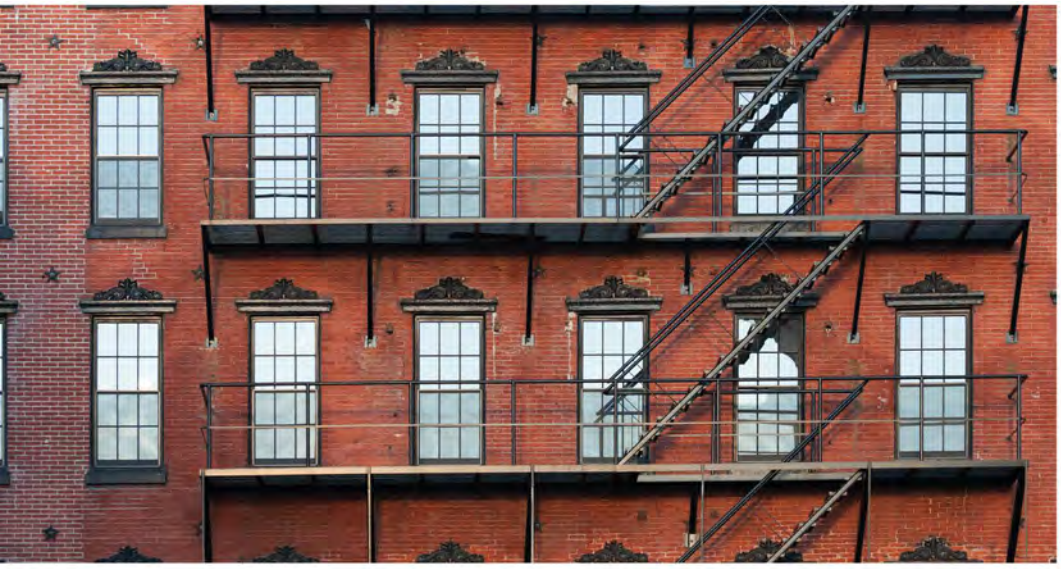

U.S. Department of Housing and Urban Development

Community Resilience Toolkit

Learn how current and future natural hazard risks might affect your community, and actions you can take to reduce those risks.

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Introduction

Purpose and Goal

The U.S. Department of Housing and Urban Development (HUD) Resilience Toolkit (Toolkit) is designed to assist communities in enhancing their resilience to climate-related natural hazard risks. Although not the focus of this toolkit, consideration of other hazards, risks, and stresses may also enhance resilience.

Resilience is a community's ability to minimize damage and recover quickly from extreme events and changing conditions. This Toolkit offers resources that housing and community development professionals can use to:

- identify climate-related natural hazard risks;
- consider actions to enhance the resilience of housing, infrastructure, and residents to those hazards; and
- implement resilience actions using HUD funds and other innovative financing options.

This guidance offers ideas for communities. It should not be considered a substitute for referring to the legislation and regulations governing each of the Community Planning and Development (CPD) programs mentioned if a community elects to use funds from one of these programs. This guidance is also intended to assist decision-making as communities invest their own resources.

Background

In 2016, HUD promulgated 24 CFR Part 91 – Modernizing HUD's Consolidated Planning Process to Narrow the Digital Divide and Increase Resilience to Natural Hazards. This rule requires jurisdictions to consider climate-related natural hazard risks – and how to build resilience to those risks – in a Consolidated Plan. Extreme events disproportionately affect low- and moderate-income residents because they are less able to prepare for, respond to, or recover from the impacts of extreme events and natural hazards. They have fewer resources to draw from to help them cope with natural hazards, and they have relatively greater incidences of conditions such as respiratory disease that can magnify the impacts of extreme events and stresses or poor local infrastructure.[1]

INCORPORATING RESILIENCY IN COMMUNITY PLANNING

The overall goal of HUD's community planning and development programs is to develop viable communities by providing decent housing and a suitable living environment and expanding economic opportunities principally for low- and moderate-income persons. The primary means towards this end is to extend and strengthen partnerships among all levels of government and the private sector, including for-profit and non-profit organizations.

States and local governments receiving community planning and development program funds from HUD complete a consolidated plan whereby they state in one document their plan to pursue goals for these programs. Considering resilience to natural hazards may assist communities in deciding where and how to invest these resources.

The Toolkit also provides ideas of how community development professionals can support and contribute to community- and region-wide resilience efforts. As much as possible, this Toolkit consolidates information from existing resources referenced at the end of the toolkit.

Who Can Use this Toolkit

- **States and their partners** can use the Toolkit to identify natural hazard risks and consider larger-scale resilience policies and programs, such as acquisition to relocate homes and businesses outside areas threatened by flooding or to ensure that infrastructure is designed and constructed to withstand chronic stresses and extreme events.
- **Local governments** can use the Toolkit to identify natural hazard risks and resilience actions that can be integrated into existing programs, such as planting trees in housing developments or modifying building

codes, and consider actions and funding opportunities that could be implemented in the future.

- **Low- and moderate-income communities** can use the Toolkit to identify low-cost resilience actions with benefits specific to these communities.

How to Use the Toolkit

This Toolkit is organized around a simplified natural hazard risk assessment, a process that communities can use to identify potential vulnerabilities from natural hazards and actions they can take to reduce their vulnerabilities. This toolkit follows three steps:

Step 1) Identify how natural hazards risks might affect your community,

Step 2) Consider actions to increase your community's resilience to these natural hazard risks, and

Step 3) Identify funding streams to implement the resilience actions.

Identify how natural hazard risks might affect your community

The **Community Hazards graphic** illustrates how natural hazards might affect buildings and infrastructure, the environment, and people. The graphic represents the diversity of risks faced by different types of communities.

Each statement in this graphic is linked to a corresponding natural hazard factsheet, described below.

Consider resilience actions

The key elements of this Toolkit are the six factsheets addressing the following natural hazards:

- **increasing temperatures and extreme heat**,
- **sea level rise and coastal storms**,
- **inland flooding**,
- **wildfire**,
- **drought**, and
- **erosion and landslides**.

These hazards are included in the Toolkit because they already pose risks to communities and there is strong scientific consensus that, in many places, these risks will change in the future.[2] These factsheets provide a suggested list of possible actions a community can undertake to reduce the effects from natural hazards and become more resilient. The natural hazard factsheets also provide additional resources that can further your understanding of risks your community may face. The factsheets include case studies to illustrate how communities are already implementing some of the identified resilience actions.

In each natural hazard factsheet, the list of resilience actions is summarized into four categories:

- **Planning** – actions that can be taken at the policy or planning level,
- **Buildings and infrastructure** – actions aimed at buildings (such as homes and critical facilities) and infrastructure (including roads and utilities),
- **Environment** – actions that can help improve the natural environment to increase community resilience, and
- **People** – actions aimed directly at supporting individuals in the community.

Each natural hazard factsheet is intended to be a starting point for identifying ideas and sparking conversation in your community. Consider which actions make the most sense for your community and brainstorm new ideas for reducing risks based on your specific needs.

In some cases, you might not be in a position to implement these actions directly but may be able to raise these ideas for broader discussions in your community. If you wish to use HUD resources available to your community, use the CPD Eligible Activity Icons to identify which activities may be eligible for HUD funding, and consult with your local HUD office to confirm if an action you would like to implement is eligible.

Work with local residents and partners

Consulting community members is essential when conducting resilience planning. Community members can offer critical insights when identifying local hazards, and they can suggest innovative resilience actions that will create community buy-in. For more information about getting the most out of community participation, visit HUD's **Citizen Participation and Consultation Toolkit**.

It is also critical to collaborate with other departments and organizations in your community to build resilience at a community or regional level. In many cases, someone in your community is already doing natural hazard risk and resilience planning. Additionally, local climate experts can provide further insights into how natural hazards are likely to affect your community in the future. They can also help facilitate resilience planning and conversations in your community or regionally. Where possible, consult local experts on climate and adaptation.

Identify funding streams to implement resilience actions

Federal assistance programs, including HUD program funding, may be used by state and local governments to implement some of the resilience actions listed in the natural hazard factsheets. The **Funding Resilience Actions factsheet** provides information on using CPD formula program funding for resilience actions. However, communities may need to seek additional, non-HUD funding to implement these actions. The funding factsheet provides funding and financing options for resilience actions, ranging from bond and fee-based programs to performance-based infrastructure and grant opportunities. The funding factsheet also provides case studies to illustrate how communities are already using innovative funding options to implement a wide range of resilience actions.

Examine how resilience actions might look in a community

This **Resilient Community Graphic** illustrates some of the actions a community affected by natural hazards could take to become a resilient community.

Additional resources

The **Additional Resources** section contains links to federal, state, and nongovernmental websites that provide general guidance and information on community and climate resilience. The links also provide specific guidance and more information on natural hazard risks.

Glossary

The **Glossary** provides a list of terms or words used throughout the Toolkit and is organized by hazard. Where appropriate, the Glossary links to external resources that provide additional information about the term.

PLANNING ACTIVITY ICON

Administration and planning. Effective planning changes policies and procedures to account for natural hazards. These changes are often low-cost efforts that can significantly increase community resilience. Recommendations with this icon could be considered in partnership with other local leaders and entities within a community.

CPD ELIGIBLE ACTIVITIES ICONS

Icons correspond to specific CPD-eligible activities categories. The categories may also be useful groupings for consideration in using local funds.

Public facilities and infrastructure improvements. When creating and improving public facilities and infrastructure in low- and moderate-income areas, consider how natural hazards might affect the facility during its expected lifetime. Public facilities and infrastructure can be more resilient to hazards by using different building materials and practices, carefully choosing building locations, retrofitting older buildings, and enhancing landscaping.

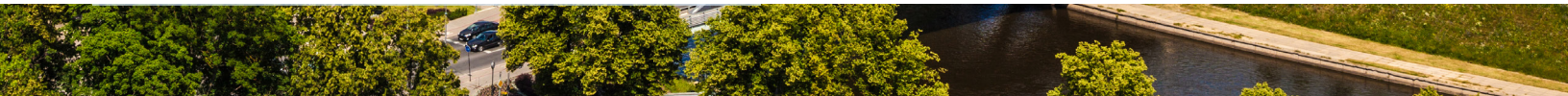
Housing rehabilitation. Making changes in building materials, building practices, landscaping, and energy efficiency improvements can contribute to the resilience of housing to be rehabilitated.

Public services. Eligible public service activities, such as public awareness campaigns or offering additional types of support to the most vulnerable during an extreme event, can focus on helping community members, especially the most vulnerable, prepare for and cope with natural hazards.

Economic development. Economic development activities, such as commercial and industrial infrastructure development, construction, and improvements can be undertaken in a manner that supports and increases resilience. Communities should consider natural hazards and their risks when funding these activities.

Acquisition, disposition, clearance, and relocation. Acquisition and relocation funding may be used to help low- and moderate-income residents living in at-risk areas from current or future hazards relocate to areas where they will be less at-risk.

New housing construction. When constructing new housing, consider how natural hazards might affect homes and residents. New units can be made resilient to current and future hazards by using different building materials and practices, carefully choosing building locations, siting, and enhancing landscaping.



How can natural hazard risks affect your community?

Climate-related natural hazards can impact all communities. To the right is a list of common impacts that might result from any of these hazards. Below, each hazard bullets hazard-specific impacts and interactions between the hazards. To learn more about each hazard and possible impacts to your community, click on the hyperlinks to go to the corresponding hazard fact sheet.

