Town of St. Michaels

San Domingo Creek and West Side Stormwater and Harbor Infrastructure Assessment and Flood Mitigation Study

TOWN COMMISSIONERS MEETING

DECEMBER 13, 2023

Introduction to BayLand

- Environmental Engineering Firm
- Specializing in Projects at the Land-Water Interface
  - Stream & Ecological Restoration
  - Stormwater Management & Sustainable Site Development
  - Marine, Dredging & Shoreline
- Project Team
  - Anna Johnson, PE, CC-P – Project Manager & Coastal Engineer
  - Megan Barniea, PE – Stormwater Engineering
  - Sepehr Baharlou, PE – QA/QC

Introduction

- Town experiences stormwater & coastal flooding, which is anticipated to increase with climate change.
- Town created the Climate Change/Sea Level Rise Commission (CC/SLR)
- San Domingo Creek and West Side Flood Mitigation Study
  - Community Resilience Partnership with the Chesapeake and Coastal Service
  - BayLand competitively selected in December 2022
    - Study will examine flooding sources now and with future conditions
    - Identify Top Tier Project and develop 'Schematic Design'
    - Provided Additional Assessment for North Street Area

Information Gathering

- Locate and map storm drain infrastructure and shoreline features.
- Identify signs of deterioration
- Photo document drainage characteristics, erosion and flow patterns
- Survey critical elevations of drainage and roadway infrastructure, and shoreline elements

San Domingo Creek Existing Conditions – Drainage

- Storm drain infrastructure
  - Developed drainage areas
  - Rain gardens to store runoff
  - Large swales to direct flow
- 3 mapped tidal outfalls
  - Impacted by sea level rise
  - Susceptible to backwatering

Existing Storm Drain Infrastructure Map

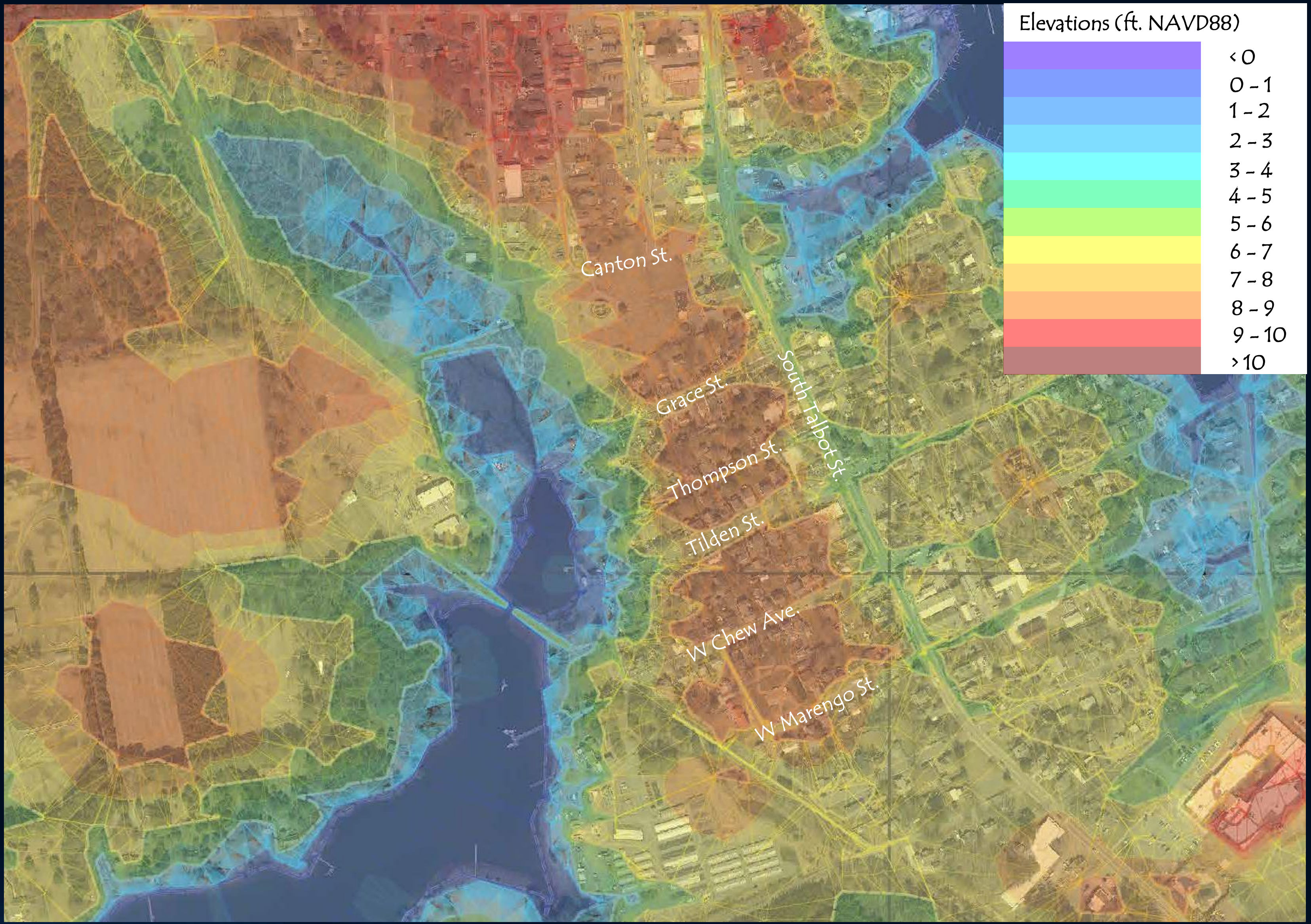
San Domingo Creek Existing Conditions – Shoreline Features

- Shoreline includes:
  - Bulkheads
  - Revetments
  - Living Shorelines
  - Natural Banks
- All features appear to be at elevation of surrounding area

Shoreline Features

San Domingo Creek Existing Conditions – Topography

- Topography from LiDAR data
- Utilized for development of hydrologic model and supplement critical elevation survey
- Utilized to develop flood maps by overlaying future water levels.

