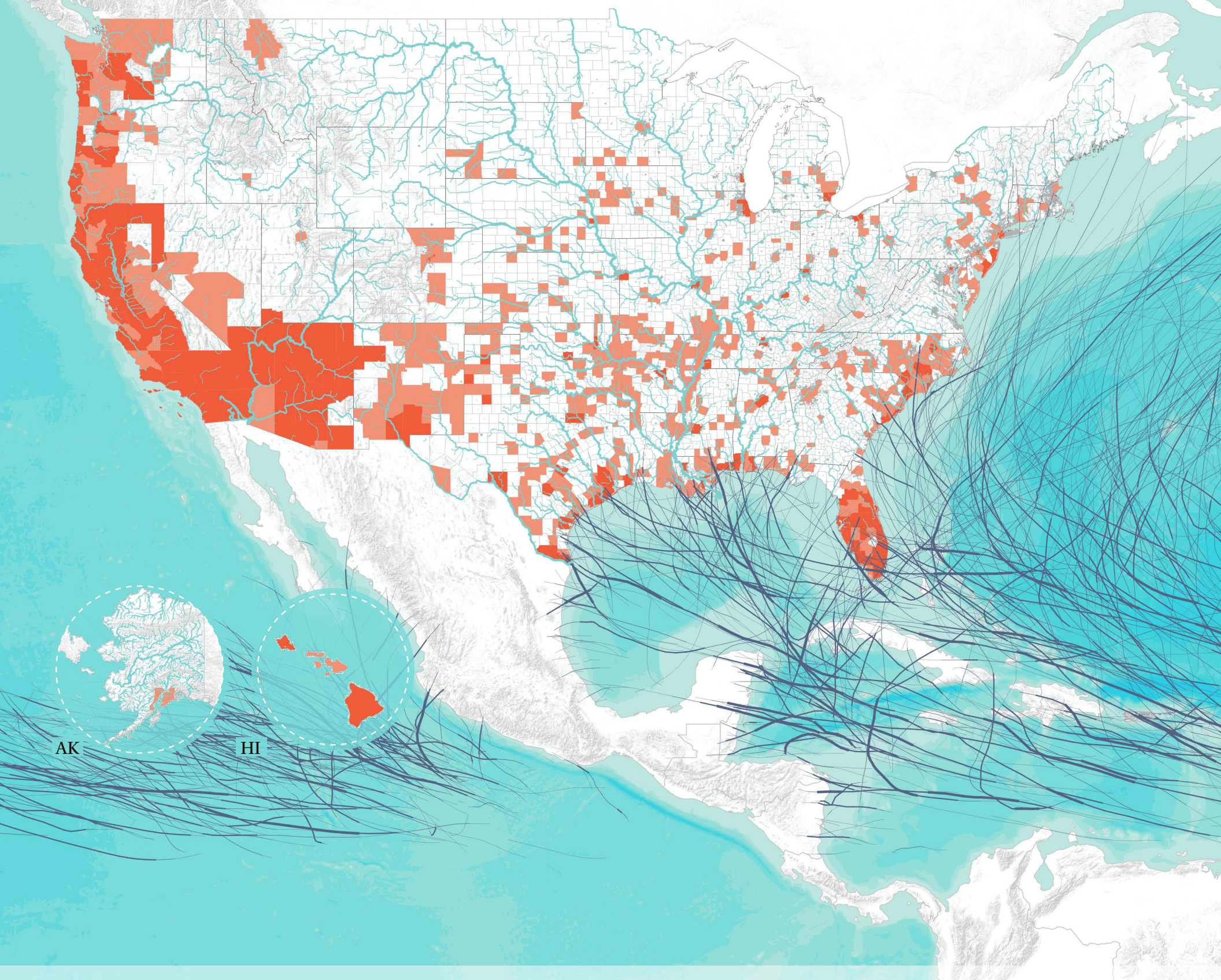
United States Environmental Protection Agency

Publication No. 230K22001
February 2023
www.epa.gov/smartgrowth



DISASTER-RESILIENT DESIGN CONCEPTS

Office of Policy, Office of the Administrator

Cover
Map: Hurricane paths between 1842-2022 and counties most at risk for all natural hazards: avalanche, coastal flooding, cold wave, drought, earthquake, hail, heat wave, hurricane, ice storm, landslide, lightning, riverine flooding, strong wind, tornado, tsunami, volcanic activity, wildfire, winter weather.

Hurricane Paths between 1842-2022

—— Category 2-5

National Risk Index Rating
All Natural Hazards

- High Risk
- Moderate Risk

Data taken from: Federal Emergency Management Agency (FEMA); National Centers for Environmental Information (NCEI); National Oceanic and Atmospheric Administration (NOAA); U.S. Department of Commerce; U.S. Census Bureau; Esri; Garmin International, Inc.; U.S. Central Intelligence Agency.
Basemap: Esri; U.S. Geological Survey (USGS); NOAA

Data for Puerto Rico, Northern Mariana Islands, Guam, American Samoa, and U.S. Virgin Islands are limited and included in this report as footnotes, where available.

Data used to assess the Risk Index Rating for all the hazards shown in this document were taken from FEMA. The **National Risk Index Rating** is defined as the potential for negative impacts as a result of a natural hazard, where Expected Annual Loss from natural hazards, Social Vulnerability and Community Resilience are factored in to produce a Risk Index Rating.

For more in-depth information about the Index, scores, ratings, and technical documentation, visit: *https://hazards.fema.gov/nri/determining-risk*

ACKNOWLEDGMENTS

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TABLE OF CONTENTS

INTRODUCTION

The potential for disaster increases as communities expand into hazard-prone areas and climate change alters the frequency, severity, and locations of threats. These disaster-resilient designs showcased in this document can help communities reduce the impact of disasters, recover more quickly, strengthen local economies, and create safer, more equitable places to live by reducing hazards especially for those most vulnerable. This document includes design concepts for seven different hazards and shows how local features and actions could be integrated into a strategy that improves disaster resiliency. This document also explains how communities can experience a layering or synergy among different hazards—for instance, drought can contribute to wildfire, after which erosion and flooding can occur in the same area.

The strategies presented here include policies such as forest management and building codes that can be key to protecting life and property from natural disasters. Designs found here were adapted from community assistance provided by EPA's Office of Community Revitalization through its Greening America's Communities program and focus more on landscape-based investments that mitigate hazards and increase outdoor benefits for the community. These design examples are intended to inspire a range of stakeholders to come together and invest in projects and infrastructure that achieve multiple benefits. Community members and decision makers alike are encouraged to evaluate both present risk and those influenced by continued climate change—and to take action appropriate to their area.

Stakeholders can use this document to reimagine the design of a town or neighborhood to serve multiple purposes and needs. For instance, adding trees to a playground can both make the playground more pleasant and help lower ambient heat in the surrounding neighborhood. Widening stream channels with natural buffers can provide more capacity for flood waters to flow while also creating space for a new hiking trail. Multi-benefit designs allow for recreation, create buffers for natural disasters, and become safe gathering places when disaster strikes.

The public and private entities that invest in resilient infrastructure should carefully consider which communities most need these investments based on historical disadvantages and greatest current and projected exposure to hazards. The maps provided here illustrate the extent of the risks already observed from historical data; climate change is expected to amplify these hazard risks and to further impact poor and vulnerable communities at disproportionate rates.[1]

Furthermore, the designs developed for a specific place must be created by and for the communities they are intended to protect through meaningful engagement. These design ideas are meant to be within certain conditions; communities are encouraged to learn more about what hazards they may be at risk for, but also explore climate change pressures that can increase frequency, severity and reach of these hazards. Data that is accessible and understandable by all stakeholders is key to successful engagement, and a good start are the resources available at https://resilience.climate.gov and https://www.epa.gov/environmentaljustice Disaster-Resilient Community Designs can spark discussion and action to building a more just and resilient future by giving communities strategies that can help them thrive in a changing climate.

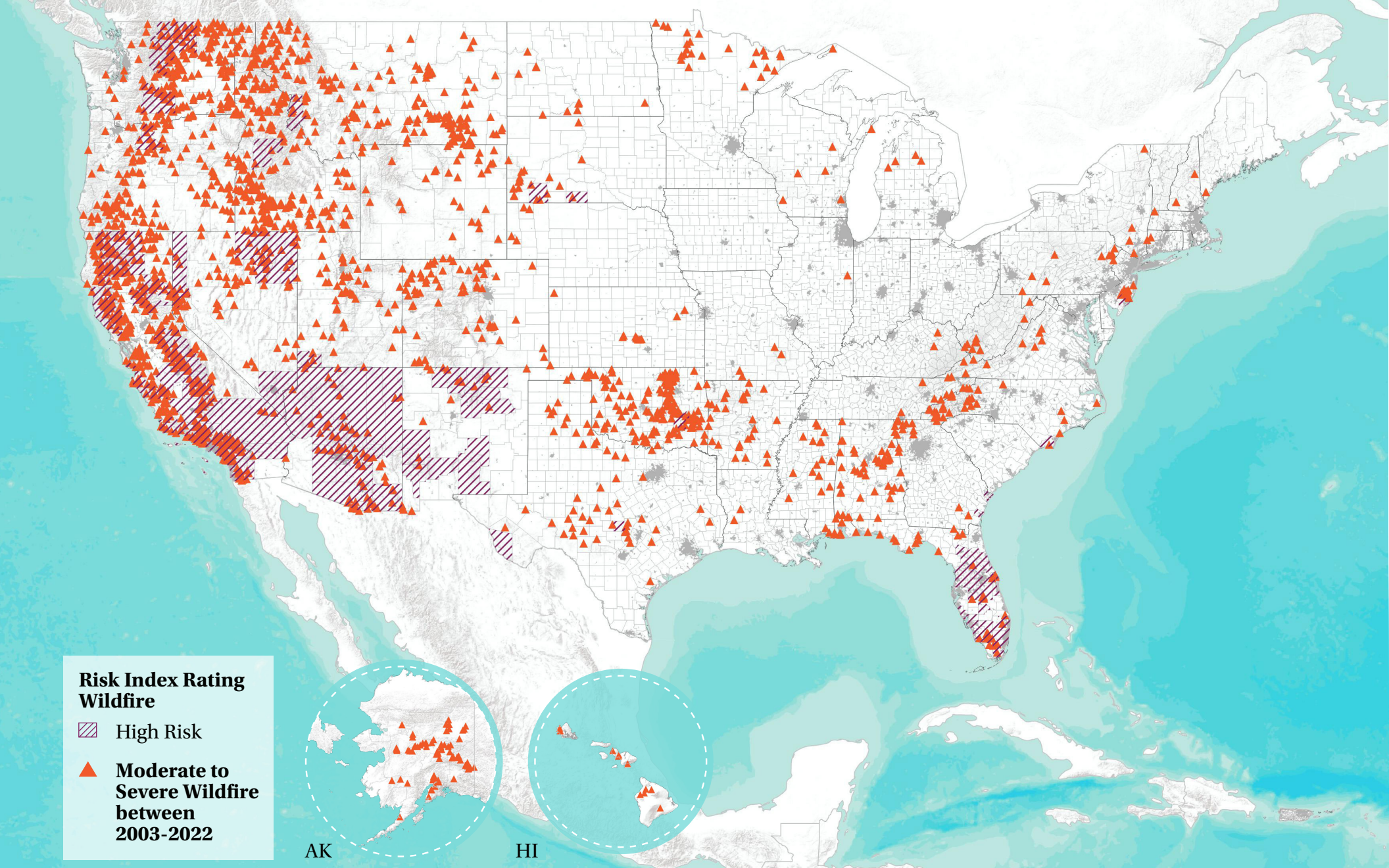
More detailed policy guides and planning resources are provided in the Resources section of each chapter and the Additional Resources section at the end of this document.

