



Climate Change and Flood Risks to Municipal Wastewater Infrastructure

NEWEA 2017 Annual Conference
January 24, 2017

Vulnerabilities and Adaptation

- Flood Hazards
- Risk Assessment
- Collection Systems
- Treatment Systems

Sea Level Rise & Storm Surge

News Feature | October 13, 2016

Utilities Face Fallout From Hurricane Matthew

Sewage spills are one of the most significant consequences of the storm for municipalities. “Utilities are in the process of assessing and correcting damage to the region’s infrastructure after Hurricane Matthew,” WJCT reported. “In addition to lingering power outages and debris-covered roads, officials are also dealing with millions of gallons of toxic sewage.”

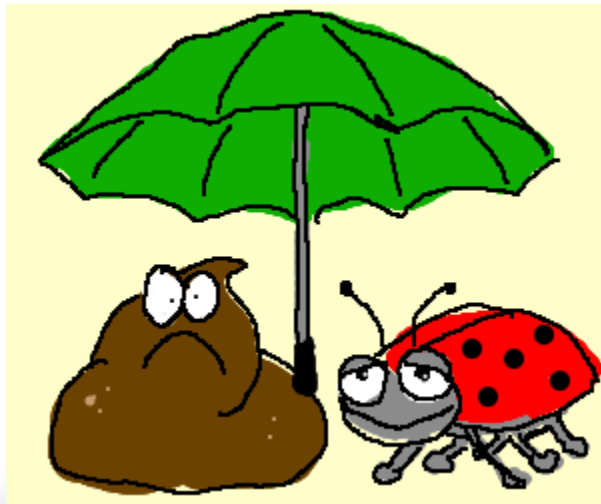


Extreme Precipitation

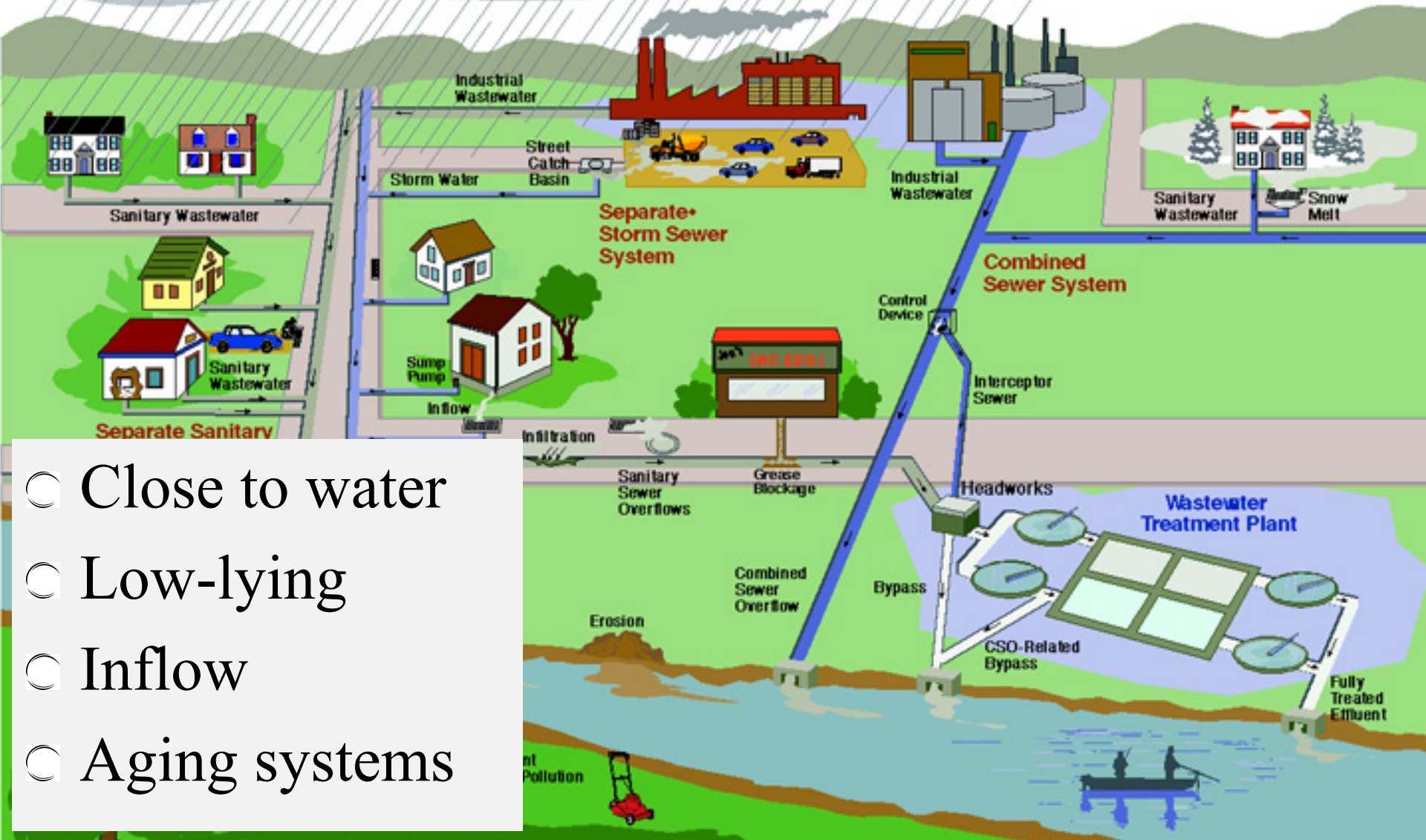
The Augusta Chronicle

January 3, 2017 11:41 pm

Heavy rains caused raw sewage overflows in several parts of Richmond County. According to Augusta Utilities Department, highly diluted wastewater began running out of several manholes because of heavy rainfall that began Monday and continued throughout



Urban Wet Weather Flows



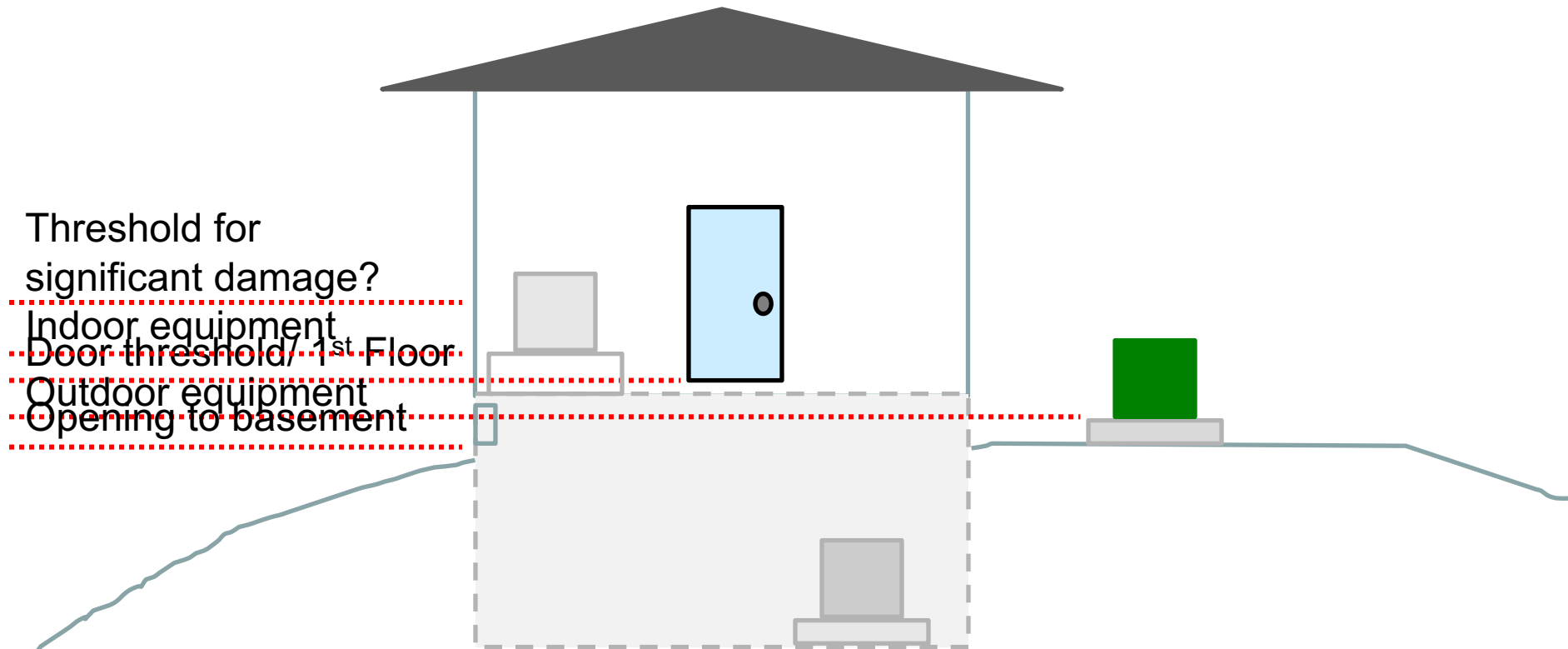
- Close to water
- Low-lying
- Inflow
- Aging systems

