



**Massachusetts Bay
Transportation Authority**

Climate Change Resiliency Program

Presentation to FMCB

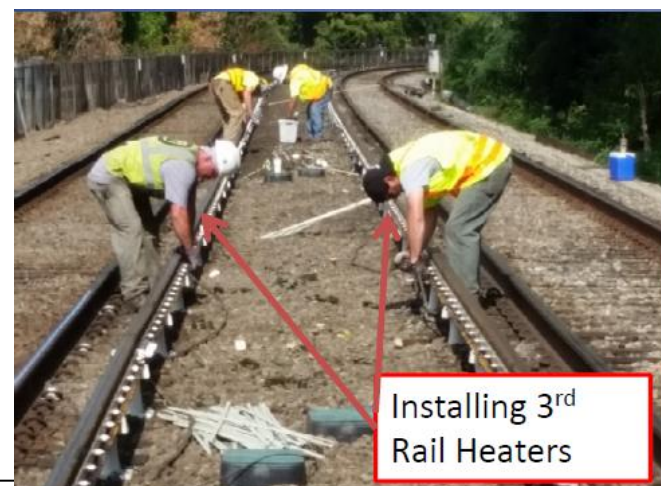
March 20, 2017



Winter of 2015 -- Winter Resiliency

Winter 2015 revealed very disruptive vulnerabilities in MBTA operations

- Response to Winter 2015
 - › New Fiscal and Management Control Board (FMCB) to identify and fix systemic problems
 - › \$100 million investment in infrastructure to make the system more resilient to snow and ice
 - › Revised Standard Operating Procedures and Storm oversight during emergency conditions





Governor Baker's Climate Change Strategy Executive Order

- Executive Order #569 (September 2016) calls on all state agencies to develop plans to address:
 - › Climate Change Vulnerability and Adaptation
 - › Greenhouse Gas Mitigation

- Climate Change Vulnerability and Adaptation
 - › Mandates the development of a statewide Climate Adaptation Plan
 - › All Executive Offices and their Agencies to assess vulnerability to climate change and identify resiliency options
 - » *Results from vulnerability assessments must be incorporated into existing policies and plans for all Executive Offices and Agencies*



MBTA's Vulnerabilities to Climate Change

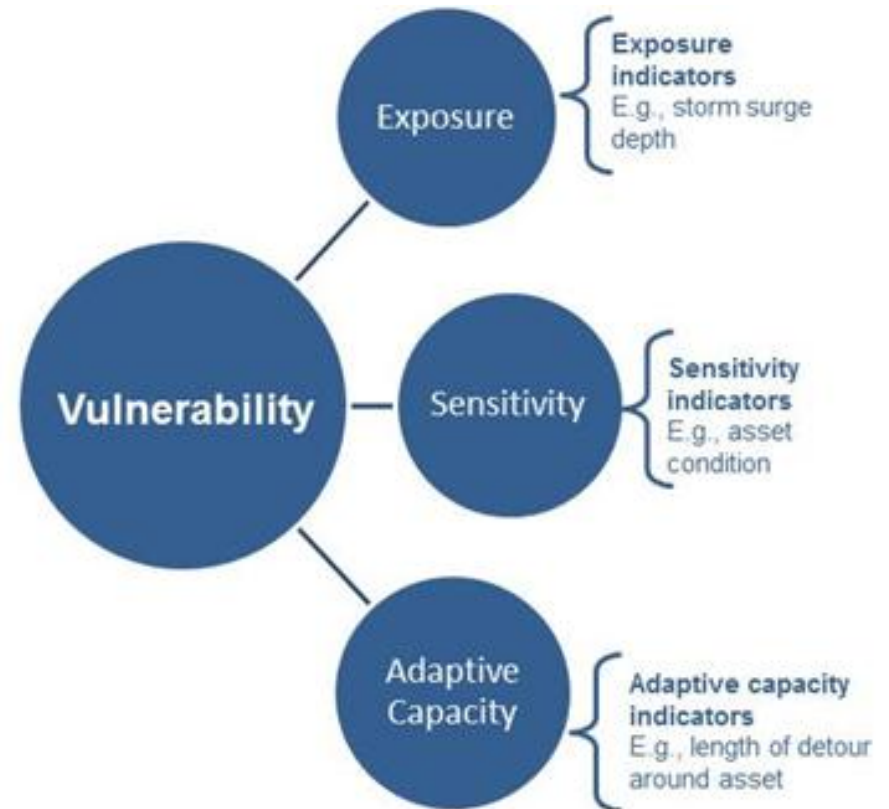
- ***Sea Level Rise, Storm Surge and Flooding***
 - › Flooded tunnels & stations and inaccessible facilities
 - › Interruption of electrification to third rail
 - › Damage to vehicles in yards
 - › Corrosion from salt water is potentially the most costly and lengthiest recovery time.
- ***Extreme Heat***
 - › Buckled rail
 - › Trains and electrical equipment may overheat
 - › Regional brownouts interrupt service delivery
 - › Health and safety risks to workers and passengers
- ***Wind***
 - › Downed Catenary on the Green, Blue Mattapan Lines & trackless trolley
 - › Damage to infrastructure such as signals, gates, building roofs, etc.
- ***Extreme Winters***
 - › Inaccessible right of way and facilities
 - › Ice damage to equipment, including switches
 - › Vehicle failure, brittle rail, frost heaves in track bed



