

Monday, November 14, 2022
Immediately following the Special
Commission Meeting at 7 pm



Town Hall Commission Chambers
247 Edwards Lane
Palm Beach Shores, FL 33404

Mayor Alan Fiers
Vice Mayor Scott McCrannels

Commissioner Tracy Larcher
Commissioner Janet Kortenhaus
Commissioner Brian Tyler

Town Attorney Keith Davis
Town Administrator Wendy Wells
Town Clerk Jude M. Goudreau

PLEASE NOTE:

THIS MEETING IS ALSO CONDUCTED USING COMMUNICATION MEDIA TECHNOLOGY

Join information

Meeting link:

<https://townofpalmbeachshores.my.webex.com/townofpalmbeachshores.my/j.php?MTID=me5cfb000ecdc63d51ea5bab3f6d84315>

Meeting number: 2633 070 5864 Password:1114 Join by phone +1-408-418-9388 United States Toll
Access code: 2633 070 5864

COMMISSION WORKSHOP AGENDA

1) CALL TO ORDER

- a) Pledge of Allegiance
- b) Roll Call

2) Discussion Items:

- Vulnerability Assessment – presentation by Monica Shaner, PE, Florida Technical Consultants
- Discussion of action items to be considered based on the Vulnerability Assessment.
- Administrative Updates:
 1. Tree Trimming
 2. EMS Contract with Riviera Beach
 3. New Accounting Software
 4. Sunset Park Plans
 5. Post Hurricane Update

3) Public Comments: (please state your name)

4) Adjournment:

PLEASE TAKE NOTICE AND BE ADVISED, that if any interested person desires to appeal any decision made by the Town Commission with respect to any matter considered at this meeting or hearing, such interested person will need a record of the proceedings, and for such purpose may need to insure that a verbatim record of the proceedings is made, which record includes the testimony and evidence upon which the appeal is based. The meeting/hearing will be continued from day to day, time to time, place to place, as may be found necessary during the aforesaid meeting. IN ACCORDANCE WITH THE PROVISIONS OF THE AMERICANS WITH DISABILITIES ACT (ADA), THIS DOCUMENT CAN BE MADE AVAILABLE IN AN ALTERNATE FORMAT (LARGE PRINT) UPON REQUEST AND SPECIAL ACCOMODATIONS CAN BE PROVIDED UPON REQUEST WITH THREE (3) DAYS ADVANCE NOTICE. FOR HEARING ASSISTANCE: If any person wishes to use a hearing device, please contact the Town Clerk.



2022

Vulnerability Assessment



Florida Technical Consultants, LLC

For: Town of Palm Beach Shores

10/14/2022



Vulnerability Assessment

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1. Objectives

The Town of Palm Beach Shores has commissioned Florida Technical Consultants LLC (FTC), to perform a Vulnerability Assessment study with the intent of satisfying Florida Statute 380.93. The objective of this study is to analyze the projected flooding impacts to the Town’s Critical Infrastructure.

This study essentially provides a broad understanding of the probability of risk associated with different flooding scenarios. The flooding scenarios are then mapped with a detailed inventory of all critical assets to determine the risk to each asset for each scenario. The result is a prioritization schedule of each asset based on risk and criticality, along with recommendations for stormwater, storm surge, and tidal flooding mitigation for high priority areas.



Figure 1: Palm Beach Shores Vulnerability Assessment Study Limits

2. Process Development

The Vulnerability Assessment included the following process steps:

Data Collection

1. FTC performed the initial tabletop Data Collection for all geographic data, including Critical Infrastructure, Planning and Zoning Information, FEMA Flood Zone Data, Utility Data, and Topographic Data
2. FTC graphically presented the data through an ArcGIS Map and performed a Gap Analysis.
3. FTC met with the Town of Palm Beach Shores to present the collected data and request the missing information.

Site Visit

4. FTC performed a site visit during a storm event to:
 - a. Visually analyze the Town's flood risks to Critical Assets
 - b. Interview the Town's Public Works Director for historical information, storm water program management and Capital Planning

Risk Analysis

5. FTC collected and analyzed the following regional flood data:
 - a. Tidal gauge data
 - b. Regional flooding sensitivity reports
 - c. Local sea level rise scenarios
 - i. 2040 Intermediate Low & Intermediate High
 - ii. 2070 Intermediate Low & Intermediate High
6. FTC Performed a detailed Critical Infrastructure inventory including elevation and capacity information
7. FTC commissioned Brizaga, Inc. to provide the local tidal flood days analysis

Exposure Analysis

8. FTC overlaid the FEMA Flood elevation maps on the Critical Infrastructure Map
9. FTC created tidal flood maps for each of the future sea level rise scenarios and overlaid these on the Critical Infrastructure Map

Sensitivity Analysis

10. FTC developed a table with all of the Critical Infrastructure that would be affected by a storm water or tidal flooding event and prioritized each of these facilities based on risk and criticality.

3. Tabletop Data Collection

FTC began the development of the data collection with a desktop review that included creating and populating an ArcGIS map with the following layers. The source of data for each of these layers is shown in Table 1 on the following page:

1. Updated boundary
2. FEMA Flood Zones
3. Subdivisions
4. Parcels
5. Existing Land Use
6. Future Land Use
7. Zoning
8. Roads
9. Utility Infrastructure
10. Municipal parks
11. Bus stops & routes
12. Senior Community Center
13. Lidar Points
14. Areas of Interest/ Critical Infrastructure
 - a. Hotels
 - b. Restaurants
 - c. Marinas
 - d. Historic Landmarks
 - e. Beach Facilities
 - f. Town Hall
 - g. Fire/Police Station
15. Data that was reviewed but does not fall within the Town limits:
 - a. Schools
 - b. Library
 - c. Traffic Signals
 - d. County/ State Parks
 - e. Mobile Homes
 - f. Communication Towers
 - g. Golf Courses
 - h. Assisted Living Facilities/ Nursing Homes
 - i. PBC Critical Erosion Areas



Table 1: Asset Data Sources as Analyzed in GIS Map

Asset Theme	Dataset	Source	Data Type - GIS
Beach Facilities	Google Maps; Map Data @ 2022	https://www.google.com/maps/place/Palm+Beach+Shores,+FL+33404	Points
Government Owned Properties			
Hotels			
Historic Landmarks			
Marinas			
Restaurants			
Road Centerlines	Palm Beach County Open Data	https://opendata2-pbcgov.opendata.arcgis.com/	Line
Bus Stops			Points
Bus Routes			Line
Municipal Parks			Polygon
Seniors Community			Polygon
Stormwater Utility Infrastructure	Village of Palm Beach Shores	Engineering Department	Points & Lines
Evacuation Routes			PDF Map
Water Utility Infrastructure	City of Riviera Beach	Utility Department	Points & Lines
Wastewater Utility Infrastructure			Points & Lines

Critical/Regionally Significant Assets

The four categories of critical and regionally significant assets included in the Vulnerability Assessment are as follows:

Transportation assets and evacuation routes

Within the study limits there are bus stops, bus routes, major roadways, marinas, and evacuation routes. The Town of Palm Beach Shores is in Palm Beach County Evacuation Zone B. The nearest risk shelter is located in the City of Riviera Beach.

