



WT0202151016NJO

# Evaluation of Mitigation Measures for Coastal Flooding in Newport, RI

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**ch2m.**

June 2016

# Agenda

## ■ Project Overview

- » Historic Issues
- » Bridge Street Study Area
- » Wellington Avenue Study Area
- » Sea Level Rise Trends and Projections

## ■ Public Involvement

- » Website
- » Survey Results

## ■ Modeling

- » Confirmation Surveys
- » Results for Historic Events

## ■ Alternatives Evaluation

- » Overview
- » Screening

## ■ Recommend Plan

- » Overview
- » Typical Year
- » Short-Term Options
- » Long-Term Options

## ■ Results

- » Cost
- » Implementation
- » Next Steps



# Historic Issues

- Historical tidal or “sunshine” flooding
- Precipitation events coinciding with high tide create a compound problem
- Previous measures not 100% effective – example, tide gates at 2<sup>nd</sup> & 3<sup>rd</sup> Streets installed in November 2011
- Sea level rise and more intense and frequent storms are already being experienced....there is more projected to come



Tidal flooding at Wellington Avenue in 2011



Tidal flooding compounded by precipitation along 2<sup>nd</sup> Street in 2011

# Bridge Street Study Area

## ■ Root Causes of Flooding

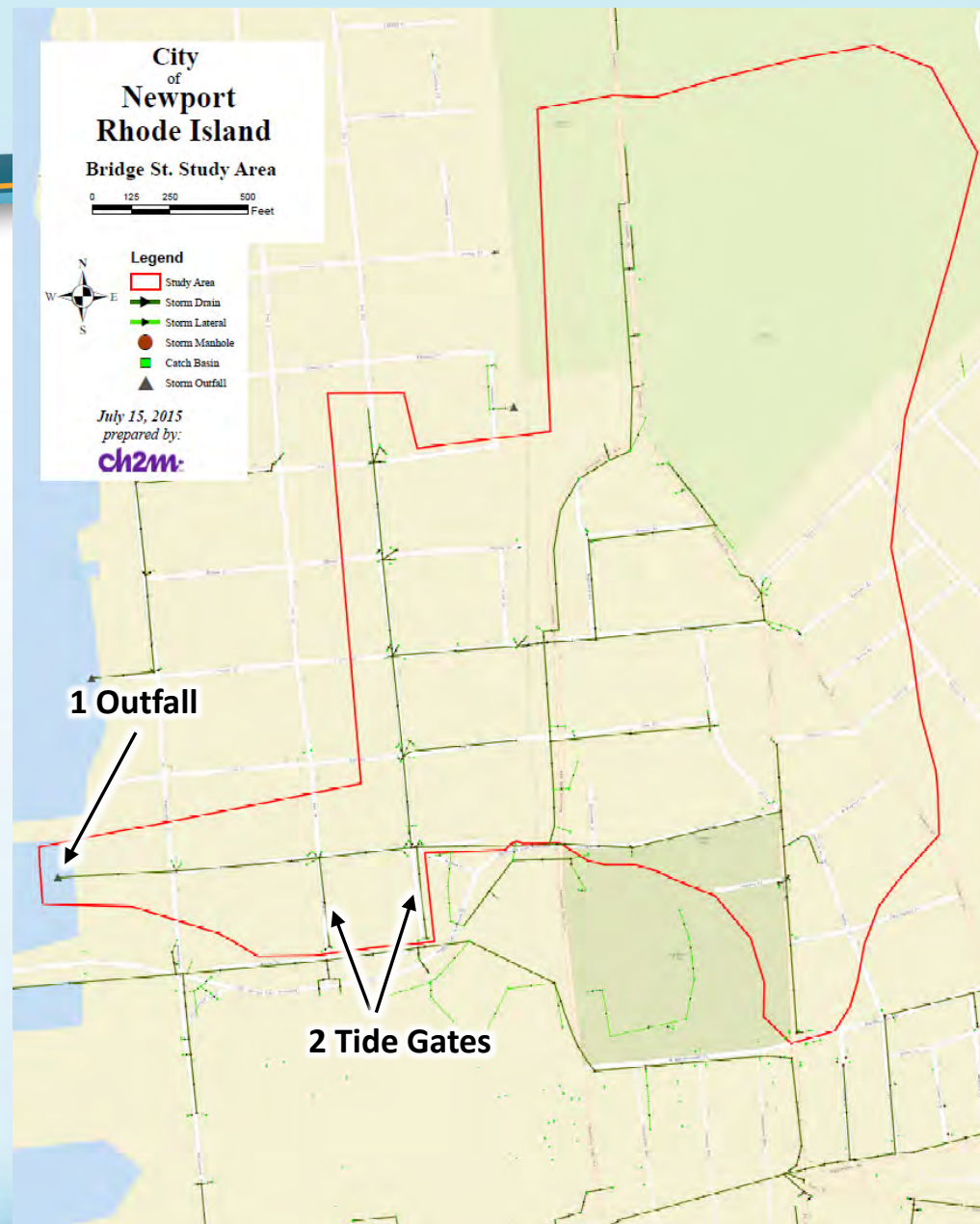
- » Precipitation events
- » Extreme high tides
- » Storm surge
- » Sea level rise
- » Combinations of above

## ■ Infrastructure

- » Storm drain outfall to harbor
- » Tide gates

## ■ Impacts

- » Residential zone flooding
- » Street flooding and access issues
- » Basement flooding





