

CLIMATE READY DC

The District of Columbia's Plan to Adapt to a Changing Climate





Photo Credit: Kevin Wolf, DC Climate Change Photo Contest

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FOREWORD

Introduction

Cities across the country and around the globe are recognizing their responsibility to prepare for a changing climate, and the District is no exception. In recent years, we have seen how climate change is already impacting us with record-breaking heat waves, flooding caused by rising sea levels and heavy rains, and the destructive 2012 derecho storm. These events are sobering reminders that without action, increasingly severe weather events will threaten to disrupt our power grid, harm our economy, and cost lives.

Recognizing the need to prepare and adapt, the Sustainable DC Plan established a goal to make the District more resilient to future climate change. Climate Ready DC is the District’s strategy for achieving this goal while helping to ensure that our city continues to grow greener, healthier, and more livable.

Purpose

For the last two years, various stakeholders and the District government—led by the Department of Energy and Environment (DOEE)—have been working with a team of technical experts to develop Climate Ready DC. This plan identifies the impacts that a changing climate will have on the District; the risks to our infrastructure, public facilities, and neighborhoods; and the actions we must take now and in the future to prepare. It is based on the best available climate science and was developed through consultation with leading experts within and outside of the District government.

What is Climate Change Adaptation?

Climate change adaptation means being prepared for a changing climate by taking action to reduce the potential impacts of climate change to people, buildings, and infrastructure like water systems, roads and electricity, and natural gas networks.

CLIMATE CHANGE IMPACTS FOR DC

In order to plan for climate change, we first must understand the changes we are likely to experience. DOEE worked with leading climate scientists to identify likely changes for the District from today through the 2080s. The results of that study are summarized below.

The District's Climate Future

As a result of climate change, DC will experience:

- Much warmer average temperatures
- Up 2-3 times as many dangerously hot days
- Longer, hotter, and more frequent heat waves
- More frequent and intense heavy rain events
- Higher tides as a result of rising sea level

Rising Temperatures/Heat

Rising Temperatures: Average annual temperatures have increased 2°F during the last 50 years, and are expected to continue to rise. Historically, the average summer high temperature was 87°F. This is projected to increase significantly to between 93°F and 97°F by the 2080s.

Heatwaves & Dangerously Hot Days: As average temperatures rise, extreme heat days will increase and heatwaves will last longer and occur more frequently.

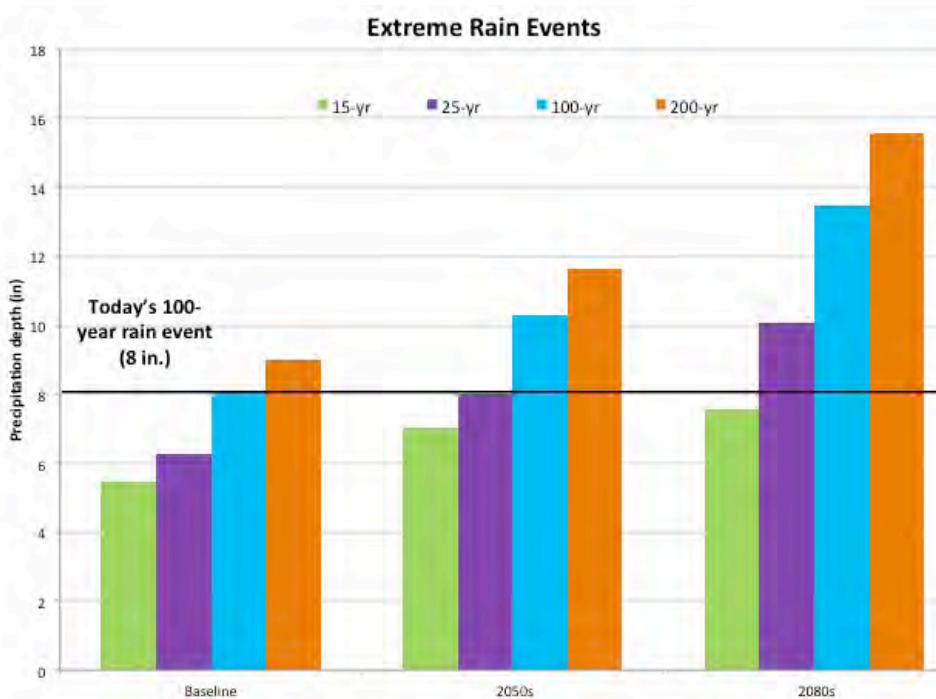
In 2012, DC experienced a record-breaking heatwave when temperatures soared above 95°F for 11 straight days. This previously unprecedented event could occur every one to two years by the 2050s.

Another important measure of heat is the heat index, which combines air temperature and humidity to measure what hot weather actually feels like to the human body. When the heat index reaches 95°F, the District activates its heat emergency plan. Historically, DC averages 30 of these dangerously hot days each year. This is projected to increase to 70-80 days by the 2050s, and 75-105 days by the 2080s.



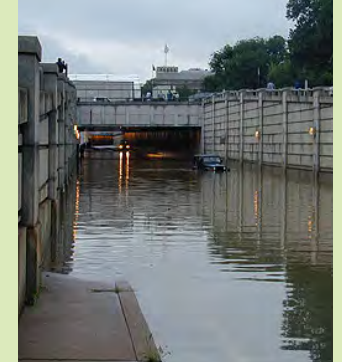
Rainfall & Flooding

Rainfall: Annual amounts of precipitation have not changed significantly; however, more precipitation is falling in the fall and winter and less in the summer. What is expected to change significantly is the frequency and intensity of heavy rainfall events that can cause flooding and pollution from stormwater run-off. As shown in the chart, today's one in 100-year rainfall event could become a one in 25-year event by mid-century, and a one in 15-year event by the 2080s.



2006 Federal Triangle Flood

In June of 2006, the District experienced several days of heavy rain, the equivalent of a 200-year storm, which overwhelmed the sewer system and caused significant flooding of the Federal Triangle area downtown. The flooding shut down federal agencies and several Smithsonian museums, inundating the 9th and 12th Street tunnels under the National Mall, and flooding two Metro stations. The Federal Triangle flood, which resulted in millions of dollars in damage, demonstrated the potential costly impacts of increasingly frequent and severe rain events.