Critical infrastructure

Within the study limits there are lift stations, stormwater collection facilities, drinking water and fire protection facilities, and a sand transfer station.

Critical community and emergency facilities

Within the study limits there is a community center, fire station, law enforcement facility, hotels, restaurants, and local government facilities.

Natural, cultural, and historical resources

Within the study limits there are parks, shorelines, and historical and cultural assets.

All of the catalogued assets, along with their respective elevations, capacities and Asset ID numbers (where applicable) are listed in Table 2 below. They are also shown graphically in Figure 2 on page 9.

Table 2: Palm Beach Shores Critical Asset Inventory

Asset Class	Asset Type	Entity Name	Asset Name	Asset Elevation	Asset Size/ Capacity	Asset Unique ID
Transportation Assets and Evacuation Routes	Bus Stops	Palm Beach County	Ocean Avenue @ Sandal Ln	7.7	N/A	2832
			Ocean Avenue @ Edwards Ln	8.8	N/A	2833
			Inlet Way @ Parkway	6.6	N/A	2837
			Lake Drive @ Claremont Ln	4.1	N/A	2839
			Lake Drive @ Bamboo Ln	2.5	N/A	2842
	Major Roadways/ Bus & Evacuation Route	Town of Palm Beach Shores	Ocean Avenue	5.3 - 8.3	2 Lane Collector	8884
			Inlet Way	3.5 - 7.2	2 Lane Collector	6063
			Lake Drive	2.5 - 4.2	2 Lane Collector	6644
			Bamboo Lane	2.5 – 8.2	2 Lane Collector	N/A
	Marinas	Private	Buccaneer Marina Resort	2.9	16 Boat Slips	N/A
			Sailfish Marina Resort	3.8	71 Boat Slips	N/A
			Cannonsport Marina	3.8	54 Boat Slips	N/A



Asset Class	Asset Type	Entity Name	Asset Name	Asset Elevation	Asset Size/ Capacity	Asset Unique ID
Critical Infrastructure	Lift Stations	Town of Palm Beach Shores	Edwards Ln & Ocean Ave	8.6	Duplex	LS2
			Edwards Ln & Lake Drive	4.9	Duplex	LS1
	Sand Transfer Plant	Town of Palm Beach	Reach 1 Sand Transfer Plant	2	202,000 cy/year	N/A
	Fire Hydrants	City of Riviera Beach	Edwards Ln & Ocean Ave	7.7	5 1/4"	3-0073
			Tacoma Ln & Ocean Ave	5.9	5 1/4"	3-0074
			Linda Ln & Ocean Ave	7	5 1/4"	3-0185
			Claremont Ln & Ocean Ave	7.8	5 1/4"	3-0183
			Tacoma Ln & Ocean Ave	8.7	5 1/4"	3-0182
			101 Edwards Ln	8.1	5 1/4"	3-0181
			Blossom Ln & Ocean Blvd	7.6	5 1/4"	3-0071
			151 N Ocean Ave	7.8	5 1/4"	3-0070
			143 Bamboo Ln	9.2	5 1/4"	3-0059
			201 Blossom Ln	8.6	5 1/4"	3-0079
			201 Edwards Ln	9.1	4 1/2"	3-0078
			188 Lake Drive	3.2	4 1/2"	3-0089
			300 Cascade Ln	6.1	5 1/4"	3-0088
			Edwards Ln	6.1	5 1/4"	3-0169
			144 Lake Drive	4.4	5 1/4"	3-0081
			Park Ave & Bamboo Ln	5.9	5 1/4"	3-0116
			301 Sandal Ln	5.1	5 1/4"	3-0080
			301 Blossom Ln	5.6	5 1/4"	3-0117
			201 Inlet Way	5.4	5 1/4"	3-0075
			20 Lake Drive	3.8	4 1/2"	3-0084
			301 Linda Ln	6.6	5 1/4"	3-0085
			300 Tacoma Ln	5.8	5 1/4"	3-0087
			201 Claremont	8.7	5 1/4"	3-0077
			241 Bravado	7.5	5 1/4"	3-0086
			201 Linda Ln	6.2	4 1/2"	3-0076
			98 Lake Drive	3.5	5 1/4"	3-0082
			72 Lake Drive	4.2	4 1/2"	3-0083
	305 Claremont Ln	5.9	5 1/4"	3-0118		
	301 Linda Ln	5.7	5 1/4"	3-0119		
	100 Cascade Ln	7.8	5 1/4"	3-0180		
106 Blossom Ln	8.1	5 1/4"	3-0179			
100 Sandal Ln	9.3	5 1/4"	3-0178			
100 Bamboo Ln	8.2	5 1/4"	3-0177			
Stormwater Outfall	Town of Palm Beach Shores	Ocean Ave & Inlet Way	1.4	42"	Outfall#1	
		Atlantic Ave & Inlet Way	1.4	24"	Outfall#2	
		Lake Drive & Inlet Way	1.4	30"	Outfall#3	
		Tacoma Ln & Lake Drive	0.0	30"	Outfall#4	
		Blossom In & Lake Drive	0.0	24"	Outfall#5	
		Bamboo Ln & Lake Drive	0.0	30"	Outfall#6	



Asset Class	Asset Type	Entity Name	Asset Name	Asset Elevation	Asset Size/ Capacity	Asset Unique ID
Critical Community and Emergency Facilities	Government Facility	Town of Palm Beach Shores	Fire Station/ Police Station	6.7	0.37 acres	
			Town Hall	5.7		
	Beach Facility	Town of Palm Beach Shores	Lifeguard Stand #11	8.6	N/A	
			Walkway - North	11.9	N/A	
			Walkway - South	13	N/A	
			Parking Lot	8.5	60 spaces	
	Critical Community	Private	Senior Community	11	16 units	
	Commercial - Restaurant	Private	Sailfish Marina Tiki Bar	4.3	0.5 acres	
			Islander Grill and Tiki Bar	9.6	N/A	
			Sailfish Marina Restaurant	4	N/A	
	Commercial - Hotel/ Timeshare/ Resort	Private	La Doral	6.7	0.22 acres	
			Marriott Ocean Pointe	8.8	10.9 acres	
			Pelican Motel	9.4	0.4 acres	
			Seaspray Inn and Beach Resort	8.2	0.65 acres	
			Palm Beach Shores Resort	9.9	7.8 acres	
			Sunshine Shores Resort	9	0.39 acres	
			Sand Dune Shores Resort	10.5	1.34 acres	
			Atlantic Shores Vacation Villas	9	0.22 acres	
Buccaneer Marina Resort			3.7	1.17 acres		
Sailfish Marina Resort			4.3	2.04 acres		
Natural, Cultural, and Historical Resources	Parks	Town of Palm Beach Shores	Inlet Park	3.8	6.02 acres	
			Palm Beach Shores Municipal Beach	9.2	4.95 acres	
			Palm Beach Shores Municipal Parkway	5.9 - 7.4	35.68 acres	
	Community Center	Town of Palm Beach Shores	Palm Beach Shores Community Center	9.3	5.06 acres	
	Historic Landmarks	Town of Palm Beach Shores	Acknowledgement Memorial	6.2	N/A	
			Acknowledgement Stone	5.4	N/A	
			Florida Easternmost Point	2	N/A	

