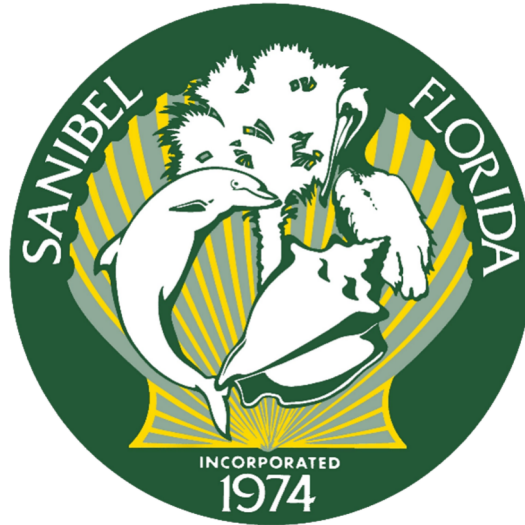


Surface Water Management Master Plan Update Following Hurricane Ian (2022)

Prepared For:



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TABLE OF CONTENTS

EXECUTIVE SUMMARY	ii
1.0 INTRODUCTION	1
2.0 DATA COLLECTION, RESULTS, AND DISCUSSION	5
3.0 SURFACE WATER MANAGEMENT DAMAGES POST-HURRICANE IAN	29
4.0 SURFACE WATER MANAGEMENT RESILIENCY	30
5.0 CONCLUSIONS AND RECOMMENDATIONS	38
6.0 CAPITAL IMPROVEMENT PLAN	44
7.0 REFERENCES	51

EXHIBITS

1. Topographic Map of Sanibel
2. Topographic Map of Sanibel Interior
3. Surface Water and Surficial Aquifer Monitoring Well Locations
4. Road Elevation Map (Existing Public Roads)
5. FEMA Flood Depth Map at 100-year Event (2022 Publication Date)
6. FEMA Coastal Flood Hazard Analysis 2022 Stillwater Flood Depth Map 50-Percent-Annual-Chance Storm Surge
7. FEMA Coastal Flood Hazard Analysis 2070 Projected Stillwater Flood Depth Map 50-Percent-Annual-Chance Storm Surge
8. Sample Location Map

APPENDIX

Appendix A	Water Levels of Freshwater Basins – July 2024 to August 2025
Appendix B	Hydrologic & Hydraulic Analysis of the Sanibel River System
Appendix C	ICPR Model – Existing Condition – 2100 MSL
Appendix D	Public Workshop Summary and Public Comments
Appendix E	Public Workshop Display Boards

SUPPLEMENTARY REPORTS

Drainage Features Map Book by Johnson Engineering, LLC, 2025.

EXECUTIVE SUMMARY

Sanibel is a barrier island located on Florida's Gulf Coast in Lee County, near the mouth of the Caloosahatchee River. Since its incorporation in 1974, the City of Sanibel (City) has successfully prioritized environmental preservation and regulated development to coexist with nature (Sanibel 2005 Comprehensive Floodplain Management Plan). As a result, two-thirds of the island is protected as conservation land, including a valuable interior freshwater wetlands ecosystem.

Since incorporation, the City has dramatically improved the rainfall-based stormwater management system island-wide. Hurricanes in 2022 and 2024 provided a recent reminder that most of the island is low and vulnerable to storm surge, which is a flooding event that is independent of the conveyance capacity of the interior surface water management system. Topographic maps of the island (see **Exhibit 1** and **Exhibit 2**) show that most of the island is below elevation 4 feet North American Vertical Datum of 1988 (NAVD 88) and developed areas generally range from 4 feet to 8 feet NAVD 88. After Hurricane Ian, USGS recorded water levels which varied across the island from 8 feet to 13 feet NAVD 88.

Sanibel contains two large freshwater basins which outfall to Pine Island Sound to the north via water control structures. Each water control structure also includes operable gates which can be opened to allow additional flow out of the basins upstream, in accordance with the City's 1994 Weir Control Policy. The surface water management system for Sanibel has a dual mandate of environmental protection and flood mitigation. The island's water control structures are integral in the protection of the upstream freshwater ecosystem. Mammals (Sanibel Island rice rat, hispid cotton rat, marsh rabbit, and river otter), reptiles (chicken turtle, Florida mud turtle, Florida water snake, American crocodile), amphibians (green treefrog, pig frog), birds (white ibis, roseate spoonbill, great egret, great blue heron, wood stork, little blue heron, limpkin, tri-colored heron, green heron, black-bellied whistling duck, common moorhen, black-necked stilt), and freshwater fish (mosquito fish [very important for mosquito control], sailfin molly, flagfish, least killifish) all rely on Sanibel's interior wetlands for habitat. At least 46 species beyond those listed here also inhabit the interior wetlands. However, the potential for sea level rise over the City's next 50 years adds another layer of complexity to management of the system.

When Hurricane Ian made landfall in late September 2022 it caused the island to be overtopped with storm surge and led to saltwater contamination of freshwater ponds and wetlands. In the

months following Hurricane Ian, there was significant vegetation loss and a general sense amongst residents that the island's hydrology changed.

One of the goals of this report is to review current and historical data to identify whether changes have occurred to the island's internal hydraulics or hydrology. Also included is a review of sea level rise projections and how the island's stormwater management system may be impacted. Finally, extensive field inspection efforts have been performed to inspect the City's drainage conveyance elements for sedimentation and refine the City's stormwater management mapping.

Water level monitoring sensors were installed in 14 locations throughout the island in 2024. These installations supplement two existing monitoring stations and USGS well L-1403. The east and west basins generally act as a level pool and runoff is efficiently conveyed to the Sanibel River, as designed. West Gulf Drive was identified as one of the "flood prone areas" which do exist across the island, but overall, the observed data indicates that Sanibel's primary stormwater management infrastructure is operating as intended.

The system is still operating similarly to observations in 1953. Little to no deep percolation is occurring, which is consistent with *The Sanibel Report* (1976). Deep percolation losses from the interior freshwater basins to the ocean have always been considered negligible on Sanibel. It is recommended that the 1988 map of maximum water levels in 1977 be utilized as a guide for new development on Sanibel, but not in locations where groundwater is tidally influenced. In those locations, the South Florida Water Management District's current minimum wet season water table/control elevation be used instead.

One method of quantifying vegetation greenness and monitoring plant health is the Normalized Difference Vegetation Index (NDVI), which can be calculated for an area using multispectral imagery. Long-term average NDVI values for Sanibel before and after Hurricane Ian in 2022 show the hurricane clearly had a tremendous impact on plant life. The initial drop in NDVI just after Ian was about 0.3. Throughout 2023 and 2024, NDVI increased and began to approach pre-Ian levels, but this recovery was reversed in the aftermath of hurricanes Helene and Milton in 2024. However, the island's vegetation is quickly rebounding and appears to be on track to return to pre-Helene levels this year.

Most of the water leaving the interior basins on Sanibel has historically done so through evapotranspiration, a process inherently tied to plants. The expectation was that following Hurricane Ian and the associated vegetation changes, water levels would decline more slowly than

before the hurricane due to a reduction in ET caused by plant stress. This was true for most post-Ian periods of analysis at Beach Road Weir except for late 2023, where water level decline rates exceeded pre-Ian conditions. Analysis of surface water decline rates in 2024 and 2025 at locations across the island confirms that ET is occurring within the interior basins but does not offer the same comparison of pre- and post-storm conditions due to a lack of available data before Hurricane Ian. A notable observation is the difference in minimum annual water levels seen at both weirs in recent years. Increases ranged from about 4 to 12 inches, likely due to reduced ET. Overall, it seems likely that water levels will recover alongside vegetation on the island.

Sanibel's water control structures for the interior freshwater basins include sluice gates that can be opened to allow additional flow out of the basins under certain conditions, as outlined in the City's Weir Control Policy adopted in 1994 (Policy). The Policy allows the gates to be opened under any one of four conditions, and the stated objective of the Policy is "to attempt to retain as much fresh surface water on the island as possible ... for the environmental benefit of the island's Interior Wetlands System, so long as developed areas are not adversely impacted." The interior wetlands serve as freshwater reservoirs for the island, helping to conserve water by mitigating saltwater intrusion, recharging the underground freshwater lens, reducing mosquito populations, and reducing exotic plant species that outcompete native vegetation. As stated in the 1987 *Surface Water Management* report by Johnson Engineering, compromising the interior wetlands would be an environmental disaster. Recent observations following significant rain events on the island show that the primary surface water management system efficiently conveys runoff to the interior Sanibel Slough and flooding does not occur when water levels are at or below the weir crest elevations. Therefore, this Policy should be continued for as long as possible when there is the presence of freshwater in the west basin. Long-term reductions in stage below the weir crest elevation will impact upstream wetlands (which will require extensive permitting and mitigation), increase the risk of wildfires, compromise the shallow aquifer (freshwater lens), and increase mosquito populations.

However, it is recommended that the City expedites the removal of brackish water from the basins. The minimum water level of freshwater inside the basins should always be at least six inches higher than sea level. If this does not happen, the freshwater lens under Sanibel is at risk of being compromised. Sea level fluctuates during the year and was as high as 1 foot NAVD 88 in September 2024. An analysis of precipitation, evaporation, ET, and 10-year average monthly sea levels shows that the freshwater lens is at risk of being compromised during the dry season if the

basin water levels are held below the weir crest elevation on October 1. Careful coordination should also be conducted with the Lee County Mosquito Control District if drastic water level fluctuations are occurring within the basins so that mosquito populations do not become overwhelming.

An additional 820 culverts and 2,220 swales were added to the City's records. An updated **Drainage Features Map Book** includes these features. Field inspection efforts found sedimentation issues at 658 drainage structures, inside 19,400 linear feet of culverts, and 24,200 linear feet of roadside swales.

It is notable that five of the highest ten records at the Fort Myers tide gauge have occurred during the past three wet seasons. Inundation mapping shows that minimal flooding occurs in developed areas on Sanibel during the 2-year storm surge event. This report recommends a minimum road elevation of 4.3 feet NAVD 88 for all new roadways. Based on the Intermediate-High curve, significant road base failure is expected for up to 7% of public roadways (4.3 miles) by 2050. In the Intermediate-Low scenario, all roads would be protected if raised to a minimum elevation of 4.3 feet NAVD 88. The Intermediate-High projection shows the 100-year storm today will have a 25-year frequency in 2070.

Regular overtopping of the crest of both weirs has already begun. Measurements clearly indicate that saltwater is regularly entering both basins, though it has historically been flushed out by rainwater shortly thereafter. After Hurricane Ian (2022), conductivity levels peaked and remained consistently above pre-hurricane levels until summer 2024, showing how long it takes the interior basins to recover to freshwater conditions following such a surge event. Conductivity levels spiked again at the end of the 2024 hurricane season, but, due to heavy rainfall in 2025, have now recovered to freshwater conditions. Adding a backflow prevention flap gate at Tarpon Bay Weir and increasing the height of the existing flap gate at Beach Road Weir would be beneficial in reducing saltwater intrusion into the east basin from monthly high tides and minor storm surge events.

Several Capital Improvement Projects are recommended to reduce saltwater intrusion, expedite post-storm recovery efforts, mitigate the effects of projected sea level rise, and improve drainage in flood-prone areas within the City. Proposed projects include flap gates for the weirs, area specific drainage projects, box culvert replacements, and sluice gate automation. Analyses were also performed on the addition of pump stations and increasing roadway elevations.

SECTION 1 – INTRODUCTION

Sanibel is a barrier island located on Florida’s Gulf Coast in Lee County, near the mouth of the Caloosahatchee River. Since its incorporation in 1974, the City of Sanibel (City) has successfully prioritized environmental preservation and regulated development to coexist with nature (Sanibel 2005 Comprehensive Floodplain Management Plan). As a result, two-thirds of the island is protected as conservation land, including a valuable interior freshwater wetlands ecosystem. As the City recently celebrated its 50th anniversary, this update of the surface water management master plan will serve as a guide for the City’s next 50 years by establishing long-range strategies focused on flood mitigation, resiliency, and adaptation to sea level rise.

Sanibel’s surface water management system is designed to retain freshwater whenever possible. The goal is not for surface water to drain out – instead, the island’s wetlands are allowed to fill up until they overflow into the ocean. Draining too much freshwater from the wetlands would cause saltwater intrusion and harm existing freshwater ecosystems.

Flooding is a weather-related natural disaster typically caused by heavy rainfall (also termed riverine flooding), tropical storm surge, inadequate drainage, or a combination of these factors. Since incorporation, the City has dramatically improved the rainfall-based stormwater management system island-wide. Steps taken include rebuilding water control structures, replacing undersized culverts, and updating the land development code. Comparing recent accounts with those from the 1970s shows that the depth and duration of rainfall-based flooding has greatly improved over the past 50 years.

Hurricanes in 2022 and 2024 provided a recent reminder that most of the island is low and vulnerable to storm surge, which is a flooding event that is independent of the conveyance capacity of the interior surface water management system. Topographic maps of the island (see **Exhibit 1** and **Exhibit 2**) show that most of the island is below elevation 4 feet North American Vertical Datum of 1988 (NAVD 88) and developed areas generally range from 4 feet to 8 feet NAVD 88. The 2022 Hurricane Ian Flood Event Mapping by USGS recorded water levels which varied across the island from 8 feet to 13 feet NAVD 88. Peak water levels recorded at the National Oceanic and Atmospheric Administration (NOAA) Tide Station 8725520 in Fort Myers were 5.4 feet NAVD

88 for Hurricane Helene and 5.5 feet NAVD 88 for Hurricane Milton. Over the course of Sanibel’s history, hurricane storm surge has wholly inundated the island with saltwater multiple times, though these events have been separated by prolonged periods of relative calm (*The Sanibel Report*, 1976).

Sanibel contains two large freshwater basins – the 2,020-acre Sanibel River West Basin and the 1,240-acre Sanibel River East Basin. They are 50% freshwater wetlands by area. Both basins are verified as impaired by the State of Florida due to high nutrient levels and low dissolved oxygen levels, and each has been assigned a Total Maximum Daily Load (TMDL) for these pollutants. The City is responsible for managing water quality on Sanibel, and the City’s impaired waterbody is also its primary stormwater system, so managing not only stormwater quantity but also quality is necessary. The two basins are separated by Tarpon Bay Road and serve as freshwater reservoirs for the island. The surrounding roads serve as the rims of the reservoirs, and stormwater runoff generally flows west to east within each basin. Each basin outfalls to Pine Island Sound to the north via water control structures. Tarpon Bay Weir is the primary outfall of the west basin and has a crest elevation of 2.0 feet NAVD 88. The east basin outfalls through Beach Road Weir which has a weir crest elevation of 1.5 feet NAVD 88 as well as a one-foot flap gate to prevent backflow from surge events up to 2.5 feet NAVD 88. An internal weir, Tarpon Bay Road Weir, creates a hydraulic connection between the two basins and has a weir crest elevation of 2.3 feet NAVD 88. Each water control structure also includes operable gates which can be opened to allow additional flow out of the upstream basins, in accordance with the City’s 1994 Weir Control Policy. This includes instances when the gates are opened proactively (ahead of a known storm event) to create capacity in the Sanibel Slough and allow easier management of extreme rainfall events. (The gates do not need to be opened ahead of storm surge events.) The primary limitation to flow out of the gates when opened is the level of the sea, as there are times when high tides or storm surges do not allow flow out of the freshwater basins.

The surface water management system for Sanibel has a dual mandate of environmental protection and flood mitigation. The 1953 report *The Water Table on Sanibel Island* stated that “the aim of water management on such an island [as Sanibel] should be to maintain as high a water table as is consistent with land usage while at the same time providing for the quick escape of excess water.” This is a delicate balance for any stormwater management system but is particularly challenging

on Sanibel given the island's low ground elevations. The potential for sea level rise over the City's next 50 years adds another layer of complexity to management of the system.

Maintaining elevated water levels internally helps to conserve freshwater by mitigating saltwater intrusion, recharging the underground freshwater lens, reducing mosquito populations, minimizing fire risk, and reducing exotic plant species that outcompete native vegetation. The 1987 *Surface Water Management* report by Johnson Engineering, Inc., for the City of Sanibel commented that protection of freshwater on the interior of the island is necessary to protect Sanibel's native flora and fauna and that water in the interior wetlands should be maintained, "as fresh as practicable." The report also mentioned that removal of the water control structures at Tarpon Bay and Beach Road would be an environmental disaster, decimating the groundwater table, allowing saltwater intrusion, and converting the freshwater system into a saltwater one.

Minimizing discharge from the weirs helps to reduce the release of nutrients into the surrounding impaired tidal waters. It is in the interest of all to minimize nutrient pollution in the waters so important for tourism and recreation.

When Hurricane Ian made landfall in late September 2022 it caused the island to be overtopped with storm surge and led to saltwater contamination of freshwater ponds and wetlands. The 1953 report on the water table mentioned that large hurricanes can submerge the island and, if not accompanied by heavy rains, drastically affect the vegetation and salinity of the island's interior soils and groundwater. In the months following Hurricane Ian, there was significant vegetation loss and a general sense amongst residents that the island's hydrology changed.

One of the goals of this report is to review current and historical data to identify whether changes have occurred to the island's internal hydraulics or hydrology. Also included is a review of sea level rise projections and how the island's stormwater management system may be impacted. Finally, extensive field inspection efforts have been performed to inspect the City's drainage conveyance elements for sedimentation and refine the City's stormwater management mapping.

Previous studies and reports conducted for the City referenced elevations to the National Geodetic Vertical Datum of 1929 (NGVD 29). For this report, the datum will reference the more recent NAVD 88, which is also consistent with State of Florida agencies and the current flood maps

published by the Federal Emergency Management Agency (FEMA). Comparing the two datums for Sanibel results in the following:

- West of Tarpon Bay Road: 0.00 feet NAVD 88 = 1.18 feet NGVD 29
- East of Tarpon Bay Road: 0.00 feet NAVD 88 = 1.17 feet NGVD 29

SECTION 2 – DATA COLLECTION, RESULTS, AND DISCUSSION

Residents of Sanibel report a common belief that the island’s hydrology has changed following Hurricane Ian in September 2022, with interior freshwater stages seeming higher during the dry season and water levels receding more slowly than they did in the past. Extensive data collection and review was undertaken in 2024 to investigate this claim and search for underlying trends. The data review also estimated the potential benefits of a modified weir policy.

2.1 Surface Water Level Monitoring

To capture how water levels vary across the island and how they respond to rainfall, recovery, and tropical storm surge events, water level monitoring sensors were installed in 14 locations throughout the island in the second half of 2024. The placement strategy of the new sensors was to: have one sensor for each freshwater subbasin identified in the 2018 Stormwater Master Plan, line up with a former U.S. Geological Survey (USGS) monitoring well location from the 1970s, and that the equipment not be installed on private property. As shown in **Exhibit 3**, many monitoring locations were able to satisfy all three requirements, though compromises had to be reached in a few locations. Johnson Engineering, LLC., installed ten (10) pressure transducers, identified as “JE Level Station 2024” on the exhibit. The Sanibel Captiva Conservation Foundation (SCCF) installed four automated monitoring systems, with radar water level sensors, tipping bucket rain gauges, and cellular connectivity. These installations supplement the two existing SCCF monitoring stations upstream of Tarpon Bay Weir (installed 2015) and Beach Road Weir (installed 2015), and USGS well L-1403 which was installed in the early 1970s.

Graphs of the data collected by the monitoring equipment since installation are provided in **Appendix A**. The graphs show that the east and west basins generally act as a level pool and runoff is efficiently conveyed to the Sanibel River, as designed. Overall, the observed data indicates that Sanibel’s primary stormwater management infrastructure is operating as intended. Some location-specific comments are:

West Gulf Drive and Murex Lakes Community: Locations JE 2124 and JE 2125 installed surrounding this neighborhood in Basin 4 recover very slowly, closely matching the rate of evapotranspiration (ET) typical for Sanibel (2.4 inches per week in early September and 1.4 inches per week in late October / early November). This confirms that ET is still occurring

on Sanibel despite the inland freshwater areas being inundated with saltwater. These rates are also within the ranges observed within Sanibel’s interior swales in the 1953 report *The Water Table on Sanibel Island*, which were 1.1 inches to 2.6 inches per week, showing that the system is still operating similarly to past observations. The rate of recovery shown in the graphs for JE 2124 and JE 2125 suggests little to no deep percolation is occurring in this location, which is consistent with the water budget presented in *The Sanibel Report* (1976) and discussed further in **Section 2.2**. The graphs for JE 2124 and JE 2125 also indicate that runoff to the interior Sanibel River occurs when water in the roadside swale is above elevation 2.9 feet NAVD 88, but not below this elevation. The subbasins throughout the island fill up and then overflow after enough rain, which is illustrated in these graphs. These observations fit well with Figure 2 of the 2018 Stormwater Master Plan, with this location being within one of the “City-identified flood prone areas” on the map. Given the distance between this area and Tarpon Bay Weir, opening the gates to lower the water level in the Sanibel River is not anticipated to significantly improve water level recovery following a storm. A potential solution for this area would be to install roadside swales and culverts along West Gulf Drive, and connect to the existing drainage ditch on the east side of Rabbit Road. The total length of additional improved swales and culverts would be approximately 2,700 feet.

Casa Ybel Road and Algiers Lane: Monitoring well location JE 2127 in Basin 5a was installed in a roadside retention swale that is immediately adjacent to a drainage ditch. The graph for this well shows that it has a slower rate of recovery than the downstream monitoring locations, which is typical for retention areas. Analyzing the graph during a dry period in October shows it recovering at a rate of 7.2 inches per week, far exceeding the recovery rates observed at JE 2124 and JE 2125. Removing the estimated evapotranspiration rate of 1.4 inches per week shows that the retention area recovered at a rate of 5.8 inches per week. This indicates that when retention areas on Sanibel are adjacent to a receiving ditch, the areas are recovering (and functioning) as designed following rainfall events.

Sanibel East Basin: Water level monitoring sensors were placed by SCCF at the Tarpon Bay Road weir and Beach Road weir, which are the west and east limits of the east basin. The graphs in **Appendix A** of SCCF data collected in 2024 show the water levels at these

two locations are nearly identical and remained so through rainfall, storm surge, and gate operation events, despite being nearly 3 miles apart from one another. This provides strong reassurance that the primary stormwater management infrastructure in Sanibel's east basin is functioning as intended. An interesting observation for the east basin is that the water levels changed very little and were nearly flat in late October and early November 2024, a dry period following Hurricane Milton. This correlates with resident observations that something in the hydrology of Sanibel changes following a storm surge event. Likely factors are reduced ET due to widespread loss of vegetation, upland areas continually draining into the central conveyance (as observed at JE 2127), percolation being de minimis for the interior wetland systems on Sanibel (consistent with discussions previously and in **Section 2.2**), and mean sea level being a foot and a half or more below the overflow weir crest (additional supporting evidence that percolation to tide is not occurring in the east basin). And, because of the loss of vegetation that previously blocked views into inundated areas (i.e., wetlands), standing water is more visible to residents post-storm. As a result, residents may come to associate the short-term hydrologic change that occurs immediately following a surge event with the visible standing water they see months or years afterward, although this water has always been present. Gate operation events in mid-November reduced the water level throughout the basin by half of a foot, and the water in the basin remained at that level throughout the month that followed. This verifies that operation of the gates is an effective way to reduce water levels in the Sanibel east basin.

However, it is also worth noting that the minimum annual water levels at Beach Road Weir have been higher in the three years following Hurricane Ian than they were in previous years. This finding is discussed in further detail in **Section 2.2**.

Sanibel West Basin: Graphs for water level monitoring sensors JE 2121 and JE 2126, placed at the west and east limits of the west basin, show water levels across the basin are nearly identical and remained so through rainfall and storm surge events, despite being separated by a distance of 4 miles. In early September 2024, the gates on Tarpon Bay Weir were opened for about two days, which lowered the water level upstream of the weir by a foot (lowering below this elevation was inhibited due to sea level). The west end of the basin showed a delayed recovery, with water levels dropping by a half of a foot after two days. Based on

this, it can be extrapolated that the west end would drain down and be nearly equal to the east end after four days. This is within the range of expectations for the stormwater management system, given the distance between the ends of the basin, there being a wetland slough separating them, and summer storms occurring before and during the gate opening event. The data and observations provide strong reassurance that the primary stormwater management infrastructure in the west basin of Sanibel is operating well.

Like Beach Road Weir, Tarpon Bay Weir has seen an increase in minimum annual water levels in the three years since Hurricane Ian. This is discussed in greater detail in **Section 2.2** of this report.

Table 1 reproduces the results of a water table data collection effort by the USGS in the 1970s. Maximum annual water table levels at several well locations were recorded for the years 1971-1977. The 1977 results were used to create a wet season water table map of Sanibel, which was published in 1988 to serve as a guide for prospective new residential development. The 2024 water level monitoring graphs in **Appendix A** include the 1977 maximum water levels of the nearest USGS well(s). Comparing the two, it is evident that the surface water levels in the interior basins are near the weir crest elevations and the groundwater levels are similar to those recorded in 1977. It is recommended that the 1988 map of maximum water levels in 1977 be utilized as a guide for new development within the freshwater basins. However, in locations outside of the interior basins, where groundwater is tidally influenced, it is recommended that the South Florida Water Management District's current minimum wet season water table/control elevation be used instead.

Table 1. Maximum water levels for the water table aquifer for Sanibel Island, 1971-1977 (freshwater basins only).

Well Number	Maximum Water Levels for Water-Table Aquifer, 1971-1977, USGS, Sanibel Island, FL (feet NAVD 88)						Current Basin Control Elev.
	1971	1972	1974	1975	1976	1977 ¹	
L-1403	2.18	2.42	2.45	2.05	1.82	2.55	1.5
L-1405	1.76	2.36	1.33	0.08	0.71	2.26	1.5
L-1411	1.66	2.11	1.27	0.88	0.82	2.24	1.5
L-1412	2.27	2.61	1.99	1.23	1.49	2.61	1.5
L-1414	1.97	2.08	1.86	0.42	0.80	2.15	2.0/1.5
L-1415	1.89	2.04	1.66	0.60	0.66	2.37	1.5
L-1416	1.89	2.78	1.47	0.12	0.44	2.43	1.5
L-1451	1.49	2.41	1.4	0.77	0.82	2.65	1.5
L-1453	1.66	2.64	1.22	0.7	0.62	2.72	1.5
L-1455	1.07	1.68	1.44	0.66	0.8	2.38	1.5
L-1459	2.21	2.86	2.27	1.52	1.71	2.89	1.5
L-1476	0.99	0.92	0.83	0.43	0.28	1.74	2.0
L-1478	1.36	0.87	0.62	0.42	0.34	1.64	2.0
L-1480	1.07	0.68	0.77	0.31	0.46	2.18	2.0
L-1482	1.67	1.09	1.33	0.06	0.95	2.2	2.0
L-1494	1.68	0.92	1.11	0.41	0.67	2.99	2.0
L-1497	1.25	0.45	0.79	0.53	0.65	2.87	2.0
L-1499	1.58	0.87	1.27	0.28	0.5	2.94	2.0
L-1501	1.96	1.11	1.89	0.49	0.93	2.63	2.0

1. Water levels from 1977 were used to create the Wet Season Water Table map for Sanibel, published in 1988.

2.2 Water Budget and the Normalized Difference Vegetation Index

A water budget estimates the quantities of water entering and leaving a system. Inflows often include precipitation, treated wastewater effluent, incoming surface water runoff from adjacent watersheds, and groundwater inflow. Outflows include runoff, groundwater outflow (percolation), open water evaporation, soil evaporation, and transpiration from plants. In vegetated areas, the last two components are often reported together and are referred to as evapotranspiration (ET). Inflows and outflows are typically equal when looking at a water budget on an annual basis, unless there was a change in storage within the basin. Sanibel generally does not have changes in storage from year to year. In *The Sanibel Report* (1976), an average annual water budget was created for the

interior wetland areas of Sanibel. This water budget is still valid today. A cross section of the island is provided in **Figure 1** to serve as a pictorial representation of the water budget.

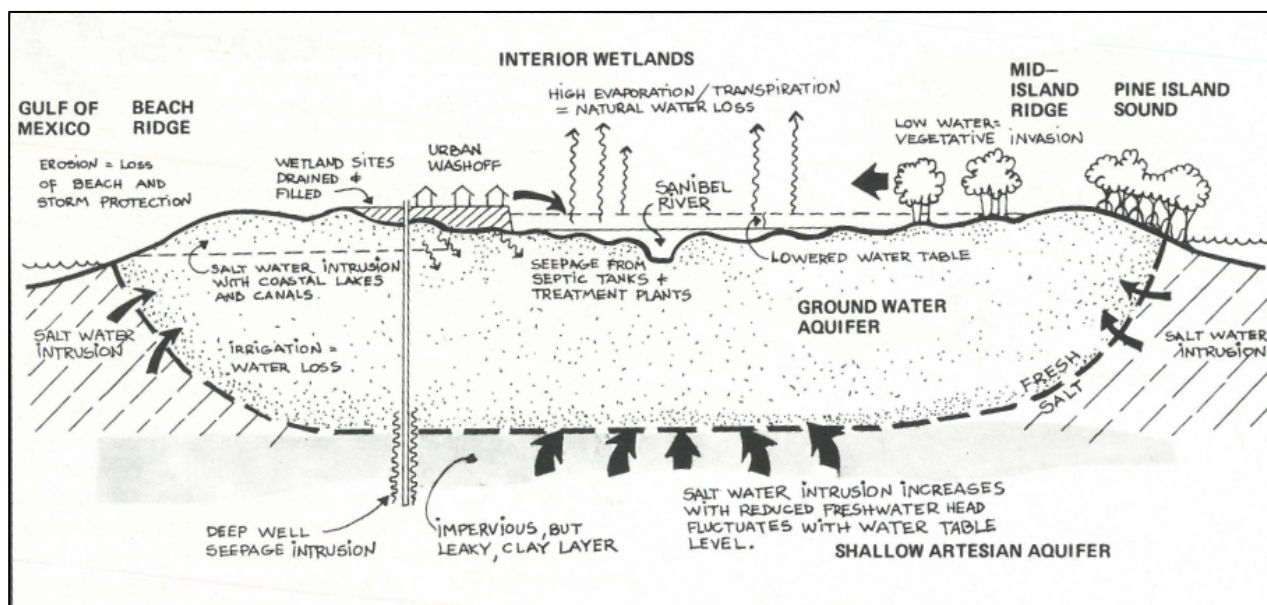


Figure 1. Graphical representation of the water budget of the freshwater basins on Sanibel, taken from *The Sanibel Report* (1976).

Open-water evaporation and ET account for nearly all yearly outflow from the interior freshwater wetlands on Sanibel, as shown in **Table 2**. Estimates of evaporation and ET can be difficult to verify, especially for wetlands on barrier islands, but approximations were made in the 1976 report using a pan evaporation coefficient of 0.7 for the basin.

Table 2. Annual water budget for interior wetlands of Sanibel, inches (from *The Sanibel Report*, 1976).

Inflows		Outflows	
Precipitation	43.2	Water Storage	0.0
Surface Water	0.0	Open Water Evaporation	12.3
Groundwater	0.0	Evapotranspiration	37.1
Upward Leakage	1.2	Irrigation Pumping	0.0
Artesian Wells	2.5	Surface Water (Runoff)	0.1
Treated Wastewater Effluent	3.8	Groundwater (Percolation)	0.3
Total	≈ 50	Total	≈ 50

Table 2 shows that deep percolation losses from the interior freshwater basins to the ocean have always been considered negligible on Sanibel. To independently verify this, a quick analysis of groundwater flow through the surficial aquifer was performed using Darcy's Law, which describes

fluid flow through porous media and considers the hydraulic gradient and aquifer permeability. The 1992 Update Report of Sanibel’s Surface Water Management Plan stated testing from 1990 measured permeability coefficients ranging from 0.77 to 34.02 feet per day on Sanibel. Multiplying these coefficients by the hydraulic gradient from the interior wetlands to the surrounding sea and an approximate/effective aquifer area result in average loss estimates of 2.9 to 130 gallons per minute, or between 0.02 inches and 0.8 inches per year, less than 2% of the annual budget. This estimate is conservatively high since it does not take into account the differing specific gravities of freshwater and saltwater. The value of 0.3 inches per year shown in **Table 2** is also a conservatively high assumption for groundwater outflows from the system and shows that deep percolation has never been a significant loss from the system, even prior to storm surge inundation in 2022.

It should be noted that, while surface water runoff accounts for only a very small portion of annual outflow in a 50-inch precipitation year, more runoff will occur during years where high precipitation or surge events cause water to be evacuated as flow over the weir crests or through the gates. Also, annual average ET_{marsh} for Sanibel is 58-59 inches per year (SFWMD, 2003), which is much greater than annual average rainfall, emphasizing the need to retain as much rainfall as possible to protect the freshwater environment on the island. Note that the estimated annual precipitation provided in *The Sanibel Report* of 43.2 inches per year is much lower than SCCF’s estimate of 54.3 inches per year.

Any impact to evaporation or ET will result in dramatic impacts to watershed hydrology on Sanibel. Open water areas did not change in size after Hurricane Ian in 2022, so the focus now shifts to changes in the plants on the island. One method of quantifying vegetation greenness and density is the Normalized Difference Vegetation Index (NDVI), which can be calculated for an area using multispectral imagery. Comparing NDVI values over time is a useful way to assess changes in plant health and coverage and subsequent changes in watershed hydrology (Worley et al., 2022). NDVI is a ratio between red and near infrared wavelengths (USGS, 2025) and is calculated as shown in **Equation 1**. The information needed to calculate NDVI can be obtained from satellites such as Landsat 8. The Landsat 8 satellite was launched by USGS and NASA in 2013 and records an image of Sanibel every 16 days at a 30-meter spatial resolution. Landsat 9, which is nearly identical to its predecessor, was launched in 2021 and also records an image every

16 days. Consequently, an image of Sanibel is now taken every 8 days. Landsat Spectral Indices products are courtesy of the U.S. Geological Survey Earth Resources Observation and Science Center. Surface reflectance and top of atmosphere datasets from Landsat 8 were used in NDVI calculations for the period of record. Surface reflectance data is atmospherically corrected and is especially useful when comparing images of a region over time (USGS, 2022). Top of atmosphere data requires less processing and can be filtered by the amount of cloud cover present. NDVI values range from -1.0 to +1.0, with more positive numbers indicating denser or healthier vegetation (see also **Figure 2**).

Equation 1. Formula for NDVI and corresponding Landsat 8 band values.

$$NDVI = \frac{NIR - R}{NIR + R} = \frac{Band\ 5 - Band\ 4}{Band\ 5 + Band\ 4}$$

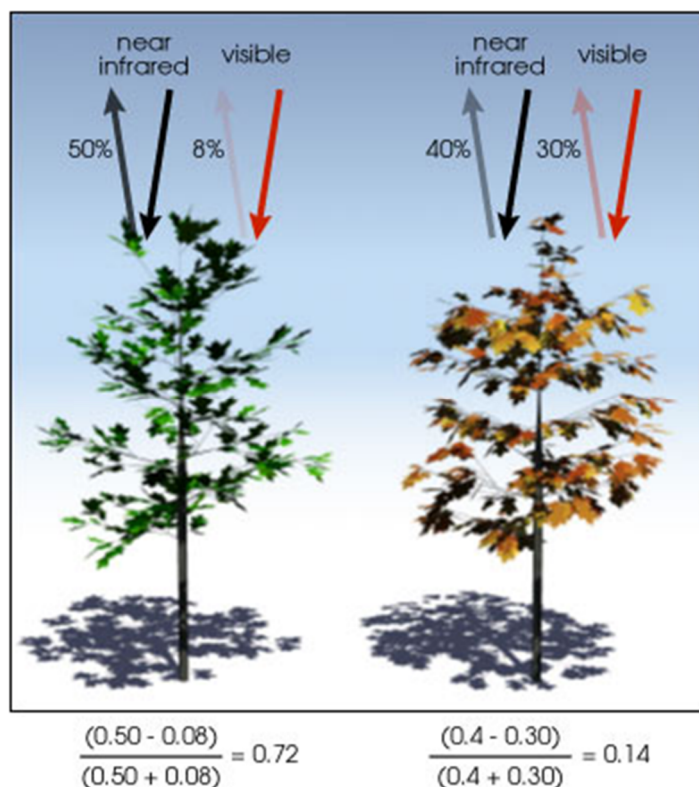


Figure 2. Example NDVI values for healthy and unhealthy vegetation (NASA, 2000).

Long-term average NDVI values for Sanibel before and after Hurricane Ian in 2022 are provided in **Figure 3** and **Figure 4**. The figures are on a scale of green to white to blue, with green being healthy vegetation, white being no or dead vegetation, and blue being open water. Satellite images with greater than 1% cloud cover were excluded from the analysis, which used top of atmosphere

data. **Figure 3** shows the pre-Hurricane Ian period from November 2013 to September 2022, and **Figure 4** shows the period after the storm, November 2022 to September 2023. The hurricane clearly had a tremendous impact on plant life.

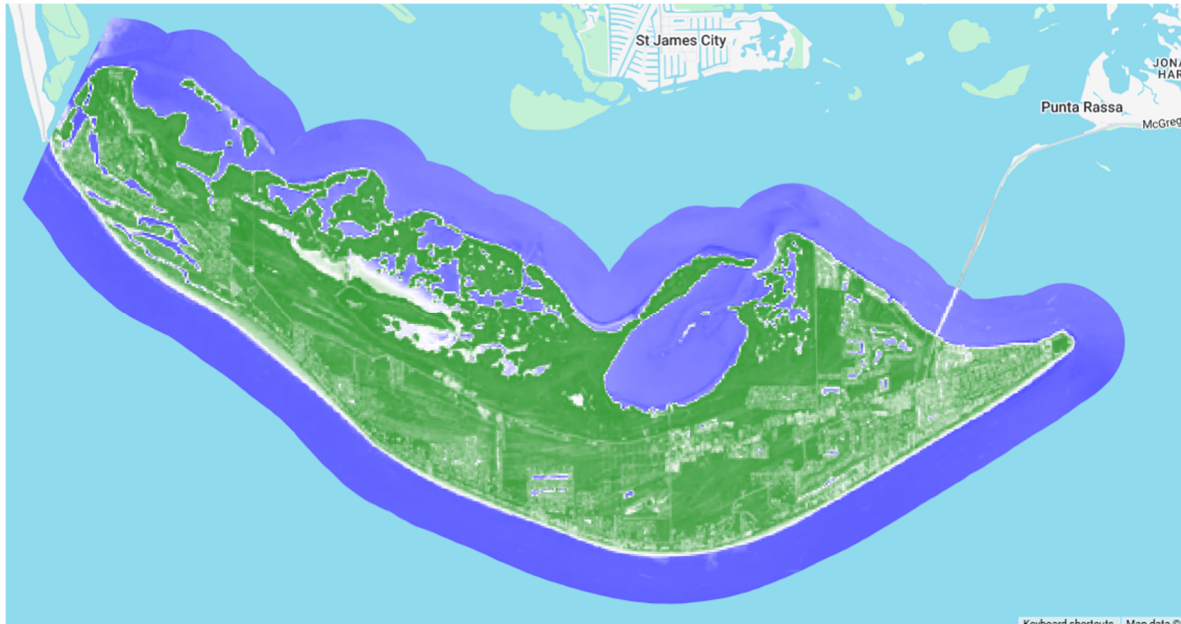


Figure 3. Map showing NDVI values before Hurricane Ian (average Nov. 2013 to Sept. 2022).



Figure 4. Map showing NDVI values after Hurricane Ian (average Nov. 2022 to Sept. 2023).

Landsat 8 and 9 surface reflectance data shown in **Figure 5** was processed to exclude cloudy pixels from the images and shows the average NDVI value over the interior freshwater basins from 2013

to 2025. The average NDVI value for 2013 to 2022 was 0.68, despite the area of analysis including both roofs and roads, areas with NDVI values at or below zero. An average NDVI value of 0.68 is very high and represents dense, healthy subtropical vegetation. For the first year after the storm, this average was reduced to 0.38, which is markedly low for a subtropical plant community and represents stressed vegetation. (As a comparison, Worley et al. [2022] reported the average NDVI value for the Chipola River watershed dropped from 0.64 to 0.59 following Hurricane Michael in 2018, which resulted in measurable reductions in ET and subsequent increases in river flows by less than 6%, with some subwatersheds seeing up to 22% increase in streamflow.)

The initial drop in NDVI just after Ian was about 0.3. Throughout 2023 and 2024, NDVI increased and began to approach pre-Ian levels, but this recovery was reversed in the aftermath of hurricanes Helene and Milton in the fall of 2024. However, the island's vegetation is quickly rebounding and appears to be on track to return to pre-Helene levels this year.

Monthly minimum and maximum water levels recorded at Beach Road Weir by SCCF from 2019 to 2025 is also included in **Figure 5**. Note that the maximum surge level from Hurricane Ian was not recorded since the monitoring equipment was inundated, so an estimate obtained from USGS was used. Water levels before and after Ian were compared to explore any changes which the hurricane may have caused. In the initial months following Hurricane Ian, there seemed to be a slight increase in the minimum water levels at Beach Road, but by the beginning of 2023, stages recovered to within about 6" of those experienced in 2019-2022. However, rather than fully returning to the typical annual lows seen in previous years, water levels did not fall as low during the dry seasons of 2024 and 2025, likely because of reduced ET. With only six years of data, it is difficult to determine how unusual these observations are, but it seems likely that surface water levels will recover fully as vegetation recovers.

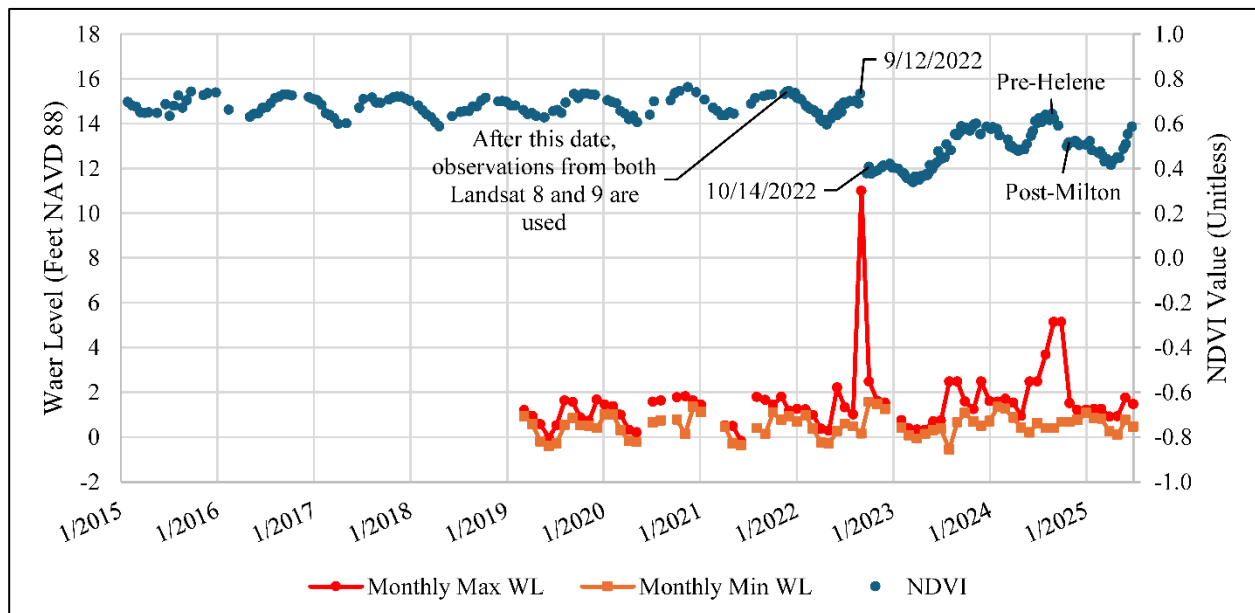


Figure 5. Water levels recorded at Beach Road Weir and average Landsat 8 and 9 NDVI values for the interior freshwater basins.

Water level data upstream of Beach Road Weir was obtained from SCCF and analyzed to see if there were changes in the rate of decline of surface water levels during periods with minimal rainfall and without weir gate operation (see **Figure 6**). Under these conditions, the rate of decline should be roughly equivalent to the combined effects of ET, open-water evaporation, upstream groundwater inflows, and groundwater outflows from the basin.

Before discussing the results of this analysis, which are shown in **Figure 7**, it is necessary to explain the use of wet marsh potential ET (ET_{marsh}) as a reference point with which to compare results. ET_{marsh} is a long-term regional average of wetland ET, with monthly values obtained from *Evapotranspiration Estimation for South Florida* (Abtew, 2003) and pro-rated to agree with Sanibel's estimated annual ET_{marsh} of 58-59 inches per year (SFWMD, 2003). This is 10% higher than the open water evaporation rate of 53 inches per year stated in the 1976 *Sanibel Plan*. It should be noted that ET varies greatly from day to day and is significantly influenced by meteorological factors such as solar radiation, relative humidity, and wind speed. ET on a sunny day is higher than ET on a cloudy day, and since the decline rates measured mostly consider days without significant rainfall, the periods of measurement are likely to be sunnier on average than if all days are considered, as in ET_{marsh} . It should therefore come as no surprise that many of the measured decline

rates exceed ET_{marsh} . It is also important to remember that ET_{marsh} is a long-term average for a given month and is not specific to the years we are considering. **Figure 7** shows water level decline rates at various times and includes ET_{marsh} for each month as a comparison. Decline rates before Ian (represented by the blue dots) are consistently greater than ET_{marsh} , as predicted. The expectation was that following Hurricane Ian and the associated vegetation changes, water levels would decline more slowly than before the hurricane due to a reduction in ET caused by plant stress, and this was true for most post-Ian periods of analysis (represented by the orange triangles) except in late 2023, where water level decline rates exceeded pre-Ian conditions. It is unclear what may have caused the increased decline rates in late 2023, but two theories present themselves. One possibility is that, with less vegetation present in the wetlands, the water surface is exposed to more direct sunlight, causing an increase in evaporation rates which make up for the reduced evapotranspiration rates. Another possible explanation is that vegetative regrowth caused increased water uptake and storage by plants.

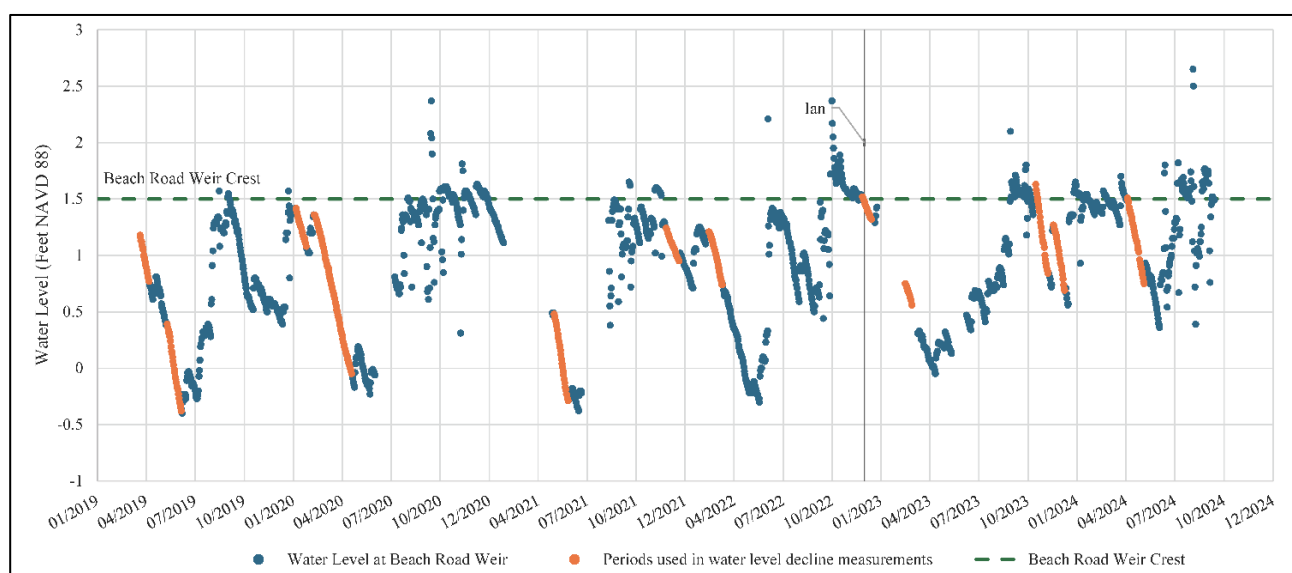


Figure 6. Water level and water level decline periods at Beach Road Weir.

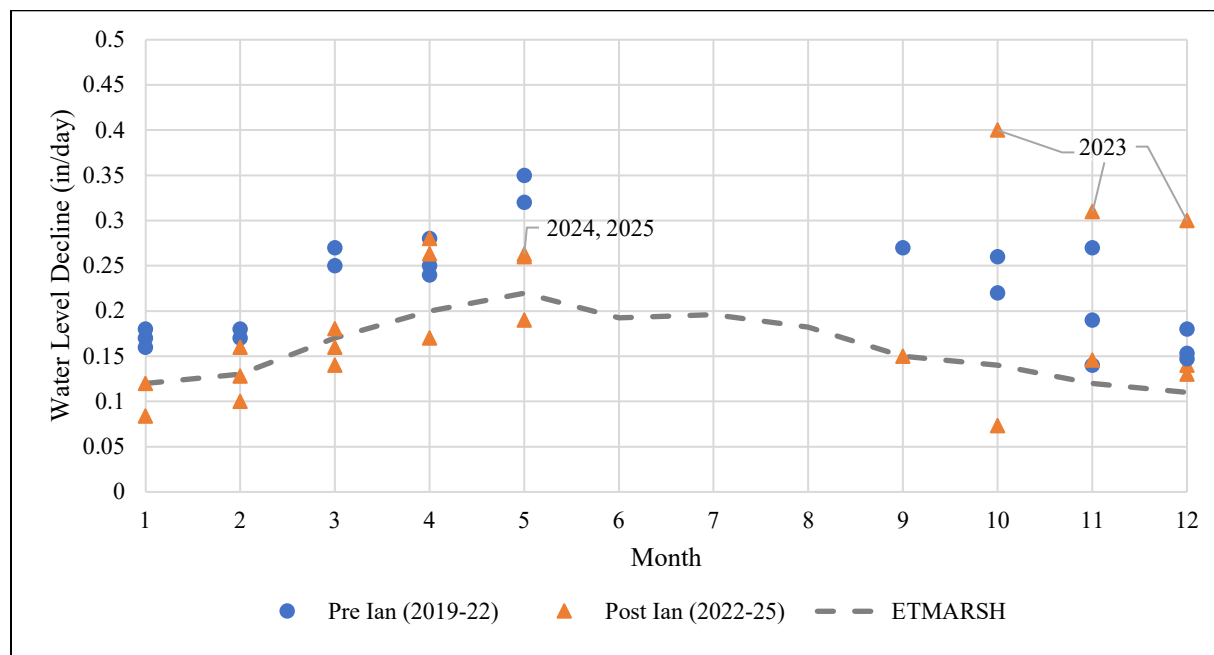


Figure 7. Water level decline rate at Beach Road Weir in inches per day during periods without opening of sluice gates or discharge over weir.

Further investigation into water level decline rates across the island was performed in order to understand current conditions. Using water level data obtained from surface water monitoring locations across the island, decline rates were calculated for 2024 and 2025, as shown in **Figure 8** and **Table 3**. Periods analyzed had minimal rainfall and no weir gate operation. Since the majority of these monitoring locations were installed in 2024, it was not possible to compare current decline rates with those before Ian. However, **Figure 8** and **Table 3** include ET_{marsh} for each month as a comparison. As discussed earlier, it is generally to be expected that the measured water level decline rates will be greater than ET_{marsh} , so instances where this was not the case were notable. One key takeaway from the data is the difference in decline rates which exists between the east and west basins. In general, the west basin has higher decline rates than the east basin.

Significant variability is present, but much of this variability can be explained. Unusually high decline rates are indicated in **Figure 8** as data points with red outlines. Sensors JE-2124 and JE-2125 recorded higher decline rates in late 2024 than did other sensors in the west basin. It is likely that this occurred because the water level at these sensors was above the Tarpon Bay Weir crest elevation, so drainage into the Sanibel River may have been occurring. Additionally, sensor JE-2127 has markedly higher decline rates than other east basin sensors. As discussed in **Section 2.1**,

JE-2127's rapid rate of decline is likely due to its location in a retention area that is adjacent to a drainage ditch. The rapid recovery seen is caused by percolation into the adjacent ditch. Another unusual observation was the rapid decline rate found at sensor JE-2123 in May 2025. Something abnormal is clearly occurring since the sensor drops below the low tide elevation and below all other sensors in the west basin, at twice the rate of other sensors in the basin.

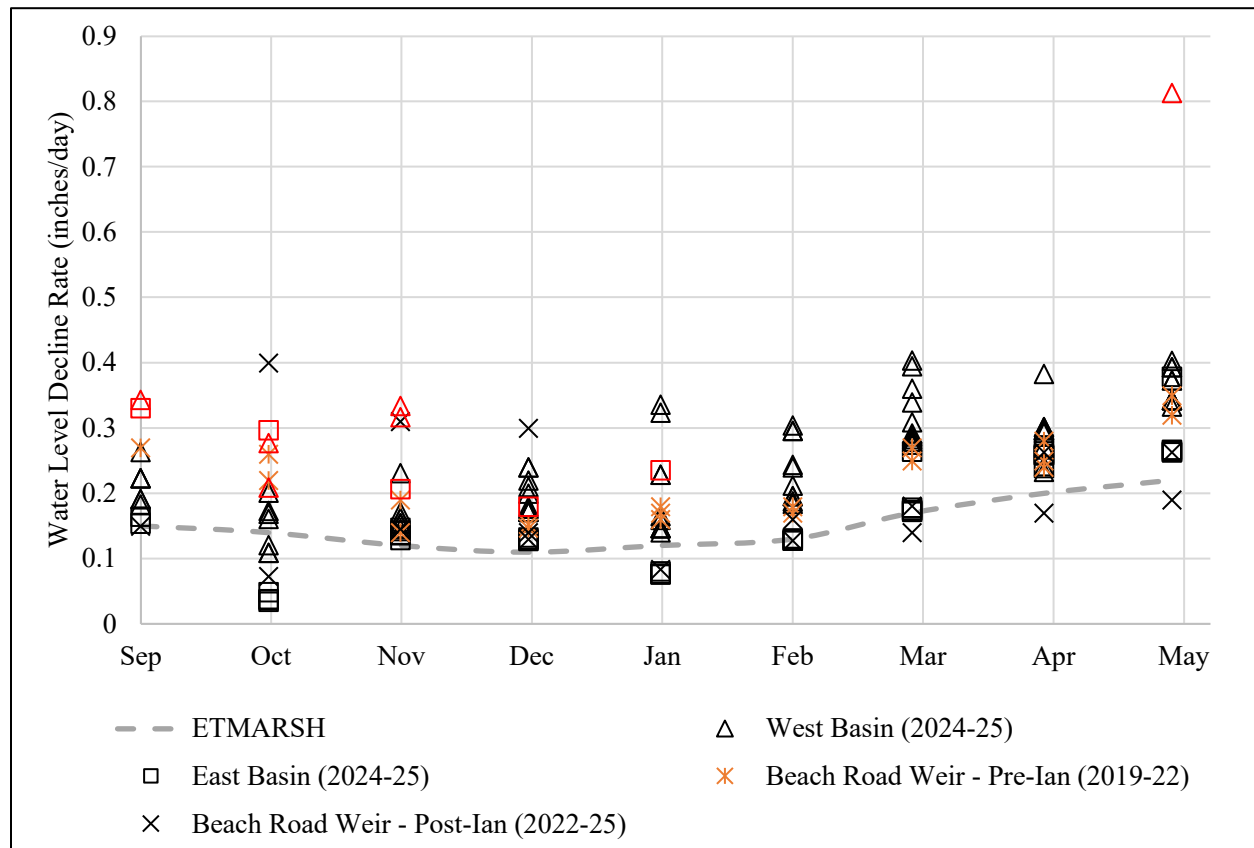


Figure 8. Water level decline rates at locations across Sanibel. Red markers indicate unusually high post-Ian decline rates.

Figure 9 and **Figure 10** were created to visualize any differences between the weirs as well as any changes in water levels over time. Water levels at Beach Road Weir and Tarpon Bay Weir are shown for 2019 through 2025. An interesting takeaway from **Figure 9** and **Figure 10** is that Tarpon Bay Weir, and by extension the entire west basin, often reaches lower stages than does Beach Road Weir and the east basin. This aligns with the conclusion drawn from **Table 3** that water levels decline more rapidly in the west basin than in the east basin. So, even though the west basin's weir has a higher crest elevation than the east basin's does, the west basin declines more quickly and

reaches lower stages than the east basin does. A potential cause of this is the larger proportion of wetland area in the west basin as compared to the east.

Table 3. Comparison of ET_{marsh} to water level decline rates at multiple locations, inches per day.

