2017 MONITORING REPORT

of

CITY OF GULF BREEZE DEADMAN'S ISLAND RESTORATION PROJECT

For the

U.S. Army Corps of Engineers

ESTUARY HABITAT RESTORATION PROGRAM

GULF BREEZE, SANTA ROSA COUNTY, FLORIDA

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2017

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1.0 Executive Summary

Year 2017 proved to be an eventful one for Deadman's Island. The shoreline restoration/sand placement portion of the project lasted from December 6, 2016 to February 26, 2017. Contractors using a hydraulic dredge placed 16,000 cubic yards (cys) of sand on the eroded beach behind the recently placed reef constructed in 2015. Planting started soon after sand placement and occurred throughout the year as the weather permitted. Several groups of local volunteers from the local community came out to assist in the planting during the spring and summer months. All major construction work for this project is now complete as it transitions into the monitoring phase.

From March to August 2017, Pensacola Bay received long lasting torrential rains which caused a significant amount of local flooding. Impacts to the Deadman's Island project included low salinity, turbid tea colored water, high tides, rough water and erosion of recent plantings. Many of the project's success criteria were not met due to this unusual weather.

In addition to these impacts, the isthmus (sand bridge) connecting Deadman's Island to the mainland also breached. The City of Gulf Breeze worked for several months repairing the breach located on the north end of the island and adjacent to the restored shoreline's recently place sand. These repair efforts were critical to protecting the Island from further erosion and returning the site to a more stable condition.

1.1 Background Description of Project

Deadman's Island is a remarkable coastal place. It is one of the few places that have a variety of ecological habitats in one area including a variety of historical and cultural resources. Deadman's Island has experienced documented accelerated erosion since the 1940's, due to the Hwy 98 bridge construction, dredging, a 12-mile fetch impact, and neighborhood seawalls. This erosion has unearthed and exposed many historic structures including an unmarked cemetery and shipwrecks dating back to the 1500's. This erosion had threatened historic *Juncus sp*. saltmarsh and killed several one-hundred-year-old marine oak trees (Morgan 1993).

In 2005, Hurricane Dennis exposed several coffins, and human remains. In an effort, to stop the erosion and prevent further exposure of human remains, eight hundred and fifty feet of the oyster breakwater (Reefblks) were placed in within the 1450 linear feet, permitted footprint. The oysters flourished on the Reefblk and created an effective breakwater until 2012 when the structure fell apart.

Through comparing 2009 pre-oil spill monitoring data and 2011 monitoring data, the oyster coverage went from 95% to 1% coverage. The 2010 Deep Water Horizon (DWH) oil spill caused delays in construction, due to the project being blocked and surrounded by the oil boom, and additional breakwater was not placed as planned. The delays resulted in additional erosion to the area and other areas on Deadman's Island. In 2011 and 2012, four hundred feet of new breakwater called Ecosystems, made by Reefmakers, was deployed in the southwest and northeast location of the footprint, only 200-250 feet were left to complete the entire breakwater. In 2013, fifty feet more of a square shape prototype of the Ecosystem breakwater was placed. Not anticipating a complete die off, the Reefblk began to lose the shells in the bags during 2012. This die-off caused the eight hundred fifty feet of Reefblk breakwater to become non-functional as wave attenuator. This non-functional reef has caused 16,000 yds^3 of newly placed sand from summer of 2012, to shift and slowly erode. In 2015, the old breakwater was removed, disposed of and replaced with a newer Ecosystems stacked vertical breakwater. Also, two hundred feet of the breakwater, located in the barren area was deployed to finish the permitted 1450-foot footprint of the State land lease.

Figure 1: An osprey family nesting in the relocated nest deployed in 2015.

In late 2016 and early 2017, 16,000 $yds^3$of sand was moved from the existing dredged disposal area located on Deadman's Island and placed in the areas where the sand had shifted and eroded. This erosion was caused by the Reefblk breakwater losing function and the lack of breakwater height and functionality. In addition to the breakwater project, an osprey nest was relocated on the signage reef pilings at Deadman's Island (Figure 1).

Another portion of Deadman's Island restoration (not related to the breakwater project) was the repair of the isthmus. The isthmus is the sandbar located between the mainland and the larger landmass of Deadman's Island. The isthmus was breached over a several month period during the spring/summer of 2017. Sand was displaced and water from the bay flowed across the normally dry island's connection to the mainland. This breach was also of concern to the recently restored shoreline and could have eroded it significantly. Fortunately, the City of Gulf Breeze conducted an emergency repair and restored the isthmus to a more erosion resistant condition which should benefit Deadman's Island for a long time.

1.2 Project Purpose

The purpose of the project is to protect the 10-acre peninsula and an existing salt marsh habitat while increasing the biological productivity of the Gulf Breeze aquatic area. An incidental benefit of this project is to provide protection to numerous cultural resources and artifacts identified at the site. The loss of the salt marsh in this area is the result of increased erosion due to wave energy. The project would create approximately 1.04 acres of emergent salt marsh for shoreline protection and an additional 0.046 acres of coastal dune. The structures protect the area by reducing the amount of wave energy that reaches the shoreline. Approximately 16,000 cubic yards of sandy material and vegetation will protect and cover historic resources and create a small peninsula that adjoins the land. To reduce anthropogenic stressors on the project, the restoration area is separated by a dune fence. In summary, the project would increase productivity and diversity of flora and fauna indigenous to the Florida areas, as well as protect and stabilize the existing shoreline.

1.3 Project Goals.

1. Repair the indirect impact during the oil spill timeframe and placed 16,000 cubic yards of sand and stabilize with vegetation (2017)
2. Complete the remaining breakwater (completed 2015)
3. Protect exposed cultural resource site by covering them with sand (completed 2016)
4. Create a nearshore island wetland using a local sand source (completed 2016)
5. Protect, conserve and restore seagrass beds (2017)
6. Create sand dunes by constructing them on the nearshore island (completed 2014)
7. Install Gulf sturgeon monitoring equipment (2 of requested 4 receivers are installed)
8. Increase the overall biological productivity of the Gulf Breeze aquatic and shoreline area (ongoing since 2011)
9. Repair south end dunes protecting Juncus salt marsh (funding dependent)

1.4 Status of erosion control structures, breakwater conditions, and vegetation

According to GPS surveys, the 2015 breakwater structures, which replaced the ReefBLK damaged during the time period of the 2010 oil spill, appears to have stabilized the shoreline on the north and south-west side, directly behind the breakwater.

In 2017, the tides continued to rise higher than the tide charts predicted and higher tides than originally predicted in 2007 permitting process. This higher tide caused the water to rise over a portion of the breakwaters. The wave height did not allow the breakwaters to attenuate the wave action and left the shoreline vulnerable. The vulnerability caused the shifting of the newly placed sand and washed out some of the new vegetation planted on the north end. To ease some of the offset, a few of the Ecosystems units were manually reset to match the height of the entire breakwater system. As tides continue to rise, the height of the breakwater may become a concern. As for now, we continue to monitor the effectiveness of the vertical wave attenuation system. This year's storms caused water to rise completely over the breakwaters at times. It was the storm episodes causing a change in the tidal height allowed more shifting of the sand and wash out of vegetation. This washout is especially apparent on the north west point of the project site. Some breakwaters were set to an even height as the other breakwaters, to provide better wave attenuation during higher tides. As of October 2017, the shoreline GPS has not changed, and the vegetation has stabilized.

In comparison to the 2013-2017 tides and monitoring reports, the tide charts are showing sea-level rise. Field validation shows the predicted tides are much lower than the actual tides. This fluctuation causes problems for daily field planning, especially for boat launching since Deadman's Island is boat access only.

1.5 2016-2017 Project- preparation, barriers, transport, and placement of the sand

The 2013 barrier project ECS designed was a successful project and was proficient in holding the pipe transported sediment in one place to allow for faster settlement on the sub-tidal floor. When the sediment was piped 1,600 feet from the disposal site, the sediment was in a liquid form and flowed and shift to equilibrium. The barrier system manipulated the flow of sand from the pipe to stay in one place and compacted the sand to prevent shifting. The problem with this barrier system was the maintenance and the size of the materials used in the system. These materials would rip, tear and bury during storms and needed to be reset on the piling system using the slide system ECS created to allow the barrier to move up and down with the tides. In 2016, it was decided to reduce the size of the barrier underwater, in an effort to prevent costly maintenance, yet produce the same results of faster settlement and maintain the shape. Unfortunately, the smaller size was quickly determined as not working and sand escaped under the modified system.

1.6 Surveying and marking for sand placement

1.6.1 2017 Project- preparation, barriers, transport, and placement of the sand

To protect the reef from being impacted or smothered, a barrier system was placed. This barrier system consisted of geo-fabric, and turbidity curtain buried six inches to prevent the sand from escaping from the site. Other lessons learned using the barrier method from the 2013 sand movement project was the barrier allowed exact placement of the sand as opposed to haphazard settling, faster settling to reduce turbidity and compaction after the placement of the sand. Due to a homeowner's agreement, the City of Gulf Breeze was restricted on where the sand could be placed, so the barrier system created this footprint; the footprint outline was successful. The barrier system will be removed once the sand has settled and the vegetation root system stabilizes.

1.6.2 Surveying and marking for sand removal

Using ground-penetrating radar studies, Deadman's Island has many historic anomalies; including human remains (TAR 2003). The challenge was to make sure no historic cultural resources were impacted. The site was leveled back in the 1970's; reducing the probability of finding historic resources. A survey was done by using survey equipment and placing several elevation stakes around the disposal site. These stakes mark the boundaries where the contractor can excavate confidently without disturbing any areas believed to have historic findings.

1.6.3 Beneficial use of dredged material -Disposal site (Donor site for clean sand)

The disposal site is owned by the City of Gulf Breeze. Approximately every five years since 1970, clean white sand from the mouth of Gilmore Bayou is placed within this disposal site. The highest elevation of the placed sand is nine feet from sea level (Figure 2). The channel mouth leading into Pensacola Bay is located adjacent to the seawall. Therefore, there is very little disturbance when placing the sand within the disposal site. This sand was the perfect donor site for our project because we were able to beneficially use the dredged material.

1.6.4 Disposal site (Donor site for clean sand)

Figure 2: Evaluating the amount of sand to be transported to the north end of Deadman's Island. The disposal site was surveyed, marked and flagged according to elevation (left). Stakes were surveyed and marked according to elevation (right)

Sixteen thousand cubic yards of sand from the disposal site located on Deadman's Island, called the Donor site, was removed by an excavator and pumped using a hydraulic dredge. The sand was piped to the northern point of Deadman's Island, called the Receiver site (Figure 3). The Donor and Receiver sites are located sixteen hundred feet from each other. The dredging portion of the project lasted from December 6, 2016 to February 26, 2017 (Figure 4). Planting of the site was completed on September 30, 2017 (Figure 6).

1.6.5 Sand Placement to Receiver site

Figure 3: The Receiver site located at the north point of Deadman's Island

Figure 4: The disposal site where sand was removed (Donor site) (left) The Receiver site where sand was transported to and 65% complete.

Figure 5: Equipment used for this project. Amphibious excavator (left) and compact dump truck, designed for sand movement (middle) and vegetation planted (right).

Figure 6: Repairing the disposal site after excavation (March 2017) and dredging (left) and a few months later in October 2017 (right).

2.0 2017 Summary of monitoring results

2.1 Description of Field Work Summary and Results

Success criteria were determined by the modified Deadman's Island monitoring plan. Underwater monitoring of the existing breakwaters occurred from February to March and July 1 to October 22, 2017. Other monitoring, such as benthic sampling, oyster collecting for tissue tests, bathymetric surveys and acoustic monitoring locating Gulf Sturgeon was performed throughout the year. One hundred and two units of the breakwater reefs were randomly selected for monitoring. Most success criteria were not met due to low salinity and storms in the summer of 2017. The visibility of the water was 1-3 feet, predominantly 1-2 feet.

2.2 Benthic monitoring

Success criteria: The success criterion were not met. Benthic surveys were performed using a coring device. Samples were preserved, and specimens were counted under a microscope. Benthic organisms were not present in fifteen samples.

2.2.1 Oyster Spat Settlement, recruitment, growth rates, predation, and health inspection

Success criteria: The success criteria were not met. Due to the drastic long-term low salinity levels, live oyster spat was not observed. The only surviving oysters observed, were approximately 50 large 4-inch oysters. The main predators, oyster drills (*Stramonita haemastoma),* showed a low population of only 26. Egg casings of the oyster drills was also found in low numbers and no live ones were observed. Of the large oysters selected for laboratory testing, none showed any sign of disease or concaved shells. Laboratory analysis showed no detection of any harmful chemical (See Appendix 2 for Lab results).

2.2.2 Shoreline vegetation monitoring

The success criteria were met. There was an increase in shoreline vegetation in 2017 when compared to 2016. The cause of this increase was due to the new placement of sand and vegetation planting projects for 2017.

2.3 Fin fish surveys

The success criteria were not met. There was a significant decrease in species abundance.

Divers counted and record all species seen on each numbered unit, each tier and each section within the tier. The individual tiers on the tabletops Ecosystem have three sections. The sections are documented by which orientation they are facing, landside (LS), north direction (ND), east direction (ED), west direction (WD) (Table 1).

2.3.1 Wetland creation

Success Criteria were met in some areas but not in others. The storms brought sand over the shoreline and flowed into the wetland bogs which were created for additional stability. The new wetland bog project was created in 2016. Three of the seven wetland bogs were completely covered with sand from the storms by Hurricane Nate in September 2017. Although the bogs were covered, it is anticipated only one of those bogs will recover from the vegetation being buried by the sand. Since these plants are wetland plants and the water tables are high underneath Deadman's Island, from past project observations, the remainder of the plants should survive.

2.3.2 Reef Structural Integrity

Success criteria were met.

The Ecosystems reef units withstood several storms in 2017. Although the live oyster population was low in 2017, the Ecosystems remained intact. Some of the units which were lower in the water were reset to match the height of the remaining units. The goal of resetting the units was not about structural integrity but more of balance for better wave attenuation during higher tides.

3.0 Monitoring Results and Description

Terrestrial and marine wildlife observed on and around Deadman's this year varied. Species observed were: Bald eagle, Osprey family, American alligator, Blue Heron, coyote, Snowy egrets, White pelicans migrating, Brown pelicans, Least terns, Sand pipers, turtle, dolphins, stingrays and Black skimmer bird.

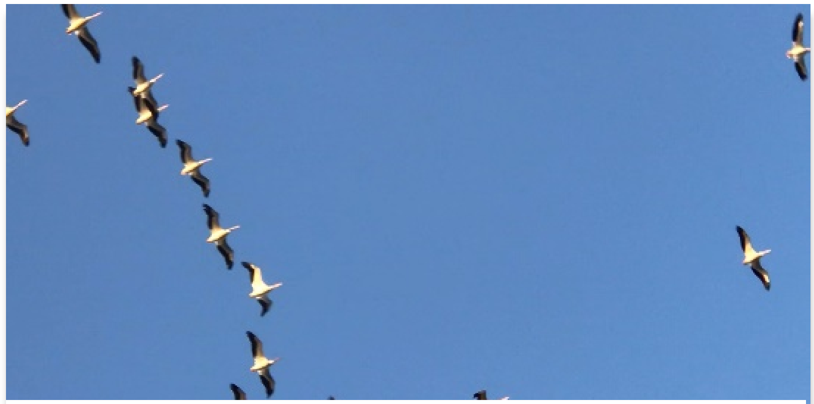
Figure 7: Hundreds of American White Pelicans, (*Pelecanus erythrorhynchos*) flying over Deadman's Island

3.1.1 Underwater Qualitative measuring techniques

Monitoring was performed when visibility was at least 1.5 feet and using an underwater flashlight. Monitoring was conducted by using shallow reef hookah rigs with supplied air and regulators. The depth was 3 to 6 feet.

3.2 East Breakwater, West Breakwater vs. Entire Breakwater

Monitoring occurred on the Ecosystems breakwater located on the east and west side. Each breakwater unit is monitored in sections according to orientation to the land, the landside (LS), the northern direction (ND), the eastern direction (ED) and the western direction (WD). The east and west direction have a different orientation, but the sections remain the same on the field sheets. The reason for the sectioning is because the landside exposure on each breakwater is protected. The opposite side is exposed to the open water and fetch wave impact. The other two sections have little exposure to land or direct wave action and may provide a more protected habitat by being adjacent to the next unit. The east side breakwater is closer to residential property, is exposed to the twelve-mile fetch and is in the path of littoral transport of sand from the northeast. The east breakwater has more exposure to morning sunlight and afternoon sunlight and is subjected to fierce northern winds.

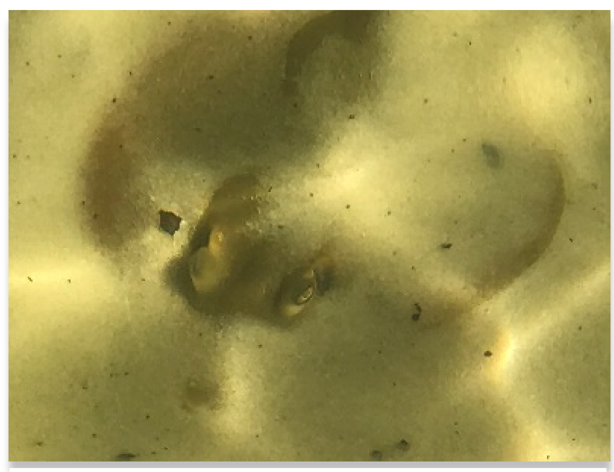
Figure 8: Juvenile southern stingray (*Dasyatis Americana*)camouflaged in the sand along the shoreline.