Risk Assessment

- Likelihood & **Consequence** of flooding

**Not “worst-case” scenarios
but
“worst-likely” scenarios**

Likelihood of Flooding



At what elevation would the asset fail to function?

Criticality and Consequences

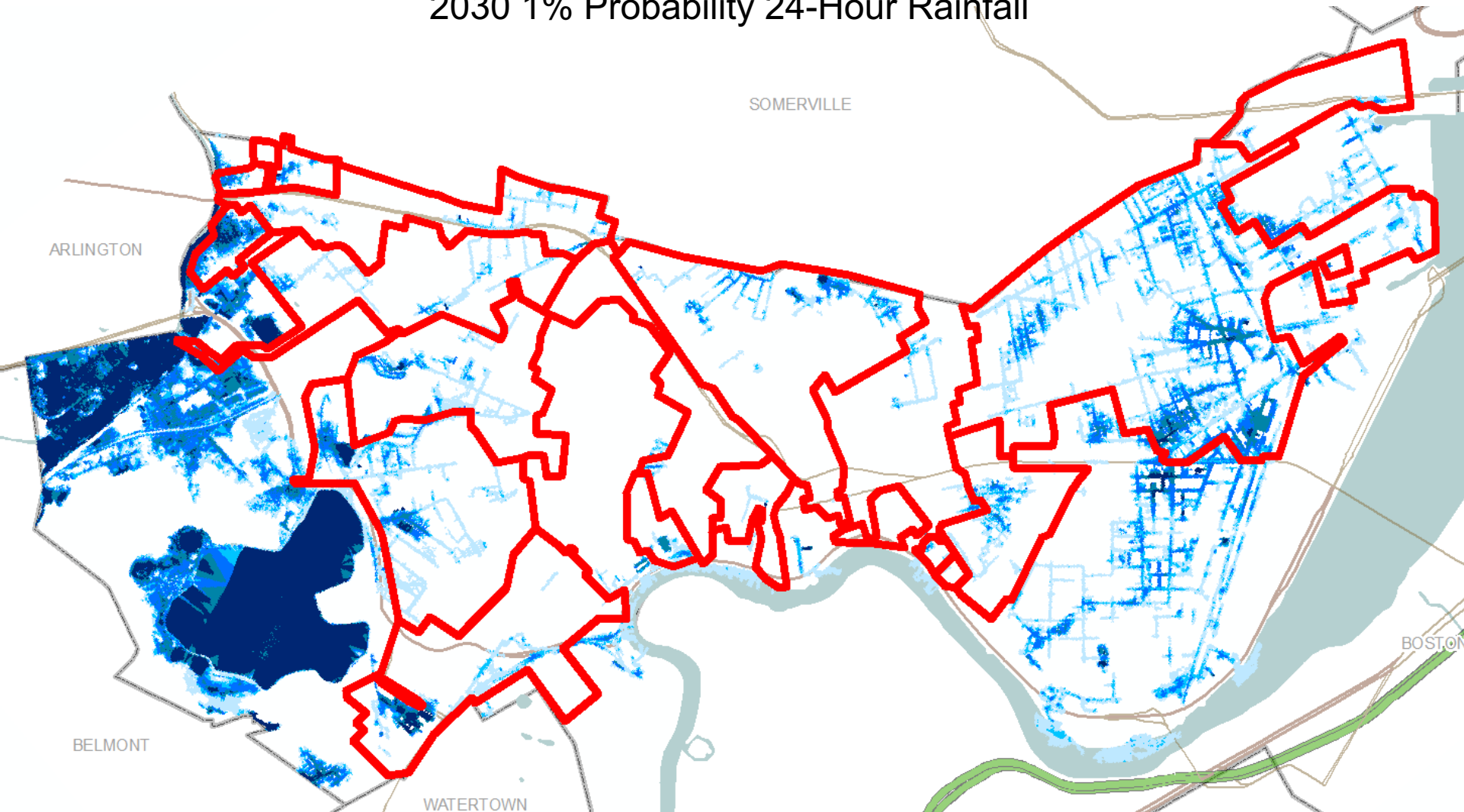
- **Area** of service loss
- **Duration** of service loss
- **Cost** of damage
- Impacts to **public safety** and emergency services
- Impacts to **economic activities**
- Impacts to **public health** and the **environment**