# Project Overview

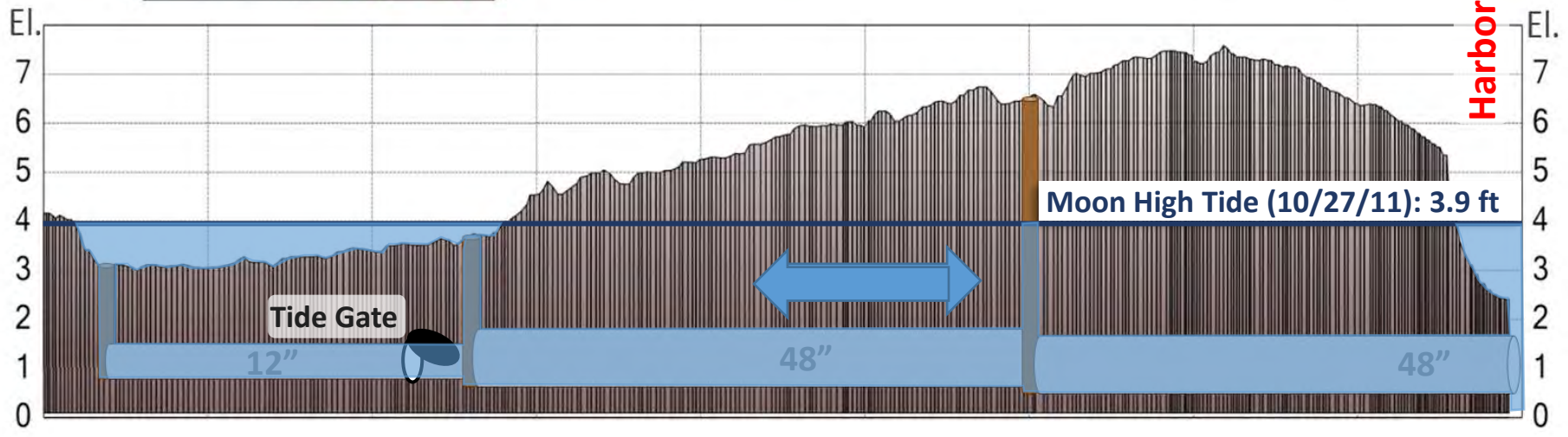
## Causes of Flooding



2<sup>nd</sup> Street



Bridge Street



# Wellington Avenue Study Area

## ■ Root Causes of Flooding

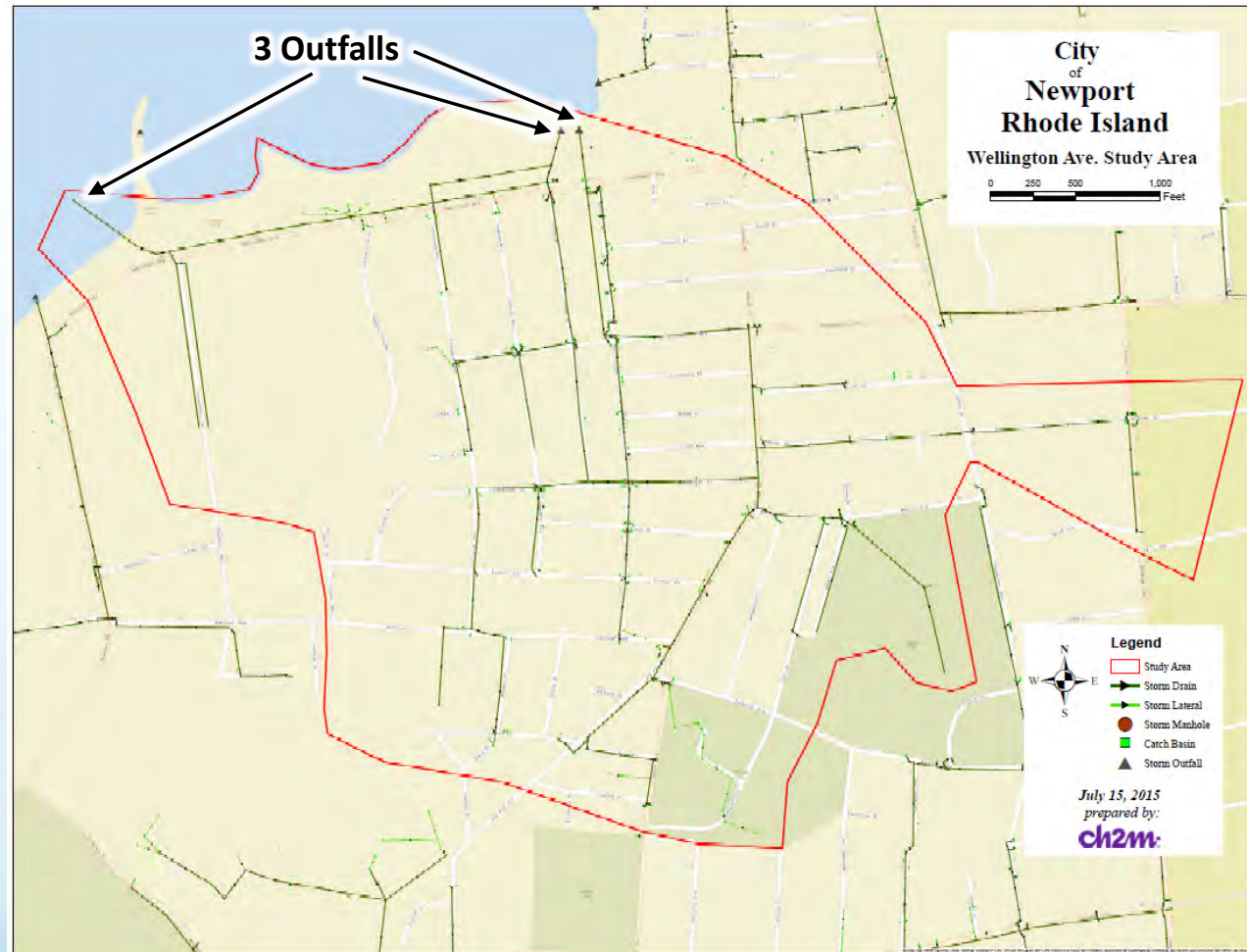
- » Extreme high tides
- » Storm surge
- » Sea level rise
- » Precipitation events
- » Combinations of above

## ■ Infrastructure

- » Existing storm drain outfalls to harbor
- » No tide gates

## ■ Impacts

- » Frequent traffic rerouting
- » Access restrictions to public facilities
- » Basement flooding