Development of Vulnerabilities Assessment

Vulnerability is a function of exposure, sensitivity, and adaptive capacity

- **Exposure** describes whether an asset or system will experience a stressor and is based on the location and the timeframe of interest
- **Sensitivity** describes whether an asset or system, *if exposed to a stressor*, will be impacted in some way
- **Adaptive Capacity** describes the ability of a sensitive asset or system to react or recover from exposure.





Pilot Study: Blue Line Vulnerability Assessment

- Incremental approach to identifying vulnerabilities of our system
- Developed in conjunction with Neighborhood Organization of Affordable Housing (NOAH)
 - › Understand overall social, economic, and infrastructure related vulnerabilities of East Boston due to extreme weather events
 - › **Transportation and Infrastructure Working Group:** MBTA, MassDOT, MassPort, BTD, MWRA, BWSC
 - › Pilot Vulnerability Assessment helps MBTA plan our system-wide approach while contributing to NOAH's goals



Background: Blue Line

- Shortest Rapid Transit Line (7.3 miles)
- Proximity to Water – tunnel under the harbor and corridor along the coast
- Provides service to the airport – a regional priority
- Accessible engineering information
- Physical Infrastructure
 - › 12 Stations (5 Underground)
 - › Maintenance Facility at Orient Heights
 - › Infrastructure at a low elevation
 - › Power from Regional Grid and distributed internally by the MBTA
 - » 3rd Rail from Bowdoin to Maverick (Tunnel)
 - » Catenary from Airport to Wonderland (Above Ground)



Blue Line Vulnerability Assessment Summary

- **Primary threat is seawater**

- Most stations on Blue Line could be exposed to flooding by 2070
- Storm surge flooding is possible at some locations even now
- Heat is a concern but recovery time is faster

- **Most consequential vulnerability point**

- Flooding entering the portal between Maverick and Airport Stations
- Entrance is 7 feet below sea level.
 - » Salt water corrosion to rail, switches, signals, cable
 - » Would isolate residents of East Boston, Revere and Winthrop



Continued Vulnerability Assessments

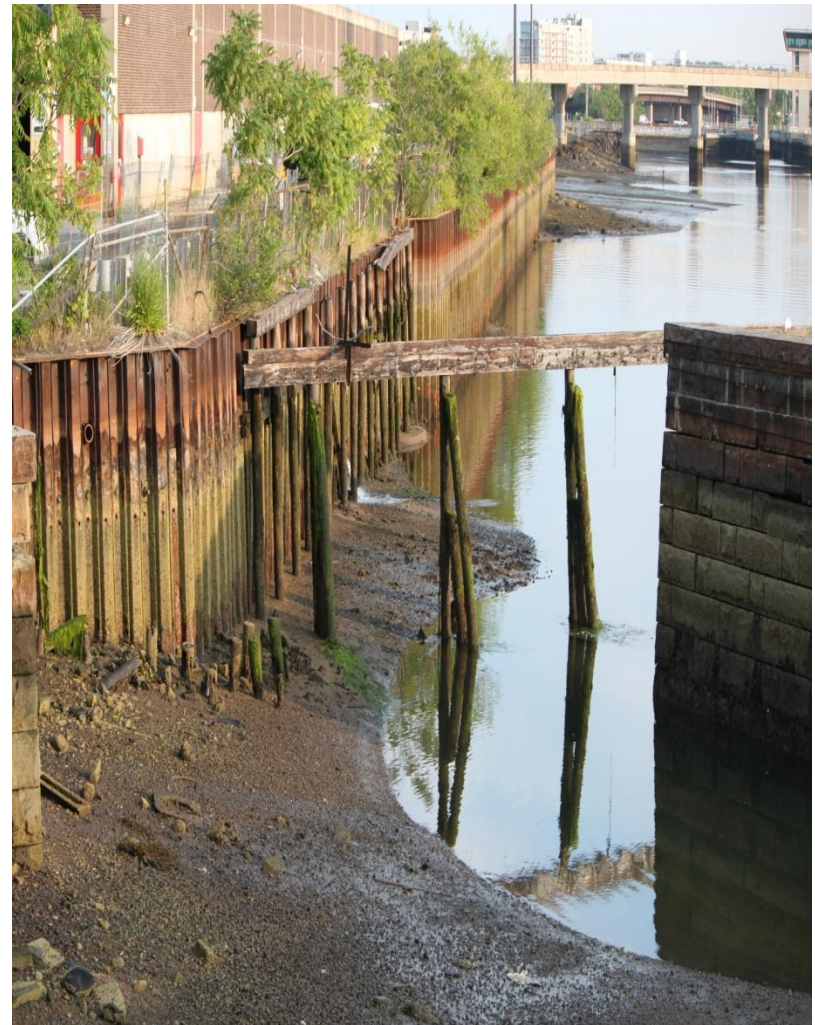
- **Expand Vulnerability Assessment to the entire system**
 - Orange, Red, Green and Mattapan Rapid Transit Lines
 - Maintenance Facilities
 - Systems – power, signals, communications *etc.*
 - Commuter Rail Network
 - Other Ancillary critical infrastructure (Control Centers, Information Technology, Power Plant, support facilities, *etc.*)
 - › Climate Resiliency Planning services currently being sought
 - » Procurement currently underway
 - » Multiple consultants to be selected
 - » Not a contract for one large assessment or plan
 - » Task Order based contract. Once engaged, consultant will be assigned discreet tasks
 -
 - » Overall vulnerability assessment will be developed in incremental steps



