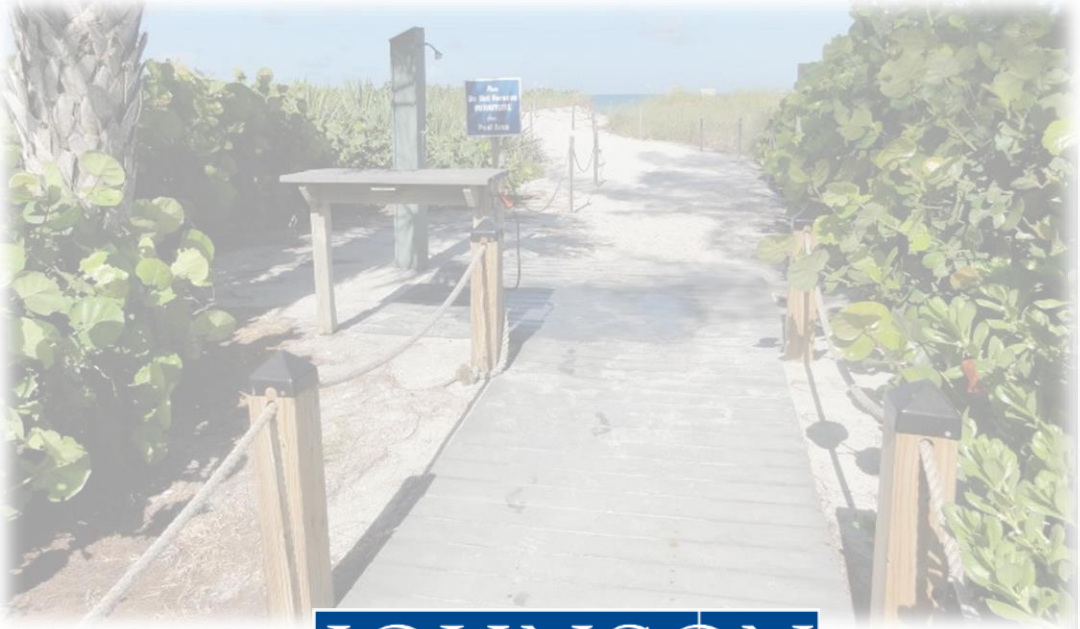


JOHNSON ENGINEERING
— An Apex Company —

City of Sanibel

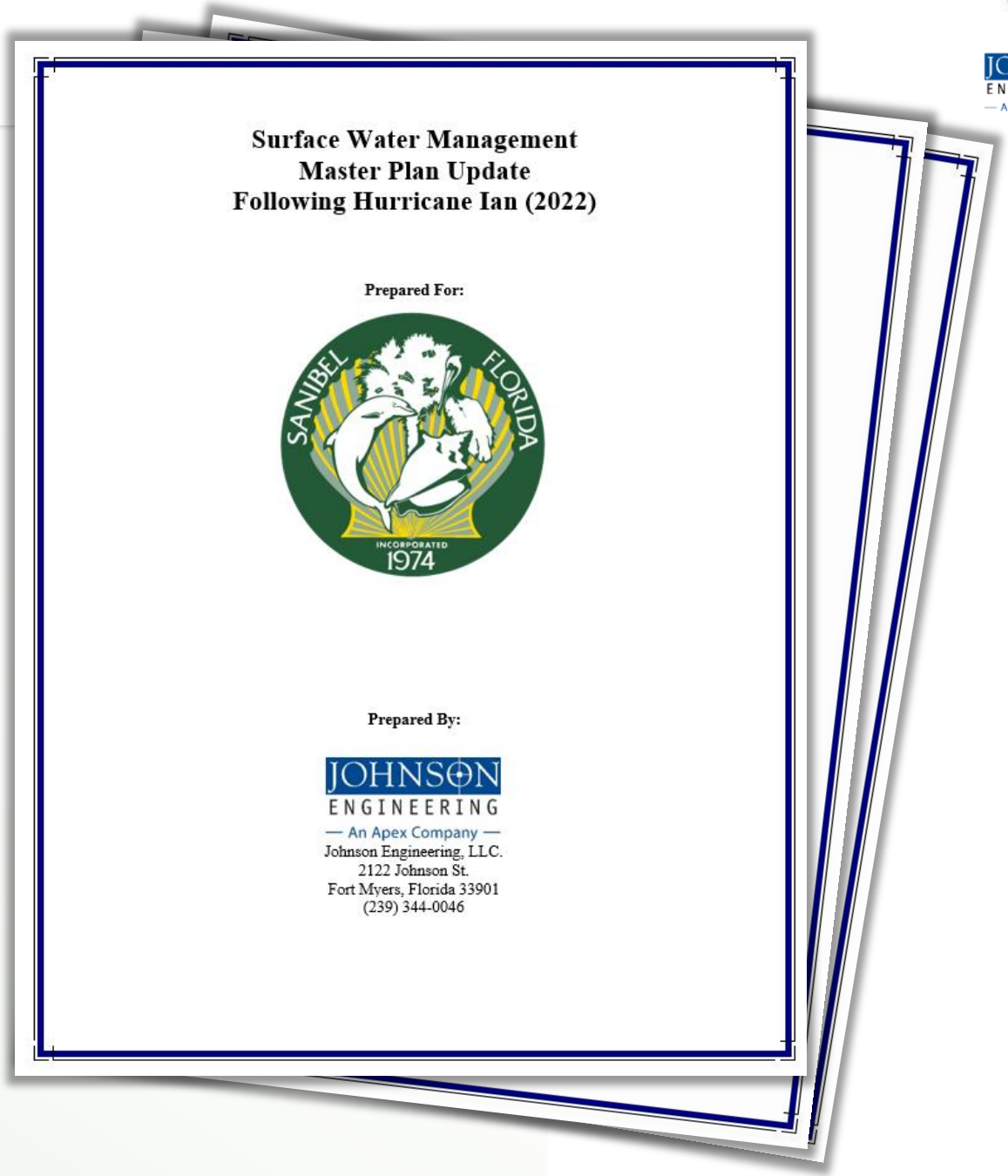
Resilient Recovery: Vegetation, Hydrology, and Stormwater Management Post-Hurricane