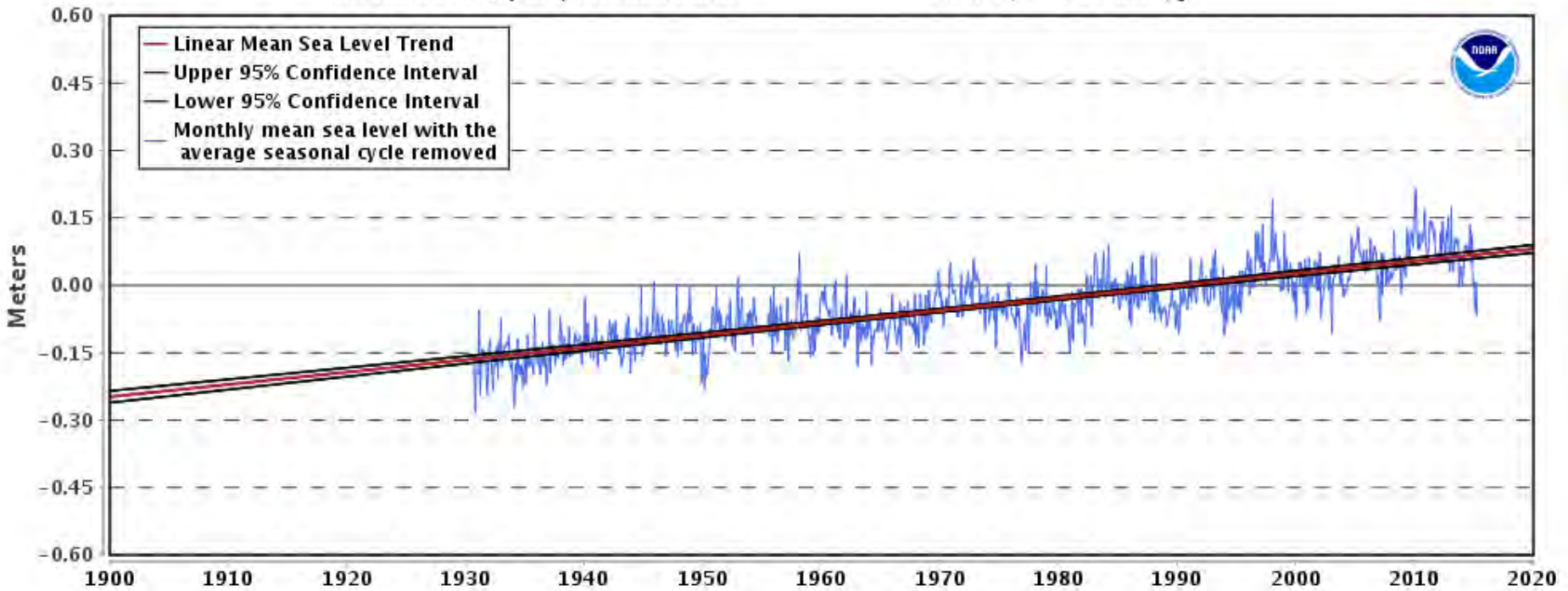


# Sea Level Trends

Historic sea level rise is 0.1 inch/year

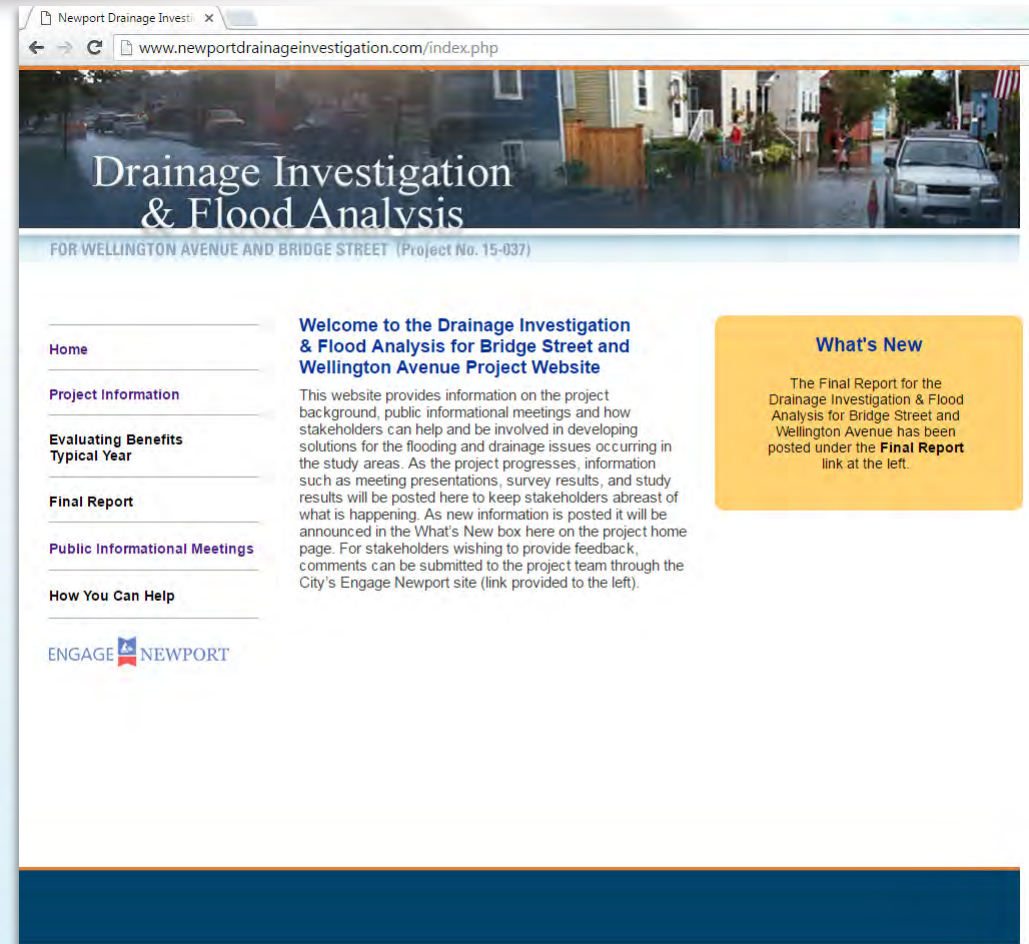
8452660 Newport, Rhode Island

2.74 +/- 0.17 mm/yr



# Public Involvement

- Website keeps the public informed
- Surveys used to identify the public's concerns
- Workshops used to present findings and discuss benefits



The screenshot shows a web browser window with the address bar displaying "www.newportdrainageinvestigation.com/index.php". The website header features a photograph of a flooded residential street with the text "Drainage Investigation & Flood Analysis" and "FOR WELLINGTON AVENUE AND BRIDGE STREET (Project No. 15-037)".

The main content area is divided into two columns. The left column contains a navigation menu with the following items: "Home", "Project Information", "Evaluating Benefits Typical Year", "Final Report", "Public Informational Meetings", and "How You Can Help".

The right column contains a "Welcome to the Drainage Investigation & Flood Analysis for Bridge Street and Wellington Avenue Project Website" section. The text reads: "This website provides information on the project background, public informational meetings and how stakeholders can help and be involved in developing solutions for the flooding and drainage issues occurring in the study areas. As the project progresses, information such as meeting presentations, survey results, and study results will be posted here to keep stakeholders abreast of what is happening. As new information is posted it will be announced in the What's New box here on the project home page. For stakeholders wishing to provide feedback, comments can be submitted to the project team through the City's Engage Newport site (link provided to the left)." Below this text is the "ENGAGE NEWPORT" logo.

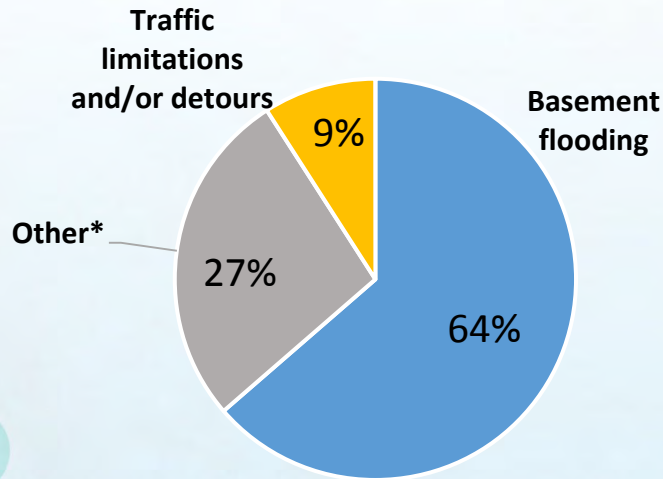
On the far right, there is a yellow "What's New" box containing the text: "The Final Report for the Drainage Investigation & Flood Analysis for Bridge Street and Wellington Avenue has been posted under the **Final Report** link at the left."



# Public Involvement Survey Results

Which best describes your greatest concern with regards to drainage and flooding issues in your area?

