# PROJECT COMPLETION REPORT

**Project Name: WEST BELLE PASS BARRIER HEADLAND RESTORATION PROJECT**

**State Project No. TE-52**

**Report Date: August 21, 2013** **By: Coastal Planning & Engineering, Inc.**

## 1. Project Managers/Contracting Officer

| | | |
|---|---|---|
| CPRA Project Manager: | Kenneth Bahlinger | Tel: (225) 342-7362 |
| CPRA Construction Project Manager: | Shane Triche | Tel: (985) 449-5073 |
| NOAA Project Manager: | Phillip Parker, P.E. | Tel: (225) 578-8341 |
| CPE Project Manager: | Gordon Thomson, P.E. | Tel: (561) 391-8102 |
| CPE Engineer of Record: | Gordon Thomson, P.E. | Tel: (561) 391-8102 |
| CPE Construction Observers: | Julien Devisse<br>Byron "Sonny" Eells | Tel: (561) 391-8102<br>Tel: (985) 868-3434 |

## 2. Location and Description of the Project as Contained in the Louisiana Coastal Wetlands Conservation and Restoration Task Force

The project is located along the Chenier Caminada headland to the west of Belle Pass, at the southeastern edge of Timbalier Bay in Lafourche Parish, Louisiana.

This headland experiences some of the highest shoreline retreat rates in the nation, measuring over 100 feet a year in some locations. As the gulf encroaches upon the shoreline, sand is removed and the headland erodes. What was once a continuous shoreline spanning several miles has been reduced to less than half its original length. Furthermore, Hurricanes Katrina and Rita removed most of the emergent headland and dunes west of the pass. This headland helps provide protection to interior marshes and the Port Fourchon area; however, its continued degradation threatens the fragile bay habitat and infrastructure it once protected.

This project will reestablish the West Belle Pass Barrier Headland by rebuilding a large portion of the beach, dune, and back barrier marsh that once existed. Approximately 9,300 feet of beach and dune will be rebuilt using nearly 2 million cubic yards of dredged sand, and 150 acres of marsh habitat will be rebuilt using nearly 1 million cubic yards of dredged material. Native vegetation will be planted upon construction to help stabilize the rebuilt marsh and dune habitat.

## 3. Final As-Built Features, Boundaries, and Resulting Acreages

The Contractor, Weeks Marine, Inc. was paid for the excavation of 2,744,745 cubic yards of beach fill and 1,416,481 cubic yards of marsh fill. However, the Contractor dredged below the sand borrow area limit but within the allowance for equipment and the total volume excavated was approximately 2,789,000 cubic yards of beach fill. Minor overdredging (6,043 cubic yards) occurred within the marsh borrow area. The total volume of material measured within the constructed beach template was approximately 2,024,252 cubic yards and approximately 2,060,208 cubic yards were measured within the marsh template, as computed using the Surfer program. Summaries of the pit-to-fill ratio (Table 1) and pit-to-pay ratio (Table 2) for each of the borrow areas are shown below.

**Table 1**
**Borrow Area Pit-to-Fill Ratios.**

| Borrow Area | Placement Area | Volume Excavated (cy) | Volume Placed (cy) | Pit-to-Fill Ratio |
|---|---|---|---|---|
| Sand Borrow Area | Beach | 2,789,000 | 2,024,252 | 1.38 |
| Marsh Borrow Area | Marsh | 1,422,524 | 2,060,208 | 0.69 |

**Table 2**
**Borrow Area Pit-to-Pay Ratios.**

| Borrow Area | Placement Area | Volume Excavated (cy) | Pay Volume (cy) | Pit-to-Pay Ratio |
|---|---|---|---|---|
| Sand Borrow Area | Beach | 2,789,000 | 2,744,745 | 1.02 |
| Marsh Borrow Area | Marsh | 1,422,524 | 1,416,481 | 1.00 |

Beach fill was placed continuously along the length of the gulf shoreline of the project area. The fill had a berm crest elevation of approximately +6.5 feet (NAVD) from Sta 45+00 to 101+50, +7.5 feet (NAVD) from Sta 101+50 to 130+00 (Change Order #3) and +4.5 from Sta 130+00 to 150+00 (Change Order #4). The maximum berm crest width was 293 feet. The landward beach face was constructed with a slope of 1V:30H from the top of the berm crest to the pre-construction grade. The seaward beach face was constructed with a slope of 1V:30H from the top of the berm to +1 feet (NAVD) and a slope of 1V:60H from the +1 feet (NAVD) to the pre-construction grade.

Marsh fill was placed between the constructed dune and primary dike along the length of the headland to an elevation of approximately +3.3 to +5.5 feet (NAVD). Marsh fill material was placed after completion of the beach so that the beach fill could act as the southern containment dike. The maximum width of the constructed marsh platform was 2,083 feet, which occurred near the east end of the island along Sta 110+00.

Sand fencing was installed along the length of the constructed dune. A single row of fence was installed along the berm crest between Sta 46+43 and Sta 146+34. Sand fence was re-installed between Sta 53+36 and Sta 59+55 due to damages incurred by Hurricane Isaac (Change Order #4). Additional sections of sand fence that were damaged during Hurricane Isaac throughout the beach fill area were also repaired.

The fence was comprised of 450-foot sections with 30 feet of overlap between adjacent sections. At the overlaps, the sections were offset 8 feet to allow passage through the fence from the Gulf shoreline to the backing marsh habitats. The total length of installed sand fence was approximately 12,352 feet.

A total of 10 settlement plates were installed to quantify the settlement and consolidation of the placed material on top of existing sediments. Four plates were installed along the dune crest centerline, three plates were installed within the marsh footprint, two plates were installed along the centerline of the primary containment dike and one plate was installed along the flotation channel centerline. The plates were installed during construction, but prior to the placement of fill material.

The as-built drawings are attached. These drawings detail the elevation and location of the placed beach and marsh fill, post-construction condition of the borrow areas, the location of the installed sand fence and settlement plates, and location of the analyzed sand samples.