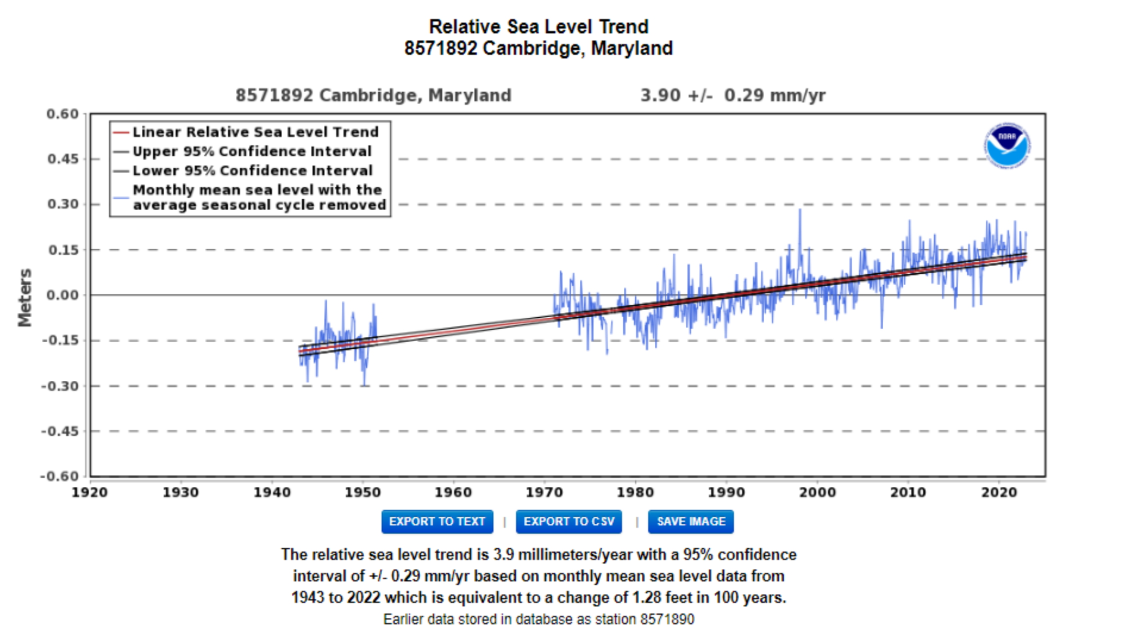


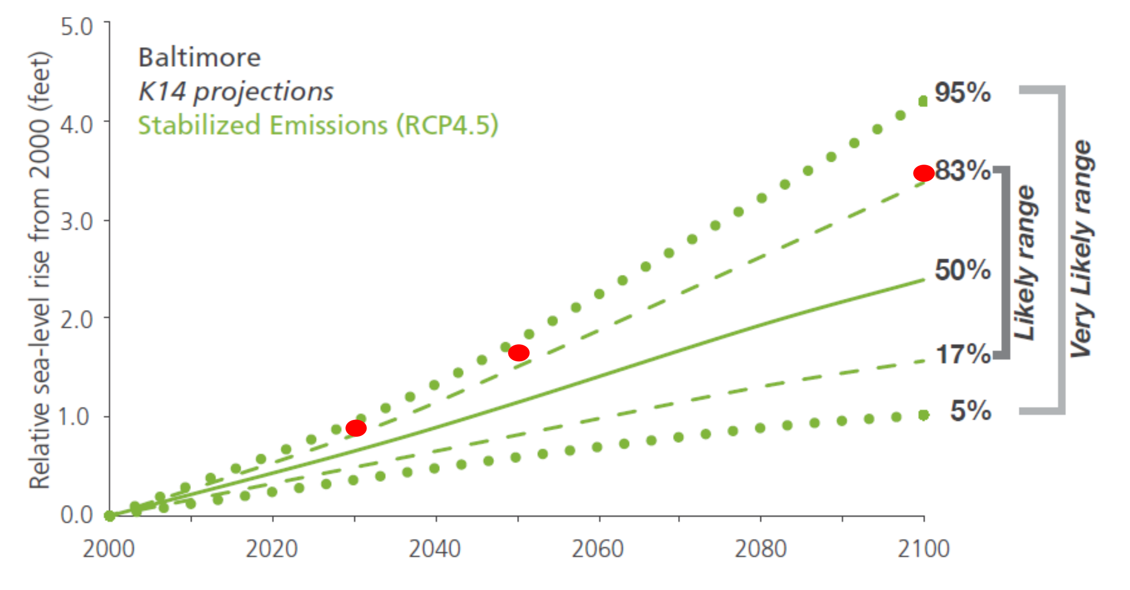
Area Elevations

Sea Level Rise Mapping

- Two Components of SLR
  - Global SLR – thermal expansion, ice melt
  - Relative SLR – land subsidence, tectonic plate movement
- Historic Sea Level Rise at Cambridge Station (NOAA) between 1943 and 2022 – 0.19 inch/year
- Stillwater Flood Analysis and Mapping:
  - Utilized SLR projections for Maryland
  - Utilized DNR Guidance on SLR projection implementation for areas with 'High Flood Risk Tolerance'