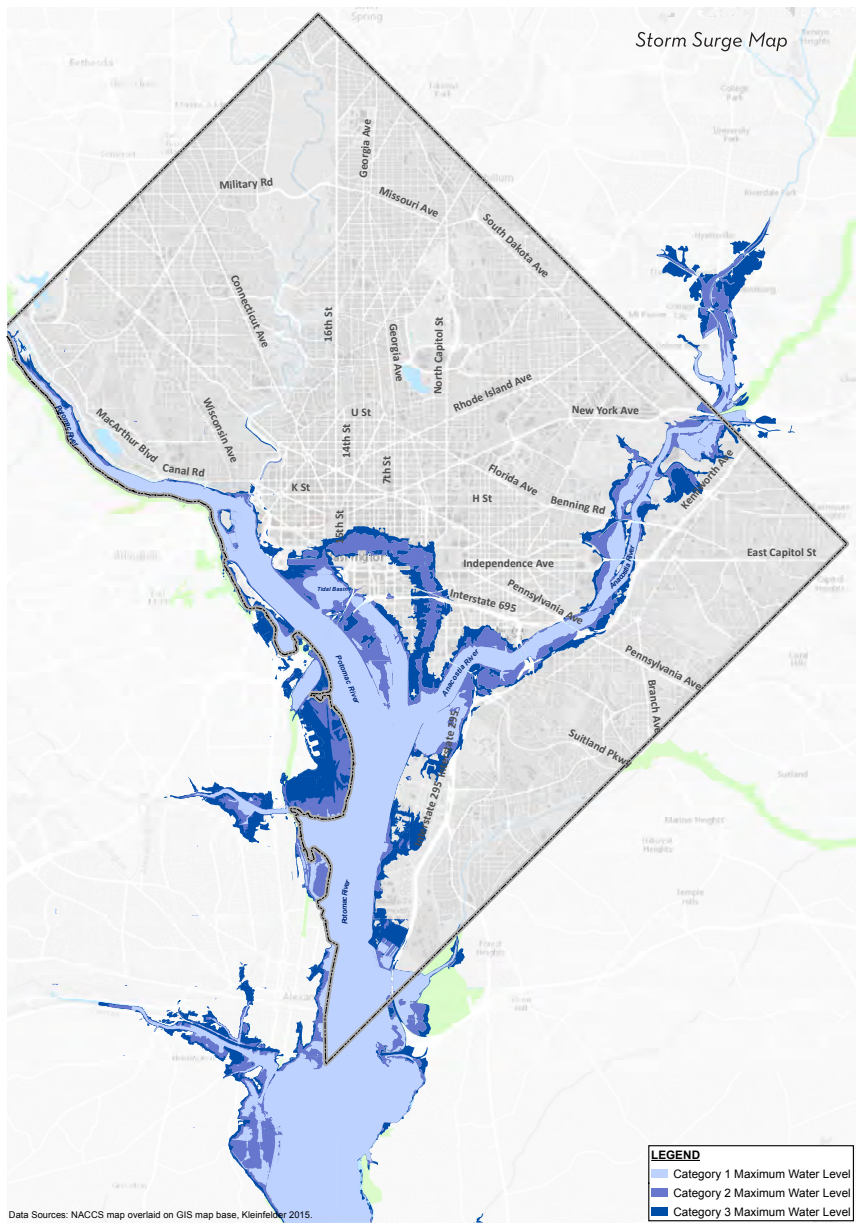


12th Street, NW Tunnel
Photo Credit: National Capital Planning Commission

Sea Level Rise & Storm Surge

Sea Level Rise: Over the last century, warmer oceans and melting ice due to climate change have caused sea levels to rise around the globe. This change in sea level rise poses significant risks to coastal cities and those adjacent to tidal rivers. In Washington, DC, water levels for the Potomac and Anacostia Rivers, both tidal rivers, have increased 11 inches in the past 90 years due to sea level rise and subsidence. As a result, nuisance flooding along our riverfront has increased by more than 300%, according to the National Oceanic and Atmospheric Administration. By 2080, the U.S. Army Corps of Engineers predicts up to 3.4 feet of additional sea level rise in DC. While this estimate accounts for both ice loss and ocean warming, recent studies have found faster rates of ice loss, which could result in even higher sea levels by the end of the century.

Storm Surge: DC is also vulnerable to coastal storms, like hurricanes, that cause storm surge flooding. Climate change can make these storms stronger. More intense storms coupled with rising sea levels puts the District at even greater risk for coastal flooding in the future.

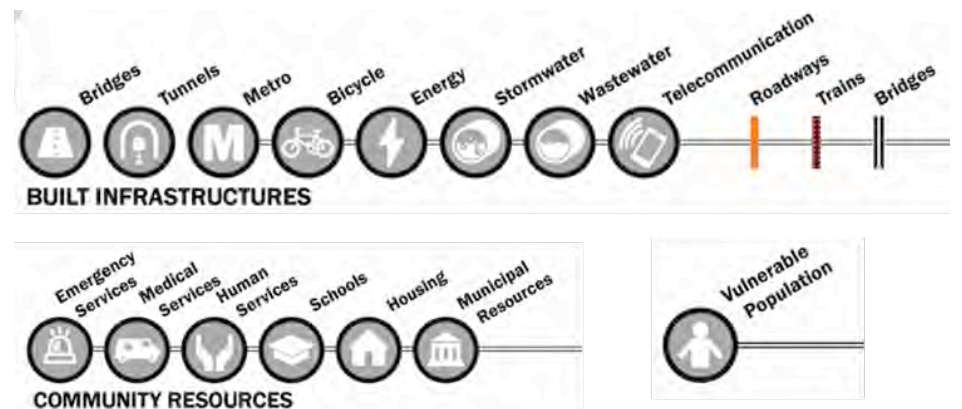


CLIMATE RISKS AND VULNERABILITIES

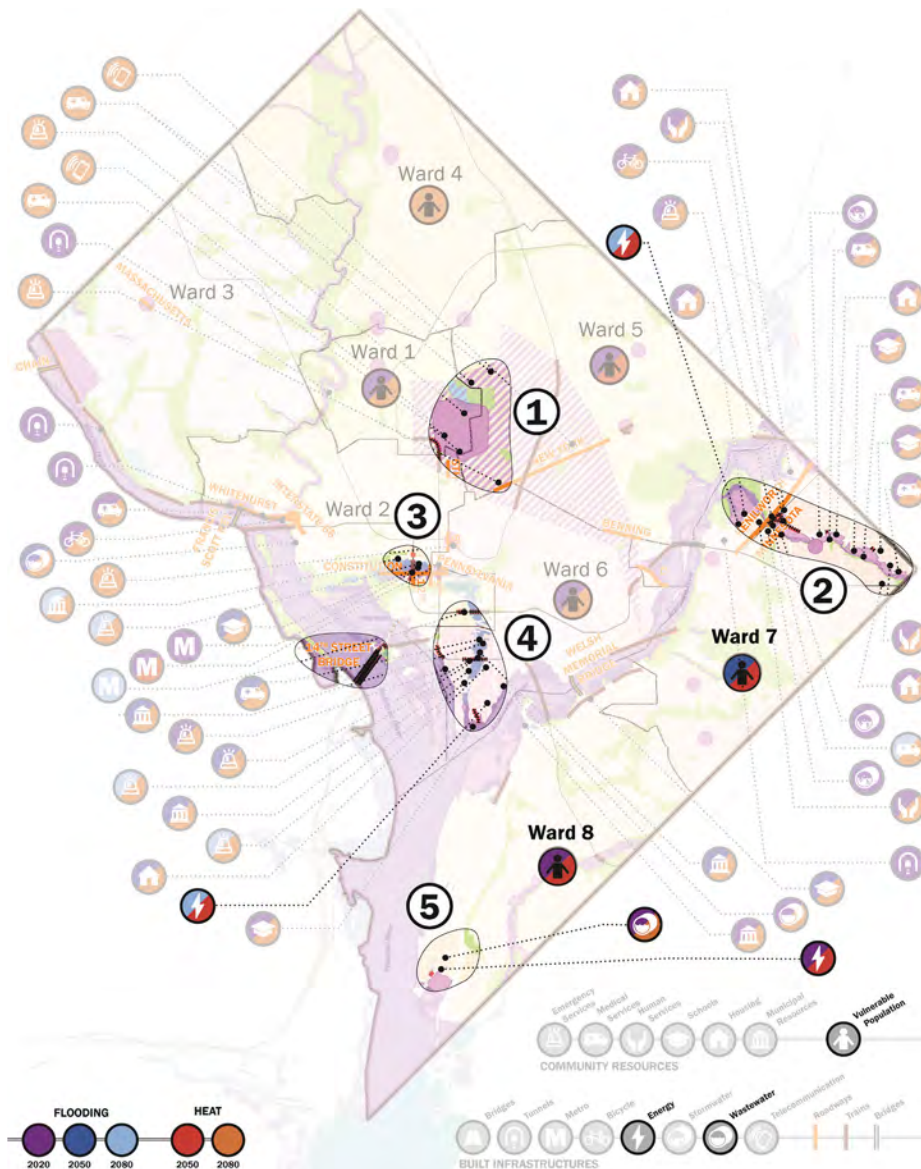
Based on the projected changes in temperature, rainfall, and sea level rise, DOEE and our technical experts conducted an assessment of the risks that these changes are likely to pose for DC’s infrastructure, our community resources and facilities, and our residents. We developed planning scenarios for heat waves, heavy rain events, rising sea levels, snowmelt, and flooding in order to identify and rank the areas at greatest risk. The rankings were developed with input from District agencies and external stakeholders. They are based on both the probability of critical infrastructure, community resources, and other assets being exposed to a climate-related event and the potential impact of that exposure on the functionality and livability of the District. The areas with the most assets and people at risk were identified as priority areas for the implementation of Climate Ready DC.

