WILDWOOD CREST

FLOOD MITIGATION AND STORM SEWER MASTER PLAN

May 2019

Presented By:

DeBlasio & Associates
CONSULTING ENGINEERS AND PLANNERS

Introduction

The Borough of Wildwood Crest is located on the Atlantic Ocean coastline and back bay intercoastal waterway in Cape May County, New Jersey. The Borough is comprised of approximately 1.31 square miles of barrier beach island and is geographically surrounded by the bay and ocean waters. Each year the Borough is presented with a constant threat to this community from sea level rise, coastal flooding, Nor'easters and tropical-borne storm activity, introducing severe wave and flood impacts.

The Borough of Wildwood Crest has been historically subject to flooding, beach accretion/erosion and many other associated problems that require an aggressive approach to successfully manage infrastructure maintenance and flood damage mitigation. The Borough has developed a varied approach to protect and maintain its infrastructure, natural areas, public safety, welfare, and property of its residents, and continues to improve annually with the implementation of improvements, new technologies and with assistance from outside public and private agencies. The Borough will continue to pursue and improve upon methods to educate its residents, protect its coastline, manage its infrastructure and natural areas, and mitigate the efforts from flood damage and natural disasters. This Flood Mitigation and Storm Sewer Master Plan (FMSSMP) demonstrates the Borough's continued commitment to these goals.

The implementation of the FMSSMP has been an ongoing activity and components of the plan include storm sewer infrastructure improvements, participation in the Community Rating System (CRS), Repetitive Loss Reduction Plan, Beach Maintenance Plan and other specific Borough projects.

➢ This FMSSMP was developed for the purpose of:

- Educating the Borough, public and private property owners of the existing flooding challenges facing the Borough.
- Establishing recommendations to mitigate the adverse impact of flooding and other coastal hazards that affect the Borough.
- Providing flood mitigation infrastructure options to guide the Borough when considering capital improvements.
- Complying with the Federal Emergency Management Agency (FEMA) Community Rating System (CRS) Program with the potential of enhancing that status.
- Participate and coordinate flood mitigation efforts with Federal, State, County and local entities.

➢ Existing Conditions

1. Topography
2. Storm Sewer Infrastructure
3. Drainage Areas
4. Coastal Tidal Data and Sea Level Rise
5. Bulkhead and Land Berm
6. FEMA Community Rating System (CRS)

1. Topography

Existing topographical maps have been developed to analyze the water flow paths throughout the Borough of Wildwood Crest. A topographic map is characterized by a detailed representation of the elevations of an area. This is generally created using contour lines that connect places of equal elevation. The closer together the contour lines, the steeper the terrain.

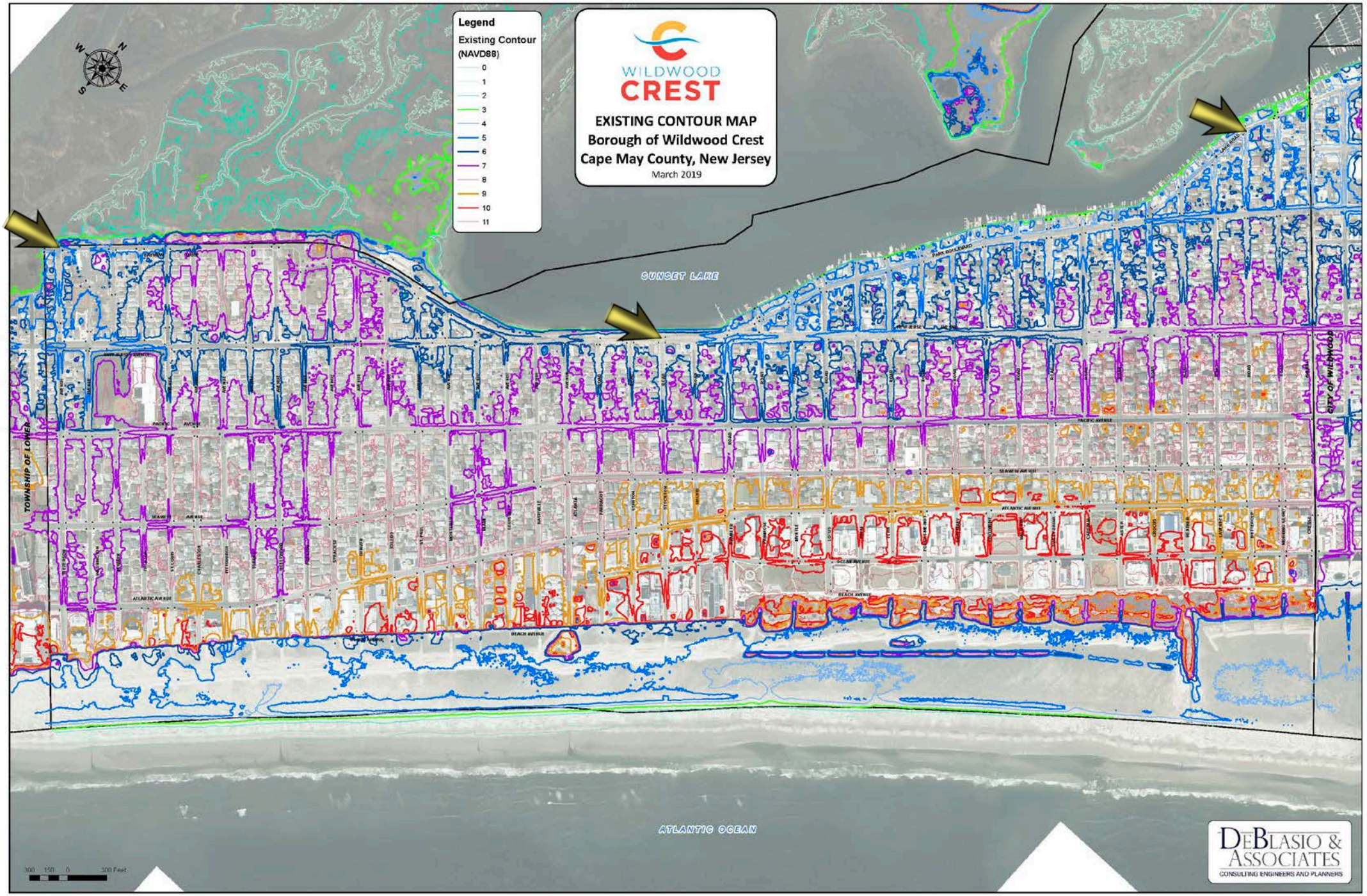
Maps for Borough of Wildwood Crest were developed through multiple sources. A main source for the topographic maps comes from the South New Jersey County LiDAR project. The project was created to provide LiDAR and elevation data for USGS and the New Jersey Department of Environmental Protection (NJDEP). Light Detection and Ranging (LiDAR) is used to create surface models and is a surveying method that can measure the distance to the surface by emitting a pulsed laser light and measuring the reflected pulses with a sensor. High accuracy data has been produced in ArcGrid format to cover approximately 874 square miles of South New Jersey. The area includes Cape May, Cumberland, and part of Salem county.

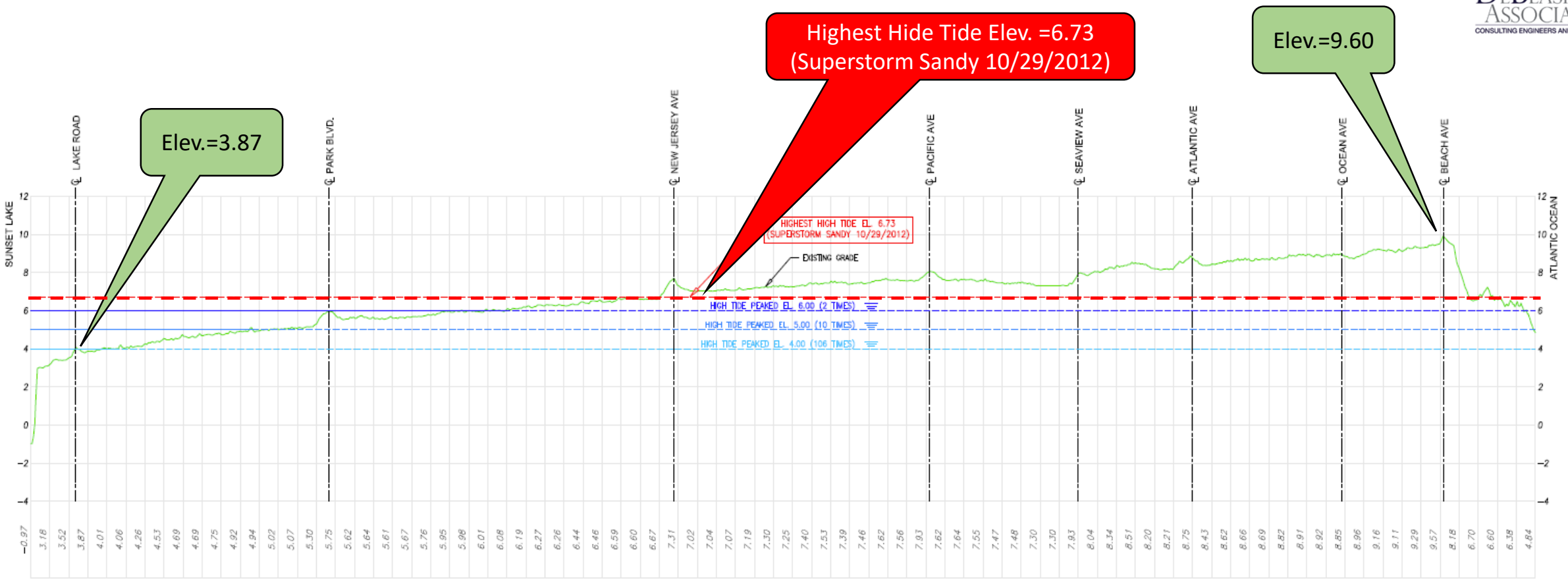
As seen on the Existing Contour Map, areas along the bayfront are lower than the properties along the ocean front. The stormwater generally travels from the oceanfront towards the bayfront until it reaches a natural or manmade barrier. Along the bay side, elevations generally range from four (4) to seven (7) feet and along the ocean side elevations generally range from eight (8) to eleven (11) feet in the NAVD 1988 datum. The highest area of the Borough is located along the ocean side between Rambler Road and Cresse Avenue, and the lowest areas of the Borough include the bay side between Trenton Avenue and Jefferson Avenue and the bay side between Rambler Road and Cresse Avenue along Park Boulevard.

The existing Contour Map was transected at Jefferson Avenue, Stockton Road and Buttercup Road to create the Existing Profile Map. The Existing Profile Map “slices” the Borough at the three (3) locations and relates the tidal elevation and inundation frequency across the profile.

Once these maps were developed, it created a way to determine stormwater flow patterns along the surface of the Borough. Low areas can be clearly seen and prioritized in storm water management programs.