SLR for the Town of St. Michaels	
Year	SLR Meets or Exceeds:
2030	0.9 ft
2050	1.7 ft
2100	3.5 ft



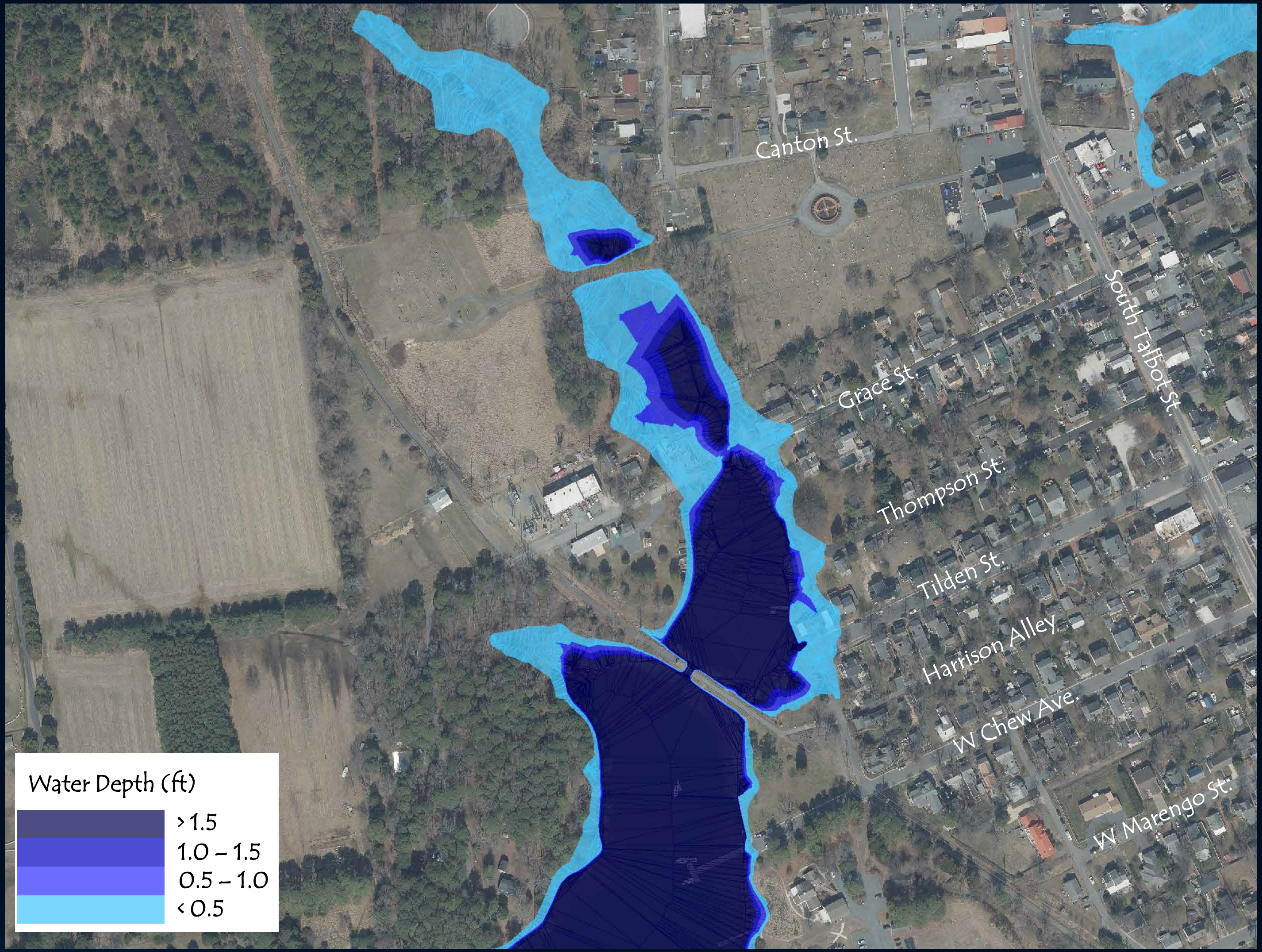


Stillwater with/ SLR Flooding Estimator:

Sea Level Rise and Coastal Flooding Impacts (noaa.gov)

