ROUTE 114
RESILIENCE PLAN

OVERVIEW

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1. INTRODUCTIONS

PROJECT TEAM + PARTNERS

PROJECT MANAGEMENT TEAM

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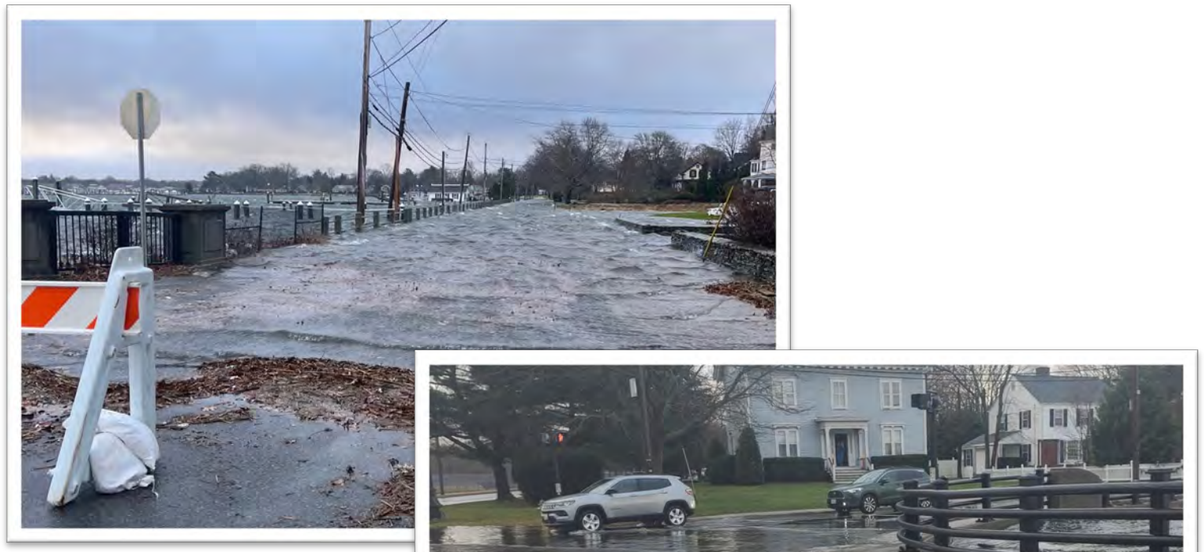
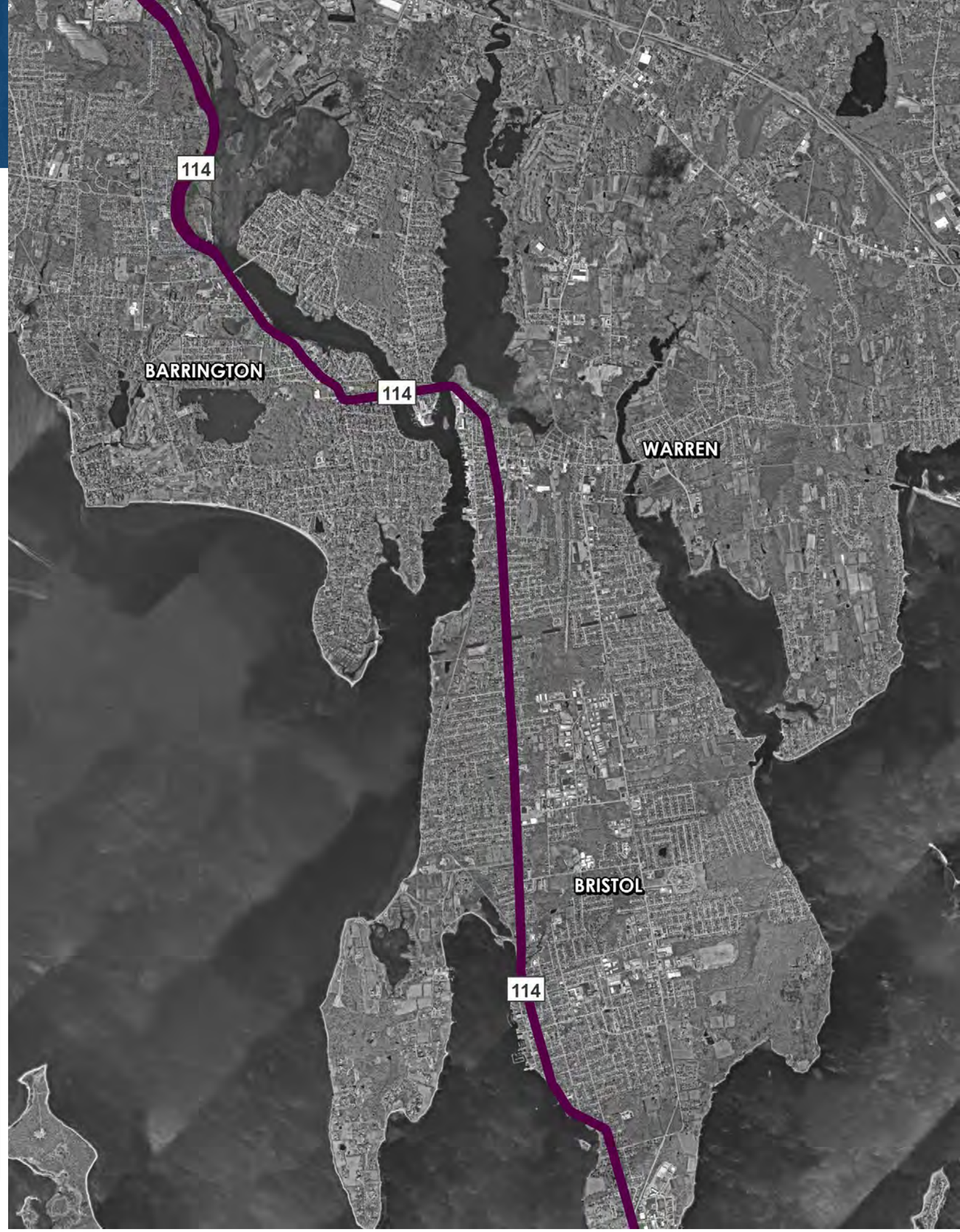
2. PLAN OVERVIEW

