5 SOFT SEDIMENT  
TIDE LOW

Submitted By: Apache Ecological Service, Inc.

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Texas Parks and Wildlife Department  
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RFP 802-14-26504

Wetland Planting Daily Report

Date: 8-14-14

Report Number: 08

Number of Plants Harvested and Transported: 0

Number of Plants Planted: 3790

Location of Plants Planted: Rows 1-9, TRAJECTS 5,6+7

Total Plants Planted to Date: 21,430

Percent Project Complete: 100%

Weather: HOT, AFTERNOON SHOWER, LOW TIDE

Comments: TRAJECTS 56+7 VERY CHALLENGING  
DUE TO SOFT SEDIMENT

PROJECT FINISHED TODAY

Submitted By: Apache Ecological Service, Inc.



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**APPENDIX C – August 25, 2014 and April 30, 2015 Site Visit Pictures**  
(directions are general directions not true compass direction )

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**Figure 6. Transect 1, east to west. August 25, 2014.**



**Figure 7. Transect 1, east to west April 30, 2015.**

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**Figure 8. Transect 1 being hit by ship wake. April 30, 2015.**



**Figure 9. Transect 1 being hit by ship wake. April 30, 2015.**

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**Figure 10. Transect 2, east to west. August 25, 2014.**



**Figure 11. Transect 2, east to west. April 30, 2015.**

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**Figure 12. Transect 3, east to west. August 25, 2014,**



**Figure 13. Transect 3, west to east.**

**Transect 3, east to west. August 25, 2014.**

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**Figure 14. Transect 5, west to east. August 25, 2014.**



**Figure 15. Transect 5, west to east. April 30, 2015.**

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**Figure 16. Transect 7, rows 1-9 intersecting it. August 25, 2014.**



**Figure 17. Transect 7, rows 1-9 can no longer be seen intersecting it. April 30, 2015.**

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**Figure 18. Rows 1-9, intersecting Transect 6. August 25, 2014.**



**Figure 19. Transect 6, rows 1-9 can no longer be seen intersecting it. April 30, 2015.**



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**Figure 20. Rows 1-9 are not visible, approximately 5 surviving planting units. April 30, 2015.**



**Figure 21. Rows 1-9 are not visible, approximately 5 surviving planting units. April 30, 2015.**

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**Figure 22. Transect 10, south to north. August 25, 2014.**



**Figure 23. Transect 10, south to north. Note the gap in vegetation. April 30, 2015.**

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**Figure 24. Transect 10, south to north. Note the suitable elevation and seedlings east of the transect. April 30, 2015.**



**Figure 25. Transect 10, north to south. Note the suitable elevation on each side of the transect. April 30, 2015.**

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**Figure 26. Transect 9, north to south. August 25, 2014.**



**Figure 27. Transect 9, north to south. April 30, 2015.**

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**Figure 28. Transect 9, south to north. August 25, 2014.**



**Figure 29. Transect 9, north to south. April 30, 2015**

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**Figure 30. Transect 4, south to north. August 25, 2014.**



**Figure 31. Transect 4, south to north. April 30, 2015.**

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**Figure 32. Transect 4, south to north. August 25, 2014**



**Figure 33. Transect 4, south to north. April 30, 2015.**

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**Figure 34. Transect 4, north to south. August 25, 2014.**



**Figure 35. Transect 4, north to south. April 30, 2015**



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**Figure 36. Transect 4, west to east. August 25, 2015.**



**Figure 37. Transect 4, west to east. Transect 8 in foreground. April 30, 2015.**

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**Figure 38. Transect 4, west to east. August 25, 2014.**



**Figure 39. Transect 4, west to east. April 30, 2015.**

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**Figure 40. Transect 4, south to north.**



**Figure 41. Transect 4, south to north. April 30, 2015.**

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**Figure 42. Transect 4a, south to north. August 25, 2014.**



**Figure 43. Transect 4a, north to south. August 25, 2014.**

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**Figure 44. Transect 4a, west to east. August 25, 2014.**



**Figure 45. Transect 4a, west to east. April 30, 2015.**

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**Figure 46. Transect 4a, west to east. Note the PVC pole. August 25, 2014.**



**Figure 47. Transect 4a, west to east. Note the PVC pole. April 30, 2015.**

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**Figure 48. Marsh die-off along the eastern shoreline (this picture is adjacent to Transect 7). April 30, 2015.**



**Figure 49. Marsh die-off along the eastern shoreline (this picture is adjacent to Transect 7). April 30, 2015.**