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

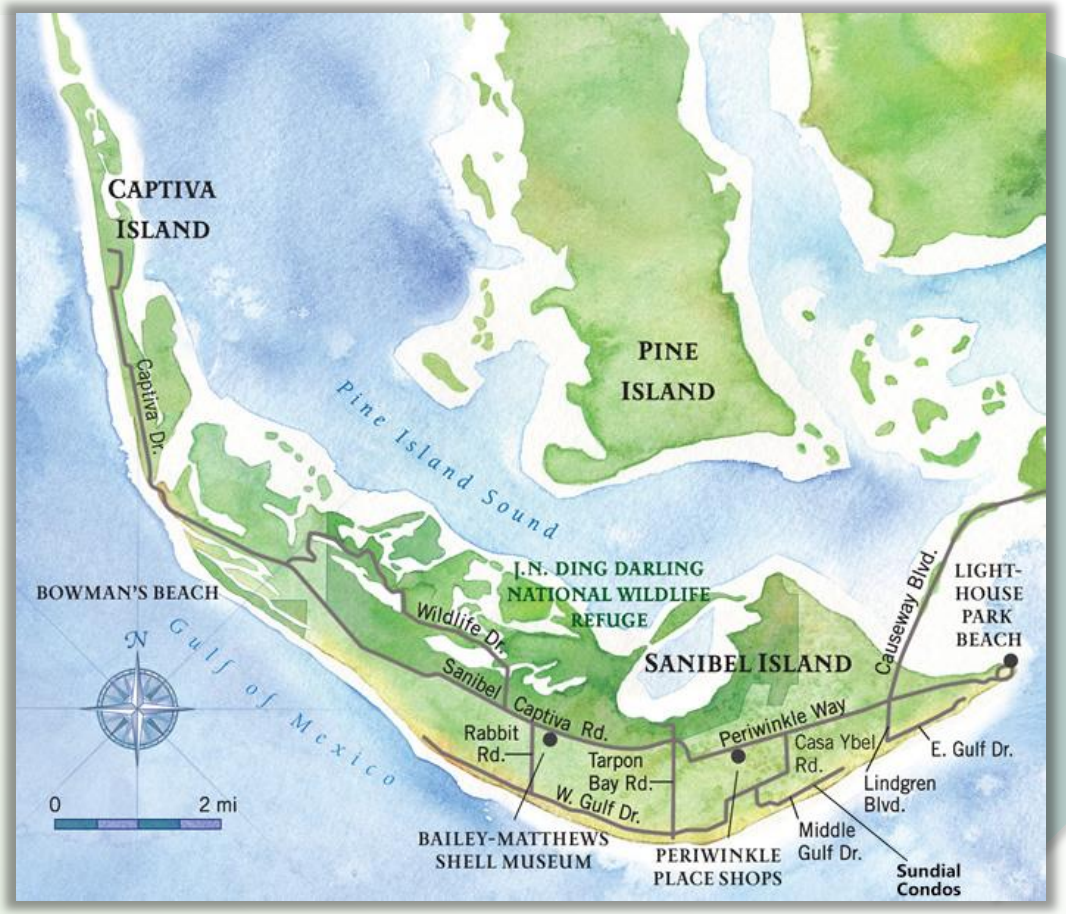
June 12, 2025

Agenda

1. Introduction
2. Damage Repairs Post-Hurricane Ian
3. Flooding and Vulnerability
4. Data Collection
5. Resiliency

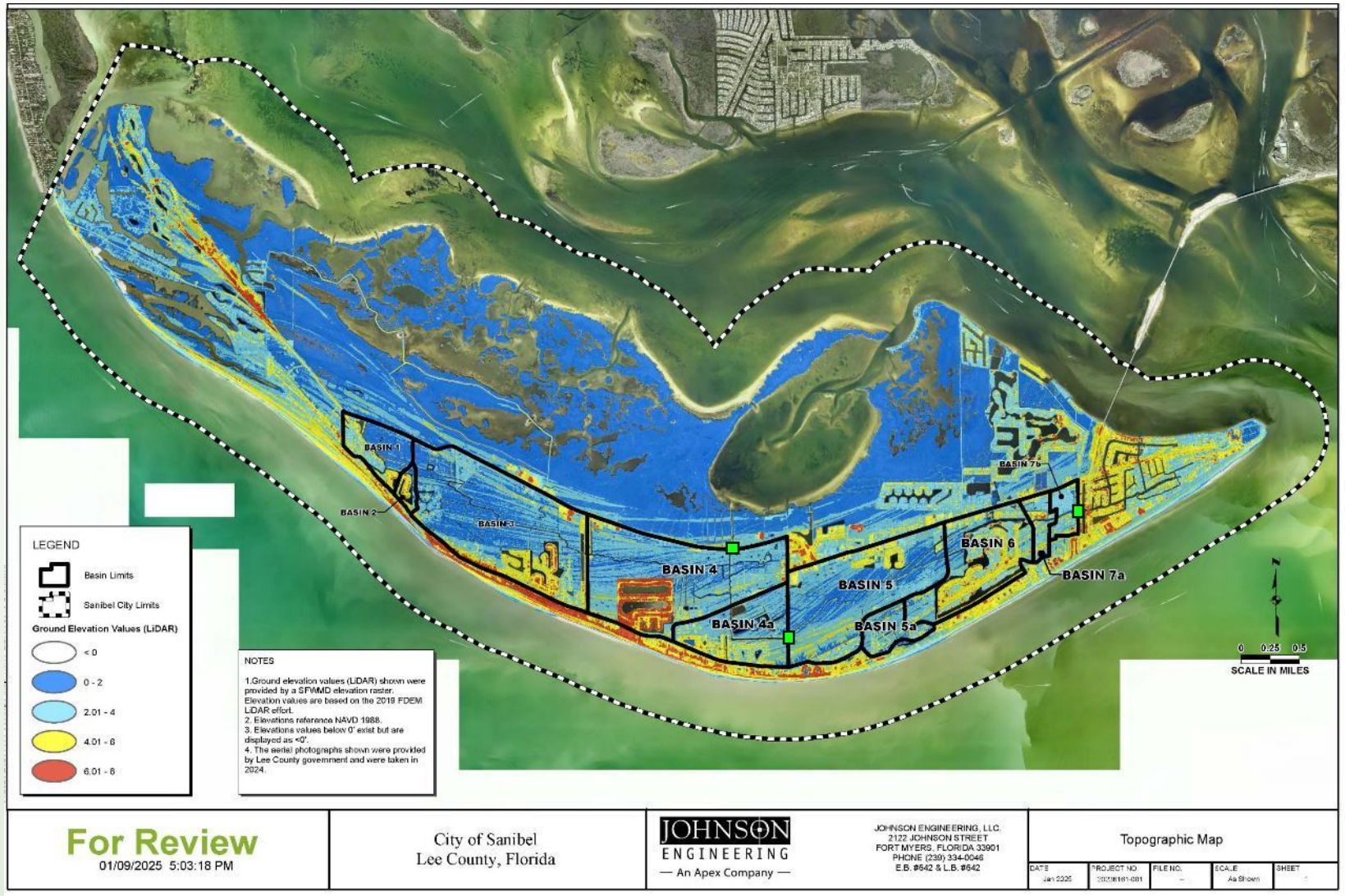


Sanibel Island



1. Introduction – Sanibel Island
   - *Sanibel is a low-lying barrier island in Lee County*
   - *It is about 12 miles long, with an average elevation of about 4 feet above sea level*
   - *The island hosts a valuable interior wetlands ecosystem*
   - *Since incorporation in 1974, the city has emphasized environmental preservation and coexistence with nature*

Interior Wetlands and Overland Flow



1. Introduction – Interior Wetlands and Overland Flow

- *The island is essentially a bowl*
- *System fills and overflows, it doesn't drain dry.*
- *Two interior freshwater basins outfall to Pine Island Sound via weirs*
- *Saltwater intrusion occurs when freshwater head decreases*
- *It is necessary to retain as much rainwater as possible to maintain the freshwater wetland ecosystem*

Damages from Hurricane Ian

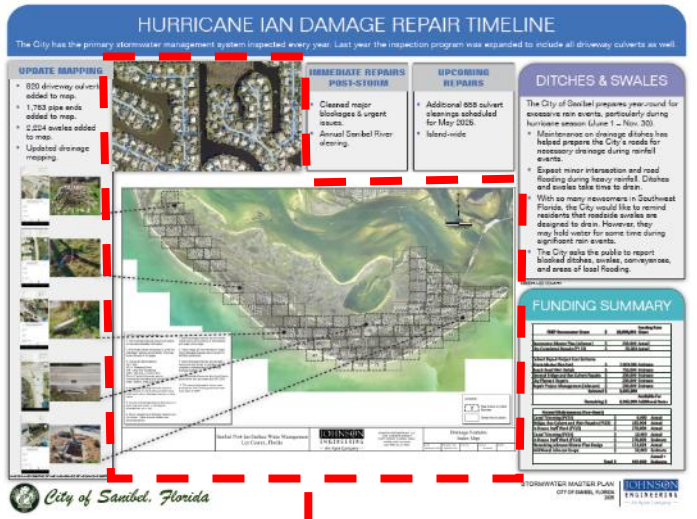
2. Damage Repairs Post-Hurricane Ian – Introduction

- *Hurricane Ian severely damaged the island's infrastructure.*
- *Culverts, inlets, and swales were buried, leaving the island more vulnerable to riverine flooding.*

PHOTO CREDIT: Steve Helber, the AP, ABC News

PHOTO CREDIT: Getty Images, ABC News

Response: Mapping, Repairs, and Funding

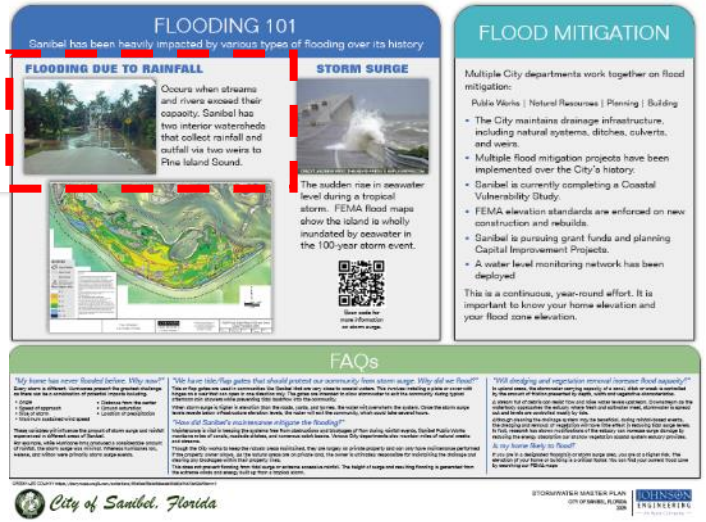


2. Damage Repairs Post-Hurricane Ian – Mapping, Repairs, and Funding

- *Mapping efforts*
  - *At least 4,807 culverts, pipe ends, and swales added to map*
- *Damage repairs*
  - *Hundreds of culverts and swales are in the process of being cleaned/dug out*
- *Funding was provided by a $10 million FDEP stormwater grant*

Flooding 101

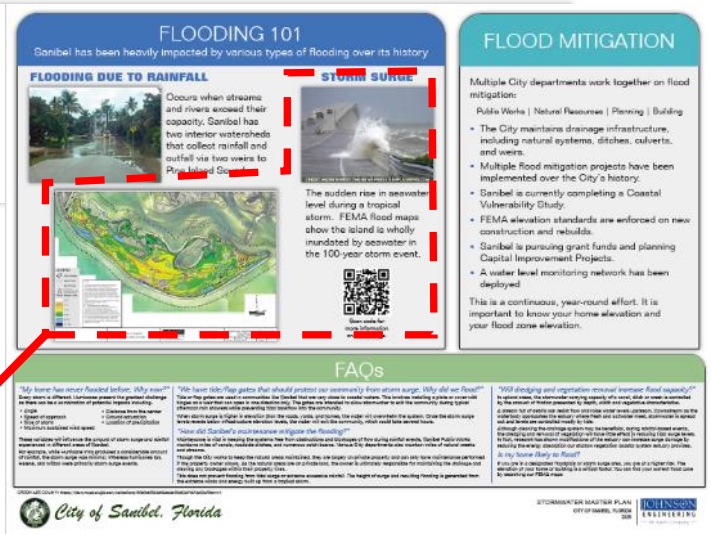
3. Flooding and Vulnerability – Riverine
   - *Public meeting display boards*
   - *Heavy rainfall causes rivers & streams to exceed their capacity.*