1 EPA. 2021. Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts. EPA 430-R-21-003. https://www.epa.gov/cira/social-vulnerability-report

1 DISASTER TYPE

WILDFIRE

Wildfire locations from 2003-2022, and counties most at risk for wildfire



Climate change is driving an increase in the risk and extent of wildfires in the United States. Projected warmer temperatures and drier conditions will make fires more frequent, larger, and harder to contain.

Changing climate patterns of increased drought, high air temperatures, low relative humidity, lightning, and strong winds throughout the United States have been the catalysis for an on-going crisis of catastrophic wildfires. According to the 2022 *Synthesis of Wildfire Crisis Strategy Roundtable Report* developed jointly by the National Forest Foundation and the USDA, Forest Service, climate change along with "overgrown forests, population growth in forested areas, and past management practices" have driven this alarming trend.[2] Smoke from wildfires greatly impairs air quality, often to hazardous levels, in areas far beyond the places that are burned. Climate change, added to years of fire suppression, creates ideal conditions for wildfires: increased drought, high air temperatures, low relative humidity, lightning, and strong winds. The result is hotter, more widespread, and longer fire seasons.

Increased development into wildland areas puts more homes and other buildings at risk from catastrophic fires that can endanger or destroy communities. It is estimated that the damage caused by U.S. wildfires in 2020 totaled $16.5 billion, ranking it as the third-costliest year on record, behind 2018 ($24 billion) and 2017 ($18 billion). At least 43 people died as a direct result of the western U.S. fires in 2020.[3] It is estimated that wildfire smoke is likely responsible for 5,000 to 15,000 deaths in an average year in the United States.[4]

RESOURCES

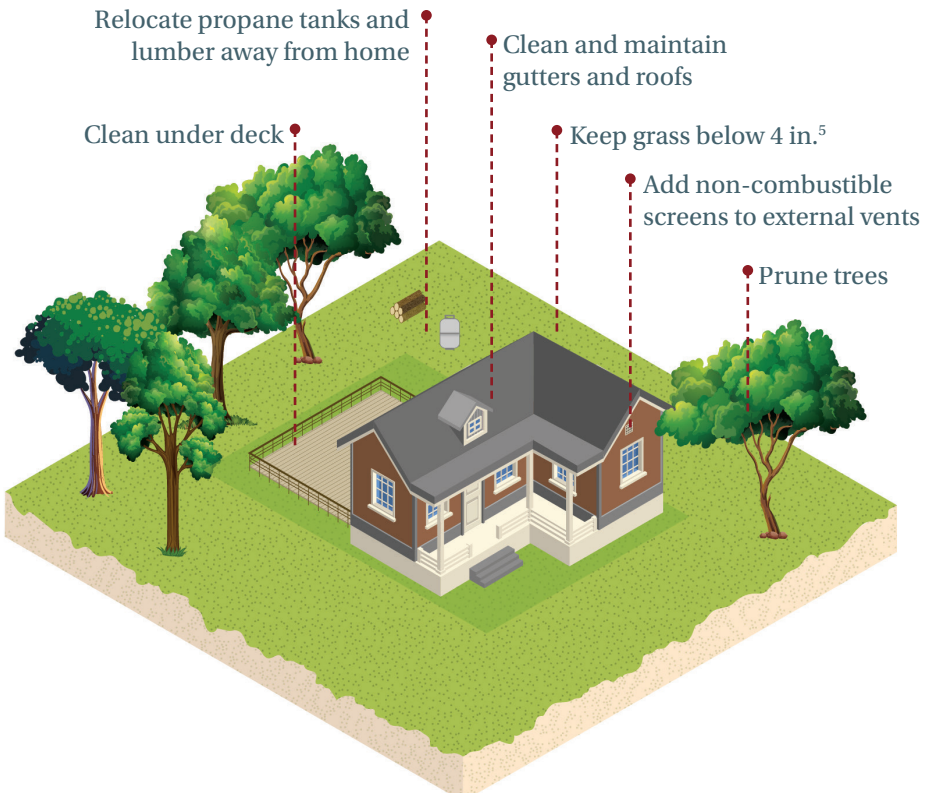
- EPA Wildfire Preparedness *https://www.epa.gov/natural-disasters/wildfires*
- EPA Smart Growth Fixes for Climate Change Adaptation and Resilience *https://www.epa.gov/smartgrowth/smart-growth-fixes-climate-adaptation-and-resilience*
- First Street Foundation Risk Factor Tool *https://riskfactor.com/*
- Resilience Strategies for Wildfire *https://www.c2es.org/document/resilience-strategies-for-wildfire/*
- Reduce Wildfire Risk *https://wildfirerisk.org/reduce-risk/*
- Managing the Wildland Urban Interface *https://www.usfa.fema.gov/wui/*
- National Fire Protection Association *https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA*

2 Synthesis of Wildfire Crisis Roundtables 2022, National Forest Foundation. 2022. https://www.nationalforests.org/assets/pdfs/Wildfire-Crisis-Strategy-Roundtables-Synthesis-Report-2022-web.pdf
3 NOAA. "2020 U.S. billion-dollar weather and climate disasters in historical context." https://www.climate.gov/disasters2020. Published January 8, 2021.
NOAA. "U.S. billion-dollar Weather & Climate Disasters 1980-2022." https://www.ncei.noaa.gov/access/billions/events.pdf. Accessed December 12, 2022.
4 Stanford University Institute for Economic Policy Research (SIEPR). "Managing the growing cost of wildfire." https://siepr.stanford.edu/publications/policy-brief/managing-growing-cost-wildfire. Published October 2020.

Insufficient data for U.S. territories and commonwealths. Puerto Rico and the Pacific Territories experience a significant wildfire risk.

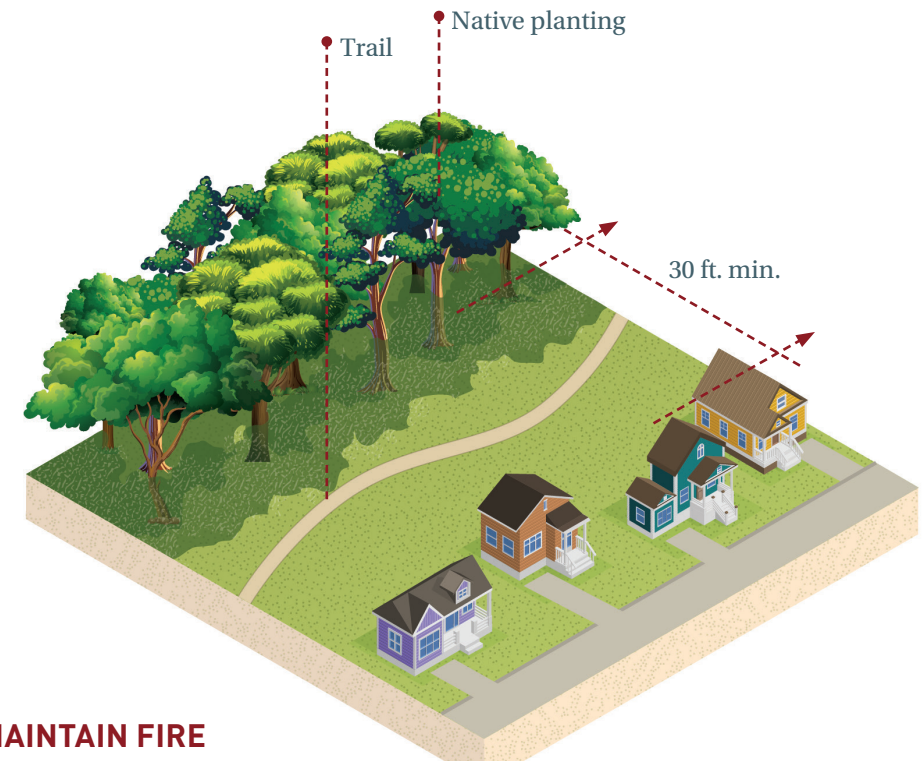
Data taken from: FEMA, Wildland Fire Interagency Geospatial Services (WFIGS), U.S. Department of Commerce, U.S. Census Bureau, Esri; Garmin International, Inc.; U.S. Central Intelligence Agency. Basemap: Esri, USGS, NOAA

1 KEY STRATEGIES
WILDFIRE



PREPARE FIRE-SMART HOMES

Fire-smart homes reduce the risk of damage to houses and the spread of fire through a neighborhood.



MAINTAIN FIRE BREAKS

Expand defensible space with protective barriers such as hardscaping and, in some cases, plants carefully selected and maintained for climate resilience and relative fire resistance. Consult state or local emergency management for landscape recommendations for compatible plant choices. [6]

5 National Fire Protection Association. "Preparing homes for wildfire." https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Preparing-homes-for-wildfire. Accessed December 5, 2022.