Case Examples

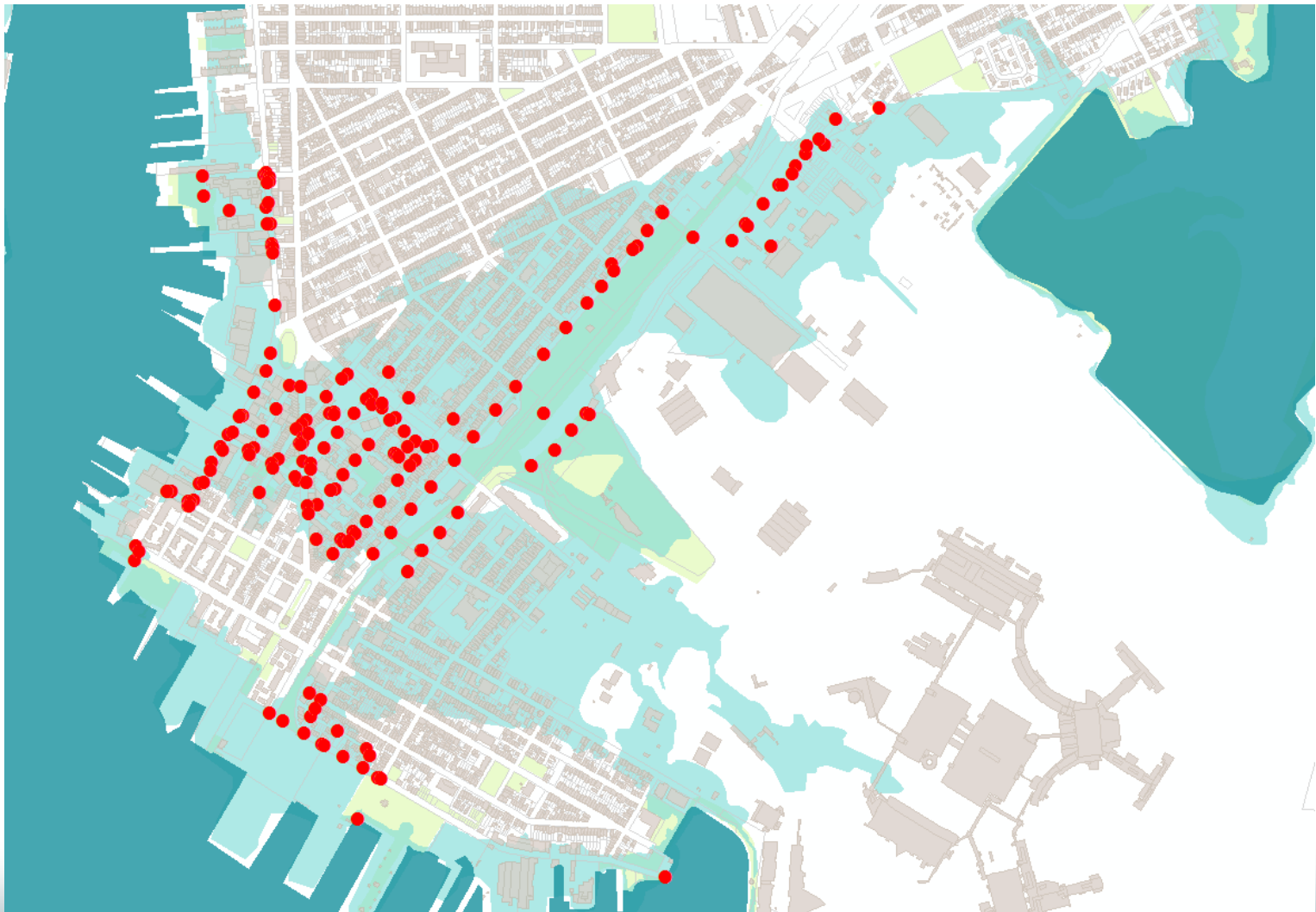
Combined Sewers	Cambridge, East Boston
Pumping Stations	Gloucester, Hingham, Hull, Oak Bluffs, Swampscott
Buildings	Massport, Cambridge
Treatment Plants	Gloucester, Hull, Swampscott

Cambridge Combined Sewers

2030 1% Probability 24-Hour Rainfall



East Boston Combined Sewers



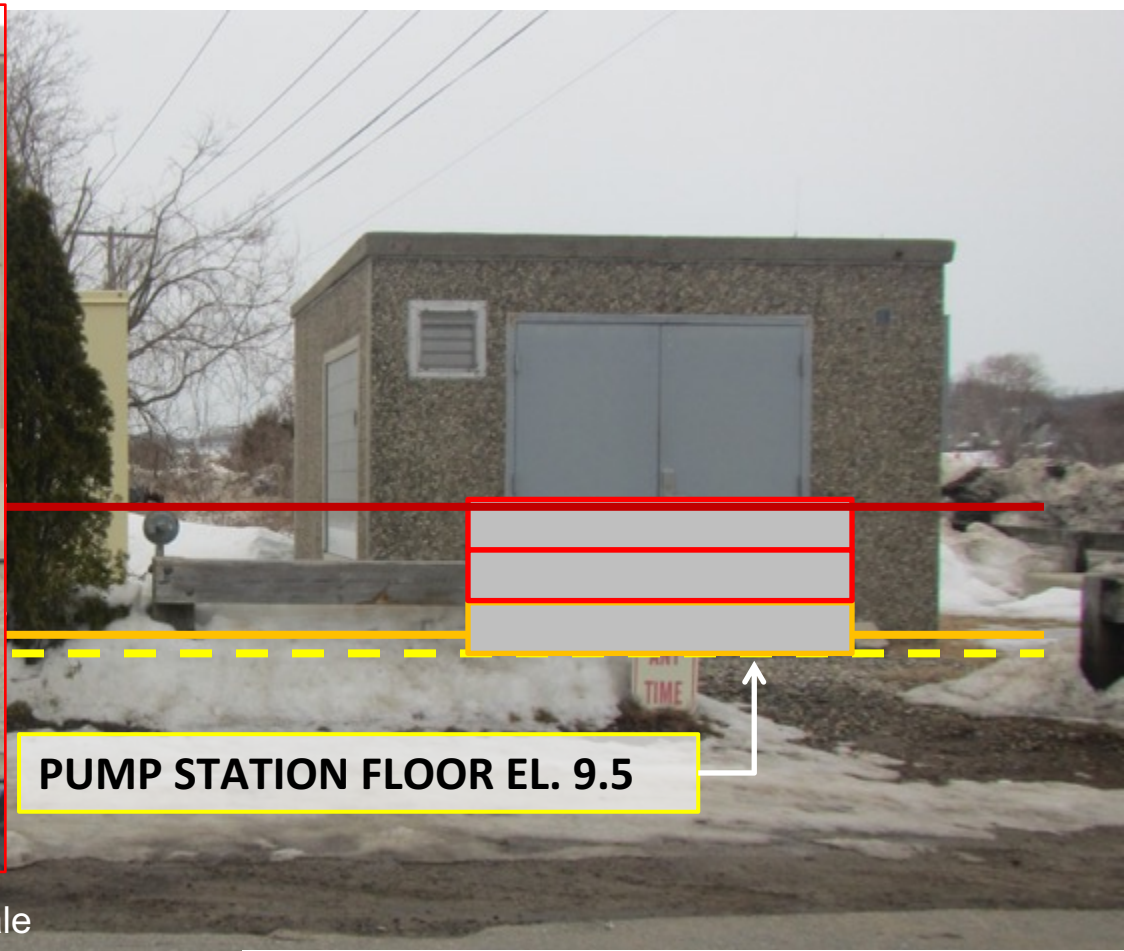
Combined Sewers

- Adaptation strategies:
 - Regional flood protection
 - Watertight manholes
 - Sewer separation
 - Storage, conveyance, and pumping capacity
 - Tide gates

Pump Stations

Municipality	Vulnerable by 2070s
Gloucester	9
Hingham	8
Hull	6
Oak Bluffs	2
Swampscott	1

Gloucester Good Harbor Pump Station



- Lines shown are approximate and not to scale
- All elevations noted are in NAVD88

Hull Waste Water Pump Station 6

Waste Water Pump Station 6

ANNUAL CHANCE OF FLOODING
 Present = 0.1% (1-in-1,000)
 2030 = 2% (1-in-50)
 2070 = 50% (1-in-2)

(2070) 1% FLOOD EL. = 13.0'

(2030) 1% FLOOD EL. = 10.0'

EST. FIRST FLOOR EL. = 9.8'

FEMA AE = 10.0'

