Acts of Nature & Public Transportation

This white paper reviews the ways in which acts of nature – particularly extreme weather events – can impact transit's $77 billion investment backlog, identifies strategies transit agencies can pursue to reduce these risks, and discusses resources and opportunities of potential use to the transit community. The paper draws heavily on an August 2011 report from the Federal Transit Administration (FTA) which describes the impacts on transit, and outlines risk assessments, strategies, and implementation issues.[i] Transit agencies will need additional federal infrastructure support to follow through on this FTA report.

Acts of nature can have serious consequences for public transit systems, including flooding, buckled rails, damaged facilities, and other threats to safety, state of good repair, and regional mobility. Transit agencies will need to undertake risk assessments, pursue adaptation strategies, and address implementation challenges; some leading transit agencies have already begun. Broadly speaking, agencies' adaptation options will involve some combination of maintaining and repairing their systems in response to acts of nature, strengthening and protecting assets to withstand extremes, enhancing redundancy to avoid loss of service, and abandoning or relocating infrastructure.

Acts of Nature & Relevant Impacts for Transit

Weather variability and extremes have always existed, but they can severely stress infrastructure already in need of investment. Consequently, these impacts could have serious ramifications for public transit systems. Some of these concerns are illustrated in FTA's graphic below (*Figure 1*). Several recent weather events have already had impacts on public transit systems. For example:

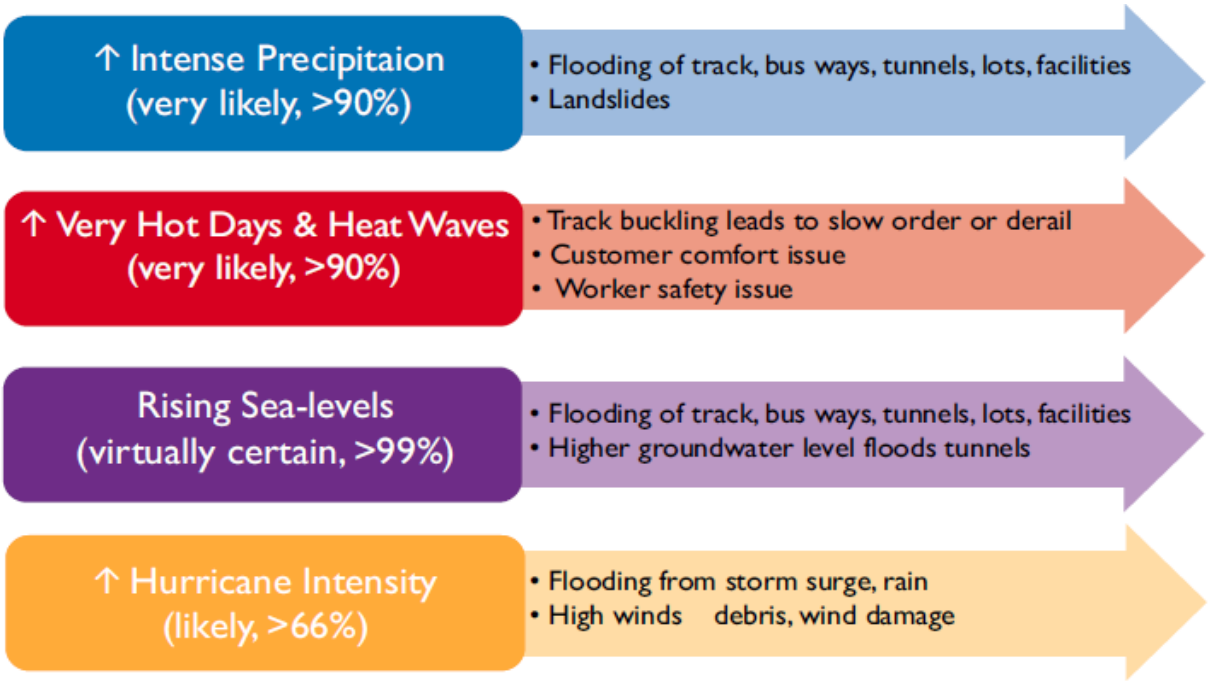
- In October 2012, Hurricane Sandy impacted Northeast Corridor cities from Boston, to Washington, DC. Nearly half of all public transit trips in the United States were disrupted during the peak of the storm activity. (Figure 4)
- A July 2010 heat wave caused buckled rails ("heat kinks") in both the Washington DC Metro and the Boston T systems, forcing them to slow trains and replace sections of rail, and there were also heat-related delays in Philadelphia's SEPTA system, Maryland's MARC train, and the Virginia Railway Express.[ii] The recent July 2012 heat wave caused another heat kink in the

