

## Technical Memorandum

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**Subject:** Tiki Point at Harborwalk - Conceptual Living Shoreline Pilot Project  
**Attention:** The Nature Conservancy  
**From:** Jacobs  
**Date:** August 7, 2018  
**Copies to:** Jason Bird, Rick Gorsira/Jacobs

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## Introduction

In 2017, the Four Points Sheraton Hotel reached out to The Nature Conservancy (TNC) and the Charlotte Harbor National Estuary Program (CHNEP) to express an interest in improving the natural aesthetics and habitat value along the hotel's seawall. This led to the formation of a collaborative partnership to promote nature-based shoreline improvements in the City of Punta Gorda (City). The partners include the City, TNC, the Four Points Sheraton, CHNEP, FL Department of Environmental Protection Charlotte Harbor Aquatic Preserves and CH2M Hill (Jacobs). The Four Points Sheraton has a public easement along the seawalled shoreline of the hotel property for the City's Harborwalk, which connects Laishley Park municipal marina with the Charlotte Harbor Event and Conference Center. This pedestrian promenade has promoted public use of the waterfront and has been a driver to continued improvements of the appearance and function of the seawall through nature-based strategies that may also help to mitigate the adverse effects of future storms. **Figure 1** shows the proposed project location just west of the US Highway 41 northbound bridge. The site includes the seawall in front of the Four Points Sheraton to the Conference Center for an approximate shoreline length of 800 feet.

This technical memorandum (TM) provides conceptual designs to create a living shoreline along this segment of the City's Harborwalk and evaluate future expansion for implementation of this concept along the City's coastline. This TM provides the result of a preliminary field evaluation and presents preliminary concepts for development of a living shoreline along the seawall to provide a higher performing coastal environment.

## Purpose of Project

This project is intended to build on the current momentum for enhancing natural habitat, improving water quality and providing increased coastal resilience in the region through conceptual design of the first living shoreline in Charlotte Harbor. As a model for the region, this living shoreline project is intended to provide an example of a public-private partnership approach to project development. The conceptual plan also explores the application of multiple elements of a living shoreline system that may be considered on other projects in the Charlotte Harbor area, recognizing that each project will require analysis and design that considers the unique needs and objectives of the local area. In addition, regulatory permitting requirements for the proposed living shoreline were evaluated and potential funding sources, including state and federal grants. This project is proposed to be sited near a seawall with existing rip rap and its primary purpose is habitat creation along the seawall while it also will serve as a buffer during storm events to increase the lifespan of the existing sea wall.

## Data Collection

Data analysis for this project consisted of desktop data collection from projects currently underway and GIS data already collected of the Charlotte Harbor/Peace River region obtained from partners and stakeholders in the region. A field visit was also conducted to evaluate site conditions and develop basic assumptions for the design concept, which will be supplemented with detailed investigations and engineering during the future design phase, prior to construction.

## Desktop Data Collection

Data was requested from Charlotte Harbor National Estuary Program, The Nature Conservancy, City of Punta Gorda, and Florida Department of Environmental Protection (FDEP) and included the following information:

- GIS data for the region including, but not limited to: bathymetry and topography digital elevation models (DEMs), shapefiles showing existing habitats, storm surge layers, and sea level rise layers
- Natural Resources
- Listed Species of Concern



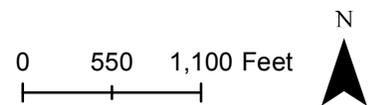
**Legend**

-  Project Area
-  Points of Interest

# Tiki Point at Harborwalk Conceptual Living Shoreline Design

Figure 1. Location Map

Note: Project shoreline length is approximately 800 feet



- Reports and data from previous studies including vulnerability assessment and other resource related surveys
- Information on recent, ongoing or planned nature-based/coastal restoration projects in the region
- Marine environment-related studies, permit and design info from ongoing park and seawall improvement projects
- Four Points property development plans including Tiki and marina expansion (permit/design plans)
  - As-builts of the seawall and pedestrian promenade
  - Existing ERP permits for past improvements along the seawall;
  - Previous studies of marine environment, ecology or related analysis along seawall and coastline
- FDOT plans for US41 (including maintenance and planned improvements)
- Review of applicable regulations pertinent to the implementation of the project

### Field Data

On May 3, 2018, a field review/survey was conducted of the project area along the seawall. This field review was focused along the proposed 800-foot seawall to collect preliminary data for the conceptual design of the living shoreline. The activities included the following:

- General shoreline observations with photographic documentation of the seawall and nearby habitats and fixed features
- Spot depth measurements at transects set at 100-foot intervals perpendicular to the seawall out to approximately 75 feet into the Peace River using survey equipment to obtain relative elevations from the seawall cap
- Qualitative water quality measurements using a secchi disk
- Characterization of surface sediment with a ponar grab
- Visual seagrass and SAV vegetation survey
- Tide elevation based on stains/barnacles on the seawall and/or rip rap

**Figure 2** shows the locations of the transects along the seawall where elevation data were surveyed to determine preliminary bathymetry at 25-foot spacing on the 75-foot long transects. Random sediment samples were collected to assess bottom conditions and evaluated for the presence of seagrass.

### Existing Water Levels

Average daily tidal datums are estimated by the National Oceanic and Atmospheric Administration (NOAA) using observed water level data at long-term tide stations. The closest tide station to the project site is the Punta Gorda station (#8725744) located about a mile southwest at Fishermen's Village. This is a subordinate station that actively recorded water levels for eight months from 1977-1978. The station is now used for local tide predictions based on calculated offsets to the long-term St. Petersburg tide station (#8726520).

Daily tide datums are presented in Table 1, relative to mean lower low water (MLLW), mean sea level (MSL), mean higher high water (MHHW), and the North American Vertical Datum of 1988 (NAVD88).

### Field Survey Results

The following describes the field results of the conceptual-level study for the proposed project area. The purpose was to gain a basic understanding of the biological community in front of the seawall, document relative bathymetry, perform a visual observation of sediment grain size, and document the presence of

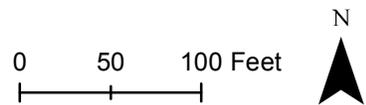


**Legend**

-  Future Construction
-  Field Sample Points
-  Field Sampling Transects

Note: Future construction sites are approximations

**Tiki Point at Harborwalk  
Conceptual Living Shoreline Design  
Figure 2. Field Survey Transects**



**Table 1. Existing Tide Levels at the Punta Gorda Tide Station**

Datum	MLLW (feet)	MSL (feet)	MHHW (feet)	NAVD88 (feet)
Mean Higher High Water (MHHW)	1.96	0.89	0	0.32
Mean High Water (MHW)	1.7	0.63	-0.26	0.06
Mean Tide Level (MTL)	1.07	0	-0.89	-0.57
Mean Sea Level (MSL)	1.07	0	-0.89	-0.57
Mean Low Water (MLW)	0.45	-0.62	-1.51	-1.19
Mean Lower Low Water (MLLW)	0	-1.07	-1.96	-1.64
North American Vertical Datum of 1988 (NAVD88)	1.64	0.57	-0.32	0
Station Datum (STND)	-2.94	-4.01	-4.9	-4.58

seagrass. These data will identify any constraints, permitting limitations, and assist with the conceptual design and preliminary cost of the future living shoreline along the seawall fronting the Four Points Sheraton hotel.

The field review was planned during a morning low tide period, so observations could be made of bay bottom conditions and biota along the seawall rip rap armoring. For the bathymetric survey, a seawall cap elevation of 5.2 feet NAVD was used as a temporary benchmark elevation to establish a reference elevation. This elevation was obtained from plan drawings from the Four Points Marina Reconstruction (dated 7/16/08) and is only to be used as an interim data set until bathymetry is measured by a Florida-registered surveyor. The seawall is currently protected by an approximately 10-foot wide edge of rip rap placed at the base of the seawall.

### Bathymetry

**Figure 2** shows the approximate locations of the transects and where elevations and water depths were collected at a 10, 25, 50, and 75-foot distance from the seawall. Rip rap is present directly in front of the seawall, so elevation data of the sediment surface was collected from the toe-of-slope (TOS) of the rip rap, which extended approximately 10 feet from the seawall. **Figure 3** shows the transect depth profiles across the proposed living shoreline area. Based on the data collection, the depth of water ranges from approximately 2.1 feet at the rip rap TOS to 8.6 feet at the deepest transect (T6) at a distance of 75 feet from the seawall. Overall, the average depth of the proposed project area is approximately 4.4 feet. Transects 5 through 7, located at the northwest corner are at slightly greater depths than the other transects, especially transect 6. This corner of the seawall projects out in the Peace River and has the greatest exposure to tidal currents and wave energy and the average depth is approximately 7 feet deep.

The slope of the bay bottom in front of the seawall is very flat for all the transects. Based on the measured depths, slopes vary from 23H : 1V (Horizontal : Vertical) to 92H : 1V at the beach in the corner of the property. **Figure 4** shows bathymetry of the project outward from the existing seawall and this will serve as a preliminary basis to determine depth for the living shoreline improvements planned along the seawall.

