Flooded Bus Barns and Buckled Rails:

Public Transportation and Climate Change Adaptation

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4 Transit Impacts

↑ Intense Precipitation
(very likely, >90%)

- Flooding of track, bus ways, tunnels, lots, facilities
- Landslides

↑ Very Hot Days & Heat Waves
(very likely, >90%)

- Track buckling leads to slow order or derail
- Customer comfort issue
- Worker safety issue

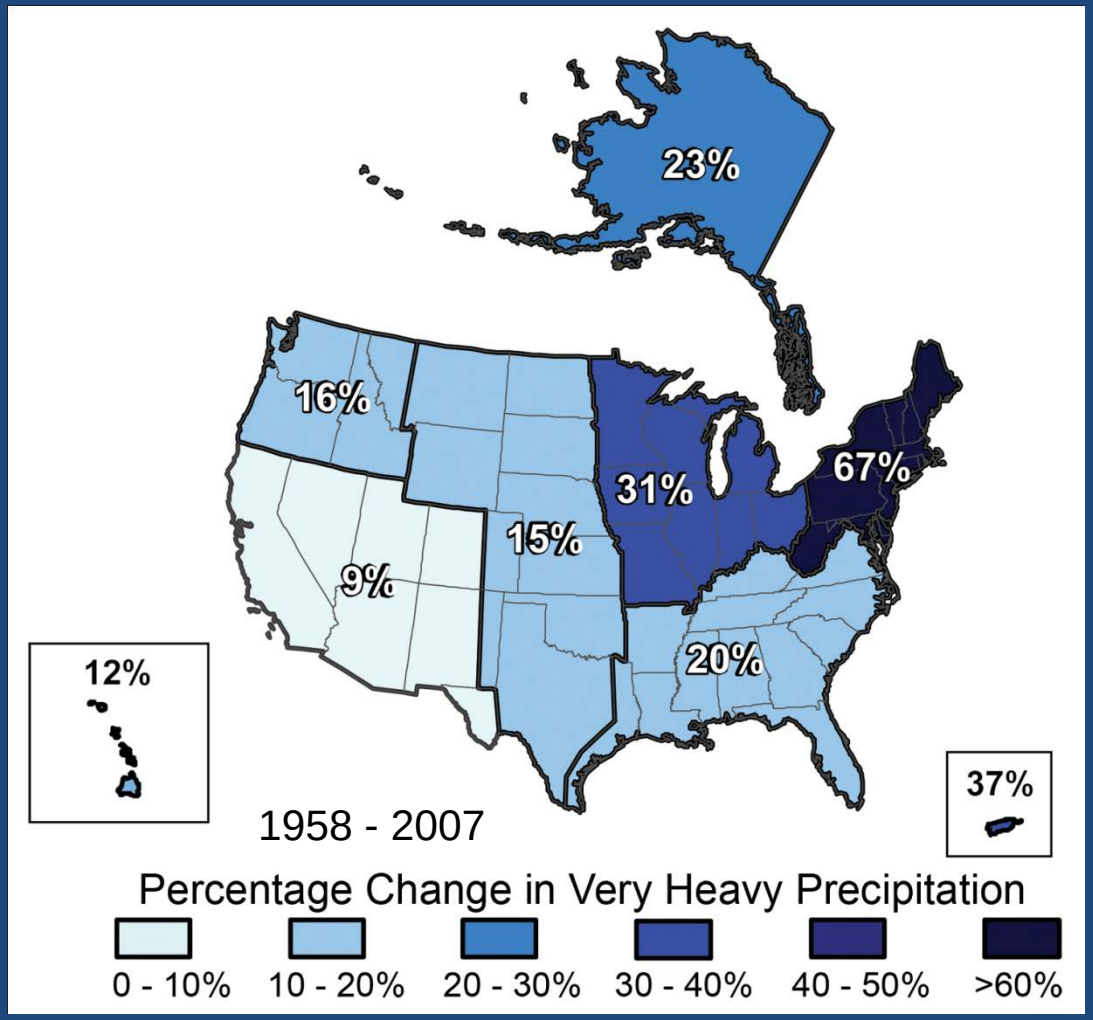
Rising Sea Levels
(virtually certain, >99%)