Palm Beach Shores Critical Infrastructure Map



Figure 2: Critical Infrastructure

Topographic Data

The Palm Beach County topographic Raster Image was overlaid on the Town of Palm Beach Shores GIS map to determine the elevations of all critical assets, and to determine the depth of each asset for the analyzed flooding events.

Palm Beach Shores Topographic Map

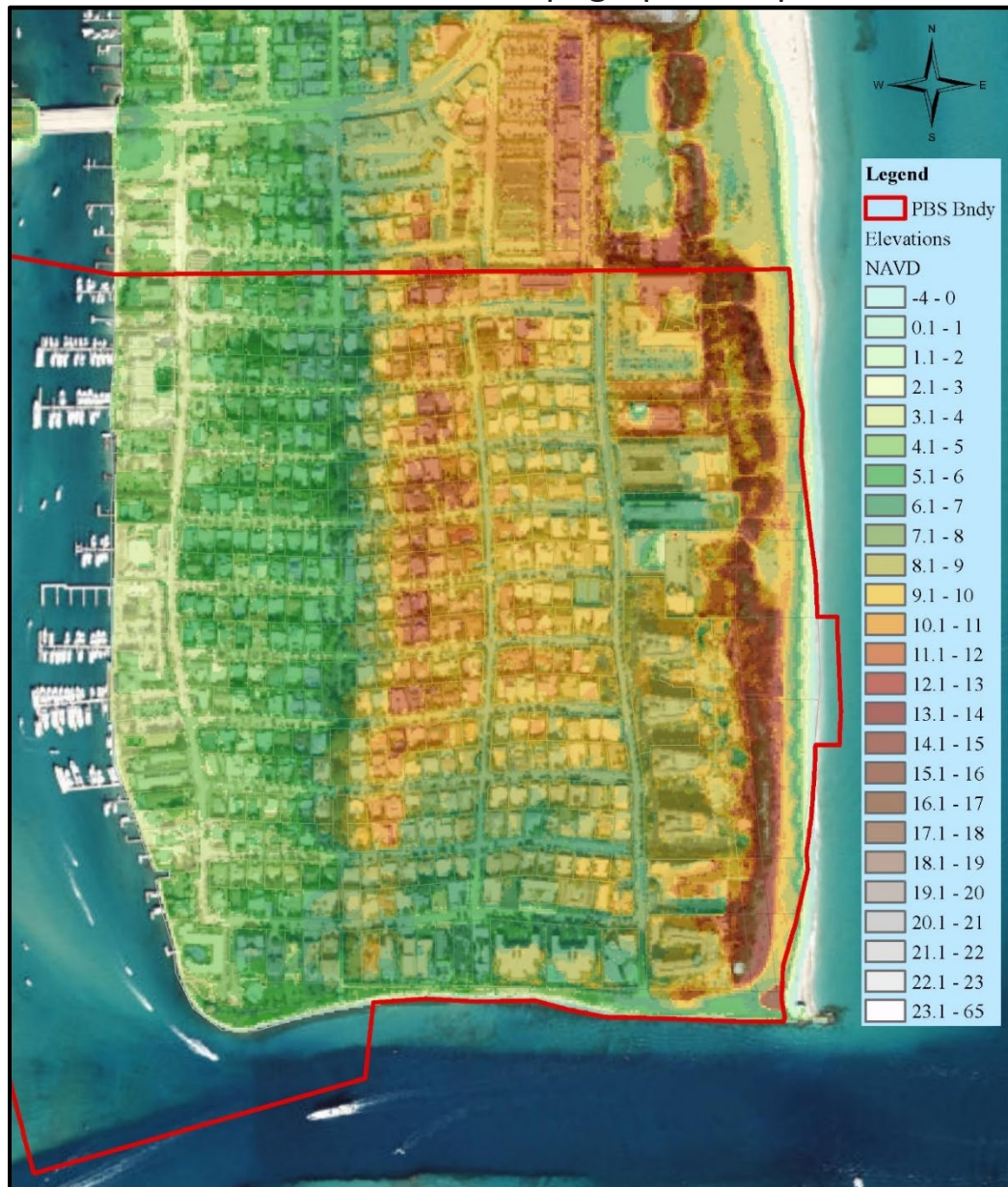


Figure 3: Palm Beach Shores Topographic Map

Flood scenario-related data

Tidal Flooding Projections

The study area falls between two tidal gauges, Lake Worth Pier and Trident Pier in Port Canaveral. The Port Canaveral Mean Tidal Level is slightly higher than the Lake Worth Pier Gauge. Therefore, the two gauge tidal levels were compared, and the interpolated tidal levels for the study area were calculated in Table 3. These interpolated values are used in the analyses of this report.

Tidal Gauge Data:

Elevations on NAVD88

Station: 8722670, Lake Worth Pier, Atlantic Ocean, FL

Status: Accepted (Sep 7 2017)

Units: Feet

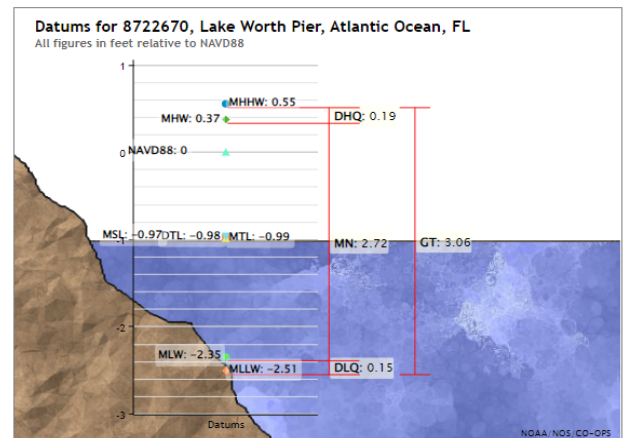
Control Station: 8721604 Trident Pier, Port Canaveral, FL