Common Impacts

Many of these hazards can:

- cause injury, illness, and death
- displace residents
- interrupt public services (e.g., electric power, water supplies), and
- damage buildings and infrastructure

Extreme Heat

- is more intense in urban areas
- strains building materials
- exacerbates chance of drought and wildfire

Sea Level Rise

- increases coastal flooding
- damages natural flood barriers, and
- exacerbates erosion

Landslides

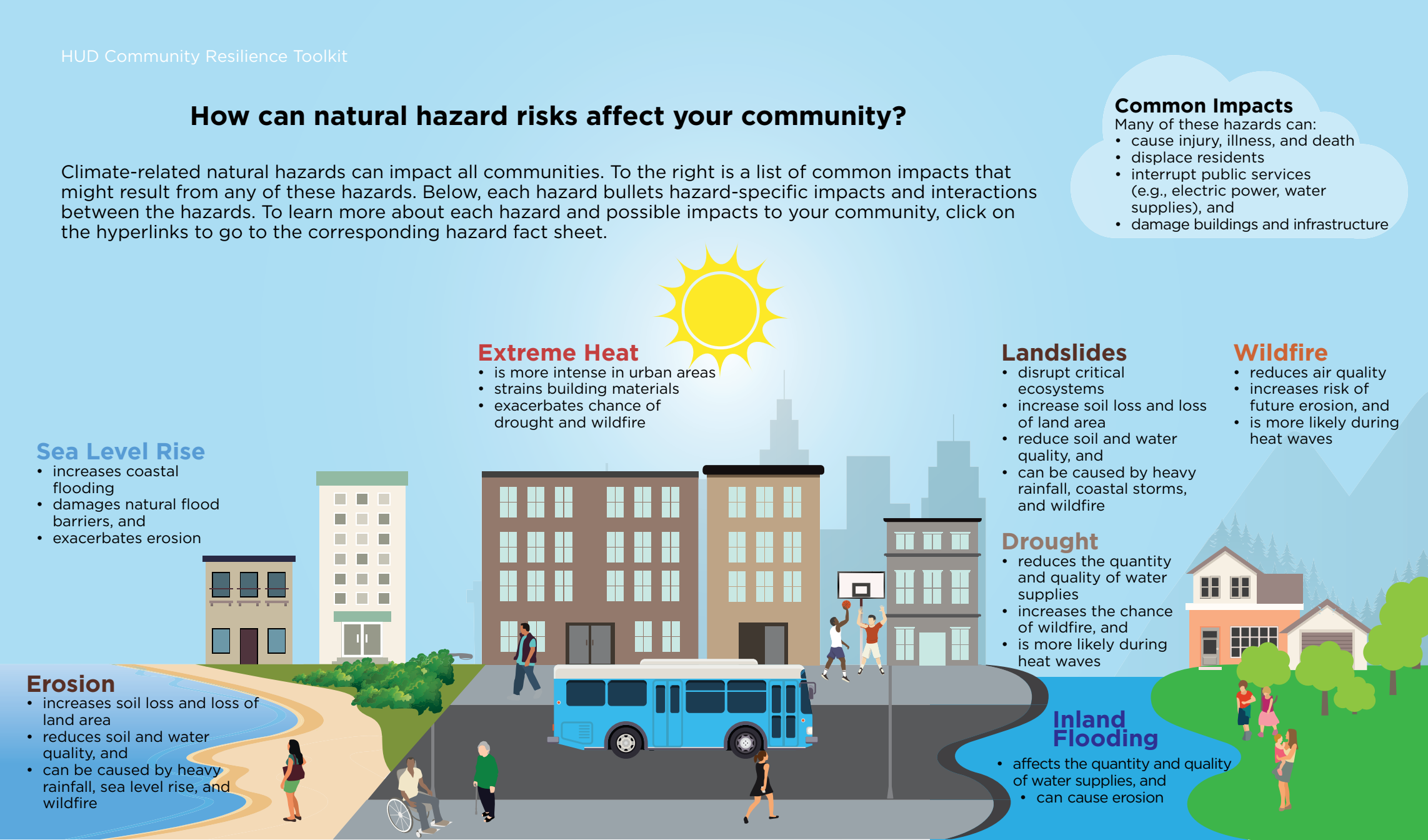
- disrupt critical ecosystems
- increase soil loss and loss of land area
- reduce soil and water quality, and
- can be caused by heavy rainfall, coastal storms, and wildfire

Wildfire

- reduces air quality
- increases risk of future erosion, and
- is more likely during heat waves

Drought

- reduces the quantity and quality of water supplies
- increases the chance of wildfire, and
- is more likely during heat waves



Erosion

- increases soil loss and loss of land area
- reduces soil and water quality, and
- can be caused by heavy rainfall, sea level rise, and wildfire

Inland Flooding

- affects the quantity and quality of water supplies, and
- can cause erosion

Increasing Temperatures and Extreme Heat

How can increasing temperatures and extreme heat affect your community?

Air temperatures and the number of extremely hot days are increasing across the country, and will continue to rise in the future.[1] Hotter temperatures can affect public health, buildings and infrastructure, and the natural environment. Risks are particularly increased for those in dense urban areas that typically have higher temperatures because of the **urban heat island** effect. Some individuals, including those experiencing homelessness, people with chronic diseases, older adults, young children, and outdoor workers, are more vulnerable to extreme heat because they may have less access to indoor, climate controlled spaces or a reduced ability to regulate their body temperature because of underlying chronic health conditions. Exposure to extreme or prolonged heat can result in heat exhaustion, heat stroke, respiratory problems, and even death. Extreme heat can also cause additional strain on building materials and mechanical equipment, making them more susceptible to failure. Rising average temperatures can also strain native plant and animal species and influence changes in vector-borne disease patterns. Hotter temperatures can also increase the risk of other hazards, such as wildfire and drought. Resilience actions can be strategically selected and designed to help decrease the vulnerability of all communities, particularly low- and moderate-income communities.

Planning Activities

Administration and planning

WANT TO LEARN MORE?

Historical records indicate that temperatures are increasing worldwide, and scientists project that temperatures will continue to rise in the future. This means increases in average temperatures as well as more frequent or longer-lasting extreme heat events.

To further understand temperature trends in your area, look at the **Climate Resilience Toolkit**. By clicking on the toolkit's Climate Explorer and then selecting "View by variable," you can obtain information on Mean Daily Max Temperature, Mean Daily Min Temperature, Days with Max Above 95°F, and Cooling Degree Days (the explorer includes descriptions of each variable and when they might be helpful). These variables demonstrate how temperature might change in your area. You can:

- Search for your community by typing your location in the "Search by location" box.
- Slide the bar in the middle of the map to view the full range of projections depending on future emissions levels.
- Slide the bar along the bottom of the screen to view how temperature is projected to change over time.

To understand how a new project today could be affected, look at the highest **emissions scenario** for 2050. Consult local climate reports or experts for additional information.

CPD Eligibility Activity Icons

- Acquisition, disposition, clearance, relocation
- Public facilities and infrastructure improvements
- Housing rehabilitation
- Economic development
- New housing construction
- Public services

RESILIENCE ACTIONS

What actions can your community take to be more resilient to increasing temperatures and extreme heat?

PLANNING

Identify and assist vulnerable populations

Create or participate in an Extreme Heat Program or similar activity.

Collaborate with your Health Department and Area Agency on Aging to identify individuals vulnerable to the effects of extreme heat and determine if they may need additional support or services during an extreme heat event. Consider including low- and moderate-income populations, those experiencing homelessness, people with chronic diseases, older adults, young children, outdoor workers, and those with limited education or English proficiency.

Develop an inventory of buildings and infrastructure that may be particularly vulnerable to extreme heat.

Consider adding requirements and policies into building rehabilitation programs that encourage heat-smart building practices, such as those listed below, in all residences and public facilities in areas at risk of extreme heat.

Identify and promote programs that can help residents access air conditioning during periods of extreme heat.

BUILDINGS AND INFRASTRUCTURE

Retrofit older buildings

Work with facility managers and building owners to:

Retrofit older buildings to reduce energy use and save money.

Install air conditioning, evaporative coolers, or whole unit fans in housing units and public facilities.

Ensure that all windows have screens.

Philadelphia, PA
Reducing Indoor Air Temperature with Cool Roofs[2,3]

Philadelphia's Cool Homes Program provided cool roofs and other cooling resources to 375 senior, low-income houses between 2001 and 2003. The cool roofs reduced indoor air temperatures by 2–3°F and second floor temperatures so that they were similar to first floor temperatures.

The program was funded in part from a U.S. Department of Health and Human Services Residential Energy Assistance Challenge (REACH) program.

Project cost: The roof coating was estimated at $1,500 per home.

Eligible activity: Cool roofs could be eligible components of a rehabilitation program for your community.

Change building practices

Build and rehabilitate housing and public facilities with materials that are more resilient to high temperatures, such as paving materials that store less heat and have lower surface temperatures (known as cool pavement).

Consider requiring or offering additional financing incentives for landlords to install green or cool roofs, which remove heat from the roof surface and surrounding air.

Incorporate natural vegetation into public facilities and housing rehabilitation projects to help expand the natural cover and reduce the impacts of extreme heat.

ENVIRONMENT

Reduce urban heat island effect

Partner with city planners to create or preserve green space such as community gardens and parks, and incorporate natural spaces in development plans, especially in urban areas. (These spaces may also enhance resilient water management.)

Work with landscape architects to ensure tree, shrub, and other natural vegetation planting in all areas including vacant lots, street rights-of-way, and medians.

Work with building developers and landscape architects to encourage planting more heat-tolerant and low-water species that will survive in future climate conditions.

PEOPLE

Increase extreme temperature awareness

Ensure that the most at-risk residents and small businesses are aware of programs and services that can help them during periods of extreme heat.

Provide education opportunities, such as online resources, fliers, telephone help lines, and public awareness campaigns about the dangers of extreme heat. Include steps residents can take to protect themselves when extreme temperatures occur.

Collaborate with knowledgeable professionals to create an education program for residents about how to most effectively use cooling systems such as indoor fans and double-hung window openings.

Implement extreme event response programs

Speak with your emergency management office about creating a community warning system or public notification system for all natural hazards.

Reach out to community development organizations to organize formal outreach to vulnerable populations at the neighborhood level such as buddy systems where neighbors are aware of and check on those at risk from health impacts during extreme heat events.

Cleveland, OH

Engaging Neighborhoods in Resilience[4]

Cleveland has incorporated resilience efforts in the revitalization of its neighborhoods. Community Development Corporations (CDCs) can apply for funding from the city's Climate Action Fund to implement specific resilience projects, for example, a 6,140 square-foot expansion of a neighborhood garden.

Project cost: The neighborhood garden was awarded $5,500.

Eligible activity: A program similar to Cleveland's Climate Action Fund could host a range of eligible activities, including public facilities, public services, or housing rehabilitation under eligible activity categories; acquisition of property; public facilities or improvements; or public services.

Establish and promote accessible cooling centers as components of public facilities such as community centers or places of worship, and offer free transportation to those sites.

Coordinate with critical service providers and contacts for those at greatest risk to ensure adequate support and intervention services during high-risk events. Examples include coordinating with faith-based groups, Continuum of Care providers, and your Health Department and Area Agency on Aging.

Encourage utility companies to offer special arrangements for paying cooling bills during times of extreme temperatures, if not already required by state law. Help educate people about these programs.

For more information, explore additional resources

Sea Level Rise and Coastal Storms

How can sea level rise and coastal storms affect your community?

Coastal areas are sensitive to sea level rise and changes in the frequency and intensity of storm events. Rising sea levels and coastal storms can: impact low-lying areas, damage coastal ecosystems, intensify **coastal erosion** and flooding, and introduce saltwater and **nonpoint source pollution** into many coastal resources such as estuaries. **Coastal inundation**, flooding, and erosion can damage buildings and property, infrastructure including roads and utilities, and impact services such as public transportation. Flooding can affect the health and welfare, including the safety, security, and livelihoods, of residents. Severe wind that accompanies hurricanes and other coastal storms also has an impact. The effects of flying debris or downed trees and power lines from severe wind can cause significant damage to lives, property, and utilities.

Resilience actions can be strategically selected and designed to help decrease the vulnerability of all communities, particularly low- and moderate-income communities, to current and future climate conditions. Low- and moderate-income areas along the coast are generally less able to prepare for, respond to, or recover from impacts of sea level rise and coastal storms. For example, these areas may not have the financial resources to repair or rebuild damaged property, or evacuate and access temporary accommodations. They are likely to be disproportionately affected by workplace closures, lost business revenue, and loss of public services such as transportation.

Planning Activities

Administration and planning

WANT TO LEARN MORE?

Sea levels are rising as oceans are warming and glaciers and ice sheets are melting. The amount of sea level observed at a particular location is also affected by vertical local land movements (i.e., the coastline is rising or subsiding). Coastal storms such as hurricanes are projected to become stronger, resulting in higher winds and storm surge. Sea level rise magnifies the impacts of coastal storms by raising the base of storm surge. Sea level rise also raises the elevation of high tides, which can cause, at a minimum, minor flooding. Sea level rise is projected to accelerate in the coming decades.[1]

If your community is located in a coastal area, consider the potential effect of sea level rise and increases in storm surge. To understand your community's vulnerability to these hazards, the **Climate Resilience Toolkit's** Climate Explorer provides coastal maps of projected sea level rise and storm surge. In "View by Topic," select "Coastal."

- The coastal maps allow you to assess sea level rise. For example, by selecting 1 foot of sea level rise, you can view U.S. coastal areas that will be covered with 1 foot of seawater by 2050. (To account for local land movements, contact your local coastal zone management office to obtain the latest information and projections.)
- The coastal maps also allow you to view potential inundation to storm surge flooding from category 1 to 5 hurricanes. The storm surge data do not include sea level rise.

CPD Eligibility Activity Icons

- Acquisition, disposition, clearance, relocation
- Public facilities and infrastructure improvements
- Housing rehabilitation
- Economic development
- New housing construction
- Public services

RESILIENCE ACTIONS

What actions can your community take to be more resilient to sea level rise and coastal storms?

PLANNING

Plan for sea level rise and coastal storms

Integrate coastal hazards mitigation into town, municipality, and county comprehensive plans.

Take sea level rise and intense hurricanes into account when planning for future storm surge heights.

Develop an inventory of public facilities, small businesses, and housing that may be particularly vulnerable to sea level rise and coastal storms.

