SHOWCASE REPORT:

THE VERSATILITY OF NATURE-BASED SOLUTIONS: PROTECTIONS AND BENEFITS FROM THE PARCEL TO COMMUNITY SCALES

NATIONAL WILDLIFE FEDERATION

ALLIED WORLD
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Cover image: Volunteer planting day, Sacred Grounds Program in Detroit, MI. Erin Kirkland, courtesy of The Kresge Foundation.

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Emily Donahoe and Jessie Ritter

Erin Kirkland, courtesy of The Kresge Foundation.

CONTENTS

THRIVING WITH NATURE

Nature is an essential component of healthy, resilient, and beautiful communities. While nature's indispensability to thriving communities and livable ecosystems may seem obvious, many of our nation's natural systems have suffered significant degradation since the start of rapid industrialization.[1] Over time, the functionality of our forests, rivers, coastlines, and prairies has been eroded, and in some places, these vital systems have vanished altogether.[2] Nature not only provides protective abilities like buffering against hazard risks, like flooding and extreme heat, but also provides a plethora of co-benefits, including cleaner air and water, increased biodiversity, enhanced recreational spaces, and bolstered local economies.[3] Thoughtfully conserving, restoring, or incorporating natural infrastructure at various scales, including the individual parcel level, can reduce energy costs, protect property, and help the surrounding communities and ecosystems become healthy and resilient spaces to live, thrive, and adapt to a changing climate.

In this report, "natural infrastructure" refers to the natural systems and features that provide essential services and benefits to people, whereas "nature-based solutions" refer to the potential for natural systems to support climate adaptation and mitigation outcomes for communities. Specifically, natural infrastructure projects use, restore, or emulate natural ecological, geological, or physical processes, and nature-based projects may utilize similar approaches in addition to engineered or hybrid components.[4] Natural infrastructure and nature-based approaches can range in complexity and scale. For example, one project could involve planting a rain garden at an apartment complex or urban elementary school to attenuate storm water, reduce pluvial flooding, decrease the urban heat island effect, and provide habitat for native species. Another project could be engineering a living shoreline to restore a community's coastline with native plants and other natural structures to improve defenses against coastal flooding and hurricane impacts and provide additional recreational opportunities for the neighborhood.

By recognizing nature's crucial role in ecosystems, we can work together to conserve existing natural systems, restore degraded natural spaces – big and small – and incorporate natural infrastructure to support healthy and resilient communities.

Sweet cone flower, blazing star and aster planted in front of a mural in Strawberry Mansion - Philadelphia. Credit: Natalie Cohen

OVERVIEW

This report features success stories about natural infrastructure projects implemented across the United States at different scales, highlighting the versatility and wide range of benefits natural infrastructure approaches provide. From smaller-scale projects located on individual properties to larger community-wide projects, each success story shows how nature-based solutions, implemented thoughtfully, can address unique community needs, reduce hazard risks, and produce numerous co-benefits to create healthy, thriving, and resilient communities and ecosystems.

This report builds on three previous publications by the NWF and Allied World, including The Protective Value of Nature: A Review of the Effectiveness of Natural Infrastructure for Hazard Risk Reduction (2019), Natural Defenses in Action: Harnessing Nature to Protect Our Communities (2016), and Natural Defenses from Hurricanes and Floods: Protecting America's Communities and Ecosystems in an Era of Extreme Weather (2014). Collectively, these past reports show that nature-based approaches are good for the environment and help make healthy, resilient, and beautiful communities. This report demonstrates nature's diverse applicability in urban, suburban, and rural landscapes. Whether planting a small native plant garden in a vacant city lot or undertaking a watershed-scale floodplain restoration project, the success stories featured in this report show that working with nature can be approachable and accessible to everyone at every scale to benefit people and wildlife alike.

Erin Kirkland, courtesy of The Kresge Foundation

Erin Kirkland, courtesy of The Kresge Foundation

SUCCESS STORIES

PARCEL-SCALE PROJECTS

Native Species Plantings in Urban Environments

Imagining how one might implement nature-based solutions in urban concrete jungles can be challenging. As climate change intensifies, many urban centers across the United States are experiencing intensified rain events, flooding, and more extreme temperatures.[5] Using the adaptable power of nature, implementing small parcel-scale projects in cities can have significant positive impacts on the properties themselves and on the surrounding environment and community. These adaptable projects often involve activities like planting native species, pollinator gardens, installing rainwater catchment systems, and other small-scale nature-based approaches to mitigate hazard impacts and provide additional benefits to the community.