- Flooded track, bus ways, tunnels, lots, facilities
- Higher groundwater level floods tunnels

↑ Hurricane Intensity
(likely, >66%)

- Flooding from storm surge, rain
- High winds – debris, wind damage
- Transit provision of evacuation service

Climate Impacts Already Occurring



- "When it rains, it pours"
- Note that largest impact is in Northeast, home of some of largest and oldest rail transit systems.

*defined as the heaviest 1 percent of all daily events

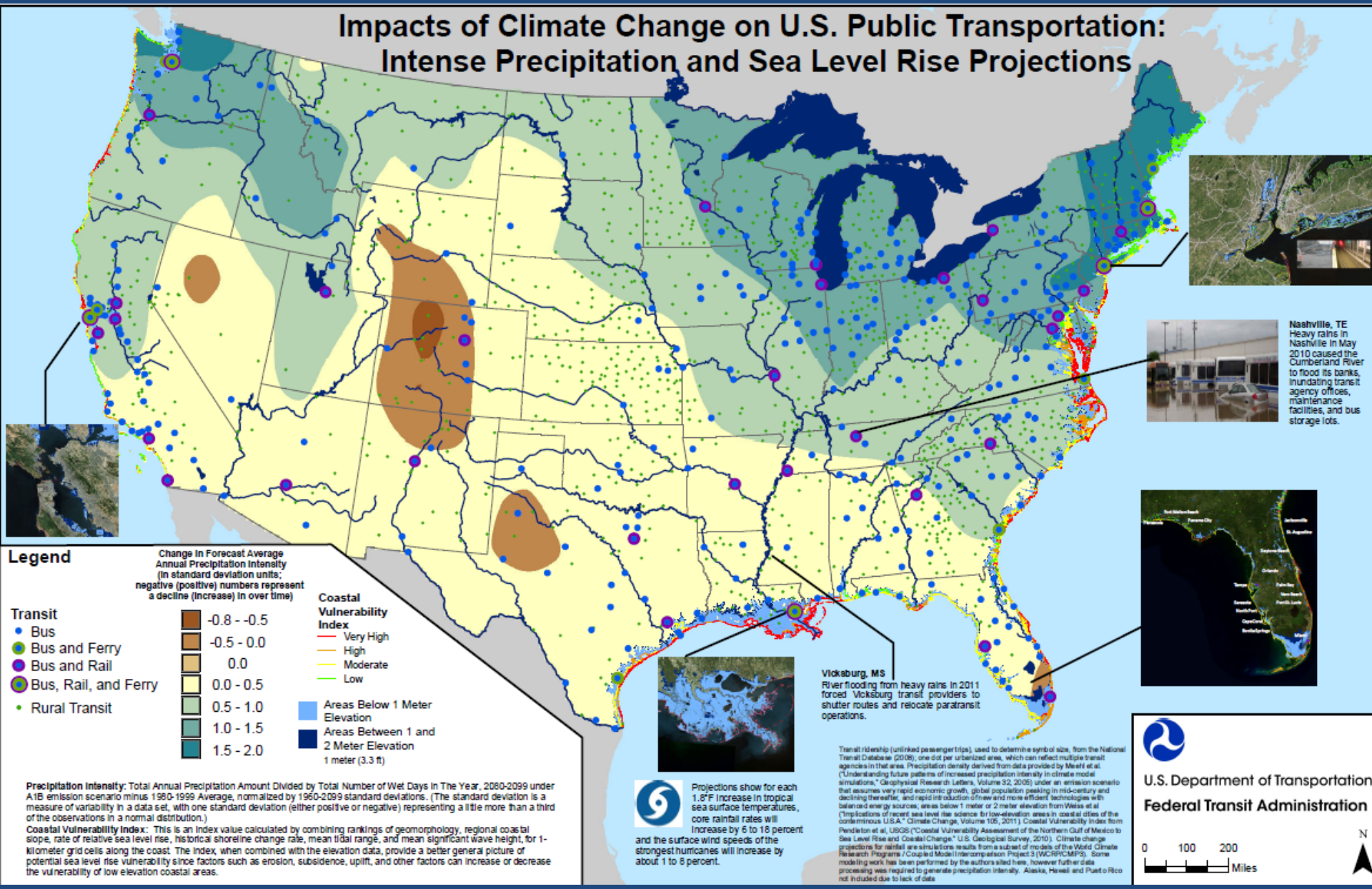
Source: Groisman et al as cited in USGCRP 2009.