The following section summarizes the key findings from each area of the assessment. The maps below demonstrate the projected risk extreme heat and flooding pose to the cities’ infrastructure and community resources in 2020, 2050 and 2080.

Scope of Vulnerability Assessment



Priority Planning Area Map



Measuring Risk

Risk is measured based on the probability of occurrence and the consequence of an impact such as flooding. For example, given the same probability of flooding, an electrical substation was considered to be at higher risk than a Capital Bikeshare station. Before the loss of one electrical substation would have a greater consequence as it could leave many residents and businesses without power, while the flooding of a Bikeshare station would likely impact fewer people and be easier and less expensive to repair.

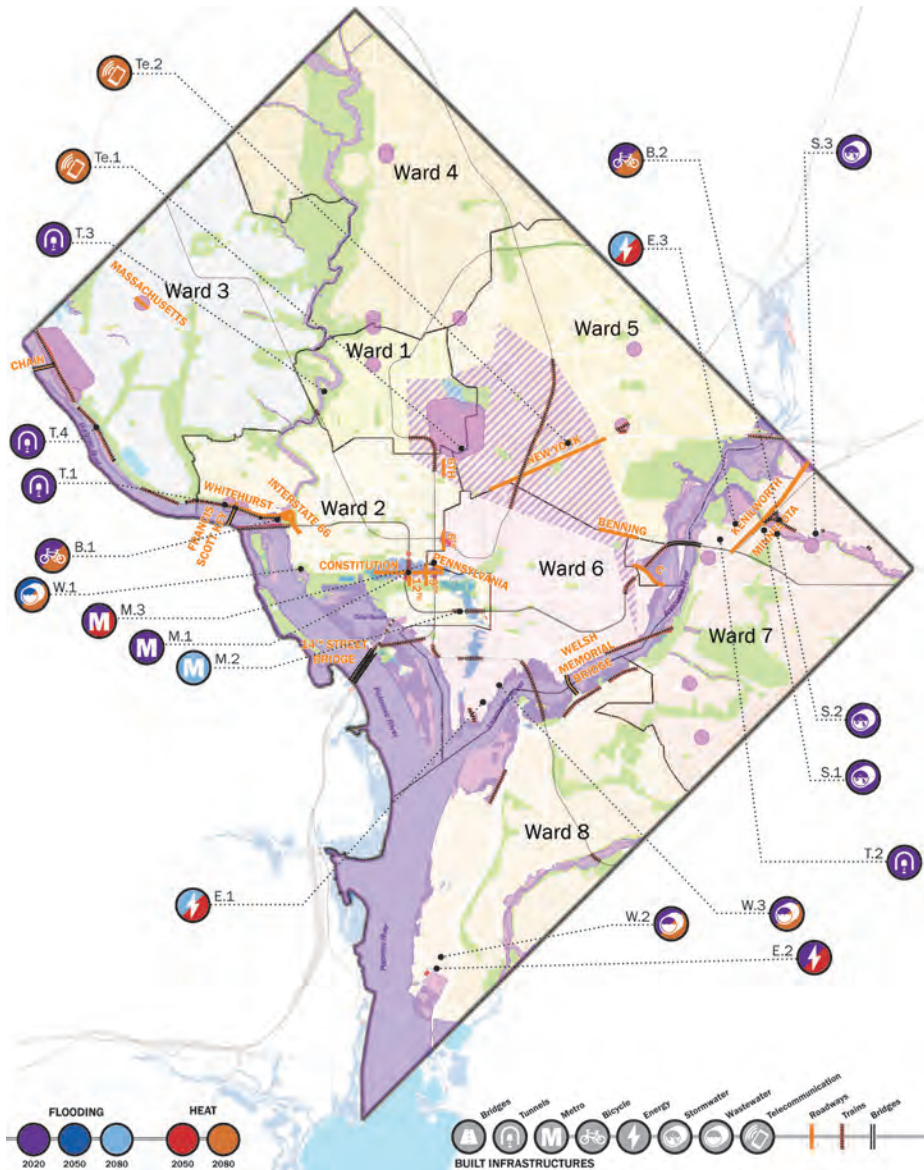
Infrastructure

The District's energy, transportation, water, and communication systems are essential to keeping the city running. The 2012 derecho—a severe storm that knocked out power in many parts of DC for several days during a record-breaking heatwave—highlighted the potential consequences of infrastructure failures on providing services. Ensuring the resilience of these systems to future changes in climate is a priority for Climate Ready DC.

The infrastructure map that follows illustrates the infrastructure assets that were identified as being at greatest risk. The key findings for each system include:

- Transportation:** The Metrorail system is at-risk to increased heat and flooding. Several underground stations already experience regular flooding while above ground rail lines, including Metrorail, MARC, VRE and Amtrak lines, could be damaged by hotter and longer heatwaves in the future. Key bridges that span the Potomac and Anacostia Rivers and many major roadways, including several that are currently designated as emergency evacuation routes, are also at risk to flooding and sea level rise.
- Energy:** Three of the District's 19 electric substations evaluated by the study were identified as at-risk to flooding now or in the future. Substations are essential to distributing power throughout the District.
- Water:** Stormwater and sewer collection systems, which were designed based on historic rainfall events, will be strained by more frequent and severe rain events and potential inundation from sea level rise and coastal storms—resulting in localized flooding and increased stormwater run-off.
- Communication:** Local cellular, TV, and radio systems were found to be only marginally impacted by climate change. However, these systems rely heavily on electrical networks, so they are also at risk when the electricity infrastructure is compromised.