In Philadelphia, Pennsylvania, NWF partnered with the Pennsylvania Horticultural Society to restore a number of vacant lots into a pollinator corridor.[6] In Philadelphia, like in many other urban centers across the U.S., there is a direct correlation between the legacy of structural racism caused by redlining with vacant lot density, low urban tree canopy, extreme heat, high asthma rates, and more challenges.[7] To combat these realities, NWF worked with the local neighborhood to install pollinator gardens in a number of vacant lots. These pollinator gardens are filled with native plants to attract pollinators like bees, butterflies, and hummingbirds. These pollinator gardens also create multi-benefit green spaces that provide vital wildlife habitat, improve community health, and provide workforce development opportunities for landscaping and maintenance.

Projects like these pollinator gardens are adaptive and can fit a variety of spaces in highly developed urban environment to provide protective and beneficial green spaces. For example, pollinator gardens also reduce urban flooding impacts by absorbing storm water runoff through permeable greenery.[8] In addition to the hazard mitigation benefits and benefits to wildlife, these gardens improve equitable community access to green spaces and improve health by improving air quality and reducing the urban heat island effect.[9]

Hazards addressed:

- Extreme heat
- Drought
- Urban flooding

Co-benefits provided:

- Recreational opportunities/green spaces
- Increased wildlife biodiversity
- Improved wildlife habitat
- Reduced urban heat island effect
- Reduced storm water runoff
- Can produce food for the surrounding community
- Beautification
- Improved habitat corridors

Manhattan Avenue Street End (MASE) Park Planting

Low-Tech Prairie Stream Restoration in Central Montana

Years of drought conditions in the American West have led to dry and eroding streams, decreasing biodiversity, and lowering groundwater levels.[10] To combat these persisting drought conditions and to increase resilience, NWF, in partnership with Montana Wildlife Federation and the Bureau of Land Management, conducted a Prairie Stream Restoration Workshop in Winifred, Montana.[11] Over 30 landowners, ranchers, and conservationists teamed up to install low-tech stream-restoration solutions.

Low-tech, process-based restoration (LTPBR) solutions are a technique designed to install simple, cost-effective, hand-built structures that help repair degraded streams. These multi-benefit structures often mimic beaver dams, which positively impact the surrounding environment in many ways. Similar to beaver dams, these structures enable improved water retention and help replenish groundwater supply by dispersing water onto the floodplain during significant flow events. These LTPBR approaches also promote healthy riparian vegetation, stabilizing bank erosion and sustaining habitat for wildlife species that are dependent on the ecosystem services the stream provides. This approach also improves drought resiliency by regulating water temperature in deep pools to provide diverse habitats for beavers, grouse, turkeys, amphibians, and aquatic species.[12] Additionally, because LTPBR mimics beaver structures that create wet meadow complexes in dry, fire-prone environments, these strategies can create wildfire safe havens and slow the spread of wildfires.[13] [14]

Hazards addressed:

› Drought

› Wildfire

Co-benefits provided:

› Groundwater recharge

› Increased biodiversity

› Decreased erosion

› Improve wildlife habitat

› Regulated stream water temperature

› Wildfire safe havens

› Slow wildfire spread

› Reduced erosion

Beaver Dam Analogs (BDAs) installed at Winifred, project site in partnership with the Bureau of Land Management (BLM), Montana Wildlife Federation (MWF), National Wild Turkey Federation (NWTF), National Fish and Wildlife Foundation (NFWF), and private landowners. Credit: the Bureau of Land Management

Installing Green Roofs in Kansas City, Missouri

In heavily built environments like cities, green roofs installed on building rooftops are an effective way to benefit from ecosystem services. Green roofs, sometimes called vegetated roofs or eco-roofs, are composed of multiple vegetative, drainage, and waterproof layers to prevent damage to the structure. Green roofs can vary in complexity, ranging from simple construction with hardy plants to more complex structures with accessible parks and gardens for residents or visitors.[15]