Flooding Due to Rainfall

Flooding 101

3. Flooding and Vulnerability – Storm Surge
   - *FEMA flood maps: Sanibel is entirely inundated in 100-year storm event*



Flooding Due to Storm Surge

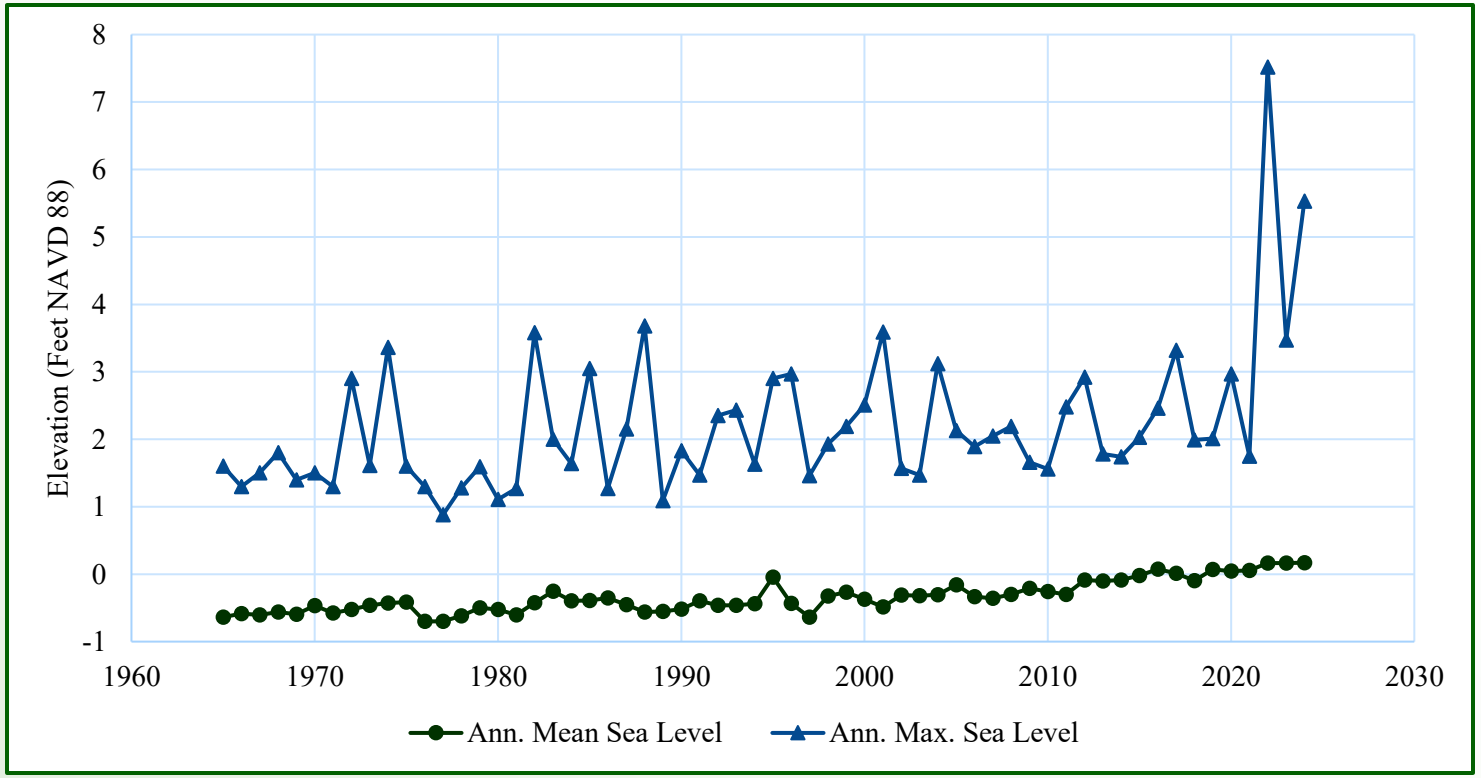

PHOTO CREDIT: ANDREW WEST, THE NEWS-PRESS & NAPLESNEWS.COM

Flooding due to Storm Surge

3. Flooding and Vulnerability – Storm Surge

- *My home has never flooded before. Why now?*
- *5 of top 10 water levels occurred within 3 storm seasons*

NOAA Tide Station – Fort Myers (8725520)



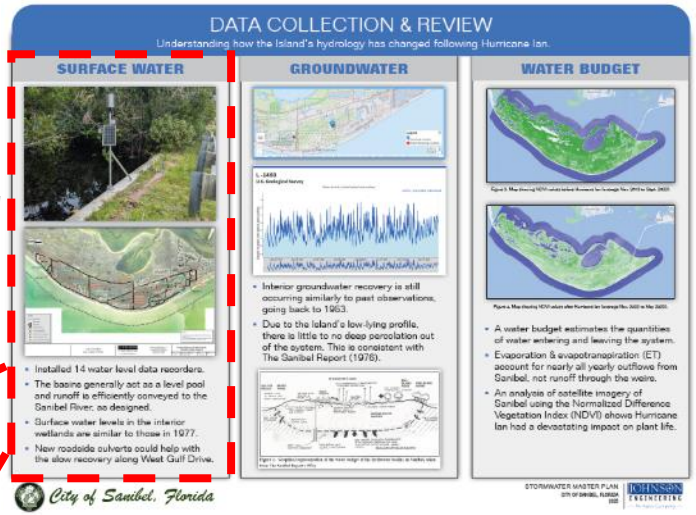
10 Highest Water Levels
1965 to Present

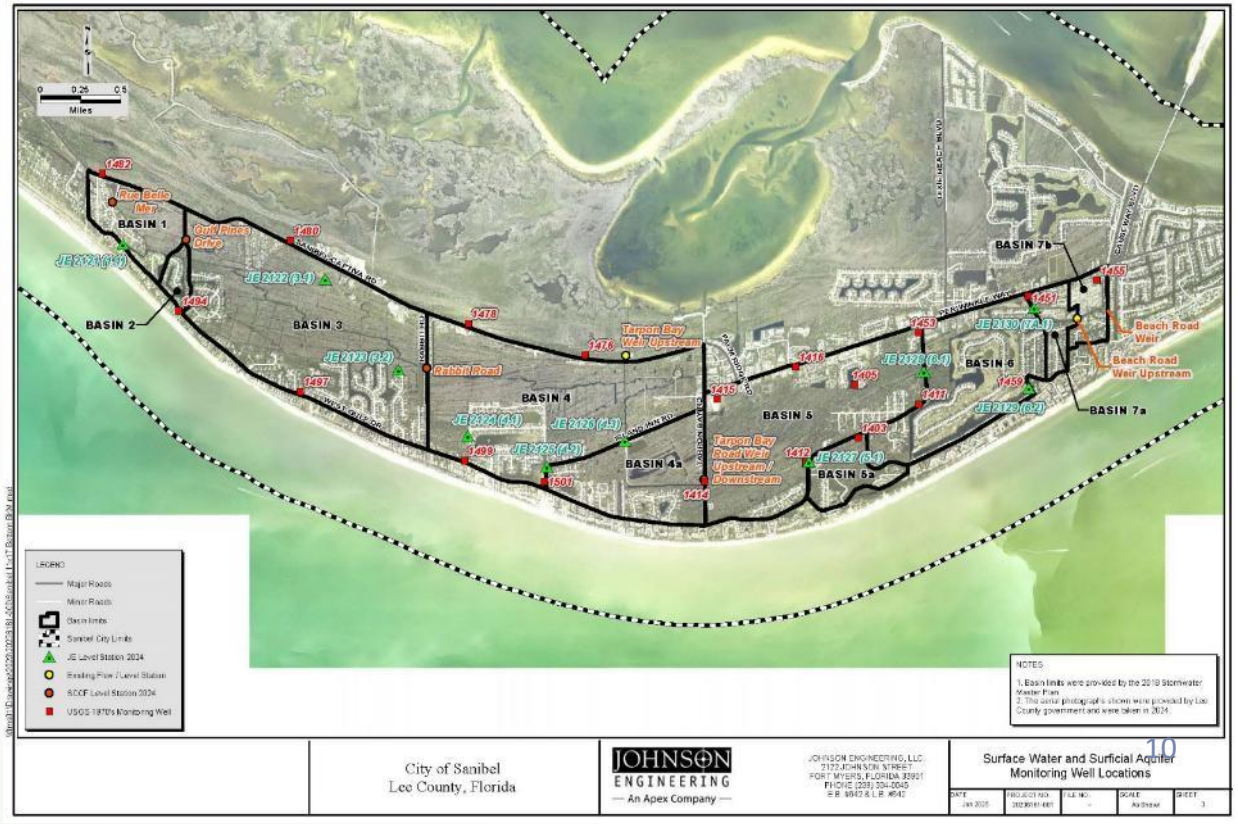
Rank	Peak EL	Date
1	7.52	2022-09-28
2	5.53	2024-10-10
3	5.4	2024-09-27
4	3.68	1988-11-23
5	3.59	2001-09-14
6	3.58	1982-06-18
7	3.53	2024-08-04
8	3.47	2023-08-30
9	3.36	1974-06-25
10	3.32	2017-09-11