Beach and marsh acreages were computed to quantify project benefits. Along the landward boundary, the most northern extents of the constructed toe of the primary dike and the construction template defined the northern horizontal limit used to quantify the project benefits. Along the seaward boundary, the most southern extent of the constructed toe of the beach fill and the construction template defined the southern horizontal limit. The intersection of the marsh and beach templates north of the landward dune crest defines the northern and southern extents of the beach and marsh, respectively. Land south of this contour with an elevation above 0.0 feet (NAVD) was considered beach, while land to the north with an elevation above -1.5 feet (NAVD) was considered marsh. Approximately 182.8 acres of beach and 333.8 acres of marsh existed within the project area immediately following construction.

**Actual Benefited Acres:** **182.8 acres of constructed beach**
**333.8 acres of created marsh**

## 4. Habitat Acreages

Barrier island shoreline projects are evaluated for environmental benefits using quantitative projections of plan form performance. Performance is quantified using habitat acreage descriptions for the wetland value assessment (WVA). The range of various habitat elevations and associated descriptions are defined in Table 3. The habitat acreages were calculated for the pre-construction, post-construction, and design template conditions to assist in future WVA calculations.

**Table 3**
**Habitat Acreage Descriptions**

| Habitat | Description |
|---|---|
| Dune | ≥ +5 feet, NAVD<br>The portions of the dune platform anticipated to be within the elevation range. |
| Supratidal | ≥ +2 feet to < +5 feet, NAVD<br>Beach berms and portions of the fore and back slope of the dune within the elevation range. Also includes primary retention / containment dikes for the period anticipated to remain in the elevation range. Generally includes a major portion of the marsh platform until the time dewatering and consolidation reduce the elevation to intertidal. |
| Gulf Intertidal | ≥ 0 feet to < +2.0 feet, NAVD<br>Gulf side beach slope / shallow open water. |
| Bay Intertidal | ≥ 0 feet to < +2.0 feet, NAVD<br>Bayside elevations including vegetated wetlands, flats and bayside open water areas. |
| Subtidal | ≥ -1.5 feet to < 0.0 feet, NAVD or 1,000 feet bayward of the 0.0 feet contour.<br>Shallow Open water bayside area only. |

The construction template (including beach and dune and marsh) defined the horizontal limits of the WVA. Intertidal acreages calculated north of the constructed dune were assumed to be Bay Intertidal. Intertidal acreages calculated south of the constructed dune along the Gulf shoreline were assumed to be Gulf Intertidal. The post-construction survey data was utilized to create a surface in AutoCAD Civil 3D. The acreages were delineated and summarized for each habitat description based on the post-construction surface. The spit at the west end was assumed to be Gulf Intertidal and was digitized utilizing the post-construction aerial (December 11, 2012).

**Table 4**
**Habitat Acreages**

| Habitat Type | Pre-Construction Acreage | Template Acreage | Post-Construction Acreage |
|---|---|---|---|
| Dune | 0.0 | 58.4 | 76.1 |
| Supratidal | 34.1 | 372.8 | 364.5 |
| Gulf Intertidal | 10.0 | 15.3 | 63.0 |
| Bay Intertidal | 120.0 | 3.2 | 6.6 |
| Subtidal | 133.3 | 1.4 | 6.3 |
| **Total:** | 297.4 | 451.0 | 487.0 |

Assumptions:

1. The outer boundary of the construction footprint and construction template defines the WVA horizontal limits.
2. Intertidal acreages calculated north of the constructed dune are assumed to be Bay Intertidal.
3. Intertidal acreages calculated south of the constructed dune are assumed to be Gulf Intertidal.
4. The constructed spit at west end of project was assumed to be Gulf Intertidal.

## 5. Key Project Cost Elements

**Table 5**
**Key Project Cost Elements**

| Project Element | Project Cost Estimate | Cost Incurred as of Construction Completion |
|---|---|---|
| Construction | $27,703,778.00 | $31,515,562.74 |
| Engineering & Design | $1,806,661.00 | $1,752,868.00 |
| Observation / Contract Administration | $420,711.00 | $685,590.00 |
| Total | $29,931,150.00 | $33,954,020.74 |

## 6. Items of Work Construction, Final Quantities, and Monetary Amounts

**Table 6**
**Items of Work Construction, Final Quantities, and Monetary Amounts**

| Item No. | Item Description | Bid Quantity | Unit | Construction Estimate | | Bid | | Final | | % Final Over / Under Estimate |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Price | Amount | Unit Price | Amount | Quantity | Amount | |
| 1 | Mobilization & Demobilization | 1 | Job | $4,000,000.00 | $4,000,000.00 | $3,350,000.00 | $3,350,000.00 | 1 | $3,350,000.00 | -16% |
| 2 | Beach and Dune Fill | 1,738,500 | CY | $7.13 | $12,395,505.00 | $7.85 | $13,647,225.00 | 2,744,745 | $21,546,248.25 | 74% |
| 3 | Marsh Fill | 3,058,500 | CY | $3.23 | $9,878,955.00 | $3.25 | $9,940,125.00 | 1,416,481 | $4,603,563.25 | -53% |
| 4 | Primary Containment Dikes | 8,600 | LF | $107.53 | $924,758.00 | $150.00 | $1,290,000.00 | 8,545 | $1,281,750.00 | 39% |
| 5 | Sand Fencing | 10,660 | LF | $16.00 | $170,560.00 | $6.50 | $69,290.00 | 12,352 | $80,288.00 | -53% |
| 6 | Settlement Plates | 10 | EA | $3,400.00 | $34,000.00 | $3,000.00 | $30,000.00 | 10 | $30,000.00 | -12% |
| 7 | Pre-Construction Survey | 1 | Job | $100,000.00 | $100,000.00 | $125,000.00 | $125,000.00 | 1 | $125,000.00 | 25% |
| 8 | As-Built Survey | 1 | Job | $200,000.00 | $200,000.00 | $100,000.00 | $100,000.00 | 1 | $100,000.00 | -50% |
| | **Sub-Total of Bid Items** | | | | **$27,703,778.00** | | **$28,551,640.00** | | **$31,116,849.50** | **12%** |
| 9 | Post Isaac Survey | 1 | LS | | | $27,058.40 | $27,058.40 | 1 | $27,058.40 | |
| 10 | Primary Dike Breach Closure | 1 | LS | | | $326,103.34 | $326,103.34 | 1 | $326,103.34 | |
| 11 | Beach Breach Repair | 3 | Day | | | $10,030.00 | $30,090.00 | 3 | $30,090.00 | |
| 12 | Post Isaac Sand Fence Repair | 1 | LS | | | $13,211.50 | $13,211.50 | 1 | $13,211.50 | |
| | **Total** | | | | **$27,703,778.00** | | **$28,948,103.24** | | **$31,513,312.74** | **14%** |