Nashville Flood, May 2010

Photos courtesy of Nashville MTA

Cumberland River floods MTA property on Nestor Street

Impacts of Climate Change on U.S. Public Transportation: Intense Precipitation and Sea Level Rise Projections



Precipitation Intensity: Total Annual Precipitation Amount Divided by Total Number of Wet Days in The Year, 2080-2099 under A1B emission scenario minus 1980-1999 Average, normalized by 1960-2099 standard deviations. (The standard deviation is a measure of variability in a data set, with one standard deviation (either positive or negative) representing a little more than a third of the observations in a normal distribution.)

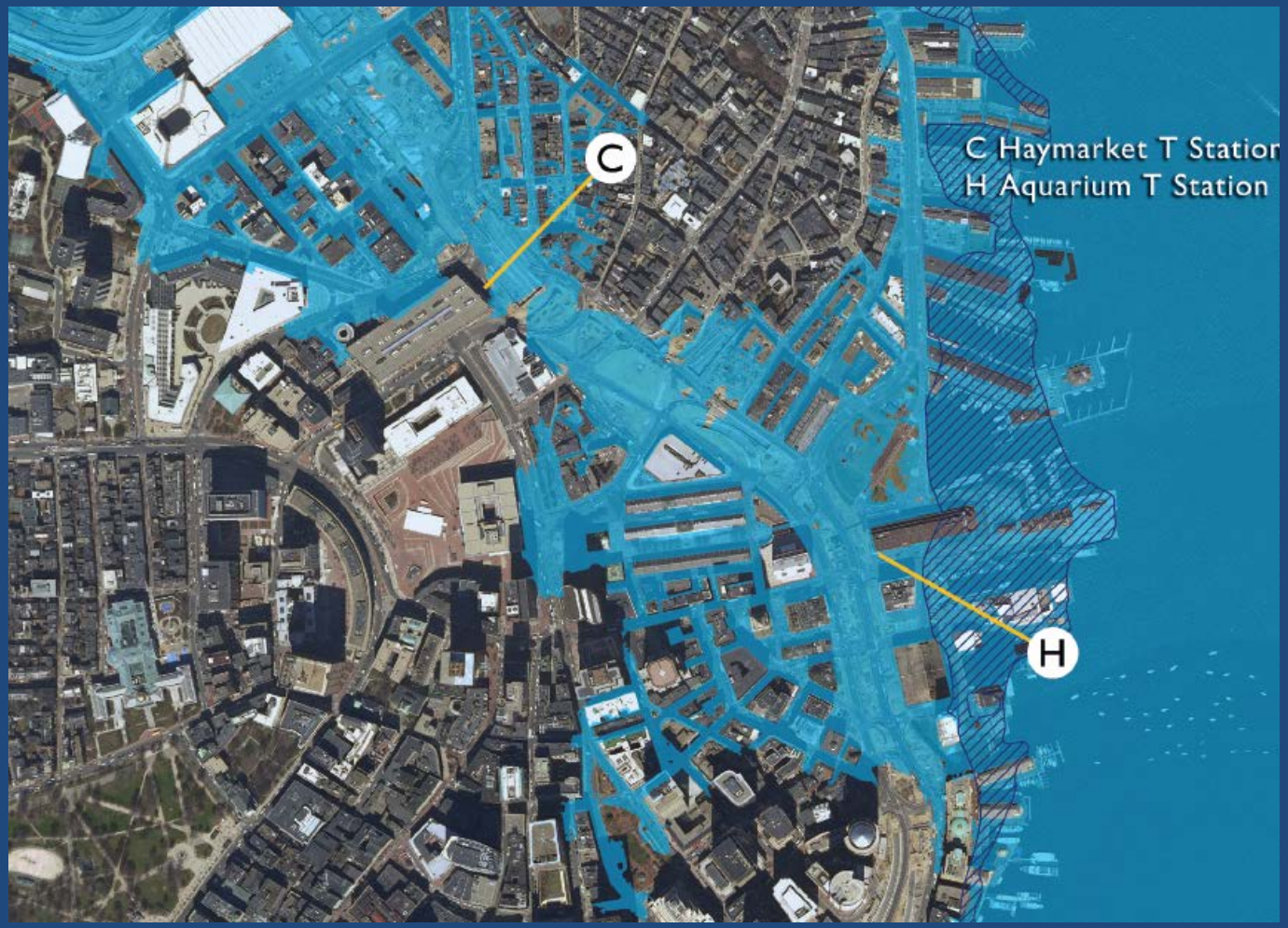
Coastal Vulnerability Index: This is an index value calculated by combining rankings of geomorphology, regional coastal slope, rate of relative sea level rise, historical shoreline change rate, mean tidal range, and mean significant wave height, for 1-kilometer grid cells along the coast. The index, when combined with the elevation data, provide a better general picture of potential sea level rise vulnerability since factors such as erosion, subsidence, uplift, and other factors can increase or decrease the vulnerability of low elevation coastal areas.