Figure 2: DC Metro Heat Kink, July 2012 Heat wave

Source: WMATA press release 7/7/12

Washington DC Metro system, causing three cars of a Green Line train to derail.[iii] (*Figure 2*)

Figure 1: FTA's Assessment of the Main Transit Impacts



Source: FTA, Figure 2-1 (2011)

- In August 2007, heavy rain in New York City overwhelmed regional drainage systems and Metropolitan Transportation Authority (MTA) pumps, forcing MTA to cut power when water levels reached the electrified third rail. The storm disrupted 19 major segments, forced the shutdown of much of the subway system, affected more than 2.5 million transit users, and forced MTA to remove 16,000 pounds of debris and repair or replace a range of equipment.[iv] (*Figure 3*)
- Following heavy rains in Nashville in May 2010, the Cumberland River flooded its banks, inundating transit agency offices, maintenance facilities, and bus storage lots (including flooding almost two-thirds of the paratransit vans and more than a quarter of the transit buses in the fleet); service was suspended for four days.[v]
- Portland's TriMet has found the ventilation systems for its electrical substations to be inadequate and has had its stainless steel ticket vending machines overheat and cease working during recent extremely hot days.[vi]

- Los Angeles area transit services have experienced the need to reroute or suspend bus services on roads closed due to wildfires.[vii]

These and other weather impacts can negatively affect numerous transit agency goals, including:

- Safety of workers and riders;
- State of good repair;
- Cost containment;
- Regional mobility; and
- Regional economic vitality.

Figure 3: NYC Subway Flooding, August 2007 Storm

Source: FTA, Figure 2-4 (2011) (from New York City Transit)

Figure 4: Hoboken PATH Station Flooding, October 2012 Storm

Source: Port Authority of New York and New Jersey

Risk Assessments, Strategies, & Implementation

To conduct risk assessments, transit agencies would generally need to undertake the following steps:

- Identify current and future related hazards (using long-term weather projections)
- Characterize the risks those weather projections may pose to infrastructure and operations
- Link response strategies to organizational structures and activities
- Implement adaptation plans
- Monitor, reassess, and update plans.

Some transit agencies have already begun to undertake risk assessments, pursue adaptation strategies, and address implementation challenges.

- New York's MTA, for instance, partnered with Columbia University (and has actively participated in other state and local adaptation efforts) to assess its weather vulnerabilities, finding that a 100-year flood

with 4-foot sea level rise would flood a significant portion of Manhattan subways; in response to heavy rains, MTA has already started to build raised ventilation grates to reduce stormwater impacts on the system.[viii]

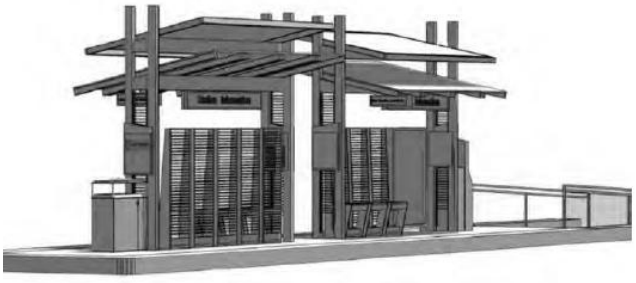
- In Mobile, Alabama, Wave Transit is participating in a federal Department of Transportation analysis to determine which of its assets are critical to regional economic and societal function and to assess their climate vulnerability (the methods and tools developed in this analysis are intended to be replicable to other regions throughout the country).[ix]
- A partnership of New Jersey state agencies (including NJ Transit) and Metropolitan Planning Organizations recently completed a weather vulnerability and risk assessment for the state's transportation infrastructure, piloting the FHWA's Vulnerability and Risk Assessment Conceptual Model.[x]
- The Los Angeles MTA used the *Guidelines for Transit Climate Action Planning*, developed by the APTA Climate Change Standards Working Group, and FHWA's vulnerability model to evaluate the vulnerability of its assets to weather risks.[xi] These agencies, along with a few others, are leading the way in considering the impact of acts of nature on transit systems.