## 7. Construction and Construction Oversight

| | |
|---|---|
| Prime Construction Contractor | Weeks Marine, Inc. |
| Subcontractor (Pre-Construction Survey) | Hydroterra Technologies, Inc. |
| Subcontractor (Post-Construction Survey) | Hydroterra Technologies, Inc. |
| Subcontractor (Sand Fence Installation) | Mitch's Landscaping, Inc. |
| Subcontractor (Primary Dike Breach Repair) | Wilco Marsh Buggies & Draglines, Inc. |
| Original Construction Contract | $28,551,640.00 |
| Change Orders | $2,961,672.74 |
| Final Construction Contract | $31,513,312.74 |

## 8. Oversight and Administration for Construction

| | |
|---|---|
| Construction Oversight Contractor | Coastal Planning & Engineering, Inc. |
| Final Amount | $685,590.00 |

## 9. Major Equipment Used

Weeks Marine, Inc.

- 30" Cutterhead Dredge "Capt. Frank"
- 30" Cutterhead Dredge "E.W. Ellefsen"
- 4600 Manitowoc Bucket Dredge 646
- Quarters Barge
- Tug Boats
- 3 Crew Boats
- 1 Crane Barge
- 1 Survey Skiff
- 6 D-6 Bulldozers
- 5 Marsh Buggies
- 1 Front End Loader

## 10. Construction Sequence

*Pre-Construction Survey (October 25, 2011 – April 25, 2012)*
Hydroterra Technologies, a subcontractor for Weeks Marine, surveyed the project area prior to construction. A total of 20 beach lines and 17 marsh lines were surveyed in October 2011. The beach and marsh lines were spaced 500 feet apart along the baseline. The beach lines extended 500 seaward of the seaward toe of the beach template and tied into the marsh lines. The marsh lines extended 150 feet north of the northern toe of the primary dike template. The pre-construction survey data was used by the Government to update the construction plans and prepare the final cross-sections.

Hydrographic surveys of the sand and marsh borrow areas were also conducted. These surveys were conducted concurrently with construction and prior to the borrow area being dredged. The pre-construction survey for the sand borrow area was conducted from December 2011 to March 2012. The pre-construction survey of the marsh borrow area was conducted from April 11 to 25, 2012. The surveys were collected on a north-south and east-west grid pattern with 50-foot spacing between lines and extended a minimum of 100 feet from the edge of the borrow area.

*Primary Dike Construction (December 31, 2011 – March 24, 2012)*
Access dredging at the west end of the island was completed during primary dike construction to gain and maintain adequate draft required by the construction equipment. WMI's bucket dredge 646 began dredging the access channel on November 18, 2011 and commenced construction of the primary dike on December 31, 2011. The dike was constructed in an eastward direction from Sta 45+00. The primary dike was constructed to an average elevation of +5.9 feet (NAVD) with a crest width of approximately 10 feet and side slopes of 1V:4H. Several lifts by the bucket dredge were required to achieve the designed elevation. Material used to construct the dike was excavated from within the flotation channel that paralleled the dike to the south. The flotation channel was located within the marsh footprint so that it would be filled during marsh creation.

Excess material that needed to be excavated for access purposes was sidecast to the south. The disposal of this material was limited to an elevation of +3 feet, NAVD and gapped every 250 feet to allow the flow of material through this area. As part of construction, the material was stacked higher than this and the dried material was used to cap the primary containment. This secondary disposal area was gapped and leveled down to +3 feet, NAVD prior to the start of marsh fill.

Once the primary dike was complete, the bucket dredge 646 re-dredged the flotation channel to gain access to the Gulf of Mexico. The bucket dredge was demobilized from the project site on April 1, 2012. Marsh buggies were used to cap and maintain the dike throughout the remainder of the project. The total length of the constructed primary dike was approximately 8,545 linear feet.

*Beach and Dune Construction (February 20, 2012 – August 19, 2012)*
The 30-inch cutterhead dredge "Capt. Frank" and the "E.W. Ellefsen" were used to construct the beach and marsh. The "Capt. Frank" demobilized from the project site on June 15, 2012, while the "E.W. Ellefsen" arrived on site on July 8, 2012.

The submerged pipeline came ashore at Sta 82+00. Beach construction started on February 20 in a westerly direction from Sta 70+00. WMI progressed in a westerly direction until April 22, constructing the entire beach template from Sta 70+00 to the western end, including the western flank that tied into the primary dike. This section was constructed to +6.5 feet, NAVD (design elevation of +6.0 feet plus 0.5-foot tolerance).

The beach discharge then proceeded east from Sta 70+00 at an elevation of +6.5 feet, NAVD until Sta 101+50. The elevation of the beach was then increased to +7.5 feet, NAVD from Sta 101+50 to Sta 130+00, per Change Order #3 (dated May 25). At Sta 130+00, the beach elevation was transitioned down to +4.5 feet, NAVD at Sta 135+00 before ending at Sta 150+00.

The fill was transitioned into the sand flat feature constructed by the USACE Belle Pass dredging project. Filling to the east was completed on August 14.

After completing the beach to the east, the discharge pipeline was once again relocated to point west to add additional material at the western portion of the beach, between approximately Sta 76+00 and Sta 55+00. This section of beach had started to erode and additional fill volume was available within the borrow area. Due to a better than expected cut to fill ratio, the State had funds available to place the additional fill. Fill was placed in this reach at an elevation of +6.5 feet, NAVD to match the previously constructed beach. Beach fill was completed on August 19.