### Biota Survey

The project area was surveyed for the presence of seagrass to identify potential impacts to seagrass habitat. Presence of seagrass is a concern during living shoreline restoration projects and a minimum setback of 3 feet needs to be maintained for placement of any breakwaters. For this reason, a preliminary survey was conducted for the presence of seagrass along the seawall to a distance of 75 feet. Most of the shallow areas were visually surveyed as portions of the sediment substrate were

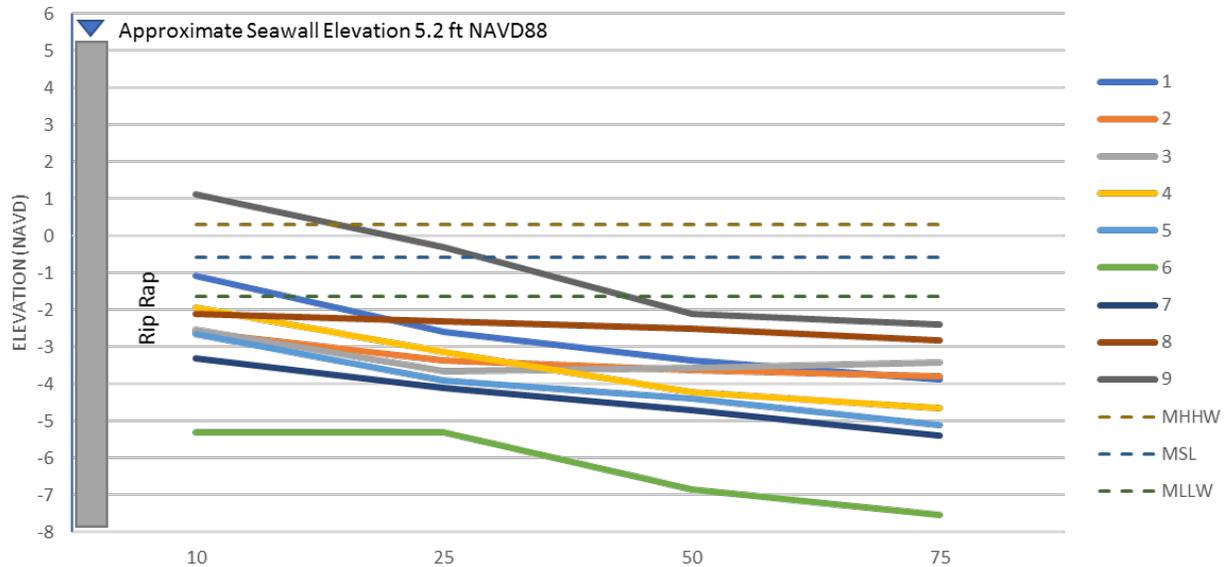


Figure 3. Transect Depth Profiles from Existing Seawall

exposed or very shallow during low tide and the bottom was clearly visible. Ponar grab samples were collected at the deeper portions of the transects where visibility was exceeded due to tannic (color) and turbid conditions of the water at low tide.

No seagrass was observed at any of the transects or within the proposed project area. The absence of seagrass may be due to high tannin-colored water from the Peace River which limits light penetration, but seagrass was also not observed in the shallow portions of the project area which is not light limited. A seagrass survey will be required for permitting and prior to construction.

During the collection of sediment samples, live tusk shells (scaphopods) and a few marine worms were found in the majority of the samples. This indicates there may be a healthy macrobenthic community present that would benefit from a living shoreline reducing wave and tidal energy in the area.

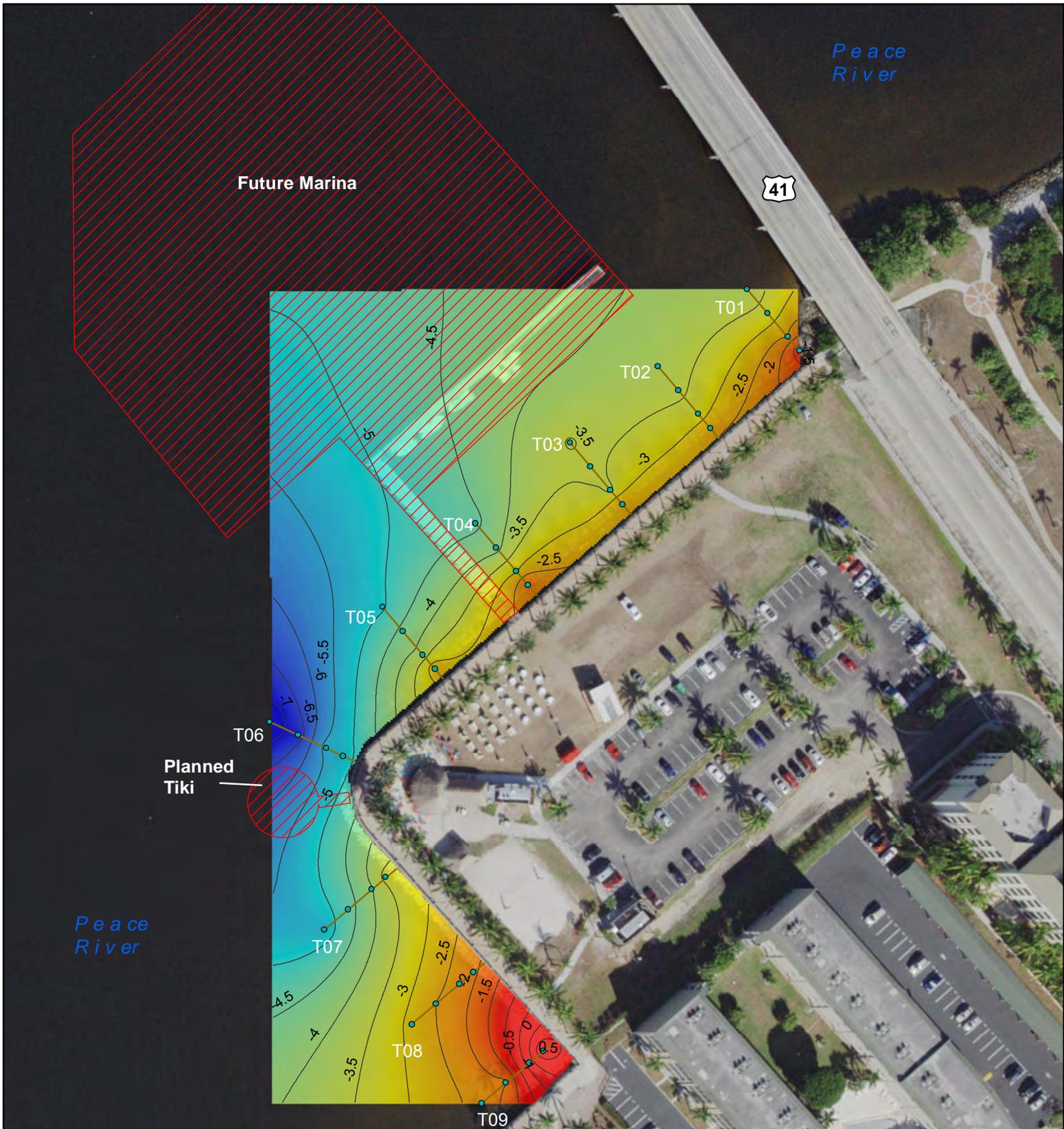
Red mangroves saplings (*Rhizophora mangle*) were observed along the seawall within the gaps of the existing rip rap present along the seawall. These were small recruits (< 12 inches) and were scattered along the upper elevation of the rip rap near the mean higher high water (MHHW) tideline. Just east of project area near the US 41 bridge several medium to adult red and black mangrove (*Avicennia germinans*) were present within the rip rap along the shoreline. The rip rap near the bridge appears to have filled in over time with accumulated sediment, indicating sediment accretion sands along the shore.

**Figure 5** shows photographs of the naturally recruiting mangroves along the shoreline. The taller mangroves were present within the sandy pockets of the rip rap.

Lastly, oysters (*Crassostrea virginica*) and barnacles (*Balanus* sp.) were observed on the rip rap as well on portions of the seawall (see **Figure 5**). These were primarily occurring at the base of the rip rap boulders and indicate the proper conditions may exist within the project area to recruit these species within the living shoreline concept.

### Sediment Survey

Sediments at all the transects consisted mostly of poorly consolidated fine sand with varying degrees of organic content. Sediments near the US 41 bridge were a silty, brown/grey fine sand with small shell fragments and a few live tusk shells. At transect 6, one of the deepest transects, sediments consisted of a black organic muck with a small fraction of fine sand and few shell fragments. At the corner near the hotel, sediments were a grey/brown silty fine sand with several oyster shells.

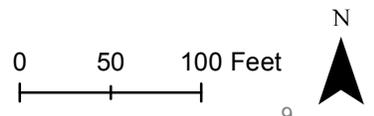


- Legend**
-  Future Construction
  -  Field Sample Points
  -  Field Sampling Transects
  -  Bathymetry Contours

**Bathymetry (ft, NAVD88)**  
 High : 1.02  
  
 Low : -7.36

Note: Future construction sites are approximations

## Tiki Point at Harborwalk Conceptual Living Shoreline Design Figure 4. Existing Conditions Bathymetry Map



Overall, most sediment samples had small shell fragments in varying densities and dead oyster shells were present in limited quantities in a few selected samples. Sediment was soft and poorly consolidated due to the organic content. This should be taken into consideration for possible settlement of material placed on the bay bottom in front of the seawall.

## **Living Shoreline Design Concepts**

A living shoreline can act as a natural buffer, enhance water quality by filtering pollutants from stormwater runoff and provide habitat for important aquatic species such as the smalltooth sawfish and terrestrial species such as birds. Improving water quality is important to preserve habitat for many commercially and recreationally species of fish and invertebrates. Living shorelines are typically designed to function as living space for wildlife, providing foraging and nesting areas for native species. Mangroves protect areas that experience erosion and provide aesthetic value, enhancing views and creating wildlife viewing opportunities for landowners and the public.

A conceptual plan was developed to create a living shoreline along this portion of the City's Harborwalk based on the existing conditions observed during the field review. The vertical seawall and observed depths are challenging design parameters to establish a resilient design for natural systems.

Throughout the conceptual design phase, three alternatives were developed based on ongoing feedback from involved partners. The sections below describe the design considerations and limitations for each option.

## **Design Considerations and Limitations**

The average depth in front of the seawall exceeds the growing range of typical mangrove vegetation but falls within tolerance limits of oysters (CHNEP, 2012) which have been documented to about six feet water depth in the Caloosahatchee River. Overall, the seawall is exposed to a large expanse of open water and has a long fetch with a northwest exposure. The following design criteria were considered during the conceptual layout of the design:

- Depth of the area in front of the seawall.
- Poorly consolidated sediment is expected to experience settling
- Maintaining adequate distance from the future dock and Tiki to allow for maintenance
- Absence of seagrass in the proposed area for rip rap placement Maintaining at least a 10-foot spacing between any structure placement to prevent marine life from getting trapped at low tide
- Minimizing bottom disturbance by selective placement of rip rap while encouraging means of sediment accretion
- Use of mangroves to slow tidal currents and promote accretion of sediment
- Materials selected for the conceptual design encourage settlement of marine faunal and floral species
- Avoid the use of synthetic materials

In addition to the above design considerations, the Four Points Sheraton has future plans to re-build the former marina in front of the hotel. A phased reconstruction of the marina is planned with the necessary boats' ingress and egress outside the marina's submerged lands lease which is located approximately 125 feet from the existing seawall. The living shoreline conceptual layout is not expected to restrict vessel movement to and from the planned marina.