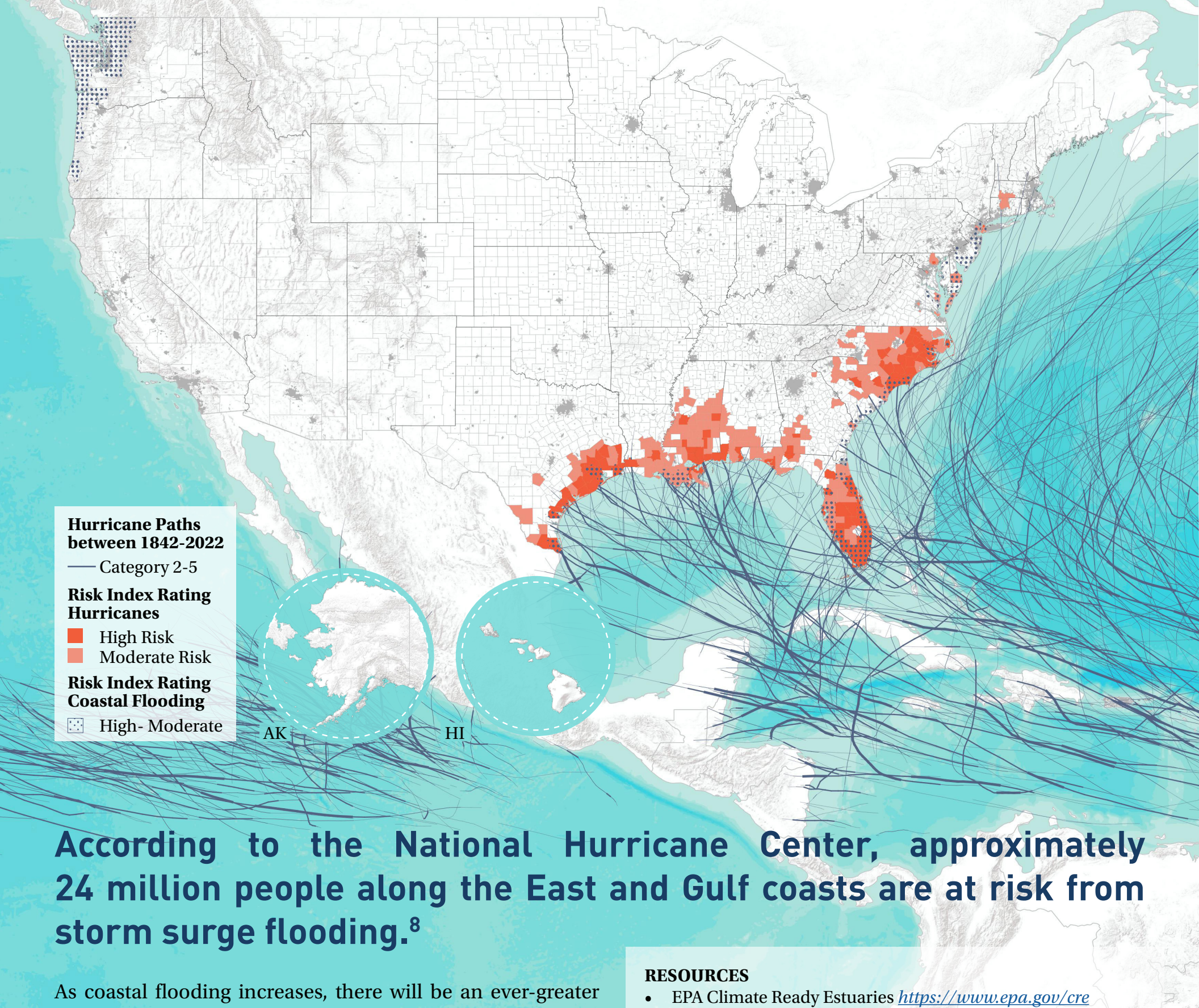
6 California Office of Emergency Services. "Prepare for Wildfire – Defensible Space." https://www.readyforwildfire.org/prepare-for-wildfire/get-ready/defensible-space/. Accessed December 12, 2022 and California Office of Emergency Services. "Prepare for Wildfire – Fire Smart Landscaping." https://www.readyforwildfire.org/prepare-for-wildfire/get-ready/fire-smart-landscaping/. Accessed December 12, 2022.

7 The Three R's of Defensible Space" - https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_020876.pdf
University of Nevada, Reno (Cooperative Extension and Agricultural Experiment Station), the Sierra Front Wildfire Cooperators and the Pacific Northwest Prevention Working Team, "Living with Fire: A Guide for the Homeowner," https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_020876.pdf, May 1999.

2 | DISASTER TYPE

HURRICANE and COASTAL FLOODING

Counties most at risk for hurricanes and coastal flooding, and hurricane paths between 1842-2022



According to the National Hurricane Center, approximately 24 million people along the East and Gulf coasts are at risk from storm surge flooding.[8]

As coastal flooding increases, there will be an ever-greater need for coastal communities to adapt to the increasing occurrence of coastal floods, higher tides as sea levels rise, storm surges, coastal erosion, and saltwater intrusion. Nature-based solutions—such as dune restoration, open space buffers, oyster beds, mangrove forests, or creating blue-green trails that can take on water during a storm—can help protect communities from hurricanes and coastal floods.

Other strategies can complement nature-based solutions, such as stronger building codes to reduce repetitive damage from hurricanes and flooding, outlining clear evacuation routes during storms, and providing emergency shelter after storms. At the planning level, preventing new development in flood-prone areas is a critical long-term strategy to minimize loss of life and property damage in coastal communities.

RESOURCES

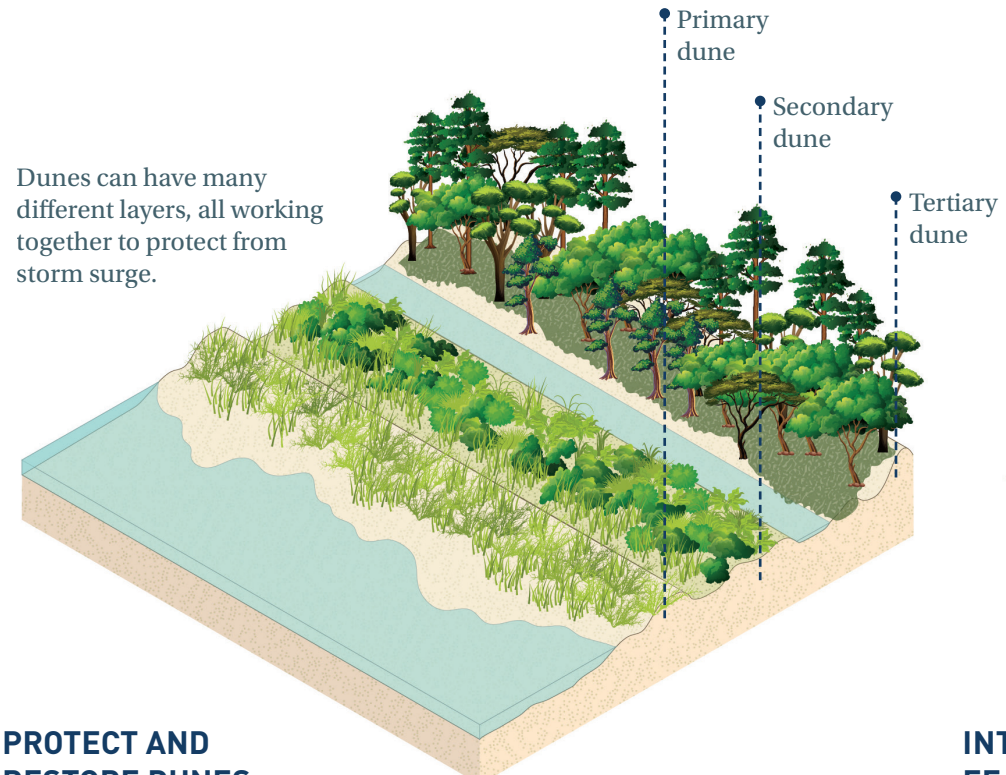
- EPA Climate Ready Estuaries *https://www.epa.gov/cre*
- EPA Smart Growth Fixes for Climate Change Adaptation and Resilience https://www.epa.gov/smartgrowth/smart-growth-fixes-climate-adaptation-and-resilience
- First Street Foundation Risk Factor Tool *https://riskfactor.com/*
- Climate Change Indicators *https://www.epa.gov/climate-indicators/climate-change-indicators-coastal-flooding*
- U.S. Climate Resilience Toolkit *https://toolkit.climate.gov*
- NOAA Coastal Inundation Toolkit *https://climatechange.lta.org/coastal-inundation-toolkit/*
- NOAA Sea Level Rise Viewer *https://coast.noaa.gov/digitalcoast/tools/slr.html*
- Flood Resilience Checklist *https://www.epa.gov/smartgrowth/flood-resilience-checklist*

8 Zachry, B. C., W. J. Booth, J. R. Rhome, and T. M. Sharon, 2015: A National View of Storm Surge Risk and Inundation. Weather, Climate, and Society, 7(2), 109–117. DOI: https://journals.ametsoc.org/view/journals/wcas/7/2/wcas-d-14-00049_1.xml

Insufficient data for U.S. territories and commonwealths. These territories experience a significant risk of hurricanes and coastal flooding.

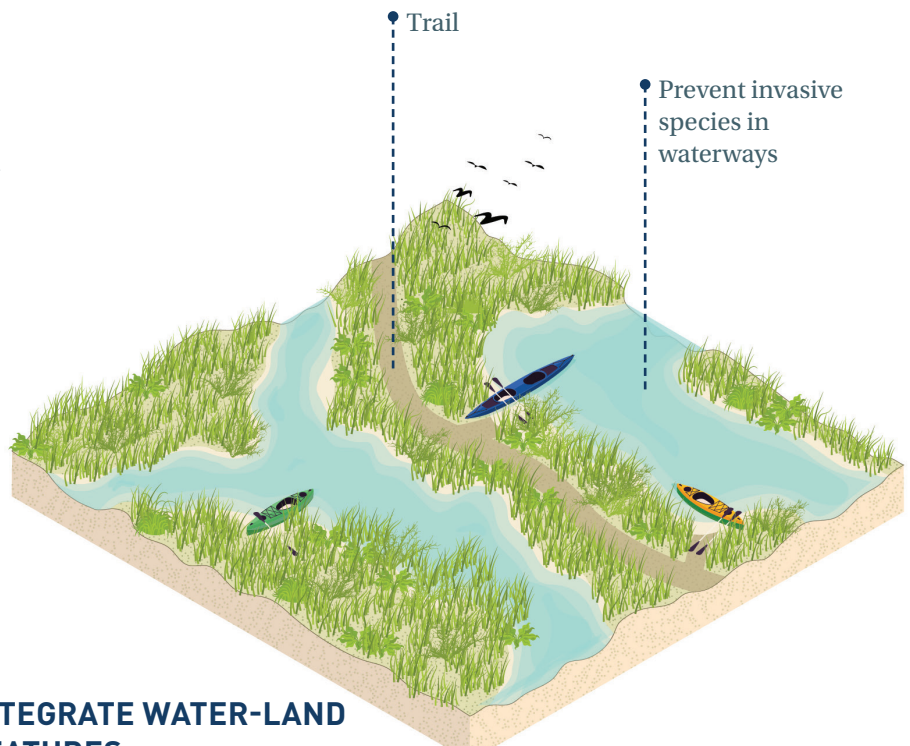
Data taken from: FEMA, NCEI, NOAA, U.S. Department of Commerce, U.S. Census Bureau, Esri; Garmin International, Inc.; U.S. Central Intelligence Agency. Basemap: Esri, USGS

2 | KEY STRATEGIES
HURRICANE and COASTAL FLOODING



PROTECT AND RESTORE DUNES

Dunes that are stabilized by native vegetation protect nearby communities from storm surges.