Typical beach fill operations included a 90° dredge pipe elbow pointed upward at the end of the discharge pipes that was used to reduce the flow velocity of the slurry. Y-valves were used to separate the single discharge pipe into up to three outfalls to further reduce the discharge velocities at the end of the pipes. By using multiple outfalls, the discharge pipeline could be extended without shutting the dredge down, thus increasing the operational time of the dredge. The outfalls were located within the beach template.

The dredge was oriented in a north/south direction for dredging. Dredging started at the eastern side of the borrow area and progressed in a westerly direction when each cut was dredged. Throughout construction, the material excavated had a grain size that was approximately 0.11 mm with less than 12% silt.

The gross production rate (total volume of material excavated divided by total time including downtime) was approximately 15,324 cubic yards per day. The pay production rate (pay volume divided by total time) was approximately 15,081 cubic yards per day. The difference is due to over dredging by the Contractor. Production rates were estimated based on the total time within the sand borrow area (182 days) from the start and end dates of beach construction and include delays such as mechanical break downs, weather, delays incurred due to the swapping of dredges and more regular down time such as resetting anchors. The average production rate while operational was approximately 37,147 cubic yards per day.

Delays were estimated based on the total beach construction time. Operational, mechanical, booster pump, and weather delays accounted for 59% of the construction time.

*Hurricane Isaac Primary Dike and Beach Breach Closures (September 2, 2012 – October 4, 2012)*

Hurricane Isaac made landfall on top of the project area on August 29. Passage of the hurricane caused a breach in the primary dike at Sta 55+00 and a breach in the constructed beach fill at Sta 60+00.

WMI closed the breach in the beach fill using bulldozers and marsh buggies. The breach was plugged and augmented using sand overwashed into the marsh area. The areas that were addressed included from Sta 50+00 to 57+00 and from Sta 70+00 to 73+00 (Change Order #4).
The breach in the primary dike was closed by installing a 200-foot long sheet pile wall in the breach. WMI's bucket dredge had already left the site and the access channel had shoaled closed. Therefore, WMI contracted Wilco Marsh Buggies & Draglines, Inc. to close the breach

in the primary dike. They used 30-foot long sheet piles to close the breach and then used material surrounding the breach to ensure the sheet pile was stable. Wilco Marsh Buggies & Draglines, Inc. also capped sections of the primary dike that were damaged during the hurricane.

*Marsh Creation (September 10, 2012 – October 23, 2012)*
The marsh template started in an easterly direction from Sta 85+88 to Sta 92+00. WMI's original plan was to start in the northwest corner around Sta 50+00 but they were concerned about material flowing out through the breach in the primary dike. Instead, they started further to the east and pointed the outfall east while a turbidity screen was positioned across the breach to limit turbidity going into the bay.

Once repairs to the primary dike were completed, the discharge outfall was relocated to the western end. During marsh fill operations at the western end, the discharging of material was intermittently stopped due to the slurry overtopping the primary dike near the breach repair. Water was intermittently discharged from an additional outfall located near Sta 96+00 to better allow the marsh fill area to dewater. The outfall was gradually advanced westward. The marsh between approximately Sta 45+00 and Sta 120+00 was filled to an elevation ranging from +3.3 to +5.5 feet (NAVD).

Weeks Marine constructed a thicker marsh fill section (lift height) from approximately Sta 50+00 to Sta 60+00 at the southern side of the marsh fill area. WMI had excavated material from this area to rebuild the breach closure within the beach template. Weeks Marine was allowed to excavate to a maximum depth of -10 feet, NAVD. Thus, the areas from which the sand was removed were deeper than the surrounding marsh fill areas. A higher initial lift height was constructed in this area compared to other sections of the marsh in order to meet the upper tolerance of +3.5 feet, NAVD thirty days after construction (see Field Adjustment Report #6). The State agreed to relax any limitations on remaining within the tolerance within this area recognizing that having more fill would help reduce the likelihood of future breaching.

Six weir boxes were placed at Sta 120+00 to facilitate marsh construction. The weir boxes allowed filling of the marsh fill area to grade by decanting of water over the weir. Given the fine nature of the fill material (silts and clay), some of this material was discharged through the weir boxes. This was expected and filled areas were encompassed within the permit.

Weeks Marine ceased dredging on October 23, 2012.

Plastic pipe was utilized to construct the marsh template. While a y-valve was located on the landward slope of the beach, only one outfall was typically used at a time. A diffuser was used to reduce the flow velocity out of the discharge. In deeper fill areas, the outfall was left on top of a pontoon while in shallower fill areas the natural buoyancy of the pipe kept approximately half of the pipe above the water line.

Production rates were estimated based on the total construction time (45 days) from the start and end dates of marsh construction inherently including any delays experienced. The gross production rate based on the total volume material placed was estimated at 31,477 cubic yards per day (inclusive of downtime). As the excavated and pay volumes were equal, the pay

production rate was also estimated at 31,477 cubic yards per day. The average production rate while operational was approximately 68,901 cubic yards per day.

Delays were estimated based on the total marsh construction time. Operational, mechanical, booster pump, and weather delays accounted for 54% of the construction time.

*Sand Fence Installation (May 7, 2012 – November 5, 2012)*
Sand fence was installed to aid in the formation of a dune feature and retain sand within the project area. The sand fence consisted of 3/8-inch thick by 1½ -inch wide by 4-foot long wooden slats with 2¼-inch gaps between slats which were connected with five strands of wire. The slats were painted with a red iron oxide stain. The sand fence was attached to untreated round 4-inch diameter by 8-foot long posts which extended approximately 4 feet above the ground. An auger was used to dig holes for the posts. The fence was secured to the posts with a minimum of three wire twist ties.

The contractor installed a single row of sand fencing between Sta 46+43 and Sta 146+34 along the dune crest. Sand fence was re-installed between Sta 53+36 and Sta 59+55 due to damages caused by Hurricane Isaac (see Change Order #4). The sand fence between these stations followed the breach repair that was performed from Sta 50+00 to Sta 57+00. Additional sections of sand fence that were damaged during Hurricane Isaac were also repaired.