T.M.: 0

Epoch: 1983-2001

Datum: NAVD88

Datum	Value	Description
MHHW	0.55	Mean Higher-High Water
MHW	0.37	Mean High Water
MTL	-0.99	Mean Tide Level
MSL	-0.97	Mean Sea Level
DTL	-0.98	Mean Diurnal Tide Level
MLW	-2.35	Mean Low Water
MLLW	-2.51	Mean Lower-Low Water
NAVD88	0.00	North American Vertical Datum of 1988
STND	-32.50	Station Datum
GT	3.06	Great Diurnal Range
MIN	2.72	Mean Range of Tide
DHQ	0.19	Mean Diurnal High Water Inequality
DLQ	0.15	Mean Diurnal Low Water Inequality
HWI	0.54	Greenwich High Water Interval (in hours)
LWI	6.71	Greenwich Low Water Interval (in hours)
Max Tide	2.67	Highest Observed Tide
Max Tide Date & Time	09/21/2020 20:00	Highest Observed Tide Date & Time
Min Tide	-4.24	Lowest Observed Tide
Min Tide Date & Time	03/28/1971 00:00	Lowest Observed Tide Date & Time
HAT	1.73	Highest Astronomical Tide
HAT Date & Time	10/27/2011 12:48	HAT Date and Time
LAT	-3.43	Lowest Astronomical Tide
LAT Date & Time	01/31/2014 06:42	LAT Date and Time



Showing datums for

8722670 Lake Worth Pier, Atl...

Datum

NAVD88

Data Units Feet

Meters

Epoch Present (1983-2001)

Superseded (1960-1978)



Elevations on NAVD88

Station: 8721604, Trident Pier, Port Canaveral, FL

Status: Accepted (Aug 29 2018)

Units: Feet

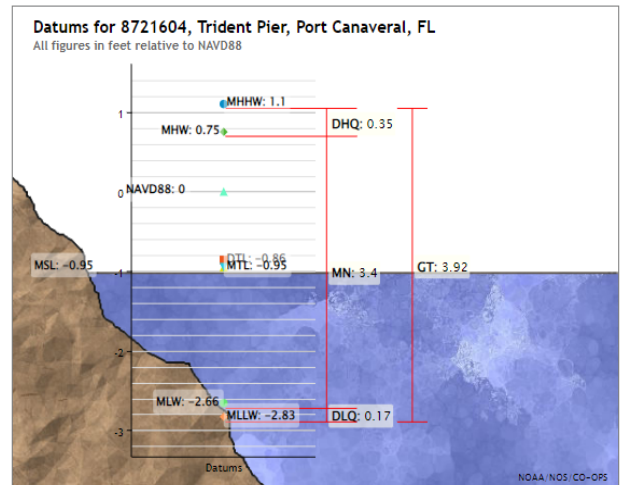
Control Station: 8720030 Fernandina Beach, FL

T.M.: 0

Epoch: 1983-2001

Datum: NAVD88

Datum	Value	Description
MHHW	1.10	Mean Higher-High Water
MHW	0.75	Mean High Water
MTL	-0.95	Mean Tide Level
MSL	-0.95	Mean Sea Level
DTL	-0.86	Mean Diurnal Tide Level
MLW	-2.66	Mean Low Water
MLLW	-2.83	Mean Lower-Low Water
NAVD88	0.00	North American Vertical Datum of 1988
STND	-20.83	Station Datum
GT	3.92	Great Diurnal Range
MN	3.40	Mean Range of Tide
DHQ	0.35	Mean Diurnal High Water Inequality
DLQ	0.17	Mean Diurnal Low Water Inequality
HWI	0.19	Greenwich High Water Interval (in hours)
LWI	6.37	Greenwich Low Water Interval (in hours)
Max Tide	5.08	Highest Observed Tide
Max Tide Date & Time	09/26/2004 09:36	Highest Observed Tide Date & Time
Min Tide	-4.71	Lowest Observed Tide
Min Tide Date & Time	01/12/2009 07:06	Lowest Observed Tide Date & Time
HAT	2.67	Highest Astronomical Tide
HAT Date & Time	10/28/2011 13:24	HAT Date and Time
LAT	-3.98	Lowest Astronomical Tide
LAT Date & Time	01/31/2014 06:24	LAT Date and Time



Showing datums for
 8721604 Trident Pier, Port C...

Datum
 NAVD88

Data Units Feet
 Meters

Epoch Present (1983-2001)
 Superseded (1960-1978)

Tidal Level Interpolations:

Table 3: Tide Gauge Level Interpolations

DATUM	NAVD88*	
INTERPOLATION DISTANCES		
DISTANCE FROM LW TIDE GAUGE TO PALM BEACH SHORES	15	MILES
DISTANCE FROM CANAVERAL TIDE GAUGE TO PALM BEACH SHORES	124	MILES
TOTAL DISTANCE BETWEEN TIDAL GAUGES	139	MILES
PALM BEACH SHORES % FROM LW GAUGE TO CANAVERAL GAUGE	10.79%	
HIGHEST OBSERVED TIDE INTERPOLATION (STORM SURGE ANALYSIS)		
LW MAX WATER LEVEL	2.67	Ft
CANAVERAL MAX WATER LEVEL	5.08	Ft
INTERPOLATED MAX TIDE LEVEL	2.93	Ft
HIGHEST ASTRONOMICAL TIDE INTERPOLATION (TIDAL ANALYSIS)		
LW HIGHEST ASTRONOMICAL TIDE	1.73	Ft
CANAVERAL HIGHEST ASTRONOMICAL TIDE	2.67	Ft
INTERPOLATED MAX ASTRONOMICAL TIDE LEVEL	1.83	Ft
MEAN HIGHER HIGH WATER TIDE INTERPOLATION (TIDAL ANALYSIS)		
LW MEAN HIGHEST HIGH WATER TIDE	0.55	Ft
CANAVERAL MEAN HIGHEST HIGH WATER TIDE	1.1	Ft
INTERPOLATED MEAN HIGHEST HIGH WATER TIDE LEVEL	0.61	Ft

*North American Vertical Datum of 1988; National Geodetic Survey

Sea Level Rise Scenarios:

This analysis projects future tidal flooding based on the increase of the maximum astronomical tide levels for the 2040 and 2070 projected sea level rise scenarios.

The NASA Interagency Sea Level Rise Scenario tool was used to obtain the sea level rise projections for the 2040 and 2070 Intermediate Low and Intermediate High Projections. The curves for the Virginia Key tide gauge are shown for 2040 in Figure 4, and for 2070 in Figure 5.