Infrastructure Map



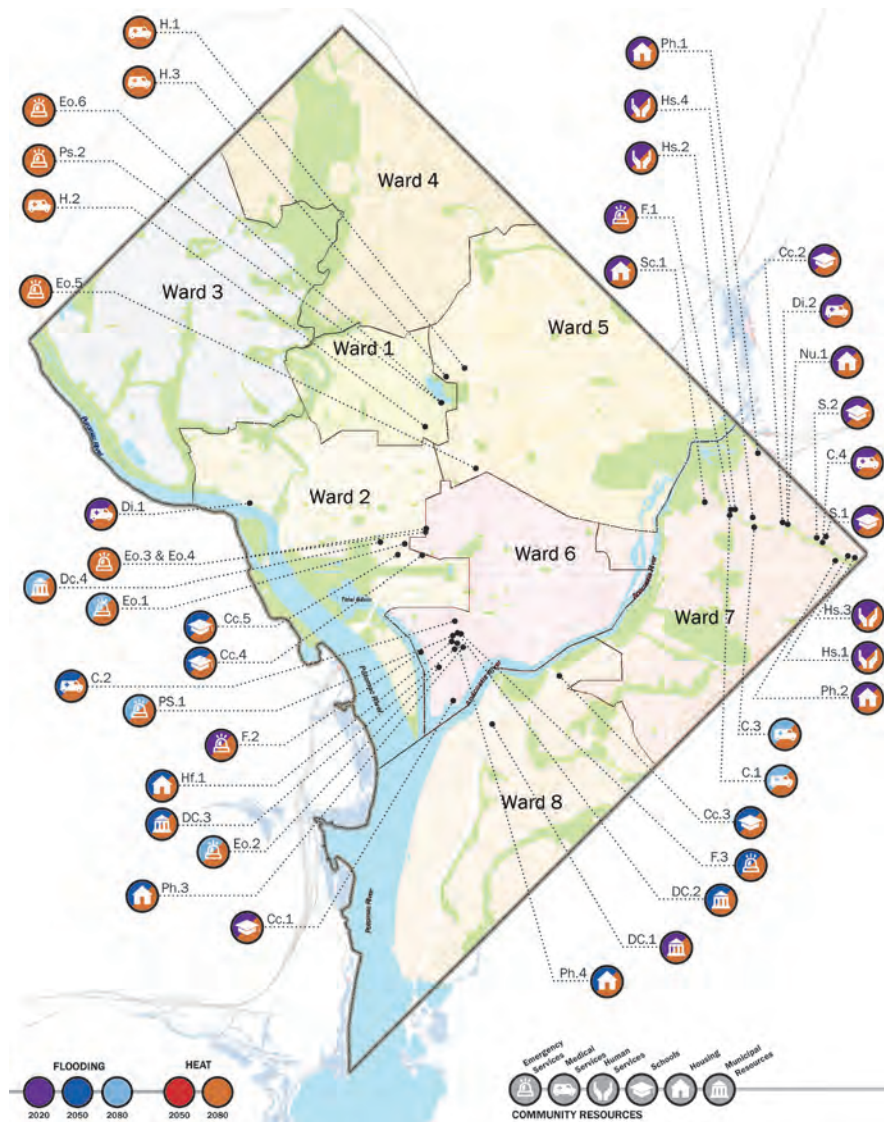
Community Resources

The District's community resources include all of the facilities that provide public services to residents, visitors, and businesses, including public safety, healthcare, and education. Many of these facilities, like schools and recreation centers, also serve as emergency shelters and cooling centers during severe weather and heatwaves.

The following Community Resources map shows the community resources at greatest risk based on their location in areas likely to be exposed to flooding. All buildings are assumed to be at risk to extreme heat by 2080 given that current building systems are designed to operate under cooler temperatures. The map shows that the at-risk community resources are concentrated in a few areas:

- **Watts Branch:** Ward 7 is home to the largest number of vulnerable community resources, including schools, medical services, and public housing located along the flood-prone Watts Branch.
- **Downtown DC:** The area around Federal Triangle is home to several District agency headquarters and operations centers that are at risk to flooding from both heavy rain events and sea level rise from the Potomac River, as demonstrated by the 2006 flood.
- **Southwest DC:** Several District agencies, public housing properties, police and fire stations, and schools located in Southwest DC are at risk to future flooding.

Community Resources Map

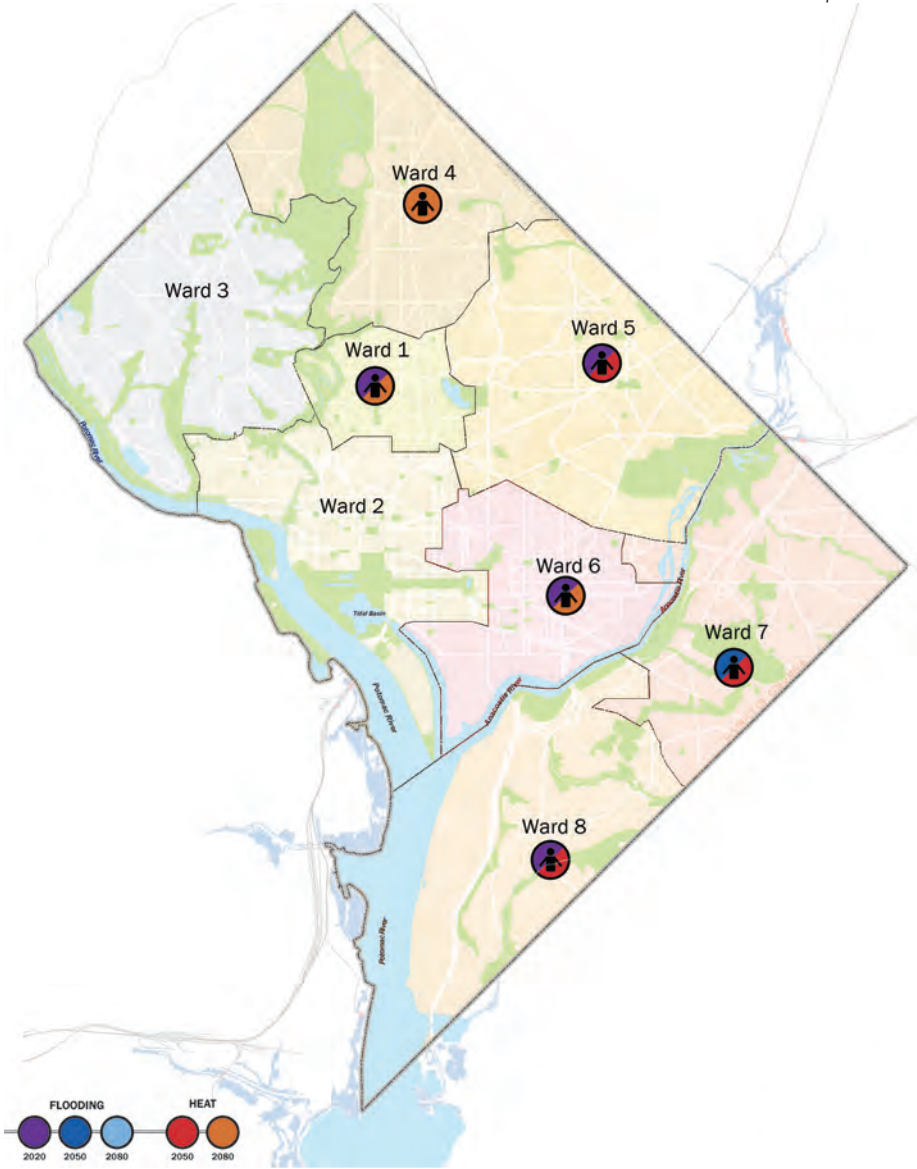


People

Climate change will not affect everyone equally. Individuals who are most vulnerable to climate change are those who are more sensitive to events like heatwaves and those who have less capacity to adapt and respond to the stresses caused by climate change. For example, older adults tend to be more sensitive to heat and more likely to suffer heat stroke or worse. And, an individual who can afford to install and run air-conditioning has greater capacity to adapt to heat waves than someone who cannot afford air-conditioning. In order to identify the areas of DC that include the largest number of residents with higher vulnerability, we assessed social and economic indicators, including unemployment, poverty prevalence, rates of obesity and adult asthma, and age.

The results, shown in the Vulnerable Populations map (left), demonstrate that vulnerability to climate change is not evenly distributed across the District. Wards 7 and 8 are most vulnerable given high levels of unemployment, poverty, obesity, and asthma, as well as a large elderly population. This is followed by Wards 5, 6, 1, and 4.

Ward Map



ADAPTATION STRATEGIES

While the risks that DC faces due to climate change are significant, there are also many actions that we can take to manage those risks and adapt to our changing climate. Many of these actions are already underway.

The following section outlines the action plan for a Climate Ready DC. The plan is organized into four sectors: Transportation & Utilities, Buildings & Development, Neighborhoods & Communities, and Governance & Implementation. For each sector we have established goals, targets, and specific actions. The goals and targets are outlined in this section, and a full summary of all the actions is provided at the end of this document. A key first step in realizing Climate Ready DC will be the development of a detailed implementation plan that will identify timeframes, potential funding sources, and metrics for tracking our progress.

Transportation & Utilities

Goal: Improve transportation and utility infrastructure in order to maintain viability during periods of extreme heat, severe weather, and flooding.

Climate change will further threaten DC’s aging infrastructure. The District will work with the public and private operators of our transportation, water and sewer, energy, and communication infrastructure to improve and adapt these systems to withstand the impacts of climate change in order to maintain service and recover quickly from outages. Through better planning and coordination, we can take advantage of ongoing investments and upgrades to our infrastructure to advance resilience. Climate Ready DC identifies five targets for the Transportation & Utilities section:

1. **Develop site-level adaptation plans for all critical facilities and service areas identified as at-risk from sea level rise and flooding.**

The risk assessment conducted by the Climate Ready DC team identified numerous infrastructure assets at-risk to flooding. Site-level assessments would be necessary to identify potential flood-proofing strategies that could be incorporated into capital improvement plans. Metro and DC Water are already investing in flood-proofing several critical elements of their systems, but those efforts need to be expanded to other critical facilities and service areas.