Identify individuals vulnerable to the effects of sea level rise and coastal storms, and determine if they may need additional support or services during and after an extreme event.

Collaborate with your Health Department and Area Agency on Aging to consider low- and moderate-income populations, those living in older or compromised structures, older adults, individuals with mobility issues, households with limited English proficiency, and households that lack personal transportation.

Create program conditions and incentives that promote conservation and management of open spaces in vulnerable areas.

Manage development in areas at risk for sea level rise

Work with local authorities to create building codes that restrict inappropriate redevelopment in areas damaged by inundation, erosion, and flooding to prevent future losses.

Develop an ongoing buyouts program that would re-purpose properties at high-risk and use them to support water management, drainage, and absorption.

Miami-Dade County, FL
Helping Residents Prepare their Homes for Hurricanes[2]

Following Hurricane Andrew in 1992, Miami-Dade County developed a Local Mitigation Strategy to prepare for coastal storms, flooding, and other hazards. The county has a robust program to mitigate wind damage including installing shutters and hurricane glass, and reinforcing roofs in low-income and elderly communities; and mitigate flood damage including installing large pumps along the county's canal system to move water over the gates during incoming tides.

Project costs: Costs vary. For the Residential Shuttering Program, aluminum storm panels were installed on 1,000 homes occupied by low-income elderly residents for $2,000 per home. Cost information on other wind mitigation projects is available in the Local Mitigation Strategy.

Eligible activities: Residential rehabilitation or public facilities and improvements may be eligible activities in your community.

Develop an open space acquisition, reuse, and disposition plan targeting areas prone to sea level rise and coastal flooding. Prioritize the low- and moderate-income communities that are particularly subject to these hazards.

BUILDINGS AND INFRASTRUCTURE

Minimize risk to new buildings and infrastructure

Locate new public facilities outside of areas susceptible to sea level rise and increased coastal flooding. Prioritize the location of buildings and infrastructure in high-risk and low- and moderate-income areas.

Develop a local program to encourage establishing or increasing freeboard for coastal structures as a way to minimize risks and impacts. For example, require that all public facilities and infrastructure be build or rehabilitated to at least two feet above the base flood elevation or above the 500-year floodplain.

Encourage city planners and officials to establish design standards for buildings located in areas susceptible to storm surge, coastal inundation, flooding, and erosion, such as **open or deep foundation** systems (e.g., piles or piers), to minimize scour and flooding; and to elevate utilities.

Require public facilities to have open or deep foundations to avoid erosion and scour, and resist higher wind speeds.

Protect buildings and infrastructure

Add program participation requirements for building owners and operators to replace exterior building components with more hazard-resistant materials, such as vinyl and ceramic tiles, concrete, pressure-treated timber, metal, and materials that can withstand direct contact with saltwater without sustaining significant damages.

Consider shore protection measures – including **non-structural shore stabilization techniques** such as wetland protection, **beach nourishment**, dune building; and **structural shore stabilization techniques** such as seawalls, revetments, berms, and bulk heads – to protect against inundation, flooding, effects of waves on infrastructure, shore erosion, salinity intrusion, and loss of natural resources. Consider features that allow for incremental additions to accommodate increased water levels and stronger wave action; and the effects of hard structural solutions on the environment, such as blocking inland retreat of beaches and wetlands.

Create a buyouts program to acquire, demolish, and **relocate residents and businesses** located in high-risk areas. Prioritize structures located in high-risk, and low- and moderate-income areas. HUD provides **guidelines for state-funded voluntary property acquisition programs** to assist property owners who wish to relocate their homes and businesses outside the threat of flooding.

Develop incentives or conditions to **retrofit critical structures** one foot above the 500-year flood elevation or the predicted level of sea level rise.

Consider using funds to construct **community safe rooms** for coastal flood events. Prioritize the availability of safe rooms with adequate supplies in low- and moderate-income areas.

ENVIRONMENT

Preserve high-hazard areas as open space and maintain health of these areas

When possible, ensure your projects preserve open space – such as wetlands and estuaries – to benefit natural resources and reduce the risk to structures from potential sea level rise. It is also important to maintain the health of these areas by removing invasive species to ensure wetlands can retreat inland as sea levels rise.

Protect and restore natural buffers

Natural resources provide floodplain protection, riparian buffers, and other ecosystem services that may mitigate sea level rise and coastal storm risk.

Work with landscape architects to promote surveying vegetative cover as you design and implement local projects. Incentivize planting vegetative cover and **vegetation barriers** to trap sediments and reduce coastal erosion. Program incentives may encourage creating a **living shoreline** or a stabilized shoreline using a variety of structural and organic materials, such as wetland plants, submerged aquatic vegetation, and oyster reefs.

Use **artificial dunes** to slow the inland progress of storm-related wind and water.

PEOPLE

Increase awareness of sea level rise

Collaborate with your local or state emergency management office to create an education program for residents and businesses in high-risk areas about hazard mitigation options (e.g., provide information on eliminating hazardous materials in high-risk areas prior to disasters to prevent leaks).

Partner with community development organizations to fund a campaign to educate individuals and community groups about the risks of sea level rise and coastal storms, preparedness measures, and evacuation procedures in cases of extreme events.

Education campaigns may include conducting workshops and preparing public outreach materials in languages other than English and, if appropriate, using alternative methods that do not require literacy or internet access.

Engage community members to participate actively in the natural hazard resilience planning process.

Engage community groups, including youth and students, in projects that plan for sea level rise and coastal storms, and consider options to build resilience to these hazards. This activity could be done as part of job training or afterschool program for low- and moderate-income youth.

Collaborate with your emergency management office to create a warning or public notification system for all natural hazards. In particular, ensure that vulnerable populations – including low- and moderate-income people, those with limited education levels or limited English proficiency, and those living in older homes – are prepared for natural hazard risks and can undertake evacuation if needed. Consider setting up a "buddy system" so people can check on and assist each other. Include social institutions such as places of worship, cultural and educational nonprofits, media, and clubs. This activity could be offered community-wide in low- and moderate-income areas.

Norfolk, VA
Adjusting Freeboard Requirements in Coastal Zones[3]

Norfolk regularly experiences coastal flooding which is being exacerbated by both sea level rise and land subsidence. Using regional sea level rise projections as a guide, the city passed an ordinance requiring that new structures in flood and coastal zones be built at least three feet above the 100-year floodplain. Existing structures that experience repeated significant flood damage must also be elevated to meet this standard.

Eligible activities: Improving the resilience of buildings and infrastructure to sea level rise and coastal storms through rehabilitation, new housing construction, or public facilities may be eligible activities in your community.

Provide technical assistance to businesses in potentially impacted areas to find ways to retain jobs (e.g., strategic planning for possible relocation to other sites). This activity could be part of a larger economic development effort.

For more information, explore additional resources

Inland Flooding

How can inland flooding affect your community?

Inland flooding is the partial or complete inundation of normally dry land with freshwater. It can be caused by overflowing rivers, heavy rain, or overwhelmed **stormwater drainage systems** (coastal flooding caused by sea level rise or storm surge is covered in the Sea Level Rise and Coastal Storms factsheet). Flooding might be extensive and reach all areas of a community or be localized and limited to a few properties. Inland flooding can damage buildings and property, infrastructure including roads and utilities, and services such as public transportation. Flooding can cause injury or death, affecting the health and welfare of individuals. Heavy precipitation and inland flooding can also exacerbate erosion and landslides.

Low- and moderate-income households and individuals may be less able to prepare for, respond to, or recover from flooding events when there is damage to buildings or homes, displacement, loss of transportation or services, and workplace closures. For example, these households might not be able to afford alternate accommodations or get to work when public transportation is shut down – potentially resulting in lost income or employment.

Resilience actions can be strategically selected and designed to help decrease the vulnerability of all communities, particularly low- and moderate-income communities, to flooding.

Planning Activities

Administration and planning

WANT TO LEARN MORE?

Flooding can occur as a result of heavy precipitation, rapid snow melt, new development that changes water runoff or drainage, or breached or broken dams or levees. Existing flood-prone areas and flooding patterns may shift as a result of changing climate conditions. Inland flooding might become more frequent or severe, and can occur in areas previously thought safe from flooding.

To understand your community's vulnerability to flooding, the Federal Emergency Management Agency's (FEMA's) **National Flood Insurance Program** (NFIP) provides a **National Flood Hazard Layer Map**.[1] View the map to determine if areas where your programs operate are in the shaded 0.2% (i.e., 500 year flood zone), 1% (i.e., 100-year flood zone), or future 1% annual flood chance hazard zone. A home built in the 1% **annual flood chance hazard zone** has a 26% chance of being flooded at least once during the course of a 30-year mortgage.[2]

RESILIENCE ACTIONS

What actions can your community take to be more resilient to inland flooding?

PLANNING

Incorporate flood mitigation in planning

Integrate flood **hazard mitigation** into program administration activities such as your community's comprehensive plan,

CPD Eligibility Activity Icons

- Acquisition, disposition, clearance, relocation
- Public facilities and infrastructure improvements
- Housing rehabilitation
- Economic development
- New housing construction
- Public services

consolidated plan, agency or department strategic plans, or program guidance materials.[3]

Update plans and guidance as new information becomes available.

Consider multiple levels of safety to integrate backup plans (e.g., evacuation) if primary lines of defense fail. (No eligible activities)

Identify individuals vulnerable to the effects of flooding and determine if they may need additional support or public services during and after a flooding event. Consider low- and moderate-income populations, those living in older or compromised structures, older adults, individuals with mobility issues, households with limited English proficiency, and households that lack personal transportation.

Establish or enhance programs to link, manage, and expand existing parks and preserves to help manage stormwater.

Collaborate with state floodplain managers and mitigation officials to incorporate **Integrated Flood Management** approaches that consider entire basins or watersheds into local plans.

Manage development to limit flooding and improve runoff and stormwater management

Design your programs to incentivize developers to limit or eliminate future development in flood-prone or critical upland areas.

Establish policies for building rehabilitation programs to limit the percentage of **impervious surface** – areas covered by impenetrable materials such as asphalt, concrete, and rooftops – within developed and re-developed parcels.

Obtain property easements and use those areas for water retention and drainage.

Incentivize the use of **low-impact development** techniques to manage stormwater.

Develop a buyouts program to acquire residential properties and local businesses that experience repetitive flood losses.

Use transfer of development rights to allow developers to increase densities on parcels with low flood risk in return for keeping flood-prone areas vacant.

Develop an open space acquisition, reuse, and preservation program targeting hazard areas.

Develop a land banking program for the preservation of natural and beneficial functions of flood hazard areas.

Conduct activities in-line with existing programs and guidance

Work with floodplain managers and encourage city officials to adopt practices that comply with the **NFIP floodplain management requirements**, such as proper issuance of development permits in a **floodplain**.

Develop a program to implement flood preparedness and damage reduction measures in the **Community Rating System (CRS)**, such as acquisition, relocation, retrofitting, and maintenance of drainage ways and retention basins. Depending upon the extent of activities, local flood insurance premiums may be reduced.

BUILDINGS AND INFRASTRUCTURE

Help stormwater utilities increase drainage with detention and retention basins, debris removal, and other methods.

Design your program policies to promote stream and wetland restoration to ensure adequate retention, drainage, and diversion of stormwater. Such policies could also encourage **green infrastructure** such as **grassy areas along roadsides** or other actions to absorb or retain stormwater.

Routinely clean and repair stormwater drains.

Implement **Best Management Practices** for stormwater when constructing or rehabilitating housing and public facilities.

Protect structures and utilities

Add or increase local **freeboard** requirements so that all housing and public facilities are built or rehabilitated to at least two feet above the **base flood elevation** or above the 500-year floodplain.

Create programs to assist or incentivize landlords to relocate utilities or other mechanical devices such as water heaters, boilers, and air-conditioning units above base flood elevation.

Use check valves, sump pumps, and backflow prevention devices in homes and public facilities.

Use **natural bank stabilization techniques**, or revetments or hardened materials atop riverbanks or slopes to protect against floods. Reference **Shoreline Stabilization** and **Bank Stabilization Design** guidelines.

Design roadways, bridges, or utilities with protective measures (e.g., elevate bridges, build protective berms) to account for future flooding projections.

Use flood walls, levees, floodways, or diversions to control and direct floodwaters; and minimize upstream and downstream impacts.

Establish a fund to maintain or rehabilitate existing flood protection infrastructure such as flood walls, levees, and diversions.

Protect critical facilities

Require that all critical public facilities be built at least three feet above the base flood elevation or above the 500-year floodplain.

Build levees or earthen dikes around flood-threatened critical public facilities.

Ensure that multiple levels of safety and contingency plans (e.g., evacuation) exist.

Adopt building codes and development standards

Reference American Society of Civil Engineers' standard 24-05 **Flood Resistant Design and Construction** requirements in the design and construction of public facilities in flood hazard areas.

Consult additional flood-resistant **building codes**.