	2024				2025				
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
ET_{marsh}	0.15	0.14	0.12	0.11	0.12	0.13	0.17	0.20	0.22
<i>West Basin</i>									
JE-2121	0.22	0.20	0.14	0.22	0.23	0.30	0.29	0.30	0.37
JE-2122	0.26	0.17	0.23	0.21	0.23	0.30	0.40	0.27	0.37
JE-2123	0.22	0.16	0.15	0.20	0.16	0.24	0.40	0.38	0.81
JE-2124	0.34*	0.21*	0.32*	0.24	0.32	0.24	0.34	0.23	0.39
JE-2125		0.28*	0.33*	0.24	0.34	0.30	0.36	0.24	0.39
JE-2126	0.22	0.17	0.17	0.18	0.17	0.21	0.31	0.30	0.40
Rabbit Rd	0.19	0.12	0.15	0.17	0.15	0.20	0.28	0.30	0.34
Gulf Pines			0.15	0.17	0.14	0.19	0.27	0.30	0.34
Rue Belle Mer			0.15	0.17	0.15	0.18	0.28	0.29	0.33
Tarpon Bay Weir	0.18	0.11	0.16	0.18			0.28	0.30	0.34
Tarpon Bay Rd West	0.19	0.11	0.16	0.18	0.15	0.20	0.29	0.30	0.34
<i>East Basin</i>									
JE-2127		0.33*	0.30*	0.21*	0.18*	0.24*	0.26	0.27	0.38
JE-2128	0.15	0.04	0.15	0.13	0.08	0.13	0.17	0.26	0.26
JE-2129		0.04	0.14	0.13	0.08	0.13	0.18	0.26	0.26
JE-2130		0.03	0.14	0.13	0.08	0.13	0.17	0.24	0.27
Tarpon Bay Rd East	0.16	0.05	0.13	0.13	0.08	0.13	0.17	0.26	0.26
Beach Rd Weir	0.15	0.07	0.15	0.13	0.08	0.13	0.18	0.26	0.26

Note: Asterisk () indicates water levels above the basin's weir crest.*

Another notable observation is the difference in minimum annual water levels seen at both weirs. For the dry seasons of 2019 through 2022, Beach Road Weir's minimum annual water level hovered around -0.5 feet NAVD 88. This changed after Ian, and minimum water levels in 2023, 2024, and 2025 were approximately 6 to 12 inches higher than in the previous four years (see **Figure 9**). 2024 exhibited a particularly significant increase of nearly 12 inches, which may be partially attributable to unusually high amounts of rainfall in the first three months of 2024. Tarpon Bay Weir tells a more complex story. The minimum water level at Tarpon Bay Weir fluctuates but is typically at or below -0.75 feet NAVD 88, which is below sea level and would have allowed

saltwater intrusion into the freshwater lens. As at Beach Road Weir, minimum annual water levels are higher than those in previous years, with increases ranging from about 4 inches to 9 inches. Interestingly, 2024 sees an increase of just 4 inches at Tarpon Bay Weir, as opposed to nearly a foot of change in 2024 at Beach Road Weir. And, in 2024, water at Tarpon Bay Weir is a foot lower than water at Beach Road Weir. However, it should be remembered that this is a manipulated system, so differences may be partially due to human intervention, such as opening of the weir gates.

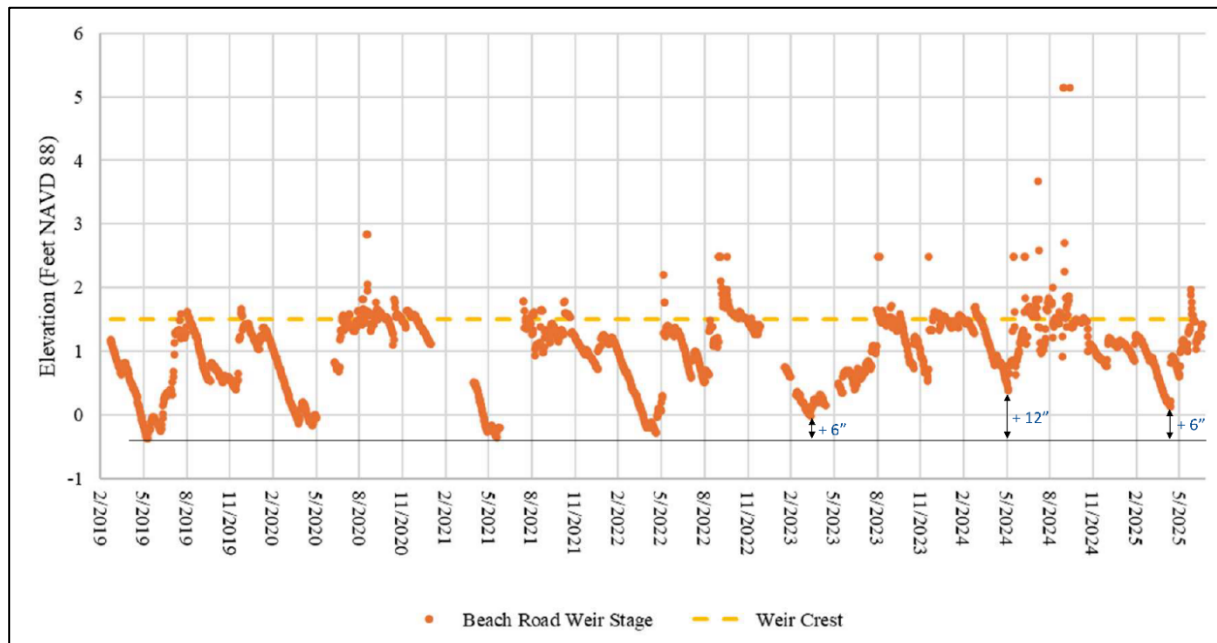


Figure 9. Water levels at Beach Road Weir (2019-2025).

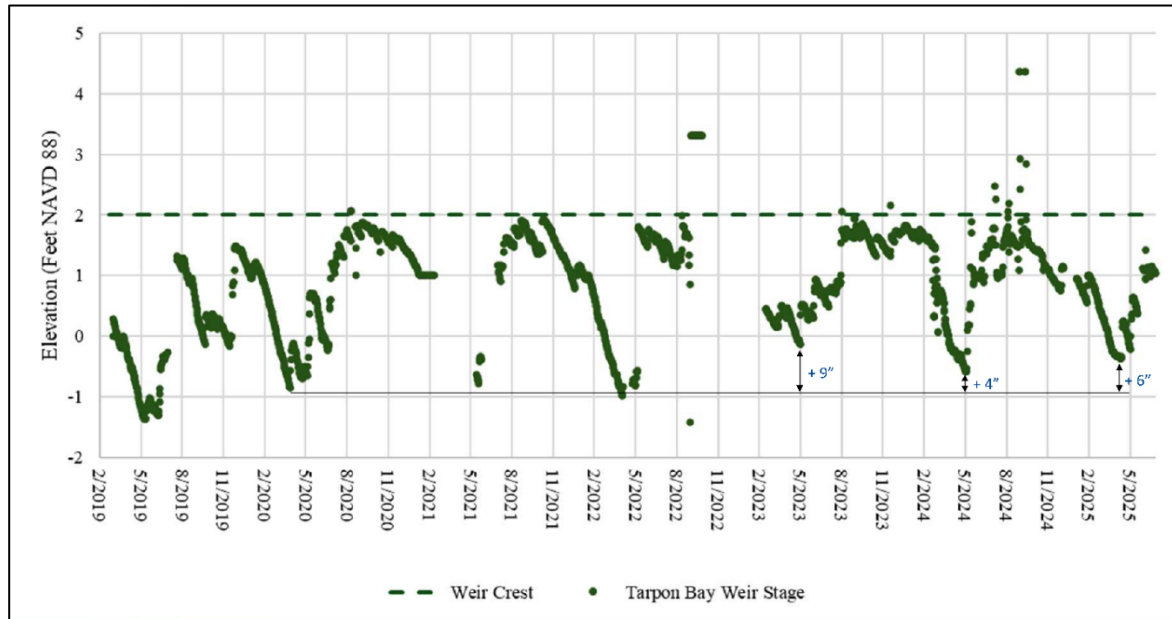


Figure 10. Water levels at Tarpon Bay Weir (2019-2025).

2.3 Groundwater Level Monitoring

In addition to the water level analyses discussed previously, groundwater data was evaluated at USGS surficial aquifer well L-1403, which is located in the east basin along Casa Ybel Road (see **Figure 11**). The well was installed in the early 1970s, and daily measurements were taken from 1973 until 2018. Periodic field measurements have also been recorded over the years, typically once per month, although this is not always the case. Any data from November 2018 or later comes exclusively from the field measurements, and it should be noted that since this data is taken infrequently, it likely fails to capture the extremes, both high and low, of the water table. It should also be noted that although measurements are typically taken once per month, no measurements have been posted online since March 2025.

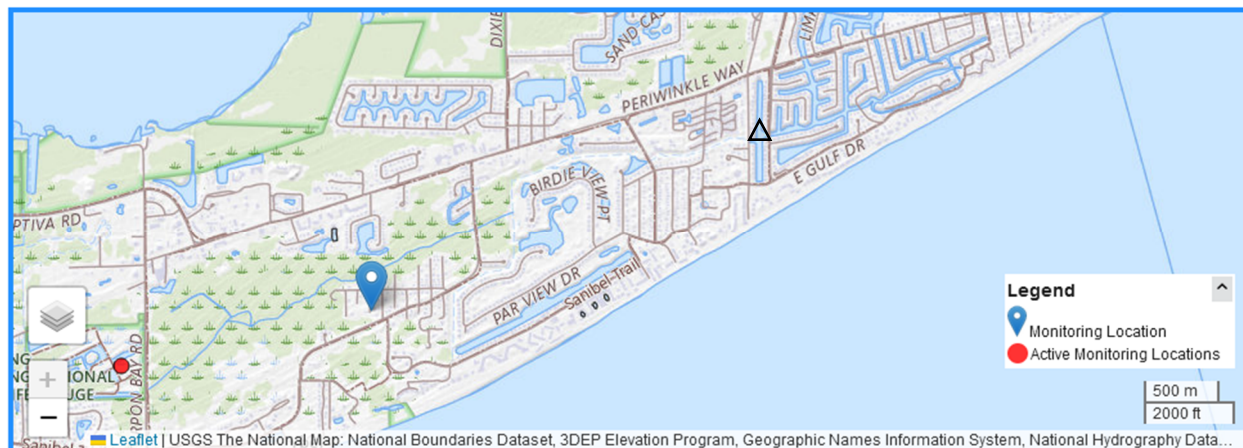


Figure 11. Location of USGS well L-1403 (blue marker) and Beach Road Weir monitoring equipment (black marker).

To quantify the changes that residents have noted, annual minimum, average, and maximum groundwater stages were reviewed at L-1403 from 2017 to 2024, shown in **Table 4**. Between 2017 and 2024, there was a net change in minimum water level of 1.3 feet, a significant rise for Sanibel. At the same time, yearly average and maximum water levels have seen more modest increases. However, it should once again be noted that over this eight-year period, between seven and twelve measurements were taken each year at the well, so the sample size is too small to allow for definite conclusions to be drawn. The minimum levels experienced in recent years are also not unprecedented. In the years 2003, 2005, and 2015, annual minimums of 0.19, -0.09, and -0.35 were recorded.

Table 4. Surficial aquifer water level at L-1403 for years 2017 to 2024, feet NAVD 88.

Year	2017	2018	2019	2020	2021	2022	2023	2024	Change 2017-2024
Minimum	-1.15	-1.20	-0.86	-0.62	-0.61	-0.45	-0.27	0.17	1.32
Average	0.58	-0.38	0.29	0.73	0.66	0.81	0.91	1.71	1.14
Maximum	2.00	0.41	1.65	1.96	1.90	2.25	2.27	2.50	0.50
Total Rainfall (in.)	54.9	38.3	43.1	66.9	49.8	51.2	37.9	76.0	--

It is likely that these increases were caused by two factors. First, Southwest Florida experienced heavy rainfall in 2024 (see **Table 4**). Second, significant vegetation loss occurred in the aftermath of Hurricane Ian.

It is possible that the heavy rainfall Southwest Florida experienced in 2024 has kept groundwater higher than normal and prevented stages from falling as low as they usually do. While the former claim appears to be true, the latter seems unlikely when other years of high rainfall are considered. When comparing 2020 (66.9 inches) and 2024 (76.0 inches), a much greater increase is seen in the annual minimum stage than in the annual maximum stage, 0.79 feet versus 0.31 feet. So, while rainfall does play a role in groundwater levels, it is not the only factor.

Most of the water leaving the interior basins on Sanibel has historically done so through evapotranspiration, a process inherently tied to plants. Given that plant populations have experienced a significant decline after Hurricane Ian, it would make sense for water levels to recede more slowly following rainfall events. **Figure 12** shows the relationship between NDVI (i.e., vegetative health) and groundwater at L-1403 over the period from 2013 to 2024. The average groundwater stage for each water year is included to show the overall trend.

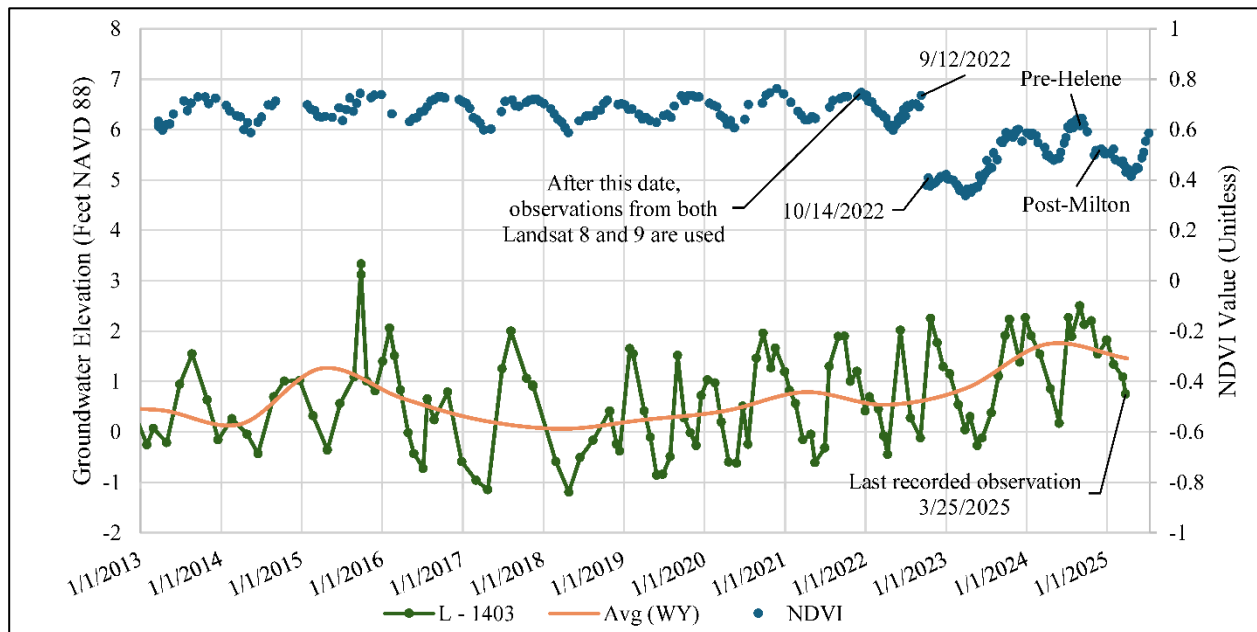


Figure 12. Water level at USGS well L-1403 and calculated Landsat 8 and 9 NDVI values for the interior basins over time. Orange line indicates average level per water year (WY).

As previously stated, it makes sense that loss of vegetation would cause water levels to recede more slowly following rainfall events. This was generally not found to be the case for surface water across the island, but an investigation into minimum groundwater levels illustrates the changes experienced by many Sanibel residents. Although minimum groundwater levels have been

trending upwards since 2017 (see **Table 4**), they are well within the historical range for the period of record (see **Figure 13**). It seems unlikely that Hurricane Ian has caused any permanent changes to water levels on the island.

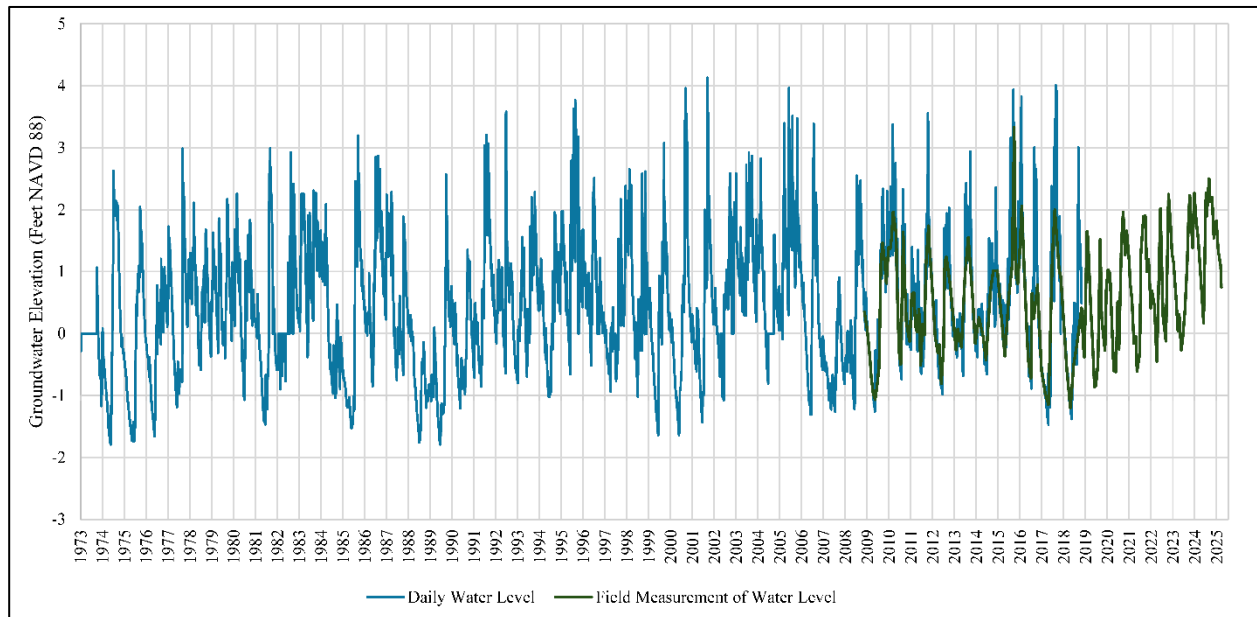


Figure 13. Long-term groundwater elevation at USGS well L-1403.

2.4 Freshwater Basin Weir Policy Review

Sanibel’s water control structures for the interior freshwater basins include sluice gates that can be opened to allow additional flow out of the basins under certain conditions. The stated objective of the City’s Weir Control Policy adopted in 1994 (Policy) is “to attempt to retain as much fresh surface water on the island as possible ... for the environmental benefit of the island’s Interior Wetlands System, so long as developed areas are not adversely impacted.” The Policy allows the gates to be opened under one of four conditions: interior flooding conditions, pre-storm conditions, surface water duration conditions, or miscellaneous conditions. It should be noted that the third condition, surface water duration, has never been used to open the weirs. The details of the first three conditions are described further in the Policy document, and the fourth condition is the shortest, saying “The City Manager may deviate from the above standards when deemed necessary for the prevention of immediate harm to persons, property, or the environment.” As mentioned previously, the interior wetlands serve as freshwater reservoirs for the island, helping to conserve water by mitigating saltwater intrusion, recharging the underground freshwater lens, reducing mosquito populations, and

reducing exotic plant species that outcompete native vegetation. The weirs were designed to keep upstream water as fresh as practicable to protect Sanibel's native flora and fauna. As stated in the 1987 *Surface Water Management* report, removal of the weirs would be an environmental disaster, would compromise the shallow freshwater aquifer, and decimate wildlife habitat for freshwater animals.

Prior to the construction of the weirs, it was common to see the groundwater fall below sea level during dry periods due to uncontrolled runoff and significant evapotranspiration (Provost, 1953). Due to differences in specific gravity, freshwater floats above saltwater, resulting in a freshwater lens under all islands, including Sanibel (see **Figure 1**). The 1953 report *The Water Table on Sanibel Island* stated that, "for every foot the fresh water table is elevated above mean sea level, the salt water underlying it is depressed by 40 feet." At the time the weir policy was adopted in 1994, mean sea level around Sanibel was about -0.4 feet NAVD 88, which meant the water levels in the west basin were elevated 2.4 feet above mean sea level. The shallow water table aquifer is underlain by a clay and limestone layer 20 to 25 feet below land surface (Clark, 1976), so the freshwater lens was not necessarily 100 feet thick but significant pressure was exerted by the west basin to maintain the freshwater lens under Sanibel. Mean sea level has averaged 0.17 feet NAVD 88 for the past three years (2022-2024) so the difference in elevation is less today, but still sufficient for maintenance of the water table aquifer.

This Policy should be continued for as long as possible when there is the presence of freshwater in the basin. Long-term reductions in stage below the weir crest elevation will impact upstream wetlands, which will require extensive permitting and mitigation, increase the risk of wildfires, compromise the shallow aquifer (freshwater lens), and increase mosquito populations.

There are times when the City Manager may want to operate the weir gates under the fourth condition, miscellaneous. This has occurred multiple times in recent years to improve working conditions during hurricane recovery efforts and to expedite the removal of brackish water from the basins. Some important considerations when operating under this condition are:

Tide: Sea level is the primary limitation to flow out of the gates. High tides or storm surges can cause sea water to flow into the freshwater basins. The gates should not be opened when tidal waters are above the water level inside the system to prevent backflow.

Freshwater Surcharge: The minimum water level of freshwater inside the basins should be at least six inches higher than mean sea level. At no point in the year should the interior water level be less than six inches above sea level, because the freshwater lens under Sanibel is at risk of being compromised if the difference between the two is less than six inches. Daily tide information included in the graphs in **Appendix A** and the 10-year mean sea level graph in **Figure 14** show that sea level fluctuates during the year and was as high as 1 foot NAVD 88 in September 2024. **Table 5** shows the 10-year average sea level for each month in addition to average monthly precipitation, evaporation and ET on Sanibel. When these combined factors are considered, the current minimum water level on October 1 is 2.2 feet NAVD 88, which is 0.2 feet higher than the west basin weir crest elevation and 0.7 feet higher than the east basin weir crest elevation; furthermore, future sea level rise will increase this minimum elevation. This shows the freshwater lens under the island is at risk of being compromised if the water levels are held below the weir crest going into the dry season. Since the east basin weir level is 1.5 feet NAVD 88, there is no capacity for water levels to be lowered further.

Dry Season: It is not uncommon to receive less than an inch of rainfall during a dry season month. May is the month with the highest potential ET, estimated at 6 inches for wetlands in South Florida (Abtew et al., 2003). At least six inches of surplus water should be retained within the basins on May 1 to allow for dry season ET outflows. This surplus amount is in addition to the minimum freshwater surcharge amount, so a total of one foot of water above mean sea level needs to be retained on May 1. The target minimum elevation for each dry season month is provided in **Table 5**.

Fire Risk: Over-draining the interior basins greatly increases the risk of wildfires.

Mosquito Control: Wide fluctuations in water levels in and around Sanibel were determined to be one of the primary causes of overwhelming populations of the black salt marsh mosquito (*Aedes taeniorhynchus*), which lays its eggs on moist ground (not water) and the eggs remain and do not hatch until inundated, weeks or months later (Provost, 1953). Construction of the weirs has the benefit of keeping water in the breeding areas as much as possible and also helps with the distribution of minnows during the early wet season,

allowing minnows to quickly access the larvae, once hatched. Careful coordination should be conducted with the Lee County Mosquito Control District if drastic water level fluctuations are occurring within the basins so that mosquito populations do not become overwhelming.

Table 5. Monthly average total rainfall, atmospheric outflows, surplus/deficit, and mean sea level on Sanibel.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Avg. Rainfall	3.7	1.8	2.1	3.0	1.5	1.2	1.9	2.5	6.9	7.9	9.1	8.8
Avg. Evap. & ET	3.7	3.1	2.9	3.2	3.1	4.5	5.1	5.8	4.9	5.2	4.8	3.9
Surplus (+) / Deficit (-)	0.0	-1.3	-0.9	-0.2	-1.6	-3.3	-3.3	-3.4	2.0	2.7	4.3	5.0
Cumulative Deficit	0.0	-1.3	-2.2	-2.3	-4.0	-7.3	-10.6	-13.9	-11.9	-9.2	-5.0	0.0
Mean Sea Level	0.4	0.2	-0.1	-0.3	-0.3	-0.2	0.0	0.0	0.2	0.1	0.3	0.5
Min. Basin WL to Overcome MSL	2.2	2.1	2.0	2.0	1.9	1.6	1.3	1.0	N/A	N/A	N/A	N/A

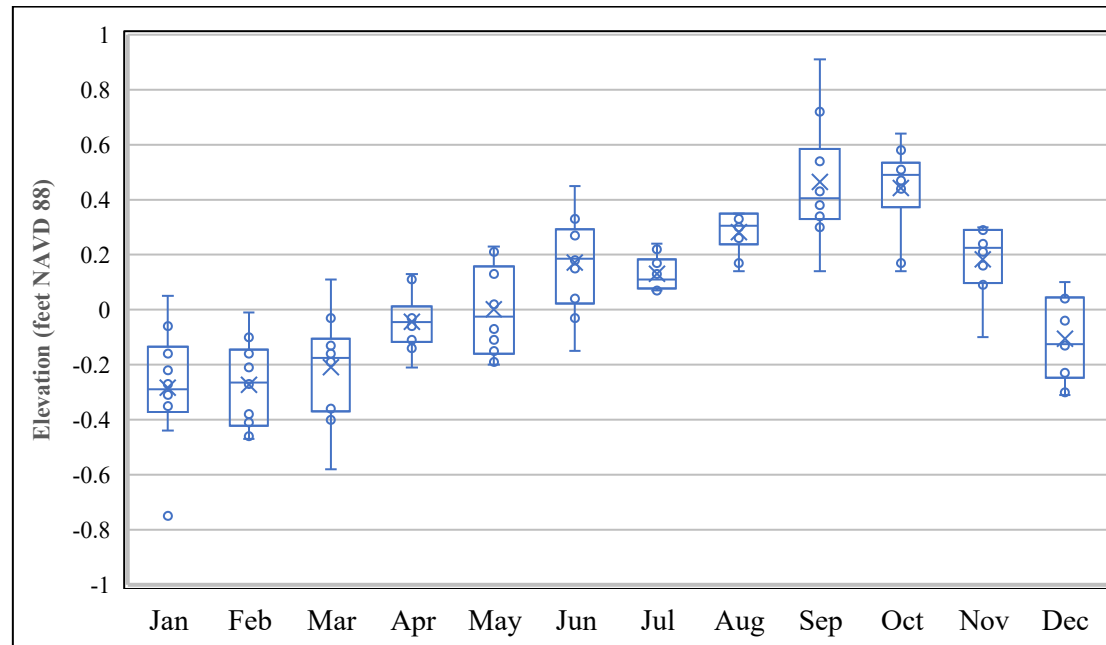


Figure 14. Monthly mean sea level, 2015-2024 at NOAA Fort Myers Tide Station 8725520.

SECTION 3 – SURFACE WATER MANAGEMENT DAMAGES POST-HURRICANE IAN

Field inspections of the primary stormwater management system on Sanibel are conducted every year, typically at the beginning of each dry season. Following Hurricane Ian in 2022, the system was reviewed by City staff to identify and repair areas of immediate concern. The primary system was further reviewed by Johnson Engineering in the early months of 2023 and 2024, and locations of highest concern were addressed by the City internally and/or through the City’s contractors.

Additional field inspections of the secondary drainage system were conducted in the summer of 2024 to create a comprehensive update to the Surface Water Management Master Plan for Sanibel, reflecting the current conditions of the system after Hurricane Ian. The inspections included an update of the City’s mapping and identification of additional repairs needed beyond the major repair efforts conducted previously.

3.1 Stormwater Management System Mapping Update

An inventory of existing pipes and inlets within the City of Sanibel are contained in a forty-page document called Map Book Drainage, dated August 30, 2007. Within the inventory document there are 32 plan sheets showing the locations of the primary drainage infrastructure throughout the City. Secondary infrastructure, including driveway culverts and swales on minor roads, was mentioned in the notes but features were not shown individually. As a part of this update to the Surface Water Management Master Plan, the secondary culverts and swales were field located and inventoried to include individual identification numbers and attributes such as culvert material and diameter, resulting in the addition of 820 culverts and 2,220 swales to the City’s records. An updated **Drainage Features Map Book** was created by Johnson Engineering to include these features and was provided to the City.

3.2 Stormwater Management System Damage Inspections

Coupled with the field mapping efforts, a visual inspection of newly added features was conducted to identify additional repairs needed beyond the previous major repair efforts. Field inspection efforts found sedimentation issues at 658 drainage structures, inside 19,400 linear feet of culverts, and 24,200 linear feet of roadside swales. A bid solicitation package was advertised by the City to select a contractor who is currently performing the repair and maintenance work.

SECTION 4 – SURFACE WATER MANAGEMENT RESILIENCY

Sanibel’s low-lying profile and status as a barrier island make it particularly vulnerable to hurricanes and storm surge. **Figure 15** shows how the monthly maximum tide at the Fort Myers tide gauge has increased over time. Refer to **Table 6** for the numerical values of the ten highest water levels recorded at the gauge, as well as the storm events they correspond with. It is notable that five of the highest ten records occurred during the past three wet seasons.

Over the course of Sanibel’s history, storm surge has wholly inundated the island with saltwater multiple times, though there was a long period of relative calm prior to 2022, as shown in **Figure 16**. Plans for stormwater management on Sanibel must consider the island’s unique susceptibility to saltwater flooding and sea level rise.

Sanibel contains two large freshwater basins which serve as freshwater reservoirs for the island. Each basin has a weir which serves as a salinity barrier by allowing freshwater to flow out of the basin and preventing tides from pushing saltwater into the interior. As discussed previously, protection of freshwater resources in the interior of the island is necessary to protect Sanibel’s native flora and fauna. However, when high sea levels exceed the weir crest elevation (or the perimeter rim elevation of the basins), backflow of saltwater into the freshwater basins occurs.

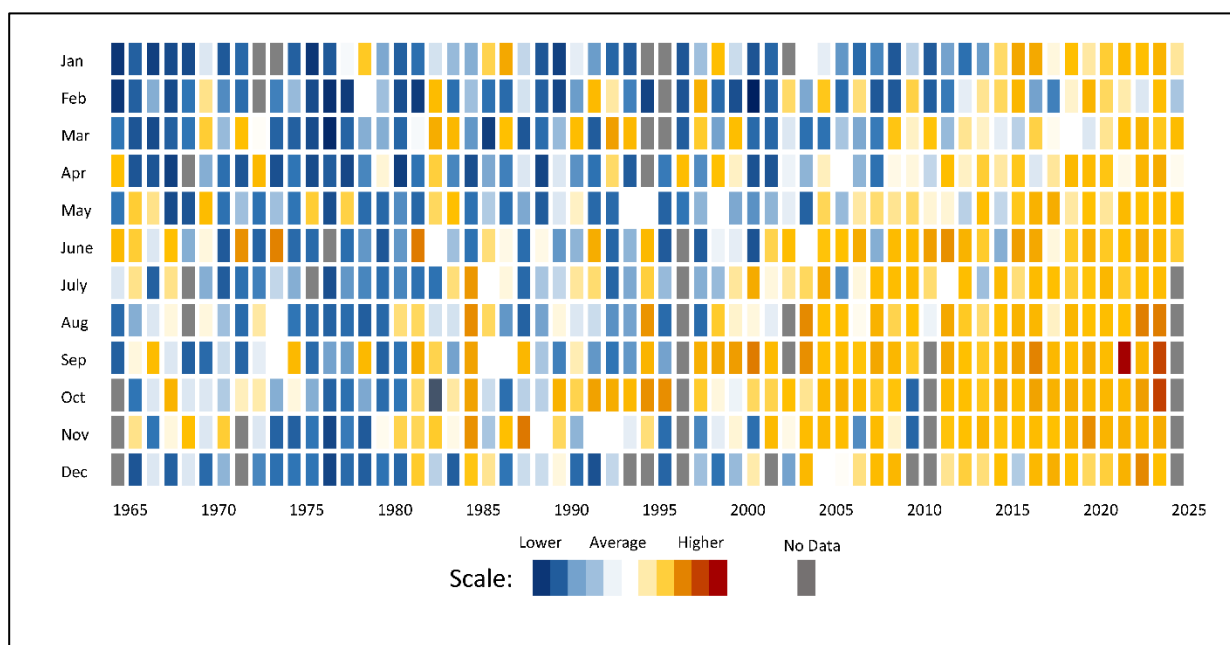


Figure 15. Overall trend of monthly maximum tide elevation at NOAA Fort Myers Tide Station 8725520.

Table 6. Ten highest water levels recorded at NOAA Fort Myers Tide Station 8725520.

10 Highest Water Levels – 1965 to Present			
Rank	Peak Elevation (ft NAVD 88)	Date	Event
1	7.52	2022-09-28	Hurricane Ian
2	5.53	2024-10-10	Hurricane Milton
3	5.4	2024-09-27	Hurricane Helene
4	3.68	1988-11-23	Tropical Storm Keith
5	3.59	2001-09-14	Tropical Storm Gabrielle
6	3.58	1982-06-18	Subtropical Storm One
7	3.53	2024-08-04	Tropical Storm Debby
8	3.47	2023-08-30	Hurricane Idalia
9	3.36	1974-06-25	Subtropical Storm One
10	3.32	2017-09-11	Hurricane Irma

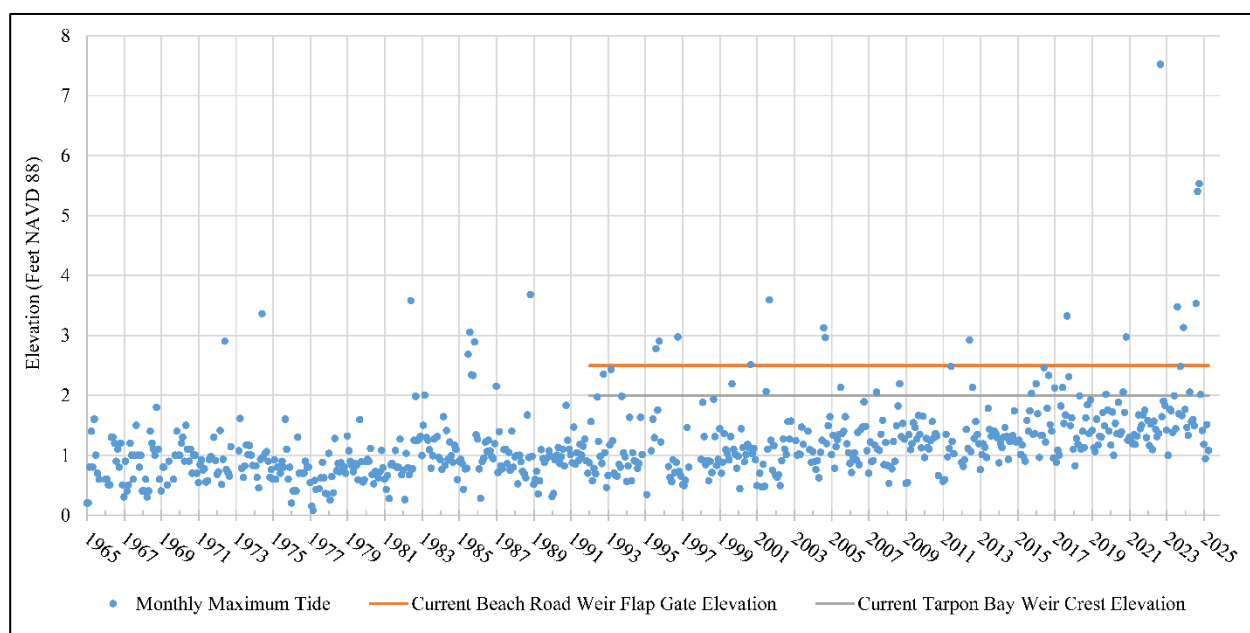


Figure 16. Recorded monthly maximum tide elevations at NOAA Fort Myers Tide Station 8725520.

4.1 City Roadway Elevation Analysis

A citywide analysis of 62 miles of public roadway elevations was performed using Light Detection and Ranging (LiDAR) data from Lee County, collected in 2018-19. To generate a representative grid of the island, points were placed at road intersections and at regular intervals when no intersections were present. Mapping of the points and their corresponding elevations is provided in **Exhibit 4**. A percent exceedance curve is provided in **Figure 17** which shows the percentage of roadways below certain elevations.

This roadway elevation analysis was repeated for several other coastal areas using LiDAR data from SFWMD, last updated in 2023. These areas were: City of Fort Myers Hurricane Evacuation Zone A, City of Naples Hurricane Evacuation Zone A, City of Marco Island, City of Miami Beach, City of Key Biscayne, and City of St. Pete Beach. Marco Island, Miami Beach, Key Biscayne, and St. Pete Beach were chosen because they are barrier islands, like Sanibel. Hurricane Evacuation Zone A for Fort Myers and Naples were chosen due to their proximity to Sanibel. **Figure 18** compares the percent exceedance curves for all these municipalities with Sanibel's. Sanibel's roadways are generally more elevated than three of the four other barrier islands studied but are lower than the nearest two mainland areas.

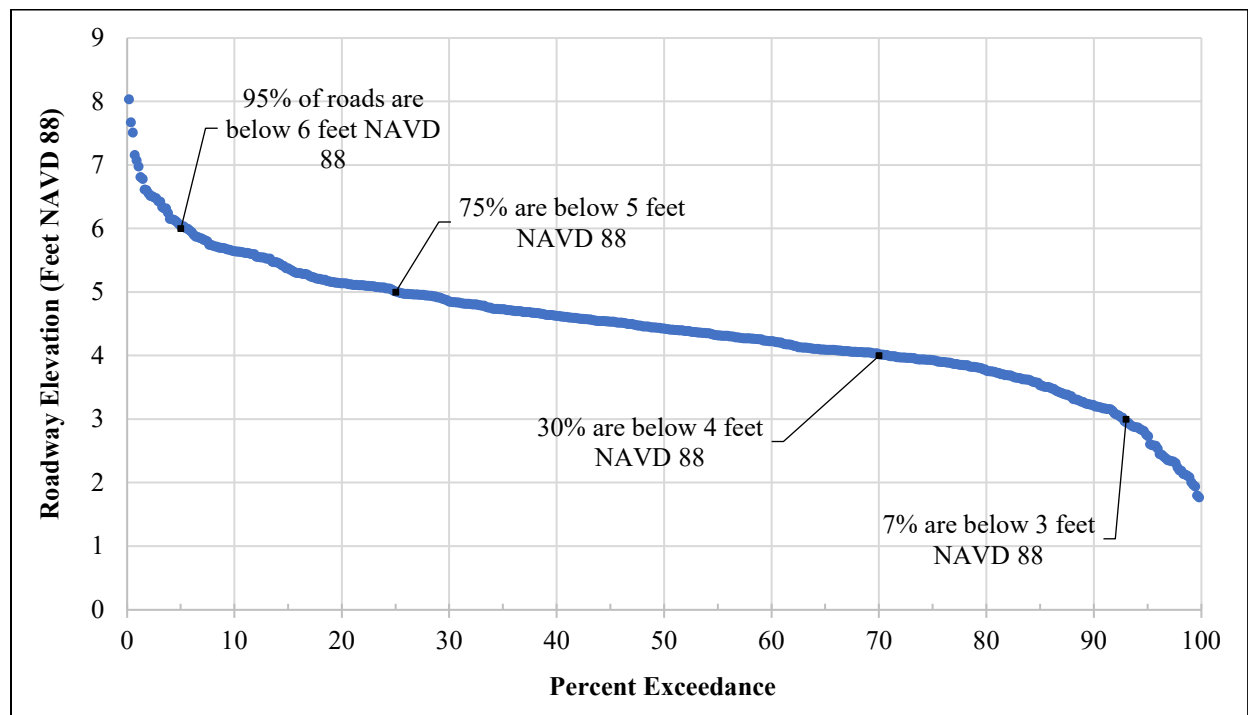


Figure 17. Percent exceedance curve for public roadways on Sanibel.

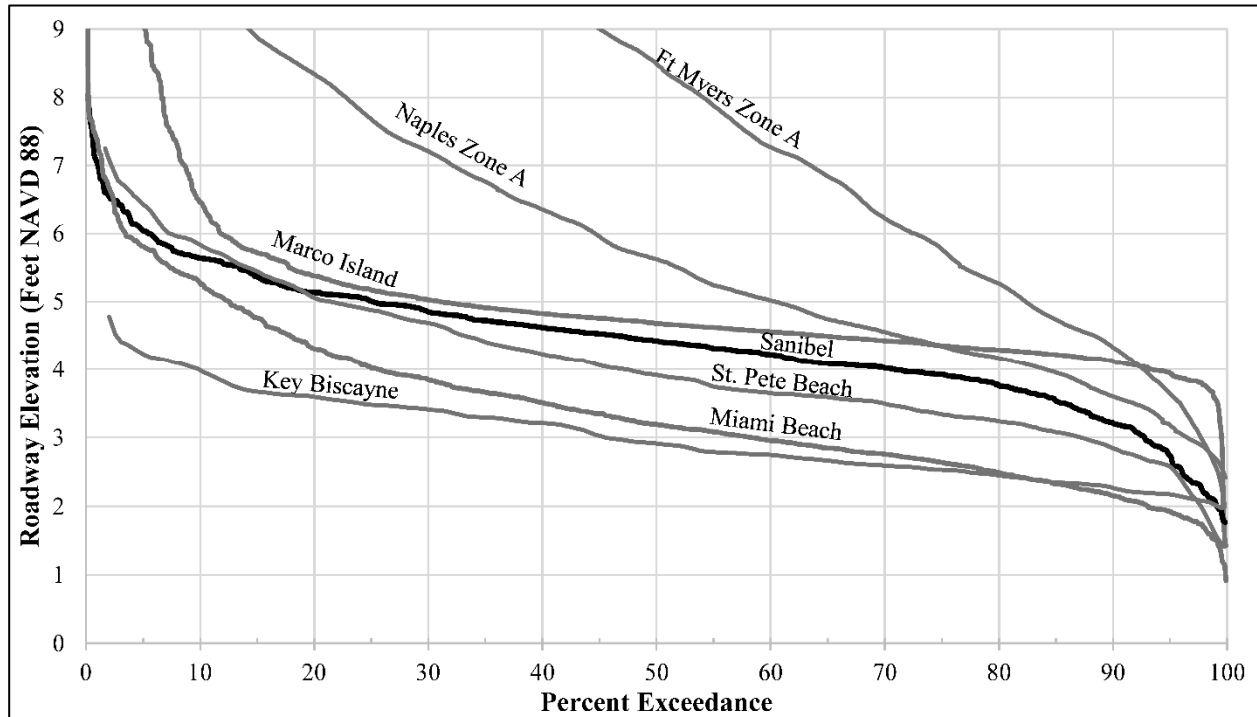


Figure 18. Comparison of percent exceedance curves for Sanibel vs. other coastal municipalities.

4.2 100-Year and 2-Year Flood Depth Maps

Public availability of flood mapping assists residents in understanding flood hazards in the vicinity of their property. FEMA publishes maps of the 100-year flood elevation which are used to establish federal flood insurance rates for a property. However, the maps do not indicate the anticipated maximum depth of water on the property. As a complement to the maps published by FEMA, a flood depth map was created to show the 100-year flood depths across Sanibel, provided as **Exhibit 5**. The flood depths shown on the map were calculated by subtracting the 2019 LiDAR ground elevations from the FEMA base flood elevations, last updated in 2022. The map shows that nearly all of Sanibel is inundated during the 100-year surge event. Additionally, a 2-year (50-percent-annual-chance) flood depth map was created and is provided as **Exhibit 6**. This map shows that minimal flooding occurs in developed areas on Sanibel during the 2-year storm surge event.

4.3 Sea Level Rise Projections

Sea level rise projections for Sanibel are provided in **Figure 19** and are based on the 2022 Intermediate-Low, Intermediate, and Intermediate-High curves developed by the National Oceanic and Atmospheric Administration for the Fort Myers Tide Station 8725520. Labeled data points are included at the planning horizons of 2050 and 2070. Additionally, the expected 2-year storm surge

elevation is layered onto the Intermediate-High curve. Critical elevations such as island-wide road crown elevations and the crest elevations of Tarpon Bay Weir and Beach Road Weir are also provided for reference. These are shown as horizontal lines to indicate the water level at which the infrastructure will become inundated.

This report recommends a minimum road elevation of 4.3 feet NAVD 88 for all new roadways, which would protect them from sea level rise until mean sea level reaches 2.3 feet NAVD 88 (assuming a target buffer of 2 feet to protect the road base material). Levels above 2.3 feet NAVD 88 would lead to a waterlogged base. Having a waterlogged base for long periods will damage a road, and total inundation can have an adverse effect on pavement life. Based on the Intermediate-High curve, significant road base failure is expected for up to 7% of public roadways by 2050, which is approximately 4.3 miles. Increasing the minimum existing roads to elevation 4.3 feet NAVD 88 (approximately 50% of roads, or 31 miles) will provide increased protection until 2070. By 2080, however, up to 75% of roads are anticipated to experience road base failure if the Intermediate-High curve becomes reality. When looking at the Intermediate-Low curve, approximately 20% of roadways (12.4 miles) are vulnerable to road base failure by 2080 and all would be protected if raised to a minimum elevation of 4.3 feet NAVD 88.

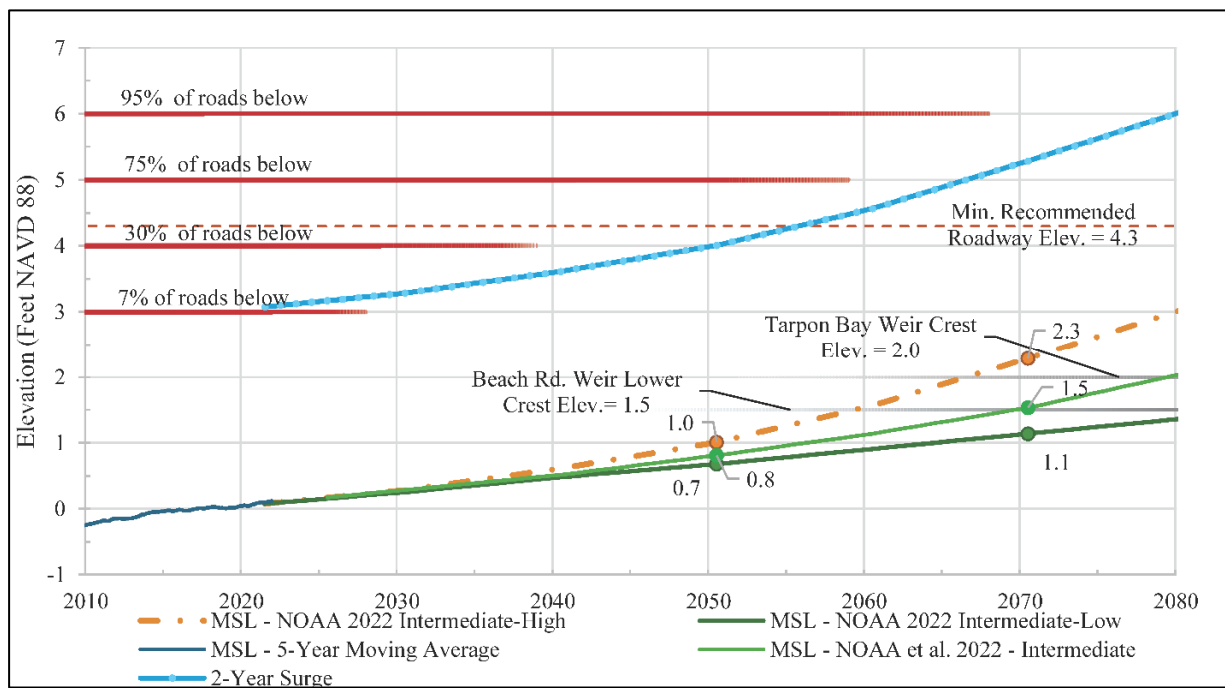


Figure 19. Sea level rise projections for Sanibel, with road elevations and weir crest elevations provided for reference.

Future sea level rise will worsen the impacts of tropical storm surge events, increasing the frequency and depth of flooding on the island. To illustrate this, a 2-year (50-percent-annual-chance) flood depth map was created based on the Intermediate-High curve at 2070 and is provided as **Exhibit 7**. Comparing this with the 2022 map, most developed areas on Sanibel are shown to be inundated with one to four feet of water. This level of inundation is similar to what was recently experienced on Sanibel from Hurricanes Helene and Milton in 2024. Over the next fifty years, residents of Sanibel need to be increasingly in tune with storm forecasts and ready to evacuate the island when necessary.

Table 7 predicts the future frequency of surge events if the Intermediate-High curve becomes reality. As sea level rises, less surge is required for water to reach a given elevation, and it is likely that high-elevation surges will occur more frequently. As a comparison, Tropical Storm Debby would be considered a 5-year storm today, hurricanes Helene and Milton would be roughly 20-year storms, and Hurricane Ian would be approximately a 300-year storm.

Table 7. Future storm surge return interval following sea level rise. Elevations reference NAVD 88.

Stillwater Surge Elev., feet	<i>Today</i> MSL $\approx$ 0 feet	<i>2040</i> MSL $\approx$ 0.6 feet	<i>2070</i> MSL $\approx$ 2.3 feet
3	<i>2-yr</i>	<i>< 2-yr</i>	<i>< 2-yr</i>
3.5	<i>5-yr</i>	<i>2-yr</i>	<i>< 2-yr</i>
4	<i>10-yr</i>	<i>5-yr</i>	<i>< 2-yr</i>
6	<i>25-yr</i>	<i>20-yr</i>	<i>7-yr</i>
8	<i>100-yr</i>	<i>80-yr</i>	<i>25-yr</i>
12	<i>500-yr</i>	<i>450-yr</i>	<i>270-yr</i>

4.4 Beach Road Weir and Tarpon Bay Weir

Based on the current 2-year storm surge of 3 feet NAVD 88 shown in **Figure 19**, regular overtopping of the lower crest of both weirs has already begun. This is occurring even with the current 1-foot flap gate on Beach Road Weir, designed to offer protection against saltwater intrusion from sea levels up to 2.5 feet NAVD 88. To confirm this, specific conductivity data collected upstream of Beach Road Weir over the past 5 years was reviewed along with data collected throughout the west basin.

Specific conductivity is a measure of a solution's ability to conduct electricity and is an indirect measurement of the concentration of dissolved ions in solution. It is often used in place of directly measuring the salinity of a sample. Generally, freshwater's specific conductivity is between 0 and 5 millisiemens per centimeter (mS/cm), ocean water tends to have a value of about 55 mS/cm, and brackish water is in between 5 and 55 mS/cm. **Figure 20** plots specific conductivity at Beach Road Weir along with maximum monthly tide measurements, and **Figure 21** plots specific conductivity at three locations in Sanibel's west basin as shown in **Exhibit 8**. Conductivity data points above the yellow line indicate that water above the Beach Road Weir is brackish, and tide points above the yellow line indicate that the monthly maximum tide exceeded the Beach Road Weir's lower crest elevation of 1.5 feet NAVD 88.

Of the measurements taken at Beach Road Weir from January 2019 to August 2022, most were above 5 mS/cm. This clearly indicates that saltwater is regularly entering the east basin, though it has historically been flushed out by rainwater shortly thereafter. The spikes in conductivity before 2022 appear to be correlated with tides which were higher than the fixed weir crest but lower than the top of the flap gate, so it is possible that the backflow prevention flap allows some saltwater backflow. Measurements taken in the west basin show a similar pattern.

In late September of 2022, Hurricane Ian made landfall in Southwest Florida, bringing massive storm surge with it. Conductivity was not measured in September 2022 due to Ian, and the monthly maximum tide shown on the graph (about 7.6 feet NAVD 88, recorded in Fort Myers) is much lower than the actual water level near the weir on Sanibel. USGS mapping on Sanibel shows the surge elevations ranged from 8 to 13 feet NAVD 88. After Ian, conductivity levels peaked and remained consistently above pre-hurricane levels until summer 2024, showing how long it takes the interior basins to recover to freshwater conditions following such a surge event. Conductivity levels spiked again at the end of the 2024 hurricane season, but, due to heavy rainfall in 2025, are nearly fully recovered as of August 2025. Recommendations for improvements to the weirs and weir policy are provided in the next section.

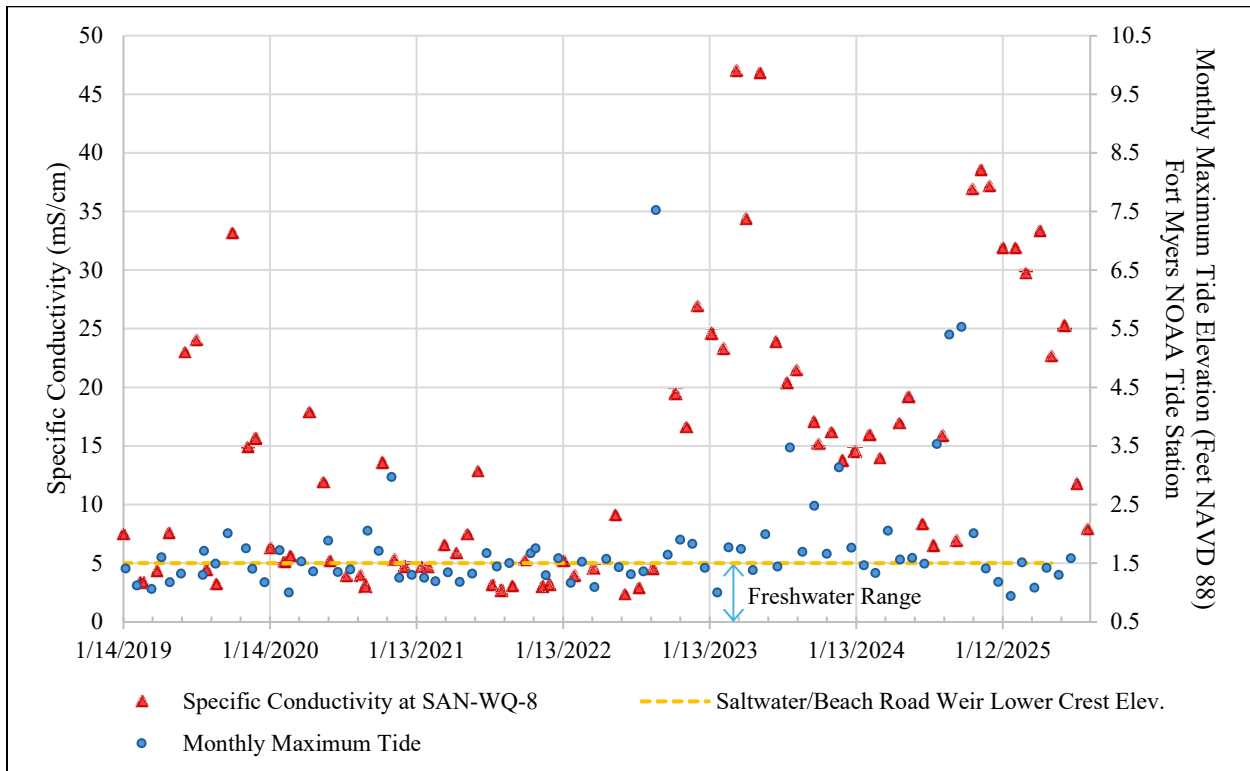


Figure 20. Specific conductivity upstream of Beach Road Weir and maximum monthly tide levels.

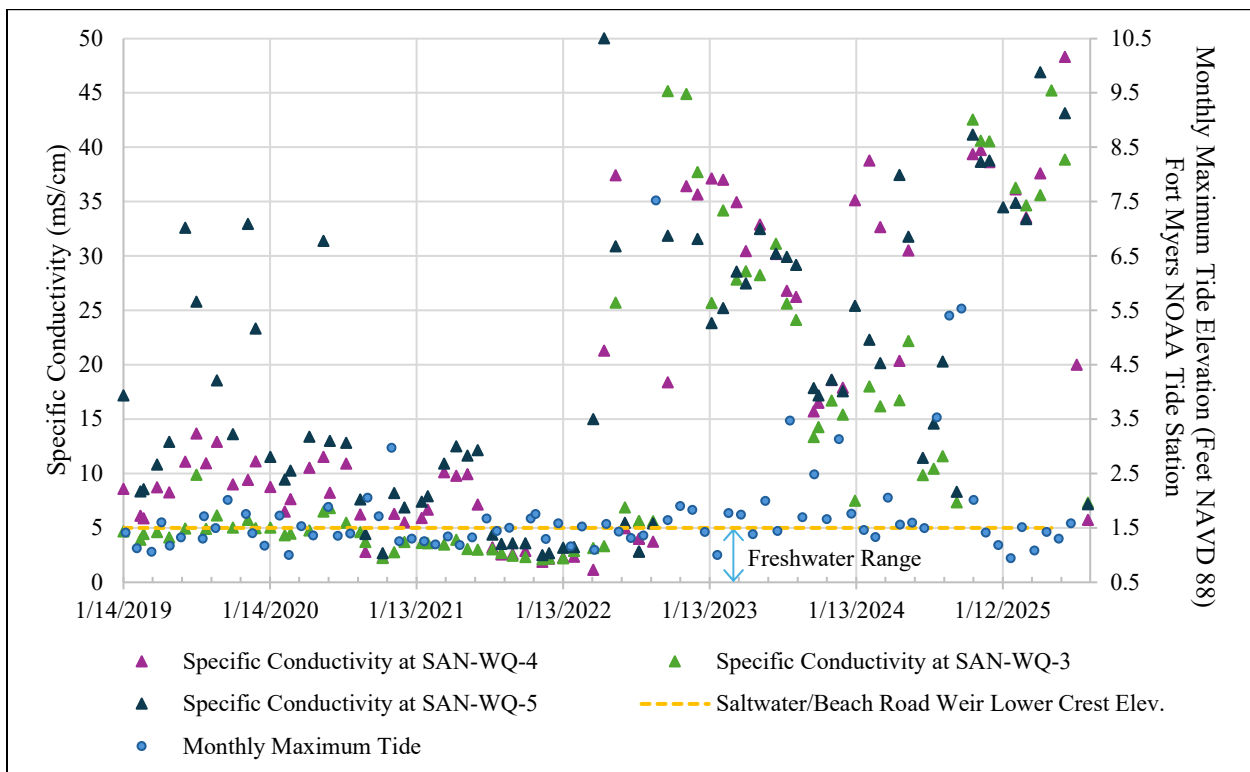


Figure 21. Specific conductivity in the west basin.

SECTION 5 – CONCLUSIONS AND RECOMMENDATIONS

Sanibel’s surface water management system is designed to retain freshwater whenever possible. Draining too much freshwater from the wetlands would cause saltwater intrusion and harm existing freshwater ecosystems. In the 50 years since its incorporation, Sanibel has prioritized environmental preservation, integrating its surface water management system with nature. This update of the surface water management master plan serves as a guide for the City’s next 50 years by establishing long-range strategies focused on flood mitigation, resiliency, and adaptation to sea level rise.

5.1 Riverine Flood Mitigation

Sanibel’s surface water management system was designed to retain freshwater, allowing the island’s wetlands to fill up until they overflow into the ocean. Improvements to the stormwater management system made by the City of Sanibel since incorporation in 1974 have dramatically reduced rainfall-based flooding across the island by improving internal hydraulic connections to encourage flow to the Sanibel Slough, and the system currently performs very well. Extensive data collection and review in the second half of 2024 found that the internal basins generally act as a level pool and runoff is efficiently conveyed to the Sanibel River and outfall weirs. One area found to need improvement was West Gulf Drive, from Island Inn Road to Rabbit Road. This area was also identified as a flood-prone area in the 2018 Stormwater Master Plan.