Sea Level Rise – San Francisco Bay Area

- Blue: Areas that could be inundated by 16 inch sea level rise
- Purple: Areas that could be inundated by 55 inches sea level rise

Source: San Francisco Bay Conservation and Development Commission, *Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on its Shoreline*, April 7, 2009.

Sea-level Rise + Bigger Storms = More Flooding



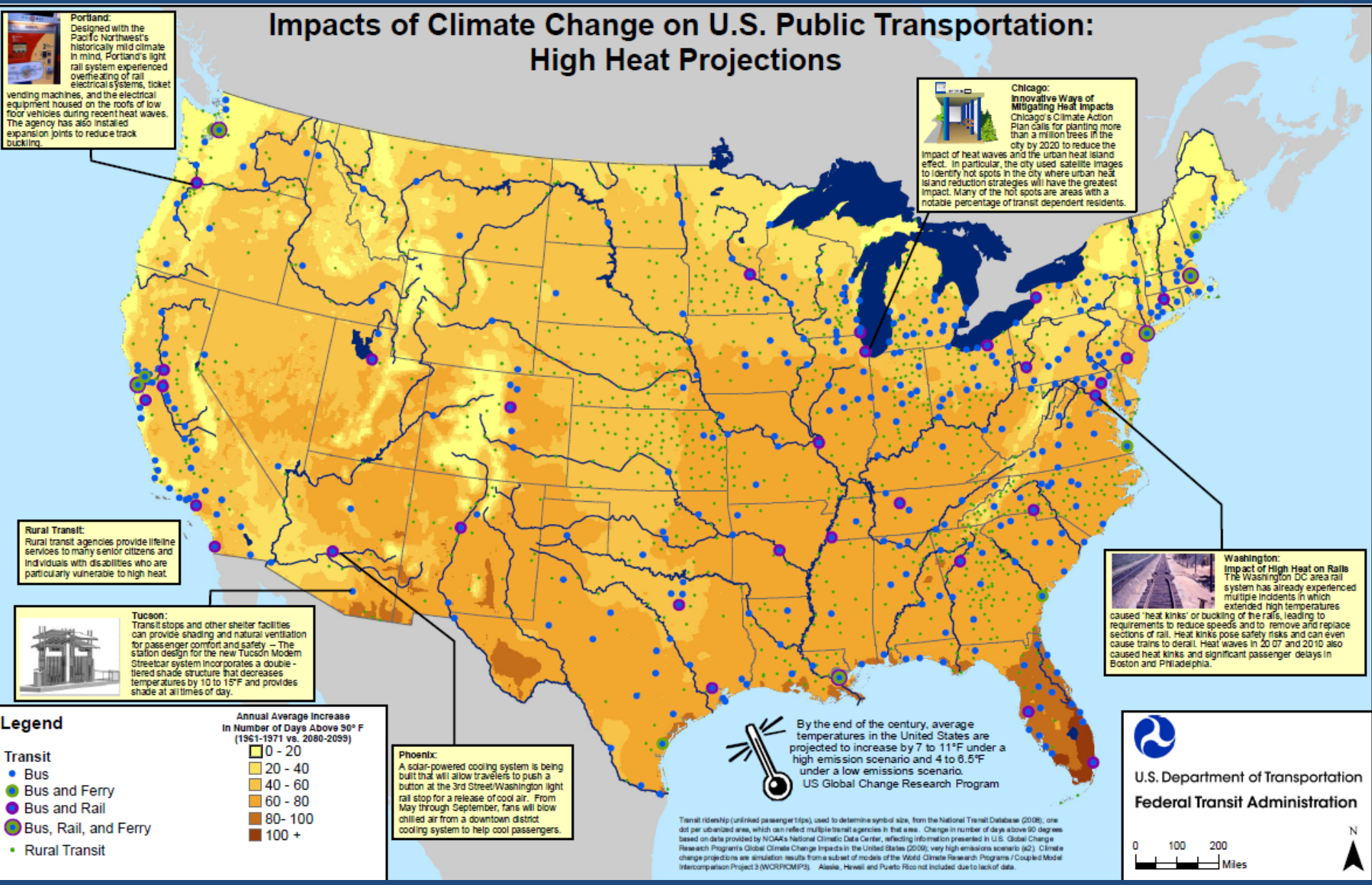
Boston

Dark blue hashed area = current 100-yr flood zone

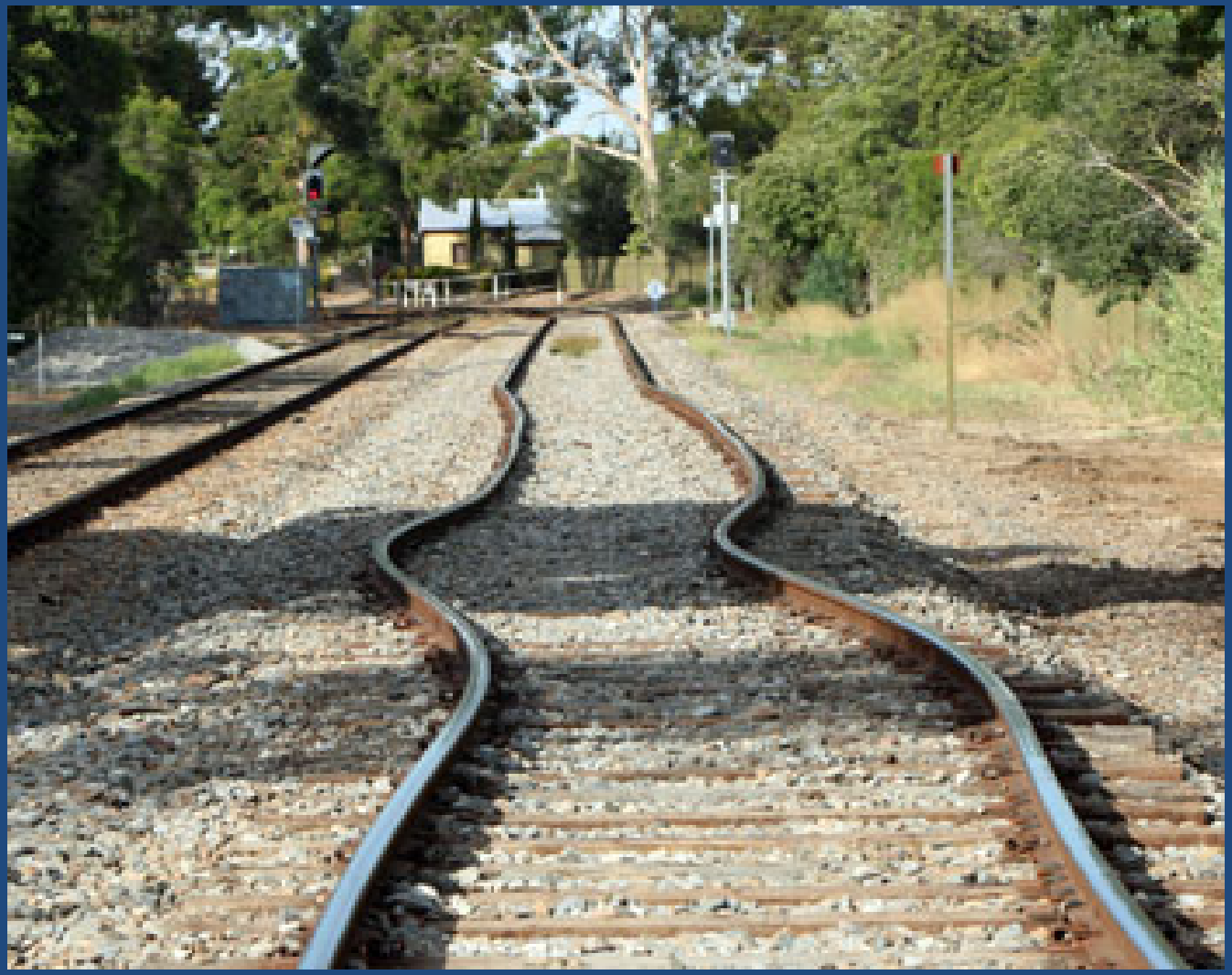
Light blue = projected 100-yr flood zone