INTEGRATE WATER-LAND FEATURES

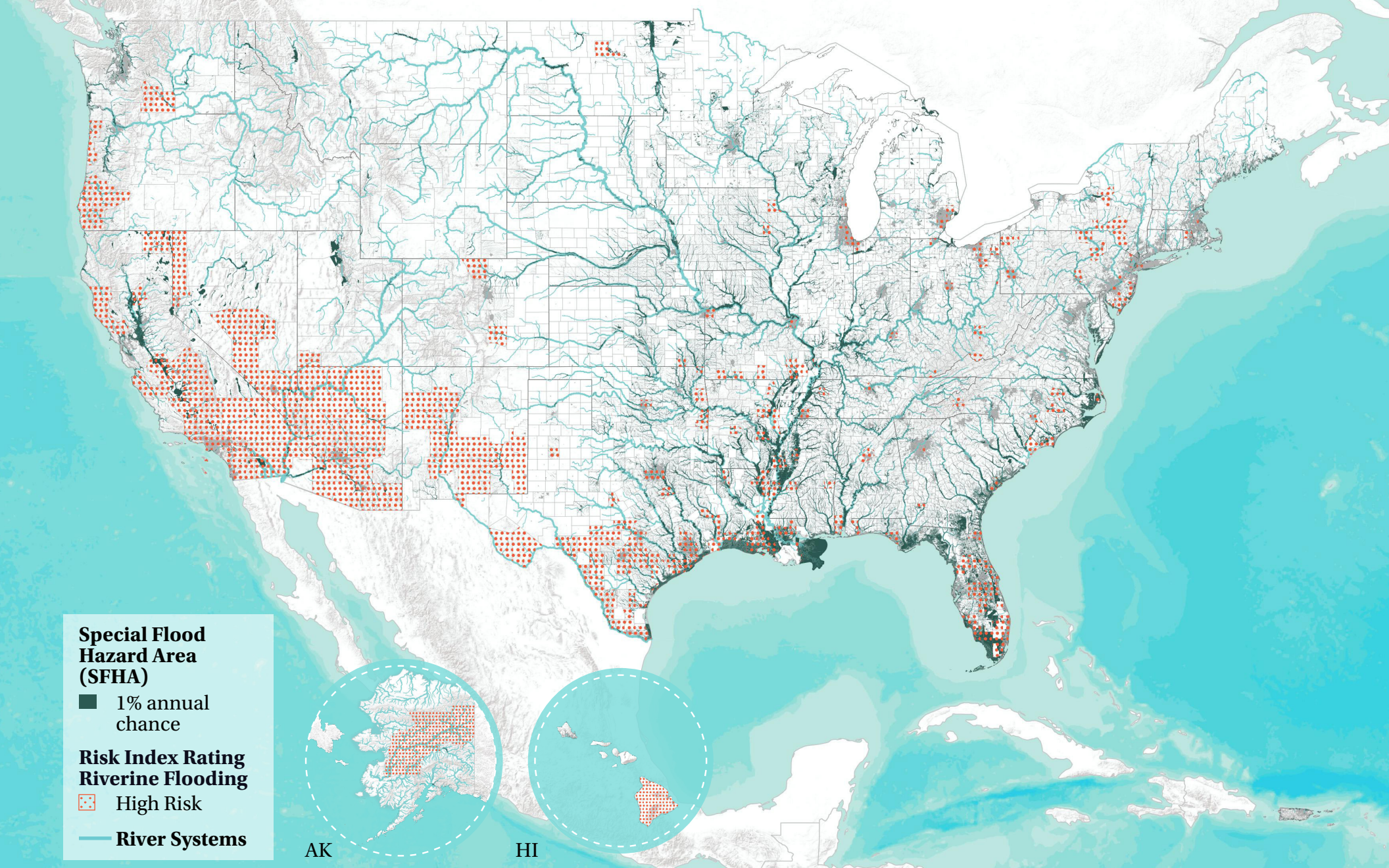
A watershed approach of multi-use functions such as trails in a flooding buffer provides health benefits to both ecosystem and residents

Data taken from: Charleston County, SC GIS viewer

3 | DISASTER TYPE

INLAND and RIVERINE FLOODING

Counties most at risk for riverine flooding and 1% annual chance flood hazard area



Climate change is causing more frequent and higher intensity rainstorms, which often result in increased flooding.

Climate change is creating new rainfall patterns across the country. Communities that historically have not had many major flood events are likely to see more, and places that already flood are likely to experience worse and more frequent flooding. New construction or infrastructure in the region—such as a new highway that changes the local drainage patterns– can further increase the likelihood of flooding.

One of the best ways to reduce the risk of flood is to improve the entire watershed's ability to quickly soak up water and prevent runoff of pollutants downstream. Increasing opportunities for infiltration helps to reduce or prevent larger floods downstream. Parks and public plazas can be designed with green infrastructure practices such as bioswales, rain gardens, and tree planting, and can offer recreational areas, store flood water, and reduce air temperature. "Green street" practices that include green infrastructure elements in the public right-of-way can reduce the impacts of intense storms by lessening the amount of runoff and slowing down the rate of flow, while also making streets more attractive and enjoyable.

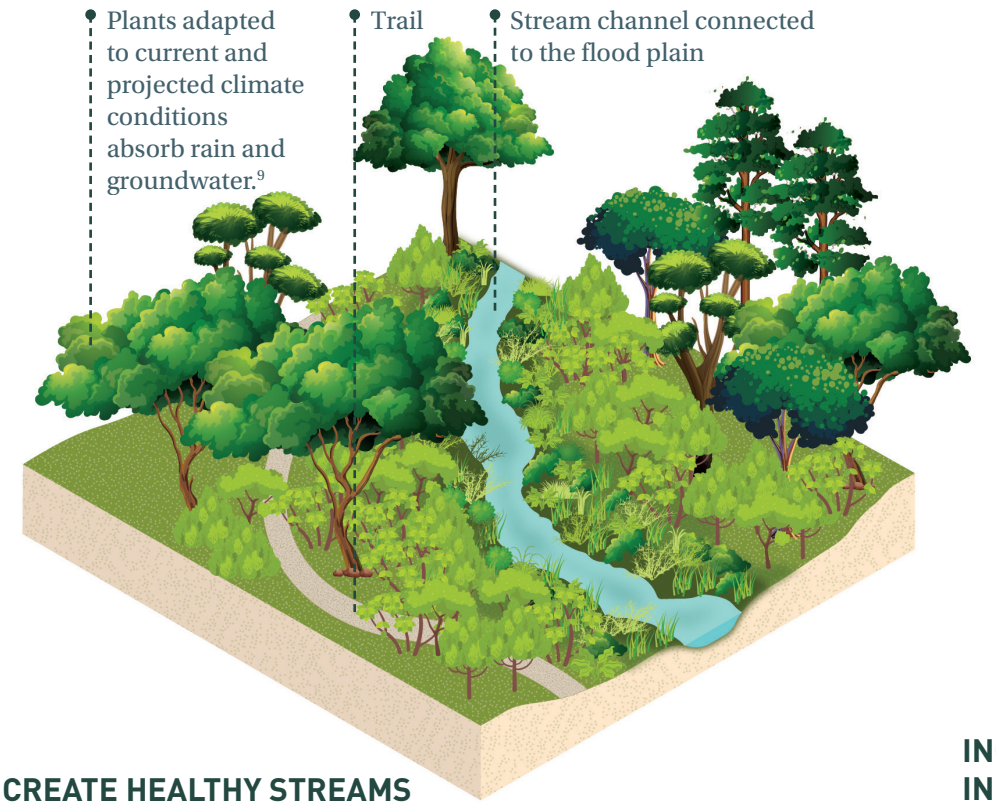
RESOURCES

- EPA: Enhancing Sustainable Communities with Green Infrastructure *https://www.epa.gov/smartgrowth/enhancing-sustainable-communities-green-infrastructure*
- First Street Foundation Risk Factor Tool *https://riskfactor.com*
- EPA Tidal Restrictions Synthesis Review *https://www.epa.gov/wetlands/tidal-restrictions-synthesis-review*
- EPA Climate Change Indicators: River Flooding *https://www.epa.gov/climate-indicators/climate-change-indicators-river-flooding*
- EPA Manage Flood Risk with Green Infrastructure *https://www.epa.gov/green-infrastructure/manage-flood-risk*
- EPA Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts *https://www.epa.gov/cira/social-vulnerability-report*
- EPA City Green: Innovative Green Infrastructure Solutions for Downtowns and Infill Locations *https://www.epa.gov/smartgrowth/city-green-innovative-green-infrastructure-solutions-downtowns-and-infill-locations*

Insufficient data for U.S. territories and commonwealths. These territories experience a significant risk of inland and riverine flooding.

Data taken from: FEMA, USGS, Esri; Rand McNally; Bartholemew and Times Books; Digital Chart of the World (DCW); U.S. National Geospatial-Intelligence Agency; i-cubed, U.S. Department of Commerce, U.S. Census Bureau, Esri; Garmin International, Inc.; U.S. Central Intelligence Agency. Basemap: Esri, USGS, NOAA

3 | KEY STRATEGIES
INLAND and RIVERINE FLOODING

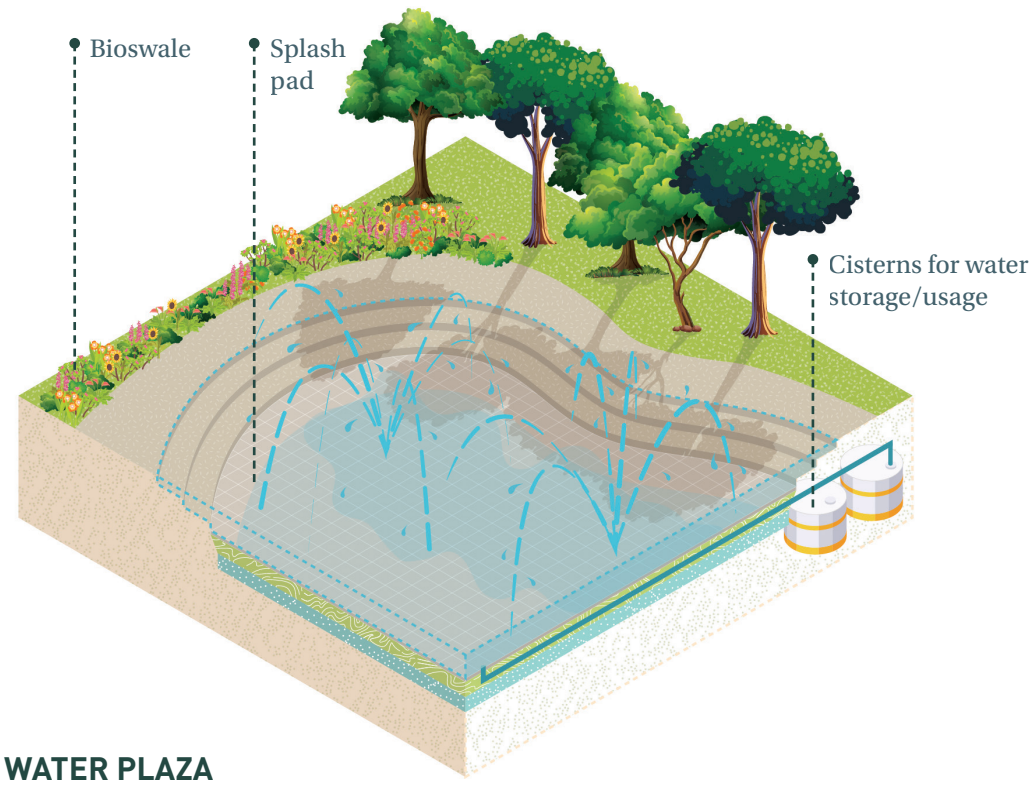


CREATE HEALTHY STREAMS

Use vegetated stream buffers to slow water during storm events, lowering downstream flood risk.