Presence of red and black mangrove at the US 41 bridge on rip rap



Natural recruitment of red mangrove among rip rap at seawall



Barnacle and oyster encrusted on rip rap at toe-of-slope



Sediment with shell fragments

Figure 5. Photographs of Biota and Sediments within the Project Area

The criteria are soft design considerations, but the following conditions should be considered during the final design of the project:

- Fetch conditions and potential wave energy considering the Peace river is very wide within this reach
- Sediment transport modeling may need to be performed for this shoreline to ensure proper orientation of the rip rap breakwater design to promote sediment accumulation
- Sediment accretion is important to the recruitment of the living shoreline vegetation so placement of sediment in between the rip rap may warrant consideration to accelerate shoreline stabilization by the advancing mangrove

### **Alternative/Option 1**

Alternative 1, as shown in **Figure 6**, maximizes the available shallow water areas along the 800-foot long shoreline to create a near semi-contiguous mangrove bar through a series of nine breakwater structures with gaps to allow tidal flow to circulate around and through structures to maintain adequate flushing and nutrient and sediment transportation. Oyster domes are scattered around these structures to provide additional habitat, slow water velocity and to promote additional oyster growth. Salt marsh grasses are provided along the toe of the existing rip rap to offer added erosion control, water quality, and habitat. This conceptual option would impact approximately 0.4 acres but actual area could potentially change after final design.

**Figure 7** provides a cross section of the initial construction and planting of Alternative 1. To encourage success of mangrove establishment, bamboo tube planters, or other suitable natural material, placed throughout the riprap stone would be used to protect newly planted mangrove seedlings. Crushed stone/granular backfill was selected for the basis of the offshore breakwater to cut down on project costs. The crushed stone berms are topped with riprap armoring sized to match the existing riprap placed at the toe of the seawall.

This option was presented and discussed with project partners at a conceptual design meeting on June 7, 2018 held at Four Points Sheraton in Punta Gorda. Partners attending represented the City, Four Points, CHNEP, FDEP and TNC. The following suggestions and concerns were raised for potential design modifications:

- Proximity of breakwater structures along northeast stretch of shoreline fronting the marina may limit the ability of boat access
- Preference for a more natural look to the living shoreline design that does not incorporate synthetic materials
- Incorporate protection and accretion of the small beach area at the southwest corner of the shoreline
- Preference for riprap armoring for breakwater structure to ensure stability during storm events



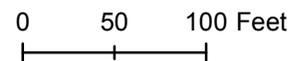
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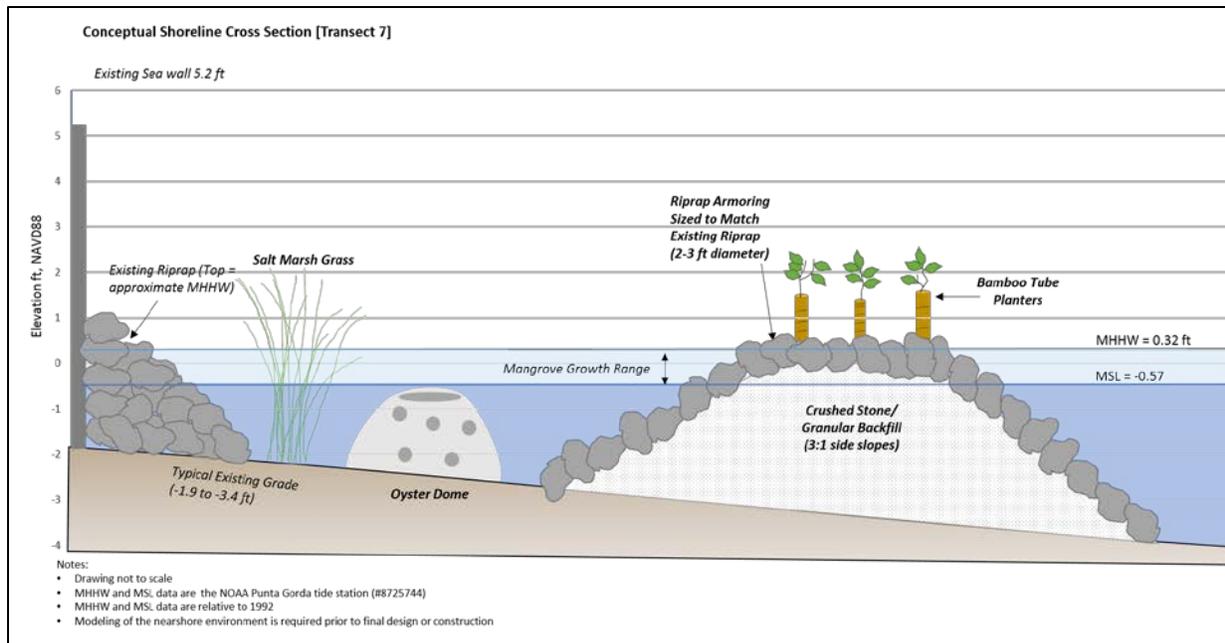
-  Field Sampling Transects
-  Oyster Reef
-  Breakwater
-  Salt Marsh Grass
-  Future Construction

Note: Future construction sites are approximations

# Tiki Point at Harborwalk Conceptual Living Shoreline Design

Figure 6 - Option 1





**Figure 7. Sample Cross Section of Alternative 1 with Breakwaters and Oyster Domes**

## Alternative/Option 2

Alternative 2 (**Figure 8**) was developed to account for suggestions and comments on Alternative 1. Alternative 2 provides three different types of living shoreline features to meet the needs of each stretch of the project area.

Along the northeast shoreline (**Figure 9**), the breakwater structures are removed to avoid boat traffic from the future dock structure planned by Four Points. One breakwater structure is preserved at the distal end of the shoreline abutting the US 41 bridge. This area, outside of the marina and once established with fully grown mature mangroves, will help to soften the view of the bridge pilings. Replacing the breakwaters along the marina are two rows of oyster domes.

The inner row is intended to provide a substrate for oyster attachment and an outer row will be planted with mangroves, which will double as added greenery to the area and provide natural “flagging” to alert boaters of the submerged structures.

Breakwaters planted with mangroves are maintained southeast of the marina and around the point (**Figure 10**). At least 10 feet of spacing is maintained for every 75 feet of structure to ensure compliance with state regulations, to avoid stagnation of water, and to allow for marine life to retreat offshore at low tide. The crushed rock making up the breakwater has been replaced by riprap stone to ensure stability and longevity of structure. The landward side of the breakwater also features layered backfill of crushed oyster shell stone, Gulf Coast Aggregates oyster balls, and fossilized oyster shells to promote oyster establishment and growth. Clusters of oyster domes are also scattered throughout the area to enhance oyster and fish habitat.

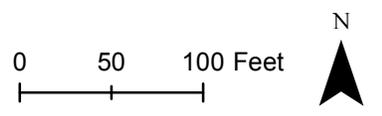
The breakwater structures end near the small beach area along the southwest shoreline. To encourage beach accretion and protection, an array of oyster domes is placed in an arc offshore of the beach (**Figure 11**). Because this area is intended for recreation and beach access, there are no plans to plant the oyster domes with mangroves. This conceptual option would impact approximately 0.3 acres but actual area could potentially change after final design



- Legend**
- Field Sampling Transects
  - Planted Oyster Reef
  - Future Construction
  - Breakwater Top
  - Breakwater
  - Oyster Reef
  - Salt Marsh Grass

Note: Future construction sites are approximations

Tiki Point at Harborwalk  
 Conceptual Living Shoreline Design  
 Figure 8 - Option 2



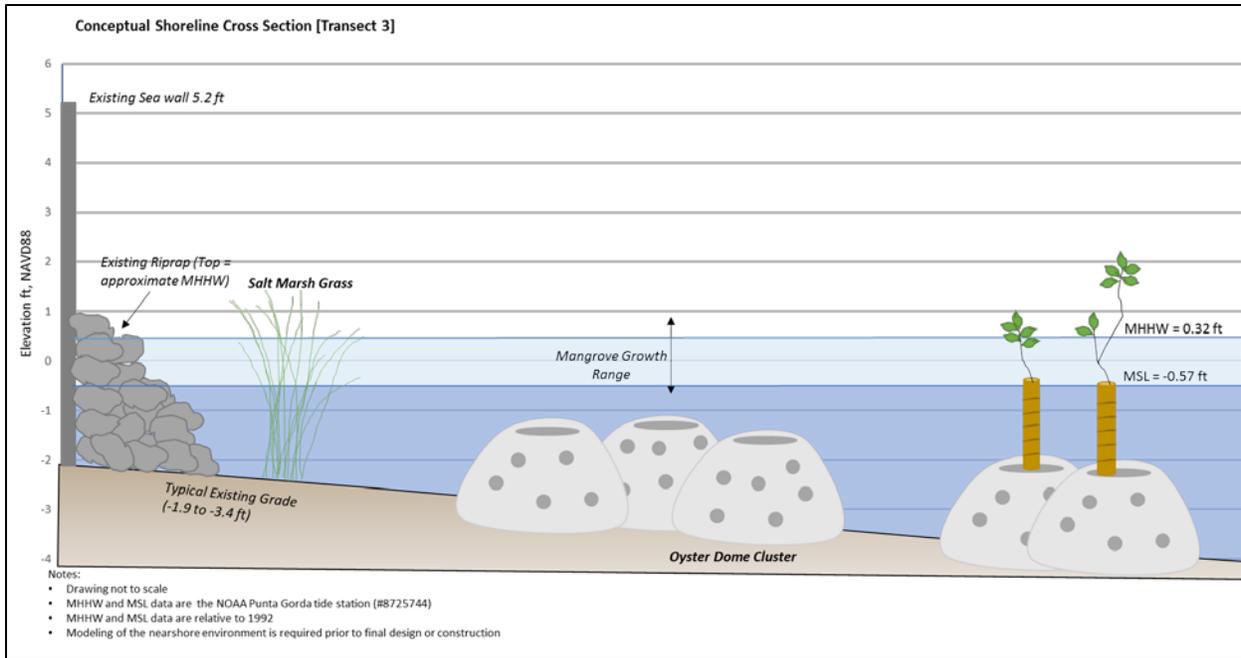


Figure 9. Sample Cross Section of Alternative 2 with Planted and Non-Planted Oyster Domes