Coastal Flooding: 2050 MHW

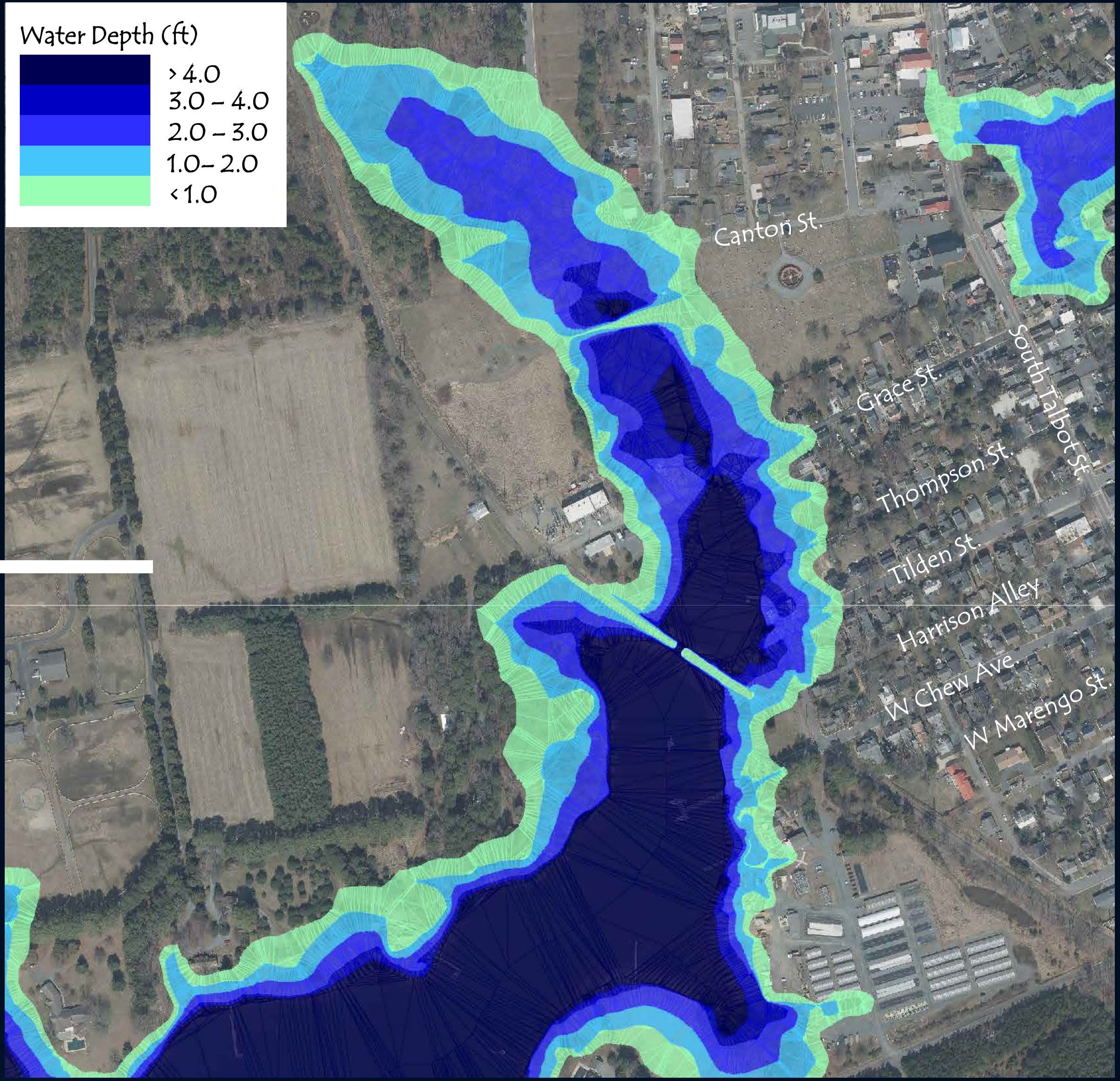
- With anticipated SLR:
  - MHW - +2.4 feet NAVD88
  - Areas shown in figure will experience flooding daily in 2050.



2050 MHW Extents

Coastal Flooding: Storm Surge + SLR

Return Period	Annual Chance of Occurrence	Storm Surge Elevation (2000)	Storm Surge + SLR Elevation (2050)
1-year (99 years per 100)	99%	+2.4 feet NAVD88	+4.1 feet NAVD88
2-year (50 years per 100)	50%	+2.9 feet NAVD88	+4.6 feet NAVD88
10-year (10 years per 100)	10%	+3.4 feet NAVD88	+5.1 feet NAVD88
100-year (1 year per 100)	1%	+4.9 feet NAVD88	+6.6 feet NAVD88



2050 10% Annual Chance Storm Event

Storm Surge Data at Cambridge Station: https://tidesandcurrents.noaa.gov/est/est_station.shtml?stnid=8571892

Stormwater Flooding Analysis

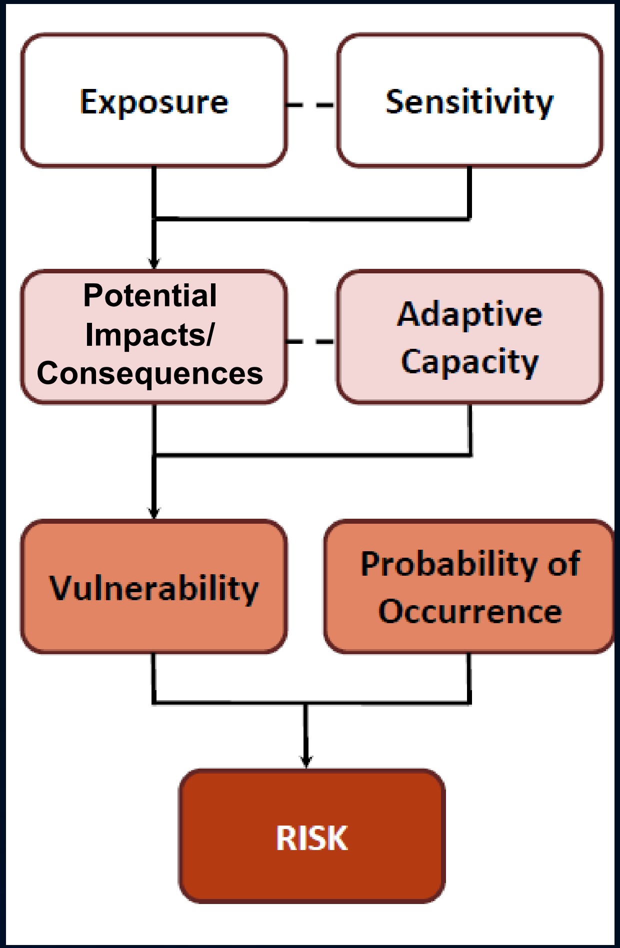
- Hydrology = the amount of flow to the system
- Hydraulics = how the stormwater flows through the system
- Model will be used to determine anticipated performance and flood reduction from proposed mitigation solutions

2050 100-year Rainfall Event

Vulnerability Assessment

- Based on the results of the assessment performed, six areas were identified as flood prone for the modelled conditions.