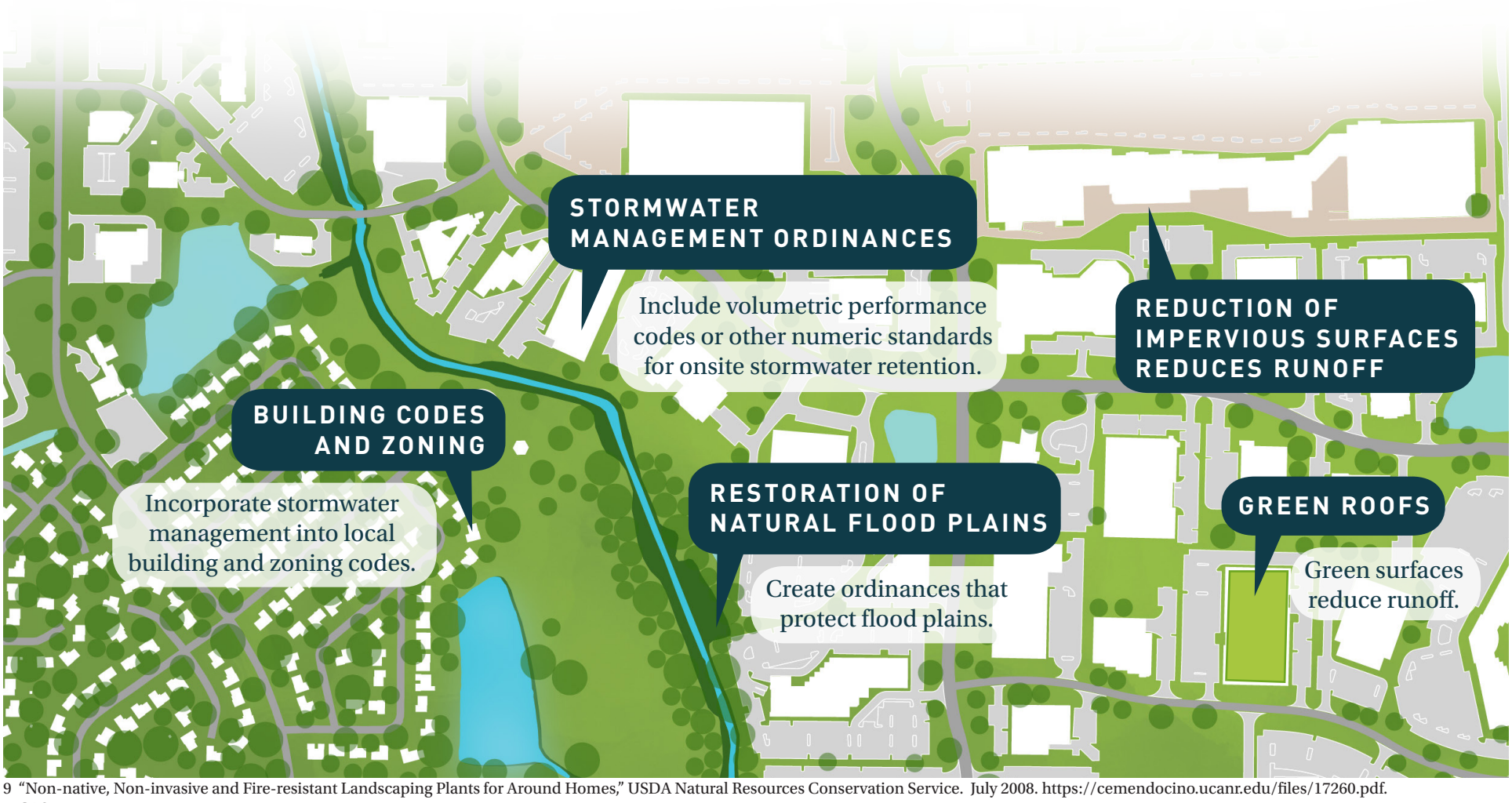
INCORPORATE GREEN INFRASTRUCTURE ON SITE

In developed areas, bioswales, rain gardens, and tree canopies help reduce runoff, which lessens flooding.



WATER PLAZA

Building play and recreational areas that store rain helps reduce flooding in the neighborhood.



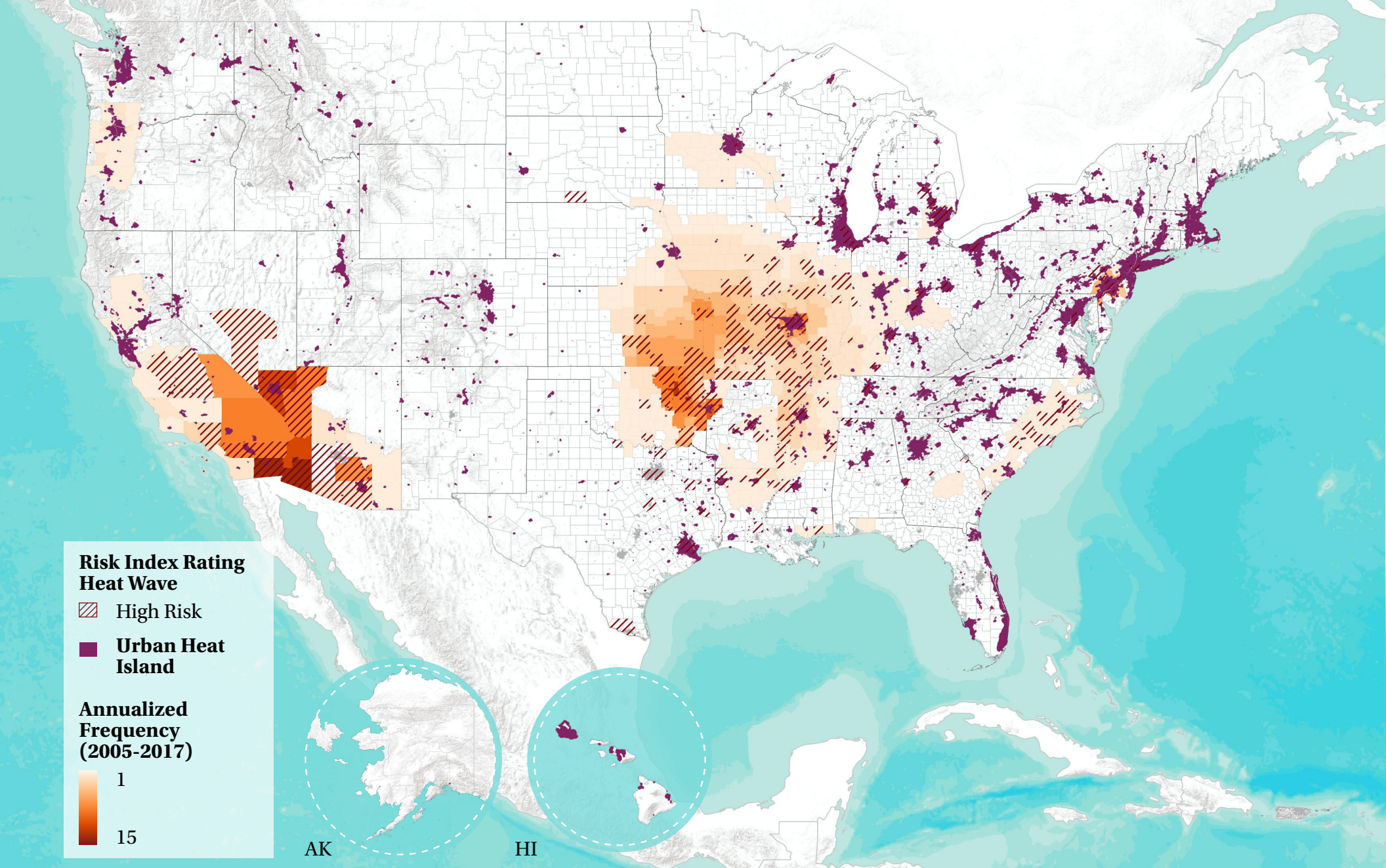
9 "Non-native, Non-invasive and Fire-resistant Landscaping Plants for Around Homes," USDA Natural Resources Conservation Service. July 2008. https://cemendocino.ucanr.edu/files/17260.pdf.

Data taken from: Lake County, IL GIS viewer

4 | DISASTER TYPE

EXTREME HEAT

Counties most at risk for heat waves, urban heat islands, and annualized frequency of heat wave events



Extreme heat events and heat waves, which kill more than 1,000 people each year in the United States, are expected to become more common, more severe, and longer lasting as our climate changes.[10]

A relative increase in high temperatures is designated as an extreme heat hazard, or heat wave if conditions persist over many days. The threshold varies by location; as an example, unusually high summer temperatures in Boston would not be exceptional in Phoenix.

Developed areas—places with a lot of pavement, buildings, and other heat-absorbing surfaces and fewer green spaces and trees—have higher temperatures than surrounding, less-developed areas. This phenomenon is called the heat island effect. Given the increase in extreme heat events, people—especially people living in lower-income communities—are at higher risk of excessive heat exposure, which can cause severe illness and death. The use of green infrastructure =practices such as trees, rain gardens, green roofs, green spaces such as parks, and reflective or light-colored, permeable pavements can reduce air temperatures while making neighborhoods more attractive.

RESOURCES

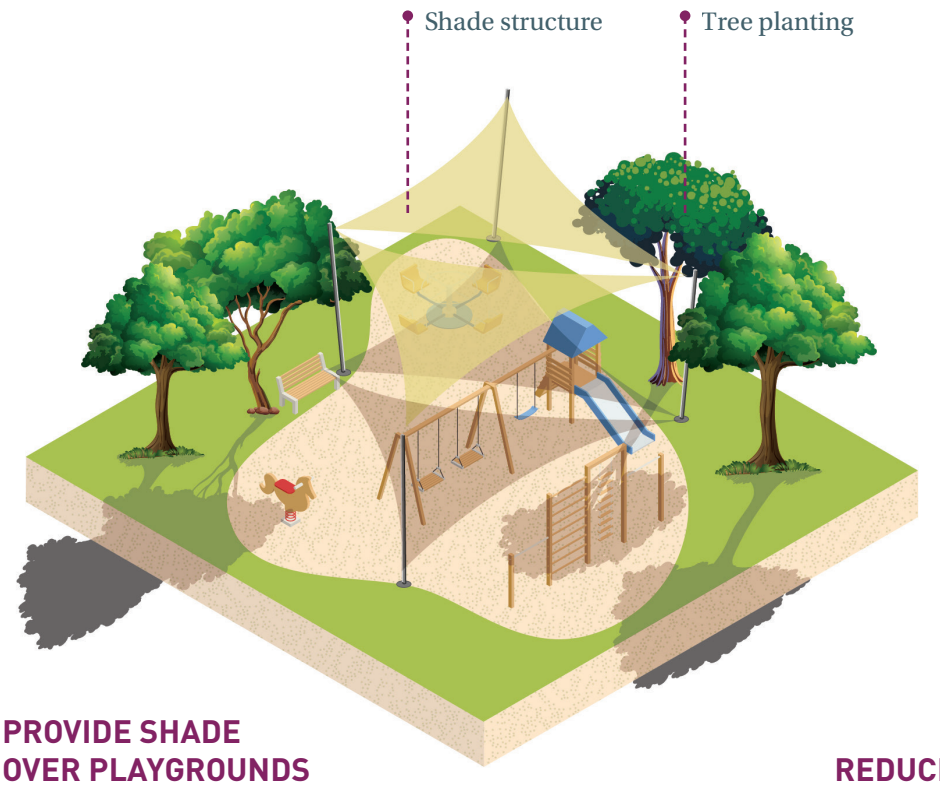
- National Integrated Heat Health Information System *https://www.heat.gov*
- EPA Heat Island Compendium *https://www.epa.gov/heatislands/heat-island-compendium*
- EPA Adapting to Heat *https://www.epa.gov/heatislands/adapting-heat*
- EPA/CDC Climate Change and Extreme Heat: What You Can Do to Prepare, October 2016 *https://toolkit.climate.gov/reports/climate-change-and-extreme-heat-what-you-can-do-prepare*
- EPA Reduce Urban Heat Island Effect *https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect*
- EPA Heat Island Cooling Strategies *https://www.epa.gov/heatislands/heat-island-cooling-strategies*
- EPA Smart Growth Fixes for Climate Change Adaptation and Resilience *https://www.epa.gov/smartgrowth/smart-growth-fixes-climate-adaptation-and-resilience*
- EPA Enhancing Sustainable Communities with Green Infrastructure *https://www.epa.gov/smartgrowth/enhancing-sustainable-communities-green-infrastructure*

10 Climate Change and Extreme Heat: What You Can Do to Prepare, EPA and CDC, 2016.

Insufficient data for U.S. territories and commonwealths. These territories experience significant risk of extreme heat.