Kansas City, Missouri, prioritized the installation of green roofs across the city's skyline with the aim to improve water and air quality, and has installed 19 green roofs as of 2018.[16] Over time, these green roofs have demonstrated numerous additional benefits, including reducing storm water runoff, and achieving health and well-being benefits through additional access to green spaces.[17] Green roofs also significantly reduce the urban heat island effect by providing additional shade and increasing evapotranspiration. These heat reduction benefits are critical, as studies show that extreme heat events are the deadliest natural hazard in the U.S.[18] In fact, green roof temperatures can be 30-40 °F lower than conventional roofs and can reduce ambient temperature by up to 5 °F.[19] Lowering building roof temperatures also helps reduce energy costs for building owners, operators, and residents, as the insulation and shading provided by green roofs help keep temperatures down.[20] As extreme heat events are expected to increase due to climate change, green roofs not only help improve comfort and green space access but also provide life-saving extreme heat mitigation effects.[21]

Hazards addressed:

- Extreme heat
- Urban heat island effect
- Flooding

Co-benefits provided:

- Green spaces
- Recreational opportunities
- Improved mental/physical health
- Reduced stormwater runoff
- Reduced water pollution

Green roof with goose. Credit: S Woodside

NEIGHBORHOOD-SCALE PROJECTS

Housing for a Greener Future with Taylor Morrison in Southern California

In more suburban environments, natural infrastructure approaches can be implemented throughout housing development projects to safeguard natural open spaces, promote biodiversity, and enhance neighborhood appeal and residential well-being. Through NWF's partnership with Taylor Morrison, a national homebuilder and development company, housing developments are designed with habitat and natural open spaces in mind. NWF Certified Wildlife Habitat® standards are applied to parks and open spaces to protect natural areas and provide wildlife with food, water, cover, and places to raise their young. These habitats apply 80-100% native plants and water conservation practices in addition to prohibiting chemical pesticides and fertilizers. Taylor Morrison is also a signatory to the Mayor's Monarch Pledge to commit to installing monarch butterfly and pollinator habitats in each new community and to educate residents about these critical pollinators.

As a part of this work, Taylor Morrison has enhanced substantial portions of the Sea Summit at Marblehead Coastal Preserve in San Clemente, California, through trash removal, weed control, soil remediation, and native plantings. The goal of the habitat restoration effort was to create self-sustaining native vegetation communities that minimize erosion, provide quality habitat for rare plant and wildlife species, and resist invasion by weeds. At the end of 2019, the Preserve supported more than 107 native plants and 73 wildlife species, including 10 special status plants and wildlife species such as the Blochman's dudleya, a small succulent plant rare throughout its range, and 31 breeding pairs of the coastal California gnatcatcher – a bird listed as threatened under the federal Endangered Species Act. People from all over come to enjoy the breathtaking views of the Pacific Ocean while walking the nearly 4 miles of nature trails. The project serves as a strong example of the way developers can be ecosystem-conscious and contribute to habitat conservation.

Blochman's Dudleya (Dudleya blochmaniae ssp. blochmaniae) is a rare plant that is protected onsite.

Hazards addressed:

- Flooding
- Wildfire

Co-benefits provided:

- Increased wildlife habitat
- Improved biodiversity
- Beautification
- Recreational opportunities
- Habitat corridors
- Cleaner water

Credit: Carey Stanton

Leveraging Grassroots Networks in Detroit, Michigan

NWF's Sacred Grounds program leverages the grassroots capacity of houses of worship to act as environmental and social change agents. As respected community leaders and some of the largest landowners, houses of worship serve as vital community anchors to disseminate native habitats, rain gardens, and other best management practices (BMPs) on site and in the surrounding neighborhoods. Through the program model in Detroit, Michigan, NWF works directly with local partners and organizations with deep experience and technical expertise in the community-engaged installation of rain gardens. Since 2020, NWF has built up resources and capacity within Detroit neighborhoods by creating and maintaining large-scale green storm water infrastructure (GSI) projects and rain gardens to increase wildlife habitat; support, safe, peaceful spaces in the community; and promote water bill reduction.

Credit: Erin Kirkland, courtesy of The Kresge Foundation

Credit: Erin Kirkland, courtesy of The Kresge Foundation

This program has supported the growth of a network for native plant infrastructure projects, which has resulted in a significant decrease in storm water runoff into the combined sewer system – collectively storing over 63 thousand gallons of storm water. Reducing storm water flows not only decreases pollution in our waterways, but additional green spaces and rain gardens also have the potential to reduce urban flooding.[22] Native plant gardens also grow strong and deep roots that help to absorb and filter water and reduce erosion.[23] Additionally, green spaces, like native plant gardens, help reduce the urban heat island effect in urban environments like Detroit by lowering surface temperatures.[24] The program has also helped develop new community partnerships and increase awareness about local greening efforts.