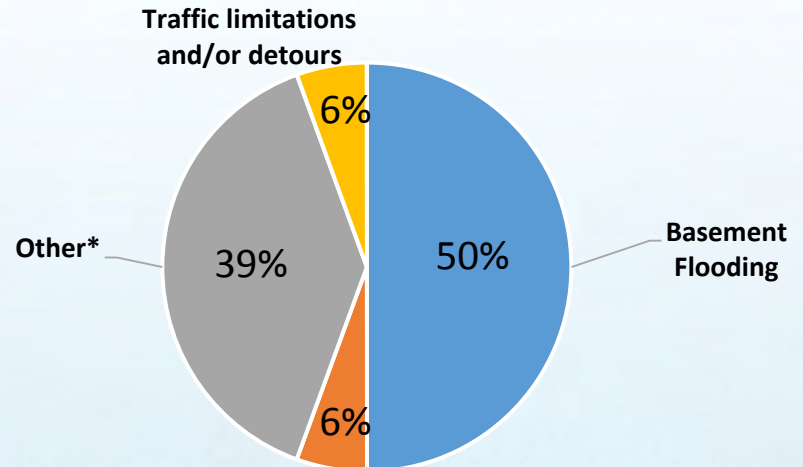
## Wellington Avenue



\*Other Includes:

- Overall property flooding
- Water damage caused by cars driving through street flooding

## Bridge Street

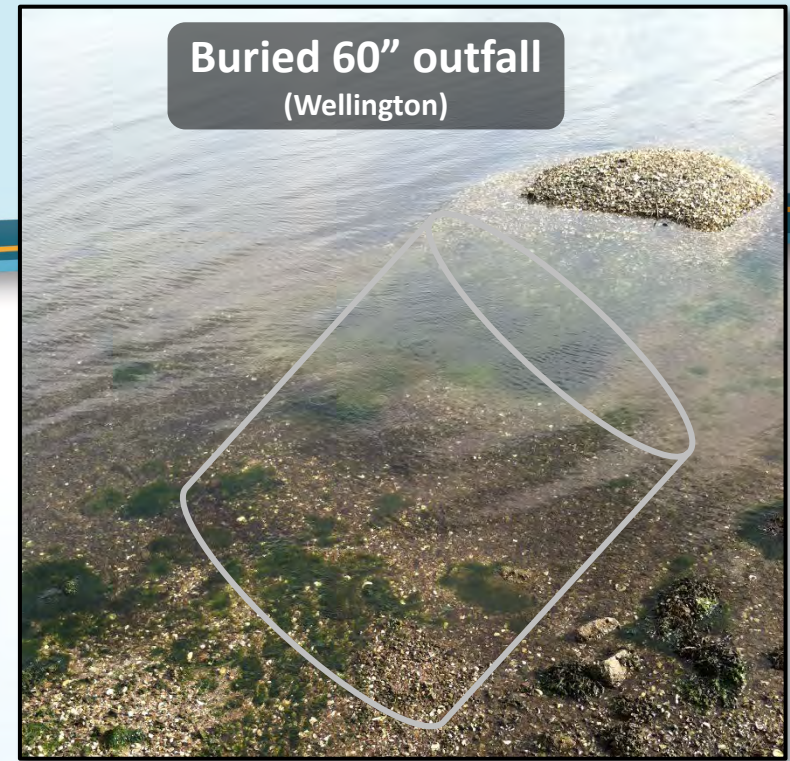


\*Other includes:

- Private property damage
- Condition of City's infrastructure
- Management of City's infrastructure relating to sea level rise

# Modeling Confirmation Surveys

- 80+ drainage manholes inspected
- Major connectivity in GIS is correct
- Both study areas heavily influenced by the tide
- 2nd St. and 3rd St. tide gates functioning but occasionally impacted by debris
- Some catch basins in need of cleaning
- 4 outfall pipes (3 Wellington, 1 Bridge) each has some sedimentation





# Confirmation Surveys

Cross-connection found between neighboring storm drain system



Modeling

# Calibration: Bridge St.

7/1/2015: 1.2 in of rain at high tide



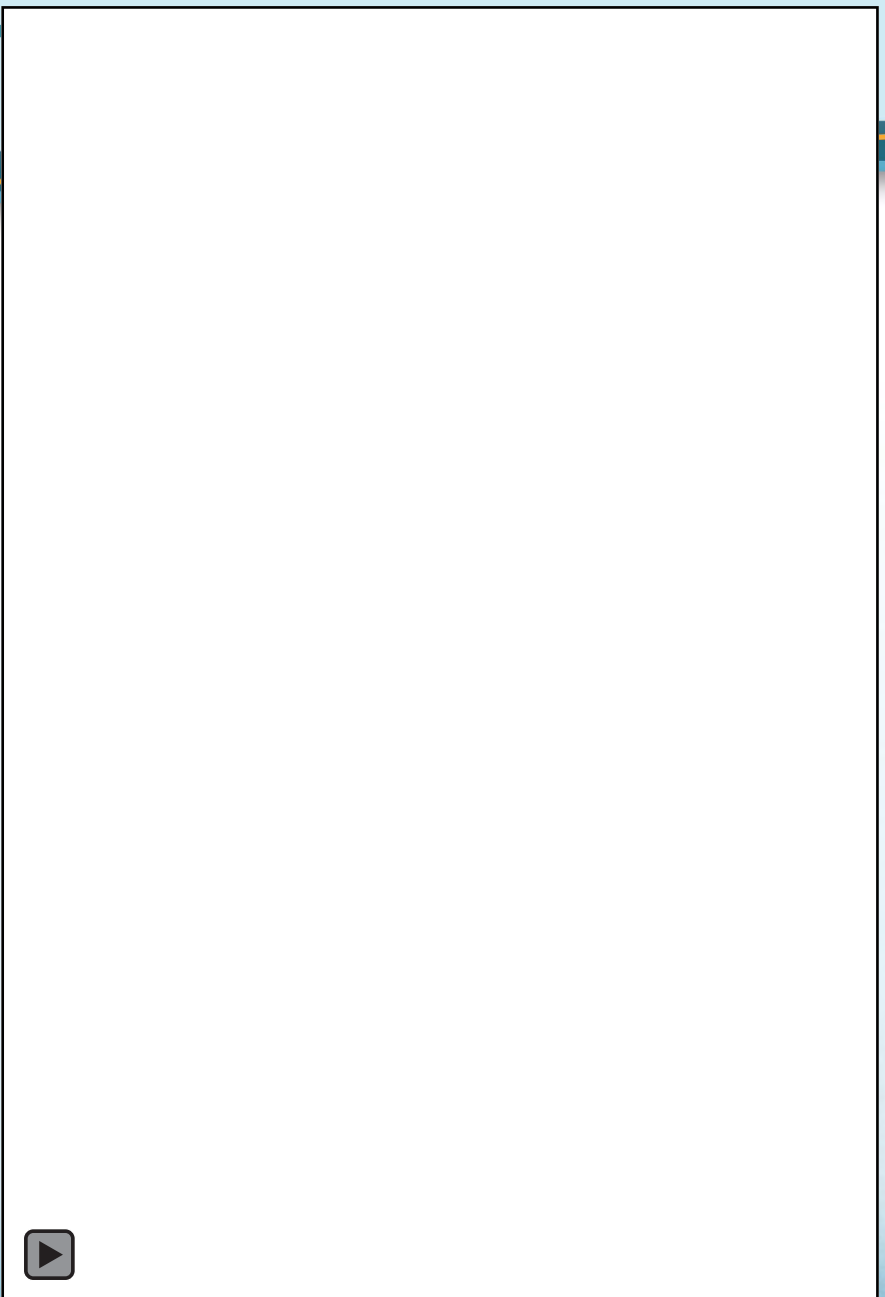
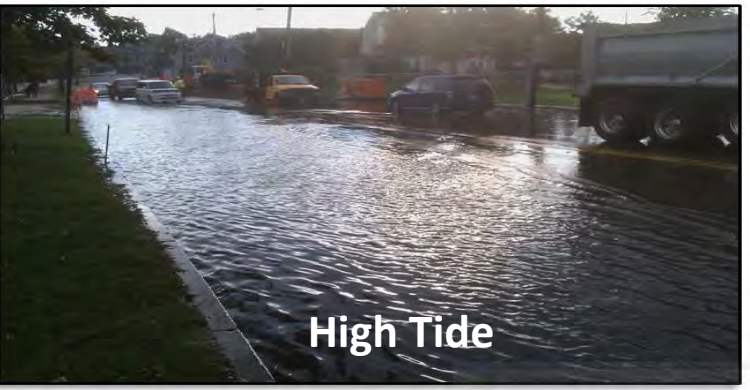
Coupled SWMM with terrain model to support flood analysis





