

Manchester-by-the-Sea

Coastal Resilience Forum

Manchester Community Center
Harbor Point
February 11, 2016



Mary Reilly, Manchester-by-the-Sea, Grants
Administrator

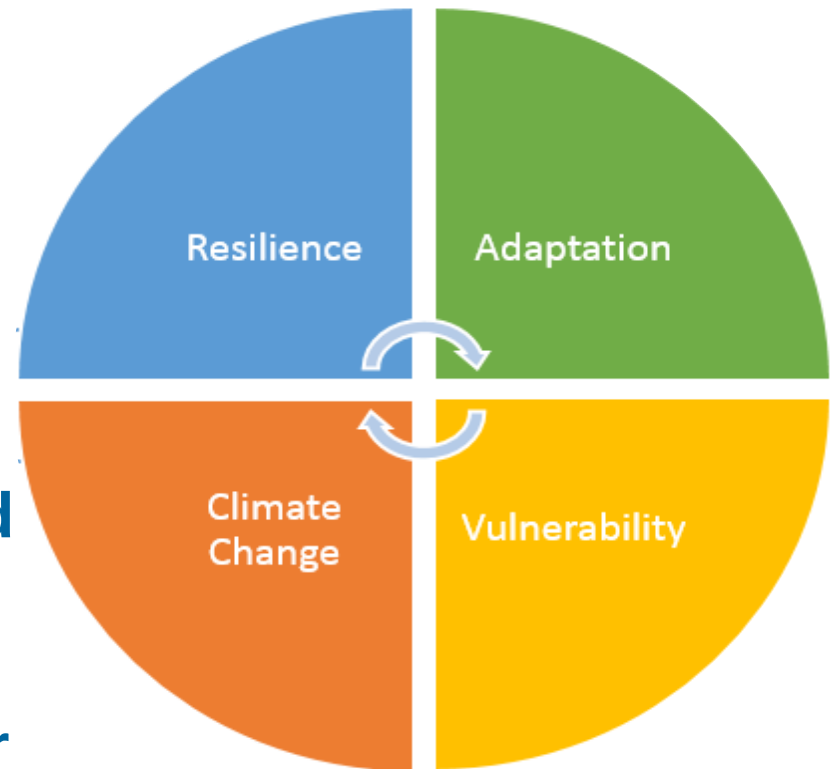
Gabrielle Belfit, Senior Environmental Scientist

Janet Moonan, P.E., Project Engineer

Maggie Hernandez, Staff Engineer

Getting Started

- **Objective: address potential impacts of climate change**
- **Define the main issues for Manchester**
- **Define the sectors that would be most adversely impacted**
- **Define mitigation projects for resiliency**



Coordinated Grants



Sawmill Brook Culvert and Green Infrastructure Analysis



Massachusetts Office of
Coastal Zone Management

Hazard Mitigation Plan Enhancement: Vulnerability Risk Assessment due to Climate Change



FEMA



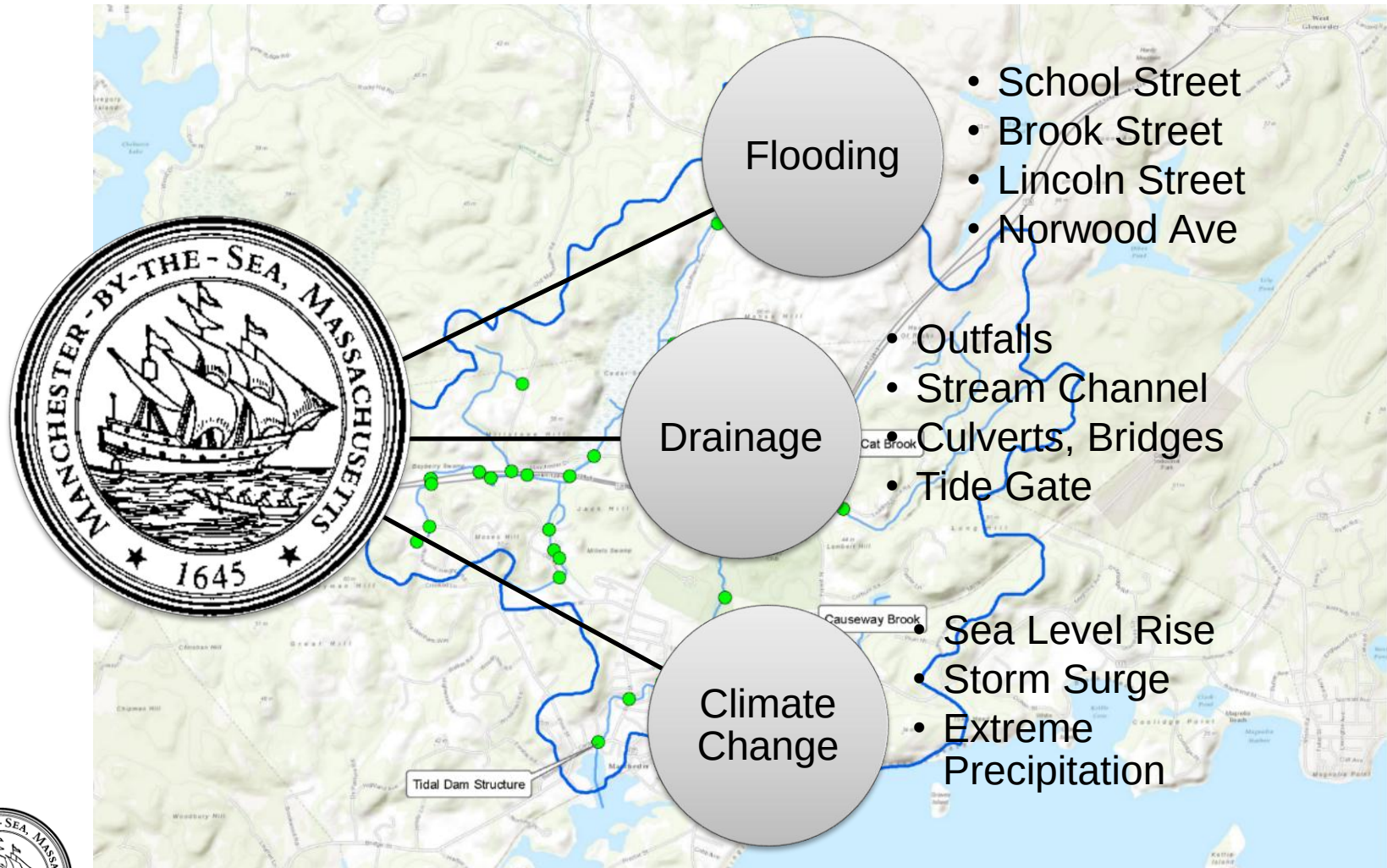
Community Involvement

Coastal Resilience Advisory Group

- *Town Administrator*
- *Grants Administrator*
- *Fire Captain*
- *Police Representative*
- *DPW Director*
- *Town Planner*
- *Salem Sound Coast Watch*
- *Manchester Coastal Stream Team*
- *Downtown Improvement Committee*
- *Citizen Advisors*
- *Coastal Zone Management*
- *Massachusetts Emergency Management Agency*



Watershed Concerns





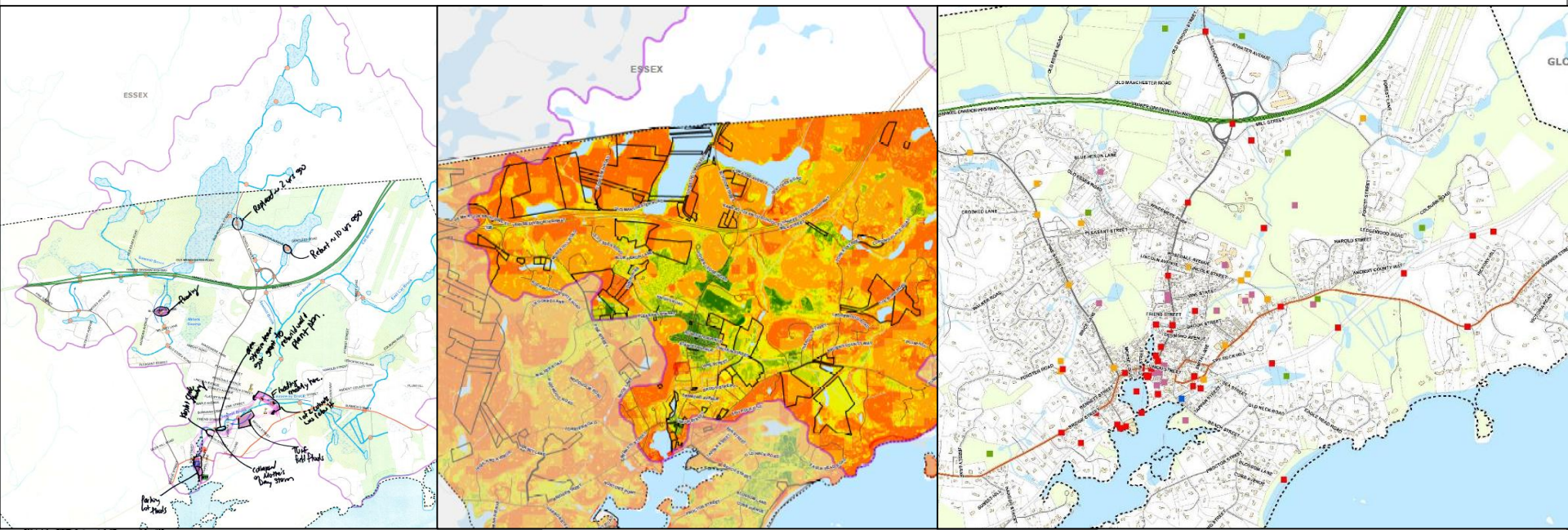
Grants Overview

- **Desktop Watershed Assessment**
- **Analysis of Culverts**
- **Hydrologic Modeling with Climate Change**
- **Enhancement to Manchester's current Hazard Mitigation Plan to address climate change impacts**
- **Locations for Flood Mitigation**
- **Conceptual Designs for Mitigation**



Desktop Assessment

- Where does it flood?
- What opportunities exist to reduce flooding and impacts from climate change?
- Where are critical community assets located?