2. Increase the resilience of the energy infrastructure.

We can increase the resilience of our energy infrastructure by reducing demand for energy while also strengthening assets within our electric and natural gas distribution systems against flooding and extreme heat. Distributed energy resources like solar power, battery storage, and microgrids will be deployed to provide backup power in the event of an outage.

3. Increase the resilience of water, stormwater, and wastewater systems.

By decreasing the load on and increasing the capacity of our stormwater and wastewater systems, we can prevent flooding and stormwater pollution caused by heavier rainfalls. The District is already investing heavily in both green infrastructure and traditional tunnel infrastructure to expand the capacity of these systems. We can further increase capacity by reducing demand on the drinking water system through the capture and reuse of water.

4. Increase the resilience of communication systems.

The ability to communicate, especially during emergencies, is critical to providing essential services before, during, and after a disaster event. The District will work with telecommunication providers to more fully assess the vulnerabilities to our communication systems, including their dependence on the electricity grid.

5. Increase the resilience of the transportation infrastructure.

The District's network of roads, bridges, and transit infrastructure keeps the city running and provides for evacuation and emergency response during extreme weather and other disruptive events. By updating design standards to account for future flooding and extreme temperatures, we can improve the resilience of these systems while identifying alternative evacuation routes for flood-prone areas.

Case Study: Green Infrastructure

DC Water, DOEE, and the District Department of Transportation (DDOT) are all working to install green infrastructure to manage stormwater. During heavy rain events, green infrastructure, such as the raingarden at DOEE's headquarters (pictured to the right), can help reduce flooding and pollution. Replacing paved surfaces with green space can also protect our neighborhoods from more extreme heat.



*Photo Credit: Matt Robinson,
Department of Energy & Environment*

Buildings & Development

Goal: Upgrade existing buildings and design new buildings and development projects to withstand climate change impacts.

Buildings across the city, both public and private, are at risk to climate-related events, including flooding, extreme weather, and heat. We will work to upgrade our existing buildings while ensuring that new buildings, especially large development projects, are designed to be climate-ready. Climate Ready DC identifies six targets for Buildings & Development:

1. Provide back-up power for emergencies at the most critical facilities.

The ability to keep the power on at critical facilities like emergency shelters, hospitals, and police and fire stations is essential to public safety during disaster events. Back-up power can be supplied by a combination of generators, solar and battery storage, and microgrids.

2. Improve thermal safety of buildings to increase resilience to extreme heat, especially in the event of a power outage.

During a heat wave, buildings can become dangerously hot, especially if they are not air-conditioned or the electricity goes out. There are many strategies

for keeping buildings cooler without air conditioning, including increased ventilation, shading, and installing cool roofs. These strategies are critical to the resiliency of our buildings, particularly when air-conditioning may not be installed in a building, becomes unavailable due to a power outage, or is unaffordable to run. The District will incorporate these strategies into its building codes and incentive programs.

3. Pursue deep energy and water efficiency for all buildings.

By continuing to advance energy and water efficiency through our building codes and incentive programs, we can increase the resiliency of energy and water systems by reducing demand, especially during peak periods.

4. Incorporate climate resilience into development planning and review.

We will develop resilience guidelines for new development projects, including public capital projects, to ensure new development is resilient to flooding, extreme weather, and heat, while also aligning our building and zoning codes, and other policies to support them.

5. Leverage land-use planning to promote resilience.

The District's land-use plans and policies provide a powerful tool to advance resilience, especially in flood and heat prone areas. We will incorporate resilience into the District's Comprehensive Plan for land-use when it is updated in 2016. We will also evaluate options to expand guidelines and restrictions for building in areas with increased risk to flooding due to climate change.

6. Provide incentives to encourage private property owners and developers to implement flood resiliency measures.

In order to provide property owners with the resources to make new and existing buildings more resilient to flooding, we will explore various incentive options, including the use of nature-based flood control measures like restoring natural floodplains and creating wetlands.

Case Study: Smart Roofs

The Department of General Services (DGS) is implementing a Smart Roofs Plan that will help make our public buildings more resilient using innovative roofing solutions. DGS is installing green roofs and cool roofs to save energy and help keep buildings cool as temperatures rise, as well as investing in solar to help reduce demand on our electric grid.



Crews install a cool roof at Browne Education Campus
Photo Credit: Paul Lanning, Lightbox Energy

Neighborhoods & Communities

Goal: Make neighborhoods and communities safer and more prepared by strengthening community, social, and economic resilience.

Disaster events and emergencies can bring neighbors together to support one another. At the same time, heat waves, storms and other disruptive events do not impact all neighborhoods equally, exacerbating existing inequalities and vulnerabilities. In order to ensure that all DC neighborhoods are prepared for climate-related disasters—and can recover quickly when disasters do occur—the actions in this section focus on improving emergency preparedness and strengthening community institutions while deploying neighborhood-scale solutions to reduce climate risks.

1. Improve emergency preparedness and planning for climate-related events with a particular focus on those most vulnerable.

Emergency preparedness and planning involves various District agencies as well as community institutions, organizations, and individuals. The District will encourage active participation in disaster preparedness training programs, especially for organizations that serve the most vulnerable residents. At the same time, we will continue to evaluate the public health risks of climate change and improve public awareness of those risks.

2. Strengthen community connections to improve safety and resilience.

Strong, resilient communities have easy access to essential services, like food, water, medical care, and vibrant social networks that enable neighbors to help one another. Through neighborhood planning and investments, we will develop and maintain neighborhoods with a diverse mix of services, housing, and transportation options. By providing capacity-building resources and training for community organizations, we can support community-level preparedness and resiliency planning.

3. Reduce the risks of extreme heat and the urban heat island.

Neighborhoods with large areas of pavement and buildings, and minimal green space, will be more negatively impacted by extreme heat. We will identify and target these areas for expanding green spaces, tree planting, cool roofs and pavements. We will also evaluate our existing heat emergency plans and cooling centers to ensure they meet the needs of the most vulnerable residents, workers, and visitors.

4. Deploy neighborhood-scale resilience solutions.

By leveraging ongoing planning, we will implement hyperlocal, neighborhood-scale energy efficiency and water investments, such as district energy systems and district stormwater and reuse systems, to improve grid reliability, increase building efficiency and provide services to communities. We will also explore the concept of community resilience hubs to locate emergency preparedness and response supplies and training in public and private community facilities, such as churches and community centers.

5. Reduce the economic impacts of severe weather and heat related events on vulnerable populations.

More frequent and intense weather and heat related events will likely lead to increased and more prolonged water, heating, and cooling use, as well as higher utility bills. By leveraging the existing Low Income Home Energy Assistance Program (LIHEAP) and the RiverSmart Program we will partner with the Department of Health, the Office of Aging and the Department of Housing and Community Development to reduce the economic impacts of climate change related events on vulnerable populations.

Case Study: Serve DC CERT Training

Serve DC's Community Emergency Response Team (CERT) volunteer program trains citizens to better prepare and respond to emergencies in their communities. When emergencies happen, CERT members can provide critical support to first responders, offer immediate assistance to victims, and help organize volunteers at a disaster site. Through CERT training and recommendations from citywide initiatives like Age Friendly DC, we can mitigate the effects of climate change related disasters on our most vulnerable populations.



*CERT Training Simulation
Photo Credit: Serve DC*

Governance & Implementation

Goal: Establish the policies, structures, and monitoring and evaluation procedures to ensure successful implementation of Climate Ready DC.

The risks posed by climate change cut across various levels of government and private sectors. Therefore, considerations of climate risk must be embedded in the day-to-day operations and planning for how the District and our partners provide services and maintain the infrastructure for our residents, businesses, and visitors. The three targets identified in this section focus on establishing a measureable process for monitoring and evaluating our efforts and aligning those efforts with related initiatives within and outside the District government.