# Calibration: Wellington Ave.

10/7/2010: Lunar High Tide – No rain



# Alternatives Evaluation

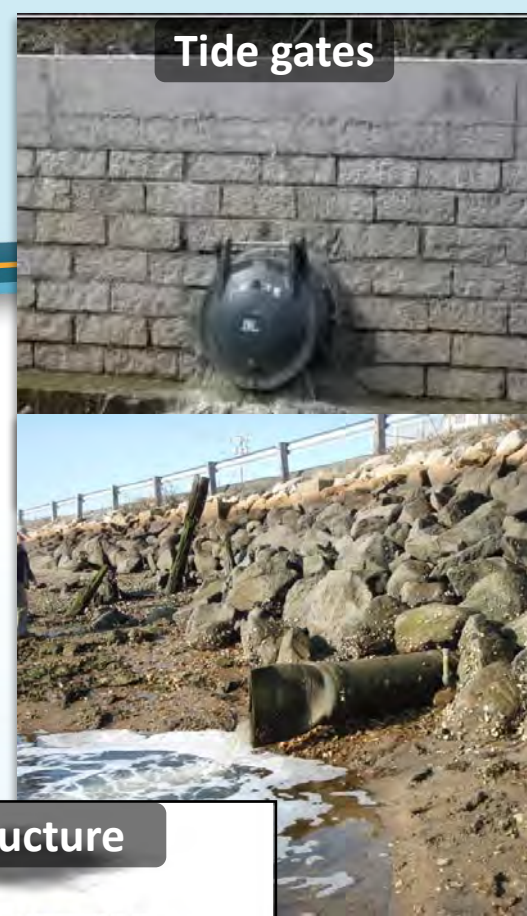
## Overview

- **Tide Gates**
  - » Prevent sunshine flooding
  - » May prolong rain event flooding
  - » Many types
- **Larger Pipes**
  - » Increased conveyance
  - » Space constraints with other utilities (gas, water, etc.)
- **Catch Basin Sumps**
  - » Collect debris in manhole to avoid clogging pipes
- **Green Infrastructure**
  - » Provides storage
  - » Can increase basement flooding
- **Pump Station**
  - » Complete solution
  - » Expensive, large facility

Wellington Ave. PS



Tide gates



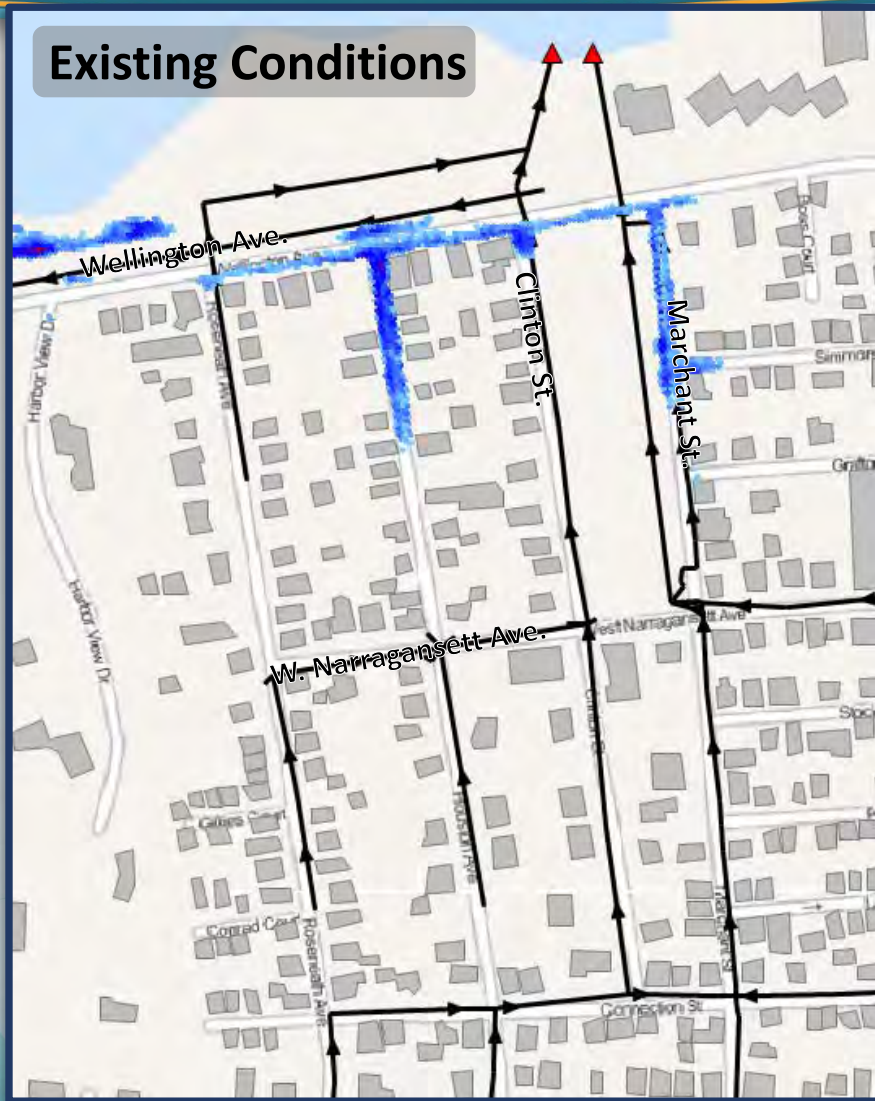
Green Infrastructure





# Alternatives Evaluation Screening

## Wellington Ave. – Sediment Removal, Rain Event at Low Tide



Datum: MLLW

## Short-term Controls

- **Key Objectives**
  - » Address today's climate conditions
  - » Reduce observed/historic flooding issues
- **Effectiveness**
  - » Technologies with largest benefit
- **Implementation Considerations**
  - » Shorter Implementation Schedule
    - Minimal technical or legal barriers
    - 5 years to implement
    - Capital costs ranging from \$1.5M - \$6M
  - » Complimentary to long-term plans