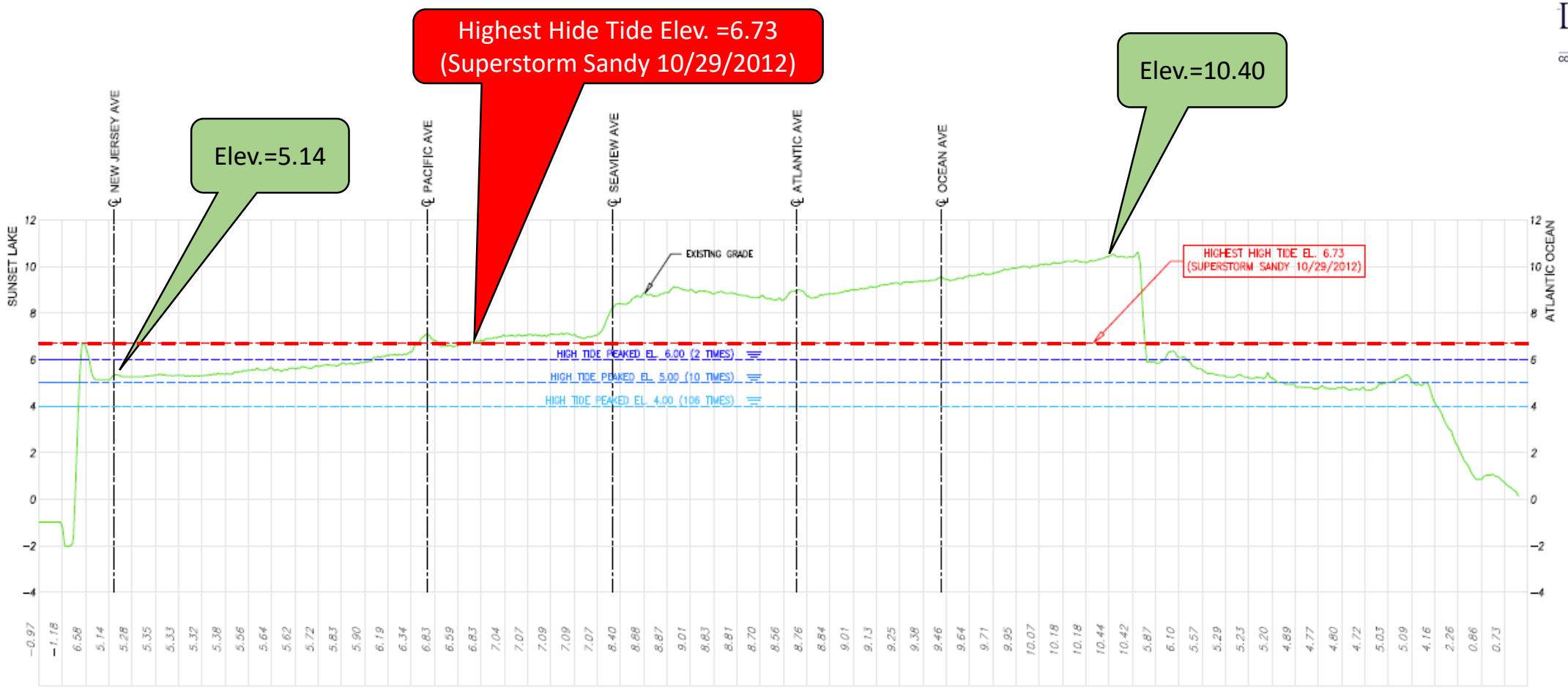
The flow path of stormwater becomes important when developing drainage areas and stormwater management infrastructure. The topographical maps clearly show the boundaries of the existing drainage areas and can be used to track where the water flows. After the drainage areas are developed it aids designers in stormwater management infrastructure. The size of drainage areas will determine the size and location of the infrastructure.


Legend
Existing Contour
(NAVD88)
0
1
2
3
4
5
6
7
8
9
10
11
WILDWOOD
CREST
EXISTING CONTOUR MAP
Borough of Wildwood Crest
Cape May County, New Jersey
March 2019
SUNSET LAKE
ATLANTIC OCEAN
TOWNSHIP OF LOWER
CITY OF WILDWOOD
DEBLASIO & ASSOCIATES
CONSULTING ENGINEERS AND PLANNERS



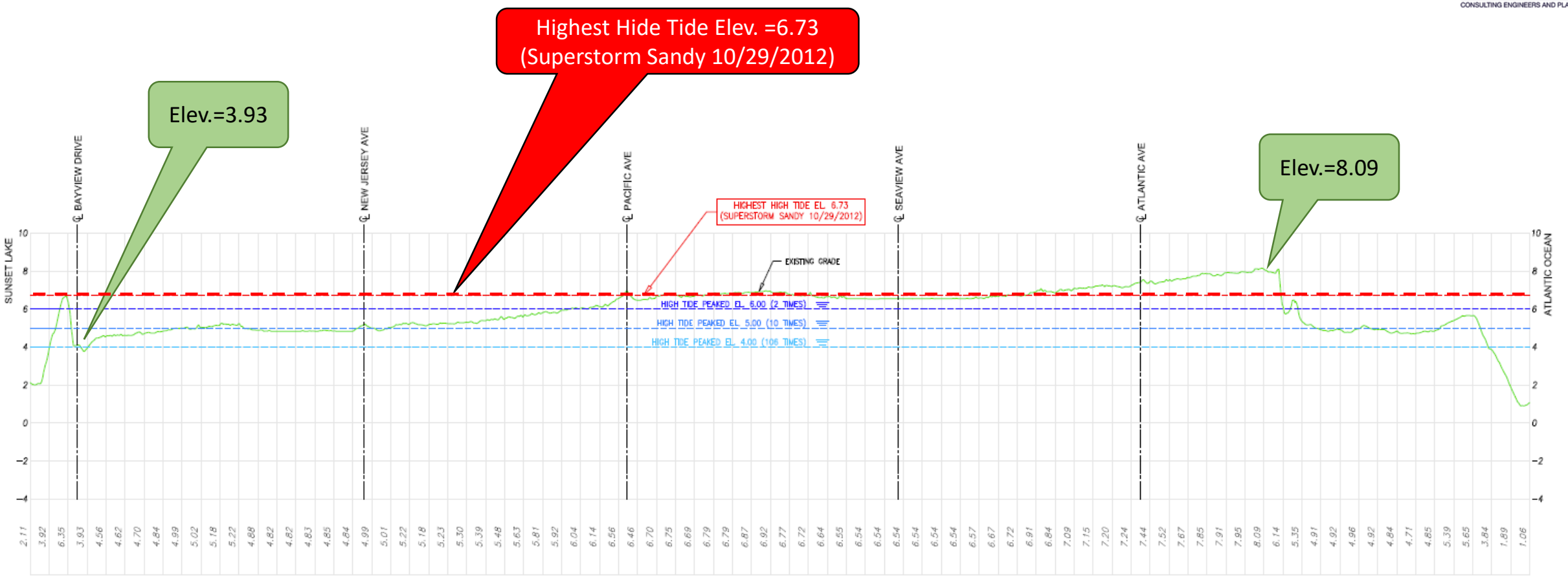
PROFILE - BUTTERCUP ROAD

NOT TO SCALE



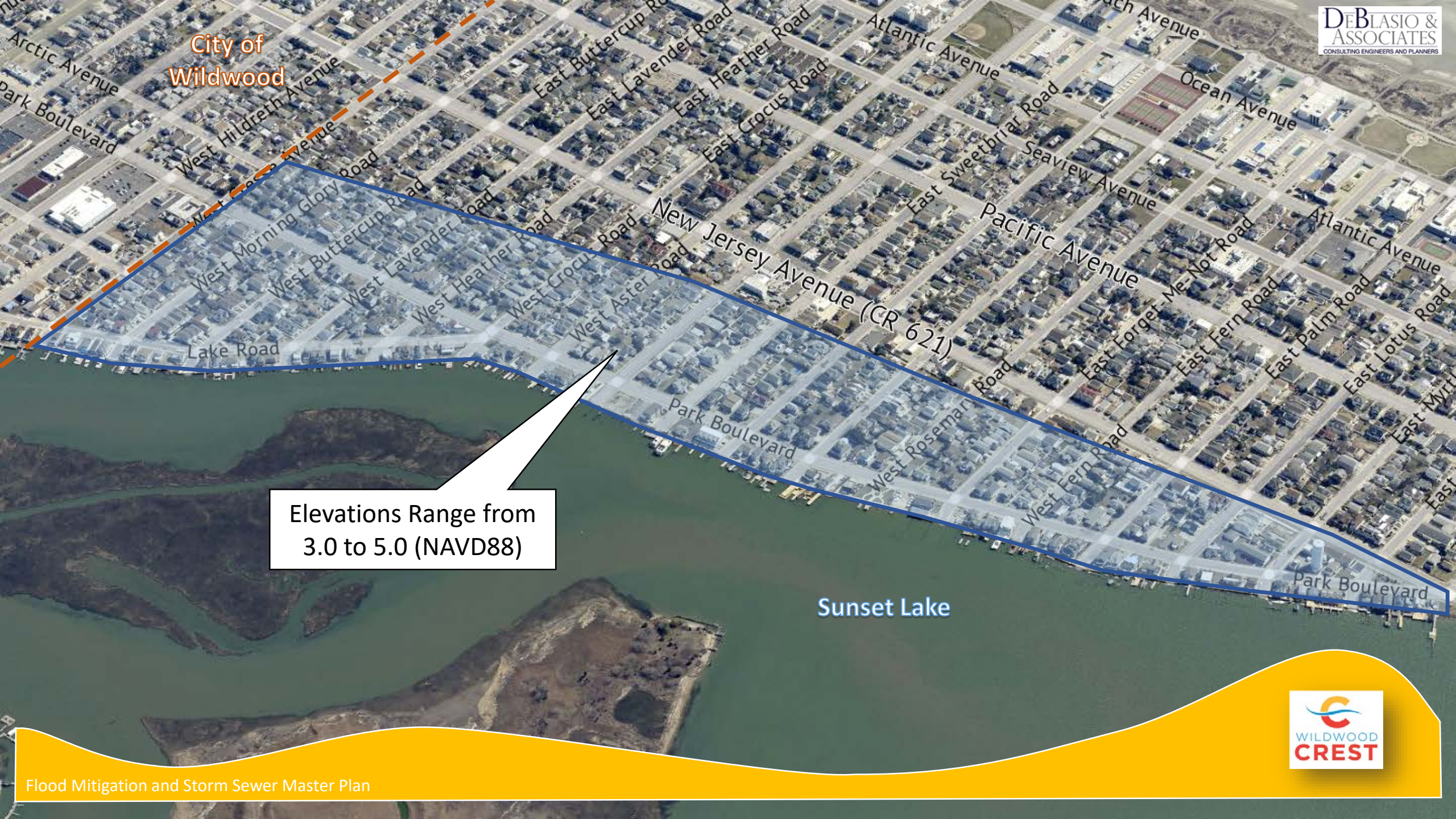
PROFILE - STOCKTON ROAD

NOT TO SCALE



PROFILE - JEFFERSON AVENUE

NOT TO SCALE


City of Wildwood
Arctic Avenue
Park Boulevard
West Hildreth Avenue
East Buttercup Road
East Lavender Road
East Heather Road
East Crocus Road
Atlantic Avenue
Ocean Avenue
East Sweetbriar Road
Seaview Avenue
Pacific Avenue
New Jersey Avenue (CR 621)
West Morning Glory Road
West Buttercup Road
West Lavender Road
West Heather Road
West Crocus Road
West Aster Road
Lake Road
Park Boulevard
West Rosemary Road
West Fern Road
East Forget-Me-Not Road
East Fern Road
East Palm Road
East Lotus Road
Atlantic Avenue
Park Boulevard
Sunset Lake
Elevations Range from 3.0 to 5.0 (NAVD88)


Elevations Range from
3.0 to 5.0 (NAVD88)
Township of
Lower
Pacific Avenue (CR 621)
East Toledo Avenue
East Denver Avenue
East Syracuse Avenue
East Preston Avenue
East Hollywood Avenue
East Topeka Avenue
East Pittsburgh Avenue
Seaview Avenue
East St Louis Avenue
East Trenton Avenue
East Newark Avenue
East Washington Avenue
East Jefferson Avenue
East Richmond Avenue
East Rochester Avenue
Memphis Avenue
West Toledo Avenue
West Denver Avenue
West Syracuse Avenue
West Preston Avenue
West Hollywood Avenue
West Topeka Avenue
West Pittsburgh Avenue
West Charleston Avenue
West Saint Louis Avenue
West Trenton Avenue
West Newark Avenue
West Washington Avenue
West Jefferson Avenue
Bayview Drive
Park Boulevard