5.2 Storm Surge

Recent hurricanes provided reminders that the island is low and vulnerable to storm surge, which is a flooding event that is independent of the interior surface water management system. The primary system was inspected, and significant blockages were repaired by the City shortly after each storm. Additional field inspections of the secondary drainage system were conducted in the summer of 2024 to create a comprehensive update of the Surface Water Management Master Plan for Sanibel. The inspections resulted in an updated map of the system and identification of additional needed repairs. A bid solicitation package was advertised by the City in January 2025 to select a contractor to perform the remaining repair work.

5.3 *Hydrology and Water Budget*

A review of multispectral satellite imagery from 2013 to 2024 showed a sudden drop in vegetation greenness and density on Sanibel following Hurricane Ian in September 2022. Water level data at Beach Road Weir suggests a reduction in evapotranspiration caused by plant stress may be responsible for some of the hydrologic changes experienced by residents following recent hurricane events. However, the overall recovery demonstrates the long-term resiliency of natural systems, even if severely impacted in the short term.

Some sensors on Sanibel also confirmed that deep percolation from Sanibel’s interior to the sea is near zero, which is consistent with publications from 1953 and 1976. Other sensors recorded that percolation is functioning well when internal retention areas have a ditch immediately adjacent. Groundwater data shows a slight increasing trend in annual minimum water levels since 2017, but the difference is well within the historical range. Surface water stages have largely behaved as expected, increasing with storm events and decreasing during droughts.

East basin water levels changed very little from mid-October through the end of 2024, aside from a gate operation event in mid-November, which correlates with observations from residents that something in the hydrology of Sanibel changes following a storm surge event. Likely factors are reduced evapotranspiration in the first month after the storm, upland areas continually draining into the central conveyance system, a lack of percolation from the interior wetland systems, and mean sea level being at least a half-foot higher during September to November 2024 than the average sea level for the year. Additionally, when the plants on the island are stripped of their leaves after a windstorm it is much easier to see into the wetlands and notice the presence of water which is not as easily observed during times when the vegetation is lush.

5.4 *Wet Season Water Table*

Current groundwater monitoring wells show that maximum water levels on Sanibel in 2024 are very similar to those recorded in 1977. It is recommended that the water table map published in 1988 be utilized as the guide for new development in Sanibel’s interior basins. In locations where groundwater is tidally influenced, it is recommended that the South Florida Water Management District’s current minimum wet season water table/control elevation be used instead.

5.5 *Weir Policy*

Review of data from the second half of 2024 verified that operation of the gates is an effective way to reduce water levels in the basin, with very little rebounding occurring during dry periods once the gates are closed. A slight update to the weir operation policy may be beneficial to encourage the evacuation of saltwater from the interior freshwater basins, reduce environmental damages caused by a prolonged increase in salinity levels, and ensure unintended consequences do not occur due to over-draining the system. This should only be done at the beginning of the wet season, to ensure that water levels do not fall too low. In general, the primary objective of the City's Weir Control Policy should be to continue retaining as much freshwater on the island as practicable. If the City Manager deems it necessary to open the gates based on the 'Miscellaneous' condition, it is recommended that: tidal waters not be allowed to flush back into the basins, water inside the basin be held at least one foot above sea level, and coordination occur with the Lee County Mosquito Control District and the Sanibel Fire Department as well as the City's environmental partners at SCCF and Ding Darling Wildlife Refuge. Although the group did not see an opportunity for changes to the policy itself at this time, the group did recognize that there is some potential flexibility that could be allowed during the early- to mid-wet season to keep levels slightly lower than the full 2.0/1.6 NAVD levels in the policy. This allows for some additional capacity to handle high rainfall events without causing harm to the freshwater lens as it's only through the earlier portions of the wet season. Before the wet season ends, it will be necessary to resume normal full basin operations to ensure that there are no issues with maintaining freshwater levels throughout the dry season. The partners agreed that the City Manager could make these seasonal adjustments as an extension of conditions number 4 and/or number 2 of the Weir Control Policy, but that it is crucially important that there is coordination with the partners to ensure seasonal changes due not cause harm to person, property, or the environment. The City Manager has been working with the partners and City staff to test this seasonal flexibility when appropriate and all partners agreed to monitor environmental and public safety conditions so the effects can be studied for future decision-making discussions. This is an ongoing collaborative effort among the partners to understand the effects in the future. It was agreed that the effects would need to be studied over multiple years before any modified operations were put into a permanent policy change.

It is also advised that the vertical datum used in the Weir Control Policy be updated to the newer NAVD 88 from the current NGVD 29. Telemetry upgrades are recommended to the gates at both weirs to allow remote operation of the gates and real-time monitoring of gate position, upstream water level, downstream water level, and salinity.

5.6 *Surface Water Management Resiliency*

Mean sea level at the NOAA Tide Station in Fort Myers has averaged 0.17 feet NAVD 88 for the past three years (2022-2024), an increase from -0.5 feet NAVD 88 in the early 1970s and -0.4 feet NAVD 88 in the late 1990s. Sea level rise projections for Sanibel anticipate mean sea level will rise to 1.1 feet NAVD 88 in 2070 based on NOAA's Intermediate-Low scenario, 1.5 feet NAVD 88 in the Intermediate scenario, or 2.3 feet NAVD 88 in the Intermediate-High scenario. It is recommended that the minimum roadway elevation for Sanibel be at least 4.3 feet NAVD 88, which would require raising approximately 50% of the City's roadways. This provides protection of roadways from road base failure for the next 45 years in the Intermediate-High sea level rise scenario.

FEMA maps of Sanibel published in 2022 show minimal flooding occurs in developed areas during the 2-year storm surge event. However, if the NOAA Intermediate-High sea level rise scenario for 2070 becomes reality, most developed areas will experience flooding in the 2-year storm surge event, with depths ranging from one to four feet above ground level. This level of inundation is similar to what was recently experienced on Sanibel from Hurricanes Helene and Milton in 2024. Over the next fifty years, residents of Sanibel need to be increasingly in tune with storm forecasts and evacuate the island when necessary.

The current 2-year storm surge elevation of 3 feet NAVD 88 indicates that regular overtopping of both weirs should be expected. Adding a backflow prevention flap gate at Tarpon Bay Weir and increasing the height of the existing flap gate at Beach Road Weir would be beneficial in reducing saltwater intrusion into the east basin from monthly high tides and minor storm surge events. However, the maximum height of the flap gate is limited by other low spots around the perimeter of the basins which would allow inflow that bypasses the weirs. In the interim, repairs are required to the flap gate at the Beach Road Weir to ensure the flap gate is achieving a sufficient seal.

5.7 *Assessment of Stormwater Ponds across Sanibel*

Sanibel has both manmade and natural bodies of water that act as detention areas for the island's freshwater. There have been concerns in some areas of the island that the open bodies of water within the City, such as wet detention ponds, have not maintained adequate depth since their original installation, which reduces water quality but does not impact flooding. Ensuring that these bodies of water are sufficiently deep is an important factor in keeping the system functioning correctly. With Sanibel's high water table, most ponds do not require extreme depths to maintain adequate residence time for water quality purposes. The City itself does not own many of the ponds or lakes so it would be important to coordinate with the private property owners and to verify which lakes are a component of publicly maintained systems. As part of future evaluation of the system, the City may desire to perform an island-wide evaluation of these ponds or evaluate them individually as regional issues are identified.

5.8 *Future Surface Water Management Plan Review*

Since Sanibel's incorporation, the Surface Water Management Master Plan has been reviewed and updated on a regular basis. The plan was last evaluated and revised by Johnson Engineering in 2018, although that updated plan remained in draft form since it was never approved by City Council.

This update of the master plan was heavily focused on the impacts of Hurricane Ian and other tropical storm surge events to assess the unique impacts those events had on Sanibel's surface water systems. This plan also evaluates how the island's future resiliency will change as the island copes with future sea level rise. The City should evaluate future updates every 3-5 years as conditions of the system change. It is recommended that the Master Plan be updated at least every 10 years.

5.9 *Public Education*

Sanibel's freshwater wetland environment requires a unique form of surface water management that is often not familiar to visitors and new residents. With this in mind, it is important to continue educating the public about how Sanibel's surface water is managed, as well as the realities that come with living on a barrier island. As part of a public workshop for this update to the Master Plan, four display boards were presented, showing many aspects of this plan. These boards can be found in **Appendix E** and include information that the City will incorporate into future surface

water management education materials. The **Drainage Features Map Book** created by Johnson Engineering can also be converted to a viewable GIS map on the City's website.

It is important for Sanibel's residents and business owners to stay educated on current stormwater-related conditions as they work and live within Sanibel's unique environment. Through the public comments (found in **Appendix D**) and engagement with public at the workshop, the City found most residents were looking to understand how storm surge and rainfall flooding differ along with understanding how they can best maintain their properties to conform with Sanibel's surface water system. When property owners are developing or restoring properties it is important to understand not just how the island's overall system works, but also how a specific neighborhood's stormwater system works and how it fits into the larger picture. Some subdivisions work differently than others and it is common for residents to not realize that until their first wet season in town. It is also important for property owners to review the FEMA flood maps for their property to understand the proper elevations for new buildings. Areas of homes below the FEMA flood elevation (such as garages) should be planned appropriately and it should be recognized that these areas are designed to flood, especially in severe storm events.

Many neighborhoods have shared subdivision retention areas such as large community lakes. All other properties are required to have on-site retention to manage rainfall within property limits. It is crucial to understand that these areas do not drain after rainfall; instead, they fill up and excess water may overflow to another area, but they are not designed to drain dry. It is important for property owners to know this, as during development many sites preserve natural low-lying retention areas or create new areas to hold water during and after rainstorms. If property owners do not recognize the importance of these low-lying areas which are typically filled with standing water, they may mistakenly fill areas in and create issues with stormwater runoff as a result.

The importance of roadside swales in subdivisions is another aspect of stormwater management that is often forgotten about by property owners. These swales are designed to hold stormwater and allow excess water to overflow through connections to the island's stormwater systems. It is normal for swales on Sanibel to hold water. Swales within the public right-of-way should not be modified without coordination with the City's Public Works Department. Failure to properly coordinate swale modification work can cause issues with how the surrounding system functions.

SECTION 6 – CAPITAL IMPROVEMENT PLAN

Many Capital Improvement Projects have been implemented by the City over the past 50 years which have been beneficial in reducing riverine (rainfall-based) flooding. Steps taken include rebuilding water control structures, replacing undersized culverts, and updating the land development code. Further Capital Improvement Projects, listed in **Table 8**, are recommended to reduce saltwater intrusion, expedite post-storm recovery efforts, mitigate the effects of projected sea level rise, and improve drainage in flood-prone areas within the City.

Table 8. Capital Improvement Plan.

Short, Intermediate, or Long-term	Master Plan Future Capital	Project Type	Design Cost	Design FY	Construction Cost	Construction FY
Short	Beach Road Weir Flap Gate Modifications	Weir System	\$ 65,000	TBD	\$ 250,000	TBD
Short	Tarpon Bay Weir Flap Gate Addition	Weir System	\$ 65,000	TBD	\$ 250,000	TBD
Short	*Tradewinds Subdivision Drainage	Area Specific Project	Design Complete	--	\$ 4,500,000	TBD
Short	Bailey Road Drainage	Area Specific Project	\$ 35,000	TBD	\$ 150,000	TBD
Short	*Sanibel Slough Dredging	Slough Dredging	\$ 212,000	25	\$ 1,630,000	26
Short	*Clam Bayou Box Culvert Replacement	Box Culvert	\$ 800,000	26	\$ 4,000,000	27
Short	*East Periwinkle Box Culvert Replacement	Box Culvert	\$ 750,000	28	\$ 4,000,000	29
Short	*Beach Road Weir Rehabilitation	Weir System	Design Complete	--	\$ 750,000	26
Short	<i>Annual Swale Maintenance</i>	<i>Ongoing Maintenance</i>	--	--	<i>\$ 250,000 – \$ 500,000</i>	<i>Annually</i>
Intermediate	Beach Road Weir Pump Station	Weir System	\$ 300,000	TBD	\$ 2,500,000	TBD
Intermediate	Tarpon Bay Weir Pump Station	Weir System	\$ 300,000	TBD	\$ 4,900,000	TBD
Intermediate	Beach Road Weir Gate Automation	Weir System	\$ 150,000	TBD	\$ 800,000	TBD
Intermediate	Tarpon Bay Weir Gate Automation	Weir System	\$ 150,000	TBD	\$ 800,000	TBD
Intermediate	West Gulf Drive Drainage	Area Specific Project	\$ 240,000	TBD	\$ 2,400,000	TBD
Long	Road Elevating (Dixie, Bailey, Tarpon)	Road Elevation	\$ 2,924,000	TBD	\$ 29,240,000	TBD
	FY26 Total		\$ 800,000		\$ 2,380,000	
	Total		\$ 5,991,000		\$ 56,170,000	

Note: Asterisk () indicates item in City's current CIP plan.*

6.1 2018 Surface Water Master Plan Recommendations

The 2018 draft Surface Water Master Plan update has been a useful resource for the City, although it was never council approved. The **Table 9** shows the status of various recommendations made in the 2018 Master Plan. The flood prone areas map found in the 2018 Plan is a resource the City uses when prioritizing maintenance to keep the system functioning. Some of these areas, such as the West Gulf at East Rocks entrance and the Tradewinds subdivision have been looked at as areas for proposed or already completed capital improvement projects. However, not all flood prone areas may require a capital improvement project, as the 2018 Plan also noted that some areas may just require additional maintenance compared to other areas to manage stormwater appropriately. The stormwater repair project involved extensive swale regrading and infrastructure cleaning in these areas. It is recommended with this update that the City continue to use this map of flood-prone areas as a guide for determining where potential future work may be needed. GIS-based mapping is something that has been developed over the past several years and the city will work on that system in the future to keep data updated and accurate. The GIS system will also provide opportunities for tracking maintenance and inspection work within the system.

Table 9. Status of 2018 Master Plan recommendations.

Project	Status
Dredge Downstream Sanibel Slough	Underway
Switch to GIS-Based Inspection System	Complete
Land Development Code Changes	
Flood Prone Areas	
Jamaica & Tahiti Flood Improvements	Designed
Algiers Lane south of Casa Ybel Road	Continue to Monitor
Atlanta Plaza Drive north side of Casa Ybel Road	Continue to Monitor
Periwinkle Way and Dixie Beach Boulevard	Continue to Monitor
Residential streets near Donax St., from Middle Gulf Dr. to Junonia St.	Continue to Monitor
East Rocks Entrance Area	Complete

6.2 Weir System Improvements

Improvements to the existing outfall weirs are recommended to improve operational flexibility and reduce saltwater intrusion into the interior freshwater wetland ecosystem in the City's interior.

Pump Stations at Weirs: As previously noted, high sea level is the primary limitation to flow out of the weir gates. Releases generally occur when freshwater stages are well above sea level, but there are times when the City Manager may want to preemptively evacuate as much water as possible (e.g., before a hurricane). When tidal waters exceed interior freshwater stages, the gates cannot be opened since they would not be able to lower the stage and would instead allow saltwater backflow. And, with potential future sea level rise, this could become a more common obstacle to releasing water. To combat this issue, pump stations could be installed at both weirs. This improvement would give the City Manager an increased ability to release water when the gravity system is limited by high tides. However, it should be noted that pumps will not negate storm surge or increase flow capacity – they would simply allow the system to continue working as it does today.

Flow through the existing weir gates was considered when determining appropriate pump sizes. Given a head difference of 6 inches between headwater and tailwater at the weirs, the Beach Road Weir gates would allow a flow of about 91,000 gallons per minute (gpm), or 204 cubic feet per second (cfs). Under the same conditions, the Tarpon Bay Weir gates would allow a flow of around 183,000 gpm, or 408 cfs. These flows are significant, and several pumps operating simultaneously would be required to match this flow capacity. Space constraints around the weirs will likely limit the size of the pumps to be much smaller than these conceptual flowrates.

Three pump size options for each weir were evaluated, and the time it would take each to reduce basin water levels by 6 inches was estimated. In this scenario, it is assumed that no rainfall or other inflow occurs during while the drawdown is performed. These options are compared in **Table 10**.

For constructability and budgetary reasons, it is recommended that portable trailer pumps be considered as an alternative to constructing permanent pump stations. If trailer pumps were implemented, it is estimated that a maximum of two pumps with capacities of 30 cfs each could be placed at Beach Road Weir, and four at Tarpon Bay Weir. In this scenario, Beach Road Weir would have a pumping capacity of 60 cfs, and Tarpon Bay Weir would have a capacity of 120 cfs. The 1989 Conceptual Plan for an entirely pump-controlled surface water

management system recommended pump sizes of 60 cfs and 350 cfs for the Beach Road and Tarpon Bay weirs, respectively, under the “all pump” scenario, which was not the final recommendation of the report. The report instead recommended continuing with gravity flow at the weirs. Stormwater modeling performed for the 2018 Master Plan shows that the peak flow at Beach Road Weir for the 3-year, 1-hour design storm (depth = 2.4 inches) is about 150 cfs, and this flow capacity was included as an option in the table at both locations.

Table 10. Comparison of pump sizes and drawdown times.

Weir	Scenario	Flow (cfs)	6" Drawdown Time (hours)
Tarpon Bay	<i>Four Trailer Pumps</i>	120	40
Tarpon Bay	<i>150 cfs Design Match</i>	150	32
Tarpon Bay	<i>1989 Plan “All Pump” Scenario</i>	350	14
Tarpon Bay	<i>Existing Gates (No Pump)</i>	300-400	12-24
Beach Road	<i>1989 Plan “All Pump” Scenario</i>	50	64
Beach Road	<i>Two Trailer Pumps</i>	60	54
Beach Road	<i>3-Year, 1-Hour Storm</i>	150	22
Beach Road	<i>Existing Gates (No Pump)</i>	150-200	16-32

Automation of Weir Gates: Currently, weir gates must be manually opened or closed by on-site personnel. Installing motors with a remote operating system would make it possible for city staff to operate the gates without having to place themselves in potentially dangerous situations by going out to the weir during storms. Additionally, since it would allow for remote operation of the gates at night, it would allow the City to adjust the gates without being on-site in the middle of the night.

Weir Flap Gate Modifications: Beach Road Weir already has a 1-foot flap gate which is designed to protect against saltwater intrusion from sea levels up to 2.5 feet NAVD 88. Based on historical specific conductivity data, it is possible that this flap is not sealed properly. If this is true, it is recommended that the flap gate be repaired. The City may also want to consider installing a larger flap gate to prevent saltwater intrusion at stages above 2.5 feet NAVD 88.

Tarpon Bay Weir has a crest elevation of 2.0 feet NAVD 88 and does not have a flap gate. As a result, it is more vulnerable to backflow than Beach Road Weir is, so installing a backflow prevention gate may be advantageous.

Beach Road Weir Rehabilitation: This project will involve repairs to the existing weir structure, including repairs to the wall and controls for the sluice gates. The repair items do not currently affect functionality.

6.3 *Box Culvert Installations*

Based on post-Ian inspections by others, the existing box culverts at Clam Bayou and East Periwinkle are damaged and should be replaced.

Clam Bayou Box Culvert: Design for the Clam Bayou Culvert is expected to begin in FY 26, and construction is anticipated to begin in FY 27. Funding will be provided by the Hurricane Ian Stormwater Repair grant from FDEP.

East Periwinkle Box Culvert: Design for the East Periwinkle Box Culvert is expected to begin in FY 29 and construction is anticipated to begin in FY 30.

6.4 *Area-Specific Projects*

The 2018 Master Plan found that the repetitive flooding which occurs in certain areas of Sanibel is likely a localized issue caused by a lack of maintenance or hydraulic connectivity to the Sanibel River.

Tradewinds Subdivision Drainage: The City has identified the Tradewinds subdivision as a flood-prone area. According to drainage improvement plans developed by Haley Ward, Inc., the system was initially designed to outfall into the Gulf but is now routed to the interior of the island. The drainage system needs to be updated so that flow will be directed toward the Sanibel River. This will involve regrading swales and replacing or adding new culverts and inlets. Design is already complete.

West Gulf Drive Drainage: West Gulf Drive has been identified as a flood-prone area, likely due to a lack of drainage infrastructure. The suggested improvement project would involve improvement of approximately 2,700 LF of roadside swales and culverts, which

would connect to the swale on the east side of Rabbit Road. This project was also recommended in the 2018 Stormwater Master Plan.

Bailey Road Drainage Improvements: This project is the addition of a culvert under Bailey Road to improve hydraulic connectivity.

6.5 Road Elevation

Following the citywide analysis of roadway elevations, city representatives identified three roads as ideal candidates for being raised to the minimum recommended roadway elevation of 4.3 feet NAVD 88 to maintain road base integrity. In total, the construction cost of raising these roads is anticipated to be about \$29 million. Dixie Beach Boulevard and Bailey Road were chosen as they are some of the lowest-elevation roads on Sanibel, problematically low (as seen in **Exhibit 4**), and Tarpon Bay Road is an important thoroughfare with some areas below the standard. In total, raising 2.75 miles of road (8% of roads which need to be raised) to 4.3 feet NAVD 88 is proposed. It is estimated that procuring and installing sheet piles will cost \$6.3 million per mile, accounting for over half the project's cost. See **Table 11** for a detailed cost breakdown.

Dixie Beach Boulevard Elevating: This project involves raising 1.74 miles of paved road to elevation 4.3 feet NAVD 88. Currently, this road's average elevation is about 2.89 feet NAVD 88.

Bailey Road Elevating: This project involves raising 0.42 miles of paved road to elevation 4.3 feet NAVD 88. Currently, this road's average elevation is about 3.09 feet NAVD 88.

Tarpon Bay Road Elevating: This project involves raising 0.59 miles of paved road to elevation 4.3 feet NAVD 88. On average, this section is at elevation 3.96 feet NAVD 88.

Table 11. Itemized cost estimate for elevating roads.

Bid Line Item	Dixie Beach	Bailey Road	Tarpon Bay Road
Mobilization	\$1,291,000	\$307,000	\$418,000
Maintenance of Traffic	\$645,000	\$154,000	\$209,000
Sheet Pile	\$10,962,000	\$2,646,000	\$3,717,000
Import Fill	\$1,300,000	\$268,000	\$216,000
Asphalt Overlay	\$375,000	\$91,000	\$128,000
Asphalt Milling	\$247,000	\$60,000	\$114,000
Road Striping	\$27,000	\$7,000	\$9,000
30% Contingency	\$3,873,000	\$921,000	\$1,255,000
<i>Sub-Total</i>	<i>\$18,720,000</i>	<i>\$4,454,000</i>	<i>\$6,066,000</i>
Total			\$29,240,000

6.6 Sanibel Slough Dredging

Sanibel Slough is considered “impaired” by the Florida Department of Environmental Protection (FDEP) due to excessive nutrients. To improve water quality and increase stormwater capacity, a dredging project is underway. This project is the dredging of approximately 1,100 linear feet of canal between Elinor Road and Beach Road. This project is currently in the permitting phase and construction is expected to begin in 2026. Dredging is expected to begin in FY 26 and will be funded by grants from FDEP and EPA. Once construction is complete, the City will monitor water quality and stormwater capacity improvements to determine if dredging other areas would be beneficial.

SECTION 7 – REFERENCES

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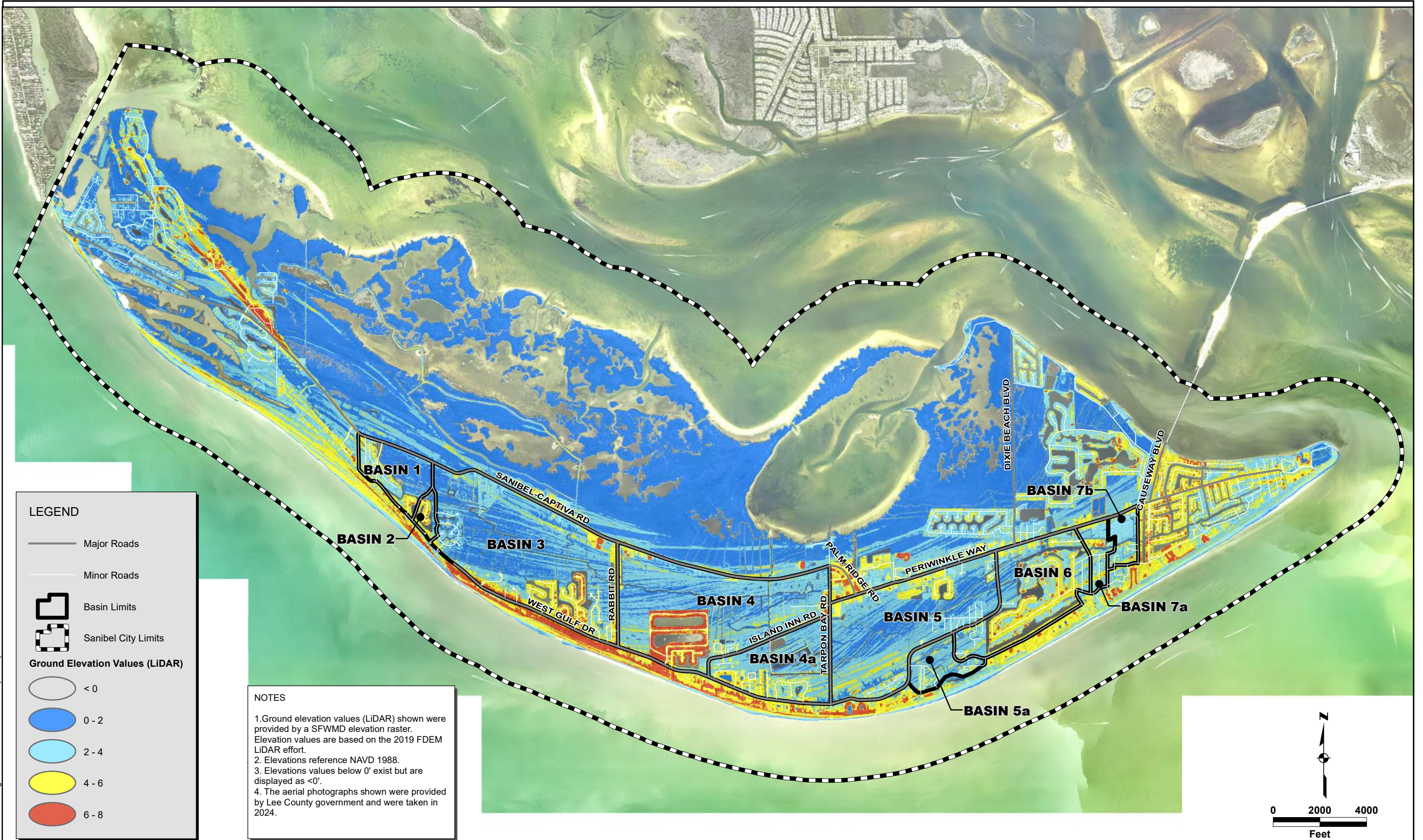
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EXHIBITS

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City of Sanibel
Lee County, Florida

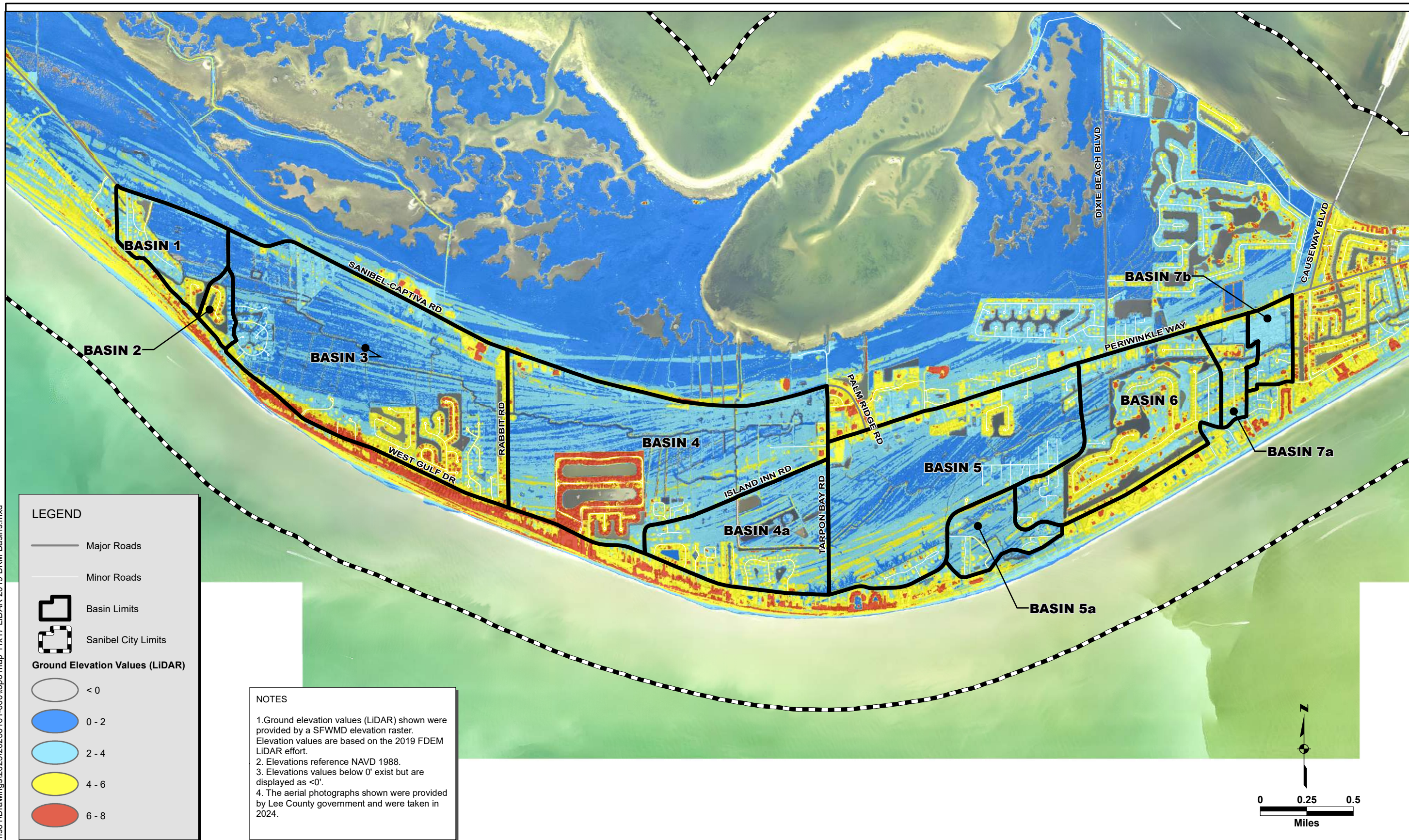
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Topographic Map of Sanibel

DATE	PROJECT NO.	FILE NO.	SCALE	SHEET
Jan 2025	20236161-001	--	As Shown	1

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LEGEND

- Major Roads
- Minor Roads
- Basin Limits
- Sanibel City Limits

Ground Elevation Values (LiDAR)

- < 0
- 0 - 2
- 2 - 4
- 4 - 6
- 6 - 8

NOTES

1. Ground elevation values (LiDAR) shown were provided by a SFWMD elevation raster. Elevation values are based on the 2019 FDEM LiDAR effort.

2. Elevations reference NAVD 1988.

3. Elevations values below 0' exist but are displayed as <0'.

4. The aerial photographs shown were provided by Lee County government and were taken in 2024.

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Topographic Map of Sanibel Interior

DATE	PROJECT NO.	FILE NO.	SCALE	SHEET
Jan 2025	20236161-001	--	As Shown	2



\\fms01\Drawings\2023\20236161-000\Sanibel 11x17 Bottom BKM.mxd

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Lee County, Florida

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Surface Water and Surficial Aquifer
Monitoring Well Locations

DATE	PROJECT NO.	FILE NO.	SCALE	SHEET
Jan 2025	20236161-001	-	As Shown	3

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Stormwater Master Plan
City of Sanibel, Florida

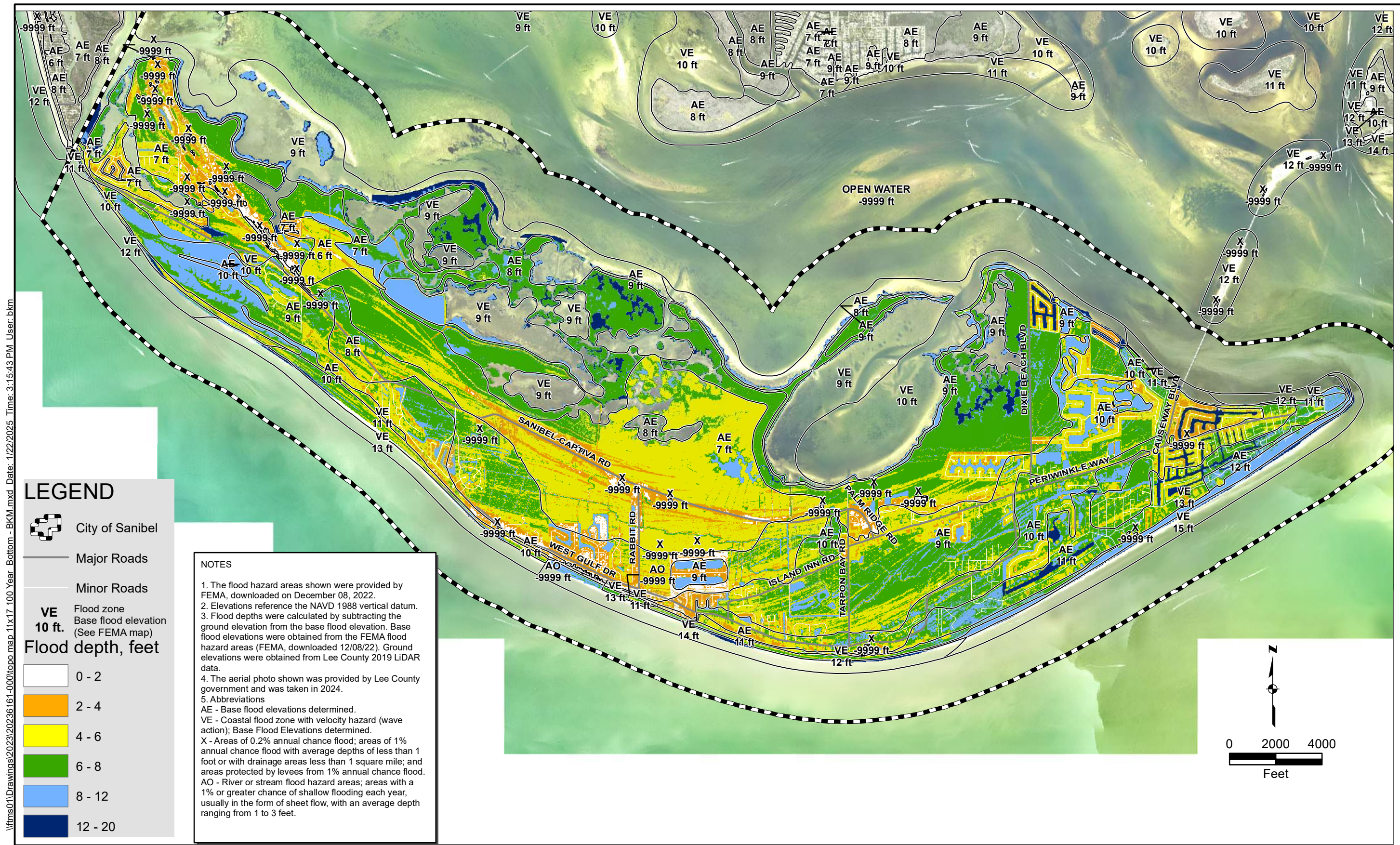
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Road Elevation Map
(Existing Public Roads)

DATE	PROJECT NO.	FILE NO.	SCALE	SHEET
Jan 2025	20236161-001	-	As Shown	4

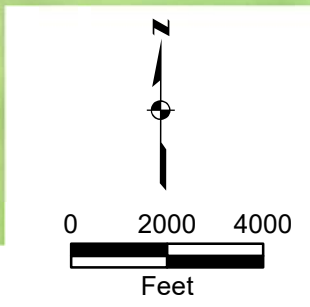
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LEGEND

-  City of Sanibel
-  Major Roads
-  Minor Roads
- VE** Flood zone
10 ft. Base flood elevation
(See FEMA map)
- Flood depth, feet**
-  0 - 2
-  2 - 4
-  4 - 6
-  6 - 8
-  8 - 12
-  12 - 20

- NOTES
- The flood hazard areas shown were provided by FEMA, downloaded on December 08, 2022.
 - Elevations reference the NAVD 1988 vertical datum.
 - Flood depths were calculated by subtracting the ground elevation from the base flood elevation. Base flood elevations were obtained from the FEMA flood hazard areas (FEMA, downloaded 12/08/22). Ground elevations were obtained from Lee County 2019 LiDAR data.
 - The aerial photo shown was provided by Lee County government and was taken in 2024.
 - Abbreviations
AE - Base flood elevations determined.
VE - Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
X - Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
AO - River or stream flood hazard areas; areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet.



City of Sanibel
Lee County, Florida

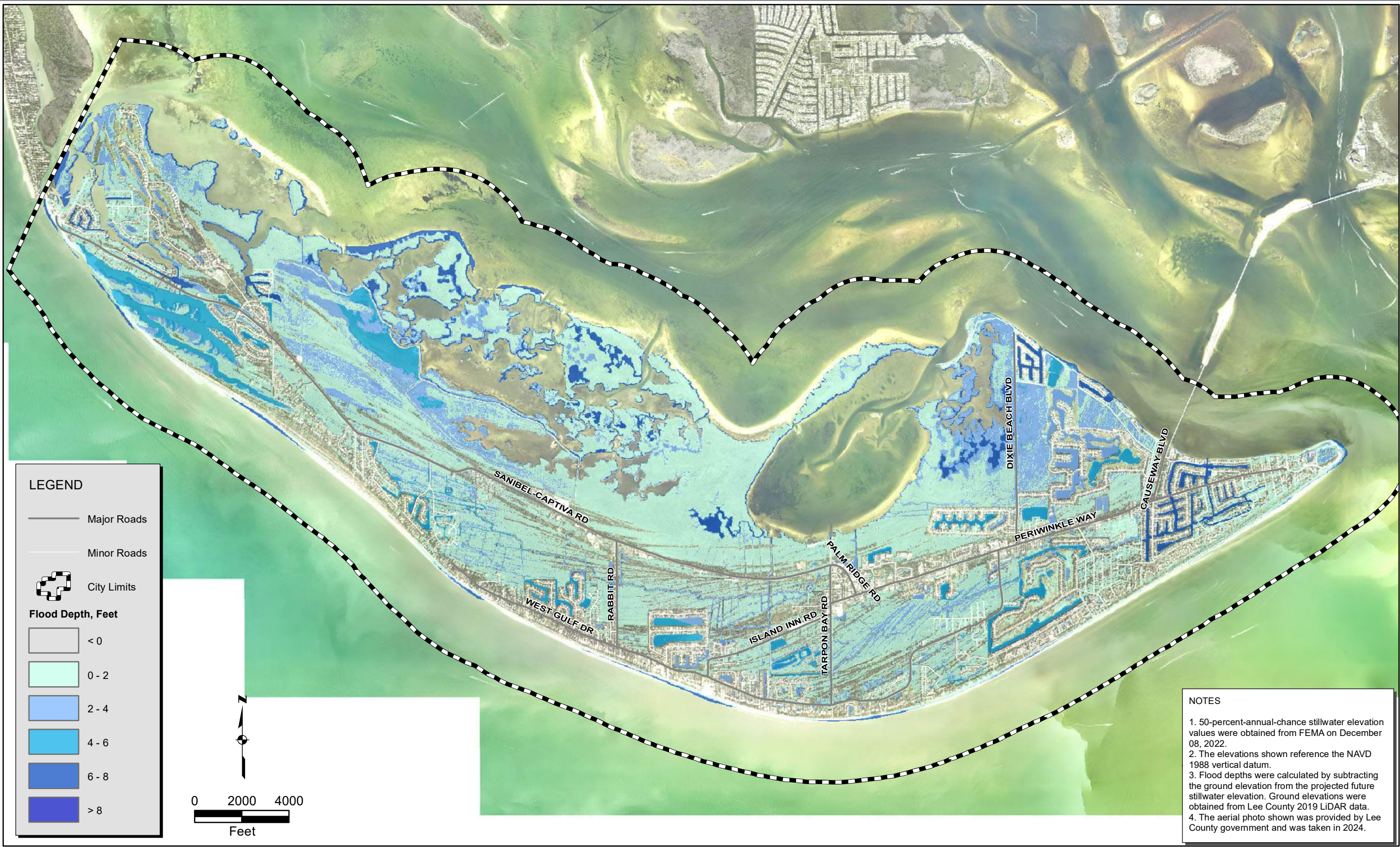
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FEMA Flood Depth Map at 100-year Event
(2022 Publication Date)

DATE	PROJECT NO.	FILE NO.	SCALE	SHEET
Dec. 2024	20236161-001	-	As Shown	5

\\fms01\Drawings\2023\20236161-000\50-pct Inundation Bottom BKM 10.0.mxd Date: 1/22/2025 Time: 3:17:56 PM User: bkm



- NOTES
1. 50-percent-annual-chance stillwater elevation values were obtained from FEMA on December 08, 2022.
 2. The elevations shown reference the NAVD 1988 vertical datum.
 3. Flood depths were calculated by subtracting the ground elevation from the projected future stillwater elevation. Ground elevations were obtained from Lee County 2019 LiDAR data.
 4. The aerial photo shown was provided by Lee County government and was taken in 2024.

Stormwater Master Plan
City of Sanibel, Florida

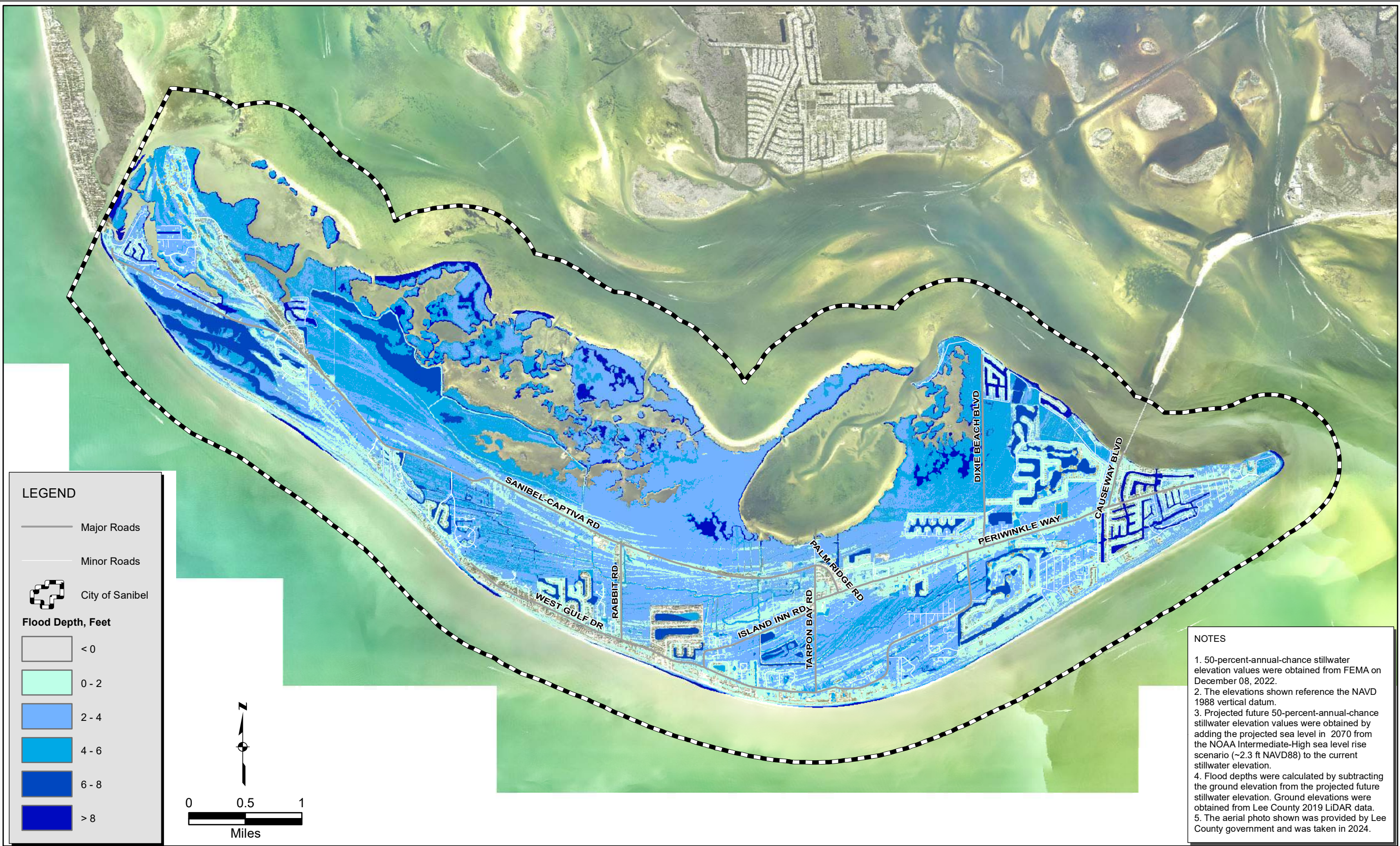
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FEMA Coastal Flood Hazard Analysis
2022 Stillwater Flood Depth Map
50-Percent-Annual-Chance Storm Surge

DATE	PROJECT NO.	FILE NO.	SCALE	SHEET
Dec 2024	20236161-001	-	As Shown	6

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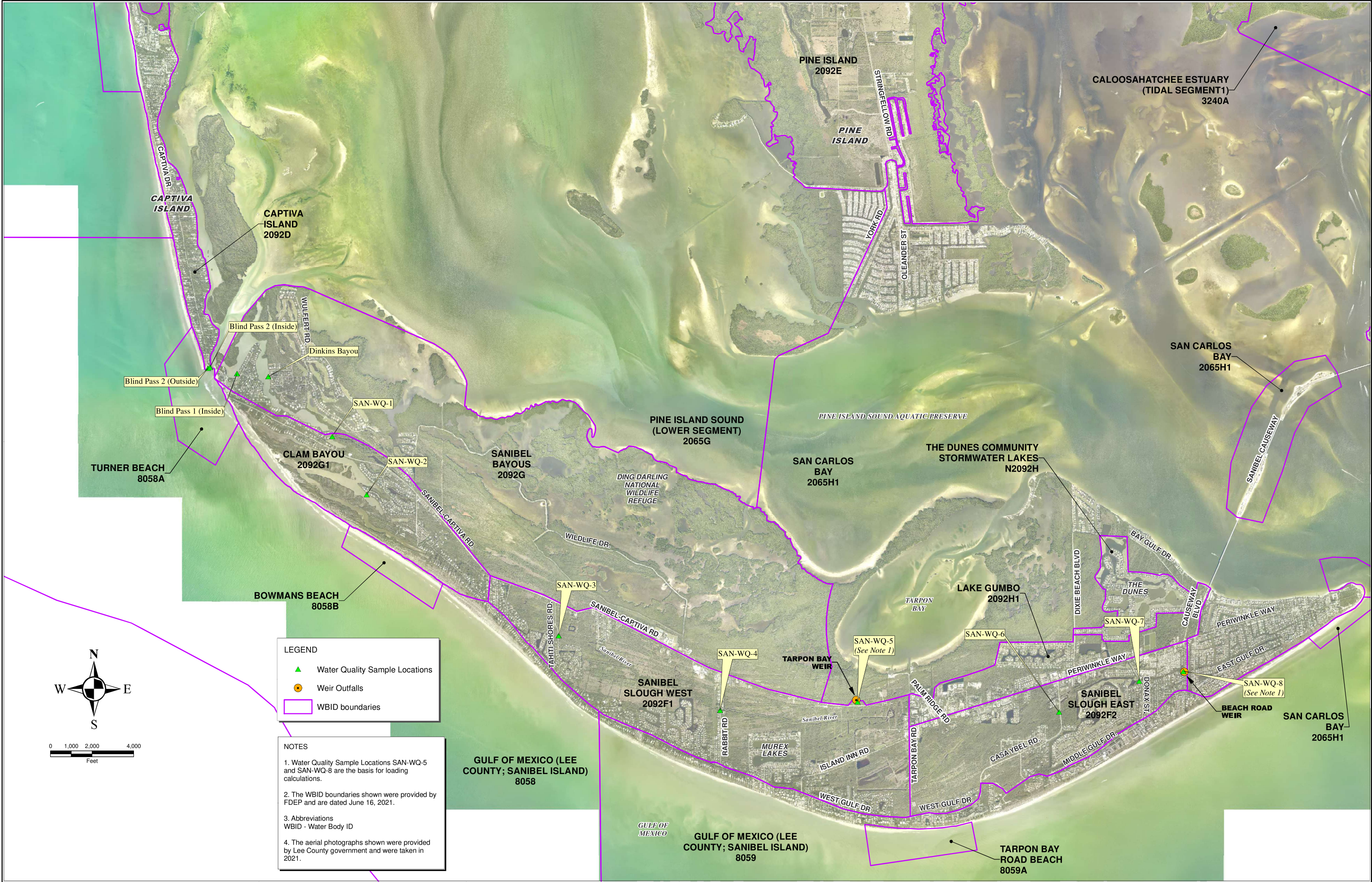
Stormwater Master Plan
City of Sanibel, Florida

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FEMA Coastal Flood Hazard Analysis
2070 Projected Stillwater Flood Depth Map
50-Percent-Annual-Chance Storm Surge

DATE	PROJECT NO.	FILE NO.	SCALE	SHEET
Jan 2025	20236161-001	-	As Shown	7



REVISIONS		

City of Sanibel
Lee County, Florida

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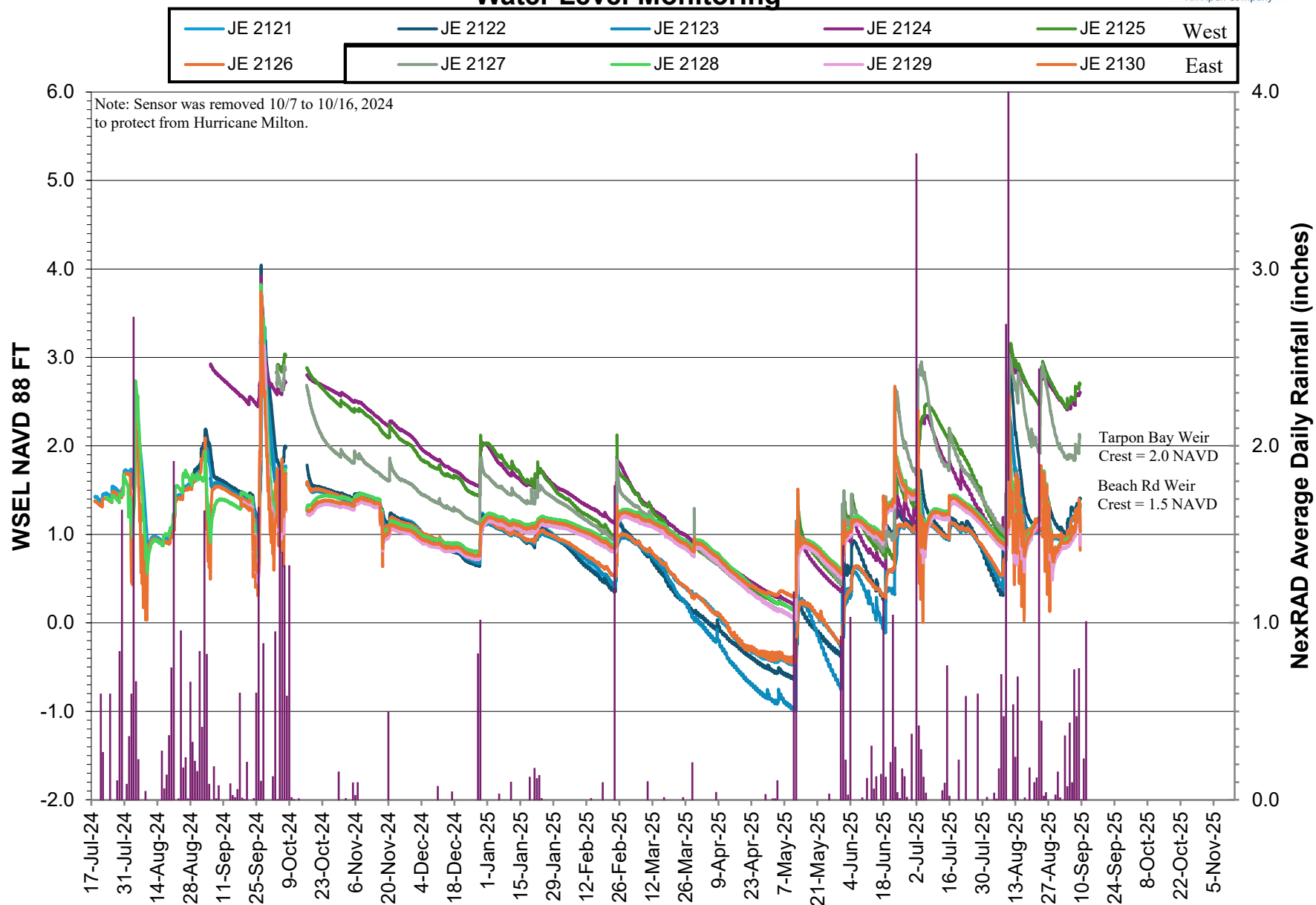
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Sample Location Map				
DATE	PROJECT NO.	FILE NO.	SCALE	SHEET
JULY 2025	20238161-001	-	As Shown	8