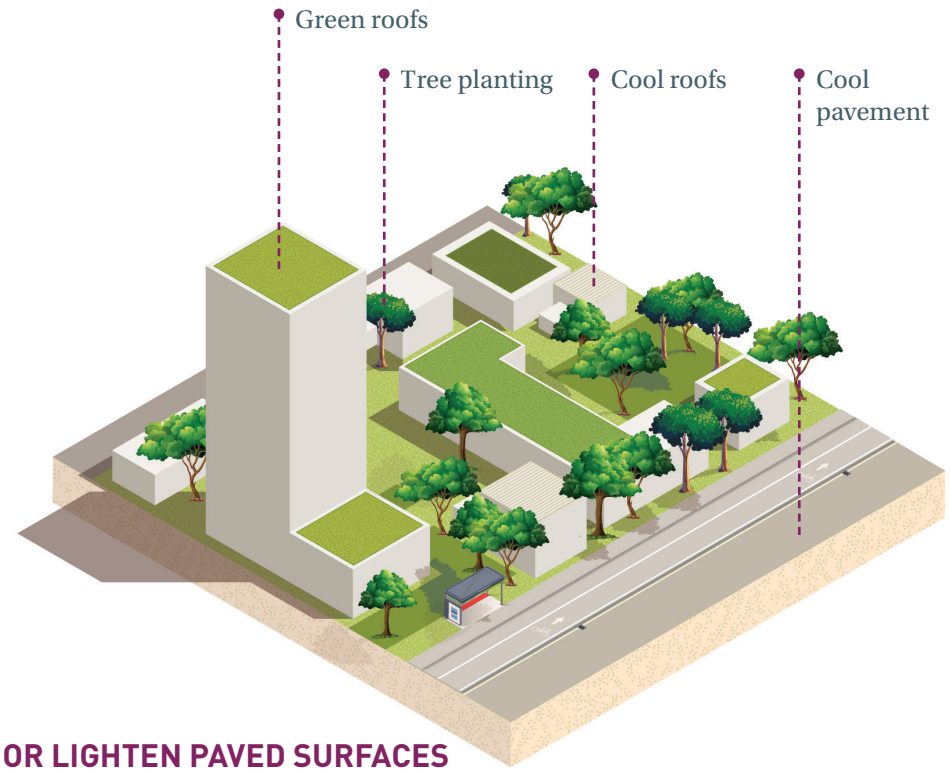
Data taken from: FEMA, Center for International Earth Science Information Network (CIESIN), Columbia University, U.S. Department of Commerce, U.S. Census Bureau, Esri; Garmin International, Inc.; U.S. Central Intelligence Agency. Basemap: Esri, USGS, NOAA

4 | KEY STRATEGIES
EXTREME HEAT



PROVIDE SHADE OVER PLAYGROUNDS

Shading playgrounds and other outdoor public spaces reduces temperatures and makes the space more attractive.



REDUCE OR LIGHTEN PAVED SURFACES

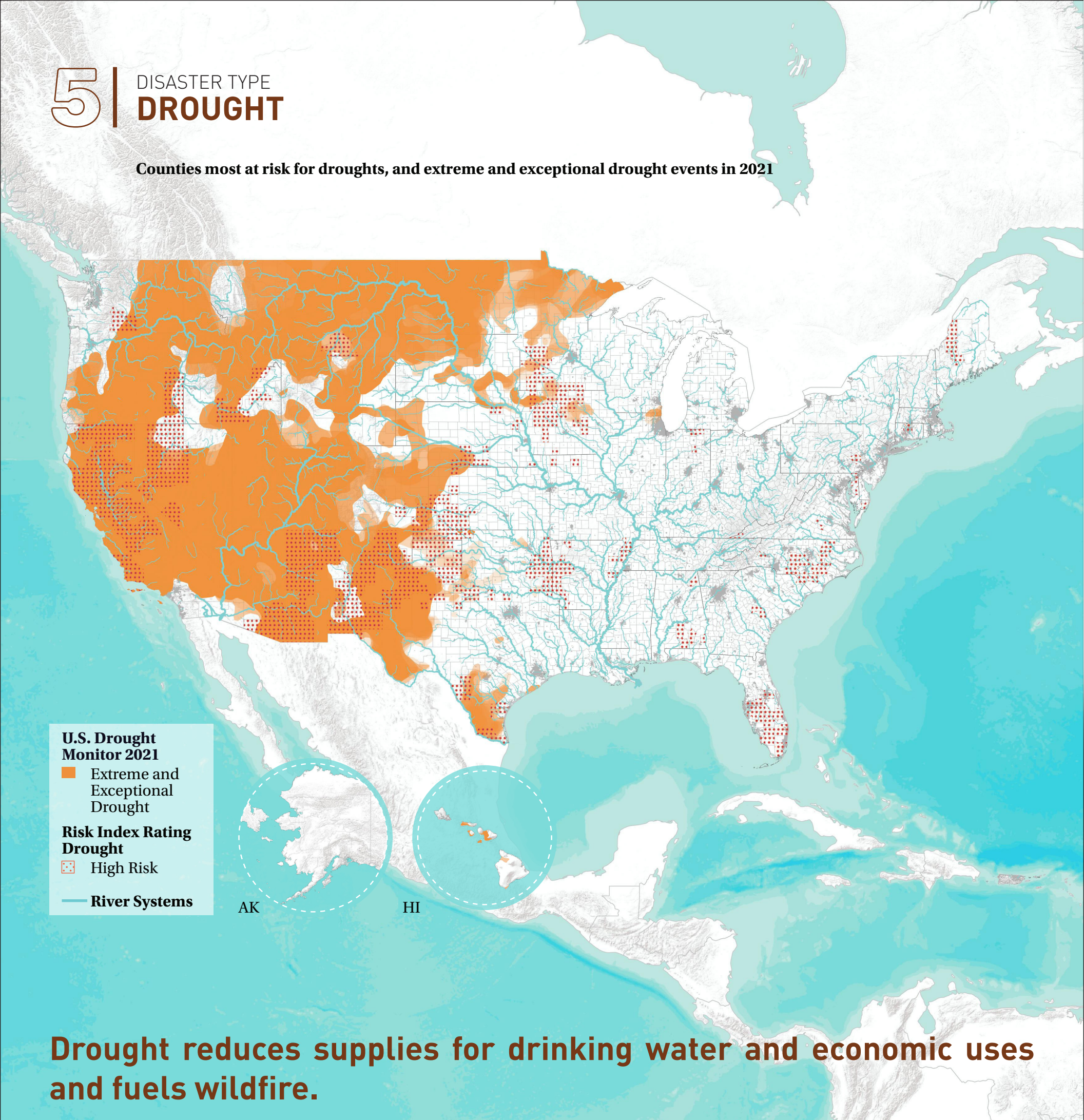
Replacing paved surfaces with greenery or lighter coatings reduces the surrounding air temperature.

Data taken from: 11 EPA. Using Trees and Vegetation to Reduce Heat Islands. https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat-islands. Accessed October 24, 2022.

5 | DISASTER TYPE

DROUGHT

Counties most at risk for droughts, and extreme and exceptional drought events in 2021



Drought reduces supplies for drinking water and economic uses and fuels wildfire.

Drought stands alone as its own hazard and is a contributing factor to other disasters such as wildfires. Drought is a prolonged period of unusually low rainfall, which varies depending on the place and time of year. It is a set of conditions that arise relatively slowly and affect communities differently. Prolonged and repeated droughts can lead to low water supply levels, which can affect energy generation, and depleted reservoirs.

The balance between agricultural and residential/commercial water demand varies at local and regional scales, and droughts often occur over large areas. Compact development patterns can reduce both water demand and the amount of water lost to leaks in aging pipes. Along with drought-tolerant landscaping and efficient use of water for buildings, green infrastructure can replenish groundwater supplies through infiltration practices such as bioretention and permeable pavements. Landscape-based designs using soil and vegetation to absorb runoff also can be used to increase stream baseflows and reduce the impacts of drought on water supplies.

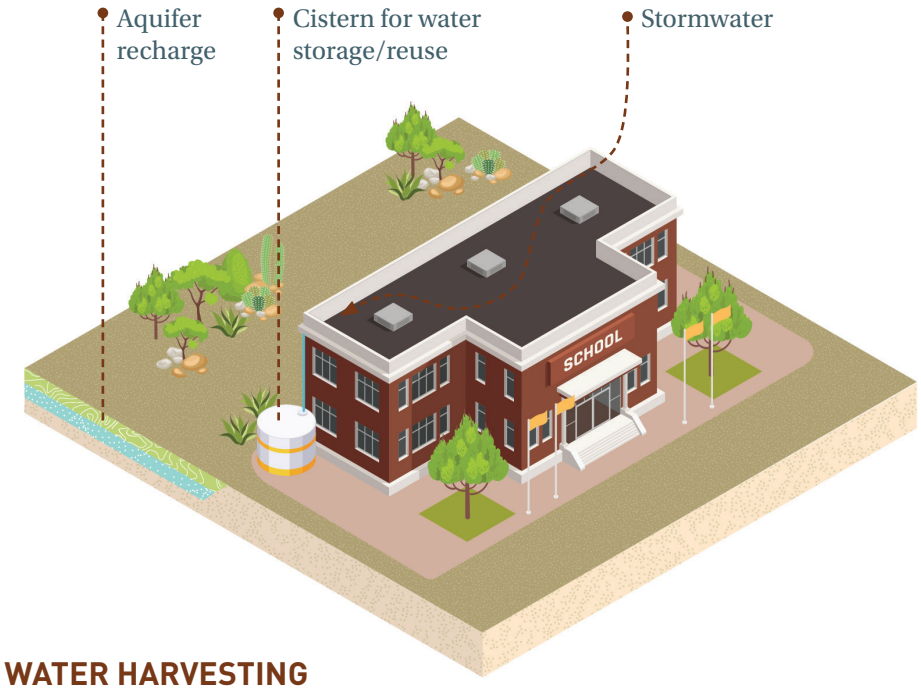
RESOURCES

- EPA WaterSense Program *https://www.epa.gov/watersense*
- National Drought Mitigation Center *https://drought.unl.edu*
- Center for Climate and Energy Solutions Resilience Strategies for Drought *https://www.c2es.org/document/resilience-strategies-for-drought/*
- FEMA Nature-Based Solutions *https://www.fema.gov/emergency-managers/risk-management/nature-based-solutions*
- Public Policy Institute of California Building Drought Resilience in California's Cities and Suburbs *https://www.ppic.org/publication/building-drought-resilience-californias-cities-suburbs/*
- NOAA, North American Drought Monitor (NADM) *https://www.ncei.noaa.gov/access/monitoring/nadm/*

Insufficient data for U.S. territories and commonwealths. These territories experience a significant risk of drought.

