



Implementing Resilience in Transportation

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Agenda

- **Lessons Learned in transportation resiliency at a local, state, national, and international level**
- ... from a project perspective (NYCT subway tunnels)
- ... from an agency perspective (MTA)
- ... from a city and state perspective (NYC, New York, CT)
- ... from a regional and national perspective (AASHTO, Federal)
- ... from an international perspective (UK)

Lessons from projects and “Resilience”, 2015. network.wsp-pb.com



How would you define “resilience?”

- *The ability of individuals, organizations, systems, and communities to bounce back more strongly from stresses and shocks. Resilience means creating diversity and redundancy in our systems and rewiring their interconnections, which enables their functioning even when individual parts fail.*
- Building resilience will enable us to *avoid unmanageable impacts*, while *managing the risks* that the future will no doubt present. Our capacity to deal with known risks, while establishing countermeasures to contend with unknowns, will be critical in this century.
- (From NY State 2100 Commission.)

What are the likely *stresses and disruptions*?

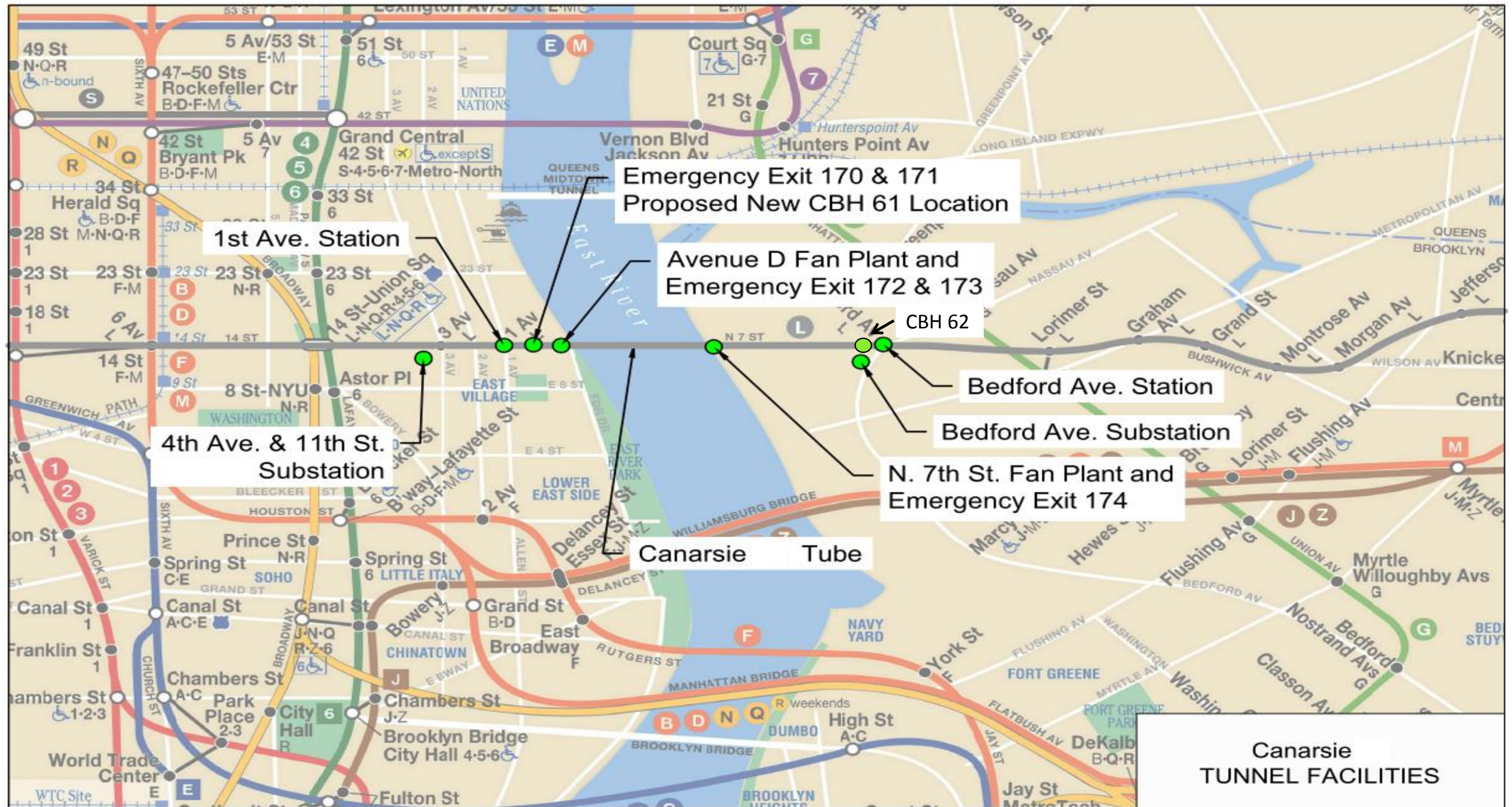
- Physical: *Climate change risks*: sea level rise, changing patterns of precipitation, temperature change and frequent extreme weather events.
- Societal: *Demographic pressures*, with significant population growth predicted for New York state
- Structural changes within the population, including further urbanization, the growth of suburban poverty, needs of those living below the poverty level, and a growing aging population.
- (From NY State 2100 Commission.)

