



COMMUNITIES ARE FACING A CHANGING WORLD – a world of warmer temperatures, less predictable weather patterns, and rising sea levels. While impacts vary by location, these and other impacts threaten the reliable delivery of many community services. This resource discusses how climate change is affecting community services, presents sample adaptation strategies, gives examples of successful community adaptation actions, and provides links to other key federal resources.

IMPACTS OF CLIMATE CHANGE ON LOCAL GOVERNMENT SERVICES

Water Resources Management

Changing precipitation patterns and increased intensity of rainfall events, storms and sea level rise are major elements of a changing climate. These changes may degrade water quality by increasing stormwater runoff, overflows of separate and combined sewer systems, and stream bank erosion. Community facilities, including drinking water and wastewater treatment facilities, may be at risk due to more frequent and severe flooding.

What are some water management adaptation strategies?

- Account for future flood risk (e.g., using the new federal flood standard) to protect drinking water and wastewater treatment facilities
- Use green infrastructure to reduce stormwater runoff
- Preserve wetlands and establish vegetated buffers along rivers and streams to reduce flooding, runoff, and erosion

Adaptation in Action: The 2008 Iowa River floods caused extensive flooding along the Iowa City, Iowa riverfront. After the flood, the community worked with state and federal organizations, including the EPA, to develop a master plan to rebuild the riverfront, promote equitable development, and address challenges from a changing

climate. The “Riverfront Master Plan” reduces future flooding risk by promoting green infrastructure; creating a green buffer along the riverfront; and redirecting growth away from the floodplain. By decommissioning a flood-prone wastewater facility and expanding service elsewhere, the city chose to adapt and reduce future flooding risk. Several years after the floods, the community continues to adapt and implement projects under the Riverfront Master Plan.

Clean Air

A warming climate is expected to worsen air quality, including ground-level ozone, which can aggravate lung diseases and lead to premature death. Actions taken to reduce ozone can both reduce greenhouse gas emissions and yield adaptation benefits. People most at risk from ozone exposure include people with asthma, children, older adults, and those who are active outside, especially outdoor workers. People with health conditions such as obesity or diabetes may also have higher risk of ozone-related health effects.

What are some clean air adaptation strategies?

- Reduce vehicle emissions by encouraging smart growth development where people can work, live, and play within a walkable area
- Upgrade existing municipal fleets to reduce air pollutants



- Incorporate travel efficiency strategies that reduce vehicle trips and miles traveled into Regional Transportation Plans and Programs

Adaptation in Action: The Sustainable Salt Lake Plan 2015 reflects a broad and ambitious agenda to protect

Salt Lake City's resources, enhance assets, and establish a path towards greater community resiliency. The plan set goals to improve air quality, protect community health, and reduce particulate matter (PM) and ozone pollution. The city adopted specific measures to decrease miles traveled, reduce vehicle idling, and promote alternative transportation. By employing these clean air strategies, the city attained both adaptation and mitigation benefits.

Waste Management and Exposure to Chemicals

Flooding from more intense and frequent storms due to climate change increases the risk of releases from contaminated sites and facilities where chemicals are stored. Such areas include Superfund sites, brownfields, and underground storage tank sites. The storms could also result in the generation of more disaster debris, further challenging local chemical and waste management capacity.

What are some chemical and waste management adaptation strategies?

- Develop crisis management plans to anticipate and prepare for future extreme climatic events
- Account for climate risks in Brownfields cleanup and redevelopment activities
- Integrate future flood risk projections into remedy selection for hazardous waste cleanups
- Consider opportunities for toxic use reduction and safer chemical storage strategies (e.g., not storing chemicals in flood-prone locations such as basements) to reduce the potential for chemical release during flood events

Adaptation in Action: Hurricane Irene dumped seven inches of rainfall in 48 hours in 2011 at the American Cyanamid Superfund site in New Jersey. The site, already in an exceedingly wet state prior to the hurricane, flooded. Although there was no major release

of contaminants, the flooding still caused significant damage to the facility's infrastructure. To anticipate and prepare for future events, officials decided to raise critical infrastructure components to several feet above previous flood events and decided to repair impoundments to withstand a 1-in-500 year flood event.