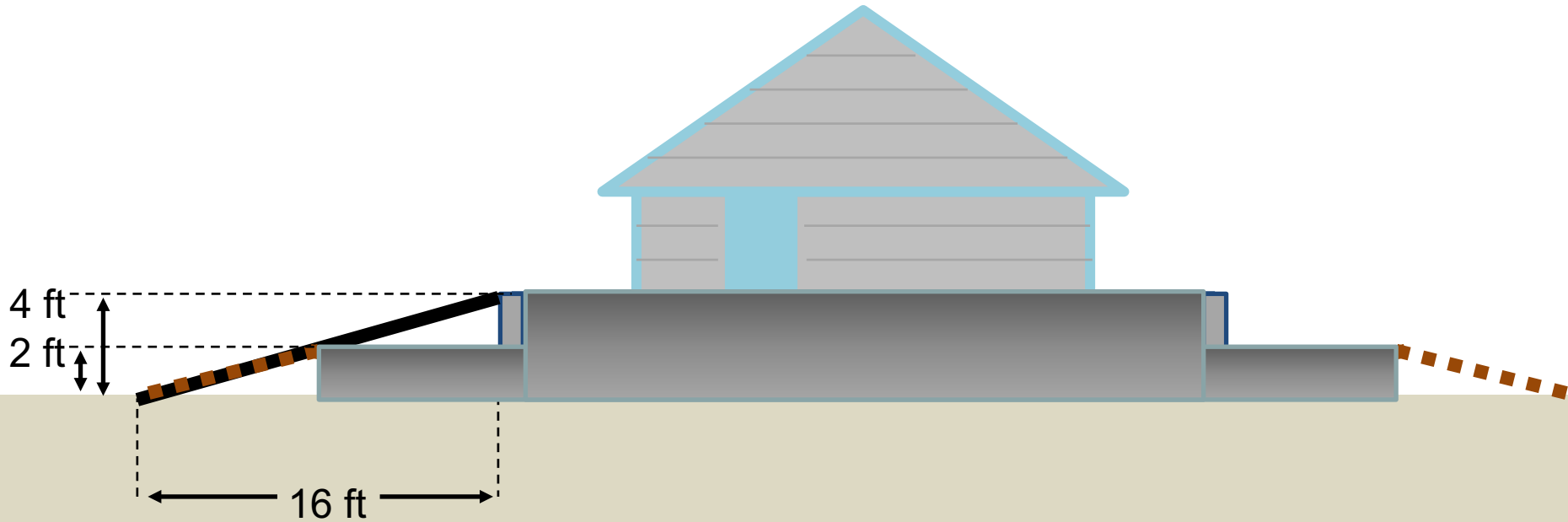
- Notes:**
- Lines shown are approximate and not to scale
 - Estimated first floor elevation noted is LiDAR ground elevation plus 0.5 ft. and reported in NAVD88 vertical datum

Incremental Adaptation Strategy



- Grassy Berm
- Demountable Flood Panels
- Concrete Flood Walls

Hull Waste Water Pump Station 6

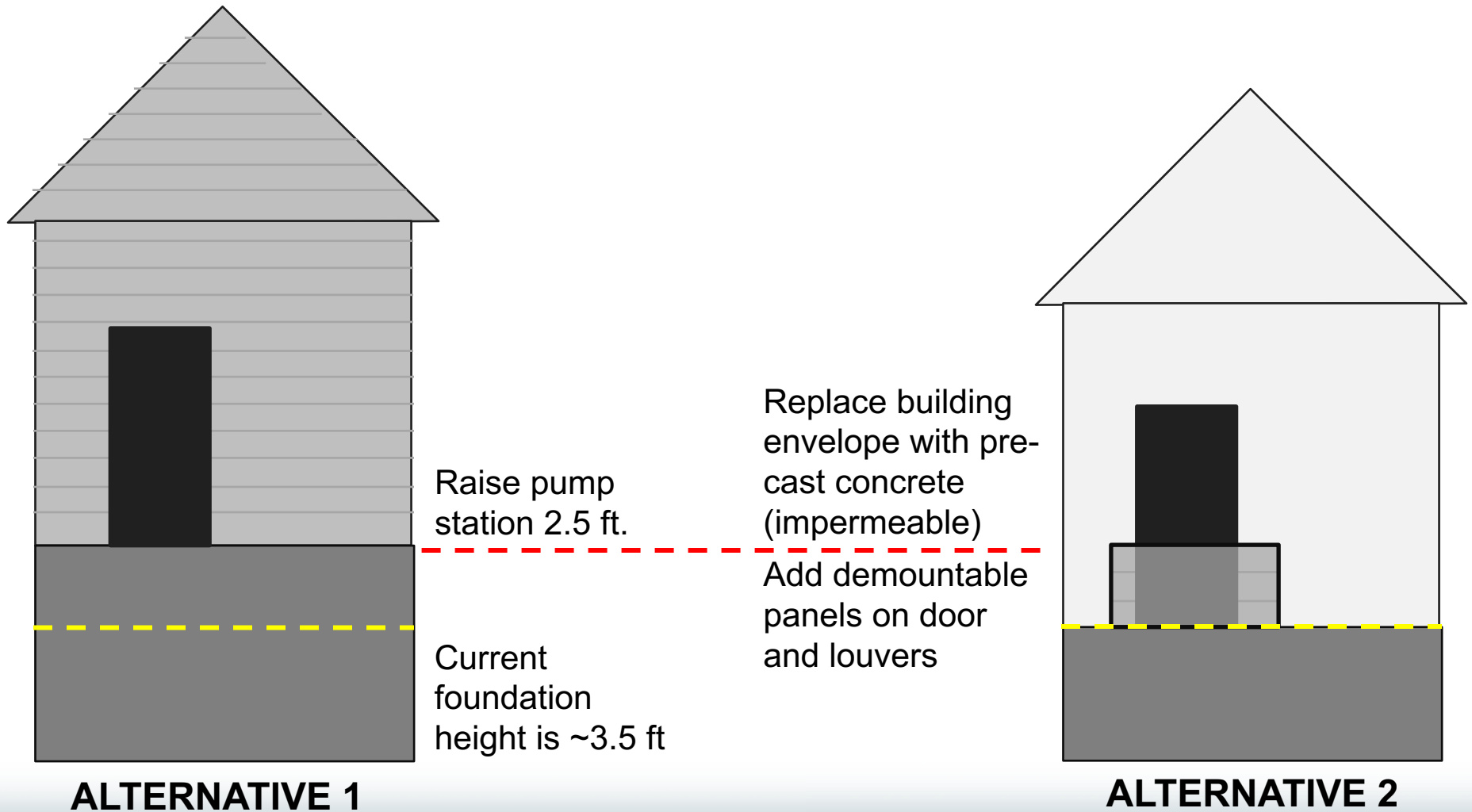


Incremental: 2 ft. high berm around three sides



Long term protection: 4 ft. high retaining wall with berm on two sides (reuse berm material)