Today's case studies/themes

- “*People, organizations, systems:*” Perspectives from different positions and layers of government, esp planning
- Focus on resilience in *transportation*, but resilience is relevant for all types of infrastructure
- Approaches are influenced by history and funding.
- Need to have a long memory or learn lessons from other places.
- Example from specific project for 1 piece of transportation infrastructure, an agency, a city, a state, many states, national.

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- Resilience from a project perspective – NYCT subways
 - *Individual* piece of infrastructure
 - Resilience repairs possible due to Federal funding
 - All subway service through East River Tunnels closed for days.
 - Montague, Clark, Canarsie Tunnels (WSP | PB/Parsons Transportation)
 - Damage from flooding, prolonged exposure by systems to saltwater and combined sewer overflow.
 - What has to be done to *respond* and *bounce back*?

Canarsie Tunnel Repair Project (the need to close L train)



A systems approach. Layers of resilience

Applying themes of *vulnerability, redundancy*

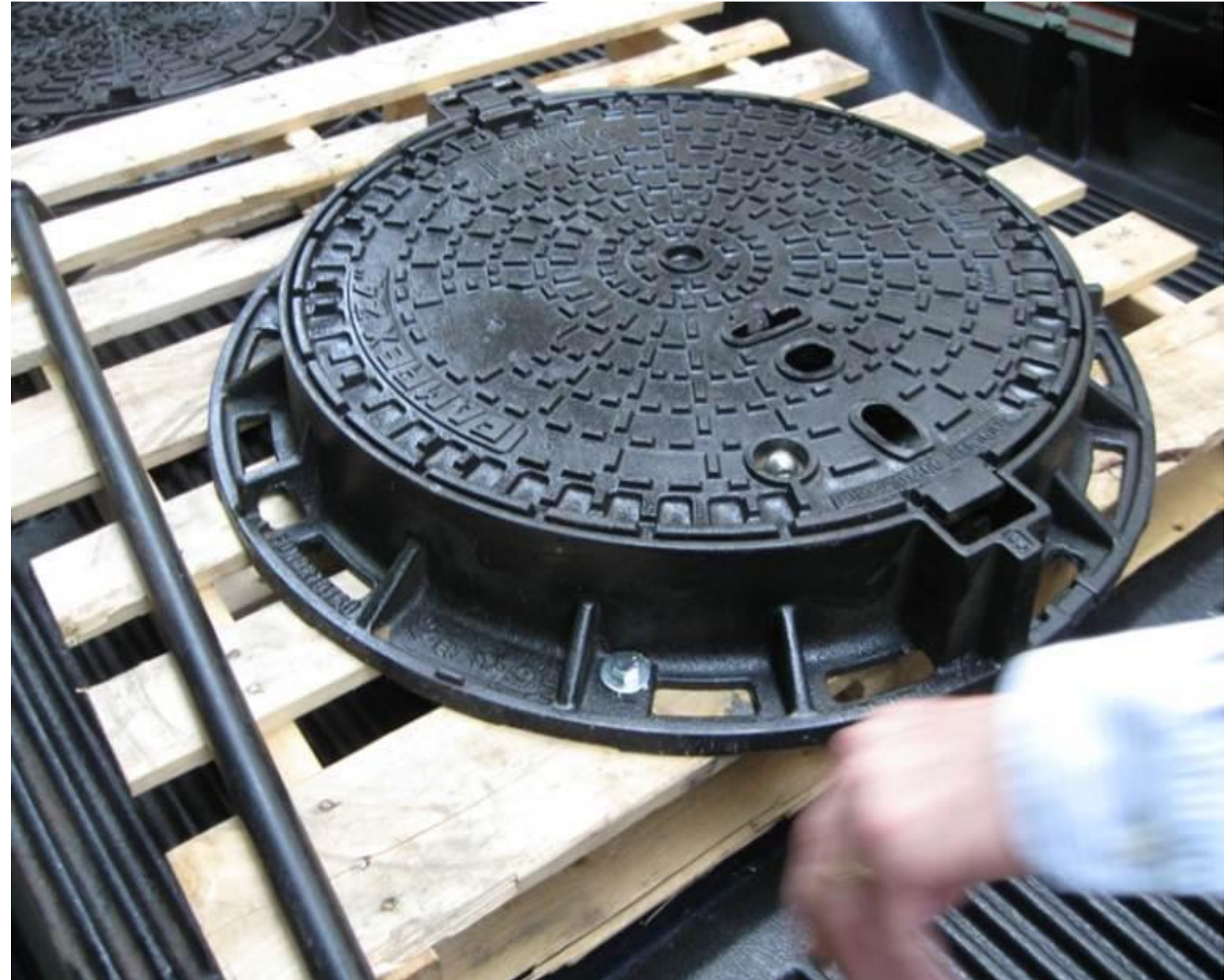
- 1st layer. Prevent water from reaching station area (protect piers, bulkheads against river and storm surge)
- 2nd layer. Prevent water from entering system from street (entrances, vents, emergency exits)
- 3rd layer. Prevent water from entering critical facilities (stations, tunnels, electrical rooms, substations, pump rooms)