1. Conduct additional analysis of climate vulnerability and adaptation strategies to account for the latest climate science.

As climate science continues to evolve, we will monitor the latest science and deepen our understanding of the potential implications for DC. We will also provide information and support to the private sector—especially the operators of our infrastructure systems—to conduct vulnerability assessments of their own.

2. Align Climate Ready DC with related planning efforts.

Climate Ready DC will be integrated into related planning efforts and processes, including the District’s land-use, hazard mitigation and emergency management planning, capital budget planning, building codes, and development review.

3. Establish the necessary structures to ensure successful implementation of Climate Ready DC.

Once Climate Ready DC is finalized, we will develop a supporting implementation plan to identify lead agencies, timelines, and potential sources of funding for each of the actions. As District government action alone will not be sufficient to make DC climate ready, we will also leverage new and existing partnerships with the private sector, federal government, and regional partners.

**Case Study: DC Silver Jackets
- 17th Street Levee**

Implementing many of the Climate Ready DC solutions will require collaboration across multiple levels of government and with the private sector. The DC Silver Jackets team is helping to improve coordination across local, regional, and federal partners to reduce flood risks. The team is working to upgrade DC’s levee system, including the new removable closure on 17th Street, NW near the Washington Monument.



*17th Street, NW Levee Installation
Photo Credit: U.S. Army Corps
of Engineers Baltimore District*

ACTION ITEMS

TIMEFRAME: Short = 1-3 yrs | Medium = 3-10 yrs | Long = 10-20 yrs

| # | Action (sub-action) | Climate Risks | Lead (s) | Partners | Timeframe |
|---|---|---|----------------|--|--------------|
| TRANSPORTATION + UTILITIES | | | | | |
| Goal: Improve the transportation and utility infrastructure to maintain viability during periods of extreme heat, severe weather and flooding. | | | | | |
| TU 1.0 | Develop site-level adaptation plans for all facilities and service areas identified as at-risk from sea level rise and flooding. | | | | |
| TU 1.1 | Identify at-risk facilities and develop adaptation or retirement plans for those facilities, prioritizing upgrades based on the age and criticality of the assets as well as their vulnerability. | Sea Level Rise Flooding | HSEMA | Infrastructure owners and operators (DDOT, WMATA, DC Water, Pepco, Washington Gas, etc). | Short |
| TU 1.2 | Conduct near-term (2020s) and long-term flooding (2050s+) evaluations for at-risk facilities based on projected increases in extreme precipitation and storm surges as well as permanent inundation due to sea level rise. | Sea Level Rise Flooding | HSEMA | Infrastructure owners and operators (DDOT, WMATA, DC Water, Pepco, Washington Gas, etc). | Short |
| TU 2.0 | Increase the resilience of energy systems. | | | | |
| TU 2.1 | Conduct distribution system planning in order to identify the best strategies for stabilizing the power grid with distributed energy resources including storage, renewable energy and micro-grids capable of islanding. Prioritize locations that could provide backup power to critical facilities, or alleviate congestion on the distribution grid. | Extreme Heat Flooding Extreme Weather | DOEE | DC SEU, Pepco, DC PSC, Washington Gas | Long |
| TU 2.2 | Ensure that climate risks are considered in utility rate cases for investments in new and upgraded infrastructure. Flood proof and/or elevate electric infrastructure including, but not limited to, substations, transformers, switch gear, etc. | Sea Level Rise Flooding | DC PSC | Pepco, DOEE | Medium |
| TU 2.3 | Ensure that climate risks are considered in utility rate cases for investments in new and upgraded infrastructure. Flood proof and/or elevate natural gas infrastructure including, but not limited to, pressure regulating stations, odorization equipment, tanks, controls, electric components, etc. | Sea Level Rise Flooding | Washington Gas | DC PSC, DOEE | Medium |
| TU 2.4 | Conduct site-level studies of extreme heat risk to electric grid infrastructure including transformers and overhead transmission and distribution lines. Identify necessary upgrades and mitigation strategies. | Extreme Heat | Pepco | DC PSC, DOEE | Short-Medium |

| # | Action (sub-action) | Climate Risks | Lead (s) | Partners | Timeframe |
|--------|---|------------------------------------|---------------|---|-----------|
| TU 3.0 | Increase resilience of drinking water, wastewater, and stormwater systems. | | | | |
| TU 3.1 | Update design standards for water and drainage infrastructure to address the projected increase in intensity of precipitation. | Extreme Precipitation | DOEE | DDOT, DC Water | Short |
| TU 3.2 | Increase combined sewer and separate stormwater system capacity with green and grey infrastructure including raingardens, green roofs, cisterns, and pervious pavement. Focus first on areas that flood regularly or have known drainage capacity issues. | Flooding, Extreme Precipitation | DOEE | DC Water, DDOT | Long |
| TU 3.3 | Reduce water demand and increase combined sewer system capacity with water recycling and reuse. Explore the use of distributed rainwater harvesting and grey/black water recycling to reduce demand on potable water systems during shortages or disruptions. | "Extreme Heat Drought | DOEE | DC Water | Long |
| TU 3.4 | Flood proof critical components of drinking water infrastructure including, but not limited to, pumping stations, raw water reservoirs, finished water storage, waste treatment facilities, building infrastructure, access roads, etc. Implement backflow prevention techniques. | Sea Level Rise Flooding | DC Water | USACE | Medium |
| TU 3.5 | Flood proof critical stormwater and combined sewer infrastructure including, but not limited to, pumping stations, inlets and outlets. Implement backflow prevention techniques. | Sea Level Rise Flooding | DOEE DC Water | DDOT | Medium |
| TU 4.0 | Increase resilience of communication systems. | | | | |
| TU 4.1 | Expand the initial findings and recommendations of this report with a comprehensive vulnerability assessment of the AM/FM, TV, cellular communication and internet systems. | All | DC PSC | OCTO, Telecommunications Companies, HSEMA | Short |
| TU 5.0 | Increase resilience of transportation systems. | | | | |
| TU 5.1 | Continue and expand efforts to mitigate flooding of the Metrorail system. | Flooding, Extreme Precipitation | WMATA | DDOT, DOEE | Medium |
| TU 5.2 | Identify alternate evacuation routes for roads and bridges identified as vulnerable to flooding and/or sea level rise. | Sea Level Rise Flooding | DDOT | HSEMA | Short |
| TU 5.3 | Update design standards for roads and transit infrastructure to account for projected extreme temperatures and extreme precipitation events. | Extreme Heat Extreme Precipitation | DDOT | WMATA, Amtrak, CSX, MARC, VRE | Short |
| TU 5.4 | Evaluate existing bridges' expansion joints and design for resilience to extreme temperatures. | Extreme Heat/ Cold | DDOT | FHWA | Medium |
| TU 5.5 | Evaluate vertical clearance for bridges on waterways based on sea level rise projections. | Sea Level Rise | DDOT | FHWA | Medium |