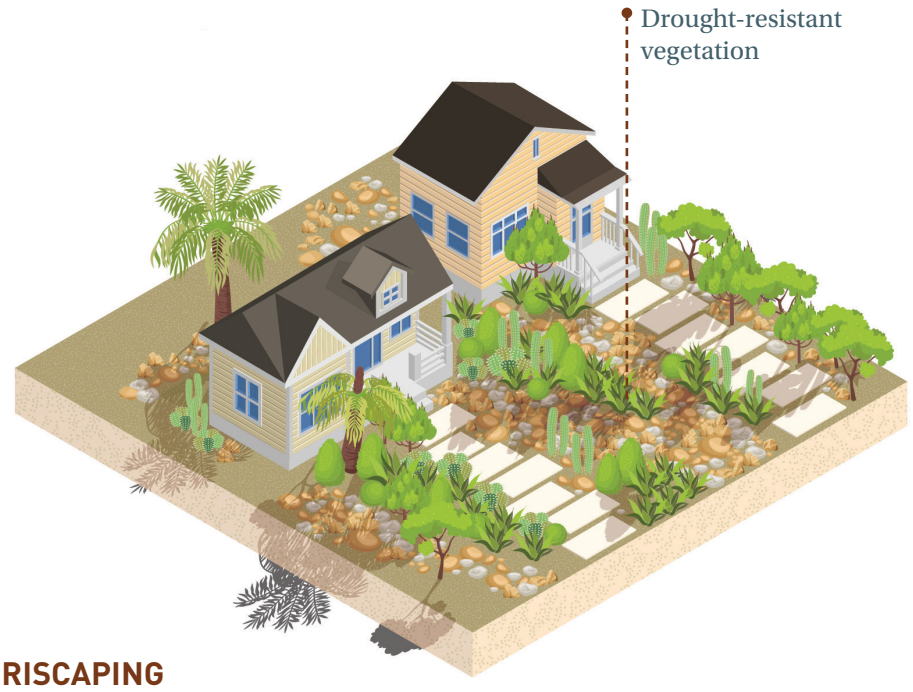
Data taken from: FEMA, National Drought Mitigation Center (NDMC), USDA, NOAA, Esri; Rand McNally; Bartholemew and Times Books; Digital Chart of the World (DCW); U.S. National Geospatial-Intelligence Agency; i-cubed, U.S. Department of Commerce, U.S. Census Bureau, Esri; Garmin International, Inc.; U.S. Central Intelligence Agency. Basemap: Esri, USGS, NOAA

5 | KEY STRATEGIES
DROUGHT



WATER HARVESTING

Collecting water for reuse and allowing water to seep into the aquifer will reduce region-wide drought.



XERISCAPING

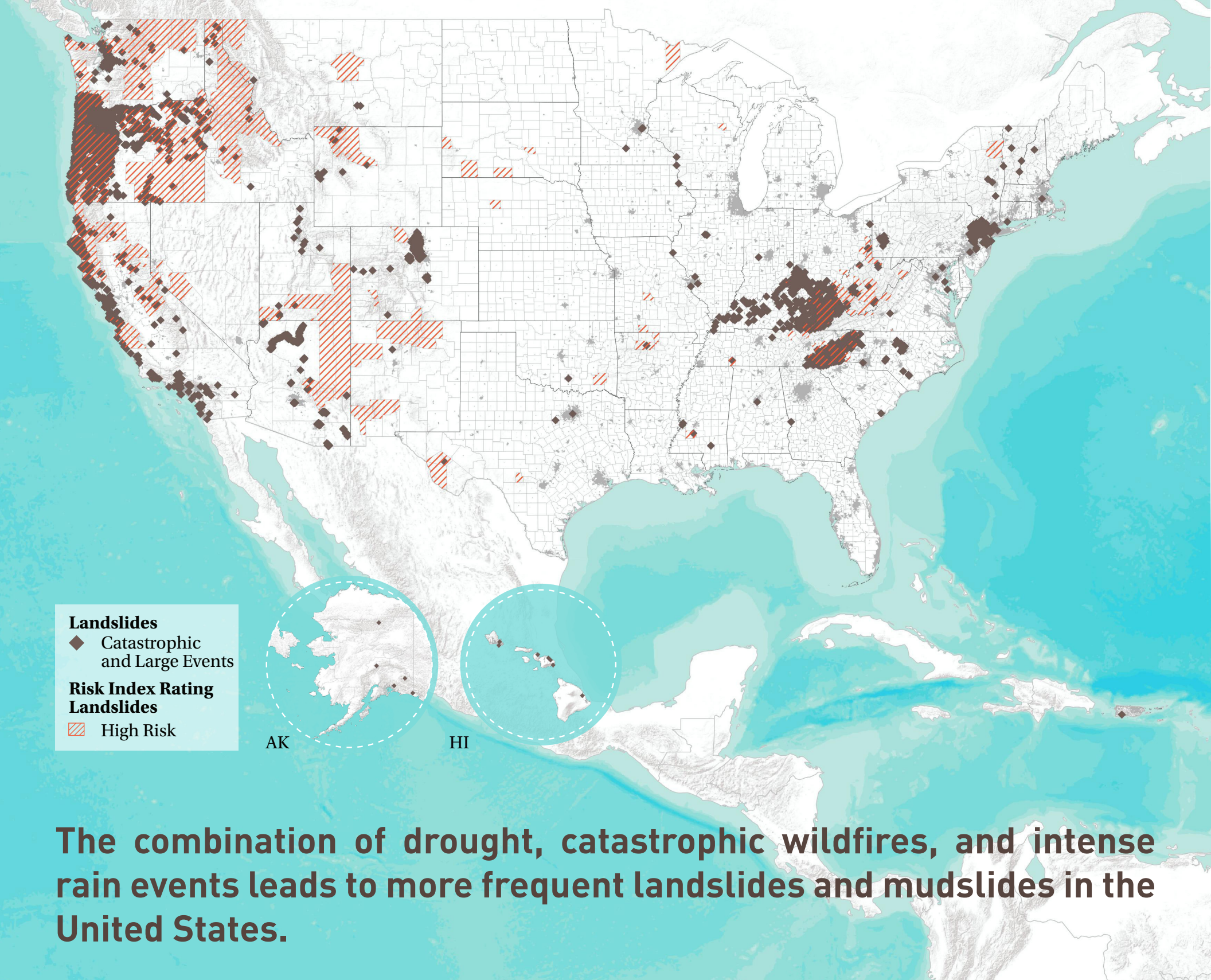
Plant native species, or increase the amount of plants in arid climates, that demand less water. Avoid popular but unsuitable plants for hotter and drier climate conditions.

Data taken from: Adams County, CO GIS viewer

6 | DISASTER TYPE

LANDSLIDE and MUDSLIDE

Counties most at risk for a landslide or mudslide, and catastrophic-large landslide events between 1916-2021



The combination of drought, catastrophic wildfires, and intense rain events leads to more frequent landslides and mudslides in the United States.

Although landslides can be associated with earthquakes and other geologic hazards, they are exacerbated by climate change impacts. Landslides are much more likely to occur where stabilizing vegetation has been removed due to development and/or has been destroyed by wildfires or weakened by drought. Heavy rain can also trigger landslides.

In the Southwestern United States and the arid West, wildfires followed by short, intense rain events are a common cause of debris flows. Post-fire debris flows can happen with little warning and cause extensive damage to infrastructure and ecosystems, putting lives at risk. Green infrastructure approaches can reduce the risk of landslides by managing the vegetation on steep slopes, reforesting areas uphill of potential landslide areas, and creating vegetated buffers on hillsides.

RESOURCES

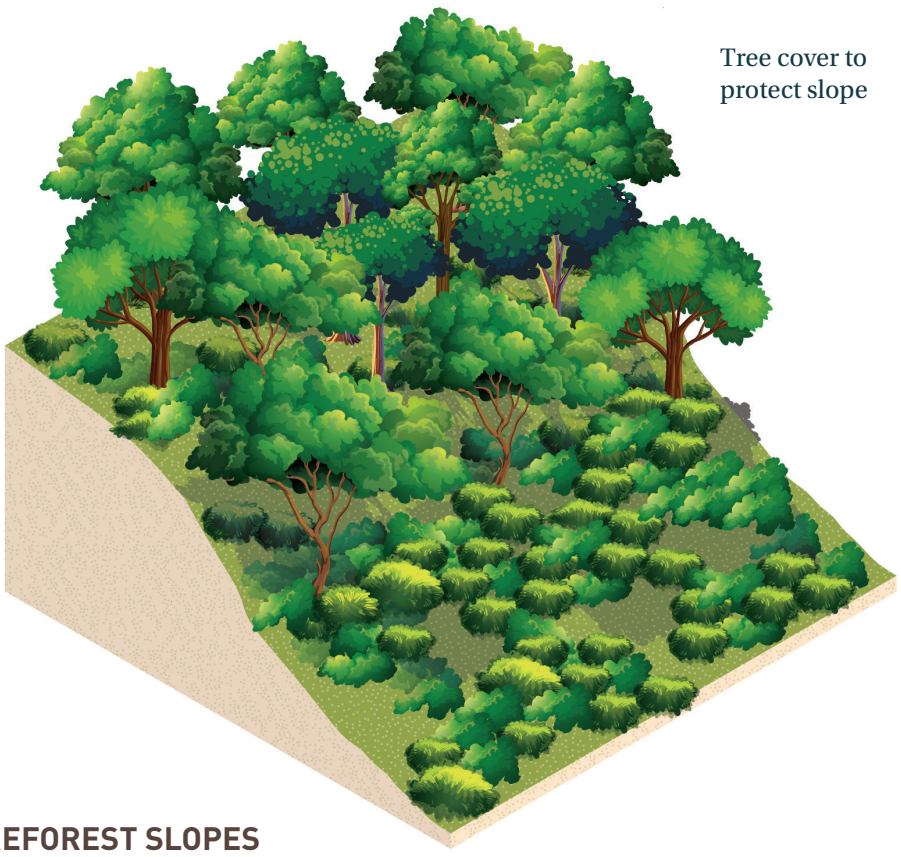
- National Landslide Risk Map *https://hazards.fema.gov/nri/landslide*
- CDC Mudslides Fact Sheet *https://www.cdc.gov/disasters/landslides.html#risk*
- USGS What is a landslide and what causes one? *https://www.usgs.gov/faqs/what-landslide-and-what-causes-one*
- Oregon DLCD and DOGAMI Preparing for Landslide Hazards *https://www.oregongeology.org/Landslide/Landslide_Guide_QuickReference_2019.pdf*
- USGS Landslide Hazards *https://www.usgs.gov/programs/landslide-hazards*

Insufficient data for U.S. territories and commonwealths. Puerto Rico and the Pacific Territories experience a significant landslide and mudslide risk.