The west breakwater is exposed to a 3-6-mile fetch and is protected from the strong current from the northeast. The west end is the closest to the shoreline of Deadman's Island. The entire breakwater encompasses North, South, East, and West.

In the past years, the monitoring compared the West section and the East section. Now the breakwater is complete, unit sections are selected equally throughout the entire reef. The entire reef including the west, the east and the northern sections. In some cases of this report, the east and west section may be compared if there is a significant difference in numbers. After 2017, the monitoring report will compare the results for the entire reef each year.

Figure 9: The completed breakwater at Deadman's Island

3.3 Oyster growth rate, spat settlement, recruitment, predation, and health

3.3.1 Oyster Growth

Success Criteria: The success criteria were not met.

Since the entire reef is now the Ecosystems units, comparing the species on the reef was more effective. The small amount of living oysters present on the reef size range from 4 to 5 inches. The oysters in the deeper water (5-6 feet) seem to show the largest size as compared to the oysters in the shallow locations. A portion of these oysters was sent to a certified non-government owned laboratory for tissue testing (Tissue testing results can be found in Appendix 2).

3.3.2 Oyster Spat Settlement Monitoring

Pre-monitoring occurs around February when the weather changes. In February, new spat was observed to have settled on the new reefs; when the July monitoring occurred, very few live spat were found. It is common to find live spat early in the year after a recent spawn but later finds increased mortality in the summer months. During the summer months, the oysters are observed spawning, but the live spat isn't observed until later in the fall. Only 2% of the reef surveyed was occupied by live oysters.

3.3.3 Oyster Predation

Evaluation is done throughout random stations- using the point count method of the quantitative underwater ecological surveying techniques. Drills are also counted individually. Sampling will occur twice a year for five years.

Predators –There are many predators of oysters on the reefs but the most abundant threat to the oysters, are oyster drills, *Stramonita haemastoma*. Oyster drills prefer salinity above 15ppt but can survive in 8ppt. The salinity dominated the reefs at 5 ppt until around late September where is raised to 14 ppt. Oyster drills were almost non-existent. Out of the 102 reefs units surveyed, there were only 26 drills found on the entire reef during the monitoring period of July to October.

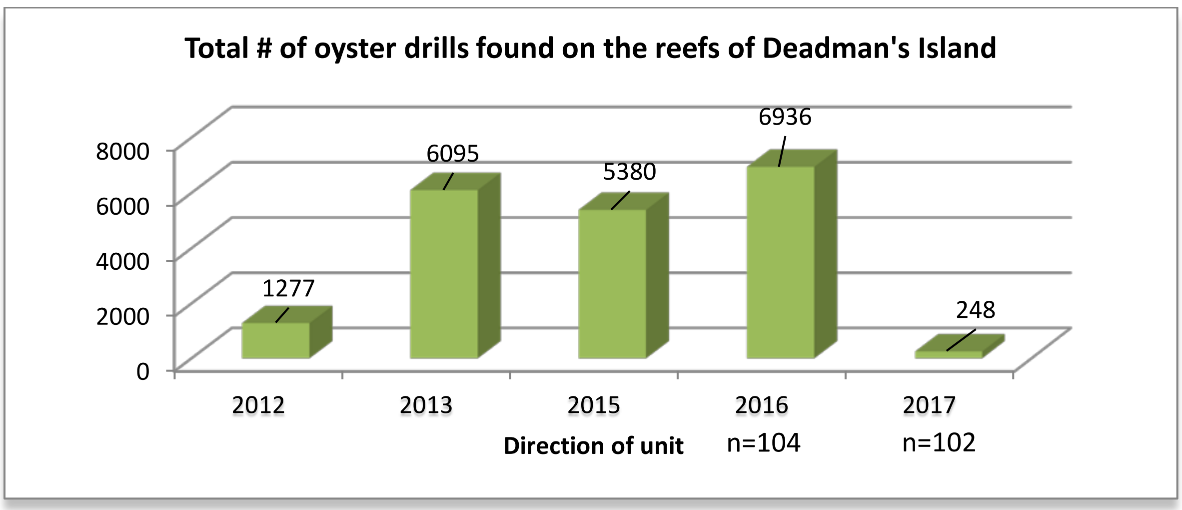

Figure 10: Total count of oyster drills over time.

3.4 Oyster Health

Evaluation of health was performed throughout random stations- Dermo was not tested for due to low salinity levels. Dermo is caused by a single-celled Protozoan parasite, *Perkinsus marinus,* Dermo is an intracellular parasite (2-4 µm) infecting the hemocytes (blood cells) of the eastern oyster mentioned in the previous 2016 report. Dermo is usually controlled in salinities less than 9 ppt. A salinity of 15 ppt is required for infection, 20 ppt is required for rapid and high mortality. Large oysters over 4 inches were collected for tissue testing (See Appendix 3 for lab results).

3.4.1 Analytical Testing Results

During the DWH oil spill of 2010, the oysters were tested to NOAA standard testing instead of the State of Florida criteria. The State criteria were extremely low, all tests showed no detection of any oil contamination even though our samples contained pure crude oil. Our oysters (and fish) were still dying off. The NOAA test results were the only testing methods showing there was above the max range of chemical compounds in the diesel range. This method means chemical compounds of crude oil compounds were found in the tissue of the fish and oysters, instead of the basic PAH compounds created from boat pollution.

The reefs had a majority of minimum market size oyster (3-5 inches) in the year 2015. This was the first time since early 2010. As discussed in the 2015 report, the 2010 oysters were tested for basic PAH according to the state of Florida criteria. No PAH results were found.

A sample of submerged oil found was halved with the FDEP laboratories and scat team. This sample was a pure sample of crude oil. The FDEP results came back as no detection. The certified petroleum laboratories results were 100% crude oil with a profile of MC252. This result was the first realization the State criteria of normal PAH was too low in the detection of crude oil in organisms. NOAA Laboratories were contacted along with BP certified labs to discuss these tests. These particular tests were able to detect carcinogenic compounds why fish and oysters were dying off. The fish and crabs died off much quicker than the oysters in 2010. Oysters cannot process PAH (Dame 1993, 1984) , so these were considered as "windows to the health of the bay." Naturally, we can't say the oil spill killed off the oysters and fish, but data shows the chemical compounds found in crude oil in the oyster tissue and there was a large amount of oil which drifted in Pensacola Bay through the Pensacola Pass. We were constantly locating and reporting in Pensacola Bay. In addition, oil washed up on Deadman's Island. At the time, these new tests showed petroleum hydrocarbons in the diesel range in the tissue of oysters and fish. Fish mortality increased in 2010 and the complete mortality of the reef occurred in 2011.

These laboratory tissue tests are now used as "post baseline" tests and should be used as a tissue test for primary monitoring. Not only does this test show the lighter weighted compounds which are volatile and in some cases, less significant. Some of the test results show heavier compounds which can penetrate the lipid fat layer and show an effect on human health. The same collection method was performed for the 2015 tests- These tests show small levels of primary PAH, which indicates pollution from anthropogenic stressors. There was no detection of the carcinogenic compounds as detected in 2010 during the oil spill. What these results show is the recovery in the Bay, from the oil spill timeframe, has finally occurred. The oyster male to female ratio has come back into balance with more growth and less observed die-offs.

The carcinogen compounds found in the oyster tissue during late 2010, were fluoranthene which is Group 3 carcinogen, naphthalene which is a Group 2B carcinogen known to damage or destroys red blood cells, phenanthrene-Group one carcinogen. Phenanthrene is not listed as hazardous to humans under Clean Water Act but the rate of exposure to humans is unknown. Pyrene which is toxic to liver, blood, and kidneys was also found. The exposure rates to toxins were judged from May 2010 to the sample date of the oysters. In the earlier stages of the oil spill around August 2010 (when the die off and sick fish were first seen), chrysene was also found along with the same chemicals referenced above. Some of these chemicals occur naturally in the environment and can be detected in lab controls, but there is a certain detection limit which is acceptable. These levels were above the detection limit, and some of these numbers increased with time. The 2015 and 2017 oyster tissue analysis showed no detection of any of the harmful compounds found in the 2010 analytical results of the oyster tissue. It is also important to note; there has been no sick fish nor any fish with lesions seen on the reef since the oil spill timeframe. The algae found during the oil spill (believed to uptake the hydrocarbons of the oil found in the bays) have not been observed since the oil spill timeframe. Moreover, the decline in the oyster population due to low salinity has only occurred seasonally and has allowed recovery of the oysters within a few spawning seasons. What this historic information and trend shows are the low salinity may cause a decline in the oyster production periodically, but it obviously did not upset the male to female ratio nor caused a complete mortality which would have to have recovery period over a few years.

3.4.2 Conclusion of the post-baseline study of the oil spill

The fish were essential to the health of the reef. The fish were the “janitors” of the reef. When the fish died off during the DWH timeframe, the oysters were left unguarded. The oyster drills also preferred to consume the abnormal growing algae as well as the “unguarded” oysters.

Due to the results of the laboratory analysis of the post-baseline study of the oyster tissue, it is unlikely we will find harmful carcinogenic compounds such as in crude oil, which was found in the oysters’ tissues in 2010 and 2011. There was a die-off of the oysters in 2012. No testing could occur until the oysters recovered. The conclusion is the entire microbial environment of Pensacola Bay, as well as other waters exposed to oil, were affected and caused a crash in the entire food chain. During the first few years of the Deep-Water Horizon Oil Spill and as predicted by many scholars of previous oil spills, recovery of the food chain and water column microbial community occurred after five years.

4.0 Abiotic Factors affecting the reef

4.1 Storm Events

4.1.1 Number of high water events/ significant storms 2017

Figure 11: a curious juvenile American Alligator, *Alligator mississippiensis* (3 ft long) taking advantage of the low salinity in Gilmore Canal adjacent to Deadman's Island.

As shown in the graphs of 2014-2017 (see figures 15-17), the actual tides continue to rise above the predicted level initially given by NOAA. This fluctuation makes it difficult to plan for tide dependent projects. Although tropical storms and hurricanes were affecting the Gulf region, the trend of sea level rise continues throughout the months where there were no storms.

4.1.2 Rainfall

The year 2017 received a substantial amount of rain with record highs of rainfall in January, May, June, and August. Although 2017 rainfall was not as high as the April flood in 2014, the frequency of rainfall increased throughout the summer months of monitoring. Data taken near the coastal site show a maximum of 20 inches; however, data inland where the watersheds are located show a maximum rainfall of 90.2 inches for 2017. Last year the inland rains were 64.62 inches, this amount was normal according to the Department of Agriculture.

Knowing the amount of rain inland will tell us of our water quality impact in the coastal areas of the site. Twenty inches is a good amount of rain to have all summer but combine the 20 inches of rain with 90 inches of rain which causes runoff from the inland areas and watersheds, was a disaster for water quality. Not only the water was turbid and the color of dark tea, which affects the light attenuation, especially for seagrass, the salinity was so low at 5 ppt, only euryhaline species who can osmoregulate, could survive long term low salinities.

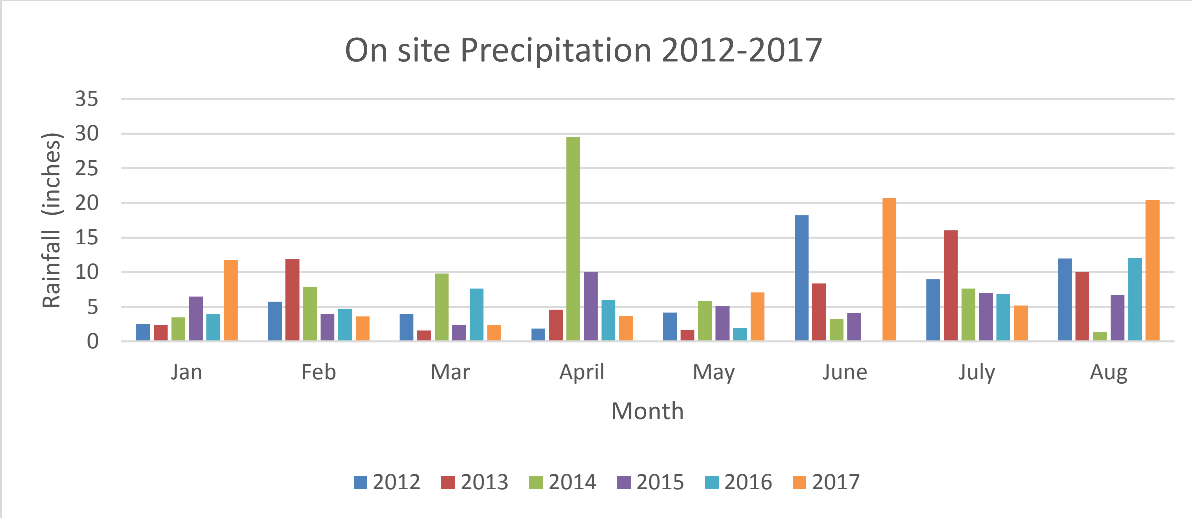

Figure 12: Precipitation near Deadman's Island. Rainfall from June and August 2017 increased in the summer months causing low salinity and turbid waters. In 2014, a massive flooding event in April also caused turbid waters and somewhat low salinity.

4.2 Hurricanes and Tropical Storms

2017 was an eventful year with Tropical Storm Cindy, Emily and Hurricane Harvey, Irma, and Nate. Each storm had different intensities, distances and effects, yet each storm had some sort of impact with the tides, sand shifting, plant wash out, smothering and/or erosion at Deadman's Island.

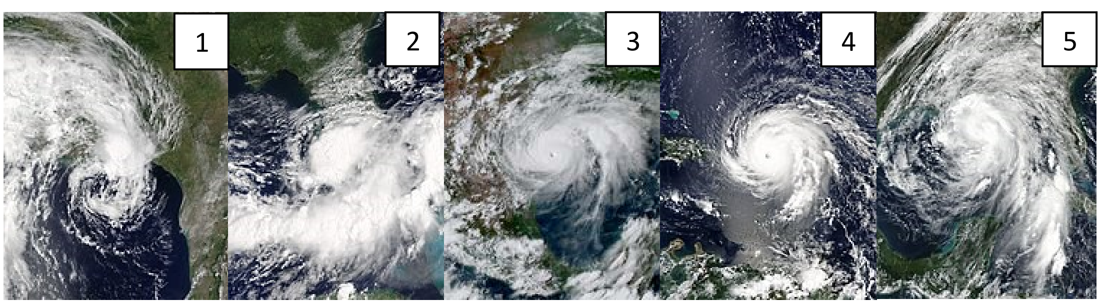

Figure 13:2017 radar pictures of 1. Tropical Storm Cindy, 2. Tropical Storm Emily, 3. Hurricane Harvey, 4. Hurricane Irma (in the Caribbean), 5. Hurricane Nate

4.2.1 Tropical Storm Cindy June 20- June 23

Developed June 13 and entered the Gulf on June 20-June 23 Tropical Cindy made landfall between Port Arthur, Texas and Cameron Louisiana with peak winds of 60 mph and 992 mbar. Cindy weakened on June 23 into a post- tropical cyclone. Tropical Storm Cindy brought over 20 inches of rain and raised the tides level to 2 ft. above normal in Gulf Breeze and started the flooding events for the summer in Santa Rosa county.

4.2.2 Tropical Storm Emily July 31-August 2

Designated a tropical depression July 31st and strengthening into a Tropical storm two hours later, peak winds were 45 mph (1005 mbar). Emily made landfall at Anna Maria Island, Florida. The storm then traveled across Florida into the western Atlantic, headed northward and dissipated on August 2, 2017.

During this timeframe the tides rose over the reefs of Deadman's Island only one foot higher than normal and completely submerged the breakwaters and caused erosion to the shoreline behind the breakwater and washed out the shoreline plants.

4.2.3 Hurricane Harvey August 17- September 1 Category 4

Developed August 13 and entered the Gulf of Mexico on August 17, 2017. Hurricane Harvey made landfall between Port Aransas and Port O'Connor, Texas with peak winds of 130 mph. The storm gradually weakened, becoming a tropical storm on August 26, as it moved across southeastern Texas. The storm to emerge into the Gulf of Mexico on August 28, but a turn toward the north-northeast brought it ashore west of Cameron, Louisiana, as a weak tropical storm around on August 30. The system weakened to a tropical depression over central Louisiana late that day before losing tropical characteristics over central Tennessee early on September 1.

Similar to Tropical Storm Cindy, Hurricane Harvey brought over 20 inches of rain to Gulf Breeze.

4.2.4 Hurricane Irma August 30- September 12 Category 5

Irma formed into a very organized storm August 26th, 2017 off the coast of Africa. Irma intensified in a Category 5 hurricane on September 5th. Peak winds were 185 mph (914 mbar). Irma moved through the northern Leeward Islands and weakened as it approached the Bahamas but intensified to a Category 5 before making landfall in Cuba on September 9. Irma then moved to Cudjoe Key in Key West, Florida on September 10. A few hours later, Irma struck Marco Island, Florida, with winds of 115 mph. Irma continued to move north and west, steadily weakening over the Southeastern United States before losing tropical characteristics in Georgia, early on September 12. Irma maintained peak intensity 37 consecutive hours. It is the only storm on record worldwide to have winds intensify for so long. As Irma approached Georgia and 300 miles from Gulf Breeze, the water was sucked out of the bay and exposed the shallow subtidal floor and the bottom tier of the breakwater at Deadman's Island for about four hours.