Each section of fence was approximately 450 feet long. There was a 30-foot overlap between each section and the overlapped sections had an 8-foot gap between them to facilitate ATV travel between the sand fence rows following construction.

*Settlement Plate Installation (January 20, 2012 – May 15, 2012)*
A total of 10 settlement plates were installed to monitor the post-construction subsidence of the island and consolidation of the placed fill material. Four plates were installed along the dune crest centerline, three plates were installed within the marsh footprint, one plate was installed within the flotation channel and two plates were installed along the centerline of the primary containment dike. The settlement plates consisted of a 4-foot by 4-foot by ¼-inch steel plate with a three-inch galvanized capped riser pipe welded to the center of the plate. The settlement plates were installed such that the top of the riser pipe was between 3 and 7 feet above the designed grade. The installed settlement plate locations are shown in Table 7. The settlement plate shown on the plans at Sta 120+00, Rng 7+04 within the proposed dune footprint was relocated to Sta 119+66, Rng 7+08 (see Field Adjustment Report #4).

**Table 7**
**Settlement Plate Locations**

| Settlement Plate Locations | | | | |
|---|---|---|---|---|
| Designed | | Installed | | |
| Station | Range | Station | Range | Location |
| 60+00 | 2+67 | 58+98 | 2+69 | Berm |
| 60+00 | -8+87 | 60+00 | -8+87 | Marsh |
| 80+00 | 4+13 | 80+02 | 4+11 | Berm |
| 80+00 | -7+34 | 79+96 | -7+34 | Marsh |
| 80+00 | -17+59 | 79+97 | -17+59 | Center Line of Dike |
| 100+00 | 5+58 | 100+02 | 5+60 | Berm |
| 100+00 | -5+82 | 97+97 | -5+75 | Marsh |
| 120+00 | 7+04 | 119+66 | 7+06 | Berm |
| 120+00 | 1+86 | 118+96 | -0+81 | Flotation Channel |
| 120+00 | -3+20 | 120+03 | -1+95 | Center Line of Dike |

## 11. Problems Encountered / Lessons Learned

*Closure of Primary Dike*
The bucket dredge accessed the flotation channel to construct the primary dike through the construction access channel at the west end of the project area. The access and flotation channel were excavated to a depth of -7 feet (NAVD) to allow adequate draft during low tide events. During the construction of the primary dike, a gap from Sta 54+00 to Sta 57+00 was left due to the deep channel located in this area. Once the remaining sections of the primary dike were completed the dredge stockpiled material near the ends of the gap and double handled material to complete the closure with a crest elevation of +5 feet (NAVD). The bucket dredge eventually stopped the tidal flow through the closure at the deep channel and completed the construction of the primary dike on March 24, 2012.

*Hurricane Isaac*
The closure in the primary dike at the deep channel and in the constructed beach fill at Sta 60+00 were breached during passage of Hurricane Isaac, which made landfall on top of the project area on August 29. The breach in the primary dike was closed by installing a 200-foot long sheet pile wall in the breach. WMI's bucket dredge had already left the site and the access channel had shoaled closed. Therefore, WMI contracted Wilco Marsh Buggies & Draglines, Inc. to close the breach in the primary dike. Thirty (30)-foot long sheet piles were utilized to close the breach and then material surrounding the breach was used to ensure the sheet pile was stable. Wilco Marsh Buggies & Draglines, Inc. also capped sections of the primary dike that were damaged during the hurricane.

WMI closed the breach in the beach fill using bulldozers and marsh buggies. The breach was plugged and augmented using sand overwashed into the marsh area. The areas that were addressed included from Sta 50+00 to 57+00 and from Sta 70+00 to 73+00 (Change Order #4).

*Marsh Construction*

Marsh fill operations commenced near the center of the marsh fill footprint at Sta 85+88 due to the repairs being conducted to the breach in the primary dike due to Hurricane Isaac. The marsh template was then constructed in an easterly direction from Sta 85+88 to Sta 92+00 while repairs were being conducted on the primary dike. WMI's original plan was to start in the northwest corner around Sta 50+00 but they were concerned about material flowing out through the breach in the primary dike.

While the contractor was able to commence marsh fill construction earlier by placing the outfall at Sta 85+88 and pumping to the east, the increased elevation due to the accumulation of material in the center of the footprint caused delays when filling areas west of Sta 85+88. The Contractor had to suspend filling operations to allow the western fill area to drain because the slurry was impeded from dewatering due to the material that was previously placed in the center of the marsh fill area. Water pooled at the west corner of the project and overtopped the primary dike at the sheet pile wall, causing marsh fill operations to be suspended periodically.

*Post-Construction Survey of the Initial Fill Source for the Primary Dike*

To document the excavated depth of the initial fill source (flotation channel) for the primary dike, post-construction surveys of the fill source should be considered. It is recommended that surveys be collected along the centerline of the initial fill source, and cross sections along marsh pay profile lines extending approximately 100 feet beyond the northern limit of the primary dike toe of fill and south of the initial fill source top of bank. To avoid increases to the overall project costs, these should be required as conditional check surveys and not certified surveys in order to minimize costs. The specifications should state that this survey will not be used for payment purposes.

This survey data would allow analysis of the pit-to-fill ratio experience during construction of the primary dike. In addition, the data would allow for more representative estimates of pit-to-fill and pit-to-pay ratios associated with marsh construction. For this project, the estimated volume of marsh fill placed included the material placed to construct the primary dike to account of the initial fill source excavated, but not documented by the marsh pre-construction surveys. The ratio would be beneficial during the design of future restoration projects. The data would also provide useful information for understanding future settlement of the fill because settlement is related to the lift height. If the fill source was dredged deeper than the permitted depth then more settlement would be expected and vice versa. Lastly, it would allow for determination of permit compliance of excavation within the fill source, though this is less important because the channel is back filled.