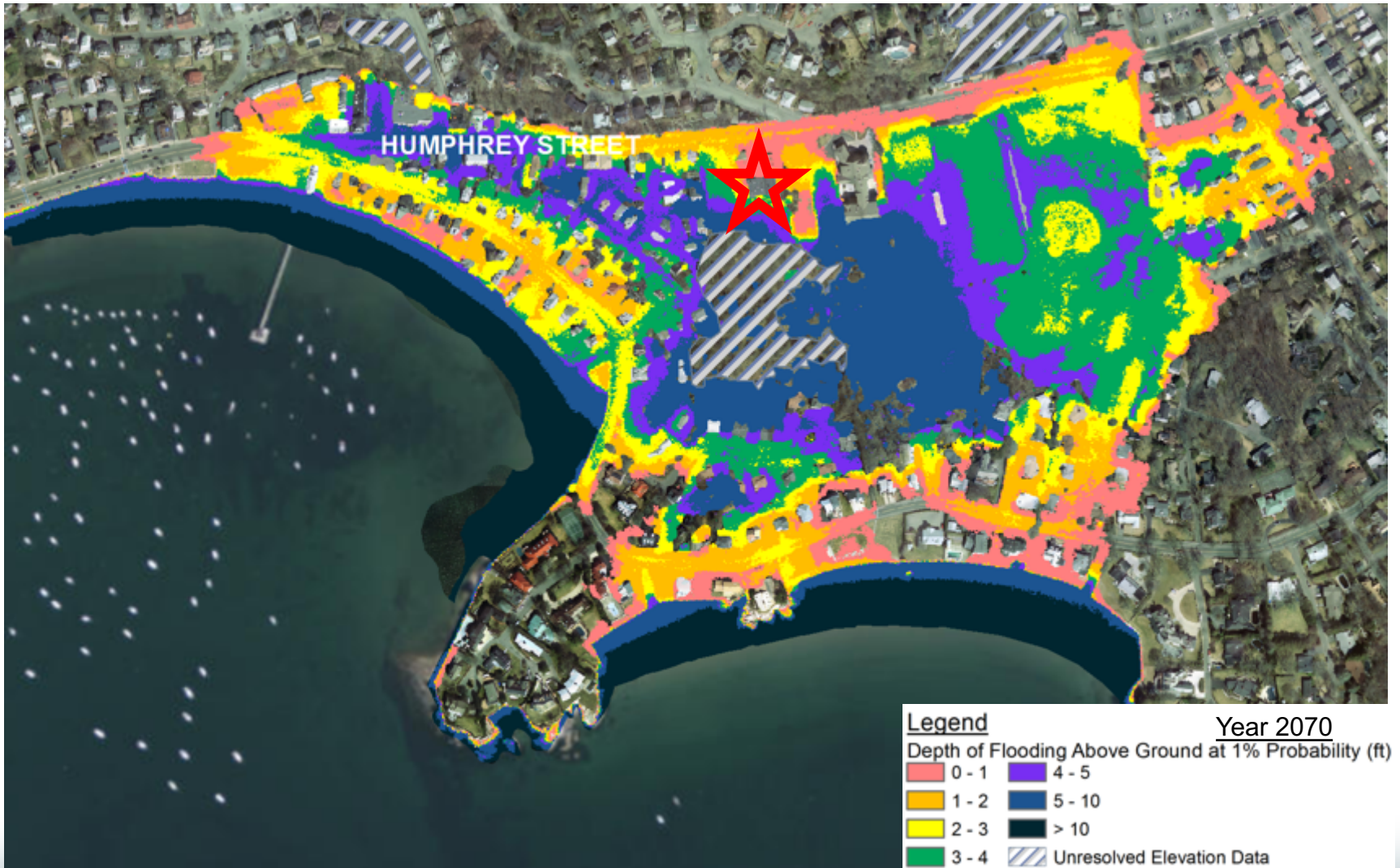
Hull Waste Water Pump Station 9



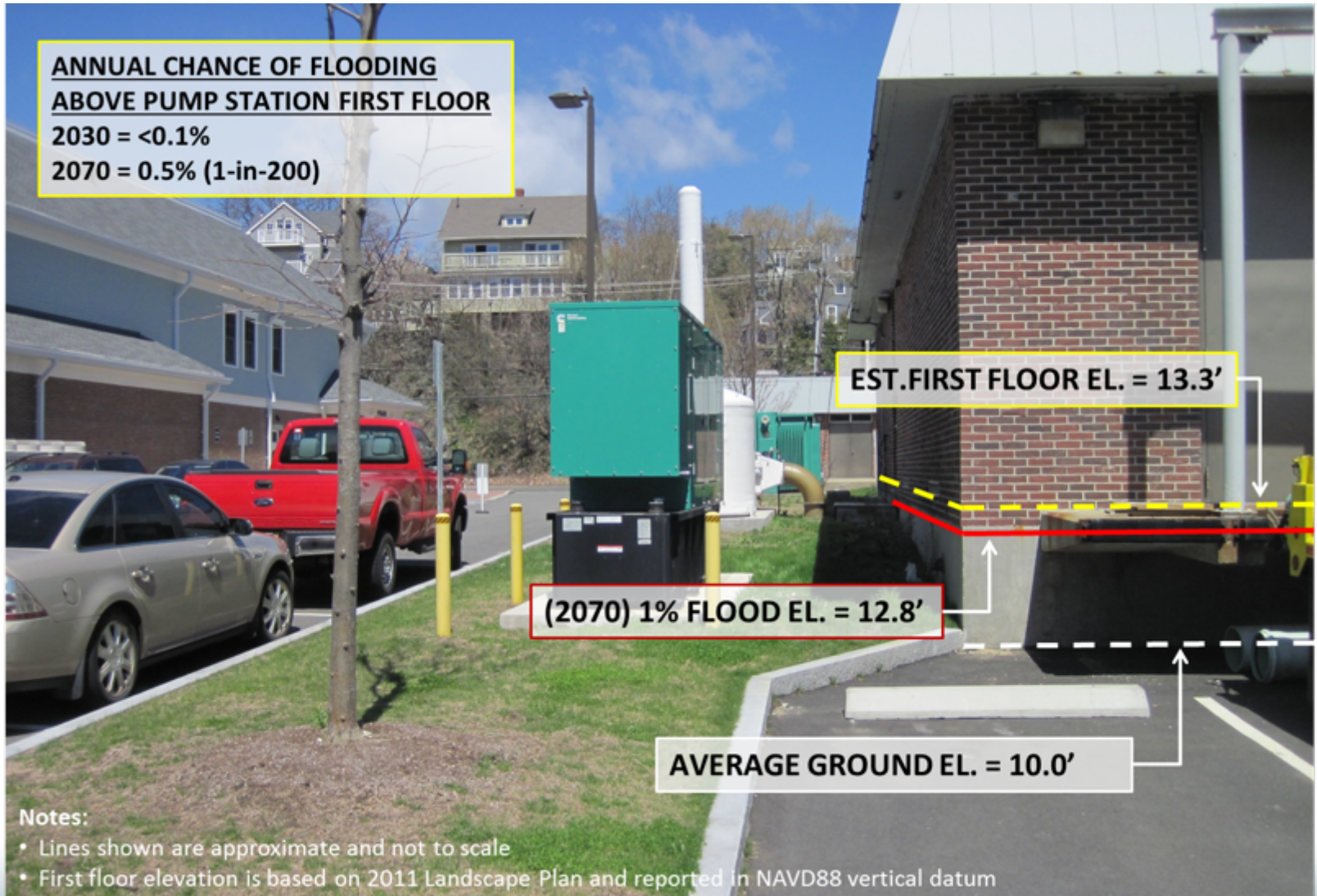
Oak Bluffs School Street Pump Station



Swampscott Humphrey Street Pump Station



Swampscott Humphrey Street Pump Station



Swampscott Humphrey Street Pump Station

EMERGENCY GENERATOR
ANNUAL CHANCE OF FLOODING
2030 = <0.1%
2070 = 5% (1-in-20)

(2070) 1% FLOOD EL. = 12.8'

**EMERGENCY GENERATOR
EST. FLOOR EL. = 12.1'**

AVERAGE GROUND EL. = 9.9'