Field Survey

23 culverts assessed in Sawmill Brook Watershed



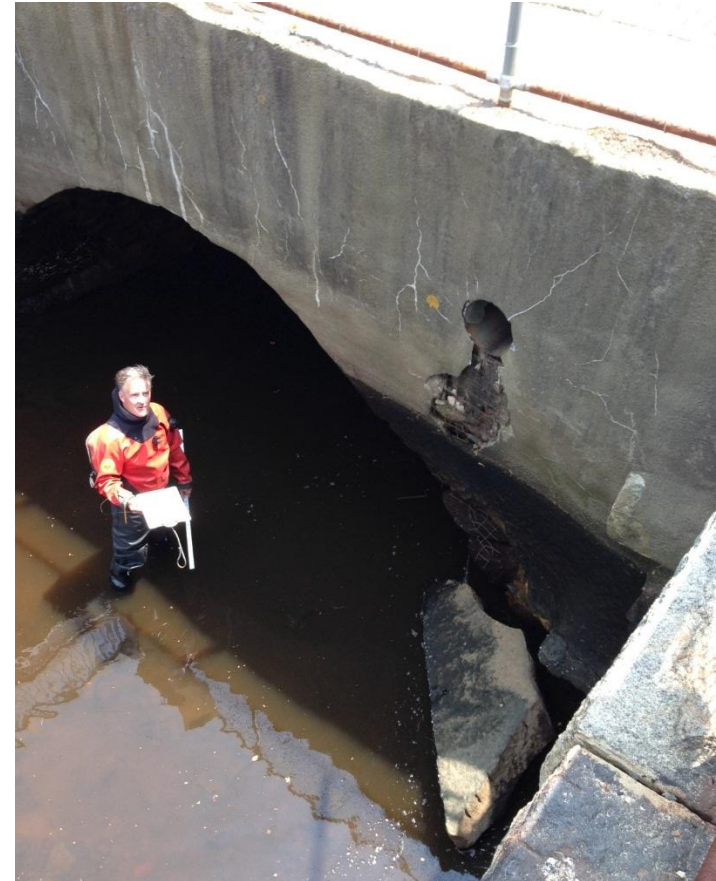
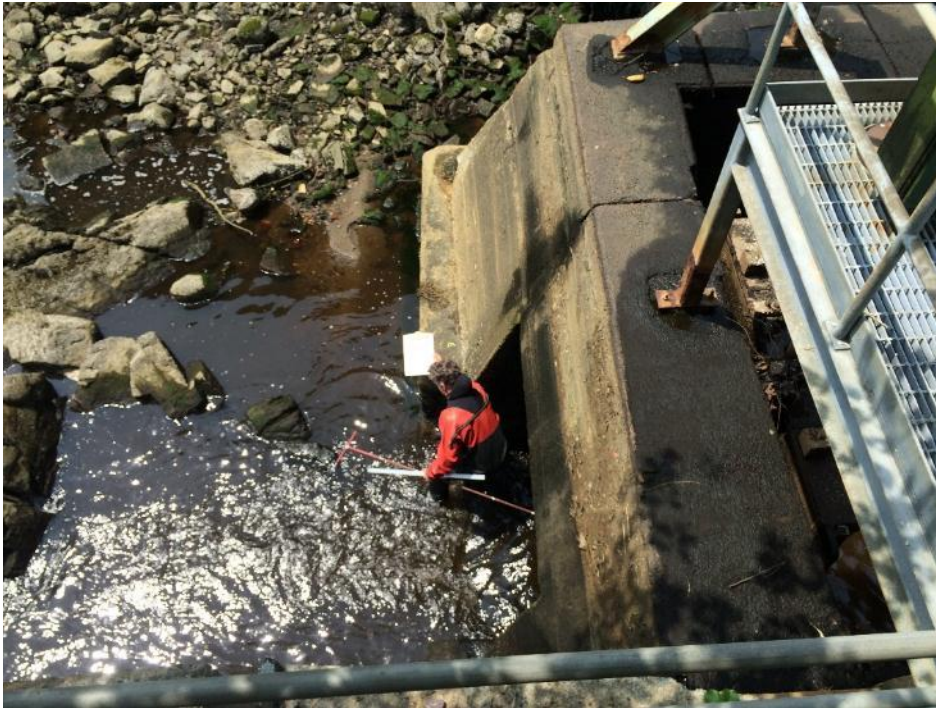
Field Survey

**15 Sites assessed for green infrastructure
and flood mitigation opportunities**



Field Survey

Central Street Tide Gate & Culvert evaluated



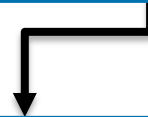
Existing and Future Conditions Model



Model existing conditions



Evaluate future potential flooding
Impacts due to climate change



Identify mitigation value of
Green infrastructure and
flood storage

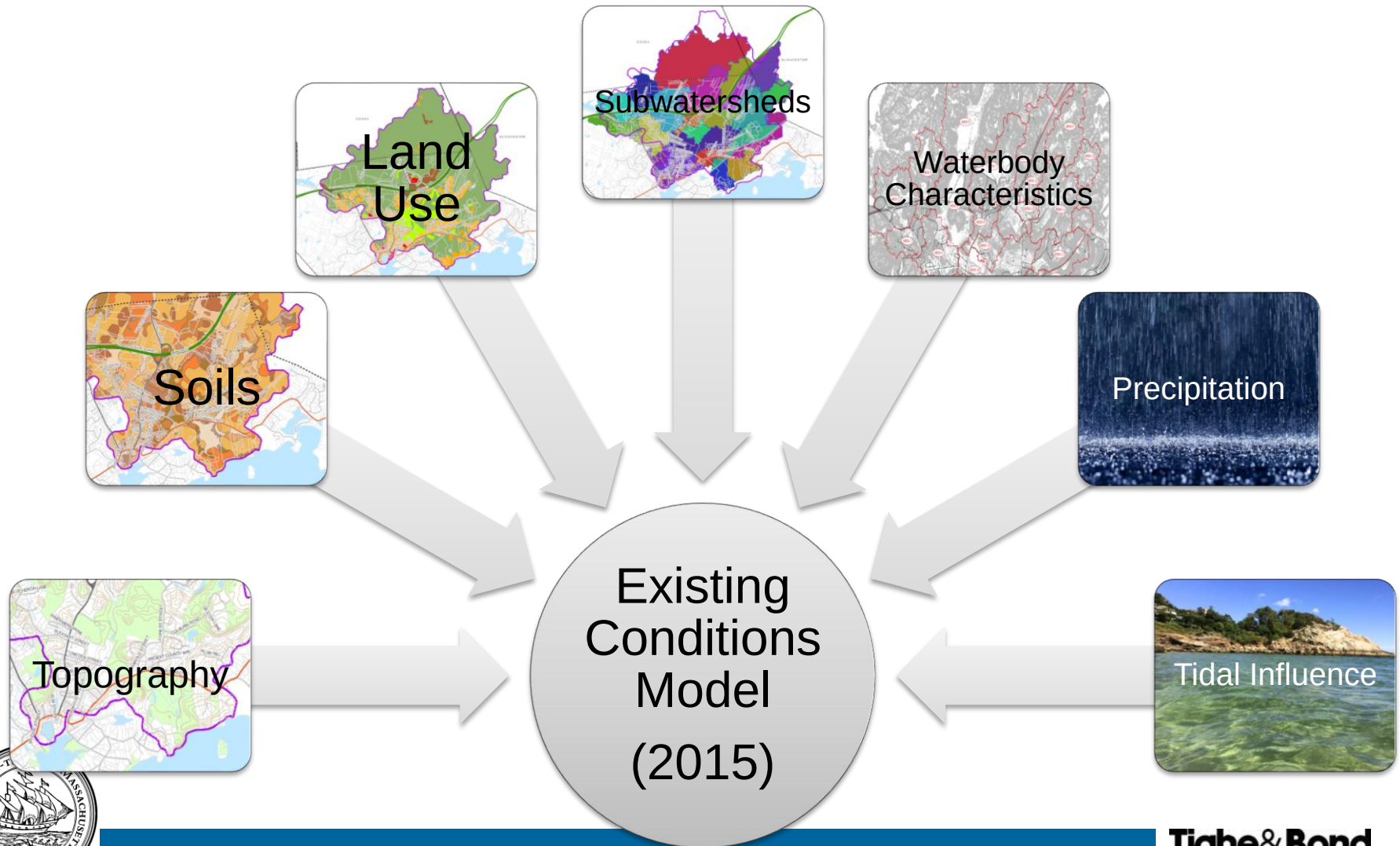


Assess adequacy
of culvert sizes

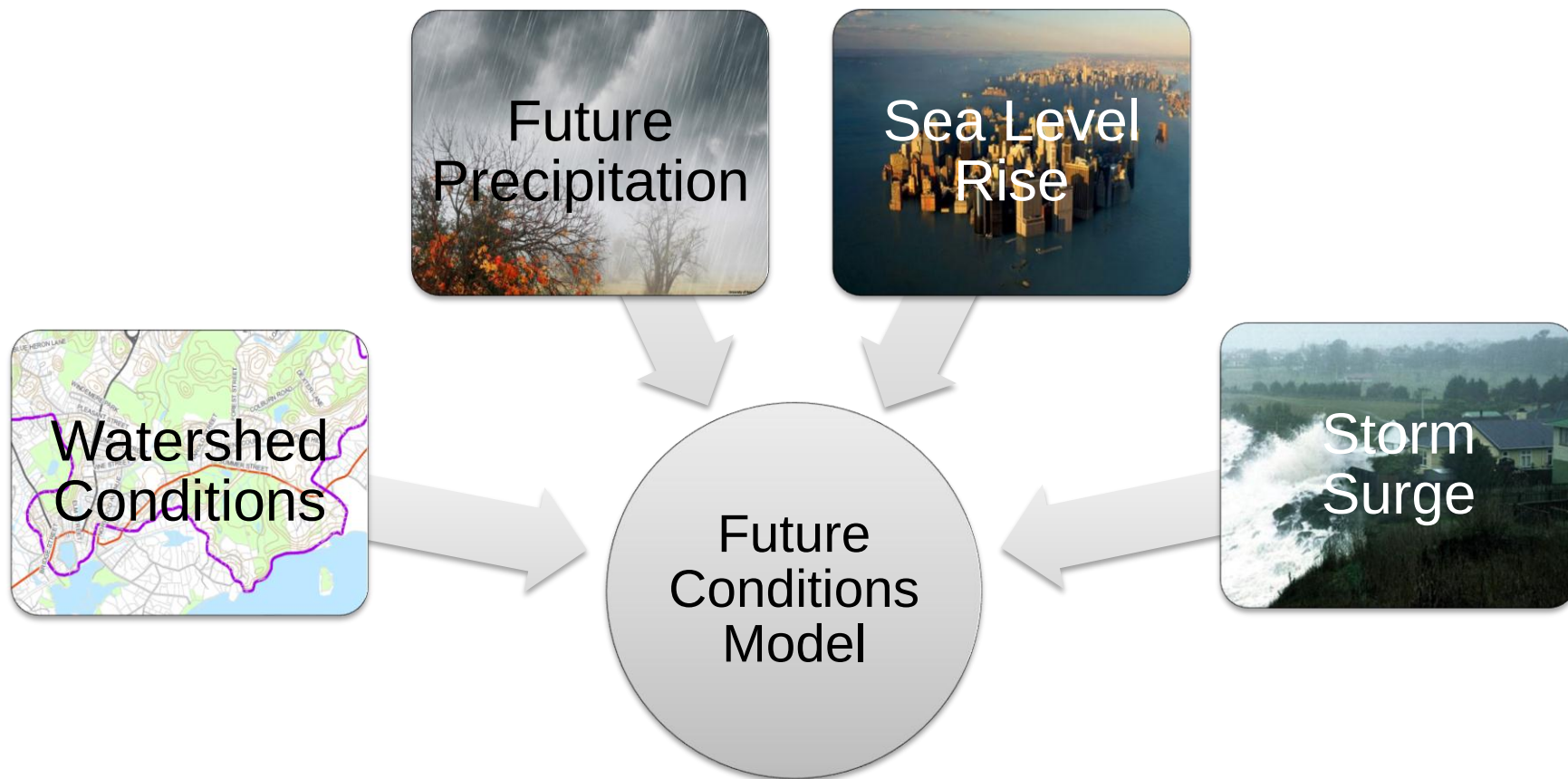


Identify impact on
Community Assets

Existing Conditions Model Inputs



Future Conditions Model Inputs

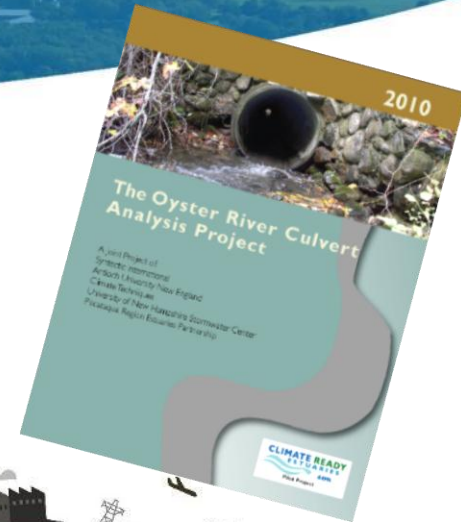


2025 2050 2100



Future Conditions Model Future Precipitation

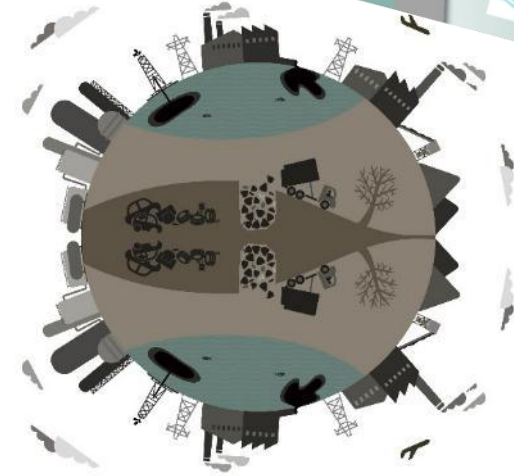
UNH Oyster River Culvert Analysis Rainfall depths for 2025, 2050, 2100