- Vulnerability Assessment of highest priority areas
  - *Exposure*
  - *Sensitivity*
  - *Consequence (Physical, Social & Economic Impact)*
  - *Adaptive Capacity*



Prioritization of Assessment Areas

Table – Prioritized Assessment Areas	
Priority	**Assessment Area Description**
1	Grace Street
2	Back Creek Park
3	West Chestnut Street @ Tilden Street
4	Canton Street @ Glory Avenue
5	St. Michaels Nature Trail
6	Thompson Street

Flood Mitigation Strategies

- Develop flood mitigation strategies and implementation plan
  - Nature-based/Passive Solutions
  - Structural Improvements
  - Green and Gray BMPs
  - Management Strategies
  - Relocation and Acquisition
  - Community Education and Outreach
  - Implementation Plan

Alternatives Analysis

- Input each alternative into a Decision Matrix
  - Feasibility – How easily can the alternative be implemented (0 – not at all; 5 – very easily);
  - Effectiveness – How well does the alternative reduce the risk from flooding (0 – not at all; 5 – very well);
  - Socio-economic Impacts – How beneficial to the community is the implementation of the alternatives for protecting against flooding (0 – not beneficial; 5 – very beneficial);
  - Environmental Impacts – How significant are the environmental impacts of the alternative (0 – significant impacts; 5 – few impacts);
  - Cost – How expensive will constructing the alternative be (0 – expensive relative to other alternatives; 5 – not expensive relative to other alternatives).
  - Grant Friendly – How likely is the project able to receive grant funding (0 – not likely; 5 – likely).