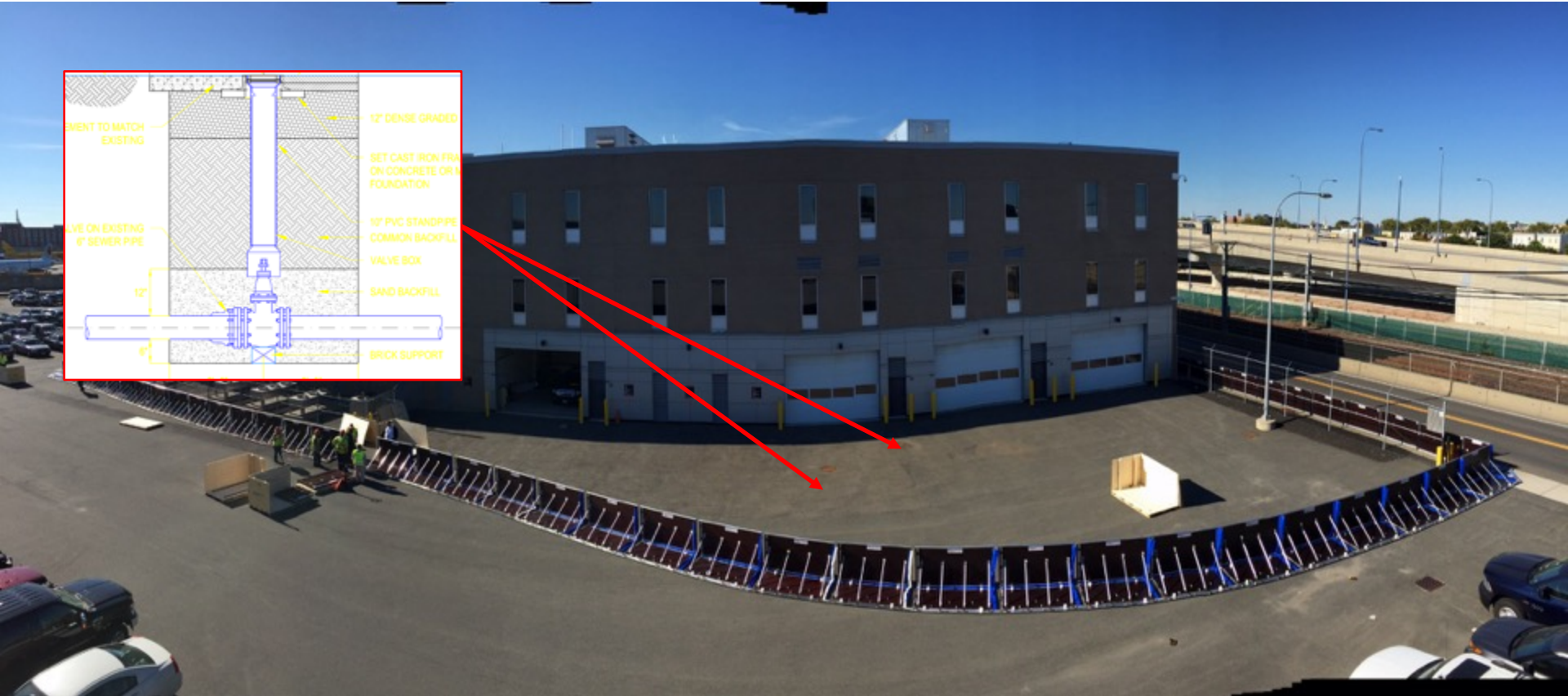
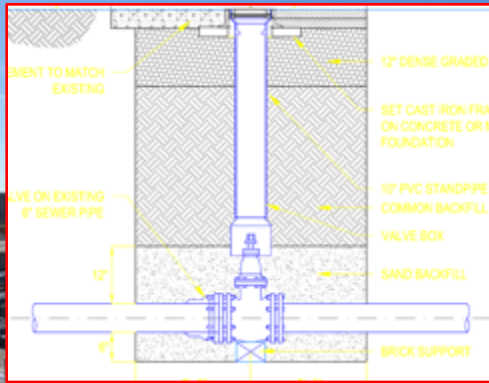
Notes:

- Lines shown are approximate and not to scale
- Ground elevation noted is based on LiDAR and reported in NAVD88 vertical datum

Pumping Stations

- Adaptation:
 - Elevation
 - Floodproofing – permanent, temporary
 - Emergency power

Logan Airport – State Police Building



Cambridge – Public Outreach

City of Cambridge
Department of Public Works
147 Hampshire Street
Cambridge, MA 02139

CITY OF CAMBRIDGE



Flooding: Is Your Property Protected?

- Existing Conditions
- New Construction
- Climate Change

DEPARTMENT OF PUBLIC WORKS
CITY OF CAMBRIDGE
INSPECTIONAL SERVICES DEPARTMENT

September 2016

Flooding Facts You Should Know

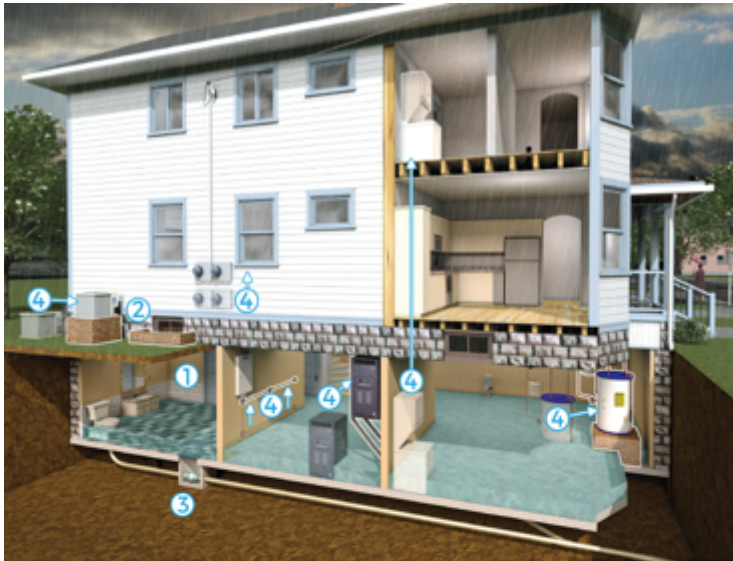
- The City's assessment on climate change vulnerability has shown that precipitation-driven flooding is likely to increase in frequency, extent, and depth.
- In the past five years, all fifty states have experienced floods.
- Flooding can occur outside designated flood zones.
- Just a few inches of water from a flood can cause tens of thousands of dollars in damage.
- Most homeowners' and renters' insurance do not cover flood damage.
- You can purchase flood protection insurance, even if your property is outside the flood insurance zone.

cambridge.gov/climate2016



Cambridge – Public Outreach

WHAT CAN I DO?



3 Install Backwater Valves

Flooding can cause flow from sanitary sewer and drain lines to back up through pipes into buildings. These backups cause damage that is difficult to repair and also creates a health hazard. A good way to protect buildings from sewage and drainage backups is to install backwater valves, a device installed to prevent sewage and drainage from flowing backwards into basement fixtures, such as dishwashers, sinks, showers, toilets, washing machines, or floor drains. Backwater valves have a flap door inside which allows wastewater to flow in one direction, out towards the street, but closes automatically and does not allow flow backwards through your pipe and into the basement.

TIPS

- Changes to the plumbing in your property must be done by a licensed plumber or contractor.
- Valves should be installed on sewer and drain lines that are connected to equipment that is below the potential flood level. Therefore, valves may be needed on washing machine drain lines, laundry sinks, floor drains, and sump pumps.

WHERE TO INSTALL

- Install on the plumbing of each basement fixture.
- Valves should be accessible for monthly maintenance.
- A licensed plumber can determine the appropriate installation location.