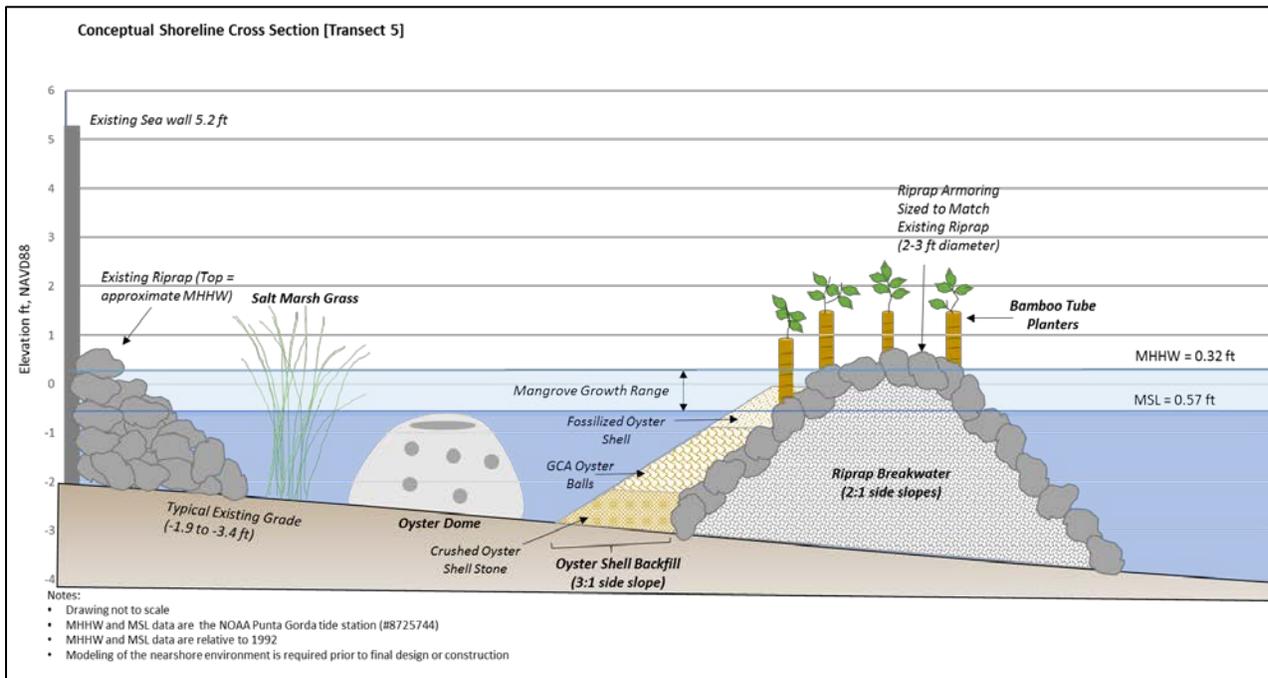
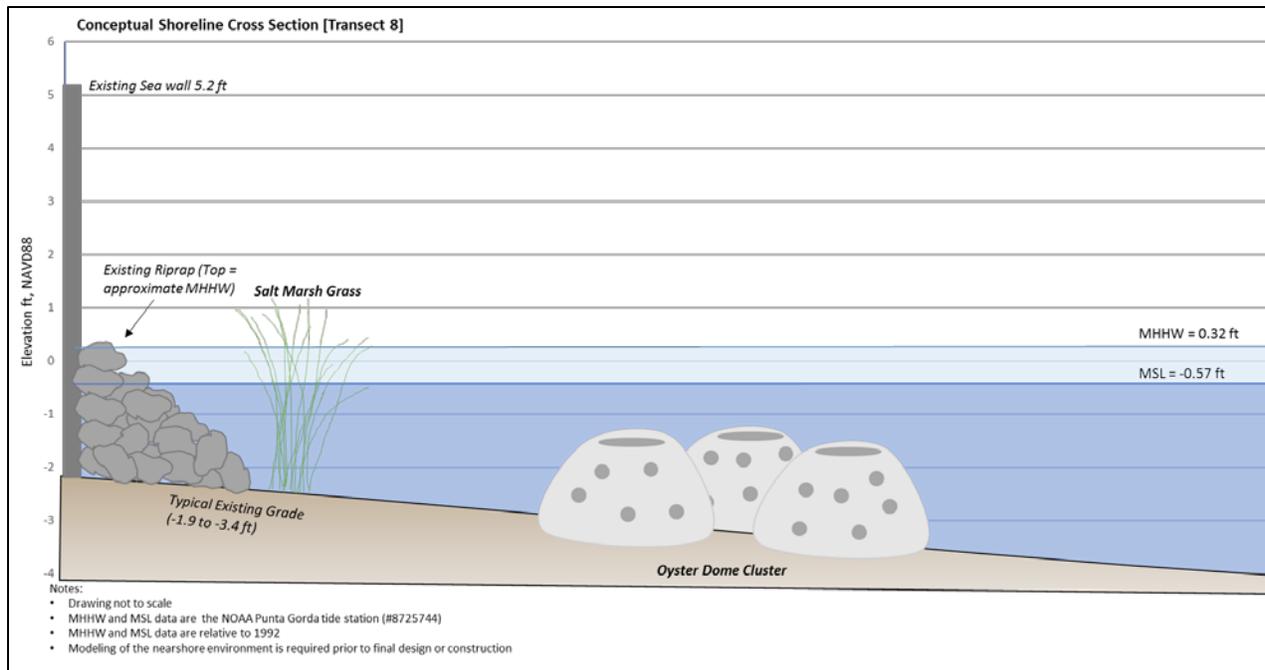


Figure 10. Sample Cross Section of Alternative 2 with Offshore Breakwater and Oyster Domes



**Figure 11. Sample Cross Section of Alternative 2 with Oyster Domes**

### Alternative/Option 3

During evaluation of Alternative 1, there was concern among some of the project partners that the living shoreline structures did not resemble a natural shoreline. Alternative 3 (**Figure 12**) attempts to enhance the condition of the existing shoreline to encourage water depths suitable to mangrove growth and removes the offshore breakwaters.

This alternative (**Figure 13**) extends the distance of the existing riprap armoring offshore to raise the elevation of the intertidal area to sustain mangrove growth. This concept mimics neighboring areas of the shoreline northeast of the US 41 bridge where mangroves are already established on a shallow gradient riprap armored area. A row of planted/non-planted oyster domes is placed at the toe of the riprap extension to provide enhanced protection of the structure from storm events and to encourage the establishment of oysters. Salt marsh grass has been removed from Alternative 3 because the depth beyond rip rap and oyster domes exceeds the range of salt marsh habitat. This conceptual option would impact approximately 0.4 acres, but actual area could potentially change after final design.

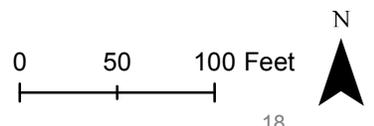
Additional cross section (**Figure 14**) and photo renderings (**Figure 15a and 15b**) were developed for Alternative 3 to showcase the before and after how the design will appear once it is established with mature mangroves and attached oysters.



- Legend**
- Field Sampling Transects
  - Oyster Reef
  - Riprap
  - Future Construction

Note: Future construction sites are approximations

**Tiki Point at Harborwalk  
Conceptual Living Shoreline Design  
Figure 12 - Option 3**



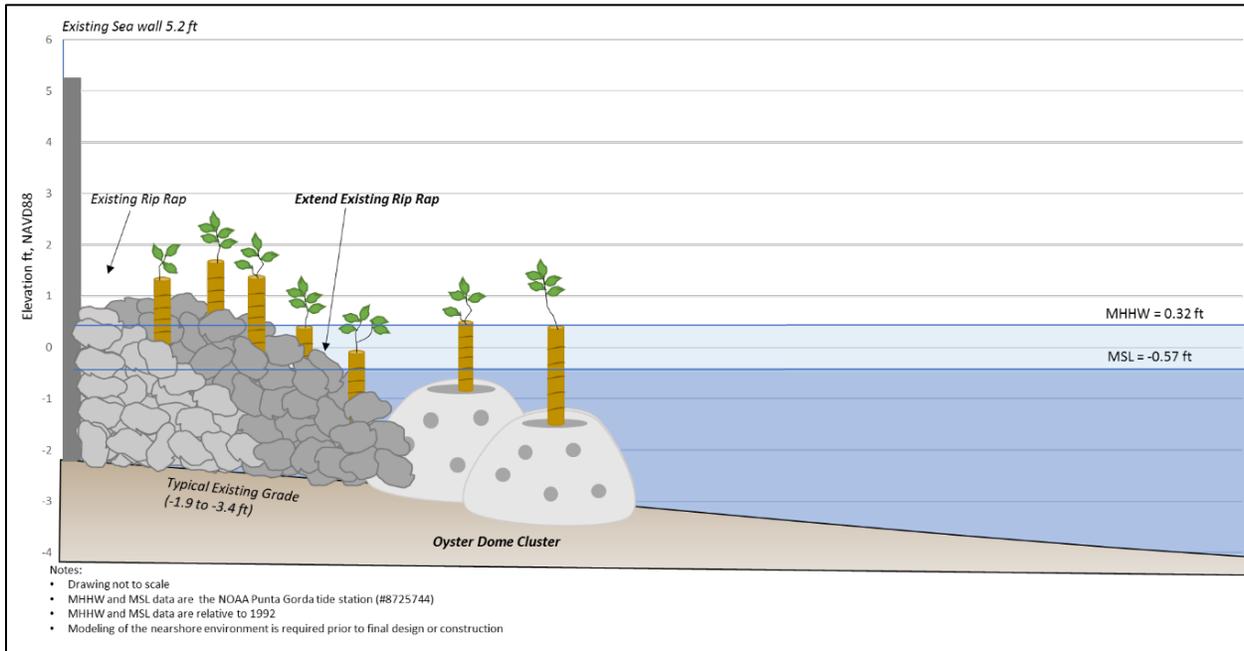


Figure 13. Sample Cross Section of Alternative 3 with Expansion of Riprap and Oyster Domes