Hazards addressed:

- Urban flooding
- Extreme heat

Co-benefits provided:

- Reduced storm water flows
- Habitat creation
- Beautification
- Heat reduction
- Economic benefits (water bill reduction)
- Providing water sources to residents
- Reduced erosion

Credit: Erin Kirkland, courtesy of The Kresge Foundation

Credit: Grace Stiller

Watershed Stewardship with Camp Second Chance in Seattle, Washington

The Weed Warriors, Nature Stewards Program, initiated in 2020, is an experiential learning program and serves as a remarkable example of an innovative nature-based approach with a profound impact. In collaboration with Camp Second Chance, a sanctioned encampment for people experiencing houselessness near Seattle, Washington, this program provides educational opportunities and enables "boots on the ground" projects to identify and remove noxious weeds surrounding the Myers Way wetlands and the encampment. The program also works to restore the riparian wetlands and offers Camp Second Chance residents stipends, educational workshops, and skill development opportunities in environmental conservation.

The health of the Myers Way wetlands is critical and intricately intertwined with the well-being of neighboring ecosystems and communities. This wetland serves as the beginning of a salmon-bearing stream, a vital artery connected to the Puget Sound. Ensuring the health of this ecosystem not only safeguards local biodiversity but also ensures the livelihoods and well-being of countless residents who depend on healthy salmon populations. This innovative partnership represents a holistic approach aimed at empowering the residents of Camp Second Chance and conserving the health of a vital wetland.

Hazards addressed:

› Flooding

Co-benefits provided:

› Healthier habitat
› Healthier wildlife and salmon populations
› Cultural benefits
› Economic benefits, such as jobs
› Reduced invasive species

Credit: Grace Stiller

Credit: Grace Stiller

COMMUNITY-SCALE PROJECTS

Oyster Reef Restoration in the Chesapeake Bay

In the Chesapeake Bay, oysters play a vital economic role and are part of regional culture both for oyster growers and consumers. However, pollution, disease, and over harvesting have devastated the bay's once abundant oyster populations. In 2015, the bay's largest oyster restoration project was completed in Maryland's Harris Creek, which was seeded with over 2 billion oysters resistant to two harmful diseases, dermo *(Perkinsus marinus)* and MSX *(Haplosporidium nelson)*.[25]

This project not only provided oyster rehabilitation and habitat creation benefits but also greatly increased the water filtration and nutrient removal capacity of Harris Creek. A study found that the restored reefs could filter the full volume of Harris Creek in less than 10 days during the summer and have the potential to remove over one million pounds of nitrogen from the Chesapeake Bay in the next ten years.[26]

Oyster reefs can also provide significant risk reduction benefits to coastal communities by serving as breakwaters that reduce shoreline erosion and attenuate wave height and energy.[27] In fact, coastal habitats like oyster reefs have the potential to reduce wave heights by 35-71%.[28] Healthy oyster reefs also have the ability to keep pace with rising sea levels, especially in intertidal zones, which help maintain their protective benefits over time.[29]

Hazards addressed:

- Storm surge
- Sea level rise

Co-benefits provided:

- Habitat creation
- Nutrient filtration
- Cleaner water
- Reduced erosion
- Economic benefits
- Food source
- Educational and engagement opportunities

As another example of oyster restoration, Allied World's environmental team collaborated with insurance industry partners to help restore the oyster population in New York Harbor in support of the Billion Oyster Project. Together, Allied World and their business partners cleaned oyster shells and constructed oyster cages to aid the restoration process. Beyond its positive impact on the local ecosystem, this event offered a unique opportunity for collaboration while providing an immersive experience and an inside look at the Billion Oyster Project's facility.

Oyster reef restoration: Gandy's Beach, New Jersey, U.S. Fish and Wildlife Service (USFWS)

Bucktown Marsh Creation and Living Shoreline in Louisiana

In southern Louisiana, sea level rise - combined with tropical storms - threaten many coastal communities. The Bucktown Marsh Creation and Living Shoreline project aims to restore native marshland and ecological features along the coastline while increasing flood mitigation and resilience capabilities.[30] The project will rebuild a breakwater structure to protect against wave energy and install a living shoreline to restore approximately 70 acres of marshland and natural areas.