Two scenarios:



**Balanced
Energy Use**



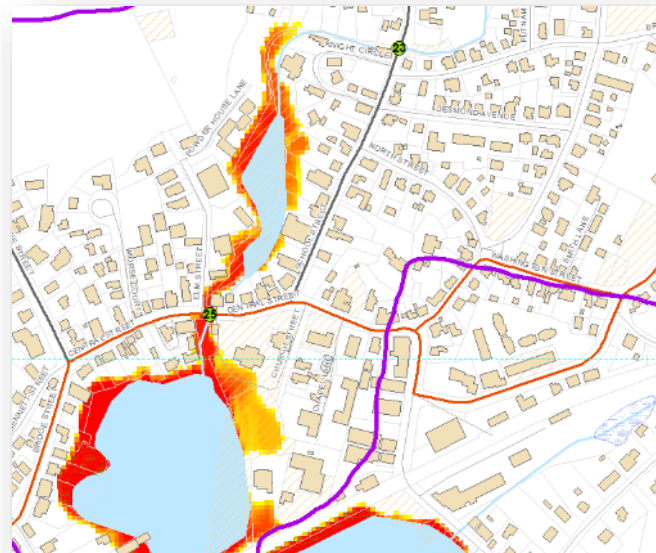
**Fossil Intensive
Energy Use**



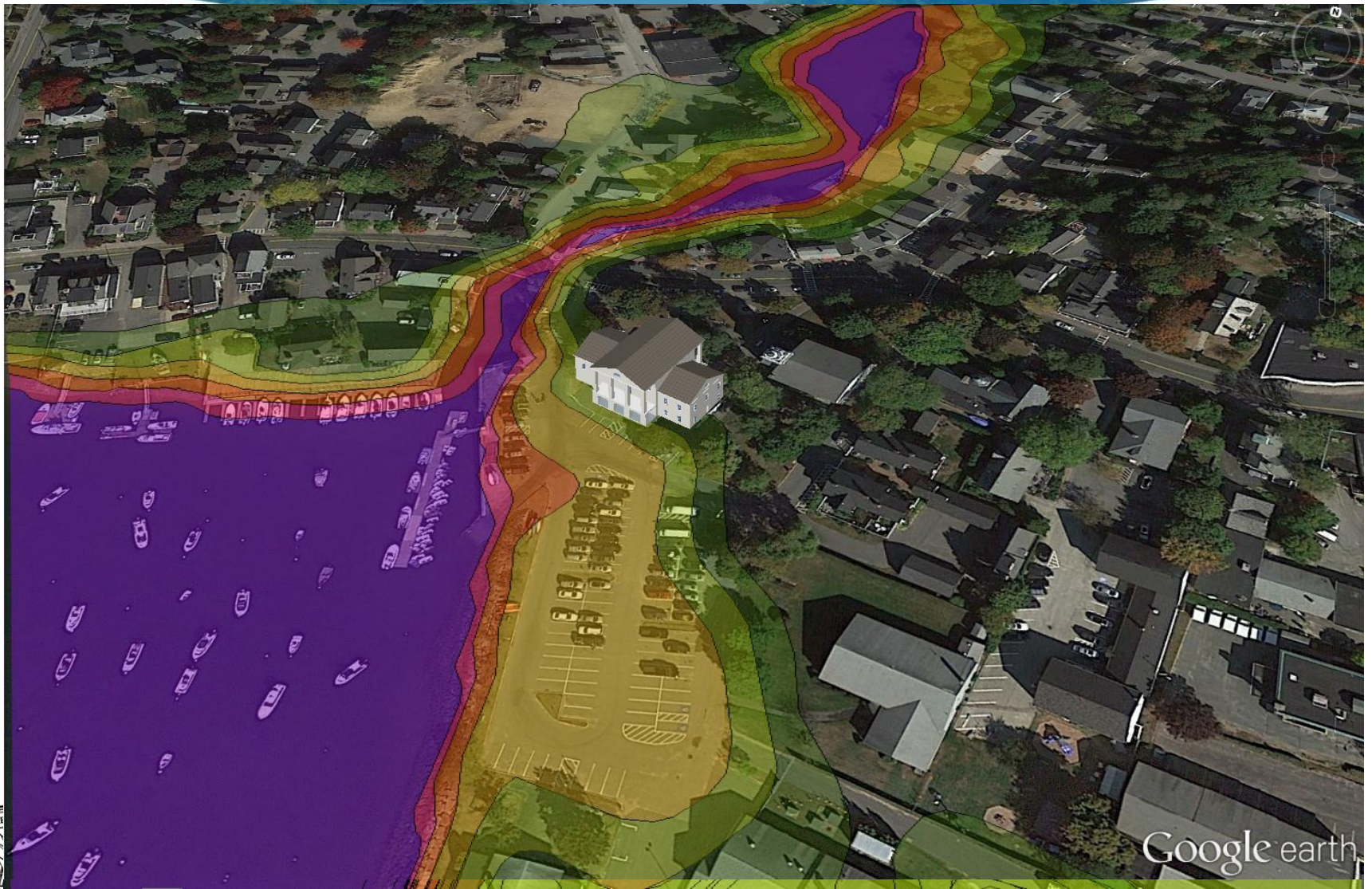
Future Conditions Model Sea Level Rise & Storm Surge

Elevations for 2025, 2050, 2100 in model based on...

- Inundation Risk Model (IRM) developed by Keil Schmidt of Geoscience Consultants
- Location of 50% probability output (i.e. flooding is as likely to occur as not occur)