Surface Water Monitoring

4. Data Collection & Review – Surface Water

- *Water Level Monitoring Network*
  - › *14 Water Level Datalogger Installations*
- *The basins generally act as a level pool*

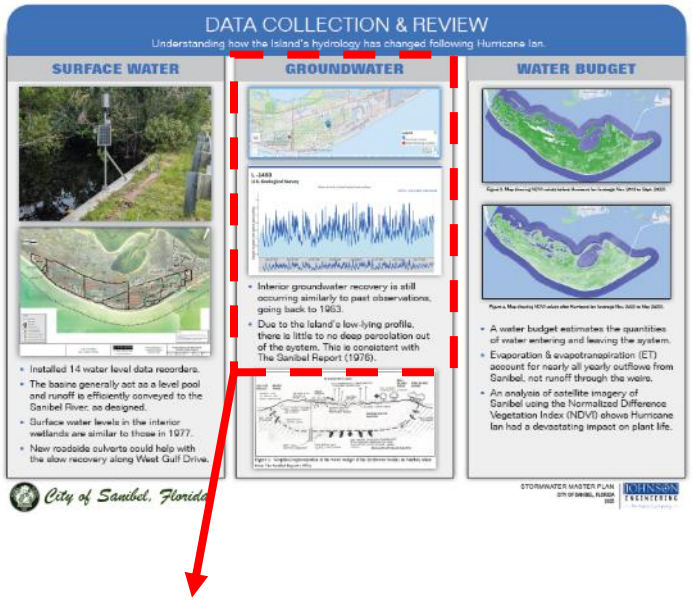


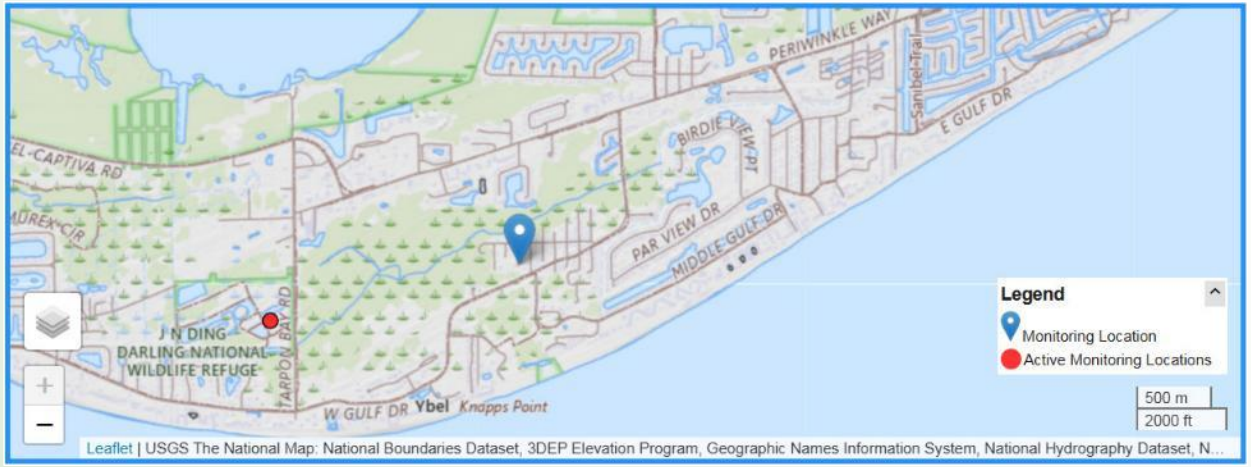


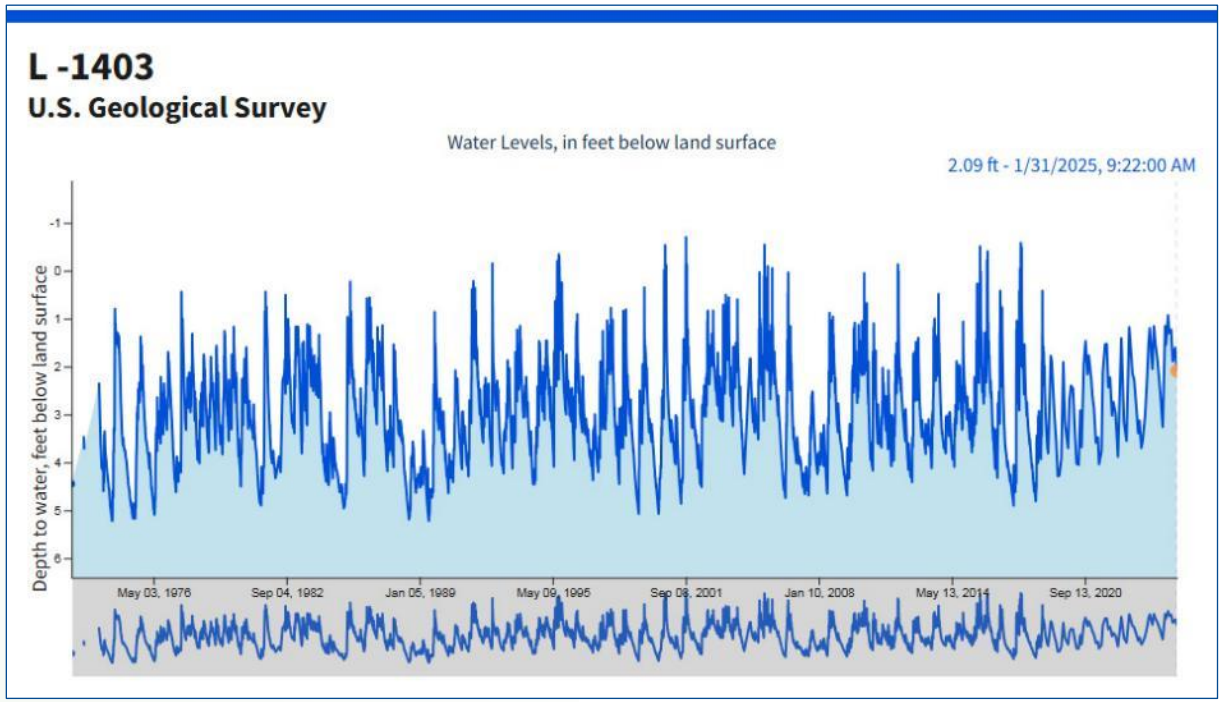
Groundwater Monitoring

4. Data Collection & Review – Groundwater

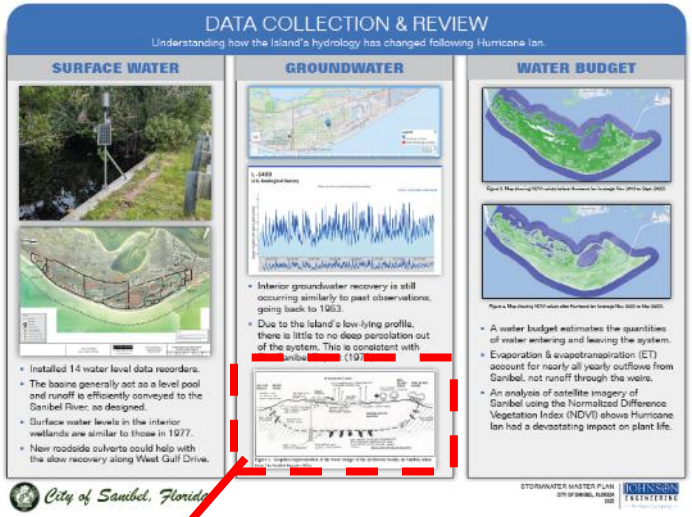
- *Interior groundwater percolation is still occurring similarly to past observations, going back to 1953.*
- *Due to the Island's low-lying profile, there is little to no deep percolation out of the system. This is consistent with The Sanibel Report (1976).*