Emergency Response to Heat Events

Higher temperatures from climate change will increase the risks of heat stress and heat-related deaths. Those most vulnerable to extreme heat are the elderly, very young children, infirm, poor, and socially isolated people. Heat events trap air pollution and humidity, making it difficult for those with respiratory illness to breathe. Extreme heat events stress city services as well as generally decrease labor productivity.

What are some heat event adaptation strategies?

- Develop an emergency heat plan to prepare city services for a heat event
- Establish cooling centers to reduce heat stress and heat-related deaths and illnesses
- Provide emergency notification and well-being checks to protect the most vulnerable
- Incorporate heat island reduction strategies - such as green or cool roofs, cool pavements, or increased vegetation and trees - into long-term planning efforts to help lower urban temperatures

Adaptation in Action: In 1995, more than 700 people died during a five-day heat event in Chicago. This event prompted Chicago to strengthen and update its heat emergency response system. The city now encourages residents to register for Notify Chicago, the city's text and email emergency notification system. Residents can also call 311 to have officials conduct well-being checks for those who may need additional assistance. Disaster preparedness and response trainings have also helped to increase individual and community resilience and better prepare Chicago for subsequent extreme heat events.

Transportation

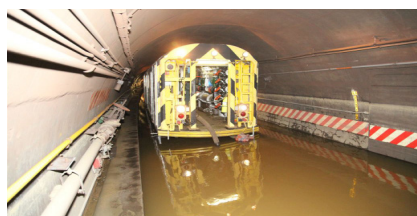
Climate change may stress the transportation network and infrastructure systems that are vital to any community's economy. Extreme weather events and flooding from intense downpours may damage transportation infrastructure and increase the risk of disruptions and delays in air, rail, and road transportation.

Sea-level rise and more severe storm surges may increase the risk of coastal flooding, threatening critical infrastructure such as airports, roads, rail lines, and tunnels.

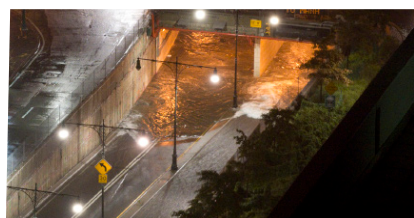
What are some transportation adaptation strategies?

- Identify vulnerable transportation systems to anticipate and prepare for future events
- Account for future extreme weather, such as floods, in land use planning (e.g., zoning ordinances) to protect infrastructure and encourage climate-resilient development
- Retrofit or relocate existing infrastructure to reduce risk of disruptions

Adaptation in Action: Hurricane Sandy generated a storm surge greater than nine feet in southern Manhattan when it made landfall in 2012. The resulting flooding severely



damaged the city's transportation network. Portions of the city's subway, light rail network, tunnel system, ferry system and La Guardia and JFK airports were out of service, or in limited service, for several days. New York City has since updated its vulnerability plan to incorporate the latest



climate change projections. To reduce vulnerabilities, the city has raised ventilation systems and is exploring erecting flood barriers.

Natural and Environmental Resources

Climate change will alter the timing and duration of seasonal events (e.g., snowfall, snowmelt) which can affect recreation and tourism (e.g., viewing fall foliage, skiing, and fishing for cold-water fish). Flooding and drought may reduce the productivity of farmland and harm sensitive environments (including habitat for ecologically, culturally, or locally important species).

What are some natural and environmental resource adaptation strategies?

- Assess tourism and recreational industry vulnerability to anticipate economic risk

- Incorporate climate risk into land management strategies to reduce the vulnerability of farmland and sensitive environments
- Retrofit or relocate existing tourism facilities and outdoor recreation infrastructure to prepare for climate change

Adaptation in Action: The "Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations" includes tourism and outdoor recreation as one of its four areas of focus for statewide adaptation planning. A state-level working group assessed the risks and vulnerabilities of the sector and recommended specific actions that local government and private business could do to adapt. Recommendations included use of green infrastructure, improved stormwater management, conserve and restore fish habitat, demonstrate sustainable practices at public facilities, and incorporate adaptation criteria into grant programs.