PLAN MOTIVATION

- Route 114 is a **key north-south regional connector**
- Route 114 is a **critical evacuation route**
- **Vulnerable to the current and future impacts of a changing climate**



Route 114 flooding in Barrington during the December 23, 2022 storm



PLAN GOALS

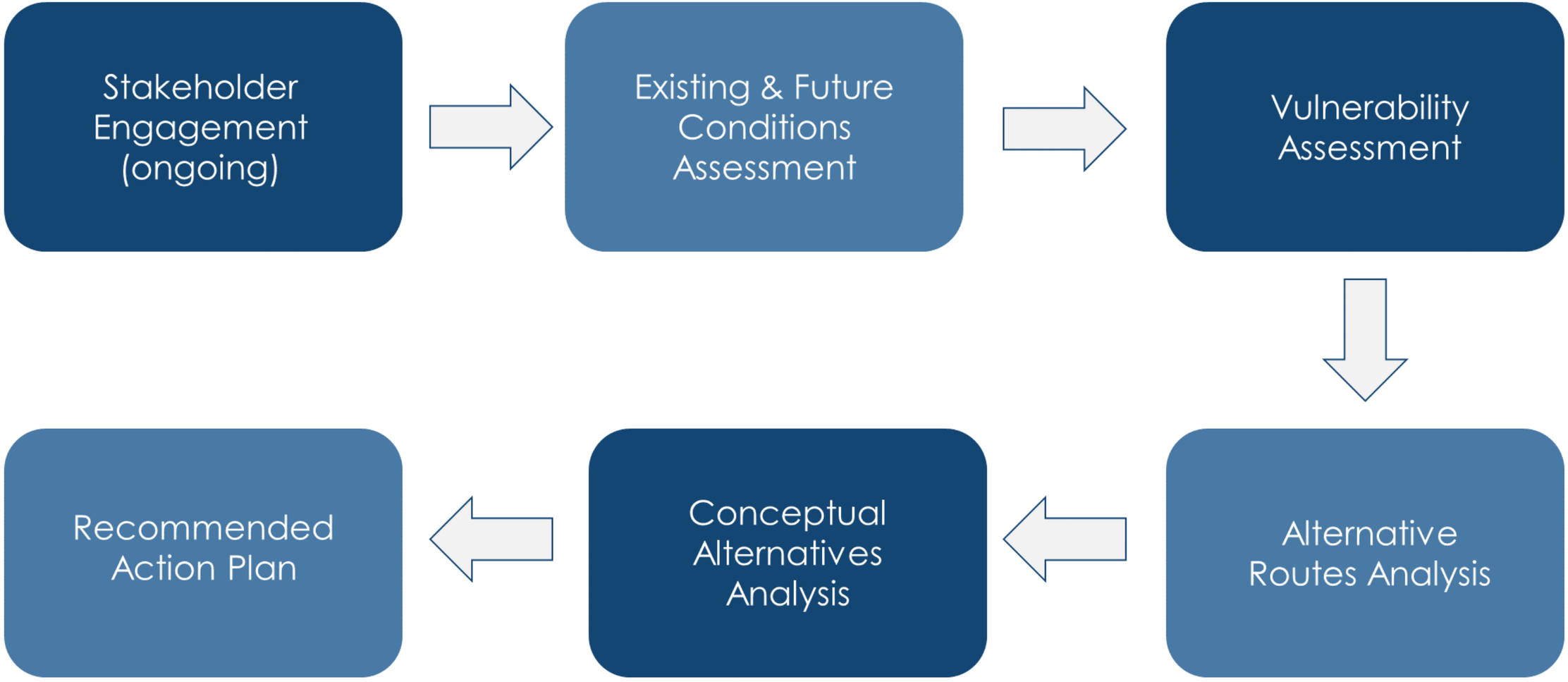
1. **Develop** a purposeful and actionable plan
2. **Engage** towns, residents, and state agencies
3. **Prioritize** flood mitigation actions
4. **Leverage** external funding opportunities

PLAN OUTCOMES

1. **Assess current and future vulnerability** of Route 114 in Barrington, Bristol, and Warren
2. **Establish conceptual alternatives** for reducing coastal flood risk and improving overall resilience

Image showing coastal flooding along Route 114 corridor in Barrington on December 23, 2022

PLANNING APPROACH



STAKEHOLDER + COMMUNITY ENGAGEMENT

- Occurred throughout the project
- Monthly meetings with the **Project Management Team** (PMT)
- Series of 3 public, **community workshops/meetings**
- Public **project website** (by RIDSP)

Project website: https://planning.ri.gov/planning-areas/climate-change-resilience/resilient-route-114

"Use real-time alerts as an early warning system when a storm is approaching."