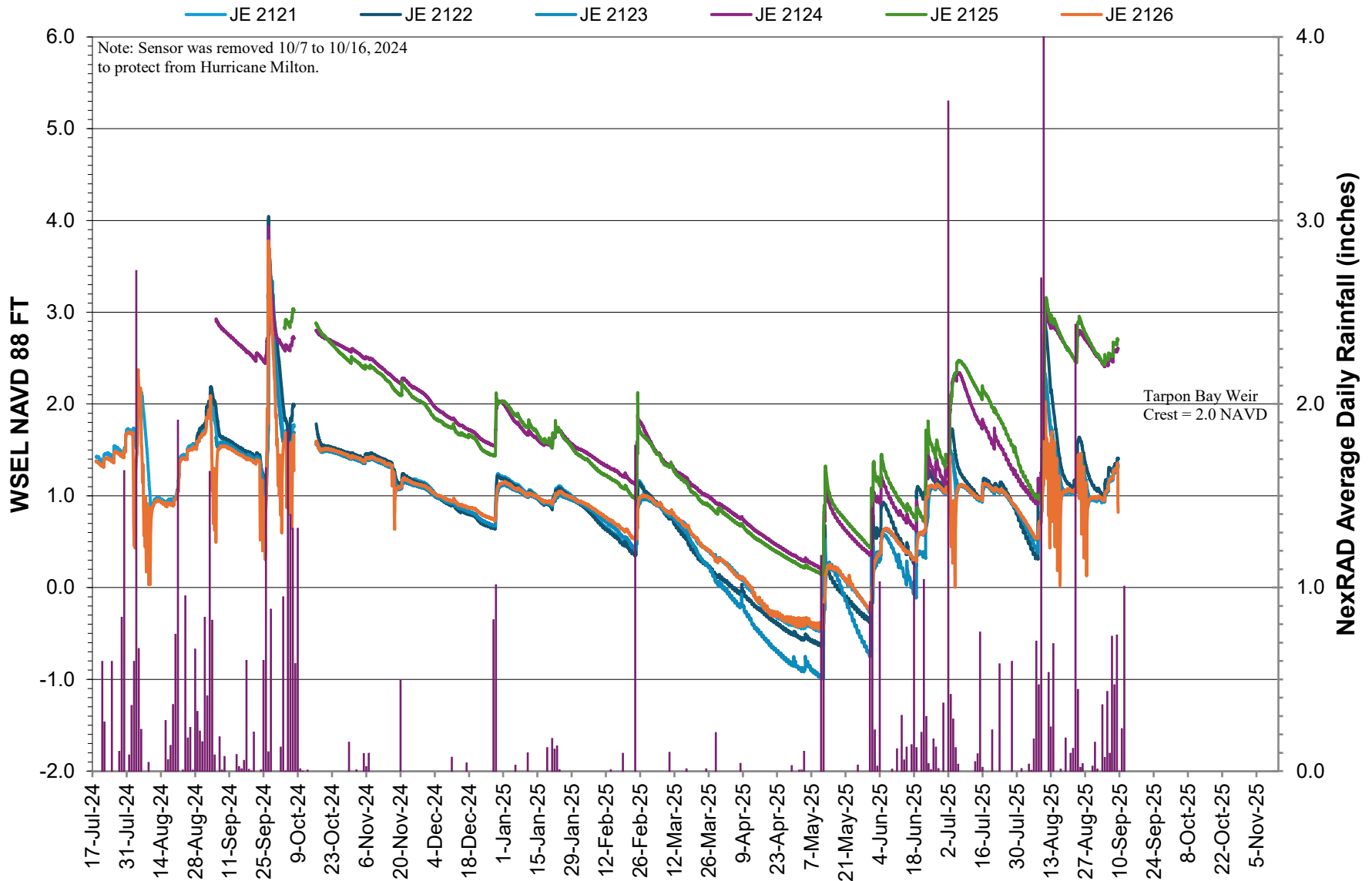
APPENDIX A

Water Levels of Freshwater Basins – July 2024 to August 2025

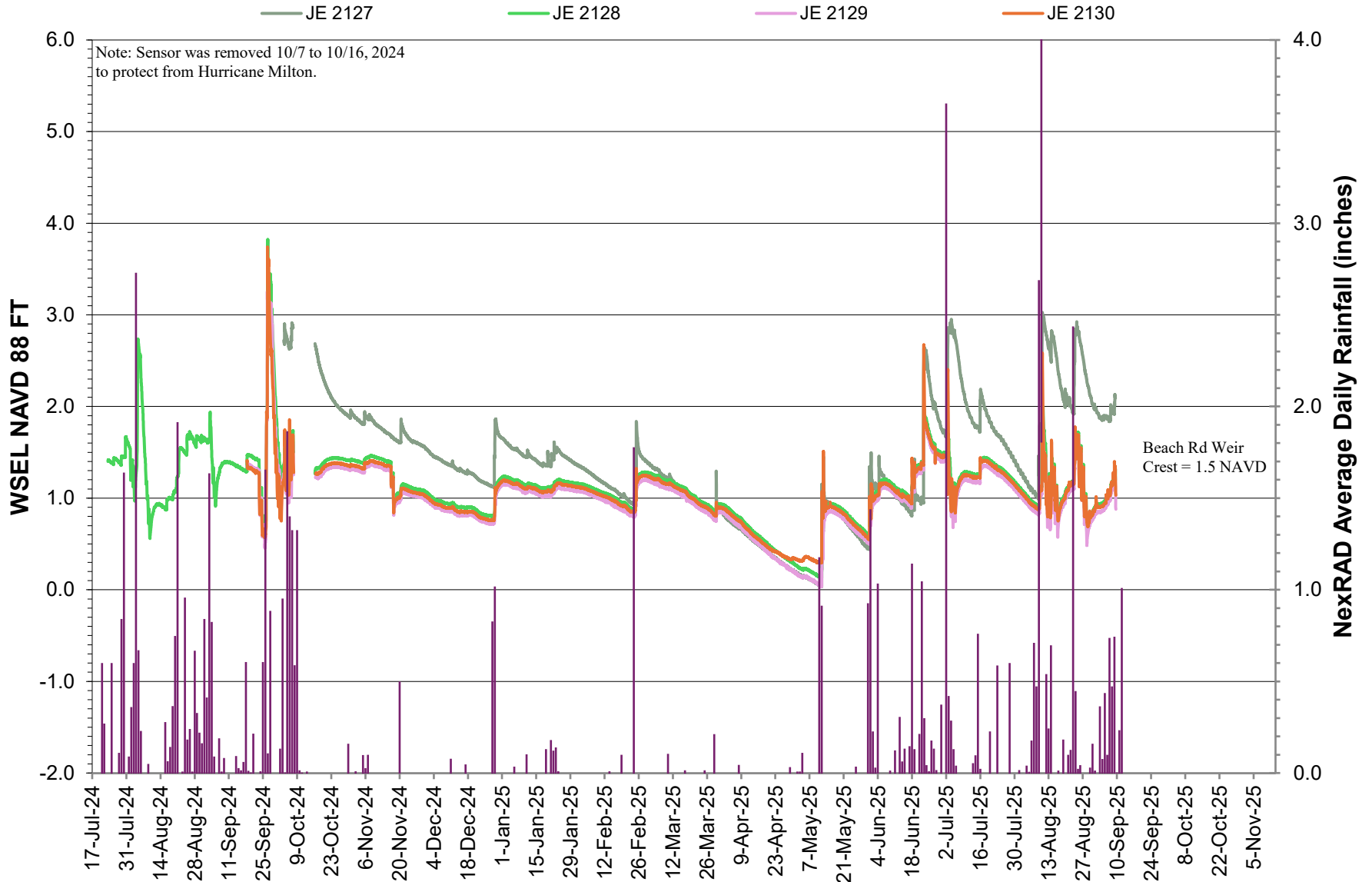
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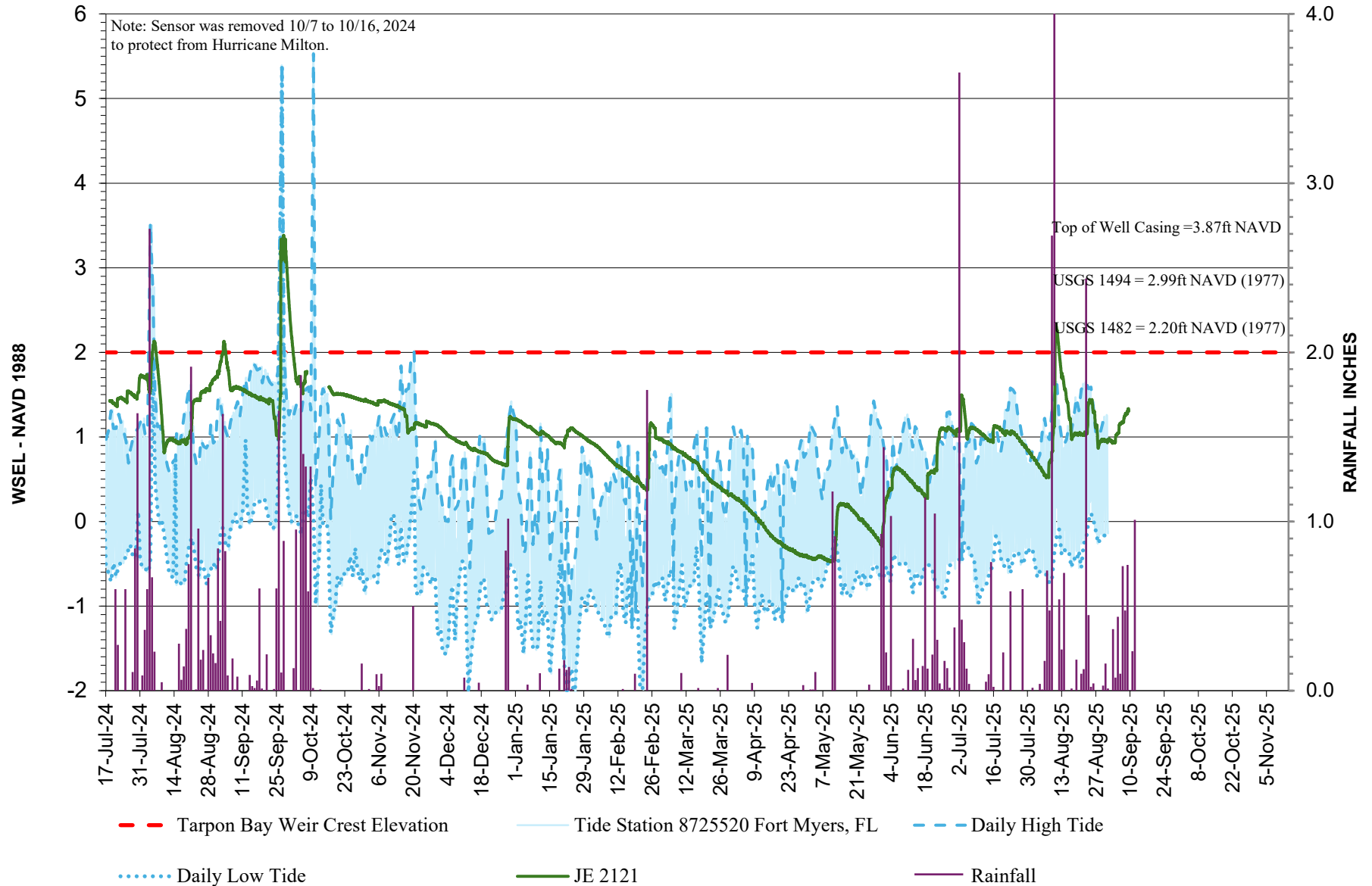
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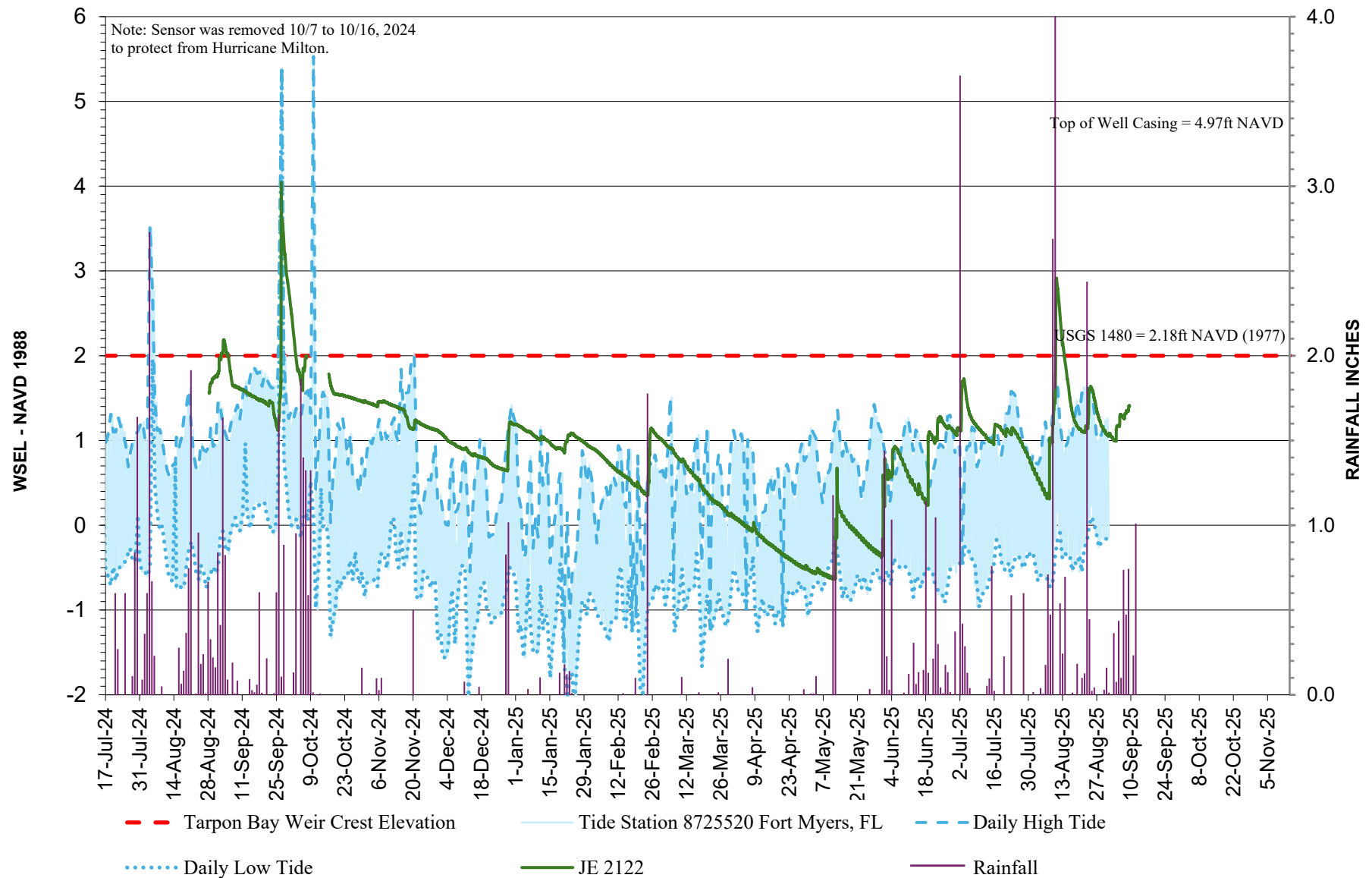
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Sanibel Island Water Levels- JE 2121

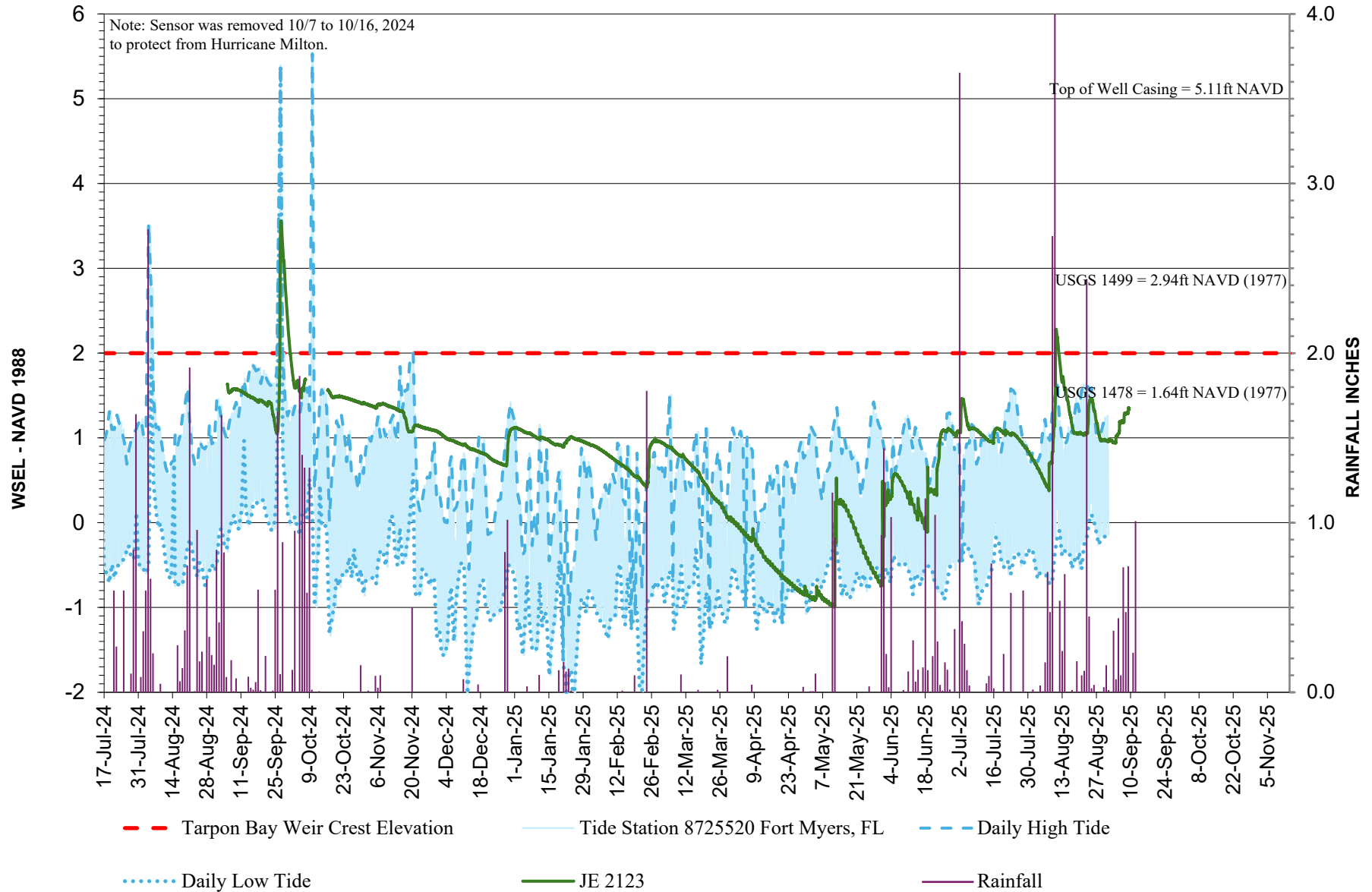


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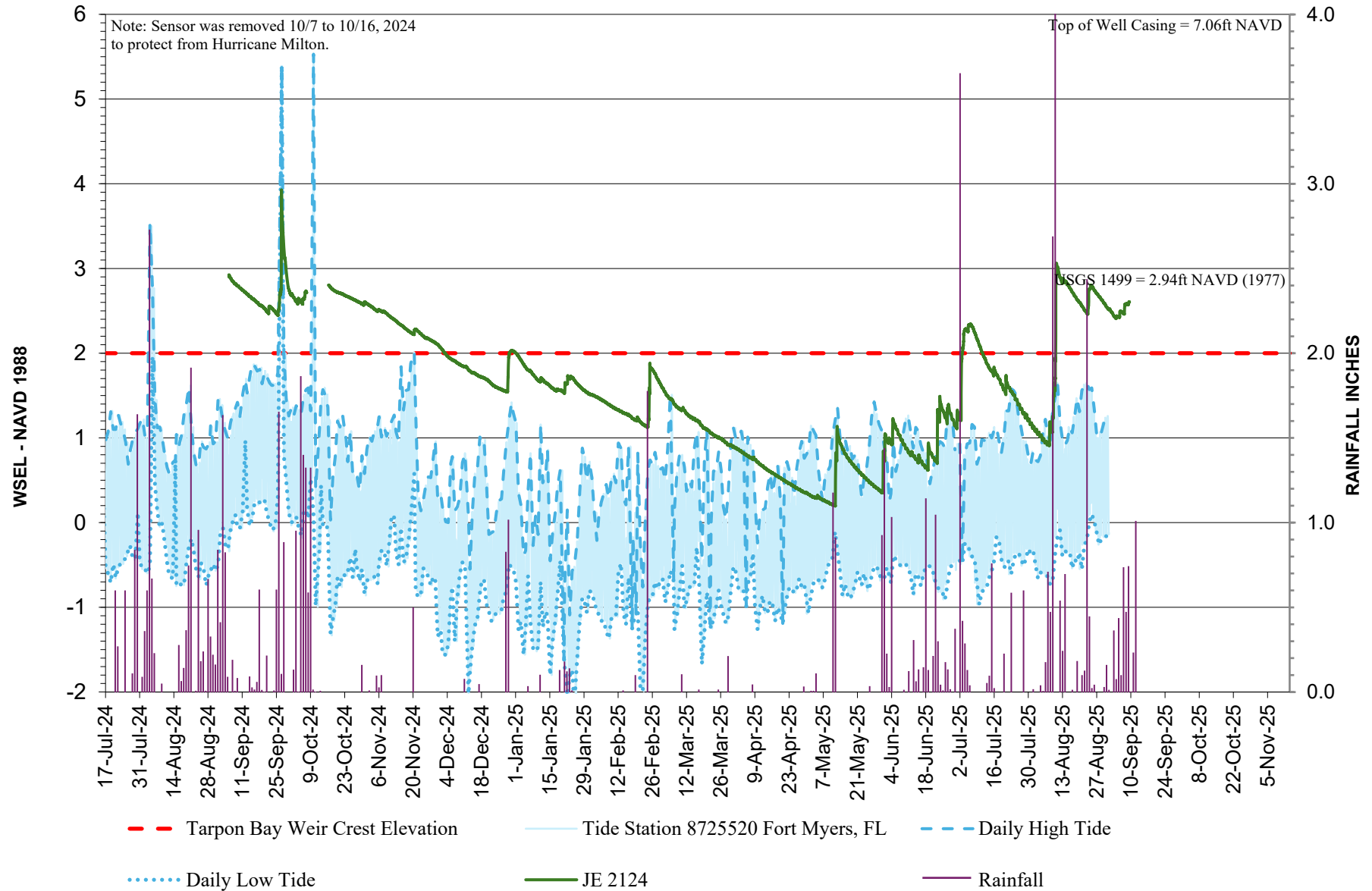
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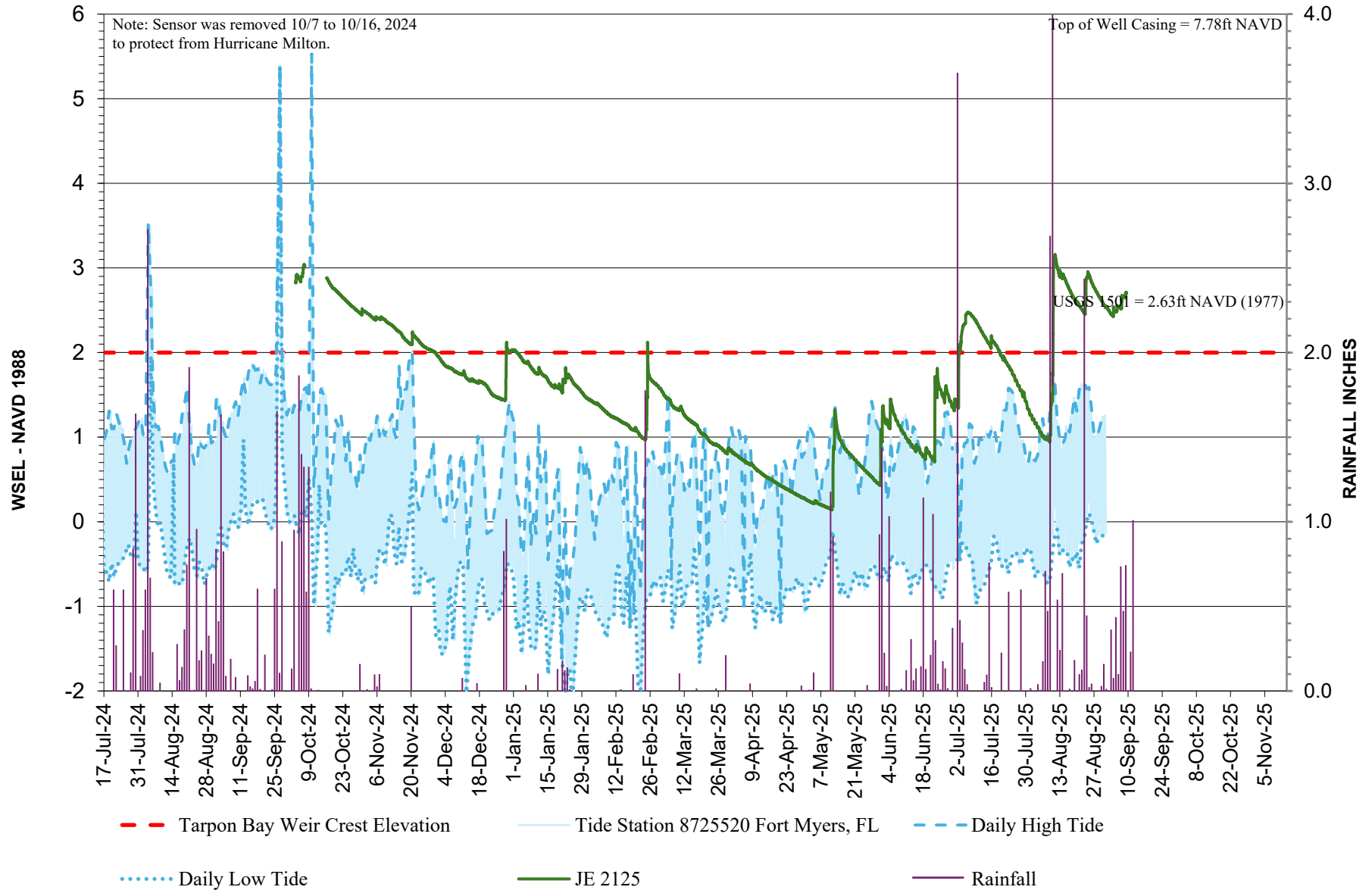
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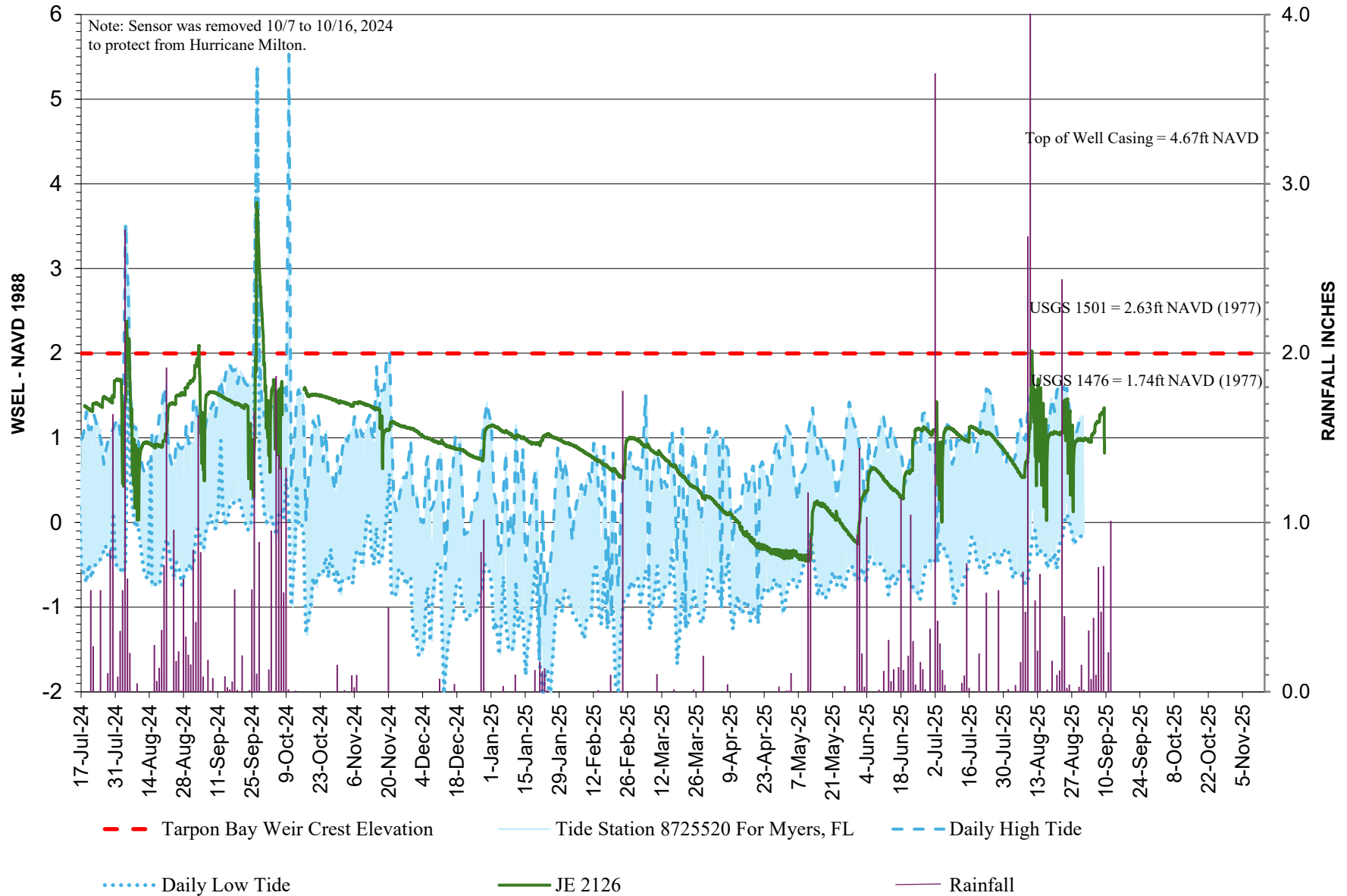
Sanibel Island Water Levels- JE 2125

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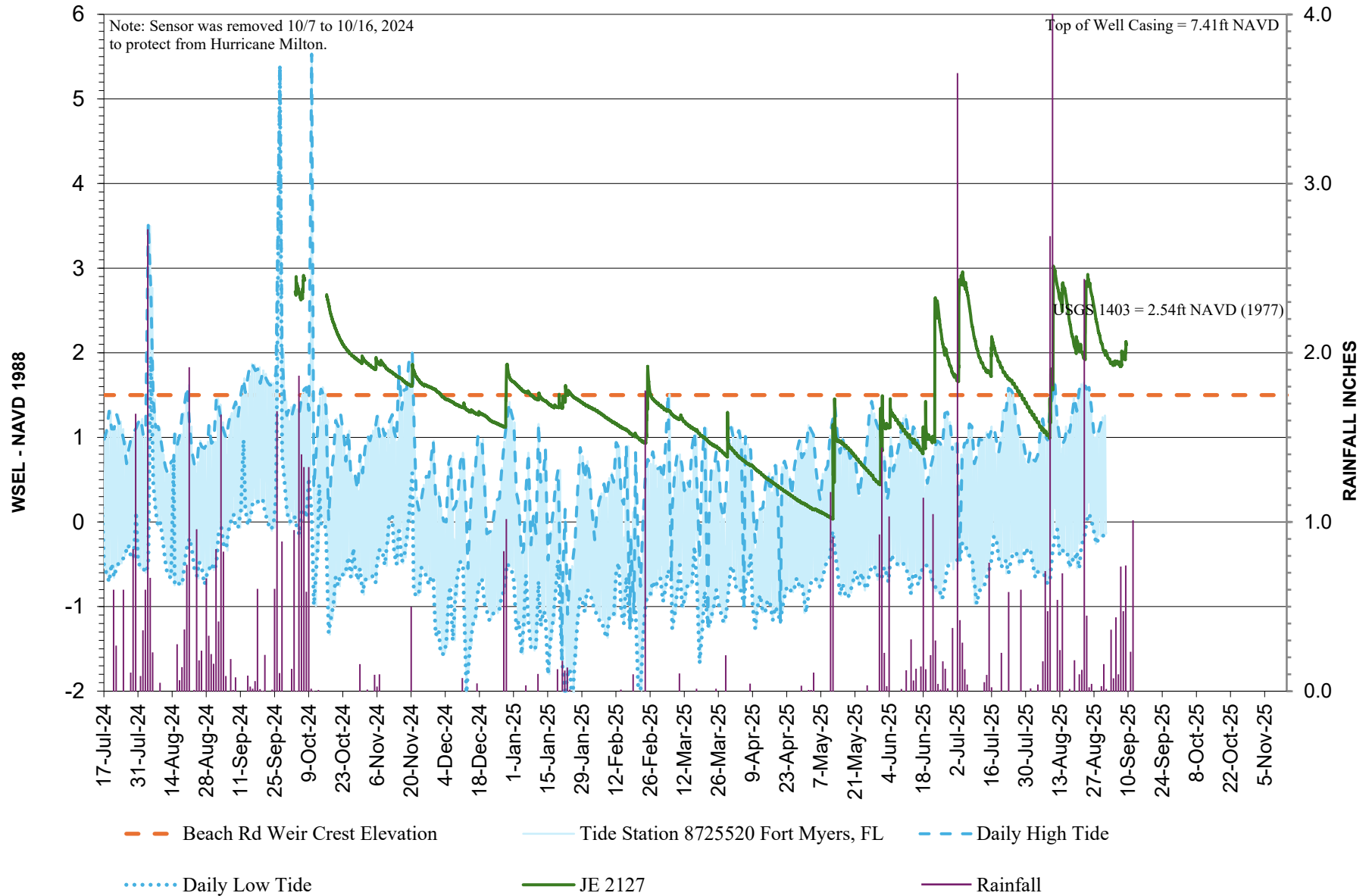
Sanibel Island Water Levels- JE 2126

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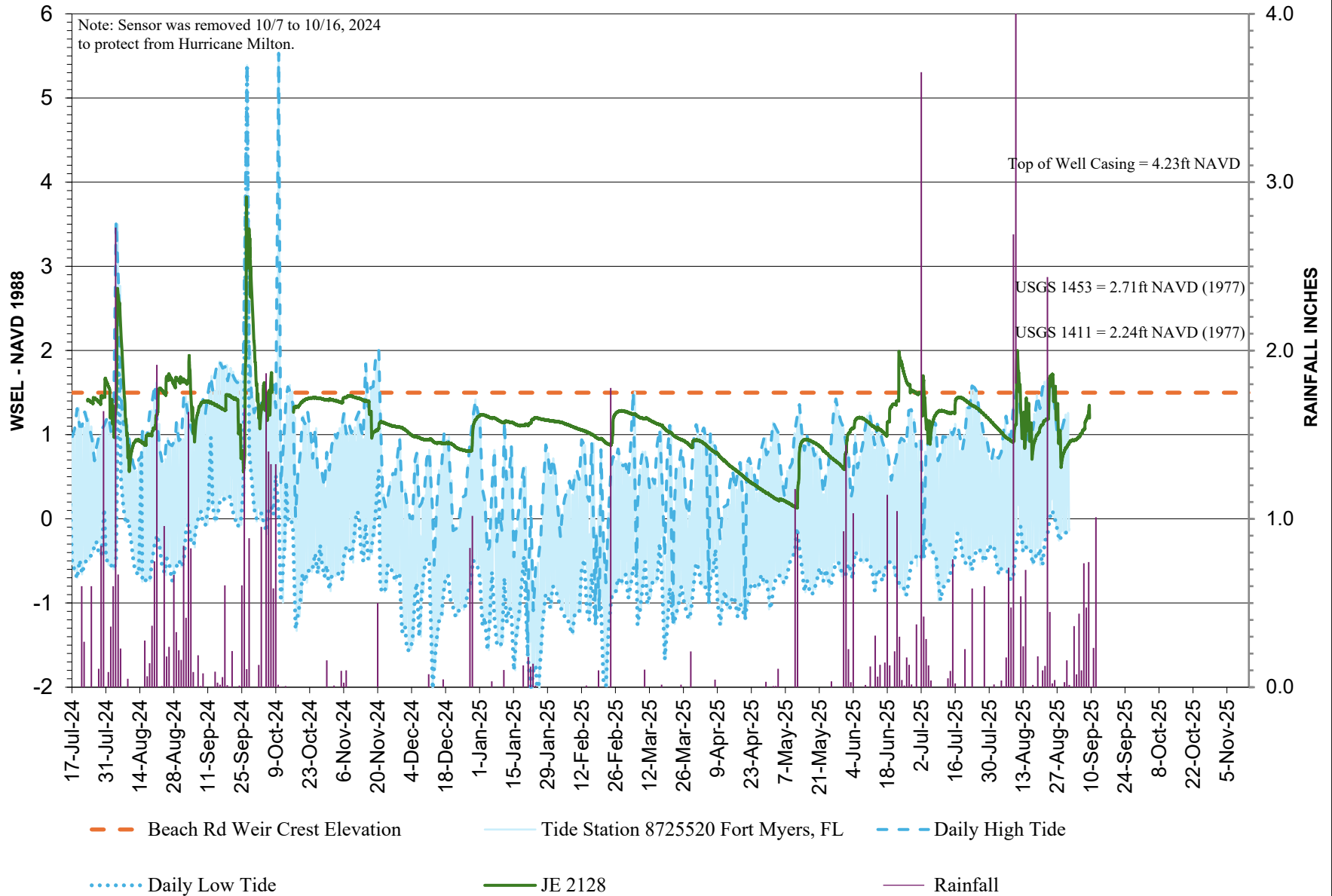


Sanibel Island Water Levels- JE 2127

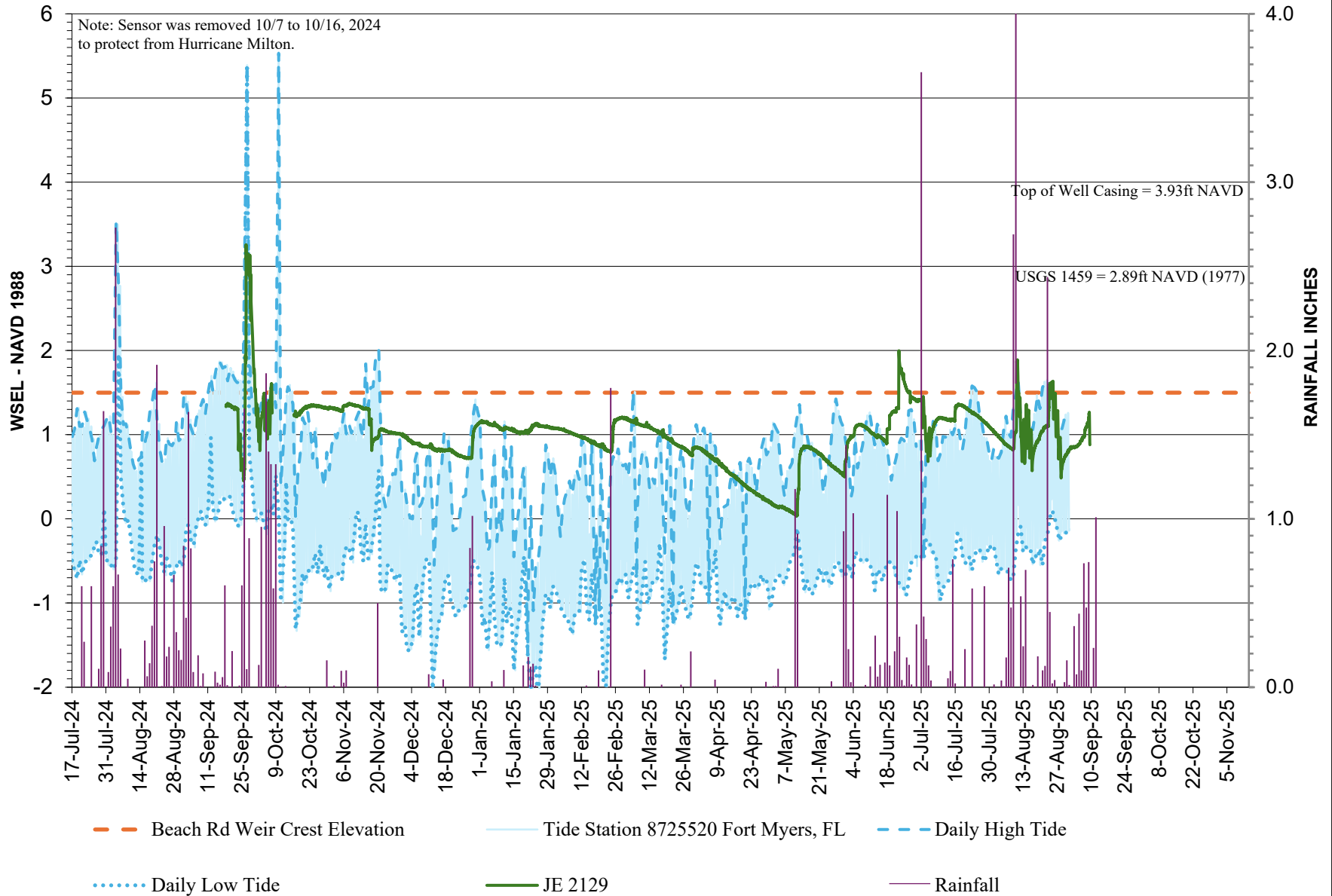
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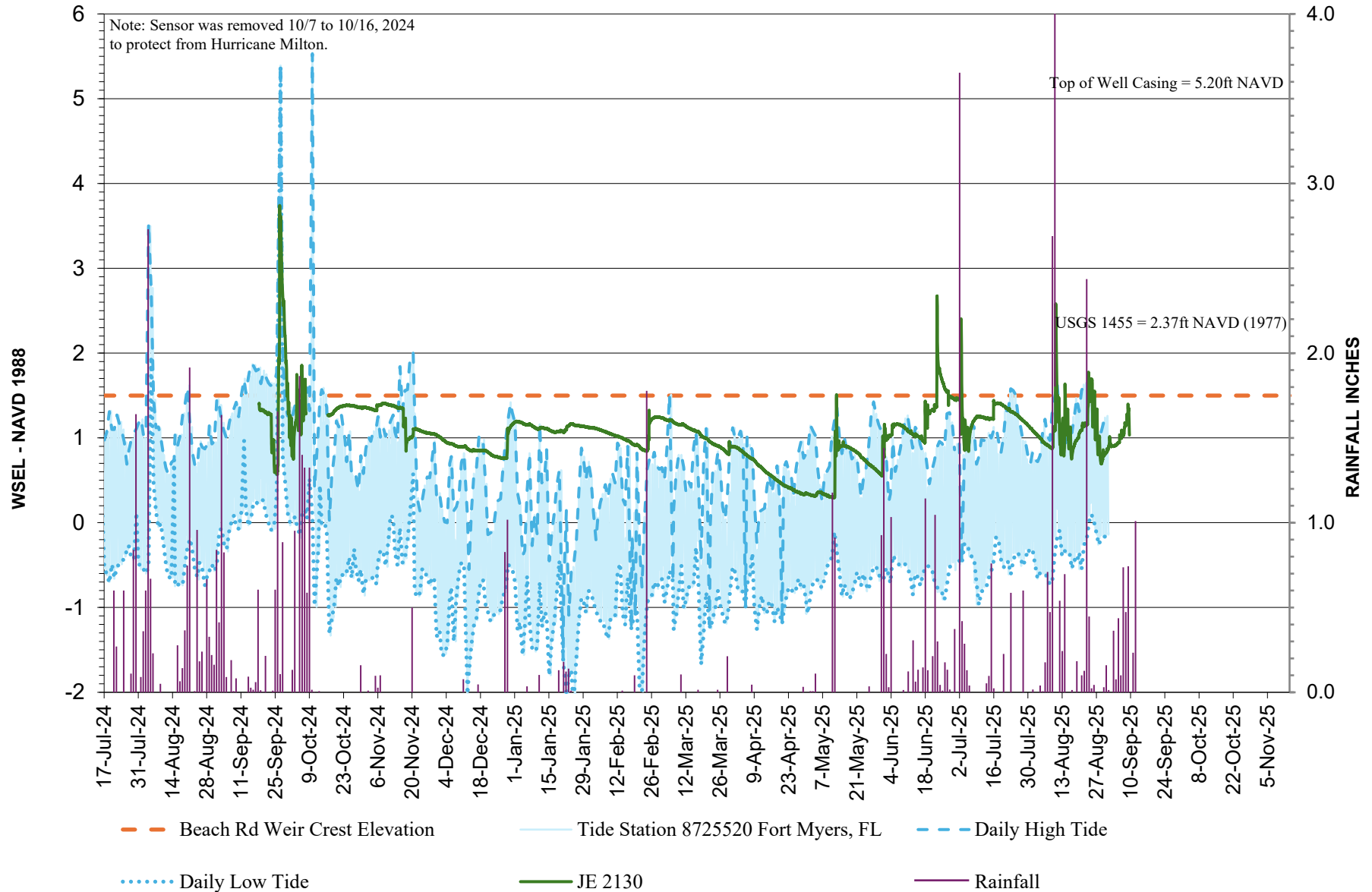
Sanibel Island Water Levels- JE 2128



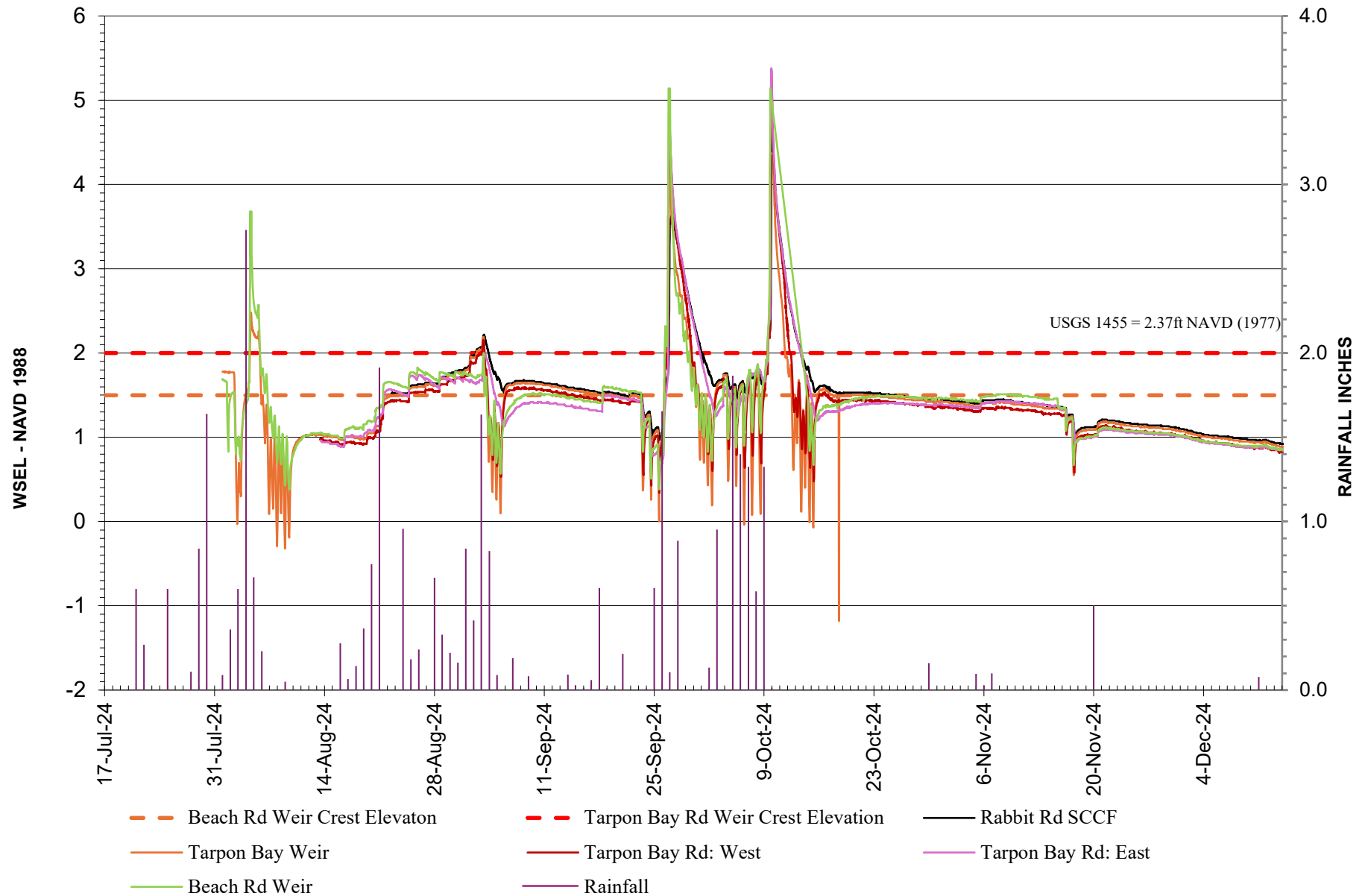
Sanibel Island Water Levels- JE 2129



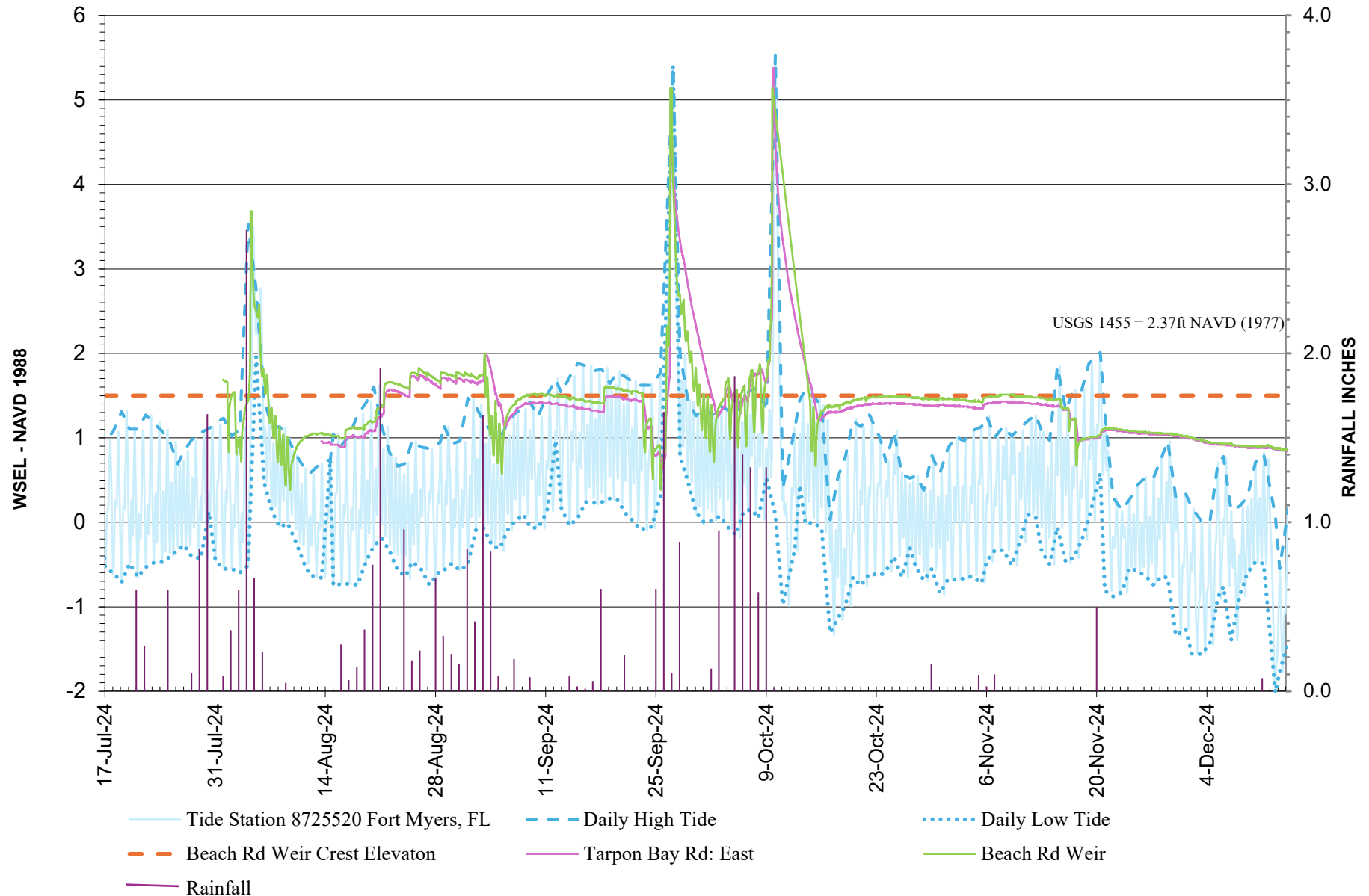
Sanibel Island Water Levels- JE 2130



Sanibel Island 2024 Water Levels- SCCF Stations

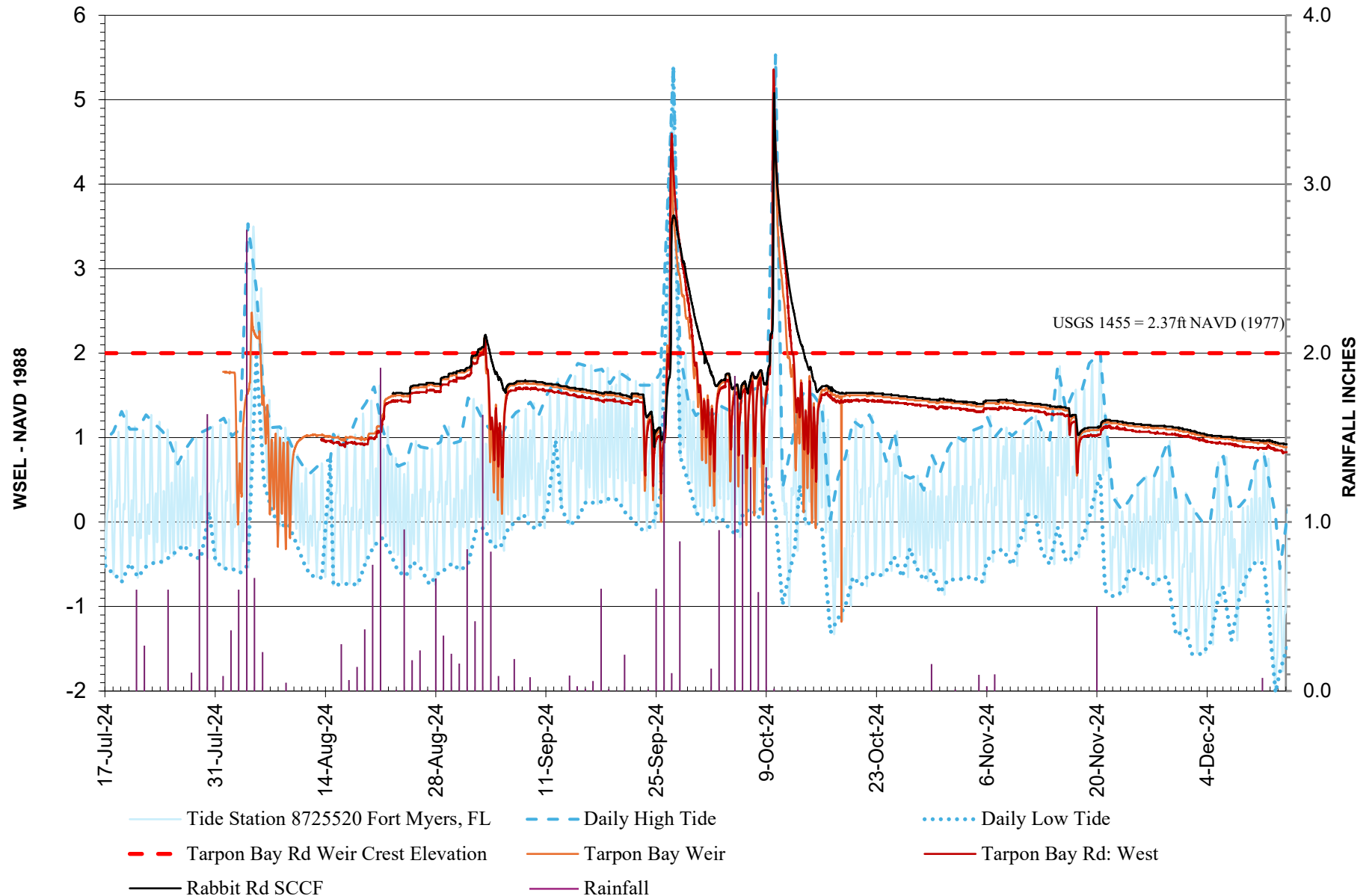


Sanibel Island 2024 Water Levels- East Basin SCCF Stations



Sanibel Island 2024 Water Levels- West Basin SCCF Stations

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APPENDIX B

Hydrologic & Hydraulic Analysis of the Sanibel River System



TO: Oisin Dolley, P.E.; Scott Krawczuk:
City of Sanibel

Jordan L. Varble, P.E.; Gabriella Santucci:
FROM: Johnson Engineering, Inc.

DATE: July 8, 2025

RE: Hydrologic & Hydraulic Analysis of the
Sanibel River System

Background

The information in this document was drawn from the draft 2018 Stormwater Master Plan. Sanibel contains two large freshwater basins – the Sanibel River West Basin and the Sanibel River East Basin – which serve as freshwater reservoirs for the island. The Sanibel River system is analogous to two separate river systems controlled by dams (weirs) and operable gates at their downstream ends. Upstream of the dams are sections of river (Sanibel) and a series of lakes (pools). Along these river routes, crossings occur at many roads.

The primary objective of this memo is to evaluate the effects of rainfall-based storm events with the following frequency and duration: 3-year, 1-hour; 5-year, 1-day; 25-year, 3-day; and the 100-year, 3-day. If constrictions that cause flooding in the 25-year, 3-day event are identified, the model will be adjusted with a replacement structure or other modification(s) to determine how much improvement could be realized with one or more alterations to remove the constriction.

Figure 1 illustrates the location of the basins within the Sanibel River System as determined by use of aerial photographs and existing topography. The SCS Unit Hydrograph method was selected for the hydrologic analysis. The parameters required for each basin are drainage area, runoff curve number (CN), and time of concentration. The CN was estimated using values from TR-55. All soils within the watershed basin are from hydrological soil group D (according to NRCS Soil Survey).

Stormwater runoff generally flows west to east within the two drainage basins that make up the Sanibel River. The westerly basin, between Jamaica Road and Tarpon Bay Road, has two points of discharge, one into Tarpon Bay via the Tarpon Bay Weir and one across Tarpon Bay Road via the Tarpon Bay Road Weir. The Tarpon Bay Road Weir separates the two basins and has a crest elevation of 2.32 feet (ft). NAVD. The Tarpon Bay Weir that allows discharge to Tarpon Bay has an elevation of 1.98 ft. NAVD.

The easterly basin of the river flows east from Tarpon Bay Road toward Beach Road, and discharges into a tidal canal within Sanibel Estates. The Beach Road Weir has a crest elevation of 1.51 ft. NAVD.

Although flows within the watershed are generally west to east, this may be reversed during high flows, depending on the timing and location of the rainfall, as well as the water levels and tide.

Many of the residential subdivisions on Sanibel have ground elevations ranging from 2 feet to 5 feet NAVD, allowing very little slope to give the water a downhill gradient on which to run. Generally, a slope gradient in Southwest Florida is considered "flat" if it is less than one foot per

mile and Sanibel falls within this definition. This extremely flat slope creates many problems in developing a comprehensive Surface Water Management Plan that provides adequate drainage in developed areas without adversely impacting natural areas.

Location

The Sanibel River is located on the central portion of Sanibel Island and is bounded by the following roadways:

- Periwinkle Way (north limit)
- Beach Road (east limit)
- East Gulf Drive (south limit)
- Middle Gulf Drive (south limit)
- West Gulf Drive (south limit)
- Jamaica Drive (west limit)
- Sanibel-Captiva Road (north limit)

Figure 1 illustrates the roadways listed above. The watershed map further divides the river into basins that are used in the model. A summary of the structures included in the model is shown in **Table 1**. These structures are identified by numbers in the leftmost column of **Table 1**, and their locations are shown in **Figure 2**.

Table 1. Structures included in ICPR model.