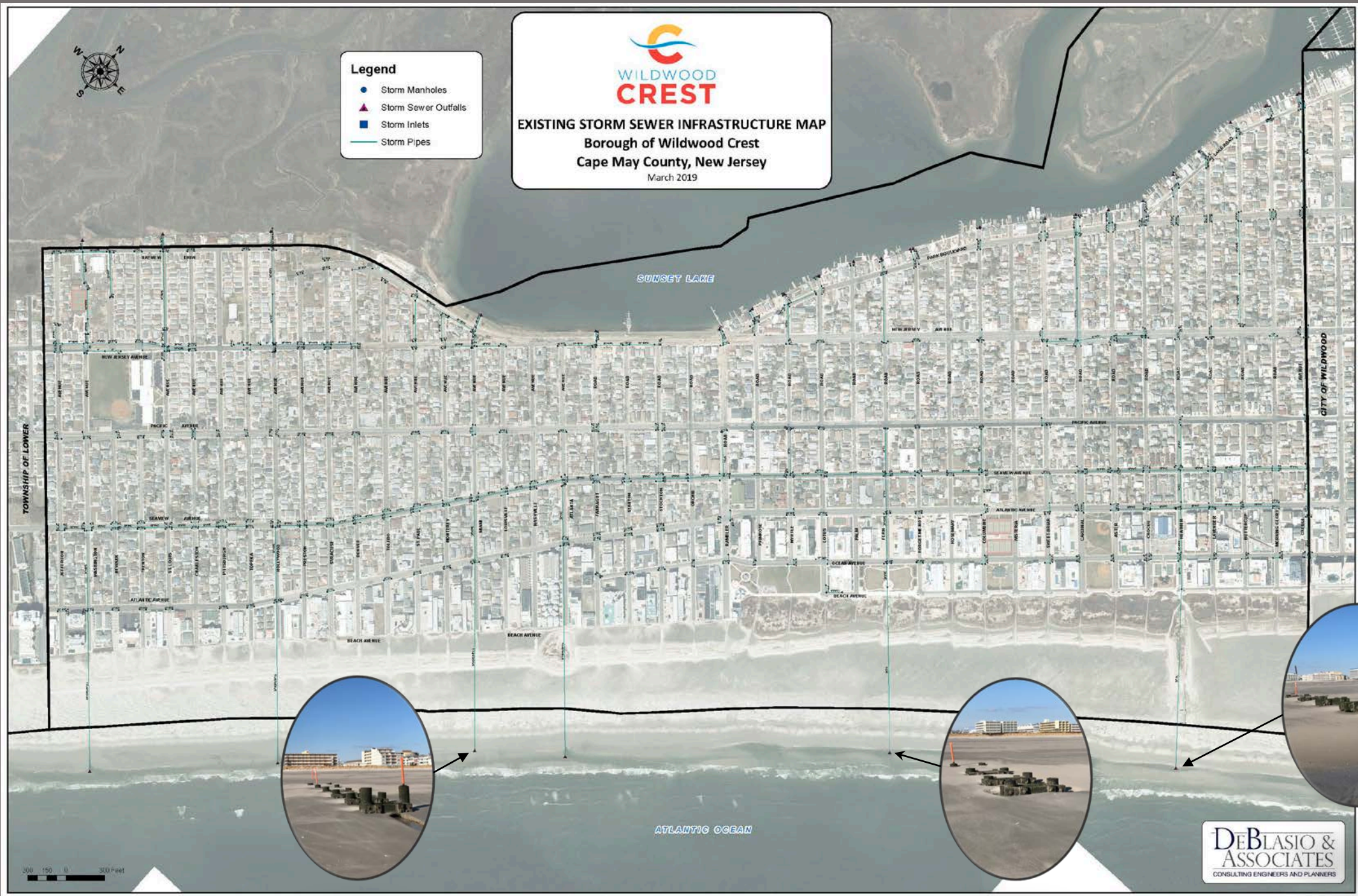
2. Storm Sewer Infrastructure

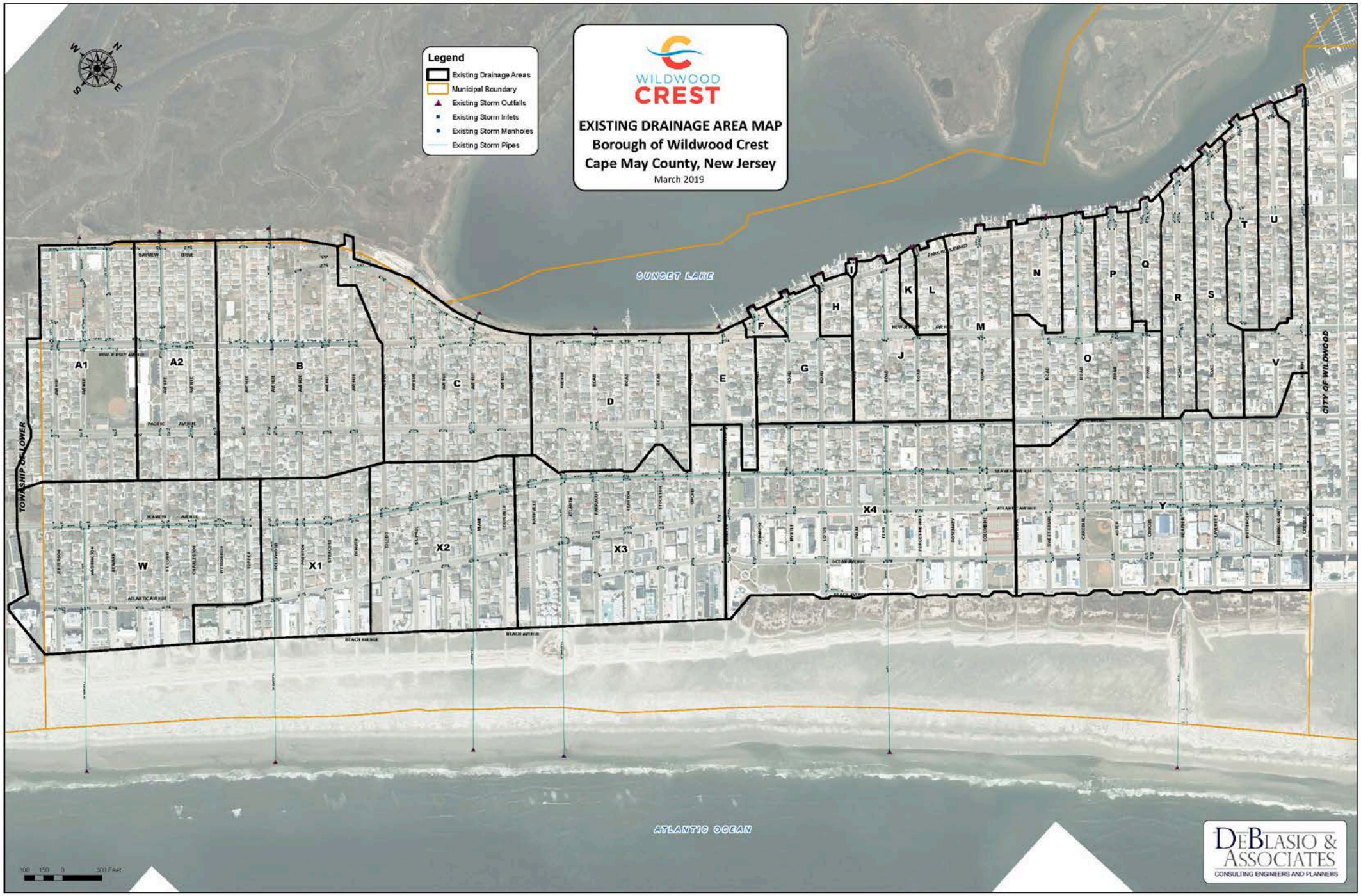
- The Borough of Wildwood Crest storm sewer infrastructure is designed to remove excess rain water from impervious surfaces such as paved streets, parking lots, sidewalks, and roofs. The subcomponents of the system vary in size and complexity and is solely a gravity sewer system that carries excess untreated water to surrounding bodies of water.

- The Borough's storm sewer infrastructure includes approximately:
  - 634 Storm Inlets
  - 126 Storm Manholes
  - 31 Storm Sewer Outfalls. The outfalls include 6 along the ocean front and 25 bay side outfalls.

- The Borough's storm sewer infrastructure is solely of gravity system and includes the following components:
  - Existing roadway gutters to transport water above ground from one intersection to another until an inlet is reached and then transported to an outfall.
  - "Bubbler" systems that utilize inlets to temporarily hold storm water until the water "bubbles up" from the lower inlet and is transported along the surface to the lower side of the intersection and eventually to an outfall.
  - Inlets with connecting storm sewer pipes that hold and transport water to existing outfalls.
  - All current storm sewer systems are gravity driven and utilize hydraulic gradients to transport water from the surface to existing outfalls.

- As tide levels increase, bay water begins to surcharge through the storm inlets and create nuisance flooding at low points. Some of the bayside outfalls lack valves or are not provided with proper valves to control tidewater. When high tide coincides with rain events, major flooding can occur.


Legend
Storm Manholes
Storm Sewer Outfalls
Storm Inlets
Storm Pipes
WILDWOOD CREST
EXISTING STORM SEWER INFRASTRUCTURE MAP
Borough of Wildwood Crest
Cape May County, New Jersey
March 2019
SUNSET LAKE
TOWNSHIP OF LOWER
CITY OF WILDWOOD
ATLANTIC OCEAN
DEBLASIO & ASSOCIATES
CONSULTING ENGINEERS AND PLANNERS


Legend
Existing Drainage Areas
Municipal Boundary
Existing Storm Outfalls
Existing Storm Inlets
Existing Storm Manholes
Existing Storm Pipes
WILDWOOD CREST
EXISTING DRAINAGE AREA MAP
Borough of Wildwood Crest
Cape May County, New Jersey
March 2019
SUNSET LAKE
ATLANTIC OCEAN
TOWNSHIP OF LOWER
CITY OF WILDWOOD
A1
A2
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X1
X2
X3
X4
Y
DeBLASIO & ASSOCIATES
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4. Coastal Tidal Data and Sea Level Rise

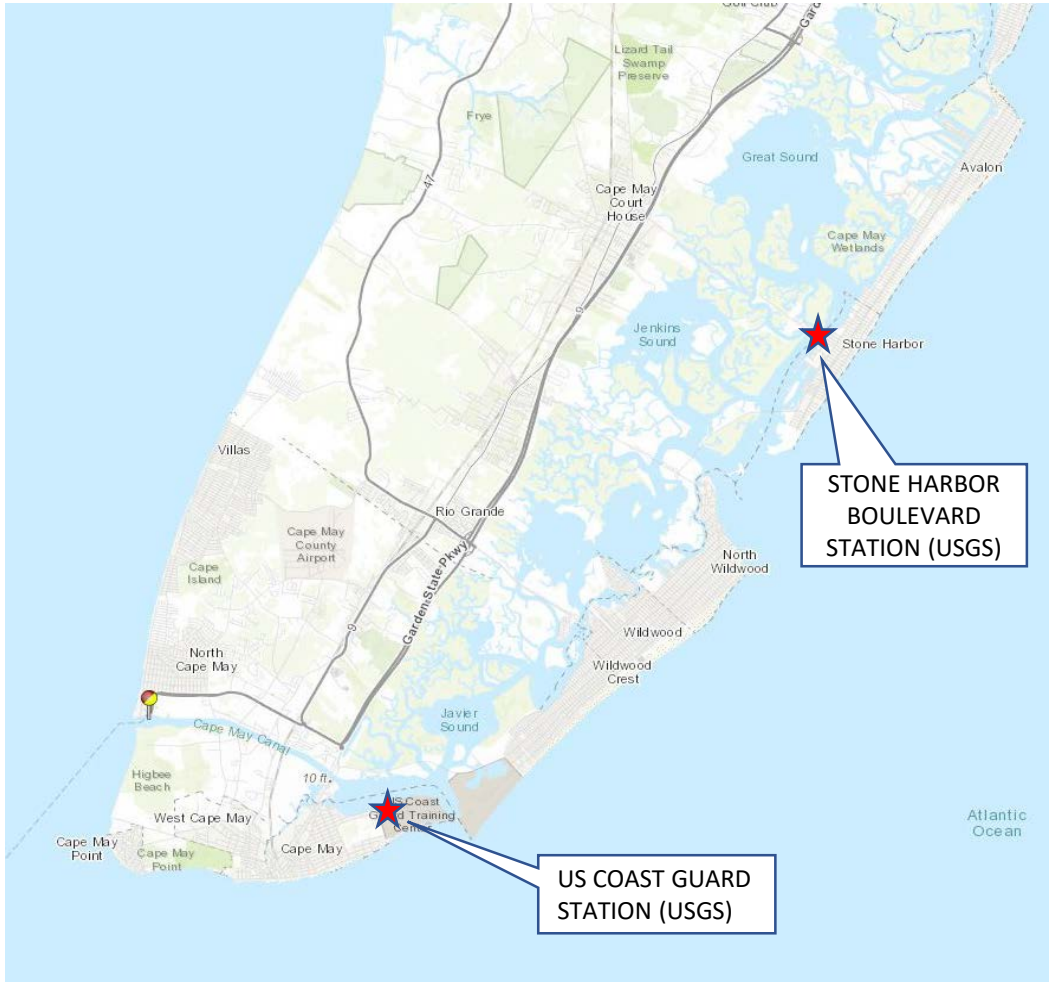
The Borough of Wildwood Crest experiences semidiurnal tides, two high tides and two low tides per lunar day with one high tide typically higher than the other. The United State Geological Survey (USGS) is responsible for tidal data collection in the back bays of New Jersey. After looking at the Tide Gage Station locations, the closest back bay station to the Borough of Wildwood Crest can be found on Stone Harbor Boulevard in Stone Harbor and the closest intercoastal U.S. Coast Guard Station in Cape May and shown on the attached map. The datum for the gages is at 0.00 feet based on NAVD of 1988 and the data was collected and reviewed from early 2000 to late 2018 for a total of 6,619 observations. Here is a table of the number of days with tides above elevations:

US Coast Guard Station	Total # of Occurrences	Average # of Occurrences/Year
Above 2 feet	4391	244
Above 3 feet	1020	57
Above 4 feet	64	3.6
Above 5 feet	4	0.3
Above 6 feet	1	0.1
Above 7 feet	0	0

Stone Harbor Boulevard Station	Total # of Occurrences	Average # of Occurrences/Year
Above 2 feet	4760	265
Above 3 feet	1036	58
Above 4 feet	106	5.9
Above 5 feet	10	0.6
Above 6 feet	2	0.2
Above 7 feet	0	0

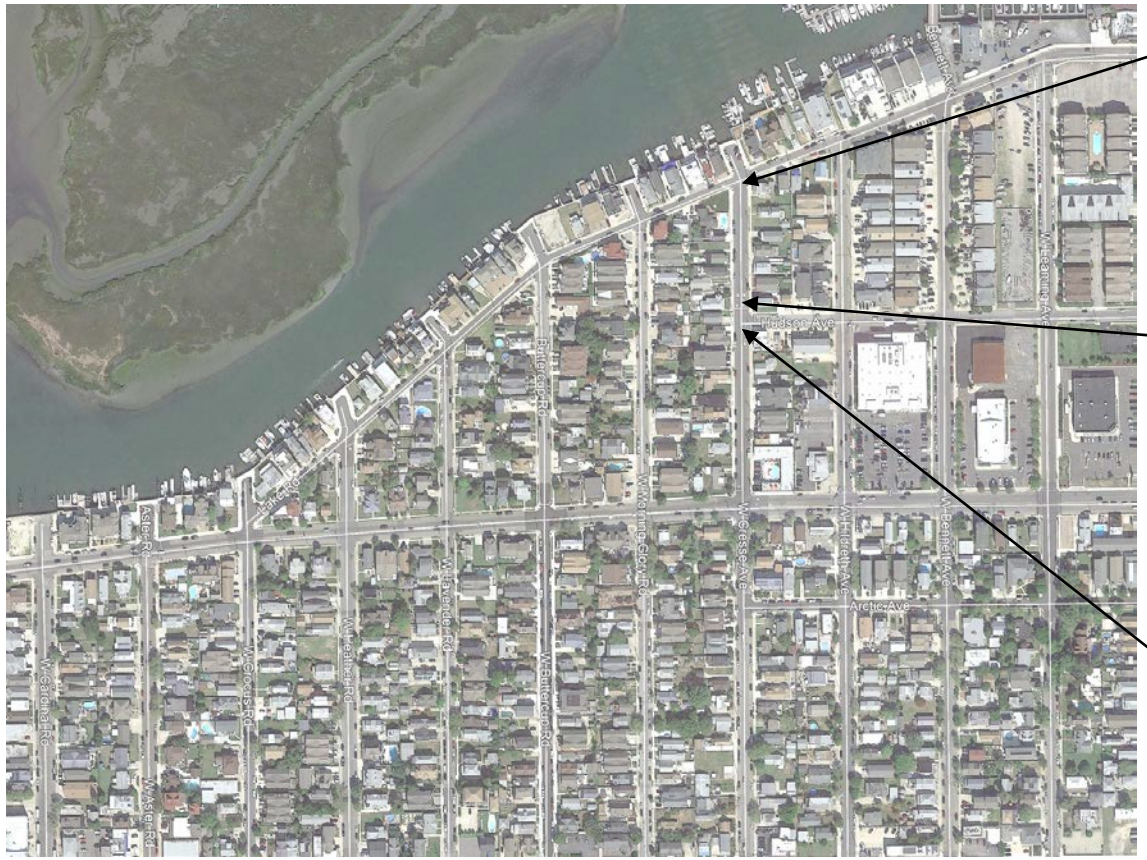
The maximum tide during this time period for the gage on Stone Harbor Boulevard was 6.73 feet on October 29, 2012 during Hurricane Sandy and the maximum for the gage at the U.S. Coast Guard Station was 6.47 feet on January 23, 2016 during Winter Storm Jonas. Below is a table of the top six tide elevations for the two stations.

Date	Storm Name	Stone Harbor Station	Cape May Station
10/27/2018	Nor'easter	5.27	5.01
1/23/2016	Winter Storm Jonas	6.22	6.47
10/29/2012	Superstorm Sandy	6.73	5.90
8/27/2011	Hurricane Irene	5.30	5.15
11/13/2009	Hurricane Ida	5.44	4.74
2/17/2003	Presidents' Day Storm II	5.37	4.48



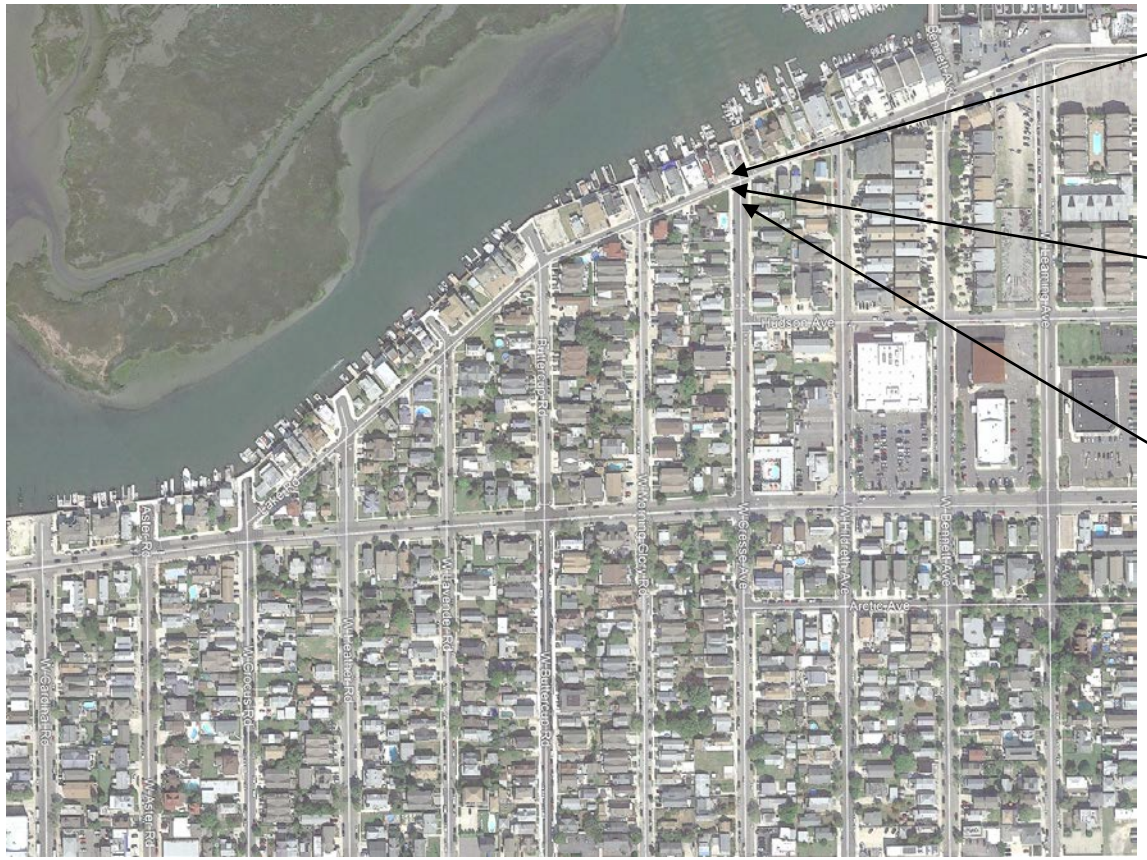
Coastal Tidal Data and Sea Level Rise

As sea level continues to rise, flooding through the Borough becomes more frequent and severe. On April 16, 2018 photographs were taken along Cresse Avenue. The west side of Cresse Avenue has an elevation 3 near the bayfront. On April 16, 2018 the high tide reached 3.75 feet in addition to 1.58 inches of rainfall. Below displays the combination of stormwater flooding and tidal flooding on Cresse Avenue:



Coastal Tidal Data and Sea Level Rise

On March 4, 2019 photographs were taken along Lake Road. The elevation along Lake Road is between 3 and 4 feet NAVD88. On this date, the high tide reached 3.44 feet with rainfall the previous day. Below displays the flooding that occurred:



NOAA Technical Report NOS CO-OPS 073

Sea Level Rise and Nuisance Flood Frequency Changes around the United States

City Dock in Annapolis, Maryland. Photo Credit: Amy McGovern.

Silver Spring, Maryland

June 2014

noaa National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF COMMERCE
National Ocean Service
Center for Operational Oceanographic Products and Services

EXECUTIVE SUMMARY

The National Oceanic and Atmospheric Administration (NOAA) water level (tide) gauges have been measuring water levels around the U.S. for over a century, providing clear evidence of sea level rise relative to land (SLR_{rel}) around most of the continental United States and Hawaii. As SLR_{rel} increases mean sea level (MSL), there is naturally an increase in tidal datum elevations, which are typically used to delineate inundation thresholds. Direct consequences of rising sea level against fixed elevations such as *today's* built infrastructure also include increased inundation during extreme events both spatially and temporally. Not only are extreme flooding events reaching higher grounds and covering larger areas due to SLR_{rel}, the frequency and duration of these extreme flood events are increasing.

Another consequence of SLR_{rel} is the increase in *lesser extremes* such as occasional minor coastal flooding experienced during high tide. These events are becoming more noticeable and widespread along many U.S. coastal regions and are *today* becoming more of a *nuisance*. As sea levels continue to rise and with an anticipated acceleration in the rate of rise from ocean warming and land-ice melt, concern exists as to when more substantive impacts from tidal flooding of greater frequency and duration will regularly occur. Information quantifying these occurrences to inform mitigation and adaptation efforts and decision makers is not widely available.

In this report, we show that water level exceedances above the elevation threshold for "minor" coastal flooding (nuisance level) impacts established locally by the National Weather Service (NWS) have been increasing in time. More importantly, we document that event frequencies are accelerating at many U.S. East and Gulf Coast gauges, and many other locations will soon follow regardless of whether there is an acceleration of SLR_{rel}. Lastly, we show a regional pattern of increasingly greater event-rate acceleration as the height between MSL and a location's nuisance flood threshold elevation decreases.

Impacts from recurrent coastal flooding include overwhelmed stormwater drainage capacity, frequent road closures, and general deterioration and corrosion of infrastructure not designed to withstand frequent inundation or salt-water exposure. From this, we conclude that there is a time horizon, largely dependent upon the local rate of SLR_{rel}, when critical elevation thresholds for various public/private/commercial serving systems will become increasingly compromised by tidal flooding. This concept of a non-linear impact trajectory needs to recognized, as it is critical for coastal planning to prevent degradation to society-serving systems at risk from SLR_{rel}. The goal of this report is to heighten awareness of a growing problem of more frequent nuisance coastal flooding respective to a community's living memory and to encourage resiliency efforts in response to impacts from SLR_{rel}.