"Raise the road out of the areas of vulnerability."

3. EXISTING + FUTURE CONDITIONS ASSESSMENT

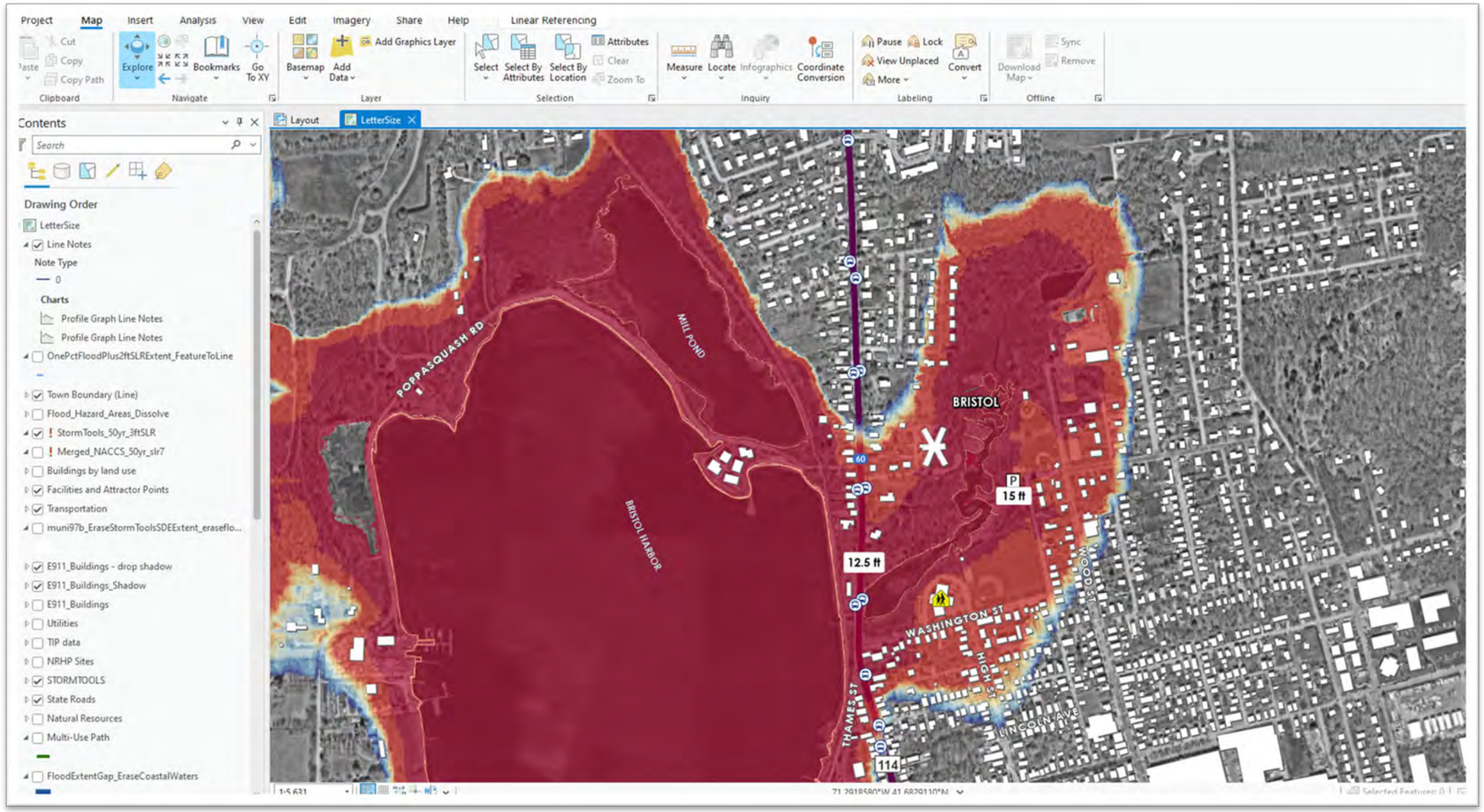
METHODOLOGY

Existing Plans and Studies:

- Examined **existing plans**, studies, and reports
- Identified **plan elements** related to the resilience of Route 114

Desktop Analysis:

- **GIS-based analysis** of state and municipal datasets
- Reviewed **coastal flood modeling data**
- Generated **maps** highlighting areas of vulnerability



Example ArcGIS screenshot showing depth of flooding along Route 114 in Bristol

METHODOLOGY

Site Visits:

- **Photo-documented existing conditions** at each area of vulnerability

- **Brainstormed** possible resilience **opportunities**

Stakeholder Meetings:

- Discussed **known areas of flooding** and planned projects in the Route 114 corridor

Images from site visits to AOV 2 (Left) and AOV 6 (Top)