4.2.5 Hurricane Nate October 4- October 9 Category 1

Hurricane Nate quickly organized on October 3 and low pressure in the southwestern Caribbean Sea. The disturbance quickly organized, and on October 4, the National Hurricane Center announced that the disturbance had strengthened into Tropical Depression Sixteen, and began issuing advisories on the storm. October 5, the storm was deemed a tropical storm and named Nate. Nate's first U.S landfall was in the mouth of the Mississippi River as a Category 1 hurricane, and Nate's second U.S landfall was at 12:30 a.m. CST near Biloxi, MS, both on

October 8. The storm's peak intensity was 90 mph, (981 mbar). After making landfall, Nate quickly weakened into a tropical depression. Hurricane Nate was only 100 miles from Deadman's Island and created winds up to 45 mph and pushed sand up to 40 feet on shore at Deadman's Island. Tide levels rose over 3 feet above normal and caused some scouring of newly planted shoreline vegetation and placed sand over vegetation approximately 40 feet along the shoreline. The full moon on October 5th, along with Hurricane Nate being on the west side of Gulf Breeze may have added to higher than normal tide.

4.3 Sea Level Rise

As mentioned in the previous year's report, sea level rise seems to have become measurable on a local scale. Historically, the NOAA tides charts depicting actual tides are above the predicted tides. This was verified in previous years (Figures 15,16,17)

The predicted tides are from models based on the last 100 years (Figure 14). In most cases, not only was the high tide greater than normal but the low tide, from some months, represented more of a high tide and remained above one foot above normal. In other words, the verified data in the charts, which is green, shows the low tide were absent at a time when salt tolerant plants needed to recover from the lengthy duration of high tides.

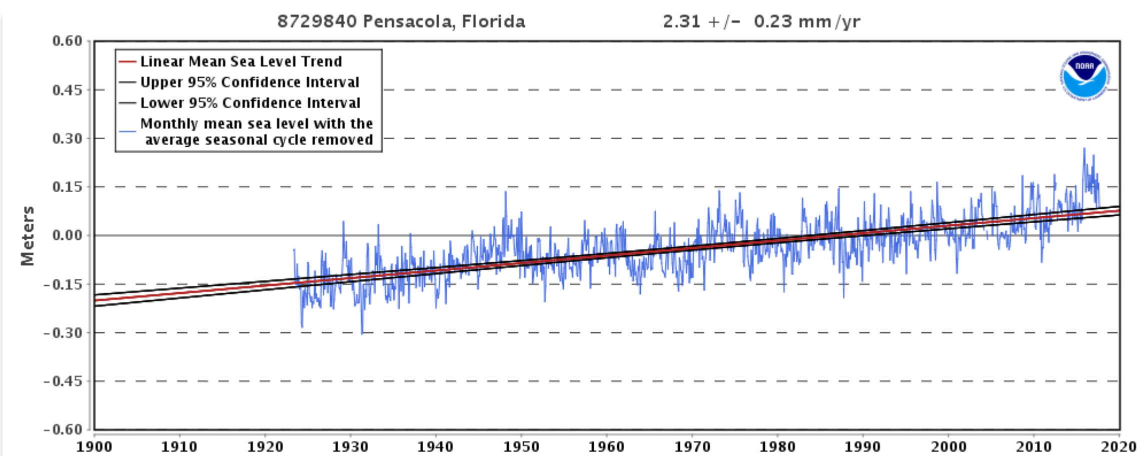

Figure 14: One Hundred year average trend of sea level rise of Pensacola, Florida.

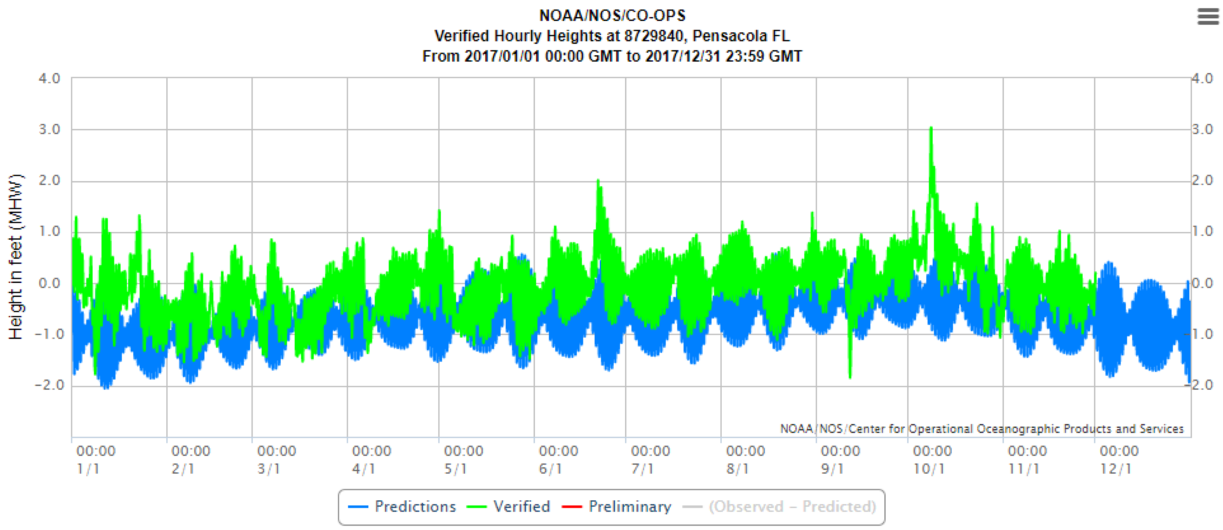

Figure 15: The actual and predicted tides levels of 2017. The blue lines are the predicted tides given, and the green lines are the verified tides which were the actual tides.

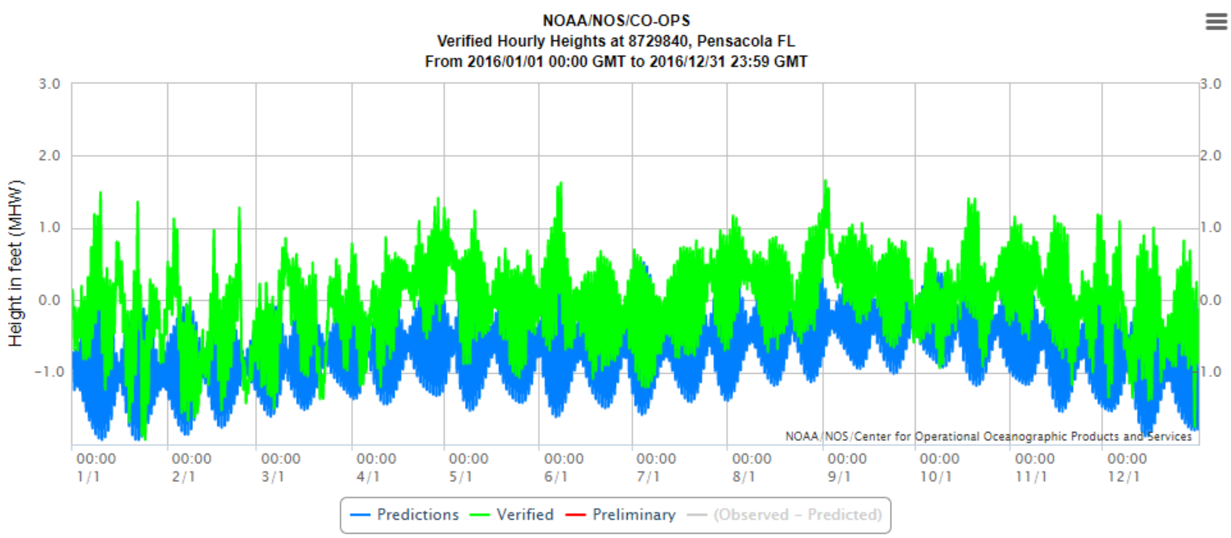

Figure 16. 2016 Historic Tides data from Station # 8729840. The blue lines are the predicted tides given, and the green lines are the verified tides which were the actual tides. In some cases, from January to July, the tides were .69 feet higher than normal tide. From July to December the tides were also approximate .85 feet above normal except a few storms in October and November raising to 2.45 feet above normal.

In April, May and June 2015, low tides were also higher than normal and never actually allowed a normal low tide. In all months of 2015 after July, the verified high tides ranged from 1 to 2 1/2 feet above normal tide. In the months of November and December, were supposed to have extreme low tides. This particular low tide was compared an average summer tide, which was 1/2 to 1 foot higher than the normal low tide.

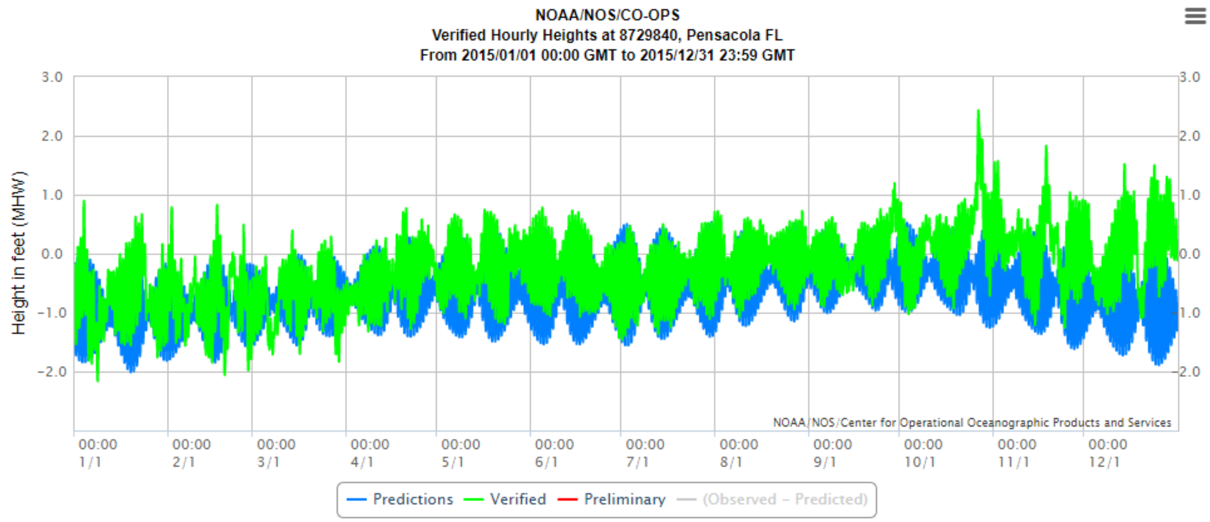

Figure 17: 2015 Historic Tides data from Station # 8729840. The blue lines are the predicted tides given, and the green lines are the verified tides which were the actual tides. In some cases, from January to July, the tides were 2.079 feet higher than normal tide. From July to December the tides were also approximate 1.058 feet above normal.

4.4 Salinity

Salinity is the most important physical factor to trend to understand whether the oysters will have a healthy year or predict a possible change in growth. Salinity influences the health of the oyster and its predators. Higher salinity accommodates most of the predators of the oysters (Savarese 2005). Oysters can grow and spawn in intermediate salinity such as 5-25 parts per thousand (Bartol et al., 1999). In 2013, the salinity reached its highest in the bay at 32ppt and every year went above the maximum limit, only briefly, the lowest in 2015 at 4.57 ppt. In 2017, salinity was the lowest on a log-term basis due to two events of heavy rainfall in June and August. Most likely the gametogenesis will be reduced causing a lower amount of gametes and therefore, less spawning (Gorzelany, J. 1986).

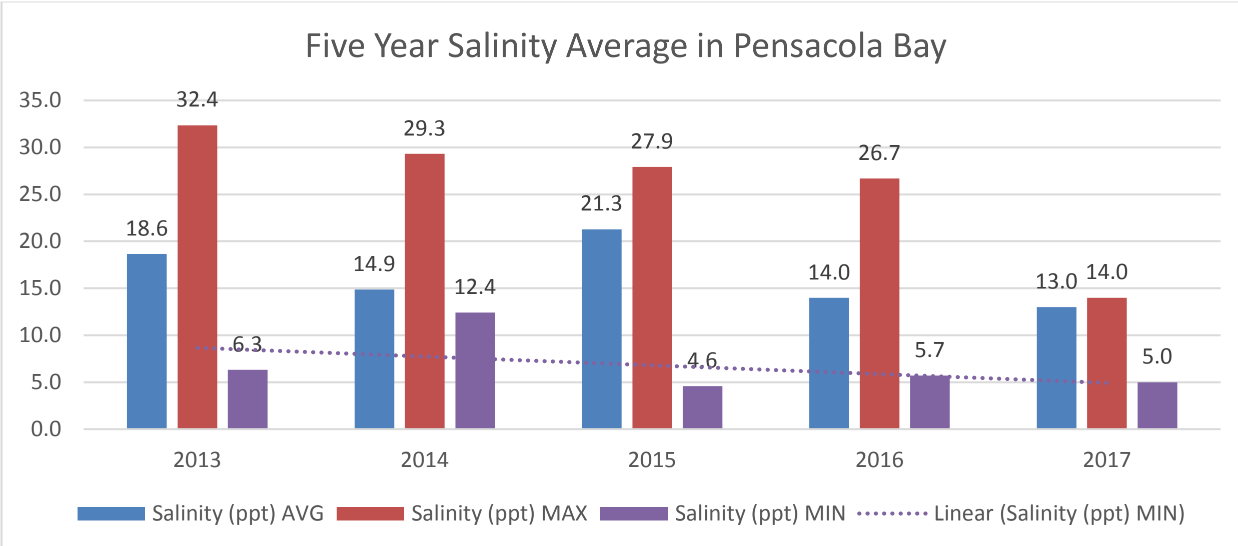

Figure 18: Salinity chart for 2013-2017. Salinity levels represent March, June, July, August, and September of 2017. The year 2017 shows an average range of 13 (ppt) and min and max range 5-14 (ppt) during spring and summer months. Data source FDEP STORET and Deadman's Island project monitoring data.

4.5 Temperature

There were several temperature fluctuations throughout the year which could have induced spawning. The temperature chart shows the large temp fluctuation in January, March, September and November(Figure 19). However, it is unlikely the oysters spawned due to such a drop in salinity. Precipitation begins to lower the salinity levels in May (Figure 12).

Salinity can be affected by water temperature. As the temperature rises, the salinity increases in the bay (Figure 20). The exception would be fresh water influx as observed with the floods of 2014 (Figure 20) and multiple heavy precipitation events in 2017. The salinity was much lower in the bay despite the temperature. Observations of nearshore shallow water oysters are more susceptible to disease from stress and baking in the sun from hotter temperatures when exposed. The offshore distance of the breakwater keeps the temperature and dissolved oxygen ideal for the oysters because of continual underwater exposure. Monitoring shows some oyster growth out of the water, but this exposure is normally tidal influenced.

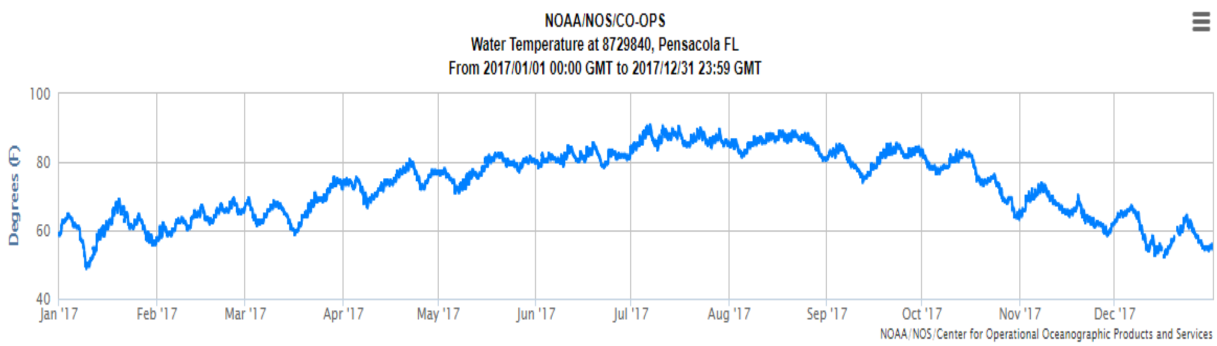

Figure 19: 2017 Water temperature. This chart was used to determine possible random spawning by determining temperature fluctuations. NOAA Air Temperature, Pensacola FL. January to November 2017

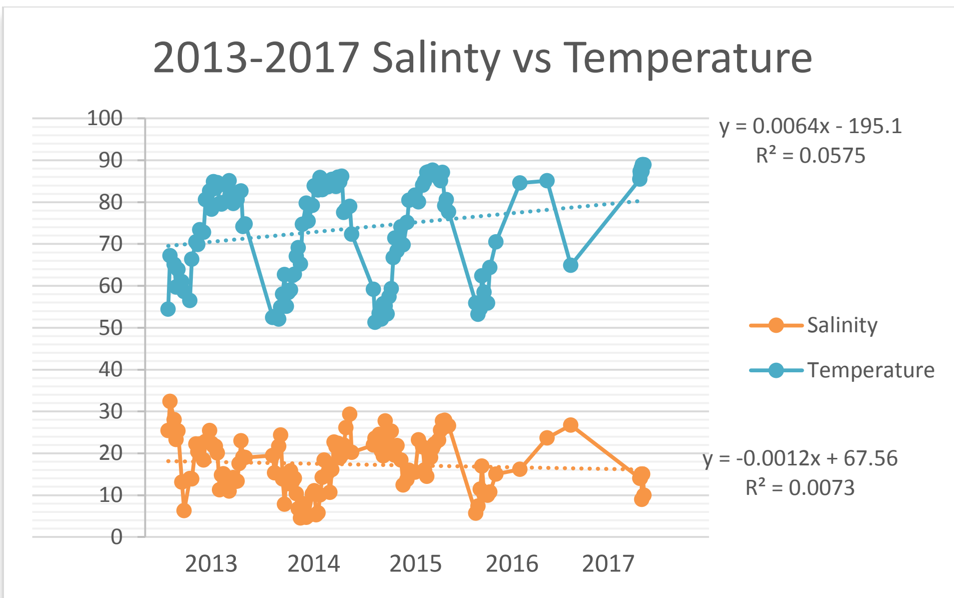

Figure 20: Water Temperature/Salinity trends from Jan 2013 through November 2017. Temperature trends through NOAA.gov are from January to November 2017.