Water enters through vents/exits, causing corrosion



Floodproof rolling door, manhole cover

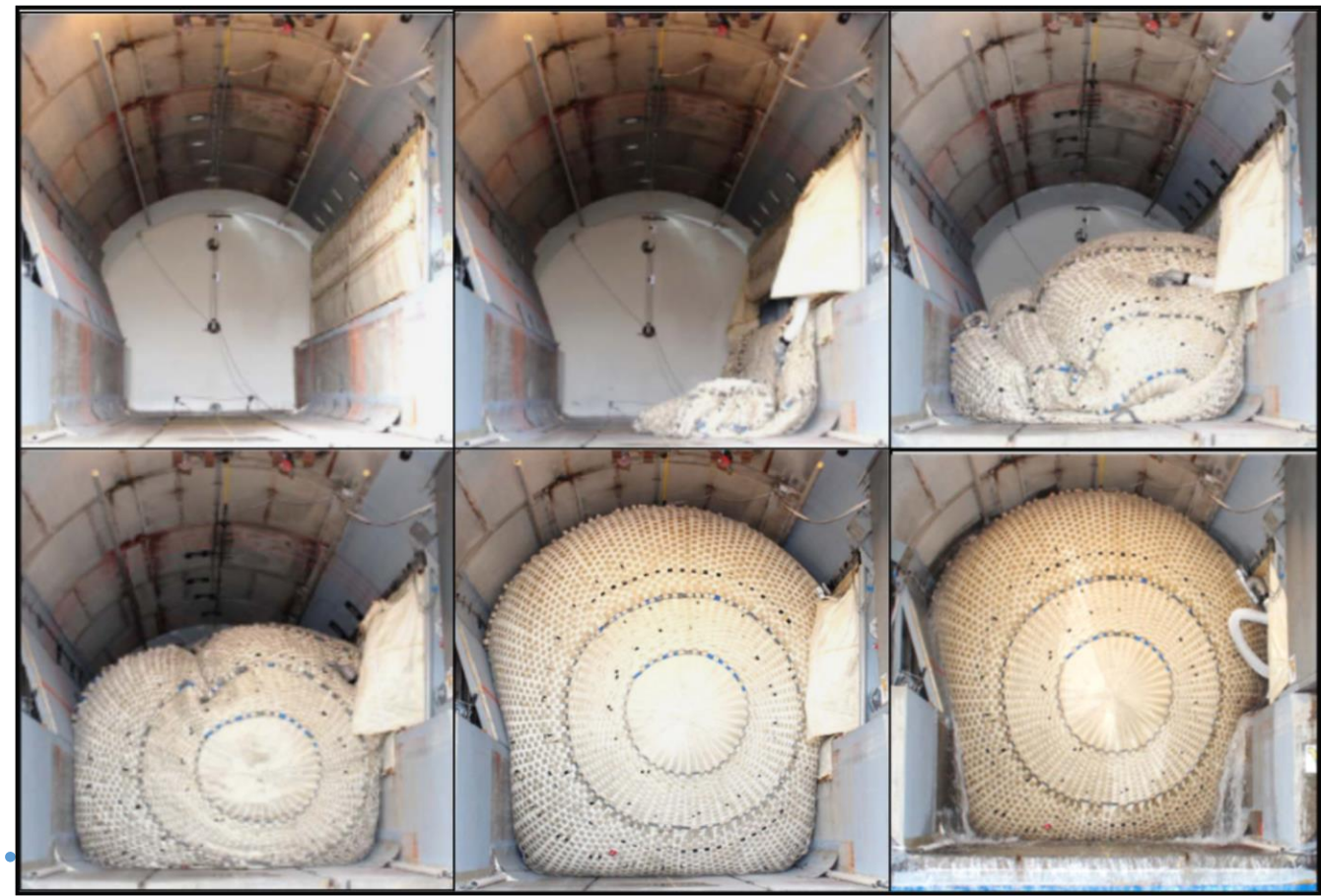


Organizations. Resilience from an agency perspective

- *Interconnections*: “Worldwide Study of Existing Flood Mitigation/Resiliency Systems Adaptable to the New York City Transit System”, August 2013
 - Lessons from Hong Kong (cyclones), Tokyo (gales), Taipei (typhoon), Singapore (monsoon), Copenhagen, Holland (theoretical collapse of dike/levee), and London (threat of rupture of large water main)
 - Layers of resilience. *Vulnerability, redundancy*