Areas of Vulnerability (AOV)

AREAS OF VULNERABILITY (AOVs)

- **Areas of concern** with respect to the impacts of **coastal flooding** events
- **Based on the results** of the plan review and desktop analysis
- Confirm with **input from Project Management Team**

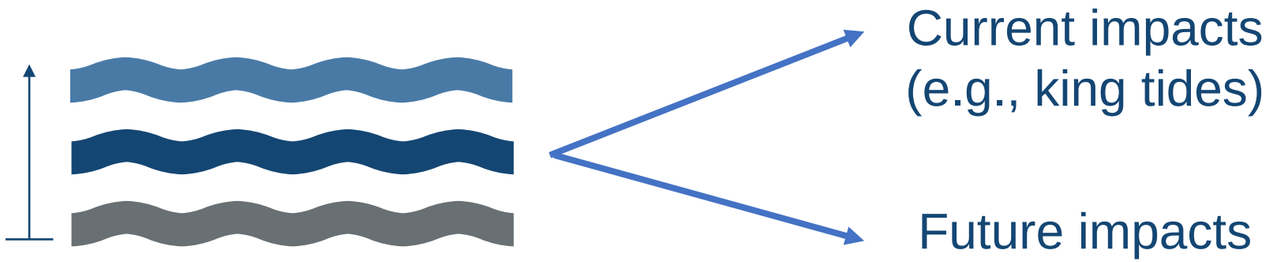
DISTRIBUTION OF AOVs

- Barrington – AOVs #1-4
- Warren – AOV #5
- Bristol – AOVs #6-7

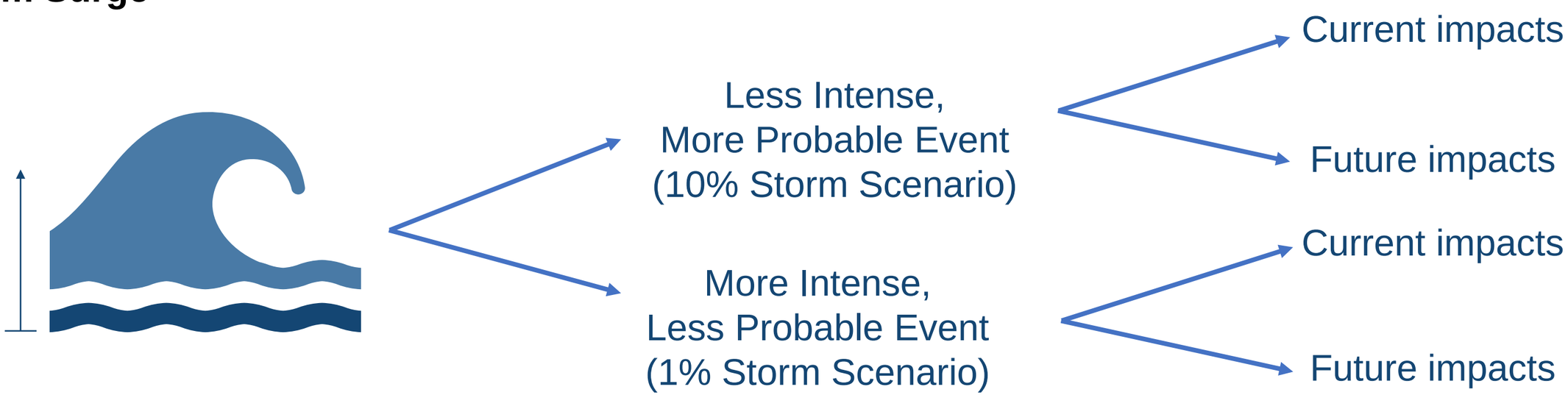
TYPES OF COASTAL FLOOD RISK

There are **two major types of coastal flood risk**:

1. Tidal Flooding & Sea Level Rise (SLR)



2. Storm Surge



4. ALTERNATIVE ROUTES ANALYSIS AND VULNERABILITY ASSESSMENT

ALTERNATE ROUTES ANALYSIS

Methodology Summary

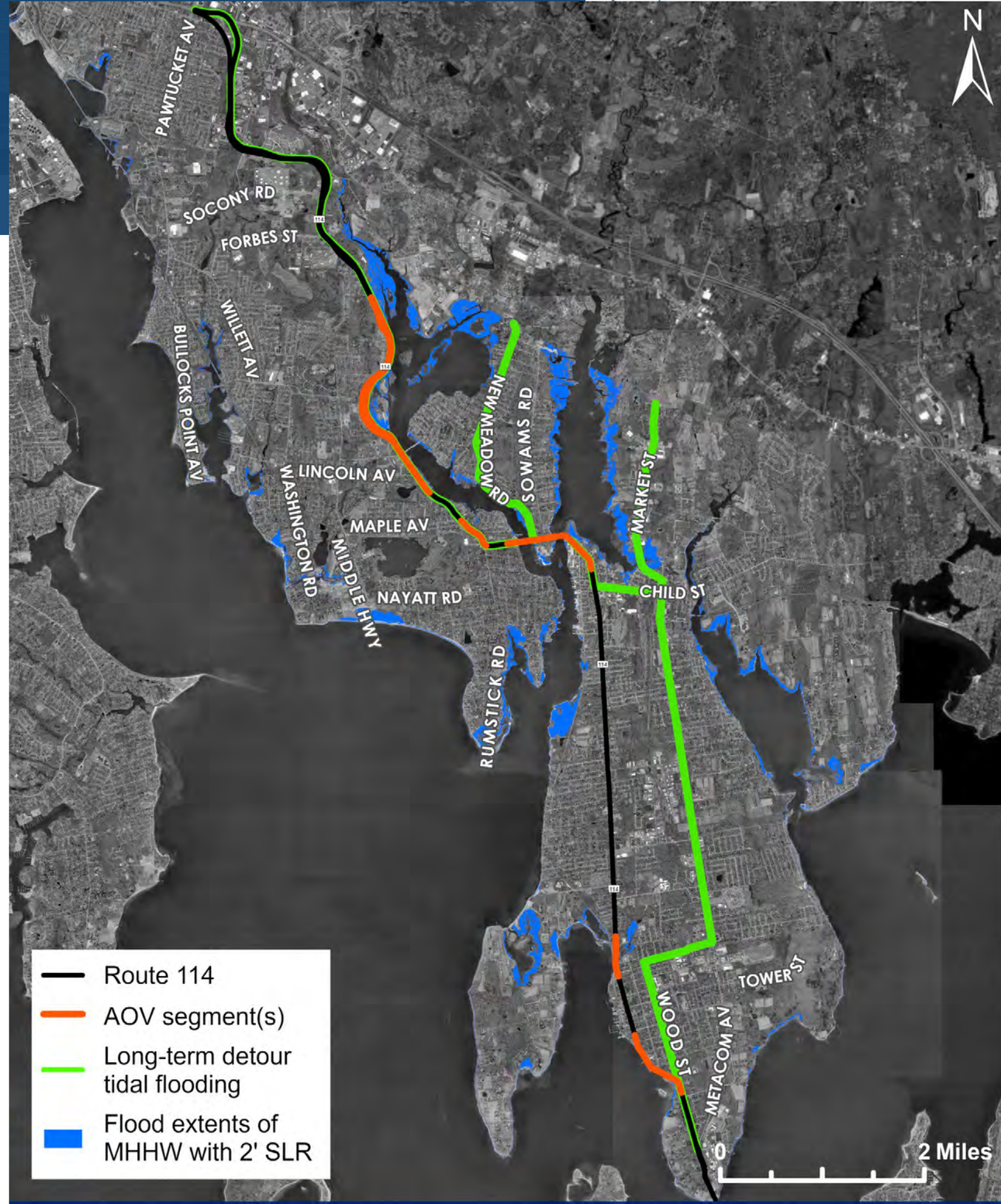
- Coastal flood data + models used to establish **short- and long-term detours** to avoid flooded portions of Route 114

- Detour routes **considered prior hazard mitigation plans, road capacity, and existing evacuation routes**

Key Takeaways

- **Detours are extensive** and will require **external coordination** (e.g., RIDOT + MassDOT)

- **Evacuations will likely be required in advance** of large storm events



Long-term Detour - Tidal Flooding

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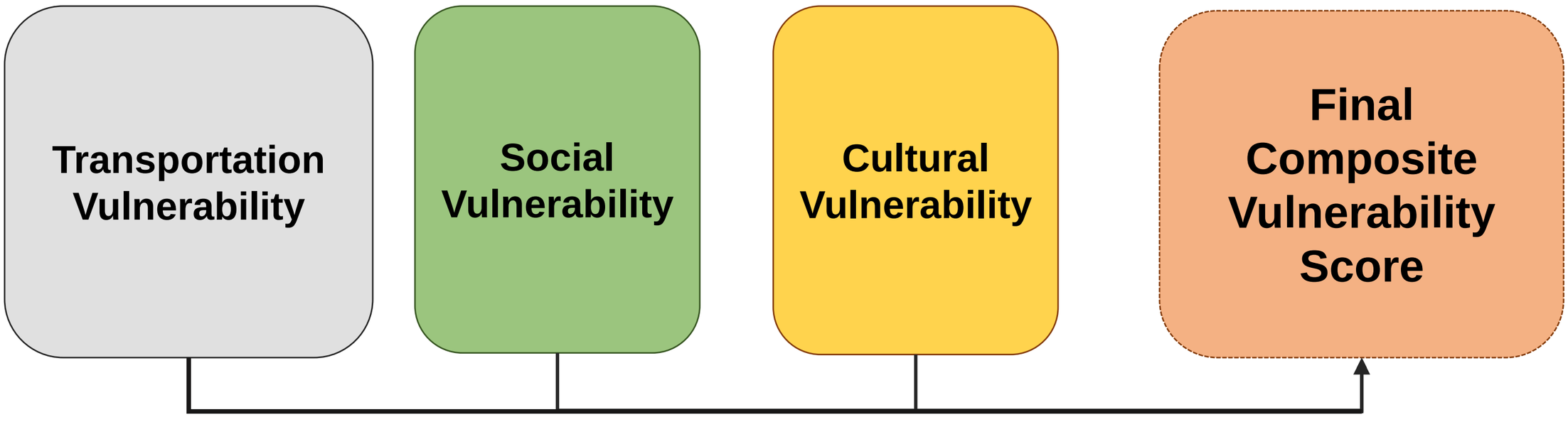
VULNERABILITY ASSESSMENT