Sea Level Rise Scenarios to be implemented in analysis:

Intermediate Low:
2040: 0.23 m = 9 in, or 0.75ft
2070: 0.44 m = 17.3 in, or 1.44ft

Intermediate High:
2040: 0.27 m = 10.6 in, or 0.88ft
2070: 0.79 m = 31 in, or 2.58ft

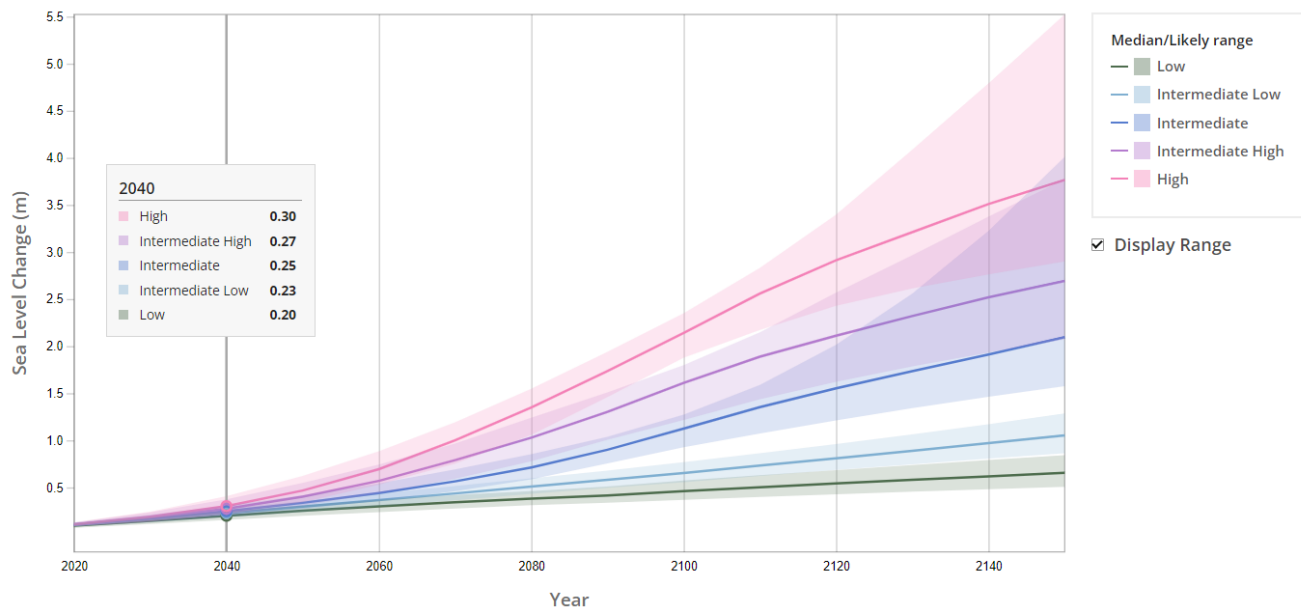


Figure 4: 2040 Sea Level Rise and Coastal Flood Hazard Scenarios and Tools Interagency Task Force 2022 technical report titled "Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities"

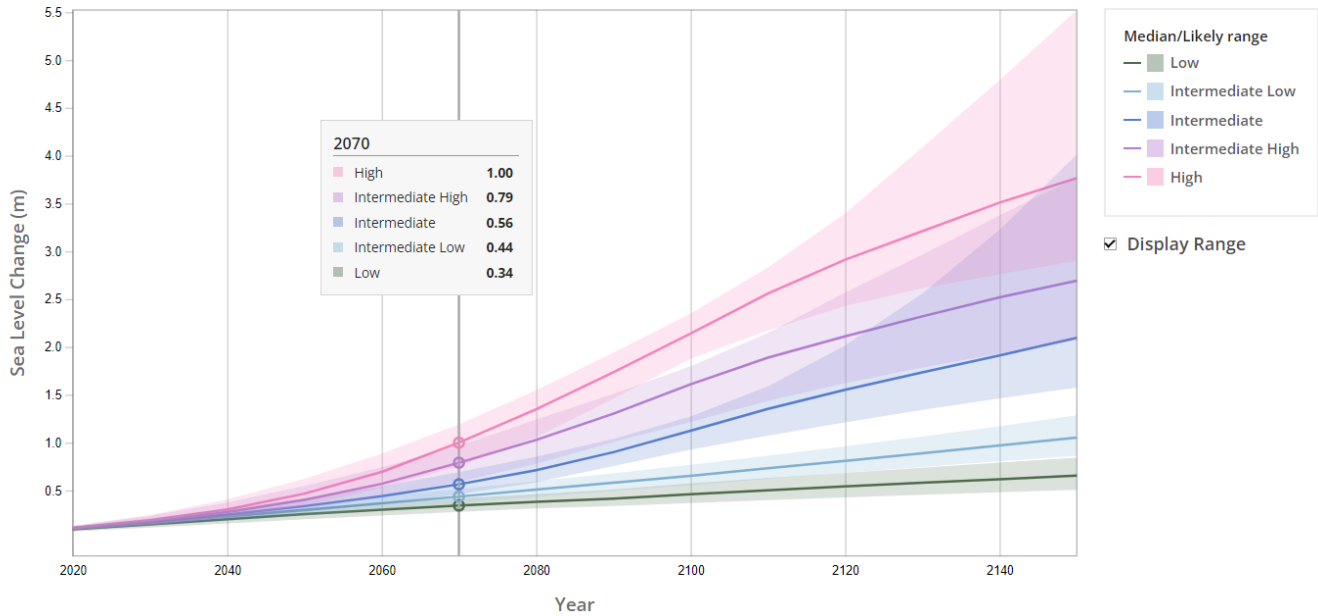


Figure 5: 2070 Sea Level Rise and Coastal Flood Hazard Scenarios and Tools Interagency Task Force 2022 technical report titled "Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities"

Field Data

A field visit was performed by FTC on 9/15/2022. During the field visit the flooding effects of an ongoing storm were observed. Mr. Alan Welch, the Palm Beach Shores Public Works Director was interviewed regarding his observations of historical flooding in the Town, and the ongoing mitigation efforts through the Town’s Stormwater Capital Improvement Program.

Figure 6 shows the main areas of concern that were discussed during the field visit, along with the Town’s major drainage structures and pipes. Areas with concerns for tidal flooding are shown in blue, and areas with concern for stormwater flooding are shown in red.

According to Mr. Welch, storm surge flooding at the southern shoreline of the island has had the highest impact on the Town. He has observed storm surge waves on the eastern part of the southern shoreline reach the second story of a coastal building, at an elevation of approximately 12 ft. Inlet Way, which runs parallel to the southern shoreline, varies in elevation from 3.5 to 7.2 NAVD. The 24 inch outfall that attenuates stormwater for inlet way has a tidal valve, and as such, tidal flooding is not a concern along Inlet way.