ID	MODEL LINK NAME	ROAD CULVERTS*	LENGTH (FT.)**	INVERT ELEVATION (FT. NAVD)	ROADWAY NAME	ROAD ELEVATION (FT. NAVD)	ROAD ELEVATION (FT. NAVD)***
①	SAN-CAP_ROAD	EX. (4) 10'X6' BOX CULVERTS	54	-4.17	SANIBEL-CAPTIVA ROAD	4.28	-
②	PIPE_3-4_RABBIT	EX. (2) 12'X5' BOX CULVERTS	44	-4.18	RABBIT ROAD	3.71	3.77
③	PIPE_2-3	EX. (2) 48" RCP	40	-	GULF PINES DRIVE	-	4.64
④	PIPE_1-2	EX. (2) 48" RCP	40	-	WHITE IBIS DRIVE	-	4.74
⑤	PIPE_4-4A_ISLAN	EX. (1) 10'X6' BOX CULVERT	40	-3.68	ISLAND INN ROAD	4.12	3.56
⑥	-	EX. (2) 8'X5' BOX CULVERTS	28	-3.13	BEACH ROAD	-	-
⑦	PIPE_7A-7B_ELIN	EX. (2) 10'X4' BOX CULVERTS	32	-3.17	ELINOR WAY	2.81	-
⑧	PIPE_6-7A_DONAX	EX. (2) 10'X4' BOX CULVERTS	60	-3.24	DONAX STREET	3.58	3.53
⑨	PIPE_5A-5_YBEL	EX. (1) 34"X53" RCP	85	-1.18	CASA YBEL ROAD		5.58
⑩	PIPE_5-6_YBEL	EX. (1) 10'X5' BOX CULVERT	46	-3.17****	CASA YBEL ROAD	-	4.38
⑪	-	EX. (1) 10'X8' BOX CULVERT	48	-3.68	TARPON BAY ROAD	4.31	4.06

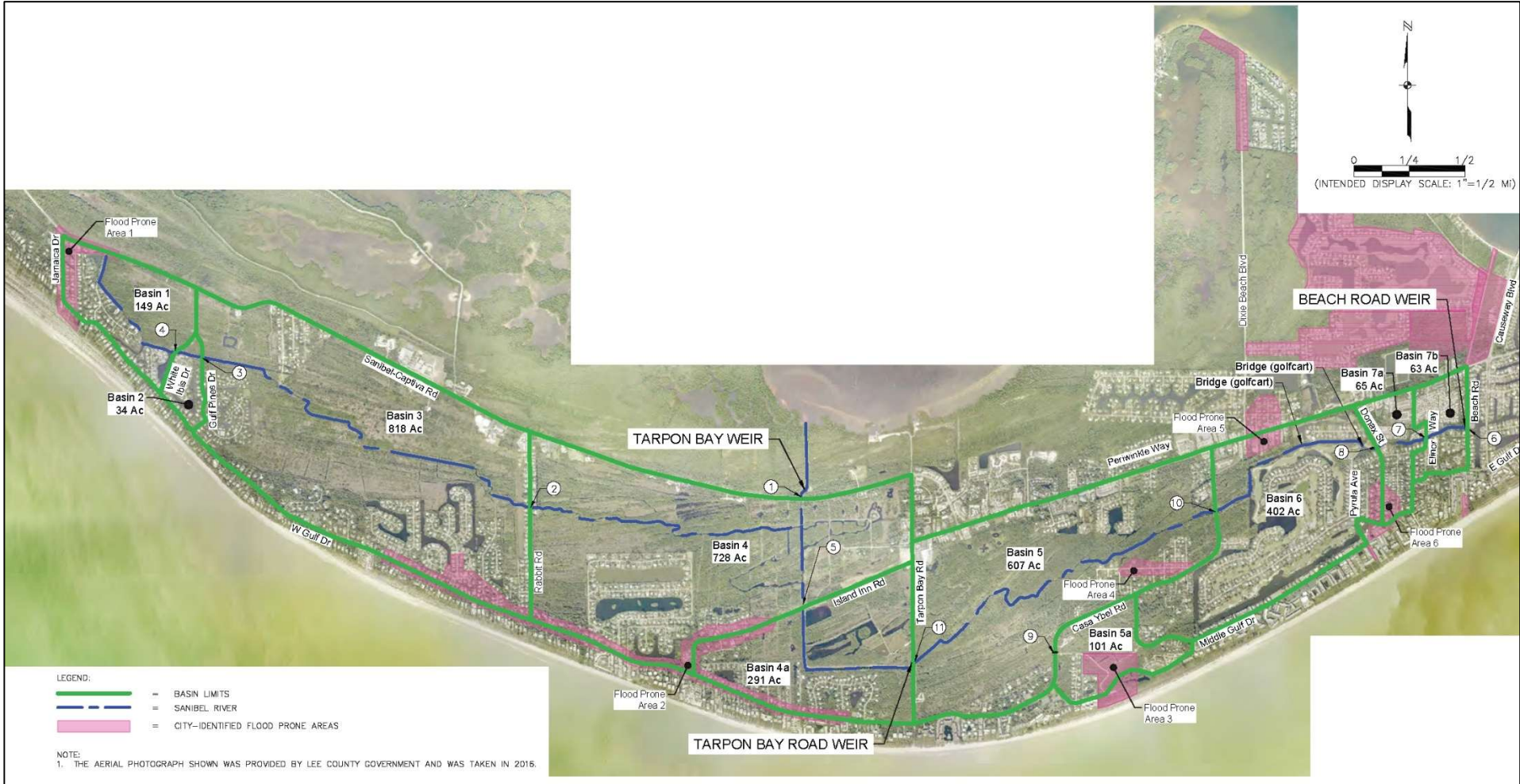


Figure I. Sanibel River watershed.

Model Selection

AdICPR and HEC-RAS are two commonly used computer programs for analyses like this. AdICPR (Advanced Interconnected Channel and Pond Routing) has the capability of computing hydrology and hydraulics. HEC-RAS (Hydrologic Engineering Center – River Analysis System) can compute hydraulic information, but a separate analysis is required to calculate the hydrology.

AdICPR was chosen to simulate the rainfall-runoff process in the Sanibel River watershed to take advantage of its capabilities of modeling both the hydrology and the hydraulics associated with this project within the model. This modeling software has been accepted by the Federal Emergency Management Agency (FEMA) for use on floodplain investigations associated with flood insurance applications and is widely used throughout Florida and the United States.

The AdICPR software consists of a network of open channel segments, culverts, bridges, weirs and lakes. AdICPR uses a link-node concept to idealize the “real world” drainage system. A node is a discrete location in the drainage system where conservation of mass (continuity) is maintained. Links, or “reaches”, are the connections between nodes and are used to convey water through the system. The entire network of nodes and reaches forms the hydraulic model network and serves as the computational framework for AdICPR.

The level-pool method approach has been assumed for the majority of the nodes, with the exception of the two easternmost basins (7a and 7b) that have been modeled as canals given the relatively small floodplain storage provided due to development adjacent to the Sanibel River. Local runoff within these basins is routed to the upstream end of the canals.

Storm Events

A variety of storm events were modeled to assess the impacts of any improvement on the Sanibel River System. Each storm event and a brief discussion of why it was chosen for this analysis follows:

- 3-year, 1-hour is for water quality and wetland inundation duration.
- 5-year, 1-day is used to check against the elevation of secondary roads and parking lots.
- 25-year, 3-day is used to assess flooding of major roads and emergency access
- 100-year, 3-day is used to assess freshwater flooding of critical infrastructure, dwellings and businesses.

The rainfall depth of the 3-year, 1-hour event is estimated at 2.4 inches. This value was obtained from plotting the depths for the 1-year, 1-hour; the 2-year, 1-hour; and the 5-year, 1-hour from the TP-40 Rainfall Frequency Atlas of the United States, U.S. Department of Commerce Weather Bureau, and interpolating. See **Figure 2**.

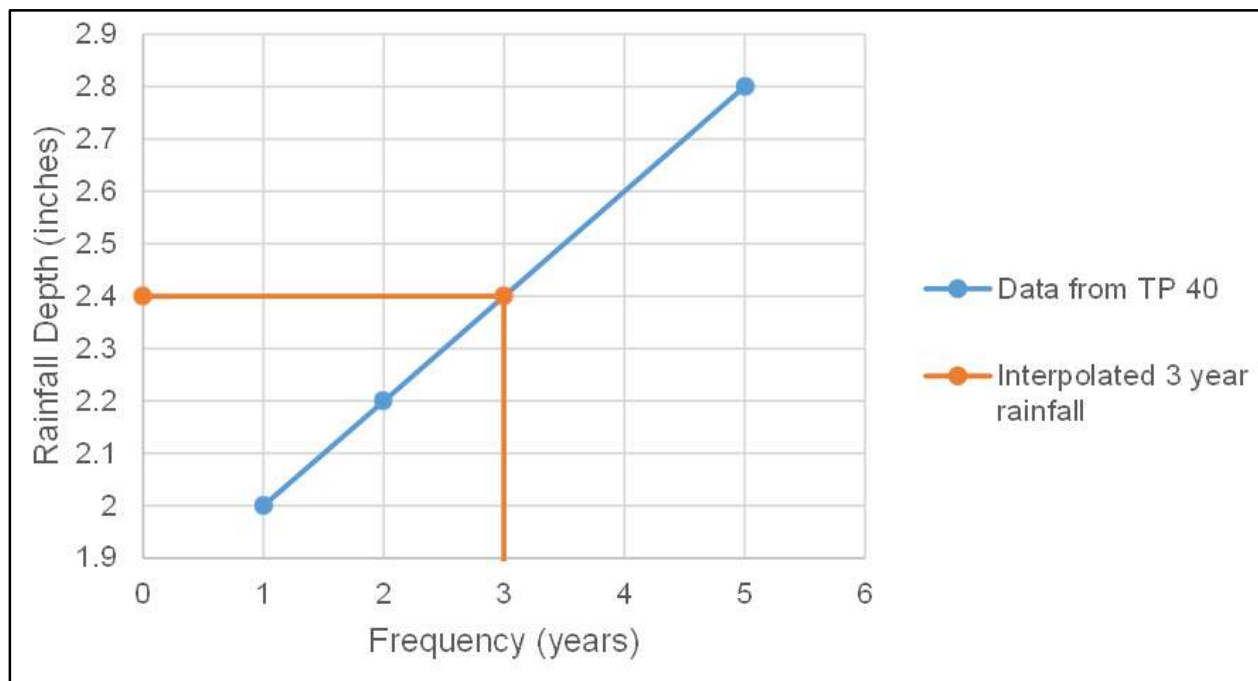


Figure 2. 3-Year, 1-Hour Rainfall Depth.

The rainfall depths for the 5-year, 1-day; 25-year, 3-day; and 100-year, 3-day were obtained from the SFWMD Environmental Resource Permitting Information Manual Volume IV and were 5.5 inches, 11.2 inches and 14.0 inches, respectively.

Existing Conditions Model

The Sanibel River system was separated into 10 basins and 10 nodes. The basins are the hydrology of the system where flow is generated and conveyed to their containing node. The nodes provide storage for the system and a connection between conveyance elements (links).

Existing Hydraulics

The AdICPR model includes channels, culverts, weirs and gates present within the Sanibel River Watershed. A summary of the structures included in the model is shown in **Table I**. Not all the structures found within the watershed were modeled. Only the structures that provide connectivity to “pools” were modeled. The Sanibel River watershed has several bridges, but they are not included in the model, because they are much less restrictive to flow than the culverts.

The model also includes Stage vs. Area tables that were estimated for every basin using the LIDAR elevation dataset. There are two segments (7a and 7b) located near the east end of the Sanibel River that were modelled as channels to account for the limited floodplain that exists between Donax Street and Beach Road.

Tailwater and Initial Water Level Scenarios

The points of discharge of the Sanibel River into the Bay are the Tarpon Bay Weir and the Beach Road Weir. Both weir structures have gates that provide flexibility in the operation of

the system. All the gates stay closed most of the year. Before certain storm events, one or several gates may be opened to lower the water level in the river system when a considerable amount of rain is anticipated and/or the water surface elevation in the pool system is deemed high. The tailwater values used in the ICPR models include the following assumptions:

- 1) The analysis assumed constant tailwater elevations during the entire simulation, disregarding the tidal fluctuations that occur daily. This is a conservative assumption.
- 2) The analysis does not take into account storm surge effects and disregarded the coastal stillwater elevations used by FEMA. This is a practical assumption that keeps the analysis from considering most of the island under water during the simulation.

Several tailwater elevations were modeled separately to evaluate scenarios that represent either present conditions related to the crest elevation of the outfall weirs or projections of the sea level rise as discussed in Section 3.4 of this report.

- **Gates Closed:** When the gates are closed at both discharge locations, the assumed tailwater elevation on the model for the “Gates Closed” scenario is at elevation 1.51 ft, NAVD (the Beach Road Weir crest). The assumed starting water elevations on the model for this scenario are:
 - Nodes 1,2,3,4 and 4a: 1.98 ft, NAVD (the Tarpon Bay and weir crest elevation).
 - Nodes 5, 5a, 6, 7a and 7b: 1.51 ft, NAVD (the Beach Road weir crest elevation).
- **Gates Open:** Several scenarios model when all gates are open at both discharge locations.

A summary of the tailwater elevations and starting water elevation associated with each scenario is shown in Table 2.

Table 2. Tailwater and Starting Water Elevation (ft, NAVD).

Parameter	Scenario				
	Gates Closed	Gates Open			
		2017 MHHW	TBW Crest 1.98	BRW Top of Flap 2.5	2100 MSL 3.42
Tailwater	1.51	0.72	1.98	2.5	3.42
Starting Water Elevation	1.98 and 1.51	0.72	1.98	2.5	3.42

Notes for **Table 2.**

- TBW = Tarpon Bay Weir
- BRW = Beach Road Weir
- MHHW = Mean High High Water
- MSL = Mean Sea Level

Model Results

A summary of the peak stages is shown graphically in **Figure 3** through **Figure 6**.

The performance of the main connecting elements (canal, pipes, culverts, gates and weirs) was evaluated by establishing the headloss across each element. The results of this evaluation are summarized in **Table 3** and **Table 4**.

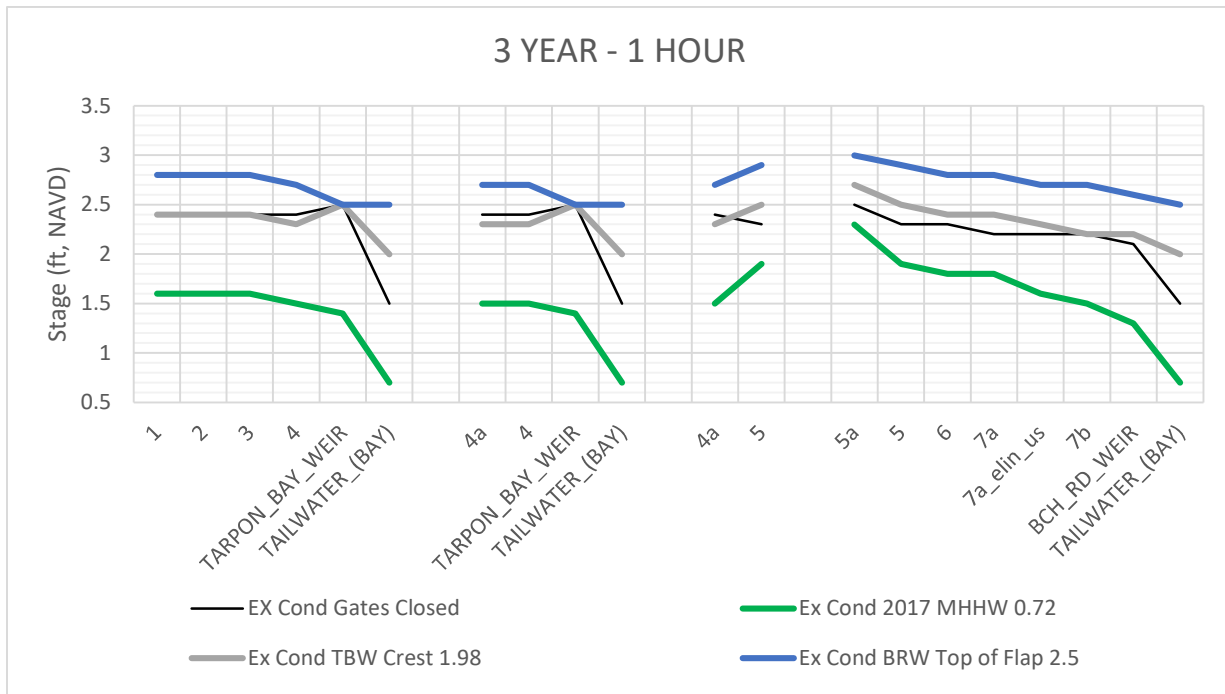


Figure 3. Existing Condition 3-Year, 1-Hour Peak Stages.

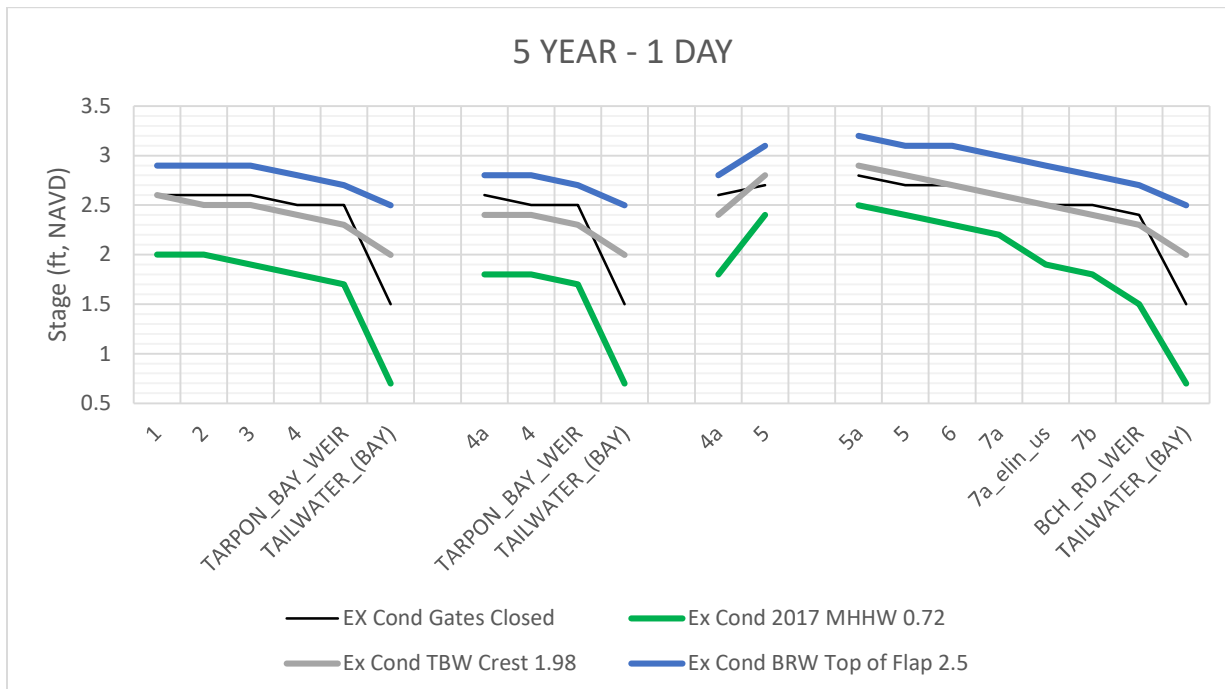


Figure 4. Existing Condition 5-Year, 1-Day Peak Stages.

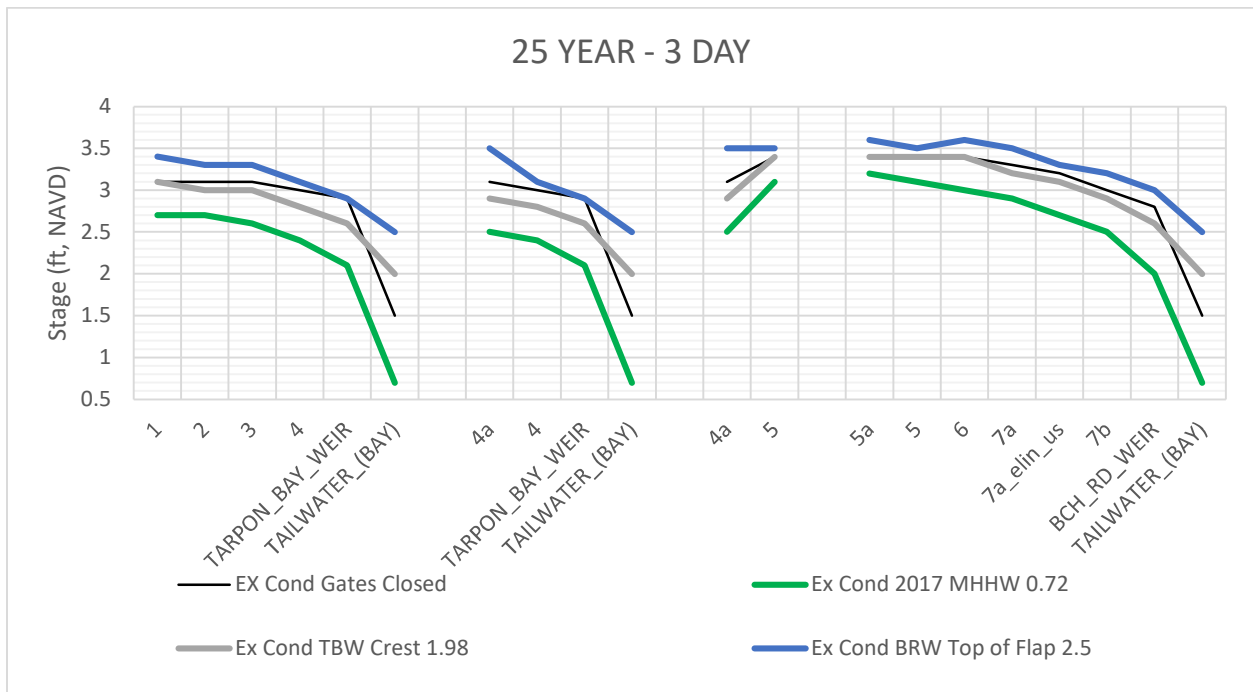


Figure 5. Existing Condition 25-Year, 3-Day Peak Stages.

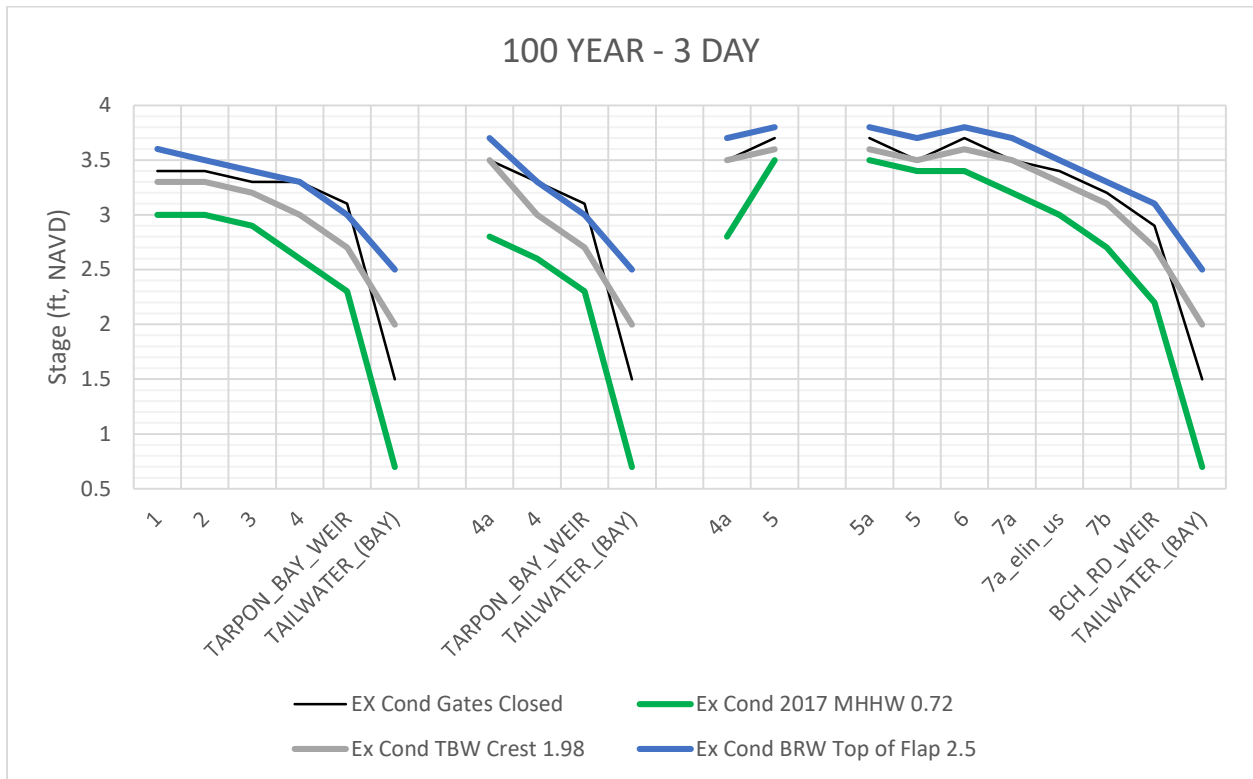


Figure 6. Existing Condition 100-Year, 3-Day Peak Stages.

Table 3. Headlosses for the 3-Year and 5-Year Storms (ft).

Storm	Link	EX Cond Gates Closed	Ex Cond 2017 MHHW 0.72	Ex Cond TBW Crest 1.98	Ex Cond BRW Top of Flap 2.5
3YEAR-1HOUR	White Ibis	0	0	0	0
3YEAR-1HOUR	Gulf Pines Dr	0	0	0	0
3YEAR-1HOUR	Rabbit Rd	0	0.1	0.1	0.1
3YEAR-1HOUR	San-Cap Rd	0	0.1	0	0.2
3YEAR-1HOUR	Tarpon Bay Weir	1	0.7	0.5	0
3YEAR-1HOUR	Island Inn	0	0	0	0
3YEAR-1HOUR	Casa Ybel Rd ERCP	0.2	0.4	0.2	0.1
3YEAR-1HOUR	Casa Ybel Rd Box	0	0.1	0.1	0.1
3YEAR-1HOUR	Donax St	0.1	0	0	0
3YEAR-1HOUR	Canal Downstream of Donax	0	0.2	0.1	0.1
3YEAR-1HOUR	Elinor Way	0	0.1	0.1	0
3YEAR-1HOUR	Canal Downstream of Elinor Way	0.1	0.2	0	0.1
3YEAR-1HOUR	Beach Road Weir	0.6	0.6	0.2	0.1
5YR-1DAY	White Ibis	0	0	0.1	0
5YR-1DAY	Gulf Pines Dr	0	0.1	0	0
5YR-1DAY	Rabbit Rd	0.1	0.1	0.1	0.1
5YR-1DAY	San-Cap Rd	0	0.1	0.1	0.1
5YR-1DAY	Tarpon Bay Weir	1	1	0.3	0.2
5YR-1DAY	Island Inn	0.1	0	0	0
5YR-1DAY	Casa Ybel Rd ERCP	0.1	0.1	0.1	0.1
5YR-1DAY	Casa Ybel Rd Box	0	0.1	0.1	0
5YR-1DAY	Donax St	0.1	0.1	0.1	0.1
5YR-1DAY	Canal Downstream of Donax	0.1	0.3	0.1	0.1
5YR-1DAY	Elinor Way	0	0.1	0.1	0.1
5YR-1DAY	Canal Downstream of Elinor Way	0.1	0.3	0.1	0.1
5YR-1DAY	Beach Road Weir	0.9	0.8	0.3	0.2

Table 4. Headlosses for the 25-Year and 100-Year Storms (ft).

Storm	Link	EX Cond Gates Closed	Ex Cond 2017 MHHW 0.72	Ex Cond TBW Crest 1.98	Ex Cond BRW Top of Flap 2.5
025YR-3DAY	White Ibis	0	0	0.1	0.1
025YR-3DAY	Gulf Pines Dr	0	0.1	0	0
025YR-3DAY	Rabbit Rd	0.1	0.2	0.2	0.2
025YR-3DAY	San-Cap Rd	0.1	0.3	0.2	0.2
025YR-3DAY	Tarpon Bay Weir	1.4	1.4	0.6	0.4
025YR-3DAY	Island Inn	0.1	0.1	0.1	0.4
025YR-3DAY	Casa Ybel Rd ERCP	0	0.1	0	0.1
025YR-3DAY	Casa Ybel Rd Box	0	0.1	0	0
025YR-3DAY	Donax St	0.1	0.1	0.2	0.1
025YR-3DAY	Canal Downstream of Donax	0.1	0.2	0.1	0.2
025YR-3DAY	Elinor Way	0.2	0.2	0.2	0.1
025YR-3DAY	Canal Downstream of Elinor Way	0.2	0.5	0.3	0.2
025YR-3DAY	Beach Road Weir	1.3	1.3	0.6	0.5
100YR-3DAY	White Ibis	0	0	0	0.1
100YR-3DAY	Gulf Pines Dr	0.1	0.1	0.1	0.1
100YR-3DAY	Rabbit Rd	0	0.3	0.2	0.1
100YR-3DAY	San-Cap Rd	0.2	0.3	0.3	0.3
100YR-3DAY	Tarpon Bay Weir	1.6	1.6	0.7	0.5
100YR-3DAY	Island Inn	0.2	0.2	0.5	0.4
100YR-3DAY	Casa Ybel Rd ERCP	0.2	0.1	0.1	0.1
100YR-3DAY	Casa Ybel Rd Box	0	0	0	0
100YR-3DAY	Donax St	0.2	0.2	0.1	0.1
100YR-3DAY	Canal Downstream of Donax	0.1	0.2	0.2	0.2
100YR-3DAY	Elinor Way	0.2	0.3	0.2	0.2
100YR-3DAY	Canal Downstream of Elinor Way	0.3	0.5	0.4	0.2
100YR-3DAY	Beach Road Weir	1.4	1.5	0.7	0.6

In general, the results obtained indicate previous Capital Improvement Projects by the City of Sanibel to reduce flooding are working. There are only a few links that have relatively larger headlosses as highlighted in **Table 4**. The following section addresses the analysis of performance improvements at some of the highlighted nodes.

Proposed Conditions

The potential improvements analyzed consisted of adding two additional box culverts under Sanibel-Captiva Road (for a total of six barrels) and performing a dredge on approximately 1,100 LF of canal between Elinor Road and Beach Road. The dredging project is already underway, and it is expected to be completed by fiscal year 2026. The canal improvements target a portion of the River that has limited undeveloped floodplain, and the flow is confined mostly to within the river banks. The proposed change to the cross section is shown in **Figure 7**.

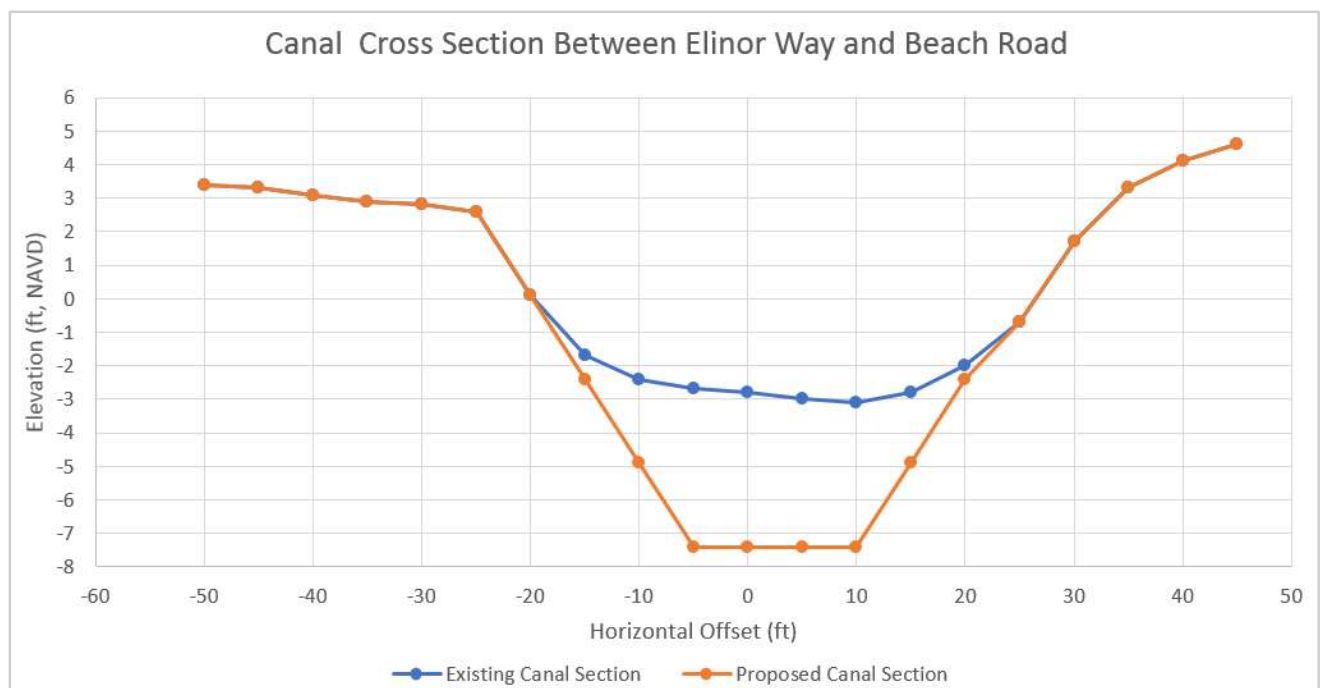


Figure 7. Proposed channel improvements.

The potential improvements were added to the existing conditions modeled previously and modeled in ICPR. A summary of the peak stages is shown graphically in **Figure 8** through **Figure 11**.

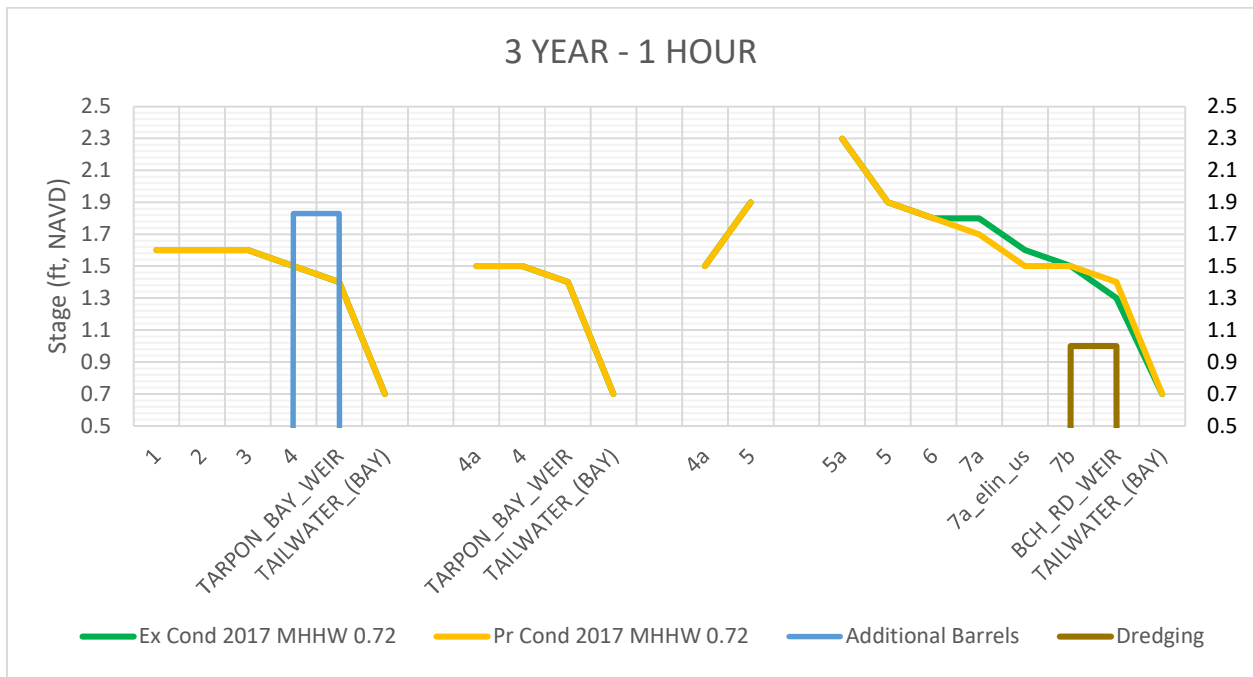


Figure 8. Proposed Improvements 3-Year Peak Stages.

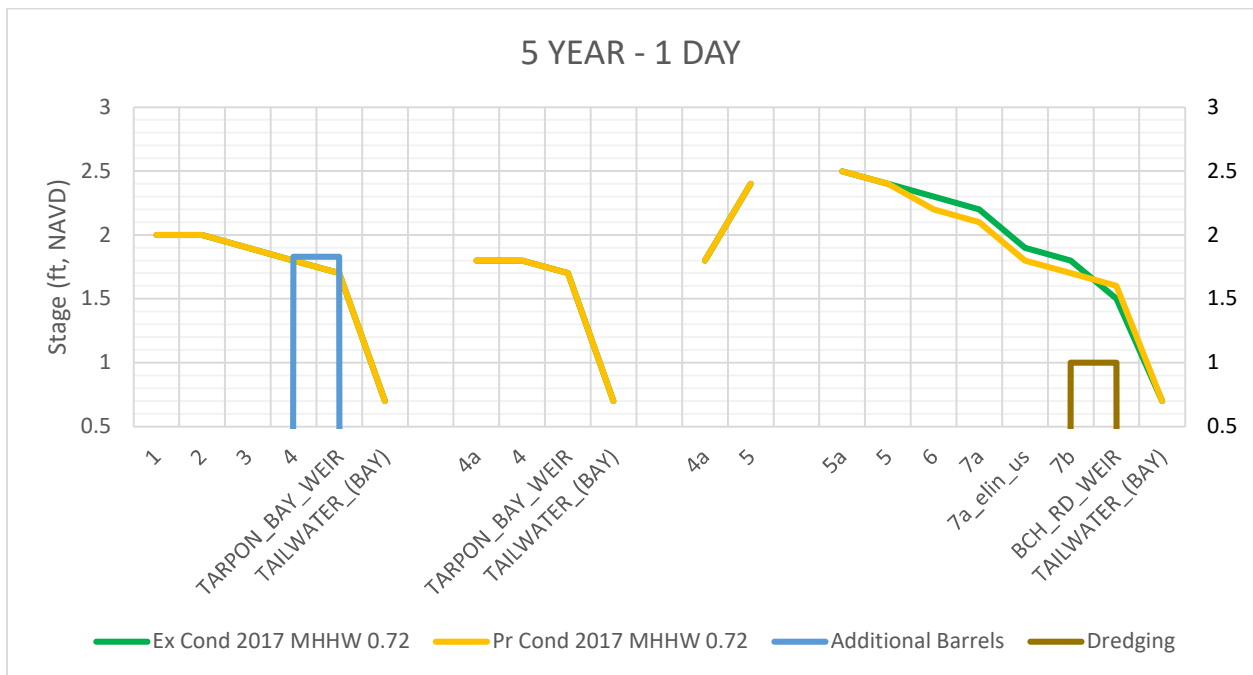


Figure 9. Proposed Improvements 5-Year Peak Stages.

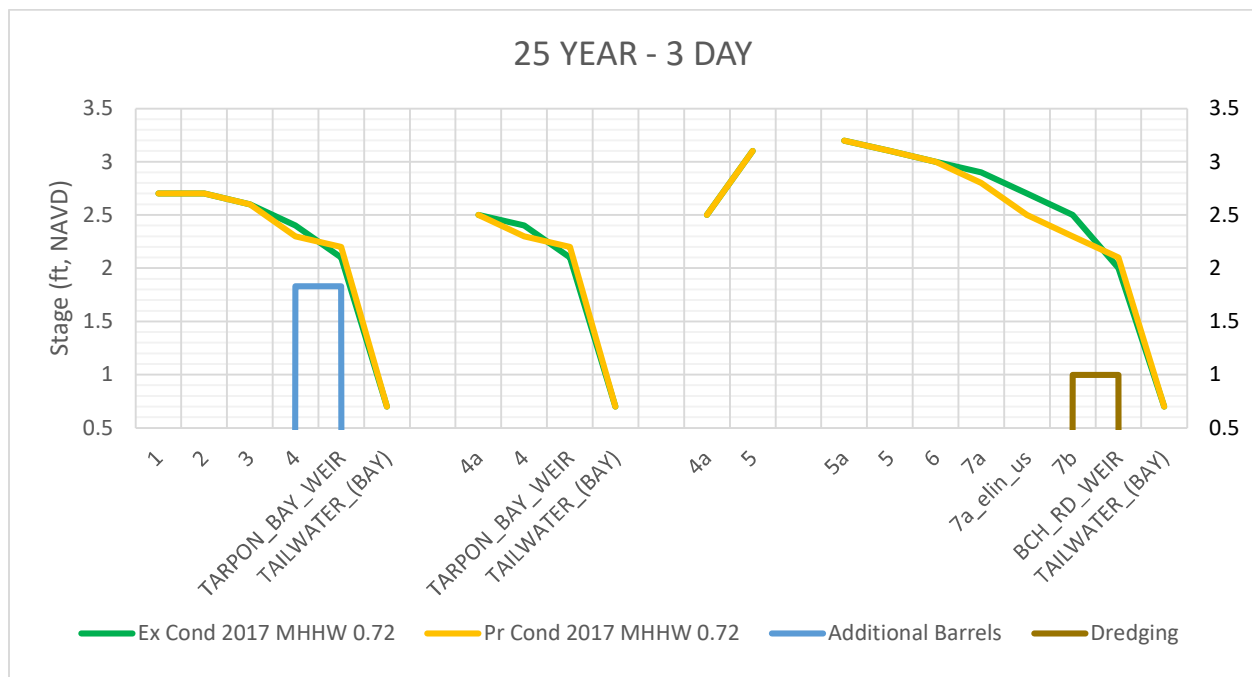


Figure 10. Proposed Improvements 25-Year Peak Stages.

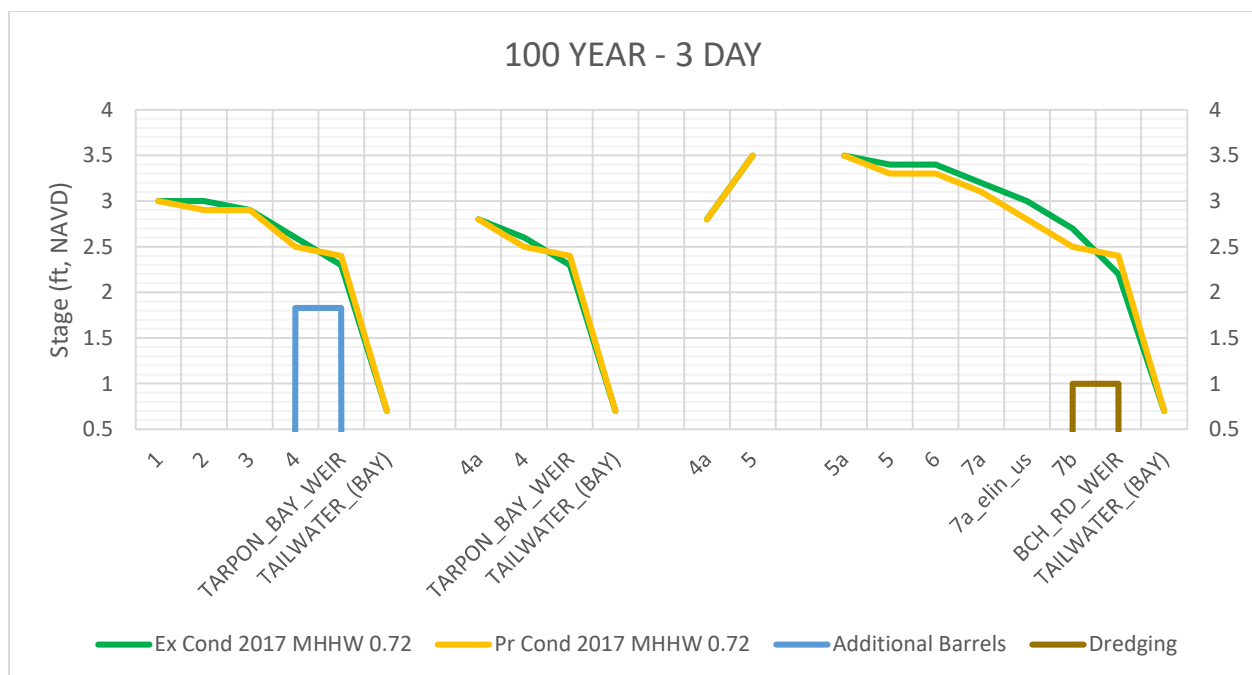


Figure 11. Proposed Improvements 100-Year Peak Stages.

The performance of the main connecting elements (canal, pipes, culverts, gates and weirs) was evaluated by establishing the headloss across each element. The results of this evaluation are summarized in **Table 5** and **Table 6**. Maximum flow at the weirs for each storm is also included.

Table 5. Existing and Proposed Headloss for the 3-Year and 5-Year Storms (ft).

Storm	Link	Ex Cond 2017 MHHW 0.72	Pr Cond 2017 MHHW 0.72	Flow at Outfall (cfs)
003YEAR-1HOUR	White Ibis	0	0	N/A
003YEAR-1HOUR	Gulf Pines Dr	0	0	N/A
003YEAR-1HOUR	Rabbit Rd	0.1	0.1	N/A
003YEAR-1HOUR	San-Cap Rd	0.1	0.1	N/A
003YEAR-1HOUR	Tarpon Bay Weir	0.7	0.7	411
003YEAR-1HOUR	Island Inn	0	0	N/A
003YEAR-1HOUR	Casa Ybel Rd ERCP	0.4	0.4	N/A
003YEAR-1HOUR	Casa Ybel Rd Box	0.1	0.1	N/A
003YEAR-1HOUR	Donax St	0	0.1	N/A
003YEAR-1HOUR	Canal Downstream of Donax	0.2	0.2	N/A
003YEAR-1HOUR	Elinor Way	0.1	0	N/A
003YEAR-1HOUR	Canal Downstream of Elinor Way	0.2	0.1	N/A
003YEAR-1HOUR	Beach Road Weir	0.6	0.7	156
005YR-1DAY	White Ibis	0	0	N/A
005YR-1DAY	Gulf Pines Dr	0.1	0.1	N/A
005YR-1DAY	Rabbit Rd	0.1	0.1	N/A
005YR-1DAY	San-Cap Rd	0.1	0.1	N/A
005YR-1DAY	Tarpon Bay Weir	1	1	547
005YR-1DAY	Island Inn	0	0	N/A
005YR-1DAY	Casa Ybel Rd ERCP	0.1	0.1	N/A
005YR-1DAY	Casa Ybel Rd Box	0.1	0.2	N/A
005YR-1DAY	Donax St	0.1	0.1	N/A
005YR-1DAY	Canal Downstream of Donax	0.3	0.3	N/A
005YR-1DAY	Elinor Way	0.1	0.1	N/A
005YR-1DAY	Canal Downstream of Elinor Way	0.3	0.1	N/A
005YR-1DAY	Beach Road Weir	0.8	0.9	219

Table 6. Existing and Proposed Headloss for the 25-Year and 100-Year Storms (ft).

Storm	Link	Ex Cond 2017 MHHW 0.72	Pr Cond 2017 MHHW 0.72	Flow at Outfall
025YR-3DAY	White Ibis	0	0	N/A
025YR-3DAY	Gulf Pines Dr	0.1	0.1	N/A
025YR-3DAY	Rabbit Rd	0.2	0.3	N/A
025YR-3DAY	San-Cap Rd	0.3	0.1	N/A
025YR-3DAY	Tarpon Bay Weir	1.4	1.5	764
025YR-3DAY	Island Inn	0.1	0.2	N/A
025YR-3DAY	Casa Ybel Rd ERCP	0.1	0.1	N/A
025YR-3DAY	Casa Ybel Rd Box	0.1	0.1	N/A
025YR-3DAY	Donax St	0.1	0.2	N/A
025YR-3DAY	Canal Downstream of Donax	0.2	0.3	N/A
025YR-3DAY	Elinor Way	0.2	0.2	N/A
025YR-3DAY	Canal Downstream of Elinor Way	0.5	0.2	N/A
025YR-3DAY	Beach Road Weir	1.3	1.4	329
100YR-3DAY	White Ibis	0	0.1	N/A
100YR-3DAY	Gulf Pines Dr	0.1	0	N/A
100YR-3DAY	Rabbit Rd	0.3	0.4	N/A
100YR-3DAY	San-Cap Rd	0.3	0.1	N/A
100YR-3DAY	Tarpon Bay Weir	1.6	1.7	869
100YR-3DAY	Island Inn	0.2	0.3	N/A
100YR-3DAY	Casa Ybel Rd ERCP	0.1	0.2	N/A
100YR-3DAY	Casa Ybel Rd Box	0	0	N/A
100YR-3DAY	Donax St	0.2	0.2	N/A
100YR-3DAY	Canal Downstream of Donax	0.2	0.3	N/A
100YR-3DAY	Elinor Way	0.3	0.3	N/A
100YR-3DAY	Canal Downstream of Elinor Way	0.5	0.1	N/A
100YR-3DAY	Beach Road Weir	1.5	1.7	377

Conclusions

The dredging activities near the downstream end of the easterly basin result in the most significant reductions in peak stages and increased capacity for the system. The additional barrels under Sanibel Captiva Road do not appear to provide significant reductions in peak stages and are not recommended at this time. None of the improvements are anticipated to have significant effects on the repetitive flooding conditions in the areas identified by City Staff or storm surge flooding, so alternative solutions for those areas are recommended.

APPENDIX C

ICPR Model – Existing Condition – 2100 MSL

Links
P Pipe
W Weir
C Channel
D Drop Structure
B Bridge
R Rating Curve
H Breach
E Percolation
F Filter
X Exfil Trench

```
===== Basins =====
```

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

Unit Hydrograph: Uh256	Peaking Factor: 256.0
Rainfall File:	Storm Duration(hrs): 0.00
Rainfall Amount(in): 0.000	Time of Conc(min): 24.00
Area(ac): 101.000	Time Shift(hrs): 0.00
Curve Number: 97.00	Max Allowable Q(cfs): 999999.000
DCIA(%): 0.00	

Name: 6	Node: 6	Status: Onsite
Group: BASE	Type: SCS Unit Hydrograph CN	

Unit Hydrograph: Uh256	Peaking Factor: 256.0
Rainfall File:	Storm Duration(hrs): 0.00
Rainfall Amount(in): 0.000	Time of Conc(min): 45.00
Area(ac): 402.000	Time Shift(hrs): 0.00
Curve Number: 91.00	Max Allowable Q(cfs): 999999.000
DCIA(%): 0.00	

Name: 7a	Node: 7a	Status: Onsite
Group: BASE	Type: SCS Unit Hydrograph CN	

Unit Hydrograph: Uh256	Peaking Factor: 256.0
Rainfall File:	Storm Duration(hrs): 0.00
Rainfall Amount(in): 0.000	Time of Conc(min): 40.00
Area(ac): 64.000	Time Shift(hrs): 0.00
Curve Number: 92.00	Max Allowable Q(cfs): 999999.000
DCIA(%): 0.00	

Name: 7b	Node: 7b	Status: Onsite
Group: BASE	Type: SCS Unit Hydrograph CN	

Unit Hydrograph: Uh256	Peaking Factor: 256.0
Rainfall File:	Storm Duration(hrs): 0.00
Rainfall Amount(in): 0.000	Time of Conc(min): 40.00
Area(ac): 64.000	Time Shift(hrs): 0.00
Curve Number: 92.00	Max Allowable Q(cfs): 999999.000
DCIA(%): 0.00	

==== Nodes =====

Name: 1	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
0.5	11.0
1.0	15.0
1.5	25.0
2.0	48.0
2.5	69.0
3.0	80.0
3.5	90.0
4.0	106.0
4.5	121.0
5.0	133.0
5.5	140.0
6.0	146.0
6.5	148.0
7.0	149.0

Name: 2	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
0.5	7.0
1.0	7.0

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

1.5	8.0
2.0	9.0
2.5	11.0
3.0	13.0
3.5	15.0
4.0	17.0
4.5	18.0
5.0	21.0
5.5	26.0
6.0	30.0
6.5	33.0
7.0	34.0

Name: 3	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
0.5	49.0
1.0	61.0
1.5	87.0
2.0	175.0
2.5	338.0
3.0	467.0
3.5	562.0
4.0	631.0
4.5	687.0
5.0	740.0
5.5	773.0
6.0	793.0
6.5	805.0
7.0	813.0

Name: 4	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
0.5	66.0
1.0	77.0
1.5	106.0
2.0	198.0
2.5	344.0
3.0	455.0
3.5	547.0
4.0	591.0
4.5	615.0
5.0	629.0
5.5	647.0
6.0	673.0
6.5	700.0
7.0	719.0

Name: 4a	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
0.5	32.0
1.0	37.0
1.5	47.0
2.0	70.0
2.5	113.0
3.0	165.0
3.5	209.0
4.0	241.0
4.5	265.0
5.0	280.0
5.5	288.0
6.0	290.0
6.5	291.0
7.0	291.0

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

Name: 5	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
0.5	16.0
1.0	29.0
1.5	56.0
2.0	130.0
2.5	237.0
3.0	340.0
3.5	437.0
4.0	509.0
4.5	561.0
5.0	591.0
5.5	602.0
6.0	605.0
6.5	606.0
7.0	606.0

Name: 5a	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
0.5	2.0
1.0	3.0
1.5	5.0
2.0	9.0
2.5	20.0
3.0	40.0
3.5	61.0
4.0	79.0
4.5	91.0
5.0	97.0
5.5	99.0
6.0	100.0
6.5	101.0
7.0	101.0

Name: 6	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
0.5	25.0
1.0	51.0
1.5	56.0
2.0	62.0
2.5	71.0
3.0	91.0
3.5	135.0
4.0	195.0
4.5	254.0
5.0	303.0
5.5	345.0
6.0	376.0
6.5	390.0
7.0	395.0

Name: 7a	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
0.5	0.1
1.0	0.6
1.5	1.6
2.0	2.4
2.5	3.7
3.0	13.0

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

3.5	26.8
4.0	39.4
4.5	48.9
5.0	55.3
5.5	59.9
6.0	62.1
6.5	63.2
7.0	63.6
7.5	64.1

Name: 7A_ELIN_US	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
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Name: 7b	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
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0.5	0.1
1.0	0.6
1.5	1.6
2.0	2.4
2.5	3.7
3.0	13.0
3.5	26.8
4.0	39.4
4.5	48.9
5.0	55.3
5.5	59.9
6.0	62.1
6.5	63.2
7.0	63.6
7.5	64.1

Name: BCH_RD_WEIR	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
-----------	----------

-5.0	0.0
5.0	0.0

Name: TAILWATER_(BAY)	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Time/Stage		

THE STAGES WILL BE ADJUSTED DEPENDING ON THE SCENARIO, STARTING WATER ELEVATIONS AND GATE POSITIONS.

SET FLOW TO "BOTH OR NONE" TO OPEN OR CLOSE THE GATES AS NECESSARY IN THE FOLLOWING LINKS:

- BR_WEIR-CUL-GAT: MANIPULATE WEIR 2 OF 2 - REPRESENTS THE (2) GATES
- TB_GATES

Time(hrs)	Stage(ft)
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0.00	3.4
1000.00	3.4

Name: TARPON_BAY_WEIR	Base Flow(cfs): 0.000	Init Stage(ft): 3.420
Group: BASE		Warn Stage(ft): 0.000
Type: Stage/Area		

Stage(ft)	Area(ac)
-----------	----------

-5.0	0.0
5.0	0.0

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

==== Cross Sections =====

Name: B7_CHANNEL
Encroachment: No

Group: BASE

Station(ft)	Elevation(ft)	Manning's N
-50.000	3.400	0.500000
-45.000	3.300	0.500000
-40.000	3.100	0.500000
-35.000	2.900	0.500000
-30.000	2.800	0.500000
-25.000	2.600	0.050000
-20.000	0.100	0.050000
-15.000	-1.700	0.050000
-10.000	-2.400	0.050000
-5.000	-2.700	0.050000
0.000	-2.800	0.050000
5.000	-3.000	0.050000
10.000	-3.100	0.050000
15.000	-2.800	0.050000
20.000	-2.000	0.050000
25.000	-0.700	0.050000
30.000	1.700	0.050000
35.000	3.300	0.500000
40.000	4.100	0.500000
45.000	4.600	0.500000

Name: RABBIT_RD
Encroachment: No

Group: BASE

Station(ft)	Elevation(ft)	Manning's N
0.000	3.600	0.000000
250.000	3.600	0.000000
1040.000	3.500	0.000000
2140.000	3.400	0.000000
2750.000	3.300	0.000000
2910.000	3.200	0.000000
3120.000	3.100	0.000000
3210.000	3.000	0.000000

Name: TARP_BAY_RD
Encroachment: No

Group: BASE

Station(ft)	Elevation(ft)	Manning's N
0.000	3.600	0.000000
40.000	3.600	0.000000
270.000	3.500	0.000000
640.000	3.400	0.000000
1260.000	3.300	0.000000
1450.000	3.200	0.000000
1560.000	3.100	0.000000
1580.000	3.000	0.000000

==== Pipes =====

Name: PIPE_1-2
Group: BASE

From Node: 1
To Node: 2

Length(ft): 40.00
Count: 2

Friction Equation: Automatic
Solution Algorithm: Most Restrictive
Flow: Both
Entrance Loss Coef: 0.50
Exit Loss Coef: 1.00
Bend Loss Coef: 0.00
Outlet Ctrl Spec: Use dc or tw
Inlet Ctrl Spec: Use dc
Stabilizer Option: None

UPSTREAM	DOWNSTREAM
Geometry: Circular	Circular
Span(in): 48.00	48.00
Rise(in): 48.00	48.00
Invert(ft): -4.180	-4.180
Manning's N: 0.013000	0.013000
Top Clip(in): 0.000	0.000
Bot Clip(in): 0.000	0.000

Upstream FHWA Inlet Edge Description:

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

NUMBER OF PIPES AND DIAMETERS FIELD VERIFIED ON 4-18-2017.
ASSUMED PIPE INVERT ELEVATION OF -4.18 NAVD (-3.00 NGVD).
PIPE LENGTHS ESTIMATED FROM AERIAL IMAGE.

Name: PIPE_2-3	From Node: 2	Length(ft): 40.00
Group: BASE	To Node: 3	Count: 2
UPSTREAM	DOWNSTREAM	Friction Equation: Automatic
Geometry: Circular	Circular	Solution Algorithm: Most Restrictive
Span(in): 48.00	48.00	Flow: Both
Rise(in): 48.00	48.00	Entrance Loss Coef: 0.50
Invert(ft): -4.180	-4.180	Exit Loss Coef: 1.00
Manning's N: 0.013000	0.013000	Bend Loss Coef: 0.00
Top Clip(in): 0.000	0.000	Outlet Ctrl Spec: Use dc or tw
Bot Clip(in): 0.000	0.000	Inlet Ctrl Spec: Use dc
		Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

NUMBER OF PIPES AND DIAMETERS FIELD VERIFIED ON 4-18-2017.
ASSUMED PIPE INVERT ELEVATION OF -4.18 NAVD (-3.00 NGVD).
PIPE LENGTHS ESTIMATED FROM AERIAL IMAGE.

Name: PIPE_3-4_RABBIT	From Node: 3	Length(ft): 44.00
Group: BASE	To Node: 4	Count: 2
UPSTREAM	DOWNSTREAM	Friction Equation: Automatic
Geometry: Rectangular	Rectangular	Solution Algorithm: Most Restrictive
Span(in): 144.00	144.00	Flow: Both
Rise(in): 60.00	60.00	Entrance Loss Coef: 0.50
Invert(ft): -4.180	-4.180	Exit Loss Coef: 1.00
Manning's N: 0.013000	0.013000	Bend Loss Coef: 0.00
Top Clip(in): 0.000	0.000	Outlet Ctrl Spec: Use dc or tw
Bot Clip(in): 0.000	0.000	Inlet Ctrl Spec: Use dc
		Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

INFORMATION OBTAINED FROM RABBIT ROAD CULVERT REPLACEMENT
ASBUILTS DATED 11-22-1994.
PIPE LENGTH ESTIMATED FROM AERIAL IMAGE.