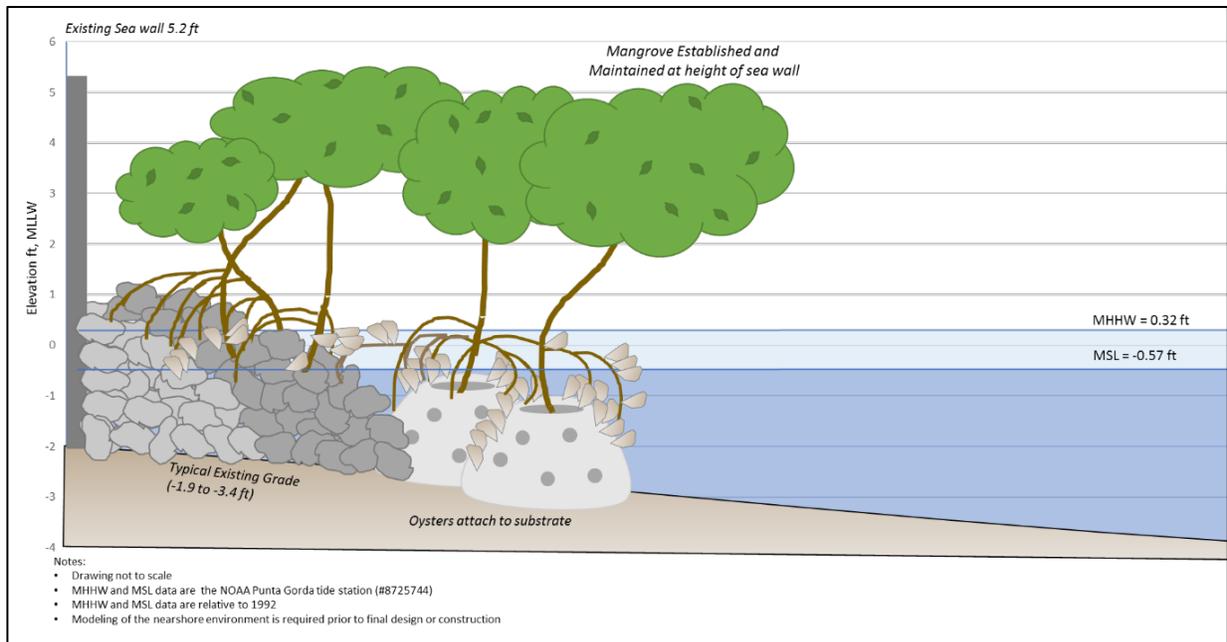


Figure 14. Sample Cross Section of Alternative 3 with Established Mangroves and Oysters.



**Figure 15a. Existing Conditions (as baseline for photo rendering)**



**Figure 15b. Photo Rendering of Alternative 3 with 5-year established mangroves and oysters**  
*Note: This image shows the intent of the conceptual design and actual placement, growth and the visibility of oyster domes will vary depending on tidal conditions, final design and permitting*

## **Benefits of Living Shoreline Conceptual Design**

The following sections detail the benefits of each living shoreline structure that is featured in the alternatives described above. The applicability of each structure type to future living shorelines within Charlotte Harbor will be dependent on unique shoreline qualities and will need to be evaluated on a case-by-case basis.

### **Rip Rap Armoring**

Rip rap will consist of appropriately sized and graded limestone boulders which are known to be suitable attachment surfaces for sea life and other biota. Placement of the riprap will provide water depths and a surface suitable for mangrove establishment, as evidenced along other nearby sections of shoreline in the immediate area.

### **Oyster Domes**

- The oyster domes are made of a special mixture of concrete with added micro-silica which provides a neutrally balanced pH to promote oyster settlement. The unfinished surface provides a rough texture which encourages biological growth and provides a niche surface for small invertebrates.
- Oysters are biological filters that can clean up to fifty-gallons of water per day which can improve water quality and improve the health of Charlotte Harbor.
- When strategically placed, oyster domes can dissipate wave energy and slow tidal currents to reduce erosion along the seawall and promote sediment accumulation.
- Oyster domes are typically designed with hollow openings and provide habitat for fish and invertebrates like crabs and anemones.
- Sizing and placement of oyster domes shall be selected for integration into a design that creates a natural-looking shoreline that also considers the site limitations. Oyster domes may be embedded into the rip rap structure to minimize the footprint of the project area while still providing a substrate for oyster growth.

### **Mangroves**

- Mangroves provide protection against storm surge and act as sediment traps for land accretion.
- Roots of mangroves are important nursery habitat for economically valuable species.
- Mangroves can provide protection from tidal erosion and storm events by reducing wave energy.
- Florida's common mangroves have subsurface and above-ground root systems that retain sediment, especially red mangroves with their extensive prop roots.
- Organic detritus from leaf fall serves as an important food source to the ecosystem and distribute essential nutrients.
- Mangroves also enhance water quality and reduce pollution by filtering suspended and dissolved materials.

### **Offshore Breakwaters**

- Breakwater structures attenuate offshore wave energy, providing protection of mangrove plantings.
- Wave attenuation from breakwaters will also result in accumulation of sediment landward of the structure, promoting long-term accretion of land for mangroves expansion.

## **Future Considerations**

### **Sea Level Rise**

Over the past century, sea levels have risen approximately 0.9 feet along Central Florida's Gulf Coast. Although there is uncertainty in future projections, all indicate that water levels will be higher than they are today. Living shorelines are particularly sensitive to sea levels due to water depth limitations of the living features in the design.

The seawall along the Tiki Point at Harborwalk project site makes the location especially susceptible to the influence of rising water levels. As water levels rise, mangroves naturally migrate up and landward to maintain their ideal water depth range. Fixed structures, such as seawalls, prevent this landward movement and may cause the mangroves to drown if they are unable to grow upward at a similar rate as the local sea level.

For the long-term success of the living shoreline project, it will be important for future sea level rise to be considered in the project design. Adding offshore structures, such as a breakwater, into the design may ensure the longevity of the established mangroves by allowing the continuous accumulation of sediment behind the structure and for added protection from wave energy during storm events.

### **Project Monitoring**

Ongoing monitoring of the project will be a critical factor of ensuring project success. Development of metrics and monitoring protocols should be established during the final design phase with sufficient funds set aside to ensure they will be followed. Ongoing elevation surveys of the design structures to assess for settling and stability, bathymetry surveys in the immediate area, rate of oyster attachment and mangrove growth, and presence of wildlife will be important parameters to record consistently for meaningful comparisons. Findings from previous projects indicate that living shorelines do not begin to thrive until several years after construction and plantings. Based on this finding, it is recommended that monitoring continue through the first five years.

### **Maintenance**

Following initial construction and planting of the living shoreline, maintenance will become a critical next step. Replanting of vegetation, removal of debris, removal of exotic species, and trimming of mangroves will help to ensure success of the project. Rock armoring may also require maintenance, particularly in the event of impacts from a large storm event. To ensure visibility of the waterscape is not impacted from the Tiki and Harborwalk perspective, a permit will be required to trim mangroves at a 6-foot height.

## Construction Cost Estimate

An estimate of probable construction costs was prepared for planning purposes and to understand the rough order of magnitude of funding necessary to implement the improvements. This cost estimate is considered a **Class 5** estimate and is consistent with Industry Standards, Association for the Advancement of Cost Engineering adjusted for local site conditions. Once a final design has been completed, a final construction cost can be determined and used as the basis for competitive contractor bidding of the project.

Living shorelines are typically competitive or cheaper than traditional armored approaches to shoreline protection. As wave energy increases, living shoreline costs go up as a function of larger stone breakwater requirements and more fill material needed for planting habitat. Costs will vary based on the area of the living shoreline to be restored and site-specific conditions. In general, a living shoreline in a low wave energy environment will cost less than a traditional hard structure breakwater.

The tables below provide Class 5 cost estimates for the proposed conceptual designs.

**Table 2. Alternative/ Option 1 Estimate**

Material	Quantity	Units	Unit Cost	Sum
Granular backfill	2,500	CY	\$ 50	\$ 125,000
Limestone rip rap	1,500	CY	\$ 180	\$ 270,000
Mangrove plants	450	EA	\$ 20	\$ 9,000
Oyster domes	50	EA	\$ 200	\$ 10,000
Salt marsh grass	550	EA	\$ 10	\$ 5,500
Turbidity Barrier	1,000	LF	\$ 20	\$ 20,000
Mobilization	1	LS	\$ 20,000	\$ 20,000
MOT	1	LS	\$ 10,000	\$ 10,000
Design	1	LS	\$ 115,000	\$ 115,000
Permitting	1	LS	\$ 15,000	\$ 15,000
Bidding Assist and CA	1	LS	\$ 15,000	\$ 15,000
Profit	1	LS	10%	\$ 59,950
Contingency	1	LS	20%	\$ 134,890
<b>TOTAL</b>				<b>\$ 674,450</b>

**Table 3. Alternative/ Option 2 Estimate**

Material	Quantity	Units	Unit Cost	Sum
Granular backfill	1,389	CY	\$ 50	\$ 69,444
Limestone rip rap	833	CY	\$ 180	\$ 150,000
Oyster balls	100	CY	\$ 100	\$ 10,000
Mangrove plants	450	EA	\$ 20	\$ 9,000
Oyster domes	50	EA	\$ 200	\$ 10,000
Salt marsh grass	550	EA	\$ 10	\$ 5,500
Turbidity Barrier	1,000	LF	\$ 20	\$ 20,000
Mobilization	1	LS	\$ 20,000	\$ 20,000
MOT	1	LS	\$ 10,000	\$ 10,000
Design	1	LS	\$ 115,000	\$ 115,000
Permitting	1	LS	\$ 15,000	\$ 15,000
Bidding Assist and CA	1	LS	\$ 15,000	\$ 15,000
Profit	1	LS	10%	\$ 43,394
Contingency	1	LS	20%	\$ 95,468
<b>TOTAL</b>				<b>\$ 492,339</b>