| # | Action (sub-action) | Climate Risks | Lead (s) | Partners | Timeframe |
|--|---|---|----------|----------------------|-----------|
| BUILDINGS + DEVELOPMENT | | | | | |
| Goal: Upgrade existing buildings and design new buildings and development projects to withstand climate change impacts. | | | | | |
| BD 6.0 | Provide back-up power for emergencies at all identified critical facilities. Ensure that existing back-up power systems are located above projected flood elevations. | | | | |
| BD 6.1 | Evaluate the most critical facilities to identify those with or without existing back-up power systems; determine if they are above flood elevations, in good working order, and provide the appropriate capacity for that facility type. | All | HSEMA | DGS, DOEE | Medium |
| BD 6.2 | Flood proof the most critical facilities to protect against future events accounting for sea level rise and increasingly severe precipitation events. | Flooding Sea Level Rise | DGS | HSEMA, DOEE | Long |
| BD 7.0 | Improve thermal safety + indoor building temperatures to increase resilience to extreme heat, especially in the event of a power outage. | | | | |
| BD 7.1 | Incorporate recommendations/requirements for improving thermal safety in residential and building codes through the use of passive cooling strategies. | Extreme Heat | DCRA | DOEE, DOH | Short |
| BD 7.2 | Identify existing residential building typologies (e.g. high rises, garden style) where residents are at highest-risk during extreme heat events and develop policies to support and encourage retrofits and upgrades. | Extreme Heat | DOEE | DHCD, DCHA, DCRA | Medium |
| BD 7.3 | Expand existing incentive programs to include thermal safety and urban heat island mitigation measures such as cool roofs and solar shading. | Extreme Heat | DOEE | DCSEU | Short |
| BD 7.4 | Evaluate the public housing portfolio for vulnerability to extreme heat and flooding and incorporate resilience in future capital improvement plans. | Extreme Heat, Flooding, Extreme Precipitation | DCHA | DOEE | Short |
| BD 8.0 | Pursue deep energy and water efficiency for all buildings. | | | | |
| BD 8.1 | Continue to pursue energy efficiency for all commercial and residential buildings through incentive programs, building codes, and financing to increase grid stability by reducing energy demand at peak periods and during extreme events. | Extreme Heat | DCRA | DOEE, DCSEU | Short |
| BD 8.2 | Consider developing a post occupancy energy optimization program for new and existing buildings to provide training and incentives to ensure the actual efficiency potential constructed into buildings is realized. | Extreme Heat | DOEE | DCRA, DCSEU | Medium |
| BD 8.3 | Develop incentives, training and technical assistance programs for significant water use reductions including rainwater and greywater harvesting and onsite blackwater treatment. | Extreme Precipitation | DOEE | DC Water, DCRA, DDOT | Medium |

| # | Action (sub-action) | Climate Risks | Lead (s) | Partners | Timeframe |
|---------|--|---|----------|--|-----------|
| BD 9.0 | Incorporate climate resilience into development planning and review processes. | | | | |
| BD 9.1 | Develop climate resilience guidelines for new development projects. | All | DOEE | OP, DMPED, DCRA | Short |
| BD 9.2 | Evaluate sequencing of agency approvals for new building development projects to determine the best point at which to incorporate flood review. | All | DCRA | DOEE, OP | Short |
| BD 9.3 | Assess feasibility of district energy and/or micro grids and district stormwater management for all large development projects. | All | DOEE | OP, DMPED | Medium |
| BD 9.4 | Require all planned unit developments, large tract review, and publicly financed projects to complete an adaptation checklist based on BD 9.1. | All | OP | DMPED, Zoning Commission, DDOT, OCFO, DOEE | Medium |
| BD 10.0 | Leverage land-use planning to promote resilience. | | | | |
| BD 10.1 | Conduct a citywide analysis of flood zones to understand the impact of setbacks, buffers, and zoning and land use policies on existing and future developments. | Extreme Precipitation, Sea Level Rise, Flooding | DOEE | OP | Short |
| BD 10.2 | Incorporate climate resilience into the District's Comprehensive Plan. | All | OP | DOEE, HSEMA | Short |
| BD 10.3 | Propose amendments to floodplain regulations and zoning and land use policies to ensure that waterfront setbacks and buffers allow for future sea-level rise, changes in precipitation patterns, sustainable landscaping practices, erosion, and reduce flood risks. | Sea Level Rise, Flooding | DOEE | OP, DCRA | Medium |
| BD 10.4 | Develop a set of flood resilience guidelines for the 500-year floodplain in addition to those existing for the 100-year floodplain for new development and substantial improvements. | Sea Level Rise, Flooding | DOEE | DCRA, OP | Medium |
| BD 10.5 | Propose regulations that limit the development of new critical facilities including hospitals, emergency services, shelter facilities and critical infrastructure systems within the 500-year floodplain. | Sea Level Rise, Flooding | DOEE | OP, HSEMA | Medium |
| BD 10.6 | Identify buildings in the current 500-year floodplain and create design guidelines for retrofitting the various typologies of buildings. | Sea Level Rise, Flooding | DOEE | DCRA | Medium |
| BD 11.0 | Provide incentives to encourage private property owners and developers to implement flood resiliency measures. | | | | |
| BD 11.1 | Offer rebates or grants for flood-resilience measures such as removable flood barriers, dry and wet flood proofing (for nonresidential buildings), elevation (for residential buildings) in vulnerable areas, and wastewater backup valves. | Flooding, Extreme Precipitation | DOEE | HSEMA | Medium |

| # | Action (sub-action) | Climate Risks | Lead (s) | Partners | Timeframe |
|---------|---|---------------|----------|-------------|-----------|
| BD 11.2 | Explore the use of buyouts and relocation for flood-prone properties in order to minimize flooding threats to residents and to facilitate the restoration of natural floodplains, as well as to account for future sea level rise. As a first step, assess potential areas through the update of the District's All Hazard Mitigation Plan. | Flooding | DOEE | FEMA, HSEMA | Medium |
| BD 11.3 | Explore the use of tax credits for conservation of floodplains and natural buffers, such as wetlands, in vulnerable areas. | Flooding | DOEE | OCFO, DISB | Medium |
| BD 11.4 | Provide guidelines and encourage developers to consider resilience measures as community benefits for planned unit developments, large tract developments, and similar projects. | All | OP | DOEE | Short |

NEIGHBORHOODS + COMMUNITIES

Goal: Make neighborhoods and communities safer and more prepared by strengthening community, social, and economic resilience.

| | | | | | |
|---------|--|--------------|-------|---|--------|
| NC 12.0 | Improve emergency preparedness and planning with a particular focus on those most vulnerable. | | | | |
| NC 12.1 | Encourage active participation by residents and businesses in disaster preparedness, response, and recovery training programs including the Community Emergency Response Team volunteer program. | All | HSEMA | Serve DC | Short |
| NC 12.2 | Continue and expand efforts to identify and reach residents with greater vulnerability to climate change impacts including heat and flooding. Provide training to home healthcare and other service providers that engage directly with vulnerable residents. | All | DOH | HSEMA, Office of Aging, DHS, DOEE, ODR, DBH | Short |
| NC 12.3 | Evaluate health risks that are exacerbated by projected climate shifts as well as the cascading consequences of those shifts. Provide training and capacity-building to public health officials to address increased cases of heat stress as well as the potential for increased prevalence of disease-carrying specimens and infectious diseases. | All | DOH | DOEE | Medium |
| NC 12.4 | Improve public awareness of health risks associated with climate change, and strategies for dealing with extreme heat and natural disasters. | All | DOH | DOEE, HSEMA | Medium |
| NC 12.5 | Create a more in-depth assessment of vulnerable populations at the neighborhood level (where they live, what their needs are) to build upon ward-level assessments completed for this study. | All | HSEMA | DOEE, DOH, OP | Short |
| NC 13.0 | Reduce risks of extreme heat and the urban heat island. | | | | |
| NC 13.1 | Develop thermal mapping of the District to identify urban heat-island hot-spots, vulnerable residents, and areas with the greatest potential for cooling. | Extreme Heat | DOEE | OCTO | Short |