Purpose of the vulnerability assessment:

- Help **identify the relative degrees of vulnerabilities** within each AOV and
- **Highlight regional and local priorities** for future decision-making

Frameworks for assessment were established for three measures of vulnerability:



VULNERABILITY ASSESSMENT

Example of Transportation Vulnerability Assessment:

- Focused on **vulnerable transportation infrastructure** (e.g., roadways, bridges, transit stops) along Route 114 in each AOV

- Looked for **opportunities to align the methodology** with that being used by RIDOT to develop the state-wide Resilience Improvement Plan (RIP)

- Assessed **exposure, sensitivity, and adaptive capacity**

Transportation Vulnerability

Exposure

The degree to which an asset is exposed to the climate stressor (e.g., inundation depths)

+

Sensitivity

Likelihood of being damaged by a stressor (e.g., pavement condition, bridge rating)

+

Adaptive Capacity

An asset's ability to respond to a climate stressor (e.g., distance to nearest transit stop)

Figure 1: Transportation Vulnerability Framework

OVERALL VULNERABILITY SCORE RESULTS BY AOV

After developing **composite vulnerability scores** for each vulnerability type (i.e., transportation, social, and cultural vulnerability), the overall vulnerability scores were calculated for each AOV based on the following weighted formula:

Example Overall Vulnerability Score for AOV 5 = (0.75 × Composite Transportation Vulnerability Score) + (0.15 × Composite Social Vulnerability Score) + (0.10 × Composite Cultural Vulnerability Score)

= (0.75 × 2.9) + (0.15 × 12.0) + (0.10 × 2.8) = 4.3

Table 11 summarizes the overall vulnerability scores for each of the AOVs. Those values highlighted with a darker red background show higher relative vulnerability scores. Vulnerability scores for each AOV can be read across the rows to highlight what type(s) of vulnerability (e.g., transportation, social, and/or cultural) may be contributing most to the overall vulnerability score for a given AOV, while relative comparisons of vulnerability across AOVs may be made when comparing the scores within a given column.

Table 11: Overall Vulnerability Scores for each AOV

AOV	Overall Vulnerability Score	Composite Transportation Vulnerability Score	Composite Social Vulnerability Score	Composite Cultural Vulnerability Score
Weights		**75%**	**15%**	**10%**
AOV 1 (Barrington)	**2.3**	1.9	1.0	7.4
AOV 2 (Barrington)	**2.0**	2.3	1.0	1.4
AOV 3 (Barrington)	**1.7**	1.8	2.0	0.0
AOV 4 (Barrington)	**2.8**	3.2	2.0	0.8
AOV 5 (Warren)	**4.3**	2.9	12.0	2.8
AOV 6 (Bristol)	**4.2**	3.8	6.0	4.6
AOV 7 (Bristol)	**2.9**	2.3	7.0	0.8

5. CONCEPTUAL ALTERNATIVES ANALYSIS

(BARRINGTON) AOV 1: CONCEPT A – LOWER RISK REDUCTION ALTERNATIVES

- **No projected daily tidal flooding** inundation on Route 114

- Community noted floodwaters encroach on Route 114 during large tidal events (e.g., king tides)

Key Actions:

- Install permanent water level sensor & establish **early warning system**

Challenges:

- Residents and businesses must **sign up**

- Assigning **a responsible party** to manage alerts

Benefits:

- Can be used for larger coastal storm events

(BARRINGTON) AOV 1: CONCEPT B – HIGHER RISK REDUCTION ALTERNATIVES

- Flood depths reach up to **10 to 12 feet**

Key Actions:

- Install **sheet pile cutoff walls**

- **Replace bus stop shelter** near Osamequin Nature Preserve

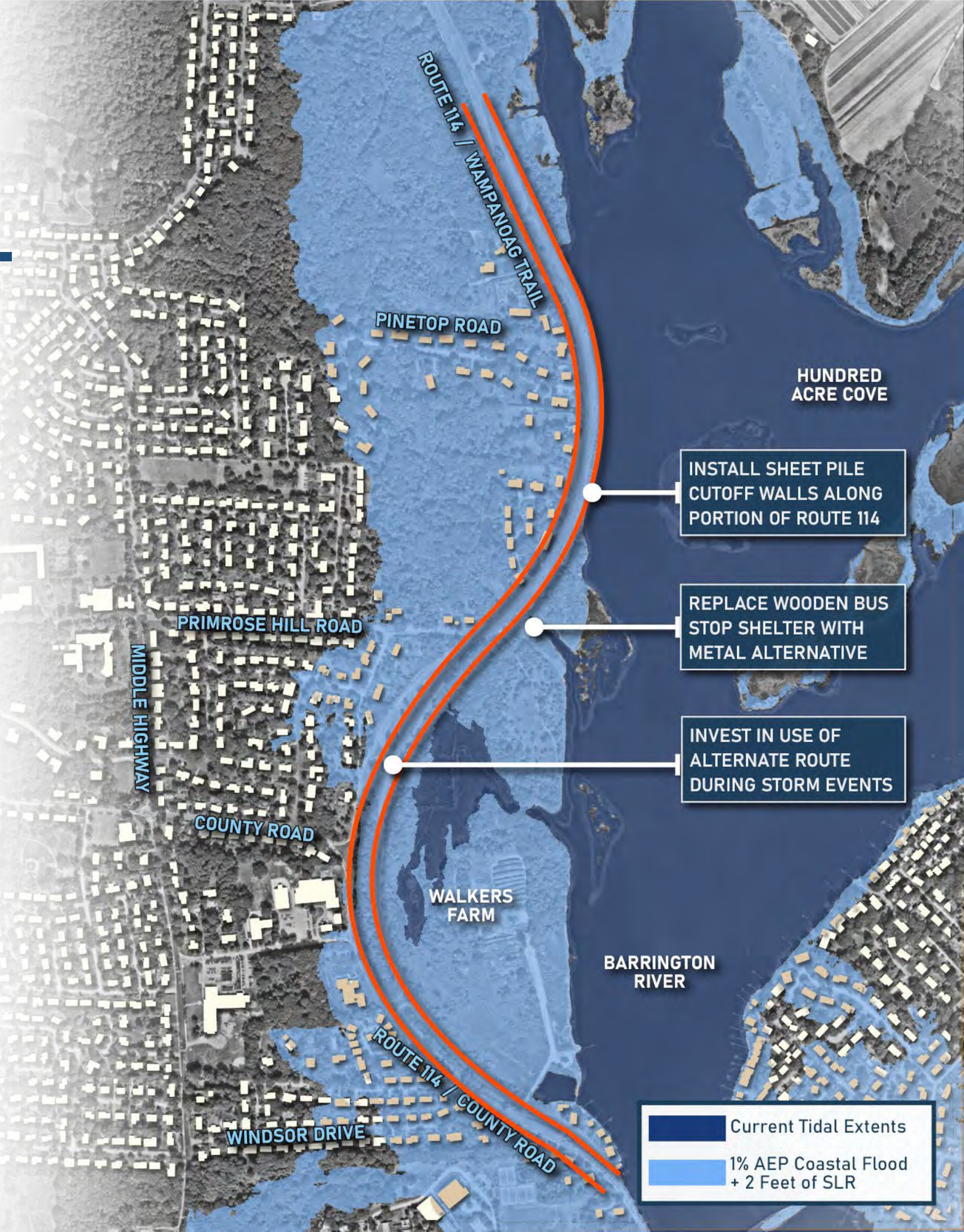
- Complete a study to **further investigate evacuation routes** and determine investments needed to add capacity to existing roadway networks

Challenges:

- Actions **cannot prevent flooding from larger, future coastal storms**

Benefits:

- Improve future evacuations & **help with washout** and improve long-term resilience of Route 114



(BARRINGTON) AOV 2: CONCEPT A – LOWER RISK REDUCTION ALTERNATIVES

- **No modeled daily tidal flooding** inundation on Route 114

Key Actions:

- Establish a **2.5- to 3-foot elevated berm** around the RIDOT Park and Ride parking lot

- Work with local residents to discuss potential for future, **voluntary buyouts and restoration** of land for interim tidal flood mitigation

Challenges:

- Buyouts are expensive and require buy-in

Benefits:

- Extend use of Park and Ride

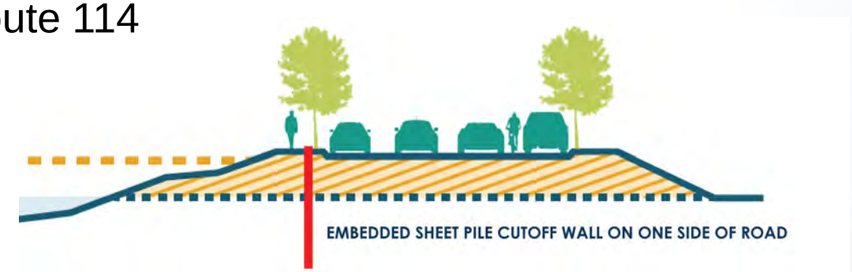
- Allows for the restoration of the natural floodplain

(BARRINGTON) AOV 2: CONCEPT B – HIGHER RISK REDUCTION ALTERNATIVES

- Flood depths reach **12⁺ feet**

Key Actions:

- Install **sheet pile cutoff walls** on one or both sides of Route 114



- Complete an evacuation study and **determine investments needed to add capacity** to existing roadway networks

Challenges:

- Actions not aimed at preventing flooding from larger, future coastal storms

Benefits:

- Improve future evacuations

- Help with washout and improve long-term resilience of Route 114

*Consider additional **floodproofing at High School**

(BARRINGTON) AOV 3: CONCEPT A – LOWER RISK REDUCTION ALTERNATIVES

- No modeled daily tidal flooding inundation on Route 114

Key Actions:

- Study the **combined coastal and pluvial* flood effects** through modeling additional hydrologic and hydraulic modeling

- Integrate with solutions also identified in **Mussachuck Creek Corridor Plan**

Benefits:

- Gain a better understanding of potential impacts of *both* coastal and pluvial flooding

*__Pluvial flooding__ occurs when intense rainfall overwhelms the ground's ability to absorb water or the capacity of urban stormwater drainage systems. This excess water then flows overland, accumulating in low-lying areas and causing flooding. It's a common type of flooding, particularly in urban areas with extensive impervious surfaces like roads and buildings.