Name: PIPE_4-4A_ISLAN	From Node: 4	Length(ft): 40.00
Group: BASE	To Node: 4a	Count: 1
UPSTREAM	DOWNSTREAM	Friction Equation: Automatic
Geometry: Rectangular	Rectangular	Solution Algorithm: Most Restrictive
Span(in): 120.00	120.00	Flow: Both
Rise(in): 72.00	72.00	Entrance Loss Coef: 0.50
Invert(ft): -3.680	-3.680	Exit Loss Coef: 1.00
Manning's N: 0.013000	0.013000	Bend Loss Coef: 0.00
Top Clip(in): 0.000	0.000	Outlet Ctrl Spec: Use dc or tw
Bot Clip(in): 0.000	0.000	Inlet Ctrl Spec: Use dc
		Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

INFORMATION OBTAINED FROM ISLAND INN ROAD BOX CULVERT
ASBUILTS DATED 2-21-1996.
PIPE LENGTH ESTIMATED FROM AERIAL IMAGE.

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

Name: PIPE_5-6_YBEL	From Node: 5	Length(ft): 46.00
Group: BASE	To Node: 6	Count: 1
UPSTREAM	DOWNSTREAM	Friction Equation: Automatic
Geometry: Rectangular	Rectangular	Solution Algorithm: Most Restrictive
Span(in): 120.00	120.00	Flow: Both
Rise(in): 60.00	60.00	Entrance Loss Coef: 0.50
Invert(ft): -3.170	-3.170	Exit Loss Coef: 1.00
Manning's N: 0.013000	0.013000	Bend Loss Coef: 0.00
Top Clip(in): 0.000	0.000	Outlet Ctrl Spec: Use dc or tw
Bot Clip(in): 0.000	0.000	Inlet Ctrl Spec: Use dc
		Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

INFORMATION OBTAINED FROM CASA YBEL BOX CULVERT DESIGN PLANS
DATED 4-1990, REVISED 11-1993.
PIPE LENGTHS ESTIMATED FROM AERIAL IMAGE.

Name: PIPE_5A-5_YBEL	From Node: 5a	Length(ft): 85.00
Group: BASE	To Node: 5	Count: 1
UPSTREAM	DOWNSTREAM	Friction Equation: Automatic
Geometry: Horz Ellipse	Horz Ellipse	Solution Algorithm: Most Restrictive
Span(in): 53.00	53.00	Flow: Both
Rise(in): 34.00	34.00	Entrance Loss Coef: 0.50
Invert(ft): -1.180	-1.180	Exit Loss Coef: 1.00
Manning's N: 0.013000	0.013000	Bend Loss Coef: 0.00
Top Clip(in): 0.000	0.000	Outlet Ctrl Spec: Use dc or tw
Bot Clip(in): 0.000	0.000	Inlet Ctrl Spec: Use dc
		Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Horizontal Ellipse Concrete: Square edge with headwall

Downstream FHWA Inlet Edge Description:
Horizontal Ellipse Concrete: Square edge with headwall

PIPE SIZE FIELD VERIFIED ON 4-18-2017.
PIPE LENGTH ESTIMATED FROM AERIAL IMAGE.
INVERT ASSUMED FROM ERP RECORDS

Name: PIPE_6-7A_DONAX	From Node: 6	Length(ft): 60.00
Group: BASE	To Node: 7a	Count: 2
UPSTREAM	DOWNSTREAM	Friction Equation: Automatic
Geometry: Rectangular	Rectangular	Solution Algorithm: Most Restrictive
Span(in): 120.00	120.00	Flow: Both
Rise(in): 48.00	48.00	Entrance Loss Coef: 0.50
Invert(ft): -3.240	-3.240	Exit Loss Coef: 1.00
Manning's N: 0.013000	0.013000	Bend Loss Coef: 0.00
Top Clip(in): 0.000	0.000	Outlet Ctrl Spec: Use dc or tw
Bot Clip(in): 0.000	0.000	Inlet Ctrl Spec: Use dc
		Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

INFORMATION OBTAINED FROM DONAX STREET CULVERT REPLACEMENTS
RECORD DRAWINGS DATED 1-1994.
PIPE LENGTH ESTIMATED FROM AERIAL IMAGE.

Name: PIPE_7A-7B_ELIN	From Node: 7A_ELIN_US	Length(ft): 32.00
Group: BASE	To Node: 7b	Count: 2
UPSTREAM	DOWNSTREAM	Friction Equation: Automatic
Geometry: Rectangular	Rectangular	Solution Algorithm: Most Restrictive
Span(in): 120.00	120.00	Flow: Both
Rise(in): 48.00	48.00	Entrance Loss Coef: 0.50
Invert(ft): -3.170	-3.170	Exit Loss Coef: 1.00
Manning's N: 0.013000	0.013000	Bend Loss Coef: 0.00
		Outlet Ctrl Spec: Use dc or tw

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

Top Clip(in): 0.000	0.000	Inlet Ctrl Spec: Use dc
Bot Clip(in): 0.000	0.000	Stabilizer Option: None

Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

INFORMATION OBTAINED FROM ELINOR WAY CULVERT REPLACEMENTS
RECORD DRAWINGS DATED 1-1994.
PIPE LENGTH ESTIMATED FROM AERIAL IMAGE.

Name: SAN-CAP_ROAD		From Node: 4	Length(ft): 54.00
Group: BASE		To Node: TARPON_BAY_WEIR	Count: 4
UPSTREAM		Friction Equation: Automatic	
DOWNSTREAM		Solution Algorithm: Most Restrictive	
Geometry: Rectangular		Flow: Both	
Span(in): 120.00		Entrance Loss Coef: 0.50	
Rise(in): 72.00		Exit Loss Coef: 1.00	
Invert(ft): -4.170		Bend Loss Coef: 0.00	
Manning's N: 0.013000		Outlet Ctrl Spec: Use dc or tw	
Top Clip(in): 0.000		Inlet Ctrl Spec: Use dc	
Bot Clip(in): 0.000		Stabilizer Option: None	

Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

INFORMATION OBTAINED FROM SANIBEL-CAPTIVA ROAD BOX CULVERT
ASBUILTS DATED 5-1995.
PIPE LENGTHS ESTIMATED FROM AERIAL IMAGE.

==== Channels =====

Name: 7A_CHANNEL		From Node: 7a	Length(ft): 1200.00
Group: BASE		To Node: 7A_ELIN_US	Count: 1
UPSTREAM		Friction Equation: Automatic	
DOWNSTREAM		Solution Algorithm: Automatic	
Geometry: Irregular		Flow: Both	
Invert(ft): -3.100		Contraction Coef: 0.100	
TClpInitZ(ft): 9999.000		Expansion Coef: 0.300	
Manning's N:		Entrance Loss Coef: 1.000	
Top Clip(ft):		Exit Loss Coef: 1.000	
Bot Clip(ft):		Outlet Ctrl Spec: Use dc or tw	
Main XSec: B7_CHANNEL		Inlet Ctrl Spec: Use dc	
AuxElev1(ft): 0.000		Stabilizer Option: None	
Aux XSec1:			
AuxElev2(ft): 0.000			
Aux XSec2:			
Top Width(ft):			
Depth(ft):			
Bot Width(ft):			
LtSdSlp(h/v):			
RtSdSlp(h/v):			

Name: 7B_CHANNEL		From Node: 7b	Length(ft): 1100.00
Group: BASE		To Node: BCH_RD_WEIR	Count: 1
UPSTREAM		Friction Equation: Automatic	
DOWNSTREAM		Solution Algorithm: Automatic	
Geometry: Irregular		Flow: Both	
Invert(ft): -3.100		Contraction Coef: 0.100	
TClpInitZ(ft): 9999.000		Expansion Coef: 0.300	
Manning's N:		Entrance Loss Coef: 1.000	
Top Clip(ft):		Exit Loss Coef: 1.000	
Bot Clip(ft):		Outlet Ctrl Spec: Use dc or tw	
Main XSec: B7_CHANNEL		Inlet Ctrl Spec: Use dc	
AuxElev1(ft): 0.000		Stabilizer Option: None	
Aux XSec1:			
AuxElev2(ft): 0.000			
Aux XSec2:			
Top Width(ft):			
Depth(ft):			
Bot Width(ft):			

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

LtSdSlp(h/v):
RtSdSlp(h/v):

==== Drop Structures =====

Name: BR_WEIR-CUL-GAT	From Node: BCH_RD_WEIR	Length(ft): 28.00
Group: BASE	To Node: TAILWATER_(BAY)	Count: 2
UPSTREAM	DOWNSTREAM	Friction Equation: Automatic
Geometry: Rectangular	Rectangular	Solution Algorithm: Most Restrictive
Span(in): 96.00	96.00	Flow: Both
Rise(in): 60.00	60.00	Entrance Loss Coef: 0.500
Invert(ft): -3.130	-3.130	Exit Loss Coef: 1.000
Manning's N: 0.013000	0.013000	Outlet Ctrl Spec: Use dc or tw
Top Clip(in): 0.000	0.000	Inlet Ctrl Spec: Use dc
Bot Clip(in): 0.000	0.000	Solution Incs: 10

Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

WEIR AND GATE INFORMATION OBTAINED FROM WATER CONTROL STRUCTURE
RECORD DRAWINGS DATED 2-1993.
PIPE LENGTHS ESTIMATED FROM AERIAL IMAGE.

*** Weir 1 of 2 for Drop Structure BR_WEIR-CUL-GAT ***

Count: 1	Bottom Clip(in): 0.000	TABLE
Type: Vertical: Mavis	Top Clip(in): 0.000	
Flow: Both	Weir Disc Coef: 3.200	
Geometry: Rectangular	Orifice Disc Coef: 0.600	
Span(in): 720.00	Invert(ft): 1.510	
Rise(in): 999.00	Control Elev(ft): 1.510	

*** Weir 2 of 2 for Drop Structure BR_WEIR-CUL-GAT ***

Count: 2	Bottom Clip(in): 0.000	TABLE
Type: Vertical: Mavis	Top Clip(in): 0.000	
Flow: Both	Weir Disc Coef: 3.200	
Geometry: Rectangular	Orifice Disc Coef: 0.600	
Span(in): 72.00	Invert(ft): -4.060	
Rise(in): 60.00	Control Elev(ft): -4.060	

Name: TARP_RD_WEIR	From Node: 4a	Length(ft): 46.00
Group: BASE	To Node: 5	Count: 1
UPSTREAM	DOWNSTREAM	Friction Equation: Automatic
Geometry: Rectangular	Rectangular	Solution Algorithm: Most Restrictive
Span(in): 120.00	120.00	Flow: Both
Rise(in): 72.00	72.00	Entrance Loss Coef: 0.500
Invert(ft): -3.680	-3.680	Exit Loss Coef: 1.000
Manning's N: 0.013000	0.013000	Outlet Ctrl Spec: Use dc or tw
Top Clip(in): 0.000	0.000	Inlet Ctrl Spec: Use dc
Bot Clip(in): 0.000	0.000	Solution Incs: 10

Upstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

Downstream FHWA Inlet Edge Description:
Rectangular Box: 30° to 75° wingwall flares

INFORMATION OBTAINED FROM TARPON BAY ROAD BOX CULVERT ASBUILTS DATED 2-21-1996.
WEIR INVERT IS THE AVERAGE OF CREST ELEVATIONS.
PIPE LENGTH ESTIMATED FROM AERIAL IMAGE.

*** Weir 1 of 2 for Drop Structure TARP_RD_WEIR ***

Count: 1	Bottom Clip(in): 0.000	TABLE
Type: Vertical: Mavis	Top Clip(in): 0.000	
Flow: Both	Weir Disc Coef: 3.200	
Geometry: Rectangular	Orifice Disc Coef: 0.600	
Span(in): 252.00	Invert(ft): 2.320	
Rise(in): 999.00	Control Elev(ft): 2.320	

*** Weir 2 of 2 for Drop Structure TARP_RD_WEIR ***

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

TABLE

Count: 1
Type: Vertical: Mavis
Flow: Both
Geometry: Rectangular
Span(in): 120.00
Rise(in): 999.00
Bottom Clip(in): 0.000
Top Clip(in): 0.000
Weir Disc Coef: 3.200
Orifice Disc Coef: 0.600
Invert(ft): 3.000
Control Elev(ft): 3.000

===== Weirs =====

Name: RABBIT_RD
Group: BASE
Flow: Both
Type: Vertical: Paved
From Node: 3
To Node: 4
Count: 1
Geometry: Irregular

XSec: RABBIT_RD
Invert(ft): 3.000
Control Elevation(ft): 3.000
Struct Opening Dim(ft): 9999.00

TABLE

Bottom Clip(ft): 0.000
Top Clip(ft): 0.000
Weir Discharge Coef: 3.200
Orifice Discharge Coef: 0.600

Name: TARP_RD_OVERTOP
Group: BASE
Flow: Both
Type: Vertical: Paved
From Node: 4a
To Node: 5
Count: 1
Geometry: Irregular

XSec: TARP_BAY_RD
Invert(ft): 3.000
Control Elevation(ft): 3.000
Struct Opening Dim(ft): 9999.00

TABLE

Bottom Clip(ft): 0.000
Top Clip(ft): 0.000
Weir Discharge Coef: 3.200
Orifice Discharge Coef: 0.600

Name: TB_GATES
Group: BASE
Flow: Both
Type: Vertical: Mavis
From Node: TARPON_BAY_WEIR
To Node: TAILWATER_(BAY)
Count: 4
Geometry: Rectangular

Span(in): 72.00
Rise(in): 60.00
Invert(ft): -4.170
Control Elevation(ft): -4.170

TABLE

Bottom Clip(in): 0.000
Top Clip(in): 0.000
Weir Discharge Coef: 3.200
Orifice Discharge Coef: 0.600

INFORMATION OBTAINED FROM TARPON BAY WATER CONTROL STRUCTURE
ASBUILTS DATED 5-1995.

Name: TB_WEIR
Group: BASE
Flow: Both
Type: Vertical: Mavis
From Node: TARPON_BAY_WEIR
To Node: TAILWATER_(BAY)
Count: 1
Geometry: Rectangular

Span(in): 1680.00
Rise(in): 999.00
Invert(ft): 1.980
Control Elevation(ft): 1.980

TABLE

Bottom Clip(in): 0.000
Top Clip(in): 0.000
Weir Discharge Coef: 3.200
Orifice Discharge Coef: 0.600

INFORMATION OBTAINED FROM TARPON BAY WATER CONTROL STRUCTURE
WEIR INVERT IS THE AVERAGE OF CREST ELEVATIONS, PER ASBUILTS DATED 5-1995.

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

==== Hydrology Simulations =====

Name: 003YEAR-1HOUR
Filename: \\FTMS01\Proj-fma\20150000\20150244-004 - City of Sanibel (SWMP Update - Ph 3)\ICPR\Ex Cond_4-2100\003YEAR-1HOUR.

Override Defaults: Yes
Storm Duration(hrs): 1.00
Rainfall File: Fdot-1
Rainfall Amount(in): 2.40

Time(hrs)	Print Inc(min)
30.000	5.00

Name: 005YR-1DAY
Filename: \\FTMS01\Proj-fma\20150000\20150244-004 - City of Sanibel (SWMP Update - Ph 3)\ICPR\Ex Cond_4-2100\005YR-1DAY.R32

Override Defaults: Yes
Storm Duration(hrs): 24.00
Rainfall File: Scsi-24
Rainfall Amount(in): 5.50

Time(hrs)	Print Inc(min)
30.000	5.00

Name: 025YR-3DAY
Filename: \\FTMS01\Proj-fma\20150000\20150244-004 - City of Sanibel (SWMP Update - Ph 3)\ICPR\Ex Cond_4-2100\025YR-3DAY.R32

Override Defaults: Yes
Storm Duration(hrs): 72.00
Rainfall File: Sfwmd72
Rainfall Amount(in): 11.20

Time(hrs)	Print Inc(min)
72.000	5.00

Name: 100YR-3DAY
Filename: \\FTMS01\Proj-fma\20150000\20150244-004 - City of Sanibel (SWMP Update - Ph 3)\ICPR\Ex Cond_4-2100\100YR-3DAY.R32

Override Defaults: Yes
Storm Duration(hrs): 72.00
Rainfall File: Sfwmd72
Rainfall Amount(in): 14.00

Time(hrs)	Print Inc(min)
80.000	5.00

==== Routing Simulations =====

Name: 003YEAR-1HOUR Hydrology Sim: 003YEAR-1HOUR
Filename: \\FTMS01\Proj-fma\20150000\20150244-004 - City of Sanibel (SWMP Update - Ph 3)\ICPR\Ex Cond_4-2100\003YEAR-1HOUR.

Execute: Yes	Restart: No	Patch: No
Alternative: No		
Max Delta Z(ft): 0.10	Delta Z Factor: 0.00500	
Time Step Optimizer: 10.000		
Start Time(hrs): 0.000	End Time(hrs): 4.00	
Min Calc Time(sec): 0.5000	Max Calc Time(sec): 60.0000	
Boundary Stages:	Boundary Flows:	

Time(hrs)	Print Inc(min)
999.000	15.000

Group	Run
BASE	Yes

Name: 005YR-1DAY Hydrology Sim: 005YR-1DAY
Filename: \\FTMS01\Proj-fma\20150000\20150244-004 - City of Sanibel (SWMP Update - Ph 3)\ICPR\Ex Cond_4-2100\005YR-1DAY.I32

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
INPUT REPORT
JUNE 2018

Execute: No Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 0.10 Delta Z Factor: 0.00500
Time Step Optimizer: 10.000
Start Time(hrs): 0.000 End Time(hrs): 30.00
Min Calc Time(sec): 0.5000 Max Calc Time(sec): 60.0000
Boundary Stages: Boundary Flows:

Time(hrs) Print Inc(min)

999.000 60.000

Group Run

BASE Yes

Name: 025YR-3DAY Hydrology Sim: 025YR-3DAY
Filename: \\FTMS01\Proj-fma\20150000\20150244-004 - City of Sanibel (SWMP Update - Ph 3)\ICPR\Ex Cond_4-2100\025YR-3DAY.I32

Execute: No Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 0.10 Delta Z Factor: 0.00100
Time Step Optimizer: 1.000
Start Time(hrs): 0.000 End Time(hrs): 100.00
Min Calc Time(sec): 0.5000 Max Calc Time(sec): 60.0000
Boundary Stages: Boundary Flows:

Time(hrs) Print Inc(min)

999.000 60.000

Group Run

BASE Yes

Name: 100YR-3DAY Hydrology Sim: 100YR-3DAY
Filename: \\FTMS01\Proj-fma\20150000\20150244-004 - City of Sanibel (SWMP Update - Ph 3)\ICPR\Ex Cond_4-2100\100YR-3DAY.I32

Execute: No Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 0.10 Delta Z Factor: 0.00100
Time Step Optimizer: 1.000
Start Time(hrs): 0.000 End Time(hrs): 100.00
Min Calc Time(sec): 0.5000 Max Calc Time(sec): 60.0000
Boundary Stages: Boundary Flows:

Time(hrs) Print Inc(min)

999.000 60.000

Group Run

BASE Yes

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Basin Name: 1
Group Name: BASE
Simulation: 003YEAR-1HOUR
Node Name: 1
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 8.80
Comp Time Inc (min): 5.00
Rainfall File: Fdot-1
Rainfall Amount (in): 2.400
Storm Duration (hrs): 1.00
Status: Onsite
Time of Conc (min): 66.00
Time Shift (hrs): 0.00
Area (ac): 149.000
Vol of Unit Hyd (in): 1.000
Curve Number: 91.000
DCIA (%): 0.000

Time Max (hrs): 1.25
Flow Max (cfs): 115.74
Runoff Volume (in): 1.520
Runoff Volume (ft3): 821907

Basin Name: 2
Group Name: BASE
Simulation: 003YEAR-1HOUR
Node Name: 2
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.27
Comp Time Inc (min): 4.27
Rainfall File: Fdot-1
Rainfall Amount (in): 2.400
Storm Duration (hrs): 1.00
Status: Onsite
Time of Conc (min): 32.00
Time Shift (hrs): 0.00
Area (ac): 34.000
Vol of Unit Hyd (in): 1.000
Curve Number: 89.000
DCIA (%): 0.000

Time Max (hrs): 0.92
Flow Max (cfs): 43.47
Runoff Volume (in): 1.367
Runoff Volume (ft3): 168680

Basin Name: 3
Group Name: BASE
Simulation: 003YEAR-1HOUR
Node Name: 3
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 10.80
Comp Time Inc (min): 5.00
Rainfall File: Fdot-1
Rainfall Amount (in): 2.400
Storm Duration (hrs): 1.00
Status: Onsite
Time of Conc (min): 81.00
Time Shift (hrs): 0.00
Area (ac): 813.000
Vol of Unit Hyd (in): 1.000
Curve Number: 94.000
DCIA (%): 0.000

Time Max (hrs): 1.42
Flow Max (cfs): 610.86
Runoff Volume (in): 1.773
Runoff Volume (ft3): 5232711

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Basin Name: 4
Group Name: BASE
Simulation: 003YEAR-1HOUR
Node Name: 4
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.00
Comp Time Inc (min): 4.00
Rainfall File: Fdot-1
Rainfall Amount (in): 2.400
Storm Duration (hrs): 1.00
Status: Onsite
Time of Conc (min): 30.00
Time Shift (hrs): 0.00
Area (ac): 728.000
Vol of Unit Hyd (in): 1.000
Curve Number: 94.000
DCIA (%): 0.000

Time Max (hrs): 0.87
Flow Max (cfs): 1241.10
Runoff Volume (in): 1.773
Runoff Volume (ft3): 4686539

Basin Name: 4A
Group Name: BASE
Simulation: 003YEAR-1HOUR
Node Name: 4a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.67
Comp Time Inc (min): 4.67
Rainfall File: Fdot-1
Rainfall Amount (in): 2.400
Storm Duration (hrs): 1.00
Status: Onsite
Time of Conc (min): 35.00
Time Shift (hrs): 0.00
Area (ac): 291.000
Vol of Unit Hyd (in): 1.000
Curve Number: 93.000
DCIA (%): 0.000

Time Max (hrs): 0.93
Flow Max (cfs): 425.00
Runoff Volume (in): 1.677
Runoff Volume (ft3): 1771922

Basin Name: 5
Group Name: BASE
Simulation: 003YEAR-1HOUR
Node Name: 5
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 7.20
Comp Time Inc (min): 5.00
Rainfall File: Fdot-1
Rainfall Amount (in): 2.400
Storm Duration (hrs): 1.00
Status: Onsite
Time of Conc (min): 54.00
Time Shift (hrs): 0.00
Area (ac): 607.000
Vol of Unit Hyd (in): 1.000
Curve Number: 95.000
DCIA (%): 0.000

Time Max (hrs): 1.17
Flow Max (cfs): 684.74
Runoff Volume (in): 1.865
Runoff Volume (ft3): 4109392

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Basin Name: 5A
Group Name: BASE
Simulation: 003YEAR-1HOUR
Node Name: 5a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 3.20
Comp Time Inc (min): 3.20
Rainfall File: Fdot-1
Rainfall Amount (in): 2.400
Storm Duration (hrs): 1.00
Status: Onsite
Time of Conc (min): 24.00
Time Shift (hrs): 0.00
Area (ac): 101.000
Vol of Unit Hyd (in): 1.000
Curve Number: 97.000
DCIA (%): 0.000

Time Max (hrs): 0.80
Flow Max (cfs): 227.85
Runoff Volume (in): 2.060
Runoff Volume (ft3): 755103

Basin Name: 6
Group Name: BASE
Simulation: 003YEAR-1HOUR
Node Name: 6
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 6.00
Comp Time Inc (min): 5.00
Rainfall File: Fdot-1
Rainfall Amount (in): 2.400
Storm Duration (hrs): 1.00
Status: Onsite
Time of Conc (min): 45.00
Time Shift (hrs): 0.00
Area (ac): 402.000
Vol of Unit Hyd (in): 1.000
Curve Number: 91.000
DCIA (%): 0.000

Time Max (hrs): 1.08
Flow Max (cfs): 433.61
Runoff Volume (in): 1.519
Runoff Volume (ft3): 2216658

Basin Name: 7a
Group Name: BASE
Simulation: 003YEAR-1HOUR
Node Name: 7a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 5.33
Comp Time Inc (min): 5.00
Rainfall File: Fdot-1
Rainfall Amount (in): 2.400
Storm Duration (hrs): 1.00
Status: Onsite
Time of Conc (min): 40.00
Time Shift (hrs): 0.00
Area (ac): 64.000
Vol of Unit Hyd (in): 1.000
Curve Number: 92.000
DCIA (%): 0.000

Time Max (hrs): 1.00
Flow Max (cfs): 79.64
Runoff Volume (in): 1.597
Runoff Volume (ft3): 371114

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Basin Name: 7b
Group Name: BASE
Simulation: 003YEAR-1HOUR
Node Name: 7b
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 5.33
Comp Time Inc (min): 5.00
Rainfall File: Fdot-1
Rainfall Amount (in): 2.400
Storm Duration (hrs): 1.00
Status: Onsite
Time of Conc (min): 40.00
Time Shift (hrs): 0.00
Area (ac): 64.000
Vol of Unit Hyd (in): 1.000
Curve Number: 92.000
DCIA (%): 0.000

Time Max (hrs): 1.00
Flow Max (cfs): 79.64
Runoff Volume (in): 1.597
Runoff Volume (ft3): 371114

Basin Name: 1
Group Name: BASE
Simulation: 005YR-1DAY
Node Name: 1
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 8.80
Comp Time Inc (min): 5.00
Rainfall File: Scsi-24
Rainfall Amount (in): 5.500
Storm Duration (hrs): 24.00
Status: Onsite
Time of Conc (min): 66.00
Time Shift (hrs): 0.00
Area (ac): 149.000
Vol of Unit Hyd (in): 1.000
Curve Number: 91.000
DCIA (%): 0.000

Time Max (hrs): 10.67
Flow Max (cfs): 117.21
Runoff Volume (in): 4.468
Runoff Volume (ft3): 2416814

Basin Name: 2
Group Name: BASE
Simulation: 005YR-1DAY
Node Name: 2
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.27
Comp Time Inc (min): 4.27
Rainfall File: Scsi-24
Rainfall Amount (in): 5.500
Storm Duration (hrs): 24.00
Status: Onsite
Time of Conc (min): 32.00
Time Shift (hrs): 0.00
Area (ac): 34.000
Vol of Unit Hyd (in): 1.000
Curve Number: 89.000
DCIA (%): 0.000

Time Max (hrs): 10.24
Flow Max (cfs): 38.10
Runoff Volume (in): 4.248
Runoff Volume (ft3): 524267

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Basin Name: 3
Group Name: BASE
Simulation: 005YR-1DAY
Node Name: 3
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 10.80
Comp Time Inc (min): 5.00
Rainfall File: Scsi-24
Rainfall Amount (in): 5.500
Storm Duration (hrs): 24.00
Status: Onsite
Time of Conc (min): 81.00
Time Shift (hrs): 0.00
Area (ac): 813.000
Vol of Unit Hyd (in): 1.000
Curve Number: 94.000
DCIA (%): 0.000

Time Max (hrs): 10.83
Flow Max (cfs): 607.73
Runoff Volume (in): 4.799
Runoff Volume (ft3): 14163632

Basin Name: 4
Group Name: BASE
Simulation: 005YR-1DAY
Node Name: 4
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.00
Comp Time Inc (min): 4.00
Rainfall File: Scsi-24
Rainfall Amount (in): 5.500
Storm Duration (hrs): 24.00
Status: Onsite
Time of Conc (min): 30.00
Time Shift (hrs): 0.00
Area (ac): 728.000
Vol of Unit Hyd (in): 1.000
Curve Number: 94.000
DCIA (%): 0.000

Time Max (hrs): 10.20
Flow Max (cfs): 945.88
Runoff Volume (in): 4.800
Runoff Volume (ft3): 12685167

Basin Name: 4A
Group Name: BASE
Simulation: 005YR-1DAY
Node Name: 4a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.67
Comp Time Inc (min): 4.67
Rainfall File: Scsi-24
Rainfall Amount (in): 5.500
Storm Duration (hrs): 24.00
Status: Onsite
Time of Conc (min): 35.00
Time Shift (hrs): 0.00
Area (ac): 291.000
Vol of Unit Hyd (in): 1.000
Curve Number: 93.000
DCIA (%): 0.000

Time Max (hrs): 10.27
Flow Max (cfs): 341.67
Runoff Volume (in): 4.684

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Runoff Volume (ft3): 4948056

Basin Name: 5
Group Name: BASE
Simulation: 005YR-1DAY
Node Name: 5
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 7.20
Comp Time Inc (min): 5.00
Rainfall File: Scsi-24
Rainfall Amount (in): 5.500
Storm Duration (hrs): 24.00
Status: Onsite
Time of Conc (min): 54.00
Time Shift (hrs): 0.00
Area (ac): 607.000
Vol of Unit Hyd (in): 1.000
Curve Number: 95.000
DCIA (%): 0.000

Time Max (hrs): 10.50
Flow Max (cfs): 583.46
Runoff Volume (in): 4.911
Runoff Volume (ft3): 10820929

Basin Name: 5A
Group Name: BASE
Simulation: 005YR-1DAY
Node Name: 5a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 3.20
Comp Time Inc (min): 3.20
Rainfall File: Scsi-24
Rainfall Amount (in): 5.500
Storm Duration (hrs): 24.00
Status: Onsite
Time of Conc (min): 24.00
Time Shift (hrs): 0.00
Area (ac): 101.000
Vol of Unit Hyd (in): 1.000
Curve Number: 97.000
DCIA (%): 0.000

Time Max (hrs): 10.13
Flow Max (cfs): 152.30
Runoff Volume (in): 5.144
Runoff Volume (ft3): 1885855

Basin Name: 6
Group Name: BASE
Simulation: 005YR-1DAY
Node Name: 6
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 6.00
Comp Time Inc (min): 5.00
Rainfall File: Scsi-24
Rainfall Amount (in): 5.500
Storm Duration (hrs): 24.00
Status: Onsite
Time of Conc (min): 45.00
Time Shift (hrs): 0.00
Area (ac): 402.000
Vol of Unit Hyd (in): 1.000
Curve Number: 91.000
DCIA (%): 0.000

Time Max (hrs): 10.33
Flow Max (cfs): 393.82

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Runoff Volume (in): 4.467
Runoff Volume (ft3): 6518069

Basin Name: 7a
Group Name: BASE
Simulation: 005YR-1DAY
Node Name: 7a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 5.33
Comp Time Inc (min): 5.00
Rainfall File: Scsi-24
Rainfall Amount (in): 5.500
Storm Duration (hrs): 24.00
Status: Onsite
Time of Conc (min): 40.00
Time Shift (hrs): 0.00
Area (ac): 64.000
Vol of Unit Hyd (in): 1.000
Curve Number: 92.000
DCIA (%): 0.000

Time Max (hrs): 10.33
Flow Max (cfs): 68.16
Runoff Volume (in): 4.569
Runoff Volume (ft3): 1061462

Basin Name: 7b
Group Name: BASE
Simulation: 005YR-1DAY
Node Name: 7b
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 5.33
Comp Time Inc (min): 5.00
Rainfall File: Scsi-24
Rainfall Amount (in): 5.500
Storm Duration (hrs): 24.00
Status: Onsite
Time of Conc (min): 40.00
Time Shift (hrs): 0.00
Area (ac): 64.000
Vol of Unit Hyd (in): 1.000
Curve Number: 92.000
DCIA (%): 0.000

Time Max (hrs): 10.33
Flow Max (cfs): 68.16
Runoff Volume (in): 4.569
Runoff Volume (ft3): 1061462

Basin Name: 1
Group Name: BASE
Simulation: 025YR-3DAY
Node Name: 1
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 8.80
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 11.200
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 66.00
Time Shift (hrs): 0.00
Area (ac): 149.000
Vol of Unit Hyd (in): 1.000
Curve Number: 91.000
DCIA (%): 0.000

Time Max (hrs): 60.58

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Flow Max (cfs): 277.92
Runoff Volume (in): 10.086
Runoff Volume (ft3): 5455174

Basin Name: 2
Group Name: BASE
Simulation: 025YR-3DAY
Node Name: 2
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.27
Comp Time Inc (min): 4.27
Rainfall File: Sfwmd72
Rainfall Amount (in): 11.200
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 32.00
Time Shift (hrs): 0.00
Area (ac): 34.000
Vol of Unit Hyd (in): 1.000
Curve Number: 89.000
DCIA (%): 0.000

Time Max (hrs): 60.16
Flow Max (cfs): 98.64
Runoff Volume (in): 9.835
Runoff Volume (ft3): 1213869

Basin Name: 3
Group Name: BASE
Simulation: 025YR-3DAY
Node Name: 3
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 10.80
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 11.200
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 81.00
Time Shift (hrs): 0.00
Area (ac): 813.000
Vol of Unit Hyd (in): 1.000
Curve Number: 94.000
DCIA (%): 0.000

Time Max (hrs): 60.75
Flow Max (cfs): 1336.93
Runoff Volume (in): 10.455
Runoff Volume (ft3): 30854958

Basin Name: 4
Group Name: BASE
Simulation: 025YR-3DAY
Node Name: 4
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.00
Comp Time Inc (min): 4.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 11.200
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 30.00
Time Shift (hrs): 0.00
Area (ac): 728.000
Vol of Unit Hyd (in): 1.000
Curve Number: 94.000
DCIA (%): 0.000

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Time Max (hrs): 60.20
Flow Max (cfs): 2236.05
Runoff Volume (in): 10.465
Runoff Volume (ft3): 27655743

Basin Name: 4A
Group Name: BASE
Simulation: 025YR-3DAY
Node Name: 4a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.67
Comp Time Inc (min): 4.67
Rainfall File: Sfwmd72
Rainfall Amount (in): 11.200
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 35.00
Time Shift (hrs): 0.00
Area (ac): 291.000
Vol of Unit Hyd (in): 1.000
Curve Number: 93.000
DCIA (%): 0.000

Time Max (hrs): 60.20
Flow Max (cfs): 816.60
Runoff Volume (in): 10.336
Runoff Volume (ft3): 10917912

Basin Name: 5
Group Name: BASE
Simulation: 025YR-3DAY
Node Name: 5
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 7.20
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 11.200
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 54.00
Time Shift (hrs): 0.00
Area (ac): 607.000
Vol of Unit Hyd (in): 1.000
Curve Number: 95.000
DCIA (%): 0.000

Time Max (hrs): 60.42
Flow Max (cfs): 1308.09
Runoff Volume (in): 10.575
Runoff Volume (ft3): 23300951

Basin Name: 5A
Group Name: BASE
Simulation: 025YR-3DAY
Node Name: 5a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 3.20
Comp Time Inc (min): 3.20
Rainfall File: Sfwmd72
Rainfall Amount (in): 11.200
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 24.00
Time Shift (hrs): 0.00
Area (ac): 101.000
Vol of Unit Hyd (in): 1.000
Curve Number: 97.000
DCIA (%): 0.000

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Time Max (hrs): 60.11
Flow Max (cfs): 352.30
Runoff Volume (in): 10.833
Runoff Volume (ft3): 3971872

Basin Name: 6
Group Name: BASE
Simulation: 025YR-3DAY
Node Name: 6
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 6.00
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 11.200
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 45.00
Time Shift (hrs): 0.00
Area (ac): 402.000
Vol of Unit Hyd (in): 1.000
Curve Number: 91.000
DCIA (%): 0.000

Time Max (hrs): 60.33
Flow Max (cfs): 962.80
Runoff Volume (in): 10.082
Runoff Volume (ft3): 14712428

Basin Name: 7a
Group Name: BASE
Simulation: 025YR-3DAY
Node Name: 7a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 5.33
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 11.200
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 40.00
Time Shift (hrs): 0.00
Area (ac): 64.000
Vol of Unit Hyd (in): 1.000
Curve Number: 92.000
DCIA (%): 0.000

Time Max (hrs): 60.25
Flow Max (cfs): 164.91
Runoff Volume (in): 10.190
Runoff Volume (ft3): 2367448

Basin Name: 7b
Group Name: BASE
Simulation: 025YR-3DAY
Node Name: 7b
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 5.33
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 11.200
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 40.00
Time Shift (hrs): 0.00
Area (ac): 64.000
Vol of Unit Hyd (in): 1.000
Curve Number: 92.000

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

DCIA (%): 0.000

Time Max (hrs): 60.25
Flow Max (cfs): 164.91
Runoff Volume (in): 10.190
Runoff Volume (ft3): 2367448

Basin Name: 1
Group Name: BASE
Simulation: 100YR-3DAY
Node Name: 1
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 8.80
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 14.000
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 66.00
Time Shift (hrs): 0.00
Area (ac): 149.000
Vol of Unit Hyd (in): 1.000
Curve Number: 91.000
DCIA (%): 0.000

Time Max (hrs): 60.58
Flow Max (cfs): 349.53
Runoff Volume (in): 12.868
Runoff Volume (ft3): 6960041

Basin Name: 2
Group Name: BASE
Simulation: 100YR-3DAY
Node Name: 2
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.27
Comp Time Inc (min): 4.27
Rainfall File: Sfwmd72
Rainfall Amount (in): 14.000
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 32.00
Time Shift (hrs): 0.00
Area (ac): 34.000
Vol of Unit Hyd (in): 1.000
Curve Number: 89.000
DCIA (%): 0.000

Time Max (hrs): 60.16
Flow Max (cfs): 124.36
Runoff Volume (in): 12.610
Runoff Volume (ft3): 1556327

Basin Name: 3
Group Name: BASE
Simulation: 100YR-3DAY
Node Name: 3
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 10.80
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 14.000
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 81.00
Time Shift (hrs): 0.00
Area (ac): 813.000
Vol of Unit Hyd (in): 1.000

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Curve Number: 94.000
DCIA (%): 0.000

Time Max (hrs): 60.75
Flow Max (cfs): 1675.96
Runoff Volume (in): 13.245
Runoff Volume (ft3): 39088032

Basin Name: 4
Group Name: BASE
Simulation: 100YR-3DAY
Node Name: 4
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.00
Comp Time Inc (min): 4.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 14.000
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 30.00
Time Shift (hrs): 0.00
Area (ac): 728.000
Vol of Unit Hyd (in): 1.000
Curve Number: 94.000
DCIA (%): 0.000

Time Max (hrs): 60.20
Flow Max (cfs): 2802.39
Runoff Volume (in): 13.258
Runoff Volume (ft3): 35034836

Basin Name: 4A
Group Name: BASE
Simulation: 100YR-3DAY
Node Name: 4a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 4.67
Comp Time Inc (min): 4.67
Rainfall File: Sfwmd72
Rainfall Amount (in): 14.000
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 35.00
Time Shift (hrs): 0.00
Area (ac): 291.000
Vol of Unit Hyd (in): 1.000
Curve Number: 93.000
DCIA (%): 0.000

Time Max (hrs): 60.20
Flow Max (cfs): 1024.48
Runoff Volume (in): 13.124
Runoff Volume (ft3): 13863434

Basin Name: 5
Group Name: BASE
Simulation: 100YR-3DAY
Node Name: 5
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 7.20
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 14.000
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 54.00
Time Shift (hrs): 0.00
Area (ac): 607.000

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Vol of Unit Hyd (in): 1.000
Curve Number: 95.000
DCIA (%): 0.000

Time Max (hrs): 60.42
Flow Max (cfs): 1638.32
Runoff Volume (in): 13.366
Runoff Volume (ft3): 29450473

Basin Name: 5A
Group Name: BASE
Simulation: 100YR-3DAY
Node Name: 5a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 3.20
Comp Time Inc (min): 3.20
Rainfall File: Sfwmd72
Rainfall Amount (in): 14.000
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 24.00
Time Shift (hrs): 0.00
Area (ac): 101.000
Vol of Unit Hyd (in): 1.000
Curve Number: 97.000
DCIA (%): 0.000

Time Max (hrs): 60.11
Flow Max (cfs): 440.67
Runoff Volume (in): 13.631
Runoff Volume (ft3): 4997478

Basin Name: 6
Group Name: BASE
Simulation: 100YR-3DAY
Node Name: 6
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 6.00
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 14.000
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 45.00
Time Shift (hrs): 0.00
Area (ac): 402.000
Vol of Unit Hyd (in): 1.000
Curve Number: 91.000
DCIA (%): 0.000

Time Max (hrs): 60.33
Flow Max (cfs): 1210.67
Runoff Volume (in): 12.863
Runoff Volume (ft3): 18771007

Basin Name: 7a
Group Name: BASE
Simulation: 100YR-3DAY
Node Name: 7a
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 5.33
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 14.000
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 40.00
Time Shift (hrs): 0.00

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
BASIN SUMMARY
JUNE 2018

Area (ac): 64.000
Vol of Unit Hyd (in): 1.000
Curve Number: 92.000
DCIA (%): 0.000

Time Max (hrs): 60.25
Flow Max (cfs): 207.12
Runoff Volume (in): 12.970
Runoff Volume (ft3): 3013292

Basin Name: 7b
Group Name: BASE
Simulation: 100YR-3DAY
Node Name: 7b
Basin Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256
Peaking Fator: 256.0
Spec Time Inc (min): 5.33
Comp Time Inc (min): 5.00
Rainfall File: Sfwmd72
Rainfall Amount (in): 14.000
Storm Duration (hrs): 72.00
Status: Onsite
Time of Conc (min): 40.00
Time Shift (hrs): 0.00
Area (ac): 64.000
Vol of Unit Hyd (in): 1.000
Curve Number: 92.000
DCIA (%): 0.000

Time Max (hrs): 60.25
Flow Max (cfs): 207.12
Runoff Volume (in): 12.970
Runoff Volume (ft3): 3013292

SANIBEL RIVER
EXISTING CONDITION - 2100 MSL
NODE PEAK REPORT
JUNE 2018

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
1	BASE	003YEAR-1HOURL	3.94	3.6	0.0	0.0000	4028154	1.25	115.74	4.00	21.61
2	BASE	003YEAR-1HOURL	3.41	3.6	0.0	0.0000	663786	0.92	27.90	4.00	22.40
3	BASE	003YEAR-1HOURL	3.08	3.5	0.0	0.0000	24732434	1.42	613.57	3.03	256.66
4	BASE	003YEAR-1HOURL	3.08	3.5	0.0	0.0000	23982575	0.83	921.08	2.14	590.50
4a	BASE	003YEAR-1HOURL	3.72	3.6	0.0	0.0000	9396833	0.92	405.44	0.85	93.96
5	BASE	003YEAR-1HOURL	3.72	3.6	0.0	0.0000	19697614	1.00	707.50	4.00	30.42
5a	BASE	003YEAR-1HOURL	2.44	3.7	0.0	0.0000	2896163	0.83	226.00	1.24	17.88
6	BASE	003YEAR-1HOURL	2.38	3.6	0.0	0.0000	6426661	1.00	381.78	4.00	85.30
7a	BASE	003YEAR-1HOURL	2.30	3.6	0.0	0.0000	1310939	1.17	116.66	3.70	93.93
7A_ELIN_US	BASE	003YEAR-1HOURL	2.24	3.6	0.0	0.0000	52421	3.70	93.93	3.71	94.12
7b	BASE	003YEAR-1HOURL	2.08	3.5	0.0	0.0000	1251716	1.17	129.99	2.07	113.52
BCH_RD_WEIR	BASE	003YEAR-1HOURL	2.08	3.5	0.0	0.0000	48176	2.07	113.52	2.08	113.52
TAILWATER (BAY)	BASE	003YEAR-1HOURL	0.00	3.4	0.0	0.0000	0	3.00	258.24	0.00	0.00
TARPON_BAY_WEIR	BASE	003YEAR-1HOURL	3.08	3.4	0.0	-0.1000	490	3.08	677.13	3.08	149.57
1	BASE	005YR-1DAY	16.35	3.7	0.0	0.0000	4229049	10.67	117.21	18.74	28.51
2	BASE	005YR-1DAY	16.33	3.7	0.0	0.0000	686178	10.78	34.93	18.10	34.01
3	BASE	005YR-1DAY	16.06	3.6	0.0	0.0000	25326378	10.83	626.75	12.67	286.61
4	BASE	005YR-1DAY	16.05	3.6	0.0	0.0000	24364279	10.49	802.12	12.67	599.63
4a	BASE	005YR-1DAY	16.56	3.7	0.0	0.0000	9787676	10.25	270.65	10.08	6.75
5	BASE	005YR-1DAY	16.56	3.7	0.0	0.0000	20575895	10.33	556.29	27.62	56.75
5a	BASE	005YR-1DAY	18.41	3.8	0.0	0.0000	3118156	10.17	150.86	10.68	16.55
6	BASE	005YR-1DAY	15.04	3.7	0.0	0.0000	7085925	10.33	340.91	16.86	114.45
7a	BASE	005YR-1DAY	14.43	3.7	0.0	0.0000	1416049	10.71	127.98	15.74	126.37
7A_ELIN_US	BASE	005YR-1DAY	13.07	3.6	0.0	-0.0005	52739	15.74	126.37	15.75	126.41
7b	BASE	005YR-1DAY	12.63	3.6	0.0	0.0000	1315418	11.12	147.25	12.62	143.35
BCH_RD_WEIR	BASE	005YR-1DAY	12.64	3.5	0.0	0.0001	48336	12.62	143.35	12.64	143.35
TAILWATER (BAY)	BASE	005YR-1DAY	0.00	3.4	0.0	0.0000	0	13.06	894.63	0.00	0.00
TARPON_BAY_WEIR	BASE	005YR-1DAY	22.73	3.6	0.0	-0.1000	490	12.67	715.04	22.73	757.27
1	BASE	025YR-3DAY	65.34	4.1	0.0	0.0000	4726767	60.58	277.92	69.81	44.15
2	BASE	025YR-3DAY	65.26	4.0	0.0	0.0000	740769	60.17	78.37	68.42	51.99
3	BASE	025YR-3DAY	64.64	3.9	0.0	0.0000	26892285	60.75	1372.05	62.75	511.51
4	BASE	025YR-3DAY	64.64	3.9	0.0	0.0000	25362274	60.17	1692.03	60.19	612.43
4a	BASE	025YR-3DAY	65.03	4.1	0.0	0.0000	10693284	60.25	704.27	60.09	102.41
5	BASE	025YR-3DAY	65.03	4.1	0.0	0.0000	22596768	60.33	1313.84	75.21	85.36
5a	BASE	025YR-3DAY	68.20	4.1	0.0	0.0001	3580435	60.08	348.78	81.81	22.16
6	BASE	025YR-3DAY	62.98	4.1	0.0	0.0001	9032934	60.33	876.31	66.37	168.42
7a	BASE	025YR-3DAY	62.72	4.0	0.0	0.0000	1779583	60.33	258.89	63.77	189.96
7A_ELIN_US	BASE	025YR-3DAY	62.62	4.0	0.0	0.0001	53911	63.77	189.96	63.78	190.39
7b	BASE	025YR-3DAY	62.29	3.8	0.0	0.0000	1566732	60.33	278.64	62.27	231.98
BCH_RD_WEIR	BASE	025YR-3DAY	62.30	3.7	0.0	0.0000	48978	62.27	231.98	62.30	231.98
TAILWATER (BAY)	BASE	025YR-3DAY	0.00	3.4	0.0	0.0000	0	61.58	1014.82	0.00	0.00
TARPON_BAY_WEIR	BASE	025YR-3DAY	61.58	3.7	0.0	-0.1000	490	64.65	759.56	61.58	786.31
1	BASE	100YR-3DAY	65.63	4.3	0.0	0.0000	4977811	60.58	349.52	73.37	50.84
2	BASE	100YR-3DAY	65.58	4.2	0.0	0.0000	755762	60.17	99.23	70.83	59.27
3	BASE	100YR-3DAY	64.84	4.0	0.0	0.0000	27713570	60.75	1716.39	62.75	611.00
4	BASE	100YR-3DAY	64.84	4.0	0.0	0.0000	25839772	60.33	2118.04	64.28	694.47
4a	BASE	100YR-3DAY	65.37	4.3	0.0	0.0000	11079087	60.25	896.90	60.09	141.94
5	BASE	100YR-3DAY	65.37	4.3	0.0	0.0000	23432595	60.33	1658.68	77.09	95.63
5a	BASE	100YR-3DAY	68.57	4.3	0.0	0.0001	3784418	60.08	436.27	86.60	25.21
6	BASE	100YR-3DAY	63.15	4.3	0.0	0.0001	10003691	60.33	1116.04	67.16	192.46
7a	BASE	100YR-3DAY	62.85	4.2	0.0	0.0001	1913304	60.33	315.11	64.07	217.50
7A_ELIN_US	BASE	100YR-3DAY	62.74	4.1	0.0	0.0001	54692	64.07	217.50	64.07	217.96
7b	BASE	100YR-3DAY	62.35	3.9	0.0	0.0000	1688017	60.33	336.45	62.33	267.03
BCH_RD_WEIR	BASE	100YR-3DAY	62.36	3.8	0.0	0.0000	49294	62.33	267.03	62.36	267.03
TAILWATER (BAY)	BASE	100YR-3DAY	0.00	3.4	0.0	0.0000	0	63.92	1128.31	0.00	0.00
TARPON_BAY_WEIR	BASE	100YR-3DAY	64.84	3.7	0.0	-0.1000	490	64.85	877.17	64.84	877.05

APPENDIX D

Public Workshop Summary and Public Comments



Oisin Dolley, PE – City Engineer
Jordan Varble, PE – Johnson Engineering

March 11, 2025

City of Sanibel



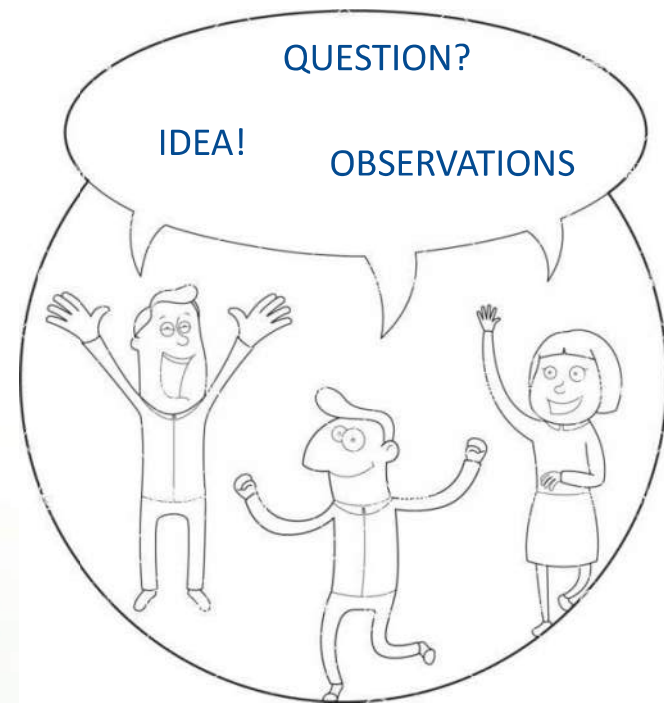
Public Workshop
STORMWATER MASTER PLAN

STORMWATER MASTERPLAN PUBLIC WORKSHOP

TONIGHT'S AGENDA

1. Presentation by Oisin Dolley & Jordan Varble (*20-30 minutes*)
2. Audience Q/A (*30 minutes*)
3. Breakout Discussions (*1 hour*)

GOAL: **HEAR FROM YOU!!!**

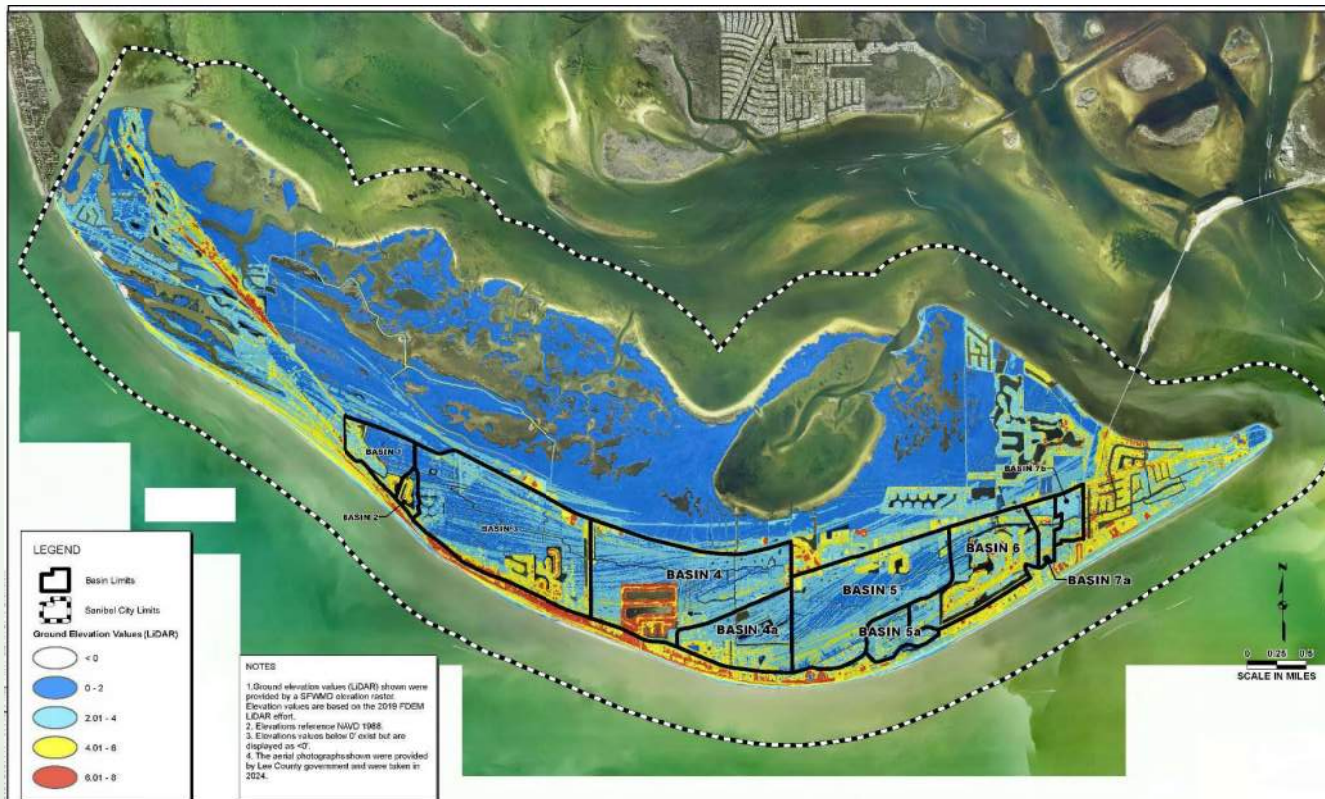


DISCUSSION POINTS

1. How Stormwater Works on Sanibel
2. Summary of Weir Management
3. 2024, What a Year it Was
4. Repair and Maintenance Work
5. Surface Water Management Master Plan Update



KNOWING HOW YOUR AREA WORKS IS KEY



For Review
01/09/2025 5:03:18 PM

City of Sanibel
Lee County, Florida

JOHNSON
ENGINEERING
— An Apex Company —

JOHNSON ENGINEERING, LLC
2122 JOHNSON STREET
FORT MYERS, FLORIDA 33901
PHONE (239) 334-0046
E.B. #042 & L.B. #042

Topographic Map

DATE	PROJECT NO.	FILE NO.	SCALE	SHEET
JAN 2025	20250101-001	—	AS SHOWN	1

1) Canal Systems (East/West Ends)

- Swales and Retention Areas overflow through tidal outfalls
- Can require 24-48 hours for excess water to overflow out depending on tides.

2) Subdivision Retention

- Properties use subdivision system as retention. Examples: Dunes, Lake Murex
- In some cases there is an established overflow route for excess water but not always.

3) River Basins

- Sanibel Slough provides overflow route through weirs and acts as retention.
- Water table within East/West basin is consistent across each basin.

4) Localized Drainage Areas

- Areas manage water within retention areas but established overflow routes for excess do not exist.
- Properties here manage water independently with on site retention systems.