Water Budget



4. Data Collection & Review – Water Budget

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

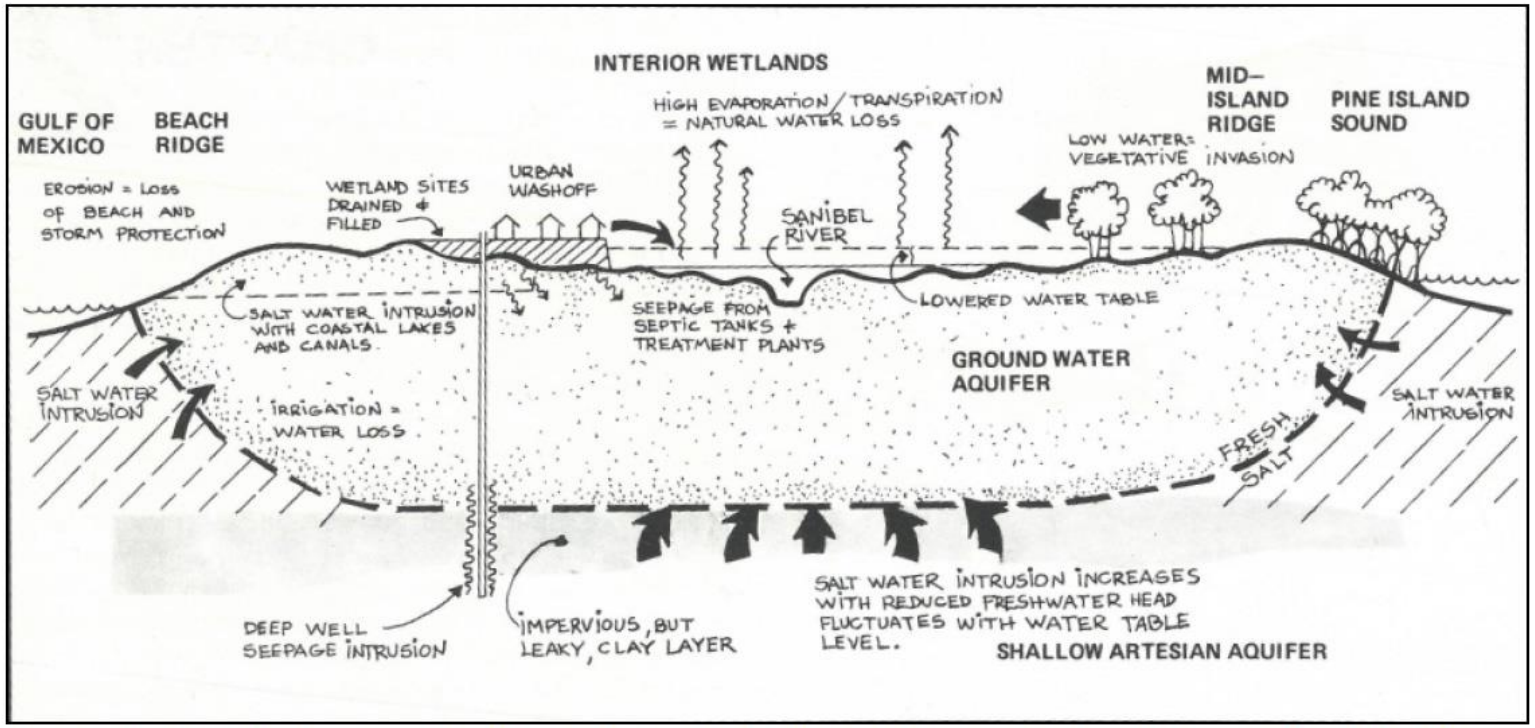
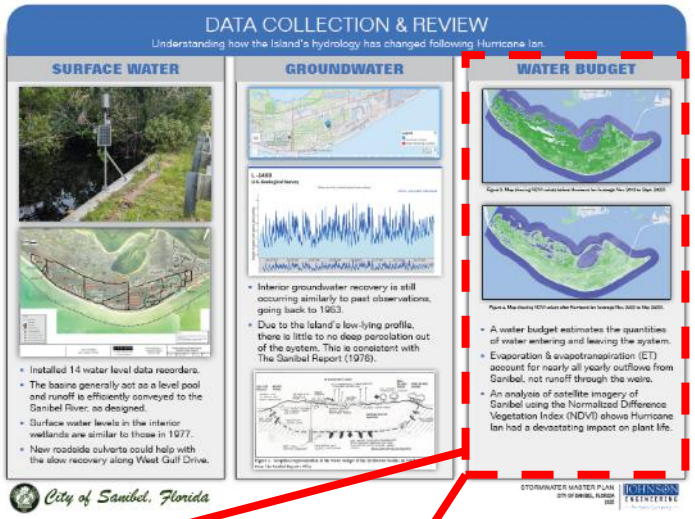


Figure 1. Graphical representation of the water budget of the freshwater basins on Sanibel, taken from The Sanibel Report (1976).

Water Budget and NDVI

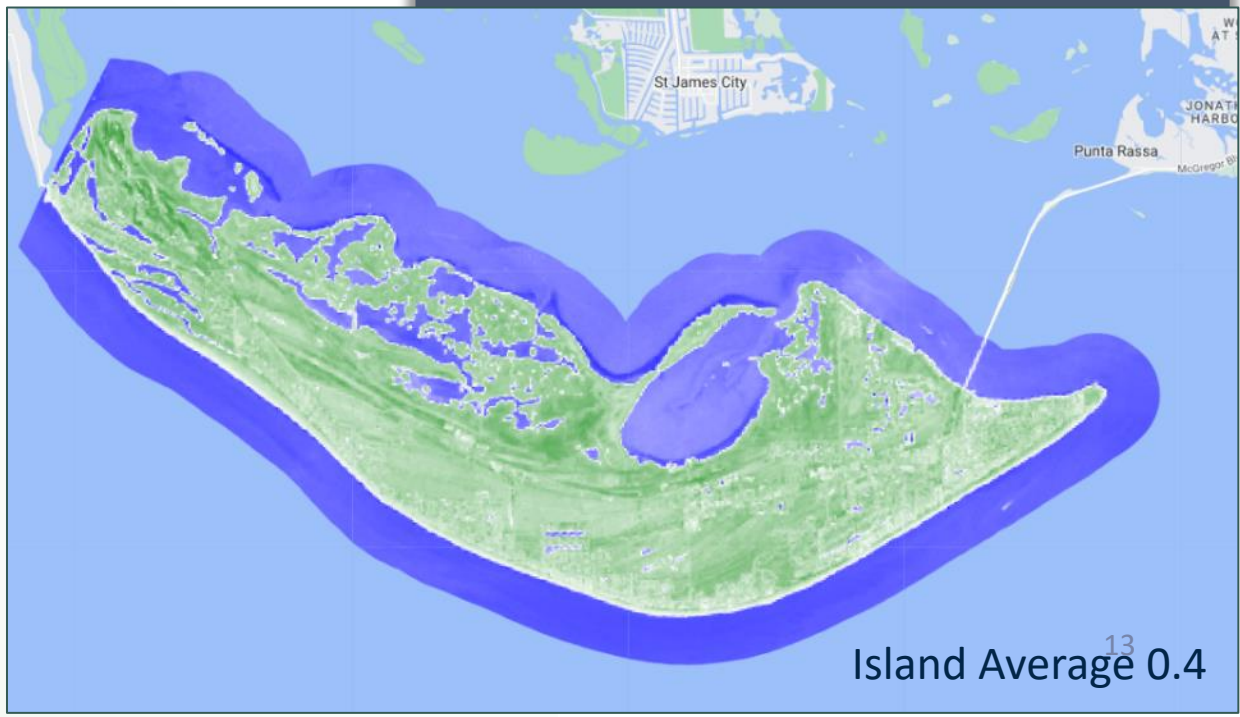


4. Data Collection & Review – Water Budget

- *An analysis of satellite imagery of Sanibel using the Normalized Difference Vegetation Index (NDVI) shows Hurricane Ian had a devastating impact on plant life.*
- *As less water is lost to ET, management strategies may change.*

NDVI BEFORE HURRICANE IAN (2013-22)

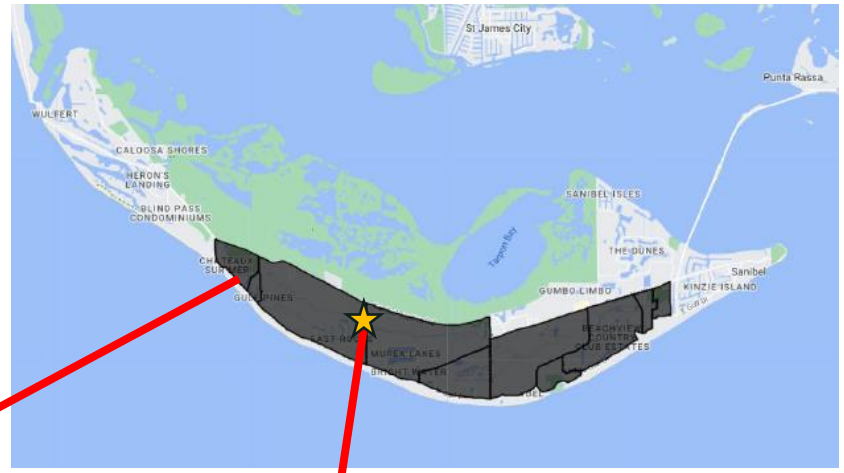
NDVI AFTER HURRICANE IAN (2022-23)