**Table 4. Alternative/ Option 3 Estimate**

Material	Quantity	Units	Unit Cost	Sum
Granular backfill	150	CY	\$ 50	\$ 7,500
Limestone rip rap	1,505	CY	\$ 180	\$ 270,833
Mangrove plants	450	EA	\$ 20	\$ 9,000
Oyster domes	50	EA	\$ 200	\$ 10,000
Salt marsh grass	-	EA	\$ 10	\$ -
Turbidity Barrier	1,000	LF	\$ 20	\$ 20,000
Mobilization	1	LS	\$ 20,000	\$ 20,000
MOT	1	LS	\$ 10,000	\$ 10,000
Design	1	LS	\$ 115,000	\$ 115,000
Permitting	1	LS	\$ 15,000	\$ 15,000
Bidding Assist and CA	1	LS	\$ 15,000	\$ 15,000
Profit	1	LS	10%	\$ 47,733
Contingency	1	LS	20%	\$ 108,013
<b>TOTAL</b>				<b>\$ 540,067</b>

**Cost estimate notes**

1. CY = cubic yard
2. EA = each
3. LF = linear feet
4. LS = lump sum
5. MOT = maintenance of traffic
6. CA = construction administration
7. Design fee is a ROM estimate only. A detailed estimate of fees has not yet been prepared.
8. Quantities were estimated based on conceptual design graphics and site conditions and may vary some during design.
9. Unit costs are based on readily available information for 2018 and have not been verified with local contractors.
10. Cost escalations are not factored in for construction beyond 2018.
11. Contingency is intended to cover design, unit cost adjustments and escalations and quantity variations, and is expected to be reduced during design phase as more detailed cost estimates are prepared.

## Potential Funding Sources

The following presents a list of potential sources of funding and grant opportunities to implement the Living Shoreline plan. Project partners will be contributing more to this cause including active pursuits of grant programs.

1. Property Owner(s)
  - a. Private investment for private benefit
  - b. Public Private Partnership (P3) financing
2. Local Partners & Non-Profit Entities
  - a. Charlotte Harbor Estuary Program
  - b. Friends of Charlotte Harbor
  - c. The Nature Conservancy
3. Local Government
  - a. City of Punta Gorda
  - b. Charlotte County
4. Philanthropic Foundations
  - a. An increasing number of philanthropic organizations are looking for opportunities to give back to the environment and local communities.
  - b. Consider reaching out to some of these groups.
5. Grant Programs (NOAA, FDEP, USACE, etc.)
  - a. Coastal and Resilience related grant programs
  - b. Wildlife, marine and boating/fishing programs
6. State Programs – Financing
  - a. Low interest loans through FL State Revolving Fund
  - b. Co-operative funding through SW FL Water Management District

**Appendix A – Meeting Minutes**

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# Living Shoreline Conceptual Design Project Kick-Off Meeting

## Meeting Minutes

May 3, 2018, Four Points Sheraton

**Attendees:** Jason Bird, Jacobs Engineering  
Erica Harris, Jacobs Engineering  
Rick Gorsira, Jacobs Engineering  
Craig Holt, Four Points  
Joe Suriol, Four Points  
Christine Shepard, TNC  
Jennifer Hecker, CHNEP  
Liz Donnelly, CHNEP  
Joan LeBeau, City of Punta Gorda  
Mitchell Austin, City of Punta Gorda

**Partners not in attendance:**

Anne Birch, TNC  
Andrea Graves, TNC  
Melinda Brown, CHAP  
Heather Stafford, FDEP

**Purpose**

The purpose of this meeting is to kick off the project, discuss goals and objectives, review scope of work and schedule, stakeholder involvement and participation.

**Meeting Agenda:**

- Introductions
- Discuss stakeholder participation and interests
  - Conceptual plan workshop
  - Permitting agency meeting
  - Mutual goals and objectives
- Review project scope, schedule, meetings & objectives
- Provide requested data & discuss remaining data gaps

**1. Discussion**

Chris initiated the meeting by explaining the funding sources: \$12k from a private foundation, \$6k from Jacobs Engineering and \$6k from Four Points Sheraton. Private donor funding must be spent by June 30, 2018 which sets a fast timeline to complete the scope of work for conceptual design.

Jason reviewed the scope of work, timeline and associated deliverables. Mr. Suriol noted the need for this project to be compatible with his future planned uses of the property. Mr. Suriol noted that he may need additional survey work completed outside of the scope of work for this current contract between TNC and Jacobs. Chris suggested Jason and Mr. Suriol/ Craig discuss a separate scope of work after the meeting.

Next, we discussed the permitting context for the project and the ownership/easement status of the harbor walk which is owned by the hotel but the easement is held by the City. It was decided that the City would be the permit holder for the living shoreline (per Joan LeBeau) and that Four Points would be a co-applicant for the permit if that was deemed necessary by the permitting agency(s).

Rick suggested the need for a project name. The rest of the group agreed and Chris Shepard offered that TNC work with the partners to come up with a list of possibilities. Mr. Suriol stated he would not want the project to be called "Four Points" or "Sheraton" but he was open to the project name containing the word "Tiki" as the community identifies this section of the Harbor Walk as the "Tiki". We also discussed the possibility of the City Council selecting the final name and the importance of considering the City's recent branding efforts.

Chris discussed the creation of a 2-pager that explains the project goals and the partnership that has advanced the project to date. TNC will create a first draft (using previously developed two pager) and will circulate to the group for edits.

Liz and Jennifer from CHNEP said they might have access to some funding to support the next steps of project development after we finish this scope of work by June 30<sup>th</sup>. Potential tasks include additional engineering design, a draft monitoring plan and expansion of the partnership to include Charlotte County and the coastline along the Charlotte Harbor Event Center which is adjacent to the "Tiki" area and owned by Charlotte County. Future community involvement through volunteer activities would also be considered during the implementation phase since there is a very active support base in the Port Charlotte area through the CHNEP.

## **2. Next steps (Action Items)**

- GIS data collection- TNC to follow up with partners regarding remaining data needs
- Jacobs to work on desktop analysis and conceptual design
- Conceptual design review meeting TBD likely June 7<sup>th</sup> or 8<sup>th</sup>
- Agency meeting to be scheduled after the design review meeting

## Four Points Living Shoreline Pilot Project

PREPARED BY: Jason Bird  
DATE: May 24, 2018 (3:00-3:30 pm)  
PROJECT: Four Points Living Shoreline Pilot Project – Conceptual Design Status Call  
ATTENDEES: Jacobs: Jason Bird, Erica Harris, Rick Gorsira  
TNC: Andrea Graves, Anne Birch

### Purpose

The purpose of this call was to discuss remaining data needs and present initial thoughts regarding conceptual design to TNC for feedback.

### Notes

- Review fabric selection technologies, if fabric is required, to prevent adverse impacts to natural environment.
- TNC prefers not to use any geotextile or plastic material if not needed, and account for settling through design (e.g., adding extra materials)
- Label limestone riprap for existing and proposed.
- Clarify term and product specs, if applicable, for oyster domes/reef balls (which are different than oyster balls)
- Specify successful concrete mix and pH as used by Tampa Bay Watch.
- Use a curvilinear design ILO straight and square layout. Show curvy shapes as design intent.
- TNC prefers that we use a rendered photo to show what the living shoreline is expected to look like in 5 years and that it will not impact view sheds of hotel and amenities
- State that oyster domes can also be used for mangrove planting in shallower areas
- Does mangrove trimming need to be performed under specific permit and by trained specialist, or can it be done by hotel landscape maintenance crew?
- TNC prefers not to use PVC pipes to seed mangroves. Jacobs will look into other successful restoration techniques (e.g., planting larger size mangroves versus seedlings) for further consideration at design charrette.
- TNC suggested that local schools could be engaged to grow mangrove seeds to 3-gallon for use in this project at a later point in time.
  - Need to determine what entity can perform this outreach. TNC, City, Friends of Charlotte Harbor, etc.?
  - How many mangroves are needed? This will help us determine how many students should be involved before we agree this is a good idea and do any outreach. We don't want students planting mangroves that then can't be used.
  - How long does this growing take?
  - What are specific needs and equipment and can they be donated.
  - What school, what location, etc.
- Concept design workshop (design charrette)
  - Add City of PG to attendees list
- Permitting meeting
  - Remove CHNEP and FDEP from list

- Add City of PG to attendees list
- Permitting agencies to meet with = FDEP, USACE, and NOAA NMFS (FWCC as a backup to NOAA)

## Action Items

- **TNC**
  - Set up conceptual design meeting at Four Points and send out invite. (done)
  - Check on possible partnership with local schools for possible growth of mangroves to 3-gal size. We will do this after the stakeholder design workshop.
- **Jacobs**
  - Research geotextile fabric materials for “green fabric”, and look into alternative design specs such as adding more material for consideration at conceptual design meeting.
  - Clarify oyster dome concrete mix pH used by Tampa Bay Watch for spec.
  - Update conceptual design and sections for conceptual design meeting.
  - Research new technology for pvc pipe used for mangrove seedling establishment for consideration during conceptual meeting.

*These are the accounts of the meeting’s transactions, to the best recollection of the author’s memory and notes. If any attendee is in disagreement with any item stated above or desires to add information omitted from these highlights, please contact the author in writing, within seven days of receipt of these minutes. Otherwise, these minutes shall remain as written and shall become a matter of record.*

**Appendix B – Conceptual Design Charrette**

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## Tiki Point at Harbor Walk Living Shoreline Demonstration Project

**PREPARED BY:** Jason Bird  
**DATE:** June 7, 2018 (1:00-3:00 pm)  
**PROJECT:** Living Shoreline Pilot Project – Conceptual Design Status Call  
**LOCATION:** Four Points Hotel conf. room  
**ATTENDEES:** Jacobs: Jason Bird, Erica Harris, Rick Gorsira (via phone)  
TNC: Andrea Graves, Anne Birch, Chris Shepard  
City of Punta Gorda: Joan LeBeau, Mitchell Austin  
CHNEP: Liz Donley  
DEP: Melynda Brown  
Four Points: Craig Holt, Leonel Maresma

### Purpose

The purpose of this workshop was to discuss the initial design concepts for team discussion and feedback. Input from this meeting will form the basis for the updated conceptual design and final Technical Memo deliverable.