*Pay on the Cut*

Payment for beach and marsh construction was based on the quantity of material removed from the borrow areas. During the construction of the beach fill area, two permit modifications were executed to widen or extend the beach template. Payment on the cut allowed greater flexibility

during the transition of the widened/extended beach fill areas. The quantity of material placed within the tapers was not required to be surveyed for payment and allowed for a continuous transition. Payment surveys within the borrow area were conducted as normal and the additional quantity of excavated material needed to perform the permit modifications was accounted for accordingly.

Additional material was also added at the western portion of the beach, between approximately Sta 76+00 and Sta 55+00. This section of beach had started to erode and additional fill volume was available within the borrow area. The contractor replaced fill eroded from the template. The payment method allowed the contractor to place as much material as possible within the template without requiring an updated pre-construction survey of the eroded section of beach.

Payment on the cut encouraged the contractor to fill the beach and marsh fill templates to the upper tolerance to claim as much material for payment as possible. Consideration should be given to this possibility when designing the beach and marsh fill elevations as the contractor is likely to build to the upper tolerance.

Payment on the cut reduces the risk placed on the contractor to accurately predict a cut to fill ratio during the bidding process. Decreasing the risk on the contractor should provide a lower unit cost. For both the beach and marsh fill areas, the observed cut to fill ratios were lower than the design ratios, resulting in a savings to the State. For the beach fill area, a cut to fill ratio of 1.38 was observed compared to the design ratio of 1.5. If the contractor had based the quantity of material removed from the borrow area on the design cut to fill ratio of 1.5, an additional 247,378 cy of material would have been estimated to be dredged from the beach fill borrow area to achieve the bid quantity. At a unit cost of $7.85 per cubic yard, the total saved on the beach fill area by using payment on the cut was $1,941,917. Similarly, a cut to fill ratio of 0.69 was observed for the marsh fill area compared to the design ratio of 1.5. An additional 1,667,788 cy of marsh fill material would have been estimated to have been dredged from the borrow area if a 1.5 cut to fill ratio was utilized. At a unit cost of $3.25 per cubic yard, the total saved on the marsh fill area by utilizing payment on the cut was $5,420,311.

*Sand Borrow Area*

A permit modification was performed to the sand borrow area layout. The original permit application was based on a survey conducted in August 2008. The contractor (Weeks Marine) performed a pre-construction survey of the beach fill borrow area and submitted this data on March 30, 2012. It was determined that there was approximately 1.7M cubic yards less material within the beach fill borrow area compared to the August 2008 conditions. A difference in elevation of up to 2.4 feet between the August 2008 and pre-construction survey conditions was observed.

The dredge cut depth of the entire beach fill borrow area was lowered by 2 feet. The permit modification increased the beach fill borrow area volume by approximately 1,684,000 cubic yards. No changes to the horizontal limits of the borrow area were proposed. No changes were proposed to the marsh fill borrow area either.

*Maximum Depth of Equipment of Dredge Cutterhead*
During excavation with the cutterhead dredge, equipment was allowed to extend up to 3 feet below the permitted excavation depth. Throughout construction of the beach, Weeks Marine indicated that approximately 0.5 to 1 foot of material was being left behind due to the restrictions of the maximum depth of equipment. The project managers and dredge captains agreed that the borrow area could be more completely excavated if the cutterhead was permitted to extended deeper than the maximum depth of equipment specified in the plans.

Consideration should be given when designing the borrow areas and the respective maximum depth of equipment. A permit modification was executed to allow the cutterhead to extend 4 feet below the permitted excavation depth to reduce the volume of material that remained in the borrow area. This would maximize the volume of material removed from the permitted borrow areas and improve the sediment management for future projects. However, the depth that the cutterhead may be lowered beneath the sand must be balanced against the risk of introducing a higher percentage of fines (silts and clay) into the beach fill.

Allowing equipment to extend 4 feet beneath the maximum depth of equipment may be more appropriate. However, strict controls must be enacted on the beach. Even with the 3-foot allowable maximum depth of equipment, the cutterhead had to be raised because it started dredging stiff clays.

*Submerged Pipeline Leak*
Weeks Marine documented one substantial subline leak (E 3589781, N 201044) on July 23, 2012. Weeks Marine provided subline leak survey data on 7/23 and 8/3. CPE calculated a volume of material contained in the mound due to the subline leak of approximately 8,687 cubic yards. The volume of 8,687 cubic yards was deducted from the final volumes excavated from the beach fill borrow area.

Future specifications should require a 500-foot wide pre-construction survey of the pipeline corridor. A post-leak survey should then be conducted on a grid pattern and extend at least 50 feet beyond the edge of the mound.

*Nesting Birds*
Least Terns were observed within the beach and marsh fill areas while beach fill operations were being conducted. Weeks Marine was instructed to restrict access to the areas in the vicinity of the observed nests. Nests within the marsh fill area were staked and a 300 foot buffer was maintained around the nests. Weeks Marine conducted abatement procedures within the marsh fill area by performing patrols a minimum of twice daily and installing tangle guard bird repeller ribbon to deter birds from nesting within the project limits during construction. Abatement procedures were not conducted within the beach fill area as the nests were located in previously accepted sections. No nests were observed immediately prior to the commencement of marsh fill operations.

*Sand Fence*
There were numerous discussions regarding the interpretation of the specifications associated with installation of the sand fence. To limit ambiguity, it is recommended that typical drawings be included in the construction plans depicting the specification requirements.

## 12. Construction Change Orders

*Change Order #1 - December 20, 2011*
Change Order #1 was intended to adjust the project quantities when the bid template was overlayed on the October 2011 pre-construction survey. The quantities adjusted included the beach and dune, marsh and primary dike. The beach and dune fill quantity was increased from 1,738,500 to 2,130,000 cubic yards at a unit cost of $7.85 per cubic yard. The marsh fill quantity was reduced from 3,058,500 to 2,379,000 cubic yards at a unit cost of $3.25 per cubic yard. The length of the primary dike was reduced from 8,600 to 8,550 linear feet at a unit cost of $150.00 per linear foot. The change order did not result in a change in unit costs, but the change in quantities resulted in a $857,400.00 increase in total project cost from $28,551,640.00 to $29,409,040.00. Due to the overall decrease in the quantities, no change was made to the contract time.