Cultural Resources

Climate change can damage important cultural resources such as historic sites, cemeteries, and major landmarks. Sea level rise, extreme weather events, and wildfires can threaten cultural resources and traditions, including access to, and availability of, food and culturally important lands.

What are some cultural resource adaptation strategies?

- Identify cultural resources at risk to anticipate and prepare for climate change
- Relocate or protect vulnerable cultural resources to reduce the threats from climate change
- Engage the community to leverage local knowledge and experience

Adaptation in Action: The National Capital Planning Commission (NCPC) is the federal planning agency for America's capital, home of many national treasures (e.g., Jefferson Memorial, Vietnam Memorial, Martin Luther King Memorial, Arlington National Cemetery, and the National Archives). Climate vulnerabilities include sea level rise, storms, and extreme heat. The



NCPC's Climate Adaptation Plan includes actions to implement a wastewater and stormwater management program that accounts for more frequent storms, develop multi-purpose indoor and outdoor cooling centers, and protect and increase designed landscapes, forested areas and other managed green areas.

PROTECTING PEOPLE MOST AT RISK

Effective adaptation strategies should consider both the risks from climate change and how they will affect the community's most vulnerable. In particular:

Young Children – Children, especially those under the age of four and unable to care for their own needs, will disproportionately suffer from the effects of heat waves, air pollution, infectious diseases, and trauma resulting from extreme weather events.

Elderly & Infirm – The elderly, people with limited mobility and those with pre-existing health conditions, especially autoimmune disorders, are more susceptible to cardiac and respiratory impacts of air pollution and severe consequences from infectious diseases and extreme weather events.

Low Income – Limited resources and a higher prevalence of chronic health conditions, including heart disease, obesity, and diabetes, place those with lower income at higher risk of health impacts from climate change.

Communities Dealing With Environmental Justice Challenges – These populations have historically been exposed to a combination of physical, chemical, biological, social, and cultural factors that have imposed greater environmental burdens on them than those imposed on the general population. Climate change is likely to exacerbate existing and introduce new environmental burdens and associated health impacts.

COMPREHENSIVE PLANNING

A number of local governments have found assessing vulnerability across the broad range of government services as an effective approach to anticipate, plan for, and adapt to a changing climate. Boston provides a

useful example.

In the 1980's and 1990's, Boston planners and engineers considered future sea level rise while overhauling the city's Deer Island Wastewater Treatment Plant. To protect its investment the city raised the plant two feet higher than originally planned.



In 2007, the mayor directed each city department to assess its vulnerabilities and risks to account for a changing climate. Departments incorporated these findings into municipal and community planning projects, permitting, and review processes. In 2011, Boston completed its first Climate Action Plan and in 2013 launched Climate Ready Boston to further advance its efforts to anticipate and prepare for the changing climate. Goals include adding climate preparedness to public health programs that are already aimed at vulnerable populations and expanding public outreach to neighborhood groups. In 2015, Boston committed to address climate impacts on a regional basis as part of the Metro Mayors Coalition.

Boston's comprehensive approach increased awareness and adaptive capacity, identified department-level risks and potential actions, and leveraged the knowledge and expertise of its departmental staff.

Climate Ready Boston identified several keys that it believes may be helpful for others, including:

- Climate preparedness must be an important and explicit criterion in the city's capital planning;
- Effects of rising temperatures should be a high priority;
- Municipal emergency plans should be reviewed and practiced in light of expanded risks posed by climate change;
- Close coordination with regional, commonwealth/state, and federal partners is necessary to address cross-jurisdictional infrastructure vulnerability; and
- Education, engagement, and communication — within city government and with the broader community — are essential for preparing for both the short-term and long-term effects of climate change.