As evidenced in Figure 3, Palm Beach Shores Topographic Map, the eastern portion of the Town is located on a coastal ridge. Ocean Avenue varies in elevation from 5.3 - 8.3 NAVD, and the properties along Ocean Avenue are served by a robust stormwater collection system that terminates in a 42 inch outfall. Therefore, this area has been observed to not experience extenuated flooding during storm events and is not an area of high concern for the Town. It is recommended that the Town eventually install a tidal valve on this outfall, although it is not a high concern when compared to the Lake Drive outfalls.

The western shoreline of the Town has four outfalls. The outfall on Bamboo Lane has a tidal valve, and the outfall on Tacoma Lane will be installed by the end of the year. The Town plans to add a tidal valve to the outfall on Inlet Way and Lake Drive. This project is scheduled for FY 2024. It is recommended that the Town also install a tidal valve on the Blossom Lane outfall, as tidal flooding along Lake Drive is a critical concern for the Town. In addition, this area is much lower in elevation than the east side, and also experiences seasonal storm surge flooding. Lake Drive varies in elevation from 2.5 to 4.2 NAVD.

See Appendix for site visit photos.

Palm Beach Shores Areas of Concern



Figure 6: Tidal and Stormwater Flooding Areas of Concern

4. Vulnerability Assessment

Exposure Analysis

The elevation for each flood scenario, based on interpolated tide elevations and projected sea level rise is given in Table 4 shown below. These elevations were used to project the tidal flooding affected areas in Table 6.

Table 4: Flood Elevations for future Sea Level Rise Scenarios

Tidal Scenarios		Sea Level Rise Scenarios			
		2040		2070	
	Tide Elevations NAVD	Intermediate Low	Intermediate High	Intermediate Low	Intermediate High
INTERPOLATED MAX TIDE LEVEL	2.93	3.68	3.81	4.37	5.51
INTERPOLATED MAX ASTRONOMICAL TIDE LEVEL	1.83	2.58	2.71	3.27	4.41
INTERPOLATED MEAN HIGHEST HIGH WATER TIDE LEVEL	0.61	1.36	1.49	2.05	3.19

For this analysis, the 2040 Intermediate High and the 2070 Intermediate High Sea Level Rise projections added to the Maximum Astronomical Tide Level will give the **2040** projected maximum tide level of **2.71 ft** and the **2070** projected maximum tide level of **4.41 ft**.

Tidal Flooding

Ten years of Higher High Water tide gauge data were statistically analyzed to estimate the probability of different flood levels. These probabilities were then converted to statistical flood days. The relative sea level rise scenarios were then added to these elevations to obtain the number of flood days for contour elevations from 2 to 5 NAVD. Table 5 below summarizes the number of tidal flood days per scenario, and Figures 7, 8 and 9 show the number of flood days graphically.

Table 5: Number of Tidal Flooding Days by elevation for future projected Sea Level Rise Scenarios

Sea Level Rise Scenario	Elevation	# Of Tidal Flood Days
2040 Intermediate Low	3	5
	2	101
2040 Intermediate High	3	8
	2	132
2070 Intermediate Low	4	2
	3	47
	2	292
2070 Intermediate High	5	4
	4	71
	3	325
	2	365



Figure 7: 2040 Intermediate Low & Intermediate High Sea Level Rise Number of Tidal Flood Days



Figure 8: 2070 Intermediate Low Sea Level Rise Number of Tidal Flood Days



Figure 9: 2070 Intermediate High Sea Level Rise Number of Tidal Flood Days



Storm Related and Compound Flooding

The FEMA 100-year flood elevation is used for the projected compound flood scenario, and the FEMA 500-year flood elevation is used for the projected storm surge scenario. Figure 10 on the following page shows the projected 100-year FEMA flood plain elevation in blue, and the 500-year FEMA flood plain scenario in orange. The impacts of these flooding scenarios on the Town of Palm Beach Shores Critical Infrastructure are observed in the Sensitivity Analysis section of this report.