Mitigation measures around the world

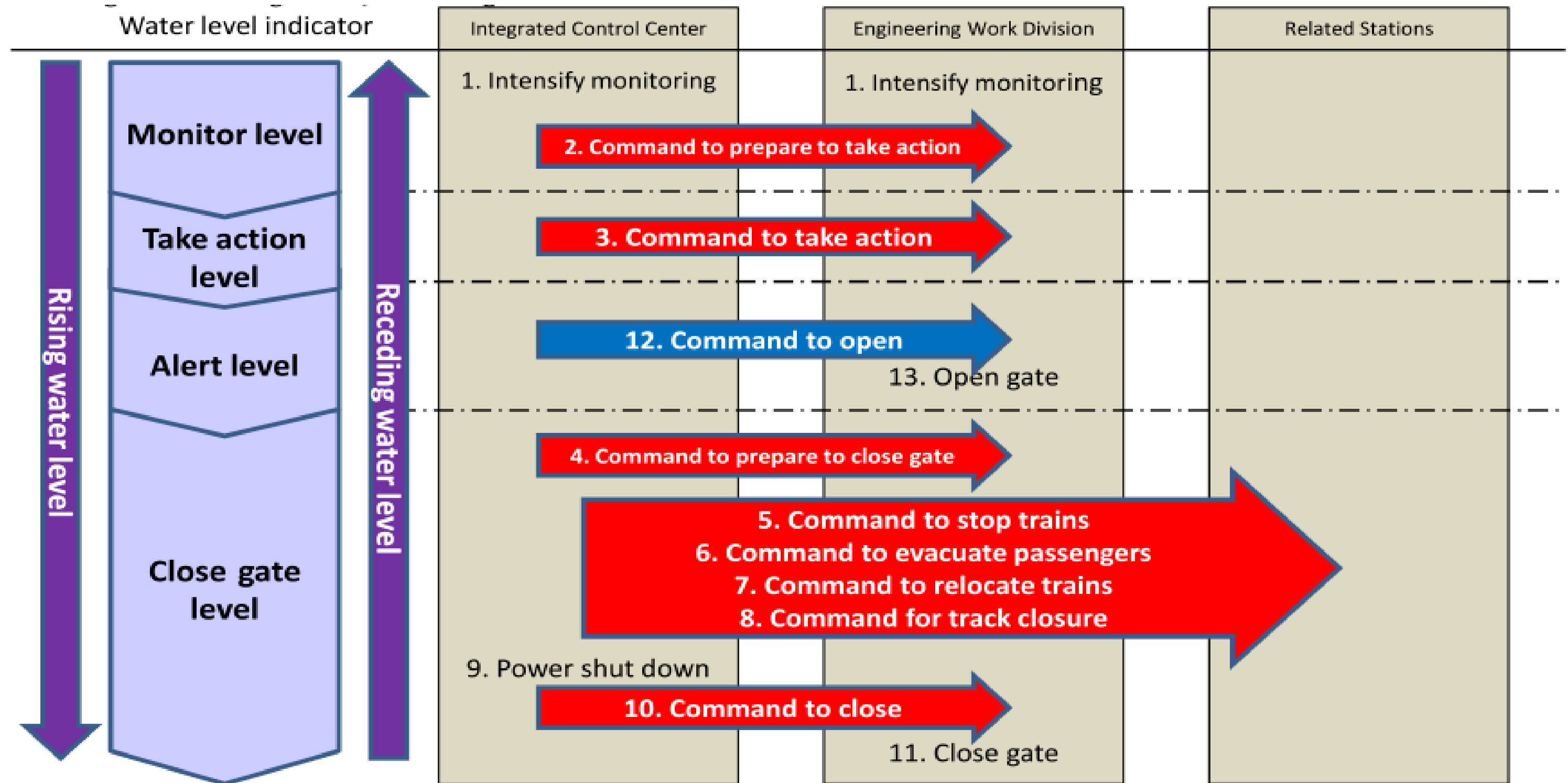
- Elevated entrances, total enclosures
- Flood doors, flood walls
- Slats/frame barriers
- Elevated tracks
- Auto-close barriers
- Inflatable barriers/tunnel plugs



Japan subway: Flood boards, hydraulic flood gate



Operation protocol for floodgate at tunnel in Japan



Organizations. Resilience from an agency perspective

- MTA. “MTA Transportation Reinvention Commission Report,” 2014.
- ***Avoid unmanageable impacts***
- ***Manage the risks***
- Resilience requires larger capital budget



- Resilience from a *city perspective*.
- NYC – PlaNYC/ OneNYC.
 - *Planning*. Bloomberg’s leadership with 2007 strategic vision and sustainability blueprint for NYC in 2030, all areas, all *systems*
 - 2007 plan included *resiliency*
 - Office of Long-Term Planning and Sustainability developed PlaNYC
 - Special Initiative for Rebuilding and Resiliency
- **Organizations:** After Sandy, Mayor’s Office of Recovery and Resiliency ensures implementation
- Carried on by DeBlasio administration as OneNYC



PlaNYC initiatives tied to Strategies

- Strategy: Protect assets to maintain system operations
 - Reconstruct and resurface key streets damaged by Sandy
 - Integrate climate resiliency features into future capital projects
 - Elevate traffic signals and provide backup electrical power
 - Protect NYCDOT tunnels in Lower Manhattan from flooding
 - Install watertight barriers to protect movable bridge machinery
 - Integrate resiliency into planning and project development
- Strategy: Prepare the transportation system to restore service after extreme climate events
- Strategy: Implement new and expanded services to increase system flexibility and redundancy