LEGEND
Municipal Boundary
Elevations:
NAVD88 Datum
< 0'
0' - 4.0'
> 4.0'
WILDWOOD CREST
MAP OF AREAS BELOW ELEV. 4.0 FT
Borough of Wildwood Crest
Cape May County, New Jersey
March 2019
SUNSET LAKE
ATLANTIC OCEAN
TOWNSHIP OF LOWER
CITY OF WILDWOOD
PACIFIC AVENUE
ATLANTIC AVENUE
BEACH AVENUE
NEW JERSEY AVENUE
SEAVIEW AVENUE
OCEAN AVENUE
PARK BOULEVARD
300 150 0 300 Feet
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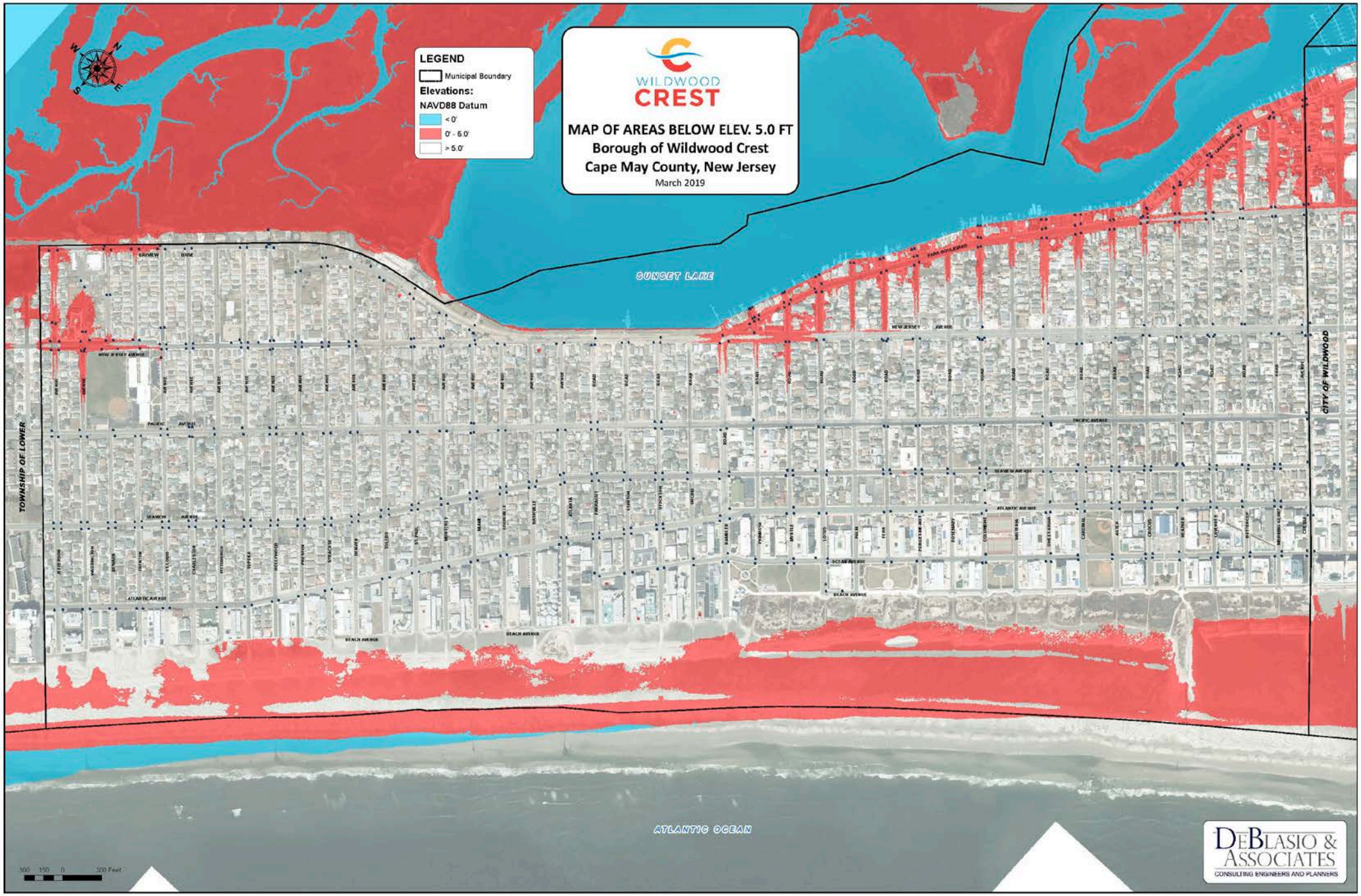
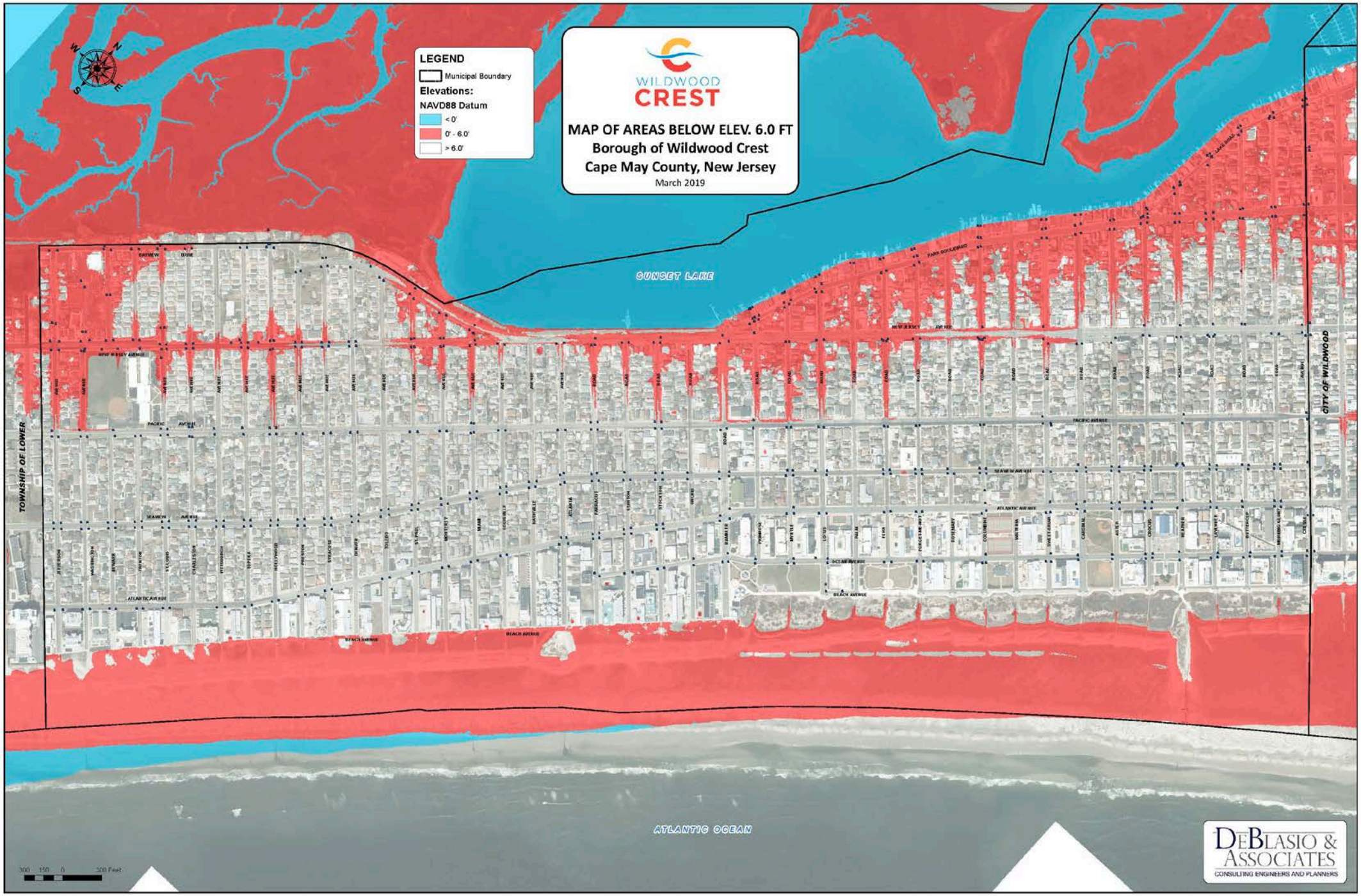
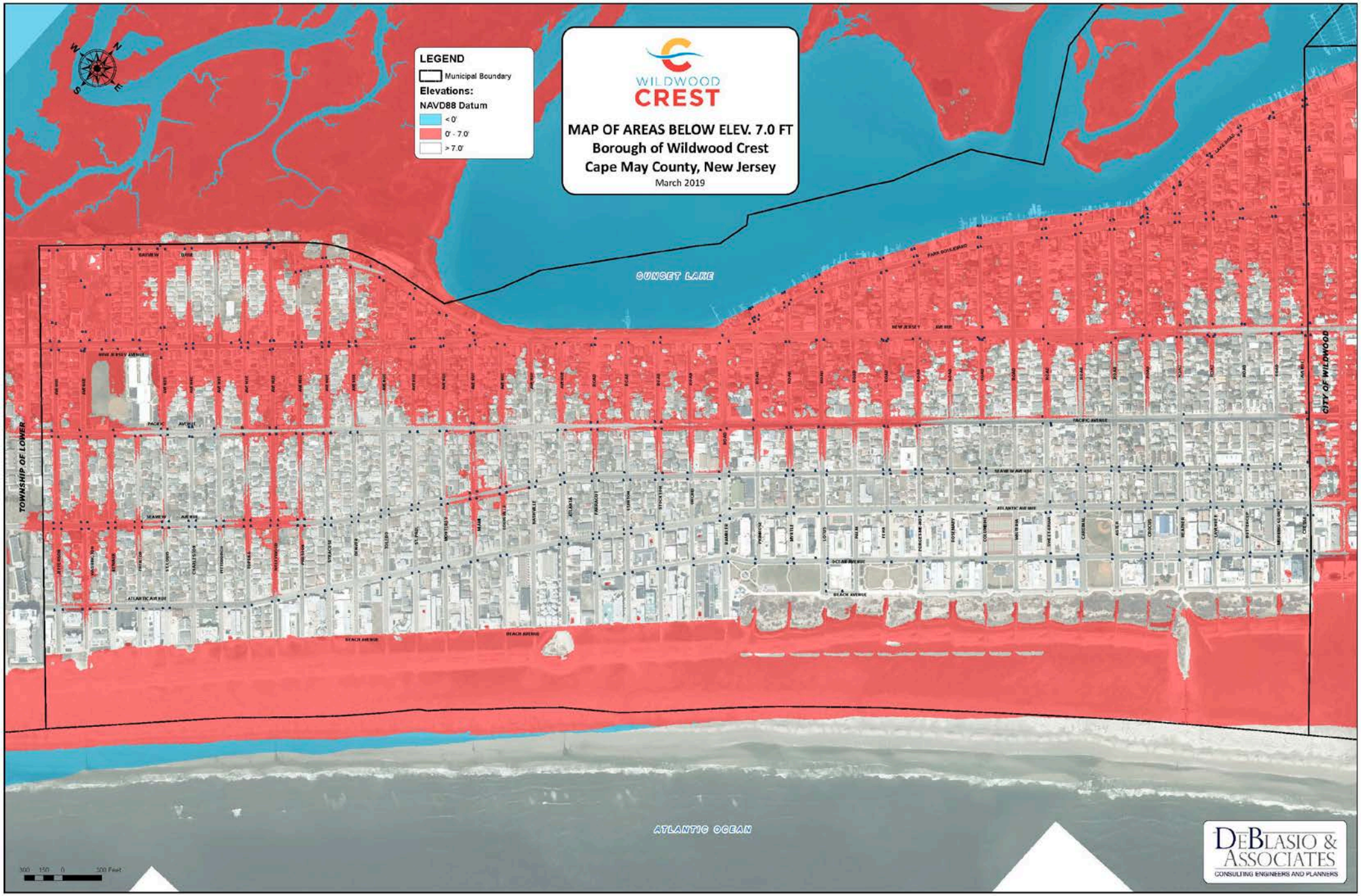

LEGEND
Municipal Boundary
Elevations:
NAVD88 Datum
< 0'
0' - 5.0'
> 5.0'
WILDWOOD CREST
MAP OF AREAS BELOW ELEV. 5.0 FT
Borough of Wildwood Crest
Cape May County, New Jersey
March 2019
SUNSET LAKE
ATLANTIC OCEAN
TOWNSHIP OF LOWER
CITY OF WILDWOOD
PACIFIC AVENUE
NEW JERSEY AVENUE
SEAVIEW AVENUE
ATLANTIC AVENUE
BEACH AVENUE
PARK BOULEVARD
300 150 0 300 Feet
DEBLASIO & ASSOCIATES
CONSULTING ENGINEERS AND PLANNERS


LEGEND
Municipal Boundary
Elevations:
NAVD88 Datum
< 0'
0' - 6.0'
> 6.0'
WILDWOOD CREST
MAP OF AREAS BELOW ELEV. 6.0 FT
Borough of Wildwood Crest
Cape May County, New Jersey
March 2019
SUNSET LAKE
TOWNSHIP OF LOWER
CITY OF WILDWOOD
ATLANTIC OCEAN
DEBLASIO & ASSOCIATES
CONSULTING ENGINEERS AND PLANNERS