Emeryville, CA
Managing Stormwater Runoff with Park Design Features[4]

Emeryville in Alameda County, CA, used multiple sources of federal, state, and local funding, including Community Development Block Grant Program (CDBG) funds, to rehabilitate a brownfield into Doyle Hollis Park. The project incorporated many elements to manage site stormwater, including rain gardens, bathroom facilities with a green roof, and porous pavers. The park features signage to educate users about its unique stormwater management, and energy and water conservation elements. The site captures an estimated 85% of stormwater runoff.

Project cost: $1,000,000–$5,000,000 for similar projects.

Eligible activities: Public facility projects such as parks and recreational facility improvements, flood drainage improvements, sidewalk improvements, and tree planting may be eligible activities in your community.

ENVIRONMENT

Protect and restore natural flood mitigation features

Design local construction programs to encourage participants to re-establish

natural floodplains. Also encourage and promote the use of **vegetative buffers** around streams, channels, and water sources to absorb and manage runoff.

With the help of floodplain managers and professionals, include requirements or parameters in all local construction programs to restore, protect, and preserve wetlands, particularly upstream of areas at risk of flooding, to absorb and manage runoff, and mitigate flood impacts.

Encourage the use of rain gardens, vegetation, landscaping, or other techniques that can **"Soak Up the Rain"** and manage stormwater runoff.

PEOPLE

Increase awareness of flood risk, safety, and mitigation

Collaborate with the emergency management office to create a **flood forecasting** and community warning or public notification system.

Consider adding program incentives for landlords and building managers to annually distribute **flood safety pamphlets or brochures** to residents in flood-prone areas.

Educate citizens and community groups about safety during flood conditions, including the dangers of driving on flooded roads (i.e., **Turn Around Don't Drown**).

Encourage landlords and residents to consult flood management professionals about how to prepare for and manage flood and stormwater effects, and develop a household evacuation plan.

Focus on low- and moderate-income populations and those living in older or compromised structures, including older adults, individuals with mobility issues, households with limited English proficiency, and households that lack personal transportation.

University City, MO
Collecting Stormwater through Sustainable Development Planning[5]

University City in St. Louis County, MO, used a HUD Community Challenge Planning Grant and U.S. Department of Transportation funding to complete the Parkview Gardens Neighborhood Sustainable Development Plan initiative. The plan seeks to build a sustainable community by integrating transportation, housing, public space, and cultural arts. The final plan included elements on the implementation of green infrastructure, urban forestry, community gardens, permeable pavement, green alleyways, green medians with native plants, green roofs, and stormwater collection.

Project cost: $316,000.

Eligible activities: public facility resilience activities such as planning, parks and recreational facility improvements, flood drainage improvements, water or sewer improvements, street and sidewalk improvements, and tree planting may be eligible activities in your community.

As part of a public information and engagement process, establish a buddy system for neighbors to support each other during flood events. Tie in local cultural institutions.

Direct residents to geographic information system (GIS) hazard mapping online to better understand their risks.

Create an education outreach campaign for the public about securing debris, propane tanks, yard items, or stored objects that may otherwise be swept away, damaged, or pose a hazard if picked up and washed away by floodwaters.

Ask residents to help keep storm drains clear of debris.

For more information, explore additional resources

Wildfire

How can wildfire affect your community?

The wildfire season is expected to extend and the size, frequency, and severity of wildfires are expected to increase, particularly in the western United States and along the **wildland-urban interface**. Changes in wildfire patterns may increase risks to people, buildings, property, and infrastructure in or near natural areas.

Wildfires can impact the physical and mental health, safety, and security of individuals. For example, wildfires increase air pollution, which can harm human health. Wildfires can also result in electricity outages and disrupt transportation and utilities. Wildfires can have cascading effects on communities, such as exacerbating flooding and creating erosion risks, threatening drinking water sources, and altering a community's aesthetics.[1]

Low- and moderate-income individuals and local businesses may be less able to prepare for, respond to, or recover from wildfire damage. For example, individuals may have difficulty accessing transportation to evacuate in an emergency situation, accessing alternate accommodations, or recovering from the loss and damage. Resilience actions can be strategically selected and designed to help decrease the vulnerability of all communities, particularly low- and moderate-income communities, to wildfires.

WANT TO LEARN MORE?

Several factors influence wildfire frequency and severity, including:

- Local weather and climate conditions such as the prevalence of storms, lightning, hot temperatures, and drought;
- Forest health characteristics such as brush conditions; tree mortality and density; and changes in storms, drought, disease, or pests;
- Human activities such as camping, debris burning, and construction; and
- Existing wildfire prevention measures and forest management practices.

To understand your community's vulnerability to wildfires, review this U.S. map of the **increase in weeks with risk of very large fires**.

Additional information on wildland fire occurrence is available from the **U.S. Forest Service**.

Planning Activities

Administration and planning

CPD Eligibility Activity Icons

- Acquisition, disposition, clearance, relocation
- Public facilities and infrastructure improvements
- Housing rehabilitation
- Economic development
- New housing construction
- Public services

RESILIENCE ACTIONS

What actions can your community take to be more resilient to wildfire?

PLANNING

Incorporate wildfire mitigation in comprehensive and land use planning

Integrate wildfire **hazard mitigation** into program administration activities such as your community's comprehensive plan, agency or department strategic plans, or program guidance materials.[2]

Consider zoning changes or special wildfire overlay districts to designate high-risk areas.

Consider program requirements to integrate actions for addressing wildfire risk and limit construction in the wildland-urban interface.

Implement program conditions that promote wildfire management of open space and wildland-urban interface boundary zones to separate developed areas from high-hazard areas.

Identify individuals vulnerable to wildfire and determine if they may need additional support or public services during a wildfire event. Consider low- and moderate-income populations, those living in older or compromised structures, older adults, individuals with mobility issues, households with limited English proficiency, and households that lack personal transportation.

Participate in wildfire-focused community planning programs

Learn more about and join a program such as Firewise or Ready, Set, Go! that will help your community become "Fire Adapted" (see the box to the right for more information on these programs).

Sponsor workshops for local officials, developers, civic groups, and neighborhood/homeowner associations.

Consult guidance and encourage best practices in your community.

Barnegat Township, Ocean County, NJ
Creating Defensible Space[3]

In May 2007, a wildfire burned 17,000 acres of pine forest surrounding Barnegat Township in Ocean County. During the fire, neighboring retirement communities were evacuated twice. In response, residents of those communities requested information to mitigate their wildfire risk from the U.S. Environmental Protection Agency, Rutgers University, the New Jersey Forest Fire Service, and the Pinelands Commission. With support of the New Jersey Forest Fire Service, the communities became recognized by Firewise (see box below). Residents often partner with others in the region to accomplish Firewise goals, including tree removal, clearing and mowing in common areas, and replacing mulch with stone.

Eligible activities: Community education and outreach, and debris clearance activities may be eligible activities in your community.

Wildfire protection and mitigation programs

Firewise

The **National Fire Protection Association's Firewise Communities Program** encourages residents to take individual responsibility for preparing their homes to reduce wildfire risk. Firewise is a key component of **Fire Adapted Communities** – a collaborative approach that connects all those who play a role in wildfire education, planning, and action with comprehensive resources to help reduce risk. The program teaches people how to adapt to living with wildfire, and encourages neighbors to work together and take action to prevent losses.

Ready, Set, Go!

Ready, Set, Go! develops a dialogue between fire departments and the residents they serve. The program helps fire departments teach individuals who live in high-risk wildfire areas how to best prepare themselves and their properties against fire threats. Firefighters encourage residents to take personal responsibility and become an active part of the solution to the problem of increased fire losses. The program complements Firewise and other existing wildland fire public education efforts.

Develop or reference a wildland-urban interface code

Develop or reference guidelines for substantial rehabilitation and new construction of housing in wildfire hazard areas.

Develop a program that addresses fire mitigation through access, signage, fire hydrants, water availability, vegetation management, and special building construction standards.

Involve fire protection agencies in setting development guidelines and standards.

Work with local elected officials to establish wildfire mitigation requirements for large-scale areas.

Reference the International Wildland-Urban Interface Code in program policies and procedures.

BUILDINGS AND INFRASTRUCTURE

Directly fund or work with insurance companies and lenders to identify financial incentives for facilities managers to install wall components, roof coverings, sheathing, flashing, skylights, roof and attic vents, eaves, and gutters that conform to ignition-resistant construction standards.

These financing incentives could also encourage the installation of water hydration systems (e.g., sprinklers), dedicated power sources, and dedicated cisterns if no water source (e.g., lake, river, swimming pool) is available.

Create defensible space around structures and infrastructure

Work with fire mitigation professionals to develop program incentives to create buffers around all structures through the removal or reduction of flammable vegetation, including the vertical clearance of tree branches.

Work with fire mitigation professionals to develop program incentives to replace flammable vegetation with less-flammable species.

Colorado Springs, CO
Reducing Wildfire Risk in Urban Areas [4, 5, 6, 7, 8, 9]

Between 2012 and 2013, 2 wildfires destroyed more than 800 homes and resulted in 4 deaths in Colorado Springs. The community had taken a number of steps to mitigate, prepare for, and respond to wildfire before 2012 but these efforts have intensified since 2013.

The Colorado Springs Fire Department conducted wildfire hazard evaluations on more than 36,485 homes within the city's wildland-urban interface. The city also provides support to homeowners to remove hazardous vegetation. In late 2012, Colorado Springs passed an ordinance with special wildfire mitigation requirements for structures in the Hillside Overlay zone. In 2014, the city issued a manual with improved construction practices to mitigate wildfire risk.

Additionally, Colorado Springs participates in the Ready, Set, Go! program. El Paso County, where Colorado Springs is located, received CDBG Disaster Recovery (CDBG-DR) funding after the fires.

Eligible activities: CDBG funds can be used for resilience activities such as homeowner rehabilitation assistance or planting fire resistant tree species if they meet a National Objective. Resilience practices and building materials can be incorporated into projects that are funded with new housing construction-related funds.

Work with fire mitigation professionals to develop program incentives to create defensible zones around infrastructure systems.

Conduct maintenance to reduce risk

Fund cleanup activities in areas with abandoned or collapsed structures, and accumulated trash or debris.

Routinely inspect the functionality of fire hydrants.

Require and maintain safe access for fire apparatus to wildland-urban interface neighborhoods and properties.

Encourage fire-resistant construction techniques

Introduce program incentives to encourage building developers to use non-combustible materials (e.g., stone, brick, stucco) for new construction.

Introduce program incentives to encourage building developers to use fire-resistant roofing and building materials in remodels and new construction. Prohibit wooden shingles and wood shake roofs.

Introduce program incentives to encourage building developers to enclose foundations of homes and other buildings in wildfire-prone areas, rather than exposing undersides to blown embers.

ENVIRONMENT

Implement a fuels management program

Explore creation of a public outreach campaign with material to help the public identify and clear fuel loads – or large areas of dry, flammable material.

Explore creation of a public outreach campaign with material to help the public conduct effective fuels management through pruning and clearing dead vegetation, performing selective logging, and cutting high grasses.

Plant fire-resistant vegetation and create fuel/fire breaks.

Sponsor local volunteer events to reduce fuel loads along the wildland-urban interface.

PEOPLE

Increase wildfire risk awareness

Work with local emergency management office to create a community warning or public notification system.

Create an education outreach program to inform the public about proper evacuation procedures, especially low- and moderate-income populations, those living in older or compromised structures, older adults, individuals with mobility issues, households with limited English proficiency, and households that lack personal transportation.

Develop partnerships with neighborhood groups, homeowner associations, and others to conduct outreach activities.

Consider working with the local emergency management agency to use social media to communicate about wildfires. See the Wildfire Safety Social Media Toolkit at Ready.gov.

For more information, explore additional resources

Drought

How can drought affect your community?

Many regions of the United States are vulnerable to periods of short- or long-duration **drought**.

Droughts pose a threat to community water availability; water quality; the environment; and key economic and employment sectors such as agriculture, tourism, and outdoor recreation. They also increase the risk of wildfires and erosion. Issues of water supply and demand are closely tied to drought. Drought conditions can create or exacerbate limited water supply, possibly resulting in water shortages. Reducing water demand conserves available water supplies in aquifers, rivers, and lakes. Additional water conservation, capture, and recharge methods extend the use of limited water supplies. For these and other reasons, water suppliers typically advocate for water conservation measures, even in non-drought conditions.

Low- and moderate-income individuals and small businesses may be less able to prepare for, respond to, or recover from water shortages or employment impacts. For example, they might not have sufficient resources to purchase or transport water during a shortage, or they may have difficulty maintaining employment. Resilience actions can be strategically selected and designed to help low- and moderate-income communities and local businesses adapt to drought conditions.

WANT TO LEARN MORE?

Droughts are induced or exacerbated by several factors, including the amount of average precipitation, the length of time between precipitation events, temperature, and water demand; climate risks are likely to affect all these factors, increasing the likelihood of water shortages.