5.0 Community Structure

Since the placement of the East 2012 reefs, the first- year monitoring data showed slow growth. Growth then exponentially increased over time in the following years. Normally, from our monitoring, oyster growth can be observed within a few months after spawning. The 2015 reef showed oyster spat almost immediately after deployment of the reefs. This immediate spawning was most likely due to the disturbance of the existing oysters when we removed and shook the Reefblk reefs over the new tiered Ecosystem reefs to get any existing organisms to fall in the water. The purpose to shake the reefs with crane why removing was to cause any existing oysters or marine organisms to fall from the reef back into the water. The idea was to repopulate the new reefs with any existing marine organisms. From personal observations and oyster research in various parts of the U.S., oysters are known spawn when disturbed.

Spawning trends are predicted through population events. Whether the populations are declining or increasing will depend on variables such weather, salinity, oyster growth, species competition, species diversity, predatory species, and water quality. By using a trend formula and our monitoring data, we are able to predict the number of spawning events in the upcoming year. This data can tell us the health of the bay through yearly increase or decrease of reef species occupying the oyster reef.

The data should also show whether the oyster reef is once again in danger of another complete or partial die-off or a sustainable level of growth. The 2017 crash was predicted due to the decrease in oyster drill egg casings. Although an increase in most reef species was observed in 2016, this increase could be the dominant species controlling the most destructive species, such as stone crabs reducing the oyster drill larvae. In 2017, community structure decreased and the main bivalve species to survive on the reef was hooked mussels. This decline in community structure and species diversity showed the importance of using non-live oyster dependent reefs for structural integrity.

Figure 21: Resident Great blue heron (*Ardea herodias)*

5.1 Species abundance and Individuals present:

During the early years of 2012 and 2013, the species abundance coincided with community structure. Last year's data showed there was a steady increase from 2012 through 2015. Normally, a stable ecosystem is observed to have a constant change in species abundance numbers. Certain species numbers increased significantly on various sides facing the reef. Again, the point to understand for reef orientation, the Landside is more protected from wave action from the open bay. The East and West side of the breakwater would appear to have similar exposure to the wave action. However, the East side of the breakwater is more exposed to the morning sun than the west side. Due to the salinity being so low, there was no correlation of species abundance about any side of the breakwater unit.

In the previous years, the oyster drill populations appear to fluctuate on the entire reef. This included both the Reefblk and the Ecosystems. There was a 4.7 times increase in the oyster drill population from 2013-2015. By 2015 there was a 65% decrease in numbers. However the egg casings increased over 2000 times. As with the 2014 floods, the salinity in the year 2017 was extremely low. This low salinity caused the lowest number of drills of all the years. This decrease coincided with the same drop in numbers as with 2014.

In 2015, the hooked mussel, *Ischadium recurvum,* occupied the reef and was added to the spreadsheet. Hooked mussels prefer the low salinity ranges. In 2017, the highest number of hooked mussels were observed. Although hooked mussels are symbionts on the reef, there is still a competition for space with the oysters. The main predator of hooked mussels is blue crabs. Very few blue crabs were found on the reef. No tropical species were found on the reef this year. The 2017 results are understandable due to the amount of rain, low visibility and salinity in the bays earlier this year.

6.0 Fish Surveys

Fish surveys are conducted throughout the monitoring event as the fish are seen on each unit- using the visual census method of the quantitative underwater ecological surveying techniques. Fish swimming in the vicinity of the reef and fish inside the reef are counted. After a few transects, the fish are more relaxed with the presence of divers and easier to quantify.
After placement of the 2015 wave attenuators, the fish and crabs showed up on the new reefs within 24 hours.

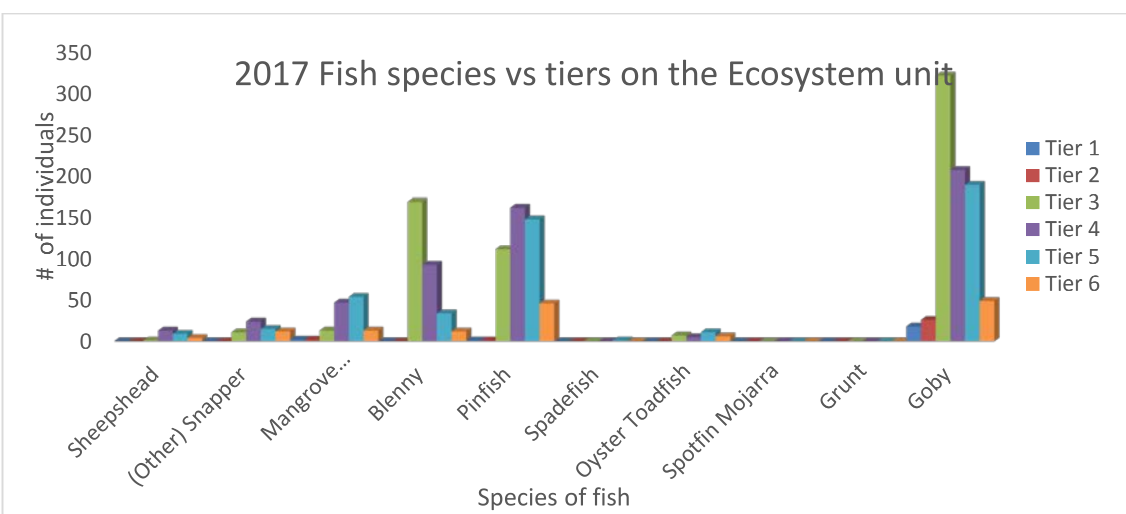

Figure 22: The fish population vs. the various sections and units of the East and West breakwater reefs.

Table 1: Species found on both reefs from 2012-2017 2012-2016 data were from the East and West breakwaters only. 2017 represented random selections of the same number of units throughout various sections on the entire reef.

Species name	Common name	2015	2016	2017
Urosalpinx cinerea	Oyster Drills (OD)	5380	6936	248
Urosalpinx cinerea	Egg Casing (EC)	74380	74900	1784
Crassostrea virginica	Live Oyster (LO) %	63	46	2
Barnacles sp.	Barnacles sp %	8	37	11
Archosargus probatocephalus	Sheepshead	1	69	24
Lutjanus campechanus	Lane Snapper	123	35	61
Lutjanus griseus	Mangrove Snapper	23	24	105
Zooanthis sp.	Zooanthids	4575	15	6
Hypsoblennius hentzi	Blenny (Feather)	4575	5428	435
Cerianthus spp.	Tunicates	0	11	1
Menippe mercenaria	Stone crab	12290	6296	1813
Pagurus longicarpus	Hermit Crab	1387	734	2692
Lagodon rhomboides	Pinfish	1336	569	1813
Chaetodipterus faber	Atlantic Spadefish	2	0	1
Astrangia danae	Coral	3	0	0
Opsanus beta	Toadfish	48	40	24
Brevoortia patronus	Menhaden juv*	2	0	0
Sabellidae spp	Feather duster worm	3	543	47
Cerianthus spp	Anemone	1755	39	0
Micropogonias undulatus	Atlantic croaker	99	39	4
Ischadium recurvum	Hooked mussels	20979	5167	26679
Callinectes sapidus	Blue crab	188	13	1
Gobiosoma bosc	Naked Goby	1955	1947	1025
Littorina littorea	Periwinkles	5182	8004	3210
Total fish		5147	8151	3492
Total oysters %		63	46	2
Total crabs		12478	6309	4506
Total # species 22		59906	35909	38189

7.0 Gulf sturgeon monitoring

The sandy substrate normally harbors fewer polychaetes and other benthic organisms. According to the tracking receivers, Gulf Sturgeon (*Acipenser oxyrinchus desotoi),* frequent the area around the breakwater. Fine sediment is the ideal foraging habitat for the Gulf Sturgeon. The method to determine the amount of foraging food present for the sturgeon is still being pioneered. Acoustic receivers picked up 300 pings throughout the months of February and April, each ping documenting the tag number. The project site was double layered with barriers and monitored daily to make sure no sturgeon was trapped. Detections were through the receivers only. No sturgeon was visibly seen during the construction of the project. The water was clear and shallow (1-3 ft.). The barrier was near the shoreline, and there were ~200 feet visible range from shore.

Twenty- three tagged Gulf Sturgeon frequented the reefs of Deadman's Island in 2017. This is a large drop in numbers compared to previous years; the 2011 results of 114 individual numbers was the maximum number of sturgeon we have detected so far. This number can change each year depending on the migration of the sturgeon through yellow river, Choctawhatchee river, Blackwater etc,. (Hightower et al, 2002, Reed 2011). This has been the lowest numbers of tagged sturgeon at Deadman's Island to date.

8.0 Bathymetric Survey

To monitor the sediment movement, erosion, and accretion, a bathymetric survey was taken by a professional surveyor in the month of October. The survey elevation points were then compared to the 2007 bathymetric baseline survey. The baseline of 2007 was before any breakwater was placed offshore of Deadman's Island.

Bathymetry points from 2007, 2011, 2012, 2013, 2014 and 2015, 2016 and 2017 were mapped and contoured to determine how the sand shifted. The results from 2007-2016 surveys were discussed in the previous year's report and won't be addressed in this report. Although most points in the surveys are not exact each year, the survey used fixed points on land and in the water. These points of reference provide confidence in measuring any off-sets. Elevation points were converted to contours to see the changes and movement of sediment as opposed to interpreting thousands of elevation readings (Figure 23) .

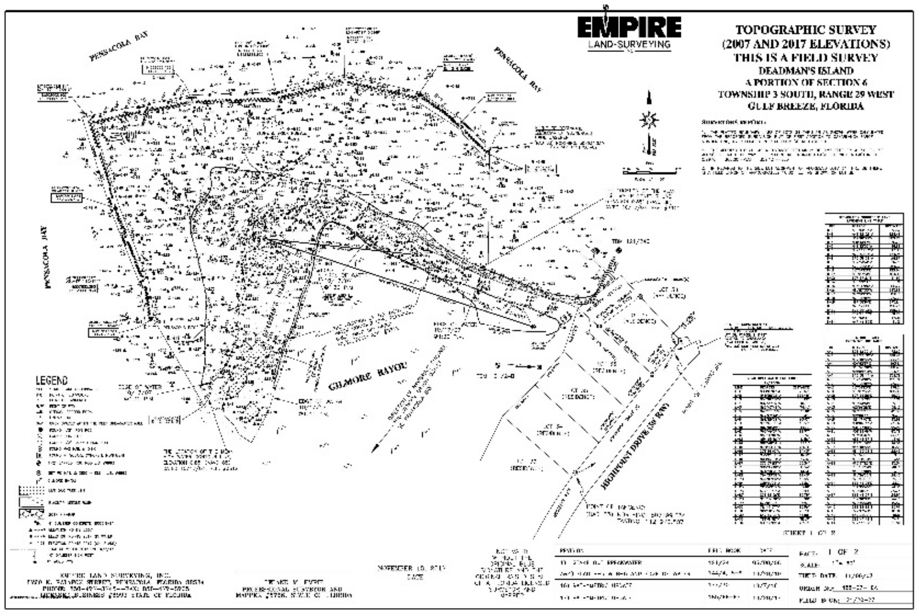

Figure 23: 2017 bathymetric survey and mean high water survey

Since there is a new type of breakwater, and the breakwater footprint is complete, the behavior of the previous year's sand placement and shifting is expected to be irrelevant when compared to the new bathymetric. For monitoring purposes, the baseline of 2007 and the prior years' of 2016, will be compared to the 2017 survey.

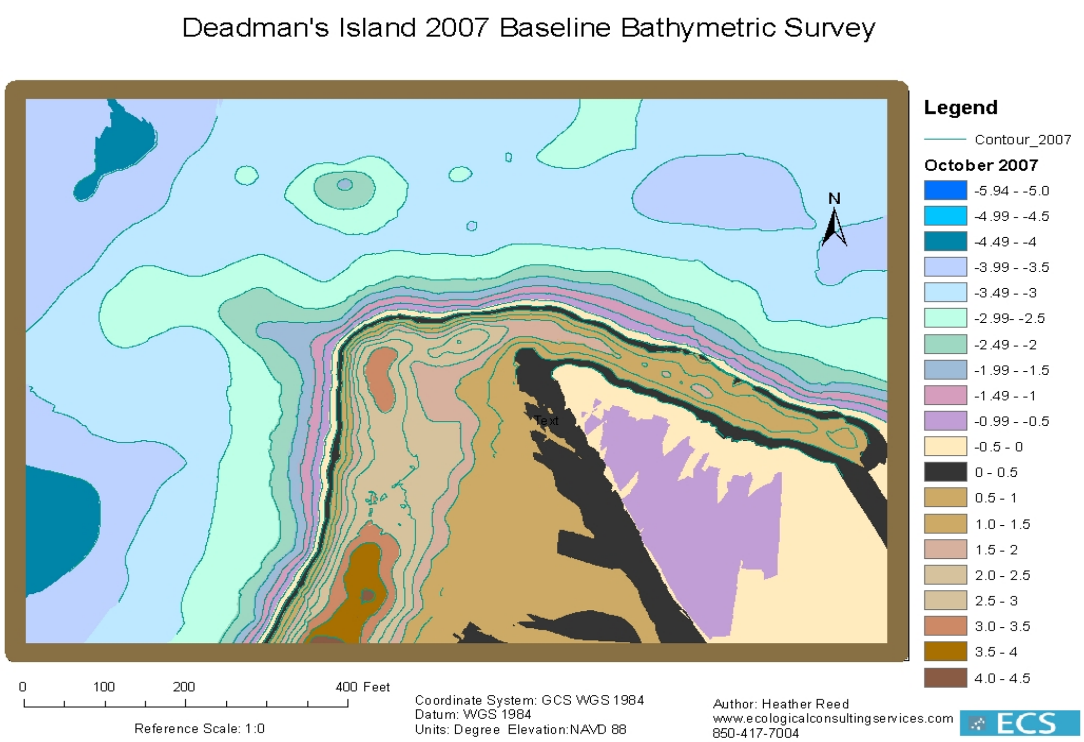

Figure 24: The 2007 Baseline survey of the bathymetry of Deadman's Island prior to breakwater placement.

Figure 25: Google Earth Aerial of Deadman's island 2007

8.1 Sand movement

The 2007 baseline shows increased depth throughout the project. In some areas (Figure 26), there was no gradual profile. This steep profile is what was causing trees and vegetation to uproot and fall into the water. The roots systems were undermined and destroyed. This depth along with the harsh current from the 12-mile fetch was the main factor the historic resources were being unearthed, and the saltmarsh was in danger of being smothered and impacted by high salinity or saltwater intrusion. The 2017 also shows a gradual slope and also a deeper depth at the corner of breakwaters, similar to 2007 bathymetric (Figure 26).