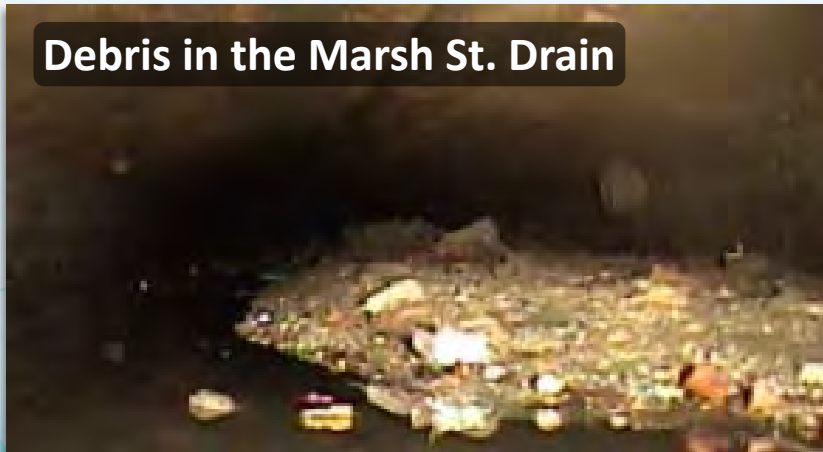
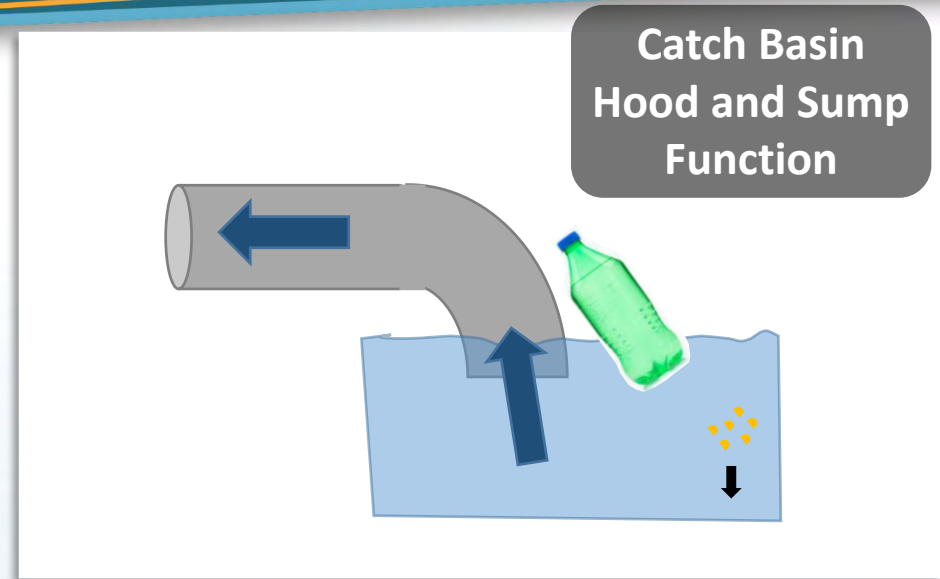
## Long-term Controls

- **Key Objectives**
  - » Address current flooding issues not mitigated by short-term controls
    - Large rain events at high tide
  - » Address future conditions related to climate change
    - Sea level rise and precipitation changes
- **Effectiveness**
  - » Sized to handle a 5-year storm
- **Implementation Considerations**
  - » Controls that take longer to implement
    - Technical and legal barriers
    - 25 years to implement
    - Capital costs ranging from \$13M - \$46M



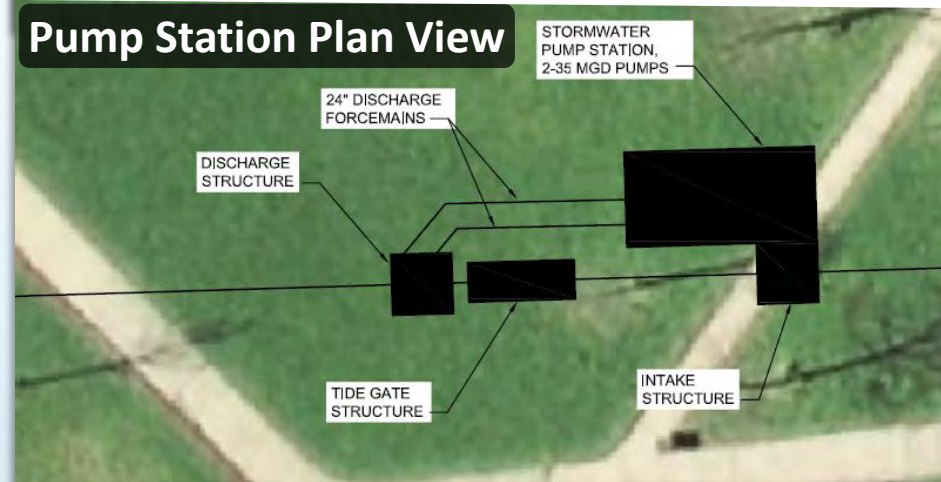
# Short-term Controls for Bridge Street

- New tide gate
- Remove old tide gates
- Sediment removal
- Catch basin sumps and rehabilitation



# Long-term Controls for Bridge Street

- Green infrastructure
- 35 MGD Stormwater pump station



Pumps for pump station will be located below ground.