STORMWATER ON SANIBEL

1. Island acts as a bowl storing freshwater and overflowing to surrounding tidal water bodies where possible. When it gets full it overflows when tide allows.
2. System fills and overflows, it doesn't drain dry.
3. NGVD 29 (older) vs NAVD 88 (modern)
NAVD=NGVD -1.18

4. Some numbers to keep in mind

Swale Elevation	2.7 NGVD
East Basin Weir	2.8 NGVD
West Basin Weir	3.2 NGVD
Arterial/Collector Road	5.5 NGVD
Local Road	4.5 NGVD
FEMA Flood Elevations	8+ NGVD

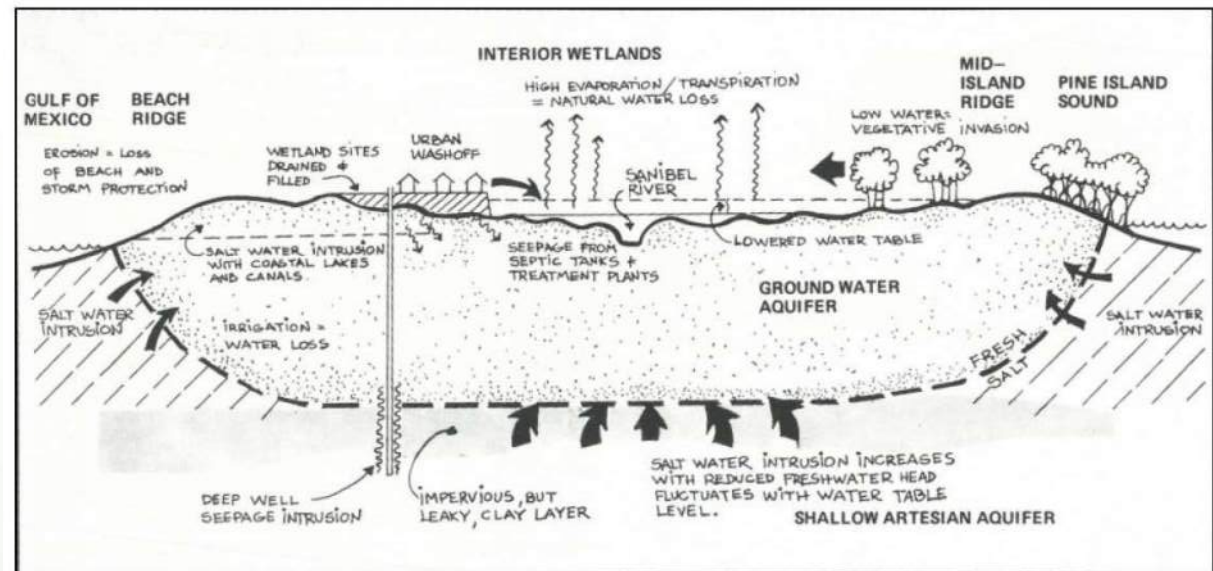


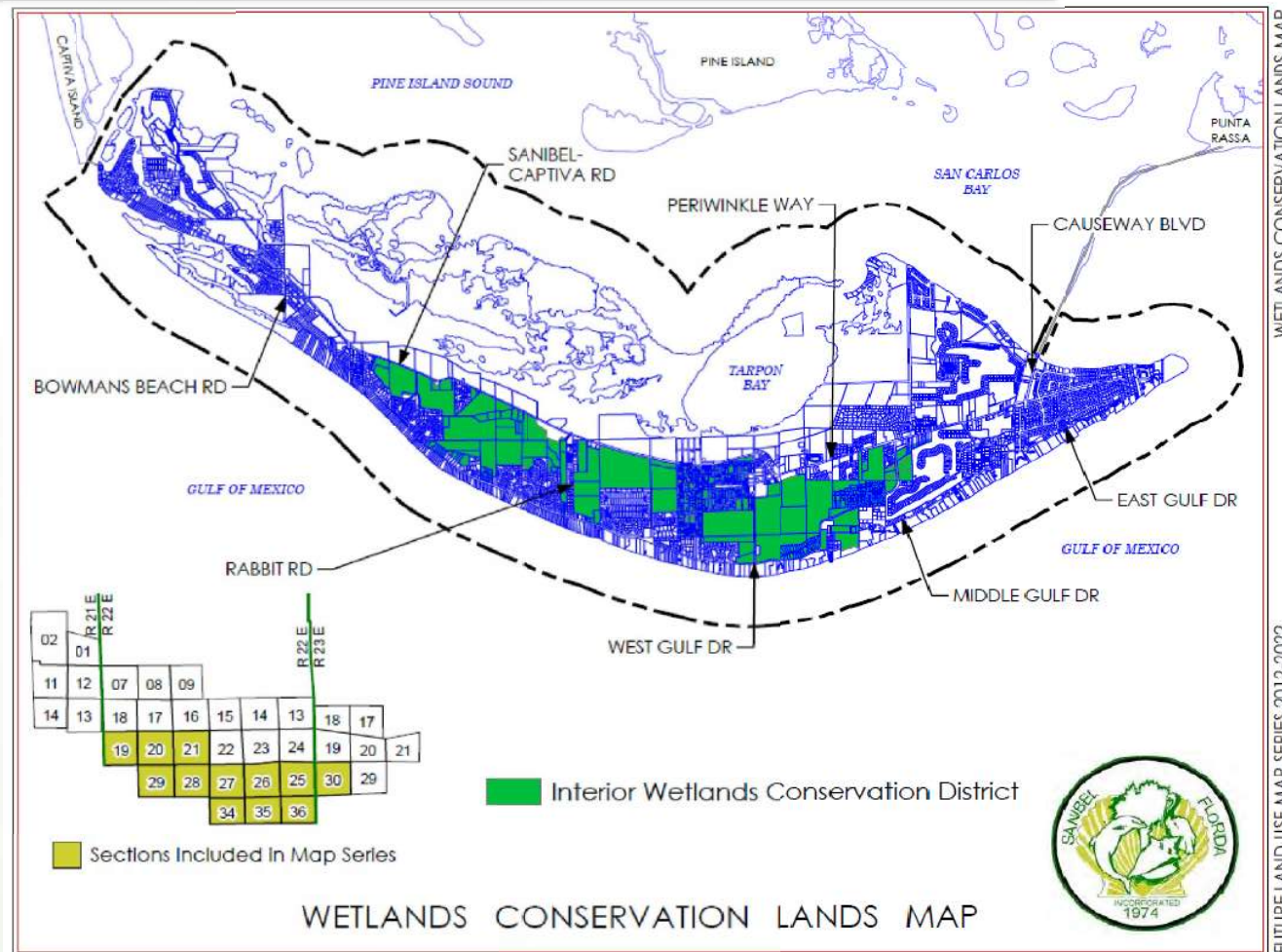
Figure 1. Graphical representation of the water budget of the freshwater basins on Sanibel, taken from The Sanibel Report (1976).

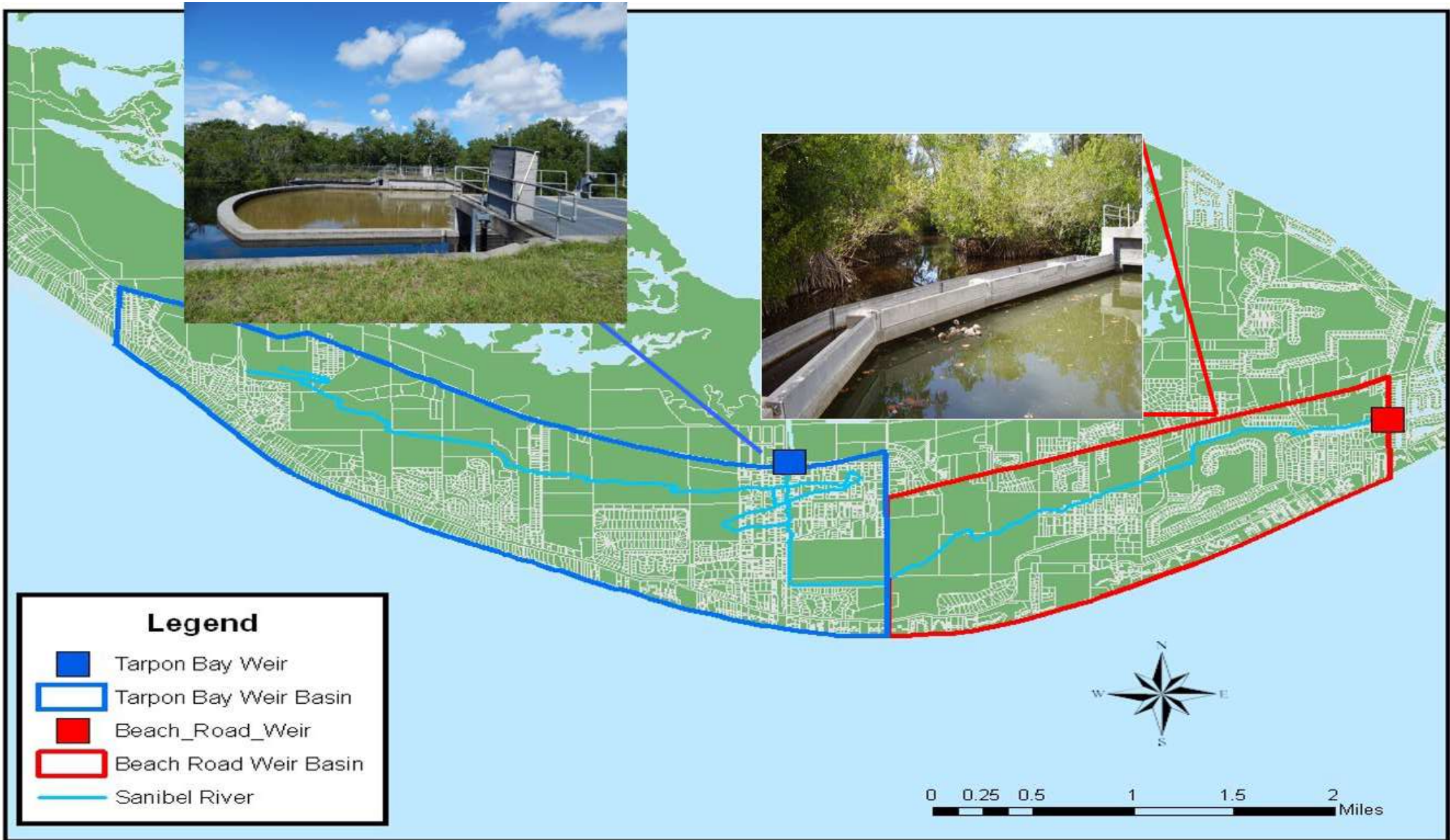
SANIBEL'S PRECIOUS FRESHWATER RESOURCE

Benefits to Maintaining Sanibel's Freshwater Environment

- Unique wetland conditions
- Fire and Mosquito Control
- Combat Salt Water Intrusion
- Controls Invasive Vegetation
- Water Quality Benefits

Goal of Surface Water Management for Sanibel is to maintain as much fresh water on island as possible to benefit the island's Interior Wetland System, so long as developed areas are not adversely impacted.





CITY OF SANIBEL WEIR CONTROL POLICY

Established through City Council approval in 1997.

Weirs are opened if:

1. Interior Flooding Conditions

- Public or private streets impassible
- When one of river gauges in west basin adjacent to Gulf Pines, Rabbit Road or San-Cap Rd. = or > 3.3' NGVD for 24 hour period; 2.8' NGVD in east basin

2. Pre-Storm Conditions

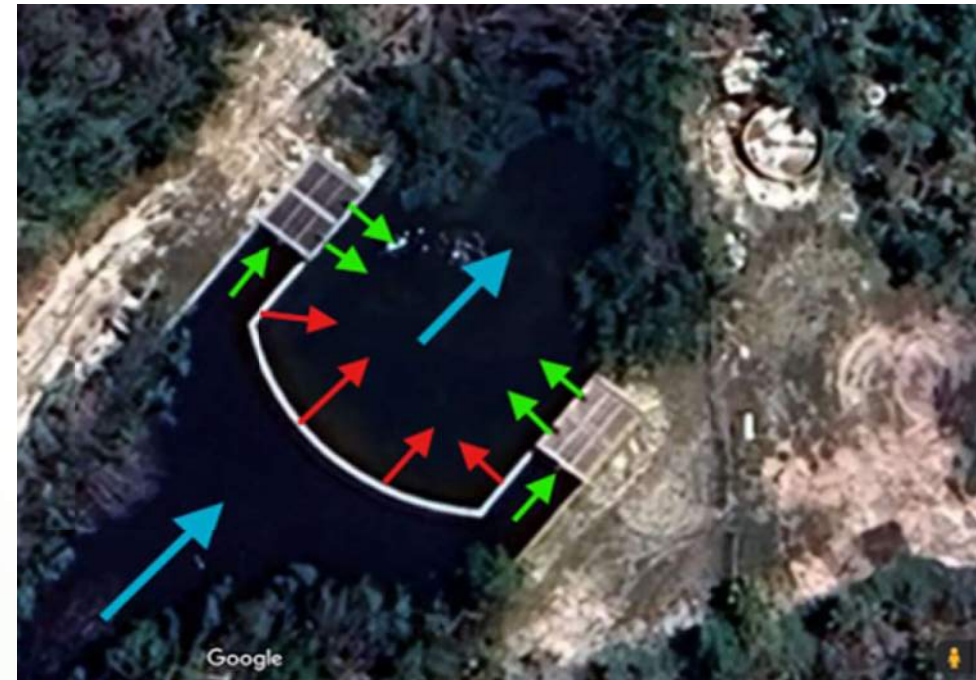
- Opened up to 36 hours in advance of storm (>3.2';2.7')

3. Surface Water Duration Conditions

- 3.2' NGVD west gauges for 90 consecutive days – reduce to 3.0' NGVD for remainder of calendar year

4. Miscellaneous Conditions

- When deemed necessary by City Manager for the prevention of immediate harm to persons, property, or the environment.



Tarpon Bay Weir

RED-Weir Overflow (>3.2 NGVD)

GREEN- Flow through Gates when tide is lower

Average Monthly Water Levels West Basin



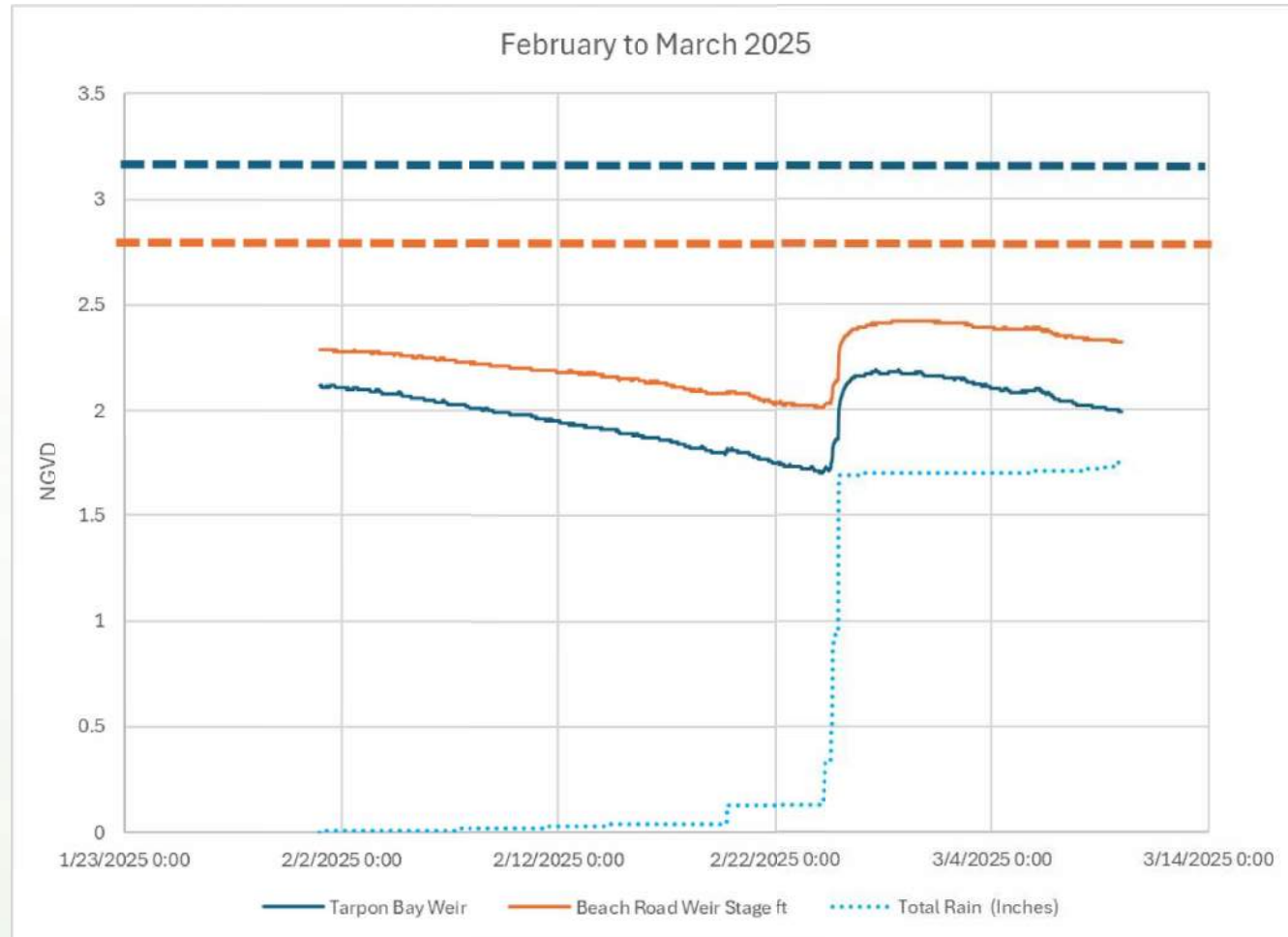
FEBRUARY/MARCH 2025

Rain: 1.7"

No Openings

Water Levels	1-Feb	24-Feb	26-Feb	9-Mar
West	2.11	1.7	2.17	1.99
East	2.29	2.01	2.39	2.32

0 gallons



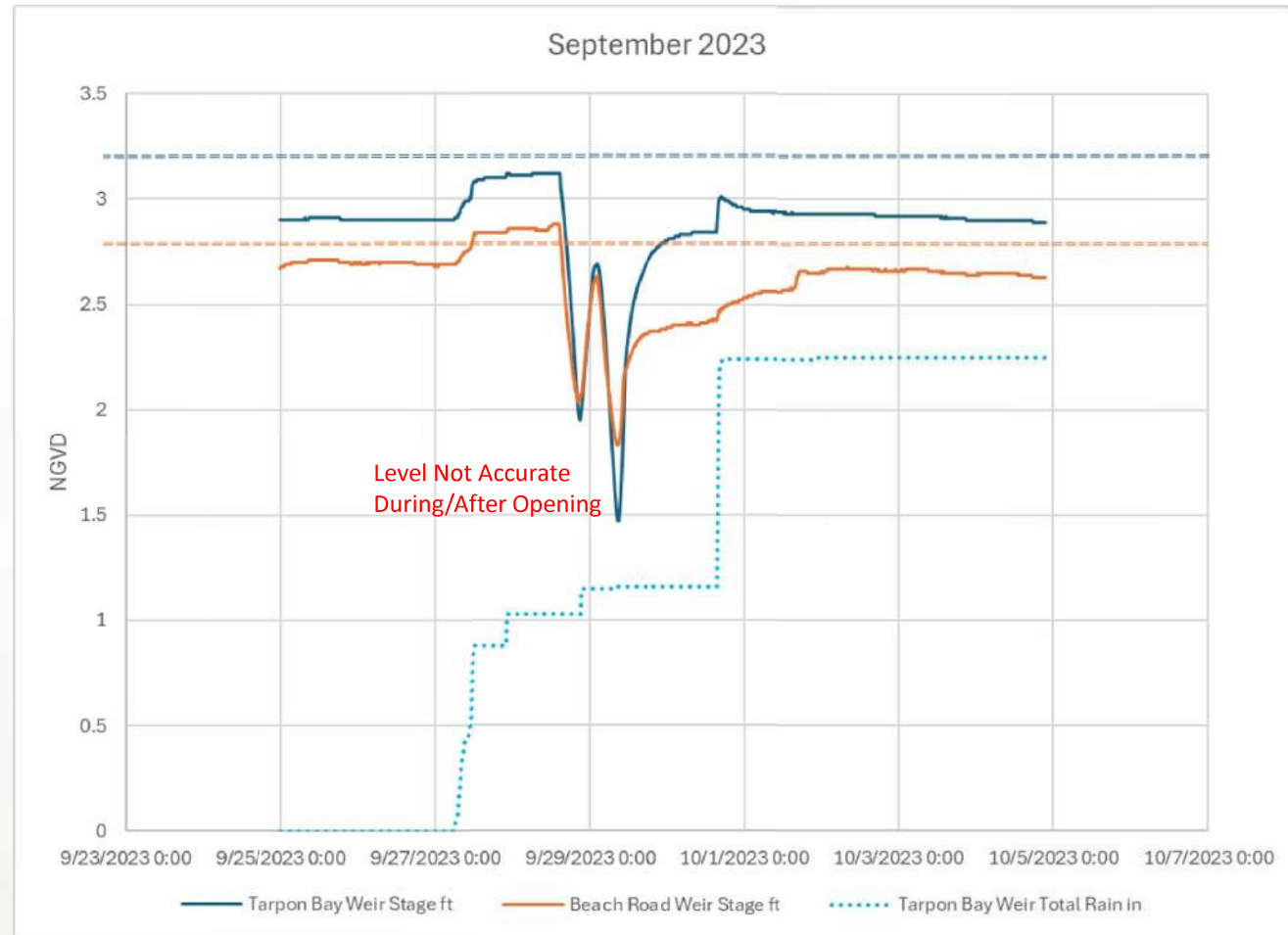
SEPTEMBER 2023

2.25" of Rain

Gates opened for roughly 16 hours

Water Levels	26-Sep	28-Sep	2-Oct
West	2.9	3.1	2.93
East	2.69	2.84	2.67
Total Rain	0	1	2.25

56,704,581 cf



RECORD RAIN IN 2024

Records

Most rain in a year since 1995

Since 2012:

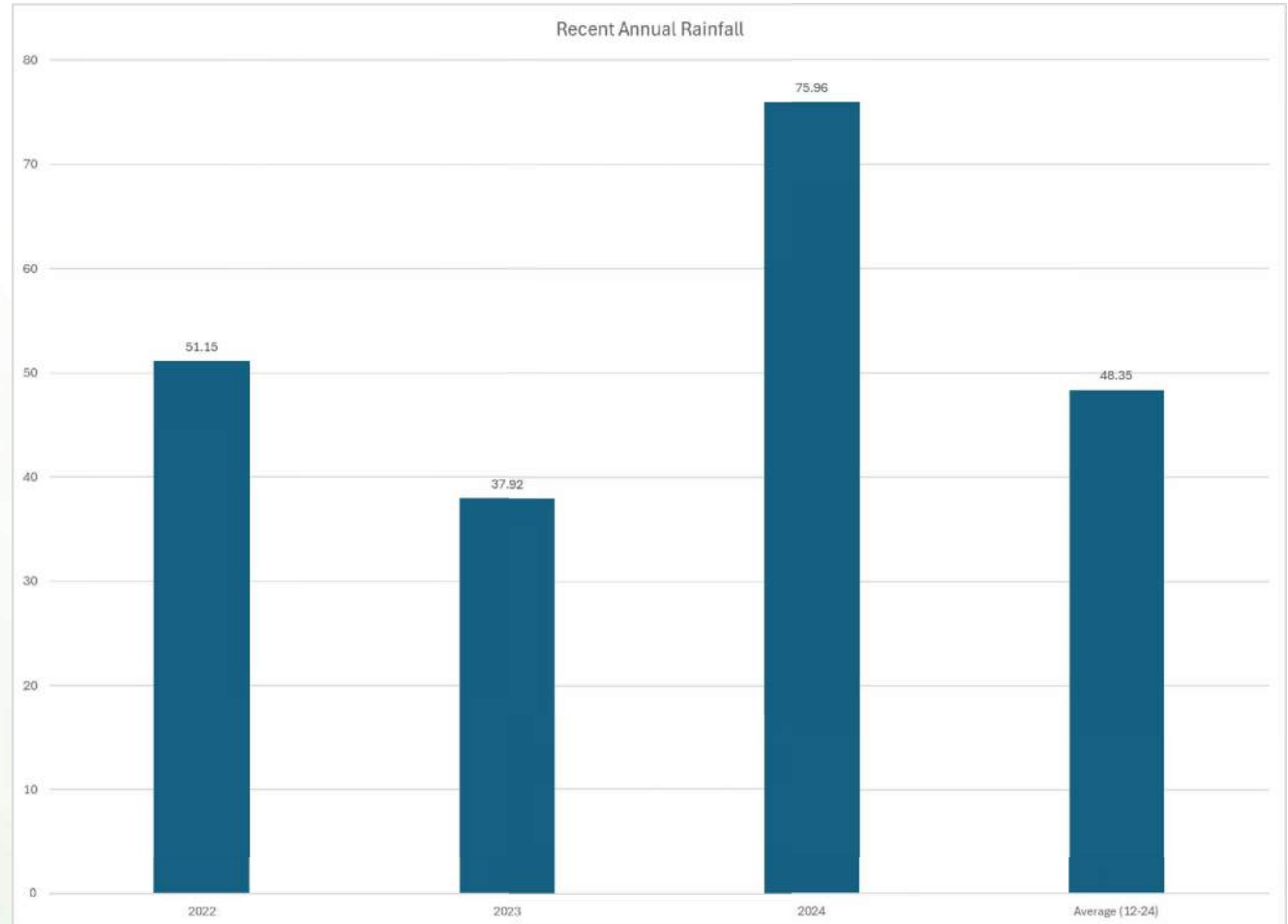
Most rain in March (4.37")

Most rain in June (16.05")

Most rain in October(5.86")

Runner Up: July (12.26")

Runner Up: Aug.(15.53")



MARCH 2024 CASE STUDY

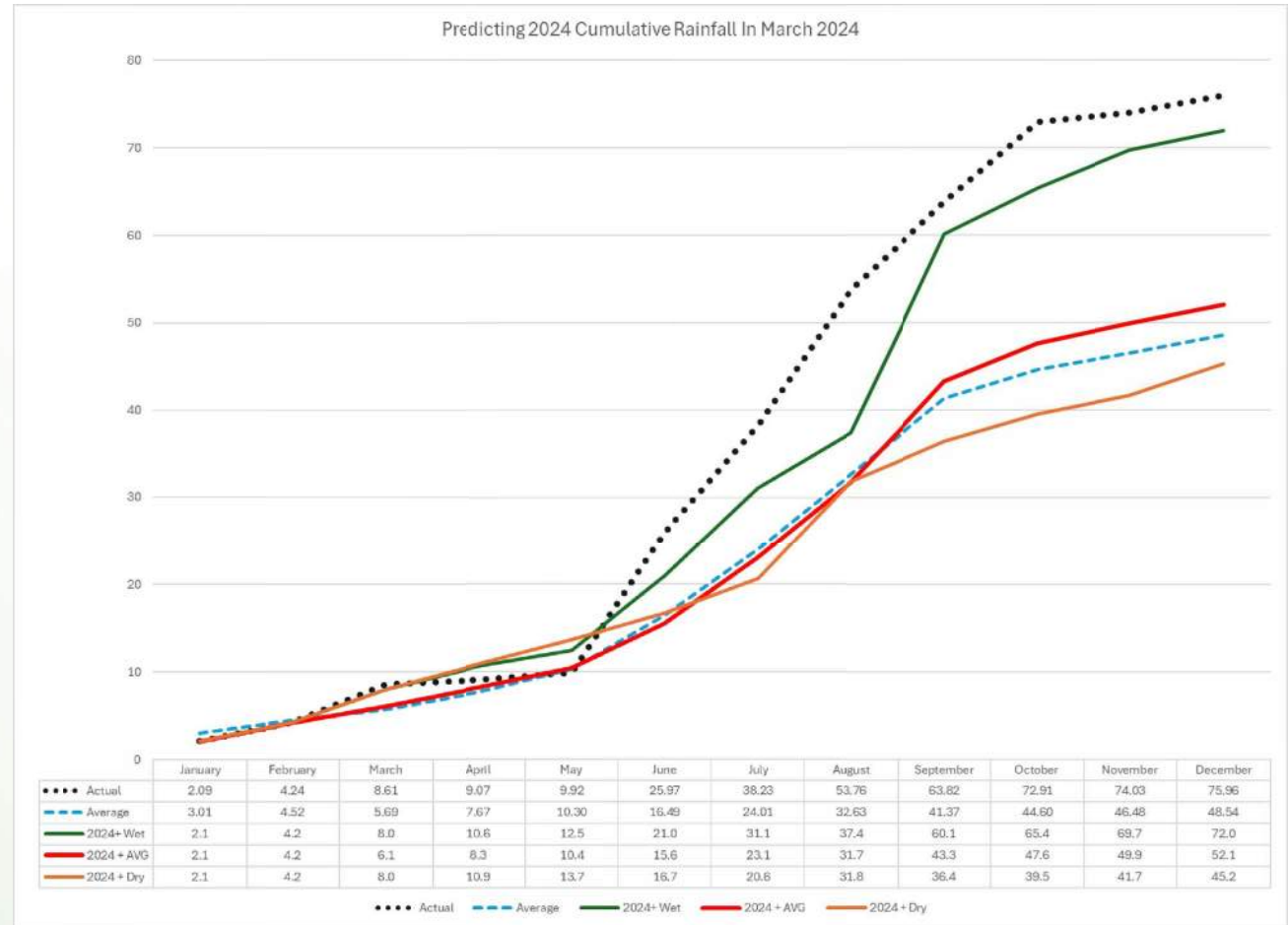
March Rain: 4.37"

West Basin: 2.65'

Average March 1.5'

City Manager Deviation

- Meet with Partners to discuss potential impacts
- Rain in forecast
- High salinity issues unique
- Fire Risk was a factor
- West Basin was lowered



JUNE 2024

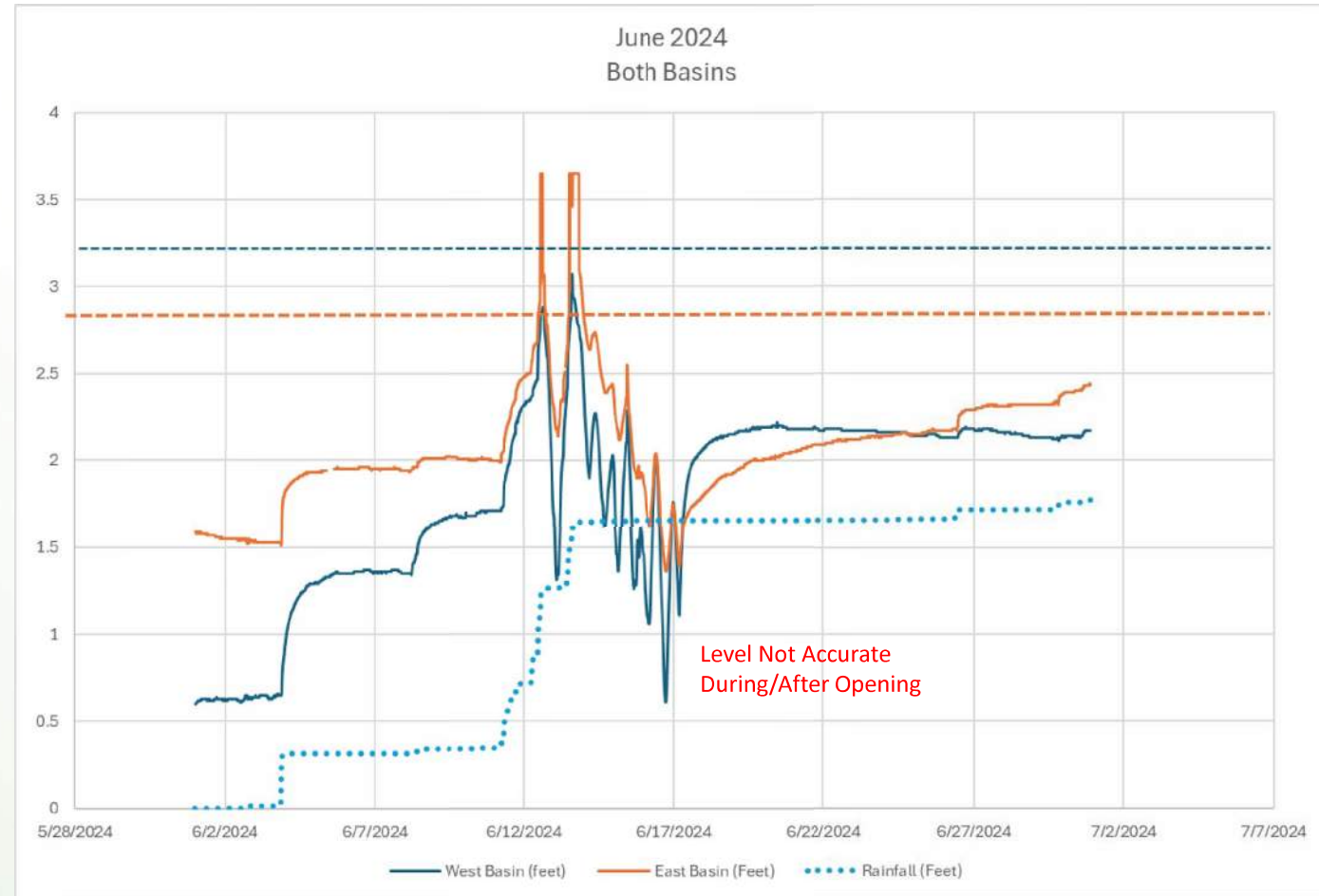
Rain 21.28"

Frequent Openings

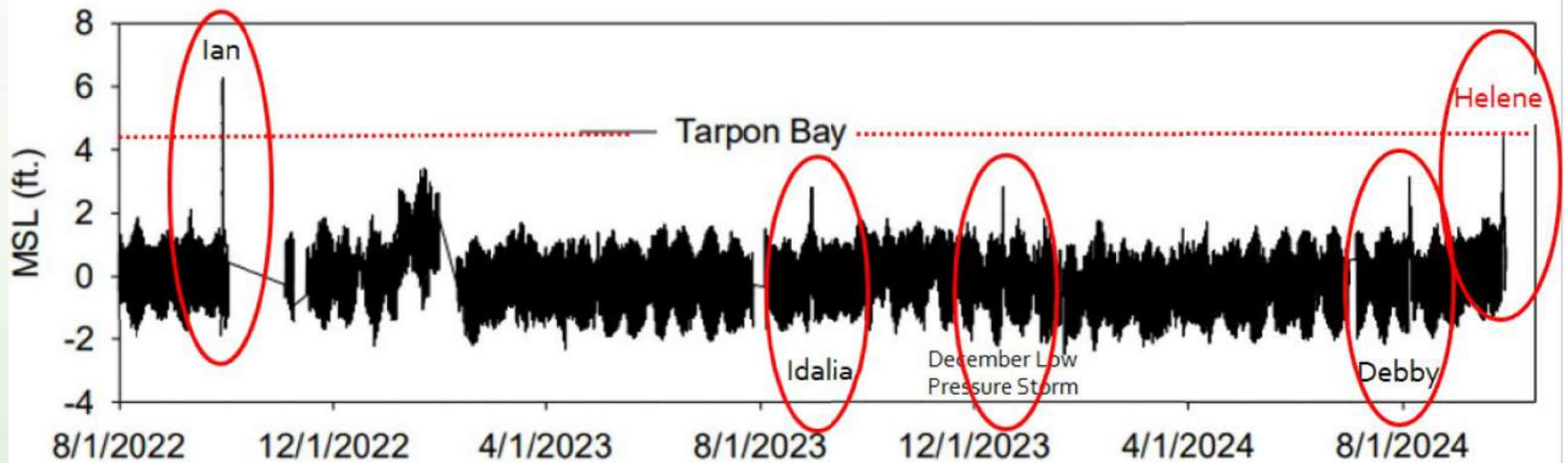
6/12 - 6/17

	6/1	6/10	6/19	6/25	6/30
West Basin	0.62	1.71	2.18	2.15	2.17
East Basin	1.57	2	2	2.16	2.43
Rain	0	4"	19"	19"	21.3"

787,905,245.92 gallons

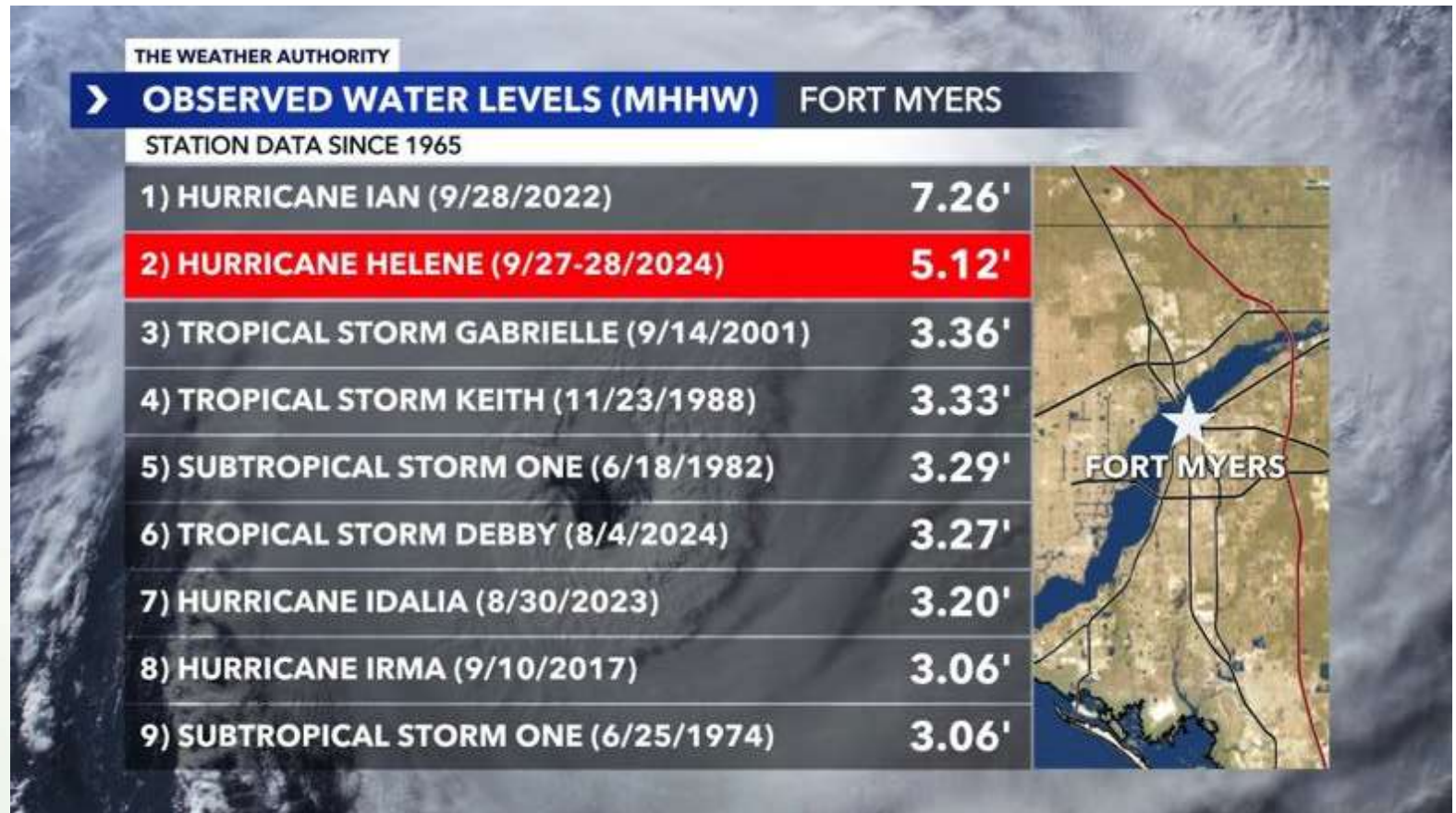


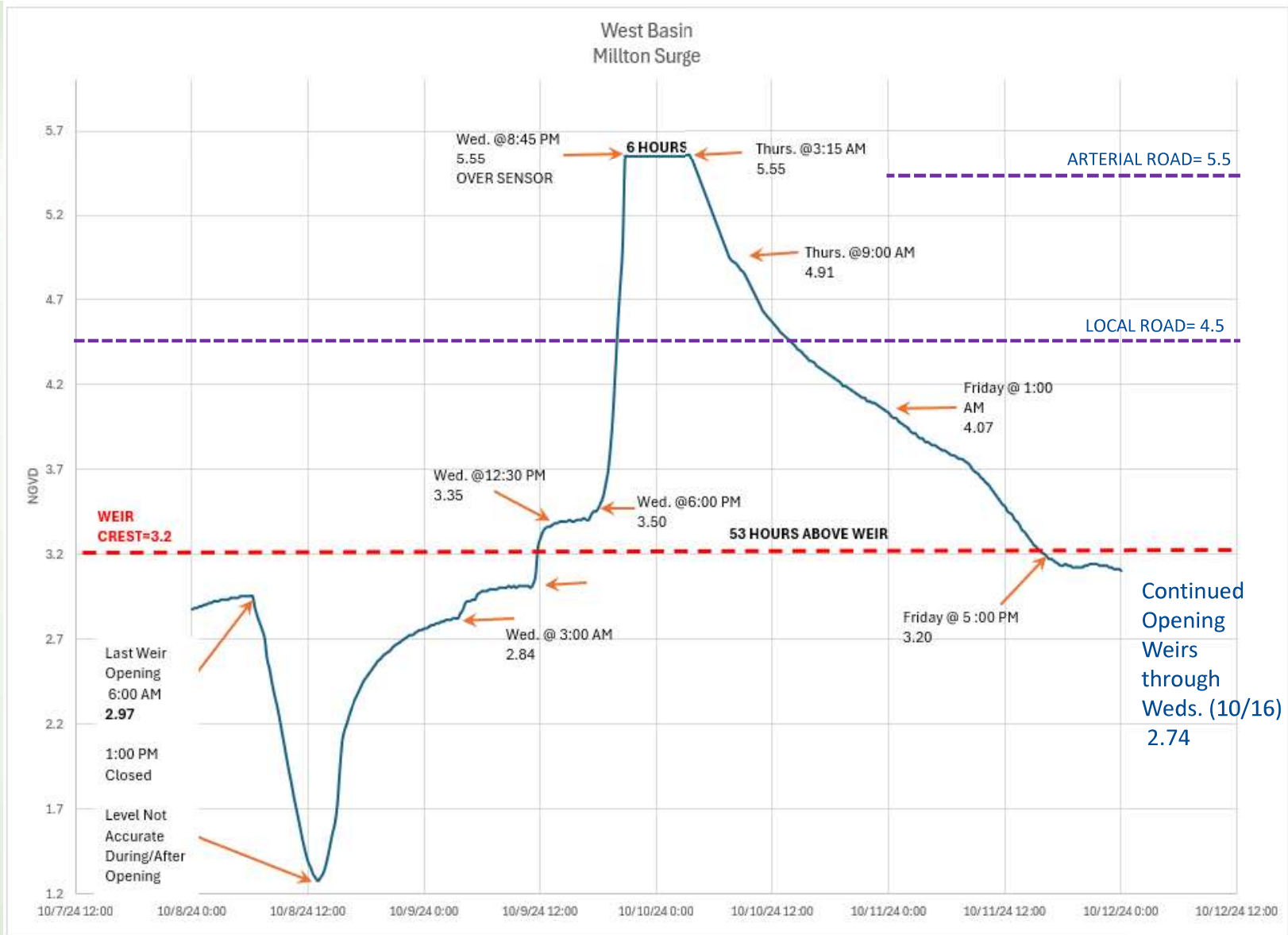
STORM SURGE



STORM SURGE

Milton 10/10/2024
5.26'





Upcoming Work



1. East Rocks Drainage Project (HMGP Grant Funded)

- Contract approved. Construction beginning this month.

2. City contracted repairs

- Work starting this month in Island Inn Rd., West Gulf, Atlanta Plaza, Dunlop Rd.
- More areas are planned.
- Focus is on culvert cleaning and swale regrading.

3. Stormwater Masterplan Repair Project

- Scheduled for approval at March City Council Meeting
- Includes infrastructure repair and replacement.

4. Beach Road Weir Rehabilitation Project

- Repairs to existing weir structure related to repairs to the wall and the controls for the gates.
- Not changing elevation of weir crest.
- Repair items do not affect functionality

Hurricane Ian Stormwater Repair Grant	\$ 10,000,000	Funding from Grant
Stormwater Master Plan (Johnson Engineering)	\$ 230,000	Actual
Johnson Engineering Repair Project (Construction)	\$ 2,390,379	Estimate
Repair Project Management (Johnson Engineering)	\$ 180,350	Estimate
Beach Road Weir Rehabilitation Project	\$ 750,000	Estimate
General Bridge and Box Culvert Repairs	\$ 200,000	Estimate
City Planned Repairs Phase 1	\$ 123,948	Estimate
City Completed Repairs (FY 23/24)	\$ 155,000	Actual
Subtotal	\$ 4,029,677	
Remaining	\$ 5,970,323	Available For Additional Items

Normal Maintenance (Non-Grant)			
Canal Trimming (FY23)	\$	6,000	Actual
Bridge, Box Culvert & Weir Repairs (FY23)	\$	185,904	Actual
In House Staff Work (FY23)	\$	270,000	Actual
Canal Trimming (FY24)	\$	10,000	Actual
In House Staff Work (FY24)	\$	270,000	Estimate
Remaining Johnson Master Plan Design	\$	151,024	Actual
Additional Johnson Scope	\$	50,000	Estimate
Total \$		942,928	Actual + Estimate

IMMEDIATE REPAIRS POST-STORM

Immediate Repairs Post-Storm



IMMEDIATE REPAIRS POST-STORM

Immediate Repairs Post-Storm

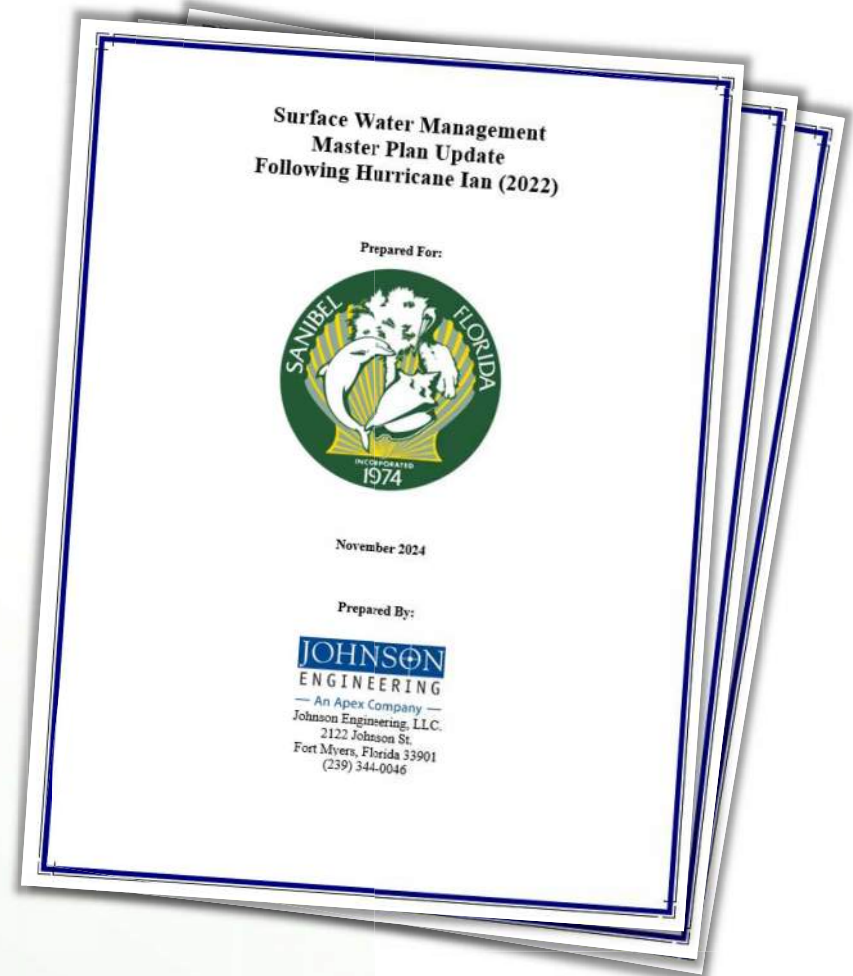


SURFACE WATER MANAGEMENT MASTER PLAN



OUTLINE:

1. Flooding 101
2. Data Collection
3. Resiliency
4. Damage Repairs Post-Hurricane Ian
5. We Want to Hear From You



SURFACE WATER MANAGEMENT MASTER PLAN

1. Introduction – Flooding 101 – Riverine

- Heavy rainfall causes rivers & streams to exceed their capacity.
- Two interior freshwater basins outfall to Pine Island Sound

Flooding Due to Rainfall



SURFACE WATER MANAGEMENT MASTER PLAN

1. Introduction – Flooding 101 – Storm Surge

- Tropical storms push seawater onto Sanibel
- FEMA flood maps: Sanibel is entirely inundated in 100-year storm event



Scan code for NOAA
video on storm surge

Flooding Due to Storm Surge



PHOTO CREDIT: ANDREW WEST, THE NEWS-PRESS & NAPLESNEWS.COM



SURFACE WATER MANAGEMENT MASTER PLAN



1. Introduction – Flooding 101 – Mitigation

- Multiple City departments working together:
Public Works | Natural Resources | Planning | Building
- Drainage Infrastructure Maintenance
- Capital Improvement Projects
- Comprehensive Vulnerability Assessment – *Public Workshop Early April*
- FEMA Elevation Standards on New Construction & Re-builds
- Water Level Monitoring Network

SURFACE WATER MANAGEMENT MASTER PLAN



1. Introduction – Flooding 101 – FAQ

- *My home has never flooded before. Why now?*
- *We have tide/flap gates that should protect our community from storm surge. Why did we flood?*
- *How did Sanibel's maintenance mitigate the flooding?*
- *Will dredging & vegetation removal increase flood capacity?*
- *Is my home likely to flood?*

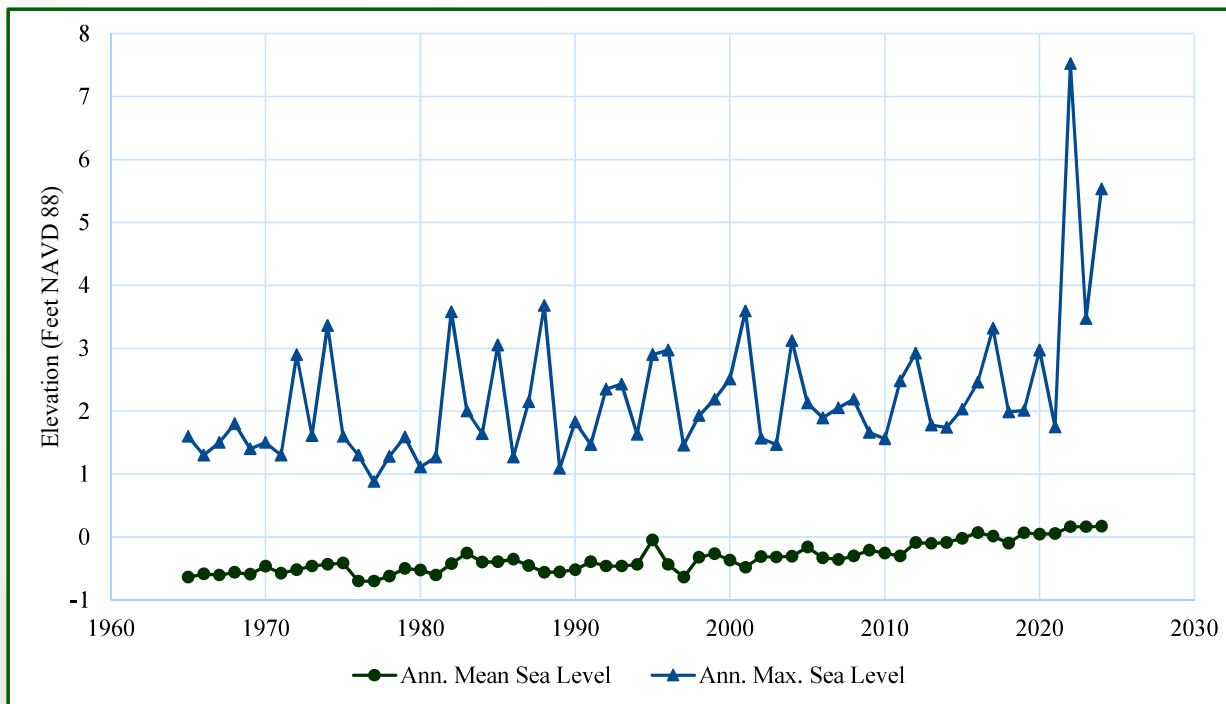
... And More from You Today

SURFACE WATER MANAGEMENT MASTER PLAN

1. Introduction – Flooding 101 – FAQ

- My home has never flooded before. Why now?*

NOAA Tide Station – Fort Myers (8725520)



10 Highest Water Levels
1965 to Present

Rank	Peak EL	Date
1	7.52	2022-09-28
2	5.53	2024-10-10
3	5.4	2024-09-27
4	3.68	1988-11-23
5	3.59	2001-09-14
6	3.58	1982-06-18
7	3.53	2024-08-04
8	3.47	2023-08-30
9	3.36	1974-06-25
10	3.32	2017-09-11

SURFACE WATER MANAGEMENT MASTER PLAN

2. Data Collection & Review

- Water Level Datalogger Installations
 - › 10 Locations Installed by Johnson Engineering
 - › 4 Locations Installed by SCCF



SURFACE WATER MANAGEMENT MASTER PLAN

2. Data Collection & Review – Surface Water

- The basins generally act as a level pool & runoff is efficiently conveyed to the Sanibel River, as designed.
- Surface water levels in the interior wetlands are similar to those in 1977.



SURFACE WATER MANAGEMENT MASTER PLAN

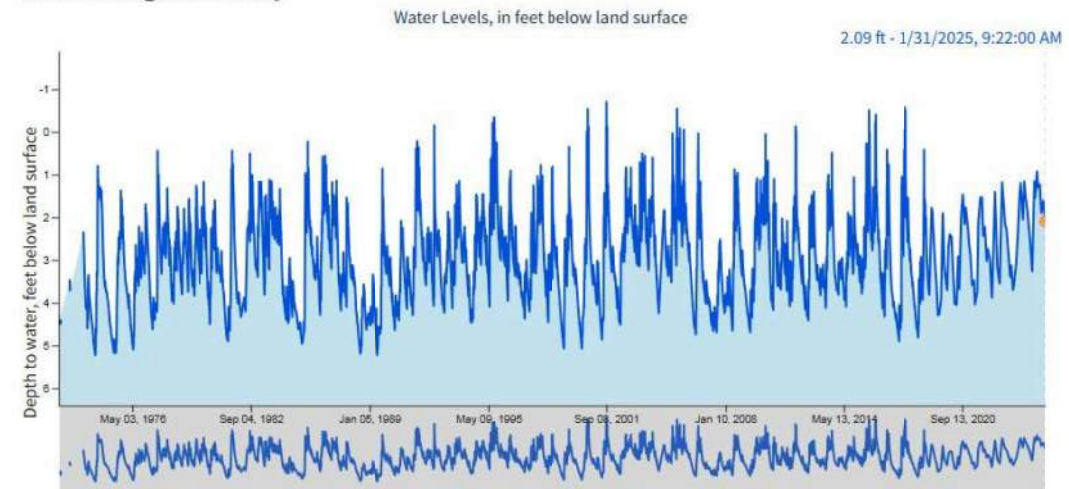
2. Data Collection & Review – Groundwater

- Interior groundwater percolation is still occurring similarly to past observations, going back to 1953.
- Due to the Island's low-lying profile, there is little to no deep percolation out of the system. This is consistent with The Sanibel Report (1976).



L -1403

U.S. Geological Survey



SURFACE WATER MANAGEMENT MASTER PLAN

2. Data Collection & Review – Water Budget

- Evaporation & evapotranspiration (ET) account for nearly all yearly outflows from Sanibel, not runoff through the weirs.

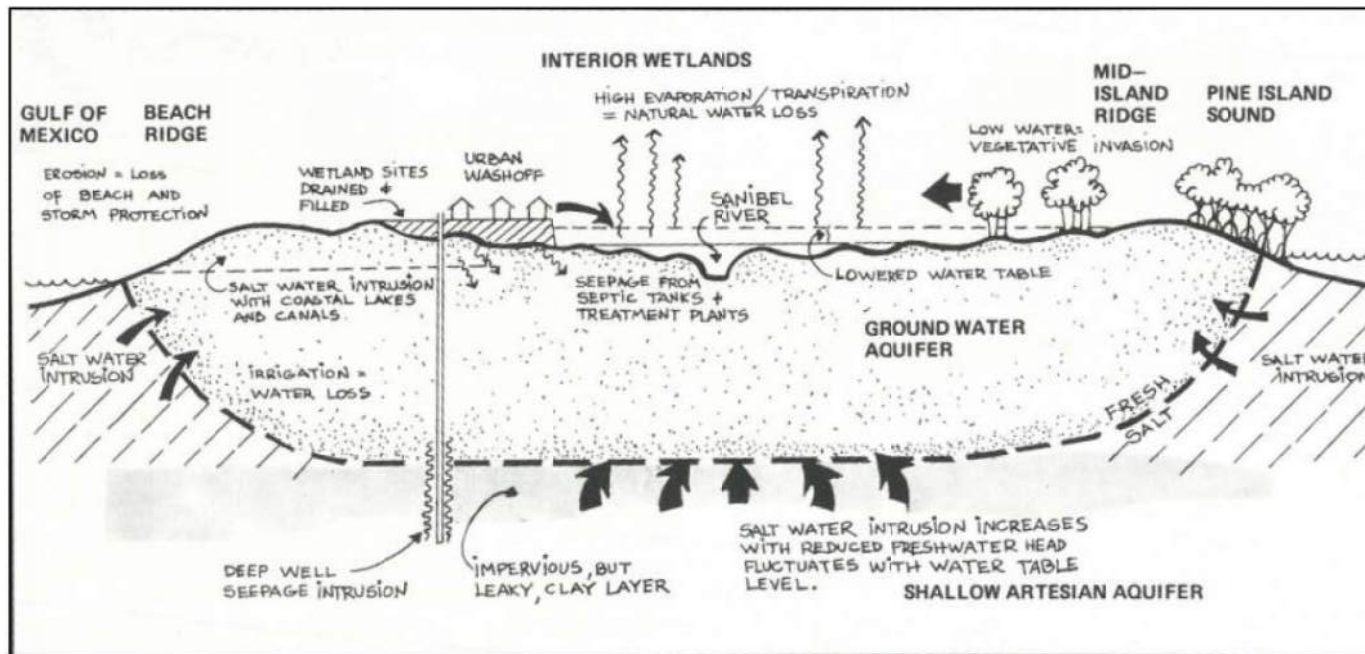


Figure 1. Graphical representation of the water budget of the freshwater basins on Sanibel, taken from The Sanibel Report (1976).

SURFACE WATER MANAGEMENT MASTER PLAN

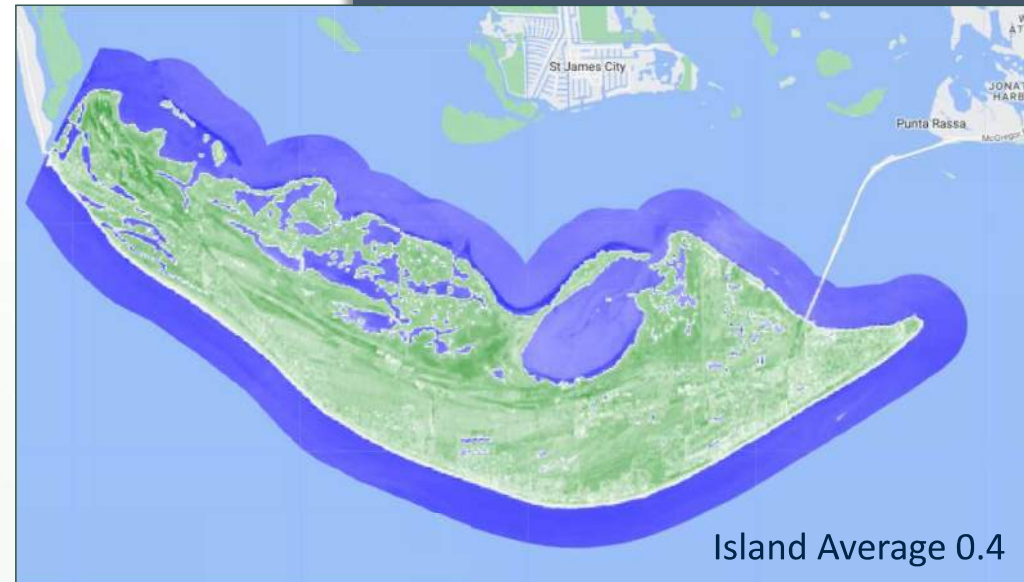
2. Data Collection & Review – Water Budget

- An analysis of satellite imagery of Sanibel using the Normalized Difference Vegetation Index (NDVI) shows Hurricane Ian had a devastating impact on plant life.