Current Climate Resiliency Projects Underway

Seawall at Charlestown Bus Garage

- Largest Bus Facility of the 9 MBTA Facilities housing 231 buses
 - › Serves 99,000 Riders a Day (29% of the MBTA's Bus Passengers)
- Seawall between facility and the Mystic River in disrepair. Storm surge has caused gradual erosion of soils behind wall. Continued erosion could jeopardize the structural stability of the facility
 - › Project underway to rebuild the seawall (\$17.86M – 75% funded by FTA)
 - › Replacement cost of the facility would be expected to be in excess of \$600 million





FTA Resiliency Grant: Charlestown Bus Garage



Draft for Discussion & Policy Purposes Only



Current Climate Resiliency Projects Underway

Fenway Portal

- Vulnerable to flooding from the Muddy River
 - › 1996 flood -- 7" of rain in 48 hours
 - › Resulted flooding from Kenmore to Arlington
- Currently utilizing timber logs and sandbags
- Extremely labor intensive and vulnerability is not completely eliminated





Fenway Portal

Project underway to build flood door (\$29 Million– 75% funded by FTA)

- Hinged gate at the top of the slope leading to portal
 - › short set-up time
 - › More effective in holding back flood water
- Increase wall height around portal
- Improve pumping and drainage capacity
- Improved monitoring of flood levels





Develop New Climate Change Resiliency Standards

- New Climate Change review standards have been added to all design RFP's providing direction to Architects and Engineers to assess the risk from extreme storms in all capital projects

Required elements for design projects at 30% stage:

- › Describe historical weather impacts at the site
 - » Is there a history of flooding or storm damage in the area?
- › Considering intended lifespan, identify exposure and sensitivities of planned components and services
- › Identify resiliency measures to minimize vulnerability
 - » Elevated footprint, flood barriers, materials that can withstand increased exposure to high temperatures and flooding, *etc.*



Coordinate with Other State and Local Government Entities

- **MassDOT Climate Change**

- Focus 40
- Coordinate on vulnerability assessment for the Artery Tunnels
- Assessing statewide impacts from heavy precipitation and extreme heat



- **Climate Ready Boston**

- MBTA is part of the Infrastructure Coordination Committee (ICC) to set consistent design standards and joint adaptation planning



- **Metro Boston Climate Preparedness Taskforce**— MAPC communities



CLIMATE
READY
BOSTON

- **Additional Coordination with other municipalities and stakeholders**

- Barr Foundation, Boston Harbor Now, Artery Business Committee, *etc.*





Program Structure Moving Forward

- Climate change resilience identified as key objective for MBTA's Strategic Plan
 - › Promotes organization-wide buy-in
- Expand the vulnerability assessment system-wide
- Incorporate climate change decision making into other key programs
 - › Capital Improvement Plan considers whether projects improve resiliency and incorporates it into funding decisions
 - › Asset Management Plan, SGR, Safety Plans
- Incorporate climate change resiliency into existing plans
 - › Per modified architecture and engineering RFP language, evaluate historical and future vulnerabilities at 30% design stage
- Develop and update Standard Operating Procedures for Emergency Preparedness
- Continued coordination with stakeholders – including our customers