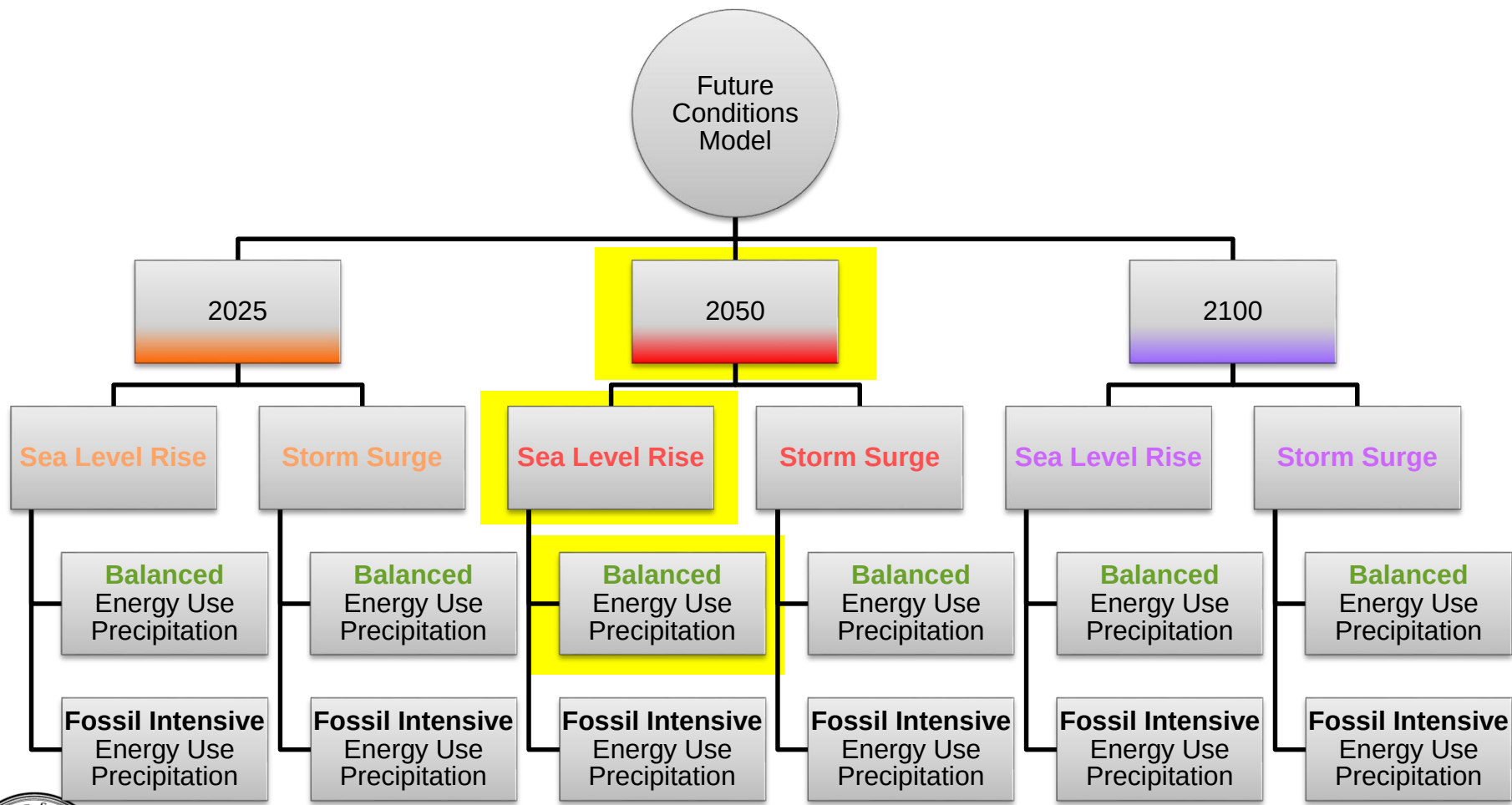
Inundation Risk Model Output



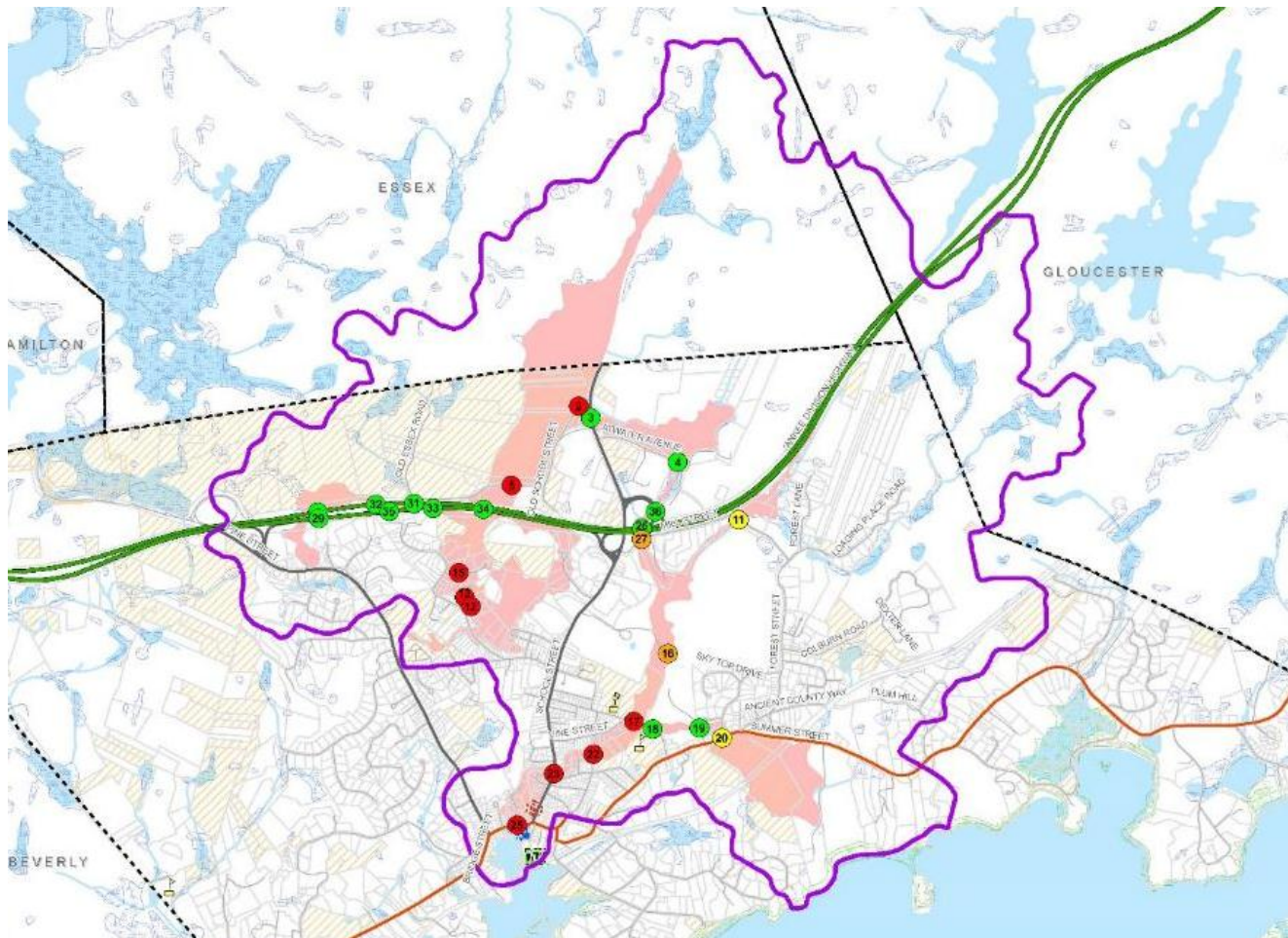
Google earth

Tighe&Bond

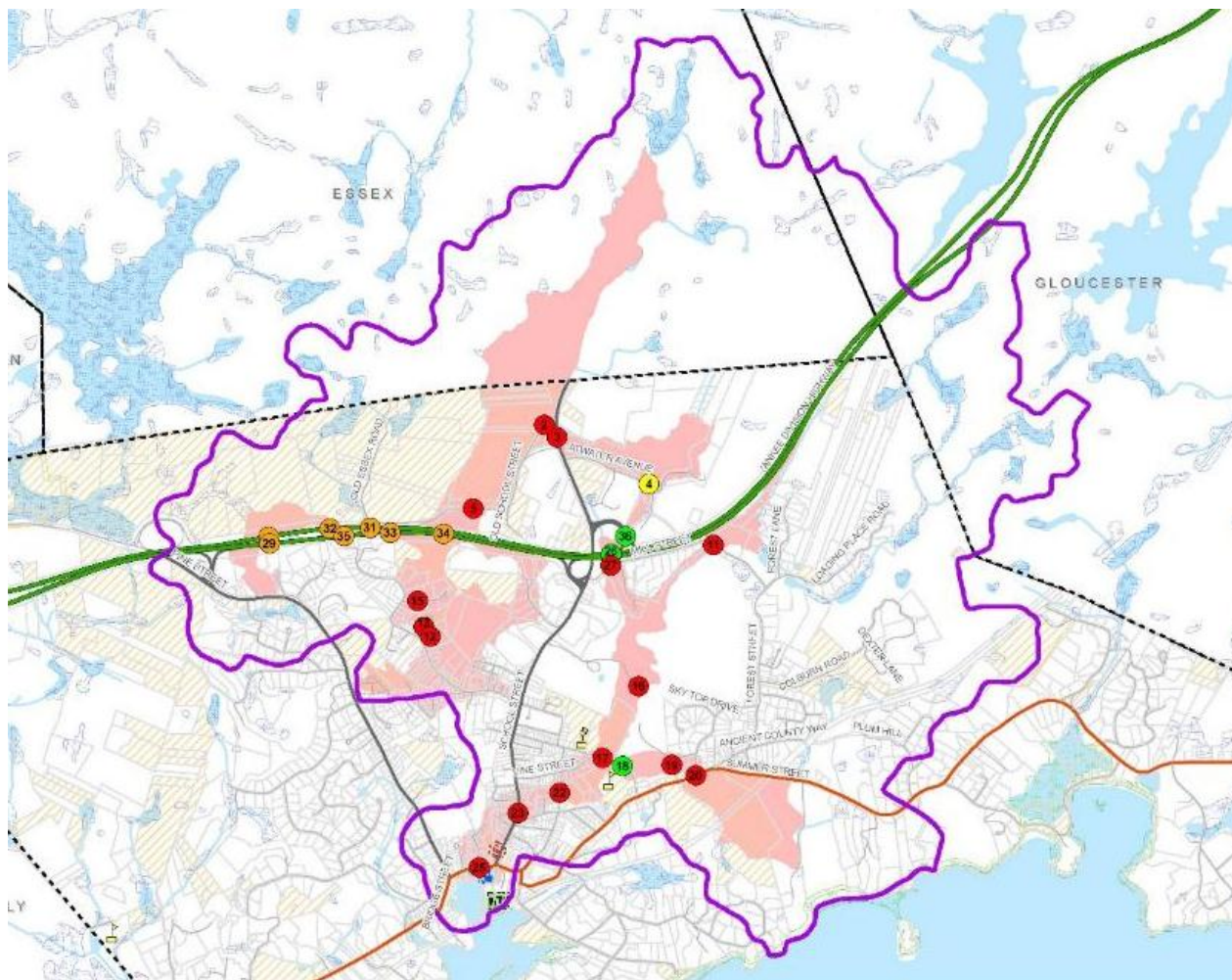
Future Conditions Model Outputs



Culvert Results 2025



Culvert Results 2100



MANCHESTER-BY-THE-SEA HAZARD MITIGATION PLAN ENHANCEMENT

Vulnerability Risk Assessment Due to Climate Change

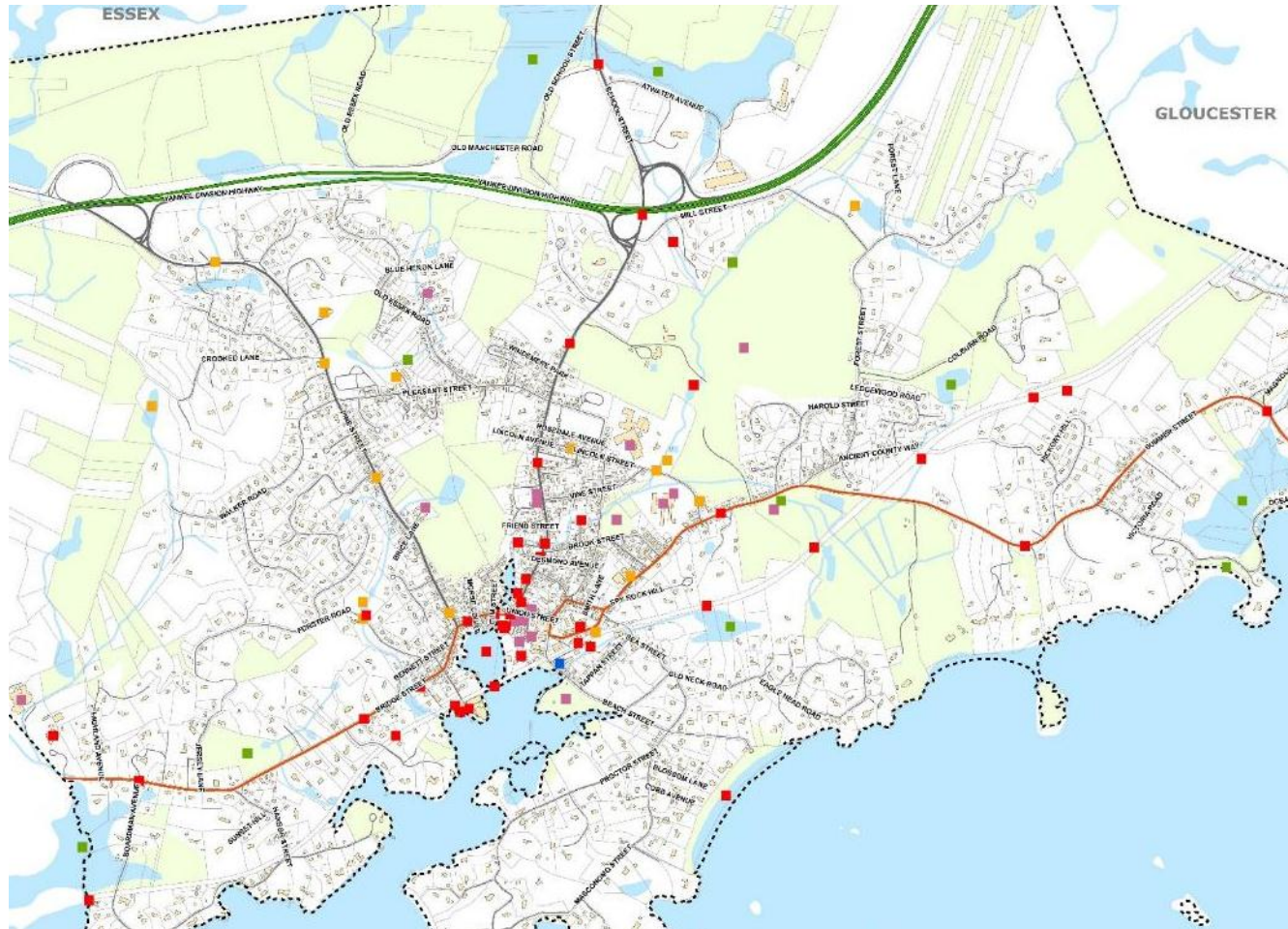


Community Asset Organization

FEMA Community Asset Categories	Critical Sectors	Characteristics of Community Assets
People	Schools, Vulnerable Populations, Cultural Facilities	Areas of greater population density, or population with unique vulnerabilities or less able to respond and recover during a disaster.
Built Environment	Critical Municipal Facilities, Water, Wastewater, Energy, Stormwater, Transportation, Cultural Resources	Critical facilities necessary for a community's response to and recovery from emergencies, infrastructure critical for public health and safety, economic viability, or needed for critical facilities to operate.
Economy	Marinas, Downtown Business District	Major employers, primary economic sectors and commercial centers where loss or inoperability would have severe impact on the community and ability to recover from a disaster.
Natural Environment	Natural Resources	Areas that provide protective function to reduce magnitude of hazard impact and increase resiliency. Areas of sensitive habitat that are vulnerable to hazard events, protection of areas that are important to community objectives, such as the protection of sensitive habitat, provide socio-economic benefits, etc.



Community Asset Locations



Community Asset Results

RISK KEY:

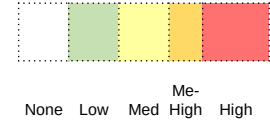
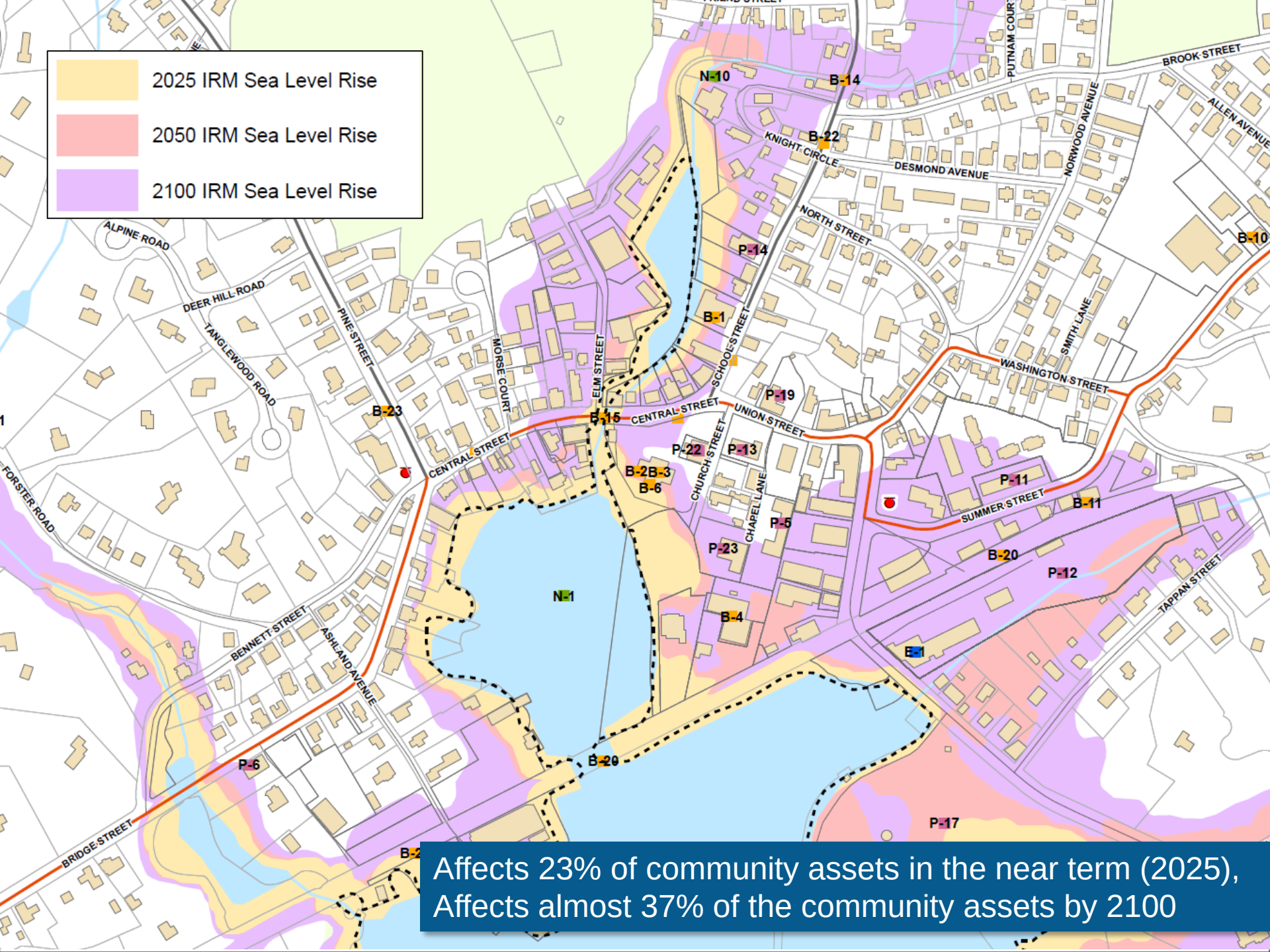


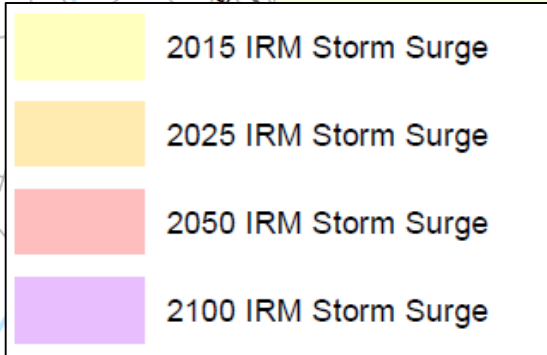
Table 7 - Community Asset: People
Risk of Flooding for 2015, 2025, 2050, 2100

ID	NAME	ADDRESS	Sector Code	Flood Zone Elevation (ft)	IRM Sea Level Rise				IRM Shallow Coastal Flooding				IRM Storm Surge				IRM Hurricane/ Cat 1				Upland Flooding			
					2015	2025	2050	2100	2015	2025	2050	2100	2015	2025	2050	2100	2015	2025	2050	2100	2015	2025	2050	2100
P-1	Brookwood Elementary School	1 Brookwood Road	CB	14	N/A													N/A	N/A	N/A				
P-2	Manchester Memorial Elementary School	71 Lincoln Street	CB	15	N/A													N/A	N/A	N/A				
P-3	Manchester Essex Regional Middle High School	36 Lincoln Street	CB		N/A													N/A	N/A	N/A				
P-4	Landmark School	167 Bridge Street	VP	14	N/A													N/A	N/A	N/A				
P-5	Magic Years Nursery School	3 Chapel Lane	VP	13	N/A													N/A	N/A	N/A				
P-6	Shore Nursery School	38 Bridge Street	VP	11	N/A													N/A	N/A	N/A				
P-7	Hornet's After School Program	71 Lincoln Street	VP	15	N/A													N/A	N/A	N/A				
P-8	Tara Montessori School	60 School Street	VP		N/A													N/A	N/A	N/A				
P-9	The Plains Seniors Housing	The Plains Road	VP		N/A													N/A	N/A	N/A				



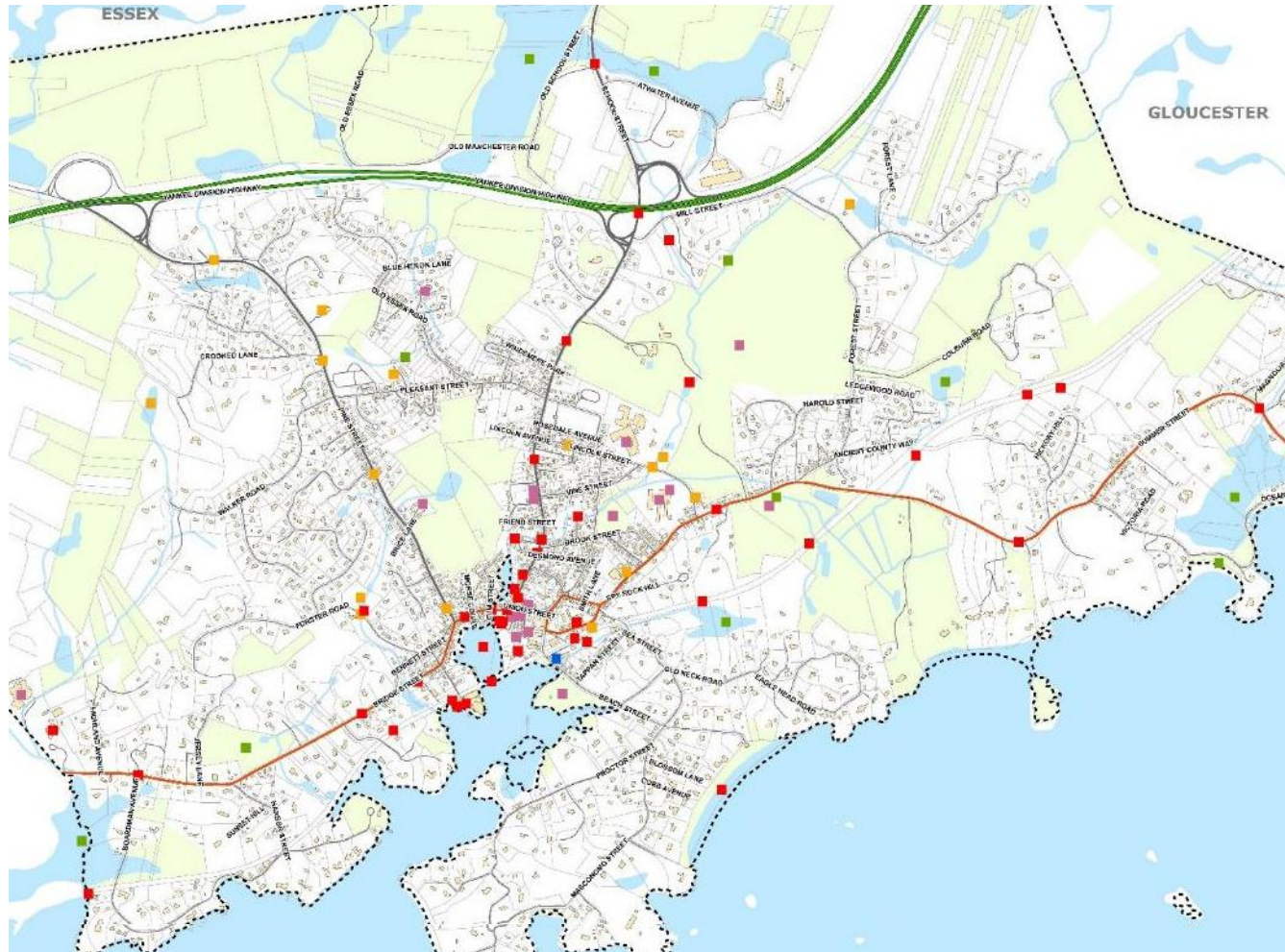


Affects 23% of community assets in the near term (2025),
Affects almost 37% of the community assets by 2100



Affects 33% of community assets in the near term (2025),
Affects over 50% of the community assets by 2100

Community Asset Locations



Selected Community Assets

People (6)

- Landmark School
- Magic Years Nursery School
- First Baptist Church
- Congregational Church
- Summer Street Apartments
- The Plains Senior Housing

Built Environment (12)

- Fire Department
- Police Department
- Town Hall & Emergency Operations
- DPW Garage
- Manchester Waste Water Treatment Plant
- Lincoln Street Well & Pump Station
- Downtown Stormwater Drainage
- Central Street Dam & Culvert
- School Street & Culvert
- Lincoln Street & Culvert
- MBTA Tracks & Bridge
- Route 127

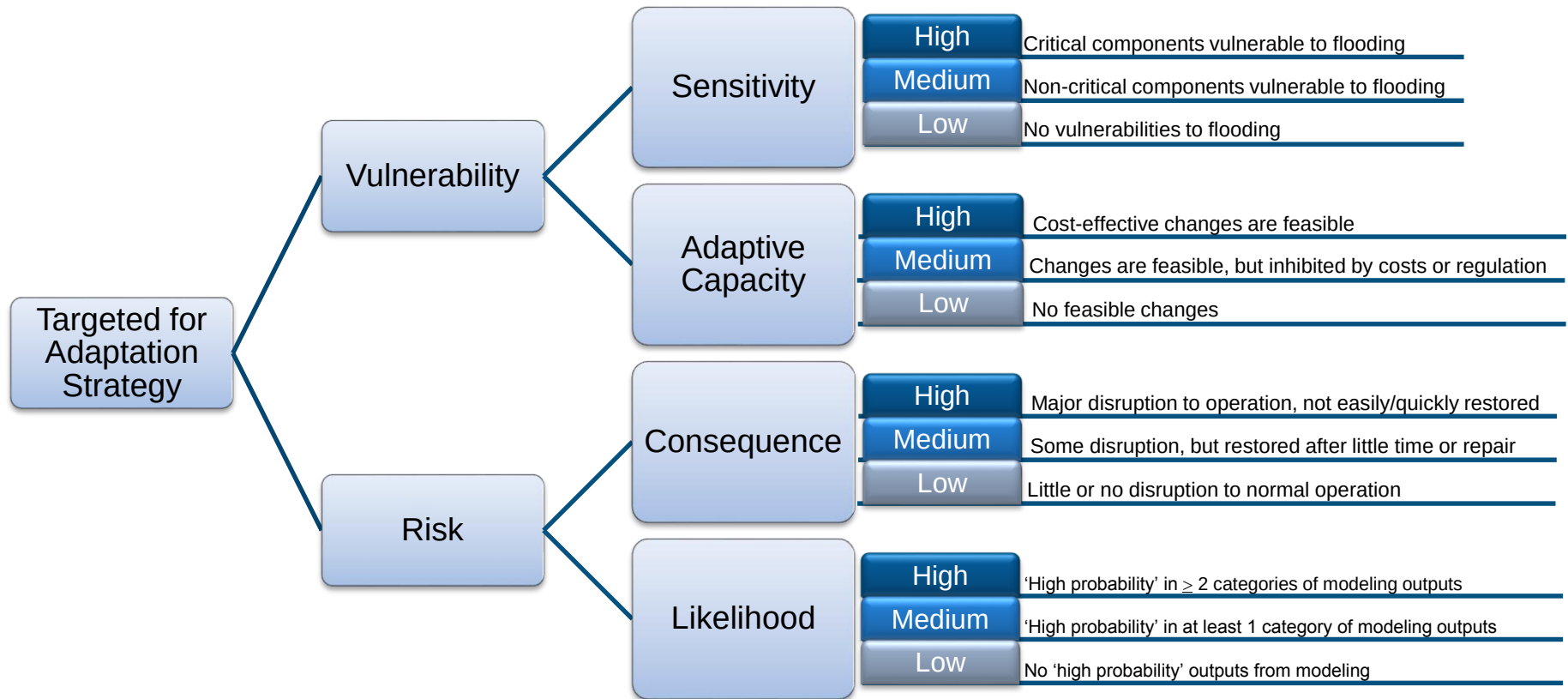
Natural Resources (5)