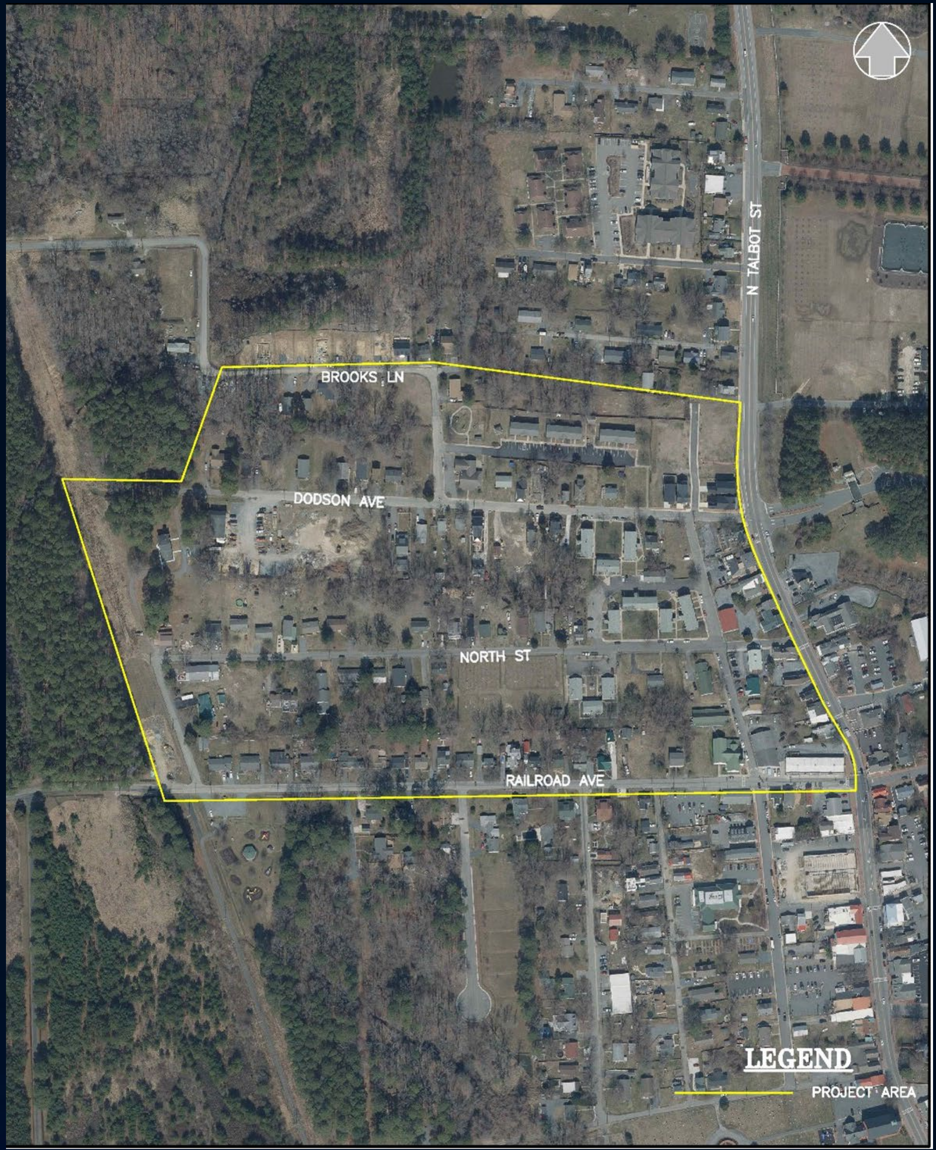
Proposed Projects

Table – Planning-Level Implementation Plan and Costs		
Project	Description	Cost
Immediate Implementation		
1	Back Creek Park Living Shoreline	$204,000
2	Tide Gate Assessment and Preliminary Design	$20,000
3	Tide Gate Implementation	$2,424,000
	Total Immediate Implementation Cost	$2,648,000.00
Short-Term Implementation		
4	Grace Street Culvert Improvements	$84,000
5	W. Chestnut & Tilden Street Retention Area Pipe Outfall Improvements	$81,000
6	Stormwater Infrastructure Replacement along St. Michaels Nature Trail	$199,200
7	Raise Boating Infrastructure at Back Creek Park	$708,000
	Total Short-Term Implementation Cost	$1,072,200.00
Long-Term Implementation		
8	Monitor Flood Risk for Assessment Areas	TBD
9	Nourish Living Shorelines along Back Creek Park	TBD
	Total Long-Term Implementation Cost	TBD

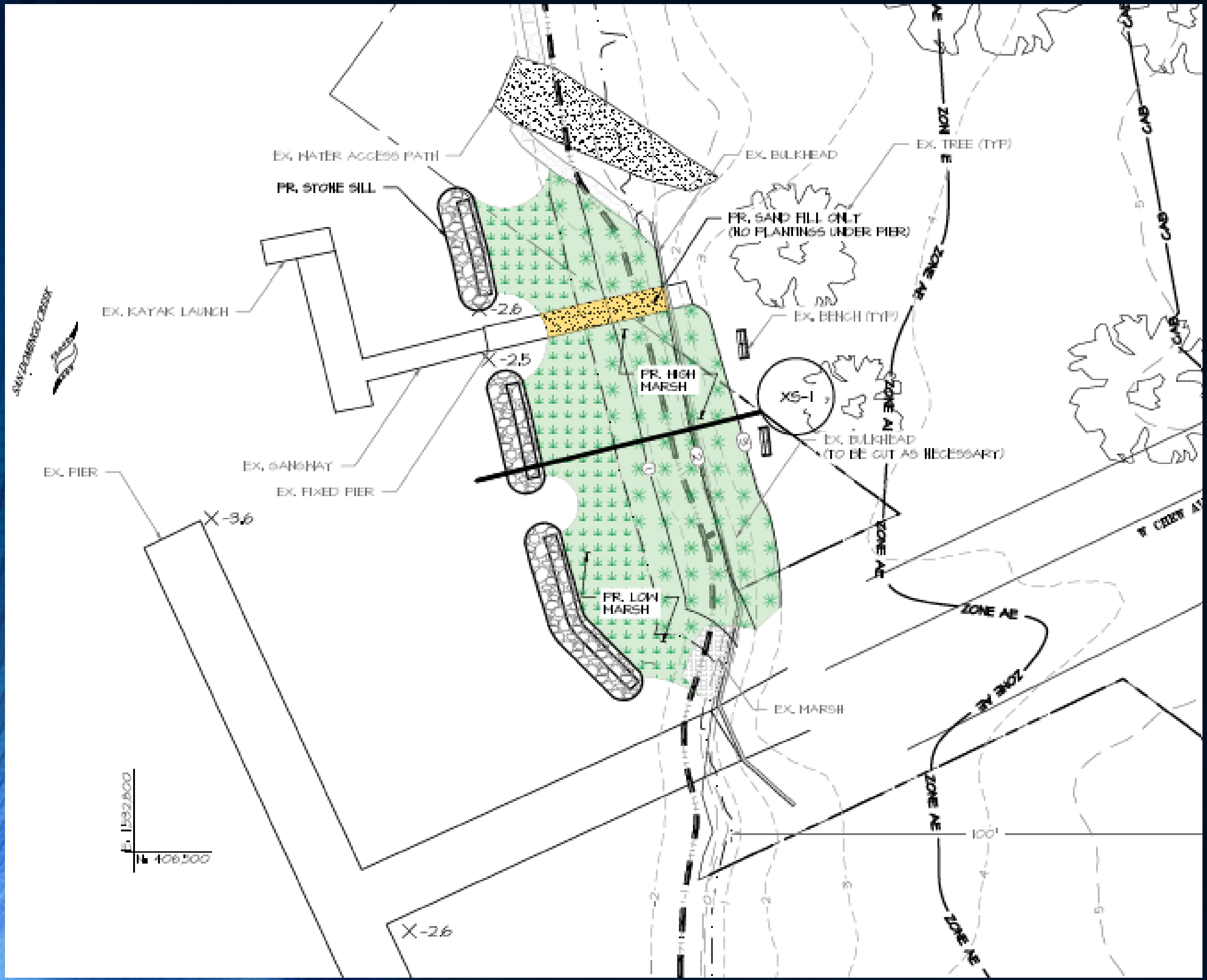
Additional Stormwater Management Assessment