BENEFITS: HELPS PREVENT DAMAGE TO A STRUCTURE AND AVOID HAZARDOUS AND COSTLY CLEANUP, AS WELL AS PROTECT THE HEALTH AND SAFETY OF THE OCCUPANTS OF THE STRUCTURE.

4 Elevate/Relocate Utilities

Electrical system components, including service panels (fuse and circuit breaker boxes), meters, switches, and outlets, are easily damaged by flood water. Another serious problem is the potential for fires caused by short circuits in flooded systems. Raising electrical system components will help you avoid problems. All components of the electrical system, including the wiring, should be raised at least one foot above the anticipated flood level.

TIPS

- Electrical system modifications must be done by a licensed contractor.
- Your contractor should check with the local power company about the maximum height to which the electric meter can be raised.
- If your property is equipped with an old-style fuse box or low-amperage service, you may want to consider upgrading to a modern circuit breaker system and higher-amperage service.

WHAT TO DO

- Outlets, switches, light sockets and junction boxes, as well as the main breaker or fuse box and electric motors, should be out of danger of getting wet.
- If a wire has to terminate below the anticipated flood level it should be specially marked in the panel box and turned off at the time of a flood warning.
- Change all outlets to ground fault interrupters (GFI's).
- Elevate water heaters, furnaces, air conditioning units, and washerdryers.



BENEFITS: HELPS PREVENT FIRES AND DAMAGE TO ELECTRICAL SYSTEM COMPONENTS, RESULTING IN FASTER CLEANUP AND REPAIRS.

For more information: www.cambridgema.gov/theworks www.cambridgema.gov/inspection

EXCESSIVE RAIN CAN OVERWHELM SEWER AND DRAIN PIPES, CAUSING BACK-UPS



During a rainfall or sewer backup event, the backwater valve closes to block sanitary sewage from entering your basement fixtures. Please be aware that closed valves also prevent basement wastewater from exiting into municipal sewer pipes.

Wastewater Treatment Facilities

Municipality	Criticality Ranking	Risk Ranking
Gloucester	1 out of 95	36 out of 95
Hull	1 out of 40	10 out of 40

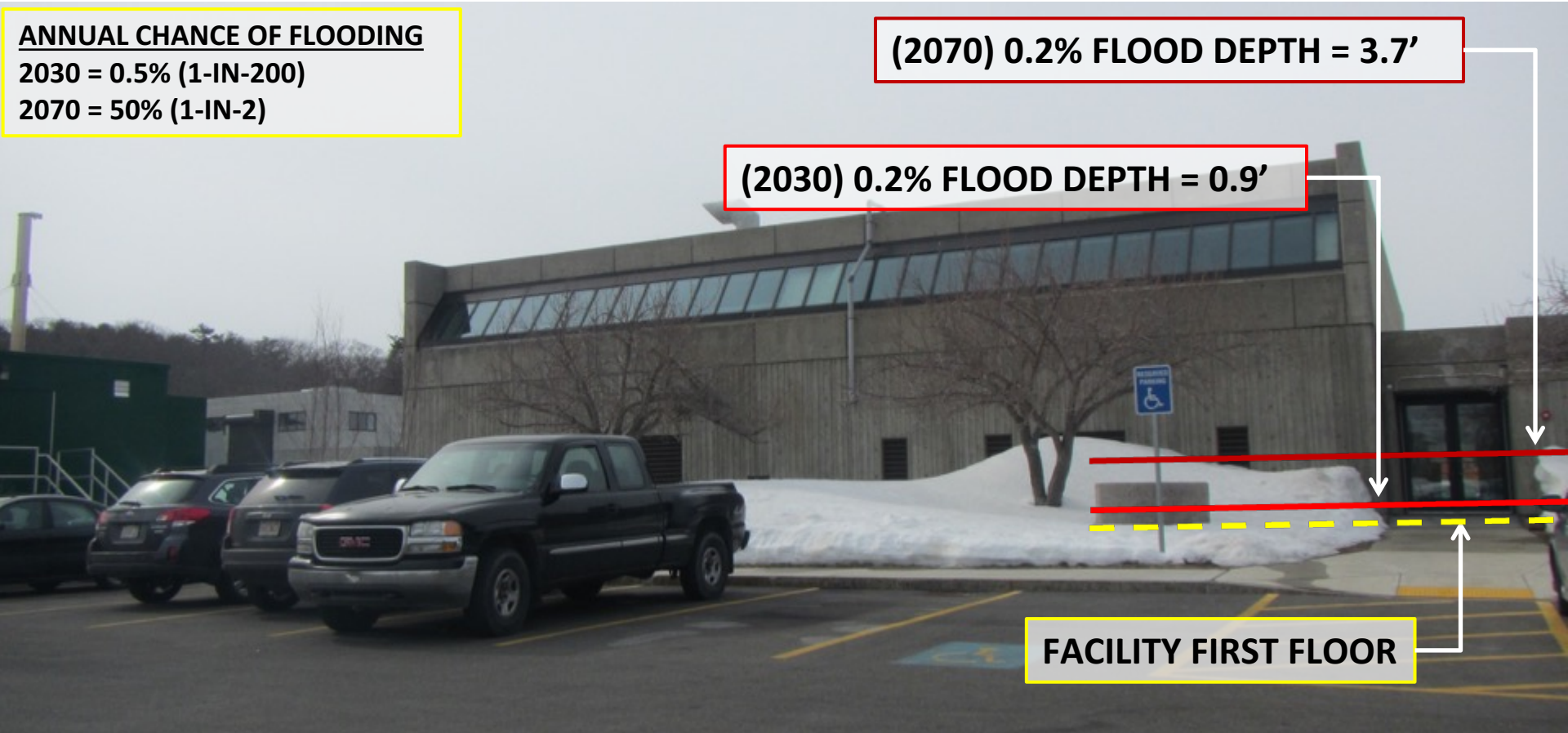
Gloucester Water Pollution Control Facility

ANNUAL CHANCE OF FLOODING
2030 = 0.5% (1-IN-200)
2070 = 50% (1-IN-2)

(2070) 0.2% FLOOD DEPTH = 3.7'

(2030) 0.2% FLOOD DEPTH = 0.9'