- Manchester Harbor
- Singing Beach
- Millet's Brook & Swamp
- Sawmill Brook
- Bennet's Brook & Marsh

Economy (3)

- Selected Downtown Business
- Manchester Marine
- Crocker's Boat Yard

Risk and Vulnerability Assessment (RVA) Rating System



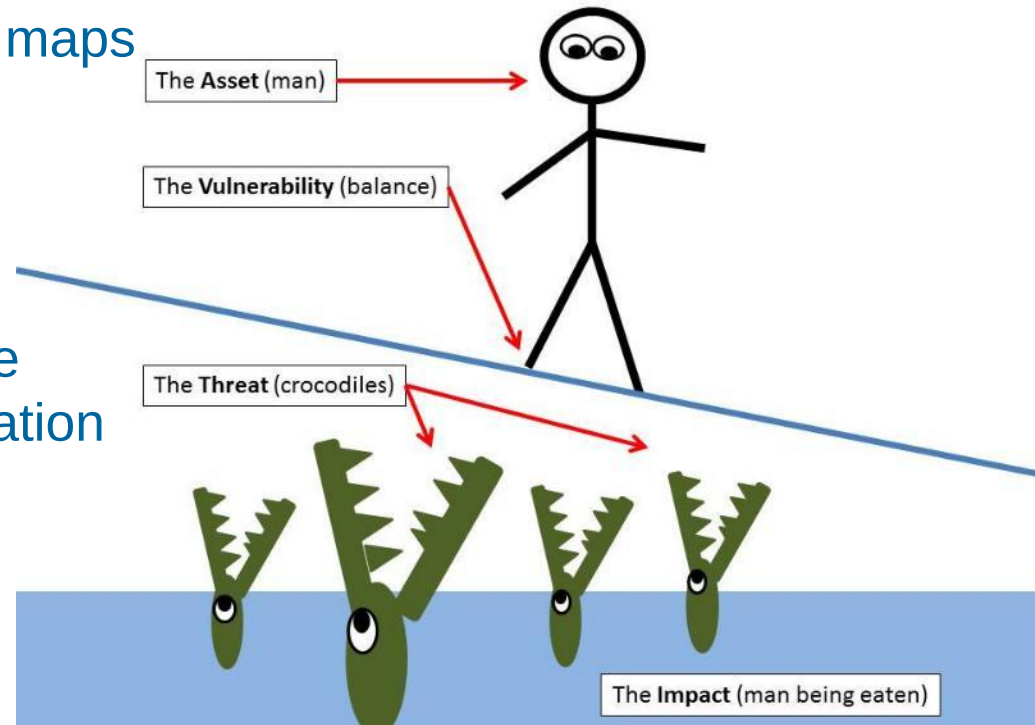
RVA Approach

Step 1: Develop rating system for sensitivity, adaptive capacity, consequence and likelihood

Step 2: Site visits and interviews with town personnel and building staff

Step 3: Review existing modeling maps and data collected in Step 2 to assign ratings

Step 4: Evaluate ratings and develop list of high risk/ vulnerable sites that have potential for adaptation



Overview of Potential Flood Reduction Improvements Assessed

Flood Storage upstream
Old School Street
(Culvert 2)

Flood Storage
along Coach
Field Playground

Green
Infrastructure at
High School

Flood Storage in
Golf Course

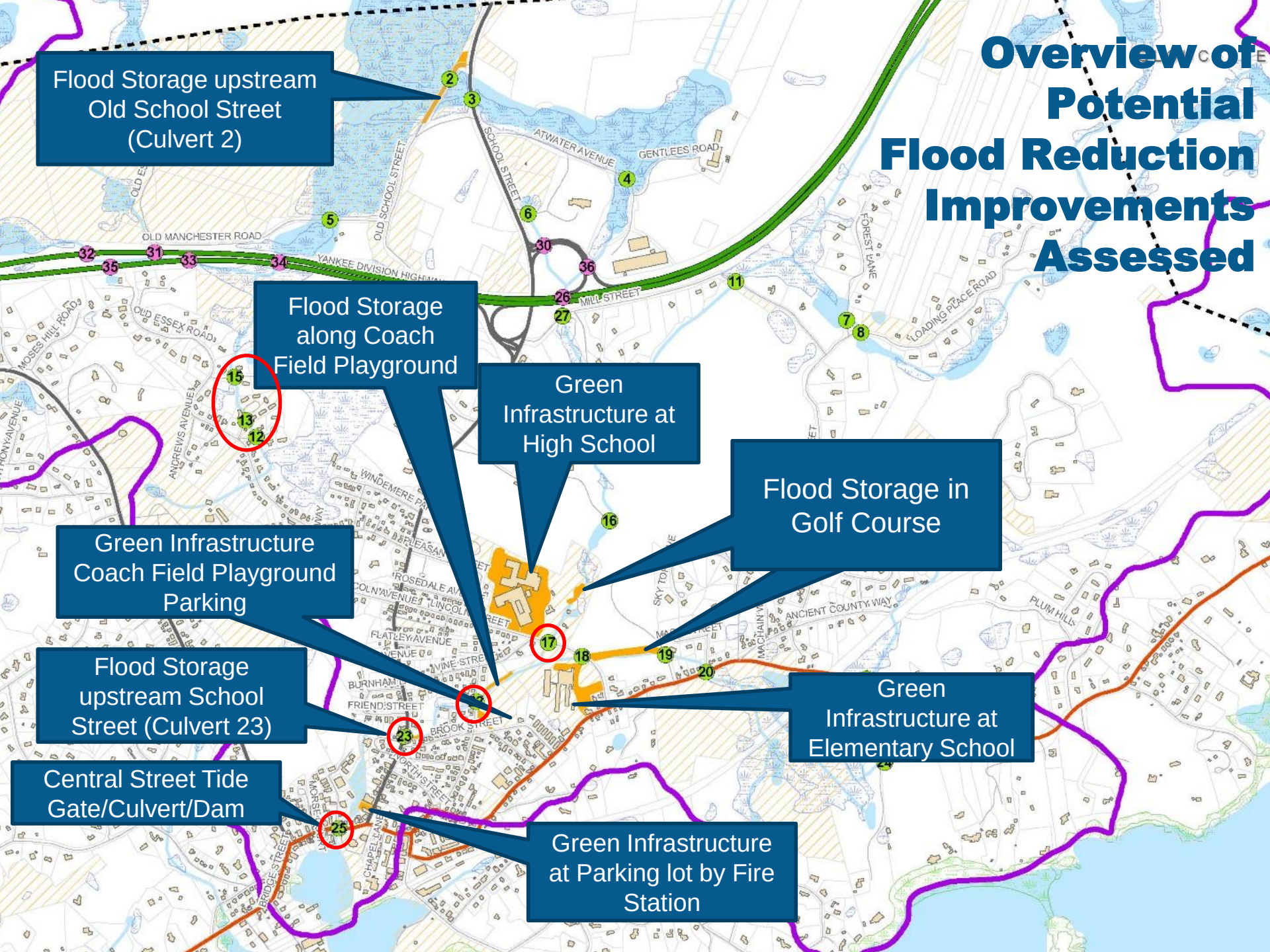
Green Infrastructure
Coach Field Playground
Parking

Flood Storage
upstream School
Street (Culvert 23)

Green
Infrastructure at
Elementary School

Central Street Tide
Gate/Culvert/Dam

Green Infrastructure
at Parking lot by Fire
Station



Nine Planning Level Designs

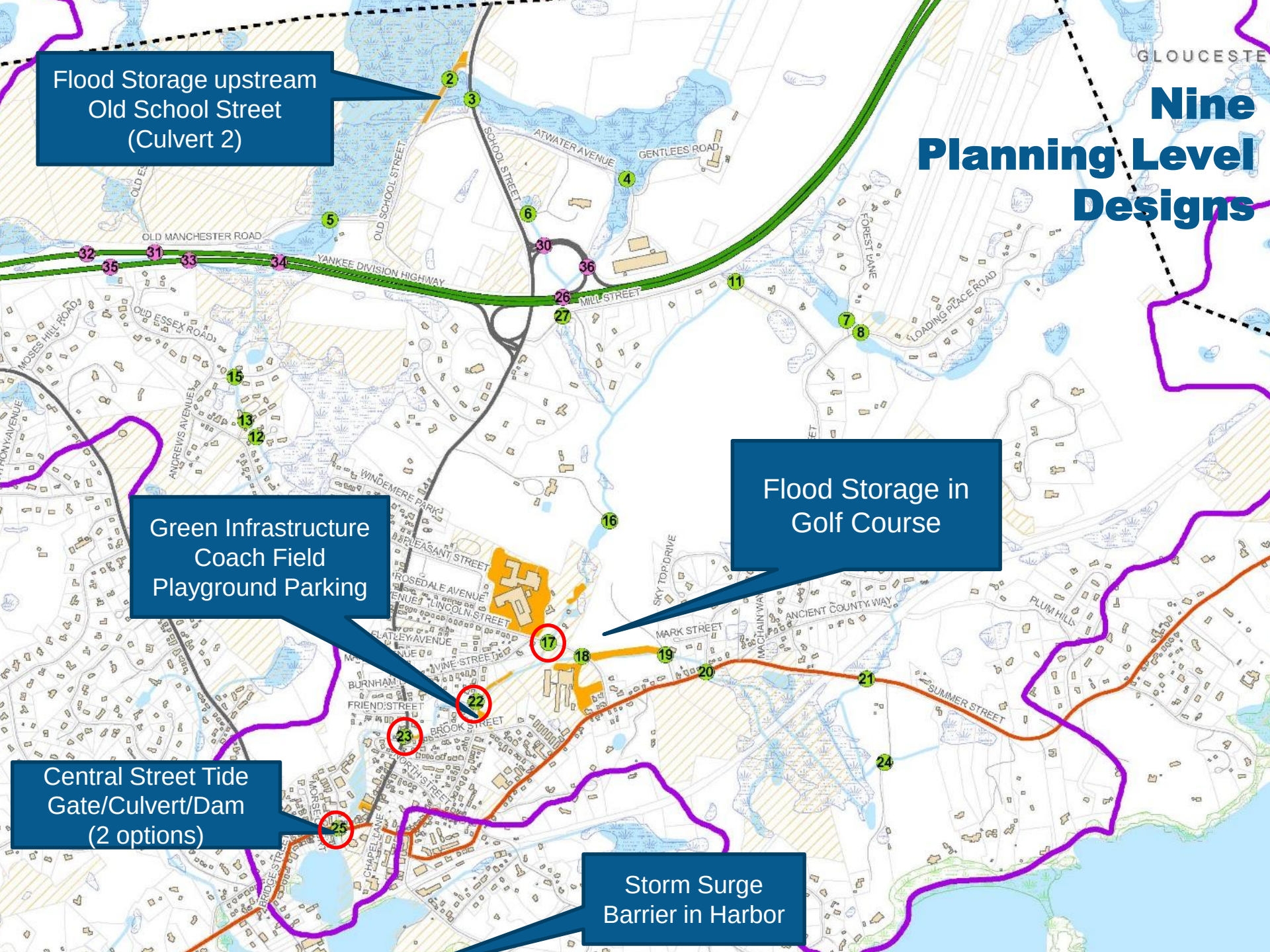
Flood Storage upstream
Old School Street
(Culvert 2)

Flood Storage in
Golf Course

Green Infrastructure
Coach Field
Playground Parking

Central Street Tide
Gate/Culvert/Dam
(2 options)

Storm Surge
Barrier in Harbor



Prioritization Considerations

- Flooding reduction (short term and long term)
- Cost
- Permitting
- Project phasing
- Coordination with other Town projects
- Operation & Maintenance