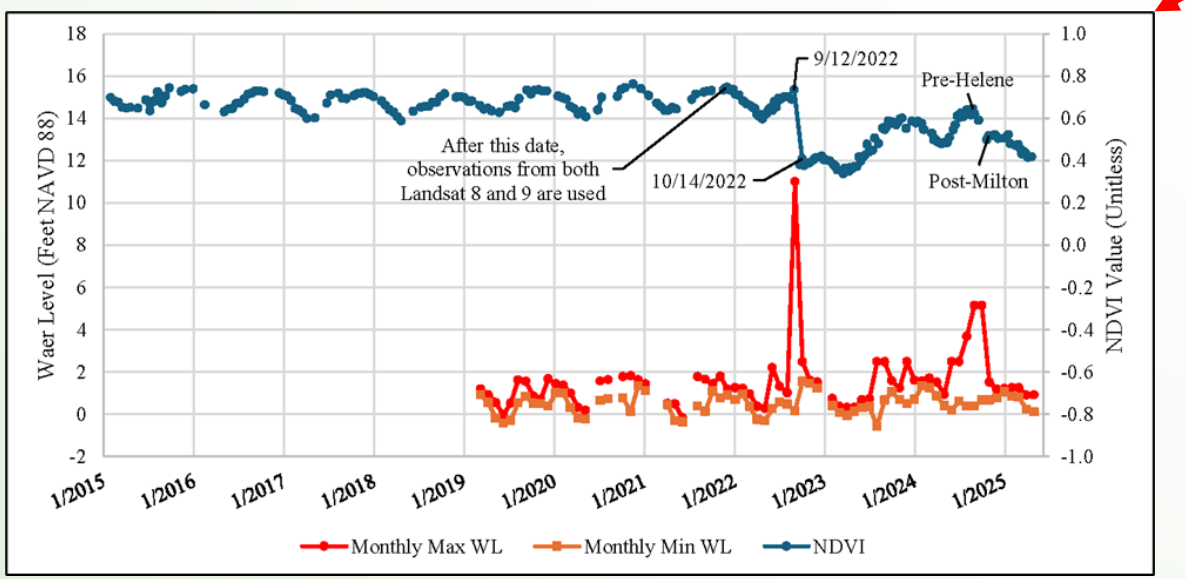


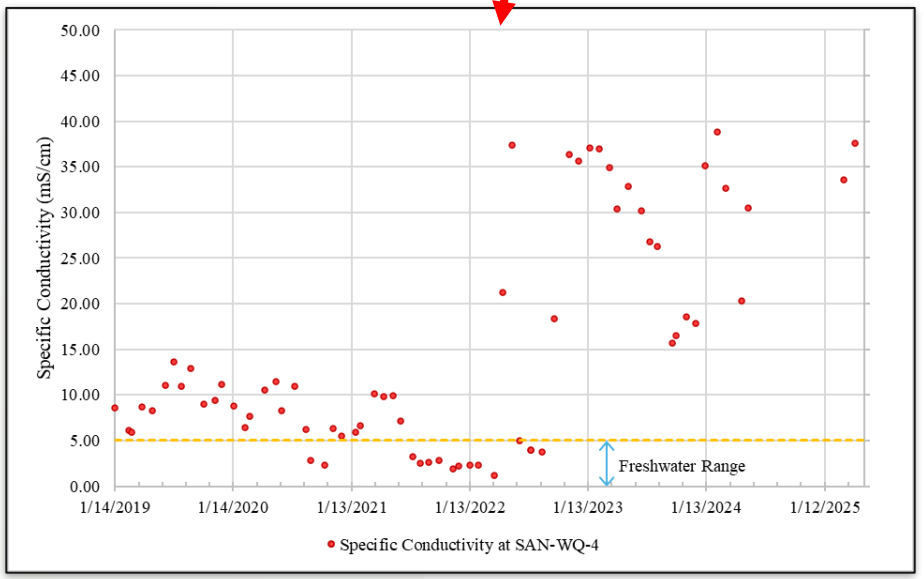
NDVI Method and Findings

4. Data Collection & Review – Method and Findings

- *Used Landsat 8 and Landsat 9 surface reflectance products to calculate average NDVI for the interior basins over time.*
- *Results:*
  - *Significant drop in NDVI post-Ian (2022)*
  - *Progress towards vegetative recovery until 2024 hurricanes*
- *This drop was likely caused by stress due to extreme wind, wave action, and increased salinity.*