Droughts can occur anywhere in the United States:

- Most U.S. regions – short-duration droughts are expected to intensify.
- Southwest, Great Plains, and Southeast – longer duration droughts may result in reduced surface and groundwater availability. Water demand (particularly in industry sectors such as agriculture or hydropower), precipitation and runoff, groundwater withdrawals, and aquifer recharge may all be affected.
- South and Northwest – the length of dry spells is projected to increase.[1]

The National Integrated Drought Information System produces a series of **outlooks and forecasts** to help understand your community's vulnerability to drought in the near-term.

Longer-duration drought projections are more difficult to determine. While droughts are a potential climate hazard in all regions, soil moisture is expected to decrease in much of the western United States. To learn more, see the figure **Projected Changes in Soil Moisture for the Western U.S.**

Planning Activities

Administration and planning

CPD Eligibility Activity Icons

- Acquisition, disposition, clearance, relocation
- Public facilities and infrastructure improvements
- Housing rehabilitation
- Economic development
- New housing construction
- Public services

RESILIENCE ACTIONS

What actions can your community take to be more resilient to drought?

PLANNING

Learn about local drought conditions

Consult information on current local drought indicators such as precipitation, temperature, surface water levels, and soil moisture from your local water utility, the National Integrated Drought Information System, and Climate.gov.

Consult knowledgeable individuals or organizations (water utilities, government agencies, universities, and nonprofits) to better understand:

- Local water supply – where your community's water comes from,
- Drought risk – the susceptibility of your community's primary and alternative water sources to drought and potential shortages, and
- Drought preparedness planning – your water supplier's efforts to prepare for drought.

Plan for drought

Integrate drought mitigation into program administration activities such as your community's comprehensive plan, agency's or department's strategic plans, or program guidance materials.[2]

Work with local water utilities or suppliers to develop water supply plans that consider alternate sources, include drought contingencies, Water Supply Diversification, and Water Conservation Plan Guidelines.

Create incentives for project plans to include criteria or triggers (e.g., water levels in local reservoirs, recent precipitation shortages) for drought-related actions, such as voluntary or mandatory conservation.

Consider how to implement a drought communication and public information campaign to facilitate timely communication of relevant information to building owners and managers, developers, and the general public. Work with officials, decision-makers, and emergency managers to ensure the message and plans align.

Identify individuals vulnerable to the effects of drought, such as reductions in water available for home uses. Determine if they may need additional public services during a drought event. Consider low- and moderate-income populations, older adults, individuals with mobility issues, households with limited English proficiency, and households that lack personal transportation.

Encourage water conservation

Develop program incentives for water conservation measures such as reducing water loss, using WaterSense fixtures and appliances, and planting landscape vegetation that consumes less water.

Encourage building owners and operators to advocate for water conservation measures, even in non-drought conditions.

Consider working with local Parks and Recreation and Public Works departments to develop guidance to restrict the use of public water resources for non-essential use during periods of drought, such as landscaping at parks or recreation facilities, washing cars, or filling swimming pools.

Develop program requirements or offer additional incentives that encourage building owners, building managers, and local businesses to adopt procedures to set priorities for water use during drought, particularly for emergency uses such as firefighting.

BUILDINGS AND INFRASTRUCTURE

Construct and renovate buildings and infrastructure to be water-efficient

Institute monitoring improvements such as improving water delivery systems to minimize breaks and leaks, and ensuring water use is metered.

Explore creating additional financing incentives that would encourage local businesses, building managers, and owners to regularly conduct maintenance that includes checks for water losses, such as checking for leaky pipes and faucets.

Encourage the installation of **greywater systems** for **water reuse**.

Create program requirements to encourage building owners, developers, and single-family home owners to install **WaterSense appliances, showerheads, and toilets** to conserve water.

Work with professionals and experts to develop guidance for building managers and owners on how to check for leaks in plumbing fixtures or dripping faucets.

Design program incentives for landlords to install rain-capturing devices (e.g., rain barrels, cisterns) for onsite irrigation and to promote groundwater recharge at public facilities.

El Paso, TX
Mitigating Drought Risk with Water Conservation[3]

To address potential water shortages and drought, El Paso has developed a long-term water conservation, reclamation, and water supply diversification program. Its year-round conservation plan includes measures such as metering all users' water; a landscaping rebate program; education and outreach; rebate, retrofit, and incentive programs (e.g., rebates for WaterSense appliances); water reuse; and measures to identify and control water losses and leaks. As a result of these efforts, the community has reduced its per capita water consumption values.

Eligible activities: Public facility improvements, infrastructure activities for publicly and privately owned projects such as flood drainage, and water and sewer improvements may be eligible activities in your community.

Clayton County, GA
Increasing Water Supply through Constructed Wetlands[4]

Clayton County's innovative water recycling project enabled it to maintain abundant water supplies during the 2007–2008 drought. The project involved a series of constructed wetlands to recharge groundwater supplies and surface reservoirs. The county has also implemented water efficiency and leak detection programs.

Project cost: $55 million for permitting, design, and construction of the wetland system from the late 1970s through 2025. Additional funding came from the Federal Construction Grants program under the Clean Water Act. Water rates and stormwater fees also contribute.

Eligible activities: Public facility improvements, infrastructure activities for publicly and privately owned projects such as flood drainage, and water and sewer improvements may be eligible activities in your community.

ENVIRONMENT

Enhance landscaping and design measures

Design and install **water-smart landscapes at parks or recreation facilities**.

Incorporate drought-tolerant plant species into landscaping to reduce dependence on irrigation. Use **xeriscape** landscaping instead of non-native grasses.

Use **permeable streets, parking lots, or sidewalks**; and increase urban green space to reduce runoff, promote groundwater recharge, and mitigate drought impacts.

Work with knowledgeable professionals to develop a program to educate building managers and homeowners about efficient watering techniques and timing.

PEOPLE

Educate residents on water-saving techniques

Create a community warning or public notification system. Consider additional outreach to low- and moderate-income populations, older adults, individuals with mobility issues, households with limited English proficiency, and households that lack personal transportation.

Develop a water conservation consumer education program, even in non-drought conditions. Encourage residents to conserve with simple water-saving activities.

For more information, explore additional resources

Erosion and Landslides

How can erosion and landslides affect your community?

Erosion is the wearing away and loss of areas such as riverbanks, hillslopes, beaches, shorelines, or dunes by wind or water. Erosion, even when gradual, can harm or destroy buildings and infrastructure. Landslides are the rapid or sudden movement of a mass of rock, debris, or earth down a slope. Debris and mud flows are similar to landslides, but involve the flow of rock, earth, and other debris saturated with water. Although conditions that trigger landslides vary, they occur only on relatively steep (typically greater than 15–20 degrees) and tall slopes. Landslides are also more likely to happen where vegetation does not exist, has been removed, or where the soil moisture level is high. Potential impacts from landslides include environmental disturbance, property and infrastructure damage, and injuries or fatalities.

Low- and moderate-income households may be less able to prepare for, respond to, or recover from damage, injury, or displacement caused by erosion and landslides. For example, these residents might not have a vehicle to evacuate in an emergency situation, be able to afford alternate accommodations, or be able to recover lost property. Local businesses may also lose economic opportunities as a result of erosion and landslides. Resilience actions can be strategically selected and designed to help decrease the vulnerability of all communities, particularly low- and moderate-income communities to current and future erosion and landslides.

WANT TO LEARN MORE?

Erosion results from periodic natural hazard events such as extreme rain, rapid snow melt, hurricanes, storm surge, wildfires, and windstorms, but may be intensified by human-related activities such as vegetation removal or urbanization. Changes in the frequency or severity of storms, wildfires, or storm surge may increase the potential for erosion.

Landslides and mud flows may be spurred by earthquakes, or inland or coastal storms, and can become more likely due to wildfire or human-induced activities. More frequent or severe wildfire, storms, or intense precipitation can increase the potential for landslides and mud flows.

Areas susceptible to these events exist across the United States. Review the **Landslide Overview Map of the Conterminous United States** to find out more.

Planning Activities

- Administration and planning

CPD Eligibility Activity Icons

- Acquisition, disposition, clearance, relocation
- Housing rehabilitation
- New housing construction
- Public facilities and infrastructure improvements
- Economic development
- Public services

RESILIENCE ACTIONS

What actions can your community take to be more resilient to erosion and landslides?

PLANNING

Learn more about local erosion and landslide risks

Consult local experts such as public works and planning departments, or state geological staff to identify areas of your community at high risk for erosion or landslides.

Complete an inventory of locations where critical facilities, other buildings, and infrastructure are at high risk for erosion or landslides.

Manage development in high-risk areas

Integrate erosion and landslide risk hazard mitigation into program administration activities such as your community's comprehensive plan, agency or department strategic plans, or program guidance materials.[1]

Define steep slope/high-risk areas in land use and comprehensive plans.

Work with your planning department staff to create guidelines or restrict development in high-risk areas.

Develop a protection plan and implement reinforcement measures for high-risk areas.

Adopt sediment and erosion-control regulations or practices.

Create zoning and erosion overlay districts.

Consult with city planning professionals to create or increase setbacks near high-risk areas.

Consider employing erosion-control easements.

Consider prohibiting or limiting development or economic development activities in high-risk areas, such as along steep river bluffs that may erode with heavy precipitation or flooding.

Cincinnati and Hamilton County, OH
Preventing Landslides in Developed Areas[2, 3, 4]

With a predisposition to and history of landslides, Cincinnati and Hamilton County began to take actions to identify and mitigate landslide risks beginning in the 1980s, including the development of an Earth Movement Task Force in Hamilton County. The county adopted ordinances to reduce landslide damage in new construction areas, and Earthwork Regulations that require earthwork development to take place under the guidance of a registered professional geotechnical engineer. Since 1989, Cincinnati's geotechnical staff have worked to reduce landslide damage through geologic mapping of selected parts of the city; constructing and inspecting retaining walls along streets, highways, and other public rights-of-way; reviewing proposed construction in hillside areas; repairing landslide areas that affect city property; and compiling geologic and geotechnical data on landslide areas.

Eligible activities: Infrastructure improvements, housing construction, and rehabilitation activities may be eligible activities for your community.

Restrict or limit activity that would strip slopes of essential top soil.

Work with utility companies to locate utilities and critical facilities outside of areas susceptible to erosion or landslides to decrease the risk of service disruption.

Collaborate with your Health Department and Area Agency on Aging to identify individuals vulnerable to the effects of erosion or landslides, and determine if they may need additional support or public services. Consider low- and moderate-income populations, those living in

older or compromised structures, older adults, individuals with mobility issues, households with limited English proficiency, and households that lack personal transportation.

BUILDINGS AND INFRASTRUCTURE

Promote or require site and building design standards to minimize erosion risk

Encourage the construction of **open foundation** systems on buildings that allow water to pass beneath or through the foundation; and minimize scour, a localized loss of soil.

Encourage the construction of deep foundations in high-risk erosion areas.

Encourage the design and orientation of infrastructure to deter erosion.

Mitigate risk or remove existing buildings and infrastructure from high-risk erosion and landslide hazard areas

Where prevention measures are not feasible, consider an acquisition, relocation, and/or demolition program for high-risk buildings and infrastructure.

Implement monitoring mechanisms or procedures (e.g., visual inspection, electronic monitoring systems).

Work with local planning departments to establish setback requirements and use large setbacks when building roads near slopes of marginal stability.

Consider developing a program to install catch-fall nets for rocks at steep slopes near roadways.

ENVIRONMENT

Stabilize high-risk areas

Offer financing incentives to program participants that apply **soil stabilization** measures, such as planting vegetation on steep, publicly owned slopes.

Fairfax County, VA
Minimizing Erosion with Revegetation[5]

The Northern Virginia Soil and Water Conservation District, including Fairfax County, provides residents with information to manage erosion concerns on their properties. Recommendations include replanting vegetation suitable to site conditions, covering footpaths with mulch or gravel, terracing steep slopes, and redirecting or capturing runoff. The district offers technical assistance and matching funds to Fairfax County community associations for projects that address drainage and erosion problems.

Project cost: A 50% match of up to $1,500–4,000, depending on the project.

Eligible activities: Public facilities and infrastructure improvements may be eligible activities in your community.

Explore using program requirements to provide incentives for proper **shoreline stabilization** and **bank stabilization** methods, including sloping or grading techniques, **terracing** hillsides, or installing riprap boulders or geotextile fabric.

Encourage the use of **natural bank stabilization techniques**.

Consider conducting an outreach program educating the public on the dangers of removing natural vegetation from dunes and slopes near buildings and infrastructure.

Consider providing incentives for projects that restore or create marine coastal habitat areas (e.g., beaches, dunes, wetlands) to minimize coastal erosion.

Consider creating special financing for program participants that plant shoreline vegetation in the coastal zone to assist in dissipation of the wind and breaking waves.

Encourage the use of a splash block made of stone or other hard material to direct runoff and minimize the potential for erosion.