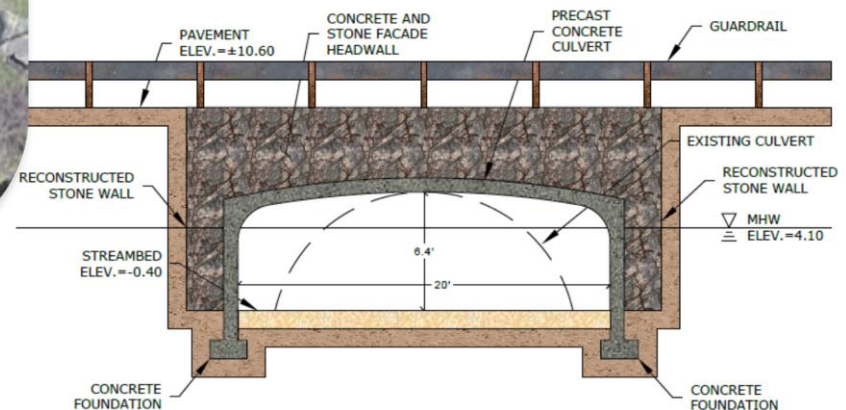
Tide Gate & Culvert Improvements



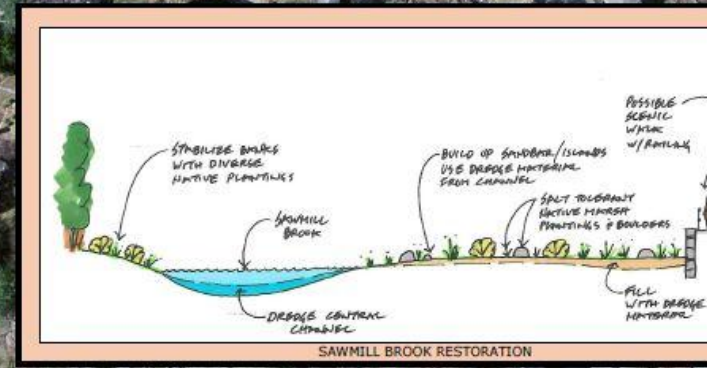
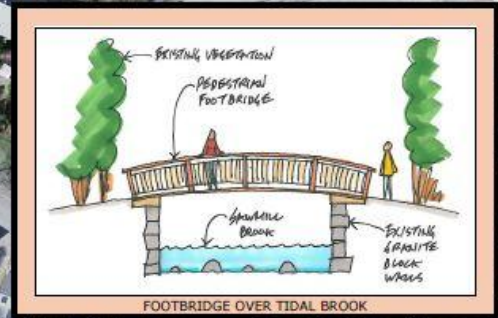
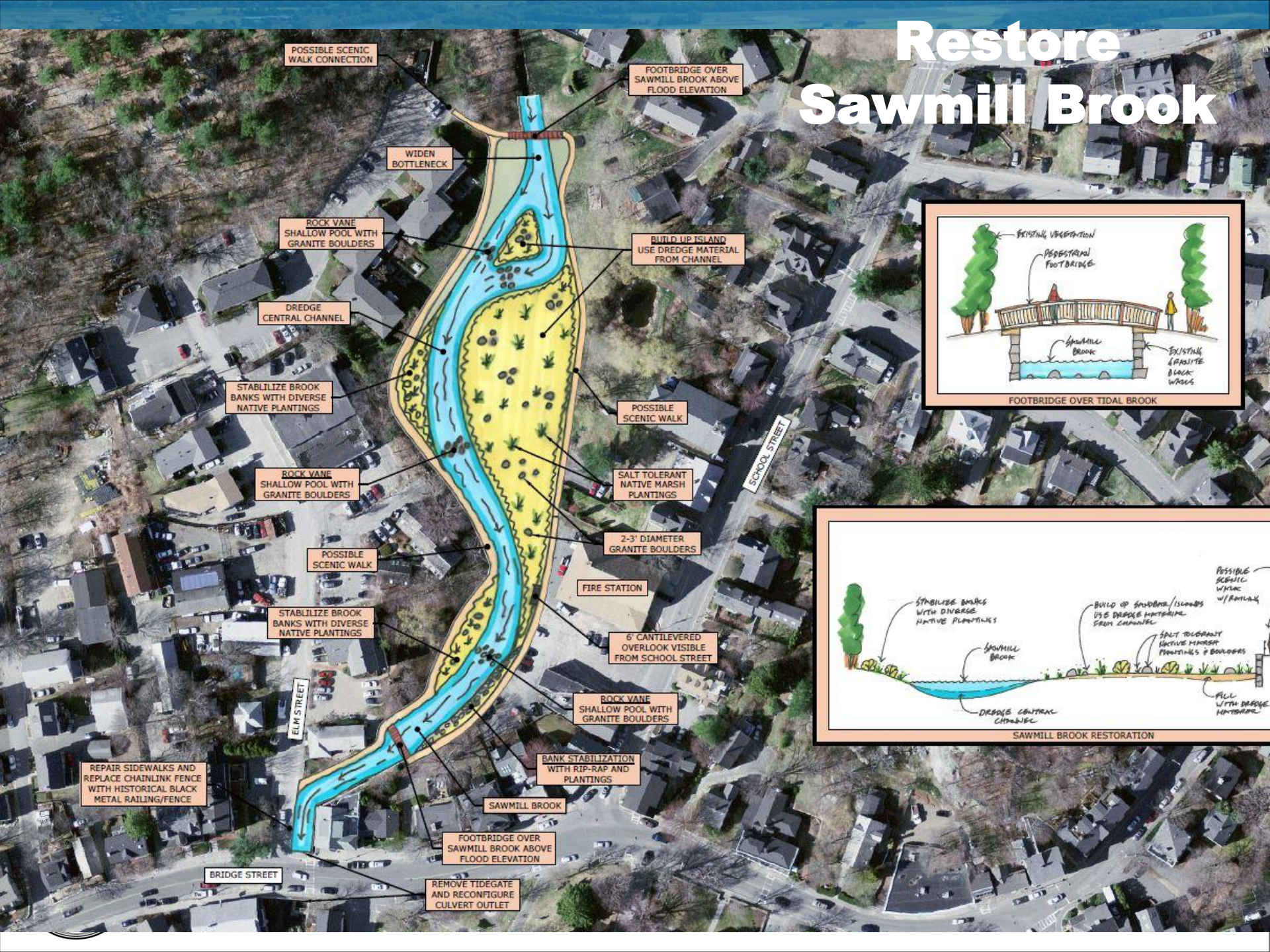
Central Street Tide Gate and Culvert Improvements – Option 2 Replace