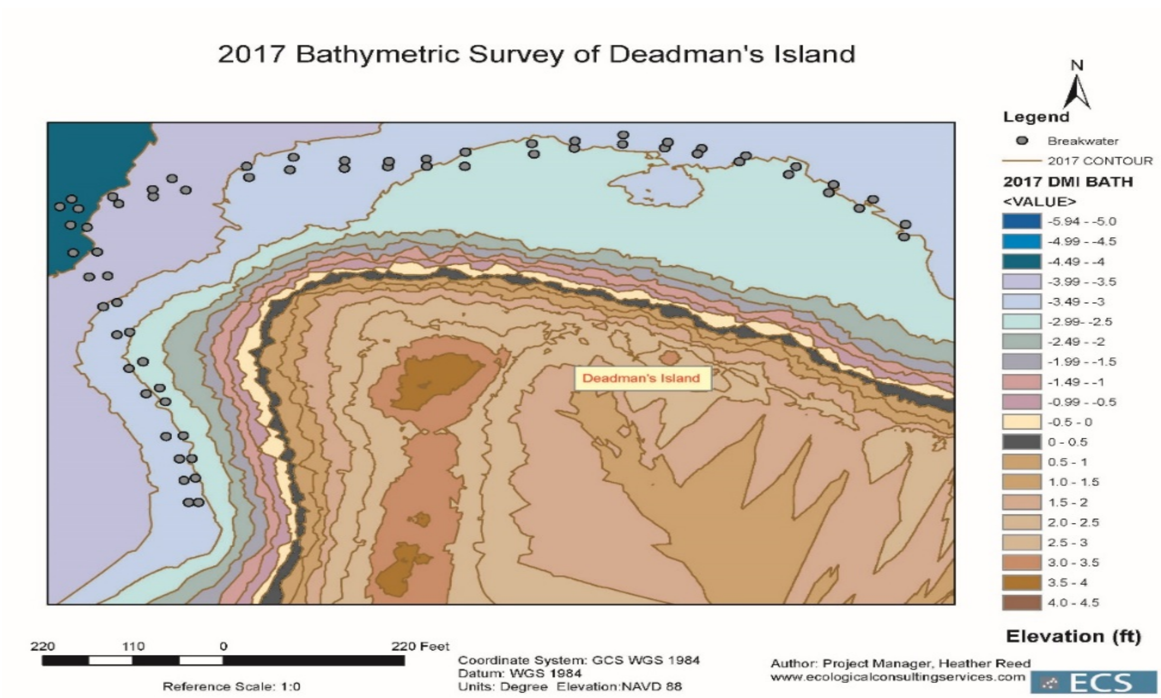

Figure 26: 2017 Bathymetric of the substrate behind the breakwater showing the fill and equilibrium of depth on the subtidal floor along Deadman's Island

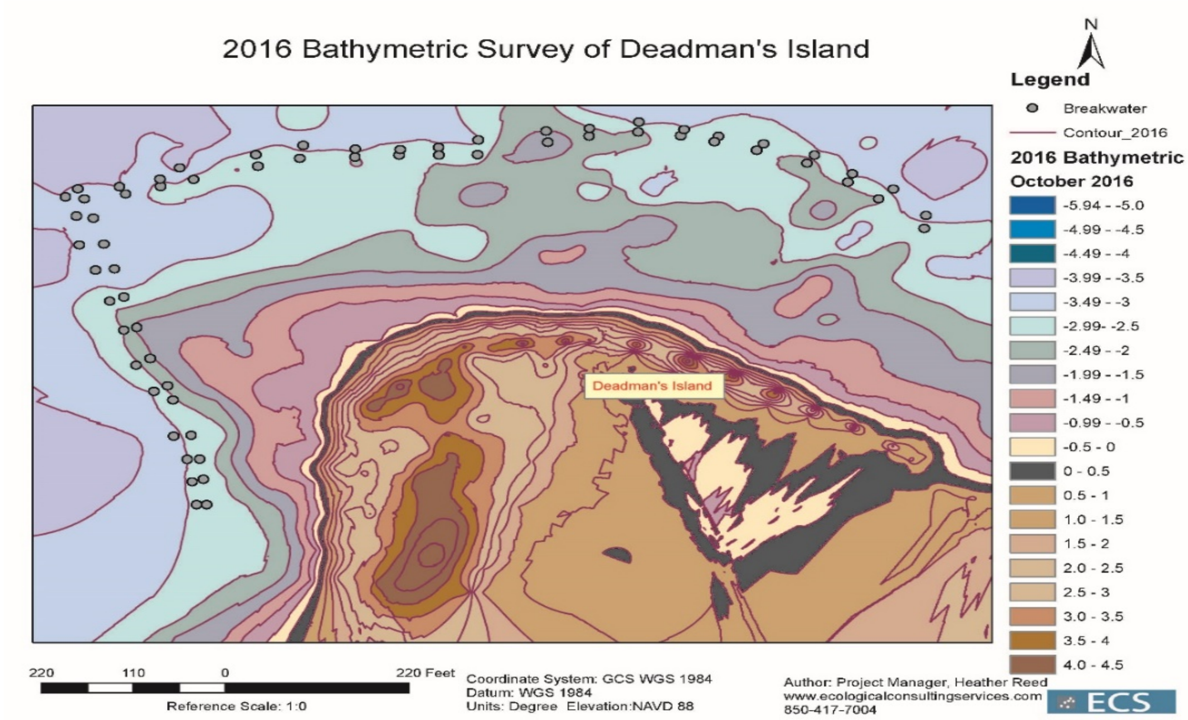

Figure 27: 2016 bathymetric of Deadman's Island

The 2017 bathymetric shows the sand movement prior to the breakwaters and sand was placed. Naturally, the elevation changed, but what is important to note, a gradual beach profile was created by the temporary barrier system, to allow the sand to settle on a slope causing the water to roll onto shore rather than scour and undermine the shoreline. The previous rebar breakwater and north east open section with no breakwater caused the wave action to push the sand to the east and south-east to spread around the project and accrete behind the existing breakwaters.

Sand continued to erode and shift with no organization before the year 2015. There appears to be no loss of sand in the area. Prior yearly bathymetrics showed the lack of breakwater on the northwest corner was causing sand to shift around the original location of placement. Once the sand was the behind the western breakwater, less shifting occurred. The North of the point was constantly eroding due to the failed rebar breakwater. Since there were no shells in the bags of the rebar reefs, wave attenuation decreased 95%. With this lack of wave attenuation and protection from the 12-mile fetch, the north point of Deadman's Island is most impacted. This impact has created continual erosion of the vegetation that was planted for stabilization. Since the placement of the breakwater, monthly GIS readings have been taken and mapped to observe any changes in the shoreline.

Although the 2007 bathymetric is a baseline for 2015, 2016 and 2017 bathymetric surveys, it is difficult to use the 2007 as a definite control due to the previous years projects and activities disturbing the sediment.

Construction projects such as removal of the rebar breakwater and geo- fabric, the placement of new breakwater disturbed the sediment and changed the depth. This disturbance does not represent stable conditions. The sandy bottom needed to reach equilibrium to determine whether the movement of the sediment is permanent. Now the breakwater footprint is complete, the 2017 survey shows more leveling, less shifting and more stability in depth.

8.2 Sand Accretion and Erosion

The 2017 bathymetric (Figure 26) shows more depth and scouring at the northwest corner of the reef. This increased in depth and scouring may be due to the exposed wood from old shipwrecks being subjectd to the strong currents. Several divers were there over the spring and summer most likely illegal "treasure hunting" and hand dredging to expose more of the wood. The other, the more scientific reason for this increase in depth is the current from the 12 miles of fetch caused scouring in the area. This can be seen in the 2017 aerial photo (Figure 28). The Google Earth picture was taken in Feb 2017, and according to the QA notes from the project, it was February 3, 2017. We cross-referenced this aerial by the QA pictures of where the amphibious excavator was located on February 3, 2017. The weather was fair with low wind from the north-west and the high tide was in the late afternoon. The white caps couldn't be from the wind, but the powerful current observed many times in this area.

This is a good aerial to see the current because on this day the wind was very low and the white caps of the water currents are seen at the north-west corner and the mid location of the north and west reef. By removing the wind variable, the white caps on the water flowing from the north-east direction shows the power and strength of the currents. The change in the north west depth is not drastic and has always been deeper. However, when compared to the 2016 bathymetric, the survey shows there is about six inches in difference (Figure 27). The changes in the spectrum of the legend are the six-inch difference. In reality, the depth in 2016 could be 3.9 feet and 2017 the depth could be 4 feet depending on the variability of the cells in the mapping program.

It is important to review all the bathymetric surveys and base a conclusion sand movement on only for the 2017 and 2016 surveys. If only 2007 and 2017 were compared, there may be the conclusion the current was scouring and creating a deeper depth. However, there is a depression (hole) of the same depth in the same area on the 2007 survey but not seen in the other surveys. The 2007 survey was prior to any construction at Deadman's Island. Other noticeable changes are the equilibrium of the sand behind the breakwater that was not yet completed.

What can be seen with the 2017 survey is more consistency in depth and the holes seen on previous surveys, seem to have disappeared one the breakwater was complete. There is one hole that has not changed, and these sites are where the units on the piling do not touch the ground. This has been consistent through all the years. The purpose of the reef units touching the ground is to allow sand build up behind the reef. The raised area does not allow build up or scouring; it still maintains its depth. The intended purpose and method were to place these particular reef types in locations that would prevent additional scouring.

The 2017 aerial also shows the white caps of the current in the mid-section of the northern reef and the west. These two areas intersect where the lower western reefs are located (Figure 28). In 2017, the lower reefs were re-set to a height even with the rest of the reef in September. Resetting reef height so all tops are even with each other, should stop the strong current when the water level is below or even with the breakwaters. The time to observe and measure the impact along the shoreline is when the water level is higher than the breakwaters. Hopefully, these events won't be frequent and the shoreline vegetation can recover fairly quickly.

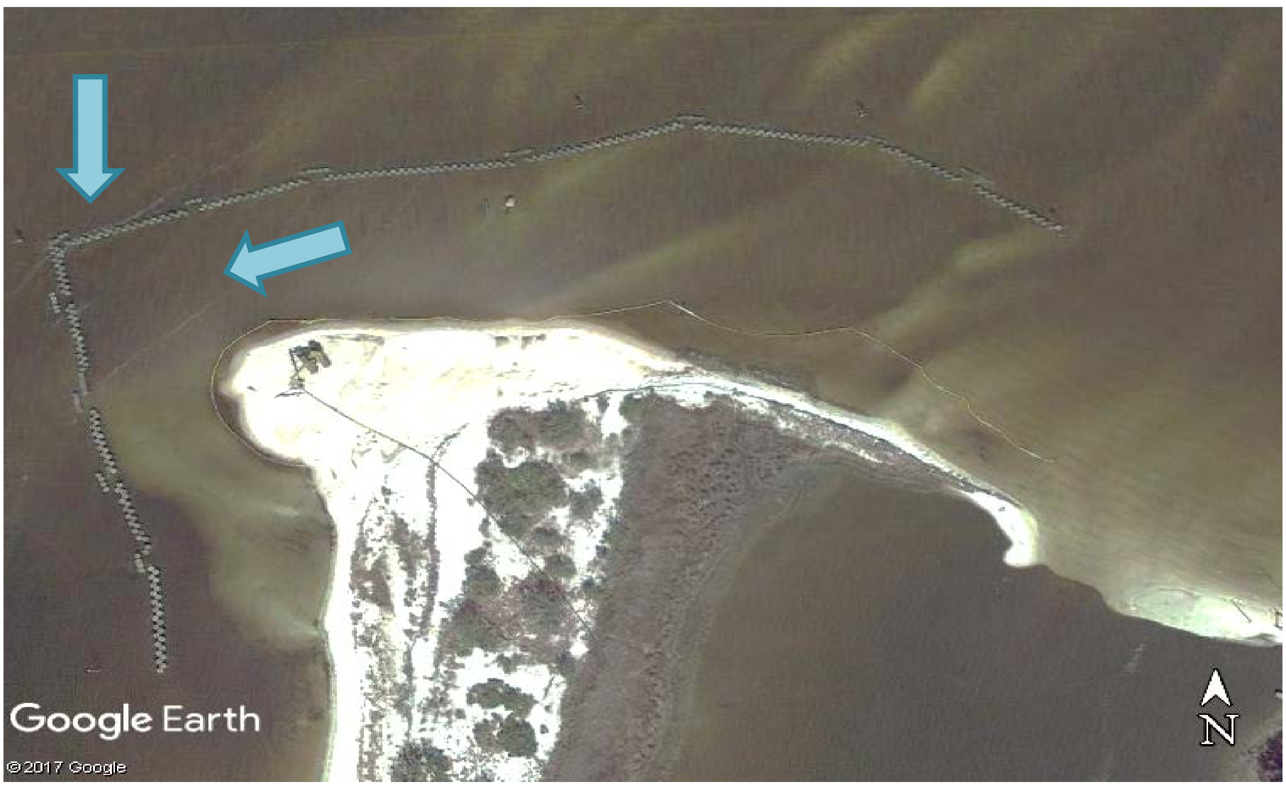

Figure 28: 2017 Aerial of Deadman's Island. Blue arrows show the whitecaps of the current from the northeast

9.0 Measurements: Shoreline Vegetation Survival, Mortality and

9.1 Shoreline Vegetation:

9.1.1 Planting

Community volunteers and paid labor planted vegetation to stabilize the newly placed sand throughout the spring and summer (Figure 29). The upland plants showed successful growth, a few of the low lying wetland bogs were smothered by displaced sand from storms but survived. The shoreline plants were also smothered by the recent hurricane Nate. The high tides caused erosion to countless attempts of shoreline planting on the north-west point.

Figure 29: Vegetation stabilized the fill recently placed on the north point of Deadman's Island

9.1.2 Shoreline Erosion Conclusion

The vegetation planted was behind the breakwater located on the north and west end. The sites where the breakwater was lower and the wave action went OVER the reefs showed erosion and the plants washed out. There is not much that can be done as far as the attenuating the waves at higher than normal tides or super moon events which create abnormal high tides. The lower units were re-set to a height even with the rest of the breakwaters to help alleviate the frequency of impact due to higher than normal tides. The breakwaters are as high as the permit will authorize. The inability to predict the tides through normal tide charts as a result of sea level rise, has caused havoc in our planning for future project. As the tides increase and become the new "normal" of the mean high-water level, a permit modification may be needed to adjust the reefs at a taller height above mean high water. Maintenance planting from storms and other high-water events will occur as additional funding becomes available. As long as there is not frequent high-water events which result in the water level washing over the breakwater units, the north-west end is anticipated to become more stabilized.

10.0 Other projects in 2017

10.1.1 Isthmus Project

Although this project was not funded by the Estuary Act, the project is connected to overall big picture the Estuary Act funding started years ago. To date, the main drive for funding has focused on the restoration of north point of Deadman's Island. The loss of land increased the risk of destroying natural resources and heightened exposure to historic artifacts and unmarked cemetery containing human remains on the northwest point. Other parts of Deadman's have also been eroding from the same time period but were not as much of a priority as the north end until recently.

The isthmus known as the strip of land that connects to the mainland protects many of the unique ecosystems in Gilmore Bayou as well as the residential homes. In 2016, the isthmus began to breach into Gilmore Bayou and by 2017 a large river was running through the breach (Figure 30, 31, 34 and 38).

Over time, the isthmus moved south as sea walls were built to protect private property. Since the 1940's erosion began to change the shoreline and push back the isthmus (Morgan 1993). This pushback of sand was caused by the homeowners building their seawalls to protect their property. Once the seawalls were built, the adjacent neighbor would also experience accelerated erosion and need to build a seawall to protect their property, as well. The bluff around Deadman's Island, known as Highpoint and is in the Casablanca subdivision, are made of sand, and this sand erodes and helps contribute to Deadman's Island in addition to the littoral zone. Once the seawall is erected this re-nourishment stops (Houser 2007).

There are two factors causing the sediment deficient at Deadman's Island. The blocking off the sand re-nourishment from the bluffs of Highpoint by erecting seawalls and the major waterway channels and bridges, north of Deadman's Island. According to coastal engineers, the bridges, dredging and seawall are trapping the sand coming from the littoral drift in Pensacola Bay. This littoral drift of sand comes from the bays and rivers leading from the watersheds.

According to a 1962 and 1977 deed, the lowlands of Gulf Breeze were given to the City by the Coe and Gilmore foundation. Over time, some of these lands were filled either by permit or illegally. According to the deed, the land below the bluff of Highpoint and west of all lots is owned by the City of Gulf Breeze. In previous years, the City has allowed people to put up a sea wall, dock, dredging around and on City property to protect the homeowner's investment. The construction of the three-mile bridge, dredging the intercoastal waterway and hardening of the shorelines, residential property, including Deadman's Island continued to erode since the 1940's. There was no choice for the homeowner north of the sand isthmus to protect their property by placement of a seawall. Erosion was ongoing and would have destroyed the bluff over time (Houser 2007). On the south side of the isthmus, lies a Juncus salt marsh and residential property with natural living shorelines. There was no need to place seawalls because the living shoreline was protected.

In 2016, the moving isthmus finally eroded back to the last standing seawall (Figure 32). Once the erosion reached the adjacent property which contains no seawall, the water scoured the land almost to the edge of the bluff. The water pushed the sand further and filled underneath a dock and boat lift (Figure 30) and buried half of the bow of a sailboat (Figure 31).

Figure 31: Facing west. The breach of the isthmus in 2017

Figure 30: Facing east. The breach of isthmus showing the strong movement and placement of sand over living shorelines and under the dock and boat lift of resident.

Once the isthmus separated from the mainland, the water cut an opening through the isthmus and began to erode both sides of the isthmus at once, joining Gilmore Bayou and Pensacola Bay (Figure 31). The water rushed through the narrow channel like a river and threatened the existing living shorelines and the Juncus salt marsh. Fortunately, the salinity in the bay was not high and did not affect the juncus sp.saltmarsh or living shorelines. If the salinity was high on a long term basis, overtime the marsh ecosystem of the spring fed bayou would be threatened.

Historically, according to the aerials, this type of breach has occurred in the past and homeowners south of the isthmus had to erect seawalls to protect their property. When the isthmus closed again, the residential property was protected. If the living shorelines died off from being smothered by sand, high salinity or fast- moving water and caused erosion to the shorelines, the homeowners would need to erect seawalls to protect their property as other homeowners have done in the previous years.

An emergency permit was obtained to place a breakwater along the isthmus and pump sand from the disposal site, located on the south side Deadman's Island, to fill in the waters up to the shoreline of 2010 (Figure 33). This line would take the sand in front of the last seawall and secure the isthmus in this location with a breakwater.

ECS created five methods of defense. To stay within the permitted guideline of using a hybrid of oyster shell and rock, we placed bagged recycled oyster shell on fabric underlayment to cradle the riprap in one place and make it easier to stack in a pyramid form (Figure 36).

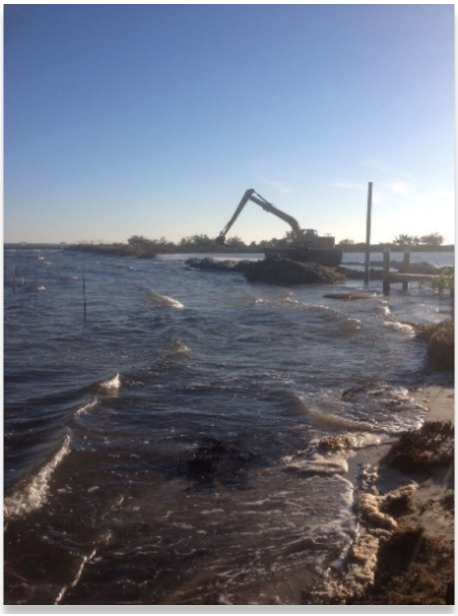

Figure 32: Amphibious excavator working in rough water conditions.