*Change Order #2 – February 20, 2012*
Change Order #2 was intended to adjust the project quantities when the primary dike at the eastern end of the project footprint was shifted to the west to tie into the existing marsh vegetation. The quantities adjusted included the marsh and primary dike. The marsh fill quantity was reduced from 2,379,000 to 2,343,000 cubic yards at a unit cost of $3.25 per cubic yard. The length of the primary dike was reduced from 8,550 to 8,560 linear feet at a unit cost of $150.00 per linear foot. The change order did not result in a change in unit costs, but the change in quantities resulted in a $115,500.00 decrease in total project cost from $29,409,040.00 to $29,293,540.00. Due to the overall decrease in the quantities, no change was made to the contract time.

*Change Order #3 – May 25, 2012*
Change Order #3 incorporated an extension of project completion date and an adjustment to the beach and dune fill quantity. An additional 540,000 cubic yards of beach and dune fill was added to the project. The beach fill template was revised to contain the additional material. The beach dune crest elevation was increased from +6.0 feet, NAVD to +7.0 feet, NAVD from Sta 101+50 to Sta 140+00. The constructed shoreline was extended seaward by 125 feet. The landward toe of fill remained in its previous location requiring the landward dune crest, seaward dune crest, break in slope and seaward toe of fill to be shifted seaward (south).

The beach and dune fill quantity was increased from 2,130,000 to 2,670,000 cubic yards at a unit cost of $7.85 per cubic yard. The change order did not result in a change in unit costs, but the change in quantities resulted in a $4,239,000.00 increase in total project cost from $29,293,540.00 to $33,532,540.00. The contract time was increased by 98 days. Contract time was extended from September 10, 2012 to December 17, 2012. Thirty-seven days were added to

allow time to pump the increased beach fill volume and 61 days were added due to weather delays encountered through May 15, 2012 (per GP-9).

*Change Order #4 – October 11, 2012*
Change Order #4 incorporated an extension of project completion date, an adjustment to the beach and dune fill and sand fence quantities, post-hurricane Isaac surveys, and the plugging of a breach in the beach from Sta 50+00 to 57+00, and Sta 70+00 to 73+00. The change in project quantities resulted in a $994,209.49 increase in the total contract cost from $33,532,540.00 to $34,526,749.49.

The purpose of this change was to create a continuous shoreline with the USACE's beneficial disposal project to avoid loss of sand from the designed beach into the gap between the two projects. The change also documented conditions following Hurricane Isaac and addressed damages caused by Hurricane Isaac, including the closing of the breach in the primary dike, augmenting the beach plug, restoring dune elevation to overwashed areas, and repairing and replacing sand fence.

The contract time was increased by 17 days. The contract time was extended from December 17, 2012 to January 3, 2013. Nine days were added to allow time to pump the additional sand quantity while 8 days were added due to delays caused by Hurricane Isaac.

The beach fill volume was increased by 74,745 cubic yards from 2,670,000 cubic yards to 2,744,745 cubic yards. The beach fill template was extended to Sta 150+00 to contain the additional material. The beach dune crest elevation was decreased from +7.0 feet, NAVD to +4.0 feet, NAVD commencing east of Sta 130+00. The landward toe of fill was revised to tie into the existing vegetation, requiring the landward dune crest, seaward dune crest, break in slope and seaward toe of fill to be shifted seaward (south).

Post-Hurricane Isaac surveys were performed to document the effect of Hurricane Isaac and determine updated fill volumes required to construct the project.

There was a breach in the primary dike that was closed in order to construct the marsh as originally intended. A 200-foot section of sheet pile wall was installed to close the breach.

The breach on the beach was plugged and augmented using sand overwashed into the marsh area. Approximately 3 days of work was performed to augment the breach and address other areas lowered by overwash. The areas that were addressed included Sta 50+00 to Sta 57+00, and Sta 70+00 to Sta 73+00.

An additional 1,692 feet of sand fence was added to extend the sand fence to Sta 150+00. Sand fence damaged and destroyed during Hurricane Isaac was also replaced and/or repaired.

*Change Order #5 – March 21, 2013*
Change order #5 adjusted the final payment quantities to match the measured pay quantities. The final as-built marsh fill volume was 1,416,481 cubic yards, a reduction of 926,519 cubic

yards from Change Order #2. The cost reduction within Change Order #5 for marsh fill was $3,011,186.75 applying a unit cost of $3.25 per cubic yard.

The final primary dike length was 8,545 feet, a reduction of 55 feet from the bid quantity and 15 feet within Change Order #5. The unit cost for primary dike was $150.00/ linear foot. Thus the reduction in cost within Change Order #5 for the primary dike was $2,250.00.

Change Order #5 reduced the contract amount by $3,013,463.75. Following Change Order #5, the final contract amount was $31,513,312.74.

**13. Construction Field Adjustments**

*Field Adjustment #1 – December 22, 2011*
Field Adjustment #1 revised the location of the access route from Belle Pass to the eastern limit of the project area. The route had to be shifted north to account for shoreline recession. Specifications SP-11, TS-30 and EP-6 had to be revised.

*Field Adjustment #2 – February 17, 2012*
Field Adjustment #2 changed a settlement plate location as the settlement plate designed at Sta 120+00, Rng 1+86 was located outside of the primary dike that Weeks Marine, Inc. had constructed. The settlement plate was relocated to the center of the flotation channel at Sta 119+00, Rng. -1+00.

*Field Adjustment #3 – May 4, 2012*
Field Adjustment #3 revised specification TS-25.7 to allow grade stakes used in the marsh area to be composed of cane poles instead of metal conduit. The field adjustment was in response to Weeks Marine's request that cane poles be used during construction of the primary dike and marsh fill area.

*Field Adjustment #4 – May 17, 2012*
Field Adjustment #4 changed a settlement plate location designed at Sta 120+00, Rng 7+04 within the proposed dune footprint to Sta 119+66, Rng 7+08. This change was made due to an inadvertent survey error during placement of the settlement plate.