Data taken from: FEMA, National Aeronautics and Space Administration (NASA) Global Landslide Catalog (GLC), USGS, U.S. Department of Commerce, U.S. Census Bureau, Esri; Garmin International, Inc.; U.S. Central Intelligence Agency. Basemap: Esri, USGS, NOAA

KEY STRATEGIES

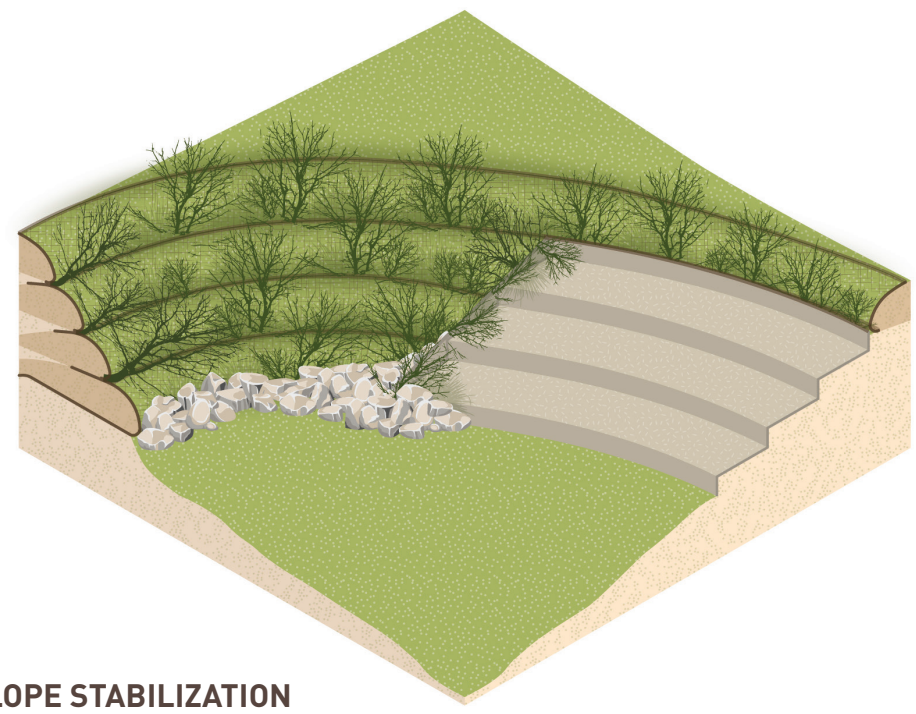
6 LANDSLIDE and MUDSLIDE



Tree cover to protect slope

REFOREST SLOPES

Trees and native understory plants help stabilize the soil and reduce landslides and mudslides.



Slope stabilization could also be an outdoor theater

SLOPE STABILIZATION

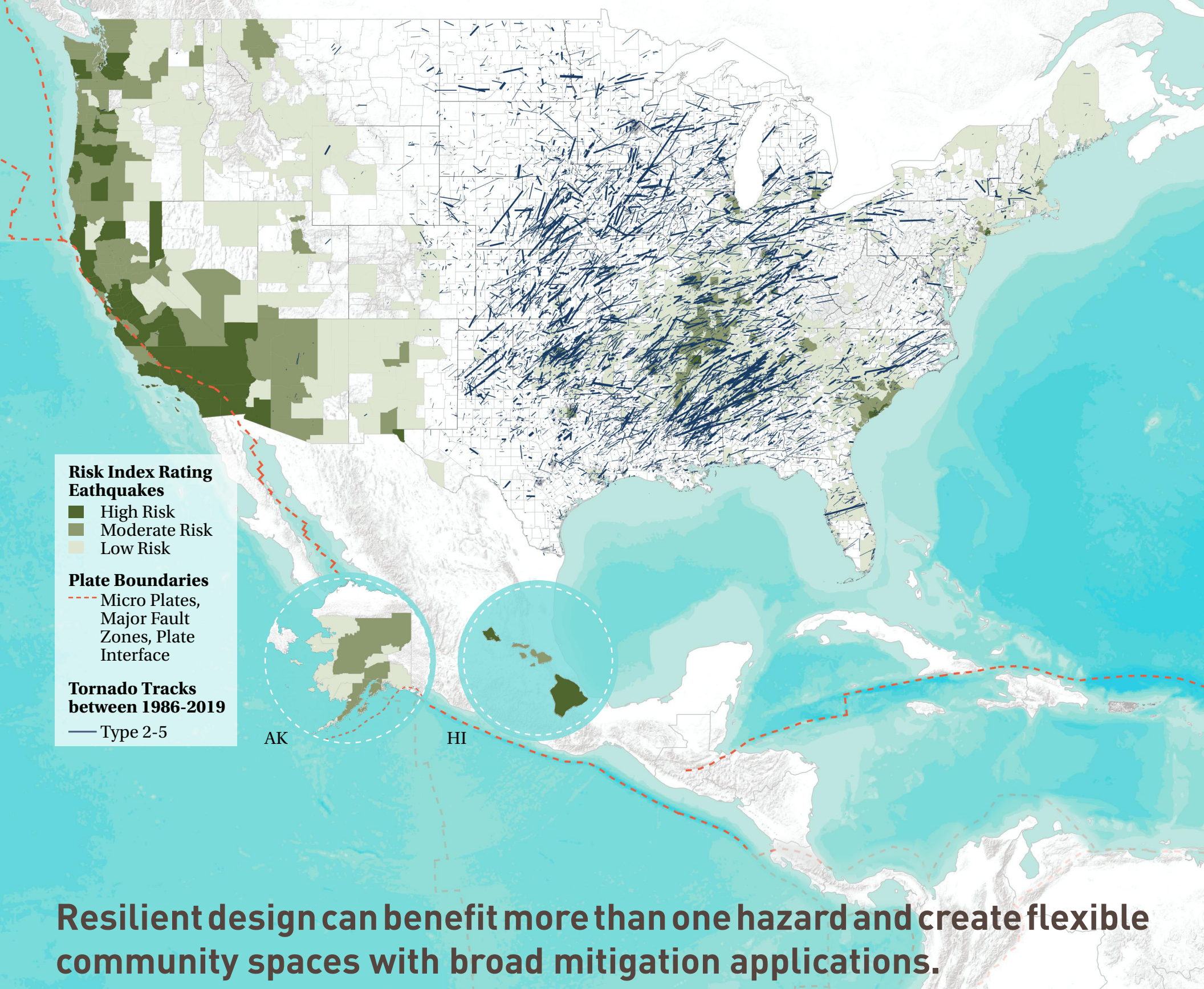
In areas with steep slopes, stabilization strategies will reduce risk.

Data taken from: portlandmaps.com

7 | DISASTER TYPE

TORNADO and EARTHQUAKE

Counties most at risk for earthquakes and tornado tracks between 1986-2019



Resilient design can benefit more than one hazard and create flexible community spaces with broad mitigation applications.

In the immediate and short-term aftermath of a tornado or earthquake, green infrastructure assets—such as parks and greenways—can provide safe areas for community members to gather and staging areas for local response teams. These areas can serve as local hubs where separated family members can reconnect, food and water can be distributed, and information can be shared. Parks can serve as some of the few spaces to gather that are safe from falling objects or downed power lines and should not be used for storing debris. As communities rebuild after tornadoes and earthquakes, local governments can build more resilient structures and protect open spaces that can reduce the severity of impacts from future events.

RESOURCES

- USGS Earthquake Hazards *https://www.usgs.gov/programs/earthquake-hazards*
- Earthquake Preparation *https://www.ready.gov/earthquakes*
- Tornado Preparation *https://www.ready.gov/tornadoes*
- NOAA Storm Prediction Center *https://www.spc.noaa.gov/*
- Tornado Damage Survey Results *https://www.weather.gov/gsp/newTornadomap*

Insufficient data for U.S. States territories and commonwealths. These territories experience a significant risk of earthquakes.

Data taken from: FEMA, NOAA, USGS, U.S. Department of Commerce, U.S. Census Bureau, Esri; Garmin International, Inc.; U.S. Central Intelligence Agency. Basemap: Esri, USGS, NOAA

7 | KEY STRATEGIES
TORNADO and EARTHQUAKE

Additional EPA Resources

Regional Resilience Toolkit: 5 Steps to Build Large-Scale Resilience to Natural Disasters (2019): Toolkit created through a partnership with FEMA that helps regions plan for disasters by working across multiple jurisdictions and with nongovernmental partners to address multi-hazard resilience through a consolidated planning process.

Smart Growth Fixes for Climate Adaptation and Resilience: Changing Land Use and Building Codes and Policies to Prepare for Climate Change (2017): Guide that describes specific changes communities could make to their land use and building policies to prepare for climate change while gaining other environmental, economic, health, and social benefits in the short and long terms.

Planning Framework for a Climate-Resilient Economy (2016): Tool, developed through a technical assistance project with the Rhode Island Division of Planning, to help communities assess how climate change could affect their economy, improve their economic resilience, and think creatively about ways to prosper in a changing climate.

Climate Adaptation: Links to EPA resources to help the nation anticipate, prepare for, adapt to, and recover from the impacts of climate change. This includes evaluating how climate change might affect efforts to attain environmental standards and identifying strategies that also reduce greenhouse gases and other pollution.

Climate Change Adaptation Resource Center (ARC-X): Lets local government decision-makers create a package of information tailored to their needs. Users can find information about the risks posed by climate change to the issues they are concerned about, relevant adaptation strategies, case studies illustrating how other communities have adapted to those risks and tools to replicate their successes, online training, and EPA funding opportunities.

Natural Disasters: Links to information on ways to reduce or avoid risks to health and the environment due to natural disasters—at home, in your community or school, or in your business. This site provides resources and steps to prepare for, respond to, and recover from many hazards referenced in this document, including drought, earthquakes, extreme heat, flooding, hurricanes, tornadoes, and wildfires.

Heat Island Effect: Information about heat islands and ways to mitigate the higher temperatures these urban and suburban areas can cause.

Green Infrastructure: Tools, case studies, and other resources to promote green infrastructure solutions.

EJ Screen: Environmental justice mapping and screening tool that provides a nationally consistent dataset and approach for combining environmental and demographic socioeconomic indicators. It includes climate change-exacerbated hazards such as drought, flooding, and sea level rise.

Smart Growth: Tools, publications, technical assistance, and other resources to help communities use design and development strategies to expand economic opportunity, protect human health and the environment, and create and enhance the places that people love.

Enviro Atlas: An interactive web-based tool providing geospatial data, easy-to-use tools, and other resources that decision-makers can use to inform policy and planning in the places where people live, learn, work and play.

EPA United States Environmental Protection Agency