The project will not only protect against flooding and storm surge hazards, but it will also help reconnect Jefferson Parish residents to native marshland habitats and provide additional recreational opportunities like walking paths, bird watching, kayaking, paddle boarding, and more. The project will enhance the local fisheries and provide necessary habitat for waterfowl, shorebirds, other native fauna, and lake species like fish and crab. The living shoreline and restored marshland will also enhance the water quality of Lake Pontchartrain and create numerous educational and research opportunities.[31]

Hazards addressed:

- Storm surge
- Hurricanes
- Flooding
- Sea level rise

Co-benefits provided:

- Habitat creation
- Nutrient filtration
- Cleaner water
- Recreational opportunities
- Food sources
- Educational opportunities

Beach and dune restoration Louisiana: Coastal Protection and Restoration Authority

Stabilizing Coastlines with the Resilient Schools Consortium Program in New York City

New York City's coastline is one of the nation's most vulnerable to risks like hurricanes and flooding. Superstorm Sandy caused the death of 43 people and over $19 billion in damages across the city.[32] Established in the wake of Superstorm Sandy, National Wildlife Federation's Resilient Schools Consortium (RiSC) Program, based in New York City, aims to educate the city's youth about climate science, climate impacts, climate justice, and the natural and built solutions that increase climate resiliency.[33]

Measuring Sea level rise with Dr. Brett Branco, RiSC, October 2022. Credit: Heather Sioux

The program engages middle and high school students and formerly incarcerated youth through on-the-ground projects along Coney Island's coastline to plant American beach grass *(Ammophila breviligulata)* to stabilize coastal dunes. This specific dune grass species is an essential tool because it grows underground stems, called rhizomes, that extend downwards up to 13 feet and outward up to ten feet wide, which helps mitigate erosion. These rhizomes also reproduce quickly, creating as many as 100 stems per grass clump annually.

These on-the-ground projects create living shorelines that provide protection to the surrounding communities from extreme weather events and provide enhanced habitats and ecosystems for the surrounding wildlife.

Hazards addressed:

- Sea level rise
- Severe storms
- Coastal flooding

Co-benefits provided:

- Educational opportunities
- Economic benefits
- Recreational opportunities
- Enhanced wildlife habitats
- Reduced dune erosion

Urban Assembly School for Emergency Management (UASEM) students at Coney Island (CI) Creek, October 20, 2022, Credit: Emmy Lee

RiSC Program Manager, Heather Sioux, March 21, 2023.

Credit: Carey Stanton.

Property Buyouts and Green Space Restoration in Paradise, California

Increased drought conditions and extreme temperatures exacerbated by climate change increase the chance for dangerous, fast-spreading wildfires. In 2018, The Camp Fire in northern California killed 85 people and destroyed approximately nineteen-thousand structures. Many fire-prone communities are located in what's called the "wildland-urban interface," areas that are between undeveloped and urbanized lands where fire risk is often high. The destruction left behind by the Camp Fire demonstrated that sometimes individual actions like home hardening or vegetation clearing are not enough to mitigate risk adequately.[34]

Hazards addressed:

- Wildfire
- Drought

Co-benefits provided:

- Recreational opportunities
- First responder staging areas
- Shelter-in-place locations
- Enhanced wildlife habitats

To help reduce future risks in fire-prone areas, the city of Paradise is conducting a voluntary buy-out program to acquire high-risk properties throughout the community and restore those properties into open green space.[35] These open green spaces serve as a nature-based solution that provides natural buffer zones to catch embers, ultimately reducing fuel loads and reducing the spread of fire.[36] These open spaces, sometimes called resilience parks, can also provide first responder staging areas and shelter-in-place options for evacuees.[37] Additionally, green spaces can provide additional recreational opportunities for the local community and critical native habitat for local wildlife species.[38]

Conquest Beach, post-restoration and planting. Credit: Amanda Poskaitis

CONCLUSION

This collection of success stories of nature-based solutions vividly illustrates the remarkable versatility and extensive range of benefits these approaches offer. Ranging from small-scale native plantings on individual properties to expansive neighborhood-wide initiatives, each success story underscores the transformative power of nature when thoughtfully and creatively integrated into our communities.

These stories are powerful reminders that natural infrastructure approaches are not limited by scale or scope. Whether it is a modest rain garden on a residential property, a green roof atop a city building, or a sprawling living shoreline project along a coastal community, nature's impact can be profound. Nature can serve as a catalyst for positive change in diverse environments, enriching our lives and safeguarding our surroundings. Nature is a powerful force to build healthier, more resilient, and more beautiful places to live and thrive.