(BARRINGTON) AOV 3: CONCEPT B – HIGHER RISK REDUCTION ALTERNATIVES

- Flood depths reach **8⁺ feet**

Key Actions:

- **Voluntary buyouts** of residential properties
- Construct **12+ foot elevated flood wall**, with a flood gate and pump station

Challenges:

- Buyouts of at least four residential properties required

Benefits:

- **Area-wide risk reduction** from coastal flood pathway
- Early conversations community members can help establish buy-in

(BARRINGTON) AOV 4: CONCEPT A – LOWER RISK REDUCTION ALTERNATIVES

- Future tidal flood extents encroach close to the Barrington Bridge approaches

King tide flooding on November 16, 2024 along Mathewson Rd just south of AOV 4 (Photo credit: Barbara Green via MyCoast)

Key Actions:

- Install permanent water level sensor and establish **early warning system**

Challenges:

- Residents/businesses must sign up and a responsible party must manage alerts

Benefits:

- Can be used for larger coastal storm events

(BARRINGTON) AOV 4: CONCEPT B – HIGHER RISK REDUCTION ALTERNATIVES

- Floodwaters make Route 114 **impassable** and **limit the options** for implementation measures

Key Actions:

- **Complete a planning study** of local evacuation routes and determine investments needed to add capacity to existing roadway networks

- Install sheet pile cutoff walls on both sides of Route 114

Challenges:

- Will not prevent flooding from 1% AEP coastal storm + 2 feet SLR

Benefits:

- Improve future evacuations & recovery of the roadway following large storm events

(WARREN) AOV 5: CONCEPT A – LOWER RISK REDUCTION ALTERNATIVES

- Future tidal flood extents encroach near the **Warren Bridge eastern approach**

Key Actions:

- Install a **2-foot elevated berm** north of existing approach
- Install permanent water level sensors and establish an early warning system

Challenges:

- Will not prevent flooding from larger coastal storm events
- Messaging must be in **multiple languages**

Benefits:

- Berm provides **additional freeboard**
- Communication can be used for larger coastal storm events

Sources: RIGIS, CRMC, Town of Bristol

(WARREN) AOV 5: CONCEPT B – HIGHER RISK REDUCTION ALTERNATIVES

- Flood depths reach **13⁺ feet**

Key Actions:

- Make use of **short-term alternate routes** and study the need for additional investments to add capacity to existing roadway networks
- Temporarily deploy road closure and detour signs

Challenges:

- Actions are not aimed at preventing flooding
- Extent of detours is large – **routing out to Massachusetts**

Benefits:

- Improve future evacuations

Sources: RIGIS, CRMC, Town of Bristol

(BRISTOL) AOV 6: CONCEPT A – LOWER RISK REDUCTION ALTERNATIVES

- Flood depths reach about **1 foot**

Key Actions:

- **Elevate** a portion of Route 114
- Re-evaluate the **sizing of the existing culvert**
- **Incorporate findings** from US Army Corps of Engineers study

Challenges:

- Requires **realignment of adjacent driveways and parking lots**, **regrading** of local roads, & temporary roadway closures during construction

Benefits:

- Reduce the risk of future tidal flooding
- Potential **water quality** benefits in Silver Creek

(BRISTOL) AOV 6: CONCEPT B – HIGHER RISK REDUCTION ALTERNATIVES

- Flood depths reach **12⁺ feet**

Key Actions:

- Install sheet pile cutoff walls and **relocate/replace RIPTA bus stop shelter near Creek Lane**
- Make use of **alternate route out to Sherry Ave** during short-term detours
- Establish an early warning system and install permanent water level sensors

Challenges:

- Actions are not aimed at preventing flooding and would not provide area-wide risk reduction

Benefits:

- Allow north-south travel
- Improve long-term resilience of Route 114

(BRISTOL) AOV 7: CONCEPT A – LOWER RISK REDUCTION ALTERNATIVES

- Floodwaters reach existing seawalls

Key Actions:

- Install a **temporary flood barrier**
- Regularly maintain existing seawalls

Challenges:

- Assigning responsible party to manage temporary flood barrier

Benefits:

- Reduce coastal impact risk

Sources: RIGIS, CRMC, Town of Bristol

(BRISTOL) AOV 7: CONCEPT B – HIGHER RISK REDUCTION ALTERNATIVES

- Flood depths of **14⁺ feet**

Key Actions:

- Build a **14-foot berm** and install a **gated flood barrier**
- **Voluntary buyouts** over time to provide space for elevated berm

Challenges:

- Does not reduce flooding risk along Route 114
- Requires voluntary buyouts of residential properties
- Potentially impacts **three properties within the Bristol Historic District**

Benefits:

- Provide area-wide risk reduction (incl. **Bristol Water Treatment Facility**)
- Allows for use of **Wood St as evacuation route**

Sources: RIGIS, CRMC, Town of Bristol

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RHODE ISLAND DIVISION OF STATEWIDE PLANNING
METROPOLITAN PLANNING ORGANIZATION

Project website: https://planning.ri.gov/planning-areas/climate-change-resilience/resilient-route-114