Consider creating a fund to help maintain vegetation in wildfire-prone areas to minimize landslide risk.

Require the planting of vegetation with strong root systems following a wildfire as a condition for program financing.

Use debris-flow measures that may reduce damage in sloping areas, such as stabilization, efforts to spread or dissipate the force, and flow control measures.

PEOPLE

Increase awareness of erosion and landslide hazards

Consult with emergency management professionals to create a community warning or public notification system. Consider additional outreach to low- and moderate-income populations, those living in older or compromised structures, older adults, individuals with mobility issues, households with limited English proficiency, and households that lack personal transportation.

Inform property owners and residents located in high-risks areas of the erosion and landslide risks they have.

Educate potential property buyers on how to assess properties that may be located in high-risk areas. Collaborate with erosion and landslide professionals to conduct workshops, develop brochures, or launch other public outreach activities describing risk and potential mitigation techniques. As appropriate, offer resources in multiple languages.

Offer GIS hazard mapping tools online to educate residents about risks.

For more information, explore additional resources

Funding Resilience Actions

State and local governments may use HUD funds to implement some of the resilience actions described in this Toolkit. Communities will also need to seek or provide additional funding to fill gaps or to finance those projects that cannot be covered by HUD funding. This factsheet provides information on HUD funding streams available as of publication of this document that can support many of the resilience actions listed in this Toolkit. It also provides suggestions for non-HUD funding options for resilience actions. Each funding section in the graphic below is linked to a corresponding section in this factsheet to provide more detail, as well as case studies to illustrate how to implement a wide range of resilience actions.

NON-HUD FUNDING STREAMS

STATE AND LOCAL BOND MARKET

State and local governments frequently use the bond market to finance public projects and, as a result, new bond products have emerged to fund innovative green financing solutions.

- Green bonds
- Other bonds

STATE REVOLVING FUNDS AND PUBLICALLY REGULATED BANKS

Federal financing provides initial capital for states to create revolving funds and publically regulated banks.

- Water, clean energy, and transportation state revolving funds
- Infrastructure banks
- Green banks

LOCAL AND REGIONAL FEE PROGRAMS

Regional and local governments often use fee-based programs to cover administrative and operational costs for city or county services and projects.

- Bag fees
- Stormwater fees

PUBLIC-PRIVATE PARTNERSHIPS AND OTHER FINANCIAL STRATEGIES

State and local governments can partner with the private sector to implement resilience projects.

GOVERNMENT ENTITIES AND PRIVATE FOUNDATION GRANTS

Government entities and private foundations offer financial and technical resources to advance local resilience actions.

HUD FUNDING STREAMS

- Community Development Block Grants (CDBG)
- CDBG – Disaster Recovery
- HOME
- Section 108 loans
- Emergency Solutions Grants (ESG) and Continuum of Care (COC) Programs
- Other HUD funding opportunities

STATE AND LOCAL BOND MARKET OPPORTUNITIES

State and local governments and private entities routinely issue bonds to raise money to finance projects, activities, and operations. In general, a bond provides a certain amount of money to a debtor for a fixed amount of time, with the promise of repaying both the original amount and a fixed or variable interest rate to cover various risk factors. Bonds offer stakeholders up-front capital for their projects. Green bonds and social impact bonds listed below have different characteristics than traditional bond and tax situations, and are suitable for funding resilience actions.

Green bonds

A green bond supports projects with environmental benefits. Green bonds differ from normal bonds in three ways: (1) they are labeled as green by the issuer, (2) proceeds are earmarked for green investments, and (3) the issuer tracks and reports on the use of proceeds to guarantee environmental compliance. There are **voluntary best practices guidelines** for green bond projects; these guidelines list eligible green project categories, including:

- Energy efficiency, including in new and refurbished buildings, district heating, smart grids, and appliances and products
- Biodiversity conservation, including protection of coastal and watershed environments
- Resilience, including natural hazard-related information support systems such as climate observation and early warning systems.

The **US Green City Bonds Coalition** offers educational materials, workshops, and seminars to help cities and municipalities take advantage of this opportunity, including a **guidance document** to assist cities in achieving issuance. (See the Massachusetts green bond case study below for more information).

Climate bonds are similar to green bonds. There is significant overlap between the two, but whereas green bonds are designed for environmental projects, climate bonds focus on climate projects and range from wind farms and solar power plants to transport and sea

Massachusetts State Green Bond Program[1]

The Commonwealth of Massachusetts issues green bonds that fund environmentally focused projects across the state. In 2013, Massachusetts sold $100 million in green bonds and enlarged the program in 2014. The proceeds were used to protect open space, restore waterways and riverine habitats, and reduce energy costs in public buildings or construct energy-saving buildings.

The photographs show the Broad Meadows salt marsh restoration: the first photograph is pre-restoration and the second photograph is post-restoration. The project was cost-shared by the U.S. Army Corps of Engineers and the City of Quincy.

walls. The Climate Bonds Standard Board provides climate bond certification guidelines for eligible projects.

Social and environmental impact bonds

Social impact bonds (SIBs) and environmental impact bonds (EIBs) are "pay-for-success" or "pay-for-performance" contracts that provide payouts based on previously established goals or criteria. SIBs and EIBs typically involve a series of contracts between multiple stakeholders, including intermediaries, governments, constituents or taxpayers, service providers, and independent assessors. These contracts fund construction and environmental remediation projects. In all cases, repayment to the investors depends on the performance or success of the project, thereby transferring risk from the government to the investors (see the Washington, DC Water EIB as an example). SIBs and EIBs align social and environmental impacts with financial returns, leverage private capital for nonprofits and impact- focused organizations, and reduce government risk and outlays.[3]

Washington, DC Water and Sewer Authority[2]

In 2016, The Washington, DC Water and Sewer Authority (DC Water) issued the nation's first EIB to finance the construction of green infrastructure that manages stormwater runoff and improves water quality. The EIB is based on an innovative financing technique, where DC water pays its investors, Goldman Sachs Urban Investment Group and Calvert Foundation, a premium over the stated coupon if stormwater runoff reductions surpass 41.3% of the measured baseline, and withholds the final interest and principal payment (considered a one-time risk share payment from its investors) if runoff reduction is less than 18.6% of the baseline. DC Water is responsible for monitoring and reporting on performance, and has its findings audited by an independent third party. While traditional bonds have a defined cost of capital and therefore payout to investors, this EIB structure allows DC Water to reduce its cost of capital in the case of under-performance.

STATE REVOLVING FUNDS AND PUBLICLY REGULATED BANKS

Initial capital from the federal government or private entities in the form of low-interest loans can create revolving funds or infrastructure and green banks through which the repayments of principal and interest can finance new projects over time.

Water, clean energy, and transportation state revolving funds

State Revolving Funds (SRFs) provide multiple financing methods for a variety of state and local water (and wastewater), clean energy, and transportation projects. While direct, low-interest rate loans are the most common form of financing offered by SRFs, they occasionally leverage their initial capitalization with bond issuances, provide credit or loan guarantees, or provide grants. Capital for the funds, especially for subsets of these funds (see Infrastructure Banks and Green Banks below), can also come from local taxes; money from federal, state, or local budgets; and other forms of debt and equity investment. Funds are replenished through repayment of principal, interest payments, and fees.[4]

Infrastructure banks

Infrastructure banks are publicly regulated subsets of SRFs that use capital from different sources to fund infrastructure needs. Typically, infrastructure banks focus on transportation. They have been used since the 1990s to allocate billions of dollars to infrastructure projects in states such as South Carolina, California, and Kansas.[5] State infrastructure banks are effective at coordinating infrastructure development and investment (including private investment). New York State created an infrastructure bank after Hurricane Sandy to centralize planning and make funding more efficient. This has allowed the state to focus infrastructure spending on projects and initiatives that increase resilience.[6]

Green banks

Green banks offer an alternative to clean energy funds (both of which are subsets of clean energy SRFs) to finance clean energy projects. Whereas clean energy funds are housed within particular government departments or commissions, or operate separately as a nonprofit; green banks operate as a single, distinct entity that can more effectively scale-up clean energy projects by utilizing private investment.[7] Green banks such as the Clean Energy Finance and Investment Authority in Connecticut and the NY Green Bank have successfully combined public and private funding to finance innovative energy technologies.[8]

PUBLIC-PRIVATE PARTNERSHIPS AND OTHER FINANCIAL STRATEGIES

Communities have access to other financing options in addition to bonds. In contrast to other resilience projects, performance-based infrastructure combines public and private funding for projects that can realize immediate financial benefits. Public-private partnerships or contracts between public and private entities can optimally combine the funding and services of each sector. Other options include contracts, redistricting, fees, and taxes that capture land value.

Public-private partnerships to promote resilient infrastructure

Public-private partnerships can be an effective mechanism for promoting resilience in infrastructure projects. These partnerships offer an opportunity for governments to execute small-scale, resilience infrastructure projects by bringing in private-sector investment.

Public-private partnerships present opportunities for enhancing the resilience of large infrastructure investments and mobilizing private finance to support small-scale infrastructure projects. They help to increase private-sector participation by providing finance, as well as expertise, in infrastructure development and public service operation. If designed correctly, public-private partnerships can appropriately allocate risks across parties; encourage innovation; and improve the reliability, quality, and sustainability of public services in the face of change. FEMA offers guidance on building resilience through private-public partnerships. (See the Prince George's County, Maryland case study).

Value-capture strategies

Value-capture is a public financing strategy that recovers some of the value that public infrastructure generates for the private sector. Urban infrastructure investment can increase land value, and value-capture strategies offer ways to recover some of this increase in value. Examples of value-capture strategies include:[9]

1. Tax-increment financing (TIF). Over a set period of time, increases in property tax revenues – based on the difference between increasing property values (resulting from investment in the area) and a "frozen" property value – are reinvested in the TIF district. Funds go through a TIF authority, such as a redevelopment agency, instead of the municipal entity that normally receives property tax revenues. TIF authorities can either issue bonds initially to pay for up-front capital costs (pay-as-you-use approach) and pay for the bond using TIF proceeds, or finance development as TIF revenues are realized (pay-as-you-go approach). Miami-Dade County, Florida, is using recapture of value through a TIF district to fund a seaward skirt-wall that will protect against coastal storms and sea level rise (see the Miami-Dade County case study on the following page).

2. Special assessment or improvement districts. These districts are defined areas within a community. When a public improvement is made in the district, such as upgrades to water or transportation infrastructure, these districts use a cost-recovery system by charging additional taxes to properties within that area.

3. Infrastructure or transit impact fees. A standardized financial exaction charged to real estate developers to recoup infrastructure and service capital costs, such as water and sewer facilities.

Prince George's County, MD[10, 11]

In Prince George's County, Maryland, the government dedicated $100 million dollars to address stormwater issues through a public-private partnership. The Prince George's County Urban Stormwater Retrofit Public-Private Partnership Demonstration Pilot combines government funding and input with private-sector planning, financing, and implementation expertise from Corvias Solutions to retrofit approximately 2,000 acres of impervious surface. If the pilot project is successful, Corvias Solutions will continue to work with the county, the U.S. Environmental Protection Agency, and the Maryland Department of the Environment to retrofit more impervious surfaces. This partnership will aid Prince George's County in reaching Total Maximum Daily Load goals and promote local economic opportunity by basing its developer's fee structure on social and economic performance goals such as employing local women- and minority-owned businesses.

Miami-Dade County, FL[12]

Miami-Dade County is one of eight pilot cities partnering with The Rockefeller Foundation and re:Focus Partners in the RE:invest Initiative, an infrastructure development approach utilizing local fiscal instruments. The project is exploring both redesigned catastrophe bonds and recapture of value through a novel, broad-based TIF district to fund a seaward skirt-wall that will protect against coastal storms and sea level rise by bolstering an existing but flawed privately owned seawall. TIF captures value via risk reduction in the sense that the cost of adaptation efforts can be amortized using the increased tax base resulting from the increased protection of infrastructure.

4. Joint development and lease/sale of public land. Local governments or other public entities such as transit agencies can cooperate with private entities such as real estate developers to fund projects. Private entities can share project costs with or provide payments to the public entity in exchange for development rights on the public entity's land.

Performance-based infrastructure

Performance-based infrastructure is an innovative approach to infrastructure projects in which the investment, risk, responsibility, and rewards of the project are shared between government and private-sector participants. Performance-based infrastructure yields two desirable outcomes for local planners: (1) increased resilience and sustainability, and (2) immediate financial benefits.

LOCAL AND REGIONAL FEE PROGRAMS

Municipalities and counties often use fees to cover administrative and operational costs for city or county services and projects. Fees are an alternative to raising taxes to increase revenue, and the proceeds can be spent on a project regardless of how the fee is charged. These fee programs might contribute to a larger loan package for funding resilience actions.