Figure 33: 1994-2016 Shoreline Change along the isthmus at the North East portion of Deadman's Island.

The sand was placed 10 feet from the shoreline to allow for the breakwater. Rough weather caused the barrier to break and sand settled on our outside barrier along the staked profile of the 2010 shoreline (Figure 35).

Figure 34: Repairing the isthmus breach. Laying the pipe to pump the sand from the spoil site.

The piped sand was used to form and place a 3-foot berm about 15 feet behind the breakwater. Funded by the City of Gulf breeze and the National Fish and Wildlife Foundation (NFWF), volunteers, field trips and events organized by Teen Socialize with Education, wetland plants were placed behind the breakwater for stabilization, and other plants were used as a transition into the berm. Originally, the berm was not in the plan. The original idea was to remain a wetland behind the breakwater. The storms kept placing the sand at a higher elevation, and due to funding, we just worked with what we had and graded a uniform berm. Upland plants were used to stabilize the sand along with jute Sporrey-Reed tents to act as a bio-degradable temporary cover until the plants become stabilized. Finally, behind the upland berm, we planted wetland vegetation along the shoreline of Gilmore bayou (Figure 37).

All the vegetation planted were chosen to have different roles in catching, stabilizing and or maintaining certain elevations which were based on how the sand was pumped into the area and leveled out.

To date, the project has stabilized (Figure 39). The project seems to be working as designed. An incidental benefit of this project came from our strong north winds and Hurricane Nate. A large amount of sand was pushed between the gaps of the breakwater. This additional sand protected the wetland plants behind the breakwater. This sand movement helped create a barrier to keep the sand wet and sustain the growth of the wetland vegetation. Also, the water tables under the isthmus will help keep the plants moist in the hot, dry season. As the tides rise, the water under Deadman's also rises sustaining the "wetland bogs."

Figure 35: Facing west, survey stakes marking the 2010 shoreline in preparation to repair the isthmus.

Figure 36: Volunteer filling bags with oyster shell and placement on geo fabric (left). The first phase of setting the foundation for the coastal protection barrier units.

Figure 37: Drone photo of the finished breach repair (left) with newly planted vegetation (right).

Figure 38: Before picture showing the isthmus blowout 2017

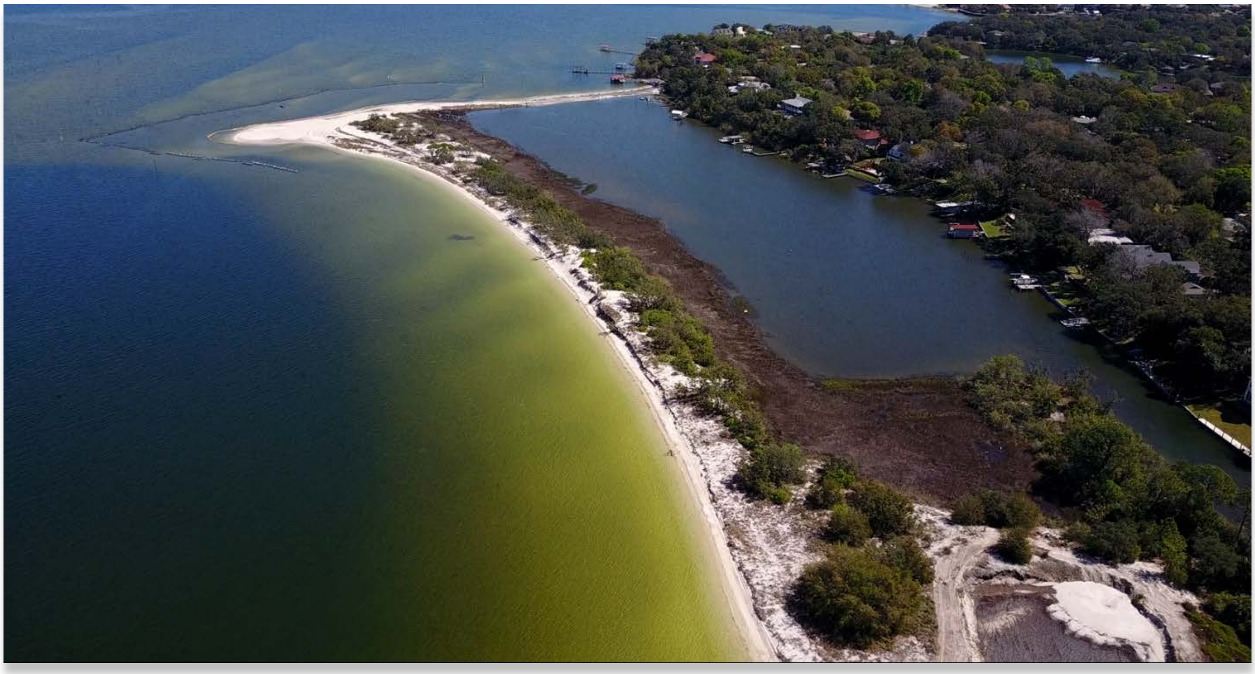

Figure 39: An after picture of the sand transport to the point and the isthmus repair

10.0 Project Future needs

With the funding from the National Fish and Wildlife Foundation Project IDEA, whom funds projects affected by the oil spill, we were able to plant the vegetation stabilizing the isthmus by community restoration, NGO's and volunteers. The isthmus project would have been addressed years ago after the breakwater footprint would have been completed in 2010. Unfortunately, funding was canceled during the DWH oil spill. Projects were delayed and had many setbacks both financially and biologically. The competition was high for funding after the DWH oil spill. Even though our project was designated a diamond level in the State of Florida's eyes to protect, funding went to other created projects. We are now starting to catch up on our planned phases.

The north end still needs funding to remove the pilings used to place the barriers in 2013 and also transport the marine debris associated with the removal of material placed in 2017.

Seagrass beds which once flourished around Deadman's Island are now only flourishing through stories from the people who were fortunate enough to experience them. ECS will take their knowledge learned by experience with seagrass restoration of the entire Florida Panhandle and apply to restoring and expanding the remaining seagrass beds.

Our final phase, the south-west section of Deadman's addresses the loss of dunes and old marine oak trees. Visitors come to Deadman's Island for its unique coastal ecosystem within Pensacola Bay. Unfortunately, the anthropogenic stressors of people and pets sliding down the dunes and damaging the root systems holding the dunes together have reduced the unique system from 80 feet to 40 feet in some areas since 2007. These dunes were tall, healthy and a unique sight in the center of Pensacola Bay.

Of course, part of the problem of the unintentional impact is lack of education to the general public. With the help of NFWF and NGO's leading school field trips, the military, community, and club projects, we were able to deploy several dune restoration pilot projects using new methods and provide education awareness to all ages. If monitoring shows these projects work as planned, the remainder of the dunes will be repaired as funding becomes available. Preferably, an extended breakwater, southerly from the existing should be placed to protect the Dunes which no longer have the 100-year-old vegetation and trees to stabilize itself. The importance of the dunes not only protect the community and homes from hurricane impact but also protect the unique salt marsh dated by historians and the State of Florida Geological team as 10,000 years old.

Protecting Northwest Florida's unique ecosystems, such as Deadman"s Island, is important for the public and future generations. Without these unique coastal resources, various recreational activities and adventures will only be appreciated through stories instead of physical hands-on weekend enjoyment.

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Report citation : Reed, Heather. 2017. The 2017 Monitoring report of city of Gulf Breeze Deadman's Island restoration project, Gulf Breeze, Santa Rosa county, Florida, for the US Army Corps of Engineers, Estuary Habitat restoration program. Ecological Consulting Services Inc. 40 pp.

Appendix

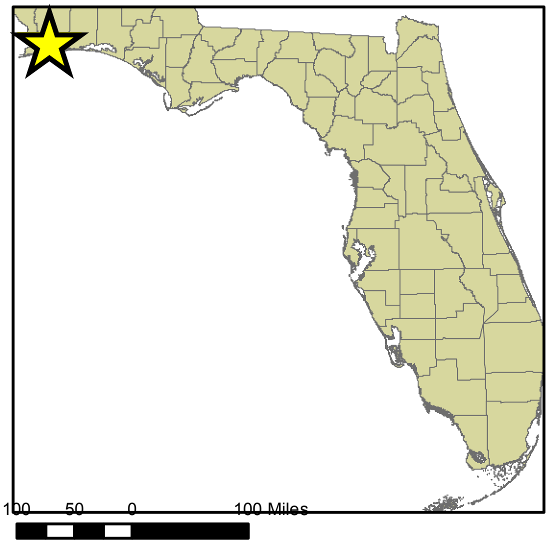
1.) Vicinity map

2.) Bathymetric survey

3.) Analytic lab results

Appendix 1

Project Vicinity Map - Deadman's Island, Santa Rosa County



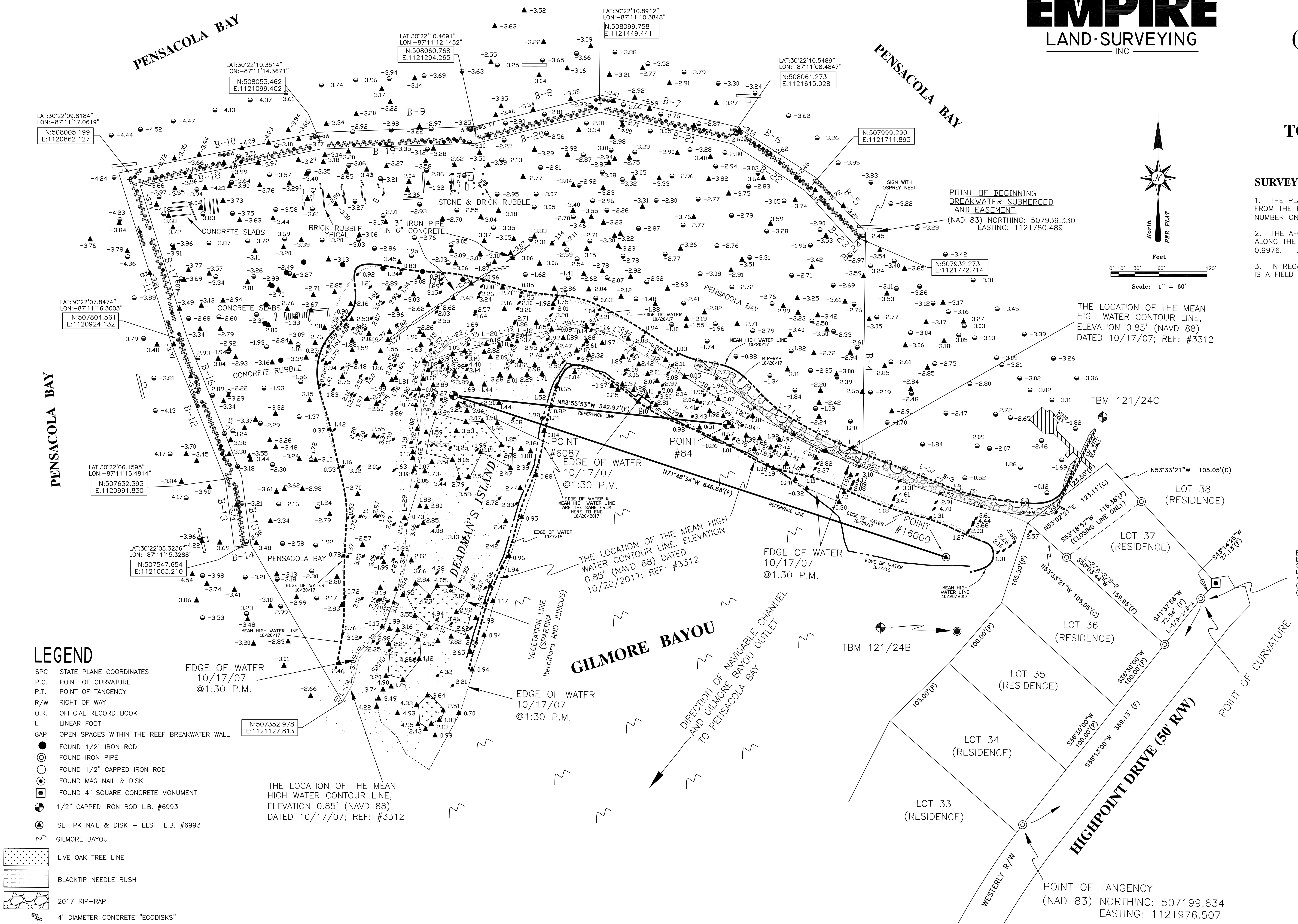
N

Gulf Breeze

Deadman's Island

Date: 12/12/2017
Prepared By: Heather Reed
www.ecologicalconsultingservices.com

Appendix 2



LEGEND

SPC	STATE PLANE COORDINATES
P.C.	POINT OF CURVATURE
P.T.	POINT OF TANGENCY
R/W	RIGHT OF WAY
O.R.	OFFICIAL RECORD BOOK
L.F.	LINEAR FOOT
GAP	OPEN SPACES WITHIN THE REEF BREAKWATER WALL
●	FOUND 1/2" IRON ROD
	FOUND IRON PIPE
	FOUND 1/2" CAPPED IRON ROD
	FOUND MAG NAIL & DISK
	FOUND 4" SQUARE CONCRETE MONUMENT
	1/2" CAPPED IRON ROD L.B. #6993
	SET PK NAIL & DISK – ELSI L.B. #6993
	GILMORE BAYOU
	LIVE OAK TREE LINE
	BLACKTIP NEEDLE RUSH
	2017 RIP-RAP
	4' DIAMETER CONCRETE "ECODISKS"
▲ -3.40	ELEVATION POINTS 2007
-2.24	ELEVATION POINTS 2017 (IN WATER)
4.51	ELEVATION POINTS 2017 (ON ISLAND)
	EDGE OF WATER 2016 ON 10/7/16
	10" DIAMETER SIGN POST
●	6" WOOD POST

EMPIRE LAND SURVEYING, INC.
8720 N. PALAFOX STREET, PENSACOLA, FLORIDA 32534
PHONE: 850-477-3745--FAX: 850-477-3705
LICENSED BUSINESS #6993 STATE OF FLORIDA

LELAND M. EMPIRE
PROFESSIONAL SURVEYOR AND
MAPPER #5766, STATE OF FLORIDA

NOVEMBER 13, 2017
DATE

NOT VALID WITHOUT THE ORIGINAL BLUE SIGNATURE AND THE ORIGINAL RAISED SEAL OF A FLORIDA LICENSED SURVEYOR AND MAPPER

EMPIRE LAND·SURVEYING INC

TOPOGRAPHIC SURVEY
(2007 AND 2017 ELEVATIONS)
THIS IS A FIELD SURVEY
DEADMAN'S ISLAND
A PORTION OF SECTION 6
TOWNSHIP 3 SOUTH, RANGE 29 WEST
GULF BREEZE, FLORIDA

SURVEYORS REPORT:

1. THE PLATTED BOUNDARY LINES OF LOTS 34 THRU 38 AS SHOWN WERE CALCULATED FROM THE RECORDED SUBDIVISION PLAT OF FIRST ADDITION TO CASABLANCA PARCEL NUMBER ONE, AS RECORDED IN PLAT BOOK 'A' AT PAGE 90.

2. THE AFORESAID PLAT HAS A DISTANCE DEFICIANCY OF 0.87 FEET FROM P.C. TO P.T. ALONG THE RIGHT OF WAY. THEREFORE WE PRORATED EACH LOT WITH A FACTOR OF 0.9976. 360.00'=PLAT 359.13'=FIELD

3. IN REGARDS TO THE SIDE LOT ALIGNMENT OF AFORESAID LOTS 34 THRU 38 THERE IS A FIELD ERROR OF APPROXIMATELY 10.00 FEET AS SHOWN ON LOT 38.