- Resilience from a state perspective (a larger *community*)
 - NY State 2100 Commission
 - “Recommendations to Improve the Strength and Resilience of the Empire State’s Infrastructure”
- *People in NYS 2100 Commission.* Types of participants.
 - Experience in insurance, finance, energy, government, transportation, water, construction, think tank, labor, environmental, non-US and engineering



NYS 2100 Commission philosophy

- *Our response capabilities to this new level of instability and the ability to bounce back stronger must be developed and strengthened. Our efforts must be rooted in robust structural underpinnings as well as **expanded operational capacities**. We cannot just restore what was there before – we have to **build back better and smarter**.*
- *In a time of fiscal constraints, the positive sign is that **inexpensive policy changes** will be as critical as the financial investments we make. Hard infrastructure improvements must be complemented by **soft infrastructure and other resilience measures**, for example, improving our **institutional coordination**, public communication, and rapid decision making abilities will make us better able to recover from the catastrophic effects of natural disasters.*

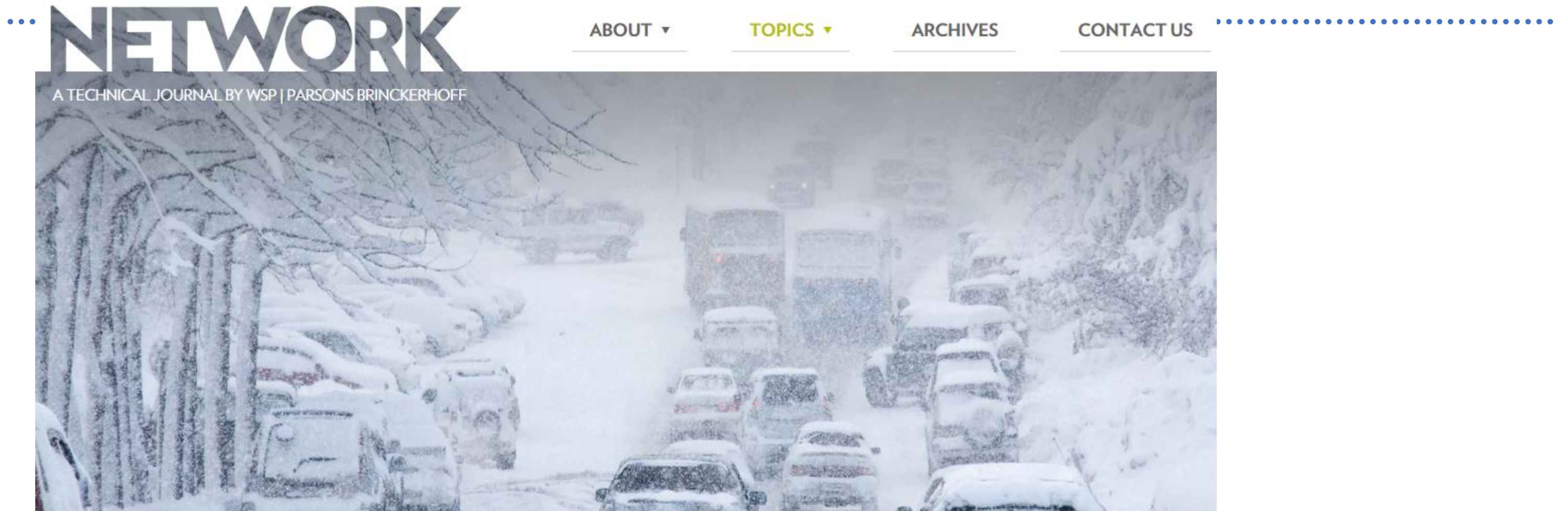
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- NYS 2100 Commission approach: Increase resilience in five main areas:
 - Transportation,
 - energy,
 - land use,
 - insurance, and
 - infrastructure finance.