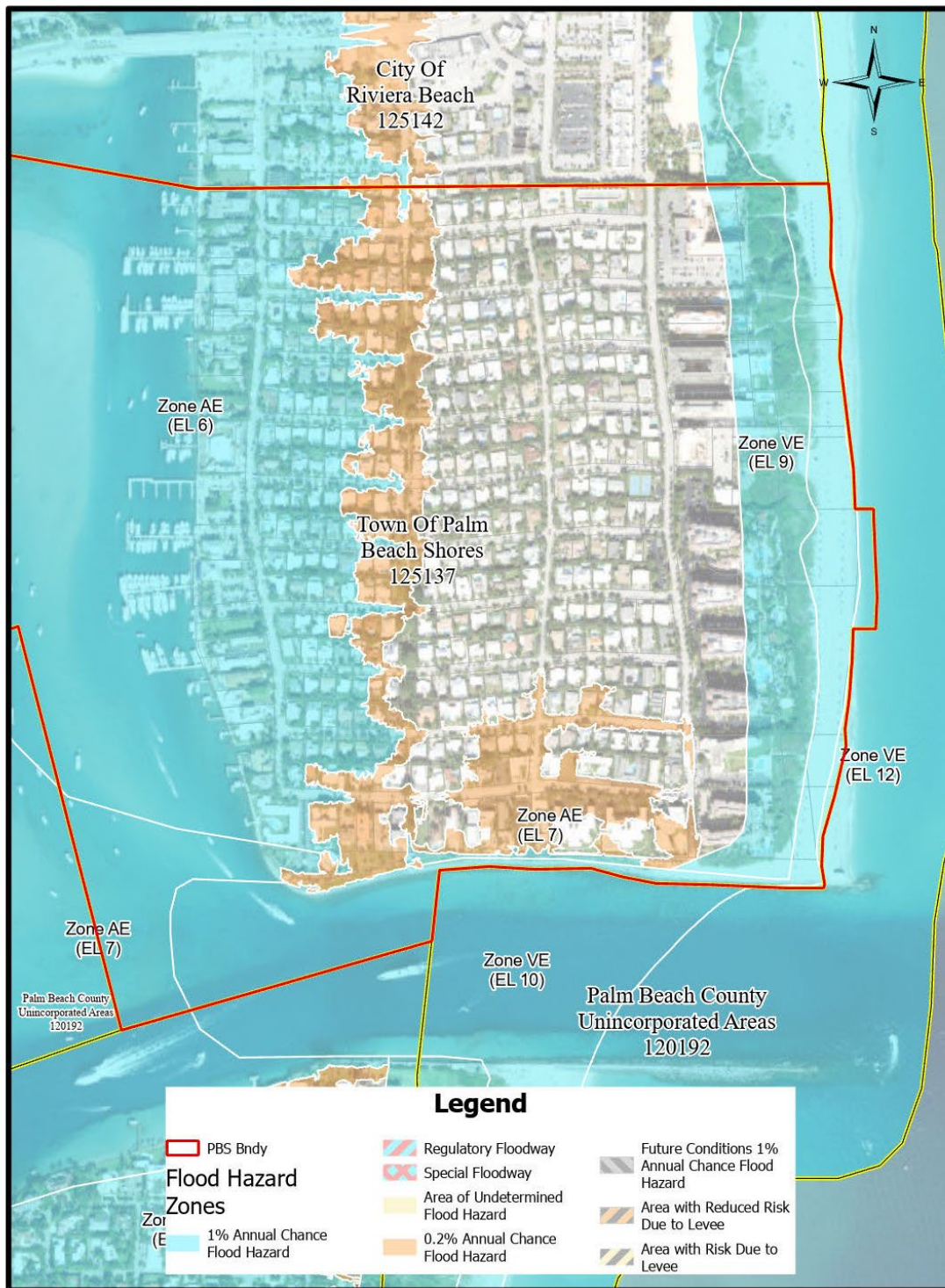


Figure 10: FEMA Flood Hazard Zone map



Sensitivity Analysis

The following maps show the Critical Infrastructure affected by the FEMA 100-year and 500-year storm events in Figure 11. The number of tidal flooding days impacting the Critical Infrastructure is shown in Figures 12, 13, and 14 on the following pages. The Critical Infrastructure affected by the FEMA 100-year and 500-year storm events are shown in Figure 11.

The criticality of these assets have been compared to the risk of inundation of these assets for the FEMA 100-year and 500-year compound flooding scenarios, and for the future high tide elevations for 2040 and 2070. The Critical Infrastructure affected by the tidal flooding events are shown in Figures 12, 13 and 14

These assets are prioritized based on their impact from the various the flooding scenarios, and on the criticality of the asset in Table 6.

As evident in the following figures, the most significant risk to the Town of Palm Beach Shores Critical Assets are the 100-year and 500-year FEMA Flood scenario inundations.



Figure 11: FEMA Flood Zones with Critical Facilities



Figure 12: 2040 Intermediate Low & Intermediate High Sea Level Rise Number of Tidal Flood Days with Critical Infrastructure



Figure 13: 2070 Intermediate Low Sea Level Rise Number of Tidal Flood Days with Critical Facilities

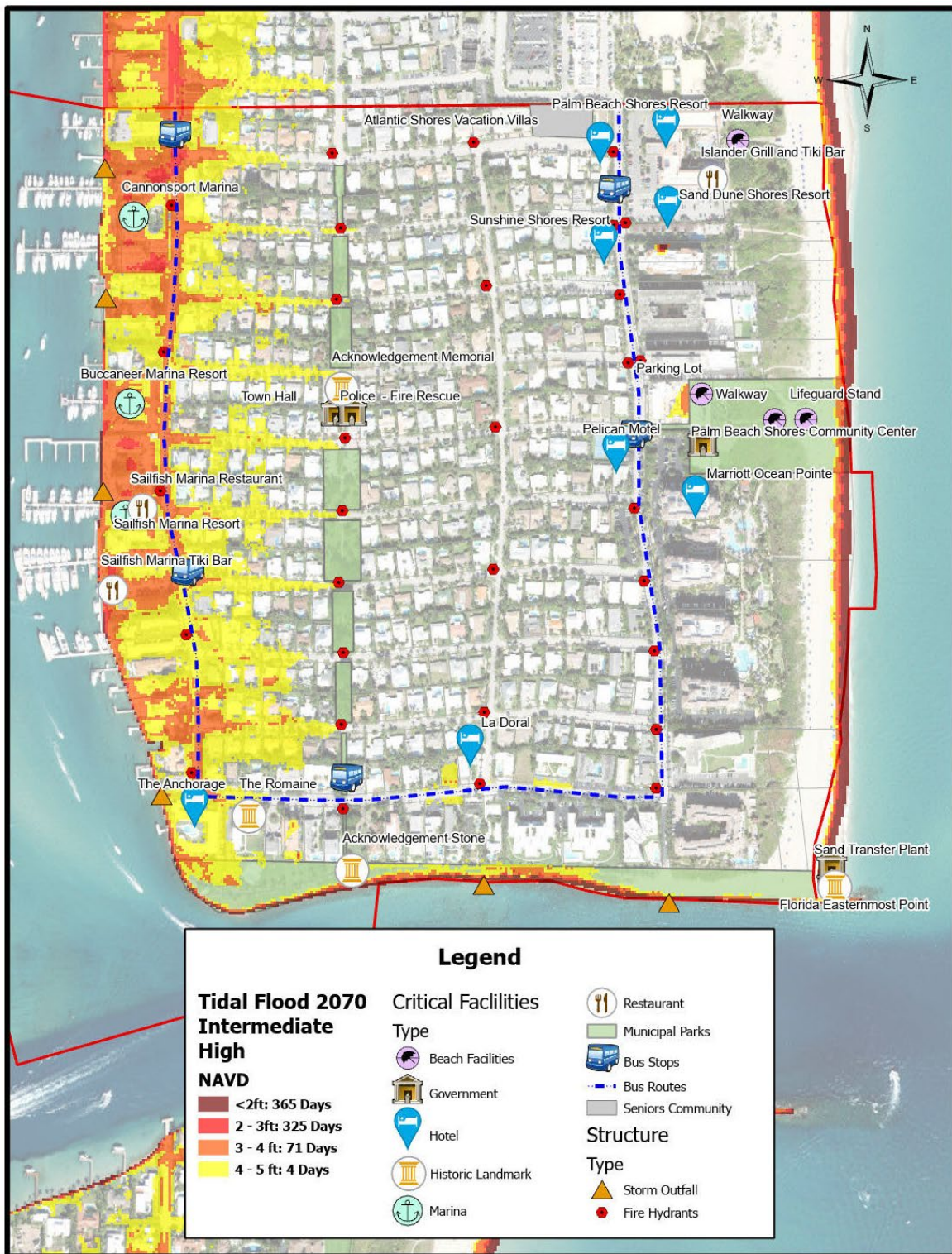


Figure 14: 2070 Intermediate High Sea Level Rise Number of Tidal Flood Days with Critical Facilities



Table 6: Priority Ranking of Affected Assets for Compound and Tidal Flooding Scenarios