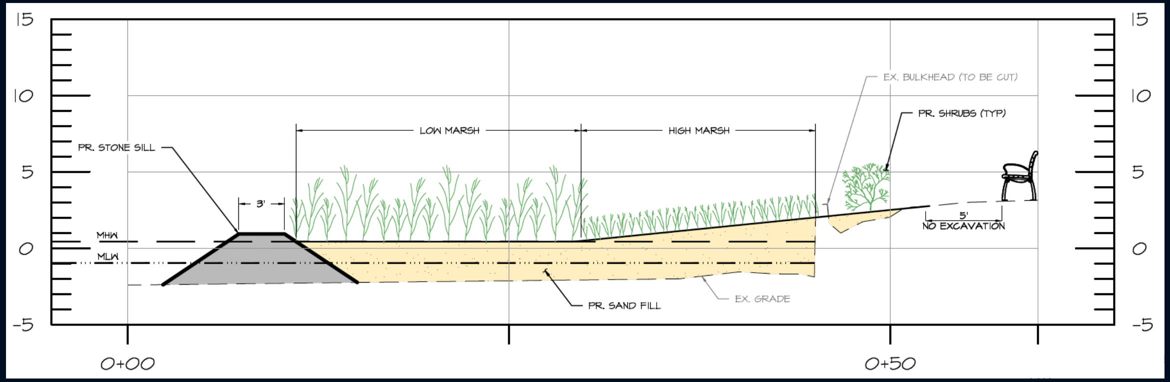
- Amendment to current DNR grant to include additional assessment of the Chester Park area

- The project encompasses stormwater management in the area north of Railroad Ave, south of Brooks Ln, and west of North Talbot St