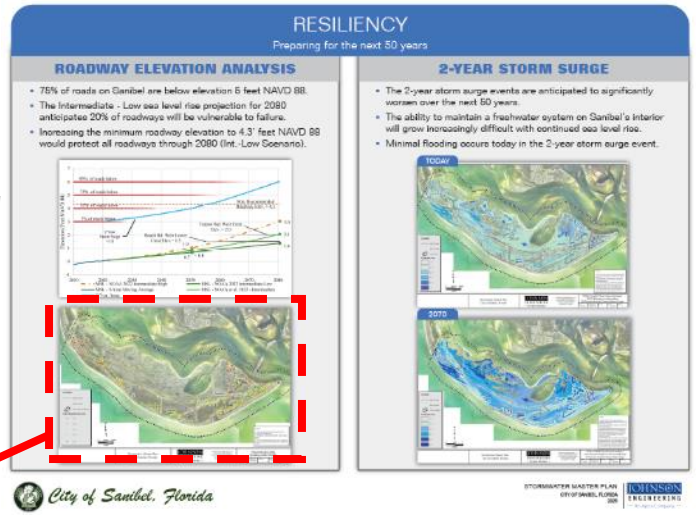


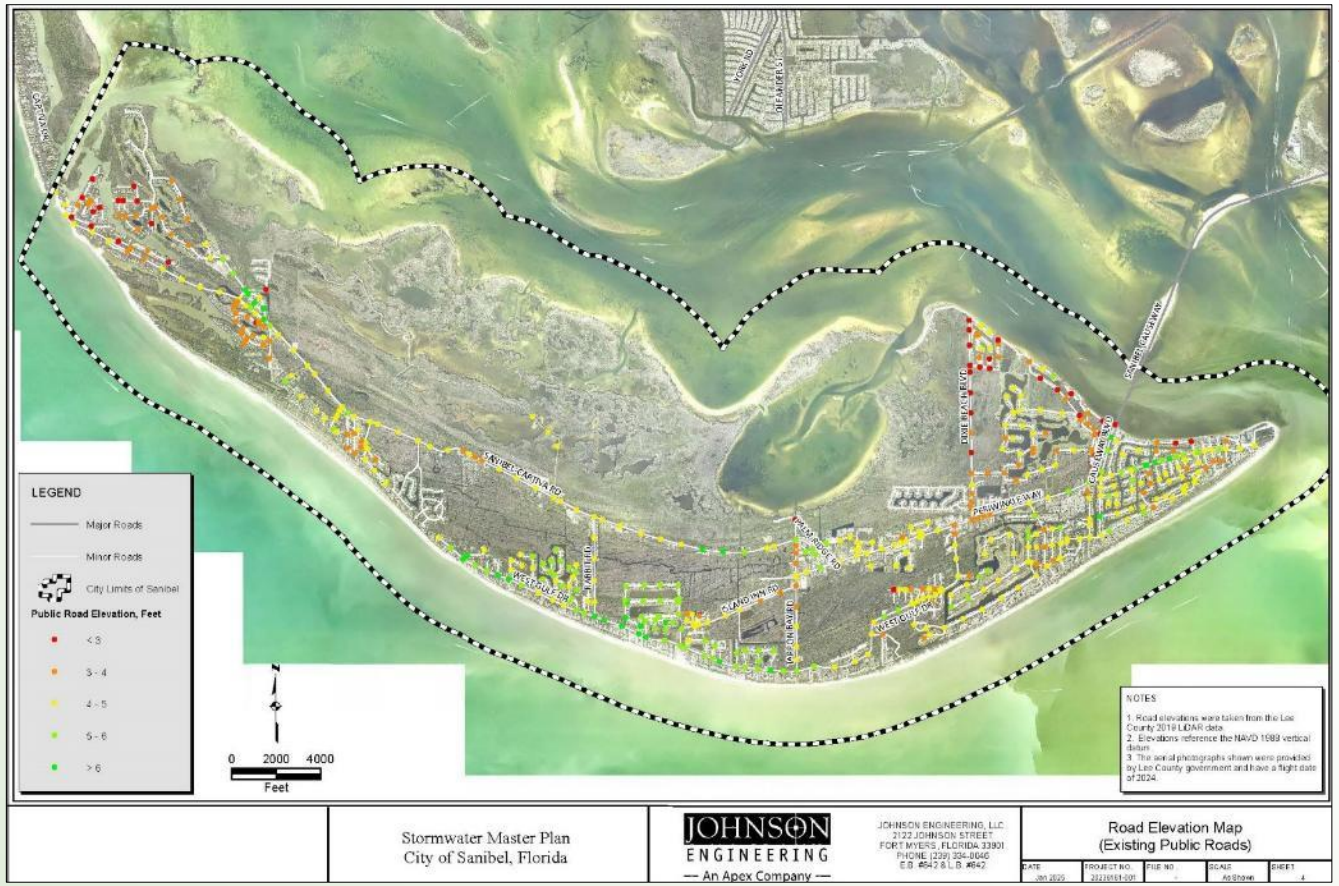


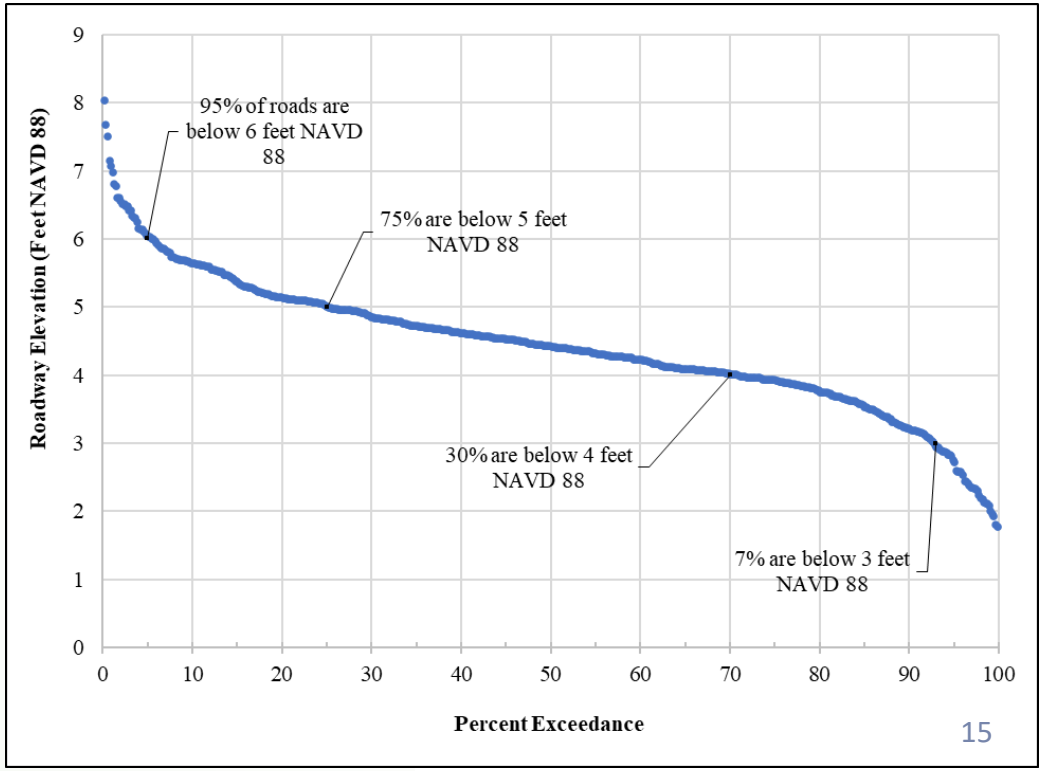
Roadway Elevation Analysis

5. Resiliency – Roadway Elevation Analysis

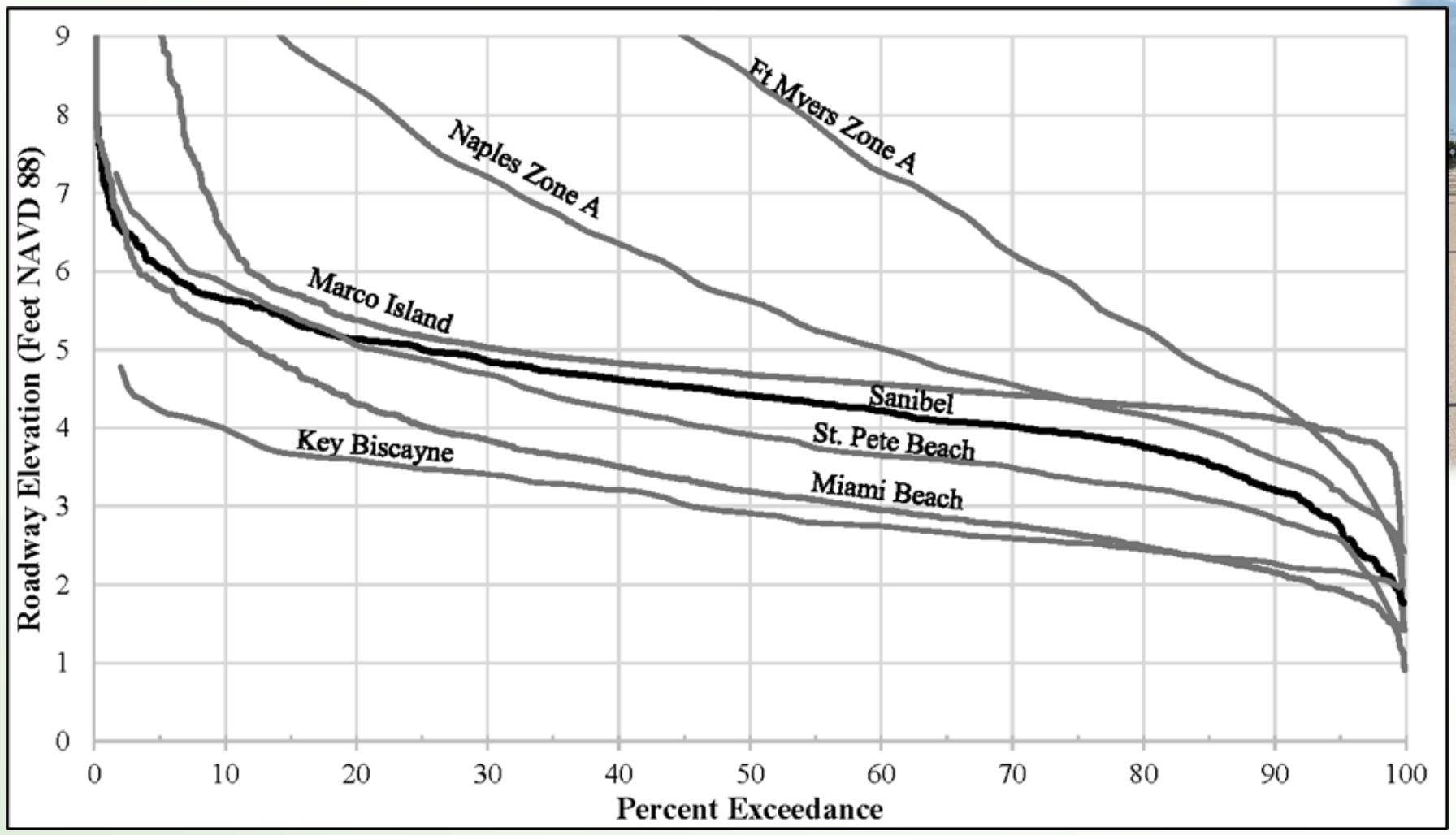
- *75% of roads on Sanibel are below elevation 5 feet NAVD 88.*