Bag fees

Cities across the country are adopting fees on disposable plastic and paper grocery bags to fund a variety of environmental initiatives, from community cleanup events and outreach[13] to other general environmental projects. This form of financing offers an alternative to tax increases that can be implemented at the local (municipal) level, and a study by MassGreen.org found that these fees do not typically have a negative effect on store sales.[14] (See the Washington, DC bag fee case study below).

Stormwater fees

Stormwater fees are either flat or proportional fees attached to water or sewer bills to fund stormwater runoff management related to both flooding and pollution. The ability of local governments or utilities to charge these fees depends on the applicable state laws governing utility fees. Utilities can use fees

Washington, DC Bag Fee

In 2010, Washington, DC, began charging a 5-cent fee on all plastic and paper bags to finance Anacostia River cleanup and adaptation plans, including stream restoration projects for flood risk reduction. Proceeds from the bag fee also fund initiatives such as green roofs, which increase energy efficiency and abate urban heat island risks.

to fund management practices, or encourage these practices through credits that offset stormwater fees. Management practices that address flooding and nonpoint source pollution include retention ponds, bioswales, green roofs, semi-permeable paving, and land acquisition. While these management practices are often adopted so that cities are in compliance with the Clean Water Act, some of the practices also serve as viable adaptation strategies. (See the City of Charlotte and Mecklenburg County, NC case study).

GOVERNMENT AGENCIES AND PRIVATE FOUNDATION GRANTS

A range of government agencies and private foundations offer financial and technical resources to advance local resilience actions. Check the government agency and foundation websites for opportunities.

Government agencies often offer grant programs to assist local and state governments, communities, and nongovernmental organizations build resilience and prepare for hazardous events. For example, the Federal Emergency Management Agency (FEMA) administers three programs that provide funding for eligible mitigation planning, and projects that reduce disaster losses and protect life and property from future disaster damages. The three programs are the **Hazard Mitigation Grant Program**, the **Flood Mitigation Assistance Program**, and the **Pre-Disaster Mitigation Program**.

Private foundations may offer grant opportunities to build resistance. Historically,

City of Charlotte and Mecklenburg County, NC[15]

The City of Charlotte and Mecklenburg County have adopted an innovative way to use stormwater fees to fund flooding adaptation. These jurisdictions charge proportional stormwater fees (based on property location, stormwater service cost, and surface area of the impervious surface) to help fund three types of land acquisition in areas prone to flooding:

1. Annual property buyouts based on overall flood risk
2. "Quick buys" in the immediate aftermath of flooding
3. Buyouts for properties adjacent to other acquired properties that did not meet requirements for federal buyouts.

The Rockefeller Foundation and the Kresge Foundation provided grants to help cities and communities become more resilient to physical, social, and economic challenges. For example, from 2013 to 2015, The Rockefeller Foundation provided financial support to 100 cities worldwide to hire a Chief Resilience Officer to lead resilience efforts and access expertise and platforms to develop a robust resilience strategy.

HUD FUNDING STREAMS (AS OF 2017)

USING CPD FUNDING FOR RESILIENCE ACTIONS

Many of the resilience actions listed in this toolkit may be supported with funding from CPD formula programs, including CDBG, HOME, and Section 108 loan guarantee programs. To receive HUD support, the actions must also meet these programs' core requirements related to national objectives and eligible activities. The principal purpose of CPD funding is to benefit low- and moderate-income persons.

Community Development Block Grants

Local governments and states may consider the use of CDBG funds to build resilience and provide services to vulnerable community members. CDBG eligible activity categories include:

- Public facilities and infrastructure improvements
- Housing rehabilitation
- Public services
- Economic development
- Acquisition, disposition, clearance, and relocation.

These categories are described in detail in the Introduction and generally characterize resilience actions that align with these CDBG eligible activity categories. A substantial number of the resilience actions presented in this Toolkit qualify as CDBG-eligible activities and may be supported with CDBG funding if benefit requirements are met.

Community Development Block Grants – Disaster Recovery

CDBG-Disaster Recovery (CDBG-DR) funds can help build resilience in a community as it rebuilds following an extreme event. In response to especially intense or damaging Presidentially declared major disasters, Congress may appropriate additional funding for CDBG-DR grants to provide crucial seed money to begin the long-term recovery process and rebuild the affected areas. CDBG-DR funding is distributed in the form of flexible grants similar in nature to CDBG and is subject to the availability of supplemental appropriations.

Within the specific rules established in appropriations legislation, designated communities may use CDBG-DR funds for recovery efforts involving housing, economic development, infrastructure, and prevention of further damage to affected areas. Grantees must use a specified percentage of CDBG-DR funds for activities that principally benefit low- and moderate-income persons, and all funds must be used to satisfy one of the three national objectives: benefiting low-

Depending on the nature of the disaster and the legislative provisions, CDBG-DR-eligible activities that may help increase resilience include:

- Buying damaged properties in a floodplain and relocating residents to safer areas;
- Rehabilitating homes, buildings, and public facilities damaged by the disaster to protect investments from future hazards (e.g., elevating homes and buildings in the floodplain);
- Supporting public services;
- Helping businesses retain or create jobs in disaster affected areas; and
- Planning and administration costs (limited to no more than 20% of the grant).

and moderate-income persons, preventing or eliminating slums or blight, and meeting urgent needs. Some natural disasters are becoming more intense. Post-disaster recovery provides an opportunity to reduce disaster risks and improve adaptive capacity. To maximize resilience to a future natural disaster, communities should consider how future risks might increase when using CDBG-DR funding to rebuild. For more information on CDBG-DR funding, visit the HUD exchange.

HOME

HOME funds may support actions to improve communities' resilience to current and future natural disasters. HOME funds can be used for the costs of acquiring, constructing, or rehabilitating single family or multifamily housing for rent or homeownership, as well as to rehabilitate existing owner-occupied housing. HOME funds can be used to demolish existing properties when rebuilding on the same site. HOME can also provide deep capital subsidies required to bring properties up to codes and standards, including state or local disaster mitigation standards. State and local HOME participating jurisdictions receive annual allocations of HOME funds for their use in locally designed and administered affordable housing programs. Several of the resilience actions listed in this Toolkit, including siting of new homes and selection of building materials or practices, can help ensure that HOME-funded properties are resilient to current and future natural hazards. For more information on HOME funding, visit the HUD exchange.

Section 108

The Section 108 Loan Guarantee Program can increase resilience by providing communities with a source of financing for larger economic development, housing rehabilitation, public

Mount Vernon, WA[16]

To address repeated flooding, Mount Vernon launched a multi-phased project to revitalize its riverfront, boost the local economy, and mitigate future flood risk. Primary project elements included demolition of seven structures; and construction of a floodwall, earthen levee, riverwalk promenade, and stormwater infiltration system in a plaza area. With these improvements, the city expects that the majority of the downtown and other riverfront areas will fall outside FEMA annual flood chance hazard zones. Since the second phase of the project finished, Mount Vernon has twice prepared its floodwall barriers in anticipation of potential flooding. The city relied on many federal, state, and local funding sources to support the project, including $1 million from the HUD Section 108 Loan Guarantee Program. The full project cost was $27 million.

facilities, and other physical development projects that could not be supported through the annual CDBG allocation. Section 108 loans are secured by the jurisdiction's CDBG allocation and other collateral and funds may be used for a variety of CDBG-eligible activities, including construction, reconstruction, or rehabilitation of infrastructure and other public facilities; acquisition; housing rehabilitation; and property acquisition. Eligible projects must meet a national objective and, depending on activity type, achieve a sufficient level of public benefit.

The 108 loan funds may be used by a designated public entity or loaned to a third-party developer to undertake eligible projects. Section 108 loans may be used for long-term recovery or to prevent future damage from natural hazards. For more information on Section 108 funding, visit the HUD exchange. (See the Mount Vernon case study).

Emergency Solutions Grants Program and Continuum of Care Program

The Emergency Solutions Grants (ESG) program is a formula grant. Eligible recipients are generally states, metropolitan cities, urban counties, and territories that apply through the Consolidated Planning process. In addition to other activities, ESG funds can be used to improve the number and quality of emergency shelters for homeless individuals and families. For more information on ESG funding, visit the HUD exchange.

The Continuum of Care (CoC) program provides funds, on a competitive basis, to geographic entities designed to carry out a variety of activities in support of those experiencing homelessness. While the CoC program generally supports housing assistance, rather than rehabilitation or construction activities, CoC-funded assistance can be directed to housing that promotes resilience. For more information on CoC funding, visit the HUD exchange.

Other HUD funding opportunities

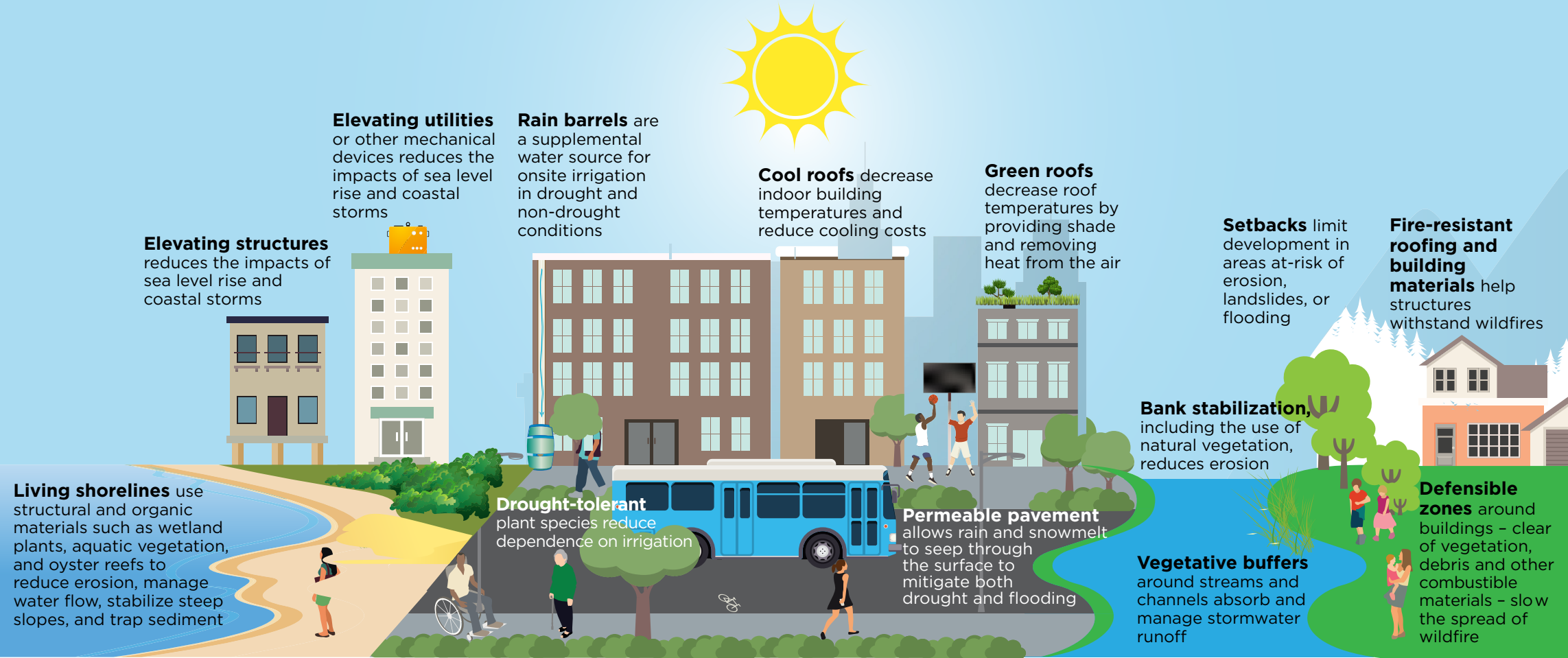
In addition to CPD funding sources, communities might also consider other sources of HUD funding to support resilience in their community. Examples of HUD funding opportunities include:

- Section 203(k) rehab loans: The Section 203(k) loan program is HUD's primary program for the rehabilitation and repair of single-family properties. Section 203(k) loans are provided through HUD-approved mortgage lenders nationwide and insured by the Federal Housing Administration (FHA), and can be used to finance the rehabilitation of a variety of owner-occupied units.
- Public Housing Authority (PHA) financing opportunities: Under the Capital Fund Financing Program (CFFP), a PHA may borrow private capital to make improvements to existing public housing units and pledge, subject to the availability of appropriations, a portion of its future year annual Capital Funds to make debt service payments for either a bond or conventional bank loan transaction. Under the Operating Fund Financing Program (OFFP), PHAs are permitted to borrow private capital to finance development and modernization of public housing. Under this program, a PHA may use a portion of its Operating Fund reserve balances to collateralize financings and pay debt service and customary financing costs.
- Choice Neighborhoods: The Choice Neighborhoods program supports locally driven strategies to address struggling neighborhoods with distressed public or HUD-assisted housing through a comprehensive approach to neighborhood transformation. The program provides both planning and implementation grants that support site improvements, critical community improvements, and rehabilitation and construction of housing and other community facilities.