LEGEND
Municipal Boundary
Elevations:
NAVD88 Datum
< 0'
0' - 7.0'
> 7.0'
WILDWOOD CREST
MAP OF AREAS BELOW ELEV. 7.0 FT
Borough of Wildwood Crest
Cape May County, New Jersey
March 2019
SUNSET LAKE
TOWNSHIP OF LOWER
CITY OF WILDWOOD
ATLANTIC OCEAN
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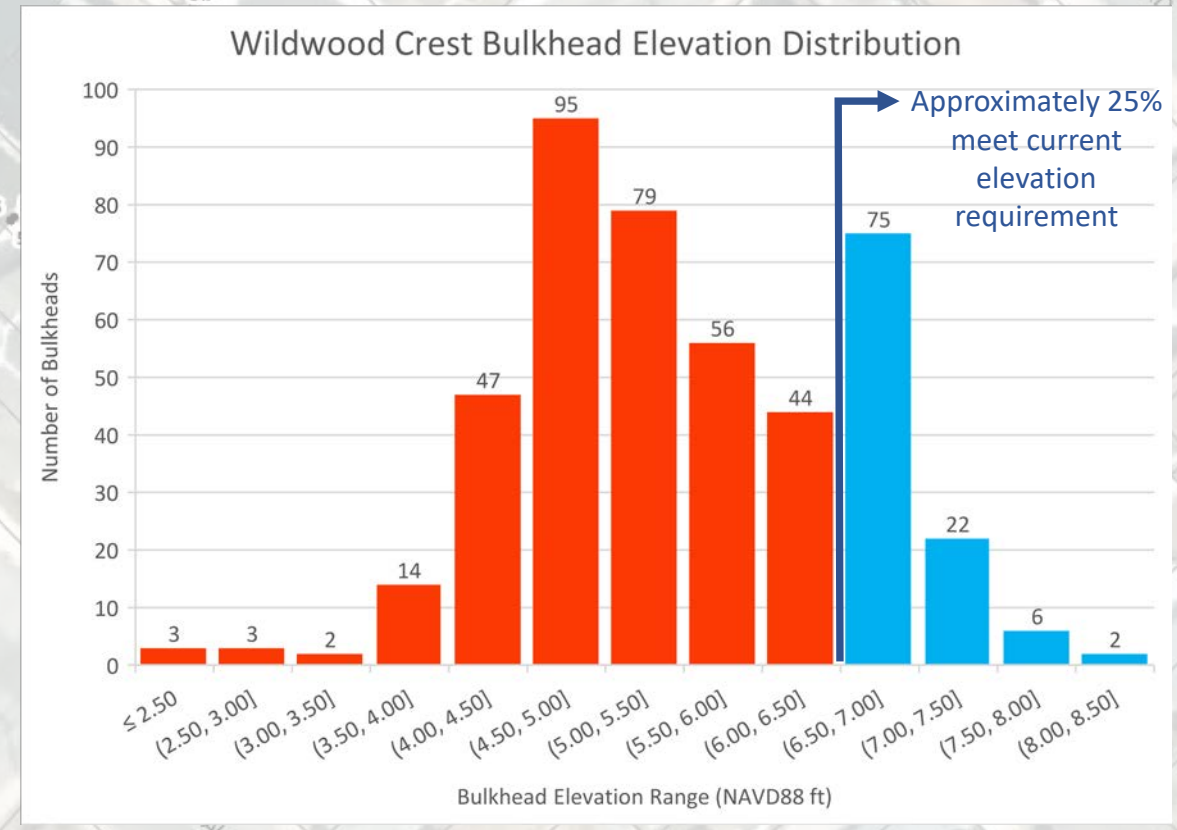
5. Bulkhead/Land Berm Elevations

A bulkhead and land berm system is the main barrier between the mainland and the bay. In order to determine the height along the barrier, a survey of bayfront properties was completed in January 2019 utilizing a GPS receiver that was placed on each property's barrier top surface and that elevation was recorded in the North American Vertical Datum (NAVD) of 1988. Over 400 points were collected and analyzed.

The current bulkhead ordinance for the Borough of Wildwood Crest Chapter 17 Bulkheads requires the top elevation of constructed bulkheads to be set to a minimum elevation of 8.0 NGVD 1929. The required height can be converted to NAVD 1988 by subtracting 1.3' for a required minimum elevation of 6.7 NAVD 1988.

LOWEST ELEVATION	**2.11 FT. (NAVD 1988)**
HIGHEST ELEVATION	**8.35 FT. (NAVD 1988)**
MEAN ELEVATION	**5.49 FT. (NAVD 1988)**
MEDIAN ELEVATION	**5.33 FT. (NAVD 1988)**



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6. FEMA Community Rating System

The National Flood Insurance Program (NFIP) offers flood insurance to all properties in communities that comply with minimum standards for floodplain management. The NFIP created a system to credit communities that go beyond the minimum standard. This program is known as the Community Rating System (CRS) and communities can strive to create a high standard for floodplain management. As communities meet certain criteria, they are awarded points. These points are used to rank communities and provide discounts on flood insurance premiums.

Communities can gain credits by following the CRS Coordinator's Manual and verifying their efforts. Based on the amount of credit points the community earns, the CRS assigns a rate class. The rate class is used to determine the discount on insurance premiums. Below displays the points and how they relate to the corresponding discount.

NFIP Discount Classes

Class	Credit Points	Floodplain Discount	Non-Floodplain Discount
1	4,500	45%	10%
2	4,000	40%	10%
3	3,500	35%	10%
4	3,000	30%	10%
5	2,500	25%	10%
6	2,000	20%	10%
7	1,500	15%	5%
8	1,000	10%	5%
9	500	5%	5%
10	< 500	0	0

Communities throughout Cape May County participate in the CRS and vary in current class. The table below displays Cape May County communities and current class as of October 1, 2018:

Community Number	Community Name	CRS Entry Date	Current Class
345279	Borough of Avalon	10/1/1996	5
345288	City of Cape May	10/1/1994	6
345289	Borough of Cape May Point	10/1/1993	6
340153	Township of Lower	10/1/2018	7
345308	City of North Wildwood	10/1/2000	6
345310	City of Ocean City	10/1/1992	5
345318	City of Sea Isle	10/1/1992	3
345323	Borough of Stone Harbor	10/1/1994	5
340159	Township of Upper	10/1/2011	5
345328	Borough of West Wildwood	10/1/1993	10
345329	City of Wildwood	05/1/2016	5
345330	Borough of Wildwood Crest	10/1/1993	6

Proposed FMSSMP Improvement Recommendations

1. Preventative

2. Capitol Infrastructure Improvements

3. Preservation of Natural Resources and Cooperation with Regulatory Agencies

Proposed FMSSMP Improvement Recommendations

1. Preventative

- Adopt a new bulkhead ordinance that requires new bulkheads to be constructed at elevation 8.0 (NAVD 1988), including a timeline requirement to retrofit existing bulkheads to elevation 8.0 (NAVD 1988).

- Adopt a new lot grading and drainage ordinance that requires private property owners to incorporate ground water recharge & elevate their properties to reduce flooding with particular emphasis on tidal nuisance flood events.

- Continue to participate in FEMA Community Rating System (CRS)

- Inform and improve communication to property owners of flooding events through advance warning systems, forecasting and emergency planning. Coordinate with the Borough's Office of Emergency Management to install advanced flood warning devices.

Proposed FMSSMP Improvement Recommendations

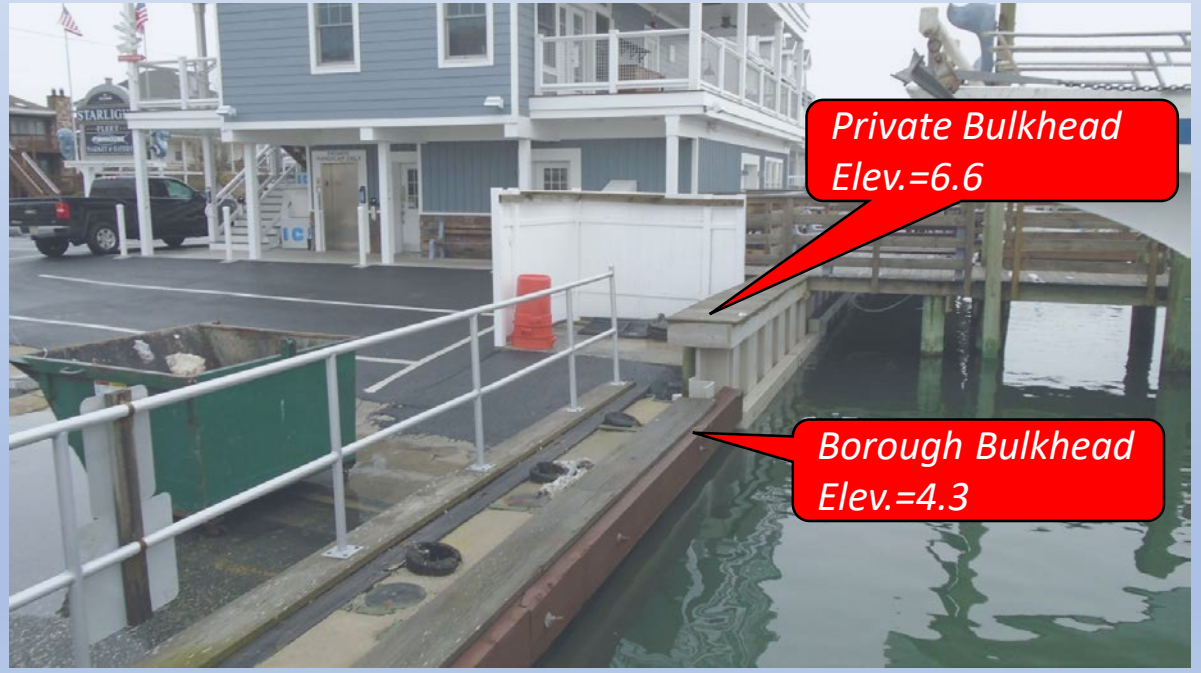
2. Capital Infrastructure Improvements

- Elevate Borough Bulkheads – Elevation 8.0 NAVD88
- Beach Outfall Improvements
  a. Increase Hydraulic Capacity
  b. Elimination of Outfalls & Install Pump Stations
- Elevate Roadways
- Bayside Tide Control
  a. Passive Control Valves
  b. Manually Operated Control Valves
  c. SCADA Operated Control Valves
  d. Storm Sewer Pump Stations
- Increase Storm Sewer System Hydraulic Capacity & Ground Water Recharge
- Green Infrastructure Improvements

➢ Elevate Borough Bulkheads – Elevation 8.00 NAVD88

As sea level continues to rise, the elevation of the Borough of Wildwood Crest will need to increase. Land berms and bulkheads provide protection to bay side properties by blocking out tidal water. If the Borough chooses to adopt a new bulkhead and land berm ordinance requiring the finished height of newly constructed bulkheads and land berms to be 8.00 NAVD 88, all Borough owned bulkheads will be below this height. Borough owned bulkheads range in height from 4.35 to 7.00 feet. As residents begin to raise the height of their newly constructed bulkheads, the Borough owned bulkheads will need to be elevated as well.

The Borough is responsible for all street end bulkheads that are found in the roadway right-of-way. From Cresse Avenue to Rambler Road there are 18 street ends with Borough constructed bulkheads. These street end bulkheads range in elevation from 4.35 to 7.00 feet. As the Borough continues its efforts to decrease tidal flooding, bulkheads with the lowest finished elevations should be a priority. The tidal water will enter through the lowest access point along the bay side of the barrier island.



Current bulkhead ordinance 6.70 NAVD88

Lowest Elevation Point	Location
4.35	Sweet Briar Road
4.40	Cardinal Road
4.48	Wisteria Road
4.61	Cresse Avenue
4.73	Myrtle Road
4.83	Buttercup Road
4.89	Primrose Road
4.94	Columbine Road
4.99	Forget Me Not Road
5.00	Fern Road
5.16	Lotus Road
5.16	Palm Road
5.57	Morning Glory Road
6.42	Heather Road
6.47	Lavender Road
6.50	Rosemary Road
6.94	Crocus Avenue
7.00	Aster Road

➢ Beach Outfall Improvements

A. Option 1 - Increase Hydraulic Capacity

The existing stormwater infrastructure in the Borough has been analyzed using HydroCAD to determine the predicted flows through the beach outfall pipes. As the community continues to develop, houses are generally becoming larger with a larger area of impervious surface. As impervious surface percentage increases, stormwater infrastructure pipes need to be upgraded to increase their hydraulic capacity. After analysis, it is determined that the Washington Avenue, Atlanta Avenue, Fern Road, and Heather Road beach outfalls should be upgraded to increase hydraulic capacity if existing drainage areas remain. The pipes are undersized and should be upgraded to 30” pipe diameter.