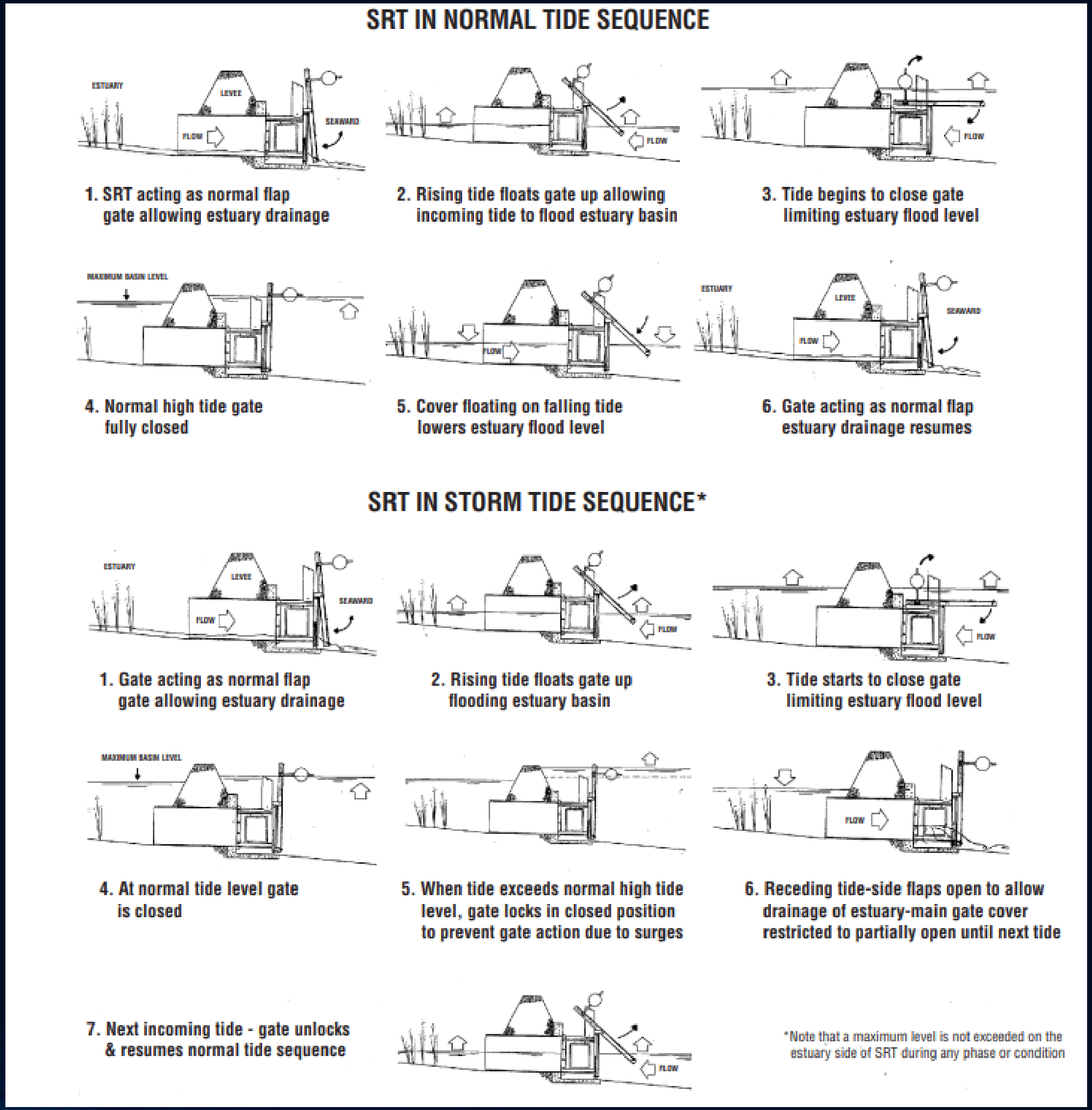


Project 1 – Back Creek Park Living Shoreline





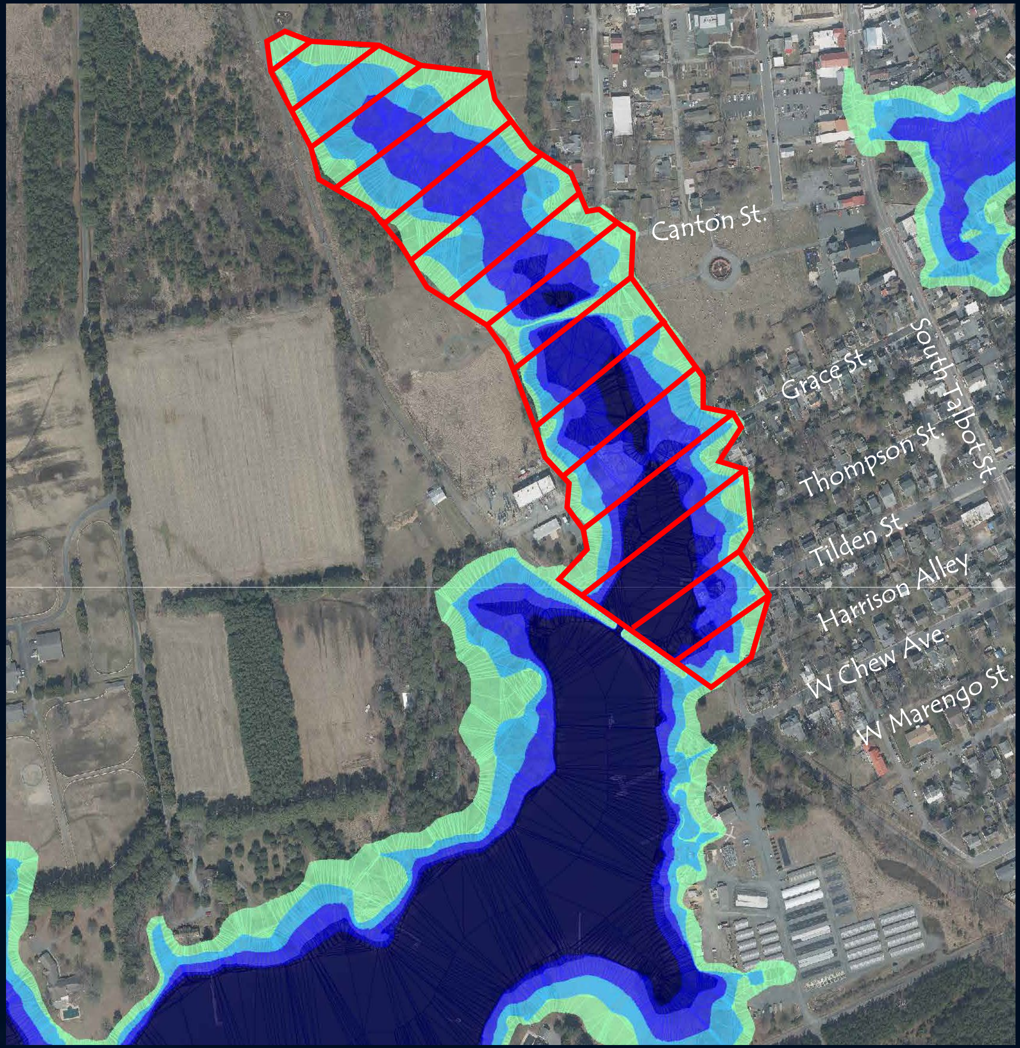
Project 2 & 3 – Tide Gate at St. Michaels Nature Trail Bridge



Project 2 & 3 – Tide Gate at St. Michaels Nature Trail Bridge

Table – Tide Gate Implementation Planning Level Costs

Description	Unit Size	Estimate Quantity	Unit Cost	Capital Cost
Design & Permitting	-	-	$180,000	$180,000
Installation of Tide Gate	EA	1	$1,000,000	$1,000,000
Elevation of Bridge and Pathway	LF	560	$1,500	$840,000
Subtotal				$2,020,000
20% Contingency				$404,000
Total Cost				$2,424,000



North Street Area – Drainage Study

- Assessment area experiences stormwater flooding which is anticipated to increase with climate change.
- Localized and persistent flooding of residential areas
  - North Street area has notably persistent flooding
- Roads, structures, and private residences affected
- Priorities for improving flooding and drainage
  - Protect private property
  - Minimize standing water in roads and yards
- Existing pipes and inlets are undersized and in poor condition
- Sedimentation and vegetation was commonly observed within the systems inlets and culverts

Recommendations

- Residential yard flooding
  - Regrade residential areas to divert flow from private property
  - Enlarge swales or Install additional swales to convey flow and prevent standing water
- Swale overtopping and roadway ponding
  - Enlarge swale size
  - Increase slope of swale
- Flooding of stormwater structures and inlets
  - Replace small inlets
  - Install Best Management Practices (BMPs) to capture and reduce runoff
  - Install underground vaults to provide additional storage
- Undersized stormwater system
  - Increase system size and capacity by replacing undersized pipes
  - Install additional pipes in parallel to increase capacity where pipe size is restricted
- Sedimentation and overgrown vegetation
  - Regular inspection and maintenance of culverts and inlet grates
  - Removal of sediment and leaf debris annually or when 1” of accumulation is observed

Flooding Prior to Improvement

Example Best Management Practice

Question and Answer Session

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  - Phone: 410-694-9401