BREAKWATER SUBMERGED LAND EASEMENT LINE TABLE

LINE	BEARING	DISTANCE
B-1	S38°13'00"W	72.67'
B-2	N48°22'02"W	228.48'
B-3	N67°18'55"W	223.22'
B-4	N00°43'17"E	276.78'
B-5	N42°13'30"W	91.89'
B-6	N57°23'07"W	117.98'
B-7	N76°53'25"W	174.24'
B-8	S75°56'53"W	161.87'
B-9	S87°51'41"W	194.51'
B-10	S78°30'24"W	254.69'
B-11	S17°10'23"E	221.94'
B-12	S21°27'51"E	184.33'
B-13	S07°37'21"E	84.07'
B-14	N82°21'04"E	21.00'
B-15	N07°38'56"W	86.77'
B-16	N21°27'55"W	185.88'
B-17	N17°10'23"W	198.01'
B-18	N78°30'09"E	229.68'
B-19	N87°51'10"E	195.24'
B-20	N75°53'44"E	158.76'
B-21	S76°29'13"E	168.78'
B-22	S57°23'07"E	108.29'
B-23	S42°13'30"E	89.10'
B-24	N47°46'30"E	21.00'

POINT OF COMMENCEMENT
BREAKWATER SUBMERGED LAND EASEMENT
SOUTHEAST CORNER
LOT 38, PARCEL 1, FIRST
ADDITION TO CASABLANCA
(PLAT BOOK A, PAGE 90)
(NAD 83) NORTHING: 507481.793
EASTING: 1122198.677

SUBMERGED LAND EASEMENT LINE TABLE

LINE	BEARING	DISTANCE
A-1	S38°13'00"W	72.67'
A-2	N48°22'02"W	228.48'
A-3	N67°18'55"W	223.22'
A-4	N00°43'17"E	105.91'
A-5	N63°40'30"W	288.42'
A-6	N19°59'48"W	204.99'
A-7	S75°53'44"W	158.76'
A-8	S87°51'10"W	195.24'
A-9	S78°30'09"W	229.68'
A-10	S17°10'23"E	198.01'
A-11	S21°27'55"E	185.88'
A-12	S07°38'56"E	86.77'
A-13	S30°13'03"E	226.90'
A-14	N30°03'51"E	27.12'
A-15	N13°01'32"E	32.15'
A-16	N40°59'18"E	45.55'
A-17	N19°50'55"E	76.78'
A-18	N11°47'07"E	35.96'
A-19	N00°04'03"W	65.97'
A-20	N08°37'08"E	99.98'
A-21	N06°22'06"W	25.79'
A-22	N07°01'42"E	23.99'
A-23	N25°49'27"E	15.40'
A-24	N59°01'06"E	16.56'
A-25	N44°18'55"E	18.56'
A-26	N64°35'56"E	22.43'
A-27	S75°45'32"E	13.13'
A-28	N86°35'18"E	30.54'
A-29	N70°07'23"E	15.54'
A-30	S83°07'34"E	40.16'
A-31	N56°20'58"E	16.12'
A-32	N71°36'05"E	24.45'
A-33	S73°48'33"E	24.18'
A-34	S82°48'04"E	23.01'
A-35	S54°15'46"E	41.56'
A-36	S60°08'04"E	39.74'
A-37	S63°46'57"E	28.97'
A-38	S57°18'39"E	44.81'
A-39	N70°49'33"E	19.57'
A-40	S62°29'36"E	65.07'
A-41	S77°17'43"E	12.34'
A-42	S40°23'16"E	15.10'
A-43	S63°47'42"E	74.41'
A-44	S87°22'37"E	18.90'

MEAN HIGH WATER LINE TABLE 10/17/07

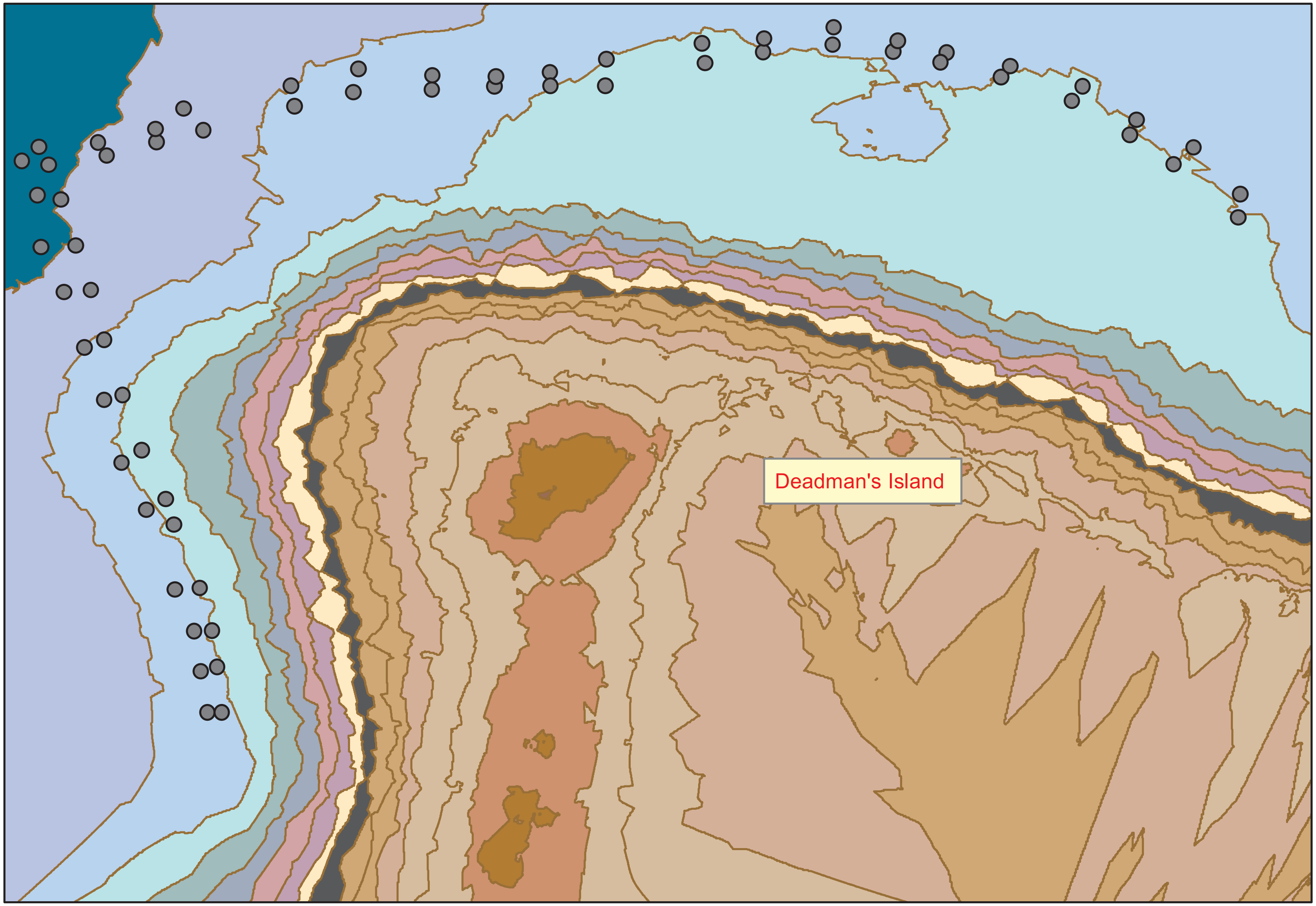
LINE	BEARING	DISTANCE
L-1	S38°13'00"W	72.67'
L-2	N48°22'02"W	228.48'
L-3	N67°18'55"W	223.22'
L-4	N87°22'37"W	18.91'
L-5	N63°47'42"W	74.41'
L-6	N40°23'16"W	15.10'
L-7	N77°17'43"W	12.34'
L-8	N62°29'36"W	65.07'
L-9	S70°49'33"W	19.57'
L-10	N57°18'39"W	44.81'
L-11	N63°46'57"W	28.97'
L-12	N60°08'04"W	39.74'
L-13	N54°15'46"W	41.56'
L-14	N82°48'04"W	23.01'
L-15	N73°48'33"W	24.18'
L-16	S71°36'05"W	24.45'
L-17	S56°20'58"W	16.12'
L-18	N83°07'34"W	40.16'
L-19	S70°07'23"W	15.54'
L-20	S86°35'18"W	30.54'
L-21	N75°45'32"W	13.13'
L-22	S64°35'56"W	22.43'
L-23	S44°18'55"W	18.56'
L-24	S59°01'06"W	16.56'
L-25	S25°49'27"W	15.40'
L-26	S07°01'42"W	23.99'
L-27	S06°22'06"E	25.79'
L-28	S08°37'08"W	99.98'
L-29	S00°04'03"E	65.97'
L-30	S11°47'07"W	35.96'
L-31	S19°50'55"W	76.78'
L-32	S40°59'18"W	45.55'
L-33	S13°01'32"W	32.15'
L-34	S30°03'51"W	27.12'

SHEET 1 OF 2

REVISION	FIELD BOOK	DATE
1) STAKE OUT BREAKWATER	121/24	05/08/08
3&4) FLAG B-5 & B-6 AND EDGE OF WATER	144/4, 8-9	10/28/10
16) BATHYMETRIC UPDATE	177/30	10/7/16
17) BATHYMETRIC UPDATE	185/66-67	10/20/17

PAGE: 1 OF 2
SCALE: 1"= 60'
FIELD DATE: 11/06/07
ORDER NO: 458-07-16A
FIELD BOOK: 121/20-27

2017 Bathymetric Survey of Deadman's Island



N

Legend

Breakwater

2017 CONTOUR

2017 DMI BATH

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-0.99 - -0.5
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0 - 0.5
0.5 - 1
1.0 - 1.5
1.5 - 2
2.0 - 2.5
2.5 - 3
3.0 - 3.5
3.5 - 4
4.0 - 4.5

Elevation (ft)

220 110 0 220 Feet

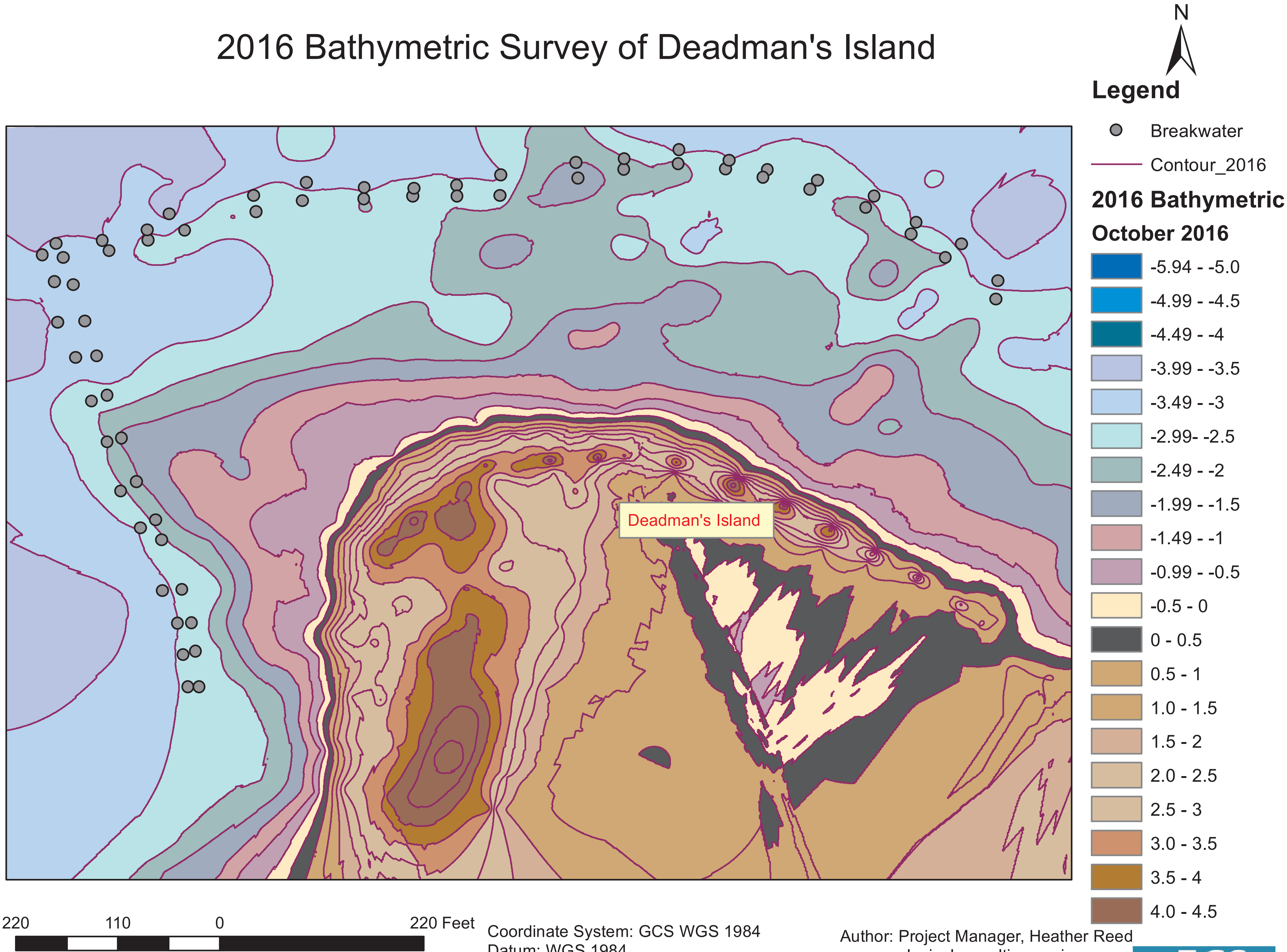
Reference Scale: 1:0

Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree Elevation:NAVD 88

Author: Project Manager, Heather Reed
www.ecologicalconsultingservices.com

ECS

2016 Bathymetric Survey of Deadman's Island



Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree Elevation:NAVD 88

Author: Project Manager, Heather Reed
www.ecologicalconsultingservices.com
850-417-7004

Appendix 3

ANALYTICAL REPORT

Lab Number:	L1729792
Client:	Ecological Consulting Services, Inc. 38 S Blue Angel Parkway #346 Pensacola, FL 32506
ATTN:	Heather Reed
Phone:	(850) 417-7004
Project Name:	DEADMAN'S ISLAND POSO
Project Number:	2
Report Date:	09/26/17

Certifications & Approvals: MA (M-MA030), NH NELAP (2062), NJ NELAP (MA015), CT (PH-0141), FL (E87814), IL (200081), LA (85084), ME (MA00030), MD (350), NY (11627), NC (685), OH (CL106), PA (68-02089), RI (LAO00299), TX (T104704419), VT (VT-0015), VA (460194), WA (C954), US Army Corps of Engineers, USDA (Permit #P330-13-00067), USFWS (Permit #LE2069641).

320 Forbes Boulevard, Mansfield, MA 02048-1806
508-822-9300 (Fax) 508-822-3288 800-624-9220 - www.alphalab.com

ORGANICS

SEMIVOLATILES

Project Name: DEADMAN'S ISLAND POSO **Lab Number:** L1729792

Project Number: 2 **Report Date:** 09/26/17

SAMPLE RESULTS

Lab ID: L1729792-01
Client ID: WPOSO
Sample Location: GULF BREEZE, FL

Matrix: Tissue
Analytical Method: 1,8270D-SIM(M)
Analytical Date: 09/22/17 18:34
Analyst: ML
Percent Solids: Results reported on an 'AS RECEIVED' basis.

Date Collected: 08/23/17 10:30
Date Received: 08/24/17
Field Prep: Not Specified
Extraction Method: ALPHA OP-018
Extraction Date: 09/02/17 14:17
Cleanup Method: EPA 3611B
Cleanup Date: 09/03/17
Cleanup Method: - - - -
Cleanup Date: 09/21/17

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
PAHs - Mansfield Lab						
Naphthalene	ND		ug/kg	19.4	2.33	1
C1-Naphthalenes	ND		ug/kg	19.4	2.33	1
C2-Naphthalenes	ND		ug/kg	19.4	2.33	1
C3-Naphthalenes	ND		ug/kg	19.4	2.33	1
C4-Naphthalenes	ND		ug/kg	19.4	2.33	1
Acenaphthylene	ND		ug/kg	11.7	0.679	1
Acenaphthene	ND		ug/kg	11.7	0.817	1
Fluorene	ND		ug/kg	11.7	1.35	1
C1-Fluorenes	ND		ug/kg	11.7	1.35	1
C2-Fluorenes	ND		ug/kg	11.7	1.35	1
C3-Fluorenes	ND		ug/kg	11.7	1.35	1
Phenanthrene	ND		ug/kg	11.7	1.28	1
C1-Phenanthrenes/Anthracenes	ND		ug/kg	11.7	1.28	1
C2-Phenanthrenes/Anthracenes	ND		ug/kg	11.7	1.28	1
C3-Phenanthrenes/Anthracenes	ND		ug/kg	11.7	1.28	1
C4-Phenanthrenes/Anthracenes	ND		ug/kg	11.7	1.28	1
Anthracene	ND		ug/kg	11.7	0.655	1
Fluoranthene	ND		ug/kg	11.7	1.20	1
Pyrene	0.876	J	ug/kg	11.7	0.762	1
C1-Fluoranthenes/Pyrenes	1.24	J	ug/kg	11.7	0.762	1
Benz(a)anthracene	ND		ug/kg	11.7	1.76	1
Chrysene	ND		ug/kg	11.7	0.809	1
C1-Chrysenes	ND		ug/kg	11.7	0.809	1
C2-Chrysenes	ND		ug/kg	11.7	0.809	1
C3-Chrysenes	ND		ug/kg	11.7	0.809	1
C4-Chrysenes	ND		ug/kg	11.7	0.809	1
Benzo(b)fluoranthene	ND		ug/kg	11.7	0.769	1
Benzo(j)+(k)Fluoranthene	ND		ug/kg	11.7	1.21	1
Benzo(e)Pyrene	ND		ug/kg	11.7	0.825	1
Benzo(a)pyrene	ND		ug/kg	11.7	0.749	1

Project Name:	DEADMAN'S ISLAND POSO	**Lab Number:**	L1729792
Project Number:	2	**Report Date:**	09/26/17

SAMPLE RESULTS

Lab ID:	L1729792-01	Date Collected:	08/23/17 10:30
Client ID:	WPOSO	Date Received:	08/24/17
Sample Location:	GULF BREEZE, FL	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
PAHs - Mansfield Lab						
Perylene	ND		ug/kg	11.7	1.11	1
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	11.7	1.56	1
Dibenz(a,h)+(a,c)anthracene	ND		ug/kg	11.7	1.67	1
Benzo(ghi)perylene	ND		ug/kg	11.7	1.15	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Naphthalene-d8	71		50-130
Phenanthrene-d10	88		50-130
Benzo(a)pyrene-d12	83		50-130