FEDERAL RESOURCES

U.S. Climate Resilience Toolkit: <http://toolkit.climate.gov/>

U.S. Climate Data Portal: <https://www.data.gov/climate/>

National Climate Assessment: <http://nca2014.globalchange.gov/>

U.S. EPA Climate Change Adaptation Training for Local Governments: <https://www.epa.gov/localadaptationtraining/>

EPA Climate Change Adaptation Plan:

<https://www.epa.gov/climatechange/adaptation-policy-and-plan>

EPA Climate Change Adaptation Implementation Plans:

<https://www.epa.gov/climatechange/epa-adaptation-planning>

EPA, Climate Change Impacts and Adapting to Change:

<https://www.epa.gov/climate-impacts>

HUD/DOT/EPA, Partnership for Sustainable Communities:

<https://www.sustainablecommunities.gov/>

CDC, Climate and Health:

<http://www.cdc.gov/climateandhealth/default.htm>

DOE, Climate Change:

<http://www.energy.gov/science-innovation/climate-change>

FEMA, Emergency Management in a Changing Climate:

<https://www.fema.gov/climate-change>

U.S. Geological Survey, Climate and Land Use Change:

<https://www.usgs.gov/science/mission-areas/climate-and-land-use-change>

U.S. Global Change Research Program:

<http://www.globalchange.gov/>

NASA, Global Climate Change:

<http://climate.nasa.gov/solutions/adaptation-mitigation/>

NASA, Images of Climate Change:

<http://climate.nasa.gov/images-of-change>

NOAA, Climate.gov - Science and information for a climate-smart nation:

<https://www.climate.gov/>

DOT, Transportation and Climate Change Clearinghouse:

<https://www.fmcsa.dot.gov/research-and-analysis/research/transportation-and-climate-change-clearinghouse>

REFERENCES

Water Management

- U.S. EPA, Office of Water Climate Change Adaptation Implementation Plan: <https://www.epa.gov/climatechange/program-office-climate-change-adaptation-implementation-plans>
- Iowa City Downtown & Riverfront Master Plan: <http://www.iowa-city.org/weblink/0/doc/1482448/Electronic.aspx>

Clean Air

- U.S. EPA, Office of Air and Radiation Climate Change Adaptation Implementation Plan: <https://www.epa.gov/climatechange/program-office-climate-change-adaptation-implementation-plans>
- Sustainable Salt Lake Plan 2015: http://www.slcdocs.com/slcgreen/SustainableSaltLake_2014.pdf

Waste Management

- U.S. EPA, Office of Solid Waste and Emergency Response Adaptation Implementation Plan: <https://www.epa.gov/climatechange/program-office-climate-change-adaptation-implementation-plans>
- U.S. EPA, Planning for Natural Disaster Debris: <https://www.epa.gov/homeland-security-waste/guidance-about-planning-natural-disaster-debris>

Emergency Response to Heat

- U.S. EPA, Excessive Heat Events Guidebook: <https://www.epa.gov/heat-islands/excessive-heat-events-guidebook>
- U.S. EPA, Heat Island Effect: <https://www.epa.gov/heat-islands>
- Alert Chicago: <https://www.cityofchicago.org/city/en/depts/oem/provdrs/alertchicago.html>
- Sustainable Chicago 2015: https://www.cityofchicago.org/city/en/progs/env/sustainable_chicago2015.html

Transportation

- U.S. EPA, Smart Growth Strategies for Disaster Resilience and Recovery: <https://www.epa.gov/smartgrowth/smart-growth-strategies-disaster-resilience-and-recovery>
- NYC, A Stronger, More Resilient New York: <http://www1.nyc.gov/site/em/ready/hazard-mitigation.page>

Natural and Environmental Resources

- U.S. EPA, Climate Change Indicators in the United States, Health and Society: <https://www.epa.gov/climate-indicators/health-society>
- Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations: <http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-103584/2700-RE-DEP4303%20Combined.pdf>

Cultural Resources

- National Capital Planning Commission: <http://www.ncpc.gov/climate/>
- U.S. EPA, Office of International and Tribal Affairs Adaptation Implementation Plan: <https://www.epa.gov/climatechange/program-office-climate-change-adaptation-implementation-plans>
- 2014 National Climate Assessment, Indigenous Peoples: <http://nca2014.globalchange.gov/report/sectors/indigenous-peoples#narrative-page-16420>

Comprehensive Planning

- Climate Ready Boston: Municipal Vulnerability to Climate Change: <http://www.cityofboston.gov/climate/adaptation/>
- Metro Boston Climate Preparedness Commitment: <http://www.mapc.org/climate-preparedness>



For additional information contact: climateadaptation@epa.gov