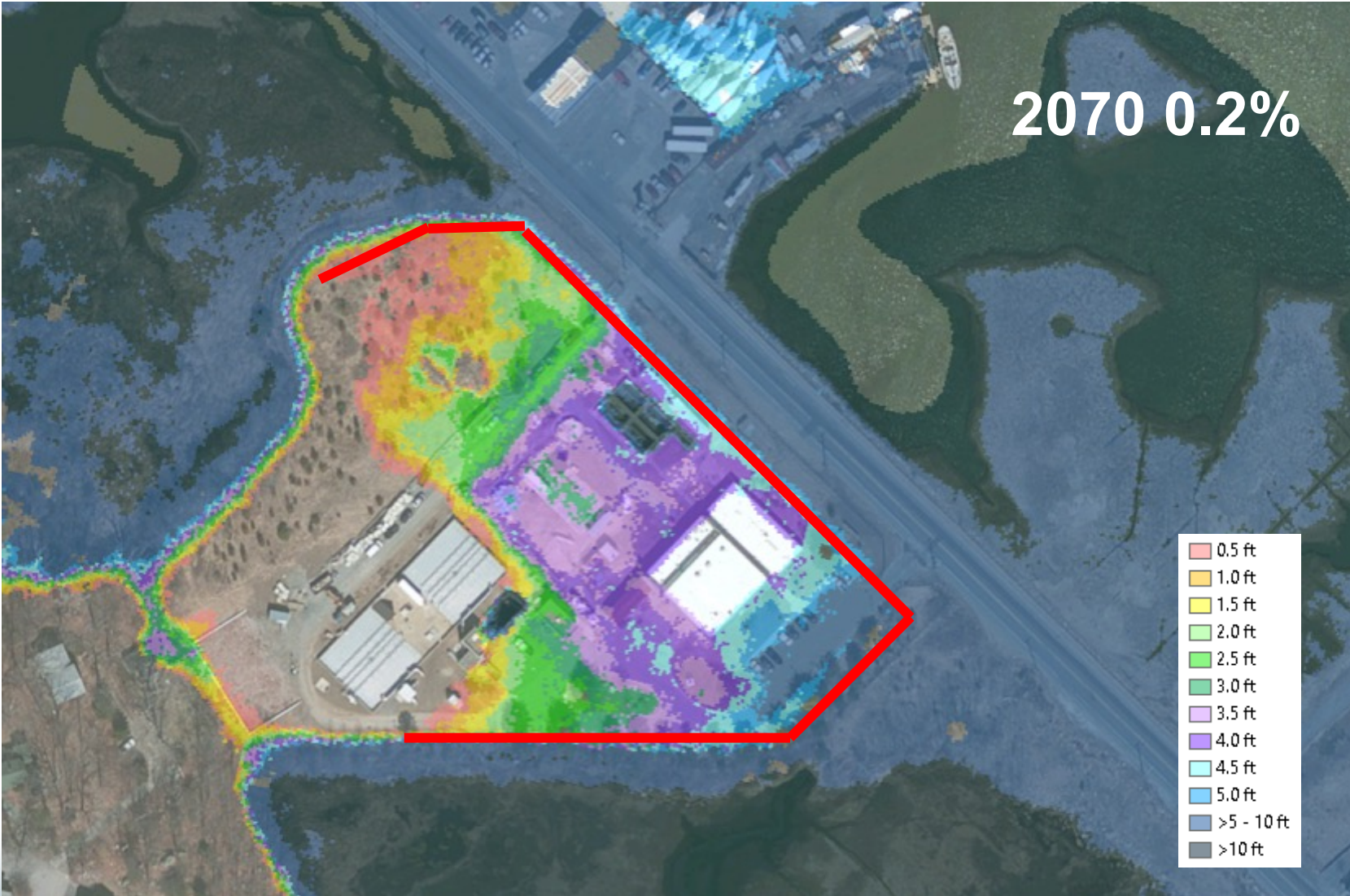
FACILITY FIRST FLOOR



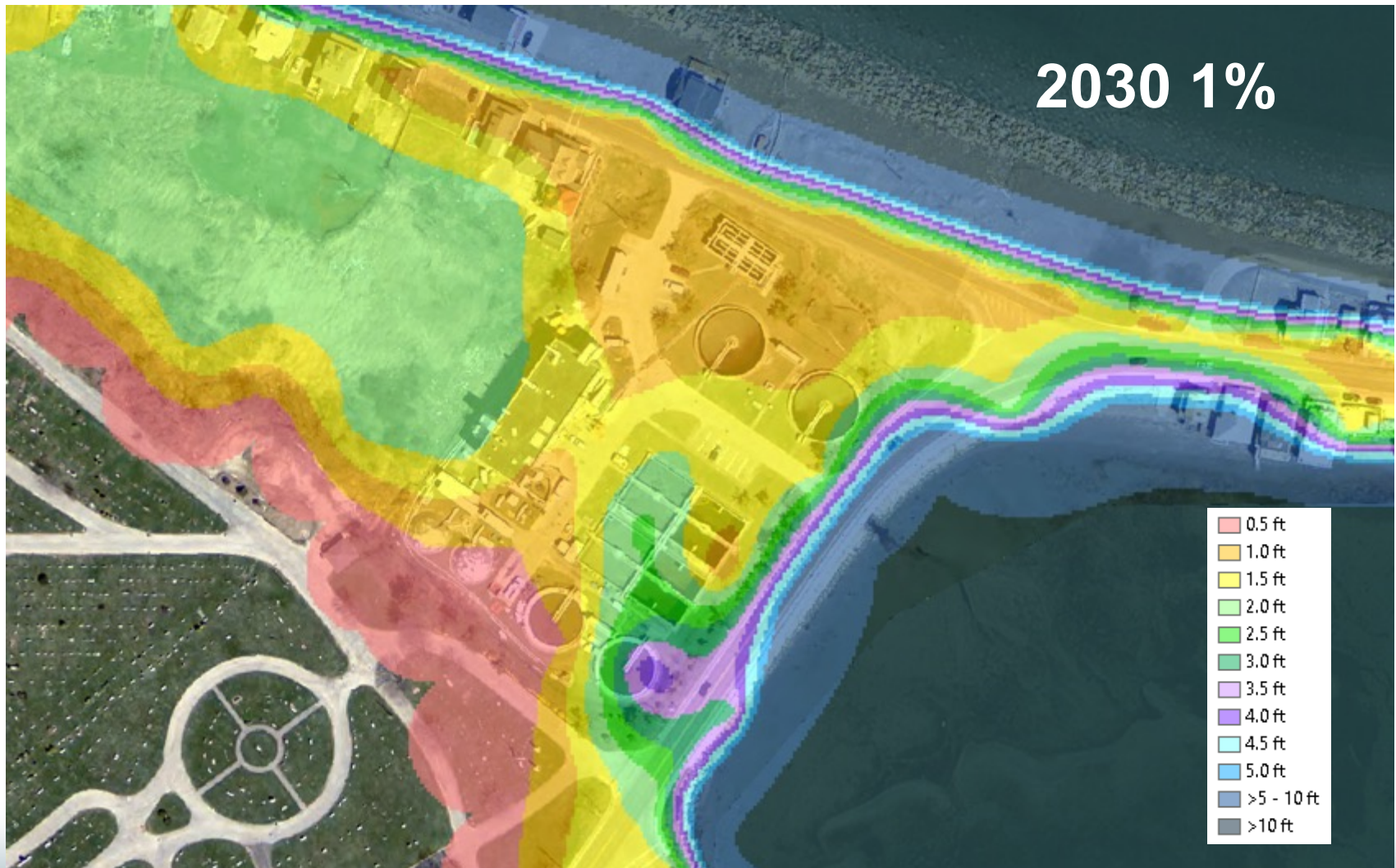
Gloucester Water Pollution Control Facility



Gloucester Water Pollution Control Facility



Hull Sewer Plant



Hull Sewer Plant



Hull Sewer Plant

Hull Sewer Plant

ANNUAL CHANCE OF FLOODING

Present = <0.1%
2030 = 1% (1-in-100)
2070 = 50% (1-in-2)

(2070) 1% FLOOD EL. = 12.8'

(2030) 1% FLOOD EL. = 10.2'

GROUND EL. = 10.2'

FEMA AE = 13.0'

Notes:
• Lines shown are approximate and not to scale
• Ground elevation noted is estimated based on LiDAR and reported in NAVD88 vertical datum



- Maintain Existing Floodproofing System
- Elevate Sensitive Exterior Equipment
- Long-Term: Perimeter Flood Wall

Takeaways

- Wastewater systems face high and growing risks over the near and long-term
- Solutions are available to help adapt buildings, collection systems, and treatment facilities to mitigate flood risk.
- Massachusetts communities are leading the way in risk assessment and planning.
- Now action is needed!

Thank you!

Nasser Brahim

Senior Climate Change Planner

nbrahim@kleinfelder.com