Project Name: DEADMAN'S ISLAND POSO
Lab Number: L1729792
Project Number: 2
Report Date: 09/26/17

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D-SIM(M)
Analytical Date: 09/22/17 12:47
Analyst: ML

Extraction Method: ALPHA OP-018
Extraction Date: 09/02/17 14:17
Cleanup Method: EPA 3611B
Cleanup Date: 09/03/17
Cleanup Method: - - - -
Cleanup Date: 09/21/17

Parameter	Result	Qualifier	Units	RL	MDL
PAHs - Mansfield Lab for sample(s): 01 Batch: WG1038172-1					
Naphthalene	ND		ug/kg	20.0	2.39
C1-Naphthalenes	ND		ug/kg	20.0	2.39
C2-Naphthalenes	ND		ug/kg	20.0	2.39
C3-Naphthalenes	ND		ug/kg	20.0	2.39
C4-Naphthalenes	ND		ug/kg	20.0	2.39
Acenaphthylene	ND		ug/kg	12.0	0.698
Acenaphthene	ND		ug/kg	12.0	0.840
Fluorene	ND		ug/kg	12.0	1.38
C1-Fluorenes	ND		ug/kg	12.0	1.38
C2-Fluorenes	ND		ug/kg	12.0	1.38
C3-Fluorenes	ND		ug/kg	12.0	1.38
Phenanthrene	ND		ug/kg	12.0	1.32
C1-Phenanthrenes/Anthracenes	ND		ug/kg	12.0	1.32
C2-Phenanthrenes/Anthracenes	ND		ug/kg	12.0	1.32
C3-Phenanthrenes/Anthracenes	ND		ug/kg	12.0	1.32
C4-Phenanthrenes/Anthracenes	ND		ug/kg	12.0	1.32
Anthracene	ND		ug/kg	12.0	0.674
Fluoranthene	ND		ug/kg	12.0	1.23
Pyrene	ND		ug/kg	12.0	0.783
C1-Fluoranthenes/Pyrenes	ND		ug/kg	12.0	0.783
Benz(a)anthracene	ND		ug/kg	12.0	1.81
Chrysene	ND		ug/kg	12.0	0.832
C1-Chrysenes	ND		ug/kg	12.0	0.832
C2-Chrysenes	ND		ug/kg	12.0	0.832
C3-Chrysenes	ND		ug/kg	12.0	0.832
C4-Chrysenes	ND		ug/kg	12.0	0.832
Benzo(b)fluoranthene	ND		ug/kg	12.0	0.790
Benzo(j)+(k)Fluoranthene	ND		ug/kg	12.0	1.25
Benzo(e)Pyrene	ND		ug/kg	12.0	0.848

Project Name: DEADMAN'S ISLAND POSO **Lab Number:** L1729792
Project Number: 2 **Report Date:** 09/26/17

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D-SIM(M)
Analytical Date: 09/22/17 12:47
Analyst: ML

Extraction Method: ALPHA OP-018
Extraction Date: 09/02/17 14:17
Cleanup Method: EPA 3611B
Cleanup Date: 09/03/17
Cleanup Method: - - - -
Cleanup Date: 09/21/17

Parameter	Result	Qualifier	Units	RL	MDL
PAHs - Mansfield Lab for sample(s): 01 Batch: WG1038172-1					
Benzo(a)pyrene	ND		ug/kg	12.0	0.770
Perylene	ND		ug/kg	12.0	1.14
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	12.0	1.60
Dibenz(a,h)+(a,c)anthracene	ND		ug/kg	12.0	1.72
Benzo(ghi)perylene	ND		ug/kg	12.0	1.18

Surrogate	%Recovery	Qualifier	Acceptance Criteria
Naphthalene-d8	70		50-130
Phenanthrene-d10	83		50-130
Benzo(a)pyrene-d12	80		50-130

Lab Control Sample Analysis
Batch Quality Control

Project Name: DEADMAN'S ISLAND POSO
Project Number: 2
Lab Number: L1729792
Report Date: 09/26/17

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
PAHs - Mansfield Lab Associated sample(s): 01 Batch: WG1038172-2 WG1038172-3								
Naphthalene	75		76		50-130	1		30
2-Methylnaphthalene	70		72		50-130	3		30
Acenaphthylene	78		74		50-130	5		30
Acenaphthene	78		76		50-130	3		30
Fluorene	80		78		50-130	3		30
Phenanthrene	94		91		50-130	3		30
Anthracene	94		92		50-130	2		30
Fluoranthene	100		95		50-130	5		30
Pyrene	93		92		50-130	1		30
Benz(a)anthracene	82		80		50-130	2		30
Chrysene	86		86		50-130	0		30
Benzo(b)fluoranthene	85		85		50-130	0		30
Benzo(j)+(k)Fluoranthene	85		87		50-130	2		30
Benzo(a)pyrene	90		90		50-130	0		30
Indeno(1,2,3-cd)Pyrene	85		85		50-130	0		30
Dibenz(a,h)+(a,c)anthracene	86		87		50-130	1		30
Benzo(ghi)perylene	85		83		50-130	2		30

Lab Control Sample Analysis
Batch Quality Control

Project Name: DEADMAN'S ISLAND POSO
Project Number: 2

Lab Number: L1729792
Report Date: 09/26/17

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
PAHs - Mansfield Lab Associated sample(s): 01 Batch: WG1038172-2 WG1038172-3								

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
Naphthalene-d8	67		66		50-130
Phenanthrene-d10	83		83		50-130
Benzo(a)pyrene-d12	78		79		50-130

PETROLEUM HYDROCARBONS

Project Name: DEADMAN'S ISLAND POSO
Lab Number: L1729792
Project Number: 2
Report Date: 09/26/17

SAMPLE RESULTS

Lab ID:	L1729792-01	Date Collected:	08/23/17 10:30
Client ID:	WPOSO	Date Received:	08/24/17
Sample Location:	GULF BREEZE, FL	Field Prep:	Not Specified
		Extraction Method:	ALPHA OP-018
Matrix:	Tissue	Extraction Date:	09/02/17 14:17
Analytical Method:	1,8015D(M)	Cleanup Method:	EPA 3611B
Analytical Date:	09/23/17 03:46	Cleanup Date:	09/03/17
Analyst:	WR	Cleanup Method:	EPA 3640A
Percent Solids:	Results reported on an 'AS RECEIVED' basis.	Cleanup Date:	09/20/17

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Saturated Hydrocarbons by GC-FID - Mansfield Lab						
n-Nonane (C9)	ND		mg/kg	0.778	0.231	1
n-Decane (C10)	ND		mg/kg	0.778	0.248	1
n-Undecane (C11)	ND		mg/kg	0.778	0.232	1
n-Dodecane (C12)	ND		mg/kg	0.778	0.170	1
n-Tridecane (C13)	ND		mg/kg	0.778	0.214	1
2,6,10-Trimethyldodecane (1380)	ND		mg/kg	0.778	0.117	1
n-Tetradecane (C14)	ND		mg/kg	0.778	0.117	1
2,6,10-Trimethyltridecane (1470)	ND		mg/kg	0.778	0.093	1
n-Pentadecane (C15)	0.154	J	mg/kg	0.778	0.093	1
n-Hexadecane (C16)	ND		mg/kg	0.778	0.117	1
Norpristane (1650)	ND		mg/kg	0.778	0.257	1
n-Heptadecane (C17)	ND		mg/kg	0.778	0.257	1
Pristane	ND		mg/kg	0.778	0.166	1
n-Octadecane (C18)	ND		mg/kg	0.778	0.156	1
Phytane	ND		mg/kg	0.778	0.098	1
n-Nonadecane (C19)	ND		mg/kg	0.778	0.200	1
n-Eicosane (C20)	ND		mg/kg	0.778	0.110	1
n-Heneicosane (C21)	ND		mg/kg	0.778	0.093	1
n-Docosane (C22)	ND		mg/kg	0.778	0.081	1
n-Tricosane (C23)	ND		mg/kg	0.778	0.099	1
n-Tetracosane (C24)	ND		mg/kg	0.778	0.130	1
n-Pentacosane (C25)	ND		mg/kg	0.778	0.412	1
n-Hexacosane (C26)	ND		mg/kg	0.778	0.114	1
n-Heptacosane (C27)	ND		mg/kg	0.778	0.094	1
n-Octacosane (C28)	ND		mg/kg	0.778	0.167	1
n-Nonacosane (C29)	ND		mg/kg	0.778	0.518	1
n-Triacontane (C30)	ND		mg/kg	0.778	0.089	1
n-Hentriacontane (C31)	0.159	J	mg/kg	0.778	0.110	1
n-Dotriacontane (C32)	0.392	J	mg/kg	0.778	0.098	1
n-Tritriacontane (C33)	ND		mg/kg	0.778	0.109	1

Project Name:	DEADMAN'S ISLAND POSO	**Lab Number:**	L1729792
Project Number:	2	**Report Date:**	09/26/17

SAMPLE RESULTS

Lab ID:	L1729792-01	Date Collected:	08/23/17 10:30
Client ID:	WPOSO	Date Received:	08/24/17
Sample Location:	GULF BREEZE, FL	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Saturated Hydrocarbons by GC-FID - Mansfield Lab						
n-Tetratriacontane (C34)	ND		mg/kg	0.778	0.124	1
n-Pentatriacontane (C35)	0.226	J	mg/kg	0.778	0.136	1
n-Hexatriacontane (C36)	0.182	J	mg/kg	0.778	0.155	1
n-Heptatriacontane (C37)	ND		mg/kg	0.778	0.173	1
n-Octatriacontane (C38)	ND		mg/kg	0.778	0.181	1
n-Nonatriacontane (C39)	ND		mg/kg	0.778	0.253	1
n-Tetracontane (C40)	ND		mg/kg	0.778	0.253	1
Total Petroleum Hydrocarbons (C9-C40)	394		mg/kg	25.7	5.65	1
DRO (C10-C28)	15.9	J	mg/kg	16.3	3.37	1
Total Saturated Hydrocarbons	1.11	J	mg/kg	0.778	0.389	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
ortho-terphenyl	86		50-130
d50-Tetracosane	85		50-130

Project Name: DEADMAN'S ISLAND POSO
Project Number: 2

Lab Number: L1729792
Report Date: 09/26/17

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8015D(M)
Analytical Date: 09/22/17 23:20
Analyst: WR

Extraction Method: ALPHA OP-018
Extraction Date: 09/02/17 14:17
Cleanup Method: EPA 3611B
Cleanup Date: 09/03/17
Cleanup Method: EPA 3640A
Cleanup Date: 09/20/17

Parameter	Result	Qualifier	Units	RL	MDL
Saturated Hydrocarbons by GC-FID - Mansfield Lab for sample(s): 01 Batch: WG1038170-1					
n-Nonane (C9)	ND		mg/kg	0.800	0.237
n-Decane (C10)	ND		mg/kg	0.800	0.255
n-Undecane (C11)	ND		mg/kg	0.800	0.239
n-Dodecane (C12)	ND		mg/kg	0.800	0.174
n-Tridecane (C13)	ND		mg/kg	0.800	0.220
2,6,10-Trimethyldodecane (1380)	ND		mg/kg	0.800	0.120
n-Tetradecane (C14)	ND		mg/kg	0.800	0.120
2,6,10-Trimethyltridecane (1470)	ND		mg/kg	0.800	0.095
n-Pentadecane (C15)	ND		mg/kg	0.800	0.095
n-Hexadecane (C16)	ND		mg/kg	0.800	0.120
Norpristane (1650)	ND		mg/kg	0.800	0.264
n-Heptadecane (C17)	ND		mg/kg	0.800	0.264
Pristane	ND		mg/kg	0.800	0.171
n-Octadecane (C18)	ND		mg/kg	0.800	0.160
Phytane	ND		mg/kg	0.800	0.100
n-Nonadecane (C19)	ND		mg/kg	0.800	0.206
n-Eicosane (C20)	ND		mg/kg	0.800	0.113
n-Heneicosane (C21)	ND		mg/kg	0.800	0.096
n-Docosane (C22)	ND		mg/kg	0.800	0.083
n-Tricosane (C23)	ND		mg/kg	0.800	0.102
n-Tetracosane (C24)	ND		mg/kg	0.800	0.134
n-Pentacosane (C25)	ND		mg/kg	0.800	0.423
n-Hexacosane (C26)	ND		mg/kg	0.800	0.118
n-Heptacosane (C27)	ND		mg/kg	0.800	0.096
n-Octacosane (C28)	ND		mg/kg	0.800	0.172
n-Nonacosane (C29)	ND		mg/kg	0.800	0.533
n-Triacontane (C30)	ND		mg/kg	0.800	0.092
n-Hentriacontane (C31)	ND		mg/kg	0.800	0.113
n-Dotriacontane (C32)	ND		mg/kg	0.800	0.101

Project Name: DEADMAN'S ISLAND POSO
Project Number: 2

Lab Number: L1729792
Report Date: 09/26/17

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8015D(M)
Analytical Date: 09/22/17 23:20
Analyst: WR

Extraction Method: ALPHA OP-018
Extraction Date: 09/02/17 14:17
Cleanup Method: EPA 3611B
Cleanup Date: 09/03/17
Cleanup Method: EPA 3640A
Cleanup Date: 09/20/17

Parameter	Result	Qualifier	Units	RL	MDL
Saturated Hydrocarbons by GC-FID - Mansfield Lab for sample(s): 01 Batch: WG1038170-1					
n-Tritriacontane (C33)	ND		mg/kg	0.800	0.112
n-Tetratriacontane (C34)	ND		mg/kg	0.800	0.127
n-Pentatriacontane (C35)	ND		mg/kg	0.800	0.140
n-Hexatriacontane (C36)	ND		mg/kg	0.800	0.159
n-Heptatriacontane (C37)	ND		mg/kg	0.800	0.178
n-Octatriacontane (C38)	ND		mg/kg	0.800	0.186
n-Nonatriacontane (C39)	ND		mg/kg	0.800	0.260
n-Tetracontane (C40)	ND		mg/kg	0.800	0.260
Total Petroleum Hydrocarbons (C9-C40)	ND		mg/kg	26.4	5.81
DRO (C10-C28)	ND		mg/kg	16.8	3.46
Total Saturated Hydrocarbons	ND		mg/kg	0.800	0.400

Surrogate	%Recovery	Qualifier	Acceptance Criteria
ortho-terphenyl	82		50-130
d50-Tetracosane	82		50-130

Lab Control Sample Analysis
Batch Quality Control

Project Name: DEADMAN'S ISLAND POSO
Lab Number: L1729792
Project Number: 2
Report Date: 09/26/17

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Saturated Hydrocarbons by GC-FID - Mansfield Lab Associated sample(s): 01 Batch: WG1038170-2 WG1038170-3								
Nonane (C9)	66		66		50-130	0		30
Decane (C10)	72		72		50-130	0		30
Dodecane (C12)	77		76		50-130	1		30
Tetradecane (C14)	79		79		50-130	0		30
Hexadecane (C16)	87		87		50-130	0		30
Octadecane (C18)	94		94		50-130	0		30
Nonadecane (C19)	86		87		50-130	1		30
Eicosane (C20)	87		88		50-130	1		30
Docosane (C22)	87		88		50-130	1		30
Tetracosane (C24)	88		89		50-130	1		30
Hexacosane (C26)	87		88		50-130	1		30
Octacosane (C28)	87		88		50-130	1		30
Triacontane (C30)	86		87		50-130	1		30
Hexatriacontane (C36)	82		84		50-130	2		30

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
o-Terphenyl	84		84		50-130
d50-Tetracosane	83		84		50-130

INORGANICS
&
MISCELLANEOUS

Project Name:	DEADMAN'S ISLAND POSO	**Lab Number:**	L1729792
Project Number:	2	**Report Date:**	09/26/17

SAMPLE RESULTS

Lab ID:	L1729792-01	Date Collected:	08/23/17 10:30
Client ID:	WPOSO	Date Received:	08/24/17
Sample Location:	GULF BREEZE, FL	Field Prep:	Not Specified
Matrix:	Tissue		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab										
Percent Lipids	0.747		%	0.100	NA	1	-	09/09/17 00:00	111,-	JP

Project Name: DEADMAN'S ISLAND POSO
Project Number: 2

Lab Number: L1729792
Report Date: 09/26/17

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab for sample(s): 01 Batch: WG1039419-1										
Percent Lipids	ND		%	0.100	NA	1	-	09/09/17 00:00	111,-	JP

Lab Duplicate Analysis
Batch Quality Control

Project Name: DEADMAN'S ISLAND POSO
Project Number: 2

Lab Number: L1729792
Report Date: 09/26/17

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Mansfield Lab Associated sample(s): 01 QC Batch ID: WG1039419-2 QC Sample: L1729792-01 Client ID: WPOSO						
Percent Lipids	0.747	0.747	%	0		20

Project Name: DEADMAN'S ISLAND POSO
Project Number: 2

Lab Number: L1729792
Report Date: 09/26/17

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	*Custody Seal*
A	Absent

Container Information

Container ID	*Container Type*	*Cooler*	*Initial pH*	*Final pH*	*Temp deg C*	*Pres*	*Seal*	*Frozen Date/Time*	*Analysis(*)*
L1729792-01A	Bag	A	NA		3.7	Y	Absent		A2-SHC(14),A2-ALKPAH(14),A2-LIPIDS(7),A2-TISSUE_PREP()
L1729792-01X	Glass 250ml unpreserved split	A	NA		3.7	Y	Absent		A2-SHC(14),A2-ALKPAH(14),A2-LIPIDS(7),A2-TISSUE_PREP()

*Values in parentheses indicate holding time in days