- Remove tide gate
- Replace culvert
- Restore seawall
- Restore Central Pond



Restore Sawmill Brook



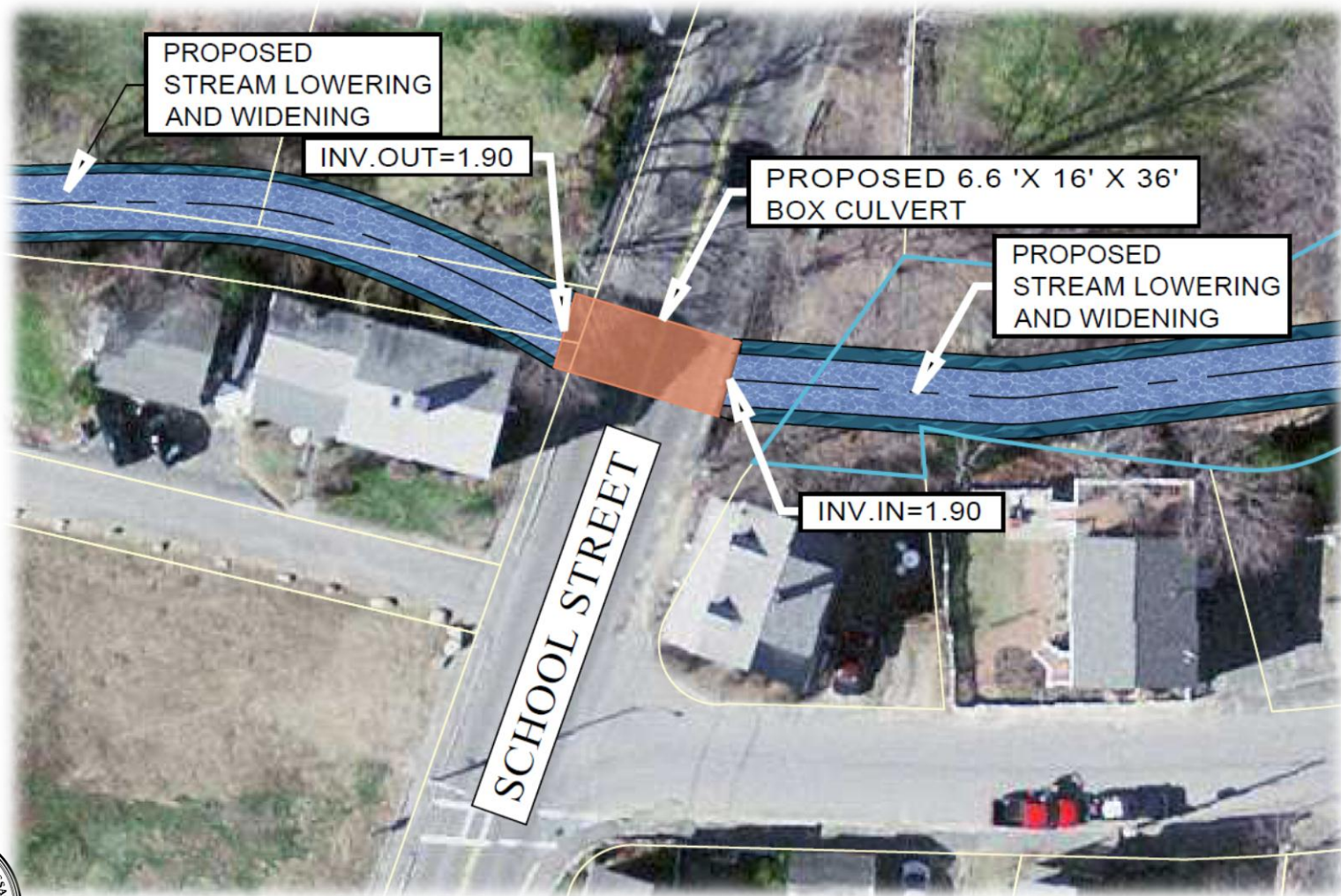




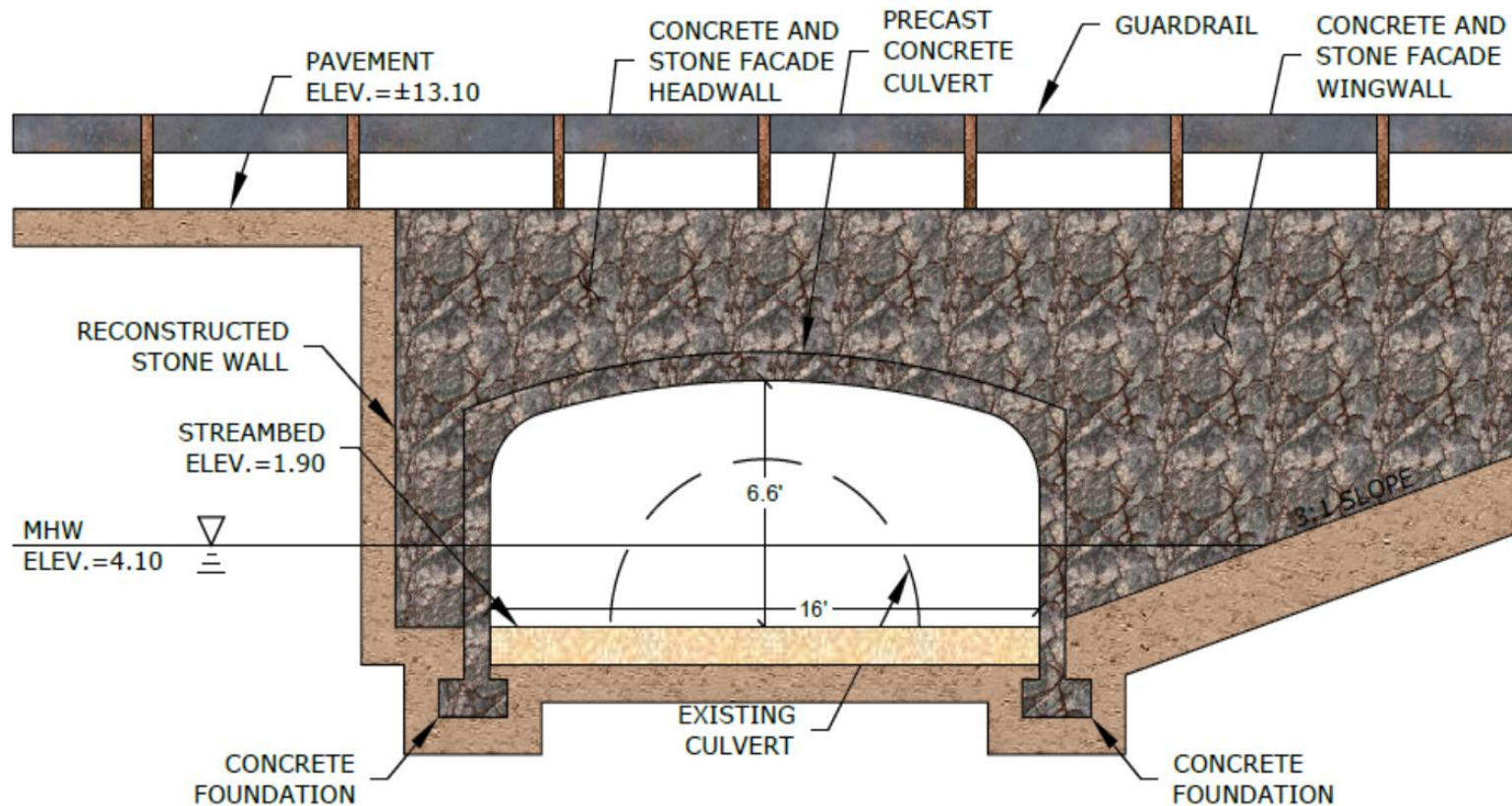
Culvert 23 – School Street



Culvert Improvement at School Street



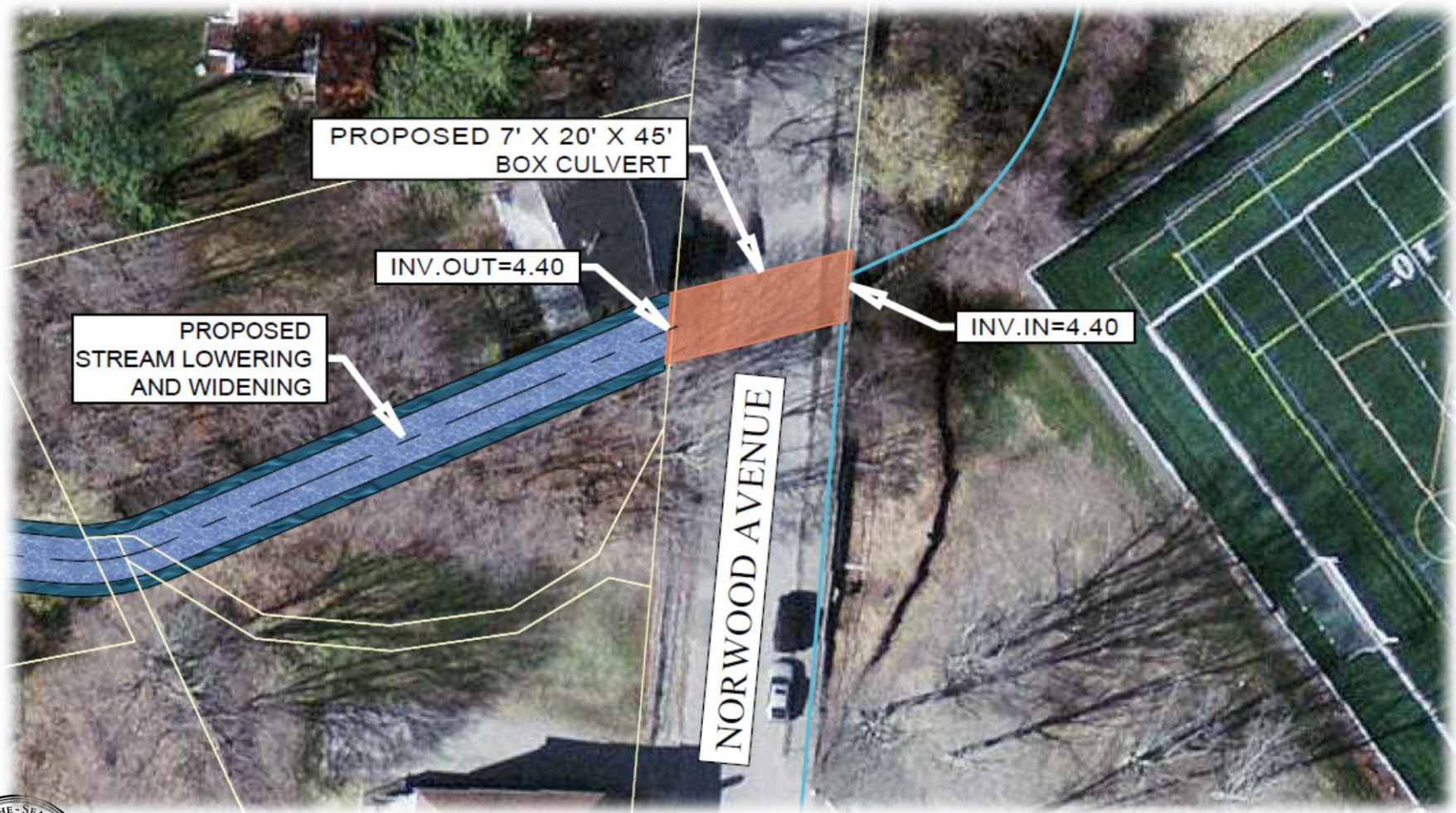
Culvert Improvement at School Street



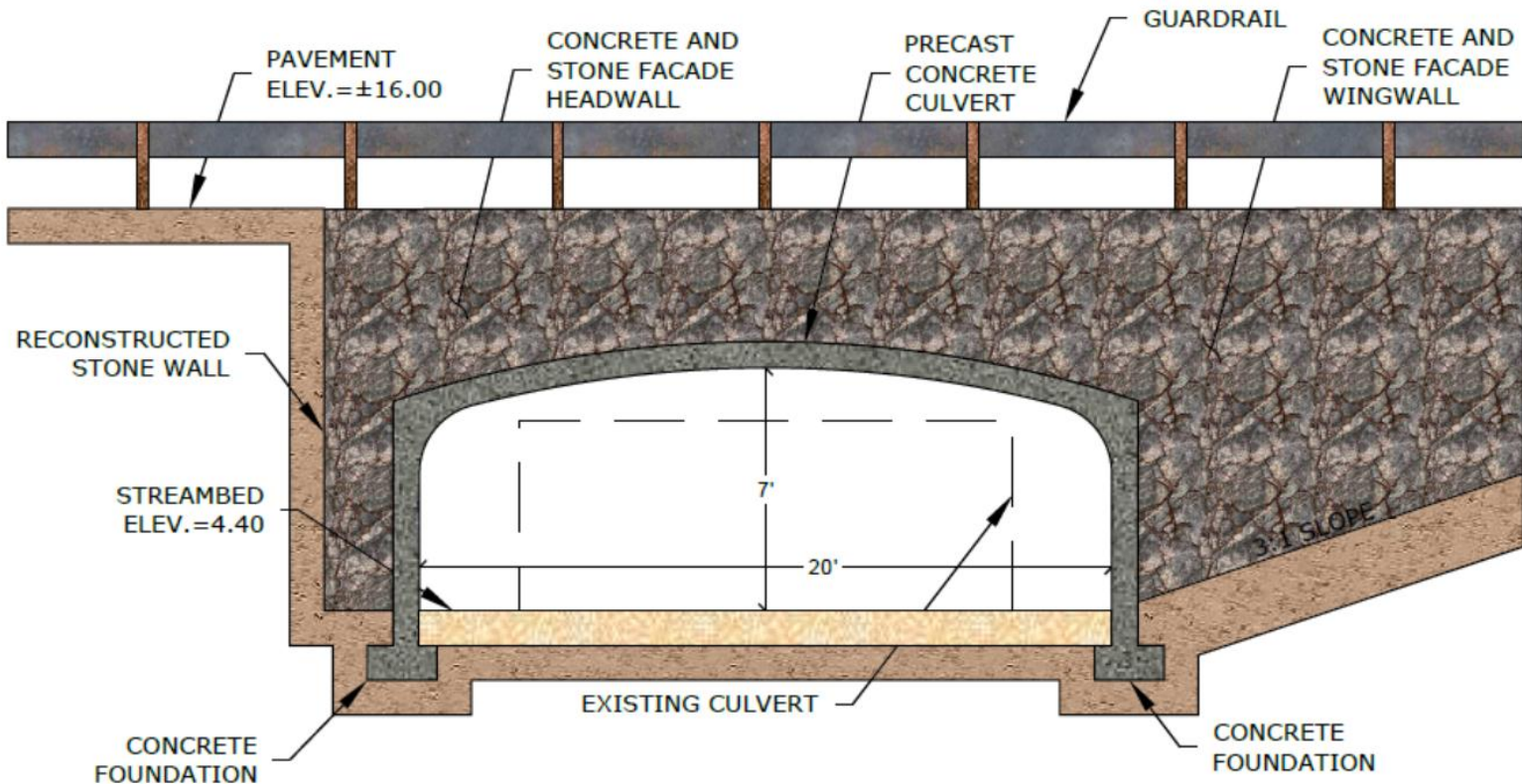
Culvert 22 – Norwood Ave



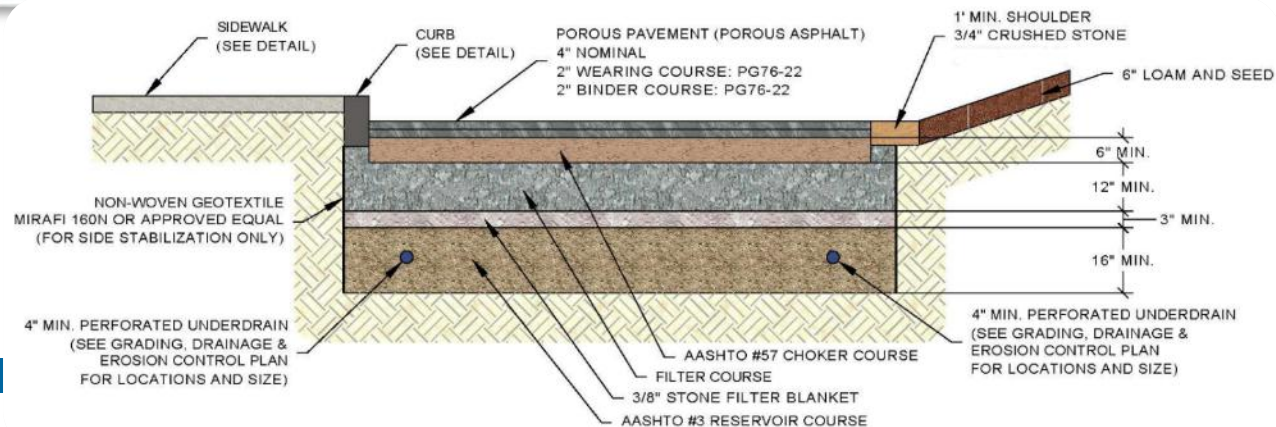
Culvert Improvement at Norwood Avenue



Culvert Improvement at Norwood Avenue



Porous Asphalt Parking Area at Coach Field Playground



Next Steps



Massachusetts Office of
Coastal Zone Management



FEMA

Grant opportunities

Project sequencing

**Funding sources
and availability**

Public input

Update HMP

**Anticipate
Phase II Grant**

Complete VRA



Questions?

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