Broadly speaking, there are four categories of adaptation strategies that transit agencies could pursue:

- *Maintaining and managing* – accepting increased maintenance and repair costs, responding to acts of nature, and incorporating "smart" technologies to detect approaching damage thresholds.
- *Strengthening and protecting* – designing and retrofitting assets to withstand expected weather extremes, building protective features (e.g., retaining walls)
- *Enhancing redundancy* – identifying system alternatives (e.g., more bus service if rail service is interrupted)
- *Relocating infrastructure* – potentially relocating transportation infrastructure and vehicle storage locations from extremely vulnerable areas.[xii]

Combinations of these strategies may be applicable to any given weather risk. To address flooding, for example, agencies can move vehicles to higher ground, prevent water from entering vulnerable systems, improve drain maintenance, increase pumping capacity, and strengthen or raise bridges. Responding to extreme heat could involve using shade shelters (*Figure 5*), air conditioning, heat-resistant materials, and plans for customer and worker safety. In many cases, transit agencies facing new weather risks can look to agencies in other places already dealing with those risks as a matter of course (e.g., flood engineering in Asian countries that face monsoon rains).[xiii]

Figure 5: Shade Design for Tucson Streetcar Stops



Source: FTA, Figure 4-10 (2011) (from City of Tucson and RTA)

Implementing these strategies will require linking them to agency structures and activities, including asset management systems, emergency preparedness and response plans, and state and metropolitan transportation planning processes. Successful implementation is also aided by having high-level support outside the agency, having a central coordinating point person, coordinating with other

relevant infrastructure providers and government agencies, and embedding weather risk into all relevant existing work streams (instead of being an "extra" tacked on to budgets and workplans as time and funds permit).[xiv]

Conclusion

Transit agencies face over $77 billion in deferred maintenance needs; acts of nature further stress infrastructure which is already in need of additional investment. Though agencies have provided the highest quality service and safety possible in a constrained funding environment, the inability of the federal government to address the nation's infrastructure challenges leaves transit agencies vulnerable to extreme acts of nature. The impact on transit emanating from recent events, such as last summer's heat wave and Hurricane Sandy, underscore the need for additional federal support to protect the state of good repair, cost containment, regional mobility, and service that local communities expect from public transportation.

Appendix: Resources & Potential Opportunities for the Transit Community

- *FTA report* – as is apparent from the first half of this paper, the FTA's August 2011 report describing weather impacts on transit, weather risk assessments, strategies, and implementation issues can be a very valuable resource for transit agencies.[xv]

- *FHWA Vulnerability Assessment Pilots* – as already noted in this paper, the Federal Highway Administration funded Departments of Transportation and Metropolitan Planning Organizations to pilot a conceptual model for conducting vulnerability and risk assessments of infrastructure to the projected impacts of acts of nature. The pilots, completed in November 2011, took place in the San Francisco Bay region, New Jersey, Virginia, Washington, and Oahu. Based on feedback from the pilots, FHWA will revise and finalize the model for national application. The conceptual model and information about the pilots are available on the FHWA website.[xvi]

- *FHWA Gulf Coast Study* – to better understand potential weather impacts on transportation infrastructure and identify adaptation strategies, the U.S. Department of Transportation is conducting a comprehensive, multi-phase study of impacts from weather events in the Central Gulf Coast region. Phase 1, completed in 2008, examined the impacts of weather on transportation infrastructure at a regional scale, investigating risks and impacts on coastal ports, road, air, rail, and public transit systems in the central Gulf Coast. Phase 2, as described earlier, focuses on the Mobile, Alabama region, with the goal of enhancing regional decision makers' ability to understand potential impacts on specific critical components of infrastructure and to evaluate adaptation options. Phase 2 is scheduled to be completed in 2013.[xvii]

- *Other DOT /FHWA publications* – the U.S. Department of Transportation has a range of publications available, including two May 2010 reports on regional weather effects and model climate change language for transportation plans.[xviii]