### Notes

#### General Discussion

- Charlotte County's recently constructed sea walls at Live Oak Point, across the river from Four Points, failed during Hurricane Irma, causing significant erosion of the public park. TNC would like to include a slide to showcase this for City Council presentations to provide further motivation for the living shoreline benefits.
- Jacobs to prepare design fee estimate for modeling and full design for estimate of project costs.
- Charlotte County was considering marina and moorings at sea wall area in front of Conference Center, adjacent to Four Points property and project site. Need to investigate this further.
- St. Pete tide gauge referenced in section. Verify that the Punta Gorda tide station is the closest station with reliable tidal data.
- City, County and Four Points likes having the beach located on the southwest section of the proposed project area. If Jacobs can prepare a design that preserves and enhances the beach, this will be beneficial.
- Trim all other mangroves at 6 ft height per allowed maintenance program using certified mangrove trimmer.
- Need educational signage along project including signs indicating No Harvesting of Oysters.
- Utilize public/volunteers to help build project, where applicable, through estuary program and other stakeholder organizations, TBD.
- Consider possible project name utilizing "Living Breakwater" term.
- Possible project name "Tiki Point at Harbor Walk"
- City Council meeting in Aug. or Sept. to discuss project.

#### Potential Funding:

- Grant application submitted to NOAA for project was not selected due to change in funding process.
- NFWF is releasing new grant RFP this coming week.

- WCIND
- FWC

#### Design Review Comments

- New FDEP rule for breakwaters – 75 ft long reefs require a min. 5 ft separation
- Consider oyster domes with integrated mangroves to improve natural look
- Concern for boat access along east side of project, adjacent to marina. Prefer to remove breakwaters and oyster domes from this area to maintain adequate boat maneuverability space. Only add mangrove planting and minor additional rip rap along this section.
- Create 3-unique living shoreline sections along project length to demonstrate various applications.
- TNC prefers not to use any synthetic materials including geotextile fabrics, PVC, etc. Would also like to continue researching mangrove restoration techniques and learn more about success of bamboo tubes in FL projects.
- Engineered design will evaluate the need for fabrics on breakwater structures
- Maintain adequate setback distance from pier for mangrove trimming and maintenance.
- Tiki Bar area needs to be larger, approx. 100 ft x 100 ft located along sea wall near transect #7.
- Consider potentially allowing mangroves close to Hwy 41 bridge to grow higher offering a visual and auditory barrier from traffic noise.
- All comments are due to Jacobs by COB Friday, June 15<sup>th</sup>, earlier if possible.

#### Permitting Agency Pre-App Meeting:

- FDEP, USACE & NOAA-NMFS will be included in pre-application meeting.
- Meeting may be set in Fort Myers, depending on agency availability
- Andrea Graves to lead contacting USACE, FDEP NOAA-NMFS about joining permitting meeting
- 
- Prefer setting meeting week of June 25<sup>th</sup>, so project can be complete by June 30<sup>th</sup>. Due to schedules, this will most likely not be possible. Currently looking at dates the 2<sup>nd</sup> and 3<sup>rd</sup> week of July.
- Permitting notes:
  - City to be permit holder on project construction applications with property owner being co-applicant.
  - Four Points hotel will be separate entity of private property owner for condo development.
  - USACE and NOAA-NMFS will be the review agencies looking at Small tooth sawfish impacts; the FDEP Coastal Program staff only review the area within the Aquatic Preserve, which does not encompass this project site.

### Action Items

- **All**
  - Provide any design review comments or related information by COB Friday, June 15<sup>th</sup>.
- **City of Punta Gorda**
  - Obtain information regarding County plans for marine area in front of Conference center.
  - Provide information related to County Live Oak Point project failure to inform design of this project.
- **Four Points**
  - Provide info on proposed marina boat maneuverability and proposed Tiki bar. (done)
- **Jacobs**
  - Prepare design fee estimate as part of full project costs.
  - Verify if Punta Gorda tide station has adequate data for MSL and MHHW elevations.
  - Update and revise design to accommodate comments above and recirculate to team for final review.

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**Appendix C – Agency Pre-Application Meeting**

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## Tiki Point at Harborwalk Living Shoreline Pilot Project

**PREPARED BY:** Rick Gorsira  
**MEETING DATE:** June 20, 2018  
**PROJECT:** Tiki Point at Harborwalk Living Shoreline Pilot Project  
**LOCATION:** US Army Corps of Engineers conf. room, Fort Myers  
**ATTENDEES:** Jacobs: Jason Bird, Rick Gorsira  
TNC: Anne Birch, Andrea Graves  
City of Punta Gorda: Joan LeBeau  
CHNEP: Jennifer Hecker  
USACE: Muriel Blaisdell, Michelle Bartley, Eric Larrat  
NOAA-NMFS: Adam Brame  
FDEP: Mark Miller, Daniel Sensi  
Sheraton Four Points: Joe Suriol, Leonel Maresma

### Purpose

The purpose of this meeting was to present the initial design concepts of the Tiki Point at Harborwalk Living Shoreline Pilot Project for discussion with the US Army Corps of Engineers (USACE), National Oceanic and Atmospheric Administration-National Marine Fisheries Service (NOAA-NMFS), Florida Department of Environmental Protection (FDEP) and project stakeholders. Three concepts were presented to obtain feedback regarding the design, material construction, and restoration of mangrove and oyster habitat along the seawall bordering the Sheraton Four Points hotel property. Input obtained from this meeting will be incorporated into the final design during the design and permitting phase. Jacobs and The Nature Conservancy will work with the City of Punta Gorda to obtain concurrence for the project from the City Council and then discuss next steps for the design phase.

### Notes

- Following introductions of the team Jason provided background on the project development and then presented the conceptual design options that are being considered for implementation along the Harborwalk in front of the Sheraton Four Points hotel.
- This project is a private-public partnership with multiple stakeholders to promote living shoreline design that may benefit future restoration concepts in the Charlotte Harbor region and beyond.
- The City of Punta Gorda would be the permit applicant with the property owner (Sheraton) as co-applicant.
- NOAA-NMFS indicated the proposed project area is critical habitat for the smalltooth sawfish (0-3 ft of water depth from the shoreline) with documented occurrences. Concerns expressed with the change in water depth and covering of bottom at the project area. Anticipating shoreline restoration activities will require Section 7 analysis, but activities may be covered by the Jacksonville Biological Opinion (JaxBo). The Fort Myers Permits Section can provide further

information once an application has been submitted, and Nicole Bonine at NMFS-Protected Resources Division is the contact for questions regarding use of the JaxBo.

- NOAA-NMFS noted Option 3 may impact more sawfish habitat than Option 1 because more of the nearshore habitat will be filled with rip rap. Quantitative impacts will be considered first followed by a qualitative evaluation of habitat.
- Other possible listed species of concern include sea turtles (unlikely in the river), manatees, and shore birds (e.g., red knots), which might require review from FWS.
- Corps suggested contacting Jeff Howe at FWS for listed species issues under their purview.
- USACE noted that Option 1 creates a greater variety of habitat types.
- USACE indicated the future marina needs to be considered during the project's final design phase. The marina already has a USACE permit and may need to be shown on project permit drawings.
- Co-applicant indicated that the tiki shown on the conceptual plans will probably be the subject of a separate permit application.
- FDEP indicated concerns with ownership of the property near the Charlotte Harbor Event and Conference Center adjacent to the project site. Need confirmation whether the City or County owns the property as it could affect the permit application to be submitted in regard to the owner's riparian rights.
- USACE Nationwide Permit 27 may be applicable (need to verify impact area) to the proposed activity. Would need to show functional lift in relation to a reference site. Corps will provide information on possible types of permit process that project will have to undergo, as well as living shoreline information from the JaxBo.
- FDEP indicated size of project likely exceeds the general permit criteria. If project is too large, then Individual Permit may be required, which will require avoidance and minimization, alternatives analysis – typically a more rigorous process.
- NOAA requested design be scaled to understand size of impacts which may fall under programmatic permits. Concerns with entrapment of species (dolphins and manatees) needs to be incorporated.
- USACE expressed concern regarding water depth for red mangroves, which are typically grown in a zone at 1-foot NGVD.
- Consider ongoing and recent research sources, including FGCU, Estero Bay, and TBEP.
- FDEP noted that a submerged lands easement will be required for work by the applicant.
- City of Punta Gorda is negotiating with a firm to revise the city's Climate Adaptation Plan that will include development of a Comprehensive Living Shoreline plan as a new element; this pilot project will help inform that effort.

*These are the accounts of the meeting's transactions, to the best recollection of the author's memory and notes. If any attendee is in disagreement with any item stated above or desires to add information omitted from these highlights, please contact the author in writing, within seven days of receipt of these minutes. Otherwise, these minutes shall remain as written and shall become a matter of record.*

**Appendix D – Work Plan**

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## Four Points – Living Shoreline Project, Punta Gorda, FL

**PREPARED BY:** Jason Bird (Jacobs)  
**DATE:** May 3, 2018 (11-12pm)  
**LOCATION:** Four Points Tiki Bar Restaurant  
**PROJECT:** Project Kickoff Meeting & Field Work (Work Plan)  
**ATTENDEES:** CH2M (Jacobs): Jason Bird, Rick Gorsira, Erica Harris  
TNC: Christine Shepard  
CHNEP: Liz Donley, Jennifer Hecker  
Four Points: Craig Holt, Joe Suriol  
City of Punta Gorda: Mitchel Austin, Joan Lebeau

### **Purpose**

The purpose of this meeting is to kick off the project, discuss goals and objectives, review scope of work and schedule, stakeholder involvement and participation.