Source: UCS / NECIA

Impacts of Climate Change on U.S. Public Transportation: High Heat Projections



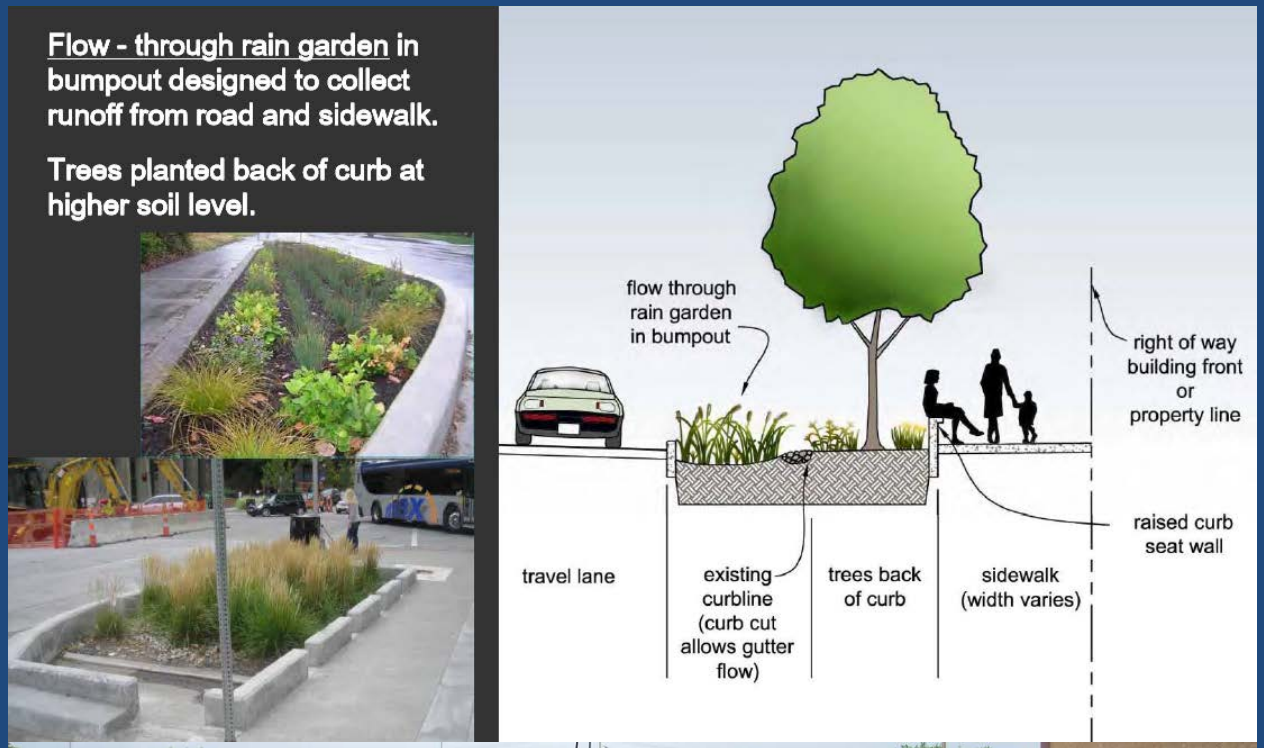
Rail Buckling



State of the Practice: Transit & Adaptation

Transit Agency	Adaptation Actions
New York MTA	1st report on climate change hazards at a US transit agency. Partnered with state and local adaptation efforts. Raised ventilation grates.
Los Angeles MTA	Conducting climate change risk assessment of assets, to be completed July
New Jersey Transit	Conducting climate change risk assessment of assets, to be completed Oct. Participating in FHWA adaptation pilot
Waves Transit, AL	Part of multi-modal US DOT Gulf Coast Study, Phase II
TriMet	Participating in regional adaptation efforts
Cape Cod Transit	Part of interagency climate change pilot, assessment of sea level rise impacts.
Honolulu Transit	Participating in FHWA adaptation pilot
King County Metro	Stakeholder in county adaptation efforts, which are at forefront of field
Transport for London	Adaptation included in risk and asset management systems. Adding air conditioning, addressing flooding to existing system. Climate impacts incorporated into design of major project – "Crossrail."
Istanbul	New rail link built for 3 ft sea level rise + 1 in 10,000 yr flood
Taipei	After typhoon dumped 50 inches of rain in two days, set new standards for entrances: 2-4' above ground + 6" above 100 yr flood, tunnel floodgates