TAKE ACTION!

The smallest impact can make a big difference. As a reader, here is what **you** can do to promote the use of natural infrastructure and contribute to healthier, more resilient communities:

Continue learning about natural infrastructure

Learn more about the concept of natural infrastructure, its benefits, and success stories in your region. A great place to start is reading the reports created in partnership with Allied World, including The Protective Value of Nature: A Review of the Effectiveness of Natural Infrastructure for Hazard Risk Reduction (2019), Natural Defenses in Action: Harnessing Nature to Protect Our Communities (2016), and Natural Defenses from Hurricanes and Floods: Protecting America's Communities and Ecosystems in an Era of Extreme Weather (2014).

Green your home, school, and workplace

Consider implementing natural infrastructure features on your property, such as rain gardens, green roofs, or native plant landscaping. These property-scale projects not only benefit your immediate surroundings but also set a great example for others in your neighborhood. Check out NWF's Certified Wildlife Habitat program to learn more about how to turn your yard, balcony container garden, schoolyard, work landscape, or roadside green space into a garden that replenishes resources for wildlife and provides benefits to people.

Engage in community project opportunities

Join or initiate projects that involve the creation or enhancement of green spaces, such as community gardens, parks, or urban forestry initiatives. Providing input in community planning sessions and town hall meetings to voice support for natural infrastructure projects can help shape the direction of your community's growth. Using your voice in these spaces about the importance of natural infrastructure will help to spread awareness about how these approaches can improve community health, well-being, and resilience.

Don't know where to start? Check out NWF's guidance, Incorporating Nature-based Solutions into Community Climate Adaptation Planning to learn how to integrate nature-based solutions into community planning and how to overcome barriers to the adoption of these approaches, including funding and financing mechanisms. Additionally, if you are looking for federal funding opportunities for this work, check out NWF's Nature-Based Funding Solutions Database.

For information about any of the above success stories and examples, please contact Emily Donahoe, policy specialist for resilient coasts and floodplains, DonahoeE@nwf.org.

BDAs installed at Winifred project site in partnership with Bureau of Land Management, Montana Wildlife Federation, National Wild Turkey Federation, National Fish and Wildlife Foundation, and private landowners. Credit: Bureau of Land Management

FOOTNOTES

1 Pathak, A., P. Glick, L.J. Hansen, L.E. Hilberg, J. Ritter, and B.A. Stein. 2022. Incorporating Nature-based Solutions into Community Climate Adaptation Planning. Washington, DC: National Wildlife Federation and EcoAdapt.

2 The U.S. has lost over half of its wetlands since the early 1600s. NOAA Fisheries. "Threats to Habitat." National Oceanic and Atmospheric Administration (NOAA) Fisheries. https://www.fisheries.noaa.gov/insight/threats-habitat. Accessed August 30, 2023; see also Dahl, T.E. 1990. Wetlands Losses in the United States 1780's to 1980's. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 13 pp.

3 Glick, P., E. Powell, S. Schlesinger, J. Ritter, B.A. Stein, and A. Fuller. 2020. The Protective Value of Nature: A Review of the Effectiveness of Natural Infrastructure for Hazard Risk Reduction. Washington, DC: National Wildlife Federation.

4 Pathak, A., Incorporating Nature-based Solutions, 6.

5 The 8th National Risk Assessment: The Precipitation Problem. First Street Foundation, June 26, 2023. URL: https://firststreet.org/research-lab/published-research/article-highlights-from-the-precipitation-problem/.

6 Cohen, Natalie. "Creating Resilient and Equitable Cities through Vacant Lot Restoration." National Wildlife Federation (NWF), October 25, 2022. URL: https://blog.nwf.org/2021/09/creating-resilient-and-equitable-cities-through-vacant-lot-restoration/.

7 Schinasi, L.H., C. Kanungo, Z. Christman, S. Barber, L. Tabb, and I. Headen. "Associations Between Historical Redlining and Present-Day Heat Vulnerability Housing and Land Cover Characteristics in Philadelphia, PA." Journal of Urban Health 99, no. 1 (February 2022): 134-145. doi: 10.1007/s11524-021-00602-6.

8 Denchak, Melissa. "Green Infrastructure: How to Manage Water in a Sustainable Way." NRDC, July 25, 2022. URL: https://www.nrdc.org/stories/green-infrastructure-how-manage-water-sustainable-way#whatis.