*Field Adjustment #5 – May 17, 2012*
Field Adjustment #5 revised specification TS-24.1 to change the overlap distance between the bathymetric survey and rod survey to a minimum of 25 feet. Due to safety concerns, Weeks Marine requested a shorter overlap distance to avoid putting survey personnel and RTK equipment at risk while performing the rod survey shots in the surf zone.

*Field Adjustment #6 – September 27, 2012*
Field Adjustment #6 revised specification TS-10.4. The State directed Weeks Marine to scrape sand overwashed during Hurricane Isaac from the overwash fan back into the beach fill template in order to reestablish the dune elevation. Weeks Marine was allowed to excavate to a maximum depth of -10 feet, NAVD in order to efficiently perform this work. This work was performed under Change Order #4.

The areas from which the sand was removed to perform this work may have been deeper than the surrounding marsh fill areas, specifically in the area between Sta 50+00 and Sta 60+00. Weeks Marine was advised that the thicker marsh fill section (lift height) may result in greater settlement. Therefore, Weeks Marine constructed a higher initial lift height in this area compared to other sections of the marsh in order to meet the design grade of 3.0 feet, NAVD. Given that this area previously breached, the State preferred that Weeks Marine err on the side of placing material slightly higher in this area. The upper tolerance for the marsh fill is +3.5 feet, NAVD and the State requested that WMI be as close to this elevation as possible after the 30-day wait period.

## 14. Requests for Interpretation

*Request for Interpretation #1 – May 20, 2012*
Request for Interpretation #1 requested 3 changes to TS-22.2.2.3. The first proposed change was to use electro galvanized coated staples to attach the fence posts to hold it in place until it is wrapped with wire. The request was granted provided that the fence was tied to the posts as required by the specifications to be eligible for payment. The second proposed change was to use electro galvanized plated staples with barbs to attach the fence to the fence posts instead of wrapping wire around it. This request was denied and the fence was required to be tied to the posts as detailed in the specifications. The third proposed change was to use a different tie wire to splice the fence sections and to attach them to the posts. This request was denied and hot dipped galvanized wire was required by the specifications.

## 15. Pipeline and Other Utility Crossings

Please see the construction plans sheets 16, 21 and 22 of 24 for the location and description of pipelines and other utility crossings within the project footprint. The table below provides contact information for the associated pipeline and utility crossing representatives.

**Table 8**
**Pipeline and Utility Company Representatives**

| Company | Rep. to Contact | Phone |
|---|---|---|
| Chevron Pipeline | Mark Bouzigard | (985) 396-3508 |
| | | (985) 637-9463 |
| Williams Gas Pipeline | Diana Casalena | (225) 654-2047 |
| Tennessee Gas Pipeline | Mike Bryan | (985) 223-6123 |

## 16. Safety and Accidents

No accidents were reported or observed.

## 17. Additional Comments Pertaining to Construction, Completed Project, etc.

The material placed on the beach had a slightly higher silt content than expected. The average beach fill grain size based on samples collected and analyzed by CPE is 0.11 mm with a 11.7% silt content. The material placed within the marsh fill matched expectations.

## 18. Significant Construction Dates

**Table 9**
**Significant Construction Dates**

| Construction Item | Date |
|---|---|
| Bid Opening | July 14, 2011 |
| Construction Contract Awarded | August 26, 2011 |
| Notice to Proceed | September 9, 2011 |
| Pre-Construction Conference | September 21, 2011 |
| Start of Primary Dike Construction | December 31, 2011 |
| Start of Settlement Plate Installation | January 20, 2012 |
| Start of Beach and Dune Construction | February 20, 2012 |
| Completion of Primary Dike | March 24, 2012 |
| Start of Sand Fence Construction | May 7, 2012 |
| Completion of Settlement Plate Installation | May 15, 2012 |
| Completion of Beach and Dune Construction | August 19, 2012 |
| Start of Marsh Construction | September 10, 2012 |
| Completion of Sand Fence Construction | November 5, 2012 |
| Completion of Marsh Construction | October 23, 2012 |
| Substantial Completion | November 26, 2012 |
| Final Acceptance | March 12, 2013 |

**Identified Other Submittals:**

| | | |
|---|---|---|
| Appendix A | - | 11x17" As-built Drawings (attached & on CD, pdf format)<br>8.5x11" As-built Beach Pay Profiles (on CD, pdf format)<br>8.5x11" As-built Marsh Pay Profiles (on CD, pdf format)<br>Borrow Area Bathymetric Survey Data (on CD, ASCII format)<br>Pre- and Post-Construction Survey Data (on CD, ASCII format) |
| Appendix B | - | Invoice Related Correspondence (on CD, pdf format) |
| Appendix C | - | General Correspondence (on CD, pdf format) |
| Appendix D | - | Change Orders (attached and on CD, pdf format) |
| Appendix E | - | Field Adjustment Reports (attached and on CD, pdf format) |
| Appendix F | - | Requests for Interpretation (on CD, pdf format) |
| Appendix G | - | WMI Daily Quality Control Reports (on CD, pdf format) |
| Appendix H | - | WMI Submittals (on CD, pdf format) |
| Appendix I | - | CPE Daily Observation Reports (on CD, pdf format) |
| Appendix J | - | CPE Bi-Weekly Reports (on CD, pdf format) |
| Appendix K | - | Construction Meeting Minutes (on CD, pdf format) |
| Appendix L | - | Survey Certification Letters (on CD, pdf format) |
| Appendix M | - | Beach Fill Grain Size Analysis (on CD, pdf format) |
| Appendix N | - | Permit Sketches (on CD, pdf format) |
| Appendix O | - | Construction Plans and Specifications (on CD, pdf format) |
| Appendix P | - | Settlement Plate Monitoring Data (on CD, pdf format) |
| Appendix Q | - | Sand Fence Summary (on CD, pdf format) |
| Appendix R | - | Subline Profile Surveys (on CD, pdf format) |


Report prepared by:

8/21/13

Julien Devisse
Coastal Engineer
Coastal Planning & Engineering, Inc.

Gordon Thomson, P.E., D.C.E.
Engineer of Record, Reg No. 31412
Coastal Planning & Engineering, Inc.