### **Schedule:**

- 8:00-11:00 am – gear up, review work plan and team safety check, flag transects and perform visual inspection
- 11:00-12:30 am – meet at Tiki Bar (table to be set up by Client) kickoff meeting with TNC, Jacobs, Four Points, City of Punta Gorda and other team members.
- 12:30-5:00 pm – perform in water survey along 6-8 transects located along 800 LF of property

### **Meeting Agenda:**

- Brief introductions
- Discuss stakeholder participation and interests
  - Conceptual plan workshop (in person)
  - Permitting agency meeting
  - Mutual goals and objectives
- Review project scope, schedule, meetings & objectives
- Provide requested data & discuss remaining data gaps (see data needs list below)
- Develop 1-page communication piece.

### **Work Plan:**

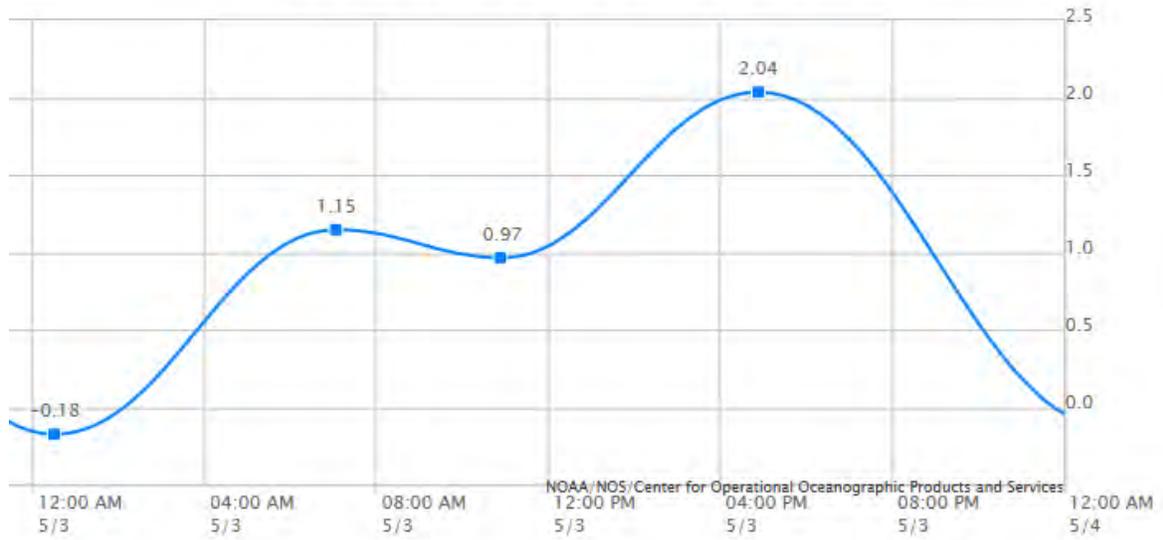
- Measurements will be taken via wading and boat, as deemed necessary by Jacobs team.
- Data collection survey includes the following activities:
  - General shoreline observations
  - Spot depth measurements
  - Shoreline slope from seawall perpendicularly out to approx. 100 ft using survey rod at regular intervals
  - Water quality (secchi disk)
  - Surface sediment profile with ponar dredge
  - Visual seagrass and SAV vegetation survey
  - Tide elevation based on stains/barnacles from top of seawall

**Data Needs (desktop):**

- City/County projects/services planned or underway in region;
  - Previous studies of marine environment including water quality, dredging, erosion control, etc.
  - Marine environment related studies, permit and design info from ongoing park and seawall improvement projects
  - FDOT plans for US41 (including maintenance and planned improvements, where available)
- Four Points property development plans including tiki bar and marina expansion (permit/design plans);
  - As-builts of the seawall and pedestrian promenade
  - Existing ERP permits for past improvements along the seawall
  - Previous studies of marine environment, ecology or related analysis along seawall and coastline.
- CHNEP, FDEP & TNC data on Charlotte Harbor.
  - Info on recent, ongoing or planned nature based/coastal restoration projects in region
  - GIS data for the region including, but not limited to: bathymetry and topography digital elevation models (DEMs), shapefiles showing existing habitats, listed species of concern, sea wall, natural resources, storm surge, and sea level rise;
  - Reports and data from previous studies including vulnerability assessment and other resource related surveys.
- Other related information that may be beneficial to this effort.



**NOAA/NOS/CO-OPS**  
**Tide Predictions at 8725744, Punta Gorda FL**  
**From 2018/05/02 12:00 AM LST/LDT to 2018/05/03 11:59 PM LST/LDT**



Data Collection Summary Table and Assumptions

Study Lead	Title/Description	Application/Assumptions
<i>Data and information received</i>		
City of Punta Gorda	City of Punta Gorda Local Mitigation Strategy (2010)	<p><i>Application:</i></p> <ul style="list-style-type: none"> <li>• Evaluation of expected storm surge ranges</li> <li>• Description of local storm damage from previous events</li> </ul>
Charlotte Harbor National Estuary Program	Charlotte Harbor Regional Climate Change Vulnerability Assessment (2010)	<p><i>Application:</i></p> <ul style="list-style-type: none"> <li>• Review of historical sea level rise rates and associated wetland impacts using the SLAMM model</li> <li>• Sea level rise projections</li> </ul> <p><i>Assumptions:</i></p> <ul style="list-style-type: none"> <li>• Climate science has continued to advance since the release of this report. The best available projections will be used in the design of the living shoreline.</li> </ul>
Charlotte Harbor National Estuary Program	Development of Climate Change Adaptation Plan for SW Florida Coastal City (2008)	Scope of work is not applicable
The Nature Conservancy	Retrospective Habitat and Future SLR Change in Charlotte Harbor, FL (2013)	<p><i>Application</i></p> <ul style="list-style-type: none"> <li>• Review of historical sea level rise rates and associated estuary impacts using the SLAMM model</li> <li>• Sea level rise projections</li> </ul> <p><i>Assumptions:</i></p> <ul style="list-style-type: none"> <li>• Climate science has continued to advance since the release of this report. The best available projections will be used in the design of the living shoreline.</li> </ul>
The Nature Conservancy	SLR Impacts on Coastal Ecosystems at Six Major Estuaries on Florida’s Gulf Coast (2015)	<p><i>Application</i></p> <ul style="list-style-type: none"> <li>• Review of historical sea level rise rates and associated estuary impacts using the SLAMM model</li> <li>• Sea level rise projections</li> </ul> <p><i>Assumptions:</i></p> <ul style="list-style-type: none"> <li>• Climate science has continued to advance since the release of this report. The best available projections will be used in the design of the living shoreline.</li> </ul>

Study Lead	Title/Description	Application/Assumptions
Charlotte Harbor National Estuary Program; SW Florida Regional Planning Council	City of Punta Gorda Adaptation Plan (2009)	<ul style="list-style-type: none"> <li>Evaluation of expected storm surge ranges</li> <li>Description of local storm damage from previous events</li> <li>Sea level rise projections</li> </ul> <p><i>Assumptions:</i></p> <ul style="list-style-type: none"> <li>Climate science has continued to advance since the release of this report. The best available projections will be used in the design of the living shoreline.</li> </ul>
Florida Sea Grant; SW Florida Regional Planning Council; Charlotte Harbor National Estuary Program; UF	SLR Summary Charlotte County (date unknown)	<ul style="list-style-type: none"> <li>Potential impacts of sea level rise to natural environment</li> </ul>
The Nature Conservancy	Trabue Harborwalk Oyster Habitat Restoration Project (2017)	<ul style="list-style-type: none"> <li>Insight for success of local oyster reef installation</li> <li>Review of permitting process, potential funding partners, project monitoring, and community involvement</li> </ul>
National Oceanic and Atmospheric Administration	National Storm Surge Hazards Map layers	<ul style="list-style-type: none"> <li>Potential storm surge depth and extents, as estimated from the Sea, Lake, and Overland Surges from Hurricanes model</li> </ul>
Duke University Marine Spatial Ecology Laboratory; The Nature Conservancy	Bathymetry (2005)- 30m resolution	<ul style="list-style-type: none"> <li>Bathymetry resolution is too coarse for use in the pilot project and is missing metadata</li> </ul>
The Nature Conservancy	Digital Elevation Model – 30 meter resolution (year unknown)	<ul style="list-style-type: none"> <li>DEM resolution is too coarse for use in the small-scale pilot study and is missing metadata</li> </ul>
The Nature Conservancy	Charlotte Harbor Habitat (date unknown)	<ul style="list-style-type: none"> <li>Will consult for reference to existing habitats surveyed in local area for suitability of living shoreline options</li> </ul>
The Nature Conservancy	Charlotte Harbor SLR (date unknown)	<ul style="list-style-type: none"> <li>Sea level rise inland flood layers not applicable for this study</li> </ul>
The City of Punta Gorda	Living Shorelines GIS (date unknown)	<ul style="list-style-type: none"> <li>May use streets, city limits, pathways, and parks layers in site overview map</li> </ul>
Four Points Sheraton	Marina – Permitted Site Plan (2005) Overall Site Plan (2007) Marina Layout (2008)	<ul style="list-style-type: none"> <li>Will incorporate proposed marina area in living shoreline design</li> </ul>
City of Punta Gorda	Harborwalk Drawings (2008)	<ul style="list-style-type: none"> <li>Provides elevation of seawall</li> </ul>
<i>Additional data and information</i>		

Study Lead	Title/Description	Application/Assumptions
National Oceanic and Atmospheric Administration	Observed tide levels	<p><i>Application</i></p> <ul style="list-style-type: none"> <li>• A long-term tide station does not exist for the Punta Gorda or Charlotte Harbor area. Therefore, tides from the St. Petersburg tide station (#8726520) will be used for design.</li> </ul> <p><i>Assumptions</i></p> <ul style="list-style-type: none"> <li>• Tides observed in St. Petersburg are representative of water levels in Charlotte Harbor.</li> </ul>
University of Florida IFAS Extension	Streamlining Resiliency: Regulatory Considerations in Permitting Small-Scale Living Shorelines in Florida (2018)	<ul style="list-style-type: none"> <li>• Permitting considerations</li> </ul>
Jacobs staff	Collection of bathymetry profiles and key elevations along 9 transects in the project area	<ul style="list-style-type: none"> <li>• Will be used to inform future site modifications and design of living shoreline.</li> </ul>