# Flood Mitigation for Bridge Street

- Existing Conditions

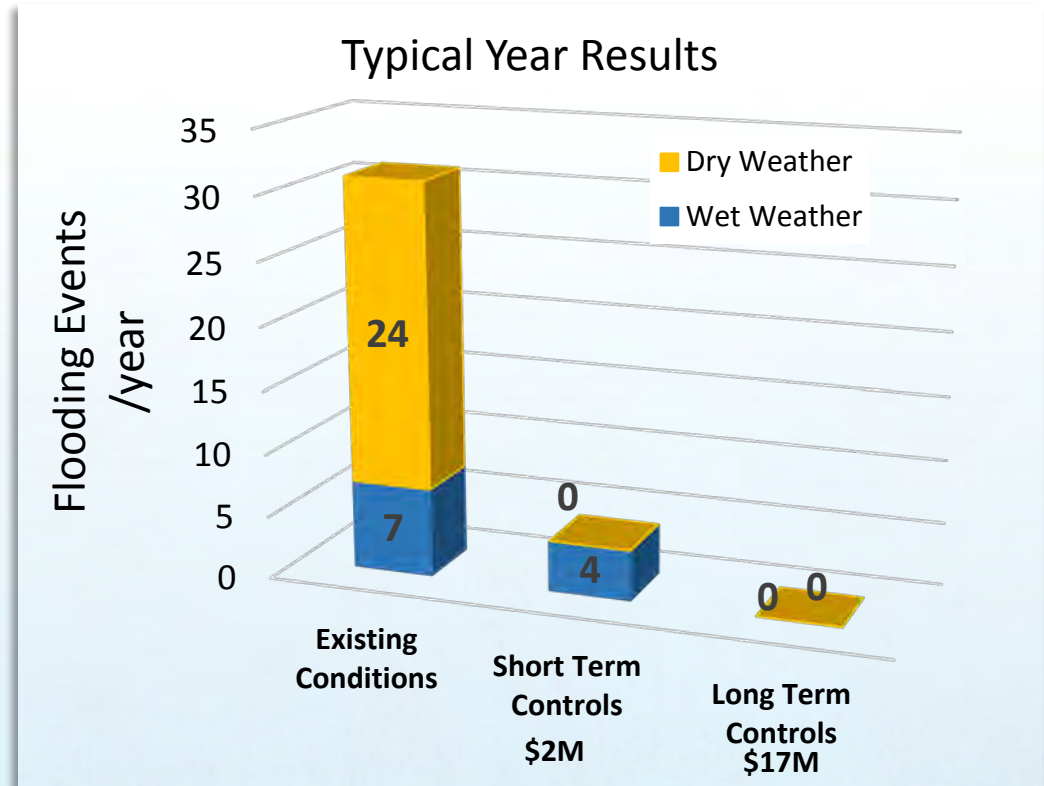
- » 1.0 million gallons/yr
- » 32 hours flooded/yr

- Short-Term Controls

- » 0.1 million gallons/yr
- » 2.1 hours flooded/yr

- Long Term Controls

- » 0 million gallons/yr
- » 0 hours flooded/yr



# Short-term Controls for Wellington Avenue

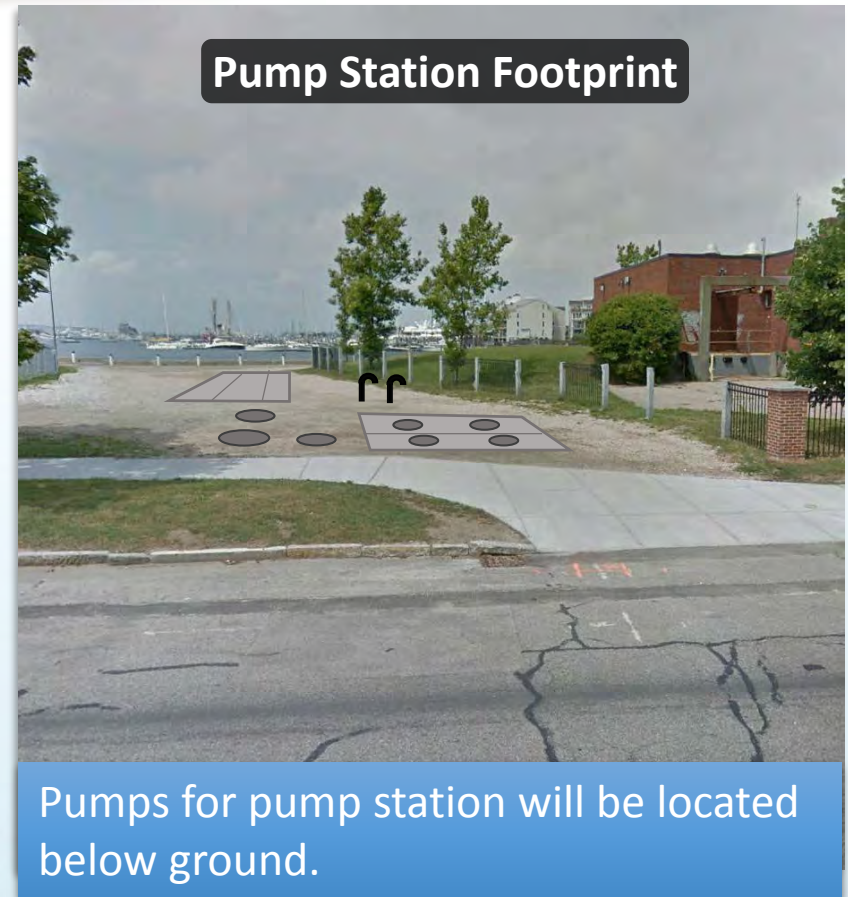
- Tide gates
- Outfall dredging
- Sediment removal
- Catch basin sumps and rehabilitation
- Pipe system improvements





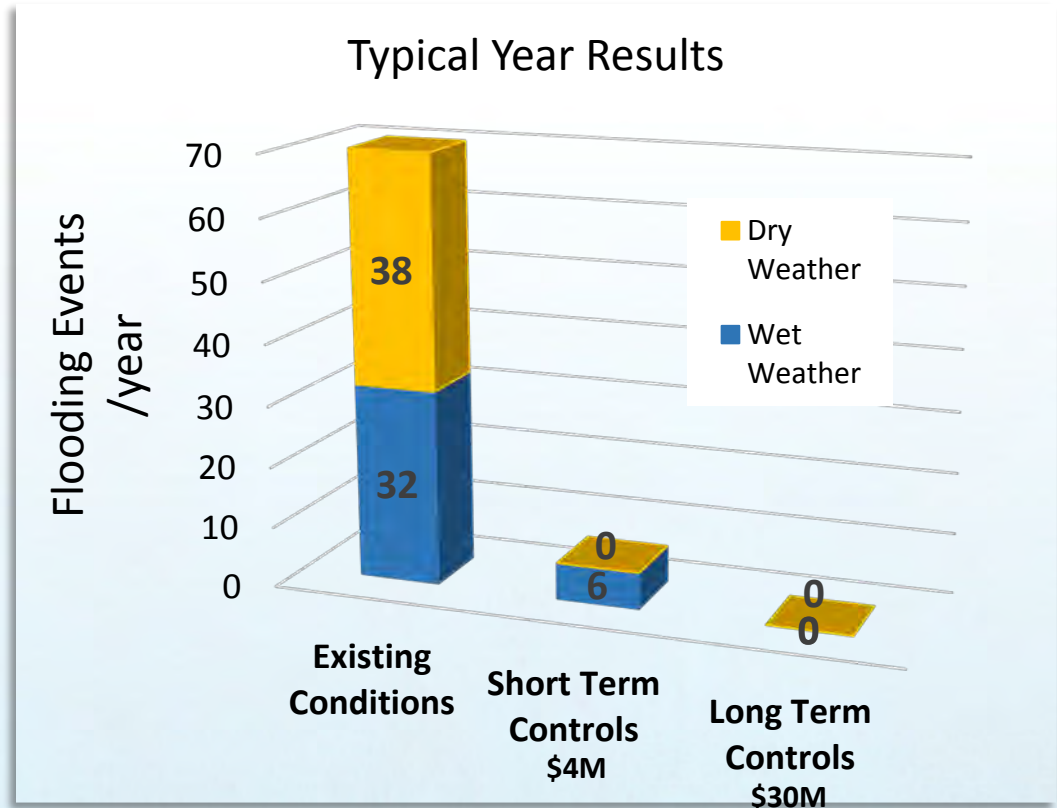
# Long-term Controls for Wellington Avenue