9 U.S. Environmental Protection Agency. "Reduce Urban Heat Island Effect." Accessed August 30, 2023. URL: https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect#:~:text=Trees%2C%20green%20roofs%2C%20and%20vegetation,releasing%20moisture%20into%20the%20atmosphere.

10 U.S. Department of Agriculture, Economic Research Service. "Drought in the Western United States." Accessed September 20, 2023. URL: https://www.ers.usda.gov/newsroom/trending-topics/drought-in-the-western-united-states/#:~:text=According%20to%20USDM%2C%20on%20April,20%20percent%20classified%20as%20severe; see also Weiskopf, Sarah R., Madeleine A. Rubenstein, Lisa G. Crozier, Sarah Gaichas, Roger Griffis, Jessica E. Halofsky, Kimberly J.W. Hyde, Toni Lyn Morelli, Jeffrey T. Morisette, Roldan C. Muñoz, Andrew J. Pershing, David L. Peterson, Rajendra Poudel, Michelle D. Staudinger, Ariana E. Sutton-Grier, Laura Thompson, James Vose, Jake F. Weltzin, and Kyle Powys Whyte. "Climate Change Effects on Biodiversity, Ecosystems, Ecosystem Services, and Natural Resource Management in the United States." Science of The Total Environment 733 (2020): 137782. doi: 10.1016/j.scitotenv.2020.137782; see also Vose, J., J. Clark, C. Luce, and T. Patel-Weynand. "Effects of Drought on Forests and Rangelands." U.S. Department of Agriculture, Forest Service, Climate Change Resource Center. Accessed September 20, 2023. URL: https://www.fs.usda.gov/ccrc/topics/drought.

11 See Water. Drought. Community: Landowners Come Together for Prairie Stream Restoration, Shelby Weigand, June 16, 2023, https://blog.nwf.org/2023/06/water-drought-community-landowners-come-together-for-prairie-stream-restoration/

12 Gladkowski, David. "Restoring the Emerald Islands in the Sagebrush Sea." National Wild Turkey Federation (NWFT), June 3, 2022. URL: https://www.nwtf.org/content-hub/restoring-the-emerald-islands-in-the-sagebrush-sea.

13 Burk, Abby. "Beavers Offer Help for Western Waters." October 22, 2021. Audubon. URL: https://rockies.audubon.org/rivers/articles/beavers-offer-help-western-waters; Burk, Abby. "Boosting Water Reliability for Birds and People." September 1, 2021. Audubon. URL: https://rockies.audubon.org/rivers/articles/boosting-water-reliability-birds-people.

14 Learn More About Low-Tech Prairie Stream Restoration: Water. Drought. Community: Landowners Come Together for Prairie Stream Restoration; BWG Newsletter: Restoring Emerald Islands: Collaborative Conservation at Work; Restoring the Emerald Islands in the Sagebrush Sea; Beavers and Wildfire: a Stop Motion Video Story by Emily Fairfax; Smokey the Beaver: beaver-damned riparian corridors stay green during wildfire throughout the western US.

15 "Using Green Roofs to Reduce Heat Islands." U.S. Environmental Protection Agency (EPA). Accessed August 30, 2023. URL: https://www.epa.gov/heatislands/using-green-roofs-reduce-heat-islands#cobenefits.

16 U.S. Environmental Protection Agency (EPA). "Estimating the Environmental Effects of Green Roofs: A Case Study in Kansas City, Missouri." EPA 430-S-18-001, 2018. Page 6. URL: www.epa.gov/heat-islands/using-greenroofs-reduce-heat-islands.

17 EPA. "Environmental Effects of Green Roofs. Page 1.

18 National Weather Service, Weather Related Fatality and Injury Statistics 2022, (last accessed October 4, 2023), https://www.weather.gov/hazstat/.

19 U.S. General Services Administration. 2011. "The Benefits and Challenges of Green Roofs on Public and Commercial Buildings. URL: https://www.gsa.gov/system/files/The_Benefits_and_Challenges_of_Green_Roofs_on_Public_and_Commercial_Buildings.pdf;" Santamouris, M. 2014. "Cooling the Cities – A Review of Reflective and Green Roof Mitigation Technologies to Fight Heat Island and Improve Comfort in Urban Environments." Solar Energy 103: 682–703.

20 U.S. Environmental Protection Agency (EPA). "Estimating the Environmental Effects of Green Roofs: A Case Study in Kansas City, Missouri." EPA 430-S-18-001, 2018. Page 3. URL: www.epa.gov/heat-islands/using-greenroofs-reduce-heat-islands.