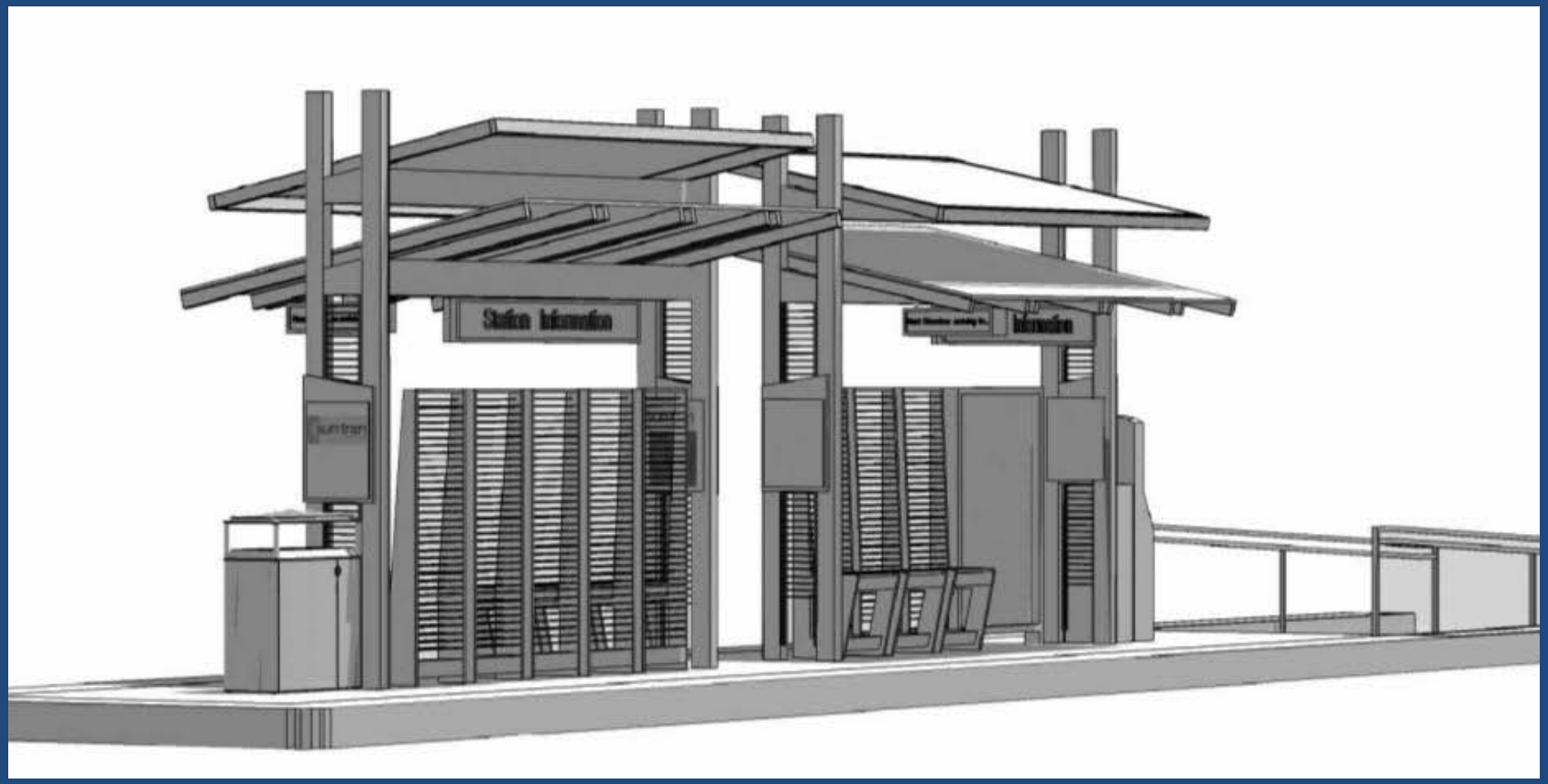
Kansas City Bus Rapid Transit



Rain Gardens

Pervious Pavement

Tucson Streetcar
Double-Tiered Shade Structures



Mainstreaming Adaptation into Transit Agency Structures & Processes

- Asset management systems: offer useful framework for incorporating climate adaptation into capital plans and budgets.
- Metropolitan and Statewide Transportation Planning
- Environmental Management Systems
- Environmental Review and Project Development
- Floodplain Assessment
- Real Estate Acquisition and Relinquishment of Assets
- Design and Construction
- Retrofit
- Maintenance
- Emergency Preparedness, Response, and Recovery
- Performance Measures
- Organizational Culture and Budget Priorities

FTA Adaptation Work

- Report – released today
- Pilots of transit agency adaptation assessments – applications due August 25 (one to focus on asset management systems)
- Workshops and webinars – first workshop Aug 3. Webinar Aug 8.
- FTA Policy Statement – signed May 2011; explains impact of climate change on state of good repair and safety; commits FTA to taking action

Take away point: Climate adaptation is responsible risk management.

Learn more: www.fta.dot.gov/sustainability click on "climate change"

Thank you!

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