B. Option 2 - Outfall Elimination and Pump Stations

Another option is to eliminate the outfalls on the beach and install pump stations. Currently, all stormwater management is accomplished using gravity. The water flows by gravity from the ocean side of the island to the ocean discharge outfalls. A pump station is proposed at the tennis courts between Columbine Road and Wisteria Road. The pump station would collect stormwater from existing drainage and utilize a force main out Palm Road to discharge the water. Miami Avenue, Atlanta Avenue, Fern Road, and Heather Road beach outfalls would be eliminated.

A second pump station would be installed at the Borough of Wildwood Crest Department of Public Work’s building between Washington Avenue and Jefferson Avenue. The pipe system would gather all stormwater from existing drainage boundaries in that area and pipe it in a closed system down Pittsburgh Avenue to the pump station. The pump station and pipe network would allow the Washington Avenue and Hollywood Avenue beach outfalls to be removed.

The proposed pump stations would be placed on Borough owned property. Pump Stations can elevate stormwater flooding even during a high tidal event. As the frequency of tidal elevations that exceed the stormwater collection points increase, gravity stormwater management becomes less effective.

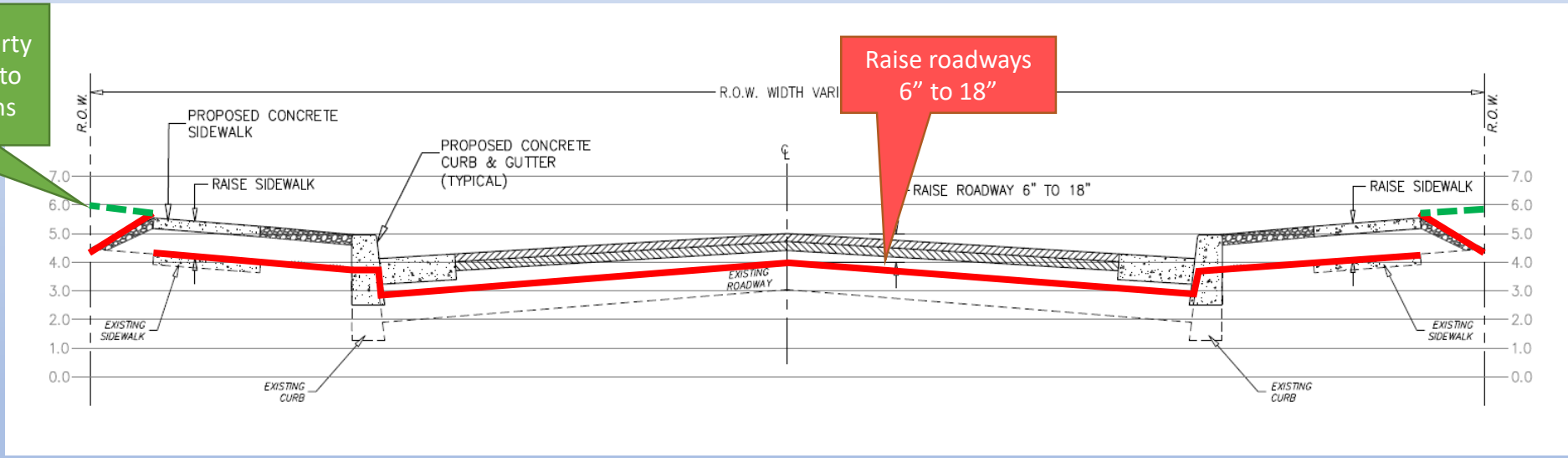
Elevate Roadways

As flooded roads become more of a problem for coastal communities, raising the street elevation is a possible solution. The Borough of Wildwood Crest contains roadways with elevations as low as three feet. When the tide rises above this point, the roadway will flood and make it difficult for residents to pass through. According to the USGS tidal gauge located on Stone Harbor Boulevard, the high tide is above three feet in elevation 58 times a year. That means that for 58 days out of the year, some roadways in the Borough experience tidal flooding.

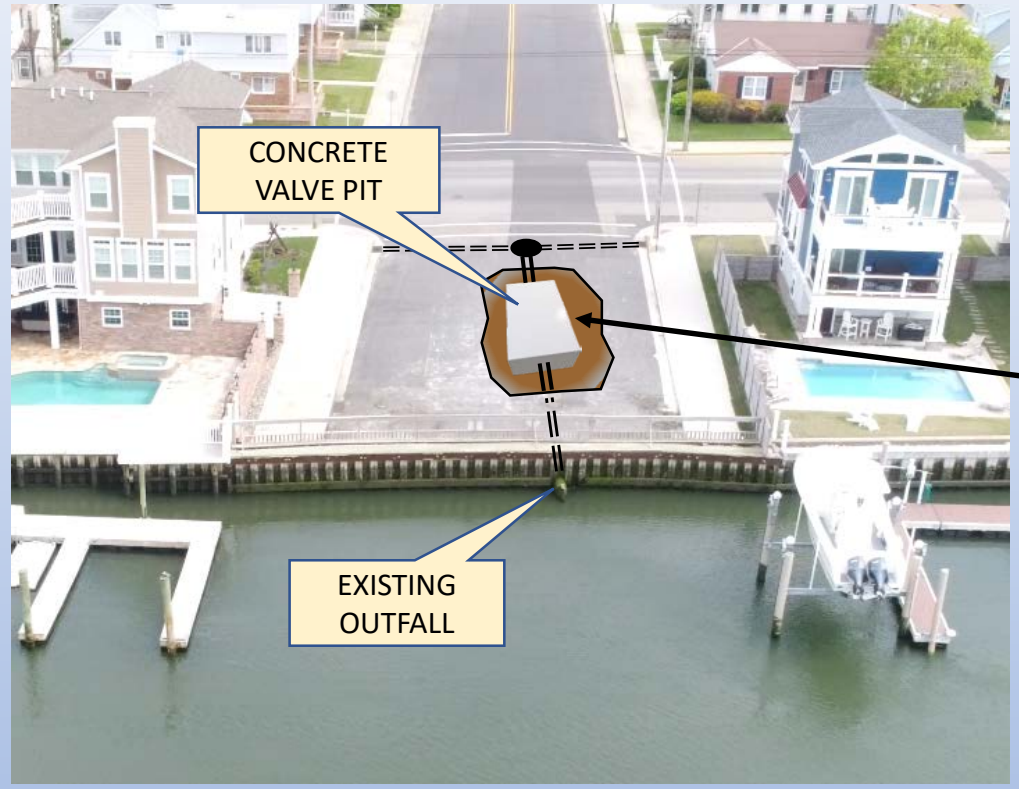
The roadways along the bay are lowest in elevation. The lowest area is bounded on the North by Cresse Avenue, the south by Rambler Road, the East by New Jersey Avenue, and the West by Sunset Lake. The roadways in this area range from three feet to six feet. As discussed before, the roadways that are at elevation three will flood 58 days of the year. If the roadways are raised to four feet in elevation, the flooding decreases to 6 times a year. If the roadways are raised to five feet in elevation, the flooding decreases to 0.5 days a year. The benefit from elevating roadways becomes clear.

Although the benefit of elevating roadways is clear, there are high costs and difficulties associated with it. The challenges associated with this improvement include coordination with the City of Wildwood and Lower Township, connecting the roadway to adjacent properties and widening the travel way.

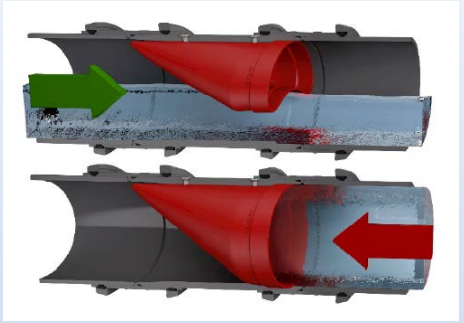
Requires Private Property Owner's cooperation to meet raised elevations



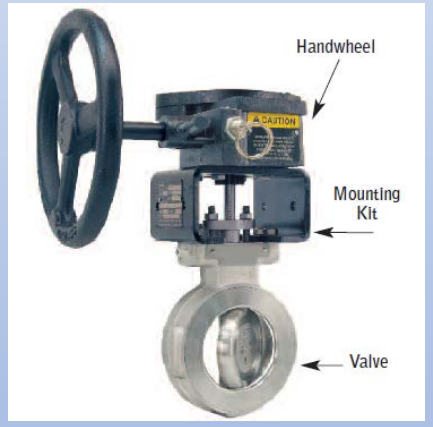
➢ Bayside Tide Control



TYPICAL BAYSIDE STREET END



OPTION “A” (IN-LINE CHECK VALVE)



OPTION “B” (MANUALLY OPERATED TIDE CONTROL VALVE)

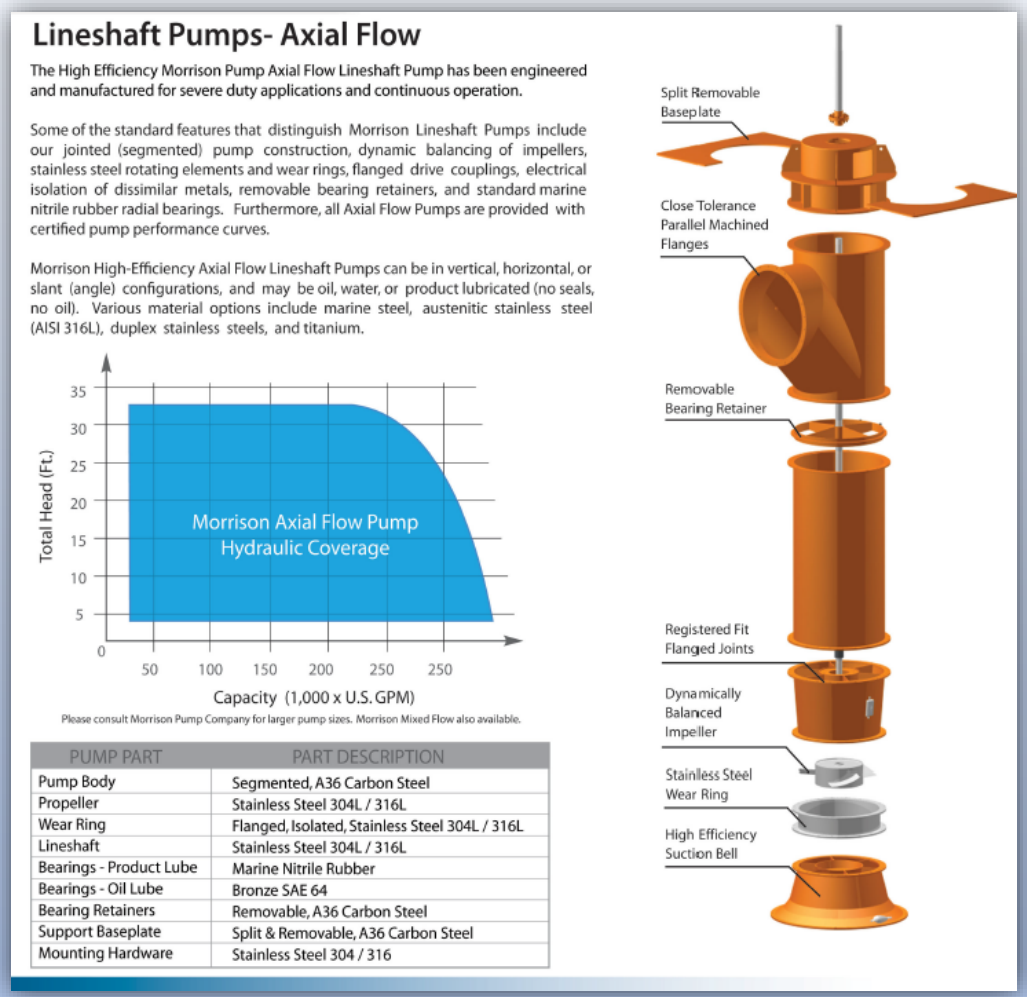
OPTION “C” (SCADA OPERATED TIDE CONTROL VALVE)

➢ Bayside Tide Control

▪ Option “D” Storm Sewer Pump Stations

Bayside tidal control is an essential aspect of flood mitigation in the Borough of Wildwood Crest. Techniques described that utilize passive, manual, or SCADA controlled valves will mitigate tidal flooding from increasing tidal elevation, but it will not be able to control stormwater flooding. When the tidal elevation is above the bay discharge outfalls, stormwater will not drain from the island. During a severe rain event with high tidal elevation, flooding will have damaging effects.