- *Guides for state & local governments* – several weather risk assessment tools have been developed for or by state and local governments and may be of use to transit agencies. Apart from those mentioned earlier in this paper, others include the New York City Panel on Climate Change's *Adaptation Assessment Guidebook*[xix] and *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments*, from the University of Washington Climate Impacts Group and King County, Washington.[xx]

- *WGA/NOAA Regional Forums* – the Western Governors' Association and the National Oceanic and Atmospheric Administration are convening regional forums to bring together leading practitioners and policy makers to address weather risk.[xxi] The first forum, focused on the Pacific Northwest, was held in April 2012.[xxii] Transit agencies in Western states should be alert for opportunities to participate in future forums.
- *EESI/CCAP/NOAA Workshop* – in November 2011, the Environmental and Energy Study Institute, the Center for Clean Air Policy, and NOAA hosted a workshop on *Climate Adaptation & Transportation: Identifying Information and Assistance Needs*. The presentations from that workshop are available on the CCAP website, covering topics such as best practices and data needs.[xxiii]
- *Interagency Climate Change Adaptation Task Force* – in 2009, the Obama Administration convened the Interagency Climate Change Adaptation Task Force, co-chaired by the Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA), and including representatives from more than 20 Federal agencies (including the Department of Transportation). The task force releases occasional progress reports – most recently in October 2011 – outlining the federal government's progress in expanding and strengthening the nation's capacity to better understand, prepare for, and respond to extreme events and other climate change impacts.[xxiv]
- *Private sector* – not all weather adaptation initiatives are governmental. The private sector also must address some adaptation needs, which may intersect with transit agency goals. Oxfam America, Calvert Investments, and Ceres recently released a guide for companies and investors on disclosure and management of physical risks from weather, highlighting relevant risks and potential responses for companies in six sectors: agriculture, food, and beverage; apparel; electric power; insurance; mining; oil and gas; and tourism.[xxv]

These resources can help transit agencies navigate their adaptation needs and strategies, but to fully evaluate and address these infrastructure challenges, transit agencies will need more financial support from federal funding sources.

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[iii] WMATA, *Investigators identify heat kink as probable cause of Friday derailment*, Press Release, July 7, 2012, http://www.wmata.com/about_metro/news/PressReleaseDetail.cfm?ReleaseID=5283&from=rss
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[v] FTA, *supra* note 1, p.16; Nashville MTA, *Nashville Flood 2010*, http://www.nashvillemta.org/PDF/NashvilleMTAFlood2010.pdf
[vi] FTA, *supra* note 1, p.23
[vii] FTA, *supra* note 1, p.24
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[x] NJTPA et al, *Climate Change Vulnerability and Risk Assessment of New Jersey's Transportation Infrastructure*, 2012, http://www.njtpa.org/plan/Element/Climate/documents/CCVR_REPORT_FINAL_4_2_12_ENTIRE.pdf
[xi] FTA, *supra* note 1, pp.60-61
[xii] FTA, *supra* note 1, p.63
[xiii] FTA, *supra* note 1, pp.63-80
[xiv] FTA, *supra* note 1, pp.81-104

[xv] FTA, *supra* note 1; *see also* FTA, *FTA Climate Change Adaptation Initiative* website, http://www.fta.dot.gov/12347_14013.html
[xvi] FHWA, *Climate Change Vulnerability Assessment Pilots* website, http://www.fhwa.dot.gov/environment/climate_change/adaptation/ongoing_and_current_research/vulnerability_assessment_pilots/index.cfm
[xvii] FHWA, *Gulf Coast Study* website, http://www.fhwa.dot.gov/environment/climate_change/adaptation/ongoing_and_current_research/gulf_coast_study/index.cfm
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[xxv] http://www.oxfamamerica.org/files/physical-risks-from-climate-change.pdf

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The American Public Transportation Association (APTA)

The American Public Transportation Association (APTA) is a nonprofit international association of more than 1,500 public and private member organizations, engaged in the areas of bus, paratransit, light rail, commuter rail, subways, waterborne services, and intercity and high-speed passenger rail. This includes: transit systems; planning, design, construction, and finance firms; product and service providers; academic institutions; transit associations and state departments of transportation. APTA members serve the public interest by providing safe, efficient and economical transit services and products. More than 90 percent of the people using public transportation in the United States and Canada ride APTA member systems.

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