- All short-term controls
- Additional tide gate
- Green infrastructure
- 55 MGD Stormwater pump station



# Flood Mitigation for Wellington Avenue

- Existing Conditions
  - » 5.8 million gallons/yr
  - » 62 hours flooded/yr
- Long-Term Controls
  - » 0 million gallons/yr
  - » 0 hours flooded/yr

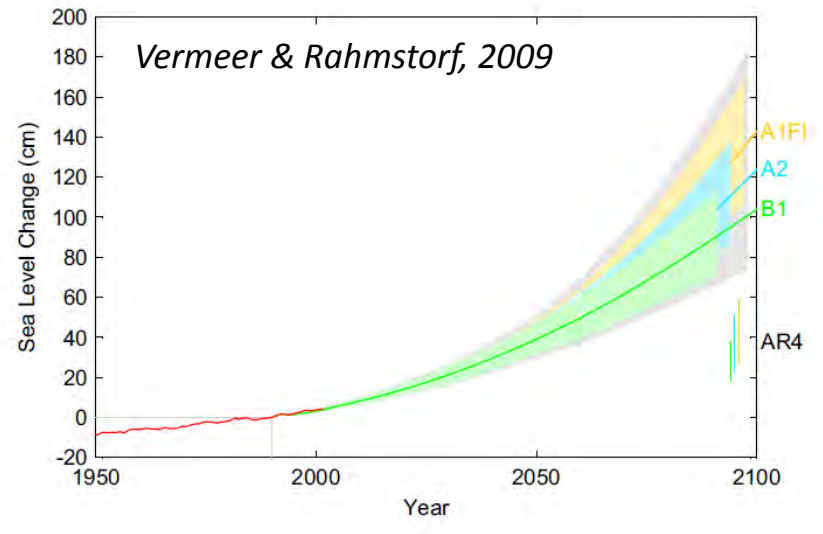




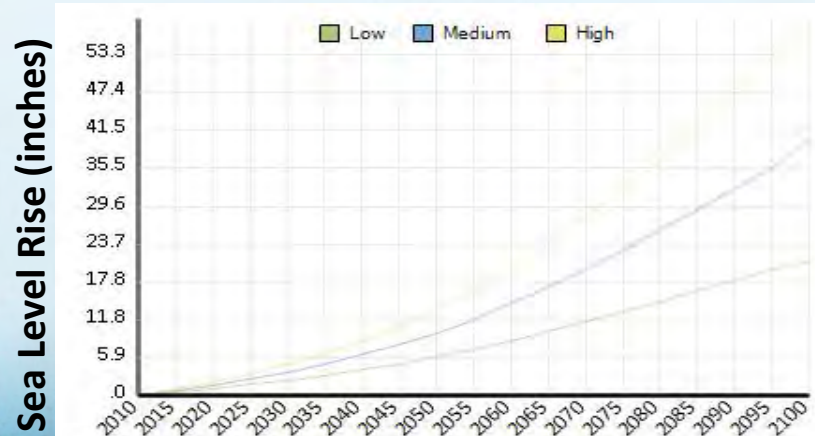
# Sea Level Projections

- 2014 US National Climate Assessment
  - » Global: 1 to 4 feet by 2100
  - » Local projections affected by subsidence and other regional factors
- RI Sea Grant for Newport:
  - » 3 to 5 feet by 2100
- US EPA CREAT 2.0
  - » Climate Resilience Evaluation & Awareness Tool for water and wastewater utilities
  - » 2 to 6 feet by 2100 at Newport

Global Sea Level Rise



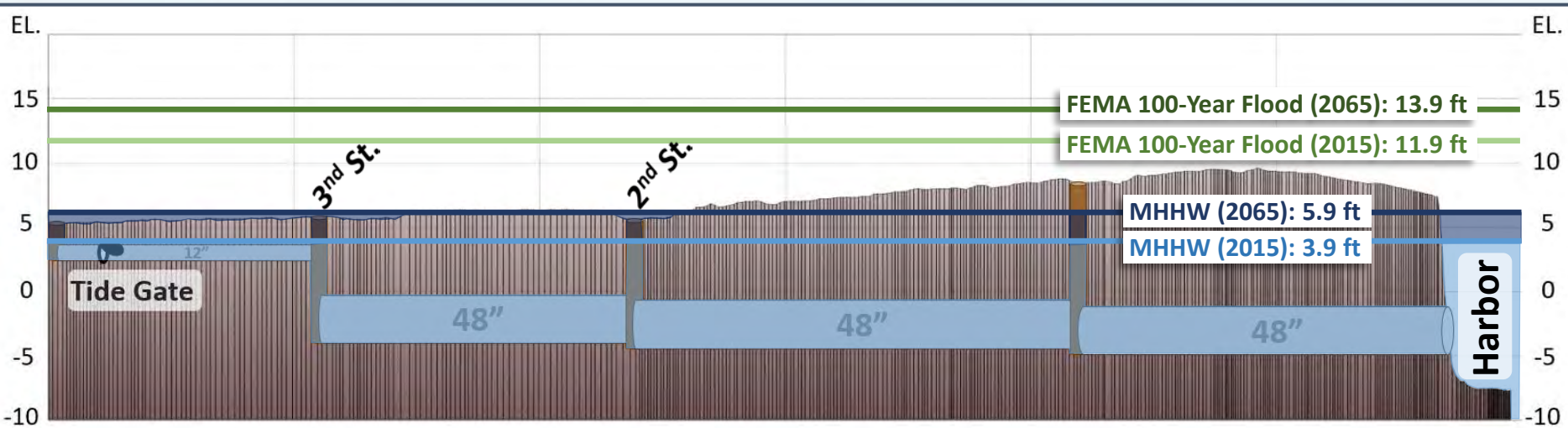
US EPA CREAT 2.0



# 100-year Flood Elevations at Bridge Street




- In 2065, higher high tides will be above some ground surfaces
- The current 100-year storm surge inundates streets over bulkheads. In 2065, the surge will be 2 feet higher





# Strategies for Addressing Effects of Climate Change

- Identify regional efforts and guidelines related to climate change.
  - Define the process and considerations for planning.
  - Define climate change scenarios for rainfall, sea level, storm surge and rivers.
  - Evaluate sewer and storm drain system performance with climate change.
  - Evaluate flooding vulnerabilities to sea level rise, storm surge and rivers.
  - Develop strategies and design standards.
  - Monitor changes over time and be prepared to adjust.
- 



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# Thank You