Priority Ranking	Asset Type	Asset Name	Asset Elevation	Flood El 100 Yr Event	Flood Depth 100 Yr	Flood El 500 Yr Event	Flood Depth 500 Yr	Tidal Flooding 2040: El 2.71	Tidal Flooding 2070: El 4.41
1	Major Roadways	Lake Dr	2.5 - 4.2	6	2.65	7	3.65	0.21	1.91
2	Major Roadways	Inlet Way	3.5 - 7.2	N/A	N/A	7	1.65	N/A	0.91
3	Hotel	Buccaneer Marina	3.7	6	2.3	7	3.3	N/A	0.71
4	Hotel	Sailfish Marina Resort	4.3	6	1.7	7	2.7	N/A	0.11
5	Hotel	Marriott Ocean Pointe	8.8	9	0.2	9	0.2	N/A	N/A
6	Sand Trans. Plant	Reach 1 Transfer Plant	2	12	10	12	10	0.71	2.41
7	Lift Station	Edwards Lane & Lake Dr	4.9	6	1.1	7	2.1	N/A	N/A
8	Marina	Buccaneer Marina	2.9	6	3.1	7	4.1	N/A	1.51
9	Marina	Sailfish Marina	3.8	6	2.2	7	3.2	N/A	0.61
10	Marina	Cannonsport Marina	3.8	6	2.2	7	3.2	N/A	0.61
11	Government	Town Hall	5.7	6	0.3	7	1.3	N/A	N/A
12	Government	Fire / Police Station	6.7	N/A	N/A	7	0.3	N/A	N/A
13	Restaurant	Sailfish Marina	4	6	2	7	3	N/A	0.41
14	Restaurant	Sailfish Marina Tiki Bar	4.3	6	1.7	7	2.7	N/A	0.11
15	Outfall	Bamboo & Lake Dr	0.0	6	4.6	7	5.6	0.71	3.01
16	Outfall	Tacoma Ln & Lake Dr	0.0	6	4.6	7	5.6	0.71	3.01
17	Outfall	Blossom In & Lake Dr	0.0	6	4.6	7	5.6	0.71	3.01
18	Outfall	Lake Dr & Inlet Way	1.4	6	4.6	7	5.6	0.71	3.01
19	Outfall	Ocean Ave & Inlet Way	1.4	10	8.6	10	8.6	0.71	3.01
20	Outfall	Atlantic Ave & Inlet Way	1.4	10	8.6	10	8.6	0.71	3.01
21	Hotel	La Doral	6.7	N/A	N/A	7	0.3	N/A	N/A
22	Fire Hydrant	188 Lake Dr	3.2	6	2.8	7	3.8	N/A	1.21
23	Fire Hydrant	98 Lake Dr	3.5	6	2.5	7	3.5	N/A	0.91
24	Fire Hydrant	20 Lake Dr	3.8	6	2.2	7	3.2	N/A	0.61
25	Fire Hydrant	72 Lake Dr	4.2	6	1.8	7	2.8	N/A	0.21
26	Fire Hydrant	144 Lake Dr	4.4	6	1.6	7	2.6	N/A	0.01
27	Fire Hydrant	301 Sandal Ln	5.1	N/A	N/A	7	1.9	N/A	N/A
28	Fire Hydrant	201 Inlet Way	5.4	N/A	N/A	7	1.6	N/A	N/A
29	Fire Hydrant	301 Blossom	5.6	N/A	N/A	7	1.4	N/A	N/A
30	Fire Hydrant	301 Linda Ln	5.7	N/A	N/A	7	1.3	N/A	N/A
31	Fire Hydrant	300 Tacoma Ln	5.8	N/A	N/A	7	1.2	N/A	N/A
32	Fire Hydrant	Park Ave & Bamboo	5.9	N/A	N/A	7	1.1	N/A	N/A
33	Fire Hydrant	Tacoma Ln & Ocean Ave	5.9	N/A	N/A	7	1.1	N/A	N/A
34	Fire Hydrant	305 Claremont	5.9	N/A	N/A	7	1.1	N/A	N/A



Priority Ranking	Asset Type	Asset Name	Asset Elevation	Flood El 100 Yr Event	Flood Depth 100 Yr	Flood El 500 Yr Event	Flood Depth 500 Yr	Tidal Flooding 2040: El 2.71	Tidal Flooding 2070: El 4.41
35	Fire Hydrant	300 Cascade Ln	6.1	N/A	N/A	7	0.9	N/A	N/A
36	Fire Hydrant	Edwards Ln	6.1	N/A	N/A	7	0.9	N/A	N/A
37	Fire Hydrant	201 Linda Lane	6.2	N/A	N/A	7	0.8	N/A	N/A
38	Fire Hydrant	301 Linda	6.6	N/A	N/A	7	0.4	N/A	N/A
39	Bus Stop	Lake Dr @ Bamboo Ln	2.5	6	3.5	7	4.5	0.21	1.91
40	Bus Stop	Lake Dr @ Claremont Ln	4.1	6	1.9	7	2.9	N/A	0.31
41	Bus Stop	Inlet Way@ Parkway	6.6	6	N/A	7	0.4	N/A	N/A
42	Beach Facility	Lifeguard Stand #11	8.6	10	1.4	10	1.4	N/A	N/A
43	Beach Facility	Parking Lot	8.5	9	0.5	9	0.5	N/A	N/A
44	Parks	Inlet Park	3.8	10	6.2	10	6.2	N/A	N/A
45	Parks	Municipal Beach	9.2	10	0.8	10	0.8	N/A	N/A
46	Parks	Municipal Parkway	5.9 - 7.4	6	N/A	7	0.35	N/A	N/A
47	Landmarks	Acknowledgement Memorial	6.2	N/A	N/A	7	0.8	N/A	N/A
48	Landmarks	Acknowledgement Stone	5.4	6	0.6	7	1.6	N/A	N/A
49	Landmarks	Florida Easternmost Point	2	12	10	12	10	0.71	2.41

5. Conclusion and Recommendations

Based on the critical infrastructure assessment and field observations, FTC offers the following flooding mitigation recommendations to the Town of Palm Beach Shores.

1. Tidal flooding impacts can be mitigated with the addition of tidal valves on all ocean outfalls that do not currently have one.
2. The sea walls constructed along the marinas and hotels on Lake Drive can be elevated to reduce the impacts of future tidal flooding. It is recommended that these walls be set to a minimum elevation of the 40 year Intermediate High projected tidal flood elevation of approximately 3ft NAVD.
3. The Public Works Department should continue the capital plan to reduce localized flooding by grading and maintaining swales located within the public right of way for stormwater conveyance and retention. The use of pea gravel, or #57 stone, wrapped in filter fabric should continue to be installed below grade to reduce flooding impacts by increasing both storage volume and the transmissivity rate of stormwater.
4. The Lift Station located on Edwards Lane & Lake Dr should have a wet well rim elevation set to a minimum of the 100 year FEAM Flood Elevation of 6 NAVD.
5. Further analysis should be performed on the Sand Transfer station, as it is in a highly vulnerable location.
6. The Town of Palm Beach Shores Public Works Department should continue to work with the Army Corps of Engineers to reduce future storm surge on the southern and southwest side of the island. These areas are highly susceptible to any inlet dredging and impacts to the Critical Facilities located adjacent to the inlet as a result of any future dredging should be fully analyzed.

Appendix

Field Visit Photos 9/15/22



