These programs are additional examples of how HUD can support communities in implementing the resilience actions described in this Toolkit.

What does a resilient community look like?

These coastal, inland, urban, and rural areas depict examples of actions communities can take to increase their resilience to climate-related natural hazards. Explore the actions to generate ideas on how to increase your community's resilience.



Additional Resources

This section contains endnotes from each section of the toolkit and additional links to federal, state, and nongovernmental websites that provide general guidance and information on community and climate resilience. The links also provide specific guidance and more information on natural hazard risks.

Endnotes

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Additional Resources

Introduction

- 2014 National Climate Assessment – U.S. Global Change Research Program (USGCRP)
- U.S. Climate Resilience Toolkit
- Mitigation Ideas – Federal Emergency Management Agency (FEMA)
- Community Resilience Resources by Disaster Type – U.S. Department of Housing and Urban Development (HUD)
- Using Community Development Block Grant for Disaster Response and Recovery – HUD
- Green Infrastructure and the Sustainable Communities Initiative – HUD
- Planning Framework for a Climate-Resilient Economy – U.S. Environmental Protection Agency (EPA)

Increasing Temperatures and Extreme Heat

- Heat Island Effect – EPA
- Green Infrastructure Municipal Handbook – EPA

Sea Level Rise and Coastal Storms

- Coastal Zone Development and Ecosystems – USGCRP
- Coastal Construction Manual – FEMA
- Home Builder's Guide to Coastal Construction – FEMA
- A Planning Guide for State Coastal Managers – National Oceanic and Atmospheric Administration

Wildfire

- Wildfire Safety Outreach Materials – U.S. Fire Administration
- Wildfire Weather Safety – National Weather Service
- Defensible Space - Ready for Wildfire
- Fire Learning Network – The Nature Conservancy
- Standard for Reducing Structure Ignition Hazards from Wildland Fire – National Fire Protection Association

Drought

- Water Use It Wisely
- Home Water Works
- Alliance for Water Efficiency
- Water Research Foundation
- WateReuse
- American Water Works Association
- Association of Metropolitan Water Agencies

Erosion and Landslides

- Coastal Erosion – U.S. Climate Resilience Toolkit
- Landslides and Debris Flow – Ready.gov
- Landslides and Mudslides – Centers for Disease Control and Prevention (CDC)
- Landslide Hazard Program – U.S. Geological Survey (USGS)
- The Landslide Handbook – USGS

Glossary

This section provides a list of terms or words used throughout the Toolkit and is organized by hazard. Where appropriate, the Glossary links to external resources that provide additional information about the word or term.

Increasing Temperatures and Extreme Heat

Hazard mitigation – The effort to reduce loss of life and property by lessening the impact of disasters. It is most effective when implemented under a comprehensive, long-term mitigation plan. State, tribal, and local governments engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural disasters, and develop long-term strategies for protecting people and property from future hazard events. Mitigation plans are key to breaking the cycle of disaster damage, reconstruction, and repeated damage. [Federal Emergency Management Agency (FEMA)]

Cool pavement – Using paving materials on sidewalks, parking lots, and streets that remain cooler than conventional pavements (by reflecting more solar energy and enhancing water evaporation). This not only cools the pavement surface and surrounding air, but can also reduce stormwater runoff and improve nighttime visibility. (EPA)

Cool roofs – Installing a cool roof – one made of materials or coatings that significantly reflect sunlight and heat away from a building – reduces roof temperatures, increases the comfort of occupants, and lowers energy demand. (EPA)

Emissions scenarios – Representations of possible futures global emissions of heat-trapping gases. The more greenhouse gases emitted, the more likelihood there will be an increase in global temperatures. The latest set of emissions scenarios is called Representative Concentration Pathways (RCPs). Each RCP has a number associated with it that is correlated with future emissions and concentrations of greenhouse gases in the atmosphere. The highest scenario, RCP 8.5, would lead to more warming. A lower emissions scenario, RCP 4.5, would result in less warming. (U.S. Global Change Research Program)

Green roofs – Growing a vegetative layer (plants, shrubs, grasses, and/or trees) on a rooftop reduces temperatures of the roof surface and the surrounding air, and improves stormwater management. Also called "rooftop gardens" or "eco-roofs," green roofs achieve these benefits by providing shade and removing heat from the air through evapotranspiration. (EPA)

Urban heat island – The term "heat island" describes built-up areas that are hotter than nearby rural areas. The annual mean air temperature of a city with 1 million people or more can be 1.8–5.4°F (1–3°C) warmer than its surrounding areas. In the evening, the difference can be as high as 22°F (12°C). Heat islands can affect communities by increasing summertime peak energy demand, air-conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality. (EPA)

Sea Level Rise and Coastal Storms

Artificial dunes – Shoreline protection measure where a new mound of sediment is built along the back of a beach. Sediment is typically brought in from an offsite source, such as a sand and gravel pit or coastal dredging project.

Beach nourishment – The process of placing sand (often by pumping) on an eroding shoreline to buffer against storm or wave damage, or to create a new beach or widen an existing beach. (Army Corps of Engineers)

- **Coastal erosion** – The process by which large storms, flooding, strong wave action, sea level rise, and human activities wear away beaches and bluffs along coastlines. (U.S. Climate Resilience Toolkit)
- **Coastal inundation** – The flooding of normally dry, low-lying coastal land, primarily caused by severe weather events along coasts, estuaries, and adjoining rivers. These storms, which include hurricanes and winter storms, bring strong winds and heavy rains. The winds drive large waves and storm surge on shore, and the heavy rains raise river levels. (NOAA)
- **Living shoreline** – A shoreline stabilized using a variety of structural and organic materials, such as wetland plants, submerged aquatic vegetation, and oyster reefs. (NOAA)
- **Nonpoint source pollution** – Pollution that generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification. Nonpoint source pollution, unlike pollution from industrial and sewage treatment plants, comes from many different sources. (EPA)
- **Non-structural shore stabilization techniques** – Measures that enhance a shoreline's natural ability to absorb and dissipate storm energy without interfering with natural beach, dune, and bank processes. Examples of these techniques include protecting or creating wetlands, renourishing beaches and dunes, and revegetating shorelines with native plants.
- **Relocate existing buildings** – Moving structures away from shorelines to reduce risks to the structure, residents or businesses occupying the building, and first responders.
- **Retrofit existing buildings** – Modifying existing buildings to improve their chances of surviving storm events. Retrofitting options can include elevating a building on open pilings above predicted flood heights, anchoring structures to resist flotation, reducing or completely removing impervious ground cover, and installing protective structures over windows and doors. FEMA has several resources to help communities determine what type of construction techniques best survive storms.
- **Storm surge** – The abnormal rise in water level, over the regular astronomical tide, caused by a severe storm such as a tropical cyclone or winter storm. Large waves also raise coastal water levels and ride on top of the storm surge, which cause extreme damage. Storm surge is one of the main causes of coastal inundation. (NOAA)
- **Structural shore stabilization techniques** – Measures that protect shorelines using hard, structural solutions. Examples of structural shore stabilization techniques include seawalls, groins, and riprap. These techniques can adversely affect surrounding properties by moving sand and stormwater, and can disrupt natural water flows.
- **Vegetation barriers** – Permanent strips of stiff, dense vegetation along the general contour of shorelines. Vegetation barriers can be applied on all eroding areas to reduce erosion, manage water flow, stabilize steep slopes, and trap sediment. (U.S. Department of Agriculture)

Inland Flooding

- **Annual flood chance hazard zones** – Flood hazard zones are areas that will be inundated by a flood event having a 1% chance of being equaled or exceeded in any given year. The 1% annual-chance flood is also referred to as the base flood or 100-year flood. Moderate flood hazard zones are areas between the limits of the base flood and the 0.2% annual-chance (or 500-year) flood. (FEMA)
- **Base flood elevation –** The computed elevation to which floodwater is anticipated to rise during the base flood. Base Flood Elevations (BFEs) are shown on flood insurance rate maps and on flood profiles. The BFE is the regulatory requirement for the elevation or flood-proofing of structures. (FEMA)
- **Floodplain** – The lowland and relatively flat areas adjoining inland and coastal waters (and flood-prone areas of offshore islands), including at a minimum, that area subject to a 1% or greater chance of flooding in any given year. (EPA)

- **Freeboard –** Freeboard is a factor of safety usually expressed in feet above a flood level for the purposes of floodplain management. Freeboard tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed. Freeboard is not required by the National Flood Insurance Program standards, but communities are encouraged to adopt at least a one-foot freeboard to account for the one-foot rise built into the concept of designating a floodway and encroachment requirements where floodways have not been designated. Freeboard results in significantly lower flood insurance rates due to lower flood risk. (FEMA)
- **Green infrastructure** – As opposed to conventional piped drainage and water treatment systems, green infrastructure uses vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier urban environments. At the city or county scale, green infrastructure is a patchwork of natural areas that provide habitat, flood protection, cleaner air, and cleaner water. At the neighborhood or site scale, green infrastructure is a stormwater management system that mimics nature, and soaks up and stores water. (EPA)
- **Impervious surface** – Traditional pavement or surfaces, including asphalt and concrete, which do not allow water to soak into the ground. These surfaces shed water into drains, storm sewers, and other collection systems that discharge into nearby water bodies.
- **Low-impact development – These s**ystems and practices use or mimic natural processes that result in the infiltration, evapotranspiration, or use of stormwater in order to protect water quality and associated aquatic habitat. (EPA)
- **Stormwater –** Water generated from rain and snow melt events that flow over land or impervious surfaces, such as paved streets, parking lots, and building rooftops, and does not soak into the ground. (EPA)
- **Vegetative buffers –** Small areas or strips of land in permanent vegetation that are designed to intercept pollutants and manage other environmental concerns. Buffers include riparian buffers, filter strips, grassed waterways, shelterbelts, windbreaks, living snow fences, contour grass strips, cross-wind trap strips, shallow water areas for wildlife, field borders, alley cropping, herbaceous wind barriers, and vegetative barriers. (NRCS)

Wildfire

- **Defensible zones** – An area around a building in which vegetation, debris, and other types of combustible fuels have been treated, cleared, or reduced to slow the spread of fire to and from the building. (FEMA)
- **Fuel load(s)** – Wood, foliage, or grass that is flammable. Ground fuels are grasses, duff, and herbaceous cover; and ladder fuels are understory branches or shrubs that can allow a fire to ascend into the canopy. Removal methods for excess fuels include thinning, limbing, slash pile burning, or other options that reduce the potential for severe wildfires. (FEMA)
- **Wildland-urban interface** – Structures built near or on lands prone to wildland fire, including brush fires, forest fires, rangeland fires, or other similar events. (Ready, Set, Go!)

Drought

- **Drought** – A deficiency in precipitation over an extended period of time. It is a normal, recurrent feature of climate that occurs in virtually all climate zones. The duration of droughts varies widely. There are cases when drought develops relatively quickly and lasts a very short time, exacerbated by extreme heat and/or wind; and there are other cases when drought spans multiple years, or even decades. [National Oceanic and Atmospheric Administration (NOAA)]
- **Greywater** – Water segregated from a domestic wastewater collection system and reused on-site. This water can come from a variety of sources such as showers, bathtubs, washing machines, and bathroom sinks. It contains some soap and detergent, but is clean enough for nonpotable uses. Water from toilets or wash water from diapers is

not considered to be greywater. Kitchen sink water is not considered greywater in many states. Many buildings or individual dwellings have systems that capture, treat, and distribute greywater for irrigation or other nonpotable uses. (WateReuse)

- **Permeable pavement** – Alternative materials that allow rain and snow melt to seep through the surface down to underlying layers of soil and gravel. The materials include pervious asphalt, pervious concrete, interlocking pavers, and plastic grid pavers. [U.S. Environmental Protection Agency (EPA)]
- **Reclaimed water/water reclaim** – The reuse of treated wastewater. (U.S. Geological Survey)
- **Water loss/real water losses** – Water that escapes the water distribution system, including leakage and storage overflows. (Alliance for Water Efficiency)
- **Water recycling/water reuse** – Treated domestic wastewater that is used more than once before it passes back into the water cycle. (WateReuse)
- **Xeriscape** – Also called dry-scape, a set of principles for water-wise landscaping that includes planning, maintaining, and watering your landscape efficiently. (Water Use it Wisely)

Erosion and Landslides

- **Scour** – A localized loss of soil, often around a foundation element. (FEMA)
- **Soil stabilization** – Activities to reduce risk to structures or infrastructure from erosion and landslides, including installing geotextiles, stabilizing sod, installing vegetative buffer strips, preserving mature vegetation, decreasing slope angles, and stabilizing with riprap and other means of slope anchoring. (FEMA)
- **Terracing** – Earthen structures that intercept runoff on moderate to steep slopes. They transform long slopes into a series of shorter slopes. Terraces reduce the rate of runoff and prevent soil particles from eroding down slopes. [Natural Resource Conservation Service (NRCS)]

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