| # | Action (sub-action) | Climate Risks | Lead (s) | Partners | Timeframe |
|---------|--|---------------|----------|-------------------|-----------|
| NC 13.2 | Reduce the heat-island effect and related increase in outside air temperatures with cool and living roofs, expanded green space and tree cover, prioritizing hotspots and those areas with the greatest number of heat vulnerable residents. Incorporate heat-island mitigation into planning for green infrastructure, tree canopy, and public space initiatives. | Extreme Heat | DOEE | OP, DDOT, DPR | Medium |
| NC 13.3 | Evaluate existing cooling centers based on location, accessibility and needs of vulnerable residents. Consider areas for pets, security, sign-language interpreters, child friendly amenities, accessible restrooms, medical assistance, back-up power, sleeping areas, and proximity to transit. | Extreme Heat | HSEMA | DOH, DOEE | Short |
| NC 13.4 | Evaluate and revise existing heat-emergency plan and warning system with community input. Leverage health and temperature data from past events to determine the best activation and warning thresholds. Consider implementing a tiered warning system to account for the increasing severity and duration of heat events. | Extreme Heat | DOH | HSEMA, DOEE | Medium |
| NC 14.0 | Strengthen community cohesion for safety and resilience. | | | | |
| NC 14.1 | Assess walkability, public transit access and non-motorized transit options in the District in order to reduce the dependence on personal cars. Use Walk Score or Walkability Index as a tool to evaluate priority planning areas and their dependency on transit systems that may be at greater risk due to climate impacts. Prioritize improvement of walkability and connectivity to those areas as part of the update to the Comprehensive Plan. | All | DDOT | OP | Short |
| NC 14.2 | Develop or maintain planning policies to support neighborhoods with easy access to fundamental resources including, but not limited to, a mix of food, emergency and health services, basic business services, housing types and cost ranges and community spaces such as meeting rooms, community gardens + tool share, park space, libraries and schools. | All | OP | DOH | Short |
| NC 14.3 | Strengthen and encourage active participation in community-based organizations and expand opportunities for civic engagement and volunteerism. Provide capacity-building and training for community level emergency preparedness and resiliency planning. An example is the Evacuteer Program in New Orleans. See www.evacuteer.org . | All | DMGEO | Serve DC, HSEMA | Medium |
| NC 14.4 | Encourage healthy lifestyles through the built environment and neighborhood planning. Apply active design to buildings. Encourage walking and biking for transportation. Provide green space that supports community activities and serves as a rain garden to capture slow precipitation runoff. Provide public spaces that encourage the community to come together to pro-actively foster a culture of resilience. Assess health profiles of priority planning areas to determine where the greatest needs are for lifestyle improvements and prioritize activities to support those areas. | All | OP | DOH | Medium |
| NC 14.5 | Leverage climate adaptation implementation projects to advance workforce development objectives and to promote business continuity planning. | All | DOES | DOEE, DDOT, DSLBD | Medium |

| # | Action (sub-action) | Climate Risks | Lead (s) | Partners | Timeframe |
|---|---|-------------------------------------|--------------|---|-----------|
| NC 15.0 | Develop eco-resilience districts and community resilience hubs. | | | | |
| NC 15.1 | Leverage ongoing work with neighborhood planning to begin to implement neighborhood-scale resilience solutions including district energy and micro grids, and district stormwater and water reuse systems. | All | OP, DOEE | OP | Medium |
| NC 15.2 | Explore the creation of Community Resilience Hubs which would locate emergency preparedness and response supplies and training in resilient community facilities, be they privately or publicly owned (e.g., churches, community centers, etc.). An example is the Evacuteer Program in New Orleans. See www.evacuteer.org . | All | DMGEO, HSEMA | DOH | Medium |
| NC 15.3 | Provide technical and financial assistance to private entities that provide essential services, including universities, hospitals and affordable housing so that these entities may conduct their own risk assessments. Work with these entities to integrate their risk assessments into the larger plan for the District. | All | HSEMA | Private entities hosting critical District facilities | Medium |
| GOVERNANCE + IMPLEMENTATION | | | | | |
| Goal: Establish the policies, structures, and monitoring and evaluation procedures to ensure successful implementation of the adaptation plan. | | | | | |
| GI 16.0 | Conduct additional analysis of climate vulnerability and adaptation strategies based on current gaps and to account for the latest climate science. | | | | |
| GI 16.1 | Develop and periodically update comprehensive flood modeling for the District that translates the projections for future sea level rise and extreme precipitation into updated flooding extents and depths for riverine, coastal, and interior flooding. | All | HSEMA | DOEE, DC Water | Short |
| GI 16.2 | Monitor annually the current climate change science regarding impacts that were not comprehensively addressed by the climate change projections, including extreme cold, wind/storms, and drought. | Extreme Cold, Extreme Wind, Drought | DOEE | HSEMA | Short |
| GI 16.3 | Support efforts by infrastructure owners including WMATA, DC Water, Pepco, Washington Gas, and telecommunication providers to conduct more in-depth climate vulnerability assessments of their systems. | All | DOEE | HSEMA | Medium |
| GI 17.0 | Align Climate Ready DC with related planning efforts including hazard mitigation, comprehensive land-use, comprehensive energy, and capital budget planning. | | | | |
| GI 17.1 | Incorporate long-term energy resilience planning into the five-year Comprehensive Energy Plan. | All | DOEE | OP | Short |
| GI 17.2 | Integrate climate change adaptation into the District's Hazard Mitigation Plan and related emergency planning efforts. | All | HSEMA | DOEE | Short |

| # | Action (sub-action) | Climate Risks | Lead (s) | Partners | Timeframe |
|----------------|---|--------------------------|-----------|--|--------------|
| GI 17.3 | Develop climate change resilience guidelines for all capital projects. Incorporate climate impact assessments into the planning, design, and engineering of capital projects. | All | EOM | DOEE, DGS | Short |
| GI 17.4 | Add resilience as an element to the Comprehensive Plan for the National Capital: District Elements. | All | OP | DOEE | Short |
| GI 17.5 | Revise engineering and building standards and codes to address climate change. | All | DCRA | DOEE | Short-Medium |
| GI 17.6 | Engage with the Historic Preservation Review Board, Zoning Commissioning, and Public Service Commission, etc. to ensure that projects are allowed/encouraged to incorporate greater resilience during design and permitting. | All | DOEE | HPRB, Zoning Commission, PSC, NCPC, OP | Short |
| GI 18.0 | Establish the necessary structures to ensure successful implementation of Climate Ready DC. | | | | |
| GI 18.1 | Develop a supporting implementation plan for the strategy that identifies lead agencies, timelines, and potential funding sources. | All | DOEE | OCA | Short |
| GI 18.2 | Identify potential sources of funding and financing including emerging financing tools like green/climate bonds. Leverage existing capital budgets (for public and private infrastructure) to implement upgrades over time. | Sea Level Rise, Flooding | OCFO | OCA | Short |
| GI 18.3 | Develop a plan for monitoring and evaluation including the identification of key indicators of climate vulnerability and successful adaptation. Integrate monitoring and evaluation into existing performance management processes. | All | DOEE | OCA | Short |
| GI 18.4 | Establish a public-private task force with key stakeholders including community organizations and infrastructure owners and operators to oversee and coordinate implementation of the plan, identify funding opportunities, and develop cross-cutting policy recommendations and design guidelines. | All | EOM | DOEE | Short |
| GI 18.5 | Require climate change training for staff responsible for capital infrastructure and large development projects to educate them about climate risks and how to manage them. | All | EOM | DOEE | Medium |
| GI 18.6 | Use existing cross-agency and inter-governmental networks like the DC Silver Jackets to share technical resources and best practices. Establish an ongoing best practices/lessons learned forum that brings together key representatives from each collaborating agency. | All | EOM | DOEE | Short |
| GI 18.7 | Develop a system to regularly evaluate sea level rise and changes in the 100-year and 500-year flood plain in order to provide clear guidance to developers and regulators. | All | DOEE | OP, DCRA | Medium |
| GI 18.8 | Incorporate health impact analysis in prioritization of transportation projects. | All | DDOT, DOH | OP, DOEE | Short |

For more information, and to submit comments on the Climate Ready DC plan, visit <http://doee.dc.gov/service/climate-adaptation-and-preparedness>.

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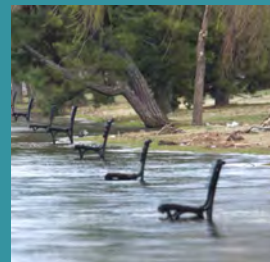


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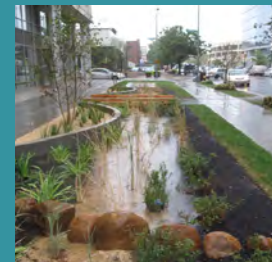


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