Currently all stormwater management in the Borough utilizes gravity. When the tidal elevations are high these systems do not work. Pump stations are required to mitigate tidal and stormwater flooding. Stations would be designed to evacuate stormwater runoff from rain events. It is recommended that the Borough install three bayside pump stations. Stormwater would discharge through force mains through existing bayside bulkheads.



Lineshaft Pumps- Axial Flow

The High Efficiency Morrison Pump Axial Flow Lineshaft Pump has been engineered and manufactured for severe duty applications and continuous operation.

Some of the standard features that distinguish Morrison Lineshaft Pumps include our jointed (segmented) pump construction, dynamic balancing of impellers, stainless steel rotating elements and wear rings, flanged drive couplings, electrical isolation of dissimilar metals, removable bearing retainers, and standard marine nitrile rubber radial bearings. Furthermore, all Axial Flow Pumps are provided with certified pump performance curves.

Morrison High-Efficiency Axial Flow Lineshaft Pumps can be in vertical, horizontal, or slant (angle) configurations, and may be oil, water, or product lubricated (no seals, no oil). Various material options include marine steel, austenitic stainless steel (AISI 316L), duplex stainless steels, and titanium.

Please consult Morrison Pump Company for larger pump sizes. Morrison Mixed Flow also available.

PUMP PART	PART DESCRIPTION
Pump Body	Segmented, A36 Carbon Steel
Propeller	Stainless Steel 304L / 316L
Wear Ring	Flanged, Isolated, Stainless Steel 304L / 316L
Lineshaft	Stainless Steel 304L / 316L
Bearings - Product Lube	Marine Nitrile Rubber
Bearings - Oil Lube	Bronze SAE 64
Bearing Retainers	Removable, A36 Carbon Steel
Support Baseplate	Split & Removable, A36 Carbon Steel
Mounting Hardware	Stainless Steel 304 / 316

CAPITOL INFRASTRUCTURE IMPROVEMENTS
BAYSIDE TIDE CONTROL

OPTION	ADVANTAGES	DISAVANTAGES	REGULATORY PERMITS REQUIRED	COST
Bayside Tide Control				
a). Passive Control Valve	▪ No power required ▪ Installed landward of bulkhead ▪ Can be maintained on land ▪ No real estate/property issues ▪ Not visible – installed underground	▪ Reliability on a firm closure/seal ▪ Maintenance ▪ Inability to evacuate surface rain water during high tide	Yes	$
b). Manually Operated Control Valves	▪ No power required ▪ Installed landward of bulkhead ▪ Can be maintained on land ▪ No real estate/property issues ▪ Not visible – installed underground	▪ Requires manual labor to close valve ▪ High labor intensive ▪ Maintenance ▪ Inability to evacuate surface rain water during high tide	Yes	$$
c). SCADA Operated Control Valves	▪ Controlled remotely ▪ Reliability ▪ Low labor intensive ▪ No real estate/property issues ▪ Installed landward of bulkhead	▪ Requires Power ▪ Requires backup generator ▪ Cost ▪ Visible above ground controls ▪ Inability to evacuate surface rain water during high tide	Yes	$$$
d). Storm Sewer Pump Stations	▪ Ability to pump surface rain water during high tide ▪ Reliability ▪ Low labor intensive ▪ Installed landward of bulkhead	▪ Requires Power ▪ Requires backup generator ▪ Real estate issues ▪ Cost to operate ▪ Visible above ground structures	Yes	$$$$

➢ Green Infrastructure Improvements

As part of managing stormwater runoff in the Borough, the Borough should investigate and implement development techniques and infrastructure and development requirements for public and private development that reduce stormwater runoff volume and increase stormwater runoff quality. Green Infrastructure (GI) is a broad term that describes efforts to capture, treat, and infiltrate stormwater runoff in urban areas. Stormwater practices include green roofs, permeable pavers, rainwater harvesting, rain gardens and planter boxes, bioswales, an urban tree canopy and constructed wetlands.

The New Jersey Department of Environmental Protection describes Green Infrastructure as follows: Green Infrastructure refers to methods of stormwater management that reduce wet weather/stormwater volume, flow, or changes the characteristics of the flow into combined or separate sanitary or storm sewers, or surface waters, by allowing the stormwater to infiltrate, to be treated by vegetation or by soils; or to be stored for reuse. Green Infrastructure (GI) methods are management practices that address stormwater runoff through soils, or reuse. GI practices include, but are not limited to:

- **Pervious Paving**
- **Bioretention Basins**
- **Vegetated Swales**
- **Cisterns**

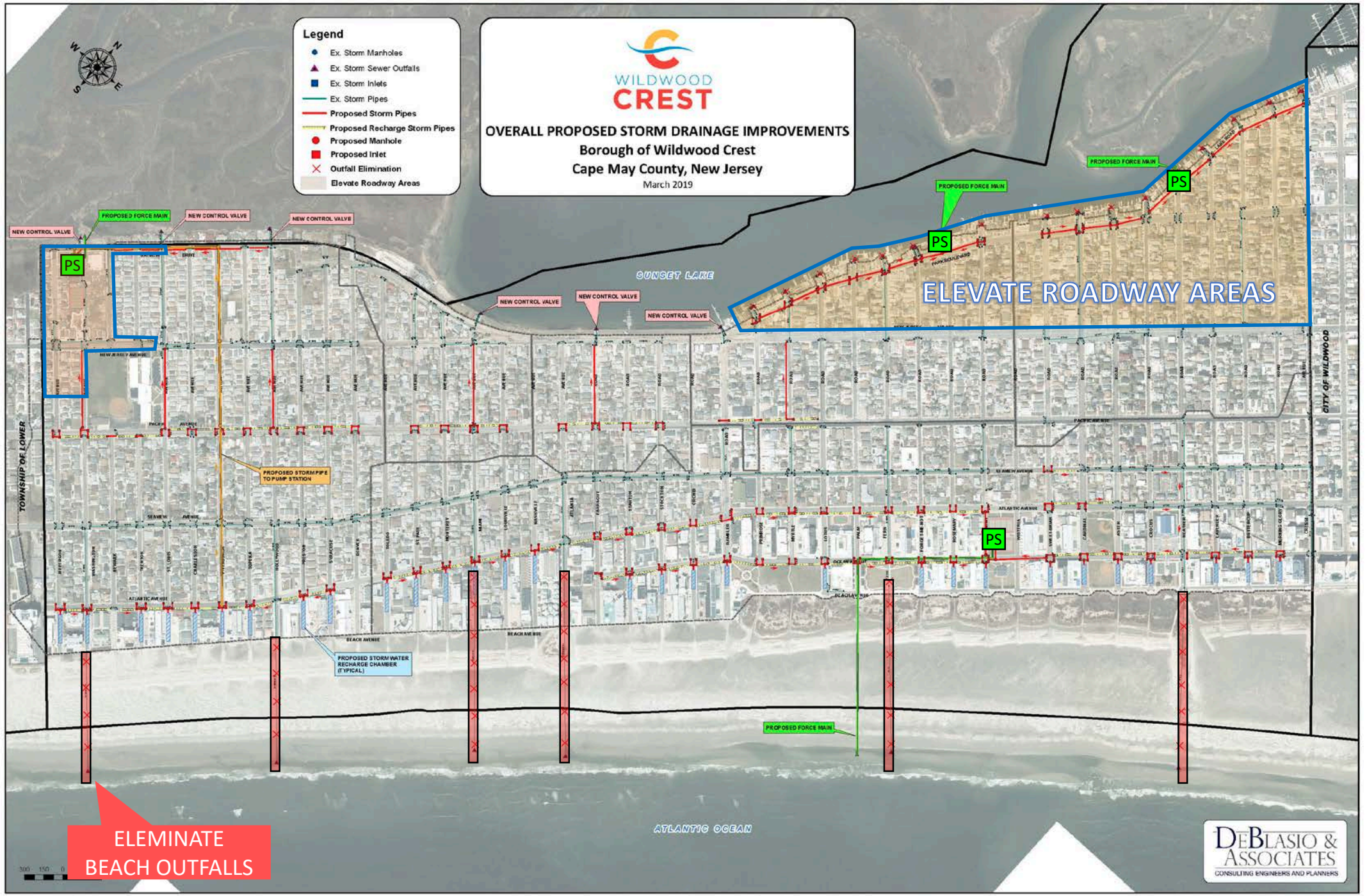
The use of green infrastructure encourages the idea that stormwater is a resource that can be reused, instead of being treated as a nuisance that needs to be removed as quickly as possible.

A well-developed Green Infrastructure Plan would help the Borough to address water quality concerns and reduce stormwater runoff volumes. Green Infrastructure can have a significant impact on the volume and rate of stormwater runoff in the types of normal, frequent rainfall events that occur in the Borough regularly. When considering the future condition of the Borough, where nearly all stormwater will need to be pumped off the island, a reduction in runoff rates and volumes from frequent small storm events would also equate to a savings in pumpage related costs.

Proposed FMSSMP Improvement Recommendations

3. Preservation of Natural Resources and Cooperation with Regulatory Agencies

- Evaluate and enact local zoning ordinances, policies and design requirements that are consistent with New Jersey Department of Environmental Protection and U.S. Army Corps of Engineers' regulations.
- Participate in Federal and State beach nourishment and dune building programs.
- Continue to monitor and survey the beaches, back bays and dunes.
- In conjunction with Federal and State agencies, participate in opportunities to restore degraded tidal marsh areas in back bay areas utilizing dredge materials.
- Consider land acquisition, purchasing repetitive loss properties and open space preservation in flood prone areas.
- Participate in the New Jersey Coastal Coalition.


Legend
Ex. Storm Manholes
Ex. Storm Sewer Outfalls
Ex. Storm Inlets
Ex. Storm Pipes
Proposed Storm Pipes
Proposed Recharge Storm Pipes
Proposed Manhole
Proposed Inlet
Outfall Elimination
Elevate Roadway Areas
WILDWOOD CREST
OVERALL PROPOSED STORM DRAINAGE IMPROVEMENTS
Borough of Wildwood Crest
Cape May County, New Jersey
March 2019
ELEVATE ROADWAY AREAS
PROPOSED FORCE MAIN
NEW CONTROL VALVE
PS
SUNSET LAKE
PROPOSED STORM PIPE TO PUMP STATION
PROPOSED STORM WATER RECHARGE CHAMBER (TYPICAL)
ATLANTIC OCEAN
TOWNSHIP OF LOWER
CITY OF WILDWOOD
ELEMINATE BEACH OUTFALLS
DEBLASIO & ASSOCIATES
CONSULTING ENGINEERS AND PLANNERS

Critical Paths & Priority Objectives

A. Preventative
   1. Adopt recommended bulkhead ordinance.
   2. Adopt new lot grading and drainage ordinance.
   3. Initiate discussions with the City of Wildwood and the Township of Lower regarding regional flood mitigation improvements and implementation.

B. Capitol Infrastructure Improvements
   1. Elevate Borough bulkheads.
   2. Select Bayside tide control method.
   3. Initiate and conduct public outreach relating to raising roadways.
   4. Implement recommendations contained in the FMSSMP current capitol improvement projects. Properly plan future projects in concert with the FMSSMP.
   5. Determine what, if any, beach outfall improvements are needed.

C. Preservation of Natural Resources and Cooperation with Regulatory Agencies
   1. Continue to monitor and survey the beaches, back bays and dunes.
   2. Participate in the New Jersey Coastal Coalition.

References

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- U.S. Army Corps of Engineers (2019). *Wildwood Beach Fill Initial Plans, February, 2019.*
- Wikipedia (2019), "Wildwood Crest, New Jersey."

Comments & Questions

- Presentation will be posted on Borough Website:
  - https://wildwoodcrest.org

- Detailed comments & questions can be submitted via email to:
  - engineering@wildwoodcrest.org