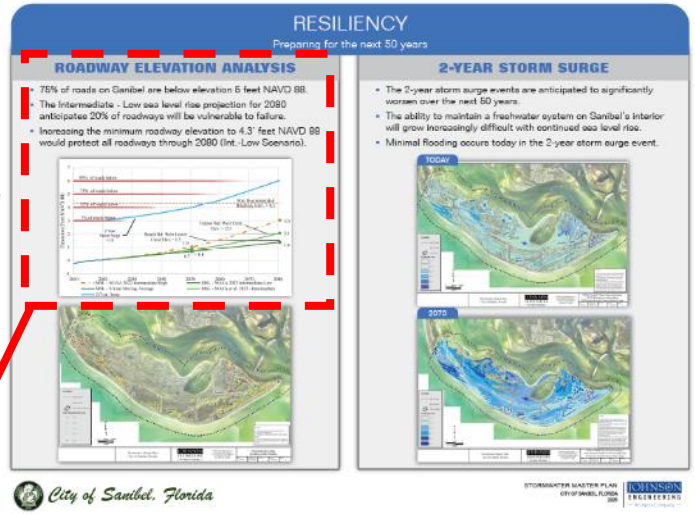


Roadway Elevation Comparison



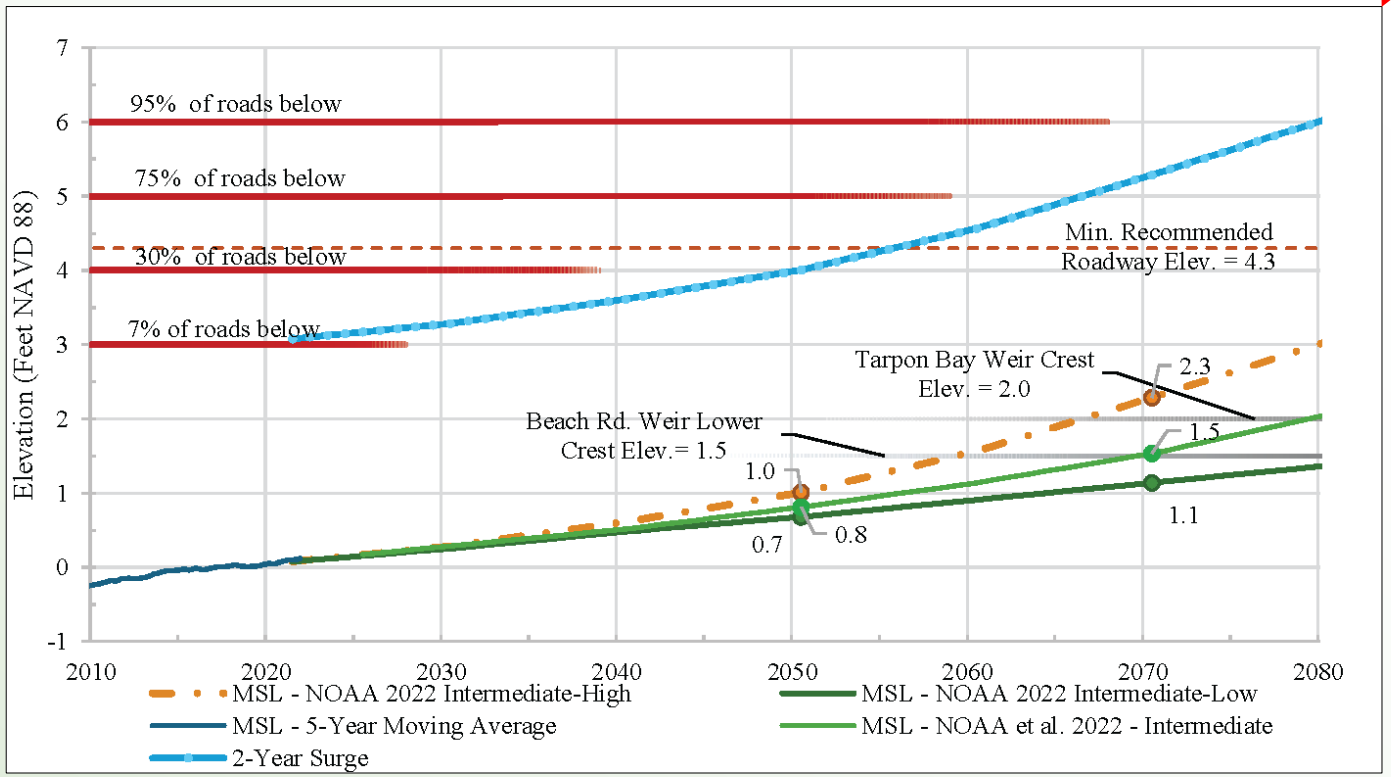
Collier County Road 92
to Marco Island

Roadway Elevation and Sea Level Rise



5. Resiliency – Roadway Elevation and SLR

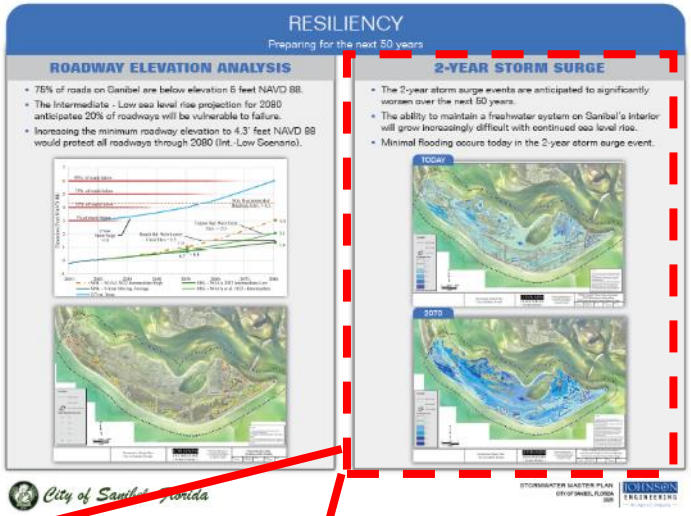
- *The Intermediate - Low sea level rise projection for 2080 anticipates 20% of roadways will be vulnerable.*
- *Increasing the minimum roadway elevation to 4.3' feet NAVD 88 would protect all roadways through 2080 (Int.-Low Scenario).*



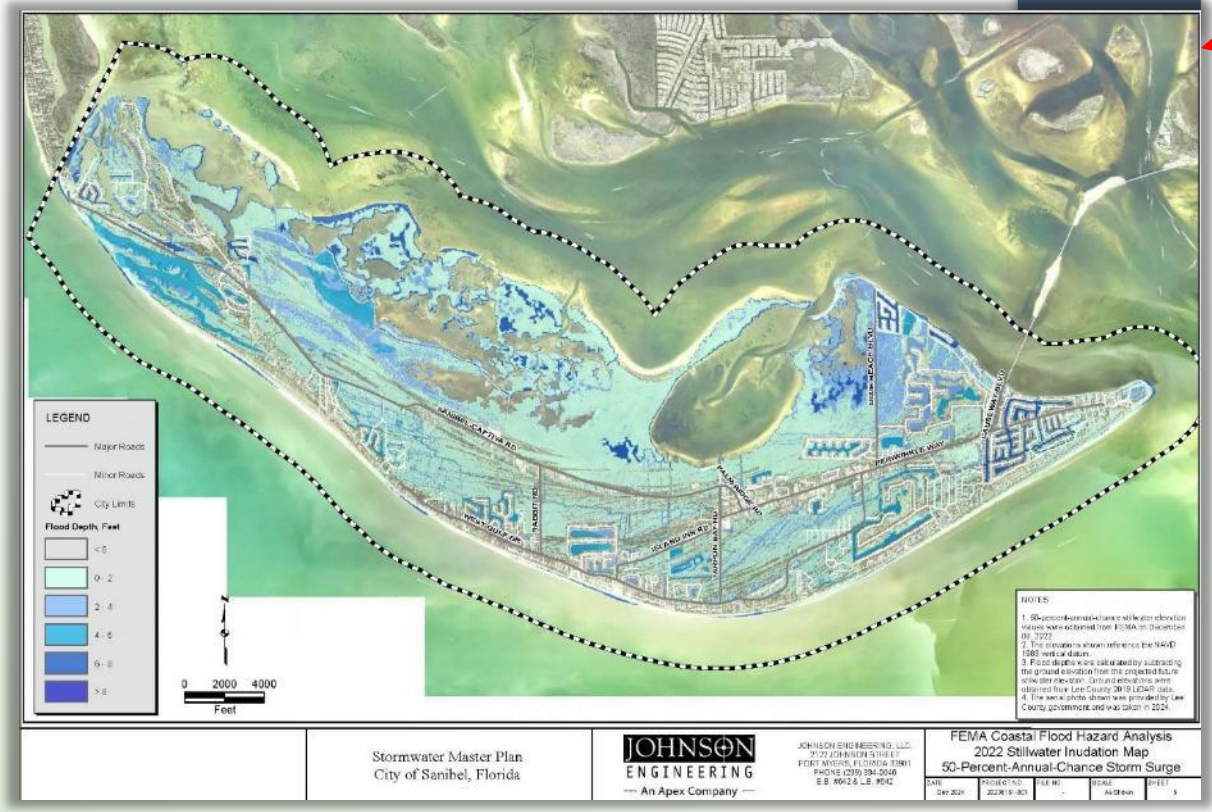
2-Year Storm Surge Event

5. Resiliency – 2-Year Storm Surge

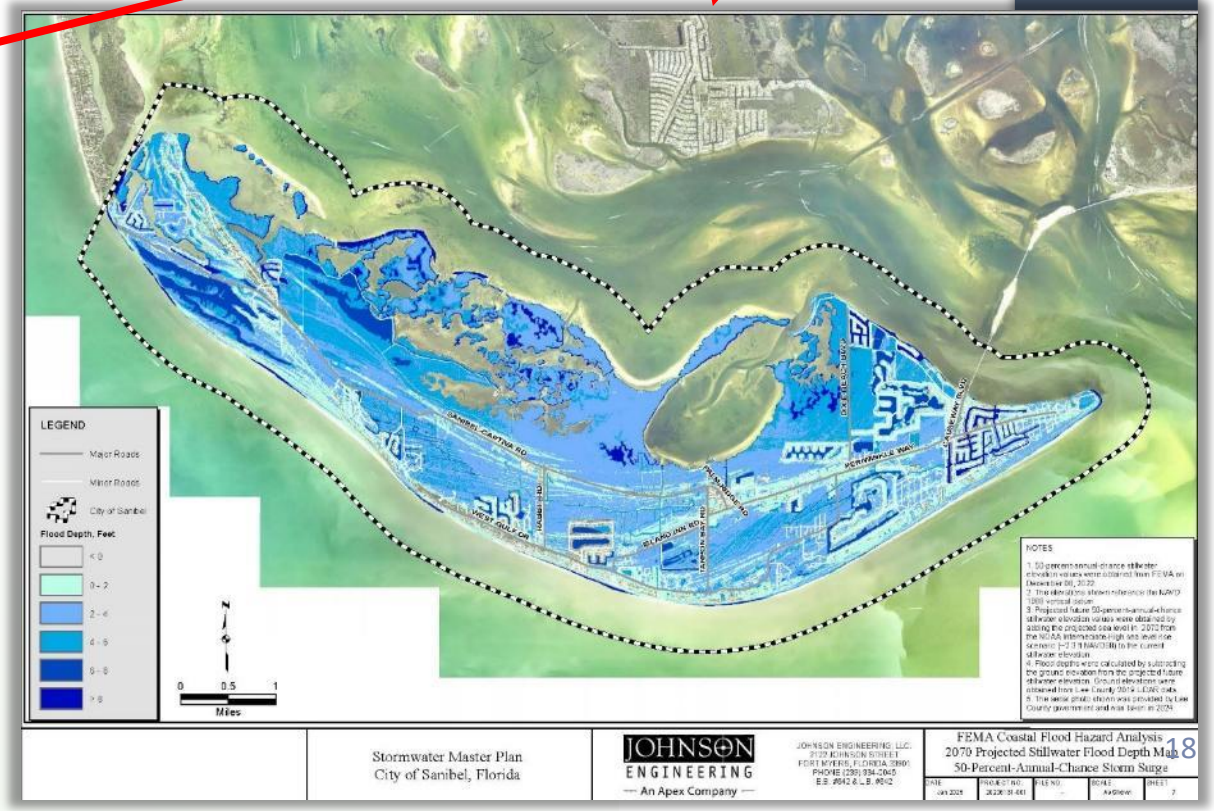
- *Minimal flooding today in the 2-year surge event.*
- *Impacts of storm surge are anticipated to worsen.*



TODAY



2070



2-Year Storm Surge Event

5. Resiliency – Weir Operations and Stormwater Management
    - *Maintaining freshwater wetlands becomes increasingly difficult.*
    - *Changes to Weir Gate Policy*
    - *Pumping During Recovery*

Questions and Comments