NDVI BEFORE HURRICANE IAN (2013-22)



NDVI AFTER HURRICANE IAN (2022-23)



SURFACE WATER MANAGEMENT MASTER PLAN

2. Data Collection & Review – City of Sanibel Weir Control Policy (1994)

- OBJECTIVE: *Retain as much fresh surface water on the island as possible ... for the environmental benefit of the island's Interior Wetlands System, so long as developed areas are not adversely impacted.*
- Benefits of Interior Wetlands:
 - › Freshwater Reservoir for the Island
 - › Mitigate Saltwater Intrusion of Freshwater Lens
 - › Reduce Mosquito Populations
 - › Reduce Exotic Plant Species
- Gate Operation Conditions:
 1. Interior Flooding
 2. Pre-Storm
 3. Surface Water Duration
 4. Miscellaneous
- MISCELLANEOUS: *The City Manager may deviate from the above standards when deemed necessary for the prevention of immediate harm to persons, property, or the environment.*
- Future Update Being Considered

SURFACE WATER MANAGEMENT MASTER PLAN

PREPARING
FOR THE
NEXT 50
YEARS



3. Surface Water Management Resiliency – Roadway Elevation Analysis

- 75% of roads on Sanibel are below elevation 5 feet NAVD 88.



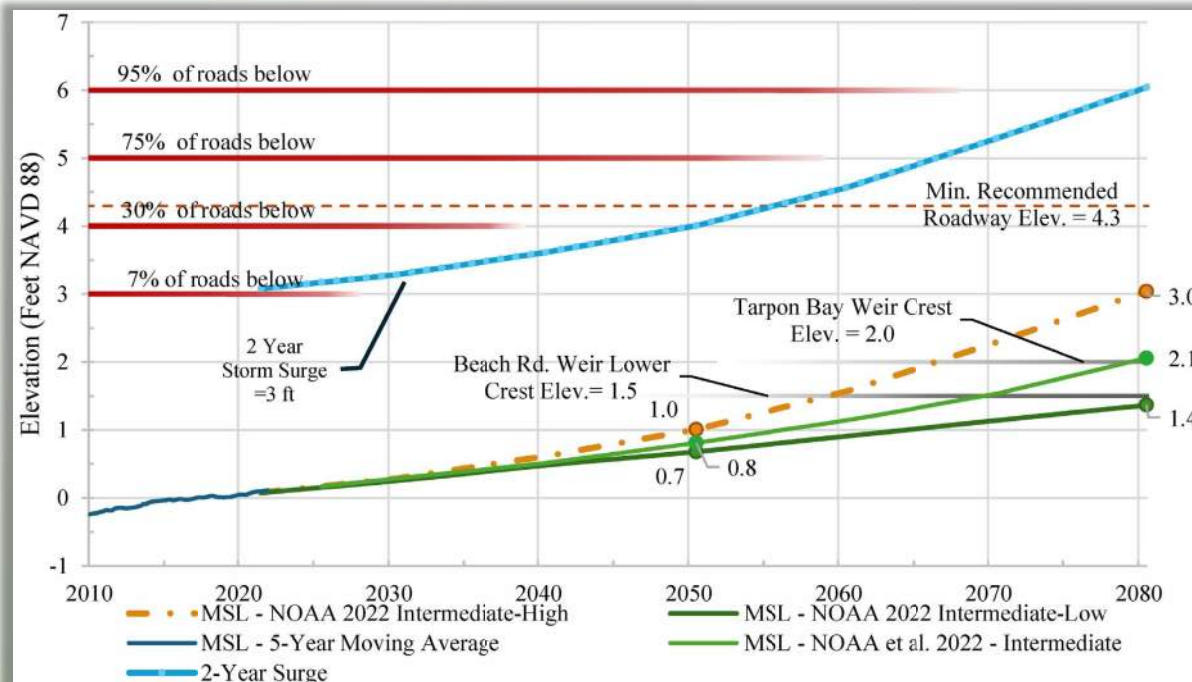
SURFACE WATER MANAGEMENT MASTER PLAN

PREPARING
FOR THE
NEXT 50
YEARS



3. Surface Water Management Resiliency – Roadway Elevation Analysis

- The Intermediate - Low sea level rise projection for 2080 anticipates 20% of roadways will be vulnerable.
- Increasing the minimum roadway elevation to 4.3' feet NAVD 88 would protect all roadways through 2080 (Int.-Low Scenario).



SURFACE WATER MANAGEMENT MASTER PLAN

PREPARING
FOR THE
NEXT 50
YEARS



3. Surface Water Management Resiliency – 2-Year Storm Surge

- Minimal Flooding Today in the 2-Year Surge Event
- Impacts of Storm Surge Anticipated to Worsen
- Ability to Maintain a Freshwater Wetlands Increasingly Difficult

TODAY



Stormwater Master Plan
City of Sanibel, Florida

**JOHNSON
ENGINEERING**
— An Apex Company —

JOHNSON ENGINEERING, LLC
2777 JOHNSON STREET
FORT MYERS, FLORIDA 33901
PHONE: (239) 344-0444
FAX: (239) 344-0444

FEMA Coastal Flood Hazard Analysis
2022 Stillwater Inundation Map
50-Percent-Annual-Chance Storm Surge

DATE: 06/20/2024 PROJECT NO: 2022-001 DRAWING NO: 01

2070



Stormwater Master Plan
City of Sanibel, Florida

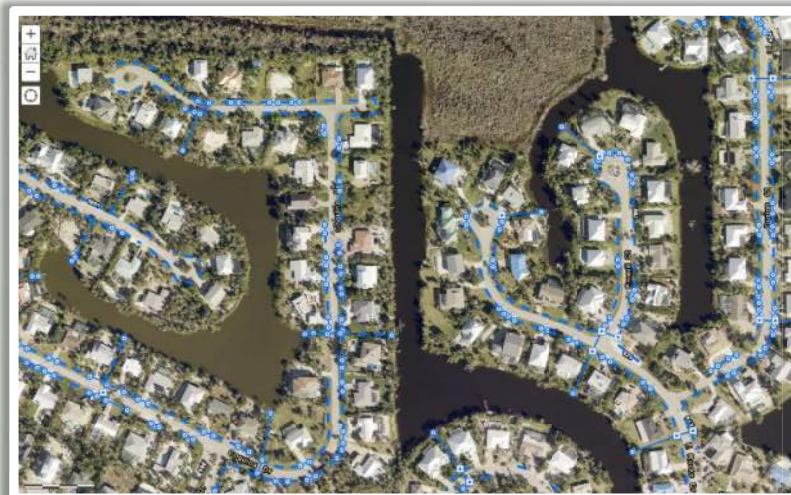
**JOHNSON
ENGINEERING**
— An Apex Company —

JOHNSON ENGINEERING, LLC
2777 JOHNSON STREET
FORT MYERS, FLORIDA 33901
PHONE: (239) 344-0444
FAX: (239) 344-0444

FEMA Coastal Flood Hazard Analysis
2070 Projected Stillwater Flood Depth Map
50-Percent-Annual-Chance Storm Surge

DATE: 06/20/2024 PROJECT NO: 2022-001 DRAWING NO: 02

- Previous Mapping Focused on Primary Infrastructure
- Developed Comprehensive Map to Include Driveway Culverts
 - › 820 Culverts Added to Map
 - › 1,763 Pipe Ends Added to Map
 - › 2,224 Swales Added to Map
 - › Updated Drainage Map Book & GIS Map



SURFACE WATER MANAGEMENT MASTER PLAN

4. Surface Water Management Damage Repairs – Upcoming Repairs

- Visual Inspection of Newly Added Features
- Additional 658 Culvert Cleanings & 4.6 Miles of Swales - Scheduled May 2025



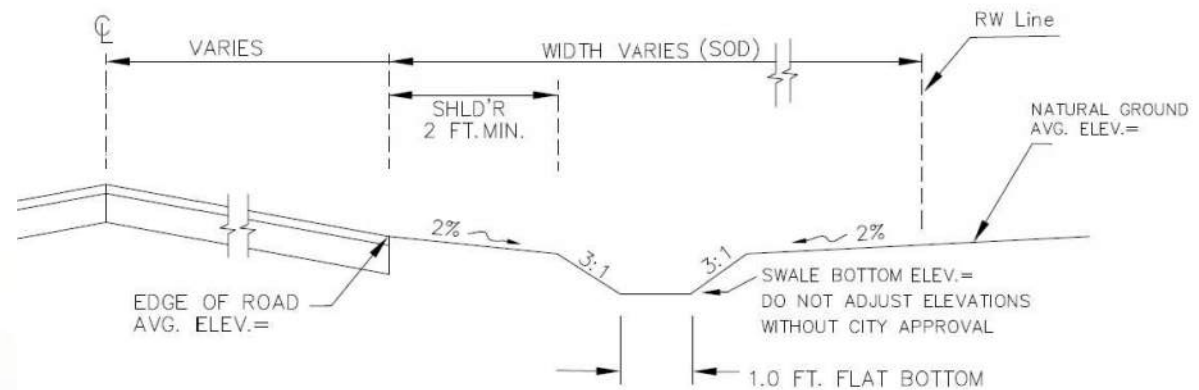
REMEMBER WE ARE ALL ON THIS TOGETHER

Let's Rebuild Right

- Reduce fill where possible.
- Use low areas rather than eliminate them.
- Plant appropriate vegetation for your property.
- Understand how your property and neighborhood works as part of the overall system.

Remember your Right-of-Way Rules

- Public works ROW permits are free of charge.
- Swales exist for a reason.
- No rocks, stones, mulch or pine straw.
- No trees, shrubs or bushes.
- Sod and/or native ground covers only.



TYPICAL SWALE SECTION

NO SCALE

SURFACE WATER MANAGEMENT MASTER PLAN

5. We Want to Hear from You

- Q&A Session
- Breakout Tables
- Written Comments
- Email: sanpw@mysanibel.com



AUDIENCE QUESTIONS



- Please fill out a card with your question and hand to City staff member.
- We will answer questions in order as asked by the moderator.
- Questions will be included as input in the Stormwater Masterplan update.
- Questions can also be emailed to sanpw@mysanibel.com for non attendees or for detailed input.

TO GET US STARTED:

- 1) What has changed since Hurricane Ian that is affecting stormwater management?
- 2) How does holding water help with stormwater management?
- 3) How does sea level rise affect the ability to manage stormwater?
- 4) What are other communities doing to better prepare for storm events and mitigate the impacts of future storms?

BREAKOUT TABLES



GROUP 1: Stormwater Masterplan Topics

Oisin Dolley and Jordan Varble

GROUP 2: Stormwater Repairs and Projects

Fred Mittl and Scott Krawczuk , City of Sanibel Public Works

GROUP 3: Wetlands, Sanibel Slough and Habitat Management

City of Sanibel Natural Resources



**Written comments are also accepted at all tables. Be considerate of everyone's time.
Can be the start of a conversation if necessary.**

Comments can also be emailed to sanpw@mysanibel.com



City of Sanibel

Stormwater Masterplan Public Workshop

March 11, 2025 5:00 PM, Recreation Center

Name: _____

Additional Information: _____

Address: _____

City, State, Zip: _____

Email Address: _____

Phone Number: _____

Do you represent an Organization: Yes ☐ No ☒ Name: _____

Comments: _____
Bailey Road between Sand Castle Rd
and Bay drive floods during moderate
rains, and stays covered a long
time after a storm surge.
Evaluate drainage + Elevating Road.

Additional comments and questions can be emailed to sanpw@mysanibel.com



City of Sanibel

Stormwater Masterplan Public Workshop

March 11, 2025 5:00 PM, Recreation Center

Name: _____

Additional Information: _____

Address: _____

City, State, Zip: _____

Email Address: _____

Phone Number: _____

Do you represent an Organization: Yes ☐ No ☐ Name: _____

Comments: WOULD IT BE POSSIBLE FOR
LAKE MURKX TO OVERFLOW INTO THE
DRAINAGE EASEMENT TO THE EAST OF
LAKE MURKX CIRCLE. THERE HAVE
BEEEN TIMES WHEN THE WATER
LEVEL OF THE LAKE IS A FOOT
ABOVE THE DRAINS AROUND LAKE
MURKX CIRCLE & TIMIN LAKES.
IT WOULDN'T TAKE MUCH TO
EXTEND THE DRAINAGE TO THAT
EASEMENT AS A AN OVER FLOW

Additional comments and questions can be emailed to sanpw@mysanibel.com



City of Sanibel

Stormwater Masterplan Public Workshop

March 11, 2025 5:00 PM, Recreation Center

Name: _____

Additional Information: _____

Address: _____

City, State, Zip: _____

Email Address: _____

Phone Number: _____

Do you represent an Organization: Yes ☐ No ☒ Name: _____

Comments: *My neighborhood - Sanibel Bayou, specifically The Ridge is regularly flooded - the swales are pretty much non-existent. Bowman's Beach Road is also flooded often and there is no adequate drainage. I assume the city is aware of all of this but I just wanted to let you know how helpless we feel about this situation.*

Additional comments and questions can be emailed to sanpw@mysanibel.com



City of Sanibel

Stormwater Masterplan Public Workshop

March 11, 2025 5:00 PM, Recreation Center

Name: _____

Additional Information: _____

Address: _____

City, State, Zip: _____

Email Address: _____

Phone Number: _____

Do you represent an Organization: Yes ☐ No ☒ Name: _____

Comments: _____

Is there a city maintained drainage system
in Sea Oats → between Sea Oats + Rabbit Rd?
Can it be cleaned?

Additional comments and questions can be emailed to sanpw@mysanibel.com



City of Sanibel

Stormwater Masterplan Public Workshop

March 11, 2025 5:00 PM, Recreation Center

Name: _____

Additional Information: _____

Address: _____

City, State, Zip: _____

Email Address: _____

Phone Number: _____

Do you represent an Organization: Yes ☐ No ☒ Name: _____

Comments: *Plant more vegetation.*

Double what is being done now.

Arbo Day organization can

fund?

Additional comments and questions can be emailed to sanpw@mysanibel.com



City of Sanibel

Stormwater Masterplan Public Workshop

March 11, 2025 5:00 PM, Recreation Center

Name: _____

Additional Information: _____

Address: _____

City, State, Zip: _____

Email Address: _____

Phone Number: _____

Do you represent an Organization: Yes ☐ No ☒ Name: _____

Comments: _____

The Jordan marsh facility provides a pumped system for water management under controlled flow. Can we add 5 or 6 more of those to provide a surge storage that can move water quickly. Provide in the design additional retention during peak periods

Additional comments and questions can be emailed to sanpw@mysanibel.com

Date

Comment

Photos

4/19/2025 Thank you for listening. We appreciate Council getting involved. There was little interest before Ian when we came forward but glad for the Grass Roots effort and a Council person who began attending the neighborhood meetings and those city leaders who made this a priority now.

With so many people selling due to coastal water concerns and the current economic and political uncertainties in USA, Sanibel needs to do everything possible to make the Island valuable to owners again.

Thank you!

4/18/2025 Good morning, I would like to verify that my culvert is scheduled for removal of debris which takes up approx 50% of the culvert's capacity. In addition the interior of my home was flooded by hurricane Milton, and within 6 inches shy of being flooded by Helene.

These are the 2 exposed ends of my culvert. As you can see, muck and debris are still present from Ian.

Please please help me with this devastating issue and costly repairs not covered by my flood insurance!!

I understand the scope of the problem is island wide but adjustments must be made please to assist ALL Sanibel residents. I appreciate your help. Thank you.



3/13/2025 Hi. Please send me a copy of the engineering study conducted by Johnson Engineering.

3/13/2025 We were not able to attend the workshop on March 11, 2025, however, we have had several meetings and communications that I have attached for your review:

- Summary of Sanibel Planning Dept and DPW meetings 1-18-2024
- Summary of Site Visit Meeting with Sanibel DPW Regarding Hideaway Ct 1-25-2024
- Memorandum Dana Souza final 4-22-2024
- Sanibel Base Map 28-46-22

The notes and memos provided background on our stormwater issues that have been raised and discussed since Hurricane Ian. Since the storms, our properties have not drained as they have done after previous storms and there is salt water standing at the rear of our lots. This has impacted plant growth and revegetation. It is important that these standing saltwater areas are flushed out with rainwater. This requires a means for flushing out the standing saltwater.

Based on the attached information, our understanding of the Sea Oats Unit 1 subdivision approval by Lee County in 1974 is that the 20-foot drainage is to manage stormwater drainage and control flooding of developed areas. In the Sea Oats Unit 1 subdivision, Exhibit F describes catch basins, underground pipes and swales conveying stormwater away from roads and properties. Along Hideaway Court, there are no catch basins and all roadways stormwater runs off onto the lots on Hideaway Court. Sanibel Base Map 28-46-22 notes that the 20' drainage easement and swale convey stormwater to East Rocks Lake.

We are requesting that you review our approval by Lee County that established drainage conveyance of stormwater on Hideaway Ct and that this conveyance system should be re-established to remove roadway stormwater off of our properties. We are available to discuss by phone, video meeting or by email. Thank you.

3/11/2025 We live in Beachview and our house is on the 5th hole so we have water issues in the front of the house from overgrown swales that prevent water from flowing to the drains and water in the back due to the need for improved course maintenance. Our driveway floods due to the lack of swale maintenance. The rain on 2/24/2025 was 2 inches, our drive flooded to 4 inches and remained that deep for 3 days. Needless to say, getting the mail, taking out the trash or taking a walk is a challenge. We have retained a civil engineer, done a drainage plan and filed it with the city and are waiting approval. We will be redoing the driveway and spending substantial money to resolve our water issues. But we need the city's help to get our water to the culvert.

3/12/2025 I attended the Stormwater Master Plan workshop yesterday and wanted to make a comment on neighborhood swales. I live in Lake Murex on Twin Lakes Lane and have noticed over the years that homeowners eliminate swales as part of their landscaping. I believe this to be unintentional, but the result is the same. There are storm drains around Lake Murex on Lake Murex Circle and Twin Lakes Lane. If everything is working properly, water will flow from the swales to these storm drains and into the lake. However, after a rain multiple front yards are flooded as neighbors have landscaped the swale away and the water is essentially dammed up in the yard. As part of the presentation, I believe that it was stated that the swales were surveyed. I would have to assume that many properties are out of compliance. Is there a plan to address this?

3/12/2025 I requested your card from yesterday's meeting at the Dunes Club when discussing culverts.

I can confirm the under drive culvert at my neighbor's in Mockingbird Dr is blocked, my culvert on the adjacent property is clear.

We both have swales and my neighbor has a drian.

Could you please add my neighbors' culver to your clean up action list.

Thank you again for all you do!

3/10/2025 The city asks for feedback of areas that are affected by rain since lan. I live in Bunting Lane. We have never really had problems with our roadways after storms in this neighborhood. Now every time there is even a moderate rain there is flooding on the street outside my house for about a block in each direction. I guess we have no connections anywhere nearby for this stretch of road. It is near the front of the sub division so it can make driving difficult for anyone that needs to access the back of the subdivision. There are about 8 houses it directly affects if they want to exit / enter their driveways. Is there some way to connect this portion of the road with existing drainage so we don't have the roadway under water every time it rains?

3/8/2025 In your TV promotion you talk FRESH WATER. However, we have salt water rivers and lakes due to the hurricanes. How do you plan to change those lakes back? Remember middle school science that salt does not evaporate!

Also our properties flood with the least amount of rain. In the past when the Sanibel River was lower we would get water to leave quickly after rains. Maybe we need to keep levels lower for rains. Please don't say you open the weirs before rains, I ride by and haven't seent hem open in months.

3/8/2025 My wife and I live in Brainard Bayou Rd (near SanCap and Bowmans Beach Rd). We are not sure if we will be able to attend the live event, so we would like to share the changes we have seen regarding stormwater since Hurricane Ian impacted all of us.

Our yard includes a small lagoon (freshwater before Hurricane Ian) in the rear of our property. It abuts the shared use path at mile marker 5 on SanCap Rd. The lagoon is connected by underground culvert (at Wulfert and SanCap) to a larger lagoon in the Lee Anne Tauck Conservation Tract. Both lagoons run @ NNW.

Our property sits on one of Sanibel's ridges, and our elevation survey shows the house site at 7.5 feet above sea level. Prior to Hurricane Ian, we experienced no instances of our lagoon exceeding it's bank, including during the heavy rain event from TS Sally in September 2020.

Since Hurricane Ian, however, the lagoon will flood into our yard during prolonged/heavy rain events, especially if there are higher than normal tides involved. Our small lagoon is not near any other sources of water other than the Tauck lagoon, so it appears to be that the lagoon in the conservation area is now connected to tidal waters somehow. I do not know if the Tauck lagoon is connected to other water sources, but I assume it used to be freshwater as well. Is it possibly taking on seawater from overland flooding between Dinkins Bayou or Caloosa Shores, whereas in the past it did not?

Hurricane Helene brought @ 3 to 4 feet of lagoon water rise into our back yard, and Hurricane Milton brought @ 4 to 5 feet of rise. Helene brought fairly clear water into our yard and pool, but Milton's waters were as sediment-filled and smelly as Hurricane Ian's surge waters.

The debris grate over the Wulfert culvert intake obviously has a lot more debris covering it after the past two years. We try to keep it clear after the water recedes, but there is so much dead and loose debris at that end of the lagoon that it gets covered over fairly easily.

And to reiterate, prior to Hurricane Ian we did not experience any water level rise of note during past storms. We are @ 3/4 mile inland from the Gulf, and about the same from the Bayside coastline.

I hope this is helpful information. We would love to prevent the increased flooding we have experienced as it has taken a toll on our established plants and trees, (and like so many others, the toll to our pocketbook!).

Thank you to everyone at the City for all that you do.

3/7/2025 I'm emailing to thank you for looking into this and helping all of us here.

I am on Ponce De Leon Rd, off Atlanta Plaza Highlands, and we've never had sitting water like this... Culverts etc, all need serious attention. We built our house in 1991.
Thank you in advance for helping us all.

3/3/2025 Per the article at WGPU website (<https://news.wgcu.org/top-story/2025-02-26/see-something-say-something-sanibel-asking-residents-to-share-flooding-storm-water-issues> dated February 27, I am submitting my observations re: flooding and storm water issues on my property.

- Hurricane Ian caused significant changes re: flooding on our properties on Turtle Gait Lane. Areas that previously had little or no standing water after rainfalls now have standing water that can last for days after a small rainstorm. After Helene, our properties had standing water for weeks. There are still areas where muck from Hurricane Ian has not broken down. In those areas, nothing grows and storm water will remain in those areas much longer than other areas where muck has broken down. Before Ian, those areas did not flood.
- Our subdivision (Cardinal Ridge) does not have common retention areas or culverts to direct stormwater away from our properties.
- Our properties back onto Palm Lake Drive. Those properties adjacent to our properties do not have mechanisms in place to prevent stormwater runoff from entering our properties. This is a contributing factors to flooding in our back yards.
- As there are no culverts or runoff mitigation from Palm Lake adjacent to our properties, storm surge is unabated and more pronounced when it comes, inundating our land and moving into our homes.

Clearly, there has to be a way to mitigate the excessive flow from the neighborhood subdivision. This is essential if we are to hold on to our properties especially because insurance coverage is not available for flooding and storm surges.

3/3/2025 I had not witnessed prior to Ian any such flooding. I am hopeful and prayerful the city can do something to mitigate this situation.

3/2/2025 Thank you for giving me the opportunity to present my drainage concerns at our home in Peaceful Drive in the Gumbo Limbo subdivision. We have lived here since 1986 when we built our home. Safe to say, we have weathered many storms over the years but nothing compared to Hurricane Ian.

While we understand that the surge of salt water over the island resulted in devastation to structures and vegetation, we are in different situation. We lost the majority of our vegetation which resulted in the loss of fill dirt. We were fortunate that we did not replant our property after Hurricane Ian as Hurricanes Helene and Milton would have killed it.

The problem is that we back up to Ding Darling and Tarpon Bay beyond that. With the loss of fill and mangroves in that area, water from Tarpon Bay flows onto our property. This occurs when there is a tide that is higher than normal. It's worse during the rainy season when the soil is saturated so the water from Tarpon Bay is not absorbed by the soil which results in standing water for weeks at a time and provides a haven for mosquitoes.

Not only is it not possible to plant anything, it is also detrimental to property values both here and island wide. We are in need of fill on our property as well as a berm to prevent water from Tarpon Bay flowing in.

We came to Sanibel on our honeymoon and never left. We basically had nothing and worked hard for almost 40 years on the island before retiring. We are not ultra rich and need our savings to continue living here in paradise. The 3 Hurricanes have hurt us both financially and mentally as I'm sure many have experienced.



us both financially and mentally as I'm sure many have experienced.

We had a drainage proposal from a company which was very expensive and not guaranteed to pass with the city. We have delayed that option with the hope that the city will let homeowners do the work themselves at much lower costs. Is there a city department that I could contact to show them our concerns? They could oversee the project to make sure we are not violating any rules. We just want to bring our property back to the way it was so we can start making landscaping improvements. The flooding that is occurring has never happened prior to Hurricane Ian.

I would also like to point out that the vegetation in Ding Darling is mostly dead as far as the eye can see. This provides the fuel for a devastating fire waiting to happen. I would hope that Ding Darling is making plans to restore the mangroves like SCCF is doing.

Thank you for hearing me out and look forward to some good news soon. Attached are a couple photos to provide a view of our dire situation.



2/28/2025 Resident called to complain about their muddy clogged culvert pipe, and would like somebody to clean it.

2/28/2025 We plan to attend the March 11 storm water meeting... But don't know if this is something Johnson Engineering can fix.

Since Hurricane Ian... The shared use paths in front of 3060 and 3050 West Gulf Drive flood and become impassable every time it rains. (Happened again a few days ago). Would it be possible for Johnson Engineering to clear/clean out the clogged culverts under these two driveways that lead to the swale filling and overflowing into the SUP at this location?

Photos of the flooded SUP are available too if that helps. We can bring photos to the meeting or email them in advance of the meeting.

Thank you for your service to Sanibel!



3/1/2024 Neighbor dispute on Boulder Dr, the City will be including that street in the Grant for Drainage Restoration.

2/27/2025 I have owned my home on Donax since March, 2019. Since Ian, every time we have a heavy downpour, there is now a pool in my front yard, across the bike path and street. That water may set there for days. That is very different compared to heavy rain and the rainy seasons before Ian where it resulted in a small area of water that dissipated fairly quickly. Now, once the pool of water is there + for days at a time, one has to drive or bike to the mailbox in front of the house to pick up mail and it makes it very difficult to walk from my house to the beach. People who are walking or biking the bike path navigate around the pool in front of my house and path by using the lesser pooled area on the street. It becomes a fairly dangerous situation for people using the path and at the very least, it is unpleasant & off-putting for me and house guests or renters. I am doing everything I can to take care of my little place and make it attractive and welcoming.

Please, please help to improve this situation.

2/27/2025 As per your request for flooding feedback, I own or work on a number of properties across the island. Since 2022 my drainage ditches or retention pond areas, which used to hold water for 2 weeks to 2 months a year during the rainy season now are full at least half the year, this includes Vinca Way, Periwinkle by the Island Cow, as well as throughout Gulf Pines, Pine Ave, etc. Additionally, I typically hand dig for footers for stairs, decks, etc., and am supposed to dig to 48". Over the past 25 years I have been in business that was not a problem, perhaps 42" deep in rainy season. For the last three years I hit water 18" - 30" virtually everywhere, year round. While I understand the desire to restore habitat, I think the raised water table is a major contributor to the severe property damage post hurricane. Obviously Ian was a 50 to 100 year event, but I think the water policy was mostly to blame for the recent 2 hurricane floodings. Additionally, I think the weirs are too small to effectively drain enough water when the city decides to open them prior to a storm. Just my 2 cents.

2/27/2025 The north side of Island Inn Road ditches or Swales between Poinciana Circle and Raintree need to be cleaned out. They do not hold stormwater and all of that water runs down Poinciana circle, Twin Ponds Rd., Singing Wind drive and Raintree and the properties on this north side of the road.

Last time I wrote, you cleaned out the south side of the road, where there are not many properties, we need to have this done on the north side where the above streets are.

The ditches and the culverts are full of dirt and plant life. In some places, the North Bank of these ditches has eroded, and so that water just flows on our properties. Therefore not a ditch at all.

Thank you for addressing these problems.

2/27/2025 Shortly after Hurricane Ian's devastation was cleaned up in our neighborhood we met with City Engineers to discuss the water flow issues affecting our home. Part of the issue is where the run off is directed to go is now full of water most of the year. The water table on the island was at a high level and remains that way 2 1/2 years later and we still have sitting water in our yard 6 months out of the year. The hurricane resulting dead vegetation along a culvert which borders the back of our property has been removed and has revealed a parking lot drainage pipe which collects all of the run off from the Oceans Reach Resort parking lot and empties it into the culvert which runs along Camino Del Mar.

While this drainage pipe was most likely installed years ago it's impact is now being felt by 9 homeowners whose property backs up to the culvert behind our houses which directs the massive run off (especially hurricane induced precipitation)towards Algiers Drive and the wetlands in Gulfside City Park.

There exists a large retention pond on the east side of Algiers Drive where Southwinds Drive neighbors are asking why this run off is not directed instead of behind our homes.

2/26/2025 Hi there- so pleased to see a focus on this important part of managing water and drainage on the island.

I live on Shell Basket Lane and have noticed since Ian that storm drains at the end of Nerita Street from the corner of Shell Basket to the Beach access are clogged with debris from Ian, and the drainage ditches are filled.

Additionally , the beach access on Norita Street was totally changed after Ian. There used to be a boardwalk that went over a low land that seemed to catch water that was filled with mangroves and palm trees. Once Ian came and the boardwalk was washed away it was all bulldozed into one level area, level with the street. The end of Narita becomes a lake when there is any major rain.

I know the condo complex across the street from Coquina dug their drainage ditch that runs along their parking lot deeper. It feeds into the clogged sewer drains. So more water will be coming to those sewer drains, and they are literally covered with debris.

There is a swale that runs next to my property and across the street on the empty lot we own. We plan on clearing that and making it deeper where it's filled throughout the years and storms.

Thank you for your attention to this corner of the island. Anything we can do to improve drainage helps us all!

- 2/25/2025 1. We don't have drainage ditches on the side of Rue Belle Mer which I believe we should have. Would you build that?
2. Tradewinds is the source of much of the storm water in our neighborhood. They need a proper drainage system provided by the town who was responsible for shutting down the gulf drainage from Tradewinds, and did NOTHING to compensate.

Water now flows down the street like a river. Before, the road was much lower and we never got water at the house.

Our neighborhood needs to be proactively considered for drainage improvements, and for earlier action to reduce water levels BEFORE storms hit, by reducing the water levels in the bayou and Sanibel River and Preserve.

- 2/25/2025 Who do I contact about finding and cleaning a storm grate/drain that was covered by lan? There is a grate that is no longer visible and functioning in Lake Murex Circle. I have attached a picture for reference. Thank you for your help.



- 2/25/2025 The storm drains on jewel box drive are not working properly. They continue to hold water causing flooding of the lots. I have pics from this morning at 740am. Flooded drain despite low tide. The drain is a direct drain to the canal. Since the canal is low tide there should be no water in the drain box to the level of canal water. It appears the drain lines are clogged at the canal discharge with sediment.

Please address before we have flooding in the homes again. The residents on the street are very concerned. We have check other drains nearby and none have the standing water. Another indication of a problem with the drain.



APPENDIX E

Public Workshop Display Boards

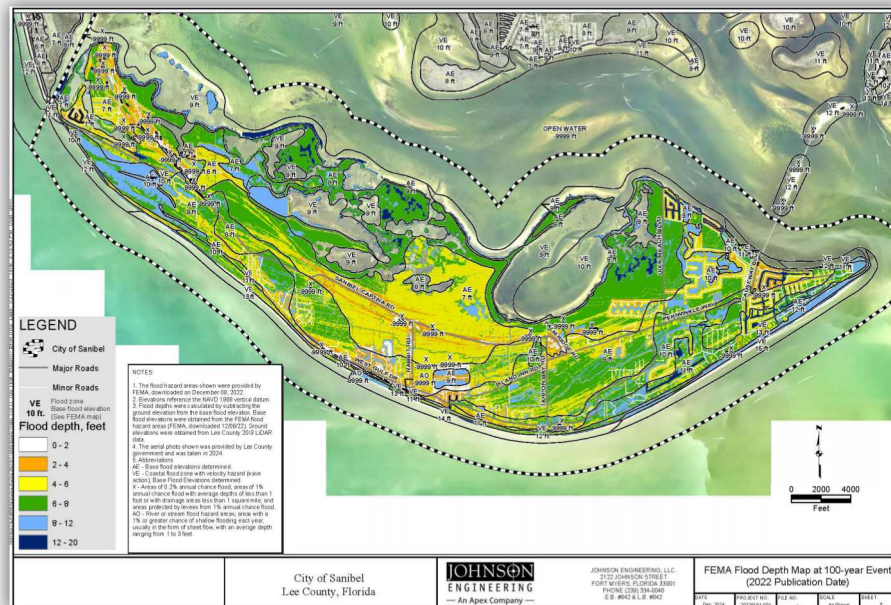
FLOODING 101

Sanibel has been heavily impacted by various types of flooding over its history

FLOODING DUE TO RAINFALL



Occurs when streams and rivers exceed their capacity. Sanibel has two interior watersheds that collect rainfall and outfall via two weirs to Pine Island Sound.



STORM SURGE



The sudden rise in seawater level during a tropical storm. FEMA flood maps show the island is wholly inundated by seawater in the 100-year storm event.



Scan code for more information on storm surge.

FLOOD MITIGATION

Multiple City departments work together on flood mitigation:

Public Works | Natural Resources | Planning | Building

- The City maintains drainage infrastructure, including natural systems, ditches, culverts, and weirs.
- Multiple flood mitigation projects have been implemented over the City's history.
- Sanibel is currently completing a Coastal Vulnerability Study.
- FEMA elevation standards are enforced on new construction and rebuilds.
- Sanibel is pursuing grant funds and planning Capital Improvement Projects.
- A water level monitoring network has been deployed

This is a continuous, year-round effort. It is important to know your home elevation and your flood zone elevation.

FAQs

"My home has never flooded before. Why now?"

Every storm is different. Hurricanes present the greatest challenge as there can be a combination of potential impacts including:

- Angle
- Speed of approach
- Size of storm
- Maximum sustained wind speed
- Distance from the center
- Ground saturation
- Location of precipitation

These variables will influence the amount of storm surge and rainfall experienced in different areas of Sanibel.

For example, while Hurricane Irma produced a considerable amount of rainfall, the storm surge was minimal. Whereas hurricanes Ian, Helene, and Milton were primarily storm surge events.

"We have tide/flap gates that should protect our community from storm surge. Why did we flood?"

Tide or flap gates are used in communities like Sanibel that are very close to coastal waters. This involves installing a plate or cover with hinges on a weir that can open in one direction only. The gates are intended to allow stormwater to exit the community during typical afternoon rain showers while preventing tidal backflow into the community.

When storm surge is higher in elevation than the roads, yards, and homes, the water will overwhelm the system. Once the storm surge levels recede below infrastructure elevation levels, the water will exit the community, which could take several hours.

"How did Sanibel's maintenance mitigate the flooding?"

Maintenance is vital in keeping the systems free from obstructions and blockages of flow during rainfall events. Sanibel Public Works maintains miles of canals, roadside ditches, and numerous catch basins. Various City departments also maintain miles of natural creeks and streams.

Though the City works to keep the natural areas maintained, they are largely on private property and can only have maintenance performed if the property owner allows. As the natural areas are on private land, the owner is ultimately responsible for maintaining the drainage and clearing any blockages within their property lines.

This does not prevent flooding from tidal surge or extreme excessive rainfall. The height of surge and resulting flooding is generated from the extreme winds and energy built up from a tropical storm.

"Will dredging and vegetation removal increase flood capacity?"

In upland areas, the stormwater carrying capacity of a canal, ditch or creek is controlled by the amount of friction presented by depth, width and vegetative characteristics.

A stream full of debris can resist flow and raise water levels upstream. Downstream as the waterbody approaches the estuary where fresh and saltwater meet, stormwater is spread out and levels are controlled mostly by tide.

Although cleaning the drainage system may be beneficial, during rainfall-based events, the dredging and removal of vegetation will have little effect in reducing tidal surge levels. In fact, research has shown modifications of the estuary can increase surge damage by reducing the energy absorption our shallow vegetation coastal system estuary provides.

Is my home likely to flood?

If you are in a designated floodplain or storm surge area, you are at a higher risk. The elevation of your home or building is a critical factor. You can find your current flood zone by searching our FEMA maps

CREDIT: LEE COUNTY <https://storymaps.arcgis.com/collections/66b8cb55c0d84bb4b69e92d7f473a624?item=1>



City of Sanibel, Florida

STORMWATER MASTER PLAN
CITY OF SANIBEL, FLORIDA
2025



DATA COLLECTION & REVIEW

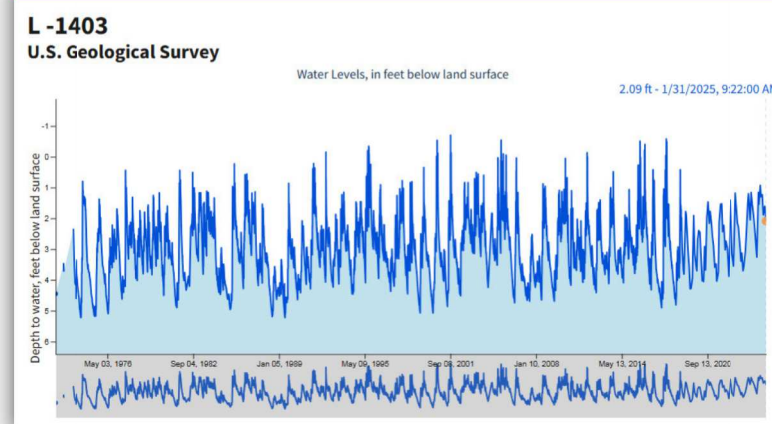
Understanding how the Island's hydrology has changed following Hurricane Ian.

SURFACE WATER



- Installed 14 water level data recorders.
- The basins generally act as a level pool and runoff is efficiently conveyed to the Sanibel River, as designed.
- Surface water levels in the interior wetlands are similar to those in 1977.
- New roadside culverts could help with the slow recovery along West Gulf Drive.

GROUNDWATER



- Interior groundwater recovery is still occurring similarly to past observations, going back to 1953.
- Due to the Island's low-lying profile, there is little to no deep percolation out of the system. This is consistent with The Sanibel Report (1976).

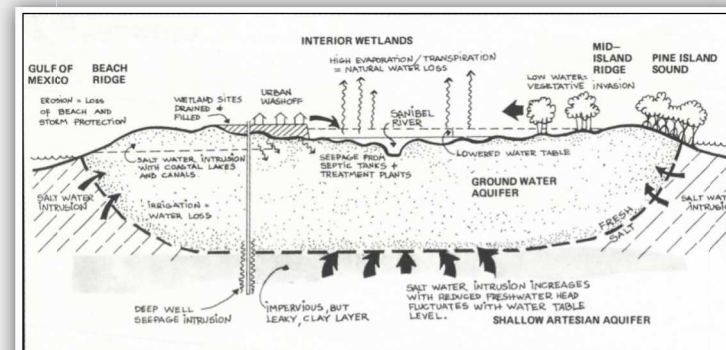


Figure 1. Graphical representation of the water budget of the freshwater basins on Sanibel, taken from The Sanibel Report (1976).

WATER BUDGET

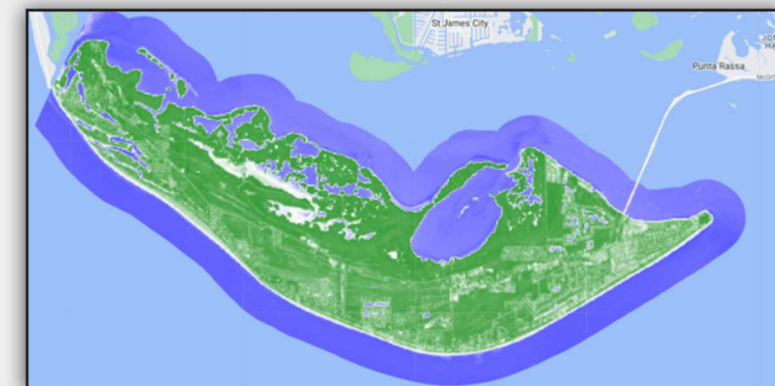


Figure 3. Map showing NDVI values before Hurricane Ian (average Nov. 2013 to Sept. 2022).

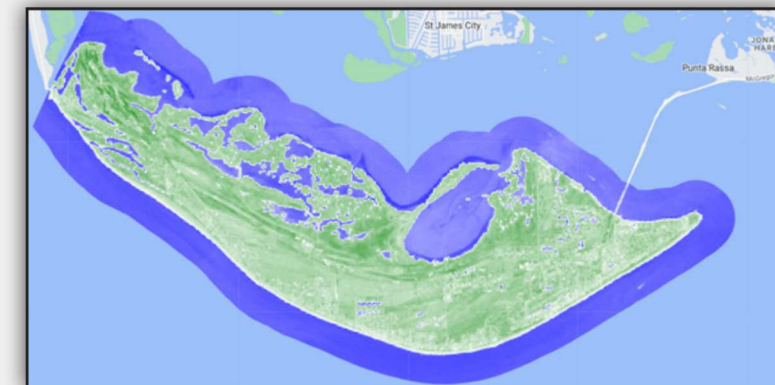


Figure 4. Map showing NDVI values after Hurricane Ian (average Nov. 2022 to May 2023).

- A water budget estimates the quantities of water entering and leaving the system.
- Evaporation & evapotranspiration (ET) account for nearly all yearly outflows from Sanibel, not runoff through the weirs.
- An analysis of satellite imagery of Sanibel using the Normalized Difference Vegetation Index (NDVI) shows Hurricane Ian had a devastating impact on plant life.



City of Sanibel, Florida

STORMWATER MASTER PLAN
CITY OF SANIBEL, FLORIDA
2025

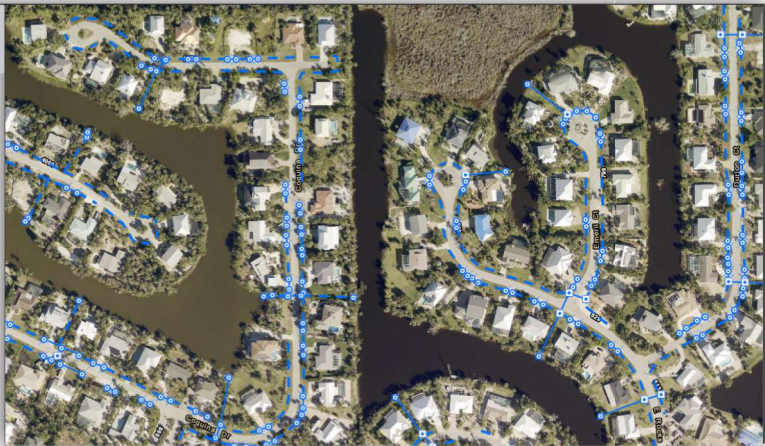
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HURRICANE IAN DAMAGE REPAIR TIMELINE

The City has the primary stormwater management system inspected every year. Last year the inspection program was expanded to include all driveway culverts as well.

UPDATE MAPPING

- 820 driveway culverts added to map.
- 1,763 pipe ends added to map.
- 2,224 swales added to map.
- Updated drainage mapping.



IMMEDIATE REPAIRS POST-STORM

- Cleaned major blockages & urgent issues.
- Annual Sanibel River clearing.

UPCOMING REPAIRS

- Additional 658 culvert cleanings scheduled for May 2025.
- Island-wide

DITCHES & SWALES

The City of Sanibel prepares year-round for excessive rain events, particularly during hurricane season (June 1 – Nov. 30).

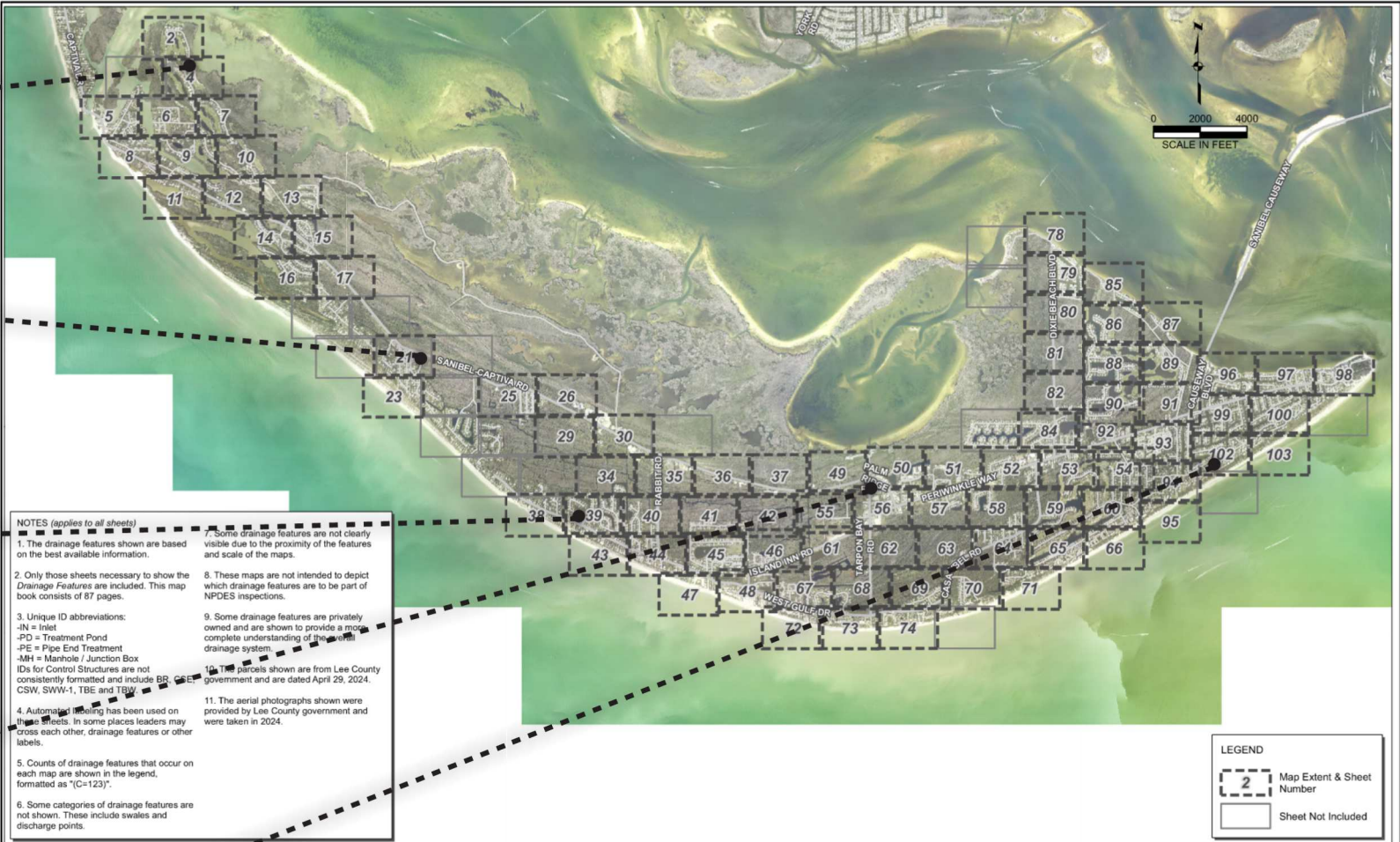
- Maintenance on drainage ditches has helped prepare the City's roads for necessary drainage during rainfall events.
- Expect minor intersection and road flooding during heavy rainfall. Ditches and swales take time to drain.
- With so many newcomers in Southwest Florida, the City would like to remind residents that roadside swales are designed to drain. However, they may hold water for some time during significant rain events.
- The City asks the public to report blocked ditches, swales, conveyances, and areas of local flooding.

CREDIT: LEE COUNTY

FUNDING SUMMARY

FDEP Stormwater Grant	\$	10,000,000	Funding from Grant
Stormwater Master Plan (Johnson)	\$	230,000	Actual
City Completed Repairs (FY 23)	\$	55,000	Actual
Culvert Repair Project Cost Estimate (From Master Plan List)			
Beach Road Weir Rehab	\$	2,000,000	Estimate
General Bridge and Box Culvert Repairs	\$	750,000	Estimate
City Planned Repairs	\$	200,000	Estimate
City Planned Repairs	\$	200,000	Estimate
Repair Project Management (Johnson)	\$	200,000	Estimate
Subtotal	\$	3,635,000	
Remaining	\$	6,365,000	Available For Additional Items

Normal Maintenance (Non-Grant)			
Canal Trimming (FY23)	\$	6,000	Actual
Bridge, Box Culvert and Weir Repairs (FY23)	\$	185,904	Actual
In House Staff Work (FY23)	\$	270,000	Actual
Canal Trimming (FY24)	\$	10,000	Actual
In House Staff Work (FY24)	\$	270,000	Estimate
Remaining Johnson Master Plan Design	\$	151,024	Actual
Additional Johnson Scope	\$	50,000	Estimate
Total	\$	942,928	Actual + Estimate



Sanibel Post-Ian Surface Water Management
Lee County, Florida

JOHNSON
ENGINEERING
— An Apex Company —

JOHNSON ENGINEERING, LLC
2122 JOHNSON STREET
FORT MYERS, FLORIDA 33901
PHONE (239) 334-0046
E.B. #642 & L.B. #642

Drainage Features
Index Map

DATE: September 2024 PROJECT NO: 20230161-001 FILE NO: SCALE: As Shown SHEET: 1

THIS IS A JUST SAMPLE OF THE THOUSANDS OF LOCATIONS MAPPED.



City of Sanibel, Florida

STORMWATER MASTER PLAN
CITY OF SANIBEL, FLORIDA
2025

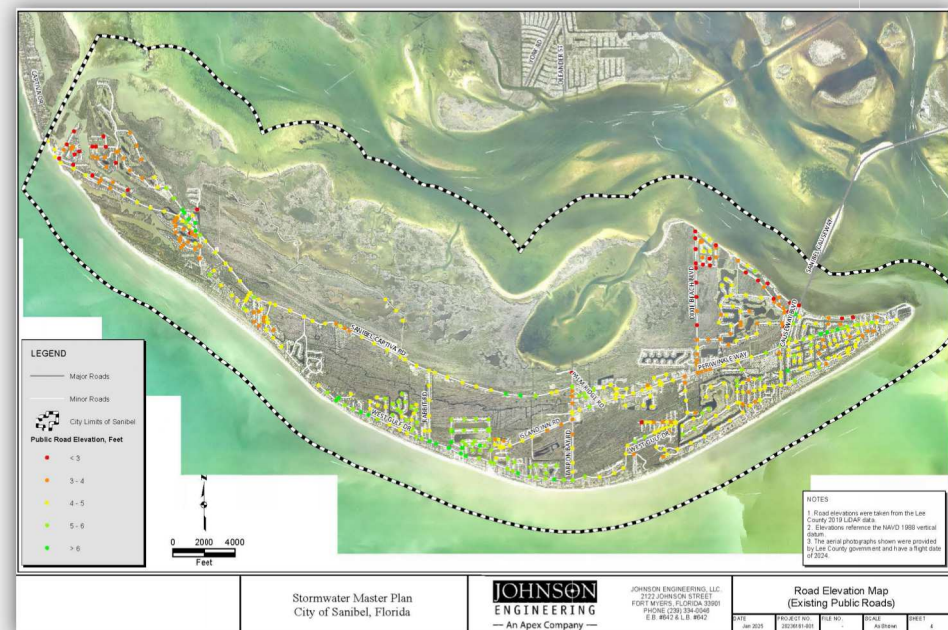
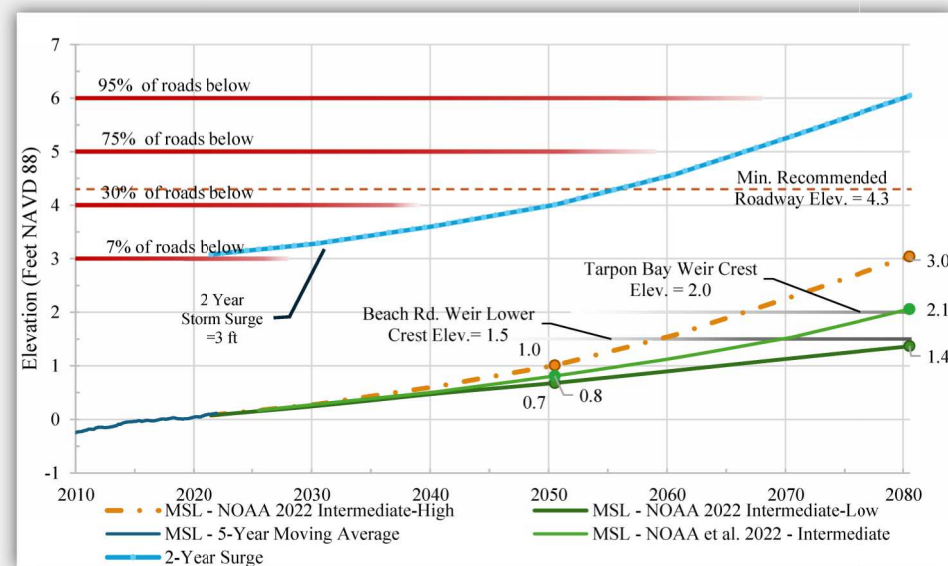
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RESILIENCY

Preparing for the next 50 years

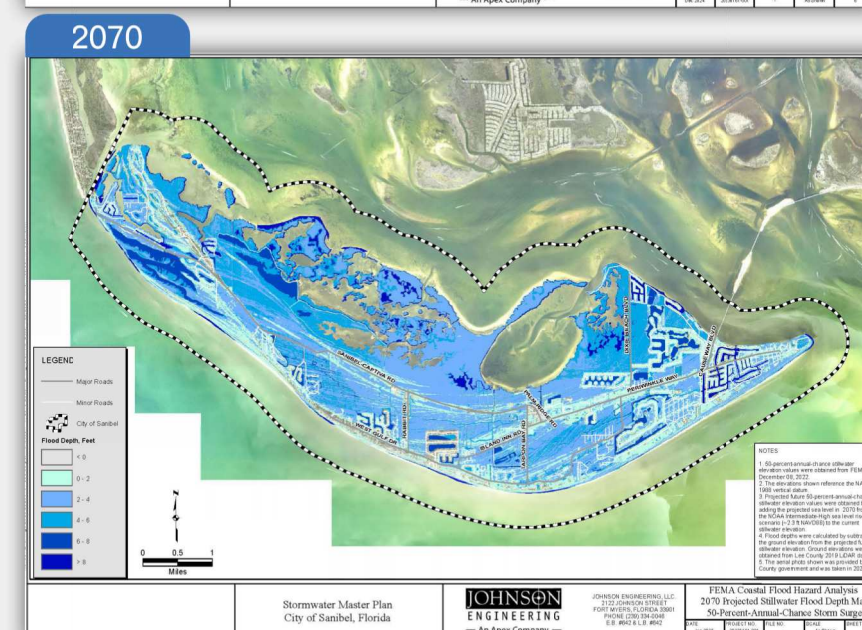
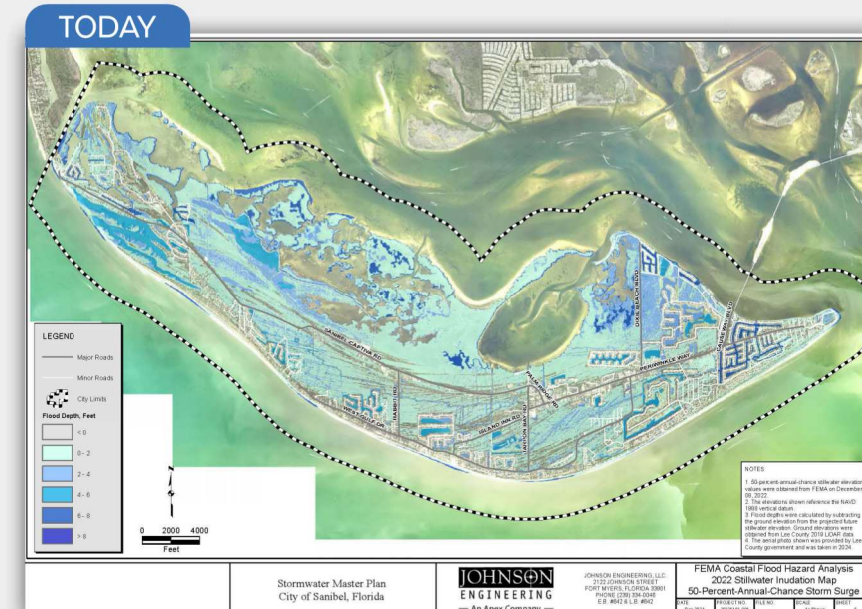
ROADWAY ELEVATION ANALYSIS

- 75% of roads on Sanibel are below elevation 5 feet NAVD 88.
- The Intermediate - Low sea level rise projection for 2080 anticipates 20% of roadways will be vulnerable to failure.
- Increasing the minimum roadway elevation to 4.3' feet NAVD 88 would protect all roadways through 2080 (Int.-Low Scenario).



2-YEAR STORM SURGE

- The 2-year storm surge events are anticipated to significantly worsen over the next 50 years.
- The ability to maintain a freshwater system on Sanibel's interior will grow increasingly difficult with continued sea level rise.
- Minimal flooding occurs today in the 2-year storm surge event.



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2025

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