Case study of resilience in Connecticut

- National Disaster Resilience Competition
- 2-phase competition for States and regions affected by natural disasters
- Created State Agencies Fostering Resilience (SAFR)
- In 2015, applied for pilot projects in Bridgeport and New Haven (\$116 M budget)
- In 2016, awarded \$53 M for Bridgeport pilot project

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- Resilience from the perspective of many regions or states
 - Each state or region will design resilience based on their **recent** experience
 - Collective and societal memory
 - Louisiana and the Gulf States respond to disasters like Hurricane Katrina, with the reinforcement of levees.
 - Midwest states prepare for river flooding or tornadoes. Western states plan for drought or seismic events.


Community of states: AASHTO resilience program



U.S. STATE DEPARTMENTS OF TRANSPORTATION (DOTS) BUILDING RESILIENCE: WHAT STATES ARE DOING TO BETTER PREPARE FOR EXTREME WEATHER EVENTS


State DOTs - Actions to better prepare for extreme weather

- *Community of states: AASHTO program.*
 - *Interconnections.* AASHTO provides resources for departments of transportation through Resilient and Sustainable Transportation Systems (RSTS) Technical Assistance Program (TAP)
 - Website, Source of knowledge sharing
 - Example: AASHTO, with support from WSP | PB, assisted VTrans in synthesizing information on state DOT resiliency efforts for *President's Task Force on Climate Preparedness and Resiliency*




AASHTO's **VISION** on Climate Change


SMARTER TRAVEL
Reduce VMT growth to 1% a year



EXTREME WEATHER
101 BRIEFINGS



Extreme Weather Sessions



CLIMATE CHANGE
State by State INTERACTIVE MAP
Learn how individual states are taking action ▶

National approach: Federal guidelines and funding

- **Funding** transportation resilience through FTA grants
- **Funding** resilience through community block grants
- National Disaster Resilience Competition grants, 2015 (with Rockefeller Foundation)
- **Managing risks:** Obama executive order for projects receiving federal **funding** to adopt new flood elevation standards and account for climate change and sea level rise, January 2015 (from the reading list)

National approach: Resilience Opportunities publication

Opportunities to Enhance the Nation's Resilience to Climate Change

Council on Climate Preparedness and Resilience

October 2016



UK: Climate change adaptation and resilience

- **History:** Since 2006, some of most severe weather on UK record.
- **2007 floods:** Widespread disruption, social distress.
National catastrophe declared.
£ 4 B losses.
- **2010 “Big freeze”**, economy shrank by 0.5 %
- **2013 blizzard** across UK cost £470 M/ day;
unprecedented travel disruption.
- In 2011, UK created **national adaptation programme (NAP)** to identify climate change preparedness of major industry sectors.
- All authorities must prepare climate change adaptation report
- Show resilience of organisation/operations to climate change.



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- *Rewiring interconnections: The intersection of resilience, sustainability, livability*
 - Notes, figure from Boule, (Network 77)
 - Balancing different needs and perspectives.
 - Storm surge of over 14 feet above sea level at max.
 - Should we build a 20 foot wall around the city?
 - But then you would not enjoy the coast, It's not sustainable or livable.

Opportunities: “...managing in an imbalanced world” ...

- While infrastructure is fundamental, long-term “sustainability” of resilience is dependent on **people, organizations, and systems**.
- A perspective on **systems and interconnections** allows you to analyze and determine the capabilities and capacity of a community to maintain resiliency.
- Examples around the world point to core characteristics that resilient systems share:
 - Have spare capacity,
 - Stay flexible,
 - Manage failure adaptively,
 - Rebound quickly
 - Improve through effective feedback loops, not just when disaster strikes.

Opportunities: “...*managing in an imbalanced world*” ...

- Approaches are affected by collective ***history and funding***
- A community can improve its success by:
 - Cultivating a longer institutional memory
 - Fostering community engagement and coordination among multiple stakeholders
 - Incorporating resilience into basic planning and decision making
 - Learning lessons from other communities/regions and experiences

Resilience in Transportation Webinar

Brought to you by Upstate NY and Sustainable Communities Division (SCD) of APA via the Northeast APA Sustainability Network.

To join the sustainability network, contact Joanna Nadeau - one of 10 sustainability champions for the SCD.

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Questions & Answers

Resilience in Transportation

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