21 EPA. "Environmental Effects of Green Roofs. Page 1.

22 U.S. Environmental Protection Agency (EPA). "Soak Up the Rain: What's the Problem." Accessed September 20, 2023. URL: https://www.epa.gov/soakuptherain/soak-rain-whats-problem.

23 "Native Gardening." U.S. Forest Service. Accessed September 25. 2023. URL: https://www.fs.usda.gov/wildflowers/Native_Plant_Materials/Native_Gardening/#:~:text=Native%20plants%20require%20less%20water,soil's%20capacity%20to%20store%20water.

24 Aram, F., E. Higueras García, E. Solgi, and S. Mansournia. "Urban Green Space Cooling Effect in Cities." Heliyon 5, no. 4 (2019): e01339. doi: 10.1016/j.heliyon.2019.e01339.

25 The Nature Conservancy. "Oyster Restoration in Maryland." Last updated April 10, 2023. URL: https://www.nature.org/en-us/about-us/where-we-work/united-states/maryland-dc/stories-in-maryland-dc/oyster-restoration-in-maryland/.

26 Kellogg, M. Lisa, Mark J. Brush, and Jeff C. Cornwell. "An Updated Model for Estimating the TMDL-Related Benefits of Oyster Reef Restoration." June 29, 2018. URL: https://www.conservationgateway.org/Documents/Harris_Creek_Model_and_Oyster_Reef_Restoration_Benefits.pdf.

27 Rezaie, A.M., J. Loerzel, and C.M. Ferreira. "Valuing Natural Habitats for Enhancing Coastal Resilience: Wetlands Reduce Property Damage from Storm Surge and Sea Level Rise." PLoS One 15 (2020): e0226275.

28 Narayan, S., M.W. Beck, B.G. Reguero, et al. 2016. The effectiveness, costs, and coastal protection benefits of natural and nature-based defences. PLoS One 11: e0154735.

29 Rodriguez, A.B., F.J. Fodrie, J.T. Ridge, et al. 2014. Oyster reefs can outpace sea-level rise. Nature Climate Change 4: 493–497.

30 McNeil, Leigha. "New Project Aims to Restore Coastline in Jefferson Parish." Last updated May 30, 2023. URL: https://www.wwltv.com/article/news/local/jefferson-parish-coastline-bucktown-jennifer-van-vrancken-living-shoreline/289-9557343e-d79e-41aa-ba84-3e3f7237187b.

31 Moffat & Nichol. "Bucktown Marsh Creation and Living Shoreline." Accessed September 25, 2023. URL: https://jefferson-parish-government.azureedge.net/images/departments/coastal-management/coastal-projects-in-my-backyard/bucktown-living-shoreline.pdf; "22-0014 Bucktown Marsh Restoration and Living Shoreline." U.S. Army Corps of Engineers. July 6, 2022. URL: https://www.mvn.usace.army.mil/Missions/Section-408/Public-Notices/Article/3084057/22-0014-bucktown-marsh-restoration-and-living-shoreline/.

32 "Sandy and Its Impacts." Accessed September 20, 2023. URL: https://www.nyc.gov/html/sirr/downloads/pdf/final_report/Ch_1_SandyImpacts_FINAL_singles.pdf.

33 "About Us." Resilient Schools Consortium. URL: https://www.riscnyc.org/more-about-us.

34 Mohr, Kylie. "Protecting Neighborhoods from Future Flames." High Country News, July 25, 2022. URL: https://www.hcn.org/issues/54.8/north-wildfire-a-new-proposal-to-ensure-fire-protection-for-all-flames.

35 Seigler, Kirk. "In Fire-Scorched California, Town Aims To Buy the Highest At-Risk Properties." NPR, August 23, 2021. URL: https://www.npr.org/2021/08/23/1028126348/in-fire-scorched-california-town-aims-to-buy-the-highest-at-risk-properties?fbclid=IwAR1cMMU0lrxifePMvR-AJ8qmxUoeaTOxcTxqdGPcpBGGl1Nx5gxwARBiMbI.

36 The Nature Conservancy (TNC). "Building Wildfire Resiliency in California." February 11, 2021. URL: https://storymaps.arcgis.com/stories/1239edd45c3248149099dab1488b1d26.

37 TNC. Building Wildfire Resiliency.

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